FANUC SYSTEM 2T-MODEL A
FANUC SYSTEM 3T-MODEL C

MAINTENANCE MANUAL

CONTENTS

B-53945E/02

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1. GENERAL

FANUC SYSTEM 3T-MODEL C and SYSTEM 2T-MODEL A (hereinafter FS 3T-C and FS 2T-A) has been developed as a high-accuracy, high-performance fixed-software CNC for turning machines to meet the needs in the world's market. Its control circuit fully uses high-speed microprocessors, custom LSIs, and semiconductors to enhance reliability and significantly improve the cost/performance ratio.

FS 3T-C and FS 2T-A are closed-loop CNC using the latest FANUC DC servo motor M series uniquely developed by FANUC and also using a high-performance pulse encoder as the detector.

FS 3T-C and FS 2T-A incorporate a self-diagnostic function and provides very easy maintenance referring to this instruction manual.

— The microprocessor always monitors internal operating conditions and displays these internal conditions by sorting them. If a trouble occurs, the microprocessor immediately stops NC with an alarm lamp lit, and displays the trouble after sorting trouble contents in detail.
— All on/off signals input to and output from NC can be displayed on the CRT display unit.
— All on/off signals output from NC can be output in bits via MDI.
— The present values of various parameters, such as acceleration/deceleration time constants, rapid traverse feedrate, etc. can be checked on the CRT display.

This instruction manual describes preventive maintenance and quick troubleshooting for possible failures (chapter 7), check point, adjustments, and details of parameters at the installation time of NC (chapter 3, 4, 5). It also covers various pieces of technical information (appendixes).

Refer to the OPERATOR'S MANUAL (FS 2T-A: B-53944E, FS 3T-C: B-53984) and CONNECTION MANUAL (B-53943E), as required.

FANUC SYSTEM 3T-MODEL C is designated to be assembled inside an NC machine tool. A dustproof enclosed structure, a cooling method, and wiring between units are designed by each machine tool builder. For these problems, refer to the instruction manual issued by the machine tool builder.

Explanation of terms frequently used in NC

Least input increment .... The minimum unit of a program inputtable move command

Least command increment .... The minimum unit of a command to be given from NC to the machine tool

Detection unit .... The minimum unit which can detect the machine tool position

Command multiplier (CMR)... A constant to enable the weight of NC command pulses to meet the weight of pulses from the detector

Detection multiplier (DMR)... A constant to enable the weight of NC command pulses to meet the weight of pulses from the detector

Note) The relations amount the least input increment, detection unit, CMR, and DMR are as specified below.

Least input increment = CMR x detection unit

Detection unit = Move amount per revolution of motor/DMR x number of pulses of detector per revolution of motor

MDI/CRT panel .... Manual data Input & panel

This operator's panel is used to input command to NC or display NC conditions by using key switches.

1.1 Structure

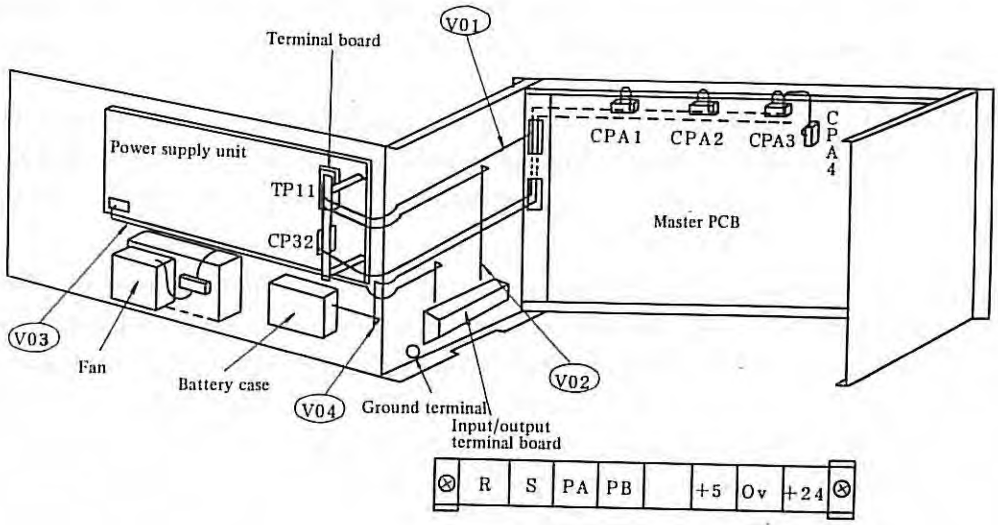


Fig. 1.1(a) Wiring Diagram of Control Unit

Table 1.1(a) Internal Connection Cables

Name	Specifications	Connections
V01	A660-8002-T802	CPA1, CPA3 — Terminal board TP11 CPA2 — CP32
V02	A660-8002-T800	Input/output terminal board — Terminal board TP11
V03	A660-8002-T801	Input/output terminal board — Terminal board for power supply unit fan
V04	A660-8002-T876 or A660-8002-T877 (Note 1)	CPA4 — Battery case

Note 1) Cable differ according to basic options A02B-0053-H020 and A02B-0053-H021 specified by order.
The relation between the order and cables is as specified below.
A660-8002-T876 for A02B-0053-H020
A660-8002-T877 for A02B-0053-H021

Note 2) When a separate type battery unit (A02B-0053-H021) is specified, the battery unit is not mounted at the position indicated in the above figure, but mounted inside the machine tool cabinet. Refer to the machine tool builder's instruction manual.

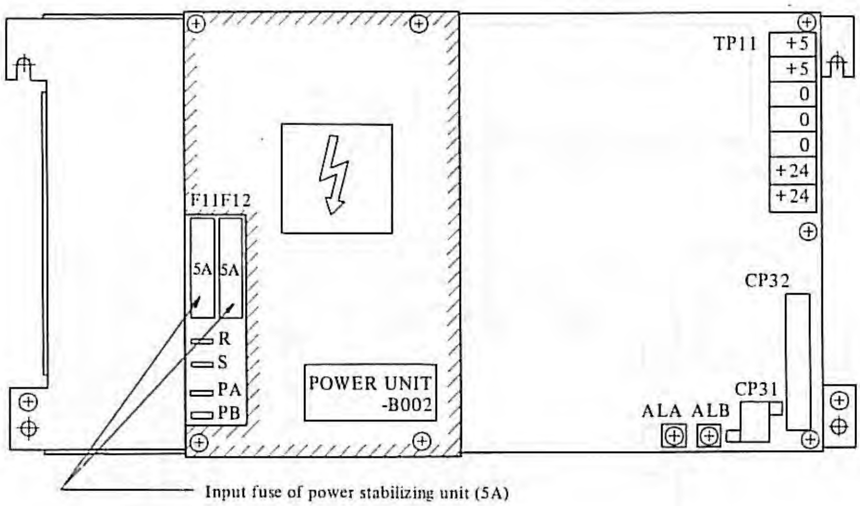


Fig. 1.1(b) Mounting Position of Fuses of Power Supply Unit

Note) For replacing fuses, refer to 8.1

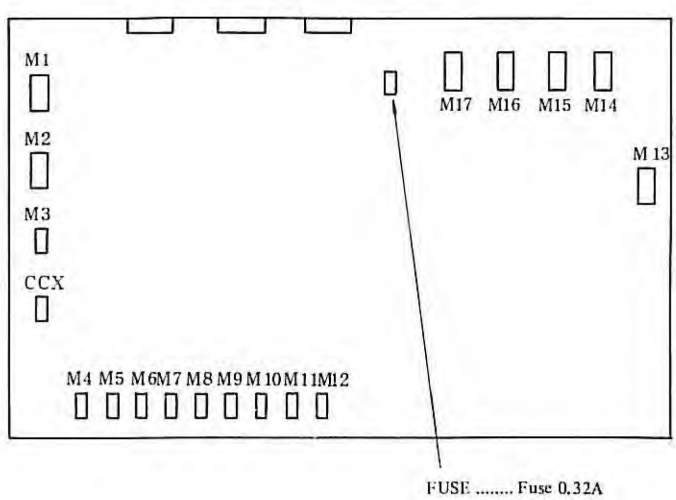


Fig. 1.1(c) Mounting Position of Master PCB Fuse

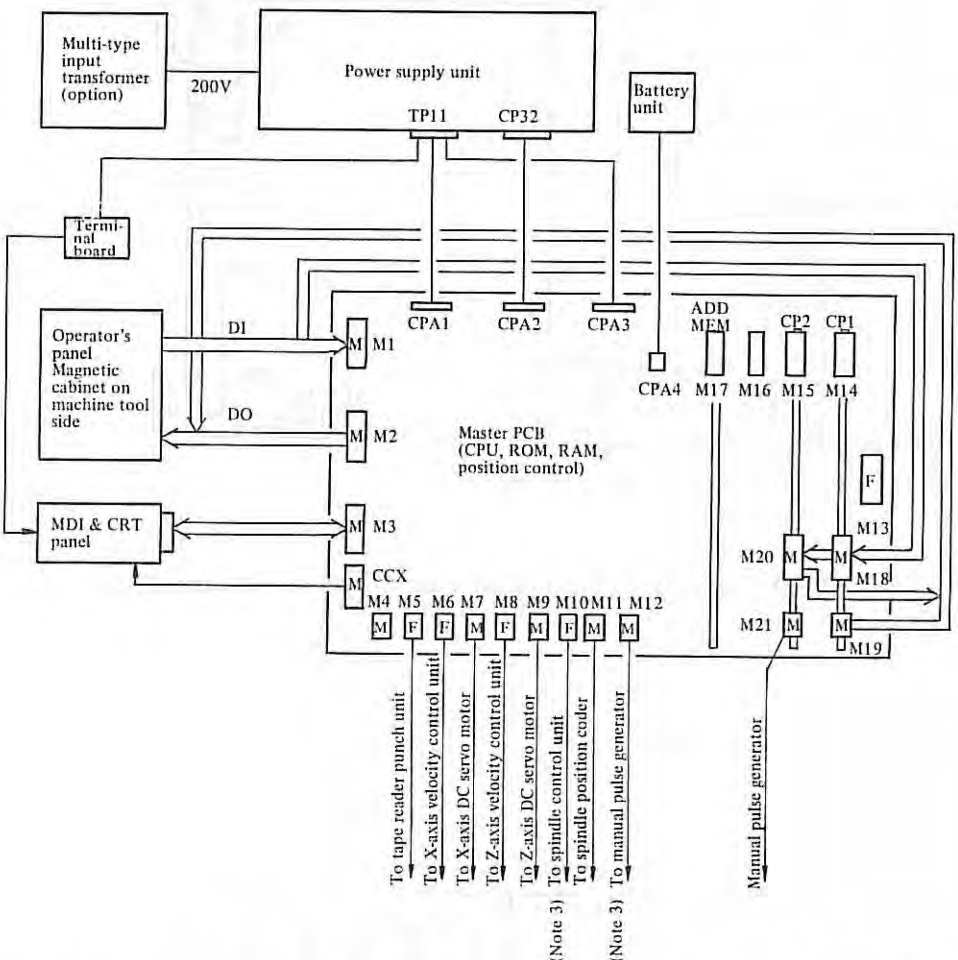
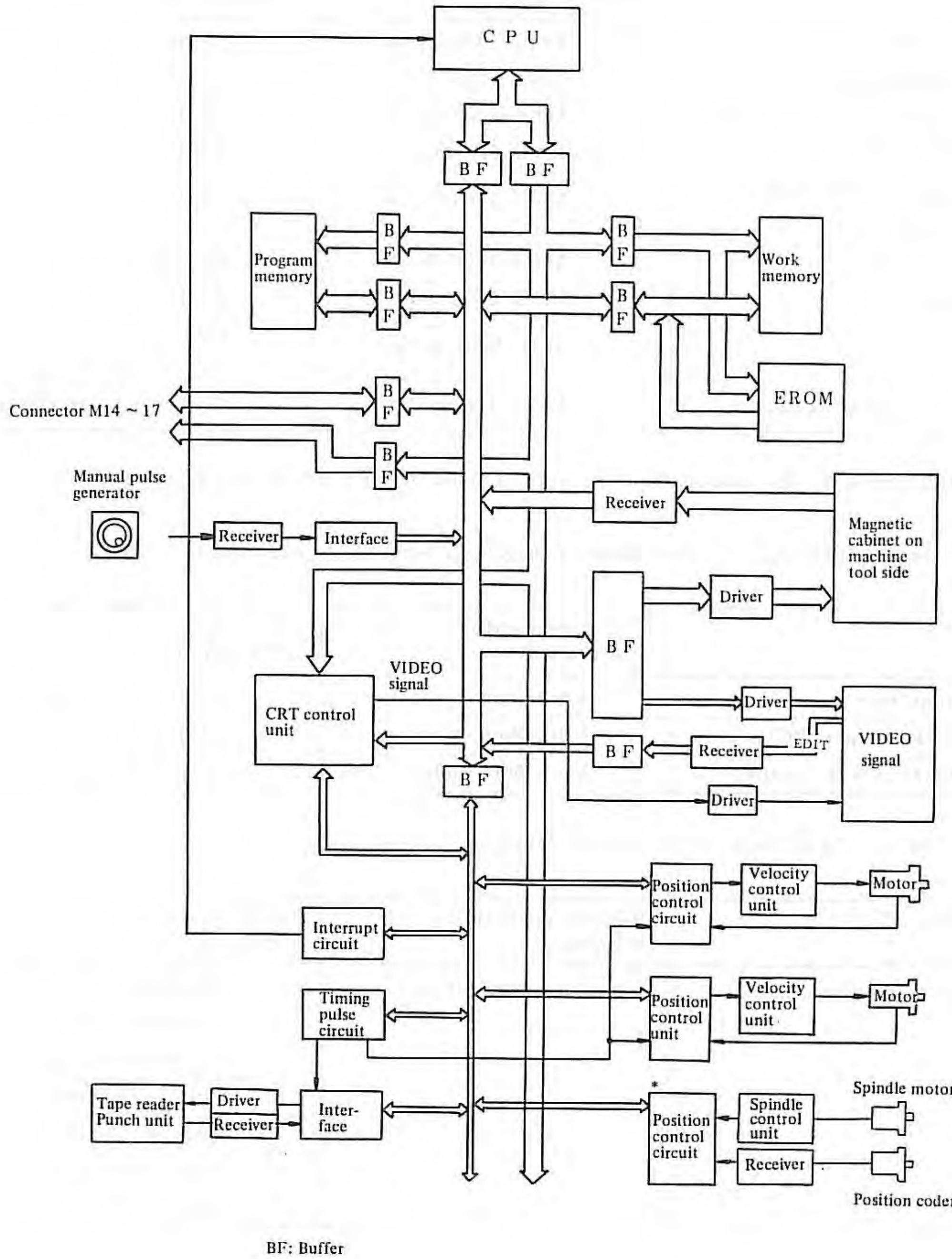


Fig. 1.1(d) Installation Layout of Connectors for Interfaces between Control Unit and Machine Tool

Note 1) For FS 3T-C, connectors M4, M13, M16 are not used.
Symbol M on connectors indicates a male connector, while symbol F indicates a female connector.
For overall connection diagram, refer to Fig. 1.1(f)(g).

Note 2) For FS 2T-A, connectors M4, M10, M16, M17 are not used.

Note 3) Only FS 3T-C is effective.



* Mark is not used for FS 2T-A.

Fig. 1.1(e) System Configuration

Table 1.1(b) PCB Unit or Control Unit

Name of PCB or unit	PCB or unit specification drawing No.	Unit specification drawing No.
Master PCB	A16B-1000-0010	A02B-0058-B501
Power supply PCB	A20B-1000-0410	A14B-0067-B002
Programable controller (PC1)	A20B-0008-0630	(Option) For PC-MODEL D
Additional I/O (PC2)	A20B-0008-0640	(Option)
Additional memory 20m (ADD, MEM)	A16B-1200-0220	(Option)
Keyboard PCB	A16B-1600-0042	MDI/CRT panel A02B-0063-C001
CRT unit	A13B-0055-C001	
CRT unit	A61L-0001-0076	CRT unit A13-0055-C001
Magnetic cabinet sequence	A16B-1200-0370	Option for PC-MODEL H

PCBs and units on the above list are not all used for FS 2T-A and FS 3T-C.

Table 1.1(c) PCB/Units of Tape Reader (RS232C interface, AC 200V)

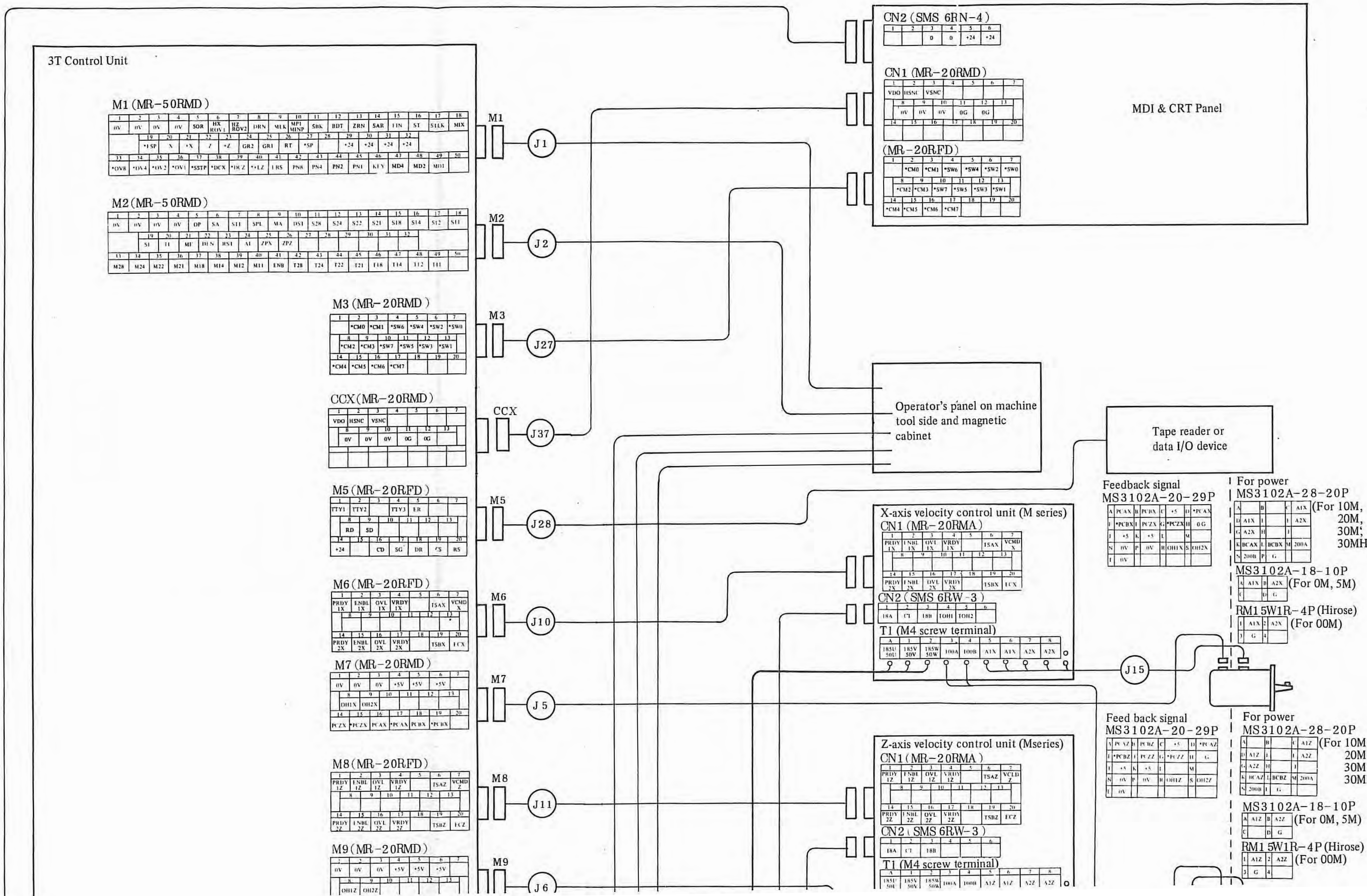
Name of PCB	PCB specification drawing No.	Unit specification drawing No.
Photoamplifier	A20B-0007-0750	A13B-0073-B001 or
RS232C interface PCB	A20B-0008-0280	A13B-0074-B001
Additional power supply	A14L-0066-0002	(Portable type)

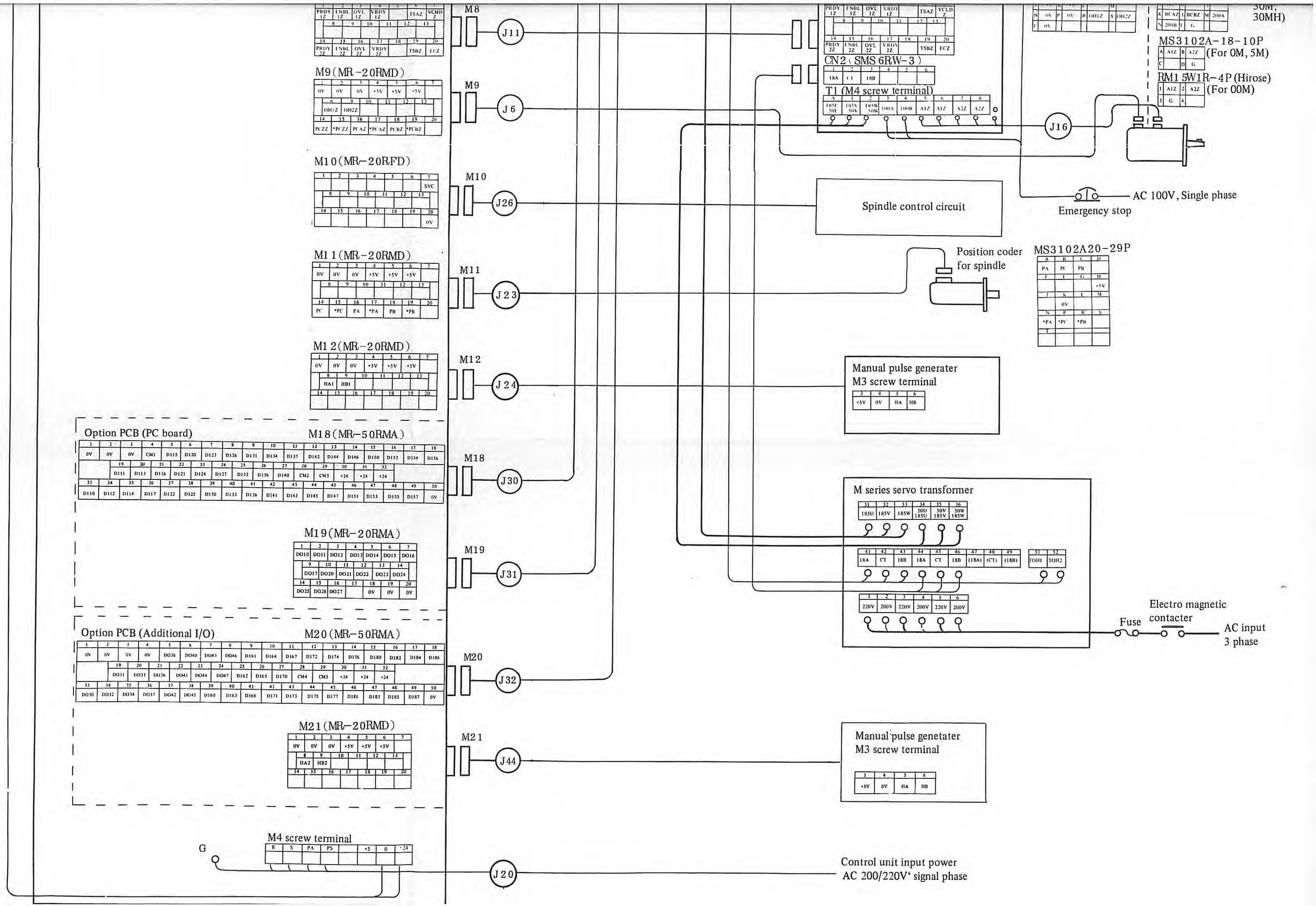
Table 1.1(d) PCB/Units of M Series Velocity Control Unit

Name of Unit	PCB specification drawing No.	Unit specification drawing No.
M series velocity control	A20B-0009-0320	A06B-6047-H001
		A06B-6047-H002
		A06B-6047-H003
		A06B-6047-H004
		A06B-6047-H005
		A06B-6047-H040
		A06B-6047-H041

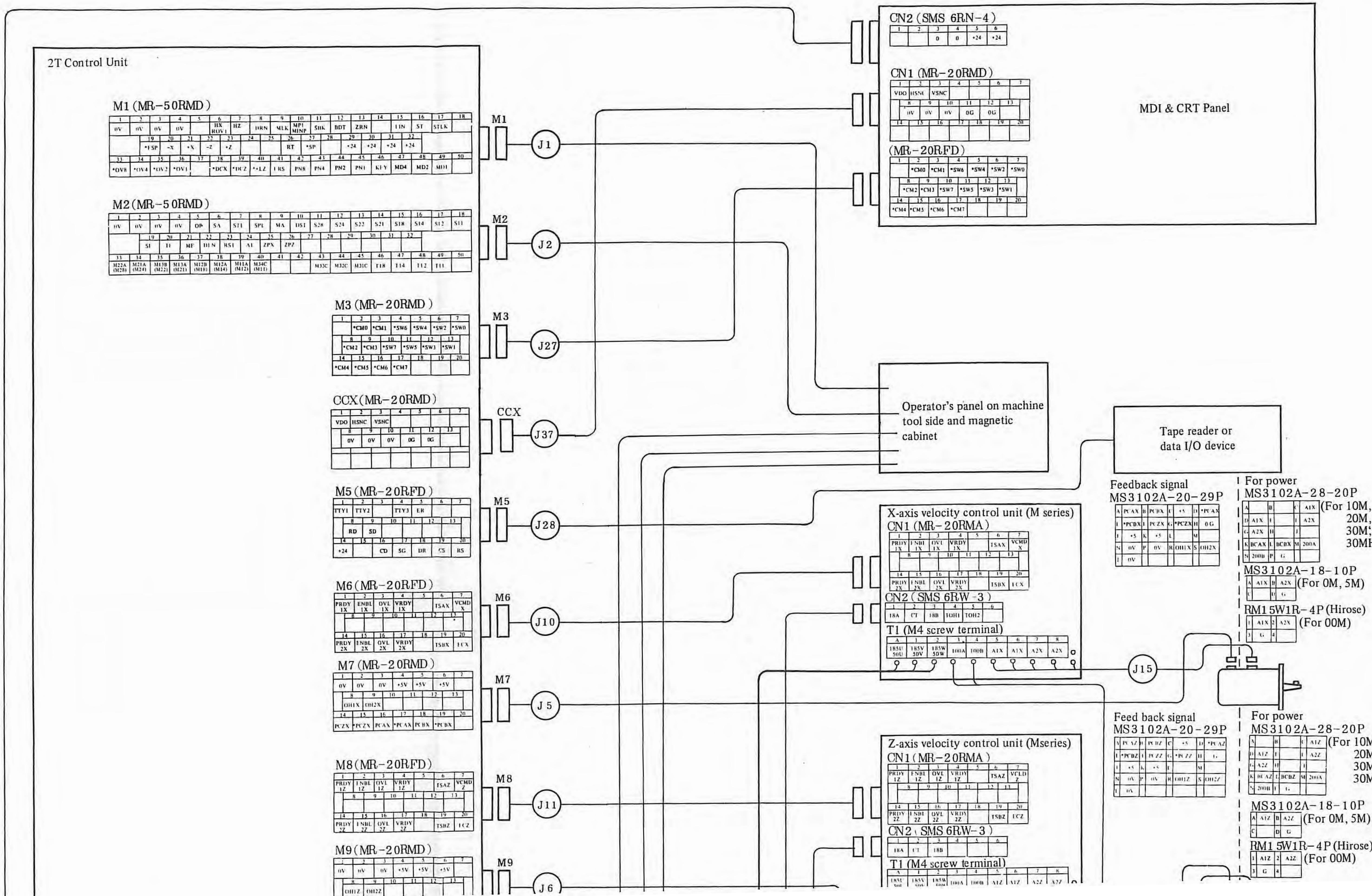
Table 1.1(e) Other Units

Name of Unit	Specification drawing No.
Multitap input transformer	A80L-0001-0176
Servo transformer	See 3.4
Manual pulse generator	A860-0201-T001
Position coder (6000rpm)	A86L-0026-0001#002
Position coder (4000rpm)	A86L-0026-0001#102

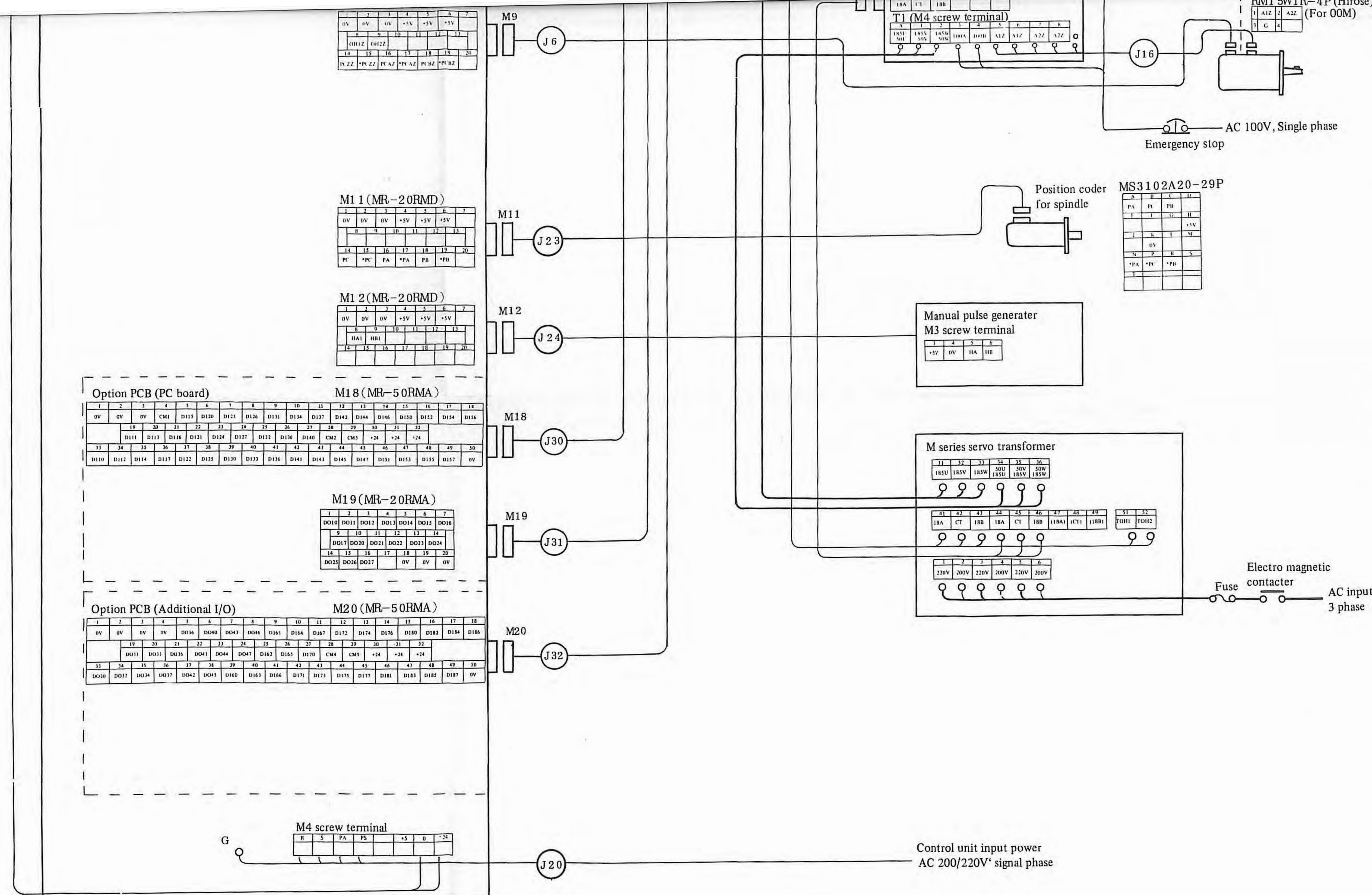

3T Control Unit
M1 (MR-50RMD)
M2 (MR-50RMD)
M3 (MR-20RMD)
CCX (MR-20RMD)
M5 (MR-20RFD)
M6 (MR-20RFD)
M7 (MR-20RMD)
M8 (MR-20RFD)
M9 (MR-20RMD)
M1
M2
M3
CCX
M5
M6
M7
M8
M9
J1
J2
J27
J37
J28
J10
J5
J11
J6
J15
CN2 (SMS 6RN-4)
CN1 (MR-20RMD)
(MR-20RFD)
MDI & CRT Panel
Operator's panel on machine tool side and magnetic cabinet
Tape reader or data I/O device
X-axis velocity control unit (M series)
CN1 (MR-20RMA)
CN2 (SMS 6RW-3)
T1 (M4 screw terminal)
Feedback signal
MS3102A-20-29P
For power
MS3102A-28-20P
(For 10M, 20M, 30M, 30MH)
MS3102A-18-10P
(For 0M, 5M)
RM15W1R-4P (Hirose)
(For 00M)
Z-axis velocity control unit (Mseries)
CN1 (MR-20RMA)
CN2 (SMS 6RW-3)
T1 (M4 screw terminal)
Feed back signal
MS3102A-20-29P
For power
MS3102A-28-20P
(For 10M, 20M, 30M, 30MH)
MS3102A-18-10P
(For 0M, 5M)
RM15W1R-4P (Hirose)
(For 00M)



M8
J11
M9(MR-20RMD)
M9
J6
M10(MR-20RFD)
M10
J26
M11(MR-20RMD)
M11
J23
M12(MR-20RMD)
M12
J24
Option PCB (PC board)
M18(MR-50RMA)
M18
J30
M19(MR-20RMA)
M19
J31
Option PCB (Additional I/O)
M20(MR-50RMA)
M20
J32
M21(MR-20RMD)
M21
J44
M4 screw terminal
G
J20
30MH)
MS3102A-18-10P
(For 0M, 5M)
RM15W1R-4P (Hirose)
(For 00M)
CN2 (SMS 6RW-3)
T1 (M4 screw terminal)
J16
AC 100V, Single phase
Emergency stop
Spindle control circuit
Position coder for spindle
MS3102A20-29P
Manual pulse generater
M3 screw terminal
M series servo transformer
Electro magnetic contacter
Fuse
AC input
3 phase
Manual pulse genetater
M3 screw terminal
Control unit input power
AC 200/220V' signal phase



2T Control Unit
M1 (MR-50RMD)
M2 (MR-50RMD)
M3 (MR-20RMD)
CCX (MR-20RMD)
M5 (MR-20RFD)
M6 (MR-20RFD)
M7 (MR-20RMD)
M8 (MR-20RFD)
M9 (MR-20RMD)
M1
M2
M3
CCX
M5
M6
M7
M8
M9
J1
J2
J27
J37
J28
J10
J5
J11
J6
J15
CN2 (SMS 6RN-4)
CN1 (MR-20RMD)
(MR-20RFD)
MDI & CRT Panel
Operator's panel on machine tool side and magnetic cabinet
Tape reader or data I/O device
X-axis velocity control unit (M series)
CN1 (MR-20RMA)
CN2 (SMS 6RW-3)
T1 (M4 screw terminal)
Z-axis velocity control unit (Mseries)
CN1 (MR-20RMA)
CN2 (SMS 6RW-3)
T1 (M4 screw terminal)
Feedback signal
MS3102A-20-29P
For power
MS3102A-28-20P
(For 10M, 20M, 30M, 30MH)
MS3102A-18-10P
(For 0M, 5M)
RM15W1R-4P (Hirose)
(For 00M)
Feed back signal
MS3102A-20-29P
For power
MS3102A-28-20P
(For 10M, 20M, 30M, 30MH)
MS3102A-18-10P
(For 0M, 5M)
RM15W1R-4P (Hirose)
(For 00M)



(Note) Option PCB, PC card and Additional I/O are not used for PC, MODEL H.

2. DAILY MAINTENANCE

FS 3T-C and FS 2T-A are designed to facilitate their adjustments by reducing periodical check points as much as possible from the viewpoints of maintenance.

On the other hand, user's sections concerned are requested to fully understand the concept of preventive maintenance to run the NC machine tool under a good condition for a long time.

Preventive maintenance needs the following items.

- Arrangement of maintenance tools
- Routine check and adjustment
- Provision of spare parts

2.1 Maintenance Tools

The following maintenance tools are recommandable.

(1) Measuring instruments

Instrument	Requirements	Use
AC voltmeter	AC power voltage can be measured with a tolerance of less than $\pm 2\%$.	AC power voltage measurement
DC voltmeter	Maximum division 10V, 30V Tolerance: Less than $\pm 2\%$ (A digital voltmeter may be required)	DC power voltage measurement
Oscilloscope	Frequency bandwidth 5MHz or higher, 2 channels	Adjustment of tape reader photoamplifier, etc.

(2) Tools

Cross-recessed (+) screwdrivers: Large and medium sizes

Conventionals (-) screwdrivers: Large, medium, and small sizes

(3) Chemicals

Tape reader cleaning solution (absolute alcohol) and oil

2.2 Cleaning of Cooling System

FS 3T-C and FS 2T-A main body do not employ any air filter, etc. However, the machine tool cabinet with built-in NC employs a heat exchanger or an air filter. Clean the cooling system periodically, referring to the machine tool builder's instruction manual.

2.3 Exchange of Dry Batteries

If battery alarm "BAT" is displayed in the bottom line of the CRT screen of the CRT display unit to inform of excessive drop of the battery voltage, the batteries must be replaced. If this exchange is neglected, data in data memory inside NC may be broken.

For the mounting position of dry batteries, refer to the machine tool builder's instruction manual. Observe the following general cautions

(1) Replace batteries while the power supply is being turned on.

(2) Particularly be careful not to insert batteries reversely.

(3) Use three alkali manganese dry batteries now being available on the market. The life of these batteries will last for about one year.
Replace these batteries periodically once every year, even if the battery alarm does not light yet.

2.4 Check and Cleaning of DC Motor

(a) Check and clean motor brushes according to the following procedure. If these brushes are abnormally worn, the motor may be damaged. Check them without fail, accordingly.

(i) Check brushes at the following intervals as the standard frequency.

- General machine tools (lathe, milling machines, machining center, etc.)
  Once every year
- Machine tools (punch press, etc.) which are accelerated and decelerated frequently
  Once every 2 months

Determine a suitable check interval by judging it from the wear condition of brushes and others in practice.

(ii) Make sure that the motor power supply is turned off. Since brushes may be still hot just after operating the motor, wait for a while until they are cooled down.

(iii) Remove brush cap ((a) in Fig. 2.4) by using a suitable screwdriver which fits to the slot.

(iv) After removing all brushes, visually check their length. If their remaining length is shorter than 10mm (or shorter than 5mm in case of DC servo motor model 00M), they cannot be used any longer. Judge them if they are employable by the next check, and replace them as required.

(v) Check brushes carefully for noticeable scars, slots on their contact faces, and arc traces on brush springs. Replace them, if defective.
Carefully check them about one month after replacing them, and if the same symptom appears, contact your nearest FANUC's service representative.

(vi) Blow off the brushes dust from all brush holders with compressed air (factory air), and the brush dust will come not of other brush holders. Before using compressed air, confirm that it does not contain any iron dust or a large amount of moisture.
Insert brushes to the innermost of brush holders. If the brush spring is caught in between the conductor metal and the brush holder, the brush cap cannot be inserted to the innermost.

Confirm that all brush caps are inserted into the brush holders to almost the same level. When putting these brushes into the brush holders, they cannot slide smoothly due to the brush dust which attaches to the inner surfaces of the brush holders. In such case, clean the inner surfaces of brush holders with the tip of a screwdriver. (Be careful not to scratch the commutator surface.)

(vii) When replacing brushes, use just the same brushes (in quality and shape) as existing ones. After replacing them, run the DC motor without load for a while to fit the brush surfaces to the commutator surface.

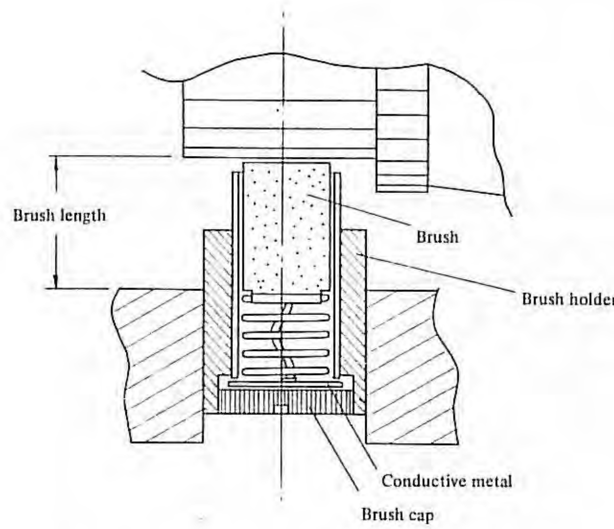
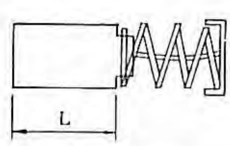


Fig. 2.4(a) Structure of Brush Holder



DC servo motor model brush	Length of new	Usable length	Purchase drawing for brush
00M	10mm	5mm	A290-0632-V001
0M, 5M	19mm	10mm	A290-0641-V001
10M,20M,30M,30MH	19mm	10mm	A290-0651-V001

Fig. 2.4(b) Brush Length

(b) Cleaning of heat pipe cooling section (in case of Model 30MH)

A large amount of dust accumulated on the net and fins of the heat pipe cooling section lowers the cooling capacity of the heat pipe and causes troubles due to the generated heat.

(i) If dust is accumulated on the net to disturbs the ventilation, remove the net, and clean it.

(ii) If a large amount of dust is accumulated on the fins consisting of many aluminum discs, clean the fins by blowing compressed air (factory air). If dust cannot be removed in this way, remove it with a thin rod or the like.

(iii) Since dirt of the cooling section depends largely upon ambient conditions, determine the periodical cleaning frequency according to the working environments. (Check the cooling section once every 6 months as the standard frequency.)

2.5 Maintenance of Tape Reader (Applicable to both separate type and portable type)

(1) Cleaning points of reelless tape reader

No. in Fig. 2.5(a)	Cleaning point	Cleaning frequency	Cleaning method
①	Read head surface (light sensing)	Every day	Clean with gauze or a thin brush wetted with absolute alcohol.
②	Read head surface (light emitting part)	Every day	
③	Tape retainer	Every day	
④	Tape path surface	Every day	
⑤	Capstan roller	Every week	
⑥	Guide roller	Every week	
⑦	Pinch roller	Every week	
⑧	Mechanical assembly under the tape path plate	Every month	Clean with a cloth or a brush.
⑨	Inside the tape reader cover	Every month	

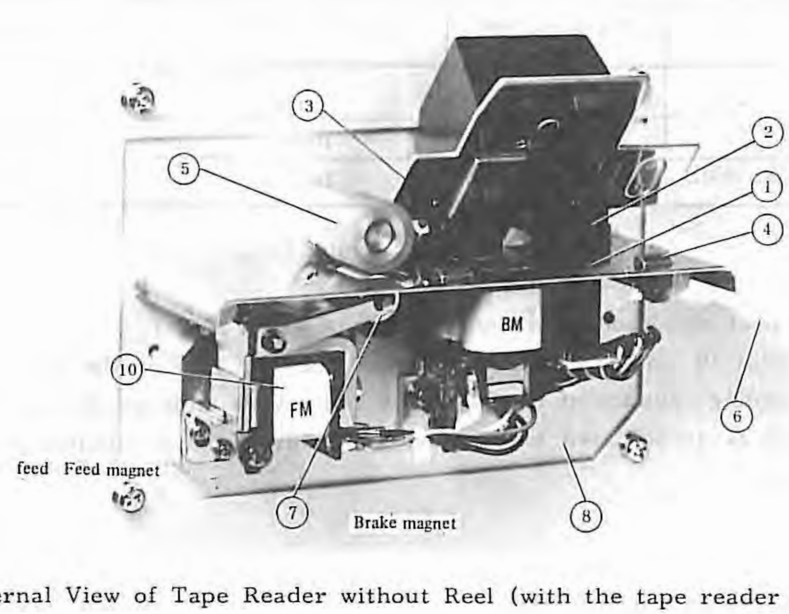
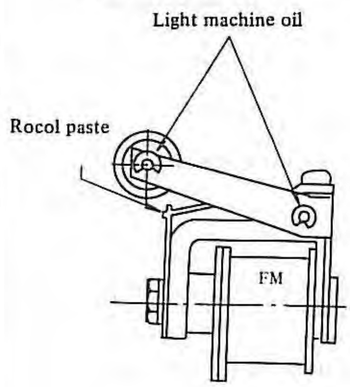


Fig. 2.5(a) External View of Tape Reader without Reel (with the tape reader cover detached)

(2) Lubrication to tape reader

Routine lubrication points and lubrication frequency are as specified below.

No. in Fig. 2.5(a)	Lubrication points	Frequency	Lubricant	Oil quantity
⑩	Magnet section	3 months	LAUNA oil	1 drop
	(FM: Feed Magnet) A860-0060-V003 	1 year	Rocal paste	To such an extent as produce a thin film

2.6 Arrangement of Spare Parts

You are requested to purchase and prepare the following consumables without fail.

(a) Fuses (See para. 8.1)
(b) Motor brush (See para. 2.4)
(c) Dry batteries (See para. 2.3)

Prepare PCB, units, etc., as required.

(a) PCB and units (See para. 1.1)
(b) Major parts of velocity control unit (See appendix 5)
(c) Maintenance parts for tape reader (See para. 2.5)
(d) Maintenance parts for power supply (See appendix 3.3)

3. INSTALLATION PROCEDURES

This section describes the setting, adjustment, and check procedures for operation NC normally after installing it.

By observing these procedures, NC can be checked appropriately at the installation time. This section finally describes data to be recorded as installation results.

Table 3(a) Installation Procedures

No.	Paragraph	Description
1	3.1	Basic check before turning on power supply
2	3.2	Checking the input power supply of control unit and setting the transformer taps
3	3.3	Setting the taps of M series servo transformer
4	3.4	Check after turning on power supply when motor power cable has been disconnected
5	3.5	Check after turning on power supply when motor power cable has been connected
6	3.6	Recording data at installation time

3.1 Basic Check before Turning on Power Supply

(1) Visual inspection

(a) Check NC for dirt and damage in appearance.

(b) Check NC for internal damage, looseness of PCB, and disconnection of PCB.

(c) Check cables and bundled wires for damage (exfoliation of sheathing, etc.)

(2) Check screw terminals for normal connections.

(a) Terminal board of power supply unit.

(b) Terminal board of tape reader unit.

(c) Terminal board of velocity control unit.

(d) Terminal board of multitap input transformer (option).

(e) Terminal board of servo transformer.

(f) Check terminal boards for normal mounting condition of covers, if provided.

(3) Check of ground wire

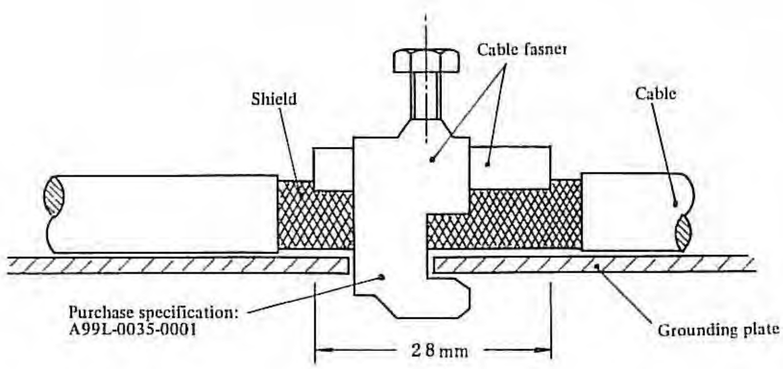
(a) Check if a grounding wire is connected to ground from the magnetic cabinet.

(b) Check if NC is connected to the magnetic cabinet by using a sufficiently thick protective grounding wire (larger than $5.5mm^2$).

(c) Check if a protective grounding wire is connected between the velocity control unit and the magnetic cabinet.

(d) Check if a protective grounding wire is connected between the servo transformer and the magnetic cabinet.

(e) Check if the cable sheath is grounded through the shielded wire or clamp fastner.



(4) Cable check (for No.1 machine only)

Check if the following cables conform to the standards specified in the connecting manual.

(a) DC servo motor feedback cables (J5, J6)

(b) Position coder cable (J23)

(c) Manual pulse generator cable (J24)

(d) Tape reader signal cable (J28)

(e) Signal cable .... Totally shield cable

(f) MDI & CRT panel signal cable (J27)

(g) CRT video signal cable (J37)

(h) DC servo command cables (J10, J11)

(i) DC motor power cables (J15, J16)

(j) MDI & CRT panel power cable (J38)

(k) Tape reader power cable

(5) Check connectors for looseness

(a) Check if clamp screws of HONDA connectors of master PCB are tightened.

(b) Check if the clamp claw of power connector (BUNDY) is fitted normally.

(c) Check if clamp screws of option PCB is loosen.

(6) Check of setting plug

Check if the setting plug is securely mounted into the setting pin in the following units.

(a) Master PCB

(b) Power supply PCB

(c) Option PCB

(d) Velocity control unit PCB

(7) Check if EROM, RAM, LSI, etc. are securely mounted onto IC socket of master PCB.

(8) Power supply unit check

Make sure that power supply unit terminals are not grounded by using an ohmmeter. Make sure that power supplies are not grounded to each other.

(a) Between 5V and 0V

(b) Between 24V and 0V

(c) Between 15V and 0V

(d) Between -15V and 0V

(e) Between 5V and 24V

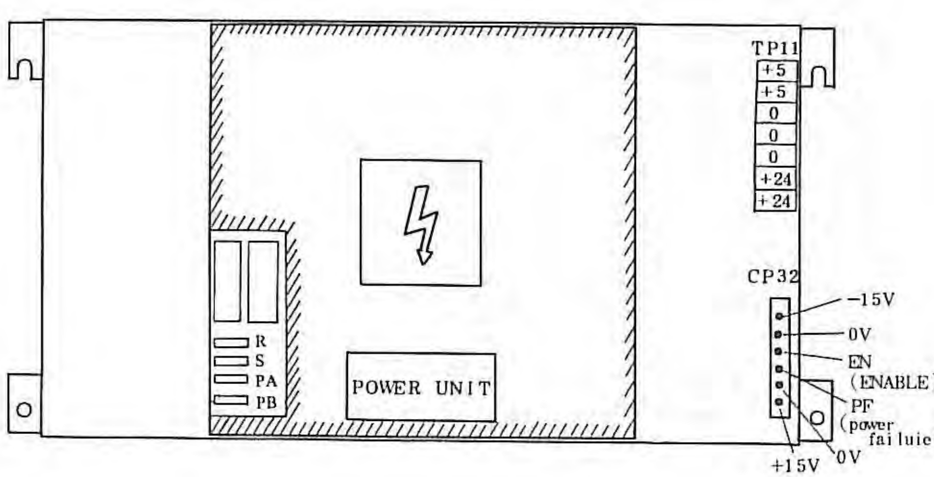
(f) Between 5V and 15V

(g) Between 5V and -15V

(h) Between 24V and 15V

(i) Between 24V and -15V

(j) Between 15V and -15V



Measuring Points in Power Supply Unit

3.2 Checking the Input Power Supply of Control Unit and Setting the Transformer Taps

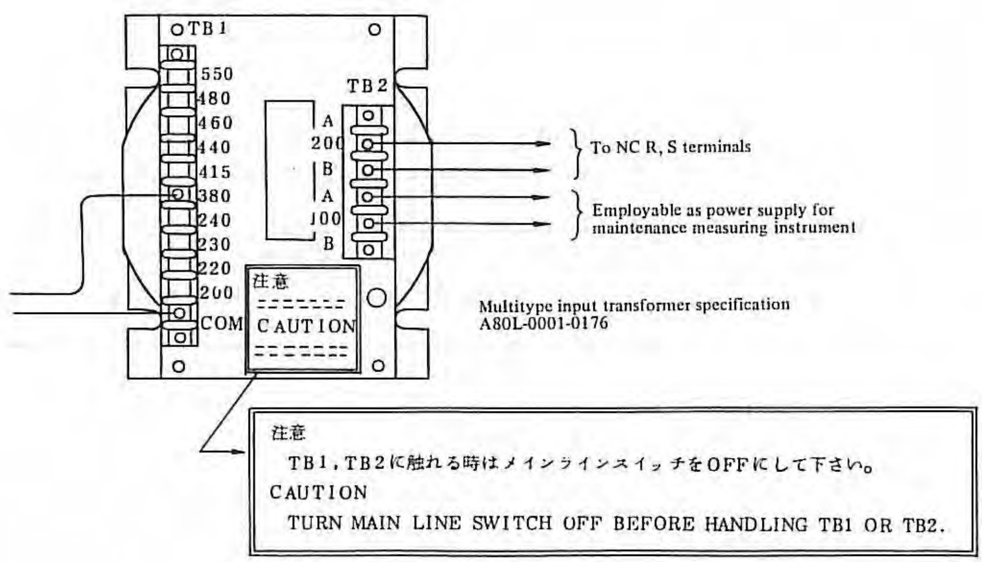
(a) Measure the power voltage at the installation place. AC ______ V

(b) Check the input power supply for fluctuation. Min. ______ V

Max. ______ V

(c) Check if the input power capacity is sufficient, judging it from the power consumption of the control unit. The power consumption of the control unit is 400 VA.

(d) Setting of taps of multi-tap input transformer (option) for NC (control unit, MDI & CRT panel, and taps reader unit)
This setting is necessary, if the NC input power voltage is temporarily deviated from a range of AC 170V to 240V. If the input voltage is AC 380V, for example, mount the above transformer, and connect cables as follows.



3.3 Setting the Taps of M Series Servo Transformer

Connect the connecting positions of power cable U, V, W and terminals as specified in Table 3.3(b) and 3.3(c).

Table 3.3(a) M Series Servo Transformer Capacity

Name of servo transformer	
MAE, MA	1.5k VA
MBE, MB	2.5k VA
MCE, MC	5 k VA

Table 3.3(b) Setting of Taps of M Series Servo Transformer
(In case of power transformers MA - MC for use in Japan)

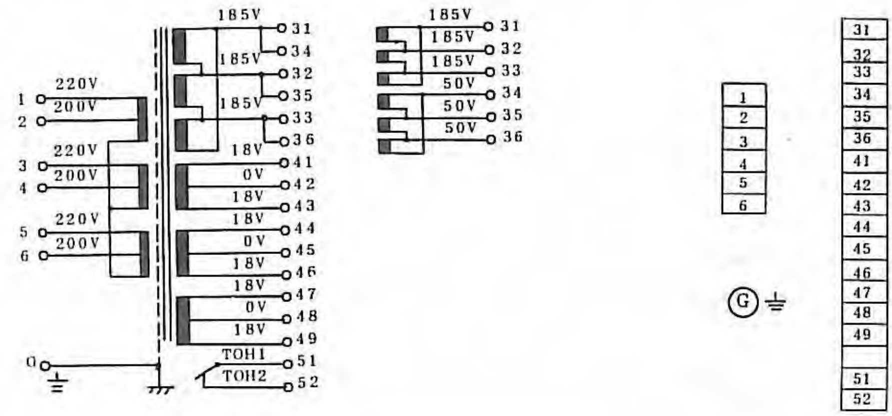
Power voltage	Connection of transformer primary terminals
200V	U-2, V-4, W-6
220V	U-1, V-3, W-5

Table 3.3(c) Setting of Taps of M Series Servo Transformer
(In case of power transformers MAE - MEC for use in overseas countries)

Power voltage	Connection of transformer primary terminals	
	Connection of power cables U,V,W	Shortage between transformer terminals
190V (Also applicable to 200V)	U-3-7, V-11-15, W-19-23	4-8-12-16-20-24
230V (Also applicable to 220V)	U-2-6, V-10-14, W-18-22	
380V	U-3, V-11, W-19	4-7,12-15,20-23,8-16-24
420V (Also applicable to 415V, 440V)	U-3, V-11, W19	4-6,12-14,20-22,8-16-24
460V (Also applicable to 480V)	U-2, V-10, W-18	4-6,12-14,20-22,8-16-24
550V	U-1, V-9, W-17	4-5,12-13,20-21,8-16-24

Connection Diagram of M Series Servo Transformer

For use in Japan



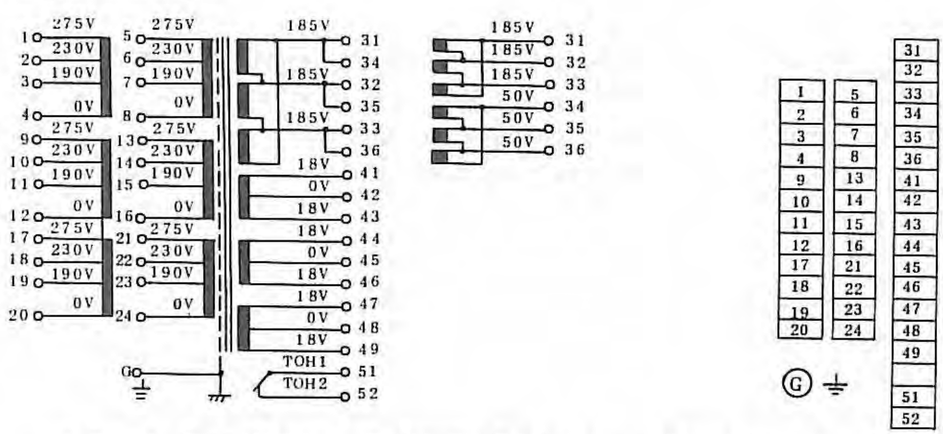
(i) Connection diagram of power transformers MA ~ MC MA31 ~ 36 terminals are connected in the same way as in (ii).

(ii) Connection diagram of power transformer MA terminals 31 ~ 36.

(iii) Arrangement of terminals (screw M4) of power transformers MA ~ MC.

Fig. 3.3(a) Connection Diagram of M Series Servo Transformers for Use in Japan

For use in overseas countries



(i) Connection diagram of power transformers MAE ~ MCE MAE31 ~ 36 terminals are connected in the same way as in (ii).

(ii) Connection diagram of power transformer MAE terminals 31 ~ 36.

(iii) Arrangement of terminals of power transformers MAE ~ MCE.

Fig. 3.3(b) Connection Diagram of M Series Servo Transformers for Use in Overseas Countries

3.4 Check after Turning on the Power Supply when Motor Power Cables has been Disconnected

When turning on the power supply after disconnecting the motor power cable, short plug D23 on PCB in M series velocity control unit.

(1) Turning on the power supply
Turn on the power supply after disconnecting the motor power cable, and make sure that the NC fan motor is rotating.

(2) Power voltage output check

(a) Make sure that the secondary output voltage of NC transformer is within a range from 170V to 240V. (The specified value is 200V.)

(b) The secondary output voltage of the servo transformer differs according to motor models as shown below.

FANUC DC servo motor Models of M series	Servo transformer Secondary voltage
00M	50V
0M, 5M, 10M, 20M	185V
30M, 30MH	

(c) Checking the DC voltage for NC
Measure each DC output voltage of the power supply unit at output voltage check terminals on the master PCB, and make sure that measured values are within the allowable range. DC +5V is adjustable to specified value +5.0V by variable resistor +5V ADJ. The voltage increases when turning this variable resistor clockwise.

Table 3.4(a) Specifications of Power Stabilizing Unit

Names of terminals on master PCB	Rated voltate	Voltage range	Current capacity (maximum value)	Use	Remarks
+5V	+5V	5±0.25V	11A	For logic circuit	Adjustable
+24V	+24V	24±2.4 V	3A	For input/output signals	
+15V	+15V	+15±0.75V	0.2A	For position control circuit	
-15V	-15V	-15±0.75V	0.2A	For position control circuit	
0V	0V	——	——	——	

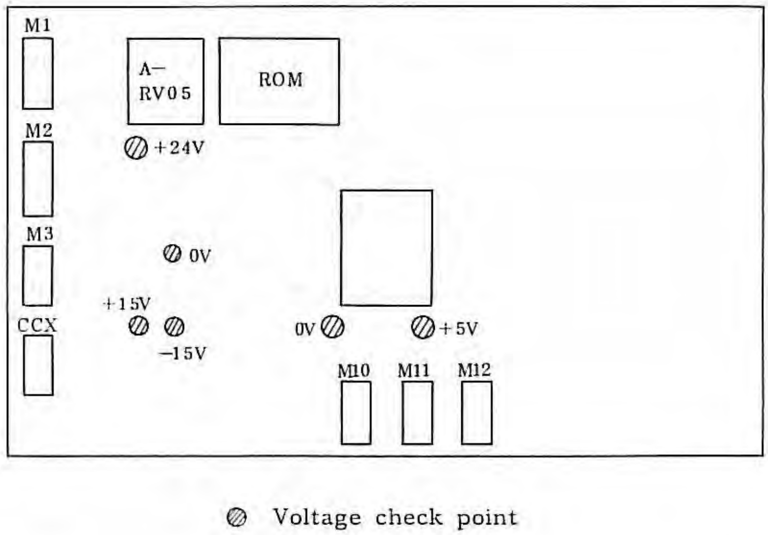


Fig. 3.4(a) Voltage Check Terminals of Master PCB (A16B-1000-0010)

(d) Checking the velocity control unit voltages

(i) Check each power voltage at the check terminals on the velocity control unit PCB of each axis.

° CH15 .... DC +24V (22 - 27V)

° CH16 .... DC +15V (14.5 - 15.5V)

° CH17 .... DC -15V (-14.5 - -15.5V)

For mounting positions of check terminals of the M series velocity control unit, refer to 4.4.

(ii) Check AC 100V power supply at T1 screw terminals No.3 and No.4 of the velocity control of each axis. If the emergency stop circuit on the machine tool side is operating or if the emergency stop button is being depressed on the operator's panel, this AC 100V is turned off. Release the emergency stop button or emergency stop circuit.

(3) Negative feedback connection check

(a) X axis

Move each axis by hand so that the X axis moves in the positive (+) direction defined in the machine tool (or turn the pulse coder shaft in the direction).

The X axis is connected properly when the voltage at check pin TSAX (Address D11 on PCB) is negative, or data at DGN No.800 is minus.

If the check pin TSAX voltage is positive or the DGN No.800 data in plus , the X axis is connected by positive feedback, and it runs away when the DC servo motor is connected. In such a case, reconnect signal lines of the control unit and DC servo motor as follows.

PCAX -- PCBX

*PCAX --*PCBX

(b) Z-axis

Move the z-axis in just the same way as in X-axis. Make sure that check pin TSAY/Z or DGN No.801 data is minus. If not, change the connections as follows.

PCAZ -- PCBZ

*PCAZ --*PCBZ

(c) When the built-in DC motor inside the tachogenerator is used;

Move the X and Z axes in the same way as described above, and make sure that the voltage is negative at check pins TSAX and TSAY/Z.

If positive, turn TSAX and TSBX for the X axis, or turn TSAZ and TSBZ for the Z axis.

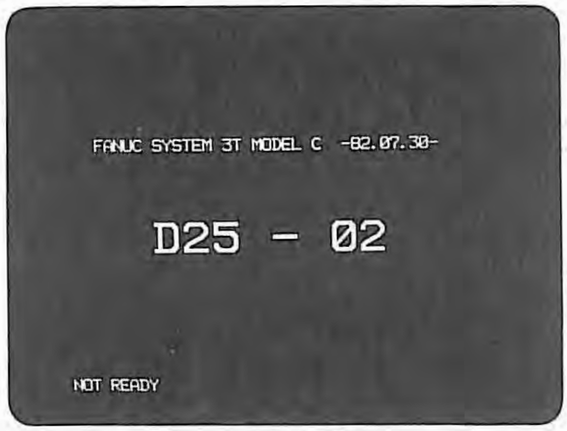
(4) Machine tool interface check

Check if input/output signals are normally transferred to and from the machine tool interface according to the self-diagnostic functions table. (See para. 6.1 and 6.3)

(5) Identification of the software version numbers

(a) When power is turned on;

The software version number is displayed as shown below until the system is set to be ready for operation after turning on the power switch or until an alarm occurs.



D25 - 01
Version
ROM series (for FS 3T-C)

Note) For FS 2T-A, ROM series is N01.

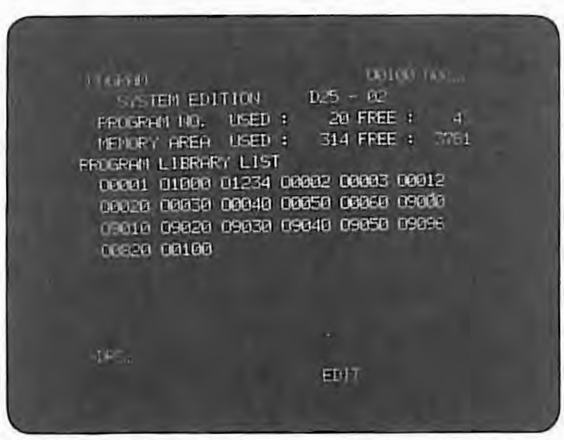
(b) After power has been turned on;

The version number can be displayed by the following procedure after power has been turned on.

(i) Set the EDIT mode

(ii) Select PRGRM (program) CRT screen.

(iii) Depress buttons in the order of $\boxed{\substack{Q\\P}}$ - $\boxed{\substack{O\\S}}$ and $\boxed{\text{INPUT}}$ on the MDI/CRT panel.



In addition to the version number, the following data are also displayed concurrently.

(i) Number of loaded program numbers (PROGRAM NO. USED)

(ii) Number of remaining program numbers (PROGRAM NO. FREE)

(iii) Number of stored program characters (MEMORY AREA USED)

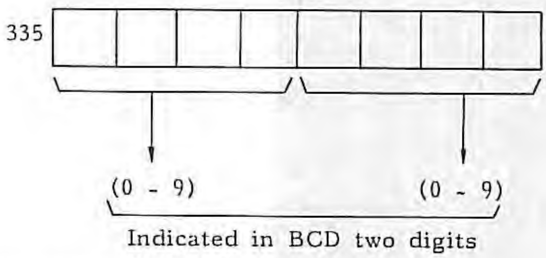
(iv) Number of remaining program characters (MEMORY AREA FEED)

(v) Program numbers being loaded (PROGRAM LIBRARY LIST)

(c) Indication of PC control software version number

The PC control software version number (option) can be displayed in DGN No. 335 after power has been turned on.

(DGNOS No.)



	Indication	Version No.
BCD	01	A
	02	B
	26	Z

(6) Parameter setting

After confirming the setting of all parameters according to the parameters table, turn off the power supply. (Refer to parameters in chapter 5.)

3.5 Check after Turning on Power Supply when Motor Power Cable has been Connected

(1) Check the motor power cable for normal connection. (For No.1 system, it is the safest to check the connection of the motor power cable after disconnecting the DC servo motor from the system.)

(a) Connect the power cable to the X-axis DC servo motor.

(b) Open short plug S23 of the X-axis velocity control unit for M series.

(c) Turn on the power supply under the condition that the emergency stop button can be pushed at once whenever necessary.

(d) A run away failure or a TGLS alarm, if any, may be caused by the following.

(i) Power cables A1X, A2X are connected reversely.

(ii) Power cables are disconnected halfway.

(iii) The feedback wire of the pulse coder or tachogenerator is disconnected.

Connect the power cable and check it in Z-axis in the same way as described above.

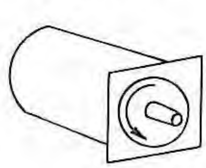
(2) Operating direction check

(a) Command the +X direction manually.

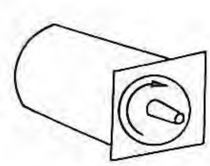
(b) Make sure that the jog direction, position display on MDI panel, and the moving direction of axes are equal to each other.

If the jog direction differs from the moving direction of the position display, the jog signal is wrongly connected at the interface.

If the jog direction is opposite to the moving direction of the axis, change the connection as follows.



A: Standard connection
Rotating direction by
(+) command



B: Reverse connection
Rotating direction by
(+) command

For rotating the motor in the B direction by (+) command, connect the DC servo motor as follows.

(a) Exchange the terminal positions for signals _ PCAa and _PCBa with each other.

(b) Exchange the terminal positions for signals *PCAa and *PCBa with each other.

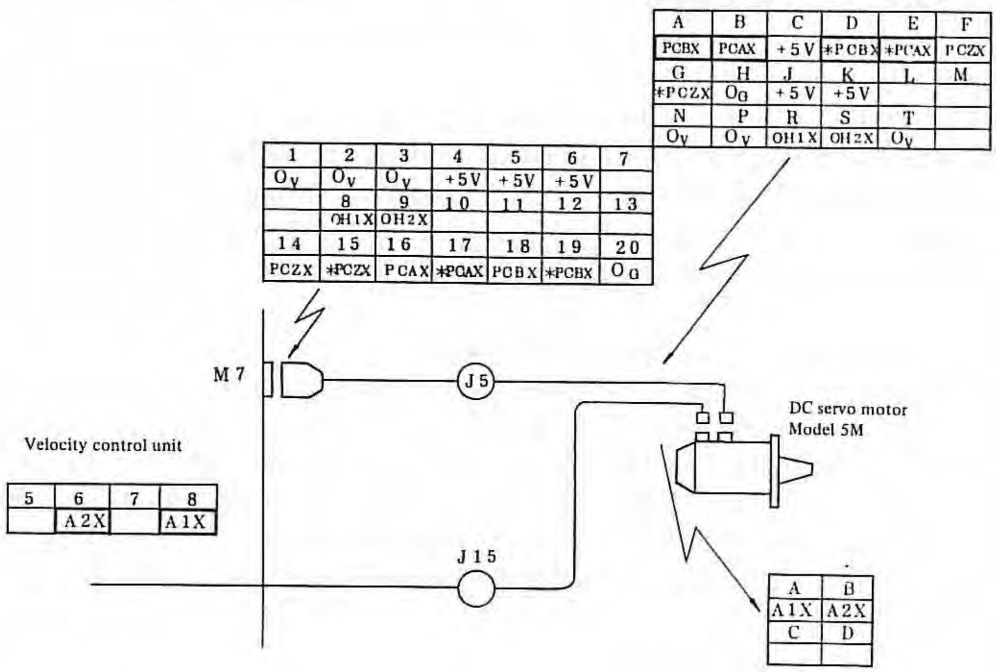
(c) Exchange power cables A1 and A2 with each other.

(d) Exchange tachogenerator signals TSAa and TSBa with each other. (Note 1)

Note 1) This should be done only when the built-in DC servo motor is used inside the tachogenerator.

Note 2) α is X or Z.

Example) When the DC servo motor is model 5M, the X axis is reversely connected by the following connection.



(3) Axis motion check

(a) Apply 10mm from MDI, and check if the axis moves 10mm securely. If not, examine parameters CMR and DMR.

(b) Check if the position control loop gain is set properly or not. The parameter No.37 values is normally 3000. The servo loop gain multiplier is set for each axis by parameters No.34 and 35.

(c) Operate the limit switch mounted on the machine tool intentionally, while moving the axis by JOG feed with a low override, and make sure that the axis stops moving when an overtravel alarm is detected.

(d) Move the axis by JOG feed or manual rapid traverse while changing the override, and make sure that an alarm, such as an excessive error, etc. is not produced even at the maximum feedrate.

(4) Final adjustment and check of servo offset

Before adjusting, turn to the emergency stop.

Then, short CH1 (VCMD) and CH3 (0V) of M series velocity control unit PCB, and measure the voltage between CH6 and CH4 (0V) by using an oscilloscope or a digital voltmeter.

Axis	Adjusting position	Observation point	Adjusting value
X	Variable resistor of X axis velocity control unit RV2	Check terminal of X axis velocity control unit CH6	0V ($\pm$0.5V)
Z	Variable resistor of Z axis velocity control unit RV2	Check terminal of Z axis velocity control unit CH6	

Note 1) If the machine tool position moves during adjustment, an excessive error or an excessive drift alarm may occur. In such a case, adjust the servo offset after setting the parameter in-position width and the limit value of positional deflection amount to about 5,000 respectively. Reset this parameter to the original value without fail after this adjustment. If the in-position width is large, the automatic drift compensation function does not operate.

Note 2) Don't short CH2 (TSA) and CH3 (0V) or CH2 and CH4 (0V) in the velocity control unit, otherwise the hybrid IC of the master PCB may be broken.

Note 3) After adjustment, disconnect the CH1-CH3 jumper wire, and apply a dial indicator to the machine tool to make sure that the machine tool does not move when turning on and off the emergency stop switch.

(5) Final adjustment and check of position control loop gain

To facilitate this work, perform programming in the metric mode if the machine tool feed screw is metric, or in the inch mode if the feed screw is inch.

Set NC to the feed per minute, and also set the feedrate override switch to 100%.

Operate the machine tool in the MDI mode, and check the position deflection amount (the detection unit value is displayed by DGN No.) at DGN 800 and 801.

Adjust RV4 (variable resistor for fine adjustment of tachogenerator voltage singal) on the velocity control unit of each axis, if desired.

Example) Adjustment and check when the position control loop gain is 30sec^{-1}.

(i) Move the axis by G21, G01, F100 (in case of metric screw) or G20, G01, F1000 (in case of inch screw).

(ii) Turn RV4 (vertical resistor for fine adjustment of tachogenerator voltage signal) on the velocity control unit of each axis until actual position deflection amount becomes 50 to 60. (detection unit).
The X-axis delay should be equal to the Z-axis delay at this time.

(6) Reference point return check

After setting the grid shift amount as a parameter, check if the reference point return is done normally. However, the set grid shift amount is not effective unless the emergency stop switch is turned on once after setting the grid shift amount and then the emergency stop switch is turned off again. Make sure of the reference point return motion without fail.

(7) Running test

Perform running test by a test program prepared according to the machine tool.

3.6 Recording of Data before Installation

Data obtained during the installation time or reinstallation time are every important for future maintenance and check, and they should be recorded without fail.

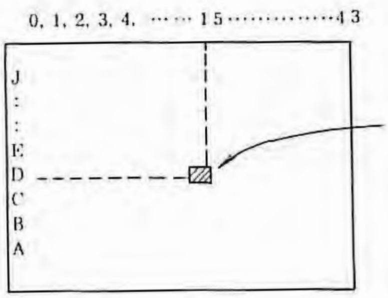
(1) Parameters
Record finally set parameters, and keep one copy of these data in the system. It is recommanded to prepare a parameter tape, if the FANUC SYSTEM 3T-MODEL C is provided with a tape reader. Utilize the parameter recording table shown in para. 5.3.

(2) Data sheet
If the data sheet is changed, rewrite it with new data.

(3) Check list
Record the check list to indicate whether check items were good or not during the installation time and what remedial action was taken if these check items were in trouble.

4. SETTING AND ADJUSTMENT OF PCB

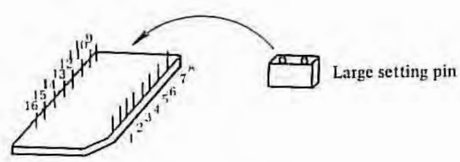
(1) The set positions of PCB are represented in the setting table as shown in the following figure (represented as an address).



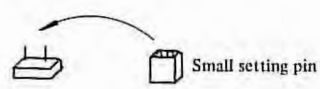
These addresses are marked with 0 - 43 in the horizontal direction and with A - J numbers in the vertical direction of PCB.
Address "D15", for example, indicates that the set position is located at the place where "D" in the vertical direction intersects "15" in the horizontal direction in the figure.

(2) Shapes of setting/adjusting parts

A: Large setting pin



B: Small setting pin



V: Variable resistor

(3) The functional version number of PCB is printed on PCB.

Example)

A16B-1000-0010/03 A

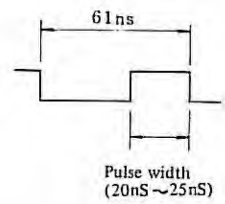
Represents function version A.
Represents total version 03.

4.1 Setting of Master PCB

(a) Setting of position control clock pulse width CLKSET (Address: G21)

The pulse width of position control clock *C16M has been set at factory before shipment. Don't change it. Since the dispersion of the pulse width is noticeable due to the clock generator circuit, the pulse width is not always set to the nominal value.

CLKSET	Nominal pulse width (nsec)				
	20	25	30	35	40
9-8					
10-7	○				
11-6		○			
12-5			○		
13-4				○	
14-3					○
15-2					
16-1					



(b) Selective setting of pulse coder
Set the pulse coder according to the number of feedback pulses from the pulse coder as follows.

(i) X-axis X-SET (Address: E12)

X-SET	Type of pulse coder			Remarks
	2000P/REV	2500P/REV	3000P/REV	
9-8				
10-7			○	
11-6	○			
12-5				
13-4				
14-3	○ (Note)	○ (Note)	○ (Note)	
15-2	(Note)	(Note)	(Note)	
16-1	○	○	○	Be sure to set this item in

(ii) Z-axis Y-SET (Address: D12)

Y-SET	Type of pulse coder			Remarks
(Z-SET)	2000P/REV	2500P/REV	3000P/REV	
9-8				
10-7			O	
11-6	O			
12-5				
13-4				
14-3	O (Note)	O (Note)	O (Note)	
15-2	(Note)	(Note)	(Note)	
16-1	O	O	O	Be sure to set this item

Note) When built-in type pulse coder and optical scale are used, and the voltage is translated by master PCB, disconnect between 14 - 3 and connect between 15 - 2. Provided that this setting is used with the master PCB later version than version 05E.

(c) Other setting

(i) Set the following 1 - 16 without fail.

Z-SET				Remarks
9-8				
10-7				
11-6				
12-5				
13-4				
14-3				
15-2				
16-1	O	O	O	Be sure to set this item

Note) Z-SET items other than 16-1 have been set before shipment from factory. However, this setting is insignificant.

(ii) Don't carry out the following setting.

Set position	Use
SH1	Watch dog timer alarm neglect
SH4	PCB test
SH5	ROM parity alarm neglect

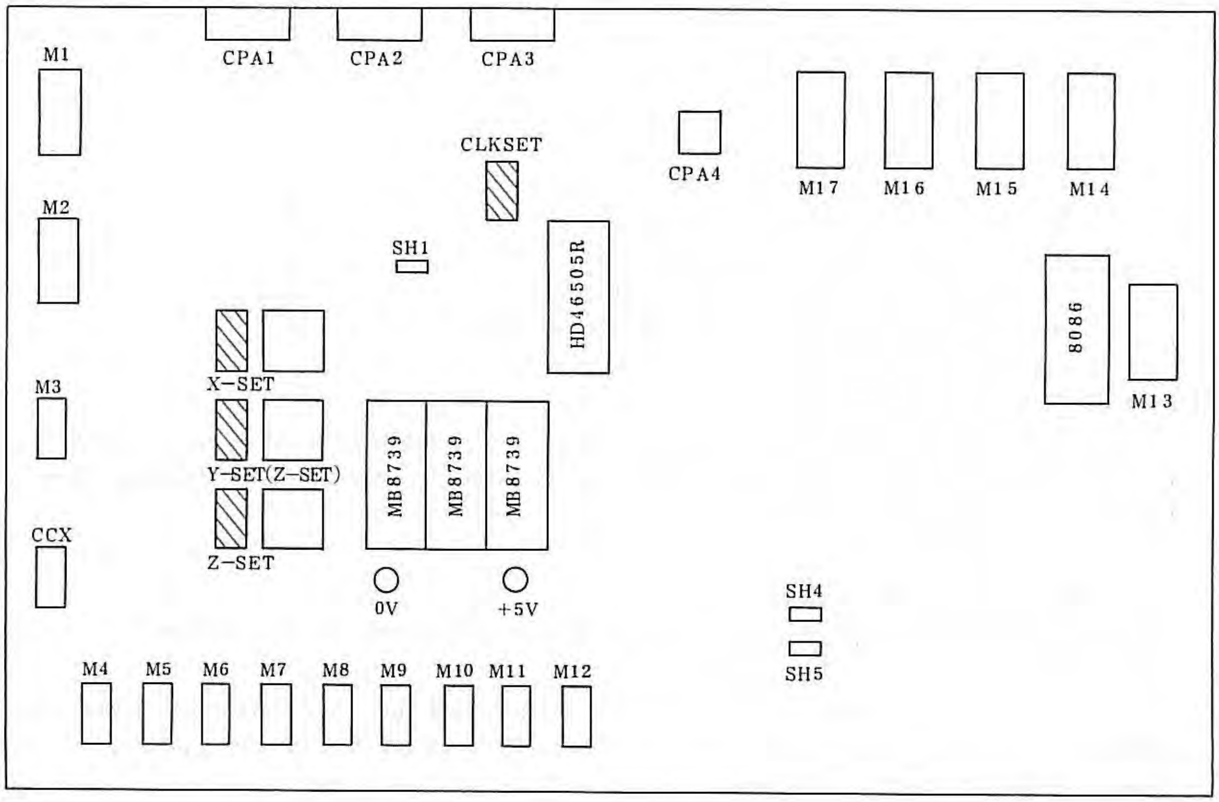
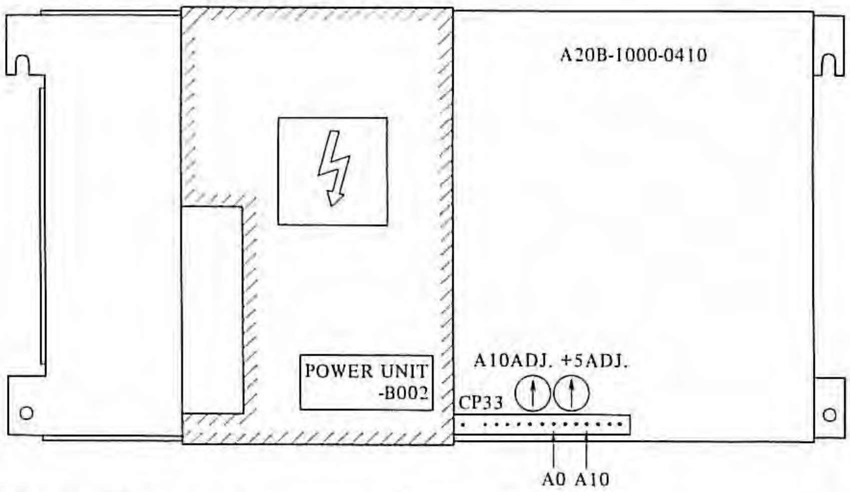


Fig. 4.1 Set Points of Master PCB (A16B-1000-0010)

Note 1) The shadowed portions indicate the set points.

Note 2) 0V and +5V indicate check terminals.

4.2 Adjustment and Setting



(1) Standard voltage adjustment

Measure by a digital voltmeter the voltage between A10 and A0 of checking connector CP33 to make sure it is 10.00V. If not, adjust by variable resistor A10ADJ. Turning clockwise produces greater voltage.

(2) +5V output voltage adjustment

Adjust by variable resistor +5 ADJ. Turning clockwise produces greater voltage.

(3) The voltage monitor circuits always monitor output voltages and auxiliary power-supply voltages, detect troubles, if present, turn the ENABLE signal OFF, and cut power.

Table 2.3 shows trouble detection levels of voltage monitor cirucits and major causes for trouble detection.

The voltage monitor circuits ar provided with jumper plugs S1 ∿ S4, S6 are all inserted (all effective). Pulling out S1 ∿ S4, S6 are all inserted (all effective). Pulling out S1 ∿ S4, S6 makes corresponding voltage monitor circuit ineffective.

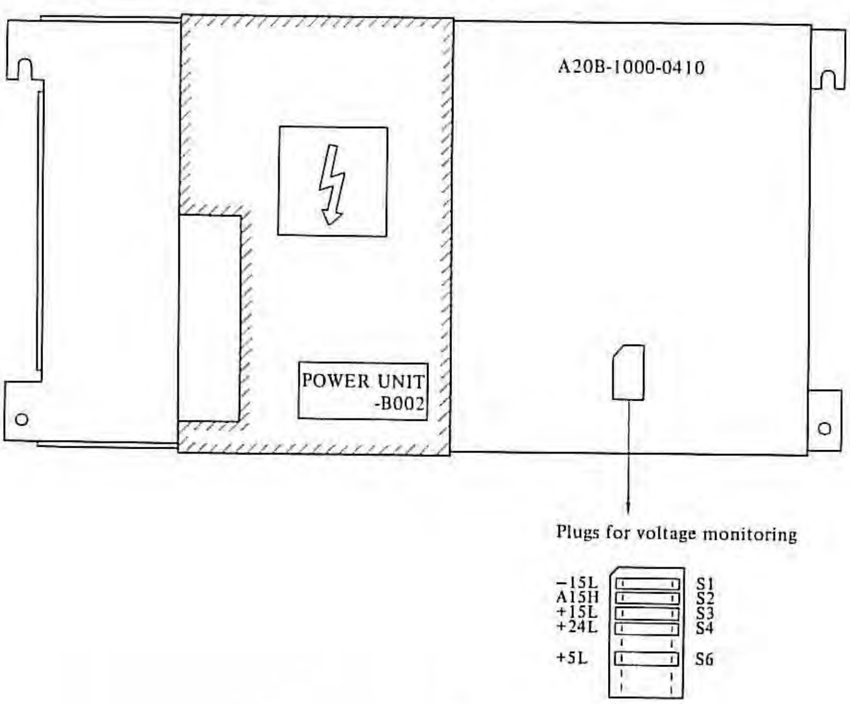


Table 4.2 Table of voltage monitoring circuit

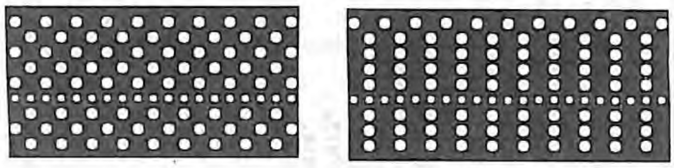
Voltage monitor circuit and abnormality detection level (absolute value)		Major causes of abnormality					Symbols of the shorting plugs
		Actuation of OVP and OCL	Rectifier and control circuit	Primary circuit	External conditions	Others	
+5V	Less than 97%	+5V circuit OVP actuation +5V circuit OCL actuation Primary circuit OCL actuation	Switching stop due to A15 voltage drop DS13 trouble Trouble of +5V control circuit (M12, M13, etc.)	Trouble of power switch circuit Blow out of F11 to AF12	Input AC voltage drop	Trouble of voltage monitor circuit (M13, M14, etc.)	S6
+24V	Less than 19.0 to 20.0V	+24V circuit OVP actuation +24V circuit OCL actuation Primary circuit OCL actuation	Switching stop due to A15 voltage drop Trouble of DS12 Trouble of +5V and +24V control circuit (M12, M13, etc.)				S4
+15V	Less than 12.7 to 13.0V	+15V and +24V circuit OVP actuation +15V and +24V circuit OCL actuation	Trouble of RG11				S3
-15V	Less than 12.0 to 13.0V	-15V and +5V circuit OVP actuation -15V and +5V circuit OCL actuation	Trouble of RG12 Trouble of D36				S1
(Auxiliary power supply)	More than 17.5 to 18.7V	――	Trouble of axiliary power (M11, etc.)	――	――	――	S2

OVP: Over voltage protecting function

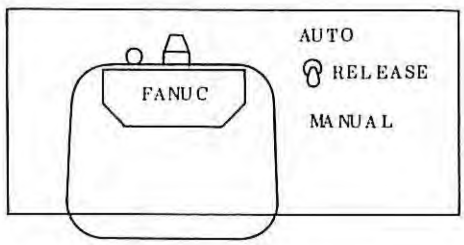
OCL: Over current limiting function

4.3 Tape Reader Adjustment

(1) Prepare a test tape about 40cm by alternately punching a paper tape other than black and gray tapes, and then, connect both ends of each tape to produce an endless tape.



(2) Load the above test tape onto the tape reader, and feed the tape by setting the switch to MANUAL.

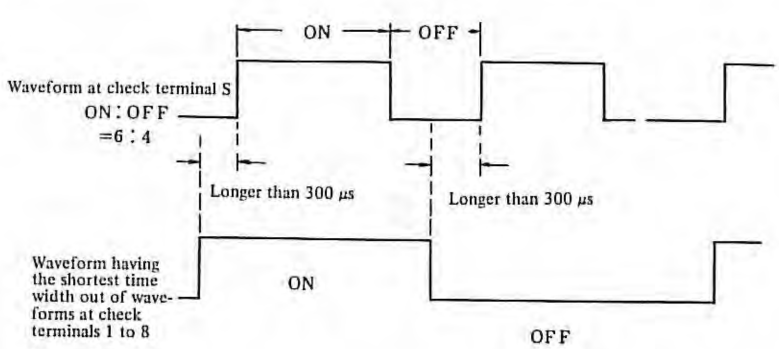


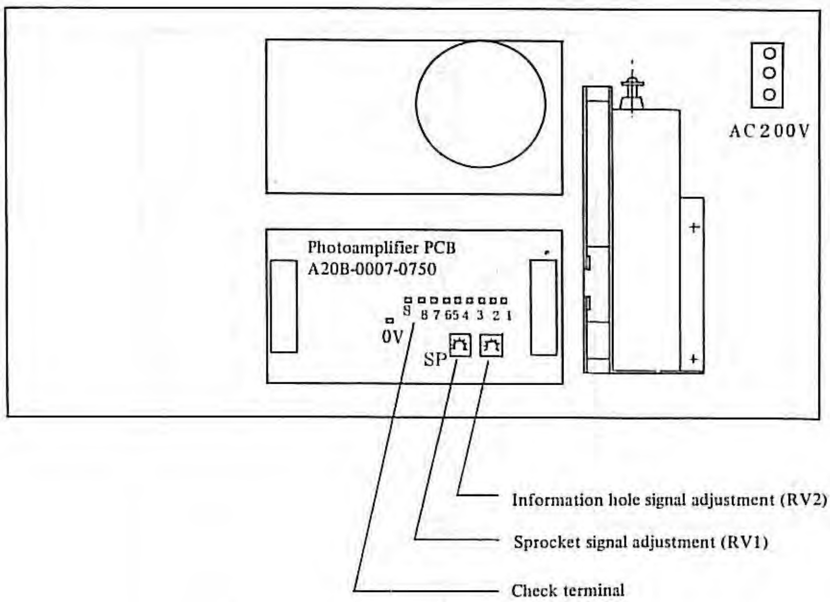
(3) Measure the waveform between check terminal S and 0V (ground) of the photoamplifier PCB mounted on the rear face of the tape reader, and adjust variable resistor SP until the ON-OFF time ratio becomes 6:4.

(4) Measure the waveform at check terminals 1 to 8 of the photoamplifier by using the oscilloscope, and find a channel having the shortest ON time width (ground:0V).

(5) Measure the waveform having the shortest ON time width out of waveforms at terminals 1 to 8 and the S waveform, and adjust the variable resistor mounted on the right side of SP so that their time relation is obtained as illustrated below.

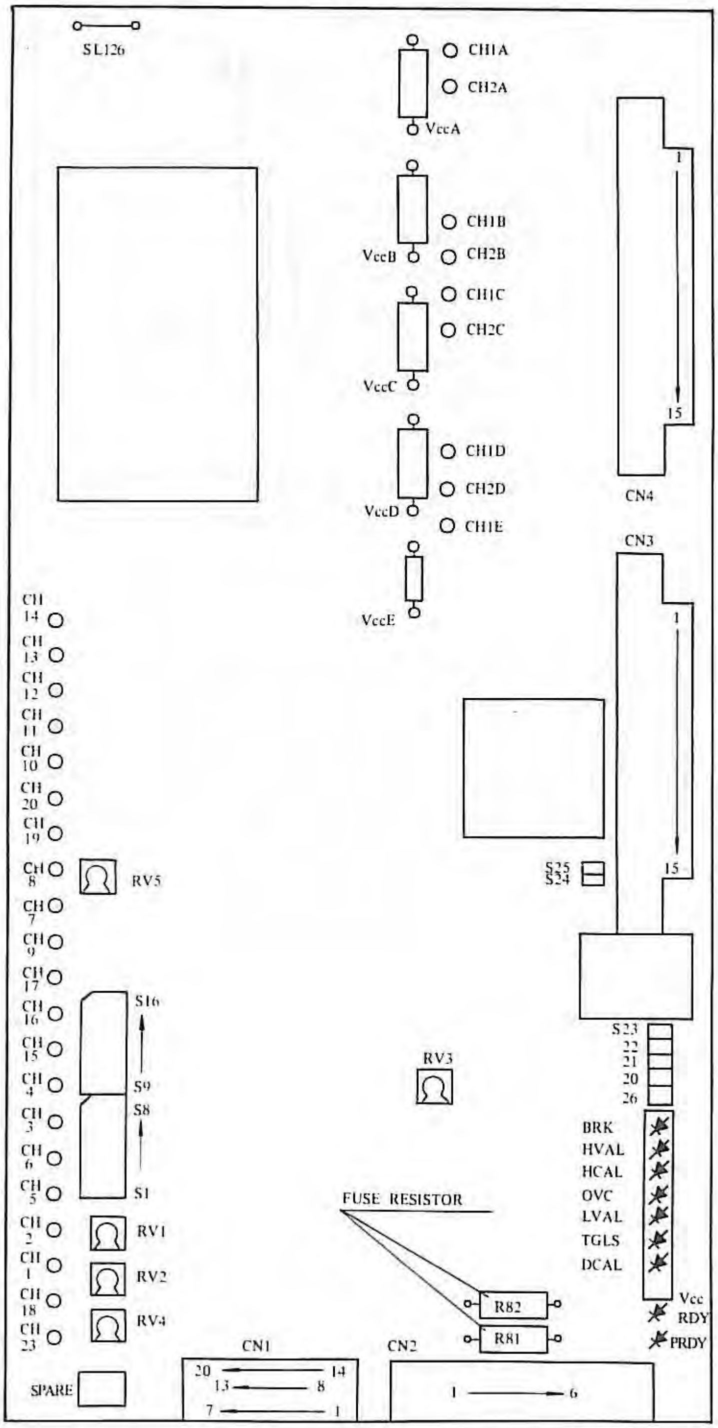
(6) Make sure that all waveforms at check terminals 1 to 8 satisfy the time relation shown in the following figure.





Note) For adjusting the output waveform of the photoamplifier, use a blue, white, pink, or yellow tape other than black and gray tapes. If a blue, white, pink or yellow tape is loaded to the tape reader which has been adjusted by using a black or gray tape, an error is produced. Don't adjust the tape reader by using a black or gray tape. (If a black tape only is used at all times, the tape reader may be adjusted by using the black tape.)

4.4 Setting and Adjustment of Velocity Control Unit



SETTING OF THERMAL RELAY

MOTOR MODEL	CURRENT
00M	4A
0M	6A
5M	9A
10M	12A
20M	18A
30M	24A
30MH	36A

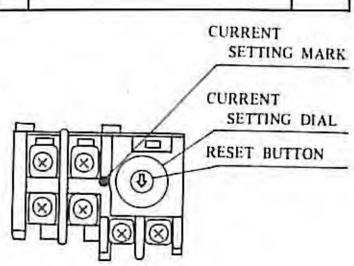


Fig. 4.4(a) Installation Diagram of Velocity Control Unit PCB

SETTING OF JUMPER	○ : POSITION TO BE SHORTCIRCUITTED						
JUMPER	00M		0M, 5M		10M ~ 30M(H)		MEANING
	PULSE CODER	PANCAKE TACHO	PULSE CODER	PANCAKE TACHO	PULSE CODER	PANCAKE TACHO	
S 1	○		○		○	○	TACHO-GENE. SETTING
2					○		
3							COMPRESSOR ENABLE
4							GAIN ATTENUATOR
5	○	○	○	○	○	○	HIGH FREQUENCY GAIN
6	○	○	○	○	○	○	
7	○	○	○	○	○	○	RIPPLE FILTER
8	○	○	○	○	○	○	HIGH-GAIN C.KT. ENABLE
9							CAPACITOR FOR COMPENSATION C.K.T.
10	○	○	○	○	○	○	
11							
12	○	○	○	○	○	○	DC GAIN
13							
14							CAPACITOR FOR HIGH-GAIN
15							SEE NOTE6
16	○	○	○	○	○	○	CHOPPING FREQUENCY SELECTOR
20	SEE NOTE1	—	—	—	—	—	THERMOSTAT FOR TRANSFORMER AND DISCHARGE UNIT ENABLE
21							BRK ALARM ENABLE
22							DCAL ALARM ENABLE
23							TGLS ALARM ENABLE
24	○	○	○	○	○	○	OVC ALARM OPERATING TIME SELECTOR
25							TGLS ALARM SENSING LEVEL
26	SEE NOTE2	—	—	—	—	—	DISCHARGE UNIT SELECTOR
126	○	○					MOTOR SELECTOR FOR ARMATURE VOLTAGE FEEDBACK C.K.T.

Adjustment and check of variable resistors

POS	ITEM	SETTING CONDITION				REMARKS
		POT	CHECK-PIN	SHORTING	SETTING AND CHECK	
1	CHECK AT JUMPER				CHECK SHALL BE MADE IN ACCORDANCE WITH ABOVE TABLE	
2	CHECK OF DC POWER SOURCE		CH15-3 CH16-3 CH17-3		CH15-3: 22~27V CH16-3: 14.5~15.5V CH17-3: -14.5~15.5V	
3	GAIN	RV1			5 SCALES	
4	OFFSET	RV2	CH6-3	CH1-3 CH2-3	±0.5V MAX	PANCAKE TACHO
					5 SCALES	PULSE CODER
5	OVERCURRENT ALARM ADJ.	RV3			10 SCALES	00M: 0.6+1.1 X SCALE(A) 0M~20M: 2+3.8 X SCALE(A) 30M(H): 4+7.5 X SCALE(A)
6	TACHO-GENERATOR COMPENSATION	RV4			1) NORMALITY 5 SCALES 2) USE FOR FINE ADJUSTING OF LOOP GAIN. REFER TO MAINTENANCE MANUAL OF NC.	
7	CURRENT LIMITER SETTING	RV5 SEE NOTE 5			9 SCALE	00M: 564/(93-5X SCALE)(A) 0M~20M: 1880/(93-5X SCALE)(A) 30M(H): 3760/(93-5X SCALE)(A)

NOTE 1. IF CONNECTION BETWEEN CN2(4)(5) AND TRANSFORMER OR DISCHARGE UNIT EXISTED, YOU WILL DISCONNECT S20.

2. IF YOU USED DISCHARGE UNIT, YOU WILL BE OPEN-CIRCUIT AT S26.

3. VOLUME SCALE IS AS FOLLOWS. RIGHT FIGURE SHOWS 8 SCALES.

4. * MARK IS TOTAL EDITION OF PCB.

5. CURRENT LIMITER FUNCTION IS APPLIED FOR PCB EDITION 02B OR LATER.
6. SETTING OF S15

01A*	CURRENT LIMITER SETTING
02B*03B*	NO CONNECTION
04B*05B*	CHOPPING FREQUENCY SELECTOR
07C*~	0.022μF INTO HIGH FREQ. GAIN DO NOT SHORT S14, S15 TOGATHER

Fig. 4.4(b) Short bars and variable resistors of velocity control unit PCB

	SYMBOL	MEANING OF CHECK TERMINAL			SYMBOL	
CH 1		3/4 X VCMD		CH11	PWA	PWM CKT OUTPUT FOR DRIVER A
2	TSA	TACHO-GENERATOR SIGNAL		12	PWB	" B
3	OV	OV		13	PWC	" C
4	OV			14	PWD	" D
5		COMPENSATION C.K.T.		15	+24V	+24V
6				16	+15V	+15V
7	TRIANGLE WAVE	SEE FIG. 2.		17	−15V	−15V
8	CURRENT	00M	0.66V/A	18	VCMD	VELOCITY COMMAND
		0M~20M	0.2V/A	19	VFB1	ARMATURE VOLTAGE FEEDBACK
		30M(H)	0.1V/A	20	VFB2	SIGNAL
9	ER	INPUT SIGNAL OF PWM C.K.T.		23	ENBL	DRIVER ENABLE
10	DISCHARGE	DISCHARGE MONITOR. SEE FIG. 3.				

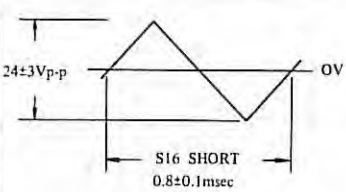


FIG. 2

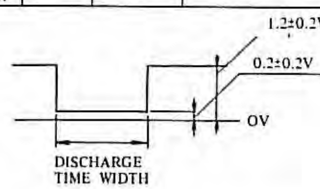


FIG. 3

LED DISPLAY

NAME	MEANING
PRDY (GREEN LED)	POSITION READY SIGNAL.
VccRDY (GREEN LED)	MONITORING FOR BREAKING OF FUSE RESISTORS (R81, R82). LIGHTING : NO-BREAKING NO LIGHTING : CHECK ITEM 1) CONTINUITY CHECK : R81, R82 2) PCB CN2 TO TRANSFORMER
BRK (RED LED)	NO FUSE BREAKER CUT OFF
HVAL (RED LED)	HIGH VOLTAGE ALARM POWER SUPPLY VOLTAGE IS TOO HIGH. DISCHARGE C.K.T. GOES WRONG. LOAD INERTIA IS TOO HIGH.
HCAL (RED LED)	HIGH CURRENT ALARM SHORT C.K.T. BETWEEN T1(5)(6) AND (7)(8). TRANSISTOR MODULE IS DAMAGED. PCB OF PWM C.K.T. GOES WRONG
OVC (RED LED)	OVERCURRENT ALARM (SET RV3) MOTOR LOAD IS TOO HEAVY.
TGLS (RED LED)	MOTOR RUNAWAY ALARM VELOCITY FEEDBACK SIGNAL IS LOSED. MOTOR ARMATURE CONNECTION IS OFF.
DCAL (RED LED)	DISCHARGE ALARM ACCELERATION AND DECELERATION FREQUENCY IS TOO HIGH. REGENERATIVE ENERGY FROM MACHINE WEIGHT OF VERTICAL AXIS IS TOO LARGE. TRANSISTOR FOR DISCHARGE IS DAMAGED.
LVAL (RED LED)	POWER SUPPLY VOLTAGE DROP ALARM. POWER SUPPLY VOLTAGE IS TOO LOW. FAULTY PCB.

Fig.4.4(c) Check Terminals and LED of Velocity Control Unit PCB

5. SYSTEM PARAMETER

Parameters must be set correctly so that the servo motor characteristics, machine tool specifications, and machine tool functions are fully displayed when NC is connected to the DC servo motor or machine tool. Since contents of parameters depend upon machine tools, refer to the attached parameter table prepared by the machine tool builder.

5.1 Parameter Display

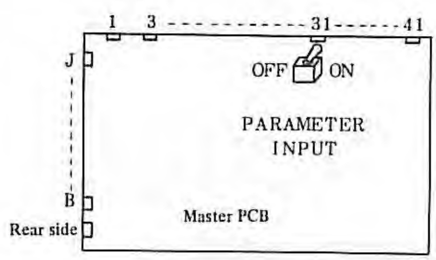
(1) Depress PARAM button on MDI/CRT panel.

(2) Select a desired page by depressing page buttons (↑, ↓).

5.2 Parameter Setting

5.2.1 Setting of parameters by using buttons on MDI/CRT panel

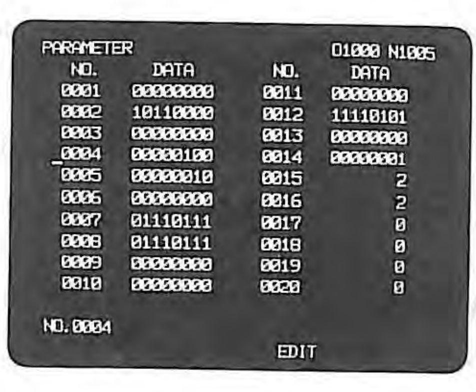
(1) Set the PARAMETER INPUT switch of the master PCB (address J30) to ON. NC is placed to P/S alarm No.100 condition.



(2) Select the MDI mode (or set the emergency stop condition)

(3) Depress PARAM button to display parameters on the CRT screen.

(4) Depress the page button to display a desired parameter page.



(5) Shift the cursor to the position of the parameter number to be changed.

Method 1

CURSOR

[↑] Depress CURSOR button. If this button is depressed continuously, the cursor shifts
[↓] sequentially. If the cursor exceeds a page, the next page appears on the CRT screen.

Method 2

Input [P P], [parameter] number and [INPUT].

(6) Key in a parameter value by data input keys.

(7) Depress INPUT. The parameter value is input and displayed.

(8) After all parameters have been set and confirmed, turn off the PARAMETER INPUT switch.

(9) Depress the RESET button to release the alarm condition. If alarm No.000 occurred, turn on the emergency stop switch, or turn off the power supply and then turn it on, otherwise the alarm is not released.

5.2.2 Setting of parameters using a tape

This method is effective only when the input/output interface option is mounted. Parameters can be input from the tape reader or teletypewriter ASR33/43.

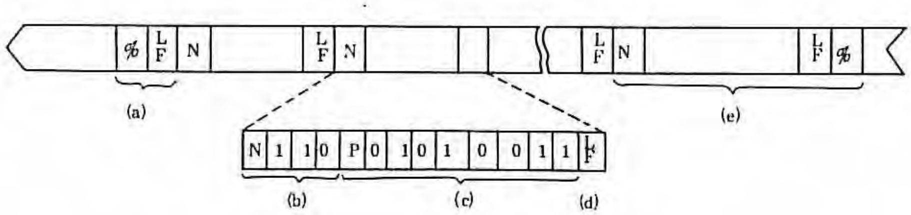


Fig. 5.2.2 Parameter Setting Tape Format

(a) Punch % (in case of ISO code) or ER or CR (in case of LF or EIA code) at the start of the tape.

(b) Punch the data number following address N next to the end of block code (LF in ISO code or CR in EIA code).

(c) Punch a data to be set after address P. Punched data at the address should correspond to the parameter number punched at address N.

(d) Punch the end of block code. Continue steps (b), (c), (d), as required. A data number following address N must be punched at the start of each block. Leading zeros of parameter data following P are omittable.

(e) Punch LF (in case of ISO code) or CR or ER (in case of % or EIA code) finally. Data input from the tape is finished with the input of this code.
Parameters not specified on the tape remain unchanged even if the parameter setting tape is input.

The parameter setting tape prepared by the above procedure can be input according to the following procedure.

(i) Turn on PARAMETER INPUT switch on master PCB.
(ii) Select EDIT mode on operator's panel
(iii) Select PARAM on MDI & CRT panel.
(iv) Turn on INPUT button on MDI & CRT panel.
(v) Turn off PARAMETER INPUT switch on master PCB.
(vi) Turn on RESET button (Turn on and off the emergency stop switch, if alarm number 000 occurred.)

Note 1) The tape stops traveling when the following alarms are detected. However, these alarms are not displayed.
(i) TH or TV (with TV check turned on) is in parity error.
(ii) An address other than N and P was input.
(iii) An N or a P value is disallowable.

Note 2) Depress RESET button, if it is desired to stop setting from the tape halfway.

Note 3) A part of parameters don't become effective unless the emergency stop switch is turned on once or power supply is turned off (when alarm No.000 occurred).

Note 4) Parameters related to the I/O interface must be set from MDI, etc. before inputting parameters from the tape.

5.3 Parameter Table

5.3.1 Parameter table

Parameter No.	Abbreviation	Meanings	Standard setting at the shipment time from FANUC
0000		Setting parameter	
0004		Various setting	
0005			
0006			
0007	DMRX GRDX	DMR detection multiplier	
0008	DMRZ GRDZ	GRD references counter capacity.	
0010		Various setting	
0011	TMF TFIN	MF, SF, T, FIN signal timming	
0012		Various setting	
0013		Various setting	
0014		Various setting	
0015	CMRX	Command multiplier	
0016	CMRZ		
0018	VLOCX	Velocity command value clamp	
0019	VLOCZ		
0021	SPLOW	Spindle rotation number at low speed	
0022	THDCH	Chamfering width in thread cutting (G76, G92)	
0023	SCTTIN	Check timing for spindle speed arrival signal	
0025	INPX	In-position width	
0026	INPZ		
0028	SERRX	Position deflection limit value	
0029	SERRZ		
0031	GRDSX	Grid shift amount	
0032	GRDSZ		
0034	LPGMX	Servo loop gain multiplier	
0035	LPGMZ		
0036	PSANGN	Data for gain adjustment of spindle analog voltage	
0037	LPGIN	Servo loop gain	
0038	RPDFX	Rapid traverse feedrate	
0039	RPDFZ		
0041	LINTX	Linear acceleration/deceleration constants	
0042	LINTZ		
0044	THRDT	Time constant in thread cutting	
0045	FEDMX	Higher-limit speed in cutting feed	
0046	THDFL	Lower-limit speed in thread cutting	

Parameter No.	Abbreviation	Meanings	Standard setting at the shipment time from FANUC
0047	FEEDT	Time constant of exponential acceleration/ deceleration of feed and JOG feed.	
0048	FEEDFL	Low speed of exponential acceleration/ deceleration of feed (FL speed).	
0049	SPALW	Tolerancse at the detection of spindle speed.	
0050	SPLMT	Spindle speed fluctuation the detection of spindle speed.	
0051	RPDFL	Least speed of rapid traverse ovserride (Fo).	
0052	ZRNFL	Low speed at referencse point return (FL speed).	
0053	BKLX	Backlash amount	
0054	BKLZ		
0056	SPDLC	Spindle speed offset compensation value.	
0057	GRMX1	Max. spindle speed of each gear in constant surfacse speed control.	
0058	GRMX2		
0059	GRMX3		
0060	GRMX4		
0061	DRFTX	Compensation amount of servo loop drift.	
0062	DRFTZ		
0064	JOGFL	Low speed of exponential acceleration/ deceleration of JOG feed (FL speed).	
0066	SEQINC	Number increment value in automatic insertion of sequence No.	
0067	LOWSP	Min. spindle speed.	
0068	BRATE0	Baud rate.	
0069	BRATE1	Baud rate.	
0070	LTIX1		
0071	LTIZ1	Stored stroke limit.	
0073	LTIX2		
0074	LTIZ2		
0076	PRSX	Coordinate values of reference point in automatic reference point return.	
0077	PRSZ		
0078	SPTIME	Start timing for checking the spindle fluctuation.	
0079	PSGRDX	Grid width of position signal output.	
0080	PSGRDY		
0082	MRCCD	Cutting depth in multiple repetitive cycle (G71, G72).	
0083	MRCDT	Relief amount in multiple repetitive cycle (G71, 72).	

Parameter No.	Abbreviation	Meanings	Standard setting at the shipment time from FANUC
0084	PESCX	Relief amount in multiple repetitive cycle (G73 in X and Z axis direction.)	
0085	PESCZ		
0086	PATIM	Number of division in multiple repetitive cycle (G73).	
0087	GROVE	Return amount in multiple repetitive cycle (G74, G75).	
0088	THRPT	Repetitive count of finishing in multiple repetitive cycsle (G76).	
0089	THANG	Angle of tool tip in multiple repetitive cycle (G76).	
0090	THCLM	Minimum cutting depth in multiple repetitive csycle (G76).	
0091	THDFN	Finishing allowance in multiple repetitive cycle (G76).	
1000		Various setting.	
1001		Various setting.	
1002		Various setting.	
1003		Various setting.	
1004		Various setting.	
1006		Various setting.	
1009	SCLMP	Upper limit of spindle speed.	
1010	CRCDL	Tool lnose R compensation.	
1011	ACALFL	Feed rate during measuring in automatic tool.	
1012	RPDJX	JOG rapid traverse rate.	
1013	RPDJZ		
1028	WIMAX	Allowable input value in tool wear compensation amount incremental input.	
1029	WOMAX	Maximum value of tool wear compensation amount.	
1030	MIRSS	Distance between tool posts to shift the coordinate system by mirror image for counter tool posts.	
1031	GANMAX	Deceleration point at automatic tool compensation for X axis.	
1032	GANMAZ	Deceleration point at automatic tool compensation for Z axis.	
1033	EPCX	Allowable deviation of measuring point during automatic tool compensation for X axis.	
1034	EPCZ	Allowable deviation of measuring point during automatic tool compensation for Z axis.	
1035	REF2X	Distance to the second reference point from the first reference point.	
1036	REF2Z		

Parameter No.	Abbreviation	Meanings	Standard setting at the shipment time from FANUC
1038	UPKY	JOG moving axis and direction setting.	
1039	DWNKY		
1040	RGTKY		
1041	LFTKY		
1044	MBUF1	Setting of M code without buffering.	
1045	MBUF1		
1046	PSORGX	Grid No. at the reference point of the position signal output.	
1047	PSORGZ		
1061 ~ 1078	M11A ~ M35C	M code decode signal output.	
1051 ~ 1114	NSW11 ~ NSW88		

Note) Setting parameters only can be changed without turning on the parameter in put switch.

PARAMETER RECORD

No.	Contents							
	7	6	5	4	3	2	1	0
0 0								
0 1								
0 2								
0 3								
0 4								
0 5								
0 6								
0 7								
0 8								
0 9								
1 0								
1 1								
1 2								
1 3								
1 4								
1 5								
1 6								
1 7								
1 8								
1 9								
2 0								
2 1								
2 2								
2 3								
2 4								
2 5								
2 6								
2 7								
2 8								
2 9								
3 0								
3 1								
3 2								
3 3								
3 4								
3 5								
3 6								
3 7								
3 8								
3 9								

No.	Contents							
	7	6	5	4	3	2	1	0
4 0								
4 1								
4 2								
4 3								
4 4								
4 5								
4 6								
4 7								
4 8								
4 9								
5 0								
5 1								
5 2								
5 3								
5 4								
5 5								
5 6								
5 7								
5 8								
5 9								
6 0								
6 1								
6 2								
6 3								
6 4								
6 5								
6 6								
6 7								
6 8								
6 9								
7 0								
7 1								
7 2								
7 3								
7 4								
7 5								
7 6								
7 7								
7 8								
7 9								

No.				Contents							
				7	6	5	4	3	2	1	0
		8	0								
		8	1								
		8	2								
		8	3								
		8	4								
		8	5								
		8	6								
		8	7								
		8	8								
		8	9								
		9	0								
		9	1								
		9	2								
		9	3								
		9	4								
		9	5								
		9	6								
		9	7								
		9	8								
		9	9								

(Note) Copy this table for the record of parameter.

5.3.2 Function parameters table

(1) Parameters for servo

Parameter No.	Bit	Description
0004	7	Whether automatic drift compensation is done or not
0007 - 0008	6 - 4	Detection multiplier (DMR) in X-axis and Z-axis
0012	2	Whether servo alarm is generated or not when VRDY is turned on before PRDY is output.
0015 - 0016		Command multiplier (CMR) in X-axis and Z-axis
0018 - 0019		Clamp of velocity command value in X-axis and Z-axis
0025 - 0026		In-position width in X-axis and Z-axis
0028 - 0029		Limit value of deflection amount in X-axis and Z-axis
0034 - 0035		Servo loop gain multiplier in X-axis and Z-axis
0037		Position control loop gain
0061 - 0062		Drift compensation amount in X-axis and Z-axis

(2) Parameters for feed command

Parameter No.	Bit	Description
0004	6	Whether dry run is effective or not for rapid traverse command
0006	4	Direction to increase the override signal (*OV1 - *OV8, ROV1) speed. For details, see Table 5.4(a)
0012	0	Whether manual rapid traverse is effective or not without reference point return after turning on power supply or emergency stop switch.
0018 - 0019		Clamp of velocity command value is X-axis and Z-axis.
0038 - 0039		Rapid traverse rate of X-axis and Z-axis.
0041 - 0042		Time constants of linear acceleration/deceleration in X-axis and Z-axis (for rapid traverse).
0045		Higher-limit speed in cutting feed.
0047		Time constant of exponential acceleration/deceleration in cutting feed and manual feed.
0048		The lower limit speed (FL) on exponential acceleration/deceleration in cutting feed.
0051 0064		Least speed of rapid traverse override (Fo). The lower limit speed (FL) on exponential acceleration/deceleration in manual feed.
1012 1013		JOG rapid tracverse rate.

(3) Parameters for reference point return

Parameter No.	Bit	Description
0004	5	Selection to determine whether deceleration signals. *DECX, *DECZ for reference point return are A contact or B contact signals.
0006	0	X-axis reference point return direction.
	1	Z-axis reference point return direction.
0012	7	Whether automatic coordinate system setting is done or not when manual reference point return was made.
0031 - 0032		Grid shift amount in X-axis and Z-axis.
0052		Low speed feedrate (FL) in reference point return.
0007, 0008	3 - 0	Capacity of reference counter for X axis and Z axis.
0076, 0077		Coordinate value of the reference point in automatic coordinate value setting.
1035, 1036		The second reference point distancse from the first reference point.

(4) Parameters for I/O interface

Parameter No.	Bit	Description
0005	7	Whether feed is output or not besfore and after the tape when a program is output
	2	Whether 20mA current interface is used or RS232C is used as I/O interface
	0	Whether stop bits are 2 bits or 1 bit in I/O interface
0013	7	Whether program input is started or not by external signal (MINP) in I/O interface
0014	7	Whether feed is output or not before and after paper tape when a program is output
	2	Whether 20mA current interface is used or RS232C is used as I/O interface
	0	Whether stop bits are 2 bits or 1 bit in I/O interface
0068		Baud rate when I/O interface is used
0069		Baud rate when I/O interface is used

Note 1) Parameters No.0005 and 0068 are effective when setting parameter is 0.
Parameters No.0014 and 0069 are effective when setting parameter is 1.

(5) Parameters for backlash compensation

Parameter No.	Bit	Description
0006	0	Initial backlash direction of X-axis when power is turned on
	1	Initial backlash direction on Z-axis when power is turned on
0010	1, 0	Backlash compensation pulse frequency
0053, 0054		Backlash amount in X-axis and Z-axis

(6) Parameters for tool compensation

Parameter No.	Bit	Description
0004	4	Whether the offset amount is specified by radius or diameter.
	3	Whether the offset is cancelled or not under the reset condition.
0010	6	Whether the conunter input function of offset amount is effective or not.
0012	6	Whether work coordinate system shift function is effective or not.
	5	Whether direct input function of tool position offset amount is effective or not. The tool position offset amount is directly input by offset numbsers 101 - 116 when the direct input funcstion is effecstive.
1000	3	Whether the offset amount is cancselled by tool offset number 0 or not.
	2	Whether tool figure is compensated by vesctor processing, that is, by tool movement or by the coordinate system shift.
	1	The geometry offset number is designated by the two high order digits or low order digits.
1001	6	Managements of high 2 digits are selected at designating T code with 2-digit value.
	5	Incremental and absolute designations are effective to tool wear offset amount and tool geometry offset.
	4	Whether the offset movement is done together with the axis movement or it is done in a T code block.
1002	4	Whether record button is provided or not in the direct input of the tool position offset amount and of the shift amount measured value in the work coordinate value.
	1	Whether "W" of the left character of each number at the tool wear offset amount display is displayed or not.
1010		Parameter be related to tool nose radius compensation at angle close to 90°.
1011		Feed rate during measuring in automatic tool compensation.
1028		Allowable value of tool wear offset incremental input.
1029		Maximum value of tool wear offset amount.
1031		Deceleration point at automatic tool compensation for X axis.
1032		Deceleration point at automatic tool compensation for Z axis.
1033		Allowable deviation of measuring point during automatic tool compensation for X axis.
1034		Allowable deviation of measuring point during automatic tool compensation for Z axis.

(7) Thread cutting

Parameter No.	Bit	Description
0022		Width of chamfering for thread cutting.
0044		The time constant value in thread cutting.
0046		The lower limit value of acceleration/deceleration in cutting feed.

(8) Coordinate system

Parameter No.	Bit	Description
0004	1	Displays program position or actual position.
0005	1	When coordinate system is set, the relative coordinate system is preset or not.
0012	7	Automatic coordinate setting is performed or not when reference point return is executed.
	6	The work coordinate system shift is effective or not.
0076		Automatic coordinate system setting value for X axis.
0077		Automatic coordinate system setting value for Z axis.

(9) Spindle servo

Parameter No.	Bit	Description
0021		Spindle speed during low-speed spindle rotation.
0023		The relay timer for checking the spindle speed arrival signal.
0036		The data for adjusting the gain of spindle analog output.
0049		Tolerance at the detection of spindle speed.
0050		Spindle speed fluctuation the detection of spindle speed.
0057 - 0060		The spindle speed corresponding to each gear.
0067		Minimum spindle speed.
0078		Start timing for checking the spindle fluctuation.
1000	7, 6	Setting polarity of spindle analog output.
	5	Setting polarity of spindle analog output at spindle orientation.
1001	1	Detection of spindle speed function is effective or not.
1009		Upper limitation of spindle speed.

5.4 Details of Parameter

Parameters are explained in detail below. Set parameters to 0 without fail, if their usage is not specified in the following detailed description.

Parameters don't always function unless the NC function (option) is provided, even if their usage is specified. Parameters for FS 3T-C and FS 2T-A are different. In the following explanations, the upper part of the parameter name is for FS 2T-A and the lower part is for FS 3T-C. Basic and option parameters are identified from each other in the "remarks" column. Confirm which parameter options are mounted in your FS 3T-C and FS 2T-A, in advance.

Parameter No.	Parameter	Remarks
0004		Basic

Bit No.	7	6	5	4	3	2	1	0
FS 2T-A	ADFT	RDRN	DECI	ORC	TOC	DCS	PROD	SCW
FS 3T-C	ADFT	RDRN	DECI	ORC	TOC	DCS	PROD	SCW

ADFT 1: Automatic drift compensation is performed.
0: Automatic drift compensation is not performed.

RDRN 1: Dry run is effective for rapid traverse.
0: Dry run is not effective for rapid traverse.

DECI 1: Deceleration signal "1" in reference point return indicates deceleration.
0: Deceleration signal "0" in reference point return indicates deceleration.

ORC 1: Offset value becomes a radius designation.
0: Offset value becomes a diameter designation.

TOC 1: Offset is cancelled by reset button.
0: Offset is not cancelled by reset button.

DCS 1: Pushing the START button on the MDI panel directly actuate the NC start without going through the machine side (MDI mode only).
0: Pushing the START button on the MDI panel issues the signal to the machine side. The NC start is actuated when the NC receives the start signal from machine side.

PROD 1: Displays programmed position in current value displaying for U and W.
0: Displays actual position.

Parameter No.	Parameter	Remarks
SCW	1: Least command increment is input in inch system. (Machine tool: inch system) 0: Least command increment is input in metric system. (Machine tool: inch system)	

Parameter No.									Remarks
		NFED	TJHD				ASR33	PPD	STP2	
0005		NFED	TJHD	HSLE			ASR33	PPD	STP2	I/O interface (option)
Bit No.		7	6	5	4	3	2	1	0	

Parameter No.	Parameter	Remarks
NFED	1: Feed is not output before and after program is output by using the input/output interface. 0: Feed is output before and after program is output by using the input/output interface. (Effective when the setting parameter I/O is 0.)	The baud rate is set with parameter No. 0068.
TJHD	1: Handle feed in the TEACH IN JOG mode by manual pulse generator is possible. 0: Handle feed in the TEACH IN JOG mode by manual pulse generator is not possible.	
HSLE	1: When the manual pulse generators are provided for two axes, the axis selecting signal is valid. (When the axis selecting signal is off, the manual pulse generators cannot operate). 0: When the manual pulse generators are provided for two axes, the axis selecting signal is invalid. (The axis whose manual pulse generator is rotated is moved regardless of the axis selecting signal).	
ASR33	1: The 20mA current interface is used as the input/output interface. 0: RS232C is used as the input/output interface. (Effective when the setting parameter I/O is 0.)	
PPD	1: The relative coordinate value is preset when the coordinate system is set. 0: The relative coordinate value is not preset when the coordinate system is set.	
STP2	1: In the input/output interface, the stop bit is set by 2 bits. 0: In the input/output interface, the stop bit is set by 1 bits. (Effective when the setting parameter I/O is 0)	

Parameter No.	Parameter	Remarks
0006		Basic

Bit No.	7	6	5	4	3	2	1	0
	PSG2	PSG1		OVRI			ZMZ	ZMX
	PSG2	PSG1		OVRI			ZMZ	ZMX

PSG2, PSG1 Gear ratio of spindle and position coder.

Table 5.4(a) Relationship between override signals and override value.

Magnification	PSG2	PSG1
1	0	0
2	0	1
4	1	0
8	1	1

$$\text{Magnification} \quad \frac{\text{Number of spindle rotation}}{\text{Number of position coder rotation}}$$

OVRI Setting values 0 and 1 can determine the direction in which the override value increase. See the following chart for details.

Parameter No.	Parameter	Remarks

Table 5.4(b) Relationship between override signals and manual continuous feedrate.

Contact status on machine side				Parameter OVRI = 0			Parameter OVRI = 1		
				Override	Manual continuous feed rate		Override	Manual continuous	
*OV1	*OV2	*OV4	*OV8		Metric system	Inch system		Metric system	Inch system
				0%	0 mm/min	0 inch/min	150%	1260 mm/min	50 inch/min
O				10	2.0	0.08	140	790	30
	O			20	3.2	0.12	130	500	20
O	O			30	5.0	0.2	120	320	12
		O		40	7.9	0.3	110	200	8.0
O		O		50	12.6	0.5	100	126	5.0
	O	O		60	20	0.8	90	79	3.0
O	O	O		70	32	1.2	80	50	2.0
			O	80	50	2.0	70	32	1.2
O			O	90	79	3.0	60	20	0.8
	O		O	100	126	5.0	50	12.6	0.5
O	O		O	110	200	8.0	40	7.9	0.3
		O	O	120	320	12	30	5.0	0.2
O		O	O	130	500	20	20	3.2	0.12
	O	O	O	140	790	30	10	2.0	0.08
O	O	O	O	150	1260	50	0	0	0

Note 1) O indicates signal is open and blank indicates signal is closed.

Note 2) When the override switch is changed during axis movement, the axis moves at the new speed.

Note 3) Generally, this signal is designated by the override switch.

Note 4) In the above table, the speed error is +3%.

Parameter No.	Parameter	Remarks

ZMX, ZMZ X axis and Z axes reference point return direction, respectively, and initial backlash direction when turning on the power.

1: Reference point return direction and the backlash initial direction are minus.

0: Reference point return direction and the backlash initial direction are plus.

Note) The backlash compensation is initially performed when the axis moves in the opposite direction against the direction which is set by this parameter after the power is turned on.

Parameter 0007 — Remarks: Basic

Bit No.	7	6	5	4	3	2	1	0
0007		DMRX			GRDX			
0007		DMRX			GRDX			

Parameter 0008 — Remarks: Basic

Bit No.	7	6	5	4	3	2	1	0
0008		DMRZ			GRDZ			
0008		DMRZ			GRDZ			

DMRX, DMRZ Command multiply ratio for X and Z axes, respectively.

Setting code 6	5	4	Multiply ratio
0	0	0	1/2
0	0	1	1
0	1	0	1
0	1	1	2
1	0	0	3/2
1	0	1	3
1	1	0	2
1	1	1	4

Parameter No.	Parameter	Remarks
GRDX, GRDZ	Capacity of reference counter for X and Z axes, respectivesly.	

Setting code				One cycle capacity
3	2	1	0	
0	0	0	1	2000
0	0	1	0	3000
0	0	1	1	4000
0	1	0	0	5000
0	1	0	1	6000
0	1	1	1	8000
1	0	0	1	10000

Note) If the code other than codes in the above table is set, capacity is set 8000.

Parameter No.	Parameter	Remarks

Relationship among DMR, CMR and GRD.

<u>Metric system</u>

Moving distance per 1 revolution of motor (Pulse coder)	Axis	Counting (detection) unit (μm)	Command multiply ratio (CMR)	Detect multiply ratio (DMR)			Capacity of reference counter
				Pulse coder 2000 (P/rev)	Pulse coder 2500 (P/rev)	Pulse coder 3000 (P/rev)	
12 mm	X	1	1/0.5			4	6000
	Z	1	1			4	6000
10 mm	X	1	1/0.5		4		10000
	Z	1	1		4		10000
8 mm	X	1	1/0.5	4			8000
	Z	1	1	4			8000
6 mm	X	1	1/0.5	3		/4	6000
	Z	1	1	3			6000
5 mm	X	1/0.5	1		2/4		5000/10000
	Z	1	1		2		5000
4 mm	X	1/0.5	1	2/4			4000/8000
	Z	1	1	2			4000
3 mm	X	1/0.5	1	1.5/3			3000/6000
	Z	1	1	1.5			3000
2 mm	X	1/0.5	1	1/2			2000/4000
	Z	1	1	1			2000
1 mm	X	0.5	2/1	1			2000
	Z	0.5	2	1			2000

Note 1) In the above table, right side value is in diameter designation, and left side value is in radius designation in X axis.

Note 2) Data in the above tasble is standard. Command and detect multiply ratio can be changed, but in that case there is limit for maximum feed rate.

Parameter No.	Parameter	Remarks

Moving distance per 1 revolution of motor (Pulse coder)	Axis	Counting (detection) unit (m)	Command multiply ratio (CMR)	Detect multiply ratio (DMR)			Capacity of reference counter
				Pulse coder 2000	Pulse coder 2500	Pulse coder 3000	
0.6 inch	X	1/0.5	1	3		/4	6000
	Z	1	1	3			6000
0.5 inch	X	1/0.5	1		2/4		5000/10000
	Z	1	1		2		5000
0.4 inch	X	1/0.5	1	2/4			4000/8000
	Z	1	1	2			4000
0.3 inch	X	1/0.5	1	1.5/3			3000/6000
	Z	1	1	1.5			3000
0.25 inch	X	1/0.5	1		1/2		5000
	Z	0.5	2		2		5000
0.2 inch	X	1/0.5	1	1/2			2000/4000
	Z	1	1	1			2000
0.15 inch	X	0.5	2	1.5			3000
	Z	0.5	2	1.5			3000
0.1 inch	X	0.5	2	1			2000
	Z	0.5	2	1			2000

Note 1) In the above table, right side value is in diameter designation, left side value is in radius designation in X axis.

Note 2) Data in the above table is standard. Command and detect multiply ratio can be changed, but in that case there is limit for maximum feed rate.

Parameter No.	Parameter	Remarks

0 0 1 0

	NOFC					CPF2	CPF1
	NOFC					CPF2	CPF1
7	6	5	4	3	2	1	0

Bit No.

Basic

NOFC 1: Offset counter input is used.
0: Offset counter input is not used.

CPF2, CPF1 Set backlash compensation pulse frequency (common to all axis)

Frequency kHz	CPF2	CPF1
32	0	0
64	0	1
128	1	0
256	1	1

0 0 1 1

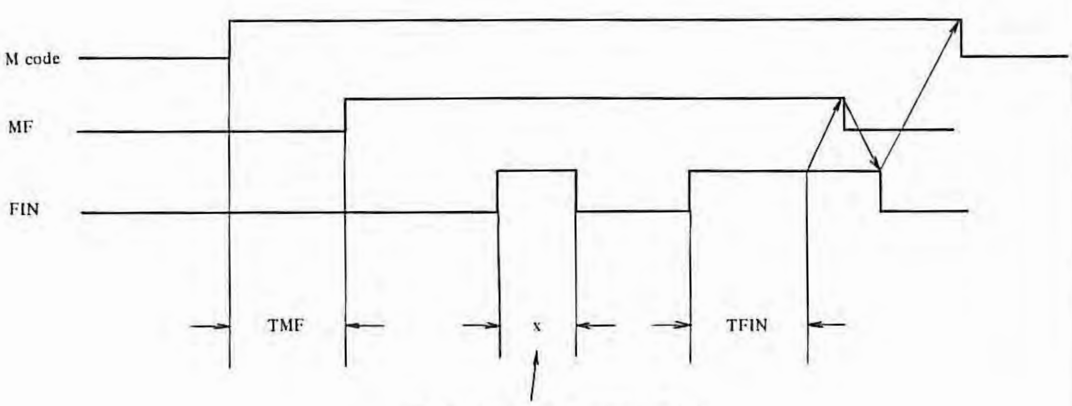
TMF				TFIN			
TFM				TFIN			
7	6	5	4	3	2	1	0

Bit No.

Basic

TMF Time from M, S, T code issue to MF, SF, TF issue. Setting range 16 to 256 msec. (16 msec increment).

TFIN Time of reception width of FIN. Setting range 16 to 256 msec. (16 msec increment.



FIN signal is ignored, because x < TFIN.

Parameter No.	Parameter	Remarks

TMF	TFIN	Parameter setting			
16 msec	More than 16 msec	0	0	0	0
32 msec	More than 32 msec	0	0	0	1
48 msec	More than 48 msec	0	0	1	0
64 msec	More than 64 msec	0	0	1	1
80 msec	More than 80 msec	0	1	0	0
96 msec	More than 96 msec	0	1	0	1
112 msec	More than 112 msec	0	1	1	0
128 msec	More than 128 msec	0	1	1	1
144 msec	More than 144 msec	1	0	0	0
160 msec	More than 160 msec	1	0	0	1
176 msec	More than 176 msec	1	0	1	0
192 msec	More than 192 msec	1	0	1	1
208 msec	More than 208 msec	1	1	0	0
224 msec	More than 224 msec	1	1	0	1
240 msec	More than 240 msec	1	1	1	0
256 msec	More than 256 msec	1	1	1	1

0	0	1	2

	APRS	WSFT	DOFSI	PRG9		OFFVY	EBCL	ISOT
	APRS	WSFT	DOFSI	PRG9		OFFVY	EBCL	ISOT
Bit No.	7	6	5	4	3	2	1	0

Basic

APRS 1: Automatic coordinate system setting is conducted when manual reference point return is performed.

0: Automatic coordinate system is not conducted.

WSFT 1: The work coordinate system is shifted when a value is set in the work shift memory.

0: The work coordinate system is not shifted.

DOFSI 1: The direct measured value input for tool offset is effective.

0: The direct measured value input for tool offset is ineffective.

PRG9 1: Protect the subprograms with program number 9000 to 9999. The following edit function are disabled.

(1) Deletion of program

When the deletion of all programs is specified, the programs with program number 9000 to 9999 are not deleted.

(2) Punch of program

These subprograms are not punched out when the punch of all programs is specified.

Parameter No.	Parameter	Remarks

(3) Program number search.

(4) Edit of program after registration.

However, the followings are possible.

(1) Registration of program

Registration by MDI key and through paper tape.

(2) Collation of program.

(Note) These programs are not normally indicated, because program number search is disabled in the EDIT mode. However, it may be indicated when protected programs alone remain in the memory after deletion of all programs, for example, or when a protected subprogram is interrupted while it is running, by a single block stop and the EDIT mode is set in. In such a case, the program edit is abled.

0: The subprograms with program number 9000 to 9999 can also be edited.

OFFVY 1: Servo alarm is not actuated when VRDY is on before PRDY is output.

0: Servo alarm is actuated when VRDY is on before PRDY is output.

EBCL 1: In the display of the program stored in the memory, the EOB code is indicated by * (asterisk).

0: In the display of the program stored in the memory, the EOB code is indicated by ; (semicolon).

ISOT 1: Rapid traverse is effective even when reference point return is not conducted after turning the power on or after effecting emergency stop.

0: Rapid traverse is invalid unless reference point return is conducted after turning the power on or after effecting emergency stop.

0013 — Basic, option

Bit No.	7	6	5	4	3	2	1	0
	MCINP							
	MCINP		SBKM					

MCINP 1: Program input is started with the data input external start signal MINP.

0: Program input is not started with the data input external start signal MINP.

Parameter No.	Parameter	Remarks

SBKM 1: Single block stop is effected with the macro instruction.
0: Single block stop is not effected with the macro instruction.
(Normally, it is set to 0)

0	0	1	4

NFED					ASR33		STP2
NFED					ASR33		STP2
7	6	5	4	3	2	1	0

Bit No.

I/O interface (option)

NFED 1: Feed is not output before and after the program is output by using the input/output interface.
0: Feed is output before and after the program is output by using the input/output interface.
(Effective when the setting parameter I/O is 1.)

The baud rate is set with parameter No. 0069.

ASR33 1: The 20mA current interface is used as the input/output interface.
0: RS232C is used as the input/output interface.
(Effective when the setting parameter I/O is 1.)

STP2 1: In the input/output interface, the stop bit is set by 2 bits.
0: In the input/output interface, the stop bit is set by 1 bits.
(Effective when the setting parameter I/O is 1.)

0	0	1	5

CMRX
CMRX

Basic

0	0	1	6

CMRZ
CMRZ

Basic

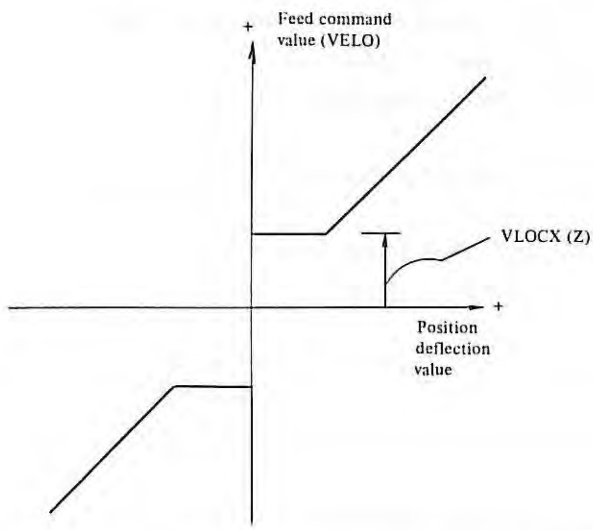
CMRX, CMRZ Command multiply for X and Z axes, respectively.

See parameters, No. 0007 and 0008.

Setting code	Multiply
1	0.5
2	1
4	2
10	5
20	10

Parameter No.	Parameter	Remarks
0018	VLOCX / VLOCX	Basic
0019	VLOCZ / VLOCZ	Basic

VLOCX, VLOCZ Clamp of feed command value of X and Z axes, respectively.
Setting range 0 to 7 (VELO).
This value should usually be set to 0.



Parameter No.	Parameter	Remarks
0021	SPLOW	Option

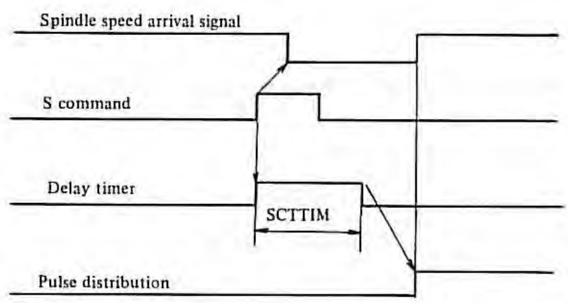
SPLOW Spindle speed during low speed spindle rotation.
Setting range: 0 to 255 (unit: rpm)

Parameter No.	Parameter	Remarks
0022	THDCH / THDCH	Option

THDCH Width of chamfering for thread cutting cycle in G92 and G76.
Setting range: 0 to 127 (unit: 0.1 lead)

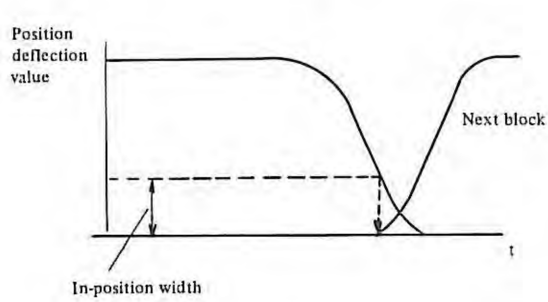
Parameter No.	Parameter	Remarks
0023	SCTTIM	Basic

SCTTIM — Set the delay timer for checking the spindle speed arrival signal. This sets the time required from execution of the S function to the beginning of checking the spindle speed arrival signal.
Setting range: 0 to 255 (unit: msec)



Parameter No.	Parameter	Remarks
0025	INPX / INPX	Basic
0026	INPZ / INPZ	Basic

INPX, INPZ — Width of X and Z axes in-position.
Setting range: 0 to 32767 (detect unit)
Standard setting in metric output: 30
Standard setting in inch output: 12



In-position check is performed when the feed mode changes from rapid traverse to rapid traverse, rapid traverse to cutting feed, or cutting feed to rapid traverse.

Parameter No.	Parameter	Remarks
0 0 2 8	SERRX / SERRX	Basic
0 0 2 9	SERRZ / SERRZ	Basic

SERRX, SERRZ Limitation value of position deviation amount during movement for X and Z axes, respectively.
Setting range: 0 to 32767 (detect unit)

As a standard, Set value 1.5 times the maximum position deviation calculated theoretically.

(Example) When the rapid traverse rate is 10m/min and the position gain is 30, the error is calculated by:

$$E = \frac{F}{G}$$

Conversion of 10 m/min. into pulses/sec. with the detection unit of 1 /pulse gives 166,666 pulses/sec. Therefore, E = 166,666/30 = 5,555 pulses. Multiply this value by a factor of 1.5, and set the obtained value 8333 as the parameter.

Parameter No.	Parameter	Remarks
0 0 3 1	GRDSX / GRDSX	Basic
0 0 3 2	GRDSZ / GRDSZ	Basic

GRDSX,GRDSZ Setting of grid shift amount of X axis and Z axis, respectively.
Setting range 0 to +32767 (detect unit).
When the reference point is shifted, the sign of this parameter is necessary.

(1) Reference point return procedure
Select manual continuous feed mode, and turn signal ZRN on (connect it with +24V). When feed towards the reference point is designated with the manual feed button, the moving part of the machine moves at rapid traverse.

Parameter No.	Parameter	Remarks

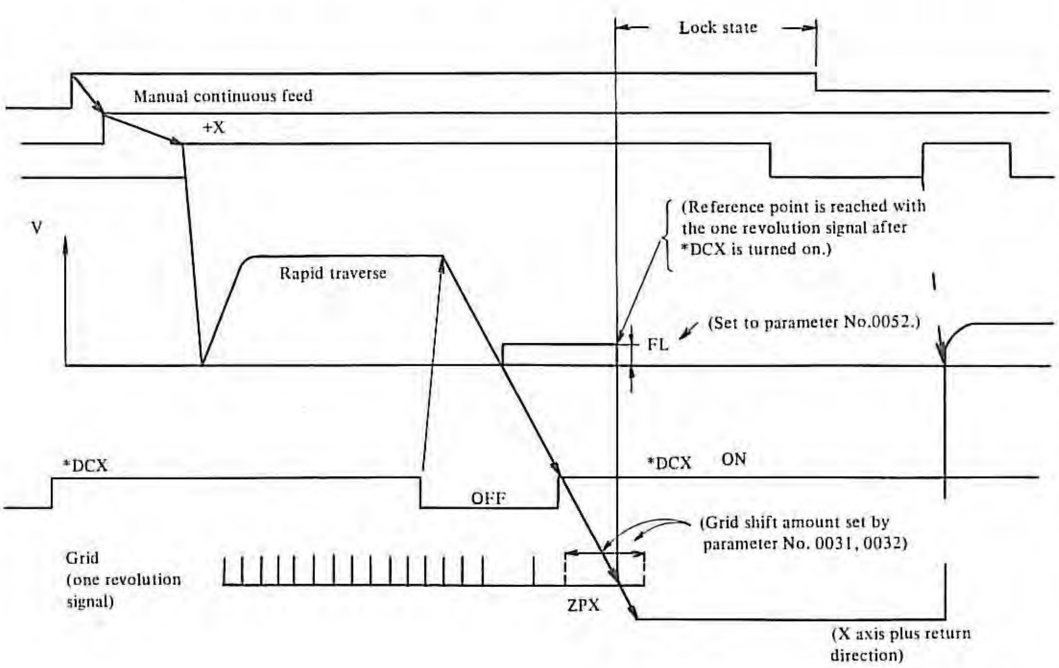
When the deceleration limit switch is operated and the contact of reference point return deceleration signal *DCX, *DCZ opens, and the feed is decelerated. Thereafter the moving part moves at a prodetermined low speed. Thereafter, when the deceleration limit switch is operated and the moving part reaches the electric grid position, feed stops, and reference point return completion signal ZPX, ZPZ is output.

The direction in which an axis is returned to reference point can be set for each axis.

Once an axis is returned to reference point and the corresponding signal ZPX or ZPZ is output, jog feed for that axis is invalid until signal ZRN is turned off.

(2) Timing chart

ZRN (reference point return)



Parameter No.	Parameter	Remarks
0 0 3 4	LPGMX LPGMX	Basic
0 0 3 5	LPHMZ LPGMZ	Basic

LPGMX, LPGMZ Setting of servo loop gain multiplier of X and Z axes, respectively.

Setting amount = $2048 \times \frac{E}{L} \times \alpha \times 1000$

$$E = \begin{cases} 7 \quad (V)\ \text{(for motor with 7V at 1000 rpm)} \\ 3.5 \quad (V)\ \text{(for motor with 7V at 2000 rpm)} \end{cases}$$

L: Machine movement amount per motor revolution (mm or inch)

: Detect unit (mm or inch)

(Example) 2 mm per motor revolution at 1000 rpm/7V

Setting value: $2048 \times \frac{7}{2} \times 0.0005 \times 1000 = 3584$

(at detect unit 0.0005 mm)

Parameter No.	Parameter	Remarks

Machine feed amount per one motor rotation	Axis	Loop gain multiplier: 7V/1000 rpm servo motor (DC motor model 10M, 20M, 30M)	Loop gain multiplier: 7V/2000 rpm servo motor (DC motor model 00M, 0M, 5M)
10 mm	X, Z	1434	717
8 mm	X, Z	1792	896
6 mm	X, Z	2389	1195
5 mm	X	2867/1437	1434/717
	Z	2867	1434
4 mm	X	3584/1792	1792/896
	Z	3584	1792
3 mm	X	4779/2389	2389/1195
	Z	4779	2389
2 mm	X	7168/3584	3584/1792
	Z	7168	3584
1 mm	X	7168/3584	3584/1792
	Z	7168	3584
0.5 inch	X	2867/1433	1434/717
	Z	2867	1434
0.4 inch	X	3584/1792	1792/896
	Z	3584	1792
0.3 inch	X	4779/2389	2389/1195
	Z	4779	2389
0.25 inch	X	5734/2867	2867/1434
	Z	2867	1434
0.2 inch	X	7168/3584	3584/1792
	Z	7168	3584
0.15 inch	X, Z	4779	2389
0.1 inch	X, Z	7168	3584

Note 1) For the X axis, the left value is indicates the radius designation and the right value is indicates the diameter designation. In the column where only one value is indicated, the value is common to diameter designation and the radius designation.

Note 2) The above table lists the standard setting value. It is also possible to change the command multiplier and the detection multiplier. In this case, however, the maximum feed rate will be limited.

Parameter No.	Parameter	Remarks
0036	PSANGN	Option
0037	LPGIN / LPGIN	Basic Standard setting 3000
0038	RPDFX / RPDFX	Basic
0039	RPDFZ / RPDFZ	Basic

PSANGN Sets the data for adjusting the gain of constant surface speed control. (analog output). This sets the data for gain adjustment in analog output.

Setting range: 700 to 1250

Standard setting value: 1000

(Adjusting method)

(1) Set the standard setting value 1000.

(2) Designate the maximum S analog value (10V)

(3) Measure the output voltage.

(4) Set this value according to the following formula.

$$\frac{10.0}{\text{Measured voltage(V)}} \times 1000 = \text{setting value}$$

(5) After setting the parameter, designate the maximum S analog value (10V) again, and make sure that the output voltage is 10V.

LPGIN Setting of servo loop gain in position control.

Setting range: 1 to 9999 (unit: 0.01 sec^{-1})

PRDFX, RPDFZ Rapid traverse rate of X and Z axes, respectively.

Setting range

30 to 15000 unit: mm/min (mm output)

30 to 6000 unit: 0.1 inch/min (inch output)

Parameter No.	Parameter	Remarks
0041	LINTX / LINTX	Basic
0042	LINTZ / LINTZ	Basic
LINTX, LINTZ	The time constant value of liner acceleration/deceleration of X and Z axes, respectively. (for rapid traverse) Setting range: 8 to 4000 (unit: msec.)	
0044	THRDT / THRDT	Option
THRDT	The time constant value of X axis in thread cutting cycle (G92 and G76) Setting range: 1 to 4000 (unit: msec.) Set the most suitable value to this parameter in consideration of the parameter THDFL (parameter No. 0046).	
0045	FEDMX / FEDMX	Basic
FEDMX	Upper speed of cutting feed (available for all axes) Setting range 6 to 15000 unit: mm/min (mm output) 6 to 6000 unit: 0.1 inch/min (inch output)	
0046	THDFL / THDFL	Option See parameter No. 0044
THDFL	The lower limit value of X axis acceleration/deceleration in thread cutting cycle (G92 and G76) (FL) Setting range 6 to 15000 unit: mm/min (mm output) 6 to 6000 unit: 0.1 inch/min (inch output) Set the most suitable value to this parameter in consideration of the parameter No. 0044.	
0047	FEEDT / FEEDT	Basic
FEEDT	Time constant of the exponential acceleration/deceleration in feed and jog feed. Setting range: 0 to 4000 unit: msec. Set this to "0", when the exponential acceleration/deceleration is not used.	

Parameter No.	Parameter	Remarks
0048	FEDFL / FEDFL	Basic

FEDFL — The lower limit of feed in exponential acceleration/deceleration.
Setting range
6 to 15000 unit: mm/min (mm output)
6 to 6000 unit: 0.1 inch/min (inch output)

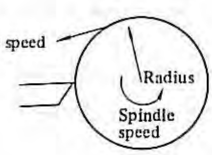
Parameter No.	Parameter	Remarks
0049	SPALW	Option

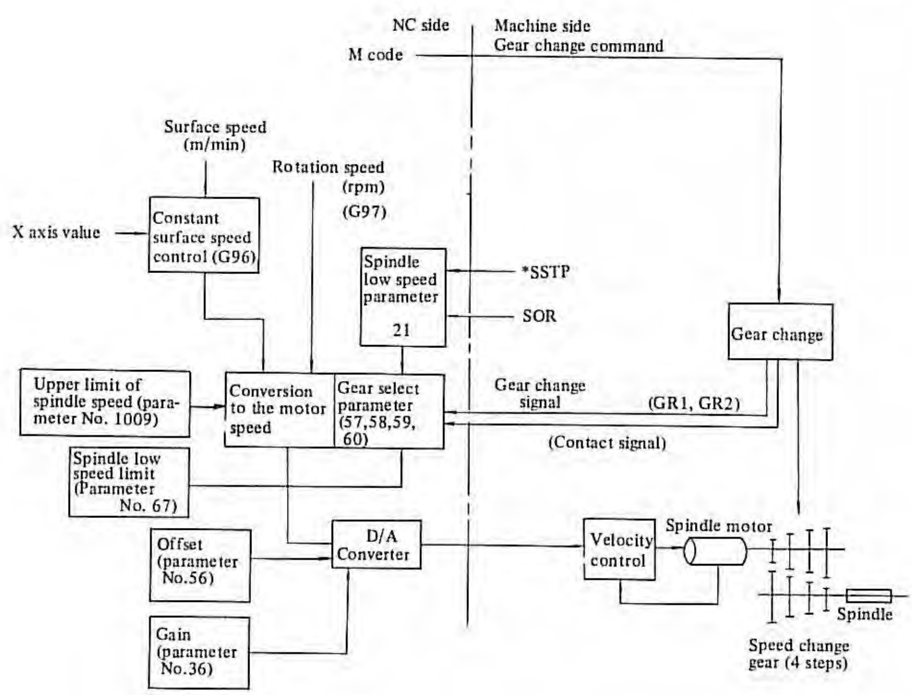
SPALW — Tolerance (q) at which the actual spindle speed is regarded to reach the command value in the detection of spindle fluctuation.
Setting range: 1 to 100 (%)
(For constant surface speed control)
The spindle change detecting function produces an overheat alarm, if actual speed of the spindle is lower than or higher than the command speed according to the machine tool conditions.
When spindle revolutions are commanded by the S function according to the machining program, the spindle speed check is started after actual speed of the spindle has reached the command speed or after a certain time has passed.
This parameter (0049) is provided to give the reference for judging if actual speed of the spindle has reached the command speed or not.
The spindle speed check is started after actual speed of the spindle has entered within the spindle speed change by the allowable change ratio preset by this parameter to the command speed.
If this parameter is 3% at command speed = 1000 (rpm), for example the spindle speed check is started when actual speed of the spindle reaches the speed within a range of 970 ~ 1030 rpm.
Also, parameter (0078) specifies the time required for starting check, assuming that actual speed of the spindle does not reach the range specified by parameter 0049.
Thus, the spindle speed change is started when the time preset by parameter No. 0078 has passed, even if actual speed of the spindle has not reached the command speed yet.

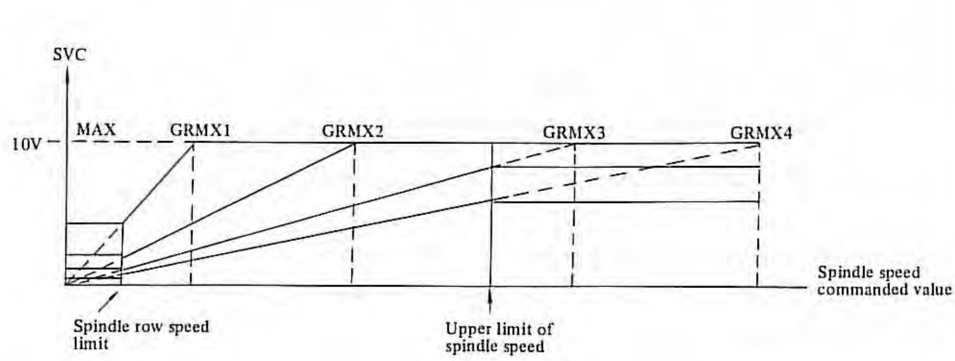
Parameter No.	Parameter	Remarks
	The alarm detection is done according to whether actual speed of the spindle has exceeded the spindle change ratio (%) set to parameter No. 0050. If parameter 0050 is set to 5% at command speed = 1000 (rpm), for example, an alarm is produced if actual speed of the spindle is deviated from the range of 950 to 1050 rpm. These parameters (No. 0049, No. 0050, No. 0051) are also rewritable by program (G26 P_p Q_q R_r).	
0 0 5 0	SPLMT	Option
SPLMT	Spindle speed fluctuation (r) at which an alarm is indicated in the detection of spindle speed fluctuation. Setting range: 1 to 100 (%) (For constant surface speed control)	
0 0 5 1	RPDFL RPDFL	Basic
RPDFL	The least speed of rapid traverse override (Fo) (Common to all axis) Setting range 6 to 15000 unit: mm/min (mm output) 6 to 6000 unit: 0.1 inch/min (inch output)	
0 0 5 2	ZRNFL ZRNFL	Basic
ZRNFL	Low feed speed at reference point return (FL) (Common to all axes) Setting range 6 to 15000 unit: mm/min (mm output) 6 to 6000 unit: 0.1 inch/min (inch output)	

Parameter No.	Parameter	Remarks
0053	BKLX / BKLX	Basic
0054	BKLZ / BKLZ	Basic
BKLX, BKLZ	Backlash amount of X and Z axes, respectively. Setting amount 0 to 255 unit: 0.001 mm (mm output) 0 to 255 unit: 0.0001 inch (inch output) (In diameter programming, set the value of X axis in diameter value).	
0056	SPDLC	Option
SPDLC	Sets the spindle speed offset compensation value, that is, compensation value of zero offset of spindle speed command voltage. (for constant surface speed control) Setting range: 0 to +8191 (unit: VELO)	
0057	GRMX 1	Option
0058	GRMX 2	Option
0059	GRMX 3	Option
0060	GRMX 4	Option
GRMX 1 to 4	The spindle speed corresponding to gears 1 to 4 when the spindle speed command is 10V. (for constant surface speed control) Setting range: 1 to 9999 (unit: rpm) Constant surface speed control For constant surface speed control, the NC automatically computes the requiste spindle revolution speed from coordinate values in X axis with a programmed surface speed (m/min).	

Parameter No.	Parameter	Remarks
	The spindle speed for the maximum spindle motor speed is set as a parameter correspondingly to each gear. The requisite motor speed for the programmed surface speed is transmitted with the analog signal to the machine tool.	







Parameter No.	Parameter	Remarks
0061	DRFTX DRFTX	Basic
0062	DRFTZ DRFTZ	Basic
	DRFTX, DRFTZ Compensation amount of drift generated in servo loop of X and Z axes, respectively. Setting range: 0 to +8191 (unit: VELO) In case of automatic drift compensation, this amount is changed automatically.	
0064	JOGFL JOGFL	Basic
	JOGFL The lower limit of jog feed in exponential acceleration/deceleration. Setting range 6 to 15000 unit: mm/min (mm output) 6 to 6000 unit: 0.1 inch/min (inch output)	
0066	SEQINC SEQINC	Basic
	SEQINC Number increment value in automatic insertion of sequence No. Setting value: 0 to 9999	
0067	LOWSP	Option
	LOWSP Minimum spindle speed in constant surface speed control mode (G96) Setting range: 0 to 9999 (unit: rpm)	
0068	BRATE0 BRATE0	I/O interface (option)
	BRATE0 This sets the baud rate when the RS232C interface is used. (Effective when the setting parameter I/O is 0.) Setting range: 50 to 4800 (unit: BPS). Selected from 50, 100, 110, 150, 200, 300, 600, 1200, 2400, and 4800.	

Parameter No.	Parameter	Remarks

0069 — BRATE1 / BRATE1 — Remarks: I/O interface (option)

BRATE1 This sets the baud rate when the input/output interface is used.
(Effective when the setting parameter I/O is 1.)
Setting range:
50 to 4800 (unit: BPS)
Selected from 50, 100, 110, 150, 200, 300, 600, 1200, 2400 and 4800.
Designate 4800 baud when using the FANUC tape reader.

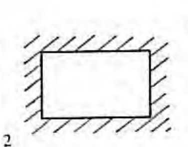
0070 — LT1X1 / LT1X1 — Remarks: Basic

0071 — LT1Z1 / LT1Z1

0073 — LT1X2 / LT1X2

0074 — LT1Z2 / LT1Z2

LT1□□
- second □: nth top in square zone (see figure.)
- first □: axis



Set stroke limit mentioned above.
Setting amount 0 to +9999999 (unit: 0.001 mm in mm output or 0.0001 inch in inch output)
Set with the distance from the reference point.
In the case of diameter designation, set the X axis with the diameter designation value.
The outside of the boundary set with the parameter is set as the inhibited region. Normally, set at the max. stroke of the machine.
When the axis enters the inhibited region, overtravel alarm is indicated. A margin should be provided with respect to the stroke to cope with the fluctuation in the detecting operation. As a rule, in the case of metric designation, multiply the rapid traverse by a factor of 1/5 and set it as the margin.

Parameter No.	Parameter	Remarks

(Example) Rapid traverse 10 m/min.

$10 \times 1/5 = 2mm$

The actual position of the machine slightly differs from the position stored in the NC unit after the power is turned on, emergency stop is reset, or servo alarm is reset. Therefore, before starting operation, be sure to return the axes to reference point. Otherwise, overtravel detecting position deviates by the value corresponding to the above-described deviation in the position. Stroke cames to be infinite when set as following.

LT1 □ 1 < LT1 □ 2

□ : axis

(Example)

LT1Z1 = -1, LT1Z2 = 1: Z axis stroke infinite

Note) Move command of the axis set as the stroke infinite, is only incremental.
If absolute command is specified, absolute resister may overflow and the axis is not operated normally.

Parameter No.	Parameter	Remarks
0076	PRSX PRSX	Basic
0077	PRSZ PRSZ	Basic

PRSX, PRSZ These set the coordinate values of the reference point of the X and Z axes when automatic coordinate system setting is conducted, respectively.

Setting range:

0 to +9999999 unit: 0.001 mm (mm output)

unit: 0.0001 inch (inch output)

In the case of diameter designation, designate the X axis value with the diameter value.

Parameter No.	Parameter	Remarks
0078	SPTIME	Option

SPTIME Time (p) for starting check when the commanded speed is not reached after a certain time.

Setting range: 0 to 999999 (unit: msec.)

(For constant surface speed control)

Parameter No.	Parameter	Remarks

0079	PSGRDX
	PSGRDX

0080	PSGRDZ
	PSGRDZ

PSGRDX,PSGRDZ Grid width of X and Z axes, respectively.

Setting range: 0 - 999999

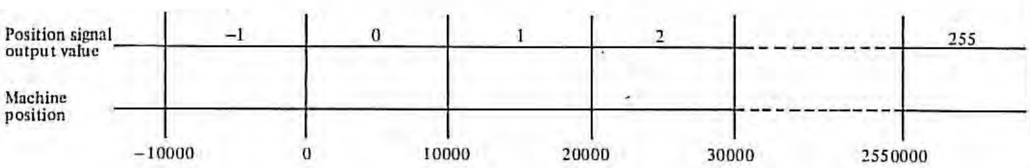
Unit: 0.001 mm (mm output)

Unit: 0.0001 inch (inch output)

No position signal is output when the setting value is 0. In order to output the position signal securely without any skip when each axis moves at the maximum setting value 24 m/min of the rapid traverse speed, the grid width must be set to be more than 6400.

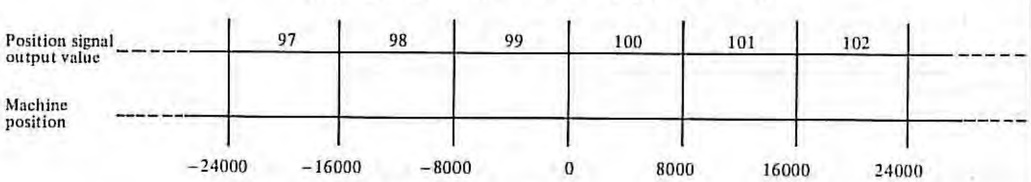
(a) Grid width = 10000

Grid number at reference point = 0



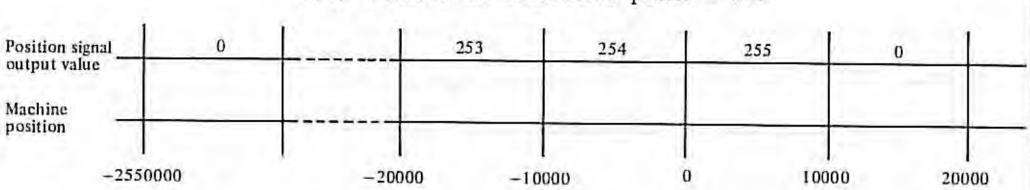
(b) Grid width = 8000

Grid number at reference point = 100



(c) Grid width = 10000

Grid number at reference point = 255



Note) Grid No. at the reference point is set by parameter No. 1046, 1047.

0082		
	MRCCD	Option

MRCCD Depth of cut in multiple repetitive cycle G71, G72.

Setting range:

1 to 9999999 unit: 0.01 mm (mm input)

1 to 9999999 unit: 0.0001 inch (inch input)

Parameter No.	Parameter	Remarks
0 0 8 4	PESCX	Option
0 0 8 5	PESCZ	Option
PESCX, PESCZ	Relief values in X and Z directions in multiple repetitive cycle G73, respectively. Setting range: 1 to +9999999 unit: 0.001 mm (mm input) 1 to +999999 unit: 0.0001 inch (inch input)	
0 0 8 6	PATIM	Option
PATIM	Number of divisions in multiple repetitive cycle G73. Setting range: 1 to 9999999	
0 0 8 7	GROVE	Option
GROVE	Return amount in multiple repetitive cycle G74, G75. Setting range: 0 to 9999999 unit: 0.001 mm (mm input) 0 to 9999999 unit: 0.0001 inch (inch input)	
0 0 8 8	THRPT	Option
THRPT	Number of repetitions of final finishing in multiple repetitive cycle G76. Setting range: 1 to 9999999	
0 0 8 9	THANG	Option
THANG	Tool nose angle in multiple repetitive cycle G76. Setting value: 0, 29, 30, 55, 60, 80	
0 0 9 0	THCLM	Option
THCLM	Minimum depth of cut in multiple repetitive cycle G76. Setting range: 0 to 9999999 unit: 0.01 mm (mm input) 0 to 9999999 unit: 0.0001 inch (inch input)	

Parameter No.	Parameter	Remarks

0	0	9	1

THDFN

Option

THDFN — Finishing allowance in multiple repetitive cycle G76.
Setting range:
0 to 9999999 unit: 0.01 mm (mm input)
0 to 9999999 unit: 0.0001 inch (inch input)

1	0	0	0

			INHMN	GOFC	GMOFS	GOFU2	JHD
TCW	CWM	ORCW	INHMN	GOFC	GMOFS	GOFU2	JHD
7	6	5	4	3	2	1	0

Option

TCW, CWM — Output code at S analog output.

TCW	CWM	Output code
0	0	Plus output for both M03 and M04.
0	1	Minus output for both M03 and M04.
1	0	Plus output for M03, minus output for M04.
1	1	Minus output for M03, plus output for M04.

ORCW 1: Minus output in orientation S analog output.
0: Plus output in orientation S analog output.

INHMN 1: The menu is not indicated even when the menu programming option is provided.
0: The menu is indicated when the menu programming option is provided.

GOFC 1: The tool geometry offset is also cancelled with the designation of offset No. 0.
0: The tool geometry offset is not cancelled with the designation of offset No. 0.

GMOFS 1: The tool geometry offset is conducted with vector processing, i.e. tool movement.
0: The tool geometry offset is conducted by the shifting of the coordinate system.

GOFU2 1: The tool geometry offset number is common to the tool selection number.

T O O X X
- X X — Tool wear offset number
- T O O — Tool selection and tool geometry offset number

The tool geometry offset is cancelled by setting the tool geometry offset number to "0".

Parameter No.	Parameter	Remarks

0: The tool geometry offset number is common to the tool wear offset number.

T O O X X

- X X — Tool geometry offset number and tool wear offset number
- T O O — Tool selection

The tool wear offset is cancelled when the tool offset number is set to "0".
The cancellation of tool geometry offset is determined by the parameter GOFC (parameter No. 1000, 3rd bit).

Note) The tool geometry offset number and tool wear offset number for FS 2T-A is 1 digit.

0: The geometry offset number is designated by the two low order digits of the T code.

JHD 1: The manual pulse generator is valid in JOG mode.
0: The manual pulse generator is invalid in JOG mode.

1 0 0 1

7	6	5	4	3	2	1	0
	T1T2	WIGA	OFSB		STDP		
	T2T4	WIGA	OFSB		STDP	SCHK	

Basic

T2T4 1: When the T code is designated with a 2-digit (1-digit) value, it is regarded that the two high order digits are equal to the two low order digits and the T code is set to the 4-digit (2-digit) value.
(Example) T12 → T1212 (T2 → T22)
0: When the T code is designated with a 2-digit (1-digit) value, the two high order digits are regarded as 00, and the T code is set to the 4-digit (2-digit) value.
(Example) T12 → T0012 (T2 → T02)

Note) In parentheses are for FS 2T-A.

WIGA 1: Setting of the tool wear offset amount is limited to incremental designation, and the setting of the tool geometry offset amount is limited to absolute designation.
0: The incremental and absolute designations are possible for both tool wear offset amount and tool geometry offset amount.

OFSB 1: Tool offset is conducted together with axis movement.
0: Tool offset is conducted by the T code block.
(The tool geometry offset by the shifting of the coordinate system is conducted by the T code block regardless of this parameter.)

Parameter No.	Parameter	Remarks

STDP 1: The actual spindle speed and the T code are always displayed.

0: The actual spindle speed and the T code are not always displayed.

SCHK 1: Spindle speed fluctuation detecting function (G26) is used.

Spindle speed fluctuation detecting function (G26) is not used.

1002									Basic
	CPRD	REP		MORB			NWCH	CBLNK	
	CPRD	REP		MORB			NWCH	CBLNK	
	7	6	5	4	3	2	1	0	

CPRD 1: Unit is set to mm, inch or sec. when the decimal point is omitted in the address for which the decimal point can be used.

0: The least input increment is set when the decimal point is omitted in the address for which the decimal point can be used.

REP 1: When the program with same program number in the memory is registered through I/O interface, the alarm does not occur and the registered program is replaced.

0: When the program with same program number in the memory is registered through I/O interface, the alarm occurs.

MORB 1: The direct measured value input for tool offset and work coordinate system shift is performed by retracting both 2 axes after cutting and pushing the RECORD button. (FANUC PC-MODEL D is nescessary for this function)

0: The RECORD button is not provided for direct measured value input.

NWCH 1: The character "W" is not displayed at the left side of the offset No. in wear offset value display.

0: The character "W" is displayed at the left side of the offset No. in wear offset value display.

CBLNK 1: The cursor does not blink.

0: The cursor blinks.

Parameter No.	Parameter	Remarks

1 0 0 3

7	6	5	4	3	2	1	0
MBCD	KYPC			NPRD		RSTMB	RSTMA
	KYPC			NPRD			

MBCD 1: Outputs the M code in the 2-digit BCD. (Output to the M11A to M22A)

0: Outputs the M code in the decoded signal.

KYPC 1: MDI key operation can be performed by the signals from the built-in type PC.

0: MDI key operation cannot be performed by the signals from the built-in type PC.

NPRD 1: Input and display with decimal point is ineffective.

0: Input and display with decimal point is effective.

RSTMB 1: Decode M code signals (M21A, M22A) of B group are cleared by resetting them.

0: Decode M code signals of B group are not cleared by resetting them.

RSTMA 1: Decode M code signals (M11 A - M13B) of A group are cleared by resetting them.

0: Decode M code signals of A group are not cleared by resetting them.

1 0 0 4 — Basic (option)

Bit No.

7	6	5	4	3	2	1	0
	OPG7	OPG6	OPG5	OPG4	OPG3	OPG2	OPG1
	OPG7	OPG6	OPG5	OPG4	OPG3	OPG2	OPG1

OPG7 1: Feed hold is effected with the software operator's panel.

0: Feed hold is not effected with the software operator's panel.

OPG6 1: Protect key is actuated with the software operator's panel.

0: Protect key is not actuated with the software operator's panel.

OPG5 1: Block delete, single block, machine lock and dry run switcshes are actuated with the software operator's panel.

OPG4 1: Jog feed rate, override, and rapid traverse override switches are actuated with the software operator's panel.

0: The above switches are not actuated with the software operator's panel.

Parameter No.	Parameter	Remarks

OPG3 1: Axis select (HX, HZ) and magnification (×10) switches for manual pulse generator are actuated with the software operator's panel.

0: The above switches are not actuated with the software operator's panel.

OPG2 1: Jog feed axis select and jog rapid traverse buttons are actuated with the software operator's panel.

0: The above buttons are not actuated with the software operator's panel.

OPG1 1: Mode select (MD1 to MD4, ZRN) is conducted from the software operator's panel.

0: Mode select is not conducted from the software operator's panel.

Note) The above parameters are effective only when the optional software operator's panel is selected.

1	0	0	6

Bit No.

7	6	5	4	3	2	1	0
						XRC	

Basic

XRC 1: Radius designation for the X axis.

0: Diameter designation for the X axis.

1	0	0	9

SCLMP

Option

SCLMP Upper limit of spindle speed (for constant surface speed control).

Setting range: 1 to 9999 (unit: rpm)

(Valid both in G96 and G97 modes.)

1	0	1	0

CRCDL

Option

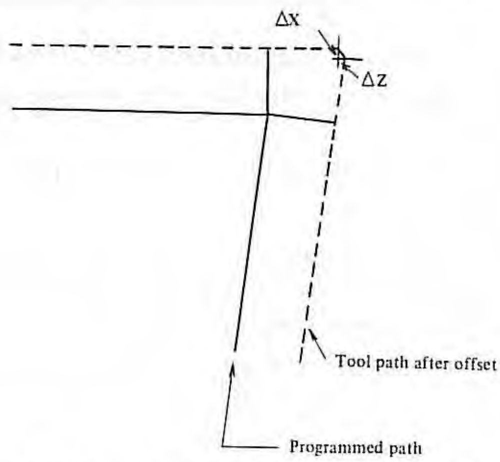
CRCDL When tool moves along the outside of an acute angle close to 90° during tool nose radius compensation, limitations on ignoring a small movement amount.

Setting range:

0 to 16383 unit: 0.001 mm (mm input)

0 to 16383 unit: 0.0001 inch (mm input)

Parameter No.	Parameter	Remarks



If X CRCDL and Z CRCDL, the small movement is ignored. This prevents the workpiece from being affected by stopping the tool at the corner.

Parameter No.	Parameter	Remarks
1011	ACALFL	Option

ACALFL — Feedrate during measuring in automatic tool compensation function (common for all axes).
Setting range:
6 to 15000 unit: mm/min (mm/min inch)
6 to 6000 unit: 0.1 inch/min (inch input)

Parameter No.	Parameter	Remarks
1012	RPDJX / RPDJX	Basic
1013	RPDJZ / RPDJZ	Basic

RPDJX, RPDJZ — Rapid traverse rate in JOG mode for X and Z axes, respectively.
Setting range
30 to 24000 unit: mm/min (mm output)
30 to 9600 unit: 0.1 inch/min (inch output)
If "0" is set to these parameter, the set values of parameter No. 0038 and 0039 are used.

Parameter No.	Parameter	Remarks
1028	WIMAX / WIMAX	Option/basic

WIMAX — Sets the tolerance value of tool wear offset incremental input.
Setting range:
1 to 999999 unit: 0.001 mm (mm input)
unit: 0.0001 inch (inch input)

Parameter No.	Parameter	Remarks
1029	WOMAX / WOMAX	Option/basic
WOMAX	Sets the maximum of the tool wear offset incremental value. Setting range: 1 to 999999 unit: 0.001 mm (mm input) unit: 0.0001 inch (inch input) (Checked together with parameter No. 1028 in the case of incremental input).	
1030	MIRSS / MIRSS	Option
MIRSS	Used for mirror image for opposite tool post. This parameter sets the distance between the tool posts in the shifting of coordinate system. Setting range: 0 to 999999 unit: 0.001 mm (mm input) unit: 0.0001 inch (inch input)	
1031	GANMAX	Option
1032	GANMAZ	Option
GANMAX, GANMAZ	The value of γ on the X axis and Z axis in the automatic tool compensation function, respectively. Setting range: 1 to 9999999 unit: 0.001 mm (mm output) 1 to 9999999 unit: 0.0001 inch (inch output) The X axis value should be set with a radius value.	

Parameter No.	Parameter	Remarks
1033	EPCX	Option
1034	EPCZ	Option

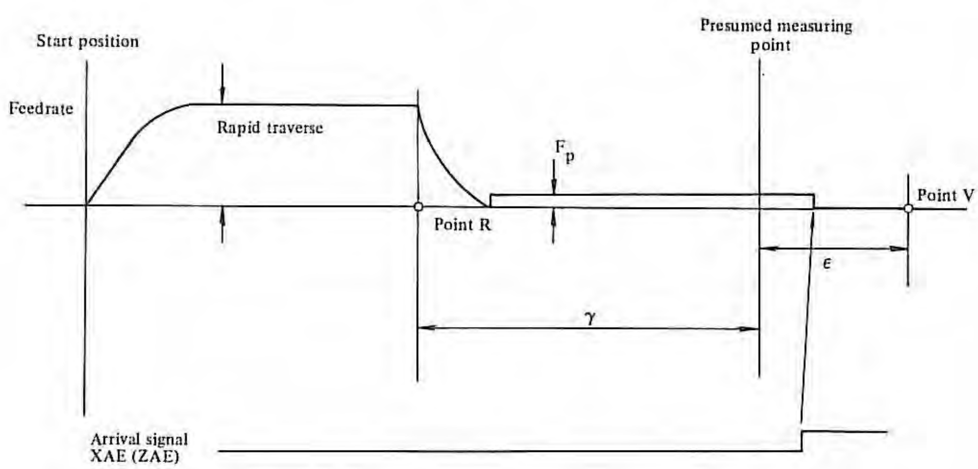
EPCX, EPCZ The value of ε on the X axis and Z axis in the automatic tool compensation function, respectively.

Setting range:

1 to 9999999 unit: 0.001 mm (mm output)

1 to 9999999 unit: 0.0001 inch (inch output)

The X axis value should be set with a radius value. By this command, the tool travels to the measuring position at rapid traverse, decelerates at point R (α before the presumed measuring point), and shifts until the measuring position arrival signal (XAE or ZAE) is sent from the machine tool. If the XAE or ZAE signal does not turn on until the tool reaches point V (ε after the presumed measuring point), an alarm is issued and the tool stops moving.



F_p : Measuring speed (set by a parameter)

γ : Deceleration position (set by a parameter)

ε : Measuring position arrival signal allowable range (set by a parameter)

The presently selected tool compensation amount is changed by the difference between the coordinate values (α,β) at arrival time to the measuring position and the xa or za value specified by G36Xxa or G37Zza.

New compensation amount x = Present compensation amount x + (α-xa)

New compensation amount z = Present compensation amount z + (β-za)

Parameter No.	Parameter	Remarks
1035	REF2X	Basic
1036	REF2Z	Basic

REF2X, REF2Z The distance from the first reference point to the second reference point of the X axis and Y axis, respectively.

Setting range:

1 to 9999999 Unit: 0.001 mm (metric output)

1 to 9999999 Unit: 0.0001 inch (inch output)

Parameter No.	Parameter	Remarks
1038	UPKY UPKY	Option
1039	DWNKY DWNKY	
1040	RGTKY RGTKY	
1041	LFTKY LFTKY	

UPKY,DWNKY,RGTKY,LFTKY

Sets the jog feed axes and directions on the software operator's panel corresponding to [↑ 8 N] [↓ 2 W] [→ 6 F] [← 4 X] key.

Axis, direction	Setting value
+X	1
-X	2
+Z	3
-Z	4

(Example) When setting

[↑ 8 N] to +X, [↓ 2 W] to -X, [→ 6 F] to +Z, and [← 4 X] to -Z set as follows.

UPKY = 1, DWNKY = 2, RGTKY = 3, LFTKY = 4

Parameter No.	Parameter	Remarks
1044	MBUF1 / MBUF1	Basic
1045	MBUF2 / MBUF2	Basic

MBUF1, MBUF2 Up to two M codes which are not subjected to buffering can be set.
Setting value: 03 to 97
When 03 is set, M03 is not subjected to buffering.

Parameter No.	Parameter	Remarks
1046	PSORGX	
1047	PSORGZ	

PSORGX, PSORGZ Grid numbers at the reference point of X and Z axes, respectively.
Setting range: 0 ~ 255

Parameter No.	Parameter	Remarks
1061	M11A	Basic
1062	M11B	
1063	M11F	
1064	M12A	
1065	M12B	
1066	M12F	
1067	M13A	
1068	M13B	
1069	M13F	

Parameter No.	Parameter	Remarks
1070	M21A	
1071	M21F	
1072	M22A	
1073	M22F	
1074	M31C	
1075	M32C	
1076	M33C	
1077	M34C	Basic
1078	M35C	
M11A to M35C	Sets the corresponding M code. Setting value: 0 to 97 Set 255 for the M code not used.	
1051	NSW11	Option
~	~	
1114	NSW88	Option
	The name of general purpose switches (SIGNAL 0 SIGNAL 7) on the software operator's panel in the following figure are set as follows.	

Parameter No.	Parameter	Remarks

```
OPERATOR'S PANEL              01234 N5678

    SIGNAL 0: ▮ OFF   ON
    SIGNAL 1:   OFF ▮ ON
    SIGNAL 2:   OFF ▮ ON
    SIGNAL 3: ▮ OFF   ON
    SIGNAL 4: ▮ OFF   ON
    SIGNAL 5: ▮ OFF   ON
    SIGNAL 6: ▮ OFF   ON
    SIGNAL 7:   OFF ▮ ON

ACTUAL POSITION (ABSOLUTE)
    X  123.456        Z  -456.789

                          AUTO
```

Parameter No.	Parameter	Remarks
	The characters to be displayed in parameters No. 1051 ∿ 1114 are set by codes.	
PRM. No. 1051:	Code (083) corresponding to character "S" of SIGNAL 0 in the above figure is set.	
PRM. No. 1052:	Code (073) corresponding to character "I" of SIGNAL 0 in the above figure is set.	
PRM. No. 1053:	Code (071) corresponding to character "G" of SIGNAL 0 in the above figure is set.	
PRM. No. 1054:	Code (078) corresponding to character "N" of SIGNAL 0 in the above figure is set.	
PRM. No. 1055:	Code (065) corresponding to character "A" of SIGNAL 0 in the above figure is set.	
PRM. No. 1056:	Code (076) corresponding to character "L" of SIGNAL 0 in the above figure is set.	
PRM. No. 1057:	Code (032) corresponding to space "␣" of SIGNAL 0 in the above figure is set.	
PRM. No. 1058:	Code (048) corresponding to character "0" of SIGNAL 0 in the above figure is set.	

Parameter No.	Parameter	Remarks
PRM. No. 1059 ∿ 1066:	Character string code of SIGNAL 1 in the above figure is set.	
PRM. No. 1067 ∿ 1074:	Character string code of SIGNAL 2 in the above figure is set.	
PRM. No. 1075 ∿ 1082:	Character string code of SIGNAL 3 in the above figure is set.	
PRM. No. 1083 ∿ 1090:	Character string code of SIGNAL 4 in the above figure is set.	
PRM. No. 1091 ∿ 1098:	Character string code of SIGNAL 5 in the above figure is set.	
PRM. No. 1099 ∿ 1106:	Character string code of SIGNAL 6 in the above figure is set.	
PRM. No. 1107 ∿ 1114:	Character string code of SIGNAL 7 in the above figure is set.	
	For character codes, refer to the characters-to-codes table in the next page. Setting value 0 is interpreted as a space.	

5.4

Character-to-codes Correspondence Table

Character	Code	Comment	Character	Code	Comment
A	065		6	054	
B	066		7	055	
C	067		8	056	
D	068		9	057	
E	069			032	Space
F	070		!	033	Exclamation mark
G	071		"	034	Quotation mark
H	072		#	035	Sharp
I	073		$	036	Dollar symbol
J	074		%	037	Percent
K	075		&	038	Ampersand
L	076		'	039	Apostrophe
M	077		(	040	Left parenthesis
N	078		)	041	Right parenthesis
O	079		*	042	Asterisk
P	080		+	043	Plus sign
Q	081		,	044	Comma
R	082		-	045	Minus sign
S	083		.	046	Period
T	084		/	047	Slash
U	085		:	058	Colon
V	086		;	059	Semi-colon
W	087		<	060	Left angle bracket
X	088		=	061	Sign of equality
Y	089		>	062	Right angle bracket
Z	090		?	063	Question mark
0	048		@	064	Commercial at mark
1	049		[	091	Left square bracket
2	050		Λ	092	
3	051		¥	093	Yen symbol
4	052		]	094	Right square bracket
5	053		_	095	Underline
				000	Space

6. DIAGNOSTIC FUNCTION (DGN)

In FS 3T-C and FS 2T-A, self-diagnostic programs always monitor the system interior and I/O signals, and both hardware and software are designed based on the safety design concept for ensuring safety and quickly locating causes of troubles.

If a trouble is detected, NC outputs an alarm signal at once and informs a machine tool operator of its diagnostic results after sorting them. It is possible that the machine tool is stopped without any motion because of waiting for external signals and other circumstances, even if the NC itself is free of any alarm condition.

As a countermeasure against such a symptom, NC classifies these conditions according to diagnostic programs and informs the machine tool operator of these classified conditions.

In addition, NC can easily check interface signals with the machine tool by displaying the open/closed conditions of contact signals sent from the machine tool and ON/OFF status of transistor output signals to be sent to the machine tool, as "0" or "1" on the MDI & CRT panel.

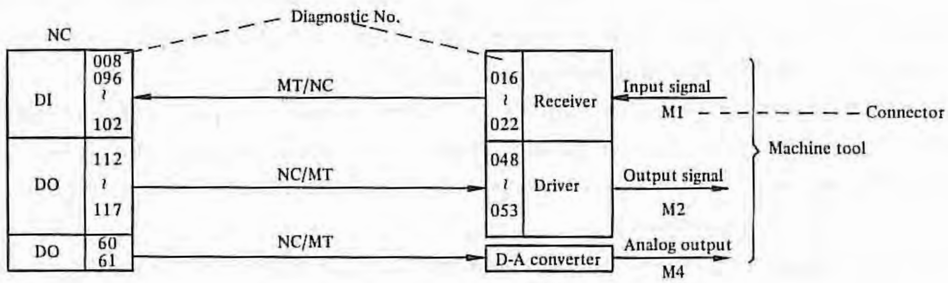
6.1 Operating Procedure of Diagnostic Function

6.1.1 Operating procedure of diagnostic function regarding the interface with machine tool

This NC system provides a diagnostic function to check interface signals efficiently by using the MDI & CRT panel. This diagnostic function is attached by reading output data or memory data corresponding to input signals or by writing and then reading the same data as output signals into the memory corresponding to respective output signals.

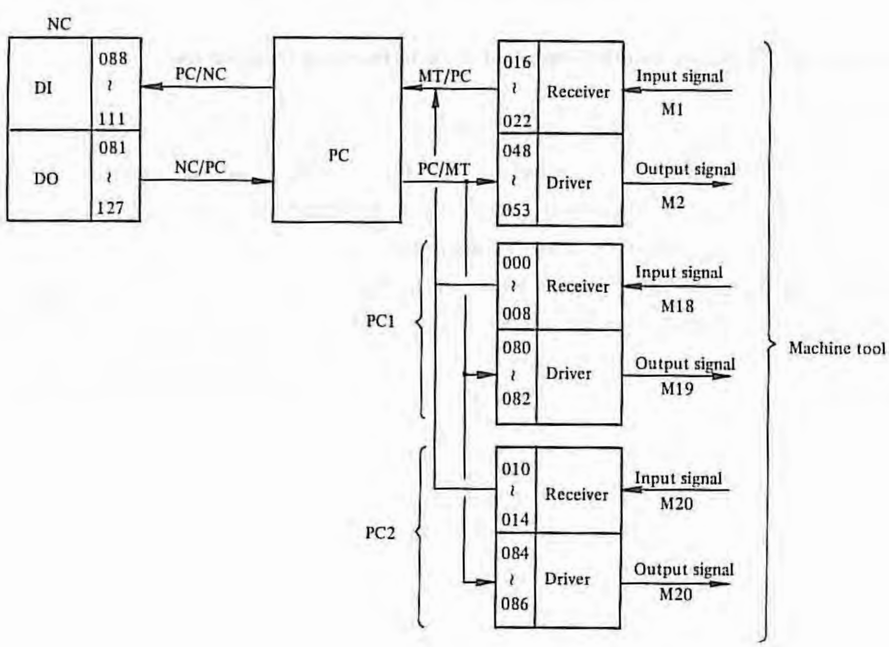
The interface signal status between NC system and machine tool can be displayed on the MDI & CRT panel. In addition, output signals from NC can be sent to the machine tool simulatedly.

Composition of an NC system without PC



An I/O signal is read out with the same content for DGNOS No. 096-102 and 016-022 and also for 122-117 and 048-053.

Composition of an NC with PC



When I/O signals have been read, data of DGN No. 088 - 111 are the same as those of DGN No. 016 - 022. Also, read data of DGN No. 081 - 127 are the same as those of DGN No. 048 - 053.

(a) Read of input signals and output signals

(1) Display the diagnostic data page by depressing the DGNOS button on the MDI & CRT panel.

(2) Display the necessary DGN No. page by depressing the PAGE button on the MDI & CRT panel.

(b) Method of sending output signals to the machine tool

(1) Select the MDI mode, or turn on the emergency stop switch.

(2) Turn on program protect signal KEY.

(3) Display the diagnostic data page by depressing DGNOS button.

(4) Display necessary diagnostic data page by depressing the PAGE button.

(5) Bring the CRT cursor to the position having the changed output data number.

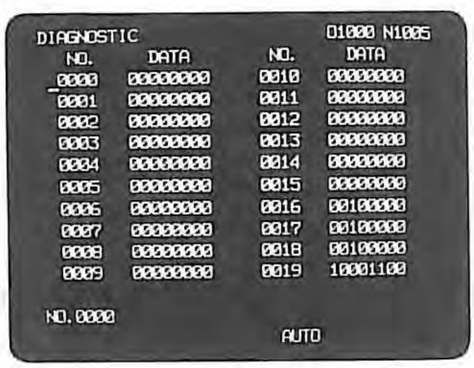
Method 1

CURSOR

[↑] [↓] Depress the CURSOR button. If CURSOR button is continuously depressed, the cursor shifts sequentially. When the cursor exceeds a page, the next page appears on the CRT screen.

Method 2

[Q/P] [Diagnostic data No.] [INPUT]



(6) Key in diagnostic data by data input keys on the MDI & CRT panel.

(7) Push the INPUT button on the MDI & CRT panel. Input diagnostic data are displayed and output to the machine tool.

(c) Cautions on I/O signals

(1) When output signals are output by this function, don't send them to DGN No. 048 - 053, but send them to DGN No. 112 - 117.

(2) Reset output signals to their original status without fail.

(3) Manual data input start signal DST cannot be output by this function. Send it by pushing the START button on the MDI & CRT panel.

6.1.2 Operating procedure for NC status display by diagnostic function

The following four internal conditions can be monitored by the diagnostic function.

(1) Condition during automatic operation. (DGN No. 700, 701)

(2) Condition during automatic operation stop and pause condition. (DGN No. 712)

(3) Position deviation amount. (DGN No. 800, 801)

(4) Machine tool position from the reference point (DGN No. 820, 821)

Operating procedure

(i) Display the diagnostic data page by depressing the DGNOS button.
(ii) Display necessary diagnostic data page by depressing the PAGE button.

6.1.3 Operating procedure for diagnostic function of the interface between NC and M servo system

Diagnostic data of the servo system are displayed by DGN No. 23 and 56.

Operating procedure is same as item 6.1.2

6.1.4 Indication of one-revolution signal from pulse coder and position coder

The one-revolution signals from pulse coder and position coder are displayed in DGN No. 027.
Operating procedure is same as item 6.1.2.

6.2 Display Data Table by Diagnostic Function

The following data can be displayed by diagnostic function.

DGN No.	Display data
000 ≀ 022	Input signals from machine tool (Output signal from receiver. No. 016 ∿ 022 are effective without PC)
023	Input signals from servo system
027	One-revolution signal from pulse coder and position coder
048 ≀ 053	Output signals to machine tool
056	Output signals to servo system
080 ≀ 086	Output signal to machine tool Output signal to driver These number cannot use without PC)
081,083, 087,093, 094	Input signals from machine tool (PC) (No. 096 ∿ 102 are effective without PC)
112 ≀ 127	Output signals to machine tool (PC) (No. 112 ∿ are effective without PC)
700	Status in the case that NC appears if it were not working during
701	automatic operation
712	Automatic operation stop and pause conditions
800	Position deviation amount of X-axis
801	Position deviation amount of Z-axis
820	X-axis machine tool position from the reference point
821	Z-axis machine tool position from the reference point

Note) For PC-MODEL H, DGN No. 000 ∿ No. 014 and DGN No. 080 ∿ No. 086 can not be used.

6.3 Details of Signals

6.3.1 I/O signal Diagnostic data table (with PC-MODEL D, MODEL H)

(1) Input signals

DGN No.		7	6	5	4	3	2	1	0
008		SKIP							
		Skip cutting signal							
096 (016) (MT→NC)	(F S 3T−C)	HX/ROV1		*DCX		−X	+X		
	(F S 2T−A)	HZ/ROV2		*DCX		−X	+X		
		Manual handle feed axis selection/rapid traverse override signal		Deceleration signal in X-axis reference point return		Feed axis direction select signal			
097 (017) (MT→NC)	(F S 3T−C)	HZ/ROV2		*DCZ		−Z	+Z		
	(F S 2T−A)	HZ		*DCZ		−Z	+Z		
		Manual handle feed axis selection signal		Deceleration signal in Z-axis reference point return		Feed axis direction select signal			
098 (018) (MT→NC)	(F S 3T−C)	DRN		*+LZ		GR2	GR1		
	(F S 2T−A)	DRN		*+LZ		*	*		
		Dry run signal		+Z overtravel signal					
099 (019) (MT→NC)	(F S 3T−C)	MLK		MP1/MINP		SBK	BDT		
	(F S 2T−A)	MLK		MP1/MINP		SBK	BDT		
		Machine lock signal		Incremental feed signal/data input external start signal		Single stop signal	Optional block skip signal		
100 (020) (MT→NC)	(F S 3T−C)	ZRN	*SSTP	SOR	SAR	FIN	ST	STLK	MIX
	(F S 2T−A)	ZRN	*	*	*	FIN	ST	STLK	MIX
		Reference point return signal	Spindle stop signal	Spindle speed orientation light signal		Miscellaneous function end signal	Cycle start signal	Interlock signal	Mirror image signal
101 (021) (MT→NC)	(F S 3T−C)	ERS	RT	*SP	*ESP	*OV8	*OV4	*OV2	*OV1
	(F S 2T−A)	ERS	RT	*SP	*ESP	*OV8	*OV4	*OV2	*OV1
		External reset signal	Manual rapid traverse signal	Feed hold signal	Emergency stop signal	Override signal			
102 (022) (MT→NC)	(F S 3T−C)	PN8	PN4	PN2	PN1	KEY	MD4	MD2	MD1
	(F S 2T−A)	PN8	PN4	PN2	PN1	KEY	MD4	MD2	MD1
		Program number select signal				Program protect signal	Mode select signal		

1: Contact on machine side is closed

0: Contact on machine side is open

Signals of DGN No. 096 - 102 are input from the machine tool, and these signals are stored into memory (RAM). NC refer to this area as input signals.

(2) Output signals.

DGN No.	7	6	5	4	3	2	1	0	
112 (048) (NC → MT)	OP	SA	STL	SPL	ENB		ZPZ	ZPX	(F S 3T-C)
	OP	SA	STL	SPL	*		ZPZ	ZPX	(F S 2T-A)
	Automatic operation signal	Servo ready signal	Cycle start lamp signal	Feed hold lamp signal	Spindle enable signal		Reference point return end signal		
113 (049) (NC → MT)	MA				DN		RST	AL	(F S 3T-C)
	MA				DN		RST	AL	(F S 2T-A)
	NC ready signal				Distribution end signal		Reset signal	Alarm signal	
114 (050) (NC → MT)			DST		TF	SF		MF	(F S 3T-C)
			DST		TF	SF		M35C(MF)	(F S 2T-A)
			Manual data input start signal		T function code read signal	S function code read signal		M function signal	
115 (051) (NC → MT)	M28	M24	M22	M21	M18	M14	M12	M11	(F S 3T-C)
	M22A(M28)	M21A(M24)	M13B(M22)	M13A(M21)	M12B(M18)	M12A(M14)	M11B(M12)	M11A(M11)	(F S 2T-A)
	M function signal								
116 (052) (NC → MT)	S28	S24	S22	S21	S18	S14	S12	S11	(F S 3T-C)
	S28	S24	S22	S21	S18	S14	S12	S11	(F S 2T-A)
	S function BCD code signal								
117 (053) (NC → MT)	T28	T24	T22	T21	T18	T14	T12	T11	(F S 3T-C)
	M34C	M33C	M32C	M31C	T18	T14	T12	T11	(F S 2T-A)
	T function BCD code signal								
	M function signal				T function BCD code signal				

Display 1: Output transistor ON

0: Output transistor OFF

Signals of DGN No. 112 - 117 are output signals to be sent to the machine tool. These signals are stored into memory (RAM). NC outputs these output signals to this area.

6.3.2 I/O Signal diagnostic data tabe (with PC-MODEL D, MODEL H)

Note 1) The signal whose name column is blank has different names according to each PC program in follows. For detail; refer to the maintenance manual individually.

Note 2) This function checks and display the control relay used on PC in addition to I/O signal.

Note 3) The pin numbers' of connector for interface between machine tool (MT) and PC are written below the name column.

Note 4) In the following dingnostic data table, above column is for FS 3T-C and the below column is for FS 2T-A. For FS 2T-A, both PC-MODEL H and PC MODEL D may be used. When PC-MODEL H is used, the diagnostic data for between MT - PC must be data of under column except connector M1 and M2 diagnostic data.

(DGNOS NUMBER) ADDRESS NUMBER	BIT NUMBER 7	6	5	4	3	2	1	0
000 (MT → PC)								
	M18-36	M18-21	M18-5	M18-35	M18-20	M18-34	M18-19	M18-33
002 (MT → PC)								
	M18-24	M18-8	M18-38	M18-23	M18-7	M18-37	M18-22	M18-6
004 (MT → PC)								
	M18-11	M18-41	M18-26	M18-10	M18-40	M18-25	M18-9	M18-39
006 (MT → PC)								
	M18-45	M18-14	M18-44	M18-13	M18-43	M18-12	M18-42	M18-27
008 (MT → PC)	SKP						ZAE	XAE
	M18-49	M18-18	M18-48	M18-17	M18-47	M18-16	M18-46	M18-15

(FS3T-C)
(FS2T-A)

←Connector name and pin number

Connector M18 (mounted on PC board) 40

Skip signal

Automatic tool compensation signal

0 1 0 (MT → PC)								
	M20-11	M20-41	M20-26	M20-10	M20-40	M20-25	M20-9	M20-39
0 1 2 (MT → PC)								
	M20-45	M20-14	M20-44	M20-13	M20-43	M20-12	M20-42	M20-27
0 1 4 (MT → PC)								
	M20-49	M20-18	M20-49	M20-17	M20-47	M20-16	M20-46	M20-15

(FS3T-C)
(FS2T-A)
Connector M20 (mounted on additional input and output card) 24

The common voltage on machine side for input signals included in connector M18 and M20 can be selected to 0V or 24V. So indication of "0" and "1" for contacter condition on machine side does not decided a conditionally.

0V common connection { Contacter open "0" / close "1"

24V common connection { Contacter open "1" / close "0"

0 1 6 (MT → PC)			* DCX / * DCX					
	M1-6		M1-38 Deceleration signal in X axis reference point return		M1-20	M1-21		
0 1 7 (MT → PC)			* DCZ / * DCZ					
	M1-7		M1-39 Deceleration signal in Z axis reference point return		M1-22	M1-23		
0 1 8 (MT → PC)			* +LZ / * +LZ					
	M1-8		M1-40 +Z overtravel signal		M1-24	M1-25		
0 1 9 (MT → PC)								
	M1-9		M1-10		M1-11	M1-12		
0 2 0 (MT → PC)								
	M1-13	M1-37	M1-5	M1-14	M1-15	M1-16	M1-17	M1-18
0 2 1 (MT → PC)				* ESP / * ESP				
	M1-41	M1-26	M1-27	M1-19 Emergency stop signal	M1-33 (Note)	M1-34	M1-35	M1-36
0 2 2 (MT → PC)								
	M1-42	M1-43	M1-44	M1-45	M1-46	M1-47	M1-48	M1-49

Connector M1 (mounted on PC board) 40

Note) Bit 4 in DGN No. 21 and bit 4 in DGN No. 101 are effective as emergency stop signal when PC-MODEL D, MODEL H are provided.

ADDRESS NUMBER (DGNOS NUMBER)	BIT 7	6	5	4	3	2	1	0	
048 (PC → MT)	M2–5	M2–6	M2–7	M2–8	M2–41	M2–27	M2–26	M2–25	(FS3T-C) (FS2T-A)
049 (PC → MT)	M2–9				M2–22		M2–23	M2–24	Connector M2 (mounted on PC board) 40
050 (PC → MT)			M2–10		M2–20	M2–19		M2–21	
051 (PC → MT)	M2–33	M2–34	M2–35	M2–36	M2–37	M2–38	M2–39	M2–40	
052 (PC → MT)	M2–11	M2–12	M2–13	M2–14	M2–15	M2–16	M2–17	M2–18	
053 (PC → MT)	M2–42	M2–43	M2–44	M2–45	M2–46	M2–47	M2–48	M2–49	
080 (PC → MT)	M19–8	M19–7	M19–6	M19–5	M19–4	M19–3	M19–2	M19–1	Connector M19 (mounted on PC board) 16
082 (PC → MT)	M19–16	M19–15	M19–14	M19–13	M19–12	M19–11	M19–10	M19–9	
084 (PC → MT)	M20–36	M20–21	M20–5	M20–35	M20–20	M20–34	M20–19	M20–33	Connector M20 (mounted on additional input and output card) 16
086 (PC → MT)	M20–24	M20–8	M20–38	M20–23	M20–7	M20–37	M20–22	M20–6	

1: Output transistor ON
0: Output transistor OFF

DGN No.	7	6	5	4	3	2	1	0	
088 (PC→NC)	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0	(F S 3T-C)
	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0	(F S 2T-A)
089 (PC→NC)	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8	
	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8	

ED0 - ED15 : External tool compensation data signal

DGN No.	7	6	5	4	3	2	1	0
090 (PC→NC)	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0

EA0 - EA6 : External tool compensation data specification signal

ESTB : External tool compensation data strobe signal

DGN No.	7	6	5	4	3	2	1	0
091 (PC→NC)	AFL	PRC	SPC	SPB	SPA		SVFZ	SVFX
	AFL	PRC					SVFZ	SVFX

SPA - C : Spindle override signal

AFL : Auxiliary function lock signal

SVFX, SVFZ : Sarvo off signal

PRC : Position record signal

DGN No.	7	6	5	4	3	2	1	0
096 (016) (PC→NC)	HX/ROV1		*DCX		−X	+X		
	HX/ROV1		(*DCX)		−X	+X		
	Manual handle feed axis selection/rapid traverse override signal				Feed axis direction select signal			
097 (017) (PC→NC)	HZ/ROV2		(*DCZ)		−Z	+Z		
	HZ		(*DCZ)		−Z	+Z		
	Manual handle feed axis selection signal				Feed axis direction select signal			
098 (018) (PC→NC)	DRN		(*+LZ)		GR2	GR1		
	DRN		(*+LZ)					
	Dry run signal							
099 (019) (PC→NC)	MLK	MP2	MP1/MINP		SBK	BDT		
	MLK		MP1/MINP		SBK	BDT		
	Machine lock signal	Incre-mental feed signal	Incremental signal/data input external start signal		Single stop signal	Optional block skip signal		
100 (020) (PC→NC)	ZRN	*SSTP	SOR	SAR	FIN	ST	STLK	MIX
	ZRN			SAR	FIN	ST	STLK	
	Reference point return signal				Miscellaneous function end signal	Cycle start signal	Interlock signal	
101 (021) (PC→NC)	ERS	RT	*SP	*ESP	*OV8	*OV4	*OV2	*OV1
	ERS	RT	*SP	*ESP	*OV8	*OV4	*OV2	*OV1
	External reset signal	Manual rapid traverse signal	Feed hold signal	Emergency stop signal (Note)	Override signal			
102 (022) (PC→NC)	PN8	PN4	PN2	PN1	KEY	MD4	MD2	MD1
	PN8	PN4	PN2	PN1	KEY	MD4	MD2	MD1
	Program number select signal				Program protect signal	Mode select signal		

Note) Bit 4 in DGN No. 101 on bit 4 in DGN No. 21 are effective as emergency stop signal when PC-MODEL D, MODEL H are provided.

DGN No.	7	6	5	4	3	2	1	0	
104 (PC→NC)	RO8I	RO7I	RO6I	RO5I	RO4I	RO3I	RO2I	RO1I	(F S 3T-C) (F S 2T-A)
105 (PC→NC)	SIND	SSIN	SGN		R12I	R11I	R10I	R09I	

SIND : Signal to specify whether spindle analog voltage is controlled by PC or NC

SSIN : Signal to specify whether spindle analog voltage polarity is controlled by PC or NC

SGN : Signal to specify the polarity of spindle analog voltage given by PC

R01I - R12I : 12-bit command signal for spindle analog voltage given by PC

DGN No.								
106 (PC→NC)	CDZ	SMZ						

SMZ : Error detect signal

CDZ : Chamfering signal

107 (PC→NC)						*ABSM		

ABSM : Manual absolute ON/OFF signal

110 (PC→NC)	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
111 (PC→NC)	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8

UI0 - UI15 : 16-bit signal read by custom macro

	7	6	5	4	3	2	1	0
081 (NC→PC)	PX7	PX6	PX5	PX4	PX3	PX2	PX1	PX0
	PX7	PX6	PX5	PX4	PX3	PX2	PX1	PX0

X axis position output signal

083 (NC→PC)	PZ7	PZ6	PZ5	PZ4	PZ3	PZ2	PZ1	PZ0
	PZ7	PZ6	PZ5	PZ4	PZ3	PZ2	PZ1	PZ0

Z axis position output signal

087 (NC→PC)	OPU7	OPU6	OPU5	OPU4	OPU3	OPU2	OPU1	OPU0
	OPU7	OPU6	OPU5	OPU4	OPU3	OPU2	OPU1	OPU0

Software operator's panel general switch signal

RO1 - RO12 : S12 bit output signal

DGN No.	7	6	5	4	3	2	1	0
093 (NC→PC)	RO8	RO7	RO6	RO5	RO4	RO3	RO2	RO1

DGN No.	7	6	5	4	3	2	1	0
094 (NC→PC)					RO12	RO11	RO10	RO9

RO1 - RO12 : S12 bit output signal

DGN No.	7	6	5	4	3	2	1	0
120 (NC→PC)	KEYO		HZO	HXO	ZRNO	MD4O	MD2O	MD1O
	KEYO		HZO	HXO	ZRNO	MD4O	MD2O	MD1O
	Program protect signal		Manual handle axis selection signal (bits 5–4)		Reference point return completion signal	Mode selection signal (bits 2–0)		

DGN No.	7	6	5	4	3	2	1	0
121 (NC→PC)	MP2O	MP1O	ROV2O	ROV1O	*JV8O	*JV4O	*JV2O	*JV1O
		MP1O		ROV1O	*JV8O	*JV4O	*JV2O	*JV1O
	Incremental feed signal (bits 7–6)		Rapid traverse override signal (bits 5–4)		Jog feed rate setting signal (bits 3–0)			

DGN No.	7	6	5	4	3	2	1	0
122 (NC→PC)	DRNO	MLKO	SBKO	BDTO	*OV8O	*OV4O	*OV2O	*OV1O
	DRNO	MLKO	SBKO	BDTO	*OV8O	*OV4O	*OV2O	*OV1O
	Dry run signal	Machine lock signal	Single block signal	Optional block skip signal	Cutting feed override signal (bits 3–0)			

DGN No.	7	6	5	4	3	2	1	0
123 (NC→PC)	SPO	RTO			-ZO	+ZO	-XO	+XO
	SPO	RTO			-ZO	+ZO	-XO	+XO
	Feedhold signal	Jog rapid traverse signal			Manual feed direction signal (bits 3–0)			

DGN No.	7	6	5	4	3	2	1	0	
112 (048) (NC→MT)	OP	SA	STL	SPL	ENB		ZPZ	ZPX	(F S 3T−C)
	OP	SA	STL	SPL			ZPZ	ZPX	(F S 2T−A)
	Automatic operation signal	Servo ready signal	Cycle start lamp signal	Feed hold lamp signal			Reference point return end signal (bits 1–0)		

DGN No.	7	6	5	4	3	2	1	0
113 (049) (NC→MT)	MA				DEN	BAL	RST	AL
	MA				DEN	BAL	RST	AL
	NC ready signal				Distribution end signal	Battery alarm signal	Reset signal	Alarm signal

DGN No.	7	6	5	4	3	2	1	0
114 (050) (NC→MT)			DST		TF	SF		MF
			DST		TF	SF		MF
			Manual data input start signal		T function code read signal	S function code read signal		M function signal

DGN No.	7	6	5	4	3	2	1	0
115 (051) (NC→MT)	M28	M24	M22	M21	M18	M14	M12	M11
	M28	M24	M22	M21	M18	M14	M12	M11
	M function signal (bits 7–0)							

DGN No.	7	6	5	4	3	2	1	0
116 (052) (NC→MT)	S28	S24	S22	S21	S18	S14	S12	S11
	S28	S24	S22	S21	S18	S14	S12	S11
	S function BCD code signal (bits 7–0)							

DGN No.	7	6	5	4	3	2	1	0
117 (053) (NC→MT)	T28	T24	T22	T21	T18	T14	T12	T11
					T18	T14	T12	T11
	M function signal (bits 7–4)				T function BCD code signal (bits 3–0)			

DGN No.	7	6	5	4	3	2	1	0
118 (NC→PC)								SPAL

SPAL : Spindle speed change detection alarm signal

1	2	4

(NC → PC)

							EREND

EREND : External tool compensation data read signal

1	2	5

(NC → PC)

						ZP2Z	ZP2X

Second reference point return completion signal

1	2	6

(NC → PC)

UO7	UO6	UO5	UO4	UO3	UO2	UO1	UO0

1	2	7

(NC → PC)

UO15	UO14	UO13	UO12	UO11	UO10	UO9	UO8

UO 0 - 15 : 16-bit signal outputted by custom macro

6.3.3 NC status display

(1) When NC appears as if it were not operating;

If NC appears it it were not operating during automatic operation without any alarm, display DGN No. 700 and 701 pages by MDI & CRT panel, and the NC status can be known.

DGN No.	7	6	5	4	3	2	1	0
700		CSCT	CITL	COVZ	CINP	CDWL	CMTN	CFIN

Display "1" means the following.

CSCT: The control is waiting for the speed arrival signal of the spindle to turn on.

CITL: STLK is turned on.

COVZ: Override is 0%.

CINP: In-position check is done.

CDWL: Dwell is being executed.

CMTN: Move command is being executed in automatic operation mode.

CFIN: M, S, T functions are being executed.

DGN No.	7	6	5	4	3	2	1	0
701			CRST				CTRD	CTPU

CRST: Emergency stop, external reset, or reset button on MDI panel is turned on.

CTRD: Data are being input via I/O interface.

CPPU: Data are being output via I/O interface.

(2) Status display during automatic operation stop and pause condition. (DGN No. 712)

DGN No.	7	6	5	4	3	2	1	0
712	STP	REST	EMS		RSTB			CSU

This information indicates the status during automatic operation stop and pause condition, and it is used for locating a cause of a trouble, if occurred.

STP: This flag stops the pulse distribution, and it is set in the following cases.

(a) External reset button is turned on.

(b) Emergency stop button is turned on.

(c) Feed hold button is turned on.

(d) Reset button on MDI panel is turned on.

(e) Manual mode (JOG, HANDLE/STEP) is selected.

(f) Other alarms occur. (Certain alarms are not preset.)

REST: This flag is set when external reset, emergency stop, or reset button is turned on.
EMS: This flag is set when emergency stop button is turned on.
RSTB: This flag is set when reset button is turned on.
CSU: This flag is set when emergency stop button is turned on or a servo alarm occurs.

(3) Display of position deviation amount (DGN No. 800 ~ 801)

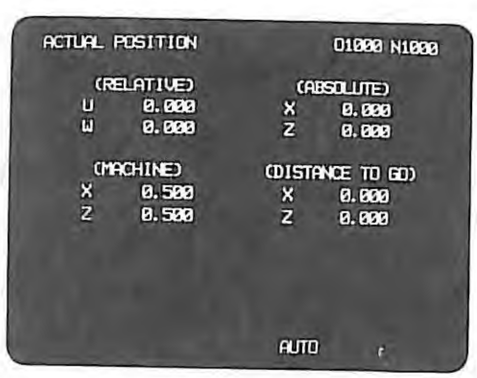
DGN No.	
800	SVERRX (X-axis)
801	SVERRZ (Z-axis)

The position deviation amounts of X-axis and Z-axis are sequentially displayed.

(4) Display of machine tool position from reference point (DGN No. 820 - 821)

DGN No.	
820	ABSMTX (X-axis)
821	ABSMTZ (Z-axis)

The machine tool position from the reference point is also displayed on the position display page of CRT character display unit.



(MACHINE) Shows the machine tool position from the reference point.

6.3.4 I/O signal diagnostic data with servo system

DGN No.

		2	3	*VRDY	OVL	OHM			DALX	DALZ	

*VRDY: Display "0" shows normal status, and "1" shows that the control unit does not detect the velocity control unit ready signal. (Servo alarm No.02 is generated.)

OVL: Display "1" shows that servo alarm No.01 is generated.

OHM: Display "1" shows that overheat alarm No.02 is generated.

DALX: Display "1" shows that servo alarm No.14 is generated.

DALZ: Display "1" shows that servo alarm No.24 is generated.

		2	7						PCX	PCZ	PCP

PCX: One-revolution signal from X axis pulse coder

PCZ: One-revolution signal from Z axis pulse coder

PCP: One-revolution signal from spindle position coder

DGN No.

		5	6							CMDEN	PRDY

CMDEN: Display "1" shows normal status, and "0" shows that velocity command voltage (VCMD) is clamped to 0V.

PRDY: Display "1" shows normal status, and "0" shows that NC does not output the position control ready signal.

0	0	5	7							*ENBZ	*ENBX

*ENBX, X, Z axis enable signal.
*ENBZ: Display "0" shows normal status, and "1" shows that NC does not output the enable signal to the velocity control unit.

6.4 Correspondence between I/O Signal DGN Numbers and Connector Pin Numbers

The signal in parenthesis is not used for FS 2T-A.

Table 6.4(a) Input Signals

Diagnostic data display		Name of signal	Connector pin No.
Number	Bit		
096/016	7	HX/ROV1	M1 (6)
096/016	5	*DCX	M1 (38)
096/016	3	-X	M1 (20)
096/016	2	+X	M1 (21)
097/017	7	HZ/(ROV2)	M1 (7)
097/017	5	*DCZ	M1 (39)
097/017	3	-Z	M1 (22)
097/017	2	+Z	M1 (23)
098/018	7	DRN	M1 (8)
098/018	5	*+LZ	M1 (40)
098/018	3	(GR2)	M1 (24)
098/018	2	(GR1)	M1 (25)
099/019	7	MLK	M1 (9)
099/019	5	MP1/MINP	M1 (10)
099/019	3	SBK	M1 (11)
099/019	2	BDT	M1 (12)
100/020	7	ZRN	M1 (13)
100/020	6	(*SSTP)	M1 (37)
100/020	5	(SOR)	M1 (5)
100/020	4	SAR	M1 (14)
100/020	3	FIN	M1 (15)
100/020	2	ST	M1 (16)
100/020	1	STLK	M1 (17)
100/020	0	(MIX)	M1 (18)
101/021	7	ERS	M1 (41)
101/021	6	RT	M1 (26)
101/021	5	*SP	M1 (27)
101/021	4	*ESP	M1 (19)
101/021	3	*OV8	M1 (33)
101/021	2	*OV4	M1 (34)
101/021	1	*OV2	M1 (35)
101/021	0	*OV1	M1 (36)
102/022	7	PN8	M1 (42)
102/022	6	PN4	M1 (43)
102/022	5	PN2	M1 (44)
102/022	4	PN1	M1 (45)
102/022	3	KEY	M1 (46)
102/022	2	MD4	M1 (47)
102/022	1	MD2	M1 (48)
102/022	0	MD1	M1 (49)

Table 6.4(b) Output signals

Diagnostic data display		Name of signal	Check pin			Connector pin No.
Number	Bit		PCB	Element	Pin No.	
112/048	7	OP	Master PCB	IC	G3-1(3)	M2 (5)
"	6	SA	"	"	G3-1(5)	M2 (6)
"	5	STL	"	"	G4-1(3)	M2 (7)
"	4	SPL	"	"	G4-1(5)	M2 (8)
"	3	(ENB)	"	"	F4-2(5)	M2 (41)
"	2		"	"	F2-2(3)	M2 (27)
"	1	ZPZ	"	"	F2-2(5)	M2 (26)
"	0	ZPX	"	"	F1-2(3)	M2 (25)
113/049	7	MA	"	"	F1-2(5)	M2 (9)
"	3	DEN	"	"	G2-1(3)	M2 (22)
"	1	RST	"	"	G2-1(5)	M2 (23)
"	0	AL	"	"	F3-2(3)	M2 (24)
114/050	5	DST	"	"	F3-2(5)	M2 (10)
"	3	TF	"	"	G1-1(3)	M2 (20)
"	2	SF	"	"	G1-1(5)	M2 (19)
"	0	MF	"	"	G4-2(3)	M2 (21)
115/051	7	M28	"	"	G4-2(5)	M2 (33)
"	6	M24	"	"	G1-2(3)	M2 (34)
"	5	M22	"	"	G1-2(5)	M2 (35)
"	4	M21	"	"	G2-2(3)	M2 (36)
"	3	M18	"	"	G2-2(5)	M2 (37)
"	2	M14	"	"	G3-2(3)	M2 (38)
"	1	M12	"	"	G3-2(5)	M2 (39)
"	0	M11	"	"	F2-1(3)	M2 (40)
116/052	7	S28	"	"	F2-1(5)	M2 (11)
"	6	S24	"	"	F1-1(3)	M2 (12)
"	5	S22	"	"	F1-1(5)	M2 (13)
"	4	S21	"	"	E3-2(3)	M2 (14)
"	3	S18	"	"	E3-2(5)	M2 (15)
"	2	S14	"	"	E2-2(3)	M2 (16)
"	1	S12	"	"	E2-2(5)	M2 (17)
"	0	S11	"	"	E1-2(3)	M2 (18)
117/053	7	(T28)	"	"	E1-2(5)	M2 (42)
"	6	(T24)	"	"	F4-1(3)	M2 (43)
"	5	(T22)	"	"	F4-1(5)	M2 (44)
"	4	(T21)	"	"	F3-1(3)	M2 (45)
"	3	T18	"	"	F3-1(5)	M2 (46)
"	2	T14	"	"	E4-2(3)	M2 (47)
"	1	T12	"	"	E4-2(5)	M2 (48)
"	0	T11	"	"	F4-2(3)	M2 (49)

Note) Pin No. G3-1, E2-2, F4-2, etc. in the table show the mounting positions of IC on PCB. (5), (3), etc. show pin numbers of IC.

7. TROUBLESHOOTING

7.1 Troubleshooting Method

Troubleshooting procedures are classified according to NC conditions when a trouble occurred as follows. Check troubles according to the following items.

(1) Power cannot be turned on. (7.2.1)

(2) The system does not operate normally after turning on the power supply (No CRT display) (7.2.2)

(3) Troubleshooting by alarm numbers (7.3 and 7.4)

(4) No. alarm is displayed, but NC does not operates normally. (7.5)
- (i) JOG operation is impossible. (7.5.1)
- (ii) Automatic operation is impossible. (7.5.2)
- (iii) Thread cutting feed is impossible. (7.5.3)
- (iv) Neither data read nor punch out is possible via I/O interface. (7.5.4)
- (v) Reference point return position is deviated. (7.5.5)

(5) Troubleshooting for servo system (7.6)

7.2 Troubleshooting when Power is Turned On

7.2.1 Power cannot be turned on

Item	Causes	Checking methods	Remedies
1	Input power supply is not connected to NC.	(1) Check if input power supply is connected to input terminal board R, S, PA, PB. (2) Check if internal cable V03 is normally connected from input terminal board to power unit (A14B-0067-B002) and fan. Check fuses for normal condition without being blown out. (3) Check if power voltage is AC $200/220V^{+10\%}_{-15\%}$.	If a fuse is blown out, eliminate its cause and replace the fuse. Fuses are generally blown out due to a defect of the power supply unit. For details, refer to the appendix.

Item	Causes	Checking methods	Remedies
2	Power supply unit or load is defective.	Make sure that the fan rotates for a while.	
3	Power supply unit trouble	After disconnecting internal cables V01, V02, turn on the power supply. If the power is not supplied, it may be caused by a trouble of the power unit.	Replace power supply unit.
4	Master PCB is defective.	Connect internal cable V01, disconnect all cables from connectors M1 - M12 on master PCB (A16B-1000-0010), turn on the power supply. Don't connect V02. If the the power is not supplied, it may be caused by a trouble of master PCB.	Replace master PCB. (Refer to item 6, when power is turned on.)
5	MDI/CRT unit defective.	If power is turned on under the connecting condition of internal cable V01, turn off power once, connect V02, and make sure that power is turned on. When the power is not supplied, connect the input terminal board to CN2 of MDI/CRT unit. Cable (J38) or MDI & CRT unit may be defective. Check cable J38 for normal connection. If this cable is connected normally, MDI/CRT unit may be defective.	Replace MDI/CRT unit.
6	Connecting cable or connecting unit is defective.	If power is applied after disconnecting cables from connectors M1 - M12, turn off power once, connect cable to M1, and make sure that power is applied again. If no power is applied, connect cable to M2, M3, ... M12 sequentially by the above method, and find out the connector to which no power is applied.	Connecting cable or the unit connected to the cable is defective. Eliminate a cause of this power failure.

Note 1) In FS 3T-C and FS 2T-A, power must be supplied to NC by using power ready signals (PA, PB). Accordingly, the above troubleshooting is a method of locating a trouble using PA and PB.

Note 2) The above troubleshooting method is described, assuming that FS 3T-C, FS 2T-A is in trouble. However, since it is possible that the machine tool contains fuses and circuits, check these components for normal conditions.

7.2.2 The system does not operate normally after turning on the power supply.

(1) No CRT display

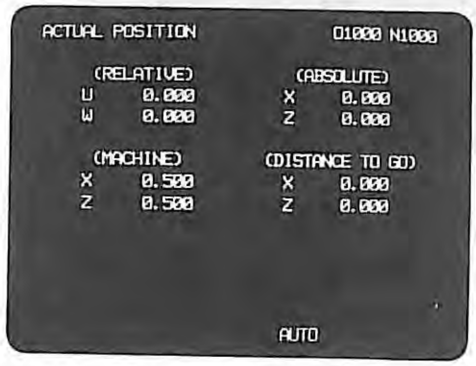
Item	Causes	Checking methods	Remedies
1	Wrong connection of cables	(1) Check if master PCB (A16B-1000-0010) connector CCX and CN1 of CRT unit are properly connected. (2) Check if input terminal board (0V, +24V) is properly connected CN2 of CRT unit.	Refer to appendix 7.
2	Master PCB is defective.	Master PCB is defective.	
3	CRT unit is defective.		

7.3 Alarm Display and Countermeasures

7.3.1 Status display

The status display appears on the bottom line of the CRT screen on MDI & CRT panel. Alarm numbers are displayed on the alarm display CRT screen.

Status display point



The following status display is provided.

NOT READY: Indicates that the control unit or servo system is not ready.

ALARM: Indicates that an alarm occurs. The kind of alarm can be known by pushing ALARM button.

BAT: Indicates that the battery power voltage is lower than the specified level. This battery is used to protect the information being stored into memory when power is off. Replace the battery, if this display appears.

BUF: Indicates that a command data is input into buffer register, and it is not executed yet.

JOG: Indicates that manual continuous feed (JOG) mode is selected.

STEP: Indicates that manual step feed (STEP) mode is selected.

HNDL: Indicates that manual handle feed (HANDLE) mode is selected.

AUTO: Indicates that automatic operation (AUTO) mode is selected.

EDIT: Indicates that memory edit (EDIT) mode is selected. This display appears at about the center of the bottom line on the CRT screen.

EDIT: Indicates that the edition is being executed at present. This display appears at the lower right part of the CRT screen, and this meaning is different from that of the above EDIT.

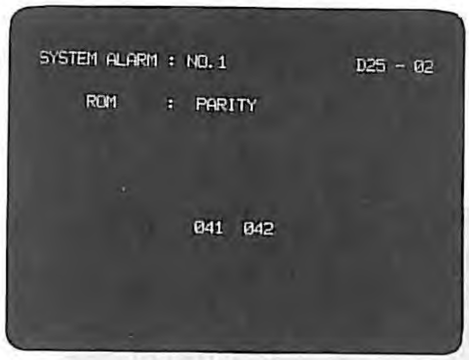
SEARCH: Indicates that sequence number search, word search, and other search are being executed.

OUTPUT: Indicates that a program is being output by I/O interface.

INPUT: Indicates that a program is being input by I/O interface.

COMPARE: Indicates that a program is being compared with memory data by I/O interface.

If ROM, RAM, etc. are defective during operation, the system is placed to the memory alarm condition with the following display on the CRT screen.



The display of the CRT of the FS 3T-C and that of FS 2T-A is a little different.

This manual carriee the display of FS 3T-C as the example.

When this display appears, depressing function buttons (CRT select buttons) is neglected.

Display "D25-01" indicates the ROM series (FS 3T-C) and version number.

Display in and after the 3rd line shows detailed contents of an alarm. In this example, it indicates that a parity alarm occurs in ROM having ROM number 001, 002, 041, 042, 051, and 052.

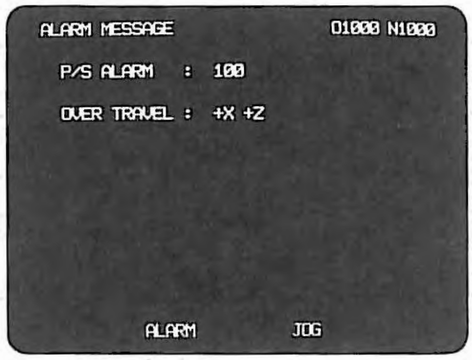
7.3.2 Alarm number display

When depressing ALARM key under an alarm condition, alarm contents are displayed as a message on the CRT screen.

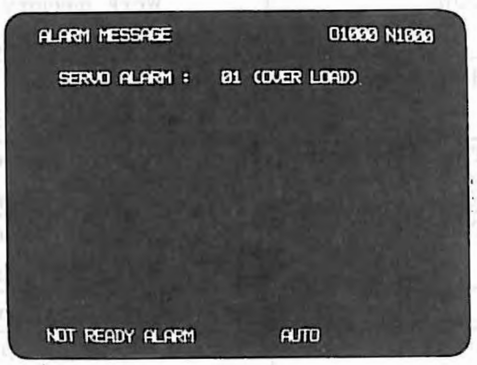
The following description shows alarm display examples. For individual messages and their contents, refer to 7.3.3 Alarm table.

(1) Overheat

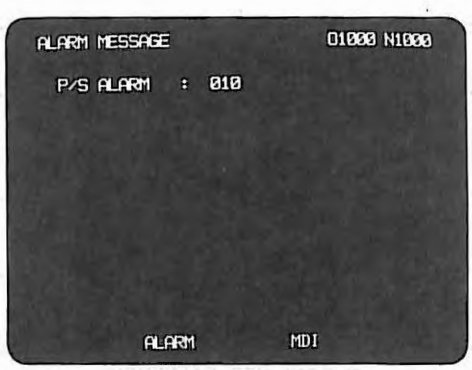
(2) Overtravel



(3) Servo alarm



(4) P/S alarm



7.3.3 Alarm table

(1) Overheat alarm

CRT message	Description	Refesrence item
OVER HEAT: CONTROL UNIT	PCB is overheated.	7.4.1
OVER HEAT: SERVO MOTOR	Servo motor is overheated.	7.4.2
OVER HEAT: SERVO MOTOR CONTROL UNIT	Both PCB and servo motor are overheated concurrently	

(2) Memory alarm

No.	CRT message	Description	Reference item
1	ROM: SERIES	ROM series error	7.4.5
	ROM: EDITION	ROM version number error	7.4.6
	ROM: PARITY	ROM parity error	7.4.4
2	WORK MEMORY: PARITY LOW	Work memory parity error (low byte)	7.4.3
	WORK MEMORY: PARITY HIGH	Work memory parity error (high byte)	7.4.3
3	PROGRAM MEMORY: PARITY LOW	Program memory parity error (low byte)	7.4.7
	PROGRAM MEMORY: PARITY HIGH	Program memory parity error (high byte)	7.4.7
4	WATCH DOG TIMER	Watch dog timer error	7.4.8
5	CPU INTERRUPT	CPU interrupt error	7.4.9

If both high byte and low byte of PROGRAM MEMORY parity error or WORK MEMORY parity error occur, the high byte is displayed.

(3) Overtravel alarm

CRT message	Description	Reference item
OVER TRAVEL: +X	X-axis has exceeded plus (+) side stroke limit.	7.4.10
OVER TRAVEL: -X	X-axis has exceeded minus (-) side stroke limit.	7.4.10
OVER TRAVEL: +Z	Z-axis has exceeded plus (+) side stroke limit.	7.4.10
PVER TRAVEL: -Z	Z-axis has exceeded minus (-) side stroke limit.	7.4.10

(4) Servo alarm

CRT message	Description	Reference item
01(OVER LOAD)	X, Z-axis overload signal is turned on.	7.4.11
02(VRDY OFF)	Velocity control READY signal (VRDY) is turned off.	7.4.12
03(VRDY ON)	Velocity control READY signal (VRDY) does not turn off after position control READY signal (PRDY) has been turned off.	
04(WRONG ZRN)	The position control system is defective. The reference point return failure may be presumed to have been caused by a trouble inside NC or in the servo system during the reference point return. Start over again fram the manual reference point return again.	7.4.13
11(X AXIS)	The error register data value is larger than the set value in X-axis.	7.4.14
12(X AXIS)	Error register data of X axis exceeds $\pm$32767 or the velocity command value of DA converter is out of the range of -8192 - +8191. This error is usually caused by various setting failures.	7.4.15
13(X AXIS)	The velocity exceeding 511875 detection unit/sec was going to be commanded in X-axis. This error is caused by a CMR setting failure.	7.4.16
14(X AXIS)	Feedback signal line from the X-axis motor is disconnected.	7.4.17
15(X AXIS)	X-axis drift amount is excessive. (It exceeds 500 VELO)	
21(Z AXIS)	The error register data value is larger than the set value in Z-axis.	7.4.14
22(Z AXIS)	Error register data of Z axis exceeds $\pm$32767, or the velocity command value of DA converter is out of the range of -8192 - +8191. This error is usually caused by various setting failures.	7.4.15

CRT message	Description	Reference item
23(Z AXIS)	The velocity exceeding 511875 detection unit/sec was going to be commanded in Z-axis. This error is caused by a CMR setting failure.	7.4.16
24(Z AXIS)	Feedback signal line from the Z axis motor is disconnected.	7.4.17
25(Z AXIS)	Z-axis drift quantity is excessive. (It exceeds 500 VELO)	

→ A "SERVO ALARM:" message is always displayed on the MDI & CRT unit screen.

(5) Program errors (P/S alarm)

Number	Contents	Remarks
000	Re-apply the power after the parameter has been input. (Parameter No. 06 to 10, 15 to 19, 31 to 37).	
001	TH alarm (A character with incorrect parity was input). Correct the tape.	
002	TV alarm (the number of characters in a block is odd). This alarm will be generated only when the TV check is effective. Correct the tape.	
003	Data exceeding the maximum allowable number of digits was input. (See item of max programmable dimensions.)	
004	A numeral or the sign (-) was input without an address at the beginning of a block.	
005	The address was not followed by the appropriate data but was followed by another address or EOB code.	
006	Sign "-" input error (Sign "-" was input after an address with which it can't be used. Or two or more "-" signs were input.)	
007	Decimal point "." input error (A decimal point was input after address with which it can't be used. Or two or more decimal points were input.)	
009	Unusable character was input (B, D, E, J, L, V or Y).	
010	An unusable G code was commanded.	
011	Feed rate was not command at cutting feed or the federate was inadequate.	
023	In circular interpolation by radius designation, negative value was commanded for address R.	
029	An offset value exceeded 6 digits. The offset value should be reset.	
031	In setting of offset amount by G10, the offset number following address P was excessive or it was not specified.	

7.3

Number	Contents	Remarks
032	In setting of offset amount by G10, the offset amount was excessive.	
033	A point of intersection can not be determined for tool nose radius compensation.	
034	The start up or cancel was going to be performed in the G02 or G03 mode in tool nose radius compensation.	
035	Skip cutting (G31) was specified in tool nose radius compensation mode.	
038	Overcutting will occur in tool nose radius compensation because the arc start point or end point coincides with the arc center.	
039	Chamfering or corner R was specified with a start-up, a cancel, or switching between G41 and G42 in tool nose radius compensation. The program may cause overcutting to occur in chamfering or corner R.	
040	Overcutting will occur in tool nose radius compensation in a canned cycle G90 or G94.	
041	Overcutting will occur in tool nose radius compensation.	
050	The chamfering or a corner R was specified in a block which includes la thread cutting command.	
051	The block after a block containing a chamfering or a corner R specification was not a G01 command.	
052	The move direction or the move amount in a block following chamfering or a corner R command was not adequate.	
054	A block in which the chamfering or the corner R was specified includes a taper command.	
055	The move distance in the block which includes the chamfering or the corner R specification is smaller than the chamfering amount or the corner R.	

Number	Contents	Remarks
059	The program with the selected number cannot searched, in external program number search.	
060	Commanded sequence number was not found in the sequence number search.	
061	Address P or Q is not specified in G70, G71, G72, or G73 Command.	
062	o The depth of cut in G71 or G72 is zero or negative value. o The repetitive count in G73 is zero or negative value. o The negative value is specified to Δ i or Δ k in G74 or G75. o The zero or negative value is specified to address U or W, though Δ i or Δ k is not zero in G74 or G75. o The negative value is specified to Δ d, though the relief direction in G74 or G75 is determined. o The zero value is specified to the height of thread or depth of cut of 1st time in G76. o The specified minimum depth of cut in G76 is greater than the height of thread. o An unusable angle of tool tip is specified in G76.	
063	The sequence number specified by address P in G70, G71, G72, or G73 command cannot be searched.	
065	o G00 or G01 is not commanded at the block with the sequence number which is specified by address P in G71, G72, or G73 command. o An address Z(W) or X(U) was commanded at the block with sequence number which is specified by address P in G71 or G72, respectively.	
066	An unallowable G code was commanded between two blocks specified address P and Q in G71, G72 or G73.	
067	G70, G71, G72, or G73 command with address P and Q was specified in MDI mode.	
069	The final move command in the blocks specified by P and Q of G70, G71, G72 and G73 ended with chamfering or corner R.	
070	The memory area is insufficient.	

Number	Contents	Remarks
071	The address to be searched was not found. Or the program with specified program number was not found in program number search.	
072	The number of programs to be stored exceeded 63.	
073	The commanded program number has already been used.	
074	The program number is other than 1 to 9999.	
076	The address P was not commanded in the block which includes a M98 command.	
077	The subprogram was called in triple.	
078	The sequence number which was specified by address P in the block which includes a M98 or M99 was not found.	
079	The contents of the program stored in the memory did not agree with that in tape in collation.	
080	In the area specified by parameter ε , the mesuring point signal does not come on. (Automatic tool compensation function)	
081	Automatic tool compensation was specified without a T code. (Automatic tool compensation function)	
082	T code and automatic tool compensation were specified in the same block. (Automatic tool compensation function)	
083	In automatic tool compensation, an invalid axis was specified or the command is incremental. (Automatic tool compensation function.)	
085	When entering in the memory by using ASR or RS232C interface, an overrun or framing error was generated. The number of bits of input data or setting of baud rate is incorrect.	
086	In entering in the memory by using RS232C interface, the ready signal (DR) or I/O devices was turned off.	
087	When entering data in the memory by using RS232C interface, though the read terminate command is specified, input is not interrupted after 10 characters read.	

Number	Contents	Remarks
090	The reference point return cannot be performed normally because the reference point return start point is too close to the reference pint or the speed is too slow.	
092	The commanded axis by G27 (reference point return check) did not return to the reference point.	
100	The switch to set parameters was turned on. Push the reset button after turning off the switch.	
101	The power was turned off while rewriting the contents of the memory in the part program storage and editing operation. When this alarm is generated, you must turn on the power while pushing the DELET and RESET buttons to clear the memory.	
111	The calculation result of macro instruction exceeds the allowable range (-2^{32} to $2^{32}-1$).	
112	Division by zero was specified. (including tan90°)	
114	An undefined H code is designated G65 block.	
115	A value not defined as variable number is designated.	
116	The variable number designated with P is forbidden for assignment.	
119	The argument of SQRT or BCD is negative.	
125	An address which cannot be used in G65 block is designated.	
128	The sequence number at the destination of divergence instruction is not in the range between 0 and 9999. Or, the sequence number is not found.	

7.3.4 Alarm display on master PCB

When NC is placed to an alarm condition, a cause of the alarm is displayed on the MDI & CRT unit (7.3.3), and the alarm lamp (red LED) lights on the master PCB. (LED3 is green.)

The meanings and mounting positions of alarm lamps are described below.

LED2	....	Lights when an alarm occurs.
LED lamp	....	Light with LED2 when a watch dog timer alarm occurs.
LED3	....	Lights when NC is operating normally without any alarm.

Note) LED3 lamp flickers during automatic operation.

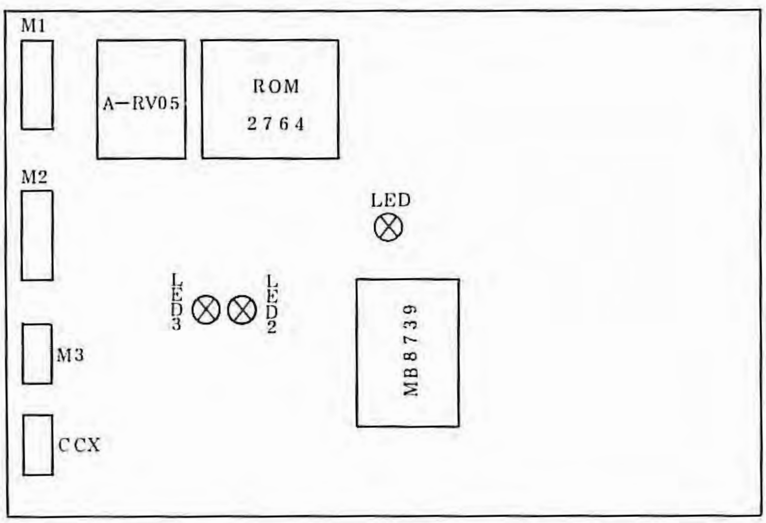


Fig. 7.3.4(a) Mounting Positions of Alarm Lamps on Master PCB (A16B-1000-0010)

7.4 Remedies Against Alarms

7.4.1 Overheat alarm of control unit

This alarm lamp lights, if temperature exceeds the allowable value inside the NC cabinet.

OVER HEAT : CONTROL UNIT

This alarm is released by depressing the reset button after temperature has reduced to be lower than the specified value. It cannot be released by the reset button until temperature is lower than the specified value.

Item	Causes of troubles	Remedies
1	High ambient temperature	Lower the ambient temperature
2	Heat exchanger is clogged	Clean
3	Fan motor is defective	Replace
4	Thermostat is defective, or its connection is faulty	Thermostat is turned on at 60°C

7.4.2 Overheat alarm for servo motor

OVER HEAD : SERVO MOTOR

Item	Causes	Checking methods	Remedies
1	Overload	° Measure the motor armature current, and make sure that it does not exceed the rated current.	° Reduce the load torque ° Decrease cutting duty.
2	Poor insulation of windings	° Measure the insulation between motor power line terminal A1 or A2 and body by using a megger or a circuit tester. The measuring value should be higher than 1Mohm (in case of a 500V megger) or infinite (in case of circuit tester).	° Clean the commutator and its surrounding by blowing compressed air. ° Replace the motor, if it cannot be repaired by the above remedy.
3	Poor insulation of winding	° After dismounting the motor from the machine tool, measure the no-load current. If the current increases in proportion to the revolutions, it is judged to have been caused by an internal short-circuit failure.	° Clean the commutator and its surrounding. This failure is apt to occur, if oil attaches to the commutator surface.

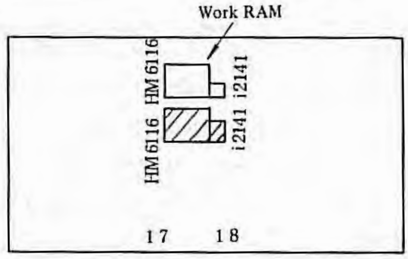
Item	Causes	Checking methods	Remedies
4	Demagnetization of field magnet	o Measure the motor terminal voltage (between A1 and A2) in rapid traverse, and check if the specified voltage is measured.	o Replace the motor, if the terminal voltage is lower than specified and the motor is overheated.
5	Heat pipe fan does not operate normally.	o Check fan for normal lvoltage and wiring. o Check fan for possible contact with wire gauze. o Check fan motor for normal conditions.	o Repair wiring. o Mount wire gauze correctly. o Replace fan motor.
6	Poor performance of heat pipe	o If the motor with the heat pipe is overheat irrespective of normal conditions in check items in item 5, the heat pipe performance may be regarded as poor.	o Replace motor.
7	Defective brake	o Check brake voltage. Allowable value 100±10%	o Replace brake
8	Connection failure	o Check the overheat connection between motor and position control.	o Repair defective connections

7.4.3 WORK MEMORY parity error

WORK MEMORY : PARITY LOW or
WORK MEMORY : PARITY HIGH

This alarm occurs, if a data parity error is detected when reading data from work RAM on master PCB.

Item	Causes	Checking methods	Remedies
1			Turning off supply once, and then, turn it on again.
2	Master PCB is defective.	If an alarm occurs again after remedy in item 1.	Replace PCB with spare. Set and adjust PCB correctly.



Master PCB

The shadowed part shows the low byte part, and the other shows the high byte part. (See 1.4.4)

7.4.4 ROM parity error

ROM: PARITY 012

└ROM number in parity error

If ROM parity error occurs, an alarm message and an ROM number are displayed on the CRT screen as described above.

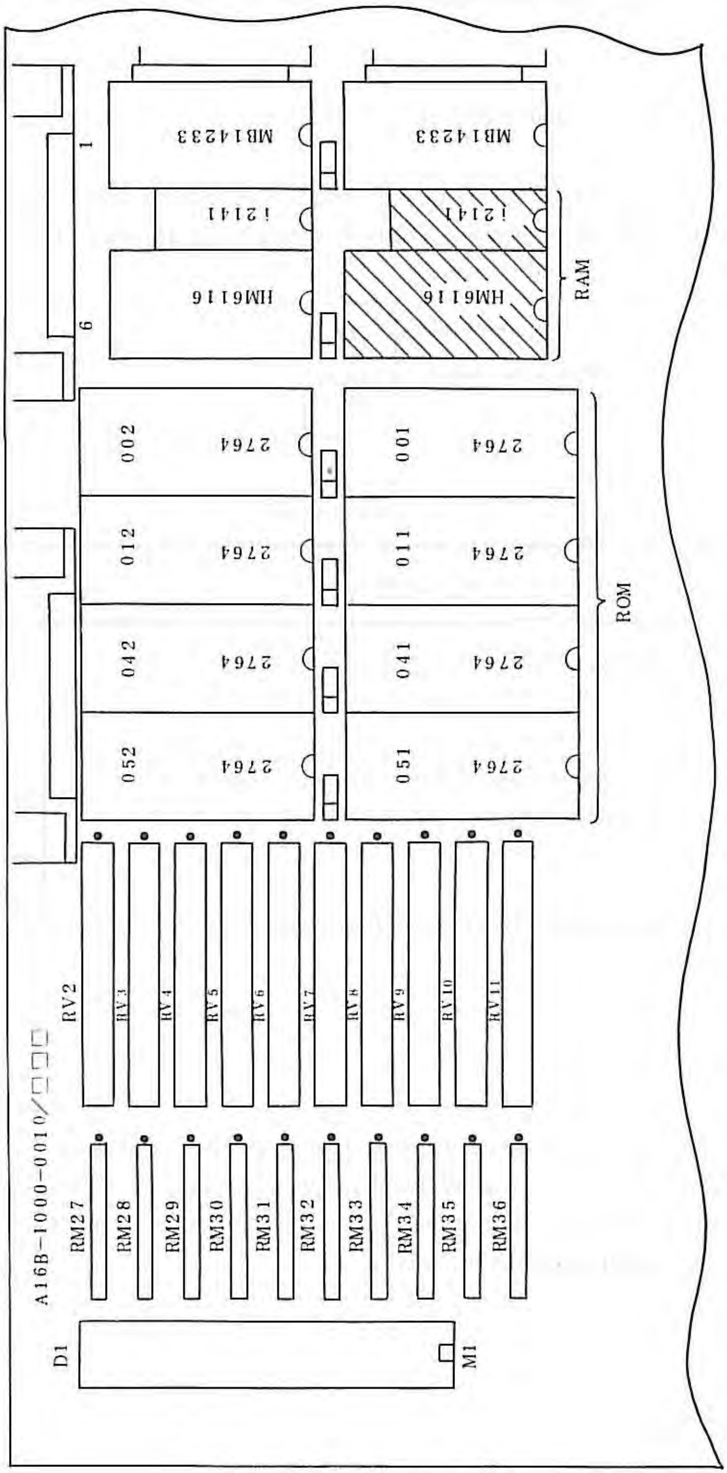


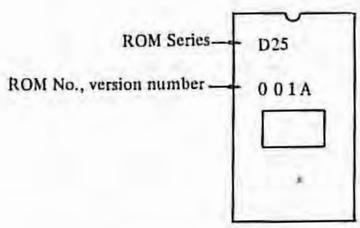
Fig. 7.4.4 Master PCB

Ite	Causes	Checking methods	Remedies
1	ROM is defective		Replace ROM corres-ponding to the displayed ROM No.
2	Master PCB is defesctive.	PCB is defective, if the trouble cannot be repaired after replacing ROM in item 1.	Replace PCB with spare. Set and adjust PCB correctly.

7.4.5 ROM series error

ROM : Series 000 (ROM No.)

ROM series of FS 3T-C and FS 2T-A is D25 and N01, respectively. This alarm occurs, if an ROM other than ROM series D25 is mounted. (See the following figure) For the mounting position of ROM, see Fig. 7.7.4.



Item	Causes	Checking methods	Remedies
1	ROM is defective.	Check ROM series printed on ROM	Replace ROM corres-ponding to the displayed ROM No.
2	Master PCB is defective.	If this trouble cannot be repaired after replacing ROM, PCB is defective.	Replace PCB with spare. Check PCB for normal setting and adjustment.

7.4.6 ROM version number error

ROM : EDITION 041

In FS 3T-C and FS 2T-A, all ROM employed should have the same version number. This alarm occurs, if one or more ROM have a different version number. The ROM version number is stamped on ROM by using alphabetic characters. For ROM version numbers, refer to 7.4.5. The version number is A (=01) in the example in 7.4.5.

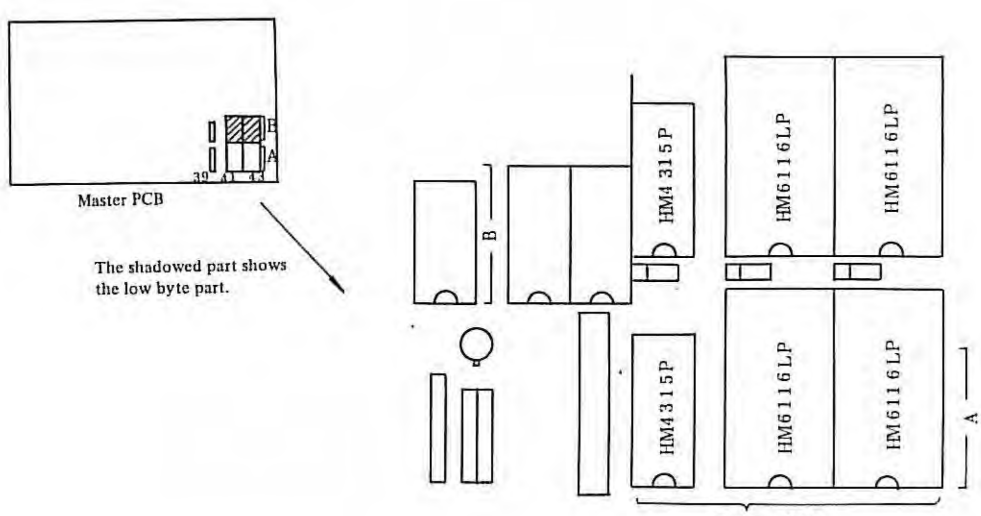
A = Version 01
B = Version 02
C = Version 03
.
.
.
Z = Version 26

Item	Causes	Checking methods	Remedies
1	ROM is defective.	Check ROM for stamped version number.	Replace ROM corresponding to displayed ROM number.
2	Master PCB is defective.	If this alarm cannot be repaired by replacing ROM, master PCB is defective.	Replace PCB with spare. Check PCB for normal setting and adjustment.

7.4.7 PROGRAM MEMORY parity error

PROGRAM MEMORY : PARITY LOW or
PROGRAM MEMORY : PARITY HIGH

This alarm occurs, if a parity error is detected when reading data from RAM which stores parameters and programs on the master PCB.



Observe the following procedure, if this alarm has occurred.

(1) Turn on the power supply while depressing the DELETE key on the MDI panel. All areas storing programs are cleared by this operation. If the alarm appears no longer, load programs again.

(2) If the alarm cannot be repaired by the operation in (1), turn on the parameter write switch and turn on the power supply while depressing both DELETE key and RESET key on the MDI panel.

All areas covering parameters, offset data, programs, and others are cleared by this operation. If the alarm appears no longer, load all pieces of information, such as parameters, offset data, programs, etc. again. If the alarm cannot be repaired yet, it may be caused by another trouble.

Item	Causes	Checking methods	Remedies
1	Program memory is defective.		Replace program memory.
2	Master PCB is defective	If this trouble cannot be repaired by replacing program memory in item 1. PCB may be defective.	Replace PCB with spare. Check PCB for normal setting and adjustment.
3	Power supply unit is defsective.	If this trouble cannot be repaired yet by items 1 and 2, power supply unit may be defective.	Replace power supply unit with spare. Check the power supplyunit for normal setting and adjustment.

7.4.8 Watch dog timer

WATCH DOG TIMER

Item	Causes	Checking methods	Remedies
1	Master PCB was exposed to intense light, such as photographic flash or the like.		Turn off the power supply once, and then, turn it on.
2	Master PCB is defective.	If this system alarm does not occurs any longer after replacing PCB, the previous PCB is confirmed to have been defective. Check new PCB for the same setting and adjustment as before.	Replace master PCB.

7.4.9 CPU interrupt error

CPU INTERRUPT

This alarm occurs, if an interrupt occurs due to a certain cause in an unemployed CPU.

(Remedy)

- Replace the master PCB with spare. Check the PCB for normal setting and adjustment.
- Contact the FANUC service center.

7.4.10 Overtravel alarm

OVER TRAVEL : +X
OVER TRAVEL : -X
OVER TRAVEL : +Z
OVER TRAVEL : -Z

(1) The machine tool exceeds the stored stroke limit.
The above alarm is displayed on the display unit when the machine tool reaches the stored stroke limit. When this alarm number lights, all axes stop feeding in the automatic operation mode. Also, the feed in the alarm axis direction only is stopped in the manual operation mode.

(Causes)

(i) Program error

(ii) The stored stroke limit is not properly set.

(iii) Deviation between actual machine tool position and the machine tool position being stored in NC due to follows.

1. Movement of the machine tool during power off.
2. Clearance of memory.
3. Replace of master PCB.

Whether the machine tool position from the reference point meets the stored stroke limit position or not can be checked by DGN No. 820 and 821.

	8	2	0	ABSMTX (X-axis)
	8	2	1	ABSMTZ (Z-axis)

(Remedy)

Correct the program in case of (i).
Set the stored stroke limit (parameter No. 70, 71, 73, 74) again in case of (ii).
Perform the reference point return once in case of (iii).

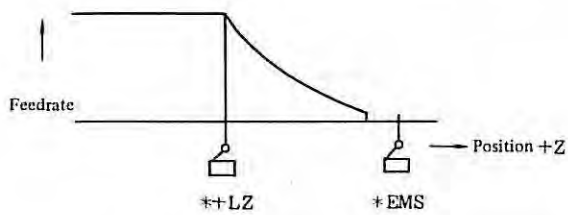
(Resetting method)

(i) After moving the manual moving part of the machine tool in the opposite direction by manual operation (JOG, STEP, HANDLE), depress RESET button on the MDI/CRT panel.

(ii) If the machine tool cannot get out of the overtravel range, turn off the power supply, and then, turn it on again while depressing $\boxed{\substack{O\\P}}$ key and $\boxed{CAN}$ key on the MDI panel. As a result of this operation, the overtravel is not checked until the reference point return is completed. Perform the reference point return under this condition.

(2) When the +Z limit switch of the machine tool is hit;

All axes stop feeding when the +Z limit switch is hit in the automatic operation mode. The alarm Z axis only stops feeding in the manual operation mode. See the following example.



*+LZ operation .... The machine tool is decelerated and stopped with OVERTRAVEL displayed on the display unit.

*EMS operation ...... The machine tool feed is stopped urgently (emergency stop).
(*ESM operates only when the *+LZ does not function.)

Since *EMS is not always installed depending upon machine tools, refer to the machine tool builder's instruction manual for details.

(Causes and remedies)

(a) Program zero point setting error in coordinate system setting → Correct the program.

(b) Program error → Correct the program.

(Resetting method)

(a) When *+LZ only operates;

Move the moving part of the machine tool in the opposite (safe) direction by manual operation (JOG, STEP, HANDLE) to make the limit switch off, and depress the reset button on the MDI/CRT panel.

Note) In this case, the moving part of the machine tool can move only in the opposite direction to the overtravel direction.

(b) When both *+LZ and *EMS operate;

(i) Release the emergency stop temporarily.

(ii) Perform the same operation as in the resetting method of *+LZ.

Note) If manual operation is made after temporarily releasing the emergency stop in the machine tool, in which *+LZ is not operating while *EMS is operating, the machine tool can move in both directions. Accordingly, particularly be careful not to take the wrong direction.

7.4.11 Overload alarm

SERVO ALARM : 01 (OVER LOAD)

<table>
<tr><th>Item</th><th>Causes</th><th>Checking methods</th><th>Remedies</th></tr>
<tr><td>1</td><td>Motor is ovesr-loaded.</td><td>Measure the motor current, and check if it is lower than the following value.
<table><tr><th>Motor</th><th>Continuous rated current</th></tr><tr><td>00M</td><td>4A</td></tr><tr><td>0M</td><td>7A</td></tr><tr><td>5M</td><td>9A</td></tr><tr><td>10M</td><td>12A</td></tr><tr><td>20M</td><td>18A</td></tr><tr><td>30M</td><td>24A</td></tr><tr><td>30MH</td><td>36A</td></tr></table></td><td>Reset thermal relay.
Reduce the cutting condition.
Machine tool must be adjusted, if the motor current exceeds the specified continuous rated current value when it is fed without load.</td></tr>
<tr><td>2</td><td>Thermal relay setting failure.</td><td>Check thermal relay for normal setting.
<table><tr><th>Motor</th><th>Set value</th></tr><tr><td>00M</td><td>4A</td></tr><tr><td>0M</td><td>7A</td></tr><tr><td>5M</td><td>9A</td></tr><tr><td>10M</td><td>12A</td></tr><tr><td>20M</td><td>18A</td></tr><tr><td>30M</td><td>24A</td></tr><tr><td>30MH</td><td>36A</td></tr></table></td><td>Reset thermal relay again.</td></tr>
</table>

Item	Causes	Checking methods	Remedies
3	Transformer. is overheated.	Disconnect cables from transformer terminals No.51 and 52, and measure the resistance between terminals No.51 and 52. The measuring value should be lower than serveral ohms. If open (higher than several hundred kΩ), the transformer thermostat is operating. If the surface temperature of the transformer is 80 - 90°C when the thermostat is operating, check the cutting motor current. If the surface temperature of the transformer is lower than 50 - 60°C, the transformer is defective.	Reduce the cutting condition. Measure the motor current during low-speed feed without load, and readjust the machine tool, if the measuring value is close to the rated value of the motor.
4	Thermostat in regenerative discharge circuit is operating. (When the regenerative discharge unit is of a separate type in the servo unit for M series.)	After disconnecting cables from terminals T3(3), (4) of the regenerative discharge circuit, measure the resistance between terminals (3) and (4). The measuring value should be lower than several kΩ. If open (higher than several hundred kΩ), the thermostat is operating. If the enclosure of the regenerative discharge unit is 80 - 90°C when the thermostat is presumable to be operating, check the acceleration/deceleration frequency. If the enclosure of the regenerative discharge unit is lower than 50 - 60°C, the regenerative discharge unit is defective. Replace the regenerative discharge unit.	Reduce the acceleration/deceleration frequency to once/sec or less. Replace the regenerative discharge unit.
5	Position control circuit of master PCB and/or velocity control unit is defective.	Replace PCB, if its spare is available.	Replace PCB.
6	Connection failure.	Check overload signal line for normal connections.	Repair defective connections.
7	Power voltage failure	Check the control unit and velocity control unit for normal voltages.	Repair defective parts.

(1) Thermal relay position

The velocity control unit is provided with a thermal relay which operates when the motor is overloaded.

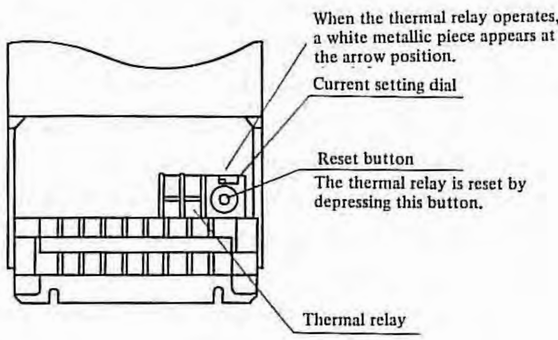


Fig. 7.4.11(a) Mounting Position of Thermal Relay for Motor Models 00M, 0M, 5M, 10M, 20M, 30M

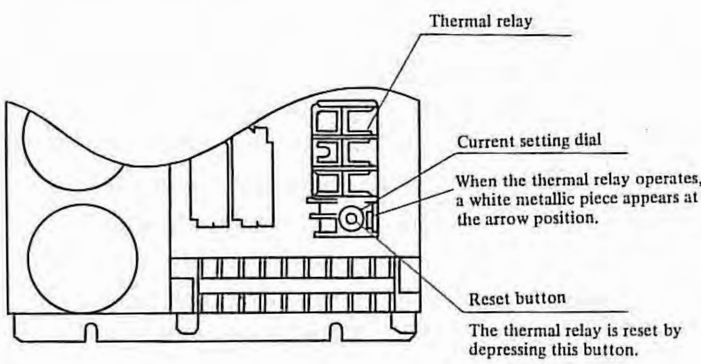


Fig. 7.4.11(b) Mounting Position of Thermal Relay for Motor Model 30MH

7.4.12 VRDY (sevo ready) off

SERVO ALARM : 02 (VRDY OFF)

Item	Causes	Checking methods	Remedies
1	AC 100V is not supplied to velocity control unit.	Check if AC 100V is supplied across terminals No.(3), (4) of terminal board T in velocity control unit.	Check the emergency stop function.
2	Velocity control unit is placed to alarm condition.	Check if various red LED light on PCB of velocity control unit.	For remedy against each alarm, see para. 7.7.
3	Position control unit of master PCB or PCB of velocity control unit is defective.	Replace PCB with spare, if available.	Replace PCB.
4	Power voltage failure	Check the position control unit and velocity control unit for normal voltages.	Repair defective parts.
5	Connection failure	Check connections between velocity control unit and position control unit.	Repair defective parts.

7.4.13 Position control failure

SERVO ALARM : 04 (WRONG ZRN)

This alarm occurs, if the reference point return end signal is not detected in the position control system when the high-speed reference point return is made.

This may be caused by a defect of the master PCB. Replace the master PCB with spare. Set and adjust PCB.

7.4.14 Error register failure

SERVO ALARM : 11 (XAXIS) ...... (X-axis error register trouble)
SERVO ALARM : 21 (ZAXIS) ...... (Z-axis error register trouble)

Item	Causes	Checking methods	Remedies
1	Setting failure of position deviation amount.		Set parameter No.28 and 29.
2	Setting failure of rapid traverse time constant or gain of velocity control unit.	An error of the position control circuit increases temporarily, if a current required for accelerating or decelerating the motor does not flow to the motor during the acceleration/deceleration time of NC. Observe the waveform at check pin CH1 of the velocity control unit, and check if the overshoot is less than 5%.	Increase the rapid traverse time constant of NC by setting it to parameters No.41 and 42. Increase the velocity control unit gain by turning RV1 clockwise.
3	Position control unit of master PCB or PCB of velocity control unit is defective.	Replace PCB with spare. Set and adjust PCB correctly.	Replace PCB.
4	Low input power voltage.	Measure the input current and voltage, and check if their fluctuations are within a range of +10 - -15%.	Select the input taps of servo power transformer.
5	Power voltage failure.	Check the control unit voltage.	Repair defective parts.
6	Connection failure.	Check the pulse coder and motor power lines for normal connections.	Repair defective connections.

7.4.15 Command velocity failure

SERVO ALARM : 12 (XAXIS) ..... (X-axis command velocity failure)
SERVO ALARM : 22 (ZAXIS) ..... (Z-axis command velocity failure)

This alarm occurs, if the velocity command value calculated inside the position control circuit of FS 3T-C and FS 2T-A exceeds its allowable value, and it may be caused by the following;

Item	Causes	Checking methods	Remedies
1	Wrong setting of servo loop gain multiplier		Calculate the servo loop gain multiplier set to parameter No.34 or 35 and set the servo loop gain multiplier again.
2	Wrong setting of CMR		Set the command multiplier (CMR) to parameter No.15 or 16 again. (The set value of CMR is primarily determined from the least input increment and the move amount of machine tool per revolution of motor.)
3	Position control loop gain is set extremely high.		Set a suitable position control loop gain to parameter No.37. The standard set value is 3000(30 sec^{-1}).
4	Feedrate is too high.		This alarm may be produced unless the feedrate is suppressed to be low in a special system, in which the position control loop gain must be set to an extremely large value. In this case, suppress the feedrate to a low value.

Item	Causes	Checking methods	Remedies
5	Master PCB is defective.	If the trouble cannot be repaired by items 1 - 4, the master PCB may be defective.	Replace PCB with spare. Check the PCB for normal setting and adjustment.

7.4.16 Feedrate command value error

SERVO ALARM : 13 (XAXIS) ..... (X-axis feedrate command value error)
SERVO ALARM : 23 (ZAXIS) ..... (Z-axis feedrate command value error)

Item	Causes	Checking methods	Remedies
1	Wrong setting of CMR		Set the command multiplier (CMR) to parameter No.15 or 16 again. (The setting value of CMR is primarily determined from the least input increment and the move amount of machine tool per revolution of motor.)
2	Master PCB is defective.	If the trouble cannot be repaired by item 1, master PCB may be defective.	Replace master PCB with spare. Check PCB for normal setting and adjustment.

7.4.17 Disconnection of DC motor feedback cable

SERVO ALARM : 14 (XAXIS) ..... (Disconnection of DC motor feedback cable in X-axis)
SERVO ALARM : 24 (ZAXIS) ..... (Disconnection of DC motor feedback cable in Z-axis)

Item	Causes	Checking methods	Remedies
1	Feedback cable connection failure.	Check the feedback cable for connector soldering, etc.	Repair defective parts.
2	DC motor is defective.	After replacing X-axis and Z-axis motors, check the alarm generating axis. Observe the following items without fail. (1) Disconnect motor power cables in both axes. (2) Support the slant axis and other axes which otherwise may fall by using a wooden piece or the like. (3) Short pin S23 on velocity control unit PCB. After replacing feedback cables of X-axis and Z-axis under the above codition, turn on the power supply, and check the alarm generating axis. The DC motor is defective, if the generating axis is changed. The DC motor is normal, if the generating axis is not changed.	Replace the defective motor with spare.
3	Master PCB is defective.	If the trouble cannot be repaired by items 1 and 2, the master PCB may be defective.	Replace master PCB with spare. Check PCB for normal setting and adjustment.

7.4.18 Excessive drift compensation amount

SERVO ALARM : 15 (XAXIS) ..... (Excessive X-axis drift compensation amount)
SERVO ALARM : 25 (ZAXIS) ..... (Excessive Z-axis drift compensation amount)

Item	Causes	Checking methods	Remedies
1	Connection failure	Check the power cable to the servo motor for disconnection. Check if position detector and servo motor are normally connected to each other.	Repair defective parts.
2	Setting failure of drift compensation amount.	Check if data of parameter No.61 and 62 exceed 500 or not.	Reset the drift compensation value as follows. After turning on the emergency stop button, turn bit 7 "ADFT" of parameter No.04 to "0" to prevent the automatic drift compensation. Set "0" to data of parameter No.61 and 62, and set the drift compensation amount (initial value) to "0". Set bit 7 "ADFT" of parameter No.04 to "1" to be ready for automatic drift compensation.
3	Velocity control unit or master PCB position control section is defective.	Replace PCB with spare, if any. Set and adjust PCB as specified.	Replace PCB.

7.4.19 TH alarm (Tape horizontal alarm)

P/S ALARM : 001

If a parity error code is detected during the significant information section of NC tape (excluding the section from the control-out to the control-in), the read operation of tape stops. Data in the error block and subsequent blocks one not input.

The alarm display is went out by depressing the RESET button.

Locate a cause of this alarm by inspecting the code hole position of the character in error by the following procedure. Depress the DGNOS key on the MDI & CRT panel and display DGN No. 710 or 711 on the CRT screen, and the following contents are known.

Contents of TH alarm when TH alarm occurs

	7	1	0	CHCNT

CHCNT: Indicates the position of the TH alarm character in case of TH alarm (No. 001)

Assume x be the value obtained by converting a binary number consisting of the displayed "0" and "1" into a decimal number. The TH alarm character is the X-th character as counted from the EOB code which is ahead of the stop position of the tape by certain blocks. (Count codes, assuming that EOB is zero.)

This EOB code counted as "0" cannot be concluded to be ahead of one , two, or more blocks.

	7	1	1	P8	P7	P6	P5	P4	P3	P2	P1

Check the tape over several blocks, accordingly.

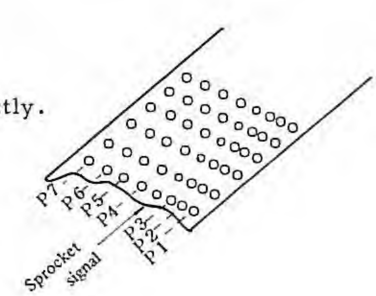
P1 - P8: Read information of character which results in TH alarm in case of TH alarm (No.001)
P1 - P8 correspond to channels 1 - 8.
"0": No hole is punched.
"1": A hole is punched.

(Causes and remedies)

(a) Drift of NC tape and read part of tape reader
Clean the read part of the tape reader or NC tape.

(b) Tape setting error
Check if the tape is set upside down, and set it correctly.

(c) Punch error of NC tape
Correct the NC tape.



7.4.20 TV alarm (Tape vertical alarm)

P/S ALARM : 002

Perform parity check of one vertical block in reading an NC tape. If odd characters are present in one block (from the next character of EOB to next EOB excluding the section ranging from control out to control in), the control unit stops reading the NC tape and displays an alarm on the CRT screen.

Data are no longer read in the error block and subsequent blocks.

The ALARM lamp is went out by the RESET button.

This TV check function can be set from the MDI panel to determine if it is effective or not.

(Remedies)

(a) Punch a code (a space, for example) neglected by the NC system before the EOB code, so that the number of characters is even.
However, the tape punched by the puncher combined with the FANUC SYSTEM 3T-MODEL C is TV-checked, and the number of characters is even in one block.

(b) If this alarm displays when the number of characters is even, it may be caused by a read error of the tape reader. Clean the read part of the tape reader or NC tape.

7.4.21 Feedrate command 0

P/S ALARM : 011

This alarm occurs in the following cases.

(1) The feedrate command is not given.

(2) Feedrate command 0 (F0) is given.

7.4.22 Memory area shortage alarm

P/S ALARM : 070

Alarm NO.070 is displayed, if the memory capacity is lack when loading an NC program into the memory.

(Remedies)

Load a new program into memory after cleaning existing loaded program in the memory.

7.4.23 Tape compare error

P/S ALARM : 079

When the tape is input with the memory protect switch turned off (memory write impossible) on the operator's panel, the tape is compared with the program being loaded into memory. This errors, if the incoincidence of data is detected by the above check.

7.4.24 Program input error

P/S ALARM : 085

This error is produced due to the following when a program or a data is read by ASR33 or RS232C interface.

(1) The transfer baud rate does not meet the baud rate of the I/O unit.
FANUC tape reader: 4800 bauds
ASR33: 110 bauds

(2) ASR33 input frequency is not as specified when using the ASR33.
Select ASR33 model according to whether the power frequency is 50Hz or 60Hz.

7.4.25 The reference point return speed is slow or the pulse coder one - revolution signal is not detected

P/S ALARM : 090

When the pulse coder is used, the reference counter is synchronized with the one-revolution signal in the first reference point return operation after turning on the power supply or after releasing the emergency stop. In this case, the following condition must be satisfied to securely catch the same edge of the one-revolution signal.

(a) The position deviation amount (DGN No.800 -) is not less than 128.

(b) The one-revolution signal must be sent at least once until the deceleration dog is hit and released after the position deviation amount (DGN No.800 -) becomes 128 or over.
If conditions (a), (b) are not satisfied, alarm No.090 is produced. The one-revolution signal is not used in the second and subsequent reference point return operation, and thus, this alarm check is not done.

Item	Causes	Checking methods	Remedies
1	Tool slow speed	Perform the reference point return under the same condition as generated the alarm, and check if the position deviation amount (DGN No.800 -) is not less than 128 by the self-diagnostic function. Be careful when the reference point return was made from the position where the deceleration dog was hit.	Increase the speed. The speed of higher than 300mm/min is required when the position gain is 30 sec^{-1}.
2	Reference point return start position is too near the reference point	Check the distance between the reference point return start position and the reference point.	Perform reference point return from a position apart from the reference point more than two revolutions of motor.
3	Pulse coder power voltage is too low.	Pulse coder voltage should be higher than 4.75V when +5V of master PCB of NC is adjusted to 5V $\pm$0.05V. (Measure the pulse coder voltage at (+), (-) or +5V and 0V check land of pulse coder PCB after removing the servo motor covser.)	Cable voltage drop should be lower than 0.2V in total in both 5V and 0V cables. Adjust +5V of master PCB to 4.95 - 5.10V.
4	Pulse coder is defective.	Replace pulse coder.	Replace.
5	Master PCB is defective.	Replace master PCB.	Replace.

7.5 When no Alarm is Displayed, but NC does not Operate Normally

7.5.1 JOG operation is impossible

Item	Causes	Checking methods	Remedies
1	Fault analysis	(1) Position display moves, but the machine tool does not move.	To item 2.
		(2) Neither position display nor machine tool moves.	To item 4.
2	Machine lock MLK ON	Make sure that bit 7 of DGN No.99 is "0".	
3	Servo system trouble	See 7.6	
4	No mode signal is applied.	Make sure that the bit 0 is "1", bit 1 is "0" and the bit 2 is "1" in DGN No. 102.	
5	Feed axis direction is not input.	Make sure that the feed axis direction is input in bits 2 and 3 of DGN No.96 and 97.	
6	Setting failure of JOG feedrate	Check bit 4 of parameter No.6 and bits 0 to 3 of DGN No. 101 to make sure that the override is not "0". If the machine tool does not move at rapid traverse, check the bit 0 of parameter No.12 as well as parameter No.38 and 39.	
7	External reset signal ERS is input.	Make sure that bit 7 is "0" and bit 4 is "1" in DGN No. 101.	
8	Reference point return signal ZRN is input.	Make sure that bit 7 of DGN No. 100 is "0".	
9	Master PCB is defective	See 7.3.4	Replace master PCB.

7.5.2 Automatic operation is impossible.

Item	Causes	Checking methods	Remedies
1	Fault analysis	(1) STL lamp does not light. (2) STL lamp lights, but no axis moves.	
2	Mode signal is not input	Bits "2 - 0" of DGN No. 102 are "001".	
3	Cycle start signal is not input.	Bit 2 of DGN No. 100 turns to "1" and "0" by turning on and off the start button.	
4	Feed hold suspension signal (*SP)	Make sure that bit 5 of DGN No. 101 is "1".	
5	External reset signal is input.	Make sure that bit 7 is "0" and bit 4 is "1" in DGN No. 101.	
6	Master PCB is defective.	See 7.3.4	
7	(1) Override is 0% (2) STLK is ON (3) During in-position check (4) Dwell is executing (5) M,S,T functions are executing (6) Waiting for spindle arrive signal	Check DGN No. 700, 701 and 712.	

7.5.3 Neither thread cutting nor cutting feed (feed per revolution) is possible.

Item	Causes	Checking methods	Remedies
1	Connection failure of cable	Check if connection M11 and position coder (J23) are properly connected.	
2	Spindle revolutions	Make sure that the spindle revolutions correspond to the commanded S code.	

Item	Causes	Checking methods	Remedies
3	Position coder is defective.		Replace position coder.
4	Master PCB is defective.		Replace master PCB.

7.5.4 Neither read nor punch out operation is possible by I/O interface.

Item	Causes	Checking methods	Remedies
1	Fault analysis	o Neither punch operation nor read operation is possible. To item 2 EDIT character is not displayed at the lower part of CRT screen during the above operation. o Neither punch operation nor read operation is possible. To item 3 EDIT character is displayed at the lower part of CRT screen during the above operation. o Read operation is impossible, but punch operation is possible. o Punch operation is impossible, but read operation is possible. o Alarm occurs (Alarm No. 085 - 087)	 To item 5 To item 5 See 7.4
2	Mode signal is not inpt	Make sure that "MD4 - MD1" of DGN No. 102 are "011" (EDIT). A program can be written into NC using I/O interface at "001" (AUTO).	
3	External reset signal is input.	Make sure that bit 7 is "0" and bit 4 is "1" in DGN No. 101.	

Item	Causes	Checking methods	Remedies
4	Parameter setting failure	Check parameters, referring to the parameter table attached to the system. Parameters 000 - 003 are covered in the list. (1) Check bits of setting parameter I/O. (2) RS232C/ASR33 selection, the number of stop bits and the setting points of baud rate are as shown below according to I/O conditions. (a) When I/O=0; Parameter 5 ... Setting of RS232C/ASR33 and the number of stop bits Parameter 68 .. Setting of baud rate (b) When I/O=1; Parameter 14 .. Setting of RS232C/ASR33 and the number of stop bits Parameter 69 .. Setting of baud rate	Alarm 85 and 86 occur, if parameter setting is wrong.
5	I/O unit operation failure	Check I/O unit operation, referring to the operator's manual.	
6	Cable connection	Check cable connections and wiring. Check cable connections according to the specifications determined between machine tool builder and I/O unit maker.	
7	Master PCB is defective.	Replace master PCB.	

7.5.5 When the reference point return position is deviated from the specified position;

(1) The reference point return position is deviated by one grid.

Item	Causes	Checking methods	Remedies
1	Deceleration dog is not properly positioned.	Move the machine tool toward the deceleration dog from the reference point, and measure the distance between the reference point and the deceleration dog position by observing the deceleration signals (bit 5 of DGN No. 096 ..... X-axis, bit 5 of DGN No.097 ...... Z-axis, by diagnostic function.	Set the distance from the separation of deceleration dog to the arrival at the reference point to about 1/2 revolution of motor.

Item	Causes	Checking methods	Remedies
2	Setting failure of deceleration dog length	Read the deceleration dog length by the same way as specified above.	Change the dog length as required, referring to the connecting manual.

(2) When the reference point position is deviated at random;

Item	Causes	Checking methods	Remedies
1	Noise	Check if cable shield is grounded, if a spark killer is connected to solenoid coil, etc., and if the pulse coder cable is separated from the magnetic cabinet cable. Make sure that the pulse coder voltage is higher.	Ground the cable shield. Mount a spark killer. Separate cables from each other.
2	Pulse coder power voltage drop	than 4.75V after adjusting +5V of master PCB of NC to 5±0.05V. (Measure the pulse coder voltage at (+) and (-) or +5V and 0V check land of pulse coder PCB after removing the servo motor cover.)	Suppress the voltage drop through cable to lower than 0.2V in total at 5V and 0V terminals. Adjust +5V of master PCB to 4.95V ~ 5.10V.
3	Looseness of coupling between servo motor and machine tool	Mark on the motor shaft, and check the correspondence to the machine tool position.	Tighten the coupling.
4	Pulse coder is defective.	Try replacing pulse coder.	Replace pulse coder.
5	Master PCB is defective.	Try replacing the master PCB.	Replace PCB.

(3) When the reference point return is deviated by a very small distance;

Item	Causes	Checking methods	Remedies
1	Momentary - disconnection of cable Poor contact of connector	Check if cable connectors are securely clamped and fixed. Check if connectors for normal soldering. Check bent portions of cables for normal conditions.	Repair defective connections
2	Offset voltage fluctuates Master PCB is defective or velocity control unit is defective.	Set bit 7 of parameter 004 to "0" prevent drift compensation, and check the position deviation amount (DGN No. 800 .... X-axis, No. 801 ....Z-axis) by diagnostic function. Fluctuations of offset voltage appear as fluctuations of the position deviation amount during stop. Try replacing master PCB or velocity control unit PCB.	Replace master PCB or velocity control unit PCB.

(3) Method of checking the reference point return operation and deceleration dog position.

(a) Set parameters according to the following table.
Set the grid shift amount of parameter No.31 and 32 to "0", in advance.

Parameter No.	Description
0004	Sets whether deceleration is made when deceleration signals *DCX, *DCZ are "1" or "0" in reference point return.
0006	Sets the reference point return system and direction.
0007, 0008	Set the capacity of the reference counter of X and Z axes.
0012	Sets whether manual rapid traverse is effective or not without executing the reference point return.
0031, 0032	Set the grid shift amount of X and Z axes.
0052	Sets the low-speed feedrate (FL) during reference point return.

(b) Perform the reference point return, and check if its operation is normal or not. Adjust the reference point position, if required, as follows.
The reference point is adjusted by the grid shift amount (Parameter No.31 and 32) in the case of grid system. If the reference point shifts by one revolution of the position detector (pulse coder) during this adjustment, shift the deceleration dog.

(c) Check the deceleration dog position.

(i) Perform the reference point turn.

(ii) Record the position display value at the reference point.

(iii) Move the machine tool at slow speed from the reference point until reference point return deceleratoin signals (*DCX, *DCZ) of DGN No. 96 and 97 turn on, while checking these signals.

(iv) Calculate the distance from the reference point to the position where the reference point return deceleration signals turn on from (ii) and (iii), and adjust the deceleration dog so that the above calculated distance becomes about 1/2 of the move amount per revolution of the pulse coder.

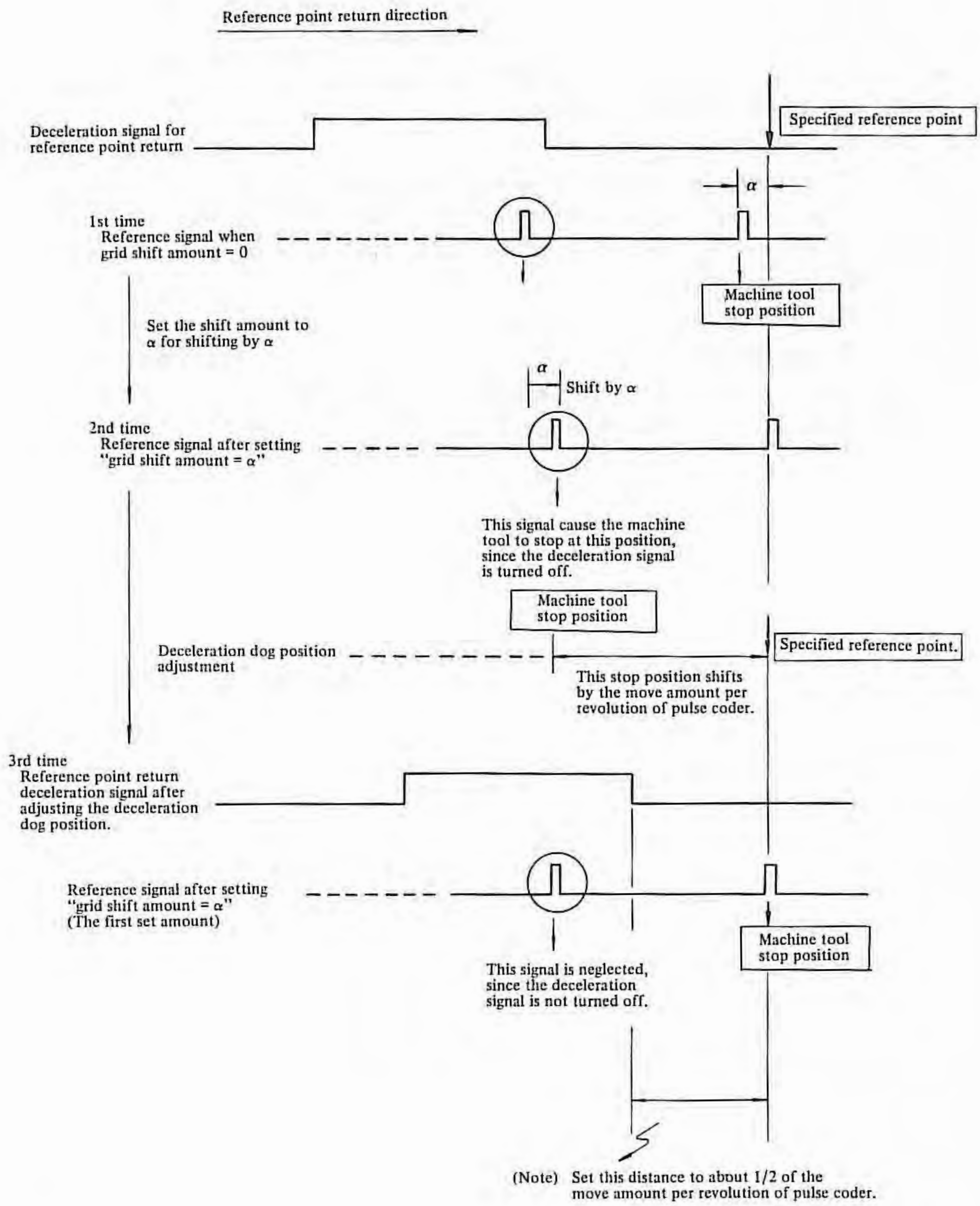
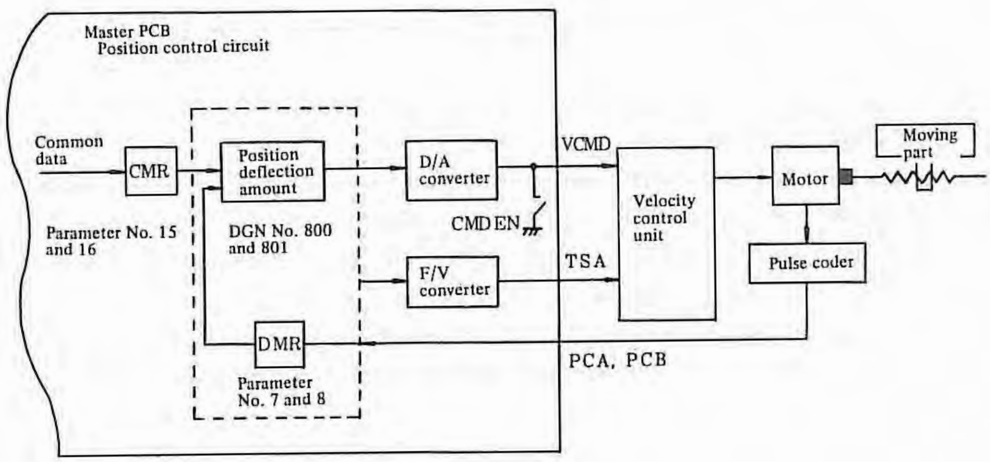


Fig. 7.5.5(a) Adjustment of Operating Position of Reference Point Return (Grid system)

7.6 Troubleshooting in Servo System

The servo system control units are divided roughly into the position control circuit, velocity control unit, and DC servo motor.

The servo system for one axis is composed as shown in the following block diagram.



(1) Method of quickly locating a defective control unit in servo system

Since the servo system composes a closed loop, all control units function similarly, if a part of these control units becomes defective, and it becomes difficult to locate the control unit in which a trouble occurs.

Observe the following method of quickly locating the defective control unit.

(a) The following servo system signals can be checked by self- diagnostic function of NC.

DGN No.

		2	3	*VRDY	OVL	OHM			DALX	DALZ	

*VRDY 0: Normal
1: Velocity control unit ready signal turns off to cause servo alarm No.02.

OVL 0: Normal
1: X, Z axis overload signal turns on the cause servo alarm No.01.

OHM 0: Normal
1: Overheat alarm

DALX 0: Normal
1: Feedback signal cable from X-axis motor is disconnected to cause servo alarm No.14.

DALZ 0: Normal
1: Feedback signal cable from Z-axis motor is disconnected to cause servo alarm No.24.

DGN No.

		5	6								CMDEN	PRDY

DMDEN 1: Normal

0: Velocity command voltage (VCMD) is clamped to 0V.

PRDY 1: Normal

0: NC does not output position control circuit ready signal.

(b) Method of checking the position control circuit operation

(i) Disconnect DC motor power cable.

(ii) Short pin S23 on velocity control unit PCB in case of M series servo system.

(iii) Set parameter No. 28 and 29 to a large value.

(iv) Check the VCMD output voltage of master PCB during step feed or manual handle feed. VCMD voltage should be as shown in Fig. 7.6(a).

(v) Check the VCMD output voltage of master PCB by slightly turning the motor shaft by a certain method. VCMD voltage should be as shown in Fig. 7.6(b).

(Note) When the NC power supply is turned on after disconnecting DC motor power cable, the table falls in the gravity axis. Insert timber or the like, in advance.

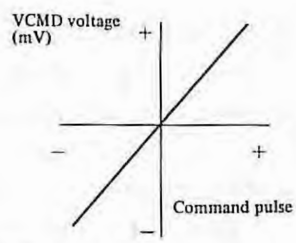


Fig. 7.6(a) VCMD (In case of step feed or handle feed)

In Fig. 7.6(a), make sure that the VCMD voltage continuously changes from minus voltage to pluse voltage during manual handle feed in the pulse direction.

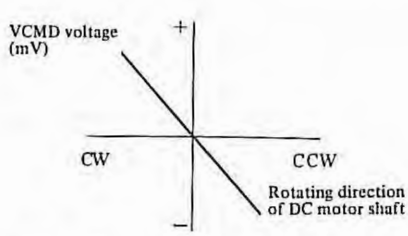


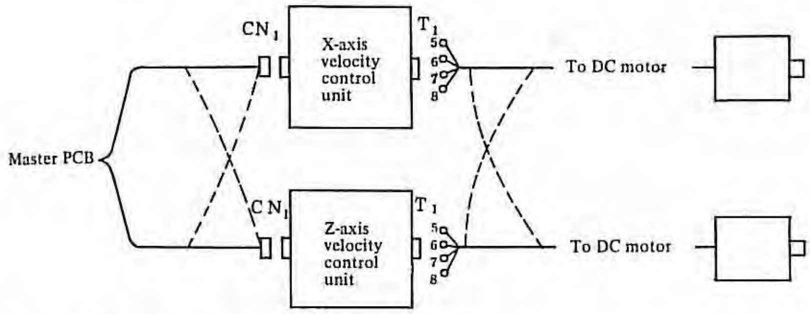
Fig. 7.6(b) VCMD (In case of step feed or handle feed)

In Fig. 7.6(b), make sure that the VCMD voltage continuously changes from plus voltage to minus voltage when turning the motor shaft counterclockwise.

Be sure to reset S23 as before after check.

(c) Velocity control unit funtion check

If one-axis motion only is suspicious, operate the system by using the velocity control unit for normal axis, and if the symptom disappears, the suspicious velocity control unit can be judged as defective.



Exchange cables to velocity control unit CN1.

Exchange cables coming out of velocity control unit T1 (5, 6, 7, 8).

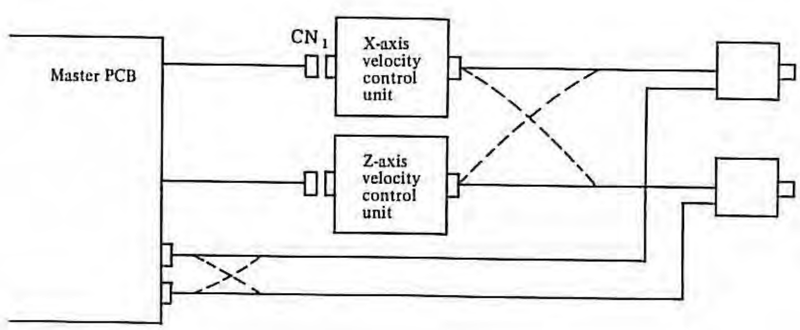
Note) Don't reconnect feedback cables. Be careful since this method is not applicable, if motor model is different.

The velocity control units can be also be checked by replacing PCB. (PCB must be set to meet the axis.)

When the velocity control units are judged as normal, the motors or pulse coders can be checked of their possible defects by reconnecting cables to the motors.

Particularly be careful when reconnecting cables, since the axis of positive feedback runs away.

If one axis is connected forward while the other axis is connected reversely, it should be carefully noted that the moving direction of the machine tool is opposite to the command direction.



(2) Troubleshooting in servo system as viewed from symptoms

The following troubleshooting covers the following cases.

(a) Dead condition
(b) Servo motors run away
(c) Oscillations
(d) Overshoot
(e) Poor accuracy in single pulse feed
(f) Swelling at low speed
(g) Positioning failure
(h) Striped patterns appear on cutting surface in circular cutting.
(i) Poor accuracy in roundness

(a) Dead condition

Item	Causes	Checking methods	Remedies
1	Power cable is not connected.	Make sure that motors don't operate at all under TGLS alarm condition.	Connect power cable correctly.
2	Enable signals (ENBL1, ENBL2) are not applied to PCB.	Check if +24V is applied between CH23 (ENBL) and CH3 (GND) of PCB.	Turn on contact signal for enable signal (ENBL1, 2).
3	PCB is defective or connection on PCB is not properly	Check if +24V and ±15V of PCB are normal.	Replace PCB or connect connector correctly.
4	Velocity command voltage (VCMD) is not applied.	Measure PCB CH18 (VCMD) - CH3 (GND) by using an oscilloscope.	Give velocity command voltage (VCMD).

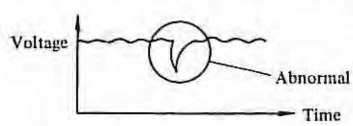
(b) Servo motors run away.

Item	Causes	Checking methods	Remedies
1	Positive feedback connection of pulse coder	Check pulse coder connection, referring to 7.6(b) "Method of checking the position control circuit operation".	Reconnect the pulse coder correctly.
2	Oldham's coupling is damaged.	After removing the motor cover, check if Oldham's coupling is normal.	Replace Oldham's coupling.

Item	Causes	Checking methods	Remedies
3	Position control circuit is defective.	Refer to the method of checking the position control circuit operation.	Replace master PCB.
4	Velocity control unit PCB is defective		Replace PCB.

(c) Oscillations (Oscillating during stop, running, acceleration or deceleration)

Item	Causes	Checking methods	Remedies
1	Setting failure or poor contact of setting pins on PCB of velocity control unit	Check if VCMD voltage and TSA voltage correctly correspond to the feedrate during running at constant feedrate. VCMD voltage (Check VCMD voltage between CH18 and GND CH3 by using an oscilloscope.) 7V/2000rpm (00M 0M 5M) 7V/1000rpm (10M 20M 30M 30MH) TSA voltage (Check TSA voltage between CH2 and GND CH3 by using an oscilloscope.) In case of pulse coder feedback 3V/1000rpm In case of tachogenerator feedback 6V/1000rpm	Correct PCB setting or poor contact of setting pins. (Check S1, S2, S3, and S4)
2	Setting failure of position loop gain	Check parameter.	
3	Machine tool side or/and detector is defective.	Check if oscillations remain uneliminated even after shorting CH5-CH6 of velocity control unit PCB by using a jumper wire.	Repair a part being synchronized with the oscillation cycle.
4	Matching failure between servo amplifier and machine tool	Oscillations will stop when shorting CH5-CH6 of velocity control unit PCB by using a jumper wire.	Contact FANUC service center, and change PCB setting.
5	Velocity control unit is defective.	Replace velocity control unit with spare, if available.	Replace velocity control unit.
6	Incoming noises.	Check if noises are introduced into F/V converter (CH2) on velocity control unit PCB.	Eliminate incoming noises.

Item	Causes	Checking methods	Remedies
7	Servo system is unstable.	Check if motor current waveform is oscillating.	(1) Adjust gain RV1 of velocity control unit. (2) Check the coupling of the machine tool feed screw and motors for high rigidity and backlash.
8	Oldham's coupling is damaged.	After removing the motor cover, check if the Oldham's coupling is normal.	Replace Oldham's coupling.
9	Pulse coder is defective.	(1) Check CH2 voltage of velocity control unit for partial voltage drop part.  (2) Check pulse coder for normal connection.	Replace Pulse coder.
10	Motor winding failure (internal short-circuit)	After removing the suspicious motor from the machine tool, measure the noload current. If the current increases in proportion to the revolutions, it may be judged to have been caused by internal short-circuit. (Short-circuit between motor power terminals 5, 6 and 7, 5)	(1) Clean the commutator and its surrounding. This failure is apt to occur, if oil is attached onto the commutator surface. (2) Replace motor.

(d) Overshoot

Item	Causes	Checking methods	Remedies
1	Poor gain of servo system	(1) Turn RV1 (gain control) of velocity control unit clockwise. (2) Increase the rapid traverse time constant of NC.	(1) Turn RV1 (gain) clockwise. (2) Increase the time constant.
2	Weak rigidity between the motor and mechanical feed screw or mechanical play.	(1) Check if this failure can be improved by decreasing the position loop gain. (2) Check backlash for excessive condition between motor and mechanical feed screw. (3) Check the timing belt, if any, for proper tension.	Reduce the position loop gain. Repair defective parts.

(e) Poor accuracy in single pulse feed

Item	Causes	Checking methods	Remedies
1	Mechanical play	Check if motor shaft is accurately positioned.	After confirming that the motor shaft is accurately positioned, ask to readjust the machine tool.
2	Poor gain of servo system	Turn RV1 gain of velocity control unit clockwise.	Turn RV1 clockwise.

(f) Swelling at low speed

Item	Causes	Checking methods	Remedies
1	Servo system is unstable.	Check if the switch swelling frequency is kept constant when changing the feedrate.	(1) Readjust servo system. (2) Replace defective parts.

(g) Positioning failure

Item	Causes	Checking methods	Remedies
1	Mechanical play	Check if the motor shaft is accurately positioned.	After confirming that the motor shaft is accurately positioned, ask to readjust the machine tool.
2	Position control circuit is defective	Check if position control circuit is normal. Check it for excessive offset, in particular.	(1) Replace master PCB. (2) Repair defective parts.

(h) Striped patterns appear on cutting surface in circular cutting.

Item	Causes	Checking methods	Remedies
1	Poor gain of servo system	Turn RV1 gain of velocity control unit clockwise.	Turn RV1 clockwise.
2	Mechanical play	Check if the motor shaft is accurately positioned.	(1) Readjust machine tool. (2) Set backlash compensation.

(i) Poor accuracy of circular interpolation

When the X-axis and Z-axis are concurrently moved in the same direction by the feed per minute in MDI mode, the position gain can be obtained from the feedrate and position deflection amount by the following equation.

$$G = \frac{1000}{60} \times \frac{F}{E}$$

F: Feedrate (mm/min), (0.1in/min), ($^\circ$/min)
E: Position deviation amount (0.001mm), (0.0001in), (0.001°)
G: Position gain (sec^{-1})

Adjust variable resistor RV4 (F/V converter voltage compensation) of the velocity control unit PCB, so that the position deviation amount is within $\pm10\%$ of the aimed value obtained from the above equation when the position deviation amount is checked by DGN No. 800 and 801; provided that the difference between axes should be within $\pm1\%$. (See para. 4.4)
The roundness can be improved by this gain adjusting method when it becomes elliptic in 45° direction. All ellipse in the axial direction cannot be improved by gain adjustment, because it is caused by poor feed accuracy of axes.

The position deflection amount values of X-axis and Z-axis are shown below.

DGN No.

	8	0	0	S V E R R X
	8	0	1	S V E R R Z

(3) M series velocity control unit fault detective function and troubleshooting

(a) Fault detective function (Alarm display function)

The M series velocity control unit provides the following functions to protect motors from being overloaded and also detect abnormal conditions inside the servo loop. For the mounting positions of alarm lamps (LED), see para. 4.4.

No.	Kind	Display	Description
1	Overload	Displayed on CRT screen	If the motor current exceeds the operating current of thermal relay, if the thermostat for power transformer operates, or if the thermostat in regenerative discharge circuit operates, overload alarm is displayed.
2	Velocity feedback cable disconnection detection	TGLS LED lights.	If the motor exceeds a certain speed due to the disconnection of velocity feedback cable, the motor is stopped by dynamic brake with TGLS LED lit.
3	Overcurrent alarm	OVC LED lights.	If a current exceeding the preset current value continuously flows more than a certain time (about 600msec), the motor is stopped by dynamic brake with OVC lit.
4	No-fuse breaker	ON button of no-fuse breaker jumps out with BRK LED lit.	No-fuse breaker operates, if an abnormal current exceeding the operating current of no-fuse breaker flows and the motor is stopped by dynamic brake.
5	Overvoltage alarm	HVAL LED lights.	If AC input voltage to servo transformer becomes abnormally high, the motor is stopped by dynamic brake with HVAL lit.
6	Undervoltage alarm	LVAL LED lights.	If the AC input power voltage is abnormally low, the motor is stopped by dynamic brake with LVAL lit.
7	Circuit fault detection	HCAL LED lights.	If an abnormal current flows to the transistor bridge circuit, the motor is stopped by dynamic brake with HCAL lit.
		DCAL LED lights.	If the regenerative discharge circuit is defective or if the acceleration/deceleration frequency is excessive, the motor is stopped by dynamic brake with DCAL lit.

(Note) All LED are mounted on PCB of velocity control unit

(b) Troubleshooting

The following description summarizes troubleshooting for M series servo system. Locate causes of troubles, and take a suitable remedy, referring to the following tables.

(i) Overload alarm LED lights.
(ii) Not servo ready
(iii) TGLS alarm LED lights.
(iv) OVC alarm LED lights.
(v) BRK alarm LED lights.
(vi) HVAL alarm LED lights.
(vii) LVAL alarm LED lights.
(viii) HCAL alarm LED lights.
(ix) DCAL alarm LED lights.

(i) Overload alarm LED lights.

Item	Causes	Checking methods	Remedies
1	Thermal relay of servo unit operates. (For mounting position and operation checking method, see 7.4.11.)	When thermal relay operates, check the set value according to 7.4.11, and reset it by turning the setting dial, if the set value is wrong. If the set value is correct, measure the cutting motor current value on PCB (between CH8 and CH3) or by connecting an ammeter to the motor power line, and check if the cutting condition is suitable or if the friction torque is not larger than the set value of thermal relay.	Change the set value or cutting condition. Check the machine tool load. (For resetting the thermal relay, wait for about 10 minutes after operating the thermal relay, and then, depress the reset button. For the mounting position of thermal relay, see 7.4.11.
2	Thermostat for transformer operates	After disconnecting cables from terminals No.51 and 53 of the transformer, measure the resistance across terminals No.51 and 52. The measuring value should be lower than several ohms. If open (higher than several hundred kohms), the thermostat for transformer is operating. If the surface temperature of transformer is 80 - 90°C, check the cutting motor current. If the surface temperature of transformer is lower than 50 - 60°C, the transformer is defective.	Change the cutting condition. Replace transformer.

Item	Causes	Checking methods	Remedies
3	Thermostat in regenerative discharge circuit operates.	After disconnecting cables from terminals T3(3), (4) of the regenerative discharge circuit, measure the resistance across terminals (3) and (4). The measuring value should be lower than several ohms. If open (higher than several hundred kohms), the thermostat is operating. If the temperature of regenerative discharge unit enclosure is 80 - 90°C, check the acceleration/deceleration frequency. If the above temperature is lower than 50 - 60°C, the regenerative discharge unit is defective.	Reduce the acceleration/ deceleration frequency to once/sec or less. Replace regenerative discharge unit.

(ii) Not servo ready

Item	Causes	Checking methods	Remedies
1	AC 100V is not supplied to velocity control unit.	Check if AC 100V is supplied across terminals No.(3) and (4) of terminal board T1 of velocity control unit.	Check emergency stop system.
2	Velocity control unit is placed to an alarm condition.	Check if various alarm lamps (red LED) light on PCB.	For remedies against various alarms, see (iii) and higher.
3	Power voltages +24V and ±15V for controlling velocity control unit PCB are abnormal.	Check voltage at check terminals CH15, CH16, CH17 shown in installation diagram of PCB, referring to para. 4.4. Check if servo transformer terminals are properly connected to PCB CN2. (See para. 1.3)	Change the tap connections of servo transformer. Correct connections of servo transformer and PCB CN2. Replace PCB.

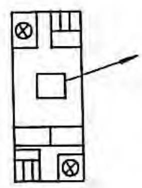
(iii) TGLS alarm LED lights

Item	Causes	Checking methods	Remedies
1	Motor power cable is not connected to (5), (6), (7), (8) of terminal board T1 of velocity control units or motor power cable is disconnected halfway.	If this alarm occurs without sending the move command after turning on power supply, it may be possibly caused by the failure described in the left column.	Correct connections of power cables
2	Wrong setting of PCB	Check velocity control unit PCB for normal setting. (See para. 4.4)	Change setting.
3	Velocity feedback voltage is not applied or inter-mittently supplied.	Observe CH2(TSA)- CH3(GND) of velocity control unit PCB by using an oscilloscope, and check if the velocity feedback voltage is applied normally without being interrupted halfway.	Repair disconnected velocity feedback voltage cable or defective velocity feedback voltage generation source. (DC servo motor or control unit)

(iv) OVC alarm LED light.

Item	Causes	Checking methods	Remedies
1	PCB is defective.	This alarm occurs even after disconnecting the motor power cable. Support the gravity axis, otherwise it may fail. Short S23 to prevent TGLS alarm. After check, open S23.	Replace velocity control unit PCB.
2	Wrong setting of PCB	Check if RV3 on PCB is properly set. This RV3 determines the motor current value to cause OVC alarm (see para. 4.4). (This VR is generally set to division 10, but this setting may differ depending upon models.)	Reset RV3.
3	Machine tool load is abnormal.	By connecting an oscilloscope across CH8 and CH3 of PCB, check if the current value determined by RV3 flows more than 600msec.	Eliminate abnormal load from the machine tool side.

(v) BRK alarm lamp lights.

Item	Causes	Checking methods	Remedies
1	No-fuse breaker operates	The operating condition of no-fuse breaker is as illustrated below. For the mounting position, see para. 5.2 in appendix.  This button jumps out forward during operation. No-fuse breaker is reset by depressing this button after turning off the power supply.	After turning off the power supply, reset no-fuse breaker. If it cannot be reset soon, wait for about 10 minutes before reset-
2	Diode module DS or other parts are defective in velocity control unit.	No-fuse breaker operates immediately when turning on the power supply after remedy in item 1.	Replace diode module DS or velocity control unit.
3	Abnormal machine tool load	By connecting an oscilloscope between CH8 and CH3 of PCB, check if the motor load current during rapid traverse exceeds the rated current.	Eliminate abnormal load from the machine tool side.
4	Defective PCB or poor contact of the connector between PCB and velocity control unit.	An alarm occurs even if no-fuse breaker does not operates.	Replace PCB or velocity control unit.

(vi) HVAL alarm LED lights.

Item	Causes	Checking methods	Remedies
1	AC input power voltage is too high.	Check if servo power transformer is correctly connected.	Correct tap connections.
2	DC servo motor is defective.	Check if insulation resistance is normal between motor armature (power cable) and body.	Clean brush assembly.
3	PCB is defective.	HVAL lamp lights when items 1 and 2 are normal.	Replace PCB.

(vii) LVAL alarm LED lights.

Item	Causes	Checking methods	Remedies
1	AC input power voltage is too low.	Check if AC input power voltage and servo transformer taps are properly connected.	Correct tap connections.
2	Connection between servo transformer and PCB CN2 are defective.	Check if +24V and ±15V of PCB are normal. (See para. 4.4) Check if servo transformer terminals (41 - 43, 44 - 46, 47 - 49) are normally connected to PCB CN2 (1, 2, 3). (See para. 1.3)	Correct connections.
3	PCB is defective.	LVAL alarm LED lights when items 1 and 2 are normal.	Replace velocity control unit PCB.

(Viii) HCAL alarm LED lights

Item	Causes	Checking methods	Remedies
1	Wrong connection of motor power cable	After disconnecting motor power cable, turn on the power supply and check if alarm occurs. Support the gravity axis suitably, since it may fall. Short S23 on PCB to prevent TGLS alarm. Open S23 after check.	Correct motor power cable connection.
2	Transistor module is defective.	After disconnecting motor power cable, turn on the power supply and check if alarm occurs. If alarm occurs, turn off the power supply, detach PCB, and measure the resistance between the following terminals of transistor module. If resistance between terminal is several ohms, (within 10 ohms), the transistor module is defective. 	Replace transistor module.

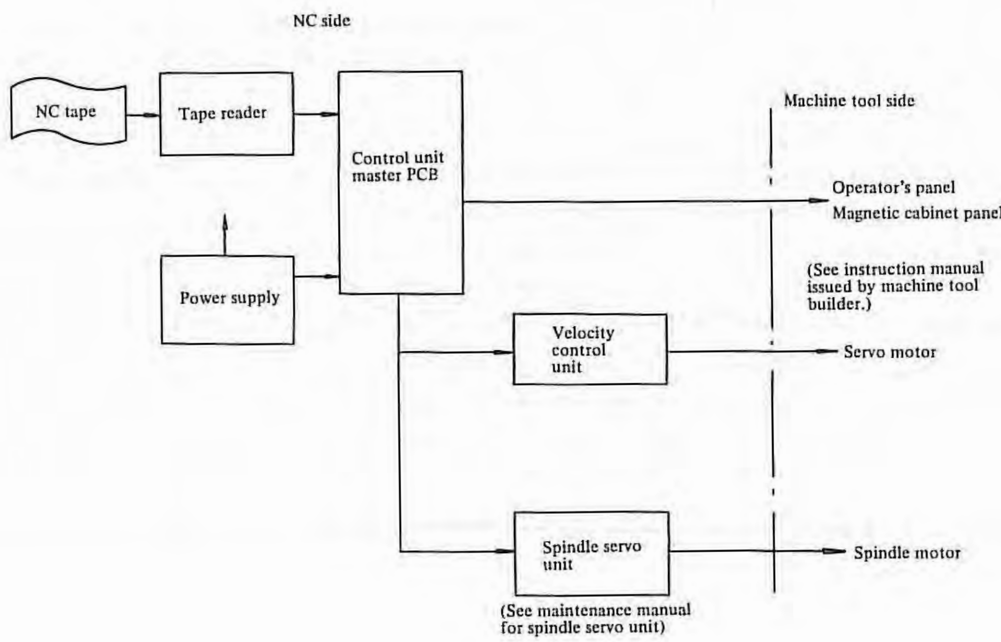
(iX) DCAL alarm LED lights.

Item	Causes	Checking methods	Remedies
1	Discharge transistor Q1 or PCB is defective.	Check if this alarm lamp lights soon after turning on the power supply.	Replace transistor Q1 or PCB, if lamp lights soon.
2	Wrong setting of PCB.	S26 of velocity control unit PCB is shorted when the separate type regenerative discharge unit is combined.	Open S26.
3	Counter balancer is defective on machine tool side.	A rectangular wave appears at constant intervals as shown in (ii) in Fig. 4.4(c) at CH10 during the downward rapid traverse in gravity axis of counter balancer.	Repair counter balancer.
4	Acceleration/ deceleration frequency is high.	Check if positioning frequency in rapid traverse exceeds 1 - 2 times/sec, or check if this alarm lamp does not light when the frequency is reduced.	Provide dwell to reduce acceleration/deceleration frequency.

7.7 For Better Understanding of Troubleshooting

Almost all troubles caused by NC and servo system can be recovered according to the troubleshooting tables given above.

If NC still remains suspicious or if the servo system remains unstable, proceed to the next step to accurately detect a trouble.



Rearrange troubles once more, and contact the FANUC service center. In such a case, inform the FANUC service center of systems as accurately as possible, and the service center can take necessary remedies accurately and promptly.

7.7.1 Troubleshooting

(1) Types of troubles
In what mode does a trouble occur?
What is displayed on MDI & CRT unit?
Is there a positioning error? If so, on which axis and by what amount?
Is there a tool path error? If so, by what amount?
Is the speed normal?
Is the trouble in an auxiliary function?
What is the alarm number?

(2) Trouble frequency
When did the trouble occur? What is its frequency?
(Was another machine tool also being operated?)
What is the frequency on the same workpiece? Which program is it?
Which program is it? What is the sequence number?
Is the trouble related to a specific mode?
Is the trouble related to tool replacement?
Is the trouble related to the feedrate?
Is the trouble related to thread cutting?

(3) Reoccurrence of troubles
Travel the program tape where the error occurs repeatedly.
Check the numerical value in memory of NC, and compare it with the programmed numerical value.
Is the trouble due to an external cause?
Check the stored offset amount.
Check the response to override by decreasing or increasing the override amount.
Ask the operator about details of the trouble.

7.7.2 Environmental conditions survey

(1) Input voltage check
Are there fluctuations in input voltage?
Is there an input voltage drop?
Are there some devices using a large amount of current?
Is there an electric discharge machine or a welding machine nearby?

(2) Peripheral conditions
What is the temperature?
Did the temperature change? Is it abrupt?
Is the filter dirty?
Is there scattering oil or cutting fluid?
Are there any vibrations?
Is the system exposed to direct sunlight?

(3) External causes
Has the machine tool recently been repaired or adjusted?
Has the magnetic cabinet recently been repaired or adjusted?
Has NC system recently been repaired or adjusted?
Is there a noise source nearby?
(such as cranes, high-frequency machines, electric discharge machine)
Has a new machine tool been mounted nearby?
Is there another NC with the same trouble?
Has the user adjusted the NC?
Has the same trouble occurred before?

(4) Operation
Has the operator been properly instructed?
Has the operator been replaced?
Is the operator familiar with the program?
Does the program finish too early or was it interrupted?
Does the program contain an incremental command?
Is the tool compensation value correctly set?
(tool compensation data setting, offset cancel, etc.)
Does the machine tool change to another mode of operation?
Is the block skip function used correctly?
Has the machine tool been operated incorrectly?

(5) Programming
Is the program new?
Was the program created according to the operator's manual?
Are addresses in the right order?
Does the trouble occur in any specific block?
Are the correct speed and lead values set for thread cutting?
Is there a clearance at the beginning and end of thread cutting?
Does the trouble occur in a subprogram?
Was the list of tapes created for checking?

(6) Operation
Has any change or adjustment been made in the operation procedure?
Has a fuse been blown out?
Is the NC in the emergency stop status?
Is the machine tool ready?
Is the NC in the alarm status?
Is the MODE SELECT switch set correctly?
Is the override switch set to zero position?
Is NC in the machine lock status?
Is the feed hold button depressed?

(7) Machine tool
Is the machine tool properly installed?
Does vibration occur during operation?
Is the top edge normal?
Is there any offset due to tool change?
Is there any distortion in a part of the machine tool due to temperature change?
Was the workpiece measured correctly.
Was the measurement made at a constant temperature?
(One meter of steel changes 10μ in length at a temperature change of $1^{\circ}C$)
Are cables normal (bent, broken, or damaged)?
Are signal lines and power lines separated from each other?

(8) Interface
Are power lines and NC cables mounted separately?
Is the shield normal?
Is a noise suppressor attached to relays, solenoids, and motors?

7.7.3 NC system check by visual inspection

(1) Appearance
Is there damage to the cabinet?
Is the MDI & CRT unit normal?
Is the filter clean?
Was the operation made with the door open?
Check chips accumulated on the cabinet did not fall inside when the door was opened.

(2) Interior of control unit
Is there dirt in the control unit?
Is the fan motor normal?
Is there corrosion due to corrosive gases?

(3) Power supply unit
Is the unit correctly connected?
Are all fuses normal?
Is the circuit breaker normal?
Is the voltage within the allowable range?
Are the shield and cable duct grounded correctly?
Is the wiring path normal?
Are all terminals securely tightened?

(4) Grounding
Is grounding connection normal?
Is the shield ground normal?

(5) Cables
Are cable connectors securely connected?
Are internal cables normal?
Are external cables normal?
Are there any scratches, bends, or breaks?

(6) PCB
Are all PCBs mounted securely?
Are plug connectors normal?
Are mechanical conditions normal (without any deformation of PCB)?
What is the PCB version number?
Are connections between PCBs good?

(7) MDI & CRT panel
Do pushbuttons operate normally?

(8) Parameters
Are contents of parameter table attached to NC system meet those of parameters?

(9) Interface
Are the power line and NC cables separately mounted?
Is the shield normal?
Is a noise suppression mounted on relays, solenoids, motors, and other parts?
Are I/O signals normal by diagnostic function (DGN)? (See 6.3.1, 6.3.2)

(10) Status display inside NC
If NC does not operate in the automatic operation mode irrespective of the no alarms condition, see 6.3.3.

8. EXCHANGE PROCEDURES

8.1 Fuse Exchange

(1) Exchange of power fuses for control unit

If a fuse is blown out inside the control unit, locate and eliminate its cause, and then, replace the blown out fuse. The fuse capacity, specification, and mounting positions are as shown below.

Name	Capacity	Specifications
F11, F12	5A	A60L-0001-0101/P450H

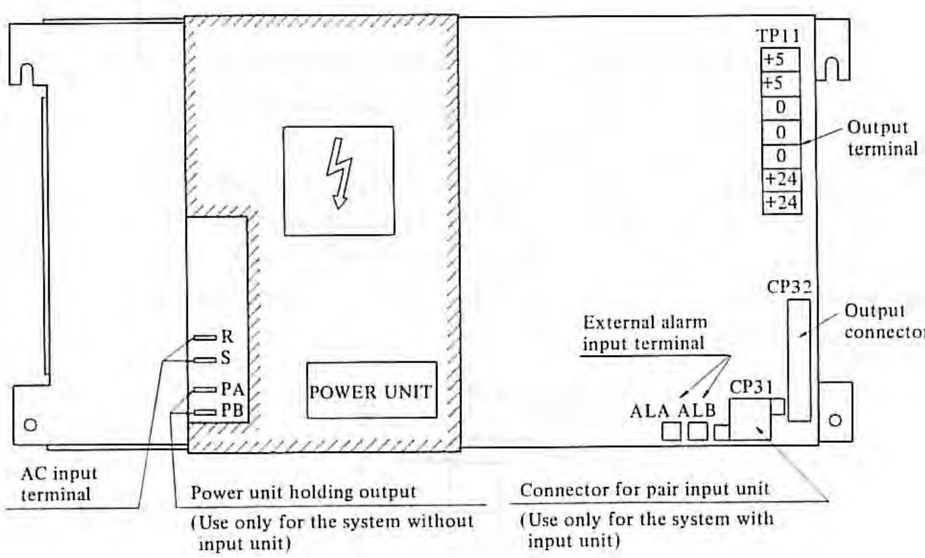


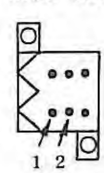
Fig. 8.1(a) Mounting Positions of Fuses in Power Supply Unit

(2) Exchange of master PCB fuse

Replace the fuse according to the following procedure.

(a) Locate and eliminate a cause of the blown out fuse.

After disconnecting the cable from connector CPA4, replace the fuse, and check the resistance across pins No.1 and 2 of connector CPA4 by using a circuit tester. (The measuring value should be higher than several ten kilo ohm.) (Note)



CPA4 pin No.

(b) Replace the fuse when the power supply of control unit is turned on.
The fuse capacity, specifications, and mounting position are as shown below.

Name	Capacity	Specifications
FUSE	0.32A	A60L-0001-0046/0.32

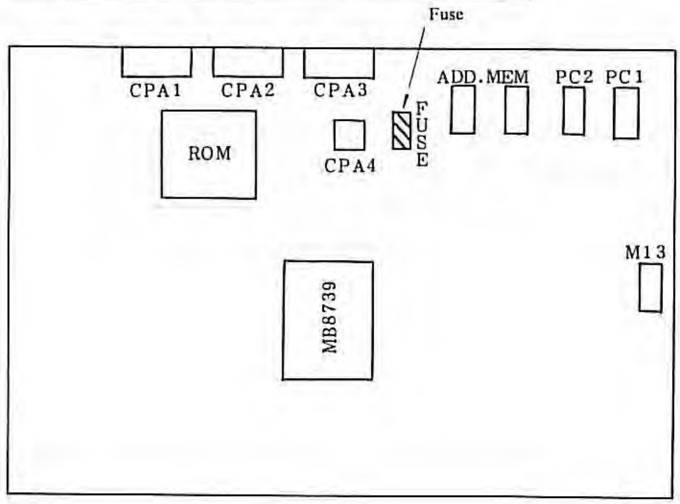
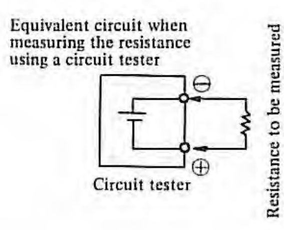


Fig. 8.1(b) Mounting Position of Fuse on Master PCB

Note) For measuring the resistance, connect the minus (-) pole of the circuit tester to No.1 pin and plus pole (+) to No.2 pin of CPA4 connector. In the resistance range of circuit testers now being available in the market, mark + shows the minus (-) pole, while mark - shows the plus (+) pole. (Marks + and - of circuit testers apply to DC voltage measurement)



8.2 Exchange of Power Supply Unit

Replace the power supply unit, referring to its mounting position in para. 1.1.

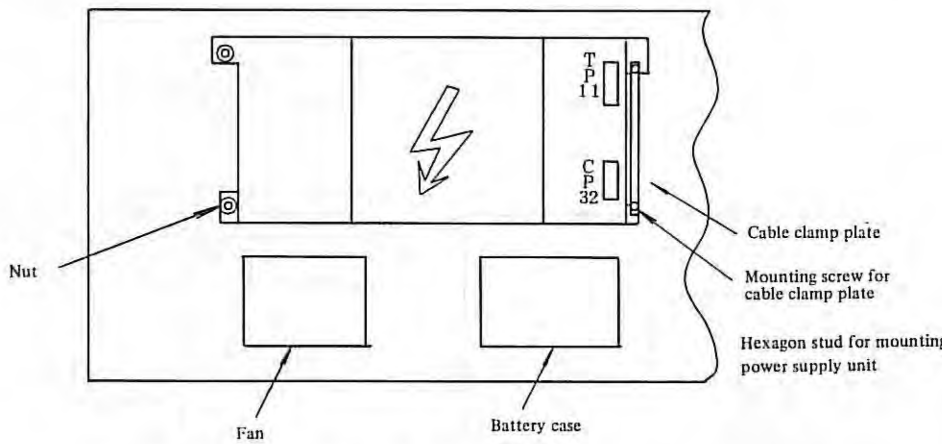


Fig. 8.2(a) Rear Door of Power Supply Unit Cabinet

Exchange procedure

(i) Disconnect cables from TP11 and CP32.

(ii) Remove mounting screw for cable clamp plate.

(iii) Remove mounting nuts and hexagon studs for the power supply unit.

(iv) Replace the power supply.
Mount the power supply unit on the rear door of the cabinet by reversing the above procedure.

8.3 Exchange of Master PCB

Replace the master PCB, referring to the mounting position of master PCB in para. 1.1.

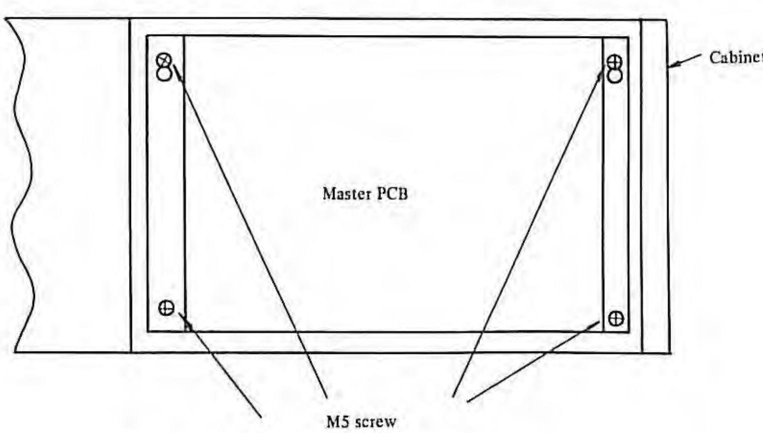
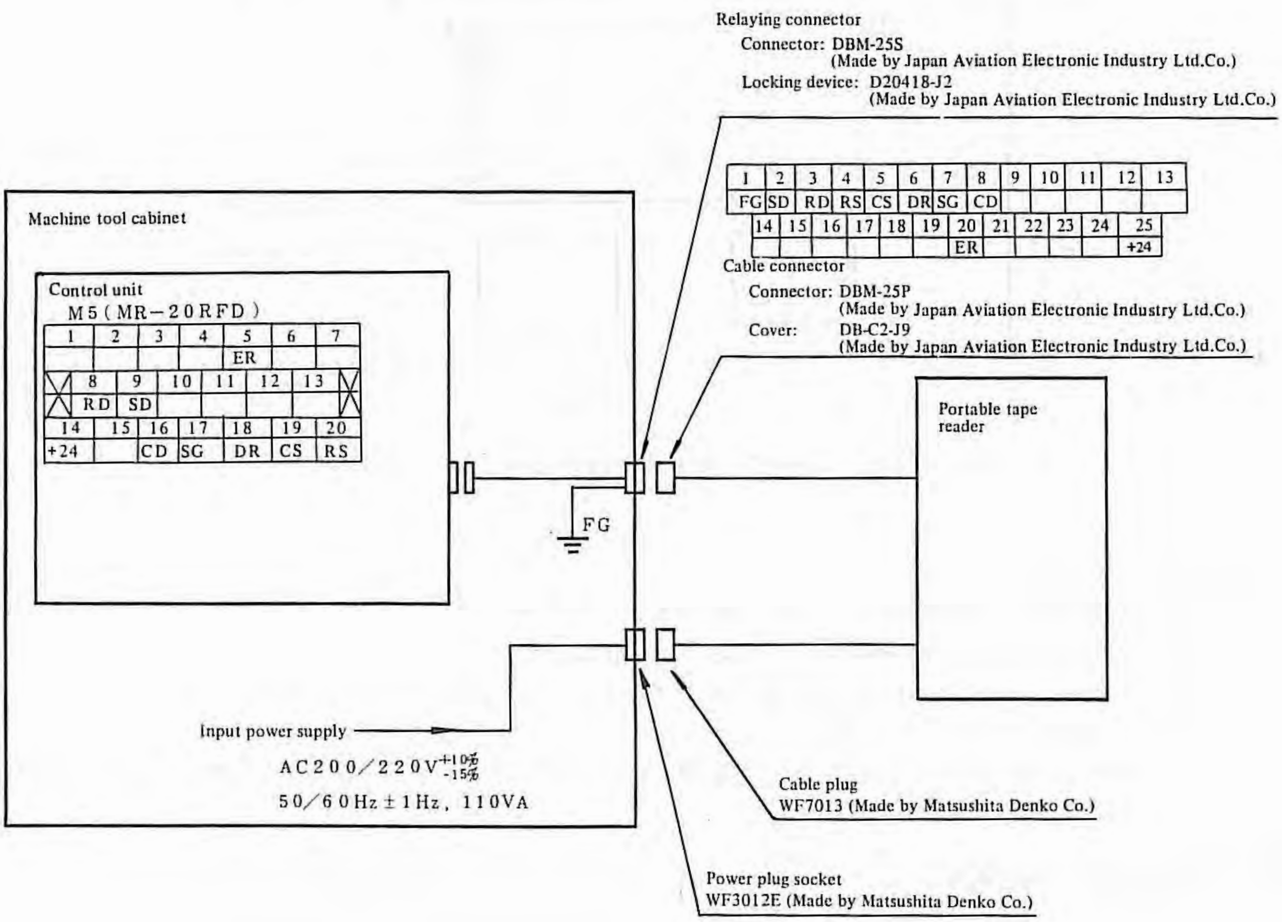


Fig. 8.5(a) Master PCB Exchange

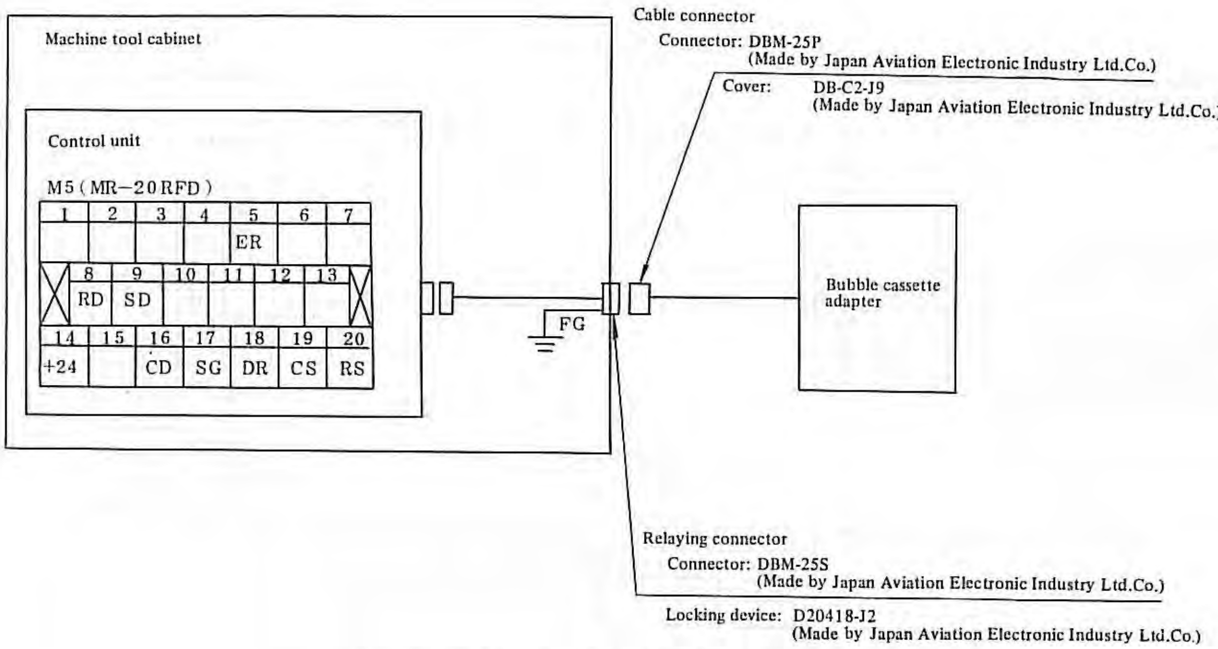
Replace the master PCB after removing four screws shown in Fig. 8.5(a).

APPENDIX 1. CONNECTIONS BETWEEN CONTROL UNIT AND I/O DEVICE

1.1 Connection to Portable Tape Reader



1.2 Connection to Bubble Cassette Adapter



1	2	3	4	5	6	7	8	9	10	11	12	13
FG	SD	RD	RS	CS	DR	SG	CD					

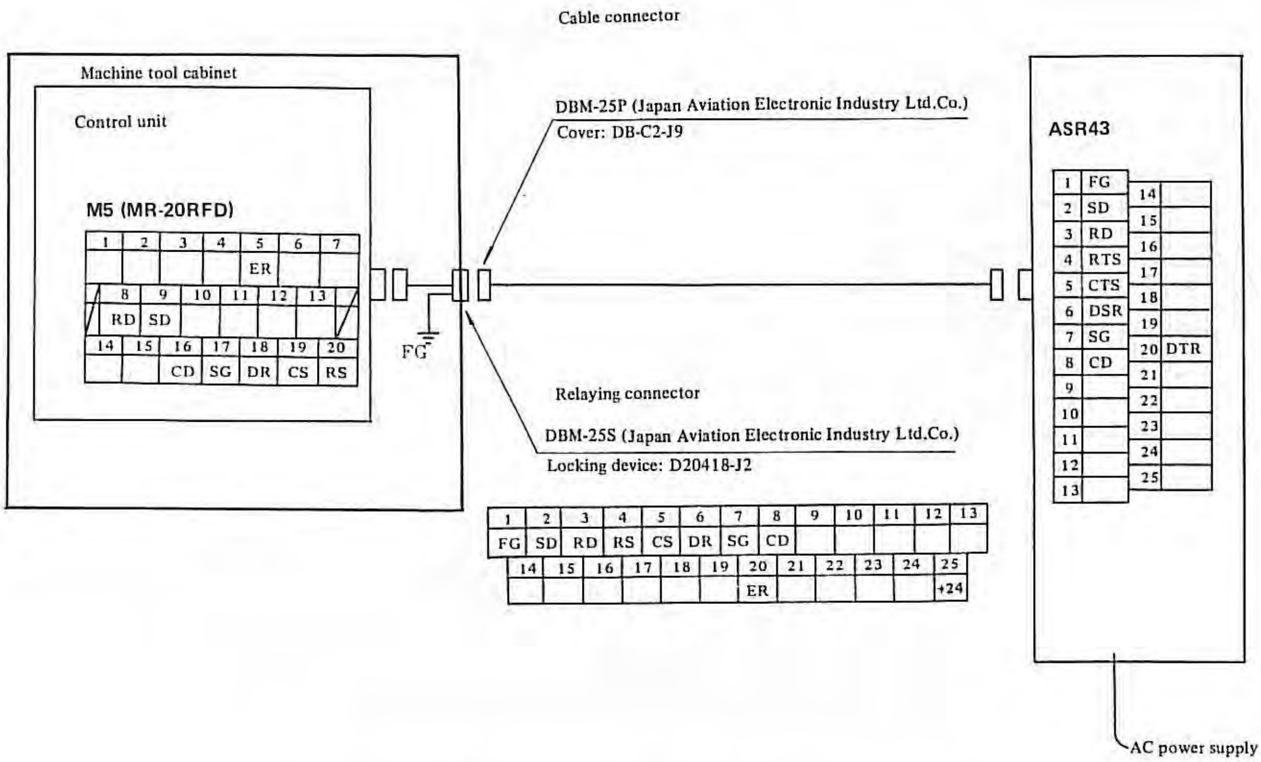
14	15	16	17	18	19	20	21	22	23	24	25
						ER					+24

Note 1) Use a totally shielded cable as the signal cable.
Recommendable cable specification: A66L-0001-0041
Cable length should be shorter than 15m.

Note 2) Open all terminals other than shown in the above figure.

Note 3) When connecting the bubble cassette adapter, set parameters so that RS232C interface is employable.
The baud rate is 4800 bauds.

1.3 Connection to ASR43

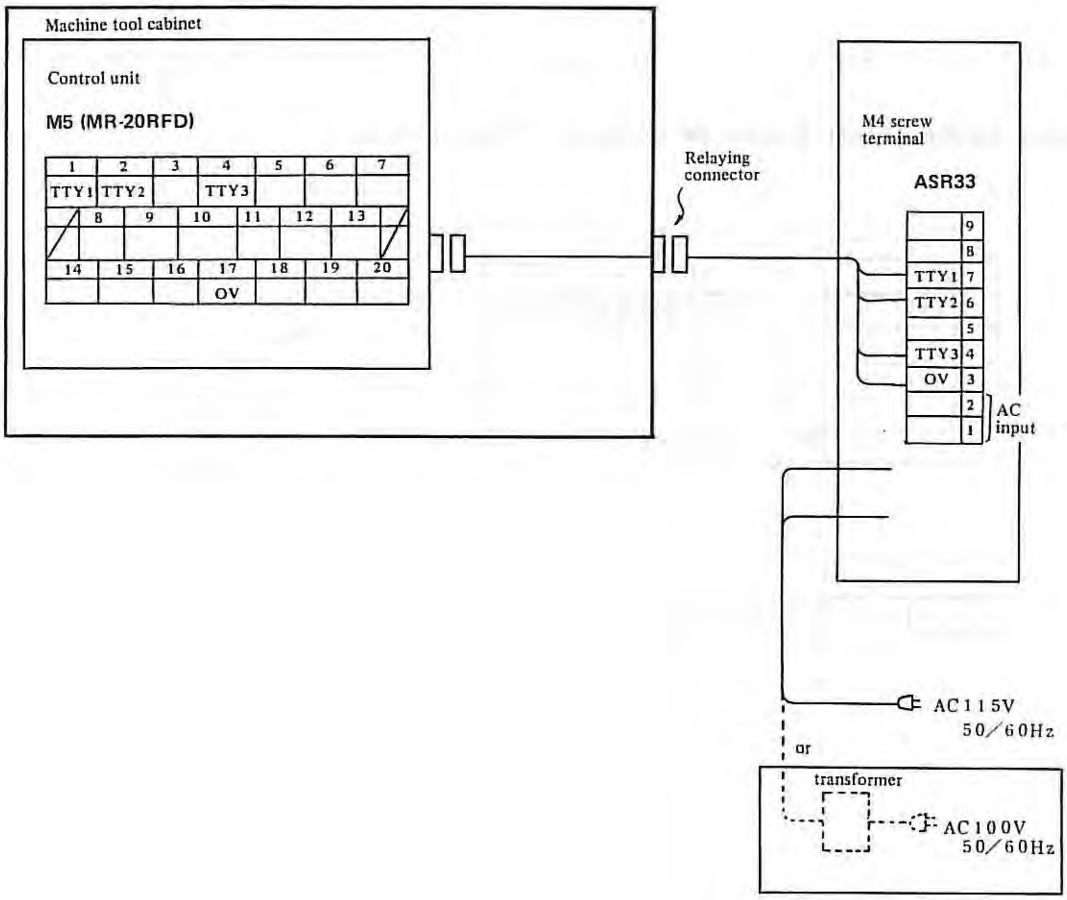


Note 1) Arrange the relaying connector at an easy-to-connect position on the machine tool cabinet, and protect it with a protective cover when it is not used.

Note 2) A recommendable connector is shown as the relaying connector in the above figure. It is also recommended to arrange signals as shown in the above figure.

Note 3) Use a totally shielded cable as the signal cable.
Recommendable cable specification: A66L-0001-0041
The cable length should be shorter than 15m.

1.4 Connection to ASR33



Note 1) Arrange the relaying connector at an easy-to-connect position on the machine tool cabinet, and protect it with a protective cover when it is not used.

Note 2) Use totally shielded cable as the signal cable.
Recommendable cable specifications: A66L-0001-0041
The cable length should be shorter than 15m

Note 3) AC 115V input power cable is attached to ASR33.

Note 4) The ASR33 model differs according to whether the input power frequency is 50Hz or 60Hz. Select the ASR33 model to meet the power frequency employed.
AC 115V, 50Hz —— Model 3320/3WE
AC 115V, 60Hz —— Model 3320/3JC

Note 5) The standard input power supply for ASR33 is AC 115V, single phase. If AC 115V cannot be prepared by the machine tool builder, a transformer (100V —— 115V) is available as an option for use in Japan. For this transformer, contact a sales agent of TELETYPE Co.

Note 6) Internal cables have been connected to the screw terminal board in ASR33. Tighten cables to FANUC SYSTEM 2T-MODEL A together with these internal cables.

Note 7) Set ASR33 to full duplex transmission system using a 20mA current interface before connecting ASR33.

Note 8) ASR33 screw terminals are mounted on the rear side below the upper cover.

APPENDIX 2. RELATION BETWEEN CABLE CONNECTIONS AND ROTATING DIRECTIONS OF SERVO MOTOR

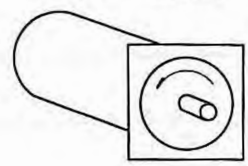
This section shows the X axis connection. However, it is also applicable to the Z-axis.

2.1 When the Pulse Coder is Mounted Inside the DC Servo Motor

Standard connection MS3102A 20−29S

A	B	C	D	E	F
PCAX	PCBX	+5V	*PCAX	*PCBX	PCZX
G	H	J	K	L	M
*PCZX	OG	+5V	+5V		
N	P	R	S	T	
OV	OV	OH1X	OH2X	OV	

Rotating direction when the move command is plus "+" direction.



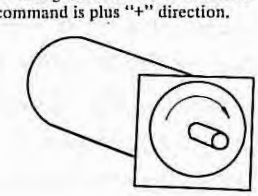
: M4 screw terminal

5	6	7	8
A1AX	A1BX	A2AX	A2BX

Reverse connection MS3102A 20−29S

A	B	C	D	E	F
PCBX	PCAX	+5V	*PCBX	*PCAX	PCZX
G	H	J	K	L	M
*PCZX	OG	+5V	+5V		
N	P	R	S	T	
OV	OV	OH1X	OH2X	OV	

Rotating direction when the move command is plus "+" direction.

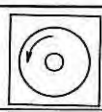
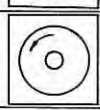
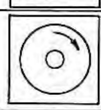
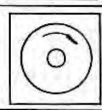


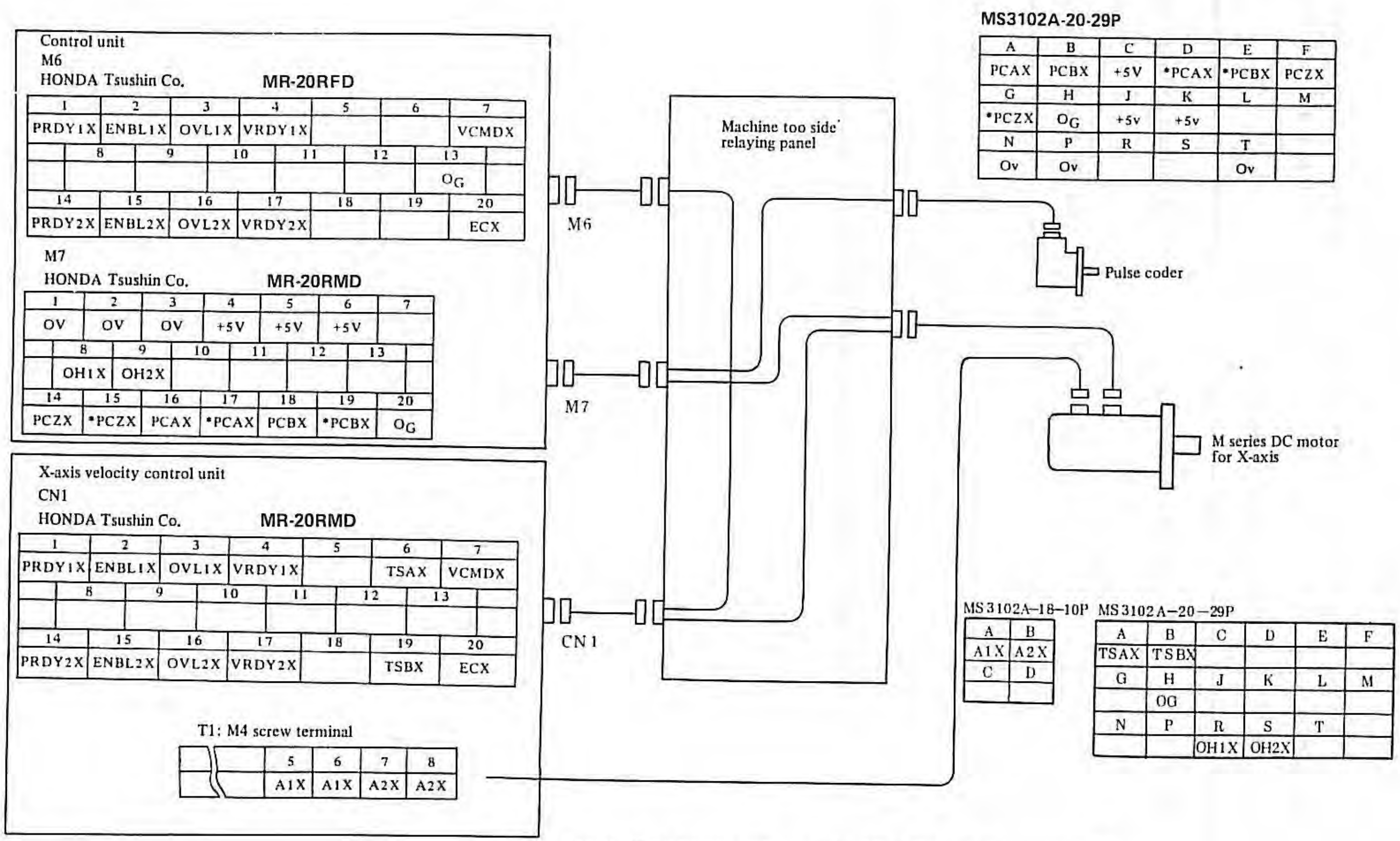
: M4 screw terminal

5	6	7	8
A2AX	A2BX	A1AX	A1BX

2.2 When a Separate Type Pulse Coder is Used

The following four type connections are presumable according to whether the motor and separate type pulse coder rotate clockwise or counterclockwise as viewed from the shaft side when the machine tool moves in the plus (+) direction.

Motor	Pulse coder	Motor power cable and tachogenerator signal	Pulse coder signal
		Standard connection	Standard connection
		Standard connection	Reverse connection
		Reverse connection	Standard connection
		Reverse connection	Reverse connection



(Note) (The figure also applies to motors 00M, 10M – 30M, correspondingly.)

Fig. 1(a) Connection of Motor Model 0M and 5M
(When both motor and pulse coder are connected by the standard connection system)

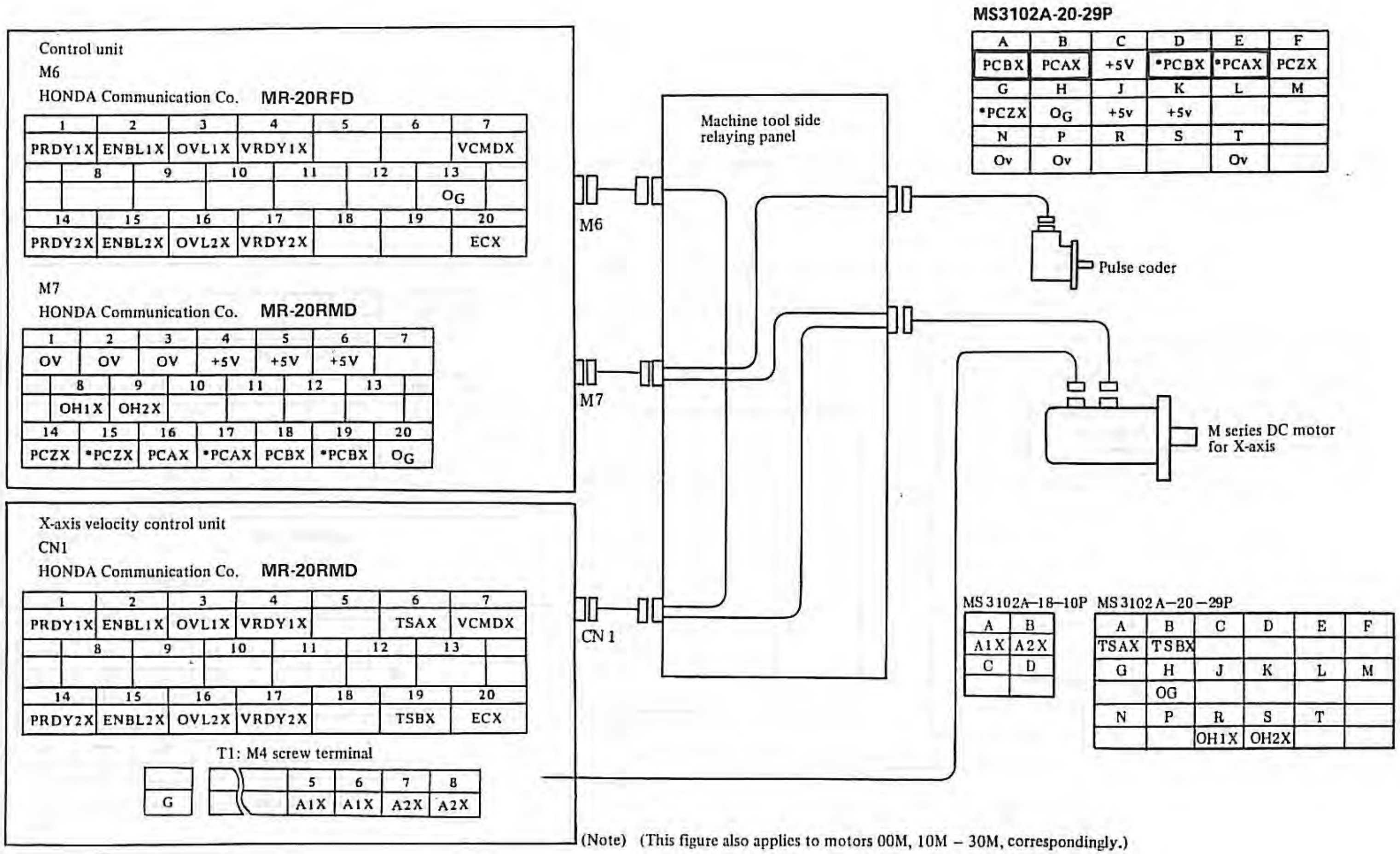
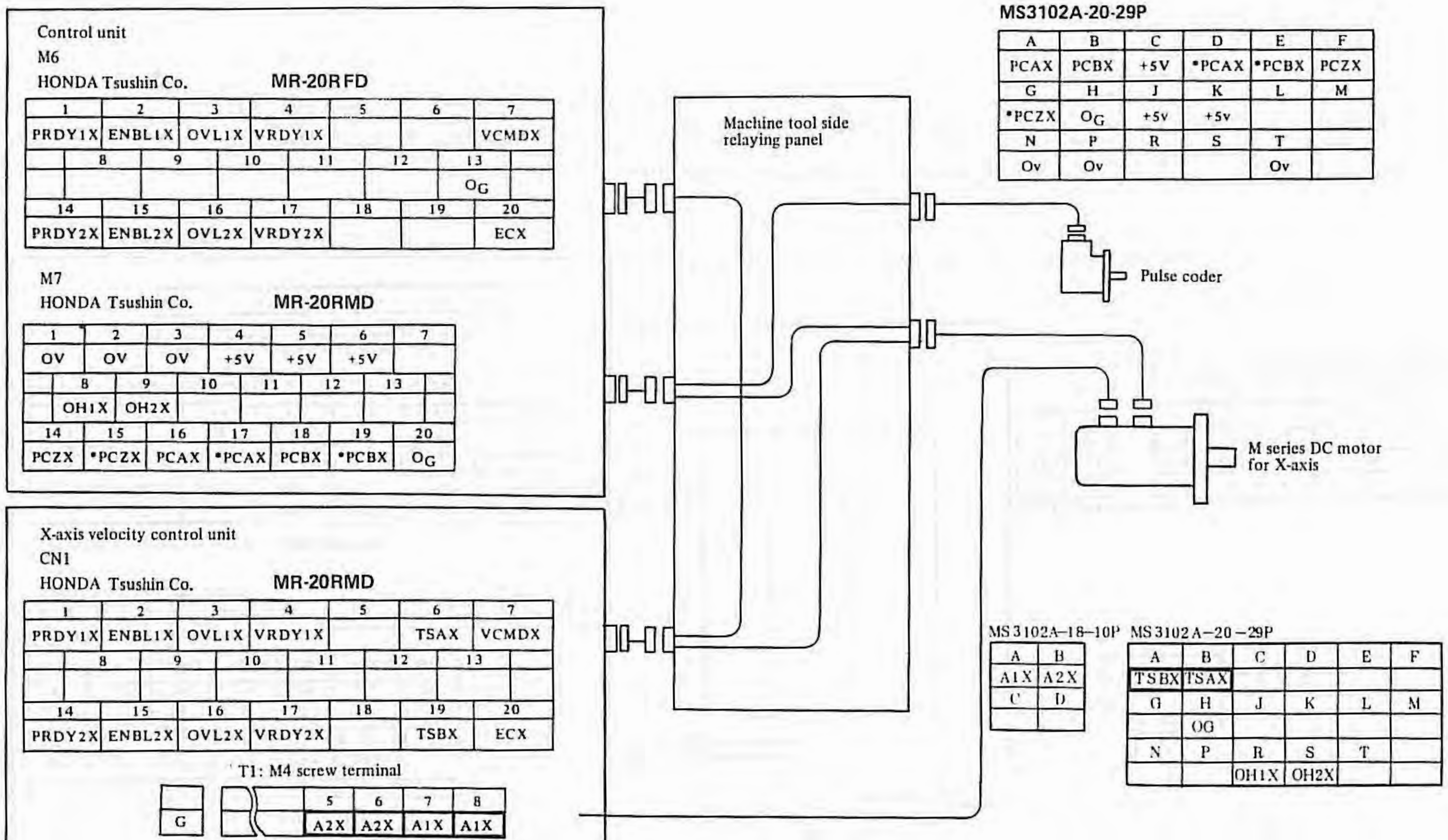


Fig. 1(b) Connection of Motor Model 0M and 5M
(When motor is connected by the standard connection system, while pulse coder is connected by the reverse connection system).



(Note) (The figure also applies to motors 00M, 10M – 30M, correspondingly.)

Fig. 1(c) Connection of Motor Model 0M and 5M
(When motor is connected by the reverse connection system, while pulse coder is connected by the standard connection system)

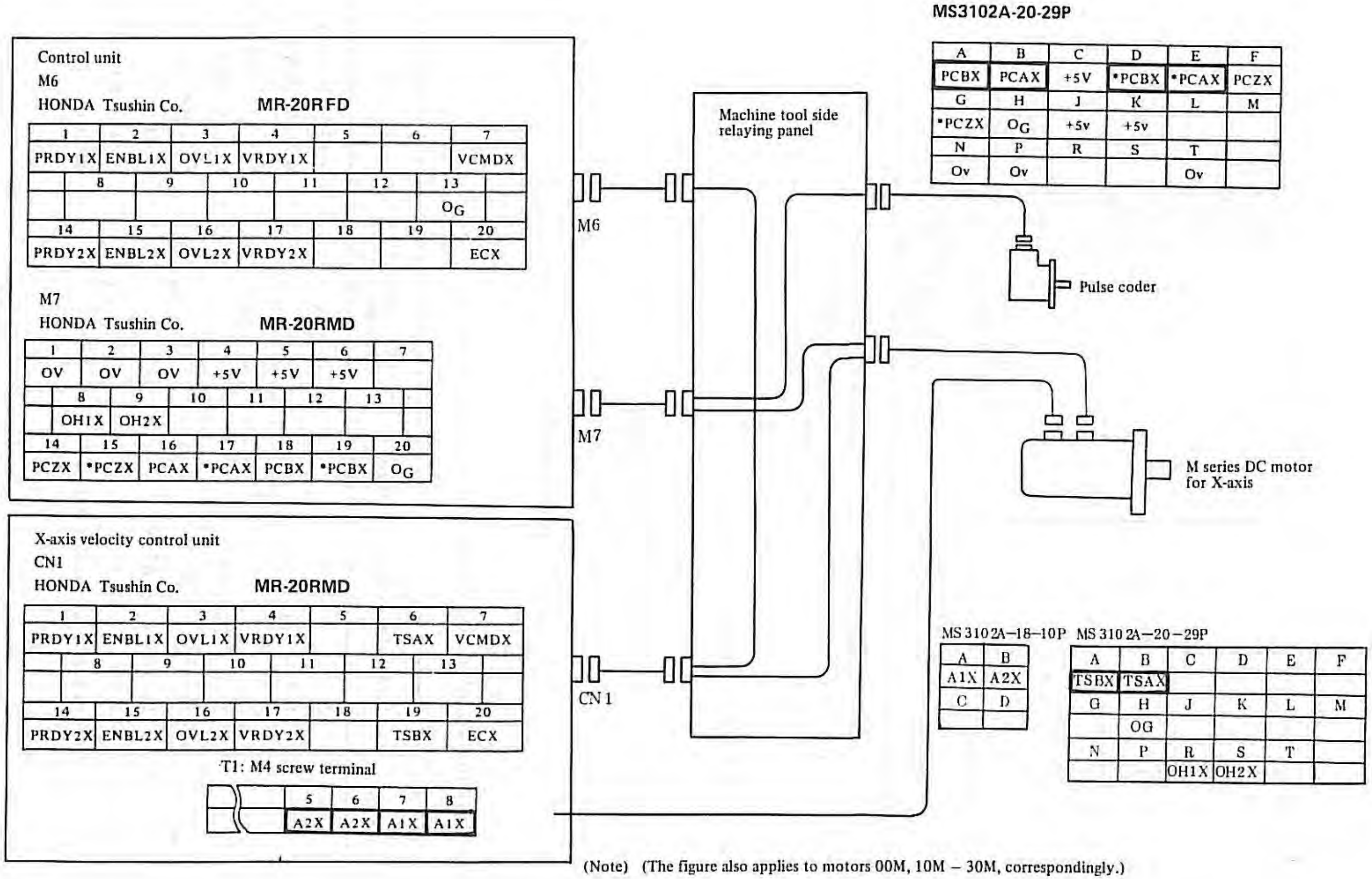


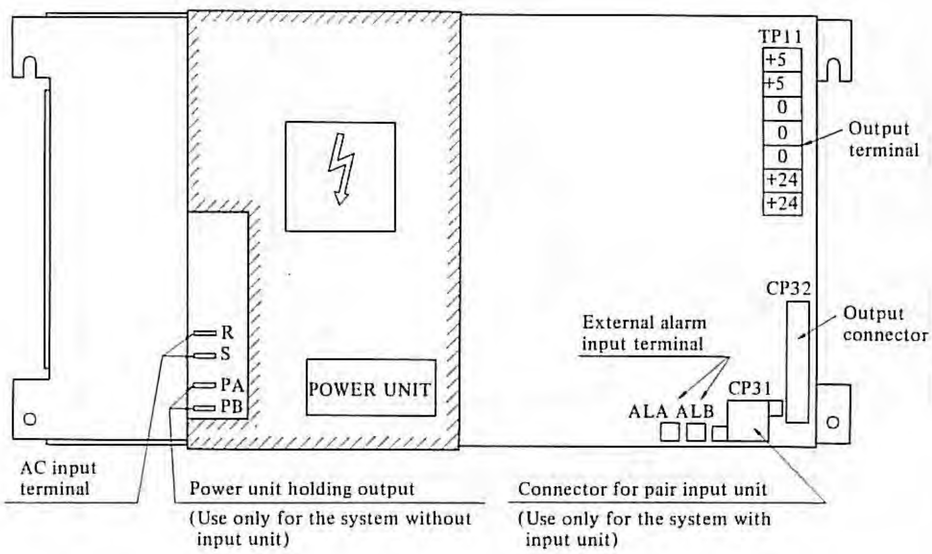
Fig. 1(d) Connection of Motor Model 0M and 5M

(When both motor and pulse coder are connected by the reverse connection system)

APPENDIX 3 DETAILED DESCRIPTION OF POWER STABILIZING UNIT

3.1 Input/Output terminals and ratings

The terminal arrangement follows.



(1) AC input terminal and rated input

R-S (phaston) terminal AC200 V $^{+10}_{-15}$% 50/60 Hz

AC220 V $^{+10}_{-15}$% 50/60 Hz

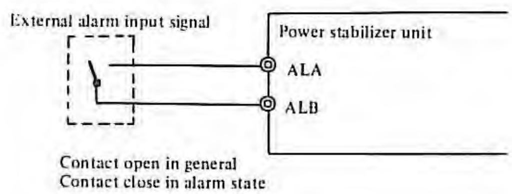
(2) Output voltage terminals and rated output

Terminal name, connector name	Rated voltage	Allowable voltage range	Current capacity (maximum)	Use
+5	+5V	±2% (4.9 - 5.1V)	11A	Logic circuit, MDI & DPL
+24	+24V	±5% (22.8 - 25.2V)	3A	For I/O signals, MDI & CRT
CP32-1	+15V	±4.5% (14.325 - 15.675V)	0.3A	Position control circuit
CP32-6	-15V	±4.5% (-14.325 - 15.675 V)	0.3A	Position control circuit
CP32-2,5 0	0V	——	——	——

(3) Input/Output signals for the system without input unit

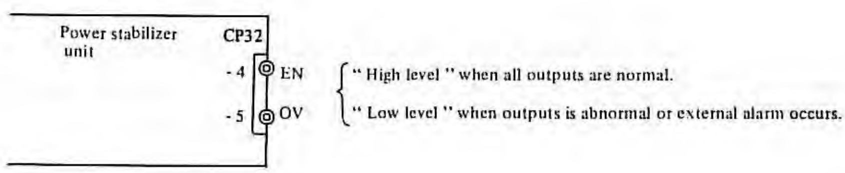
1 External alarm input signal

This is an alarm signal from other than the power stabilizer unit (e.g., additional power unit) and operates the same as the alarm in the power stabilizer unit.



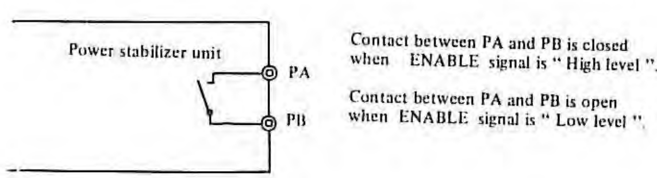
2 ENABLE signal (EN)

This is a TTL level signal indicating that all DC outputs are being transmitted normally and becomes "Low level" when output trouble is detected in any circuit or when external alarm signal is received.

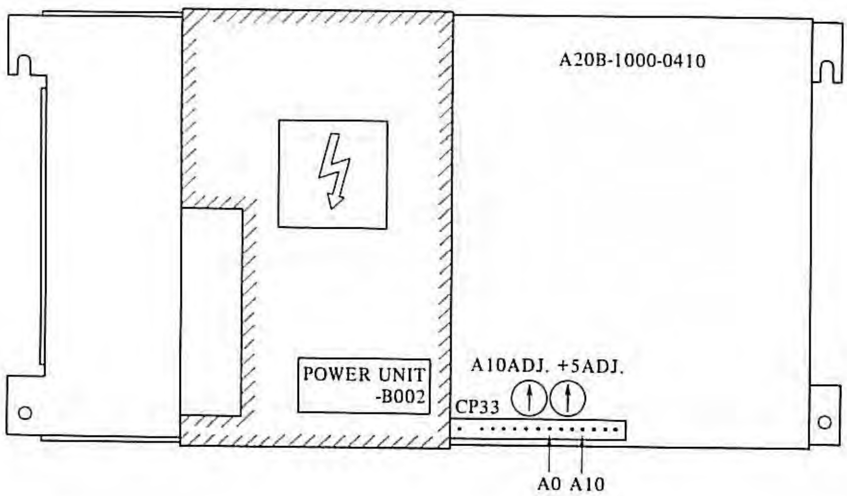


3 Power input holding signal

This is a contact signal used for power input holding with the system using no input unit, and is output from the power stabilizer unit.



3.2 Adjustment and Setting



(1) Standard voltage adjustment

Measure by a digital voltmeter the voltage between A10 and A0 of checking connector CP33 to make sure it is 10.00V. If not, adjust by variable resistor A10ADJ. Turning clockwise produces greater voltage.

(2) +5V output voltage adjustment

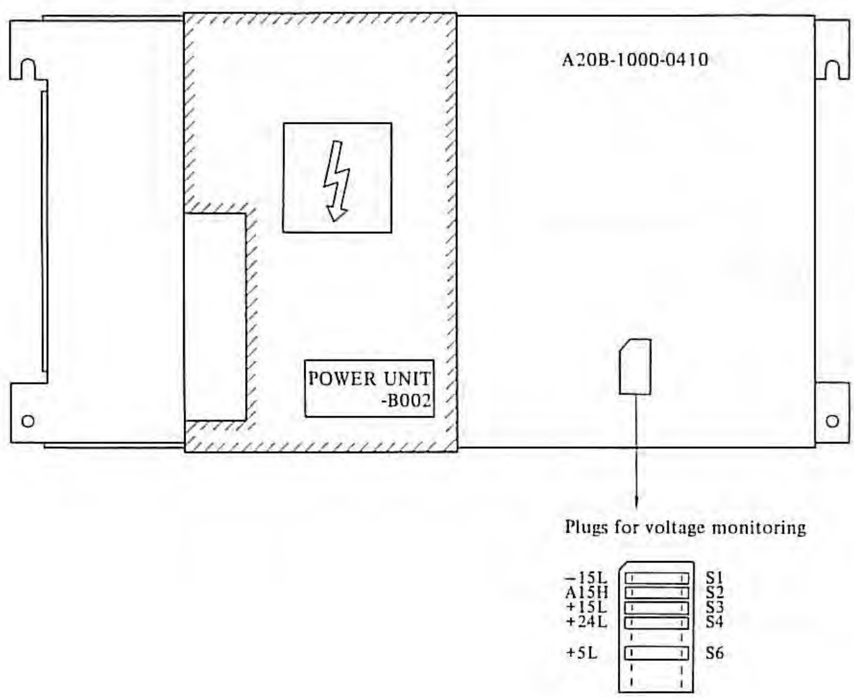
Adjust by variable resistor +5 ADJ. Turning clockwise produces greater voltage.

3.3 Voltage Monitor Circuits

This voltage monitor circuits always monitor output voltage and auxiliary powersupply voltages, detect troubles, if present, turn the ENABLE signal OFF, and cut power.

Table 2.3 shows trouble detection levels of voltage monitor circuits and major causes for trouble detection.

The voltage monitor circuits are provided with jumper plugs S1 - S4, S6 which make their trouble detection effective or ineffective. Usually, S1 - S4, S6 are all inserted (all effective). Pulling out S1 - S4, S6 makes corresponding voltage monitor circuit ineffective.



3.4 OVP and OCL Functions

Each circuit is provided with the overvoltage protecting (OVP) and overcurrent limiting (OCL) functions, which are activated at the levels listed below.

When the OVP function is activated, the thyristor at the output end is turned on to short-circuit the output and absorb the overvoltage. The OCL function makes the output voltage drop according to the degree of the overcurrent.

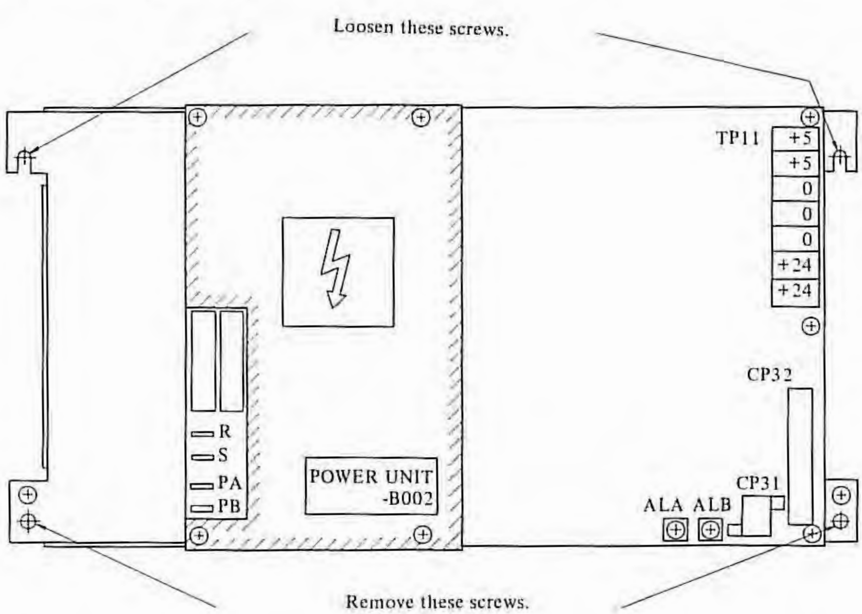
Accordingly, both OVP and OCL functions serve as the factors for abnormality detection in the voltage monitor circuit.

	OVP activation level (absolute value)	OCL activation level
+5V	6.3 - 6.8V	1.8 - 22A
+24V	29 - 32V	4.4 - 4.8A
+15V	16 - 18V	About 0.4A
-15V	16 - 18V	About 1.4A
Primary circuit	——	5 - 6A (peak value)

3.5 Changing the Stabilizing Unit

(1) (a) Turn the power off.
(b) Disconnect the wire from Faston terminals R and S.
(c) Disconnect the wires from the +5V, 0V and +24V output terminals.
(d) Disconnect connectors CP31 and CP32.
(e) Disconnect the wire connected to screw terminals ALA and ALB, if any.

(2) Loosen two upper screws fixing the stabilizing unit, and remove two lower screws. Then, change the stabilizing unit with new one.



(3) After fixing the new unit, connect all wires disconnected in (1) as before.

(4) Turn the power on, and check the following:

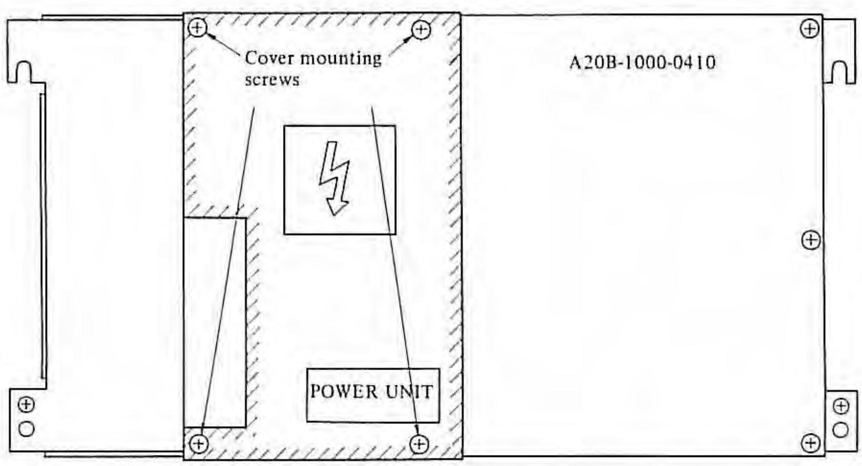
(a) Measure the voltage between check terminals CP33 (A10-A0) with a digital voltmeter, and make sure that the voltage is 10.00V. If the voltage is not 10.00V, adjust variable resistor A10 ADJ.

(b) Measure the +5V output voltage, and make sure that it is 5.00V. If it is not 5.00V, adjust variable resistor +5V ADJ.
(If the measuring point and the adjusting value for the +5V voltage are specified for each unit, adjust according to them.)

(c) Measure the following voltages, and make sure that they are within the allowable range (see item 2.1 (2)):
+24V output voltage
+15V output voltage
-15V output voltage

3.6 Changing the PC Board Unit

(1) Turn the power off, and remove the cover (fixed with four screws marked +).



(2) (a) Disconnect the wires from Faston terminals R, S, PA and PB.

(b) Disconnect the wires from the +5V, 0V and +24V output terminals.

(c) Disconnect connectors CP31 and CP32.

(d) Disconnect the wires connected to screw terminals ALA and ALB, if any.

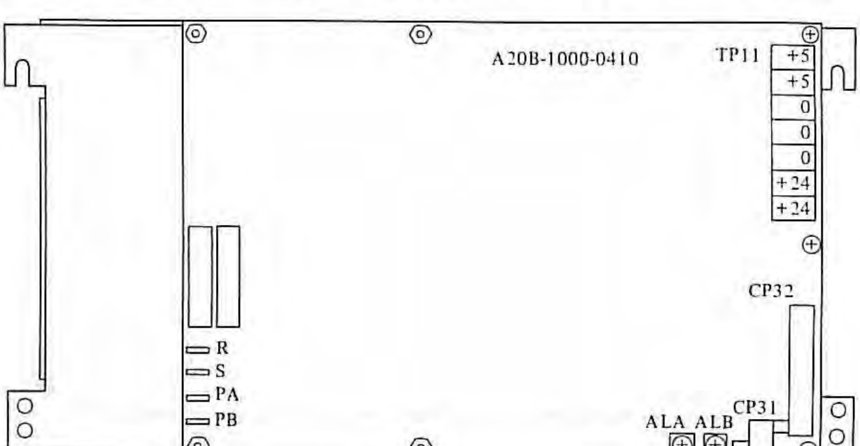
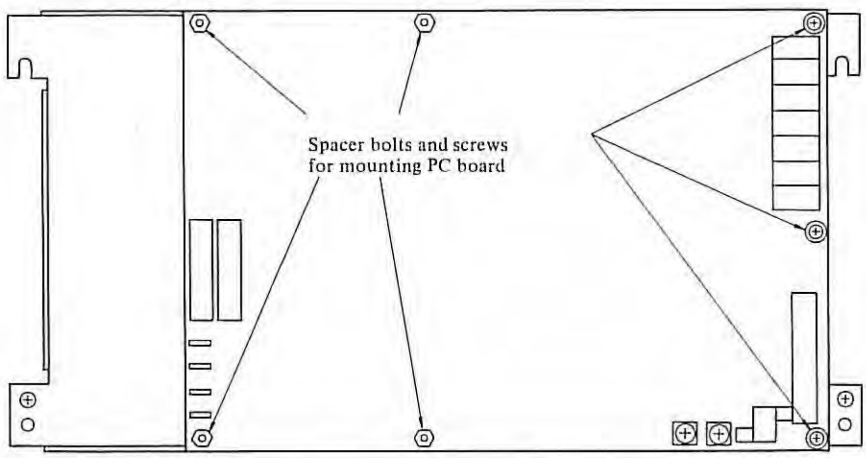


Table 3.3 Table of voltage monitoring circuit

Voltage monitor circuit and abnormality detection level (absolute value)		Major causes of abnormality: Actuation of OVP and OCL	Major causes of abnormality: Rectifier and control circuit	Major causes of abnormality: Primary circuit	Major causes of abnormality: External conditions	Major causes of abnormality: Others	Symbols of the shorting plugs
+5V	Less than 97%	+5V circuit OVP actuation +5V circuit OCL actuation Primary circuit OCL actuation	Switching stop due to A15 voltage drop DS13 trouble Trouble of +5V control circuit (M12, M13, etc.)				S6
+24V	Less than 19.0 to 20.0V	+24V circuit OVP actuation +24V circuit OCL actuation Primary circuit OCL actuation	Switching stop due to A15 voltage drop Trouble of DS12 Trouble of +5V and +24V control circuit (M12, M13, etc.)	Trouble of power switch circuit Blow out of F11 to AF12	Input AC voltage drop	Trouble of voltage monitor circuit (M13, M14, etc.)	S4
+15V	Less than 12.7 to 13.0V	+15V and +24V circuit OVP actuation +15V and +24V circuit OCL actuation	Trouble of RG11				S3
-15V	Less than 12.0 to 13.0V	-15V and +5V circuit OVP actuation -15V and +5V circuit OCL actuation	Trouble of RG12 Trouble of D36				S1
(Auxiliary power supply)	More than 17.5 to 18.7V	——	Trouble of axiliary power (M11, etc.)	——	——	——	S2

(3) Remove PC board unit A20B-1000-0410 (fixed with four spacer bolts and three screws). Change it with new one.



(4) After fixing the new PC board unit, connect all wires disconnected in (2) as before. At this time, completely insert the connectors until they are locked.

(5) Turn the power on, and check as described in item 2.5 (4).

(6) Turn the power off, and mount the cover as before.

3.7 Causes and Checking Procedures for Fuse Blowout

The power unit input terminals contain F11-12 fuses. The checking procedure for fuse blowout follows.

Causes for blowout of F11-12

(1) Short of surge absorber VS11
VS11 is inserted to absorb surge voltage between input lines. When VS11 is applied with extremely large surge voltage or with constant overvoltage, it is shorted, blowing out F11-12.

(2) Short of diode stack DS11.

(3) Short of condenser C12.

(4) Short of power hybrid IC for auxiliary power M11.

(5) Short of switching transistors Q14-15.

(6) Short of diode DS24-25.

(7) Contact wiring of primary circuits or parts with the casing.

(8) When VS11 absorbes an instantaneous high voltage occurring at the AC input and short-circuiting does not occur, it sometimes happens that only F11 and F12 blow.
This tends to occur in the cases of lightning surge and weak distribution system.

Checking procedure:

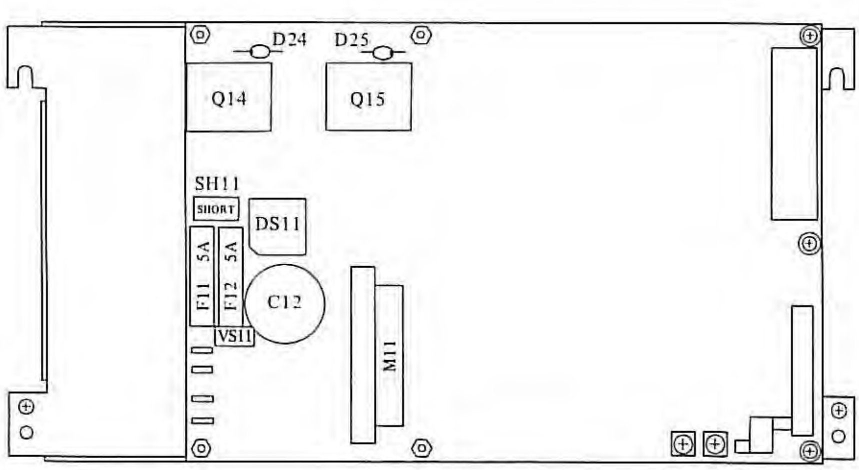
(1) Remove the cover and the PC board unit as described in item 2.6 (1) to (3). At this time, also make sure that the primary circuit and the parts are not in contact with the case or the cover.

(2) Extract strapping plug SH11 to divide into the group of VS11, DS11, C12 and M11, and the group of Q14, Q15, D24 and D25. By using a tester, find a part of these groups at which the short-circuiting failure occurs.

(3) Change the defective part or correct the contacting condition between the part and the case. Then, return all cover, PC board, wire and strapping plug, which were disconnected for the checking, to the original condition.

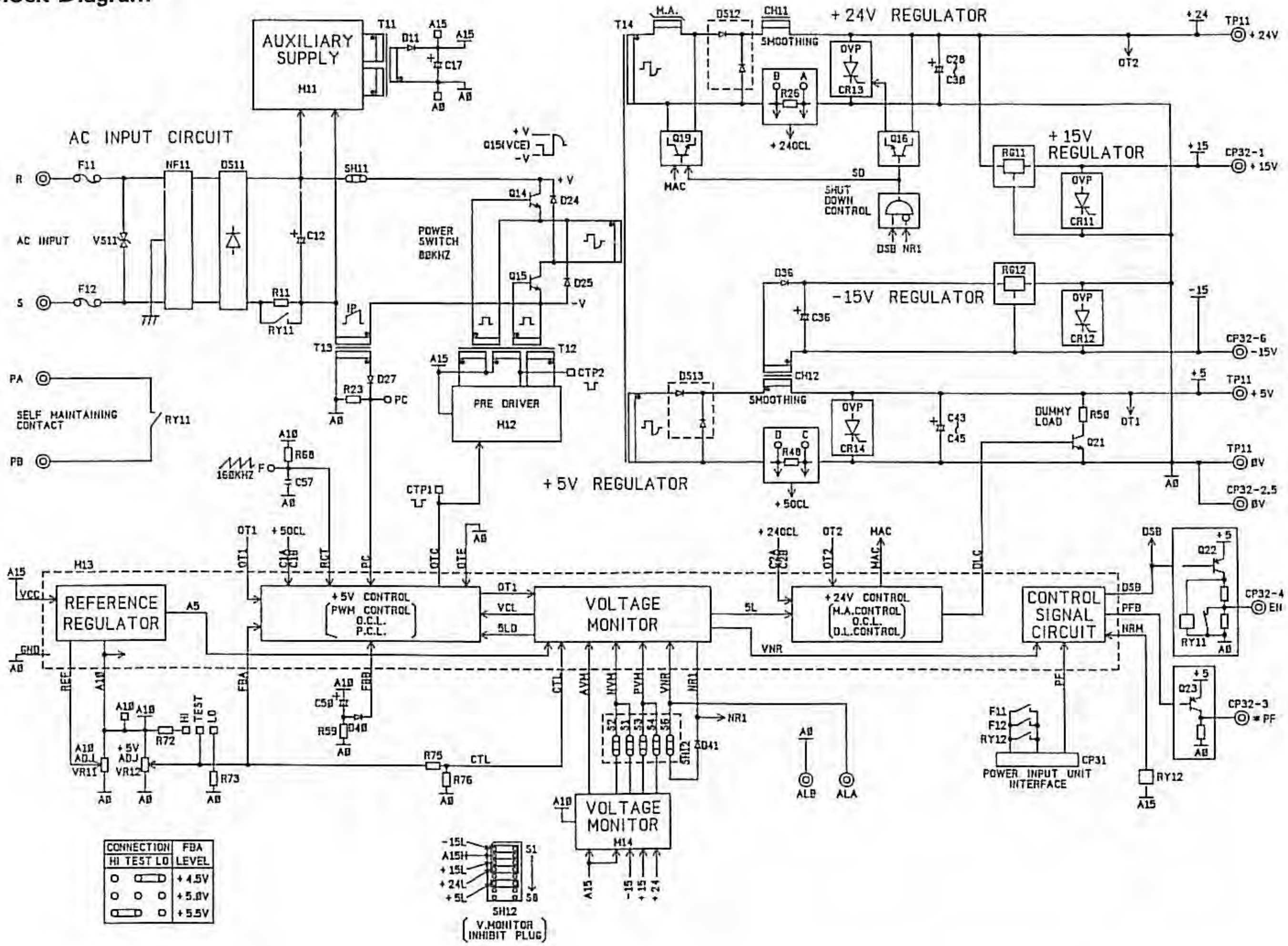
(4) After changing the fuses, turn the power on, and check whether the cause of blown fuses has been removed. Since F11 and F12 are the UL-approved products, it is impossible to perform fuse wire changing like a general alarm fuse. When changing the fuses, use those of the same specifications.
The specification number is A60L-0001-0101#P450H.

(5) When VS11 is short-circuited and there is no parts for replacement, the unit may be operated with VS11 removed. In this case, procure and mount a new part as early as possible. (This is necessary particularly when the surge voltage occurs frequently.)
The specification number of VS11 is A50L-8001-0067#391 or A50L-8001-0077.



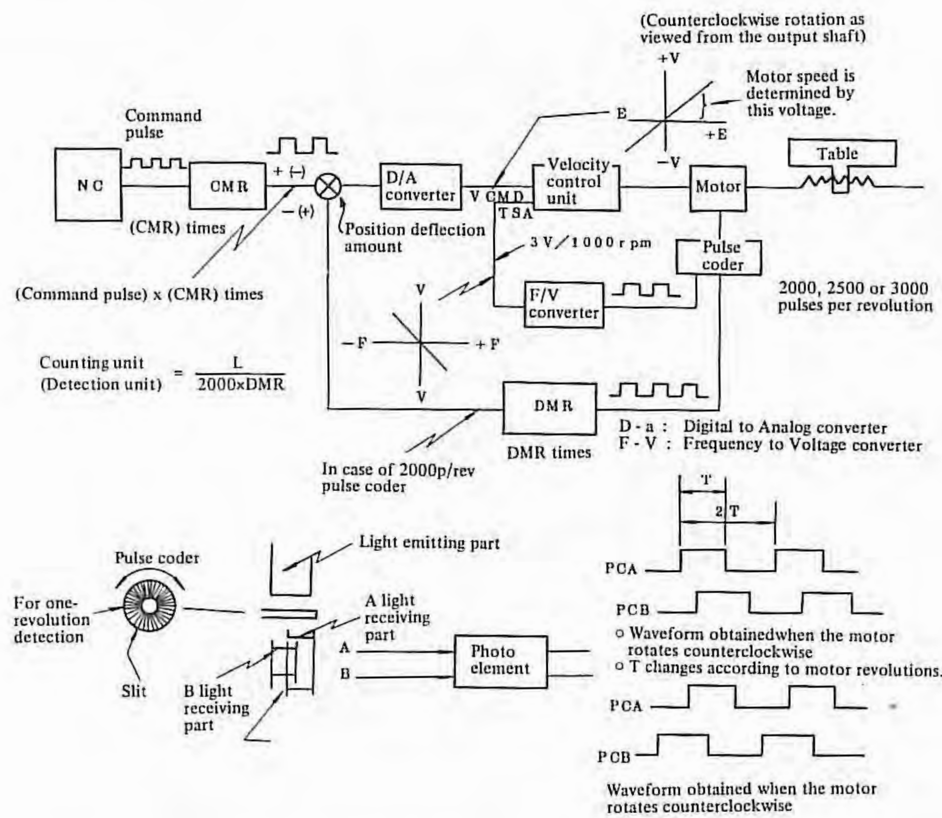
Arrangement of main parts of primary circuit (with the cover removed)

3.8 Block Diagram



APPENDIX 4. BLOCK DIAGRAM OF SERVO SYSTEM AND INDIVIDUAL ADJUSTMENTS OF VELOCITY CONTROL UNIT

4.1 Outline of Servo System



o CMR and DMR are set so that the table move amount meets the command pulse.

CMR: Command multiplier

CMR is set by parameters No.15 and 16.

DMR: Detection multiplier

DMR is set by parameters No.07 and 08.

L: Move amount per revolution of motor (Unit: mm or inch)

Counting unit: Value obtained by dividing the move amount per revolution of motor by the feed pulse 2000 x DMR per revolution (in case of 2000p/rev pulse coder).

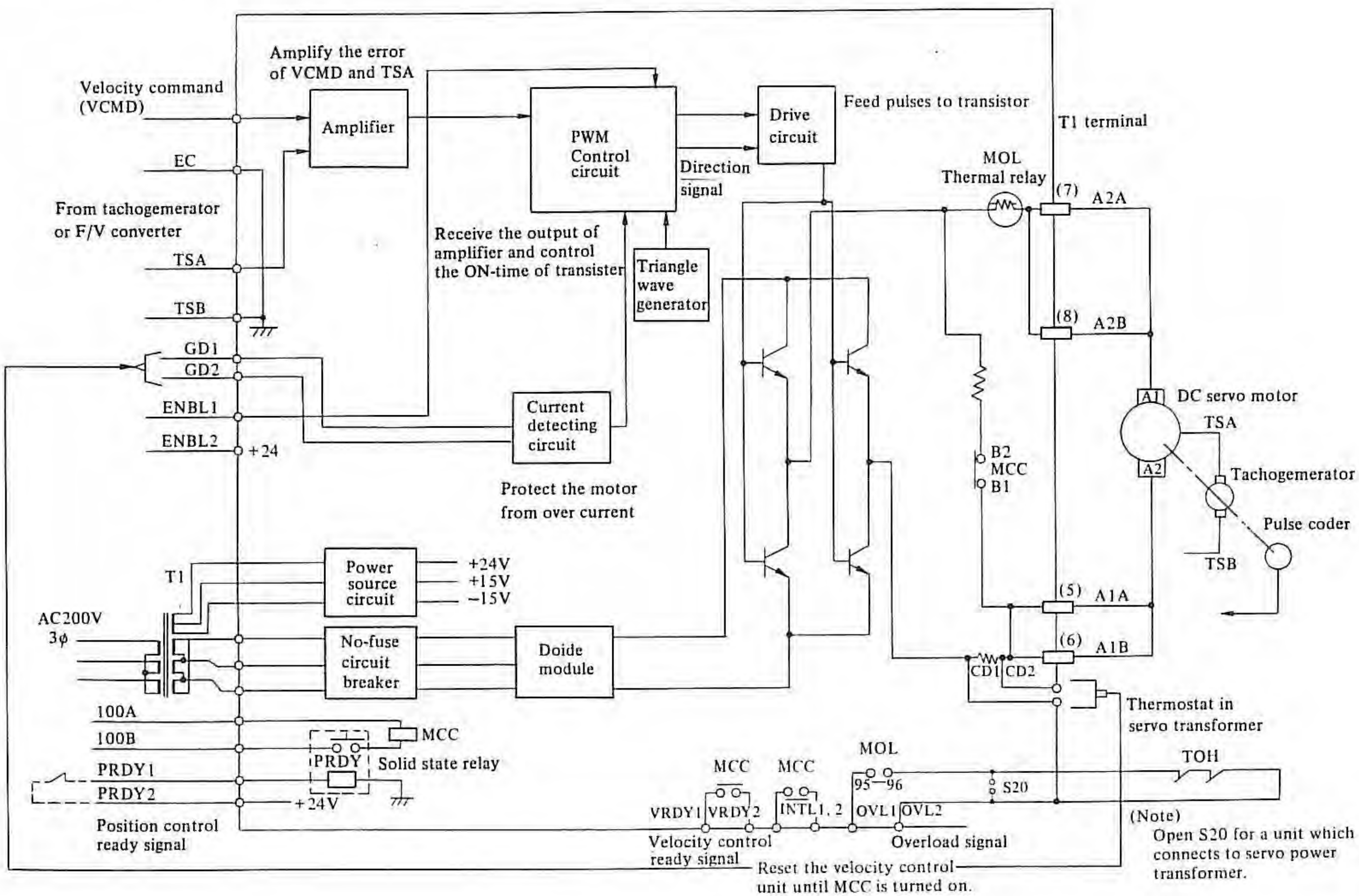
CMR and DMR are set to allow the weight of command pulse to meet the weight per feedback pulse.

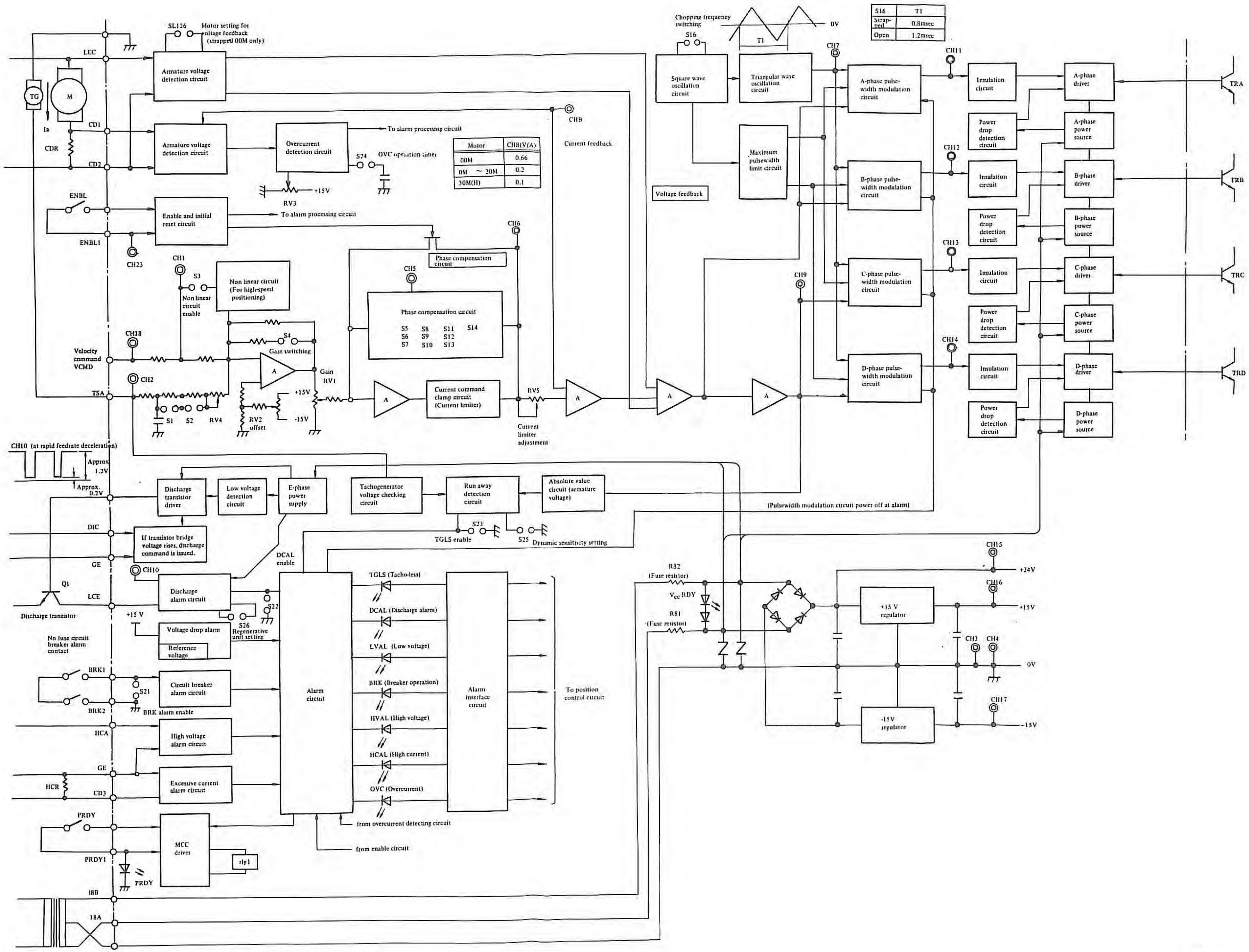
(Example) In case of 2000p/rev pulse coder;

$$\frac{\text{Least command increment (mm or inch)}}{\text{CMR}} = \frac{\text{L(mm or inch)}}{2000\text{xDMR}}$$

(Note) Replace 2000 with 2500 for 2500p/rev pulse coder.

4.2 Block Diagram of Velocity Control Unit PCB (M Series)





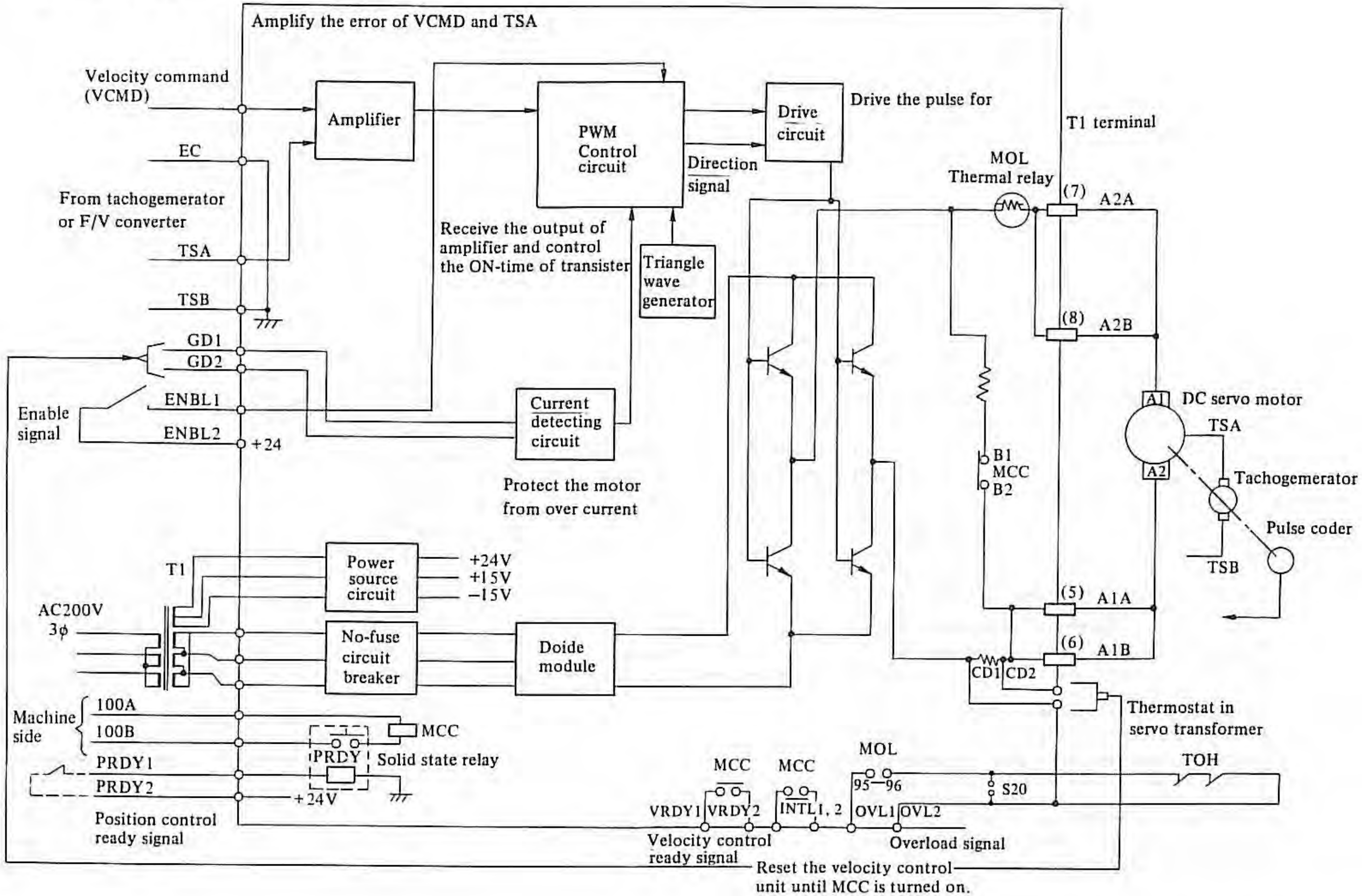
SL126 Motor setting for voltage feedback (strapped 00M only)
LEC
TG
M
Ia
CD1
CDR
CD2
Armature voltage detection circuit
Armature voltage detection circuit
Overcurrent detection circuit
To alarm processing circuit
S24 OVC operation timer
RV3
+15V
ENBL
ENBL1
Enable and initial reset circuit
To alarm processing circuit
CH23
CH8
Current feedback
Motor
CH8(V/A)
00M
0.66
0M ~ 20M
0.2
30M(H)
0.1
CH6
Phase compensation circuit
CH5
Phase compensation circuit
S5 S8 S11 S14
S6 S9 S12
S7 S10 S13
CH1
S3
Non linear circuit enable
Non linear circuit (For high-speed positioning)
CH18
S4
Gain switching
Velocity command VCMD
Gain RV1
CH2
TSA
S1 S2 RV4
RV2 offset
+15V
-15V
Current command clamp circuit (Current limiter)
RV5
Current limiter adjustment
Chopping frequency switching
S16
0V
T1
S16
T1
Strapped
0.8msec
Open
1.2msec
CH7
Square wave oscillation circuit
Triangular wave oscillation circuit
Maximum pulsewidth limit circuit
Voltage feedback
CH9
A-phase pulse-width modulation circuit
B-phase pulse-width modulation circuit
C-phase pulse-width modulation circuit
D-phase pulse-width modulation circuit
CH11
CH12
CH13
CH14
Insulation circuit
Power drop detection circuit
A-phase driver
A-phase power source
B-phase driver
B-phase power source
C-phase driver
C-phase power source
D-phase driver
D-phase power source
TRA
TRB
TRC
TRD
CH10 (at rapid feedrate deceleration)
Approx. 1.2V
Approx. 0.2V
Discharge transistor driver
Low voltage detection circuit
E-phase power supply
Tachogenerator voltage checking circuit
Run away detection circuit
Absolute value circuit (armature voltage)
(Pulsewidth modulation circuit power off at alarm)
S23
TGLS enable
S25
Dynamic sensitivity setting
DIC
If transistor bridge voltage rises, discharge command is issued.
GE
CH10
DCAL enable
Q1
LCE
Discharge transistor
Discharge alarm circuit
S22
+15 V
Voltage drop alarm
Reference voltage
S26 Regenerative unit setting
No fuse circuit breaker alarm contact
BRK1
BRK2
S21
Circuit breaker alarm circuit
BRK alarm enable
HCA
High voltage alarm circuit
HCR
CD3
Excessive current alarm circuit
Alarm circuit
TGLS (Tacho-less)
DCAL (Discharge alarm)
LVAL (Low voltage)
BRK (Breaker operation)
HVAL (High voltage)
HCAL (High current)
OVC (Overcurrent)
Alarm interface circuit
To position control circuit
from overcurrent detecting circuit
from enable circuit
PRDY
PRDY1
MCC driver
rly1
PRDY
18B
18A
CT
R82 (Fuse resistor)
Vcc RDY
R81 (Fuse resistor)
CH15
+24V
CH16
+15V
+15 V regulator
CH3
CH4
0V
CH17
-15V regulator
-15V

4.3 Descriptions of Signals in Velocity Control Unit

No.	Signal	Designation	Type	Significant level	No. of lines	Sending direction: Control Unit → Velocity Control Unit → Servo Motor	Remark
1	Velocity control ON signal	PRDY1 PRDY2	Contact	Contact ON	2	⇒	The power is supplied to Velocity control Unit when the contact signal turns ON. Dynamic breaking is made for servo motor, when this signal turned OFF.
2	Firing control signal	ENBL1 ENBL2	Contact	Contact ON	2	⇒	Thyristors are fired when this contact signal is turned ON. The motor current is cut, but no dynamic braking is made when this signal turned OFF.
3	Overload signal	OVL1 OVL2	Contact	Contact OFF	2	⇐	An excessive motor current turns the contact OFF. The contact signal of verload relay.
4	Velocity control READY signal	VRDY1 VRDY2	Contact	Contact ON	2	⇐	The contact turns ON when the Unit is ready to operate.
5	Tachogenerator signal (F/V convertor)	TSA TSB	Analog signal	A negative voltage with counterclock wise rotation of motor.	2	Pulse coder ⇒ ⇐ Tachogenerator	3V-1000 rpm. or 6V-1000 rpm.
6	Velocity command signal	VCMD Ec	Analog signal	A positive signal with counterclock wise rotation of motor.	2	⇒	7V/2000 rpm for model 0 or 5, and 7V/1000 rpm for model 10, 20, 30 10H, 20H or 30H.

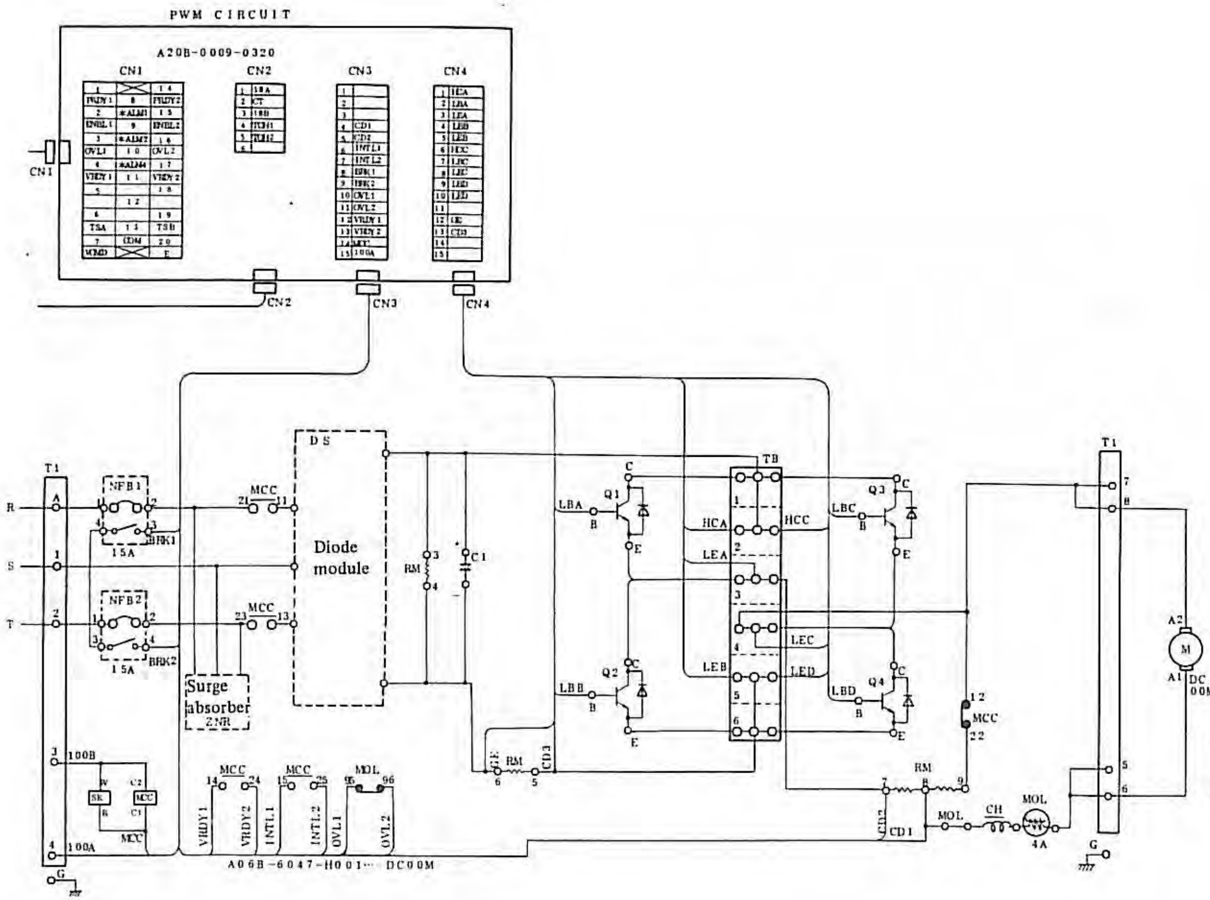
4.4 Connection Diagram of Velocity Control Unit

Block diagram of velocity control unit (M series)



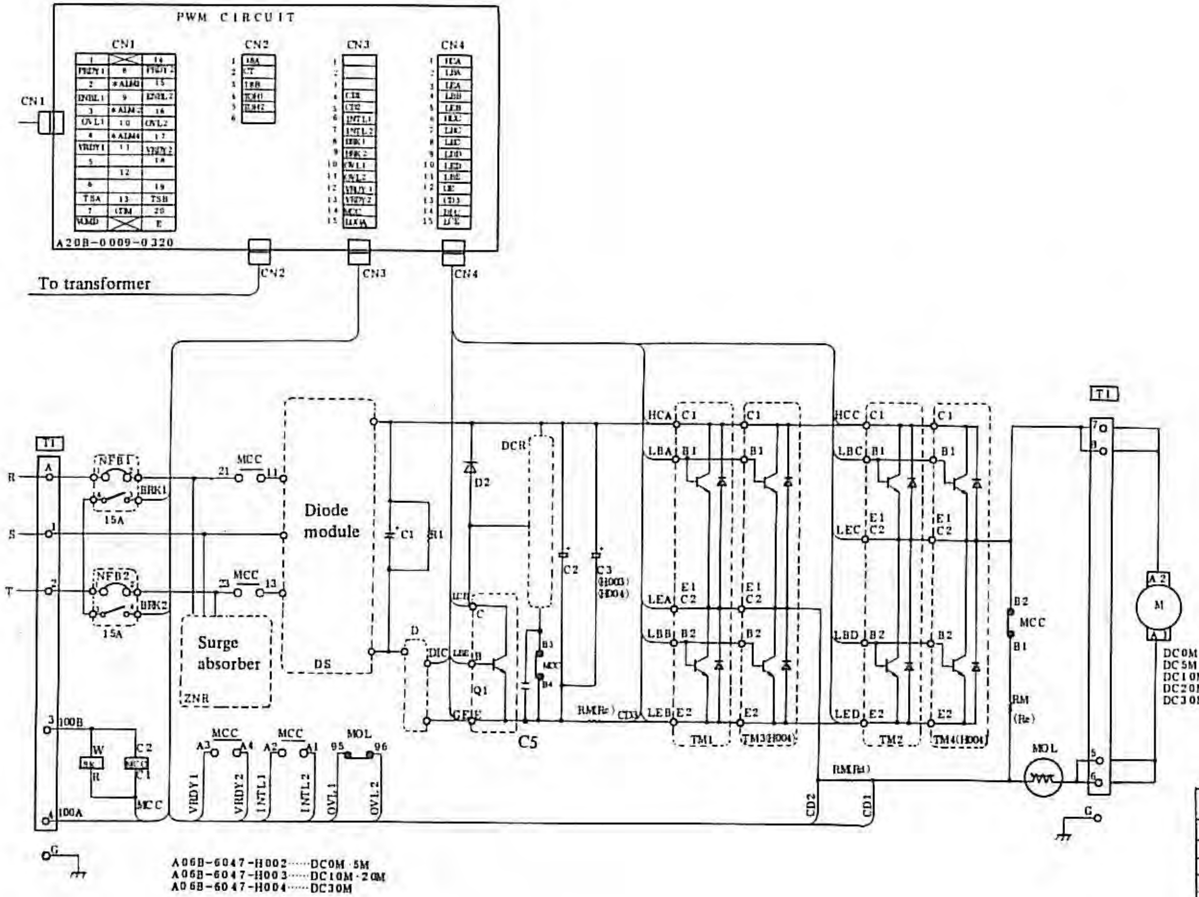
(Note) Open-circuit at S20 for velocity unit which is connected to servo transformer.

4.4.1 In case model 00M (A06B-6047-H001)



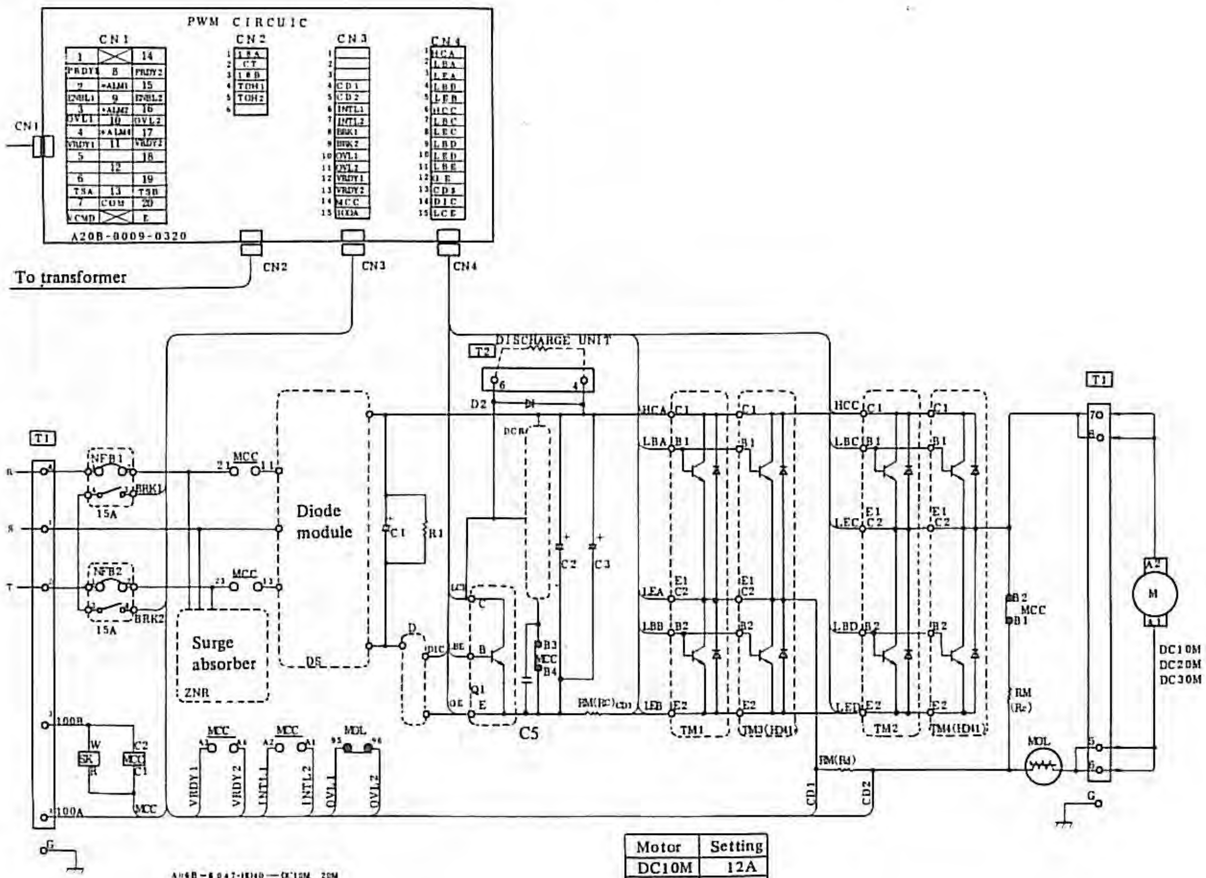
Motor	Setting
DCOOM	4A

4.4.2 In case model 0M ～30M (A06B-6047-H002 ～ 4)



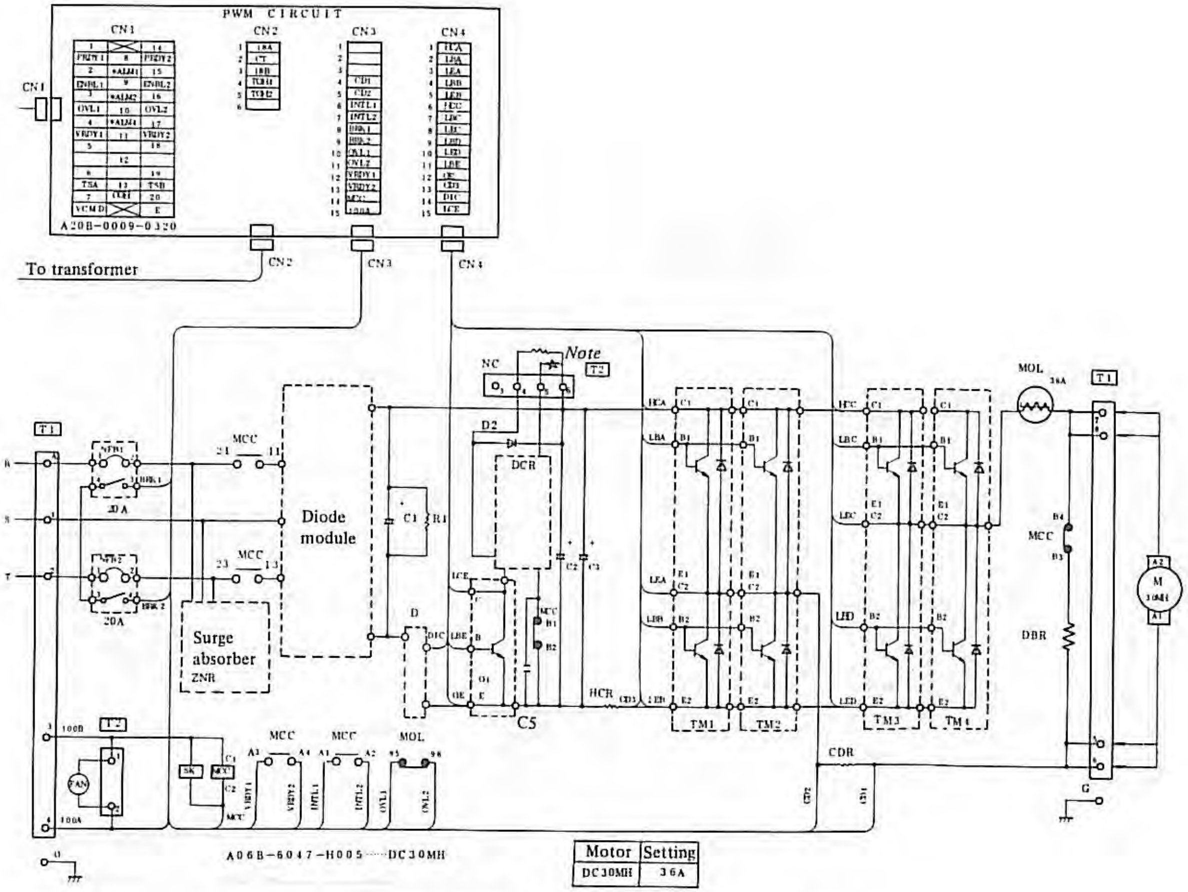
Motor	Setting
DC0M	6A
DC5M	9A
DC10M	12A
DC20M	18A
DC30M	24A

4.4.3 In case model 10M ~ 30M with separate discharge unit (A06B-6047-H040, H041)



Motor	Setting
DC10M	12A
DC20M	18A
DC30M	24A

4.4.4 In case model 30MH (A06B-6047-H005)



Motor	Setting
DC30MH	36A

Note) Remove the short bar when the discharge unit is provided.

APPENDIX 5. PARTS SPECIFICATIONS ON VELOCITY CONTROL UNIT

5.1 Parts Specifications

Parts specifications in the velocity control unit are as follows.

5.1.1 MODEL 00M velocity control unit

A06B-6047-H001

Symbol	Name	Specification
PWB	Printed Circuit Board	A20B-0009-0320
MCC	Magnetic Contactor	A58L-0001-0158
MOL	Thermal Relay	A58L-0001-0148/5
NFB1, 2	Circuit breaker	A60L-0001-0143/15A
RM	Resistor Module	A40L-0001-0103/B
Q1 ~ Q4	Transistor	A50L-0001-0092
DS	Diode Module	A50L-2001-0134
C1	Capacitor	A42L-0001-0095/102
ZNR	Surge absorber	A50L-2001-0139

5.1.2 MODEL 0M, 5M velocity control unit

A06B-6047-H002

Symbol	Name	Specification
PWB	Printed Circuit board	A20B-0009-0320
MCC	Magnetic Contactor	A58L-0001-0151/15N
MOL	Thermal Relay	A58L-0001-0148/6
NFB1, 2	Circuit Breaker	A60L-0001-0143/15A
RM	Resistor Module	A40L-0001-0103/A
DCR	Discharging Resistor	A40L-0001-0114/A
TM1, 2	Transistor Module	A50L-0001-0091
Q1	Discharging Transistor	A50L-0001-0092
DS	Diode Module	A50L-2001-0134
D	Diode	A50L-2001-0135
C1	Capacitor	A42L-0001-0095/121
C2	Capacitor	A42L-0001-0095/102
ZNR	Surge Absorber	A50L-2001-0139

5.1.3 MODEL 10M, 20M velocity control unit

A06B-6047-H003
A06B-6047-H040

Symbol	Name	Specification
PWB	Printed Circuit Board	A20B-0009-0320
MCC	Magnetic Contactor	A58L-0001-0151/15N
MOL	Thermal Relay	A58L-0001-0148/12
NFB1, 2	Circuit Braker	A60L-0001-0143/15A
RM	Resistor Module	A40L-0001-0115/A
DCR	Discharging Resistor	A40L-0001-0114/A
TM1, 2	Transistor Module	A50L-0001-0091
Q1	Discharging Transistor	A50L-0001-0092
DS	Diode Module	A50L-2001-0134
D	Diode	A50L-2001-0135
C1	Capacitor	A42L-0001-0095/121
C2, C3	Capacitor	A42L-0001-0095/102
ZNR	Surge Absorber	A50L-2001-0139

5.1.4 MODEL 30M velocity control unit

A06B-4047-H004
A06B-6047-H041

Symbol	Name	Specification
PWB	Printed Circuit Board	A20B-0009-0320
MCC	Magnetic Contactor	A58L-0001-0151/15N
MOL	Thermal Relay	A58L-0001-0148/18
NFB1, 2	Circuit Braker	A60L-0001-0143/15A
RM	Resistor Module	A40L-0001-0115/B
DCR	Discharging Registor	A40L-0001-0114/A
TM1 ~4	Transistor Module	A50L-0001-0091
Q1	Discharging Transistor	A50L-0001-0092
DS	Diode Module	A50L-2001-0134
D	Diode	A50L-2001-0135
C1	Capacitor	A42L-0001-0095/121
C2, 3	Capacitor	A42L-0001-0095/102
ZNR	Surge Absorber	A50L-2001-0139

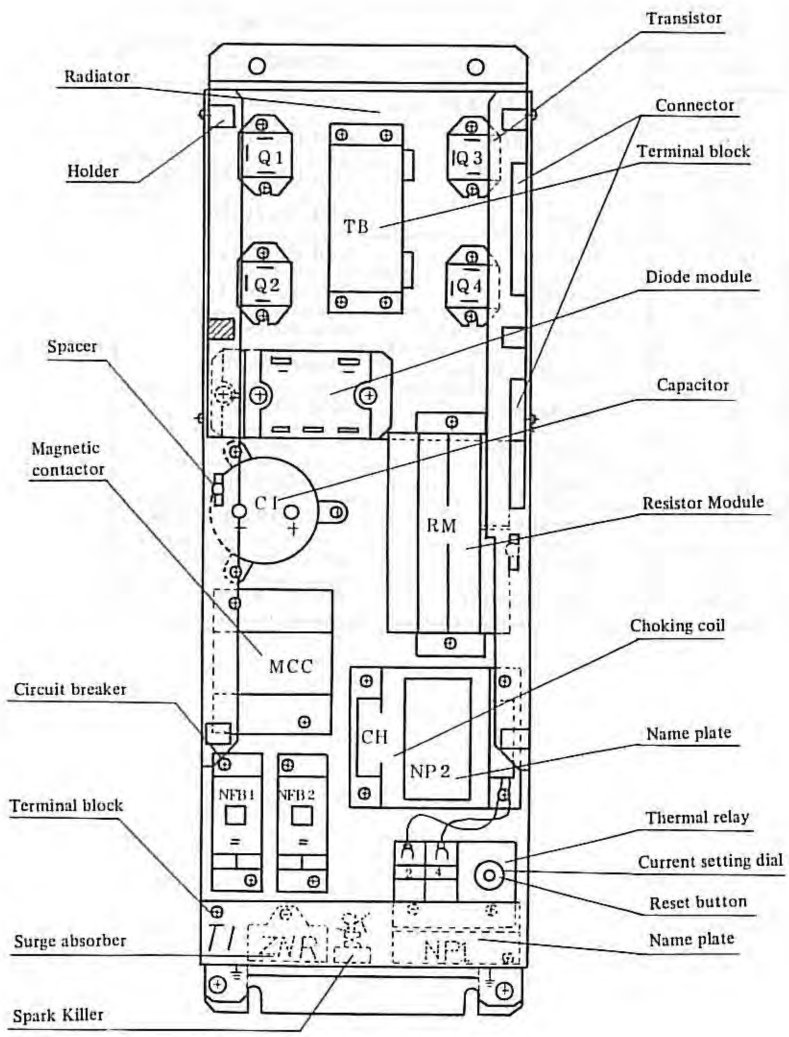
5.1.5 MODEL 30MH velocity control unit

A06B-6047-H005

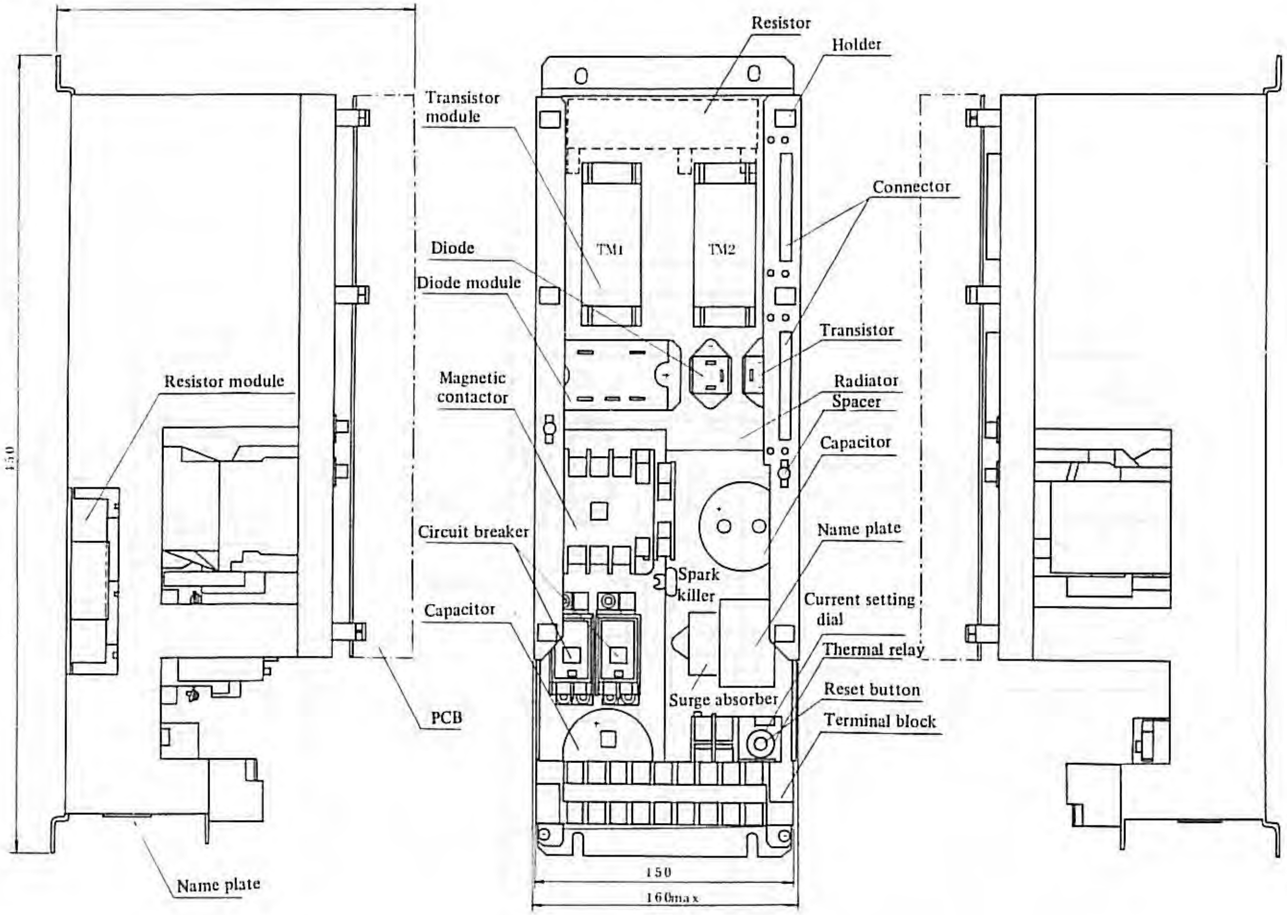
Symbol	Name	Specification
PWB	Printed Circuit Board	A20B-0009-0320
MCC	Magnetic Contactor	A58L-0001-0151/20N
MOL	Thermal Relay	A58L-0001-0135/36
NFB1, 2	Circuit Braker	A60L-0001-0143/20A
CDR	Resistor	A40L-0001-0110
HCR	Resistor	A40L-0001-0111
DBR	Resistor	A40L-0001-0112
DCR	Discharging Resistor	A40L-0001-0113
TM1 ~ 4	Transistor Module	A50L-0001-0091
Q1	Discharging Transistor	A50L-0001-0097
DS	Diode Module	A50L-2001-0138
D	Diode	A50L-2001-0135
C1	Capacitor	A42L-0001-0061/2G331E
C2, 3	Capacitor	A42L-0001-0095/152
ZNR	Surge Absorber	A50L-2001-0139

5.2 External View of Velocity Control Unit

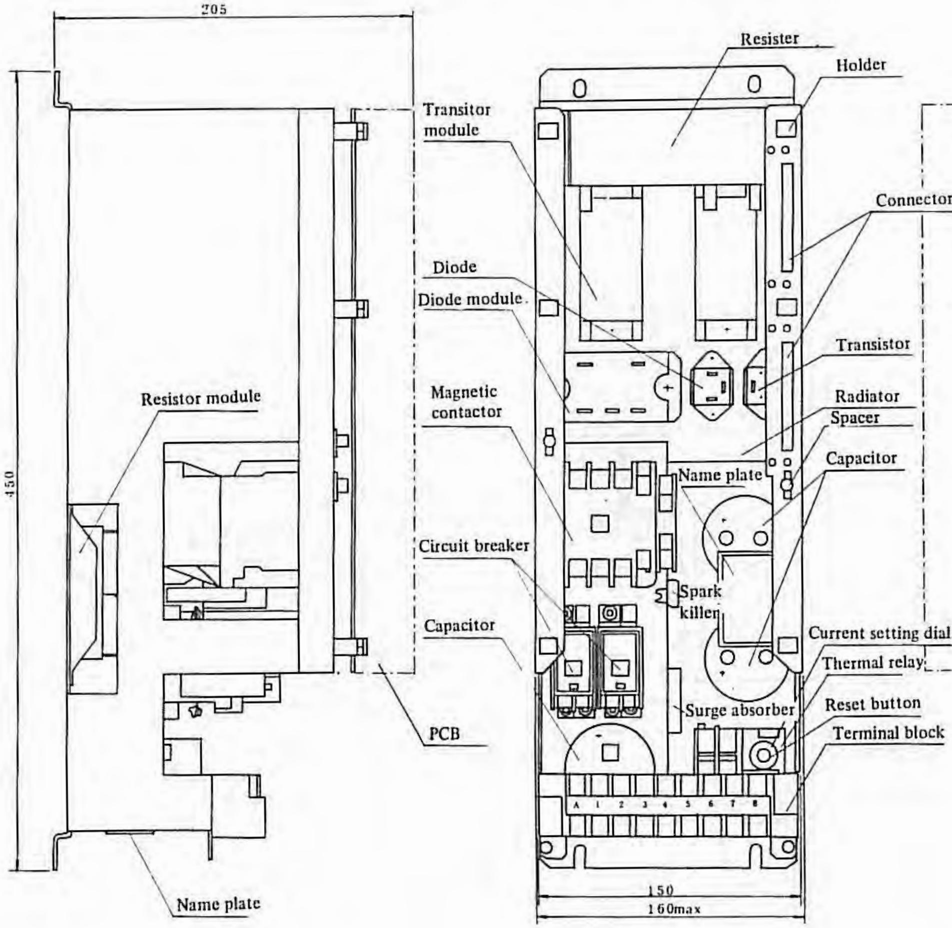
5.2.1 Velocity control unit for MODEL 00M (A06B-6047-H001)



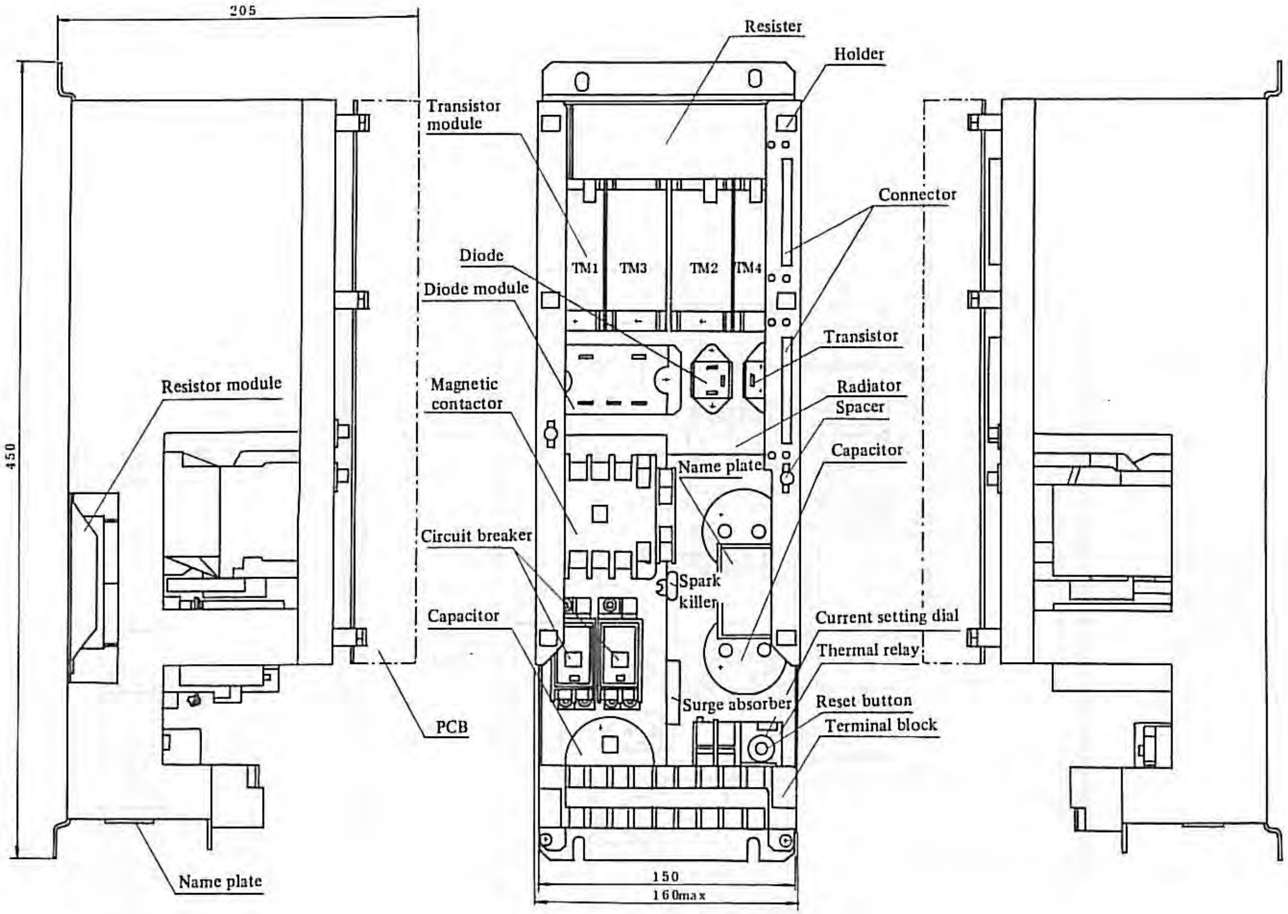
5.2.2 Velocity control unit for MODEL 0M, 5M (A06B-6047-H002)



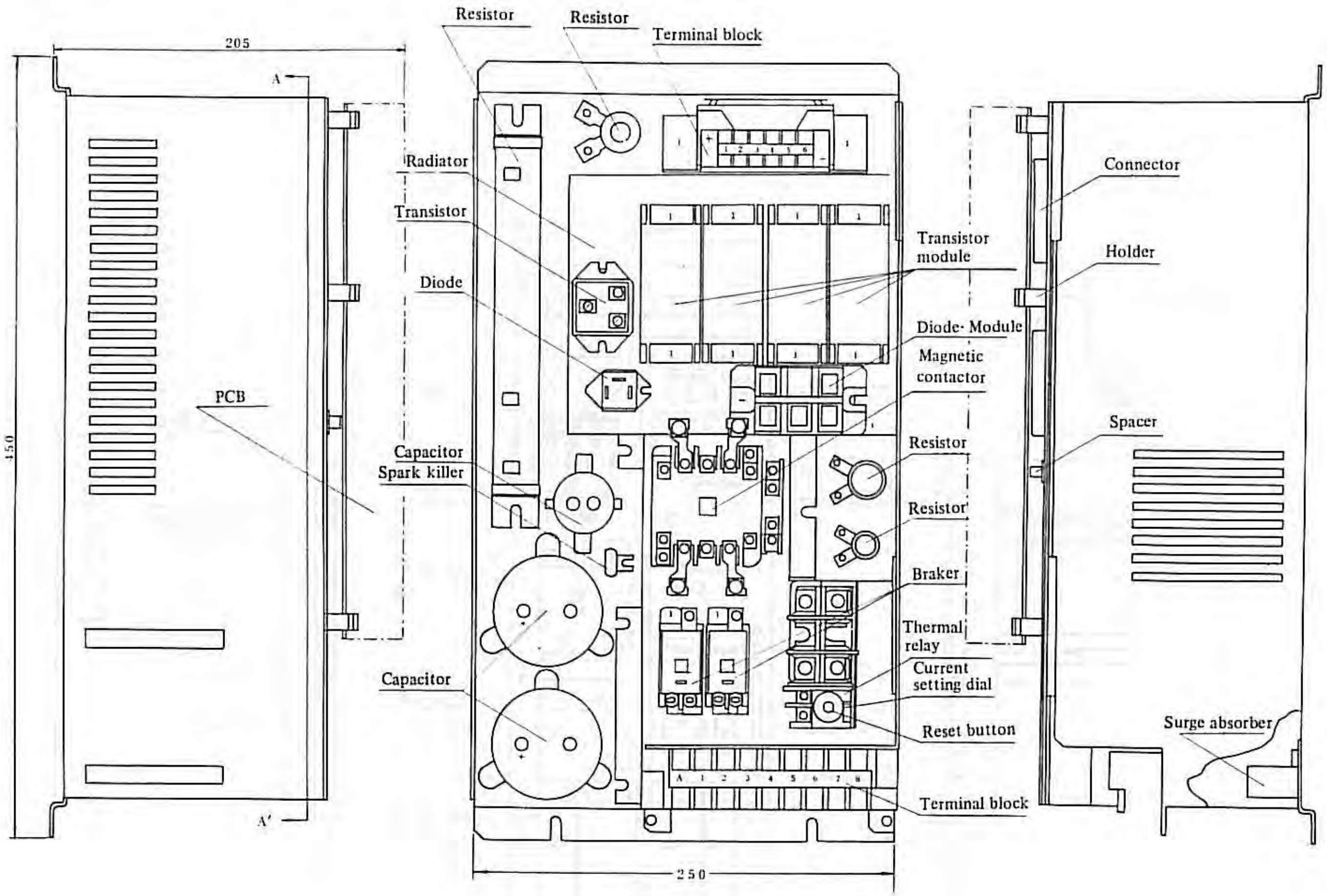
5.2.3 Velocity control unit for MODEL 10M, 20M (A06B-6047-H003)



5.2.4 Velocity control unit for MODEL 30M (A06B-6047-H004)



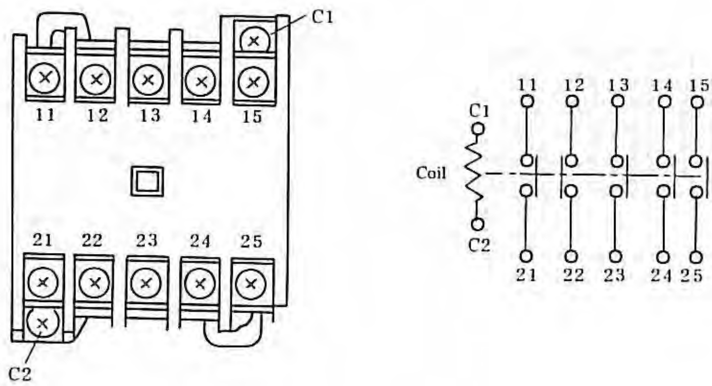
5.2.5 Velocity control unit for MODEL 30MH (A06B-6047-H005)



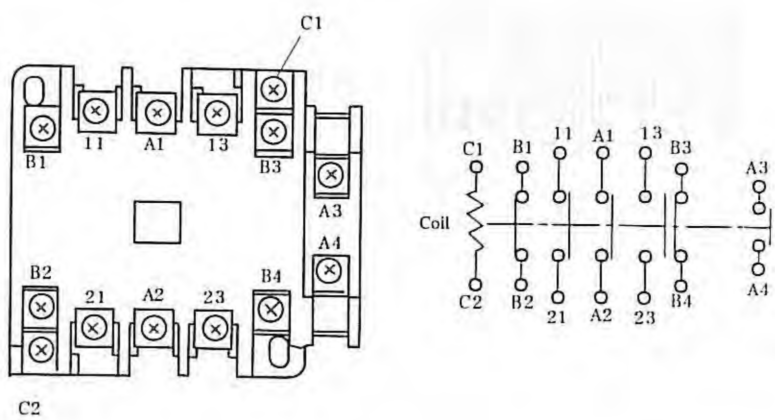
5.3 Others

5.3.1 Magnetic contactor terminals arrangement

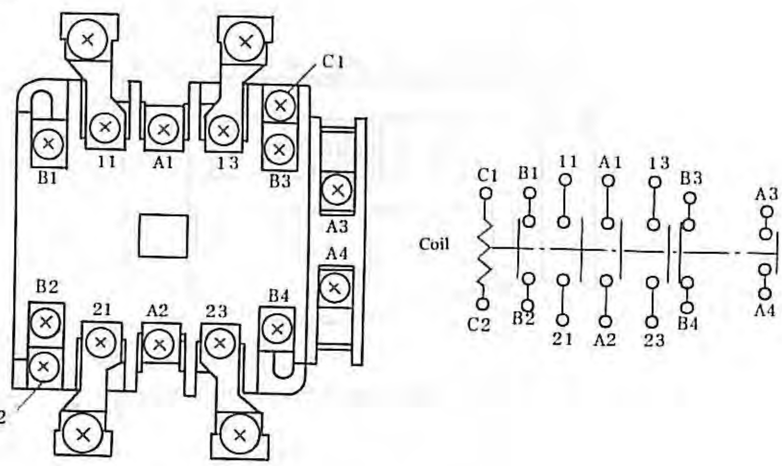
(a) For Model 00M



(b) For Model 0M, 5M, 10M, 20M, and 30M

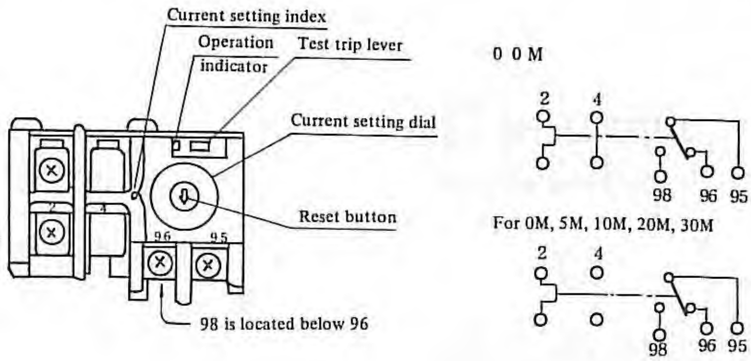


(c) For Model 30MH

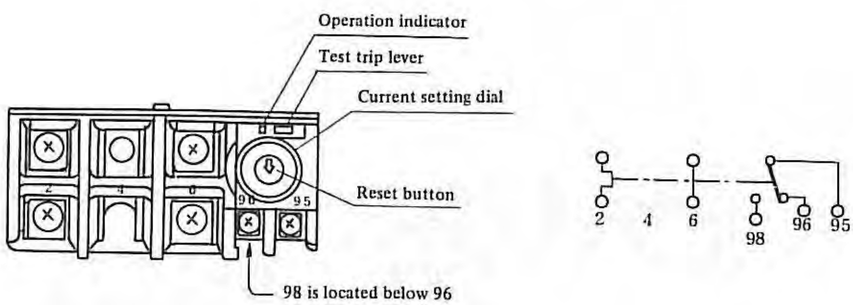


5.3.2 Thermal relay terminals arrangement

(a) For Models 00M, 0M, 5M, 10M, 20M, 30M

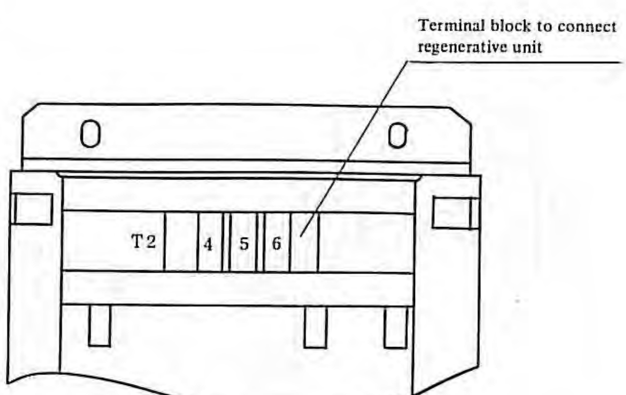


(b) For Model 30MH



5.3.3 Regenerative unit
10M, 20M, 30M velocity control unit

A06B-6047-H040, H041



Note: Other components are same as (c), (d).

APPENDIX 6. DC SERVO MOTOR MAINTENANCE

6.1 Outline

Proper maintenance inspection, such as check of the brush, is necessary to insure continued satisfactory operation of the DC servo motor used for driving the NC machine tool.

It is recommended that the concrete maintenance plan be made, referring to this manual, on the basis of the operating environment and operating condition in order to perform the proper maintenance inspection.

6.2 Reception and Storage

Immediately upon receipt of the DC servo motor, check the following items.

- Whether the DC servo motor is exactly the specified one (check the type, detector type).
- Whether there is any mechanical damage sustained in transit or not.
- Whether the rotating part can be normally turned by hand.
- In the case of the DC servo motor with brake, whether the brake is normal.
- Whether there is any loosened screw or play.

Every DC servo motor undergoes strict inspection before shipment, therefore any special receipt inspection may not be required as a rule. If the receipt inspection is particularly needed, however, it is advisable to refer to the specifications regarding the wiring of DC servo motor and detector, current, and voltage so as to make the inspection without any mistake. Don't leave the received DC servo motor outdoors, but preserve it indoors as soon as possible. Avoid storing it in the place with an extremely high or low humidity, a radical change of temperature, and dust.

If the DC servo motor is to be stored for more than one year, the brush should be removed from the DC motor. Because if the brush is left contacting the same place of the commutator for a long time, rusting and corrosion can take place from that place, which may cause poor commutation and noise.

6.3 Mounting

Note the following points when mounting the DC servo motor.

(1) The place where the DC servo motor is mounted should be so structured that check and replacement of the brush can easily be made. As the brush must be checked periodically, the structure which facilitates the check work is inevitably required.

(2) In the case of the DC servo motor with a heat pipe (with a fan motor), design the strucsture of the mounting place so as to easily check and clean the cooler.

(3) The water-proof structure of the DC servo motor is not so strict. If cutting oil, lubricating oil, etc. penetrate into the inside of the DC servo motor, these may cause poor insulation, short-circuit of the coil, defective commutator surface due to poor commutation, or abnormal wear of the brush. Therefore, due care should be taken so that the motor body will be kept away from such liquids as cutting oil and so on.

(4) When mounting the DC servo motor on the gear box where liquid lubrication is performed, use the DC servo motor with oil seal on the output shaft. If the lip of the oil seal is always exposed to oil, there is a possibility that the oil may penetrate little by little into the inside of the motor in the course of a long time. Therefore the height of the oil level must be lower than the oil seal lip. When the DC servo motor is mounted with the output shaft upward, mount another oil seal than the one on the motor shaft so as to make the structure where the oil which passed through the first oil seal can directly flow outside.
The oil seals used for the respective DC servo motors are listed in the following.

° The DC servo motors equipped with the oil seal as the standard parts.

DC motor model	Oil seal specification
00M	AC0382A0 (SC type)
0M, 5M	AB1017F0 (SB type)

° The DC servo motors having no oil seal as the standard parts. If the oil seal is necessary, the oil seal flange should be specially specified, or the oil seal should be furnished at the machine side.

DC motor model	Oil seal specification
10M, 20M, 30M, 30MH	AC2057A0 (SC type)

The oil seals used for the DC servo motors are the products of JAPAN OIL SEAL INDUSTRY Co., Ltd.

(5) The DC servo motor is coupled with the load through the direct coupling, gears, timing belt or such. In any case the force exerted on the motor shaft must not exceed the values shown in the following table, therefore due care should be taken for the operating condition, mounting method, and mounting accuracy.

DC motor model	Permissible radial load	Permissible axial load
00M	25 kg	8 kg
0M, 5M	75 kg	20 kg
10M, 20M, 30M, 30MH	450 kg	135 kg

° The values of permissible radial loads are the ones when the load is imposed on the end of the shaft.
The values in this table indicate the maximum permissible loads which are the sum of the constant force always exerted on the shaft owing to the mounting method (e.g., the force given by the tension of the belt when the belt coupling is used) and the force generated by the load torque (e.g., the force transmitted from the gear face).

(6) Make the wiring between the DC servo motor and the control circuit without any mistake, just as specified in the specifications. (See the connection diagram of the machine.) A mistake made in the wiring may cause runaway or abnormal oscillation and may give damage to the motor or the machine. When the DC servo motor is run by the open loop, the relations between the signals at the rspective terminals and the rotating direction are as follows.

i) Motor power line terminals (A1 and A2).
When the positive voltage is applied to terminal A1, the DC servo motor turns clockwise when viewed from the output shaft.

ii) Tachogenerator terminals (G1 and G2).
When the motor rotates clockwise when viewed from the shaft, the positive voltage generates on the G1 side.

iii) Resolver terminals (S1, S3; S2, S4; R1, R3)
When the excitation is made by applying Cosin across terminals S1 and S3 and by applying Sin across terminals S2 and S4, thus the motor is turned clockwise, the phase of output of R1 and R3 changes to negative.

6.4 Replacing Method for Pulse Coder

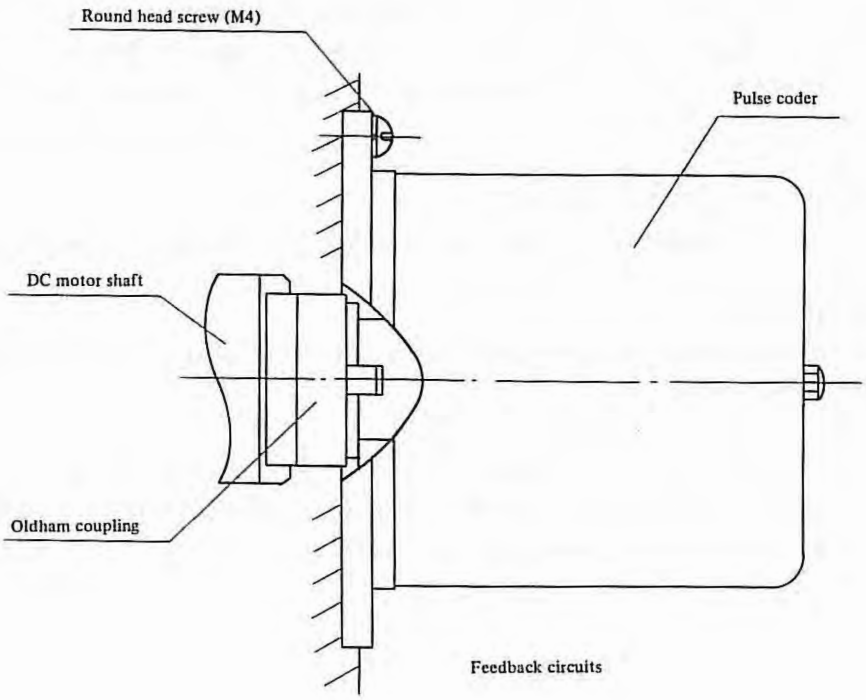
(1) Replacing process

(a) Remove M4 + screw.

(b) Remove the lead wires from the cannon connector by soldering.

(c) Remove the pulse coder.

(d) Mount the new pulse coder and tighten M4 screw.



Wining (Feed back)

Signal	Color	Cannon connector	Terminal name
A	(B and W) Pair B	A	G1
$\bar{A}$	(B and W) Pair W	D	S2
B	(Bl and W) Pair Bl	B	G2
$\bar{B}$	(Bl and W) Pair W	E	S4
Z	(G and W) Pair G	F	S1
$\bar{Z}$	(G and W) Pair W	G	S3
0V	G and W 2 lines	NPT	R1
5V	R and W 2 lines	CJK	R2

W: White B: Black Bl: Blue G: Green R: Red Gr: Gray

6.5 Cautions

(1) Brake

The brake which is built in the DC servo motor is the spring set brake of non-excitation type which operates on 100V AC power line. As the brake operates on AC power, the connection of the lead wires must be changed according to the frequency of power line. If the wiring is wrong, there is a possibility that the coil may be burned down or chart-tering is generated at absorption of the moving magnet core. Therefore confirm the wiring before turning on power. When the brake is needed to be temporarily released at installation of the machine, turn the knob of manual release fully clockwise. And after the work is finished, turn the knobfully counterclockwise to restore the state where the brake is applied at turning off the power. Immediately after this state is restored by means of the manual release knob, sometimes the brake disc is not normally pushed, consequently the brake torque becomes low. In such a case, try turning on and off the power several times to remove the trouble.

(2) DC motor with pulse coder

Since a disc made of glass is used in the pulse coder, avoid giving such extremely great shocks as hammering the DC motor and so on. As for the DC servo motor, there are not particular points to be periodically checked except the maintenance described in paragraph 4. In the event that the DC servo motor does not work normally, contact the FANUC Office. In general, avoid disassembling the motor or such work.

6.6 Spare Parts

As the spare parts, at least one set of motor brushes should always be kept for each DC servo motor.

Motor model	Number of spare brushes per set	Brush specification
Model 00M	4	A290-0632-V001
Model 0M, 5M	8	A290-0641-V001
Model 10M, 20M, 30M, 30MH	12	A290-0651-V001

APPENDIX 7. MAINTENANCE FOR CHARACTER DISPLAY

7.1 Adjustment

In general, an adjustment of character display is not required. Howevser, for the adjustment of brightness and contrast when required, variable resistors are provided in the side panel of display unit with an indication as shown brightness (B) and contrast (C). Perform the adjustment of these two resistors. (Refer to Fig. 1.1)

Note 1) The display unit, being applied a high voltage of 10 to 11 kV, should be taken care when the power is ON.

Note 2) In the case when a signal cable is disconnected, picture face becomes fully white.

Brightness (BRIGHT)

Brightness of the full portion of picture can be adjusted, and the adjustment must be normally made in such manner with the back-ground darkened when displaying the character.

(a) Raster (scanning line) is made not visible in the background for the contrast at maximum. (with the character becoming brightest)

(b) Raster must be made not visible in the background for the contrast at minimum. (With the character becoming darkest)

(c) Being affected by a condition of peripheral brightness, the rester must be made not visible when becoming dark.
And for the operation of above adjustment, which is made for providing better contrast, a trick of the work is to adjust the brightness immediately before the raster is seen.

Note) According to the parts of the character display unit, there are two adjusting places.

	Adjusting place	
	Fig. 1.1(a)	Fig. 1.1(b)
Character display unit	A13B-0055-C001 *1	
CRT display unit	A61L-0001-0072	A61L-0001-0076 *2
Regulator unit	A14L-0065-0001	————

*1 Character display unit is composed of CRT display unit, regulator unit and the other prts.

*2 Regulator unit is included.

Contrast (CONTRAST)

(a) The contrast, a difference of brightness, becomes an adjustment of character brightness, because the background has been made to zero brightness by the above described adjustment.

Make adjustment to easy-to-see brightness. Care should be taken not to excessively raise the contrast that may deform a figure of the character.

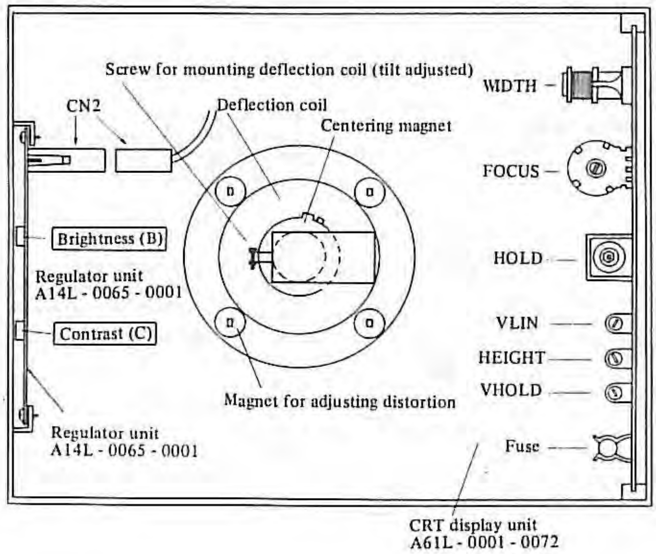


Fig. 7.1(a) Adjustment point (when as viewed from rear of the display unit)

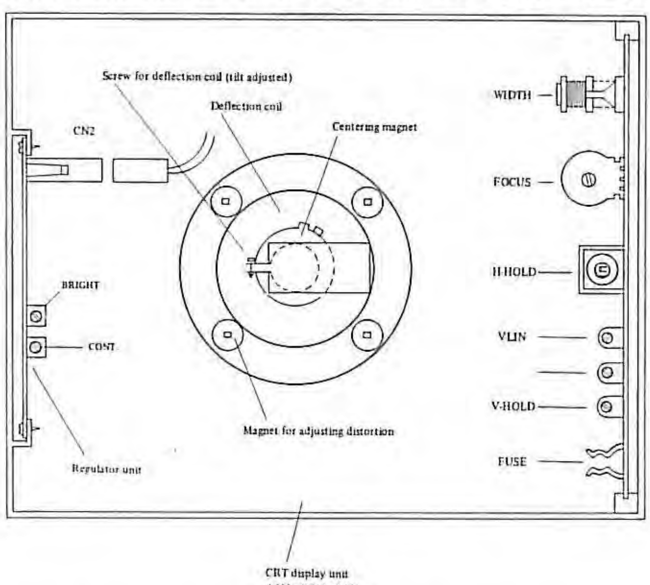


Fig. 7.1(b) Adjusting point (when as viewed from rear of the display unit)

7.2 Particular Adjustment

For repairing defects of the picture, flowing, distorted, tilted, etc., the following adjustment points are provided in the CRT display unit side. The adjustment is normally not required but becomes necessary after the replacement of CRT and deflection coil and the like.

(a) Picture distortion and position adjustment

The adjustment must be made by a distortion adjusting magnet, centering magnet, and the screw for mounting deflection coil.

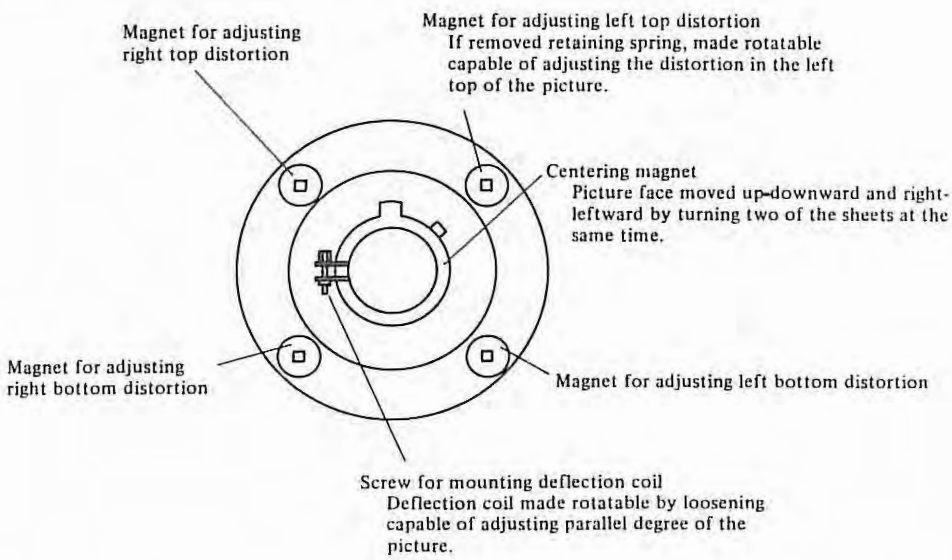
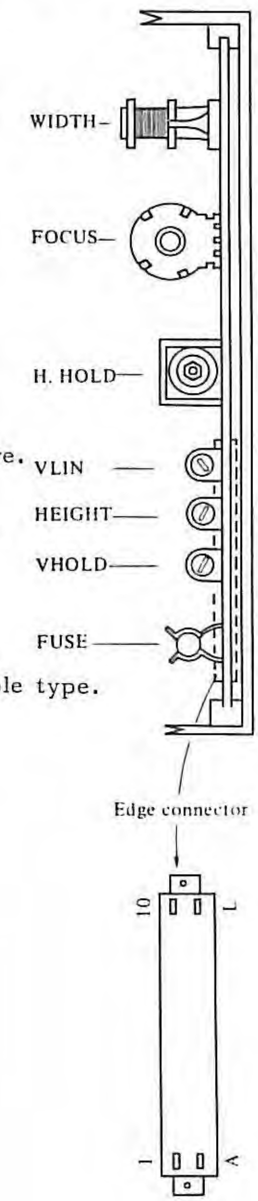


Fig. 7.2 (Deflection coil when as viewed from the rear of CRT)

(b) Adjustment of synchronization, focus, linearity, etc.
Adjustment must be made by a use of variable resistor, coil, etc. on PCB in the CRT display unit.

WIDTH	Size of the picture horizontally changed.
FOCUS	Character made clearer.
H.HOLD	Horizontal synchronization to stop right-left flowing of the picture.
V.LIN	Vertical linearity. Capable of vertically equalizing size of character in top and bottom stage.
HEIGHT	Vertical amplitude to vertically change a size of picture.
V.HOLD	Vertical synchronization to stop up-downward flowing of the picture.

(c) Fuse
The fuse for CRT display unit power source 1.6A 125V Rush durable type.



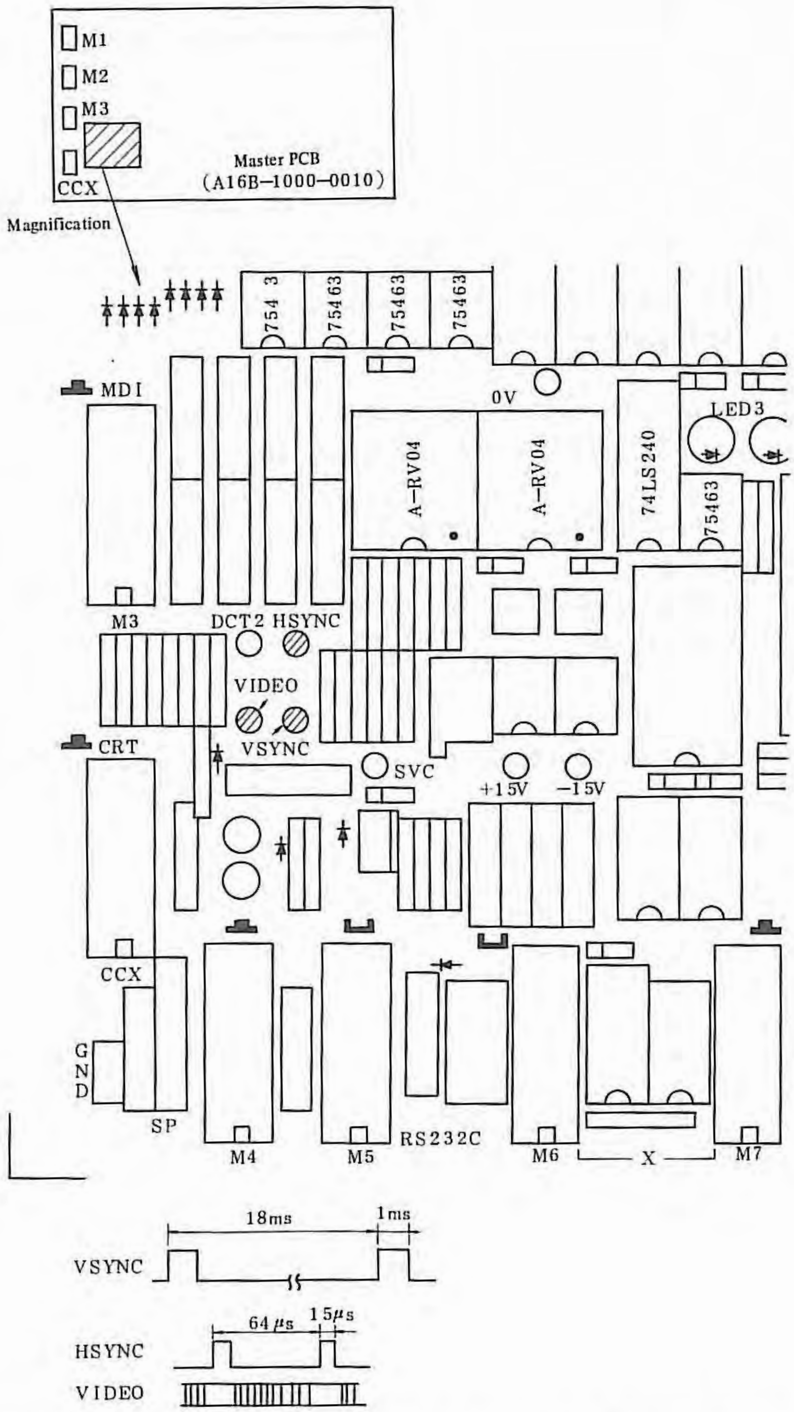


Fig. 7.2(c) Mounting position of check terminal and signal wave form of character generater signal

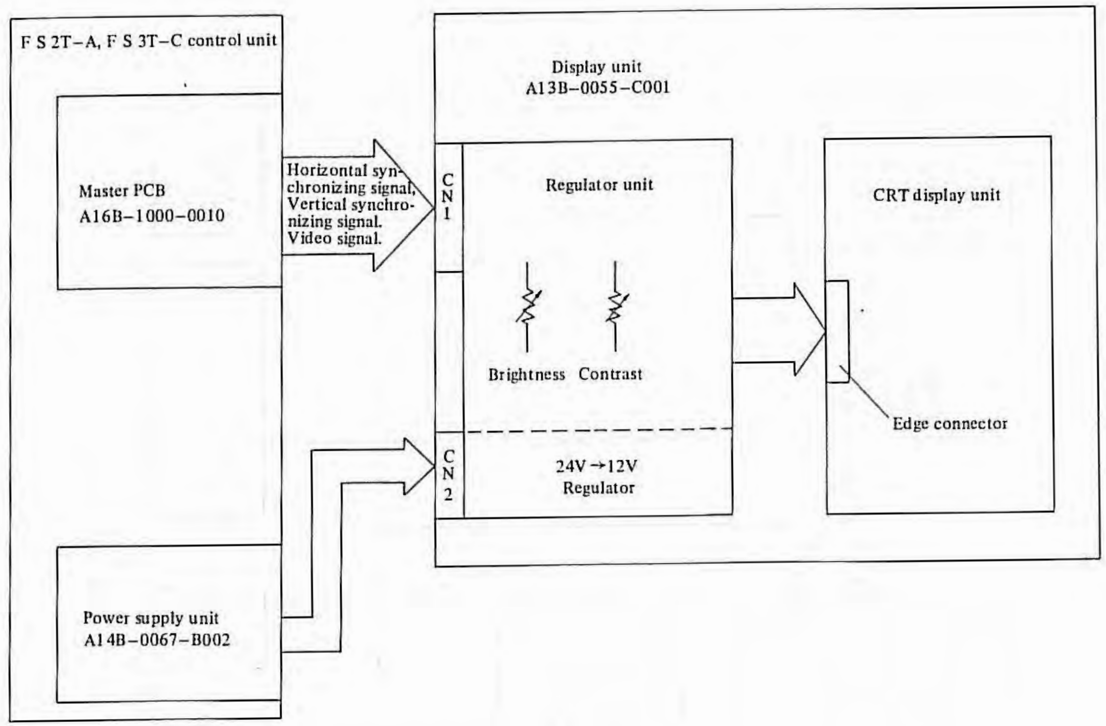
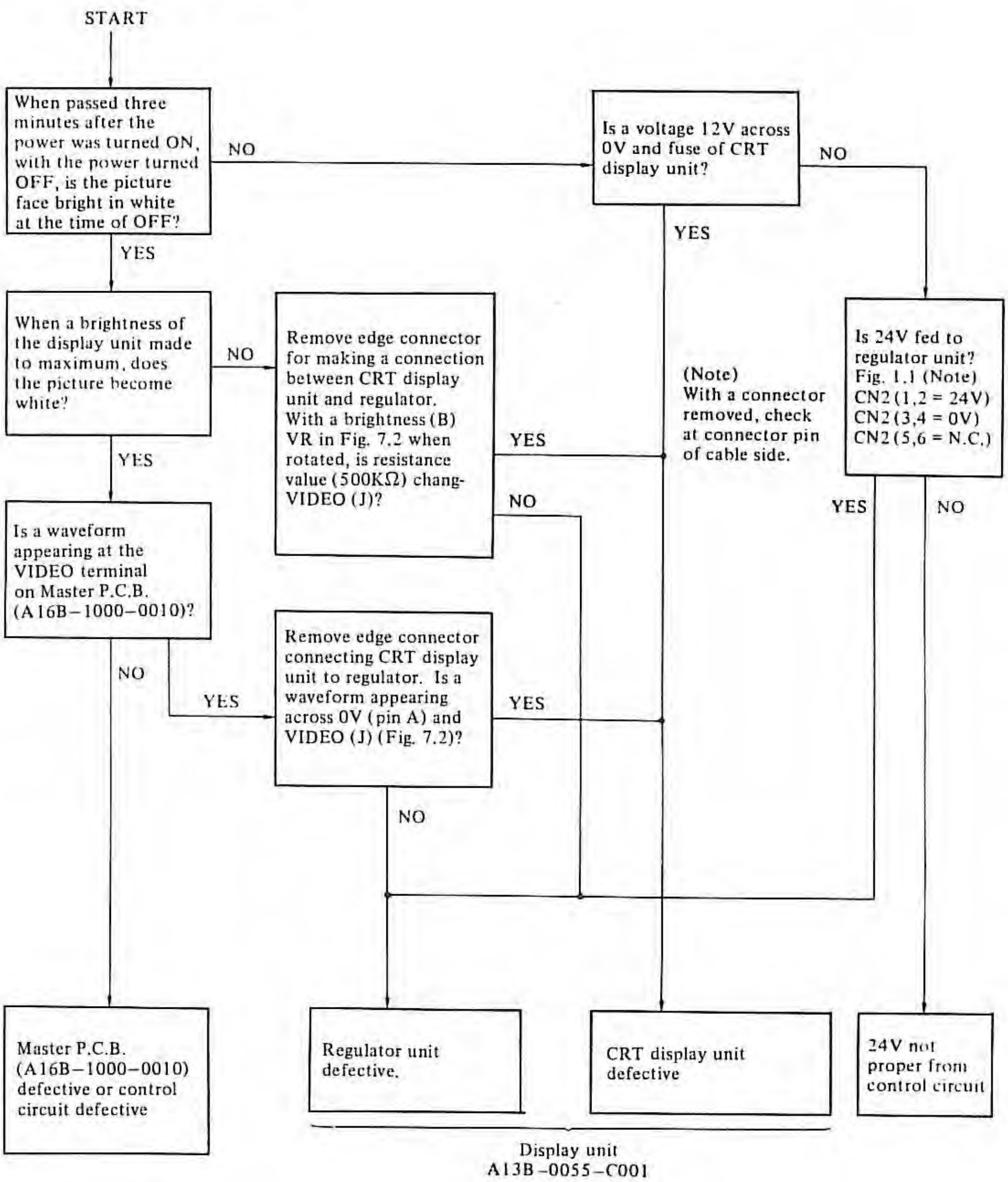


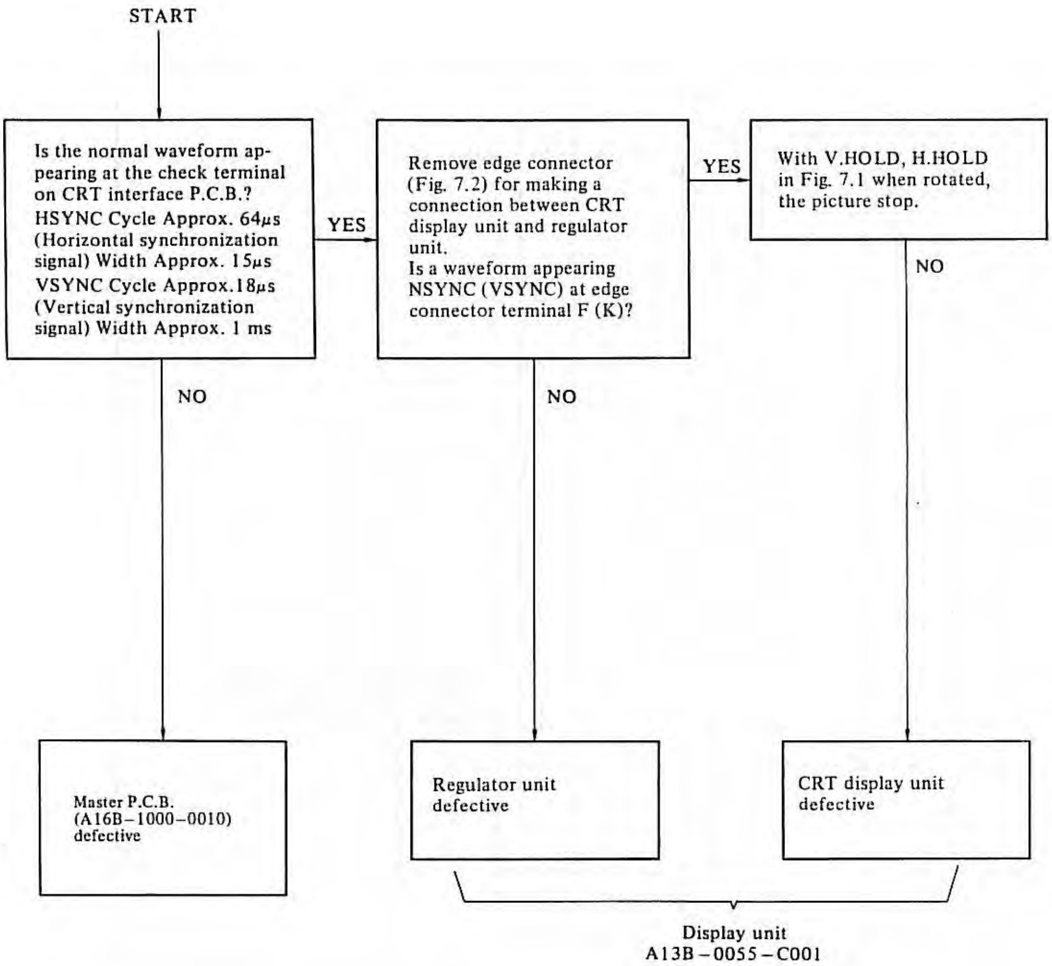
Fig. 7.2(d) Block diagram of character display

7.3 Flow Chart of Trouble Shooting

7.3.1 Not displayed



7.3.2 Flowing the picture



APPENDIX 8. TAPE CODE USED FOR PROGRAMMING

ISO code										EIA code											Meaning
Character	8	7	6	5	4		3	2	1	Character	8	7	6	5	4		3	2	1		
0			O	O		o				0			O			o					Numeral
1	O		O	O		o			O	1						o			O		"
2	O		O	O		o		O		2						o		O			"
3			O	O		o		O	O	3				O		o		O	O		"
4	O		O	O		o	O			4						o	O				"
5			O	O		o	O		O	5				O		o	O		O		"
6			O	O		o	O	O		6				O		o	O	O			"
7	O		O	O		o	O	O	O	7						o	O	O	O		"
8	O		O	O	O	o				8					O	o					"
9			O	O	O	o			O	9				O	O	o			O		"
A		O				o			O	a		O	O			o			O		Address A
B		O				o		O		b		O	O			o		O			" B
C	O	O				o		O	O	c		O	O	O		o		O	O		" C
D		O				o	O			d		O	O			o	O				" D
E	O	O				o	O		O	e		O	O	O		o	O		O		" E
F	O	O				o	O	O		f		O	O	O		o	O	O			" F
G		O				o	O	O	O	g			O	O		o	O	O	O		" G
H		O			O	o				h		O	O		O	o					" H
I	O	O			O	o			O	i		O	O	O	O	o			O		" I
J	O	O			O	o		O		j		O		O		o			O		" J
K		O			O	o		O	O	k		O		O		o		O			" K
L	O	O			O	o	O			l		O				o		O	O		" L
M		O			O	o	O		O	m		O		O		o	O				" M
N		O			O	o	O	O		n		O				o	O		O		" N
O	O	O			O	o	O	O	O	o		O				o	O	O			Cannot be used in significant section in ISO code, and regarded as a program number in EIA code.
P		O		O		o				p		O		O		o	O	O	O		Address P
Q	O	O		O		o			O	q		O		O	O	o					" Q
R	O	O		O		o		O		r		O			O	o			O		" R
S		O		O		o		O	O	s			O	O		o		O			" S
T	O	O		O		o	O			t			O			o		O	O		" T
U		O		O		o	O		O	u			O	O		o	O				" U
V		O		O		o	O	O		v			O			o	O		O		" V
W	O	O		O		o	O	O	O	w			O			o	O	O			" W
X	O	O		O	O	o				\			O	O		o	O	O	O		" X
Y		O		O	O	o			O	y			O	O	O	o					" Y
Z		O		O	O	o		O		z			O		O	o			O		" Z
DEL	O	O	O	O	O	o	O	O	O	Del		O	O	O	O	o	O	O	O	•	Delete (cancel of an error punch)
NUL						o				Blank						o				•	Not punched. Cannot be used in a significant section in EIA code
BS	O				O	o				BS			O		O	o		O		•	Back space
HT					O	o			O	Tab			O	O	O	o	O	O		•	Tabulator
LF or NL					O	o		O		CR or EOB	O					o					End of block
CR	O				O	o	O		O											•	Carriage return
SP	O		O			o				SP				O		o				•	Space
%	O		O			o	O		O	ER					O	o		O	O		Absolute rewind stop
(			O		O	o				(2-4-5)				O	O	o		O			Control out (A comment part is started)
)	O		O		O	o			O	(2-4-7)		O			O	o		O			Control in (A comment part ends)
+			O		O	o		O	O	+		O	O	O		o				•	Positive sign
–			O		O	o	O		O	–		O				o				–	Negative sign
:			O	O	O	o		O													Regarded as a programnumber in ISO code
/	O		O		O	o	O	O	O	/			O	O		o			O		Optional block skip
.			O		O	o	O	O		.		O	O		O	o		O	O		Period (Dedimal point)
#	O		O			o		O	O											•	Sarp
$			O			o	O													•	Dollar sign
&	O		O			o	O	O		&					O	o	O	O		•	Ampersand
'			O			o	O	O	O											•	Apostrophe
*	O		O		O	o		O												•	Asterisk
,	O		O		O	o	O			,			O	O	O	o		O	O	•	Comma
;	O		O	O	O	o		O	O											•	Semicolon
<			O	O	O	o	O													•	Left angle bracket
=	O		O	O	O	o	O		O											•	Equal sign
>	O		O	O	O	o	O	O												•	Right angle bracket
?			O	O	O	o	O	O	O											•	Question mark
@	O	O				o														•	Commercial at mark
"			O			o		O												•	Quotation mark

APPENDIX 9 G CODE TABLE

(1) For FS 2T-A

The following G codes are available.

G code	Group	Function	Basic or option
G00	01	Positioning	B
G01		Linear interpolation	B
G02		Circuler interporation (CW)	O
G03		Circuler interporation (CCW)	O
G04	00	Dwell	B
G10		Offset value setting	B
G20	06	Input in inch	B
G21		Input in mm	B
G27	00	Reference point return check	B
G28		Return to reference point	B
G32	01	Thread cutting	B
G50	00	Work coordinate system select	B
G68	04	Mirror image for double turret	O
G69		Mirror image cancel	B
G90	01	Cutting cycle A	B
G92		Thread cutting cycle	B
G94		Cutting cycle B	B
G98	05	Per minute feed	B
G99		Per revolution feed	B

APPENDIX 9.

(2) For FS 3T-C

Standard G code	Special G code	Group	Function	Basic/option
G00	G00	01	Positioning (rapid traverse)	B
G01	G01		Linear interpolation (feed)	B
G02	G02		Circular interpolation CW	B
G03	G03		Circular interpolation CCW	B
G04	G04	00	Dwell	B
G10	G10		Offset value setting	O
G20	G20	06	Inch data input	O
G21	G21		Metric data input	O
G25	G25	08	Spindle speed fluctuation detect OFF	B
G26	G26		Spindle speed fluctuation detect ON	B
G27	G27	00	Reference point return check	B
G28	G28		Return to reference point	B
G31	G31		Skip cutting	O
G32	G33	01	Thread cutting	B
G36	G36	00	Automatic tool compensation X	O
G37	G37		Automatic tool compensation Z	O
G40	G40	07	Tool nose radius compensation cancel	B
G41	G41		Tool nose radius compensation left	O
G42	G42		Tool lnose radius compensation right	O
G50	G92	00	Coordinate system setting, max. spindle speed setting	B, O
G65	G65		Custom macro calling	O
G68	G68	04	Mirror image for double turrets ON	O
G69	G69		Mirror image for double turrets OFF	B
G70	G70	00	Finishing cycle	O
G71	G71		Stock removal in turning	O
G72	G72		Stock removal in facing	O
G73	G73		Pattern repeating	O
G74	G74		Pack drilling on Z axis	O
G75	G75		Grooving on X axis	O
G76	G76		Thread cutting cycle	O
G90	G77	01	Cutting cycle A	O
G92	G78		Thread cutting cycle	O
G94	G79		Cutting cycle B	O
G96	G96	02	Constant surface speed control	O
G97	G97		Constant surface speed control cancel	B
G98	G94	05	Per minute feed	B
G99	G95		Per revolution feed	B
–	G90	03	Absolute programming	B
–	G91		Incremental programming	B

B: Standard O: Option

Note 1) Maximum spindle speed setting (G50) is valid when the constant surface speed control (option) is provided.

Note 2) The G codes marked with ▼ are set when the power is turned on.

Note 3) The G codes in the group 00 are not modal. They are effective only in the block in which they are specified.

Note 4) An alarm occurs when a G code not listed in the above table is specified (No. 010).

Note 5) A number of G codes can be specified in a block even if they do not belong to the same group. When a number of G codes of the same group are specified, the G code specified last is effective.

Note 6) A G code from each group is displayed.

APPENDIX 10 TABLE OF RANGE OF COMMAND VALUE

		Input in mm Output in mm	Input in inch Output in mm	Input in mm Output in inch	Input in inch Output in inch
Least input increment		0.001 mm	0.0001 inch	0.001 mm	0.0001 inch
Maximum stroke (Value from the reference point)		±9999.999 mm	±9999.999 mm	±999.9999 inch	±999.9999 inch
Maximum programmable dimension		±9999.999 mm	±999.9999 inch	±9999.999 mm	±999.9999 inch
Cutting feed rate override 100%	Feed per minutes	1 - 15000 mm/min	0.01 - 600.00 inch/min	1 -15000 mm/min	0.01 - 600.00 inch/min
	Feed per revolution	0.0001 - 500.0000 mm/rev	0.000001 - 9.999999 inch/rev	0.0001 - 500.0000 mm/rev	0.000001 - 9.999999 inch/rev
Rapid traverse rate (Separate for each axis)		30 - 24000 mm/min	30 - 24000 mm/min	3.0 - 960.0 inch/min	3.0 - 960.0 inch/min
Upper limit of value of cutting feed rate		6 - 15000 mm/min	6 - 15000 mm/min	0.6 - 600.0 inch/min	0.6 - 600.0 inch/min
Fo					
Manual jog feed rate		0 - 1260 mm/min	0 - 50.0 inch/min	0 - 1260 mm/min	0 - 50.0 inch/min
Thread lead		0.0001 - 500.0000 mm	0.000001 - 9.999999 inch	0.0001 - 500.0000 mm	0.000001 - 9.999999 inch
Max. spindle speed		9999 rpm	9999 rpm	9999 rpm	9999 rpm
Tool offset amount		0 - ±999.999 mm	0 - ±99.9999 inch	0 - ±999.999 mm	0 - ±99.9999 inch
Minimum value in incremental feed		0.001 mm	0.0001 inch	0.001 mm	0.0001 inch
Backlash compensation value		0 - 0.255 mm	0 - 0.255 mm	0 - 0.0255 inch	0 - 0.0255 inch
Dwell		0 - 9999.999 sec	0 - 9999.999 sec	0 - 9999.999 sec	0 - 9999.999 sec

APPENDIX 11 STATUS AT TURNING POWER ON AND AT RESET

O: The status is not changed or the movement is continued.

X: The status is canceled or the movement is interrupted.

	Item	At turning power on	At reset
Setting data	Offset value	O	O
	Data SETTING	O	O
	Parameter	O	O
Data	Program in the memory	O	O
	Content in the buffer	X	O: In MDI mode X: In other mode
	Display of the sequence number	X	O
	One-shot G code	X	X
	Modal G code	Initial code (G20/G21 is not changed.)	O
	F function	Zero	O
	S, T, M function	X	O
	Repetitive count	X	X
Coordinate system	Work coordinate value	Zero	O
Executing movement	Movement	X	X
	Dwell	X	X
	Sending of M, S or T code M31C - M35C output	X	X
	Miscellaneous function output other than M31C - M35C	X	O (X in emergency stop)
	Tool offset	X	O In MDI mode, in other mode, depends on parameter "TOC"
	Tool nose radius compensation	X	O: MDI mode X: In other modes
	Memorization of called subprogram number	X	X (Note 1)
Display LED	Indication of alarm	If there is no alarm, extinguishes	Same as left
	Indication of NOT READY	X	O (X in emergency stop)
	Indication of BUF	It is extinguished	O In MDI mode, In other modes, extinguishes

	Item	At turning power on	At reset
Output signals	Reference point return LED	X	O (X in emergency stop)
	S and T code	X	O
	M code, M31C - M35C	X	X
	Miscellaneous function output other than M31C - M35C	X	O (X in emergency stop)
	M, S and T strobe signal	X	X
	Spindle revolution signal (analog signal)	O	O
	NC ready signal	ON	O
Outputs signals	Servo ready signal	ON (Other than servo alarm)	ON (Other than servo alarm) (X in emergency stop)
	CYCLE START LED	X	X
	FEED HOLD LED	X	X

Note 1) When the NC is reset during the subprogram execution, the control returns to the start of the main program. The subprogram cannot be executed from the middle of it.

APPENDIX 12 OPERATION TABLE

Classification	Function	Key switch	Parameter enabl switch	Mode switch button	Function button	Operation
Clear	Memory all clear		O	Power ON	-	[RESET] and [DELET]
	Clearing parameter		O	Power ON	-	[RESET]
	Clearing stored program			Power ON	-	[DELET]
Data Input from Tape	Parameter (Tape→Memory)		O	EDIT	PARAM	[INPUT]
	PC parameter input	O		EDIT made	DGNOS	[INPUT]
	Offset value			EDIT	OFSET	[INPUT]
	Program input	O		EDIT/AUTO	PRGRM	[INPUT]
Data Input from MDI	Parameter		O	MDI	PARAM	[O/P] → Parameter No. → [INPUT] → [Data] → [INPUT] →* *Parameter enable switch OFF → [RESET]
	Offset value			-	OFSET	[O/P] → Offset No. → [INPUT] → Offset data → [INPUT]
	Setting data			MDI	PARAM	[O/P] → 0 → [INPUT] → Data → [INPUT]
Tape Punch	Parameter			MDIT	PARAM	[START]
	Offset value			EDIT	OFSET	[START]
	All program			EDIT	PRGRM	[O] → -9999 → [START]
	One Program			EDIT	PRGRM	[O] → Program No. → [START]
Search	Program No. search			EDIT/AUTO	PRGRM	[O] → Program No. → [↓] (CURSOR)
	Address sequence number search			AUTO	PRGRM	Program No. search → [N] → Sequence No. → [↓] (CURSOR)
	Address word search			EDIT	PRGRM	Searching address and data input → [↓] (CURSOR)
	Address search			EDIT	PRGRM	Searching address → [↓] (CURSOR)
	Deletion of all Programs	O		EDIT	PRGRM	[O] → -9999 → [DELET]
Program Editing	Deletion of a program	O		EDIT	PRGRM	[O] → Program No. → [DELET]
	Deletion of several blocks	O		EDET	PRGRM	[N] → Sequence No. → [DELET]
	Deletion of a block	O		EDIT	PRGRM	[EOB] → [DELET]
	Deletion of a word	O		EDIT	PRGRM	Search the word to be deleted → [DELET]
	Alteration of a word	O		EDIT	PRGRM	Search the word to be dltered → Address → Data → [ALTER]
	Insertion of a word	O		EDIT	PRGRM	Search the word before the place in the program Address → Data → [INSRT]
Collation	Collation in memory with tape			EDIT/AUTO	PRGRM	[INPUT]
Input/output with FANUC Cassette	Program input	O		EDIT/AUTO	PRGRM	[N] → File No. → [INPUT] → [INPUT]
	Output all program			EDIT	PRGRM	[O] → -9999 → [START]
	Output one program			EDIT	PRGRM	[O] → Program No. → [START]
	Searching for a head of a file			EDIT/AUTO	PRGRM	[N] → File No. or -9999 or -9998 → [INPUT]
	Deletion of file	O		EDIT	PRGRM	[N] → File No. → [START]
	Collation in file with tape			EDIT/AUTO	PRGRM	[N] → File No. → [INPUT] → [INPUT]

Revision Record

FANUC SYSTEM 2T-MODEL A
FANUC SYSTEM 3T-MODEL C
Maintenance Manual (B-53945E)

Edition	Data	Contents	Edition	Data	Contents
02	1983.11	· Addition of the explanations for FS 3T-C maintenance. · Addition of the explanation for the new type CRT display unit (A61L–0001–0076). · Error correction. (1984.1)			
01	1982.09	————			

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