FANUC 10/100 series
FANUC 11/110 series
FANUC 12/120 series

MAINTENANCE MANUAL

B-54815E/05

This manual describes the following products.

Name of products	Abbreviation		
FANUC 10T-MODEL A	10T-A	10T	10 series
FANUC 10T-MODEL F	10T-F		
FANUC 10M-MODEL A	10M-A	10M	
FANUC 11T-MODEL A	11T-A	11T	11 series
FANUC 11TT-MODEL A	11TT-A	11TT	
FANUC 11TT-MODEL F	11TT-F		
FANUC 11M-MODEL A	11M-A	11M	
FANUC 11M-MODEL F	11M-F		
FANUC 12T-MODEL A	12T-A	12T	12 series
FANUC 12M-MODEL A	12M-A	12M	
FANUC 100T-MODEL A	100T-A	100T	100 series
FANUC 100M-MODEL A	100M-A	100M	
FANUC 110T-MODEL A	110T-A	110T	110 series
FANUC 110M-MODEL A	110M-A	110M	
FANUC 120T-MODEL A	120T-A	120T	120 series
FANUC 120M-MODEL A	120M-A	120M	

CONTENTS

1. GENERAL 1
1.1 Structure 2
1.2 Construction 21
1.3 System Block Diagram 36
1.3.1 10/100 series 36
1.3.2 11/110 series 39
1.3.3 12/120 series 41
1.4 PCB and Units Table 48

2. PERIODIC MAINTENANCE AND MAINTENANCE EQUIPMENT 64
2.1 Periodic Maintenance 64
2.2 Maintenance Equipment 75
2.3 Main Spare Parts 75

3. TROUBLESHOOTING 76
3.1 Procedures 76
3.2 Error Message 76
3.3 Checking and Countermeasures 77
3.3.1 No power can be turned on 77
3.3.2 CRT screen is not displayed after turning on power supply 78
3.3.3 Troubleshooting by alarm number 78
3.3.4 Lighting of LED on master PCB 97
3.3.5 JOG operation failure 104
3.3.6 Operation failure with manual pulse generator 105
3.3.7 Synchronous feed operation failure 106
3.3.8 Tape is not ready normally 106
3.3.9 No automatic operation is possible 111
3.3.10 Spindle binary/analog output voltage is abnormal 112
3.3.11 Analog output voltage linearity is not good 114
3.3.12 Reader/puncher and ASR33 interface do not operate normally 115
3.3.13 Stop position does not coincide with reference point return position 116
3.3.14 System error 121
3.4 Power Voltage Check 124
3.4.1 Input unit 124
3.4.2 Input power voltage check 127
3.4.3 DC voltage checking 133
3.4.4 Power voltage check on velocity control unit PCB 143
3.5 Tape Reader Photo-amplifier Adjustment 144
3.5.1 Tape reader without reels photo-amplifier adjustment 144
3.5.2 Tape reader with reels photo-amplifier adjustment 146
3.6 Connecting Diagram of NC Inside 150
3.7 Status Display by Self-Diagnostic Function 169
3.7.1 Interface display 169
3.7.2 Display of 170
3.7.3 Memory contents display 172
3.7.4 I/O signal diagnostic data 173
3.7.5 Address list for 11TT 187
3.7.6 LED display of I/O module 224
3.8 Block Diagram of Servo System 225
3.8.1 Block diagram of position control 225
3.8.2 Block diagram of M series velocity control unit 227
3.8.3 Internal connection diagram of M series velocity control unit 228
3.8.4 Block diagram of M series velocity control unit PCB 231
3.8.5 Block diagram of AC series velocity control unit 232

3.8.6 AC servo velocity control unit inside connecting diagram 233
3.9 Connection with Servo 237
3.9.1 Connection to M series servo 237
3.9.2 Connection to AC servo 242
3.10 Standard Connection and Reverse Connection of Motor 256
3.10.1 When using M series servo 256
3.10.2 When using analog AC servo 261
3.10.3 When using digital AC servo 264
3.11 Troubleshooting for Servo Unit 265
3.11.1 Machine tool runs away 265
3.11.2 Machine tool vibrates 265
3.11.3 Poor positioning accuracy or machining accuracy 266
3.11.4 Method of confirming the operation of velocity control unit and position control unit (For analog servo) 269
3.12 Error Display and It's Contents of I/O Unit 270
3.12.1 Error display and contents in interface module (IF01A) 270
3.12.2 Error display and contents in interface module (IF04C) 272
3.12.3 Error display and contents in positioning module (PT01A) 274
3.12.4 Fuse alarm of I/O module 296

4. ADJUSTMENT 302
4.1 Procedure of Adjustment 302
4.2 Connection of Power Transformer 309
4.2.1 Tap change of control power transformer 309
4.2.2 Connection of M series servo power transformer 309
4.2.3 Connection of AC servo power transformer 312

5. PARAMETER 317
5.1 Parameter Display 317
5.1.1 Displaying parameters other than pitch error compensation data 317
5.1.2 Displaying pitch error compensation data 317
5.2 Parameter Setting 317
5.2.1 Parameter tape format 317
5.2.2 Setting parameters using parameter tape 319
5.2.3 Setting from MDI 319
5.3 Parameter Tape Punch 320
5.3.1 Punching all parameters 320
5.3.2 Punching the parameters except pitch error compensatio 320
5.3.3 Punching pitch error compensation data 320
5.4 Parameters 321
5.5 PMC Data Setting and Display (PCPRM) 333
5.5.1 Timer setting and display 333
5.5.2 Counter setting and display 334
5.5.3 Setting and display of keep relay and nonvolatile memory control data 335
5.5.4 Setting and display of data table 336
5.5.5 Setting and display of positioning MODULE parameter 338

6. SETTING AND ADJUSTMENT ON PCBs 340
6.1 Setting and Adjustment on the Control Unit PCBs 340
6.1.1 Setting on the control unit PCBs for 10 and 11 series 340
6.1.2 Adjustment on the control unit PCBs for 10/11/100/110 series .. 347
6.1.3 Mounting positions of setting pins/variable resistor on control unit PCBs 348
6.1.4 Adjusting methods related DSCG 362
6.1.5 Setting and adjustment on 12/120 series control unit PCB 367
6.1.6 I/O unit setting and adjustment 385
6.2 Setting and Adjustment for M Series Velocity Control Unit 392
6.2.1 Setting and adjustment on M series velocity control unit PCB .. 392

6.3 Setting and Adjustment on PCB for Velocity Control Unit for Analog Servo AC Servo Motor 398
6.3.1 Parts location on PCB 398
6.3.2 Setting terminal 408
6.3.3 Variable resistor 419
6.3.4 Check terminal list 419
6.4 Setting and Adjustment on PCB for Velocity Amplifier for AC Servo Motor 423
6.4.1 Parts location on PCB 423
6.4.2 Setting terminal 429
6.4.3 Check terminals list 430
6.5 Setting and Adjustment for AC Spindle Servo Unit 431
6.5.1 PCB parts mounting diagram 431
6.5.2 Main parts list for AC spindle servo unit for motor model 3 - 15 432
6.5.3 Adjustment of variable resister on the PCB for AC spindle servo unit 434
6.5.4 Description of check terminal 439
6.6 Adjustment of Spindle Orientation Control Circuit 441
6.6.1 Adjustment of magnetic sensor system spindle orientation 441
6.6.2 For position coder system 452

7. REPLACING METHOD OF PCB AND UNITS 456
7.1 Replacing Methods of Power Supply Unit 456
7.1.1 Procedure 457
7.2 Replacing Methods of Option PCB (for 10/11/100/110 series) and Control PCB (for 12/120 series) 457
7.3 Replacing Methods of PMC ROM Cassette 459
7.4 Replacing Methods of Master PCB 460
7.5 Replacing Methods of 12/120 Series 469
7.6 Replacing Methods of 10TF, 11MF, 11TT-F, Conversational PCB 470
7.7 Replacing Methods of Connection Unit 1 472
7.8 Replacing Methods of Connection Unit 2 473
7.9 Replacing Methods of Built-in Type I/O Unit PCB (12/120 series only) 477
7.9.1 Replacing method of interface and I/O module 477
7.9.2 Replacing method of I/O base unit 478
7.10 Exchange Methods of I/O Unit 479
7.10.1 Exchange methods of power supply module 479
7.10.2 Exchange methods of main control module and I/O module 480
7.10.3 Exchange methods of base units 483
7.11 Replacing Methods of Small CRT/MDI PCB 485
7.11.1 Replacement of PCB A (keyboard PCB) 485
7.11.2 Replacement of PCB B (soft key PCB) 485
7.12 Replacing Methods of 9" Standard CRT/MDI Unit PCB 487
7.13 Replacing Methods of 14" Color CRT/MDI (horizontal type) PCB 490
7.13.1 10/11/12 series 490
7.13.2 100/110/120 series 492
7.14 Replacing Methods of 14" CRT/MDI Graphic Unit (vertical type) PCB (10/11/12 series) 494
7.15 Replacing Methods of PCB and Others Referred to Tape Reader 495
7.15.1 Replacement of PCB of tape reader without reels photoamplifier 495
7.15.2 Replacing methods of tape reader with reels PCB and fuse 496
7.15.3 Replacement of capstan roller of tape reader without reels 496
7.15.4 Replacement of capstan roller of tape reader with reels 496
7.15.5 Replacement of brushes of tape reader with reels sole motor ... 499
7.16 Replacement of PCB for Velocity Control Unit and AC Servo Amplifier 500

APPENDIX

APPENDIX 1 CONNECTION DIAGRAMS 505
APPENDIX 2 DETAILS OF POWER UNIT 574
APPENDIX 3 SPECIFICATIONS OF MAJOR PARTS IN M SERIES VELOCITY CONTROL UNIT 589
APPENDIX 4 DC SERVO MOTOR MAINTENANCE 592
APPENDIX 5 AC SERVO MOTOR MAINTENANCE 601
APPENDIX 6 HOW TO INITIALIZE BUBBLE MEMORY 603
APPENDIX 7 FUSES LIST 608
APPENDIX 8 PROPERTY OF LUBRICATION OIL FOR MAINTENANCE OF TAPE READER .. 623
APPENDIX 9 FAN UNIT LIST 626
APPENDIX 10 PARAMETER AND DIAGNOSTIC DISPLAY FUNCTION OF POSITIONING MODULE 627

1. GENERAL

10/11/12/100/110/120 series is specifically designed to be latest CNC system having a structure common to both software and hardware. It can easily satisfy the demands of many different machine tools. This up-to-date CNC system uses powerful microprocessors, newly developed large-scale custom LSI, optical fiber, large-capacity bubble memory, color CRT, and other components created by using the latest technology.
This manual describes preventive maintenance for using the 10/11/12/100/110/120 series, quick troubleshooting procedures for possible failures, check points and adjustments at the time of installation.
Refer to 10/11/12/100/110/120 series operator's manual (Appendix) (B-54810E) for various pieces of technical information such as detailed description of parameters.
Please refer to the operator's manual (B-54814E) and connecting manual (B-54813E) when needed.

Description of terms frequently used in this manual

Least input increment ..... The minimum unit for program input of the move command
Least command increment ..... The minimum unit of a command given from NC to machine tool
Detection unit ..... The minimum unit to detect a machine tool position
Command multiplier (CMR) ..... A constant to enable the weight of NC command pulses to coincide with the weight of pulses from the detector
Detection multiplier (DMR) .... A constant to enable the weight of NC command pulses to coincide with the weight of pulses from the detector

(Note) The relationships among the least input increment, detection unit, CMR and DMR are as specified below.

$$\text{Least input increment} = \text{CMR} \times \text{detection unit}$$

$$\text{Detection unit} = \frac{\text{Movement per rotation of motor}}{\text{DMR} \times \text{No. of pulses of detector per rotation of motor}}$$

CRT/MDI panel ..... Abbreviation for Manual Data Input & CRT panel
This operation panel is used to input a command to the NC and display NC conditions by using key switches.
Parameters ..... Values to be set to fully display functional features of an NC machine tool to the maximum extent when the NC is combined with the machine tool.

	10T/100T	10M/100M	11T/110T	11M/110M
Small CRT/MDI	A02B-0072-C001	A02B-0073-C001		
Standard CRT/MDI	A02B-0076-C022	A02B-0076-C021	A02B-0076-C022	A02B-0076-C021
Tape Reader Without Reels	A13B-0073-B001		A13B-0070-B001	
Tape Reader With Reels	A13B-0080-B001			
Input Unit B	A14B-0076-B003		A14B-0076-B101	
C	A14B-0076-B004		A14B-0076-B102	
D	A14B-0076-B005		A14B-0076-B103	

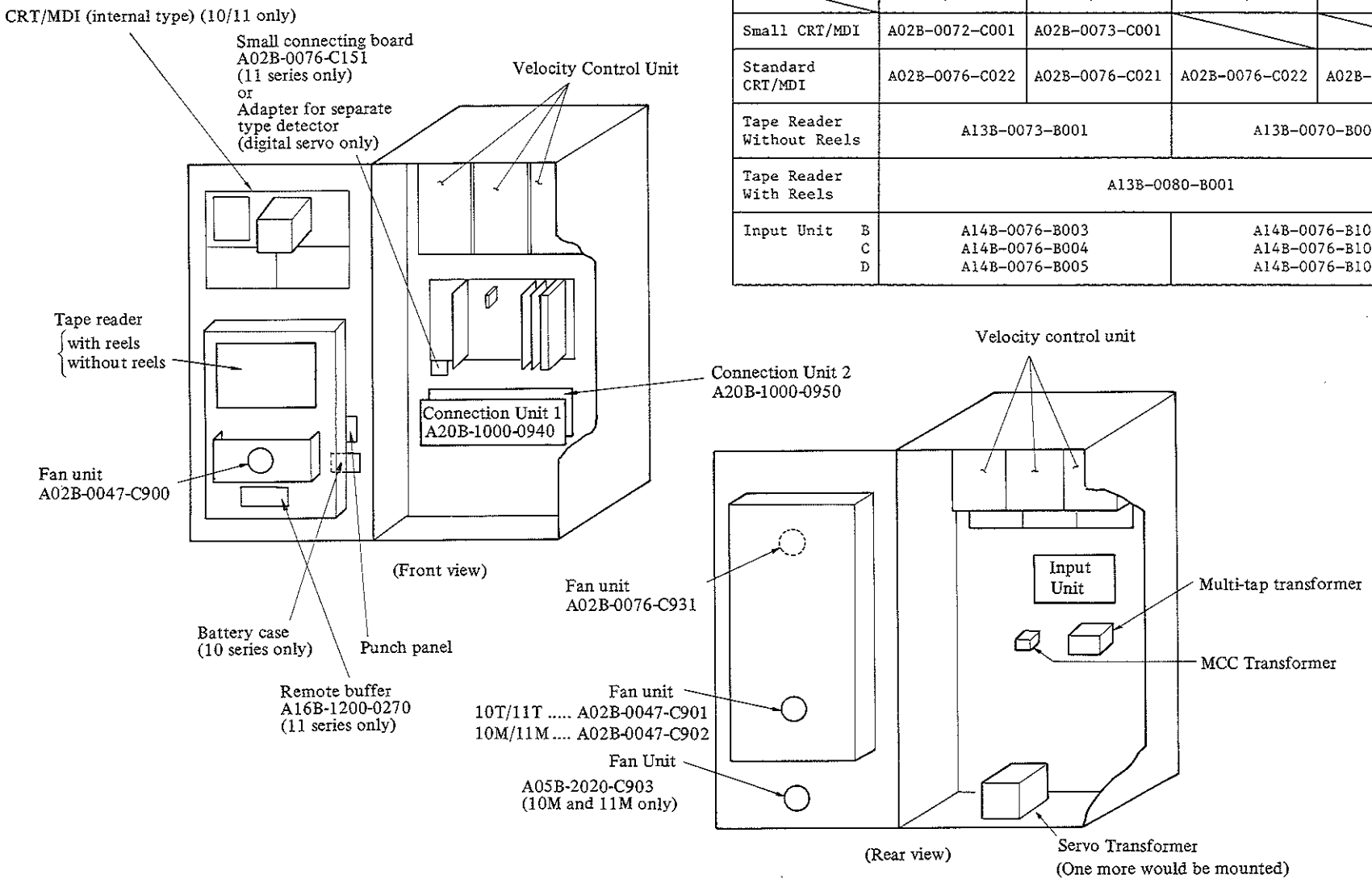


Fig. 1.1 (a) Free-standing cabinet internal component location for 10/11/100/110

	10T	10M	11T/11TT	11M
Small CRT/MDI	A02B-0072-C001	A02B-0073-C001		
Standard CRT/MDI	A02B-0076-C022	A02B-0076-C021	A02B-0076-C022	A02B-0076-C021

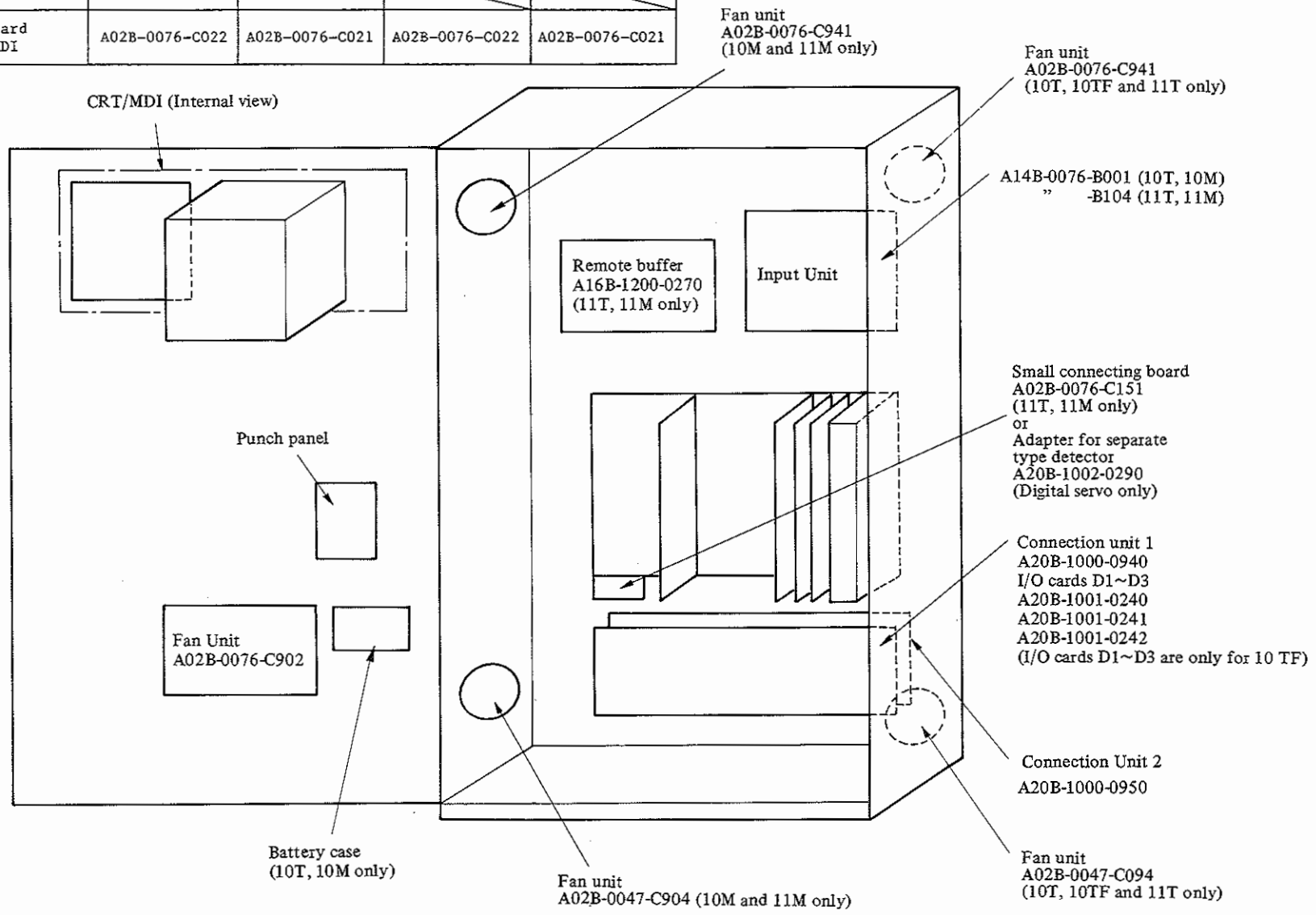
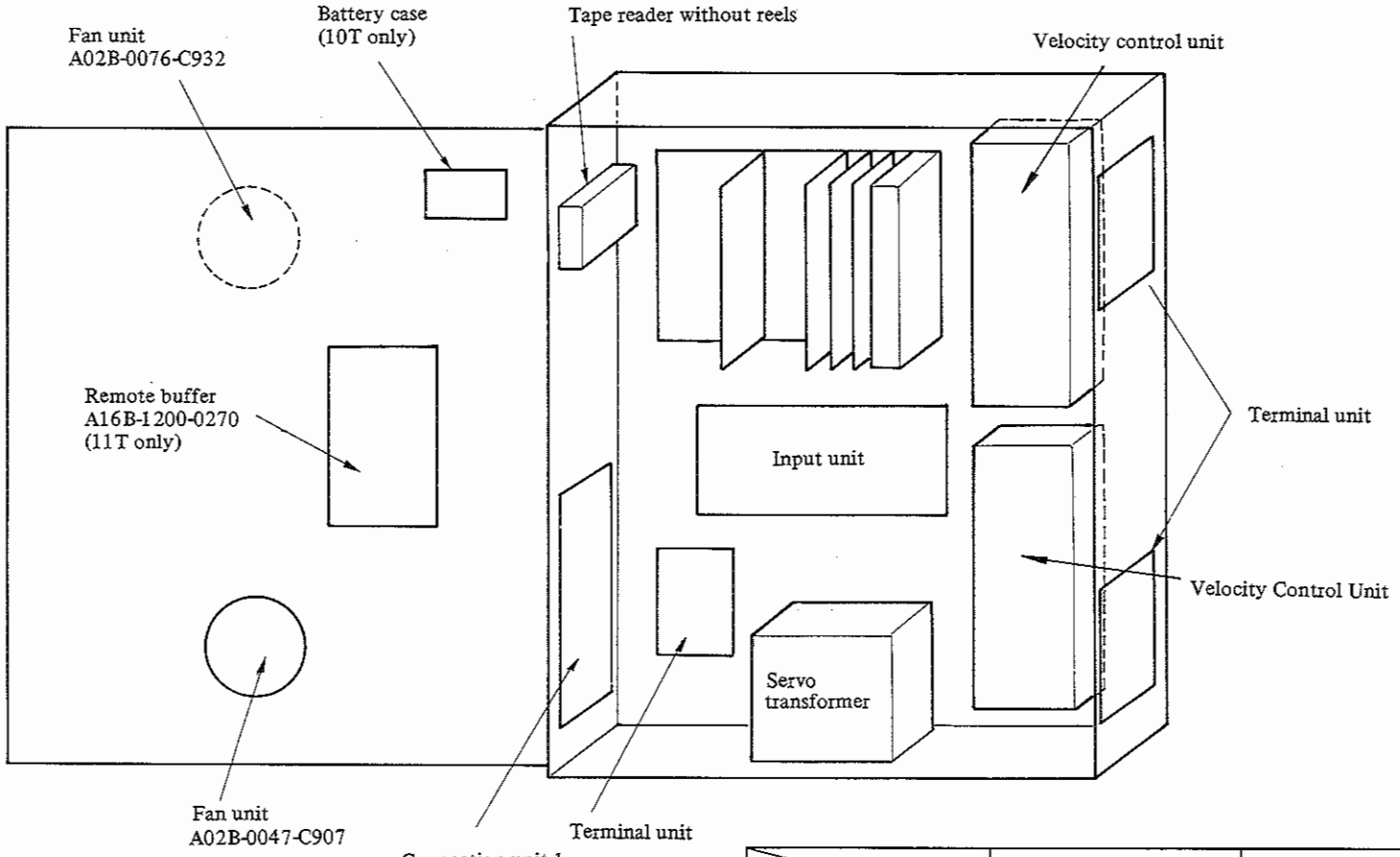


Fig. 1.1 (b) Built-in 1 cabinet internal component location for 10/11/100/110 series



	10T	11T
Input unit B	A14B-0076-B003	A14B-0076-B101
C	A14B-0076-B004	A14B-0076-B102
D	A14B-0076-B005	A14B-0076-B103

Fig. 1.1 (c) Built-in 2 cabinet internal component location (for 10T/11T)

	10M	11M	11TT
Small CRT/MDI	A02B-0073-C001		
Standard CRT/MDI	A02B-0076-C021	A02B-0076-C021	A02B-0076-C022
Tape Reader Without Reels	A13B-0073-B001	A13B-0070-B001	
Tape Reader With Reels	A13B-0080-B001		

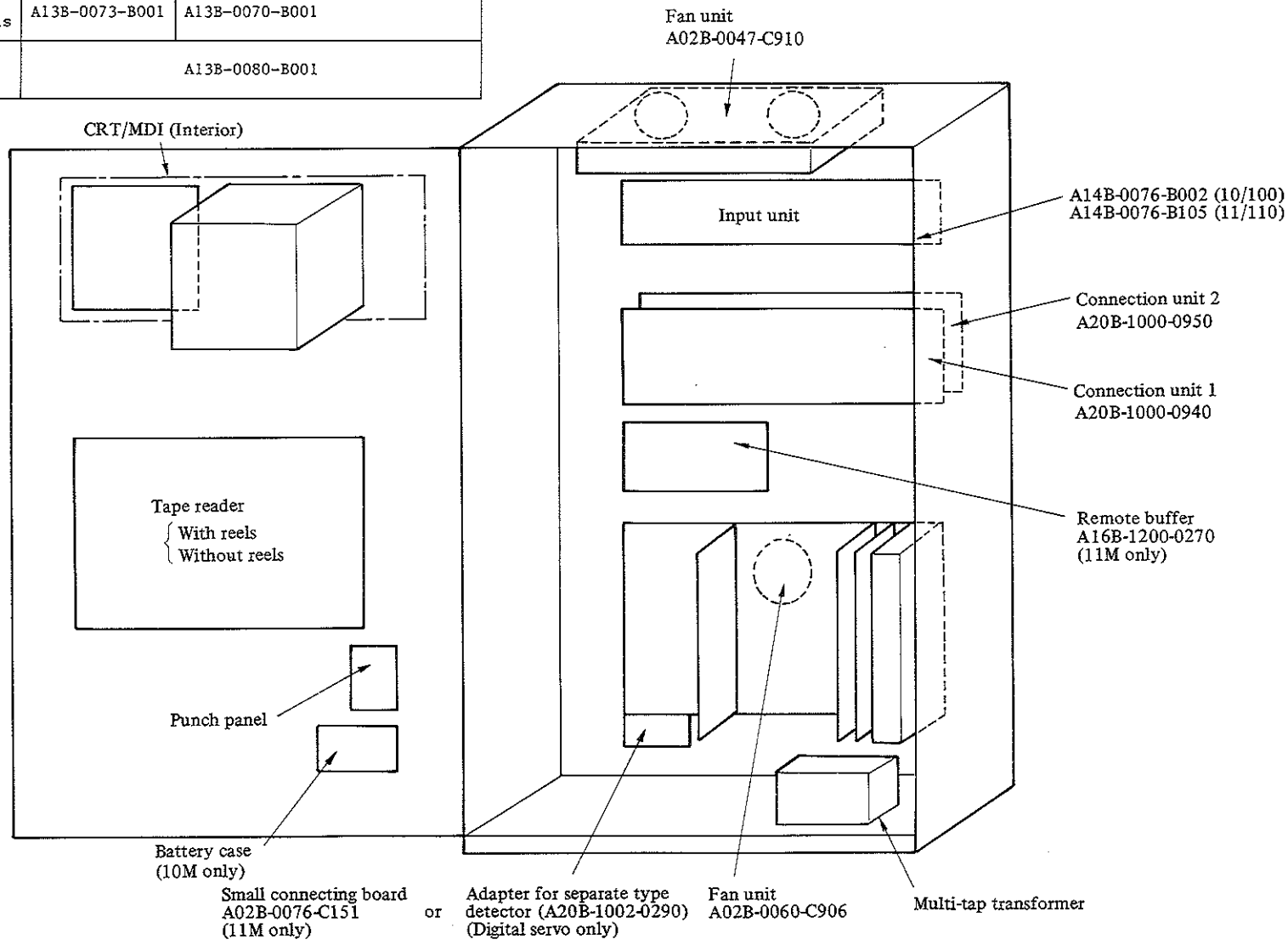


Fig. 1.1 (d) Built-in 2 cabinet internal component location (for 10M/11M/11TT)

	10M	11M
Small CRT/MDI	A02B-0073-C001	
Standard CRT/MDI	A02B-0076-C021	A02B-0076-C021
Tape Reader Without Reels	A13B-0073-B001	A13B-0070-B001
Tape Reader With Reels	A13B-0080-B001	

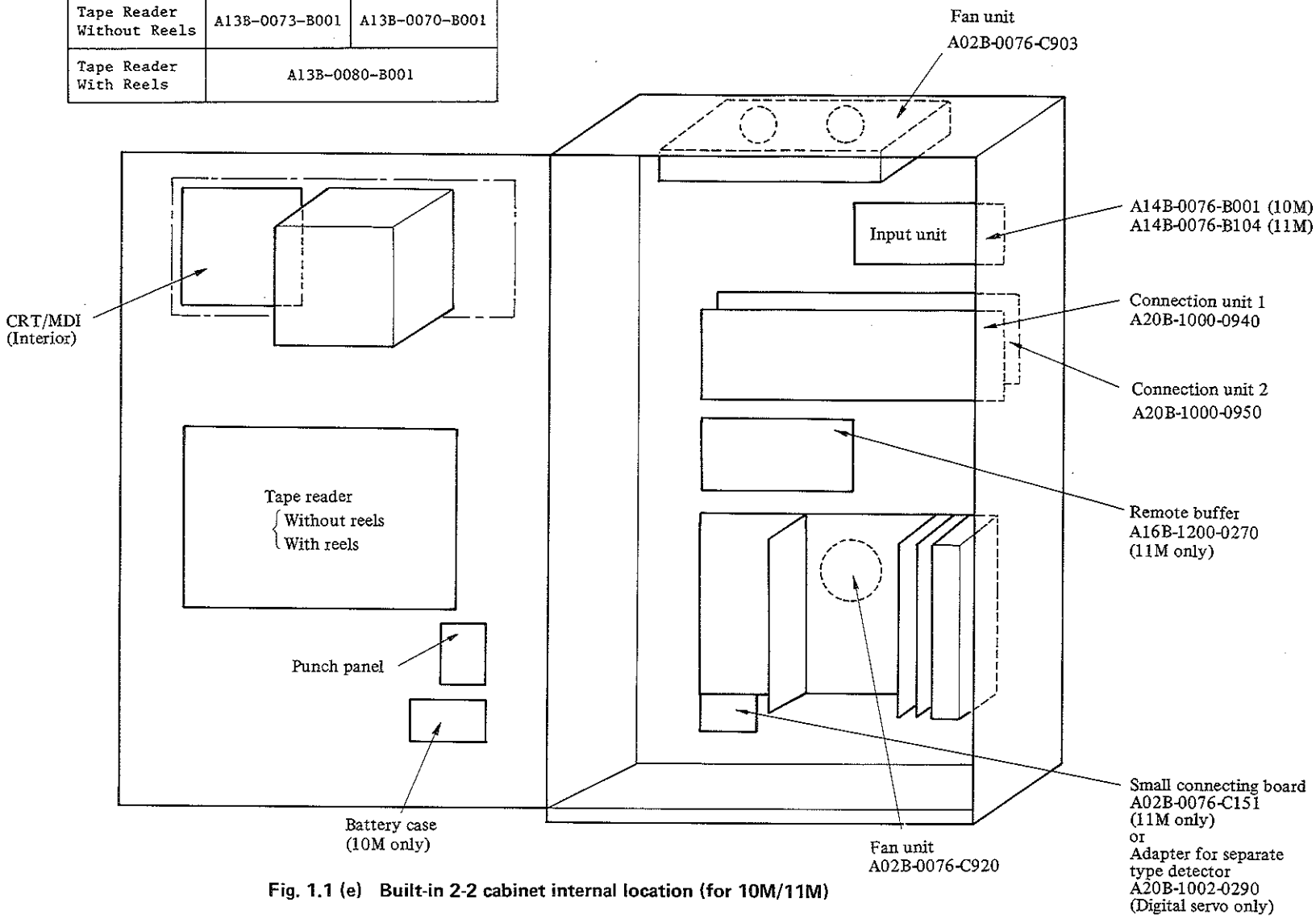


Fig. 1.1 (e) Built-in 2-2 cabinet internal location (for 10M/11M)

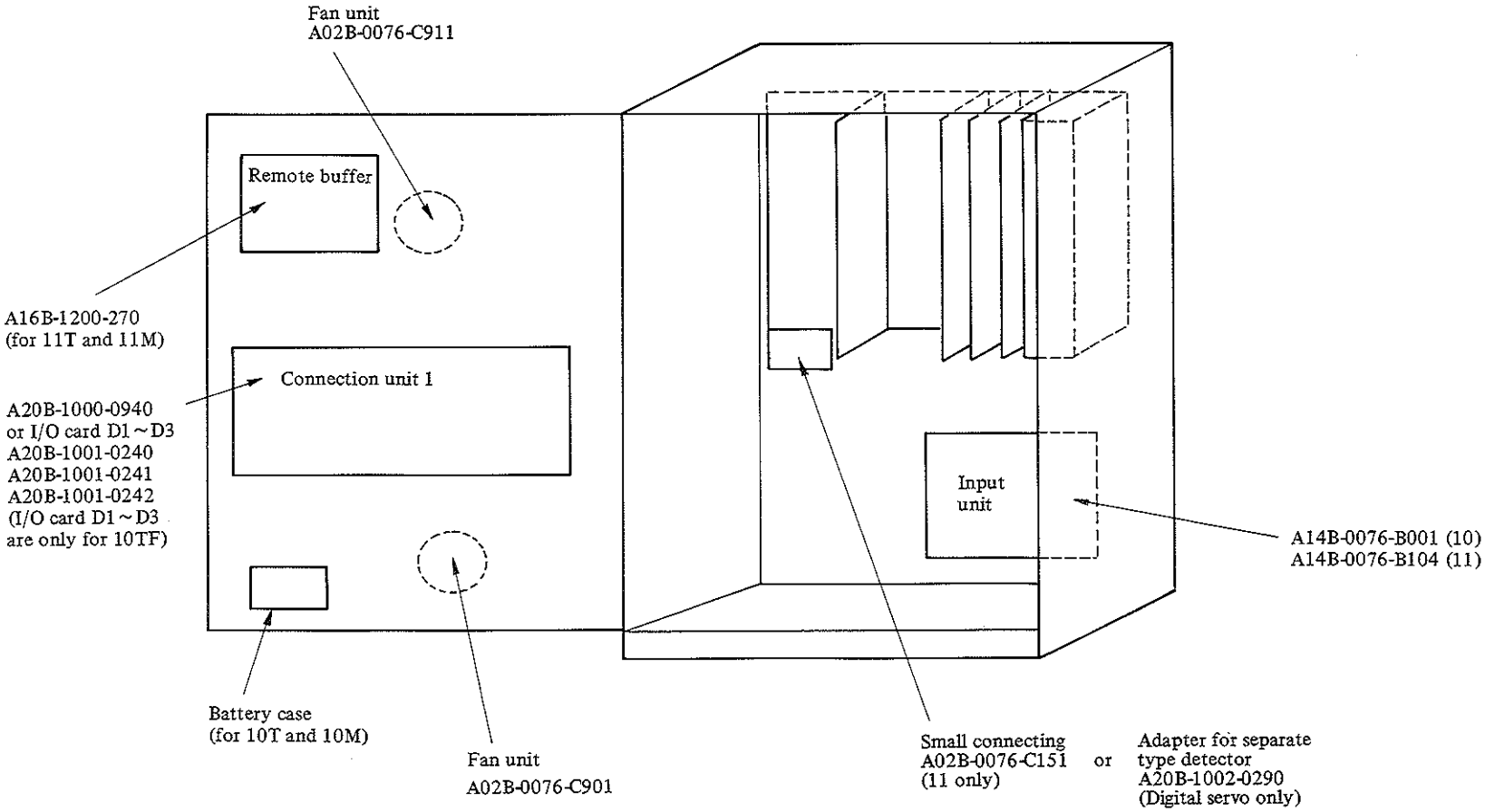


Fig. 1.1 (f) Unbundled cabinet control component location for 10/11/100/110 series

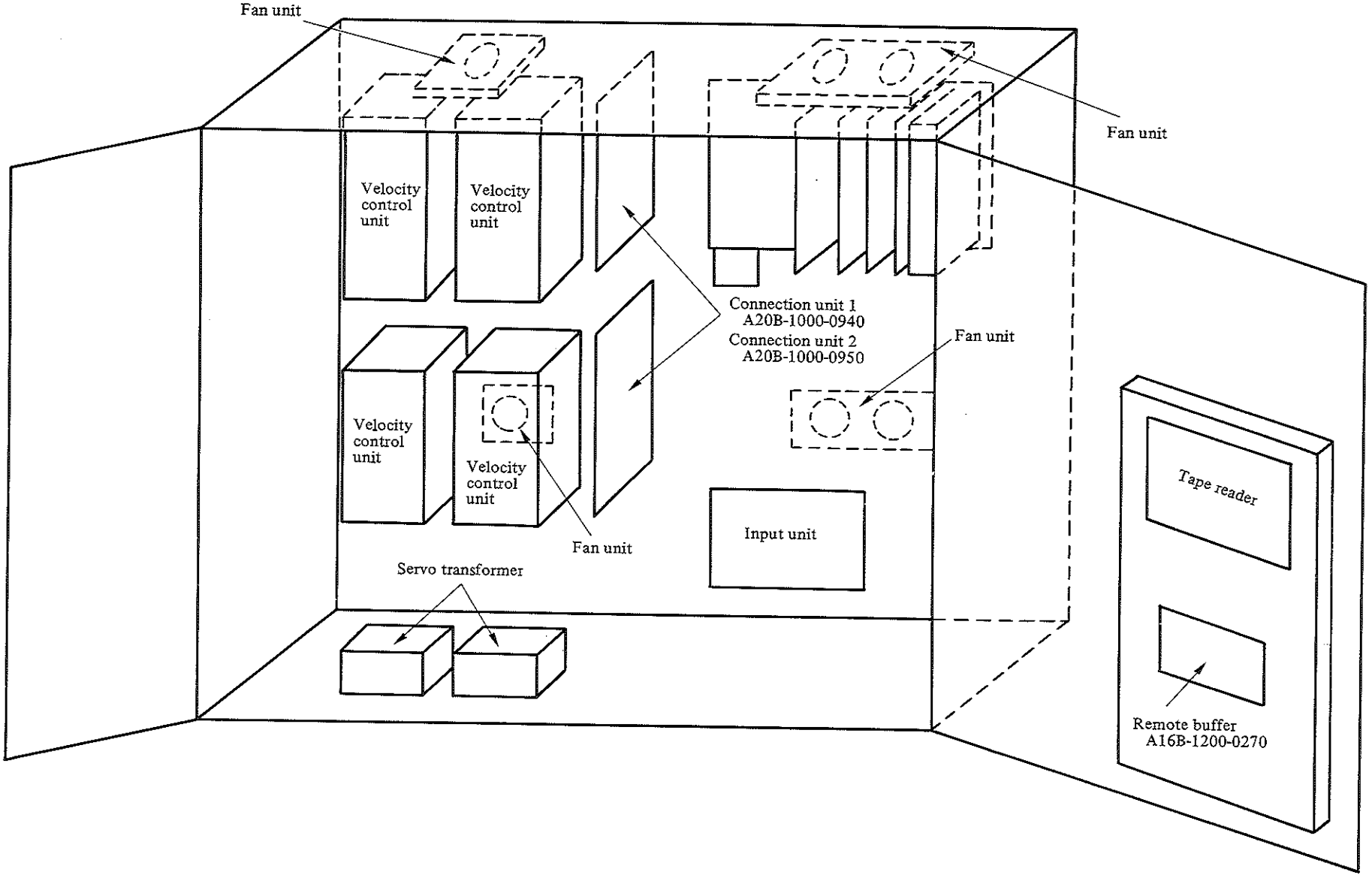


Fig. 1.1 (g) Built-in 3 cabinet internal component location for 11TT/110TT

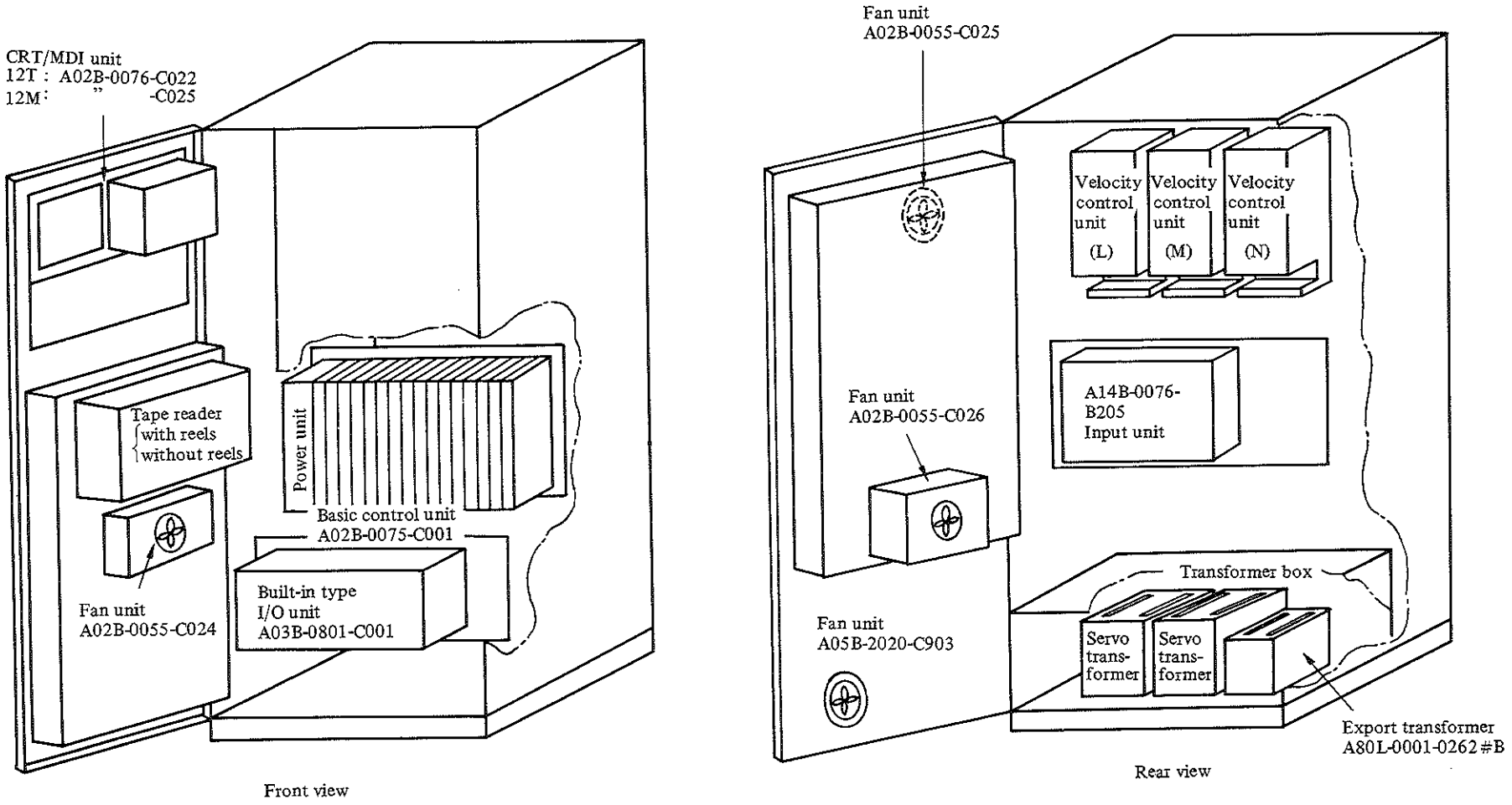


Fig. 1.1 (h) Free-standing cabinet A internal component location for 12/120 series

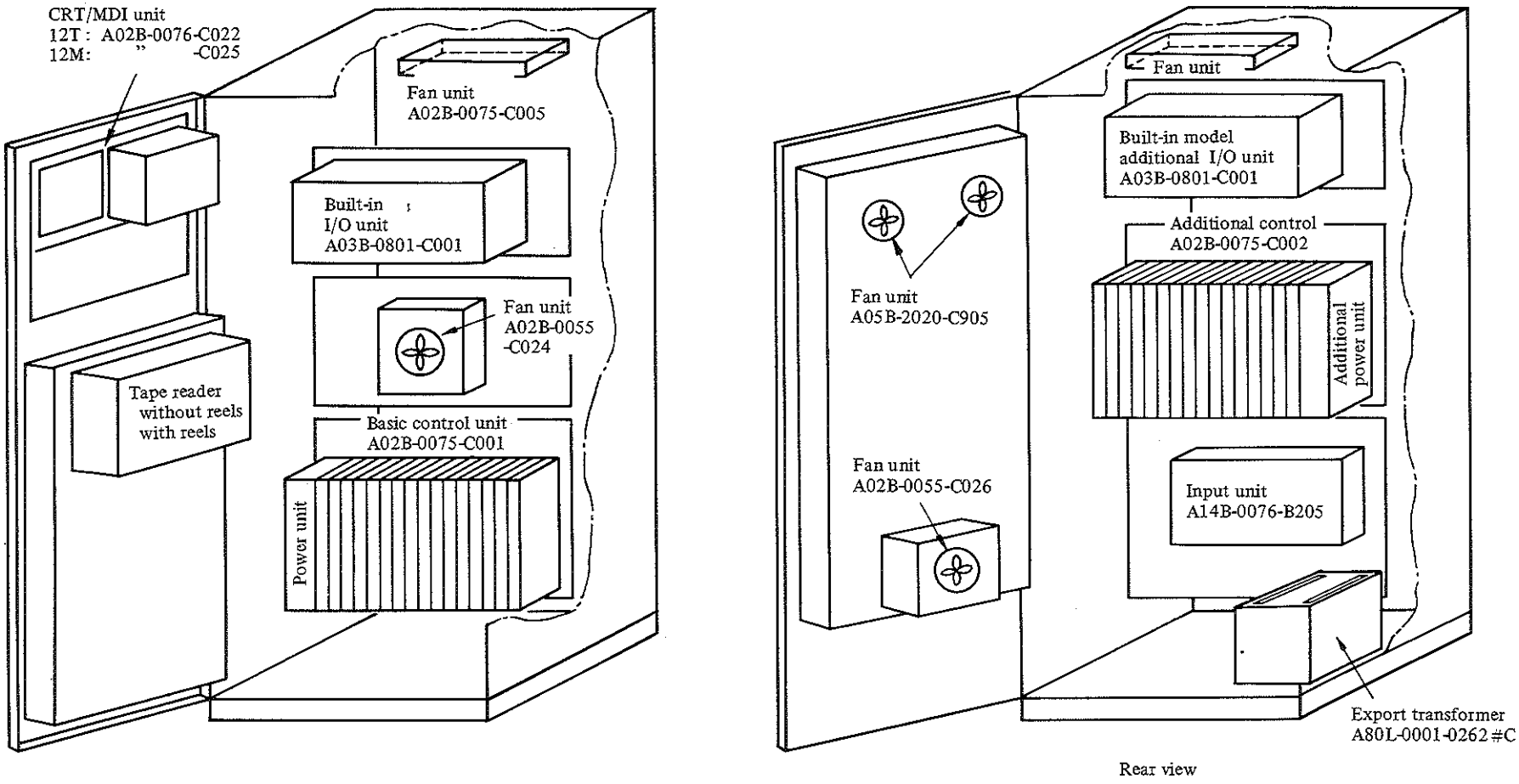


Fig. 1.1 (i) Free-standing cabinet B internal component location for 12/120 series

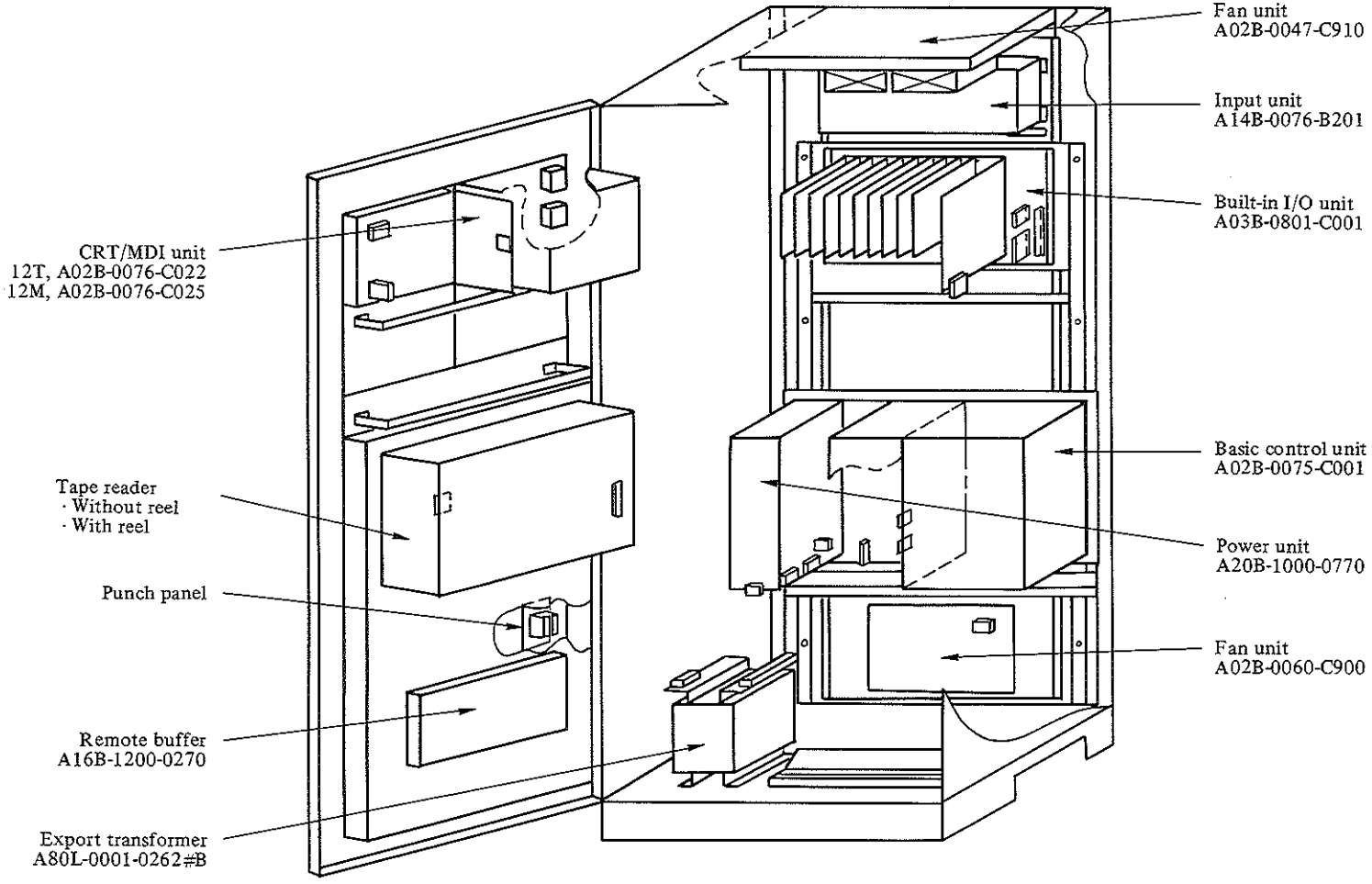


Fig. 1.1 (j) Built-in cabinet internal component location for 12/120 series

10/11/100/110 Master & Option PCB

1) Analog servo 10 series master PCB structure

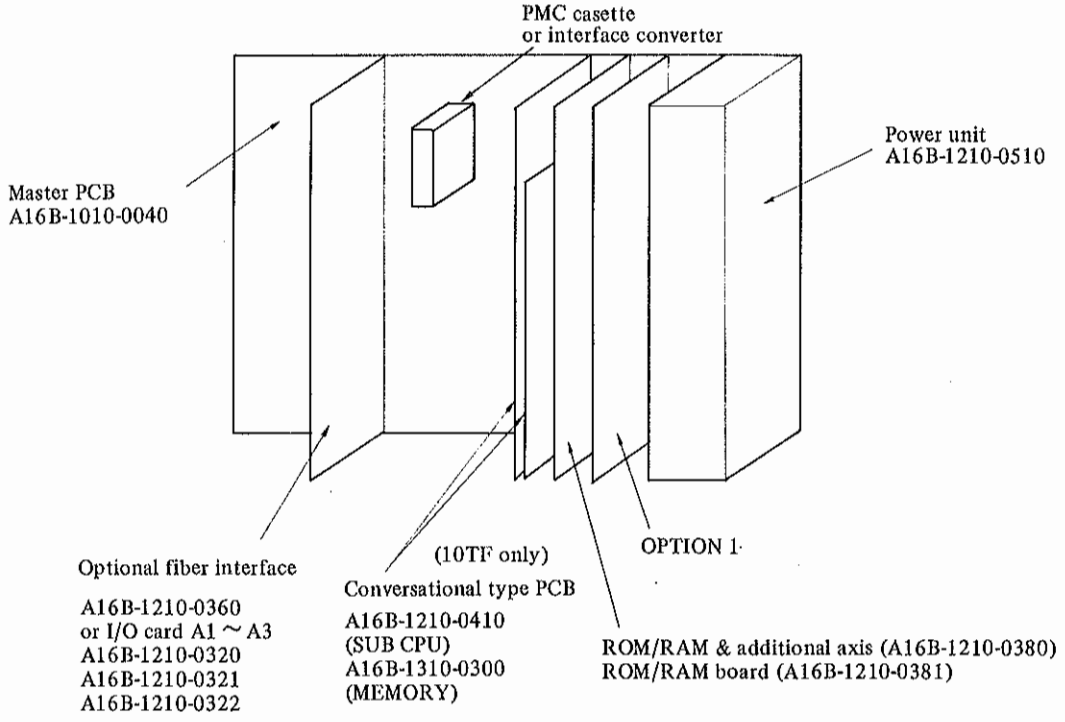


Fig. 1.1 (k)

2) Analog servo 11 series master PCB structure

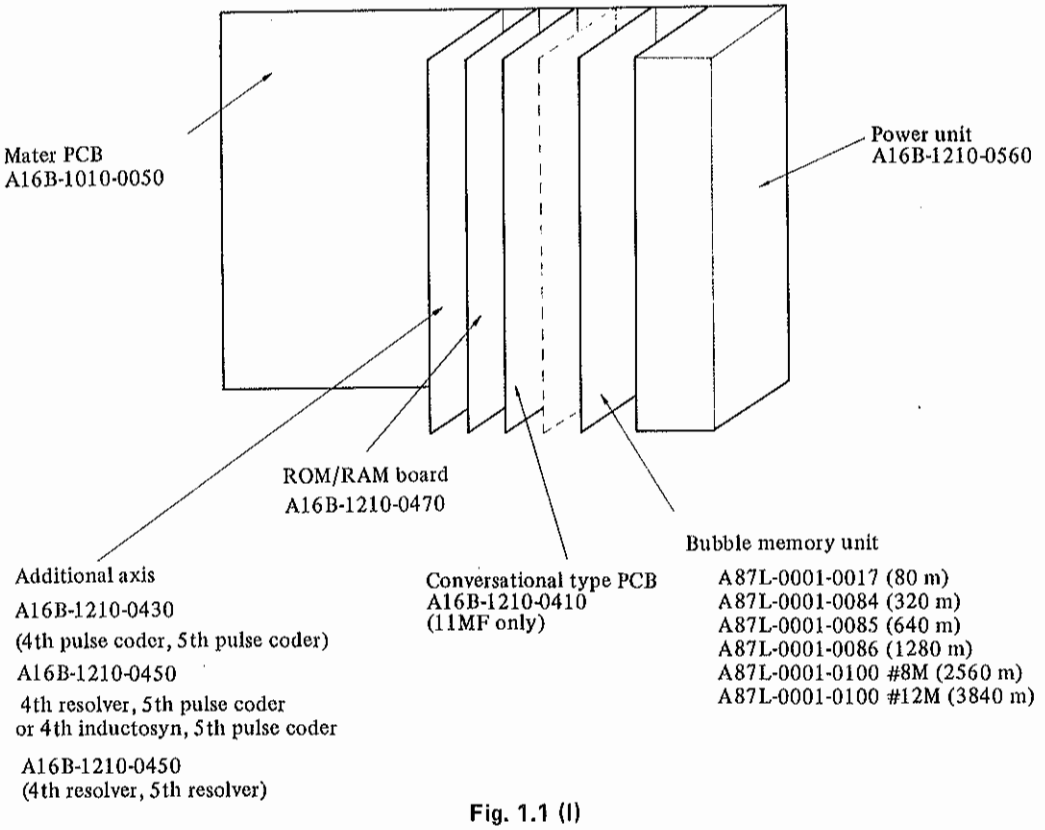
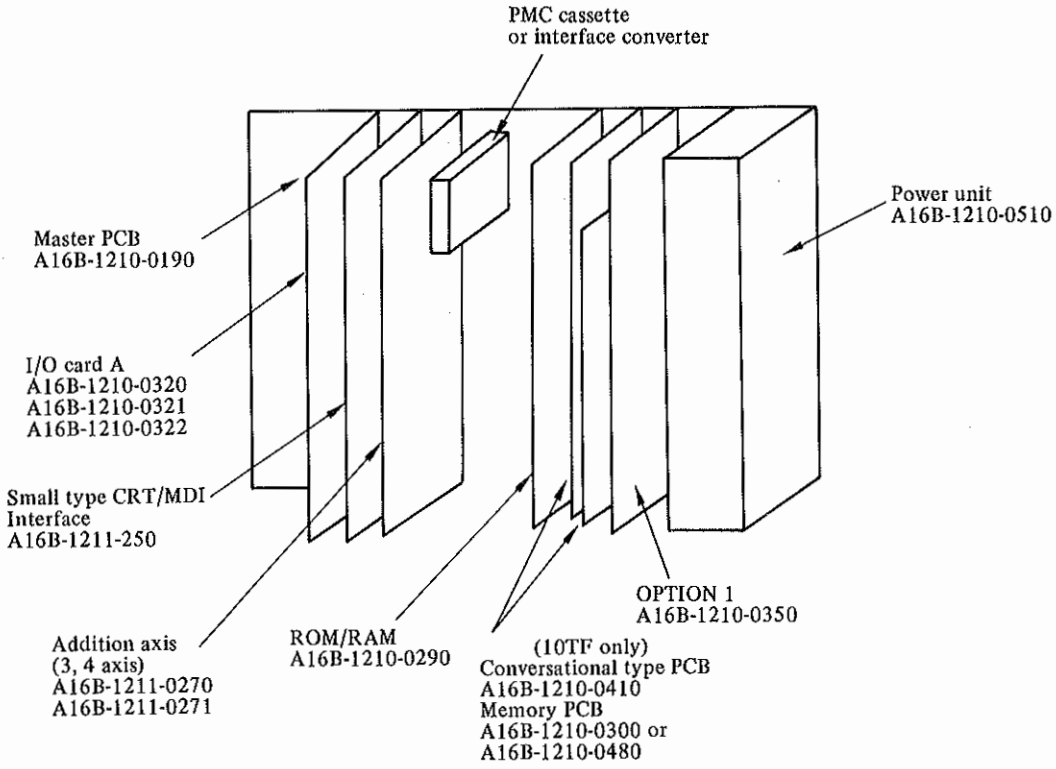
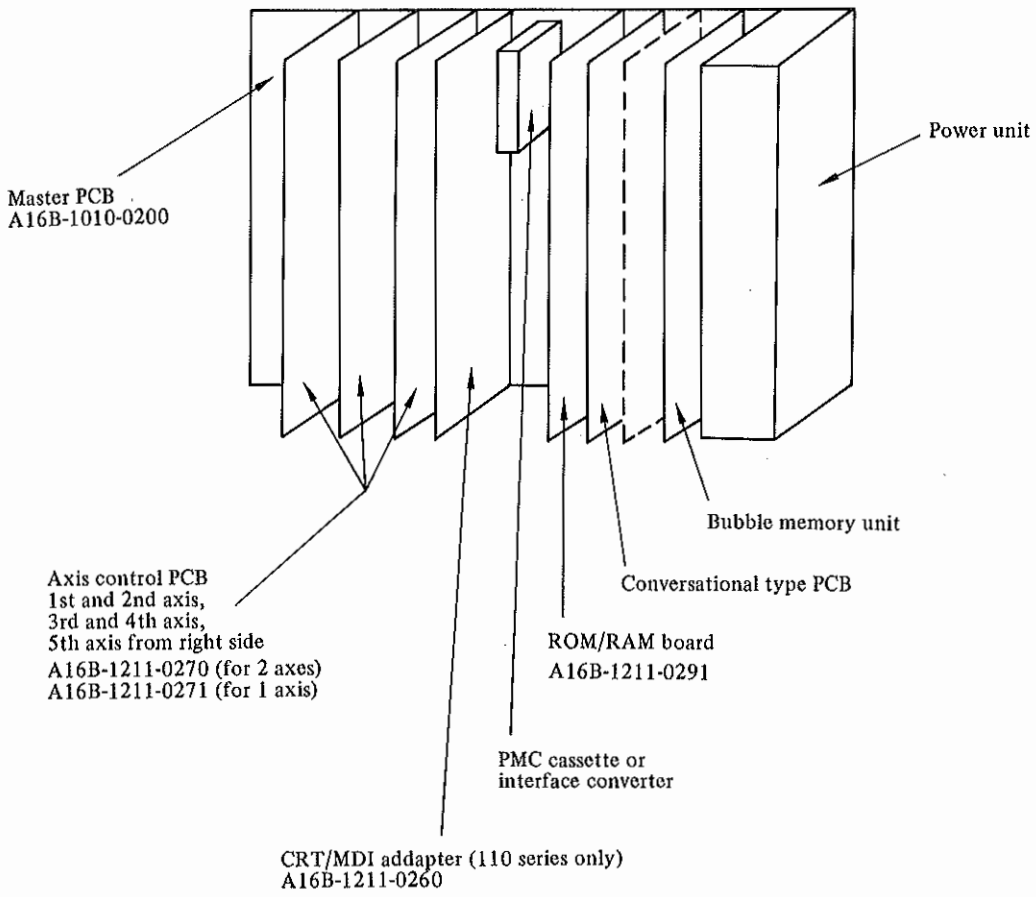


Fig. 1.1 (l)

3) Digital servo 10 series/100series



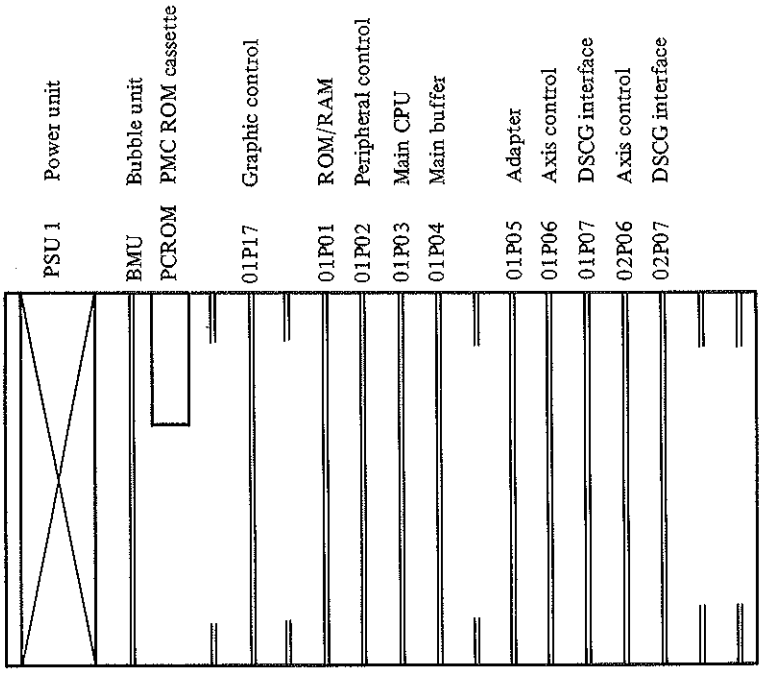
4) Digital servo 11 series/110 series



Power unit
Bubble memory unit
Conversational type PCB
PMC cassette
Interface PCB

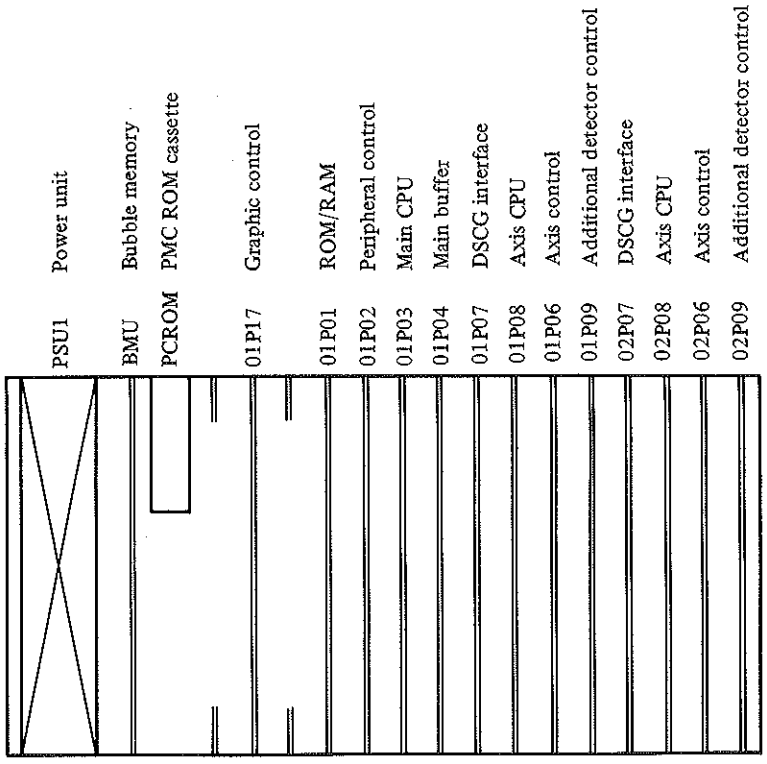
} These are same as analog servo.

5) 12 series basic control unit PCB structure



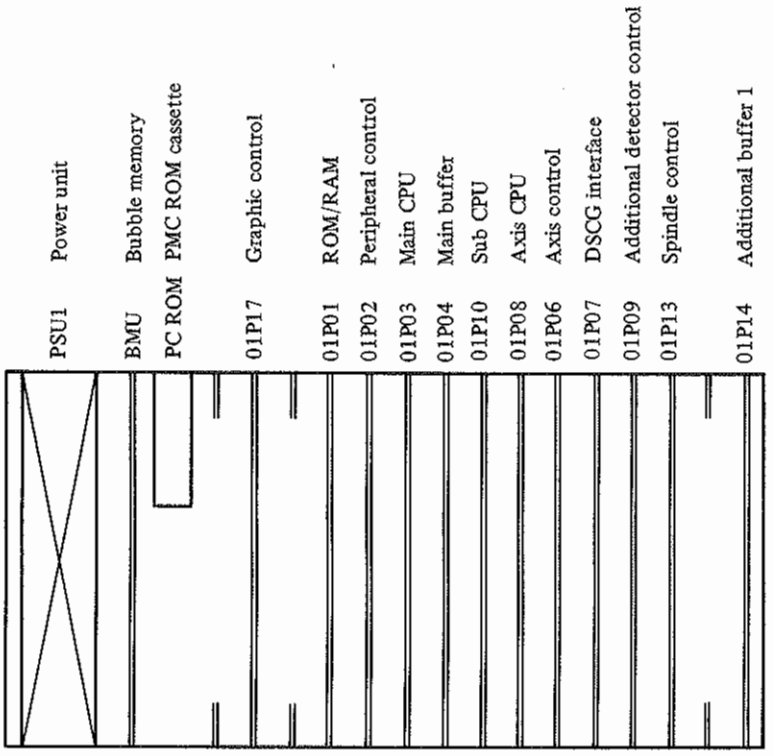
Basic control unit PCB layout of built-in cabinet and free-standing cabinet A. (One of synchronous operation, hybrid control and double check system is not performed when 5 or less axes are controlled.)

Fig. 1.1 (m) 12 series basic control unit layout (1)



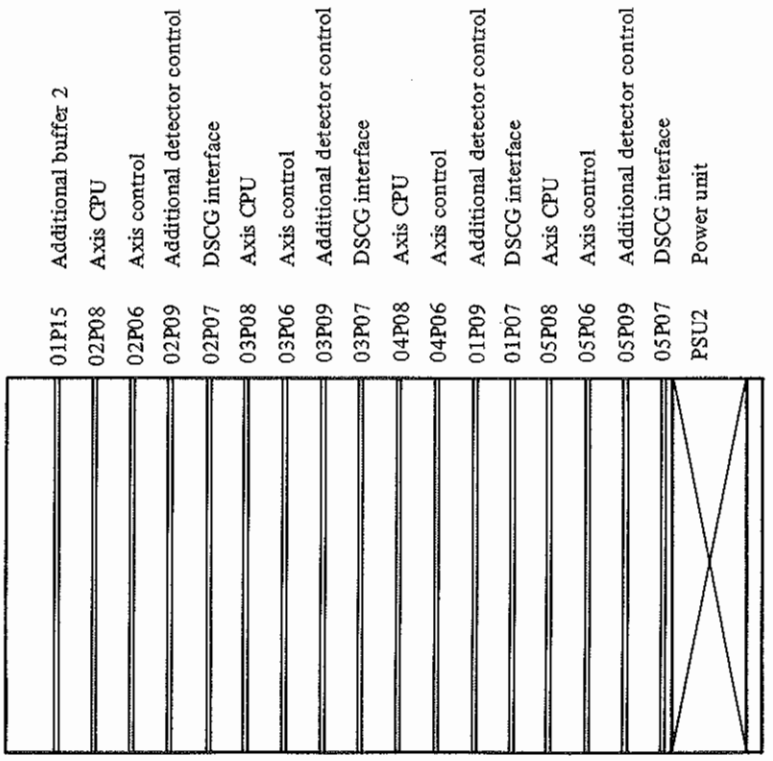
Basic control unit PCB layout of built-in cabinet and free-standing A cabinet. (One of 6 axes control; synchronous operation, hybrid control and double check system is performed.)

Fig. 1.1 (n) 12 series basic control unit layout (2)



Basic control PCB layout of free-standing cabinet B.

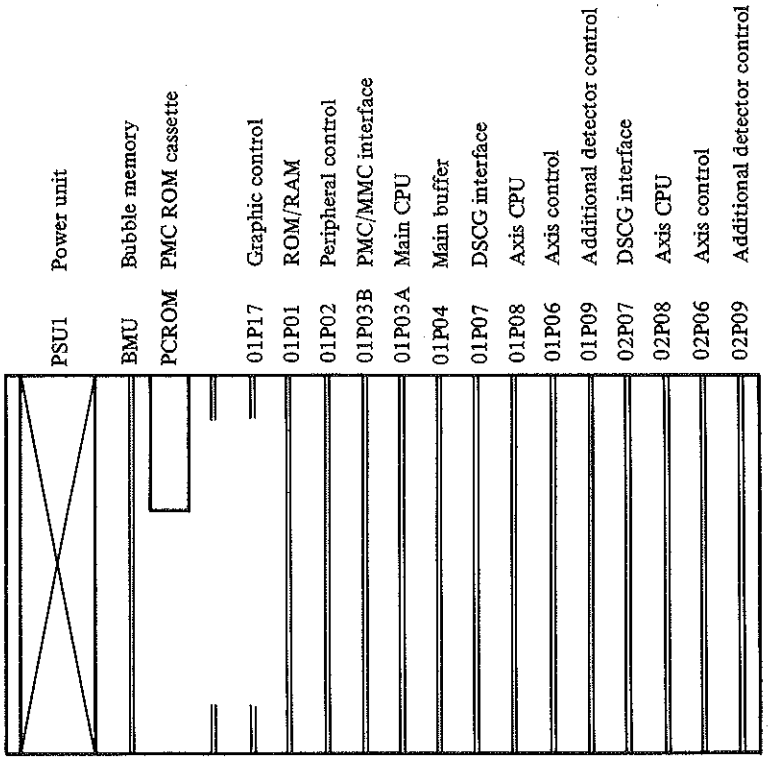
Fig. 1.1 (o) 12 series basic control unit layout (3)



Additional control unit PCB layout of free-standing cabinet B.

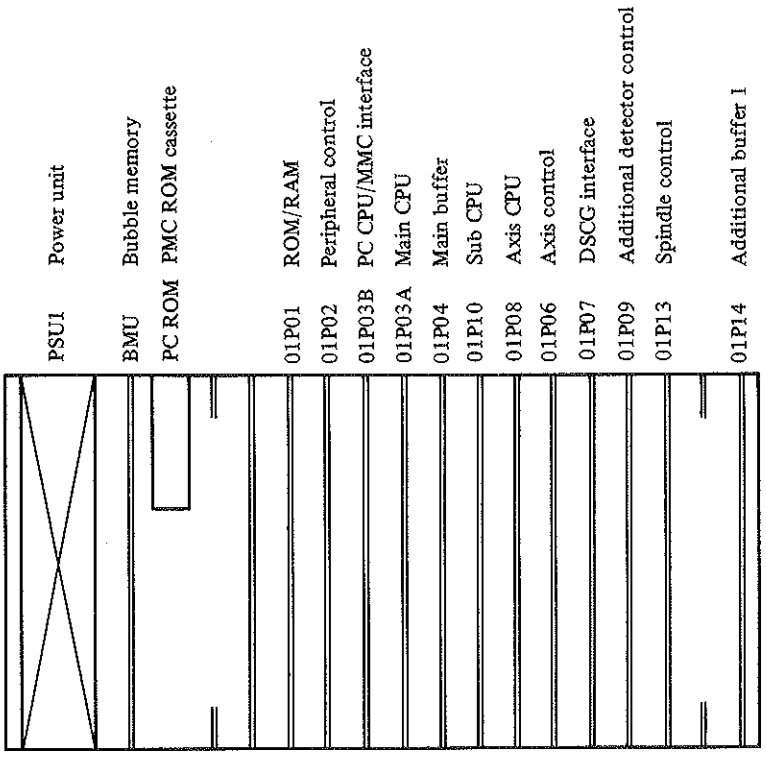
Fig. 1.1 (p) 12 series basic control unit layout (4)

6) 120 series basic control unit PCB structure



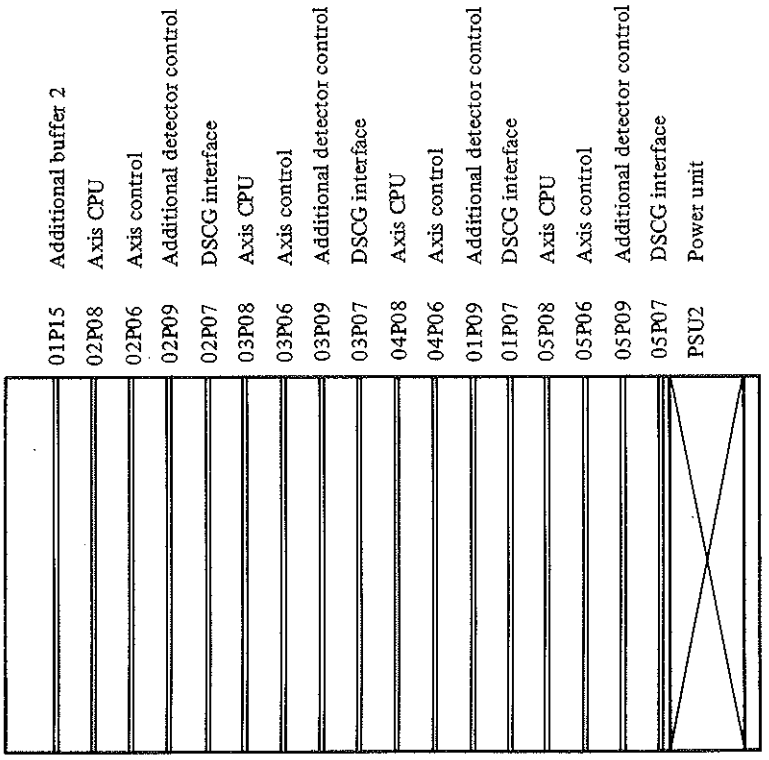
Basic control unit PCB layout of built-in cabinet and free-standing A cabinet. (6 or less axes control; synchronous operation, hybrid control and double check system is performed.)

Fig. 1.1 (q) 120 series basic control unit layout (1)



Basic control PCB layout of free-standing cabinet B.

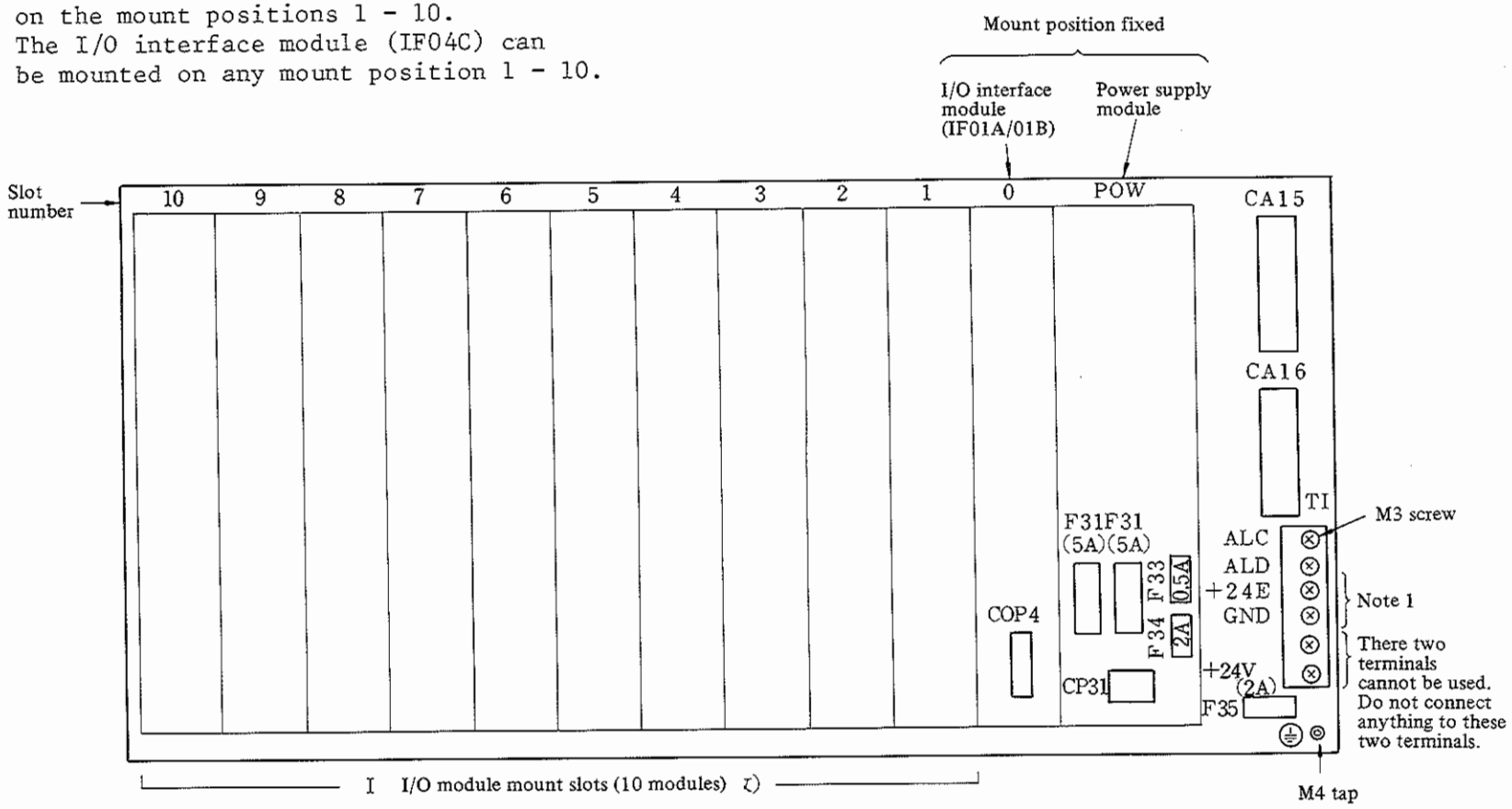
Fig. 1.1 (r) 120 series basic control unit layout (2)



Additional control unit PCB layout of free-standing cabinet B.

Fig. 1.1 (s) 120 series basic control unit layout (3)

. Mount positions of the two modules at the right are fixed.
. Arbitrary I/O modules can be mounted on the mount positions 1 - 10.
. The I/O interface module (IF04C) can be mounted on any mount position 1 - 10.



Note 1: Use these terminals to supply power to the external contacts, when using a non-insular type input module. Be careful not to connect short with the + 24E of other base units.

Fig. 1.1 (t) Module mount drawing of I/O base unit BU10A

. Mount positions of the two modules at the right are fixed.
. Arbitrary I/O modules can be mounted on the mount positions 1 - 8.
. The I/O interface module (IF04C) can be mounted on any mount positions 1 - 10.

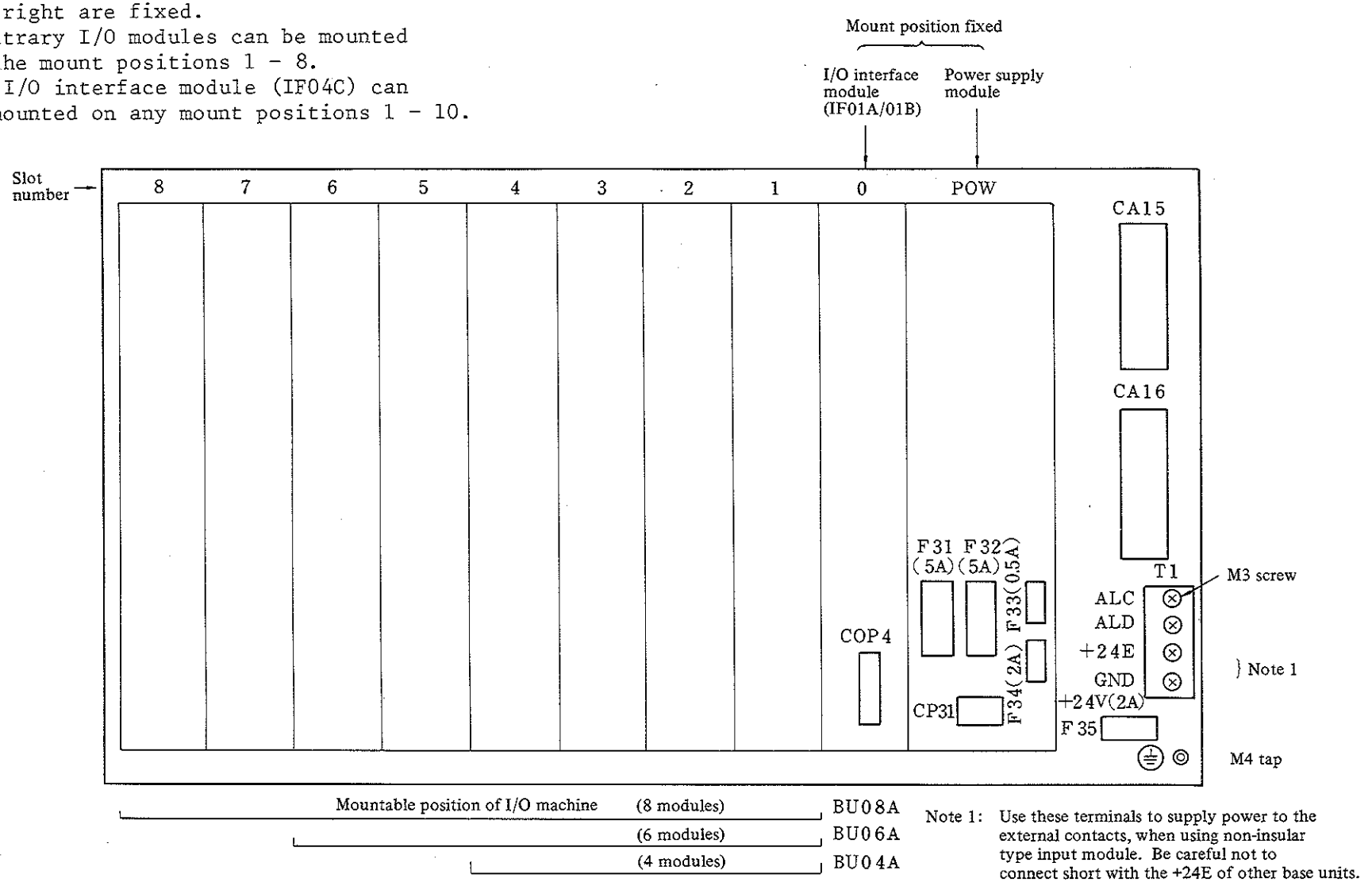


Fig. 1.1 (u) Module mount drawing of I/O base unit BU04A, BU06A, BU08A

1.2 Construction

1) Analog servo 10 series connecting construction
   a) For small CRT/MDI

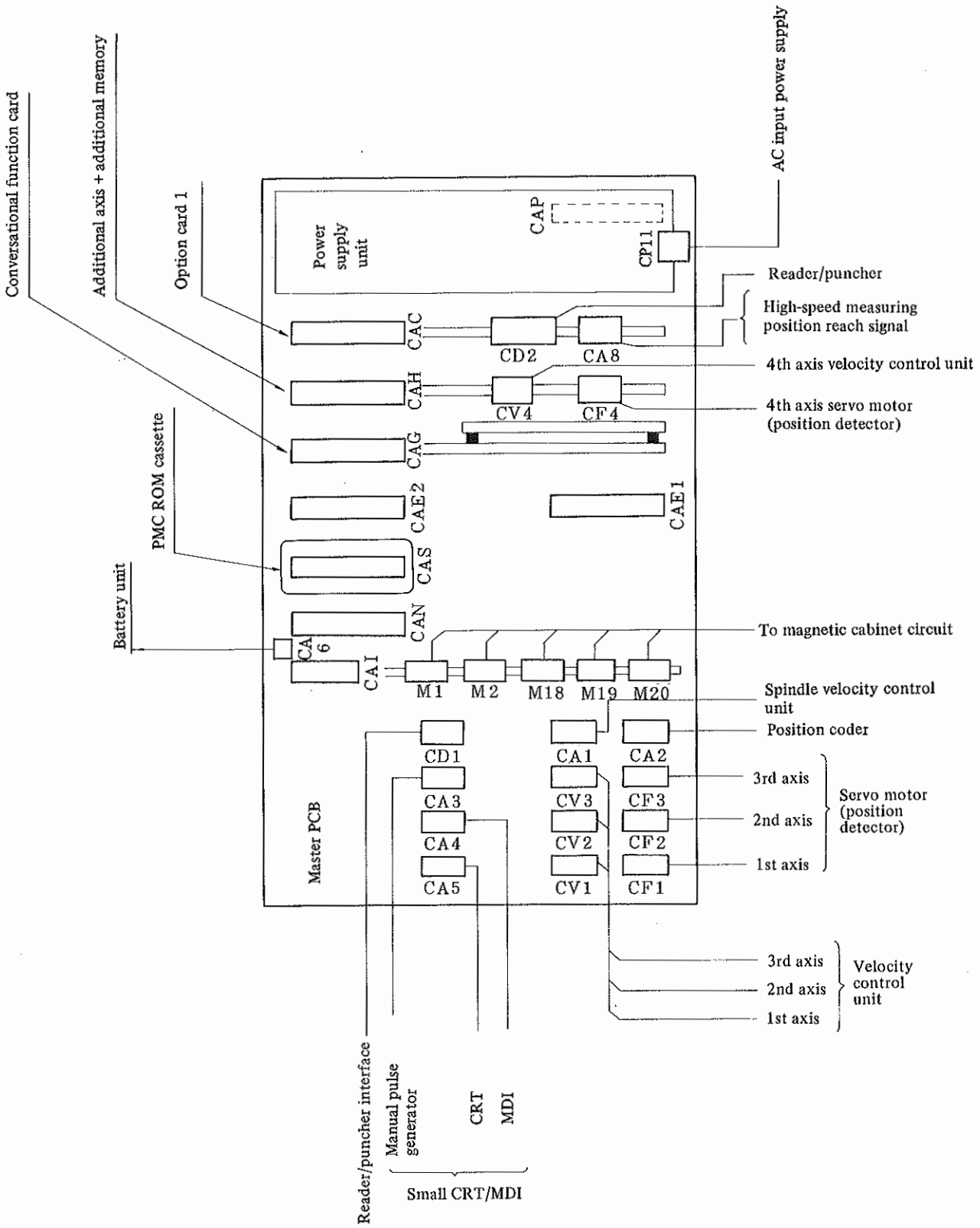


Fig. 1.2 (a) 10 series master PCB structure

b) For standard or 14" color CRT/MDI

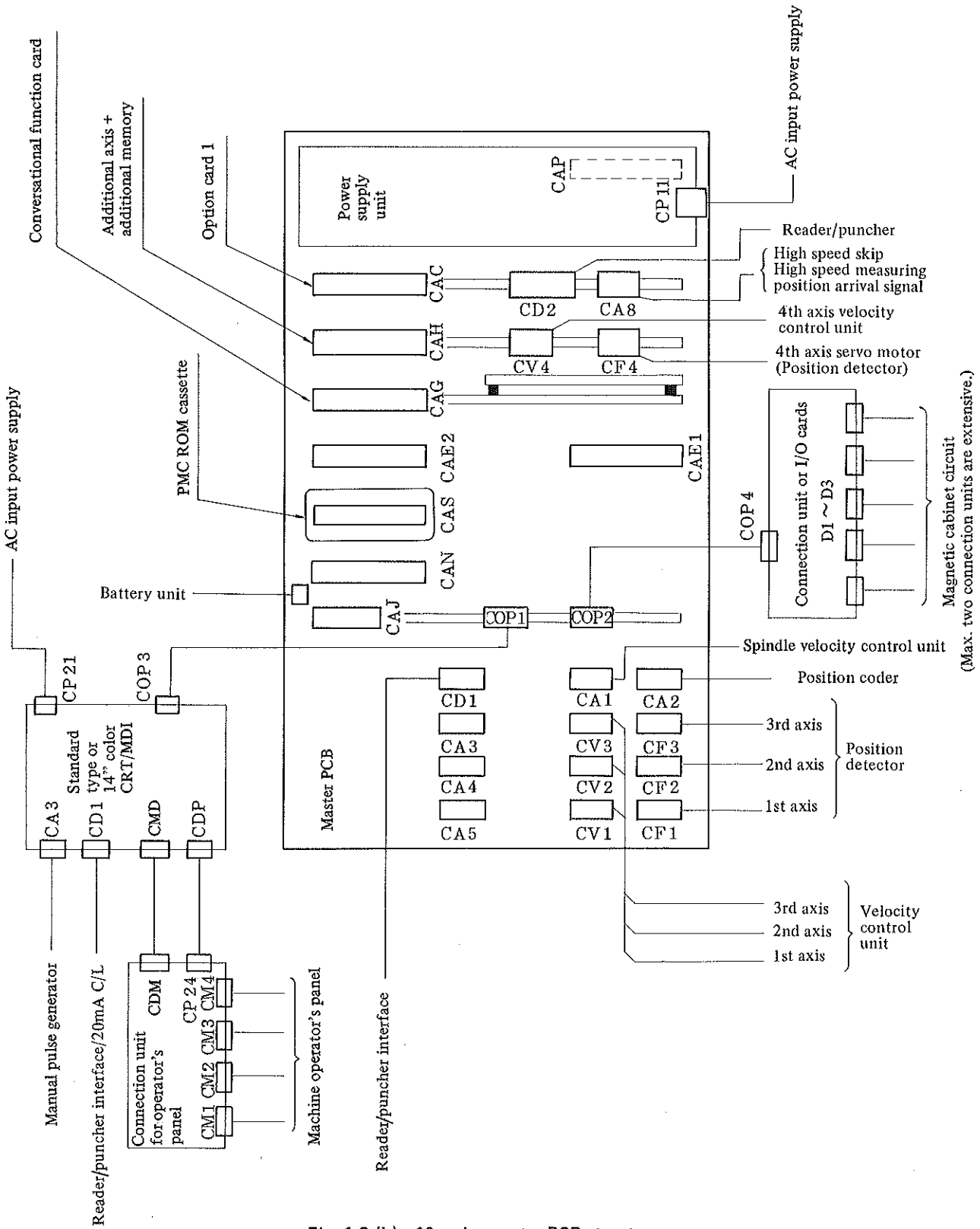


Fig. 1.2 (b) 10 series master PCB structure

c) Digital servo

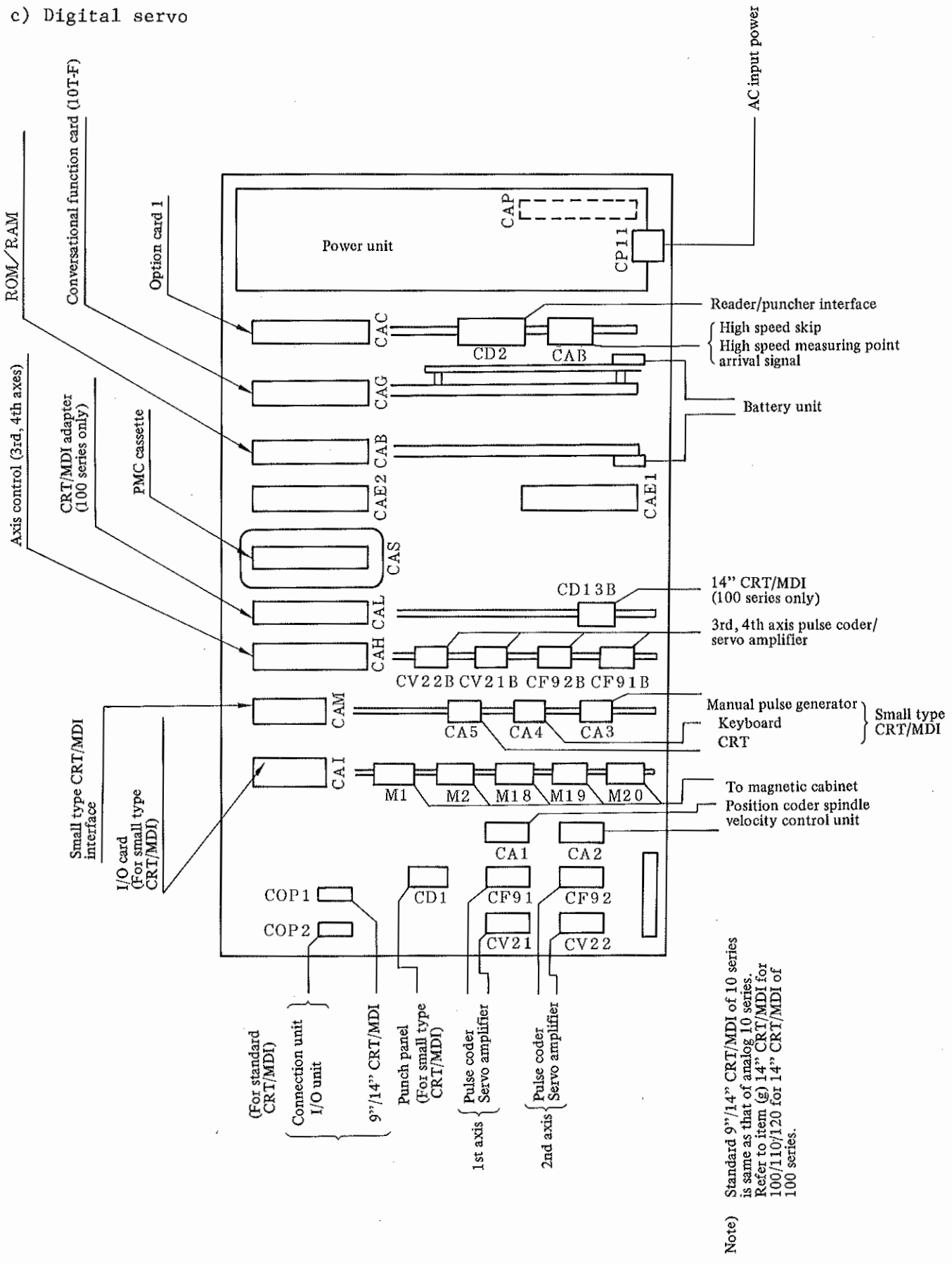


Fig. 1.2 (c) Digital servo 10 series master PCB structure

2) 11 series connecting construction
(a) Analog servo

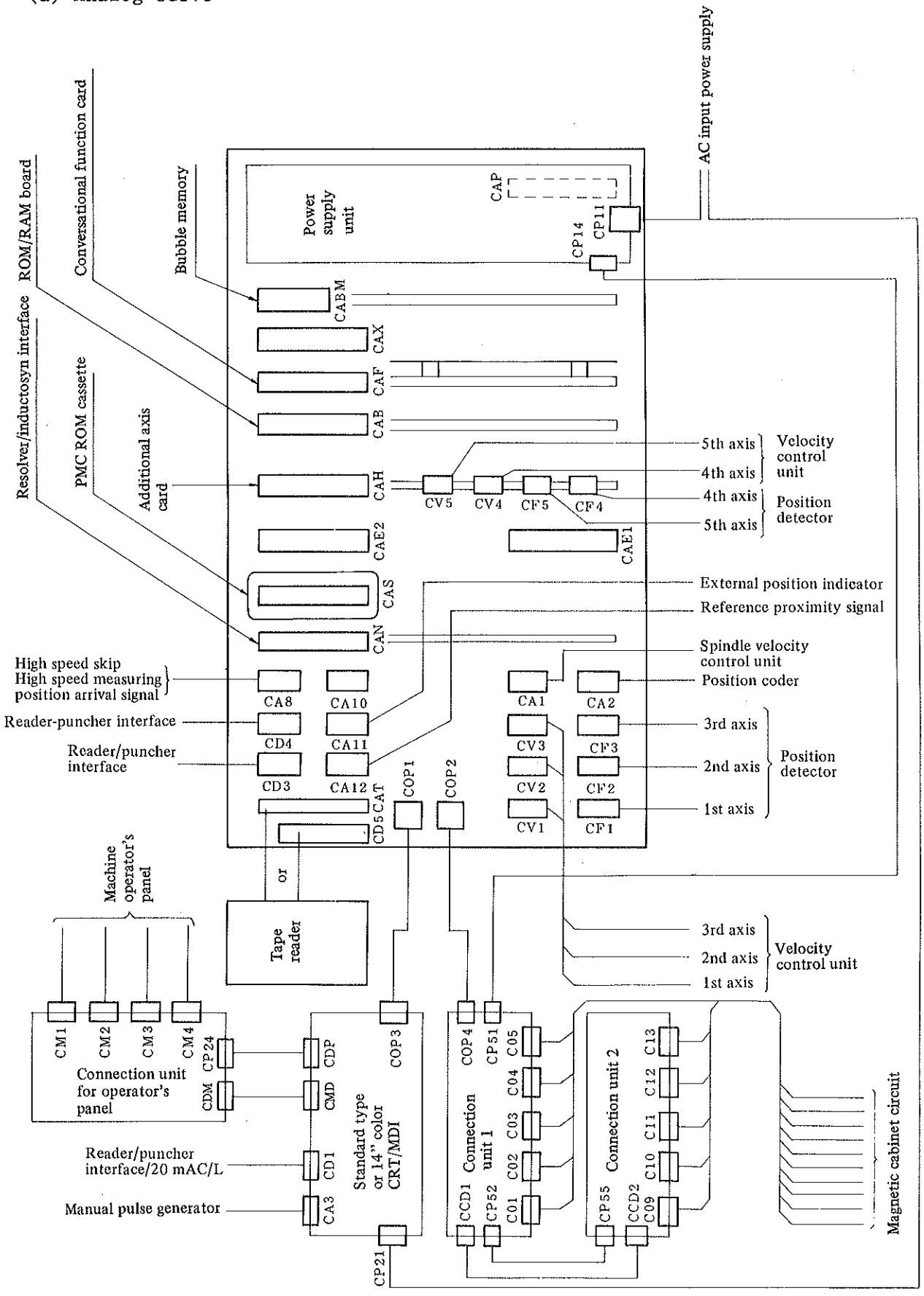


Fig. 1.2 (d) 11 series master PCB structure

(b) Digital servo

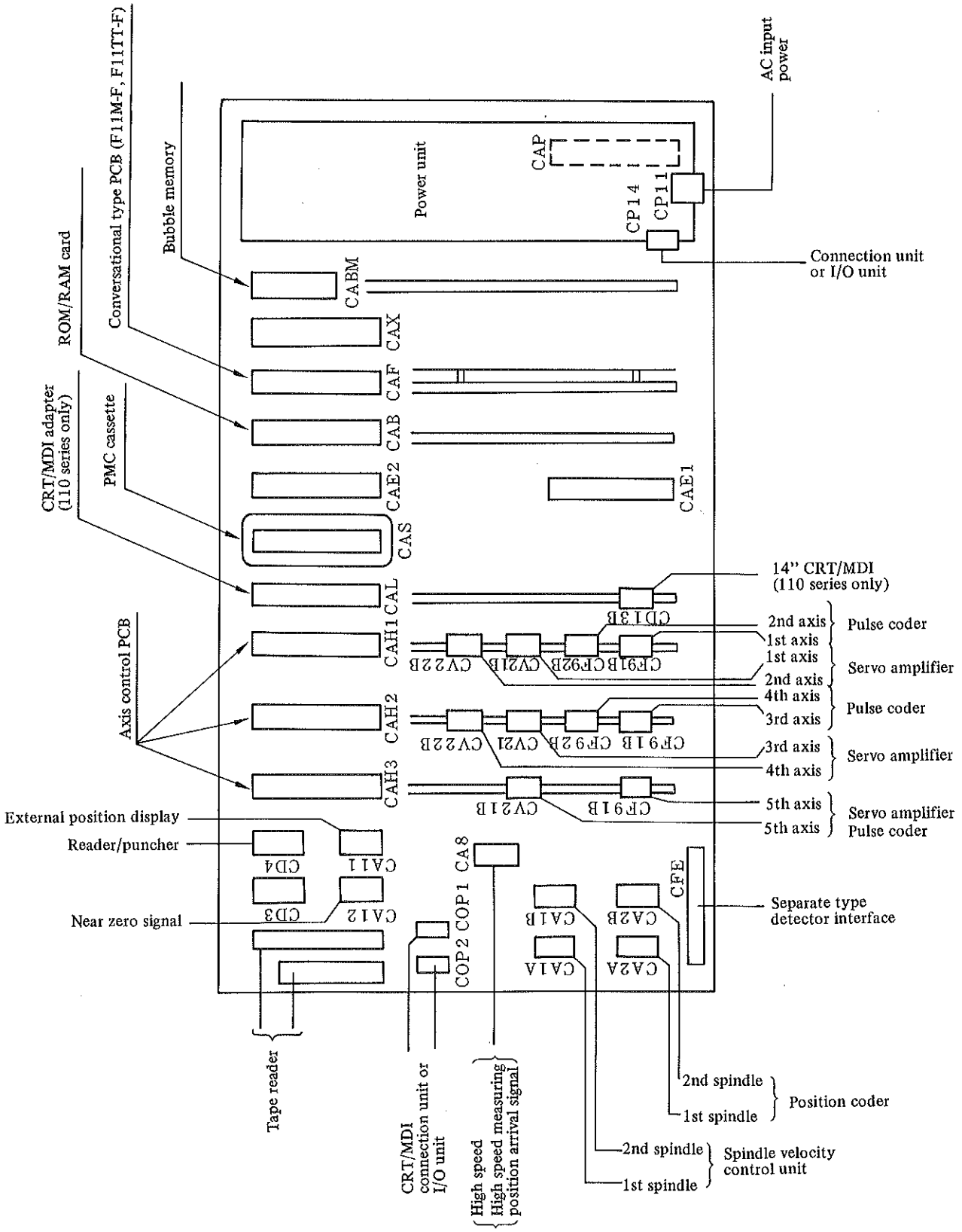
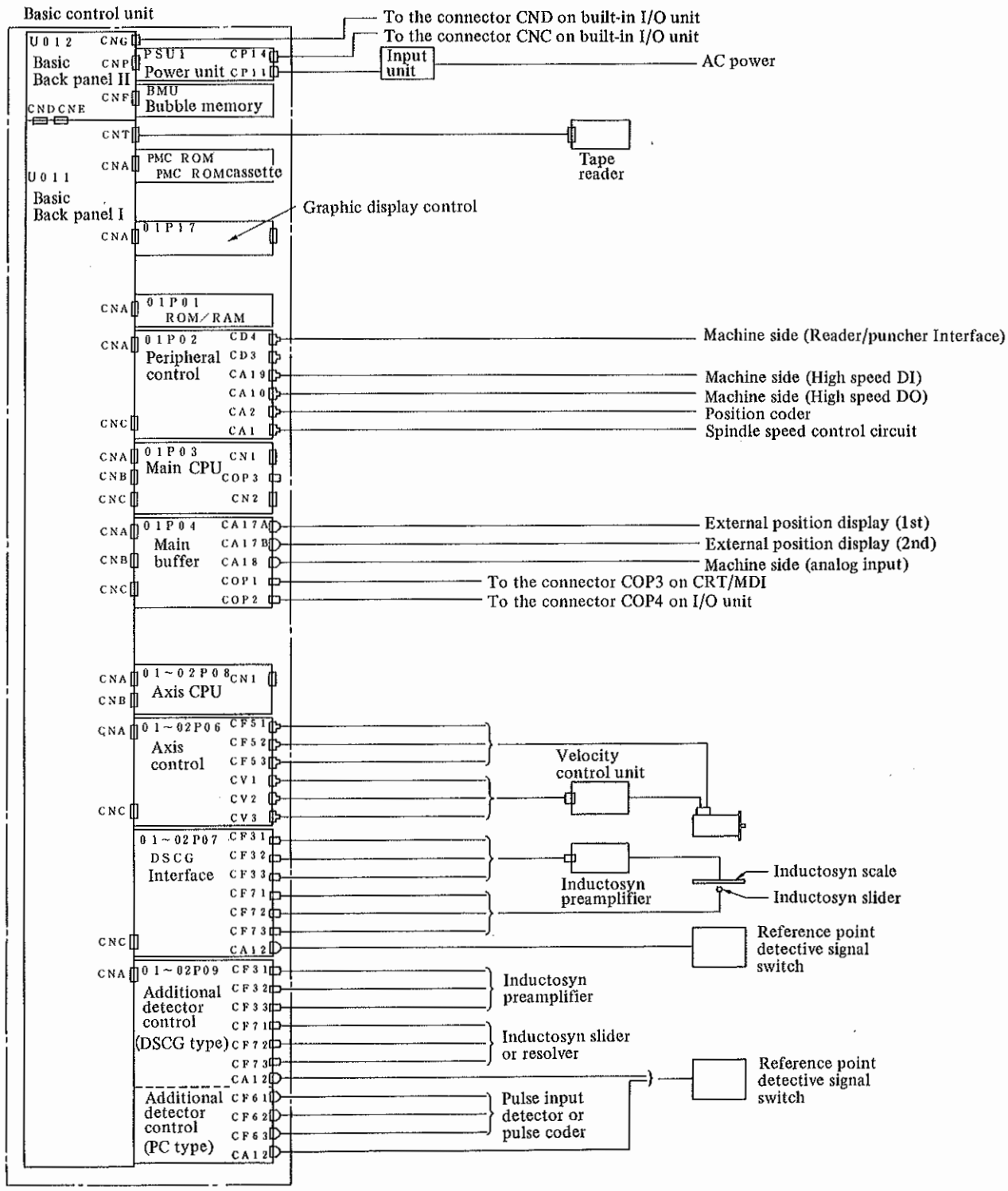


Fig. 1.2 (e) Digital servo 11 series master PCB structure

3) 12/120 series construction
12/120 series is divided into the following 3 types according to the cabinet in which the control unit is installed.

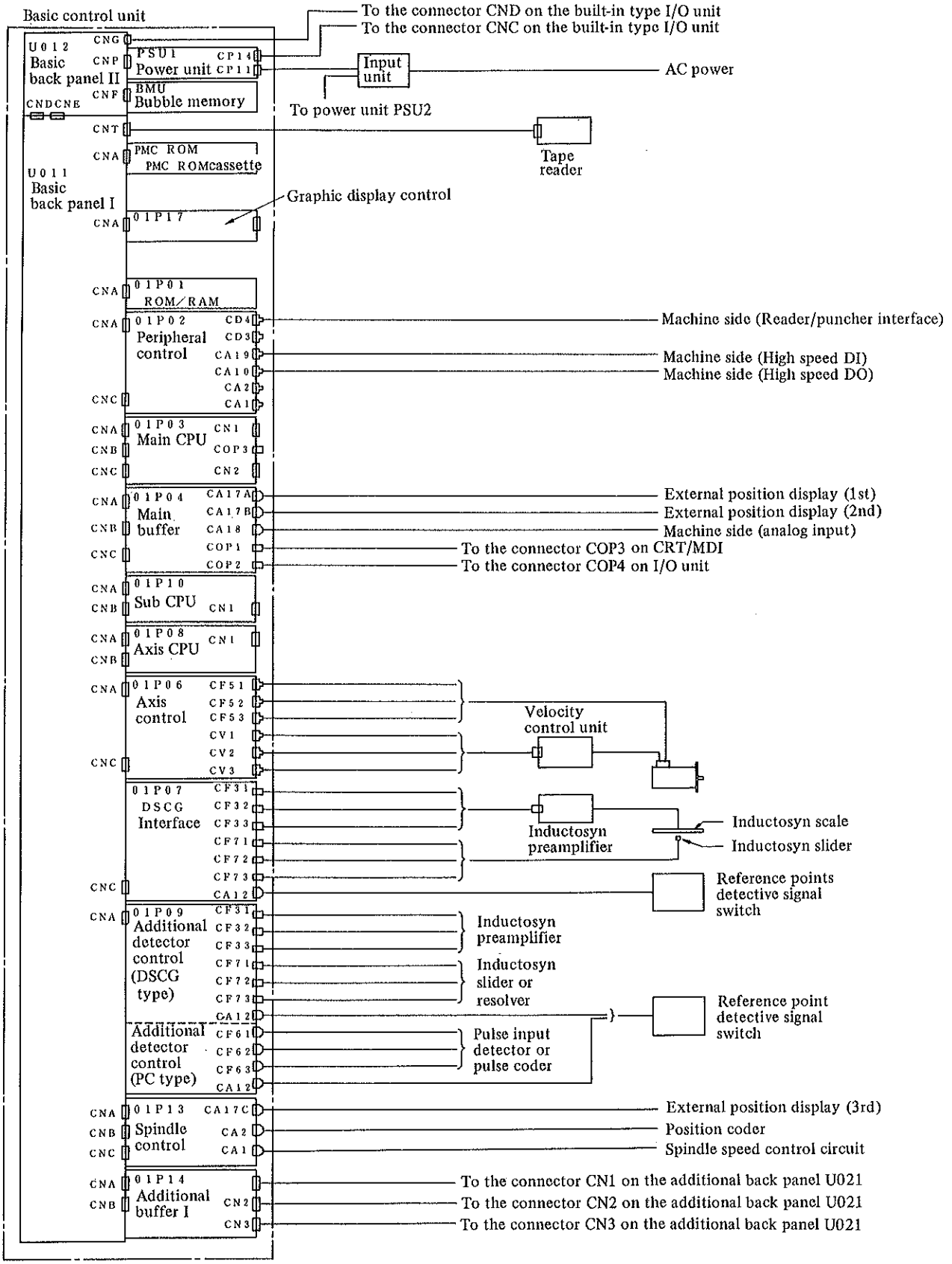
	Cabinet type where the control unit is installed	Controlled axis number	Axis control
1	Built-in type cabinet	2 - 5 axes (Note)	The main CPU controls the axes directly.
		6 axes (Note)	Every 3rd axis has the axis CPU which controls the axes.
2	Free-standing type cabinet A	2 - 5 axes (Note)	The main CPU controls the axes directly.
		6 axes (Note)	Every 3rd axis has the axis CPU which controls the axes.
3	Free-standing type cabinet B	7 - 8 axes	Every 3rd axis has the axis CPU which controls the axes.
		9 - 15 axes	Every 3rd axis has the axis CPU which controls the axes. The sub CPU is prepared to control this axis CPU.

Note) The axes are controlled by the axis CPU when the hybrid control, synchronous operation, or double check system performed even though only 2 - 5 axes are controlled.



When using built-in cabinet or free-standing cabinet A
(When 6 or less axes control; the synchronous operation,
the hybrid control, and the double check system are
performed)

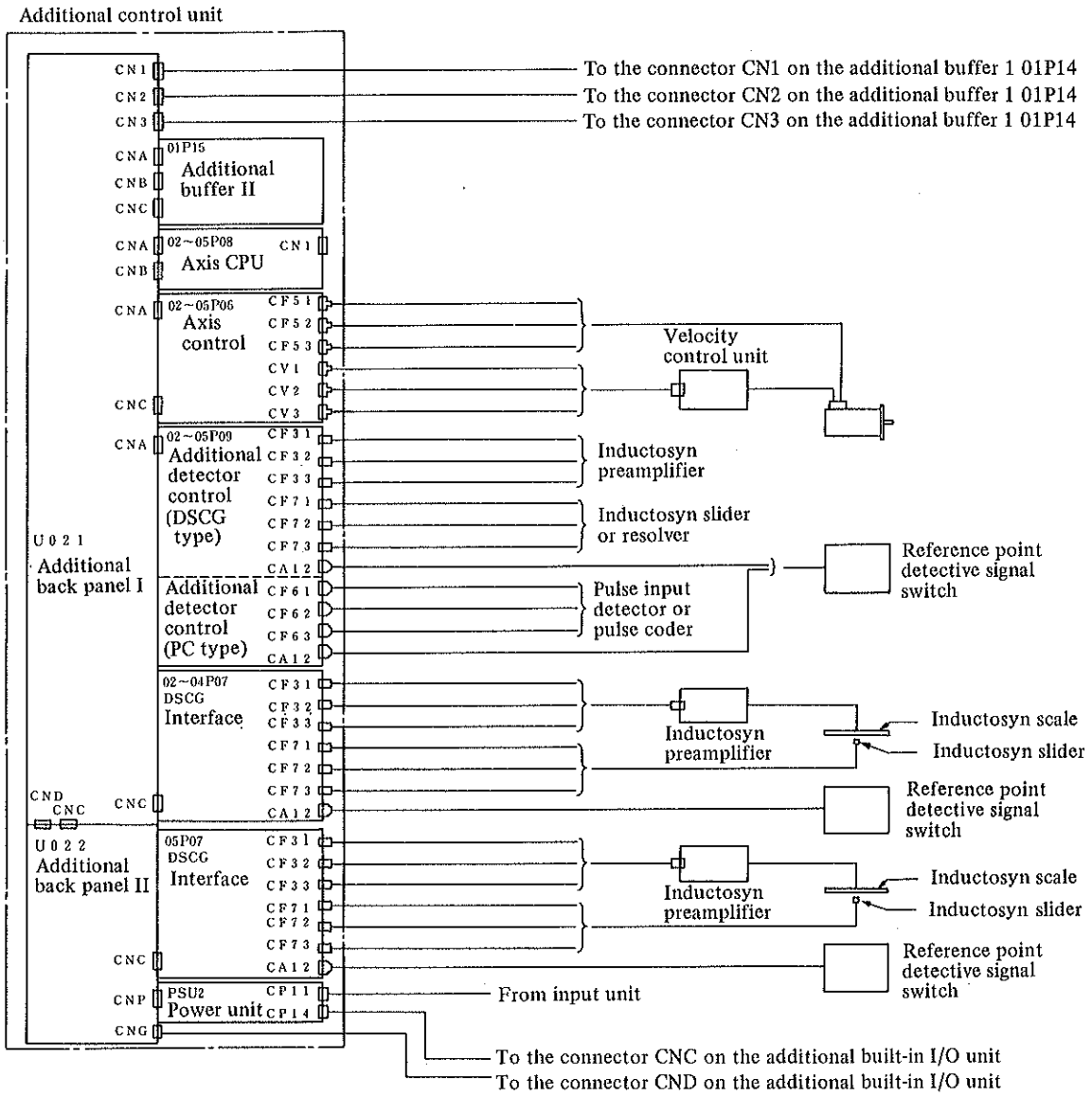
Fig. 1.2 (f) 12 series basic control unit connecting structure



When using free-standing type cabinet B
(When more than 7 axes are controlled)

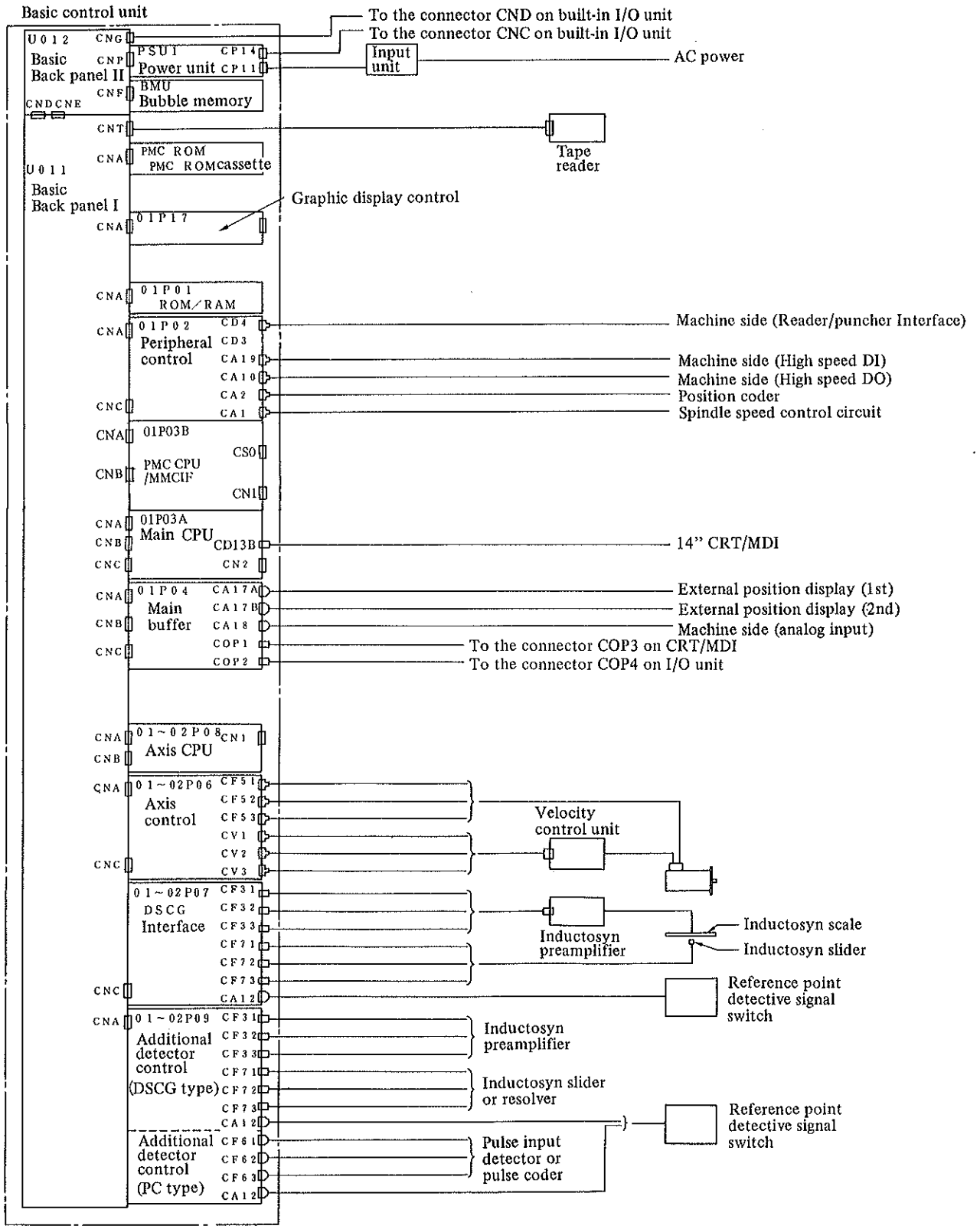
Fig. 1.2 (g) 12 series basic control unit connecting structure

b) 12 series additional control unit connecting structure



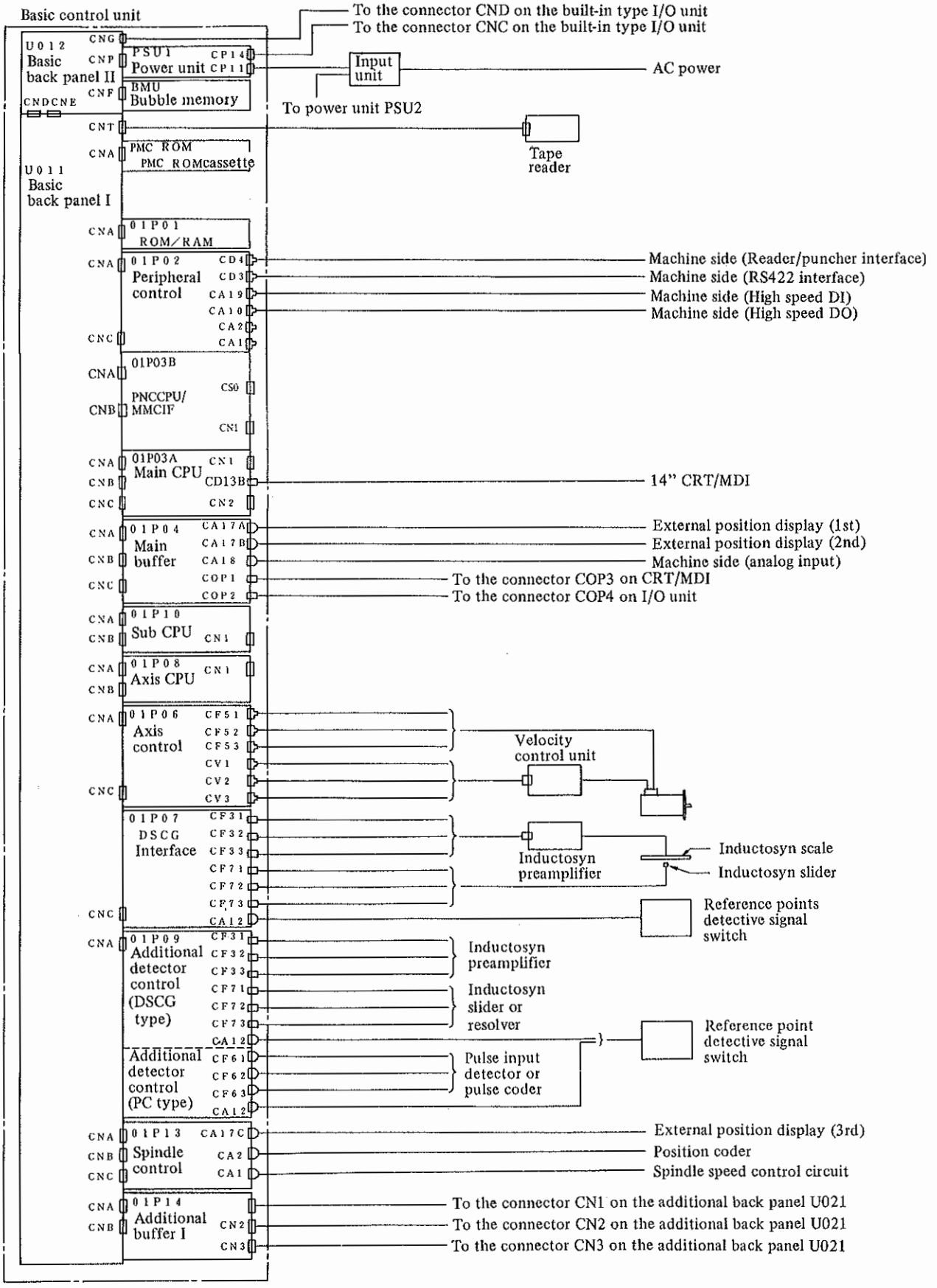
When using free-standing cabinet B
(When more than 7 axes are controlled)

Fig. 1.2 (h) 12 series additional control unit connecting structure



When using built-in cabinet or free-standing cabinet A (6 axes or less control; the synchronous operation, the hybrid control, and the double check system are performed)

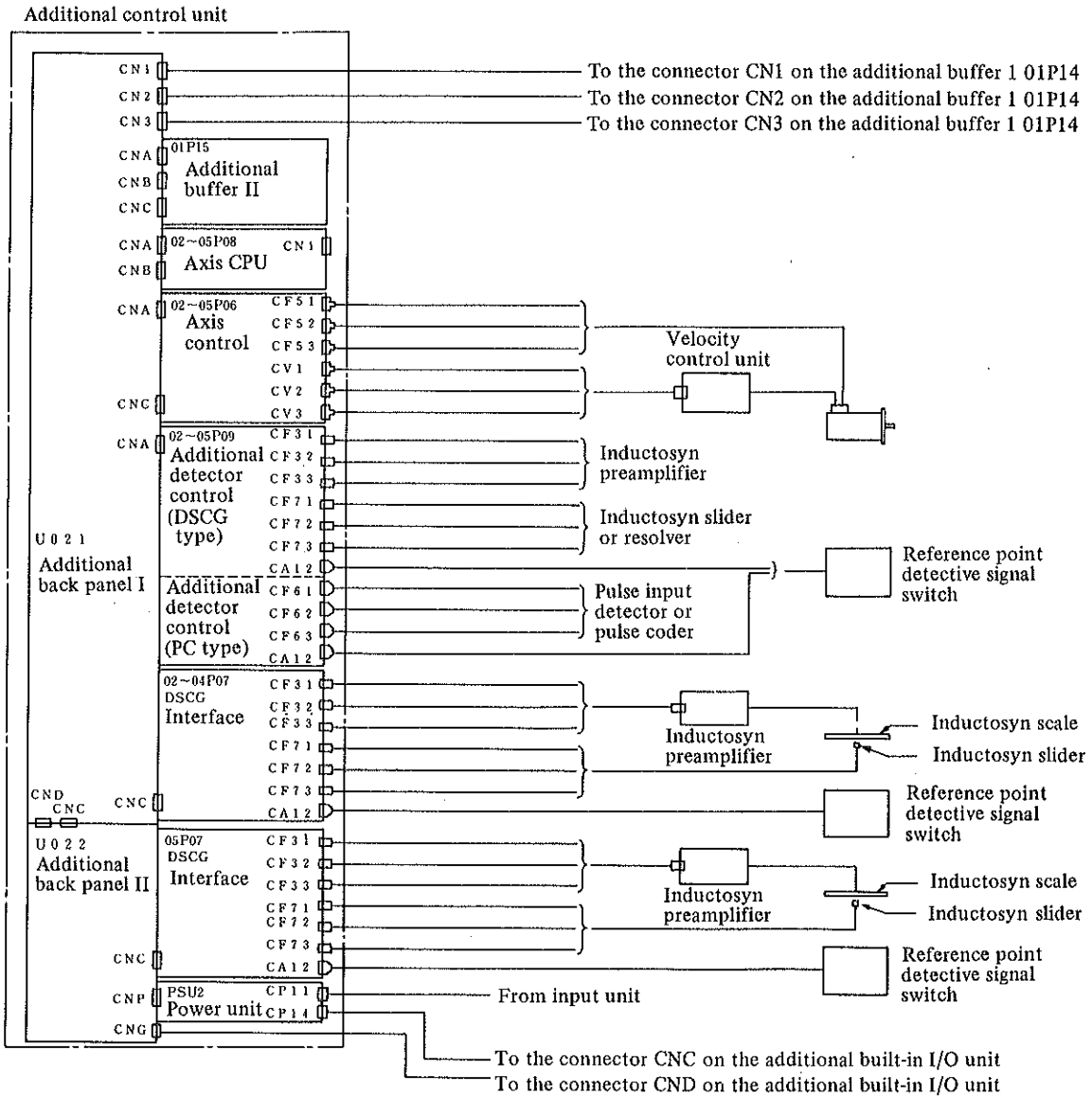
Fig. 1.2 (i) 120 series basic control unit connecting structure



When using free-standing type cabinet B
(When more than 7 axes are controlled)

Fig. 1.2 (j) 120 series basic control unit connecting structure

b) 12 series additional control unit connecting structure



When using free-standing type cabinet B
(When more than 7 axes are controlled)

Fig. 1.2 (k) 120 series additional control unit connecting structure

c) 12 series CRT/MDI unit

9" CRT/MDI unit

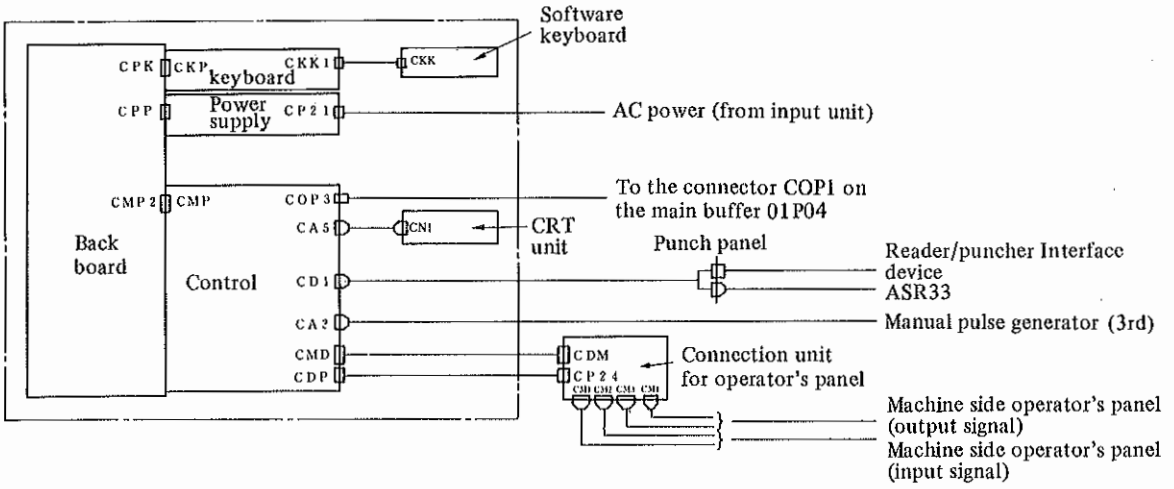


Fig. 1.2 (l)

14" CRT/MDI unit

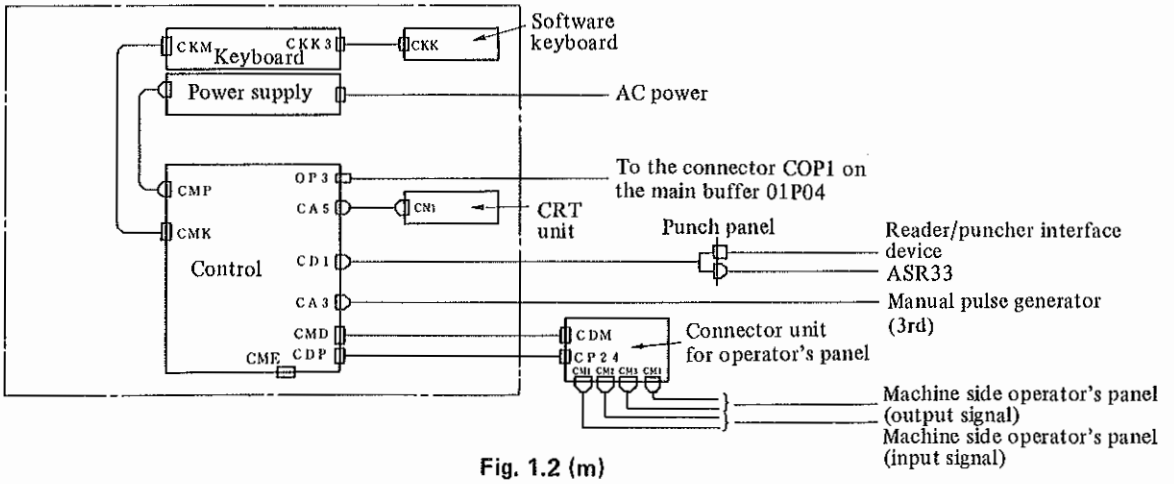
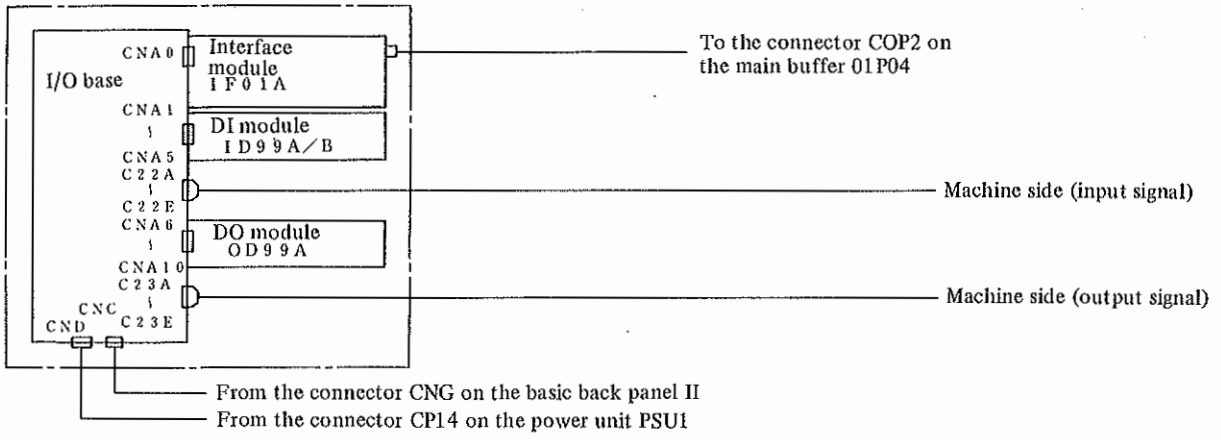


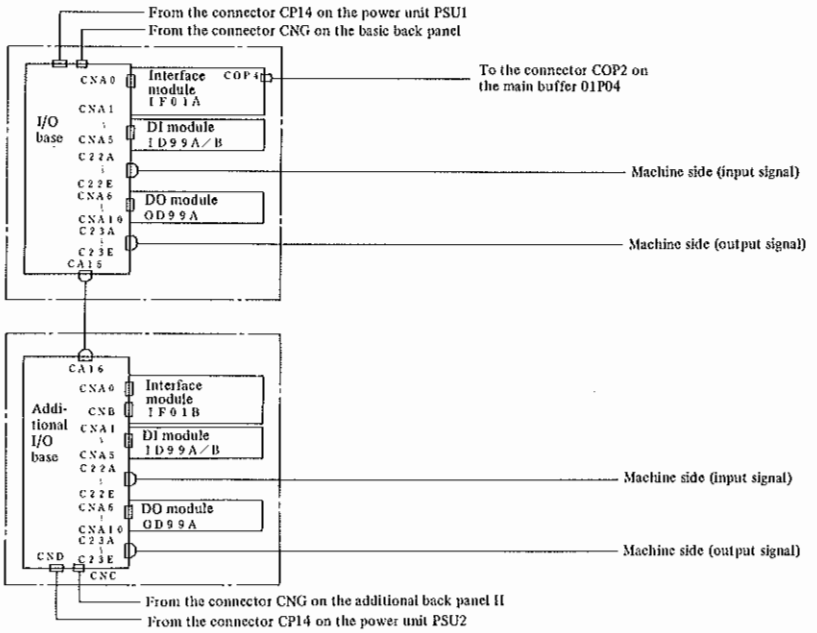
Fig. 1.2 (m)

d) 12 series built-in type I/O unit



Built-in type I/O unit used in
Built-in type cabinet or free-standing type cabinet A

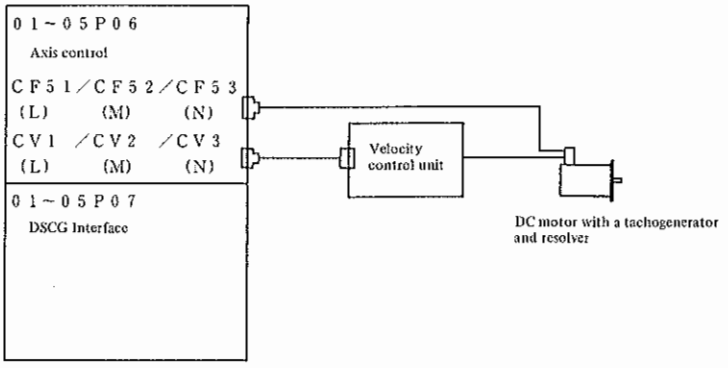
Fig. 1.2 (n)



Built-in type I/O unit used in free-standing type cabinet

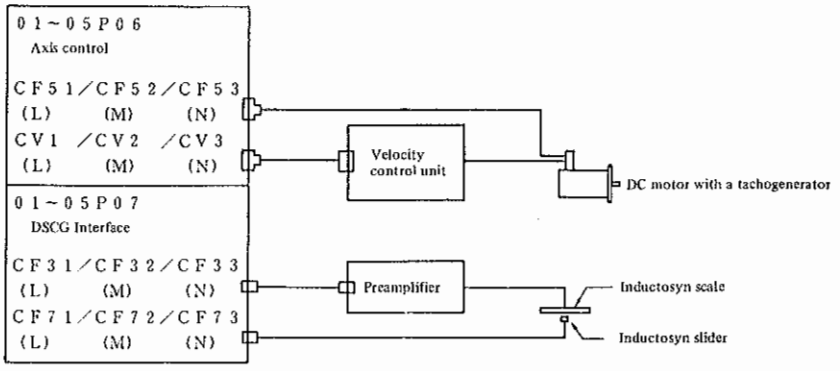
Fig. 1.2 (o)

e) 12 series connecting with servo system.
When an M series servo motor is used, the connecting differences caused by the type of position detector are as follows:
i) For resolver

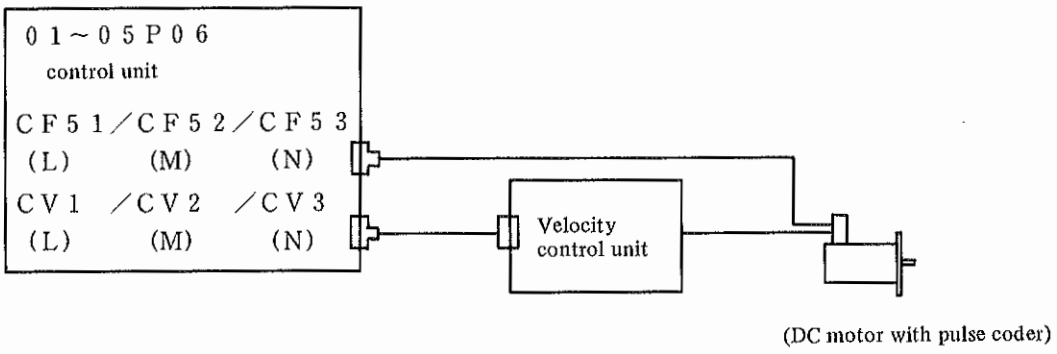


Note) L = 1st, 4, 7, 10, 13th axis
M = 2nd, 5, 8, 11, 14th axis
N = 3rd, 6, 9, 12, 15th axis

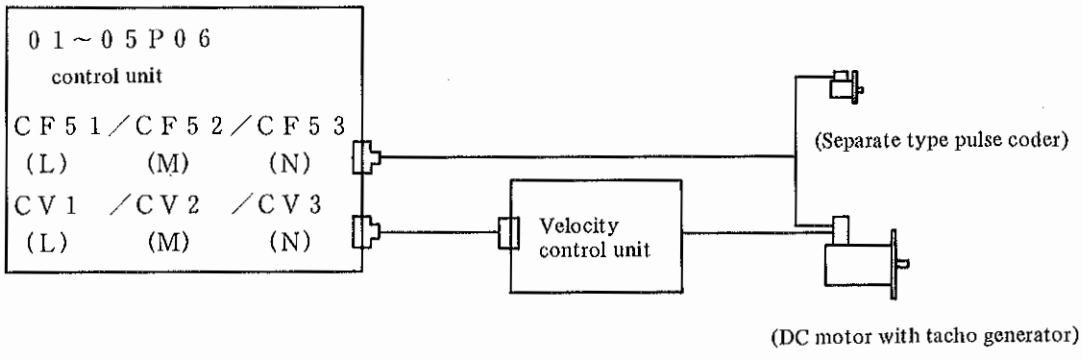
ii) For inductosyn



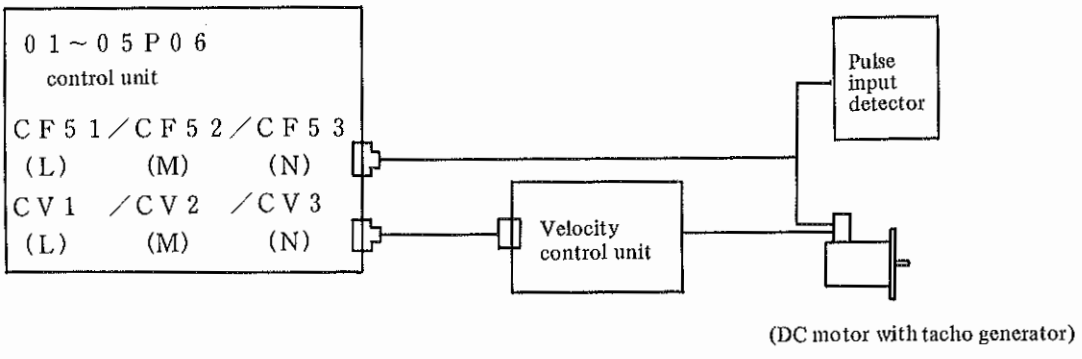
iii) For built-in type pulse coder



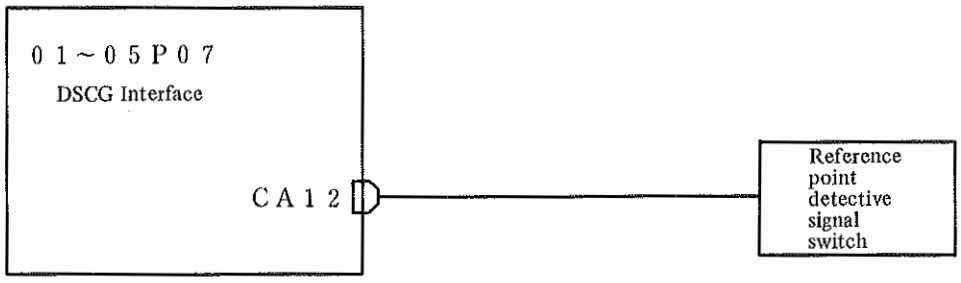
iv) For separate type pulse coder



v) For pulse input detector (optical scale, magne-scale)



vi) For reference point detective signal switch



1.3 System Block Diagram

1.3.1 10/100 series

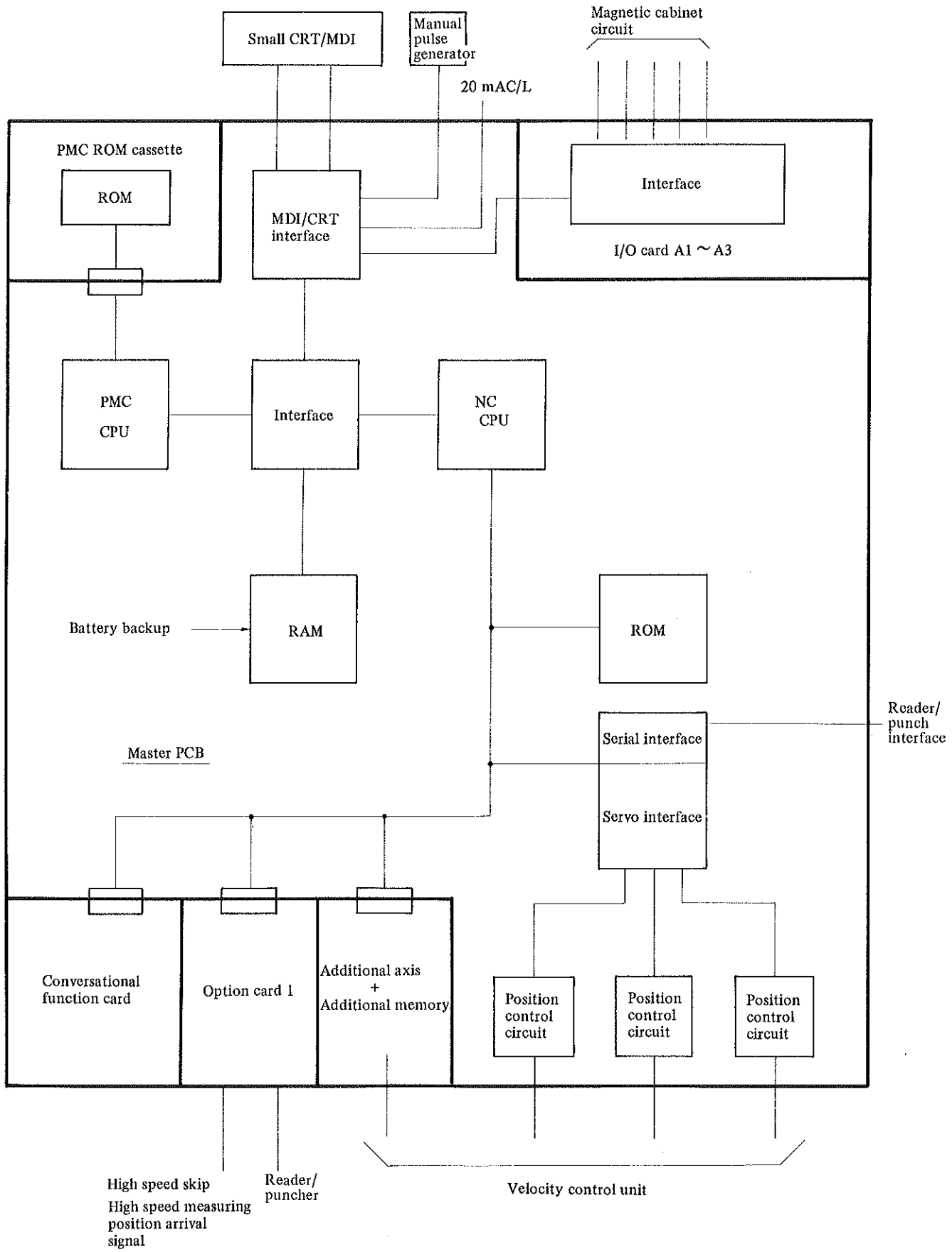


Fig. 1.3.1 (a) Analog servo 10 series system block diagram (when small CRT/MDI is used)

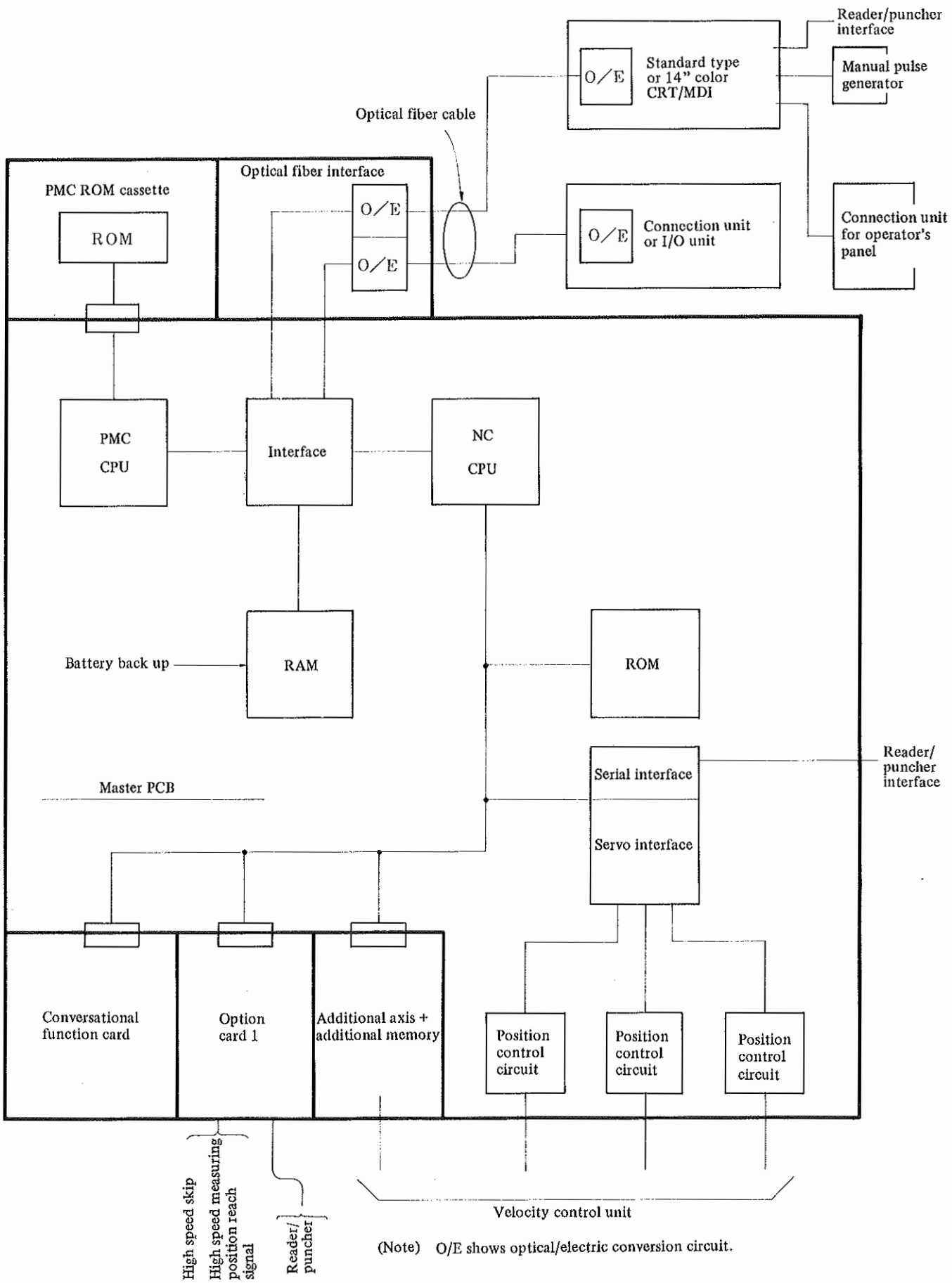


Fig. 1.3.1 (b) Analog servo 10 series system block diagram (when standard or 14" color CRT/MDI is used)

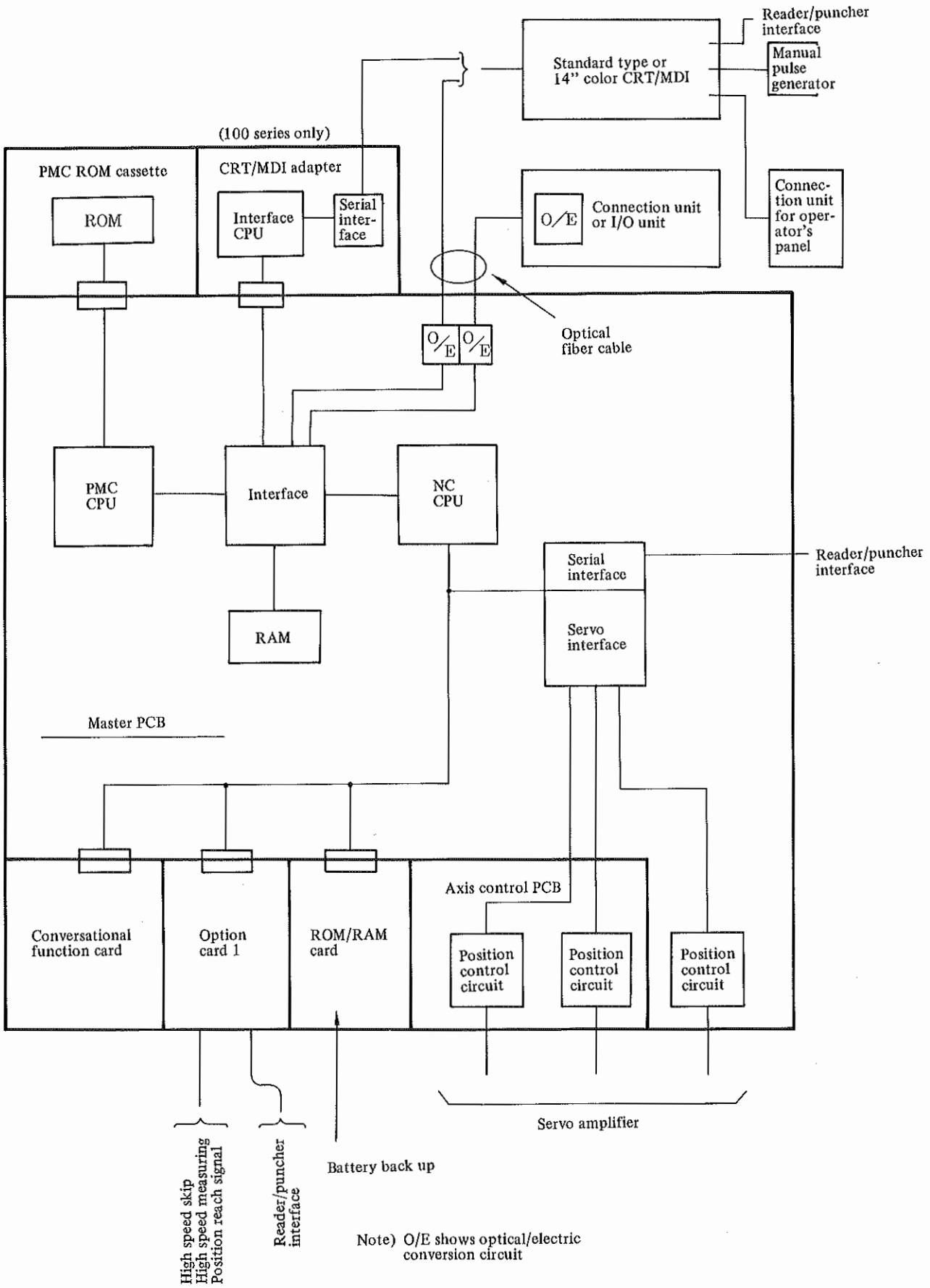
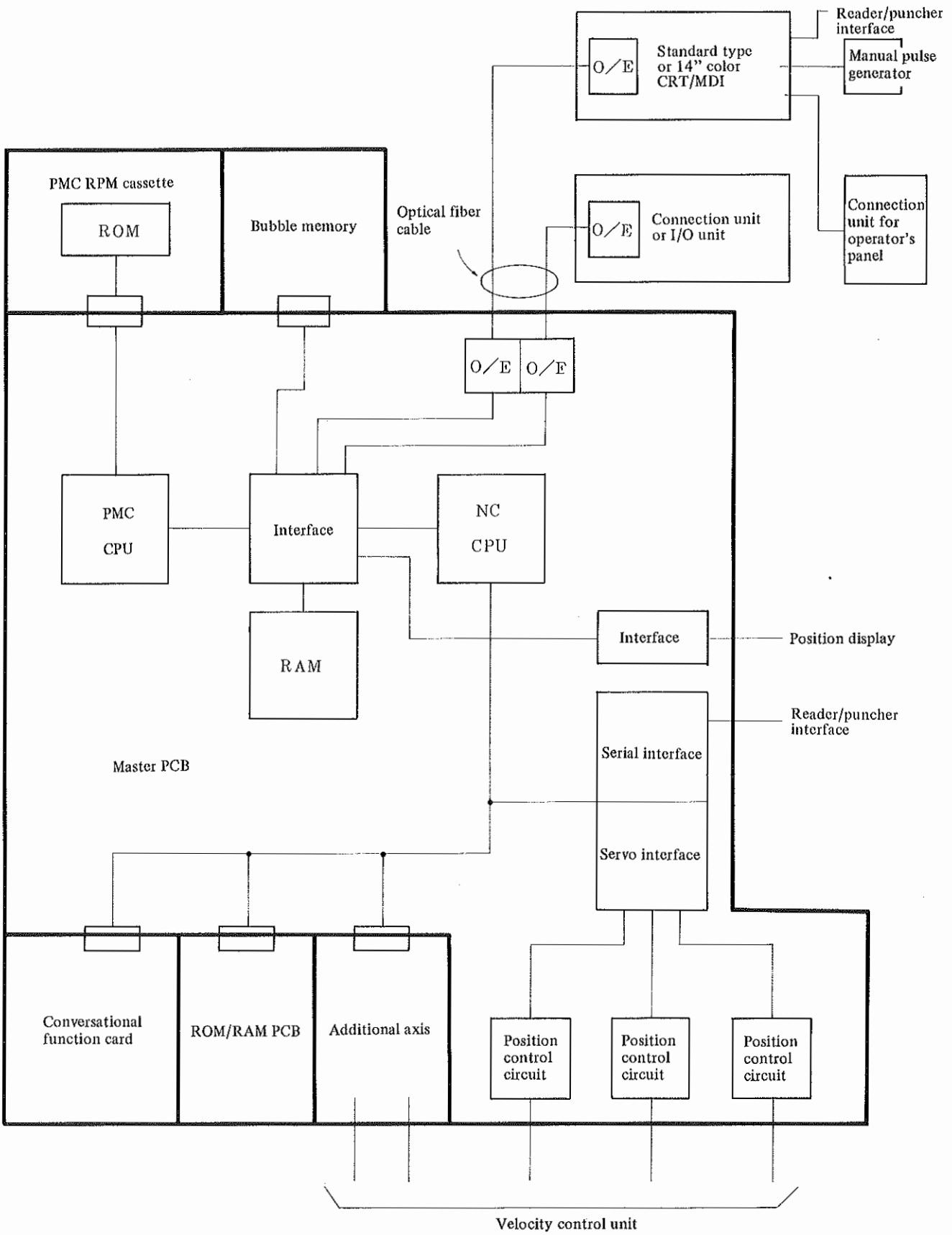


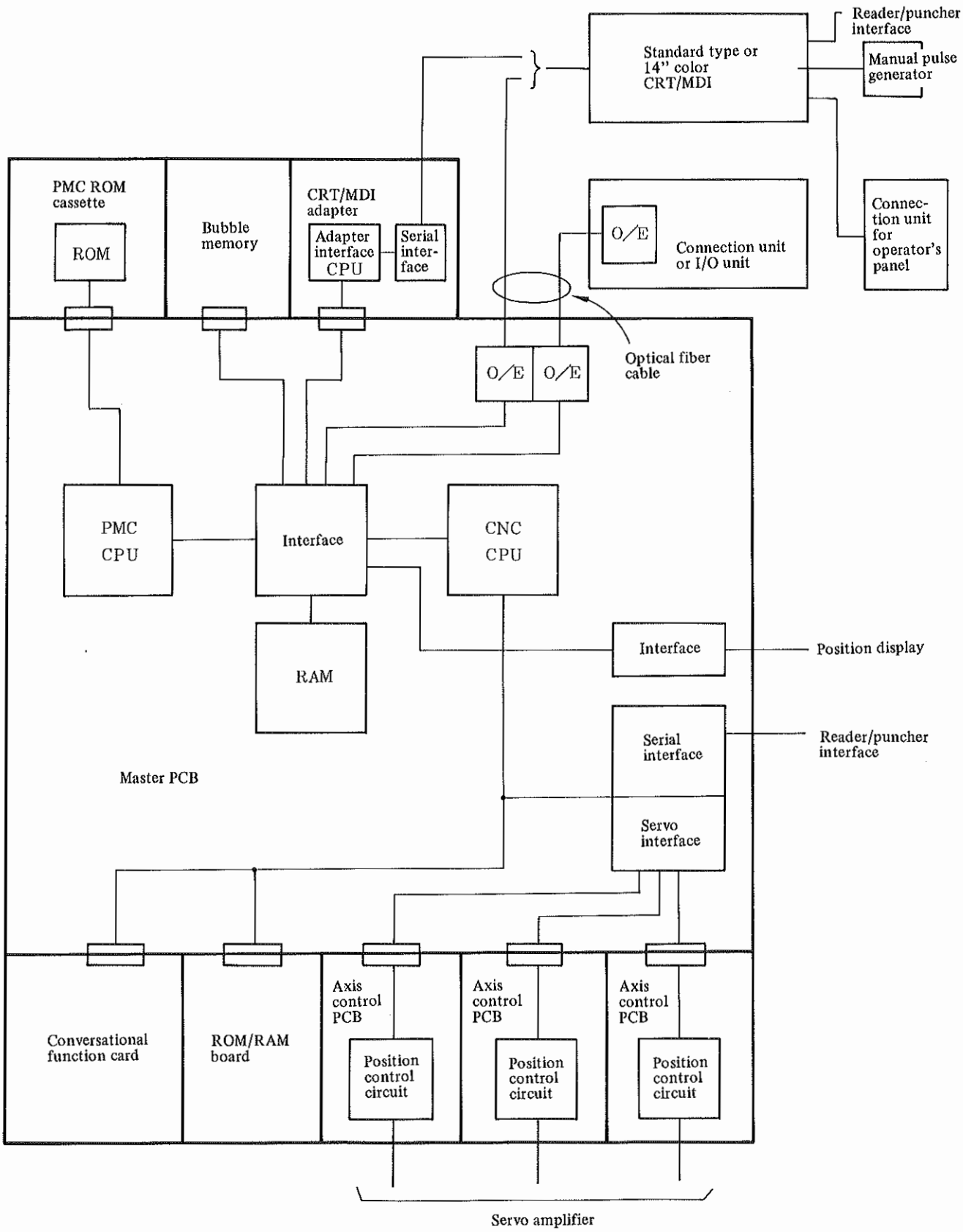
Fig. 1.3.1 (c) Digital servo 10/100 series system block diagram

1.3.2 11/110 series



(Note) O/E shows optical/electric conversion circuit.

Fig. 1.3.2 (a) 11 series system block diagram



Note) O/E shows optical/electric conversion circuit.

Fig. 1.3.2 (b) Digital servo 11/110 series system block diagram

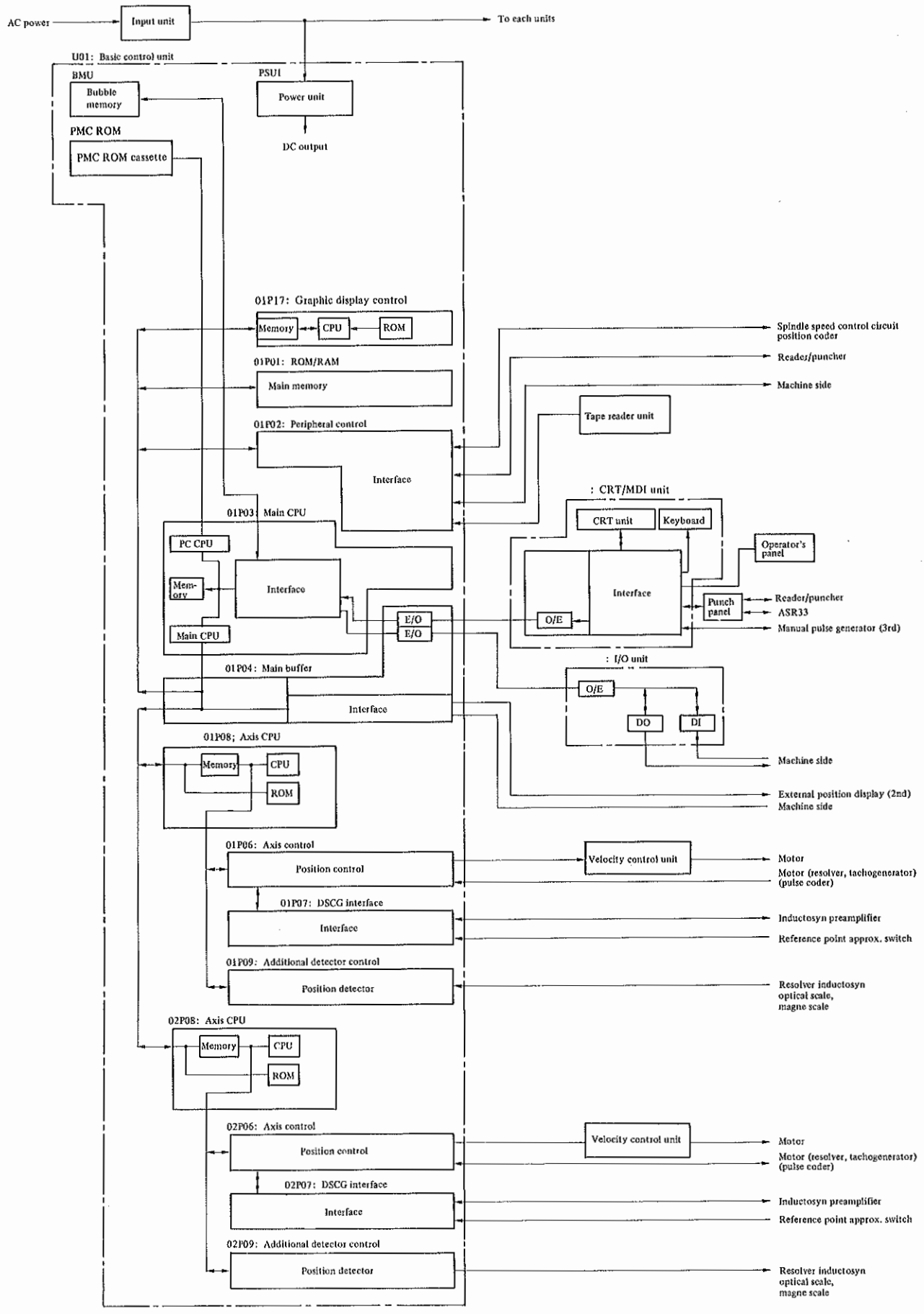


Fig. 1.3.3 (a) 12 series system block diagram

When using built-in type cabinet or free-standing type cabinet A (When 6 or less axes control, hybrid control, synchronous operation or double check system is performed)

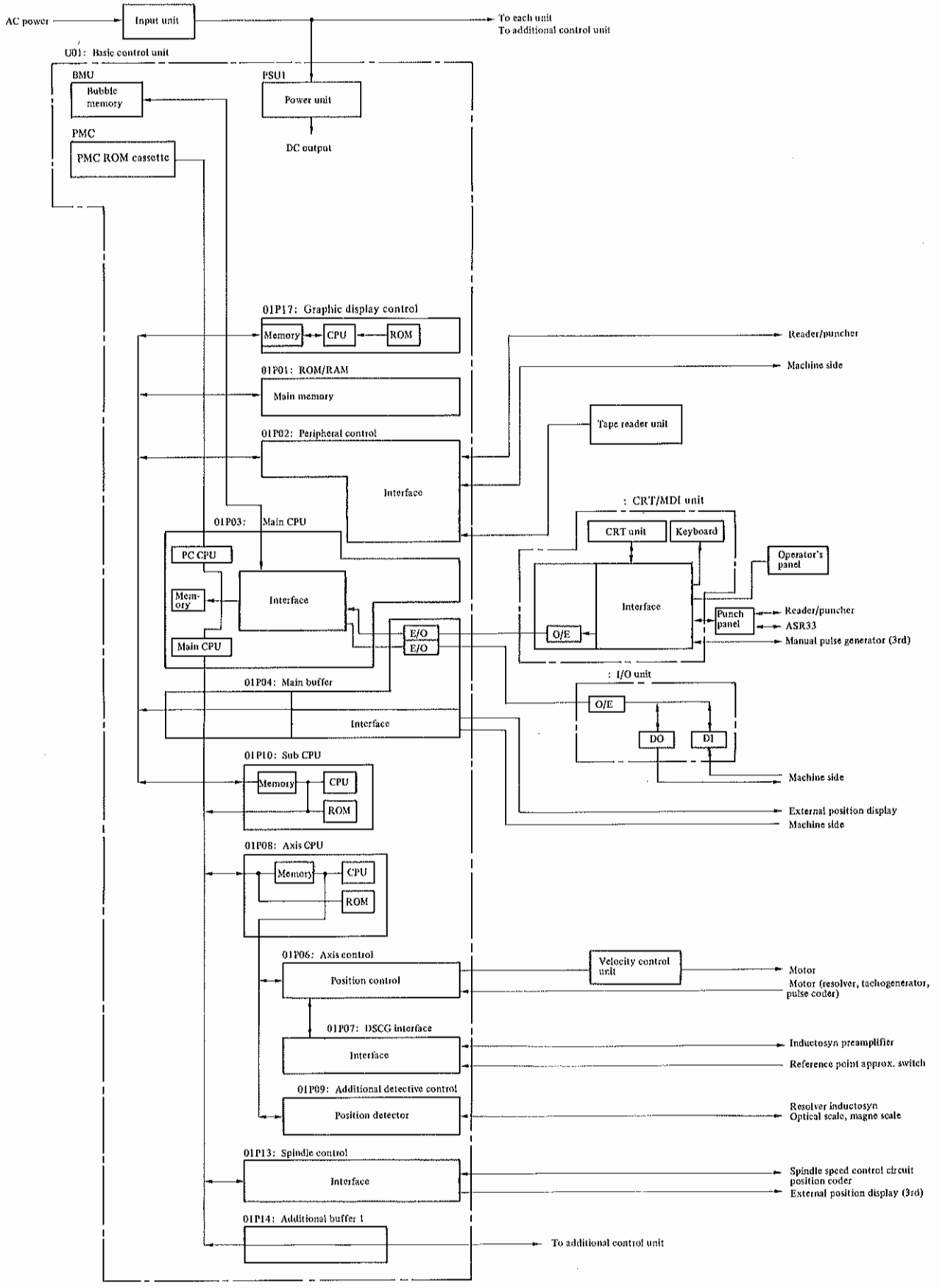


Fig. 1.3.3 (b) 12 series system block diagram

When using free-standing type cabinet B
(When more than 7 axes are controlled)

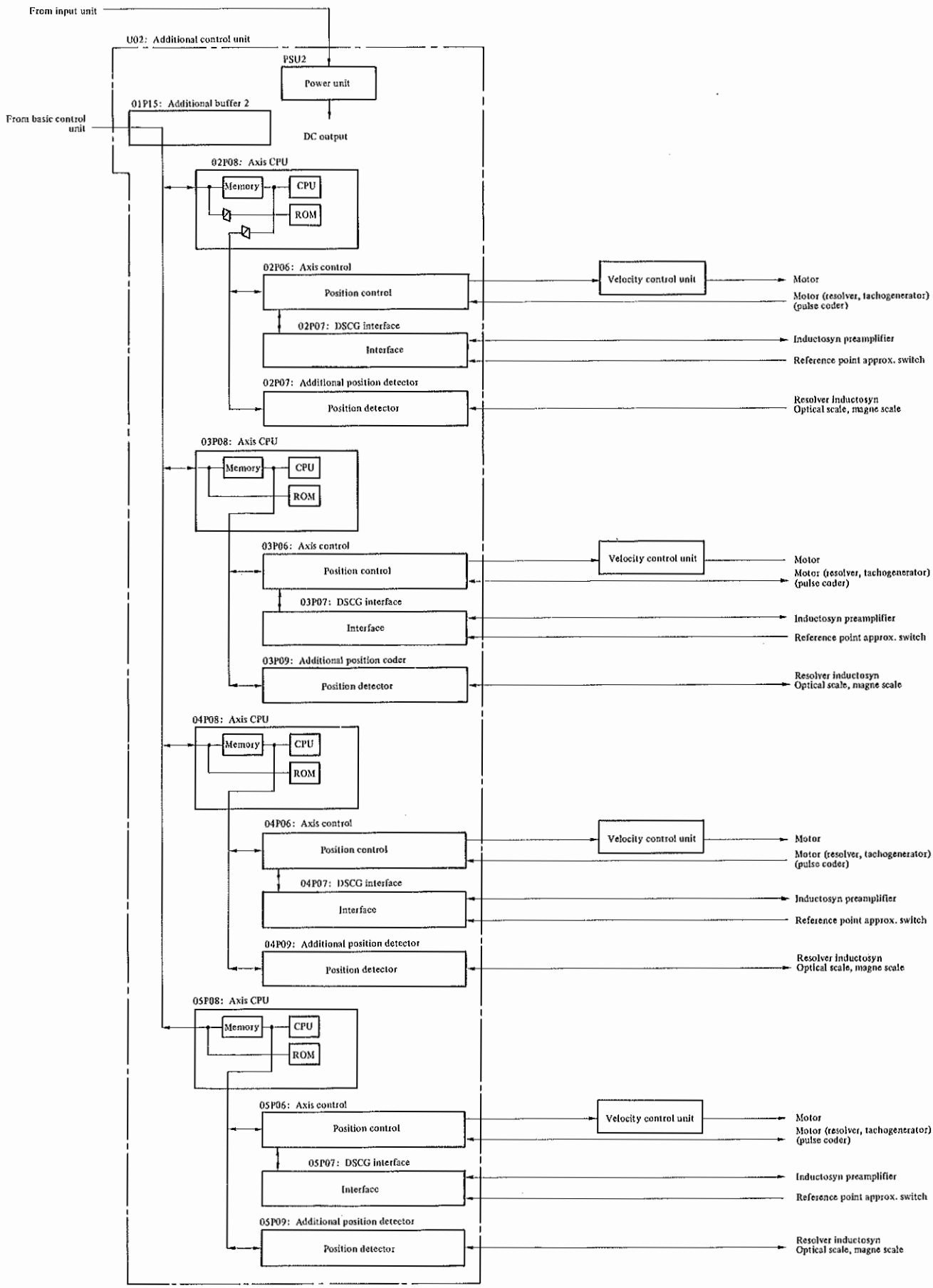
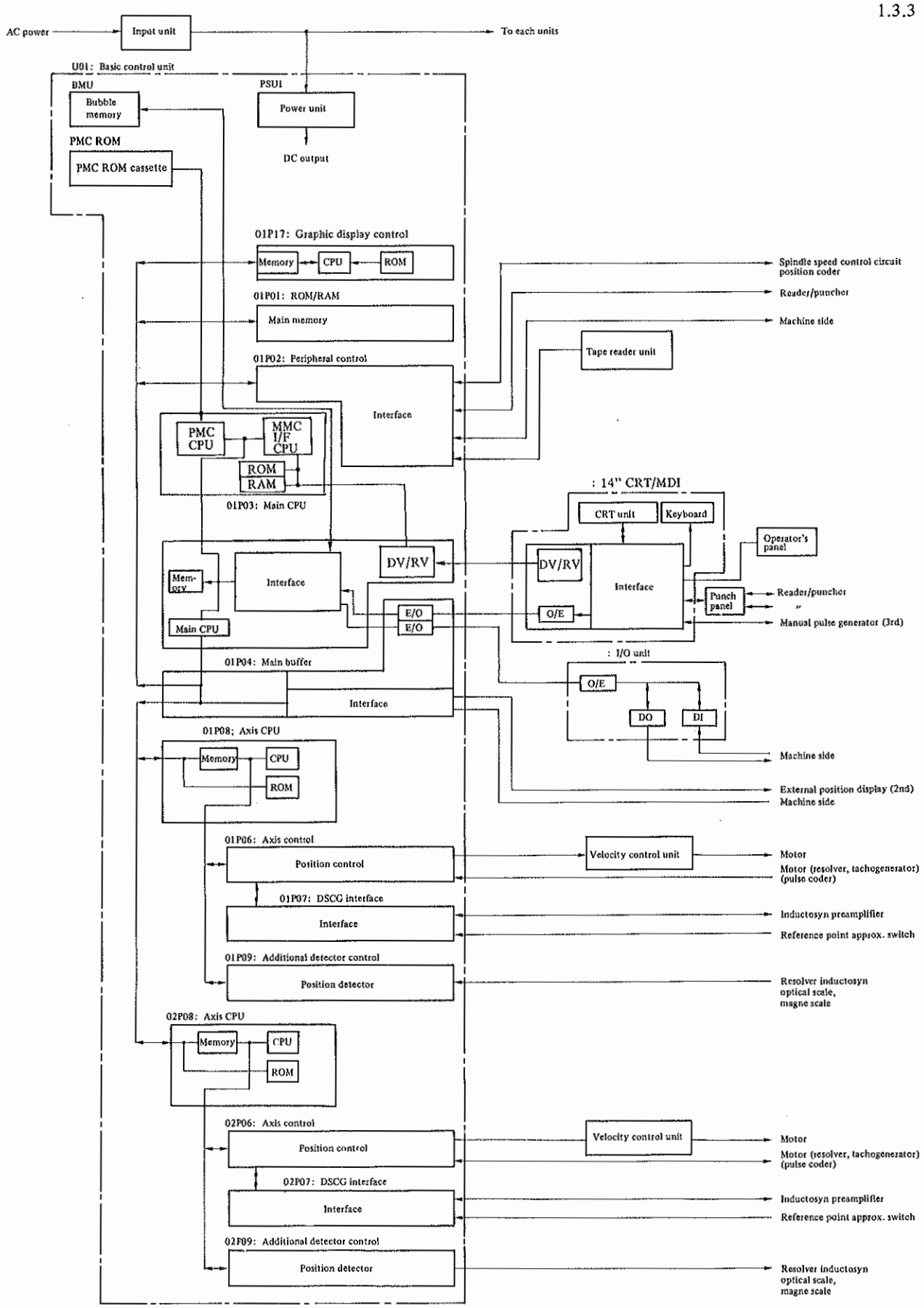


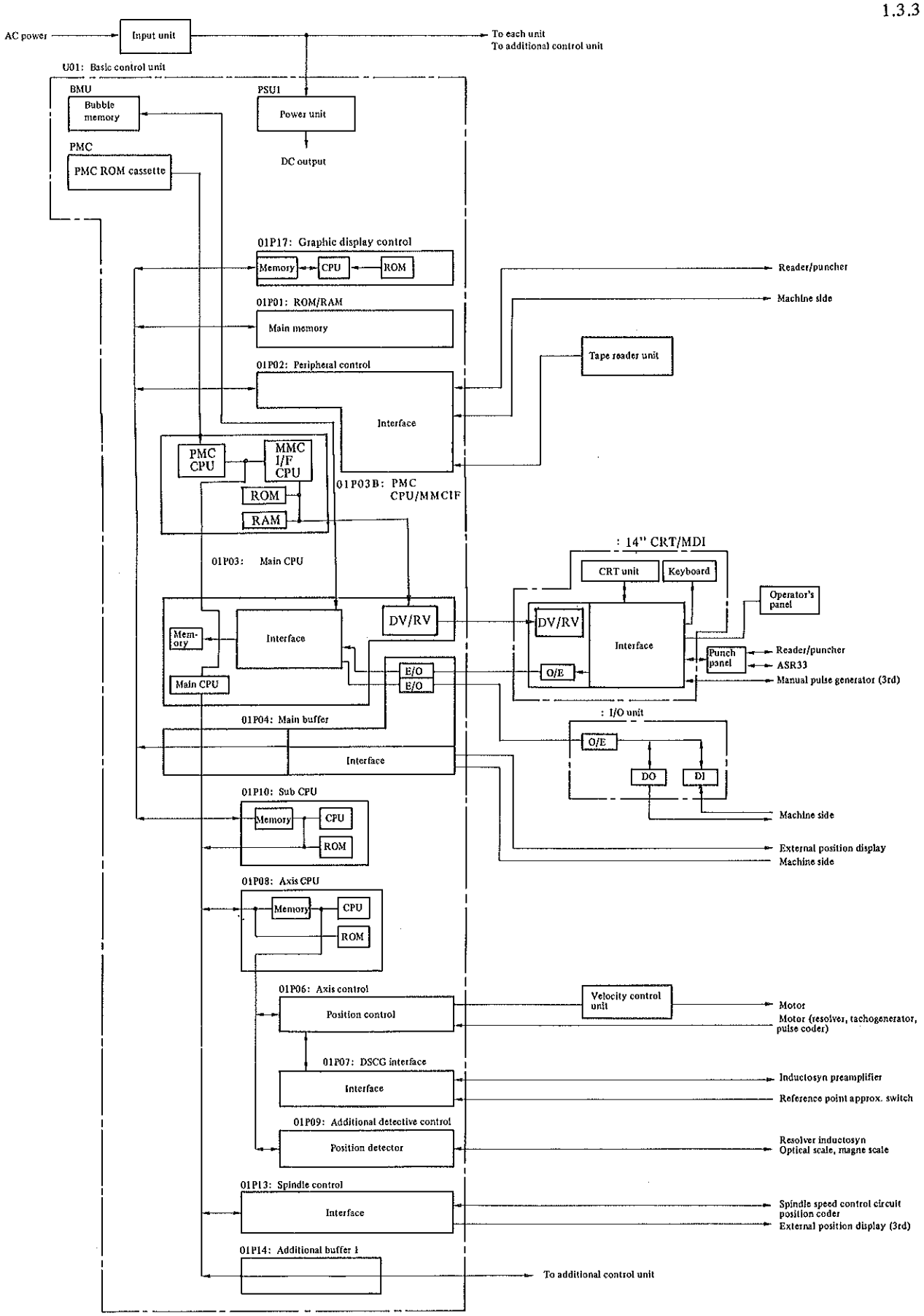
Fig. 1.3.3 (c) 12 series system block diagram

When using free-standing cabinet B
(When more than 7 axes are controlled)



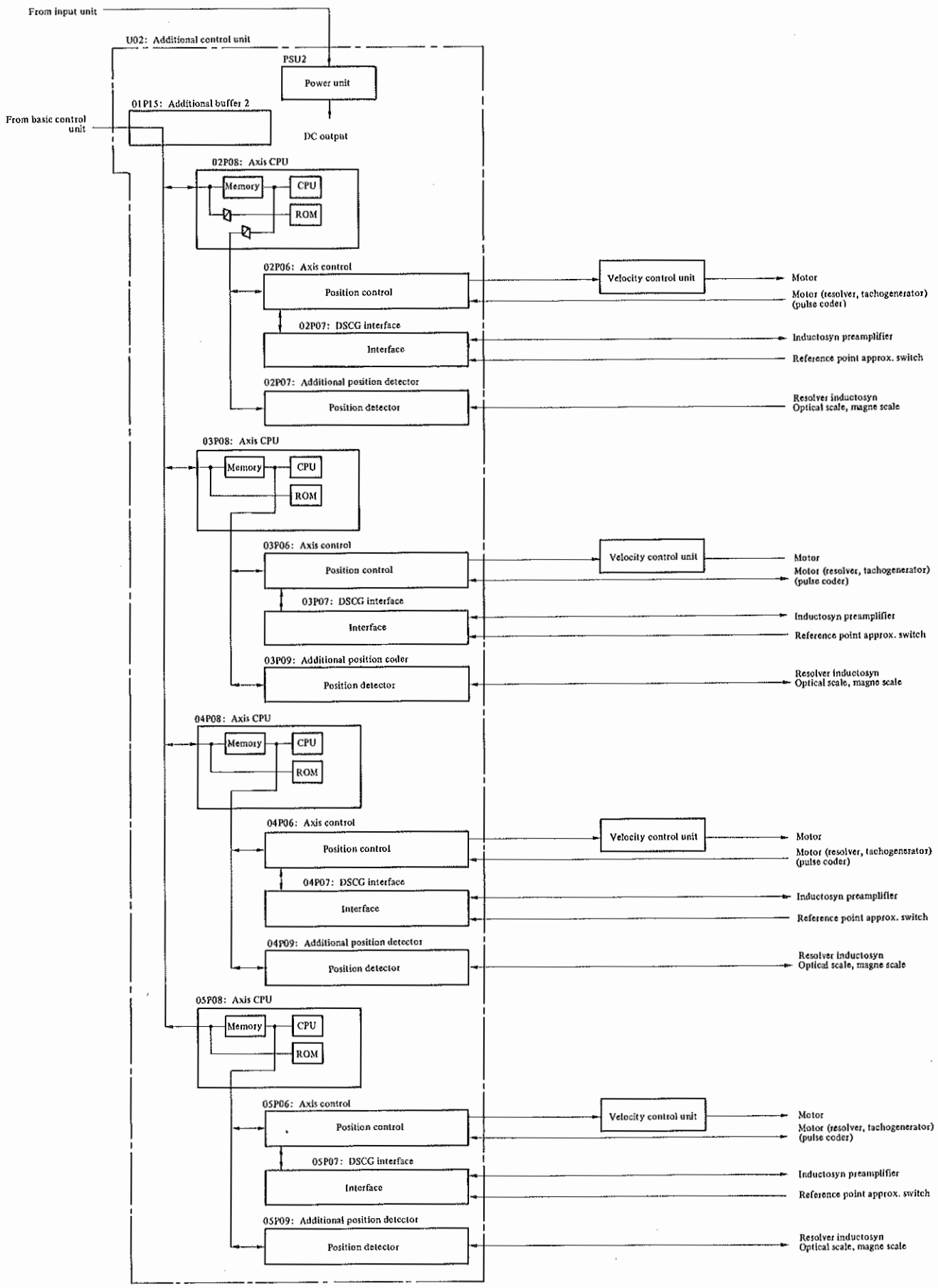
When using built-in type cabinet or free-standing type cabinet A (6 axis or less control, hybrid control, synchronous operation or double check system is performed)

Fig. 1.3.3 (d) 120 series system block diagram



When using free-standing type cabinet B
(When more than 9 axes are controlled)

Fig. 1.3.3 (e) 120 series system block diagram



When using free-standing type cabinet B
(When more than 7 axes are controlled)

Fig. 1.3.3 (f) 120 series system block diagram

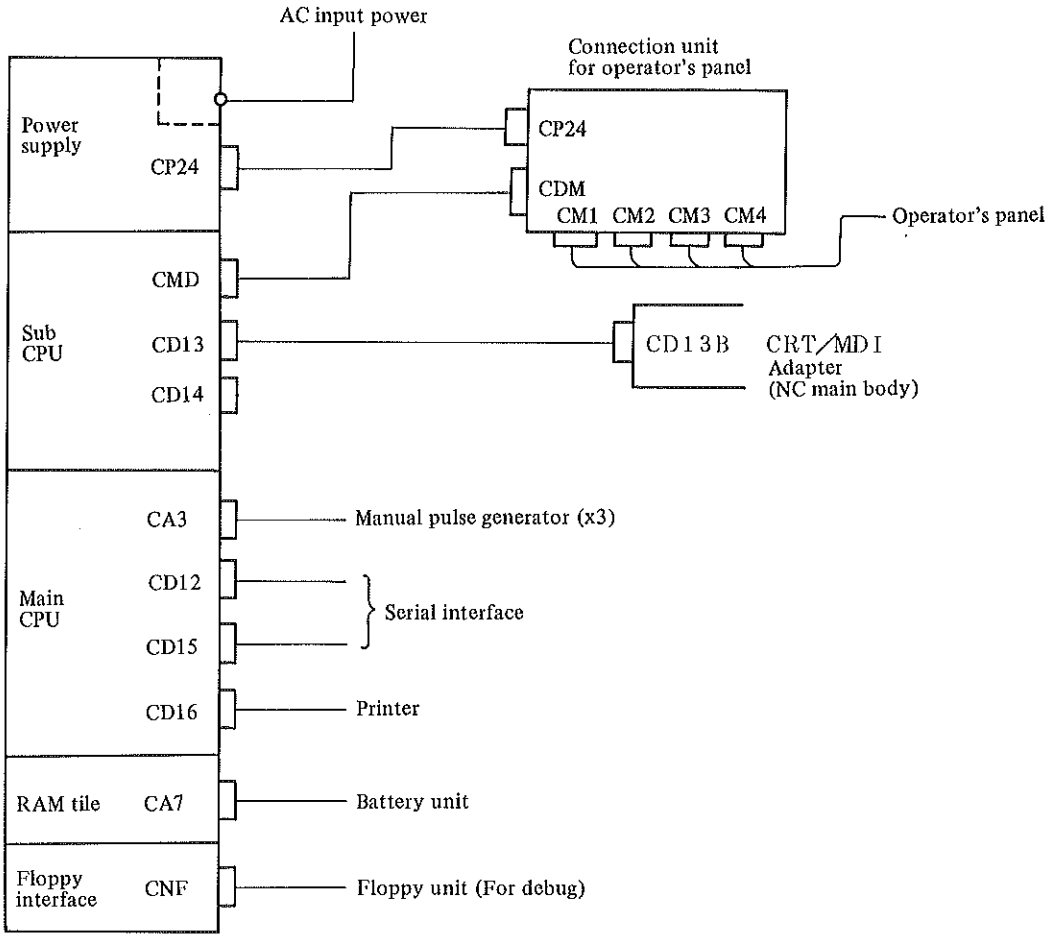


Fig. 1.3.3 (g) 14" CRT/MDI for 100/110/120 series

1.4 PCB and Units Table

Table 1.4 (a) PCB & units for 10/100 series only

Name	Abbreviation	Specification	Remarks
Master PCB	MASTER	A16B-1010-0040	Analog servo
		A16B-1010-0190	Digital servo
I/O Card (10T/M)	DI/DO 1	A16B-1210-0320	DI/DO = 40/40
	DI/DO 2	A16B-1210-0321	DI/DO = 80/56
	DI/DO 3	A16B-1210-0322	DI/DO = 104/72
I/O Card (for 10TF)		A20B-1001-0240	DI/DO = 40/40
		A20B-1001-0241	DI/DO = 80/56
		A20B-1001-0242	DI/DO = 104/72
ROM/RAM board	ROM/RAM	A16B-1211-0290	Digital servo system only
Small type CRT/ MDI interface	CRT/MDI INT	A16B-1211-0250	Digital servo system only
Optical Interface	OPT. INTERFACE	A16B-1210-0360	Analog servo system only
Option 1	OPTION 1	A16B-1210-0350	
Additional Axis Card	AD. AXS (P)	A16B-1210-0431	
Additional Axis + Additional ROM/RAM	ADD. AXIS/MEM	A16B-1210-0380	Analog servo system only
Additional ROM/RAM	ADD. MEMORY	A16B-1210-0381	
CRT/MDI Switcher	CRT/MDI SWITCHER	A16B-1210-0370	
CRT/MDI Panel		A20B-1001-0090	T keyboard
		A20B-1001-0091	M keyboard
		A98L-0001-0111	Sheet switch
		A20B-1000-0842	Small CRT/MDI panel soft key
		A61L-0001-0079	Small, standard CRT/MDI panel common CRT unit A13B-0056-C001

Name	Abbreviation	Specification	Remarks
CRT/MDI Panel (for 10TF)		A20B-1000-0850	Controller
		A20B-1001-0200	Keyboard
		A20B-1000-0890	Soft key
		A20B-1001-0160	Power supply
Power Supply PCB		A16B-1210-0510	
PCB for Input Unit		A16B-1600-0090	

Table 1.4 (b) PCB & units for 11/110 series only

Name	Abbreviation	Specification	Remarks
Master PCB	MASTER	A16B-1010-0050	Analog servo system
		A16B-1010-0200	Digital servo system
ROM/RAM Board	ROM/RAM	A16B-1210-0470	Analog servo system
		A16B-1211-0291	Digital servo system
Additional Axis (PP)	AD.AXS(P,P)	A16B-1210-0430	Pulse coder x 2 Analog servo system only
Additional Axis (RP)	AD.AXS(R,P)	A16B-1210-0440	Resolver + Pulse coder Analog servo system only
Additional Axis (RR)	AD.AXS(R,R)	A16B-1210-0450	Resolver x 2 Analog servo system only
Resolver/Inductosyn Interface	RES/IND	A16B-1210-0460	Analog servo system only
Power Supply PCB		A16B-1210-0560	
PCB for Input Unit		A16B-1600-0080	
Tape Reader		A20B-0007-0750	Photoamplifier
Tape Reader 2		A20B-1001-0050	Controller
		A20B-1001-0060	Keyboard
CRT/MDI Panel (14" for 11TTF)		A20B-1000-0900	Controller
		A20B-1000-0990	
		A20B-1001-0200	Keyboard
		A20B-1000-0890	Soft key
		A20B-1001-0160	Power supply
		A20B-0001-0074	CRT unit

Table 1.4 (c) PCB & units common to 10/11/100/110

Name	Abbreviation	Specification	Remarks
Axis control PCB	AXIS CONTROL	A16B-1211-0270	Digital servo 2 axes
		A16B-1211-0271	Digital servo 1 axis
Interface Converter	INT. CONVERTER	A20B-1000-0913	(except 11TT)
PMC Cassette A		A20B-1000-0910	4000 STEP
PMC Cassette B		A20B-1000-0920	16000 STEP
PMC RAM Board	PMC RAM 1	A16B-1210-0340	For PMC-I
Standard CRT/MDI Panel (9") (10/11 series only)		A20B-1000-0800	Controller
		A20B-1000-0970	Backboard
		A20B-1001-0160	Power supply
		A61L-0001-0079	CRT unit A13B-0056-C001
		A20B-1000-0830	M keyboard
		A20B-1000-0831	T keyboard
		A86L-0061-0110	Sheet switch
		A20B-1000-0840	Horizontal soft key
		A20B-1000-0841	Vertical soft key
CRT/MDI Panel (14") (10/11 series only)		A20B-1000-0850	Controller
		A20B-1000-0870	Horizontal keyboard M
		A20B-1000-0871	Horizontal keyboard T
		A20B-1000-0880	Vertical keyboard M
		A20B-1000-0881	Vertical keyboard T
		A20B-1000-0890	Horizontal soft key
		A20B-1000-0891	Vertical soft key
		A20B-1001-0160	Power supply
		A61L-0001-0074	CRT unit

Name	Abbreviation	Specification	Remarks
Connection Unit for Operator's Unit		A16B-1210-0480	DI/DO = 96/64
		A16B-1210-0481	DI/DO = 64/32
Connection Unit 1		A20B-1000-0940	
Connection Unit 2		A20B-1000-0950	
Tape Reader 1		A20B-0007-0750	Photoamplifier
		A20B-0008-0280	Serial interface
		A20B-1000-0472	Power supply A14B-0075-B120
PPR		A20B-1000-0200	I/O controller
		A20B-1000-0190	Power supply for 100 V AC
		A20B-1000-0191	Power supply for 200 V AC
		A13B-0117-C001	Switch unit
Conversational function card (for 10TF and 11TTF) (for 11M graphic)	ACP	A16B-1210-0410	SDB CPO
		A16B-1310-0300	MEMORY (10TF, 11TTF only)
		A16B-1310-0301	MEMORY (11MF)
		A16B-1310-0310	MEMORY (11MF)
		A16B-1310-0480	MEMORY (10TF,11TTF)

Table 1.4 (d) PCB & units list for 12 series

Module name		PCB specification	Name & function	Cabinet type (Note 1)	Group (Note 2)
U01 (12 series)		A02B-0075-C001	Basic control unit . Control PCB is mounted (Consisting of 2 kinds of the back panel PCB A16B-1010-0010 (12 series) A16B-1010-0230 (120 series) A20B-1001-0100 (12/120 series)	Bu, A, B	B
U05 (120 series)		A02B-0075-C012			
PCB mounted in basic control unit U01 or U05	01P01	A16B-1210-0012 A16B-1211-0600	ROM/RAM	Bu, A, B	B.O.
	01P02	A16B-1210-0080	Peripheral control . Spindle speed analog output . Position coder interface . Reader/puncher interface . High speed DI/DO . Tape reader interface	Bu, A, B	B
	01P03	A16B-1210-0060 (12 series only)	Main CPU . Main CPU . PMC CPU . Shared RAM		
	01P03A	A16B-1211-0540 (120 series only)	Main CPU-1 . Main CPU . Shared RAM . Interface for 14" CRT/MDI		
	01P03B	A16B-1211-0550 (120 series only)	Main CPU-2 . Main CPU . PMC CPU . Interface for 14" CRT/MDI		
	01P04	A16B-1210-0070	Main buffer . Main buffer . Buffer of main bus and peripheral bus . Buffer of main bus and global bus . Position display control (for 1st or 2nd) . Analog input interface		

Note 1) The cabinet type is abbreviated as follows:
- Bu : Built-in type cabinet
- A : Free-standing type A cabinet
- B : Free-standing type B cabinet

Note 2) The abbreviations are as follows:
- B : Basic
- B.O.: Basic option
- O : Option

Module name		PCB specification	Name & function	Cabinet type	Group
PCB mounted in basic control unit U01 or U05	01P05	A16B-1210-0090	Adapter . Buffer of global bus and axis bus	Bu, A	B.O.
	01P06 ⟩ 02P06	A16B-1210-0030	Axis control . Position control 3 axes (pulse coder, pulse input detector, and resolver inductosyn are available as detectors. Resolver inductosyn requires DSCG interface)	Bu, A, B	B.O.
	01P07 ⟩ 02P07	A16B-1210-0110	DSCG interface . Resolver, inductosyn interface	Bu, A, B	O
	01P08 ⟩ 02P08	A16B-1210-0020	Axis CPU . CPU memory for axis control . 1 pce of this PCB can control 3 axes (The hybrid servo control, double check system, and synchronous operation are possible)	Bu, A, B	B.O.
	01P09 ⟩ 02P09	A16B-1210-0180	Additional detector control (DSCG) . Additional detective control in the hybrid servo control and double check system . Resolver inductosyn is available as a position detector	Bu, A, B	O
		A16B-1210-0170	Additional detector control (pulse input type) . Additional detective control in the hybrid servo control and double check system . Pulse coder and pulse input type detector is available as a detector		

Module name		PCB specification	Name & function	Cabinet type	Group
PCB mounted in basic control unit U01 or U05	01P10	A16B-1210-0100	Sub CPU . CPU memory for sequence control when more than 7 axes are controlled	B	0
	01P13	A16B-1210-0160	Spindle (Used in the system where sub-CPU is used) . Spindle analog output . Position coder interface . Position display control (for 3rd)		
	01P14	A16B-1210-0250	Additional buffer 1 . Buffer to expand the global bus to the additional control unit	B	B
	01P16				
	01P17				
	PMC ROM	A20B-1000-0910	PMC ROM cassette . ROM for PMC 64 kB	Bu, A, B,	B.O.
		A20B-1000-0920	PMC ROM cassette . ROM for PMC 128 kB		
		A20B-1000-0913	Interface converter . ROM for PMC 16 kB		
	BMU	A87L-0001-0017	Bubble memory . Memorize parameter . Part program memory & edit (60 m)	Bu, A, B.	B.O.
		A87L-0001-0084	Bubble memory . Memorize parameter . Part program memory & edit (320 m)		
		A87L-0001-0085	Bubble memory . Memorize parameter . Part program memory & edit (640 m)		
		A87L-0001-0086	Bubble memory . Memorize parameter . Part program memory & edit (1280 m)		
		A87L-0001-0100 #8M	Bubble memory . Memorize parameter . Part program memory & edit (2560 m)		

Module name		PCB specification	Name & function	Cabinet type	Group
PCB mounted in basic control unit U01 or U05	BMU	A87L-0001-0100 #12M	Bubble memory . Memorize parameter . Part program memory & edit (3840 m)		
		A87L-0001-0100 #16M	Bubble memory . Memorize parameter . Part program memory & edit (5120 m)		
	PSU1	A20B-1000-0770	Power unit . Supply the DC voltage to basic control unit	Bu, A, B	B
	U02	A02B-0075-C002	Additional control unit . PCB is mounted for 4th or subsequent axis position control when more than 7 axes are controlled. (Consisting of 2 kinds of back panel PCBs A16B-1010-0020 A20B-1001-0180)	B	B
PCB mounted in additional control unit U02	02P06 ⟆ 05P06	A16B-1210-0030	Axis control	B	B.O.
	02P07 ⟆ 05P07	A16B-1210-0110	DSCG interface	B	O
	02P08 ⟆ 05P08	A16B-1210-0020	Axis CPU	B	B.O.
	02P09 ⟆ 05P09	A16B-1210-0180	Additional detector control (DSCG)	B	O
		A16B-1210-0170	Additional detector control (pulse input type detector)		
	01P15	A16B-1210-0260	Additional buffer 2 . Buffer to receive the global bus from basic control unit	B	B
	PSU2	A20B-1000-0770	Power unit . Supply DC voltage to additional control unit	B	B

Module name		PCB specification	Name & function	Cabinet type	Group
		A03B-0801-C001	Built-in type I/O unit . I/O PCB is mounted Max. for input ... 5 pcs Max. for output .. 5 pcs	Bu, A, B	B.O.
PCB mounted in built-in type I/O unit	IF01A	A16B-1310-0020	Interface module . Interface between basic control unit and built-in type I/O unit		
	ID99A	A20B-1000-0750	Input module . Low speed input 48 points . Used as a receiver of contact signal		
	ID99B	A20B-1000-0751	Input module . High speed input 48 points . Used as a receiver of photo coupler, etc.		
	OD99A	A20B-1000-0760	Output module . Contactless output 32 points		
		A03B-0801-C001	Built-in type additional I/O unit . I/O PCB is mounted Max. for input ... 5 pcs Max. for output .. 5 pcs	B	O
PCB mounted in built-in type additional I/O unit	IF01B	A16B-1210-0030	Interface module . Interface between built-in type I/O unit and built-in additional I/O unit		
	ID99A	A20B-1000-0750	Input module		
	ID99B	A20B-1000-0751	Input module		
	OD99A	A20B-1000-0760	Output module		

Module name	PCB specification	Name & function	Cabinet type	Group
	A14B-0076-B201	Input unit . Power ON/OFF control circuit, power magnetic contactor and fuses are mounted	Bu	B
	A14B-0076-B206	Input unit (When a velocity control unit is not installed in the free-standing type A cabinet)	A	B.O.
	A14B-0076-B207	Input unit (When a velocity control unit is installed in the free-standing type A cabinet, and when servo transformer total capacity is 5 kVA or less)		
	A14B-0076-B208	Input unit (When a velocity control unit is installed in the free-standing type A cabinet, and when servo transformer total capacity is 5 kVA or more)		
	A14B-0076-B205	Input unit	B	B
	A16B-1600-0080	Input unit PCB (Commonly used in the input unit for built-in type cabinet, and free-standing cabinet type A and B)		
	A20B-1001-0210	Input unit PCB (Used in the input unit for free-standing type B cabinet)		
	A02B-0075-C003	Punch panel . Connection to ASR33 . Connection to reader/ puncher interface device	Bu, A, B	O

Name		Specification	Remarks	Cabinet type	Group
CRT/MDI unit (12 series only)		A02B-0076-C022	9" horizontal type for 12T	Bu, A, B	B.O.
		A02B-0076-C025	9" horizontal type for 12M		
		A02B-0076-C042	9" vertical type for 12T	External type	
		A02B-0076-C062	14" horizontal type for 12T (color)		
		A02B-0076-C063	14" horizontal type for 12M (color)		
		A02B-0076-C082	14" vertical type for 12T (color)		
9" CRT/ MDI unit compo- nent	Control PCB	A20B-1000-0800			
	Back board	A20B-1000-0970			
	Power	A20B-1001-0160			
	CRT unit	A13B-0056-C001			
	Key board PCB	A20B-1000-0831	For 12T		
		A20B-1000-0832	For 12M		
	Soft key PCB	A20B-1000-0840	For horizontal type		
		A20B-1000-0841	For vertical type		

Name		Specification	Remarks	Cabinet type	Group
14" CRT/ MDI unit compo- nent	Control PCB	A20B-1000-0850			
	Power	A20B-1001-0160			
	CRT unit	A61L-0001-0074			
	Keyboard PCB	A20B-1000-0871	Horizontal type for 12T		
		A20B-1000-0872	Horizontal type for 12M		
		A20B-1000-0881	Vertical type for 12T		
	Soft key PCB	A20B-1000-0890	Horizontal type		
		A20B-1000-0891	Vertical type		
Connection unit for operator panel		A16B-1210-0480	DI 96 points, DO 64 points	External type	0
		A16B-1210-0481	DI 64 points, DO 32 points		
Tape reader		A13B-0070-B001	Without reels	Bu, A, B	B.O.
		A13B-0080-B001	With reels		
Tape reader compo- nent	Photo amplifier	A20B-0007-0750	Without reels		
	Control PCB	A20B-1001-0050	With reels		
	Keyboard	A20B-1001-0060	With reels		

Table 1.4 (e) 14" CRT/MDI for 100/110/120 series

Name		Specification	Remarks
14"CRT/MDI unit		A02B-0087-C200	
14" CRT/MDI unit compo-nent	Main CPU	A20B-1001-0830	
	Sub CPU	A20B-1001-0840	
	ROM file (512KB)	A20B-1001-0860	
	ROM file (1 MB)	A20B-1001-0870	
	RAM file (128KB)	A20B-1001-0880	
	RAM file (256KB)	A20B-1001-0881	
	RAM file (512KB)	A20B-1001-0882	
	Bubble memory (512KB)	A20B-1001-0911	
	Bubble memory (1MB)	A20B-1001-0910	
	Floppy interface	A20B-1001-0901	For debug.
	Power supply	A20B-1001-0930	
	Back panel	A20B-1001-0920	
	Key board	A86L-0001-0130	
Floppy unit terminal board		A20B-1002-0060	
ROM file adapter		A20B-1002-0110	For ROM file and PMC writer

Table 1.4 (f) PCB & unit for I/O unit (common to 10/11/12/100/110/120 series)

Name		Specification	Remarks		
I/O base unit	BU10A	A03B-0801-C009	I/O unit back panel (for 10 pcs)		
	BU08A	A03B-0801-C004	I/O unit back panel (for 8 pcs)		
	BU06A	A03B-0801-C006	I/O unit back panel (for 6 pcs)		
	BU04A	A03B-0801-C007	I/O unit back panel (for 4 pcs)		
Power module	POW	A16B-1310-0010	Common to main unit and I/O unit 200 VAC input		
I/O interface module	IF01A	A03B-0801-C101	Optical signal → I/O bus, electric signal → I/O bus		
	IF01B	A03B-0801-C102	I/O bus extension		
	IF04C	A03B-0801-C103	Optical signal extension		
Output module	OD64A	A03B-0801-C141	DO=64	24∿48VDC/ 0.125A	Connection via connectors
	OD32A	A03B-0801-C140	DO=32		
	OD64B	A03B-0801-C113	DO=64	24∿48VDC/ 0.25A	
	OD32B	A03B-0801-C112	DO=32		
	OD16B	A03B-0801-C111	DO=16	24∿48VDC/ 0.5A	Connection via terminals
	OD08B	A03B-0801-C110	DO= 8		
	OD16C	A03B-0801-C115	DO=16	24∿48VDC/ 2A	
	OD08C	A03B-0801-C114	DO= 8		
	OA16D	A03B-0801-C117	DO=16	120VAC/1.6A	
	OA08D	A03B-0801-C116	DO= 8		
	OA16E	A03B-0801-C119	DO=16	240VAC/1.6A	
	OA08E	A03B-0801-C118	DO= 8		
Input module	ID64A	A03B-0801-C133	DI=64	24VDC/20mS non insulation	Connection via connectors
	ID32A	A03B-0801-C132	DI=32		
	ID16A	A03B-0801-C131	DI=16		Connection via terminals
	ID08A	A03B-0801-C130	DI= 8		

Name		Specification	Remarks		
Input module (cont'd)	ID64B	A03B-0801-C137	DI=64	24VDC/2mS non insulation	Connection via connectors
	ID32B	A03B-0801-C136	DI=32		
	ID16B	A03B-0801-C135	DI=16		Connection via terminals
	ID08B	A03B-0801-C134	DI= 8		
	ID64C	A03B-0801-C123	DI=64	24VDC/20mS insulation	Connection via connectors
	ID32C	A03B-0801-C122	DI=32		
	ID16C	A03B-0801-C121	DI=16		Connection via terminals
	ID08C	A03B-0801-C120	DI= 8		
	ID64D	A03B-0801-C127	DI=64	24VDC/2mS insulation	Connection via connectors
	ID32D	A03B-0801-C126	DI=32		
	ID16D	A03B-0801-C125	DI=16		Connection via terminals
	ID08D	A03B-0801-C124	DI= 8		
	IA16E	A03B-0801-C129	DI=16	120VAC/30ms insulation	Connection via terminals
	IA08E	A03B-0801-C128	DI= 8		
Positioning module (software is necessary)	PT01A	A03B-0801-C051			
Positioning module control		A03B-0801-J501 #775	Software for positioning module		
Analog input module	AD04A	A03B-0801-C052	Analog input = 4		
Analog output module	DA03A	A03B-0801-C055	Analog output = 3		
	DA02A	A03B-0801-C053	Analog output = 2		
Pulse counter module	CT01A	A03B-0801-C054	Pulse input = 1		
PCB for power input unit		A16B-1600-0090	200VAC input		
PCB for additional power input unit		A20B-1001-0210	200VAC input		

2. PERIODIC MAINTENANCE AND MAINTENANCE EQUIPMENT

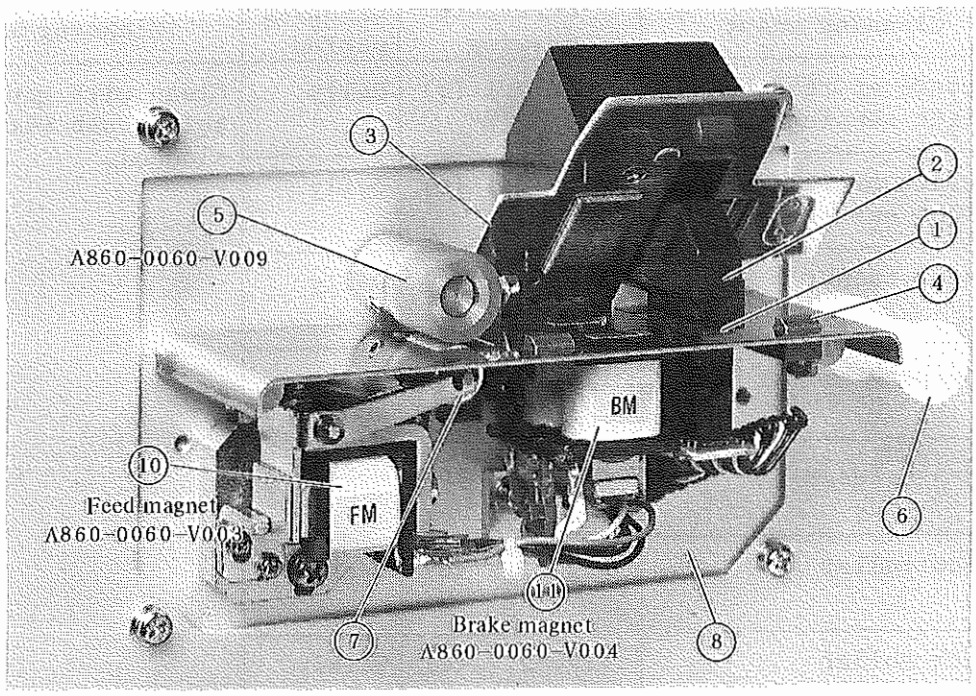
10/11/12/100/110/120 series is designed for ease of maintenance, such as reduction of regular check points, easy adjustment, etc. It is also important that the user make the departments concerned fully aware of the concept of preventive maintenance in order to keep the NC machine tool in good condition. Preventive maintenance includes the following:

. Routine check and adjustment.
. Arrangement of maintenance tools.
. Main spare parts.

2.1 Periodic Maintenance

(1) Tape reader cleaning
    (a) Tape reader without reels

Item	Cleaning point	Reference drawing	Cleaning period	Cleaning method
1	Surface of read head (light sensing part)	Fig. 2.1 (a) ①	Daily	Cleaning with gauze or thin brush with pure alcohol.
2	Surface of read head (light emitting part)	Fig. 2.1 (a) ②	Daily	
3	Tape retainer	Fig. 2.1 (a) ③	Daily	
4	Tape path	Fig. 2.1 (a) ④	Daily	
5	Capstan roller	Fig. 2.1 (a) ⑤	Weekly	
6	Guide roller	Fig. 2.1 (a) ⑥	Weekly	
7	Pinch roller	Fig. 2.1 (a) ⑦	Weekly	
8	Assembly under tape path plate	Fig. 2.1 (a) ⑧	Monthly	Clean with cloth or a brush.
9	Inside tape reader cover	Fig. 2.1 (b) ⑨	Monthly	



(A13B-0070-B001)

Fig. 2.1 (a) Tape reader without reels front view (with cover removed)

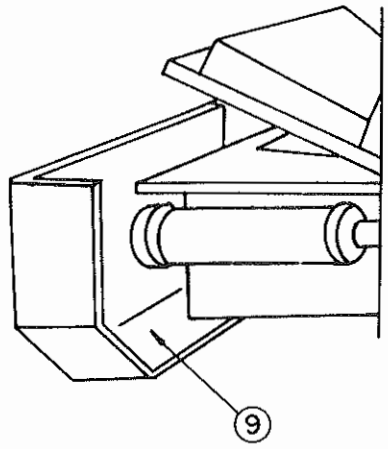


Fig. 2.1 (b) Tape reader without reels side view

(b) Tape reader with reels

Item	Cleaning point	Reference drawing	Cleaning period	Cleaning method
1	Surface of read head (light sensing part)	Fig. 2.1 (c) ①	Daily	Clean with gauze or a thin brush with pure alcohol.
2	Surface of read head (light emitting part)	Fig. 2.1 (c) ②	Daily	
3	Tape retainer	Fig. 2.1 (c) ③	Daily	
4	Tape path	Fig. 2.1 (c) ④	Daily	
5	Capstan roller	Fig. 2.1 (c) ⑤	Weekly	
6	Guide roller	Fig. 2.1 (c) ⑥	Weekly	
7	Pinch roller	Fig. 2.1 (c) ⑦	Weekly	
8	Assembly under tape path plate	Fig. 2.1 (c) ⑧	Monthly	Clean with cloth or a brush.
9	Inside tape reader cover	Fig. 2.1 (d) ⑨	Monthly	

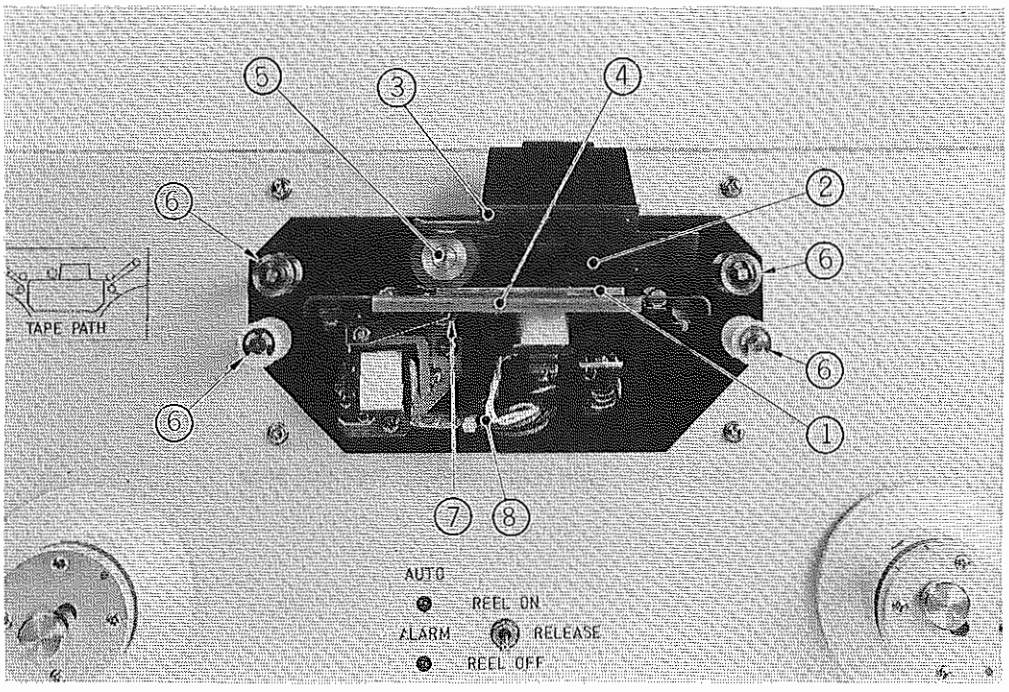


Fig. 2.1 (c) Tape reader with reels front view (with cover removed)

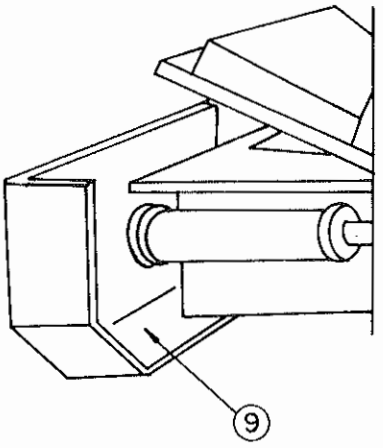
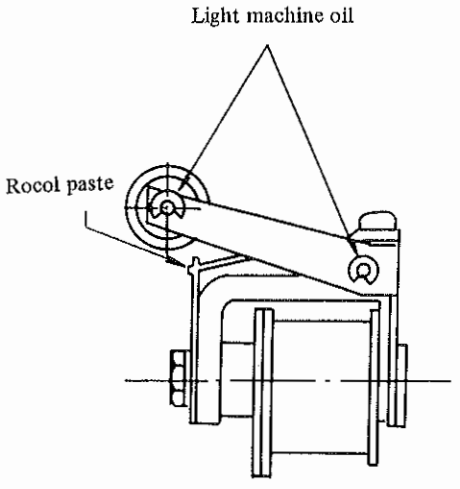


Fig. 2.1 (d) Tape reader with reels side view

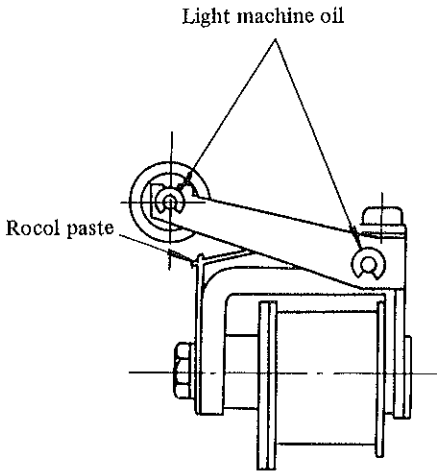
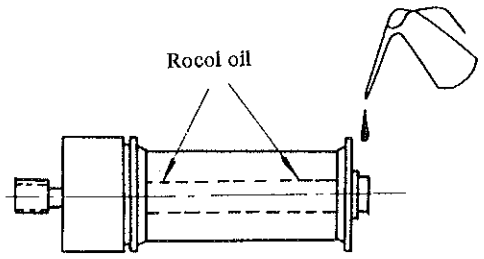
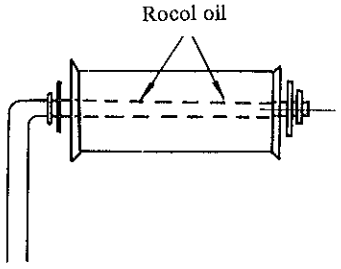
(2) Tape reader lubrication

a) Tape reader without reel

The routine lubrication points and lubrication periods are as follows:

Item	Lubrication point	Period	Lubrication (Note)	Amount
1	Magnetic section **See Fig. 2.1 (a) ⑦** 	3 months	Light machine oil	1 drop
		1 year	Rocol paste	Sufficient to form a thin film

b) Tape reader with reels
The routine lubrication points and lubrication periods are as follows:

Item	Lubrication point	Period	Lubrication (Note)	Amount
1	Magnetic section **See Fig. 2.1 (e) ①**	3 months	Light machine oil	1 drop
		1 year	Rocol paste	Sufficient to form a thin film
2	Guide roller **See Fig. 2.1 (e) ②**	6 months	Rocol oil	2 ∿ 3 drops
				
3	Tension arm guide roller **See Fig. 2.1 (f) ③**	6 months	Rocol oil	2 ∿ 3 drops
				

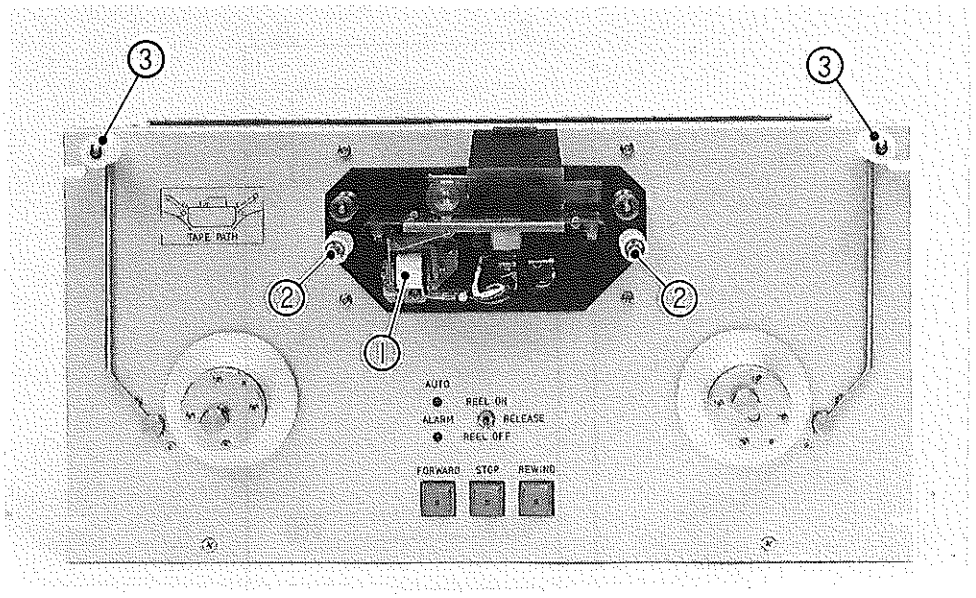


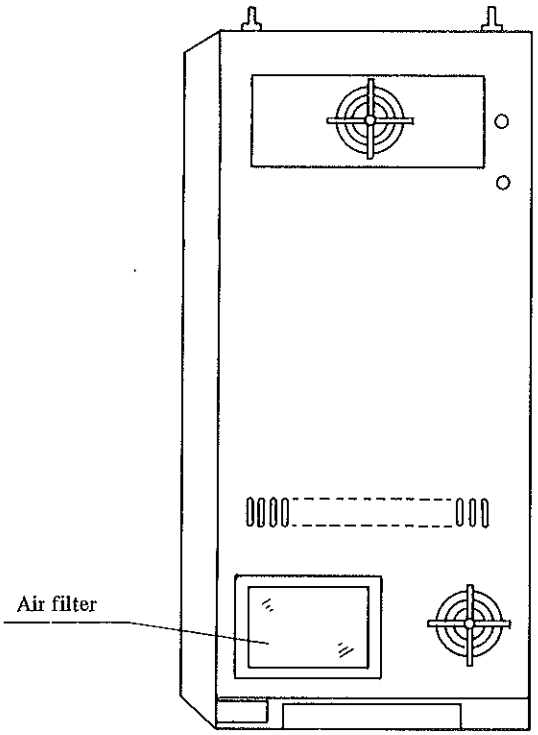
Fig. 2.1 (e) Tape reader with reels front view

(Note) Lubricant

Item	Name	Manufacturer
1	Rocol oil (ROCOL ASO)	ROCOL CO., Ltd. (U.K.)
2	Rocol Paste (ROCOL ASP)	ROCOL CO., Ltd. (U.K.)
3	Luna oil	Nippon Sekiyu

Refer to appendix 18 about characteristics of oil.

(3) Air Filter cleaning (For free-standing type cabinet only)
When the air filter installed at the bottom rear of the equipment is dusty, the dust collection efficiency will drop, and the temperature in the equipment will rise. Therefore, the filter must be cleaned weekly as follows:
a) Remove the fastener and air filter from the bottom rear of the equipment.
b) Blow the air filter out with compressed air from the inside while shaking the filter lightly.
c) When the filter is very dirty, wash it in a neutral cleaner with pressure and then dry in the shade. (At this time, do not wash it by rubbing.) Wash it with pressure in a neutral cleaner and water (about 40°C or 104°F) (cleaner 5%; water 95%), then rinse in clear water.



(4) Check and Cleaning of Motor Brush

a) Check and clean the motor brush as follows. If the motor brush is abnormally worn due to neglect, the motor can be damaged as a result; therefore, be sure to check the motor brush periodically.

i) Periodic checks should be made at the intervals listed below.
. When using a general machine tool (lathe, milling machine, machine center, etc.): Once a year.
. When using a machine tool with a high frequency of acceleration/deceleration (turret punch press, etc.): Every two months
However, it is recommended that the check interval be determined by judging the actual wear of the motor brush.

ii) Confirm that the power supply to the DC servo motor (machine) is OFF. Immediately after the DC servo motor has been operated, the brush may be hot. In such case, make the check after the brush is completely cooled.

iii) Remove the brush cap, as shown in Fig. A, using a screwdriver which fits the slot.

iv) After taking out the brush, measure (visually) the length of the brush (see Fig. B). If the length of the remaining brush is shorter than 10 mm (5 mm for model 00M), the brush can no longer be used. Taking this into consideration, make a judgement as to whether the brush can be used until the next check and, if necessary, replace the brush.

v) Check the brush carefully. If any deep groove or scar is found on the contact surface of the brush, or if any mark of arcing is seen on the brush spring; replace the brush. If this occurs, check the brush occasionally for about a month after the replacement; if this recurs during this period, contact our nearest service office.

vi) Blow off the dust in every brush holder with compressed air (factory air), and the dust will come out through another brush holder. Before using the compressed air, confirm that the air does not contain iron dust or a large amount of moisture.

vii) After the check, put back the brush and tighten the brush cap completely. Be careful as sometimes the brush spring may be caught in between the conducting metal and brush holder and the brush cap may not go in correctly make sure that all the brush caps are tightened into the respective brush holders to almost the same level.
When putting the brush into the brush holder, sometimes the brush cannot slide smoothly due to brush dust which adhered to the inside surface of the brush holder. In such a case, clean the inside surface of the brush holder with the tip of a screwdriver. (Take care not scratch the commutator surface.)

viii) When replacing the brush, use a brush similar (in quality, shape, etc.) to the existing one. After replacement of the brush, run the DC servo motor without load for a while to fit the brush surface to the commutator surface.

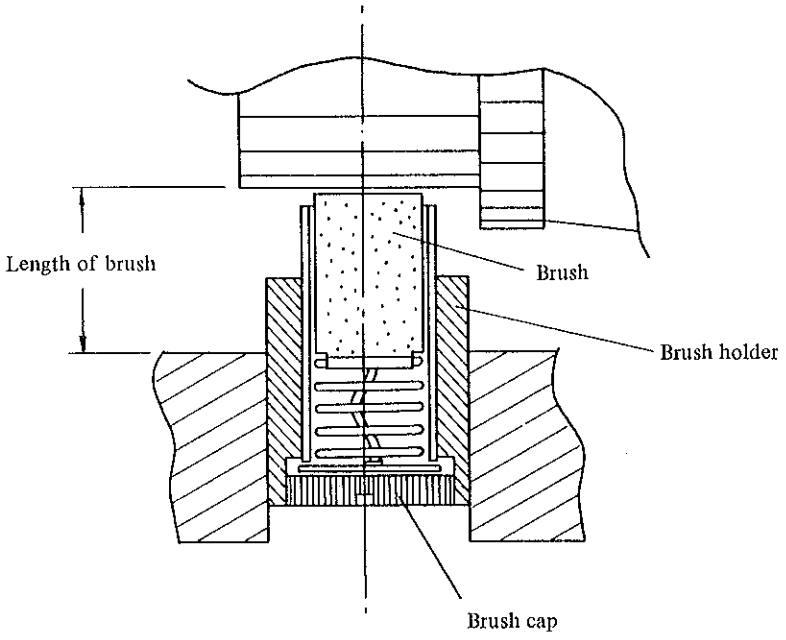
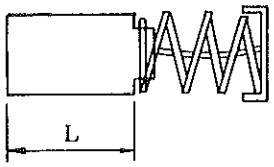


Fig. A Structure of brush holder

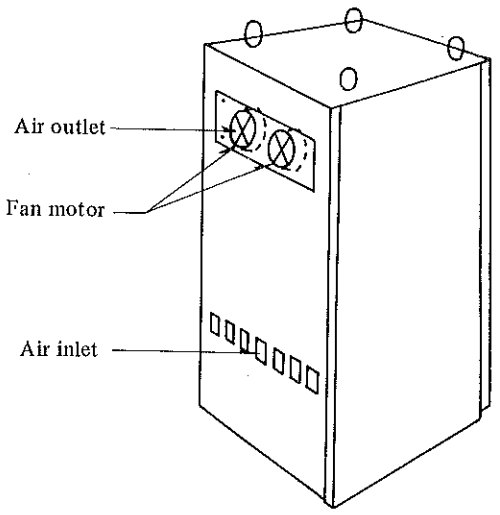


Motor model	Length of new brush	Usable length
Model 00M	10 mm	5 m
Model 0L, 5L, 0M, 5M, 10M, 20M, 30M, 30MH	19 mm	10 m

Fig. B Brush length

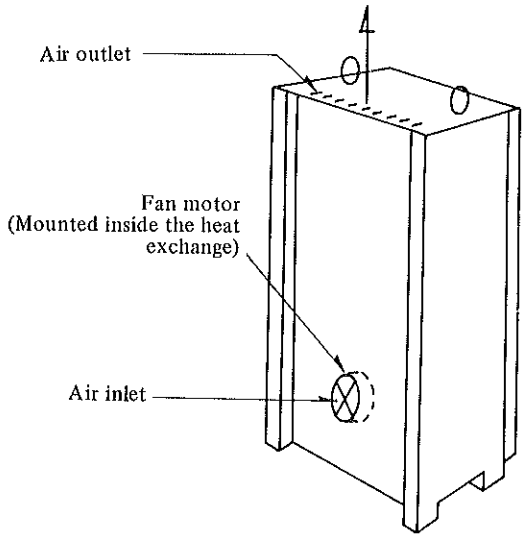
(5) Cleaning of heat exchange
The heat exchange and fan motors should be cleaned periodically.
If they are contaminated with dust, mist, or foreign substances, the heat exchanging capacity may deteriorate, or fan motor trouble may occur.
The cleaning interval differs according to the installation environment of the units.
Clean them at least once a every year; or clean more frequently according to the environmental circumstances.

a) External view of unit
i) A type cabinet
The mounting face of the heat exchange is open, and the heat exchange can be cleaned from the outside of the cabinet.
(free-standing type, built-in type 1, unbundled type)



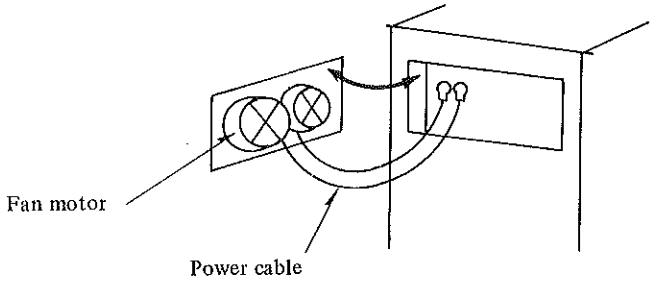
Rear view

ii) B type cabinet
The heat exchange is mounted at the coupling joint with the machine tool, and it cannot be cleaned from the outside of the cabinet.
(10M/11M built-in type 2, etc.)
(Clean the heat exchange of this type from the interior of the cabinet after opening the door)



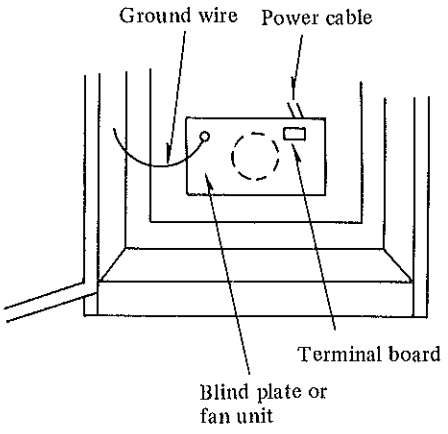
Rear view

b) Preliminary work for cleaning
Turn off the power supply before starting the following work.
Before cleaning, blow compressed air through the air inlet.
For the i)-A type cabinet: detach the fan motor together with its mounting plate, detach the protective caps from the terminal board mounted at the innermost part of the heat exchange, and disconnect the power cables of the fan motors.

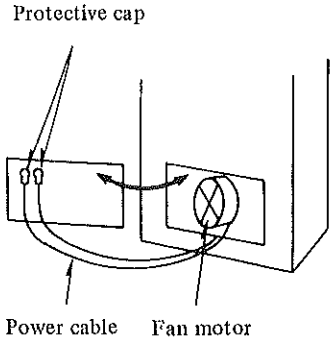


For the ii)-B type cabinet: open the front door, and detach the unit mounted in front of the fan motor.
For instructions on how to remove these units, see Chapter 7- "Replacement of PCB and Units".
The mounting structures of the fan motors in the heat exchange are divided into the fan motor rear plate mounting type (the mounting plate and fan motor are separated from each other) and the fan unit type (the mounting plate and fan motor are assembled together).
Remove the blind plate from the former or remove the fan unit from the latter.

. Disconnect the power cable and grounding wire from the terminal board.
. Detach the blind plate or fan unit by removing mounting screws.



. Detach the protective caps from the terminal board; then, disconnect the fan motor power cables in case of the fan motor rear plate mounting type.
. Unscrew mounting screws and remove the fan motor.



c) Cleaning method

i) Cleaning of fan motors

Remove dust, mist, and other foreign substances from the fan motors, terminal board, fan mounting plate, and other parts by using a brush or other cleaning tool.

If they cannot be removed easily, wipe them off with a damp cloth after wetting the cloth with water containing a neutral detergent. Be careful not to allow detergent to go into the fan motor rotors and other electric parts.

Completely dry the fan motors if water or detergent was used.

ii) Cleaning of heat exchange

Remove dust, mist, and other foreign substances from the interior of the heat exchange through the mounting opening of the detached fan motors or fan unit by using dry waste or something similar.

d) Installation

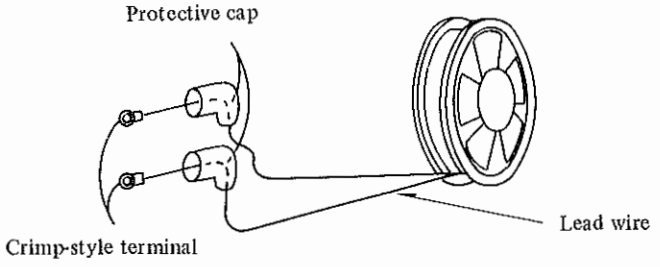
After cleaning the fan motors and heat exchange, remount the fan motors or fan unit, blind plate, and other parts, and connect the power cables to the terminals. Be sure to fully cover the terminals with their protective caps.

Mount the units which have been removed in the preliminary work for cleaning to their specified mounting places.

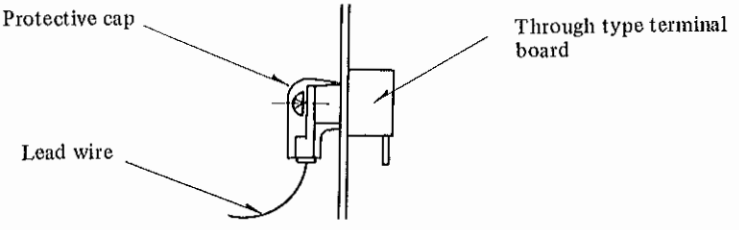
Be particularly careful not to connect the cable connectors incorrectly.

(Note) If defective, replace the fan motor. Mount the protective caps as illustrated below. (If protective caps are not mounted correctly, a leak may occur.)

i) Pass the protective cap through each lead wire of the fan motor before attaching the crimp-style terminal.



ii) Fully cover the terminals with protective caps.



2.2 Maintenance Equipment

The following equipments are recommended.
1) Measuring instruments

Instrument	Requirements	Usage
AC voltmeter	AC power-supply voltage can be measured with a tolerance of ±2% or downward.	Measurement of AC power-supply voltage
DC voltmeter	Maximum degree of 10 V, 30 V Tolerance of ±2% or downward (digital voltmeter may be required.)	Measurement of DC power-supply voltage
Phase rotation meter		Check of connection sequence of AC 3-phase input power
Oscilloscope	Frequency bandwidth of 5 MHz or upward, 2 channels	Adjustment of tape reader photoamplifier, etc.

2) Tools
   + screw driver: large, medium and small
   - screw driver: large, medium and small
3) Chemicals
   Tape reader cleaning liquid (pure alcohol) and oil.

2.3 Main Spare Parts

Always keep the following parts on hand:
o Fuses (see Appendix 17)
o Motor brush (see Appendix 14)
  As required, provide P.C.Bs and units.
o P.C.B. and unit (see Table 1.4)
o Primary parts of the velocity control unit (see Appendix 13)

3. TROUBLESHOOTING

3.1 Procedures

Troubleshooting procedures are classified below, according to the status of the failing NC.

1) No power can be turned on ..... Section 3.3.1
2) Nothing is displayed on CRT screen after power is turned on . Section 3.3.2
3) Troubleshooting by alarm ..... Section 3.3.3
4) LEDs on the master PCB light ..... Section 3.3.4
5) Jog operation is not possible ..... Section 3.3.5
6) Manual pulse generator does not operate ..... Section 3.3.6
7) Synchronous feed or feed per revolution is not possible..... Section 3.3.7
8) Tape reader does not operate normally ..... Section 3.3.8
9) Automatic operation is not possible ..... Section 3.3.9
10) Spindle binary analog output voltage is abnormal ..... Section 3.3.10
11) Analog output voltage linearity is not possible ..... Section 3.3.11
12) Reader/puncher interface do not operate normally ..... Section 3.3.12
13) Stop position does not coincide with reference point in reference point return ..... Section 3.3.13
14) System error ..... Section 3.3.14
15) Power supply voltage checking ..... Section 3.4
16) Tape reader photo-amplifier adjustment ..... Section 3.5
17) Connection diagram inside the NC ..... Section 3.6
18) Status display by self-diagnostic function ..... Section 3.7
19) Block diagram and standard setting of servo system ..... Section 3.8
20) Confirmation of connections between NC and servo unit ..... Section 3.9
21) Motor normal connection and reverse CONNECTION ..... Section 3.10
22) Troubleshooting for servo unit ..... Section 3.11
23) Error display and its contents of I/O unit ..... Section 3.12

Survey on Trouble Phenomena

Inform our Service Center of checked data on the following items, when trouble occurrs.

1) Phenomena
   i) Mode in which the trouble occurred
   ii) Position where the trouble occurred
   iii) Alarm number
   iv) Trouble frequency
   v) Amount of error in the position
   vi) Display of the position when trouble occurrs
2) Other information
   i) Software series and edition number displayed on the CRT when the power is turned on (see Subsec. 3.3.2)
   ii) Parameter contents
   Inform our Service Center of the results of a comparison between the parameter table attached to the NC and the parameters set in the NC.
   iii) Program contents and cutter compensation values for automatic operation
   iv) Contents of other items if checked

3.2 Error Message

See error meassage table of a separate volume (B-54810E).

3.3 Checking and Countermeasures

3.3.1 No power can be turned on

Item	Cause of trouble	Check points	Countermeasures
1	No input power supply is connected to NC.	1 See Sec. 3.4. Make sure that input unit pilot lamp PIL (green LED) is ON.	
		2 When PIL is OFF, make sure that input power is supplied at input unit power-supply terminal TP1.	
		3 When power is supplied at input unit TP1 and pilot lamp is OFF, see Sec. 3.4. fuses F1, F2 or F3 are considered blown out.	Remove blowout causes and replace fuses.
2	Alarm lamp is ON.	1 See Sec. 3.4. Make sure that input unit alarm lamp ALM (red LED) is OFF. When ON, remove the cause (see Appx. 12 for details) and press POWER OFF button once; then press POWER ON button.	
3	OFF contact of external power-supply ON/OFF is faulty.	Make sure that EOF and COM are shorted at input unit terminal	
4	POWER OFF switch on CRT/MDI unit is faulty.	1 Make sure that POWER OFF button contact is closed.	
		2 Make sure that two pins ⊓OFF⊓ are shorted in input unit.	
5	POWER ON switch on CRT/MDI unit is faulty.	1 Make sure that pressing POWER ON button closes the contact.	
		2 Make sure that pressing POWER ON button short circuit two pins ⊓ON⊓ in input unit.	
6	Input unit is faulty.		Replace the input unit.

3.3.2 CRT screen is not displayed after turning on power supply

If no display appears on CRT screen after power is turned on, a faulty point can be checked by the display conditions of 7-segment LED on the master PCB (10/11 series) or LED on the each PCB in the control unit (12 series). For details see 3.3.4.

3.3.3 Troubleshooting by alarm number

1) SR590 TH error (Tape Horizontal error)
   If a tape code which is not covered in the code table is detected during the significant information section of an NC tape (other than the section from control out to in), the readout operation of tape is stopped. When the control unit is executing the previous block, it stops after completion of the block, and SR590 is displayed on CRT.
   The block in error is invalid, and is not executed.
   The alarm condition is reset by pressing the RESET button.
   Locate the cause according to the following information obtainable through the diagnostic function.

No.	Display	Meaning of data
1100	POSITION (CHARACTER) F	If TH alarm occurs, the position of the character in TH alarm is displayed by the number of characters counted from the start of the block. (TH alarm in front)
1101	BIT PATTERN (CHARACTER) F	The readout code of the character in TH alarm is displayed by the bit pattern. (TH alarm in front)
1100	POSITION (CHARACTER) B	If TH alarm occurs, the position of the character in TH alarm is displayed by the number of characters counted from the start of the block. (TH alarm in back)
1101	BIT PATTERN (CHARACTER) B	The readout code of the character in TH alarm is displayed by the bit pattern. (TH alarm in back)

   Causes and countermeasures
   - o Contamination of NC tape and tape reader
     Clean NC tape.
     Clean the tape reader.
   - o Tape setting failure NC tape is set upside down;
     Reset the NC tape correctly.
   - o Punching error of NC tape
     Correct NC tape.

2) Alarm number
   SR591 TV error (Tape Vertical error)
   If during parity check, an odd number of characters are in a block (from the character next to EOB), the control unit will execute the preceding block, stopping after completion of it. (The tape stops on the next character to the EOB of the erroneous block.)
   "SR591" is displayed the CRT.
   Alarm status is reset by pressing the reset button.
   Error block is ignored.

This TV checking function can be made effective by setting the parameter.

Countermeasures

- o Something (a space symbol, for example) that is ignored by the NC should be punched before *(EOB) code for odd-numbered holes. The tape punched out by CNC is checked by the TV check.
  The number of characters in one block must be made an even number.
- o If this lamp lights up with an even number of characters punched, the tape reader may be misreading. Clean the reading section of the tape reader or the NC tape.

3) PS200 Pulse coder synchronous error

The one-revolution signal of the pulse coder was not applied in reference point return, or the feed rate is too low.

When using a pulse coder, after turning on the power or resetting an emergency stop, the reference counter is synchronized with the one-revolution signal when the first reference point return is performed. The following conditions are required to catch the same edge of the 1 revolution signal:

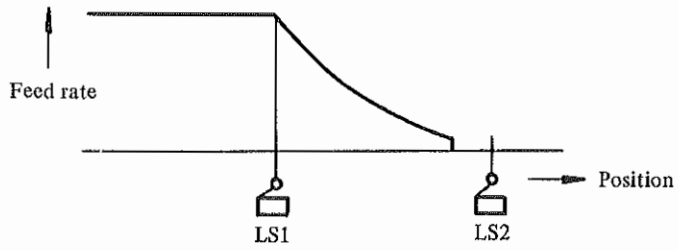
a) The position deviation (DGN No. 3000) should be 128 or more.

b) After the position deviation amount has exceeded 128 the one-revolution signal should be input at least once before the deceleration dog is separated again.

The one-revolution signal is not used during the second or subsequent reference point return. This alarm check is not made.

Item	Cause of trouble	Check points	Countermeasures
1	Feedrate is too low.	Perform reference point return under the same conditions in which the alarm occurred. Confirm that the position deviation is 128 or more by using the self-diagnostic function (DGN 3000). The start point of the reference point return must not be on the deceleration dog.	Increase the feed rate. When the position gain is 30 sec^{-1}, a feed rate of at least 300 mm/min is necessary.
2	The start point of the reference point return is too close to the reference point.	Check the distance from the start point to the reference point.	The distance from the start point to the reference point must be equivalent to at least two motor revolutions.
3	Source voltage for the pulse coder is too low.	The source voltage of the pulse coder should be 4.75 V or more. (Remove the pulse coder cover and measure the source voltage at the + and - terminals on the pulse coder board.)	Cable loss must be 0.2 V or less including both sides of 5 V and 0 V.
4	Defective pulse coder.	Replace the pulse coder.	Replacement.
5	Defective master PCB.	Replace the master PCB.	Replacement.

4) OT007 + OVERTRAVEL (HARD)
OT008 - OVERTRAVEL (HARD)
When the movable part of the machine tool reaches the stroke end, the above alarm message is displayed on the CRT screen.
When this alarm occurrs, movement of all axes stop in auto operation. In manual mode, the axis that alarm occurred on stops.
To stop the movable part of the machine tool, two limit switches (LS1, LS2) are provided on each axis in each direction as shown in the figure below.



- o When LS1 operates, the feed is stopped after deceleration. This alarm message is displayed on CRT.
- o When LS2 operates, the feed is emergency-stopped. (LS2 operates only when LS1 malfunctions)

Cause of Trouble and Countermeasures

1 Check the reference point setting for errors; then, correct the program.
2 Check the program for errors; then, correct the program.

Release

a) When only LS1 operates
Move the movable part of the machine tool by manual operation (Jog, Step or Handle) in the opposite direction (safe side) to separate it from the limit switch. Push the RESET key on the MDI panel.

(Note) In this case, the movable part of the machine tool can be moved in the opposite direction only.

b) When both LS1 and LS2 operate
i) Set 2nd L.S. REMOVE button to ON on operator's panel.
ii) Follow the same instructions given for LS1.

(Note) In the equipment in which LS1 is not operating when LS2 in operation, the movable part is movable in both directions by manual operation. Be careful of the direction in which it is to be moved when LS1 has malfunctioned.

5) OT001 + OVERTRAVEL (SOFT1)
OT006 - OVERTRAVEL (SOFT3)
} Stored Stroke limit alarm

When a machine reaches stored stroke limit, one of these messages is indicated on the CRT screen. When this alarm occurrs, movement of all axes stop in auto operation. In manual mode, the axis that alarm occurred on stops.

Cause of trouble

a) Program miss.
b) Setting of stored stroke limit is abnormal.

Countermeasures

- o The movable part of the machine tool can be moved in the opposite direction.
- o If the movable part of the machine tool can not be moved, push the emergency stop button and command G23 (Stored Stroke Limit Function OFF). If the setting value is in error, correct the setting value and return to reference point.

Confirm
Check the actual machine position (position on machine coordinate system) from the reference point displayed on CRT screen.

(Note) To make stored stroke check 1 invalid until the reference point return end after turning on the power, in the 10 series, the following operation should be done.

Operating procedure
(i) Turn on the power while pressing [-] and [.] keys.

(ii) It is attached to IPL mode and the following menu is displayed on the screen:
IPL
1 CUMP MEMORY
2 -
3 CLEAR FILE
4 SETTING
5 -
6 END IPL

(iii) Key is [4] [INPUT] to select "4 SETTING"

(iv) Key in [N] in response to the question "CHECK SOFT OT AT POWER ON?"

(v) The menu described in (ii) is displayed on the CRT. Key in [6] [INPUT] to change IPL mode.

6) SV023 SV overload

Item	Cause of trouble	Check points	Countermeasures
1	(analysis)	Check if OVERLOAD lamp lights when turning on NC power supply.	Connection/setting failure. Proceed to item 6 or 7.
		Check to see if thermal relay of M series velocity control unit functions. (AC servo is not provided with this thermal relay.)	Proceed to item 2 or 3.
		Check to see if radiation fins of AC servo velocity control unit are overheated. (M series servo is not provided with these radiation fins.)	Proceed to item 2.
		Check thermostat of servo transformer functions.	Proceed to item 2 or 4.
		Check thermostat of regenera-tive discharge unit functions.	Proceed to item 5.
		Check thermostat of AC servo motor functions.	Proceed to item 2.

Item	Cause of trouble	Check points	Countermeasures
2	Overload of motor	Measure the motor current. The continuous rated current is as specified below: M series servo 00M ... 4A 0M ... 7A 5M ... 9A 10M ... 12A 20M ... 18A 30M ... 24A AC servo 4-0 ... 0.93A 30R ... 29A 3-0 ... 0.93A 2-0 ... 3A 1-0 ... 2.9A 0 ... 4.6A 5 ... 6.8A 10 ... 11A 20 ... 20A 30 ... 22A	Reduce the cutting condition. If the continuous rated current exceeds the specified value during idle feed. Adjust the machine tool.
3	Setting failure of thermal relay of M series servo	Check to see if the thermal relay is set to the continuous rated current value of the motor specified in item 2.	Reset the thermal relay setting.
4	Thermostat of servo transformer is defective.	If thermostat functions when the surface temperature of transformer is lower than 60°C, it's defective.	Replace transformer.
5	Excessive regenerative energy	1) Excessive acceleration/deceleration frequency. Check to see if the positioning frequency exceeds 1 ∿ 2 times/sec in rapid traverse. Check that no alarm occurs when this frequency is reduced.	Reduce the acceleration/deceleration frequency by inserting a pause time.
		2) Counter balance on machine tool side.	Correct the counter balance.
6	Wiring failure	Check to see if the following wiring is correct. o NC (CV1 ∿) - velocity control unit (CN1) o Servo transformer - velocity control unit (CN2) o Regenerative discharge unit - velocity control unit (CN2) o AC servo motor - velocity control unit (CN5)	Correct wiring.

Item	Cause of trouble	Checking points	Countermeasures
7	Setting failure on velocity control unit PCB	Check to see if setting pin S20 is set as specified in M series servo. Check to see if setting pin S1 is set as specified in AC servo.	Reset pin S20 or S1, as specified.

7) SV000 TACHOGENERATOR DISCONNECT

a) For M series servo

Item	Cause of trouble	Checking points	Countermeasures
1	The motor power cable is not connected to terminals (5), (6), (7) or (8) of terminal board T1 in the velocity control unit, or the power cable is broken.	If the alarm occurs when a motion command is not input, the alarm cause described here should be checked.	Correct the power cable connection.
2	PCB setting is incorrect.	Check the setting according to section 6.2. "Setting and adjustment of PCB •••••".	Adjust the setting.
3	Velocity feedback voltage is not being applied or is intermittent.	Measure the velocity feedback voltage between check terminals CH2 (TSA) and CH3 (GND) with an oscilloscope. Verify whether the voltage is being interrupted.	Repair the cable carrying the velocity feedback voltage. Repair the defective source (i.e., motor or control) of the velocity feedback voltage.

b) For AC servo

Item	Cause of trouble	Checking points	Countermeasures
1	The motor power cable is not connected to terminals (5), (6), or (7) of terminal board T1 in the velocity control unit, or the power cable is broken.	If the alarm occurs when a motion command is not input, the alarm cause described here should be checked.	Repair the power cable of motor.
2	PCB setting is incorrect.	Check the setting.	Adjust the setting.
3	Pulse coder feedback signal is not be sent.	Check the feedback cable.	Repair the feedback cable.

8) SV001 MOTOR OVERLOAD

a) For M series servo

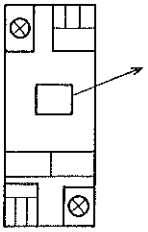
Item	Cause of trouble	Checking points	Countermeasures
1	PCB is defective.	The OVC alarm occurs if the power is turned on when the motor power cable is disconnected. (In this case, the gravity axis may fall down; therfore, it should be supported.) (The S23 terminal should be shorted so that the TGLS alarm does not occur. After confirmation, the S23 connection should be opened.)	Replace the PCB.
2	PCB setting is incorrect.	Check the setting of variable registor RV3 which is used to set the upper limit of the motor current. (Generally, RV3 is set to 10, but the adjustment may differ with the machine tool.)	Change the RV3 setting.
3	Mechanical load is irregular.	Observe the waveform between check terminals CH8 and CH3 with an oscilloscope. Check whether the current which is determined by RV3 flows more than 600 msec.	Remove the mechanical overload.

b) For AC servo

Item	Cause of trouble	Checking points	Countermeasures
1	Pulse coder feedback signal is not sent.	Check the feedback cable.	Reconnect the feedback cable.
2	Motor current exceeds rated current.	Check motor current.	Change the cutting conditions.

9) SV002 VELOCITY UNIT BREAKER OFF

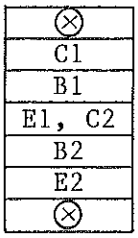
a) For M series servo

Item	Cause of trouble	Checking points	Countermeasures
1	The no fuse breaker operated.	The breaker is open when it is as shown below. See section 3.4 for the location of the breaker.  This button pops up when the breaker operates. To reset the breaker, press the button after turning off the power.	Turn off power and reset the breaker. (If it does not reset immediately, wait about ten minutes and try again.)

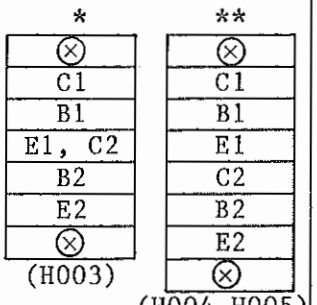
Item	Cause of trouble	Checking points	Countermeasures
2	Diode module DS or some other part of the velocity control unit is defective.	The breaker operates again when power is restored after the countermeasures of item 1.	Replace diode module DS or the whole velocity control unit.
3	Mechanical load is excessive.	Observe the motor load current at rapid traverse between terminals CH8 and CH3 on the PCB with an oscilloscope. Check whether it exceeds the rated current.	Remove the mechanical overload.
4	The PCB or the connection between the PCB and the velocity control unit is defective.	The BRK alarm occurs when the no fuse breaker is not operating.	Replace the PCB or the velocity unit.

This alarm message is not displayed for AC servo.

10) SV003 EXCESS CURRENT IN SERVO
a) For M series servo

Item	Cause of trouble	Checking points	Countermeasures
1	Incorrect motor power cable connection.	The HCAL alarm does not occur when the power is turned on when the motor power cable is disconnected. (In this case, the gravity axis may fall down, so it should be supported. The S23 terminal on the PCB should be shorted so that the TGLS alarm will not occur. The S23 connection should be opened after confirmation.)	Fix the motor power cable connection.
2	The transistor module is defective.	The HCAL alarm goes on when the motor power cable is disconnected. Turn off power and measure the resistance between the following terminals using a multi-meter. If the measured value is 10 ohms or less, the transistor module is defective.	Replace the transistor module.  Confirm between C1-E1, C2. E1, C2-E2.

b) For AC servo

Item	Cause of trouble	Checking points	Countermeasures
1	Incorrect connection of motor power line.	HC alarm does not occur when turning on the power supply after disconnecting the motor power line. (Since the gravity axis may drop, support it or disconnect the drive cable of gravity axis brake.)	Reconnect the motor power line correctly. If the motor power line is checked while disconnected, set terminal S10 setting to L side, or TG alarm occurs.
2	Transistor module is defective.	Check if HC alarm occurs when turning on the power supply after disconnecting the power line according to item 1. Turn off the power supply, remove PCB, and observe the resistance between terminals of the transistor module with a circuit tester.	Replace transistor module. * Check resistance between C1 - E1 and C2; also between E1 and C2-E2. ** Check resistance between C1-E1 and also between C2-E2. 
3	Internal short-circuit failure of motor windings.	Check motor windings for normal insulation.	Replace the motor.
4	PCB is defective.	PCB is defective if HC alarm occurs when there is no defect in items 1, 2, or 3.	Replace the PCB.

11) SV004 EXCESS VOLTAGE IN SERVO

a) For M series servo

Item	Cause of trouble	Checking points	Countermeasures
1	Input AC power voltage is too high.	Check the tap connection of servo power transformer.	Correct the tap connection.
2	Servo motor is defective.	Check to see if the insulation resistance is normal between the motor armature (power line) and the body.	Clean brushes.
3	PCB is defective.	Check to see if alarm occurs when item 1 and 2 are normal.	Replace PCB.

b) For AC servo

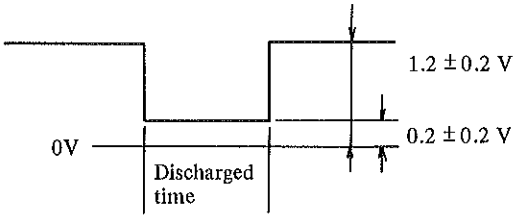
Item	Cause of trouble	Checking points	Countermeasures
1	Input AC power voltage is higher than specified.	Check to see if the servo transformer taps are properly connected.	Repair the tap connection.
2	Servo motor is defective.	Check to see if the insulation resistance is normal between the motor armature (power line) and the body.	Replace the motor.
3	Load is excessively motionless.		Increase the acceleration/deceleration time constant.
4	PCB is defective.	PCB is defective if HV alarm occurs when there are no defects in items 1, 2, or 3.	Replace the PCB.

12) SV005 EXCESS DISCHARGE CURRENT

a) For M series servo

Item	Cause of trouble	Checking points	Countermeasures
1	Discharge transister Q1 or the PCB is defective.	The alarm occurs immediately after turning on power.	Replace transistor Q1 or replace PCB.
2	PCB setting is incorrect.	Terminal S26 is shorted although the separate regenerative discharge unit is used with the gravity axis.	Open terminal S26.

Item	Cause of trouble	Checking points	Countermeasures
3	Machine tool counterbalance is incorrect.	The waveform shown in the following figure is measured at stated periods on check terminal CH10 while the counterbalanced axis is moving down at rapid traverse speed.	Adjust the counterbalance.
4	The acceleration/ deceleration rate frequency is too high.	Check whether the positioning frequency at rapid traverse speed exceeds 1 to 2 time per second. Check that the alarm indicator does not go on when the rate is decreased.	Use a dwell period and decrease the acceleration/ deceleration rate.



b) For AC servo

Item	Cause of trouble	Checking points	Countermeasures
1	Regenerative transistor Q1 is defective or PCB is defective.	DC alarm occurs immediately after power is turned on.	Replace the transistor Q1 or replace the PCB.
2	PCB setting is incorrect.	Setting pin S2 is set to L side, although a separate regenerative discharge unit is used.	Set S2 correctly.
3	The acceleration/ deceleration rate frequency is too high.	Check whether the positioning frequency at rapid traverse speed exceeds 1 to 2 times per second. Check that the alarm does not occur when the rate is decreased.	Use a dwell period and decrease the acceleration/ deceleration rate.

13) SV 006 VELOCITY-UNIT POWER TOO LOW

a) For M series servo

Item	Cause of trouble	Checking points	Countermeasures
1	AC power voltage is too low.	Check to see if connection between input AC power voltage and servo transformer tap is correct.	Correct the tap connection.
2	Connection is defective between servo transformer and CN2 on the PCB.	Check to see if PCB voltage +24 V and ±15 V are correct. Check that the servo transformer terminals (41 ∿ 43, 44 ∿ 46, 47 ∿ 49) and PCB CN 2 (1, 2, 3) are connected correctly.	Correct the connection.
3	PCB is defective.	LVAL alarm occurs when above items 1 + 2 are normal.	Replace the PCB.

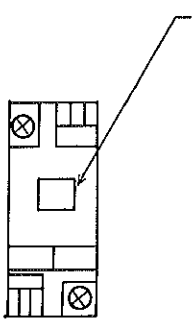
b) For AC servo

Item	Cause of trouble	Checking points	Countermeasures
1	AC power voltage is too low.	Check to see if the connection between input AC power voltage and servo transformer is correct.	Correct the tap connection.
2	Connection is defective between servo transformer and PCB CN2.	Check to see if PCB voltage +24 V, ±15 V and +5 V are correct. Check that servo transformer terminal 41 ∿ 49 (AC 18 V) and PCB CN2 (1, 2, 3) are connected correctly.	Correct the connection.
3	+5 V fuse is blown out.	Check to see if the fuse for +5 V is blown out.	Replace the fuse.
4	PCB is defective.	PCB is defective if LV alarm occurs when above items 1 ∿ 3 are correct.	Replace the PCB.

14) SV013 Improper V-READY OFF

Item	Cause of trouble	Checking points	Countermeasures
1	100 V AC is not supplied to velocity control unit.	Check to see if 100 V AC is supplied across terminals (3) and (4) of the terminal board of the velocity control unit.	Supply 100 V AC.
2	No fuse breaker is turned off in AC servo.	Check the no fuse breaker button on/off state.	If the button is off, proceed to next block.

Causes and countermeasures when no fuse breaker functions in AC servo

Item	Cause of trouble	Check procedure	Countermeasures
1	No fuse breaker function	The operating condition is illustrated below:  This button is pushed inward during normal operation of the motor. If the breaker has functioned, turn off the three-phase power supply once and press this button.	Reset the no fuse breaker after turning off the power supply. (If the no fuse breaker cannot be reset, wait for about 10 minutes, then try again.)
2	Diode module, surge absorber (ZNR) or other parts are faulty in velocity control unit.	No fuse breaker functions simultaneously when power supply is turned on after countermeasure in item 1.	Replace diode module DS or surge absorber (ZNR) of velocity control unit.
3	Irregular mechanical load	Check to see if the motor load current exceeds the rated current during rapid traverse, while monitoring CH10 and CH11 or CH12 and CH3 (OV) of PCB using and oscilloscope.	Eliminate irregular load from machine tool side.

15) SV008 Excess error (Stop)
SV009 Excess error (Moving)

Position deviation excessive alarm

Item	Cause of trouble	Checking points	Countermeasures
1	Mis-setting of position deviation	Check that parameters 1828 ∿ 1830 are the same as the parameter list attached to the NC.	Correct the parameter setting.
2	Overshoot	When sufficient current does not flow to the motor during acceleration or deceleration, deviation value of position control circuits increases. Check waveform at CH1 on velocity control PCB and confirm whether overshoot is within 5%.	Increase the rapid traverse time constant of NC. (set at NC side) Increase gain (RV1) of the velocity control unit.

Item	Cause of trouble	Checking points	Countermeasures
3	Drop of input power voltage	Check to see if input power voltage is within ±10% and -15%.	Change the input tap of power transformer for servo.
4	Voltage of power supply is irregular.	Check the voltage of control part.	Repair the fault.
5	Connection is erroneous	Check the connection of power line of motor, tacho-generator, etc.	Repair the fault.
6	Trouble with position control circuit on the master PCB (for FS10/11) or 01∿05P06 axis control PCB, 01∿05P07 DSCG interface PCB (for FS12). Trouble with velocity control unit PCB.	Replace the PCB with a new one (if provided) and recheck. Adjustment and setting.	Replace the PCB with spare.
7	Poor brush contact due to loosened DC motor brush cap	Confirm the motor brush contact.	Tighten the brush cap.

16) SV010 Excess drift compensation

Item	Cause of trouble	Checking points	Countermeasures
1	Bad connection	Check the connection of power lines to servo motor. Check the connection between position detector and servo motor.	Repair the fault.
2	Setting of drift compensation value is incorrect.	Check whether the contents of parameter No. 1834 exceed 500.	When emergency stop condition occurs, set 0 bit (ADR) of parameter number 1800 to "0" and set the contents of parameter No.1834 to "0". Then reset ADR to "1" and release the emergency stop.

Item	Cause of trouble	Checking points	Countermeasures
3	Trouble with velocity control unit or/and position control circuit on master PCB (for 10 and 11 series). Trouble with 01∿05P06 axis control PCB (for 12 series).	Check by changing with spare PCB (if provided). Adjustment and setting must be done correctly.	Replace the PCB with spare.

17) SV011 LSI overflow

These alarms occur when:

a) Positional deviation in the axis involved exceeds ±32767. However, when positional deviation limits (parameters 1828 ∿ 1830) are set correctly, alarm SV008 or SV009 is displayed before any of the above-noted alarms occur. So they usually cannot occur on this condition.

b) D/A converter velocity command value does not include the +8191 to -8192 range.

D/A converter velocity command value = $0.192 \times K \times G \times E \times 10^{-6}$

where K: servo loop gain multiplier (parameters 1826)

G: servo loop gain 0.01 sec^{-1} (parameter 1825)

E: position deviation (can be verified by DGN 3000)

Theoretical value (when feed has become constant)

$$E = \frac{F}{60} \times \frac{1}{G} \times \frac{1}{\alpha} 10^2$$

where F: feed rate mm/min (inch/min)

α: detection unit mm (inch)

G: servo loop gain 0.01 sec^{-1}

Item	Cause of trouble	Checking points	Countermeasures
1	Parameter setting is incorrect.	1) Check servo loop gain multiplier. Parameter 1826 2) Check servo loop gain. Parameter 1825 3) Check CMR. Parameter 1820 4) Check DMR. Parameter 1816	

Item	Cause of trouble	Checking points	Countermeasures
2	Extreme positional deviation.	Compare the theoretically calculated value with positional deviation by DGN 3000. 1) Feed rate Rapid traverse rate: parameter 1420	
		Feed rate is correct; positional deviation is also correct.	Proceed to 6.
		Feed rate is correct; positional deviation is incorrect.	Proceed to 3.
3	Machine tool does not move the usual distance.	Issue a command (feed of several mm) (do not cause alarm) to see if machine tool moves by a normal value.	
		If machine tool does not move by a normal value.	Proceed to 4.
		Machine tool does move by a normal value.	Proceed to 5.
4	Position detector is incorrect.		Replace the position detector.
5	PCB is incorrect (for 10 and 11 series.)		For pulse coder, replace master PCB. For resolver/ inductosyn, replace PCB A16B-1210-0460.
6	Master PCB is incorrect (for 10 and 11 series).		Replace the master PCB.
7	01∿05P06 axis control PCB or 01∿05P07 DSCG interface PCB is bad (for 12 series).	Replace the PCB with the spare PCB (if provided). Adjustment and setting should be correct.	Replace the PCB.

18) SV018 UNFIT DSCG FREQUENCY
SV020 UNFIT PHASE SHIFT VALUE

Position detecting system trouble. (Resolver/inductosyn)

Item	Cause of trouble	Checking points	Countermeasures
1	Connection is bad.	Check to see if connector connection, cable signal line connection, and the signal line are shorted to the ground or to another line.	Repair error
2	Detected gain is bad.	See Subsect. 6.1.2 or 6.1.5 for detected gain adjustment.	Adjust detected gain.
3	Phase shift is bad.	Check to see if phase shift value was initialized (parameter 1802, bit 0, PSF=0) at first field adjustment or after position detector replacement.	Initialize phase shift value.
4	Setting on PCB is erroneous.	Check the short circuit of inductosyn/resolver interface PCB (for 11 series) or 01∿05P07 DSCG interface PCB (for 12 series). See Subsect. 6.1.1 or 6.1.5.	Correct erroneous setting.
5	Parameter setting is erroneous.	Check if resolver inductosyn parameters RES (parameter 1815, bit 0) is set to "1" for pulse coder-type position detection.	Set parameter correctly.
6	PCB adjustment is bad.	Check Fmin and Fmax adjustment on inductosyn/resolver interface PCB (for 11 series) or 01∿05P07 DSCG interface PCB (for 12 series) (see Subsect. 6.2.1 or 6.1.5).	Readjust.
7	Position detector is faulty.	Change position control axis to another axis for checking.	Replace the position detector.
8	Inductosyn gap is clogged with chips.	Insert a piece of paper in the gap. While NC-side cable is removed, check to see if scale-side signal and slider-side signal are insulated.	Remove chips.
9	Inductosyn/ resolver interface PCB is faulty (for 11 series).	Replace the PCB for checking.	Replace the PCB. A16B-1210-0460

Item	Cause of trouble	Checking points	Countermeasures
10	Inductosyn pre-amplifier is faulty.	Replace the preamplifier for checking.	Replace the pre-amplifier.
11	Master PCB is faulty (for 11 series).	Replace the PCB for checking.	Replace the PCB.
12	01∿05P07 DSCG interface PCB or 01∿05P06 axis control PCB is bad (for 12 series).	Replace the PCB for checking.	Replace the PCB.

19) SV015 Pulse coder disconnection
(Disconnection detective alarm)

Item	Cause of trouble	Checking points	Countermeasures
1	Cable connection is erroneous.	Check pulse-coder feedback cable connection and wiring.	
2	PCB is faulty.		Replace the master PCB or replace the additional axis PCB (for 11 series). Replace 01∿05P06 axis control PCB (for 12 series).
3	Pulse coder is faulty.		Replace the pulse coder.

20) OH001 Locker overheating

"OH001" is displayed when overheating inside the NC control unit is detected.
Release
Restart is impossible with reset button while this alarm is displayed.
After the temperature is lowered, the alarm releases.

Item	Cause of trouble	Countermeasures
1	Surrounding temperature is too high.	Lower surrounding temperature.
2	Air filter is dusty.	Clean the air filter.
3	Fan Motor of NC is not working properly.	Replace the fan motor.

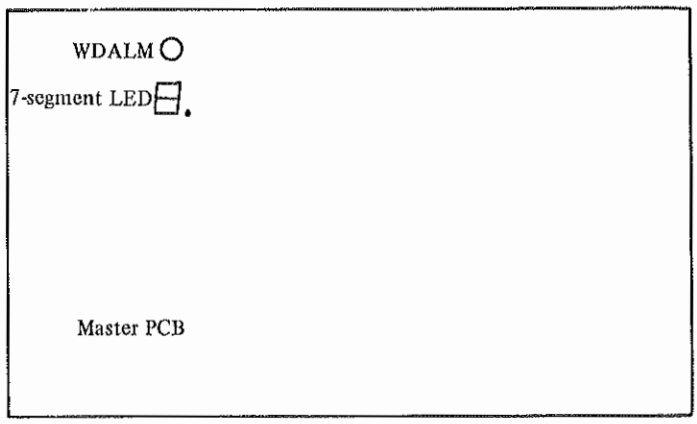
21) OH000 Overheat alarm of DC servo motor

Item	Cause of trouble	Checking points	Countermeasures
1	Overload	Check that the motor armature current exceeds the rated current.	Decrease load torque. Decrease cutting condition.
2	Winding insulation trouble	Check the insulation between the terminals A1 or A2 of motor power cable and the motor bodies with a tester or a megger. Over 1 MΩ at 500 V is normal for the megger check. Infinite value is normal in the tester check.	Clean around the commutator with forced air. Change the motor if the above counter measure is ineffective.
3	Shortcircuit inside of winding	Measure no-load current by removing the motor from the machine. If the current increases in proportion to the motor rotation rate, there is a short-circuit inside of winding.	Clean around the commutator. This problem can easily occur when the oil adheres to the surface of the commutator.
4	Demagnetization of field system magnet	Check to see if the motor terminal voltage between A1 and A2 is normal at rapid traverse.	Change the motor if terminal voltage is low and the motor is overheated at the same time.
5	Trouble with heat pipe fan operation	Check the fan voltage and the wiring. Check whether the fan does not touch a wire gauze. Check the fan motor itself for a problem.	Rearrange the wiring. Refix the wire gauze. Replace the fan motor.
6	Trouble in heat pipe efficiency	The heat pipe does not work when a motor with a heat pipe is overheated, despite the fact that all the above items are normal.	Replace the motor.
7	Brake trouble	Check to see that the brake connection corresponds to the power source frequency. Check to see that the voltage is 100 V $\pm$10%(allowable value.)	Replace the brake.
8	Connection trouble	Check the overheat connection between motor and position control.	Repair the fault.

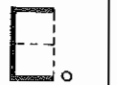
Item	Cause of trouble	Checking points	Countermeasures
9	Master PCB and/or additional axis control PCB is faulty.		Replace the PCB.
10	01∿05P06 axis control PCB is bad (for 12 series).		Replace the PCB.

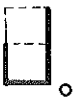
3.3.4 Lighting of LED on master PCB

If an alarm occurred, an alarm message should be displayed on the CRT screen. However, it is possible that no alarm will appears if the display function is not working.
In such case, the alarm contents are displayed by the LED on the master PCB as shown below.
(i) For 10 and 11 series



The 7-segment LED display changes after turning on the power supply, and it finally displays "1" after stopping. If an alarm occurred, it displays as follows.

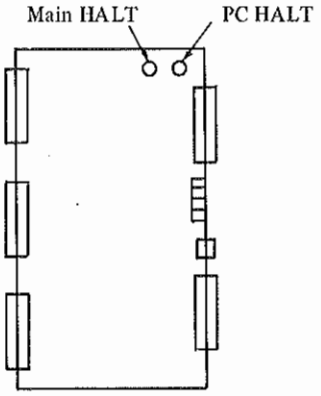
Display	Alarm contents	Countermeasures
	MDI connection failure	Check optical fiber cable connection and connector of CRT/MDI unit.
		Replace master PCB, MDI PCB, or optical fiber cable.
	MDI failure (Incorrect ID number)	Check the type (9", 14", etc.) of CRT/MDI unit or the edition number of NC software. Connection unit of operators panel or its connecting cable is defective.

Display	Alarm contents	Countermeasures
	Connection failure of connection unit or I/O cards D1 ∿ D3	Check the optical fiber cables connection of these units and connectors.
		Replace master PCB, connection unit, I/O cand D1 ∿ D3, or optical fiber cable.
	Different type of above mentioned unit (Incorrect ID number)	Check the above units for their specified types or check the edition number of NC software. Connection of unit 2 or its connecting cable is defective
	Transfer error through optical fiber cable	Check alarm LED of the units connected by optical fiber cable. Replace master PCB, MDI PCB, connection unit PCB, I/O unit, or optical fiber cable. Replace PMC RAM in case of PC debug.
	PC or interface converter does not function (While waiting for answer)	Check if PMC-ROM cassette, PMC RAM board or interface converter is mounted on master PCB; or replace the above PCB.
	Waiting for PMC ready	Replace PMC ROM, PMC ROM cassette or PMC RAM board. Check PMC program.
	RAM check error	Replace master PCB or ROM/RAM board additional memory board.
	System error	Replace master PCB, NC software ROM or ROM board.
	(IPL mode)	
	(Normal operation is in progress.)	
Others	System error	Replace master PCB, NC software ROM or ROM PCB.

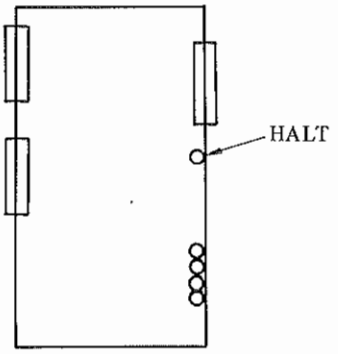
WDALM lights	Watch-dog alarm occurs	Replace master PCB, NC software ROM or ROM PCB.

ii) For 12 series

a) The "HALT" red LED is mounted on MAIN CPU (01P03), SUB CPU (01P10) and AXIS CPU (01 ∿ 05P08) PCB in 12 series as shown below. The LED is lit when CPU is in "HALT" condition.



Main CPU (01P03)



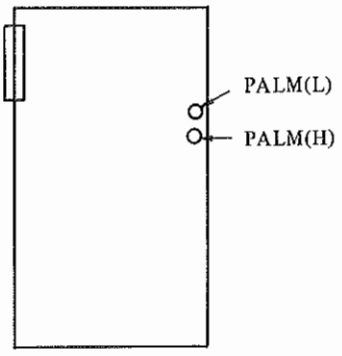
Axis CPU (01 – 05P08) or
Sub CPU (01P10)

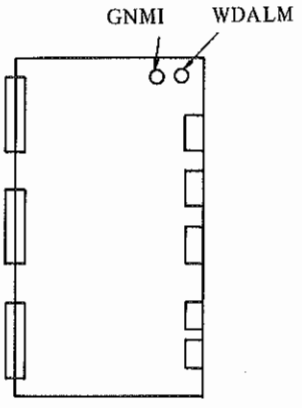
The following conditions are considered to correct this:

① Replacement of PCB that LED is lit
② Replacement of ROM on the PCB that LED is lit
③ Replacement of Main buffer PCB when all HALT LEDs are lit

Furthermore, when power is ON, the LEDs are lit for about 0.5 sec.; however, it causes no abnormality.

b) The PALM(L)/(H) red LED is mounted on ROM PCB (01P01) and the GNMI/WDALM red LED is mounted on MAIN BUFFER PCB (01P04) respectively, as shown below.

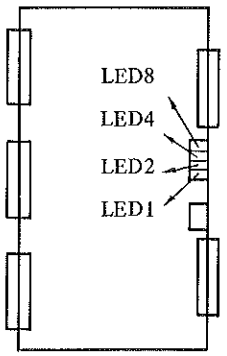




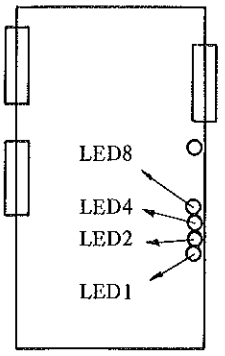
The following conditions are considered to correct this:

	Alarm contents	Countermeasures
PALM(L)	Parity error detection in low-byte RAM on ROM PCB	Replacement of ROM PCB (01P01). Replacement of ROM on ROM PCB.
PALM(H)	Parity error detection in high-byte RAM on ROM PCB	Replacement of ROM PCB (01P01). Replacement of ROM on ROM PCB.
GNMI	RAM parity error detection in AXIS CPU	Replacement of ROM of the PCB which the four LEDs for CPU condition indication becomes "E" condition. (See Item C-2) in AXIS CPU (01 ∿ 05P08), or PCB.
WD ALM	Watch dog alarm detection	Replacement of NC software ROM or replacement of each PCB.

c) The four green LEDs for display of the CPU condition are mounted on the each PCB of MAIN CPU (01P03), (01P01) and AXIS CPU (01∿05P08) as shown below.
The following are details of the LEDs.



Main CPU (01P03)



Axis CPU (01 – 05P08) or
Sub CPU (01P10)

How to check the LED:
The ON or OFF condition of LEDs are regarded as 1 or 0 respectively. These are coded like as following formula,

$(LED8) \times 2^3 + (LED4) \times 2^2 + (LED2) \times 2^1 + (LED1) \times 2^0$

Ex. LED8 and LED2 are ON. It shows "A" in hexadecimal.
The display of four LEDs changes after power on, and stops on display "1" at last. If a trouble occures, its display stops as follows.

C-1 MAIN CPU (01P03) A16B-1210-0060

o OFF ● ON ☼ Flick-ering	Light on condi-tion	Alarm details	Countermeasures
o o o o	0	Power system failure Trouble in LED	See Item 3.3.1. Replace MAIN CPU (01P03) PCB.
● ● ● ●	F	System doesn't start	Check ROM mounting and mount-ing position. Replace PCB of ROM PCB (01P01), MAIN CPU (01P03) and/or MAIN BUFFER (01P04).
☼ o ☼ ☼	B (Flick-ering)	RAM check error	Replace ROM PCB (01P01) or MAIN CPU (01P03).
● o ● o	A	Abnormality of CRT/MDI unit connection	Check optical fiber cable connection and connector of CRT/MDI unit. Replace MAIN CPU (01P03), MAIN BUFFER (01P04), MDI PCB or optical fiber cable.
o o ☼ ☼	3 (Flick-ering)	Discrepancy in CRT/MDI unit (ID number doesn't conform).	Check the type of CRT/MDI unit (9 inch, 14 inch, etc.) or NC software series.
● ● o ●	D	Abnormality of connec-tion with built-in type I/O unit or external I/O unit	Check optical fiber cable connection or connector of unit. Replacement MAIN CPU (01P03), MAIN BUFFER (01P04), MDI PCB or optical fiber cable.
o o o ☼	1 (Flick-ering)	Discrepancy in I/O unit (ID number doesn't conform)	Check the type of I/O unit or NC software series.

o OFF ● ON ☼ Flick-ering	Light on condi-tion	Alarm details	Countermeasures
☼ ☼ o o	C (Flick-ering)	Trouble sending data in optical fiber cable	Check alarm condition of LED on the unit connected by optical fiber cable. Replacement of MAIN CPU (01P03), MAIN BUFFER (01P04), MDI PCB, optical interface PCB in I/O unit or optical fiber cable. Replace PCRAM PCB when PC debugging.
☼ o o o	8 (Flick-ering)	PMC doesn't start (waiting answer)	Check the mounting of PMC ROM, PMC ROM cassette or PMC RAM PCB. Replace the PCB as described above.
● o ● ●	B	Waiting PMC-ready	Replace the PMC ROM, PMC ROM cassette or PMC RAM PCB. Check PMC programming.
● ● o o	E	System error	See Item (b) when the red LED on MAIN BUFFER (01P04) or ROM PCB (01P01) is lit.
			Replace the SUB CPU (01P10), when the "E" condition displays on the MAIN CPU (01P03) and SUB CPU (01P10) PCB only.
			Replace NC software ROM or MAIN CPU (01P03) PCB when the "E" condition displays on the MAIN CPU (01P03) PCB only.
● ● o o	C	IPL mode	
o o o ●	1	Under normal operation	
	Others	System error	Replace NC software ROM or PCB each.

(C-2) AXIS CPU (01 ∿ 05P08) A16B-1210-0020

Light on Condition	Alarm details	Countermeasures
0	Power system failure Trouble in LED	See Item 3.3.1. Replace the AXIS CPU (01∿05P08) that is not lit.
F	AXIS CPU software doesn't start.	Check ROM mounting or PCB mounting position. Replace AXIS CPU (01∿05P08).
E	RAM check error System error	See Item (b) when the red LED is lit on the MAIN BUFFER (01P04) PCB.
		Except in the above case, replace ROM on AXIS CPU (01∿05P08) or AXIS CPU PCB.
D	ROM parity error on AXIS CPU	Replace ROM on AXIS CPU (01∿05P08) or AXIS CPU PCB.
1	Under normal operation	

(C-3) SUB CPU (01P10) A16B-1210-0100

Light on Condition	Alarm details	Countermeasures
0	Power system failure Trouble in LED	See Item 3.3.1. Replace the SUB CPU (01P10) that is not lit.
F	SUB CPU software doesn't start.	Check ROM mounting or PCB mounting position. Replace SUB CPU (01P10).
E	RAM check error System error	See Item (b) when the red LED is lit on the MAIN BUFFER (01P04) PCB.
		Except in the above case, replace ROM on SUB CPU (01P10) or SUB CPU PCB.
D	ROM parity error on SUB CPU	Replace ROM on AXIS CPU (01∿05P08) or AXIS CPU PCB.
1	Under normal operation	

3.3.5 JOG operation failure

Item	Cause of trouble	Checking points	Countermeasures
1	(analysis)	Check whether the position display functions under display lock DLK OFF condition.	
		1) Position display functions, but machine does not move.	Proceed to item 2.
		2) Neither position display nor machine functions.	Proceed to item 5.
2	Machine lock MLK ON	Check MLK signal by DGN.	
3	Servo off signal ON	Check servo off signal by DGN. Check parameter No. 1802.	
4	Servo system failure	See 3.11.	
5	Interlock signal ON JOG override is 0%.	Check DGN No. 1000.	
6	No mode signal is input.	Check whether JOG or "J+H" is displayed on CRT status display.	
7	Feed axis direction signal is not input.	Check whether feed axis direction signal of DGN is applied. (Note) If an axis command is applied before JG mode selection, the axis does not move. Turn off the axis command once and input it again. The axis should move.	
8	JOG speed setting failure	Check parameter No. 1423. Check rapid traverse speed parameter No. 1420 ∿ if the rapid traverse does not function.	
9	External reset ERS ON Reset & rewind RRW ON.	Check whether "RSET" is displayed on CRT status display.	Check connections.
10	Reference point return ZRN ON.	Check whether "REF" appears on CRT status display.	Check connections.
11	LED of master PCB is other than "1"	See 3.3.4.	

3.3.6 Operation failure with manual pulse generator

Item	Cause of trouble	Checking points	Countermeasures
1	(analysis)	Check whether the position display functions under the display lock DLK OFF condition.	
		1) Position display functions, but machine does not move.	Proceed to item 2.
		2) Neither position display nor machine functions.	Proceed to item 5.
2	Machine lock MLK ON	Check DGN.	
3	Servo off signal ON	Check DGN, and parameter No. 1802.	
4	Servo system failure	See 3.11.	
5	Interlock signal JOG override is 0%.	Check DGN No. 1000.	
6	Mode signal is not input.	Check whether "HND" or "J+H" is displayed on CRT status display.	
7	Feed axis select signal is not input.	Check whether feed axis select signal of DGN is applied.	
8	External reset ERS ON Reset & rewind RRW ON	Check whether "RSET" appears on CRT status display.	
9	Reference point return ZRN ON	Check whether "REF" appears on CRT status display.	
10	Manual pulse generator cable is faulty.		
11	LED lights on master PCB	See 3.3.4.	
12	Option is added.	Check it according to the data sheet.	

3.3.7 Synchronous feed operation failure

Item	Cause of trouble	Checking points	Countermeasures
1	Cable connection failure	Check the connection between NC and position coder.	
2	Spindle revolution number check	Check spindle revolutions on CRT screen. Check DGN No. 1000.	
3	Position coder failure		Replace the position coder.
4	Master PCB is faulty (for 10 and 11 series)		Replace the master PCB.
5	01P02 peripheral control PCB (when less than 8 axes are controlled) or 01P13 spindle control PCB (when more than 9 axes are controlled) is faulty (for 12 series)		Replace the PCB.

3.3.8 Tape is not read normally

Item	Cause of trouble	Checking points	Countermeasures
1	(analysis)	1) Tape does not move even when pressing the START button in tape mode.	Proceed to item 3.
		2) Tape moves when pressing START button in tape mode, but it is not read properly.	Proceed to item 10.
		3) An alarm message appears on CRT.	See 3.3.3.
		4) Alarm lamp on tape reader lights (tape reader with reels).	Proceed to item 16.

Item	Cause of trouble	Checking points	Countermeasures
2	Setting failure	Check to see if input device number for foreground is set to the tape reader being used. (Setting input No. 0020.) Check to see if select device number of tape reader is correct. 10/100 series (small MDI) 3: Reader/puncher interface 3 10/100 series (standard MDI) 2: Reader/puncher interface 2 11/12/110/120 series 0: Tape reader Check to see if corresponding parameters are correct.	
3	Mode signal is not input.	Check to see if "TAPE" is displayed on CRT status display.	
4	Start signal is not input (in tape mode only)	Check to see if start signal turns to 1 or 0 when turning on of off according to DGN.	
5	AC power is not supplied to tape reader.	Check to see if tape reader motor is rotating. If this motor is not operating, AC power is not being applied.	
6	DC power is not supplied to tape reader. (+24 V, +5 V, 0 V) (in case of 11/12/110/120 series tape reader without reels)	Check to see if the tape moves when setting the tape reader switch to MANUAL. If the tape does not move, check DC power supply on PCB in tape reader.	
7	Tape reader is faulty.		Replace the tape reader.
8	Tape is set up-side down.		
9	Tape is not black in tape reader with reels.		Change to black tape.
10	EOB code punch failure	Check EOB code of paper tape.	
11	Tape reader adjustment	1) Check if LED (green) lights on photoamplifier PCB, referring to 3.5. 2) Adjust the photoamplifier, referring to 3.5.	Proceed to 3.5.

Item	Cause of trouble	Checking points	Countermeasures
12	LED on master PCB is not "1".	See 3.3.4.	
13	Cable connection failure	Check cable connection.	
14	Tape reader is faulty.		Replace the tape reader.
15	Master PCB is faulty (for 10/11/100/110 series) or 01P02 peripheral control PCB is faulty (for 12/120 series).		Replace the PCB.
16	Tape reader is in an alarm condition. (tape reader with reels)	The alarm condition is known by the lighting conditions of LED on the front panel of tape reader with reels. For details, see next page.	Set front panel switch to RELEASE to release the alarm.

Item 16 Alarm contents concerning tape reader with reels

No.	Lighting	Flickering	Contents	Countermeasures
1	——	ALARM	Reel function is abnormal 1. No tape is loaded or tape is loosened with REEL ON. 2. Reel is used with REEL OFF.	1. Load the tape correctly with REEL ON. 2. Load the tape correctly with REEL OFF.
2	ALARM	FORWARD	Tape readout failure 1. Malfunction of brightness ratio. 2. Punching failure.	1. Adjust photoamplifier. 2. Replace tape.
3		STOP	Tape end 1. Tape comes to an end.	1. Load tape.
4		REWIND	Tape does not stop in EOR during rewind. 1. Stop magnet is faulty. 2. Tape readout failure.	1. Tape reader is faulty if tape is lightly stretched with REEL OFF. 2. Adjust the photoamplifier.
5	——	ALARM REWIND	Reverse operation was made with REEL OFF. 1. Rewind command or reverse command was applied in AUTO mode. 2. REWIND switch was pressed in MANUAL mode.	1. Perform rewind operation with REEL ON.
6		ALARM FORWARD STOP REWIND	Serial data failure 1. Baud rate error. 2. Stop bit error. 3. Transmission does not stop when CS is turned off or DC3 is received on the host side. (PTR BUFFER FULL)	1. Check baud rate (4800 bauds). 2. Check to see if stop bit is 2. 3. Check cable disconnection.

No.	Lighting	Flickering	Contents	Countermeasures
7	AUTO ALARM FORWARD STOP REWIND		1. Watch dog 2. Power failure	1. A power alarm occurs if power on/off frequency is short. Wait for 30 seconds after turning off power once, then, turn on power switch again. If the same sympton appears again, the tape reader is faulty.
8	All lamps light.		Power abnormal	Check fuse in tape reader with reels.

If an alarm occurs again after the above countermeasures, check to see if the PCB voltage for tape reader with reels is as specified. If the alarm occurs again when the voltage is normal, the tape reader with reels is faulty.

3.3.9 No automatic operation is possible

Item	Cause of trouble	Checking points	Countermeasures
1	(analysis)	Turn the start button off and on in AUTO mode (T, D, or MEM).	
		1) STL lamp does not light.	Proceed to item 2.
		2) STL lamp lights, but no axis moves.	Proceed to item 7.
2	Mode signal is not input	Check to see if "TAPE" "MEM" and "MDI" are displayed on CRT status display.	
3	Start signal is not input	Check start signal according to DGN.	
4	Automatic operation stop signal (*SP) is applied	Check to see if "HOLD" signal appears on CRT status display.	
5	Reset signal is applied	Check to see if "RSET" appears on CRT status display. Check DGN No. 1000.	
6	LED on master PCB is other than "1"	See 3.3.4.	
7	1) Override is 0% 2) Start lock/ interlock is ON 3) Imposition check is progressed 4) Waiting for spindle one-revolution signal during thread cutting 5) Waiting for spindle revolution in each revolution feed 6) Waiting for spindle speed arrival signal 7) Read operation from tape reader in progress	Check DGN No. 1000 and 1001.	
8	Dwell is being executed	Check to see if "DWL" is displayed on CRT status display.	

Item	Cause of trouble	Checking points	Countermeasures
9	M, S, or T function is being executed	Check if "FIN" appears on CRT status display.	

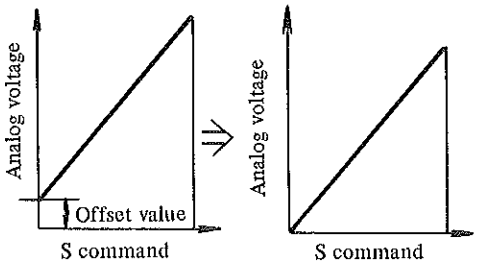
3.3.10 Spindle binary/analog output voltage is abnormal

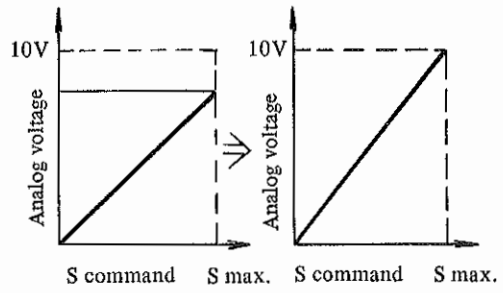
Item	Cause of trouble	Checking points	Countermeasures
1	(analysis) (3/6 interface only)	Perform G97S-M03 command by MDI. Check to see if R01 ∿ R12 conform to the following equation in DGN 424 and 425. $R12x2^{11}+R11x2^{10}+ \ldots . R01x2^{0} = 0.8 \times \frac{S}{Smax} \times \frac{Sovr}{100} \times 4095$ s : Specified revolutions rpm Smax: Maximum revolution of selected gear (Parameters 120 ∿ 123) Sovr: spindle override %	
		All R01 ∿ R12 are 0.	Proceed to item 3.
		R01 ∿ R12 are other than that specified in the above equation.	Proceed to item 5.
		R01 ∿ R12 are as specified in the above equation, but no analog voltage appears.	Proceed to item 10.
2	(analysis) (in case of BMI only)	Check to see if voltage is correctly written into DGN output RI0 ∿ RI15 by PC.	
		The written voltage value is correct, the analog voltage is low.	Proceed to item 11.
		The written voltage value is incorrect. The spindle revolution output R00 ∿ R015 is not output normally.	Proceed to item 6.
		The voltage value is not written correctly, R00 ∿ R015 are output normally.	Proceed to item 15.
3	Spindle stop signal (*SSTP) (3/6 interface only)	Make sure that "SSTP" is not input according to the following: 1) DGN *SSTP = 1 when bit 0 of parameter 5602 is "0" 2) DGN *SSTP = 0 when bit 0 of parameter 5602 is "1"	

Item	Cause of trouble	Checking points	Countermeasures
4	Parameter setting failure of S code output (3/6 interface only)	Check to see if 7th bit of parameter No. 5600 is "0".	
5	Gear select signal is applied incorrectly (3/6 interface only)	Check DGN (in case of analog output B type).	
6	Maximum spindle speed setting failure (parameter setting failure)	Check to see if parameters No. 5621 ∿ 5627 are set correctly.	
7	Analog output gain setting failure (parameter setting failure)	Check to see if parameter No. 5514 is "1000".	
8	Check to see if spindle speed binary code/analog output option has been added.	Check it with data sheet.	
9	LED on master PCB is other than "1"	See 3.3.4.	
10	(analysis)	Make sure by reviewing DGN 004 and 005 that R01 ∿ R12 are the same as DGN 424 and 425 (for the NC with Programmable Controller may vary according to its specifications).	
		Same as above, but no analog voltage is output.	Proceed to 11.
		Output voltage is varied.	Proceed to 15.
11	Cable connection is erroneous	NC-side output connector is CA1. Check the cable for connection.	
12	Load is abnormal	Remove the cable connected to NC-side output connector CA1 and check the voltage between CA1 connector pin 7 (VCMS) and pin 19 (ECS). Note: VCMS voltage is; $V = \frac{S}{Smax} \times 10$ (V)	

Item	Cause of trouble	Checking points	Countermeasures
13	Check specifications of Programmable Controller, if attached	Check to see if the signals from the machine tool clamp the analog output on the Programmable Controller.	
14	LEDs on master PCB are other than "1"	See Subsect. 3.3.4.	
15	Master PCB is faulty (for 10 and 11 series).		
16	01P02 peripheral control PCB (when less than 8 axes are controlled) or 01P13 spindle control PCB (more than 9 axes are controlled) is faulty (for 12 series).		

3.3.11 Analog output voltage linearity is not good

Item	Cause of trouble	Checking points	Countermeasures
1	Parameter setting is wrong.	1) Command S0 so that output voltage can become 0 V; then make sure that S analog voltage is 0 V (offset adjustment). If not, set parameter 5613 so that 0 V can be output. 	

Item	Cause of trouble	Checking points	Countermeasures
		2) Command Smax so that output voltage becomes 10 V; then make sure that S 4-digit analog voltage is 10 V (gain adjustment). If not, set parameter 5614 according to the following equation, so that 10 V may be output. $\frac{10.0}{\text{Measured voltage (V)}} \times 1000$ = Setting value 	
2	Load is abnormal	See art. (11) of Subsec. 3.3.10.	
3	PCB is faulty	See art. (15) and (16) of Subsec. 3.3.10.	

3.3.12 Reader/puncher and ASR33 interface do not operate normally

Item	Cause of trouble	Checking points	Countermeasures
1	(analysis)	Punching or reading is impossible. As a result, "PUNCH" or "READ" not displayed below on CRT screen.	Proceed to 2. After confirming by operating again.
		Punching or reading is impossible, but "PUNCH" or "READ" is displayed.	Proceed to 6.
		Alarm occurs.	Proceed to item 3.2.
2	Reset signal is input	Check DGN No. 1000. Check to see if "RSET" appears on CRT status display.	
3	Mode signal is not applied	Check to see if either EDT or MEM mode is "1" by DGN No. 003.	
4	Check to see if an option is added	Check it with data sheet.	

Item	Cause of trouble	Checking points	Countermeasures
5	LED on master PCB is other than "1"	See 3.3.4.	
6	Setting failure	Check to see if correct I/O device is selected (or check parameters No. 20 ∿).	
7	Baud rate setting failure	Check to see if correct value is set on I/O device number selected by parameter No. 5001 ∿ . 1) Baud rate. 2) Stop bit. 3) Use control code.	
8	I/O device operation is wrong	Check I/O device operation according to the operator's manual.	
9	Cable operation failure	Check to see if cable is connected to correct connector. Check cable connection and wiring. Signals are connected according to the specifications determined between machine tool builder and I/O unit maker.	
10	LED on master PCB is other than "1"	See 3.3.4.	
11	CRT/MDI PCB is faulty		Replace the PCB.
12	Master print PCB is faulty (for 10 and 11 series) or 01P02 peripheral control PCB is faulty (FS12).		Replace the PCB.

3.3.13 Stop position does not coincide with reference point return position

a) 1-grid deviation

Item	Cause of trouble	Checking points	Countermeasures
1	The deceleration dog position is incorrect	Move the machine tool from the reference point position to the deceleration dog direction and check the deceleration signal with the diagnostic function. Read the distance between the reference point and the deceleration dog position on the NC position display.	The distance between the deceleration dog and the reference point should be equivalent to one-half of a motor revolution. (Resolver inductosyn)

Item	Cause of trouble	Checking points	Countermeasures
2	The deceleration dog length is too short	Use the procedure given in item 1 to read the length of the deceleration dog.	Replace the dog, according to CONNECTING MANUAL.
3	The position of the reference point approximate signal switch is bad.	Move the machine tool from the reference point position to the deceleration dog direction and check the deceleration signal with the diagnostic function. Read the distance between the reference point and the deceleration dog position on the NC position display.	The distance between the reference point and the reference point approximate signal switch should be about 1/2 of the grid width. Motor 1/2 rotation: for pulse coder 1/2λ: for resolver inductosyn

b) Random deviation

Item	Cause of trouble	Checking points	Countermeasures
1	Noise	Check to see if the shielding is grounded. Check that the spark killer is connected to the solenoid coil, etc. Check to see if the pulse coder cable and the power cable are in close proximity.	Ground the shielding wire. Connect the spark killer. Separate the pulse code and power cables.
2	Source voltage to the pulse coder is too low	When the voltage at power checking terminals on the master PCB is 5.0 V ±0.05 V, the source voltage should be 4.75 V or more. (Measure the pulse coder voltage between + and - or +5 V and 0 V of checking terminals or pulse coder PCB)	Cable loss must be 0.2 V or less, including both sides of 0 V and 5 V. The voltage at +5 V terminal on the master PCB should be within the range of 4.95 to 5.10 V.
3	Coupling between the servo motor and the machine tool is loose	Mark the motor shaft and check the correspondence between the shaft and machine tool position.	Tighten the coupling.
4	Defective pulse coder	Replace the pulse coder.	Replacement.

Item	Cause of trouble	Checking points	Countermeasures
5	Defective master PCB (for 10 and 11 series) or defective 01∿05 axis control PCB (for 12 series)	Replace the PCB.	Replacement.

c) Minute deviation

Item	Cause of trouble	Checking points	Countermeasures
1	Broken cable or defective connector	Make sure the cable connector is tight. Check the solder connections and bends in the cable.	Repair the connection.
2	Variation in offset voltage. Defective master PCB (for 10 and 11 series), 01∿05P06 axis control PCB (for 12 series)	In case analog servo system Release the drift compensation function with the parameter (7th bit of No. 1800 is "0"), and check the position deviation using the diagnostic function. (DGN No. 3000∿) The offset value variation should correspond to the variation of the position deviation value at stoppage. Replace the master PCB, axis control PCB or the velocity control unit PCB to determine the source of the problem.	Replace the master PCB, axis control PCB or velocity control unit PCB.

Checking method of reference point return operation and deceleration dog position.

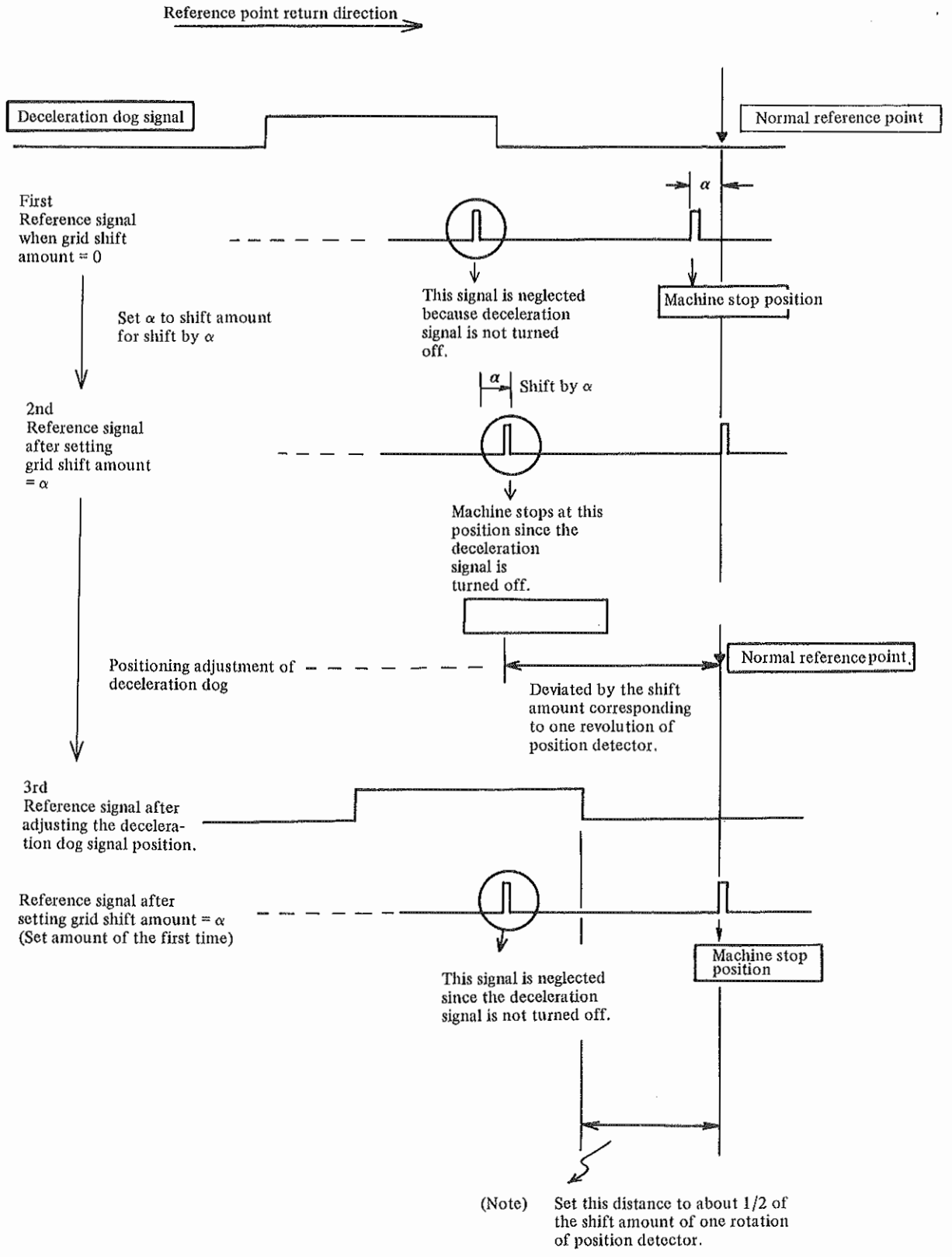
1) Set the parameter according to the following table.
   As for parameter No. 1580, set "0" at beginning.

Parameter number	Contents
1400	Manual rapid traverse is effective without performing the reference point return.
1006	Reference point return direction.
1816	Capacity of reference counter for each axis.
1005	Reference point return function is provided (Return method).
1850	Setting of grid shift amount of each axis.
1425	Low feed rate (FL) for reference point return.

Parameter number	Contents
1240 ∿	Coordinate value of reference point in machine coordinate system.
1024	FM feed rate at reference point return by magnetic switch method.

2) Perform the reference point return and confirm the operation is correct.
   If reference point adjustment is needed:
   i) grid method ..... Adjusted by grid shift amount (parameter No. 1850)
      If reference point shifts a portion of 1 revolution of detector (pulse coder, resolver), deceleration dog must be moved.
   ii) magneswitch method ..... Adjusted by position of proximity switch.

3) Confirm the deceleration dog position (grid method only).
   i) Perform reference point return.
   ii) Write down position display value at reference point.
   iii) Check deceleration dog signal (*DECX, *DECY, *DECZ, *DEC4, *DEC5) and return the machine to DEC signal beginning at reference point with low speed.
   iv) Calculate the distance from reference point to DEC signal using position in (ii) and (iii) procedure. Make that distance a half of 1-revolution distance of detector by adjustment of Deceleration dog.


Reference point return direction
Deceleration dog signal
Normal reference point
α
First
Reference signal
when grid shift
amount = 0
This signal is neglected
because deceleration
signal is not turned
off.
Machine stop position
Set α to shift amount
for shift by α
α
Shift by α
2nd
Reference signal
after setting
grid shift amount
= α
Machine stops at this
position since the
deceleration
signal is
turned off.
Positioning adjustment of
deceleration dog
Normal reference point
Deviated by the shift
amount corresponding
to one revolution of
position detector.
3rd
Reference signal after
adjusting the decelera-
tion dog signal position.
Reference signal after
setting grid shift amount = α
(Set amount of the first time)
Machine stop
position
This signal is neglected
since the deceleration
signal is not turned off.
(Note) Set this distance to about 1/2 of
the shift amount of one rotation
of position detector.

3.3.14 System error

If a system error occurrs, the system can rarely be repaired by users. Please contact your nearest FANUC service center.
The system may be recovered by changing parameters and other countermeasures. For details, refer to the following table.
1) System error when power is turned on

No.	Display on CRT	Error contents	Counter-measures
1	ROM PARITY ERROR aaa bbb ...	Inconsistency of ROM parity aaa,bbb,...: Faulty ROM No.	Check to see if ROM is mounted correctly.
2	RAM TEST : ERROR (LED display b)	An error was detected by RAM test. (RAM in short area)	
3	RAM TEST : ERROR aaaaaa : wwwwwwww rrrrrrrr	An error was detected by RAM test. aaaaaa: Address wwwwwwww: rrrrrrrr: Readout data	
4	MISSING OPTION ROM aaa bbb ...	Essential option ROM is missing. aaa,bbb,...: Required ROM No.	Check to see if ROM is mounted correctly. Check parameter setting is correct.
5	MISSING OPTION RAM	Essential option RAM is missing.	Check option RAM for correct mounting condition. Check to see if parameters are set correctly.
6	IMPROPER NUMBER OF AXIS	The number of preset controlled axes is incorrect. (Not within the range of 1 ∿ (the number of installed axes).)	Check to see if the additional axis card is correctly installed. Check to see if parameter setting is correct.

No.	Display on CRT	Error contents	Counter-measures
7	LOAD SYSTEM LABEL : ERROR SAVE SYSTEM LABEL : ERROR LOAD PC PARAMETER : ERROR CLEAR FILE # n : ERROR LOAD FILES : ERROR BUBBLE PREPARATION : ERROR CLEAR BUBBLE : ERROR ..... aaaa bbbb cccc (Displayed after one of the above is displayed)	An alarm occurred halfway during read/write operation of bubble memory.	
8	BUBBLE INITIALIZE : NO BUBBLE BUBBLE PREPARATION : NO BUBBLE CLEAR BUBBLE : NO BUBBLE	Essential bubble memory is not mounted.	Check to see if correct bubble memory is mounted.
9	CHECK BUBBLE ID : ERROR	Identification code showing the type of bubble memory is incorrect.	
10	BUBBLE PREPARATION : NOT READY CLEAR BUBBLE : NOT READY	Power-on processing of bubble memory has been terminated incorrectly. This alarm does not usually occur at first, but is displayed when bubble was accessed after alarm 7, 8, etc., occurred.	
11	NO SYSTEM LABEL	System label (area used to store the type of system, construction, and other data) does not exist. This alarm does not usually appear at first, but appears after the system label was accessed after alarm 7, 8, etc., occurred.	
12	CHECK SYSTEM LABEL : ERROR	System label (see item 11) is incorrect. This alarm is generally displayed when a bubble memory has been installed without initializing it for the system or when the memory has not been initialized after fully clearing it.	Initialize the system.

No.	Display on CRT	Error contents	Counter-measures
13	FILE # n : DATA BROKEN	Data of file No. n is broken. This alarm is displayed when power was turned off halfway during the course of changing the file. (10 series)	Clear corresponding file, and remake it.

Note 1) If one of the above system alarms occurred, a message in "CRT display" column is displayed on CRT. The system is set to IPL and the initial menu of IPL is displayed after the alarm message.
The system cannot be operated normally until the cause of the system alarm has been eliminated.

2) System alarms during system operation

No.	Display on CRT	Error contents	Counter-measures
1	TRAP 15	System software functions abnormally.	
2	ADDRESS ERROR	An address error (access to odd address) occurred.	
3	BUS ERROR	A bus error (invalid address access) occurred.	
4	ILLEGAL INSTRUCTION	An attempt was made to execute an invalid command.	
5	ZERO DIVIDE	An attempt was made to execute the division when divisor is zero.	
6	CHECK INSTRUCTION	Register exceeds the range in register range check.	
7	TRAPV INSTRUCTION	Overflow trap occurred.	
8	PRIVILEGE VIOLATION	A privilege command violation error occurred.	
9	TRACE	CPU was set to the trace condition.	
10	L1010 EMUL	An attempt was made to execute a command having a command code of Axxx.	
11	L1111 EMUL	An attempt was made to execute a command having a command code of Fxxx.	
12	UNASSIGNED TRAP	An unassigned TRAP occurred.	

No.	Display on CRT	Error contents	Counter-measures
13	UNASSIGNED INTERRUPT	An unassigned interruption occurred.	
14	SPURIOUS INTERRUPT	A false interruption whose cause remains unknown occurred.	
15	NON MASK INTERRUPT	A NMI whose cause remains unknown occurred.	
16	WATCHDOG ALARM	Watch dog alarm occurred.	
17	RAM PARITY ALARM	An RAM parity error is detected.	Clear all memory in case of 10 series.
18	ROM PARITY ALARM	An ROM parity error is detected.	
19	PC ALARM	A serious PC error occurred.	

Note 1) If one of these system alarms occurred, the CRT displays it and the system cannot be operated. The "display on CRT" in the above table indicates a message will be displayed on the top of the CRT screen. Diagnostic data caused by the error are displayed in the remaining part of the CRT screen. (Detail is omitted.)

3.4 Power Voltage Check

3.4.1 Input unit

1) Types of input units
   Six types of input units are provided for 10/11/12/100/110/120 series, respectively. (The input units for 10/100 series are different from those for 11/110 series.)
   a) For control unit (multitap transformer is not connected) ... Fig. 1
      (10/100 series Built-in type 1, 10TF Built-in type 3, 10/100/11/110M Built-in type 2-2, 10/11 series unbundled type)
   b) For control unit (multitap transformer is connectable) ..... Fig. 2
      (10/11/100/110M Built-in type 2)
   c) For control unit and servo ..... Fig. 3
      (10/11/100/110 series Free-standing type, 10/11/100/110T Built-in type 2)
   d) For control unit ..... Fig. 4
      (12/120 series Built-in type)
   e) For control unit ..... Fig. 5
      (12/120 series Free-standing type A)
   f) For control unit ..... Fig. 6
      (12/120 series Free-standing type B)
   g) For additional power input unit ..... Fig. 7
      (I/O unit)

2) Input unit PCB
For 10 series A16B-1600-0090
For 11 series A16B-1600-0080
For 12 series A16B-1600-0080
A20B-1001-0210 (only 12 series free standing type B)
Fuses F1, F2, F3, F91, F92 on the PCB
F1, F2, F91, F92 ..... A60L-0001-0901#P4110H (10A) (Control unit input fuse)
F3 ..... A60L-0001-0172#DM03 (0.3A) (Power on/off control circuit fuse)
LED on PCB
PIL ..... Pilot lamp Green light-emitting diode
This lamp remains lit when power is applied to NC.
ALM ..... Alarm Red light-emitting diode
This lamp lights when an alarm signal is received from stabilizer power supply unit.

The PCB (10 series: A16B-1600-0090, 11 series: A16B-1600-0080) in the power input unit
The maintenance procedure on this PCB is mentioned below.

① Two LEDs of PIL and ALM are provided with this PCB. PIL (Green LED) lights while the power is supplied to the power input terminal board TP1. ALM (Red LED) lights when this PCB receives an alarm signal from the power stabilizer unit. When ALM lights, NC line contactors LC1 and LC2 rurn OFF. NC power cannot be turned on under this condition. To reset this condition power supply must be once cut off or the POWER OFF button (Either NC POWER OFF button or external POWER OFF button) must be pushed.

② Even when NC power is off, the power has been supplied to the circuit before the line contactors LC1 (adn LC2) while PL1 lighghts. When you touch some units inside the power input unit, confirm that PIL is not lighting.

③ Check the voltage for relays in the PCB Unit between (0) and (E), 21 to 22V is normal.

④ When it is desired not to cut off the power with an alarm at troubleshooting by ALM lighting, connect check pins between P1 and P2. However, the time taken for troubleshooting must be as short as possible and you must disconnect the check pins immediately after the troubleshooting.

⑤ The fuse F3 (0.32A) will blow out by short-circuiting of parts within the PCB.
Replace the fuse after troubleshooting.
The ordering number of F3 is A60L-0001-0172#DM03.

3) Multitap transformer input fuse (Fig. 2 - 6)
For 10/11/100/110 series F1, F2 ..... A60L-0001-0042#JG1-10 (10A)
For 12/120series Built-in type, Free-standing type A:
F1, F2 ..... A60L-0001-0042#JG1-20
For 12/120 series Free-standing type B:
F1, F2 ..... A60L-0001-0042#JG1-30

4) Servo transformer input fuses
The fuse capacity differs according to servo transformer capacity. See the following table.

Table 3.4.1 (a) Servo input fuse for 10/11/100/110

Power voltage	Fuse type / Transformer Capacity(KVA)	PC type made by Utsunomiya Electric Co.	FCF type made by Fuji Electric Co.
200 V 220 V	1.5 kVA	15 A	20 A
	2.5	20	30
	5	30	30
	10	40	40
	15	50	50
380 V 〜 440 V	1.5	10	10
	2.5	10	15
	5	15	15
	10	25	30
	15	30	30
480 V 〜 550 V	1.5	10	10
	2.5	10	15
	5	15	20
	10	20	30
	15	25	30

Table 3.4.1 (b) Servo input fuse for 12/120 series

Power voltage	Fuse type / Transformer Capacity(KVA)	JG type made by Utsunomiya Electric Co.
200 V 〜 550 V	1.5 KVA	15 A
	2.5	20 A
	5	30 A
	10	40 A

3.4.2 Input power voltage check

Check to see if the input power voltage satisfies the following requirements:

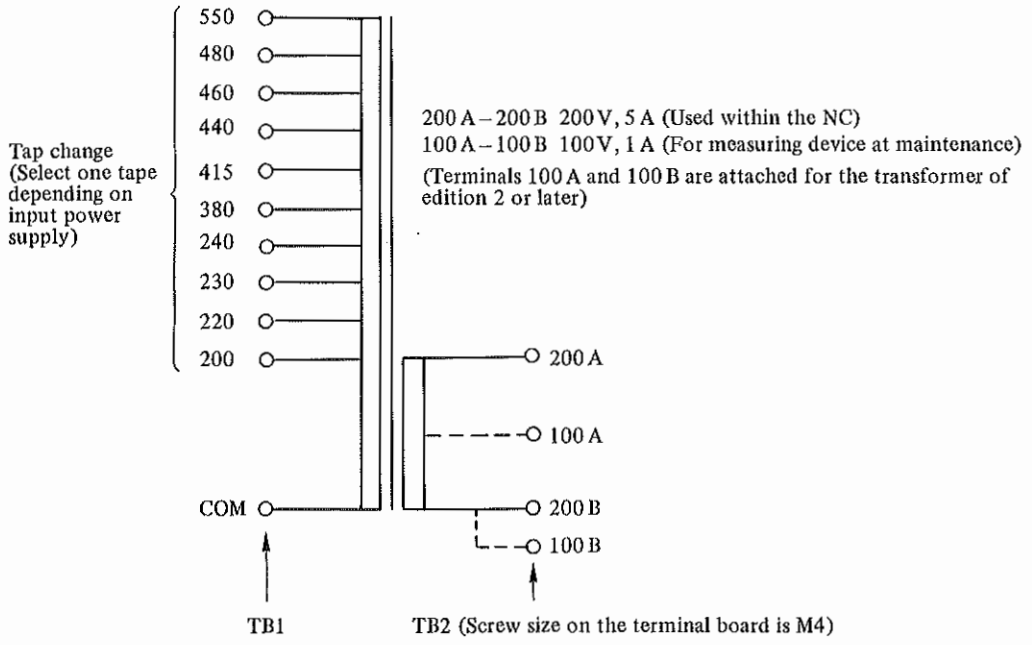
1) In case of input unit shown in Fig. 1.
   AC 200 V $^{+10\%}_{-15\%}$, 50/60 Hz $\pm$1 Hz, 1ϕ, AC 220 V $^{+10\%}_{-15\%}$, 60 Hz $\pm$1 Hz, 1ϕ

2) In case of the input unit shown in Fig. 2, 4 and 6 (when multitap transformer is used).
   AC 200 V/220 V/230 V/240 V/380 V/415 V/440 V/460 V/480 V/550 V
   Rated fluctuation range $^{+10\%}_{-15\%}$, 50/60 Hz $\pm$1 Hz, 1ϕ

3) In case of input unit shown in Fig. 3 and 5 (when multitap transformer is used).
   AC 200 V/220 V/230 V/240 V/380 V/415 V/440 V/460 V/480 V/550 V
   Rated fluctuation range $^{+10\%}_{-15\%}$, 50/60 Hz $\pm$1 Hz, 3ϕ

CONTROL UNIT POEWR TRANSFORMER

A control unit power transformer (A80L-0001-0176) is required when the input power supply is other than AC 200V, 50 Hz and AC 220V, 60Hz.
This transformer has taps for AC 200/220/230/240/380/415/440/460/480/550V on the primary side (MULTI-TAP TRANSFORMER). Select one tap depending on input power voltage.



An output between 100A and 100B is used only for measuring device at maintenance. This output must not be used for a long time. Also, because this output does not have any protective means such as fuses, even when used for measuring device, you must carefully examine whether the measuring device has the shrot-circuit or whether the load current does not exceed 1A.
Moreover, when you touch on the terminals such as TB1, TB2, etc, you should touch after turnign off the main switch of the magnetics cabinet. (You can confirm the main switch ON and OFF by the PIL lamp in the power input unit. PIL lights while the main switch is ON, but extinguishes while that is OFF.)

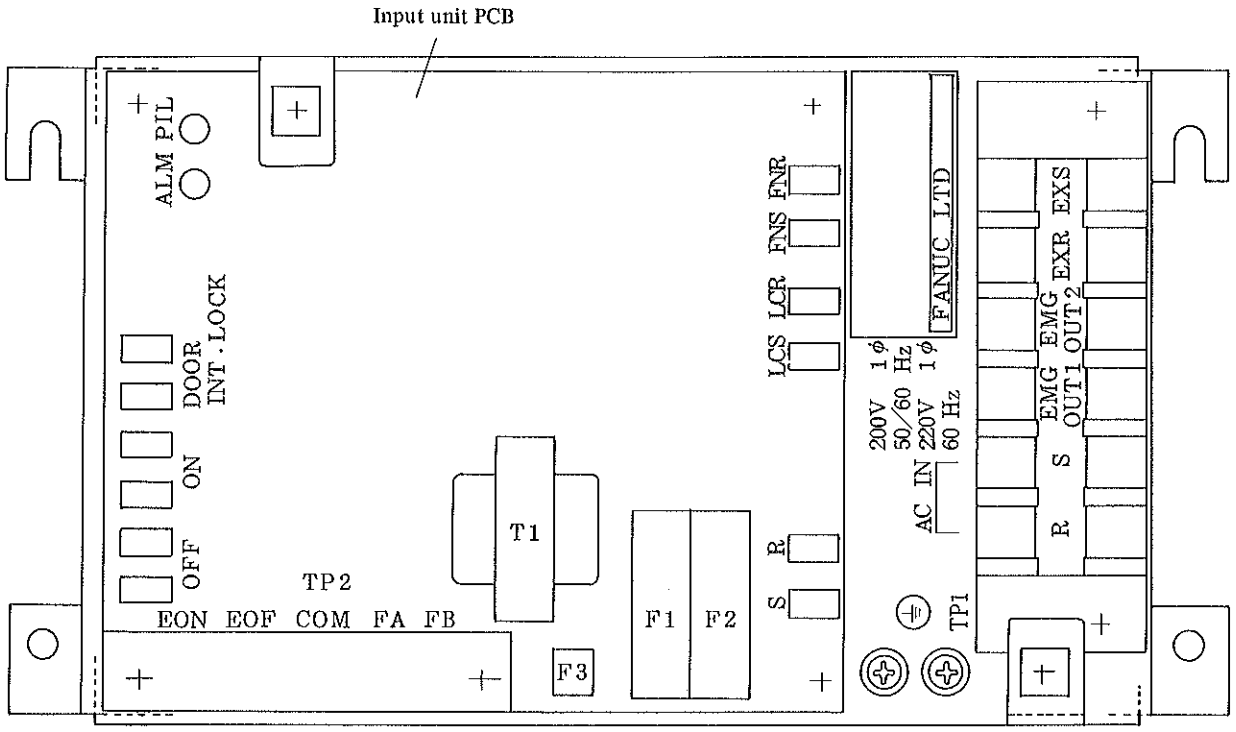


Fig. 3.4.2 (a) Input unit for 10/11 series built-in type 1, 10TF built-in type 3 10M/11M built-in type 2-2, and 10 series 11T/M unbundle-type cabinet

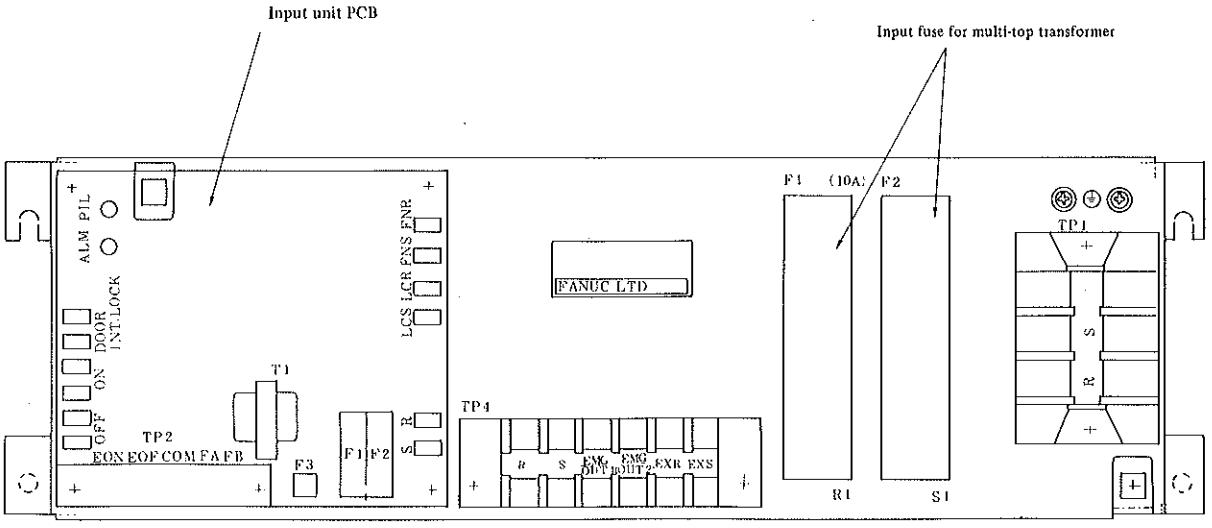


Fig. 3.4.2 (b) Input unit for 10M/11M built-in type cabinet

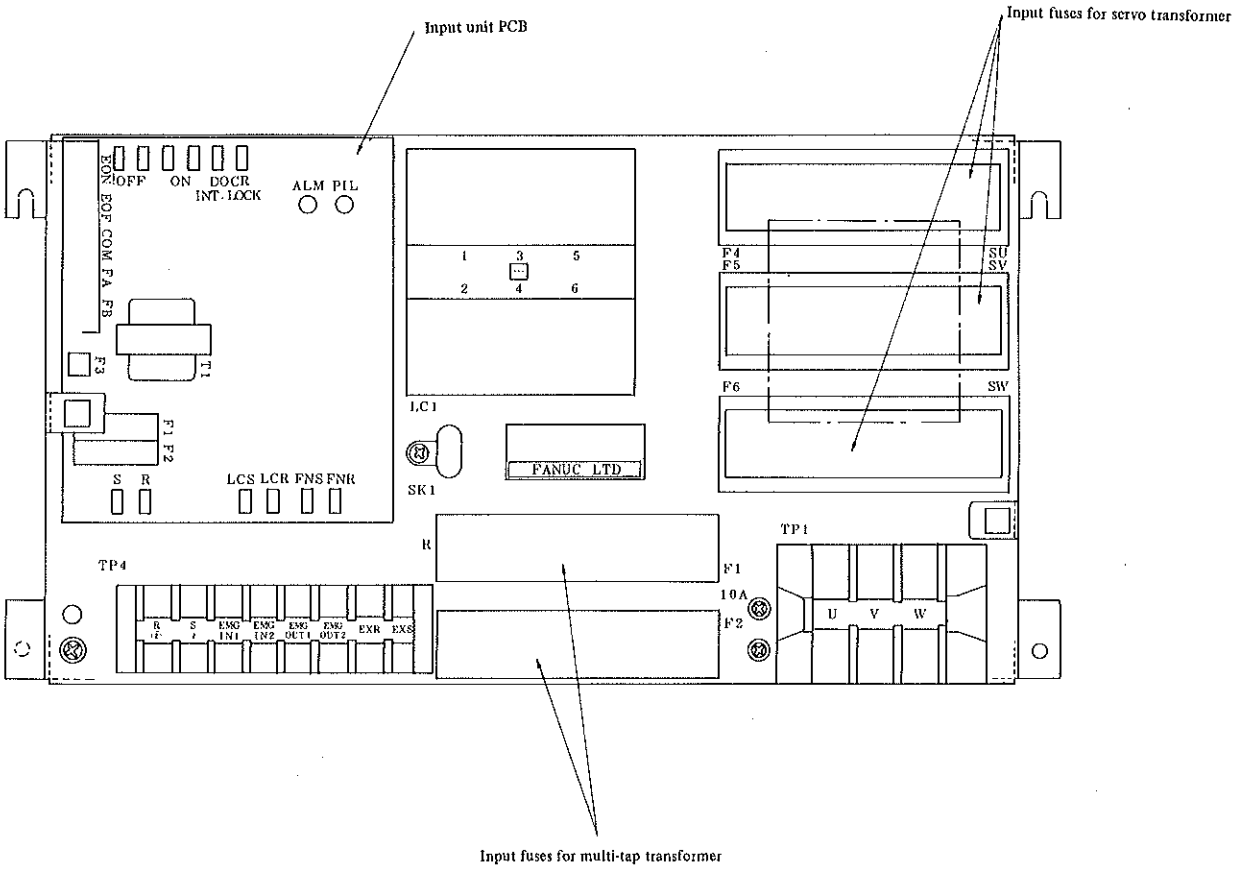


Fig. 3.4.2 (c) Input unit for 10T/M, 11T/M free-standing type and 10T/11T built-in type 2 cabinet

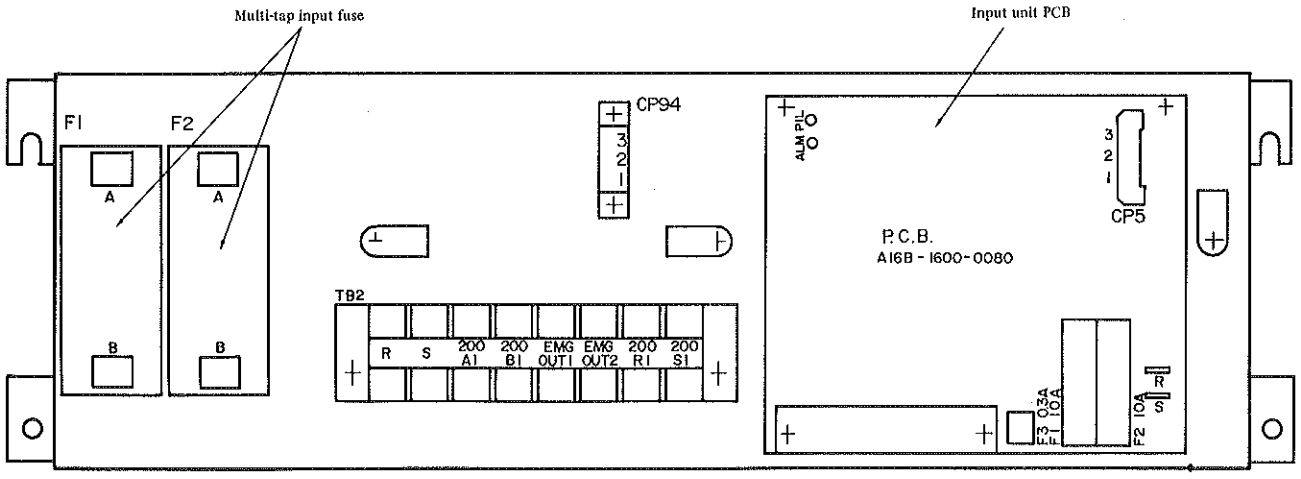


Fig. 3.4.2 (d) Input unit for 12 series built-in type cabinet

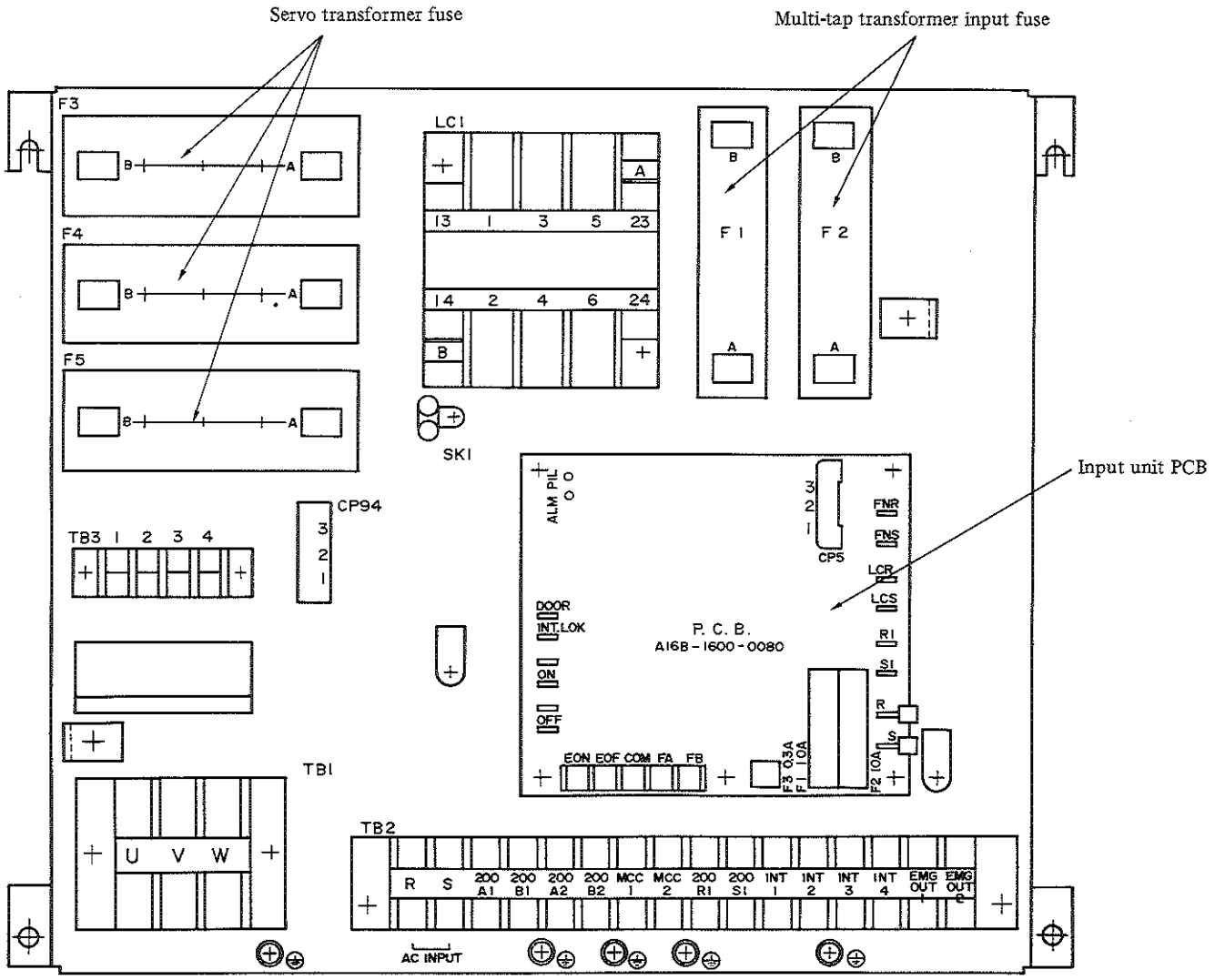


Fig. 3.4.2 (e) Input unit for 12 series free-standing type A cabinet

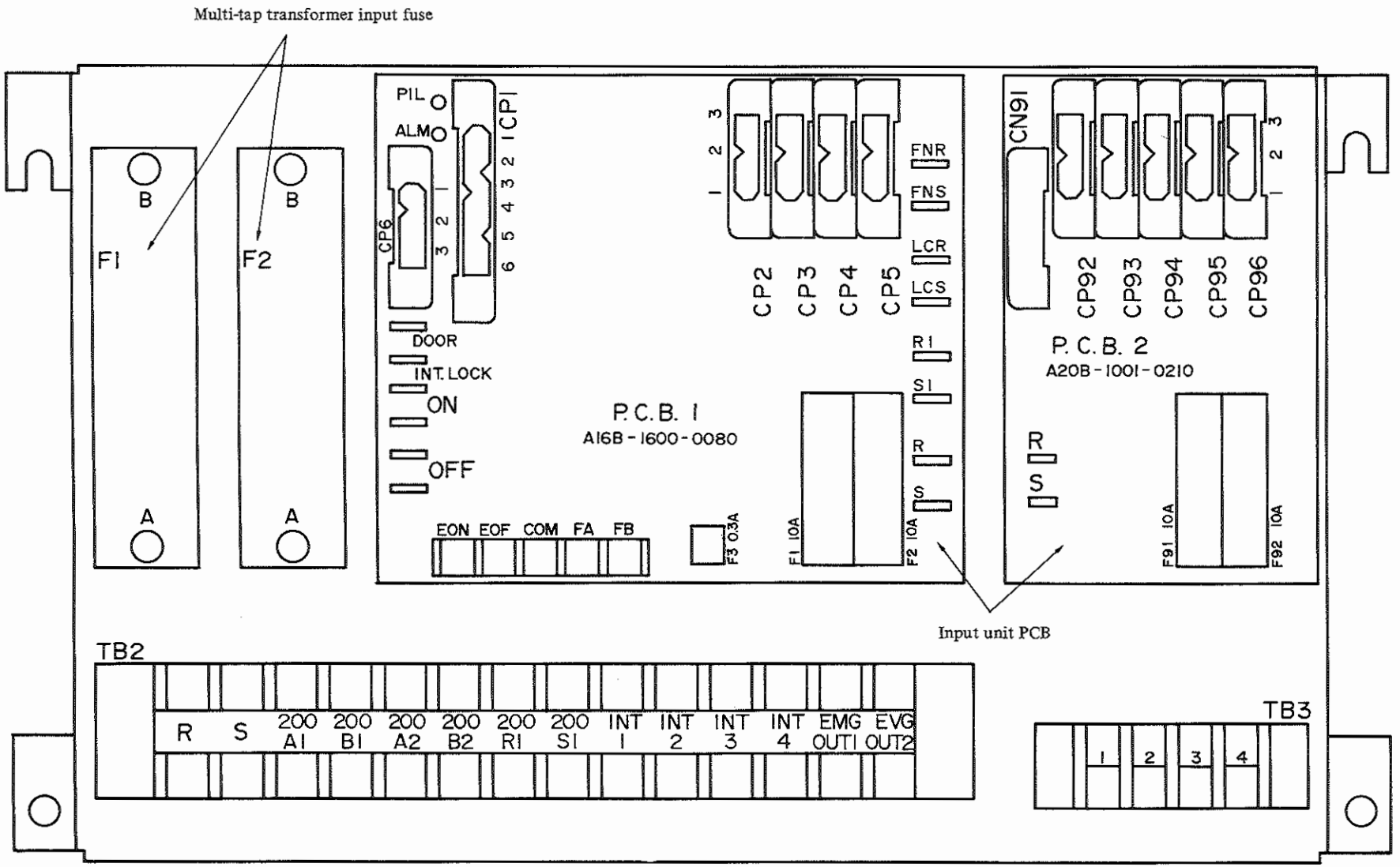


Fig. 3.4.2 (f) Input unit for 12 series free-standing type B cabinet

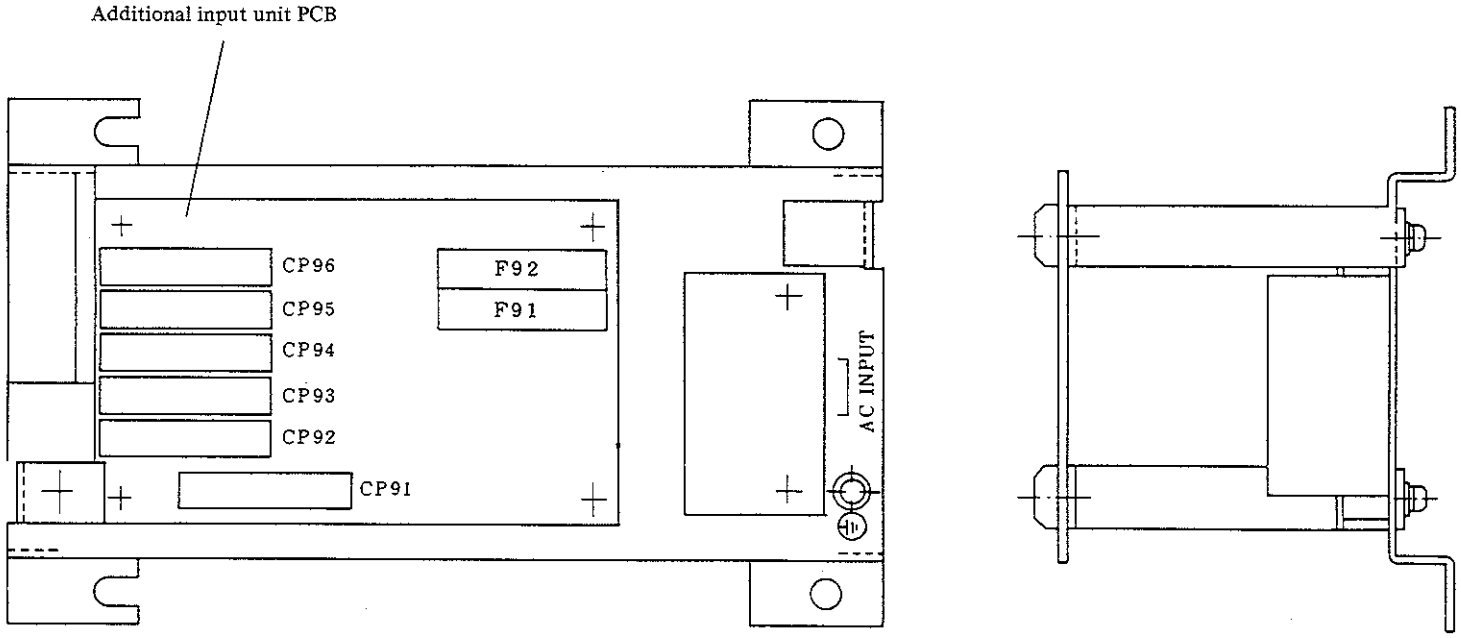


Fig. 3.4.2 (g) Additional power input unit

3.4.3 DC voltage checking

DC voltages supplied from the power unit must be measured at CP17 checking terminals on the power unit. Confirm that DC voltages are within the allowable range.

1) Rated output voltage

Terminal name	Rated voltage	Allowable fluctuation	Use
+5	+5 V	±5%	Logical circuit
+24	+24 V	±10%	Bubble memory, tape reader, Small type, CRT
+24E	+24 V	±10%	I/O signals
+15	+15 V	±5%	Position control circuit
-15	-15 V	±5%	Position control circuit, Bubble memory
A0	0 V	-	——

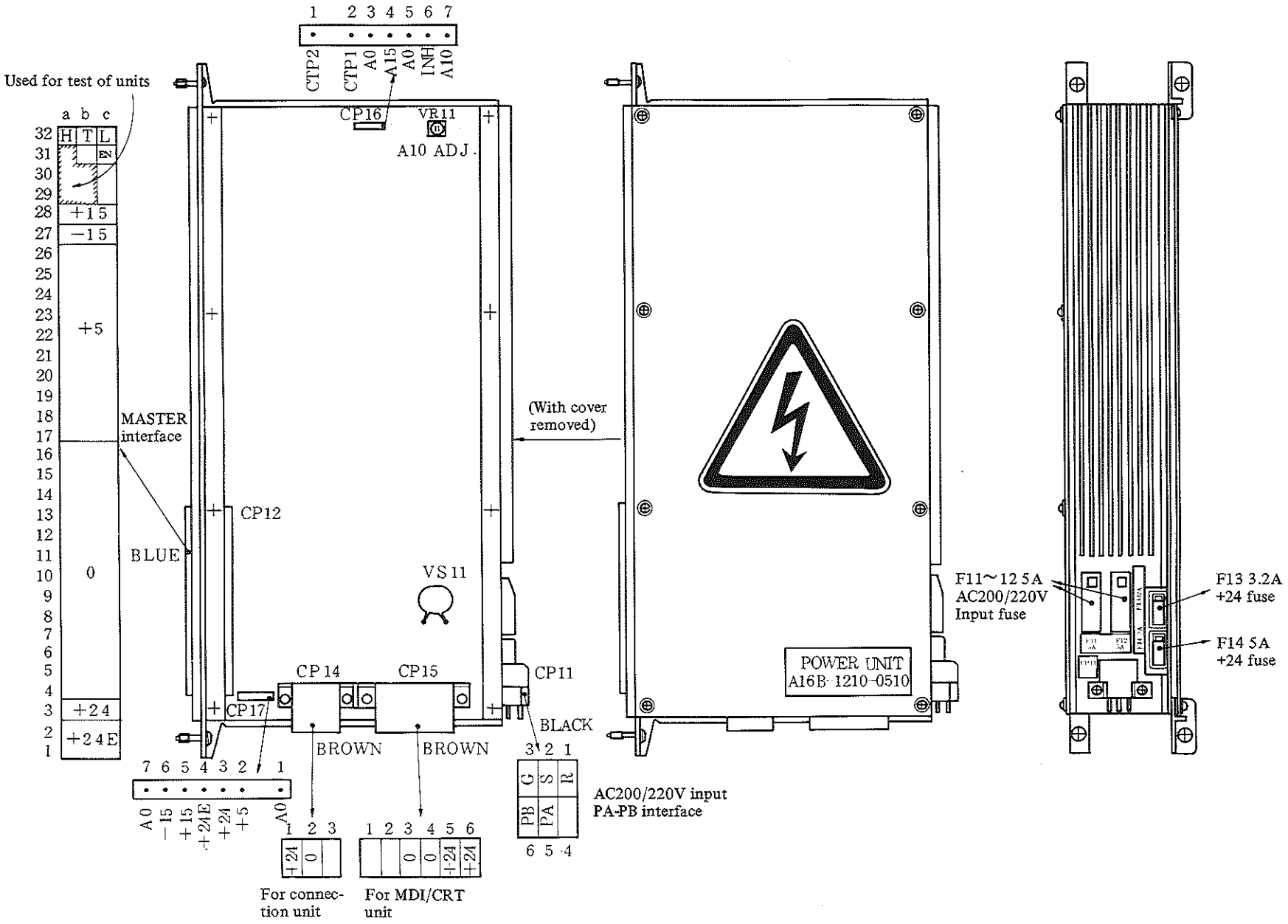


Fig. 3.4.3 (a) Power unit for 10/100 series outer view

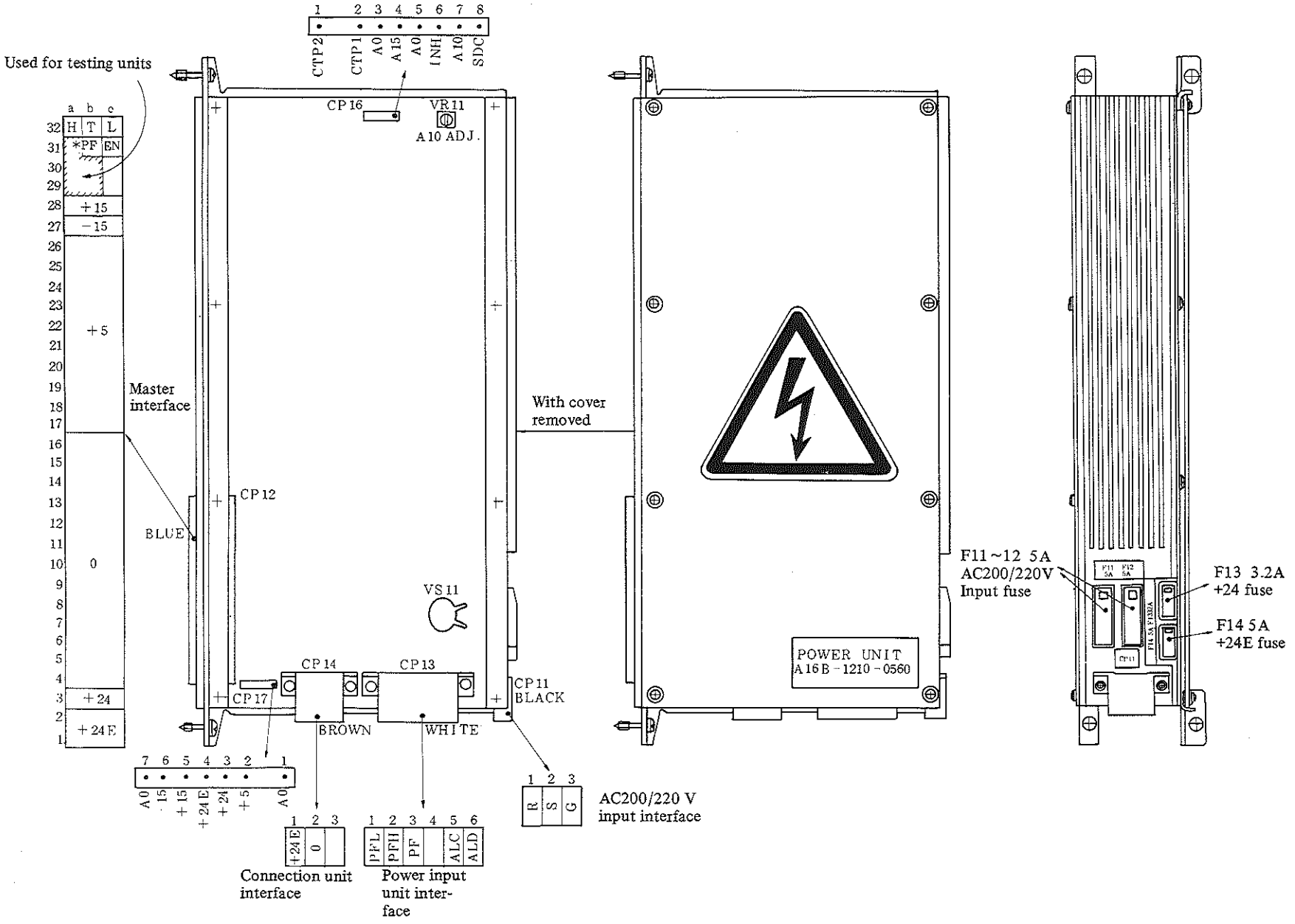


Fig. 3.4.3 (b) Power unit for 11/110 series outer view

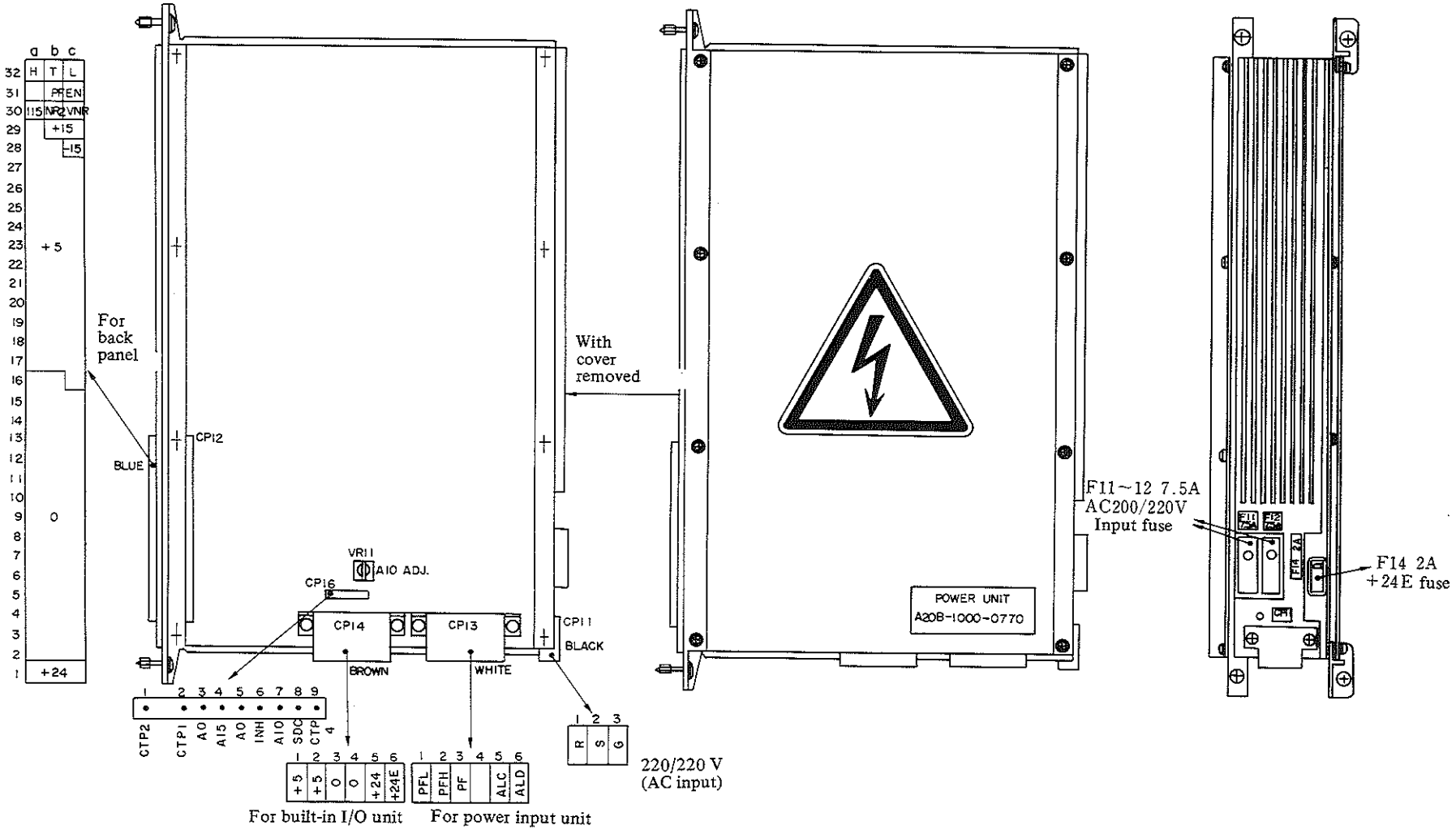


Fig. 3.4.3 (c) Power unit for 12/120 series outer view

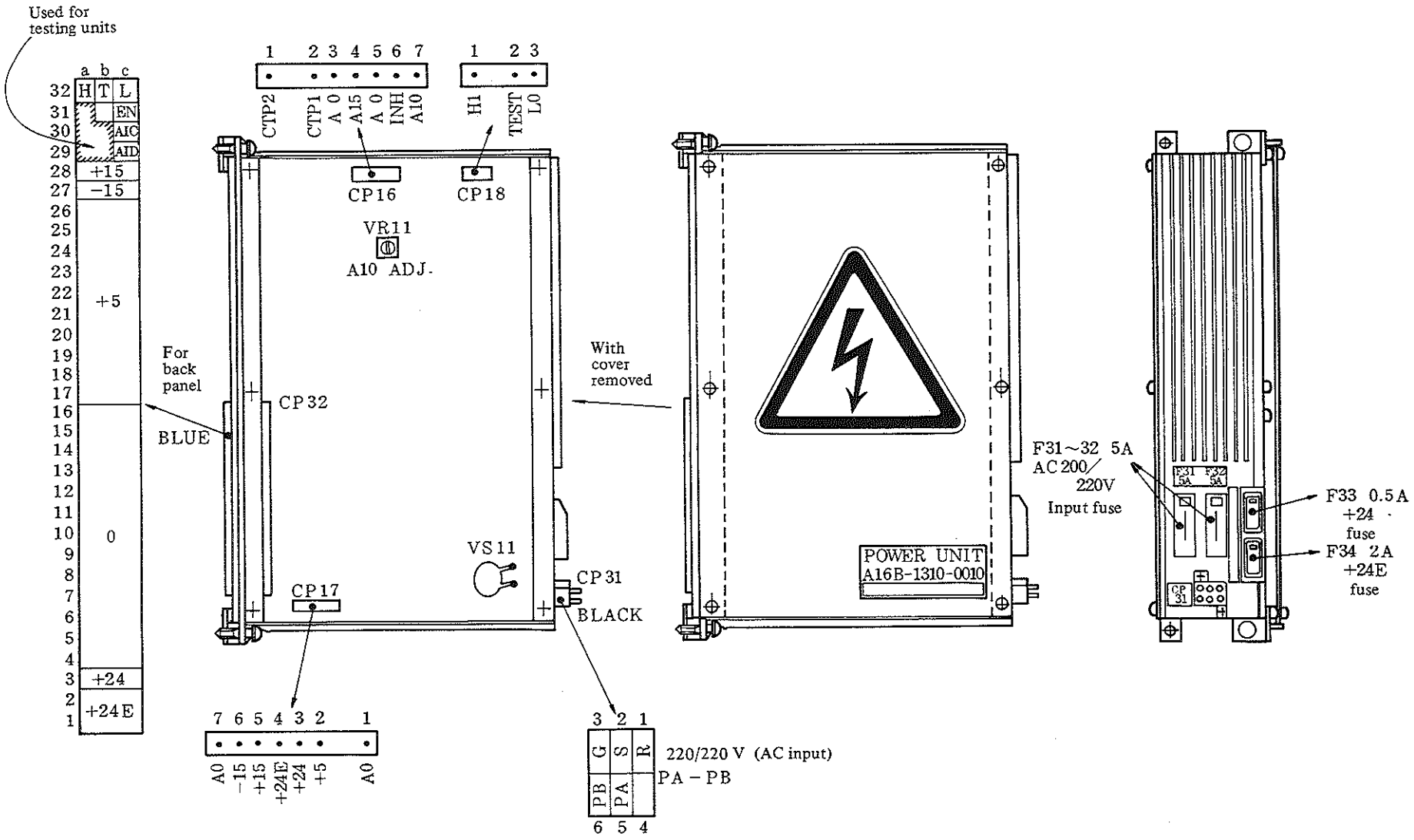
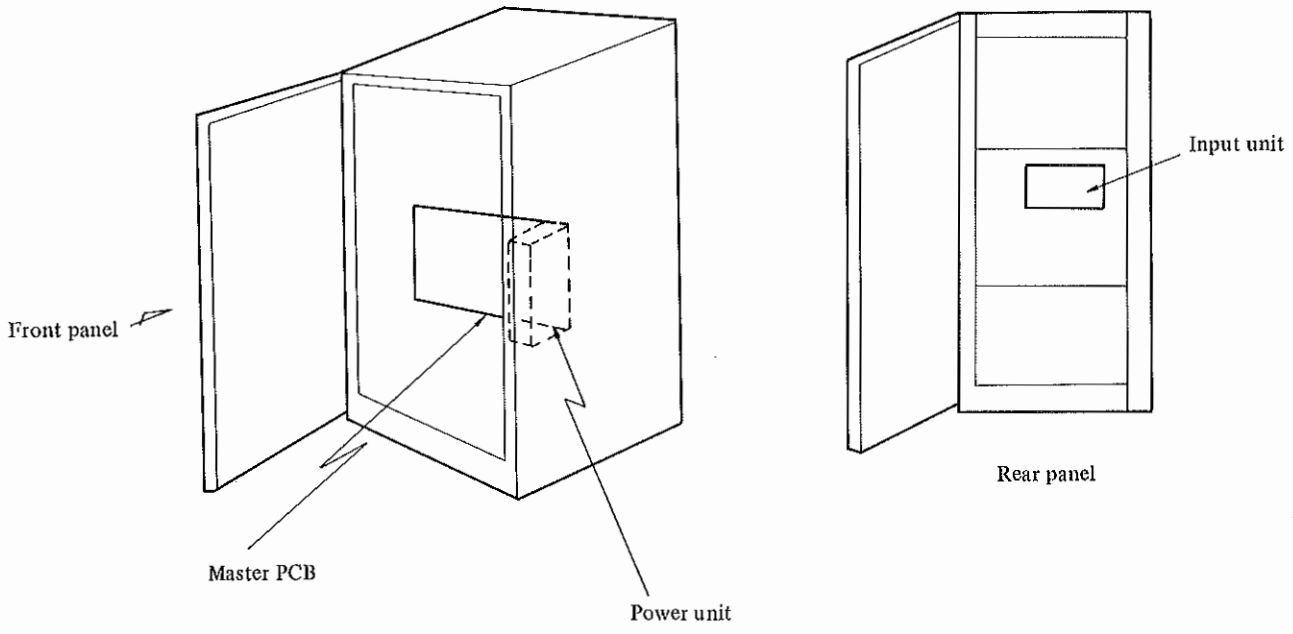


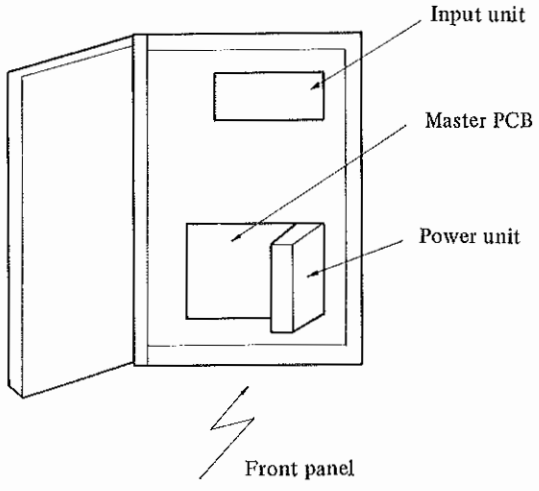
Fig. 3.4.3 (d) Power unit for I/O unit outer view

2) Adjustable points on power unit PCB
   10/100 series A16B-1210-0510
   11/110 series A16B-1210-0560
   12/120 series A20B-1000-0770
   It is not usually necessary to adjust the reference voltage (+10 V). However, if the reference voltage is deviated due to a certain cause, a power alarm may occur.
   The reference voltage can be readjusted by VR11 (A10 ADJ) to +10.00 V while measuring the voltage between A0 - A10 terminals of CP16 using a digital voltmeter.

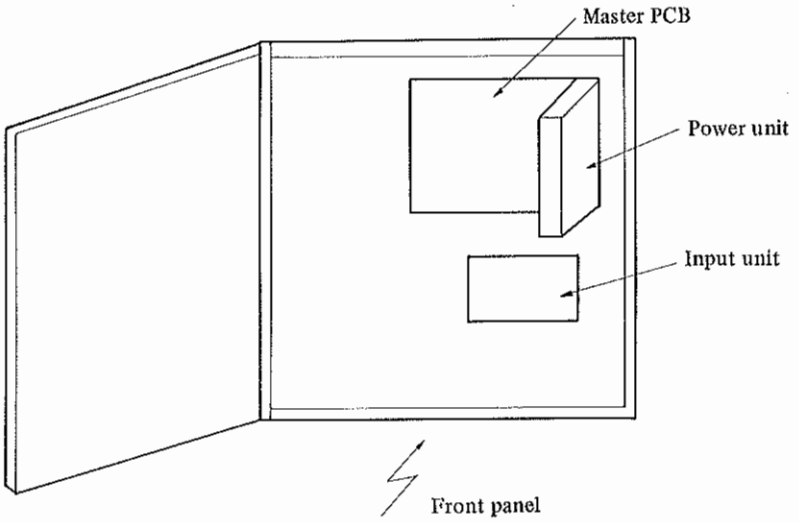
3) Mounting position of the input unit and power unit in each cabinet
   a) 10/11/100/110 series Free-standing type cabinet



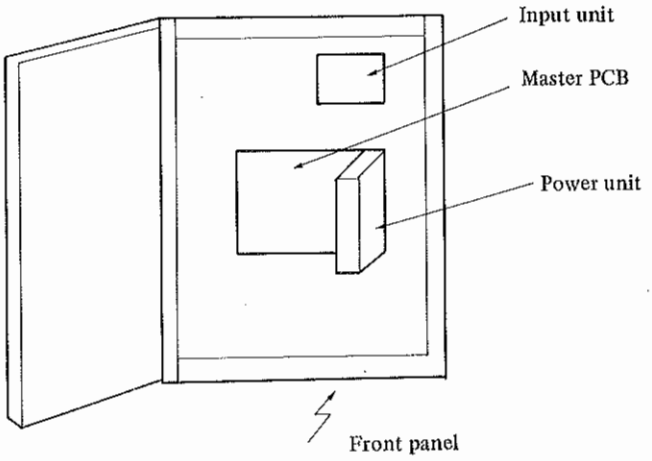
   b) 10/11/100/110 series Built-in type 1 cabinet



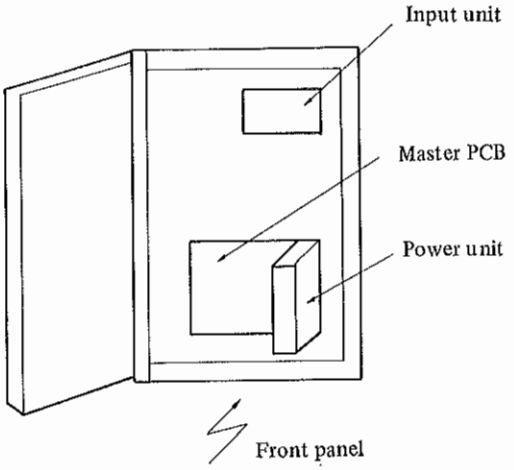
c) 10/11/100/110T Built-in type 2 cabinet



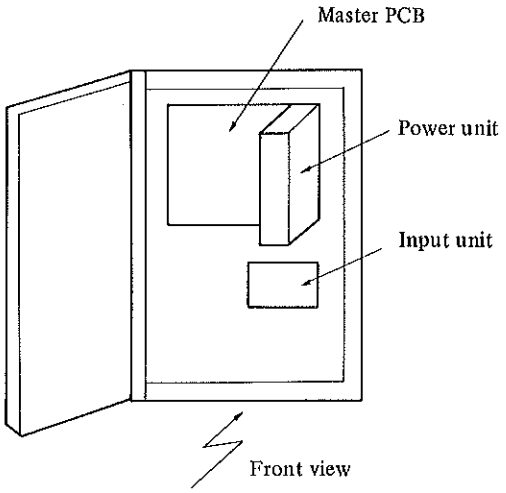
d) 10/11/100/110M Built-in type 2 cabinet



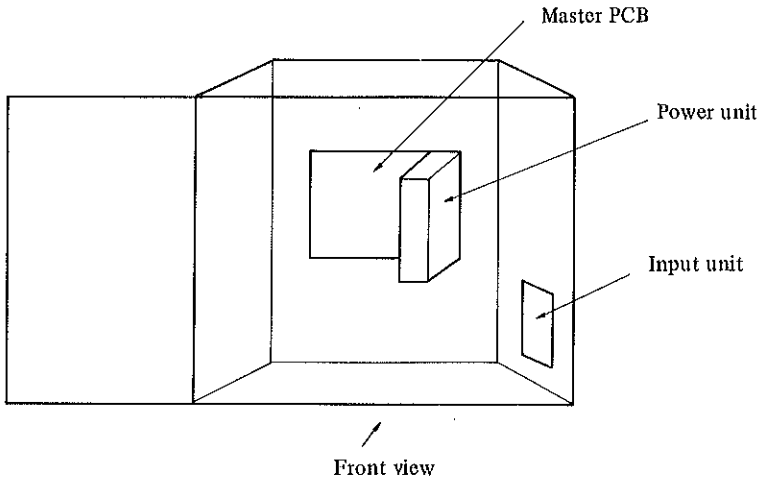
e) 10/11/100/110M Built-in type 2-2 cabinet



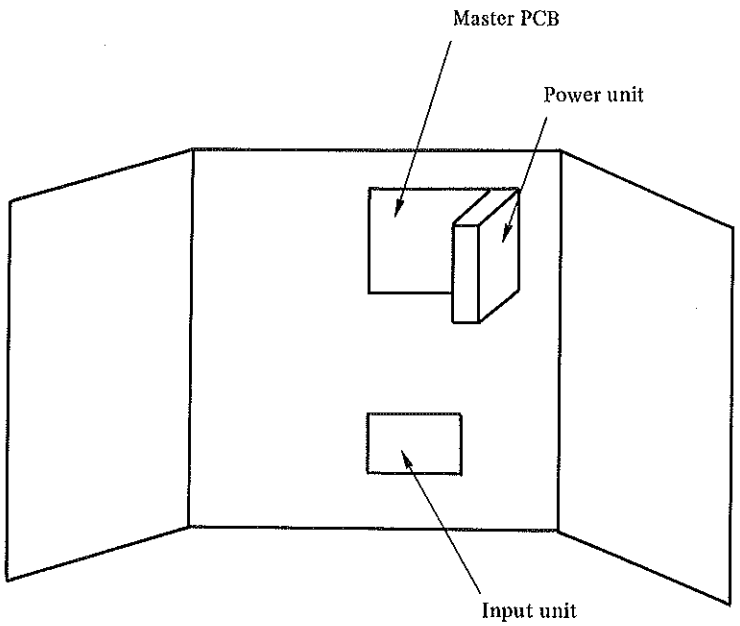
f) 10/11 series Unbundled type cabinet



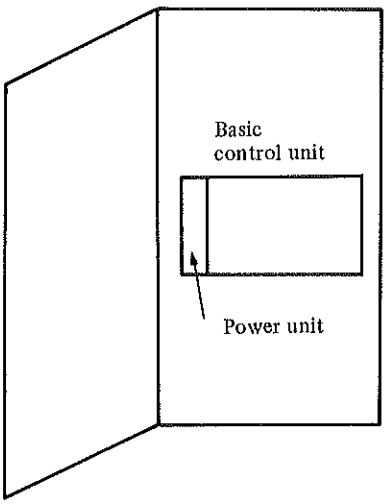
g) 10TF Built-in type 3 cabinet



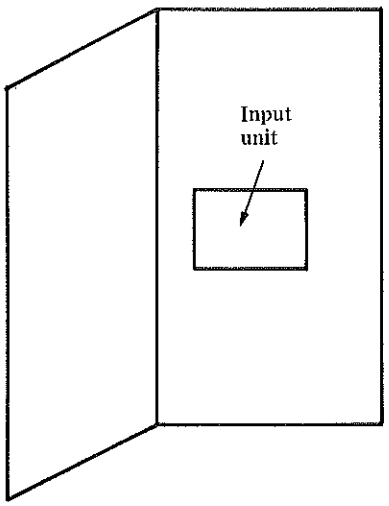
h) 11TT Built-in type 3 cabinet



i) 12/120 series Free-standing type A cabinet

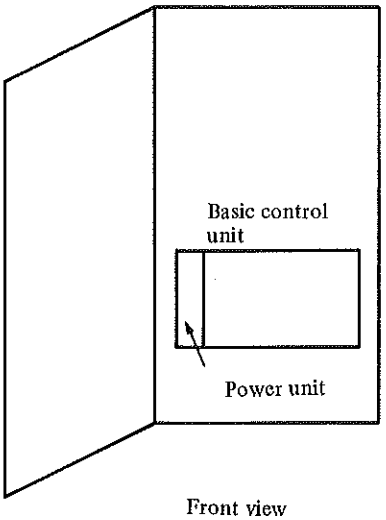


Front view

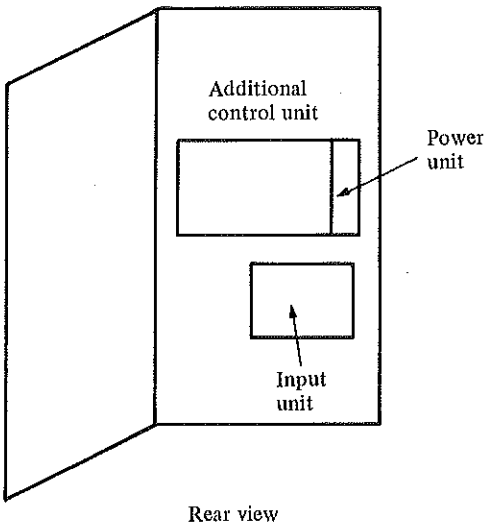


Rear view

j) 12/120 series Free-standing type B cabinet

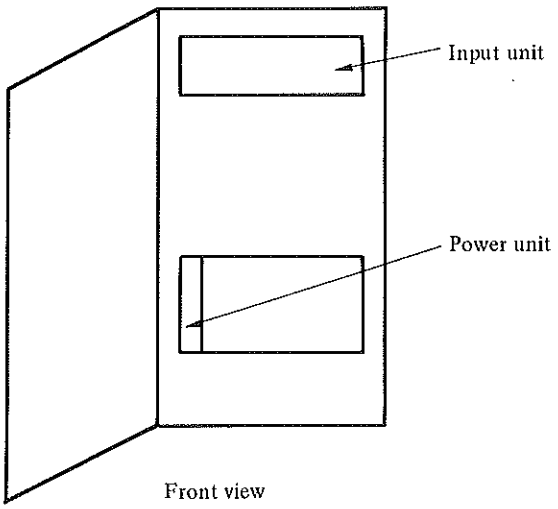


Front view



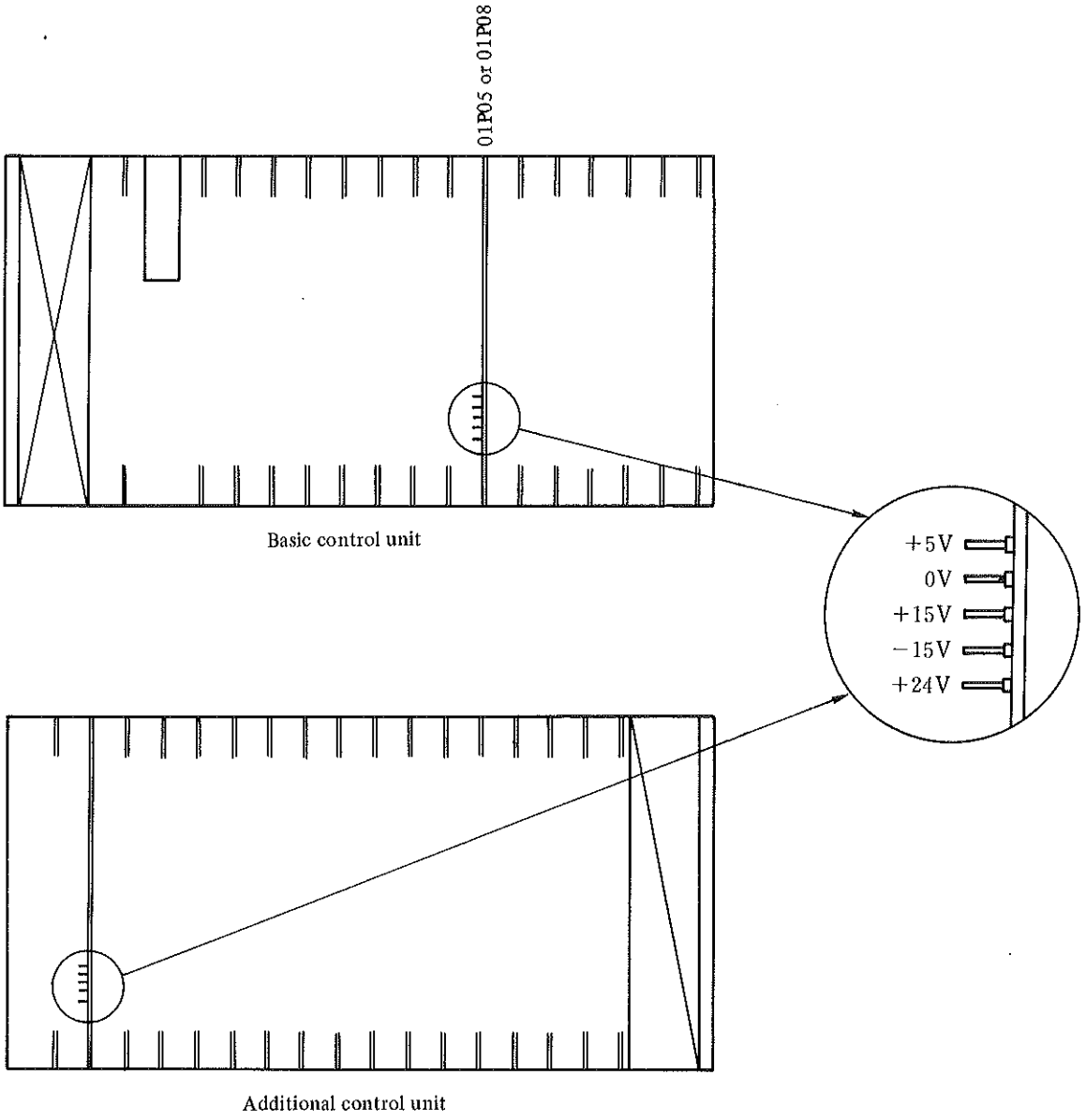
Rear view

k) 12/120 series Built-in type



Front view

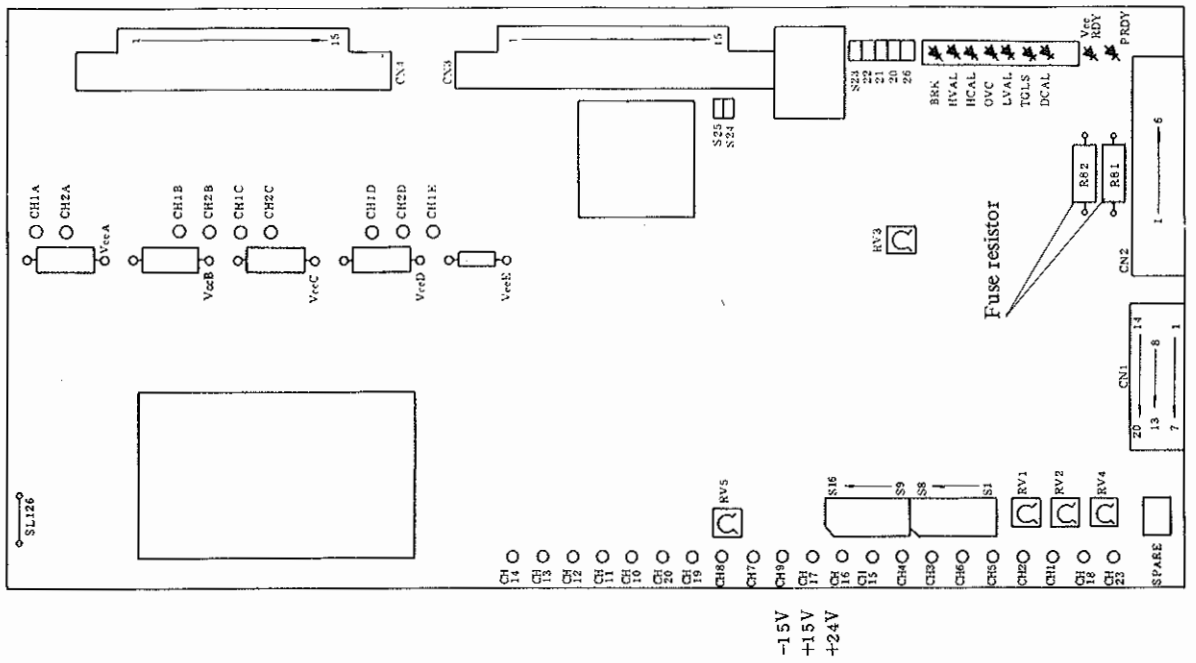
4) 12/120 series power voltage checking position



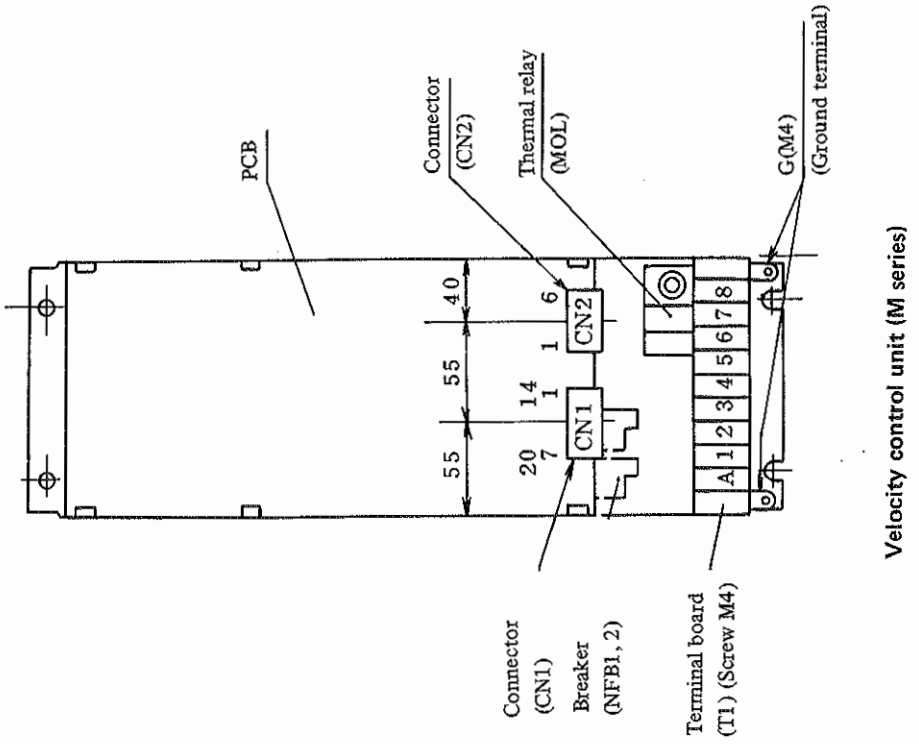
3.4.4 Power voltage check on velocity control unit PCB

1) Check each power output at the check terminals of velocity control unit PCB for each axis.
   - o CH15 ..... +24 V (+23 ∿ +27 V)
   - o CH16 ..... +15 V (+14.55 ∿ +15.45 V)
   - o CH17 ..... -15 V (-14.55 ∿ -15.45 V)

2) Check 100 VAC power supply at T1 screw terminals No. 3 and 4 for each axis. If the emergency stop button of the operator's panel or the emergency stop circuit of the machine tool side is functioning, the 100 V is turned off. In such a case, the emergency stop button or emergency stop circuit must be reset in advance.



Velocity control unit PCB (M series)
A20B-0009-0320

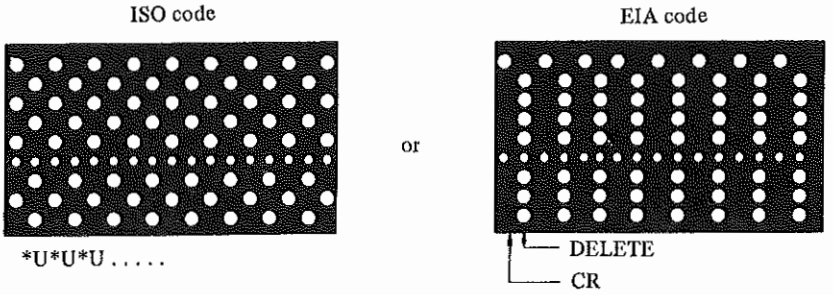


Velocity control unit (M series)

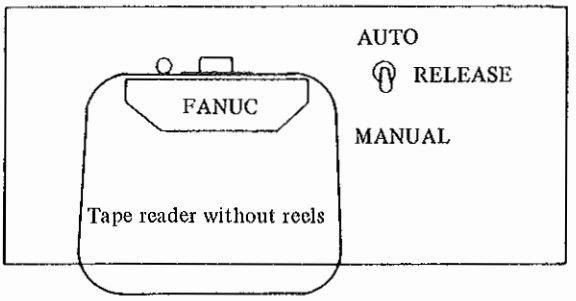
3.5 Tape Reader Photo-amplifier Adjustment

3.5.1 Tape reader without reels photo-amplifier adjustment

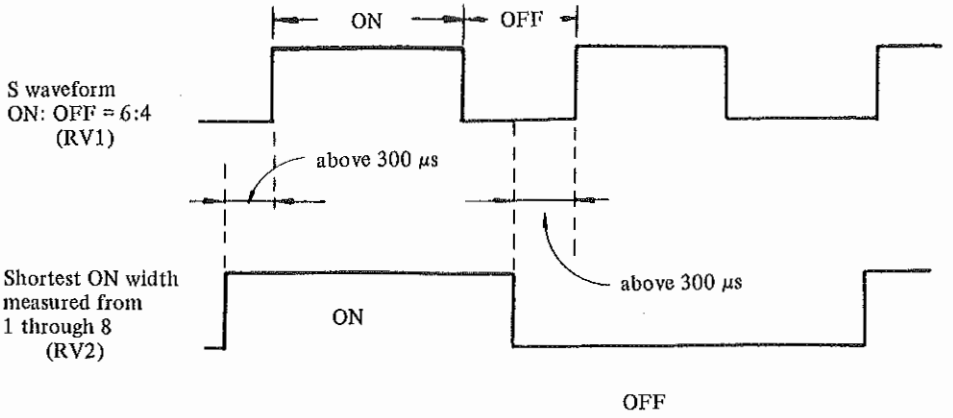
1) With paper tape, make a test tape (approx. 40 cm) as illustrated below that alternates punching and non-punching and connect ends to form an endless loop of tape. (See Note 2, Note 3.)



2) Mount the test tape in the tape reader and turn the switch to MANUAL to read the tape.

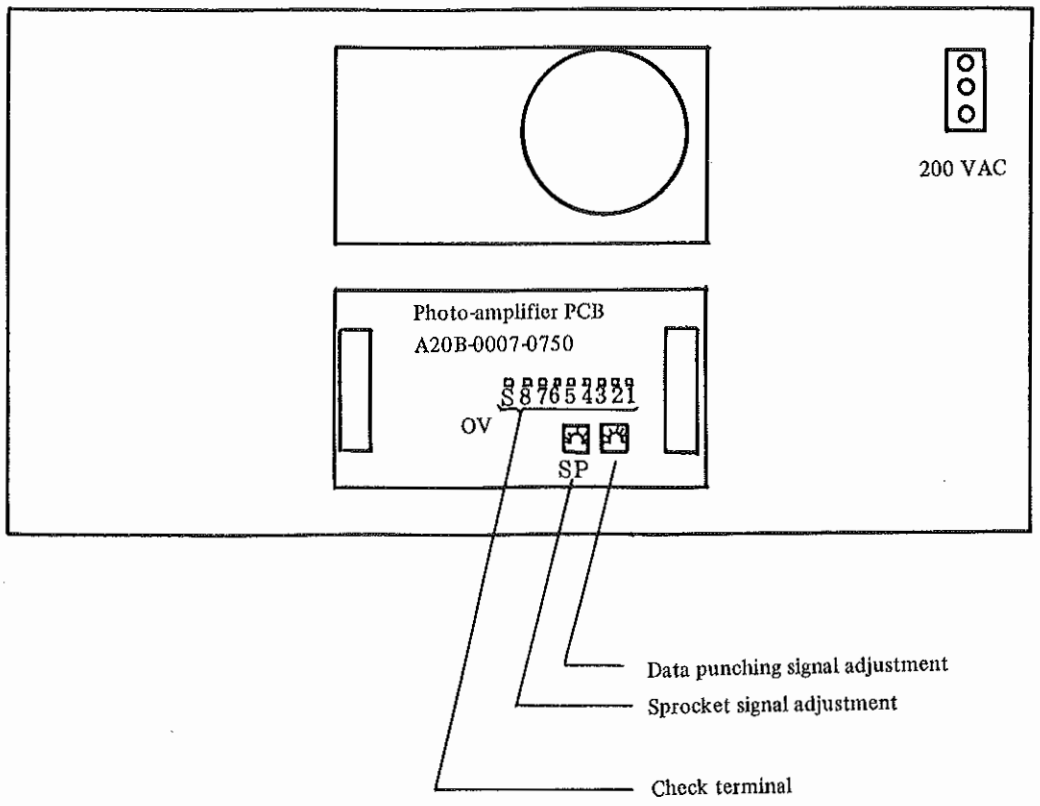


3) With an oscilloscope, measure the waveform between check terminals S and OV (ground) on the photo-amplifier. Adjust it with RV1 so that the ON/OFF timing ratio is 6:4.
4) Measure the waveforms at check terminals 1 through 8 on the photo-amplifier using an oscilloscope. Find the channel where the ON width is the shortest. (Use the terminal OV for grounding.)
5) Measure the waveform where the ON time width is the shortest among 1 through 8 and compare it with the waveform of S. Adjust with RV2 so that the timing indicated in the diagram below is obtained.
6) Confirm that waveforms 1 through 8 satisfy the timing in the diagram below.



Ajusting position of tape reader without reels photo amplifier

For the tape reader without reel (A13B-0070-B001)



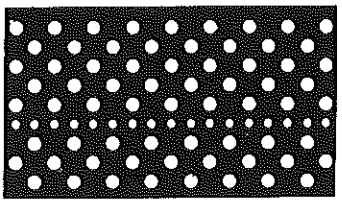
(Note 1) Use paper tape that conforms to the following standard:
Paper tape for data exchange JIS C6243-1970.
Position and size of paper tape punch for data exchange JIS C6246-1971.

(Note 2) A read error will occur if another tape is used after the tape reader was adjusted with black tape.
When performing an output waveform adjustment of the photo amplifier, use a paper tape color of blue, white, pink, yellow, orange, etc. (other than black or gray) to perform the adjustment. The use of a tape, colored blue, white, pink, etc. with a tape reader adjusted with a black or gray colored tape may sometimes cause a read error. For the case where black colored tape is normally used, a black tape may be used for adjustment.

3.5.2 Tape reader with reels photo-amplifier adjustment

1) Prepare about 40 cm of the following test tape (see Notes 2, 3 on the previous page) which alternately repeats punching and unpunching, and splice both ends to make an endless tape.

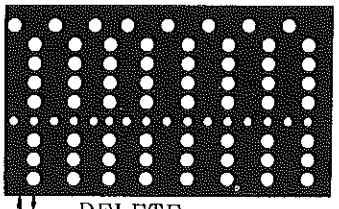
In case of ISO code



*U*U*U*U ·····

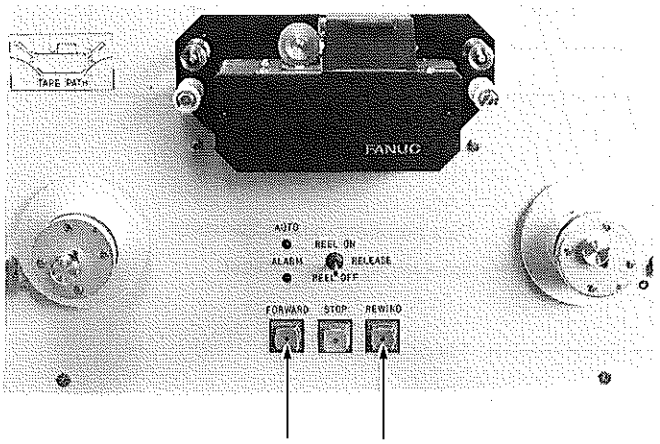
or

In case of EIA code (see Note 4)

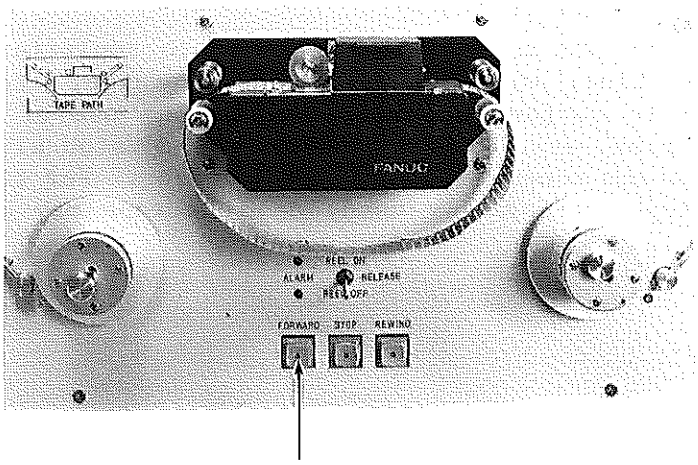


Adjust the photoamplifier by using the built-in adjusting program of the tape reader with reels.

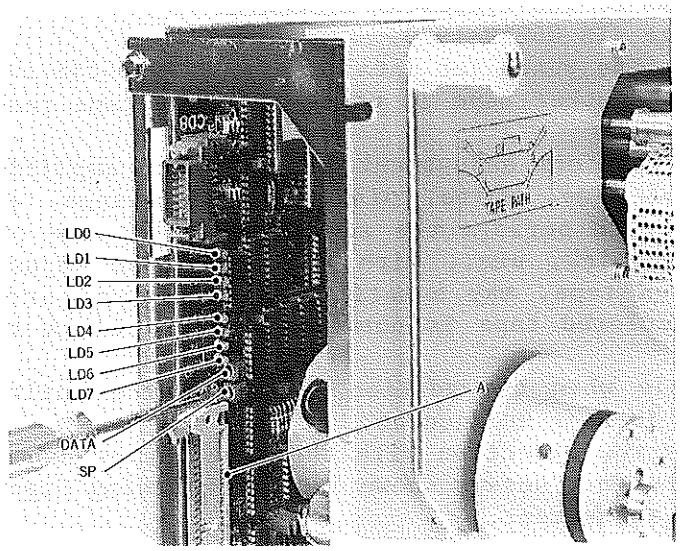
2) Start the adjusting program



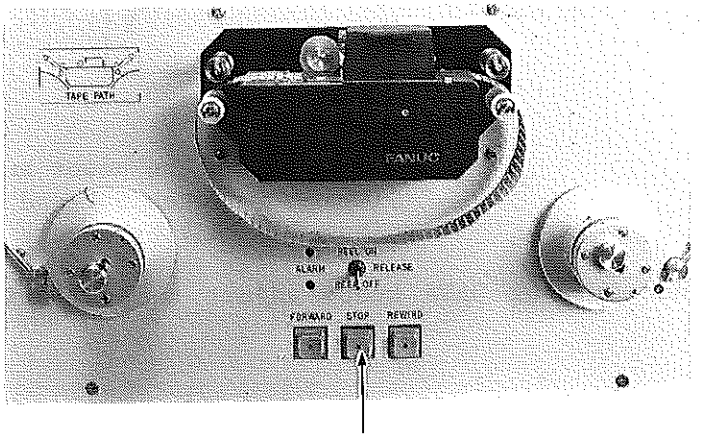
a) Press FORWARD and REWIND switches at the same time while in the RELEASE condition.
b) AUTO and ALARM LED flicker.
c) The adjusting program mode has now been set.



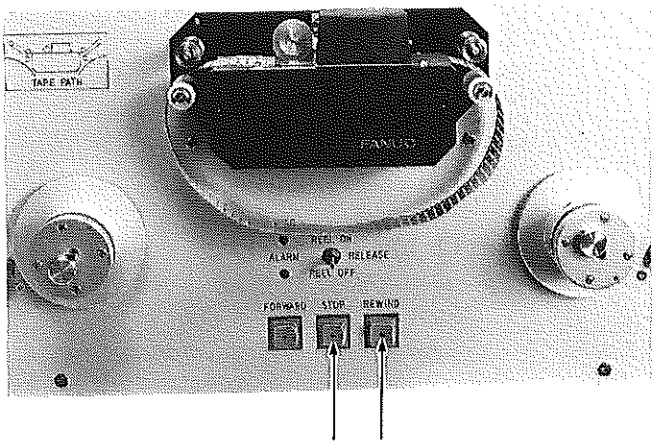
d) Load the test tape. (See Note 3.)
e) Set REEL OFF.
f) Press FORWARD switch.
g) The tape starts moving.



3) Adjustment
   a) The adjusting position is mounted on the right side as viewed from the rear face of the tape reader with reels. If it is not mounted at the position shown in the left figure, (it is mounted at "A". See Note 4.)
   b) Turn SP knob until LD5 lights.
   c) Turn DATA knob until LD1 flickers. (See Note 5.) This adjustment cannot be made unless LD5 lights.



4) Adjustment end
   a) Press STOP switch.



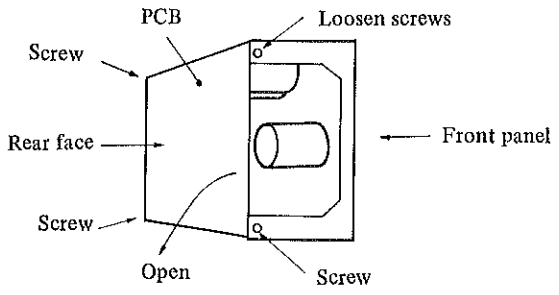
   b) Set RELEASE.
   c) Press FORWARD and STOP switches at the same time.
   d) Normal mode has been set.
   e) Operate the tape reader with the signal cable normally connected.

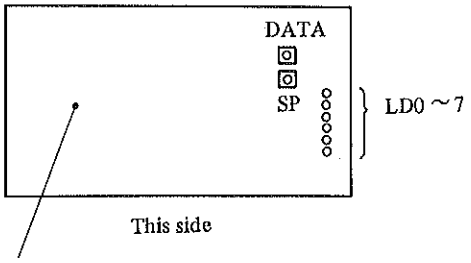
(Note 1) Use paper tape that conforms to the following standard:
Paper tape for data exchange JIS C6243-1970.
Position and size of paper tape punch for data exchange JIS C6246-1971.

(Note 2) A read error will occur if another tape is used after the tape reader was adjusted with a black tape.
When performing an output waveform adjustment of the photo amplifier, use a paper tape color of blue, white, pink, yellow, orange, etc. (other than black or gray), to perform the adjustment. The use of a tape, colored blue, white, pink, etc., with a tape reader adjusted with black and gray colored tape, may sometimes cause a read error. For the case where black colored tape is normally used, a black tape may be used for adjustment.

(Note 3) EIA test tape is applicable when the edition number of the built-in program of the tape reader is B or subsequent.

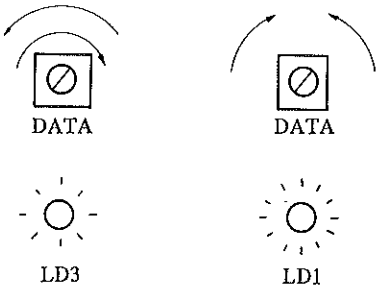
(Note 4) The PCB is opened in the arrow direction with the lower screw used as the fulcrum by loosening the four screws shown in the following figure. Tighten these screws after adjustment.





Never touch the power supply (which produces 5 V and 24 V from 200 VAC) by hand.

(Note 5) If LD0 and LD3 flicker when turning DATA knob, adjust the following knobs.



1) LD3 is flickering.
2) Turn the knob toward the midpoint until LD1 flickers.

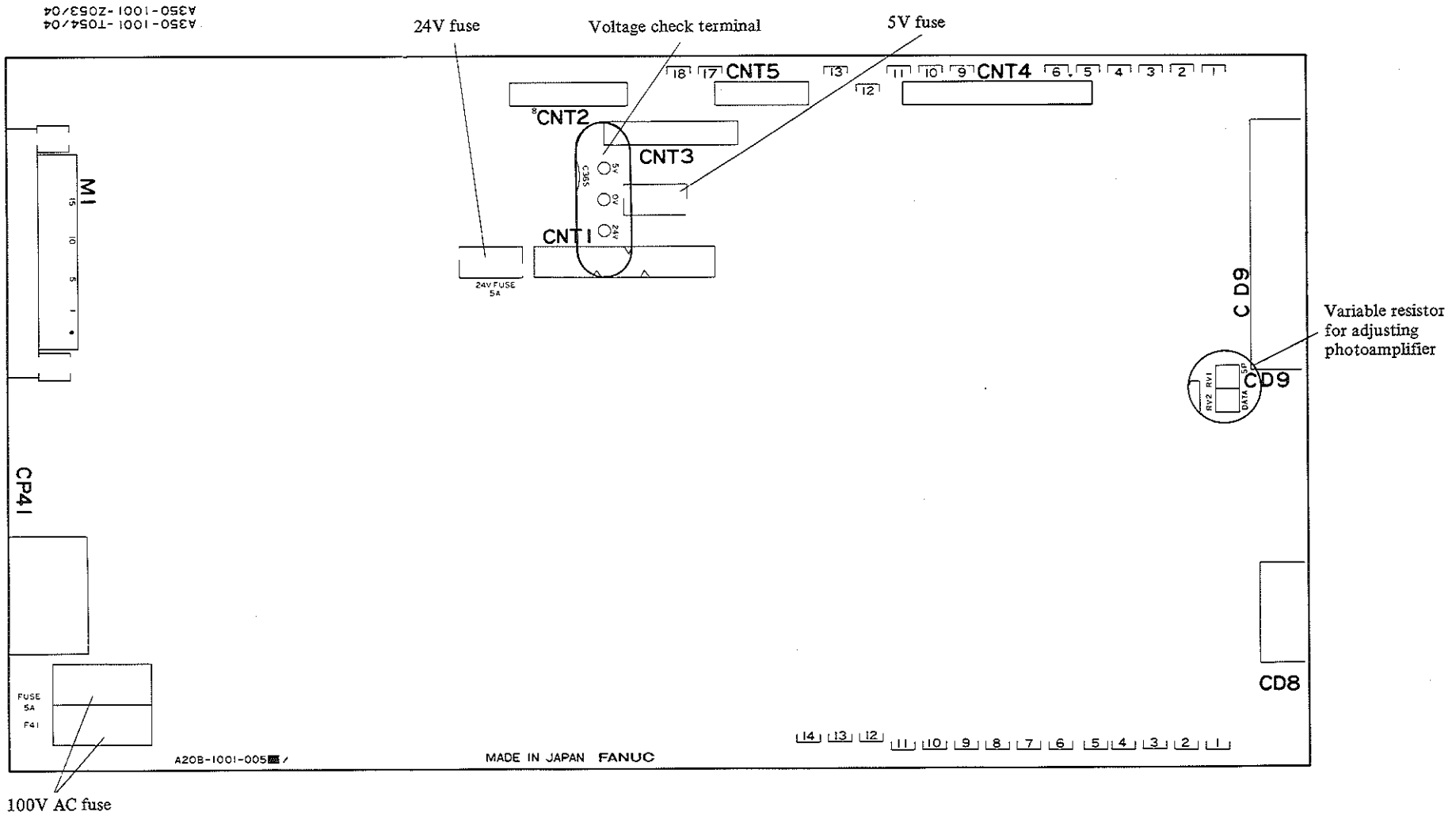


Fig. 3.5.1 (a) Adjusting points on the tape reader with reels PCB

3.6 Connection Diagram of NC Inside

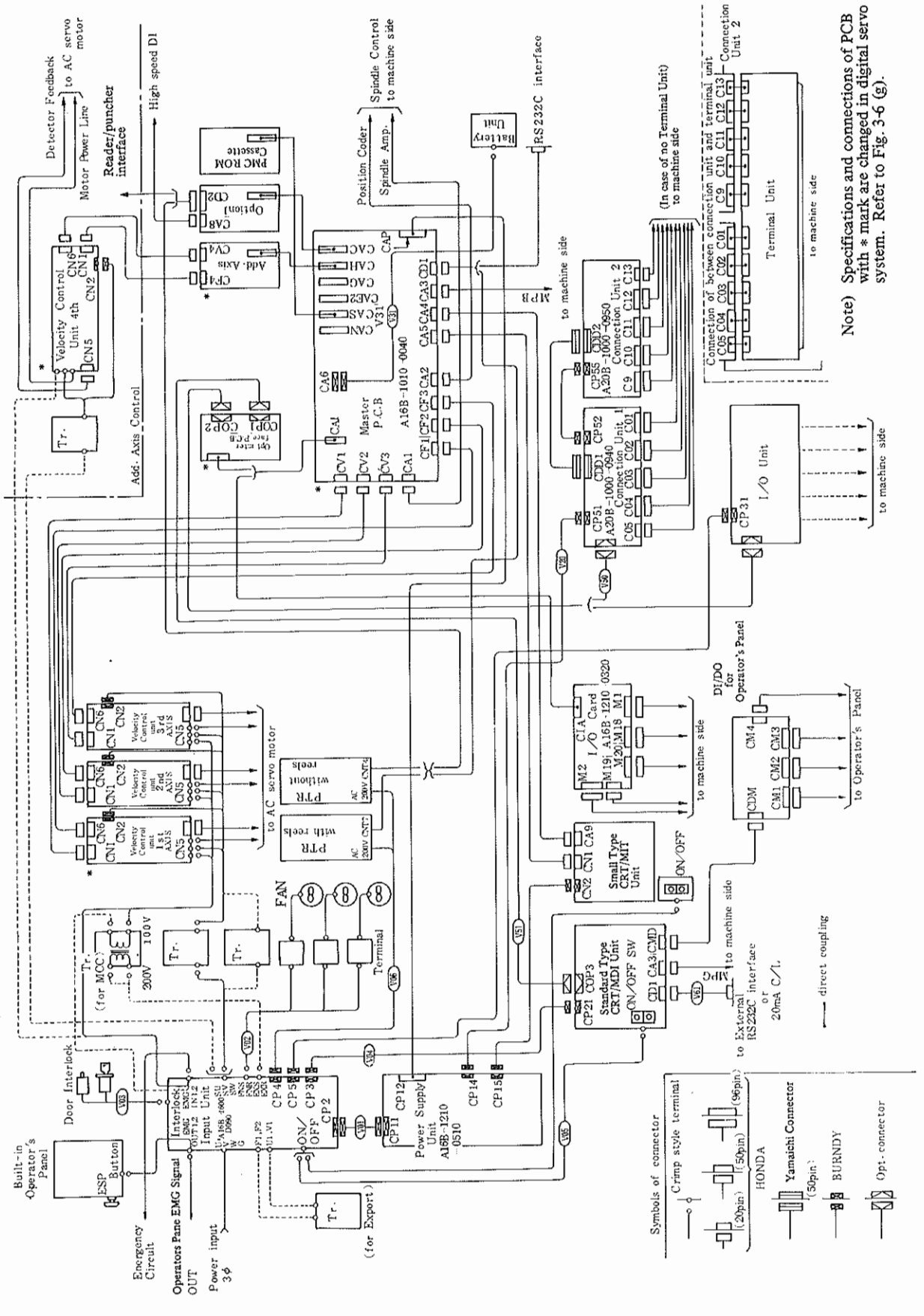
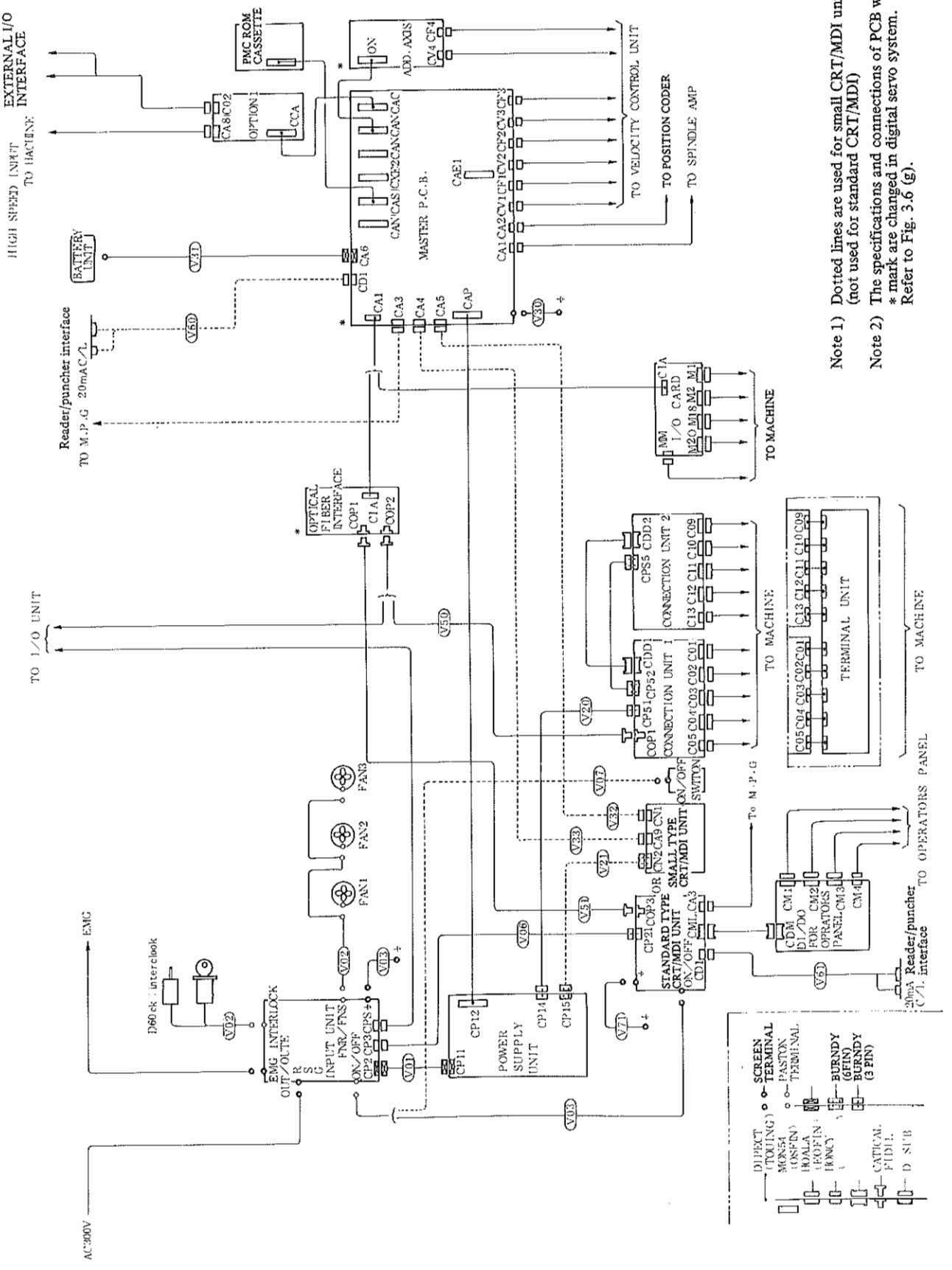


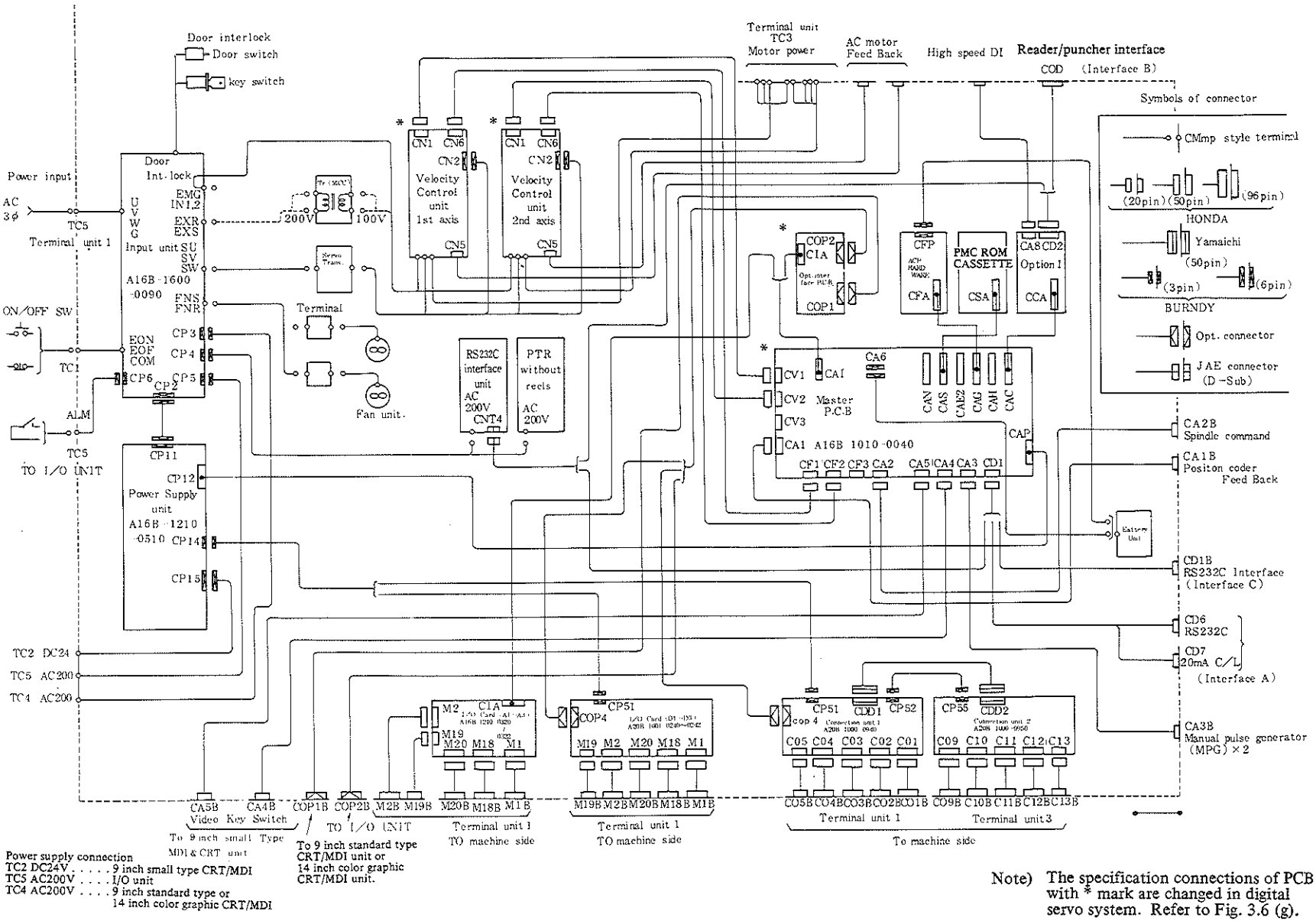
Fig. 3.6 (a) Connecting diagram inside 10/100 series free-standing type cabinet



Note 1) Dotted lines are used for small CRT/MDI unit (not used for standard CRT/MDI)

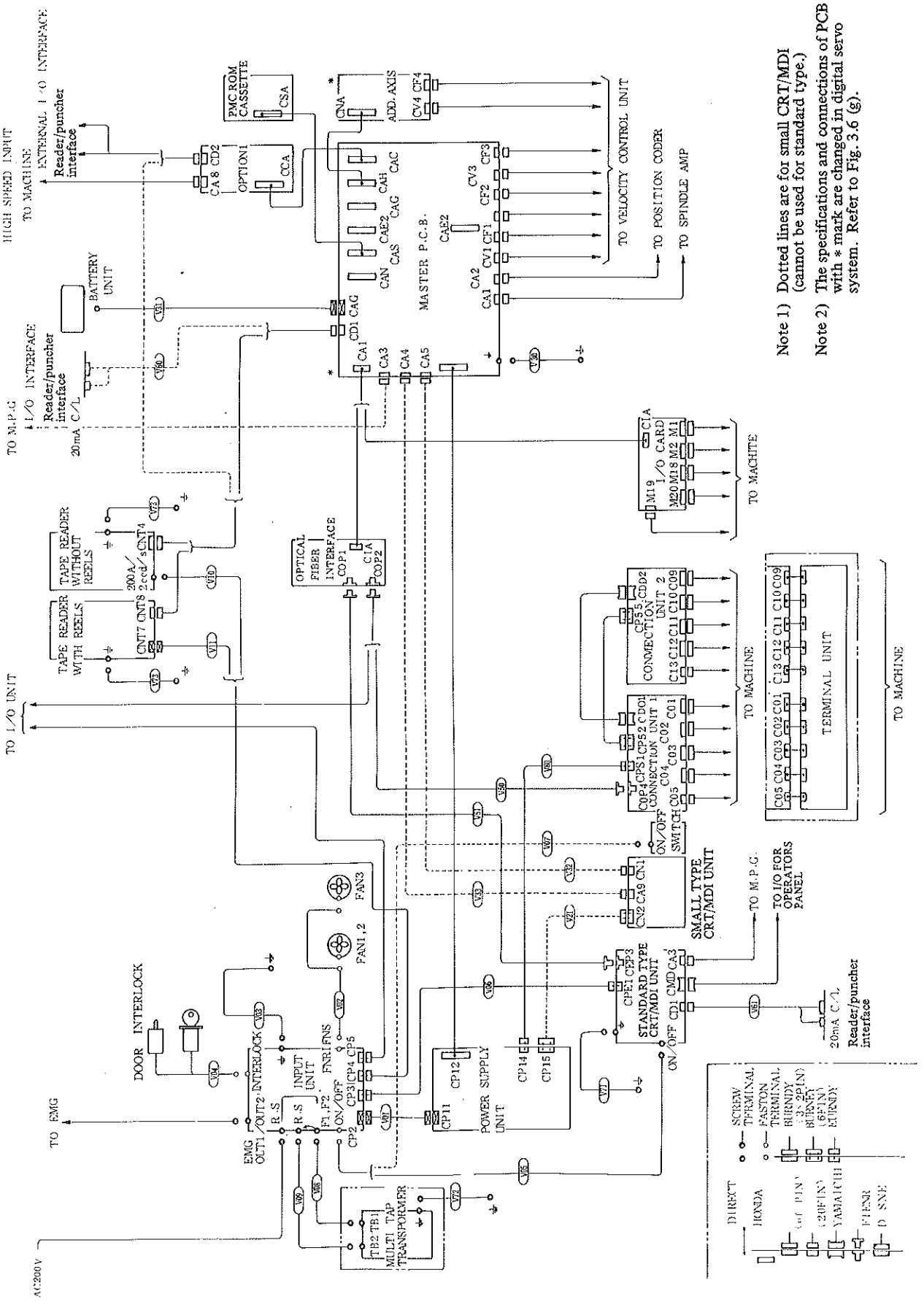
Note 2) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (g).

Fig. 3.6 (b) Connecting diagram inside 10/100 series built-in type 1 cabinet



Note) The specification connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (g).

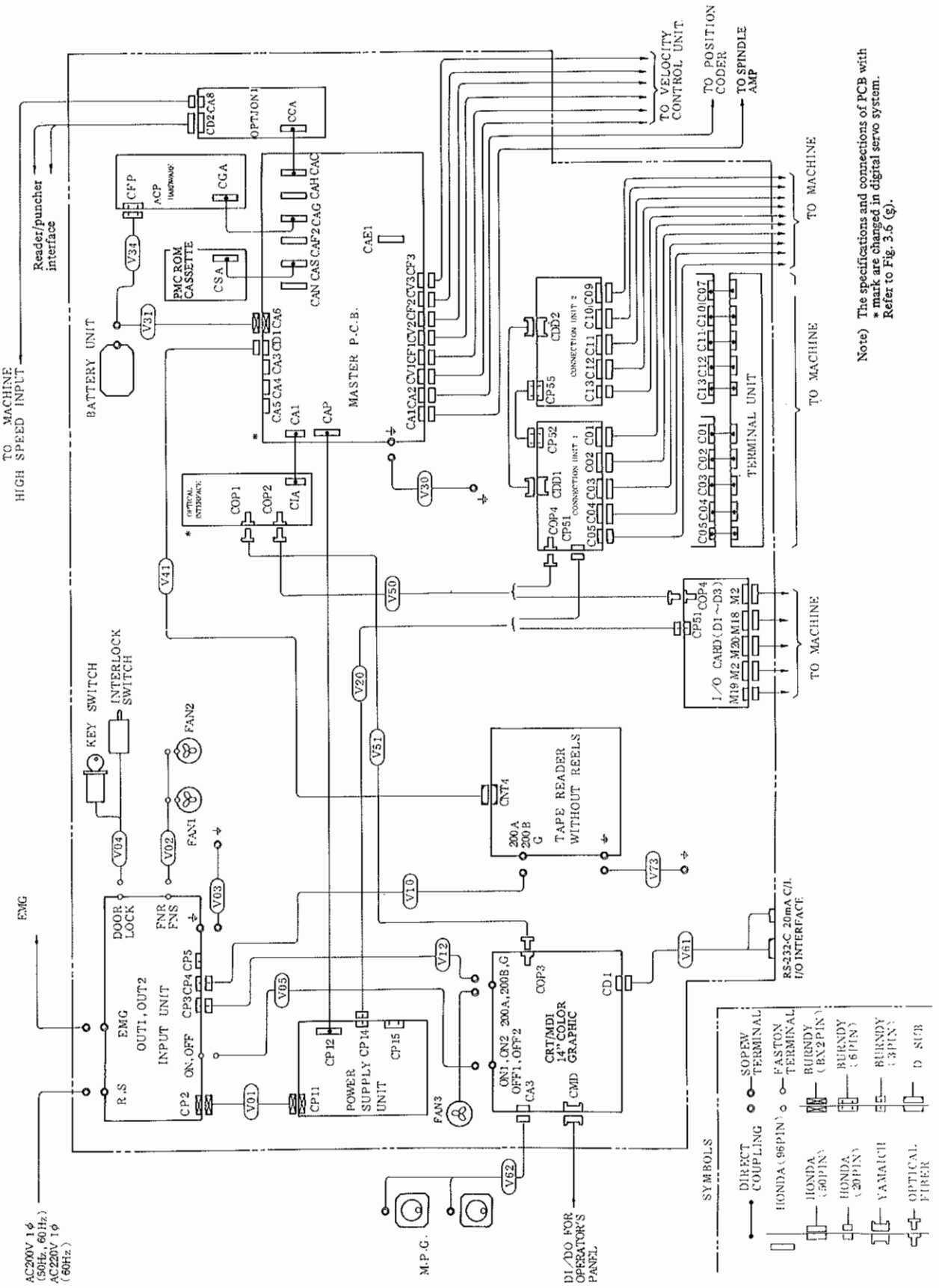
Fig. 3.6 (c) Connecting diagram inside 10T/100T built-in type 2 cabinet



Note 1) Dotted lines are for small CRT/MDI (cannot be used for standard type.)

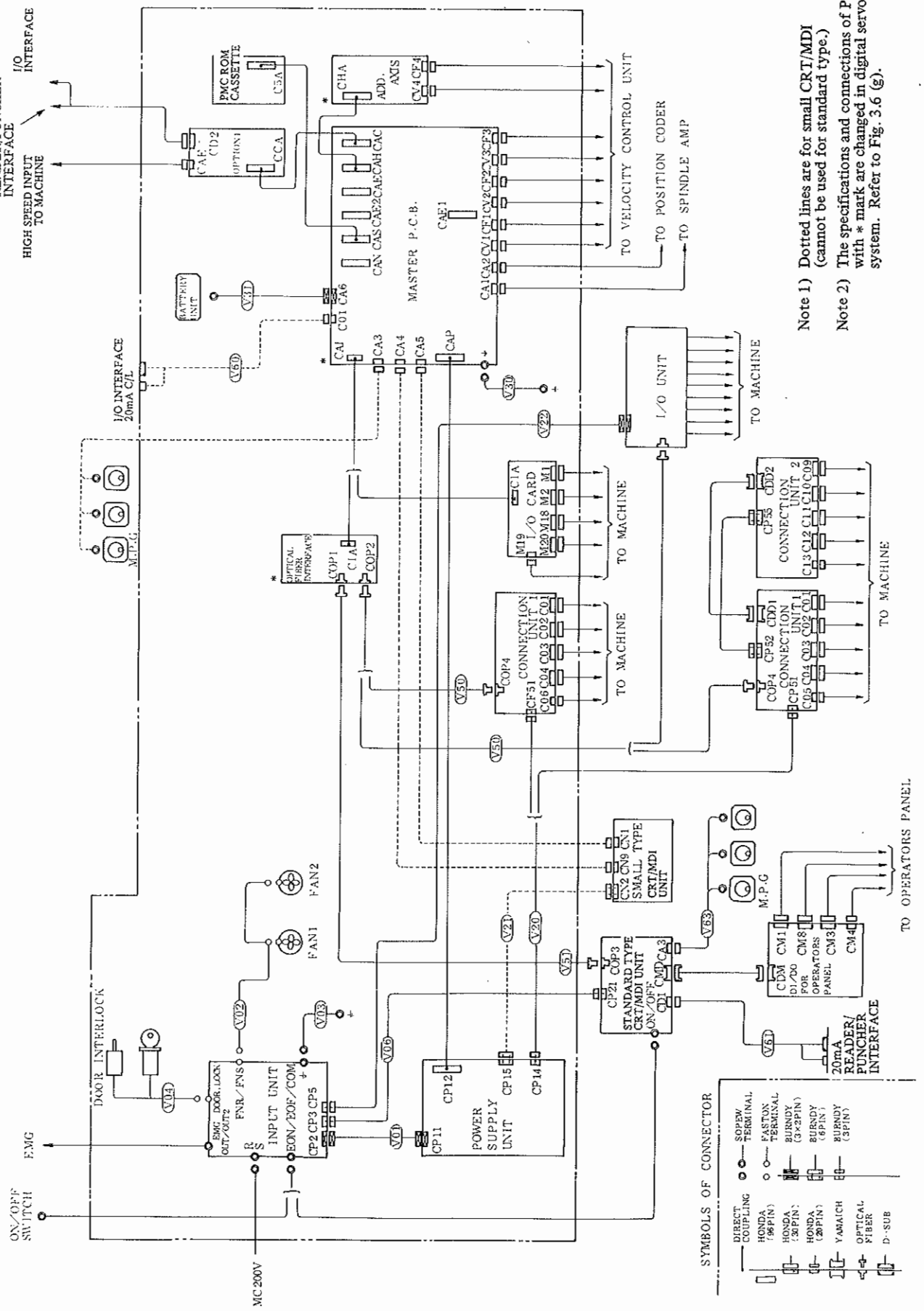
Note 2) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (g).

Fig. 3.6 (d) Connecting diagram inside 10M/100M built-in type 2 and 10M/100M built-in type 2-2 cabinet



Note) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (g).

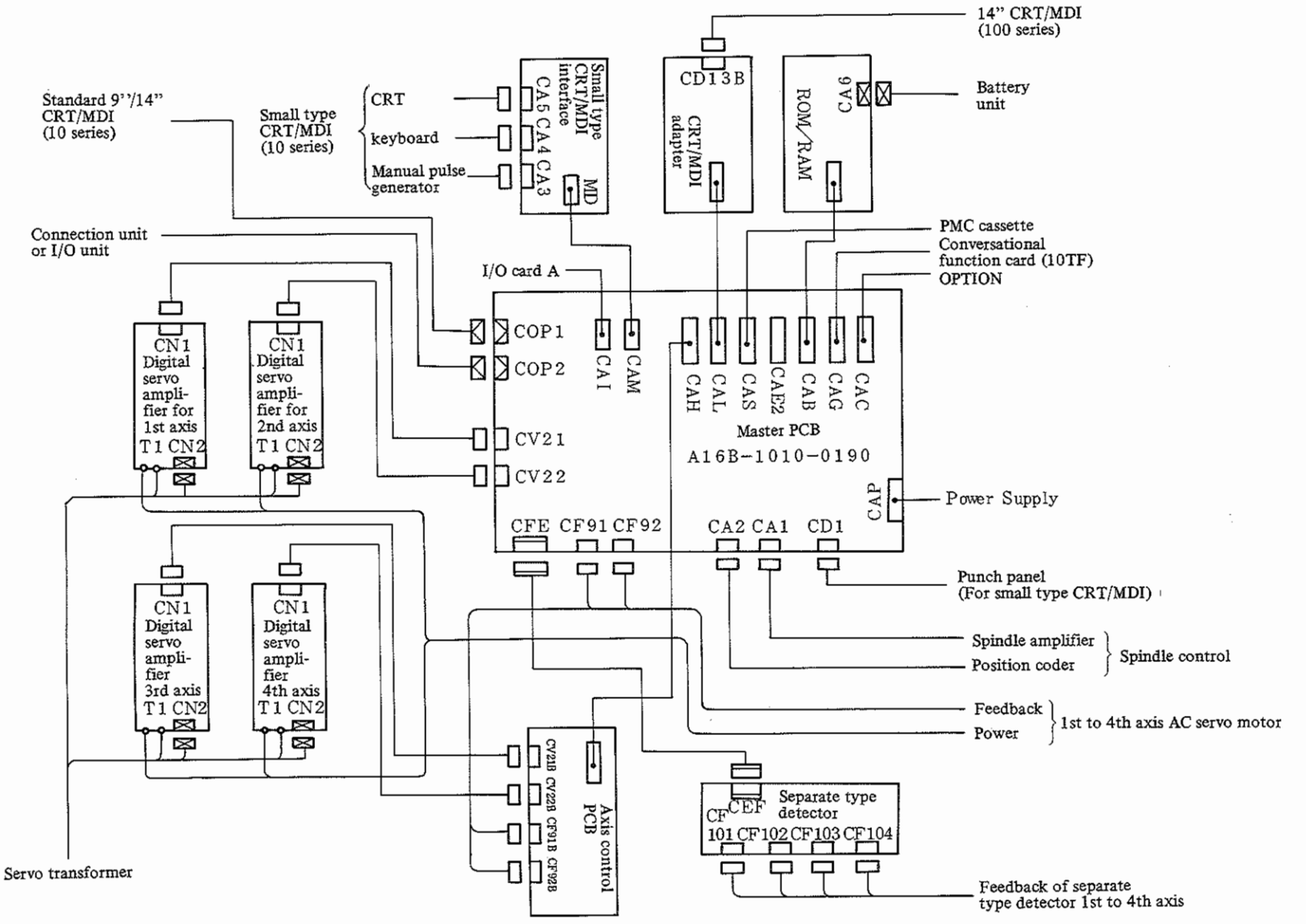
Fig. 3.6 (e) Connecting diagram inside 10TF built-in type 3 cabinet



Note 1) Dotted lines are for small CRT/MDI (cannot be used for standard type.)

Note 2) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (g).

Fig. 3.6 (f) Connecting diagram inside 10 series unbundled type cabinet



Note) Other specifications and connections than above mentioned are same as in analog servo system

Fig. 3.6 (g) Digital servo 10/100 series

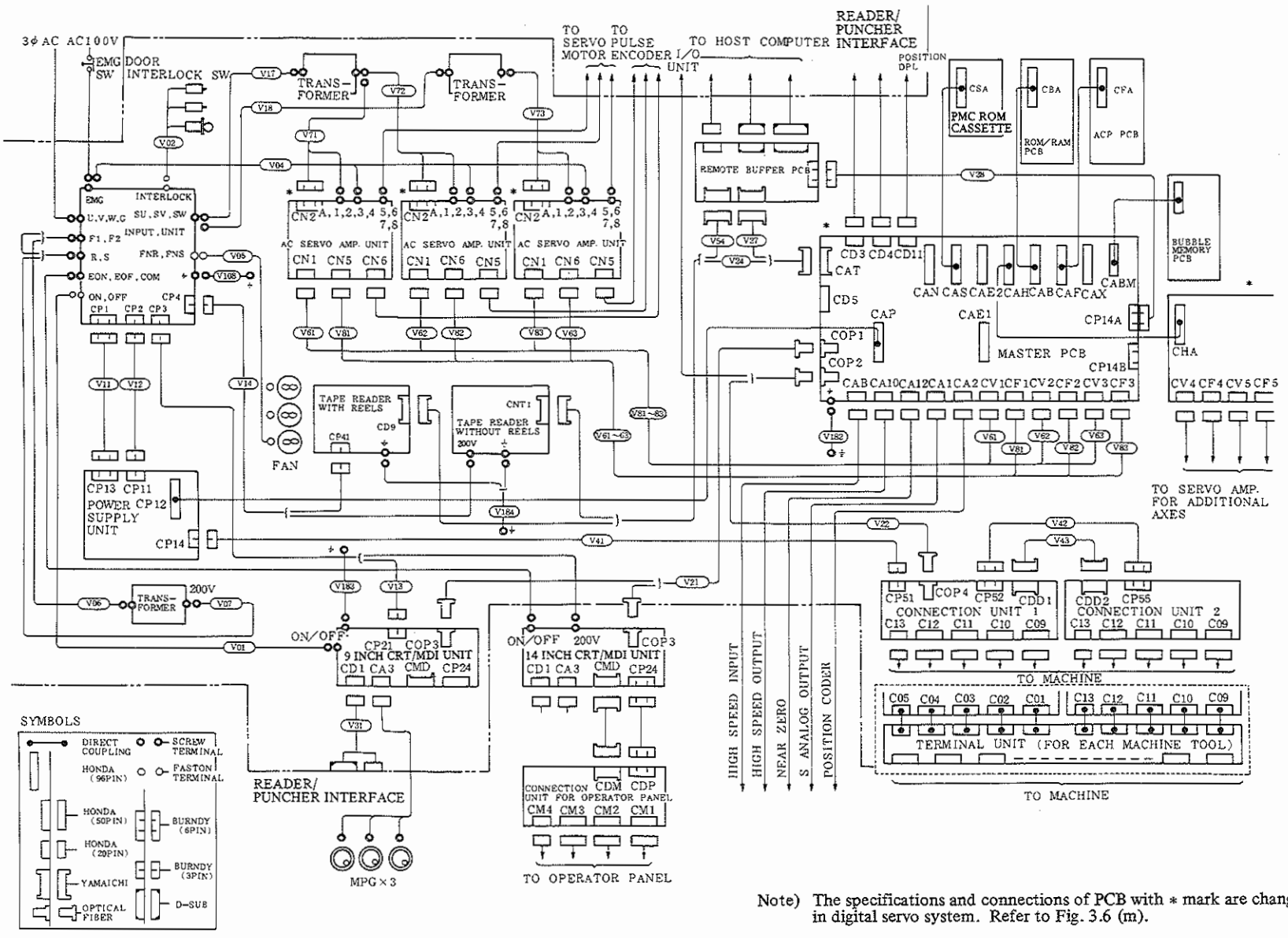


Fig. 3.6 (h) Connecting diagram inside 11/110 series free standing type cabinet

Note) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (m).

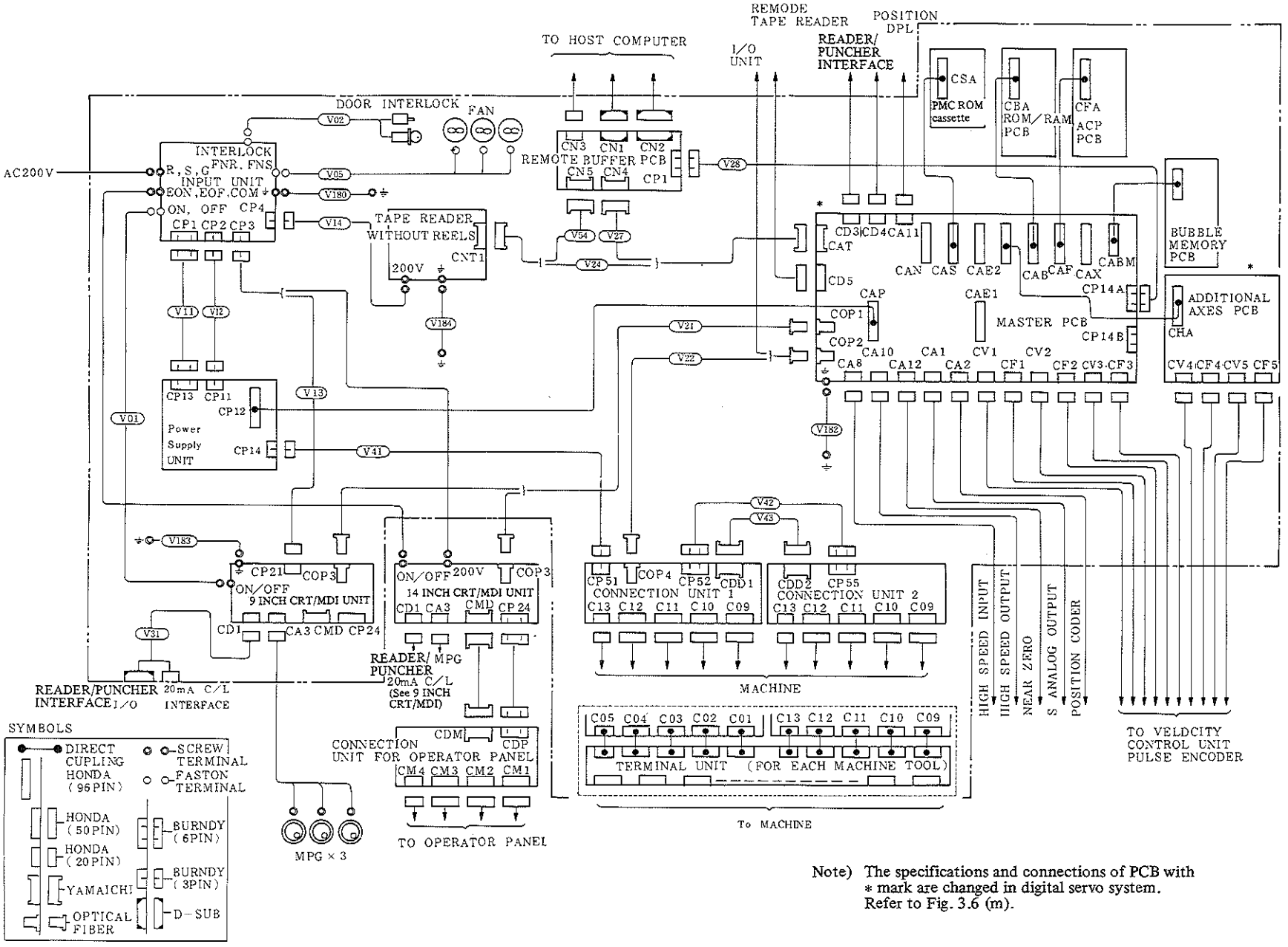


Fig. 3.6 (i) Connecting diagram inside 11/110M built-in type 1 cabinet

Note) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (m).

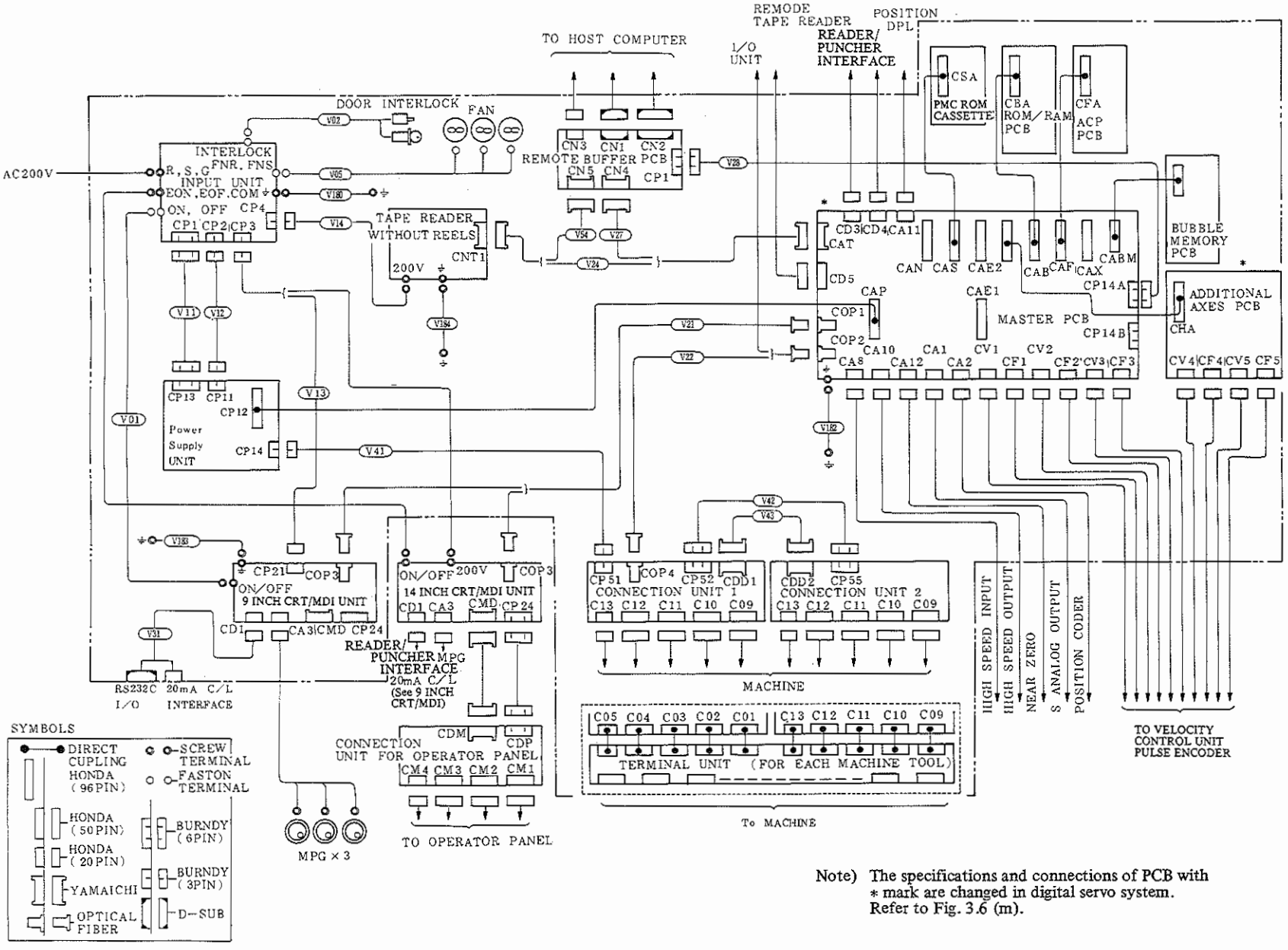


Fig. 3.6 (i) Connecting diagram inside 11T built-in type 1 cabinet

Note) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (m).

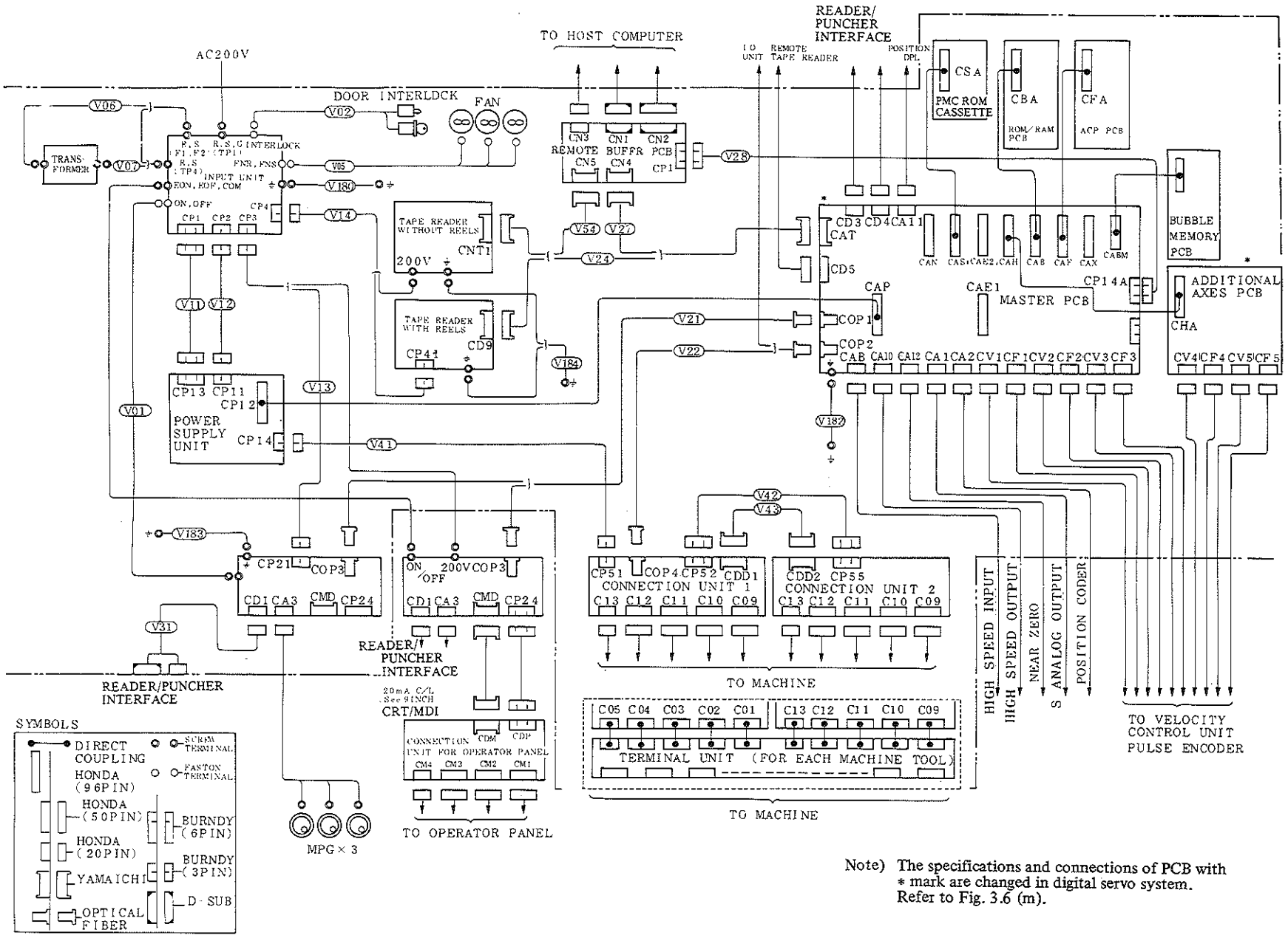
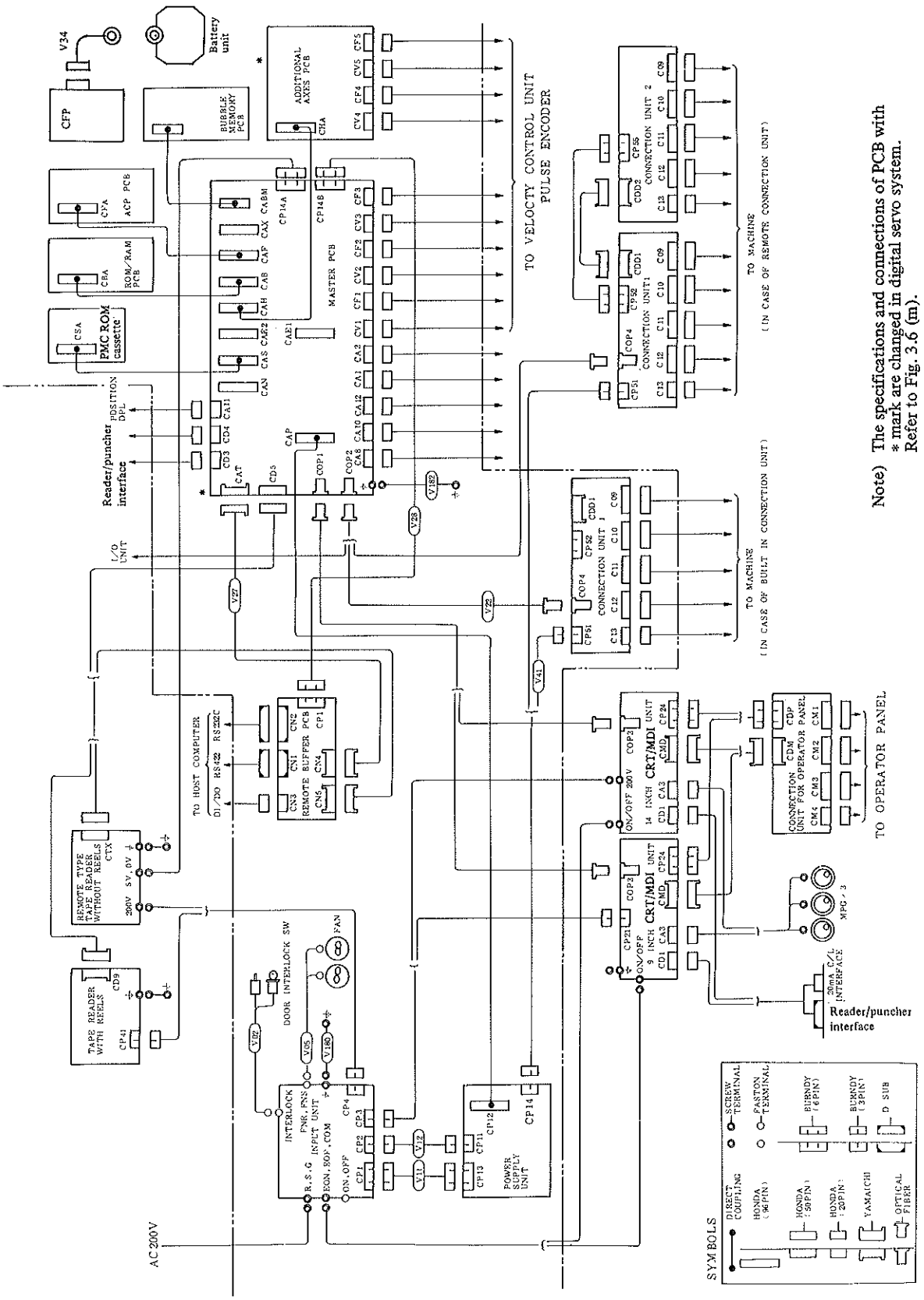


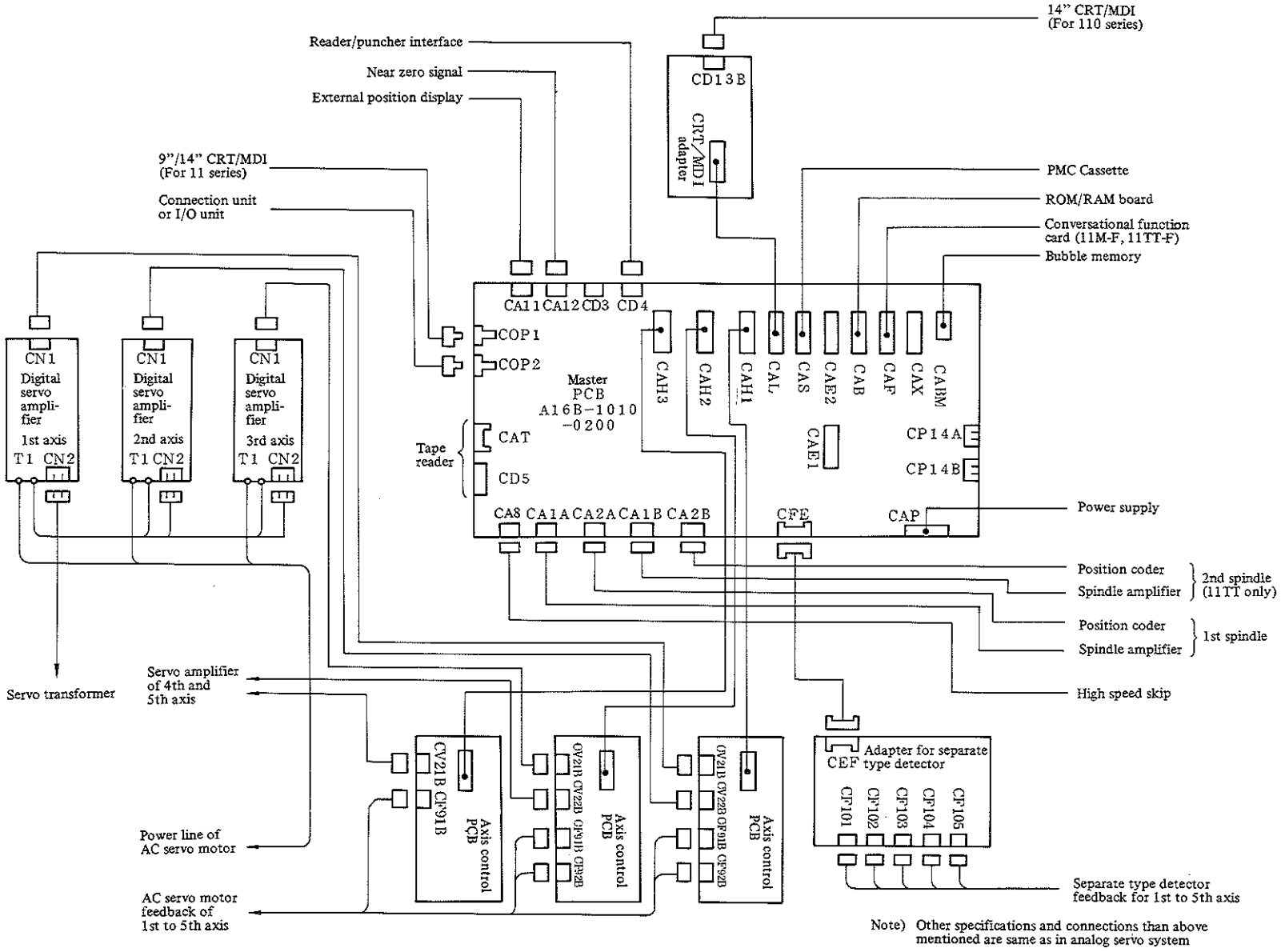
Fig. 3.6 (k) Connecting diagram inside 11/110M built-in type 2 cabinet

Note) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (m).



Note) The specifications and connections of PCB with * mark are changed in digital servo system. Refer to Fig. 3.6 (m).

Fig. 3.6 (l) Connecting diagram inside 11/110 series unbundled type cabinet



Note) Other specifications and connections than above mentioned are same as in analog servo system

Fig. 3.6 (m) Digital servo 11/110 series

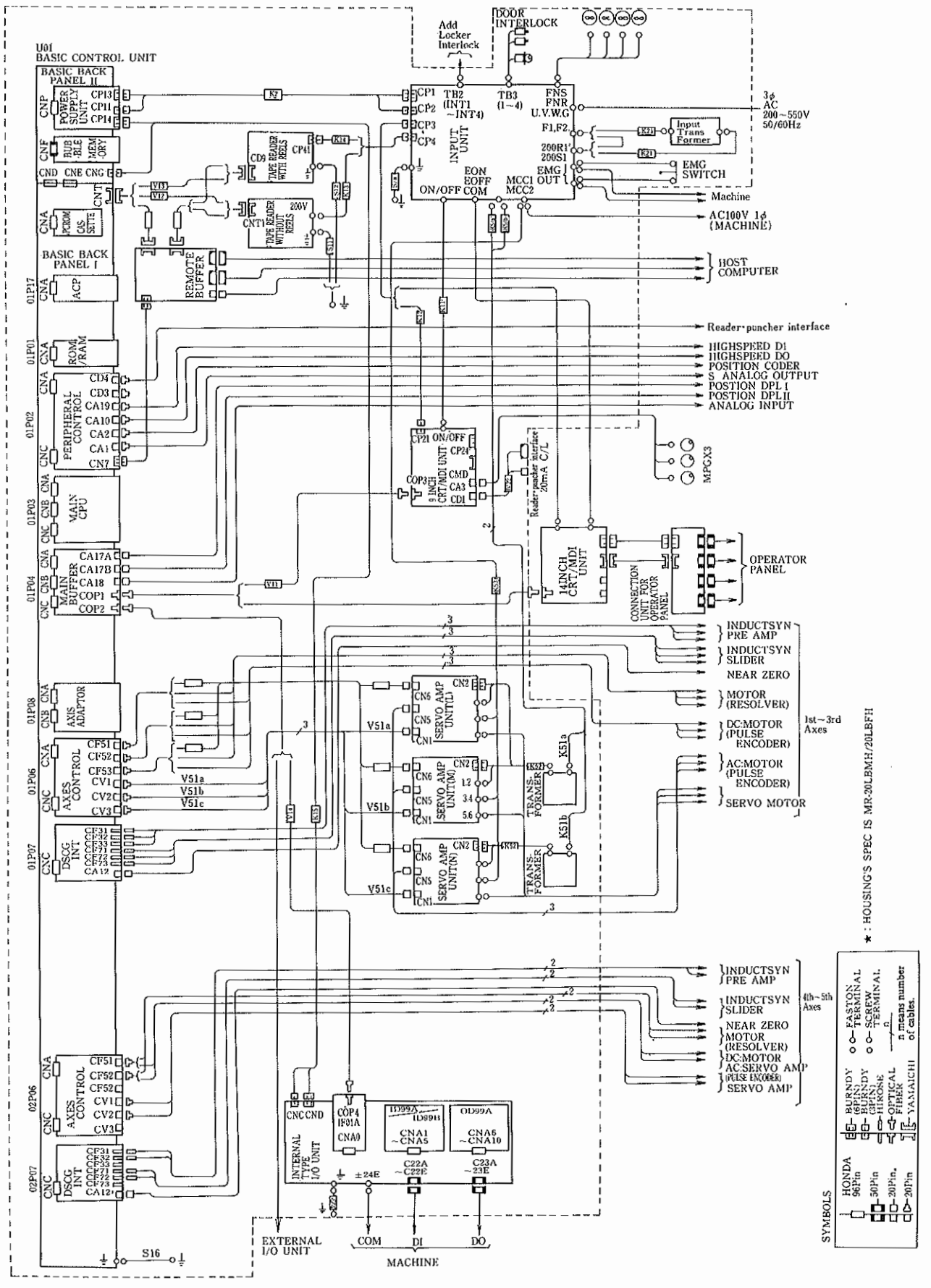


Fig. 3.6 (n) Connecting diagram inside 12/120 series free-standing type cabinet A (when one of synchronous operation, hybrid control or double check is not performed in 5 or less axis control)

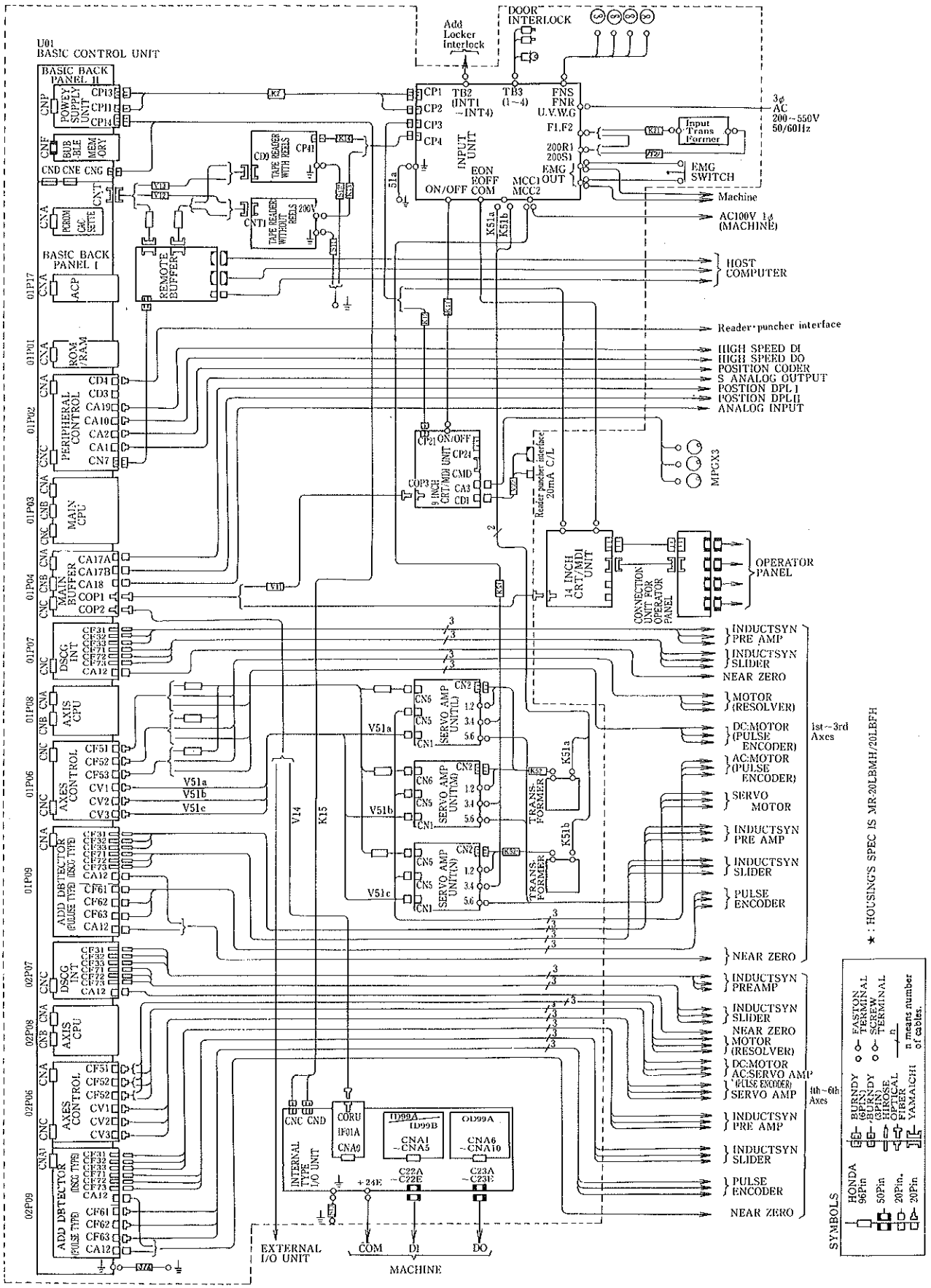


Fig. 3.6 (o) Connecting diagram inside 12/120 series free-standing type cabinet A (when one of synchronous operation, hybrid control or double check is performed in 6 or less axis control)

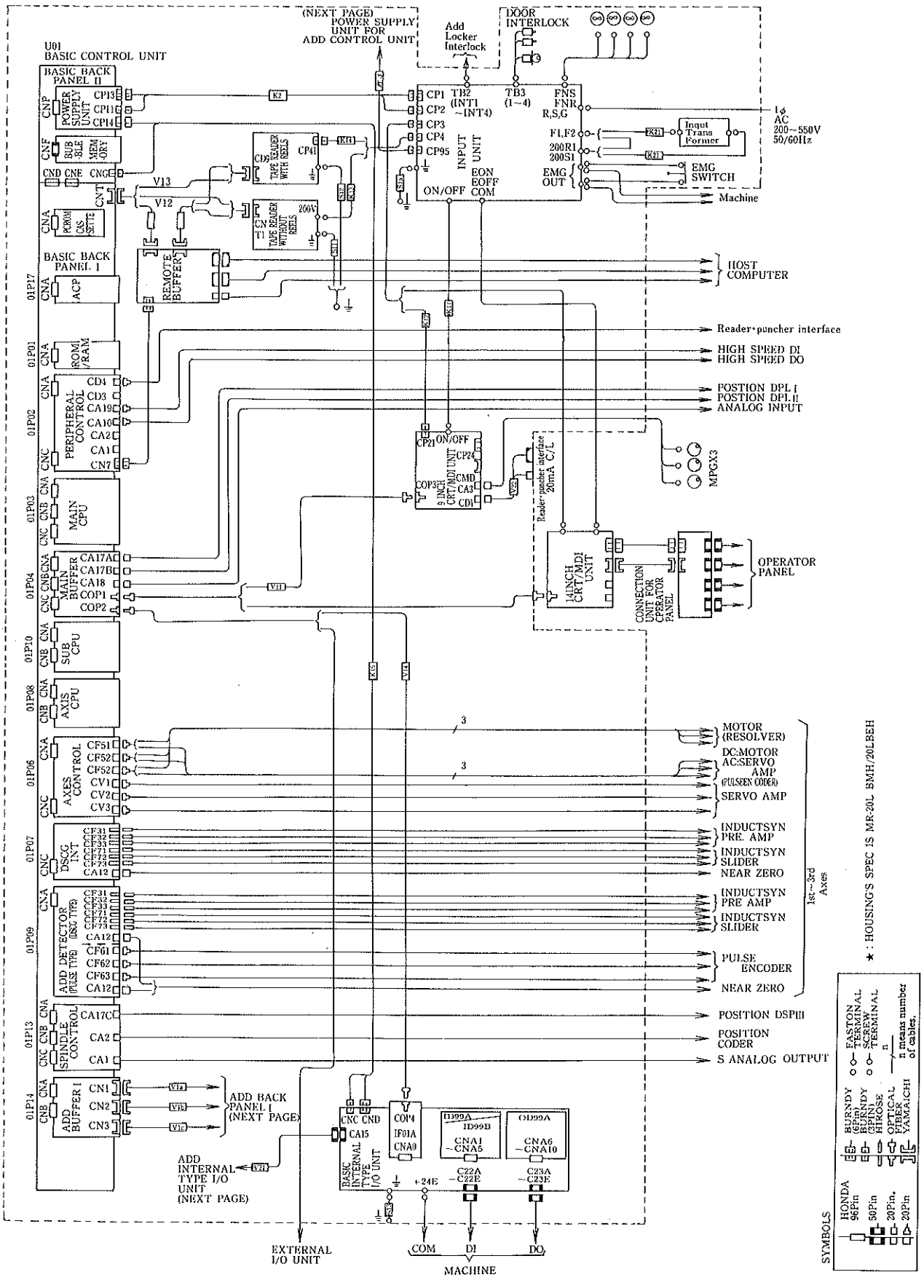


Fig. 3.6 (p) Connecting diagram inside 12/120 series free-standing type cabinet B (a) (when more than 7 axes are controlled)

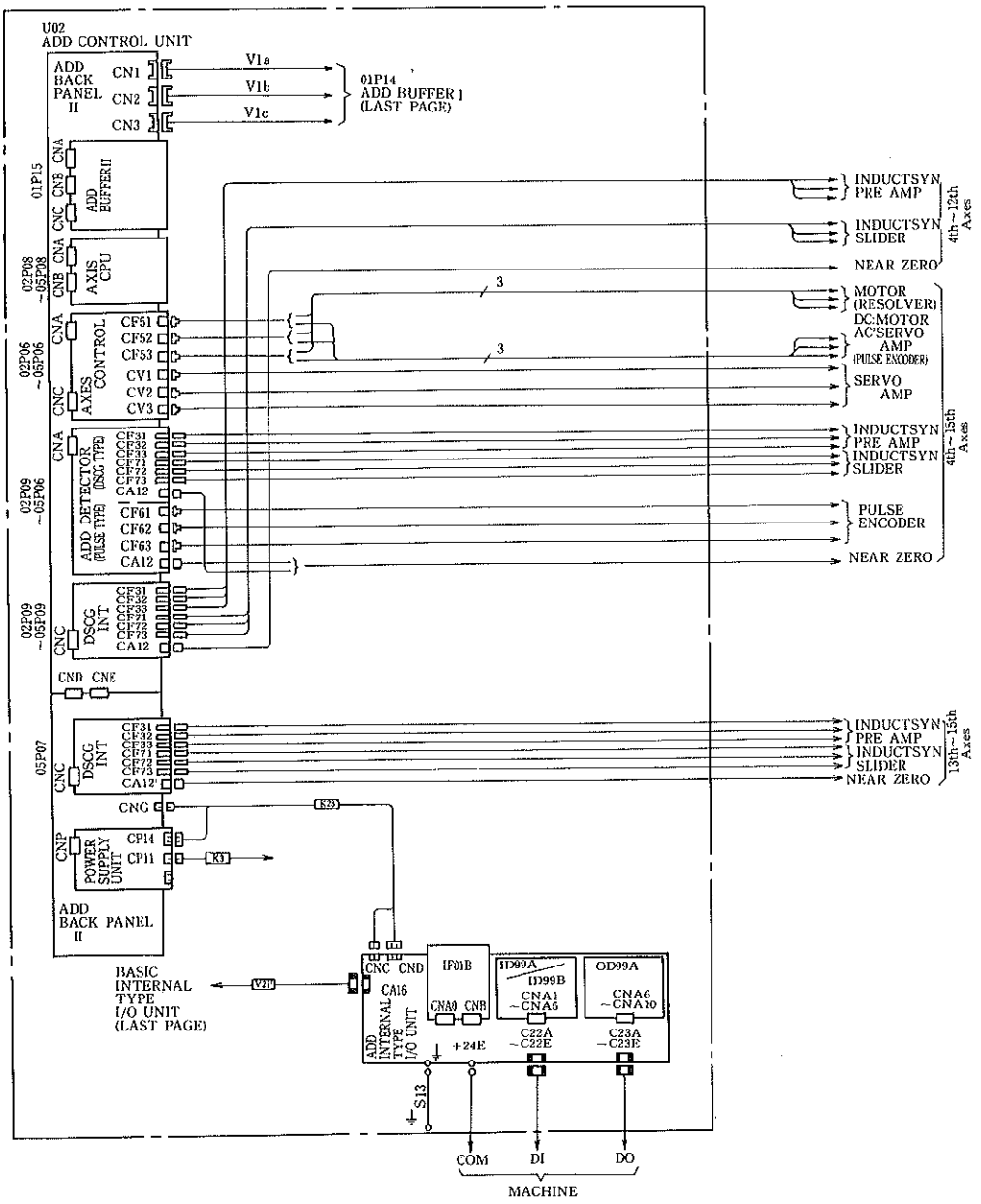


Fig. 3.6 (q) Connecting diagram inside 12/120 series free-standing type cabinet B (b)
(when more than 7 axes are controlled)

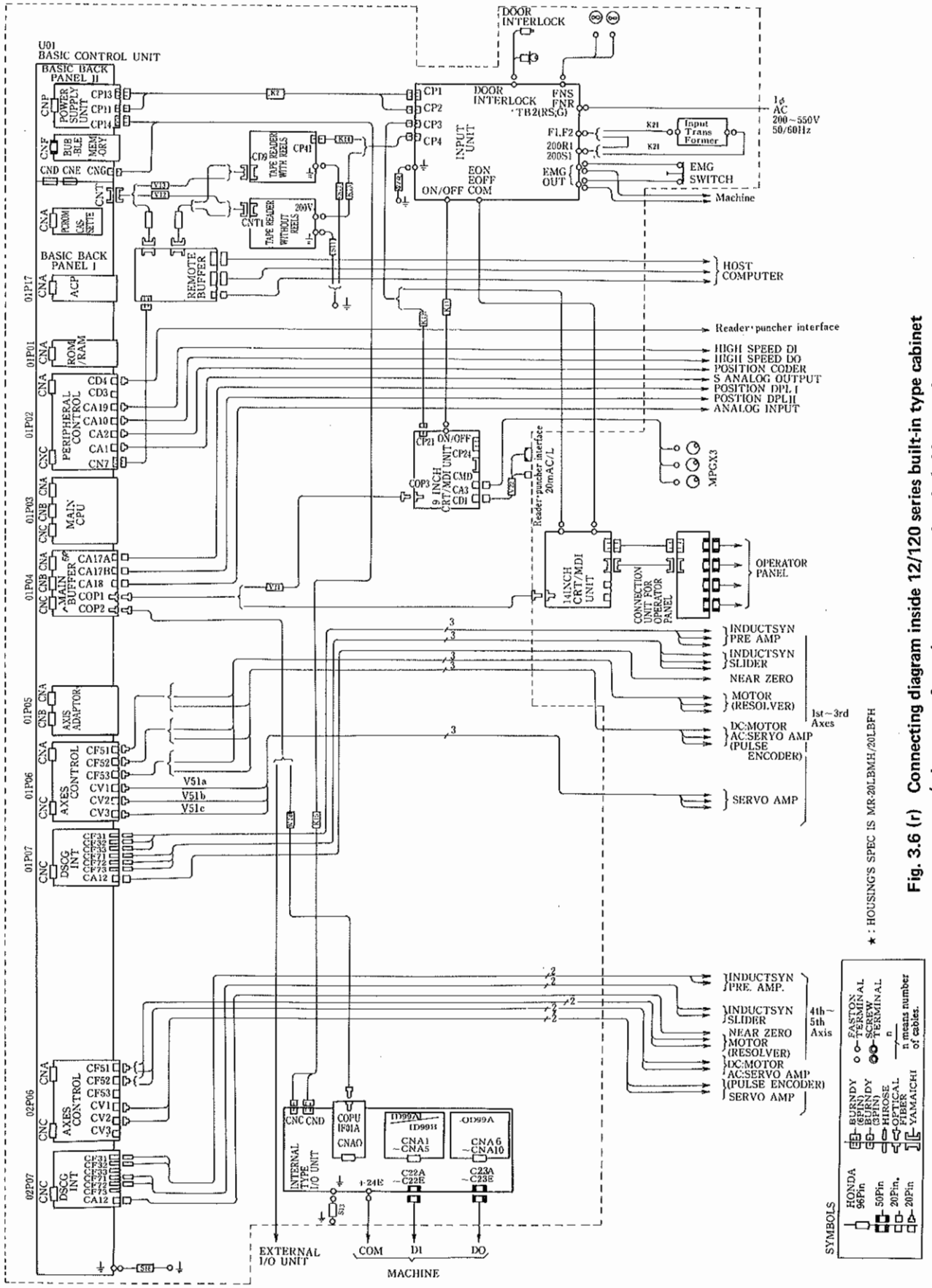


Fig. 3.6 (r) Connecting diagram inside 12/120 series built-in type cabinet (when one of synchronous operation, hybrid control, double check system is not performed in 6 or less axes control)

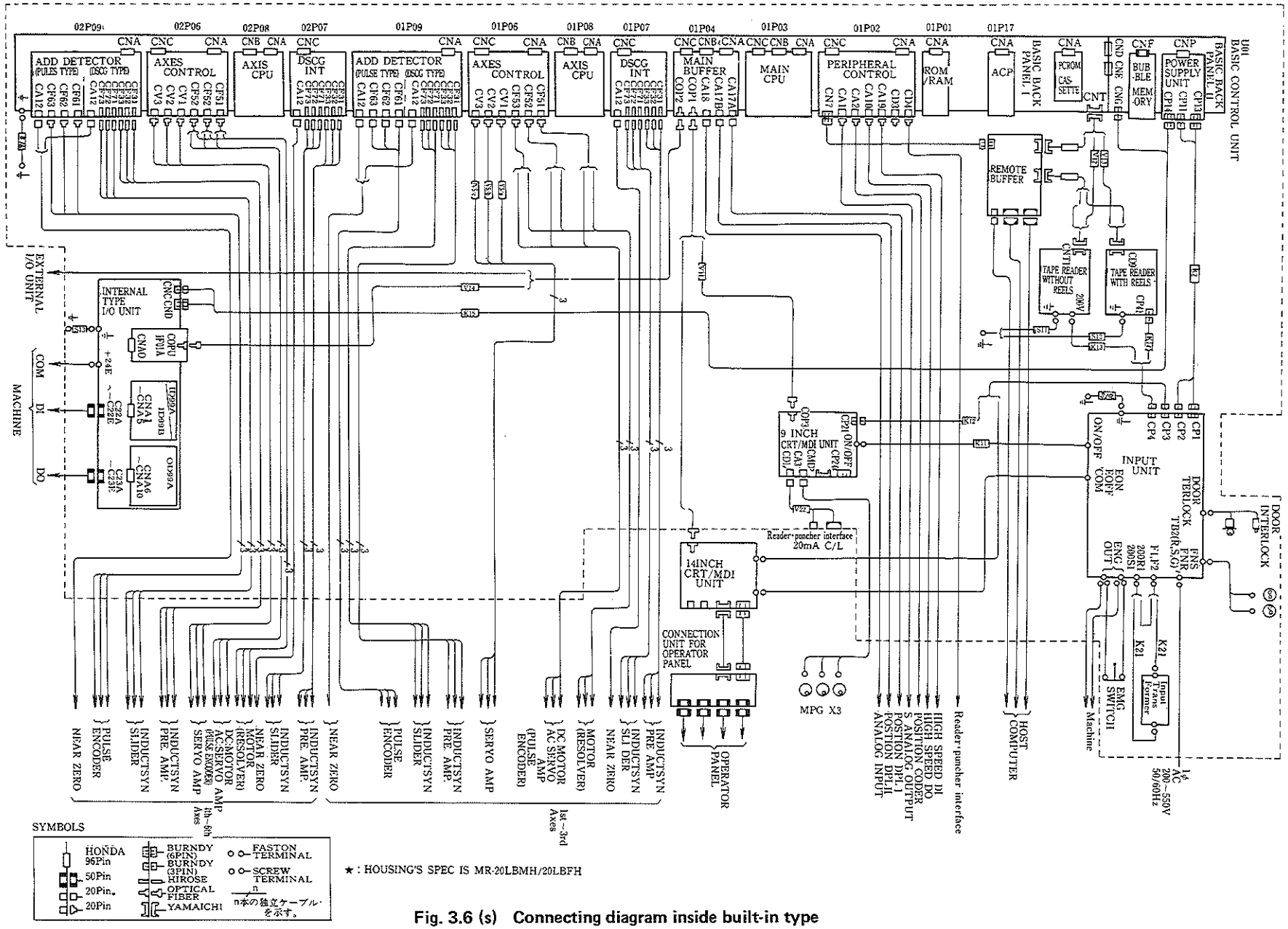


Fig. 3.6 (s) Connecting diagram inside built-in type (when one of synchrous operation, hybrid control or double check is performed in 6 or less axis control)

3.7 Status Display by Self-Diagnostic Function

General
If trouble occurrs, you must clarify whether the trouble occurred inside the NC or on the PMC or machine side. In order to do this, examine the interface condition between NC and PC or between NC and machine as well as the internal conditions of NC.
How DGN function displays the condition of NC on the CRT screen when a problem occurs is described in this section.
Refer to 10/11/12/100/110/120 series operator's manual for general operation of CRT/MDI.
The 9" CRT/MDI unit is equipped with five soft keys. The 14" CRT/MDI unit is equipped with ten soft keys. In this manual, the 9" CRT/MDI unit equipped with five soft keys will be described. The soft keys are displayed as follows:

POSITION	PROGRAM	OFFSET	PRG-CHK	CHAPTER	+

The characters in the frames are the names of the soft keys displayed at the bottom of the CRT screen. The "+" mark at the right shows that "+" is displayed at the right end of the lowest line on the CRT screen. This means that some key is not displayed on the CRT screen because of insufficient soft keys.
The basic operation of the 9" CRT/MDI unit is the same as that of the 14" CRT/MDI unit. With the latter, more keys can be operated simultaneously, so there is less need for changeover of the soft keys.

3.7.1 Interface display

Interface signal ON/OFF (1/0) conditions can be displayed.
a) Set the soft key as a function select key by pressing the function menu key.

SETTING	SERVICE	NOTICE		CHAPTER	+

b) A maintenance screen is selected by pressing SERVICE Key.
c) If the maintenance screen is not a diagnostic data screen, press CHAPTER key to select the soft key for the chapter select key.

PARAM	PITCH	DIAGNOS	DSP.MEM		

Press DIAGNOS key or press SERVICE key repeatedly until a diagnostic data screen appears.
d) If a desired diagnostic data screen does not appear, observe the following procedure:
d)-1 Method by page select key
Select pages by using page select key.
d)-2 Method by soft key
i) Press the operation menu key to select the soft key of the operation select key.

				INP-NO.	+

ii) Press INP-NO, and the soft key is selected for the operation guide key.

(VALUE)					

iii) Input a data number key of the desired diagnostic data to be displayed. When data number is entered by the key, the soft key becomes as shown below.

EXEC					

iv) When EXEC key is pressed, the CRT screen displays the diagnostic data of the data number entered by the keying operation. The soft key is returned to the operation select key.
For I/O signals list, see 3.7.4.

3.7.2 Display of internal conditions of NC

The internal conditions of NC can be displayed by the same method used in the interface display method described in 3.7.1.

1) Display of the condition where a command is apparently not executed

No.	Bit	Display	Internal conditions when 1 is displayed
1000	0	INPOSITION CHECK	Inposition check is in progress.
	1	FEED RATE OVERRIDE	Feed rate override is 0%.
	2	JOG FEED OVERRIDE	Jog feed override is 0%.
	3	INT./START LOCK ON	Start lock/interlock is ON.
	4	SPEED ARRIVAL CHECK	Waiting for speed arrival signal to turn on
	5	WAIT REVOLUTION	Waiting for spindle 1 revolution signal in threading
	6	STOP POSITION CODER	Waiting for the rotation of position coder in spindle revolution feed
	7	FOREGROUND READING	Tape is being read in foreground.
1001	0	BACKGROUND READING	Tape is being read in background edition.

2) Display of reset condition
The conditions of the input signals related to the reset and feed hold are displayed.

No.	Bit							
1010	7	6	5	4	3	2	1	0
					RST	ERS	RRW	ESP

Display of "1" means the following conditions
ESP Emergency stop condition
RRW Reset & rewind signal is turned on.
ERS External reset signal is turned on.
RST Reset key is being pressed.

3) Display of TH alarm conditions
TH alarm conditions are displayed as follows.

No.	Display	Meaning of data
1100	POSITION (CHARACTER) F	Indicates the character position where TH alarm occurred by the number of characters counted from the start of the block. (TH alarm of foreground)
1101	BIT PATTERN (CHARACTER) F	Indicates the readout code of the TH alarm character by bit pattern. (TH alarm of foreground)
1100	POSITION (CHARACTER) B	Indicates the character position where TH alarm occurred by the number of characters counted from the start of the block. (TH alarm of background)
1101	BIT PATTERN (CHARACTER) B	Indicates the readout code of the TH alarm character by bit pattern. (TH alarm of background)

4) Display of abnormal conditions of bubble memory
Abnormal conditions of bubble memory are displayed as follows.

No.	Bit							
1200	7	6	5	4	3	2	1	0
	PR4		PR3	MWP	PR2	WPE	TOE	UNL

No.	Bit							
1201	7	6	5	4	3	2	1	0
	BPE		PSO	PR1	TME	MDL	NOM	UNC

PR4 MAP SINGLE-BIT PARITY ERROR
PR3 MAP MULTI-BITS PARITY ERROR
MWP TOO MANY WRONG PAGES
PR2 DATA SINGLE-BIT PARITY ERROR
WPE WRITE PLOTECT ERROR
TOE READ/WRITE TIME OUT ERROR
UNL UNLOSSED
BPE DATA BUS PARITY ERROR
PSO PAGE SIZE OVER
PR1 DATA MULTI-BITS PARITY ERROR
TME TRANS MISSING ERROR
MDL MANY DEFECT LOOPS
NOM NO MARKER
UNC UNDEFINED COMMAND

When "1" is displayed, it shows that the above error occurred.

5) Display of position deviation amount
The position deviation amount of each axis is displayed.

No.	Display	Meaning of display data
3000	X SERVO ERROR	Indicates the position deviation amount of X axis in the detection unit.
	Y SERVO ERROR	Indicates the position deviation amount of Y axis in the detection unit.
	Z SERVO ERROR	Indicates the position deviation amount of Z axis in the detection unit.
	:	
	:	

6) Display of resolver or inductosyn frequency check results
Resolver or inductosyn frequency check results are displayed. This display is used for frequency adjustment.

No.	Display	Meaning of display data
3001	DSCG PULSE LOW	(Display data) 0.125 is normal when it lies within a range of 230 ∿ 800.
3002	DSCG PULSE HIG	(Display data) 0.125 is normal when it lies within a range of 1466 ∿ 1900.

7) Display of servo control information
The servo control information is displayed as follows.

No.	Axis corresponding to number
3010 ∿ 3023	Servo control information of 1st axis
3030 ∿ 3043	Servo control information of 2nd axis
3050 ∿ 3063	Servo control information of 3rd axis

3.7.3 Memory contents display

Memory contents can be displayed as follows:
a) Set the soft key to the function select key.

SETTING	SERVICE	NOTICE		CHAPTER	+

b) Press SERVICE key. A maintenance screen is selected.
c) If the maintenance screen does not indicate memory contents, press CHAPTER key to switch the soft key to the chapter select key.

PARAM	PITCH	DIAGNOS	DSP.MEM		

Press DSP MEM key or press SERVICE key repeatedly until a memory contents display screen appears.
d) Select the soft key for the operation select key.

				INP-NO.	+

e) Press INP-NO and the soft key is switched to the operation guide key.

(VALUE)					

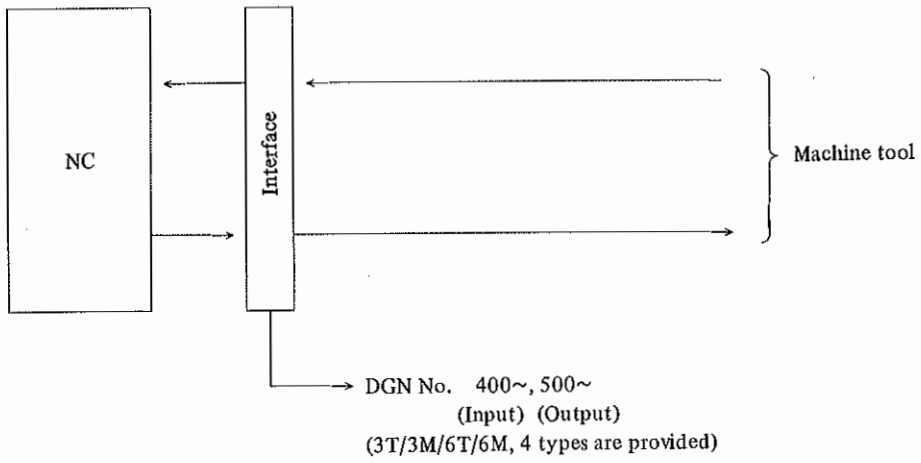
f) Enter the address of the memory to be displayed using a six decimal number by pressing keys.
When the data number is entered, the soft key is reset as shown below.

EXEC					

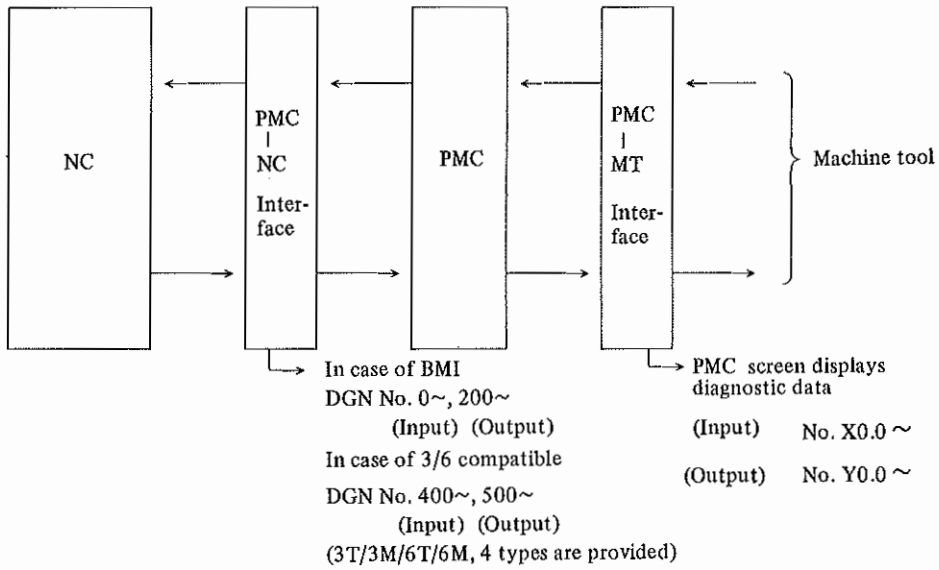
g) Press EXEC key to display the memory contents of the input address. The soft key is reset to the operation select key.

3.7.4 I/O signal diagnostic data

I/O signal diagnostic data of the NC are constructed as follows:
1) When PMC is not provided;



2) When PMC is provided;



PMC diagnostic data display method

① Press [NC/PC] key on the keyboard. A PMC basic menu is displayed in the soft key part.
② Press [PCDGN] soft key. The CRT screen shows PMC diagnostic function, and the soft key menu turns to [SEARCH].
③ Press [SEARCH] key after inputting the address to be displayed.
④ Continuous 10 byte data are displayed by a bit pattern from the designated address on the top stage of the CRT screen.
⑤ To display other addresses, repeat operation starting with step ③.
⑥ After display operation, press [RET] key to reset the menu to the PMC basic menu.

BMI signal list

BMI - DI

DGN No.	7	6	5	4	3	2	1	0
0	ERS	RRW	*SP	*ESP	SKIP1	UNIT	*CSL	*IT
1	SKIP4	SKIP3	SKIP2	AE3	AE2	AE1	*BSL	*AIT
2	ZRN	BRN	SRN	MOVL	TCHIN			
3	AGJ	EDT	MEM	T	D	J	H	S
4	MLK	DLK	ABS	OVC	SBK	EDT1	DRN	AFL
5	KEY4	KEY3	KEY2	KEY1	F1D	FFIN	FIN	ST
6	RT	ROV2	ROV1	MP4	MP2	MP1		
7	BDT9	BDT8	BDT7	BDT6	BDT5	BDT4	BDT3	BDT2
8	TMRON		PRC				*CSM2	*CHF
9	TLSKP	TL64	TL32	TL16	TL08	TL04	TL02	TL01
10	TLRST	OMEP	OME		HS3D	HS3C	HS3B	HS3A
11	HS2D	HS2C	HS2B	HS2A	HS1D	HS1C	HS1B	HS1A
12	*FV7	*FV6	*FV5	*FV4	*FV3	*FV2	*FV1	*FV0
13	*AFV7	*AFV6	*AFV5	*AFV4	*AFV3	*AFV2	*AFV1	*AFV0
14	*JV15	*JV14	*JV13	*JV12	*JV11	*JV10	*JV9	*JV8
15	*JV7	*JV6	*JV5	*JV4	*JV3	*JV2	*JV1	*JV0

BMI - DI

DGN No.	7	6	5	4	3	2	1	0
16	AJSTB	-AJ	+AJ	AJA12	AJA11	AJA10	AJA9	AJA8
17	AJA7	AJA6	AJA5	AJA4	AJA3	AJA2	AJA1	AJA0
18	AJP2D	AJP2C	AJP2B	AJP2A	AJP1D	AJP1C	AJP1B	AJP1A
19	*BECLP	*BEUCL		WN16	WN8	WN4	WN2	WN1
20						DIST26	DIST25	DIST24
21	DIST23	DIST22	DIST21	DIST20	DIST19	DIST18	DIST17	DIST16
22	DIST15	DIST14	DIST13	DIST12	DIST11	DIST10	DIST9	DIST8
23	DIST7	DIST6	DIST5	DIST4	DIST3	DIST2	DIST1	DIST0
24	RISGN			RI12	RI11	RI10	RI9	RI8
25	RI7	RI6	RI5	RI4	RI3	RI2	RI1	RI0
26	WOSET	GS4	GS5	GS1	*SECLP	*SEUCL		SPSTP
27	CDV7	CDV6	CDV5	CDV4	CDV3	CDV2	CDV1	CDV0
28						SPC	SPB	SPA
29								
30								
31								

BMI - DI

DGN No.	7	6	5	4	3	2	1	0
32	EISTB	ERDRQ	EOREND			EXSTP	EXRD	EXPUN
33	EIA7	EIA6	EIA5	EIA4	EIA3	EIA2	EIA1	EIA0
34	EID47	EID46	EID45	EID44	EID43	EID42	EID41	EID40
35	EID39	EID38	EID37	EID36	EID35	EID34	EID33	EID32
36	EID31	EID30	EID29	EID28	EID27	EID26	EID25	EID24
37	EID23	EID22	EID21	EID20	EID19	EID18	EID17	EID16
38	EID15	EID14	EID13	EID12	EID11	EID10	EID9	EID8
39	EID7	EID6	EID5	EID4	EID3	EID2	EID1	EID0
40								
41								
42								TL256
43	TL128							
44								
45								
46								
47								

BMI - DI

DGN No.	7	6	5	4	3	2	1	0
48	UI031	UI030	UI029	UI028	UI027	UI026	UI025	UI024
49	UI023	UI022	UI021	UI020	UI019	UI018	UI017	UI016
50	UI015	UI014	UI013	U0012	UI011	UI010	UI009	UI008
51	UI007	UI006	UI005	UI004	UI003	UI002	UI001	UI000
52	UI131	UI130	UI129	UI128	UI127	UI126	UI125	UI124
53	UI123	UI122	UI121	UI120	UI119	UI118	UI117	UI116
54	UI115	UI114	UI113	UI112	UI111	UI110	UI109	UI108
55	UI107	UI106	UI105	UI104	UI103	UI102	UI101	UI100
56	UI231	UI230	UI229	UI228	UI227	UI226	UI225	UI224
57	UI223	UI222	UI221	UI220	UI219	UI218	UI217	UI216
58	UI215	UI214	UI213	UI212	UI211	UI210	UI209	UI208
59	UI207	UI206	UI205	UI204	UI203	UI202	UI201	UI200
60	UI331	UI330	UI329	UI328	UI327	UI326	UI325	UI324
61	UI323	UI322	UI321	UI320	UI319	UI318	UI317	UI316
62	UI315	UI314	UI313	UI312	UI311	UI310	UI309	UI308
63	UI307	UI306	UI305	UI304	UI303	UI302	UI301	UI300

BMI - DI

DGN No.	7	6	5	4	3	2	1	0
64	DTCH1	*SVF1	*DEC1	*IT1	*-ED1	*+ED1	*-L1	*+L1
65			*CL1	PK1	MLK1	MI1	-J1	+J1
66								
67								
68	DTCH2	*SVF2	*DEC2	*IT2	*-ED2	*+ED2	*-L2	*+L2
69			*CL2	PK2	MLX2	MI2	-J2	+J2
70								
71								
72	DTCH3	*SVF3	*DEC3	*IT3	*-ED3	*+ED3	*-L3	*+L3
73			*CL3	PK3	MLK3	MI3	-J3	+J3
74								
75								
76	DTCH4	*SVF4	*DEC4	*IT4	*-ED4	*+ED4	*-L4	*+L4
77			*CL4	PK4	MLK4	MI4	-J4	+J4
78								
79								

BMI - DI

DGN No.	7	6	5	4	3	2	1	0
80	DTCH5	*SVF5	*DEC5	*IT5	*-ED5	*+ED5	*-L5	*+L5
81			*CL5	PK5	MLX5	MI5	-J5	+J5
82								
83								

} 11/12/ 110/120 series only

Continued in the same way (for 12/120 series only)

84 ∿ 87:	6th axis	104 ∿ 107:	11th axis
88 ∿ 91:	7th axis	108 ∿ 111:	12th axis
92 ∿ 95:	8th axis	112 ∿ 115:	13th axis
96 ∿ 99:	9th axis	116 ∿ 119:	14th axis
100 ∿ 103:	10th axis	120 ∿ 123:	15th axis

BMI - DO

DGN No.	7	6	5	4	3	2	1	0
200	MA	SA	OP	STL	SPL	RST	AL	RWD
201	CSS	THRD	RPD	TAP	INCH	DST	IPEN	DEN
202	MZRN	MBRN	MSRN	MMOVL				
203	MAGL	MEDT	MMEM	MT	MD	MJ	MH	MS
204	MMLK	MDLX	MABS		MSBK	MEDT1	MDRN	MAFL
205	MBDT9	MBDT8	MBDT7	MBDT6	MBDT5	MBDT4	MBDT3	MBDT2
206	MSALM	EGPSALM	DIALM	SYALM	OTALM	OHALM	SVALM	PSALM
207	TLCHB	TLCHA	ESEND	RPBSY			BCLP	BUCLP
208	SSP	SRV	FMF	EF	BF	TF	SF	MF
209	DM30	DM02	DM01	DM00				
210	RO15	RO14	RO13	RO12	RO11	RO10	RO9	RO8
211	RO7	RO6	RO5	RO4	RO3	RO2	RO1	RO0
212	AR15	AR14	AR13	AR12	AR11	AR10	AR9	AR8
213	AR7	AR6	AR5	AR4	AR3	AR2	AR1	AR0
214	MR15	MR14	MR13	MR12	MR11	MR10	MR9	MR8
215	MR7	MR6	MR5	MR4	MR3	MR2	MR1	MR0

BMI - DO

DGN No.	7	6	5	4	3	2	1	0
216	M31	M30	M29	M28	M27	M26	M25	M24
217	M23	M22	M21	M20	M19	M18	M17	M16
218	M15	M14	M13	M12	M11	M10	M9	M8
219	M7	M6	M5	M4	M3	M2	M1	M0
220	S31	S30	S29	S28	S27	S26	S25	S24
221	S23	S22	S21	S20	S19	S18	S17	S16
222	S15	S14	S13	S12	S11	S10	S9	S8
223	S7	S6	S5	S4	S3	S2	S1	S0
224	T31	T30	T29	T28	T27	T26	T25	T24
225	T23	T22	T21	T20	T19	T18	T17	T16
226	T15	T14	T13	T12	T11	T10	T9	T8
227	T7	T6	T5	T4	T3	T2	T1	T0
228	B31	B30	B29	B28	B27	B26	B25	B24
229	B23	B22	B21	B20	B19	B18	B17	B16
230	B15	B14	B13	B12	B11	B10	B9	B8
231	B7	B6	B5	B4	B3	B2	B1	B0

BMI - DO

DGN No.	7	6	5	4	3	2	1	0
232	EOSTB		EIREND					
233	EOA7	EOA6	EOA5	EOA4	EOA3	EOA2	EOA1	EOA0
234	EOD47	EOD46	EOD45	EOD44	EOD43	EOD42	EOD41	EOD40
235	EOD39	EOD38	EOD37	EOD36	EOD35	EOD34	EOD33	EOD32
236	EOD31	EOD30	EOD29	EOD28	EOD27	EOD26	EOD25	EOD24
237	EOD23	EOD22	EOD21	EOD20	EOD19	EOD18	EOD17	EOD16
238	EOD15	EOD14	EOD13	EOD12	EOD11	EOD10	EOD9	EOD8
239	EOD7	EOD6	EOD5	EOD4	EOD3	EOD2	EOD1	EOD0
240	BTAL	PBATL	PBATZ		SPAL8	SPAL4	SPAL2	SPAL1
241								
242		SPCO	SPBO	SPAO	*REEL	SPAL	SCLP	SUCLP
243								
244								
245								
246								
247								

BMI - DO

DGN No.	7	6	5	4	3	2	1	0
248	UO031	UO030	UO029	UO028	UO027	UO026	UO025	UO024
249	UO023	UO022	UO021	UO020	UO019	UO018	UO017	UO016
250	UO015	UO014	UO013	UO012	UO011	UO010	UO009	UO008
251	UO007	UO006	UO005	UO004	UO003	UO002	UO001	UO000
252	UO131	UO130	UO129	UO128	UO127	UO126	UO125	UO124
253	UO123	UO122	UO121	UO120	UO119	UO118	UO117	UO116
254	UO115	UO114	UO113	UO112	UO111	UO110	UO109	UO108
255	UO107	UO106	UO105	UO104	UO103	UO102	UO101	UO100
256	UO231	UO230	UO229	UO228	UO227	UO226	UO225	UO224
257	UO223	UO222	UO221	UO220	UO219	UO218	UO217	UO216
258	UO215	UO214	UO213	UO212	UO211	UO210	UO209	UO208
259	UO207	UO206	UO205	UO204	UO203	UO202	UO201	UO200
260	UO331	UO330	UO329	UO328	UO327	UO326	UO325	UO324
261	UO323	UO322	UO321	UO320	UO319	UO318	UO317	UO316
262	UO315	UO314	UO313	UO312	UO311	UO310	UO309	UO308
263	UO307	UO306	UO305	UO304	UO303	UO302	UO301	UO300

BMI - DO

DGN No.	7	6	5	4	3	2	1	0
264		INP1	ZP41	ZP31	MD1	MV1	ZP21	ZP1
265							MMLK1	MMI1
266								
267								
268		INP2	ZP42	ZP32	MD2	MV2	ZP22	ZP2
269							MMLK2	MMI2
270								
271								
272		INP3	ZP43	ZP33	MD3	MV3	ZP23	ZP3
273							MMLK3	MMI3
274								
275								
276		INP4	ZP44	ZP34	MD4	MV4	ZP24	ZP4
277								MMI4
278								
279								

BMI - DO

DGN No.	7	6	5	4	3	2	1	0
280		INP5	ZP45	ZP35	MD5	MV5	ZP25	ZP5
281							MMLK5	MMI5
282								
283								

11/12/ 110/120 series only

Continued in the same way (for 12/120 series only)

284 ∿ 287:	6th axis	304 ∿ 307:	11th axis
288 ∿ 291:	7th axis	308 ∿ 311:	12th axis
292 ∿ 295:	8th axis	312 ∿ 315:	14th axis
296 ∿ 299:	9th axis	316 ∿ 319:	14th axis
300 ∿ 303:	10th axis	320 ∿ 323:	15th axis

3.7.5 Address list for 11TT

BMI-DI 1

	7	6	5	4	3	2	1	0
00					SKIP1 #1	UINT #1	*CSL #1	
01				AE3 #1	AE2 #1	AE1 #1	*BSL #1	*AIT #1
02								
03								
04				OVC #1		BDT1 #1		
05							FIN #1	
06								
07	BDT9 #1	BDT8 #1	BDT7 #1	BDT6 #1	BDT5 #1	BDT4 #1	BDT3 #1	BDT2 #1
08	TMRON						*CSMZ #1	*CHF #1
09	TLSKP #1	TL64 #1	TL32 #1	TL16 #1	TL8 #1	TL4 #1	TL2 #1	TL1 #
10	TLRST #1							
11								
12	*FV7 #1	*FV6 #1	*FV5 #1	*FV4 #1	*FV3 #1	*FV2 #1	*FV1 #1	*FV0 #1
13	*AFV7 #1	*AFV6 #1	*AFV5 #1	*AFV4 #1	*AFV3 #1	*AFV2 #1	*AFV1 #1	*AFV0 #1
14								
15								

(Note) There are some signals which are provided for the first and second tool posts respectively and they provide just the same function.
These signals are identified by symbol #1 or #2 which is affixed to their names. Symbol #1 shows a signal exclusively provided for the first tool post, while symbol #2 shows a signal exclusively provided for the second tool post.

BMI-DI 2

	7	6	5	4	3	2	1	0
16								
17								
18								
19				WN16 #1	WN8 #1	WN4 #1	WN2 #1	WN1 #1
20								
21								
22								
23								
24	RISGN #1			RI12 #1	RI11 #1	RI10 #1	RI9 #1	RI8 #1
25	RI7 #1	RI6 #1	RI5 #1	RI4 #1	RI3 #1	RI2 #1	RI1 #1	RI0 #1
26								
27								
28								
29								
30								
31								

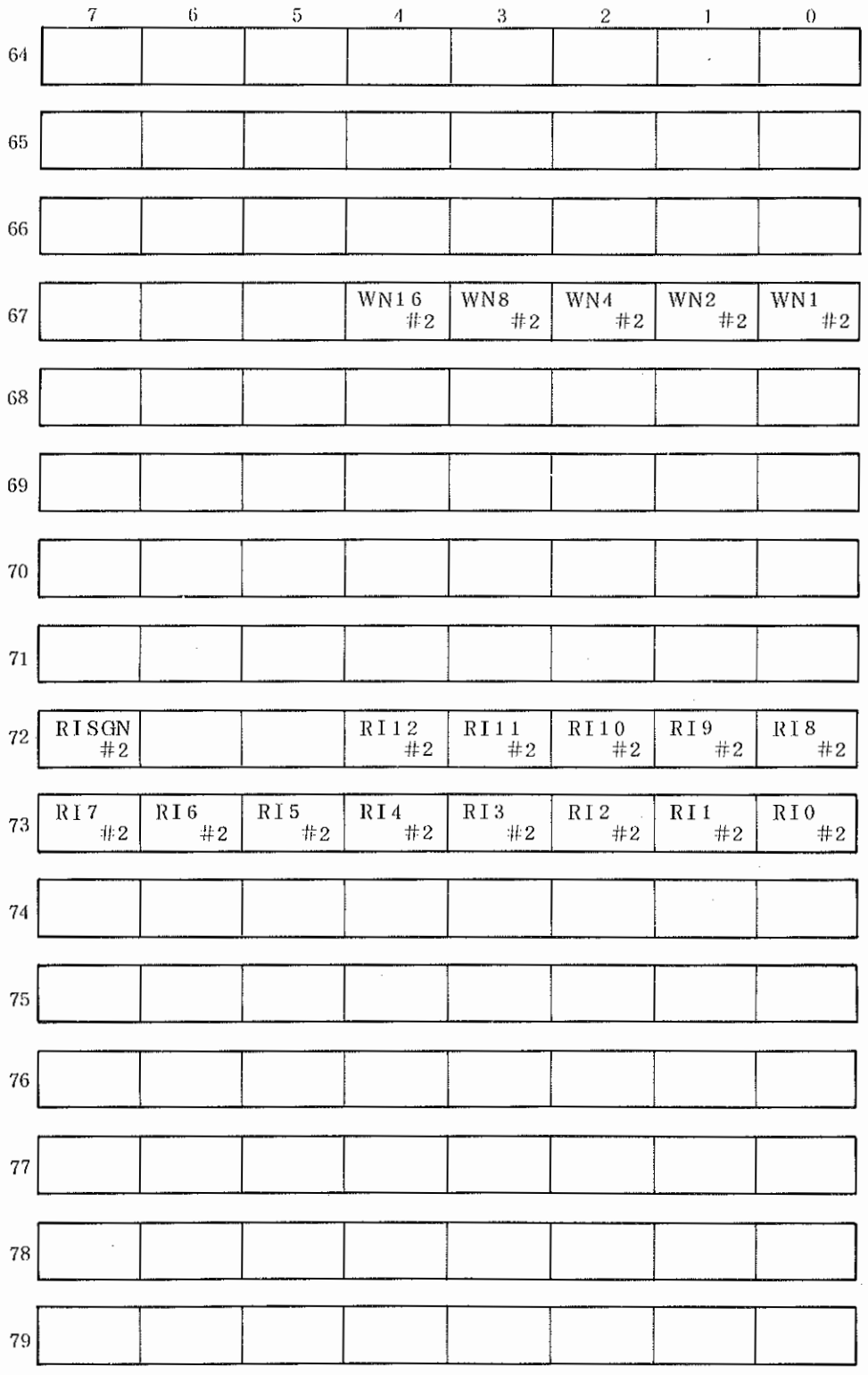
BMI-DI 3

	7	6	5	4	3	2	1	0
32	UI031 #1	UI030 #1	UI029 #1	UI028 #1	UI027 #1	UI026 #1	UI025 #1	UI024 #1
33	UI023 #1	UI022 #1	UI021 #1	UI020 #1	UI019 #1	UI018 #1	UI017 #1	UI016 #1
34	UI015 #1	UI014 #1	UI013 #1	UI012 #1	UI011 #1	UI010 #1	UI009 #1	UI008 #1
35	UI007 #1	UI006 #1	UI005 #1	UI004 #1	UI003 #1	UI002 #1	UI001 #1	UI000 #1
36	UI131 #1	UI130 #1	UI129 #1	UI128 #1	UI127 #1	UI126 #1	UI125 #1	UI124 #1
37	UI123 #1	UI122 #1	UI121 #1	UI120 #1	UI119 #1	UI118 #1	UI117 #1	UI116 #1
38	UI115 #1	UI114 #1	UI113 #1	UI112 #1	UI111 #1	UI110 #1	UI109 #1	UI108 #1
39	UI107 #1	UI106 #1	UI105 #1	UI104 #1	UI103 #1	UI102 #1	UI101 #1	UI100 #1
40	UI231 #1	UI230 #1	UI229 #1	UI228 #1	UI227 #1	UI226 #1	UI225 #1	UI224 #1
41	UI223 #1	UI222 #1	UI221 #1	UI220 #1	UI219 #1	UI218 #1	UI217 #1	UI216 #1
42	UI215 #1	UI214 #1	UI213 #1	UI212 #1	UI211 #1	UI210 #1	UI209 #1	UI208 #1
43	UI207 #1	UI206 #1	UI205 #1	UI204 #1	UI203 #1	UI202 #1	UI201 #1	UI200 #1
44	UI331 #1	UI330 #1	UI329 #1	UI328 #1	UI327 #1	UI326 #1	UI325 #1	UI324 #1
45	UI323 #1	UI322 #1	UI321 #1	UI320 #1	UI319 #1	UI318 #1	UI317 #1	UI316 #1
46	UI315 #1	UI314 #1	UI313 #1	UI312 #1	UI311 #1	UI310 #1	UI309 #1	UI308 #1
47	UI307 #1	UI306 #1	UI305 #1	UI304 #1	UI303 #1	UI302 #1	UI301 #1	UI300 #1

BMI-DI 4

	7	6	5	4	3	2	1	0
48					SKIP1 #2	UINT #2	*CSL #2	
49				AE3 #2	AE2 #2	AE1 #2	*BSL #2	*AIT #2
50								
51								
52				OVC #2		BDT1 #2		
53							FIN #2	
54								
55	BDT9 #2	BDT8 #2	BDT7 #2	BDT6 #2	BDT5 #2	BDT4 #2	BDT3 #2	BDT2 #2
56							*CSMZ #2	*CHF #2
57	TLSKP #2	TL64 #2	TL32 #2	TL16 #2	TL8 #2	TL4 #2	TL2 #2	TL1 #2
58	TLRST #							
59								
60	*FV7 #2	*FV6 #2	*FV5 #2	*FV4 #2	*FV3 #2	*FV2 #2	*FV1 #2	*FV0 #2
61	*AFV7 #2	*AFV6 #2	*AFV5 #2	*AFV4 #2	*AFV3 #2	*AFV2 #2	*AFV1 #2	*AFV0 #2
62								
63								

BMI-DI 5


7 6 5 4 3 2 1 0
64
65
66
67
WN16 #2
WN8 #2
WN4 #2
WN2 #2
WN1 #2
68
69
70
71
72
RISGN #2
RI12 #2
RI11 #2
RI10 #2
RI9 #2
RI8 #2
73
RI7 #2
RI6 #2
RI5 #2
RI4 #2
RI3 #2
RI2 #2
RI1 #2
RI0 #2
74
75
76
77
78
79

BMI-DI 6

	7	6	5	4	3	2	1	0
80	UI031 #2	UI030 #2	UI029 #2	UI028 #2	UI027 #2	UI026 #2	UI025 #2	UI024 #2
81	UI023 #2	UI022 #2	UI021 #2	UI020 #2	UI019 #2	UI018 #2	UI017 #2	UI016 #2
82	UI015 #2	UI014 #2	UI013 #2	UI012 #2	UI011 #2	UI010 #2	UI009 #2	UI008 #2
83	UI007 #2	UI006 #2	UI005 #2	UI004 #2	UI003 #2	UI002 #2	UI001 #2	UI000 #2
84	UI131 #2	UI130 #2	UI129 #2	UI128 #2	UI127 #2	UI126 #2	UI125 #2	UI124 #2
85	UI123 #2	UI122 #2	UI121 #2	UI120 #2	UI119 #2	UI118 #2	UI117 #2	UI116 #2
86	UI115 #2	UI114 #2	UI113 #2	UI112 #2	UI111 #2	UI110 #2	UI109 #2	UI108 #2
87	UI107 #2	UI106 #2	UI105 #2	UI104 #2	UI103 #2	UI102 #2	UI101 #2	UI100 #2
88	UI231 #2	UI230 #2	UI229 #2	UI228 #2	UI227 #2	UI226 #2	UI225 #2	UI224 #2
89	UI223 #2	UI222 #2	UI221 #2	UI220 #2	UI219 #2	UI218 #2	UI217 #2	UI216 #2
90	UI215 #2	UI214 #2	UI213 #2	UI212 #2	UI211 #2	UI210 #2	UI209 #2	UI208 #2
91	UI207 #2	UI206 #2	UI205 #2	UI204 #2	UI203 #2	UI202 #2	UI201 #2	UI200 #2
92	UI331 #2	UI330 #2	UI329 #2	UI328 #2	UI327 #2	UI326 #2	UI325 #2	UI324 #2
93	UI323 #2	UI322 #2	UI321 #2	UI320 #2	UI319 #2	UI318 #2	UI317 #2	UI316 #2
94	UI315 #2	UI314 #2	UI313 #2	UI312 #2	UI311 #2	UI310 #2	UI309 #2	UI308 #2
95	UI307 #2	UI306 #2	UI305 #2	UI304 #2	UI303 #2	UI302 #2	UI301 #2	UI300 #2

BMI-DI 7

	7	6	5	4	3	2	1	0
96	ERS	RRW	*SP	*ESP				*IT
97		EDT	MEM		D	J	H	S
98	ZRN							
99	MLK	DLK	ABS		SBK		DRN	AFL
100	KEY4	KEY3	KEY2	KEY1				ST
101	RT	ROV2	ROV1	MP4	MP2	MP1		PRC
102					HS3D	HS3C	HS3B	HS3A
103	HS2D	HS2C	HS2B	HS2A	HS1D	HS1C	HS1B	HS1A
104	*JV15	*JV14	*JV13	*JV12	*JV11	*JV10	*JV9	*JV8
105	*JV7	*JV6	*JV5	*JV4	*JV3	*JV2	*JV1	*JV0
106						DIST26	DIST25	DIST24
107	DIST23	DIST22	DIST21	DIST20	DIST19	DIST18	DIST17	DIST16
108	DIST15	DIST14	DIST13	DIST12	DIST11	DIST10	DIST9	DIST8
109	DIST7	DIST6	DIST5	DIST4	DIST3	DIST2	DIST1	DIST0
110							IHEAD2	IHEAD1
111								

BMI-DI 8

	7	6	5	4	3	2	1	0
112	EISTB	ERDRQ	EOREND	EIHEAD		EXSTP	EXRD	EXPUN
113	EIA7	EIA6	EIA5	EIA4	EIA3	EIA2	EIA1	EIA0
114	EID47	EID46	EID45	EID44	EID43	EID42	EID41	EID40
115	EID39	EID38	EID37	EID36	EID35	EID34	EID33	EID32
116	EID31	EID30	EID29	EID28	EID27	EID26	EID25	EID24
117	EID23	EID22	EID21	EID20	EID19	EID18	EID17	EID16
118	EID15	EID14	EID13	EID12	EID11	EID10	EID9	EID8
119	EID7	EID6	EID5	EID4	EID3	EID2	EID1	EID0
120								
121								
122								
123								
124								
125								
126								
127								

BMI-DI 9

	7	6	5	4	3	2	1	0
128	DTCH1	＊SVF1	＊DEC1	＊IT1	＊−ED1	＊+ED1	＊−L1	＊+L1
129					MLK1	MI1	−J1	+J1
130								
131								
132	DTCH2	＊SVF2	＊DEC2	＊IT2	＊−ED2	＊+ED2	＊−L2	＊+L2
133					MLK2	MI2	−J2	+J2
134								
135								
136	DTCH3	＊SVF3	＊DEC3	＊IT3	＊−ED3	＊+ED3	＊−L3	＊+L3
137					MLK3	MI3	−J3	+J3
138								
139								
140	DTCH4	＊SVF4	＊DEC4	＊IT4	＊−ED4	＊+ED4	＊−L4	＊+L4
141					MLK4	MI4	−J4	+J4
142								
143								

BMI-DI 10

	7	6	5	4	3	2	1	0
144	DTCH5	＊SVF5	＊DEC5	＊IT5	＊−ED5	＊+ED5	＊−L5	＊+L5
145					MLK5	MI5	−J5	+J5
146								
147								

BMI-DO 1

	7	6	5	4	3	2	1	0
200	CSS #1	THRD #1	RPD #1				IPEN #1	DEN #1
201						MBDT1 #1		
202	MBDT9 #1	MBDT8 #1	MBDT7 #1	MBDT6 #1	MBDT5 #1	MBDT4 #1	MBDT3 #1	MBDT2 #1
203	TLCHB #1	TLCHA #1	ESEND #1					
204					BF #1	TF #1	SF #1	MF #1
205	DM30 #1	DM02 #1	DM01 #1	DM00 #1				
206	RO15 #1	RO14 #1	RO13 #1	RO12 #1	RO11 #1	RO10 #1	RO9 #1	RO8 #1
207	RO7 #1	RO6 #1	RO5 #1	RO4 #1	RO3 #1	RO2 #1	RO1 #1	RO0 #1
208	AR15 #1	AR14 #1	AR13 #1	AR12 #1	AR11 #1	AR10 #1	AR9 #1	AR8 #1
209	AR7 #1	AR6 #1	AR5 #1	AR4 #1	AR3 #1	AR2 #1	AR1 #1	AR0 #1
210	MR15 #1	MR14 #1	MR13 #1	MR12 #1	MR11 #1	MR10 #1	MR9 #1	MR8 #1
211	MR7 #1	MR6 #1	MR5 #1	MR4 #1	MR3 #1	MR2 #1	MR1 #1	MR0 #1
212					SPAL8 #1	SPAL4 #1	SPAL2 #1	SPAL1 #1
213								
214								
215								

BMI-DO 2

	7	6	5	4	3	2	1	0
216	M31 #1	M30 #1	M29 #1	M28 #1	M27 #1	M26 #1	M25 #1	M24 #1
217	M23 #1	M22 #1	M21 #1	M20 #1	M19 #1	M18 #1	M17 #1	M16 #1
218	M15 #1	M14 #1	M13 #1	M12 #1	M11 #1	M10 #1	M9 #1	M8 #1
219	M7 #1	M6 #1	M5 #1	M4 #1	M3 #1	M2 #1	M1 #1	M0 #1
220	S31 #1	S30 #1	S29 #1	S28 #1	S27 #1	S26 #1	S25 #1	S24 #1
221	S23 #1	S22 #1	S21 #1	S20 #1	S19 #1	S18 #1	S17 #1	S16 #1
222	S15 #1	S14 #1	S13 #1	S12 #1	S11 #1	S10 #1	S9 #1	S8 #1
223	S7 #1	S6 #1	S5 #1	S4 #1	S3 #1	S2 #1	S1 #1	S0 #1
224	T31 #1	T30 #1	T29 #1	T28 #1	T27 #1	T26 #1	T25 #1	T24 #1
225	T23 #1	T22 #1	T21 #1	T20 #1	T19 #1	T18 #1	T17 #1	T16 #1
226	T15 #1	T14 #1	T13 #1	T12 #1	T11 #1	T10 #1	T9 #1	T8 #1
227	T7 #1	T6 #1	T5 #1	T4 #1	T3 #1	T2 #1	T1 #1	T0 #1
228	B31 #1	B30 #1	B29 #1	B28 #1	B27 #1	B26 #1	B25 #1	B24 #1
229	B23 #1	B22 #1	B21 #1	B20 #1	B19 #1	B18 #1	B17 #1	B16 #1
230	B15 #1	B14 #1	B13 #1	B12 #1	B11 #1	B10 #1	B9 #1	B8 #1
231	B7 #1	B6 #1	B5 #1	B4 #1	B3 #1	B2 #1	B1 #1	B0 #1

BMI-DO 3

	7	6	5	4	3	2	1	0
232	UO031 #1	UO030 #1	UO029 #1	UO028 #1	UO027 #1	UO026 #1	UO025 #1	UO024 #1
233	UO023 #1	UO022 #1	UO021 #1	UO020 #1	UO019 #1	UO018 #1	UO017 #1	UO016 #1
234	UO015 #1	UO014 # #1	UO013 #1	UO012 #1	UO011 #1	UO010 #1	UO009 #1	UO008 #1
235	UO007 #1	UO006 #1	UO005 #1	UO004 #1	UO003 #1	UO002 #1	UO001 #1	UO000 #1
236	UO131 #1	UO130 #1	UO129 #1	UO128 #1	UO127 #1	UO126 #1	UO125 #1	UO124 #1
237	UO123 #1	UO122 #1	UO121 #1	UO120 #1	UO119 #1	UO118 #1	UO117 #1	UO116 #1
238	UO115 #1	UO114 #1	UO113 #1	UO112 #1	UO111 #1	UO110 #1	UO109 #1	UO108 #1
239	UO107 #1	UO106 #1	UO105 #1	UO104 #1	UO103 #1	UO102 #1	UO101 #1	UO100 #1
240	UO231 #1	UO230 #1	UO229 #1	UO228 #1	UO227 #1	UO226 #1	UO225 #1	UO224 #1
241	UO223 #1	UO222 #1	UO221 #1	UO220 #1	UO219 #1	UO218 #1	UO217 #1	UO216 #1
242	UO215 #1	UO214 #1	UO213 #1	UO212 #1	UO211 #1	UO210 #1	UO209 #1	UO208 #1
243	UO207 #1	UO206 #1	UO205 #1	UO204 #1	UO203 #1	UO202 #1	UO201 #1	UO200 #1
244	UO331 #1	UO330 #1	UO329 #1	UO328 #1	UO327 #1	UO326 #1	UO325 #1	UO324 #1
245	UO323 #1	UO322 #1	UO321 #1	UO320 #1	UO319 #1	UO318 #1	UO317 #1	UO316 #1
246	UO315 #1	UO314 #1	UO313 #1	UO312 #1	UO311 #1	UO310 #1	UO309 #1	UO308 #1
247	UO307 #1	UO306 #1	UO305 #1	UO304 #1	UO303 #1	UO302 #1	UO301 #1	UO309 #1

BMI-DO 4

	7	6	5	4	3	2	1	0
248	CSS #2	THRD #2	RPD #2				IPEN #2	DEN #2
249						MBDT1 #2		
250	MBDT9 #2	MBDT8 #2	MBDT7 #2	MBDT6 #2	MBDT5 #2	MBDT4 #2	MBDT3 #2	MBDT2 #2
251	TLCHB #2	TLCHA #2	ESEND #2					
252					BF #2	TF #2	SF #2	MF #2
253	DM30 #2	DM02 #2	DM01 #2	DM00 #2				
254	RO15 #2	RO14 #2	RO13 #2	RO12 #2	RO11 #2	RO10 #2	RO9 #2	RO8 #2
255	RO7 #2	RO6 #2	RO5 #2	RO4 #2	RO3 #2	RO2 #2	RO1 #2	RO0 #2
256	AR15 #2	AR14 #2	AR13 #2	AR12 #2	AR11 #2	AR10 #2	AR9 #2	AR8 #2
257	AR7 #2	AR6 #2	AR5 #2	AR4 #2	AR3 #2	AR2 #2	AR1 #2	AR0 #2
258	MR15 #2	MR14 #2	MR13 #2	MR12 #2	MR11 #2	MR10 #2	MR9 #2	MR8 #2
259	MR7 #2	MR6 #2	MR5 #2	MR4 #2	MR3 #2	MR2 #2	MR1 #2	MR0 #2
260					SPAL8 #2	SPAL4 #2	SPAL2 #2	SPAL1 #2
261								
262								
263								

BMI-DO 5

	7	6	5	4	3	2	1	0
264	M31 #2	M30 #2	M29 #2	M28 #2	M27 #2	M26 #2	M25 #2	M24 #2
265	M23 #2	M22 #2	M21 #2	M20 #2	M19 #2	M18 #2	M17 #2	M16 #2
266	M15 #2	M14 #2	M13 #2	M12 #2	M11 #2	M10 #2	M9 #2	M8 #2
267	M7 #2	M6 #2	M5 #2	M4 #2	M3 #2	M2 #2	M1 #2	M0 #2
268	S31 #2	S30 #2	S29 #2	S28 #2	S27 #2	S26 #2	S25 #2	S24 #2
269	S23 #2	S22 #2	S21 #2	S20 #2	S19 #2	S18 #2	S17 #2	S16 #2
270	S15 #2	S14 #2	S13 #2	S12 #2	S11 #2	S10 #2	S9 #2	S8 #2
271	S7 #2	S6 #2	S5 #2	S4 #2	S3 #2	S2 #2	S1 #2	S0 #2
272	T31 #2	T30 #2	T29 #2	T28 #2	T27 #2	T26 #2	T25 #2	T24 #2
273	T23 #2	T22 #2	T21 #2	T20 #2	T19 #2	T18 #2	T17 #2	T16 #2
274	T15 #2	T14 #2	T13 #2	T12 #2	T11 #2	T10 #2	T9 #2	T8 #2
275	T7 #2	T6 #2	T5 #2	T4 #2	T3 #2	T2 #2	T1 #2	T0 #2
276	B31 #2	B30 #2	B29 #2	B28 #2	B27 #2	B26 #2	B25 #2	B24 #2
277	B23 #2	B22 #2	B21 #2	B20 #2	B19 #2	B18 #2	B17 #2	B16 #2
278	B15 #2	B14 #2	B13 #2	B12 #2	B11 #2	B10 #2	B9 #2	B8 #2
279	B7 #2	B6 #2	B5 #2	B4 #2	B3 #2	B2 #2	B1 #2	B0 #2

BMI-DO 6

	7	6	5	4	3	2	1	0
280	UO031 #2	UO030 #2	UO029 #2	UO028 #2	UO027 #2	UO026 #2	UO025 #2	UO024 #2
281	UO023 #2	UO022 #2	UO021 #2	UO020 #2	UO019 #2	UO018 #2	UO017 #2	UO016 #2
282	UO015 #2	UO014 #2	UO013 #2	UO012 #2	UO011 #2	UO010 #2	UO009 #2	UO008 #2
283	UO007 #2	UO006 #2	UO005 #2	UO004 #2	UO003 #2	UO002 #2	UO001 #2	UO000 #2
284	UO131 #2	UO130 #2	UO129 #2	UO128 #2	UO127 #2	UO126 #2	UO125 #2	UO124 #2
285	UO123 #2	UO122 #2	UO121 #2	UO120 #2	UO119 #2	UO118 #2	UO117 #2	UO116 #2
286	UO115 #2	UO114 #2	UO113 #2	UO112 #2	UO111 #2	UO110 #2	UO109 #2	UO108 #2
287	UO107 #2	UO106 #2	UO105 #2	UO104 #2	UO103 #2	UO102 #2	UO101 #2	UO100 #2
288	UO231 #2	UO230 #2	UO229 #2	UO228 #2	UO227 #2	UO226 #2	UO225 #2	UO224 #2
289	UO223 #2	UO222 #2	UO221 #2	UO220 #2	UO219 #2	UO218 #2	UO217 #2	UO216 #2
290	UO215 #2	UO214 #2	UO213 #2	UO212 #2	UO211 #2	UO210 #2	UO209 #2	UO208 #2
291	UO207 #2	UO208 #2	UO205 #2	UO204 #2	UO203 #2	UO202 #2	UO201 #2	UO200 #2
292	UO331 #2	UO330 #2	UO329 #2	UO328 #2	UO327 #2	UO326 #2	UO325 #2	UO324 #2
293	UO323 #2	UO322 #2	UO321 #2	UO320 #2	UO319 #2	UO318 #2	UO317 #2	UO316 #2
294	UO315 #2	UO314 #2	UO313 #2	UO312 #2	UO311 #2	UO310 #2	UO309 #2	UO308 #2
295	UO307 #2	UO306 #2	UO305 #2	UO304 #2	UO303 #2	UO302 #2	UO301 #2	UO300 #2

BMI-DO 7

	7	6	5	4	3	2	1	0
296	MA	SA	OP	STL	SPL	RST	AL	RWD
297					INCH	DST		
298	MZRN							
299		MEDT	MMEM		MD	MJ	MH	MS
300	MMLK	MDLK	MABS		MSBK		MDRN	MAFL
301		TIALM		SYALM	OTALM	OHALM	SVALM	PSALM
302				RPBSY				
303								
304								
305								
306								
307								
308								
309								
310							OHEAD2	OHEAD1
311								

BMI-DO 8

	7	6	5	4	3	2	1	0
312	EOSTB		EIREND	EOHEAD				
313	EOA7	EOA6	EOA5	EOA4	EOA3	EOA2	EOA1	EOA0
314	EOD47	EOD46	EOD45	EOD44	EOD43	EOD42	EOD41	EOD40
315	EOD39	EOD38	EOD37	EOD36	EOD35	EOD34	EOD33	EOD32
316	EOD31	EOD30	EOD29	EOD28	EOD27	EOD26	EOD25	EOD24
317	EOD23	EOD22	EOD21	EOD20	EOD19	EOD18	EOD17	EOD16
318	EOD15	EOD14	EOD13	EOD12	EOD11	EOD10	EOD9	EOD8
319	EOD7	EOD6	EOD5	EOD4	EOD3	EOD2	EOD1	EOD0
320					*REEL			TICHK
321								
322								
323								
324								
325								
326								
327								

BMI-DO 9

	7	6	5	4	3	2	1	0
328		INP1	ZP41	ZP31	MD1	MV1	ZP21	ZP1
329							MMLK1	MMI1
330								
331								
332		INP2	ZP42	ZP32	MD2	MV2	ZP22	ZP2
333							MMLK2	MMI2
334								
335								
336		INP3	ZP43	ZP33	MD3	MV3	ZP23	ZP3
337							MMLK3	MMI3
338								
339								
340		INP4	ZP44	ZP34	MD4	MV4	ZP24	ZP4
341							MMLK4	MMI4
342								
343								

BMI-DO 10

	7	6	5	4	3	2	1	0
344		INP5	ZP45	ZP35	MD5	MV5	ZP25	ZP5
345							MMLK5	MMI5
346								
347								

Tool posts and BMI

11TT controls turning machines which can turn one or two workpieces concurrently by operating two tool posts independently.
In other words, it is applicable to either turning machine (with 2 spindles and 2 tool posts) which can turn two workpieces concurrently by using two tool posts with two spindles, or turning machine (with 1 spindle and 2 tool posts) which can turn one workpiece concurrently by using two tool posts with one spindle.
The DI/DO signals of BMI can be sorted when dividing them from the viewpoints of tool posts as described below.

- DI/DO signals common to two tool posts
  A signal having a certain function is provided to both first and second tool posts in common. The reset signal, emergency signal, and other signals that select basic operation modes of the control unit belong to this group. If a memory command operation mode is selected, for example, the memory command operation is selected for both first and second tool posts in common.
  Both first and second tool posts are reset or urgently stopped concurrently by the reset or emergency stop signal.

- DI/DO signals exclusively provided for individual tool posts
  A signal having a certain signal is provided for the first tool post and second tool post independently. These signals are affixed with #1 or #2 at the end of their signal names.
  Symbol #1 shows a signal exclusively provided for the first tool post, while symbol #2 shows a signal exclusively provided for the second tool post.
  These signals are also subdivided into the following two groups.

- Spindle control DI/DO
  The following signals belong to this group.
  i. Command spindle speed signals R00 - R015
  ii. Maximum spindle speed signals MR0 - MR15
  iii. Actual spindle speed signals AR0 - MR15
  iv. Spindle motor command voltage signals RISGN, RI0 - RI12

  In case of 2 spindles and 2 tool posts;
  Individual tool post spindles are controlled by using spindle control DI/DO exclusively provided for tool posts.

  In case of 1 spindle and 2 tool posts;
  The spindle common to two tool posts is controlled by using spindle control DI/DO signals provided for the first tool post.

- DI/DO other than those for spindle control
  The feedrate override signal, auxiliary function code signals, stroke signal, etc. belong to this group. The override of the cutting feedrate can be independently applied to individual tool posts, and auxiliary function code signal and strobe signal are sent to these tool posts independently of each other.

The DI/DO signals provided for each control axis may be said to belong to "DI/DO exclusively provided for individual tool posts" because that the axis controls either tool post only. However, these signals are not affixed with divided by tool posts, but divided by control axis numbers as viewed from the entire system.

In the 11TT the following three groups are provided as the configuration of control axes.

<table>
<tr><td></td><td>1st axis</td><td>2nd axis</td><td>3rd axis</td><td>4th axis</td><td>5th axis</td></tr>
<tr><td rowspan="2">1</td><td colspan="2">1st tool post</td><td colspan="2">2nd tool post</td><td rowspan="2">Not provided</td></tr>
<tr><td>X1</td><td>Z1</td><td>X2</td><td>Z2</td></tr>
<tr><td rowspan="2">2</td><td colspan="3">1st tool post</td><td colspan="2">2nd tool post</td></tr>
<tr><td>X1</td><td>Z1</td><td>Additional axis</td><td>X2</td><td>Z2</td></tr>
<tr><td rowspan="2">3</td><td colspan="2">1st tool post</td><td colspan="2">2nd tool post</td><td rowspan="2">Additional axis</td></tr>
<tr><td>X1</td><td>Z1</td><td>X2</td><td>Z2</td></tr>
</table>

Two axes are provided for each tool post (or, 4 axes in total) as the basic configuration, and one additional axis is provided for either tool post (5 axes in total) as the optional configuration.

10/11/100/110M with same interface as 6M

6M MI - DI

DGN No.	7	6	5	4	3	2	1	0
400	DTCHX	*SVFX	*DECX	*ITX	*-EDX	*+EDX	*-LX	*+LX
401	HX				MLKX	MIX	-X	+X
402	DTCHY	*SVFY	*DECY	*ITY	*-EDY	*+EDY	*-LY	*+LY
403	HY				MLKY	MIY	-Y	+Y
404	DTCHZ	*SVFZ	*DECZ	*ITZ	*-EDZ	*+EDZ	*-LZ	*+LZ
405	HZ				ZNG	MIZ	-Z	+Z
406	4NG	*SVF4	*DEC4	*IT4	*-ED4	*+ED4	*-L4	*+L4
407	H4				MLK4	MI4	-4	+4
408	MLK	DLK	ABS	OVC	SBK	BDT1	DRN	AFL
409	ZRN	BRN	SRN	KEY	F1D		FIN	ST
410	ERS	RRW	*SP	*ESP	SKIP	UINT	SAR	
411	GST	SOR	*SSTP	GRB	GRA	SPC	SPB	SPA
412	AGJ	EDT	MEM	T	D	J	H	S
413	MP4	MP2	MP1	*FV16	*FV8	*FV4	*FV2	*FV1
414	RT	ROV2	ROV1	*JV16	*JV8	*JV4	*JV2	*JV1
415	BDT9	BDT8	BDT7	BDT6	BDT5	BDT4	BDT3	BDT2
	AGSTB	AG24	AG22	AG21	AG18	AG14	AG12	AG11

6M • MI – DI

DGN No.	7	6	5	4	3	2	1	0
416	TLRST							
417	TLSKP	TL64	TL32	TL16	TL08	TL04	TL02	TL01
418			AGST	WN16	WN8	WN4	WN2	WN1
419	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
420	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8
421	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0
422	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8
423	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
424	SIND			R13I	R12I	R11I	R10I	R09I
425	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
426	5NG	*SVF5	*DEC5	*IT5	*-ED5	*+ED5	*-L5	*+L5
427	H5				MLK5	MI5	-5	+5

6M • MI - DO

DGN No.	7	6	5	4	3	2	1	0	
500	MA	SA	OP	STL	SPL	RST	AL	RWD	
501	CSS	THRD	RPD	TAP	INCH	DST	IPEN	DEN	
502	SSP	SRV	FMF	EF	BF	TF	SF	MF	
503	MMIY	SEY	ZP2Y	ZPY	MMIX	SEX	ZP2X	ZPX	
504	MMI4	SE4	ZP24	ZP4	MMIZ	SEZ	ZP2Z	ZPZ	
505	TLCHB	TLCHA	ESEND	EREND	MMI5	SE5	ZP25	ZP5	
506	M30	M02	M01	M00	M38	M34	M32	M32	
507	M28	M24	M22	M21	M18	M14	M12	M11	
508	T48	T44	T42	T41	T38	T34	T32	T31	
509	T28	T24	T22	T21	T18	T14	T12	T11	
510	S28	S24	S22	S21	S18	S14	S12	S11	(param.)
	S52	S51	S48	S44	S42	S41	GRB	GRA	S12BIT-A
	S48	S44	S42	S41	S38	S34	S32	S31	S12BIT-B
511	B38	B34	B32	B31	B28	B24	B22	B21	(param.)
	S28	S24	S22	S21	S18	S14	S12	S11	S12BIT-A
	S28	S24	S22	S21	S18	S14	S12	S11	S12BIT-B
512	B18	B14	B12	B11	R12	R11	R10	R09	(param.)
	B38	B34	S32	S31	R12	R11	R10	R09	S12BIT-A
	S58	S54	S52	S51	R12	R11	R10	R09	S12BIT-A
513	R08	R07	R06	R05	R04	R03	R02	R01	
514	UO15	UO14	UO13	UO12	UO11	UO10	UO9	UO8	
515	UO7	UO6	UO5	UO4	UO3	UO2	UO1	UO0	

6M · MI - DO

DGN No.	7	6	5	4	3	2	1	0
516	MMLK	MDLK	MABS	MZNG	MSBK	MBDT1	MDRN	MAFL
517	MBDT9	MBDT8	MBDT7	MBDT6	MBDT5	MBDT4	MBDT3	MBDT2
518							BCLP	MUCL

* The underlined signals are added to 6M.
  DI DTCHX, Y, Z : detach axis
  MLKX, Y, 4, 5 : machine lock axis
  MIZ : mirror image
  *+ED4, 5, *-ED4, 5: external deceleration
  BRN : block return
  DO CSS : constant cutting speed mode
  THRD : threading mode
  TAP : tapping mode
  INCH : inch input mode
  IPEN : interpolation end
  MMIZ : mirror imaged
  SE5 : axis select

* The following signals are not provided for 6T, but exclusively for 6M.
  DI F1D, angular jogs (AGJ, AGSTB, AG11 ∿ AG24, AGST), OVRCD, *BECLP, *BEUCL
  DO SSP, SRV, FMF, EF, BF, M 3rd, S 5th, T 3rd-4th, B 1st-3rd, MZNG, BCLP, BUCL

* The following signals are defined in 6T, but not included in above.
  DI STLK, XAE, ZAE, PRC, SMZ, CDZ, *SECLP, *SEUCL, SPSTP
  DO SCLP, SUCL

10/11/100/110T with the same interface as 6T

6T • MI - DI

DGN No.	7	6	5	4	3	2	1	0
400	DTCHX	*SVFX	*DECX	*ITX	*-EDS	*+EDX	*-LX	*+LX
401	HX				MLKX	MIX	-X	+X
402	DTCHZ	*SVFZ	*DECZ	*ITZ	*-EDZ	*+EDZ	*-LZ	*+LZ
403	HZ				MLKZ	MIZ	-Z	+Z
404	DTCH3	*SVF3	*DEC3	*IT3	*-ED3	*+ED3	*-L3	*+L3
405	H3				MLK3	MI3	-3	+3
406	DTCH4	*SVF4	*DEC4	*IT4	*-ED4	*+ED4	*-L4	*+L4
407	H4				MLK4	MI4	-4	+4
408	MLK	DLK	ABS	OVC	SBK	BDT1	DRN	AFL
409	ZRN	BRN	SRN	KEY			FIN	ST
410	ERS	RRW	*SP	*ESP	SKIP	UINT	SAR	STLK
411	GST	SOR	*SSTP			SPC	SPB	SPA
412		EDT	MEM	T	D	J	HS	
413	MP4	MP2	MP1		GR4	GR3	GR2	GR1
414	RT	ROV2	ROV1	*OV16	*OV8	*OV4	*OV2	*OV1
415	BDT9	BDT8	BDT7	BDT6	BDT5	BDT4	BDT3	BDT2

6T • MI - DI

DGN No.	7	6	5	4	3	2	1	0
416	TLRST		PRC		ZAE	XAE	SMZ	CDZ
417	TLSKP				TL08	TL04	TL02	TL01
418				WN16	WN8	WN4	WN2	WN1
419	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
420	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8
421	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0
422	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8
423	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
424	SIND			R13I	R12I	R11I	R10I	R09I
425	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I
426					*SECLP	*SEUCL		SPSTP
427								

6T • MI – DO

DGN No.	7	6	5	4	3	2	1	0
500	MA	SA	OP	STL	SPL	RST	AL	RWD
501	CSS	THRD	RPD	TAP	INCH	DST	IPEN	DEN
502						TF	SF	MF
503	MMIZ	SEZ	ZP2Z	ZPZ	MMIX	SEX	ZP2X	ZPX
504	MMI4	SE4	ZP24	ZP4	MMI3	SE3	ZP23	ZP3
505	TLCHB	TLCHA	ESEND	EREND				
506	M30	M02	M01	M00				
507	M28	M24	M22	M21	M18	M14	M12	M11
508								
509	T28	T24	T22	T21	T18	T14	T12	T11
510	S48	S44	S42	S41	S38	S34	S32	S31
511	S28	S24	S22	S21	S18	S14	S12	S11
512					R12	R11	R10	R09
513	R08	R07	R06	R05	R04	R03	R02	R01
514	UO15	UO14	UO13	UO12	UO11	UO10	UO9	UO8
515	UO7	UO6	UO5	UO4	UO3	UO2	UO1	UO0

6T • MI - DO

DGN No.	7	6	5	4	3	2	1	0
516	MMLK	MDLK	MABS		MSBK	MBDT1	MDRN	MAFL
517	MBDT9	MBDT8	MBDT7	MBDT6	MBDT5	MBDT4	MBDT3	MBDT2
518							SCLP	SUCL

* The underlined signals are added to 6M.

DI DTCHX, Z, 3, 4 : detach axis
MLKX, Z, 3, 4 : machine lock axis
MIZ, 3, 4 : mirror image
*+EDX, Z, 3, 4 : external deceleration
*-EDX, Z, 3, 4
BRN : block return

DO CSS : constant cutting speed mode
THRD : threading mode
TAP : tapping mode
INCH : inch input mode
IPEN : interpolation end
MMIX, Z, 3, 4 : mirror imaged
SEX, Z, 3, 4 : axis select

* The following signals are not provided for 6M, but exclusively for 6T.

DI STLK, XAE, ZAE, PRC, SMZ, CDZ, *SECLP, *SEUCL, SPSTP
DO SCLP, SUCL

* The following signals are defined in 6M, but not included in above.

DI F1D, angular jogs (AGJ, AGSTB, AG11 ∿ AG24, AGST), OVRCD, *BECLP, *BEUCL
DO SSP, SRV, FMF, EF, BF, M 3rd, S 5th, T 3rd-4th, B 1st-3rd, MZNG, BCLP, BUCL

10/100M with the same interface as in 3M

M • MI - DI1

DGN No.	7	6	5	4	3	2	1	0
400	DTCHX	*SVFX	*DECX	*ITX				
401	HX/ ROV1				MLKX	MIX	-X	+X
402	DTCHY	*SVFY	*DECY	*ITY				
403	HY/ ROV2				MLKY	MIY	-Y	+Y
404	DTCHZ	*SVFZ	*DECZ	*ITZ				
405	HZ/ DRN				ZNG	MIZ	-Z	+Z
406								
407								
408	MLK	DLK	ABS	OVC	SBK	BDT		AFL
409	ZRN	BRN		KEY			FIN	ST
410	ERS		*SP	*ESP	SKIP		SAR	*ILK
411		SOR	*SSTP			SPC	SPB	SPA
412						MD4	MD2	MD1
413		MP2	MP1					
414	RT				*OB8	*OV4	*OV2	*OV1
415								

(Note) The underlined signals are newly added.

3M • MI - DI

DGN No.	7	6	5	4	3	2	1	0
416								
417								
418					PN8	PN4	PN2	PN1
419	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
420	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8
421	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0
422	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8
423	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
424	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
425	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I

3M • MI - DO

DGN No.	7	6	5	4	3	2	1	0	
500	MA	SA	OP	STL	SPL	RST	AL		
501	CSS	THRD	RPD	TAP	INCH	DST	IPEN	DEN	
502					BF	TF	SF	MF	
503			ZP2Y	ZPY			ZP2X	ZPX	
504							ZP2Z	ZPZ / EF	(param.)
505				EREND					
506	M30	M02	M01	M00					
507	M28	M24	M22	M21	M18	M14	M12	M11	
508									
509	T28	T24	T22	T21	T18	T14	T12	T11	
510	S28	S24	S22	S21	S18	S14 / MIG	S12 / MDG	S11 / LWG	(param.)
511	B38	B34	B32	B31	B28	B24	B22	B21	
512	B18	B14	B12	B11					
513									
514	UO15	UO14	UO13	UO12	UO11	UO10	UO9	UO8	
515	UO7	UO6	UO5	UO4	UO3	UO2	UO1	UO0	

3M • MI - DO

DGN No.	7	6	5	4	3	2	1	0
516								
517								
518				ENB				

10/100T with the same interface as 3T

3T • MI - DI

DGN No.	7	6	5	4	3	2	1	0
400	DTCHX	*SVFX	*DECX					
401	HX/ ROV1				MLKX	MIX	-X	+X
402	DTCHZ	*SVFZ	*DECZ					*+LZ
403	HZ/ ROV2				MLKZ	MIZ	-Z	+Z
404								
405								
406								
407								
408	MLK	DLK	ABS	OVC	SBK	BDT	DRN	AFL
409	ZRN	BRN		KEY			FIN	ST
410	ERS		*SP	*ESP	SKIP		SAR	STLK
411		SOR	*SSTP			SPC	SPB	SPA
412						MD4	MD2	MD1
413		MP2	MP1				GR2	GR1
414	RT				*OV8	*OV4	*OV2	*OV1
415								

(Note) The underlined signals are newly added to 3T.

3T • MI - DI

DGN No.	7	6	5	4	3	2	1	0
416			PRC		ZAE	XAE	SMZ	CDZ
417								
418					PN8	PN4	PN2	PN1
419	ESTB	EA6	EA5	EA4	EA3	EA2	EA1	EA0
420	ED15	ED14	ED13	ED12	ED11	ED10	ED9	ED8
421	ED7	ED6	ED5	ED4	ED3	ED2	ED1	ED0
422	UI15	UI14	UI13	UI12	UI11	UI10	UI9	UI8
423	UI7	UI6	UI5	UI4	UI3	UI2	UI1	UI0
424	SIND	SSIN	SGN		R12I	R11I	R10I	R09I
425	R08I	R07I	R06I	R05I	R04I	R03I	R02I	R01I

3T • MI - DO

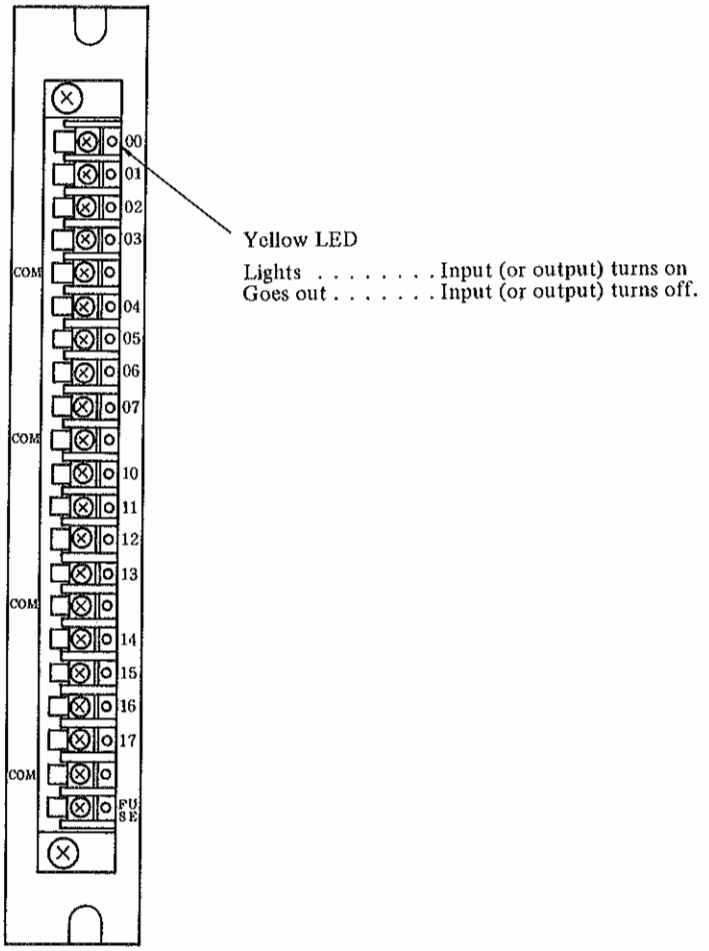
DGN No.	7	6	5	4	3	2	1	0
500	MA	SA	OP	STL	SPL	RST	AL	
501	CSS	THRD	RPD	TAP	INCH	DST	IPEN	DEN
502						TF	SF	MF
503			ZP2Z	ZPZ			ZP2X	ZPX
504								
505				EREND				
506								
507	M28	M24	M22	M21	M18	M14	M12	M11
508								
509	T28	T24	T22	T21	T18	T14	T12	T11
510								
511	B28	B24	B22	B21	B18	B14	B12	B11
512					R12	R11	R10	R09
513	R08	R07	R06	R05	R04	R03	R02	F01
514	UO15	UO14	UO13	UO12	UO11	UO10	UO9	UO8
515	UO7	UO6	UO5	UO4	UO3	UO2	UO1	UO0

3T • MI - DO

DGN No.	7	6	5	4	3	2	1	0
516								
517								
518				ENB				

3.7.6 LED display of I/O module

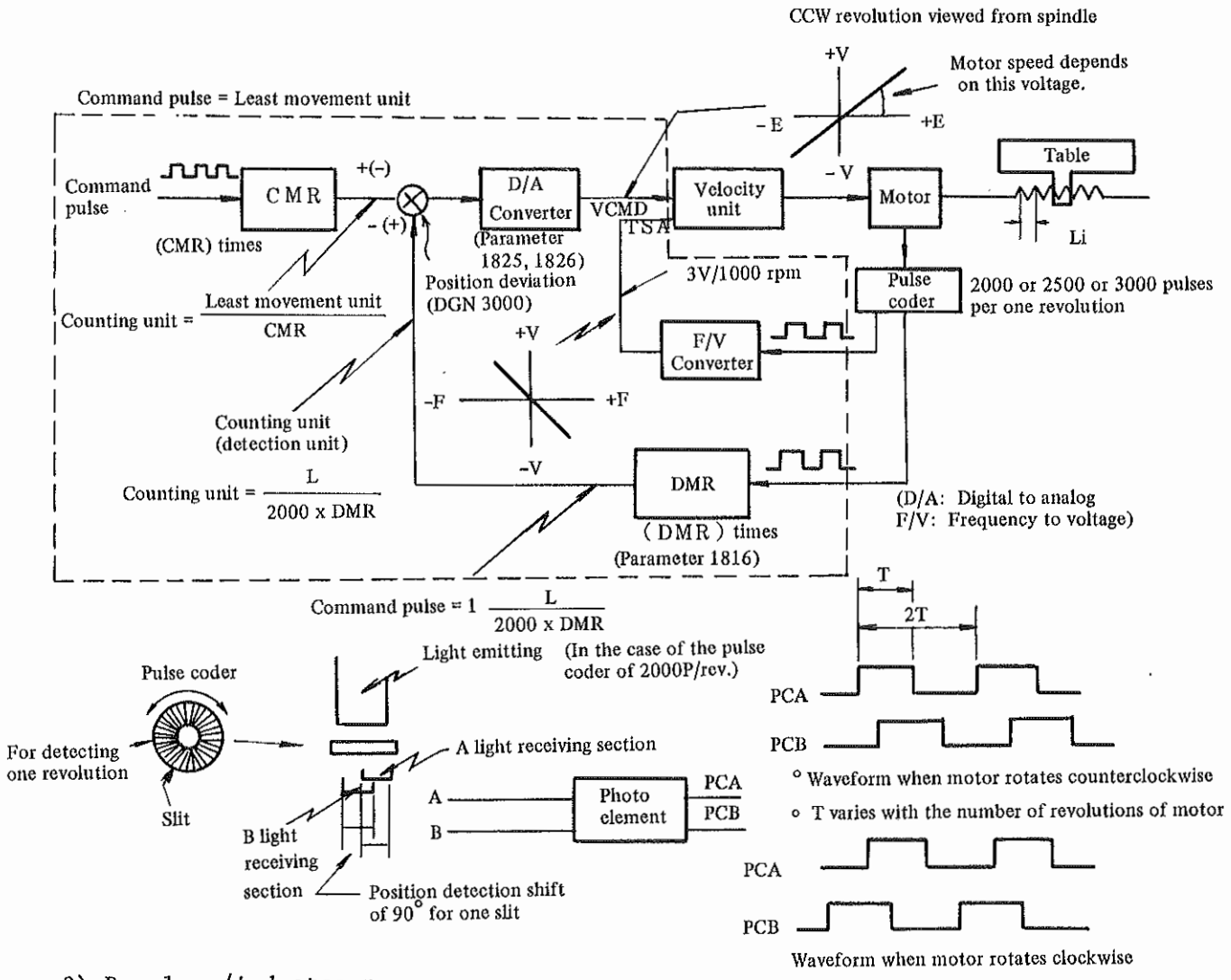
The terminal board connection module of the digital input/digital output modules is provided with LED for indicating the on/off conditions of each I/O signal.



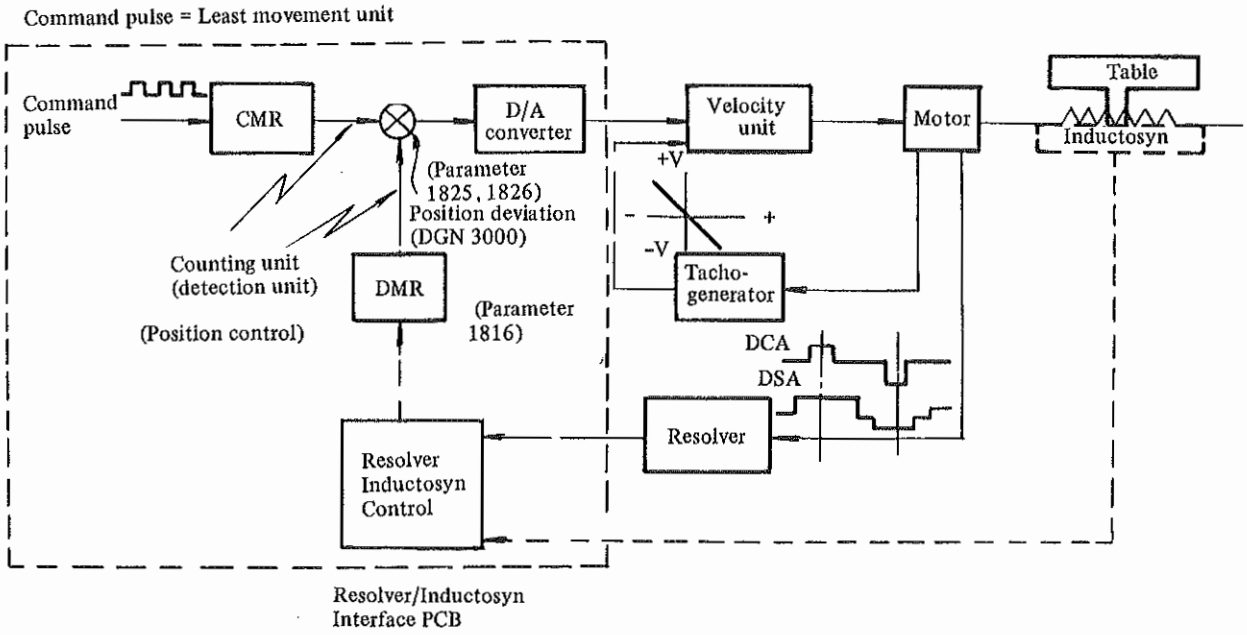
3.8 Block Diagram of Servo System

3.8.1 Block diagram of position control

1) Pulse coder



2) Resolver/inductosyn



o CMR and DMR are the settings required to adjust the amount of table movement complying with the command pulse.

Command pulse: 0.001 mm in metric system 0.0001 inch in inch system

CMR : Command multiply ratio
..... Parameter number 1820 (Standard value: 1 for pulse coder, Resolver and Inductosyn)

DMR : Detect multiply radio
..... Parameter number 1816 (Standard value: 1/2 for Resolver and Inductosyn)

L : Movement amount (mm or inch) for one revolution of the detector

Counting unit: The value which is obtained by dividing the traverse for one revolution of the motor by the feedback pulse of (2000) x DMR (in the case of the pulse coder of 2000P/rev)

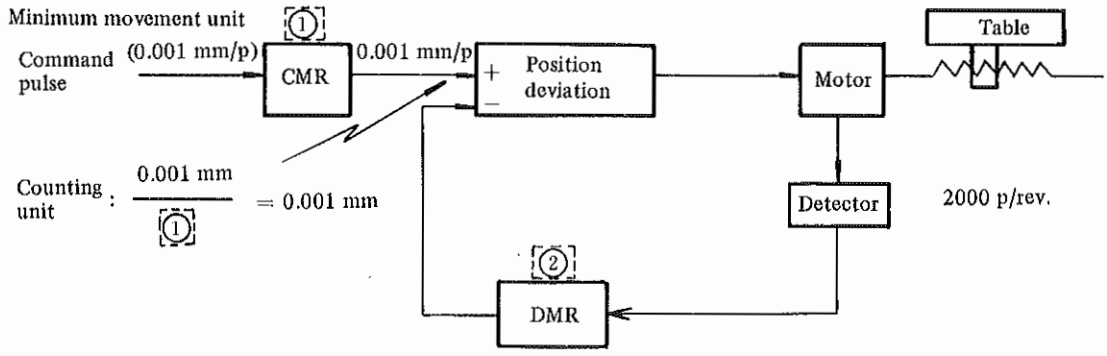
CMR and DMR are the settings to equalize the weight of the command pulse and feedback pulse for one pulse.

$$\text{Counting unit: } \frac{\text{Minimum movement unit (mm or inch)}}{\text{CMR}} = \frac{\text{L (mm or inch)}}{\alpha \times \text{DMR}}$$

α: 2,000 p/rev, 2,500 p/rev or 3,000 p/rev for pulse coder
4,000 p/rev for Resolver or Inductosyn

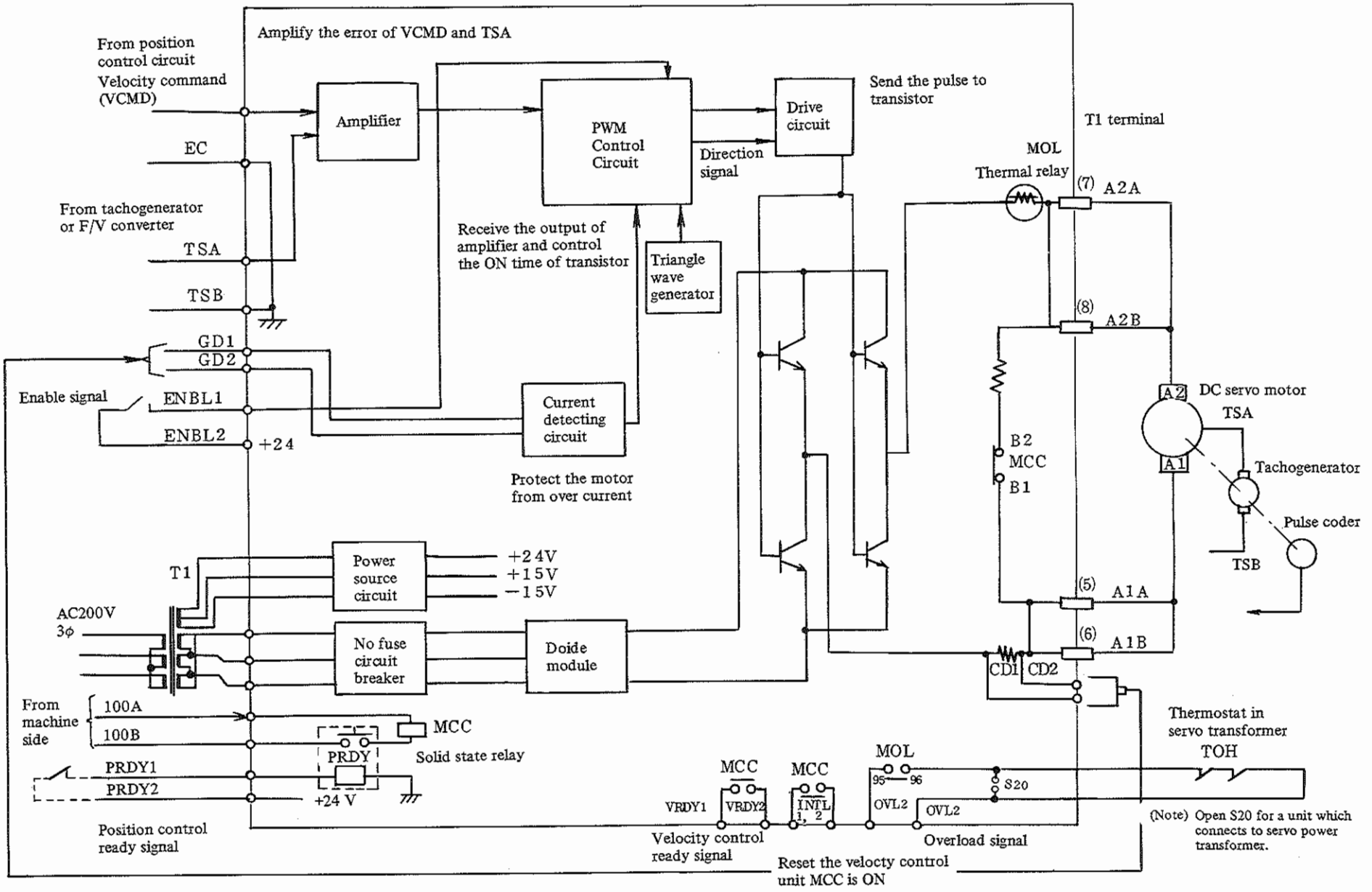
Minimum movement unit: Command pulse

ex. CMR is set to ① and DMR to ② when a movement distance is ④mm per ①revolution of detector.



$$\text{Counting unit} : \frac{4\ \text{mm}}{2000 \times ②} = 0.001\ \text{mm}$$

3.8.2 Block diagram of M series velocity control unit



3.8.3 Internal connection diagram of M series velocity control unit

a) For DC servo motor model 00M (A06B-6047-H001)

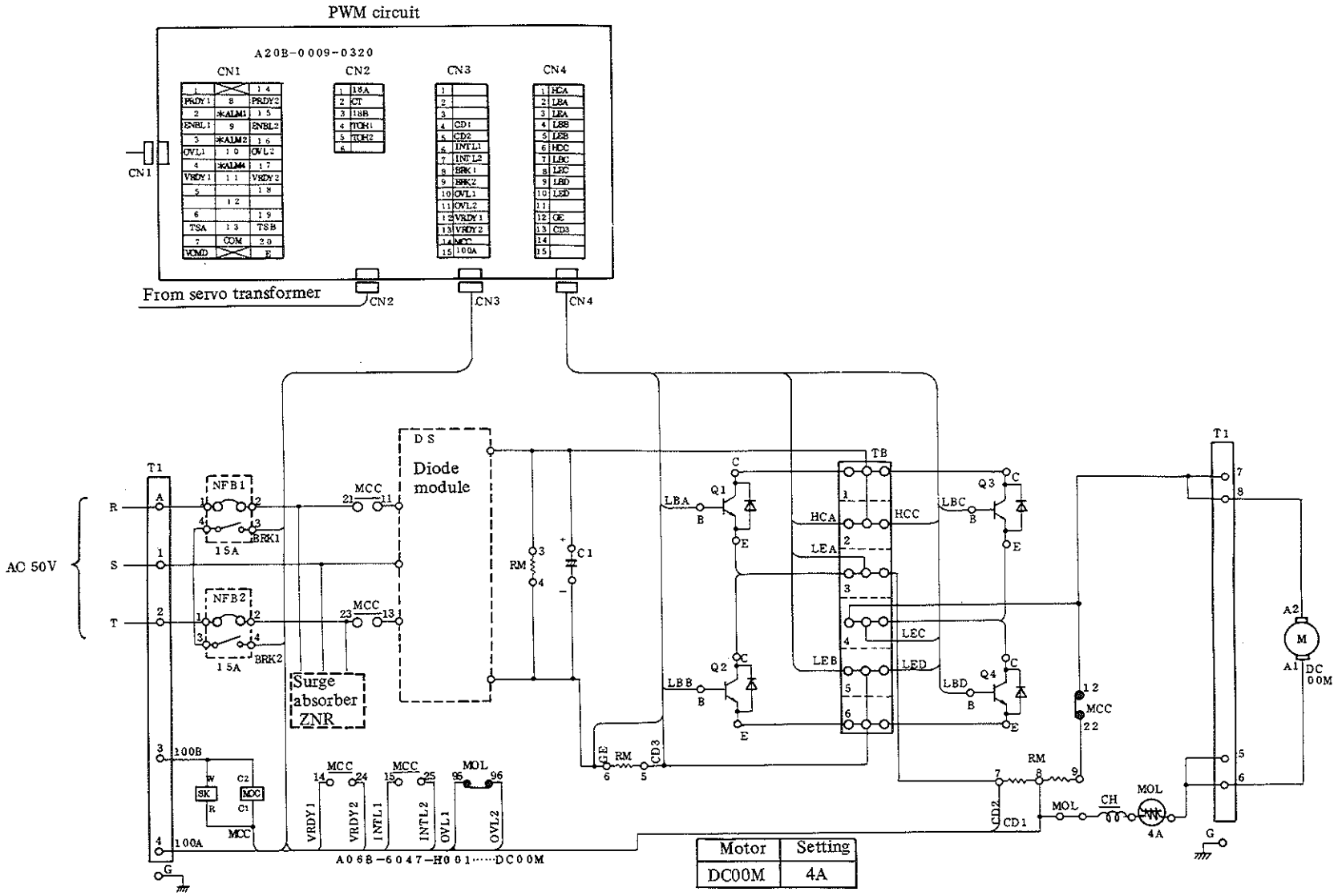
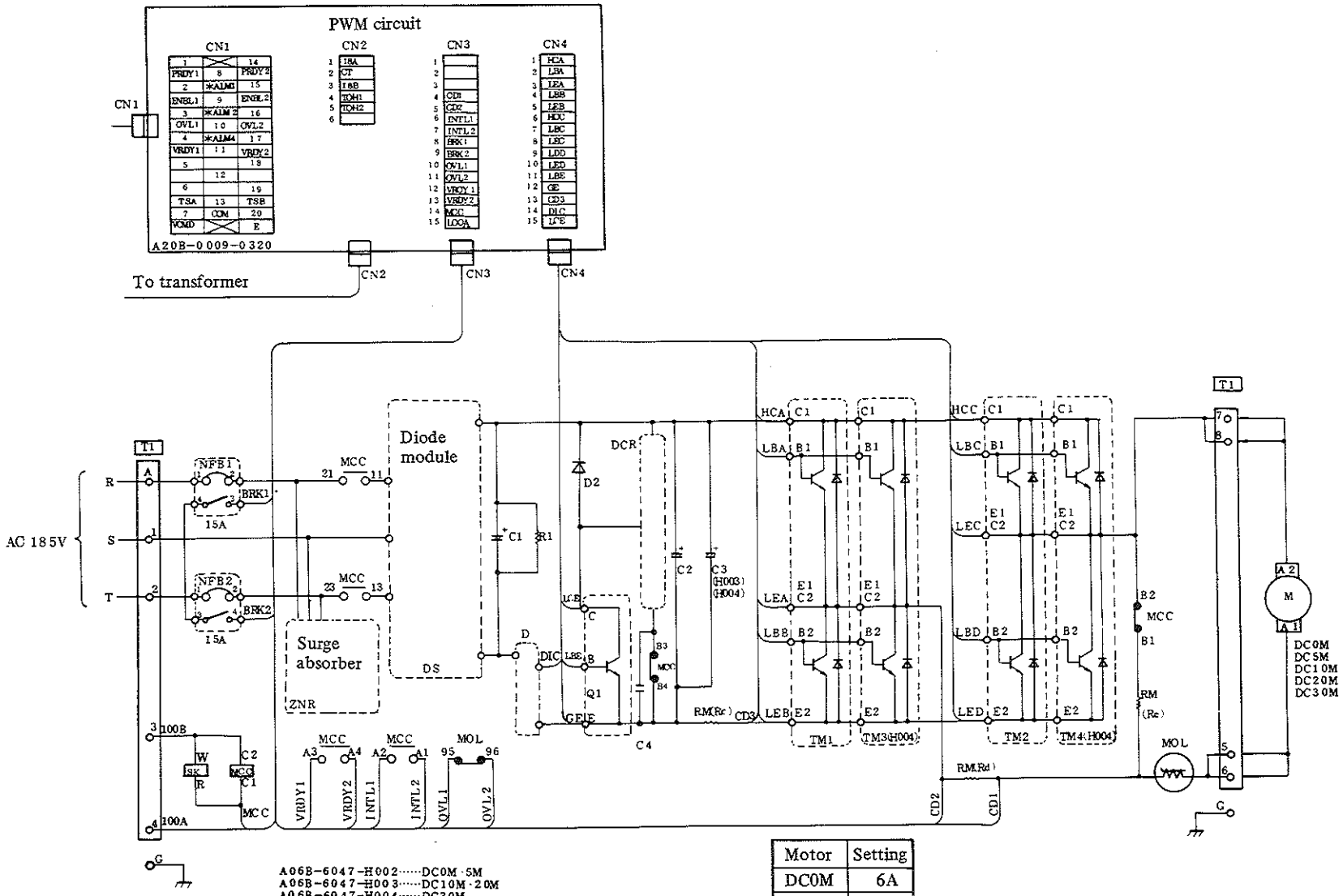


Fig. 3.8.3 (a)

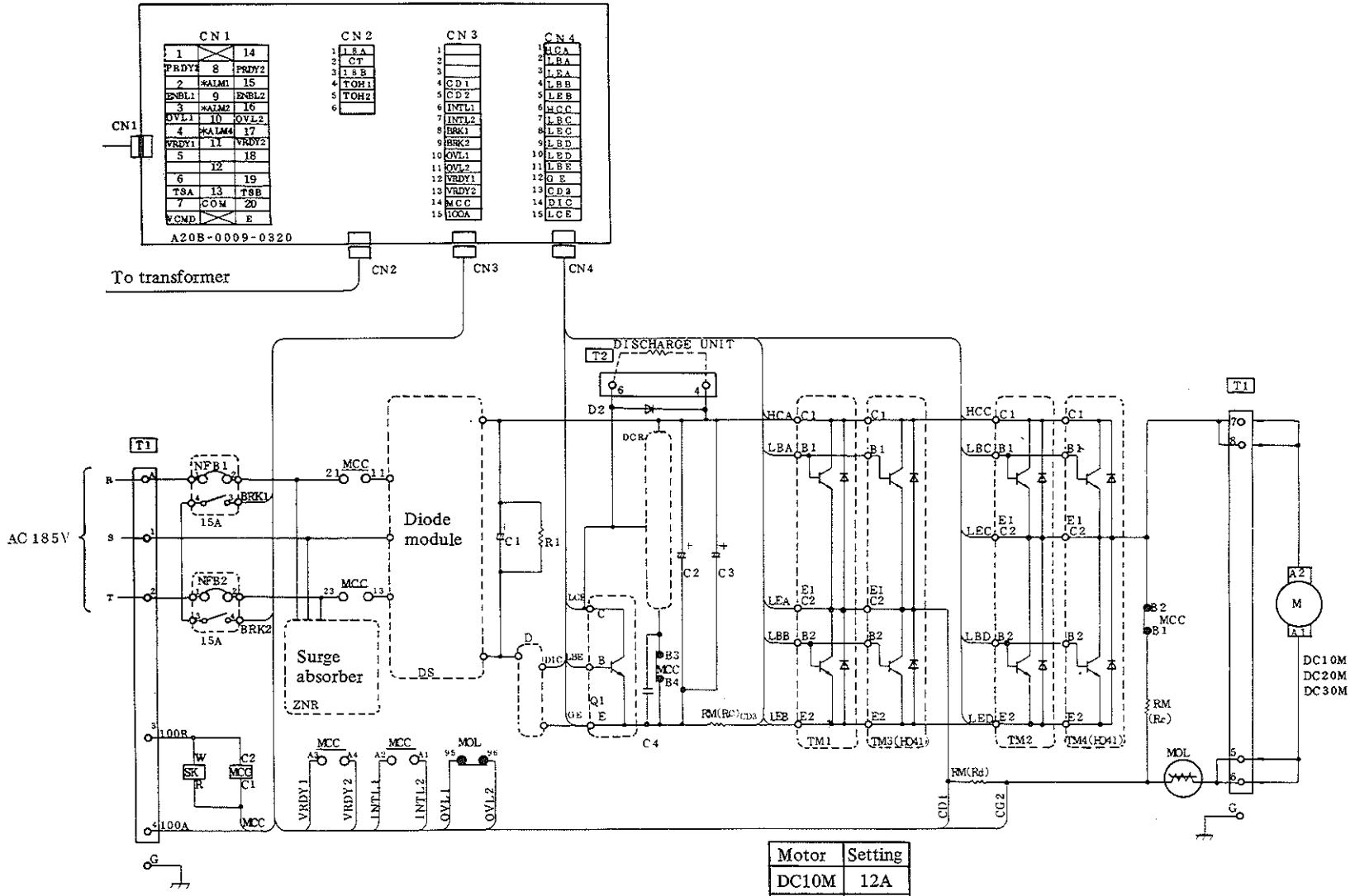
b) For DC servo motor model 0M ∿ 30M (A06B-6047-H002 ∿ 4)



Motor	Setting
DC0M	6A
DC5M	9A
DC10M	12A
DC20M	18A
DC30M	24A

Fig. 3.8.3 (b)

c) For DC servo motor model 10M ∿ 30M for separate discharge circuit
(A06B-6047-H040, H041)



Motor	Setting
DC10M	12A
DC20M	18A
DC30M	24A

Fig. 3.8.3 (c)

3.8.4 Block diagram of M series velocity control unit PCB

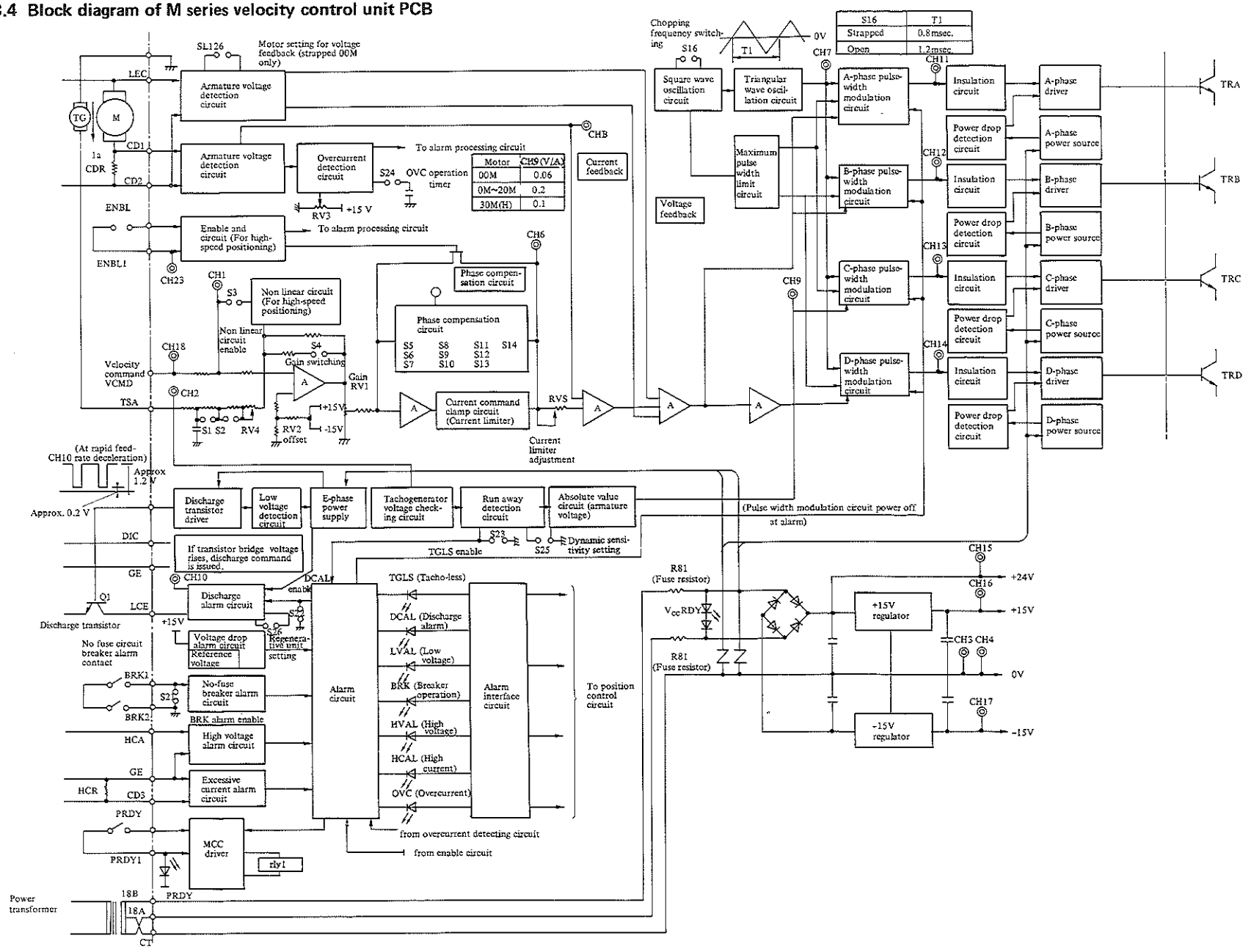


Fig. 3.8.4 (a)

3.8.5 Block diagram of AC series velocity control unit

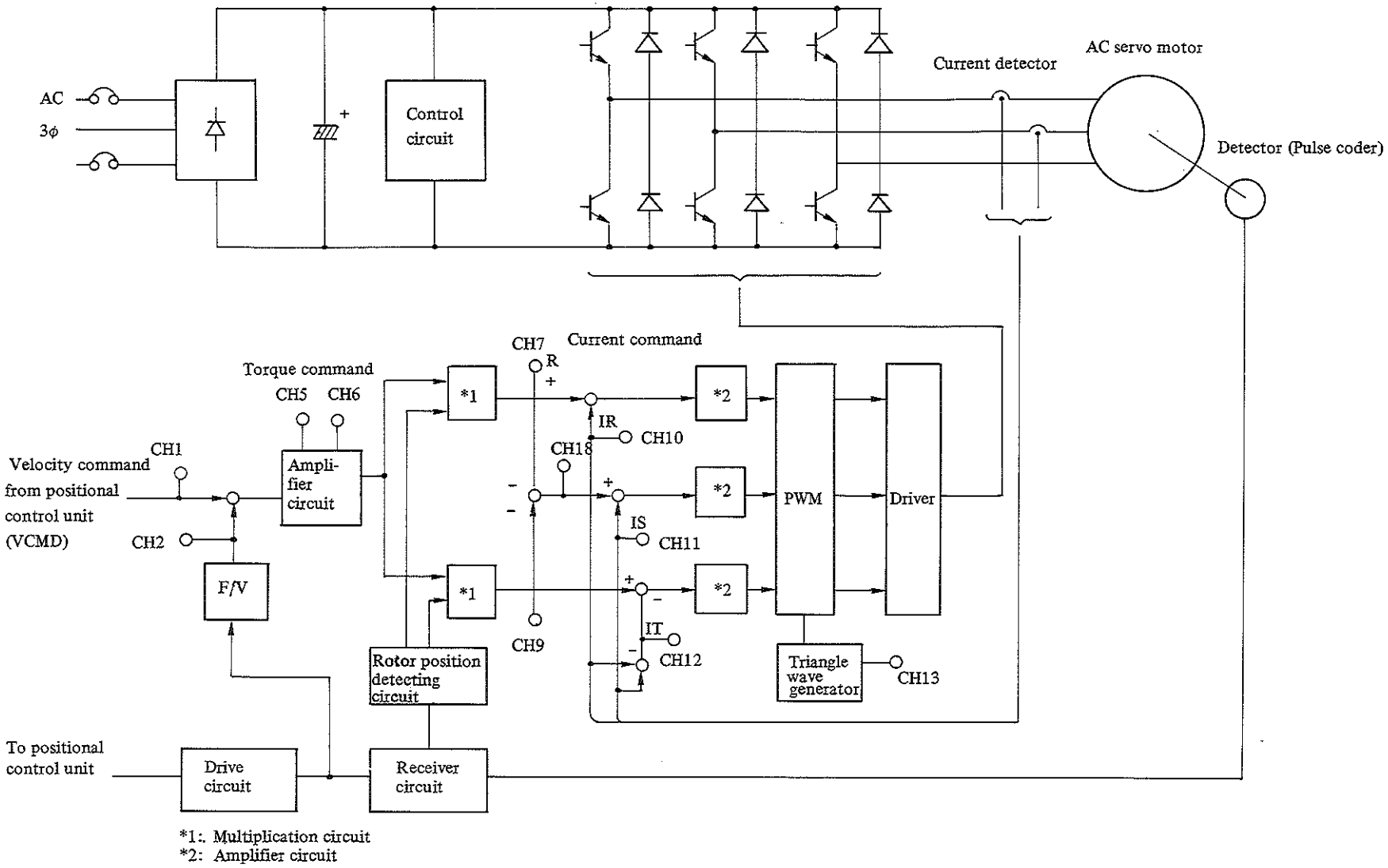


Fig. 3.8.5 (a)

a) For model 2-0, 1-0 (A06B-6050-H002)

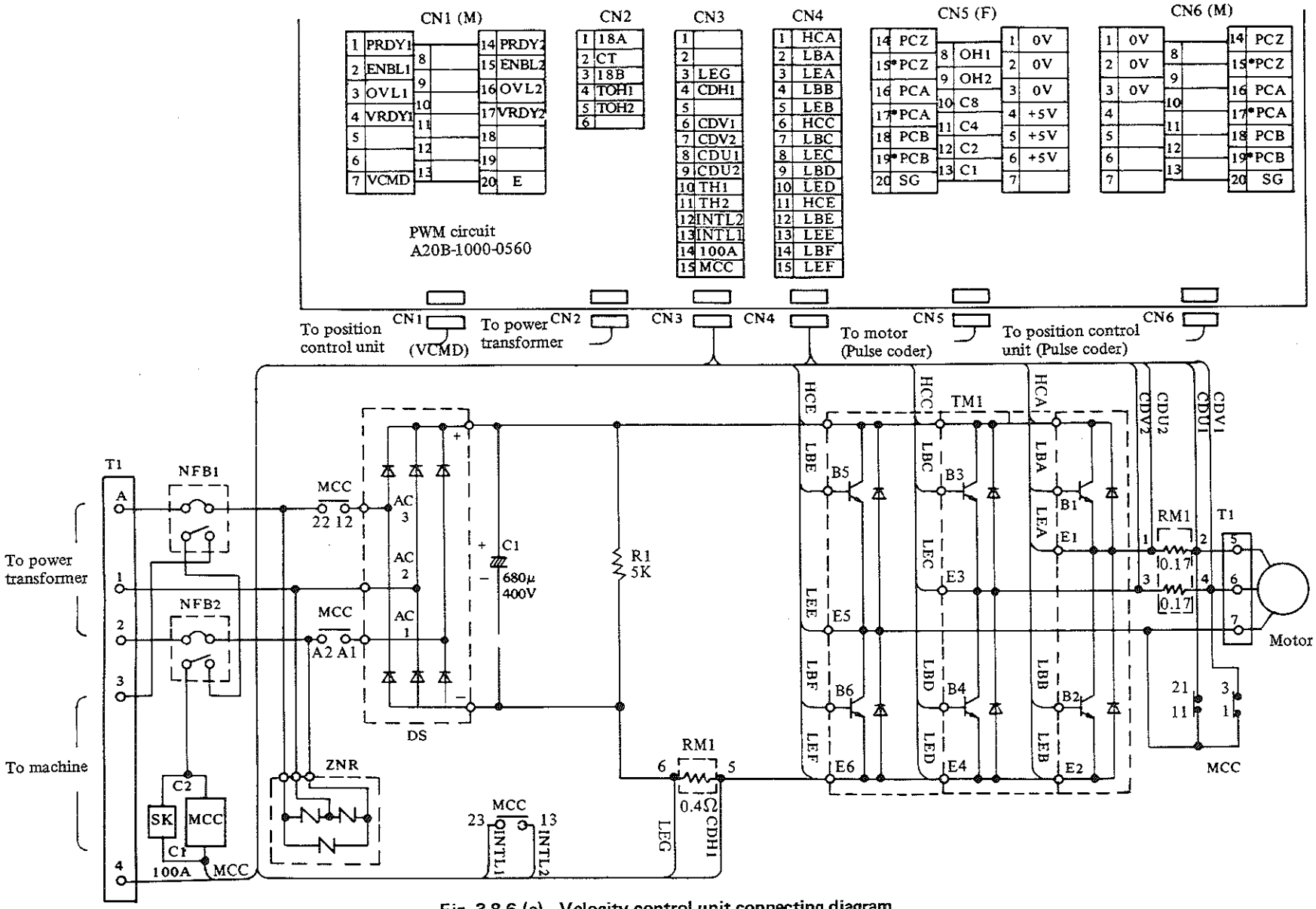


Fig. 3.8.6 (a) Velocity control unit connecting diagram

b) For AC series motor model 0, 5 (A06B-6050-H102)

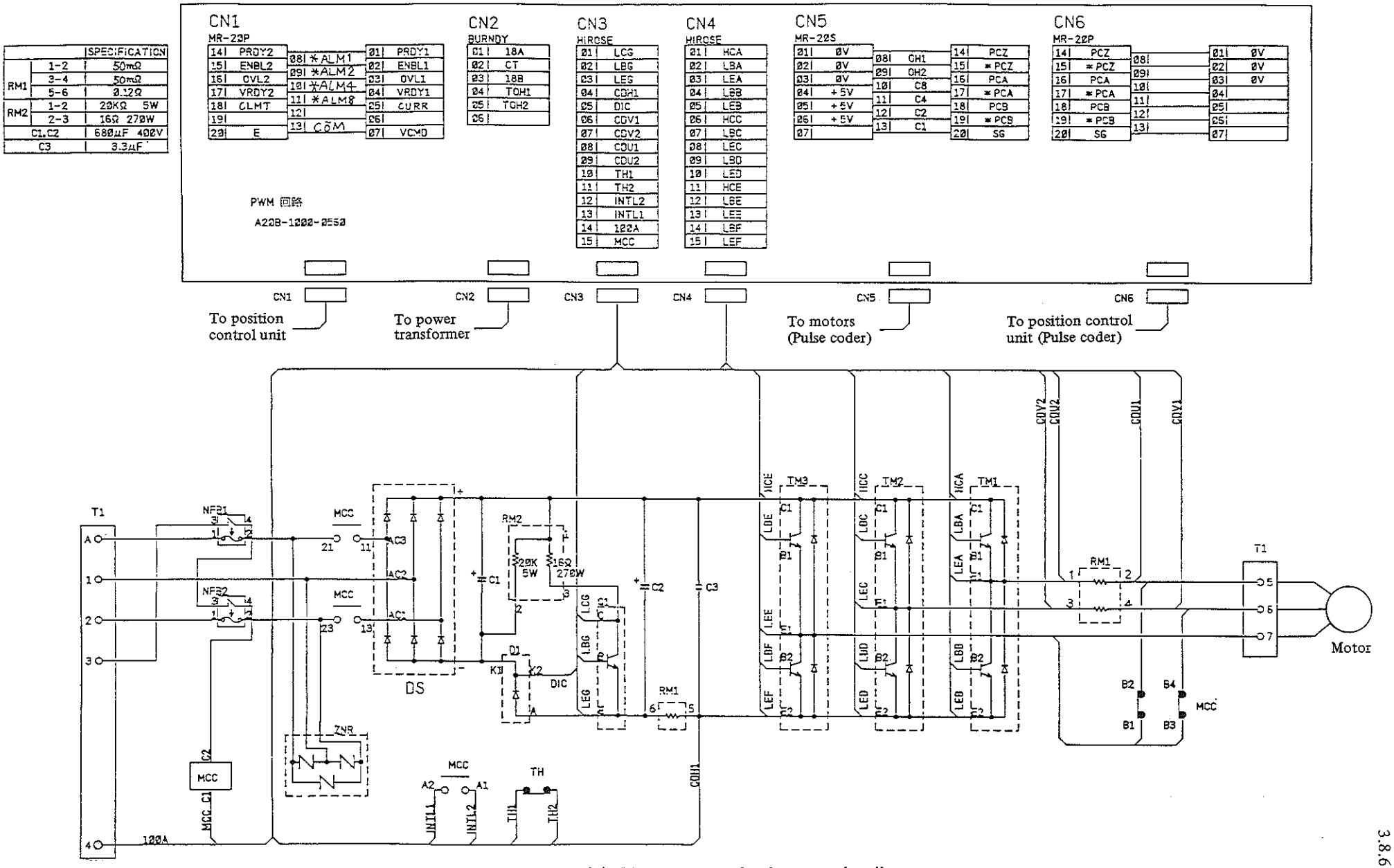
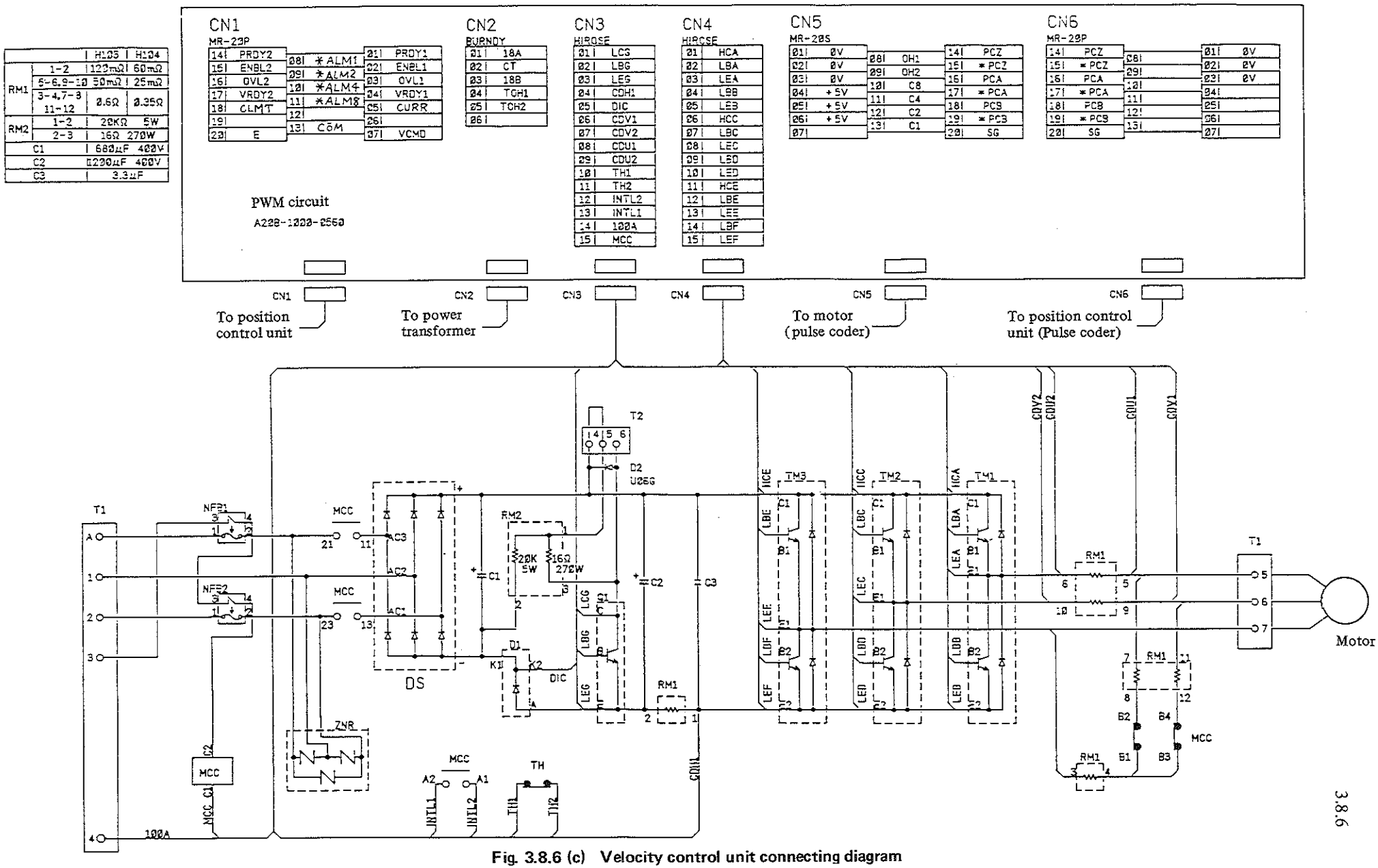


Fig. 3.8.6 (b) Velocity control unit connecting diagram

c) For AC servo motor model 10, 20, 30 (A06B-6050-H103, H104)



		H103	H104
RM1	1-2	120mΩ	60mΩ
	5-6,9-10	50mΩ	25mΩ
	3-4,7-8 11-12	0.6Ω	0.35Ω
RM2	1-2	20KΩ	5W
	2-3	16Ω	270W
C1		680μF	400V
C2		1200μF	400V
C3		3.3μF	

Fig. 3.8.6 (c) Velocity control unit connecting diagram

d) For AC servo motor model 30R (A06B-6050-H005)

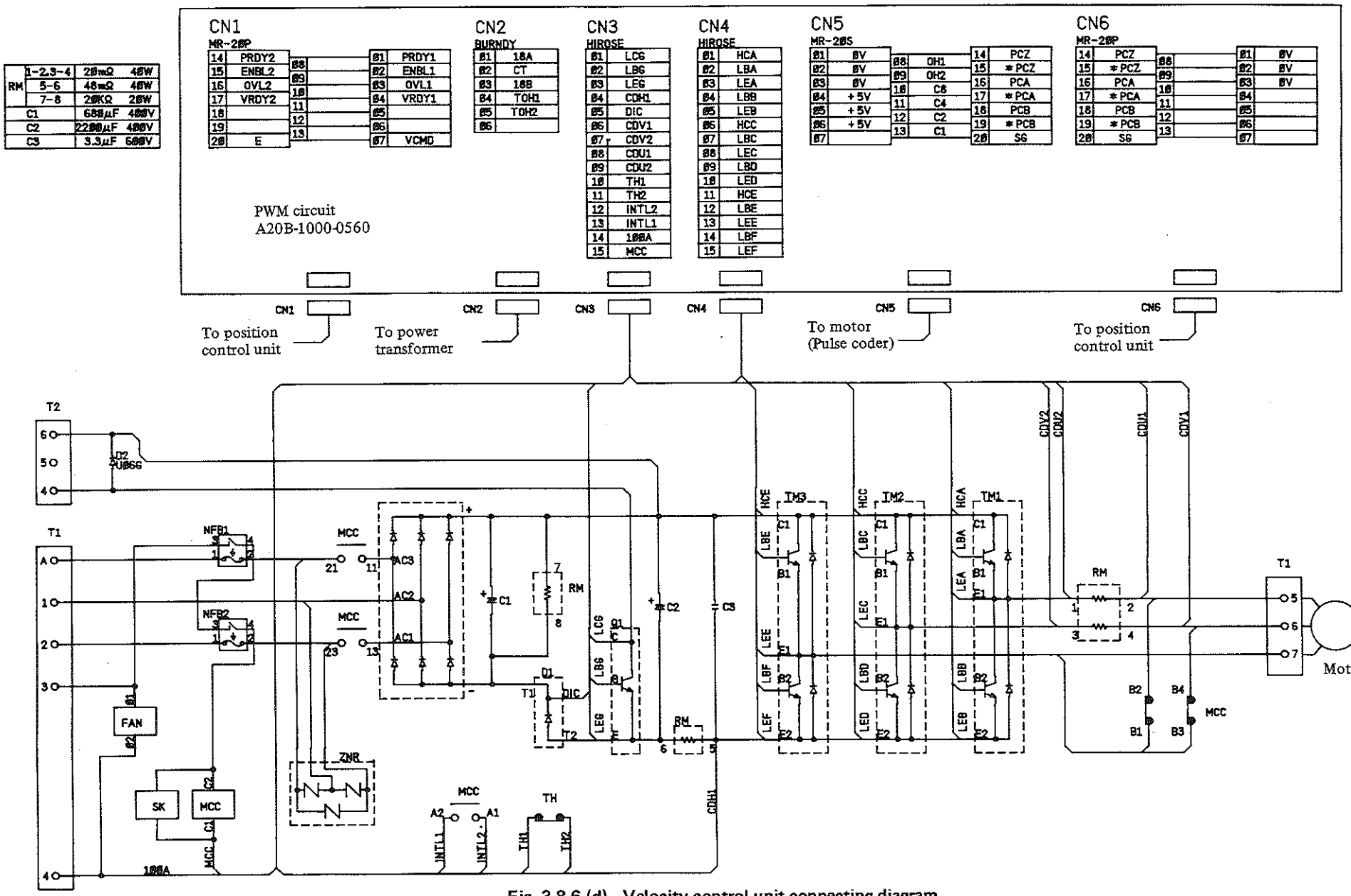


Fig. 3.8.6 (d) Velocity control unit connecting diagram

3.9.1 Connection to M series servo

1) Total connection diagram

The 4th and subsequent axes are also connected as shown in this figure.

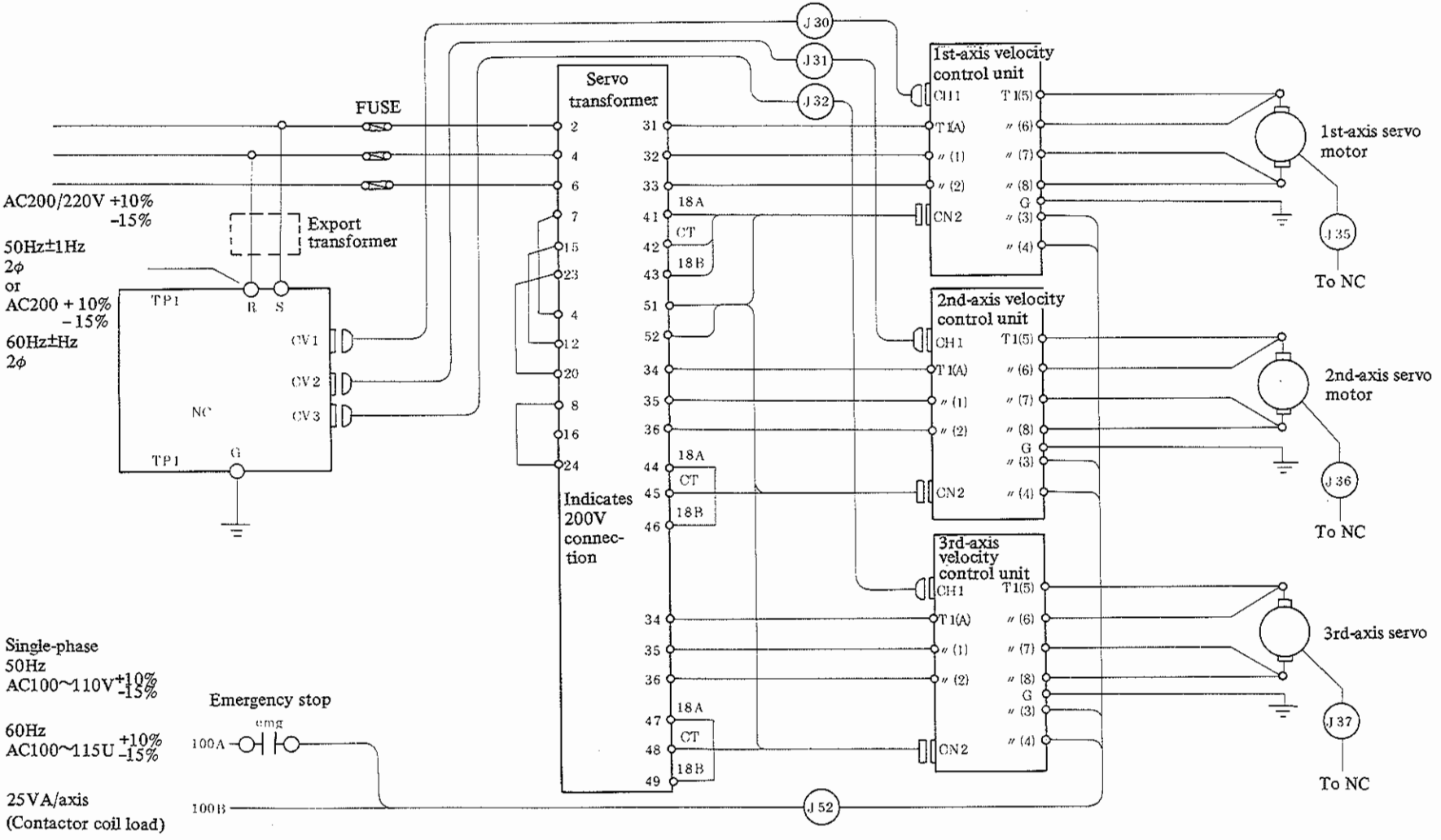
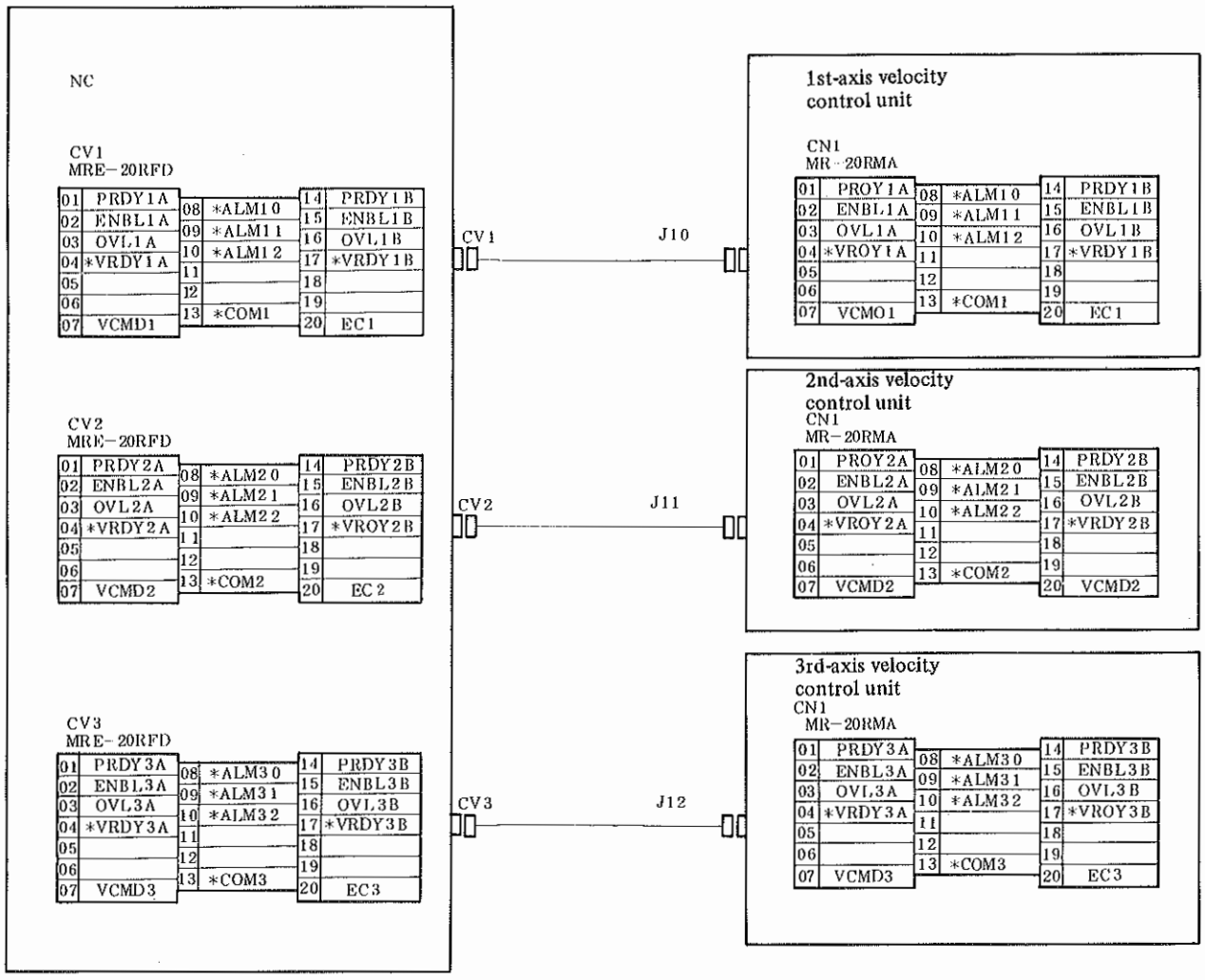


Fig. 3.9.1 (a)

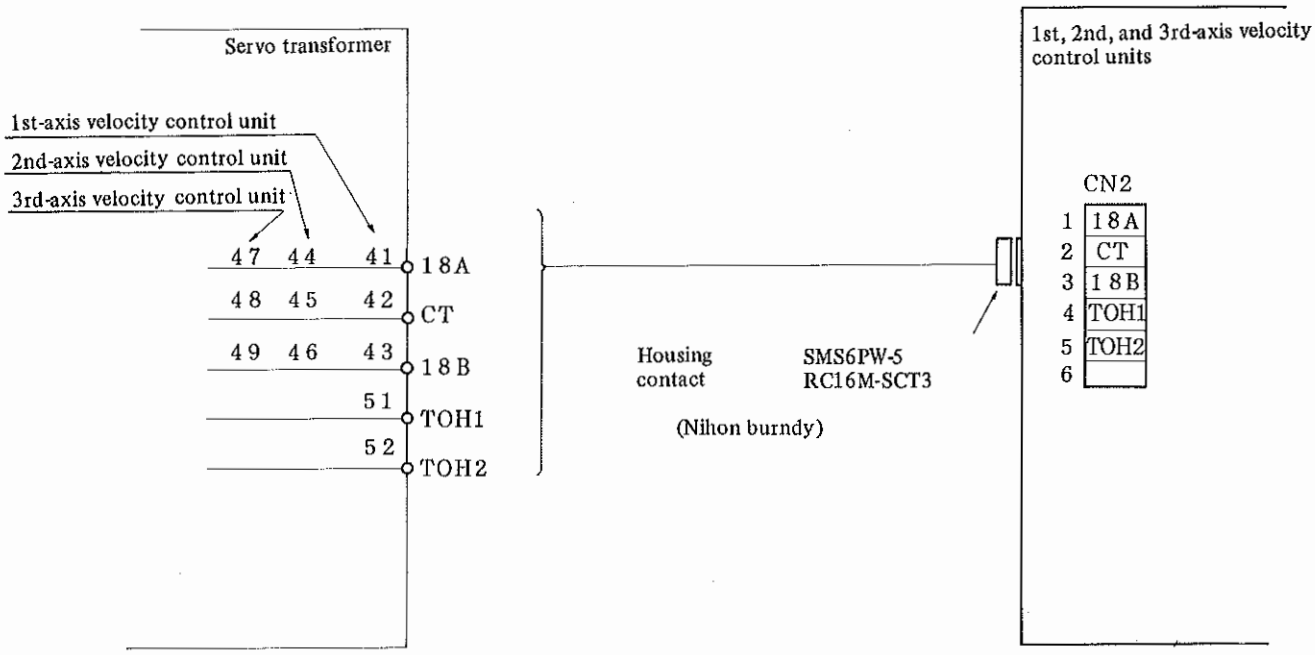
2) Cable J10 ∿ J12 connection diagram



The 4th and subsequent axes are also connected as shown in the above figure.

Fig. 3.9.1 (b) Cable J10 ~ J12 connections

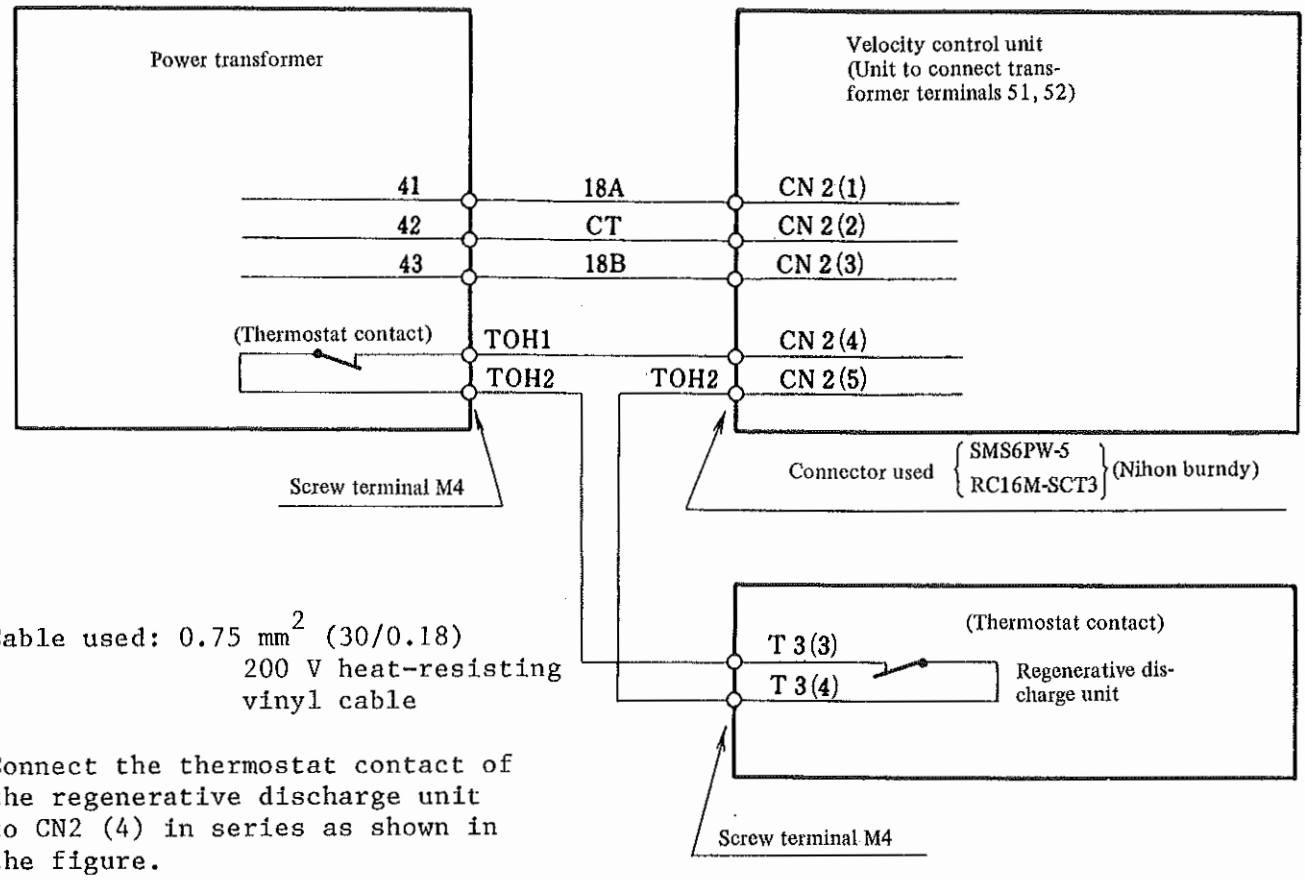
3) Connection of overheat signal line of servo transformer



Cable used: 30/0.18 (0.75 mm^2) vinyle wire

Note: Connect overheat signals TOH1 and 2 of the servo transformer in parallel to all velocity control units to which power is supplied from the servo transformer. Connect signals must parallel each other (as illustrated above) because CN2 (4) (5) terminals on the velocity control unit side are polarized.

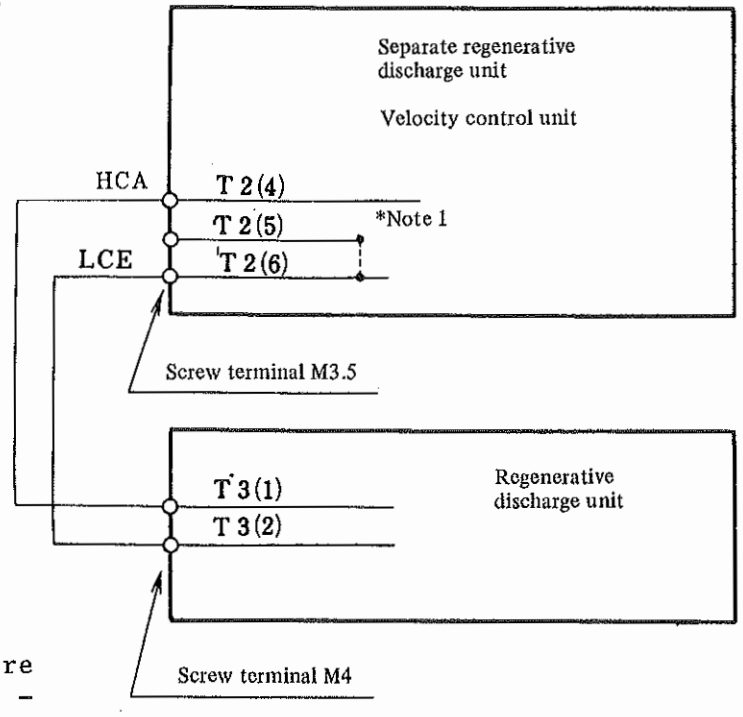
4) Connection to separate regenerative discharge unit



Cable used: 0.75 mm^2 (30/0.18)
200 V heat-resisting vinyl cable

Connect the thermostat contact of the regenerative discharge unit to CN2 (4) in series as shown in the figure.

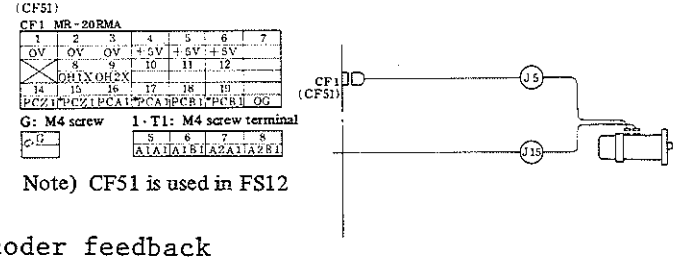
Cable used: 2.0 mm^2 (37/0.26)
200 V heat-resisting vinyl cable



*Note 1) Disconnect the jumper wire between terminals T2 (5) - T2 (6) when the regenerative discharge unit is used with model 30 MH velocity control unit.

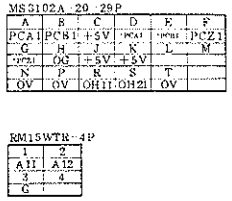
5) Connection to M series DC servo motor

a) Pulse coder feedback (mounted type pulse coder)

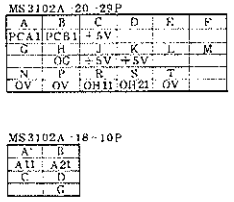


Note) CF51 is used in FS12

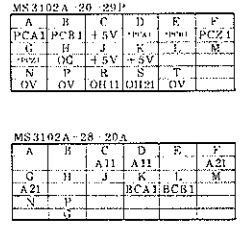
In case of 00M



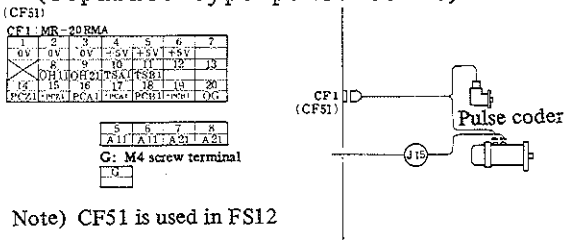
In case of 0M, 5M



In case of 10M, 20M, 30M

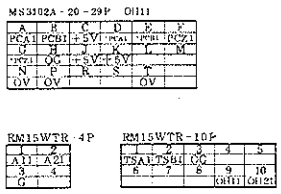


b) Pulse coder feedback
(separate type pulse coder)

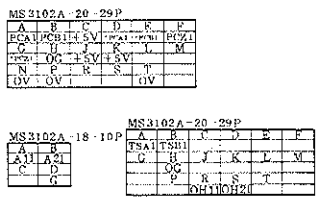


Note) CF51 is used in FS12

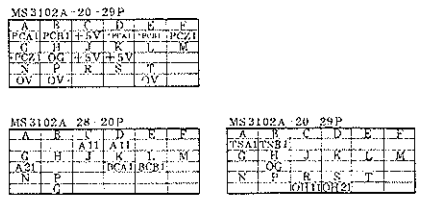
In case of 00M



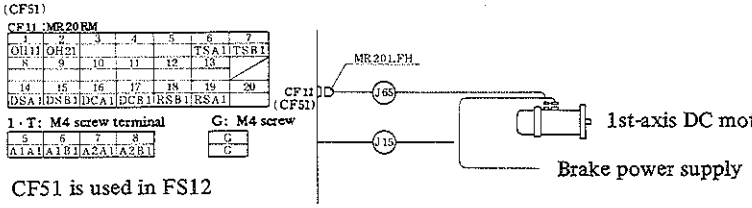
In case of 0M, 5M



In case of 10M, 20M, 30M

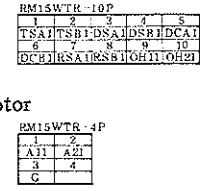


c) Resolver feedback

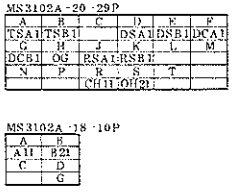


Note) CF51 is used in FS12

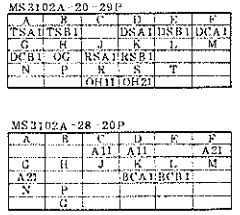
In case of 00M



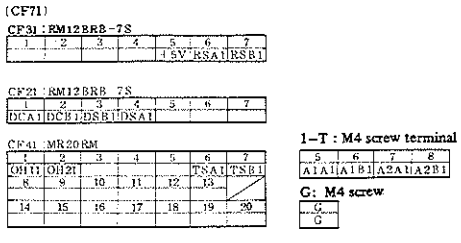
In case of 0M, 5M

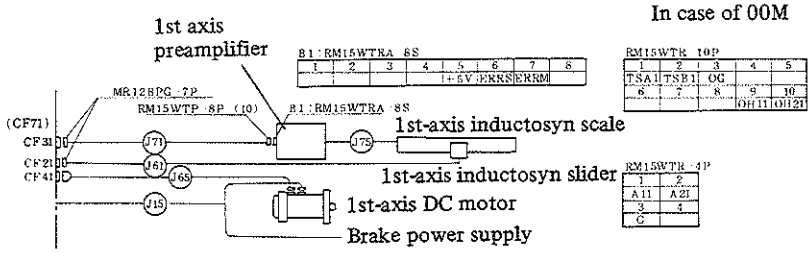


In case of 10M, 20M, 30M



d) Inductosyn feedback

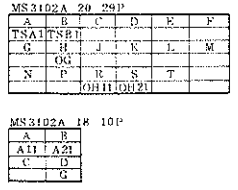




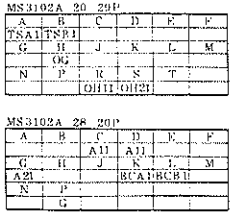
Note) CF71 is used in FS12

In case of 00M

In case of 0M, 5M

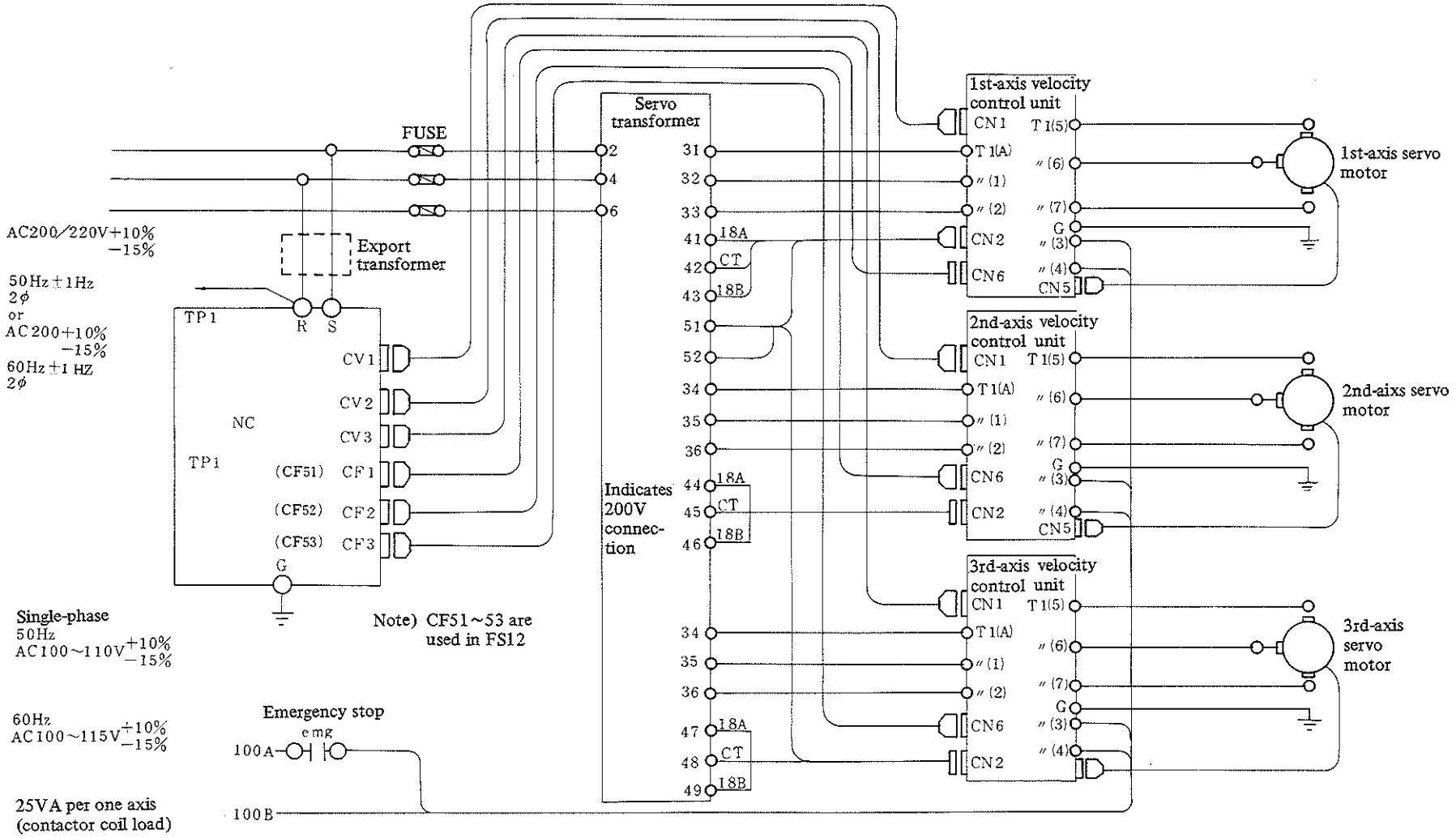


In case of 10M, 20M, 30M

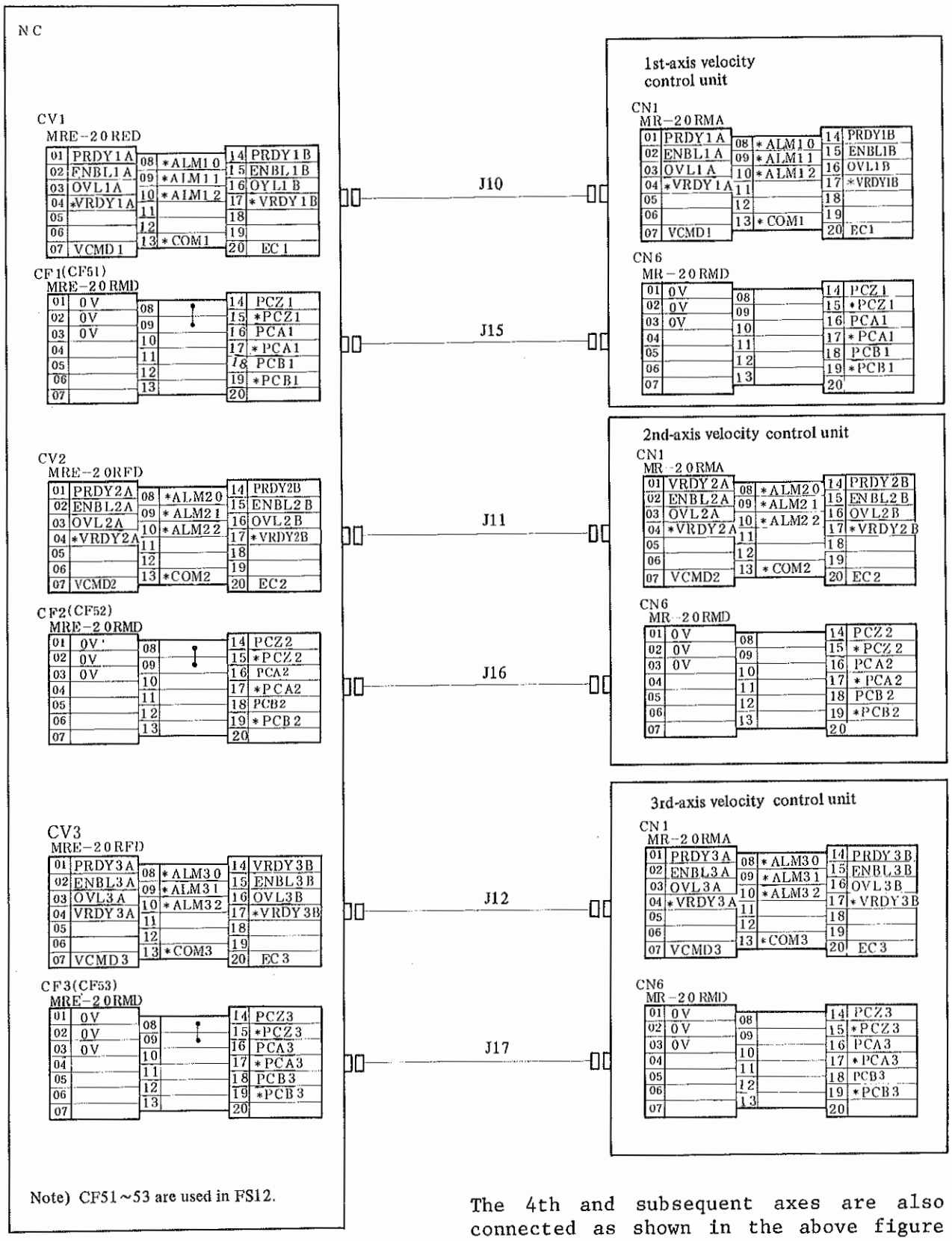


3.9.2 Connection to AC servo

1) Total connection diagram (For analog servo)
The 4th and subsequent axes are also connected as shown in this figure.



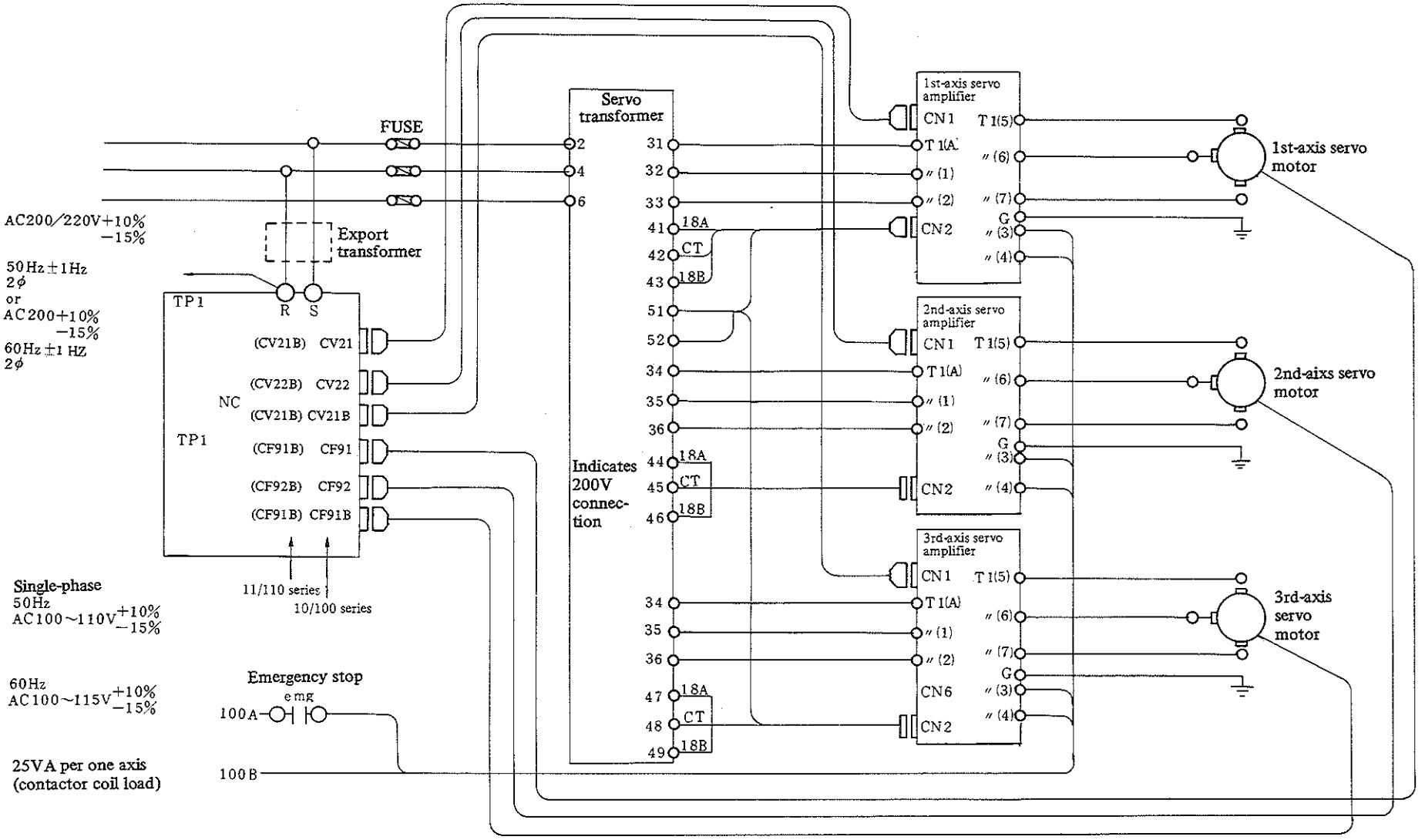
Cable J10 - J12, J15 - J17 connection diagram



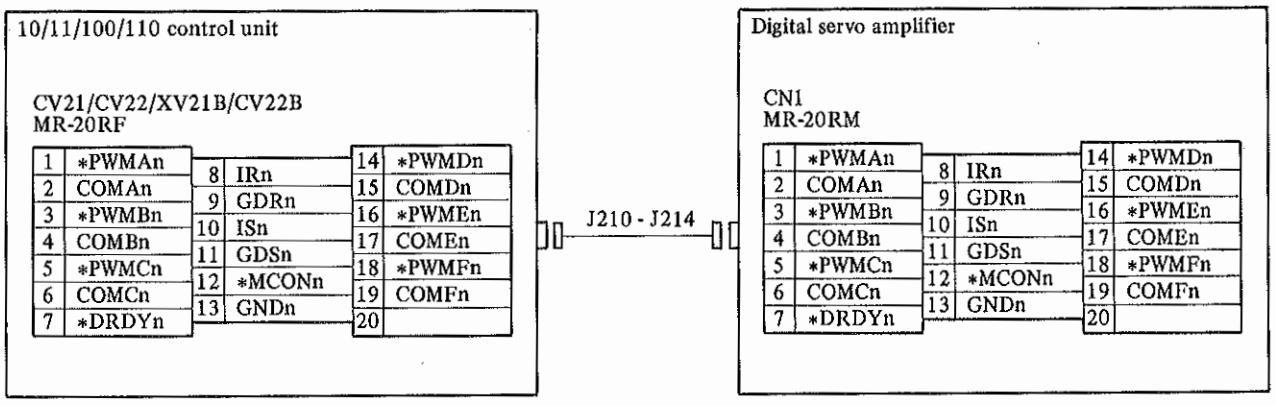
The 4th and subsequent axes are also connected as shown in the above figure correspondingly.

(Mark •—• in the above connectors CF1∿3 shows a short-circuit condition.)

2) Total connection diagram (For digital servo)

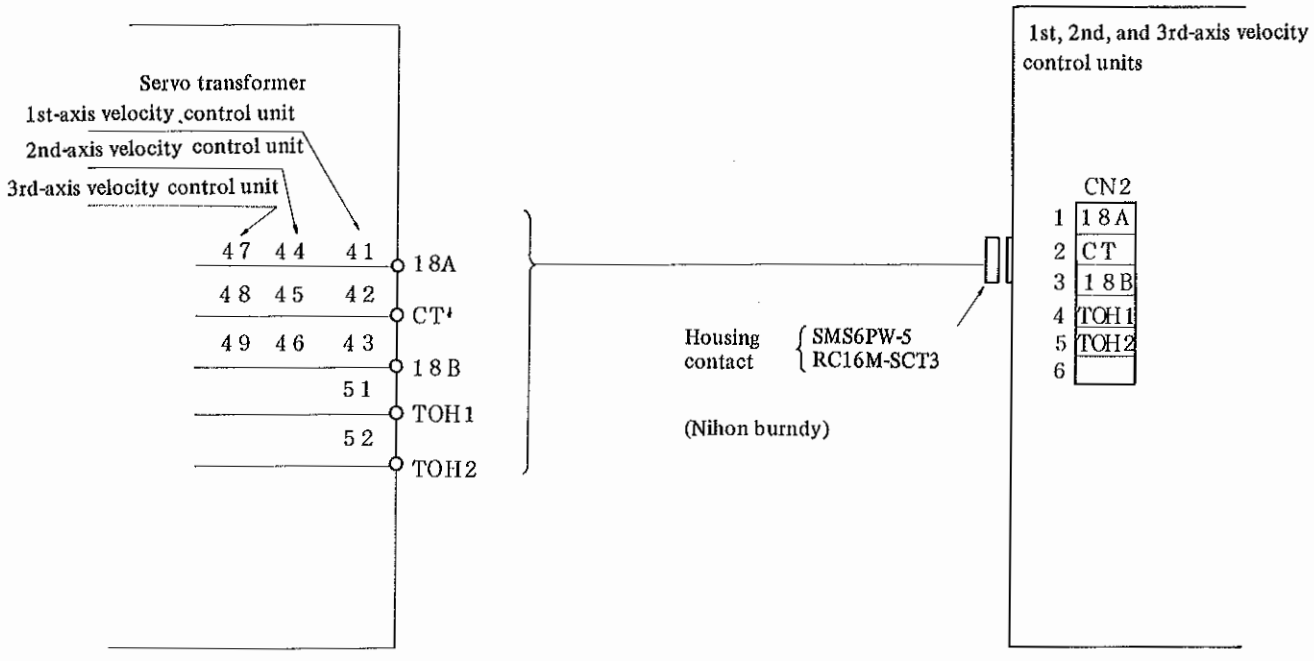


Cable J210 - J214 Connection diagram



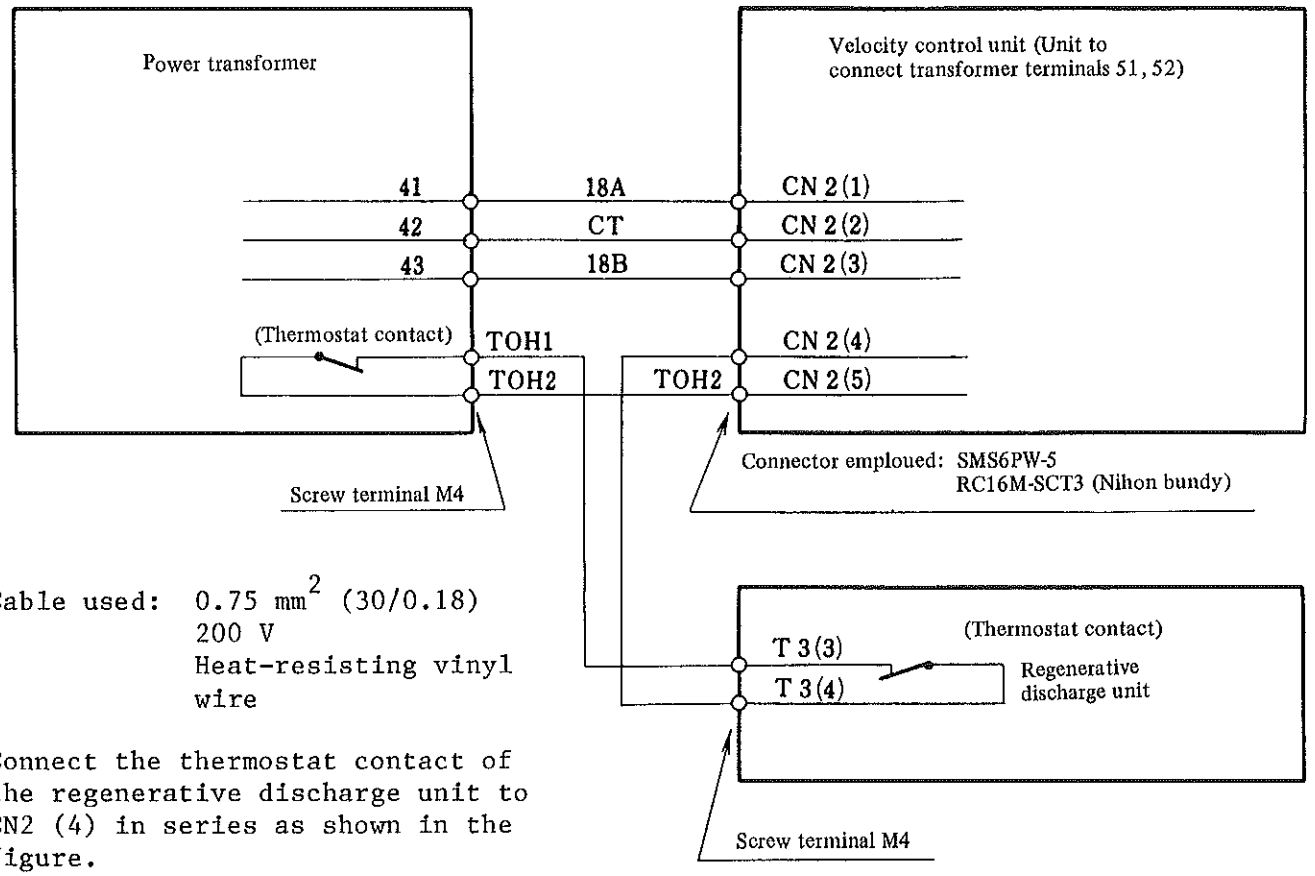
Note) n means number of axis.

3) Connection of overheat signal line of servo transformer



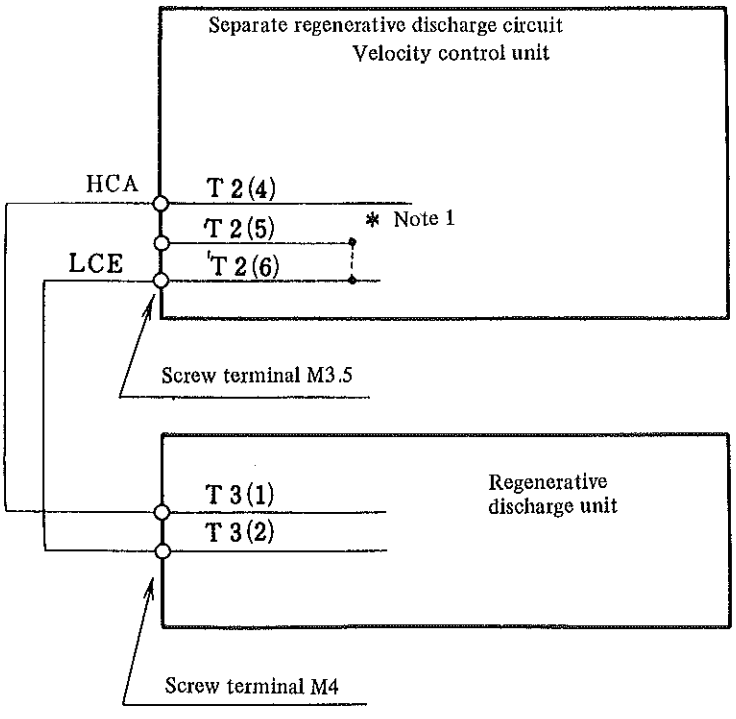
Note: Connect overheat signals TOH1 and 2 of the servo transformer in parallel to all velocity control units to which power is supplied from the servo transformer. Connect signals must parallel each other (as illustrated) because CN2 (4), (5) terminals on the velocity control unit side are polarized.

4) Connection to separate regenerative discharge unit



Cable used: 0.75 mm^2 (30/0.18)
200 V
Heat-resisting vinyl wire

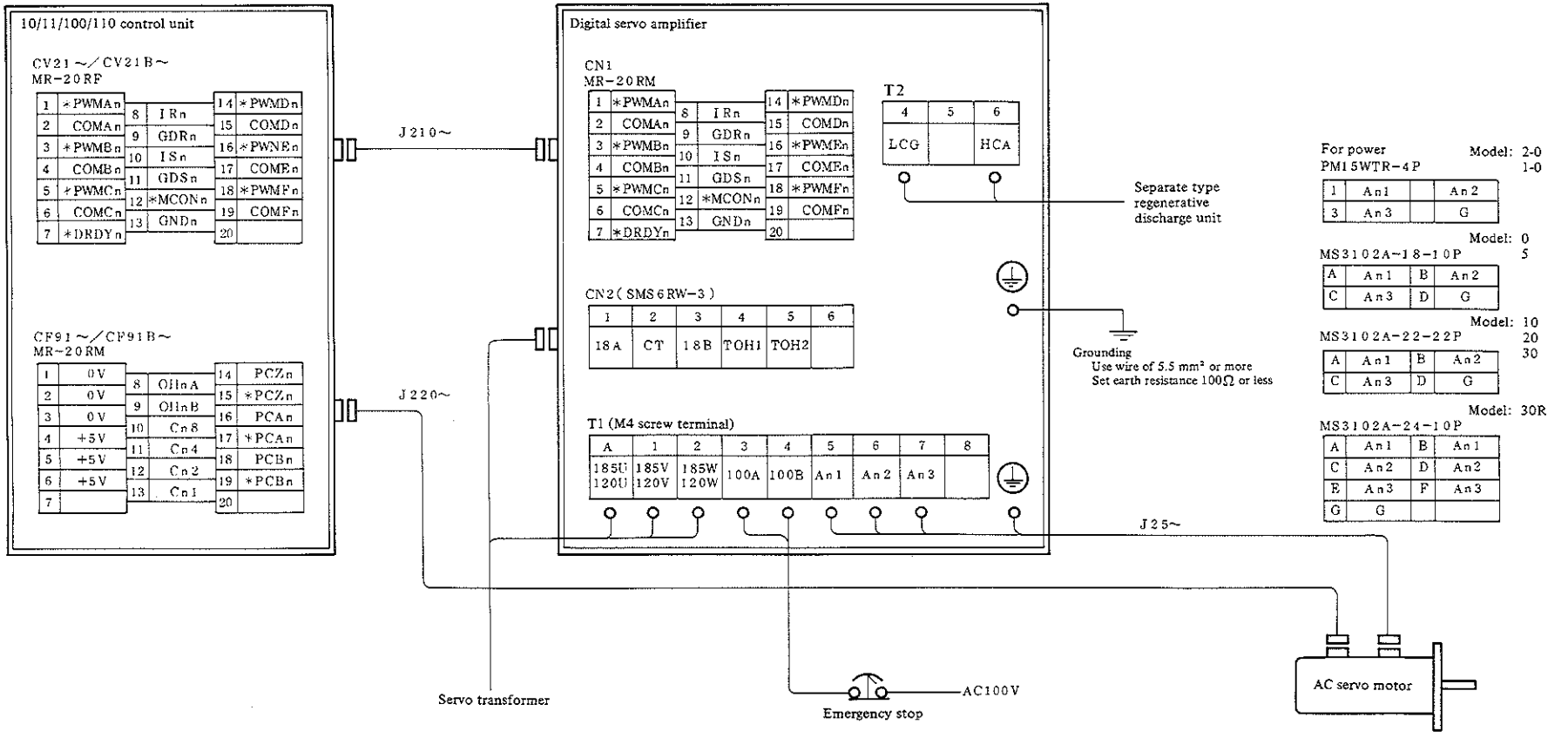
Connect the thermostat contact of the regenerative discharge unit to CN2 (4) in series as shown in the figure.



Note 1: Disconnect jumper wire (if any) from terminals T2 (4), (5), (6) when the seperate type regenerative discharge unit is used. Be sure to connect to the regenerative discharge unit after jumper wire is disconneced.

Cable used: 20 mm^2 (37/0.26)
600 V Heat-resisting vinyl wire

5) Connection diagram of digital servo (Built-in incremental pulse coder)



1	*PWMAn	8	IRn	14	*PWMDn	1	*PWMAn	8	IRn	14	*PWMDn	4	5	6	1	An1		An2
2	COMAn	9	GDRn	15	COMDn	2	COMAn	9	GDRn	15	COMDn	LCG		HCA	3	An3		G
3	*PWMBn	10	ISn	16	*PWNEn	3	*PWMBn	10	ISn	16	*PWMEn							
4	COMBn	11	GDSn	17	COMEn	4	COMBn	11	GDSn	17	COMEn				A	An1	B	An2
5	*PWMCn	12	*MCONn	18	*PWMFn	5	*PWMCn	12	*MCONn	18	*PWMFn				C	An3	D	G
6	COMCn	13	GNDn	19	COMFn	6	COMCn	13	GNDn	19	COMFn							
7	*DRDYn			20		7	*DRDYn			20					A	An1	B	An2
															C	An2	D	An2
1	0V	8	OHnA	14	PCZn										E	An3	F	An3
2	0V	9	OHnB	15	*PCZn										G	G		
3	0V	10	Cn8	16	PCAn													
4	+5V	11	Cn4	17	*PCAn													
5	+5V	12	Cn2	18	PCBn													
6	+5V	13	Cn1	19	*PCBn													
7				20														

1	2	3	4	5	6
18A	CT	18B	TOH1	TOH2	

A	1	2	3	4	5	6	7	8
185U 120U	185V 120V	185W 120W	100A	100B	An1	An2	An3	

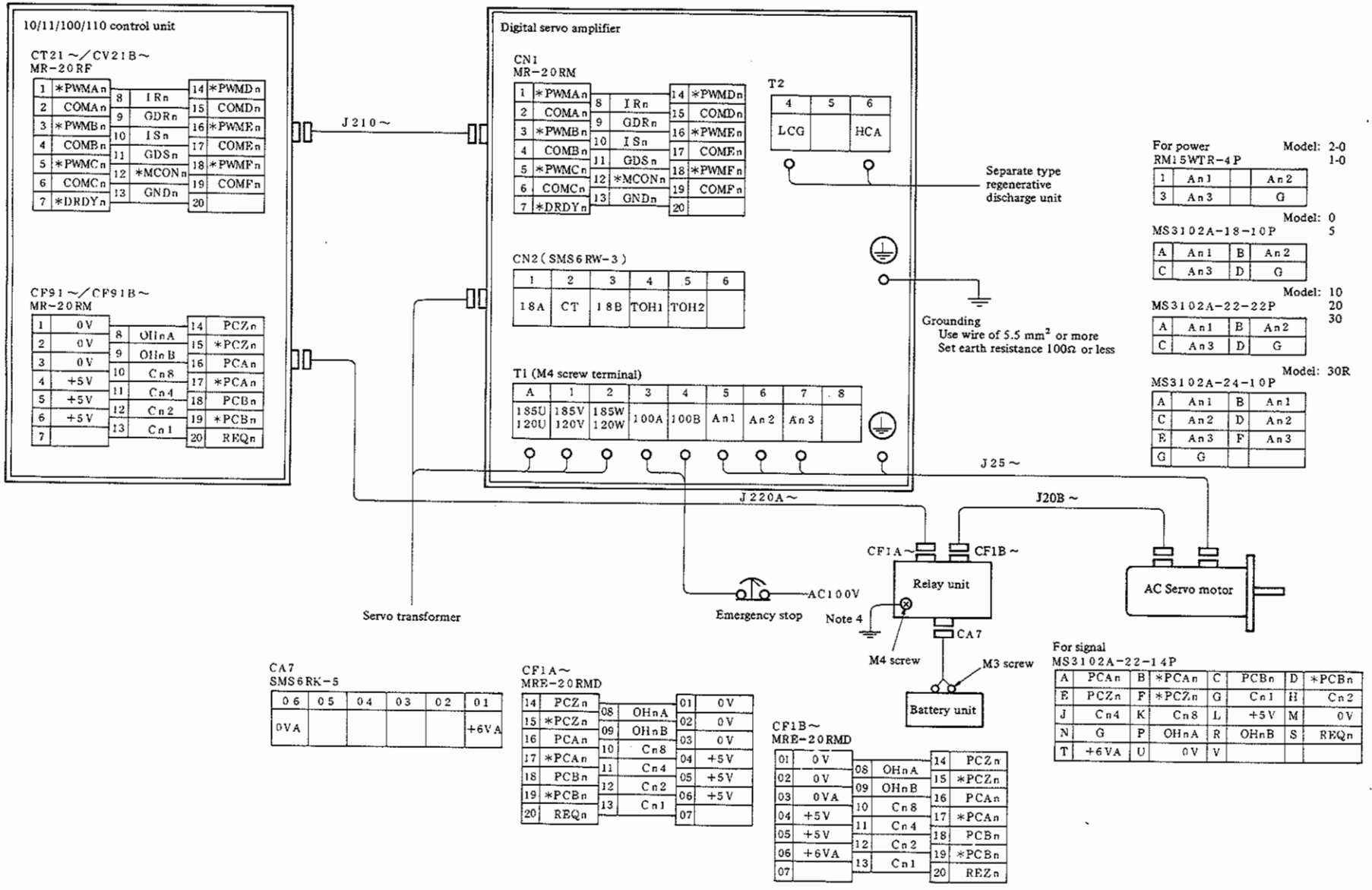
For signal (0.1μ detection)
MS3102A 22-14P

A	PCAn	B	*PCAn	C	PCBn	D	*PCBn
E	PCZn	F	*PCZn	G	Cn1	H	Cn2
J	Cn4	K	Cn8	L	+5V	M	0V
N	G	P	OHnA	R	OHnB	S	
T	+5V	U	0V	V			

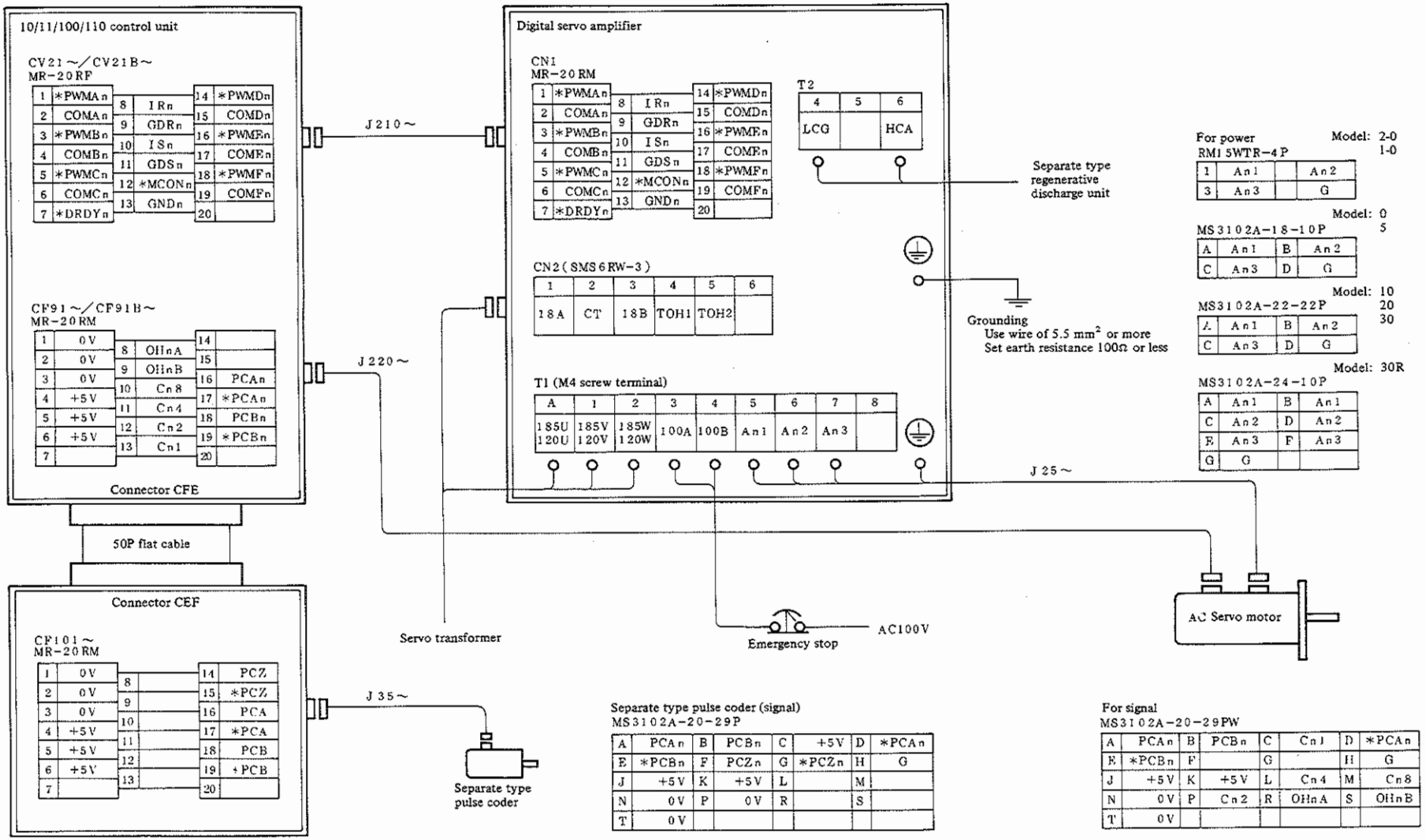
For signal (1μ detection)
MS3102A-20-29PW

A	PCAn	B	PCBn	C	Cn1	D	*PCAn
E	*PCBn	F	PCZn	G	*PCZn	H	G
J	+5V	K	+5V	L	Cn4	M	Cn8
N	0V	P	Cn2	R	OHnA	S	OHn8
T	0V						

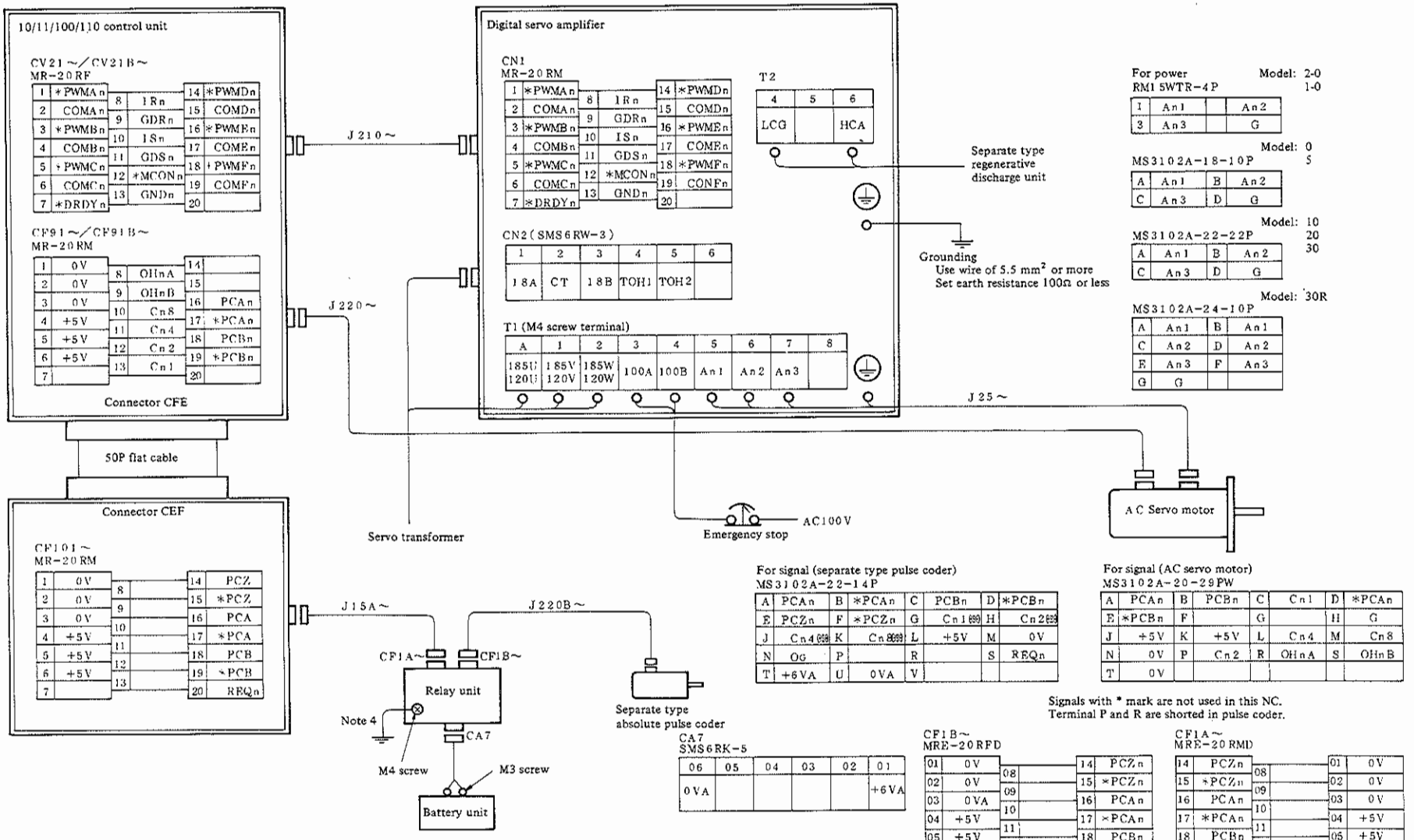
6) Connection diagram of digital servo (1μ detection, built-in absolute coder)



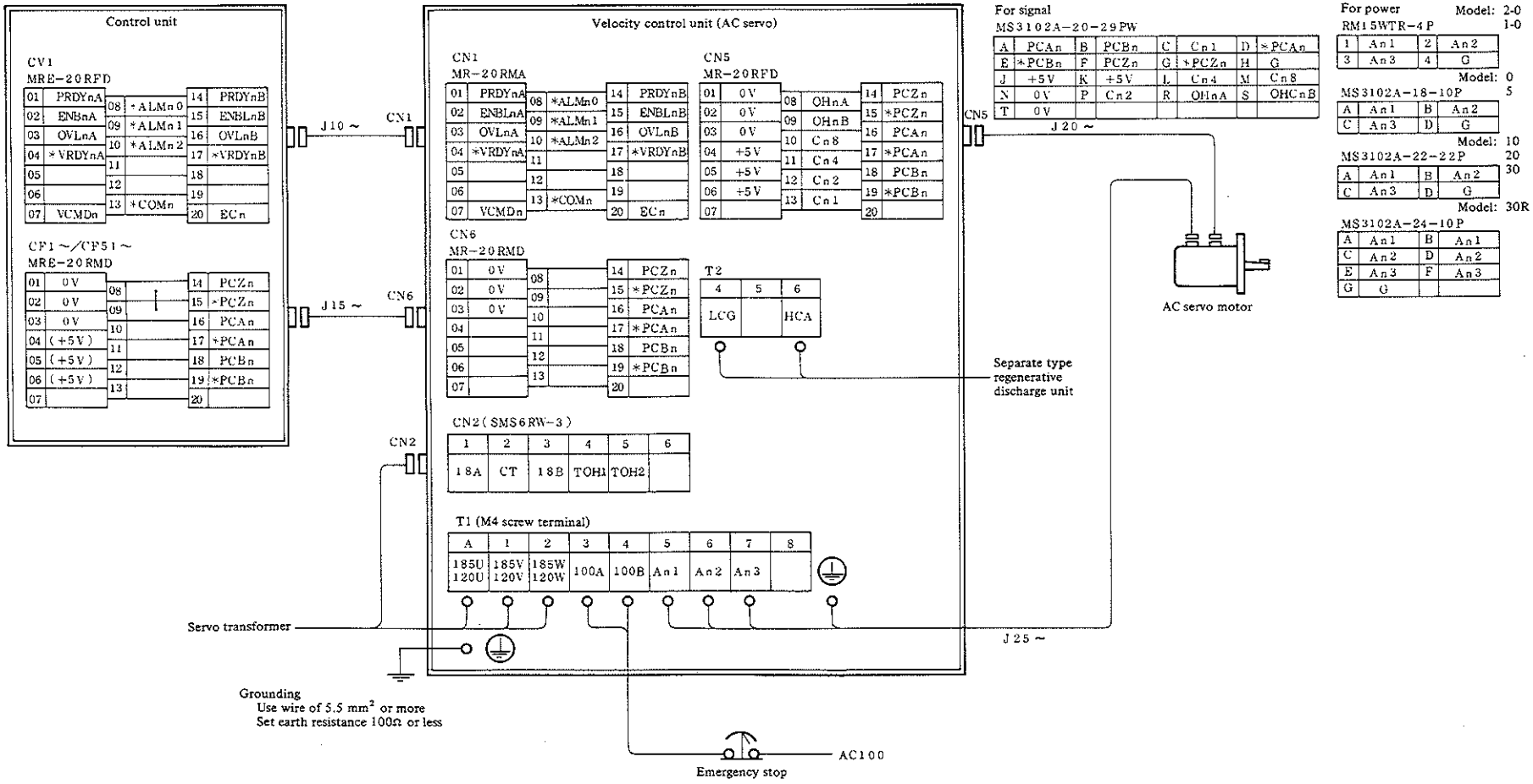
7) Connection diagram digital servo (Separate type incremental pulse coder)



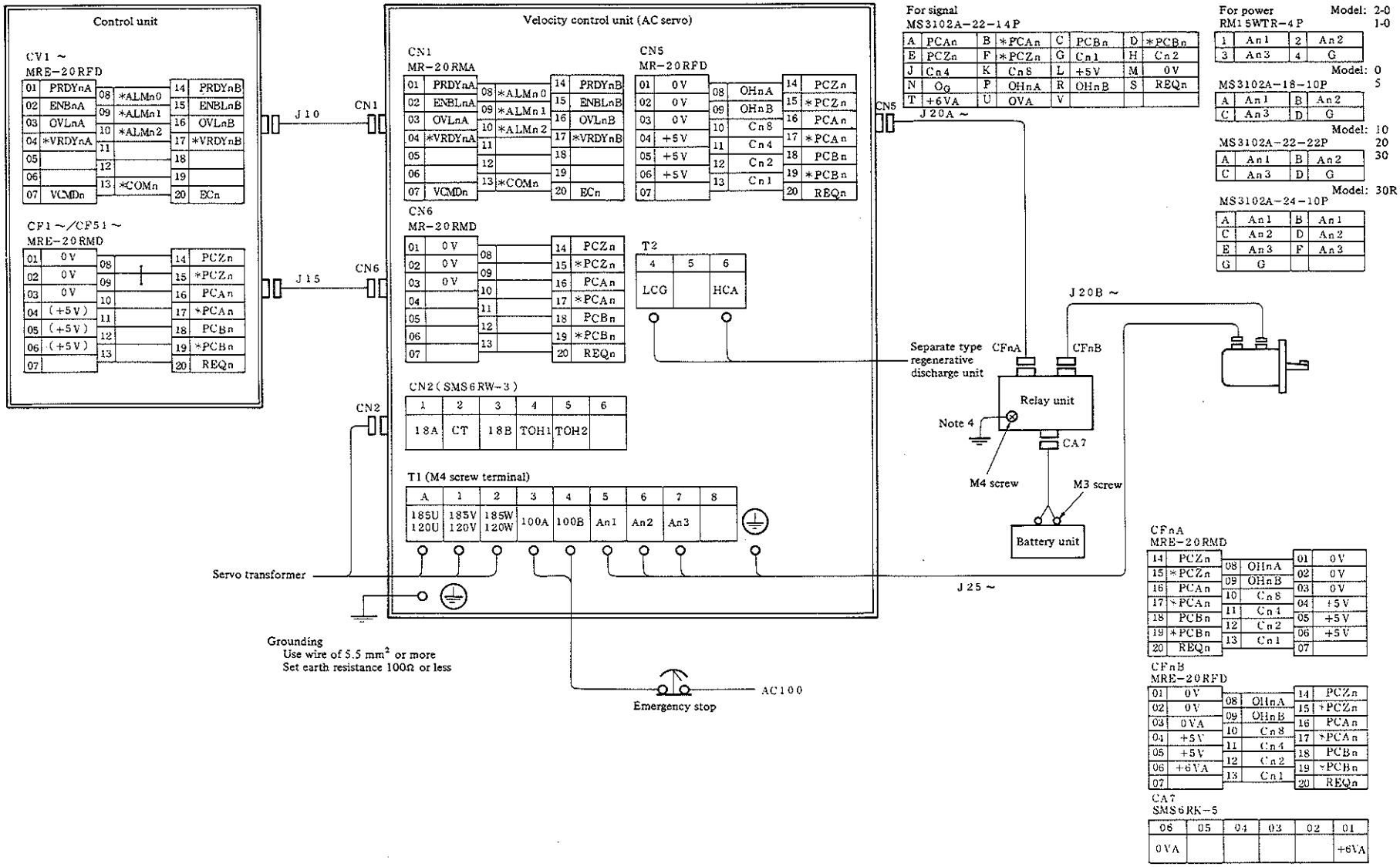
8) Connection diagram of digital servo (1μ detection, separate type absolute pulse coder)



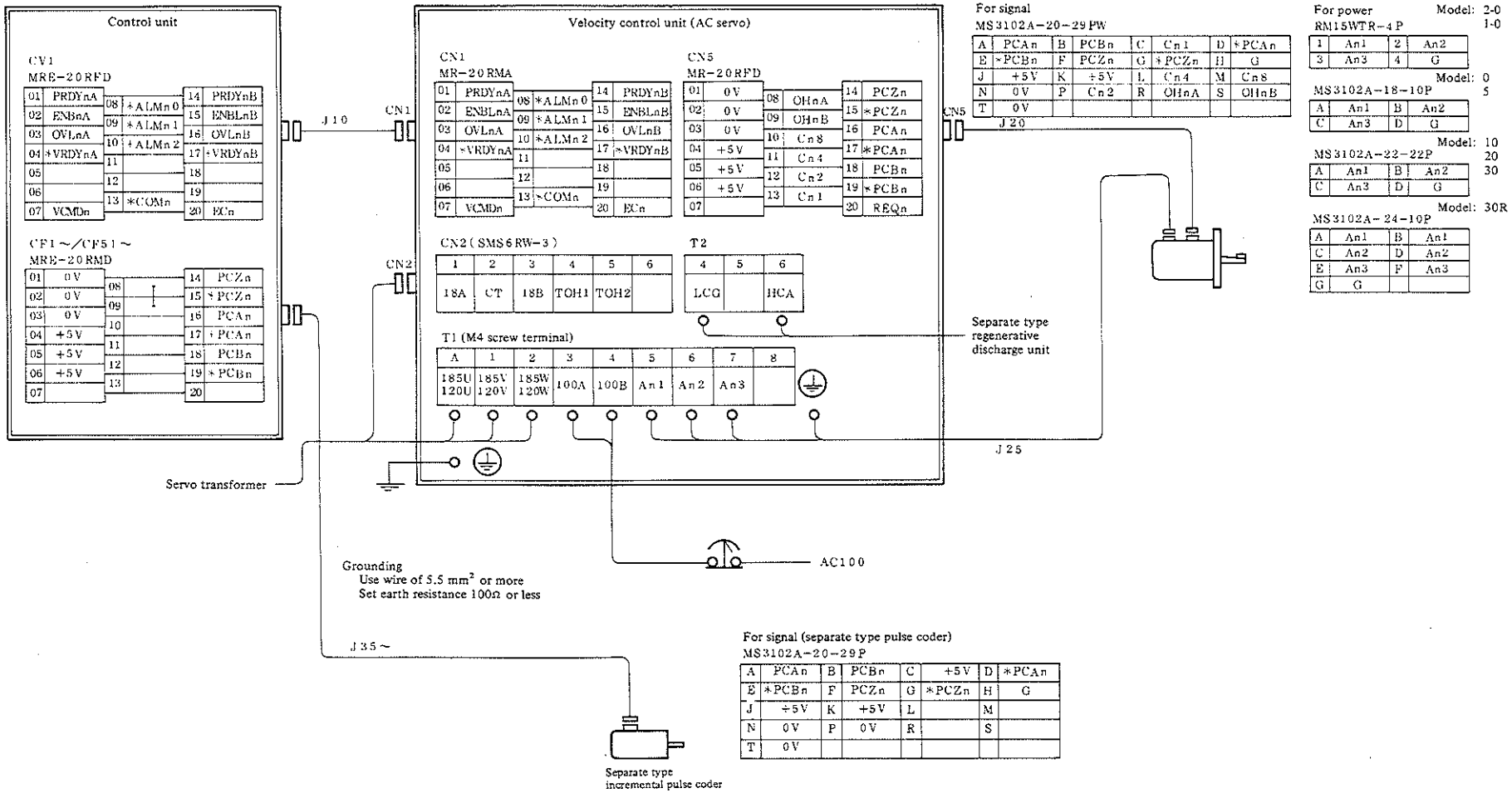
9) Connection diagram of analog servo (1μ detection, built-in type incremental pulse coder)



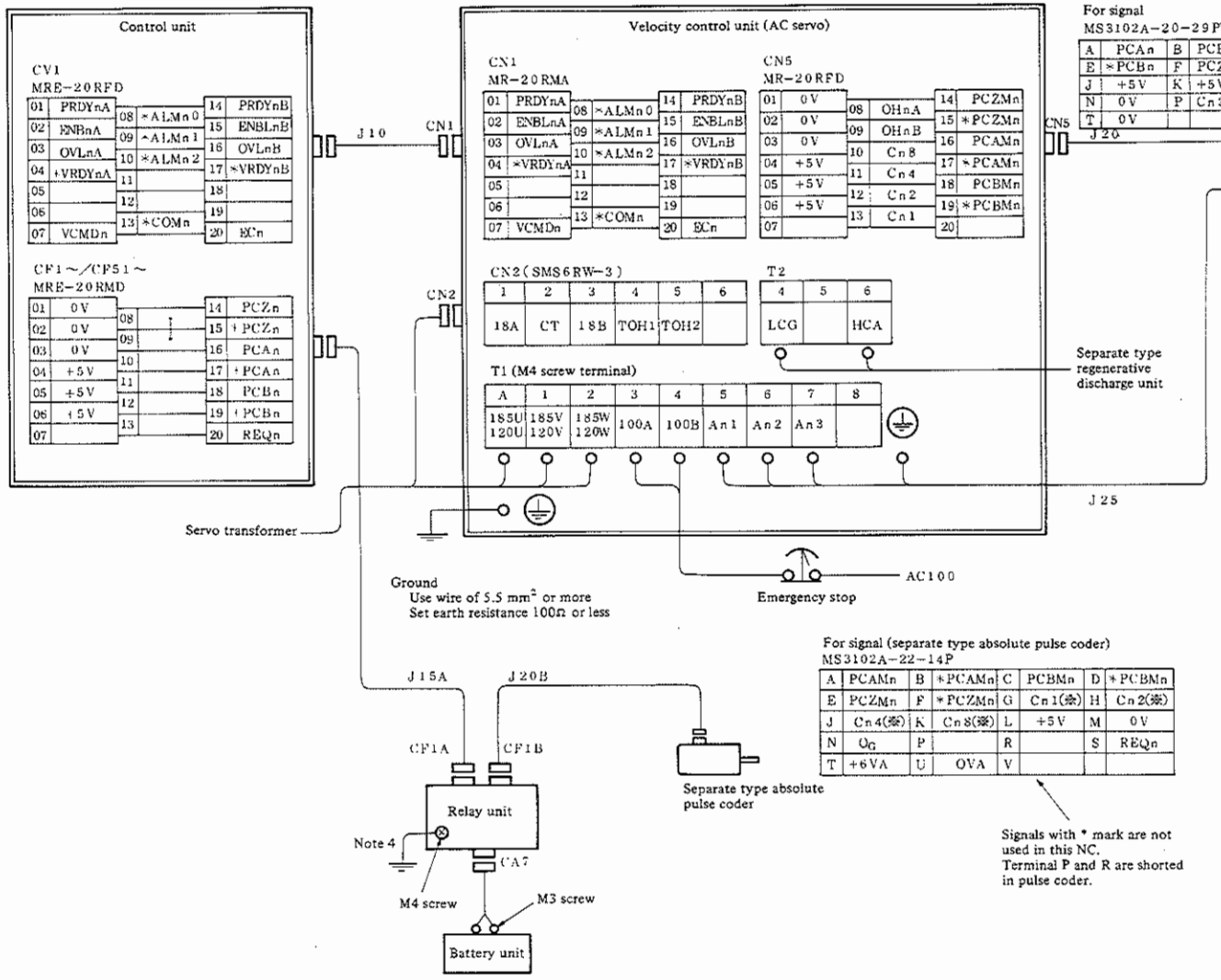
10) Connection diagram of analog servo (1μ detection, built-in type absolute pulse coder)



11) Connection diagram of analog servo (1μ detection, separate type incremental pulse coder)



12) Connection diagram of analog servo (1μ detection, separate type absolute pulse coder)



For signal
MS3102A-20-29PW

A	PCAn	B	PCBn	C	Cn1	D	*PCAn
E	*PCBn	F	PCZn	G	*PCZn	H	G
J	+5V	K	+5V	L	Cn4	M	Cn8
N	0V	P	Cn2	R	OHnA	S	OHnB
T	0V						

For power
RM15WTR-4P

1	An1	2	An2
3	An3	4	G

Model: 2-0, 1-0

MS3102A-18-10P

A	An1	B	An2
C	An3	D	G

Model: 0, 5

MS3102A-22-22P

A	An1	B	An2
C	An3	D	G

Model: 10, 20, 30

MS3102A-24-10P

A	An1	B	An1
C	An2	D	An2
E	An3	F	An3
G	G		

Model: 30R

For signal (separate type absolute pulse coder)
MS3102A-22-14P

A	PCAMn	B	*PCAMn	C	PCBMn	D	*PCBMn
E	PCZMn	F	*PCZMn	G	Cn1(※)	H	Cn2(※)
J	Cn4(※)	K	Cn8(※)	L	+5V	M	0V
N	O_G	P		R		S	REQn
T	+6VA	U	OVA	V			

CF1A
MRE-20RMD

14	PCZMn	01	0V
15	*PCZMn	02	0V
16	PCAMn	03	0V
17	*PCAMn	04	+5V
18	PCBMn	05	+5V
19	*PCBMn	06	+5V
20	REQn	07	

08 OHnA, 09 OHnB, 10 Cn8, 11 Cn4, 12 Cn2, 13 Cn1

CF1B
MRE-20RFD

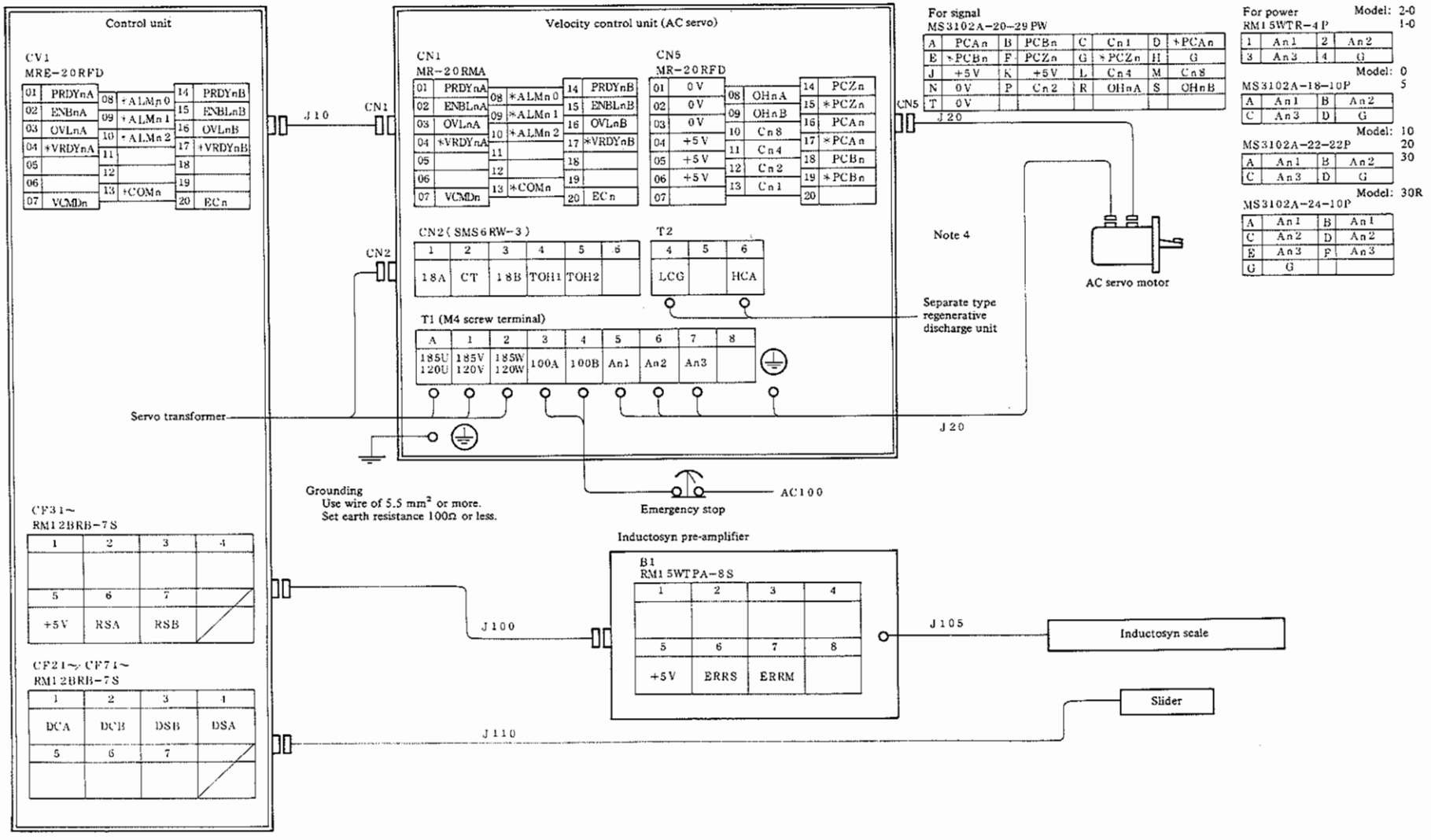
01	0V	11	PCZMn
02	0V	15	*PCZMn
03	0VA	16	PCAMn
04	+5V	17	*PCAMn
05	+5V	18	PCBMn
06	+6VA	19	*PCBMn
07		20	REQn

08 OHnA, 09 OHnB, 10 Cn8, 11 Cn4, 12 Cn2, 13 Cn1

CA7
SMS6RK-5

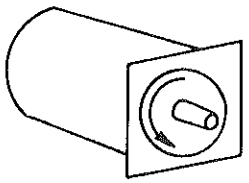
06	05	01	03	02	01
0VA					+6VA

13) Connection diagram of analog servo (1μ detection, inductosyn feedback)

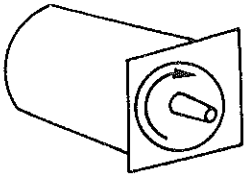


3.10 Standard Connection and Reverse Connection of Motor (Relationship between connections and rotating directions of servo motor)

Servo motor connection and rotating direction
When the servo motor is connected as shown in the connection diagram in 3.9 (standard connection), the motor shaft rotates as shown below when a "+" move command is applied.



A: Standard connection
Rotating direction with "+" command



B: Reverse connection
Rotating direction with "+" command

This paragraph describes the connection used to rotate the motor in the direction shown in figure B with "+" command (as opposed to the above).
The first, second, and subsequent axes are all considered.

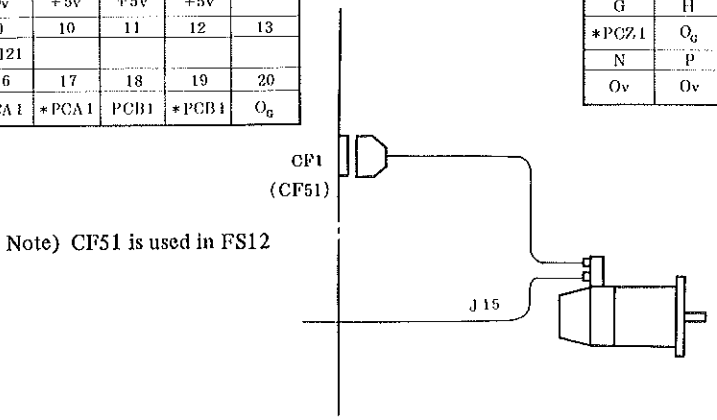
3.10.1 When using M series servo

1) Motor built-in pulse coder

1) Exchange terminals of signals PCA1 and PAB1.
2) Exchange signals *PCA1 and *PCB1.
3) Exchange drive power lines A11 and A21.

1	2	3	4	5	6	7
0v	0v	0v	+5v	+5v	+5v	
	8	9	10	11	12	13
	0H11	0H21				
14	15	16	17	18	19	20
PCZ1	*PCZ1	PCA1	*PCA1	PCB1	*PCB1	0_G

A	B	C	D	E	F
PCB1	PCA1	+5V	*PCB1	*PCA1	PCZ1
G	H	J	K	L	M
*PCZ1	0_G	+5v	+5v		
N	P	R	S	T	
0v	0v	0H11	0H21	0v	



Note) CF51 is used in FS12

1 —T1 : M4 Screw terminal

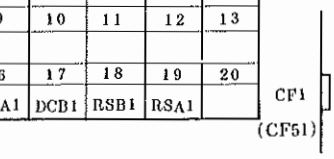
5	6	7	8
A21	A21	A11	A11

A	B
A11	A21
C	D

2) When using resolver (built-in type motor)

1) Exchange terminal positions of signals TSA1 and TSB1.
2) Exchange terminal positions of signals *DSA1 and *DSB1.
3) Exchange drive power lines A11 and A21.

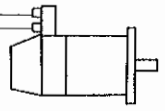
1	2	3	4	5	6	7
OH11	OH21				TSA1	TSB1
	8	9	10	11	12	13
14	15	16	17	18	19	20
DSA1	DSB1	DCA1	DCB1	RSB1	RSA1	



A	B	C	D	E	F
TSB1	TSA1		*DSB1	*DSA1	DCA1
G	H	J	K	L	M
DCB1	OG	RSA1	RSB1		
N	P	R	S	T	
		OH11	OH21		

Note) CF51 is used in FS12

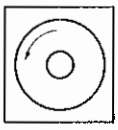
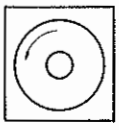
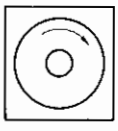
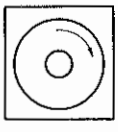
T11 M4 Screw terminal



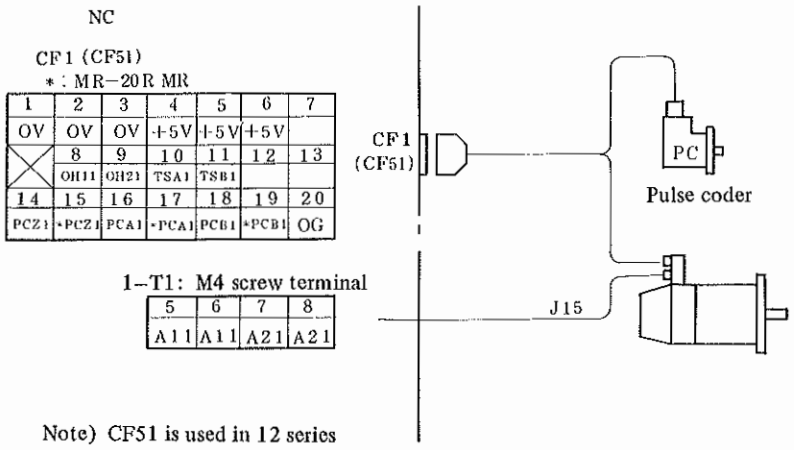
5	6	7	8
A21	A21	A11	A11

A	B
A11	A21
C	D

3) When using separate pulse coder
The following four connections are determined according to whether the motor and separate pulse coder rotate clockwise or counter-clockwise as viewed from the shaft side when the machine moves in the (+) direction.

	Motor	Pulse coder	Motor drive power line and tacho-generator signal	Pulse coder signal
(1)	CCW 	CCW 	Standard connection	Standard connection
(2)	CCW 	CW 	Standard connection	Reverse connection
(3)	CW 	CCW 	Reverse connection	Standard connection
(4)	CW 	CW 	Reverse connection	Reverse connection

a) Standard connection of motor
Standard connection of pulse coder



1	2	3	4	5	6	7
OV	OV	OV	+5V	+5V	+5V	
	8	9	10	11	12	13
	OH11	OH21	TSA1	TSB1		
14	15	16	17	18	19	20
PCZ1	*PCZ1	PCA1	*PCA1	PCB1	*PCB1	OG

5	6	7	8
A11	A11	A21	A21

MS3102A-20-29P

A	B	C	D	E	F
PCA1	PCB1	+5V	*PCA1	*PCB1	PCZ1
G	H	J	K	L	M
*PCZ1	OG	+5V	+5V		
N	P	R	S	T	
OV	OV			OV	

MS3102A-18-10P

A	B
A11	A12
C	D

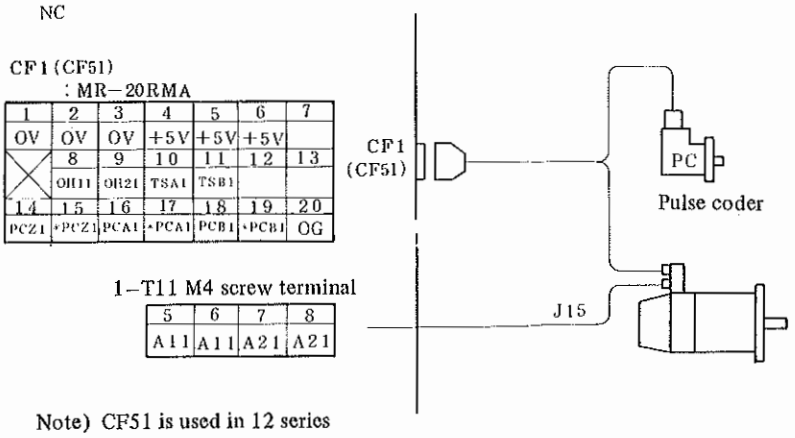
MS3102A-20-29P

A	B	C	D	E	F
TSA1	TSB1				
G	H	J	K	L	M
N	P	R	S	T	
		OH11	OH21		

Note) CF51 is used in 12 series

b) Standard connection of motor
Reverse connection of pulse coder

1) Exchange the terminal positions of signal PCA1 and PCB1.
2) Exchange the terminal positions of signal *PCA1 and *PCB1.



1	2	3	4	5	6	7
OV	OV	OV	+5V	+5V	+5V	
	8	9	10	11	12	13
	OH11	OH21	TSA1	TSB1		
14	15	16	17	18	19	20
PCZ1	*PCZ1	PCA1	*PCA1	PCB1	*PCB1	OG

5	6	7	8
A11	A11	A21	A21

MS3102A-20-29P

A	B	C	D	E	F
PCB1	PCA1	+5V	*PCB1	*PCA1	PCZ1
G	H	J	K	L	M
*PCZ1	OG	+5V	+5V		
N	P	R	S	T	
OV	OV			OV	

MS3102A 18 10P

A	B
A11	A21
C	D

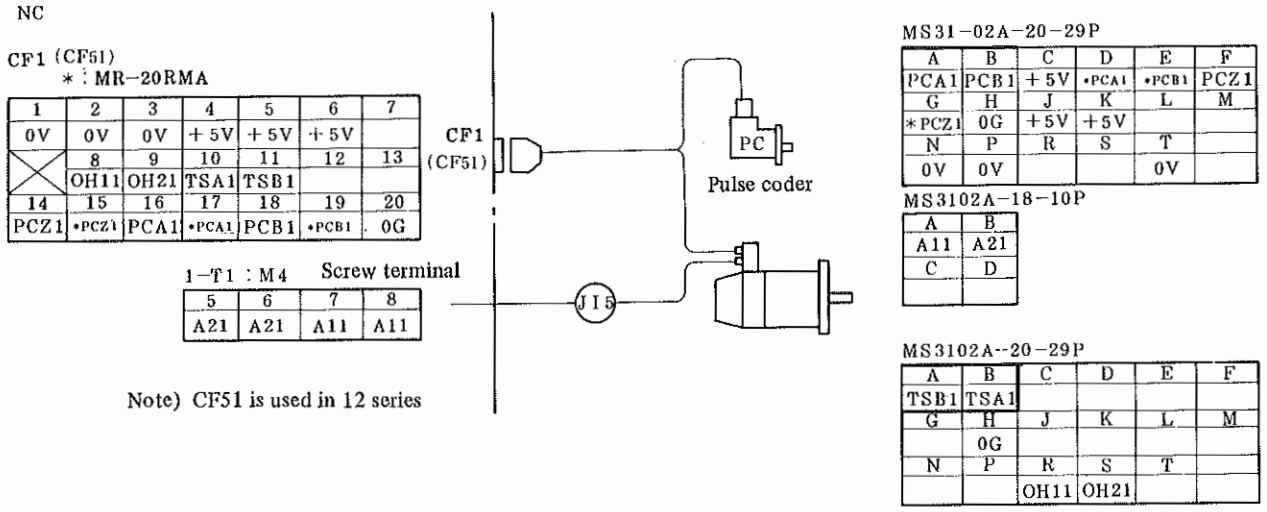
MS3102A-20-29P

A	B	C	D	E	F
TSA1	TSB1				
G	H	J	K	L	M
	OG				
N	P	R	S	T	
		OH11	OH21		

Note) CF51 is used in 12 series

c) Reverse connection of motor
Standard connection of pulse coder

1) Exchange power lines A11 and A21.
2) Exchange the terminal positions of signals TSA and TSB.



1	2	3	4	5	6	7
0V	0V	0V	+5V	+5V	+5V	
	8	9	10	11	12	13
	OH11	OH21	TSA1	TSB1		
14	15	16	17	18	19	20
PCZ1	*PCZ1	PCA1	*PCA1	PCB1	*PCB1	0G

5	6	7	8
A21	A21	A11	A11

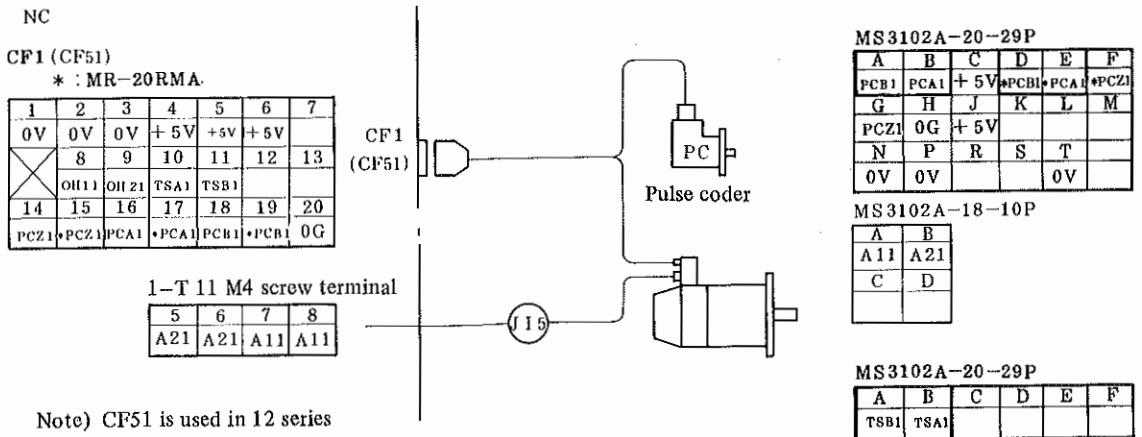
A	B	C	D	E	F
PCA1	PCB1	+5V	*PCA1	*PCB1	PCZ1
G	H	J	K	L	M
*PCZ1	0G	+5V	+5V		
N	P	R	S	T	
0V	0V			0V	

A	B
A11	A21
C	D

A	B	C	D	E	F
TSB1	TSA1				
G	H	J	K	L	M
	0G				
N	P	R	S	T	
		OH11	OH21		

d) Reverse connection of motor
Reverse connection of pulse coder

1) Exchange the terminal positions of PCA1 and PCB1.
2) Exchange the terminal positions of *PCA1 and *PCB1.
3) Exchange power lines A11 and A21.
4) Exchange signals TSA and TSB.



1	2	3	4	5	6	7
0V	0V	0V	+5V	+5V	+5V	
	8	9	10	11	12	13
	OH11	OH21	TSA1	TSB1		
14	15	16	17	18	19	20
PCZ1	*PCZ1	PCA1	*PCA1	PCB1	*PCB1	0G

5	6	7	8
A21	A21	A11	A11

A	B	C	D	E	F
PCB1	PCA1	+5V	*PCB1	*PCA1	*PCZ1
G	H	J	K	L	M
PCZ1	0G	+5V			
N	P	R	S	T	
0V	0V			0V	

A	B
A11	A21
C	D

A	B	C	D	E	F
TSB1	TSA1				
G	H	J	K	L	M
	0G				
N	P	R	S	T	
		OH11	OH12		

4) When using inductosyn
Four combinations are possible for the inductosyn using the same method as in the separate pulse coder.
Next, the reverse connection of the detector will be described. Refer to the seperate pulse coder, for the motor.
The relationship between the connection to the inductosyn slider and the moving direction of the machine is as illustrated below.

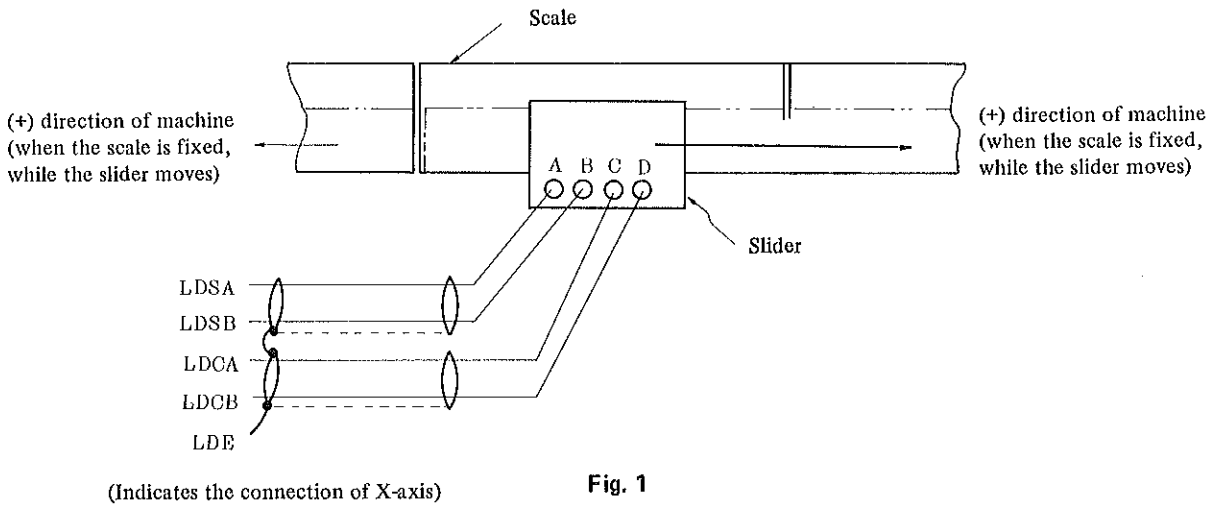


Fig. 1

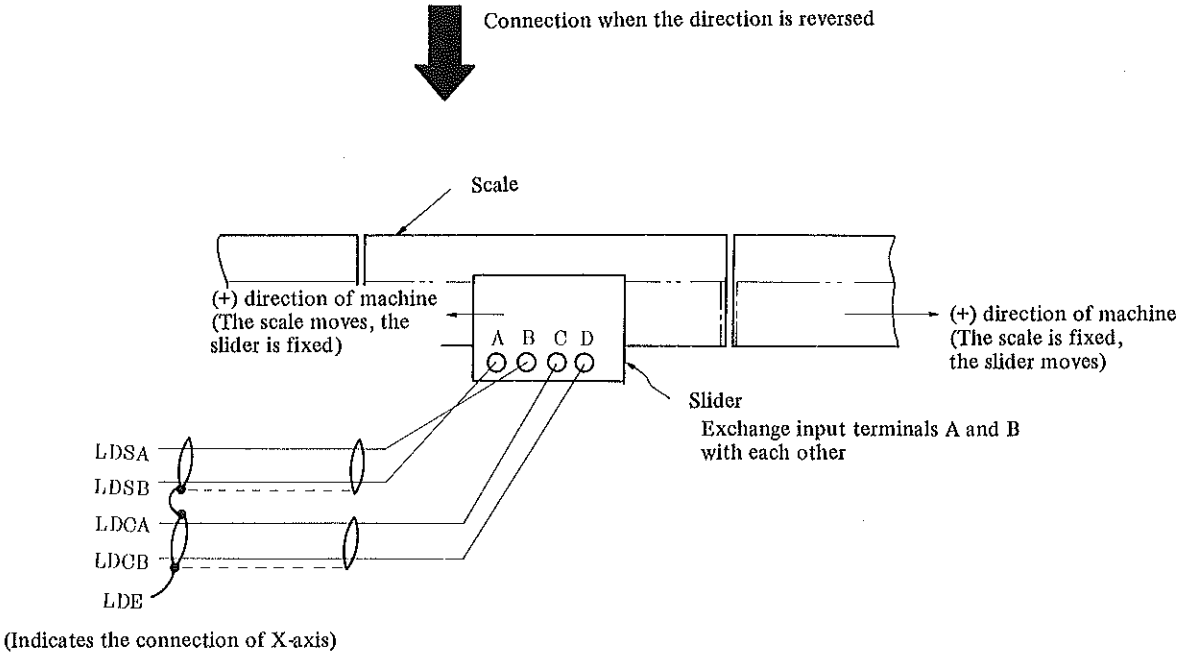


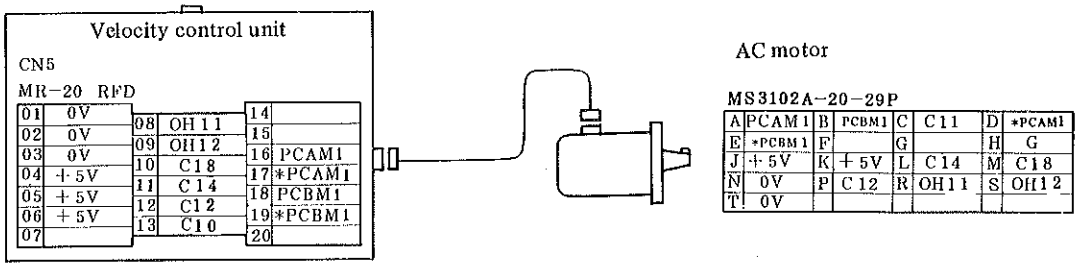
Fig. 2

3.10.2 When using analog AC servo

It is not necessary to exchange the power lines A11 and A21 to reverse the motor connection when using analog AC servo. Instead of exchanging these power lines, connect pin No. 7 of connector CN5 to 0 V.
The power lines between AC motor and velocity control unit are omitted in the following figure.

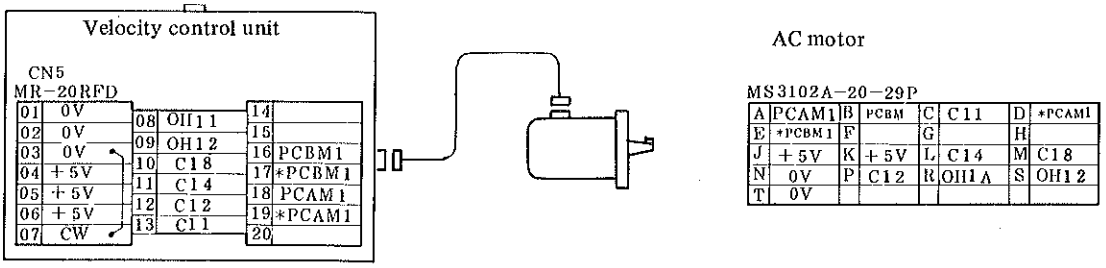
1) When using mounted pulse coder

a) Standard connection



b) Reverse connection

(1) Connect pin 7 "CW" of connector CN5 to 0 V

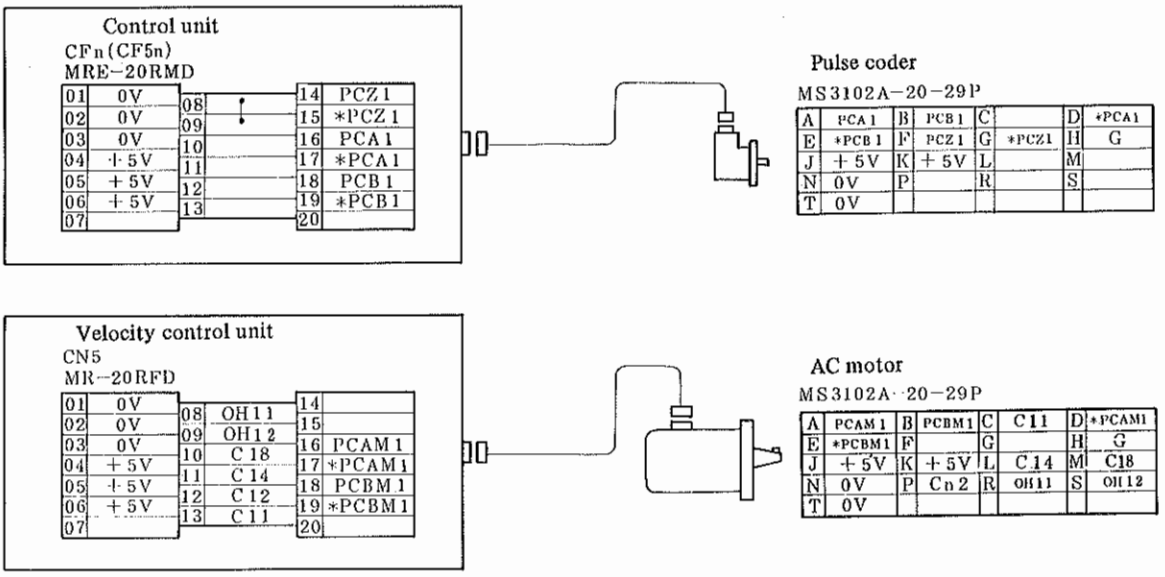


2) When using separate pulse coder:

Four connections are possible depending on whether the motor and separate pulse coder rotate clockwise or counterclockwise as viewed from the shaft side when moving the machine in the (+) direction. (See the table at right)
(Note) No cable is connected to connector CN6 of the velocity control unit.

No.	Motor	Pulse coder	Motor feedback signal	Pulse coder signal
1	CCW 	CCW 	Standard connection	Standard connection
2	CCW 	CW 	Standard connection	Reverse connection
3	CW 	CCW 	Reverse connection	Standard connection
4	CW 	CW 	Reverse connection	Reverse connection

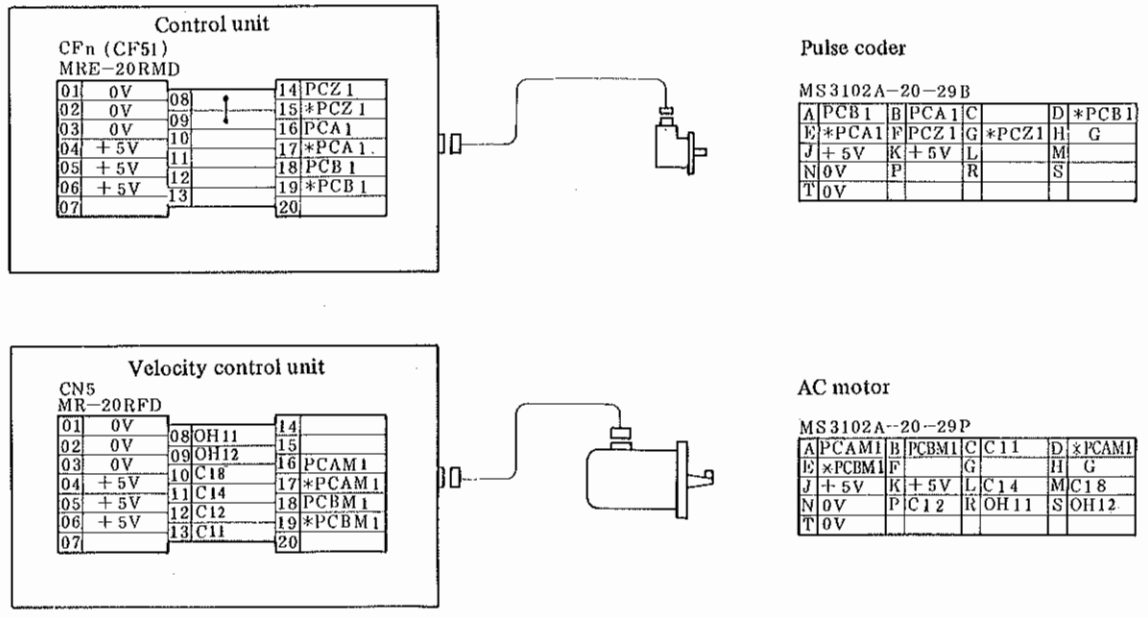
a) Standard connection of motor and pulse coder.



Note) CF5n is used in 12 series

b) Standard connection of motor and reverse connection of pulse coder

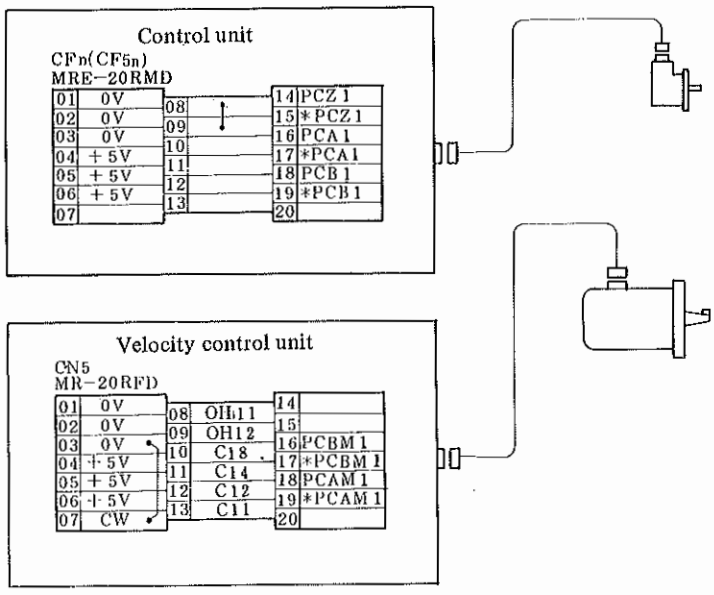
1) Exchange the terminal positions of signals PCA1 and PCB1.
2) Exchange the terminal positions of signals *PCA1 and *PCB1.



Note) CF51 is used in 12 series

c) Reverse connection of motor and standard connection of pulse coder

1) Connect pin 7 "CW" of connnector CN5 to 0 V.



Pulse coder

MS3102A-20-29P

A	PCA1	B	PCB1	C		D	*PCA1
E	*PCB1	F	PCZ1	G	*PCZ1	H	G
J	+5V	K	+5V	L		M	
N	0V	P		R		S	
T	0V						

AC motor

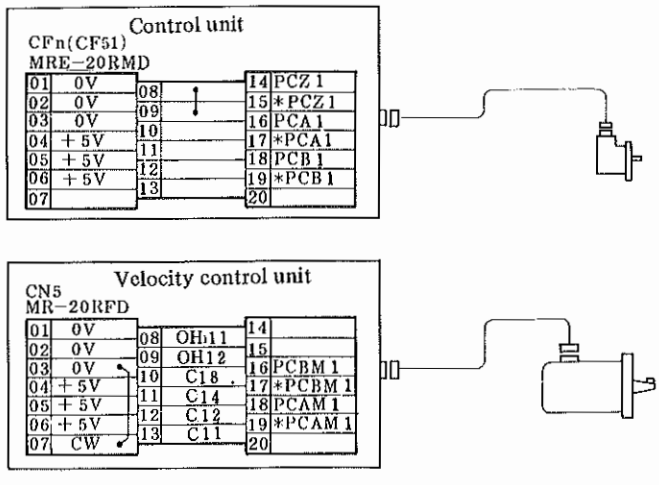
MS3102A-20-29P

A	PCAM1	B	PCBM1	C	C11	D	*PCAM1
E	*PCBM1	F		G		H	
J	+5V	K	+5V	L	C14	M	C18
N	0V	P	C12	R	OH11	S	OH12
T	0V						

Note) CF5n is used in 12 series

d) Reverse connection of motor and pulse coder

1) Exchange the terminal positions of signals PCA1 and PCB1.
2) Exchange the terminal positions of signals *PCA1 and *PCB1.



Pulse coder

MS3102A-20-29P

A	PCB1	B	PCA1	C		D	*PCB1
E	*PCA1	F	PCZ1	G	*PCZ1	H	G
J	+5V	K	+5V	L		M	
N	0V	P		R		S	
T	0V						

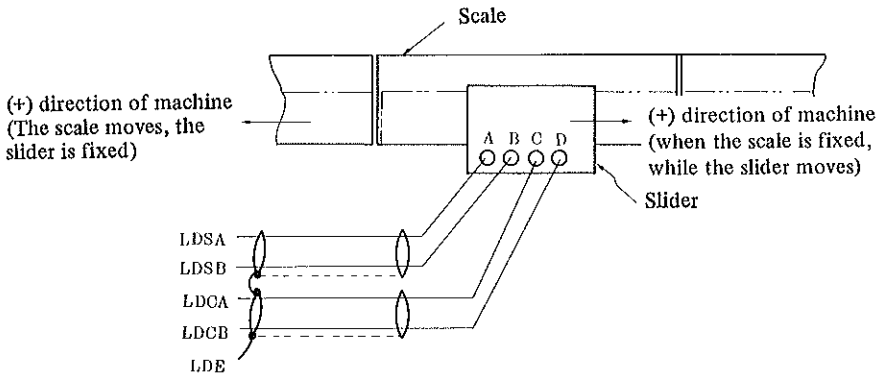
AC motor

MS3102A-20-29P

A	PCAM1	B	PCBM1	C	C11	D	*PCAM1
E	*PCBM1	F		G		H	G
J	+5V	K	+5V	L	C14	M	C18
N	0V	P	C12	R	OH11	S	OH12
T	0V						

Note) CF51 is used in 12 series

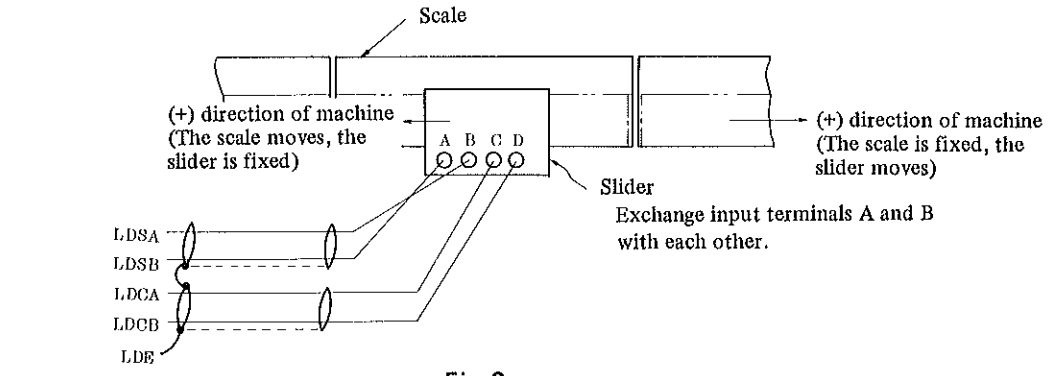
3) When using inductosyn
The relationship between the connection to the inductosyn slider and the moving direction of machine is as illustrated below.



(Indicates the connection of X-axis)

Fig. 1

Connection when the direction is reversed



(Indicates the connection of X-axis)

Fig. 2

Four combinations are possible for the inductosyn using the same method as in the separate pulse coder. The reverse connection of the detector is shown in Fig. 2. Refer to the separate pulse coder, for the motor.

3.10.3 When using digital AC servo

1) For built-in type pulse coder
It is not needed to change the wiring. The standard connection and reverse connection are selected by parameter setting.
2) For separate type pulse coder
It is needed to exchange PCA and PCB for reverse connection of pulse coder same as analog servo system. Refer to item 3.10.2 (2).

3.11 Troubleshooting for Servo Unit

Trouble in the servo unit doesn't always cause an alarm. If an alarm appears on the CRT, observe the corresponding procedures according to alarm numbers.
This paragraph summarizes troubleshooting procedures for such servo unit trouble that may not cause an alarm.

1) Machine tool runs, even though no command has been given ..... See Subsec. 3.11.1
2) Machine tool vibrates during movement or stopping ..... See Subsec. 3.11.2
3) Poor positioning accuracy and poor machining accuracy .. See Subsec. 3.11.3
4) Checking methods for the operation of velocity control unit and position control unit ..... See Subsec. 3.11.4

3.11.1 Machine tool runs away

Item	Cause of trouble	Checking points	Countermeasures
1	Signals from position detector are abnormal.	Check wiring. Check for positive feedback.	Reconnect wiring correctly.
2	Defect between motor and position detector.	Check by DGN. See Sec. 3.7. (DGN 3000) See Appendix 10 item 2 for positioning module.	Reconnect them correctly.
3	Master PCB, positioning module or velocity control unit PCB is defective.		Replace defective PCB.

3.11.2 Machine tool vibrates

Item	Cause of trouble	Checking points	Countermeasures
1	Setting failure of position control system parameters.	Check according to Sec. 5.3.	Set parameters correctly.
2	Setting failure of velocity control unit PCB.	Check setting on PCB according to Sec. 6.2. Check PCB for special setting (special number) according to data sheet.	Correct the setting.
3		Check to see if vibration cycle changes in proportion to the feedrate	Proceed to 6 if the vibration cycle changes in proportion to the feedrate. Proceed to 4 if the vibration cycle fairly remains constant, regardless of the the feedrate.

Item	Cause of trouble	Checking points	Countermeasures
4		Short CH5-CH6 on velocity control unit PCB by using a jumper wire. Check to see if vibrations are eliminated during operation.	Proceed to 7 if vibrations are eliminated. Proceed to 5 if they are not eliminated.
5		Short CH5-CH6, and check to see if vibrations are reduced when turning RV1 counterclockwise.	Proceed to 8 if reduced. Proceed to 9 if not reduced.
6	Machine tool, detector, or motor is defective. Interpolation accuracy is poor. Detection gain is excessively high.	Check the unit being synchronized with vibration cycle, and find defective parts. If interpolation accuracy is poor, the vibration cycle is one or two times the wavelength of the position detection signal. Vibration often occur due to high detection gain in the case of rotary inductosyn.	Replace or repair defective parts. See section on interpolation adjustment or detection gain adjustment (Subsec. 6.1.6).
7	Servoamplifier setting is not suited to machine tool.	(DC M series servo) Short S9 and S11, and check if vibrations are reduced. (AC servo motor) Short S21 or S27, and check if vibrations are reduced.	Change PCB setting. Contact FANUC service center.
8	Same as described in item 7.	Check to see if vibration cycle ranges from several ten Hz to seversal hundred Hz.	Change PCB setting. Contact FANUC service center.
9	Velocity control unit PCB is defective.	Check the waveform at each part of velocity control unit PCB, or replace PCB.	Replace PCB.

3.11.3 Poor positioning accuracy or machining accuracy

1) Overshoot

Item	Cause of trouble	Checking points	Countermeasures
1	Short acceleration/deceleration time.	Check to see if motor current is saturated.	Lengthen the acceleration/ deceleration time.
2	Low rigidity or play at coupling flanges between motor and machine tool.	Check to see if this problem can be fixed by decreasing the position loop gain.	Reduce the position loop gain. Tighten the rigidity and play of machine tool.

2) Poor 1-pulse feed accuracy

Item	Cause of trouble	Checking points	Countermeasures
1		Check to see if the positioning is correct at the detector position by DGN 3000. Check by DGN 1B ∿ 1D for positioning module.	Proceed to 2 if correct. Proceed to 3 if incorrect.
2	Deflection, stick slip, or play in machine tool system.	Measure the positioning accuracy at each part of machine tool and motor shaft.	Adjust the machine tool.
3	Low gain of servo system.	Check to see if this is improved by turning RV1 in velocity control unit PCB clockwise by 2 ∿ 3 divisions.	Readjust RV1. Contact FANUC service center.

3) Poor positioning accuracy when using correct commands

Item	Cause of trouble	Checking points	Countermeasures
1		Check to see if positioning is correct at the detector position by DGN 3000. Check by DGN 1B ∿ 1D for positioning module.	Proceed to 2 if correct. Proceed to 3 if incorrect.
2	Deflection, stick slip, or play in machine tool system.	Measure the positioning accuracy at each part of machine tool and motor shaft.	Adjust the machine tool.
3	Position control unit is defective.	Replace PCB (Master PCB, etc.) containing the position control unit.	Replace defective PCB.
4	Position detector is defective.		Replace defective unit.
5	Velocity control unit PCB is defective.		Replace defective PCB.

4) Poor shape of circle by 2-axis feed

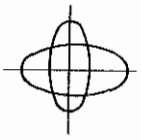
Item	Cause of trouble	Checking points	Countermeasures
1		Measure the roundness. Then check whether circle is distorted in the axial direction or if it is formed to be an ellipse in 45° direction.	Proceed to 2 if distorted axially. Proceed to 3 and 4 if formed in 45° direction.
2	Poor positioning accuracy.	Roughness at change of quadrants. Measure positioning accuracy of each axis.	Proceed to 5 and 6. Adjust the machine tool around inaccurate axis.
3	Maladjustment of position loop gain.	Perform simultaneous 2-axis 45° feed and adjust RV4 of velocity control unit PCB so that the difference of the position deviation amounts is within ±1% between axes by DGN 3000.	Adjust position loop gain to eliminate gain difference between axes (see Note 1).
4	Detection gain differs on every axis.	A circle is formed to be an ellipse in 45° direction even after adjustment in item No. 3.	Adjust the detection gain (see Sec. 6.1.6).
5	Adjustment failure of Fmin of inductosyn or resolver interface PCB.	Check Fmin adjustment.	Readjust Fmin. See Sec. 6.1.6.
6	Improper backlash or backlash compensation amount of machine tool.	Try changing the backlash compensation amount.	Adjust backlash or change backlash compensation amount.

(Note 1) The position gain, when X, Y, Z and 4th axes are moved in the same direction by F4 digit feed from MDI operation, can be obtained by calculating as below:

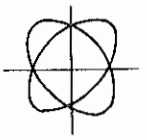
$$G = \frac{16.7F}{E}$$

F: Feed rate (mm/min), (0.1 inch/min), (degree/min)
E: Position deviation (0.001 mm), (0.0001 inch), (0.001 degree)
G: Position gain (sec^{-1}), (standard: 30 sec^{-1})

Then check the servo position deviation from DGN 800 ∿ 804. Adjust the position deviation within ±10% of the target value by turning the variable resistor (RV4) (F/V converter voltage compensation) in the velocity control unit. However, the difference between axes must be within ±1%.
45° directional ellipse can be adjusted using this method, but X axis or Y axis directional ellipse cannot.



Not adjustable

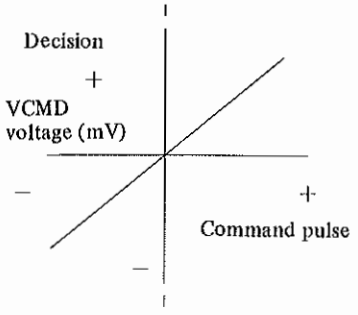


Adjustable

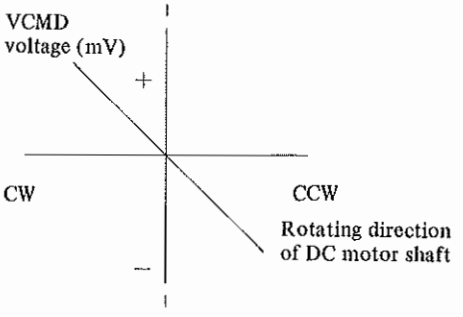
3.11.4 Method of confirming the operation of velocity control unit and position control unit (For analog servo)

The servo system can roughly be divided into the following position control unit, velocity control unit, DC motor, and detector.
Since these component units compose a closed loop, the entire servo system becomes defective if one of these component units is not working properly. It is sometimes difficult to identify the defective unit among these.
In such a case, check the operating conditions of the position control unit and velocity control unit using the following procedure.

1) Position control part of master PCB operation check
   a) Disconnect the power cable from the DC motor.
   b) Set a large value to parameter No. 1828 ∿ 1830 in advance.
   c) After turning on the power of NC, apply pulses by handle, and check the output voltage of VCMD output signal of master PCB.
   d) Turn the motor shaft slightly manually, and check the VCMD signal of master PCB.
   (Note) If NC is turned on after disconnecting power cable from the DC motor, the table powers in case of the gravity axis. Insert suitable lumber or the like.



When a positive (+) pulse is applied from the handle, VCMD voltage should continuously changes from - voltage + voltage.



When turning the motor shaft counter-clockwise, the VCMD voltage should continuously change from + voltage to - voltage.

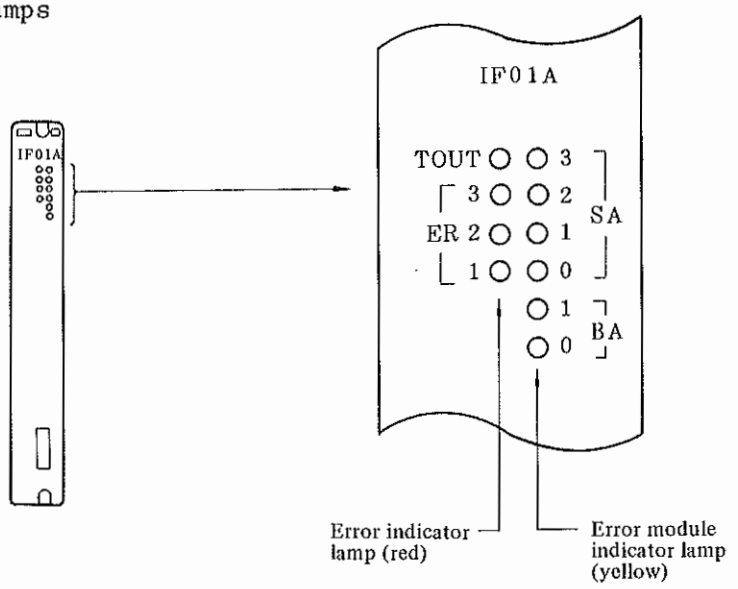
2) Velocity control unit operation check
   Major circuits of the velocity control unit are mounted on the corresponding PCB. Whether the velocity control unit is operating normally can be judged by exchanging its PCB with the PCB in a normal axis. Use caution with the following items when replacing PCB.
   . If an alarm lights on the velocity control unit PCB, don't replace the PCB at once. Eliminate the alarm first according to the alarm processing method.
   . When replacing PCB, place its setting and adjustment to the same values as before. If PCB has been modified, it is not always replaceable. If you have any questions, please contact your nearest FANUC service center.

3.12 Error Display and it's Contents of I/O Unit

3.12.1 Error display and contents in interface module (IF01A)

Error indicator lamps are mounted on the front panel of IF01A to indicate an error which may occur during data transfer between main unit and IF01A or between IF01A and I/O module. (See the following figure.)

- Error indicator lamps



(This lamp display is meaningless in a case other than the parity error)

- Error contents

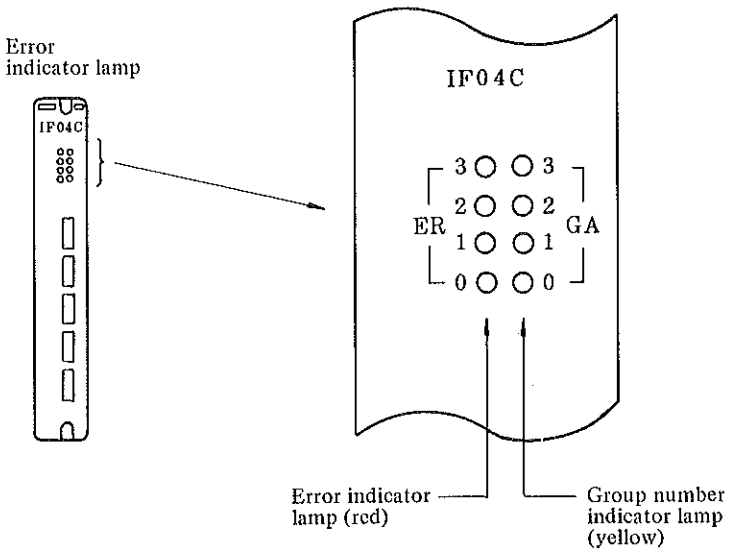
Error display				Name of error	Error contents	Causes
TOUT	ER3	ER2	ER1			
-	-	-	-	Normal operation	———	———
-	o	o	o	CLOCK STOP	An error occurred during data transfer between IF01A and main unit or between IF01A and IF04C.	1. Optical cable is disconnected. 2. Optical connector is not sufficiently connected. 3. Optical connector tip is dirty. 4. IF01A is defective. 5. Main unit or OF04C is defective.
-	o	o	-	CARRIER STOP		
-	o	-	o	SIGNAL FORM ERROR		
-	o	-	-	FORMAT ERROR		
-	-	o	o	OVERRUN ERROR		
-	-	o	-	ERROR WORD		
o	-	-	o	TIME OUT ERROR		
-	-	-	o	PARITY ERROR	A parity error was detected during data transfer between IF01A and I/O module, or a parity error occurred in RAM of IF01A. In this case, the mounting base number of the data transfer module is troubled and the slot number is displayed in SA3-SA0 and BA1-0. SA3-SA0: slot number (binary display) BA1, BA0: Base number (binary display) Example) Base #1, slot #5 SA3 SA2 SA1 SA0 BA1 BA0 0 1 0 1 0 1 Slot #5 Base #1 0: Goes out 1: Lights If both slot number and base number are "0", its display shows a parity error of RAM in IF01A.	1. I/O module is defective. 2. IF01A is defective.

o: Lamp lights
-: Lamp goes out

3.12.2 Error display and contents in interface module (IF04C)

The error indicator lamps on the front panel of IF04C shown in the following figure indicate an error was detected inside IF04C by the self diagnostic function of IF04C as well as an error during data transfer between IF04C and main unit or between IF04C and IF01A.

- Error indicator lamp



<table>
<tr><th colspan="8">Error display</th><th rowspan="2">Error name</th><th rowspan="2">Error contents</th><th rowspan="2">Causes</th></tr>
<tr><th>ER3</th><th>ER2</th><th>ER1</th><th>ER0</th><th>GA3</th><th>GA2</th><th>GA1</th><th>GA0</th></tr>
<tr><td>-</td><td>-</td><td>o</td><td>-</td><td>-</td><td>o</td><td>o</td><td>-</td><td>Group number incoincidence</td><td>Setting of group numbers of IF01A connected to IF04C is wrong.</td><td>1. IF01A group number setting failure
2. Optical fiber cable connection failure</td></tr>
<tr><td>o</td><td>o</td><td>o</td><td>o</td><td>-</td><td>-</td><td>-</td><td>o</td><td>CPU error</td><td rowspan="5">CPU, RAM, or EPROM in IF04C is defective.</td><td>CPU is defective.</td></tr>
<tr><td>o</td><td>o</td><td>o</td><td>o</td><td>-</td><td>-</td><td>o</td><td>-</td><td>RAM error (D6)</td><td>RAM (mounting position D6) is defective.</td></tr>
<tr><td>o</td><td>o</td><td>o</td><td>o</td><td>-</td><td>-</td><td>o</td><td>o</td><td>RAM error (D8)</td><td>RAM (mounting position D8) is defective.</td></tr>
<tr><td>o</td><td>o</td><td>o</td><td>o</td><td>-</td><td>o</td><td>-</td><td>-</td><td>RAM error (A8)</td><td>RAM (mounting position A8) is defective.</td></tr>
<tr><td>o</td><td>o</td><td>o</td><td>o</td><td>-</td><td>o</td><td>o</td><td>-</td><td>EPROM error</td><td>EPROM is defective.</td></tr>
<tr><td>-</td><td>o</td><td>o</td><td>o</td><td colspan="4" rowspan="6">See the right table.</td><td>CLOCK STOP</td><td rowspan="6">An error occurred during data transfer between IF04C and main unit or between IF04C and IF01A. In this case, the data transfer channel in error is displayed in GA3 - GA0 as follows.
<table><tr><th>Channel in error</th><th>Optical connector No.</th><th>GA3</th><th>GA2</th><th>GA1</th><th>GA0</th></tr><tr><td>IF04C↔ group 0</td><td>COP2A</td><td>-</td><td>-</td><td>-</td><td>o</td></tr><tr><td>IF04C↔ group 1</td><td>COP2B</td><td>-</td><td>-</td><td>o</td><td>-</td></tr><tr><td>IF04C↔ group 2</td><td>COP2C</td><td>-</td><td>-</td><td>o</td><td>o</td></tr><tr><td>IF04C↔ group 3</td><td>COP2D</td><td>-</td><td>o</td><td>-</td><td>-</td></tr><tr><td>IF04C↔ main unit</td><td>COP4</td><td>o</td><td>o</td><td>o</td><td>o</td></tr></table></td><td rowspan="6">1. Optical fiber cable is disconnected.
2. Optical connector is not sufficiently connected.
3. Optical connector tip is dirty.
4. IF04C is defective.
5. IF01A is defective.
6. Main unit is defective.</td></tr>
<tr><td>-</td><td>o</td><td>o</td><td>-</td><td>CARRIER STOP</td></tr>
<tr><td>-</td><td>o</td><td>-</td><td>o</td><td>SIGNAL FORM ERROR</td></tr>
<tr><td>-</td><td>o</td><td>-</td><td>-</td><td>FORMAT ERROR</td></tr>
<tr><td>-</td><td>-</td><td>o</td><td>o</td><td>OVERRUN ERROR</td></tr>
<tr><td>-</td><td>-</td><td>o</td><td>-</td><td>ERROR WORD</td></tr>
<tr><td>*</td><td>*</td><td>*</td><td>*</td><td>x</td><td>x</td><td>x</td><td>x</td><td>INITIALIZE ERROR</td><td>If one of ER3 - ER0 flickers, it indicates an error during initial communication between main unit and IF04C.</td><td>1. Main unit is defective.
2. IF04C is defective.
3. IF01A is defective.</td></tr>
</table>

o : Lights
- : Goes out
* : Flickers
x : Nothing to do with light on/off

3.12.3 Error display and contents in positioning module (PT01A)

Display	Name	Contents
WDA	Watch dog alarm	Lighting - positioning module operation is in error.

When WDA lights, it basically shows a positioning module error. Check the error display of interface module (IF01A) as well. If the error contents displayed by IF01A show a parity error and the error slot number shows the positioning module, the positioning module may be judged as defective.
Even if an error with another cause is displayed by IF01A, the entire system operation is stopped. As a result, the positioning module shows the watch dog alarm.

Table 3.12.3 (a) Classification of alarms

	Rotary switch		Indicator lamp (DGN)								Alarm contents	Causes of alarms and countermeasures
	RSW2	RSW1	7	6	5	4	3	2	1	0		
System alarms	Note 1	Note 1	o	o	o	o	-	-	-	o	ROM parity error	Positioning module is defective. Replace it.
			o	o	o	o	-	-	o	-	RAM failure	"
			o	o	o	o	-	-	o	o	System failure	"
			o	o	o	o	-	o	-	-	Parameter receiving error	Interface module, CPU module, or memory module is defective.
			o	o	o	o	-	o	-	o	I/O error	I/O bus is in trouble. This I/O error is displayed if other modules as well as position module become defective.
Kinds of alarms	0	0	-	-	-	-	x	x	x	o	PC alarm	See Table 3.2.3 (b) types of alarms.
			-	-	-	-	x	x	o	x	Servo alarm	"
			-	-	-	-	x	o	x	x	Overtravel	"
			-	-	-	-	o	x	x	x	Motor over heat	Overheating when DC motor is used. If motor overheating occurs when AC motor is used, it is displayed as an overload alarm.

o: Lamp lights
-: Lamp goes out
x: This lamp lights concurrently, if another alarm occurs, too.

Note 1) If a system alarm occurs, the above display remains lit regardless of the numbers of rotary switches RSW1 and RSW2.

Table 3.12.3 (b) Kinds of alarms

	Rotary switch		Indicator lamp (DGN)								Alarm contents	Causes of alarms and countermeasures
	RSW2	RSW1	7	6	5	4	3	2	1	0		
PC alarms	0	1	–	–	–	–	–	o	o	–	Cutting feedrate data zero	Almost all causes of this alarm may be caused due to an error in generating a user's program. Examine user generated programs.
			–	–	–	–	–	o	o	o	Operation mode selection error	"
			–	–	–	–	o	–	–	o	Data type selection error	"
			–	o	–	o	o	–	o	–	Reference point return error	See 3.2.3 (1).
Servo alarm	0	2	–	–	o	–	–	–	–	o	V-READY off (Velocity control unit failure)	Causes of alarms are displayed in detail. See Table 3.2.3 (c) Causes of V-READY off.
			–	–	o	–	–	–	o	–	Pulse coder disconnection	See 3.2.3 (2).
			–	–	o	–	–	–	o	o	Excessive position deviation value	See 3.2.3 (3).
			–	–	o	–	–	o	–	–	Position deviation value overflow or D/A conversion overflow	See 3.2.3 (4).
			–	–	o	–	–	o	–	o	Velocity overload	See 3.2.3 (5).
			–	–	o	–	–	o	o	–	Servo overload	See 3.2.3 (6).

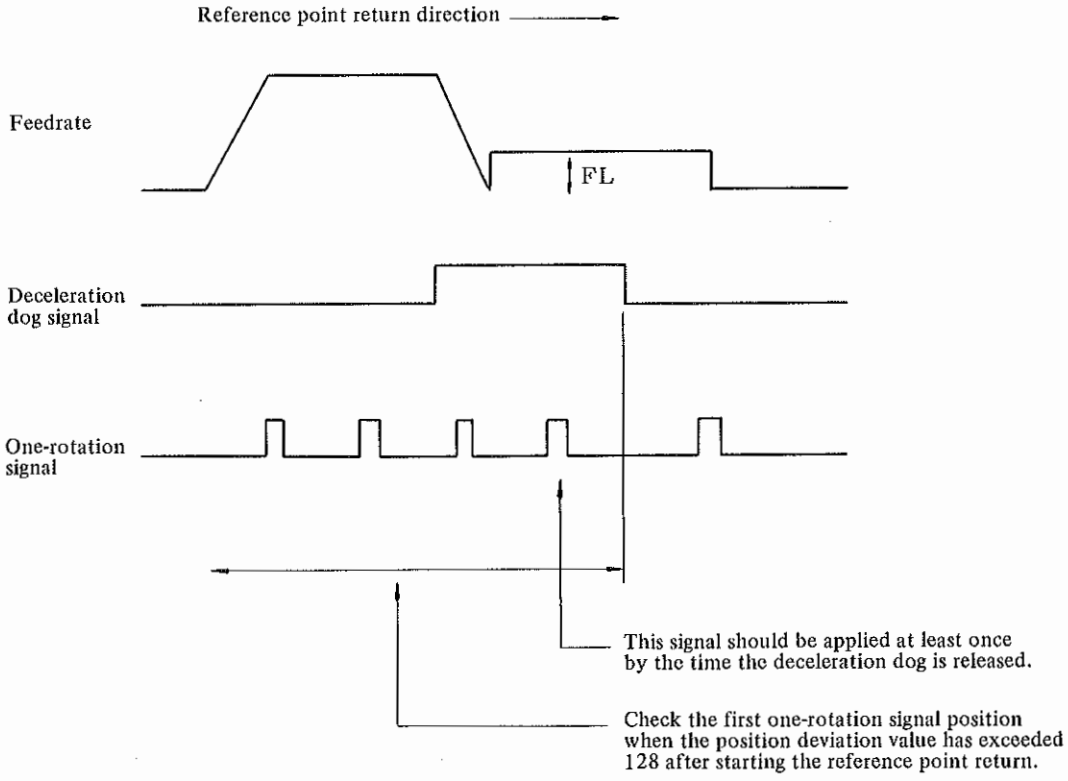
	Rotary switch		Indicator lamp (DGN)								Alarm contents	Causes of alarms and countermeasures
	RSW2	RSW1	7	6	5	4	3	2	1	0		
Servo alarm (cont'd)			–	–	o	–	–	o	o	o	V-READY on at PRDY off	See 3.2.3 (7).
			–	–	o	–	o	–	–	–	Excessive drift compensation amount	See 3.2.3 (8).
Over-travel	0	3	–	o	–	–	–	–	–	o	Overtravel in + direction	See 3.2.3 (9).
			–	o	–	–	–	–	o	–	Overtravel in – direction	See 3.2.3 (9).
Motor over-heat	0	4	o	o	–	–	–	–	–	o	Servo motor over-heat	See 3.2.3 (10). Motor overheat alarm is displayed for DC motor, but overload alarm is displayed for AC motor.

Table 3.12.3 (c) Causes of V-READY off (Velocity control unit failure)

	Rotary switch		Indicator lamp (DGN)								Alarm contents		Causes of alarms and counter-measures
	RSW2	RSW1	7	6	5	4	3	2	1	0	DC servo M series	AC servo	
Velocity control unit failures	1	7						–	–	–	Normal	Normal	
								–	–	o	TGLS runaway detection	TG runaway detection	See 3.2.3 (11).
								–	o	–	Abnormal load of OVC	Abnormal load of OVC	See 3.2.3 (12).
								–	o	o	BRK nofuse breaker off	———	See 3.2.3 (13).
								o	–	–	HCAL high-current alarm	HC high-current alarm	See 3.2.3 (14).
								o	–	o	HVAL high-voltage alarm	HV high-voltage alarm	See 3.2.3 (15).
								o	o	–	DCAL discharge alarm	DC discharge alarm	See 3.2.3 (16).
								o	o	o	LVAL power voltage drop alarm	LV power voltage drop alarm	See 3.2.3 (17).

└→ Indicates the conditions of various signals. For details, see parameters and diagnostic display function of positioing module in para. 8.

1) Reference point return failure
This alarm occurs if the one-rotation signal is not applied from the pulse coder or if the velocity is slower than specified. The following check is done in the first reference point return operation after turning on the power supply or after cancelling the emergency stop.
a) Position deviation value (DGN No. 1B - 1D) exceeds 128.
b) The one-rotation signal is applied at least once by the time the deceleration dog is released again after the position deviation value (DGN No. 1B - 1D) has exceeded 128.



Unless the above conditions are satisfied, an alarm occurs at the position where the deceleration dog is released.

Item	Cause of trouble	Checking points	Corrective action
1	Feedrate is too low.	Perform reference point return under the same conditions in which the alarm occurred. Confirm that the position deviation is 128 or more by using the self-diagnostic function (DGN 1B - 1D). The start point of the reference point return must not be on the deceleration dog.	Increase the feed rate. When the position gain is 30 sec^{-1}, a feed rate of at least 300 mm/min is necessary.
2	The start point of the reference point returns is too close to the reference point.	Check the distance from the start point to the reference point.	The distance from the start point to the reference point must be equivalent to at least two motor revolutions.
3	Source voltage for the pulse coder is too low.	The source voltage of the pulse coder should be 4.75 V or more. (Remove the pulse coder cover and measure the source voltage at the + and - terminals on the pulse coder board.)	Cable loss must be 0.2 V or less including both sides of 5 V and 0 V.
4	Defective pulse coder.	Replace the pulse coder.	Replacement.
5	Defective positioning module.	Replace the positioning module with another one.	Replacement.

2) Pulse coder disconnection

Item	Cause of trouble	Checking points	Corrective action
1	Cable connection failure	Check the pulse coder feedback for disconnection and normal connection.	
2	Pulse coder is defective.		Replace the pulse coder.
3	Positioning module is defective.		Replace the positioning module.
4	Velocity control unit is defective (in case of AC servo).		Replace the velocity control unit PCB.

Item	Cause of trouble	Checking points	Corrective action
5	Pulse coder power voltage is abnormal.	Check if pulse coder power voltage is within 4.75 V - 5.15 V.	If the pulse coder power voltage is lower than 4.75 V, check the cable length and cable size for specified values.

3) Position deviation value is excessive.

Item	Cause of trouble	Checking points	Corrective action
1	Setting error of position deviation limit value	Check the contents of parameter No. 5 (position deviation limit value).	Reset the parameter correctly.
2	Overshoot	When enough current does not flow to motor in acceleration or deceleration, deviation value increases. Check waveform of CH1 on velocity control PCB and confirm whether overshoot is within 5% or not.	Increase the rapid traverse time constant. (parameter No. 11) Increase gain (RV1) of velocity control.
3	Drop of input power voltage	Check that input power voltage is within +10% and -15%.	Change the input tap of power transformer for servo.
4	Voltage of power supply is abnormal.	Check the voltage of main unit on I/O unit.	Repair the error.
5	Connection trouble	Check the power line of motor, pulse coder.	Repair the error.
6	Positioning module and/or velocity control unit are defective.	Try replacing the axis with another axis.	Replace the unit if trouble recurs using the replaced axis.
7	Poor brush contact by loosened DC motor brush cap	Confirm the brush contact face of the motor brush cap.	Tighten the brush cap.

4) Position deviation overflow or D/A conversion overflow
These alarms occur when:
a) Positional deviation in the axis involved exceeds ±32767. However, when positional deviation limits (parameter No. 5) are set correctly, position deviation excess alarm is displayed prior to any of the above-noted alarms, so they usually cannot occur during this condition.
b) D/A converter velocity command value is outside the range of +8191 to -8192.

D/A converter velocity command value = $0.192 \times K \times G \times E \times 10^{-6}$
where K: servo loop gain multiplier (parameter No. 7)
G: servo loop gain 0.01 sec^{-1} (parameter No. 8)
E: position deviation (can be verified by DGN 1B - 1D)
Theoretical value (when feed has become constant)

$$E = \frac{F}{60} \times \frac{1}{G} \times \frac{1}{\alpha} 10^2$$

where F: feed rate mm/min (inch/min)
α: detection unit mm (inch)
G: servo loop gain 0.01 sec^{-1}

Item	Cause of trouble	Checking points	Corrective action
1	Parameter setting is wrong.	1) Check servo loop gain multiplier. Parameter No. 7 2) Check servo loop gain. Parameter No. 8 3) Check CMR. (Command multiply ratio) Parameter No. 3 4) Check DMR. (Detective multiply ratio) Parameter No. 1	
2	Positional deviation is too high.	Compare theoretically calculated value with positional deviation by DGN 1B - 1D. 1) Feed rate Rapid traverse rate: Parameter No. 10	
		Feed rate is right; positional al deviation is right.	Proceed to 5.
		Feed rate is right; positional al deviation is not right.	Proceed to 3.
3	Machine tool does not move a normal distance.	Issue a command (feed of several mm) causing no alarm to check to see if machine tool moves by a normal value.	
		Machine tool does not move by a normal value.	Proceed to 4.
		Machine tool moves by a normal value.	Proceed to 5.

Item	Cause of trouble	Checking points	Corrective action
4	Position detector is faulty.		Replace the position detector.
5	Positioning module PCB is faulty.		Replace the positioning module.

5) Velocity over

Item	Cause of trouble	Checking points	Corrective action
1	In correct setting of command multiply ratio (CMR)	Check that the value of parameter No. 3 (CMR) is one of 1, 2, 4, 10, 20.	Set correct parameter.

6) Servo overload

Item	Cause of trouble	Checking points	Corrective action
1	(analysis)	Check to see if OVERLOAD lamp lights simultaneously when turning on NC power supply.	Connection/setting failure. Proceed to item 6 or 7.
		Check to see if thermal relay of M series velocity control unit functions. (AC servo is not provided with this thermal relay.)	Proceed to item 2 or 3.
		Check to see if radiation fins of AC servo velocity control unit is overheated. (M series servo is not provided with these radiation fins.)	Proceed to item 2.
		Thermostat of servo transformer functions.	Proceed to item 2 or 4.
		Thermostat of regenerative discharge unit functions.	Proceed to item 5.
		Thermostat of AC servo motor functions.	Proceed to item 2.

Item	Cause of trouble	Checking points	Corrective action
2	Overload of moter	Measure the motor current. The continuous rated current is as specified below. M series servo 00M ... 4A 0M ... 7A 5M ... 9A 10M ... 12A 20M ... 18A 30M ... 24A AC servo 4-0 ... 0.93A 30R ... 29A 3-0 ... 0.93A 2-0 ... 3A 1-0 ... 2.9A 0 ... 4.6A 5 ... 6.8A 10 ... 11A 20 ... 20A 30 ... 22A	Reduce the cutting condition. Adjust the machine tool if the continuous rated current exceeds the specified value during idle feed.
3	Setting failure of thermal relay of M series servo	Check to see if the thermal relay is set to the continuous rated current value of the motor specified in item 2.	Reset the thermal relay setting.
4	Thermostat of servo transformer is faulty	Thermostat is faulty if it functions when the surface temperature of transformer is lower than 60°C.	Replace transformer.
5	Excessive regenerative energey	1) Excessive acceleration/deceleration frequency. Check to see if the positioning frequency exceeds 1 - 2 times/sec in rapid traverse. Check to see if alarm does not occur when this frequency is reduced.	Reduce the acceleration/deceleration frequency by inserting a pause time.
		2) Faulty counterbalance on machine tool side.	Correct the counter balance.

Item	Cause of trouble	Checking points	Corrective action
6	Wiring failure	Check to see if the following wiring is correct. o Positioning module (CV1) - velocity control unit (CN1) o Servo transformer - velocity control unit (CN2) o Regenerative discharge unit - velocity control unit (CN2) o AC servo motor - velocity contol unit (CN5)	Correct wiring.
7	Setting failure on velocity control unit PCB	Check to see if setting pin S20 is set as specified in M series servo. Check to see if setting pin S1 is set as specified in AC servo.	Reset pin S20 or S1, as specified.

7) V-RDY on at P-RDY off
V-RDY (velocity control unit ready) is turned on when P-RDY (positioning module ready) has turned off.

Item	Cause of trouble	Checking points	Corrective action
1	Velocity control unit is defective.	Check to see if VRDY indicator lamp lights when PRDY indicator lamp of the velocity control unit went out when power was turned on.	Replace the velocity control unit.
		Check if VRDY indicator lamp remains lit even after 100 VAC has been disconnected from terminal board T1 (3), (4) of velocity control unit.	
2	Positioning module is defective.	Make sure that the VRDY indicator lamp of velocity control unit goes out.	Replace positioning module.
3	Cable failure	Check VRDY signal of cable between positioning module and velocity control unit for short-circuit failure.	Repair the cable.
4	Parameter setting failure in 2-axis velocity control unit	OFFVY of parameter No. 1 must be set to "1" in the case of 2-axis velocity control unit.	Reset parameter correctly.

8) Excess drift compensation

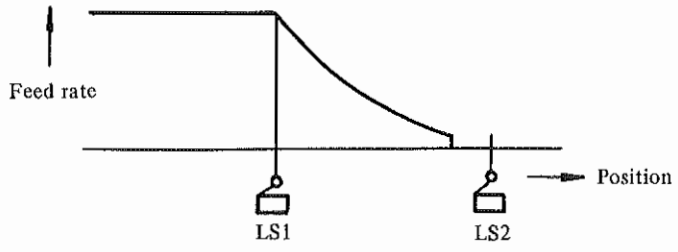
Item	Cause of trouble	Checking points	Corrective action
1	Connection trouble	Check the connection of power lines to servo motor. Check the connection between position detector and servo motor.	Repair the connection error.
2	Setting of drift compensation value is wrong.	Check whether the contents of parameter No. 9 exceed 500.	See the following description: "Drift compensation amount setting method".
3	Trouble in velocity control unit or/and position module	Check this by changing with a spare PCB or positioning module (if provided). Adjustment and setting should be done correctly.	Replace the PCB or positioing module with spare one.

Drift compensation amount setting method

① Make sure that the variable resistor RV2 on velocity control unit PCB is set to 50%.
② Turn on the power supply with the emergency stop button pushed on, and set bit 0 "ADFT" of parameter no. 1 of the positioning module to 1 to execute automatic drift compensation.
③ Turn off the power supply once; then, turn it on again.
④ Turn off the emergency stop button, and agitate the motor.
⑤ Read the drift compensation amount of parameter No. 9 by the positioing module LED and set the readout value to the parameter screen of the positioning module shown in para. 5.5 as the drift compensation amount.

9) Overtravel (in + and - directions)
The overtravel failure is divided into two sections: When it is detected as a hardware failure and when it is detected as a software failure. The software failure is called stored stroke limit alarm. The following description shows possible causes of overtravel and countermeasures.

9)-1 Overtravel (hard)
When the movable part of the machine tool reaches the stroke end, an over trouble alarm message is displayed on the CRT screen.
When this alarm occurrs, axis feed stops.
Two limit switches (LS1, LS2) are provided on each axis in each direction as shown in the figure below to stop the movable part of the machine tool.



o When LS1 operates, the feed is stopped after deceleration. Overtravel alarm message is displayed.
o When LS2 operates, the feed is emergency-stopped. (LS2 operates only when LS1 malfunctions)

Cause of Trouble and Countermeasures

① If the reference point setting in program coordinate system is in error, correct the program.
② If the program is in error, correct the program.

Release

a) When only LS1 operates:
Move the movable part of the machine tool by manual operation in the opposite direction (safe side). Reset after separating it from the limit switch.

Note) In this case, the movable part of the machine tool can be moved only in the opposite direction.

b) When both LS1 and LS2 operate:
i) Set 2nd L.S. REMOVE button to ON on operator's panel.
ii) Do the same operation as in releasing LS1.

Note) In the equipment in which LS1 is not operating when LS2 is in operation, the movable part is movable in both directions by manual operation. Be careful of the direction in which it is to be moved when LS1 has malfunctioned.

9)-2 Overtravel (software) ... Stored stroke limit alarm

If the machine has reached the stored stroke limit value, an overtravel alarm is displayed.
The axis feed is stopped if this alarm occurs.

Causes and countermeasures

① Stored stroke limit setting (parameter No. 60 - 65) error → Correct parameters.
② Program error → Correct parameters.

Release

The machine can move in the opposite direction of the last moving direction. Move the moving part of the machine in the opposite (safe) direction by manual operation, and reset the stored stroke limit.

10) Motor overheat
DC servo motor overheat alarm (overload when AC servo motor is overheated)

Item	Cause of trouble	Checking points	Corrective action
1	Overload	Check to see if the motor armature current exceeds the rated current.	Decrease load torque. Decrease cutting condition.
2	Winding insulation trouble	Check the insulation between the terminals A1 or A2 of motor power cable and the motor bodies with a tester or a megger. Over 1 mΩ at 500 V is normal for the megger check. Infinite value is normal in the tester check.	Clean around the commutator with forced air. Change the motor if the above countermeasure is ineffective.
3	Shortcircuit inside of winding	Measure no-load current by removing the motor from the machine. If the current increases in proportion to the motor rotation rate, there is a short-circuit inside of winding.	Clean around the commutator. This problem can easily occur when the oil adheres to the surface of the commutator.
4	Demagnetization of field system magnet	Check the motor terminal voltage between A1 and A2 is normal at rapid traverse.	Change the motor if terminal voltage is low and the motor is overheated at the same time.
5	Trouble in heat pipe fan operation	Check the fan voltage or the wiring. Check that the fan does not touch a wire gauze. Check to see if the fan motor itself has a problem.	Rearrange the wiring. Refix the wire gauze. Replace the fan motor.
6	Trouble in heat pipe efficiency	The heat pipe is ineffective when the motor with a heat pipe is overheated, despite the fact that all the above items are normal.	Replace the motor.
7	Brake trouble	Check to see that the brake connection corresponds to the power source frequency. Check to see that the voltage is 100 V $\pm$10% (allowable value).	Replace the brake.

Item	Cause of trouble	Checking points	Corrective action
8	Connection trouble	Check the overheat connection between motor and positioning module.	Repair the fault.
9	Positioning module is defective.		Replace the positioning module.

11) Overrun detection (Tachogenerator signal loss) TGLS/TG
a) For M series servo

Item	Cause of trouble	Checking points	Corrective action
1	The motor power cable is not connected to terminals (5), (6), (7) or (8) of terminal board T1 in the velocity control unit, or the power cable is broken.	If the alarm occurs when a motion command is not input, the alarm cause described at the left should be checked.	Check the power cable connection.
2	PCB setting is improper.	Check the setting according to section 6.2. "Setting and adjustment of PCB .....".	Adjust the setting.
3	Velocity feedback voltage is not being applied or is intermittent.	Measure the velocity feedback voltage between check terminals CH2 (TSA) and CH3 (GND) with an oscilloscope. Confirm whether the voltage is being interrupted.	Repair the cable carrying the velocity feedback voltage. Repair the defective source (i.e., motor or control) of the velocity feedback voltage.

b) For AC servo

Item	Cause of trouble	Checking points	Corrective action
1	The motor power cable is not connected to terminals (5), (6), or (7) of terminal board T1 in the volocity control unit, or the power cable is broken.	If the alarm occurs when a motion command is not input, the alarm cause described at the left should be checked.	Repair the power cable of motor.

Item	Cause of trouble	Checking points	Corrective action
2	PCB setting is improper.	Check the setting.	Adjust the setting correctly.
3	Pulse coder feedback signal is not sent.	Check the feedback cable.	Repair the feedback cable.

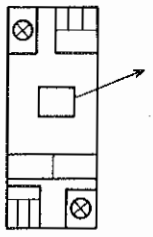
12) Abnormal load OVC
a) For M series servo

Item	Cause of trouble	Checking points	Corrective action
1	PCB is defective.	The OVC alarm occurs if the power is turned on when the motor power cable is disconnected. (In this case, since the gravity axis may fall down, it should be supported.) (The S23 terminal should be shorted so that the TGLS alarm will not occur. After confirmation, the S23 connection should be opened.)	Replace the PCB.
2	PCB setting is improper.	Check the setting of variable register RV3 which is used to set the upper limit of the motor current. (Generally, RV3 is set to 10, but the adjustment may differ with the machine tool.)	Change the RV3 setting.
3	Mechanical load is abnormal.	Observe the waveform between check terminals CH8 and CH3 with an oscilloscope. Check whether the current which is determined by RV3 flows over 600 msec.	Remove the mechanical overload.

b) For AC servo

Item	Cause of trouble	Checking points	Corrective action
1	Pulse coder feedback signal is not sent.	Check the feedback cable.	Reconnect the feedback cable.
2	Motor current exceeds rated current.	Check motor current.	Change the cutting conditions.

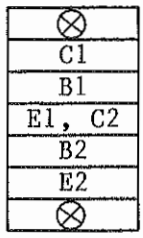
13) No fuse breaker BRK
a) For M series servo

Item	Cause of trouble	Checking points	Corrective action
1	The no fuse breaker operated.	The breaker is open when it is as shown below.  This button pops up when the breaker operates. To reset the breaker, press the button after turning off the power.	Turn off power and reset the breaker. (If it cannot be reset immediately, wait about ten minutes and try again.)
2	Diode module DS or some other part of the velocity control unit is defective.	The breaker operates again when power is restored after the countermeasures of item 1.	Replace diode module DS or the whole velocity control unit.
3	Mechanical load is excessive.	Observe the motor load current at rapid traverse between terminals CH8 and CH3 on the PCB with an oscilloscope. Check whether it exceeds the rated current.	Remove the mechanical overload.
4	The PCB or the connection between the PCB and the velocity control unit is defective.	The BRK alarm occurs when the no fuse breaker is not operating.	Replace the PCB or the velocity unit.

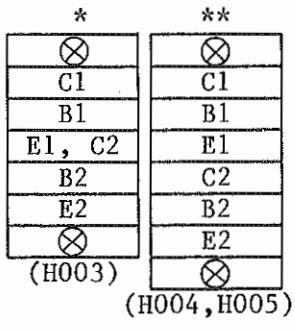
This alarm message is not displayed for AC servo.

14) High current alarm HCAL/HC
a) For M series servo

Item	Cause of trouble	Checking points	Corrective action
1	Improper motor power cable connection.	The HCAL alarm does not occur when the power is turned on with the motor power cable disconnected. (In this case, since the gravity axis may fall down, it should be supported. The S23 terminal on the PCB should be shorted so that the TGLS alarm will not occur. The S23 connection should be opened after confirmation.)	Fix the motor power cable connection.

Item	Cause of trouble	Checking points	Corrective action
2	The transistor module is defective.	The HCAL alarm goes on when the motor power cable is disconnected. Turn off power and measure the resistance between the following terminals using a multimeter. If the measured value is 10 ohms or less, the transistor module is defective.	Replace the transistor module.  Confirm between C1-E1, C2. E1, C2-E2.

b) For AC servo

Item	Cause of trouble	Checking points	Corrective action
1	Wrong connection of motor power line.	HC alarm does not occur when turning on the power supply after disconnecting the motor power line. (Since the gravity axis may drop in this case, support it or disconnect the drive cable of gravity axis brake.)	Reconnect the motor power line correctly. If the motor power line is checked while disconnecting it, set setting terminal S10 to L side; otherwise, TG alarm occurs.
2	Transistor module is defective.	Check to see if HC alarm occurs when turning on the power supply after disconnecting the power line according to item 1. Turn off the power supply, remove PCB, and observe the resistance between terminals of the transistor module using a circuit tester.	Replace transistor module. * Check resistance between C1-E1 and C2 also between E1 and C2-E2. ** Check resistance between C1-E1 and also between C2-E2. 

Item	Cause of trouble	Checking points	Corrective action
3	Internal short-circuit failure of motor windings.	Check motor windings for normal insulation.	Replace the motor.
4	PCB is defective.	If HC alarm occurs with no defects in item 1, 2, 3, PCB is defective.	Replace the PCB.

15) High voltage alarm HVAL/HV
a) For M series servo

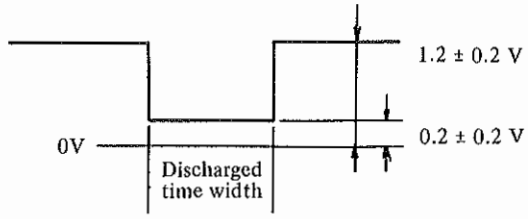
Item	Cause of trouble	Checking points	Corrective action
1	Input AC power voltage is too high.	Check to see if the tap connection of servo power transformer is correct.	Correct the tap connection.
2	Servo motor is defective	Check to see if the insulation resistance is normal between the motor armature (power line) and the body.	Clean brushes.
3	PCB is defective.	Check to see if alarm occurs when items 1 and 2 are normal.	Replace PCB.

b) For AC servo

Item	Cause of trouble	Checking points	Corrective action
1	Input AC power voltage is higher than specified.	Check to see if the servo transformer taps are properly connected.	Repair the tap connection.
2	Servo motor is defective.	Check to see if the insulation resistance is normal between the motor armature (power line) and the body.	Replace the motor.
3	Load inertia is excessive.		Increase the acceleration/ deceleration time constant.
4	PCB is defective.	If HV alarm occurs with no defect in items 1, 2, 3, PCB is defective.	Replace the PCB.

16) Discharge alarm DCAL/DC
a) For M series servo

Item	Cause of trouble	Checking points	Corrective action
1	Discharge transistor Q1 or the PCB is defective.	The alarm occurs immediately after turning on power.	Replace transistor Q1. Replace PCB.
2	PCB setting is improper.	Terminal S26 is shorted even though the separate regenerative discharge unit is used with the gravity axis.	Open terminal S26.
3	Machine tool counterbalance is improper.	The waveform shown in the following figure is measured at started periods on check terminal CH10 while the counterbalanced axis is moving down at rapid traverse speed.	Adjust the counterbalance.
4	The acceleration/ deceleration rate frequency is too high.	Check whether the positioning frequency at rapid traverse speed exceeds 1 to 2 time per second. Check that this alarm indicator does not go on when the rate is decreased.	Use a dwell period and decrease the acceleration/ deceleration rate.



b) For AC servo

Item	Cause of trouble	Checking points	Corrective action
1	Regenerative transistor Q1 is defective or PCB is defective.	DC alarm occurs immediately after power is turned on.	Replace the transistor Q1. Replace the PCB.
2	PCB setting is improper.	Setting pin S2 is set to L side even though a separate regenerative discharge unit is used.	Set S2 correctly.

Item	Cause of trouble	Checking points	Corrective action
3	The acceleration/ deceleration rate frequency is too high.	Check whether the positioning frequency at rapid traverse speed exceeds 1 to 2 times per second. Check to see if this alarm does not occur when the rate is decreased.	Use a dwell period and decrease the acceleration/ deceleration rate.

17) Low power voltage alarm LVAL/LV
a) For M series servo

Item	Cause of trouble	Checking points	Corrective action
1	AC power voltage is too low.	Check to see if connection between input AC power voltage and servo transformer tap is correct.	Correct the tap connection.
2	Connection defective between servo transformer and CN2 on the PCB.	Check to see if PCB voltage +24 V and ±15 V are correct. Check that the servo transformer terminals (41 - 43, 44 - 46, 47 - 49) and PCB CN2 (1, 2, 3) are connected correctly.	Correct the connection.
3	PCB is defective.	LVAL alarm occurs when above items 1, 2 are normal.	Replace the PCB.

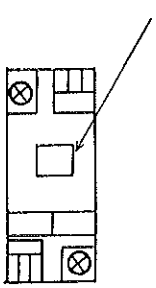
b) For AC servo

Item	Cause of trouble	Checking points	Corrective action
1	AC power voltage is too low.	Check to see if the connection between input AC power voltage and servo transformer is correct.	Correct the tap connection.
2	Connection defective between servo transformer and PCB CN2.	Check to see if PCB voltage +24 V, +15 V and +5 V are correct. Check that servo transformer terminal 41 - 49 (AC 18 V) and PCB CN2 (1, 2, 3) are connected correctly.	Correct the connection.
3	+5 V fuse is blown out.	Check to see if the fuse for +5 V is blown out.	Replace the fuse.
4	PCB is defective.	PCB is defective if LV alarm occurs when above items 1 - 3 have no problem.	Replace the PCB.

18) Other V-READY off (Velocity control unit failure)
If the V-READY off is not caused by the failures described before, check the following items.

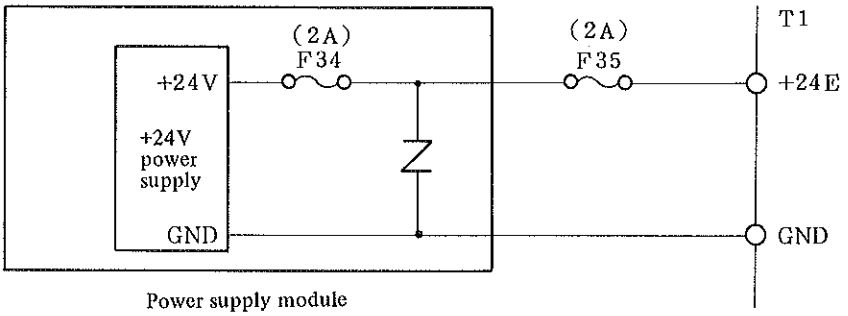
Item	Cause of trouble	Checking points	Corrective action
1	100 VAC is not supplied to velocity control unit.	Check to see if 100 V AC are supplied across terminals (3) and (4) of the terminal board of velocity control unit.	Supply 100 V AC.
2	No fuse breaker is turned off in AC servo.	Check the no fuse breaker button on/off state.	When the button is off, proceed to next block.

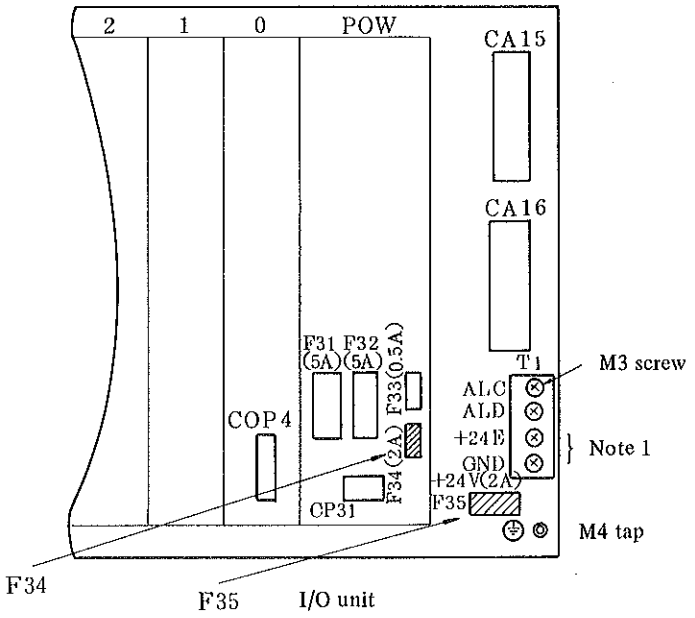
Causes and countermeasures when no fuse breaker functions in AC servo

Item	Cause of trouble	Checking points	Corrective action
1	No fuse breaker functions	The operating condition is as illustrated below.  This button is pushed inward during normal operation of the motor. If the breaker has functioned, turn off the three-phase power supply once; then press this button.	Reset the no fuse breaker after turning off the power supply. (Wait for about 10 minutes if the no fuse breaker cannot be reset at once.)
2	Diode module, surge absorber (ZNR) or other parts are faulty in velocity control unit.	No fuse breaker functions simultaneously when power supply is turned on after countermeasure in item 1.	Replace diode module DS or surge absorber (ZNR) of velocity control unit.
3	Abnormal mechanical load	Check to see if the motor load current exceeds the rated current during rapid traverse while monitoring CH10 and CH11 or CH12 and CH3 (0 V) of PCB using an oscilloscope.	Eliminate abnormal load from machine tool side.

3.12.4 Fuse alarm of I/O module

1) External output power supply (+24E) fuse
When digital input modules ID □□ A and ID □□ B are used, +24 V power supply (+24E) is fed to terminal board T1 of the main unit and I/O unit in order to feed the voltage to an external contact. Two types of fuses F34 and F35 are inserted into this +24E power supply to protect the power supply modules and I/O modules which are mounted on the I/O unit from a short-circuit failure or a contact failure with other power lines.

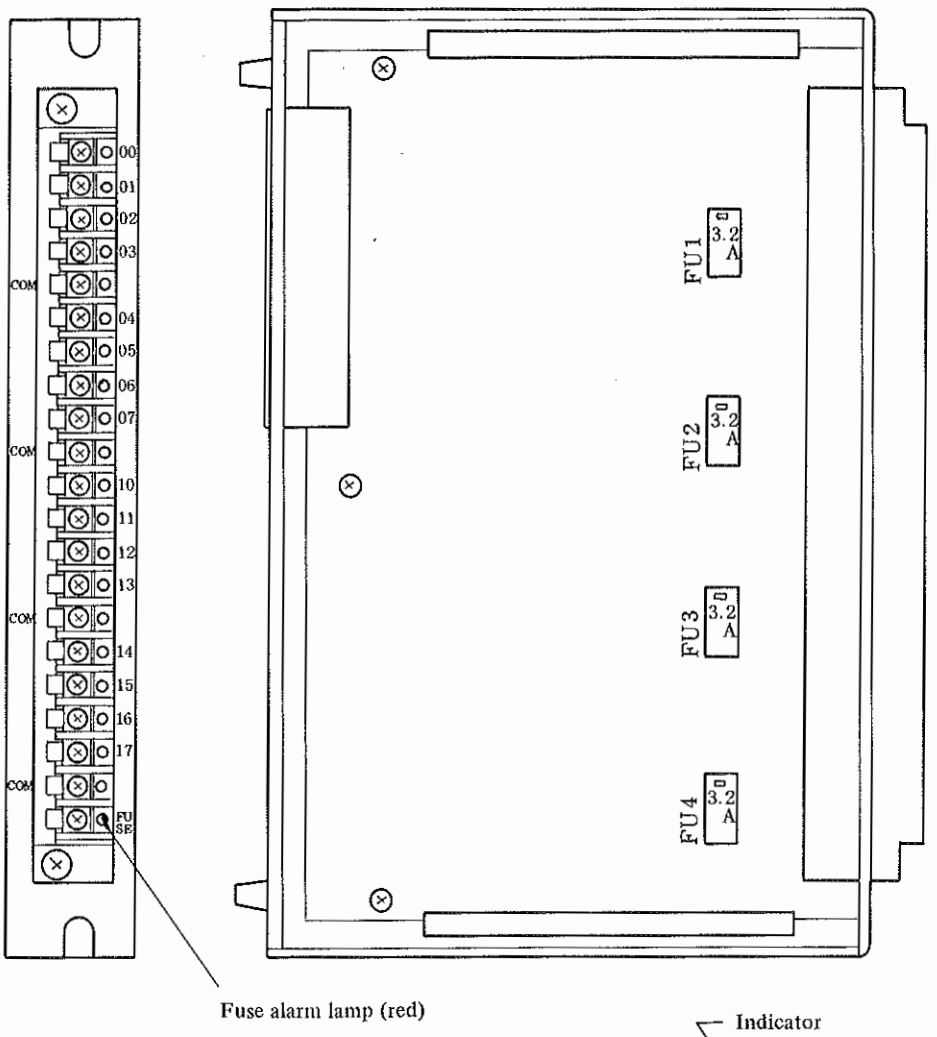
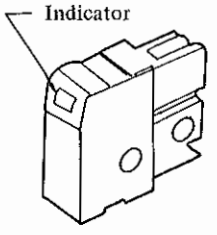




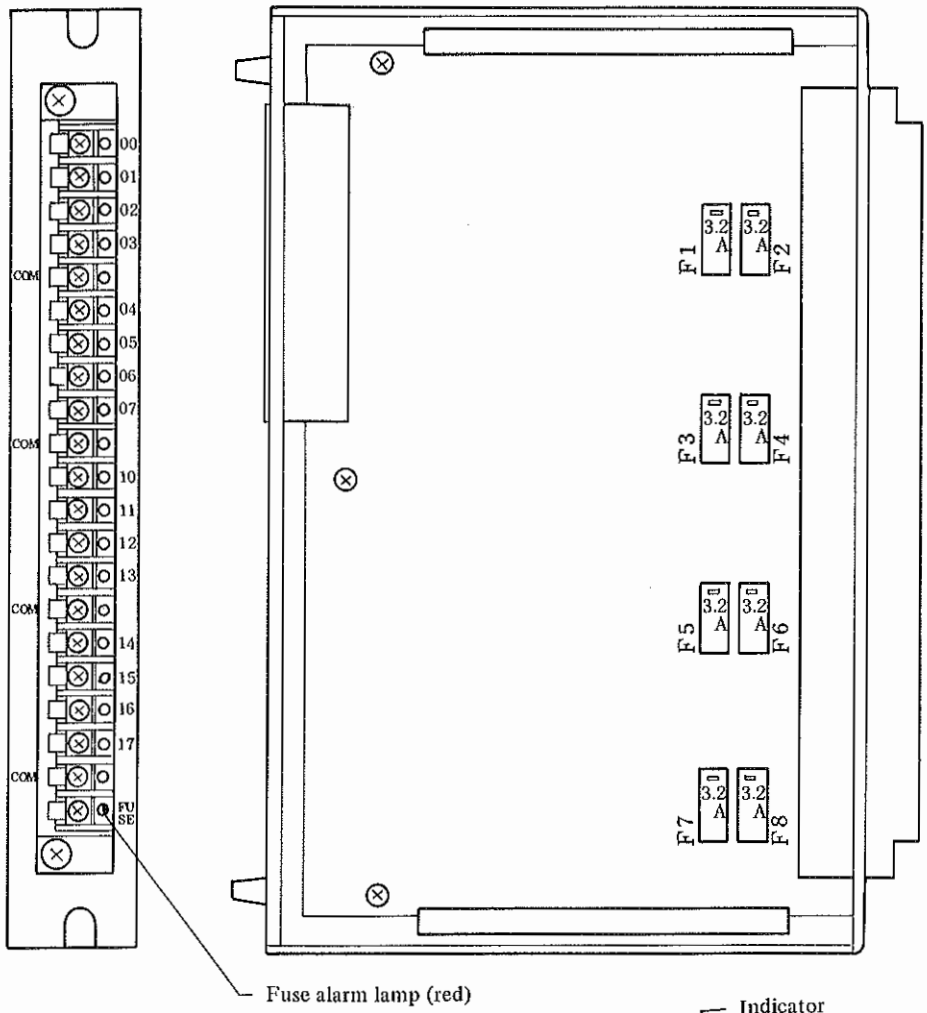
2) Fuse alarm in digital output module

The terminal board type digital output module is provided with built-in fuses.

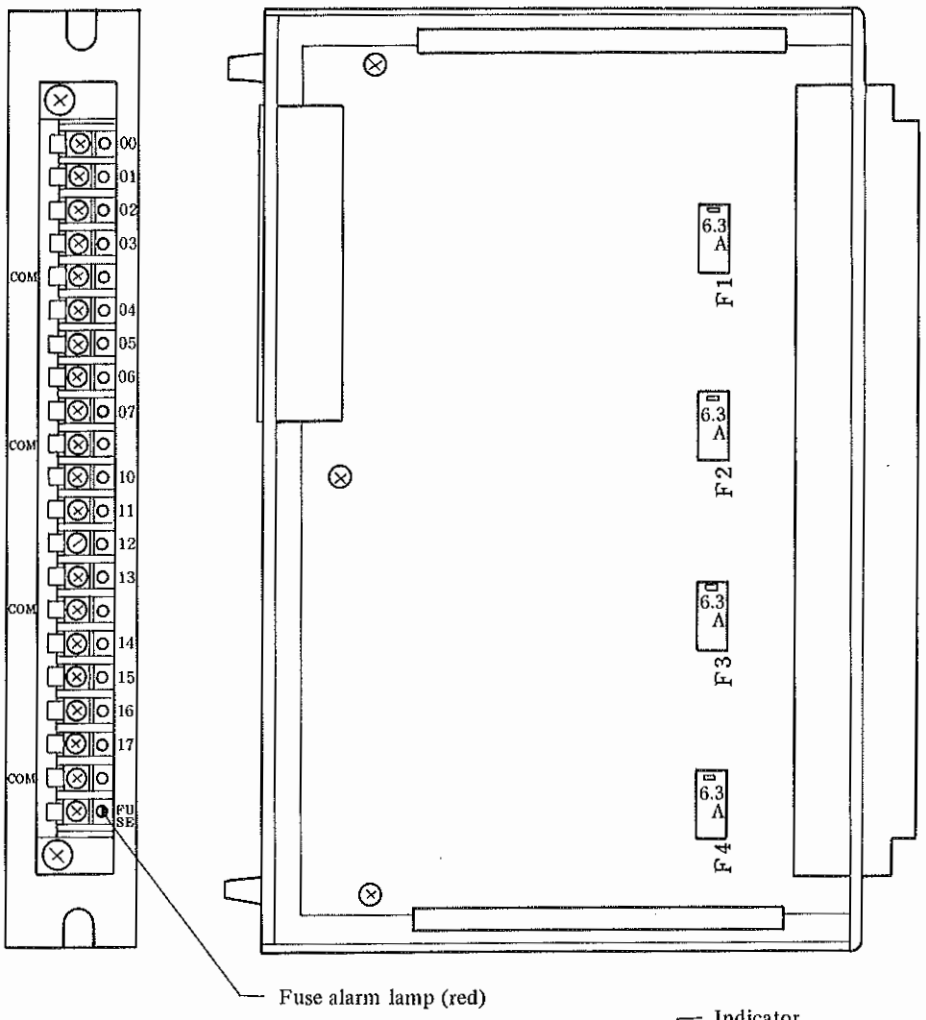
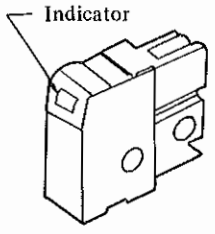
If these fuses are blown out, the fuse alarm indicator lamp of corresponding module lights to indicate the fuse failure. The following figure shows the mounting positions of fuse alarm indicator lamps of each module and the mounting positions of fuses.

Module name	OD08B, OD16B
Mounting positions of fuse alarm indicator lamps and mounting positions of fuses	 If one of fuses FU1 - FU4 is blown out, the above fuse alarm lamp lights. The blown out fuse shows a white failure display as in the indicator shown in the right figure. 
Correspondence between fuses and output terminals	

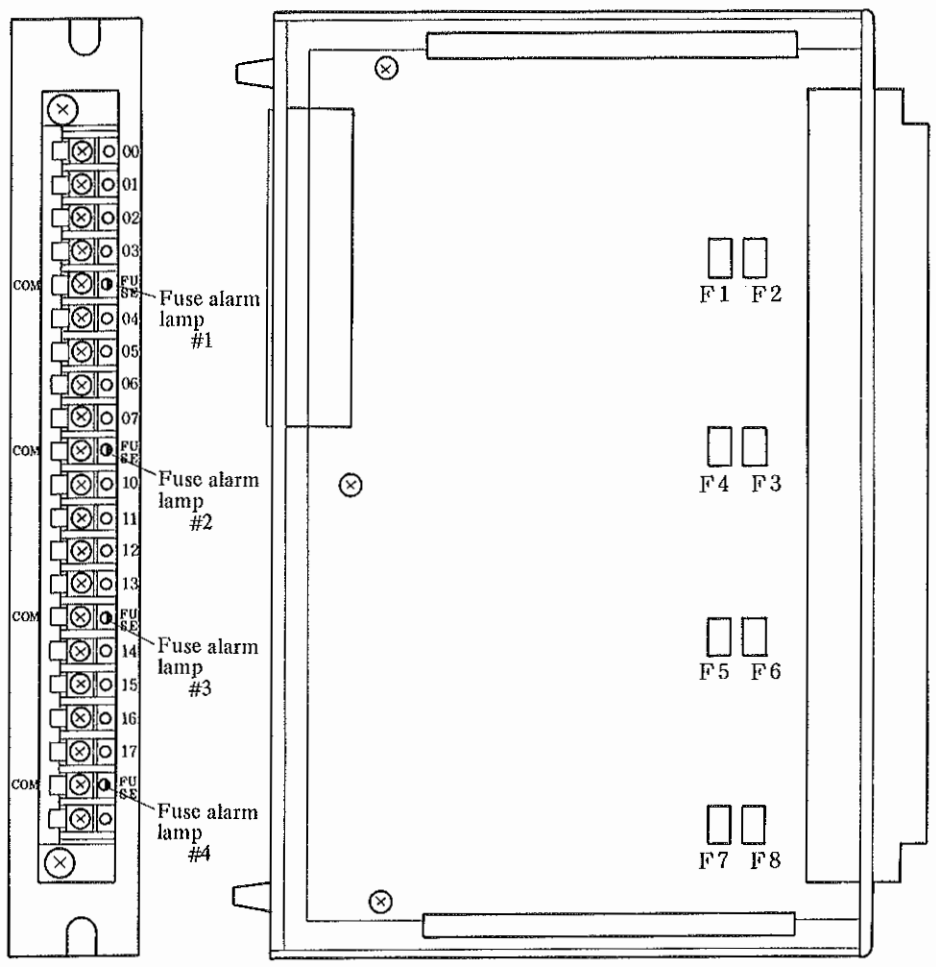
Fuse number	FU1	FU2	FU3	FU4
Output number	OS00-OS03	OS04-OF07	OS10-OS13	OS14-OS17

Module name	OD08C, OD16C
Mounting positions of fuse alarm indicator lamps and mounting positions of fuses	 If one of fuses F1 - F8 is blown out, the above fuse alarm lamp lights. The blown out fuse shows a white failure display as in the indicator shown in the right figure.
Correspondence between fuses and output terminals	

Fuse No.	F1	F2	F3	F4	F5	F6	F7	F8
Output No.	OS00 OS01	OS02 OS03	OS04 OS05	OS06 OS07	OS10 OS11	OS12 OS13	OS14 OS15	OS16 OS17

Module name	OA08D, OA16D
Mounting positions of fuse alarm indicator lamps and mounting positions of fuses	 If one of fuses F1 - F4 is blown out, the above fuse alarm lamp lights. The blown out fuse shows a white failure display as in the indicator shown in the right figure. 
Correspondence between fuses and output terminals	

Fuse number	F1	F2	F3	F4
Output number	OS00-OS03	OS04-OF07	OS10-OS13	OS14-OS17

Module name	OA08E, OA16E
Mounting positions of fuse alarm indicator lamps and mounting positions of fuses	 If one of fuses F1 - F8 is blown out, the above fuse alarm lamp lights. Correspondence between fuse and lamp is as follows. F1 - F8 have no alarm indicator. Replace the fuse where inside fuse element is blown out.
Correspondence of fuses alarm lamp number, fuse number and output number.	

Alarm lamp No.	#1		#2		#3		#4	
Fuse No.	F1	F2	F3	F4	F5	F6	F7	F8
Output No.	OS00 OS01	OS02 OS03	OS04 OS05	OS06 OS07	OS10 OS11	OS12 OS13	OS14 OS15	OS16 OS17

4. ADJUSTMENT

4.1 Procedure of Adjustment

This section shows adjustment procedure when the system is installed. Adjust your system according to the following items. Details of each item are described in the table below.

No.	Contents	Remarks
1	Check external views of control unit and servo unit.	See Item 4.1 (1)
2	Check the connection of screw terminals.	See Item 4.1 (2)
3	External cables connection.	See Item 4.1 (3)
4	When power source for NC is "OFF", connect the power input cable.	See Item 4.1 (4)
5	Check the insert position of connector and PCB.	See Item 4.1 (5)
6	Setting confirmation . Tap setting transformer . Velocity control unit PCB setting . Control section PCB setting	See Item 4.1 (6)
7	Check input power source voltage, frequency and phase rotation.	See Item 4.1 (7)
8	Check that output voltage is not shorted with ground.	See Item 4.1 (8)
9	Power on and check output voltage.	See Item 4.1 (9)
10	Adjustment of velocity control unit.	See Item 4.1 (10)
11	Adjustment of photo Amp. output wave form of tape reader.	See Item 4.1 (11)
12	Check interface signal between NC and machine side.	See Item 4.1 (12)
13	Setting and confirmation should be made for each parameter and setting data.	See Item 4.1 (13)
14	Power off.	See Item 4.1 (14)
15	Connect motor power cable.	See Item 4.1 (15)
16	Power on.	See Item 4.1 (16)
17	Check movement of each axis by manual feed.	See Item 4.1 (17)
18	Adjustment for servo system.	See Item 4.1 (18)
19	Check whether all functions of NC operate normally.	See Item 4.1 (19)

1) Check external or internal view of control unit and servo unit

Items
Check dirt and damage on external view of CRT/MDI unit, internal position display unit, internal manual operation board, etc.
Check loosening fixture or detachment of PCB, tape reader unit, velocity control unit, etc., inside of locker.
Check damage on cables, conduits, etc., inside of locker. (Cover strippings, etc.)

2) Check that the connection of screw terminals is correct

Items
Terminal plate TP1 or TB1 of input unit (U, V, W).
Terminal plate TP2 of input unit (EON, EOF, COM, FA, FB).
Terminal plate TP3 of input unit (200A, B).
Terminal plate TP4 of input unit (U1, V1, EMGIN1, 2, EMGOUT1, 2).
Terminal plate TB2 of input unit (R, S, 200A1, 200B1, others).
Power ON/OFF button of CRT/MDI unit.
Terminal block of tape reader unit.
Terminal block of input transformer for export. (Primary and secondary side)
Terminal block for servo power transformer. (Primary side, secondary side 100A, B TOH1, 2)
Check that the cover is not detached (if applicable).

3) External cables connection
Check following items at time of installation for each unit

Items
After striping cable external cover, check whether the cable is connected to the earth plate by cramp metal.
Check whether the larger (more than 14 mm^2) protection earth cable is connected between NC and machine side magnetics cabinet.
Check the protection earth is being one point earth type or not as connecting from the machine side magnetics cabinet to the grounding earth.

Check following items only for the initial equipment.

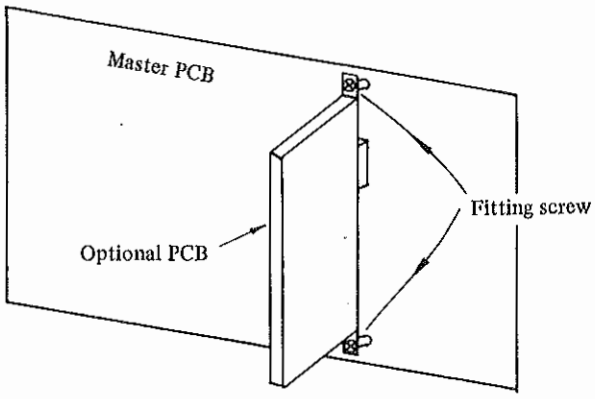
Items
Check whether all signal cables are made into unified shield.
Cable specifications are as designated by connecting manual. (For motor signal)
Cable specifications are as designated by connecting manual. (For motor drive)
Cable specifications are as designated by connecting manual. (For velocity control unit interface)
Cable specifications are as designated by connecting manual. (For position coder)
Cable specifications are as designated by connecting manual. (For spindle analogue output)
Cable specifications are as designated by connecting manual. (For manual pulse generator)
Cable specifications are as designated by connecting manual. (For external position display)
Cable specifications are as designated by connecting manual. (For external CRT/MDI)
Cable specifications are as designated by connecting manual. (For Reader•puncher interface)

4) As setting power source for NC "OFF" connect the power input cable

Items
Disconnect motor power cables.
Short short bar S23 on the velocity control unit PCB for M series servo motor.
Put short bar S10 to L-side on velocity control unit PCB for AC servo.

5) Check the mounting position of connector and PCB

Items
Are cramp screws for HONDA connector firmly tightened?
Are nail-type fixtures fitted with flat cable connector?
Are nail-type fixtures fitted with brown connector for power source?

Items
Are screws tightened for optional PCB? 
Are ROMs exactly mounted with IC socket on ROM card.

6) Setting confirmation
Perform following items a) ∿ e) for every unit at time of installation.
a) Tap set of transformer (see Item 4.2).

Items
Tap setting of servo power transformer.
Tap setting of input transformer for export.

b) Setting on control section PCB (see Item 6.1).
c) Setting on M series velocity control Unit PCB (see Item 6.2).
d) Setting on AC servo velocity control unit PCB (see Item 6.3).
e) Setting on AC spindle servo unit PCB (see Item 6.4).

7) Confirmation for input power source voltage and frequency

Items
When power source is used for control unit and servo unit, confirm that input is applied as follows: AC 200/220 V $^{+10\%}_{-15\%}$, 50/60 Hz $\pm$1 Hz, 3 ϕ (However, combination with 220 V and 50 Hz is not recommended.)
Power source input for control unit only is applied as follows: AC 200/220 V $^{+10\%}_{-15\%}$, 50,60 Hz $\pm$3 Hz, 1 ϕ (However, combination with 220 V and 50 Hz is not recommended.)
Power source input for servo unit only is applied as followings: AC 200/220 V $^{+10\%}_{-15\%}$, 50,60 Hz $\pm$1 Hz, 3 ϕ (However, combination with 220 V and 50 Hz is not recommended.)

Items
Power source for export transformer is applied as follows: AC 200/220/230/240/380/415/440/460/480/550 V $^{+10\%}_{-15\%}$
Input power capacity is enough for consumptive power of control unit and servo unit.

8) Confirm that output voltage is not shorted with ground

Items
Power unit output +5 V is not shorted with 0 V.
Power unit output +24 V is not shorted with 0 V.
Power unit output +15 V is not shorted with 0 V.
Power unit output -15 V is not shorted with 0 V.

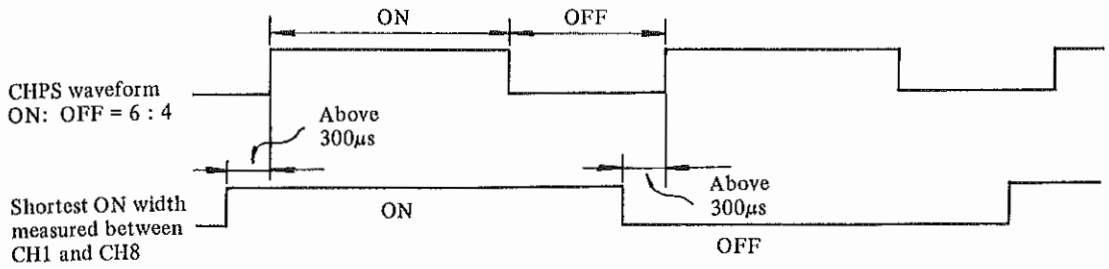
9) Power on and check output voltage (see Item 3.4)

Items		
Are the fans in the locker operating?		
At the check terminal on master PCB or control PCB, confirm that output voltage is within the ranges at table to the right.	+5 V (C12)	+4.75 - +5.25 V
	+24 V (C12)	+21.6 - +26.4 V
	+15 V (C12)	+14.25 - +15.75 V
	-15 V (C12)	-14.25 - -15.75 V
Confirm each output voltage at check terminal on velocity control unit P.C.B.	CH15 (+24 V)	+22 - 27 V
	CH16 (+15 V)	+14.55 - 15.45 V
	CH17 (-15 V)	-14.55 - -15.45 V

10) Adjustment of velocity control unit (see Item 6.2)

Items
Confirm servo offset a) Set RV2 on velocity control unit PCB to 50% (for pulse coder feedback). Set RV2 so that voltage between CH6 and CH3 is within ±0.5 V while shorting between CH1 and CH3 and between CH2 and CH3. Note 1: When machine moves during adjustment, position deviation error stop page or drift excessive error will occur. In this case, set approx. 5000 to in-position width and position deviation limit value. After adjustment, reset normal data. If the large data is set to in-position width, automatic drift compensation is not performed. Note 2: Don't short CH2 (TSA) and CH3 (0 V) or CH2 and CH4 (0 V) on velocity control PCB because hybrid IC on master PCB will be damaged (This note applies to a system with pulse coder feedback).

11) Adjustment of photo Amp. output wave form of tape reader
(Refer to Item 3.5)

Items
After setting endless tape (repeating respectively punching and non-punching), send the tape by setting switch for MANUAL. 1) With an oscilloscope, measure the waveform at check terminals CHPS on the photo-amplifier. Adjust it so that the ON/OFF timing ratio is 6:4 by RV1 (SP). 2) Measure the waveform between check terminals CH1 and CH8 on the photo-amplifier using oscilloscope, and find the channel where the ON time width is the shortest. 3) Measure the waveform where the ON time width is the shortest between CH1 and CH8 and compare it with the waveform of CHPS. Adjust so that the timing indicated below is obtained by RV2. 4) Confirm that the waveforms CH1 and CH8 satisfy the timing in the diagram below.  Note) Names of check terminal and variable resistor for tape reader (A13B-0070-B001) are changed as below. CHPS → S, CH1 ∿ CH8 → 1 ∿ 8, CHG → 0V, RV1 → SP, RV2 → right side volume of SP.

12) Confirm interface signal between NC and machine side

Items
Refer to the self-diagnostic function table (see Item 3.7).

13) Setting and confirmation should be made for each parameter and setting data

Items
Refer to the parameter table (refer to Item 5.3).
Set parameter ADR (PRM, 1800, 0 bit) to "1".
Set parameter PSF (Parameter No. 1802) to 0 for a resolver or an inductosyn.

14) Turn off the power supply

15) Connect the motor power line
Open S23 for M series servo. Set S10 to H side for AC servo.

16) Turn on the power supply

Items
If an alarm occurred, take corrective action according to the alarm list.
The motor rotates more or less simultaneously when MCC of the velocity control unit was turned on, but it is soon reset due to the function of the automatic drift compensating function. Then, the motor does not rotate even when the power supply is turned on and off. Repeat the power on/off operation and emergency stop several times and make sure that the motor does not rotate.

17) Examine the movement of each axis by manual feed

Items
Try moving each axis every 10 μm by the manual pulse feed or incremental feed. Check to see if the machine normally follows up the movement.
Operate the limit switches mounted on the machine while moving each axis with low override by manual JOG feed; make sure that the machine stops moving securely when an overtravel alarm was detected.
Move each axis while changing the override by manual JOG feed and manual rapid traverse. Make sure that none of the alarms such as excessive error, etc., appear even at the maximum feed rate.

18) Adjust the servo system

Items
Operate each axis by F4 digit feed in MDI mode, and check the positional deviation amount by the CRT/MDI unit at this time (DGN No. 3000). Obtain the position gain from the feed rate and positional deviation amount by the following equation: $G = \frac{16.7F}{E}$ F: Feed rate (mm/min) (0.1 in/min), (deg/min) E: Positional deviation amount (0.001 mm), (0.0001 in), (0.01 deg) G: Position gain (sec^{-1}) (standard: 30 sec^{-1}) Adjust the position gain to be less than ±10% of the aimed value by turning variable resistor (F/V converter voltage compensation) RV4 (in case of M series servo) or RV3 (in case of AC servo) of the velocity control unit PCB. The difference among axes should be within 1%. (Take the initial positional deviation amount into due consideration.)
Perform standard setting and adjustment of the inductosyn, resolver interface PCB, referring to Subsec. 6.1.6.

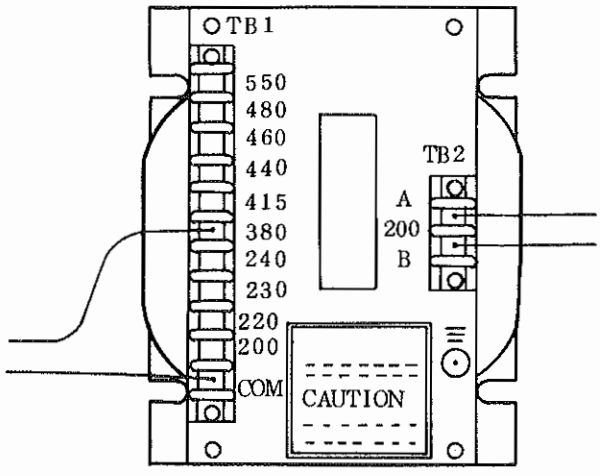
19) Confirm that all functions of NC are able to operate normally.

Items
Perform a reference point return. Perform setting of grid shift amount. This performance will become effective only after power is turned off and on again. Confirmation is required.
Running is made by the test tape being made to match the machine.

4.2 Connection of Power Transformer

4.2.1 Tap change of control power transformer

A control power transformer is required when the input power supply is other than 200 VAC 50/60 Hz or 200 VAC 60 Hz.
This transformer can be installed in the free-standing type cabinet and FS12 built-in type cabinet only. As a power transformer is mounted in the machine tool when the other type cabinets are used, refer to the manual issued by the machine tool builder.
Check the transformer tap, and confirm that the voltage (at the NC power supply terminal) is within +10% and -15% of the tap voltage. If the voltage is outside this range, the tap must be changed.



Tap connection for 380 VAC

4.2.2 Connection of M series servo power transformer

1) Primary connections
   a) For power transformers MA ∿ MC (for Japan)

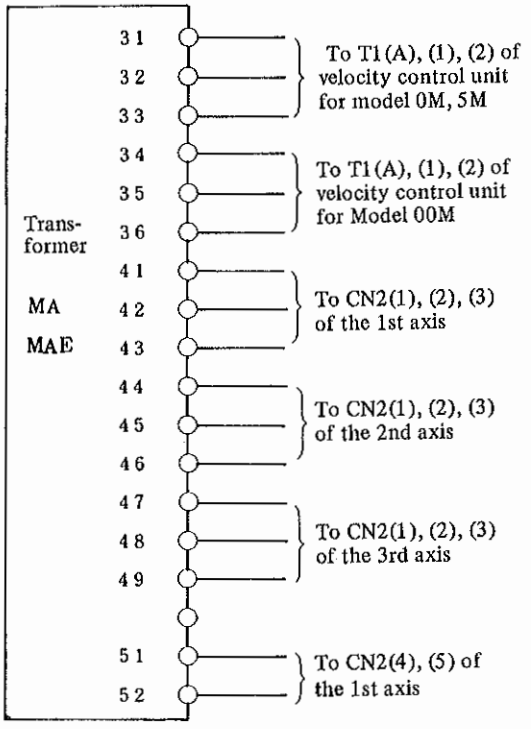
Power voltage	Connection of transformer primary terminals
200 V	U-2, V-4, W-6
220 V	U-1, V-3, W-5

b) For power transformers MAE ∿ MCE (for countries other than Japan)

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

2) Secondary connections

a) For power transformers MA, MAE



b) For power transformers MB, MC, MBE, MCE

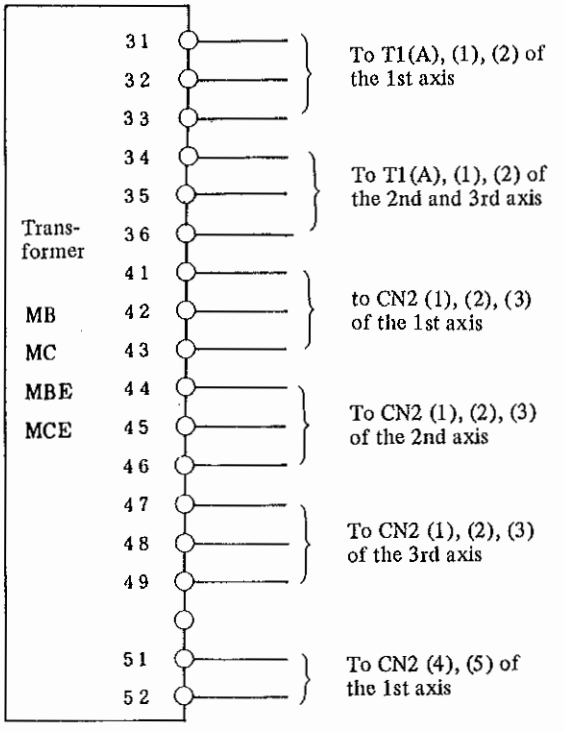
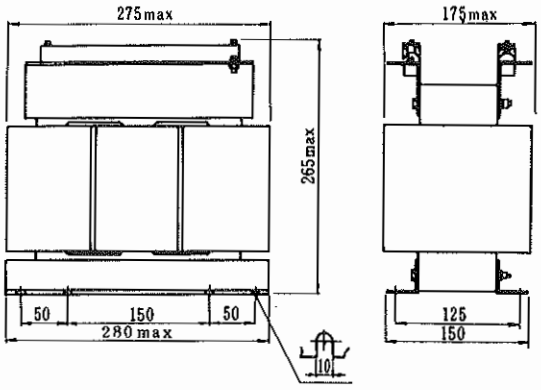


Fig. 4.2.1

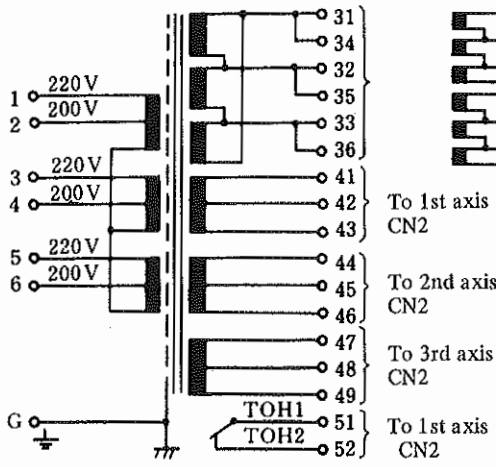
Note: The output voltage of the power transformer differs for Model 00M. (A voltage lower than the voltages for other motors is used.) If the power transformer for other motors should be connected to the velocity control unit for Model 00M by mistake, it causes trouble. Be particularly careful with connection, accordingly.

3) External dimensions of power transformer

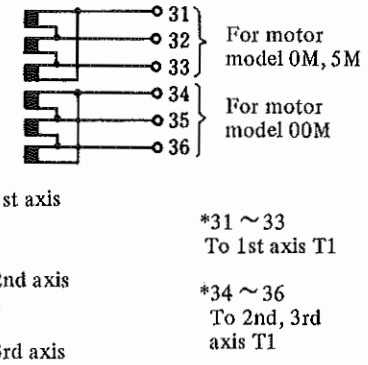


Power transformer	Weight
MA MAE	About 20 kg
MB MBE	About 30 kg
MC MCE	About 36 kg

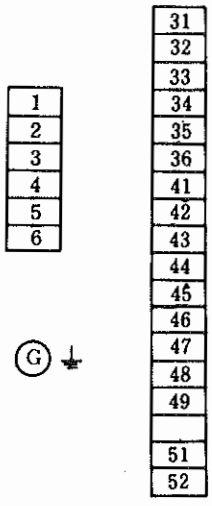
Connection diagram of power transformer MA - MC. Connections of MA31 - 36 are as shown in the figure at right.



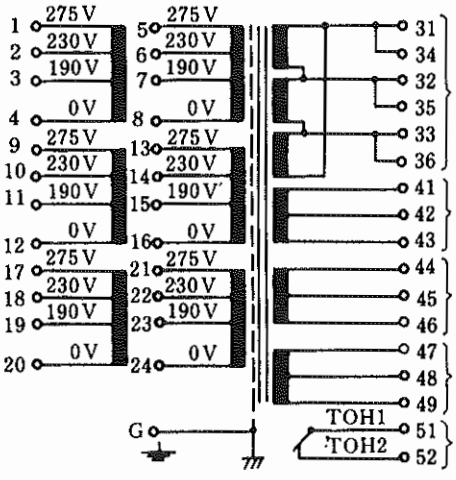
Connections of power transformer MA31 - 36



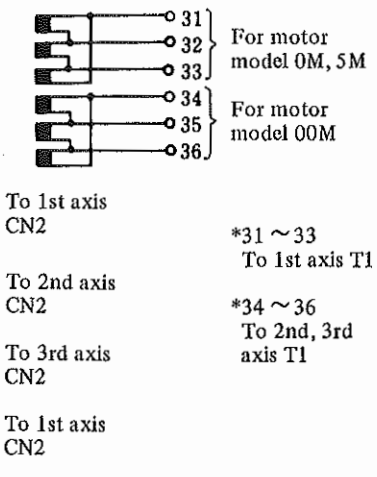
Terminal layout of power transformers MA - MC. (Screw M4)



Connection diagram of power transformer MAE - MCE. Connections of MAE31 - 36 are as shown in the figure at right.



Connections of power transformer MAE31 - 36



Terminal layout of power transformers MAE - MCE.

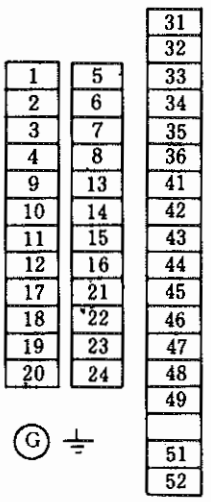


Fig. 4.2.2 (e)

4.2.3 Connection of AC servo power transformer

Be sure the input tap of the power supply transformer is set according to the input voltage when connecting the power supply cable to the AC servo unit.
If set incorrectly, the AC servo unit may cause trouble.

1) Primary side connection
   Connection of the transformer terminals and power supply cables U, V, and W must follow the input supply voltage specifications in Tables (a) and (b).
   a) For power supply transformers AA, MB and MC for Japan

Table 4.2.3 (a)

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

b) For power supply transformers MBE, and MCE for countries other than Japan

Table 4.2.3 (b)

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

c) Power transformer AAE, ABE and ACE for Japan and other countries

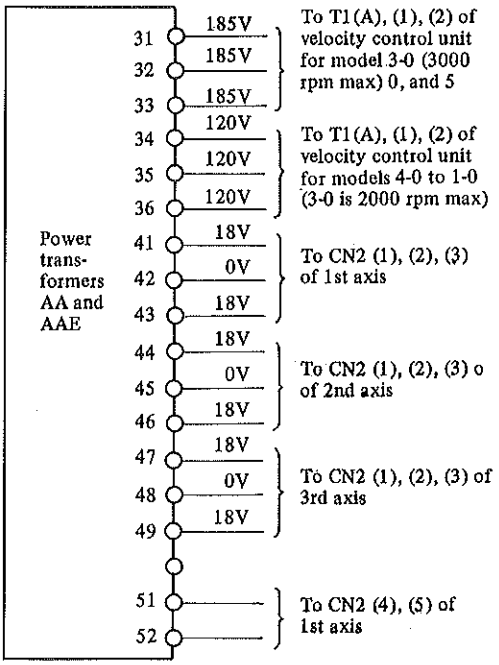
Table 4.2.3 (c)

Power voltage	Connection of primary-side terminals		
	Connection of power cables U, V, W	Short between transformer terminals	Connection type
200 V	U-7, V-15, W-23	8-15, 16-23, 24-7	Delta connection
220 V	U-6, V-14, W-22	8-14, 16-22, 24-6	
230 V	U-5, V-13, W-21	8-13, 16-21, 24-5	
240 V	U-4, V-12, W-20	8-12, 16-20, 24-4	
380 V	U-6, V-14, W-22	8-16, 16-24 or (8-16-24)	Star connection
420 V	U-4, V-12, W-20		
460 V	U-3, V-11, W-19		
480 V	U-2, V-10, W-18		
550 V	U-1, V-9, W-17		

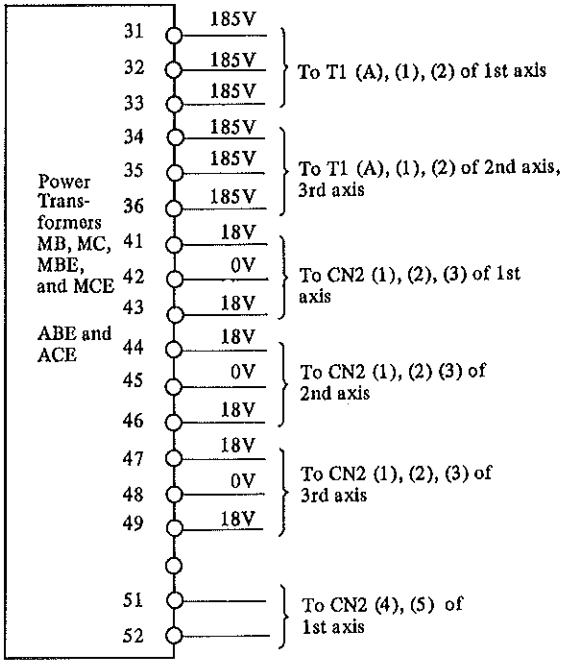
Remarks: If more than one power supply transformer is used, both must be connected to the tap in the same way. Also, the connection of transformer overheat must be done in the same manner.

2) Secondary side connection

a) For power supply transformers AA and AAE



b) For power supply transformers MB, MC, MBE MCE, ABE and ACE



Note: The models 4-0 to 1-0 motors use a relatively low power supply transformer voltage. If the higher voltage used for the other models is applied to the velocity control unit for Models 4-0 to 1-0, it will cause an error.

3) Motors and power transformers used for each axis

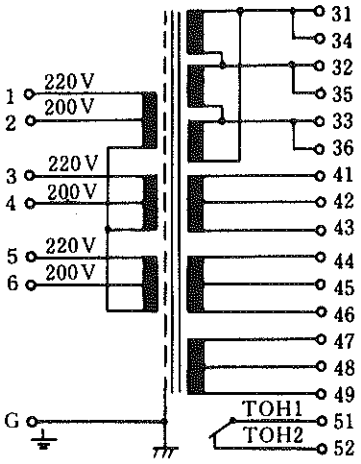
Table 4.2.3 (d)

1st axis	2nd axis	3rd axis	Power transformer	Remarks
Models 4-0,3-0, 2-0	Models 4-0,3-0, 2-0	Models 4-0,3-0, 2-0	Transformer AA (AAE) (1.5 kVA)	Models 4-0, 3-0 (2000 rpm max), 2-0, 1-0, and 0 use transformer output terminals 34, 35, 36, while Models 3-0 (3000 rpm max) and 5 use transformer output terminals 31, 32, 33.
Models 4-0,3-0, 2-0	Models 4-0,3-0, 2-0	Model 5		
Models 4-0,3-0, 2-0,1-0	Models 1-0,0			
Models 4-0,3-0, 2-0,1-0, 0	Model 5			
Model 5	Model 5	Model 5	Transformer MB (MBE, ABE) (2.5 kVA)	
Models 5, 10	Model 10			
Models 20, 30				
Model 5	Model 5	Model 10	Transformer MC (MCE, ACE) (5 kVA)	See Note.
Model 5	Models 20, 30			
Model 30R				

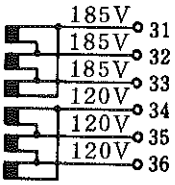
Note: Two or more transformers MC, MCE, or ACE, become necessary according to the load conditions in the case of Models 10, 20, 30 x 3 axis.

4) Connections in the power supply transformer

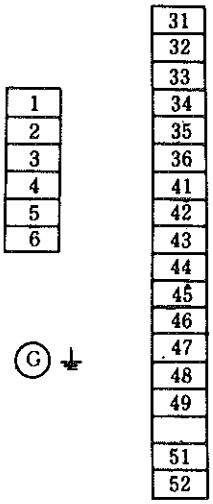
Connections for power supply transformers AA, MB, and MC (Connection for 31-36 of AA is as shown at right.)



Connections for power supply transformers AA 31 to 36.

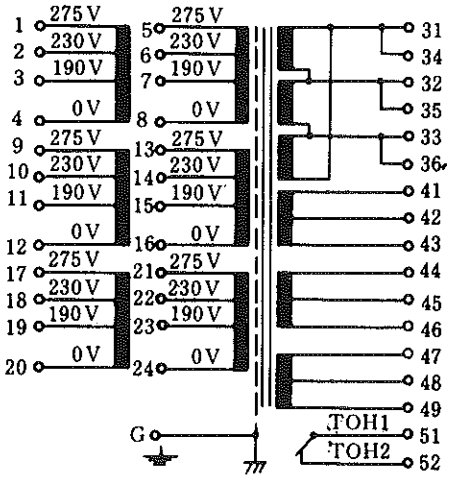


Terminal layout of power supply transformers AA, MB, and MC.

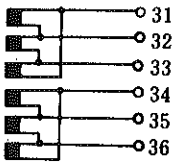


Models for countries other than Japan

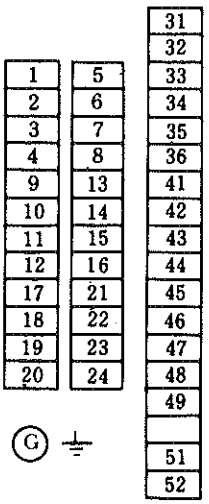
Connections for power supply transformers MBE, and MCE. (Connection for 31-36 of MAE is as shown at right)



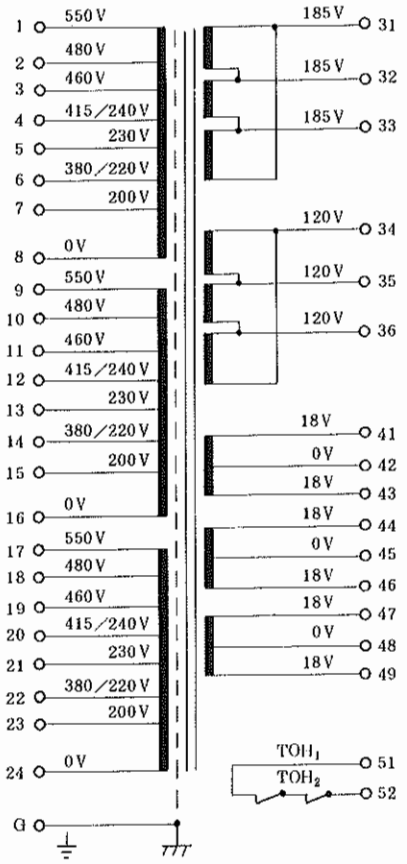
Connections of power transformer MAE 31 to 36.



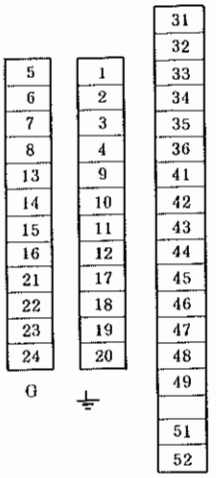
Terminal layout of power supply transformers MBE and MCE.



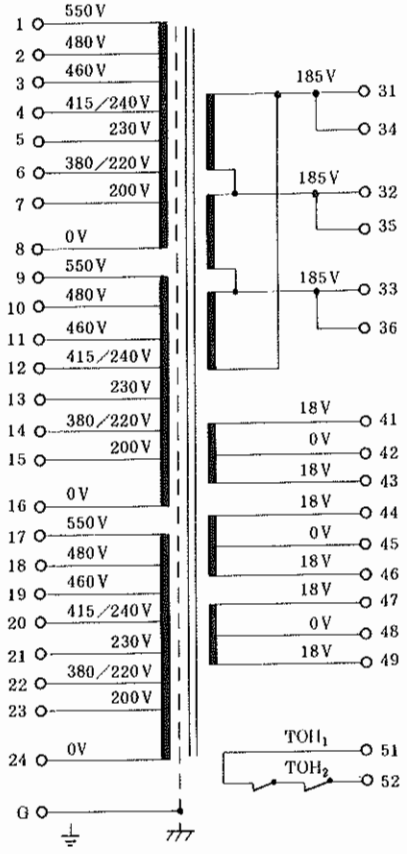
Connection of power supply transformer AAE.



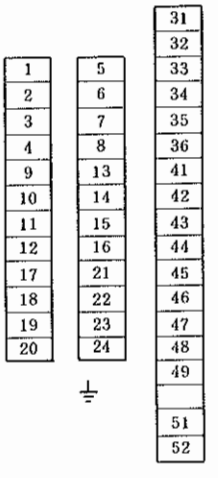
Terminal layout of power supply transformer AAE.



Connection of power transformers ABE and ACE.



Terminal layout of power supply transformers ABE and ACE.



5. PARAMETER

5.1 Parameter Display

5.1.1 Displaying parameters other than pitch error compensation data

1) Press the 'SERVICE' software key followed by the 'PARAM' software key. The parameter screen appears.
2) Enter the data number of the parameter to be displayed and press the 'IMP-NO' software key. Instead of entering a data number, the required parameter can be displayed using the cursor or the page key.

5.1.2 Displaying pitch error compensation data

1) Press the 'SERVICE' software key followed by the 'PITCH' software key. The parameter screen appears.
2) Enter the data number of the parameter to be displayed and press the 'IMP-NO' software key. Instead of entering a data number, the required parameter can be displayed using the cursor or the page key.

5.2 Parameters Setting

5.2.1 Parameter tape format

1) Format of parameter tape except pitch error compensation data

Parameters are classified into the following based on data formats:

Data format	Data range	Remarks
Bit type	0 or 1	
Bit axis type	0 or 1	
Byte type	0 - ±127	
Byte axis type	0 - ±127	
Word type	0 - ±32767	
Word axis type	0 - ±32767	
2-word type	0 - ±99999999	
2-word axis type	0 - ±99999999	

Note 1) Independent data can be specified for each control axis if axis types are used.

Note 2) Data ranges are general ranges. Data ranges vary based on parameters. See the explanation of each parameter for more information.

a) Bit type parameter tape format

N___ P___ ;

N ___ : The data number is a 4-digit numeric value following N (A positive integer)

P ___ : Parameter value (0, 1) is given as an 8-digit numerical value following P. A data number contains 8 bit-type parameters. Parameter bit 0 is stored in the first digit and parameter bit 7 is stored in the 8th digit. (positive integer)

; : End of block (LF in ISO code or CR in EIA code)

Note 1) Address N and P should be specified in the order described above.

Note 2) Leading zeros can be omitted.

Example:

N0000 P00010001; or N0 P10001;

b) Bit axis type parameter tape format

N ___ A ___ P ___ ;

N ___ : The data number is a 4-digit numeric value following N (A positive integer)

A ___ : An axis number (1 - 15) (A positive integer)

P ___ : Parameter value (0, 1) is given as an 8-digit numerical value following P. A data number contains 8 bit-type parameters. Parameter bit 0 is stored in the first digit and Parameter bit 7 is stored in the 8th digit. (positive integer)

; : End of block (LF in ISO code or CR in EIA code)

Note 1) Address N, A, and P should be specified in the order described above.

Note 2) Leading zeros can be omitted.

Example:

```
N0012 A1 P0000011; or N12 A1 P11;
N0012 A2 P0000010; or N12 A2 P10;
N0012 A3 P0000010; or N12 A3 P10;
```

The parameters of various axes can be specified in one block as follows:

```
N12 A1 P11 A2 P01 A3 P01;
```

c) Byte type parameter tape format

N ___ P ___ ;

N ___ : The data number is a 4-digit numeric value following N (A positive integer)

P ___ : Parameter value is given as a numerical value following P. (An integer)
Valid data range depends on the parameters.

; : End of block (LF in ISO code or CR in EIA code)

Note 1) Address N and P should be specified in the order described above.

Note 2) Leading zeros can be omitted.

Example:

```
N2010 P100;
```

d) Byte axis type parameter format

N ___ A ___ P ___ ;

N ___ : The data number is a 4-digit numeric value following N (A positive integer)

A ___ ; An axis number (1 - 15) (A positive integer)

P ___ : Parameter value is given as a numerical value following P. Specific data ranges vary according to parameters.

; : End of block (LF in ISO code or CR in EIA code)

Note 1) Address N, A, and P should be specified in the order described above.

Note 2) Leading zeros can be omitted.

Example:

```
N1020 A1 P88;
N1020 A2 P89;
N1020 A3 P90;
```

The parameters of various axes can be specified in one block as follows:

```
N020 A1 P88 A2 P89 A3 P90
```

e) Word-type parameter tape format

Same as the byte-type parameter tape format.

f) Word-axis type parameter tape format

Same as the byte-axis type parameter tape format.

g) 2-word type parameter tape format

Same as the byte-type parameter tape format.

h) 2-word type parameter tape format

Same as the byte-axis type parameter tape format.

Example of a parameter (except pitch error compensation data) tape:

```
%;
N0 P1;
N3 P0;
N10 P10;
N11 P0;
  :
  :
  :
%
```

2) Pitch error compensation data tape format

N ___ P ___;

N ___ : 5-digit numeric value (10000+ pitch error compensation point number) after N (positive integer)

P ___ : Pitch error compensation value after P (An integer) Valid data range is -7 - 7.

; : End of block (LF in ISO code or CR in EIA code)

Note) Address N and P should be in the order described above.

Example of pitch error compensation data tape (ISO code)

```
%;
N10000 P1;
N10001 P4;
N10002 P-7;
N10003 P-3;
N10004 P2;
  :
  :
  :
%
```

5.2.2 Setting parameters using parameter tape

1) Put the system into MDI mode or emergency stop status.
2) Press the software key 'SETTING' to select the setting screen.
3) Enter 8000.
4) Press the software key 'INP-NO.'; data number 8000 parameter is displayed.
5) Enter 1 and press the 'INPUT' software key. PWE=1 is shown and parameters can now be specified. NC enters an alarm status.
6) Press the function menu key and the soft key is changed over to the function selection key.
7) Press the 'SERVICE' software key and then press the 'PARAM' software key to select a screen.
8) Mount the parameter tape on the tape reader.
9) Press the software key 'READ' and then software key 'ALL'. The parameter tape is read and parameters are set.
10) Temporarily turn NC power off.

5.2.3 Setting from MDI

1) Put the screen into MDI mode or emergency stop status.
2) Press the software key 'SETTING' to select the setting screen.
3) Enter 8000.
4) Press the software key 'INP-NO.'; data number 8000 parameter is displayed.
5) Enter 1 and press the 'INPUT' software key. PWE=1 is shown and parameters can now be specified. NC enters an alarm status.
6) Press the function menu key and the soft key is changed over to the function selection key.

7) Press the 'SERVICE' software key and then press the 'PARAM' software key to select a screen.
8) Enter the data number of the parameter to be set and press the 'INP-NO.' software key. The screen for the parameter to be set will be displayed.
9) Enter the data to be set and press the 'INPUT' software key; the entered data is assigned. Data can be continuously input from the selected data number by delimiting data ';'.
   Example:
   If 10; 20; 30; 40 are entered and the software key 'INPUT' is pressed, 10, 20, 30, and 40 are sequentially assigned to the parameters starting with the parameter indicated by the cursor.
10) Repeat steps 7), 8) and 9).
11) After parameters are established, set 0 to the parameter PWE of data number 8000 to inhibit further parameter setting.
12) Reset the NC and release the alarm 'Parameters can be established'. If the alarm 'A parameter which requires to turn NC power to be temporarily turned off has been established' appears, turn NC power off.

5.3 Parameter Tape Punch

5.3.1 Punching all parameters

1) Connect a punch unit to the I/O interface.
2) Put the system into EDIT mode.
3) Press the 'SERVICE' software key and then press the 'PARAM' software key to select a screen.
4) Press the 'PUNCH' software key followed by the 'ALL' software key and all of the parameters will be punched.

5.3.2 Punching the parameters except pitch error compensation data

1) Connect a punch unit to the I/O interface.
2) Put the system into EDIT mode.
3) Press the 'SERVICE' software key and then press the 'PARAM' software key to select a screen.
4) Press the 'PUNCH' software key followed by the 'PARAM' software key and parameters (except the pitch error compensation data) are punched.

5.3.3 Punching pitch error compensation data

1) Connect a punch unit to the I/O interface.
2) Put the system into EDIT mode.
3) Press the 'SERVICE' software key and then press the 'PITCH' software key to select a screen.
4) Press the 'PUNCH' software key followed by the 'PITCH' software key and parameters on the pitch error compensation data are punched.

5.4 Parameters

Parameters are specified by type of function as follows. For details, see 10/11/12/100/110/120 series operator's manual (Appendix) (B-54810E)

Parameter list

1) Parameter related to setting

Parameter No.	Contents
0000	TV check is performed or not. TV check is performed or not during control out. ISO code is with parity bit or not. Method of punching EOB by ISO code. Punch code is ISO or EIA.
0010	Input unit is by metric or inch. Single block stop in custom macro is performed or not.
0011	08000 ∿ 08999 programs can be edited or not. 08000 ∿ 08999 programs are displayed on executing.
0012	Mirror image ON/OFF. Each axis scaling Validity/Invalidity.
0020, 0021	Input device No. for foreground.
0022, 0023	Input device No. for background.

2) Parameter related to timer

Parameter No.	Contents
0100	Timer 1 (Accumulated power on hour).
0101	Timer 2 (Accumulated automatic operation hour).
0102	Timer 3 (Accumulated automatic operation hour).

3) Parameters related to axis control

Parameter No.	Contents
1000	In-position and interlock condition.
1002	Linear axis detection unit.
1004	Each axis setting unit. Input unit is multiplied by 10 or not.
1005	Setting related to reference point return. External deceleration signal, machine lock, and axis detach signal are valid or invalid.

Parameter No.	Contents
1006	Setting inch/metric conversion is required or not. Setting machine coordinate system for stroke check and automatic reference point return. Setting machine coordinate system for stored pitch error compensation. Axis movement amount is specified by diameter or radius. Specifying manual reference point return direction.
1020	Program axis name of each axis.
1021	Axis number in parallel axis.
1022	Specifying each axis in basic coordinate system.
1023	Servo axis number of each axis.
1030	2nd auxiliary function command address.
1031	Standard axis.

4) Parameters related to coordinate system

Parameter No.	Contents
1220	Each axis external work zero point offset value.
1221	Work zero point offset value of work coordinate system 1.
1222	Work zero point offset value of work coordinate system 2.
1223	Work zero point offset value of work coordinate system 3.
1224	Work zero point offset value of work coordinate system 4.
1225	Work zero point offset value of work coordinate system 5.
1226	Work zero point offset value of work coordinate system 6.
1240	Coordinate value of the 1st reference point in the machine coordinate system.
1241	Coordinate value of the 2nd reference point in the machine coordinate system.
1242	Coordinate value of the 3rd reference point in the machine coordinate system.
1243	Coordinate value of the 4th reference point in the machine coordinate system.
1260	Movement value of rotary axis per rotation.

5) Parameters related to feed rate

Parameter No.	Contents
1400	Dry run is valid or invalid for rapid traverse command. Dry run is valid or invalid for thread cutting command. Manual rapid traverse is valid or invalid from reference point return after power on. Skip function feed rate. Positioning is by non-linear interpolation type or linear interpolation type. 2nd feed rate override is valid or invalid.
1401	External deceleration invalid for all feeds or only for rapid traverse.
1410	Dry run rate.
1412	Percentage to rapid traverse override F1.
1413	Manual handle feed allowable flow.
1414	Magnification n of manual handle feed.
1420	Rapid traverse rate of each axis.
1421	Fo-rate for each axis rapid traverse override.
1422	Maximum cutting feed rate of each axis.
1423	Jog feed rate of each axis.
1424	Manual reference point return FM rate of each axis.
1425	Manual reference point return FL rate of each axis.
1426	External deceleration rate for cutting feed.
1427	External deceleration rate at rapid traverse of each axis.
1428	Feed rate of skip function.

6) Parameter related acceleration/deceleration control

Parameter No.	Contents
1600	Rapid traverse acceleration/deceleration is by linear or exponential.
1620	Linear type rapid traverse acceleration/deceleration time constant of each axis.
1621	Linear type rapid traverse acceleration/deceleration FL rate of each axis.
1622	Cutting feed acceleration/deceleration constant time of each axis.

Parameter No.	Contents
1623	Cutting feed acceleration/deceleration FL rate of each axis.
1624	Jog feed acceleration/deceleration constant time of each axis.
1625	Jog feed acceleration/deceleration FL rate of each axis.
1626	Chamfering time constant at thread cutting cycle of each axis.
1627	FL rate at thread cutting cycle of each axis.
1628	Exponential type rapid traverse acceleration/deceleration time constant of each axis.
1629	Exponential type rapid traverse acceleration/deceleration FL rate of each axis.
1630	Parameter 1 to establish linear acceleration/deceleration prior to interpolation.
1631	Parameter 2 to establish linear acceleration/deceleration prior to interpolation.

7) Parameter related to servo

Parameter No.	Contents
1800	Automatic drift compensation is performed or not. Servo alarm occurs or not when velocity control ready signal (VRDY) turns on before position control ready signal turns on. Follow-up is performed or not during servo-off.
1802	Automatic setting of phase shift value has completed or not. Servo off signal is valid or invalid.
1810	Feed back pulse frequency is checked or not. Setting of compensational rate of backlash and pitch error compensation. Position control LSI is checked or not at turning on power. Feed back pulses of pulse coder is monitored or not.
1815	Position detective method is by digital feed back or analog feed back.
1816	Setting of reference counter capacity. Setting of detective multiplier.
1820	Command multiplier (CMR) of each axis.
1825	Servo loop gain of each axis.
1826	Loop gain multiplier of each axis.
1827	In-position width of each axis.

Parameter No.	Contents
1828	Position deviation limit value at servo off of each axis.
1829	Position deviation limit value at stoppage of each axis.
1830	Position deviation limit value at servo off at each axis.
1831	Lowest clamp value of velocity command value of each axis.
1832	Feed stop position deviation of each axis.
1833	Position detector phase shift value of each axis.
1834	Drift compensation amount of each axis.
1835	Number of pulse per pulse coder one rotation.
1850	Grid shift amount of each axis.
1851	Backlash compensation of each axis.
1890	Feed back pulse check move distance of each axis.

8) Parameter related to DI/DO

Parameter No.	Contents
2000	Resetting signal (RST) is always output or only when reset button on MDI panel is pressed. Rewinding signal (RWD) is output only when tape reader is rewinded or when either tape reader or program in memory is rewinded. Cycle start lamp signal (STL) is output or not during operation by manual numeric command. Cycle start lamp signal is output or not when programs are registered by cycle start signal in tape editting mode. Cycle operating signal (OP) is turned on or not at searching for sequence number. MDI mode can be started or not by pressing start button on the panel. Programs are registered by cycle start signal in tape editing mode or not.
2001	Reset or alarm is effective at emergency stop. If all of the mode selection signal turn off, no mode is assumed or the previously selected mode is assumed. Incremented feed amount is specified by magnification specification signals MP1, MP2 and MP3. Rapid traverse override signal ROV1 and ROV2 has a standard interface or logical 0/1 reverse interface. Selection BMI or FS3/FS6 as machine interface. Selection FS3 or FS6 interface. External operation command signal EF is output or not.
2010	Delay time of strobe signal MF, SF, TF, BF.

Parameter No.	Contents
2011	Acceptance width of M, S, T and B function completion signal (FIN).
2014	Mode unselected status ignore time.
2015	Invalid mode selection status ignore time.
2016	Manual feed rate override clamp value.
2020	Software operator's panel (+) direction command button.
2021	Software operator's panel (-) direction command button.

9) Parameter related to MDI/EDIT/CRT

Parameter No.	Contents
2200	All of the programs are loaded at once by external I/O device next to programs previously loaded or after deleting previous programs. When program with the same program number as the one already loaded, program can not be loaded by alarm or loaded after deleting previously loaded programs. M02, M30 and M99 are assumed as program end or not in program loading. M99 is assumed as program end in program loading. Program No. 09000 - 09999 are deleted or not by all program deleting operation or command.
2201	Program editing of program No. 09000 ∿ 09999 is prohibited or not. Program No. 09000 - 09999 are displayed or not during execution. Single block is stopped or not at the macro statement of programs 09000 - 09999.
2202	Display on external position display and position display on CRT are by standard unit or by 10 magnification of standard unit. External position display, CRT relative position display and absolute position display include tool length compensation value or not. External position display, CRT relative position display and absolute position display include tool radius compensation/tool nose R compensation value or not. External position display, CRT relative position display and absolute position display are with considering the delay at acceleration/deceleration control or not. External position display, CRT relative position display and absolute position display are with considering the delay in servo or not. Machine position display or CRT is with considering the delay at acceleration/deceleration control or not. Machine position display on CRT is with considering the delay at servo or not.

Parameter No.	Contents
2203	Machine position display on CRT is by detective unit or inch/metric unit.

10) Parameters related to programming

Parameter No.	Contents
2400	Decimal point is input by conventional or calculator method. Feed per minute F code in metric without decimal point is processed by 1 mm/min or 0.1 mm/min unit. Commands of inch input and metric input are G20/21 or G70/G71. Condition setting of M30 at memory operation. Always dwell per minute or dwell per minute in feed per minute mode and dwell per revolution in feed per revolution mode. G code system selection.
2401	Mode at power turn on and in clear status.
2402	Travel command path for absolute are same as for incremental or not after manual intervention by manual absolute on.
2410	Arc radius error limit value.
2411 2418	M codes 1 - 8 which do not perform buffering.
2900	Distance between double turrets.

11) Parameters related to Reader/puncher interface

Parameter No.	Contents
5001 5003	I/O device No. connected to Reader/puncher interface.
5011	I/O device No. connected to ASR33/44 interface.
5110, 5120, 5130, 5140, 5150, 5160	Reader/puncher device specification number corresponding to device No. 1 - 6.
5110, 5121, 5131, 5141, 5151, 5161	Stop bit number of Reader/puncher device corresponding to device No. 1 - 6.
5112, 5122, 5132, 5142, 5152, 5162	Band rate corresponding to device No. 1 - 6.

12) Parameter related to stroke limit

Parameter No.	Contents
5200	Stored stroke limit inhibited area is in interior or exterior.
5210	Stored stroke limit is checked or not.
5220	(+) direction coordinate value of stored stroke limit 1 of each axis.
5221	(-) direction coordinate value of stored stroke limit 1 of each axis.
5222	(+) direction coordinate value of stored stroke limit 2 of each axis.
5223	(-) direction coordinate value of stored stroke limit 2 of each axis.
5224	(+) direction coordinate value of stored stroke limit 3 of each axis.
5225	(-) direction coordinate value of stored stroke limit 3 of each axis.

13) Parameter related pitch error compensation

Parameter No.	Contents
5420	Pitch error compensation number for reference point of each axis.
5421	Pitch error compensation point number nearest the "-" end of each axis
5422	Pitch error compensation point number nearest the "+" end of each axis
5423	Pitch error compensation magnification for each axis.
5424	Interval of pitch error compensation for each axis.
5425	Movement amount per rotation in rotating axis type pitch error compensation.

14) Parameter related to spindle control

Parameter No.	Contents
5600	Voltage polarity of spindle speed analog output. Gear change system during thread cutting or tapping. Spindle orientation or gear shift is performed by spindle orientation signal (SOR). Spindle speed output is by analog or 12 bit binary output.
5601	Spindle override is valid or invalid. Spindle override is valid or invalid during thread cutting or tapping. When spindle speed command beyond maximum spindle speed, speed is clamped it maximum speed or an alarm occurs. Gear select signal output is code output or signal output corresponding to gear selection. SF signal is output or not when gear select signal is output. SF signal is output when gear select signal is output or when S code is commanded. Type of spindle speed analog output/spindle speed binary output. Gear selection on the machine side.
5602	Spindle stop signal (SSTP) input type. One of gear select signal and BCD S code is output or both of them are inputted. Gear select signal input type. Alarm of spindle velocity control unit in checked or not. Tool position offset amount is excluded or not from the preset position of constant surface speed controlled axis. Tool length compensation amount is excluded or not from the preset position of constant surface speed controlled axis. Present position or end point coordinate value is used in positioning command during constant surface speed control. Speed arrival signal is used or not.
5603	Gear select condition for 3/6 interface. Position coder disconnection is checked or not.
5610	Gear ratio of spindle to position coder.
5611	Sampling number for finding the moving average of spindle speed.
5612	Spindle speed unit generated by BMI.
5613	Offset voltage compensation value of spindle speed analog output.
5614	Gain adjusting data of spindle speed analog output.
5615	Spindle speed during spindle gear shift.
5616	Time upto new spindle speed after spindle gear select signal is output.

Parameter No.	Contents
5617	Spindle speed during spindle orientation.
5618	Minimum clamp speed of spindle motor.
5619	Maximum clamp speed of spindle motor.
5620	Time for checking the speed arrival signal.
5621 ⟆ 5628	Maximum spindle speed corresponding to gears.
5631 ⟆ 5637	Spindle speed at each gear switching point during tapping and thread cutting.
5640	Axis number of constant surface speed.
5641 ⟆ 5648	Minimum spindle speed at gear during constant surface speed control.

15) Parameter related to tool compensation

Parameter No.	Contents
6000	New offset value is valid after the next block where D or H code is specified or valid after the next block. Tool position compensation is specified by D code or H code. Tool position compensation is effective or not for arc command. Axis selection for tool length compensation. Tool length compensation vector can be cleared by reset or not. Offset number of tool position offset is specified by low order two digits or by low order one digit of the T code. Condition to execute tool position offset.
6001	Start up type of tool R compensation or tool nose R compensation. Condition of interference check of tool R compensation or tool nose R compensation. Tool position compensation geometry offset is performed shifting work coordinate system or by moving the tool. Tool wear offset of tool position compensation is performed by shifting work coordinate system or moving the tool. Offset number specifying method of geometry and wear in tool position compensation. Offset state when tool number 0 is specified.

Parameter No.	Contents
6002	Setting of offset amount unit. Tool position compensation amount is specified by diameter or radius value. Position recode signal (PRC) is used or not when tool position offset amount is inputted directly.
6010	Limit value to ignore small movement amount created by tool R compensation.
6011	Denominator constant by three-dimensional tool offset.

16) Parameters related to canned cycle

Parameter No.	Contents
6200	Selection of drilled axis in canned cycle. Dwell command is valid or not by P in canned tapping cycle. Tool return direction and movement amount in canned fine boring cycle and canned back boring cycle after spindle orientation. Movement to drilling point in canned cycle is done by rapid traverse or by linear interpolation. Initial level point is changed or not when origin setting is above by reset or MDI during canned cycle. G80 and G81 are specified by canned cycle or external operation command.
6201	Spindle control in canned cycle is performed or not by M code. M05 is output or not when spindle rotation direction is changed. FFIN signal or FIN signal which corresponds to SSP signal and SRV signal. FMF signal is output or not after returning to R point or initial point when SSP and SRV are output. FMF signal is output or not when SSP and SRV are output.
6202	Cutting cycle is performed or not at the block which has no movement command during signal cutting cycle mode. Finishing workpiece is performed or not at the end of roughing cycle. Override can be applied or not to infeed during roughing cycle.
6210	Return amount of canned cycle G73.
6211	Clearance amount of canned cycle G83.
6212	Chamfering amount of thread cutting cycle.
6213	Chamfering angle of thread cutting cycle.
6214	Overcutting override value of roughing cycle.

Parameter No.	Contents
6215	Retract amount in roughing cycle.
6216	Clearance amount in rough cutting cycle.
6217	Return amount in peck cycle.
6218	Minimum cutting amount in thread cutting cycle.
6219	Finish allowance in thread cutting cycle.
6220	Number of spark-out in thread cutting cycle.
6240	Tool retract direction after G76, G87 orientation.

17) Parameter related to scaling and coordinate system rotation

Parameter No.	Contents
6400	Designation of angle of coordinate system rotation.
6410	Magnification of scaling.
6411	Angle of coordinate system rotation.

18) Parameter related to one directional positioning

Parameter No.	Contents
6820	One directional positioning and approach amount.

19) Parameter refer to custom macro

Parameter No.	Contents
7000	Custom macro is called or not by T, S and B codes. Custom common valiables 1#100 - #199 are cleared or not by reset.
7010	EIA code which represents is set by hole pattern.
7011	EIA code which represents is set by hole pattern.
7012	EIA code which represents # is set by hole pattern.
7013	EIA code which represents * is set by hole pattern.

Parameter No.	Contents
7014	EIA code which represents = is set by hole pattern.
7050 7059	G code for calling the custom macro of program No. 9010 ∿ 9019.
7071 7079	M code for calling the custom macro of program No. 9001 ∿ 9009.

20) Parameter related to service

Parameter No.	Contents
8000	Parameters setting which can not be specified by setting input are forbidden or allowed. CRT screen is automatically changed or not to the error message screen when an error is caused. When parameter PWE is 1, an error is indicated or not.
8010	When power is turned off, parameter at data number 8000 is set to 0 or maintained.

5.5 PMC Data Setting and Display (PCPRM)

Parameters of timer, counter, keep relay, data table, and positioning module are set and displayed from CRT/MDI unit.
For this operation, depress soft key [PCPRM] of PC basic menu to bring up the following menu.

TIMER	COUNTER	KEEPRL	DATA	POS

In case of PMC-I, NC must be set to the MDI mode or emergency stop status for data setting.

5.5.1 Timer setting and display

The variable timer time is set and displayed. If timer screen does not appear, depress [TIMER] soft key to bring up the timer screen.

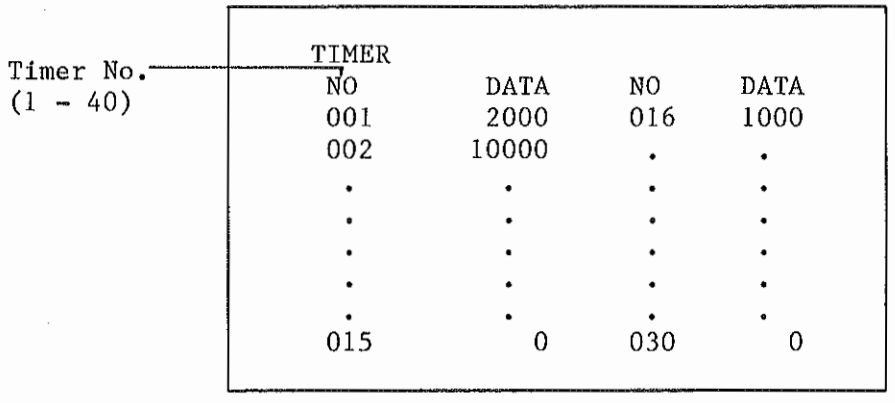


Fig. 5.5.1 Timer screen

Specifications / Timer No.	Minimum setting time	Maximum Setting time
1 - 8	50 ms	1638.3 sec
9 - 40	8 ms	262.136 sec

1) Setting and display from CRT/MDI unit
   ① For timer setting in the case of PMC, set NC to MDI mode or emergency stop status, and turn on the NC parameter for writing parameters (Data No. 8000, PMW). This operation is not required for display.
   ② Display the timer screen (see Fig. 5.5.1) by depressing the [PCPRM] soft key of PMC basic menu.
   ③ Bring data of necessary timer No. on the screen by depressing page key [↓]. Stop ④ and subsequent steps are required for timer setting.
   ④ Set the cursor to the setting point on the screen by the cursor key operation.
   ⑤ The timer is set by depressing [INPUT] key after entering timer data by numeric keys. For subsequent data setting, repeat the operation, starting with step ③.
   ⑥ After setting timer data, turn off the NC parameter for writing parameters. Depress [RET] key to return to the PMC basic menu.

5.5.2 Counter setting and display

Set and display the preset values and integrated values of the counter. If counter screen does not appear, depress [COUNTR] soft key to bring the counter screen.

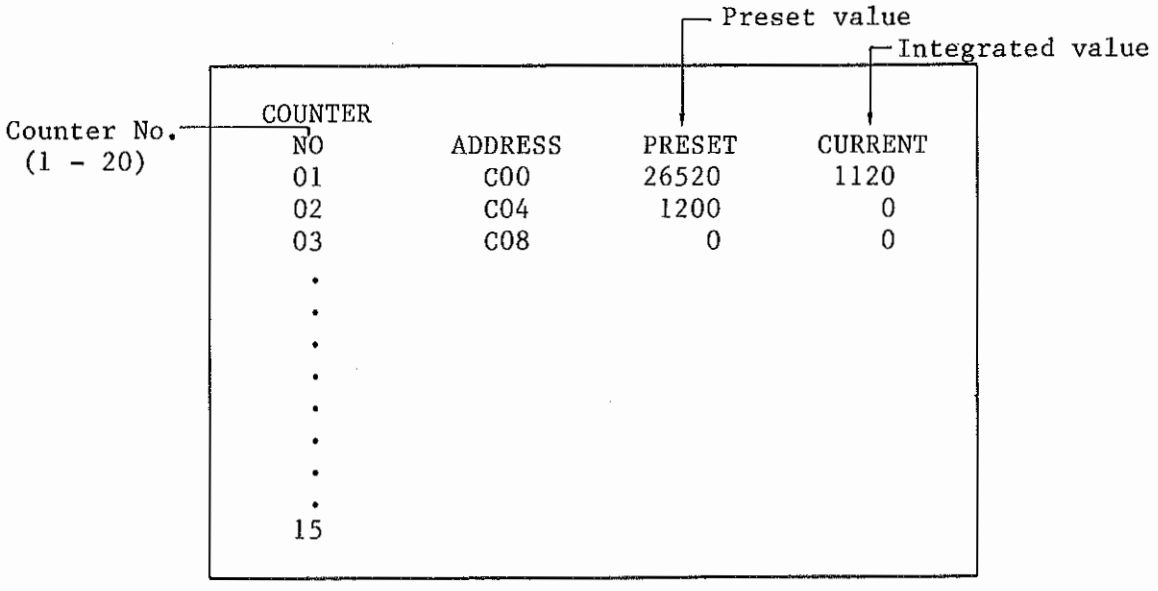


Fig. 5.5.2 Counter screen

1) Setting and display from CRT/MDI panel
   ① After changing a menu by depressing [PCPRM] soft key of PMC basic menu, depress [COUNTR] soft key to bring the counter screen. (See Fig. 5.5.2).
   ② Display data of necessary counter number by depressing page key [↓]. The operation in ③ and subsequent steps are required for setting counter data.

③ Set NC to MDI mode (emergency stop status in case of PMC-I). Set key signal KEY4=1 in case of BMI interface. Set KEY=1 for an interface corresponding to FS3 or FS6.
④ Set the cursor to the setting point on the screen by using the cursor key.
⑤ The counter is set by depressing [INPUT] key after entering counter data by numeric keys. For setting subsequent data, repeat the operation starting with step ④.
⑥ After setting counter data, depress [RET] key to return to the PMC basic menu.

5.5.3 Setting and display of keep relay and nonvolatile memory control data

Set the display keep relay and nonvolatile memory control data. If keep relay screen is not displayed, depress [KEEPRL] soft key to bring the keep relay screen.

```
KEEP RELAY
NO      ADDRESS       DATA
01        K00       10100011
02        K01       00011100
 .         .            .
 .         .            .
 .         .            .
 .         .            .
 .         .            .
 .         .            .
 .         .            .
 .         .            .
15        K14       11000101
```

Fig. 5.5.3 Keep relay screen

1) Setting and display of keep relay
   ① For data setting in the case of PMC-I, set NC to the MDI mode or emergency stop status and turn on the NC parameter for writing parameters. This operation is not required for display.
   ② After changing the menu by depressing [PCPRM] soft key of PMC basic menu, depress [KEEPRL] soft key to display the keep relay screen. (See Fig. 5.5.3.)
   ③ Bring data of necessary keep relay on the screen by depressing page key [↓]. The operation in ④ and subsequent steps are required for setting the keep relay and nonvolatile memory control data.
   ④ Set the cursor to the setting point on the screen by the cursor key operation.
   ⑤ Set keep relay data by depressing [INPUT] key after inputting numeric keys. Perform operation from ④ for setting subsequent data.
   ⑥ After setting keep relay data, depress [RET] key to return to the PMC basic menu.
2) Setting and display of nonvolatile memory control data
   Set and display nonvolatile memory control data in the same way as in setting and displaying the keep relay.
   Nonvolatile memory control data are displayed at No. 17 address K16 on the keep relay screen and only data of bit 6 and 7 are used.

5.5.4 Setting and display of data table

If no data table screen is displayed, the data table control data screen (see Fig. 5.5.4 (a)) appears by depressing the [DATA] soft key of PMC parameter menu. If correct data are being set as data table control data, data contents (see Fig. 5.5.4 (b), (c)) of data table #1 are displayed first by depressing page key, and the data of data table #2, #3, ... #n are displayed each time page key is depressed hereafter.

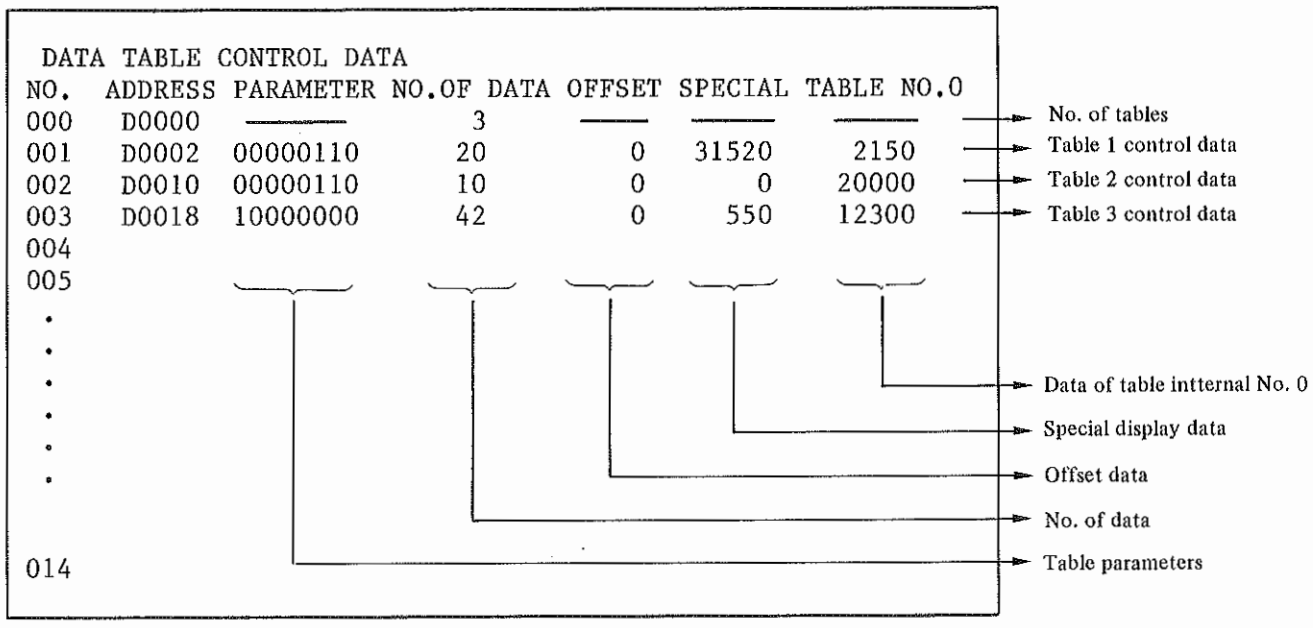


Fig. 5.5.4 (a) Data table control data screen

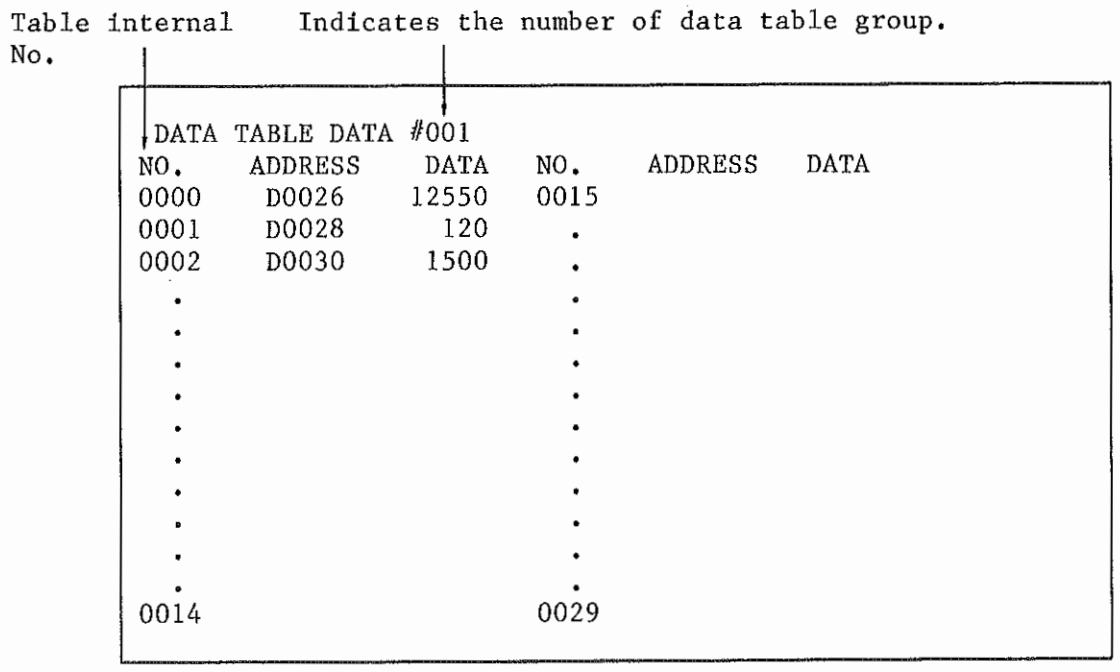
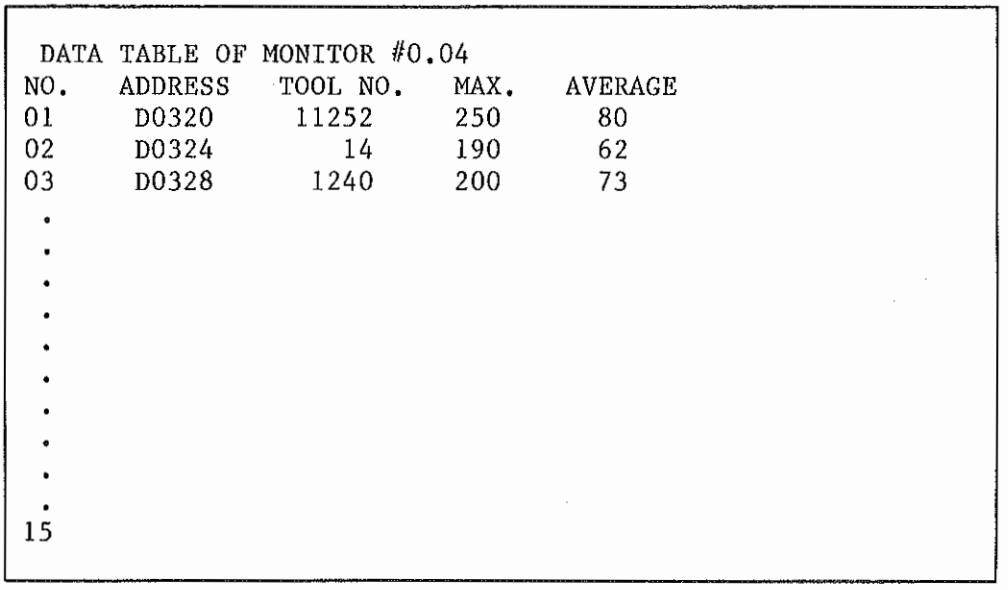


Fig. 5.5.4 (b) Data table data screen



```
 DATA TABLE OF MONITOR #0.04
NO.   ADDRESS   TOOL NO.   MAX.   AVERAGE
01     D0320     11252     250      80
02     D0324        14     190      62
03     D0328      1240     200      73
 .
 .
 .
 .
 .
 .
 .
 .
 .
 .
15
```

Fig. 5.5.4 (c) Monitor data table screen

(Display screen of each data for monitor control MONI (SUB 47))

1) Setting and display of data table control dat
Only control data of each data table are displayed in the format shown in Fig. 5.5.4 (a). Data of data number 0 are data of the number of data tables. Only NO. OF DATA column is used for setting the number of data tables. No. 1 and subsequent data serve as table control data of each data table.
The following data are set and displayed from the CRT/MDI.

PARAMETER : Table parameter
NO. OF DATA: No. of data (Set the number of tables used in case of No=0 line.)
OFFSET : Offset data
SPECIAL : Special display data
TABLE NO. 0: Data of table internal number 0

① For setting data in the case of PMC-I; set NC to MDI mode or emergency stop status, set KEY4=1 in the case of BMI interface, or KEY=1 in the case of FS3 or FS6 interface.
② Depress [PCPRM] soft key of PMC basic menu and depress [DATA] soft key after changing the menu.
③ The data table control screen appears as shown in Fig. 5.5.4 (a).
For displaying the table control data screen after No. 15, depress page key [↓] to display the next data.
For data setting, the operations in ④ and subsequent steps are required.
④ Set the cursor to the setting data point by using the cursor key of CRT/MDI panel.
⑤ Depress [INPUT] key after setting data by numeric keys.
⑥ Data are changed at the designated cursor position.
⑦ For setting subsequent data, repeat operation starting with ④.
⑧ For setting data table data after setting control data, depress page key to display the data table screen. See 2) in the next paragraph.
To return to the PMC basic menu, depress [RET] key.

2) Setting and display of data table
① For setting data in the case of PMC-I set NC to MDI mode or emergency stop status, set KEY4+1 in the case of BMI interface, or set KEY=1 in the case of interface corresponding to FS3 or FS6.
This operation is not required for data dispaly.

② Depress [DATA] soft key after changing the menu by depressing [PCPRM] soft key of PMC basic menu.
The data control data screen shown in Fig. 5.5.4 (a) appears first.
Depress page key to display the data table screen. See Fig. 5.5.4 (b).
Data of data table 1 appears on the data table screen.
By depressing page key again, data of table 2 appears. Data tables 3, 4, ... are sequentially selected, each time page key is depressed.
Display the data table screen of corresponding table.

③ If 30 or more data table data are present, display the next data by depressing page key [↓].
The operations in ④ and subsequent steps are required for data setting.

④ Set the cursor to the setting data point by using the cursor key of the CRT/MDI panel.

⑤ Depress [INPUT] key after setting data by numeric keys.

⑥ Data are rewritten at the designated cursor point.

⑦ Repeat operation, starting with step ④, if data are to be set sequentially.

⑧ After setting data table, depress [RET] key to return to the PMC basic menu.

5.5.5 Setting and display of positioning MODULE parameters

Set and display positioning module parameters. If the positioning module screen is not displayed, depress [POS] soft key to display the screen.

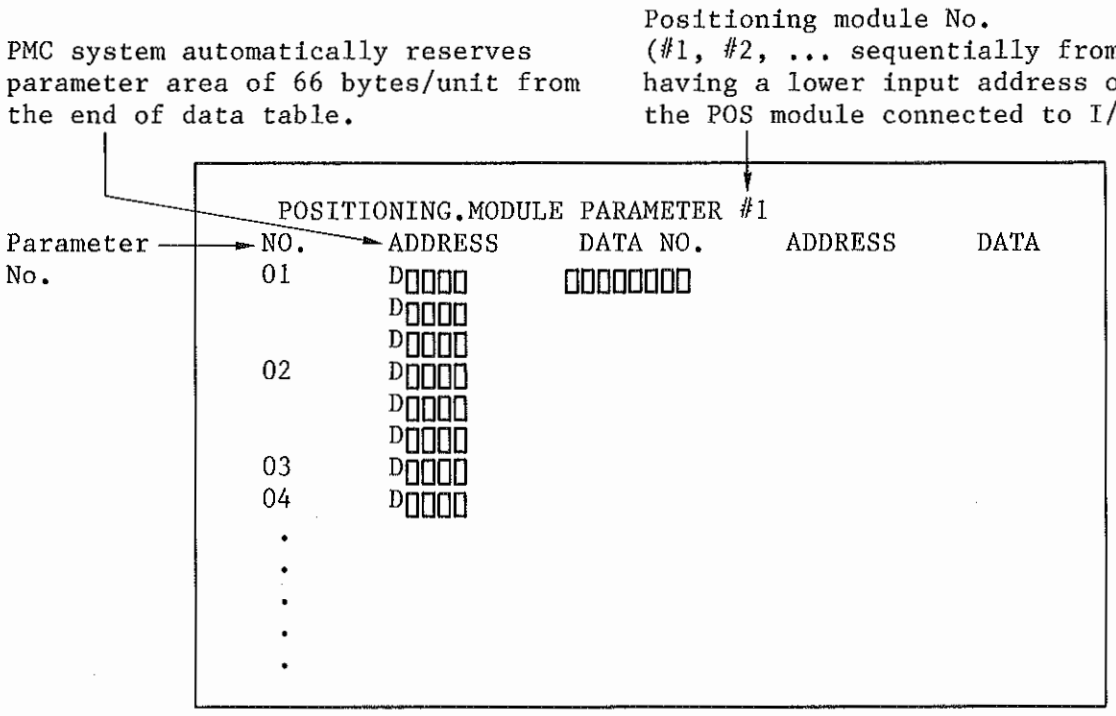


Fig. 5.5.5 Positioning module parameter screen

Note) When setting a parameter to parameter, No. 1, 2, H, M, and L parameters are set sequentially from the top of the CRT screen.
For H, M, and L parameters, refer to the positioning module in Section V.

1) Setting and display from CRT/MDI panel
Positioning module parameters are classified into bit type and numeric type according to parameter numbers and entered from CRT/MDI panel in the format. For details of parameters, refer to Appendix 20.

(1) For setting parameters in the case of PMC-I, set NC to the MDI mode or emergency stop status and turn on an NC parameter for writing parameters. This operation is not required for displaying parameters.

(2) After changing the menu by depressing [PCPRM] soft key of PMC basic menu, depress [POS] soft key to bring the positioning module parameter screen. (See Fig. 5.5.5.)

(3) Depress page key [↓] to bring necessary positioning module No. screen. The operations in (4) and subsequent steps are required for setting parameters.

(4) Set the cursor to the setting point on the screen by cursor key operation.

(5) Set parameters by depressing [INPUT] key after entering data of the specified format correspoinding to parameter numbers by numeric keys. For subsequently setting data, repeat operation starting with step (4).

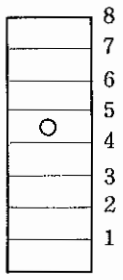
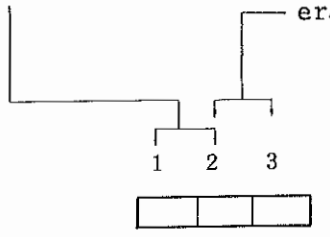
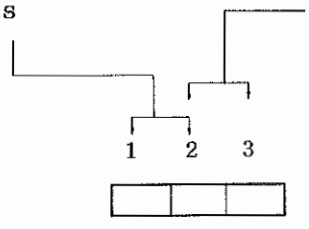
(6) After setting parameters, depress [RET] key to return to the PMC basic menu.

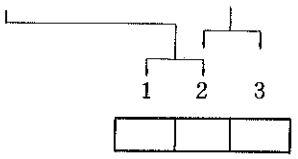
6. SETTING AND ADJUSTMENTS ON THE PCBs

6.1 Setting and Adjustments on the Control Unit PCBs

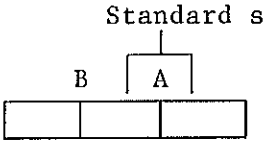
6.1.1 Setting on the control unit PCBs for 10 and 11 series

1) Setting on the analog servo 10 series master PCB (A16B-1010-0040)

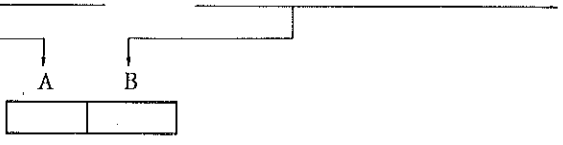
Item	Symbols	Description
1	SE1	Sets position LSI clock 16.384 MHz pulse width. Fixed. This setting applies to edition number - 03B only. Edition number 04C and higher don't include this setting function. 
2	TAC1 〜 TAC3	Set the velocity feedback system when M series servo is used. This setting is ineffective for AC servo. FV side when tachogenerator is not used. TG side when tachogenerator is used. 
3	REV1 〜 REV3	Set the number of pulses of pulse coder when M series servo uses the pulse coder. This setting is ineffective if tachogenerator or AC servo is used. 2000 pulses 3000 pulses  Neither 2000 pulses nor 3000 pulses should be set in case of 2500 pulses.

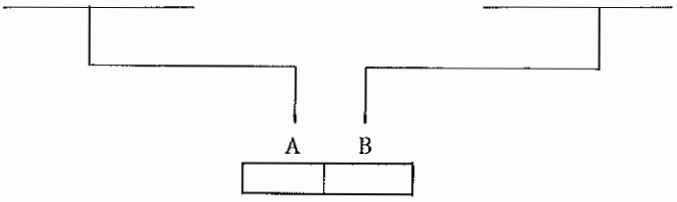
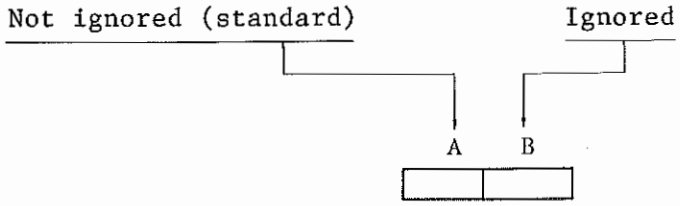
Item	Symbols	Description
4	SUP1 ⟆ SUP3	Set when the speed feedback is ignored due to a minor error. Set these parts to the standard (not ignored) at a time other than when vibrations are produced when the motor stops operating or the like. This setting is ineffective for AC servo. Not ignored (standard) Ignored 
5	SJ1	Sets the ROM capacity of character generator. Standard setting is 64K (not set) 64K ... Not set 256K ... Set
6	SF1	Used for intracompany test. Open this part without fail.

2) Setting on the digital servo 10 series and 100 series master PCB (A16B-1010-0190)

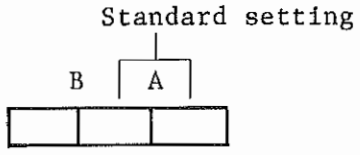
Item	Symbols	Description
1	ST	Not used. Fixed A side. Standard setting 

3) Setting on the analog servo 11 series master PCB (A16B-1010-0050)

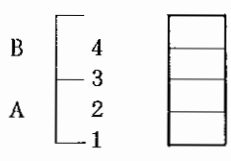
Item	Symbols	Description
1	TAC1 ⟆ TAC3	Set the velocity feedback system when M series servo is used. This setting is ineffective for AC servo. FV side when tachogenerator is not used. TG side when tachogenerator is used. 

Item	Symbols	Description
2	REV1 〈 REV3	Set the number of pulses of pulse coder when M series servo uses the pulse coder. This setting is ineffective if tachogenerator or AC servo is used. 2000 pulses — 3000 pulses  Neither 2000 pulses nor 3000 pulses should be set in case of 2500 pulses.
3	SUP1 〈 SUP3	Set when the speed feedback is ignored due to a minor deviation. Set these to the standard (not ignored) position at a time other than when vibrations are produced when the motor stops operating or the like. This setting is ineffective for AC servo. Not ignored (standard) — Ignored 

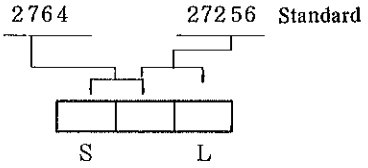
4) Setting on the digital servo 11 series and 110 series master PCB (A16B-1010-0200)

Item	Symbols	Description
1	ST	Not used. Fixed A side. 

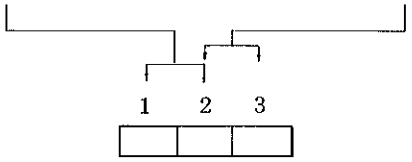
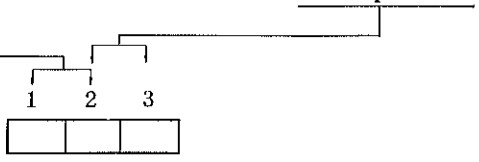
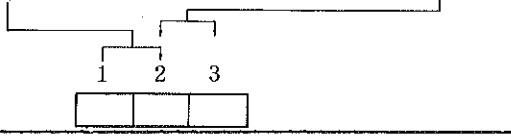
5) Setting on the 10 and 11 series connection unit 1 PCB (A20B-1000-0940)

Item	Symbols	Description
1		Sets to select DC common of STL, SPL, etc. Set this part to B when PMC is provided or A when PMC is not provided. 

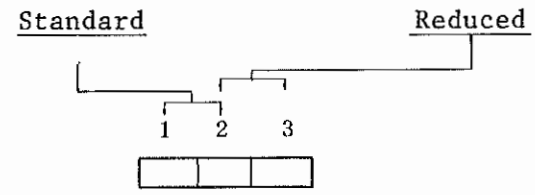
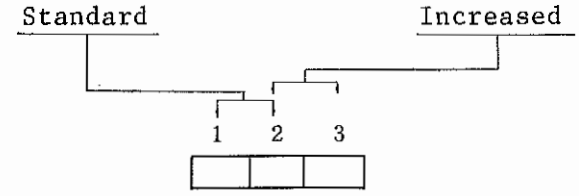
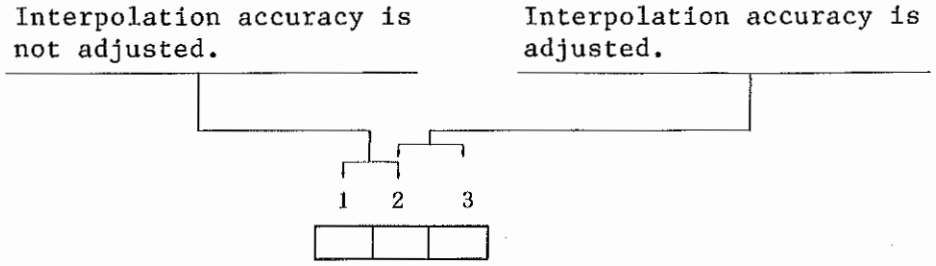
6) Setting on the 10 and 11 series 14" color graphic control PCB (A20B-1000-0850)

Item	Symbols	Description
1	SCG	Sets the type of character generator ROM. L (27256) is the standard setting. This setting does not apply to edition 06C and subsequent editions, but does apply to edition No. - 05B. 

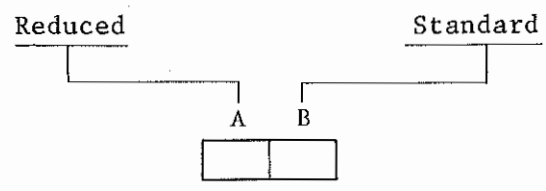
7) Setting on the analog servo 10 and 11 series additional axis PCB (pulse coder) (A16B-1210-0430/0431)

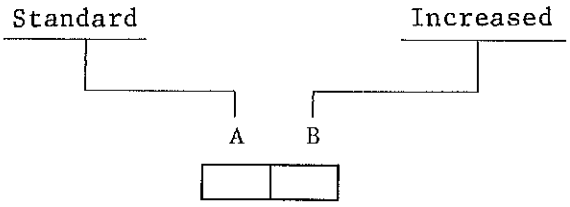
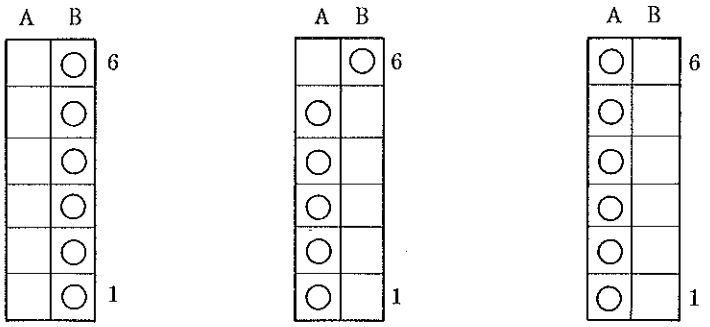
Item	Symbols	Description
1	TAC4 TAC5	Sets the velocity feedback system when M series servo is used. This setting is ineffective for AC servo. When tachogenerator is not used. / When tachogenerator is used. 
2	REV4 REV5	Sets the number of pulses of pulse coder when M series servo uses the pulse coder. This setting is ineffective if tachogenerator or AC servo is used. 2000 pulses / 3000 pulses  Neither 2000 pulses nor 3000 pulses should be set in case of 2500 pulses.
3	SUP4 SUP5	Set when the speed feedback is ignored due to a minor deviation. Set these to the standard (not ignored) at a time other than when vibrations are produced when the motor stops operating or the like. This setting is ineffective for AC servo. Not ignored (standard) / Ignored 

8) Setting on the analog servo 11 series additional axis PCB (DSCG) (A16B-1210-0450)

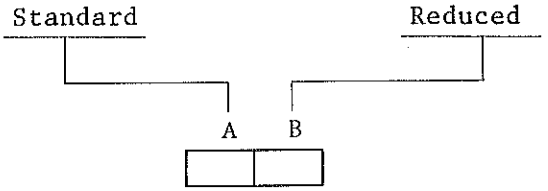
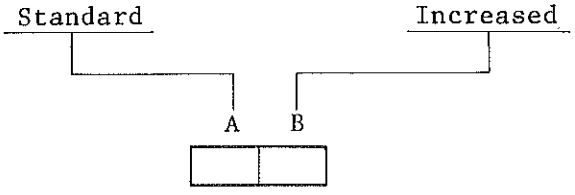
Item	Symbols	Description
1	SH44 SH54	Set to reduce the detection gain in DSCG system only when a 12" rotary inductosyn is used. 
2	SH45 SH55	Set to increase the detection gain in DSCG system. Normally, set these to standard. 
3	SH46 SH56	Set to determine whether the interpolation accuracy is adjusted. 

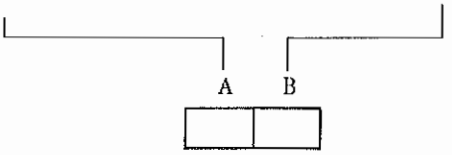
9) Setting on the analog servo 11 series DSCG PCB (A16B-1210-0460)
a) Overall the PCB edition No.01A ∿ No.03A

Item	Symbols	Description
1	SPN1X SPN1Y SPN1Z	Set to reduce the detection gain in DSCG system only when a 12" rotary inductosyn is used. 

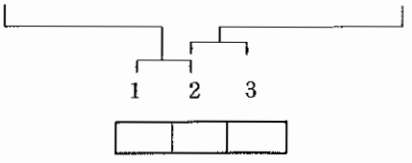
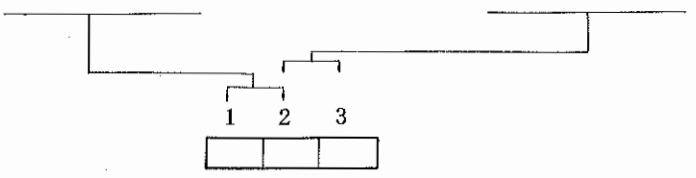
Item	Symbols	Description
2	SPN2X SPN2Y SPN2Z	Set to increase the detection gain in DSCG system. Normally, set standard. 
3	SPN3X SPN3Y SPN3Z	Set the type of position detector.  Resolver Inductosyn (Interpolation accuracy is fixed.) Inductosyn (Interpolation accuracy is variable.)

b) Overall the PCB edition No.04A and subsequent editions

Item	Symbols	Description
1	SN14 SN24 SN34	Set to reduce the detection gain in DSCG system only when a 12" rotary inductosyn is used. 
2	SN15 SN25 SN35	Set to increase the detection gain in DSCG system. Normally, set standard. 

Item	Symbols	Description
3	SN16 SN26 SN36	Set to determine whether the interpolation accuracy adjustment is done. (Set these parts to "not adjusted" for the resolver.) Interpolation accuracy is not adjusted. — Adjusted 
4	SN17 SN27 SN37	Set the position detector. 

10) Setting on the additional axis + additional memory PCB (A16-1210-0380) for 10 and 11 series

Item	Symbols	Description
1	TAC4	Sets the velocity feedback system when M series servo is used. This setting is ineffective for AC servo. When tachogenerator is not used. — When tachogenerator is used. 
2	REV4	Sets the number of pulses of pulse coder when M series servo uses the pulse coder. This setting is ineffective if tachogenerator or AC servo is used. 2000 pulses — 3000 pulses  Neither 2000 pulses nor 3000 pulses should be set in case of 2500 pulses.

Item	Symbols	Description
3	SUP4	Set when the speed feedback is ignored due to a minor deviation. Set to the standard (not ignored) at a time other than when vibrations are produced when the motor stops operating or the like. This setting is ineffective for AC servo. Not ignored (standard) Ignored 1 2 3

6.1.2 Adjustment on the control unit PCBs for 10/11/100/110 series

These variable resistors have already been ajusted at factory before delivery. Normally, it is not necessary to adjust them.

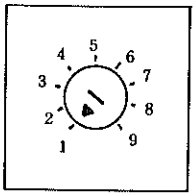
1) Adjustment of connection unit power supply

   Adjust the reference voltage "A10" to $10^{+0.01}_{-0.00}$ V by turning VR11.

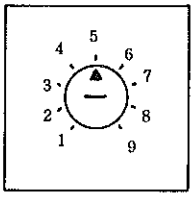
2) Adjustment of I/O card (D1 - D3) power supply.

   Set the reference voltage "A10" to $10^{+0.01}_{-0.00}$ V by turning VR11.

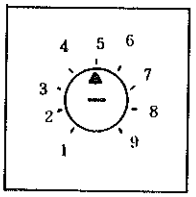
3) Adjustment of DSCG (Analog servo 10/11 series)



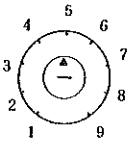
   a) VR11 1st-axis detection gain
      VR21 2nd-axis detection gain
      VR31 3rd-axis detection gain
      VR41 4th-axis detection gain
      VR51 5th-axis detection gain
      When turning variable resistor clockwise, the gain increases.
      For adjusting method, see 6.1.4 1).



   b) VR12 X-axis Fmin
      VR22 Y-axis Fmin
      VR32 Z-axis Fmin
      VR42 4th-axis Fmin
      VR52 5th-axis Fmax
      When tuning variable resistor clockwise, Fmin decreases.
      For the adjusting method, see 6.1.4 2).



   c) VR13 X-axis Fmax
      VR23 Y-axis Fmax
      VR33 Z-axis Fmax
      VR43 4th-axis Fmax
      VR53 5th-axis Fmax
      When turning variable resistor clockwise, Fmax increases.
      For the adjusting method, see 6.1.4 2).



   d) VR14 X-axis inductosyn interpolation accuracy
      VR24 Y-axis inductosyn interpolation accuracy
      VR34 Z-axis inductosyn interpolation accuracy
      VR44 4th-axis indutcosyn interpolation accuracy
      VR54 5th-axis inductosyn interpolation accuracy
      When turning variable clockwise, the sine exciting component increases.
      For the adjusting method, see 6.1.4 3).

VR11 - 14 are indicated as VR1X - VR4X, VR21 - 24 are indicated as VR1Y - VR4Y, and VR31 - 34 are indicated as VR1Z - VR4Z in DSCG PCB A16B- 1210-0460, whose overall edition number is 03A or lower.

6.1.3 Mounting positions of setting pins/variable resistor on control unit PCBs for 10/11/100/110 series

1) 10 series master PCB (A16B-1010-0040)
2) 10 series master PCB (A16B-1010-0190)
3) 11 series master PCB (A16B-1010-0050)
4) 11 series master PCB (A16B-1010-0200)
5) Connection unit 1 (A20B-100-0940)
6) I/O card D1- D3 (A20B-1001-0240-0242)
7) 14" color graphic PCB (A20B-1000-0850)
8) Additional axis PCB (pulse coder) (A16B-1210-0430/431)
9) Additional axis PCB (Pulse coder) (A16B-1210-0440)
10) Additional axis PCB (DSCG) (A16B-1210-0450)
11) DSCG PCB (A16B-1210-0460)
12) Additional axis + additional memory PCB (A16B-1210-0380)

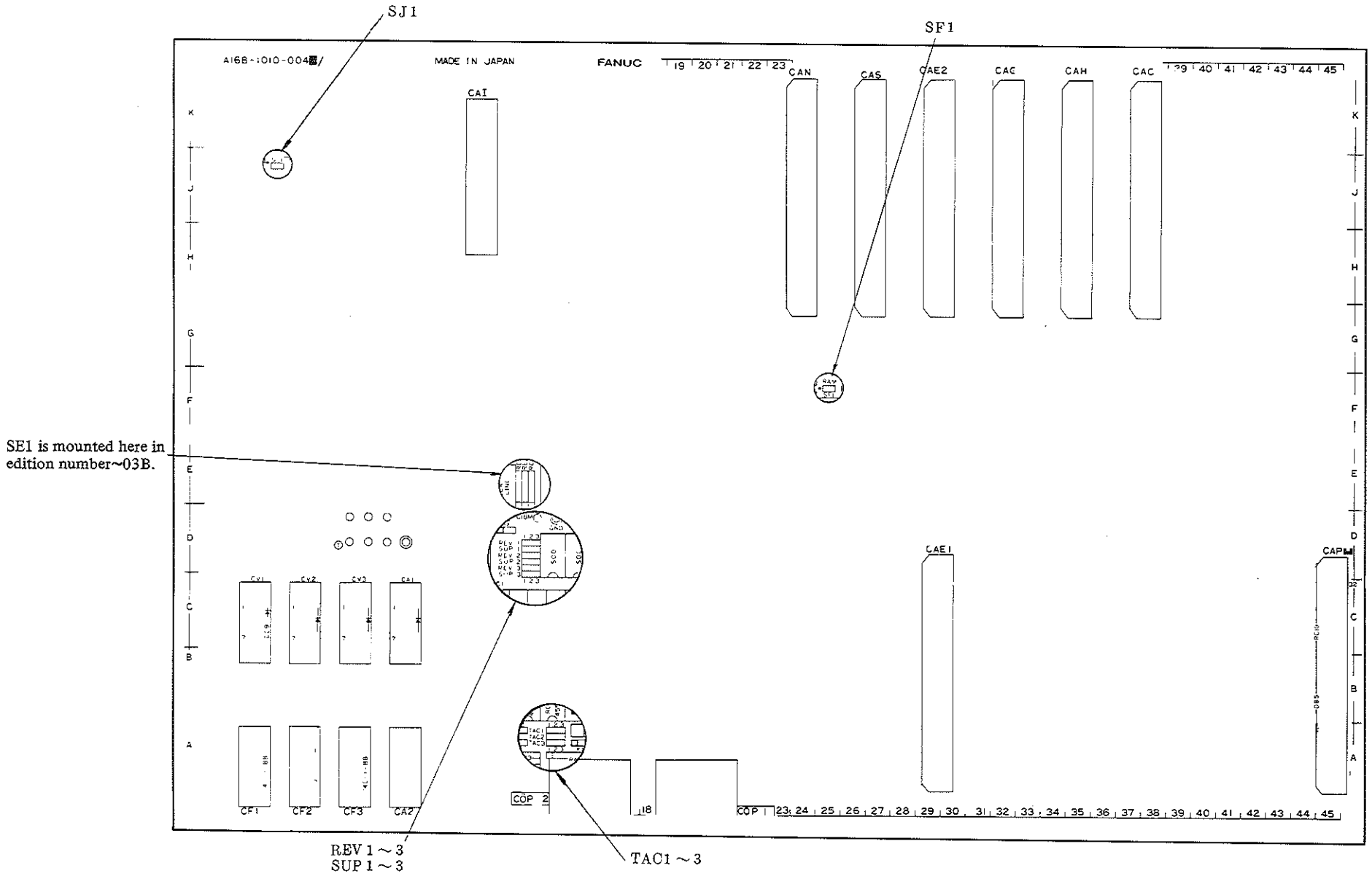


Fig. 6.1.3 (a) Adjusting points on analog servo 10 series master PCB (A16B-1010-0040)

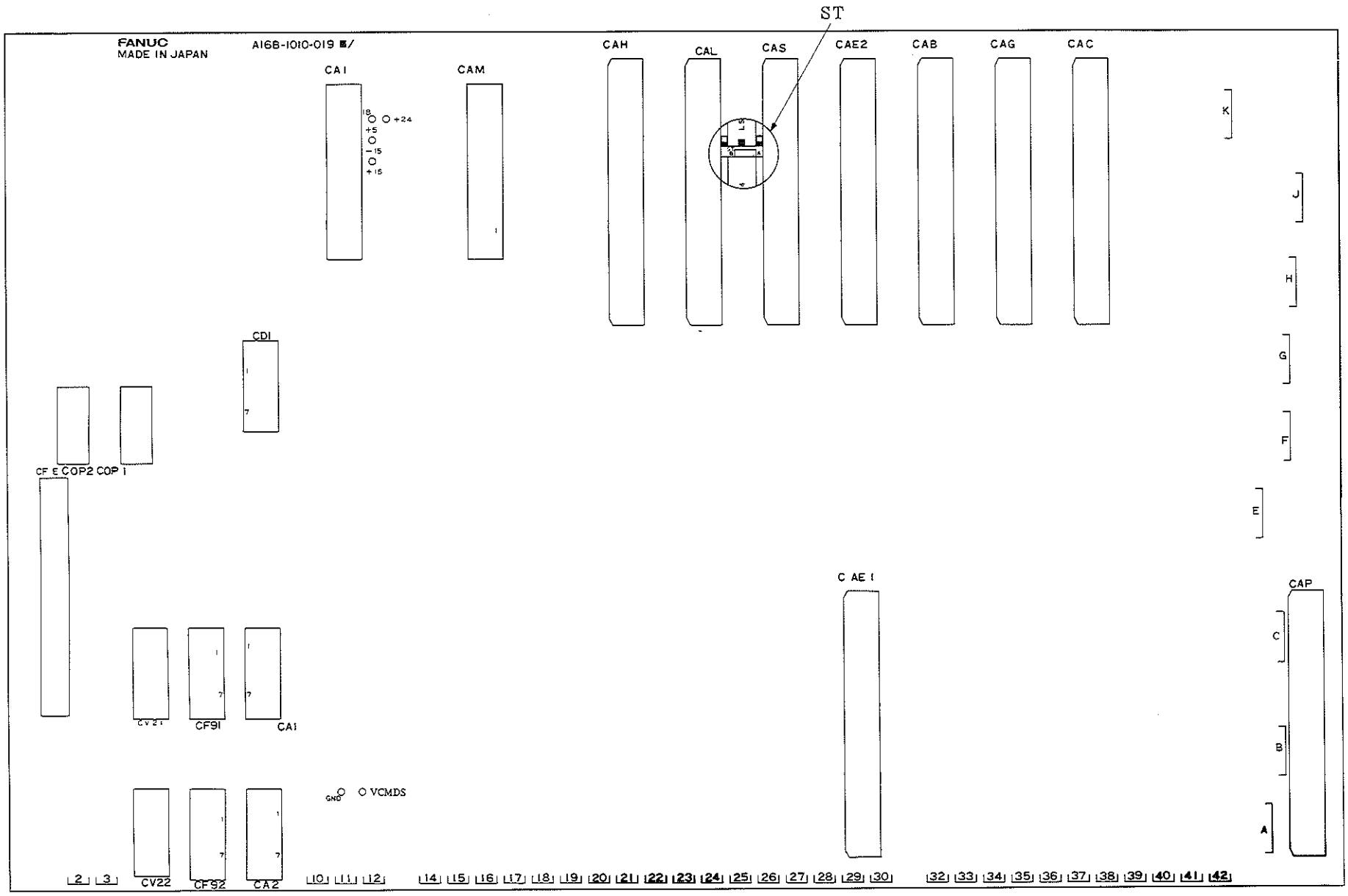


Fig. 6.1.3 (b) Digital servo 10 series master PCB (A16B-1010-0190)

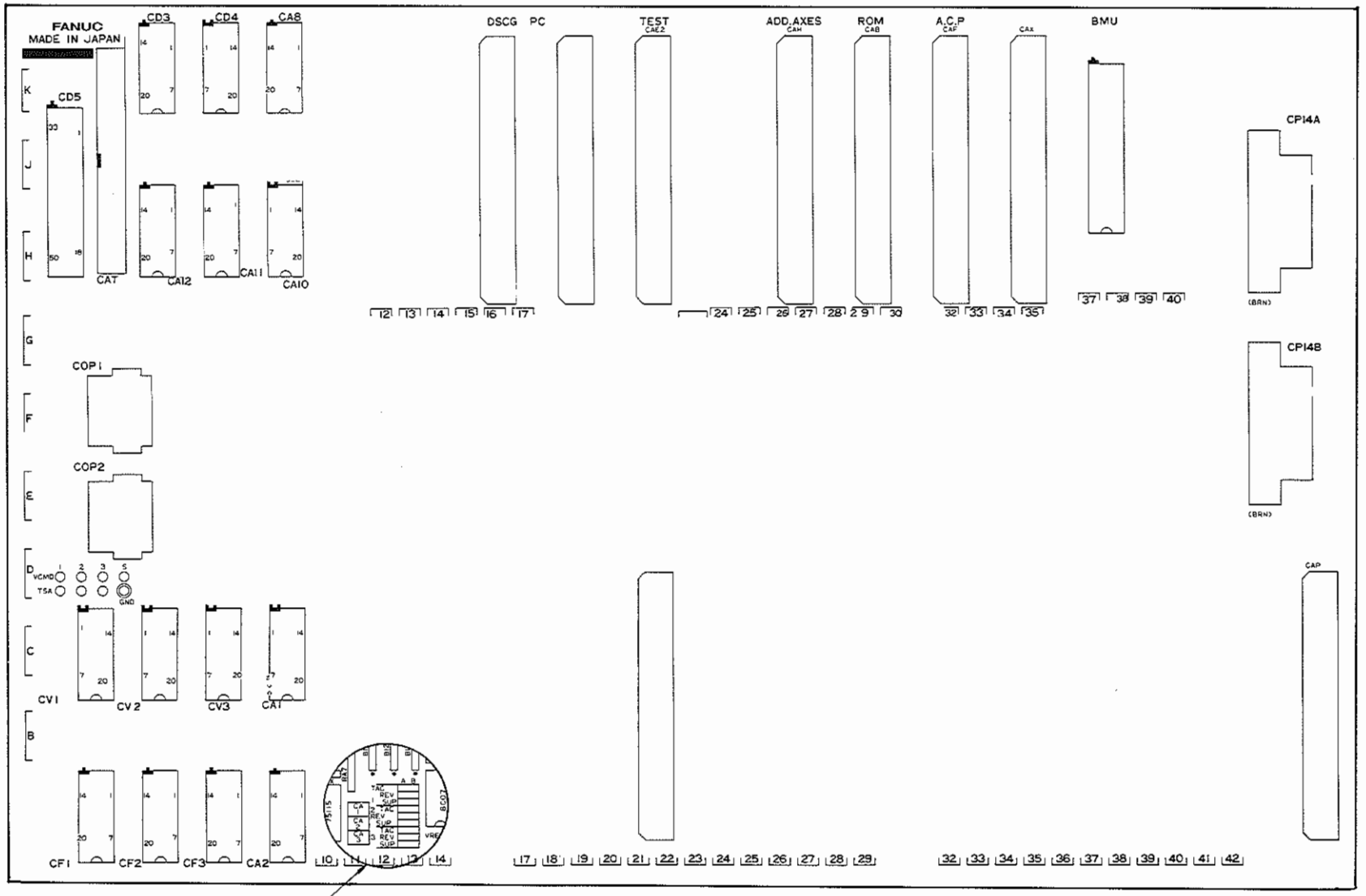


Fig. 6.1.3 (c) Adjusting points on analog servo 11 series master PCB (A16B-1010-0050)

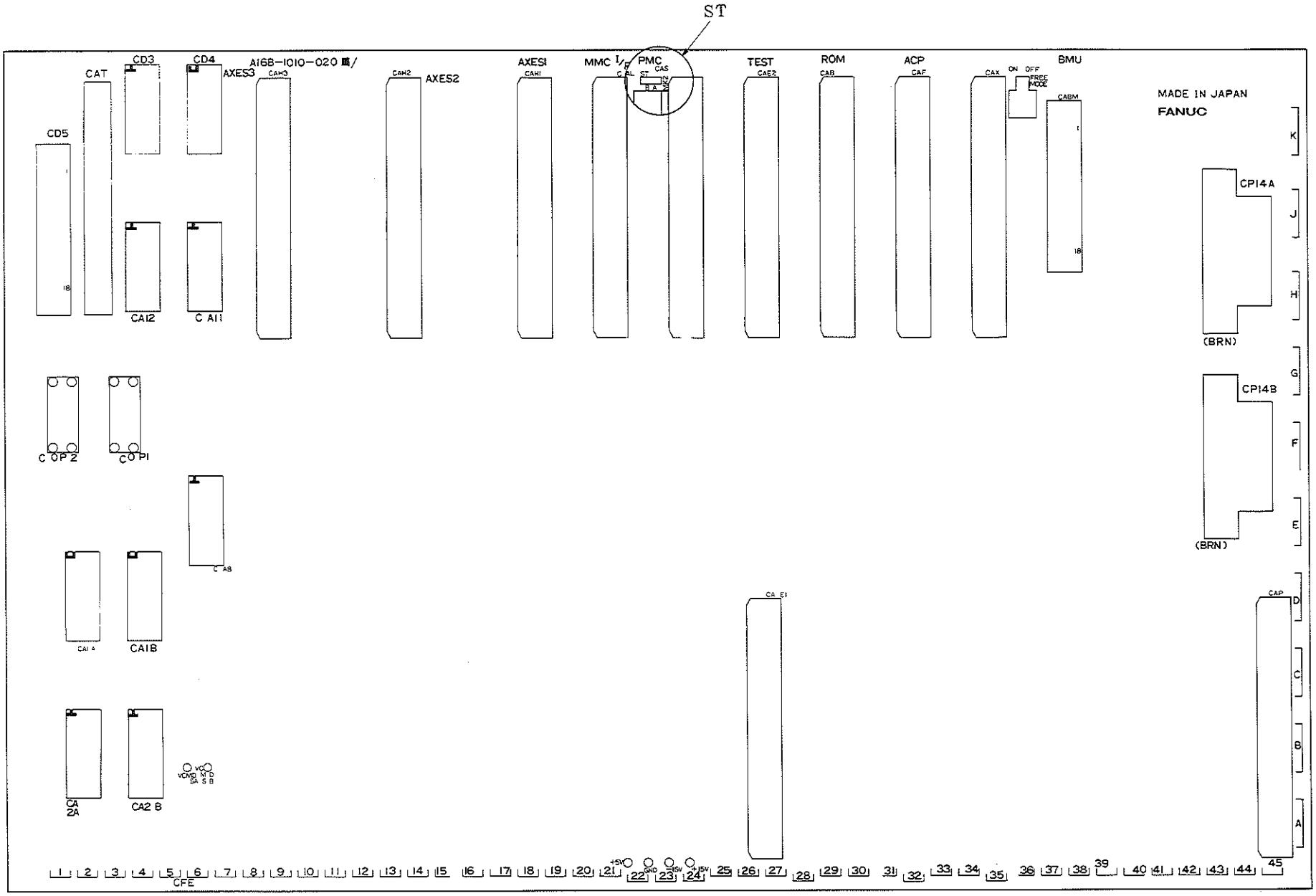


Fig. 6.1.3 (d) Digital servo 11 series master PCB (A16B-1010-0200)

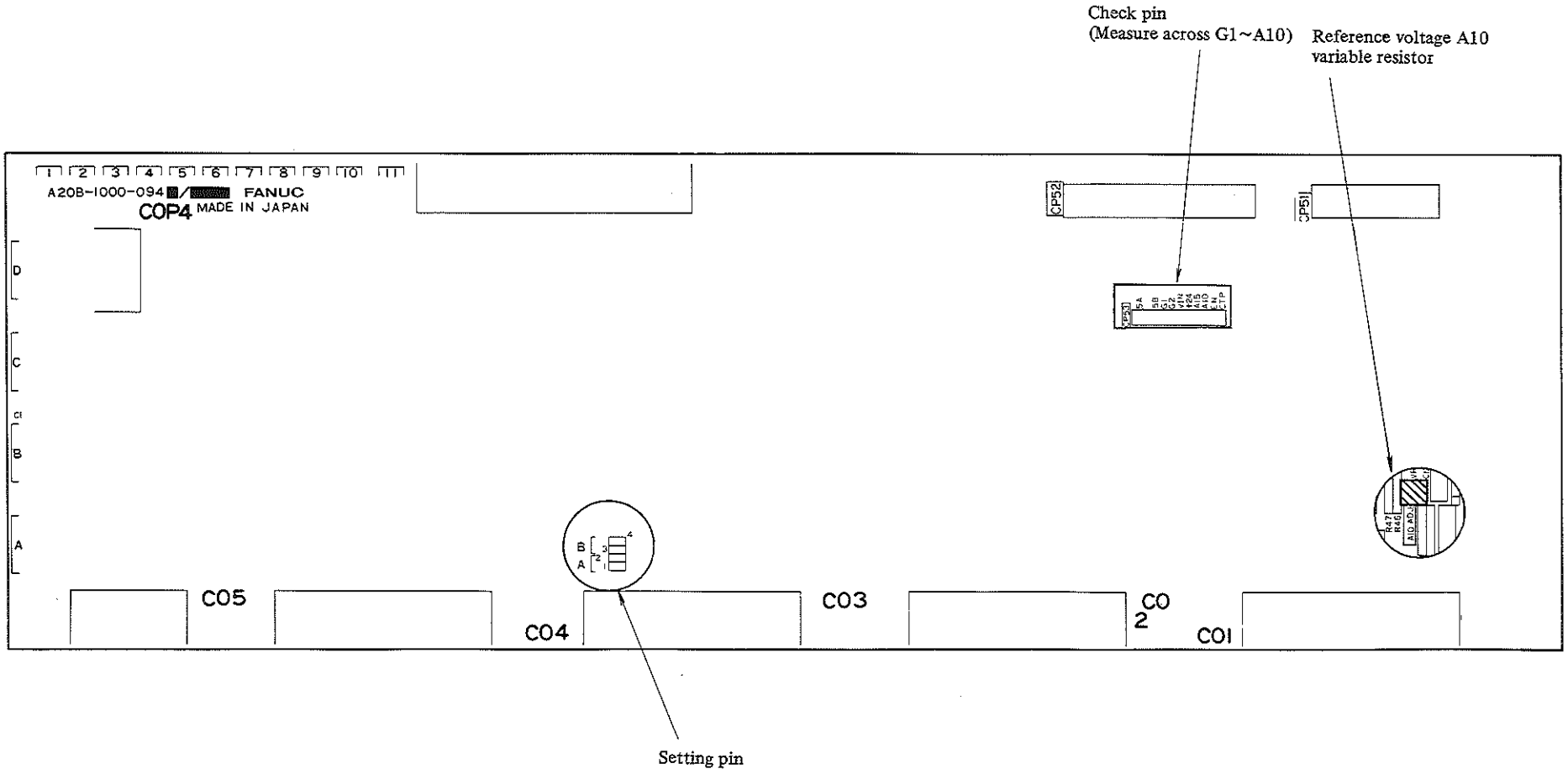


Fig. 6.1.3 (e) Adjusting points on 10/11 series connection unit 1 PCB (A20B-1000-0940)

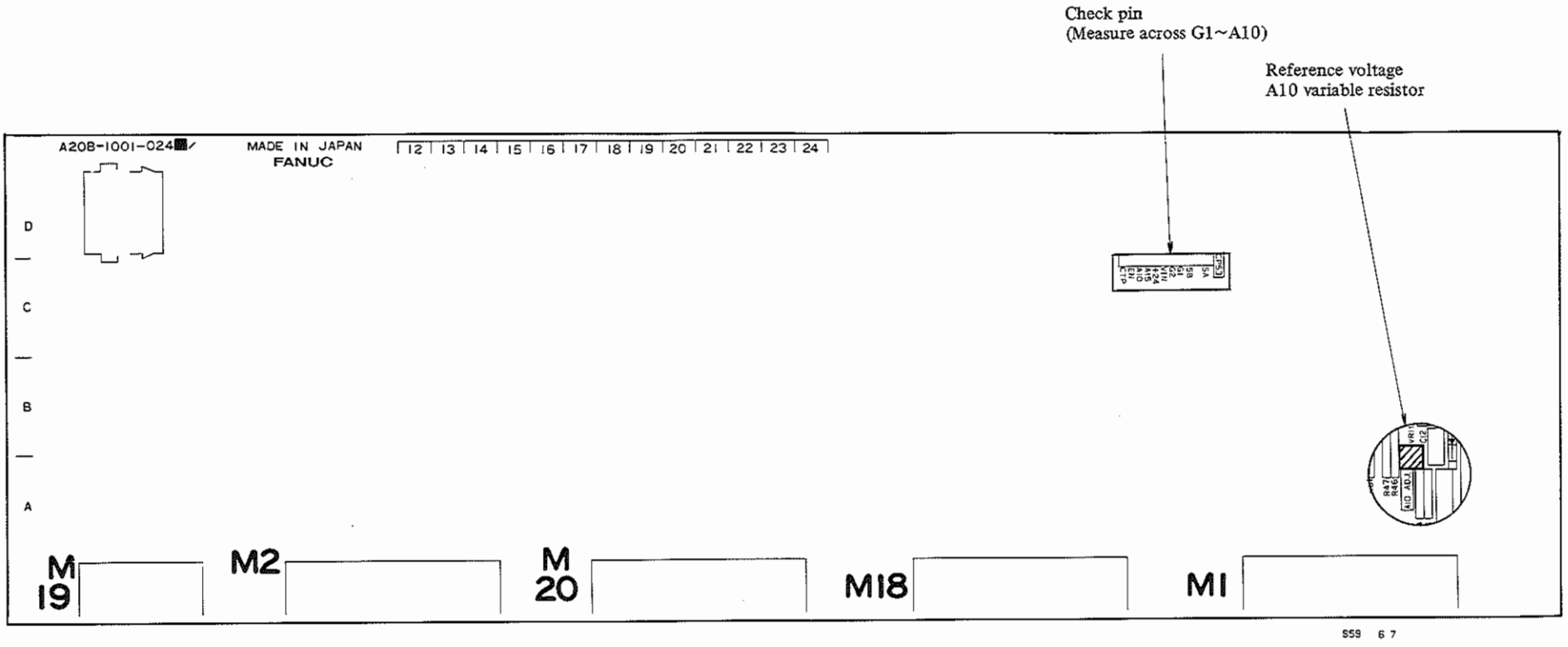


Fig. 6.1.3 (f) Adjusting points on I/O Card D1 ~ D3 (A20B-1001 0240 ~ 242) for 10TF

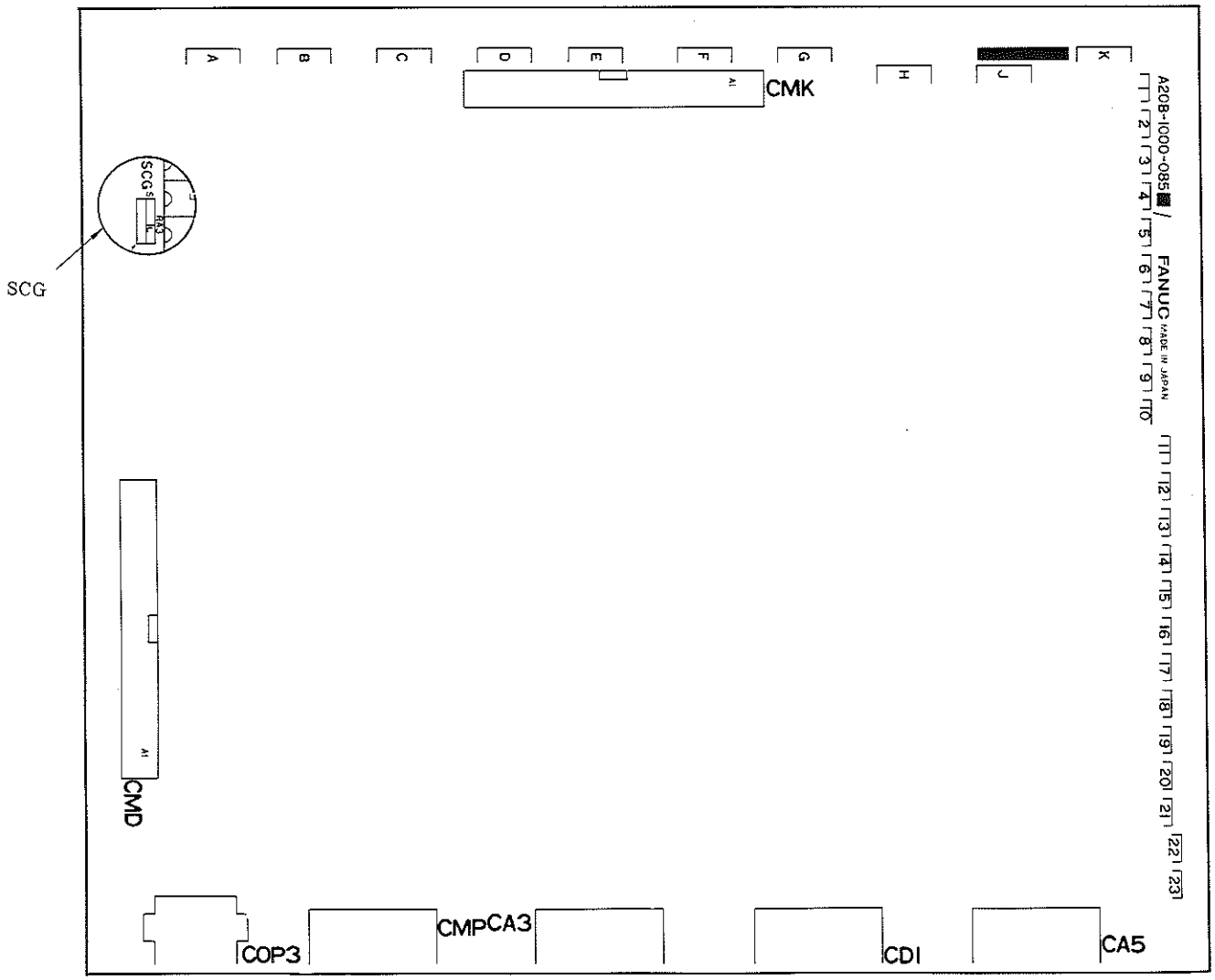


Fig. 6.1.3 (g) Adjusting points on 10/11 series 14" color graphic control PCB (A20B-1000-0850)

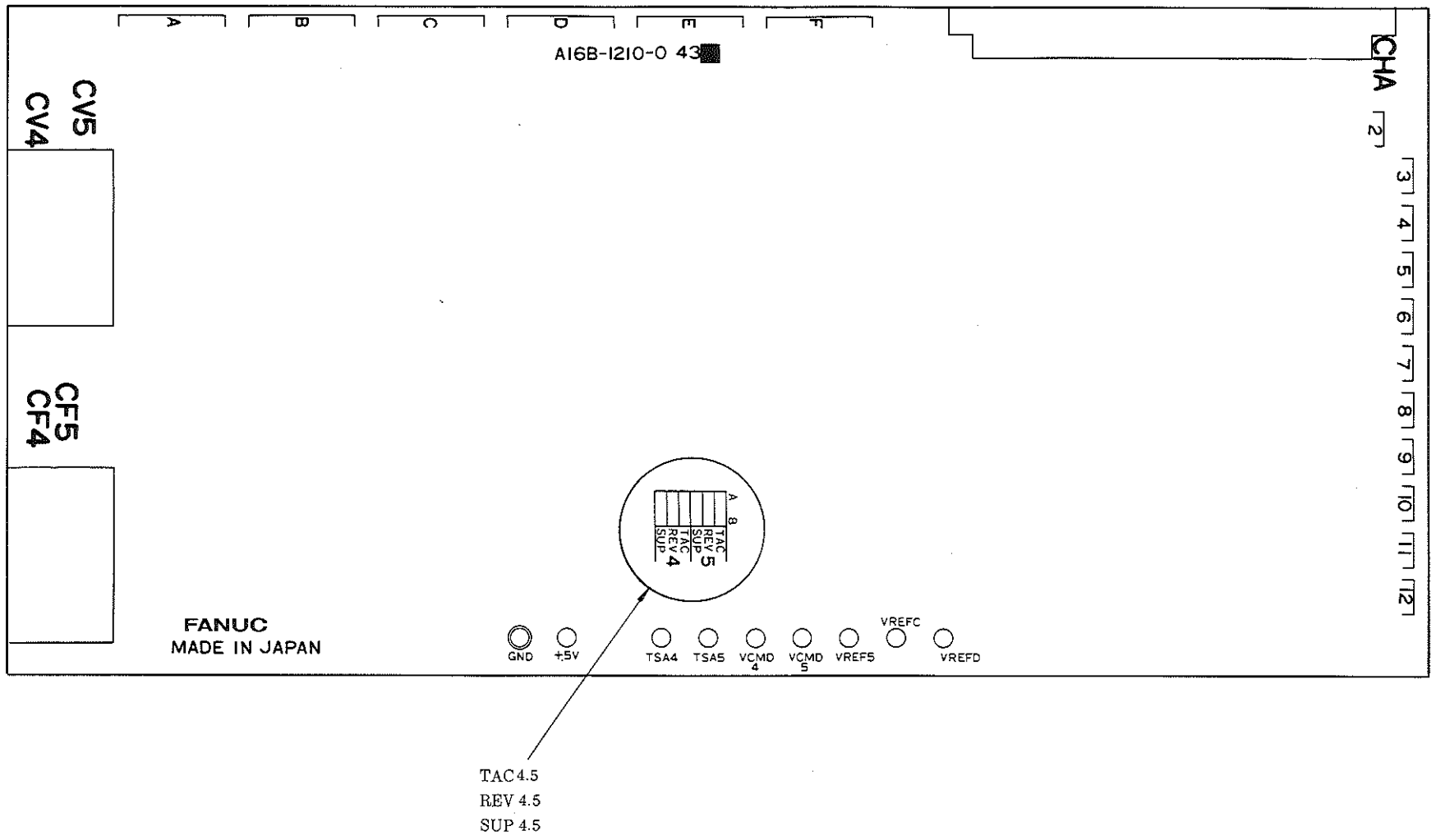


Fig. 6.1.3 (h) Adjusting points on analog servo additional axis PCB (pulse coder) (A16B-1210-0430/0431)

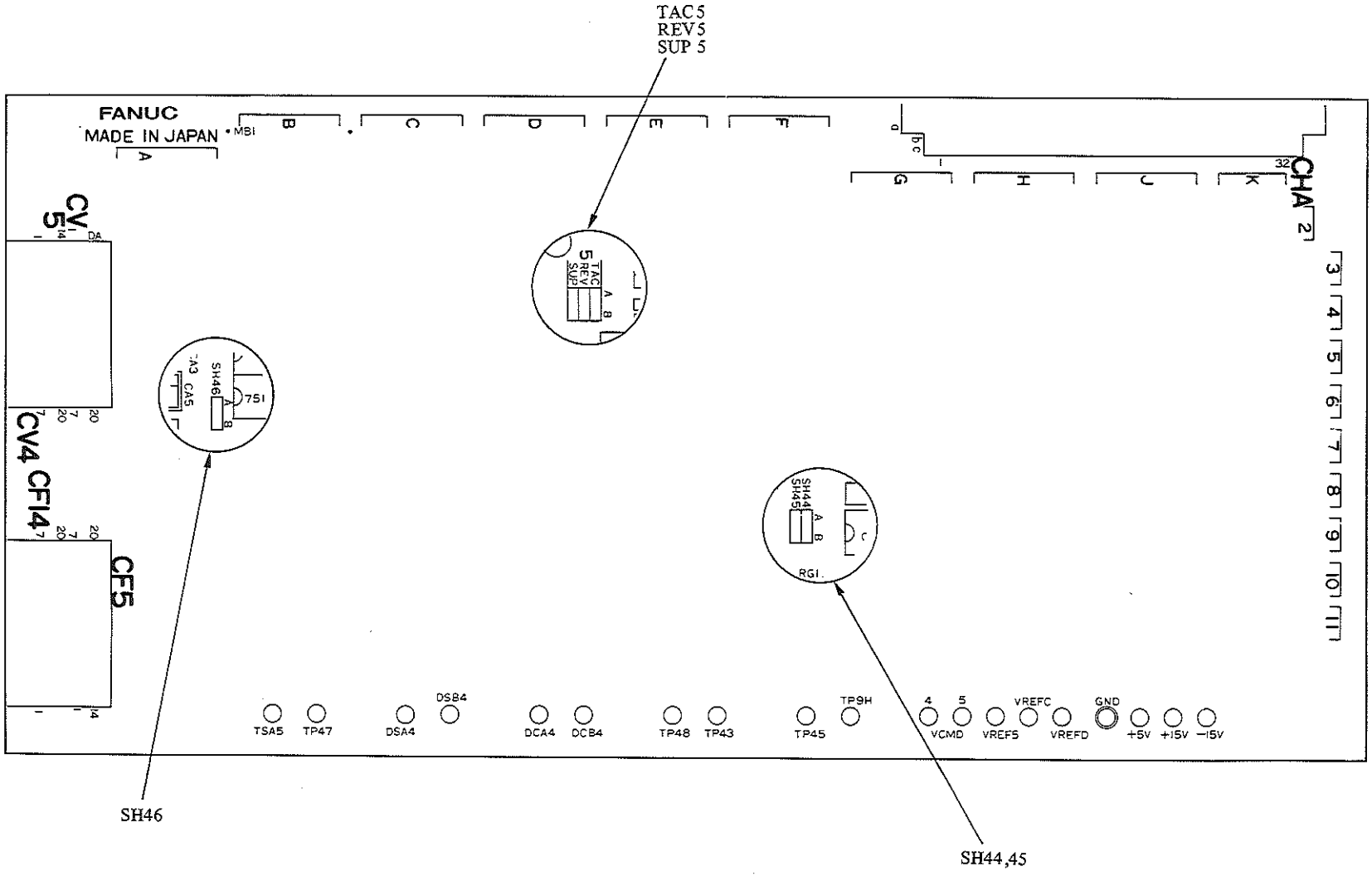


Fig. 6.1.3 (i) Adjusting points on 11 series analog servo additional axis PCB A20B-1210-0440

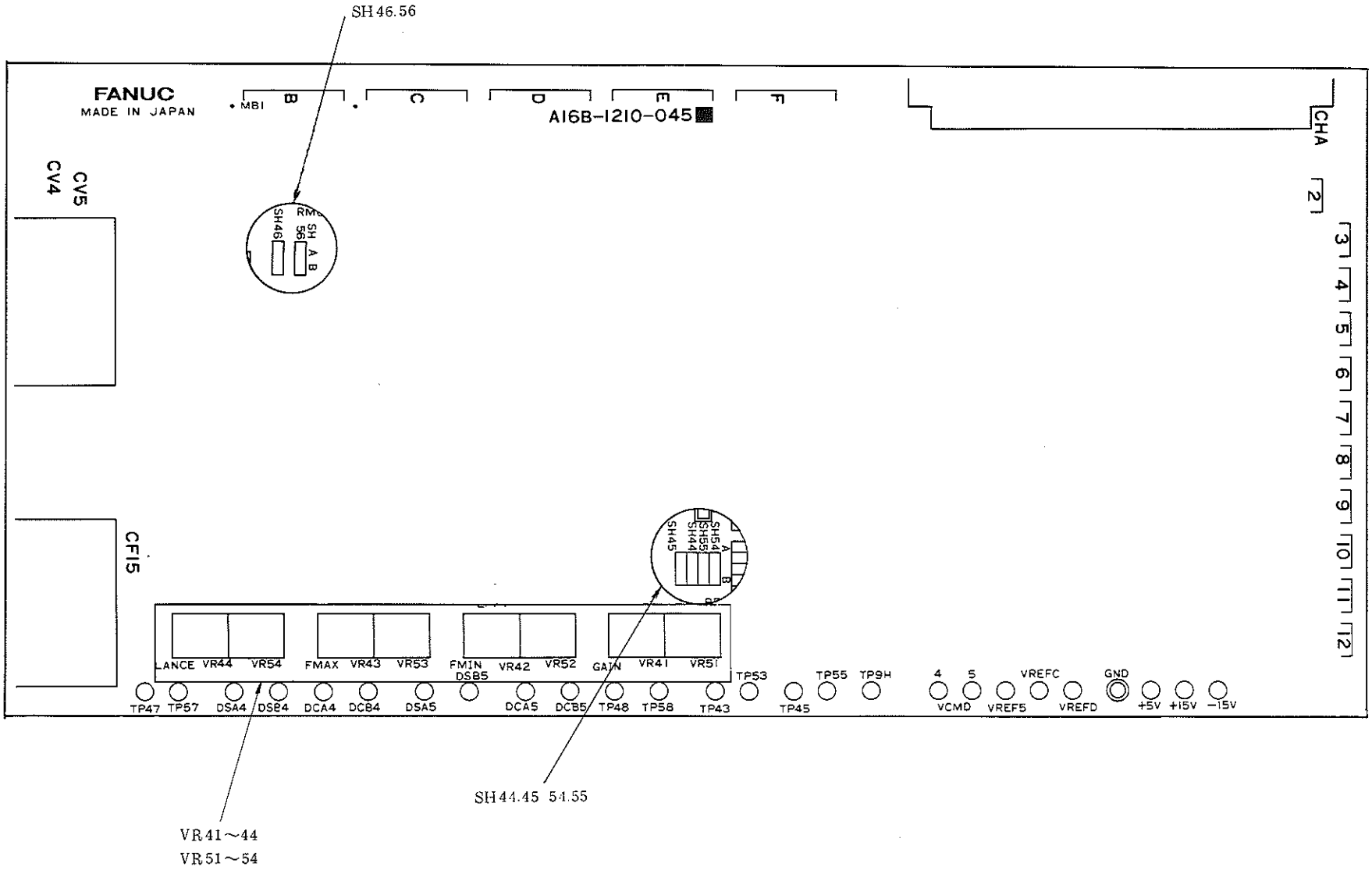


Fig. 6.1.3 (j) Adjusting points on 11 series analog servo additional axis PCB (DSCG) (A16B-1210-0450)

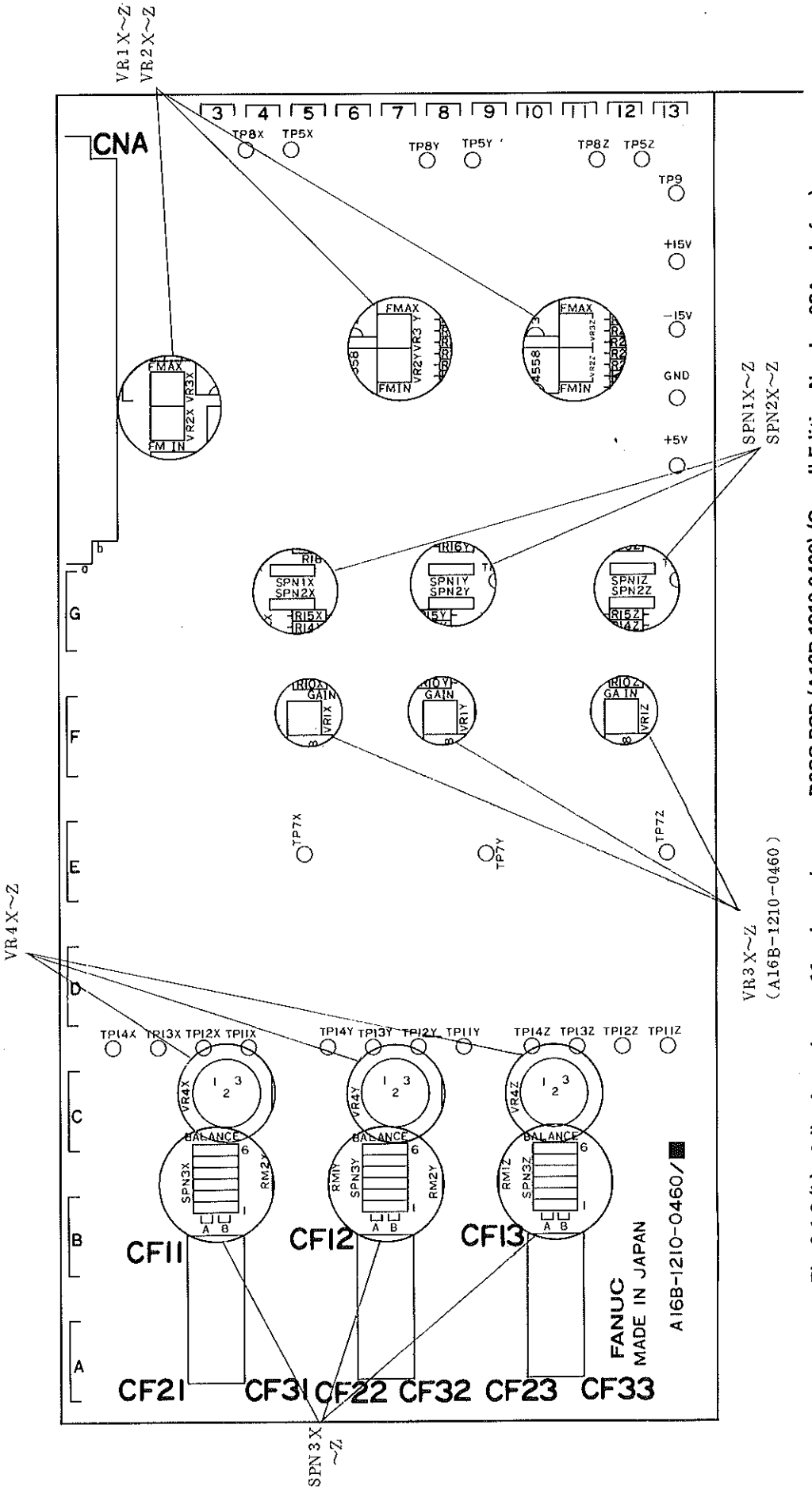


Fig. 6.1.3 (k) Adjusting points on 11 series analog servo DSCG PCB (A16B-1210-0460) (Overall Edition Number 03A or before)

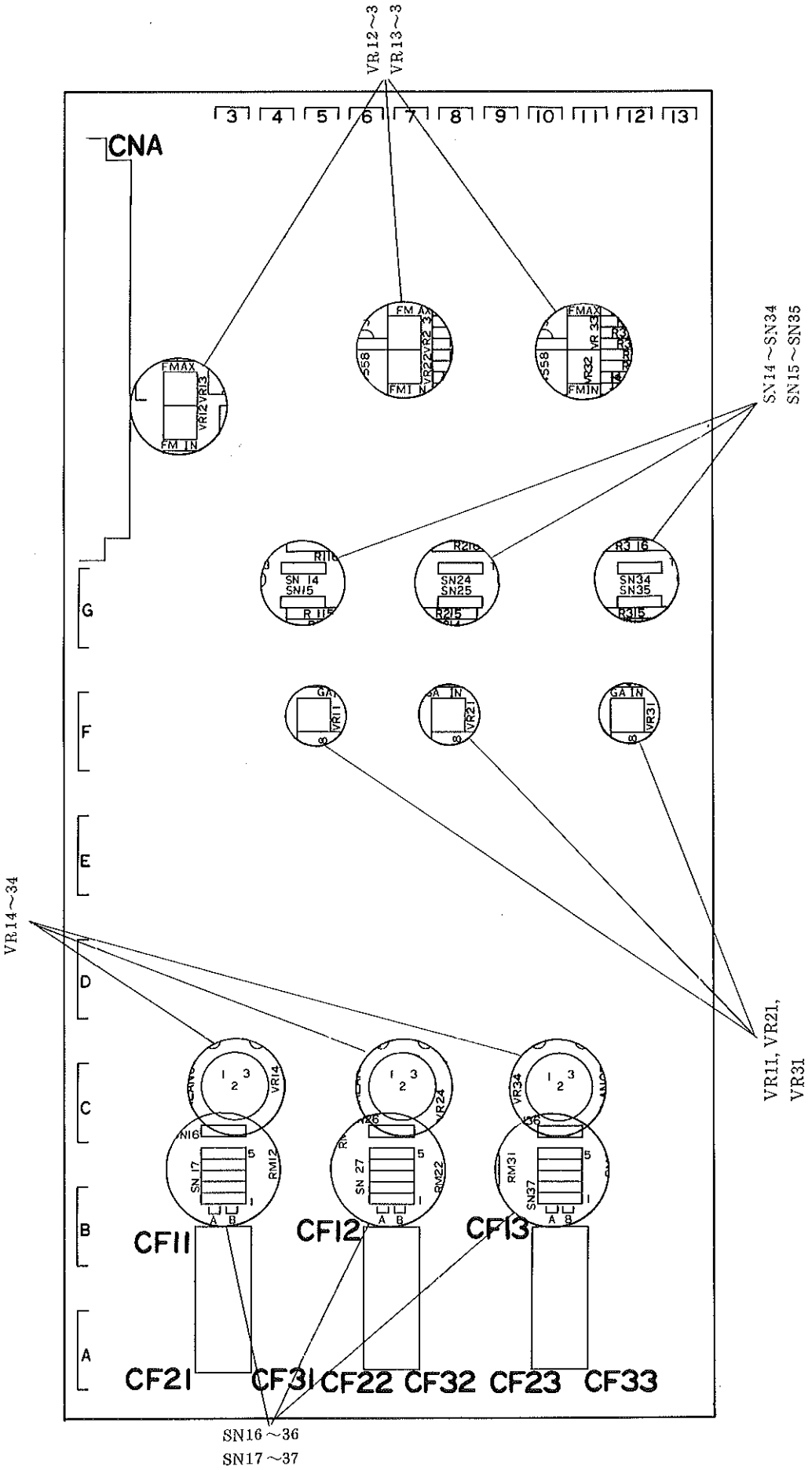


Fig. 6.1.3 (l) Adjusting points on 11 series analog servo DSCG PCB (A16B-1210-0460) (Overall Edition Number 04A～)

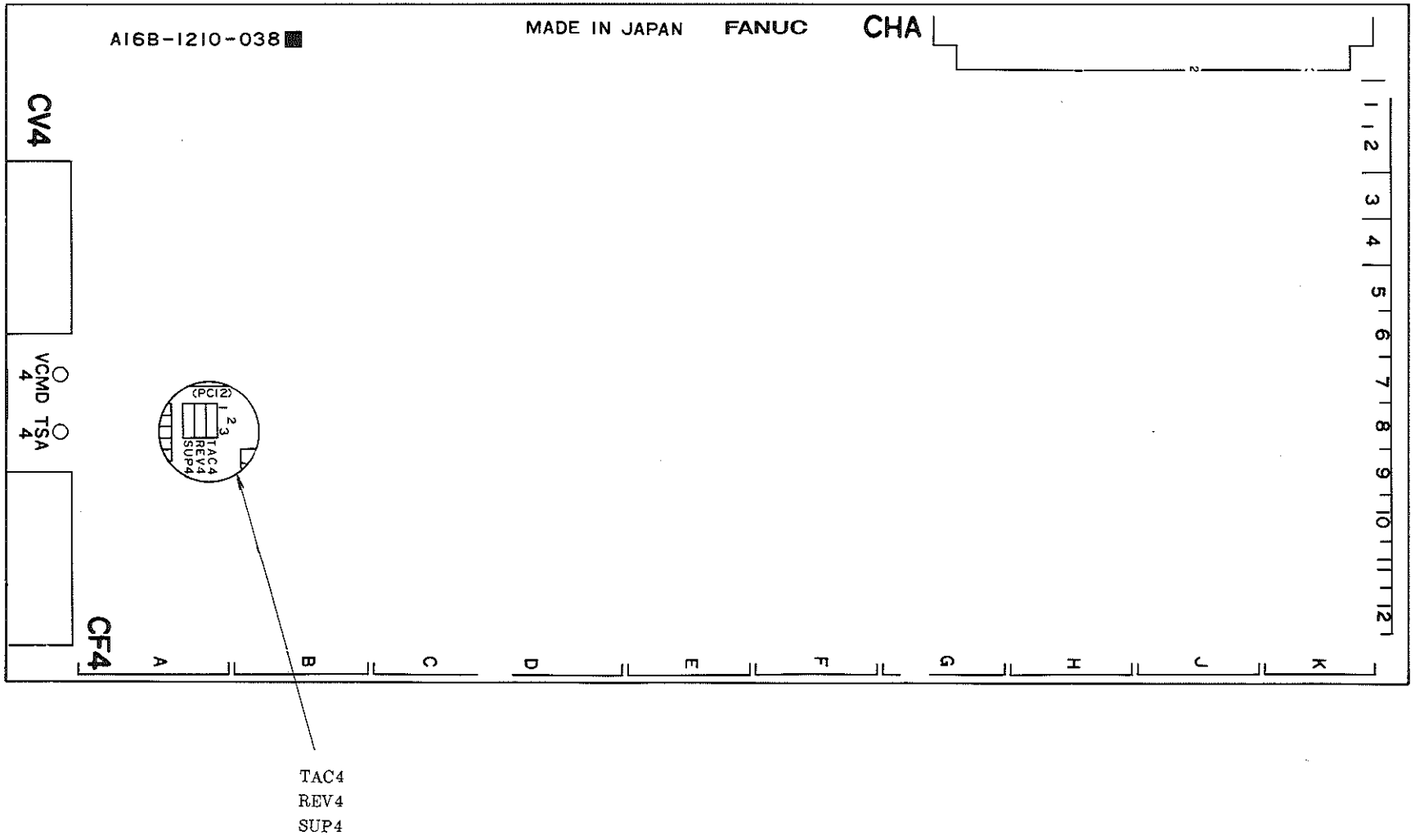


Fig. 6.1.3 (m) Adjusting points on 10 series analog servo additional axis + additional memory PCB (A16B-1210-0380)

6.1.4 Adjusting methods related DSCG

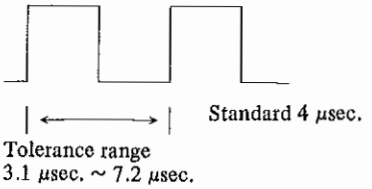
1) Adjustment of detected gain

The resolver and the inductosyn agitate the primary coil and detect positional information from the secondary-coil output signal. The voltage transfer ratio between the primary and secondary coils varies with the resolver type, the inductosyn type and the gap distance, as well as the secondary-coil output level. Since the output impedance varies with the inductosyn scale length, the secondary-coil output level is also affected. The detected gain needs to be adjusted at instratiain without fail according to the secondary-coil output level.

a) Adjusting procedure of detected gain

Prepare a synchroscope and 1 pce of jumper with clips (10 cm or more).

Step	Operation
1	Set the parameters: PSFα = 1 (No.1802 bit 0), where α = X,Y,Z,A,B, ... (Axis name) Phase grid shift amount of each axis = 0 (No.1833) CDS = 1 (No.1810, bit 0)
2	Power OFF, then ON. (When DSCG alarm does not disappear, other trouble has occurred.)
3	Set the parameter ADR = 1 (No.1800 bit 0) In-position width of each axis = 0 (No.1827)
4	Wait more than ten seconds at this condition
5	Restore the parameter ADR = original value (No.1800 bit 0) In-position width of each axis = original value (No.1827)
6	Perform Reference Point Return. (Observe DSAα-GND by the synchroscope: high-level pulse width of up to 0.5μsec also will do.) α = 1,2,3,4,5
7	Move the machine tool by 100/4000 wavelength. (When Detect Multiply is 1, detection unit is 100; when 1/2, 50.)
8	Set the parameters: CDS = 0 (No. 1810, bit 0)
9	Power OFF.
10	Short TP9-GND. (Input of detected pulse to position LSI stops.) (Short TP9H in the case of additional axes)
11	Power ON. (DSCG abnormal alarm must always occur.)

Step	Operation
12	Observe TPα5-GND by the synchroscope to adjust detected gain. (when frequency is low, detected gain becomes low.)  α = 1,2,3,4,5
13	Open TP9 or TPα5 and set parameter PSFα to 0 (No.1802, 0 bit)
14	Power OFF, then ON.
15	Set parameter PSFα to 1 (No.1802, bit 0)
16	Repeat steps 6-12 to make sure that adjustment is correct.
17	Restore the parameters. Phase grid shift amount of each axis = original value (1833) CDS = 0 (No.1810, bit 0)

b) Reference of detection gain adjustment
The following table shows reference values for detection gain adjustment. These values may differ according to makers and gap distance in the case of inductosyn.

Position detector		Detection gain range setting	Variable resistance GAIN
Standard resolver (motor built-in type)		SHα4 (Additional axis) SHα4 (Basic 3 axes)	0%
Multipolar resolver (M series motor built-in type)			60%
Linear inductosyn	Scale length 2m or shorter	Standard	0%
	Scale length longer than 2m		More than 0% (adjustment)
Tape or narrow inductosyn	Scale length 2m or shorter		65%
	Scale length longer than 2m		More than 65% (adjustment)
Rotary inductosyn	12 inch 360 pole	Reduce	0%
	12 inch 720 pole		65%
	7 inch 360 pole	Standard	0%
	7 inch 720 pole		50%

Note: SHα5 and SNα5 should be set to standard. α = 1, 2, 3, 4, 5

2) Adjustment of resolver, inductosyn Fmin and Fmax
Adjust these values with the emergency stop button turned on.

Item	Adjustment
Fmin	This has already been adjusted at FANUC before delivery and adjustment is not usually required. For this adjustment, use a frequency counter or an oscilloscope. Short circuit TPα8-GND Observation TPα5-GND Adjusting variable resistor Fmin Frequency range 1.67kHz ±150Hz (cycle 0.6ms ±0.06ms)
Fmax	This has already been adjusted at FANUC before delivery and adjustment is not usually required. For this adjustment, use a frequency counter. (Don't use an oscilloscope due to poor accuracy.) Short circuit TPα8- -15V Observation TPα5- GND Adjusting variable resistor Fmax Frequency range 850kHz ±20kHz

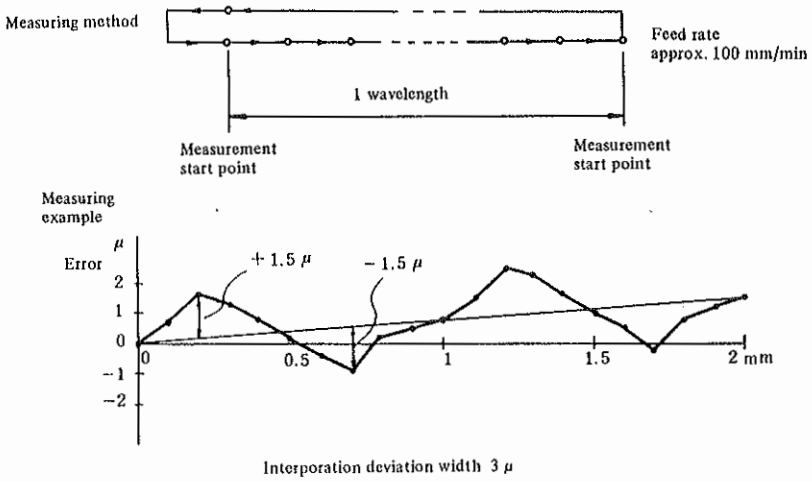
α = 1,2,3,4,5

3) Adjustment of inductosyn interpolation accuracy

With the absence of interpolation accuracy adjustment, a fairly good accuracy can be attained. When interpolation accuracy adjustment set is present, adjustment needs to be made.

a) Simple adjusting method
Feed the machine tool at low speed and observe motor-current waveforms on an oscilloscope to adjust the variable resistor BALANCE so that current-waveform swell may be smallest. A division error will cause current waveforms to swell twice per wavelength of inductosyn. The swell frequency is proportionate to the feed rate, and as the feed rate becomes more than a certain degree, usually the swell disappears. Using the above characteristics, whether current-waveform swell occurs due to another cause is checked.

b) Strict adjusting method
Adjustment is made by actually measuring the machine tool position, using a high-precision, high-resolution measuring instrument, such as a laser measuring machine. One wavelength of an inductosyn is divided by the NC and the position is detected in resolutions of 1/4000. The accuracy that one wavelength is divided is called the interpolation accuracy. The accuracy within one wavelength is strongly affected by the NC position detector circuit and the position accuracy of an integral multiple of one wavelength depends primarily on the scale accuracy.
The division accuracy is checked by dividing one wavelength into 1/10 or 1/20, measuring the positioning accuracy, writing the error on a graph, and viewing the distance of each division point from a straight line connecting both ends of the wavelength.

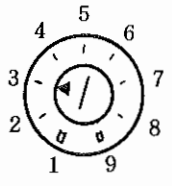


Interporation deviation width 3 μ

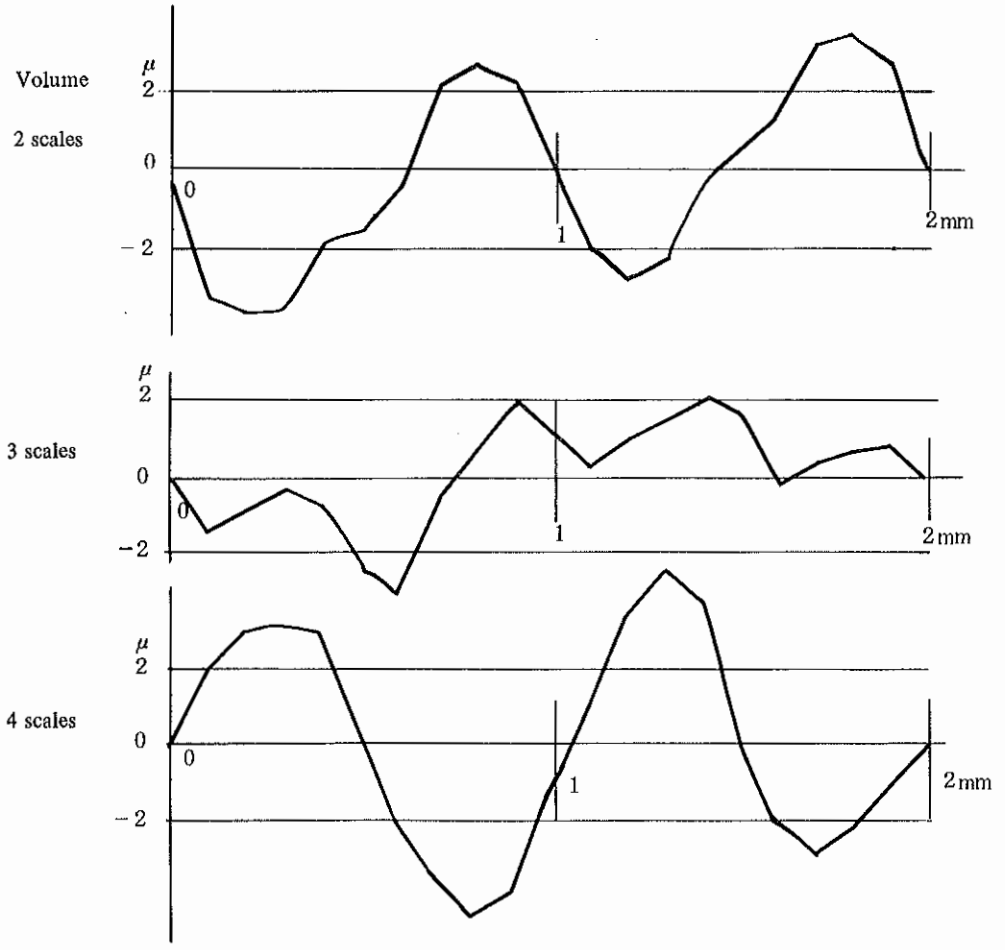
Adjusting variable resistor BALANCE
Measure their respective interpolation accuracy at degrees 2 and 3 on the volume, and write the errors on a graph. Rotate the volume by another one degree in the direction to the small error, measure the interpolation accuracy, and observe the condition of the error. The error develops with its peak and valley positioned reversely between when the volume is rotated too much and when it is rotated too little. When it is not found clearly where the peak and the valley are, the volume is set at an optimum position.
A interpolation error having a two-cycle swell per wavelength of inductosyn can usually be improved by this adjustment. But a interpolation error having a one-cycle swell or an irregular error cannot be improved by this adjustment. Examine other causes on inductosyn mounting, gap adjustment, slider replacement, etc.

Scale on the volume
Example: 3 scales

BALANCE

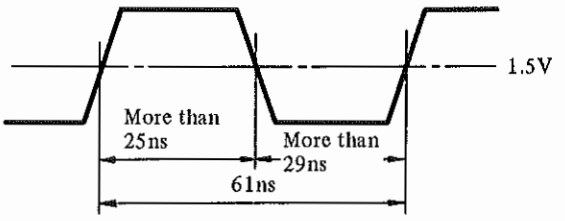


Adjusting example
The figure below suggests that about degree 2.8 is an optimum position for the knob to be set.



6.1.5 Setting and adjustment on 12/120 series control unit PCB

1) The peripheral control PCB
   . Module name 01P02
   . PCB specification A16B-1210-0080
   a) Setting of the clock pulse width

Setting position	Setting method
One set of the following pins on the short terminal F2 should be shorted. (1) - (16) (2) - (15) (3) - (14) (4) - (13) (5) - (12)	Check the checking terminal C16MP with an oscilloscope to set the pulse width as follows: 

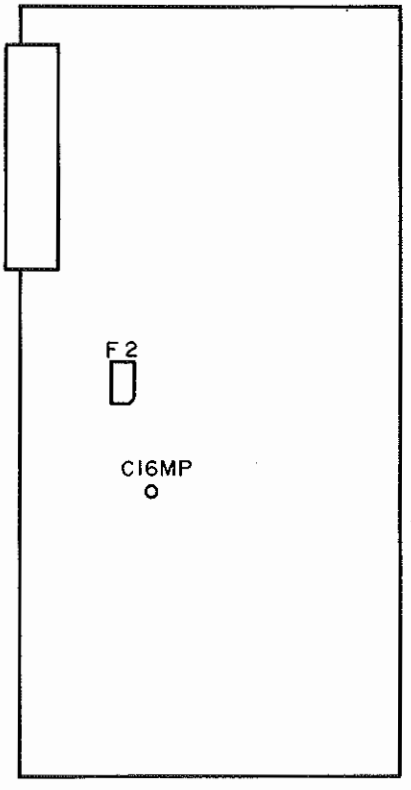


Fig. 6.1.5 (a) Setting and adjusting position on the peripheral control PCB A16B-1210-0080

2) The main CPU PCB
   . Module name 01P03
   . PCB specification A16B-1210-0060
   a) BUBBLE FREE switch
      Normally, set this switch to OFF. Switch to ON only for initializing bubble memory.

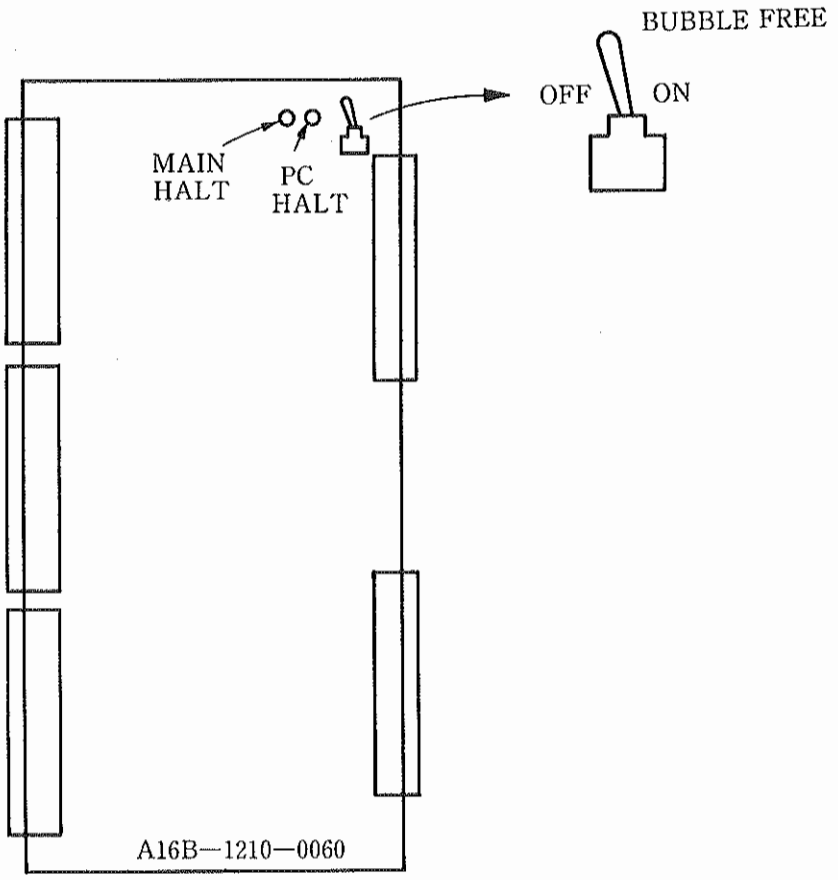


Fig. 6.1.5 (b) Setting position on the main CPU PCB A16B-1210-0060

3) Main bubble PCB
. Module name 01P04
. PCB specification A16B-1210-0070
a) Setting pin P1

Setting type	Meaning
Short	Standard setting (when 8031 program is loaded in 2764)
Open	Not standard (when 8031 program is loaded in 8031 inside ROM)

b) Setting pin SPCLK

Setting type	Meaning
A side short	For testing: clock margin check
B side short	Standard setting

View from the mounting face

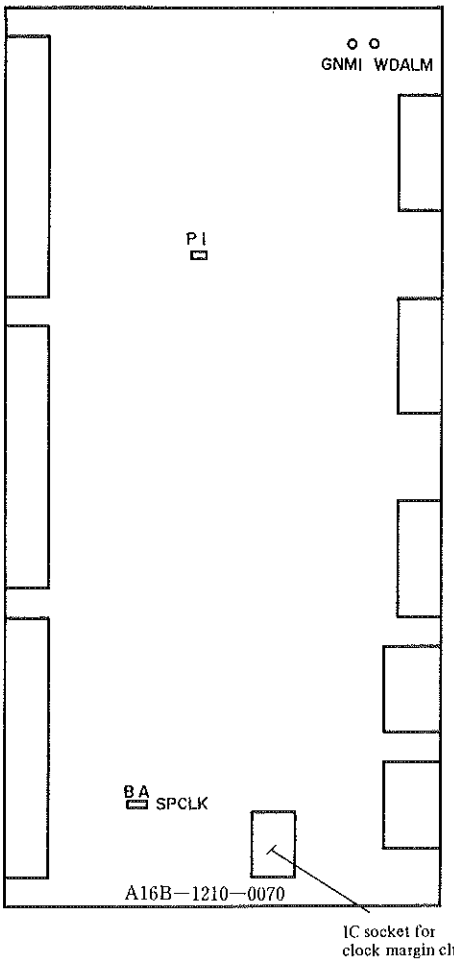
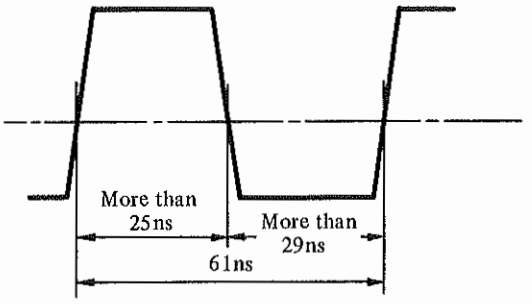


Fig. 6.1.5 (c) Setting position on the main bubble PCB A16B-1210-0070

4) Axis control PCB

. Module name ..... 01P06 - 05P06
. PCB specification A16B-1210-0030

a) Setting of clock pulse width

Setting position	Setting method
One set of the following pins on the short terminal G3 should be shorted. (1) - (16) (2) - (15) (3) - (14) (4) - (13) (5) - (12)	Set 16.384 MHz cycle at check pin C16M as follows. 

b) The setting concerning 1st axis (L axis) control

Item	Setting position	Setting	Meaning
1	PJ1 - PJ5	A side	Pulse types (note 1) are used as a detector.
		Open	Inductosyn is used as a detector.
		B side	Resolver is used as a detector.
2	PJ6 -PJ9	A side	Pulse types (note 1) are used as a detector.
		B side	Resolver/inductosyn is used as a detector.
3	PJ10	Short	Overheat alarm signal from motor is ignored.
		Open	Standard setting
4	PD9	Short	Ready signal from servo amplifier is ignored.
		Open	Standard setting
5	PD10	Short	Overload alarm signal from servo amplifier is ignored.
		Open	Standard setting
6	PE1	A side	F/V converter output is regarded as velocity feedback signal (when a pulse coder is used.)
	PE2	B side	Tachogenerator signal is regarded as velocity feedback signal (when a tachogenerator is used.)
7	PD3	Short	Special setting (note 2)
		Open	Standard setting
8	PD4	A side	2000PPR pulse coder is used.
		Open	2500PPR pulse coder is used.
		B side	3000PPR pulse coder is used.

Note 1) Pulse type: pulse coder, optical scale, magnescale
Note 2) The vibration may be reduced by this setting when the machine vibrates 1 - 2 pulses (1 - 2 μm) at stoppage.

c) The setting concerning 2nd axis (M axis) control

Item	Setting position	Setting	Meaning
1	PJ1 - PJ5	A side	Pulse types (note 1) are used as a detector.
		Open	Inductosyn is used as a detector.
		B side	Resolver is used as a detector.
2	PG6 - PG9	A side	Pulse types (note 1) are used as a detector.
		B side	Resolver/inductosyn is used as a detector.
3	PG10	Short	Overheat alarm signal from motor is ignored.
		Open	Standard setting
4	PC1	Short	Ready signal from servo amplifier is ignored.
		Open	Standard setting
5	PC2	Short	Overload alarm signal from servo amplifier is ignored.
		Open	Standard setting
6	PD1 PD2	A side	F/V converter output is regarded as velocity feedback signal (when a pulse coder is used.)
		B side	Tachogenerator signal is regarded as velocity feedback signal (when a tachogenerator is used.)
7	PD5	Short	Special setting (note 2)
		Open	Standard setting
8	PD6	A side	2000PPR pulse coder is used.
		Open	2500PPR pulse coder is used.
		B side	3000PPR pulse coder is used.

Note 1) Pulse type: pulse coder, optical scale, magnescale
Note 2) The vibration may be reduced by this setting when the machine vibrates 1 - 2 pulses (1 - 2 μm) at stoppage.

d) The setting concerning to 3rd axis (N axis) control

Item	Setting position	Setting	Meaning
1	PF1 - PF5	A side	Pulse types (note 1) are used as a detector.
		Open	Inductosyn is used as a detector.
		B side	Resolver is used as a detector.
2	PF6 - PF9	A side	Pulse types (note 1) are used as a detector.
		B side	Resolver/inductosyn is used as a detector.
3	PF10	Short	Overheat alarm signal from motor is ignored.
		Open	Standard setting
4	PA2	Short	Ready signal from servo amplifier is ignored.
		Open	Standard setting
5	PA3	Short	Overload alarm signal from servo amplifier is ignored.
		Open	Standard setting
6	PB1	A side	F/V converter output is regarded as velocity feedback signal (when a pulse coder is used.)
	PB2	B side	Tachogenerator signal is regarded as velocity feedback signal (when a tachogenerator is used.)
7	PD7	Short	Special setting (note 2)
		Open	Standard setting
8	PD8	A side	2000PPR pulse coder is used.
		Open	2500PPR pulse coder is used.
		B side	3000PPR pulse coder is used.

Note 1) Pulse type: pulse coder, optical scale, magnescale
Note 2) The vibration may be reduced by this setting when the machine vibrates 1 - 2 pulses (1 - 2 μm) at stoppage.

e) Setting pin PA1 should be opened.

View from the mounting face

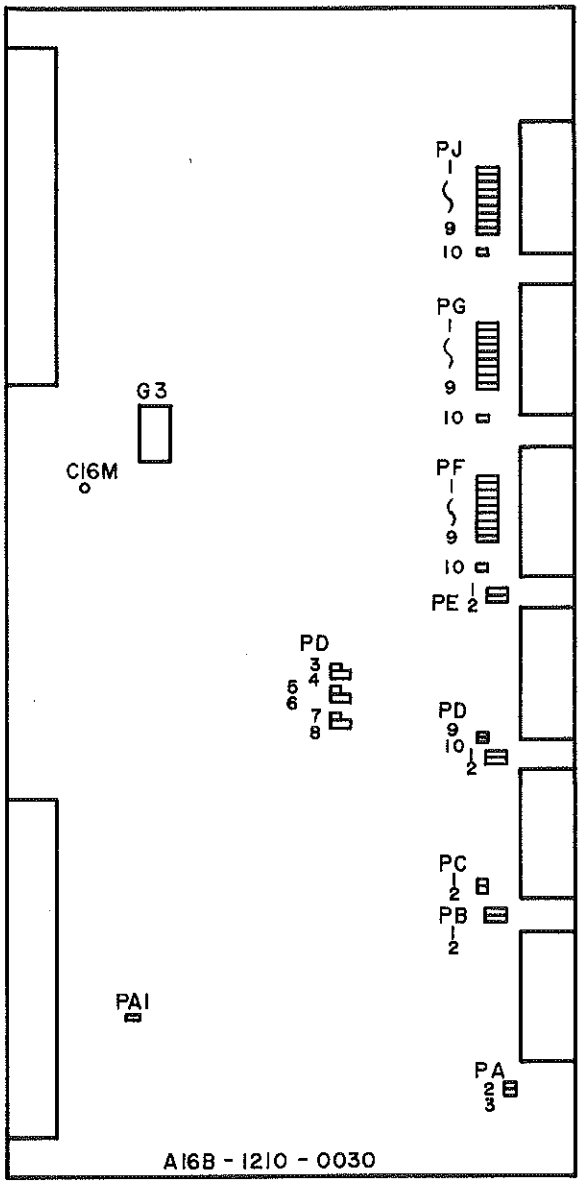


Fig. 6.1.5 (d) Setting position on the axis control PCB A16B-1210-0030

5) DSCG interface PCB and additional detector control (DSCG) PCB.
. Module ..... 01P07 - 05P07, 01P09 - 05P09
. PCB specification A16B-1210-0110, A16B-1210-0180
a) Setting

Setting pin	Standard setting	Usage
P1L P1M P1N	2 - 3	If the interpolation accuracy is necessary for an inductosyn, change the setting for adjustment. (Refer to (d) Inductosyn interpolation accuracy adjustment for details)
P2L P2M P2N	2 - 3	Change setting to adjust the amplification of a feedback signal from a detector. (Refer to (b) Detective gain adjustment for details)
P3L P3M P3N	1 - 2	
P4L P4M P4N	Open	Used at adjustment. Refer to (c) V-F converter frequency adjustment.
P5L P5M P5N	Open	Used at testing. The position feedback is stopped to open the position control loop by shorting.

Note: P1L

Setting pin for the L axis

b) Detective gain adjustment
① Set the setting pin P2L (M, N) and P3L (M, N) in advance according to the adjusting standard described later.
② Turn the power ON.
③ Display the DGN 3001, 3002 (the checking result of resolver inductosyn frequency). Check that each axis value multiplied by 0.125 is within the range of 230 - 800, 1466 - 1900.
④ Adjustment is finished if all axis values are reduced or increased to the above range.
⑤ Turn the power OFF.
⑥ If an axis is out of the range mentioned in 3 , adjust the setting pin P2L (M, N), P3L (M, N) and variable resistor VR2L (M, N) to reduce the axis value into the range.

Setting pin short circuit	Variable resistor VR2L(M,N)	Result of the frequency check	Detective gain
P2L(M,N): 2-3 P3L(M,N): 2-3	90% I 0%	Big ↑ Sma$$	Big ↑ Sma$$
P2L(M,N): 1-2 P3L(M,N): 2-3	90% I 0%		
P2L(M,N): 2-3 P3L(M,N): 1-2	85% I 0%		
P2L(M,N): 1-2 P3L(M,N): 1-2	85% I 0%		

⑦ Proceed to ② to repeat adjustment until the adjustment end.

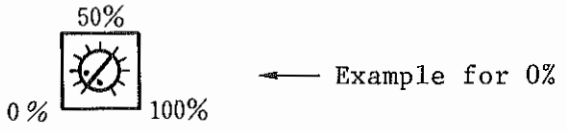
Detective gain adjustment standard

Setting pins P2L, P2M, P2N, P3L, P3M, P3N and the variable resistor VR2L, VR2M, VR2N should be set as follows in accordance with the type of detector.

Position detector		Setting pin P2L(M,N)	Setting pin P3L(M,N)	Variable resistor VR2L (M, N)
Standard resolver (Motor built-in type)		2 - 3	1 - 2	0%
Multi-pole resolver (M series motor built-in type)				60%
Linear inductosyn	Scale length: less than 2 m			0%
	Scale length: more than 2 m	1 - 2	2 - 3	More than 0% (Adjustment is necessary)

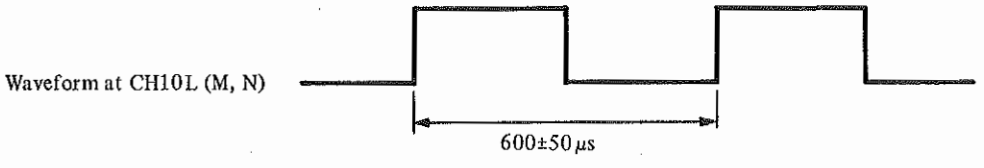
Position detector		Setting pin		Variable resistor
		P2L(M,N)	P3L(M,N)	VR2L (M, N)
Tape or narrow inductosyn	Scale length: less than 2 m	2 - 3	1 - 2	65%
	Scale length: more than 2 m	1 - 2	2 - 3	More than 0% (Adjustment is necessary)
Rotary inductosyn	12 inches, 360 poles	1 - 2	1 - 2	0%
	12 inches, 720 poles			65%
	7 inches, 360 poles	2 - 3	1 - 2	0%
	7 inches, 720 poles			50%

VR2L (M, N)

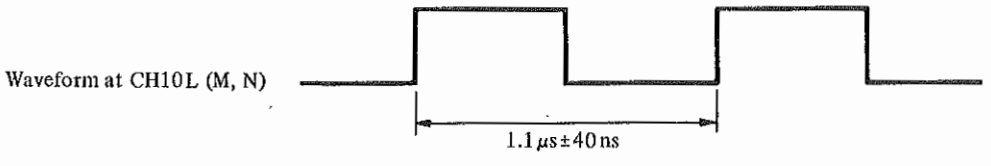


c) V/F converter frequency adjustment
This adjustment should be done at emergency stop.

① Adjustment of lowest frequency
After shorting the setting pin P4L (M, N) with 1-2, turn the variable resistor VR4L (M, N) so that the waveform cycle at check terminal CH10L (M, N) is 600 μs ± 50 μs.



② Adjustment of highest frequency
After shorting the setting pin P4L (M, N) with 2-3, turn the variable resistor VR3L (M, N) so that the waveform cycle at check terminal CH10L (M, N) is 1.1 μs ± 40 μs.

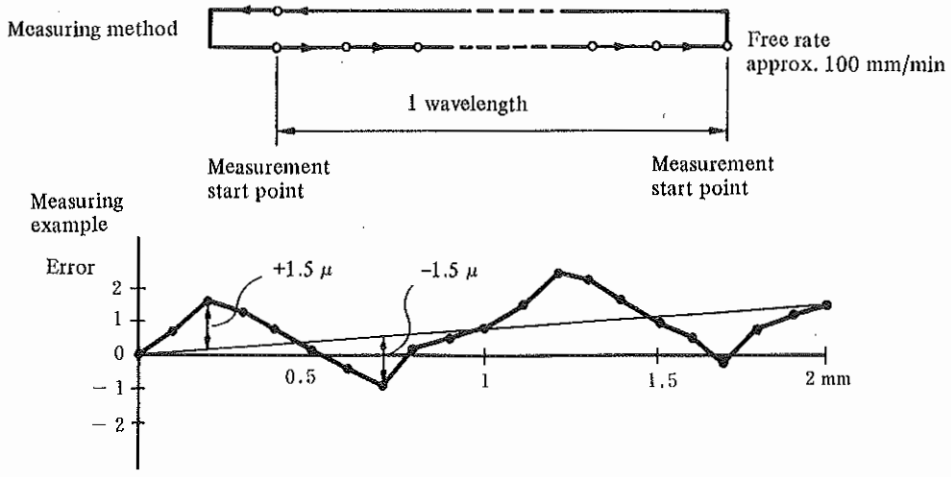


Note) Open the setting pin P4L (M, N) after adjustment.
Do not short No. 1 pin with No. 3 pin.

d) Adjustment of inductosyn interpolation accuracy
With interpolation accuracy adjustment set absent, a fairly good accuracy can be attained. When interpolation accuracy adjustment set is present, adjustment must be made.

i) Simple adjusting method
Feed the machine tool at low speed and observe motor-current waveforms on an oscilloscope to adjust the variable resistor VR1L (M, N) so that current-waveform swell may be smallest. A division error will cause current waveforms to swell twice per wavelength of inductosyn. The swell frequency is proportionate to the feed rate and as the feed rate becomes more than a certain degree, usually the swell disappears. Using the above characteristics, whether current-waveform swell occurs due to another cause is checked.

ii) Strict adjusting method
Adjustment is made by actually measuring the machine tool position, using a high-precision, high-resolution measuring instrument, such as a laser measuring machine. One wavelength of an inductosyn is divided by the NC and the position is detected in resolutions of 1/4000. The accuracy that one wavelength is divided is called the interpolation accuracy. The accuracy within one wavelength is strongly affected by the NC position detector circuit and the position accuracy of an integral multiple of one wavelength depends primarily on the scale accuracy.
The division accuracy is checked by dividing one wavelength into 1/10 or 1/20, measuring the positioning accuracy, writing the error on a graph, and viewing the distance of each division point from a straight line connecting both ends of the wavelength.



Interpolation deviation width 3 μ

Adjusting variable resistor VR1L (M, N)
Measure their respective interpolation accuracy at degrees 2 and 3 on the variable resistor, and write the errors on a graph. Rotate the variable resister by another degree in the direction of the minor error, measure the interpolation accuracy, and observe the condition of the error. The error develops with its peak and valley positioned reversely between when the variable resistor is rotated too much and when it is rotated too little. When it is not clear where the peak and the valley are, the variable resistor is set at an optimum position.

An interpolation error having a two-cycle swell pare wavelength of inductosyn can usually be improved by this adjustment. But an interpolation error having a one-cycle swell or an irregular error cannot be improved by this adjustment. Examine other causes on inductosyn mounting, gap adjustment, slider replacement, etc.

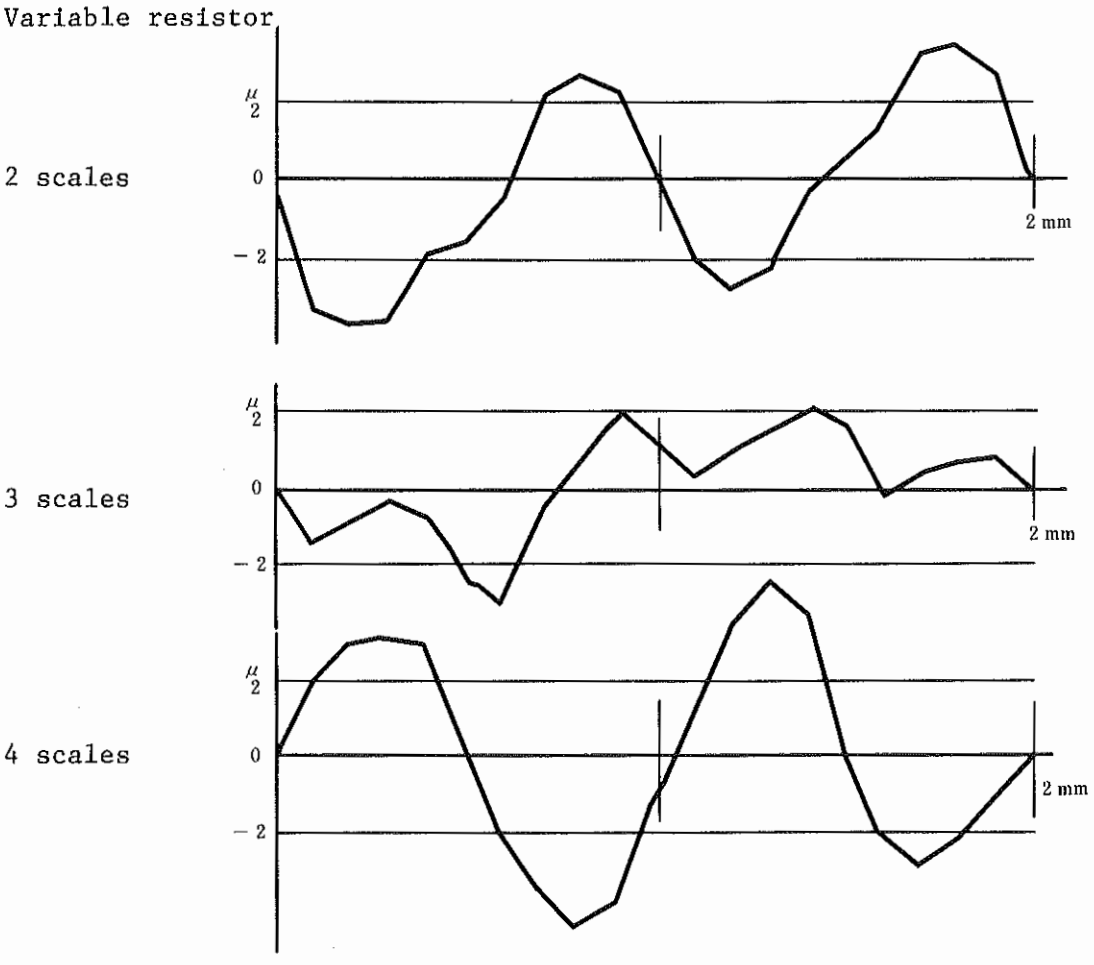
VR1L (M, N)



Scale on variable resistor
Example: 3 scales

Adjusting example
The figure below suggests that an approximate degree of 2.8 is an optimum position for the knob to be set.

Variable resistor



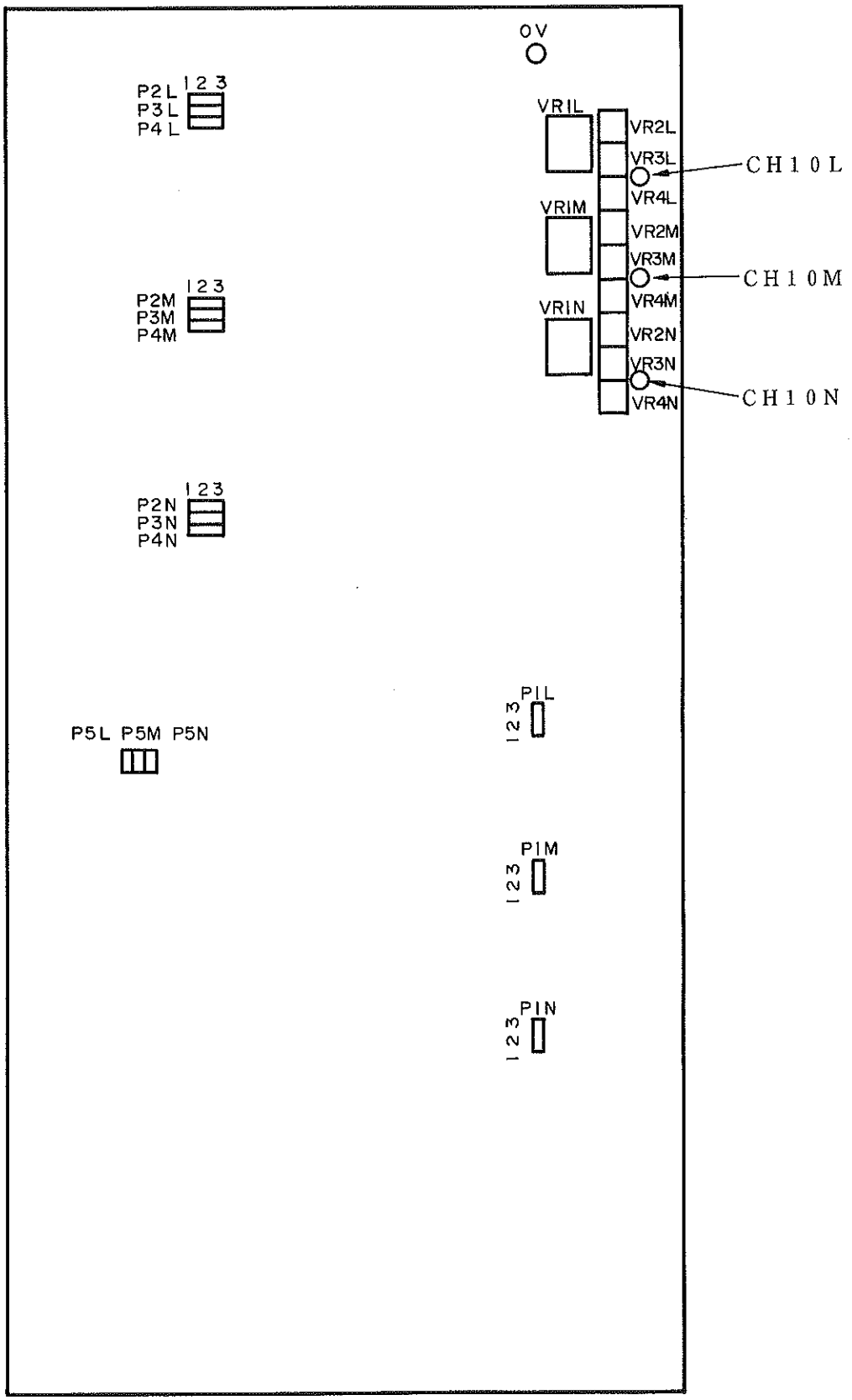


Fig. 6.1.5 (e) Setting and adjusting position on the DSCG interface PCB A16B-1210-0110

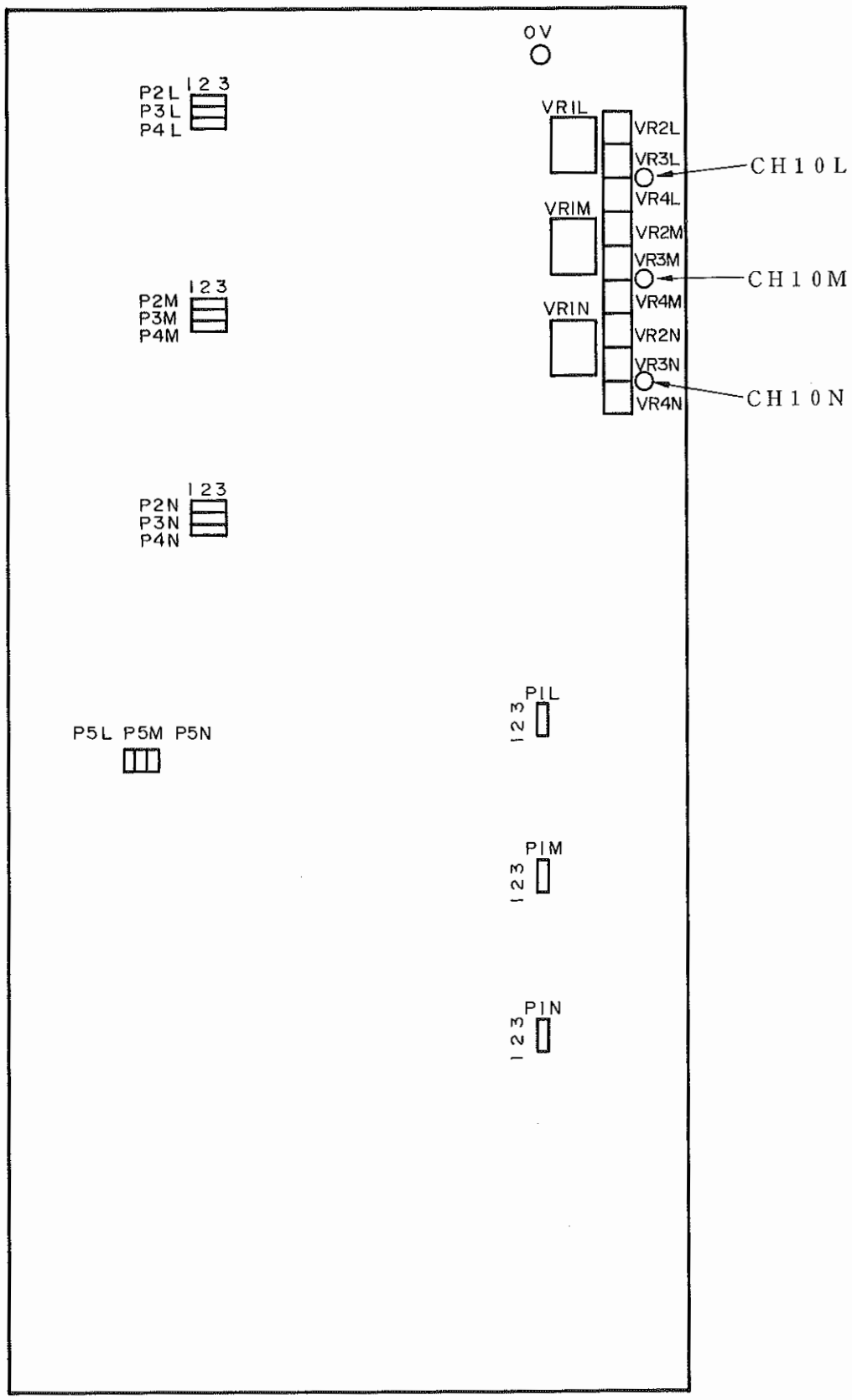


Fig. 6.1.5 (f) Setting and adjustment on the additional detector control PCB A16B-1210-0180

6) Axis CPU PCB
. Module name ..... 01P08 - 05P08
. PCB specification A16B-1210-0020
a) Setting

Setting position	Setting	Meaning
SP1	Short between 2 - 3	Standard setting: 128 K ROM (27128) is used.
	Short between 1 - 2	Special setting: 256 K ROM (27256) is used.

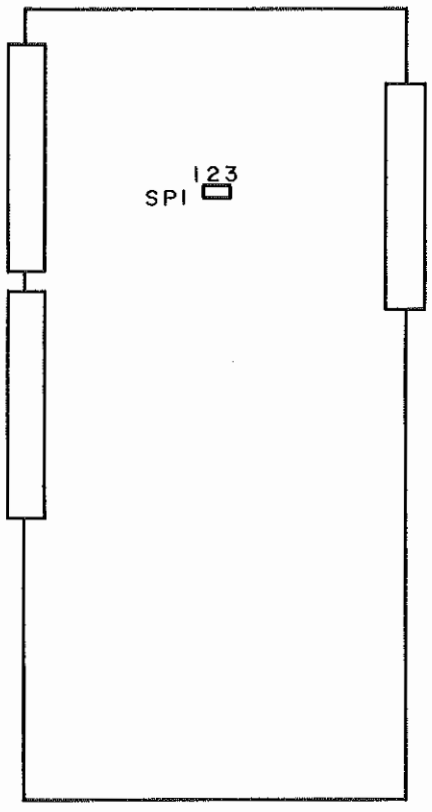
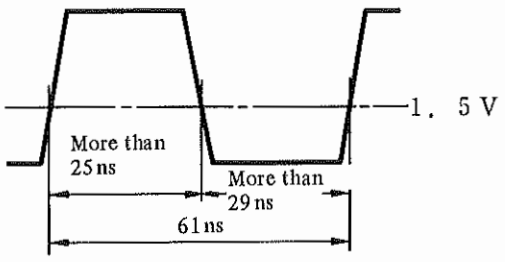


Fig. 6.1.5 (g) Setting position on the axis CPU PCB A16B-1210-0020

7) Spindle control PCB
. Module name 01P13
. PCB specification A16B-1210-0160
a) Adjustment of clock pulse width

Setting position	Setting method
One set of the following pins on the short terminal G3 should be shorted. (2) - (15) (3) - (14) (4) - (13) (5) - (12) (6) - (11)	Set 16.384 MHz cycle as follows at check pin C16MP. 

b) Setting pin

Setting type	Meaning
Short	Standard setting (when 8031 program is loaded in 2764)
Open	Not standard (when 8031 program is loaded in 8031 inside ROM)

View from the mounting face

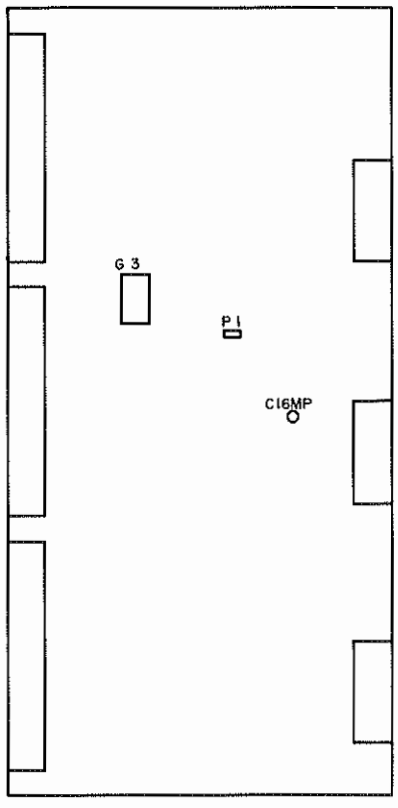


Fig. 6.1.5 (h) Setting position on the spindle control PCB A16B-1210-0160

8) Additional buffer 2 PCB
   . Module name 01P15
   . PCB specification A16B-1210-0260
   a) Setting pin SPCLK

Setting type	Meaning
A side short	For testing: clock margin check
B side short	Standard setting

View from mounting position

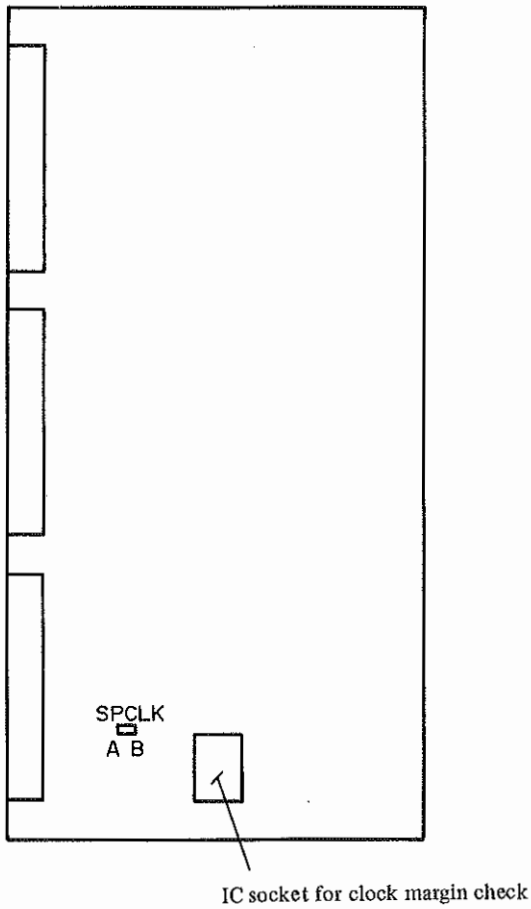


Fig. 6.1.5 (i) Setting position on the additional buffer 2 PCB A16B-1210-0260

9) Built-in type I/O unit, I/O interface PCB
. Module name IF01A
. PCB specification A16B-1310-0020
a) Setting pin

SH1	Open
SH2	Short
SH3	Short

View from the mounting face

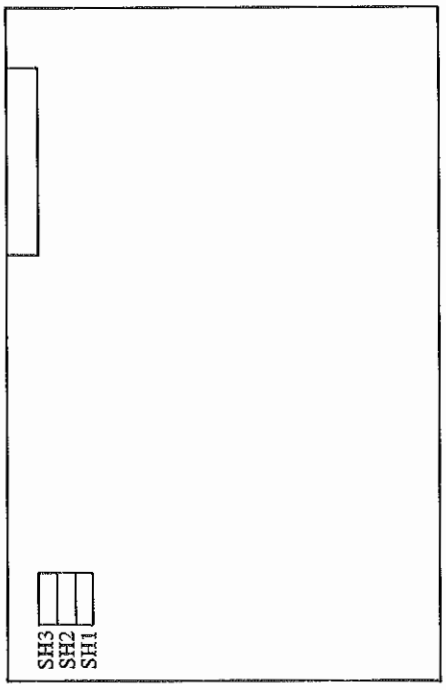
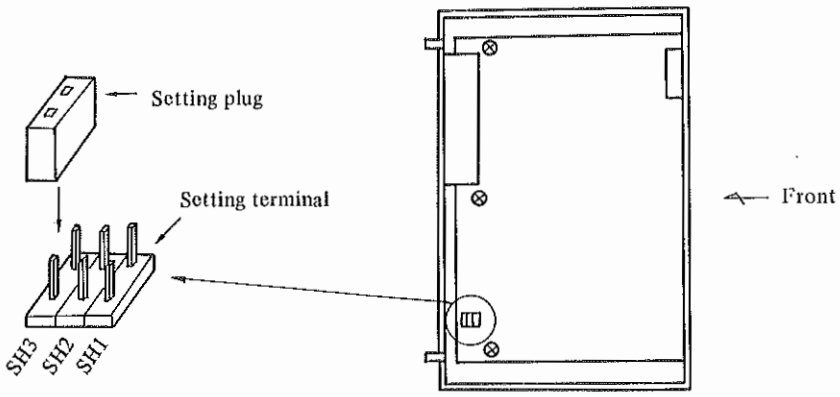


Fig. 5.1.5 (j) Setting position on the built-in type I/O unit/I/O interface PCB A16B-1310-0020

6.1.6 I/O unit setting and adjustment

1) I/O interface module (IF01A) setting
In the I/O unit, it is possible to expand one group into a maximum of four groups by combining the interface units IF01A and IF04C. In this case, the setting terminals in the IF01A must be set as follows according to the group number to which the IF01A belongs:
a) Location of setting terminal



b) Method of setting

Availability of IF04C	IF01A group No.	Setting		
		SH3	SH2	SH1
Not available	Gruop 0	o	o	
Available	Group 0	o		o
	Group 1	o		
	Group 2		o	o
	Group 3		o	

Insert the setting plugs into the setting terminal marked "o".
The unmarked terminals should be left open.

2) I/O interface module (IF04C) setting
Although IF04C is the same as IF01A, these settings must be set as below. (At shipment, the setting is exactly as given below.)
a) Setting
SH2 and SH3 are shorted.
SH1 is opened.

b) Setting position

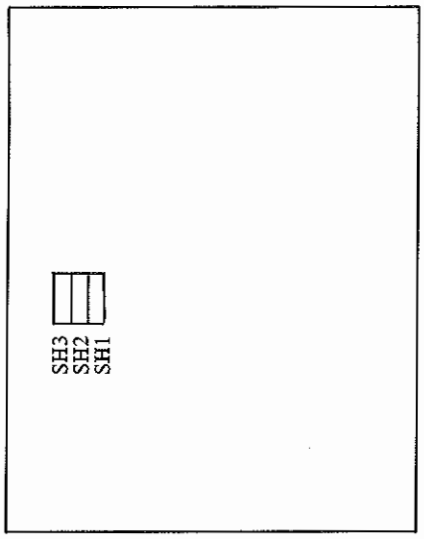
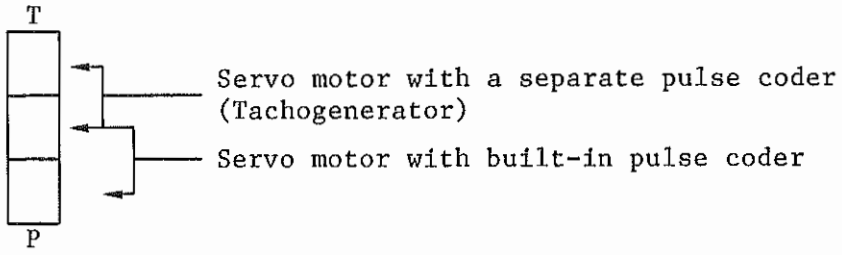


Fig. 6.1.6 (b) Setting position on I/O interface module (IF04C)

3) Setting of positioning module PT01A (A03B-0801-C051)
The following setting is effective when the DC servo motor is used. This setting does not apply when the AC servo motor is used.

<table>
<tr><th>Item</th><th>Symbol</th><th>Contents</th></tr>
<tr><td>1</td><td>ST1
ST2</td><td>Setting of velocity gain
Set the velocity gain according to the types of pulse coders used as follows:

<table>
<tr><th rowspan="2">Type of pulse coder</th><th colspan="2">Setting</th></tr>
<tr><th>ST1</th><th>ST2</th></tr>
<tr><td>2000 pulses/revolution</td><td></td><td>o</td></tr>
<tr><td>2500 pulses/revolution</td><td></td><td></td></tr>
<tr><td>3000 pulses/revolution</td><td>o</td><td></td></tr>
</table>
o: Shorted</td></tr>
<tr><td>2</td><td>ST3</td><td>Setting whether or not suppress function is provided.
The suppress function neglects a detection pulse when the moving direction of the machine is reversed.
If the machine uses a DC servo motor with a built-in pulse coder, 1 - 2-pulse (1 - 2 μm) vibration may occur when the machine has just stopped. This vibration can be eliminated by effectively setting this function.
Suppress function is provided ... Shorted
No suppress function is provided ... Open (standard setting)</td></tr>
</table>

Item	Symbol	Contents
3	ST4	Setting of velocity detection signal selection This setting is done to select either pulse coder or tachogenerator for velocity detection. 

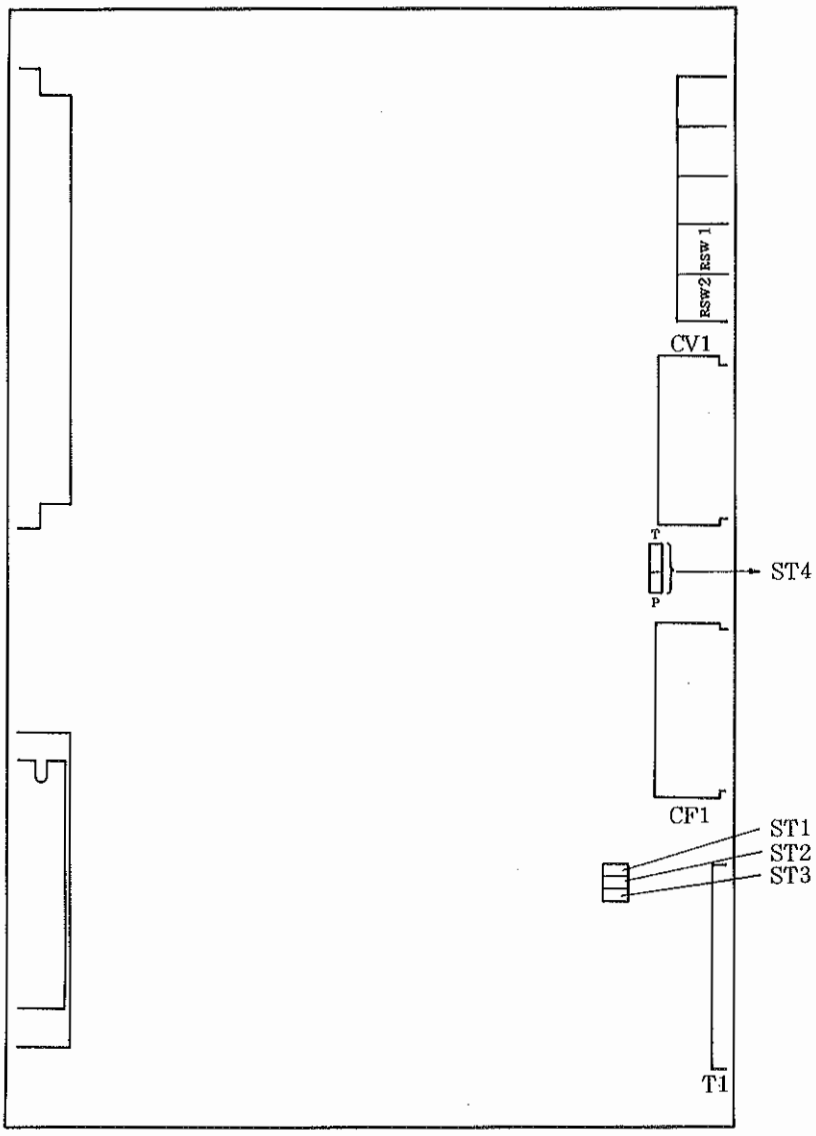


Fig. 6.1.6 (c) Setting position on the positioning module (PT01A)

4) Adjustment of analog input module AD04A (A03B-0801-C052)

<table>
<tr><th>Item</th><th>Contents</th></tr>
<tr><td>Preparation</td><td>① Remove AD04A from the base unit, detach the plastic cover, and then mount AD04A to the base unit again.
② Remove I/O module mounted on the left side of the AD04A to leave space for turning the AD04A variable resistor.
③ Open the input terminals (terminal board) of AD04A.
④ Indicate AD04A input data on the diagnose screen.</td></tr>
<tr><td>Measuring instruments</td><td>Voltage/current source ... Use a voltage/current source thats resolution is higher than 1 mV/4 mA.
Voltmeter ... Use a voltmeter thats resolution (measuring sensitivity) is higher than 0.1 mV.
Resistance meter ... Use a resistance meter having a resolution (measuring sensitivity) of more than 0.1 #, and measure four terminals.</td></tr>
<tr><td>Adjusting procedure</td><td>For the mounting positions of variable resistor and check terminals, see Fig. 6.1 (a).
① Connect TP1 and TP3 to GND (TP9). Adjust VR3 until the TP5 voltage becomes 0.0 mV.
② Connect TP1 and TP3 to GND (TP9). Adjust VR4 until the TP6 voltage becomes 0.0 mV.
③ Apply +5 V to TP1 and TP3 by connecting to +5 V terminal (TP10). Adjust VR5 until the TP5 voltage becomes 0.0 mV.
④ Apply 0.000 V to TP1 and +10.000 V to TP3. Adjust VR6 until the TP6 voltage becomes +9.768 V.
⑤ Apply 0.000 V to TP1 and -10.000 V to TP3. Adjust VR12 until the output reads -2000 (decimal) (or 830 in hexadecimal notation).
⑥ Apply 0.000 V to TP1 and +10.000 V to TP3. Adjust VR11 until the output reads +2000 (decimal) (or 7D0 in hexadecimal notation).
⑦ Apply 0.000 V to TP1 and TP3. Make sure that the output reads 0 (decimal) (000 in hexadecimal).
⑧ Repeat steps ⑤ - ⑦.
⑨ Adjust VR7 to make the resistance between CNT2 and CNT3 250.0 Ω.
⑩ Adjust VR8 to make the resistance between CNT6 and CNT7 250.0 Ω.
⑪ Adjust VR9 to make the resistance between CNT10 and CNT11 250.0 Ω.
⑫ Adjust VR10 to make the resistance between CNT14 and CNT15 250.0 Ω.
⑬ - ⑰ Make sure the output reads the following setting at voltage input.
<table>
<tr><th>POS</th><th>CH1</th><th>CH2</th><th>CH3</th><th>CH4</th><th>Unit</th></tr>
<tr><td>13</td><td>0.000</td><td>0.000</td><td>0.000</td><td>0.000</td><td>V</td></tr>
<tr><td>14</td><td>+10.000</td><td>0.000</td><td>0.000</td><td>0.000</td><td>V</td></tr>
<tr><td>15</td><td>0.000</td><td>+10.000</td><td>0.000</td><td>0.000</td><td>V</td></tr>
<tr><td>16</td><td>0.000</td><td>0.000</td><td>+10.000</td><td>0.000</td><td>V</td></tr>
<tr><td>17</td><td>0.000</td><td>0.000</td><td>0.000</td><td>+10.000</td><td>V</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Item</th><th>Contents</th></tr>
<tr><td></td><td>⑱ - ㉒ Make sure the output reads the following setting at current input
<table>
<tr><th>POS</th><th>CH1</th><th>CH2</th><th>CH3</th><th>CH4</th><th>Unit</th></tr>
<tr><td>18</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>mA</td></tr>
<tr><td>19</td><td>+20.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>mA</td></tr>
<tr><td>20</td><td>0.00</td><td>+20.00</td><td>0.00</td><td>0.00</td><td>mA</td></tr>
<tr><td>21</td><td>0.00</td><td>0.00</td><td>+20.00</td><td>0.00</td><td>mA</td></tr>
<tr><td>22</td><td>0.00</td><td>0.00</td><td>0.00</td><td>+20.00</td><td>mA</td></tr>
</table></td></tr>
</table>

Table 6.1 (a) shows adjusting procedure list.

Table 6.1 (a) Adjusting procedure list

Item	Setting						Adjustment										Measurement											
	CH1 IN	CH2 IN	CH3 IN	CH4 IN	TP1	TP3	VR3	VR4	VR5	VR6	VR7	VR8	VR9	VR10	VR11	VR12	TP2	TP4	TP5	TP6	CNT 2 3	CNT 6 7	CNT 10 11	CNT 14 15	CH1 OUT	CH2 OUT	CH3 OUT	CH4 OUT
1	Open	Open	Open	Open	0.000 V	0.000 V	o												0.0 mV									
2	"	"	"	"	"	"		o												0.0 mV									
3	"	"	"	"	+5V	+5V			o										0.0 mV									
4	"	"	"	"	0.000 V	+10.000 V				o										9.768 V									
5	"	"	"	"	"	-10.000 V										o									-2000 (830)			
6	"	"	"	"	"	+10.000 V									o										2000 (700)			
7	"	"	"	"	"	0.000 V																			0 (000)			
8	Repeat Item 5, 6, 7.																											
9	Open	Open	Open	Open	Open	Open					o										250.0 Ω							
10	"	"	"	"	"	"						o										250.0 Ω						
11	"	"	"	"	"	"							o										250.0 Ω					
12	"	"	"	"	"	"								o										250.0 Ω				
13	0V	0V	0V	0V	"	"																			0	0	0	0
14	10.000 V	0V	0V	0V	"	"									o										2000	0	0	0
15	0V	10.000 V	0V	0V	"	"																			0	2000	0	0
16	0V	0V	10.000 V	0V	"	"																			0	0	2000	0
17	0V	0V	0V	10.000 V	"	"																			0	0	0	2000
18	0mA	0mA	0mA	0mA	"	"																			0	0	0	0
19	20mA	0mA	0mA	0mA	"	"																			1000	0	0	0
20	0mA	20mA	0mA	0mA	"	"																			0	1000	0	0
21	0mA	0mA	20mA	0mA	"	"																			0	0	1000	0
22	0mA	0mA	0mA	20mA	"	"																			0	0	0	1000

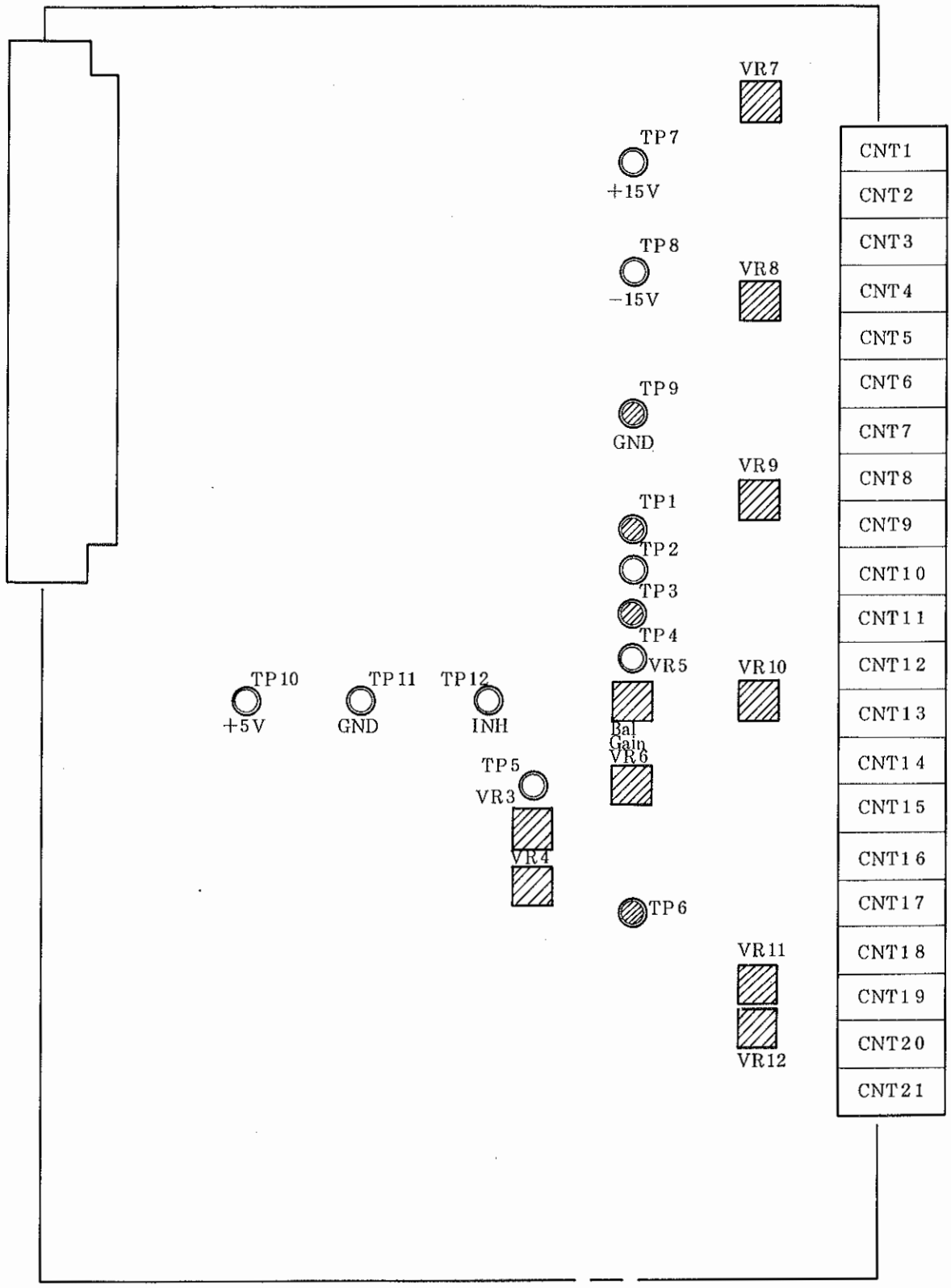
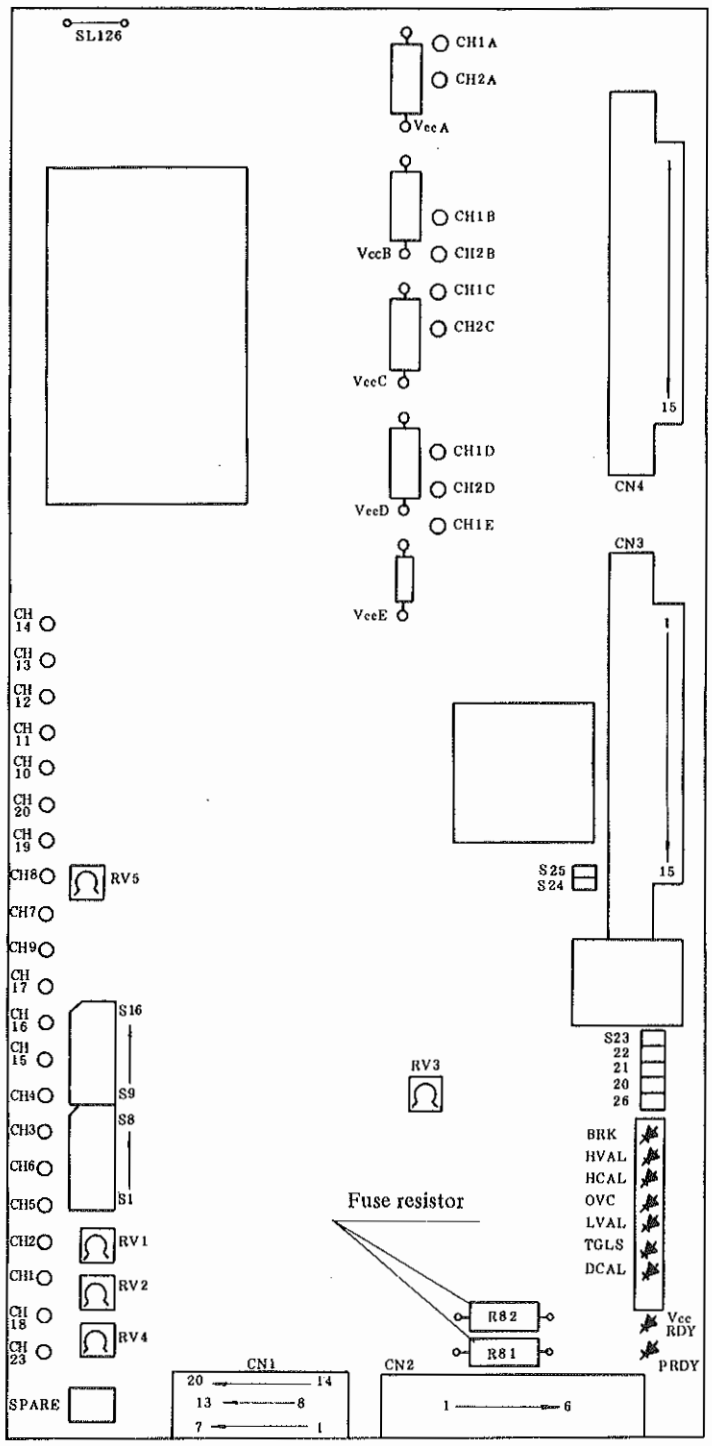


Fig. 6.1.6 (d) Mounting position of variable resistor and check terminal

6.2 Setting and Adjustment for M Series Velocity Control Unit

6.2.1 Setting and adjustment on M series velocity control unit PCB



Note) Parts location on PCB may be changed without notice.

Fig. 6.2.1 (a) Parts mounting position on the PCB (A20B-0009-0320) 07C version or subsequence

Setting of Thermal Relay

Motor model	Current value
00M	4A
0M	6A
5M	9A
10M	12A
20M	18A
30M	24A
30MH	36A

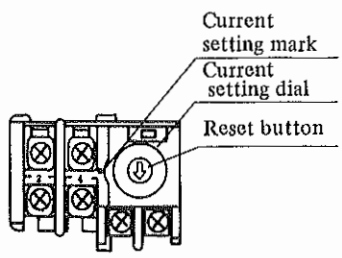


Table 6.2.1 (a) Setting of short bar

O: Position to be Shortcircuitted

Motor model / Short bar	00M		0M, 5M		10M - 30M(H)		SETTING MEANING
	PULSE CODER	PANCAKE TACHO GENERATOR	PULSE CODER	PANCAKE TACHO GENERATOR	PULSE CODER	PANCAKE TACHO GENERATOR	
S 1	o		o		o	o	TACHO-GENERATOR SETTING OF VOLTAGE
2					o		
3							COMPRESSOR ENABLES
4							GAIN ATTENUATOR
5	o	o	o	o	o	o	HIGH FREQUENCY GAIN
6	o	o	o	o	o	o	
7	o	o	o	o	o	o	RIPPLE FILTER
8	o	o	o	o	o	o	HIGH-GAIN C.KT. ENABLE
9							CAPACITOR FOR COMPENSATION C.K.T.
10	o	o	o	o	o	o	
11							
12	o	o	o	o	o	o	DC GAIN
13							
14							CAPACITOR FOR HIGH-GAIN
15	Note 6						OPENS 14 WHEN S15 IS SHORTED
16	o	o	o	o	o	o	CHOPPING FREQU-ENCY SELECTOR
20	SEE NOTE 1						THERMOSTAT FOR TRANSFORMER AND DISCHARGE UNIT ENABLE
21							BRK ALARM ENABLE
22							DCAL ALARM ENABLE
23							TGLS ALARM ENABLE
24	o	o	o	o	o	o	OVC ALARM OPERAT-ING TIME SELECTOR

Motor model / Short bar	00M		0M, 5M		10M - 30M(H)		SETTING MEANING
	PULSE CODER	PANCAKE TACHO GENERATOR	PULSE CODER	PANCAKE TACHO GENERATOR	PULSE CODER	PANCAKE TACHO GENERATOR	
25							TGLS ALARM SENSING LEVEL
26	SEE NOTE 2						DISCHARGE UNIT SELECTOR
126	o	o					MOTOR SELECTOR FOR ARMATURE VOLTAGE FEEDBACK C.K.T.

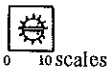
Table 6.2.1 (b) Variable resistor adjustment and check

POS	ITEM	SETTING CONDITION						REMARKS
		VARIABLE RESISTOR	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 GENERA-TOR
					5 SCALES			PULSE CODER
5	OVER-CURRENT ALARM SETTING	RV3			10 SCALES		00M	0.6+1.1X SCALE(A)
							0M-20M	2+3.8X SCALE(A)
							30M(H)	4+7.5X SCALE(A)

POS	ITEM	SETTING CONDITION						REMARKS
		VARIABLE RESISTOR	CHECK-PIN	SHORTING	SETTING AND CHECK			
6	TACHO-GENERATOR VOLTAGE COMPENSA-TION	RV4			1) NORMALITY 5 SCALES 2) USE FOR FINE ADJUSTING OF LOOP GAIN. REFER TO MAINTENANCE MANUAL OF NC.			
7	CURRENT LIMITER SETTING SEE NOTE 5	RV5			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, S20 IS OPEN
2. IF YOU USED DISCHARGE UNIT, YOU WILL BE OPEN-CIRCUIT AT S26.
3. VOLUME SCALE IS AS FOLLOWS. 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.

5 SCALES.



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 TOGETHER

Table 6.2.1 (c) Type of check terminal

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

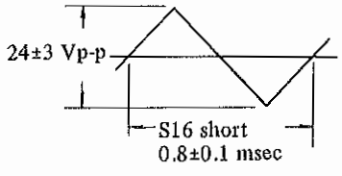


Fig. 2

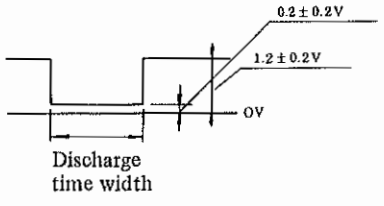


Fig. 3

LED DISPLAY

NAME	MEANING
PRDY (GREEN LED)	POSITION CONTROL READY END 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) CONTINUITY CHECK: 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 BAD. 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 BAD.
OVC (RED LED)	OVERCURRENT ALARM (SET RV3) MOTOR LOAD IS TOO HEAVY.
TGLS (RED LED)	MOTOR RUNAWAY ALARM VELOCITY FEEDBACK SIGNAL IS LOST. 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.

6.3 Setting and Adjustment on PCB for Velocity Control Unit for Analog Servo AC Servo Motor

6.3.1 Parts location on PCB

1) For AC servo motor Model 2-0 - Model 30R
   a) PCB A20B-1000-0560 (Edition number E)

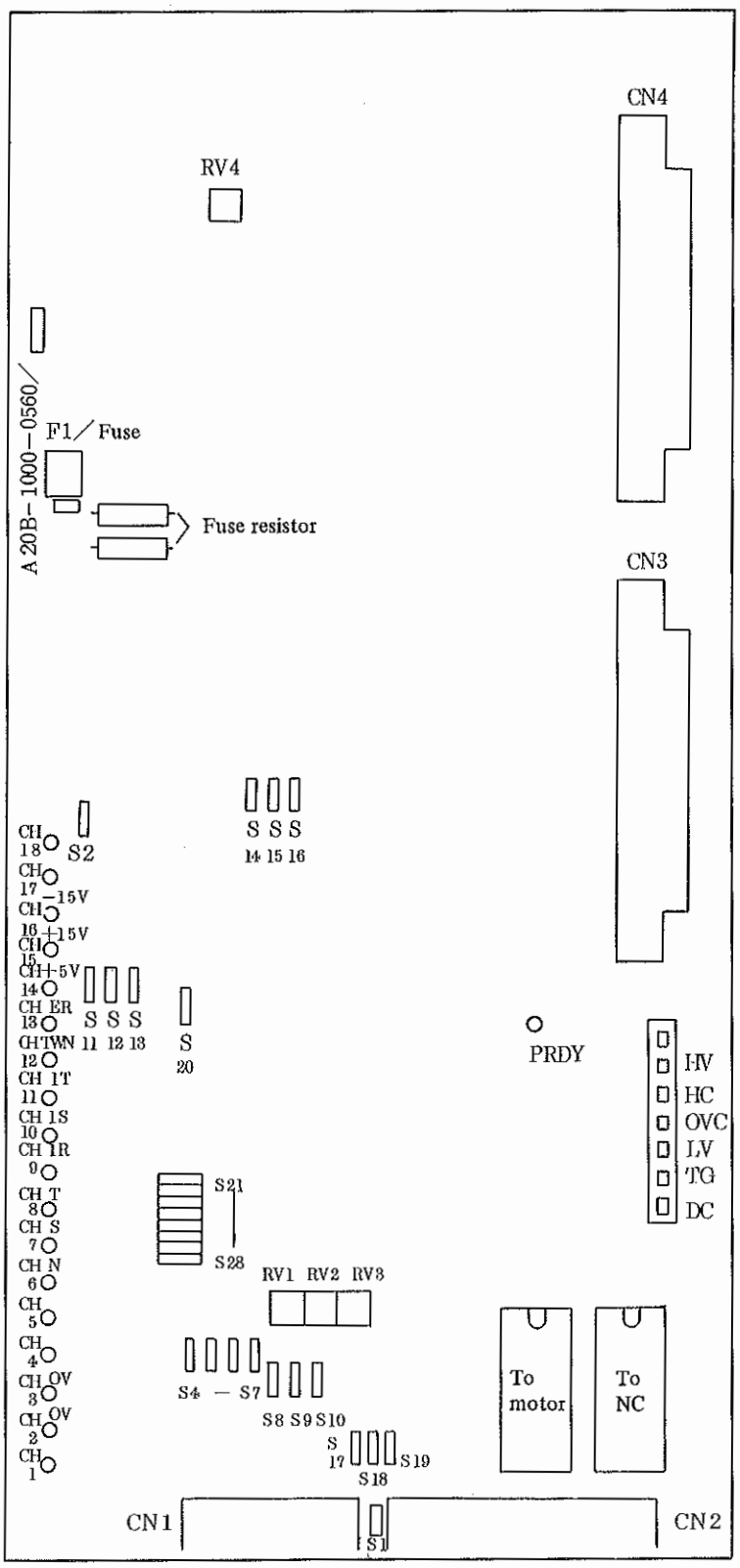


Fig. 6.3.1 (a) Parts location on the PCB A20B-1000-0560

Note) Parts location on PCB may be changed without notice.

b) PCB A20B-1000-0560 (Edition number F or subsequent)

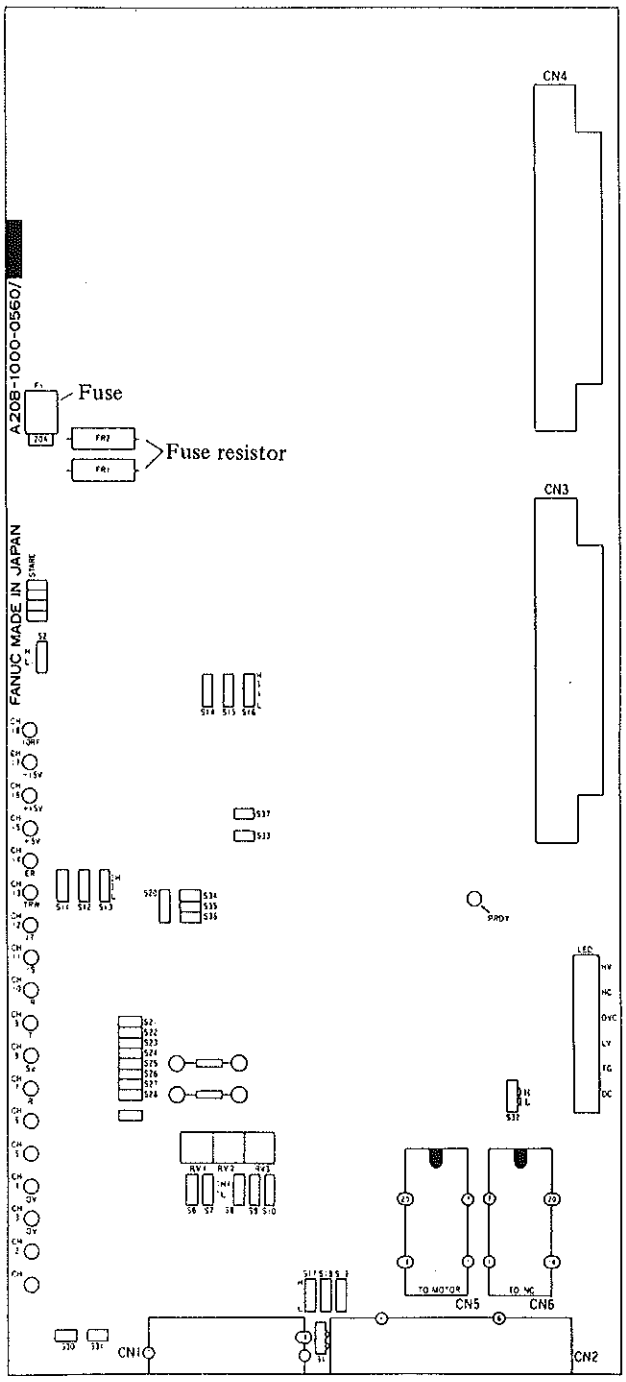


Fig. 6.3.1 (b) Parts location on the PCB A20B-1000-0560

Note) Parts location on PCB may be changed without notice.

2) For AC servo motor Model 4-0, 3-0
   a) PCB A20B-1000-0590 (Edition number A)

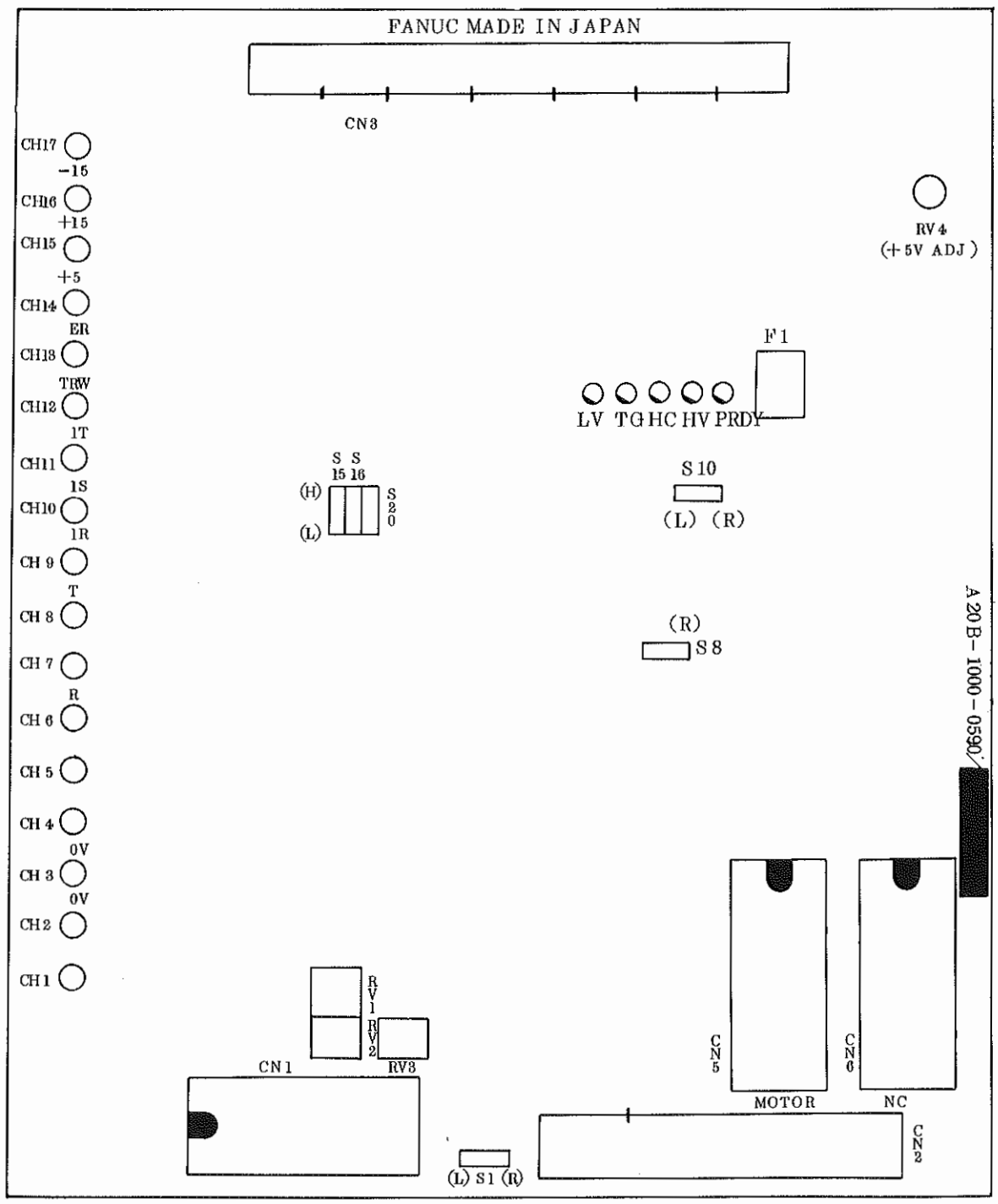


Fig. 6.3.1 (c) Parts location on the PCB A20B-1000-0590

Note) Parts location on PCB may be changed without notice.

b) PCB A20B-1000-0590 (Edition number B or subsequent)

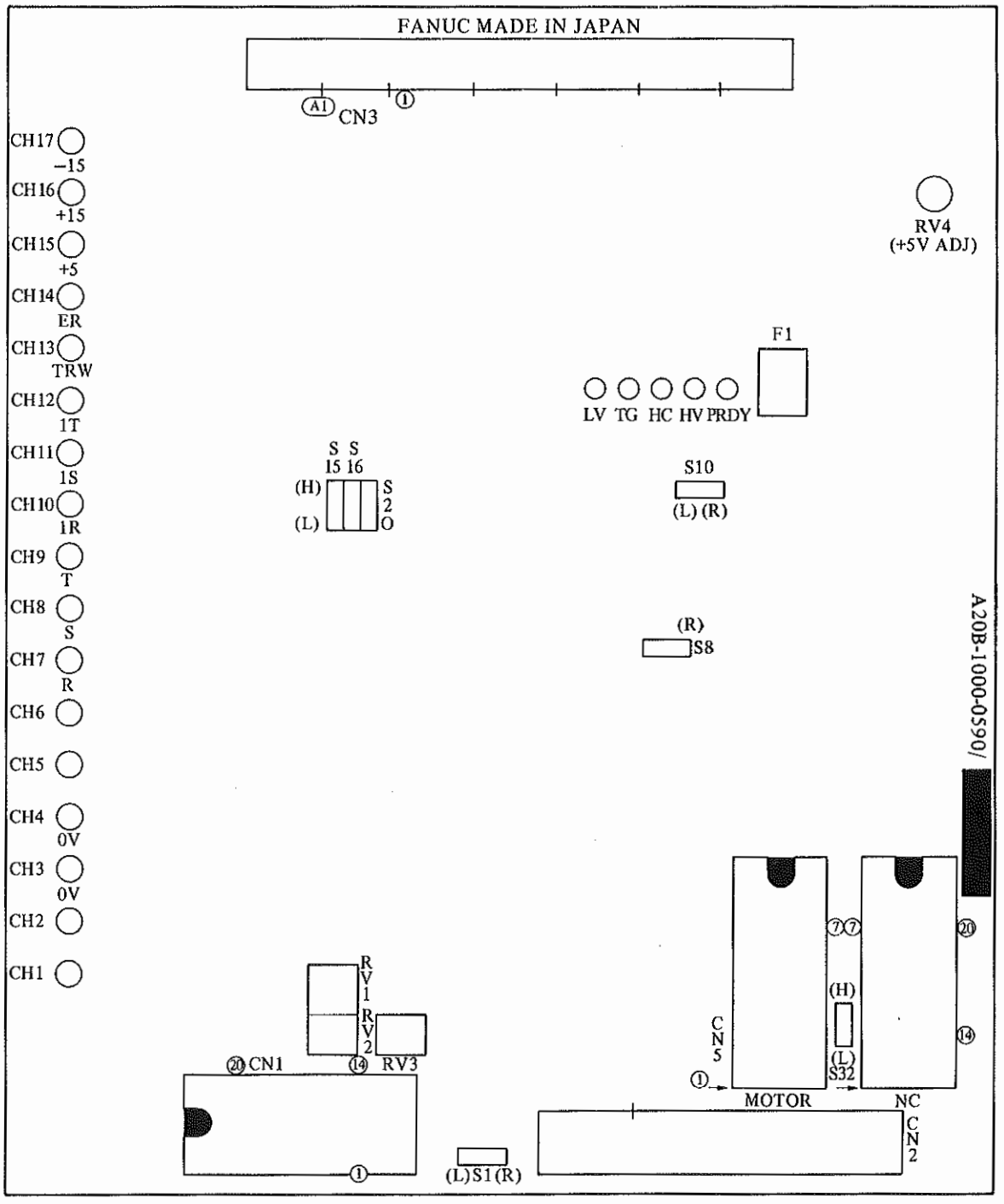


Fig. 6.3.1 (d) Parts location on the PCB A20B-1000-0590

Note) Parts location on PCB may be changed without notice.

c) PCB A20B-1000-0600

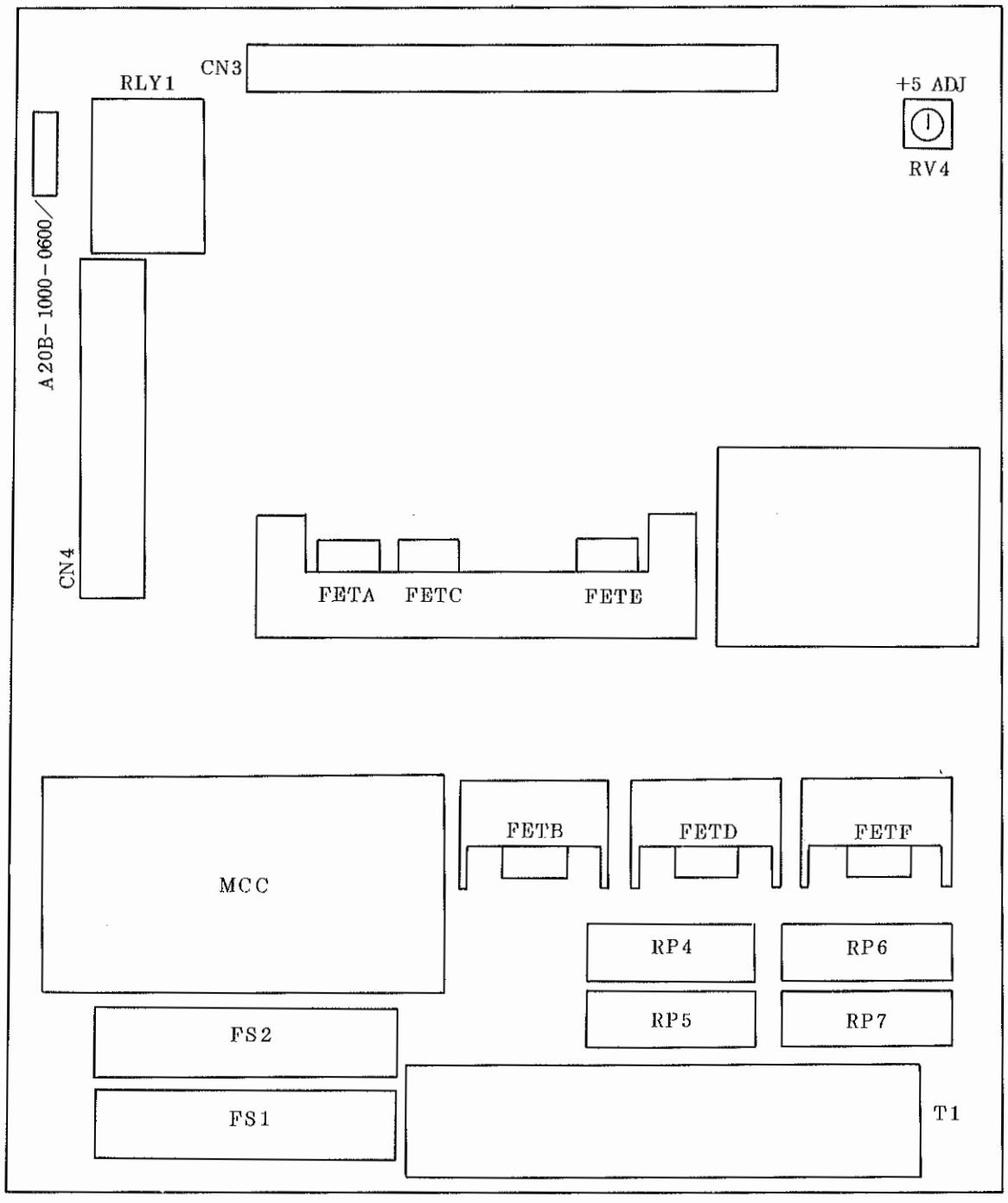


Fig. 6.3.1 (e) Parts location on the PCB A20B-1000-0600

Note) Parts location on PCB may be changed without notice.

3) Model 5-0
a) PCB A20B-1001-0420

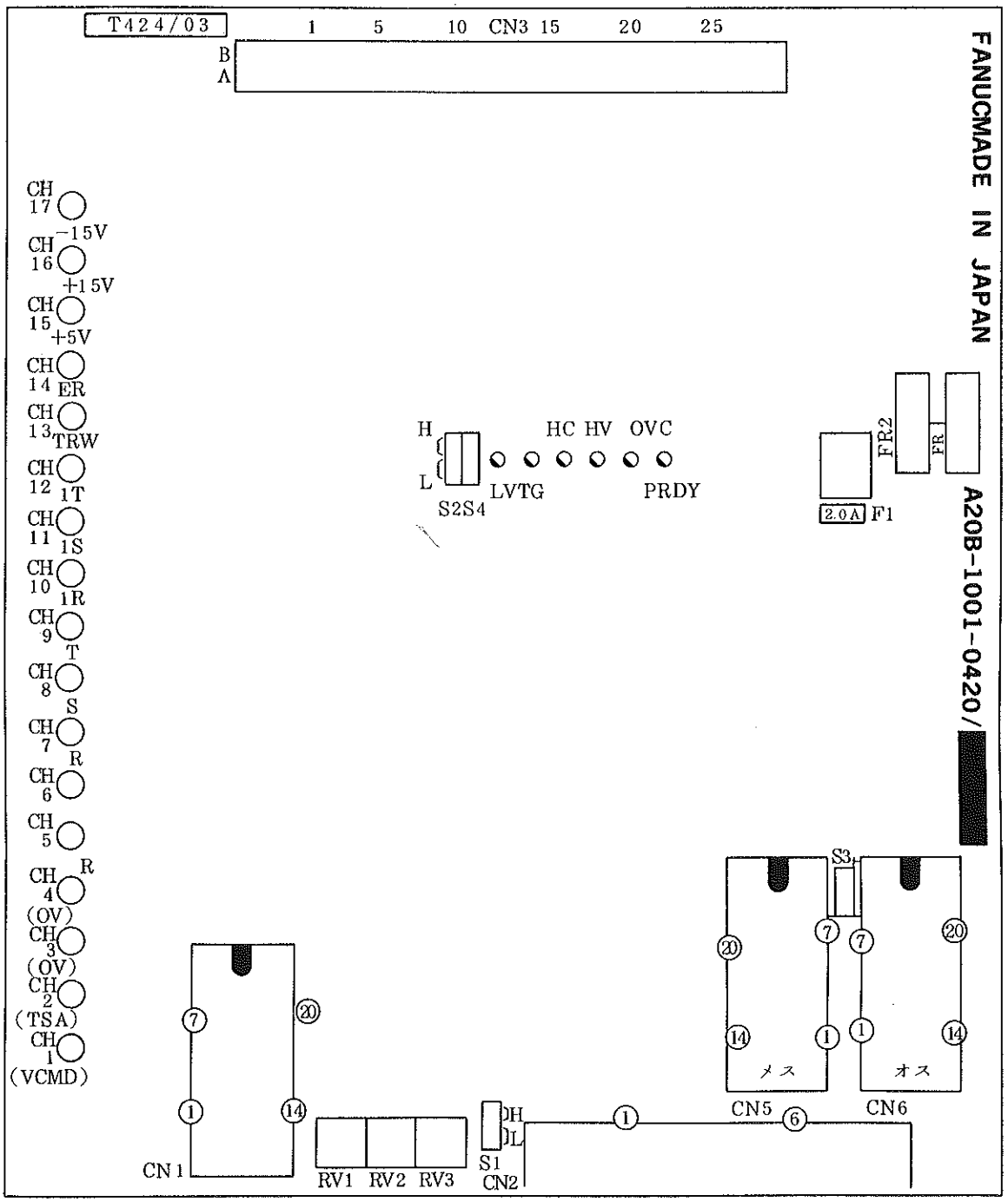


Fig. 6.3.1 (f) Parts location on the PCB A20B-1001-0420

Note) Parts location on PCB may be changed without notice.

b) PCB A20B-1001-0410

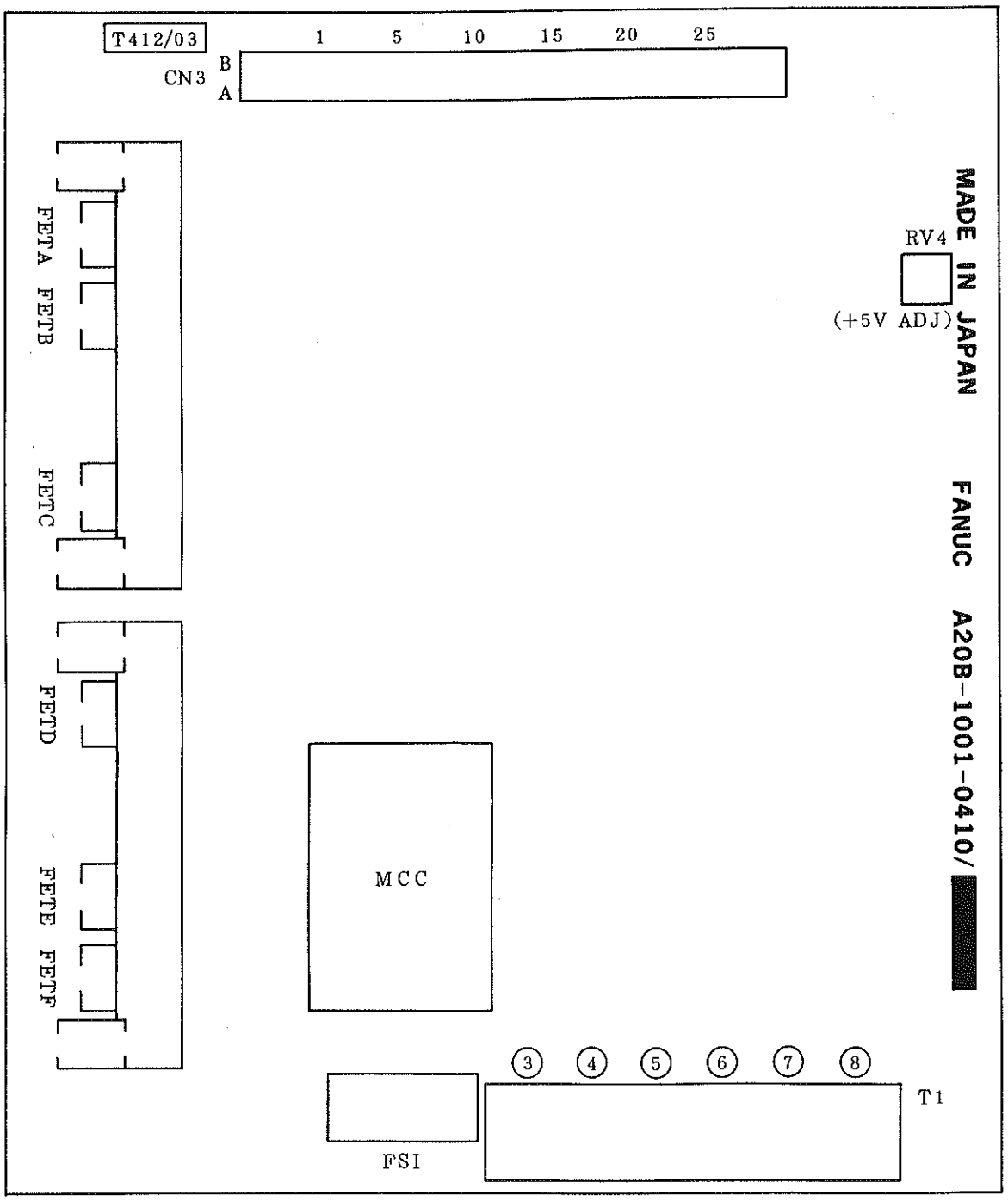


Fig. 6.3.1 (g) Parts location on the PCB A20B-1001-0410

Note) Parts location on PCB may be changed without notice.

4) For 2-axis control AC servo unit (analog servo)
   a) A16B-1200-0520 (Mother board)

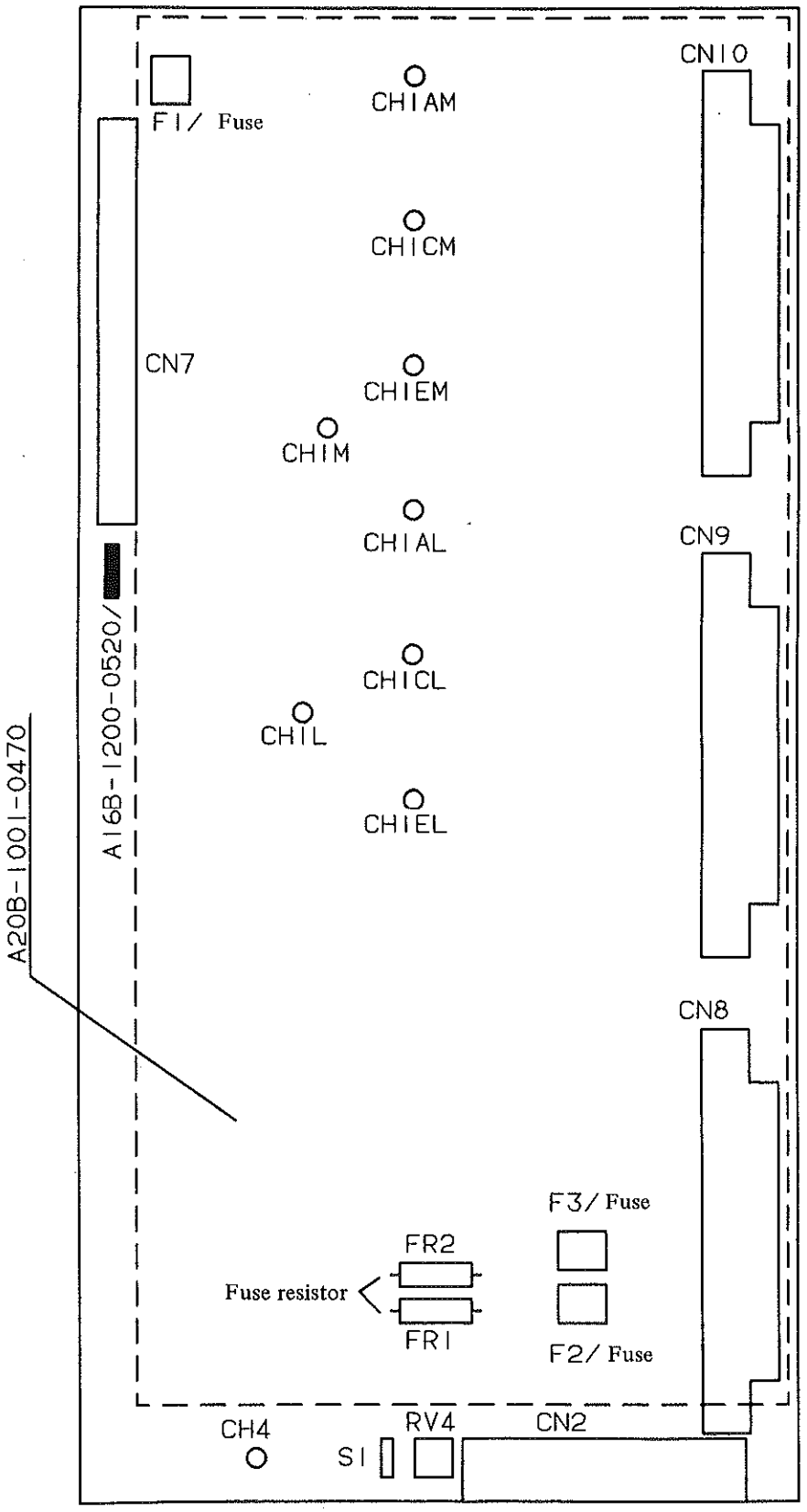
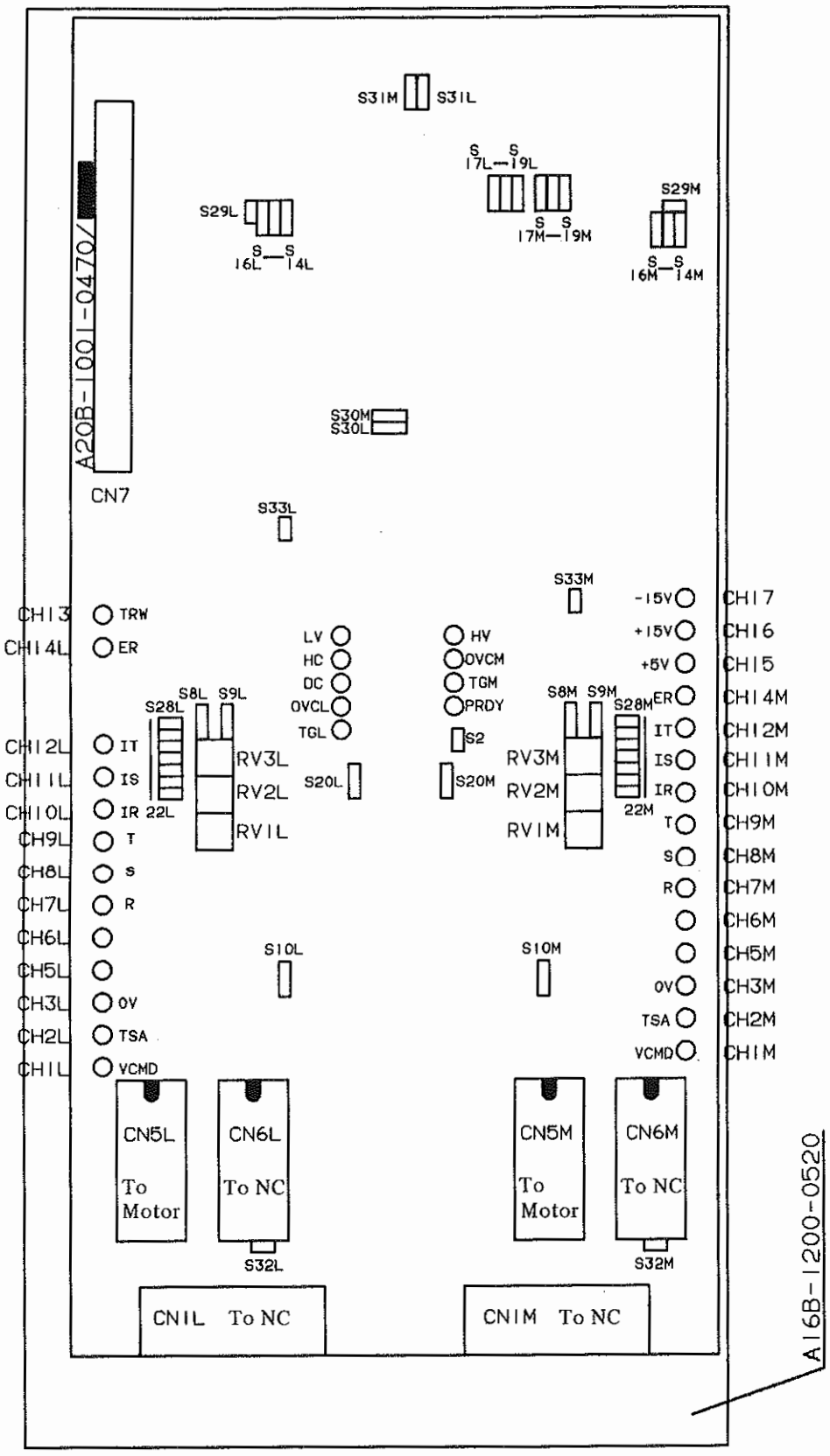


Fig. 6.3.1 (h) Parts location on the PCB A16B-1200-0520

b) A20B-1001-0470 (Child board)



Note 1: Two PCB is 1 sets.
Note 2: Part location on PCB may be changed without notice.

Fig. 6.3.1 (i) Parts location on the PCB A20B-1001-0470

5) For 3-axis control AC servo unit (analog servo)
   a) PCB A20B-1001-0770

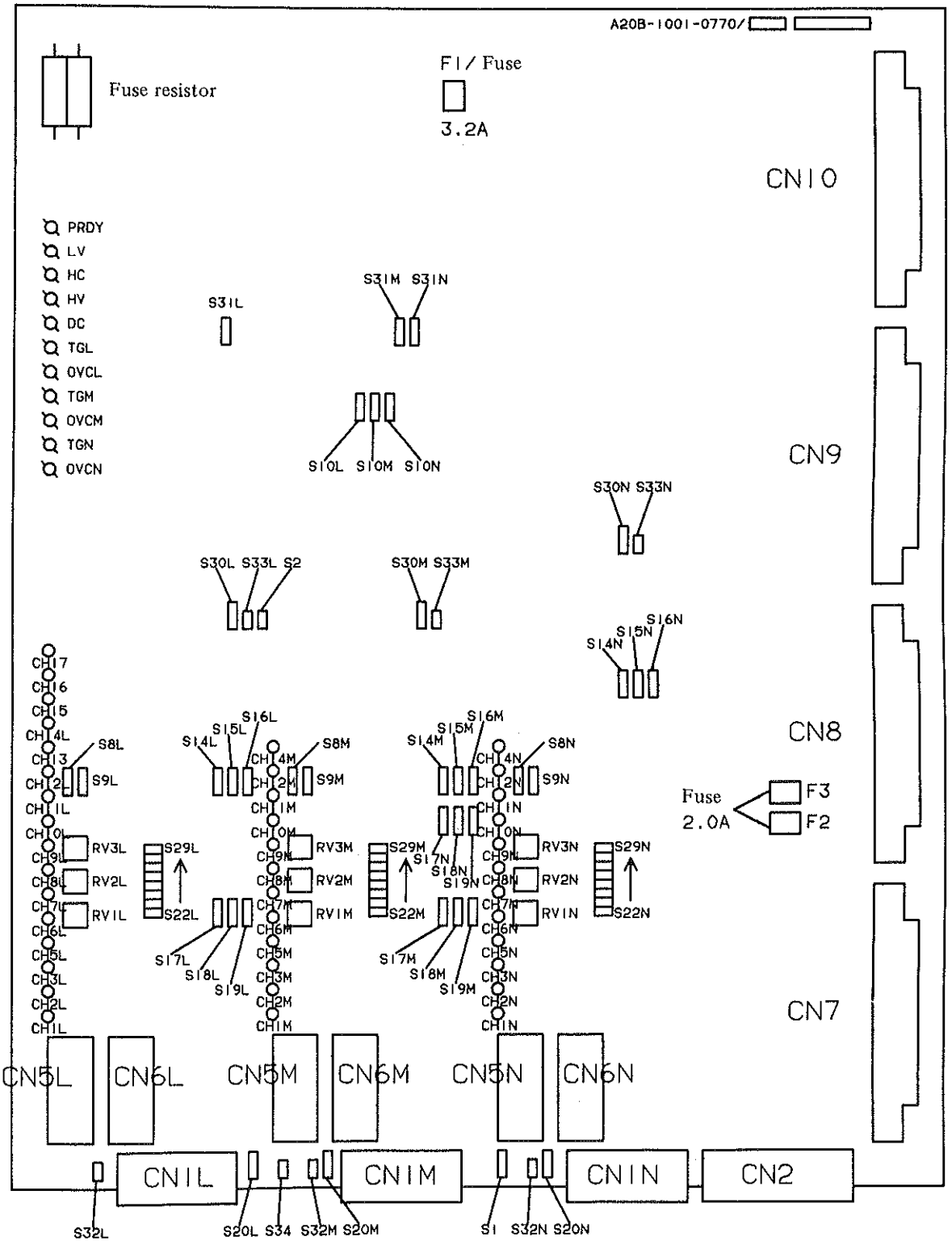


Fig. 6.3.1 (j) Parts location on the PCB A20B-1001-0770

6.3.2 Setting terminal

1) For AC servo motor Model 2-0 to 30R
   a) PCB A20B-1000-0560 (Edition number F or subsequent)

Table 6.3.2 (a)

Setting terminal	Standard setting						Remarks
	2-0,1-0	0,5	10	20M	20,30	30R	
S 1	L	L	L	L	L	L	TOH setting (Note 1)
S 2	L	L	L	L	L	L	DC alarm setting (Note 2)
S 6	H	H	H	H	H	H	Compensation circuit setting
S 7	H	H	H	H	H	H	
S10	H	H	H	H	H	H	TG alarm enable (Note 3)
S11	H	H	L	L	L	H	Current loop gain setting
S12	H	H	L	L	L	H	
S13	H	H	L	L	L	H	
S17	H	H	H	H	H	L	Current limit setting
S18	H	L	L	L	H	H	
S19	H	H	H	H	H	H	
S20	H	H	H	H	H	H	Absolute code output enable (Note 4)
S32	L	L	L	L	L	L	Setting for absolute pulse coder (Note 5)

Setting terminal	2-0, 1-0, 0, 5, 10, 20M, 20, 30, 30R			Remarks
	Pulse coder			
	2000P	2500P	3000P	
S 8	L	L	H	Pulse coder F/V gain setting
S 9	H	L	L	
S14	L	H	H	Pulse coder, pole number, and pulse number setting
S15	H	L	L	
S16	H	L	H	

Setting terminal	Standard setting							Remarks
	2-0,1-0	0	5	10	20M	20,30	30R	
S21								Compensation circuit setting
S22	o	o	o	o	o	o	o	
S23	o	o	o					VCMD gain setting (Note 6)
S24	o	o	o	o	o	o	o	F/V circuit filter setting
S25	o	o	o	o	o	o	o	Compensation circuit setting
S26								
S27								
S28								
S29								
S30								External analog current limitter setting
S31								Connect CN1(19) pin and 0V
S33		o						OVC alarm level setting
S34			o					
S35		o	o	o	o			Current feedback gain setting (Note 7)
S36		o	o	o	o			
S37								Speed feedback gain setting (Note 8)
S38		o	o	o	o			Compensation circuit setting

b) PCB A20B-1000-0560 (Edition number E)

Table 6.3.2 (b)

Setting terminal	Standard setting					Remarks
	2-0,1-0	0,5	10,20M	20,30	30R	
S 1	L	L	L	L	L	TOH setting (Note 1)
S 2	L	L	L	L	L	DC alarm setting (Note 2)
S 4	L	L	L	L	L	Compensation circuit setting
S 5	L	L	L	L	L	
S 6	H	H	H	H	H	
S 7	H	H	H	H	H	
S10	H	H	H	H	H	TG alarm enable (Note 3)
S11	H	H	L	L	H	Current loop gain setting
S12	H	H	L	L	H	
S13	H	H	L	L	H	
S17	H	H	H	H	L	Current limit setting
S18	H	H	H	H	H	
S19	H	H	H	H	H	
S20	H	H	H	H	H	Absolute code output enable (Note 4)
S32	L	L	L	L	L	Setting for absolute pulse coder (Note 5)

Setting terminal	2-0, 1-0, 0, 5, 10, 20M, 20, 30, 30R			Remarks
	Pulse coder			
	2000P	2500P	3000P	
S 8	L	L	H	Pulse coder F/V gain setting
S 9	H	L	L	
S14	L	H	H	Pulse coder, pole number, and pulse number setting
S15	H	L	L	
S16	H	L	H	

Setting terminal	Standard setting					Remarks
	2-0,1-0	0,5	10,20M	20,30	30R	
S21						Compensation circuit setting
S22						
S23	o	o				VCMD gain setting (Note 6)
S24	o	o	o	o	o	F/V circuit filter setting
S25	o	o	o	o	o	Compensation circuit setting
S26						
S27						
S28						
S29						
S30						External analog current limitter setting

c) PCB A20B-1000-0560 (Edition number C or D)

Table 6.3.2 (c)

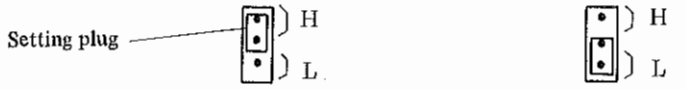
Setting terminal	Standard setting					Remarks
	2-0,1-0	0,5	10	20,30	30R	
S 1	L	L	L	L	L	TOH setting (Note 1)
S 2	L	L	L	L	L	DC alarm setting (Note 2)
S 4	L	L	L	L	L	Compensation circuit setting
S 5	L	L	L	L	L	
S 6	H	H	H	H	H	
S 7	H	H	H	H	H	
S10	H	H	H	H	H	TG alarm enable (Note 3)
S11	H	H	L	L	H	Current loop gain setting
S12	H	H	L	L	H	
S13	H	H	L	L	H	

Setting terminal	Standard setting					Remarks
	2-0,1-0	0,5	10	20,30	30R	
S17	H	H	L	L	L	Current limit setting
S18	H	H	H	H	H	
S19	H	H	H	H	H	
S20	H	H	H	H	H	Absolute code output enable (Note 4)

Setting terminal	2-0, 1-0, 0, 5, 10, 20, 30, 30R Pulse coder			Remarks
	2000P	2500P	3000P	
S 8	L	L	H	Pulse coder F/V gain setting
S 9	H	L	L	
S14	L	H	H	Pulse coder, pole number, and pulse number setting
S15	H	L	L	
S16	H	L	H	

Setting terminal	Standard setting					Remarks
	2-0,1-0	0,5	10	20,30	30R	
S21						Compensation circuit setting
S22						
S23	o	o				VCMD gain setting (Note 6)
S24	o	o	o	o	o	F/V circuit filter setting
S25	o	o	o	o	o	Compensation circuit setting
S26						
S27						
S28						

Note 1) If either power transformer or regenerative discharge unit is connected across terminals CN2 (4) and (5), set S1 to open (L side).
If neither power transformer nor regenerative discharge unit is connected across terminals CN2 (4) and (5), set S1 to short (H side).
2) Set S2 to open (L side), if the regenerative discharge unit is not mounted, and set it to short (H side), if the regenerative discharge unit is mounted.
3) Set S10 to L side, if it is needed to check with motor power cable disconnected.
4) If S20 is set at L side, absolute codes from the pulse coder is output to NC while VRDY is on. If VRDY is turned OFF, the alarm code is output. If S20 is set at H side, the alarm code is always output.
5) When the absolute value pulse coder is used, set S32 at H side.
6) If S23 is short-circuited, 7V/2000 rpm will be set. If it is open, 7V/1000 rpm will be set. If models 10, 20, and 30R are used over 1500 rpm, change the above settings and NC parameters (loop gain multipliers).
7) Models 0, 5, 10, and 20M only may be short-circuited. If S35 and S36 are short-circuited, conversion of current feedback signals (CH10, 11, 12) is 0.183 V/A.
8) If S37 is short-circuited, the rate feedback voltage is changed from 3V/1000 rpm to 1.5V/1000 rpm. Normally, set it in the open state.
9) The way of setting is shown as following figures.



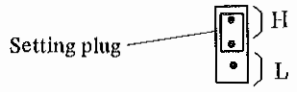
(a) Setting of H side (b) Setting of L side

2) For Model 4-0, 3-0 (PCB A20B-1000-0590) (analog servo)

Table 6.3.2 (d)

Setting terminal	Pulse coder		Remarks
	2000P	2500P	
S 1	R		TOH setting (Note 1)
S 8	R	OPEN	Pulse coder F/V Gain
S10	L		TG alarm enable (Note 2)
S15	L	L	Pulse coder Pole number, pulse number setting
S16	L	H	
S20	L	L	
S32	L		For ABS pulse coder setting (Note 3)

Note 1) If power transformer is connected across terminals CN2 (4) and (5), set S1 to open (R side).
If power transformer is not connected across terminals CN2 (4) and (5), set S1 to short (L side).
2) Set S10 to R side if it is needed to check with motor power cable disconnected.
3) If the absolute pulse coder is used set S32 at H side.
4) The way of setting is shown as following figures.



(a) Setting of H side



(b) Setting of L side



(c) Setting of L side



(d) Setting of R side

3) For Model 5-0 (analog servo)

Table 6.3.2 (e)

Terminal setting	Standard setting	Remarks
S 1	L	TOH setting (Note 1)
S 2	L	Pulse coder setting (Note 2)
S 3	L	Absolute pulse coder setting (Note 3)
S 4	L	TG, OVC alarm desable setting (Note 4)

Note 1) If the power transformer connected to CN2 (4) and (5), set S1 at L. If there is no connection, set S1 at H.
2) If the pulse coder is 1000P/rev, set S2 at L, and if 2000P/rev, set it at H.
3) If the absolute pulse coder is used, set S3 at H, and if not used set it at L.
4) If TG and OVC alarms are made invalid, set S4 at H.
5) If a 1000P/rev pulse coder is used, care should be taken in DMR setting. (DMR setting should be double that in a normal 2000P/rev pulse coder.)

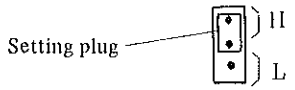
4) For 2-axis control AC servo unit (analog servo)
PCB A20B-1001-0470
A16B-1200-0520

Table 6.3.2 (f)

Terminal setting	Standard setting		Remarks
	2-0,1-0	0,5	
S1	L	L	TOH setting (Note 1)
S2	x	x	DC alarm setting (Note 2)
S10L,M	H	H	TG alarm enable (Note 3)
S17L,M	H	H	Current limit setting
S18L,M	H	H	
S19L,M	H	H	
S20L,M	H	H	Absolute code output enable (Note 4)
S22L,M	o	o	Compensation circuit setting
S23L,M	o	o	VCMD gain setting (Note 5)
S24L,M	o	o	F/V circuit filter setting
S25L,M	x	x	Compensation circuit setting
S26L,M	x	x	
S27L,M	o	o	
S28L,M	x	x	
S29L,M	x	x	F/V input pulse width setting (Note 6)
S30L,M	Le	R	Current loop gain setting
S31L,M	H	H	TG alarm enable
S32L,M	o	o	Setting for absolute pulse coder (Note 7)
S33L,M	x	x	OVC alarm level setting

Terminal setting	Pulse coder			Remarks
	2000P	2500P	3000P	
S 8L,M	L	L	H	Pulse coder F/V gain setting
S 9L,M	H	L	L	
S14L,M	L	H	H	Pulse coder pole number and pulse number setting
S15L,M	H	L	L	
S16L,M	H	L	H	

Note 1) If the power transformer is connected to terminals CN2 (4) and (5), set S1 at L side.
2) If the regenerative discharge unit is mounted, set S2 in the short-circuit state. If it is not mounted, set S2 in the open state.
3) If check is required without connection of the motor power cable, set S10 at L side.
4) If S20 is set at L side, absolute codes from the pulse coder is output to NC while VRDY is on. If VRDY is turned OFF, the alarm code is output. If S20 is set at H, the alarm code is always output.
5) If S23 is short-circuited, 7V/2000 rpm is set, and if it is open, 7V/1000 rpm is set.
6) If S29 is short-circuited, the velocity feedback voltage is changed from 3V/1000 rpm to 1.5V/1000 rpm. Normally, set it in the open state.
7) If ABS pulse coder is used, set S32 in the open state.
8) Setting operations are shown in the Fig. below.



(a) Setting of H side



(b) Setting of L side



(c) Setting of L side



(d) Setting of R side

5) For 3-axis control AC servo unit (PCB A20B-1001-0770)

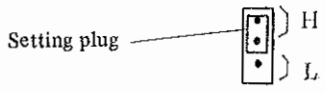
Table 6.3.2 (g)

Terminal setting	Standard setting		Remarks
	0/5	10	
S1	L	L	TOH setting (Note 1)
S2	x	x	DC alarm setting (Note 2)
S10L,M,N	H	H	TG alarm enable (Note 3)
S17L,M,N	H	H	Current limit setting
S18L,M,N	L	L	
S19L,M,N	H	H	
S20L,M,N	H	H	Absolute code output enable (Note 4)
S22L,M,N	o	x	Compensation circuit setting
S23L,M,N	o	x	VCMD gain setting (Note 5)
S24L,M,N	o	o	F/V circuit filter setting
S25L,M,N	x	x	Compensation circuit setting
S26L,M,N	x	x	
S27L,M,N	x	x	
S28L,M,N	x	x	
S29L,M,N	x	x	F/V input pulse width setting (Note 6)
S30L,M,N	L	L	Current loop gain setting
S31L,M,N	H	H	TG alarm enable
S32L,M,N	o	o	Setting for absolute pulse coder (Note 7)
S33L,M,N	x	x	OVC alarm level setting

Terminal setting	Pulse coder			Remarks
	2000P	2500P	3000P	
S 8L,M,N	L	L	H	Pulse coder F/V gain setting
S 9L,M.N	H	L	L	
S14L,M,N	L	H	H	Pulse coder pole number and pulse number setting
S15L,M,N	H	L	L	
S16L,M,N	H	L	H	

Terminal setting	N system		Remarks
	0 series, 1 series 2 series, 3 series 6 series, 9 series	10/11/12/100/ 110/120 series	
S34	x	o	VRDY signal setting

Note 1) If the power transformer is connected to terminals CN2 (4) and (5), set S1 at L side.
2) If the regenerative discharge unit is mounted, set S2 in the short-circuit state. If it is not mounted, set S2 in the open state.
3) If check is required without connection of the motor power cable, set S10 at L side.
4) If S20 is set at L side, absolute codes from the pulse coder is output to NC while VRDY is on. If VRDY is turned OFF, the alarm code is output. If S20 is set at H, the alarm code is always output.
5) If S23 is short-circuited, 7V/2000 rpm is set, and if it is open, 7V/1000 rpm is set.
6) If S29 is short-circuited, the velocity feedback voltage is changed from 3V/1000 rpm to 1.5V/1000 rpm. Normally, set it in the open state.
7) If ABS pulse coder is used, set S32 in the open state.
8) Setting operations are shown in the Fig. below.



(a) Set at H side



(b) Set at L side

6.3.3 Variable resistor

Table 6.3.3

Variable resistor	Standard setting	Remarks
RV1	40%	Gain setting
RV2	-	Offset voltage adjustment
RV3	-	Tachogenerator voltage adjustment
RV4	-	+5 V power supply fine adjustment

Note) RV2-RV4 have been adjusted at factory before the shipment.

6.3.4 Check terminals list

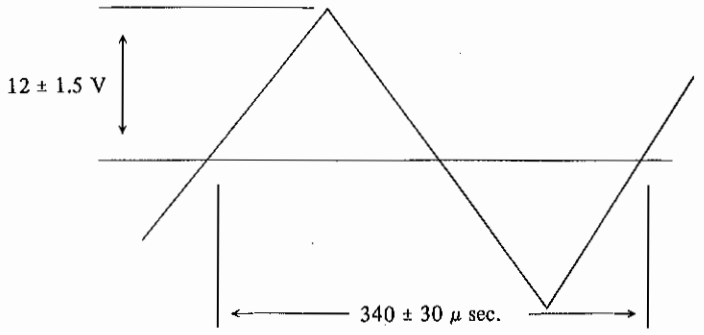
1) For 1-axis control AC servo unit

Table 6.3.4 (a)

Check terminal	Symbol	Description	
CH 1		a x velocity command voltage (Note 2)	
2		0.8 x tachogenerator voltage	
3	OV	OV	
4	OV	OV	
5		Compensation circuit	
6			
7	R	R-phase current command	
8	S	S-phase current command	
9	T	T-phase current command	
10	IR	R-phase current feedback	2.4V/A for motor 4-0,3-0 0.85V/A for motor 2-0,1-0 0.25V/A for motor 0,5,10 0.125V/A for motor 20,30 0.1V/A for motor 30R
11	IS	S-phase current feedback	
12	IT	T-phase current feedback	
13	TRW	Triangle wave (See Note 1)	
14	ER	Error voltage (Torque command)	
15	+5V	+5V	

Check terminal	Symbol	Description
16	+15V	+15V
17	-15V	-15V
18	10RF	10V reference voltage

Note 1) Triangle wave
2) a = 0.344 when VCMD = 7 V/1000 rpm
a = 0.687 when VCMD = 7 V/2000 rpm



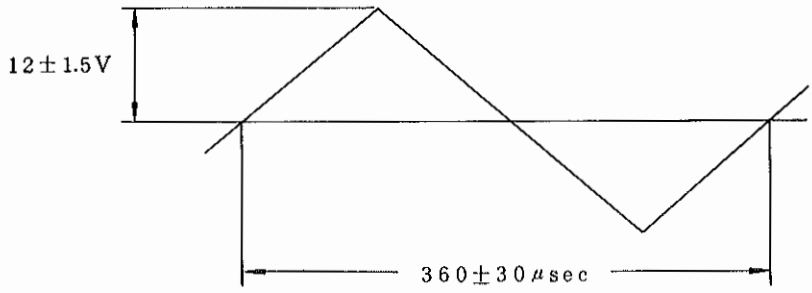
2) For 2-axis control AC servo unit

Table 6.3.4 (b)

Check terminal	Symbol	Description	
CH 1L,M	VCMD	a x velocity command voltage (Note 1)	
CH 2L,M	TSA	0.8 x velocity feedback voltage	
CH 3L,M	OV	OV	
CH 4	OV	OV	
CH 5L,M		Compensation circuit	
CH 6L,M			
CH 7L,M	R	R-phase current command	
CH 8L,M	S	S-phase current command	
CH 9L,M	T	T-phase current command	
CH10L,M	IR	R-phase current feedback	1.18 A/V (Motor 1-0, 2-0)
CH11L,M	IS	S-phase current feedback	
CH12L,M	IT	T-phase current feedback	4.00 A/V (Motor 0,5)

Check terminal	Symbol	Description
CH13	TRW	Triangle wave (Note 3)
CH14L,M	ER	Error voltage (Torque command voltage) (Note 4)
CH15	+5V	+5V
CH16	+15V	+15V
CH17	-15V	-15V

Note 1) a = 0.344 when VCMD is 7V/1000 rpm
a = 0.687 when VCMD is 7V/2000 rpm
2) Setting terminal S4 is on the PCB A16B-1200-0520.
3) Waveform of triangle wave is as follows.



4) Motor load currents (peak values) can be monitored using the same conversion as CH10-12. Effective values can be obtain by multiplying $1/\sqrt{2}$.

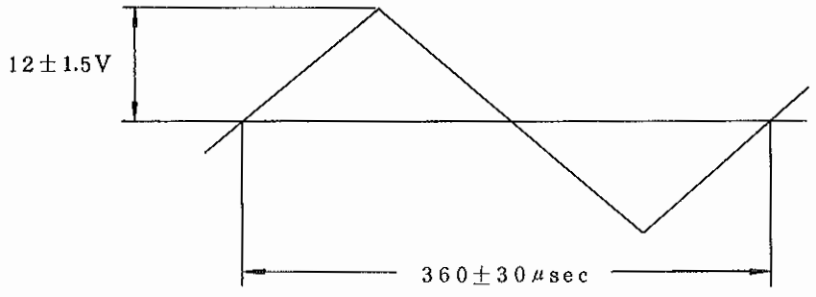
3) For 3-axis control AC servo unit

Table 6.3.4 (c)

Check terminal	Symbol	Description
CH 1L,M,N	VCMD	a x velocity command voltage (Note 1)
CH 2L,M,N	TSA	0.8 x velocity feedback voltage
CH 3L,M,N	OV	OV
CH 5L,M,N		Compensation circuit
CH 6L,M,N		
CH 7L,M,N	R	R-phase current command
CH 8L,M,N	S	S-phase current command

Check terminal	Symbol	Description	
CH 9L,M,N	T	T-phase current command	
CH10L,M,N	IR	R-phase current feedback	5.45A/V (Motor 0, 5, 10)
CH11L,M,N	IS	S-phase current feedback	
CH12L,M,N	IT	T-phase current feedback	
CH13	TRW	Triangle wave (Note 2)	
CH14L,M,N	ER	Error voltage (Torquecommand)	
CH15	+5V	+5V	
CH16	+15V	+15V	
CH17	-15V	-15V	

Note 1) a = 0.344 when VCMD is 7V/1000 rpm
a = 0.687 when VCMD is 7V/2000 rpm
2) Waveform of triangle wave is as follows.



3) Motor load currents (peak values) can be monitored using the same conversion as CH10-12. The effective values can be obtained by multiplying $1/\sqrt{2}$.

6.4 Setting and Adjustment on PCB for Velocity Amplifier for AC Servo Motor

6.4.1 Parts location on PCB

1) For Model 2-0 - Model 30R (digital servo)
   a) A16B-1200-0670

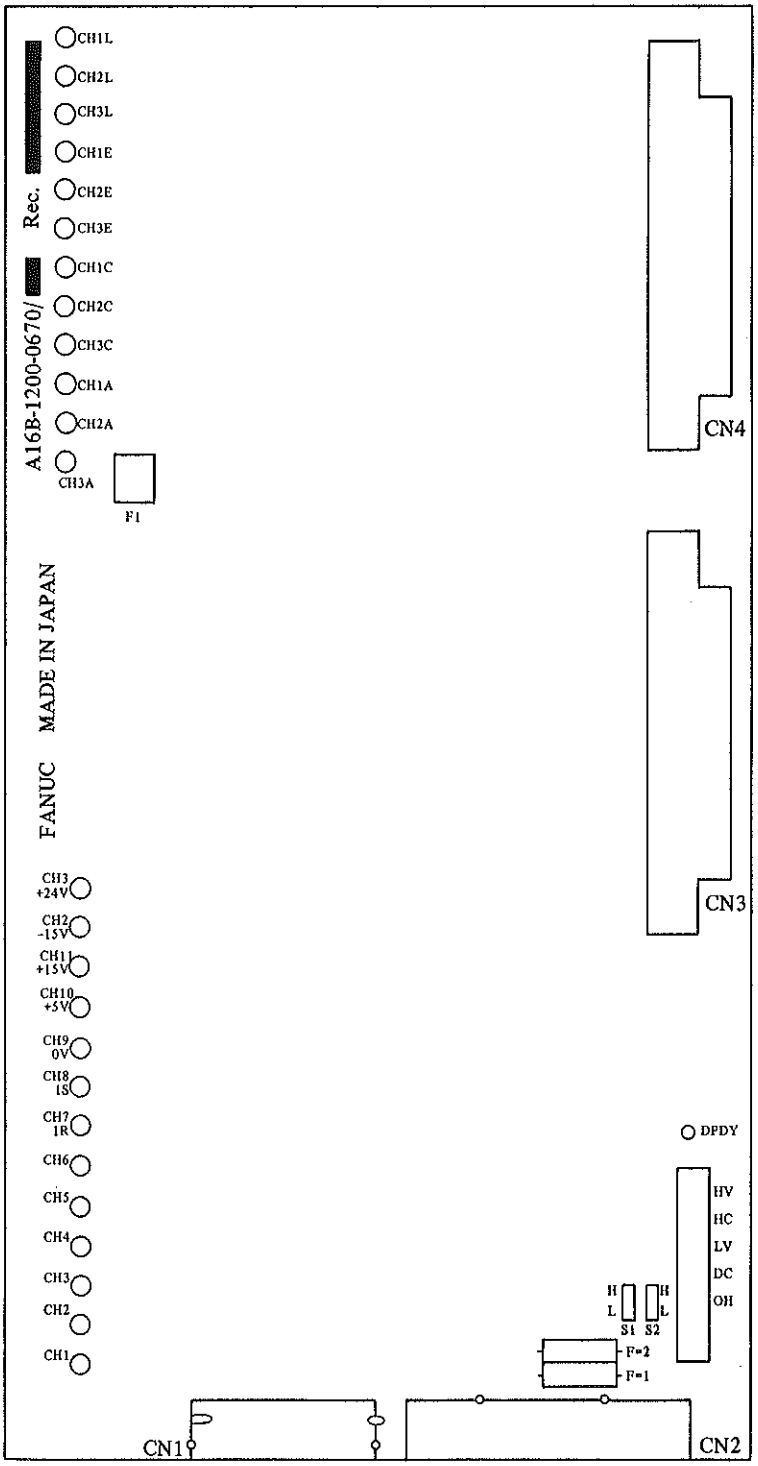
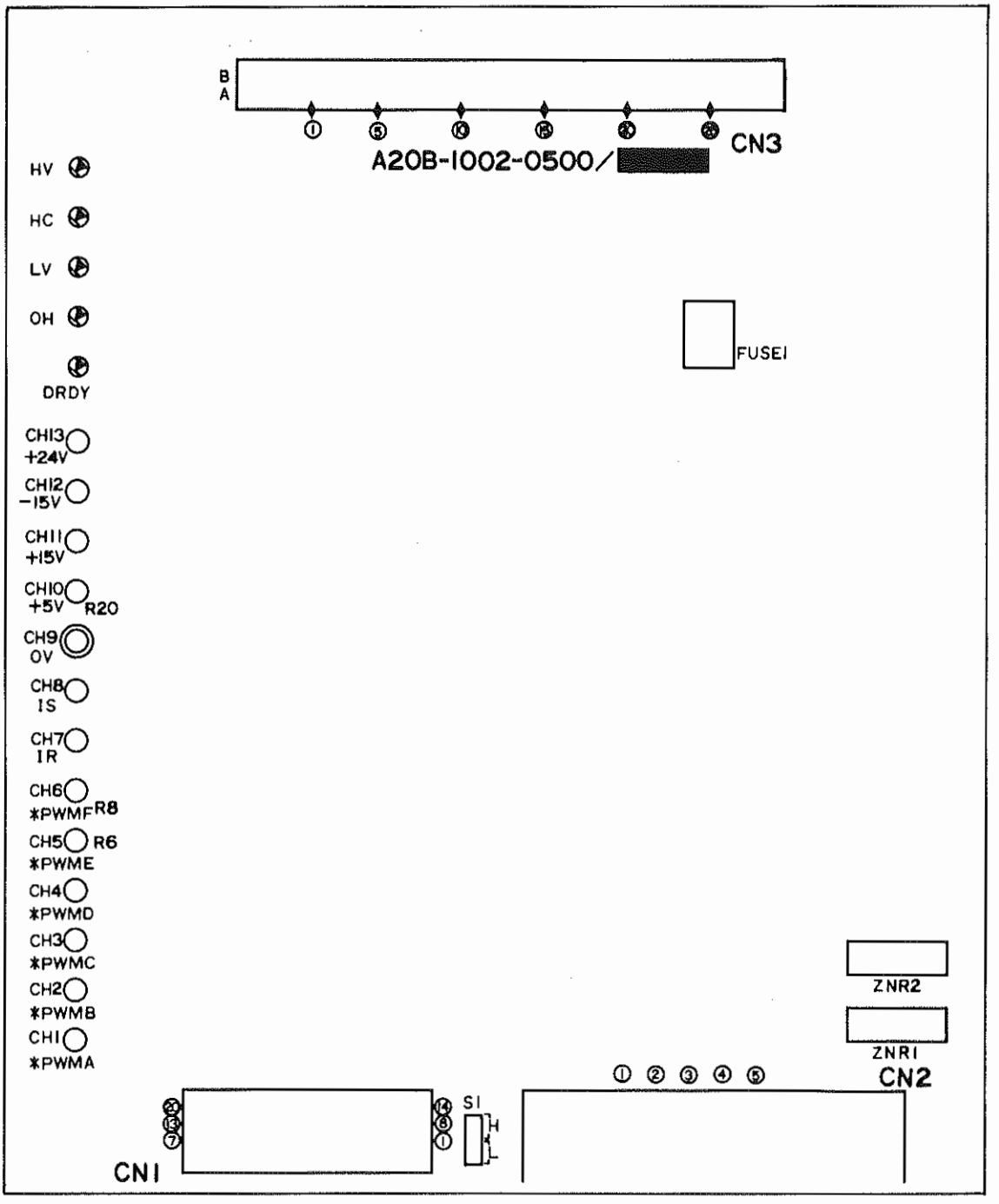


Fig. 6.4.1 (a) A16B-1200-0670

2) For AC servo motor Model 4-0 and 3-0 (digital servo)
   a) A20B-1002-0500



A350-1002-T502/00
A350-1002-Z503/00

Fig. 6.4.1 (b) A20B-1002-0500

b) For Model 4-0, 3-0 (A20B-1000-0600)

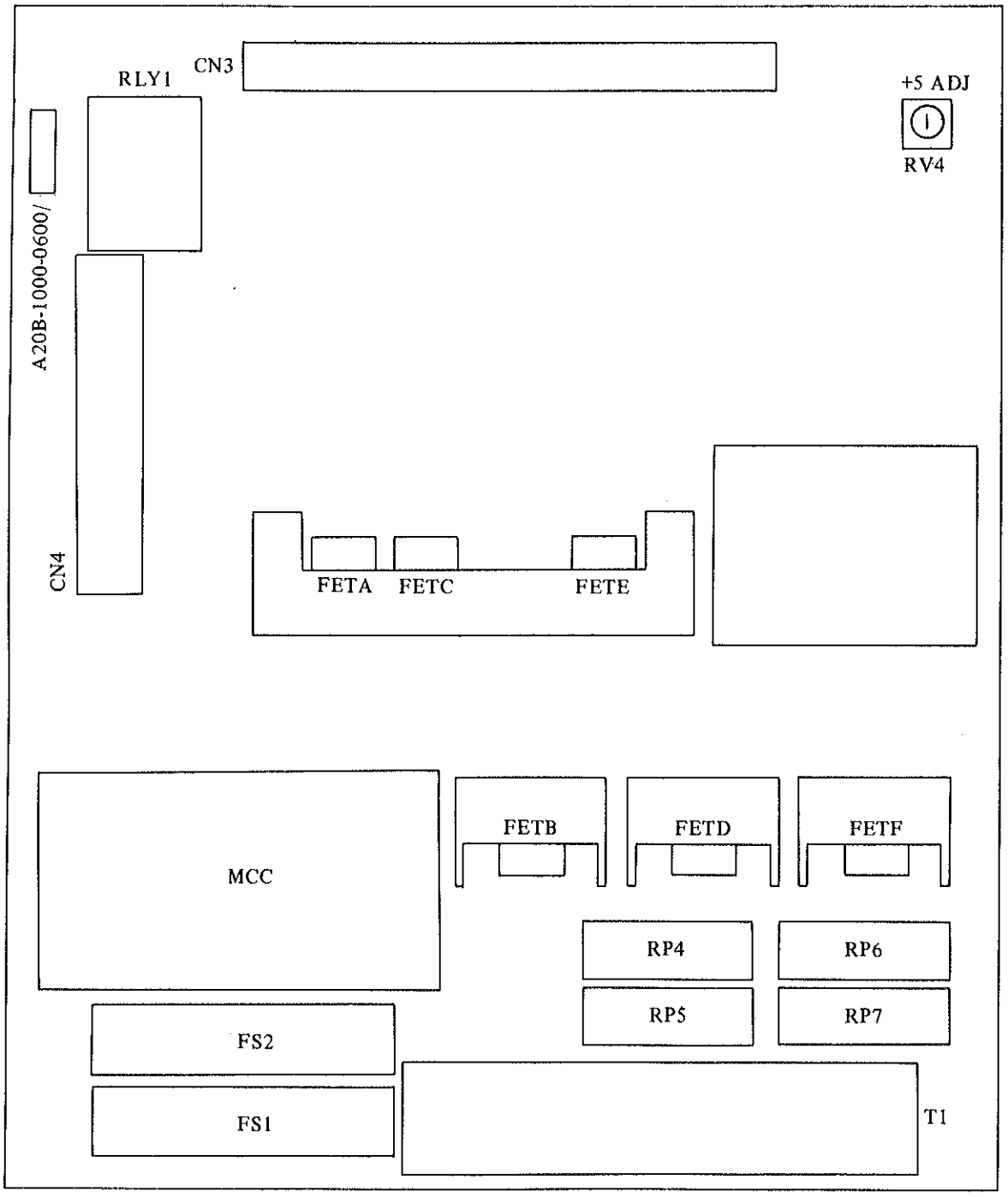


Fig. 6.4.1 (c) A20B-1000-0600

3) For AC servo motor Model 5-0 (digital servo)
   a) A20B-1001-0430

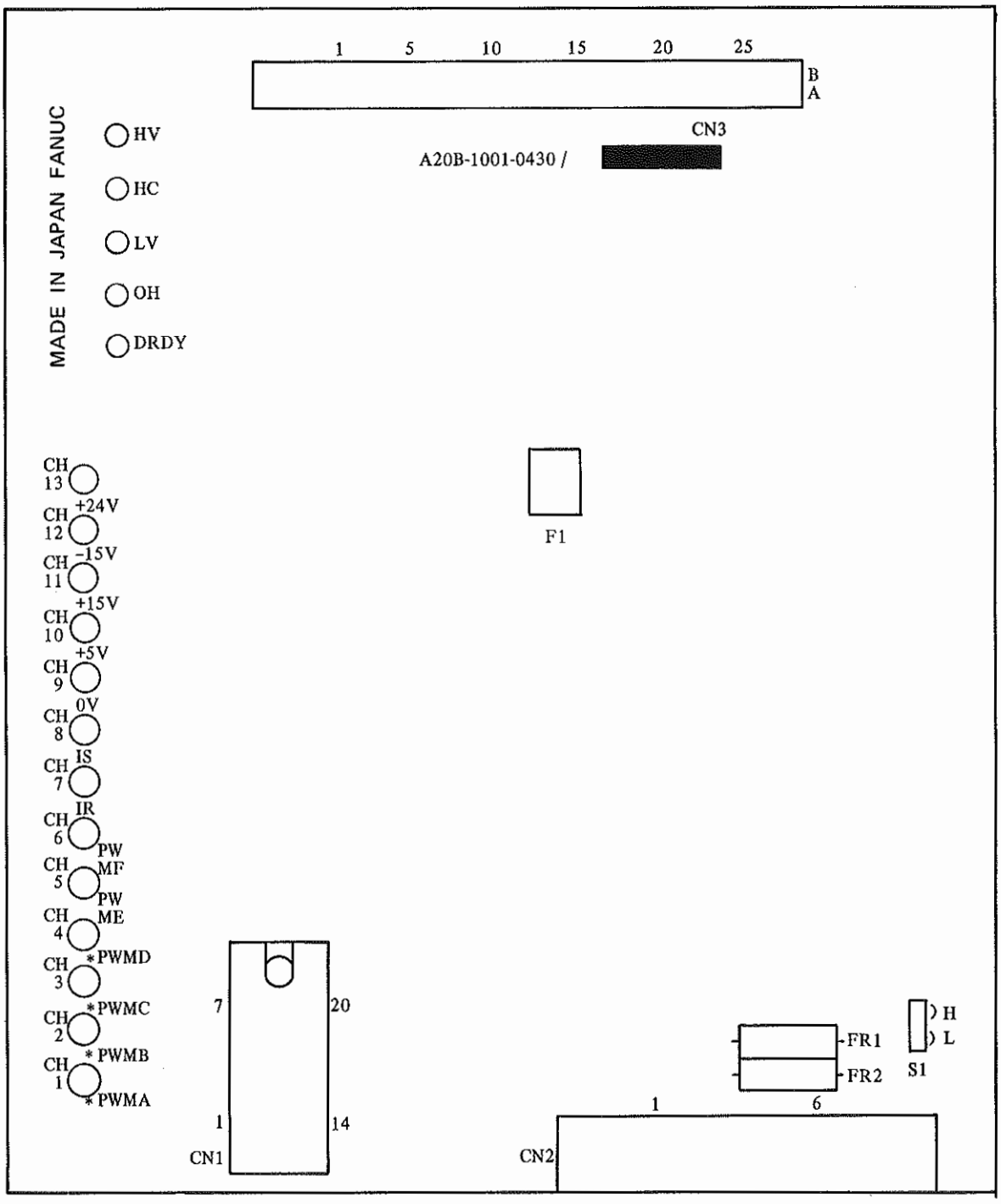


Fig. 6.4.1 (d) A20B-1001-0430

4) Servo amplifier for 2-axis control
   a) A16B-1200-0680

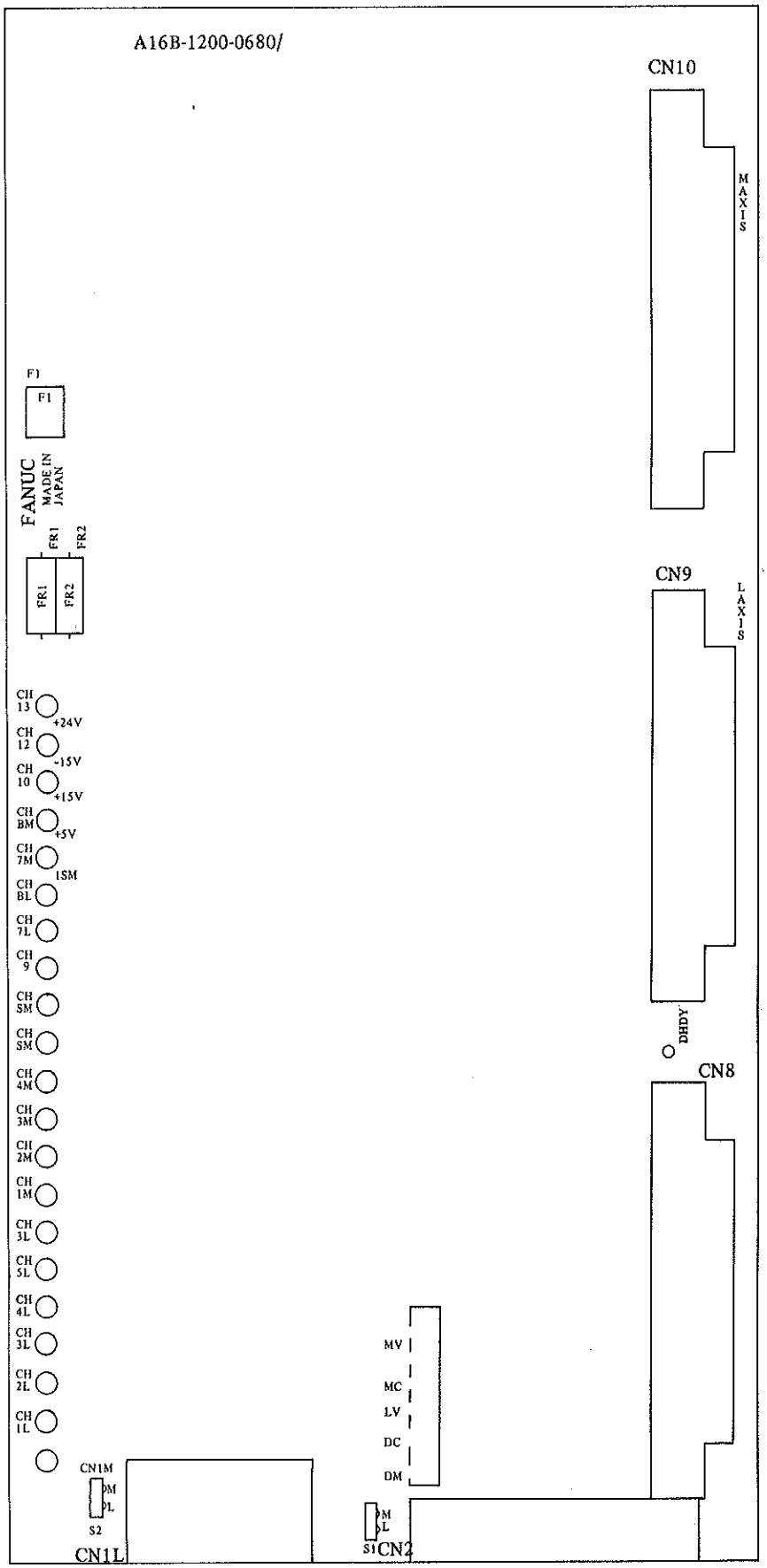


Fig. 6.4.1 (e) A16B-1200-0680

5) Servo amplifier for 3-axis control
   a) A20B-1002-0280

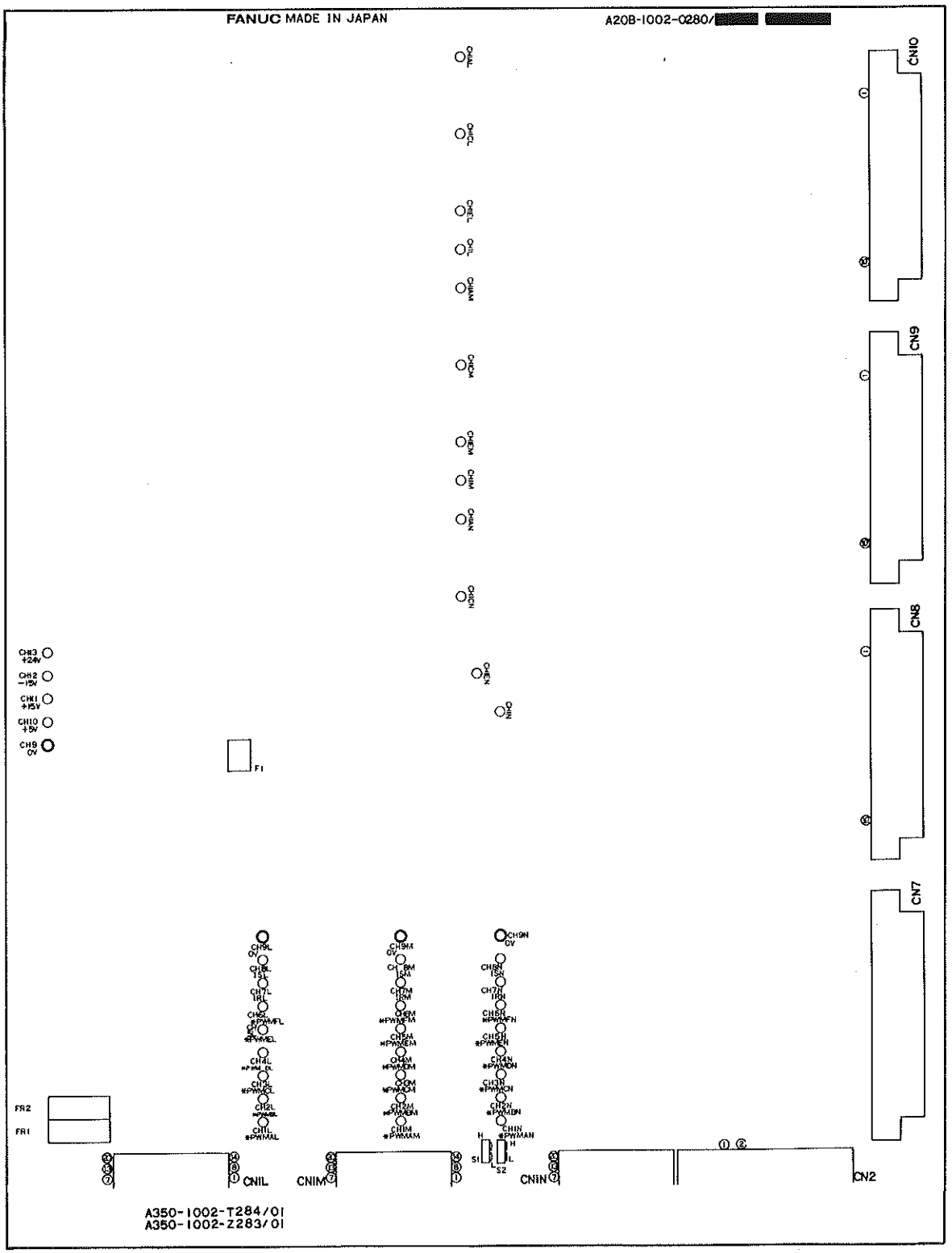


Fig. 6.4.1 (f) A20B-1002-0280

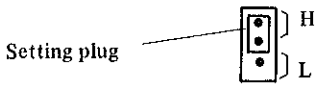
6.4.2 Setting terminal

1) For Model 2-0 - 30R, 5-0, 4-0, 3-0 and servo amplifier for 2 axes control (digital servo)
   Settings are S1 and S2 only for digital servo.

Setting terminal	Standard setting	
S1	L	TOH setting (See Note 1)
S2	L	DC alarm setting (See Note 2) This setting is not provided to servo amplifier for model 5-0.

Note 1) If either power transformer or regenerative discharge unit is connected across terminals CN2 (4) and (5), set S1 to open (L side).
If neither power transformer nor regenerative discharge unit is connected across terminals CN2 (4) and (5), set S1 to short (H side).

Note 2) Set S2 to open (L side), if the regenerative discharge unit is not mounted, and set it to short (H side), if the regenerative discharge unit is mounted.



(a) Setting of H side



(b) Setting of L side

6.4.3 Check terminals list

1) Servo amplifier of digital
   ① For 1-axis
      i) For Model 5-0 P.C.B A20B-1001-0430
      ii) For Model 4-0, 3-0 P.C.B A20B-1002-0500
      iii) For Model 2-0 - 30R P.C.B A16B-1200-0670
   ② For 2-axis P.C.B A16B-1200-0680
   ③ For 3-axis P.C.B A20B-1002-0280

Table 6.2.4 (a)

Setting terminal	Standard setting	Remarks
S1	L	TOH setting (Note 1)
S2	L	DC alarm setting (Note 2)

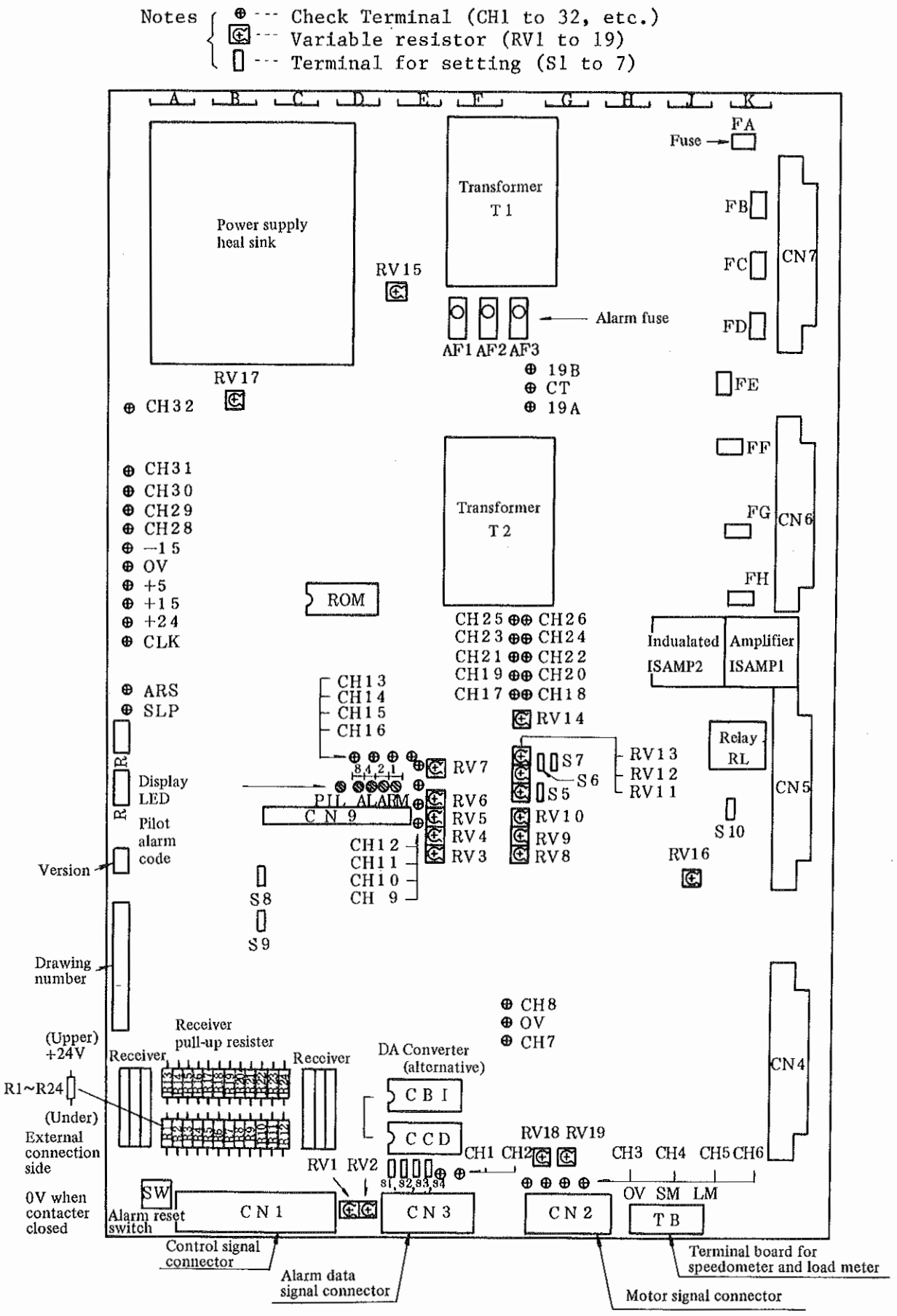
Note 1) If either power transformer or regenerative discharge unit is connected across terminals CN2 (4) and (5), set S1 to open (L side).
If neither power transformer nor regenerative discharge unit is connected across terminals CN2 (4) and (5), set S1 to short (H side).

Note 2) Set S2 open (L side), if the regenerative discharge unit is not mounted, and set it to short (H side), if the regenerative discharge unit is mounted.

Note 3) The setting S2 is not mounted on the PCB for model 5-0 and for model 4-0 and 3-0.

6.5 Setting and Adjustment for AC Spindle Servo Unit

6.5.1 PCB parts mounting diagram



6.5.2 Main parts list for AC spindle servo unit for motor model 3~15

1) Fuses and surge absorbers

Item	Symbol	Name	Specification				
			Model 3	Model 6	Model 8	Model 12	Model 15
1	F1∿3	Fuse	A60L-0001-0127/25FH75		A60L-0001-0145	A60L-0001-0149	
2	F4	Fuse	A60L-0001-0031/5A				
3	F5,6	Fuse	A60L-0001-0036/PC1-20		A60L-0001-0036/PC1-30		
4	F7	Fuse	A60L-0001-0147		A60L-0001-0145		A60L-0001-0149
5	Z1∿4	Surge absorber	A50L-0221-0062/441-12				
6	AF1	Fuse on PCB	A60L-0001-0046/3.2(3.2A)				
7	AF2,3	Fuse on PCB	A60L-0001-0075/3.2(3.2AS)				

2) Main parts

Item	Symbol	Name	Specification				
			Model 3	Model 6	Model 8	Model 12	Model 15
1	P.C.B.	Printed circuit board	A20B-0009-0530	A20B-0009-0531	A20B-0009-0532	A20B-0009-0533	A20B-0009-0534
2	ROM	Memory element	J10	J11	J02	J03	J04
3	TM1∿11	Transistor module	A50L-0001-0096				
4	SM1∿3	SCR module	A50L-5000-0029/30		A50L-5000-0029/50		
5	DM1∿3	Diode module	A50L-2001-0138		A50L-2001-0146		
6	D1∿3	Diode	A50L-2001-0103/12JH11				
7	D4∿6	Diode	A50L-2001-0103/12JG11				
8	D7	Diode	A50L-2001-0081/60				
9	D8	Diode	A50L-2001-0097/U06G				
10	C1∿3	Capacitor	A42L-0001-0103				
11	MCC	Electromagnetic contactor	A58L-0001-0094/200V1A1B		A58L-0001-0092/A		
12	TF	Transformer	A80L-0001-0276				
13	FAN	Cooling fan	A90L-0001-0099/A				
14	TH	Thermostat	A57L-0001-0028				
15	SW	Switch	A57L-0001-0030/2				

6.5.3 Adjustment of variable resistor on the PCB for AC spindle servo unit

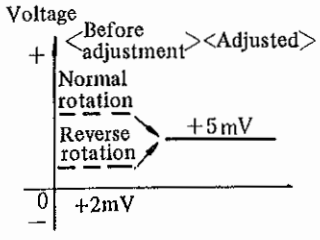
Notes 1. This table is applicable to PCBs of versions A20B-0009-0530 to 0534.
2. Since the variable resistor, RV7, 8, 14 through 19, are adjusted by factory at shipment, they must not be readjusted by the user.

No.	Symbol	Item	Standard setting	Check terminals	Procedure
1	RV1	Velocity command voltage level		CH13-0V	See Subsection (1) on the next page.
2	RV2	Velocity command voltage offset		CH13-0V	See Subsection (1) on the next page.
3	RV3	Speed arrival detection level		CH10-0V	See Subsection (4)
4	RV4	Speed detection level		CH9-0V	See Subsection (5)
5	RV5	Torque limitation level			See Subsection (6)
6	RV6	Regenerated power limitation	3 scale		See item 5.1.5.
7	RV7	VF conversion level (1)		CH23-0V	When the voltage between LM and OM is 10 V, the frequency is 200 $\pm$ 2 kHz.
8	RV8	Setting for speed detection circuit		CH18-0V	When the voltage between CH17 and 0 V, is 0.2 V, 2.2 $\pm$ 0.1 V.
9	RV9	Adjustment of forward motor speed		Number of motor revolutions	See Subsection (2)
10	RV10	Speed detection offset		CH17-0V	When the spindle is stopped, the offset voltage must be within $\pm$2 mV.
11	RV11	Adjustment of reverse motor speed		Number of motor revolutions	See Subsection (2)
12	RV12	Velocity loop gain	5 scale		
13	RV13	Velocity loop offset		Spindle	See Subsection (3)

No.	Symbol	Item	Standard setting	Check terminals	Procedure
14	RV14	Adjustment of loadmeter amplitude		LM-OM	10 ± 0.1V at acceleration (without torque limit)
15	RV15	Voltage adjustment of +5 V		+5V - 0V	5 ± 0.05 V
16	RV16	Regenerated voltage limitation level	4 scale		
17	RV17	VF conversion level (2)		CH32-0V	When input voltage is 200 V AC, the frequency is 24 ± 0.2 kHz.
18	RV18	Adjustment of RA offset		CH5-0V	2.5 ± 0.05 V when CN2 is open.
19	RV19	Adjustment of RB offset		CH6-0V	Same as the above.

1) Velocity command voltage (RV1, RV2)
When the velocity command voltage is 10 V, the motor rotates at the rated speed.

Item	Measuring terminals	Adjustment procedure
Offset	CH13-0V	Set the motor to operating status and supply a velocity command voltage of 0V (equivalent to S00) to the motor. Adjust RV2 so that the voltage between the measuring terminals will not change when forward rotation and reverse rotation commands are issued alternately. See the following NOTE.
Level	CH13-0V	Supply a rated rotational command voltage of 10 V to the motor and adjust RV1 so that the voltage between the measuring terminals becomes +10 V ± 0.05 V when the spindle forward rotation command is issued.

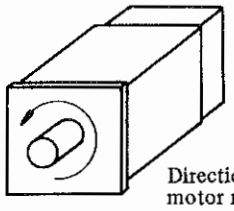


(Example) For example, if the voltage at CH13 is +5.0 mV when the spindle rotates forward and it is +5.0 mV ± 1.0 mV when the spindle rotates in reverse, the offset error of the velocity command voltage is ±1.0 mV.

2) Rotational speed adjustment (RV9, RV11)
The number of motor revolutions can be adjusted accurately by the following procedure. The number of motor revolutions should be measured directly using a stroboscope or tachometer.

Item	Measuring point	Adjusting procedure
Number of forward motor revolutions	Spindle	Supply the rated velocity command voltage to the motor. Adjust RV9 so that the motor rotates at the rated speed when a forward rotation (SFR) command is issued.
Number of reverse motor revolutions	Spindle	Adjust RV11 so that the motor rotates at the rated speed when a reverse rotation (SRV) command is issued.

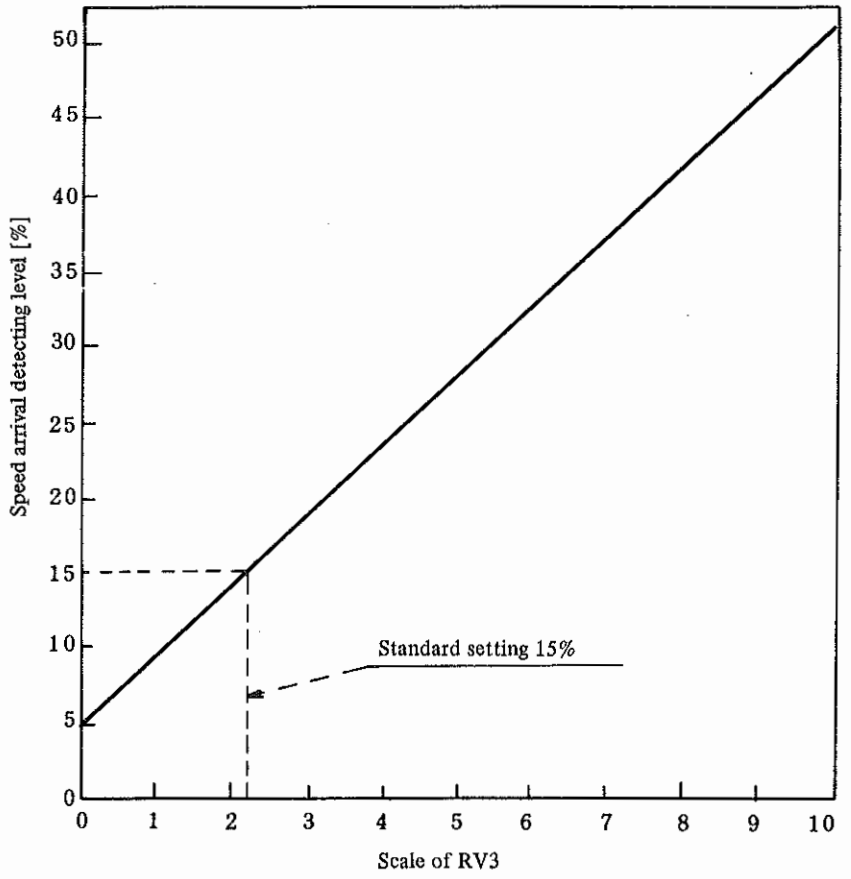
(Example) The forward rotation means that the AC spindle motor rotates counterclockwise (forward rotation) as seen from the shaft. Thus, it may not correspond to the forward rotation of the machine spindle.

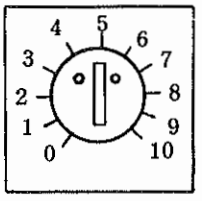


3) Velocity offset (RV13)
This adjustment is made so that the spindle will not rotate at low speed when a velocity command voltage of 0V is supplied. This should be performed after the previous adjustments.

Item	Measuring point	Adjusting procedure
Velocity offset	Spindle (or Motor)	Supply a velocity command voltage of 0V. Adjust RV13 so that the spindle will not rotate when forward or reverse rotation commands are issued.

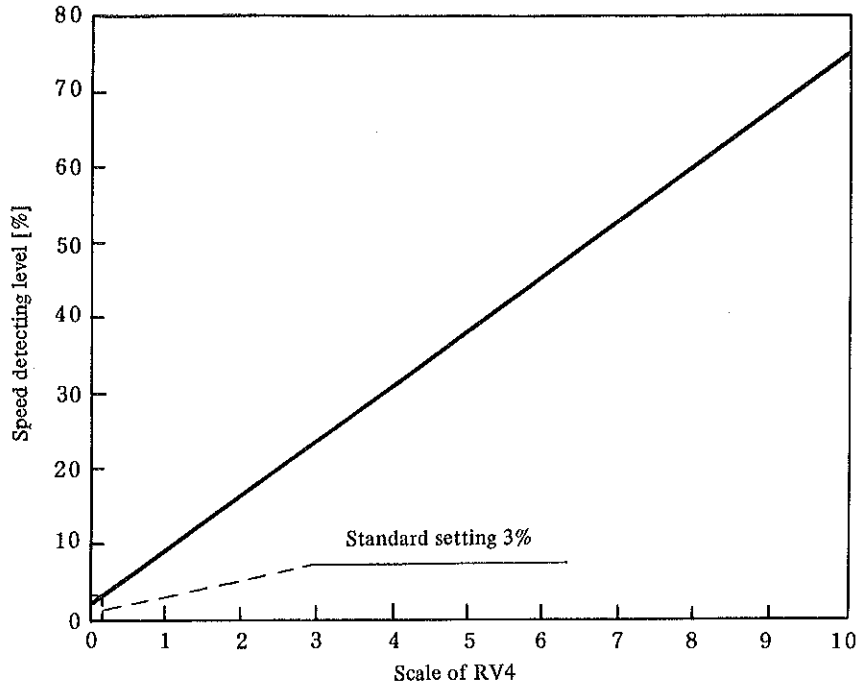
4) Speed arrival detection level (RV3)
Setting of the speed arrival detection level can be performed by using the following graph.
Vertical axis is the percentage of motor speed to the rated value.



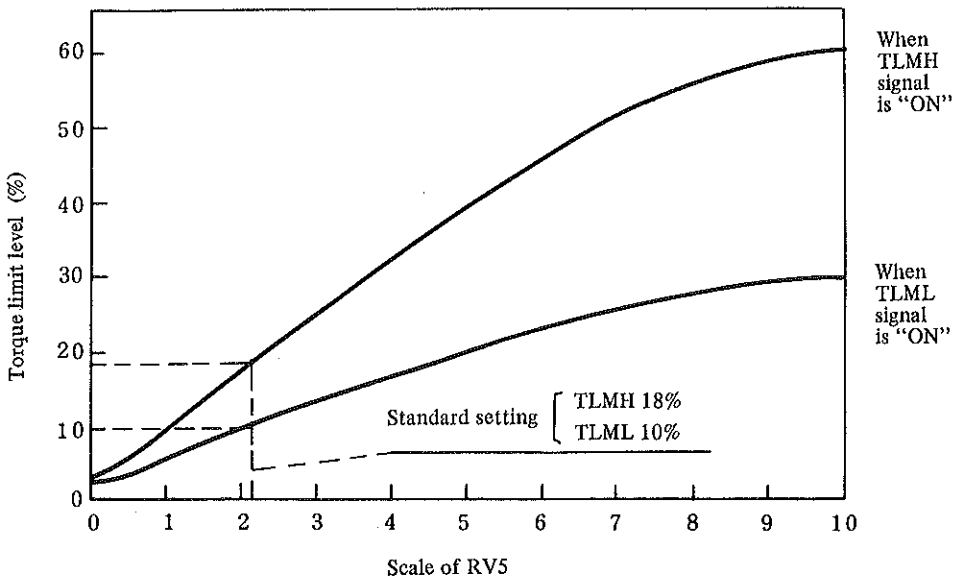


How to read the scale of potentiometer

5) Speed detecting level (RV4)
Vertical axis is the percentage of motor speed when rated value is assumed as 100%. This signal can be used for confirmation when clutch or gear is being changed.

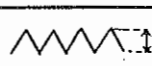


6) Torque limit level (RV5)
Vertical axis is the percentage of torque when 30 minutes rated torque is assumed as 100%.



6.5.4 Description of check terminal

Terminal name	Signal name	Contents	Remarks
CH1	DA2	Analog command voltage	0 - 10.0 V
CH2	DA1	Output voltage from D/A converter	0 - 10.0 V
CH3	PA	Phase A output from pulse generator	(2.5 V ± 5%) ± 0.2 V_{TYP}.
CH4	PB	Phase B output from pulse generator	PA leads PB by 90° when CW rotation
CH5	RA	Reference voltage of phase A	Direct current of PA: ±25 mA
CH6	RB	Reference voltage of phase B	Direct current of PB: ±25 mA
CH7	PSA	Phase A square weve	Duty 50% (at constant speed) ± 10%
OV	OV	OV of printed circuit board	
CH8	PSB	Phase B square wave	Duty 50% (at constant speed) ±10%
CH9	SDTRF	Speed detection level	Variable 0.14 V through 7.4 V by RV4
CH10	SARRF	Speed arrival level	Variable by RV3
CH11	BUZY	Acceleration/deceleration busy	"1" / "0" 1: During Acc/Dcc
CH13	VCMD	Velocity command voltage	0 - ±10.0 V + ; CCW, - CW
CH14	RVP	Reverse rotation speed pulse	Pulse width: 3.2 microseconds (Only for reverse rotation)
CH15	FWP	Forward rotation speed pulse	Pulse width: 3.2 microseconds (Only for reverse rotation)
CH16	OV	OV of printed circuit board	
CH17	TS1	F/V output of velocity feedback	6000 rpm (CCW): -10 V
CH18	TS2	Low speed detection signal	120 rpm (CCW): -2.2 V
CH20	TSA	Velocity feedback signal	Rated rotational speed: ±10 V, CCW: -
CH21	LTRF	Output torque limitation voltage	Output = $-[(\lvert V_{CH21} \rvert + 1.8)/10]$ x Maximum output

Terminal name	Signal name	Contents	Remarks
CH22	CRU	Phase U current detection signal	Current per 1V M3,6: 16.7A / M8: 25A / M12: 35.7A / M15: 50A
CH23	ERP	VF conversion output	CH28 10 V: 200 kHz width; 0.4 μs
CH24	CRV	Phase V current detection signal	V phase motor current detection signal
CH25	TRWF	Triangle wave signal	 10 Vp-p
CH26	CRW	Phase W current detection signal	W phase motor current detection signal
CLK	CLK	Clock signal	312.5 kHz 200 ns typ
+24	24V	Power source voltage of +24 V	DC25.6 Vtyp, Ripple: 0.5 V_{p-p} 100 Hz
+15	15V	Power source voltage of +15 V	-15 V ±4%
+5	5V	Power source voltage of +5 V	+5V ±1% (Preadjusted by RV15)
OV	OV	OV of printed circuit board	OV, same as CH16
-15	-15V	Power source voltage of -15 V	-15 V ±4%
CH28	ER	Error voltage	0 - 10 V
CH29	UCM	Phase U command voltage	
CH30	VCM	Phase V command voltage	
CH31	WCM	Phase W command voltage	
CH32	24VP	Pulse signal	24 kHz at AC 200 V
19A	19A	Input voltage of 19 V AC	PCB Control power supply
CT	CT	OV	PCB Control power supply
19B	19B	Input voltage of 19 V AC	PCB Control power supply

6.6 Adjustment of Spindle Orientation Control Circuit

6.6.1 Adjustment of magnetic sensor system spindle orientation

1) Mounting magnetizing element and magnetic sensor
Determine the mounting direction for the magnetizing element and magnetic sensor as follows. Incorrect mounting may cause repetition of clockwise and counterclockwise rotation of spindle without stopping during positioning, hunting, and the end of the magnetizing element and sensor head to stop in the opposite position.

Mounting methods of magnetizing element and sensor

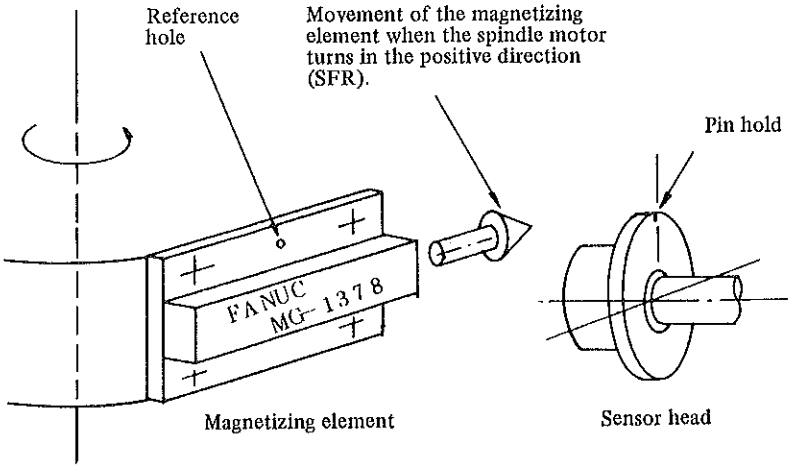
Item	Explanation
1	Mount the magnetizing element so that the reference hole moves and faces as shown in Figure 1 when the spindle rotates in the positive direction by the command of spindle motor CW rotation (SFR and VCMD positive).
2	Mount the magnetic sensor head so that the pin hole of the flange and the reference hole of the magnetizing element face in opposite directions.
3	The gap between the magnetizing element and sensor head should be minimum of 1.5 $\pm$ 0.5 mm.
4	

Fig. 1 Mounting magnetizing element

2) Setting and adjustment of two-speed steps type
Spindle orientation circuit C A06B-6041-J120
Orientation circuit C PCB A20B-0008-0030
a) Setting and function of jumper terminal (SH)
The connection and function of jumper terminals (SH) which can be freely selected are listed below. SH01 should be connected after the power is on since it is used only for adjustment and testing. It should be disconnected after adjustment making sure that LED7 goes off.

Connection and functions of jumper terminals (SH)
(A double outline indicates the standard setting)

(Note 1) Status			Function	Remarks
SH	1-2	2-3		
01	/	o	Test mode (Note 2)	Connected only for adjustment
02	o	x	When an orientation instruction is issued after power is turned on and before driving the spindle, the motor shaft end rotates in a clockwise direction.	The setting of SH03 takes priority of the setting on SH02. The setting on SH02 is effected only when SH03 1-2 is connected.
	x	**o**	When an orientation instruction is issued after power is turned on and before driving the spindle, the motor shaft end rotates in a counterclockwise direction.	
03	**o**	**x**	Moves in the direction the spindle was turning just before the orientation instruction was issued.	The setting on SH02 becomes effective.
	x	o	The orientation direction is always CCW.	
	x	x	The orientation direction is always CW.	
04	**x**	**x**	Initial orientation speed is about 60 x_{-1} spindle position loop gain Sec. r.p.m. of the spindle. (usual rate)	Since spindle position loop gain is generally close to 5 $sec.^{-1}$, the usual rate is about 300 r.p.m.
	o	x	The initial rate of speed is limited to 1/3 the usual rate.	
	x	o	The initial rate of speed is limited to 2/3 the usual rate.	

Notes: (1) o indicates "close", x indicates "open".
(2) When in Test Mode
(a) The orientation instruction is issued.
(b) Orientation end signal (ORAR 1,2) is not transferred.
(c) The spindle turns at the initial speed while SW1 (INITIALIZING BUTTON) is pressed. When it is released, the spindle stops at a fixed position.
(d) The red light emitting diode (LED7) is on in this mode.

b) LED indicators
Seven display lamps (LED 1-7), indicating the meanings listed below, are mounted on this option board. (LED 1 and LED 2 are not mounted on PCB of 01A edition).

LED indicators

LED	Meaning	Color	Explanation
1	ORIENTATION	Green	Lights during execution of an orientation instruction. (ORCM 1 and 2 are connected: ON)
2	CLUTCH (gear) LOW	Green	Lights when the clutch (gear) LOW signal is on. (*CTH 1 and 2 are connected: ON)
3	MS PEAK LEVEL	Green	Lights while the peak value of the magnetic flux detection signal (MS) is out of the range of ±10 V. Adjustment indicator.
4	SLOWDOWN PERIOD	Green	Lights during the low turning speed period when the spindle position approaches the stop position during orientation.
5	IN-POSITION FINE	Green	Lights when the value of MS output approaches within +0.1° of the spindle angle. Sometimes lights when the sensor is not on the magnetizing element.
6	IN-POSITION	Green	Lights when orientation has been completed and the spindle is within ±1° of the adjustment position. When it lights while not in TEST MODE, the Orientation Completion signal is transmitted, (ORAR 1 and 2 are connected: ON)
7	TEST MODE	Red	Lights when SH01 pins are connected. In this mode, the Adjustment Completion signal is not transmitted and ORCM is on. The orientation motion can be repeatedly confirmed by pressing SW1.

c) Variable resistor setting
Set the variable resistor according to the following values followed by table before orientation adjustment. * will be reset at a later stage.

Settings

Variable resistor name	RV	1*	2*	3	4	5	6*	7*	8	9*	10*	11*
Variable resistor scale position		5.0	6.0	①	①	②	2.0	5.0	③	2.0	5.0	5.0

① RV3 and RV4 settings
Set RV3 and RV4 according to the distance H between the turning axis of the magnetizing element and the center of the sensor head.

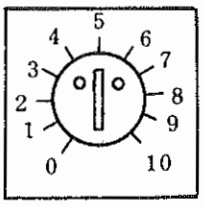
H (mm)	60 - 65	- 70	- 75	- 80	- 85	- 90	- 95	- 100	- 105	- 110
Scale position	7.0	6.0	5.0	4.0	3.0	2.5	2.0	1.5	1.0	0.5

② RV5 setting
Set RV5 according to the number of revolutions (N_{HM}) when the spindle rotates at rated speed.

N_{HM} (rpm)	2,000 - 2,200	- 2,500	- 2,700	- 3,100	- 3,500	- 4,000	- 4,500	- 5,000	- 5,500	- 6,000
Scale position	7.5	6.5	5.5	4.5	3.5	2.5	2.0	1.5	1.0	0.5

③ RV8 setting
Set RV8 according to the transmission ratio of $R_{H/L}$ of spindle HIGH/LOW.

$R_{H/L}$	- 2.0	- 2.2	- 2.5	- 2.8	- 3.2	- 3.7	- 4.4	- 5.3	- 6.0	- 7.0
Scale position	2.0	3.0	4.0	5.0	6.0	7.5	8.0	9.0	9.5	10



Scale of variable resistor

d) Variable resistor adjustment
Adjust RV1 - RV11 according to the following table. Adjustment of orientation PCB must be performed after the adjustment of spindle control PCB. Orientation position may be shifted if the adjustment of RV12 or RV13 on spindle control PCB is altered.

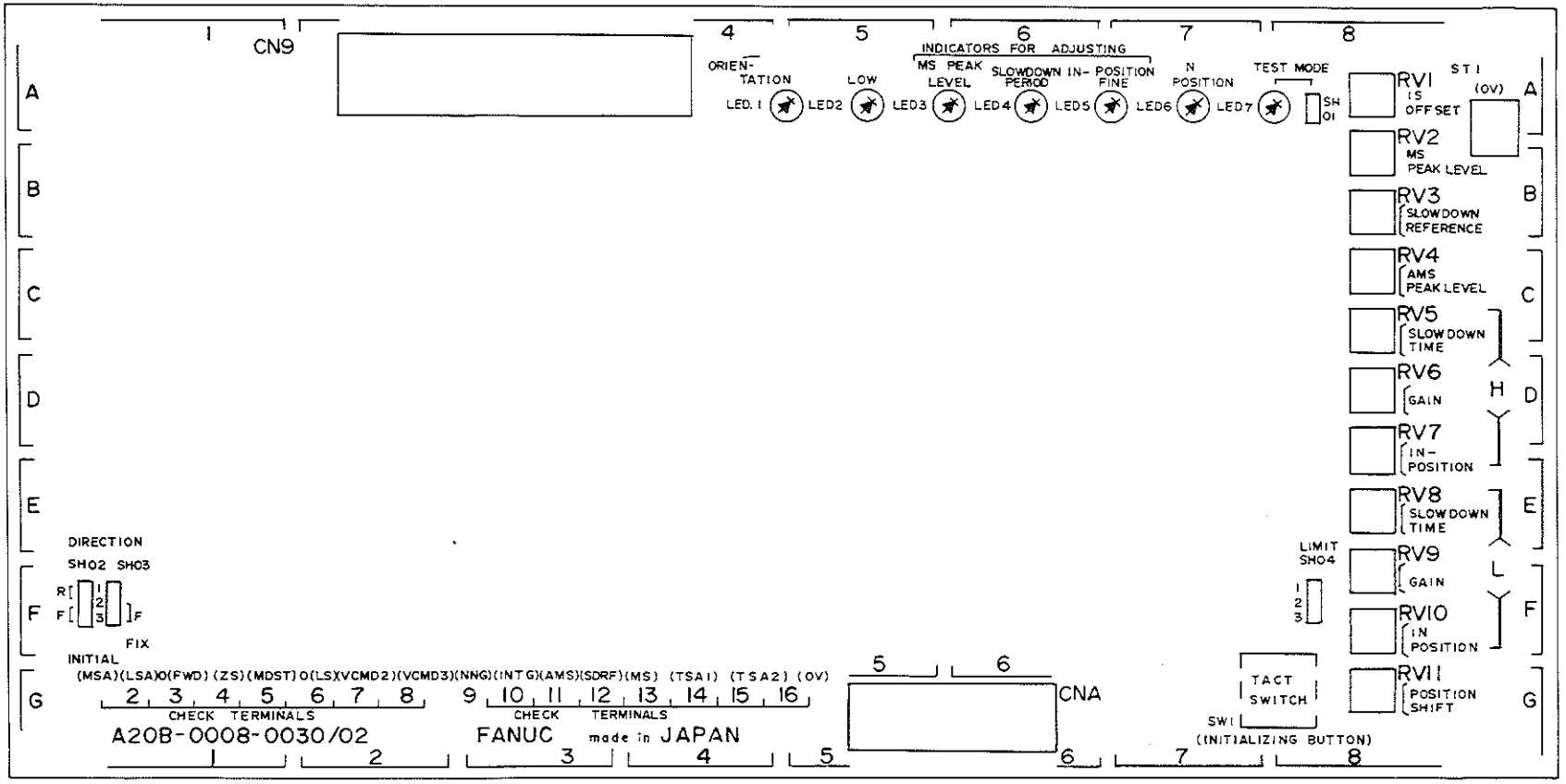
Variable resistor adjustment

The following adjustments should be performed in Test Mode by connecting SH01 pins.

Term	Name	Adjustment	Condition	Adjustment method (Specification)
1	RV1	TS OFFSET	The spindle should be stopped.	Voltage across check 15 (TSA2) and 16(0V) should be within ±1.0 mV
2	RV2	MS PEAK LEVEL	Keep pressing SW1 (INITIALIZING BUTTON)	Adjust position until LED3 (MSPEAK LEVEL) begins to light.
3	RV3	SLOWDOWN REFERENCE		According to the setting terms.
4	RV4	AMS PEAK LEVEL		According to the setting terms.
5	RV5	SLOWDOWN TIME IN HIGH MODE	Clutch (gear) is HIGH. Press SW1 to stop the spindle at the fixed position. The *CTH signal is off (open).	Just before stopping LED4 (SLOWDOWN PERIOD) should immediately light up clearly.
6	RV6	GAIN H	Clutch (gear) is HIGH. Press SW1 to stop the spindle at the fixed position. The *CTH signal is off (open).	Turn in the CW direction being careful not to over-shoot when stopping.
7	RV7	IN-POSITION H	Clutch (gear) is HIGH. Press SW1 to stop the spindle at the fixed position. The *CTH signal is off (open).	LED5 (IN-POS. FINE) should light while LED6 (IN-POSITION) is on.
8	RV8	SLOWDOWN TIME IN LOW MODE	Clutch (gear) is LOW. Press SW1 to stop the spindle at the fixed position. The *CTH signal is on (closed).	LED4 (SLOWDOWN PERIOD) should immediately light up clearly just before stopping. (See term 5)
9	RV9	GAIN L	Clutch (gear) is LOW. Press SW1 to stop the spindle at the fixed position. The *CTH signal is on (closed).	Turn in the CW direction being careful not to over-shoot when stopping.

Term	name	Adjustment	Condition	Adjustment method (Specification)
10	RV10	IN-POSITION L	Clutch (gear) is LOW. Press SW1 to stop the spindle at the fixed position. The *CTH signal is on (closed).	LED5 (IN-POS. FINE) should be on when LED6 (IN-POSITION) is on.
11	RV11	POSITION SHIFT		The stop position can be finely adjusted to within ±1° of the spindle angle.

After adjustment, release the test mode and check that LED7 (red) is turned off.



Adjusting position on the orientation circuit C PCB

3) Setting and adjustment of three-spindle speed steps type
Orientation circuit D A06B-6041-J121
Orientation circuit D
PCB drawing number A20B-0009-0520

The spindle speed range is as listed below.

	Spindle speed range
High	4000 - 8000 rpm
Medium	1000 - 2000 rpm
Low	250 - 667 rpm

a) Setting and function of jumper terminal (SH)
Same as in item 6.5.1 (2)-(a).
b) LED indicators

LED No.	Symbol	Color	Contents
LED1	ORIENTATION	Green	Lights during execution of an orientation command.
LED2H	GEAR/CLUTCH	Green	Lights when the gear/clutch is shifted to high position.
LED2M			Lights when the gear/clutch is shifted to middle position.
LED2L			Lights when the gear/clutch is shifted to low position.
LED3	MS PEAK LEVEL	Green	Lights when the peak value of the MS signal sent from the magnetic sensor is out of the range of $\pm$10 V.
LED4	SLOWDOWN PERIOD	Green	Lights during low turning speed and goes out when the magnetizing element reaches the sensor.
LED5	IN-POSITION FINE	Green	Lights when orientation has been completed and the spindle is within $\pm$0.1° of the adjustment position.
LED6	IN-POSITION	Green	Lights when orientation has been completed and the spindle is within $\pm$1° of the adjustment position. When it lights while not in TEST mode, the orientation completion signal is transmitted.
LED7	TEST MODE	Red	Lights when terminals 01 and 02 of SH01 are shorted.

c) Adjustments
The adjustments should be performed in the following sequence in TEST mode after turning on the power.

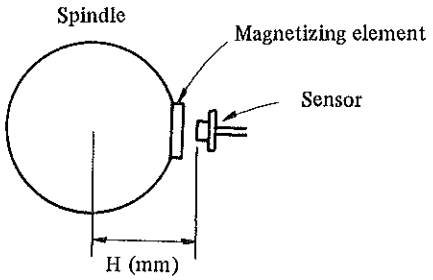
Item	Variable resistor	Adjustment item	Condition	Adjustment procedure
1	RV1	TSA OFFSET Tachogenerator offset	The spindle should be stopped.	Voltage across check terminals CH15 (TSA2) and 16(OV) should be within 0 ± 1.0 mV.
2	RV2	MS PEAK LEVEL Amplitude adjustment of MS signal	SW1 should be kept pressed.	Adjust the position until LED3 begins to light.
3	RV3	SLOWDOWN REFERENCE Setting of the slowdown level	Measure the distance from the center of the spindle to the sensor head.	See NOTE 1.
4	RV4	AMS PEAK LEVEL Amplitude value of AMS signal		
5	RV5	SLOWDOWN TIME HIGH slowdown time	Shift the gear to the HIGH position and LED2H goes on. Turn SW1 on and off repeatedly.	Just before stopping, LED4 should immediately light up clearly (about 0.2 sec).
6	RV6	GAIN HIGH Position loop gain		Turn clockwise to increase the gain being careful not to overshoot when stopping.
7	RV7	IN-POSITION H Adjusting the spindle stop position.		Adjust so that LED5 lights while LED6 is on. LED5 may ficker.
8	RV8	SLOWDOWN TIME LOW Adjustment of slowdown time	Shift the gear to the LOW position and LED2L goes on. Turn SW1 on and off repeatedly.	Same as item 5 above.
9	RV9	GAIN LOW Position loop gain		Same as item 6 above.
10	RV10	IN-POSITION LOW Adjusting the spindle stop position		Same as item 7 above.

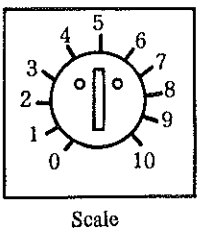
Item	Variable resistor	Adjustment item	Condition	Adjustment procedure
11	RV11	SLOWDOWN TIME MEDIUM Adjusting slow-down time	Shift the gear to the MEDIUM position and LED2M goes on. Turn SW1 on and off repeatedly.	Same as item 5 above.
12	RV12	GAIN MEDIUM Position loop gain.		Same as item 6 above.
13	RV13	IN-POSITION MEDIUM Adjusting the spindle stop position		Same as item 7 above.
14	RV14	POSITION SHIFT Shifting of spindle stop position	The stop position can be finely adjusted within a range of ±1° of the spindle angle.	Match the key position of the ATC arm to the groove position of the spindle.

After adjustment, release test mode making sure that LED7 (Red) is off.

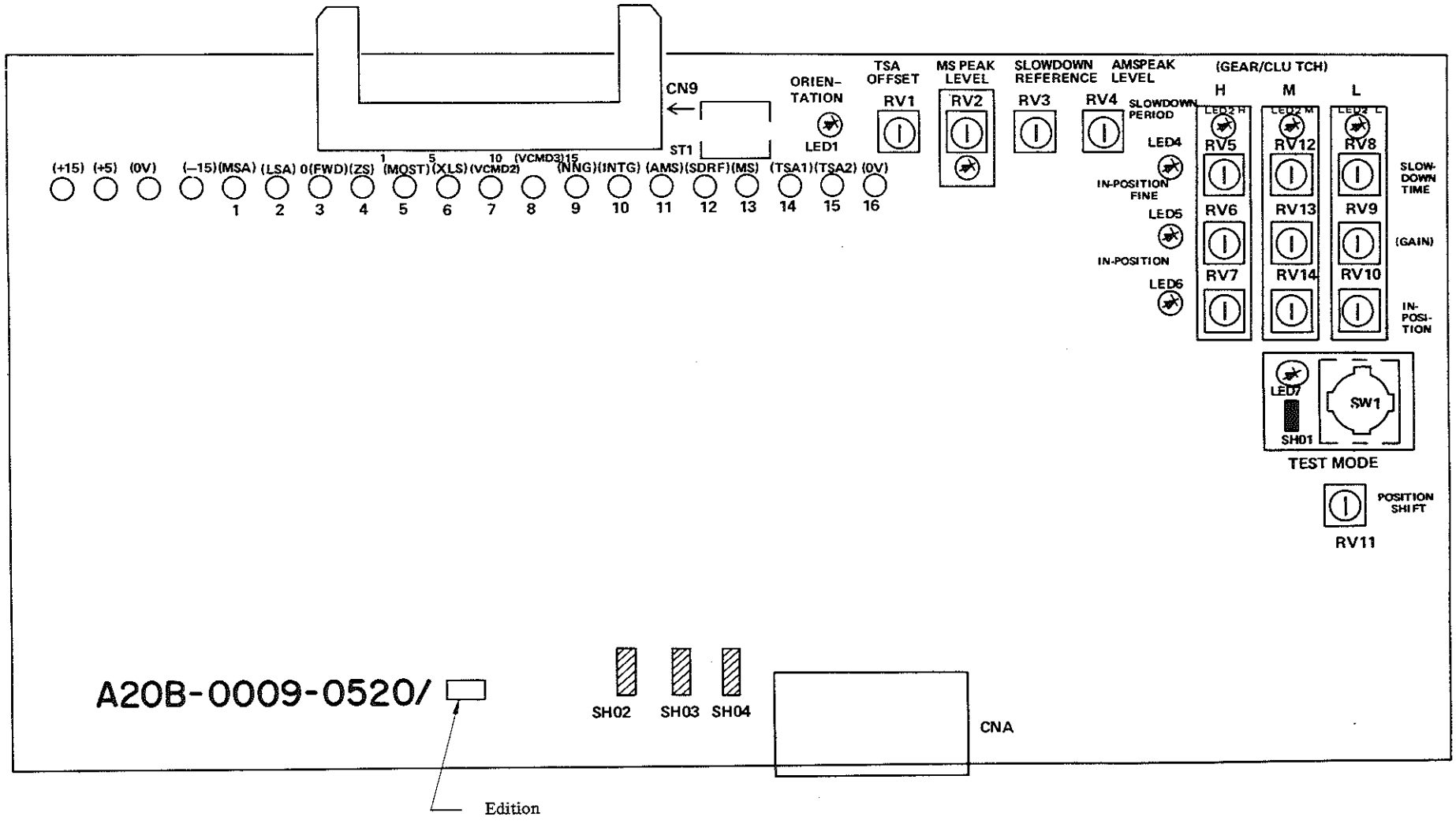
(Note 1) Adjust RV3 and RV4 based on the distance (Hmm) from the center of the spindle to the sensor as listed below.

H (mm)	50	60	70	80	90	100	110	120
Position RV3, 4	9.5	6.5	4.5	3.0	2.2	1.5	1.0	0.5





Scale



Check terminals and variable resistor location on the PCB

4) Confirmation of the spindle position loop gain
The spindle position loop gain should be tested after orientation stop control circuit adjustment by using the procedure outlined in the next table.

Spindle position loop gain	
Procedure	
1	Connect SH01 pins, to enter Test Mode (LED7 goes on).
2	Disconnect SH04 1-2 and 2-3 pins to remove limits.
3	Measure the number of spindle revolutions $N_{S(H)}$ and $N_{S(L)}$ (r.p.m) when SW1 (INITIALIZING BUTTON) is on, for each of the following conditions. Spindle clutch (gear) HIGH (*CTH1 and 2 not connected) Spindle clutch (gear) LOW (*CTH1 and 2 connected)
4	The spindle position loop gain can be determined using the following equations: $K_{p(H \text{ or } L)} = N_{s(H \text{ or } L)} \div 55(\text{sec}^{-1})$, where $K_{p(H)}$: Position loop gain for spindle HIGH gear (clutch) $K_{p(L)}$: Position loop gain for spindle LOW gear (clutch)

6.6.2 For position coder system

1) Printed circuit board
Spindle control circuit A20B-0009-0530 - 0534
Position coder method spindle orientation control circuit
a) Stop position internal setting A20B-0008-0240
b) Stop position external setting A20B-0008-0241

2) Display

Light emitting diode

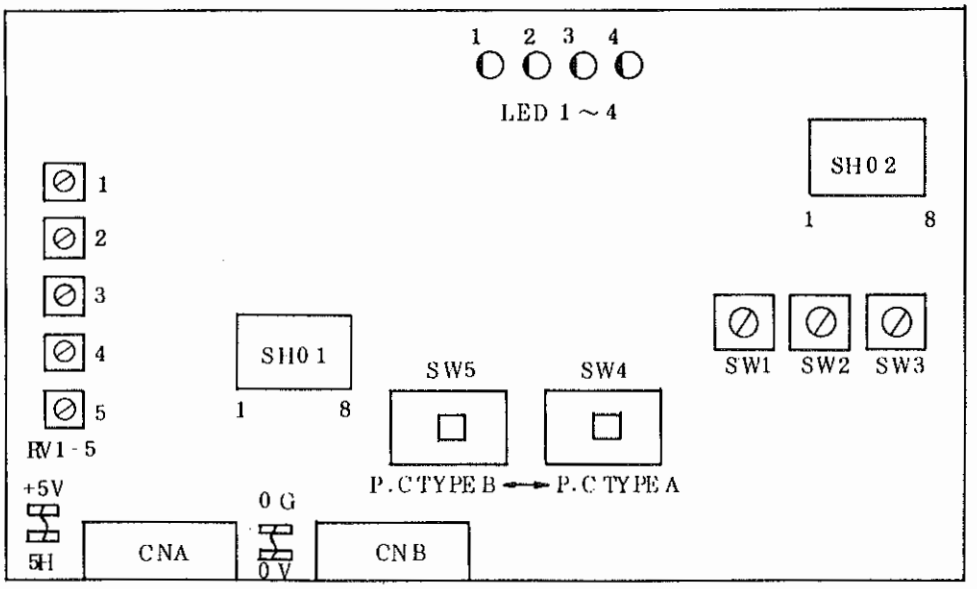
LED1 ORIENTATION ..... Lights when orientation command (ORCM1, 2 ON) is issued.

LED2 LOW ..... Lights when the contact of clutch change signal *CTH is closed. Lighting indicates that clutch LOW is selected.

LED3 IN-POSITION OUT ..... Lights when orientation completion signal ORAR 1-2 is issued.

LED4 IN-POSITION ADJUST ... Lights when spindle enters within one pulse of orientation position.
Stop position can be the same at HIGH and LOW by adjusting POT RV3/RV5 for OFFSET adjustment so that this LED lights at gear HIGH/LOW.

3) Setting



a) +5V - 5H When the power of +5V for position coder is supplied from spindle amplifier, connect between +5V and 5H and between 0G and 0V. When the power of +5V is supplied from NC, open between +5V and 5H between 0G and 0V.
0G - 0V

b) Setting of SW5 and SW4

Position coder	Type	SW4	SW5
Balanced type	Type A	Right	Right
Unbalanced type	Type B	Left	Left

c) Setting of SH01 and SH02
Follow the next table.

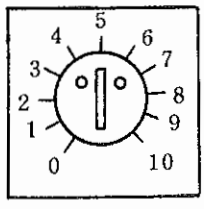
d) Setting of stop position SW1, 2, 3

Switch	Contents
SW1 (16 positions)	1 position is 4096/16 = 256 pulses, equivalent to 22.5°
SW2 (16 positions)	1 position is 256/16 = 16 pulses, equivalent to 1.4°
SW3 (16 positions)	1 position is 16/16 = 1 pulse, equivalent to 0.088°

An arbitrary position in a rotation can be positioned by the unit of 0.088° = 1/4096 x 360° by setting in the order of SW1, 2 and 3.

4) Adjustment

No.	Item	Variable resistor	Measuring point	Standard Adjustment	Note
1	Velocity feedback offset	RV1	TSA2 CH14	5 scale	The voltage at TSA2 should be ±1 mV.
2	Position gain at gear High	RV2	Do not let spindle overshoot.	3 - 4 scale	
3	Offset at gear High	RV3	Let LED4 ADJUST light.	About 5 scale	Gleaming of the LED is sufficient.
4	Position gain at gear Low	RV4	Do not let spindle overshoot.	3 - 6 scale	
5	Offset at gear Low	RV5	Let LED4 ADJUST light.	About 5 scale	



Scale of variable resistor

Table 1 Setting of SH01 and SH02

o: Connected x: Open

No.	Contents		SH01								SH02								Remarks
			1 o 16	2 o 15	3 o 14	4 o 13	5 o 12	6 o 11	7 o 10	8 o 9	1 o 16	2 o 15	3 o 14	4 o 13	5 o 12	6 o 11	7 o 10	8 o 9	
1	Initial orientation direction immediately after turning on power	CCW	o	x															(Standard)
		CW	x	o															
2	Orientation direction after initial orientation	CCW only			x	o													(Standard)
		CW only			x	x													
		Spindle rotational direction			o	x													(Standard)
3	Orientation speed which is set by position gain	1					x	x											
		2/3					o	x											
		1/3					x	o											
4	Rotational direction of spindle and position coder	Same direction							o	x									Different from machine tool to machine tool, Incorrect setting will cause hunting.
		Reverse direction							x	o									
5 (Note)	In-position width to issue orientation completion signal (ORAR 1, 2)	±2 pulses									o	o	o	o	o	o			±16 pulses correspond to ±1.3°
		±4 pulses										o	o	o	o	o			
		±8 pulses											o	o	o	o			
		±16 pulses												o	o	o			
		±32 pulses													o	o			
		±64 pulses														o			
6	Setting due to position coder hysteresis	No pulse															x	x	(Standard)
		+1 pulse															o	x	
		-1 pulse															x	o	

(Note) The condition (c) of issue of orientation completion signal
c = (Spindle is within the in-position width) and (Velocity zero signal is ON) and (ORCM is ON)

7. REPLACING METHOD OF PCB AND UNITS

7.1 Replacing Method of Power Supply Unit

1) For 10/11/100/110 series

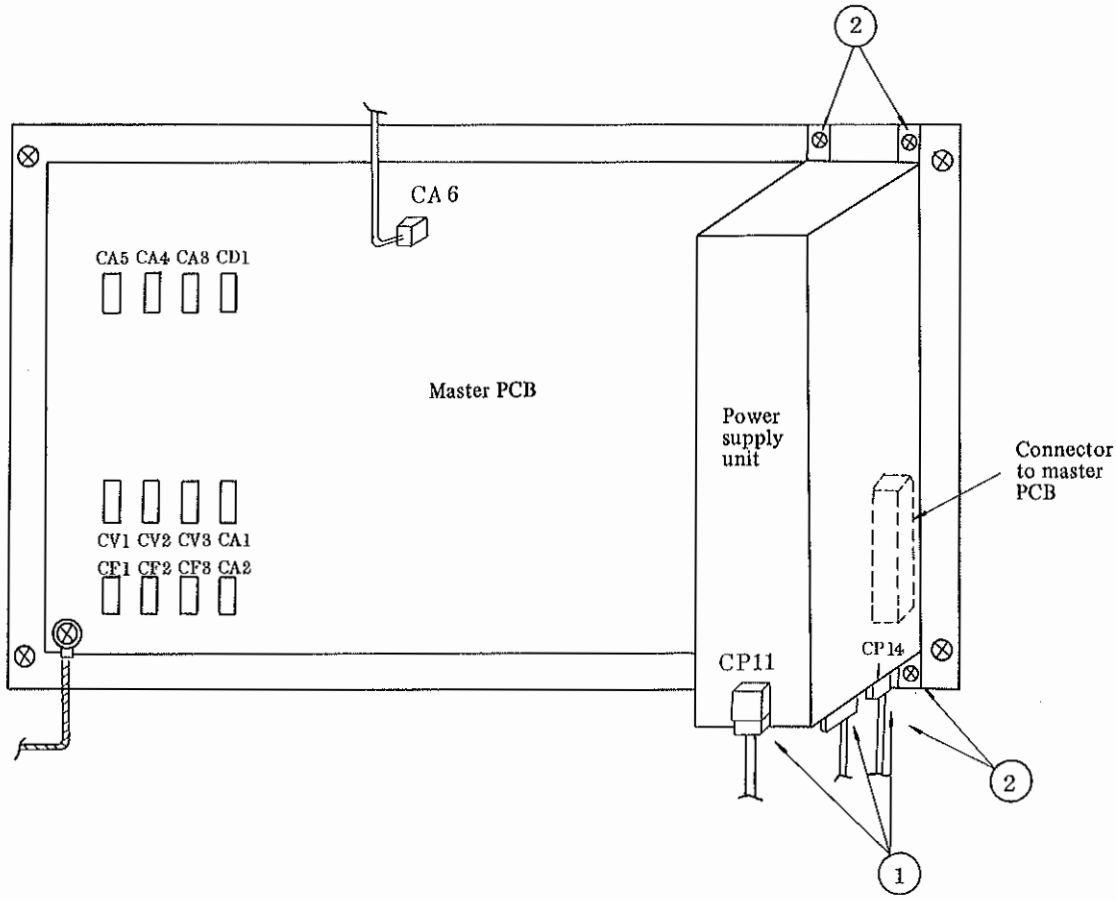
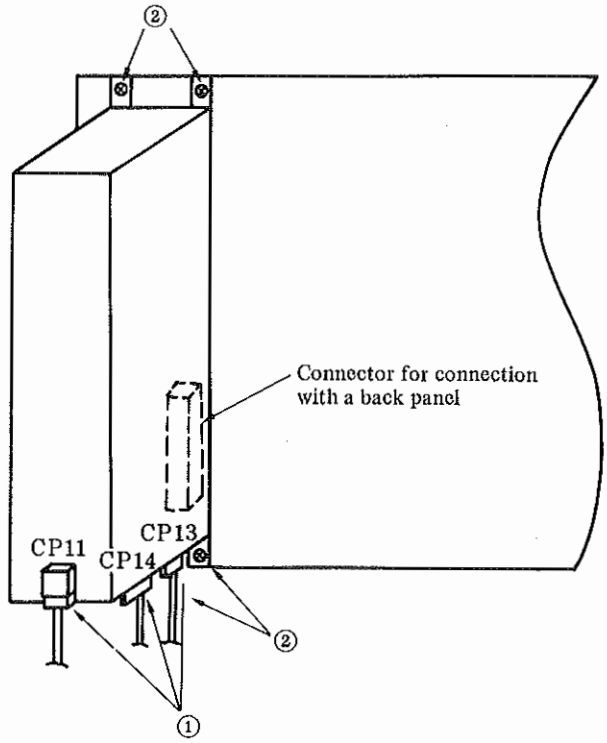


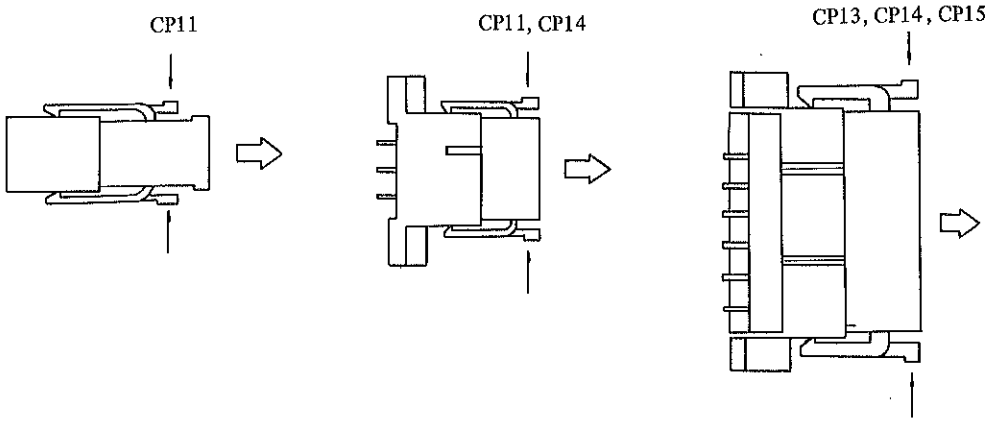
Fig. 7.1 (a) Power supply unit mounting position for 10 and 11 series

2) For 12/120 series



7.1.1 Procedure

1) Disconnect cables of connectors CP11, CP13, CP14, and CP15 as illustrated below.

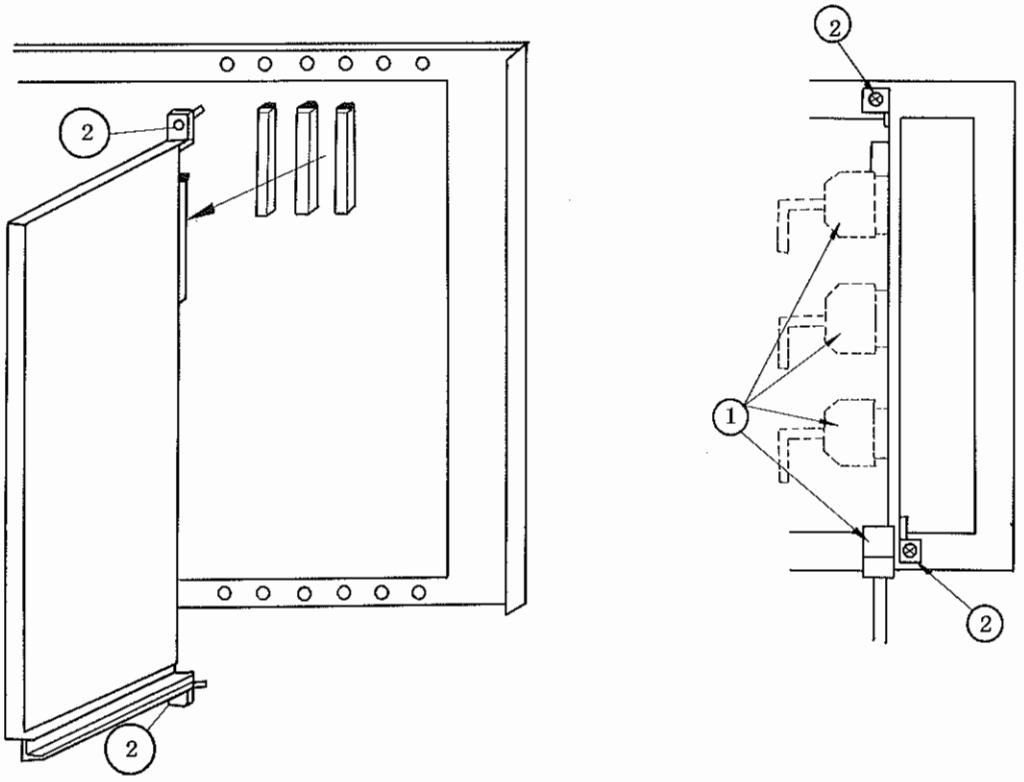


2) Detach the power supply unit by removing the four screws. The power supply unit is connected to the master PCB or back panel by the connector shown by a dotted line in the fig. 7.1 (a).
3) For mounting new power supply unit, reverse the above procedure 2) → 1).

7.2 Replacing Methods of Option PCB (for 10/11/100/110 series) and control PCB (for 12/120 series)

Replacement of the following PCBs connected to the master PCB or back panel is described.

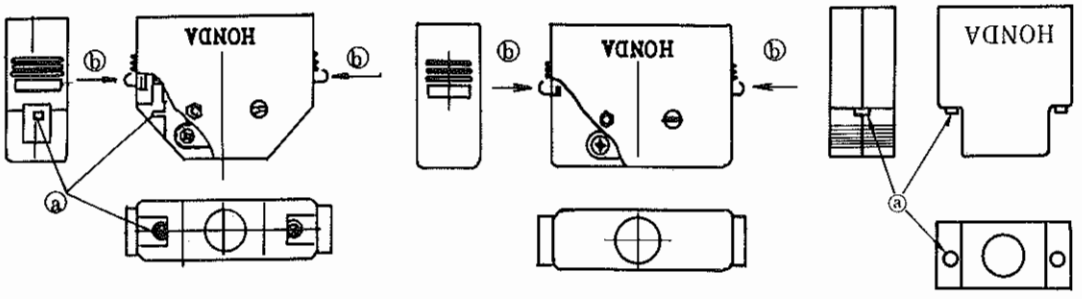
. Option card 1 . Additional axis + additional memory PCB (analog servo) . I/O card A1 - A3 . ROM/RAM board (digital servo) . Optical fiber interface PCB	For 10/110 series
. Bubble memory . Conversational function card . ROM/RAM card . Additional axis card (analog servo) . Resolver/inductosyn interface	For 11/110 series
. Axis control PCB (digital servo) . CRT/MDI adapter (100/110/120 series)	Common to 10/11/100/110 series
. A11 control PCB	For 12/120 series



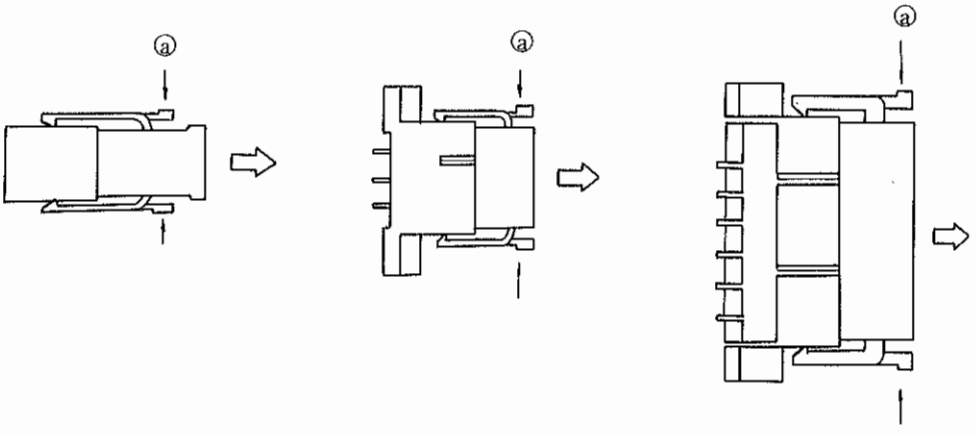
1) Procedure

(1) Disconnect cables from PCBs.

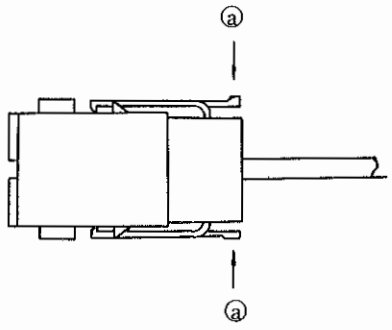
i) Disconnect HONDA connector by pushing part (b) after loosening two screws (a) as shown in the following figure.



ii) Disconnect NIHON BURNDY connector in the arrow (⇨) direction by pushing part (a) as illustrated below.



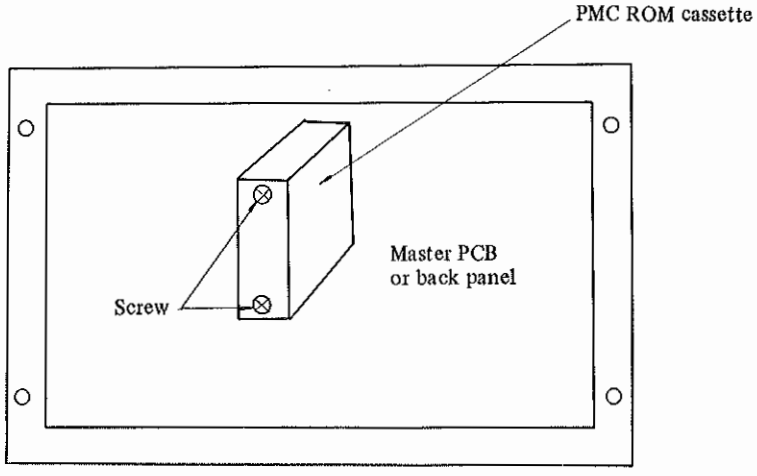
iii) Disconnect the optical fiber cable by pushing part a as illustrated below.



② Detach PCB by loosening two screws ②.
③ For mounting new PCB, reverse the above procedure ② → ①.

2) Setting
Set new PCB in the same way as in PCB before exchange.
3) Cautions
a) Additional axis + additional memory PCB
Check the number of mounted ROM and RAM, ROM No., and edition number.
b) Conversational PCB and ROM/RAM board
Check the number of mounted ROM and RAM, ROM number, and edition number.
c) Axis CPU PCB, Sub CPU PCB, main buffer PCB
Spindle control PCB ... Check the ROM number and edition number.
CRT/MDI adapter
d) Bubble memory PCB
* Check the specifications of bubble memory PCB.
* Clear all bubble memory and reset parameters, NC data, and other setting data without fail whenever the bubble memory PCB is replaced.
If resetting of parameters is neglected, an alarm may occur.

7.3 Replaceing Methods of PMC ROM Cassette



Detach the PMC ROM cassette after loosening the two screws in back.
Make sure that the same contents used in the old cassette are written into new ROM cassette.

7.4 Replacing Methods of Master PCB

1) Procedure
   ① Remove the power supply unit according to Sec. 7.1.
   ② Remove the option PCB according to Sec. 7.2
   ③ Remove the PMC ROM cassette according to Sec. 7.3.
   ④ Disconnect all cables from master PCB.

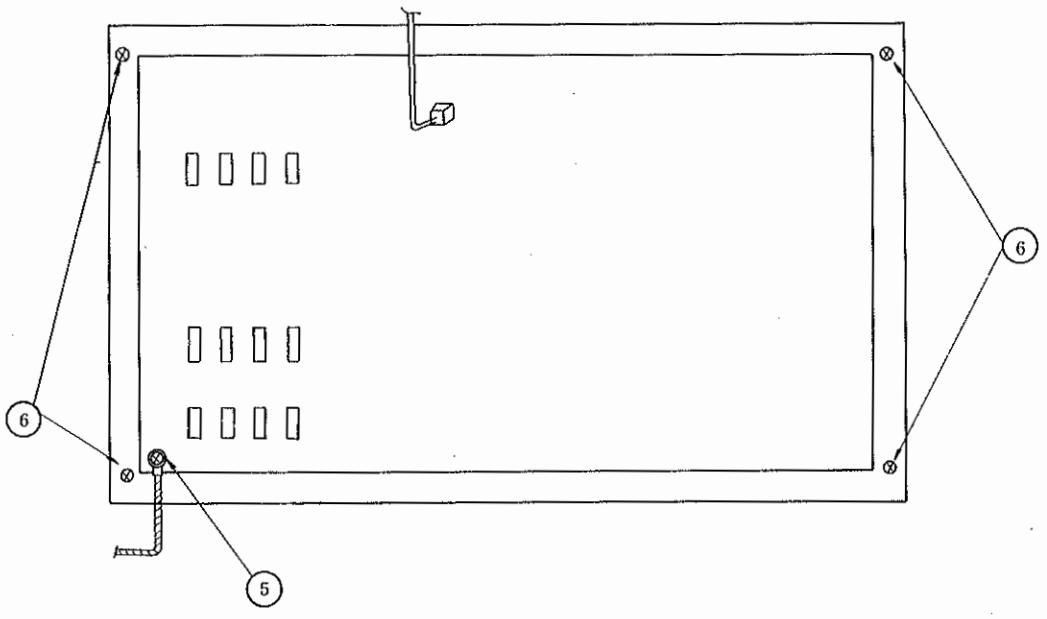


Fig. 7.4 (a) 10 series master PCB

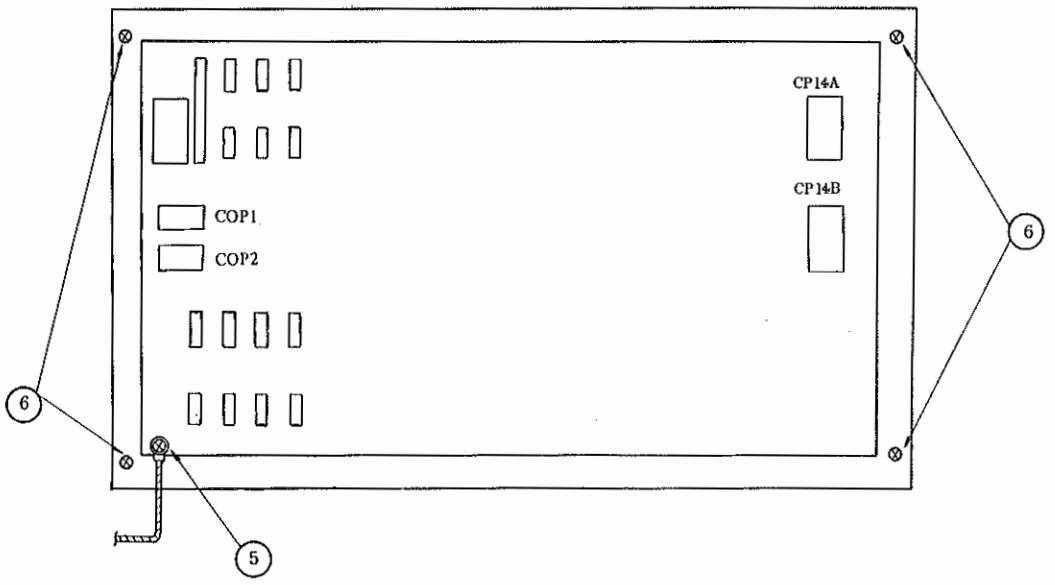
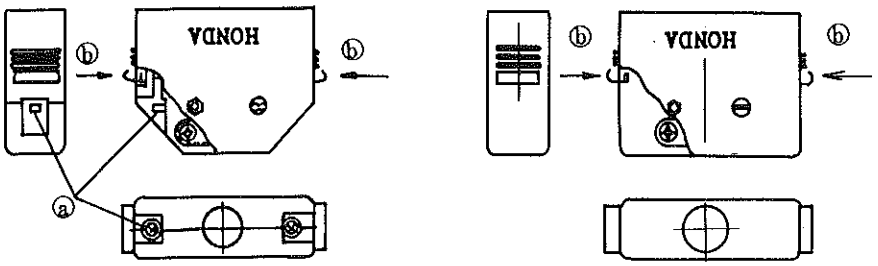


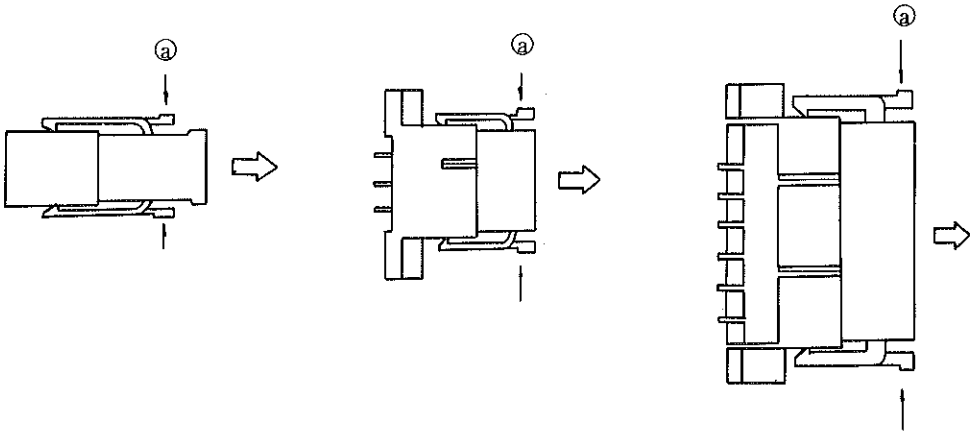
Fig. 7.4 (b) 11 series master PCB

Disconnect cables by the following procedures.

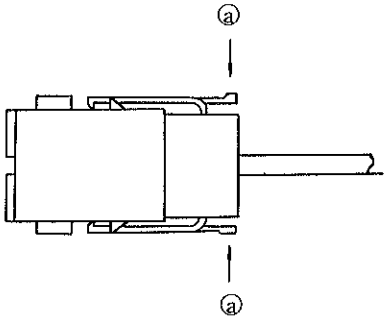
i) Disconnect HONDA connector by pushing part (b) after loosening two screws (a) as illustrated below.



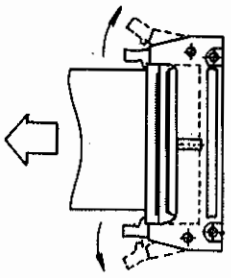
ii) Disconnect NIHON BURNDY connector in the arrow (⇨) direction by pushing part (a) as illustrated below.



iii) Disconnect optical fiber cable by pushing part (a) as illustrated below.



iv) Disconnect connector CAT cable in the arrow direction after unlocking it as illustrated below.



(Note) For connecting the cable, push it in the direction opposite to ⇐ after setting it to mark ▼ of the connector under the unlocked condition, and then, lock the cable. In this case, push the connector forcibly, or else the cable cannot be locked. The left figure shows the locked condition.

⑤ Disconnect the ground wire.
⑥ The master PCB can be removed by loosening the four screws shown in ⑥.
⑦ For mounting new PCB, reverse the above procedure ⑥ → ①.

2) Setting
① Setting on new PCB should be same as that on old PCB before exchange.
② For 10/100 series, check position control LSI, OPC (in case of small CRT/MDI), character generator (in case of small CRT/MDI), and ROM for normal mounting conditions.
③ For 11/110 series, check the position control LSI for normal mounting
④ condition.
For 10/100 series, a memory parity alarm occurs after replacing the master PCB. Reset parameters after clear the memory.

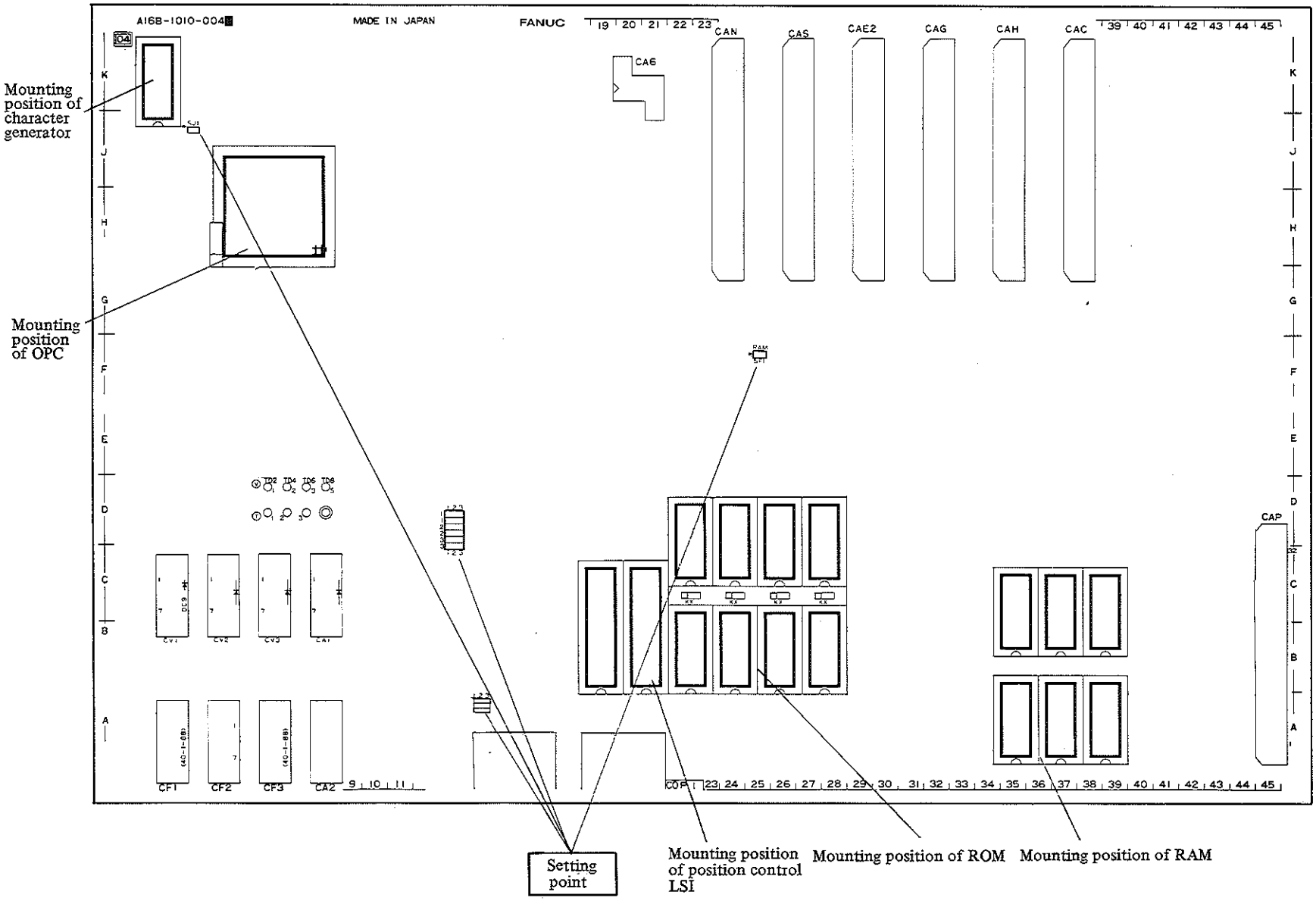


Fig. 7.4 (c) Check positions after replacing analog servo 10 series master PCB

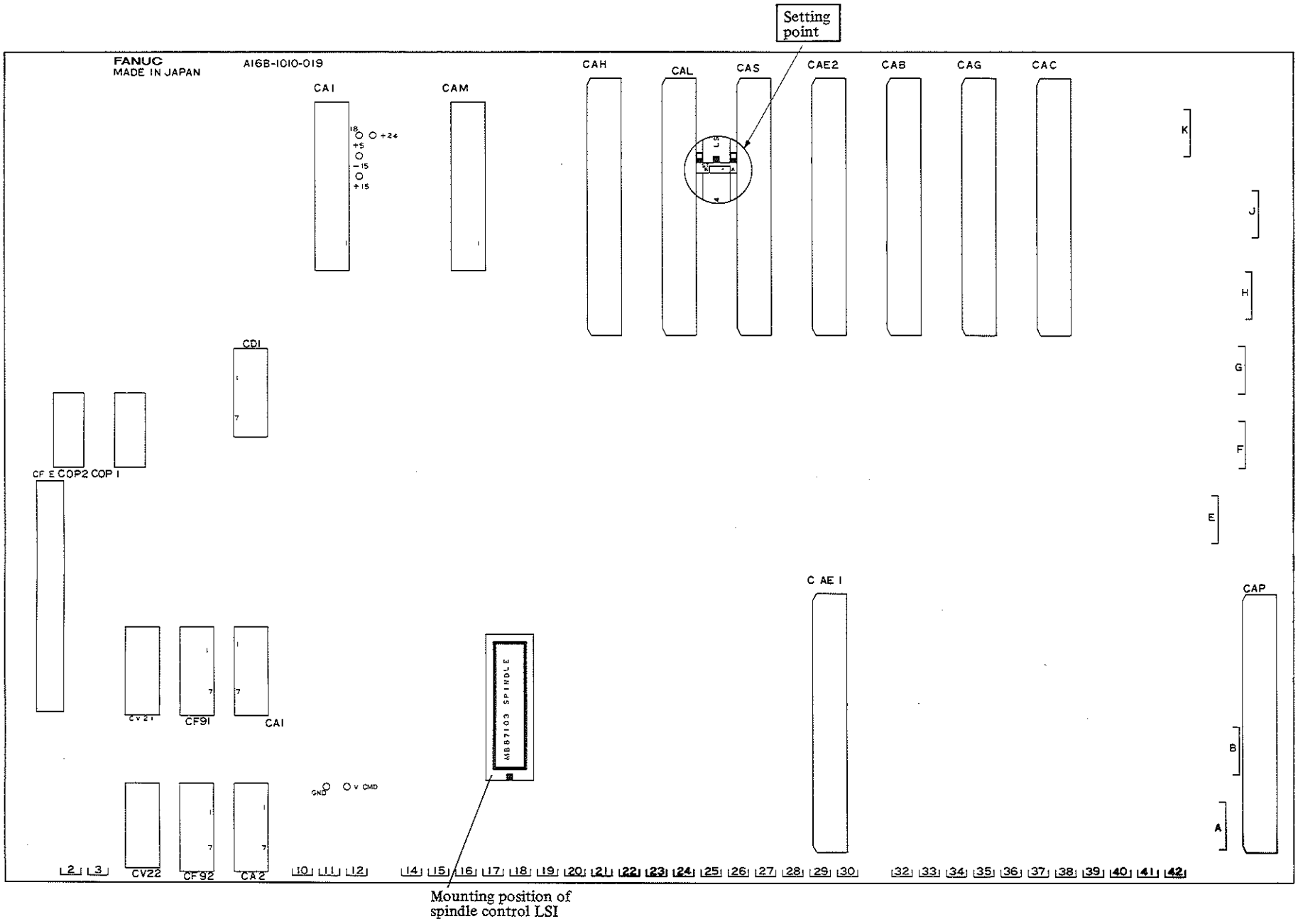


Fig. 7.4 (d) Check positions after replacing digital servo 10 series master PCB

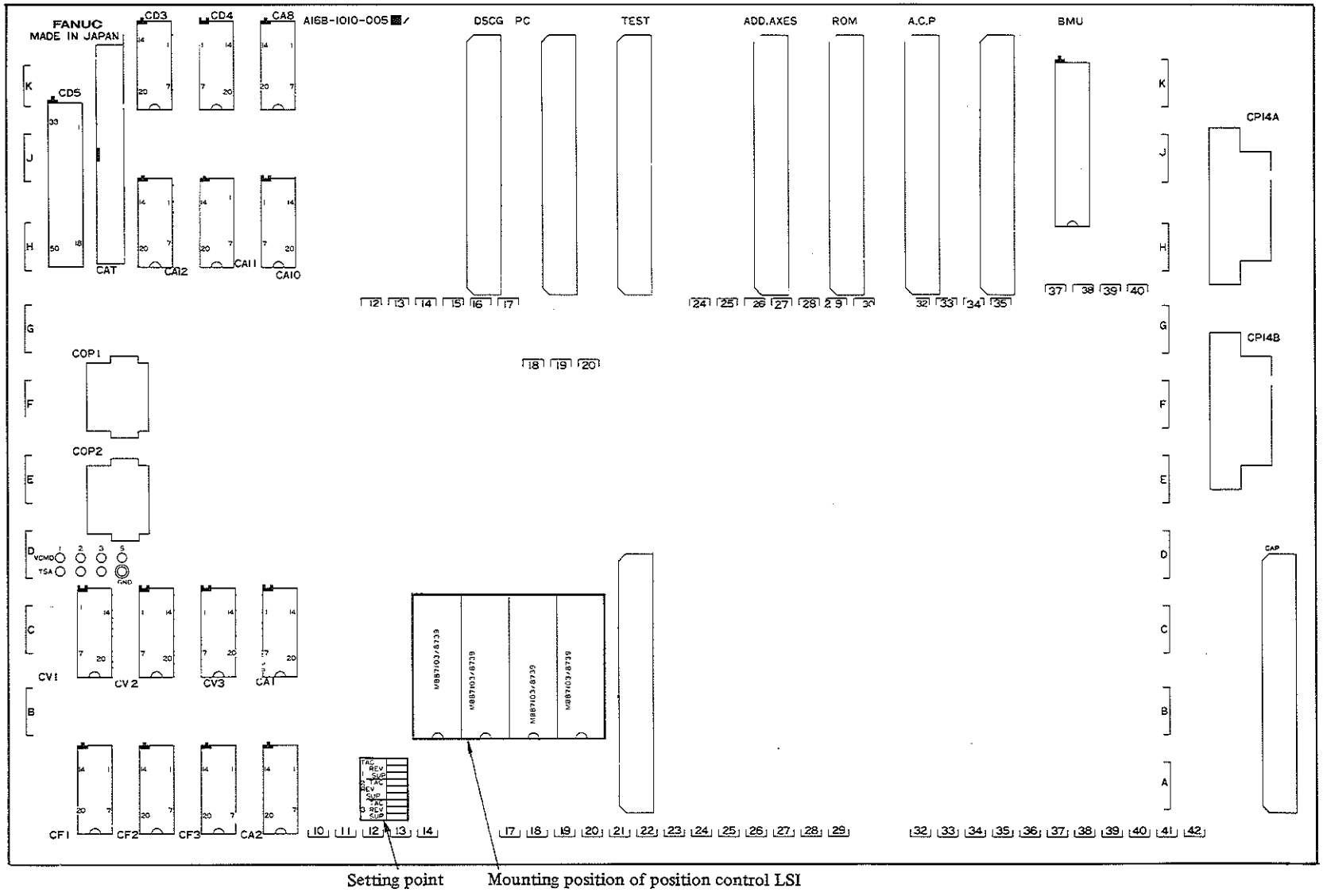


Fig. 7.4 (e) Check positions after replacing analog servo 11 series master PCB

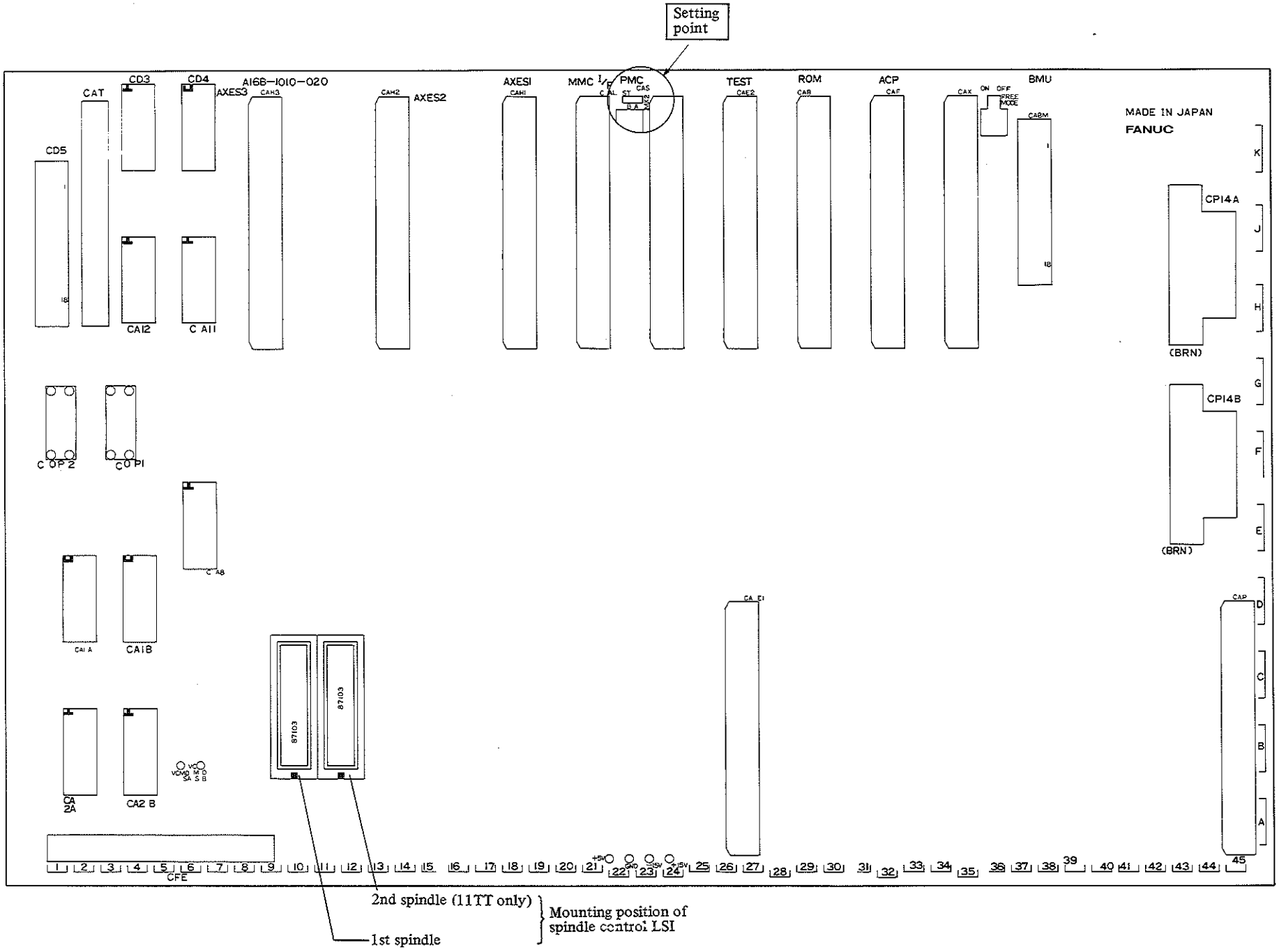


Fig. 7.4 (f) Check position after replacing digital servo 11 series master PCB

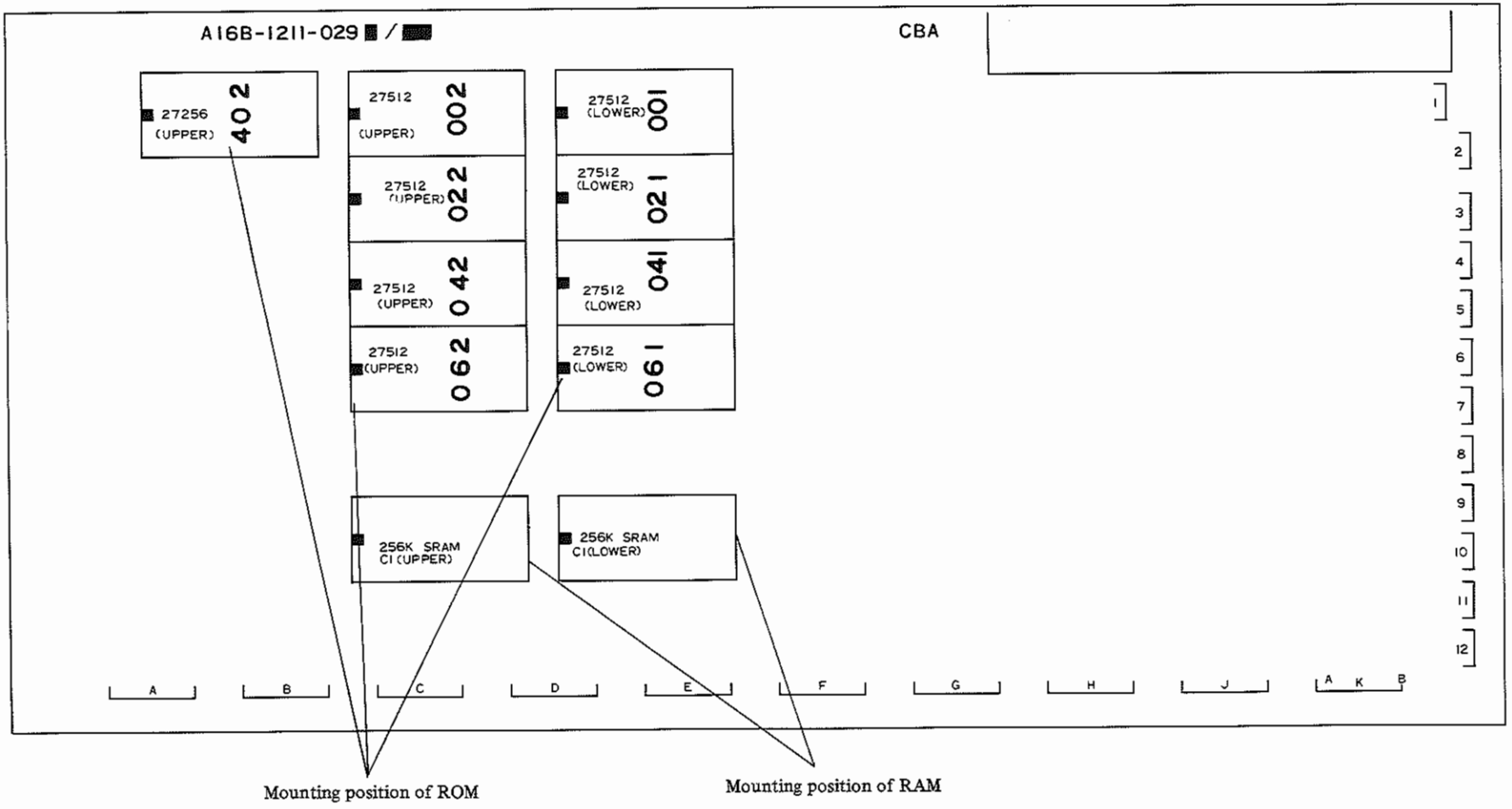


Fig. 7.4 (h) Check position after replacing digital servo 11 series ROM/RAM board

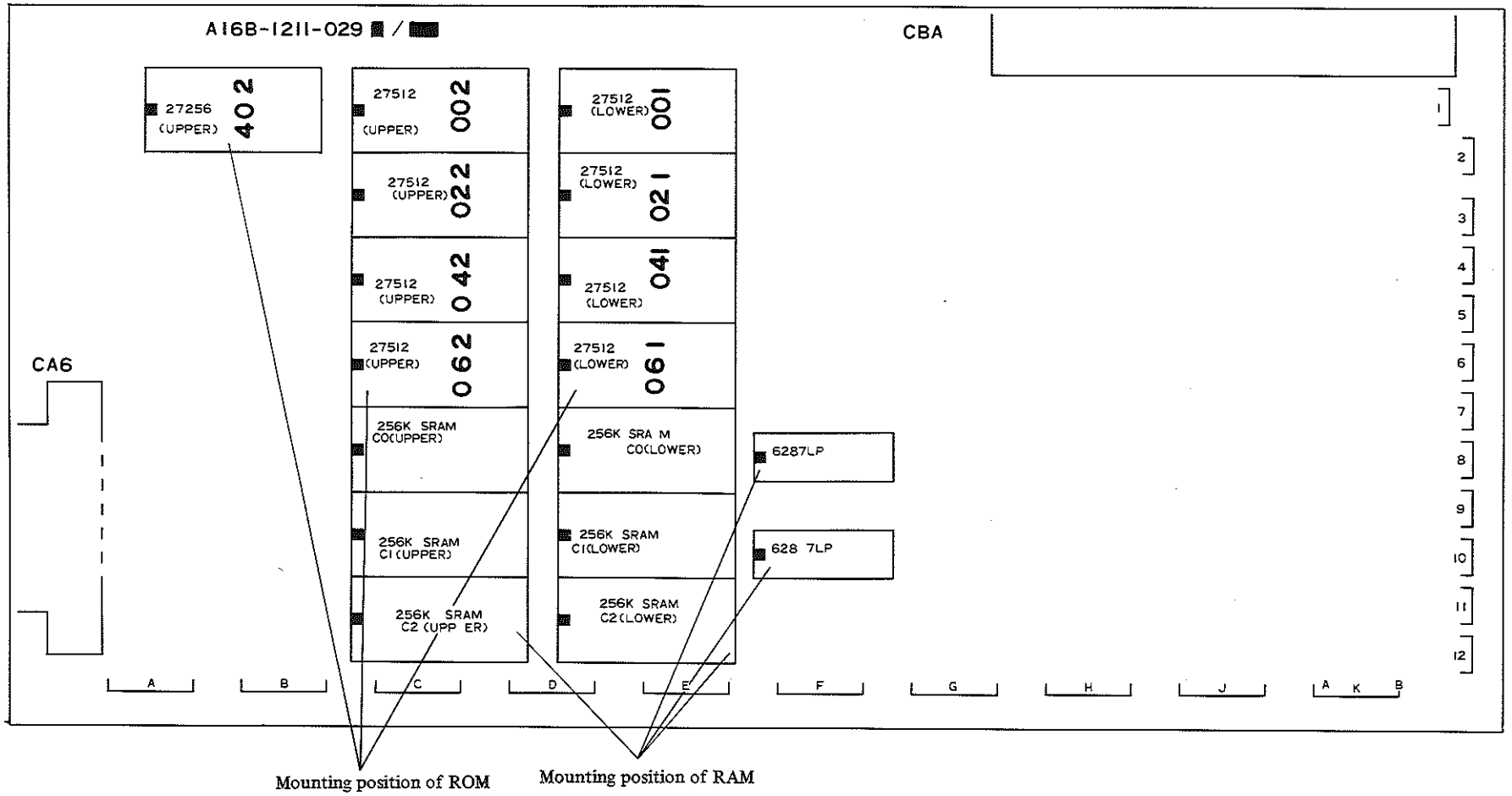
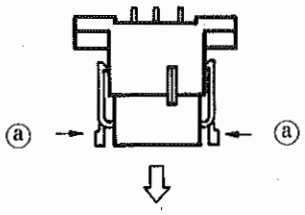


Fig. 7.4 (g) Check position after replacing digital servo 10 series ROM/RAM board

7.5 Replacing Method of 12/120 Series Back Panel

1) Procedure

① Remove the power unit according to 7.1.
② Remove the control PCB according to 7.2.
③ Remove the PMC ROM cassette according 7.3.
④ Disconnect the cable connected to connector CNG in the arrow direction (⟹) shown below pushing part ⓐ.

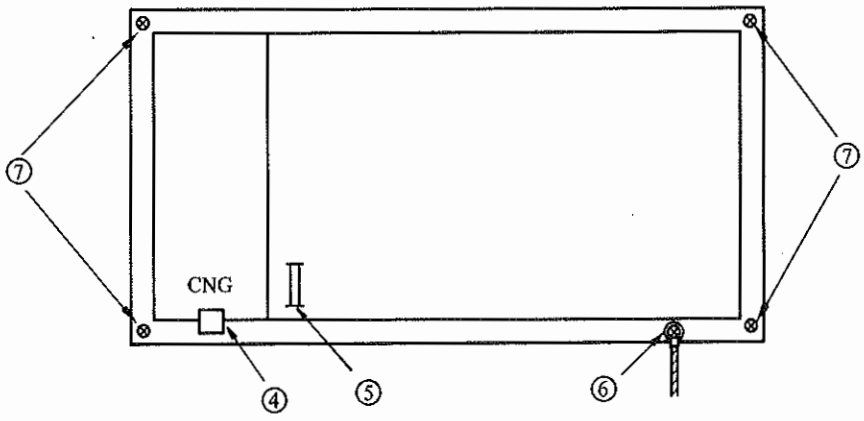


⑤ Disconnect the connector CAT ⑤ cable in the arrow direction after unlocking it as illustrated below.

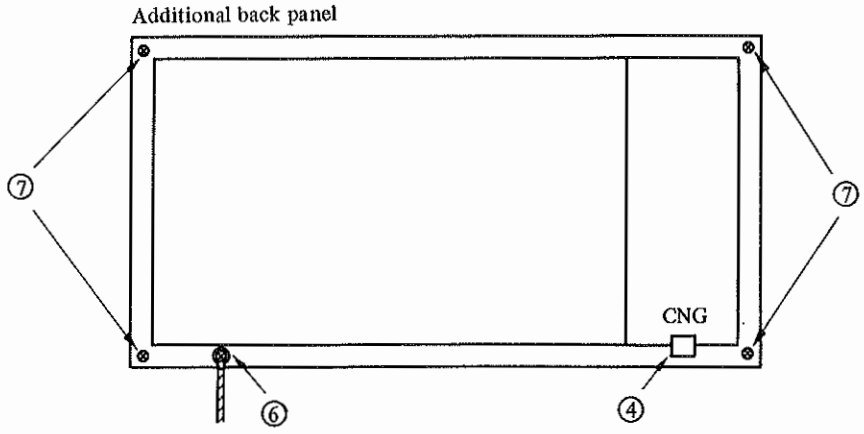
(Note) For connecting the cable, push it in the direction opposite to ⟸ after setting it to mark ▼ of the connector under the unlocked condition; lock the cable. In this case, push the connector forcibly, or else the cable cannot be locked. The left figure shows the locked condition.

⑥ Disconnect the earth cable.
⑦ The back panel can be detached by removing the four screws.
⑧ For mounting new back panel, reverse the procedure ⑥→ ①.

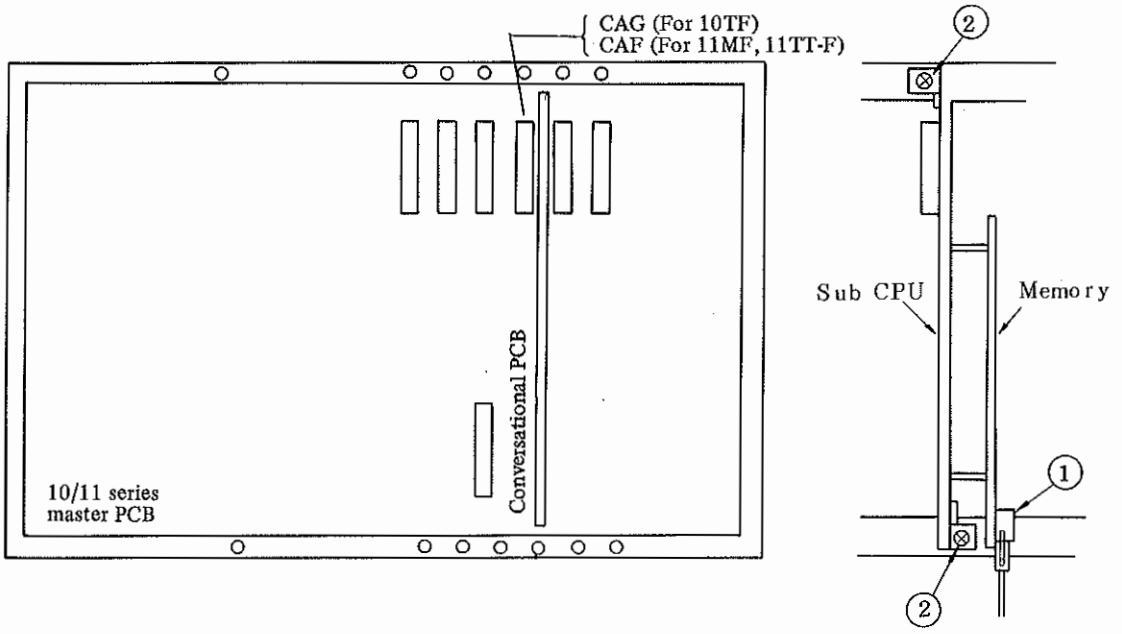
Basic back panel



Additional back panel

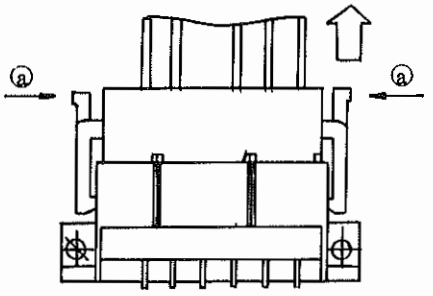


7.6 Replacing Methods of 10TF, 11MF, 11TT-F Conversational PCB



1) Replacement of both sub CPU PCB and memory PCB

① Disconnect the connector cable ① by pushing part ⓐ as illustrated.

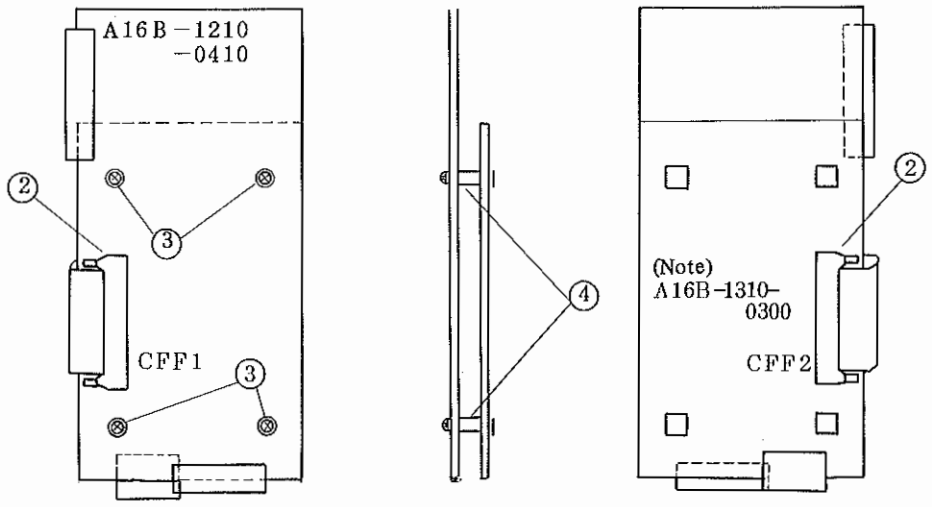


② Draw out PCB by loosening two screws ②.
③ For mounting new PCB, reverse the above procedure ② → ①.

(Caution)
1) Check the number of mounted ROM/RAM, ROM NO., and edition number.
2) In case 10T-F or 11TT-F, a conversational memory parity alarm occurs after replacing PCB.
Clear all submemory.

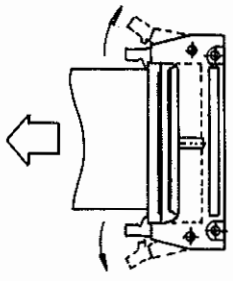
2) Replacement of either sub CPU PCB or memory PCB

① Detach PCB from the master PCB in the same way as described above.



Note) The memory PCB specification is different depend on kind of NC and it's option.

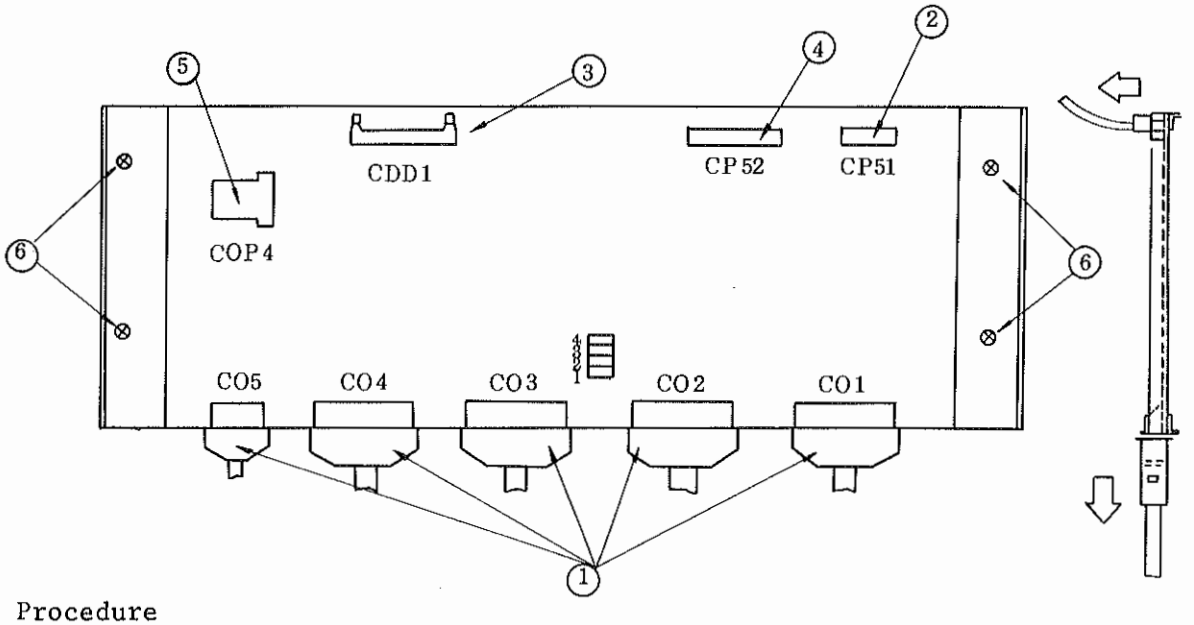
② Disconnect the connector CFF1/CFF2 ② cable in the arrow direction after unlocking it as illustrated below.



(Note) For connecting the cable, push it in the direction opposite to ⇐ after setting it to mark ▼ of the connector under the unlocked condition; then, lock the cable. In this case, push the connector forcibly, or else the cable cannot be locked.
The left figure shows the locked condition.

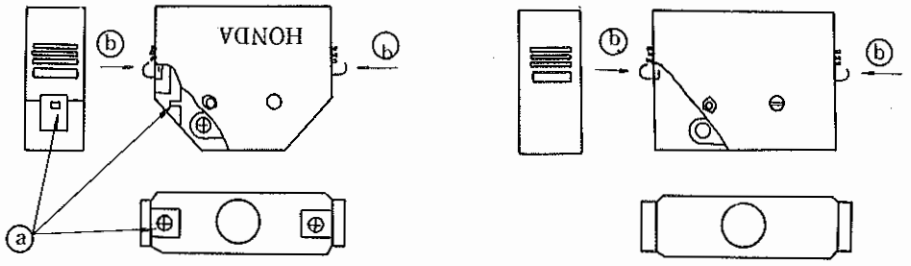
③ Sub CPU PCB can be detached by removing four screws ③.
④ Memory PCB can be detached by removing four spacers ④.
⑤ For mounting new PCB, reverse the above procedure ④ → ①.

7.7 Replacing Methods of Connection Unit 1

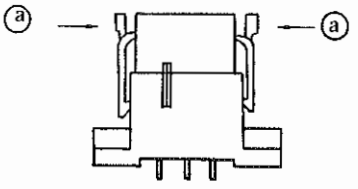


1) Procedure

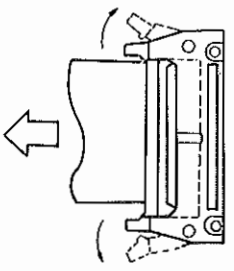
① Disconnect CO1 - CO5 connector cables by pushing part ⓑ after loosening two screws ⓐ as illustrated below.



② Disconnect CP51 connector cable by pushing ⓐ as illustrated below.

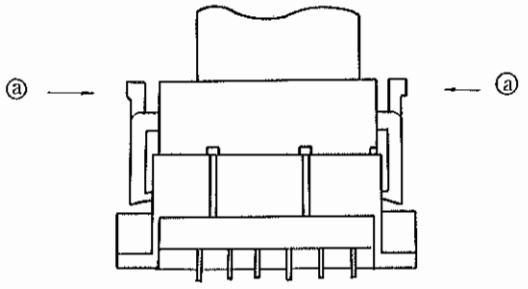


③ If connection unit 2 is mounted, disconnect connector CDD1 cable in the arrow direction after unlocking it as illustrated below.

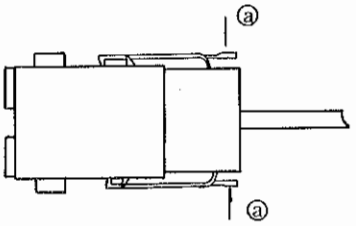


For connecting the cable, push it in the direction opposite to ⟸ after setting it to mark ▼ of the connector under the unlocked condition, then, lock the cable. In this case, push the connector forcibly, or else the cable cannot be locked.
The left figure shows the locked condition.

④ If connection unit 2 is provided, disconnect the CP52 connector cable by pushing ⓐ as illustrated below.



⑤ Disconnect the COP4 connector cable by pushing ⓐ as illustrated below.

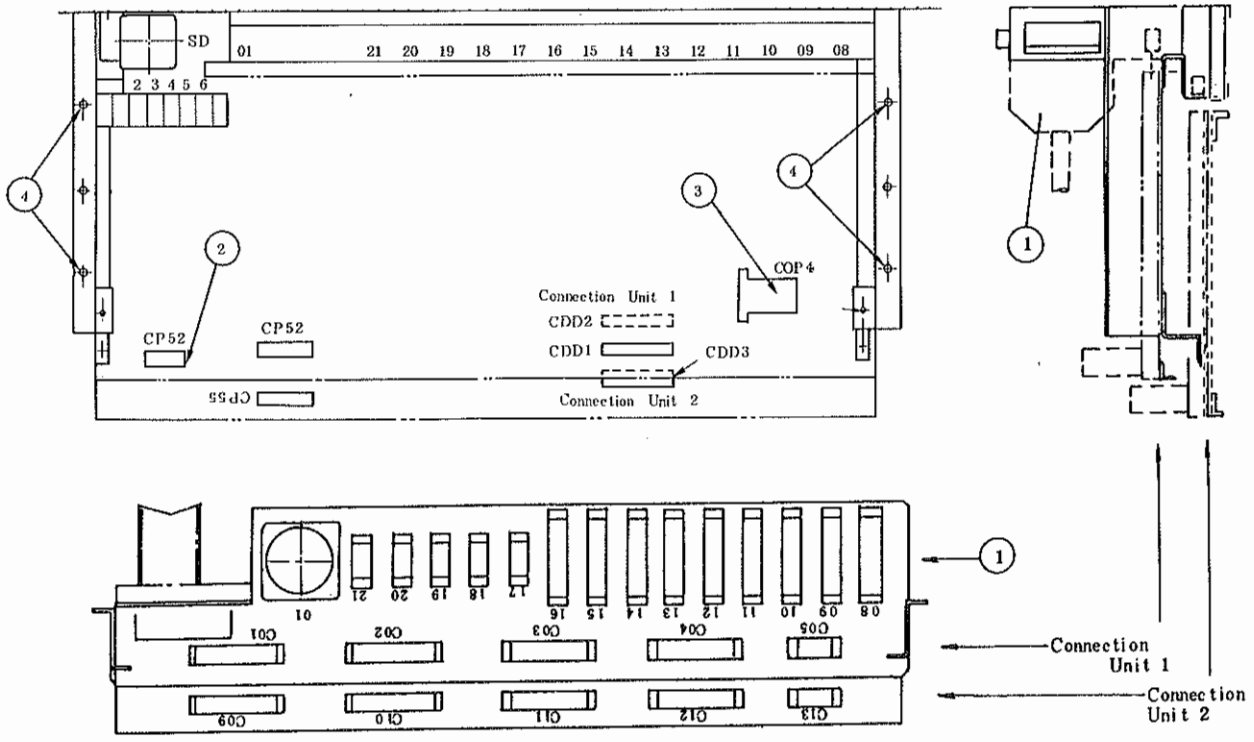


⑥ The connection unit is detached by removing the four screws shown in ⑥.

⑦ For mounting new PCB, reverse the above procedure ⑥ → ①.

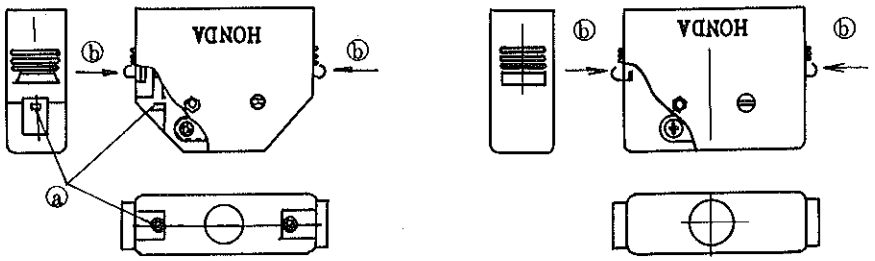
2) Setting
Perform setting (1 - 4) of new PCB in the same way as in old PCB before exchange.

7.8 Replacing Methods of Connection Unit (with Connecting Board)

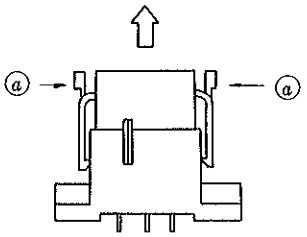


1) Procedure

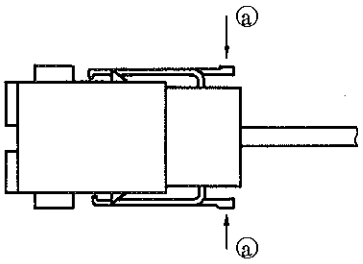
① Disconnect connector cables 08 - 21 by pushing ⓑ after loosening two screws ⓐ as illustrated below.



② Disconnect the CP51 connector cable by pushing ⓐ as illustrated below.



③ Disconnect connector COP4 cable by pushing ⓐ as illustrated below.



④ The unit can be detached by removing four screws ④.
⑤ Put the unit on the board as illustrated below.

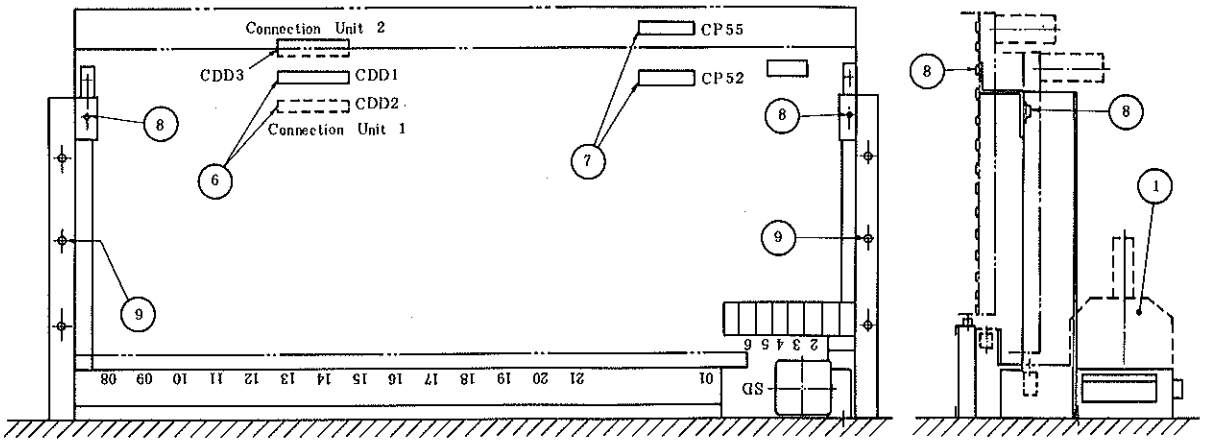
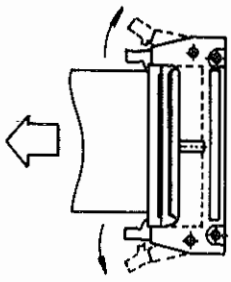


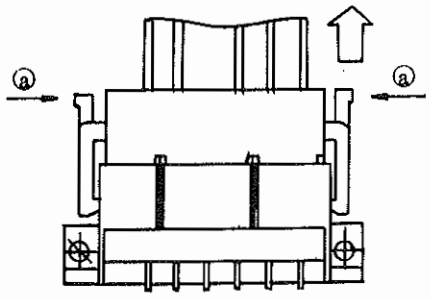
Fig. 2

⑥ Disconnect connector CDD1/CDD2 cable in the arrow direction after unlocking it as illustrated below.

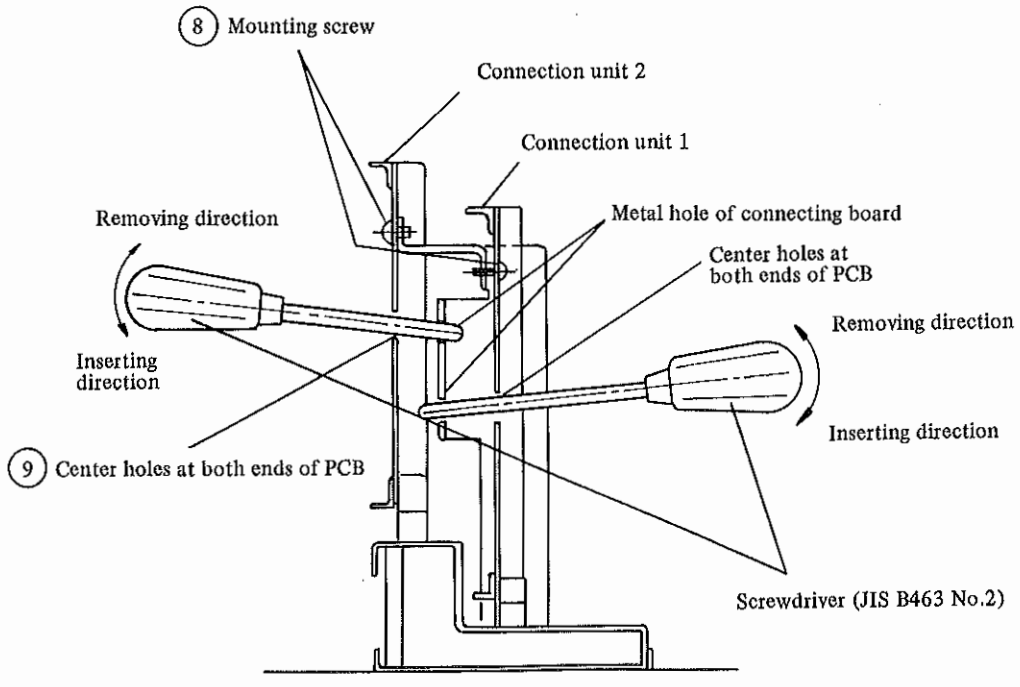


(Caution)
For connecting the cable, push it in the direction opposite to ⇐ after setting it to mark ▼ of the connector under the unlocked condition, then, lock the cable. In this case, push the connector forcibly, or else the cable cannot be locked.
The left figure shows the locked condition.

⑦ Disconnect the CDP connector cable by pushing ⓐ as illustrated below.



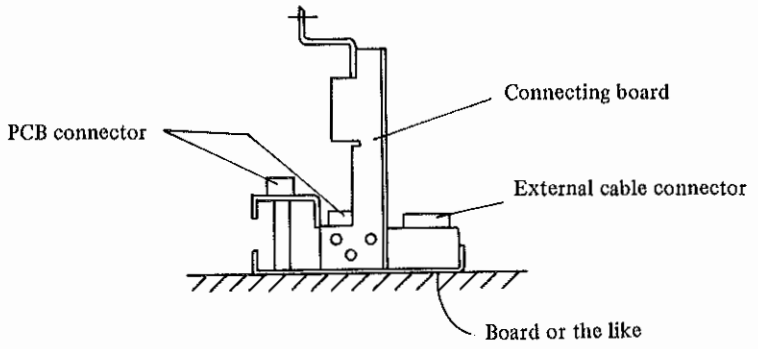
⑧ After removing the two right and left mounting screws ⑧ in the connection unit, insert screwdrivers into center holes ⑨ at both ends of the connection unit, and detach the connection unit by alternately lifting screwdrivers.



2) Setting

Perform setting on new PCB in the same way as in old PCB before exchange.
Mounting Methods
For mounting PCB (for DI/DO) used on the connecting board, observe the following procedure.

① Put the disconnecting board on a board or the like as illustrated below.



② Make sure the inserting directions of PCB connector and PCB connector on the disconnecting board; lightly push these connectors after positioning.

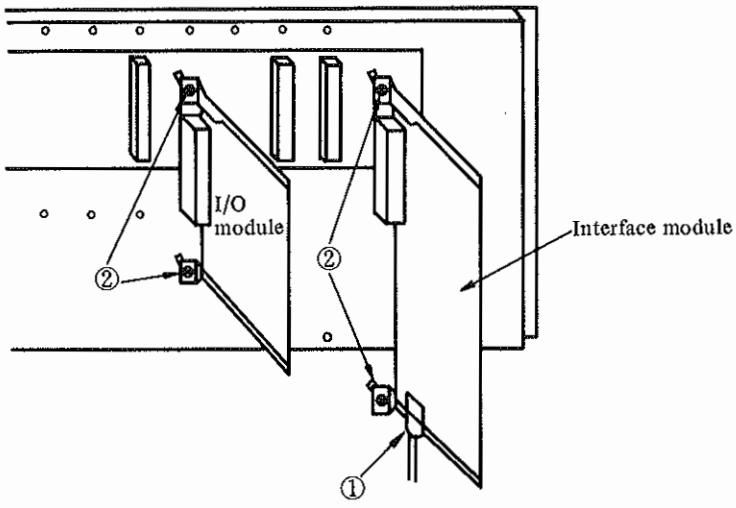
③ Insert a screwdriver into the center holes (ø8) at both ends of PCB and the hole (ø7) on the connecting board metal, and insert PCB by pushing the right and left of PCB downward alternately 2 - 3 times by means of lever. Fix the PCB by mounting screws ⑧ after inserting the connector.

(Caution)
Confirm the inserting direction of the connector, and check to see if the connector has been securely connected by lightly pushing it before starting the work, otherwise the connector may be broken.

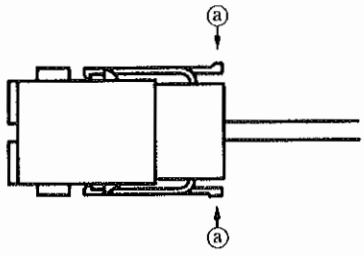
④ Mount the unit to NC by reversing the dismounting procedure ⑦ → ①.

7.9 Replacing Method of Built-in Type I/O Unit PCB (12/120 series only)

7.9.1 Replacing method of interface and I/O module



1) Procedure
   ① Detach the optical fiber cable for interface module the cable pushing part ⓐ as illustrated below.

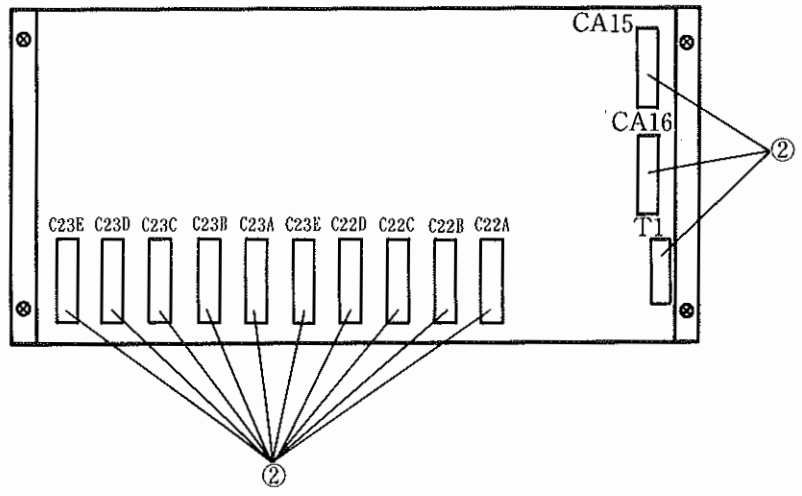


   ② The PCB can be detached by loosing two screws.
   ③ For mounting new PCB, reverse the above procedure ② → ①.
2) Setting
   ① Setting on new module should be same as that in an old interface module for exchange.

7.9.2 Replacing method of I/O base unit

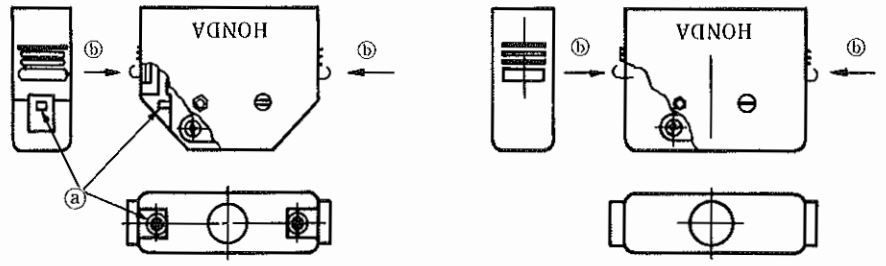
1) Procedure

① Detach the interface module and I/O module according to 7.9.1.
② Remove all cables connected to the I/O base unit.

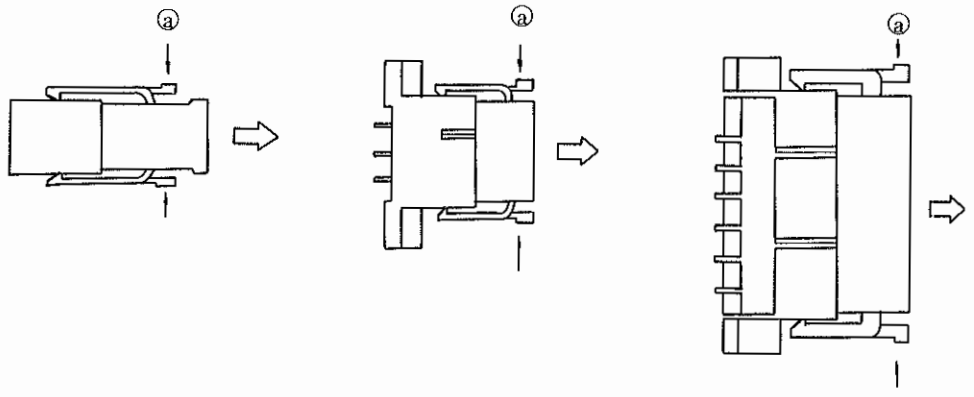


Disconnect cables using the following procedure.

i) Disconnect HONDA connector by pushing part ⓑ after loosing two screws as illustrated below.



ii) Disconnect NIHON BURNDY connection in the arrow (⇒) direction by pushing part ⓐ as illustrated below.



③ I/O base unit can be detached by unscrewing four screws Ⓐ.
④ For mounting new I/O base unit, reverse the above procedure ③ → ①.

7.10 Exchange Methods of I/O Unit

7.10.1 Exchange method of power supply module

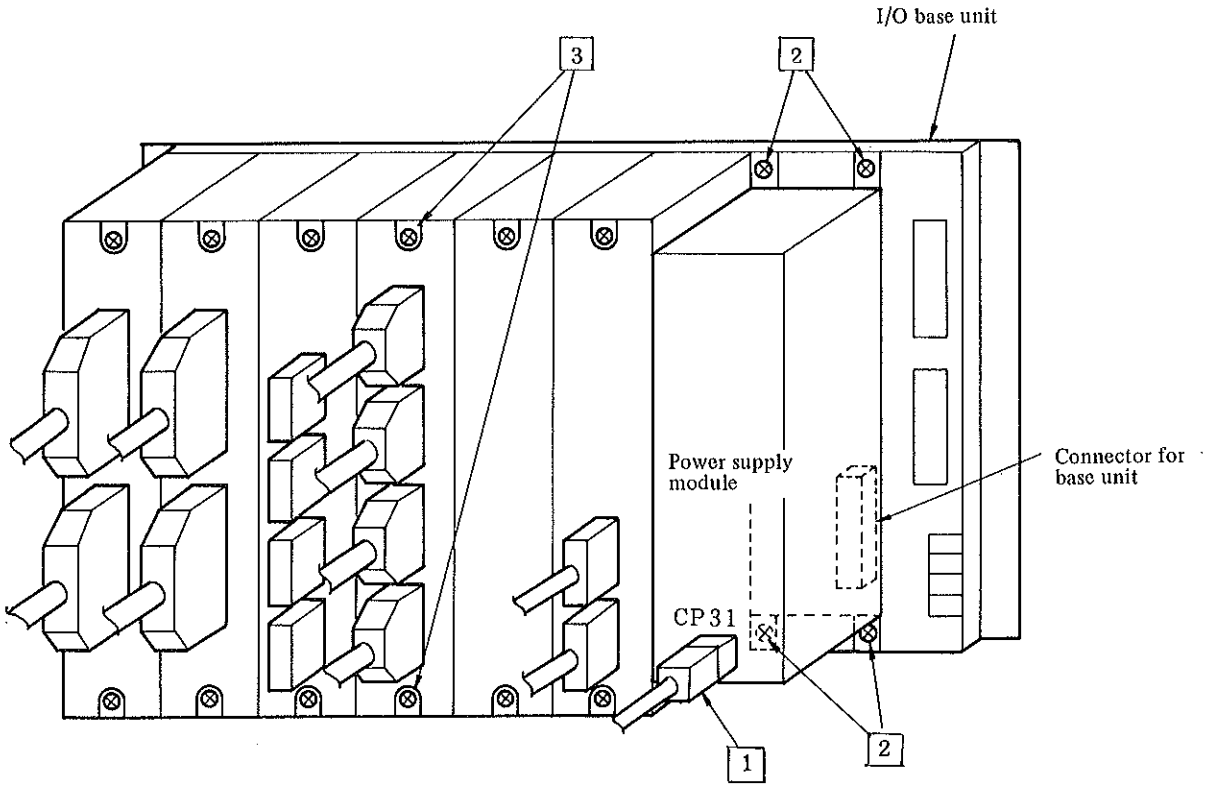
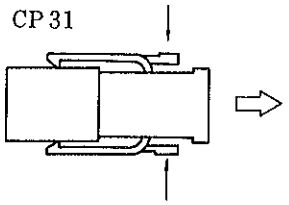


Fig. 7.10.1 Installation diagram of module

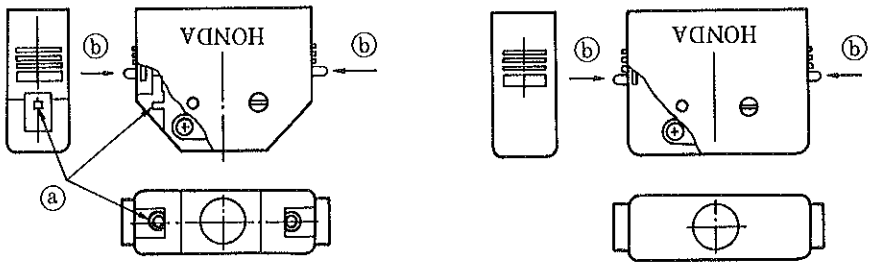
1) Procedure
   ① Draw out the connector CP31 cable [1] according to the illustrated procedure.



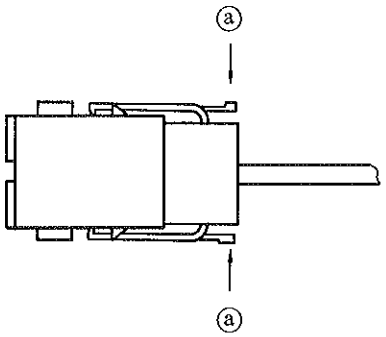
   ② Remove the power supply module by loosening four screws [2].
   The power supply unit is connected to the base unit by the connector shown by the dotted line in the figure 7.1.
   ③ Reverse the above procedure (② → ①) when mounting new module.

7.10.2 Exchange method of main control module and I/O module

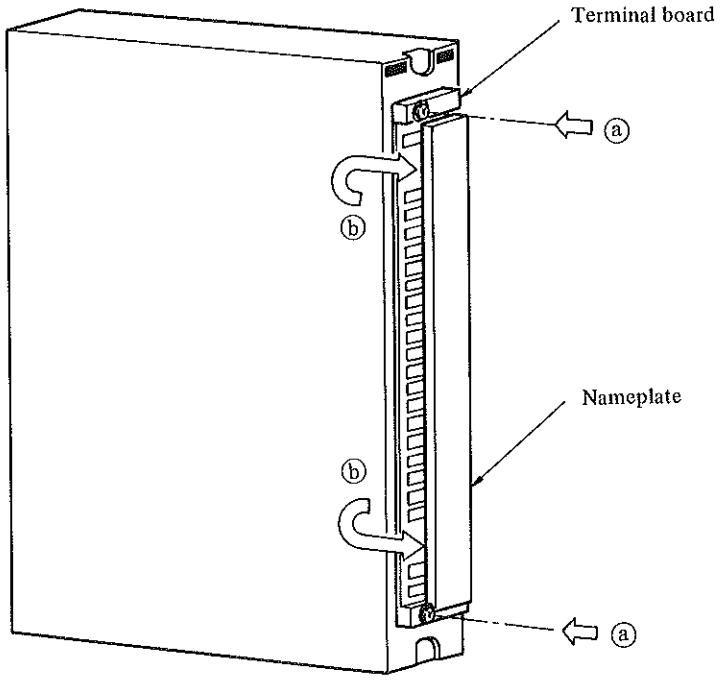
1) Procedure
Replace these modules according to the following procedure, referring to Fig. 7.10.1.
1 Disconnect cables from the modules (if connected).
Loosen two screws a and draw them out by pressing b in the case of the HONDA connector as shown below.



Draw out the optical fiber cable while pushing part a as illustrated below.



For the terminal board connection, remove the entire terminal board by drawing it toward you while holding its upper and lower ends after loosening the two screws a shown below.
For disconnecting the wiring, open the nameplate.
The nameplate is opened by drawing it toward you while applying your fingers to parts b shown in the following figure.

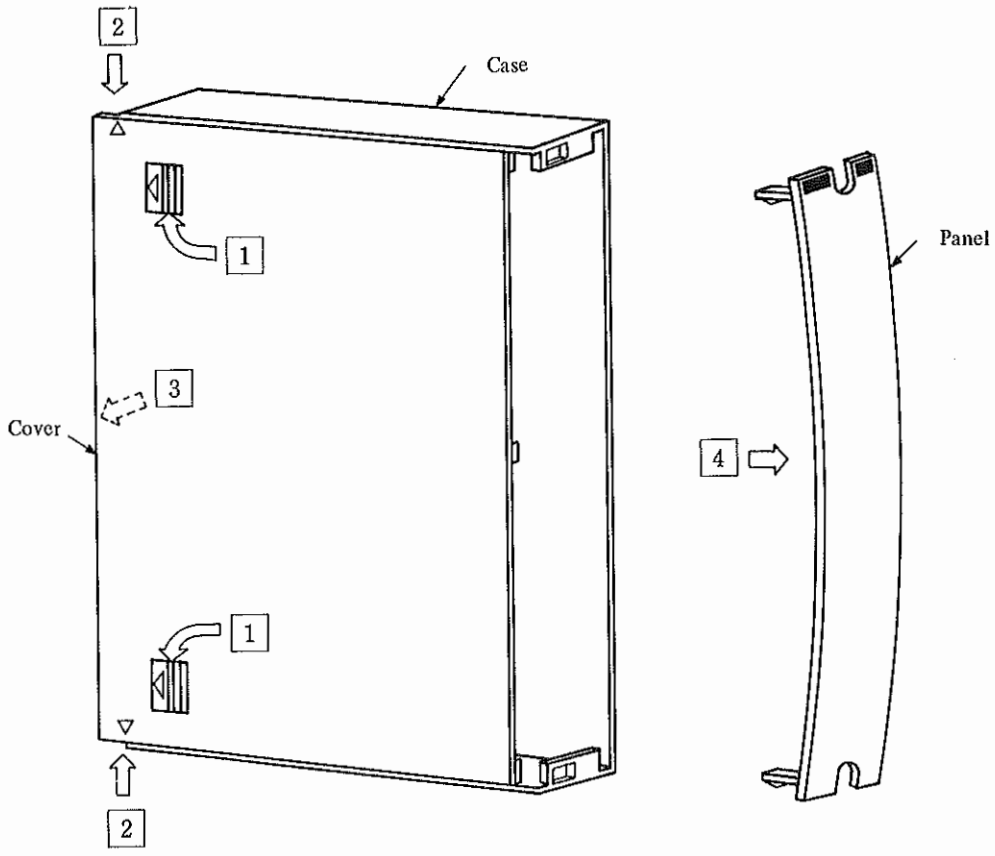


② Draw out each module after loosening the two screws shown in Fig. 7.1. Each module is connected to the base unit in the same way as in the power supply module.
③ Reverse the procedure (② → ①) when mounting new modules.

2) Setting
Set the new modules in the same way as in modules before exchange.

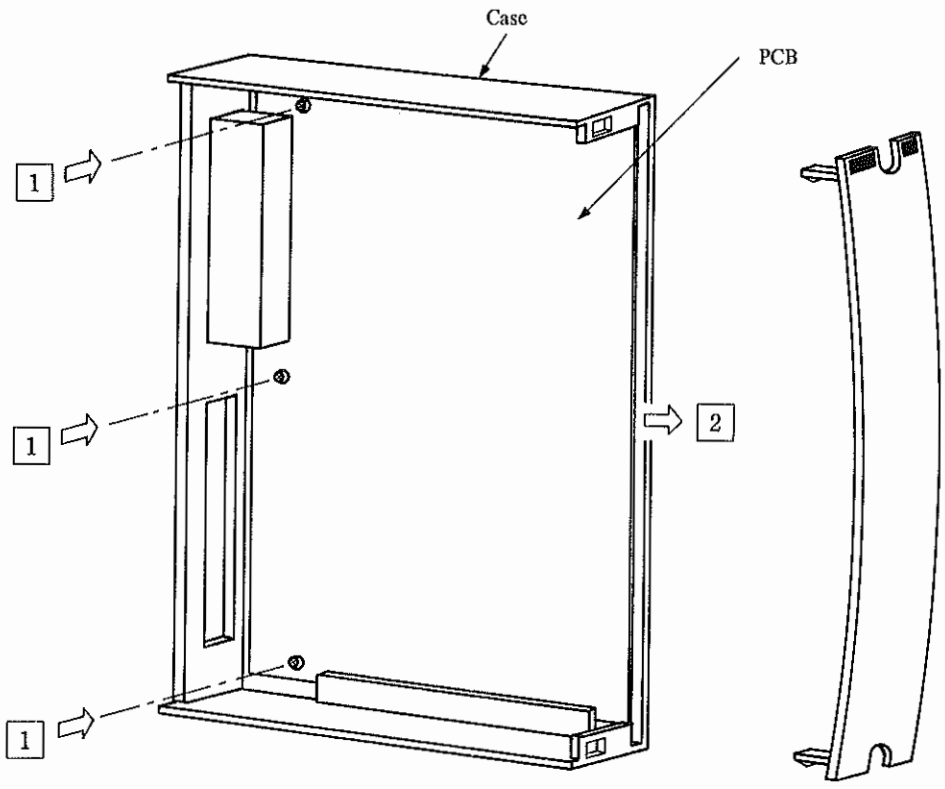
3) Cautions
a) Positioning module ... Check the mounting number of ROM (1 pce), the ROM number and edition number. Check the positioning control LSI.
b) Module for terminal board wiring
Detach the terminal board mounted on the module for replacement. Mount the detached terminal board on the module thats terminal board has been removed. (Return these modules with terminal boards mounted.)

4) Plastic case disassembly method



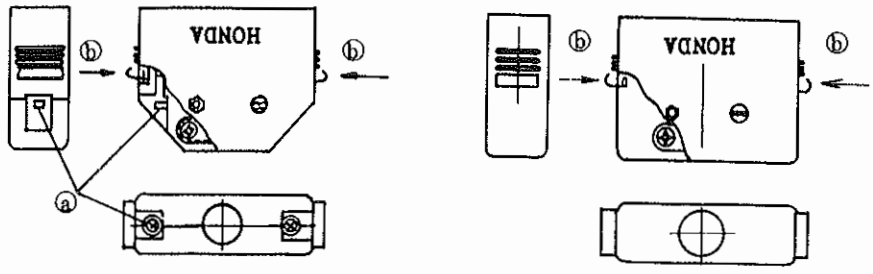
① Push the positions shown by [1] on the cover using both thumbs towards the ▽ marks [2] at the extreme left of the case.
② Remove the cover by pushing the center of the left end of the cover shown by [3] from the rear side.
③ The panel can be detached by pushing the center of the panel (direction [4] until it is curved.

Observe the following procedure when detaching the PCB from the plastic case.



① Remove PCB mounting screws [1] .
② Draw the PCB out of the case in direction [2] .

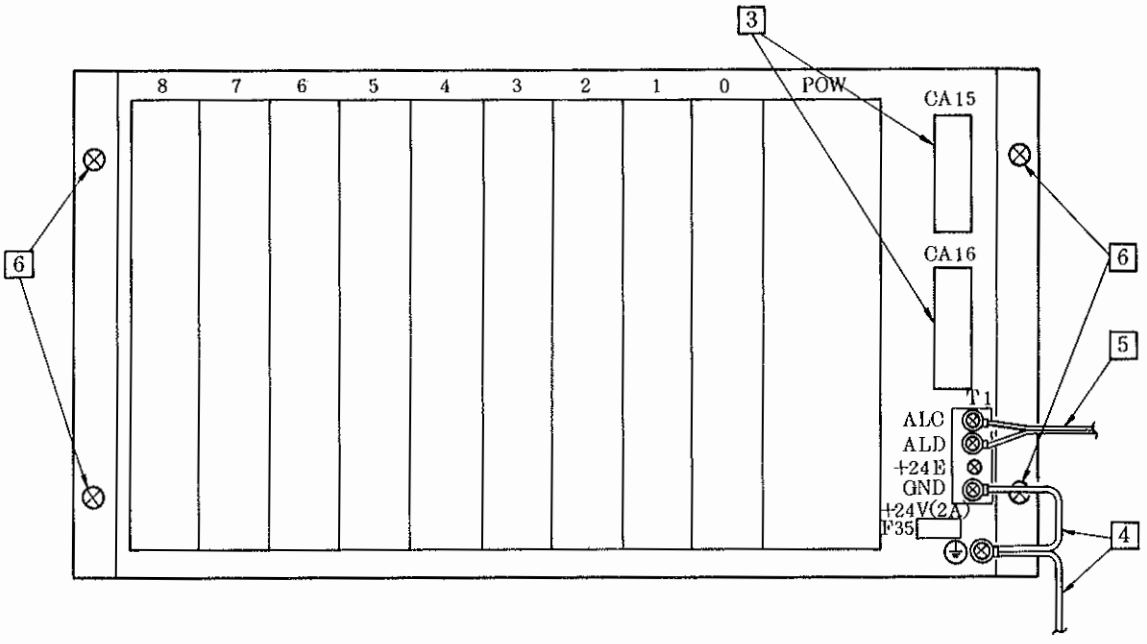
Disconnect each cable as follows:
Disconnect HONDA connector by pushing part ⓑ after loosening the two screws ⓐ shown in the following figure.



7.10.3 Exchange method of base units

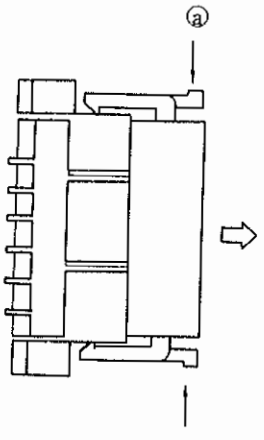
1) Procedure

① Remove the power supply module according to 7.1
② Remove each module according to 7.2
③ Disconnect all cables from the base units shown by [3] .



I/O unit

Disconnect NIHON BURNDY connector in the arrow (⇒) direction while pushing parts ⓐ shown in the following figure.



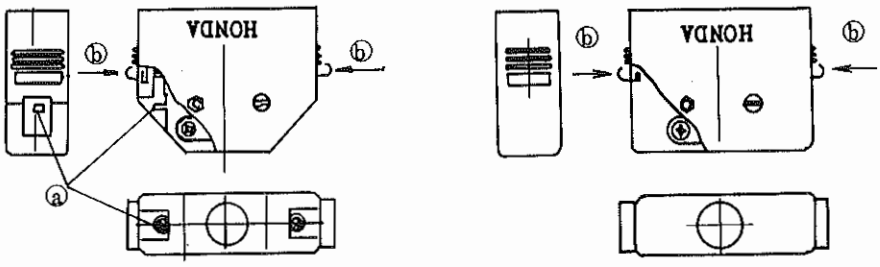
④ Disconnect the ground wires shown in [4] .
⑤ Disconnect the power alarm signal cables shown in [6] . (This wiring is not always connected.)
⑥ The base unit can be detached by loosening the four screws shown in [6] .
⑦ Reverse the procedure ([6] - [1]) when mounting new units.

2) Caution
Reset parameters after replacing the main unit.

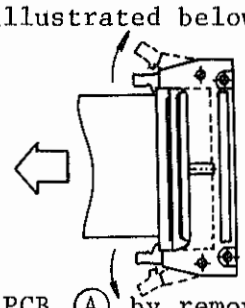
7.11 Replacing Methods of Small CRT/MDI PCB

7.11.1 Replacement of PCB A (keyboard PCB)

① Disconnect connector CA9 cable by pushing part ⓑ after loosening the two screws a as illustrated below.



② Disconnect the connector CKK1 cable in the arrow direction after unlocking it as illustrated below.



(Caution)
To connect the cable, push it in the direction opposite to ⟸ after setting it to mark ▼ of connector under the unlocked condition, then lock the cable.

③ Detach PCB Ⓐ by removing six nuts ③.
In case of a sheet switch, detach PCB A by removing the sheet from the front.

④ To mount new PCB, reverse the above procedure ③ z ①.

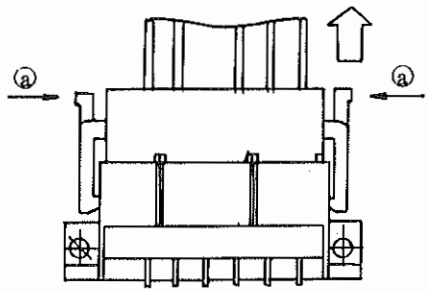
7.11.2 Replacement of PCB B (soft key PCB)

It is necessary when replacing PCB B to detach the CRT unit. It is recommended to detach the CRT/MDI unit from the panel as described below.

① Disconnect connector CN1 cable in the same way as in disconnecting the CA9 cable.

② Disconnect connector CKK1 cable in the same way as described in ② of 7.8.1.

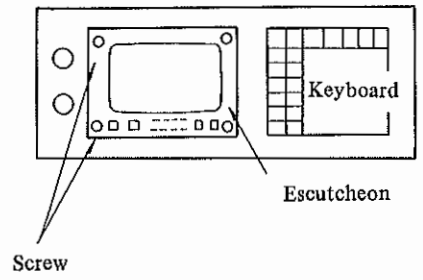
③ Disconnect connector CN2 cable by pushing ⓐ as illustrated below.



④ Detach the CRT/MDI unit by removing the eight screws from the front panel.

⑤ The CRT unit can be detached by removing four screws D by inserting a screwdriver from the rear part of the CRT unit.

⑥ Remove the soft key PCB together with escutcheon by unscrewing the four screws on the front panel.

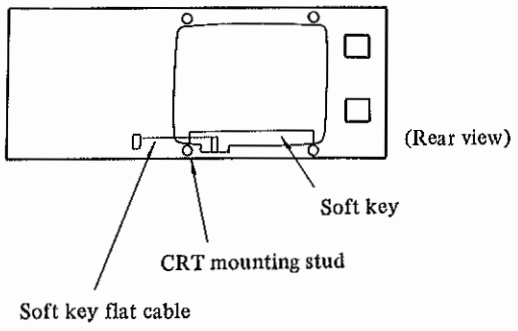


Detach the soft key PCB together with CRT escutcheon because they are assembled into a unit.

⑦ Remove the soft key PCB by unscrewing the two screws from the rear side of the escutcheon.

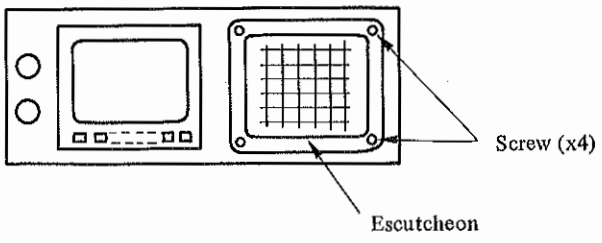
⑧ Assemble PCB by reversing the above procedure ⑦ → ①.

(Note) Assembly of soft key



Mount CRT by passing the flat cable of soft key through the position above the CRT mounting stud bolts.

⑨ Replace the key sheet. (In case of sheet switch on CRT/MDI)

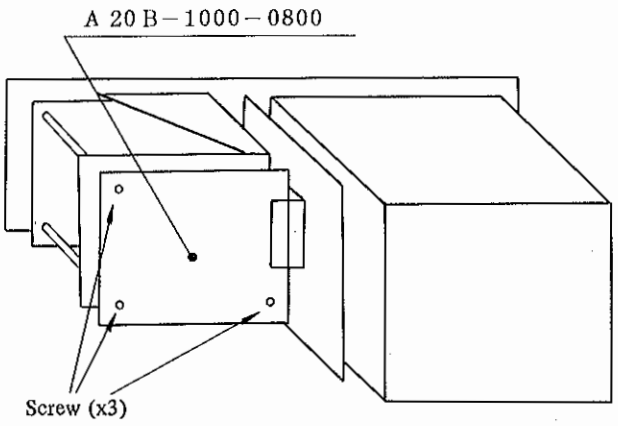


Remove the screws to detach the escutcheon. Then remove the sheet.

7.12 Replacing Methods of 9'' Standard CRT/MDI Unit PCB

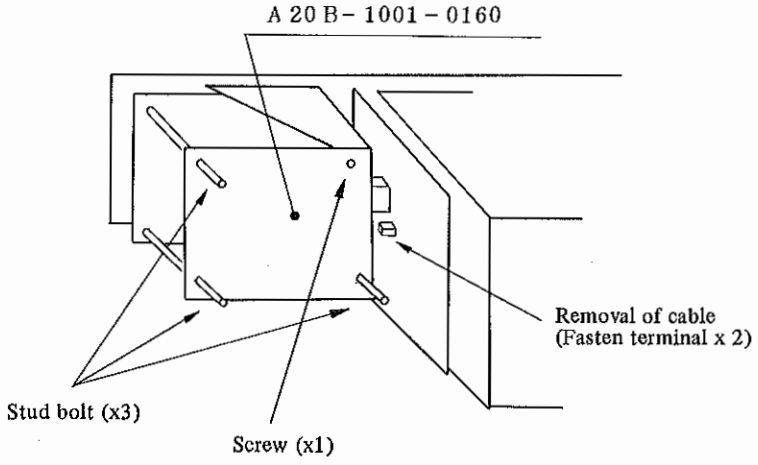
(The following description covers the horizontal CRT/MDI, but also applicable to the vertical type, accordingly)

1) Control PCB



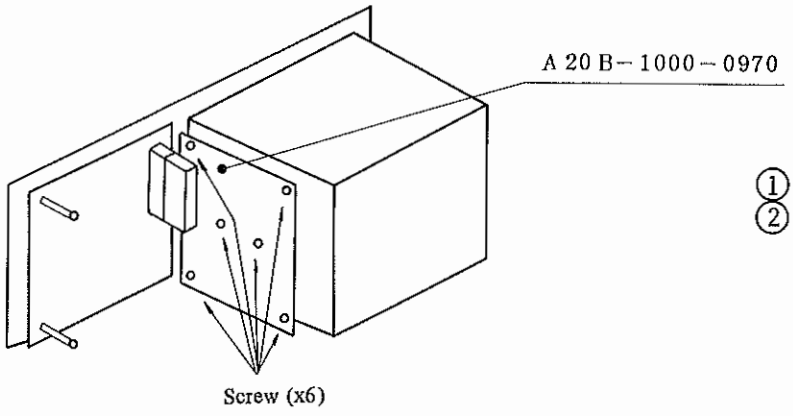
① Disconnect PCB cable.
② Remove screws.
③ Remove the PCB from the connector.

2) Power supply PCB



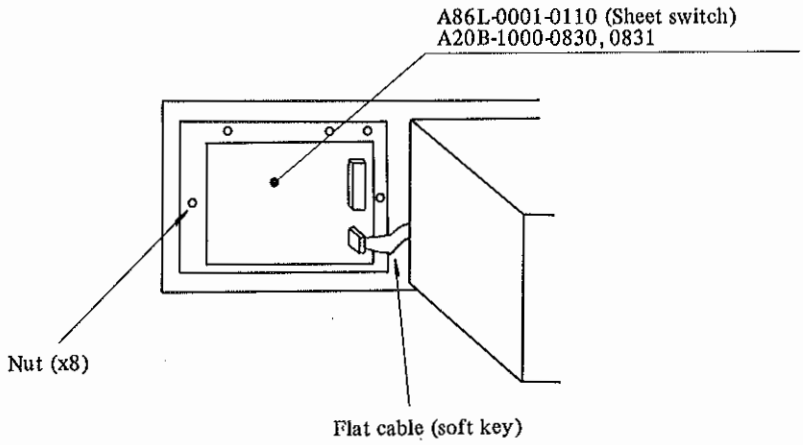
① Disconnect the cable (fasten terminal).
② Remove stud bolts and screws.
③ Remove PCB from the connector.

3) Backboard PCB



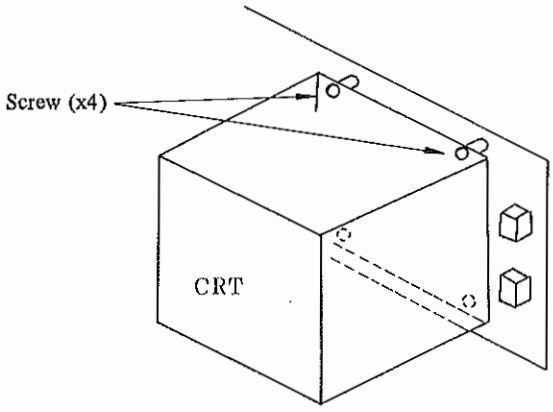
① Remove screws.
② Remove PCB from the connector.

4) Keyboard PCB



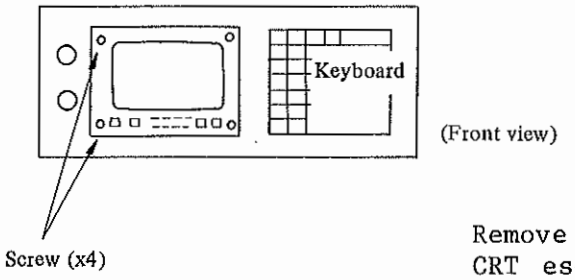
① Disconnect the flat cable from keyboard PCB.
② Remove the nuts from the keyboard fixing plate and detach the keyboard PCB together with the fixing plate.
(The fixing plate and PCB are assembled.)
③ In the case of a sheet switch, remove the PCB after sheet switch is detached.

5) CRT



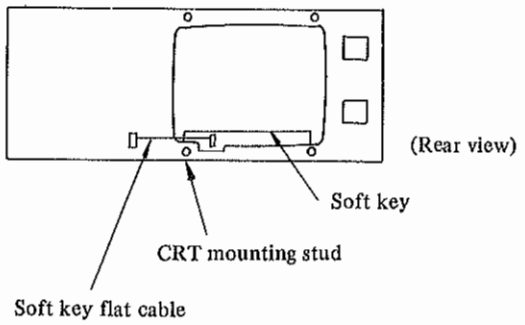
Remove CRT fixing screws.

6) Soft key



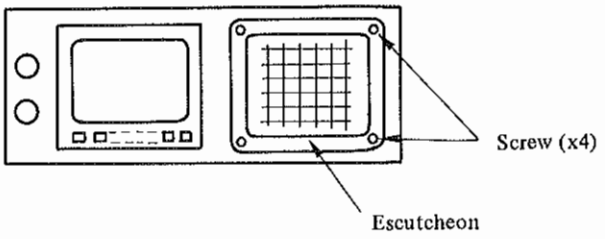
Remove the soft key PCB together with CRT escutcheon because they are assembled into a unit.

(Note) Assembly of soft key



Mount CRT by passing the flat cable of soft key through the position above the CRT mounting stud bolts.

7) Replace the key sheet. (In case of sheet switch on CRT/MDI)

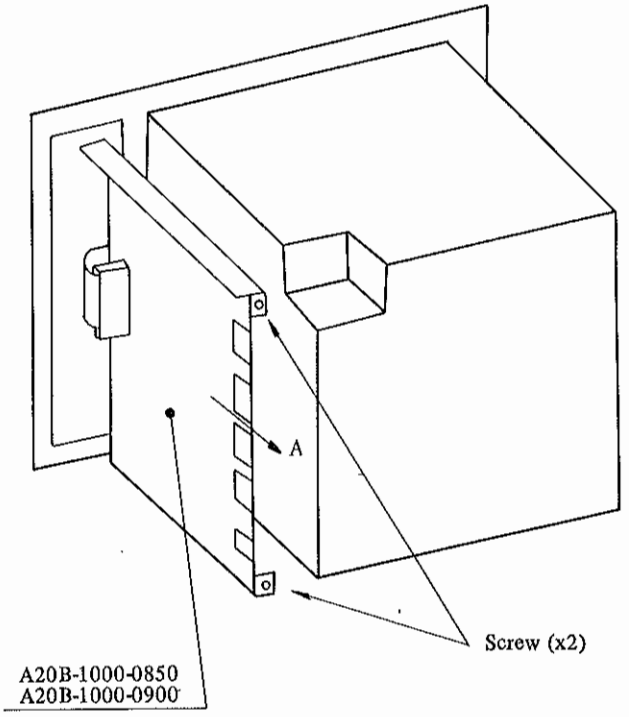


Remove the screws to detach the escutcheon. Then remove the sheet.

7.13 Replacing Methods of 14" Color CRT/MDI (horizontal type) PCB

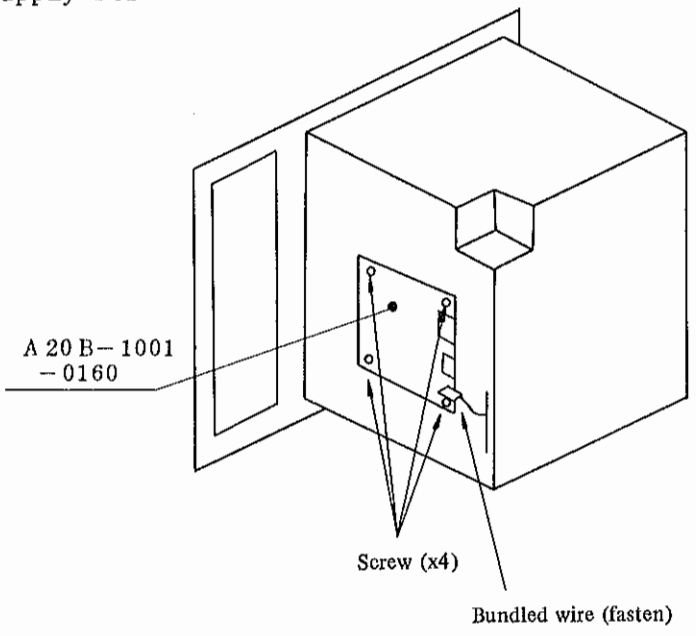
7.13.1 10/11/12 series

1) Control PCB



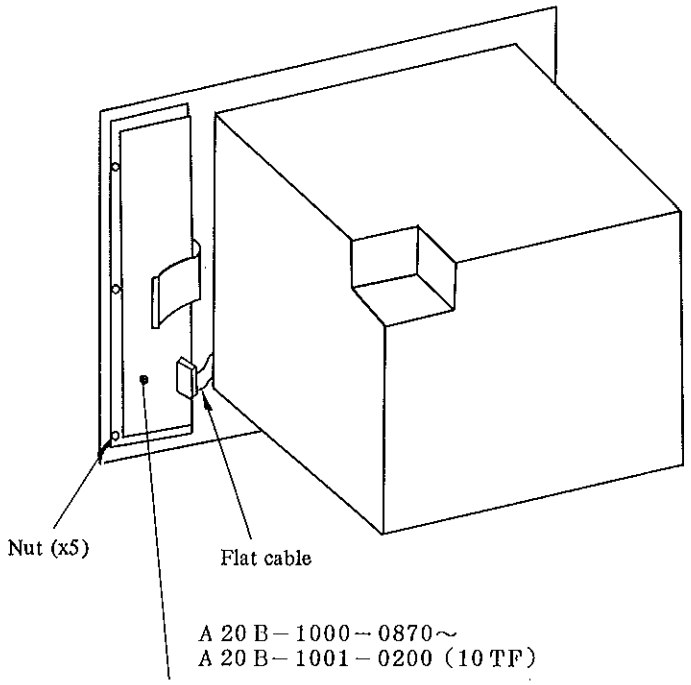
① Disconnect all connector cables from PCB.
② Remove PCB by sliding it in the Ⓐ direction after removing screws.

2) Power supply PCB



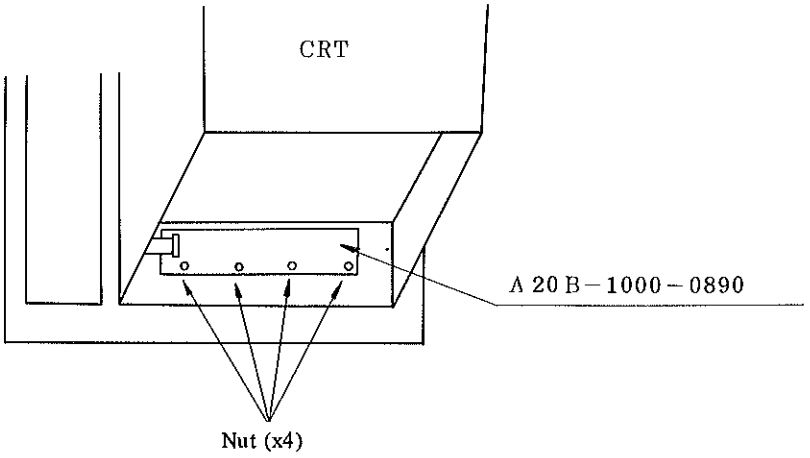
① Disconnect the bundled wire (fasten).
② Remove PCB by unscrewing screws.

3) Keyboard PCB



① Disconnect the flat cable of soft key from PCB.
② Remove nuts; then remove together with the fixing plate.

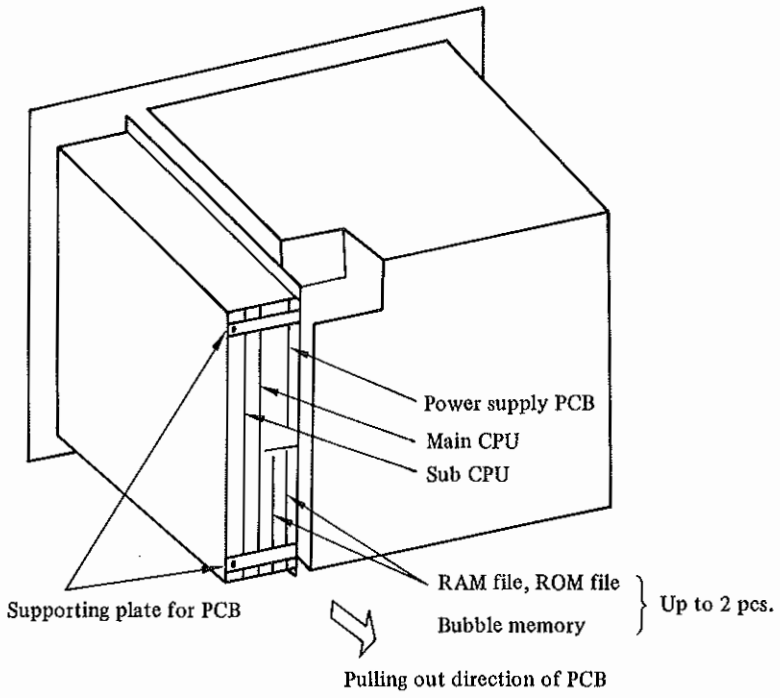
4) Soft key PCB



1) Remove nuts. Remove the soft key PCB together with the fixing board.

7.13.2 100/110/120 series

1) Main and sub CPU, Power supply PCB, ROM/RAM file, Bubble memory

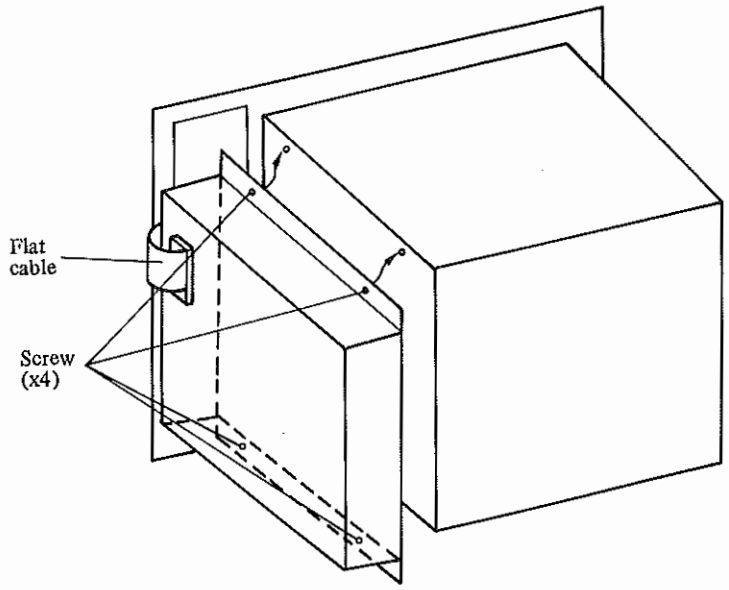


① Remove the supporting plate for PCB after removing two screws (up and down) on its.

② Each one of main-CPU, sub CPU, power supply unit, RAM/ROM file and bubble memory can be pulled out along to a rail after rising up the ejector.

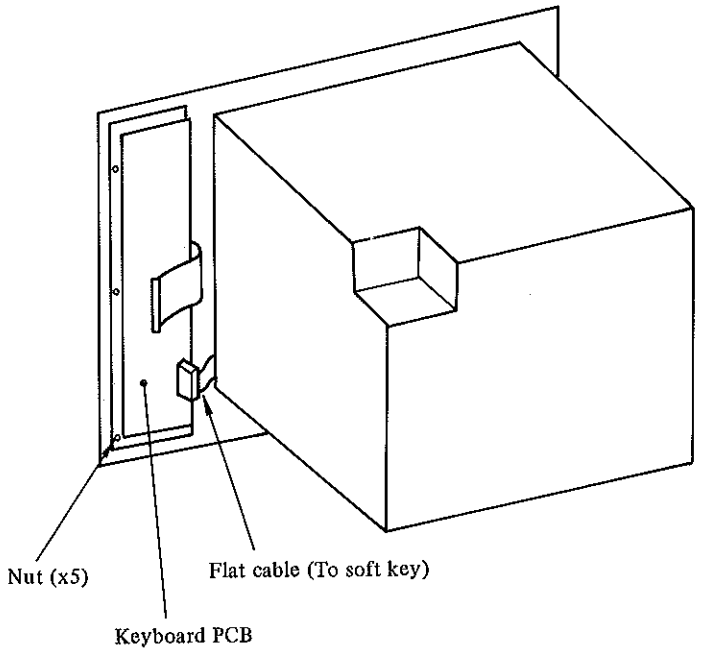
2) Keyboard PCB

1 Removing of control



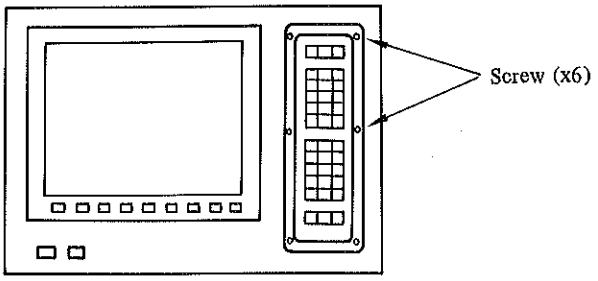
Disconnect the cable connected to PCB and flat cable for keyboard signal, then control section can be remove by removing the above four screws.

② Removing of keyboard



Remove the keysheet from front, then remove the keyboard PCB.

3) Replacement of key sheet

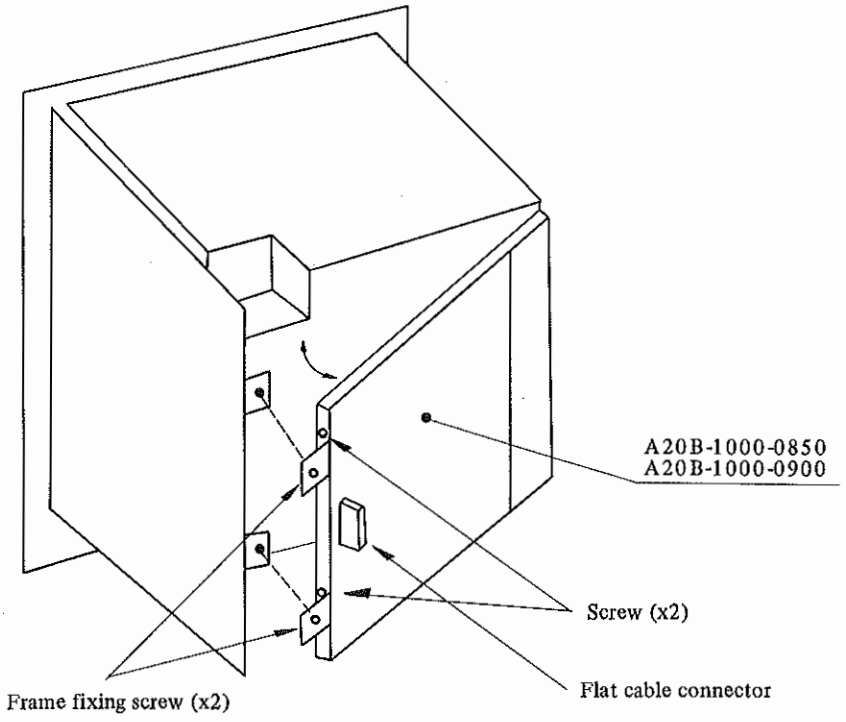


① Remove the screw to detach the escutcheon. Then remove the escutcheon and sheet and replace the new sheet.

4) Softkey PCB
The procedure is same as 14" CRT/MDI for 10/11/12 series.

7.14 Replacing Methods of 14" CRT/MDI Graphic Unit (vertical type) PCB (10/11/12 series)

1) Control PCB



1) Disconnect the flat cable from keyboard.
2) Remove the frame fixing screws and open the PCB metal.
3) Remove screws and detach PCB.

2) Power supply PCB A20B-1001-0160

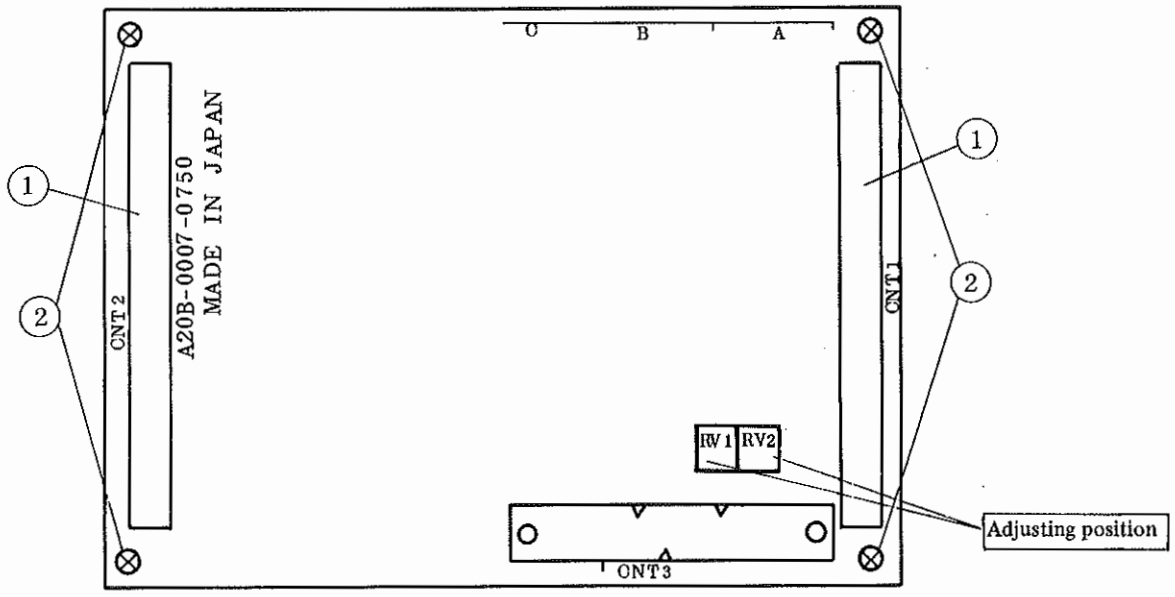
Keyboard PCB A20B-1000-0880 -
A20B-1001-0270 (10TF)

Soft key PCB A20B-1000-0891

These PCBs can be replaced using the same procedure as in vertical type in 7.10.

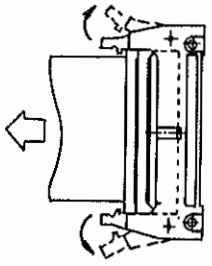
7.15 Replacing Methods of PCB and Others Referred to Tape Reader

7.15.1 Replacement of PCB of tape reader without reels photoamplifier



1) Procedure

① Disconnect connectors CNT1, CNT2 in the arrow direction by unlocking them as shown below.



② Remove PCB by unscrewing four screws.
③ Mount new PCB by reversing the above procedure ② → ①.

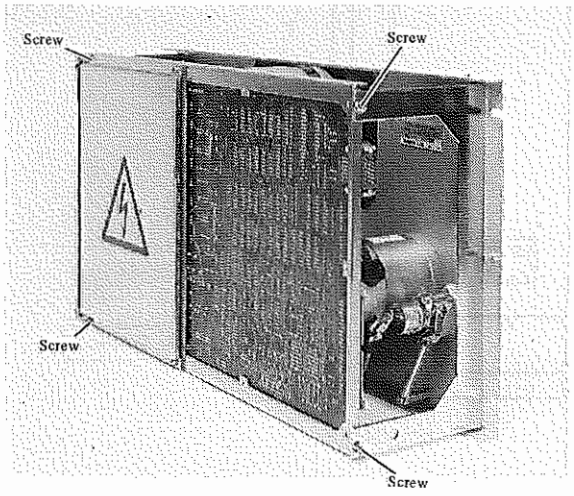
2) Adjustment

Adjust RV1 and RV2 according to the maintenance manual (B-54815E).

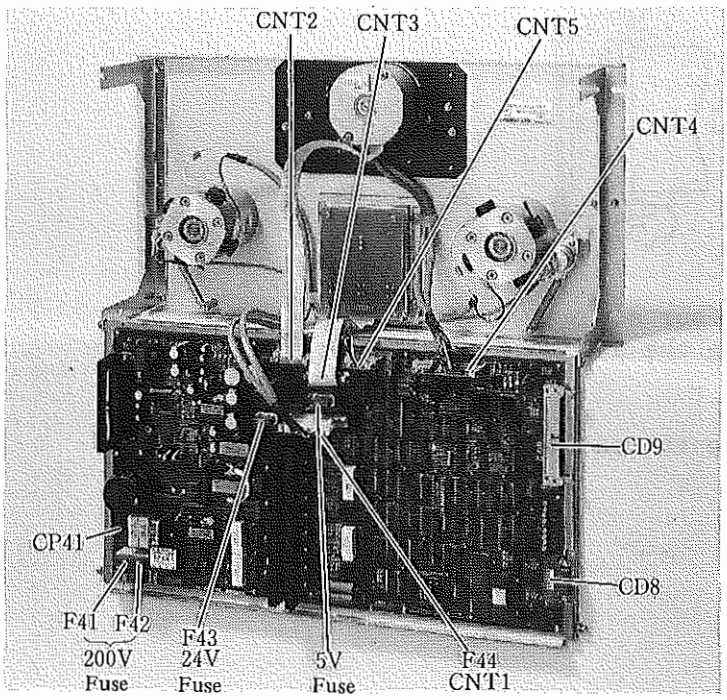
7.15.2 Replacing methods of tape reader with reels PCB and fuses

1) Procedure

① Disconnect connectors CD9 (CD8) and CP41.
② Loosen the four screws on sides of the rear panel of the tape reader.
③ Detach PCB from the metal by pulling it upward as illustrated in the figure below.
④ Disconnect PCB cables from connectors (CTN2 - CTN5).
⑤ Remove PCB by unscrewing screws.

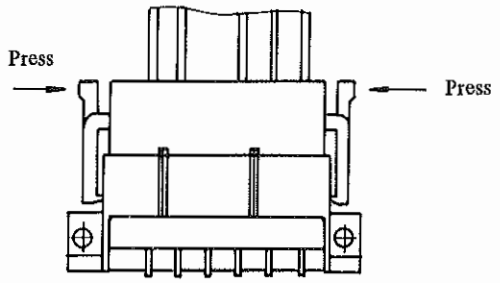


(Adjustment)
Adjust the photoamplifier after replacing it.

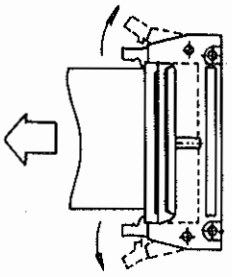


(Replacement of fuses)
Replace fuses after eliminating the cause of blowout.

How to remove CNT1 and CP41 (3 pins)



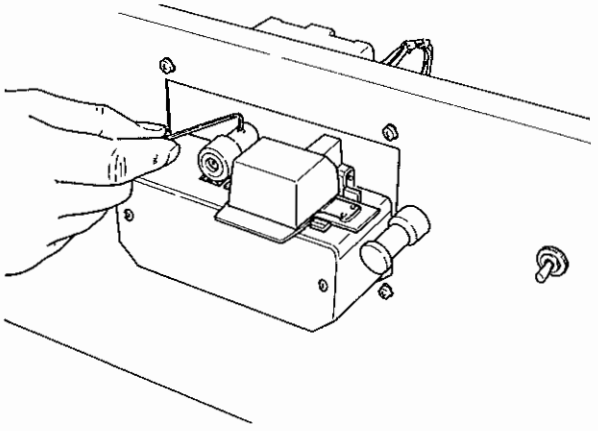
How to remove CD9, CNT2, CNT3, CNT4, and CNT5

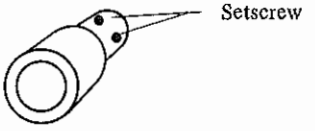


(Note) When connecting a cable push it in the direction opposite ⟸ after setting it to mark ▼ of the connector under the unlocked condition, then lock the cable.
In this case, push the connector forcibly, otherwise the cable cannot be locked.
The left figure shows the locked condition.

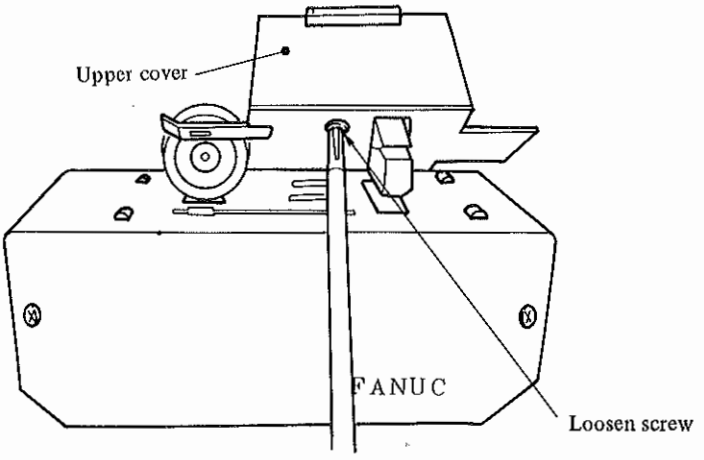
7.15.3 Replacement of capstan roller of tape reader without reels

Loosen the two set screws of capstan roller, and detach the capstan roller from the motor shaft.

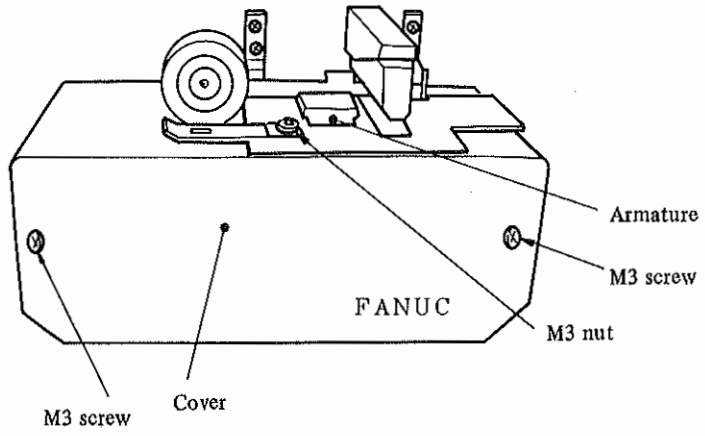




7.15.4 Replacement of capstan roller of tape reader with reels



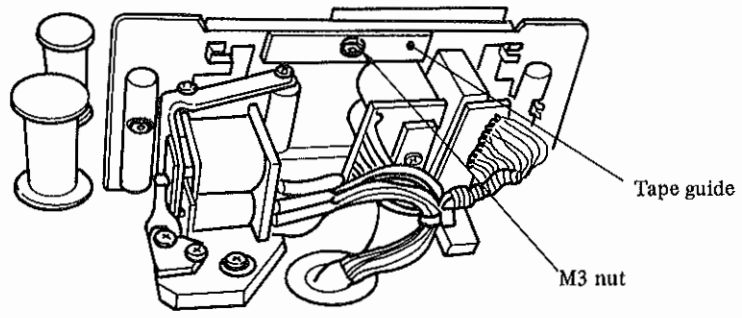
① Remove the upper cover.



② Remove the armature.

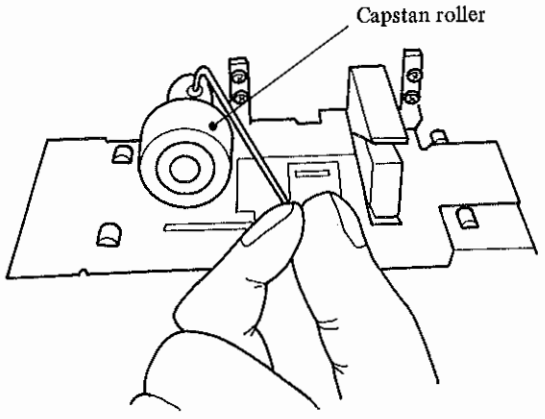
③ Remove the tape guide by loosening M3 nuts.

④ Remove the cover by loosening M4 screws.



⑤ Remove the tape guide by loosening M3 nuts.

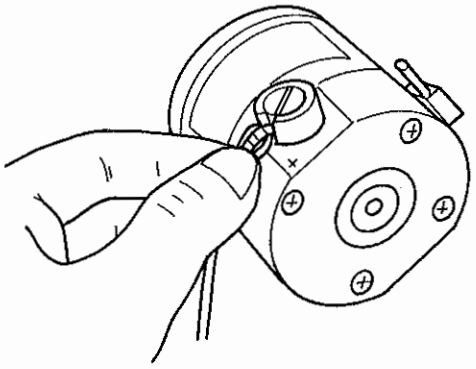
Interior of cover as viewed from the bottom



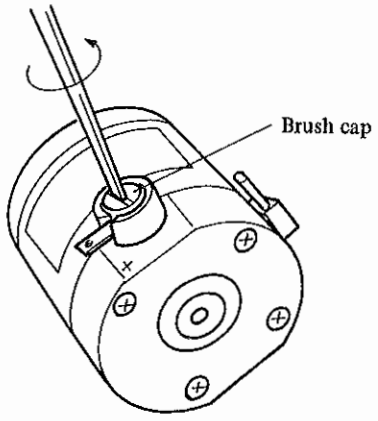
⑥ Remove the capstan roller by loosening two setscrews.



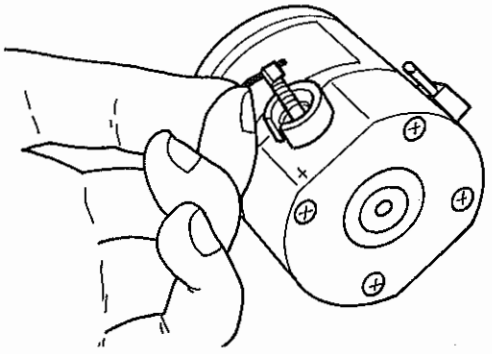
7.15.5 Replacement of brushes of tape reader with reels sole motor



① Four brushes are mounted in one motor.
② Disconnect cables from these brushes.

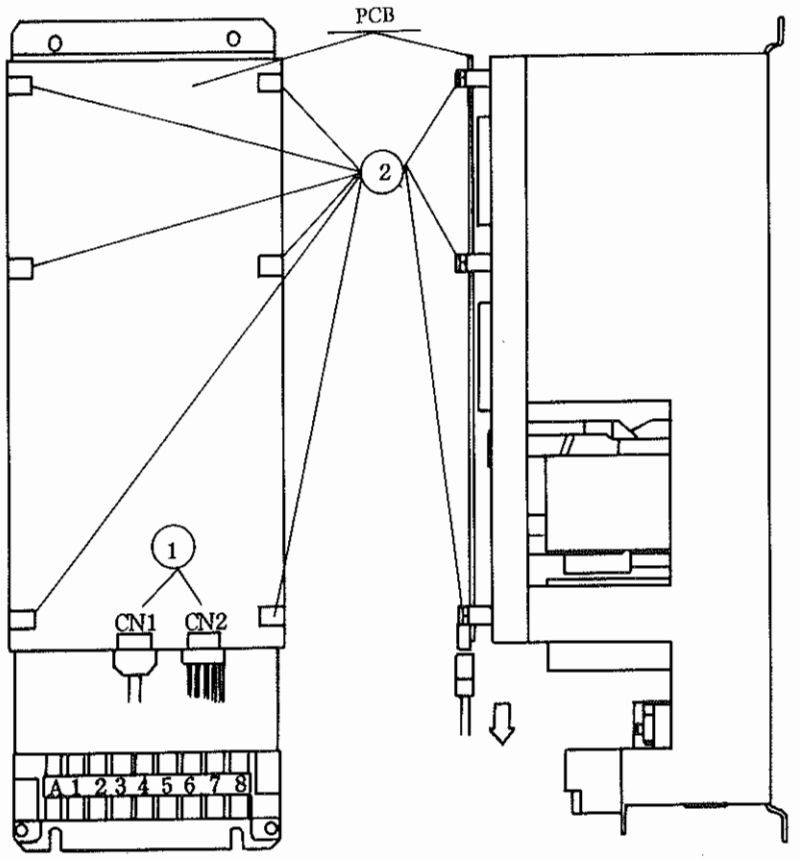


③ Remove the brush caps.



④ Remove brushes.
⑤ Assemble brushes after replacement by reversing the above procedure.
⑥ Securely connect cables to the same place as before, otherwise the rotating direction is reversed and will cause an alarm.

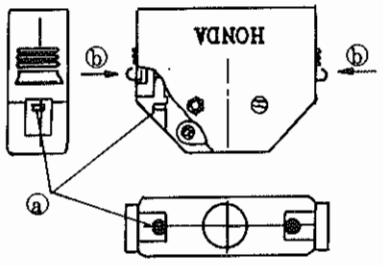
7.16 Replacement of PCB for Velocity Control Unit and AC Servo Amplifier



1) Procedure

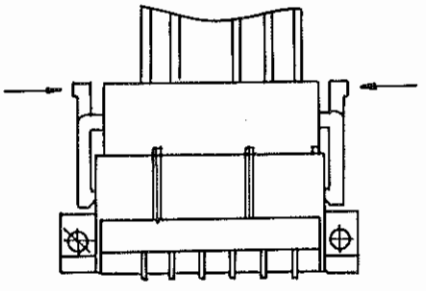
① Disconnect the cables from connectors CN1 and CN2.

(CN1)



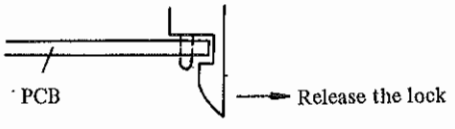
Loosen screw ⓐ, and pull out the connector by pushing ⓑ.

(CN2)



Pull out the connector by pushing the arrow-marked position.

② Pull the PCB forward by opening the locks with your finger, and the PCB can be removed.



③ Mount the new PCB according to procedure ② and ①.

2) Setting and adjustment
   ① Set the PCB in the same way as on the old one.
   ② Make adjustments as required according to maintenance manual.

APPENDIX 1 CONNECTION DIAGRAMS

1.1 10 Series

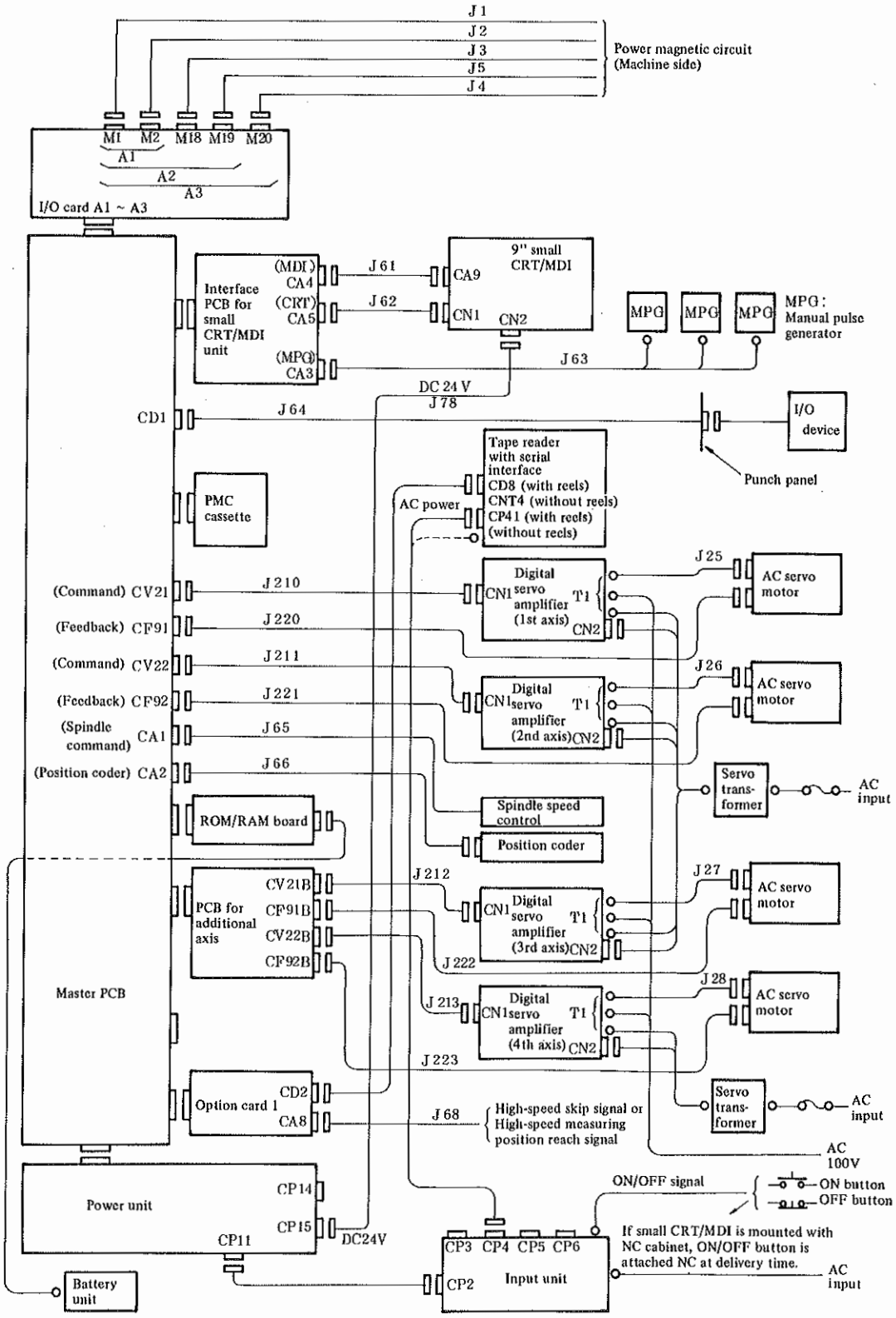


Fig. 1.1 (a) 10TA/10MA total connecting diagram (Digital servo, 9" small CRT/MDI and I/O card A1 ~ A3 are used.)

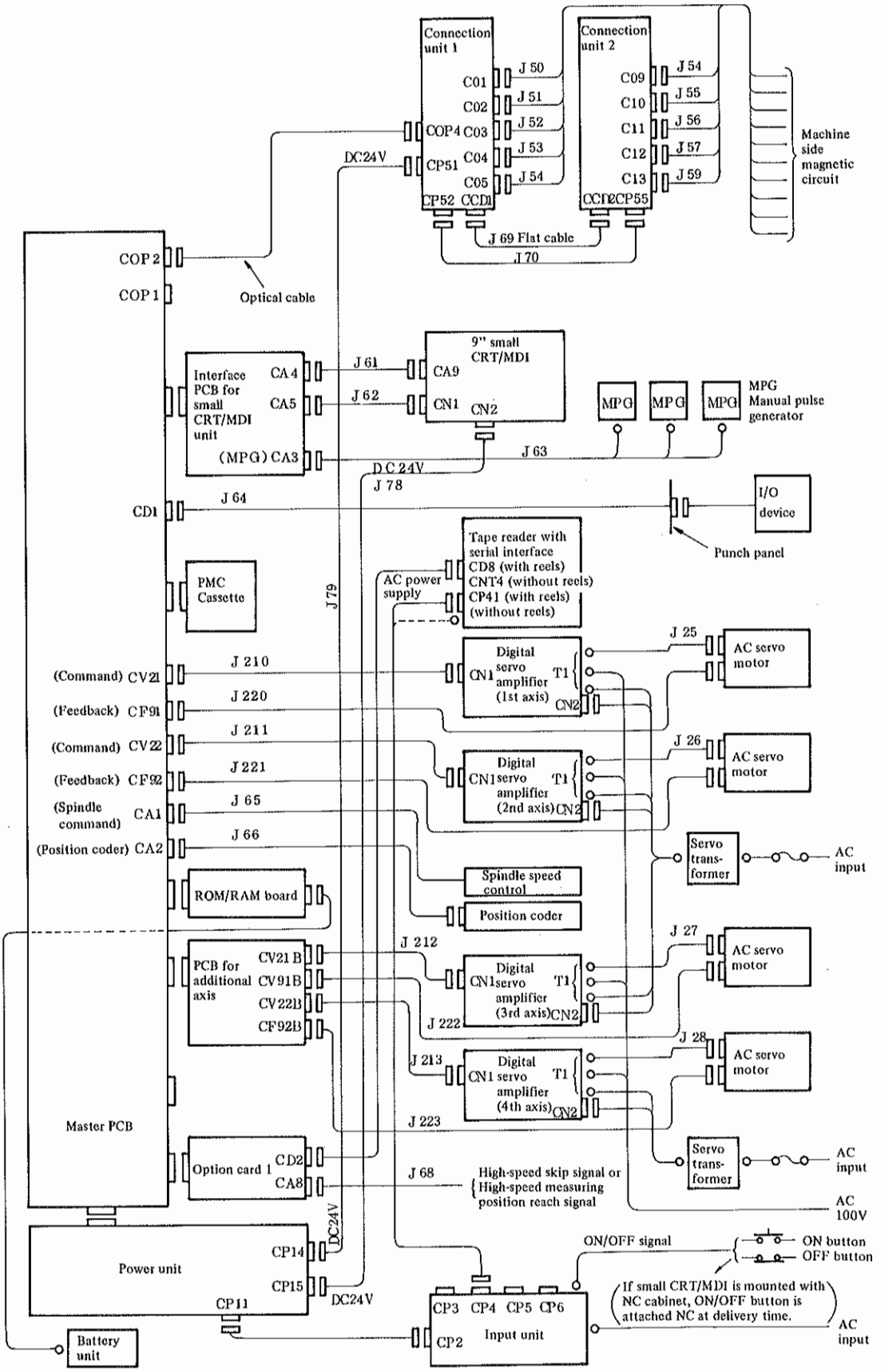


Fig. 1.1 (b) 10TA/10MA total connecting diagram (Digital servo, 9" small CRT/MDI and connection unit are used.)

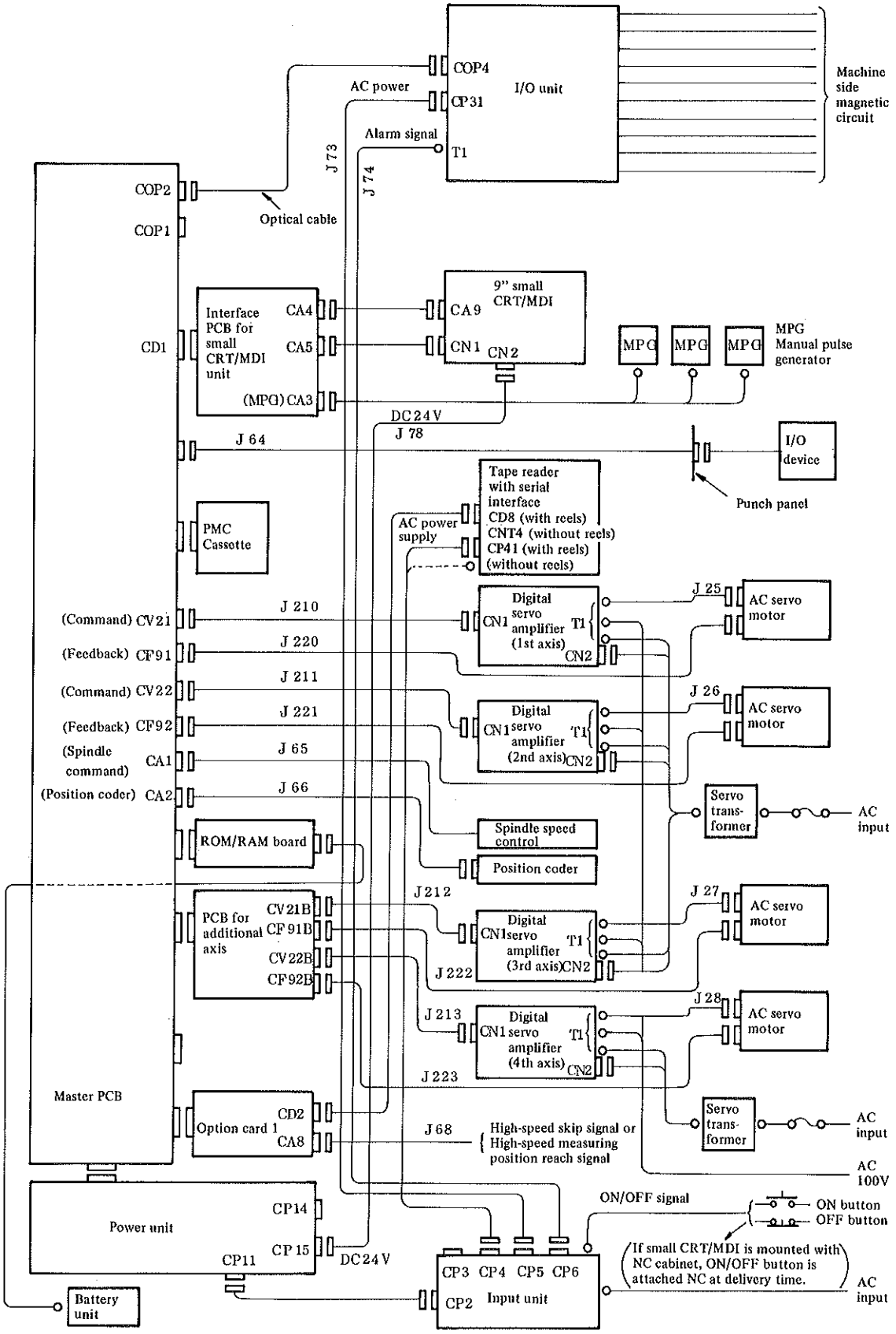


Fig. 1.1 (c) 10TA/10MA total connecting diagram (Digital servo, 9" small CRT/MDI and I/O unit)

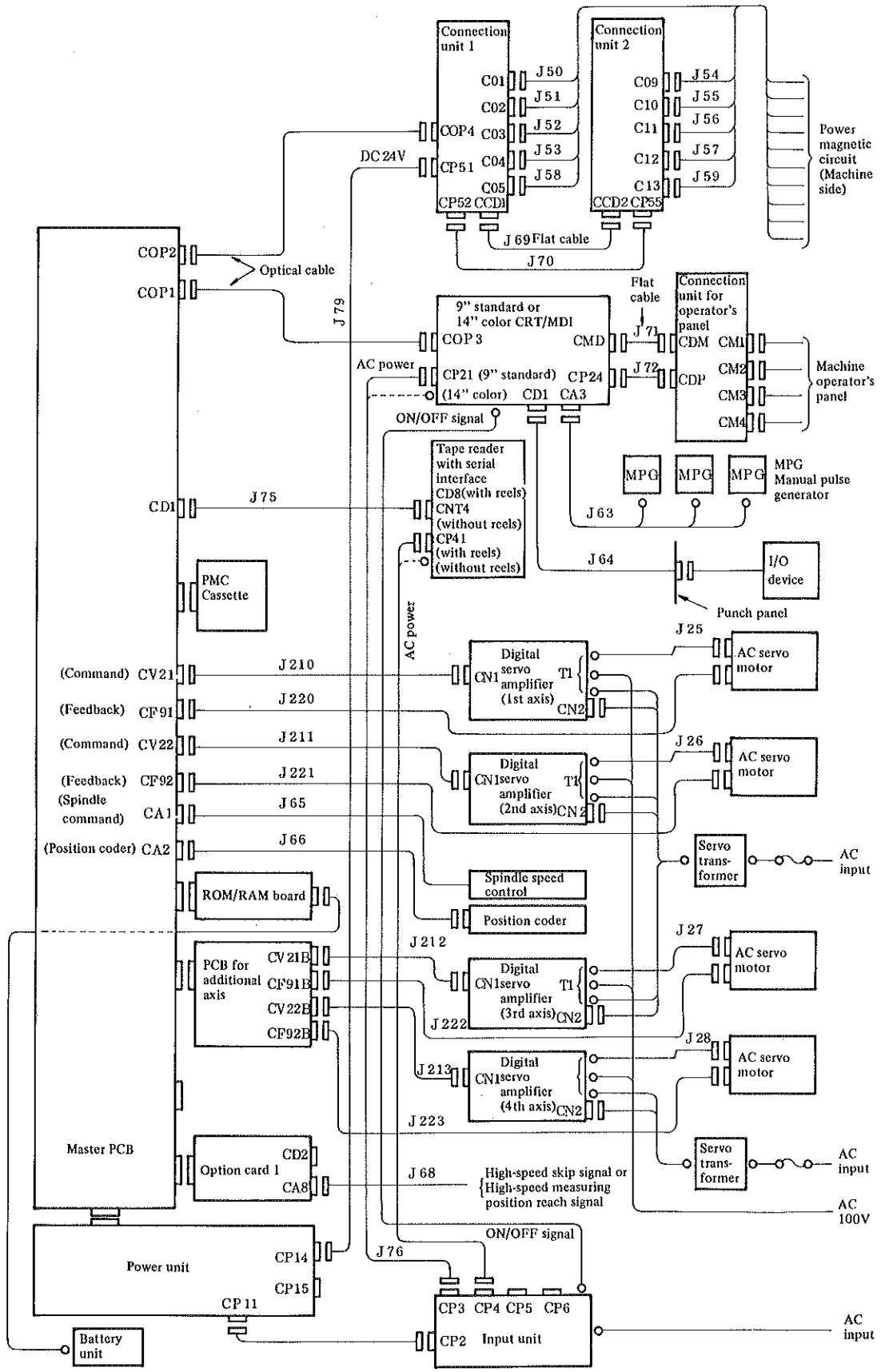


Fig. 1.1 (d) 10TA/10MA total connection diagram (Digital servo, 9" standard or 14" color CRT/MDI and connection unit are used.)

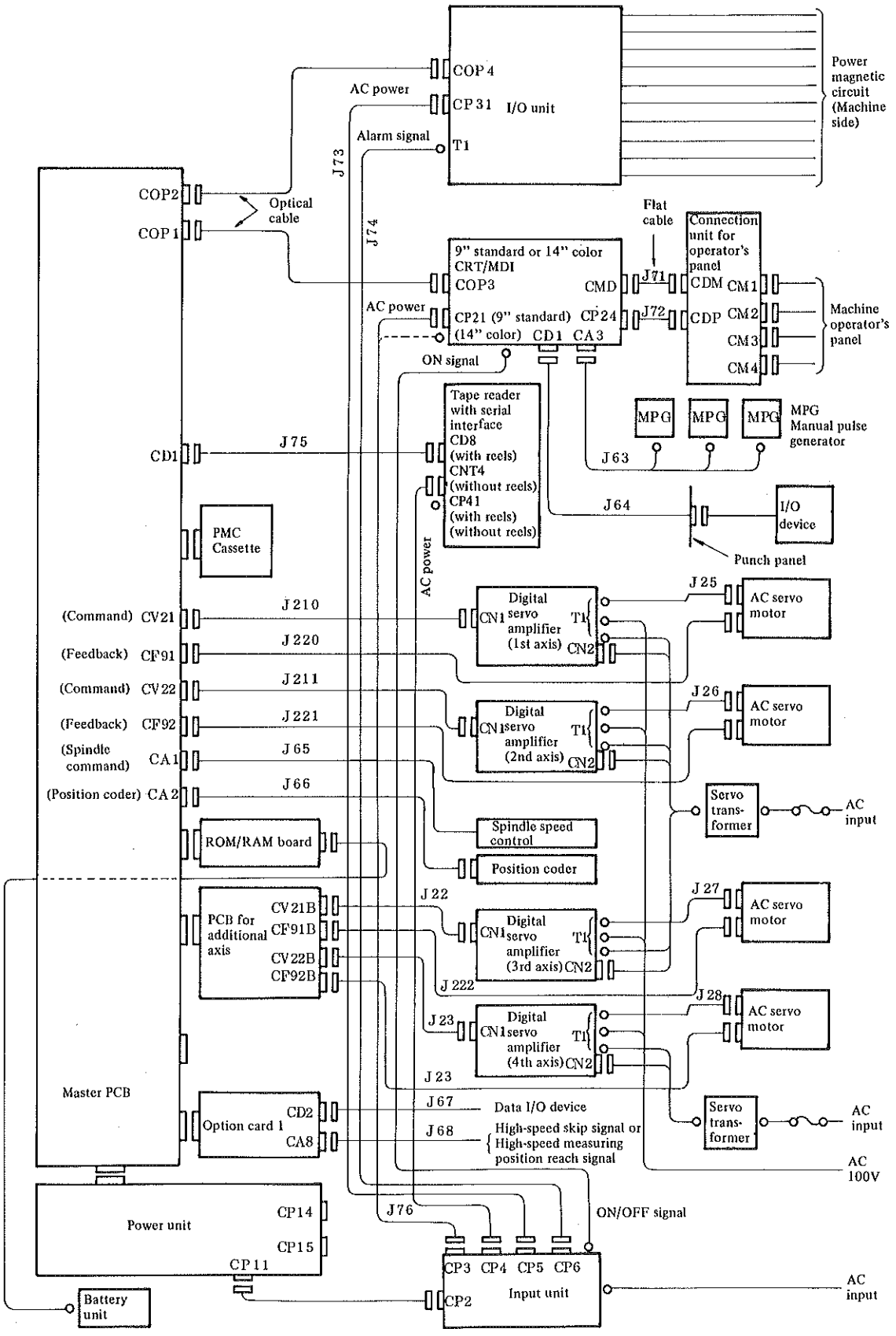


Fig. 1.1 (e) 10TA/10MA total connecting diagram
(Digital servo, 9" standard or 14" color CRT/MDI and I/O unit are used.)

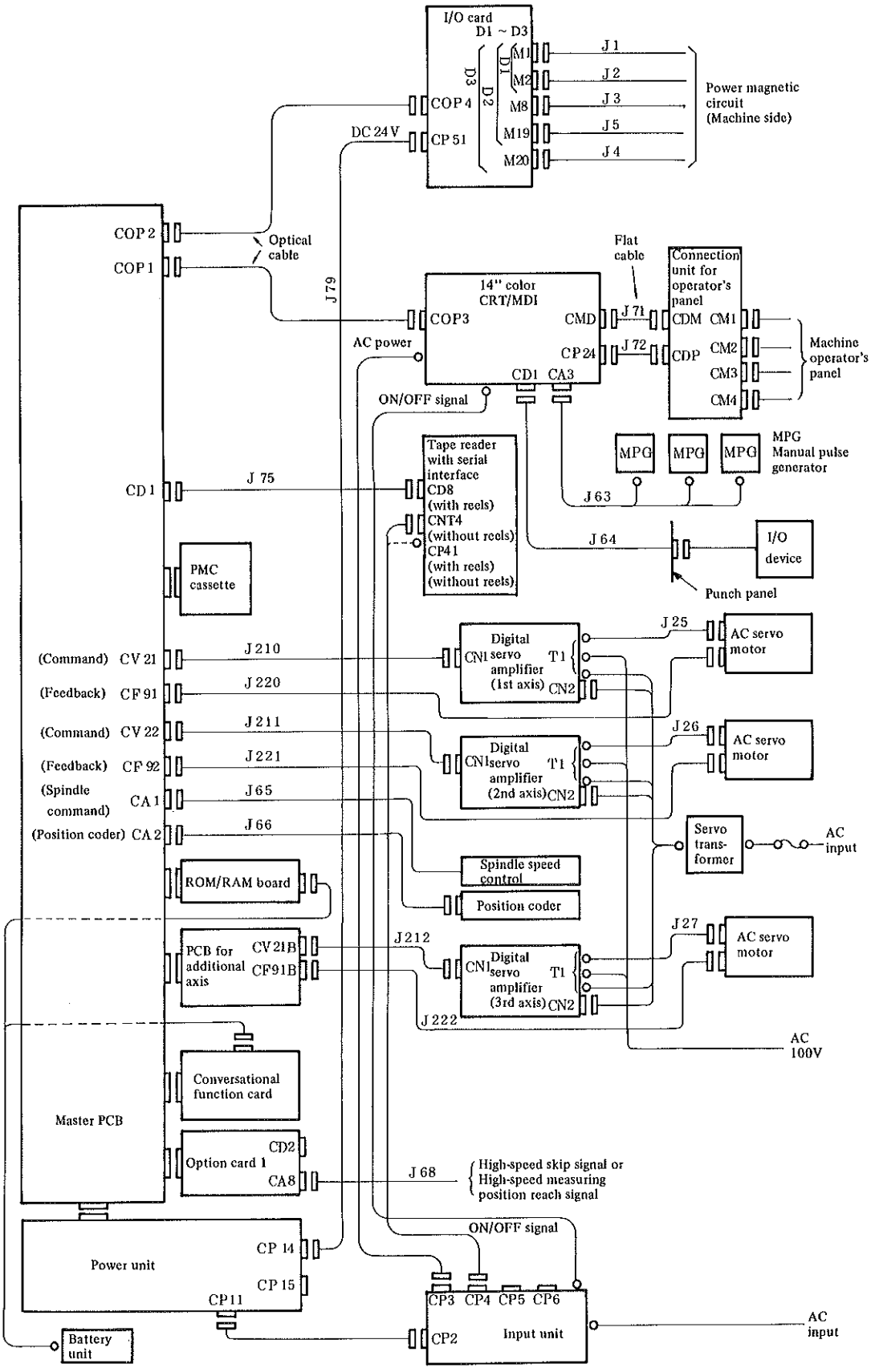


Fig. 1.1 (f) 10TF total connecting diagram (Digital servo, 14" color CRT/MDI, and I/O card are used.)

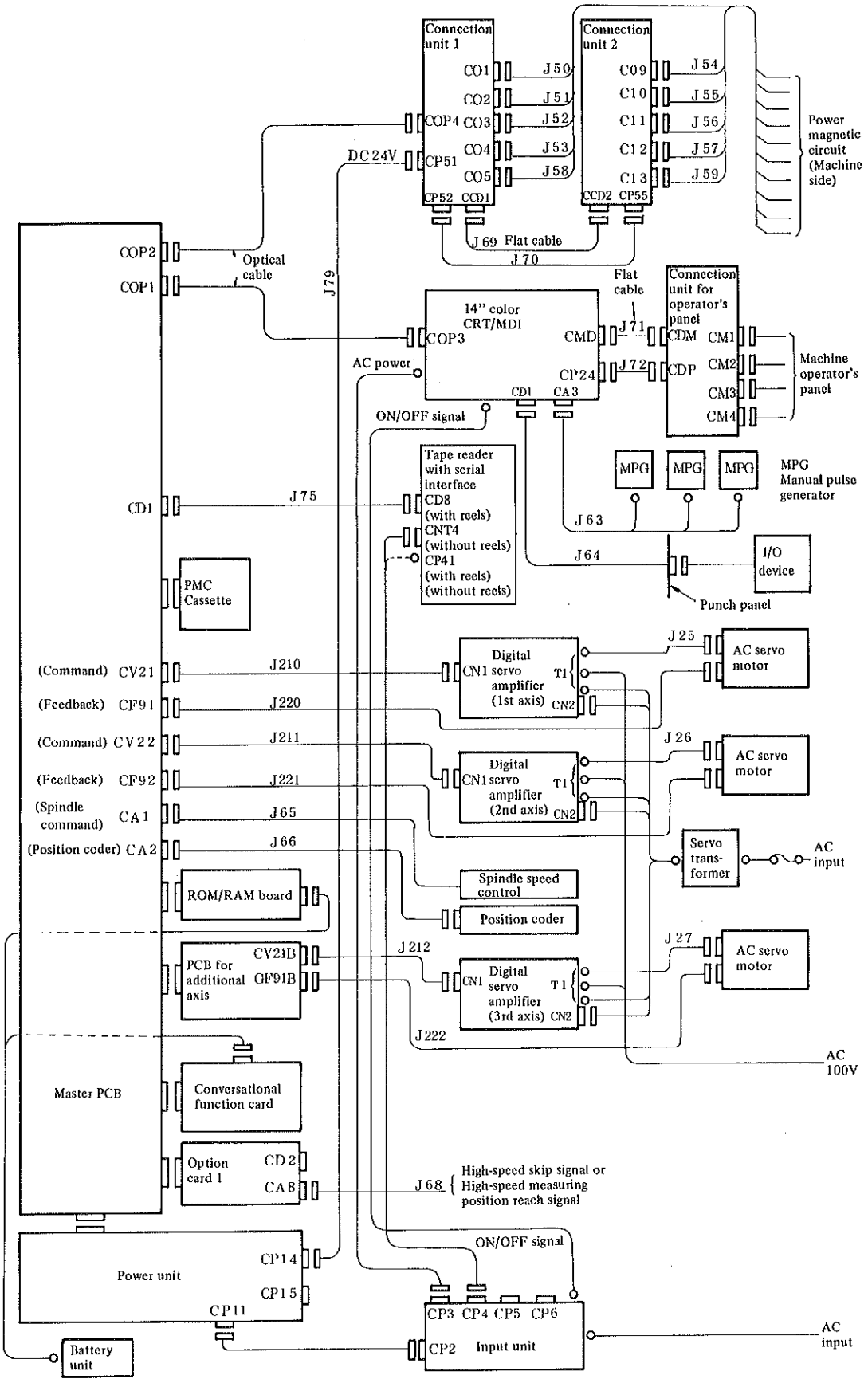


Fig. 1.1 (g) 10TF total connecting diagram (Digital servo, 14" color CRT/MDI, and connection unit are used.)

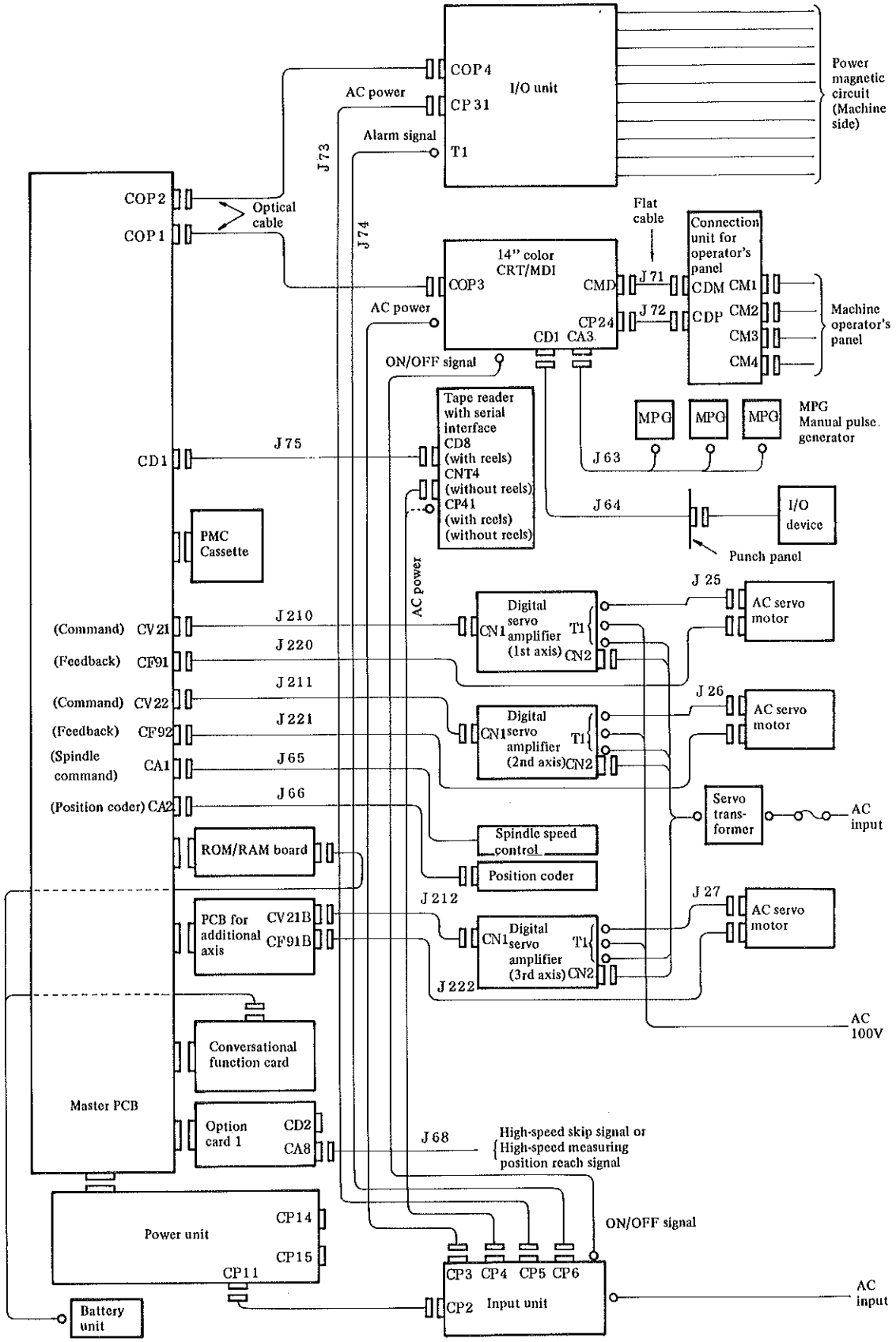


Fig. 1.1 (h) 10TF total connecting diagram (Digital servo, 14" color CRT/MDI, and I/O unit are used.)

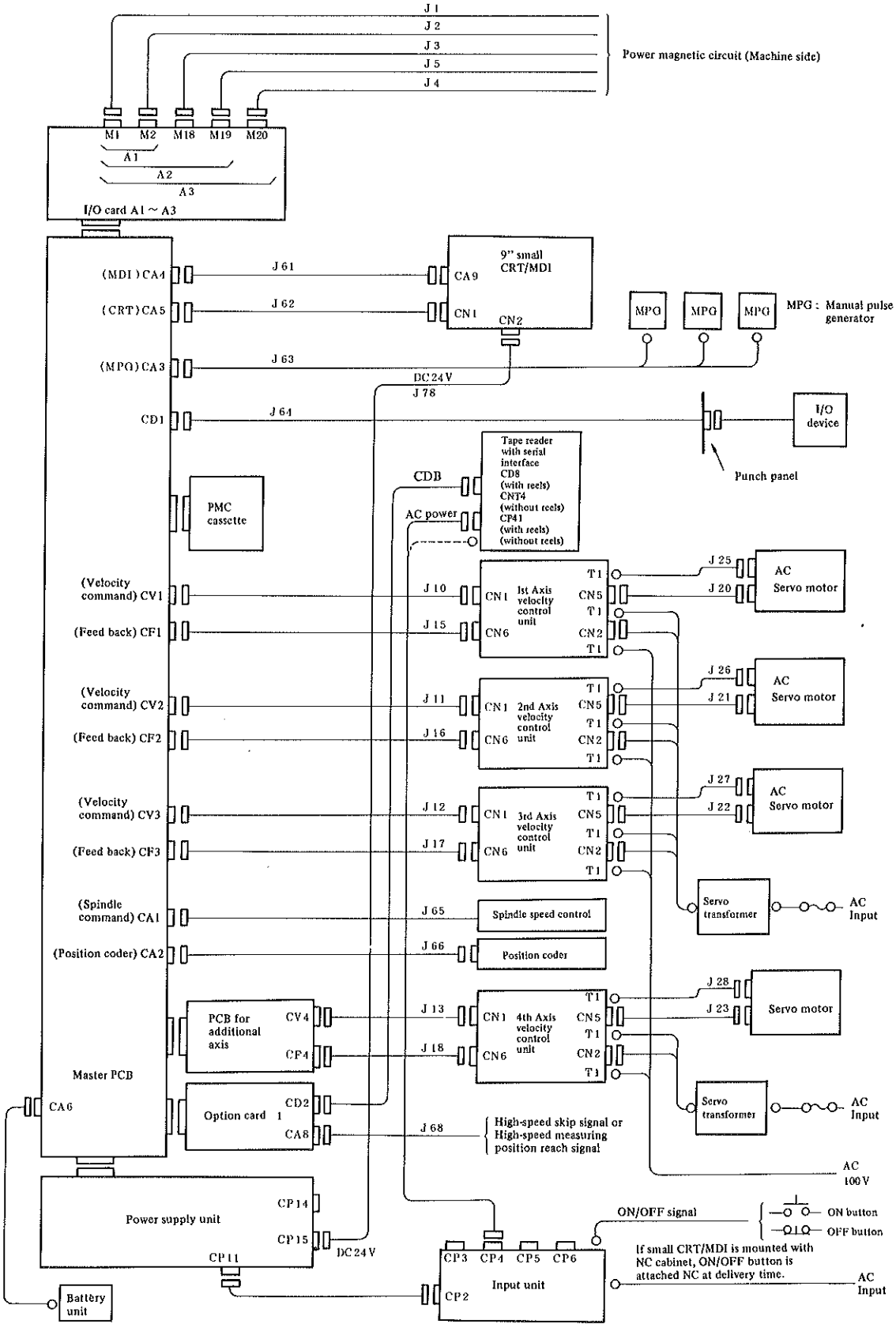


Fig. 1.1 (i) 10TA/10MA total connecting diagram (Analog servo, 9" small CRT/MDI and I/O card A1 ~ A3 are used.)

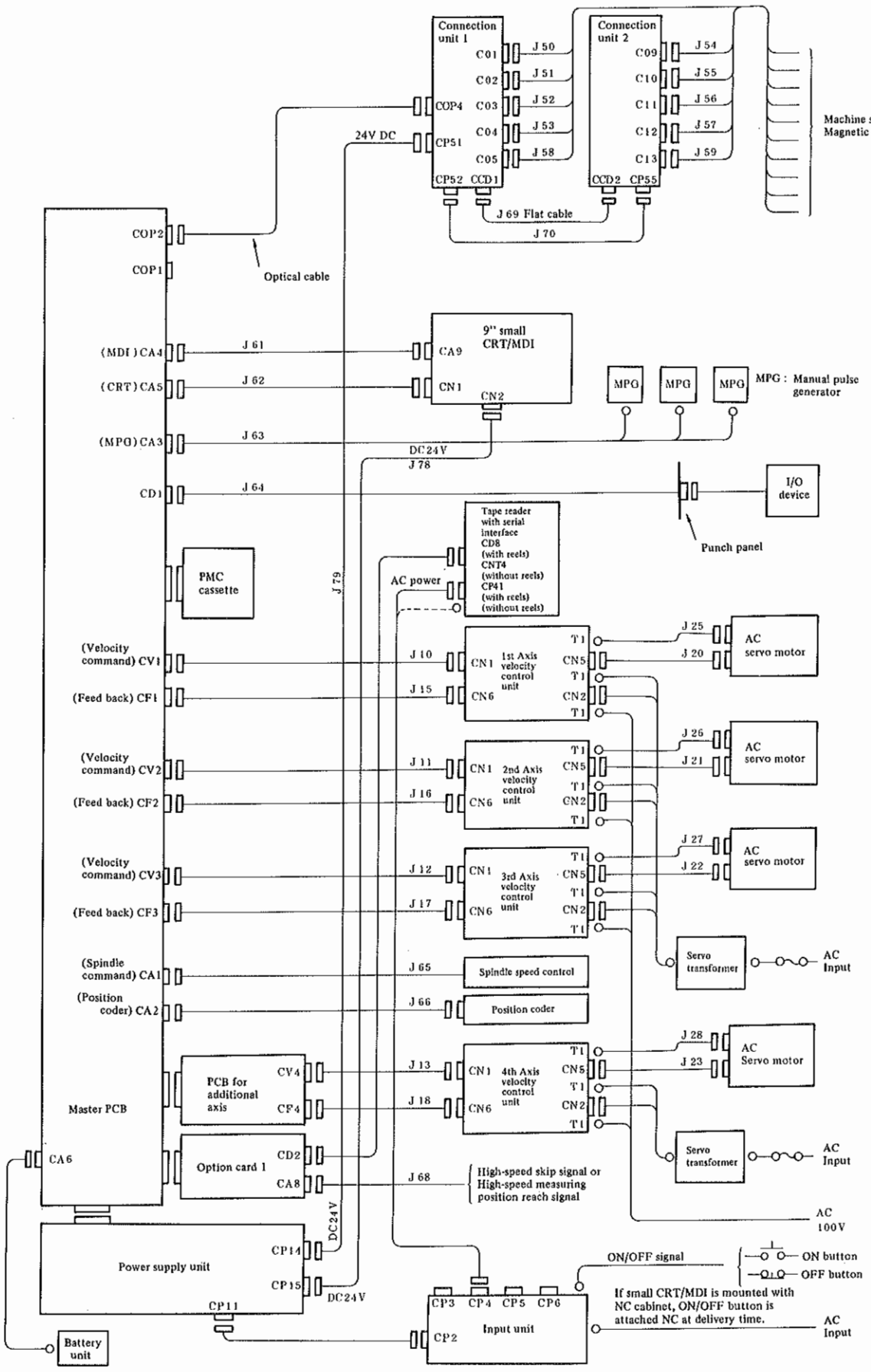


Fig. 1.1 (j) 10TA/10MA total connecting diagram (Analog servo, 9" small CRT/MDI and connection unit are used.)

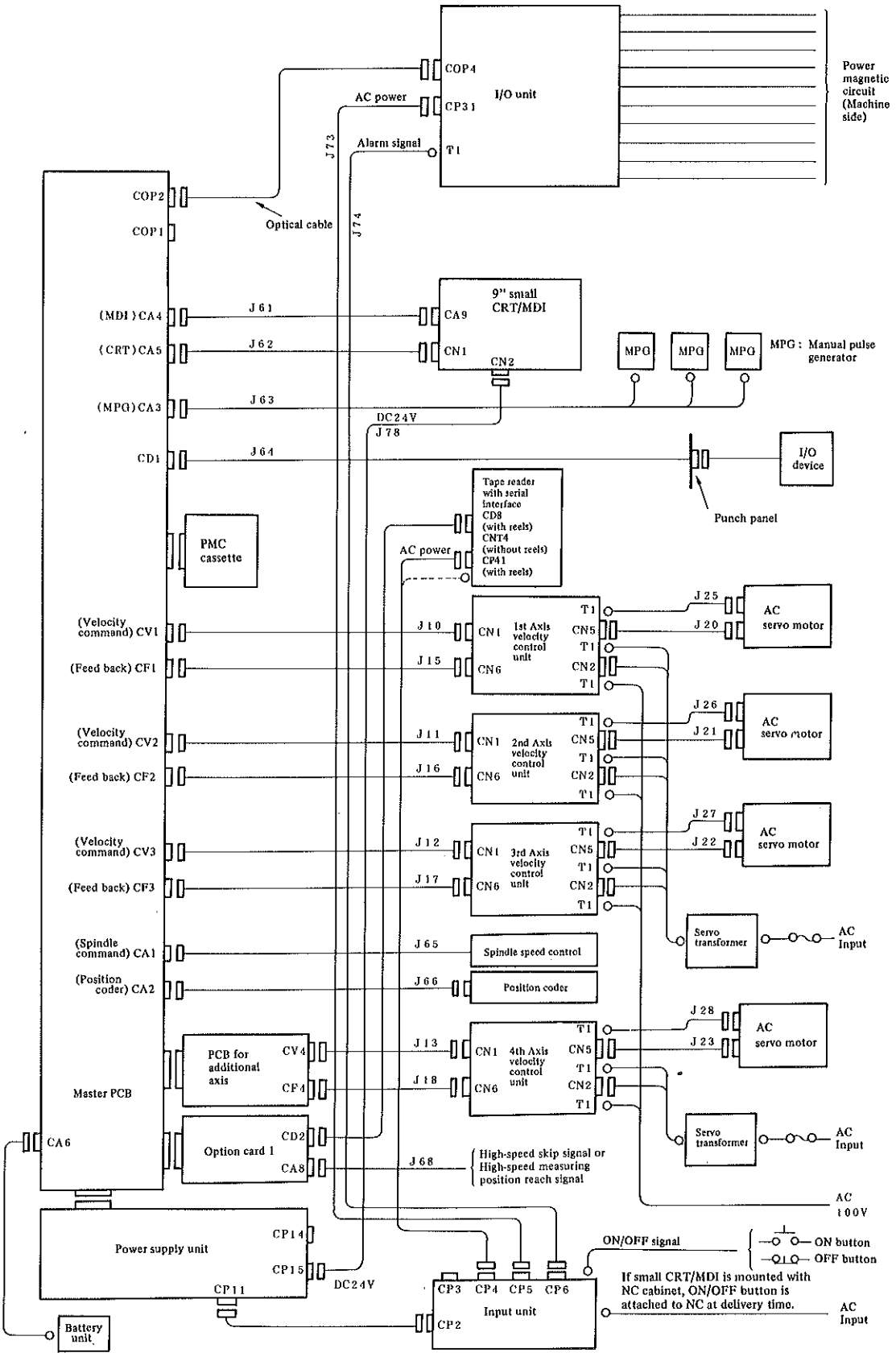


Fig. 1.1 (k) 10TA/10MA total connecting diagram (Analog servo, 9" small CRT/MDI and I/O unit are used.)

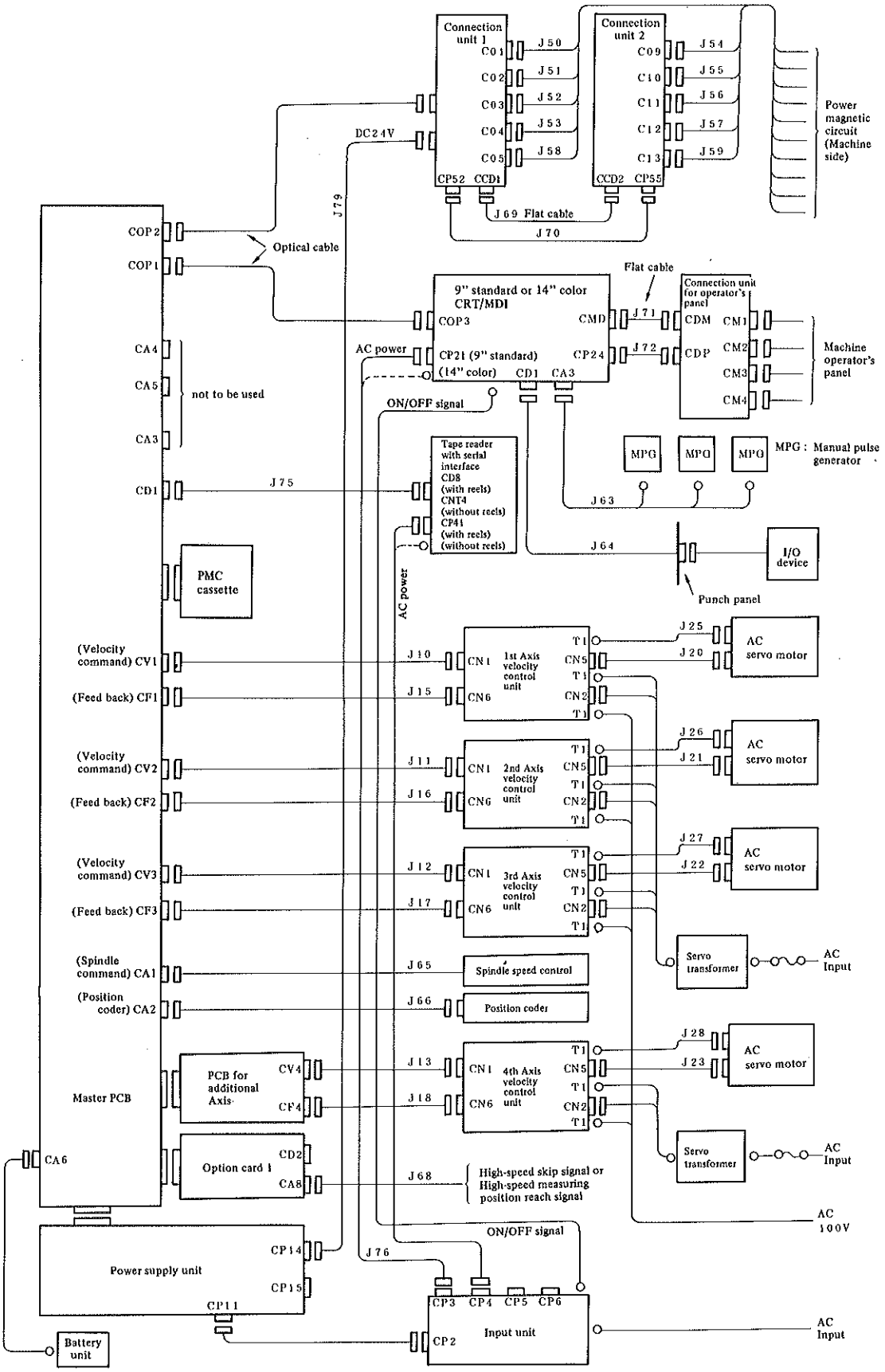


Fig. 1.1 (I) 10TA/10MA total connecting diagram (Analog servo, 9" standard or 14" color CRT/MDI and connection unit are used.)

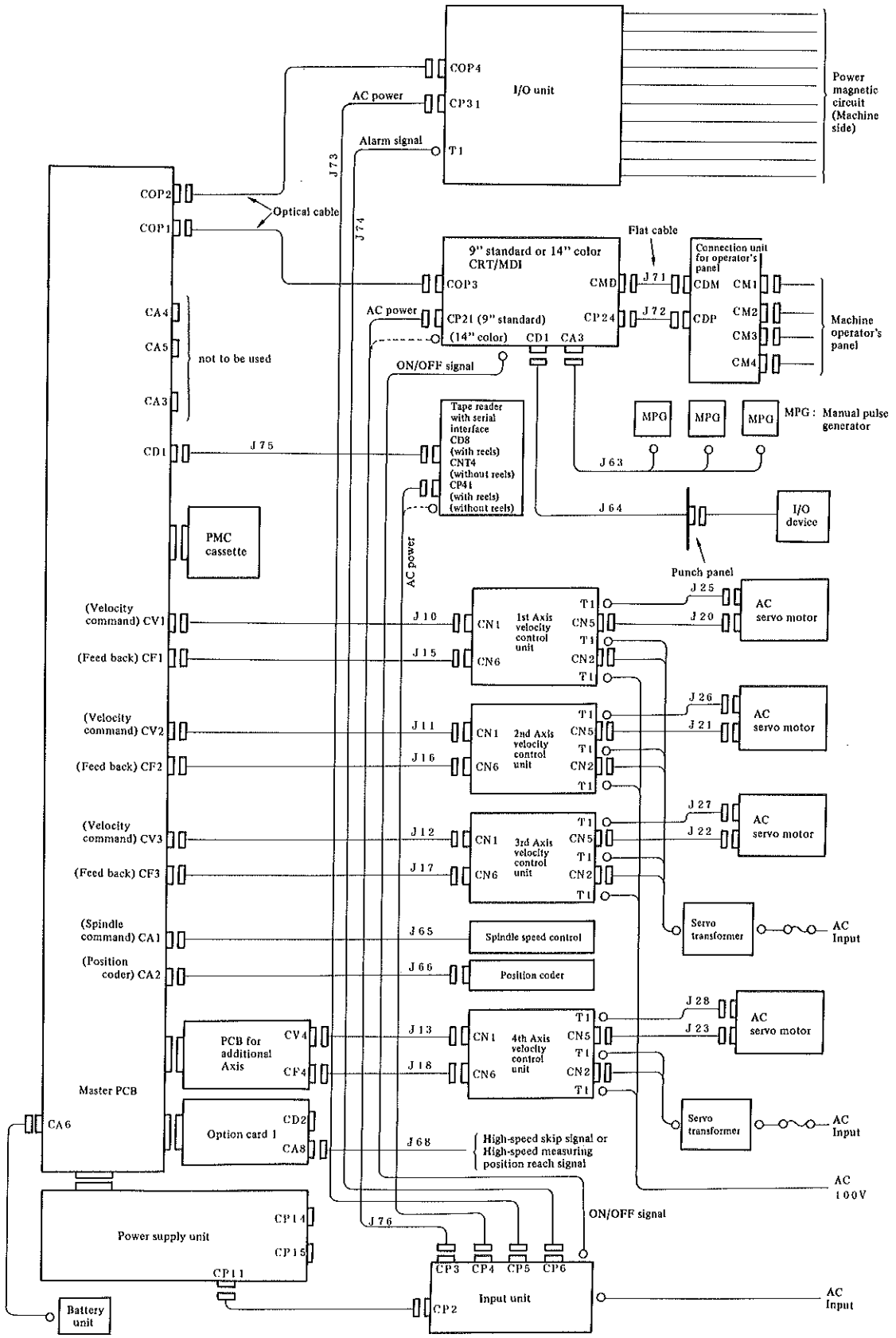


Fig. 1.1 (m) 10TA/10MA total connecting diagram (Analog servo, 9" standard or 14" color CRT/MDI and I/O unit are used.)

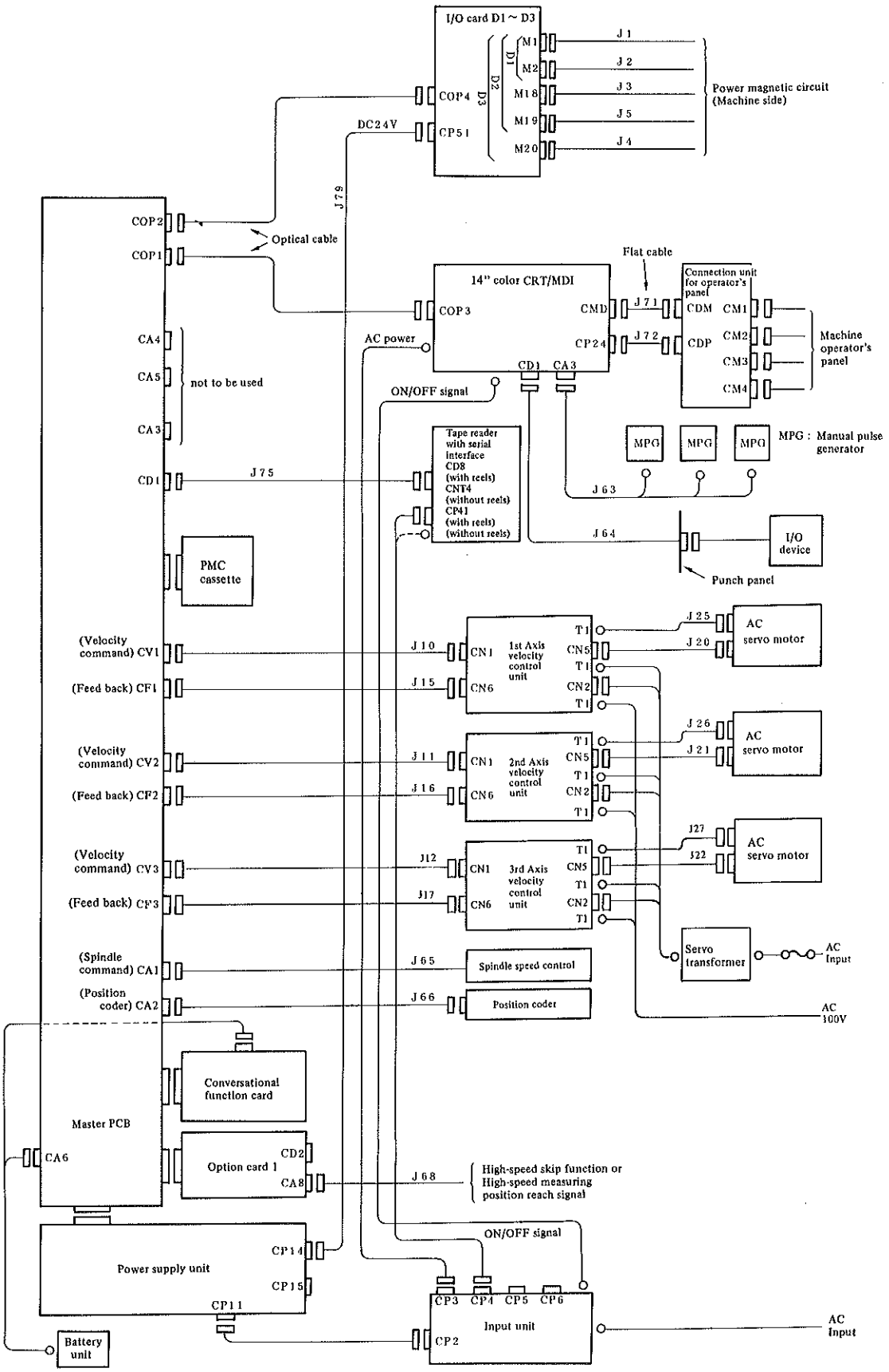


Fig. 1.1 (n) 10TF total connecting diagram (14" color CRT/NDI and I/O card D1 ~ D3 are used.)

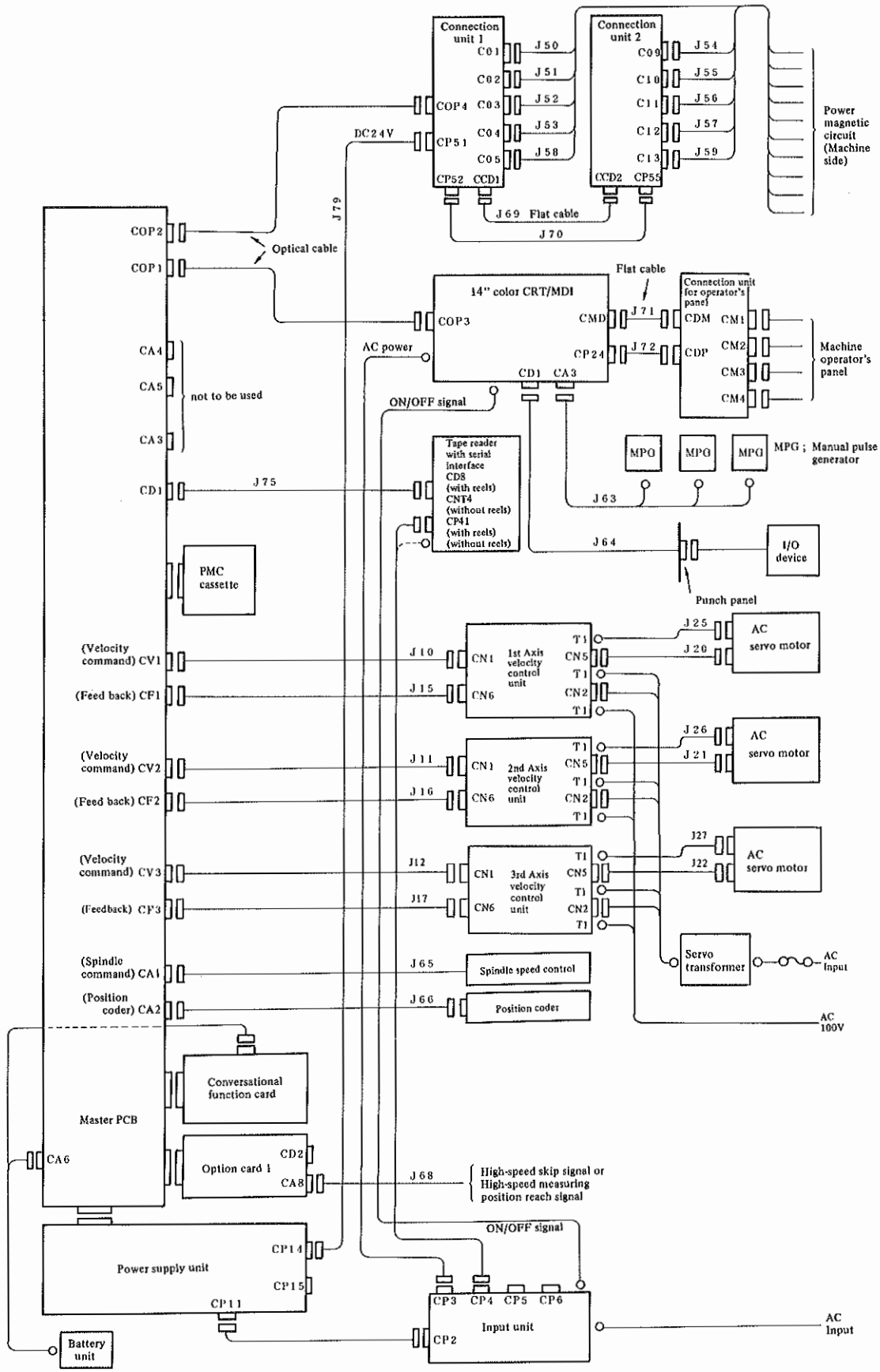


Fig. 1.1 (o) 10TF total connecting diagram (14" color CRT/MDI and connection unit are used.)

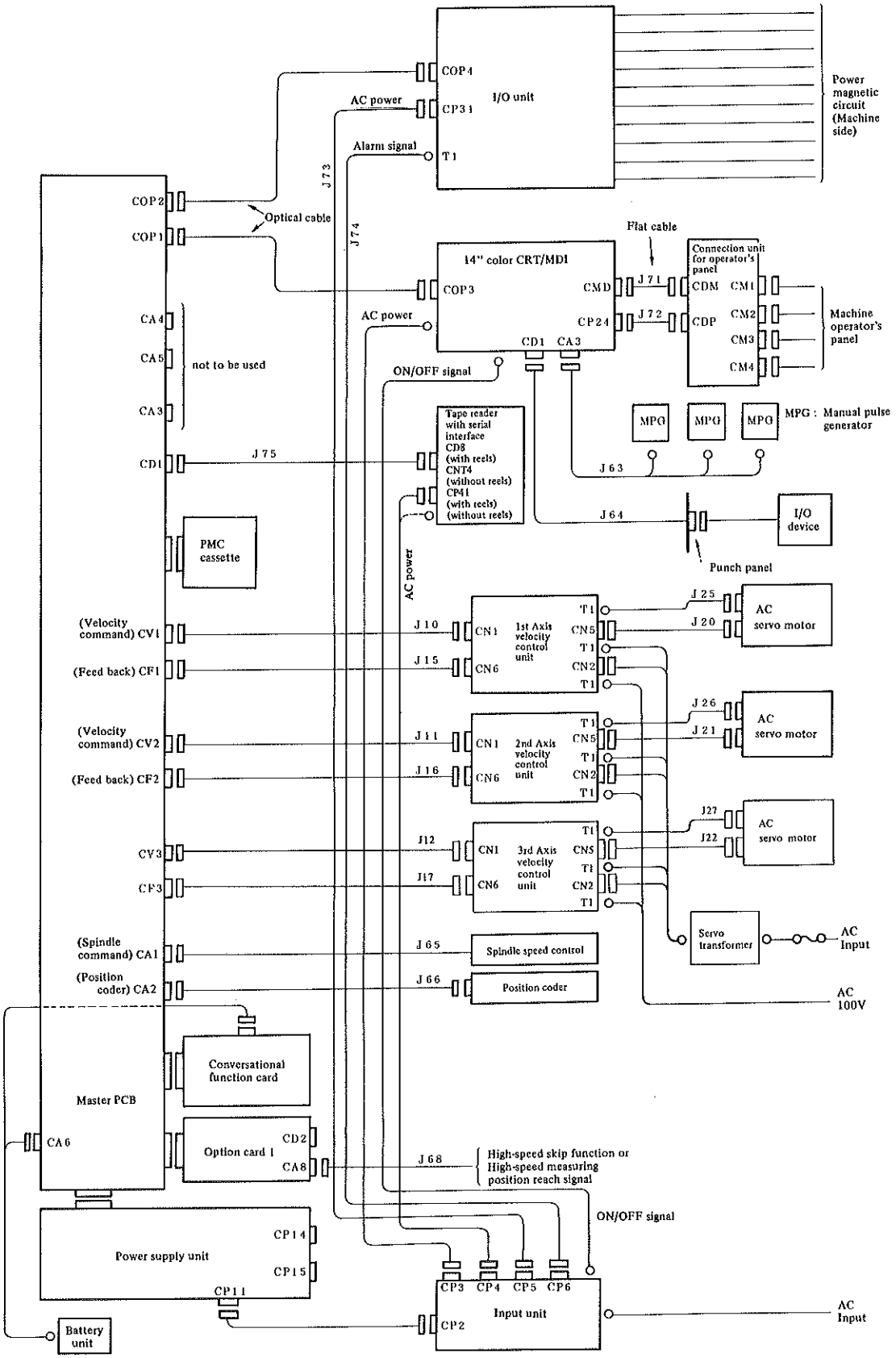


Fig. 1.1 (p) 10TF total connecting diagram (14" color CRT/MDI and I/O unit are used.)

1.2 11 Series

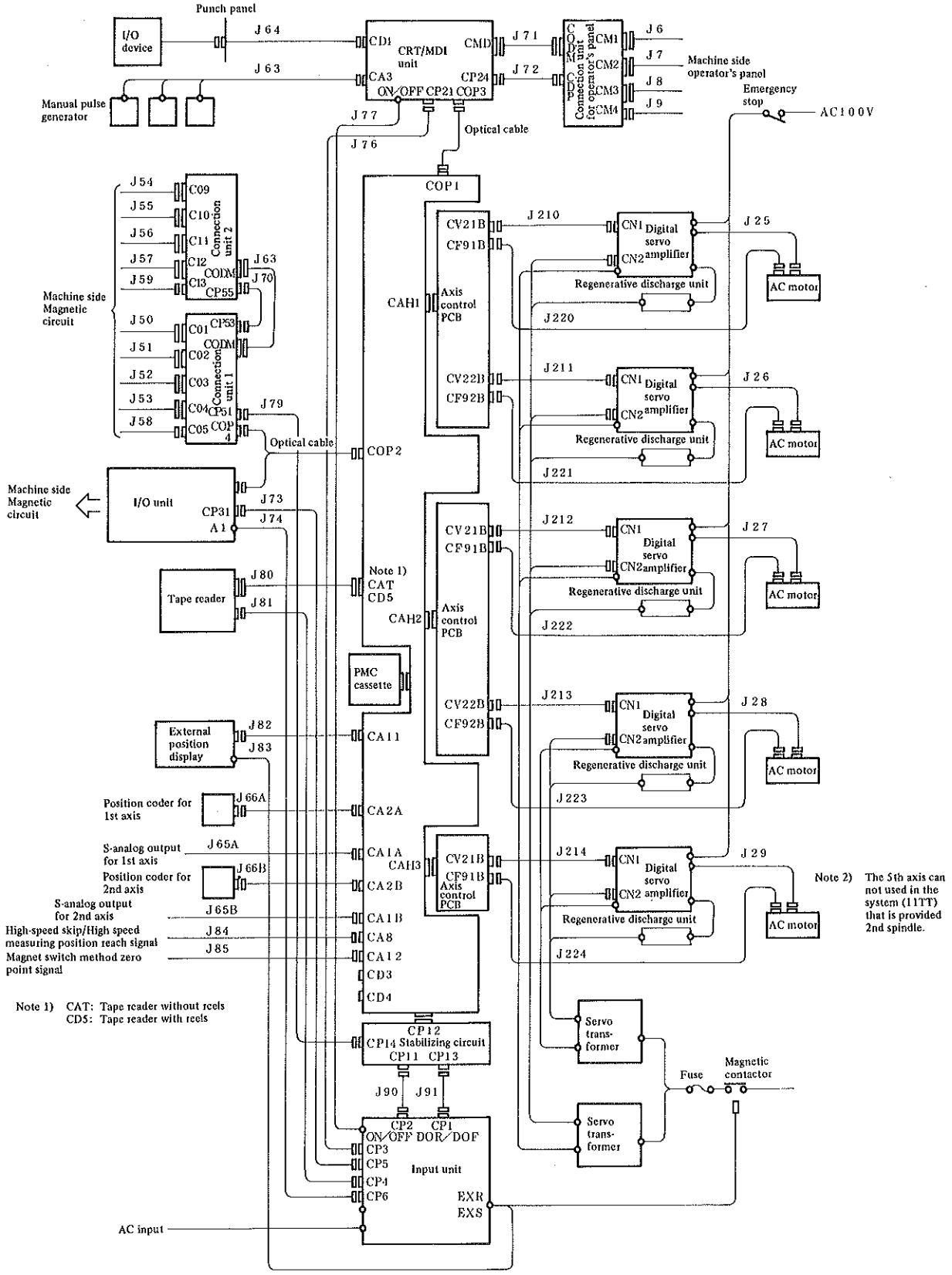


Fig. 1.2 (a) 11 series total connecting diagram (Digital servo without separated pulse coder)

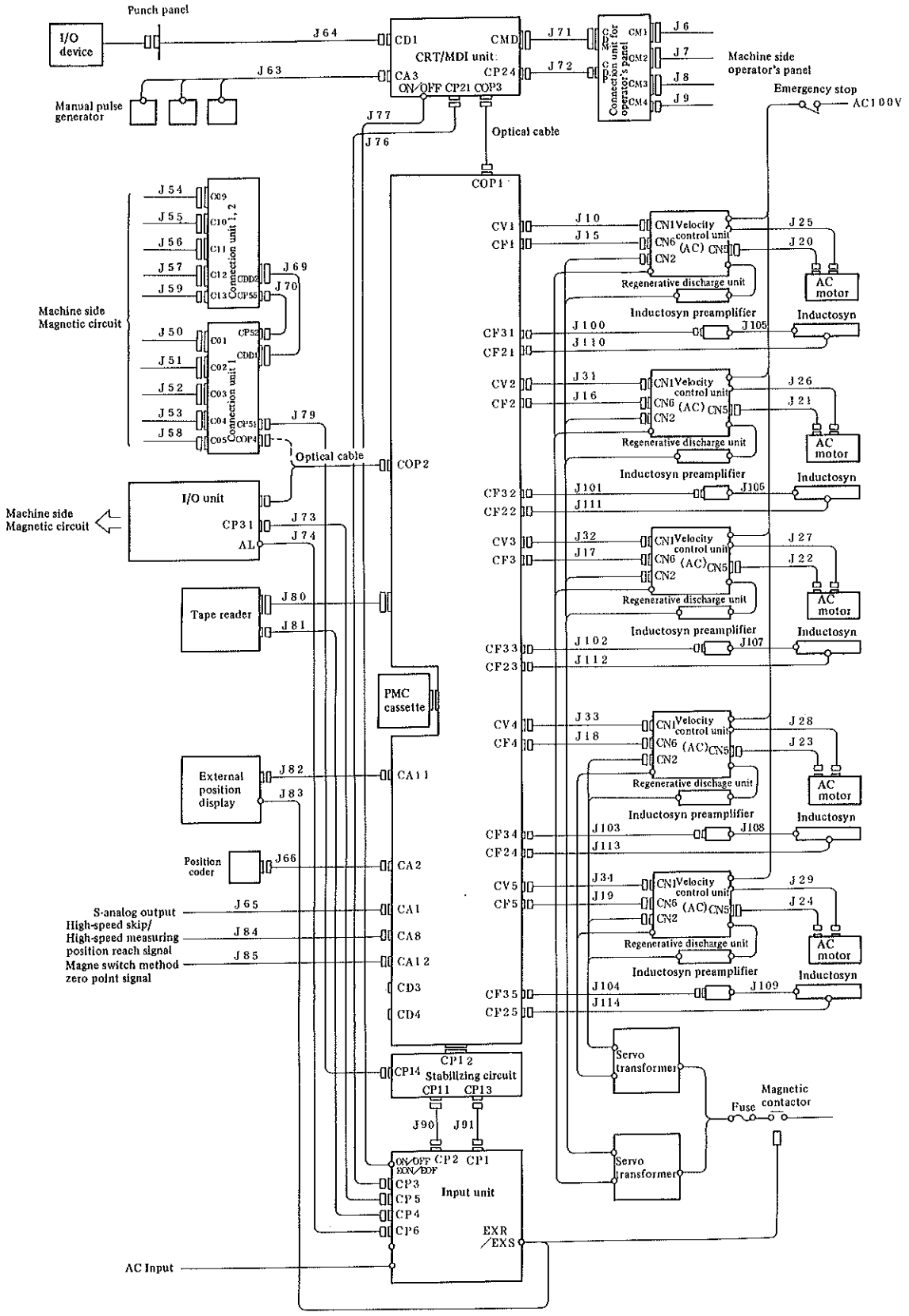


Fig. 1.2 (b) 11 series total connecting diagram (for Analog servo without separate type pulse coder)

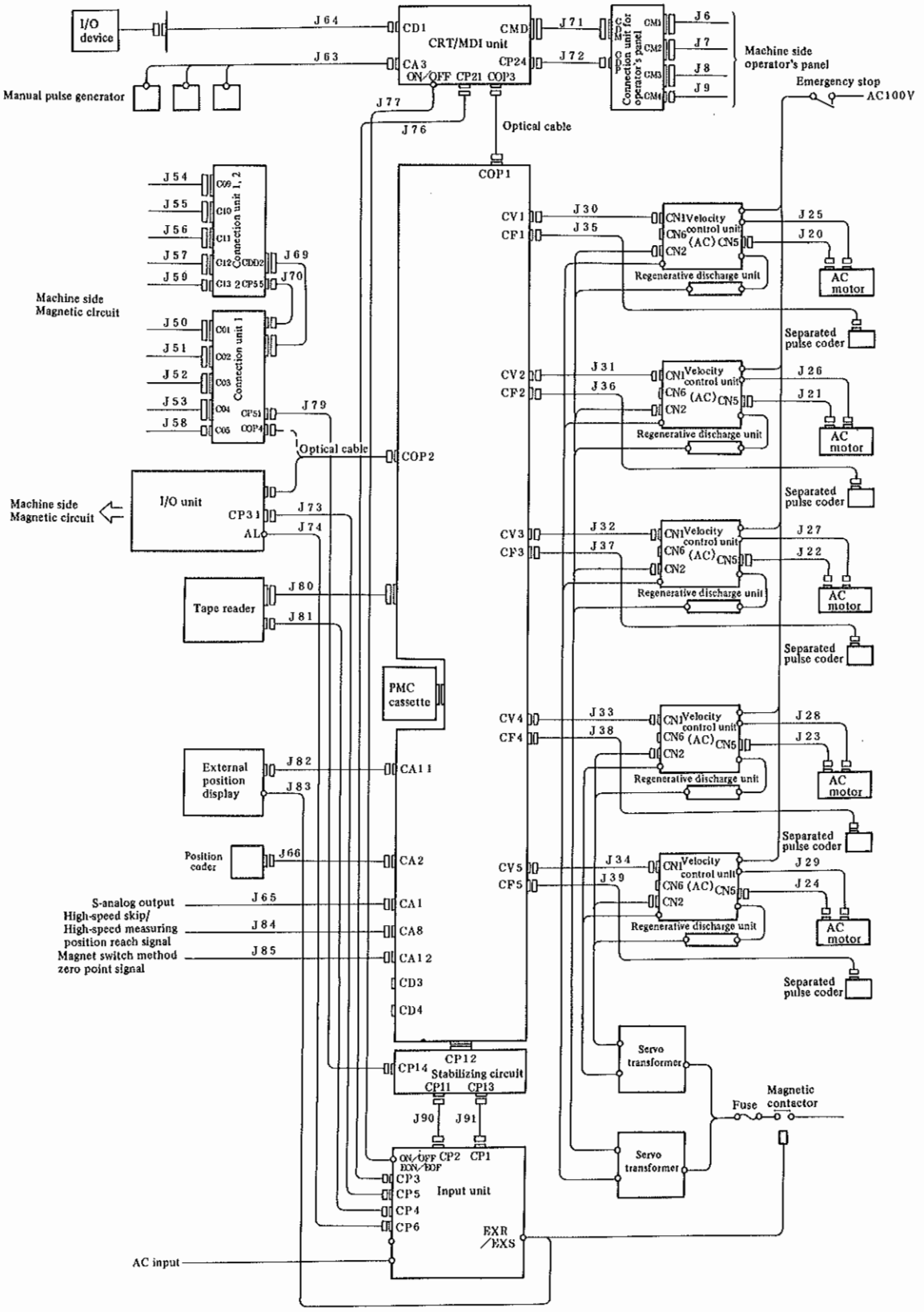
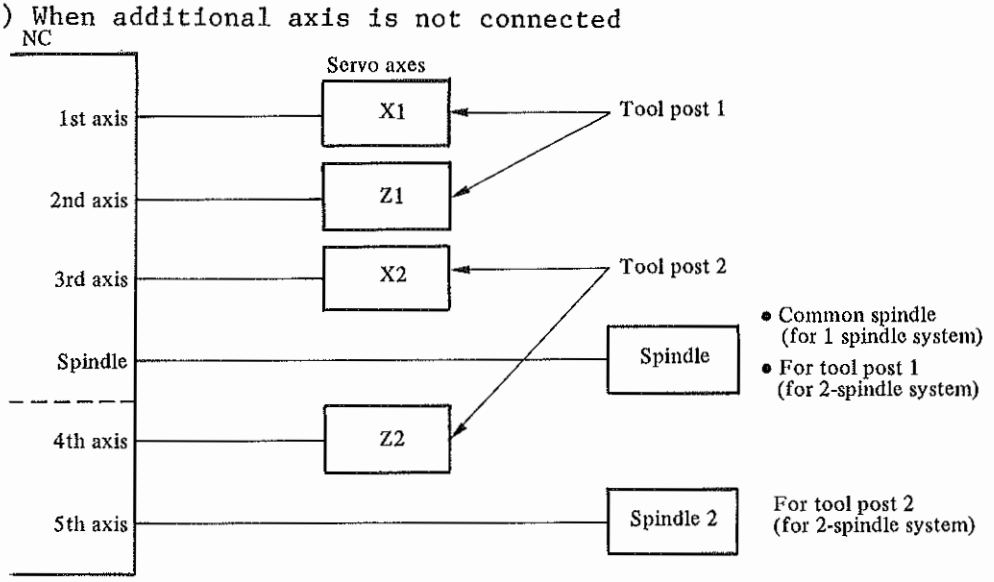


Fig. 1.2 (c) 11 series total connecting diagram (for analog servo with separate type pulse coder)

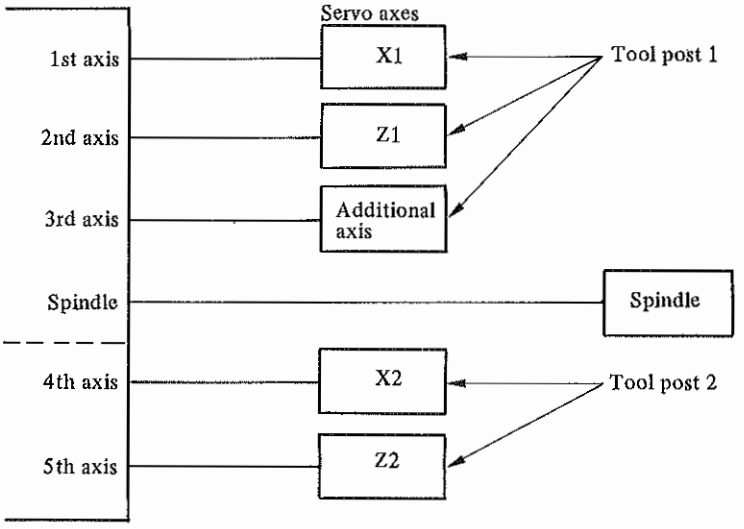
1) 11TT servo axes and spindle connection diagram

a) For analog servo

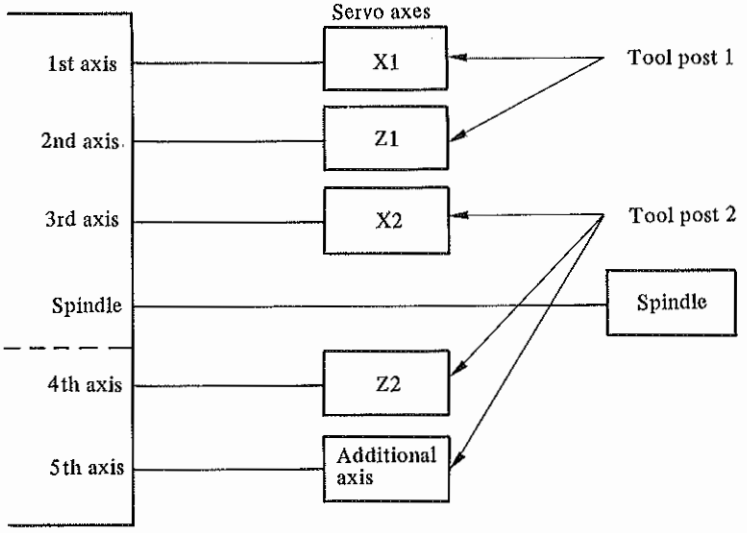
i) When additional axis is not connected



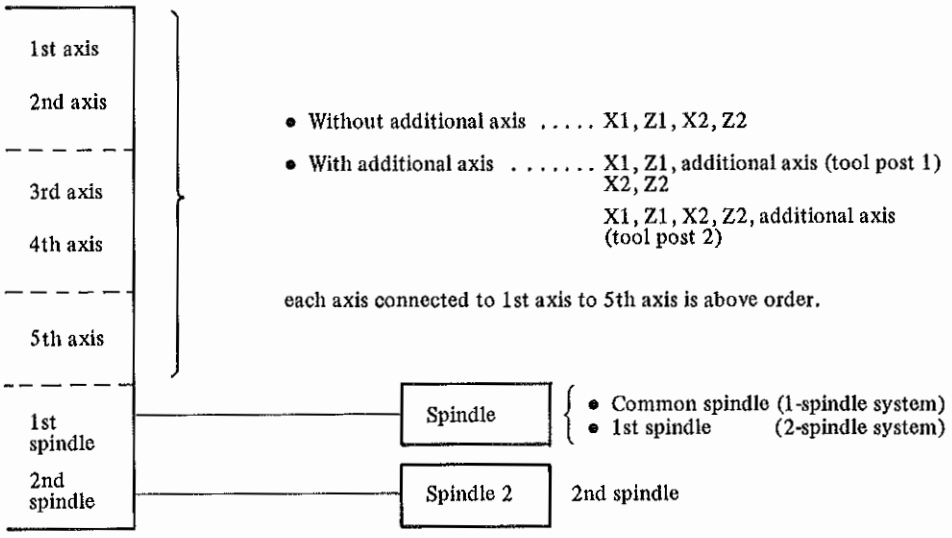
ii) When additional axis is connected to tool post 1



iii) When additional axis is connected to tool post 2



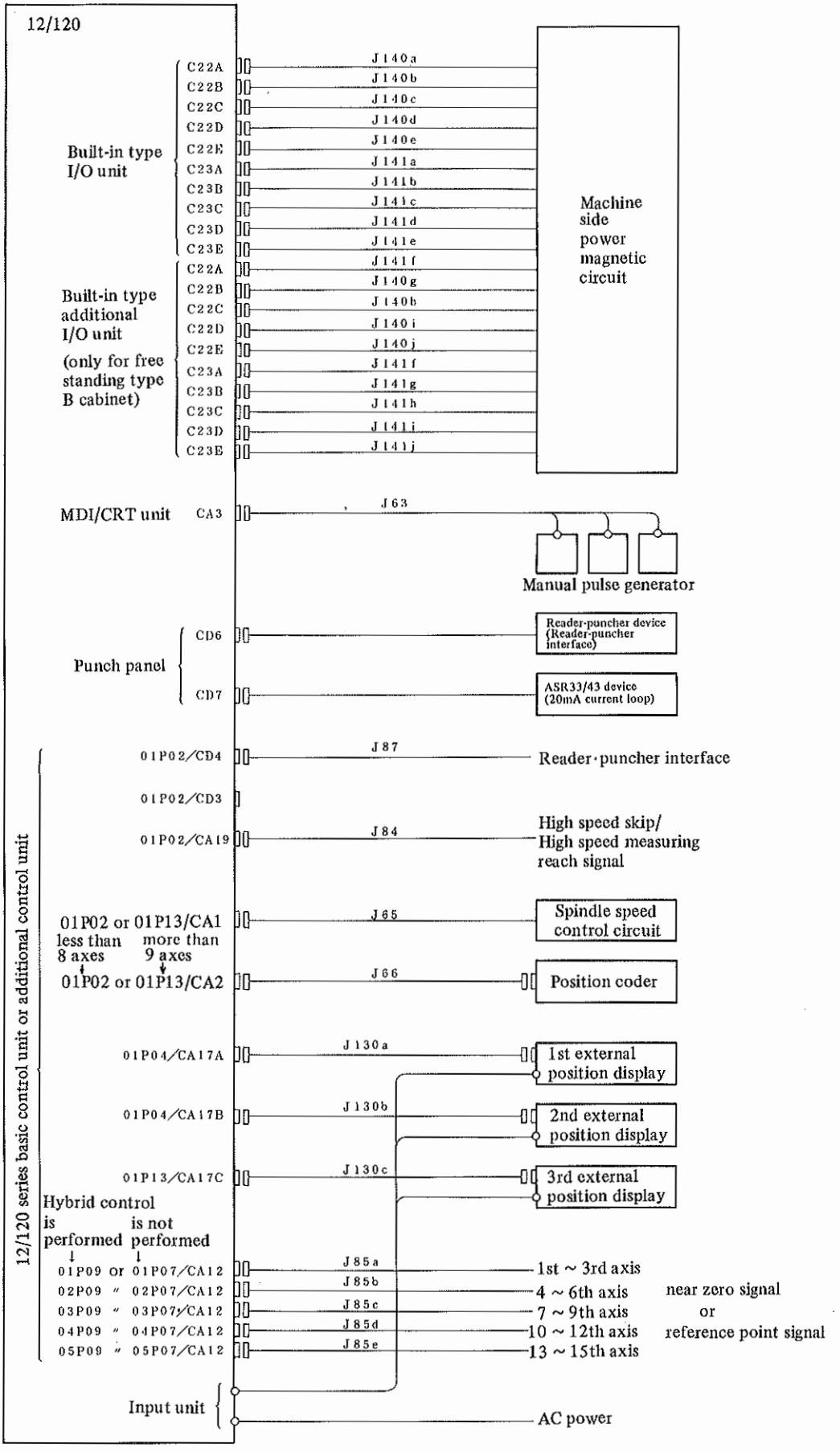
b) For digital servo



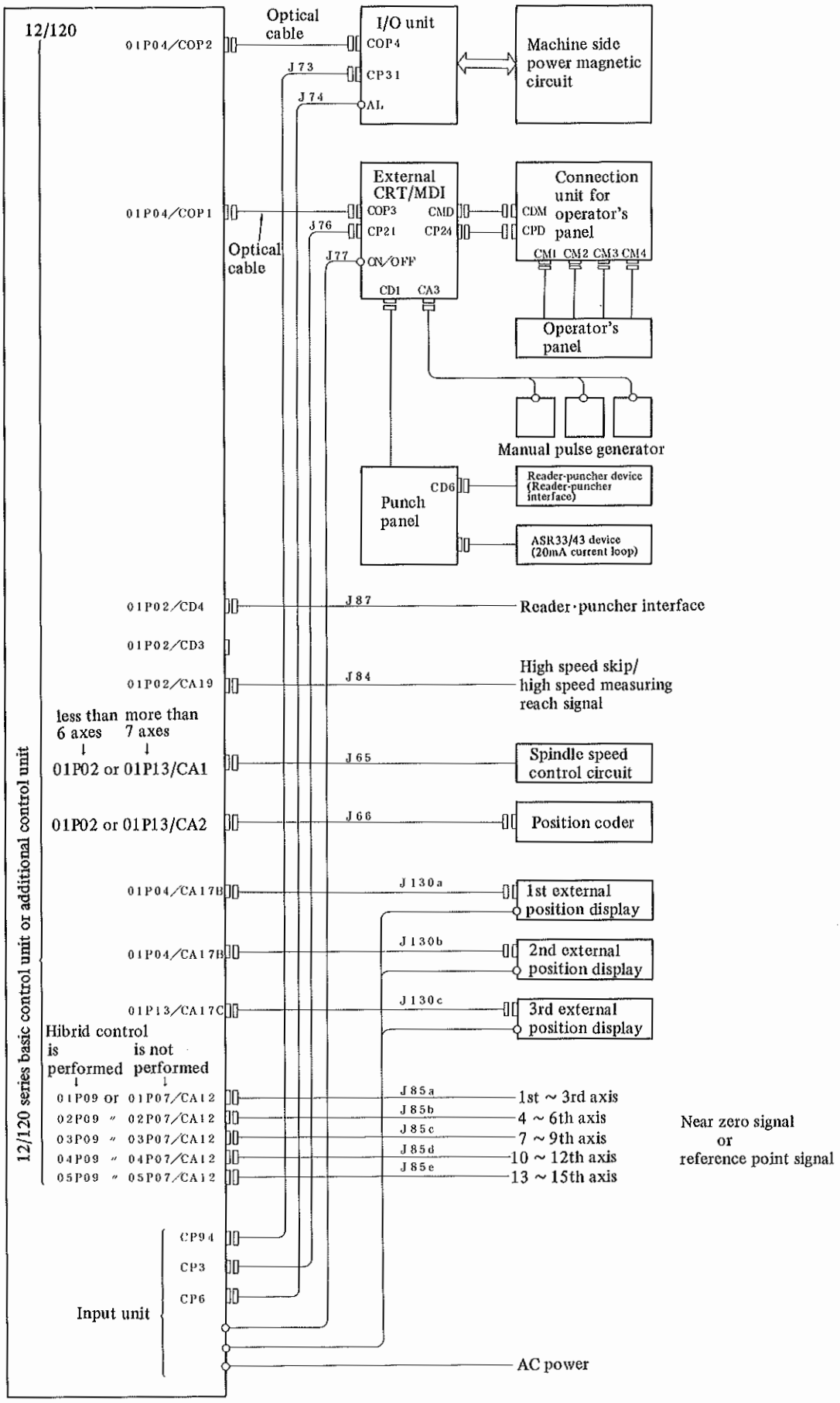
(Note) The additional axis can not be used when 2nd spindle is provided.

1.3 12/120 Series

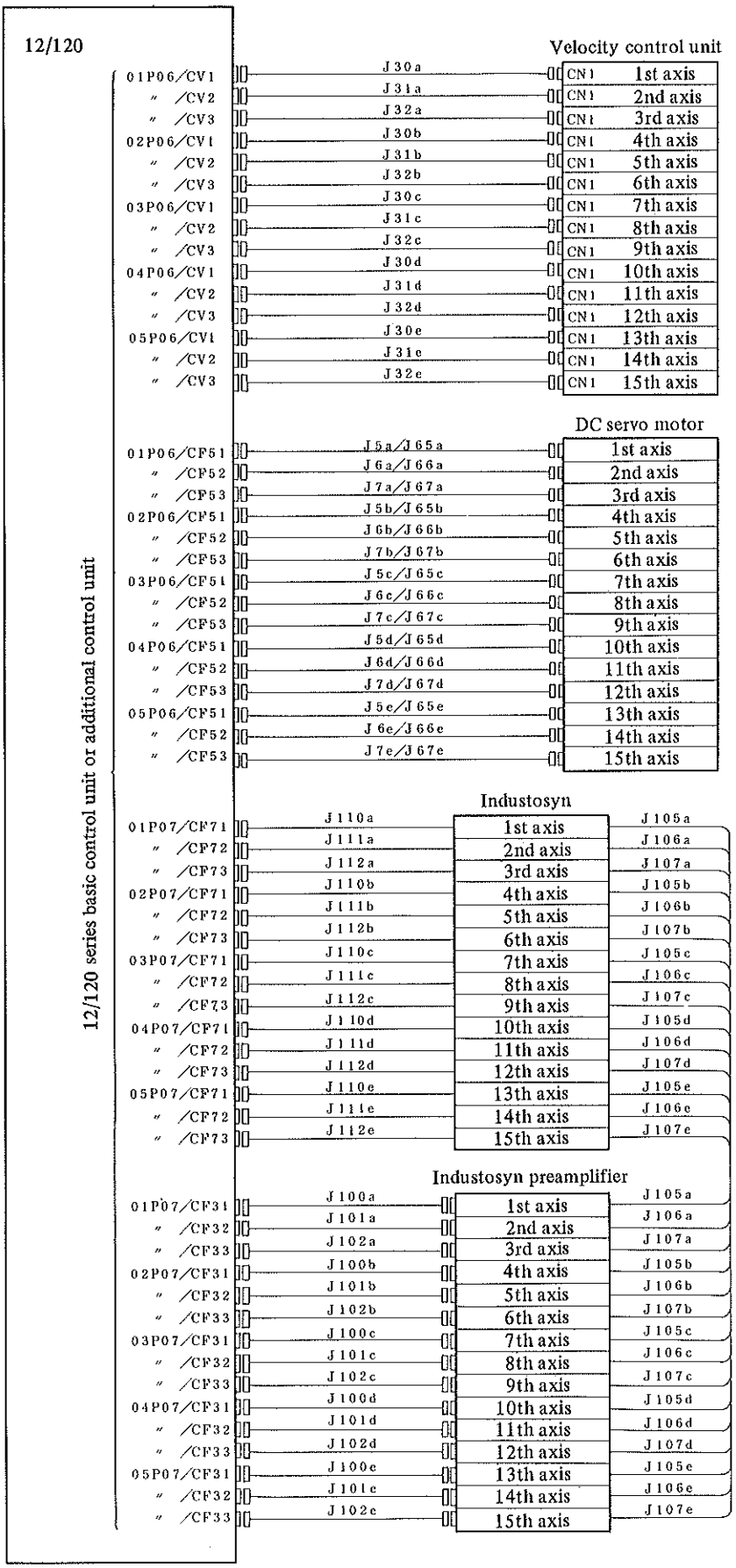
1) 12/120 series total connection diagram
(Connection other than servo system; Internal CRT/MDI and Built-in type I/O unit are used.)



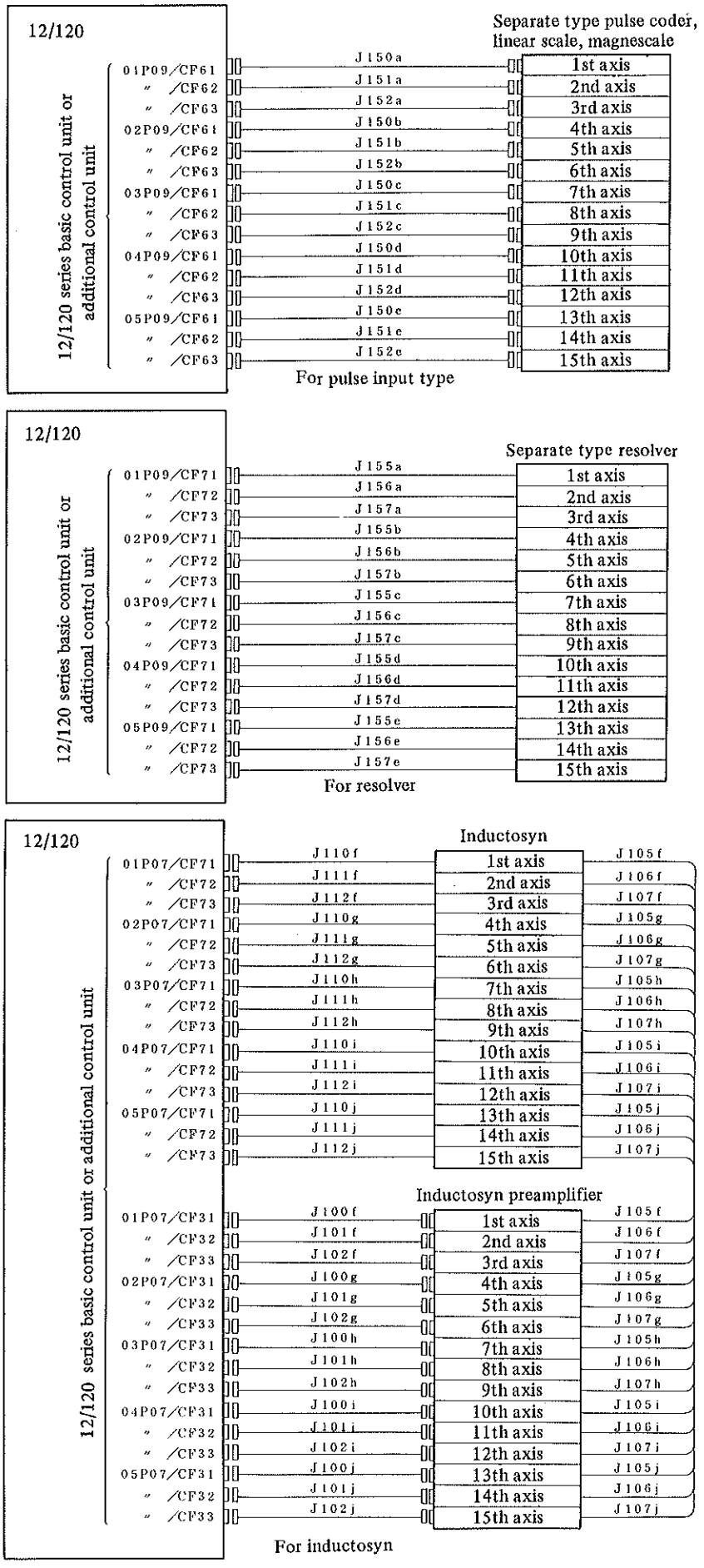
2) 12/120 series total connecting diagram
(Connection other than servo system; External CRT/MDI and Separate I/O unit are used.)



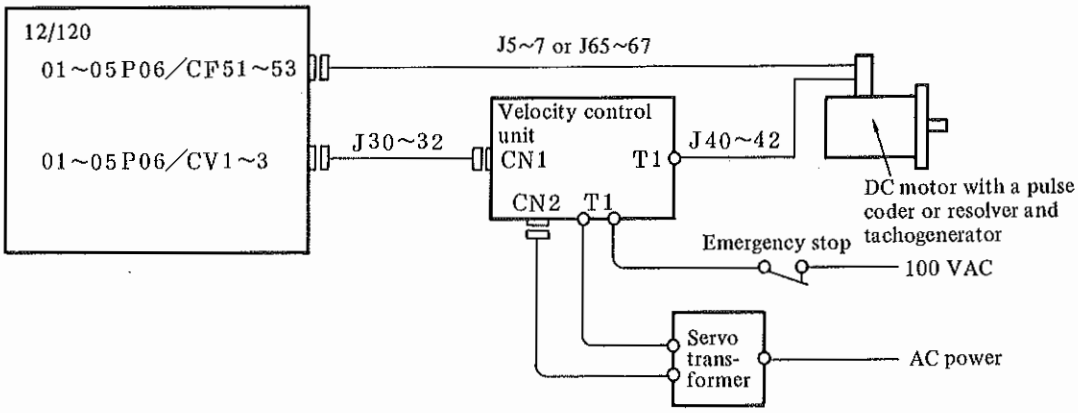
3) 12/120 series total connecting diagram
(Servo system signal connection; when a pulse coder, a resolver and an inductosyn are used in DC servo motor.)



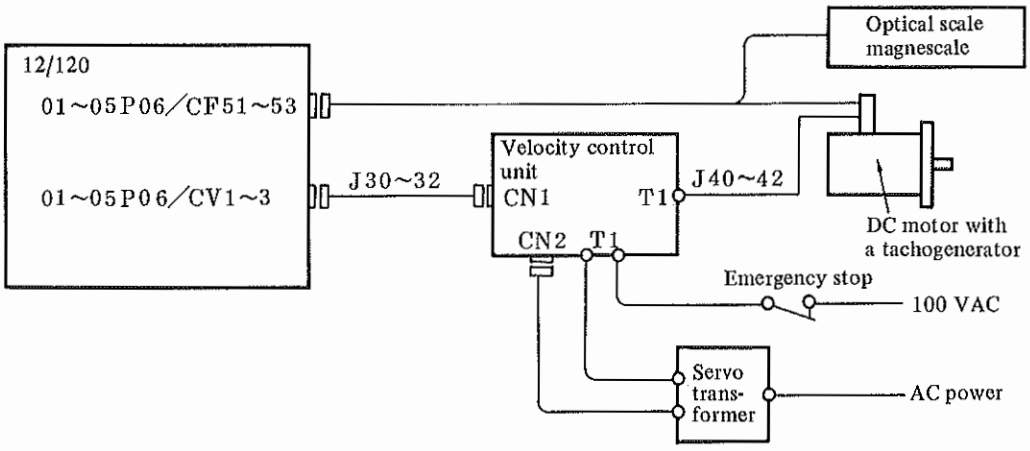
4) 12/120 series total connecting diagram
(Additional detector connection)



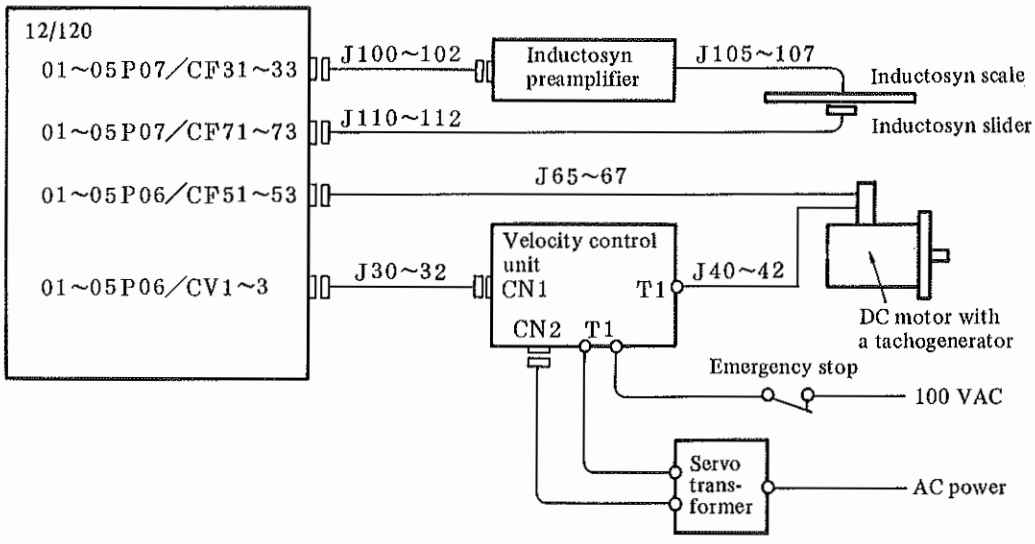
5) 12/120 series servo system connecting diagram
(When DC motor is used.)



Pulse coder or resolver is used as a position detector.

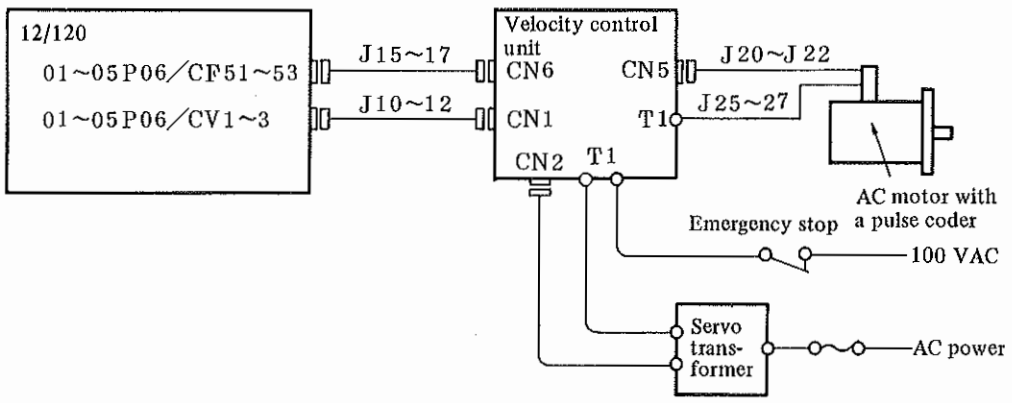


Optical scale or magnescale is used as a position detector.

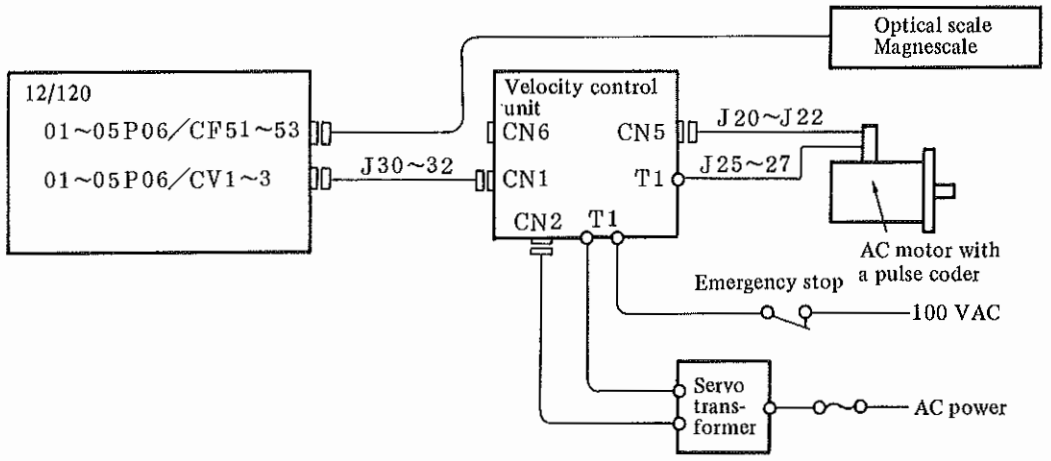


Inductosyn is used as a position detector.

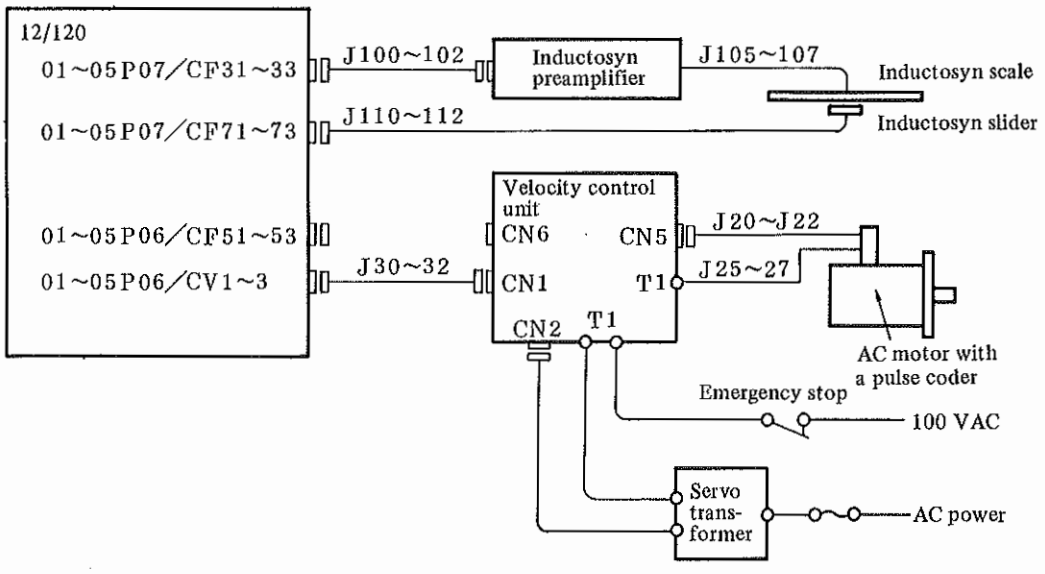
6) 12/120 series servo system connection diagram
(When AC motor is used.)



Pulse coder is used as a position detector.



Optical scale or magnescale is used as a position detector.



Inductosyn is used as a position detector.

1.4 100 Series

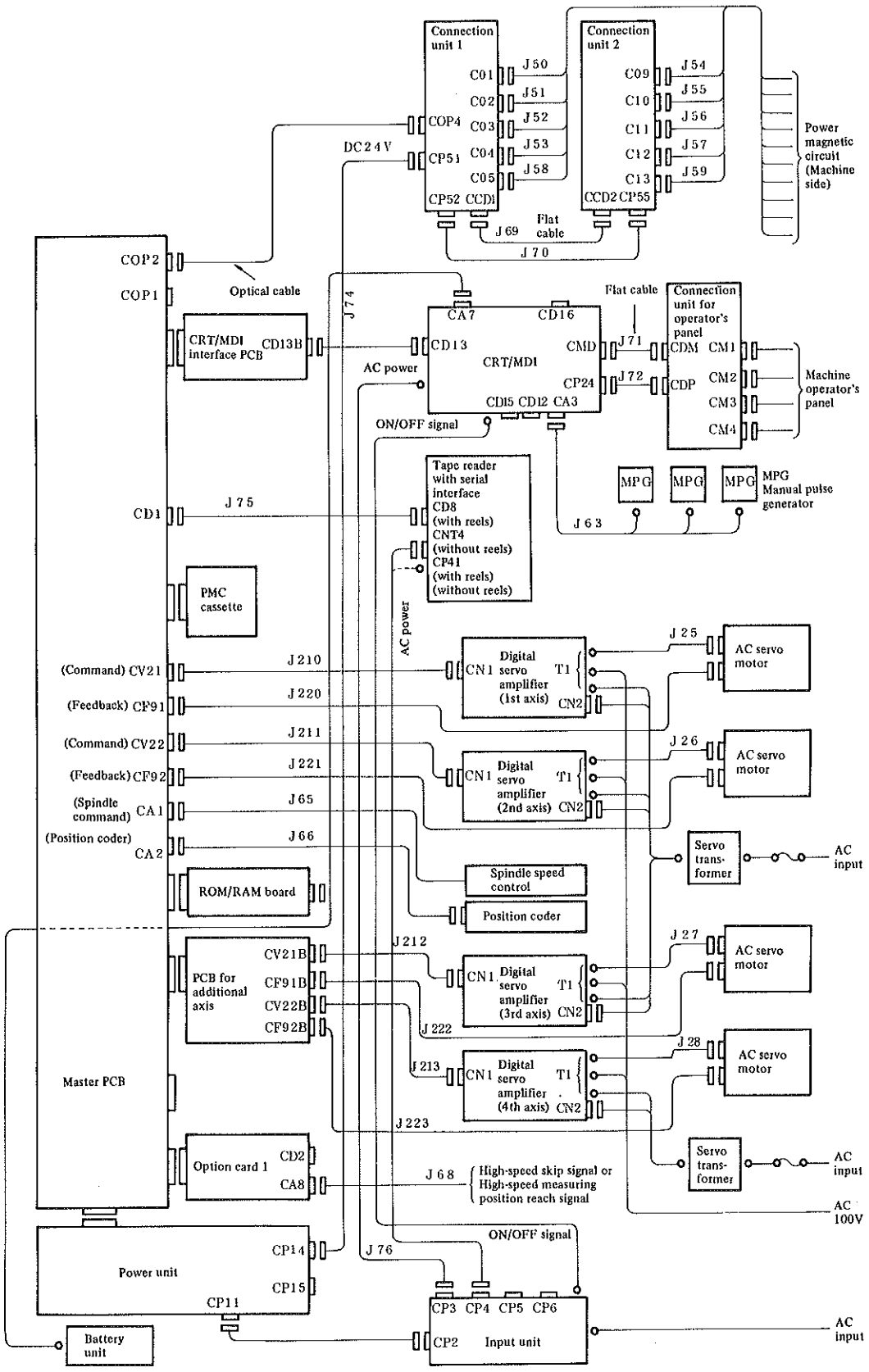


Fig. 1.4 (a) 100T/100M total connection diagram (Digital servo and connection unit are employed)

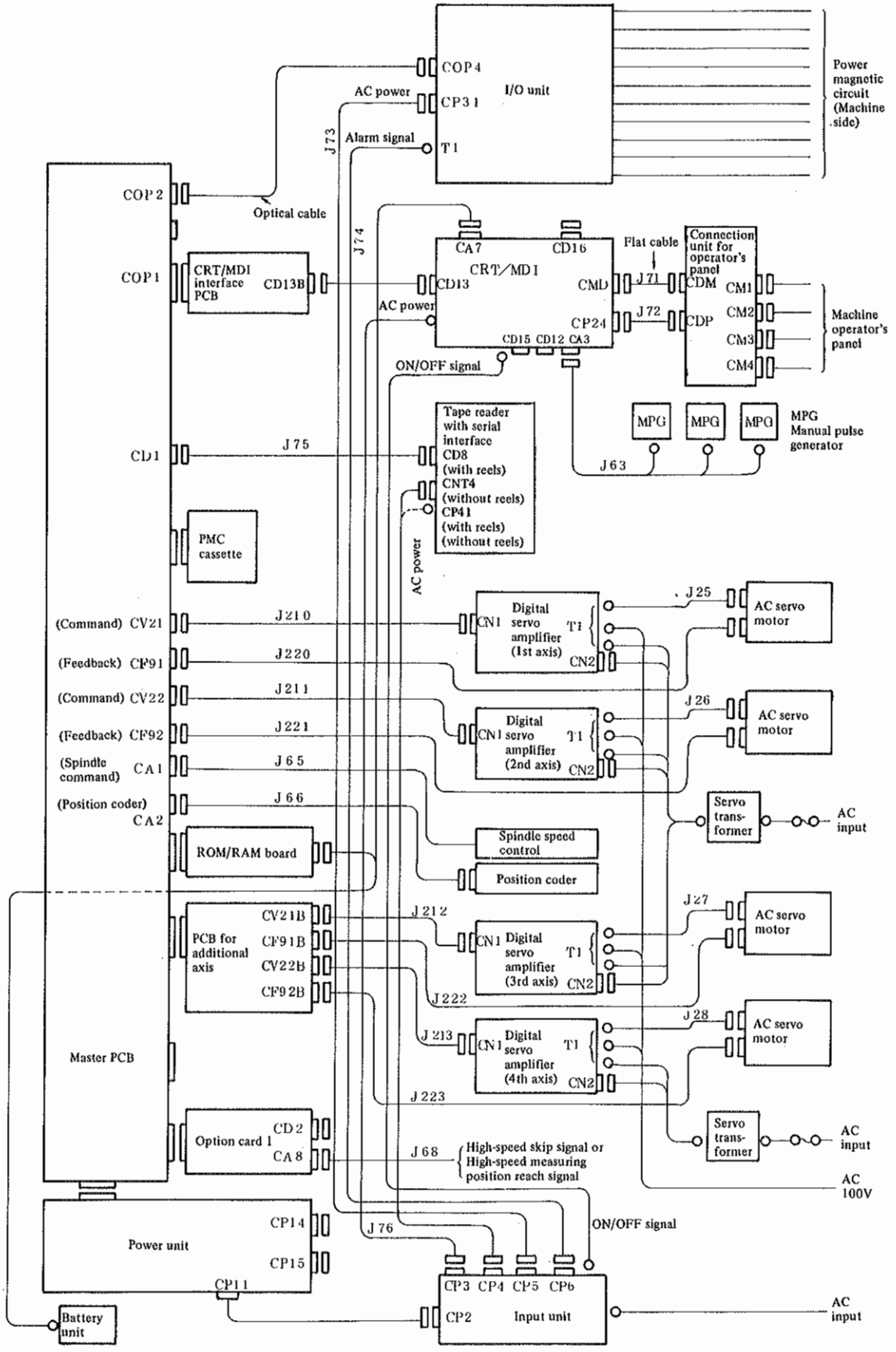


Fig. 1.4 (b) 100T/100M total connecting diagram (Digital servo and I/O unit are employed)

1.5 110 series

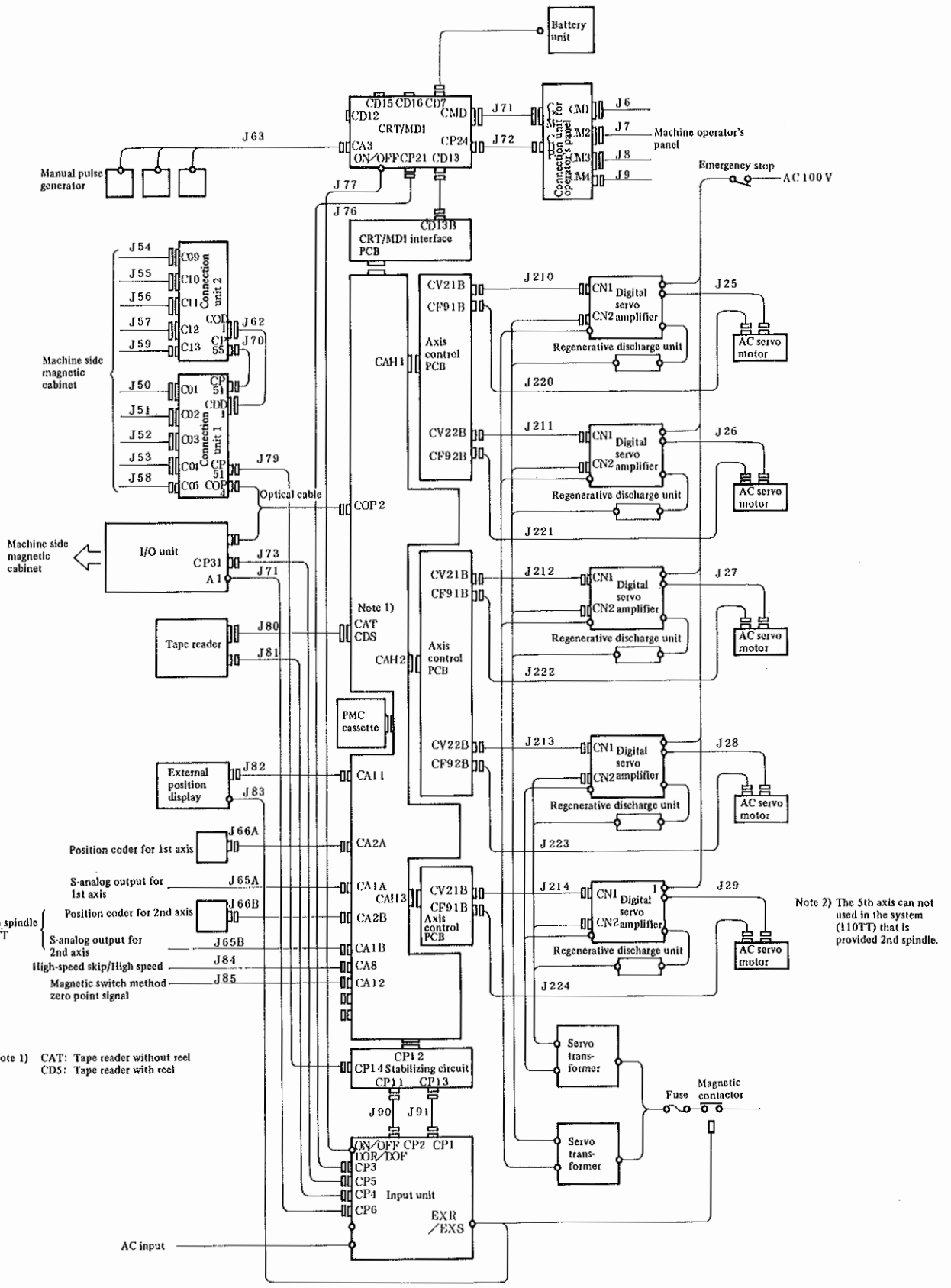
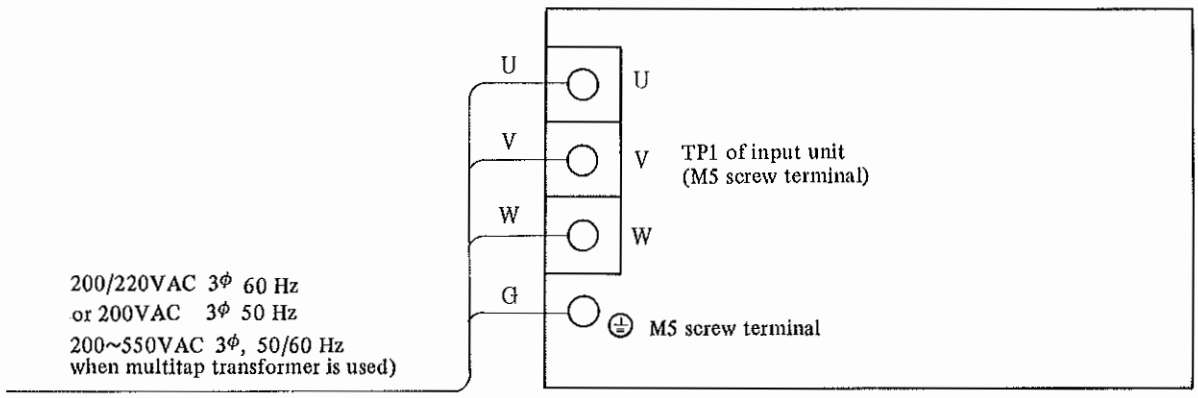


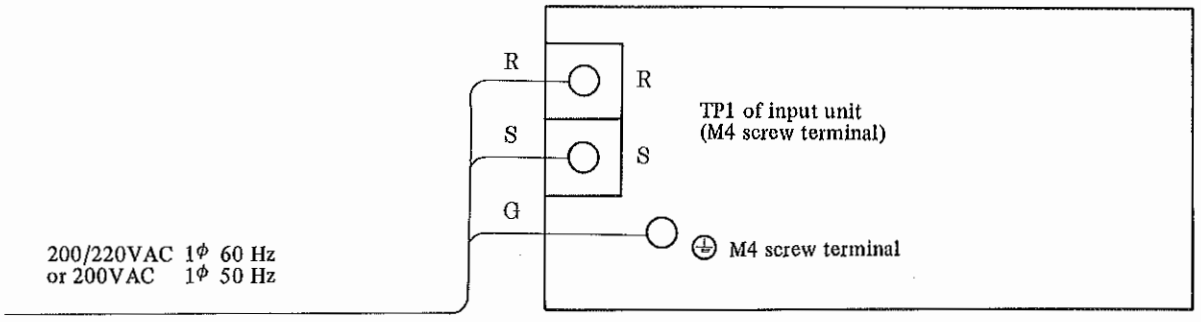
Fig. 1.5 110 series total connecting diagram (Digital servo without separated pulse coder)

1.6 Connecting of Input Power Supply

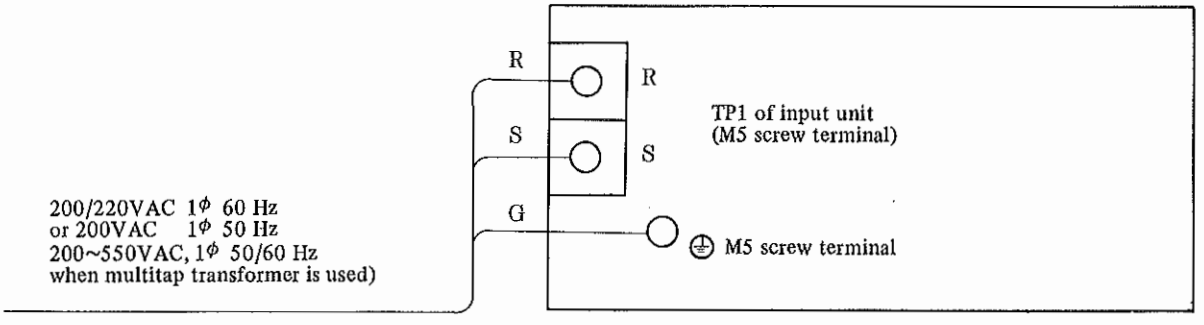
1) In case of free-standing type



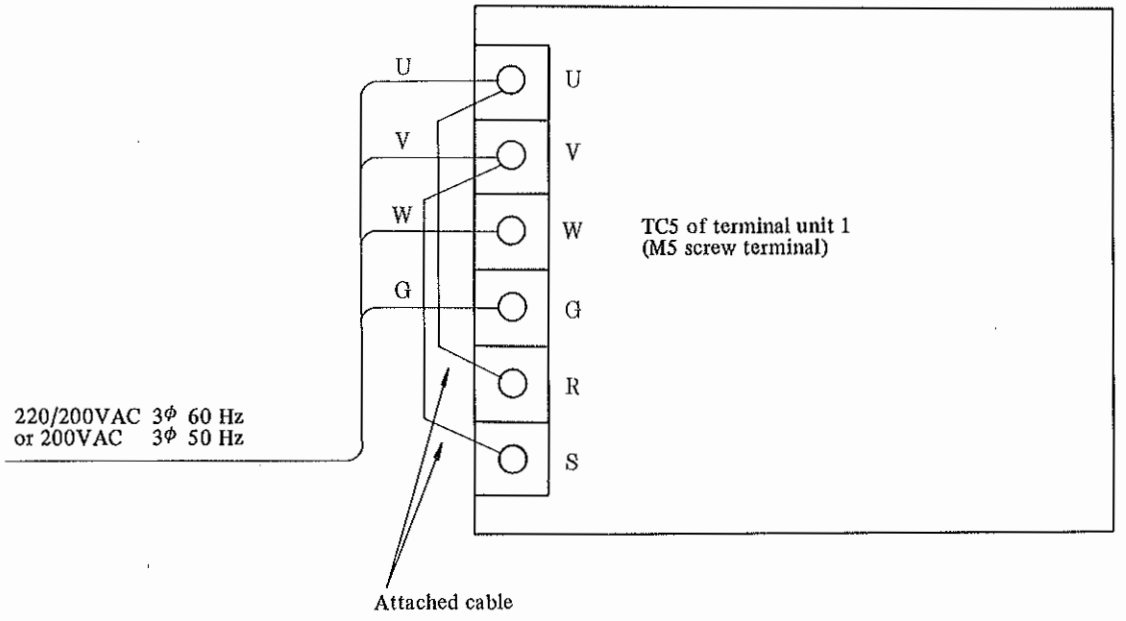
2) T series/M series built-in type 1, M series built-in type 2-2, built-in type 3, and unbundled type



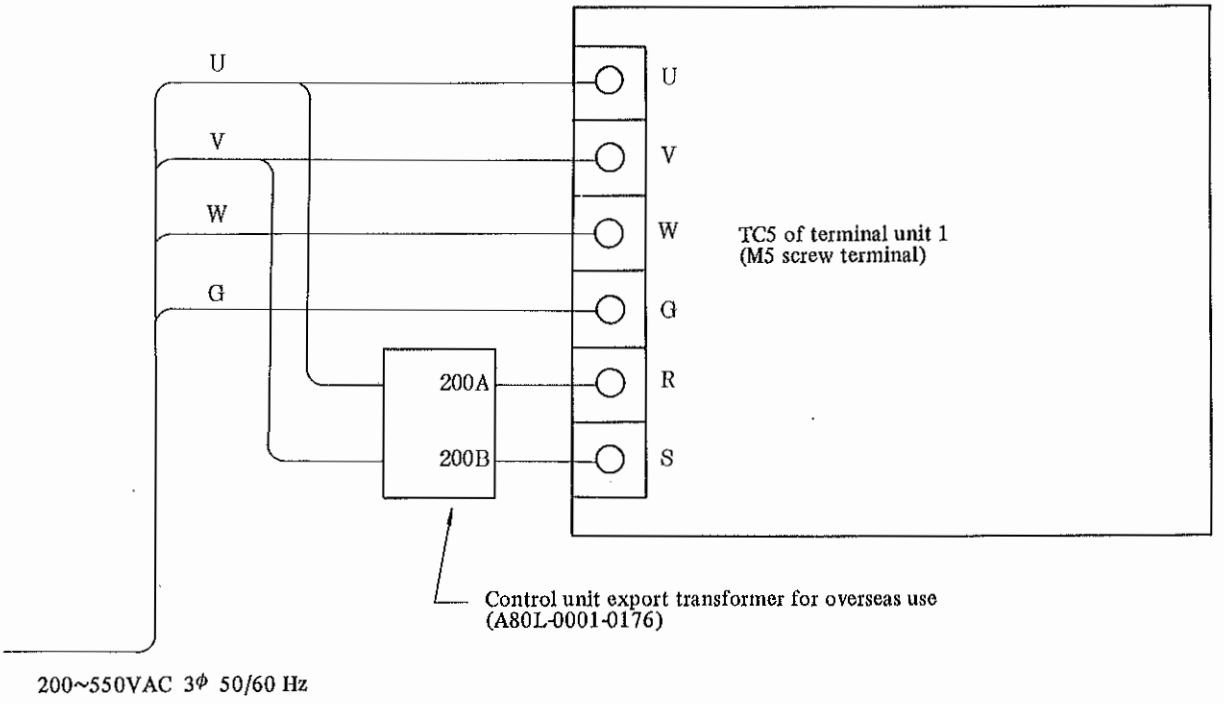
3) In case of M series built-in type 2



4) In case of T series built-in type 2 (for domestic use)

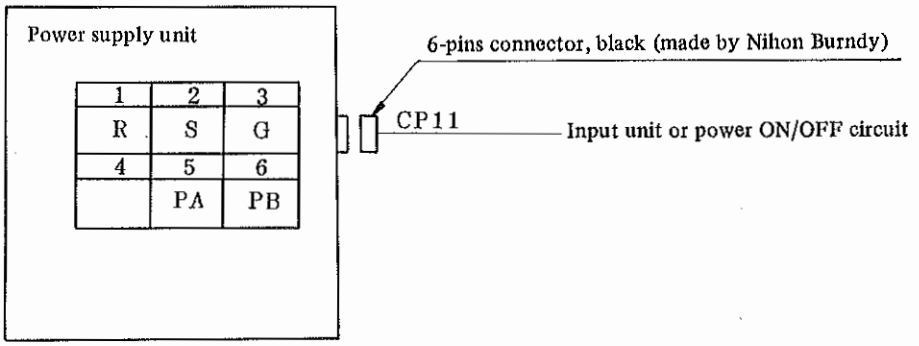


5) In case of T series built-in type 2 (for countries other than Japan)

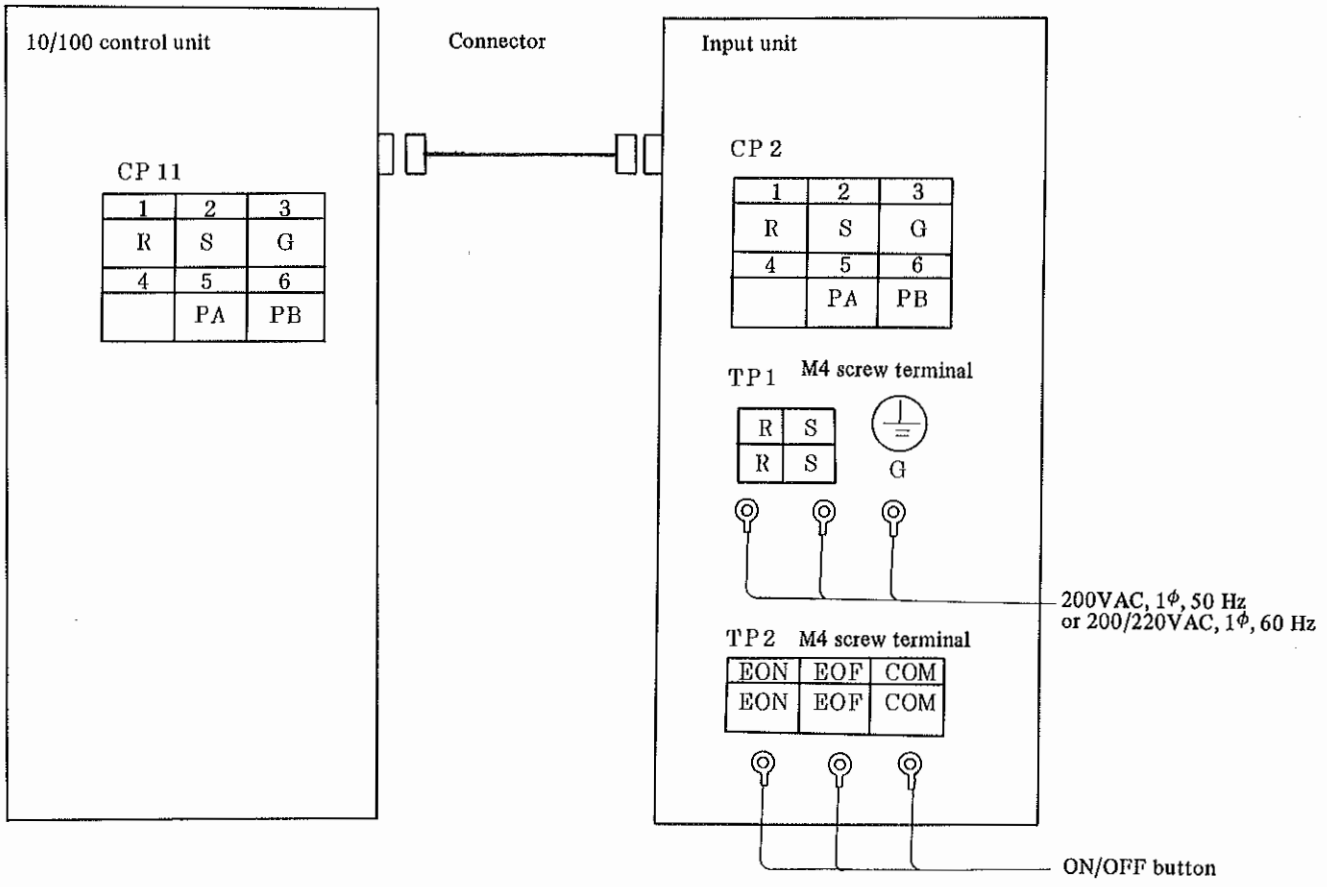


(Note) Connect the control unit transformer as shown in this figure, if the export transformer does not satisfy the power supply condition shown in (4). Then remove the attached cable.

6) In case of 10/100 series panel-mount Type

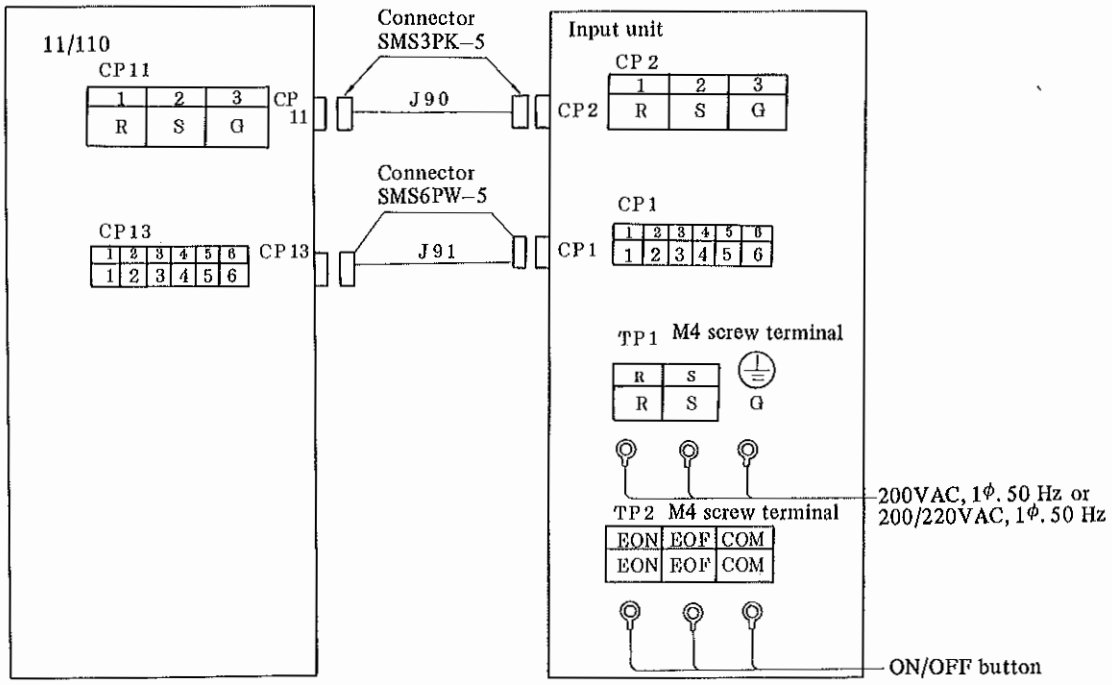


Connection diagram with input unit used



For details of input unit, see 8).

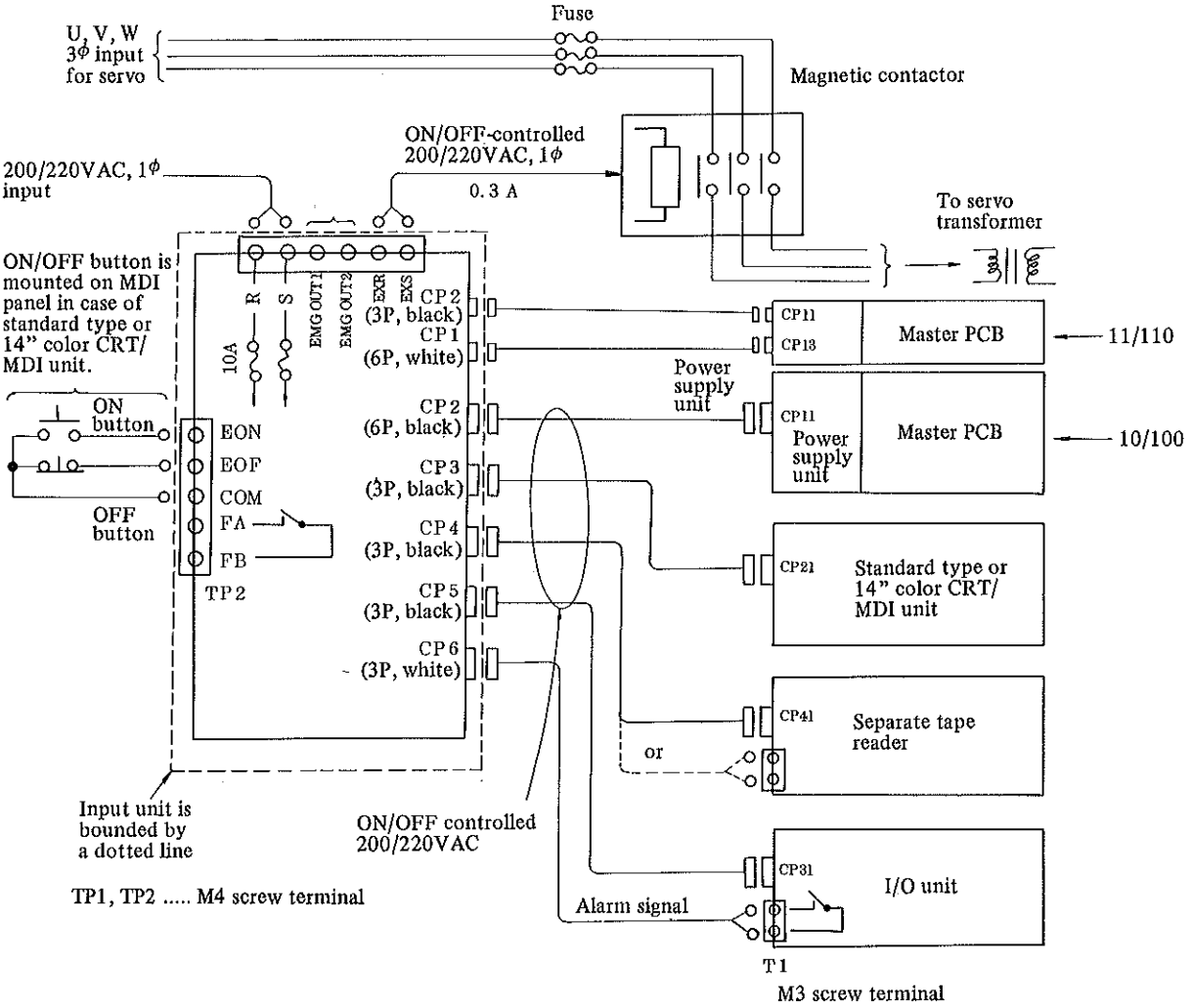
7) In case of 11/110 series panel-mount type
Unlike 10/100 series, our input unit should be used.



8) Input unit

The input unit receives AC input power signal and ON/OFF button signal. It feeds the ON-OFF controlled AC power to the control unit and peripheral units.

i) Connection block diagram



ii) Power system connector terminal layout

a) CP2 (10/100 series),
CP11 (11/110 series), CP31 ..... 6-pin connector, black
(made by Nihon Burndy)

1	2	3
R	S	G
4	5	6
	PA	PB

PA, PB power ready signals

b) CP2 (10/100 series) CP3, CP4, CP5,
CP11 (11/110 series), CP21, CP41 .. 3-pin connector, black
(made by Nihon Burndy)

1	2	3
R	S	G

c) CP6 ..... 3-pin connector, white
(Nihon Burndy)

1	2	3
ALA	ALB	

(ALA/ALB receive an alarm signal from I/O unit and turn off the system power supply.

d) CP1 ..... 6-pin connector, white
(made by Nihon Burndy)

1	2	3	4	5	6
1	2	3	4	5	6

CP1 control signal connector is used for turning the 11/110 series stabilizing power unit on and off. Connect it with power supply unit as a pair.

iii) How to control servo transformer input power supply ON/OFF

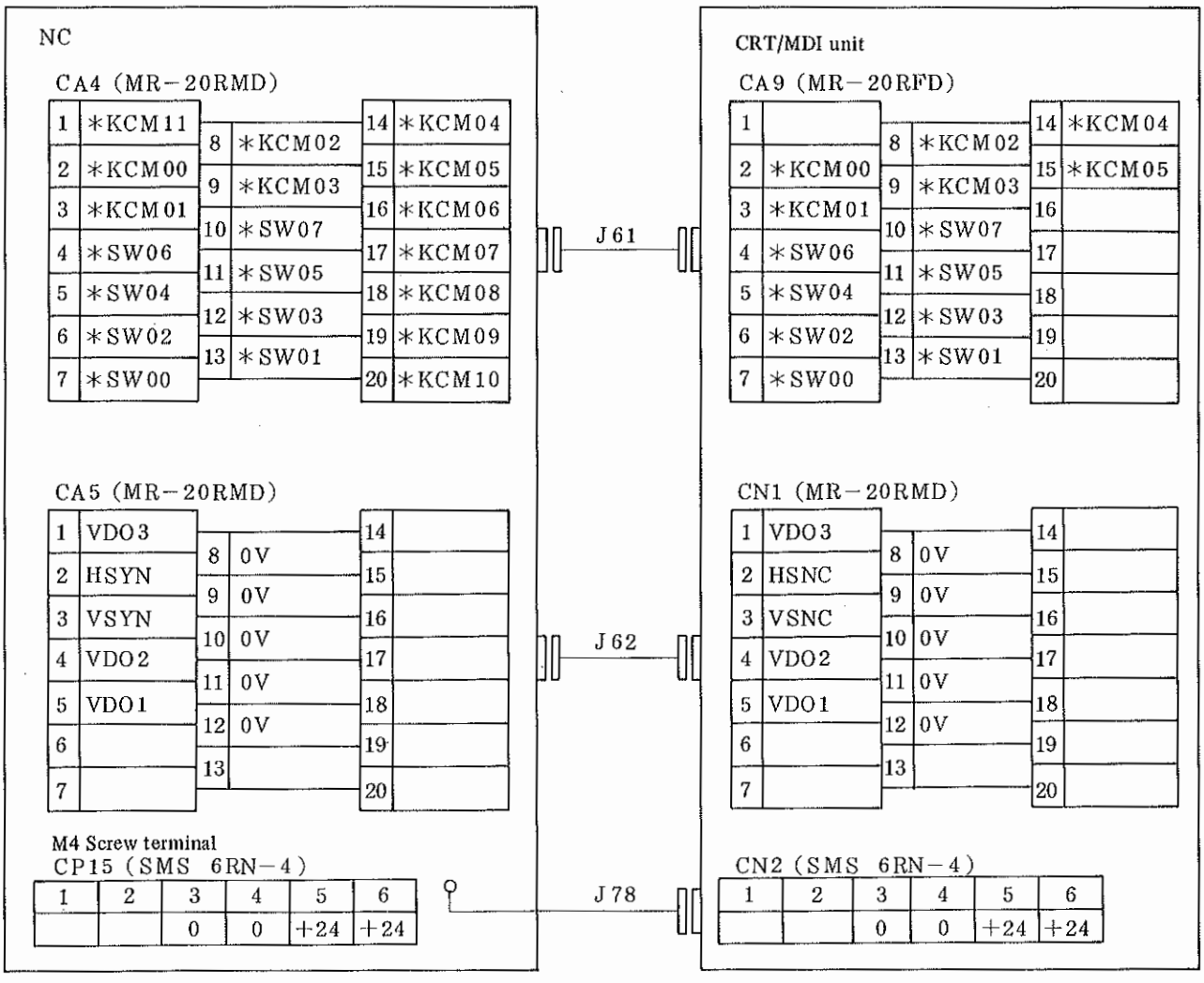
The ON/OFF-controlled 200/220 VAC, 1ϕ power supply can be obtained from EXR/EXS terminals of terminal board TP1 of the input unit as shown in the block diagram.

By connecting an electromagnetic contactor (to be prepared by machine tools builder) to these terminals, the servo power supply can be turned on and off in synchronization with the NC power supply.

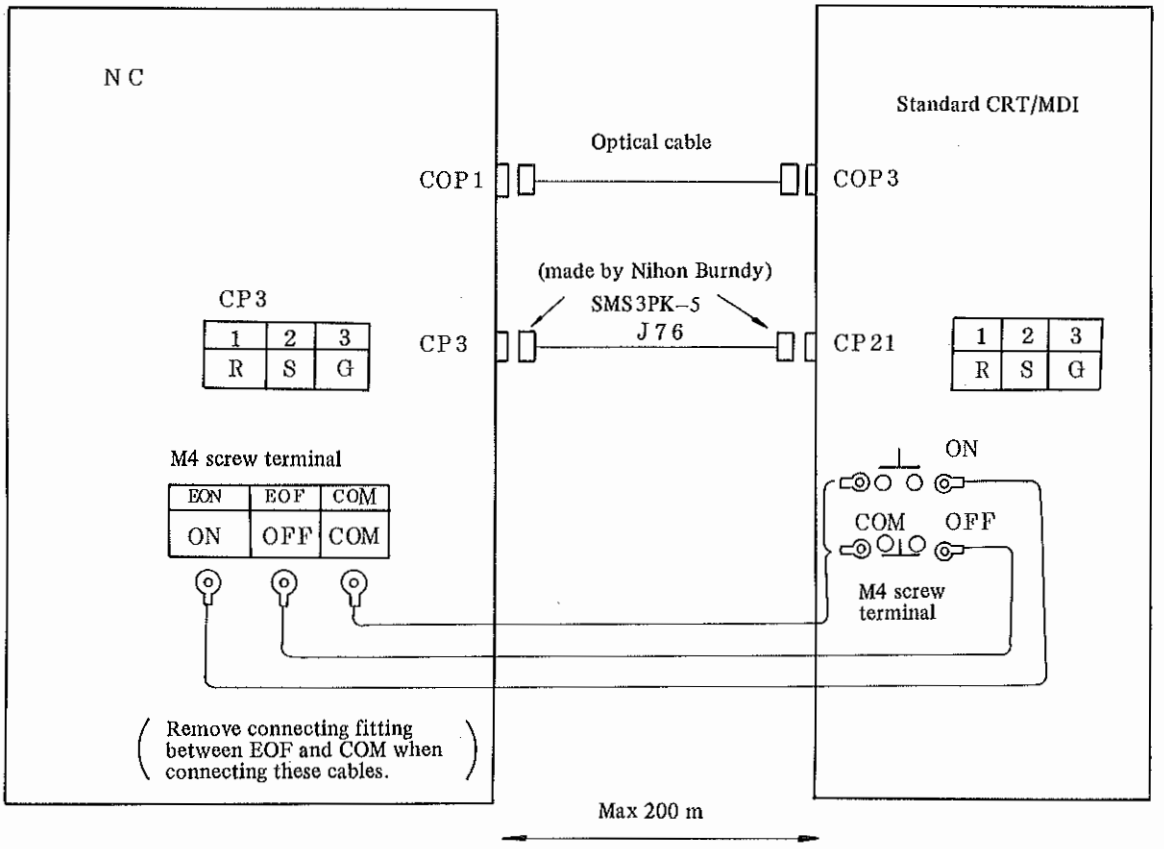
Suppress the current to be lower than 0.3A.

1.7 Connection Diagram for Each Unit

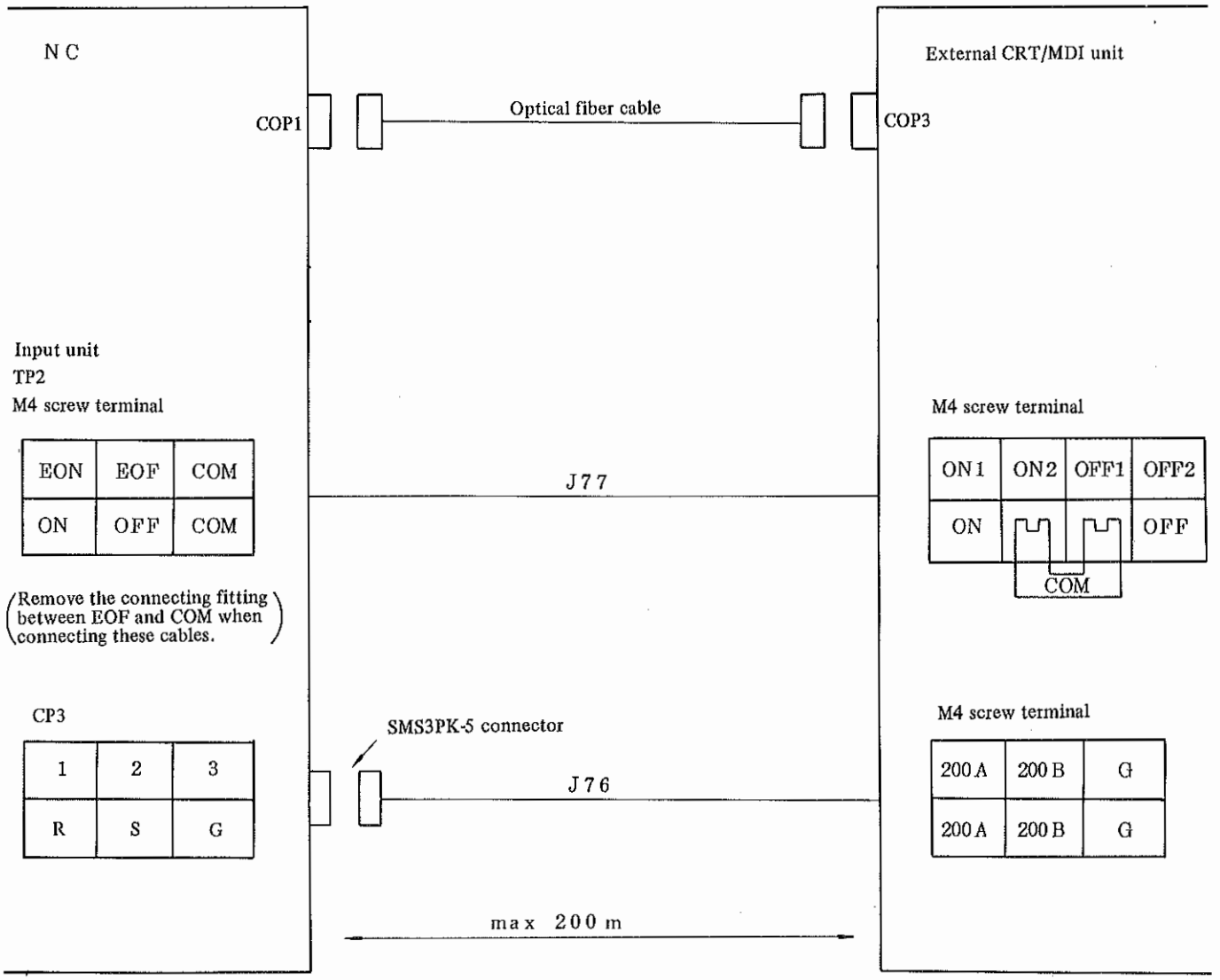
1) Connection to small CRT/MDI unit (10 series only)



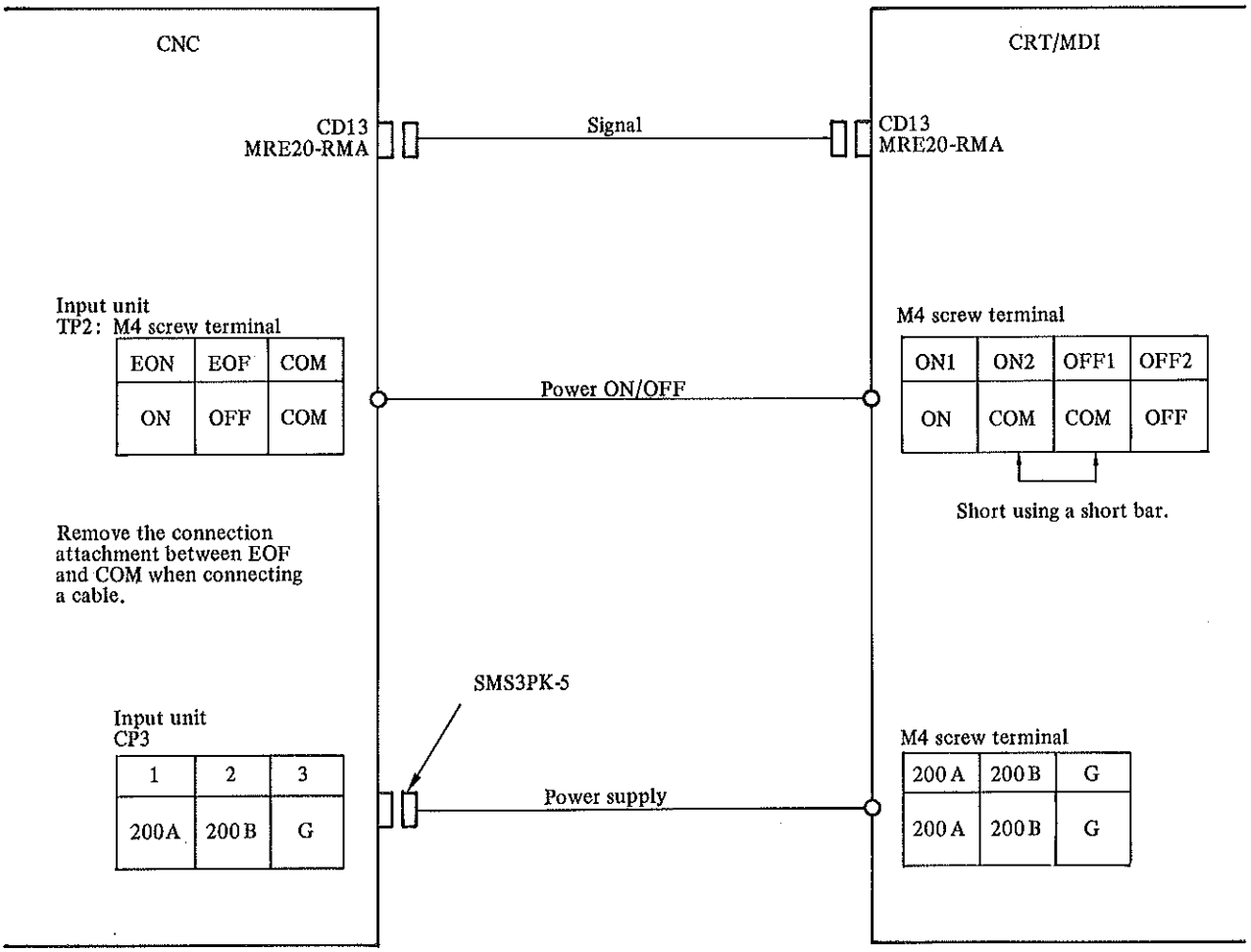
2) Connection to standard CRT/MDI unit (10/11/12 series)



3) Connection to 14" color CRT/MDI unit
   a) 10/11/12 series

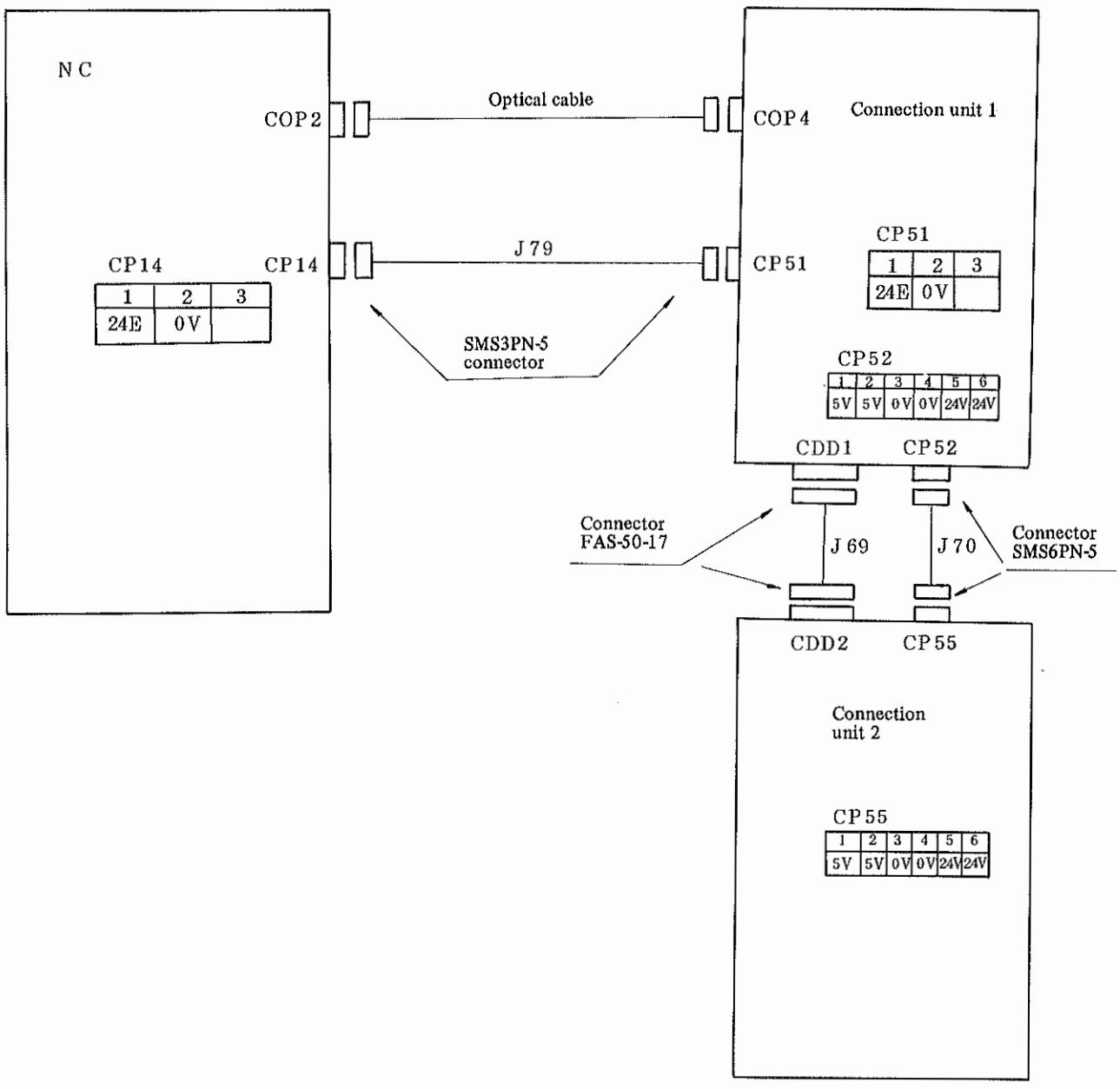


b) 100/110/120 series

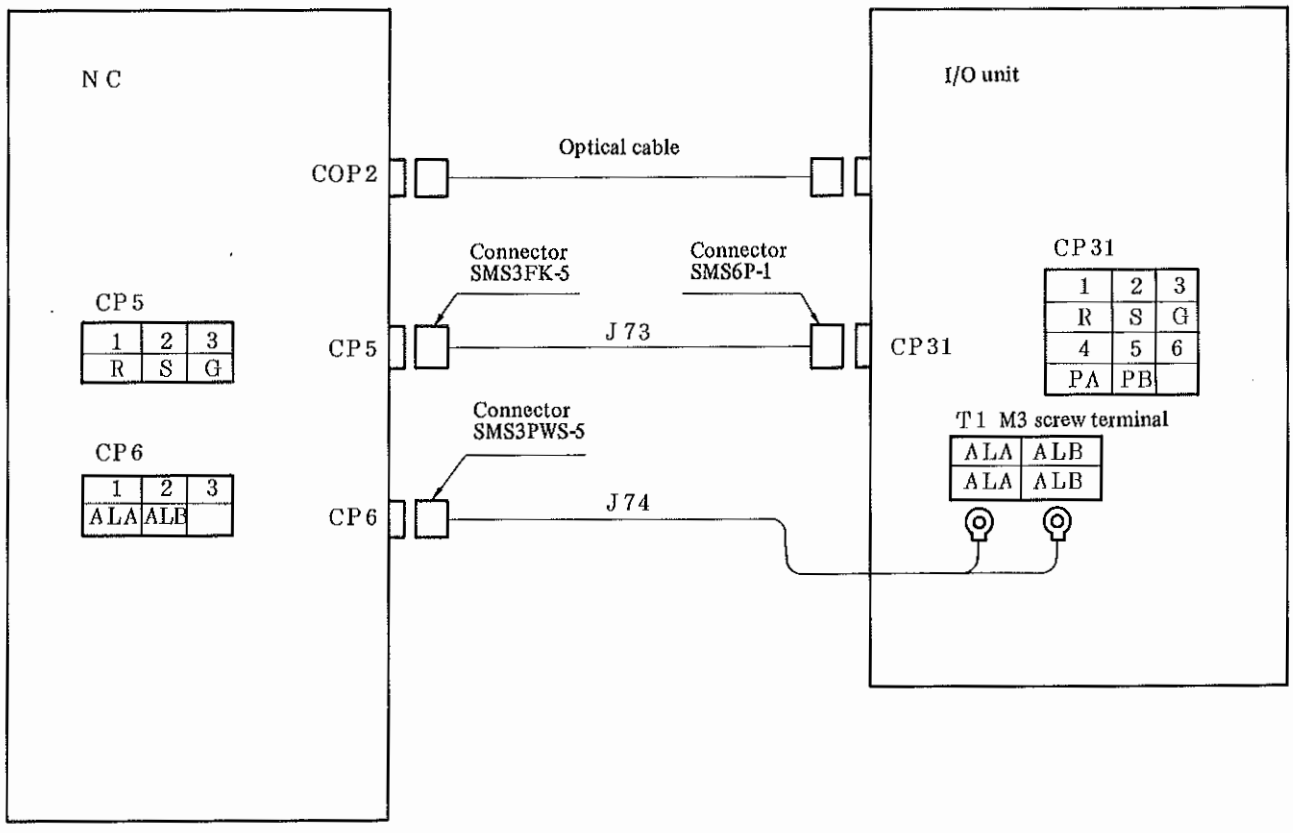


(Note 1) A power cable 30/0.18 (0.75 mm^2) and over in gauge should be used.
(Note 2) For the signal cable, see the next page.

4) Connection to connection unit



5) Connection to I/O unit

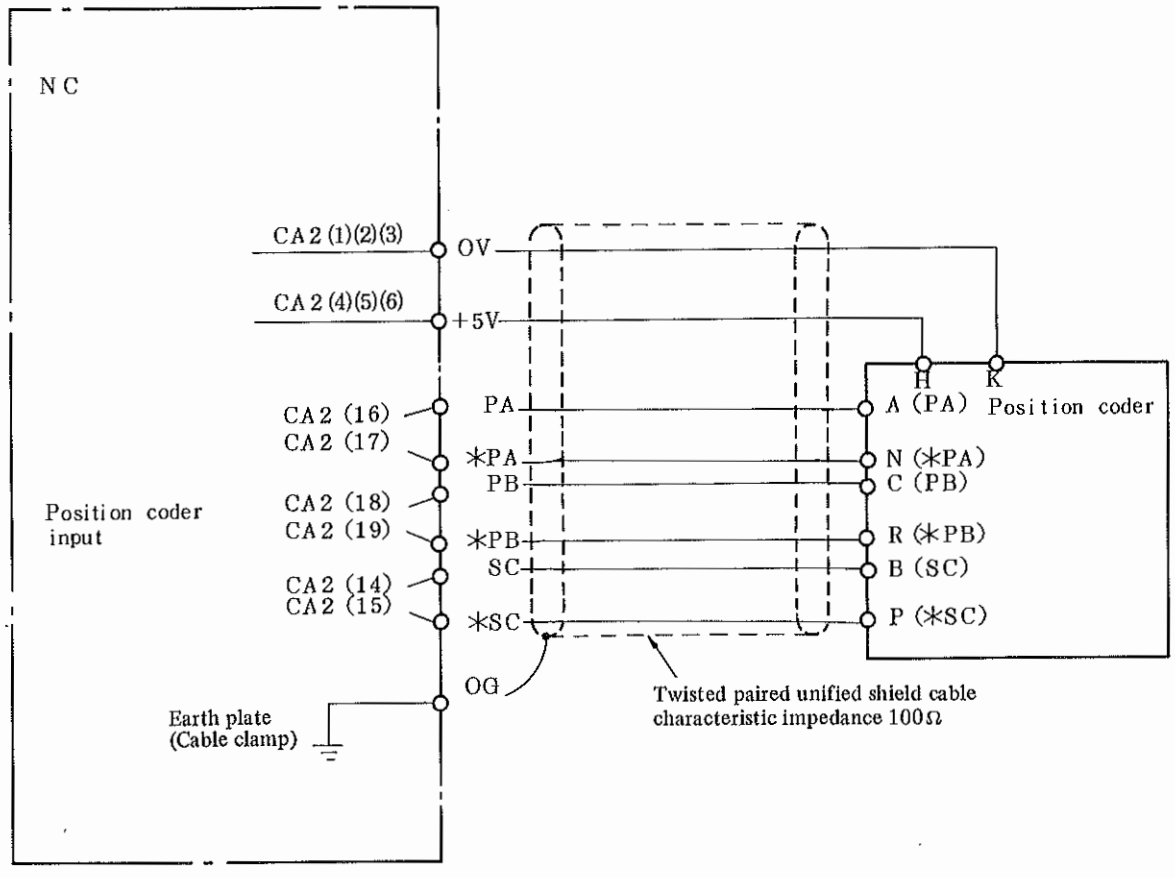


6) Connection to position coder

CA2 MRE20-RMD
Note) (CA2A, CA2B)

1	0V	8	14	SC	
2	0V	9	15	*SC	
3	0V	10	16	PA	
4	+5V	11	17	*PA	
5	+5V	12	18	PB	
6	+5V	13	19	*PB	
7			20		

Name of signal	Contents
SC, *SC	Position coder C-phase signal
PA, *PA	Position coder A-phase signal
PB, *PB	Position coder B-phase signal



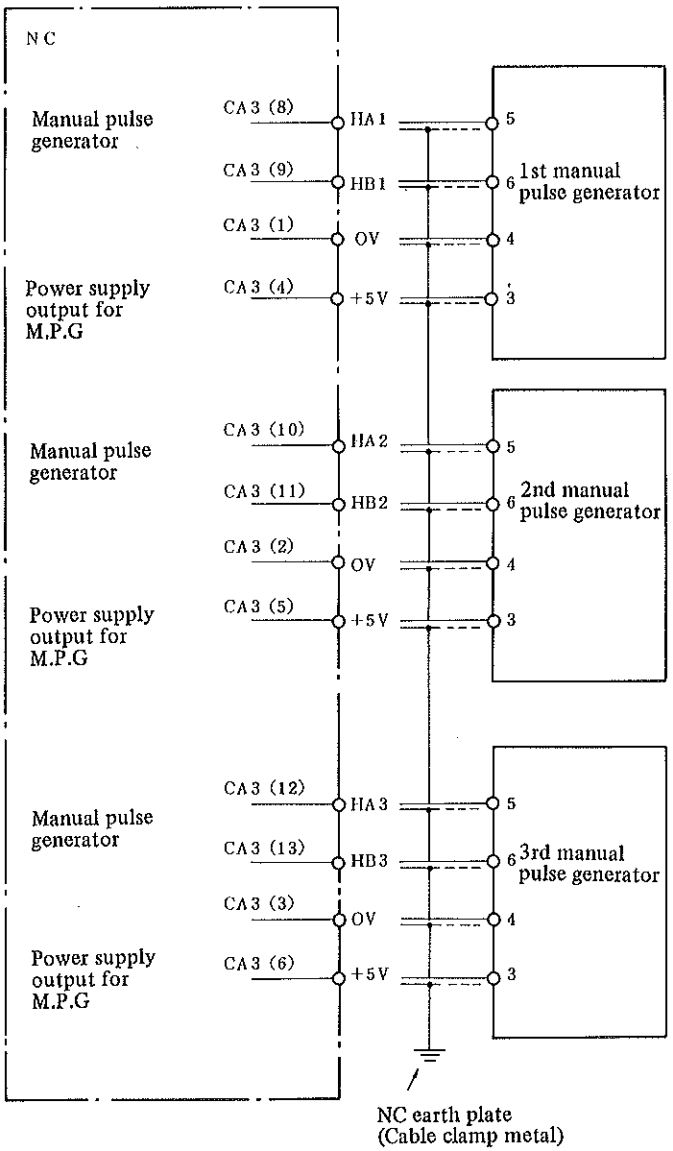
(Note) In case of digital servo
The position coder of 11/110 series and 11TT 1st spindle is connected to CA2A, that of 11TT 2nd spindle is connected to CA2B.

7) Connection to manual pulse generator

CA3 MRE20-RMD

1	OV			14	
2	OV	8	HA1	15	
3	OV	9	HB1	16	
4	+5V	10	HA2	17	
5	+5V	11	HB2	18	
6	+5V	12	HA3	19	
7		13	HB3	20	

Name of signal	Contents
HA1∿3	Manual pulse generator A-phase signal
HB1∿3	Manual pulse generator B-phase signal

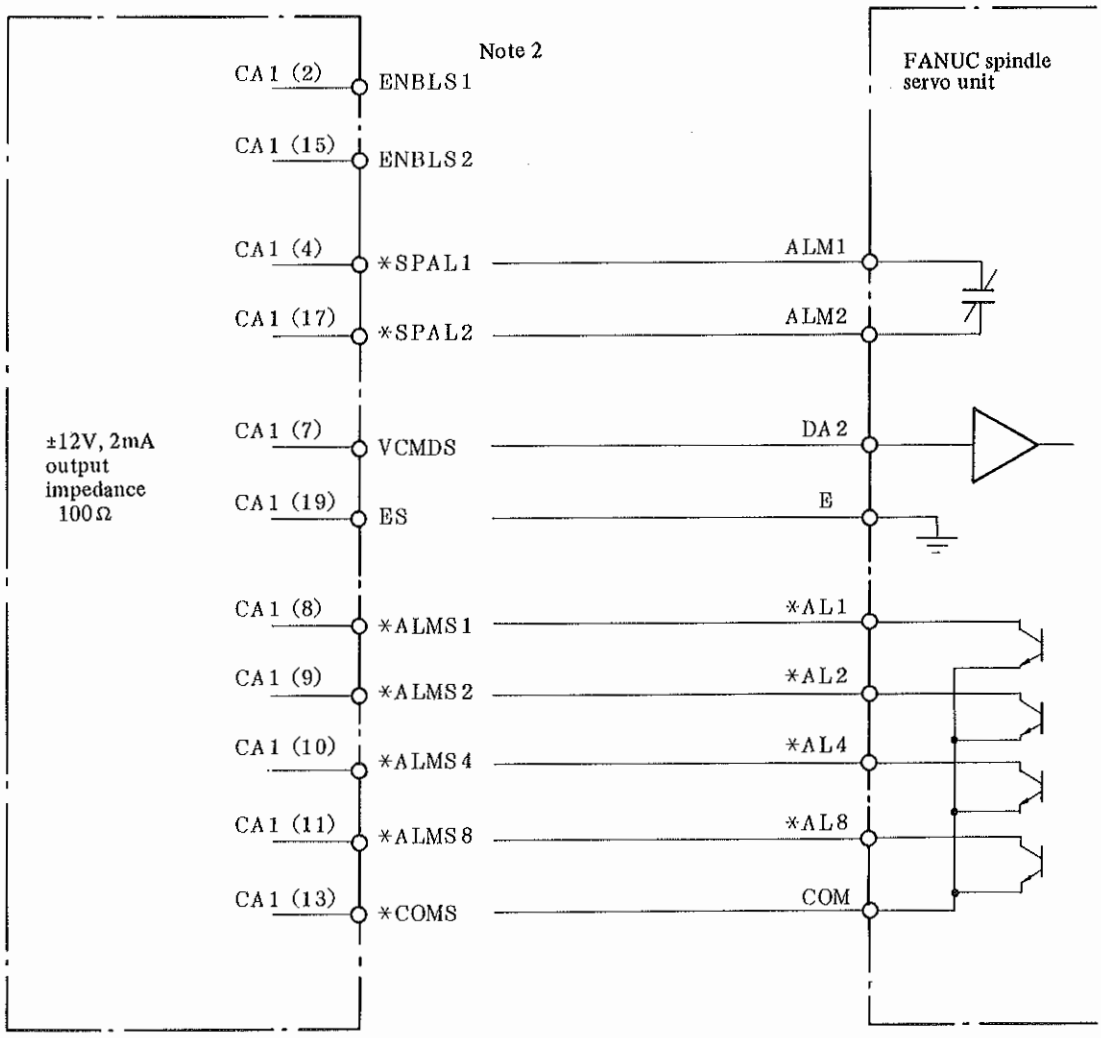


8) Connection to spindle amplifier

CA1 MRE20-RFD
Note 1) (CA1A, CA1B)

1		8	*ALMS1	14	
2	ENBLS1	9	*ALMS2	15	ENBLS2
3		10	*ALMS4	16	
4	*SPAL1	11	*ALMS8	17	*SPAL2
5		12		18	
6		13	*COMS	19	ES
7	VCMDS			20	

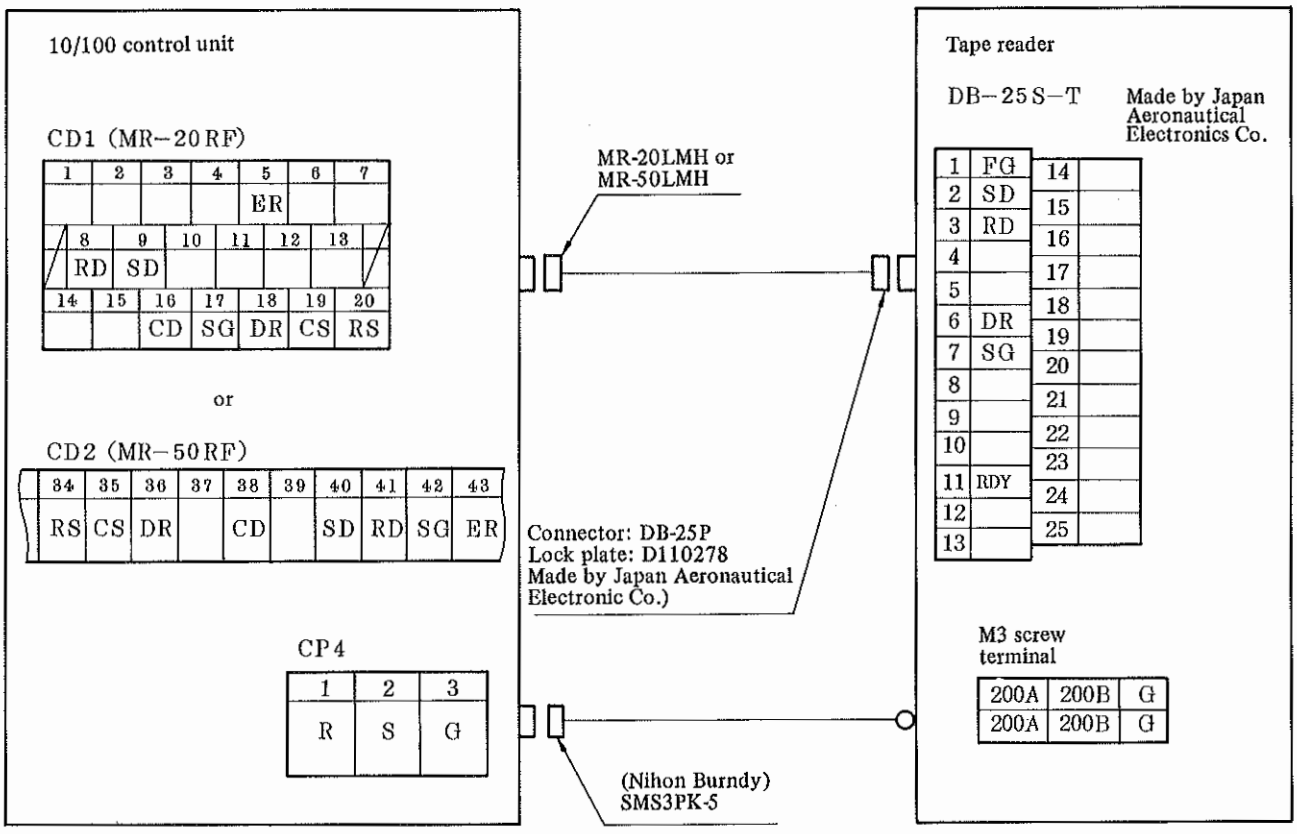
Name of signal	Contents
ENBLS1, ENBLS2	Spindle enable
*SPAL1, *SPAL2	Spindle alarm
VCMDS, ES	Spindle command voltage and common
*ALMS1∿ S8 *COMS	Alarm code signal and common



(Note 1) In case of digital servo,
CA1A is used for 11/110 series and 11TT 1st spindle
CA1B is used for 11TT 2nd spindle

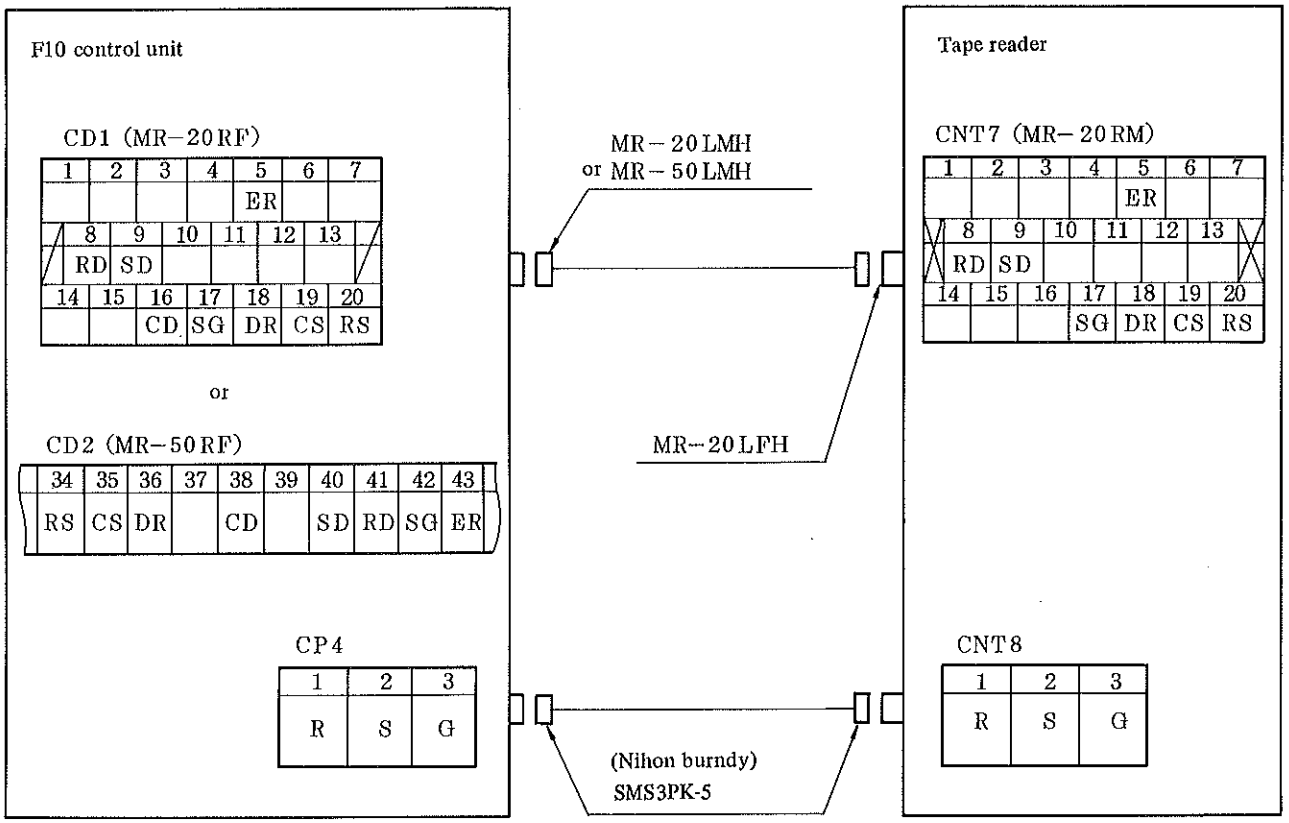
(Note 2) ENBLS1 and ENBLS2 signals are turned on when the spindle command voltage is effective. These NEBLS1 and NEBLS2 signals are not used when FANUC spindle servo unit is used.

9) Connection to separate tape reader
   a) Connection between 10/100 series and tape reader without reels with Reader/puncher interface



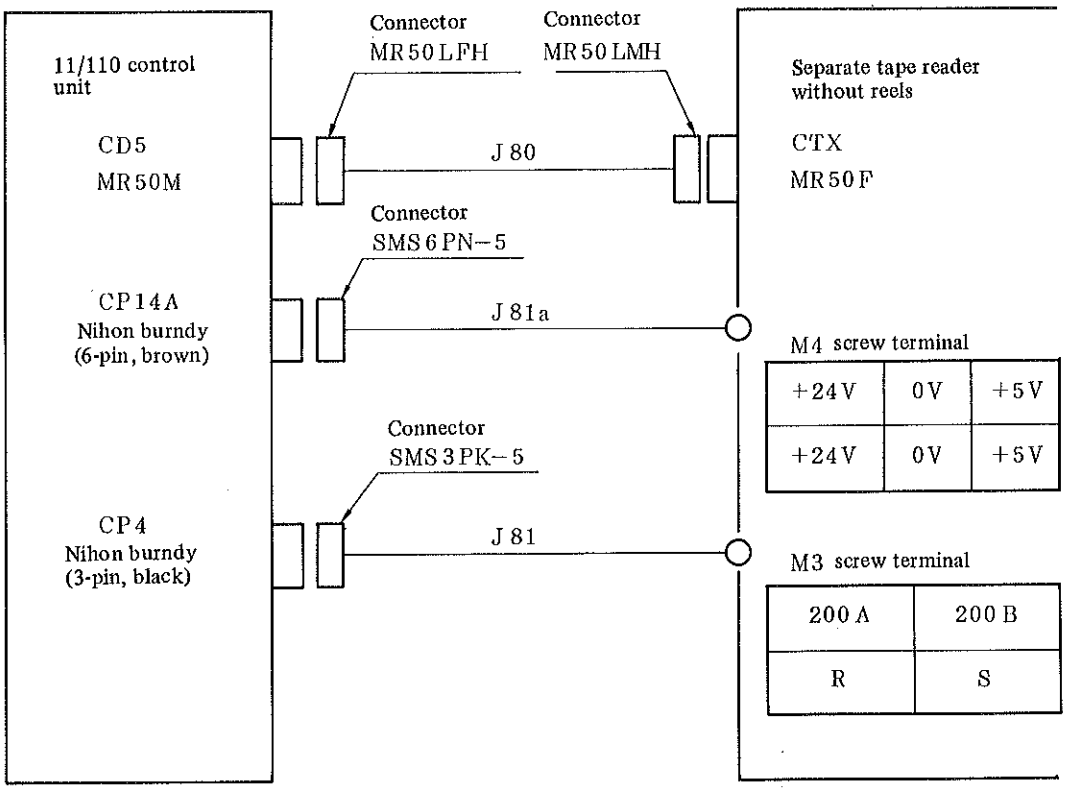
(Note 1) Connector CD1 is mounted on master PCB.
(Note 2) Connector CD2 is mounted on option card 1.
(Note 3) Connector CP4 is mounted on input unit.

b) Connection between 10/100 series and tape reader with reels



(Note 1) Connector CD1 is mounted on master PCB.
(Note 2) Connector CD2 is mounted on option card 1.
(Note 3) Connector CP4 is mounted on input unit.

c) Connection between 11/110 and tape reader without reels with parallel interface

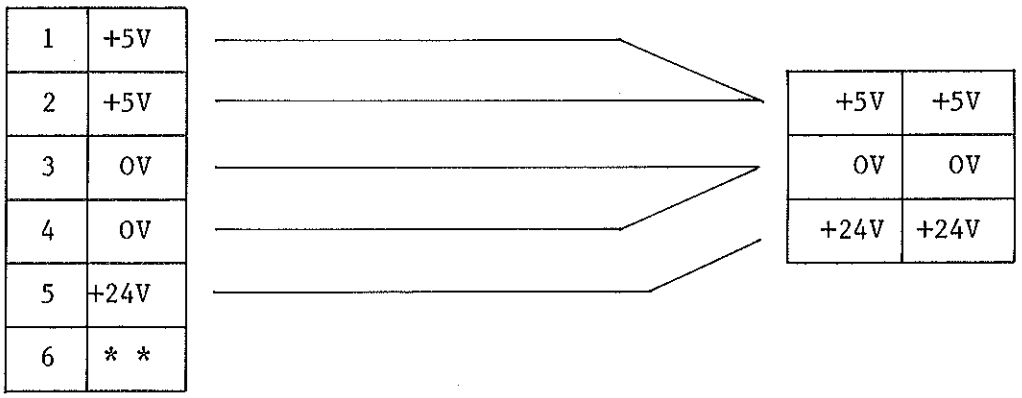


(Note 1) CP14A is mounted on the master PCB below the stabilizing power circuit. Disconnect the stabilizing power circuit once and connect CP14A.

(Note 2) CP4 is mounted on the input unit.

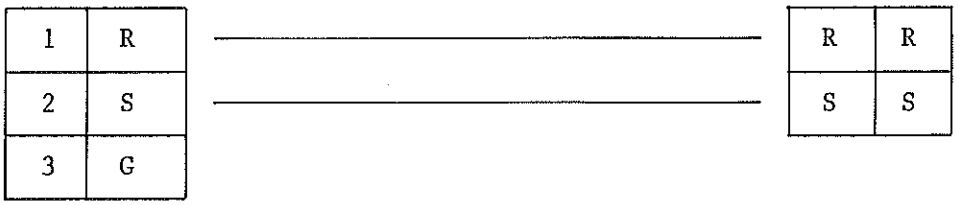
(Note 3) Connection of J81a

CP14A — Tape reader

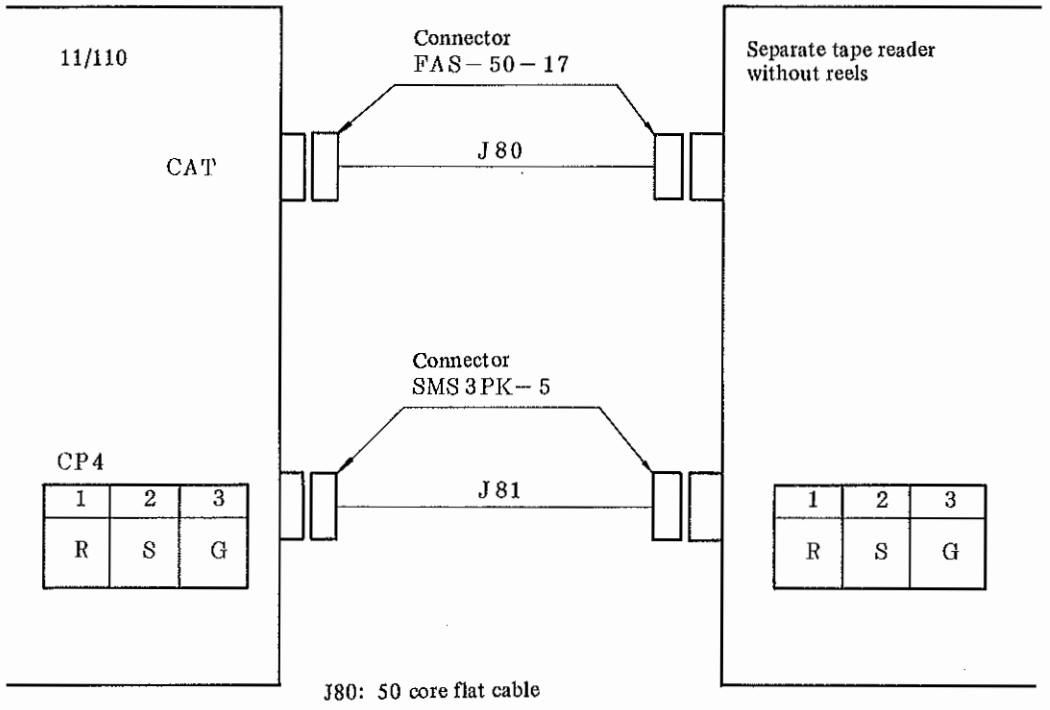


(Note 4) Connection of J81

CP4 — Tape reader

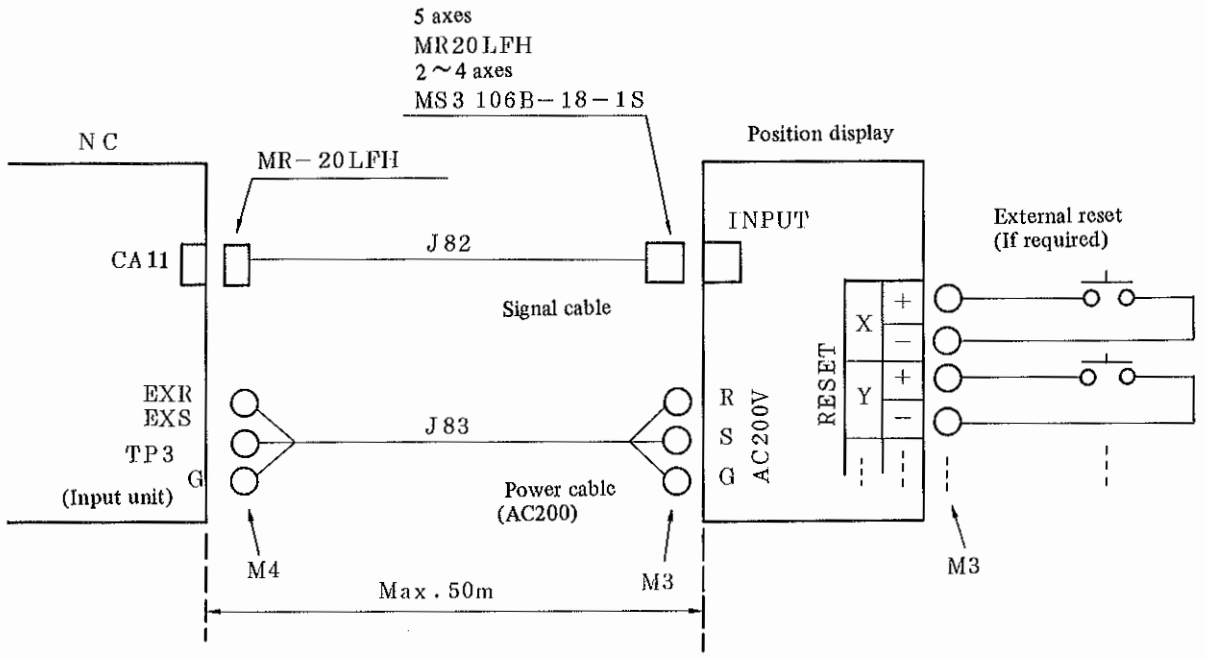


d) Connection between 11/110 series and tape reader with reels
The separate tape reader with reels is connectable via I/O interface. It is also directly connectable to the master PCB in 11/110 series.



J80: 50 core flat cable

10) Connection to external position display (11/110 series)
The external position display is provided for 2 axes, 3 axes, 4 axes, and 5 axes. The connection of signal cable more or less differs among 2/3 axes, 4 axes and 5 axes types, as shown below.



CA11 MR20RM

1	0V	8	0V	14	0V
2	0V	9	DD1	15	
3	RS1	10	DD2	16	
4	RS2	11	DD4	17	
5	RS3	12	DD8	18	
6	RS4	13	DWT	19	RS5
7	0V			20	

Name of signal	Contents
DD1∿DD8	Data
DWT	Data strobe
RS1∿RS5	Reset input

- Interface on position display side

2/3-axis position display
INPUT

A	B	C	D
DD1	DD2	DD4	DD8
E	F	G	H
DWT	RSX	RSY	RSZ
I	J		
OV	OV		

4-axis position display
INPUT

A	B	C	D
DD1	DD2	DD4	DD8
E	F	G	H
DWT	RSX	RSY	RSZ
I	J		
OV	PSB		

Connector: CANNON MS3102A-18-1P

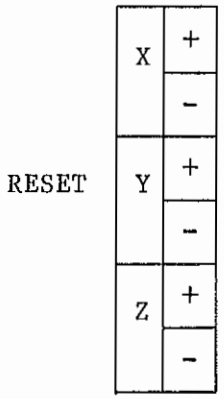
- 5-axis position display

MR20RM

1	OV	8	OV	14	OV
2	OV	9	DD1	15	
3	RS1	10	DD2	16	
4	RS2	11	DD4	17	
5	RS3	12	DD8	18	
6	RS4	13	DWT	19	RS5
7	OV			20	

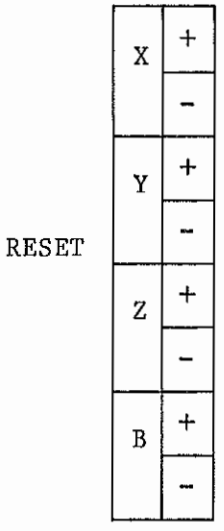
- Position display external reset input

2/3-axis position display



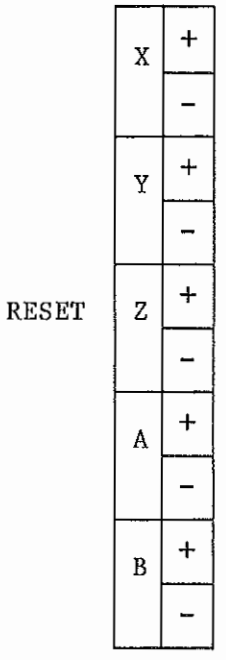
M3 screw terminal

4-axis position display



M3 screw terminal

5-axis position display



M3 screw terminal

11) Connection of high-speed skip signal and high-speed measuring position arrival signal

In case of 11/110 series
CA8 MR20RM

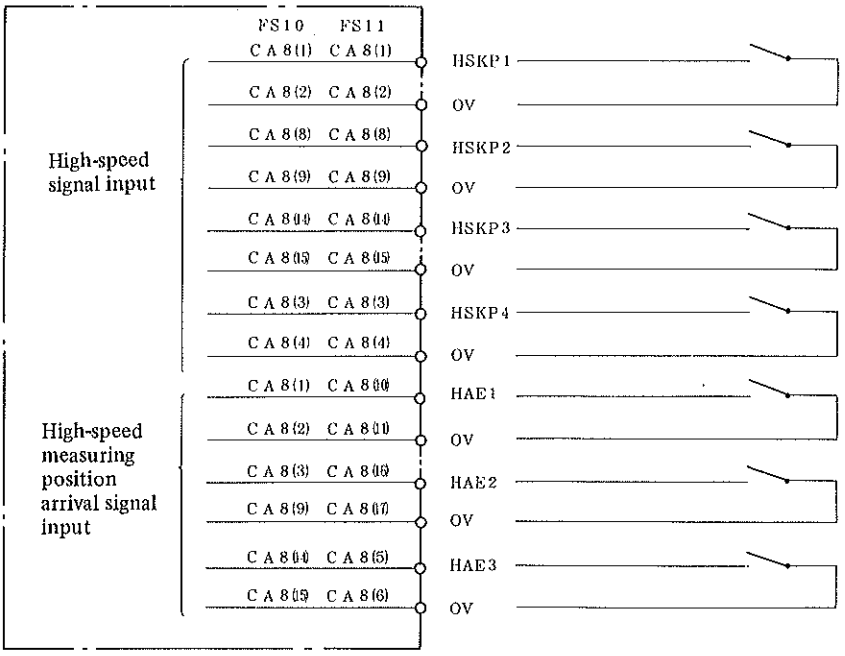
1	HSKP1	8	HSKP2	14	HSKP3
2	OV	9	OV	15	OV
3	HSKP4	10	HAE1	16	HAE2
4	OV	11	OV	17	OV
5	HAE3	12		18	
6	OV	13		19	
7				20	

Name of signal	Contents
HSKP1∿4	High-speed skip signal
HAE1∿3	High measuring position arrival signal

In case of 10/100 series
CA8 MRE20-RMD

1	HS01	8	HS02	14	HS03
2	OV	9	OV	15	OV
3	HS04	10		16	
4	OV	11		17	
5		12		18	
6		13		19	OV
7				20	OV

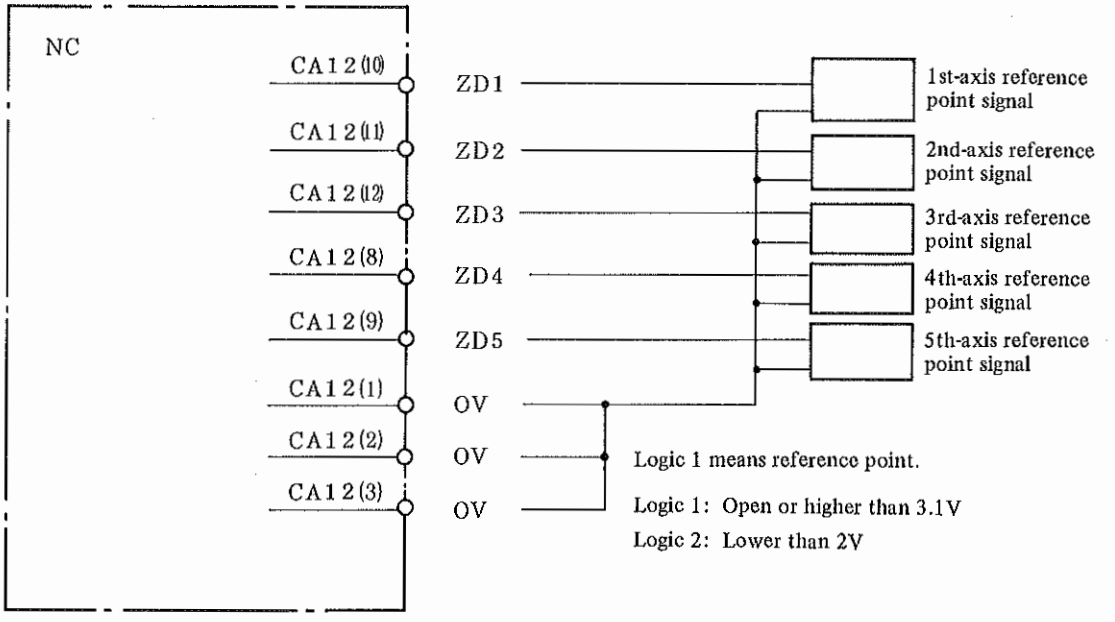
Name of signal	Contents
HS01∿03	High-speed skip signal (HSKP1∿3) or high-speed measuring position arrival signal (HAE1∿3)
HS04	High-speed signal (HSKP4)



12) Connection of magnetic switch system reference point signal (11 series)
CA12 MR20RM

1	OV			14	
2	OV	8	ZD4	15	
3	OV	9	ZD5	16	
4		10	ZD1	17	
5		11	ZD2	18	
6		12	ZD3	19	
7		13		20	

Name of signal	Contents
ZD1∿ZD5	Magnetic switch system reference point signal



13) 20mA current loop

CD7 (when punch panel is used)

1		14
	8	
2		15
	9	
3		16
	10	
4	OV	17
TTY3	11	
5		18
	12	
6		19
TTY2	13	
7		20
TTY1		

1.8 Connecting of I/O Unit

1) I/O unit signal connection diagram (In case of one group)

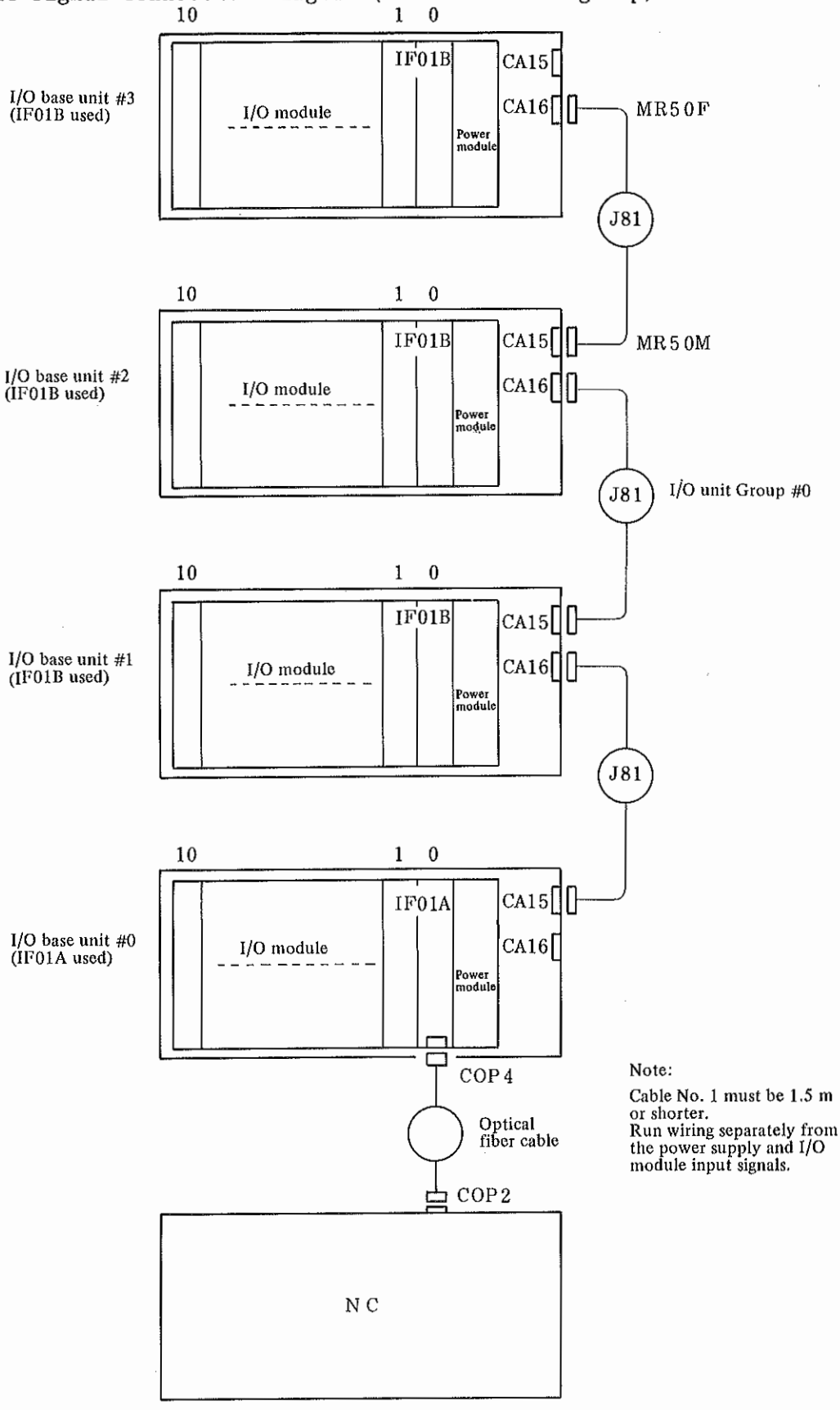
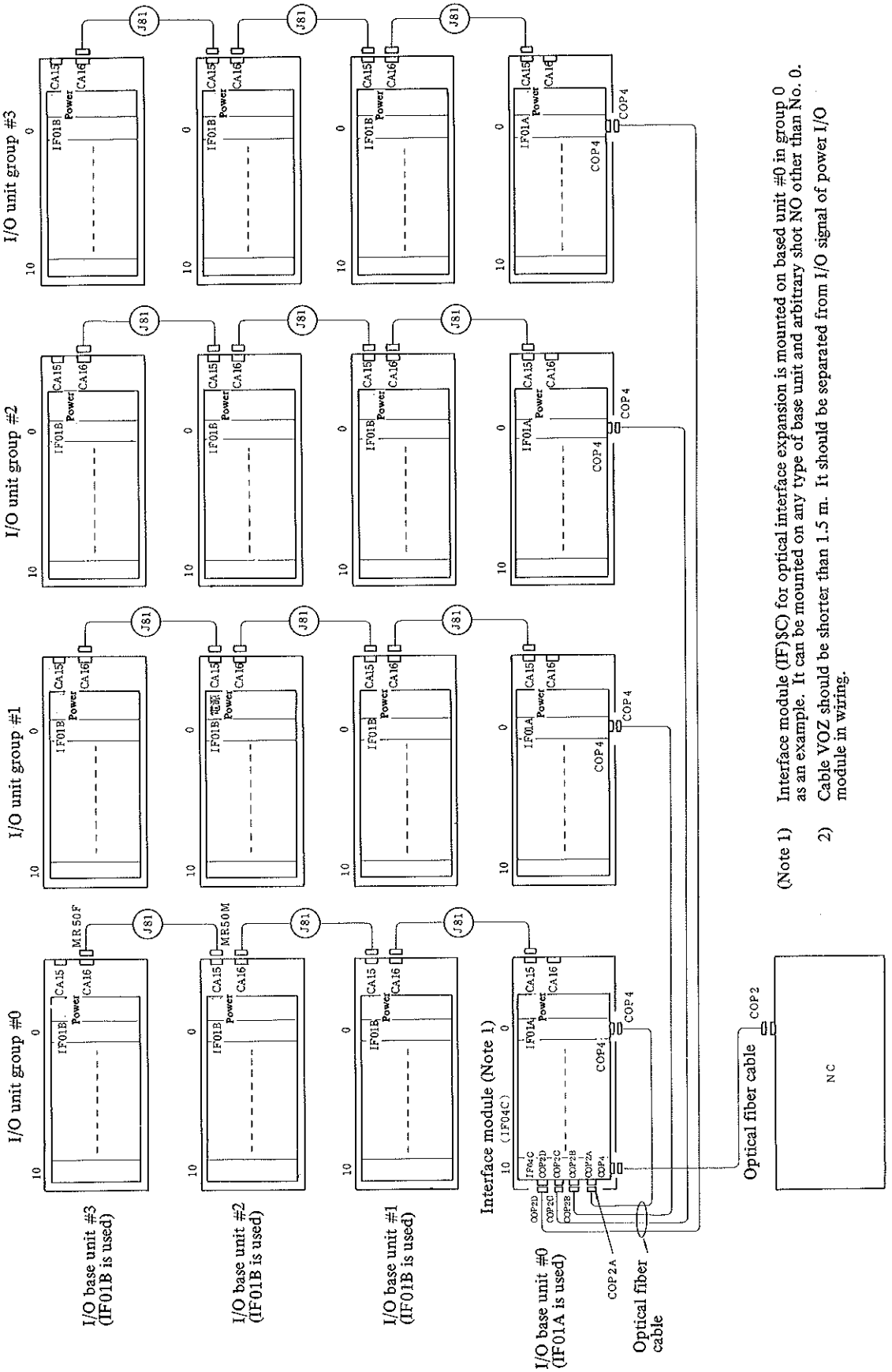


Fig. 1.8 (a) I/O unit signal connection diagram (1) (In case of one group)

2) I/O unit signal connection diagram (In case of several groups)



(Note 1) Interface module (IF)$C) for optical interface expansion is mounted on based unit #0 in group 0 as an example. It can be mounted on any type of base unit and arbitrary shot NO other than No. 0.

2) Cable VOZ should be shorter than 1.5 m. It should be separated from I/O signal of power I/O module in wiring.

Fig. 1.8 (b) I/O unit signal connecting diagram (2) (When several groups are used)

3) I/O units connecting signal cable

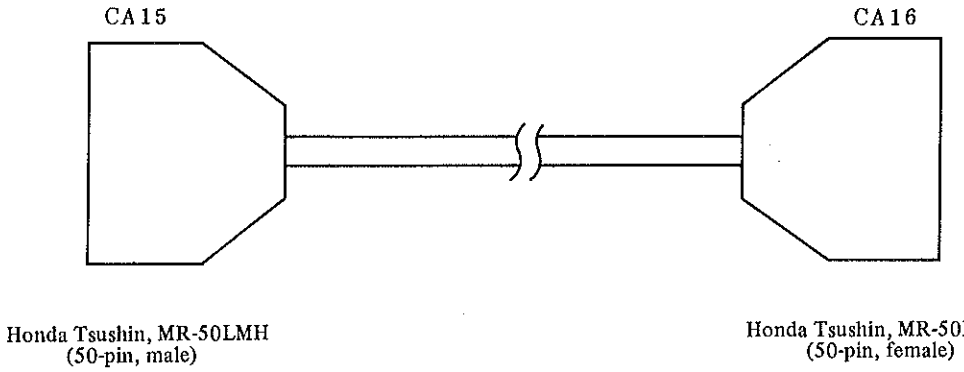


Fig. 1.8 (c) Connector for I/O units connecting signal cable (V02)

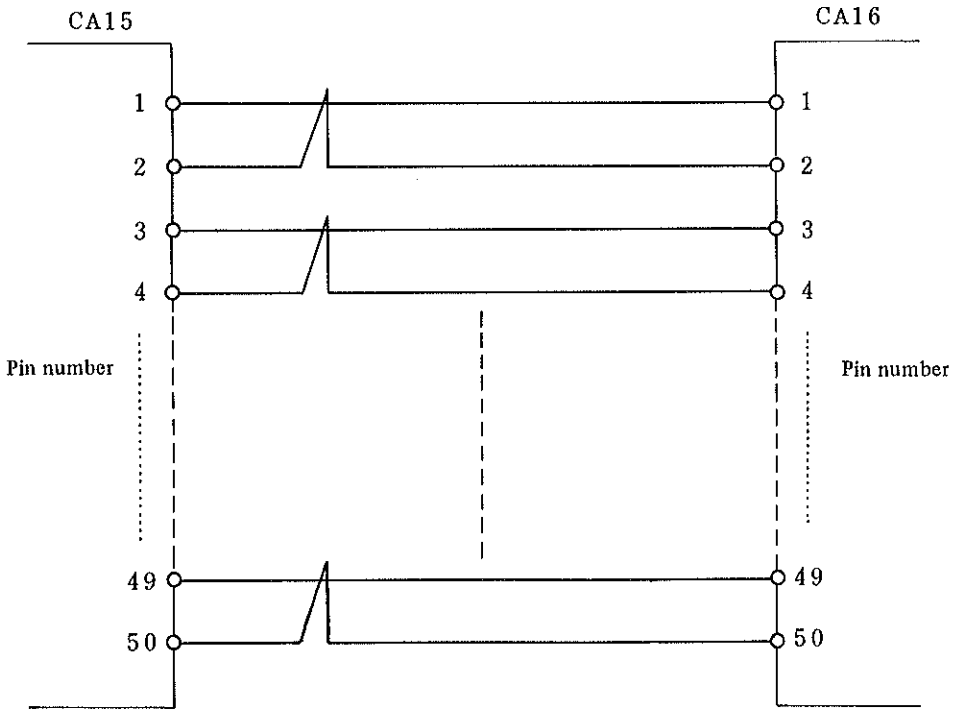
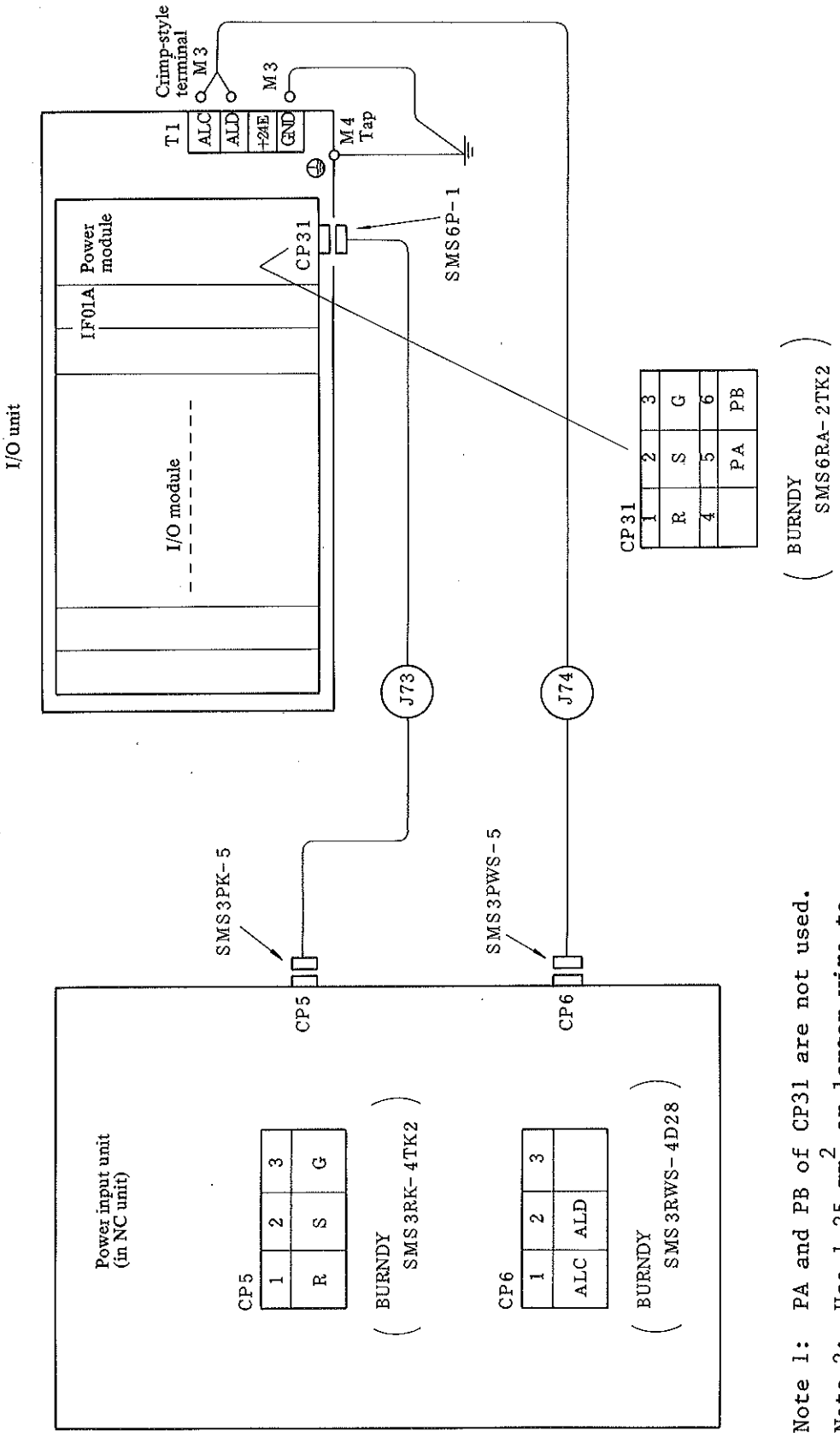


Fig. 1.8 (d) Signal cable connection diagram between main unit and I/O unit

4) I/O unit power connection diagram (In the case of one I/O base unit)

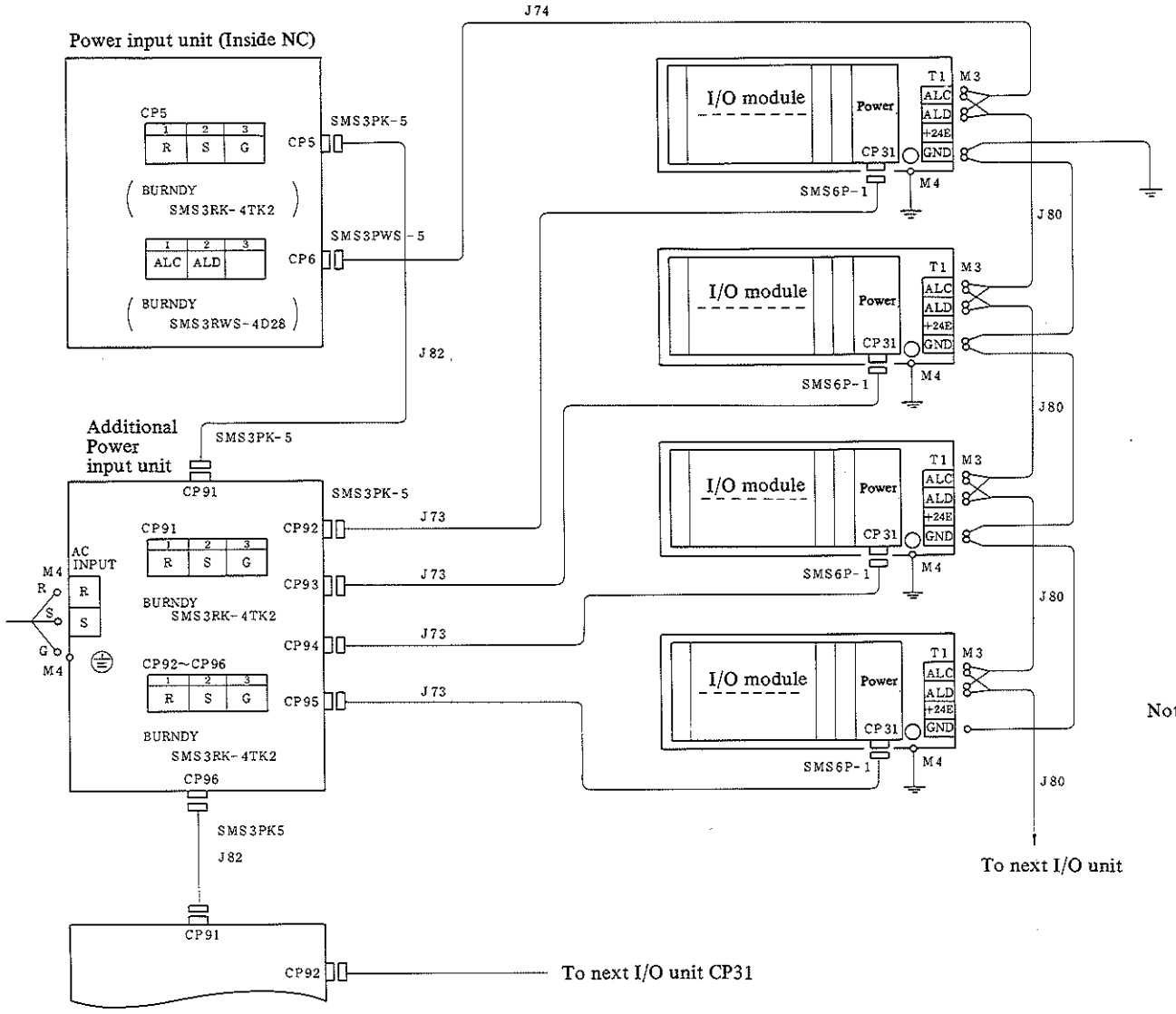


Note 1: PA and PB of CP31 are not used.

Note 2: Use 1.25 mm^2 or larger wire to ground for GND terminal of T1.

Note 3: Use 30/0.18 (0.75 mm) or larger wire for J73 and J74.

Fig. 1.8 (e) I/O unit power connection diagram (in the case of one I/O unit)



Note 1) PA and PB in CP31 are not used.

2) GND terminal (T1) of I/O unit (max. 4 sets) in one group is connected by the wire with cross section more than 1.25 mm².

3) Wires more than 30/0.18 (0.75 mm²) are used for J73, 74 and 80.

4) One additional power input unit can control I/O unit power input. (Max. 4 sets)

5) Connector contact specification (made in Burnday)

1 Other than CP6. . RC16M-SCT3
2 CP6 . . . . . RC16M-23D28

Fig. 1.8 (f) I/O unit power connection diagram (When several I/O units are employed)

6) Analog input module connection

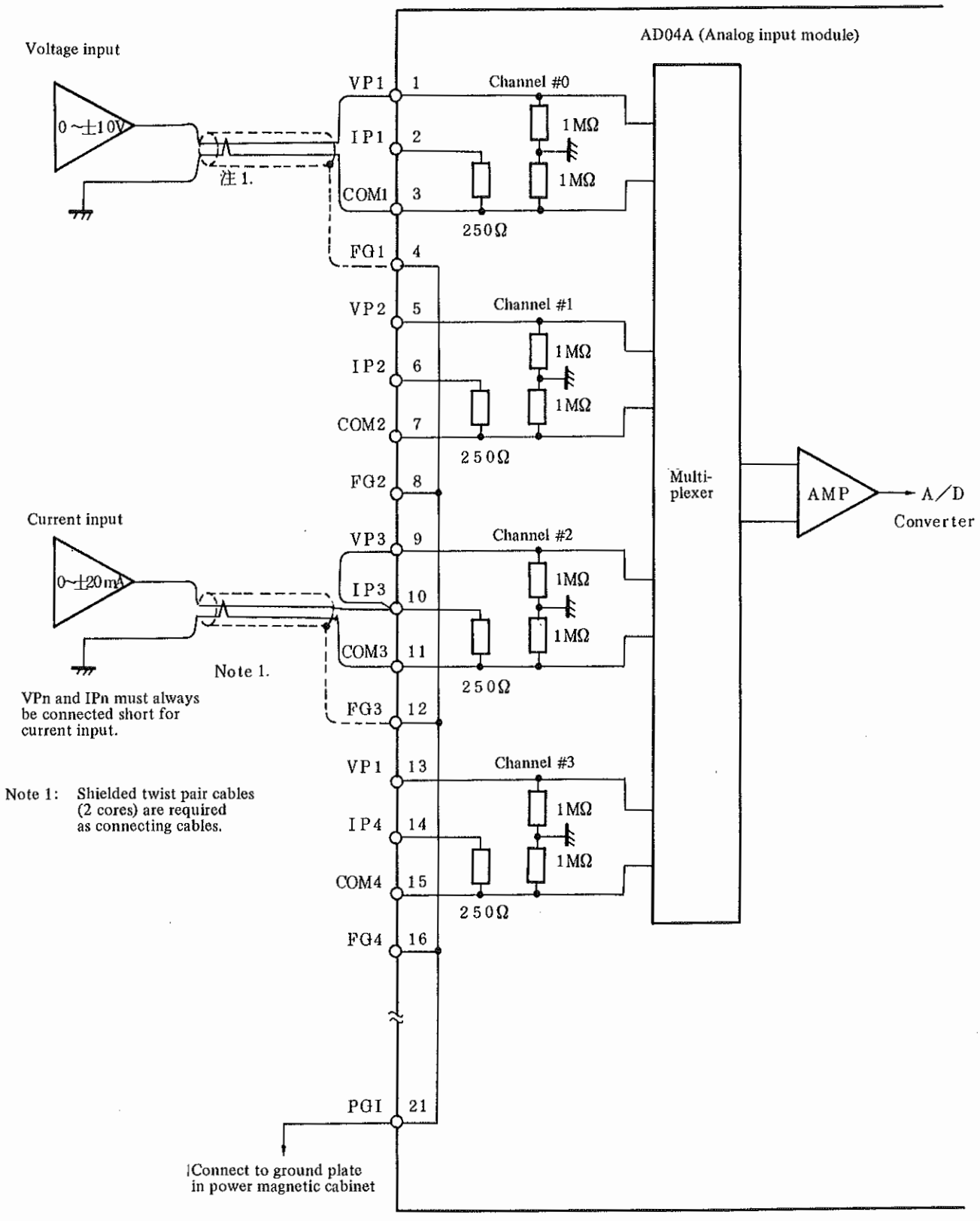
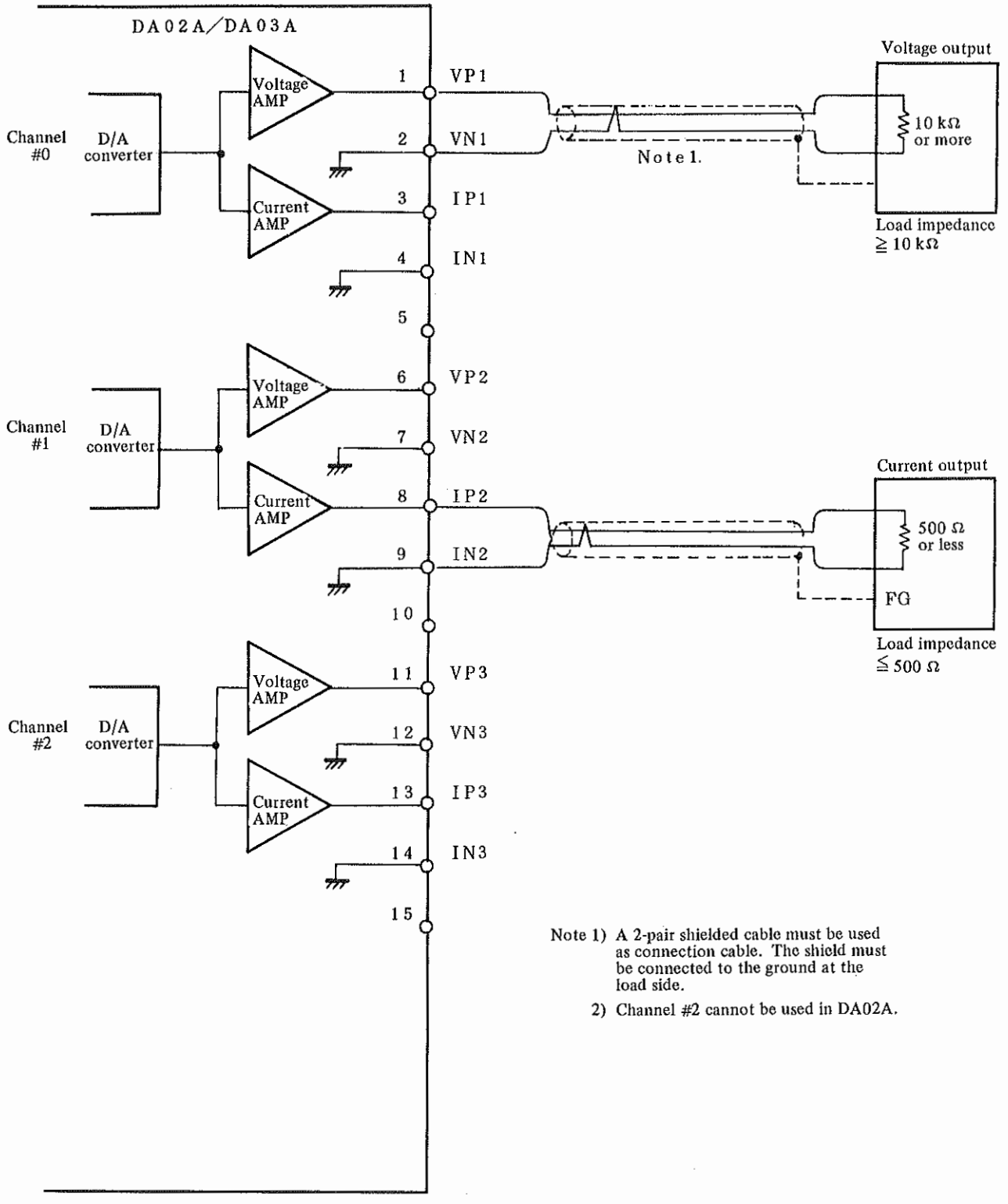


Fig. 1.8 (g) Analog input module connection

7) Analog output module connection



Note 1) A 2-pair shielded cable must be used as connection cable. The shield must be connected to the ground at the load side.

2) Channel #2 cannot be used in DA02A.

Fig. 1.8 (h) Analog output module connection

8) Positioning module connection
   a) Total connecting block diagram (For DC servo motor)

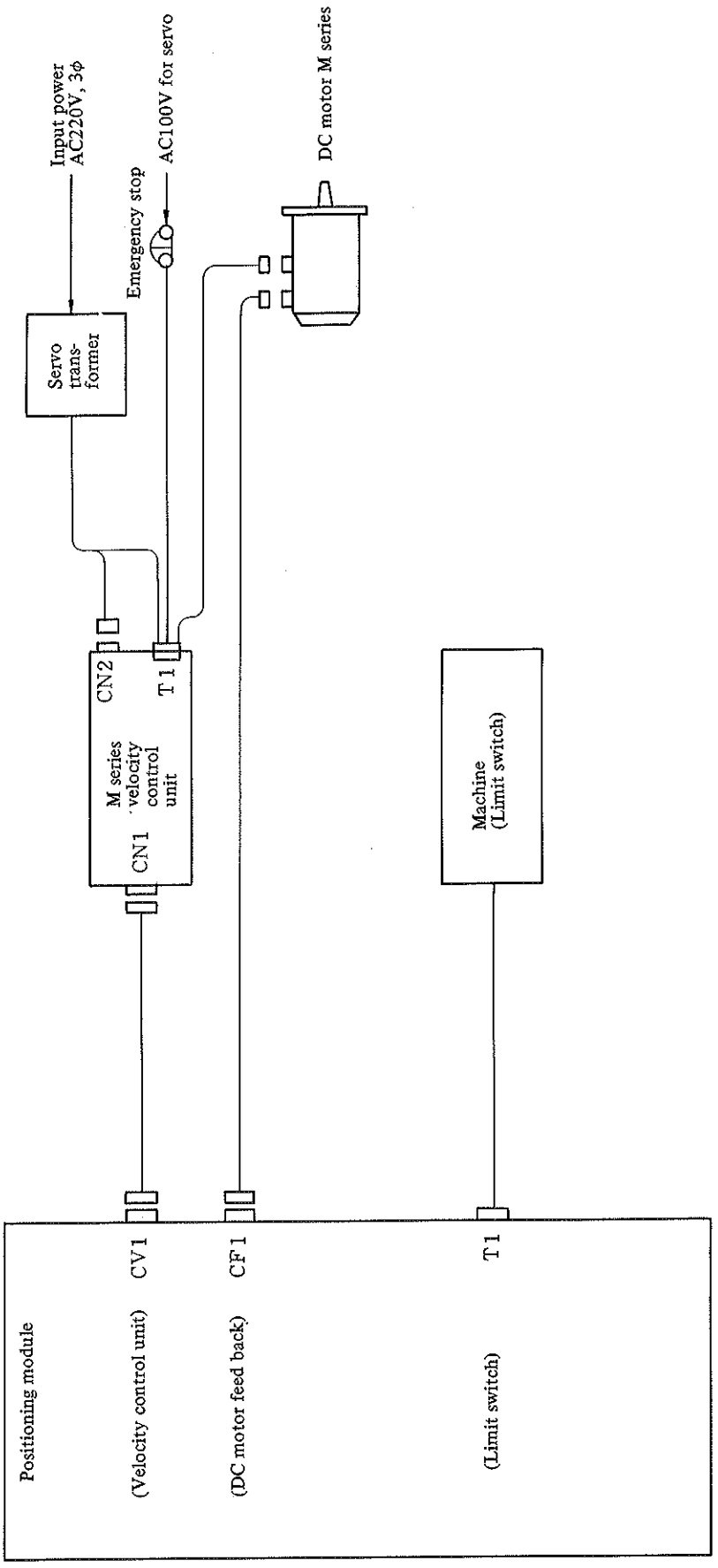


Fig. 1.8 (i) Positioning module total connecting block diagram (For DC sevo motor)

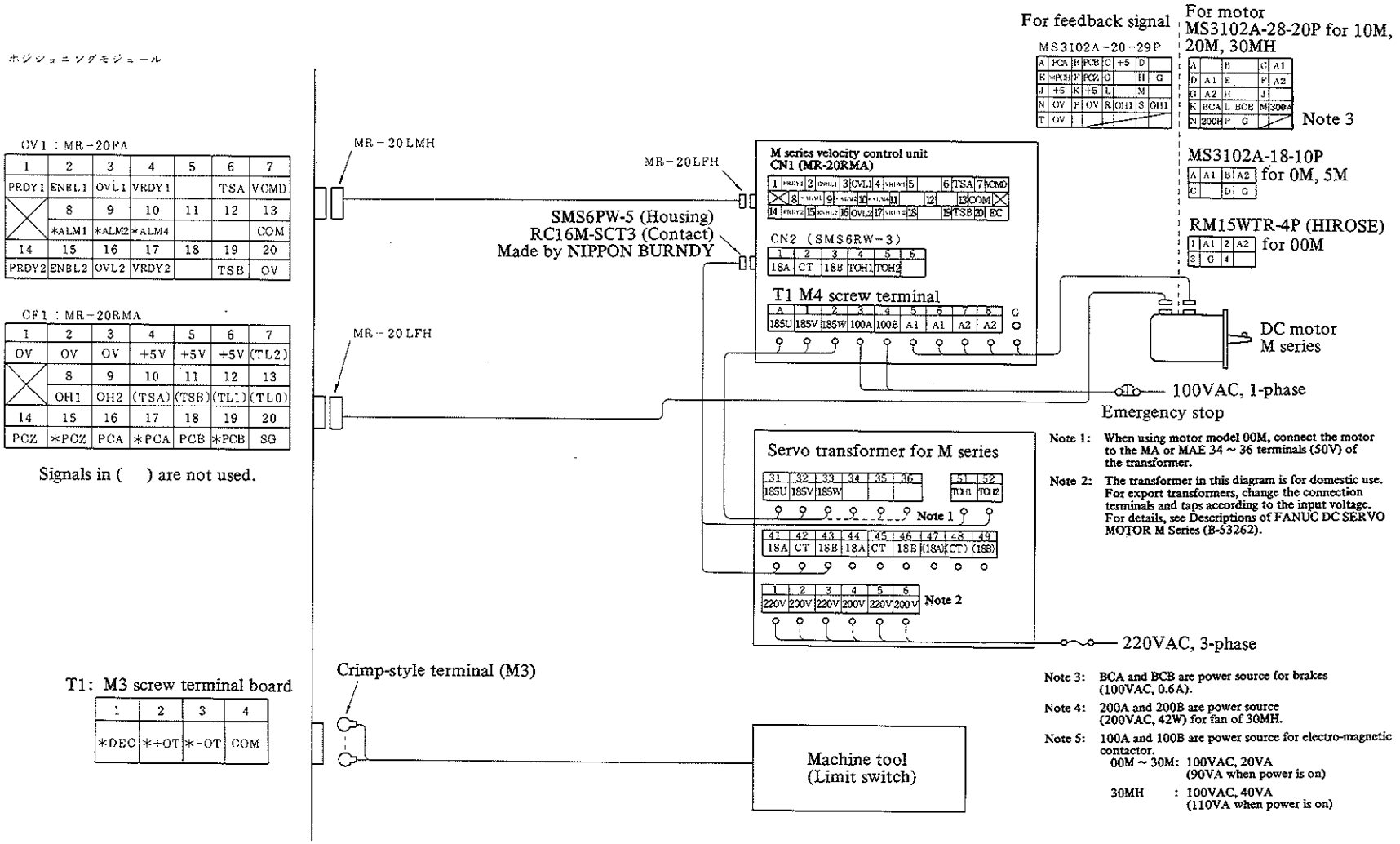
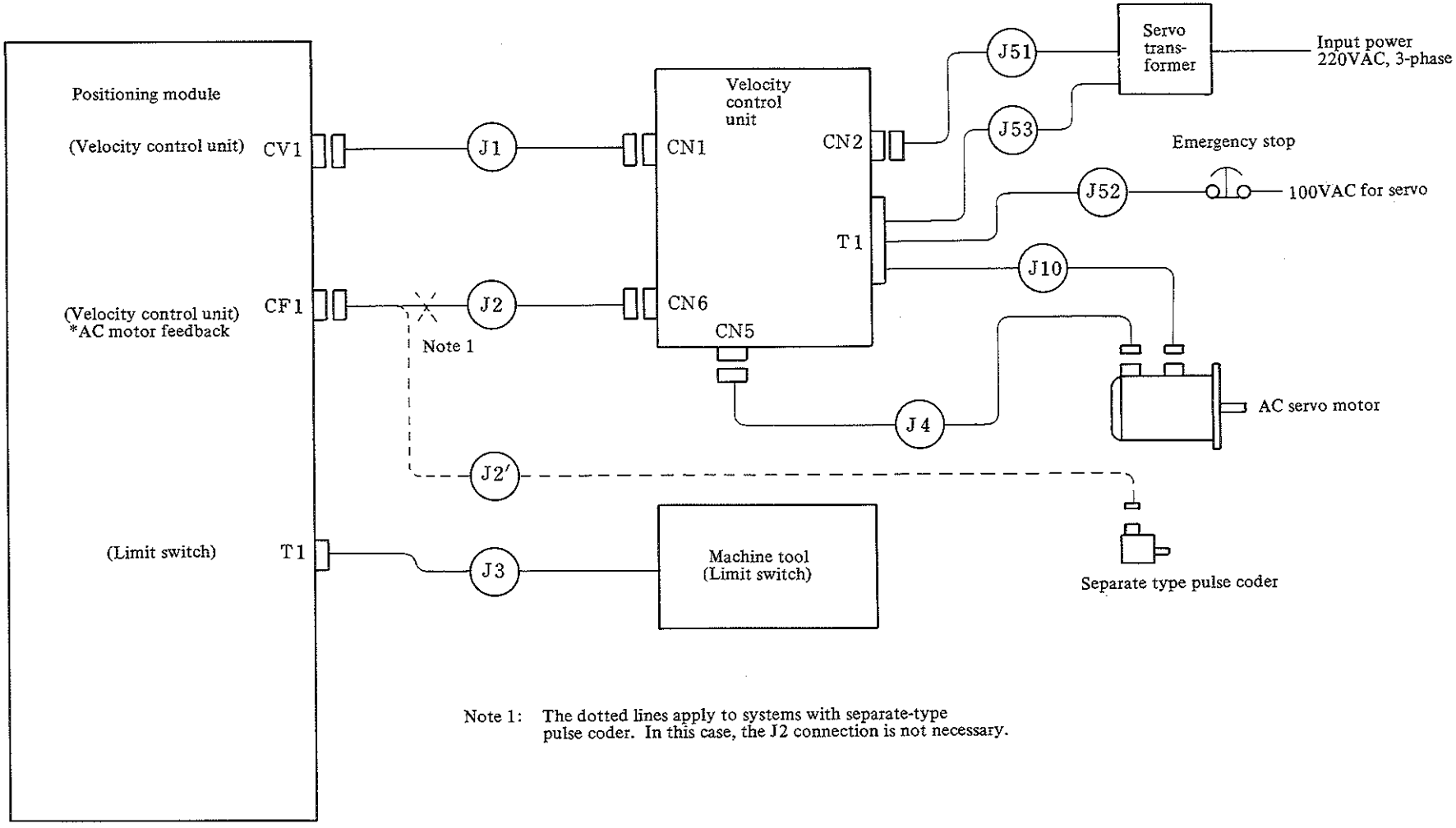


Fig. 1.8 (j) Total connection diagram of the positioning module

c) Total connection block diagram (when AC servo motor is used)



Note 1: The dotted lines apply to systems with separate-type pulse coder. In this case, the J2 connection is not necessary.

Fig. 1.8 (k) Total connecting block diagram of the positioning module (When AC servo motor is used)

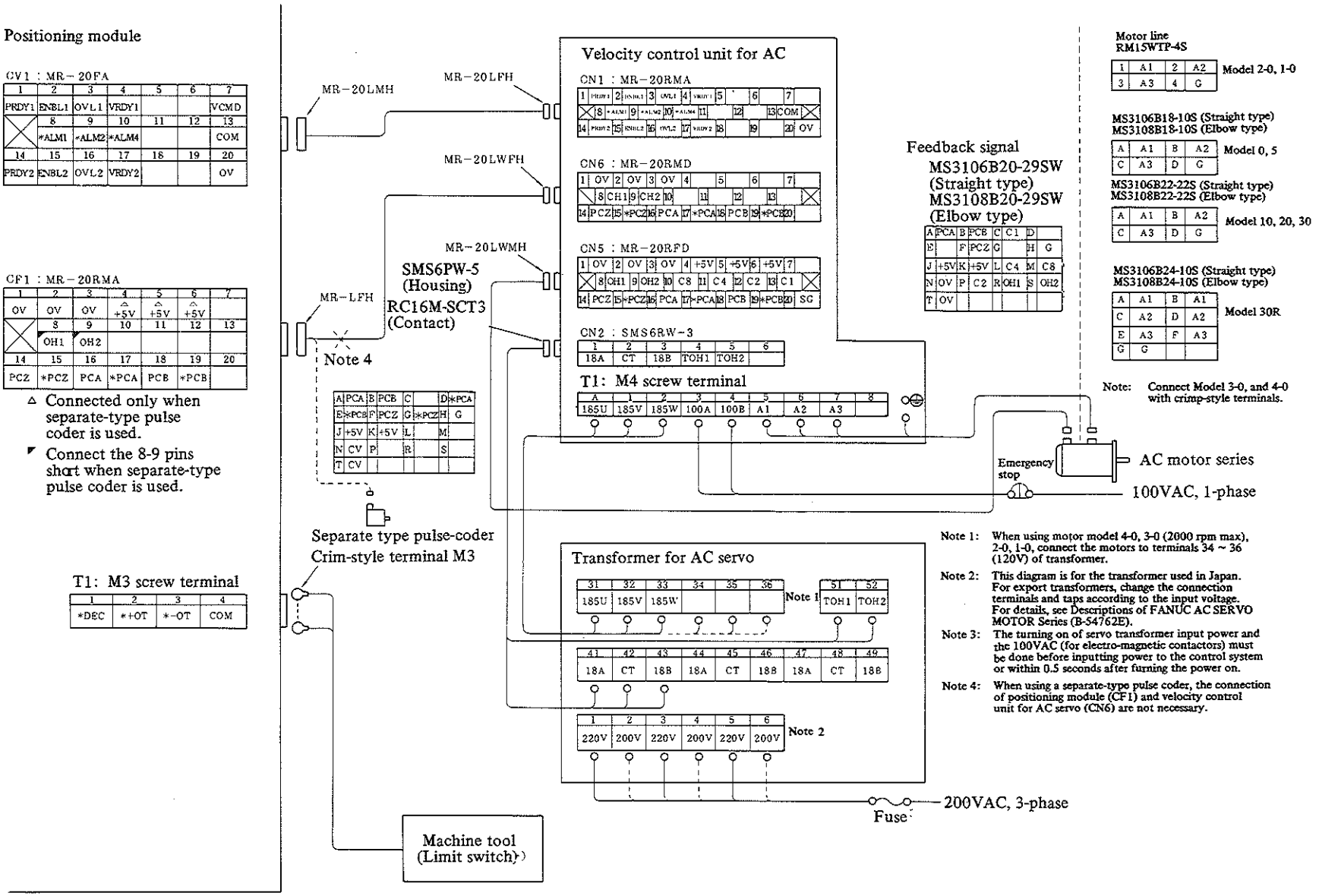


Fig. 1.8 (I) Total connection diagram of the positioning module

e) Machine tool connection (limit switch)

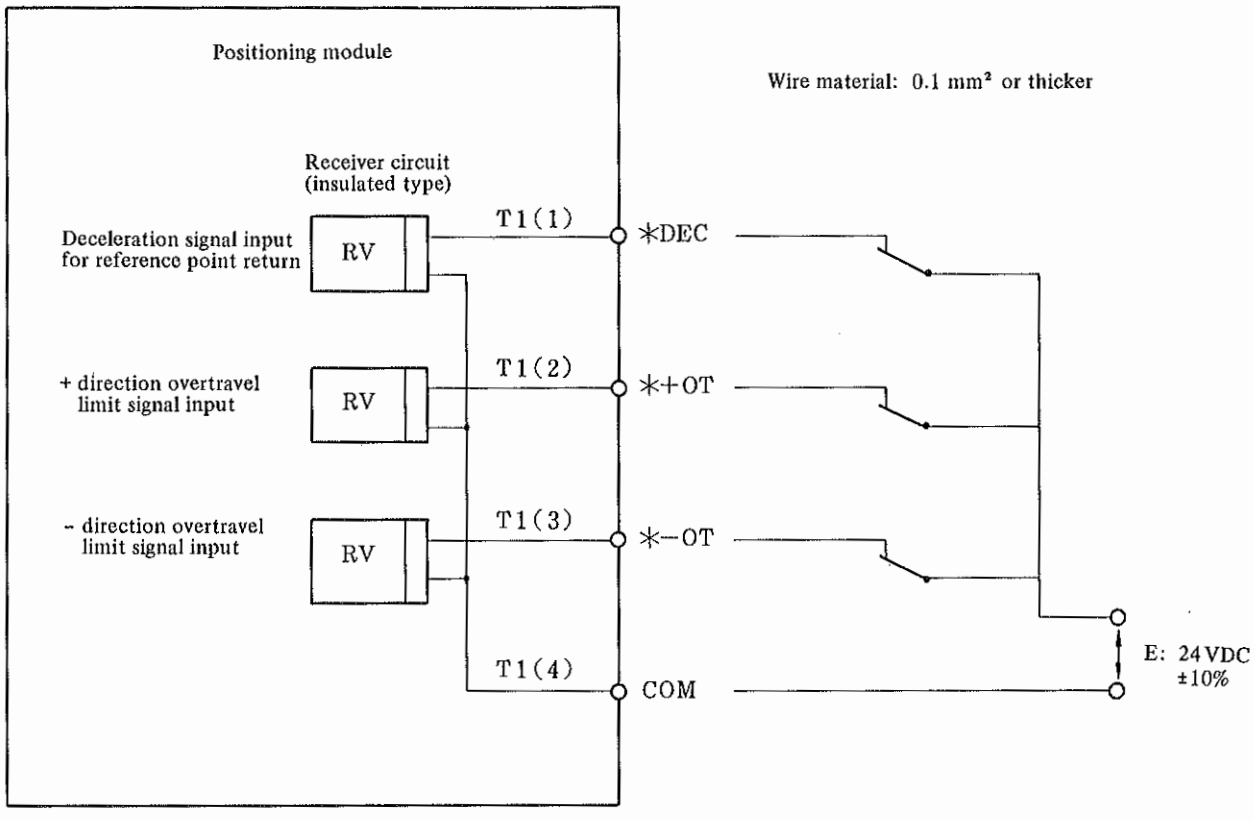
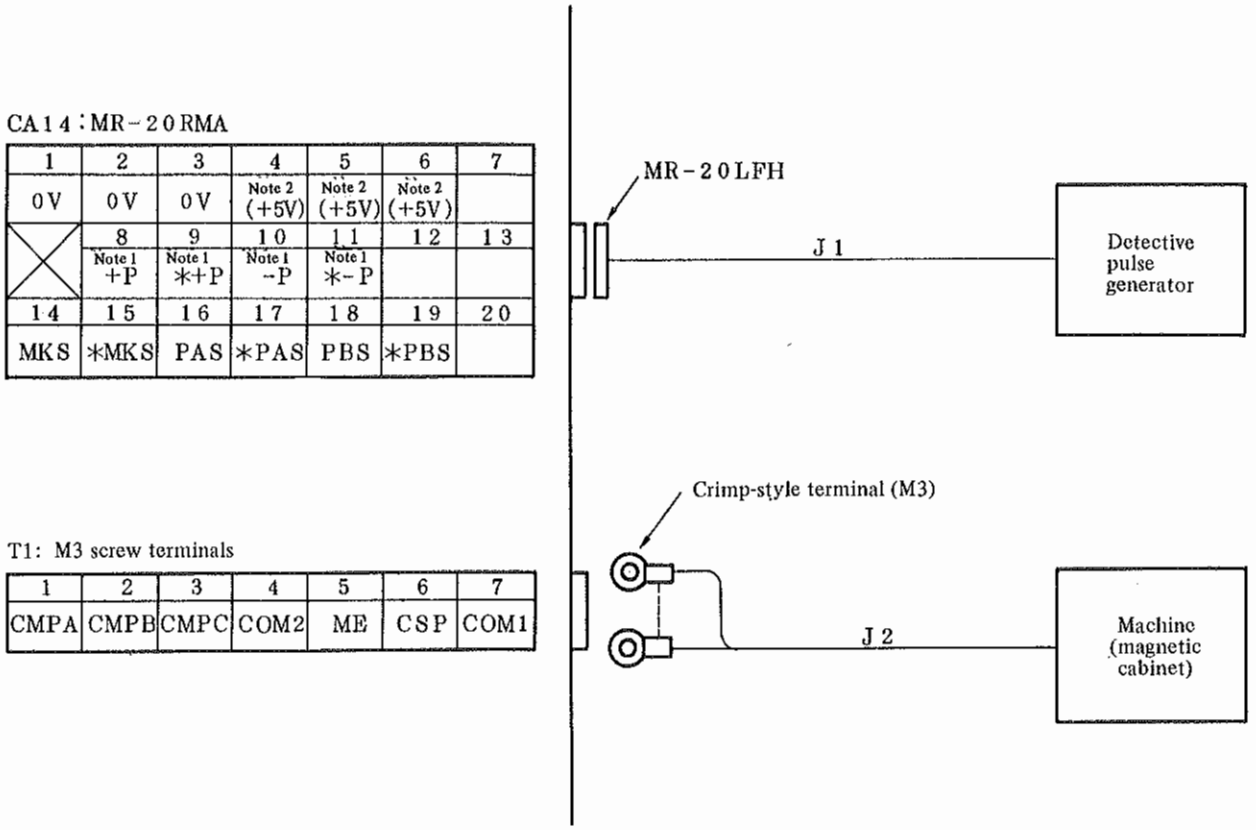


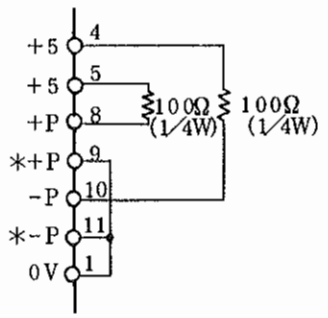
Fig. 1.8 (m) Machine tool connection diagram

9) Pulse counter module connection
   a) Total connection diagram

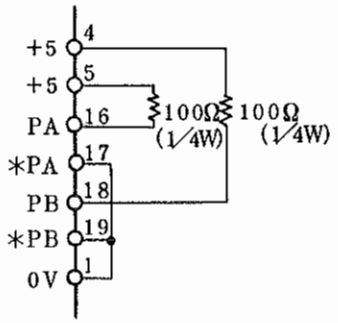


Note 1) Connect either +/- pulse (+P.*+P, +P.*P) or phase A/B pulse (PAS.*PAS, PBS.*PBS) of the detection pulse generator to the pulse counter module. The pulse which is not used must be connected as follows:

A. When +/- pulse is not used



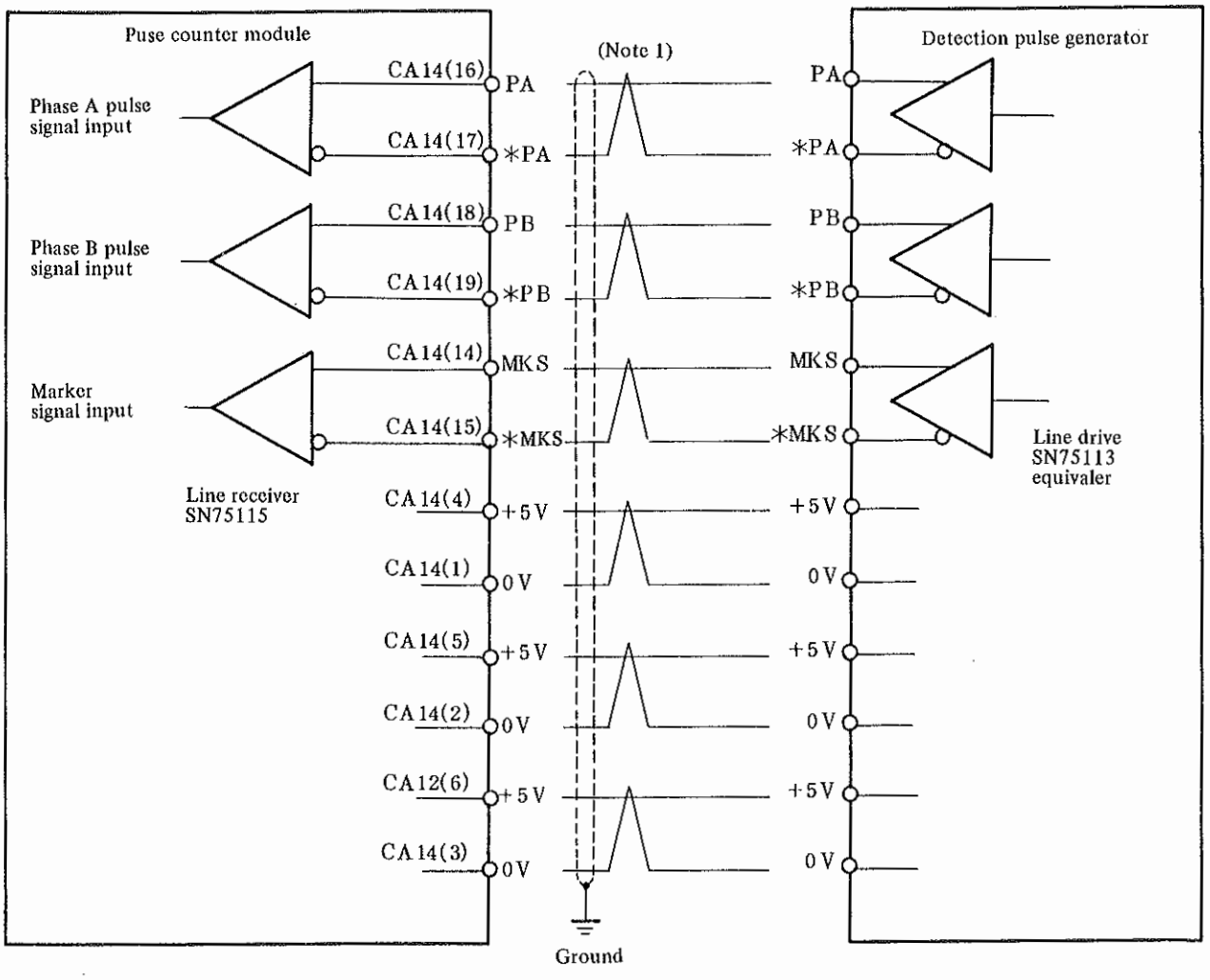
B. When phase A/B pulse is not used.



Note 2) When using the +5V for the detection pulse generator, the capacity maximum is 350 mA. In case it exceeds 350 mA, the power supply must be prepared at the machine tool builder.

Fig. 1.8 (n) Pulse counter module total connecting diagram

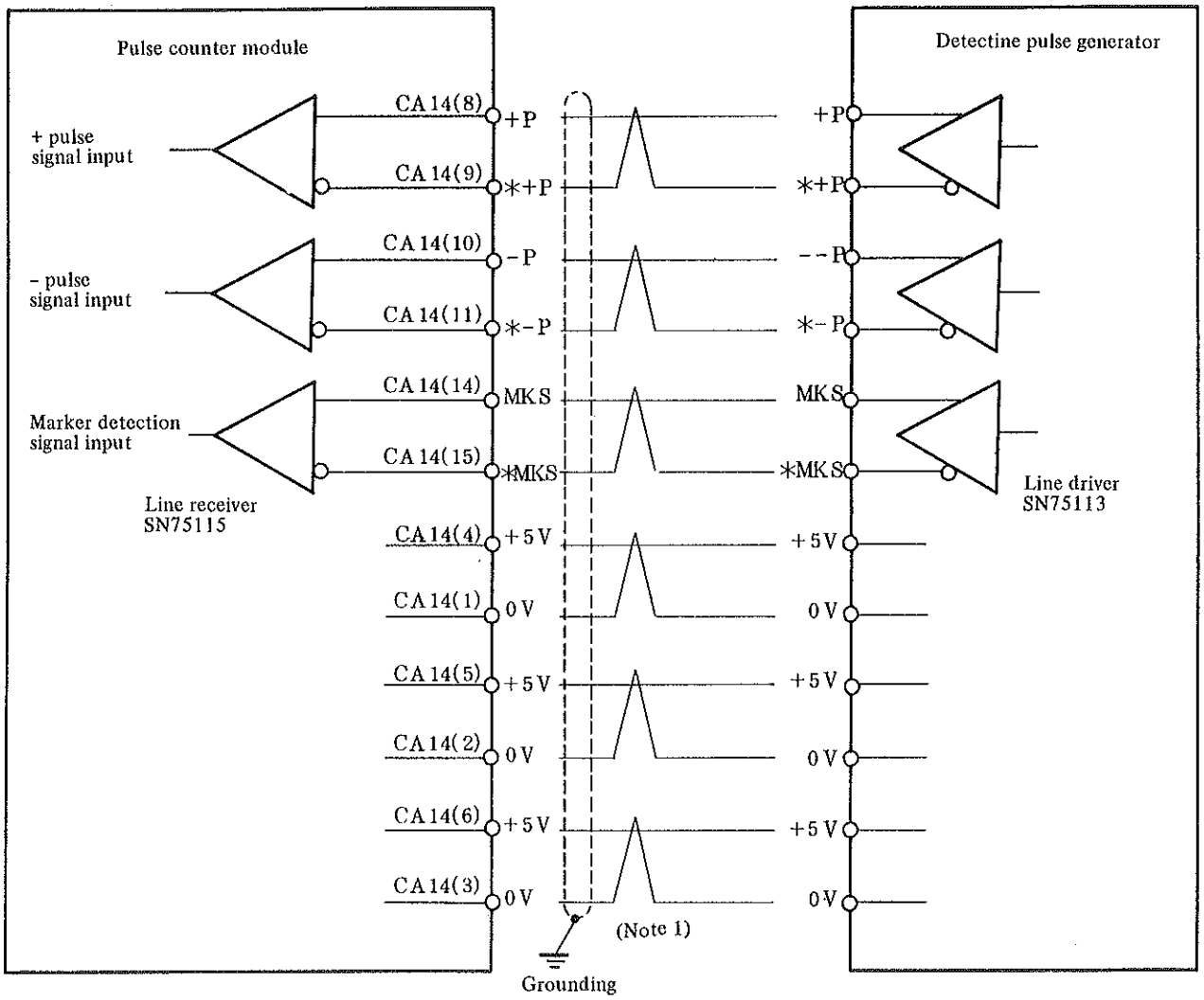
b) Connection between the detection pulse generator and pulse counter module (when phase A/B pulse is used)



Note 1) Twisted pair unified shield wire
Recommended cable: A66L-0001-0041
Connect at least 6 lines thicker than 0.18 mm^2 for the +5V, 0V lines.
(The three terminals of +5V, 0V will have two each.)

Fig. 1.8 (o) Connection between the detection pulse generator and pulse counter module (When phase A/B pulse is used)

c) Connection between detective pulse generator and pulse counter module (for +/- pulse)



Note 1) Twisted pair unified shield wire
Recommended cable specification: A66L-0001-0041
More than 6 pieces of wire should be connected to +5V and 0V (each 0.18 mm^2 or more).

Fig. 1.8 (p) Connection between detective pulse generator and pulse counter module (for +/-pulse)