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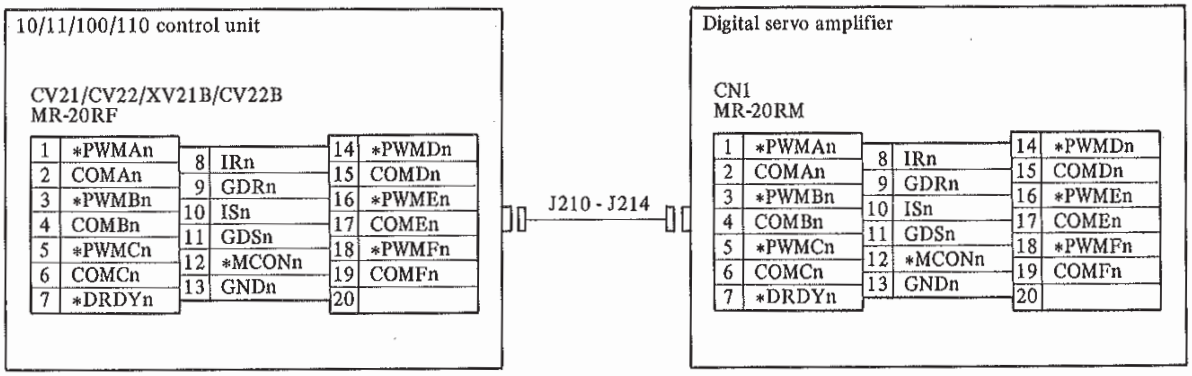
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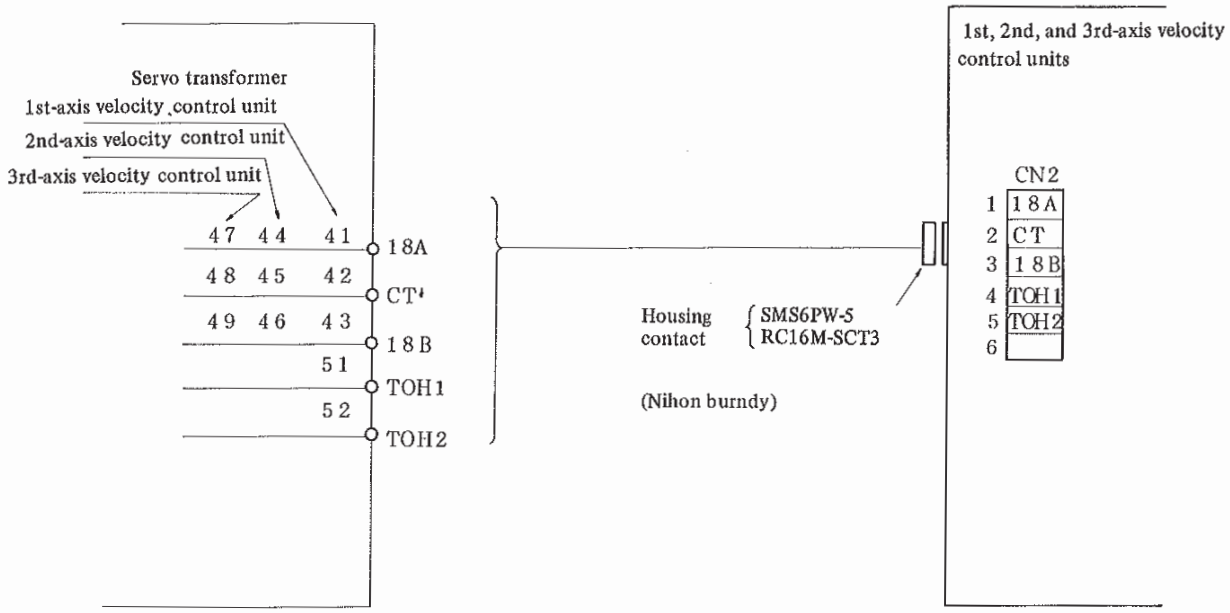
Find the *Fanuc / Hitachi A87L-0001-0105* at our website: *Click HERE*

Cable J210 - J214 Connection diagram




Note) n means number of axis.

3) Connection of overheat signal line of servo transformer

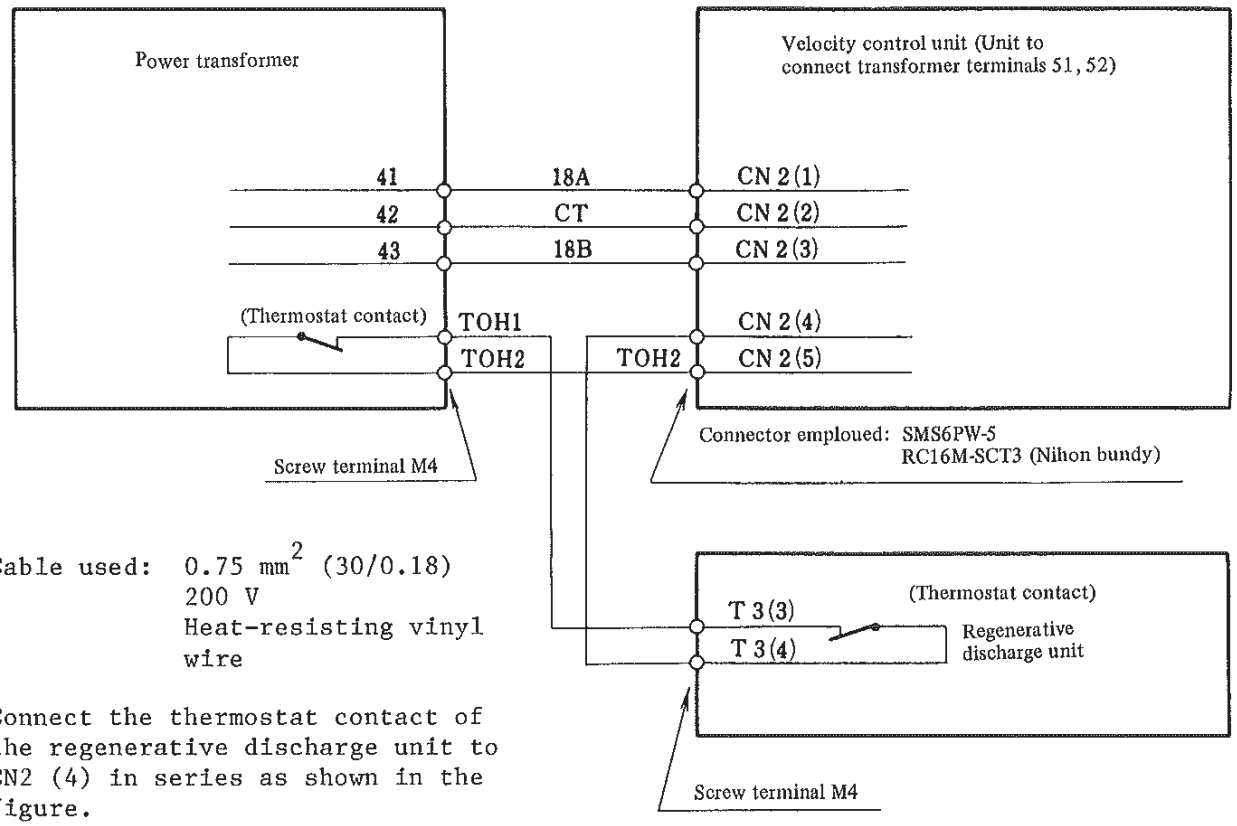



Note: Connect overheat signals TOH1 and 2 of the servo transformer in parallel to all velocity control units to which power is supplied from the servo transformer. Connect signals must parallel each other (as illustrated) because CN2 (4), (5) terminals on the velocity control unit side are polarized.



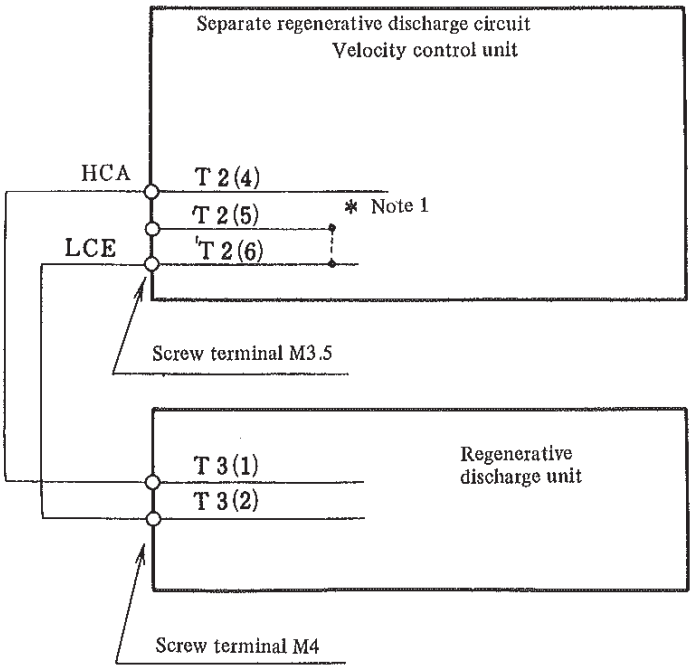
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4) Connection to separate regenerative discharge unit




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.



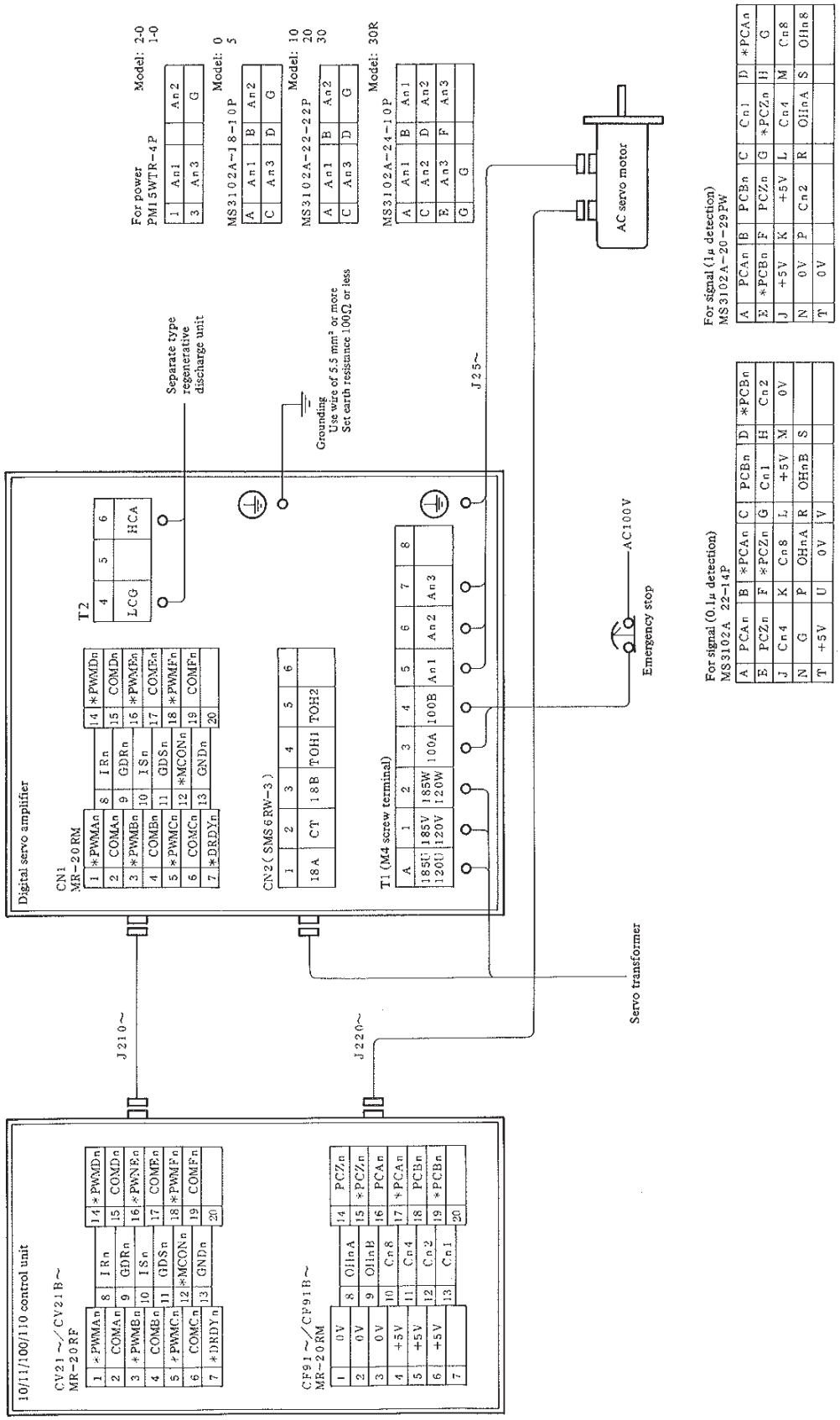

Note 1: Disconnect jumper wire (if any) from terminals T2 (4), (5), (6) when the seperate type regenerative discharge unit is used. Be sure to connect to the regenerative discharge unit after jumper wire is disconneced.

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



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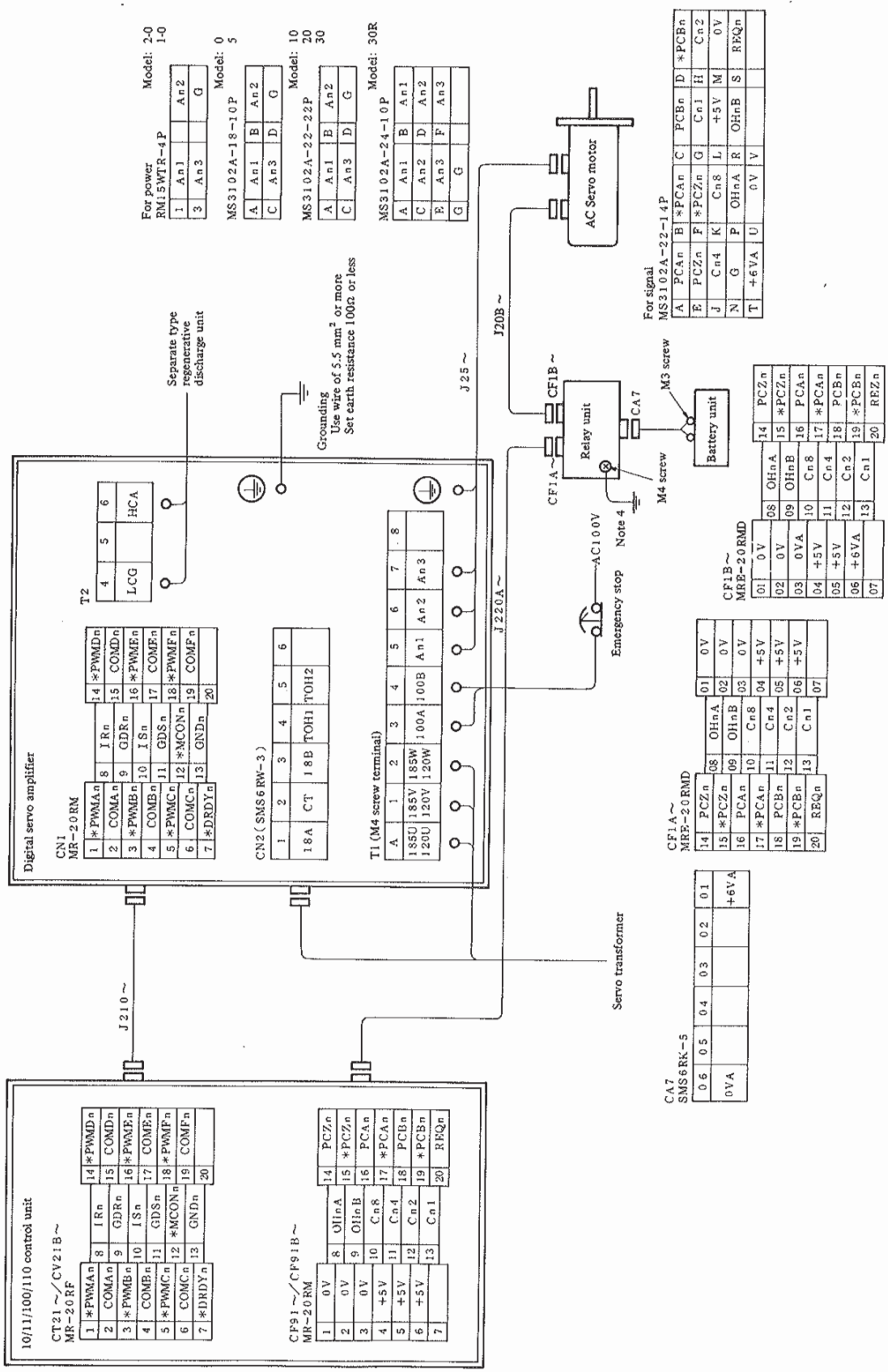
5) Connection diagram of digital servo (Built-in incremental pulse coder)






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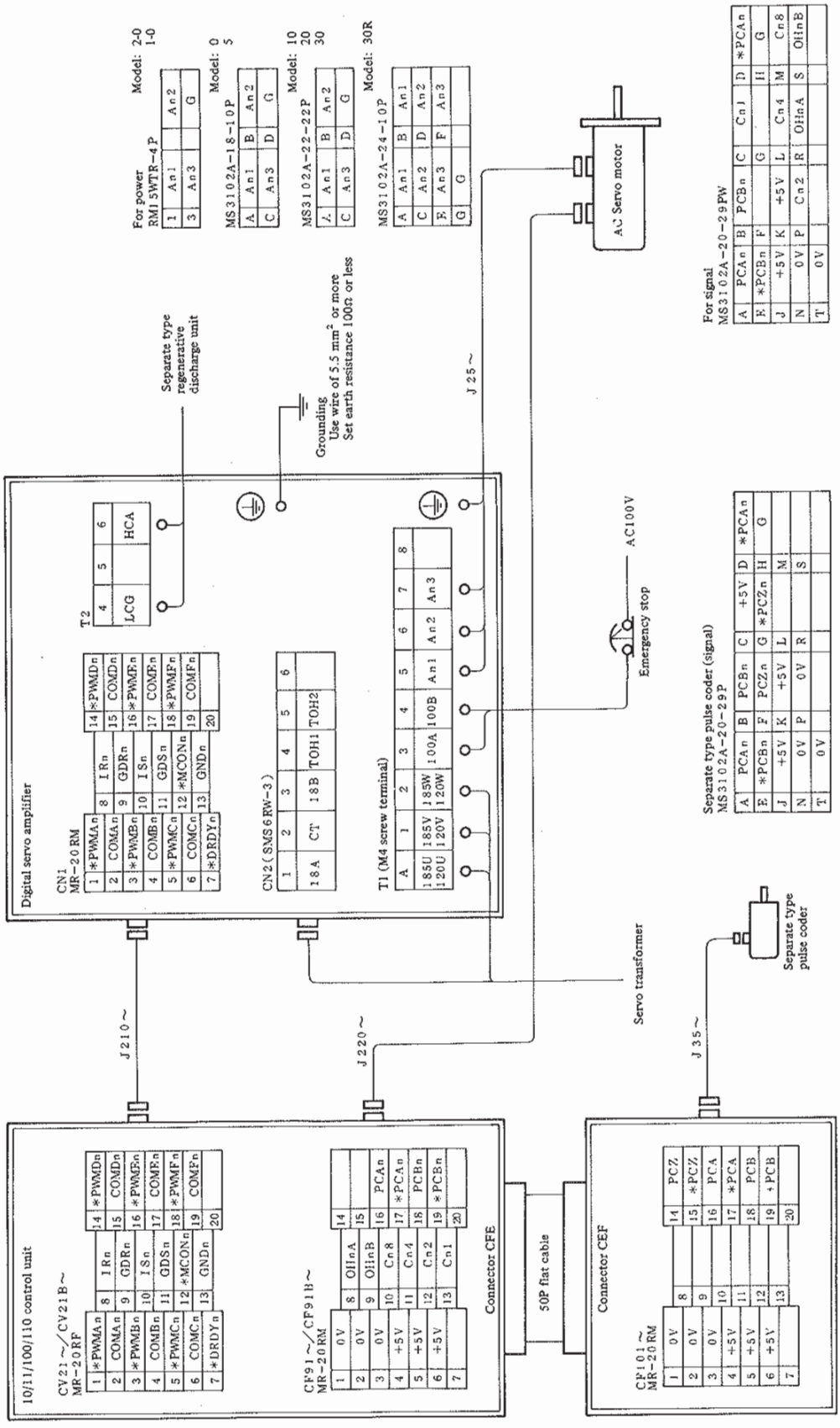
6) Connection diagram of digital servo (1μ detection, built-in absolute coder)






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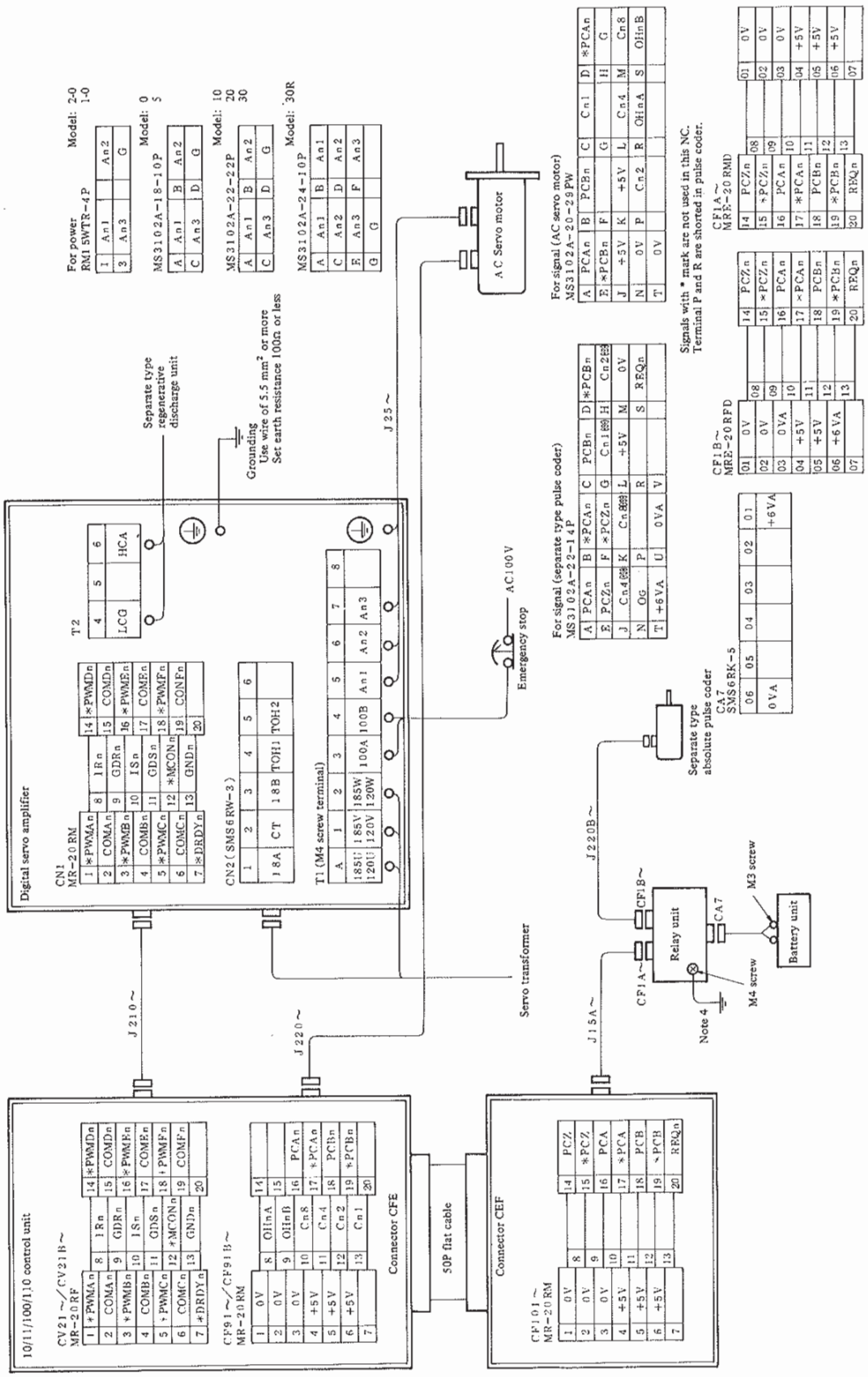
7) Connection diagram digital servo (Separate type incremental pulse coder)






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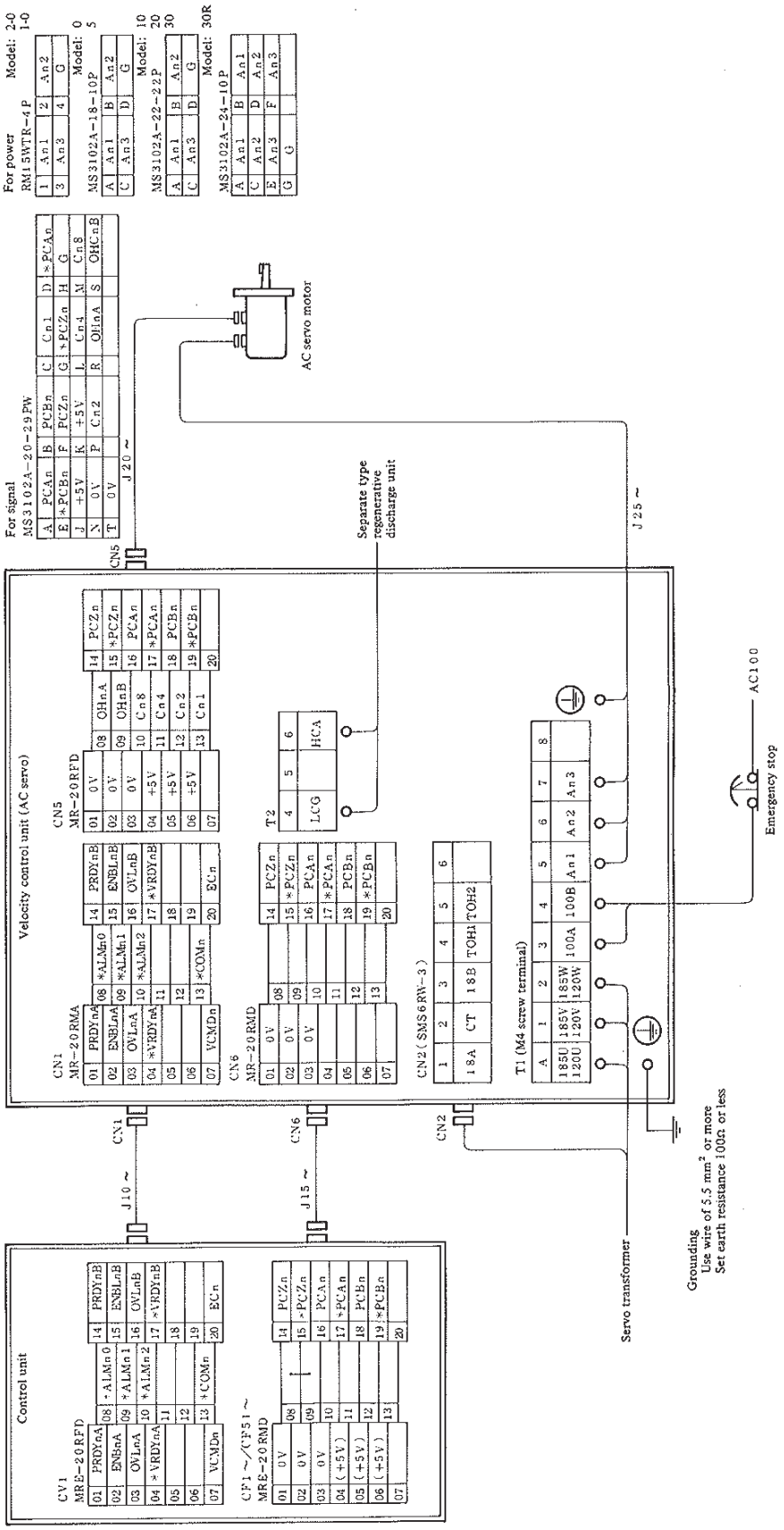
8) Connection diagram of digital servo (1μ detection, separate type absolute pulse coder)






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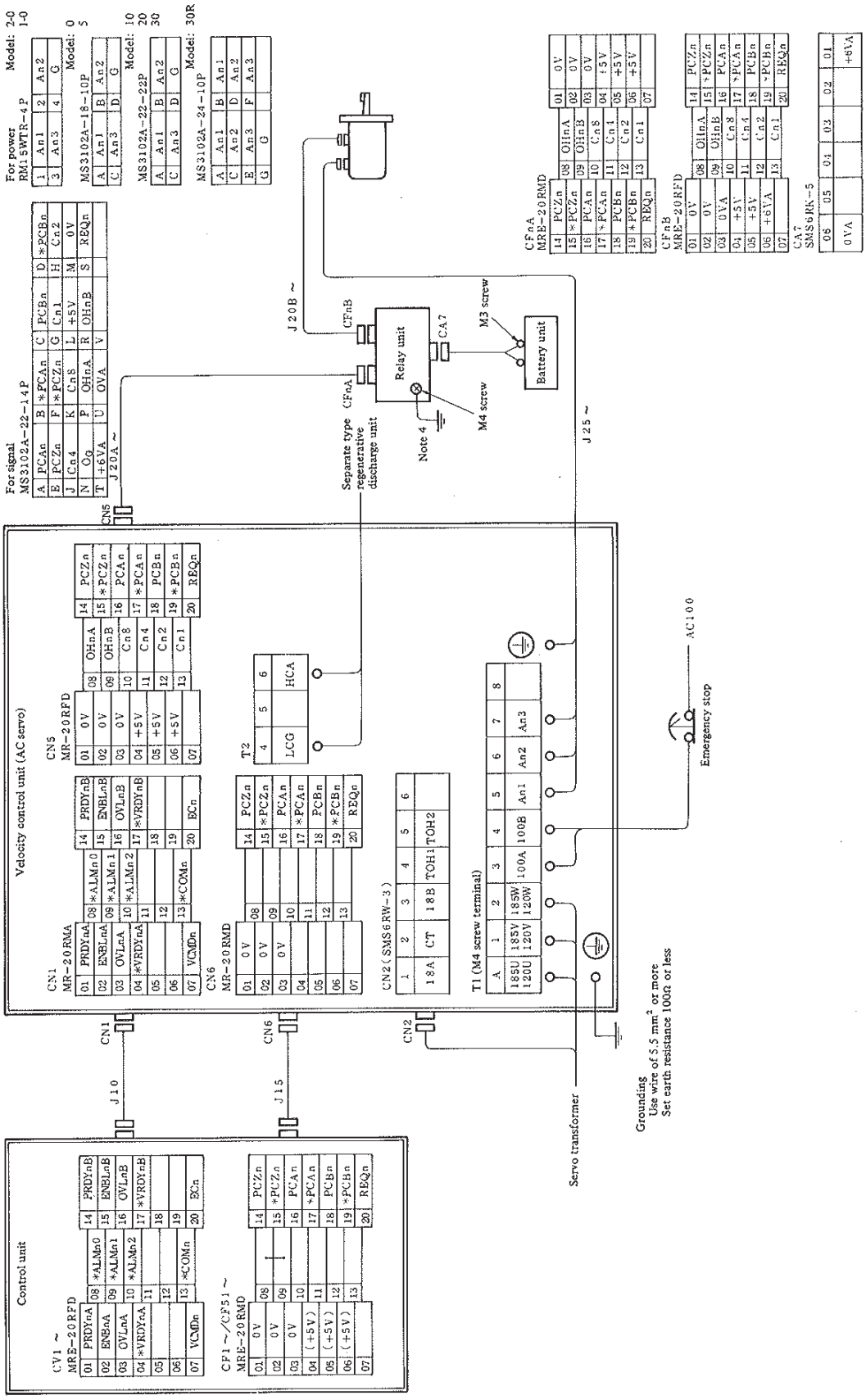
9) Connection diagram of analog servo (1μ detection, built-in type incremental pulse coder)






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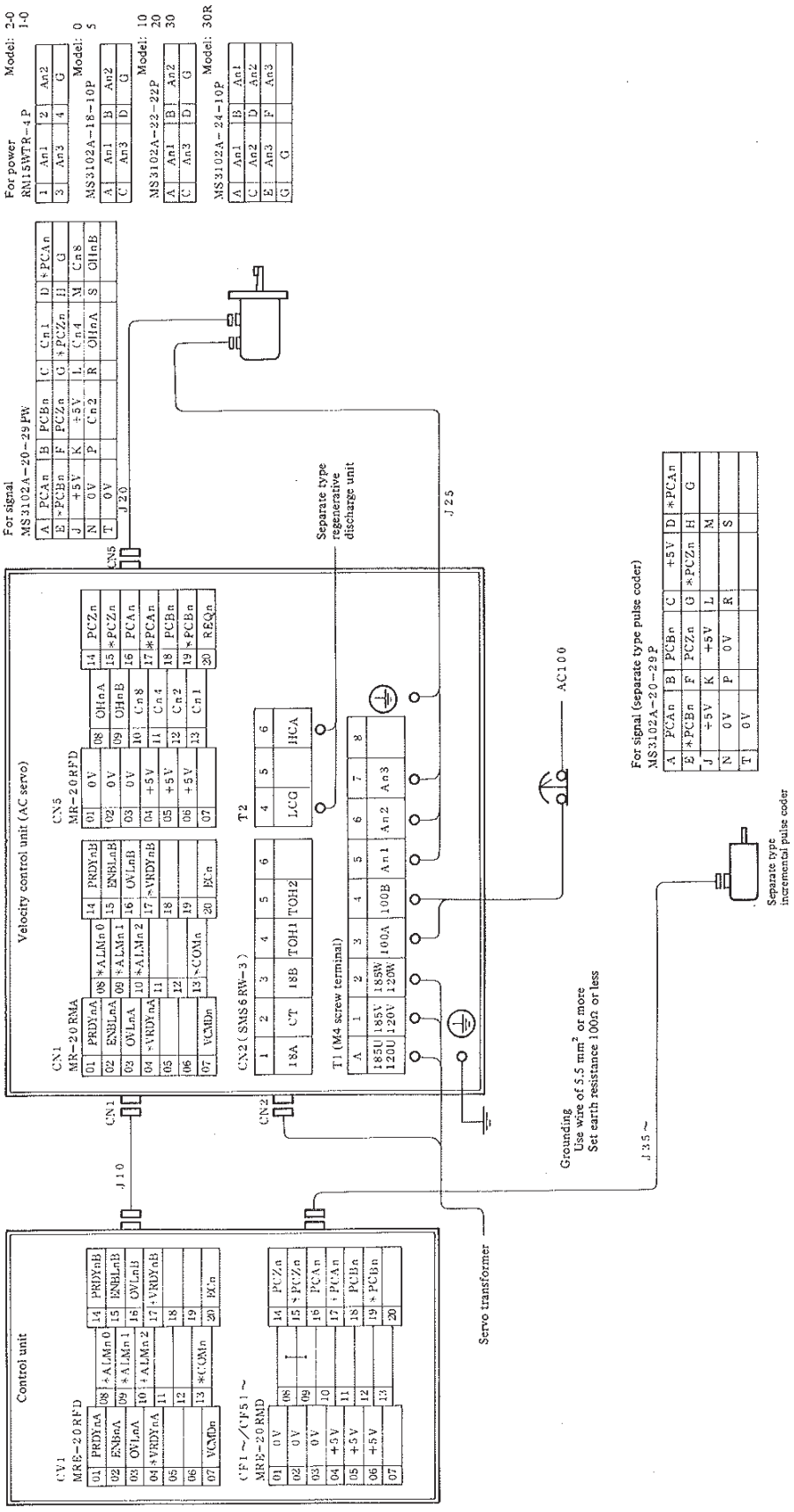
10) Connection diagram of analog servo (1μ detection, built-in type absolute pulse coder)






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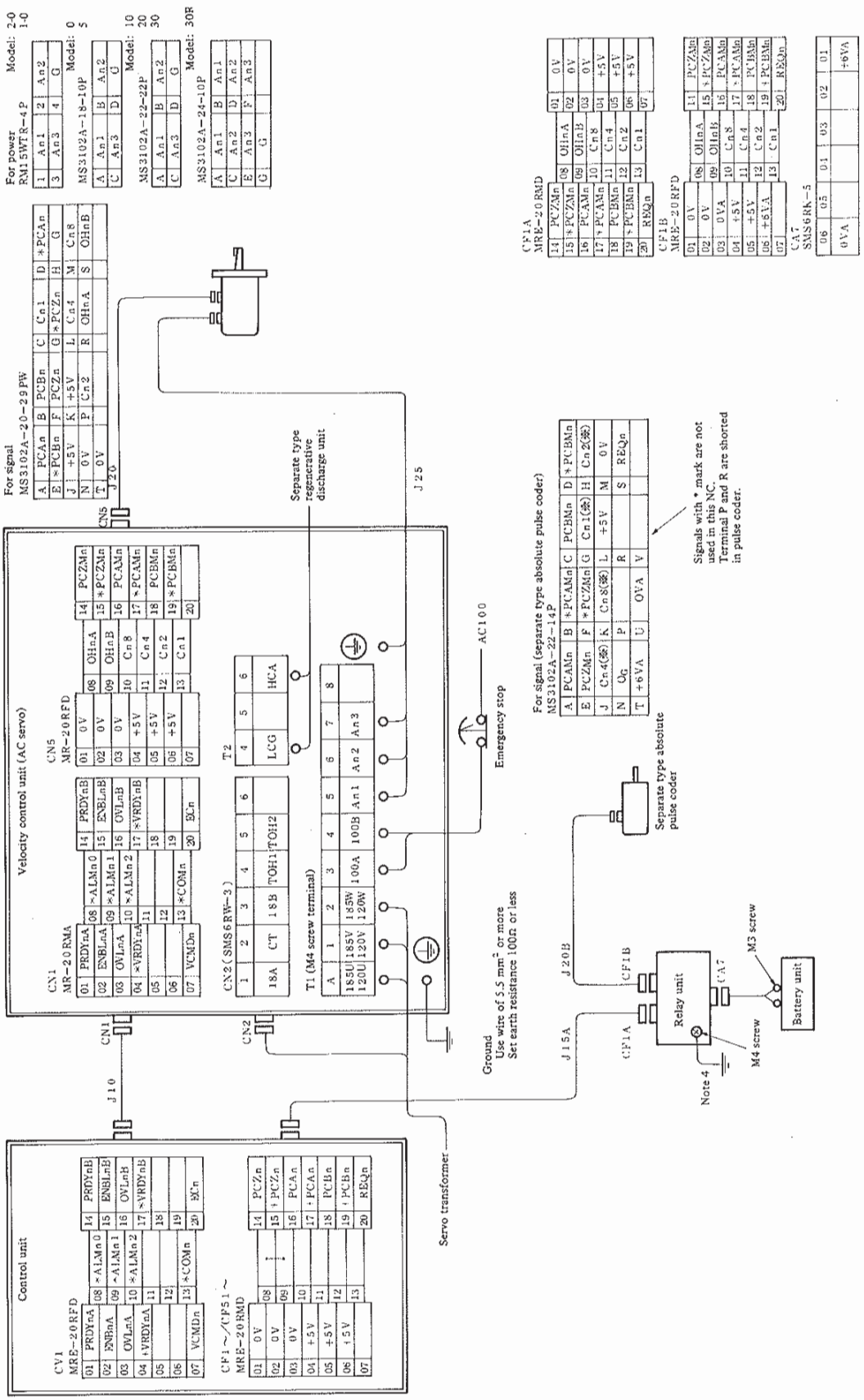
11) Connection diagram of analog servo (1μ detection, separate type incremental pulse coder)






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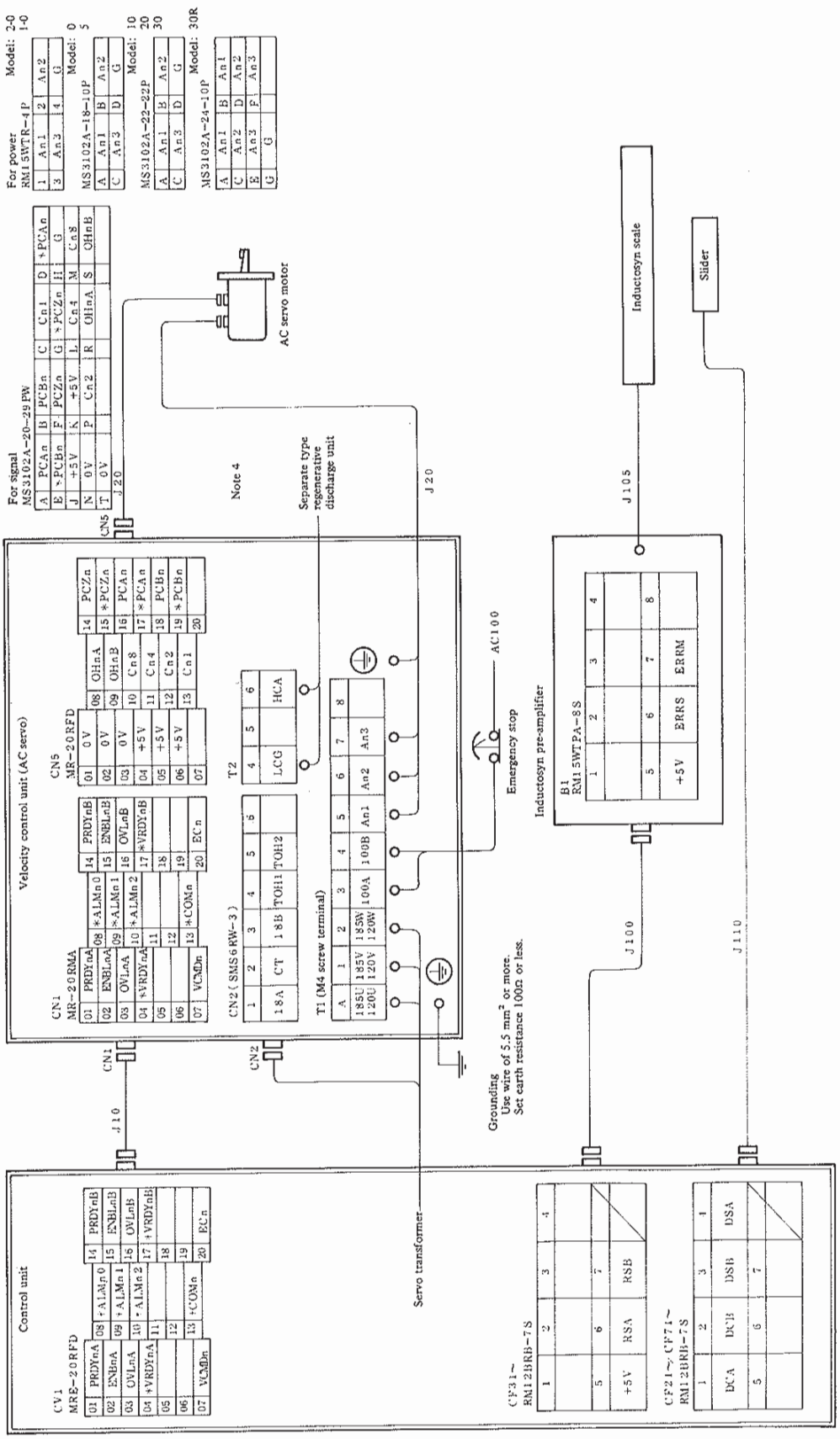
12) Connection diagram of analog servo (1μ detection, separate type absolute pulse coder)






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

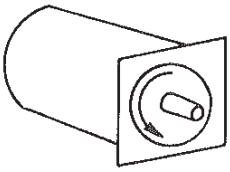




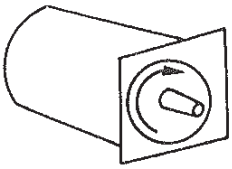

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## 3.10 Standard Connection and Reverse Connection of Motor (Relationship between connections and rotating directions of servo motor)

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.

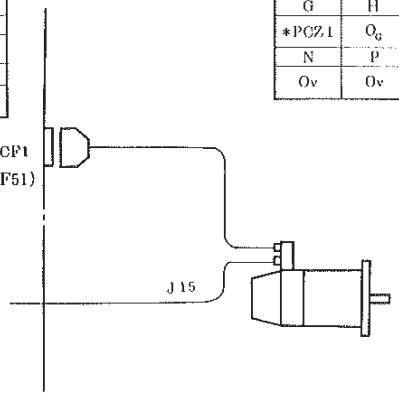
### 3.10.1 When using M series servo

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 |
|---|---|---|---|---|---|---|
| Ov | Ov | Ov | +5v | +5v | +5v | |
| | 8 | 9 | 10 | 11 | 12 | 13 |
| | OH11 | OH21 | | | | |
| 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| PCZ1 | *PCZ1 | PCA1 | *PCA1 | PCB1 | *PCB1 | $O_G$ |

| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PCB1 | PCA1 | +5V | *PCB1 | *PCA1 | PCZ1 |
| G | H | J | K | L | M |
| *PCZ1 | $O_G$ | +5v | +5v | | |
| N | P | R | S | T | |
| Ov | Ov | OH11 | OH21 | Ov | |




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 |
| | |



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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 | |

CF1
(CF51)

| 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

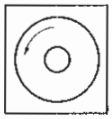
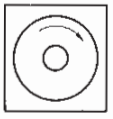
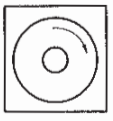
T11 M4 Screw terminal

J15

| 5 | 6 | 7 | 8 |
|---|---|---|---|
| A21 | A21 | A11 | A11 |

| A | B |
|---|---|
| A11 | A21 |
| C | D |
| | |

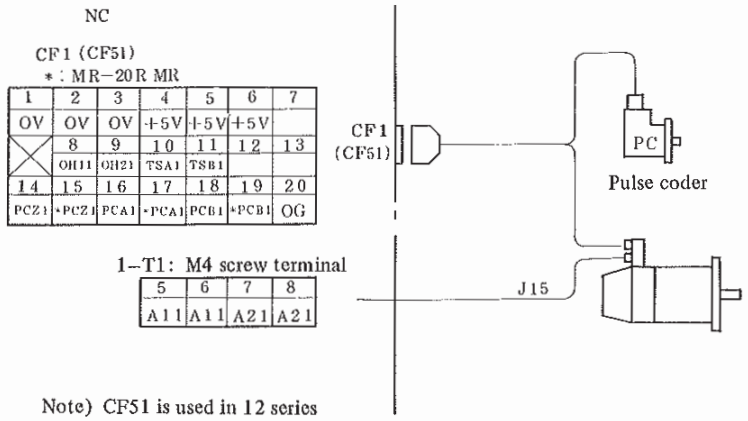
3) When using separate pulse coder
The following four connections are determined according to whether the motor and separate pulse coder rotate clockwise or counter-clockwise as viewed from the shaft side when the machine moves in the (+) direction.

| | 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 |



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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

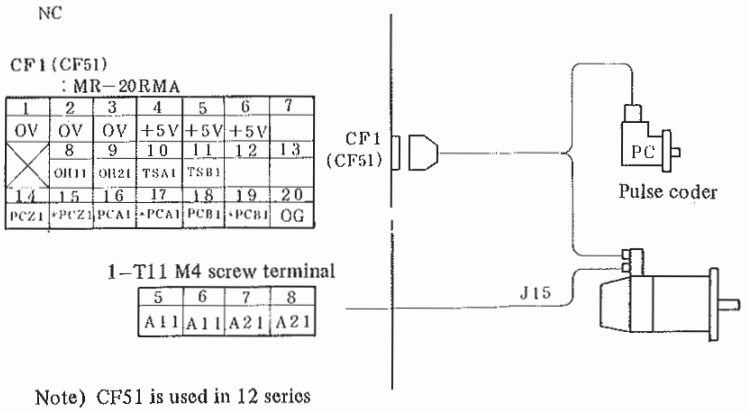
| A | B |
|---|---|
| A11 | A12 |
| C | D |
| | |

MS3102A-20-29P

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

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

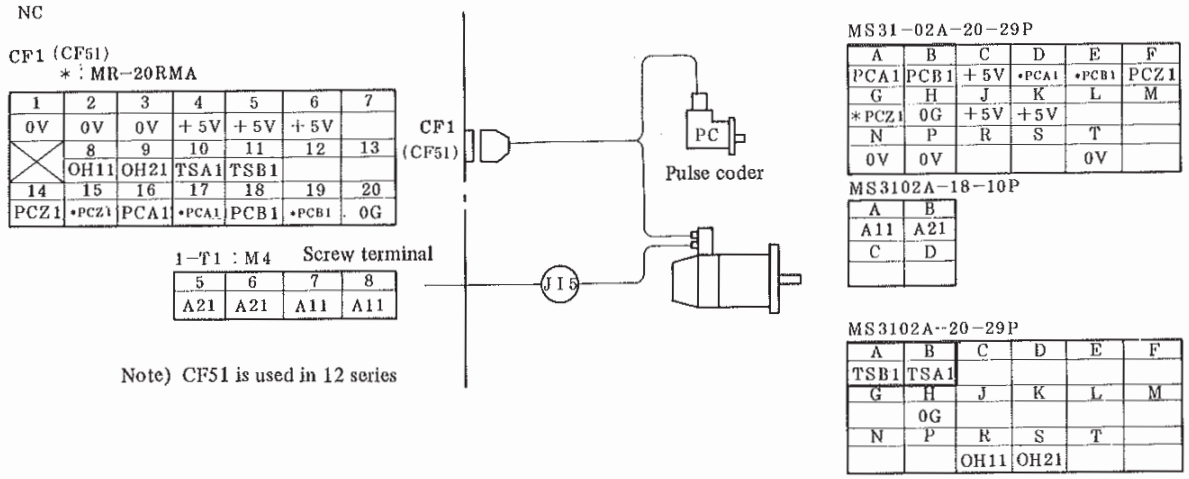
| A | B | C | D | E | F |
|---|---|---|---|---|---|
| TSA1 | TSB1 | | | | |
| G | H | J | K | L | M |
| | OG | | | | |
| N | P | R | S | T | |
| | | OH11 | OH21 | | |



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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 |

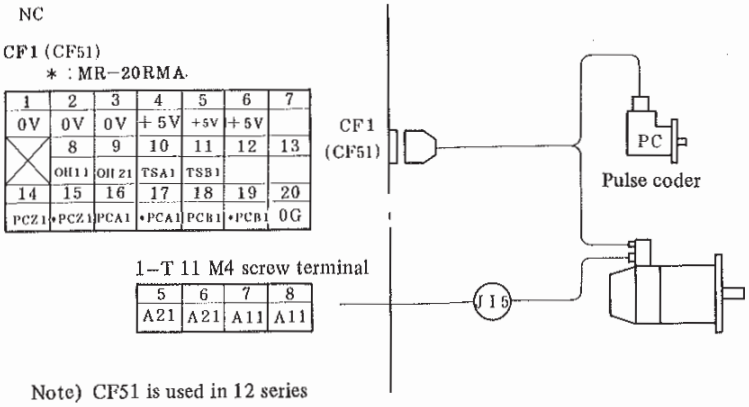
| A | B | C | D | E | F |
|---|---|---|---|---|---|
| PCA1 | PCB1 | +5V | *PCA1 | *PCB1 | PCZ1 |
| G | H | J | K | L | M |
| *PCZ1 | 0G | +5V | +5V | | |
| N | P | R | S | T | |
| 0V | 0V | | | 0V | |

| 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 | | |



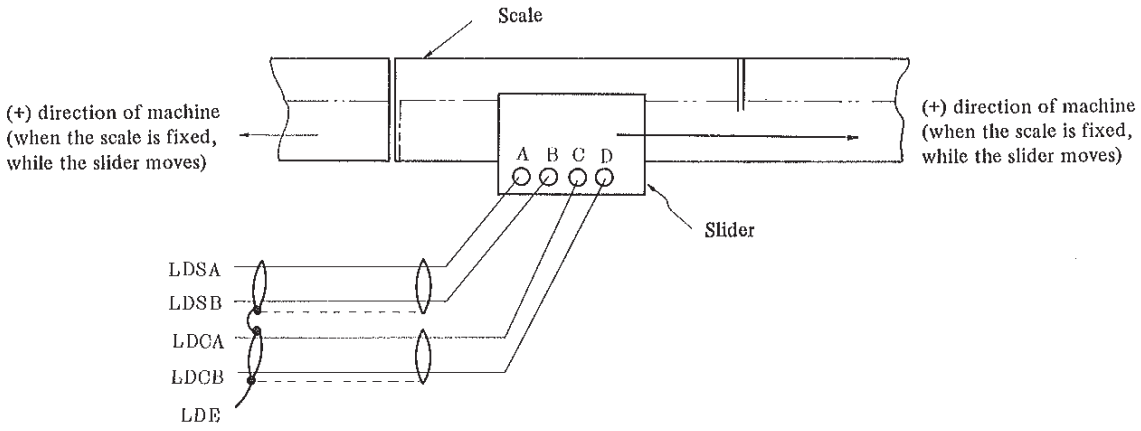
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4) When using inductosyn

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.

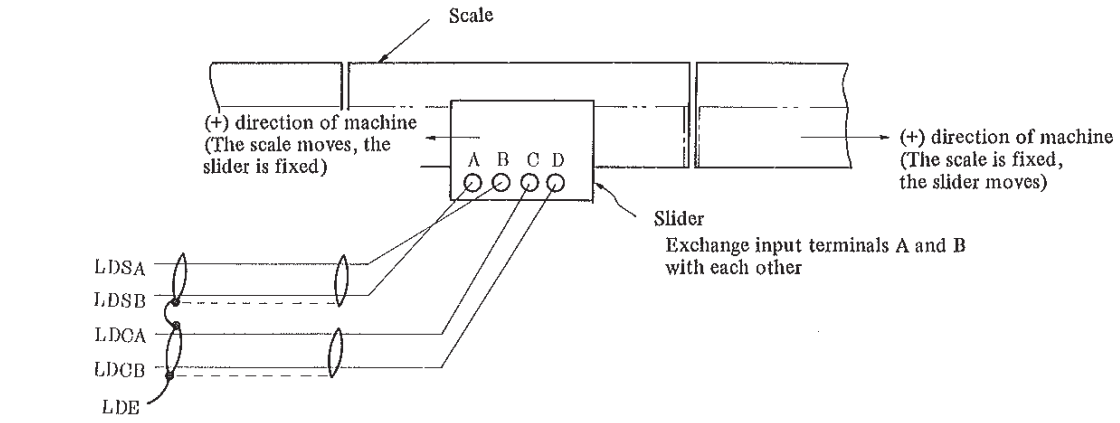
The relationship between the connection to the inductosyn slider and the moving direction of the machine is as illustrated below.




(Indicates the connection of X-axis)

Fig. 1

Connection when the direction is reversed




(Indicates the connection of X-axis)

Fig. 2



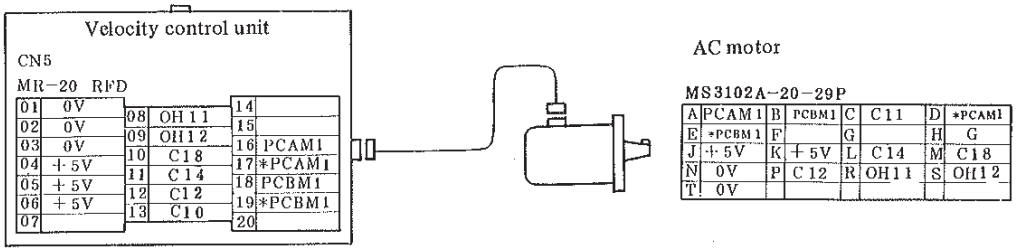
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### 3.10.2 When using analog AC servo

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.

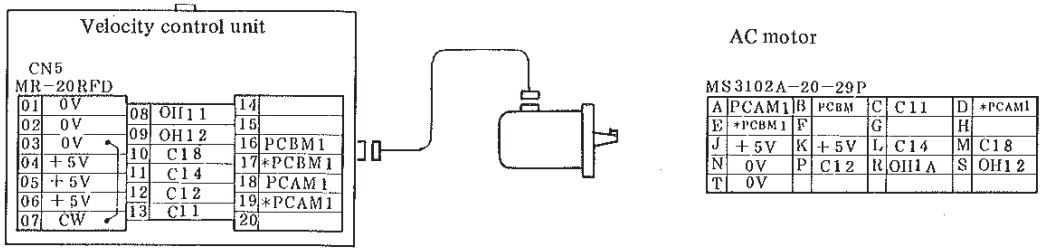
1) When using mounted pulse coder

a) Standard connection




b) Reverse connection

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




2) When using separate pulse coder:

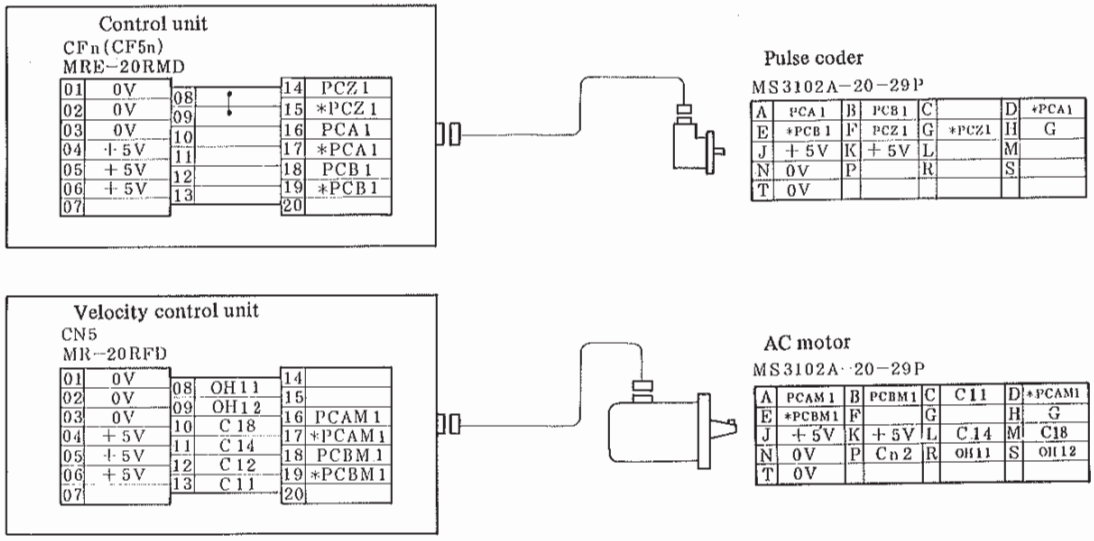
Four connections are possible depending on whether the motor and separate pulse coder rotate clockwise or counterclockwise as viewed from the shaft side when moving the machine in the (+) direction. (See the table at right)
(Note) No cable is connected to connector CN6 of the velocity control unit.

| 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 |



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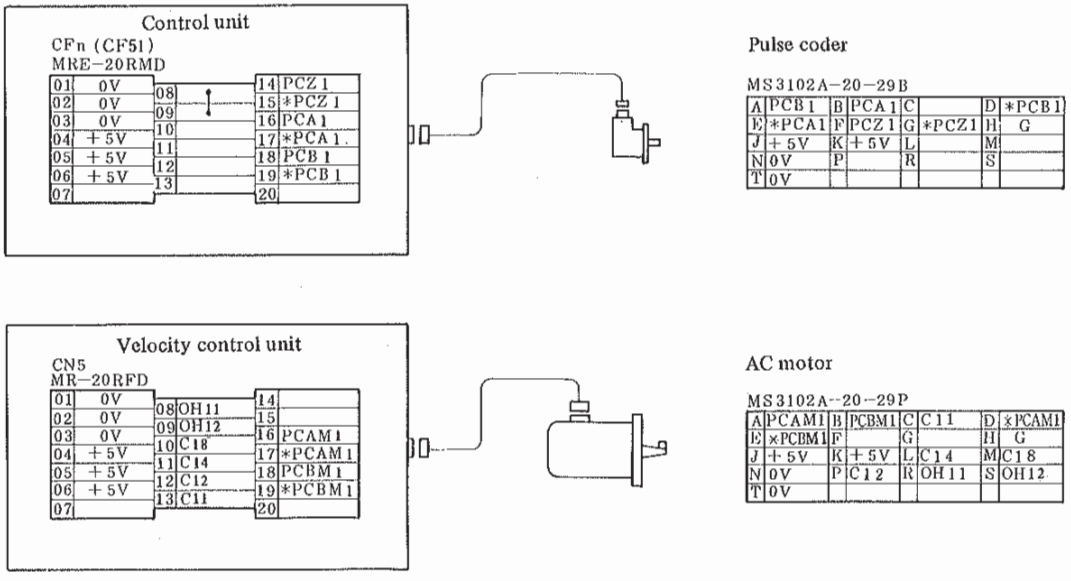
a) Standard connection of motor and pulse coder.




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.



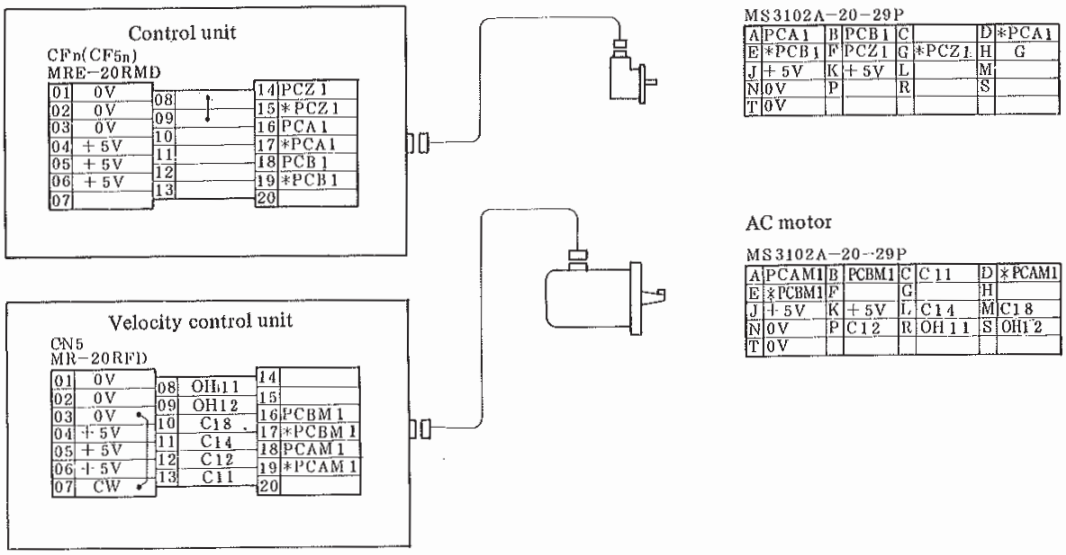

Note) CF51 is used in 12 series



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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

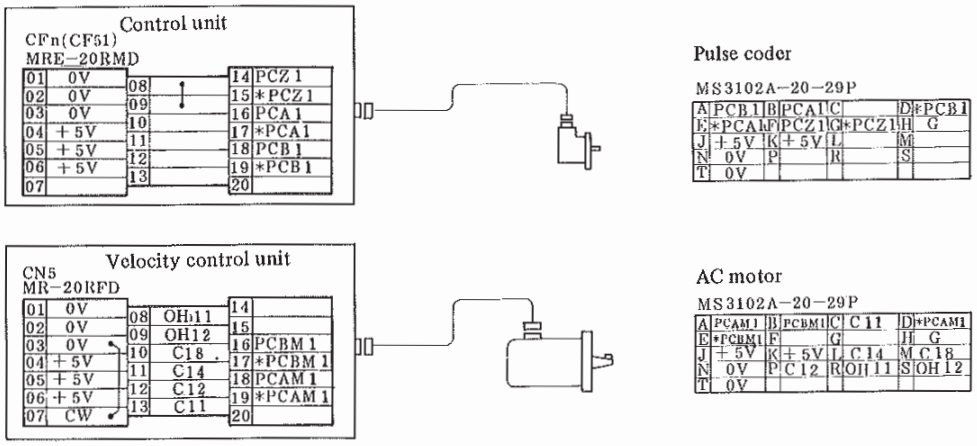
MS3102A-20-29P

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 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



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

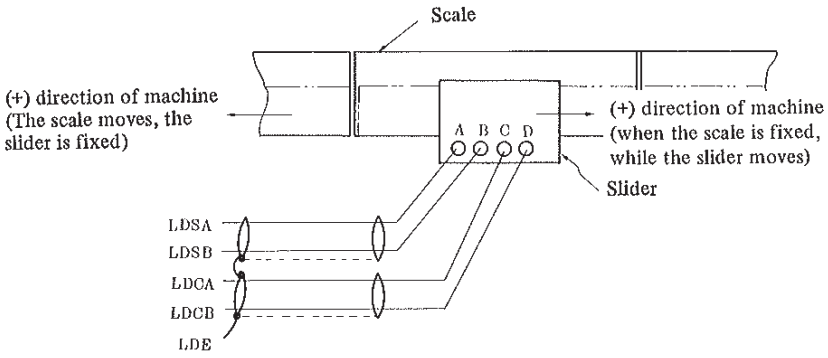



Fig. 1

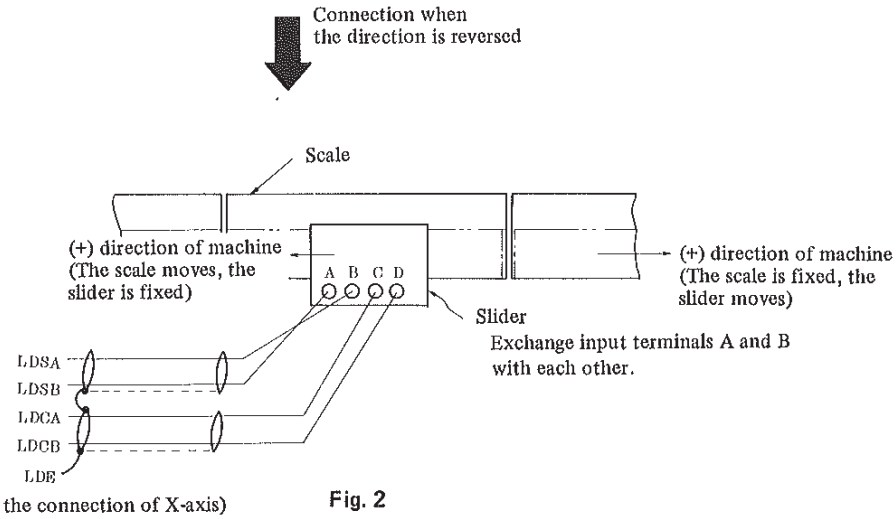



Fig. 2

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).



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## 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)<br>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.<br>Proceed to 4 if the vibration cycle fairly remains constant, regardless of the the feedrate. |



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| 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. |



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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 postion by DGN 3000.<br>Check by DGN 1B ∿ 1D for positioning module. | Proceed to 2 if correct.<br>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.<br>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.<br>Check by DGN 1B ∿ 1D for positioning module. | Proceed to 2 if correct.<br>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. |



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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:

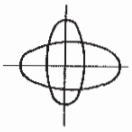
$$G = \frac{16.7F}{E}$$

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 $sec^{-1}$)

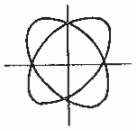
Then check the servo position deviation from DGN 800 ∿ 804. Adjust the position deviation within ±10% of the target value by turning the variable resistor (RV4) ($F\overline{/}V$ converter voltage compensation) in the velocity control unit. However, the difference between axes must be within ±1%.
45°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



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Not adjustable

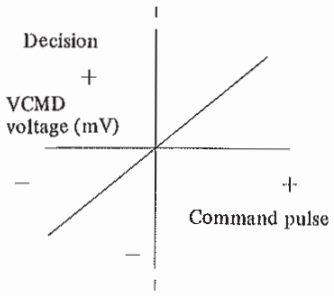


Adjustable

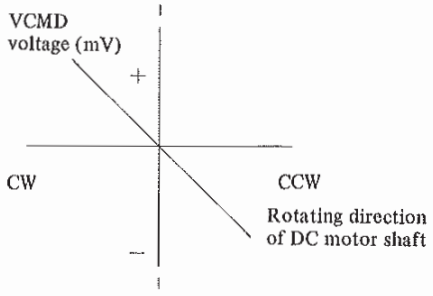
### 3.11.4 Method of confirming the operation of velocity control unit and position control unit (For analog servo)

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.



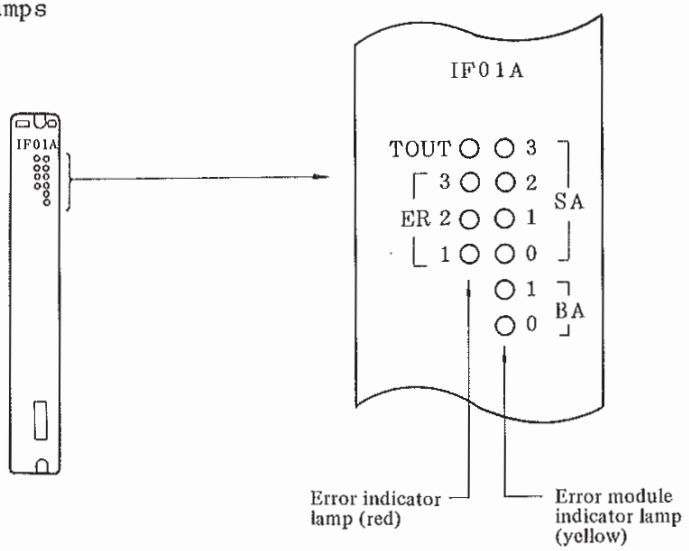
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## 3.12 Error Display and it's Contents of I/O Unit

### 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)



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- 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.<br>2. Optical connector is not sufficiently connected.<br>3. Optical connector tip is dirty.<br>4. IF01A is defective.<br>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.<br>SA3-SA0: slot number (binary display)<br>BA1, BA0: Base number (binary display)<br><br>Example)<br>Base #1, slot #5<br>SA3 SA2 SA1 SA0 BA1 BA0<br>0 1 0 1 0 1<br>Slot #5 Base #1<br>0: Goes out<br>1: Lights<br><br>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.<br>2. IF01A is defective. |

o: Lamp lights
-: Lamp goes out

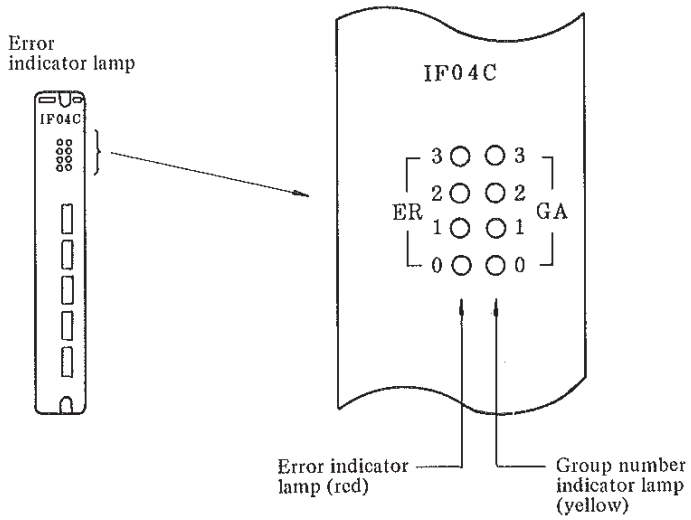


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### 3.12.2 Error display and contents in interface module (IF04C)

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






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<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<br>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.<br><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.<br>2. Optical connector is not sufficiently connected.<br>3. Optical connector tip is dirty.<br>4. IF04C is defective.<br>5. IF01A is defective.<br>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.<br>2. IF04C is defective.<br>3. IF01A is defective.</td></tr>
</table>

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



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### 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.



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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.





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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). |





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| | 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).<br>Motor overheat alarm is displayed for DC motor, but overload alarm is displayed for AC motor. |



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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). |

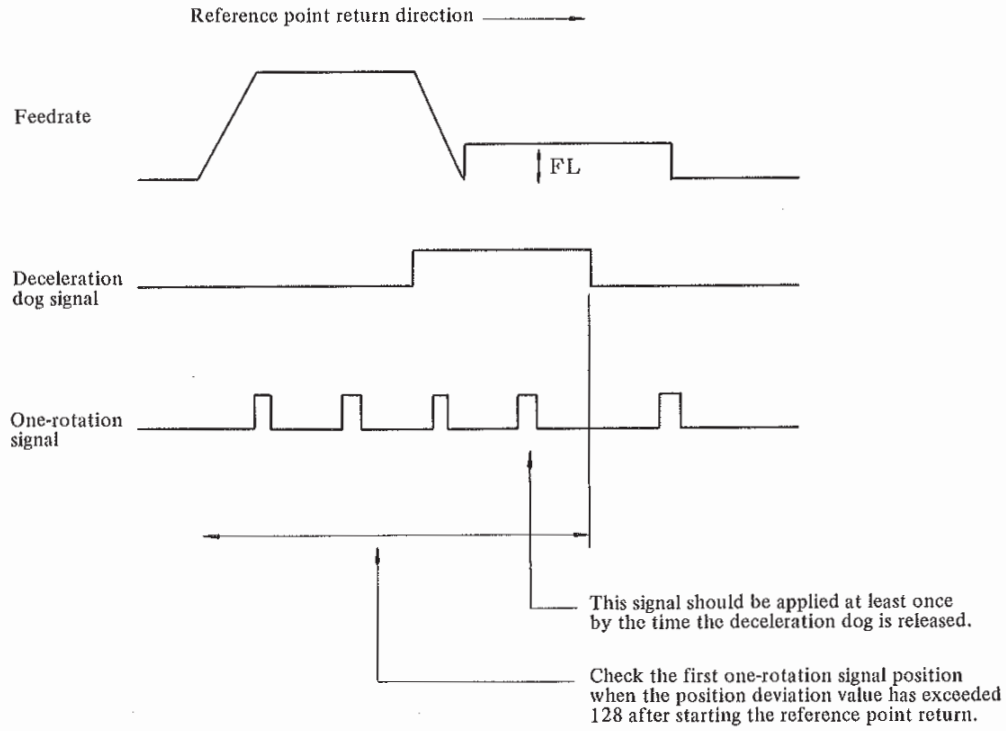
└→ Indicates the conditions of various signals. For details, see parameters and diagnostic display function of positioing module in para. 8.





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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.



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| 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. |



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| 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. |



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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<br>2) Check servo loop gain. Parameter No. 8<br>3) Check CMR. (Command multiply ratio) Parameter No. 3<br>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.<br>1) Feed rate Rapid traverse rate: Parameter No. 10 | |
| | | Feed rate is right; positional deviation is right. | Proceed to 5. |
| | | Feed rate is right; positional 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. |



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| 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. |



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| Item | Cause of trouble | Checking points | Corrective action |
|---|---|---|---|
| 2 | Overload of moter | Measure the motor current. The continuous rated current is as specified below.<br>M series servo<br>00M ... 4A<br>0M ... 7A<br>5M ... 9A<br>10M ... 12A<br>20M ... 18A<br>30M ... 24A<br>AC servo<br>4-0 ... 0.93A 30R ... 29A<br>3-0 ... 0.93A<br>2-0 ... 3A<br>1-0 ... 2.9A<br>0 ... 4.6A<br>5 ... 6.8A<br>10 ... 11A<br>20 ... 20A<br>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. |



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| Item | Cause of trouble | Checking points | Corrective action |
|---|---|---|---|
| 6 | Wiring failure | Check to see if the following wiring is correct.<br>o Positioning module (CV1)<br>- velocity control unit (CN1)<br>o Servo transformer<br>- velocity control unit (CN2)<br>o Regenerative discharge unit<br>- velocity control unit (CN2)<br>o AC servo motor<br>- 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.<br>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. |



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8) Excess drift compensation

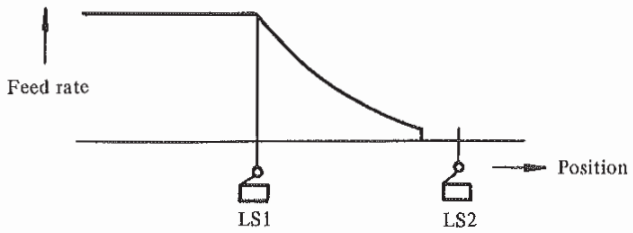
| Item | Cause of trouble | Checking points | Corrective action |
|---|---|---|---|
| 1 | Connection trouble | Check the connection of power lines to servo motor. Check the connection between position detector and servo motor. | Repair the connection error. |
| 2 | Setting of drift compensation value 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.






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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.



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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.<br>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.<br>Over 1 mΩ at 500 V is normal for the megger check.<br>Infinite value is normal in the tester check. | Clean around the commutator with forced air.<br>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.<br>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.<br>Check that the fan does not touch a wire gauze.<br>Check to see if the fan motor itself has a problem. | Rearrange the wiring.<br>Refix the wire gauze.<br>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. |



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| 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. |



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| 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. |

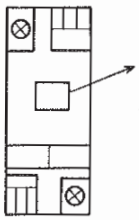
b) For AC servo

| 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. |



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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. |

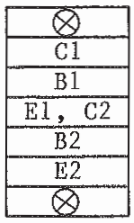
This alarm message is not displayed for AC servo.

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

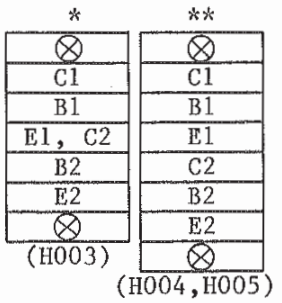
| Item | Cause of trouble | Checking points | Corrective action |
|---|---|---|---|
| 1 | Improper motor power cable connection. | The HCAL alarm does not occur when the power is turned on with the motor power cable disconnected. (In this case, since the gravity axis may fall down, it should be supported. 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. |



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| 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.<br>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.<br><br><br>Confirm between C1-E1, C2.<br>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.<br>(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.<br>* Check resistance between C1-E1 and C2 also between E1 and C2-E2.<br>** Check resistance between C1-E1 and also between C2-E2.<br><br> |



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| 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. |

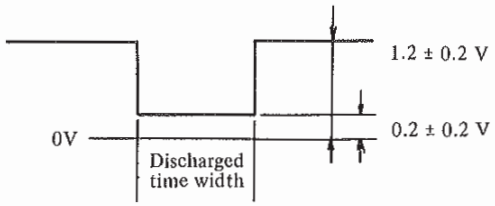


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16) Discharge alarm DCAL/DC

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. |



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| 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. |

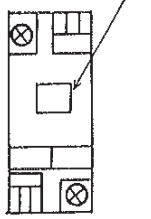


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18) Other V-READY off (Velocity control unit failure)
If the V-READY off is not caused by the failures described before, check the following items.

| 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

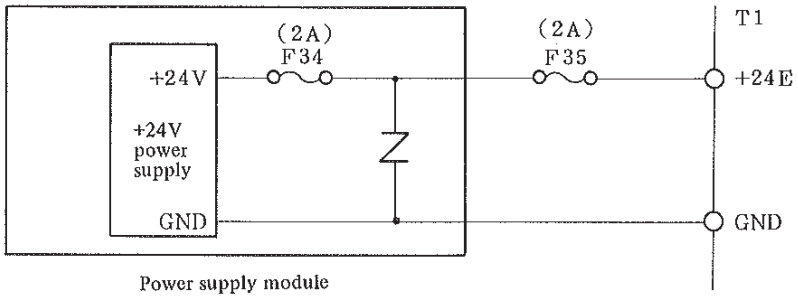
| Item | Cause of trouble | Checking points | Corrective action |
|---|---|---|---|
| 1 | No fuse breaker functions | The operating condition is as illustrated below.  This button is pushed inward during normal operation of the motor. If the breaker has functioned, turn off the three-phase power supply 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. |

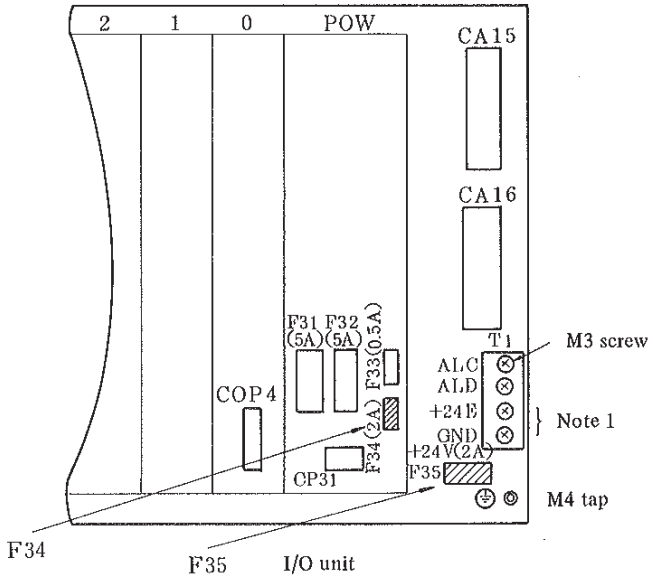
### 3.12.4 Fuse alarm of I/O module

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.



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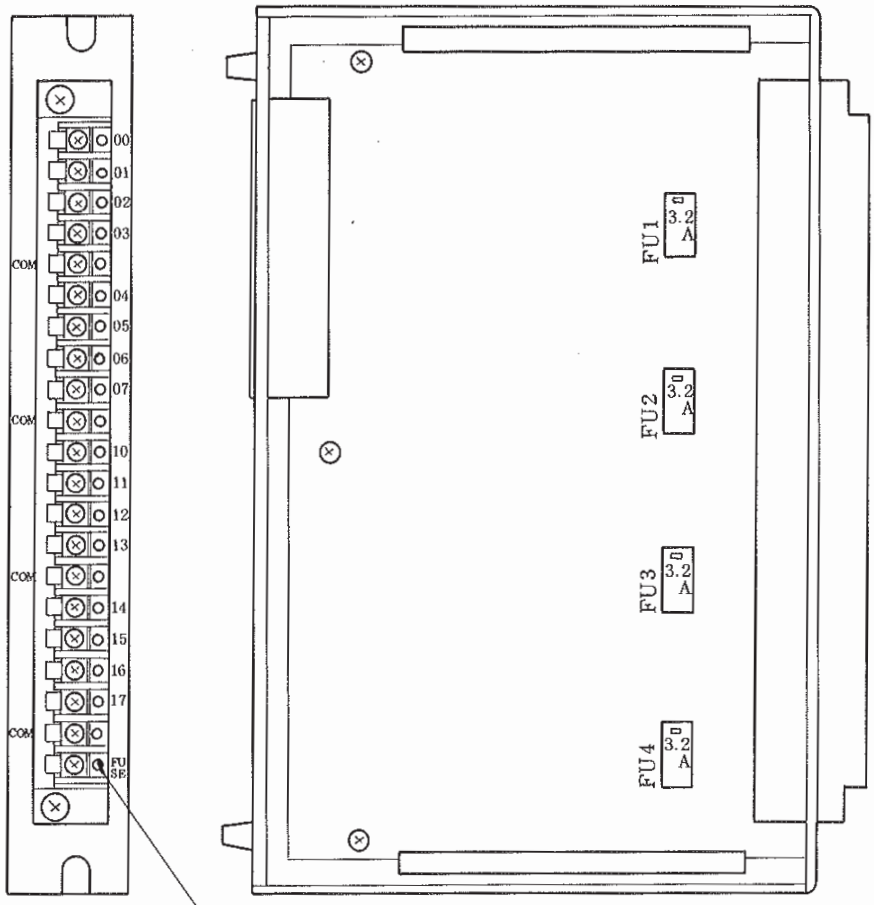
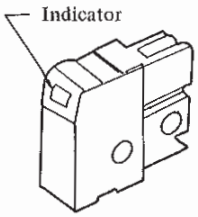

2) Fuse alarm in digital output module

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.



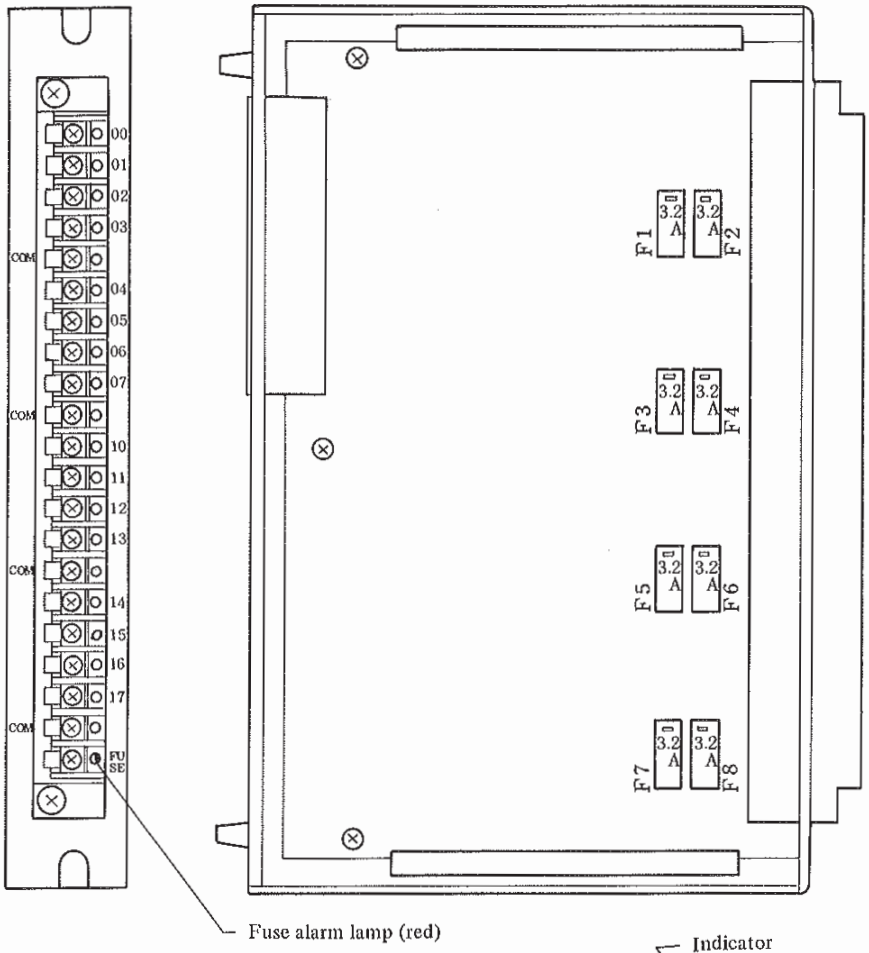
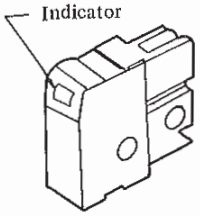
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| Module name | OD08B, OD16B |
|---|---|
| Mounting positions of fuse alarm indicator lamps and mounting positions of fuses | <br>If one of fuses FU1 - FU4 is blown out, the above fuse alarm lamp lights. The blown out fuse shows a white failure display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

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



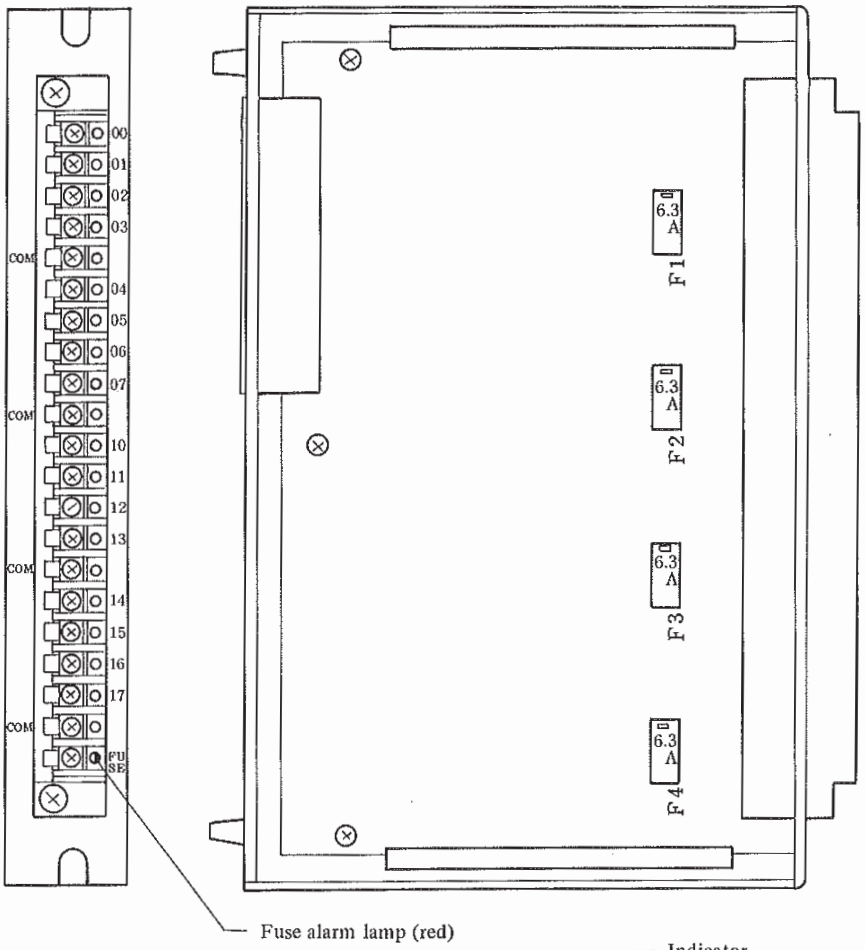
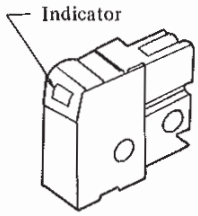
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| Module name | OD08C, OD16C |
|---|---|
| Mounting positions of fuse alarm indicator lamps and mounting positions of fuses | <br>If one of fuses F1 - F8 is blown out, the above fuse alarm lamp lights. The blown out fuse shows a white failure display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

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



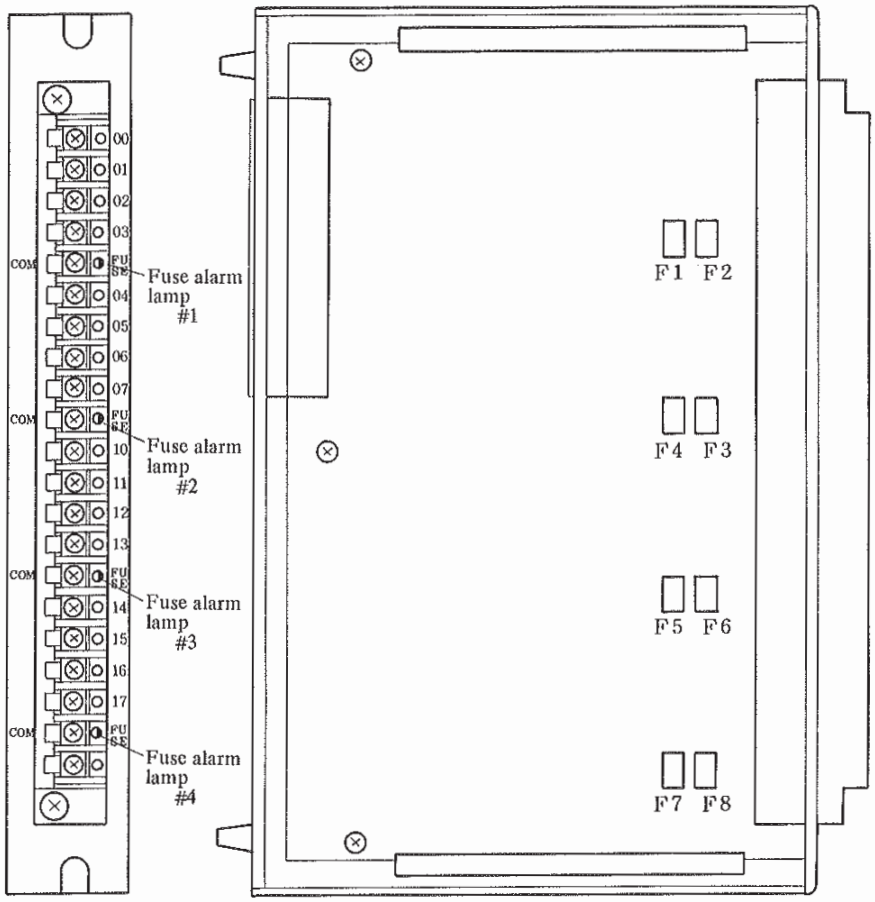
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| Module name | OA08D, OA16D |
|---|---|
| Mounting positions of fuse alarm indicator lamps and mounting positions of fuses | <br>If one of fuses F1 - F4 is blown out, the above fuse alarm lamp lights. The blown out fuse shows a white failure display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

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



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| Module name | OA08E, OA16E |
|---|---|
| Mounting positions of fuse alarm indicator lamps and mounting positions of fuses | <br>If one of fuses F1 - F8 is blown out, the above fuse alarm lamp lights. Correspondence between fuse and lamp is as follows.<br>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<br>OS01 | OS02<br>OS03 | OS04<br>OS05 | OS06<br>OS07 | OS10<br>OS11 | OS12<br>OS13 | OS14<br>OS15 | OS16<br>OS17 |



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# 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<br>. Tap setting transformer<br>. Velocity control unit PCB setting<br>. 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) |



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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. |



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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

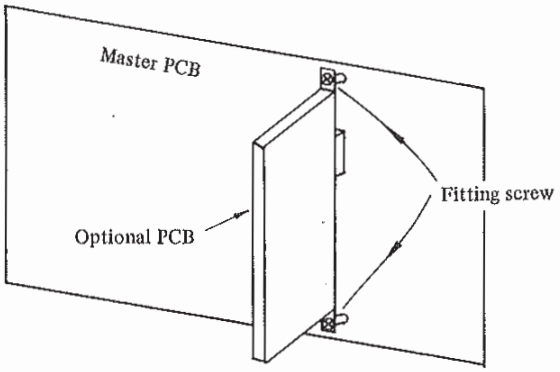
| Items |
|---|
| Disconnect motor power cables. |
| Short short bar S23 on the velocity control unit PCB for M series servo motor. |
| Put short bar S10 to L-side on velocity control unit PCB for AC servo. |

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? |



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| Items |
|---|
| Are screws tightened for optional PCB?<br><br> |
| 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:<br>AC 200/220 V $^{+10\%}_{-15\%}$, 50/60 Hz $\pm$1 Hz, 3 $\phi$<br>(However, combination with 220 V and 50 Hz is not recommended.) |
| Power source input for control unit only is applied as follows:<br>AC 200/220 V $^{+10\%}_{-15\%}$, 50,60 Hz $\pm$3 Hz, 1 $\phi$<br>(However, combination with 220 V and 50 Hz is not recommended.) |
| Power source input for servo unit only is applied as followings:<br>AC 200/220 V $^{+10\%}_{-15\%}$, 50,60 Hz $\pm$1 Hz, 3 $\phi$<br>(However, combination with 220 V and 50 Hz is not recommended.) |



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| Items |
|---|
| Power source for export transformer is applied as follows:<br>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 |

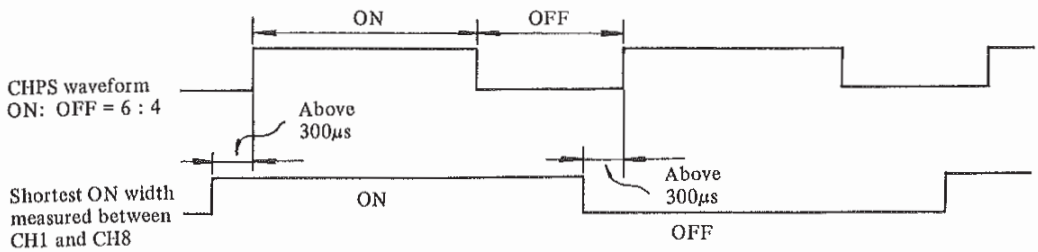
10) Adjustment of velocity control unit (see Item 6.2)

| Items |
|---|
| Confirm servo offset<br>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 $\pm$0.5 V while shorting between CH1 and CH3 and between CH2 and CH3.<br>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.<br>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). |



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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.<br>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).<br>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.<br>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.<br>4) Confirm that the waveforms CH1 and CH8 satisfy the timing in the diagram below.<br><br>Note) Names of check terminal and variable resistor for tape reader (A13B-0070-B001) are changed as below.<br>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.



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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:<br>$G = \frac{16.7F}{E}$<br>F: Feed rate (mm/min) (0.1 in/min), (deg/min)<br>E: Positional deviation amount (0.001 mm), (0.0001 in), (0.01 deg)<br>G: Position gain ($sec^{-1}$) (standard: 30 $sec^{-1}$)<br>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. |



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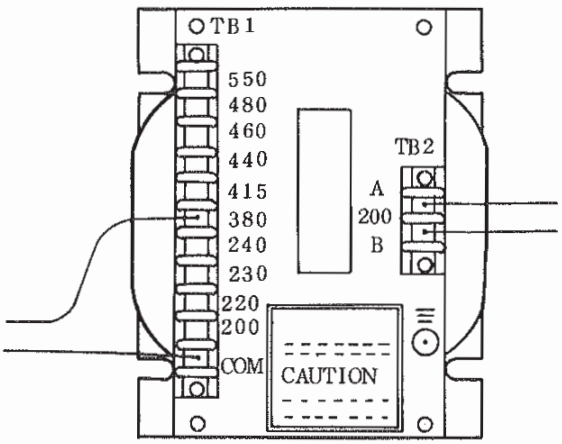
19) Confirm that all functions of NC are able to operate normally.

| Items |
|---|
| Perform a reference point return.<br>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 |



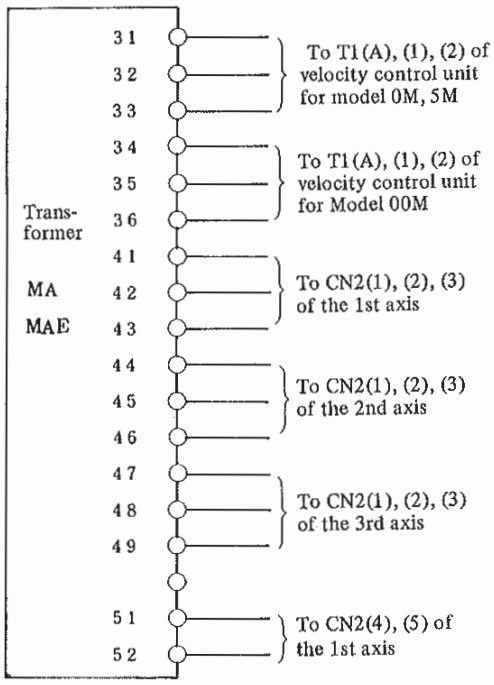
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b) For power transformers MAE ∿ MCE (for countries other than Japan)

| 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

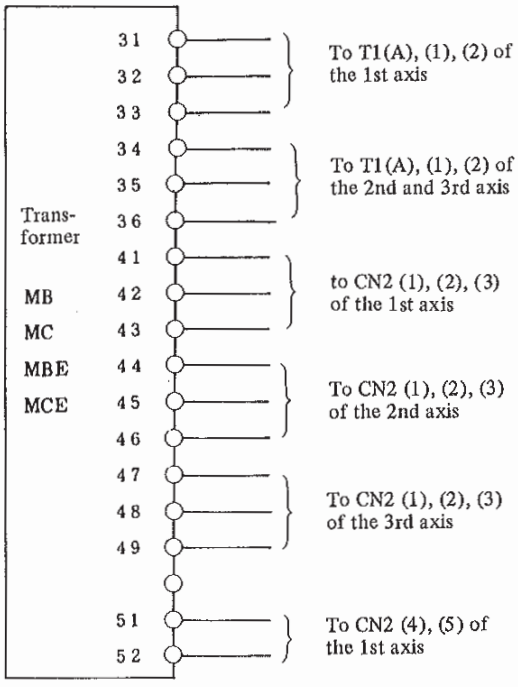


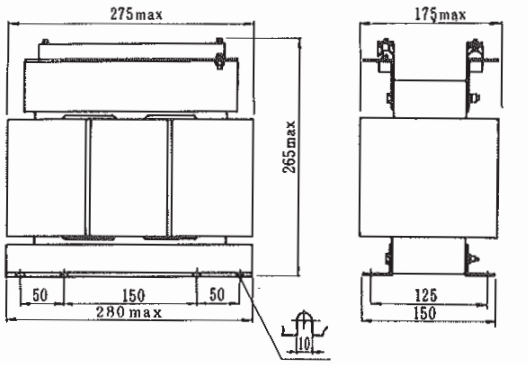

Fig. 4.2.1

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.



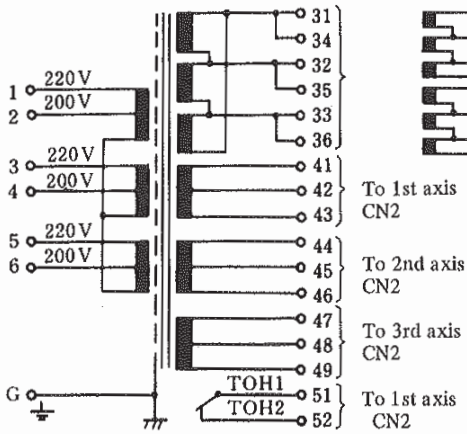
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3) External dimensions of power transformer

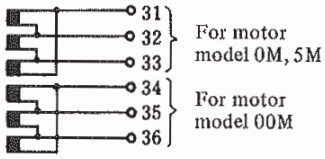



| Power transformer | Weight |
|---|---|
| MA<br>MAE | About 20 kg |
| MB<br>MBE | About 30 kg |
| MC<br>MCE | About 36 kg |

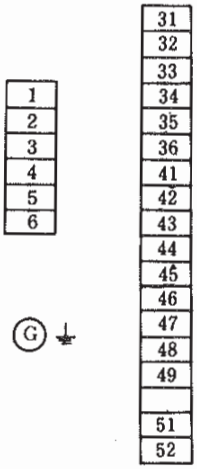
Connection diagram of power transformer MA - MC. Connections of MA31 - 36 are as shown in the figure at right.



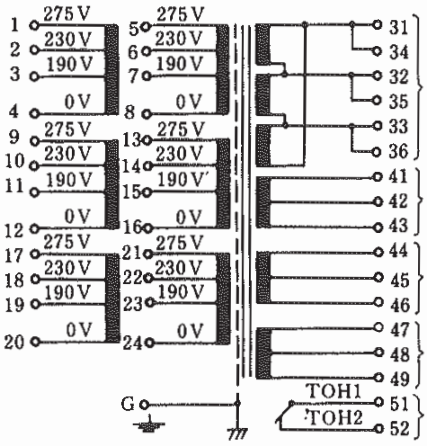

Connections of power transformer MA31 - 36



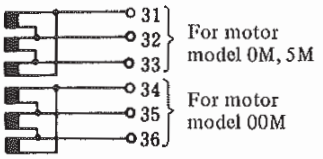

Terminal layout of power transformers MA - MC. (Screw M4)




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.

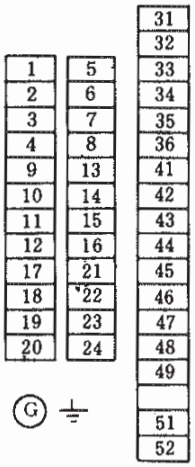



**Fig. 4.2.2 (e)**



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### 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 |



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

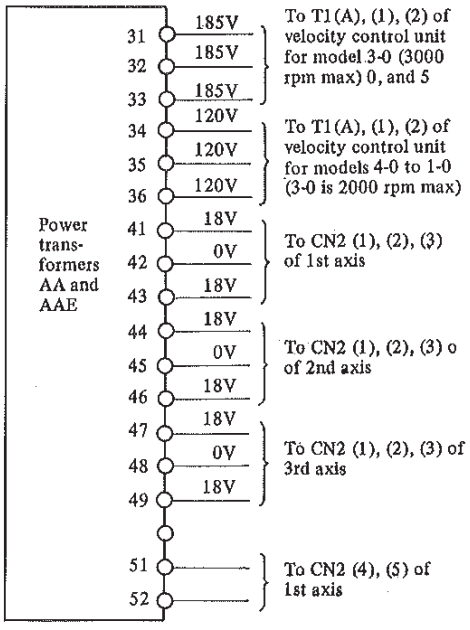
**Table 4.2.3 (c)**

| 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 | | |

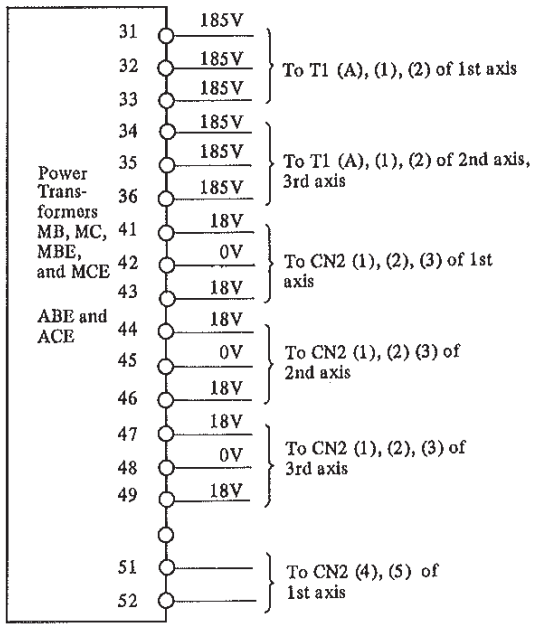
Remarks: If more than one power supply transformer is used, both must be connected to the tap in the same way. Also, the connection of transformer overheat must be done in the same manner.

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.



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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 | | | | |

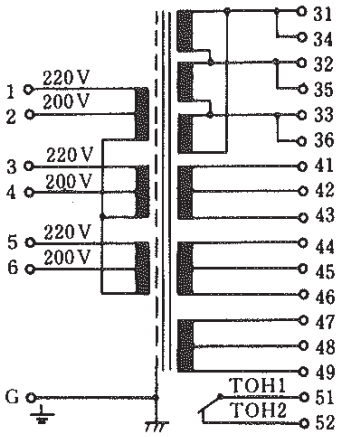
Note: Two or more transformers MC, MCE, or ACE, become necessary according to the load conditions in the case of Models 10, 20, 30 x 3 axis.



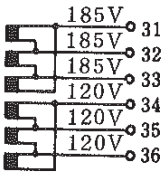
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4) Connections in the power supply transformer

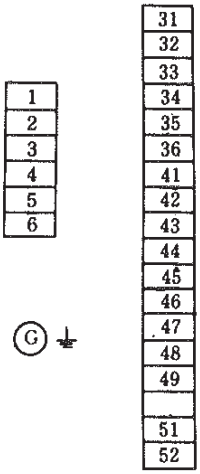
Connections for power supply transformers AA, MB, and MC (Connection for 31-36 of AA is as shown at right.)




Connections for power supply transformers AA 31 to 36.

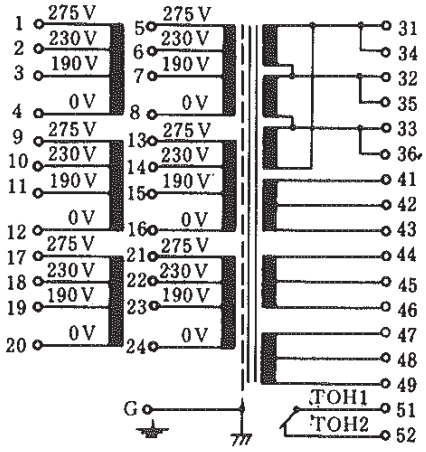



Terminal layout of power supply transformers AA, MB, and MC.

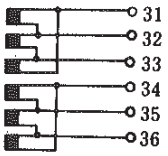



Models for countries other than Japan

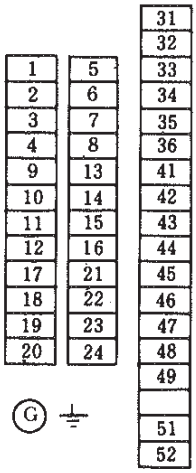
Connections for power supply transformers MBE, and MCE. (Connection for 31-36 of MAE is as shown at right)




Connections of power transformer MAE 31 to 36.



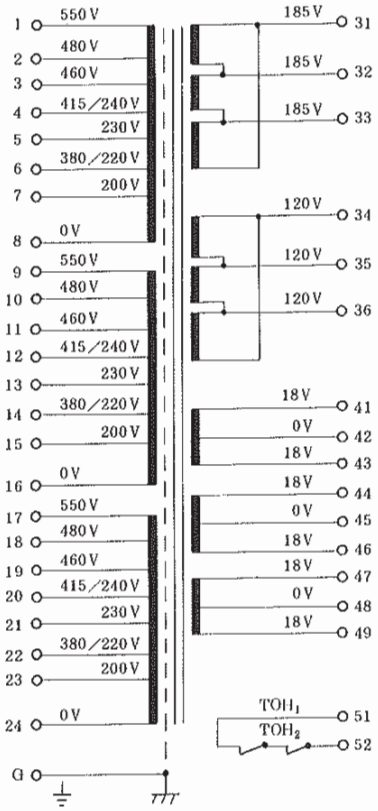

Terminal layout of power supply transformers MBE and MCE.



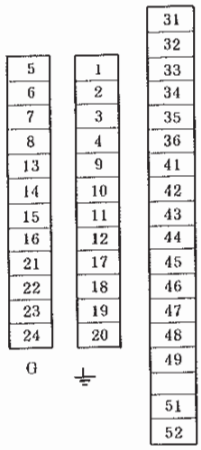



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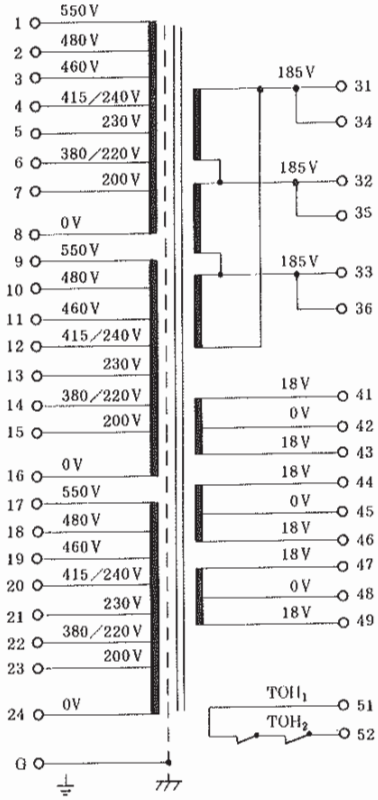
Connection of power supply transformer AAE.



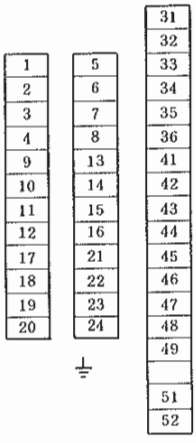

Terminal layout of power supply transformer AAE.




Connection of power transformers ABE and ACE.




Terminal layout of power supply transformers ABE and ACE.






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# 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;



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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.



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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.



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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.



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## 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.<br>TV check is performed or not during control out.<br>ISO code is with parity bit or not.<br>Method of punching EOB by ISO code.<br>Punch code is ISO or EIA. |
| 0010 | Input unit is by metric or inch.<br>Single block stop in custom macro is performed or not. |
| 0011 | O8000 ∿ O8999 programs can be edited or not.<br>O8000 ∿ O8999 programs are displayed on executing. |
| 0012 | Mirror image ON/OFF.<br>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.<br>Input unit is multiplied by 10 or not. |
| 1005 | Setting related to reference point return.<br>External deceleration signal, machine lock, and axis detach signal are valid or invalid. |



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| Parameter No. | Contents |
|---|---|
| 1006 | Setting inch/metric conversion is required or not.<br>Setting machine coordinate system for stroke check and automatic reference point return.<br>Setting machine coordinate system for stored pitch error compensation.<br>Axis movement amount is specified by diameter or radius.<br>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. |



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5) Parameters related to feed rate

| Parameter No. | Contents |
|---|---|
| 1400 | Dry run is valid or invalid for rapid traverse command.<br>Dry run is valid or invalid for thread cutting command.<br>Manual rapid traverse is valid or invalid from reference point return after power on.<br>Skip function feed rate.<br>Positioning is by non-linear interpolation type or linear interpolation type.<br>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 Fl. |
| 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. |



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| 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.<br>Servo alarm occurs or not when velocity control ready signal (VRDY) turns on before position control ready signal turns on.<br>Follow-up is performed or not during servo-off. |
| 1802 | Automatic setting of phase shift value has completed or not.<br>Servo off signal is valid or invalid. |
| 1810 | Feed back pulse frequency is checked or not.<br>Setting of compensational rate of backlash and pitch error compensation.<br>Position control LSI is checked or not at turning on power.<br>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.<br>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. |



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| 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.<br>Rewinding signal (RWD) is output only when tape reader is rewinded or when either tape reader or program in memory is rewinded.<br>Cycle start lamp signal (STL) is output or not during operation by manual numeric command.<br>Cycle start lamp signal is output or not when programs are registered by cycle start signal in tape editting mode.<br>Cycle operating signal (OP) is turned on or not at searching for sequence number.<br>MDI mode can be started or not by pressing start button on the panel.<br>Programs are registered by cycle start signal in tape editing mode or not. |
| 2001 | Reset or alarm is effective at emergency stop.<br>If all of the mode selection signal turn off, no mode is assumed or the previously selected mode is assumed.<br>Incremented feed amount is specified by magnification specification signals MP1, MP2 and MP3.<br>Rapid traverse override signal ROV1 and ROV2 has a standard interface or logical 0/1 reverse interface.<br>Selection BMI or FS3/FS6 as machine interface.<br>Selection FS3 or FS6 interface.<br>External operation command signal EF is output or not. |
| 2010 | Delay time of strobe signal MF, SF, TF, BF. |



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| 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.<br>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.<br>M02, M30 and M99 are assumed as program end or not in program loading.<br>M99 is assumed as program end in program loading.<br>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.<br>Program No. 09000 - 09999 are displayed or not during execution.<br>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.<br>External position display, CRT relative position display and absolute position display include tool length compensation value or not.<br>External position display, CRT relative position display and absolute position display include tool radius compensation/tool nose R compensation value or not.<br>External position display, CRT relative position display and absolute position display are with considering the delay at acceleration/deceleration control or not.<br>External position display, CRT relative position display and absolute position display are with considering the delay in servo or not.<br>Machine position display or CRT is with considering the delay at acceleration/deceleration control or not.<br>Machine position display on CRT is with considering the delay at servo or not. |



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| 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.<br>Feed per minute F code in metric without decimal point is processed by 1 mm/min or 0.1 mm/min unit.<br>Commands of inch input and metric input are G20/21 or G70/G71.<br>Condition setting of M30 at memory operation.<br>Always dwell per minute or dwell per minute in feed per minute mode and dwell per revolution in feed per revolution mode.<br>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<br>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<br>5003 | I/O device No. connected to Reader/puncher interface. |
| 5011 | I/O device No. connected to ASR33/44 interface. |
| 5110, 5120,<br>5130, 5140,<br>5150, 5160 | Reader/puncher device specification number corresponding to device No. 1 - 6. |
| 5110, 5121,<br>5131, 5141,<br>5151, 5161 | Stop bit number of Reader/puncher device corresponding to device No. 1 - 6. |
| 5112, 5122,<br>5132, 5142,<br>5152, 5162 | Band rate corresponding to device No. 1 - 6. |



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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. |



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14) Parameter related to spindle control

| Parameter No. | Contents |
|---|---|
| 5600 | Voltage polarity of spindle speed analog output.<br>Gear change system during thread cutting or tapping.<br>Spindle orientation or gear shift is performed by spindle orientation signal (SOR).<br>Spindle speed output is by analog or 12 bit binary output. |
| 5601 | Spindle override is valid or invalid.<br>Spindle override is valid or invalid during thread cutting or tapping.<br>When spindle speed command beyond maximum spindle speed, speed is clamped it maximum speed or an alarm occurs.<br>Gear select signal output is code output or signal output corresponding to gear selection.<br>SF signal is output or not when gear select signal is output.<br>SF signal is output when gear select signal is output or when S code is commanded.<br>Type of spindle speed analog output/spindle speed binary output.<br>Gear selection on the machine side. |
| 5602 | Spindle stop signal (SSTP) input type.<br>One of gear select signal and BCD S code is output or both of them are inputted.<br>Gear select signal input type.<br>Alarm of spindle velocity control unit in checked or not.<br>Tool position offset amount is excluded or not from the preset position of constant surface speed controlled axis.<br>Tool length compensation amount is excluded or not from the preset position of constant surface speed controlled axis.<br>Present position or end point coordinate value is used in positioning command during constant surface speed control.<br>Speed arrival signal is used or not. |
| 5603 | Gear select condition for 3/6 interface.<br>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. |



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| 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.<br>Tool position compensation is specified by D code or H code.<br>Tool position compensation is effective or not for arc command.<br>Axis selection for tool length compensation.<br>Tool length compensation vector can be cleared by reset or not.<br>Offset number of tool position offset is specified by low order two digits or by low order one digit of the T code.<br>Condition to execute tool position offset. |
| 6001 | Start up type of tool R compensation or tool nose R compensation.<br>Condition of interference check of tool R compensation or tool nose R compensation.<br>Tool position compensation geometry offset is performed shifting work coordinate system or by moving the tool.<br>Tool wear offset of tool position compensation is performed by shifting work coordinate system or moving the tool.<br>Offset number specifying method of geometry and wear in tool position compensation.<br>Offset state when tool number 0 is specified. |



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| Parameter No. | Contents |
|---|---|
| 6002 | Setting of offset amount unit.<br>Tool position compensation amount is specified by diameter or radius value.<br>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.<br>Dwell command is valid or not by P in canned tapping cycle.<br>Tool return direction and movement amount in canned fine boring cycle and canned back boring cycle after spindle orientation.<br>Movement to drilling point in canned cycle is done by rapid traverse or by linear interpolation.<br>Initial level point is changed or not when origin setting is above by reset or MDI during canned cycle.<br>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.<br>M05 is output or not when spindle rotation direction is changed.<br>FFIN signal or FIN signal which corresponds to SSP signal and SRV signal.<br>FMF signal is output or not after returning to R point or initial point when SSP and SRV are output.<br>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.<br>Finishing workpiece is performed or not at the end of roughing cycle.<br>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. |



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| 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.<br>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. |



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| Parameter No. | Contents |
|---|---|
| 7014 | EIA code which represents = is set by hole pattern. |
| 7050<br>7059 | G code for calling the custom macro of program No. 9010 ∿ 9019. |
| 7071<br>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.<br>CRT screen is automatically changed or not to the error message screen when an error is caused.<br>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.

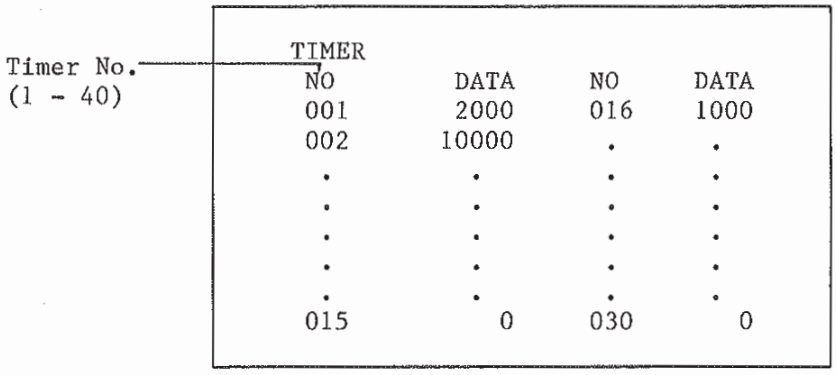



Fig. 5.5.1 Timer screen



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| 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.

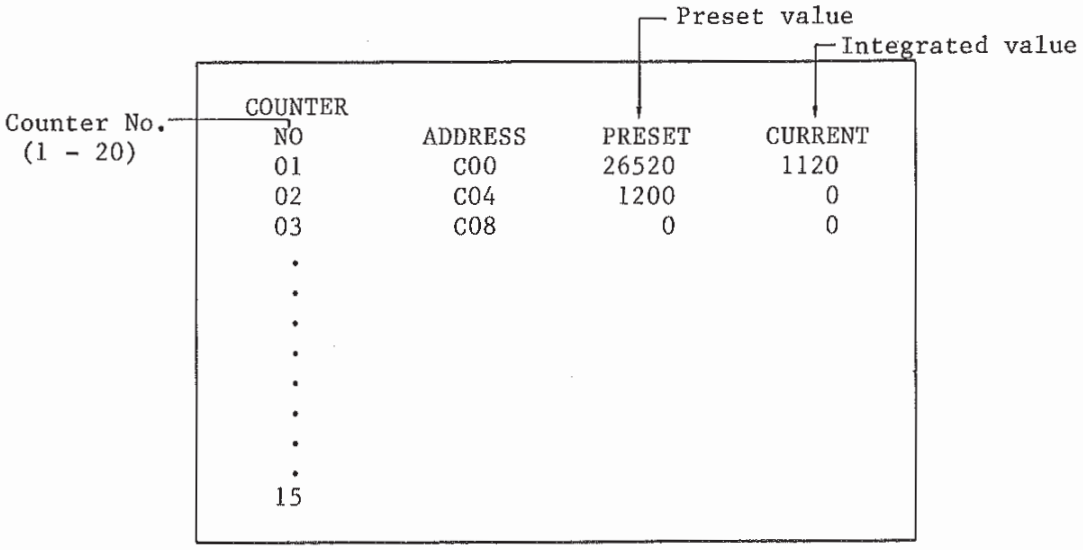



Fig. 5.5.2 Counter screen

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.



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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.



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### 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.

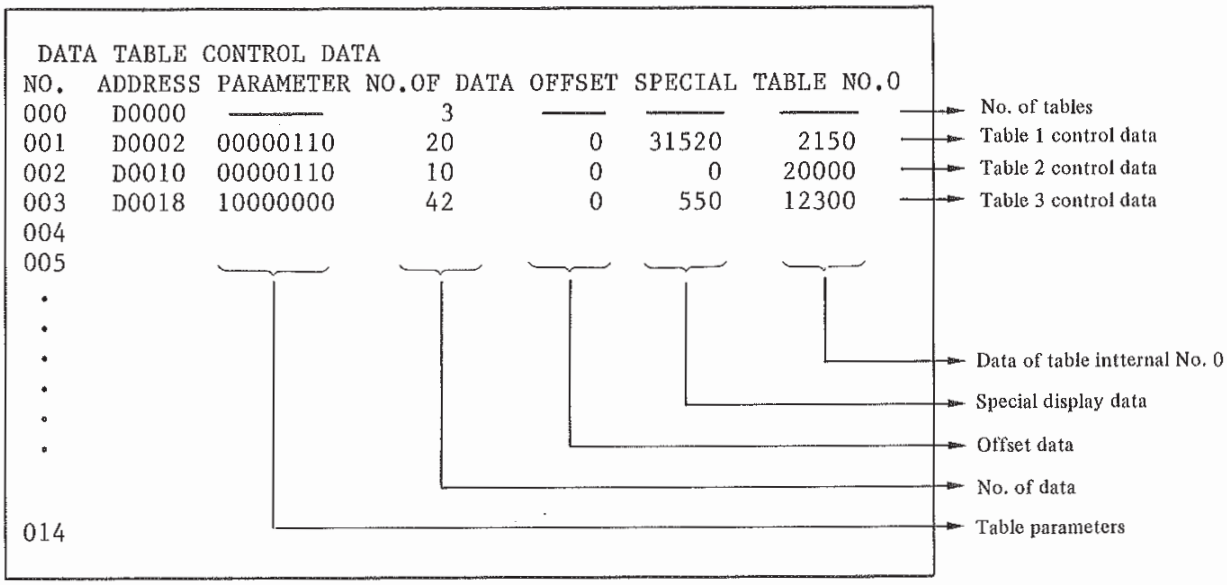



Fig. 5.5.4 (a) Data table control data screen

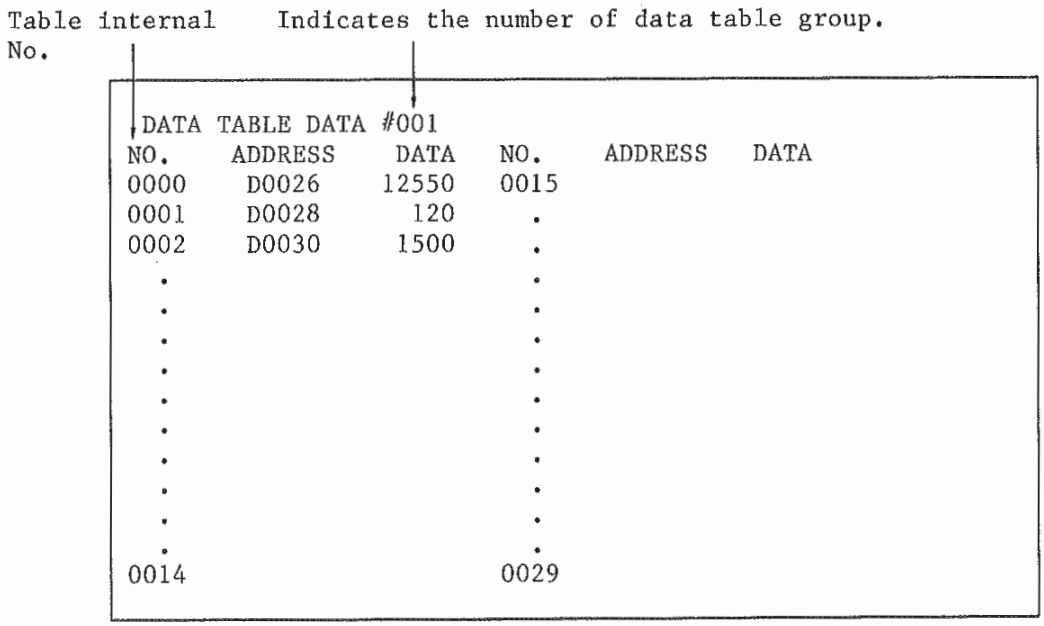



Fig. 5.5.4 (b) Data table data screen



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```
 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.



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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.

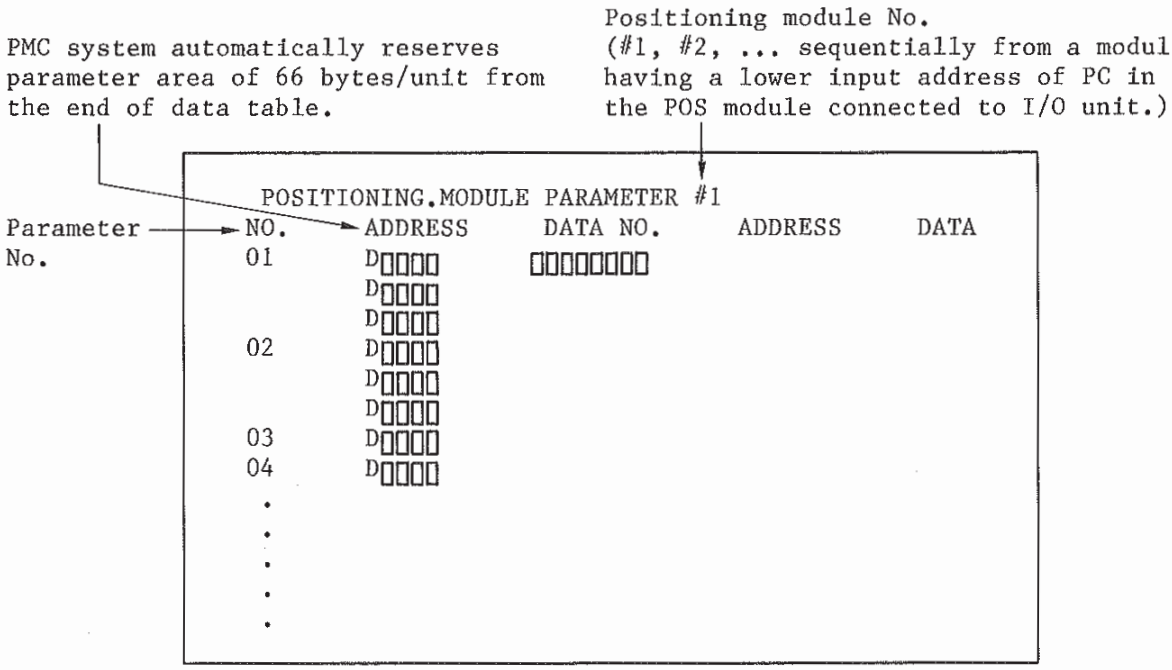



Fig. 5.5.5 Positioning module parameter screen

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.



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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.



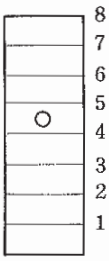
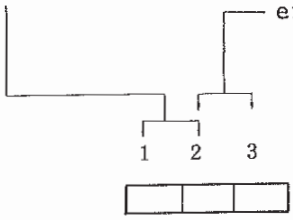
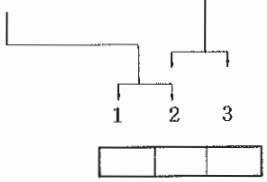
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# 6. SETTING AND ADJUSTMENTS ON THE PCBs

## 6.1 Setting and Adjustments on the Control Unit PCBs

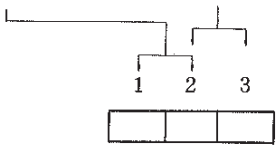
### 6.1.1 Setting on the control unit PCBs for 10 and 11 series

1) Setting on the analog servo 10 series master PCB (A16B-1010-0040)

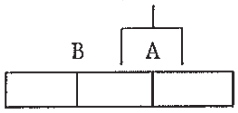
| Item | Symbols | Description |
|---|---|---|
| 1 | SE1 | Sets position LSI clock 16.384 MHz pulse width. Fixed. This setting applies to edition number - 03B only. Edition number 04C and higher don't include this setting function.   |
| 2 | TAC1 ~ TAC3 | Set the velocity feedback system when M series 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. |



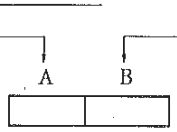
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| Item | Symbols | Description |
|---|---|---|
| 4 | SUP1 ⟨ SUP3 | Set when the speed feedback is ignored due to a minor error. Set these parts to the standard (not ignored) at a time other than when vibrations are produced when the motor stops operating or the like. This setting is ineffective for AC servo.<br>Not ignored (standard) Ignored<br> |
| 5 | SJ1 | Sets the ROM capacity of character generator.<br>Standard setting is 64K (not set)<br>64K ... Not set<br>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)

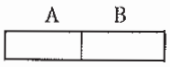
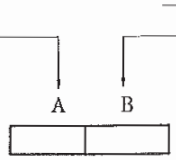
| Item | Symbols | Description |
|---|---|---|
| 1 | ST | Not used. Fixed A side.<br>Standard setting<br> |

3) Setting on the analog servo 11 series master PCB (A16B-1010-0050)

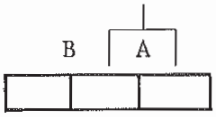
| Item | Symbols | Description |
|---|---|---|
| 1 | TAC1 ⟨ TAC3 | Set the velocity feedback system when M series servo is used. This setting is ineffective for AC servo.<br>FV side when tachogenerator is not used. TG side when tachogenerator is used.<br> |



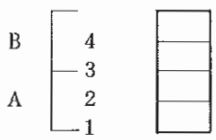
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| Item | Symbols | Description |
|---|---|---|
| 2 | REV1 〈 REV3 | Set the number of pulses of pulse coder when M series servo uses the pulse coder. This setting is ineffective if tachogenerator or AC servo is used.<br>2000 pulses — 3000 pulses<br><br><br>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.<br>This setting is ineffective for AC servo.<br>Not ignored (standard) — Ignored<br><br> |

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.<br>Standard setting<br><br> |

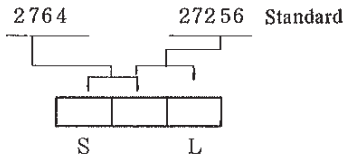
5) Setting on the 10 and 11 series connection unit 1 PCB (A20B-1000-0940)

| 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.<br><br> |

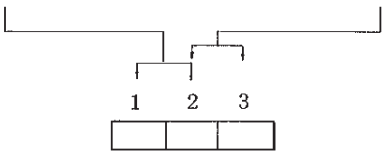
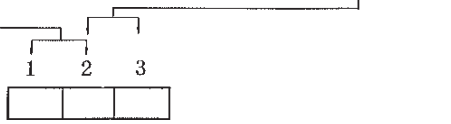
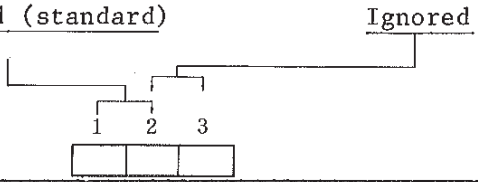


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6) Setting on the 10 and 11 series 14" color graphic control PCB (A20B-1000-0850)

| Item | Symbols | Description |
|---|---|---|
| 1 | SCG | Sets the type of character generator ROM. L (27256) is the standard setting.<br>This setting does not apply to edition 06C and subsequent editions, but does apply to edition No. - 05B.<br> |

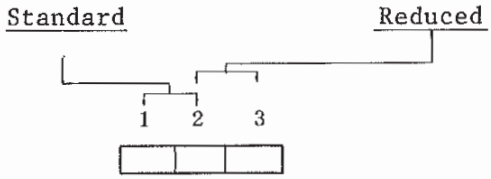
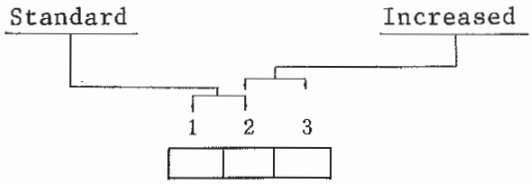
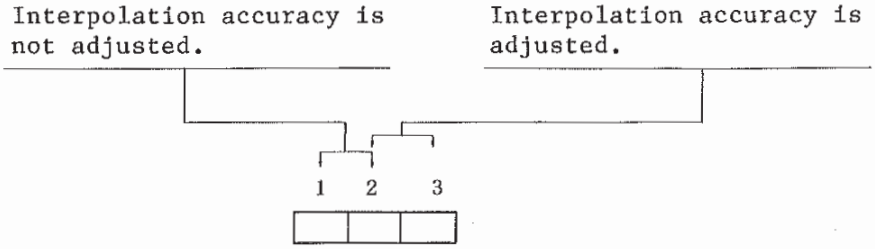
7) Setting on the analog servo 10 and 11 series additional axis PCB (pulse coder) (A16B-1210-0430/0431)

| Item | Symbols | Description |
|---|---|---|
| 1 | TAC4<br>TAC5 | Sets the velocity feedback system when M series servo is used.<br>This setting is ineffective for AC servo.<br>When tachogenerator is not used. When tachogenerator is used.<br> |
| 2 | REV4<br>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.<br>2000 pulses 3000 pulses<br><br>Neither 2000 pulses nor 3000 pulses should be set in case of 2500 pulses. |
| 3 | SUP4<br>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.<br>This setting is ineffective for AC servo.<br>Not ignored (standard) Ignored<br> |

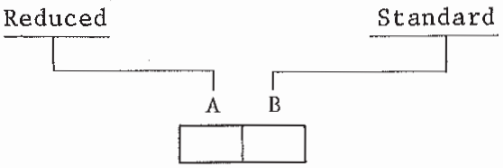


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8) Setting on the analog servo 11 series additional axis PCB (DSCG) (A16B-1210-0450)

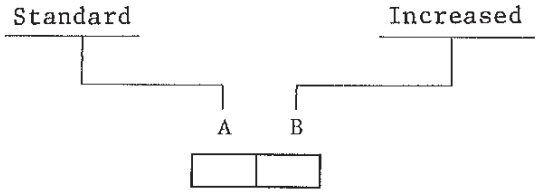
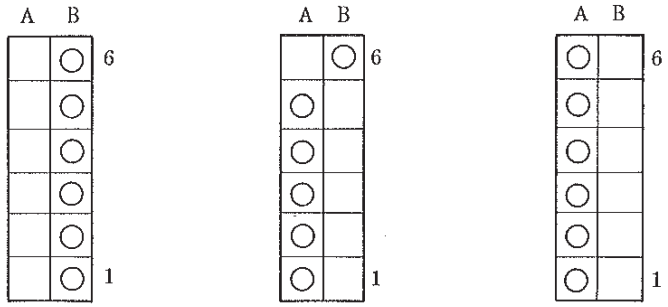
| Item | Symbols | Description |
|---|---|---|
| 1 | SH44<br>SH54 | Set to reduce the detection gain in DSCG system only when a 12" rotary inductosyn is used.<br> |
| 2 | SH45<br>SH55 | Set to increase the detection gain in DSCG system. Normally, set these to standard.<br> |
| 3 | SH46<br>SH56 | Set to determine whether the interpolation accuracy is adjusted.<br> |

9) Setting on the analog servo 11 series DSCG PCB (A16B-1210-0460)
a) Overall the PCB edition No.01A ∿ No.03A

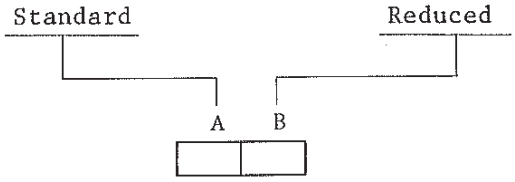
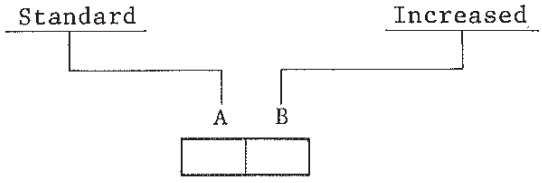
| Item | Symbols | Description |
|---|---|---|
| 1 | SPN1X<br>SPN1Y<br>SPN1Z | Set to reduce the detection gain in DSCG system only when a 12" rotary inductosyn is used.<br> |



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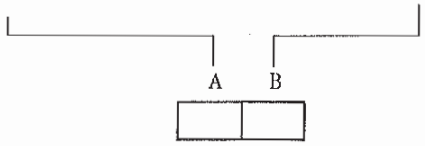
| Item | Symbols | Description |
|---|---|---|
| 2 | SPN2X<br>SPN2Y<br>SPN2Z | Set to increase the detection gain in DSCG system. Normally, set standard.<br> |
| 3 | SPN3X<br>SPN3Y<br>SPN3Z | Set the type of position detector.<br><br>Resolver<br>Inductosyn (Interpolation accuracy is fixed.)<br>Inductosyn (Interpolation accuracy is variable.) |

b) Overall the PCB edition No.04A and subsequent editions

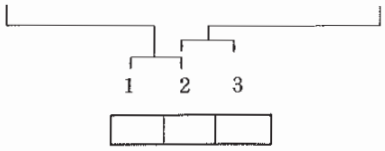
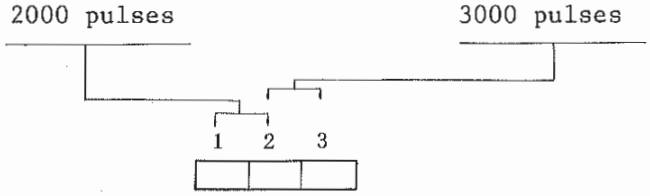
| Item | Symbols | Description |
|---|---|---|
| 1 | SN14<br>SN24<br>SN34 | Set to reduce the detection gain in DSCG system only when a 12" rotary inductosyn is used.<br> |
| 2 | SN15<br>SN25<br>SN35 | Set to increase the detection gain in DSCG system. Normally, set standard.<br> |



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| Item | Symbols | Description |
|---|---|---|
| 3 | SN16<br>SN26<br>SN36 | Set to determine whether the interpolation accuracy adjustment is done. (Set these parts to "not adjusted" for the resolver.)<br>Interpolation accuracy is not adjusted. Adjusted<br><br> |
| 4 | SN17<br>SN27<br>SN37 | Set the position detector.<br><br> |

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.<br>When tachogenerator is not used. When tachogenerator is used.<br><br> |
| 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.<br>2000 pulses 3000 pulses<br><br><br>Neither 2000 pulses nor 3000 pulses should be set in case of 2500 pulses. |



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| 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.<br>This setting is ineffective for AC servo.<br>Not ignored (standard) — Ignored<br>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.

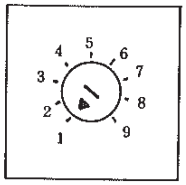
1) Adjustment of connection unit power supply

   Adjust the reference voltage "A10" to $10^{+0.01}_{-0.00}$ V by turning VR11.

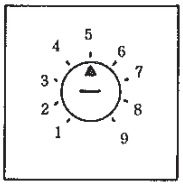
2) Adjustment of I/O card (D1 - D3) power supply.

   Set the reference voltage "A10" to $10^{+0.01}_{-0.00}$ V by turning VR11.

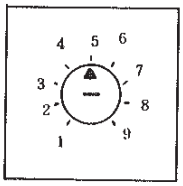
3) Adjustment of DSCG (Analog servo 10/11 series)



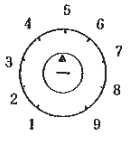

   a) VR11 1st-axis detection gain
      VR21 2nd-axis detection gain
      VR31 3rd-axis detection gain
      VR41 4th-axis detection gain
      VR51 5th-axis detection gain
      When turning variable resistor clockwise, the gain increases.
      For adjusting method, see 6.1.4 1).




   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.



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### 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)



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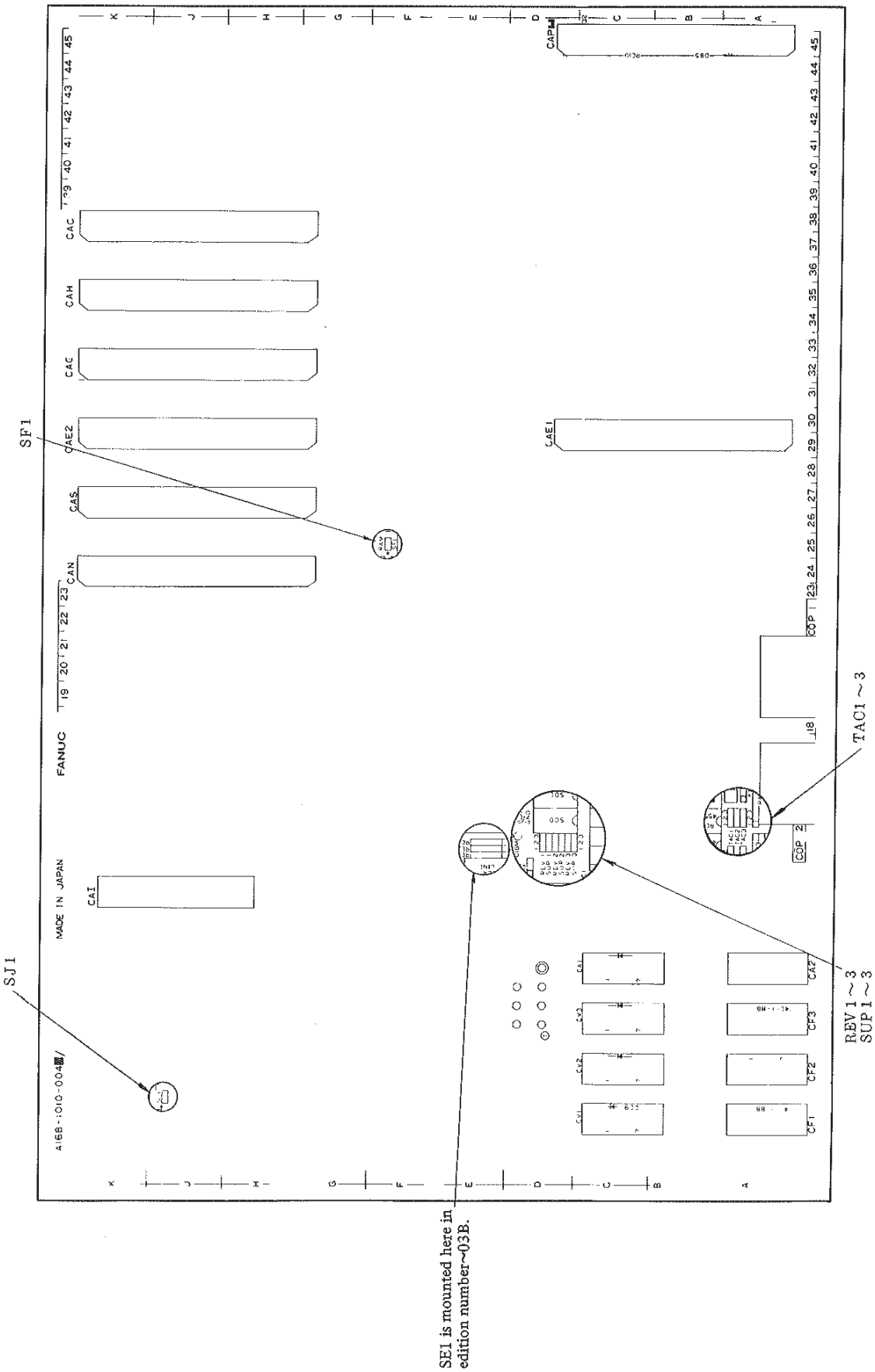



Fig. 6.1.3 (a) Adjusting points on analog servo 10 series master PCB (A16B-1010-0040)



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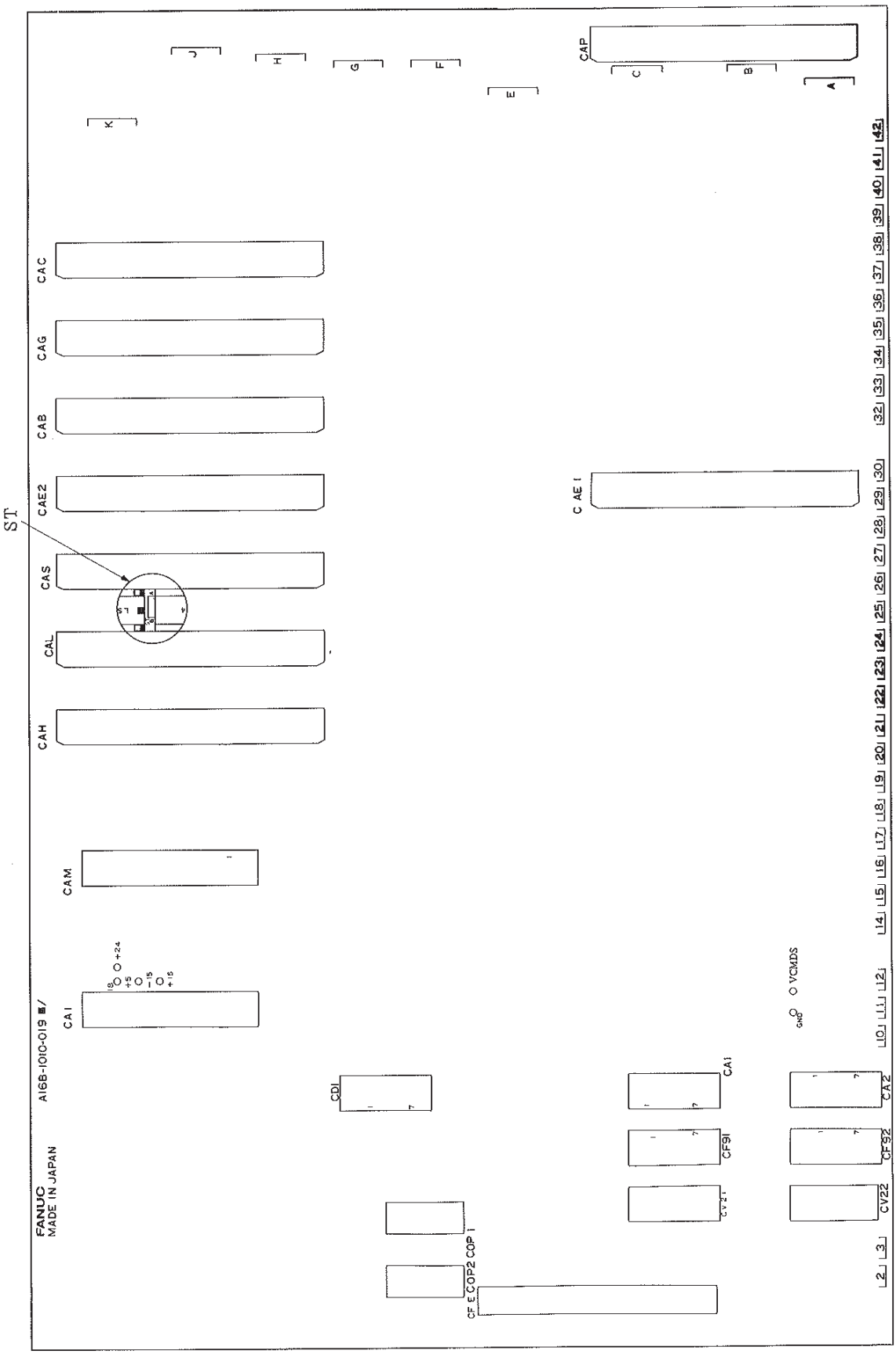



Fig. 6.1.3 (b) Digital servo 10 series master PCB (A16B-1010-0190)



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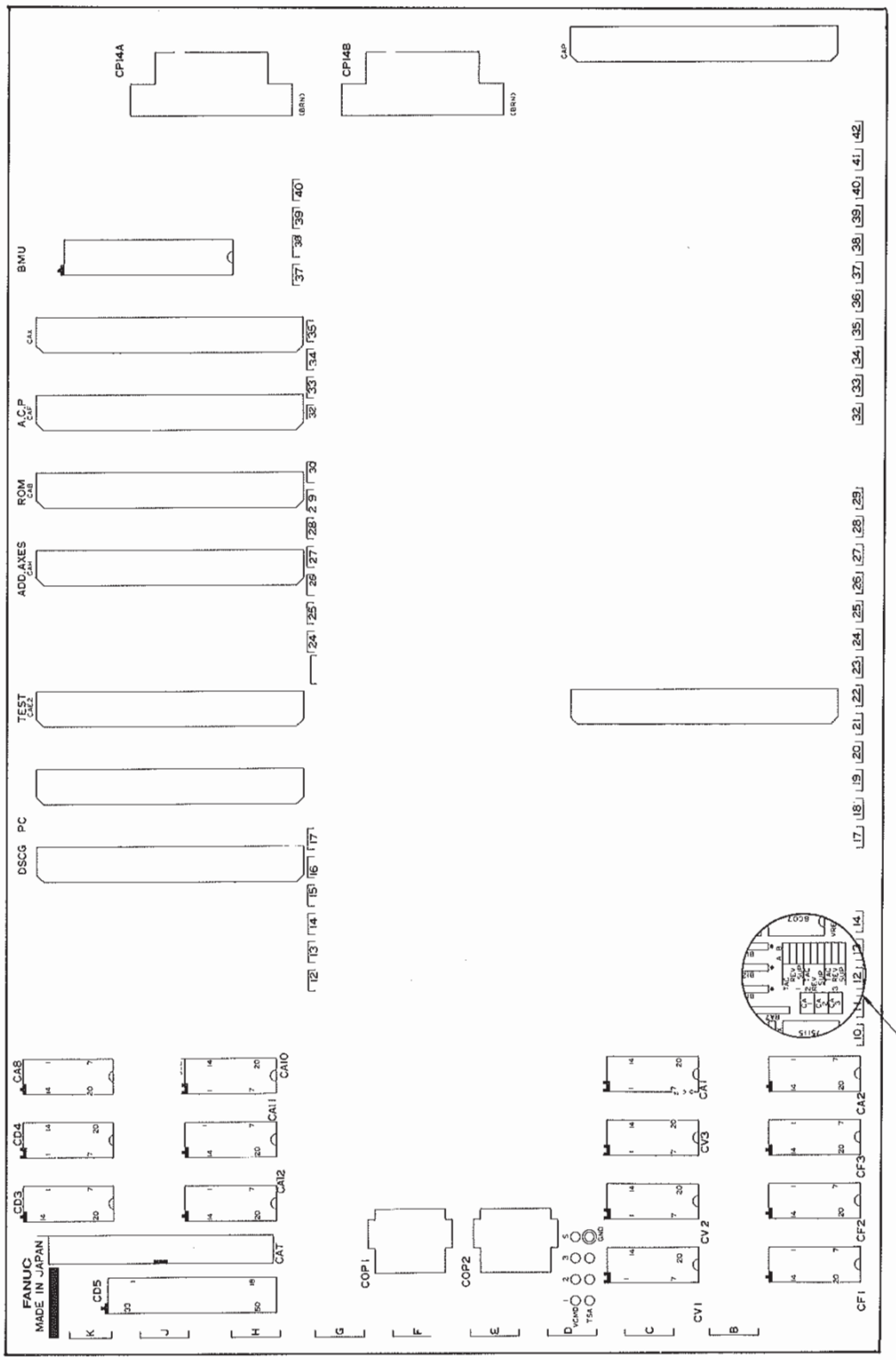



**Fig. 6.1.3 (c) Adjusting points on analog servo 11 series master PCB (A16B-1010-0050)**



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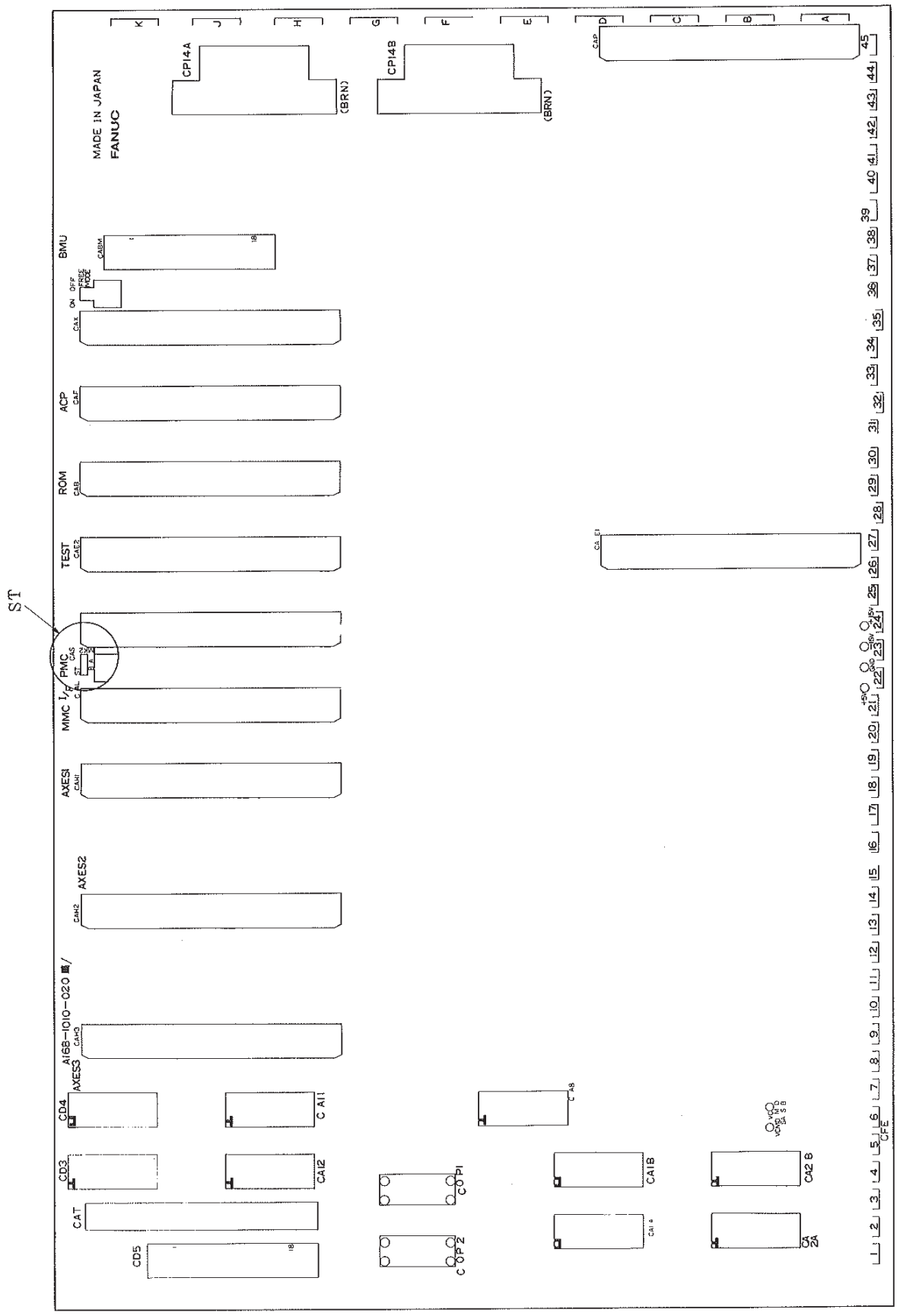



**Fig. 6.1.3 (d) Digital servo 11 series master PCB (A16B-1010-0200)**



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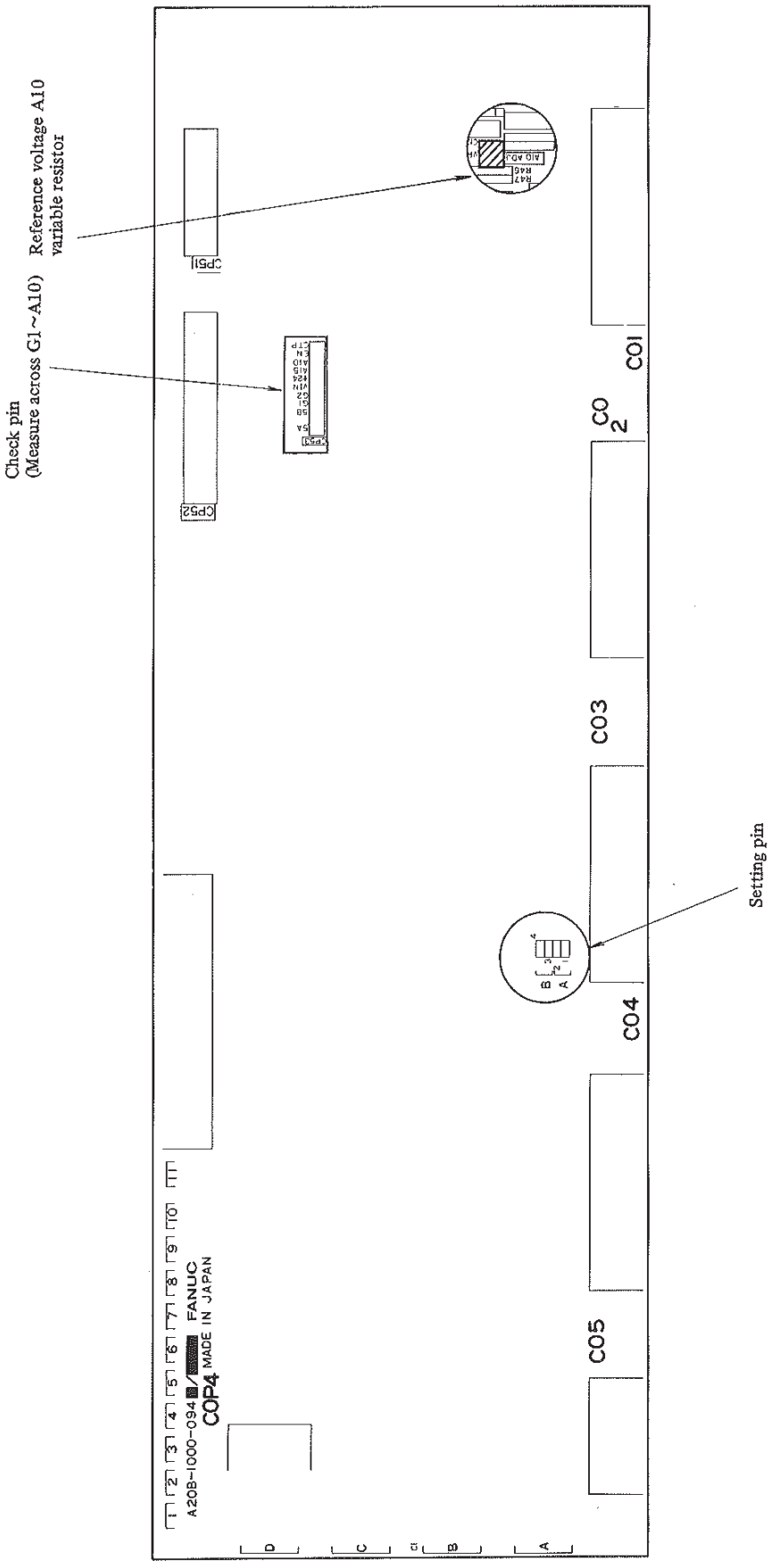



Fig. 6.1.3 (e) Adjusting points on 10/11 series connection unit 1 PCB (A20B-1000-0940)



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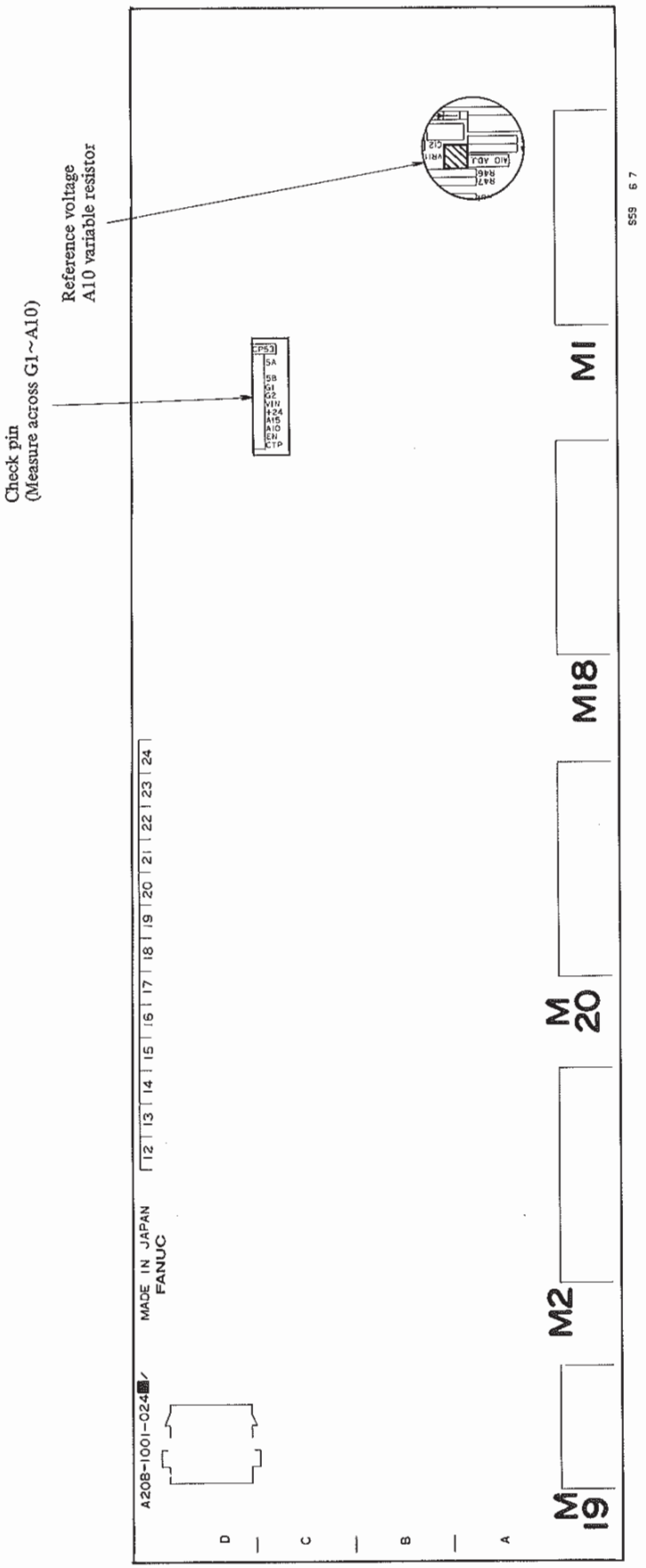



Fig. 6.1.3 (f) Adjusting points on I/O Card D1 ~ D3 (A20B-1001 0240 ~ 242) for 10TF



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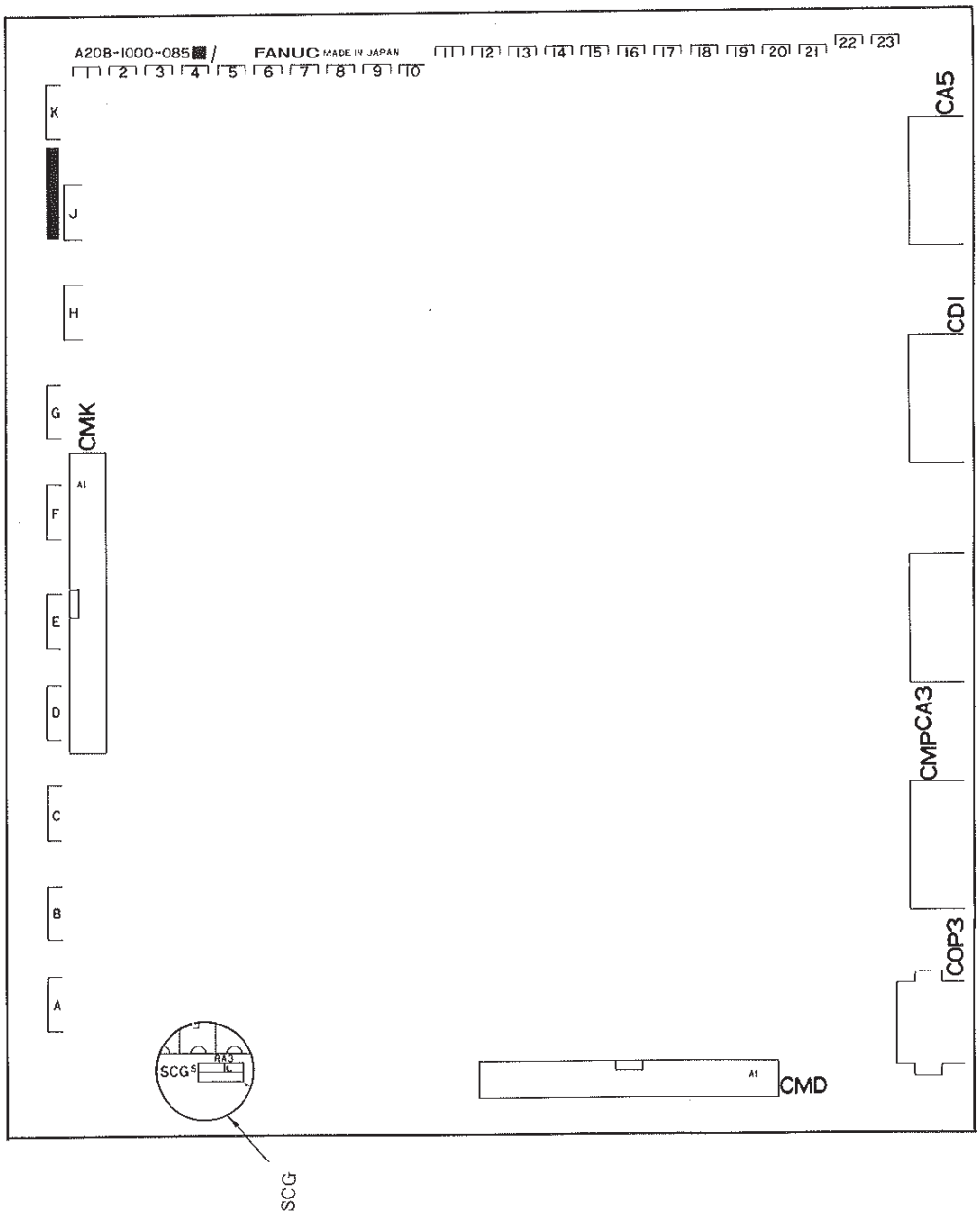



Fig. 6.1.3 (g) Adjusting points on 10/11 series 14" color graphic control PCB (A20B-1000-0850)



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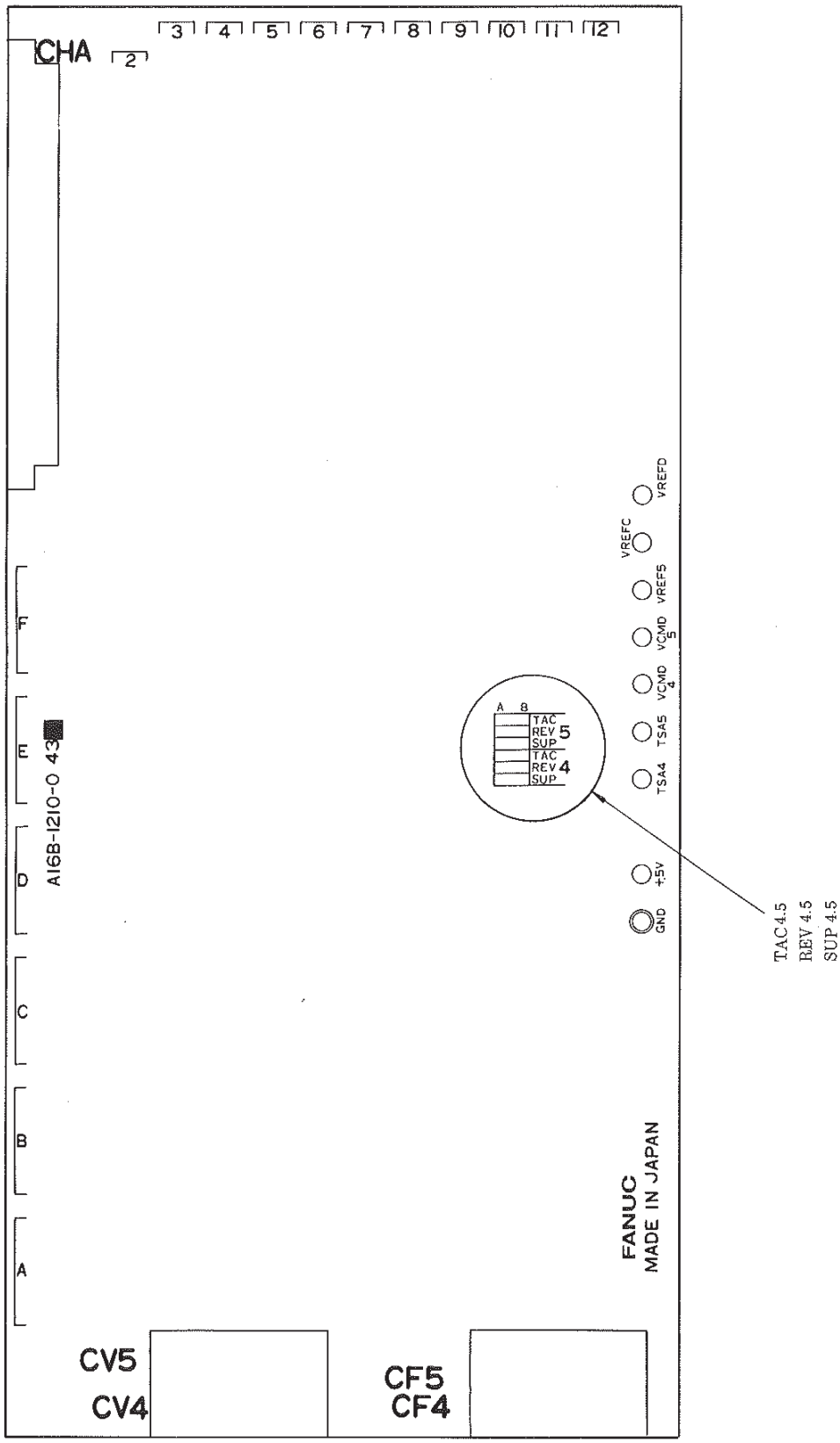



**Fig. 6.1.3 (h) Adjusting points on analog servo additional axis PCB (pulse coder) (A16B-1210-0430/0431)**



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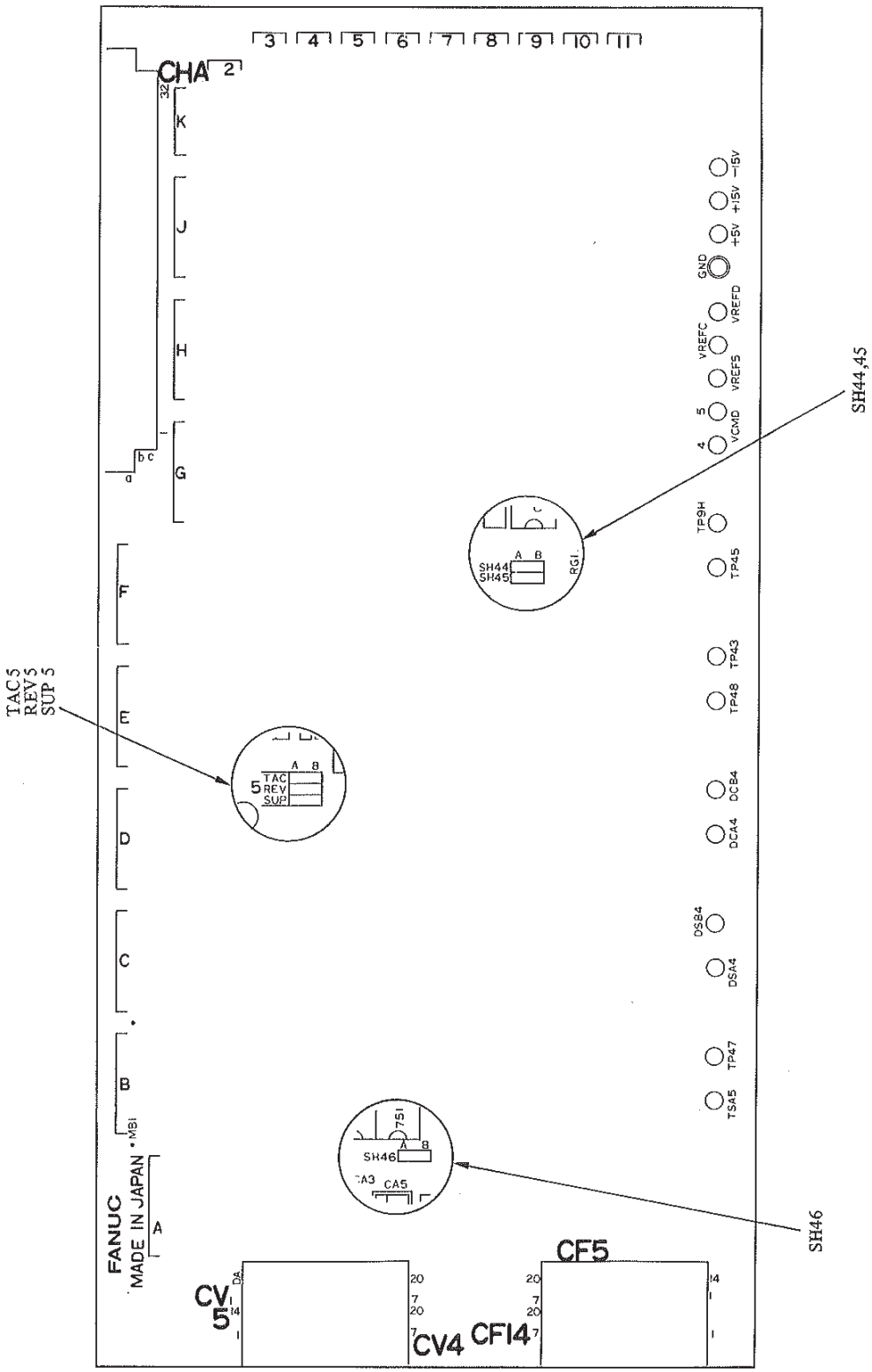



**Fig. 6.1.3 (i) Adjusting points on 11 series analog servo additional axis PCB A20B-1210-0440**



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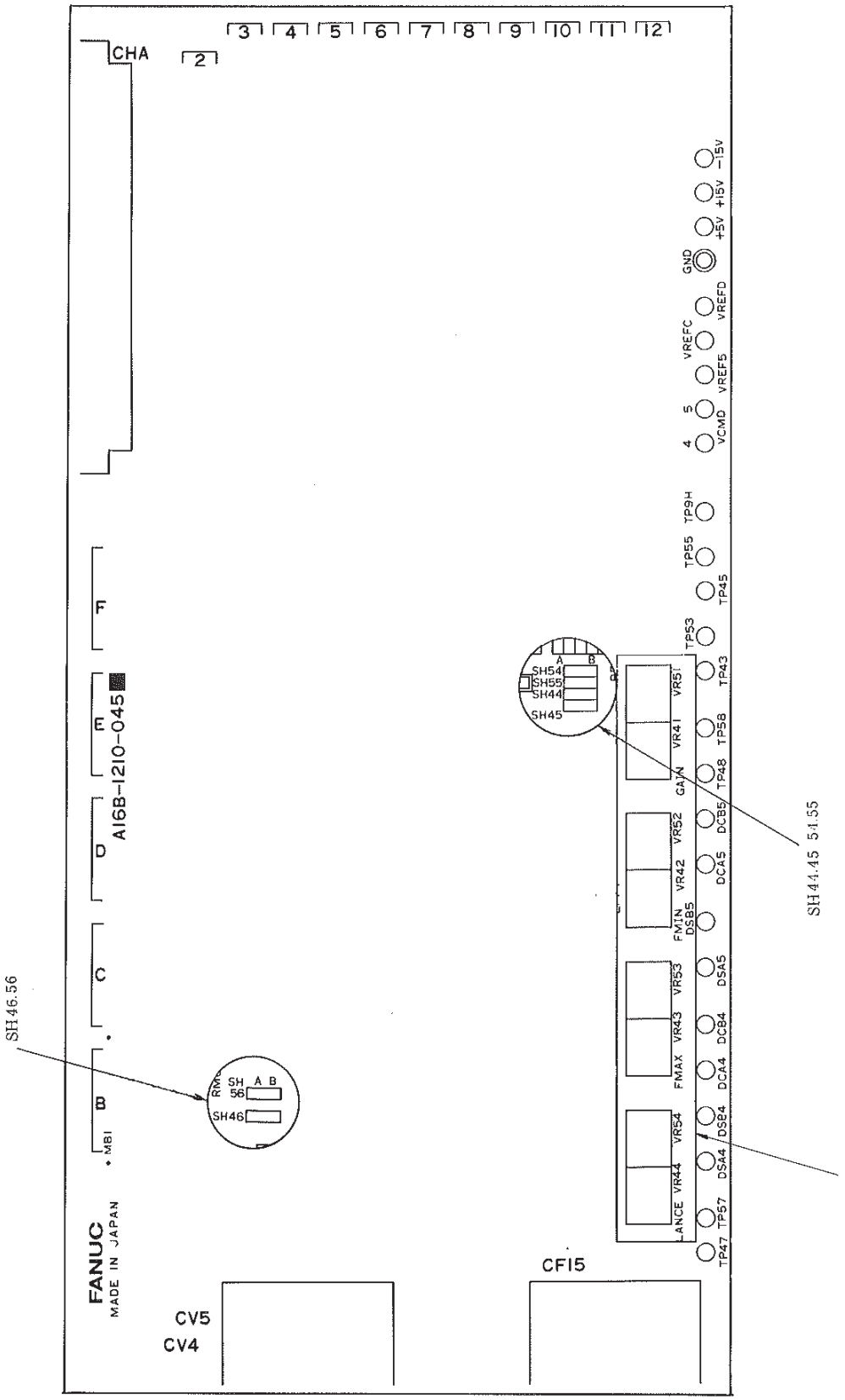



**Fig. 6.1.3 (j) Adjusting points on 11 series analog servo additional axis PCB (DSCG) (A16B-1210-0450)**



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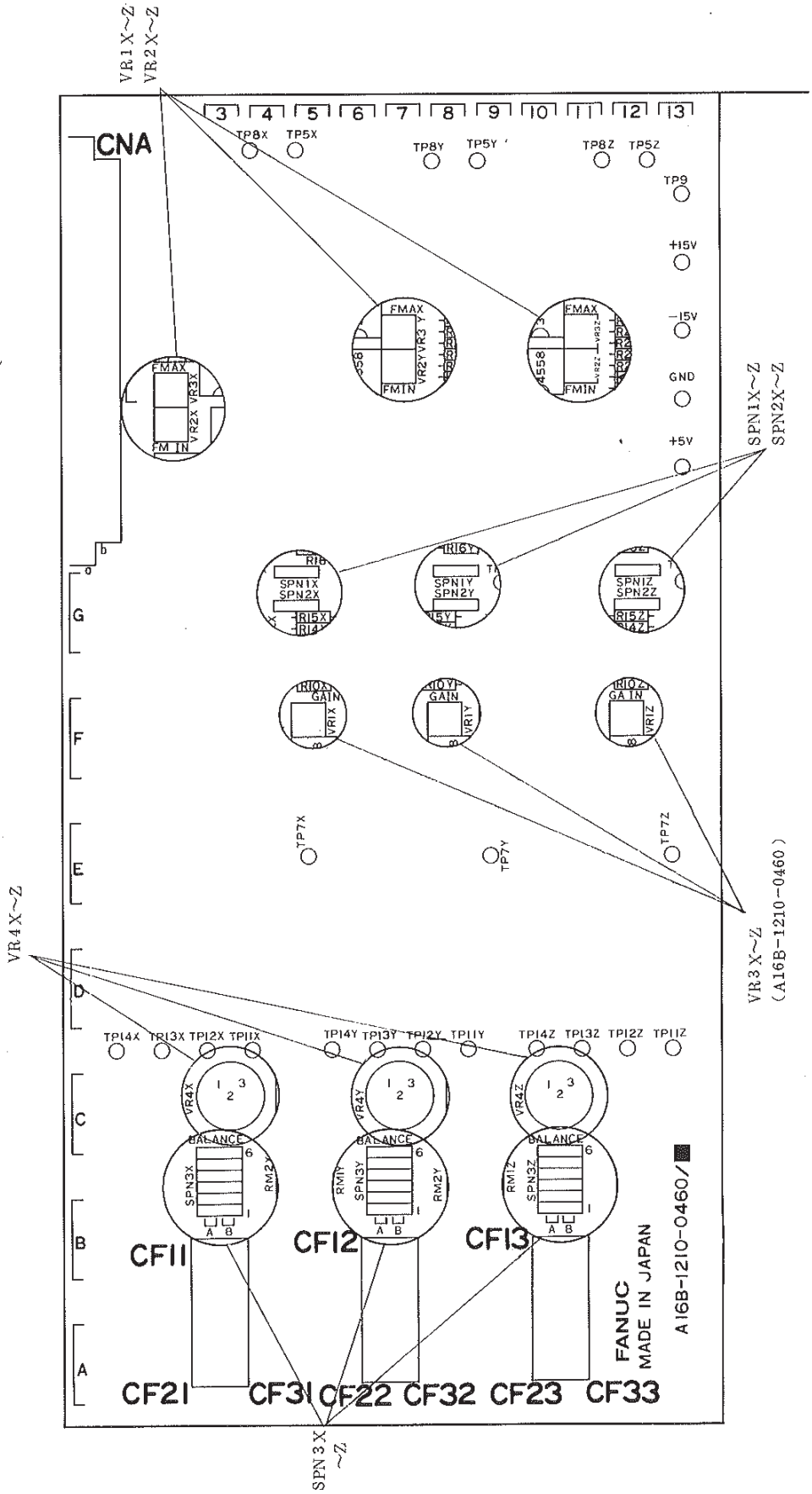



**Fig. 6.1.3 (k) Adjusting points on 11 series analog servo DSCG PCB (A16B-1210-0460) (Overall Edition Number 03A or before)**



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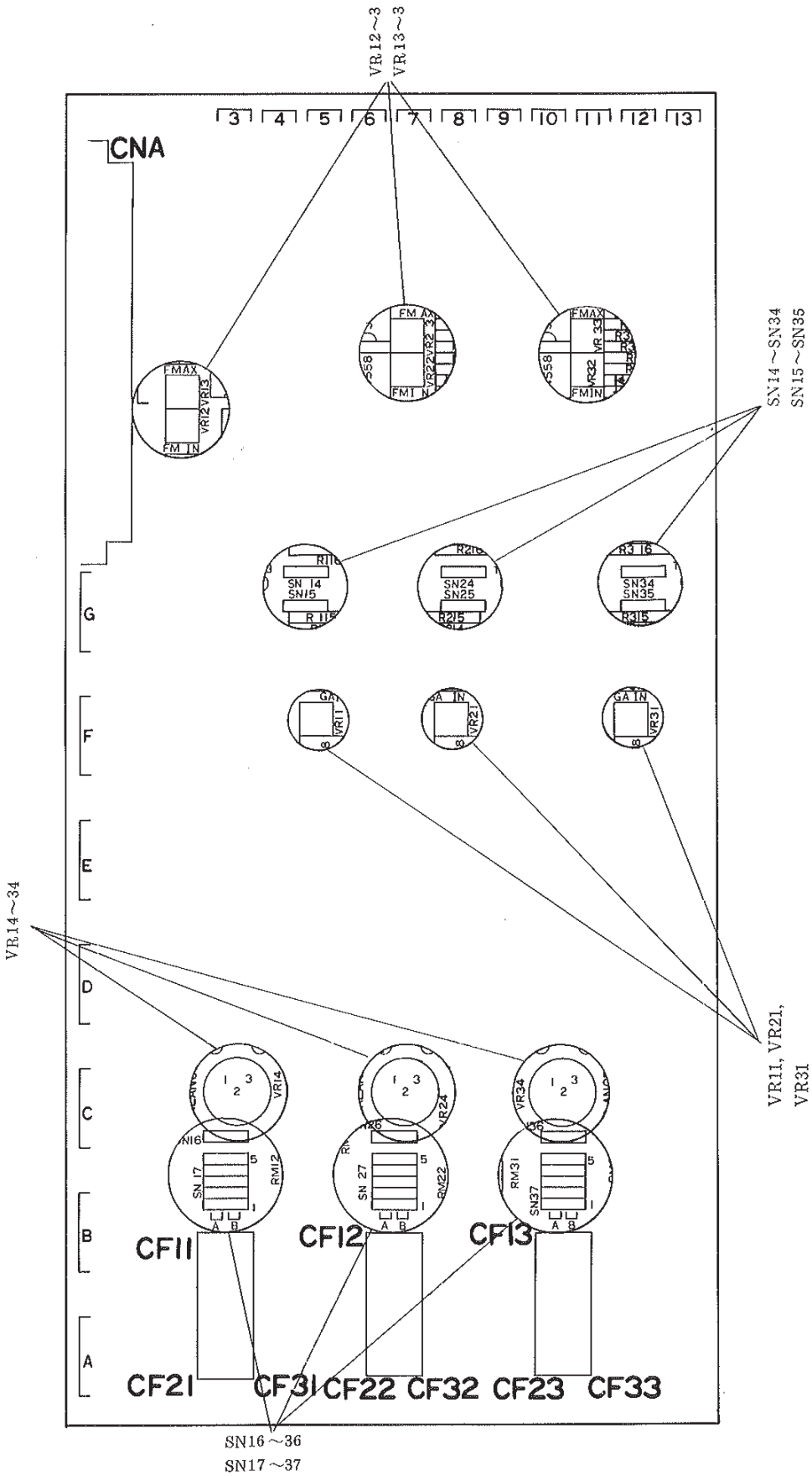



Fig. 6.1.3 (i) Adjusting points on 11 series analog servo DSCG PCB (A16B-1210-0460) (Overall Edition Number 04A～)



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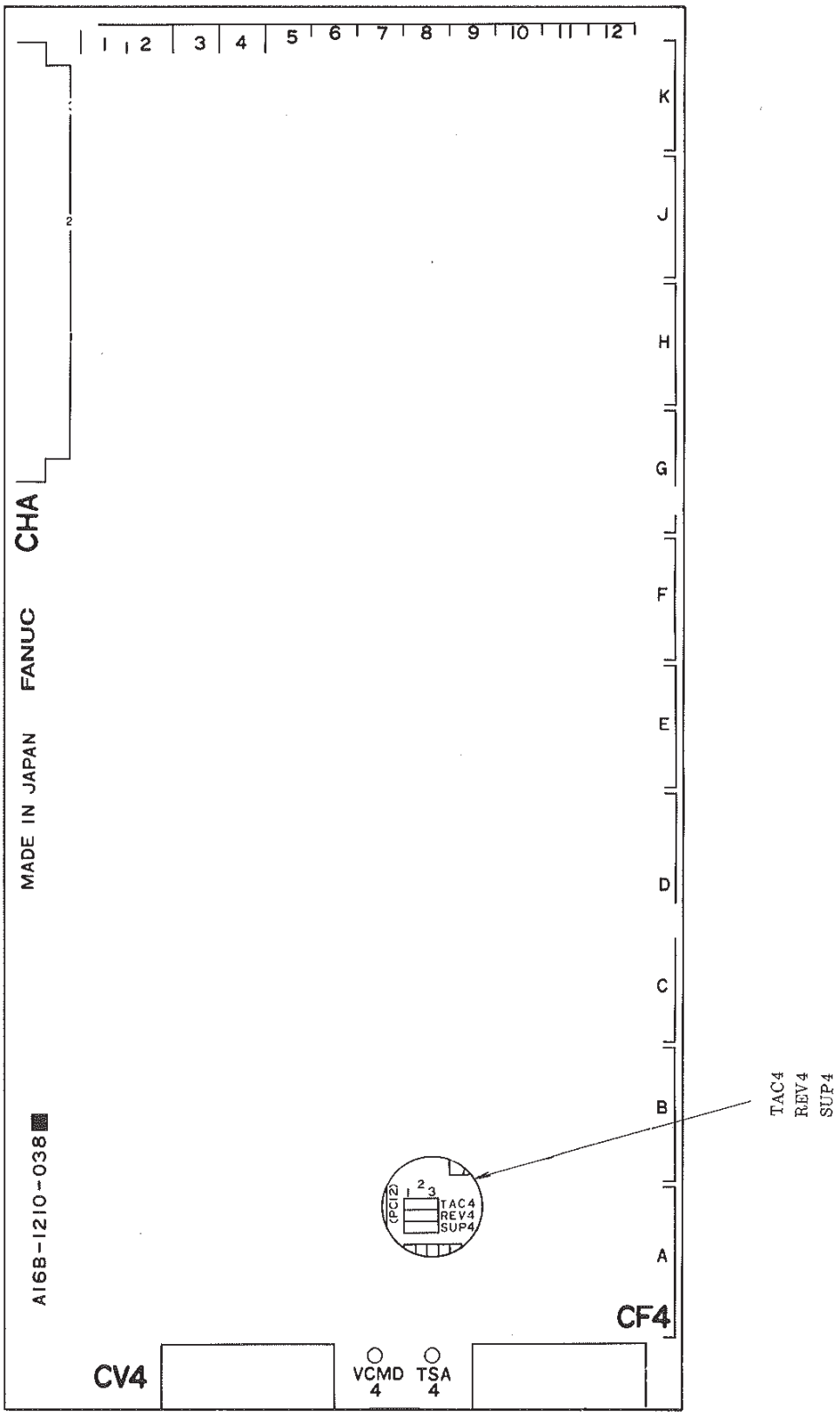



Fig. 6.1.3 (m) Adjusting points on 10 series analog servo additional axis + additional memory PCB (A16B-1210-0380)



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### 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.

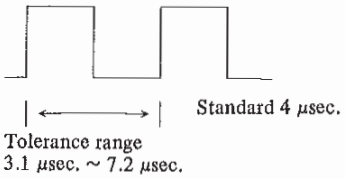
a) Adjusting procedure of detected gain

Prepare a synchroscope and 1 pce of jumper with clips (10 cm or more).

| Step | Operation |
|---|---|
| 1 | Set the parameters:<br>PSFα = 1 (No.1802 bit 0), where α = X,Y,Z,A,B, ... (Axis name)<br>Phase grid shift amount of each axis = 0 (No.1833)<br>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<br>ADR = 1 (No.1800 bit 0)<br>In-position width of each axis = 0 (No.1827) |
| 4 | Wait more than ten seconds at this condition |
| 5 | Restore the parameter<br>ADR = original value (No.1800 bit 0)<br>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:<br>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.) |



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| Step | Operation |
|---|---|
| 12 | Observe TPα5-GND by the synchroscope to adjust detected gain. (when frequency is low, detected gain becomes low.)<br><br><br>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)<br>SHα4 (Basic 3 axes) | 0% |
| Multipolar resolver (M series motor built-in type) | | | 60% |
| Linear inductosyn | Scale length 2m or shorter | | 0% |
| | Scale length longer than 2m | Standard | 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



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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.<br>For this adjustment, use a frequency counter or an oscilloscope.<br>Short circuit TPα8-GND<br>Observation TPα5-GND Adjusting variable resistor Fmin<br>Frequency range 1.67kHz ±150Hz<br>(cycle 0.6ms ±0.06ms) |
| Fmax | This has already been adjusted at FANUC before delivery and adjustment is not usually required.<br>For this adjustment, use a frequency counter. (Don't use an oscilloscope due to poor accuracy.)<br>Short circuit TPα8- -15V<br>Observation TPα5- GND Adjusting variable resistor Fmax<br>Frequency range 850kHz ±20kHz |

α = 1,2,3,4,5

3) Adjustment of inductosyn interpolation accuracy

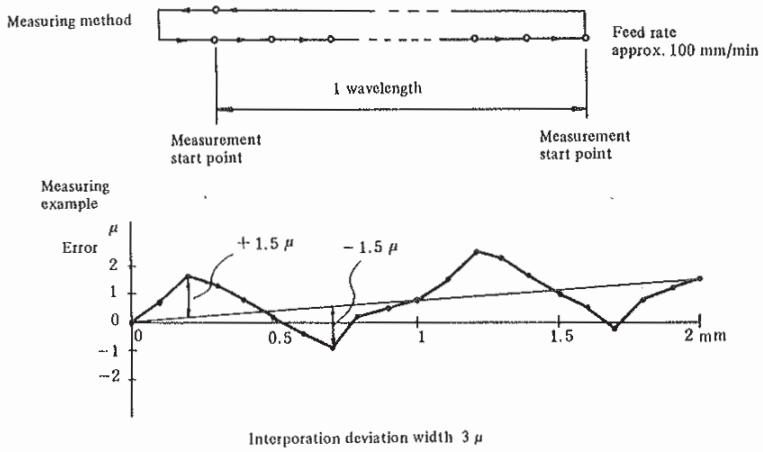
With the absence of interpolation accuracy adjustment, a fairly good accuracy can be attained. When interpolation accuracy adjustment set is present, adjustment needs to be made.

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.



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Interporation deviation width 3 μ

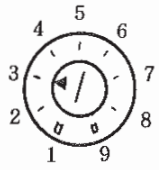
Adjusting variable resistor BALANCE

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

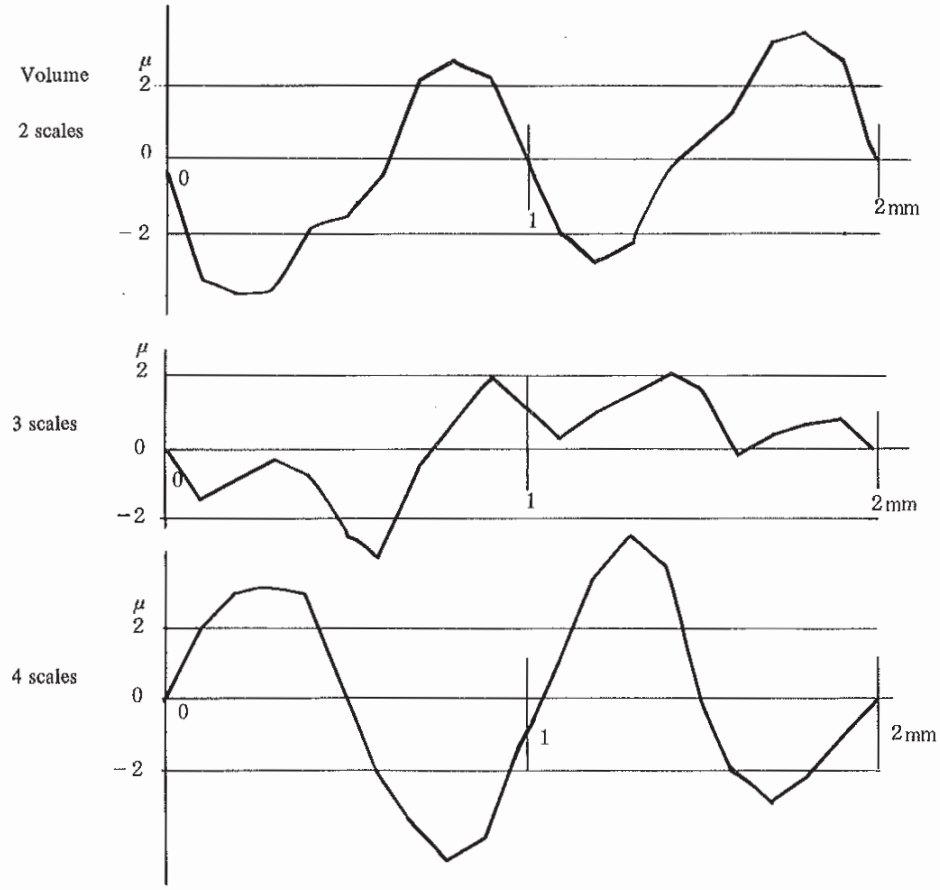
BALANCE






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Adjusting example
The figure below suggests that about degree 2.8 is an optimum position for the knob to be set.

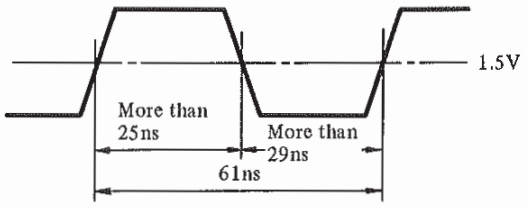





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### 6.1.5 Setting and adjustment on 12/120 series control unit PCB

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.<br><br>(1) - (16)<br>(2) - (15)<br>(3) - (14)<br>(4) - (13)<br>(5) - (12) | Check the checking terminal C16MP with an oscilloscope to set the pulse width as follows:<br><br> |

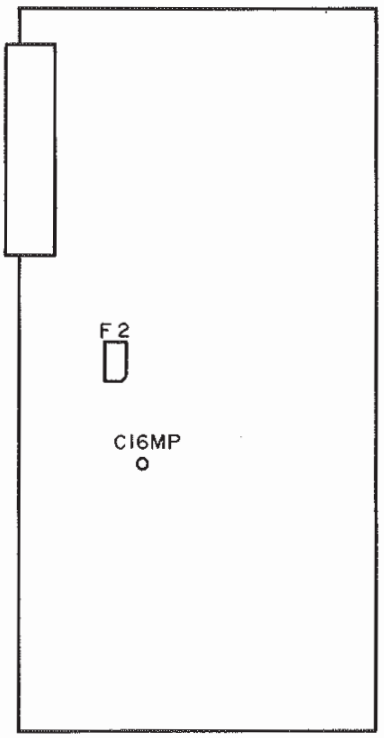



Fig. 6.1.5 (a) Setting and adjusting position on the peripheral control PCB A16B-1210-0080



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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.

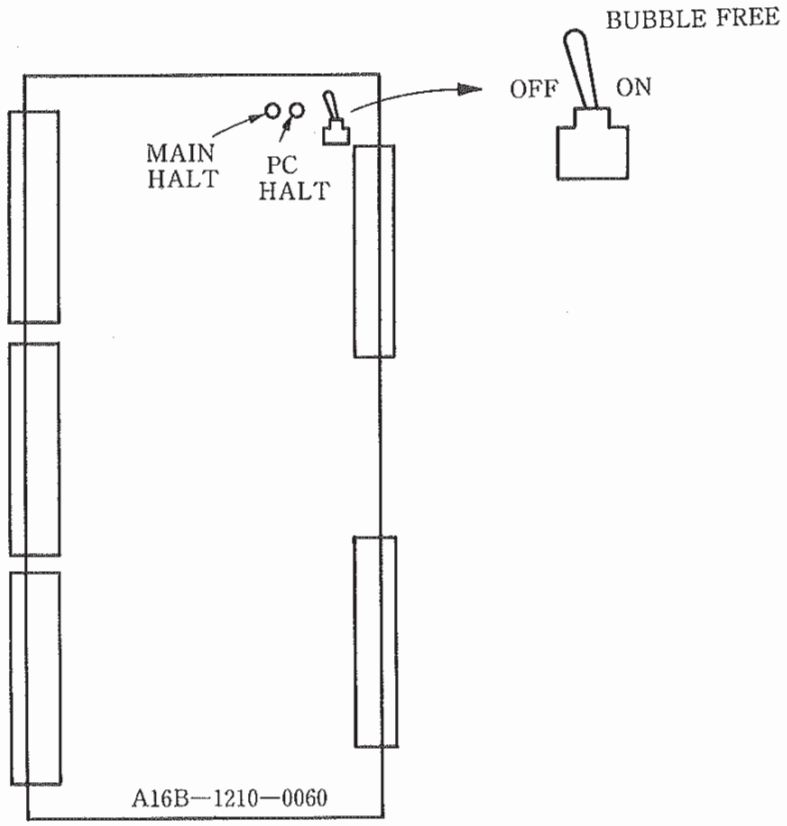



**Fig. 6.1.5 (b) Setting position on the main CPU PCB A16B-1210-0060**



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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

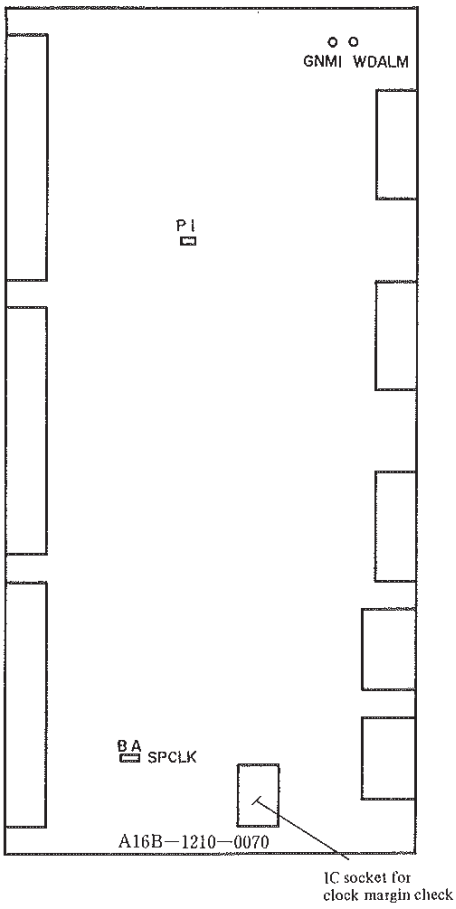


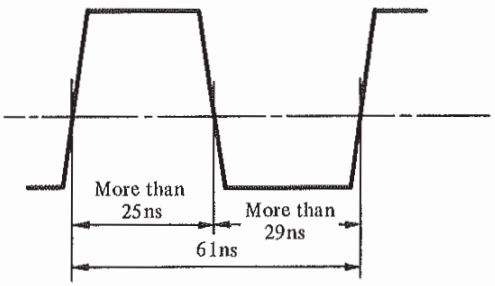

**Fig. 6.1.5 (c) Setting position on the main bubble PCB A16B-1210-0070**



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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.<br><br>(1) - (16)<br>(2) - (15)<br>(3) - (14)<br>(4) - (13)<br>(5) - (12) | Set 16.384 MHz cycle at check pin C16M as follows.<br> |

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<br><br>PE2 | 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 | 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.



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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.



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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.



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e) Setting pin PA1 should be opened.

View from the mounting face

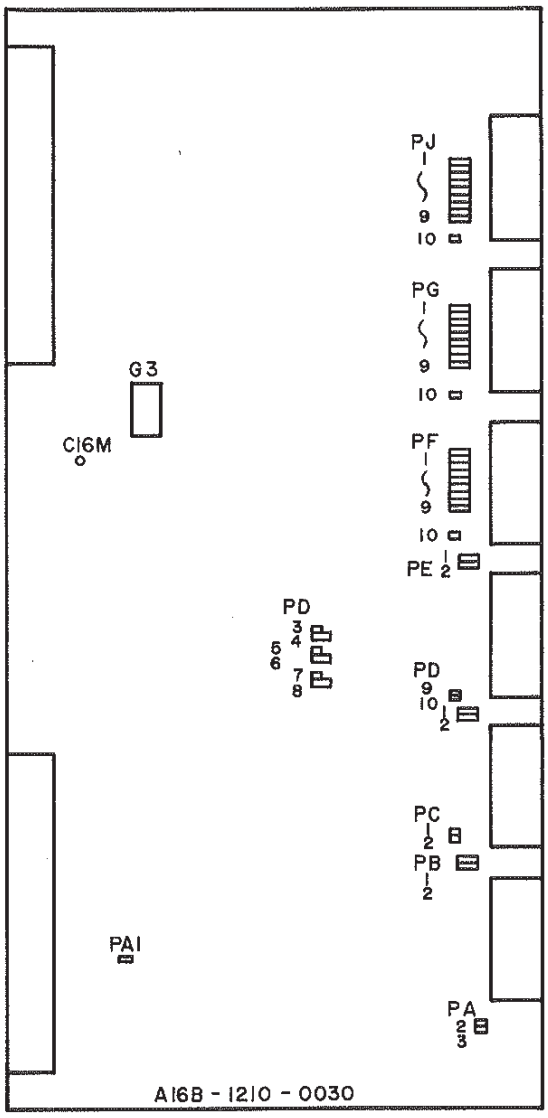



Fig. 6.1.5 (d) Setting position on the axis control PCB A16B-1210-0030



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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<br>P1M<br>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<br>P2M<br>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<br>P3M<br>P3N | 1 - 2 | |
| P4L<br>P4M<br>P4N | Open | Used at adjustment. Refer to (c) V-F converter frequency adjustment. |
| P5L<br>P5M<br>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.



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| Setting pin short circuit | Variable resistor VR2L(M,N) | Result of the frequency check | Detective gain |
|---|---|---|---|
| P2L(M,N): 2-3<br>P3L(M,N): 2-3 | 90%<br>I<br>0% | Big<br>↑<br>Sma$$ | Big<br>↑<br>Sma$$ |
| P2L(M,N): 1-2<br>P3L(M,N): 2-3 | 90%<br>I<br>0% | | |
| P2L(M,N): 2-3<br>P3L(M,N): 1-2 | 85%<br>I<br>0% | | |
| P2L(M,N): 1-2<br>P3L(M,N): 1-2 | 85%<br>I<br>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.

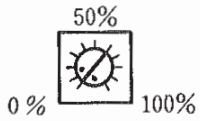
| Position detector | | Setting pin P2L(M,N) | Setting pin P3L(M,N) | Variable resistor VR2L (M, N) |
|---|---|---|---|---|
| Standard resolver (Motor built-in type) | | 2 - 3 | 1 - 2 | 0% |
| Multi-pole resolver (M series motor built-in type) | | | | 60% |
| Linear inductosyn | Scale length: less than 2 m | | | 0% |
| | Scale length: more than 2 m | 1 - 2 | 2 - 3 | More than 0% (Adjustment is necessary) |



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| Position detector | | Setting pin P2L(M,N) | Setting pin P3L(M,N) | Variable resistor 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% |

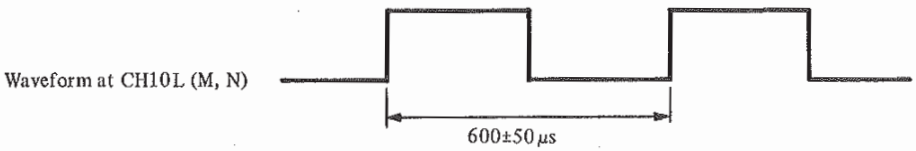
VR2L (M, N)



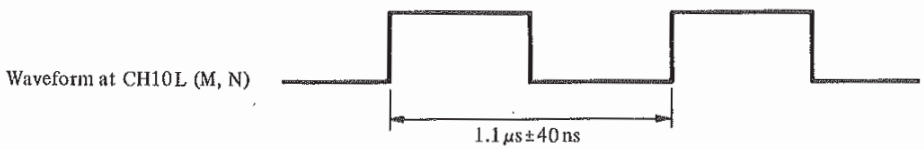

← Example for 0%

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.

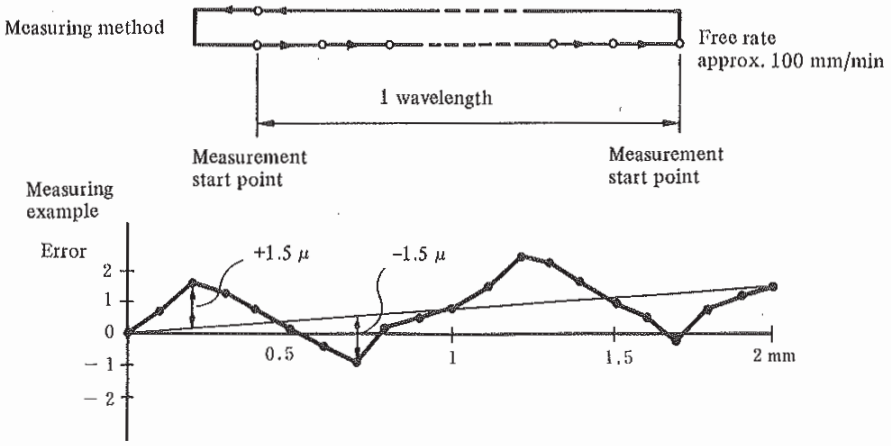


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d) Adjustment of inductosyn interpolation accuracy
With interpolation accuracy adjustment set absent, a fairly good accuracy can be attained. When interpolation accuracy adjustment set is present, adjustment must be made.

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



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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.

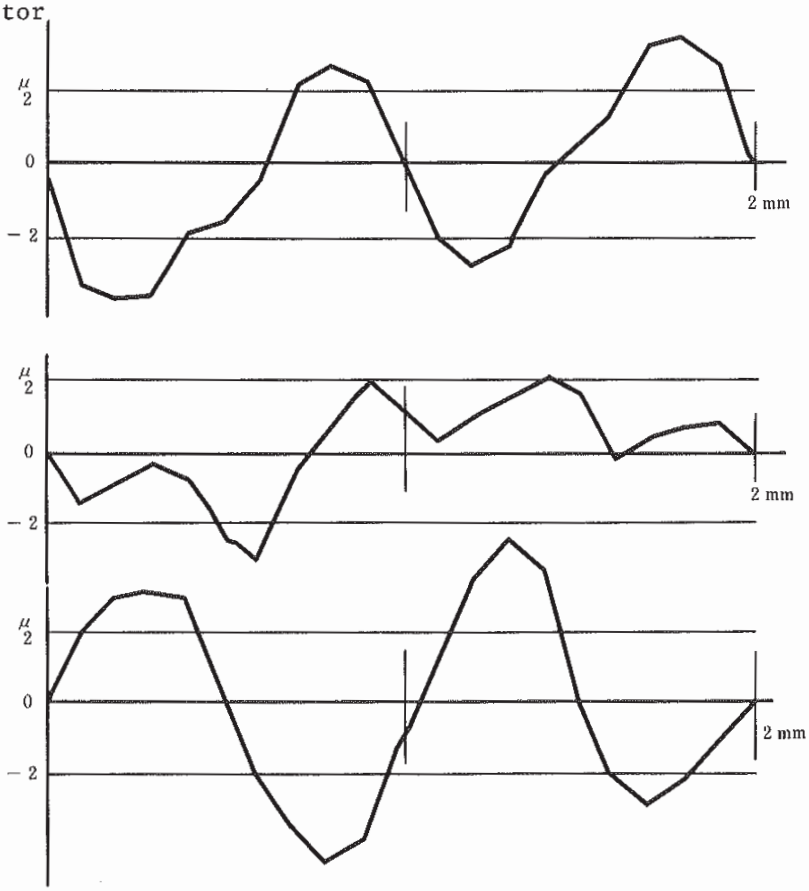
VR1L (M, N)



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






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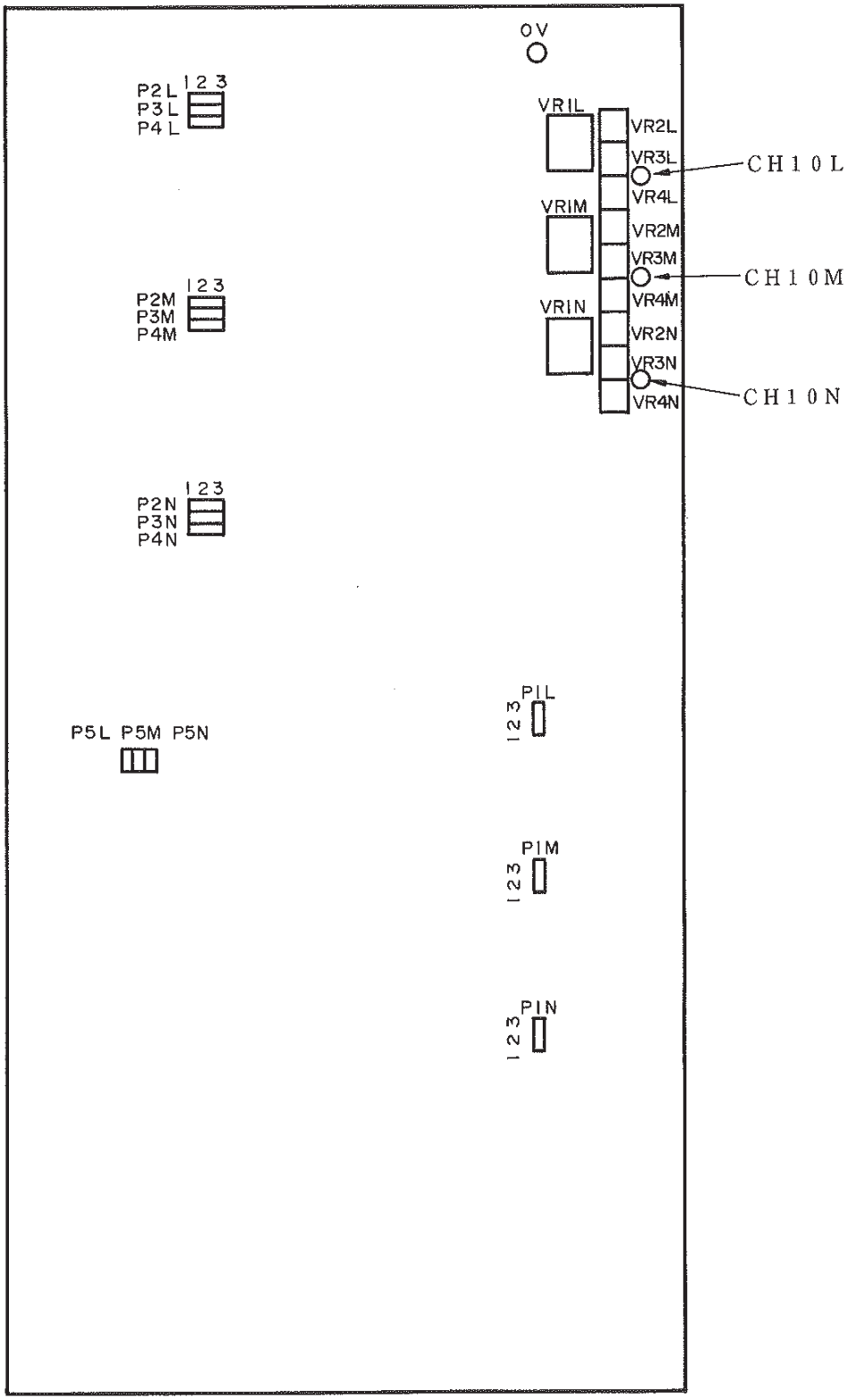



Fig. 6.1.5 (e) Setting and adjusting position on the DSCG interface PCB A16B-1210-0110



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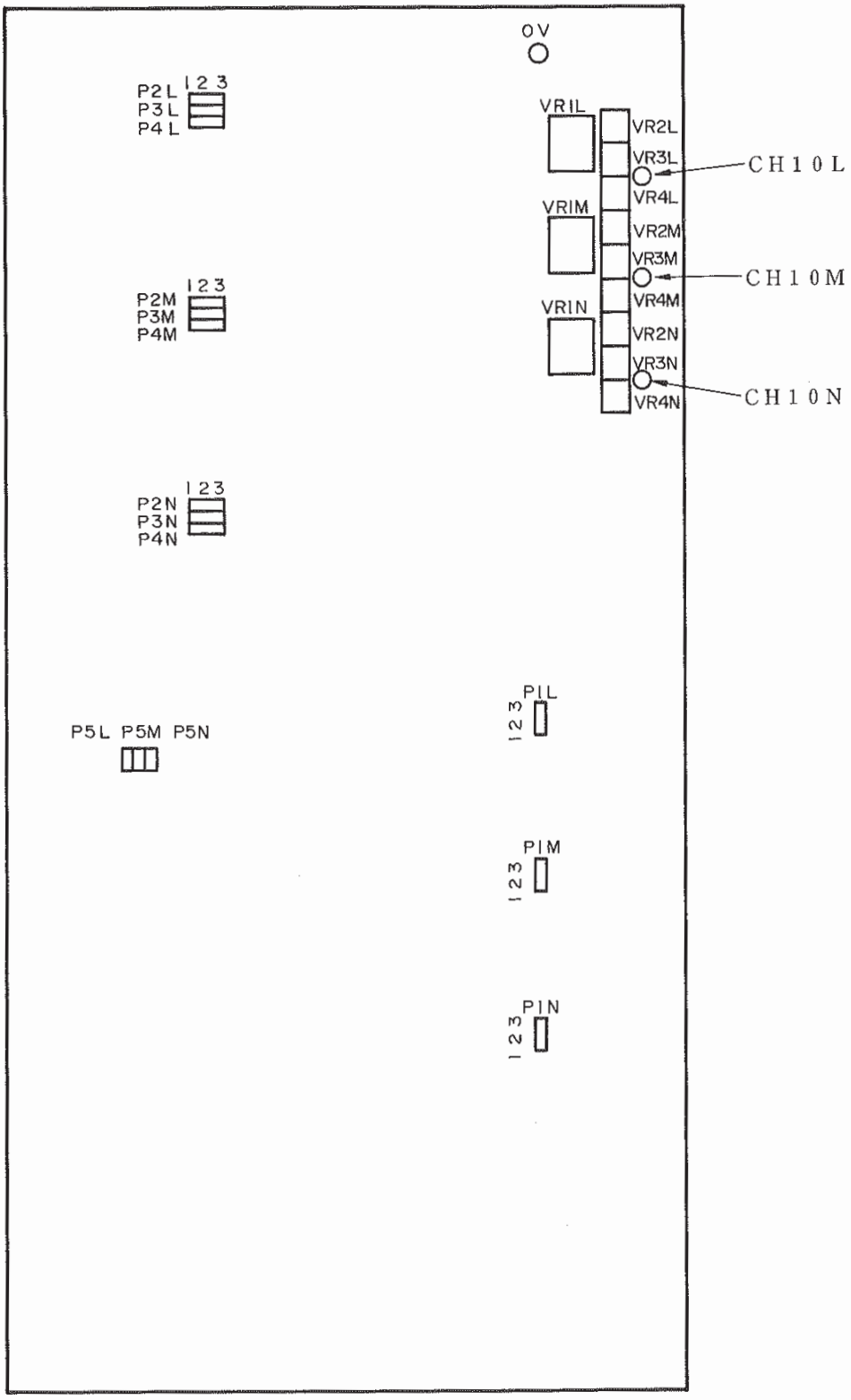



**Fig. 6.1.5 (f) Setting and adjustment on the additional detector control PCB A16B-1210-0180**



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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. |

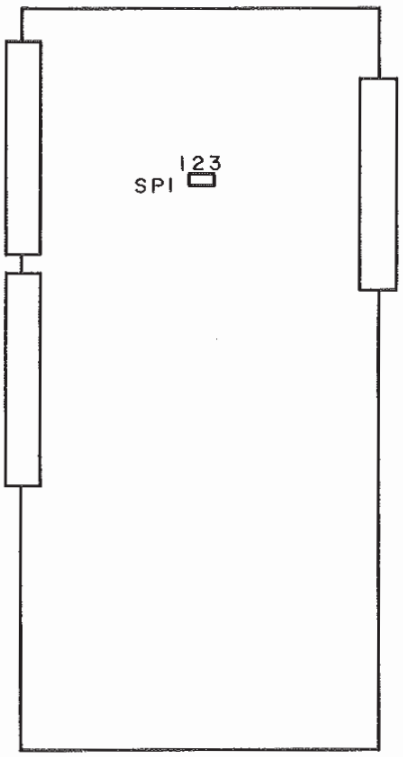
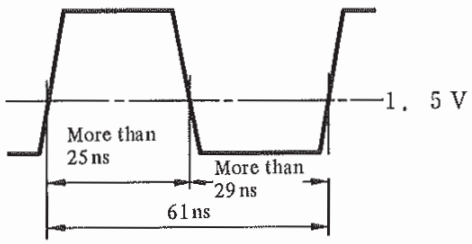



**Fig. 6.1.5 (g) Setting position on the axis CPU PCB A16B-1210-0020**



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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.<br><br>(2) - (15)<br>(3) - (14)<br>(4) - (13)<br>(5) - (12)<br>(6) - (11) | Set 16.384 MHz cycle as follows at check pin C16MP.<br><br> |

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

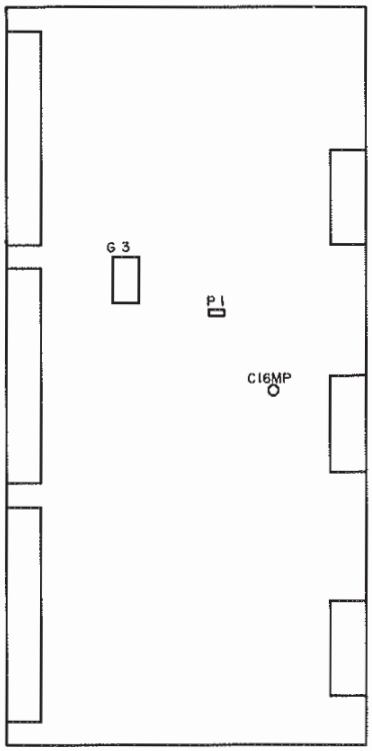



**Fig. 6.1.5 (h) Setting position on the spindle control PCB A16B-1210-0160**



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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

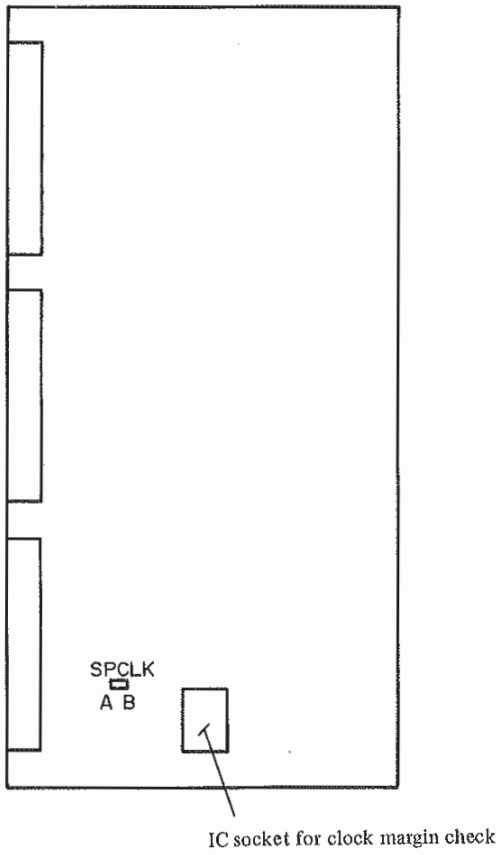



**Fig. 6.1.5 (i) Setting position on the additional buffer 2 PCB A16B-1210-0260**



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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

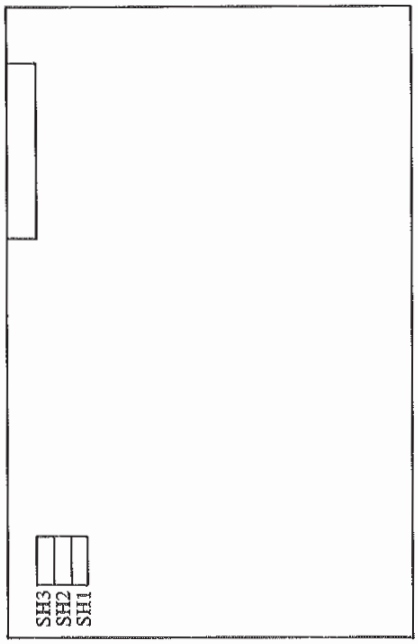



**Fig. 5.1.5 (j) Setting position on the built-in type I/O unit/I/O interface PCB A16B-1310-0020**



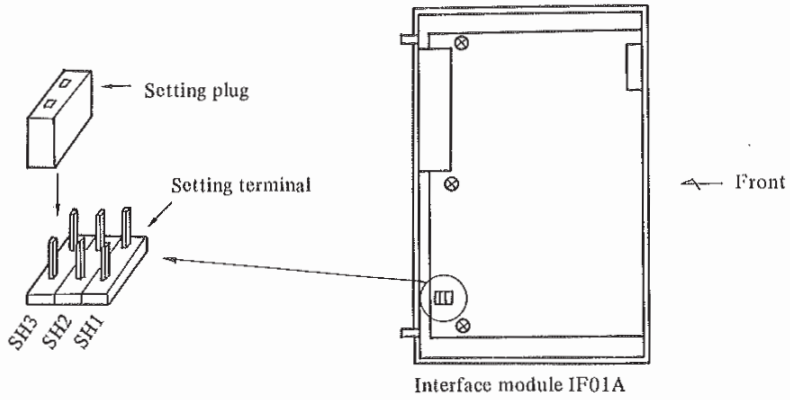
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### 6.1.6 I/O unit setting and adjustment

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




Interface module IF01A

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.



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b) Setting position

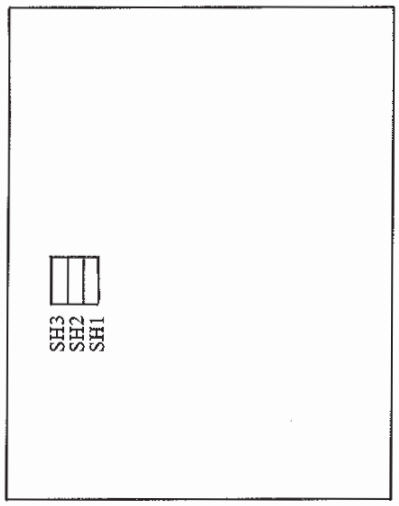


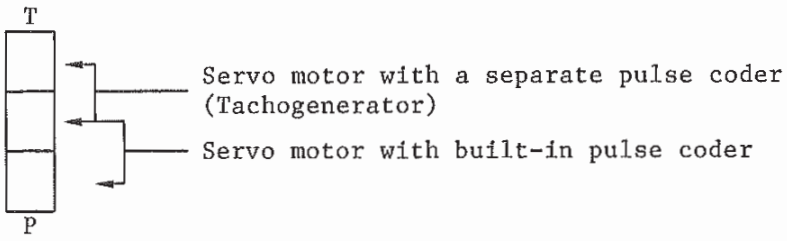

**Fig. 6.1.6 (b) Setting position on I/O interface module (IF04C)**

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<br>ST2</td><td>Setting of velocity gain<br>Set the velocity gain according to the types of pulse coders used as follows:<br><br>
<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.<br>The suppress function neglects a detection pulse when the moving direction of the machine is reversed.<br>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.<br>Suppress function is provided ... Shorted<br>No suppress function is provided ... Open (standard setting)</td></tr>
</table>



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| Item | Symbol | Contents |
|---|---|---|
| 3 | ST4 | Setting of velocity detection signal selection<br>This setting is done to select either pulse coder or tachogenerator for velocity detection.<br><br> |

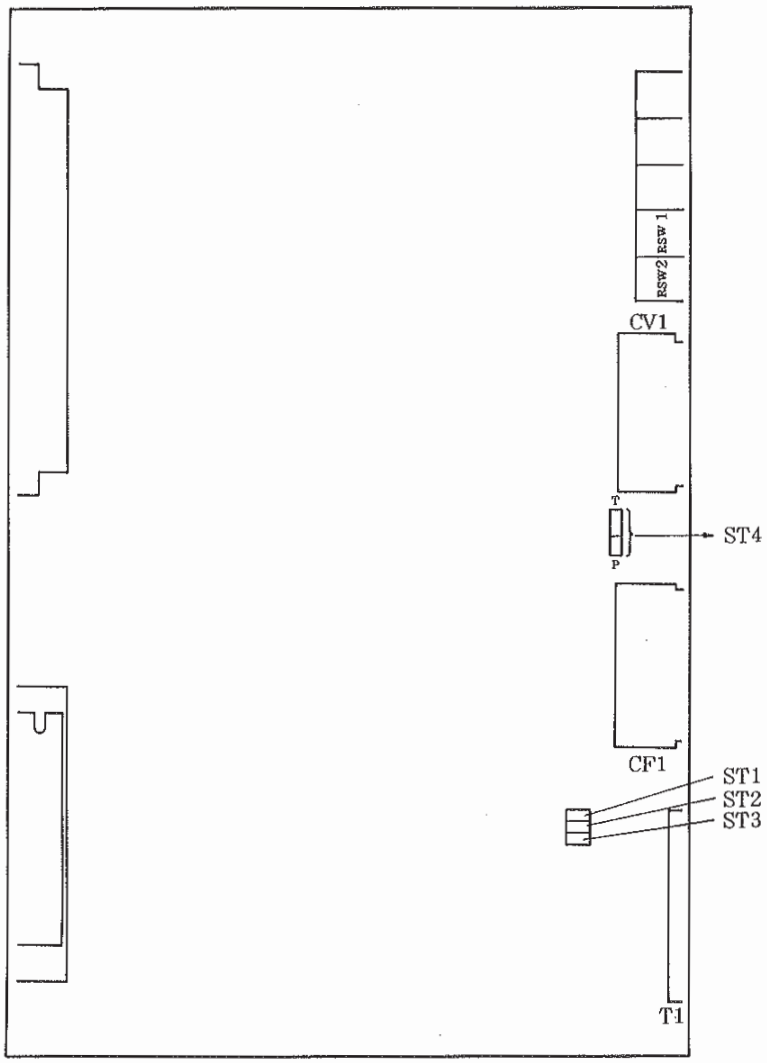



**Fig. 6.1.6 (c) Setting position on the positioning module (PT01A)**



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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.<br>② Remove I/O module mounted on the left side of the AD04A to leave space for turning the AD04A variable resistor.<br>③ Open the input terminals (terminal board) of AD04A.<br>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.<br>Voltmeter ... Use a voltmeter thats resolution (measuring sensitivity) is higher than 0.1 mV.<br>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).<br>① Connect TP1 and TP3 to GND (TP9). Adjust VR3 until the TP5 voltage becomes 0.0 mV.<br>② Connect TP1 and TP3 to GND (TP9). Adjust VR4 until the TP6 voltage becomes 0.0 mV.<br>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.<br>④ Apply 0.000 V to TP1 and +10.000 V to TP3. Adjust VR6 until the TP6 voltage becomes +9.768 V.<br>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).<br>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).<br>⑦ Apply 0.000 V to TP1 and TP3. Make sure that the output reads 0 (decimal) (000 in hexadecimal).<br>⑧ Repeat steps ⑤ - ⑦.<br>⑨ Adjust VR7 to make the resistance between CNT2 and CNT3 250.0 Ω.<br>⑩ Adjust VR8 to make the resistance between CNT6 and CNT7 250.0 Ω.<br>⑪ Adjust VR9 to make the resistance between CNT10 and CNT11 250.0 Ω.<br>⑫ Adjust VR10 to make the resistance between CNT14 and CNT15 250.0 Ω.<br>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>



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<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.



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## 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 |





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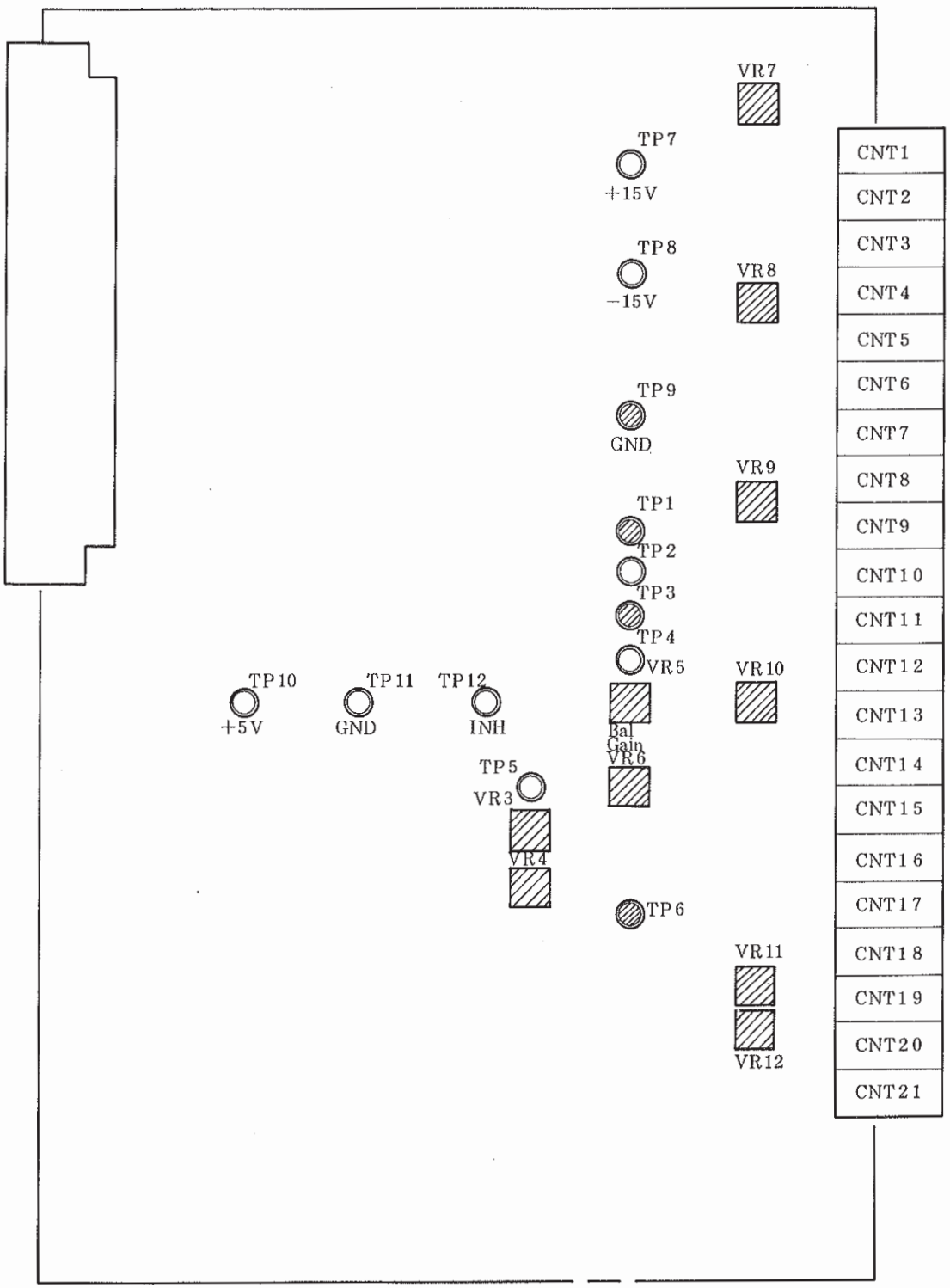


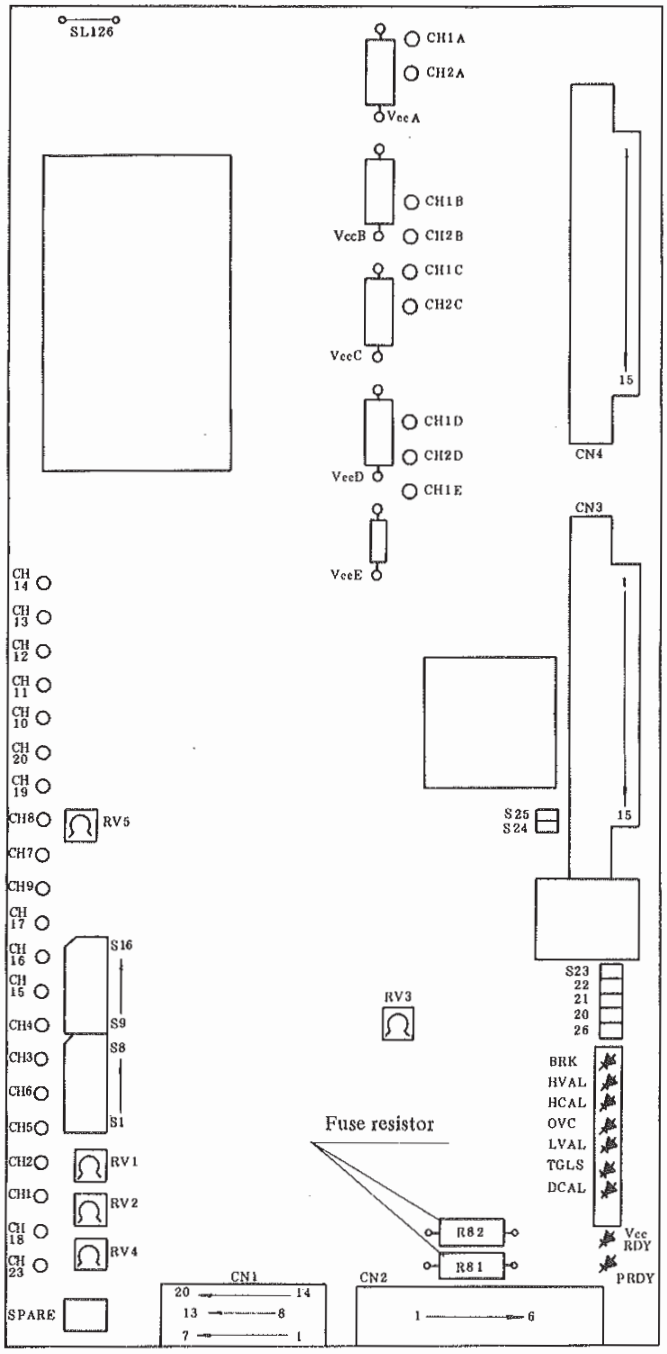

**Fig. 6.1.6 (d) Mounting position of variable resistor and check terminal**



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## 6.2 Setting and Adjustment for M Series Velocity Control Unit

### 6.2.1 Setting and adjustment on M series velocity control unit PCB

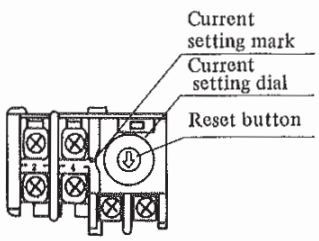



Note) Parts location on PCB may be changed without notice.

**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 |






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**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 |



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| 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<br>CH16-3<br>CH17-3 | | CH15-3<br>22 - 27V | CH16-3<br>14.5 - 15.5V | CH17-3<br>-14.5 - 15.5V | |
| 3 | GAIN | RV1 | | | 5 SCALES | | | |
| 4 | OFFSET | RV2 | CH6-3 | CH1-3<br>CH2-3 | ±0.5V MAX | | | PANCAKE TACHO GENERATOR |
| | | | | | 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) |



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