DC SERVO UNIT

MAINTENANCE MANUAL

B-51401E/01

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In this manual, we endeavor to include all pertinent matters.
There are, however, a very large number of operations that must not or cannot be performed, and if the manual contained them all, it would be enormous in volume.
It is, therefore, requested to assume that any operations that are not explicitly described as being possible are "not possible".

Section 1

This manual is applied to the 2-phase controlled (single phase-full wave) DC Serve Unit.

Section 2

This manual is applied to the 6-phase controlled (3 phase-full wave DC Servo Unit type A06B-6035-B005~007.

Section 3

1. This manual is applied to the 6-phase controlled (3 phase-full wave) DC Servo Unit with the Velocity Control Unit type A06B-6035-H313~8 which drives DC motors model 0, 5, 10, 20 or 30.

2. This manual is applied to the 6-phase controlled (3 phase-full wave) DC Servo Unit with the Velocity Control Unit type A06B-6035-H295~6, which drives DC motors model 40, 50, 60 or 60H.

CONTENTS

Section 3

SECTION 1

1. General

This maintenance manual describes the procedure to be followed for the handling and maintenance of the GETTYS. FANUC DC Servo Unit.

A) When installing the NC system, connect the servo unit and motor as instructed in "Connection of Servo Unit and Motor". After connecting them, proceed to set the servo unit as instructed in "Setting After Installation".
The above steps will make the GETTYS. FANUC DC Servo Unit ready for operation.

B) Conduct Periodical check-up as instructed in "Periodical Maintenance".

C) In Case of trouble, take the steps indicated in "Steps in Case of Trouble".

2. Connection of Servo Unit and Motor (For Special-purpose model)

This section describes the procedure for extending feedback signal cables and power cables for motor drive between the servo unit and motor.

In a closed loop, incorrect connection would bring the system into an oscillatory state which may cause damage to the servo unit and motor. Make sure of proper connection.

2.1 Connection for resolver system

For a DC motor with a built-in resolver, either the regular or reverse connection should be made according to the direction of motor rotation as indicated in Fig. 2.1 and Fig. 2.2.

Servo Unit side

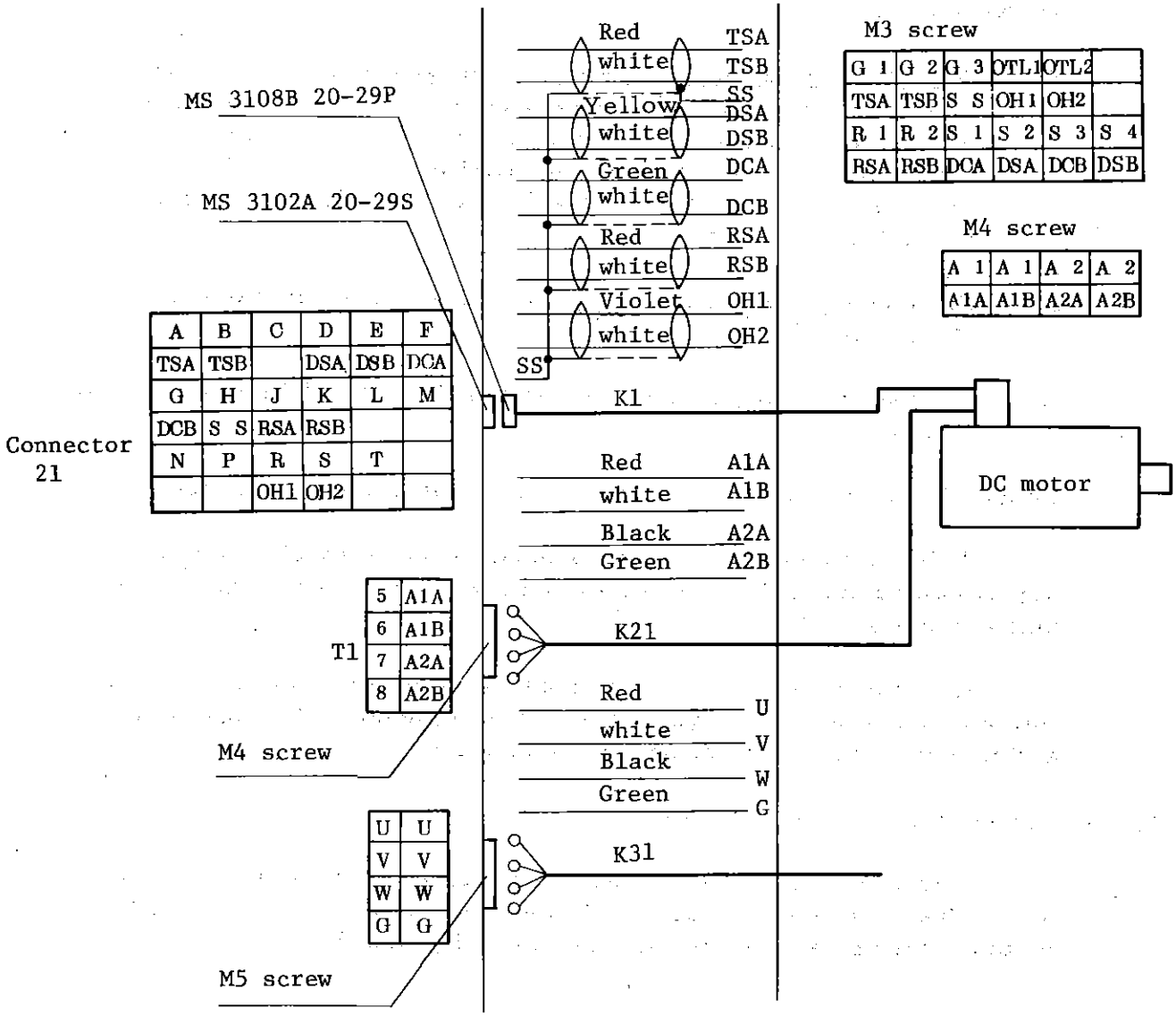


Fig. 2.1 Regular connection

Connector 21

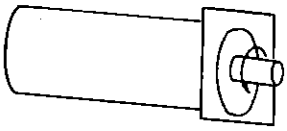
A	B	C	D	E	F
TSB	TSA		DSB	DSA	DCA
G	H	J	K	L	M
DCB	S S	RSA	RSB		
N	P	R	S	T	
		OH1	OH2		

T1

5	A2A
6	A2B
7	A1A
8	A1B

Fig. 2.2 Reverse connection

Regular connection (NC "+" move command)



Reverse connection (NC "-" move command)

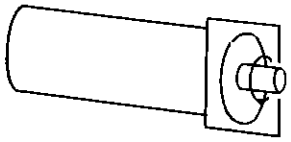
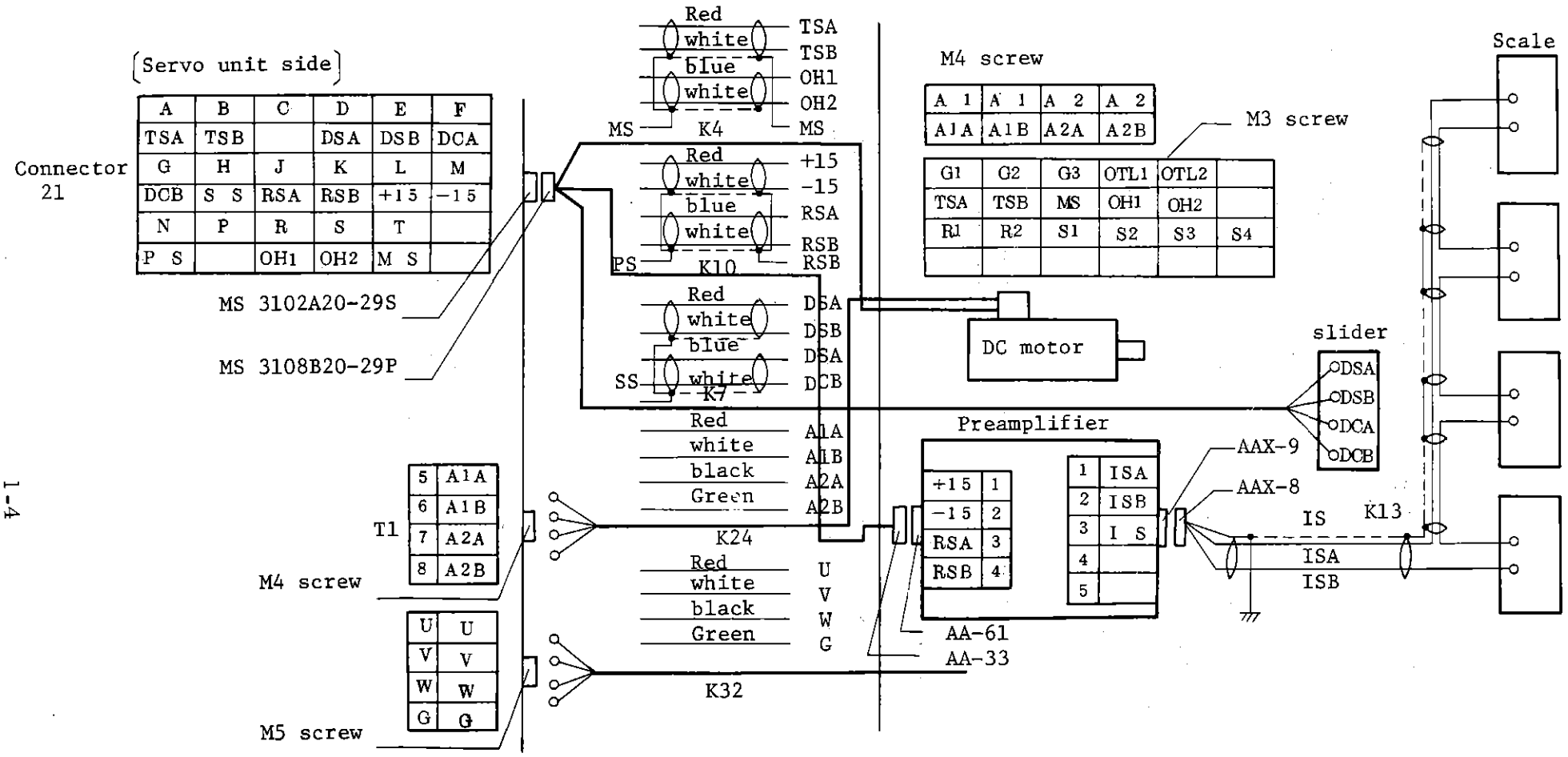


Fig. 2.3 Direction of motor rotation

2.2 Connection for Inductosyn

For the Inductosyn, either the regular or reverse connection should be made according to the direction of motor rotation as indicated in Fig. 2.4 and 2.5.



The connection and the direction of motor rotation are shown in Fig. 2.3.

Fig.2.4 Regular connection

Connector 21

A	B	C	D	E	F
TCB	TSA		DSB	DSA	DCA
G	H	J	K	L	M
DCB	S S	RSA	RSB	+15	−15
N	P	R	S	T	
P S		OH1	OH2	M S	

T1

5	A2A
6	A2B
7	A1A
8	A1B

Fig. 2.5 Reverse connection

2.3 Terminal Positions and Cable Routes

A rear view of the servo unit specially designed for the NC device is provided in the figure below. Be careful not to confuse the shaft of the motor power.

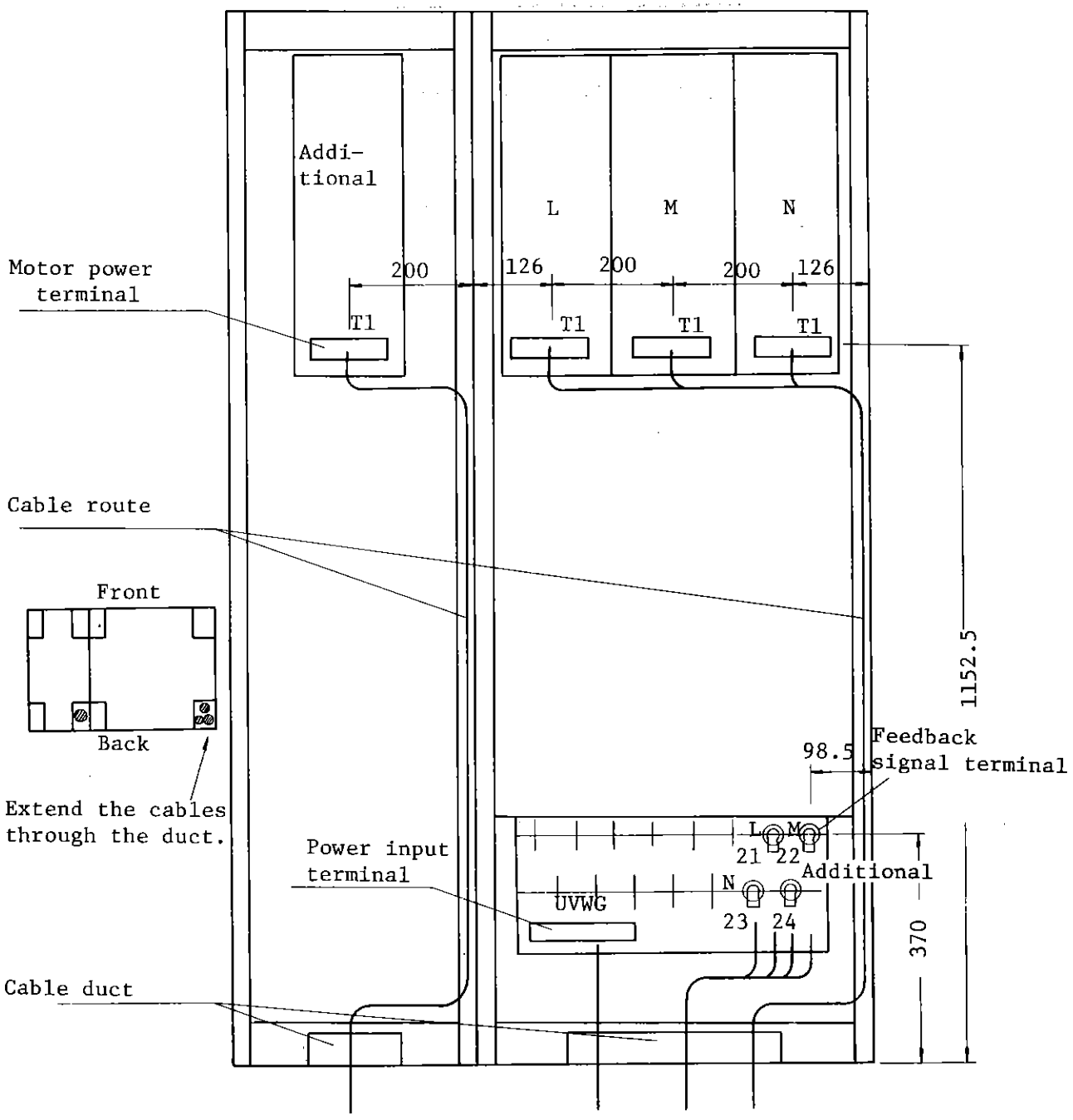
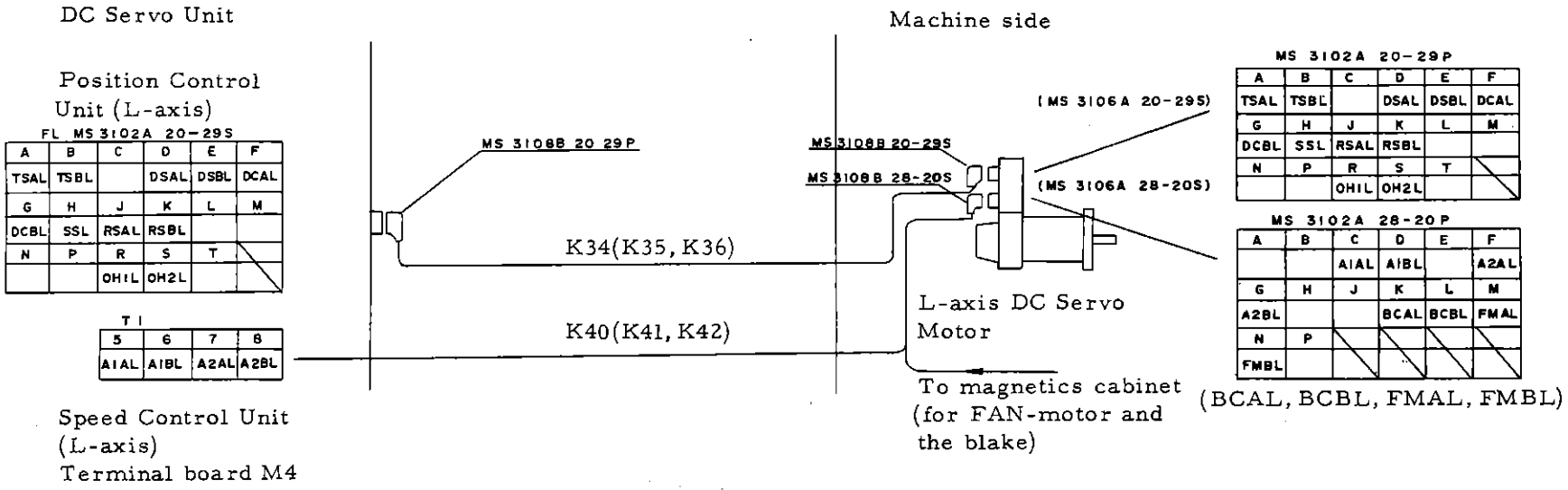


Fig. 2.7

In case of CANNON connectors are used at DC servo motor with resolver.



NOTE (1) Cable K34 to K36 are for the analog signals from the detectors. Connect the servo unit and motor directly without relaying on the machine side.

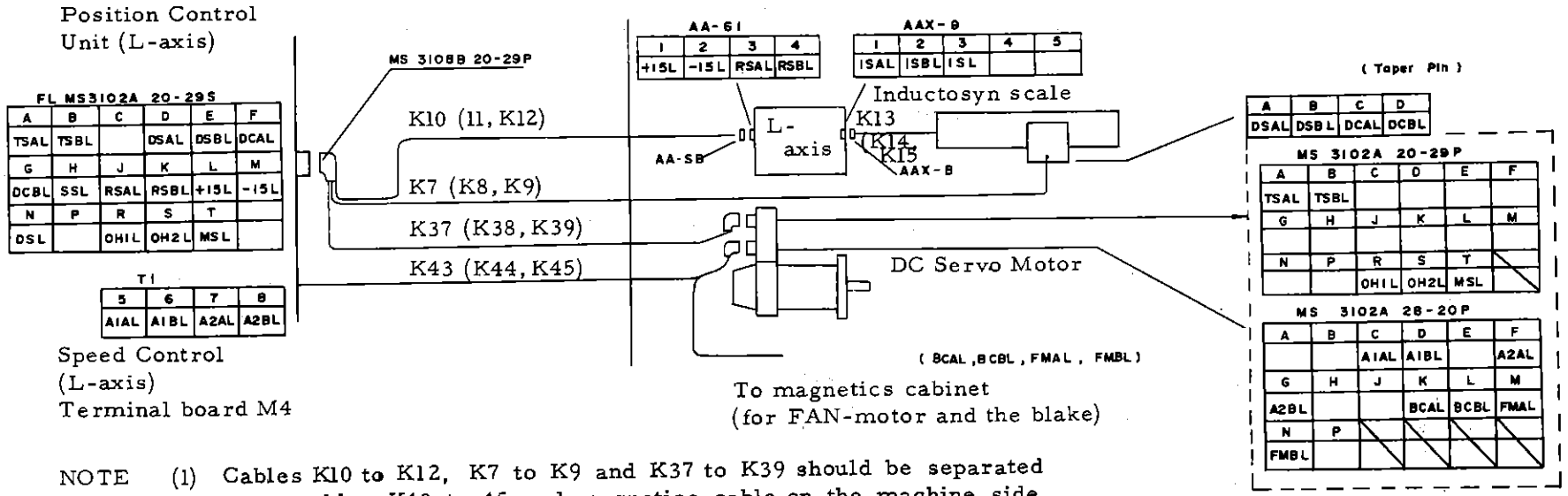
(2) Cables K34 to K36 should be separated from cables K40 to K42 and the magnetics cable on the machine side (by means of an electromagnetic shield).

(3) Terminal alignment in the connectors for M and N axis is as same as L-axis.

In case of CANNON connectors are used at DC servo motor with inductosyn.

DC Servo Unit

Machine Side



NOTE (1) Cables K10 to K12, K7 to K9 and K37 to K39 should be separated cables K43 to 45 and magnetics cable on the machine side (by mcans of an electromagnetic shield).

(2) Cables K13 to K15 should be separated sufficiently from any other cable.

(3) Refer to the Inductosyn wiring specifications, A06P-9001-4003.

(4) Terminal alignment in the connectors for M and N axis is as same as L-axis.

2.4 Maintenance area

The minimum required space to be secured for smooth maintenance is shown in Fig. 2.8.

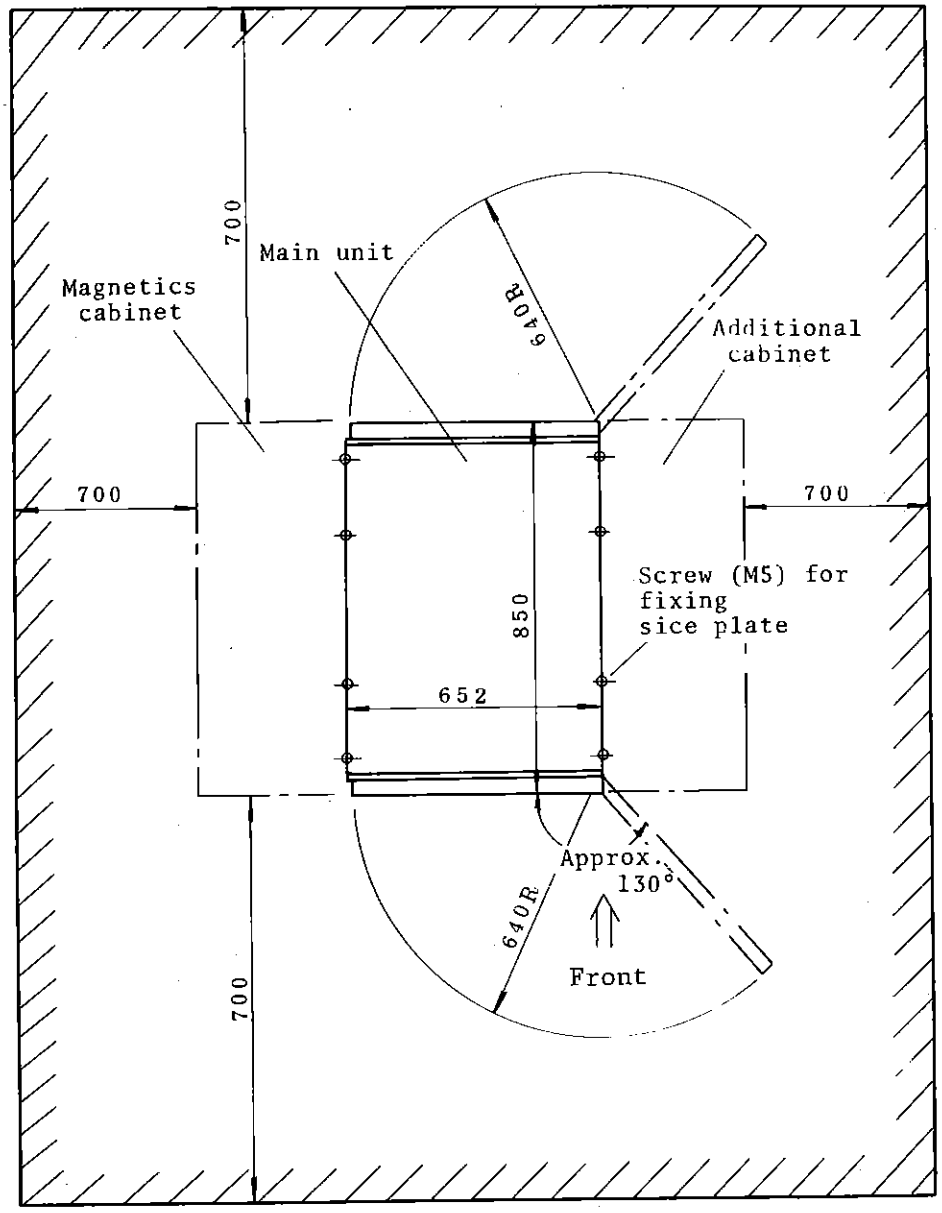


Fig. 2.8

3. Setting After Installation (For special-purpose model)

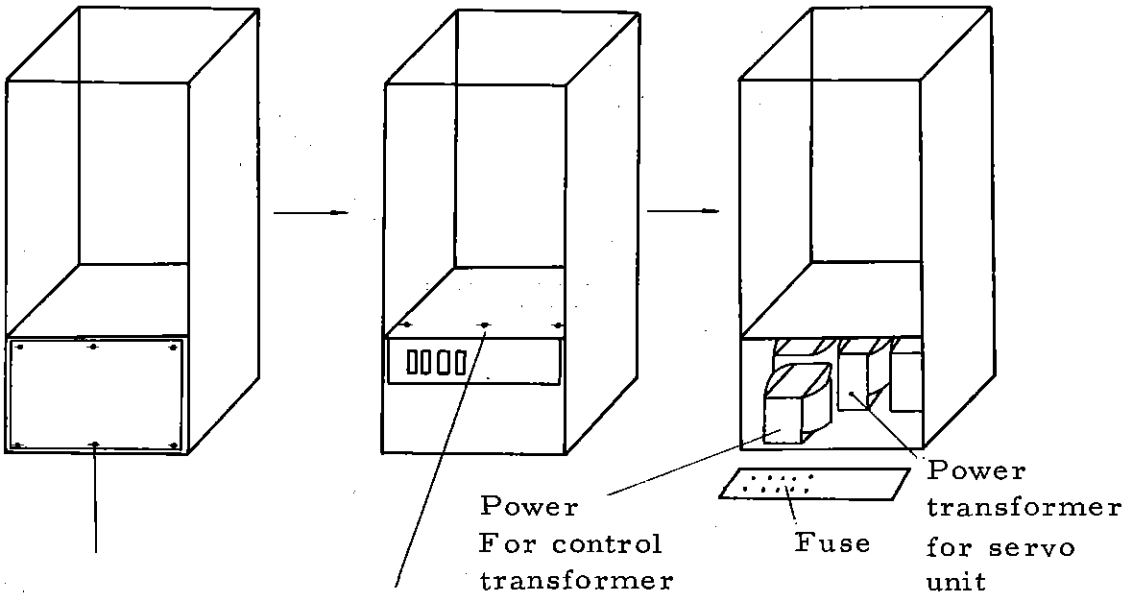
A closed-loop FANUC NC servo unit requires partial change in setting according to input power supply voltage and input frequency (50/60Hz).

3.1 Setting according to input power supply voltage

Set the input taps of the power transformers according to input power supply voltage.

Power transformers for the servo unit and for control are provided. One power transformer for the servo unit is provided for each axis. Conduct the setting in respect of all the axes.

As the taps of the power transformers are not visible from the front, follow the procedure shown in Fig. 3.1. When the setting is over, fix all disassembled items back in their original positions.



(1) Remove the six screws and remove the cover.

(2) Remove the three screws and remove the plate on which fuses are provided.

(3) Set the taps of the power transformer for the servo unit and the one for control.

Fig. 3.1

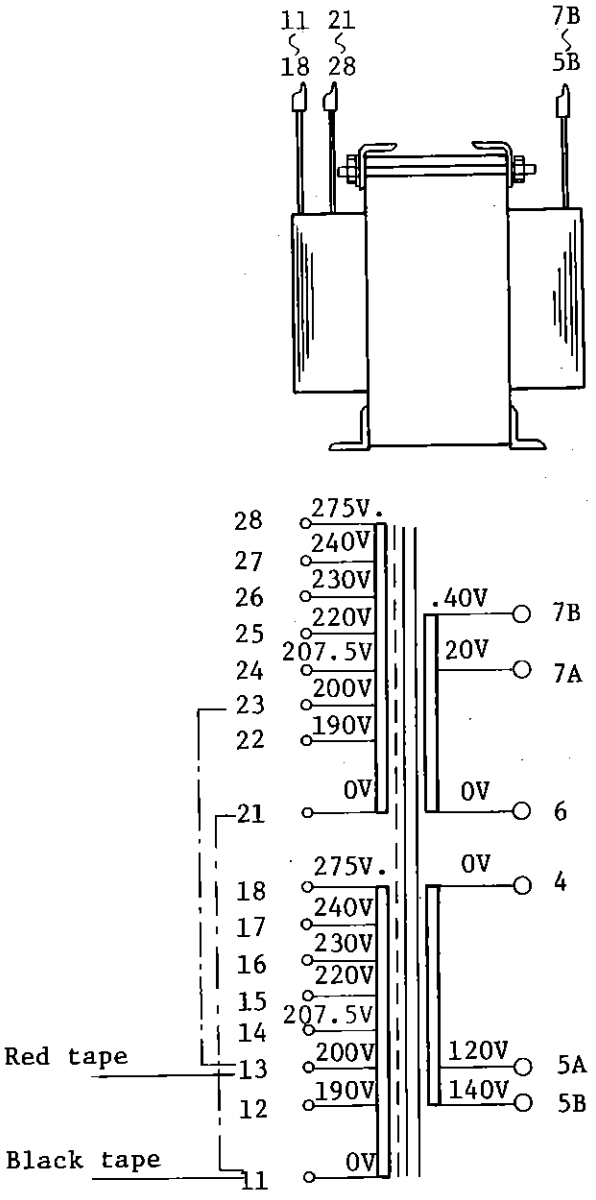
1) Setting tap of transformer for servo unit

Make the connections specified in Table 3-1.
Make the connections at terminals of the power transforme and tighten them securely.
Cover the terminals fully with the furnished cap for insulation.

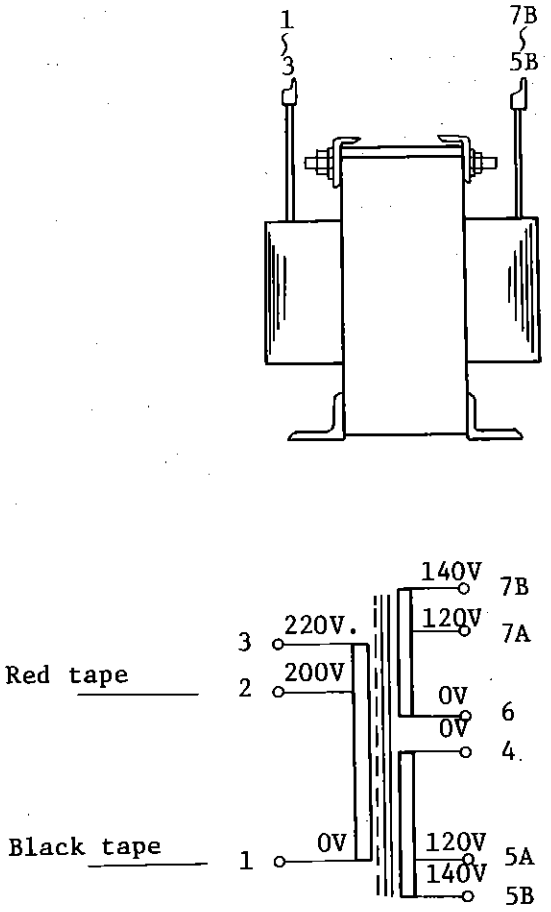
Table 3.1 Tap setting

Type	Input voltage(V)	Connection points for transformer		
		Cable with red tape	Cable with black tape	Transformer tap
For use in Japan	200±10%	2	1	
	220 "	3	1	
For use in other countries	200 "	13, 23	11, 21	
	220 "	15, 25	11, 21	
	230 "	16, 26	11, 21	
	240 "	17, 27	11, 21	
	380 "	22	11	12, 21
	415 "	24	11	14, 21
	440 "	25	11	15, 21
	460 "	26	11	16, 21
	480 "	27	11	17, 21
	550 "	28	11	18, 21

For use in countries other that Japan



For use in Japan



Fir. 3.2 Power transformer for servo unit

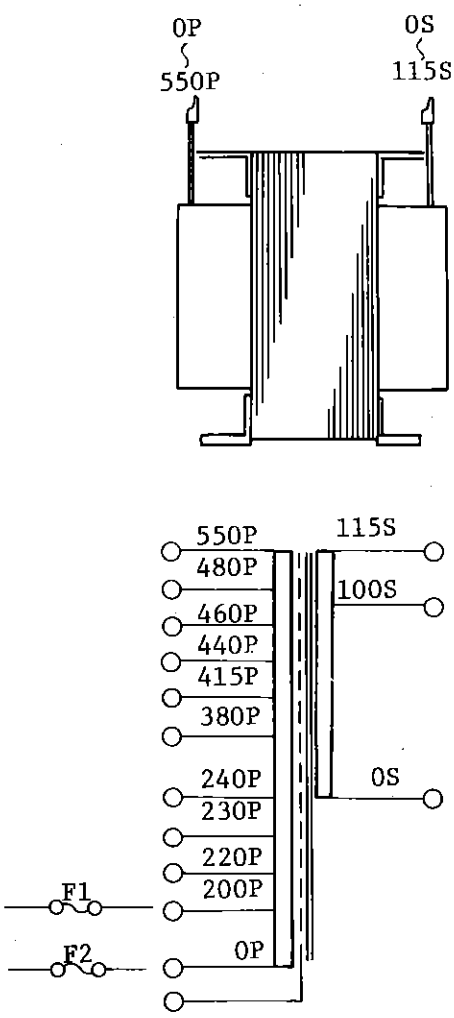
2) Setting tap of power transformer for control

Make the connections specified in Table 3.2.
Make the connections at terminal below fuse Fl. Tighten them securely.
Cover the terminals of the power transformer fully with the furnished cap for insulation.

Table 3.2

Type	Input Voltage (V)	Connection at terminal below fuse Fl
For use in Japan	200 ±10%	200P
	220 "	220P
For use in other countries	200 "	200P
	220 "	220P
	230 "	230P
	240 "	240P
	380 "	380P
	415 "	415P
	440 "	440P
	460 "	460P
	480 "	480P
	550 "	550P

For use in countries other than Japan



For use in Japan

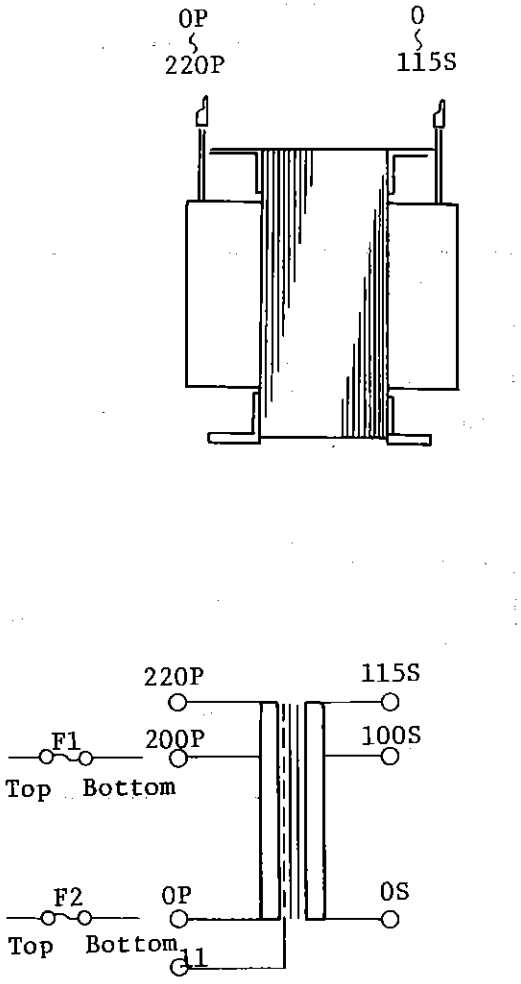


Fig. 3. 3 Power transformer for control

3.2 Setting according to input power supply frequency

Set the dither and gain of the thyristor firing circuit of the speed control unit according to input power supply frequency, 50 or 60Hz.

One control speed unit is provided for each axis. Conduct similar setting for all the axes.

Black and red tapes are attached to the thyristor firing circuits to indicate they are for 50Hz. And 60Hz respectively.

These circuits, when used at the specified frequency, do not require the setting described above.

Prior to setting

1) Connect to the NC device the feedback signal cable from the DC motor.

2) For the power cable for the DC motor, remove terminals T1 5 and 6 of the speed control unit. Then bring them back in their original positions.

3) As the setting is to be conducted with the DC motor in inactive state, the table may be lowered by its own weight when the NC device is turned ON. Before conducting the setting, fix the table so that it will not lower.

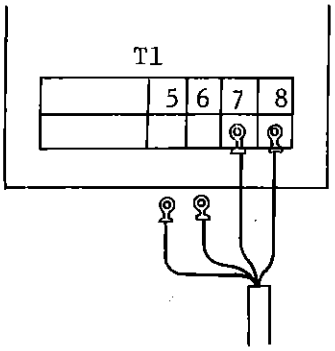


Fig. 3.4 Rear view of speed control unit

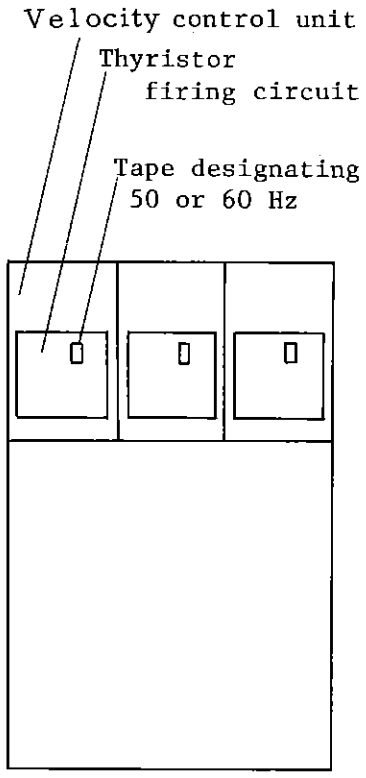
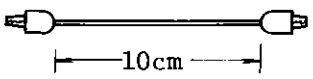


Fig. 3.5 Front view of NC

3.2.1 Setting dither

1) Tools required for setting

Oscilloscope	1
Small alligator clip	2



2) Setting procedure

a) Set the NC device and servo unit ON.

b) Short CH7 and CH12, and CH4 and CH12 of the thyristor firing circuit with the clip.

c) Set the pulse width of CH11 at 1,000 μs with variable resistor RV7 when the frequency is 50Hz and at 830 μs when the frequency is 60Hz. After the setting, remove the clip.

d) Short CH6 and CH12, and CH5 and CH12 of the thyristor igniting circuit by using the clip.

e) Set the pulse width of CH11 at 1,000 μs with variable resistor RV8 when the frequency is 50Hz and at 830 μs with the frequency is 60Hz. After the setting, remove the dip.

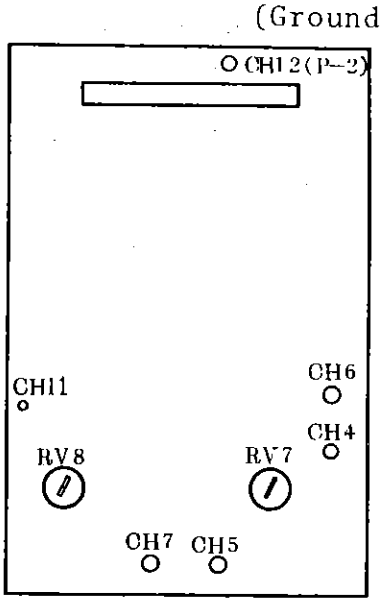


Fig. 3.6 Thyristor firing circuit

Table 3-3 Setting level

Power supply frequency	Pulse width of CH11
50Hz	1,000 μs
60Hz	830 μs

3.2.2 Setting gain

1) Tool required for setting

Oscilloscope 1

2) Setting procecure

a) Set the NC device and servo unit ON.

b) Feed a "+" move command from the control panel so that CH1 of the thyristor circuit is set at +1v.

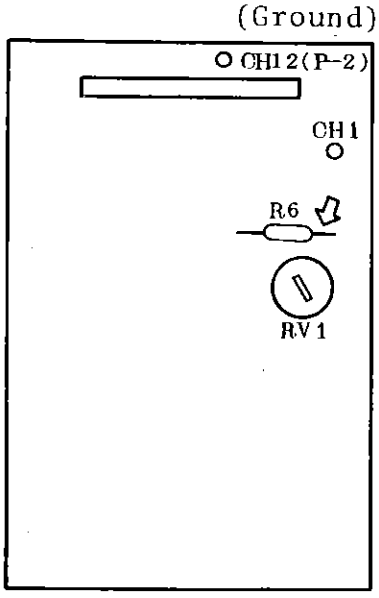


Fig. 3.7 Thyristor firing circuit

The number of command pulse varies with the gear ratio. The number of pulses at the level of 10 μ pulses is 100.

c) Adjust variable resistor RV1 at the point marked "⇦ EP" of R6 of the thyristor igniting circuit. Set it at +0.7v when the frequency is 50Hz and at +1v when the frequency is 60Hz.

Power supply frequency	Voltage setting at point " " when +1v is applied to CH1
50Hz	+0.7v
60Hz	-1.0v

Table 3-4

4. How To Use Zero Position Shift Function (For special-purpose model)

Zero return in a closed-loop FANUC NC device is effected by the grid system for stopping at a grid point of the position detector (resolver or Inductosyn) of the DC motor.

The zero position shift function can move the mechanical stoppage point by electrically shifting the grid point.

4.1 Setting procedure

a) Set the switch in Fig.4.2 at 0, set the control panel for zero return and set the dial in zero position.

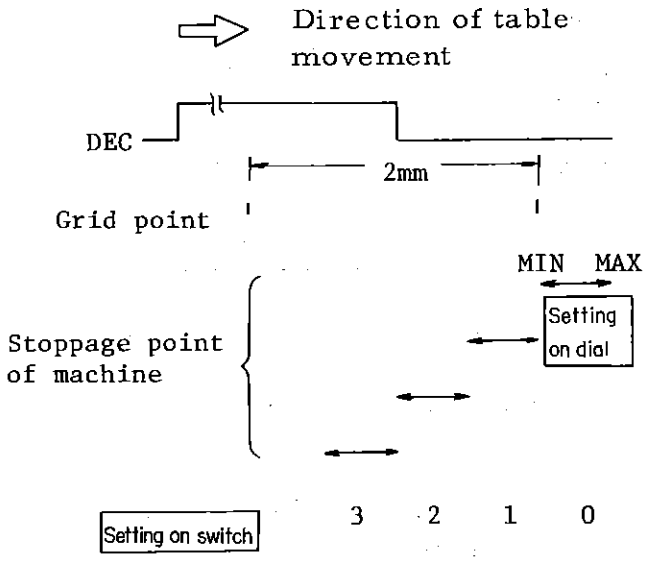
b) If the setting range on the dial is too narrow, turn the power for the NC device OFF and set the switch at 0 to 3 for zero return again.

c) If the position is outside the setting range of the switch, change the dog position.

Fig. 4-1

Setting range for zero position shift

Zero return at "+" move command



Zero return at "-" move command

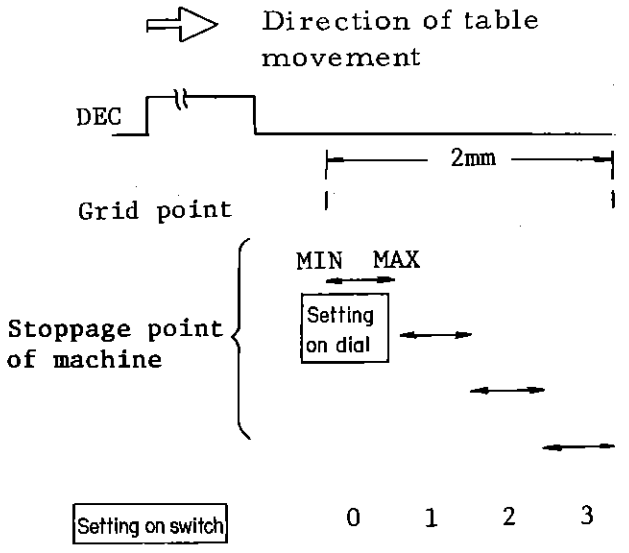
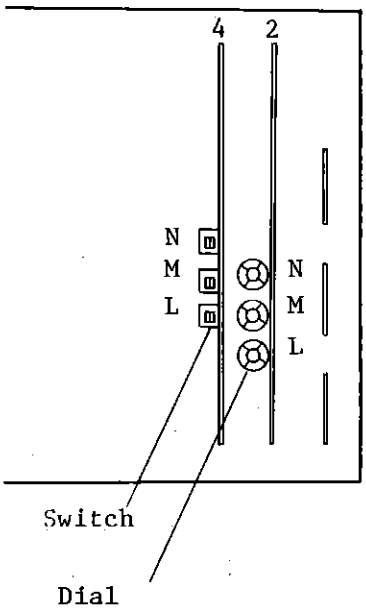


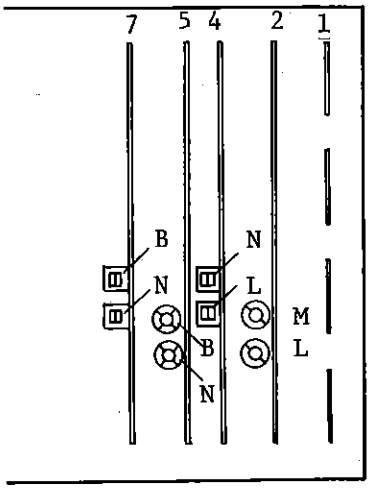
Fig. 4-2

Positions of switch and dial

2 or 3 axes



4 axes



Open the front door and look at printed circuit board.

Zero position adjustment

For a system without a circuit for zero position shift function (optional), a zero position adjustment can be made by rotating the stator of the resolver.
Make a zero position adjustment as follows.

1) Turn the power ON for zero return.

2) Remove the motor cover (2 M6 bolts with a hexagonal hole)

3) Loosen the screws for the pawl fixing the resolver.

4) Retating the stator of the resolver will move the machine. Fix the resolver at the time the machine reaches a specifie position (zero position).

5) Check if the deceleration dog is in proper position.

Note: If the screw mentioned in 3) above is excessively loosened until it falls off, the machine will start moving abruptly. Loosen the screw carefully.

5. Steps in Case of Trouble (For special-purpose model)

The following three lamps to indicate the state of the DC servo unit are provided on the display panel of the NC device.

(1) READY — Indicates that both the NC device and DC servo unit are ready.

(2) ALARM OH — Indicates that either the NC device or servo unit is overheated.

(3) ALARM SV — Indicates that the DC servo unit is in alarm state.

The remedies in the following cases will be described here.

(1) READY does not light.

(2) ALARM OH lights.

(3) ALARM SV lights.

The operator should take the remedial steps indicated by a circled number. If its cause is not found out after these steps, please contact Fujitsu FANUC.

5.1 READY Lamp does not Light

Step	Item	Check point	Remedy
①	Is the servo alarm lamp lighted? YES → / NO ↓		Refer to 5.3.
②	Is any phase of the AC input voltage lacking?	Check the voltages at the AC input terminals shown in Fig.5.1.	Check the power supply side.
3	Has the AC input blown out?	Check the voltages (AC200/220v) among the output ends of fuses 3 to 10.	Replace the fuse.
4	Has the input fuse of the speed control unit blown out?	Check the voltages between the output end of fuses 12 and 13, 15 and 16, 13 and 19 and 21 and 22. (AC240v)	
5	Has the +24v fuse of the speed control unit blown out?	Check the voltages at the output ends of fuses 23, 26, 29 and 32 shown in Fig. 5.9. (DC 24v)	Eliminate the cause and replace the fuse.
6	Is AC 115v applied to T2 of the speed control unit?	Check the voltages at T2 (1) and (2) shown in Fig. 5.7.	Check the NC power supply circuit.
7	Is the VELOCITY READY signal ON for the position control unit?	Check the voltages at J9-A8 shown in Fig.5.2 and 5.3. (VELOCITY READY at Ov)	Check the cable between the speed control unit and position control u unit inside the speed/ position control unit.

Step	Item	Check point	Remedy
8	Is SERVO READY from the position control unit ON?	Check the voltages at J7-AB in Fig. 5.2 and 5.3. (SERVO READY at +5v)	Check the interior of the position control unit.
9	Check the NC device side.	Refer to the maintenance manual of the NC device.	

5.2 Overheat lamp lights

Step	Item	Check point	Remedy
①	Is the DC motor overheated? ⇨ YES NO ⇩	Check the temperature of the surface of the DC motor. (Overheat at approx. 80°C or higher level)	Turn the power OFF to cool the DC motor.
②	Is the overheated cable from the DC motor disconnected?	Check the cable between the DC motor and servo unit.	Connect the cable securely.
3	Is the overheat signal ON for the position control unit?	Check the voltage at J1-A10 shown in Fig. 5.2 and 5.3. (Overheat at +20v)	Check the input cable in the servo unit.
4	Is the overheat signal from the position control unit?	Check the voltage at J7-B15 shown in Fig. 5.2 and 5.3. (Overheat at 0 v)	Check the interior of the position control unit.
5	Check the NC device side.	Refer to the maintenance manual of the NC device.	

Table 5.2

5.3 Servo alarm lamp lights

The servo alarm lamp lights inside the servo unit in the following cases.

1) Excessive error

2) Lowered level

3) Overload

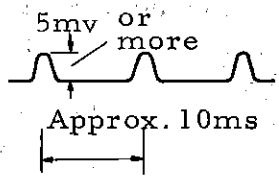
If the content of the error register reaches 8,000 pulses (each converted into 1 in length), the servo alarm lamp lights.

If the sine wave input from the position detector (resolver, Inductosyn) is at $3v_{p-p}$ or lower, this alarm lamp lights.

If an excessive current flows through the DC motor to activate the thermal relay in the speed control unit, the alarm lamp lights.

1) Excessive error lamp lights

Step	Item YES	Check point	Remedy
①	Is the power cable of the DC motor disconnected? ⇩NO	⇨Check the power cable of the DC motor.	Connect the cable securely.
②	Is the table of the machine braked?	Check the clutch of the machine.	Check the clutch, magnetics panel, etc.
3	Has the fuse of the speed control unit blown out?	For the L axis, check the voltage between the output ends of fuses 14 and 15 shown in Fig. 5.1. (AC 240v) Check the voltage between the output ends of fuses 15 and 16. (AC 24v) Check the voltage at the output end of Fuse 29. (DC 24v) Check the voltage at the output end of fuse 30. (DC 15v) Check the voltage at the output end of fuse 31. (DC 15v)	Eliminate the cause of fuse blow-out and replace the fuse.
4	Is the speed control unit out of order?	Check the waveform between terminals of the thermal relay of the speed control unit shown in Fig. 5.4. The waveform shown below must be attained between terminals	Replace or repair the printed circuit board of the speed control unit.

Step	Item	Check point	Remedy
		when the machine is moved at low spee.  	
5	Is the DA converter of the position control unit in order?	Check the voltages at J9-A5 (L axis), J9-B3 (M axis) and J9-A2 (N axis) shown in Fig. 5.2 and 5.3. Disconnect the power cable of the DC motor to prevent its rotation. The voltage at the terminal should be +1.25v when +1,000 pulses are applied to the error register for position control. This, however, is the value when the gear ratio is 1:5. If this ratio is at different levels, the voltage is inversely proportional to the gear ratio.	Replace or repair the printed circuit board of the position control unit.
6	Do feedback pulses return to the error register of the position control unit?	Check the amount of movement of the machine, applying +1,000 pulses (1 in length) from the NC device. If feedback pulses are normal, the machine moves 1mm and stops. In case of trouble, it moves until an excessive error is detected.	Replace or repair the printed circuit board of the position control k unit. Check if the gear of the resolver of the DC motor is loosened.

Step	Item	Check point	Remedy
7	Is the NC device out of order with high-frequency pulses emitted?	Refer to the maintenance manual of the NC device.	

2) Alarm lamp for lowered level light.

Table 5-4

Step	Item	Check point	Remedy
①	Is any feedback signal cannon connector from the DC motor disconnected? NO YES ⇩ ⇨	Check the feedback signal cannon connectors shown in Fig. 2.7.	Connect the connector securely.
②	Is any feedback cable from the DC motor broken?	Check the feedback cables from the DC motor.	Connect the cable securely.
3	Is the feedback signal from the resolver applied to the position control unit?	Check the levels of the sine waves of CH6L to CH6B shown in Fig. 5.2 and 5.3. A level of $3v_{p-p}$ or higher is normal.	Check the feedback cables in the servo unit. Examine or replace the position control printed circuit board.
4	Is the circuit for detecting a lowered level inside the position control unit out of order?	Check the A16B-0160-0540 to 0543 circuit for detecting a lowered level shown in Fig. 5.2 and 5.3. The level is lowered when comparator C41 (15), L axis, C41 (02), M axis, and C41 (03) N axis are at 5v.	Repair or replace the printed circuit board of the position control unit.

3) Overload lamp lights

Table 5-5

Step	Item	Check point	Remedy
①	Is the axis torque of the machine abnormally great? NO ⇩ YES ⇨	Check the clutch and others of the machine.	Replace the brake.
②	Is continuous heavy cutting parformed?		Refer to the over-load duty Characteristics of the DC motor.
3	Is the overload signal to the position control unit ON?	Check the level at J9-A11 shown in Fig. 5.2 and 5.3. Over travel at +20v	Check the cable between the speed and position control units.
4	Is the receiver for overload inside the position control unit out of order?	Check the A16B-0160-0540 to 0543 receiver shown in Fig. 5.2 and 5.3. Overload when receiver D41 (30) is at +5v.	Repair or replace the printed circuit board of the position control unit.

Arrangement of fuses

Front view

Rear view

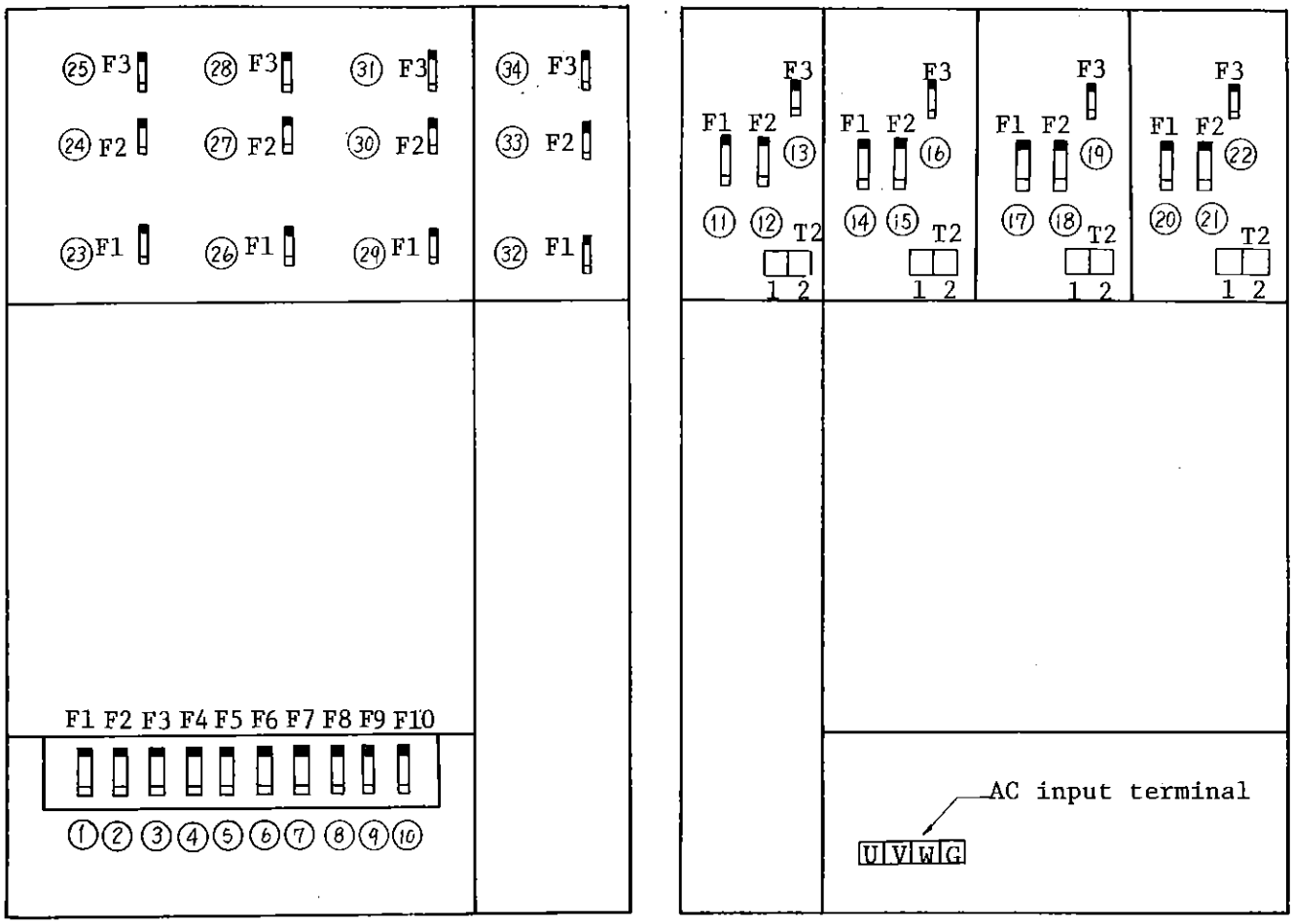
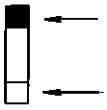


Fig. 5.1

Note 1.  Input end

Output end

Note 2. For a description of the fuses, refer to Table 4.6.

Description of fuses

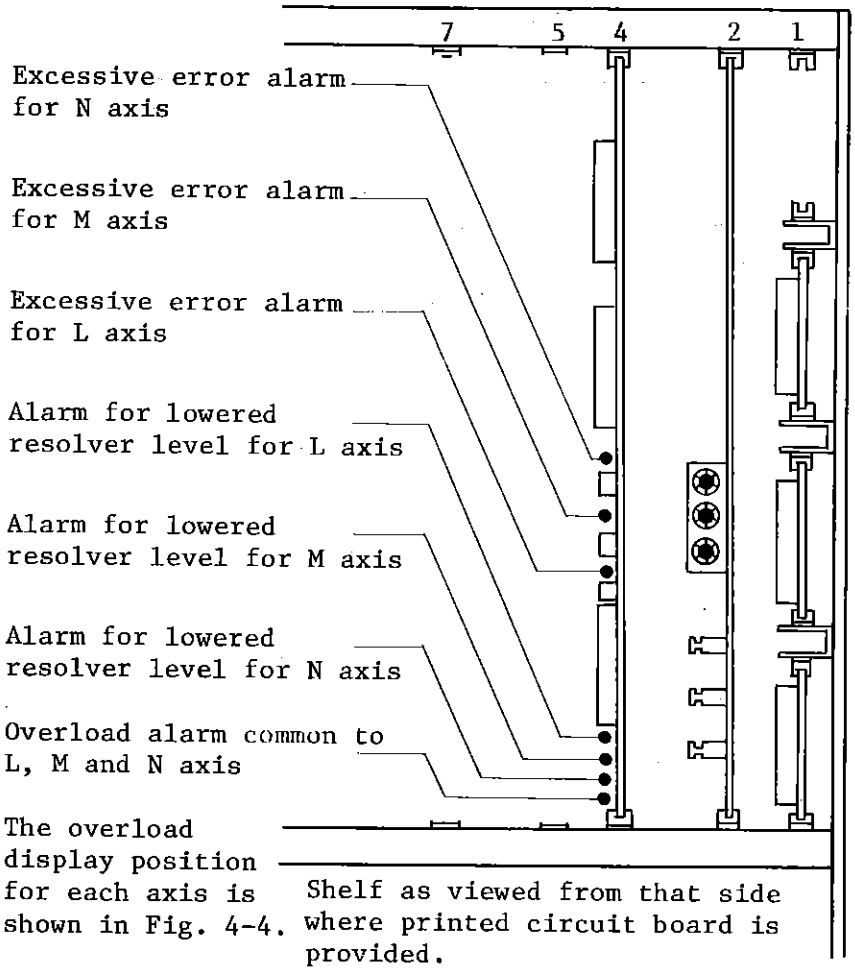
Table 5-6

Fuse No.	Use		FANUC specification No.	Remarks
	Location	Line voltage		
1 2	Input fuse of NC device proper	AC200/220V	A60L-0001-0036#PC1-15	15A
3 4	Input fuse of servo unit. L axis	"	" #PC1-30	30A
5 6	Input fuse of servo unit M axis	"	"	"
7 8	Input fuse of servo unit N axis	"	"	"
9 10	Input fuse of servo unit B axis	"	"	"
11 12	Speed control unit L axis	AC120V	"	"
13	Speed control unit L axis	AC240V	A60L-0001-0039#A-1	1A
14 15	Speed control unit M axis	AC120V	A60L-0001-0036#PC1-30	30A
16	Speed control unit M axis	AC240V	A60L-0001-0039#A-1	1A
17 18	Speed control unit N axis	AC120V	A60L-0001-0036#PC1-30	30A
19	Speed control unit N axis	AC240V	A60L-0001-0039#A-1	1A
20 21	Speed control unit B axis	AC120V	A60L-0001-0036#A-1	30A
22	Speed control unit B axis	AC240V	A60L-0001-0039#A-1	1A

Fuse No.	Use		FANUC specification No.	Remarks
	Location	Line voltage		
23	Speed control unit L axis	+ 24V	A60L-0001-0041#R3A	0.3A
24	Speed control unit L axis	+ 15V	"	"
25	Speed control unit L axis	- 15	"	"
26	Speed control unit M axis	+ 24V	"	"
27	Speed control unit M axis	+ 15V	"	"
28	Speed control unit M axis	- 15V	"	"
29	Speed control unit N axis	+ 24V	"	"
30	Speed control unit N axis	+ 15V	"	"
31	Speed control unit N axis	- 15V	"	"
32	Speed control unit B axis	+ 24V	"	"
33	Speed control unit B axis	+ 15V	"	"
34	Speed control unit B axis	- 15V	"	"

Note 1. The positions of fuses 1 to 34 are shown in Fig. 5.1.

Positions of alarm lamps (2 or 3 axes)



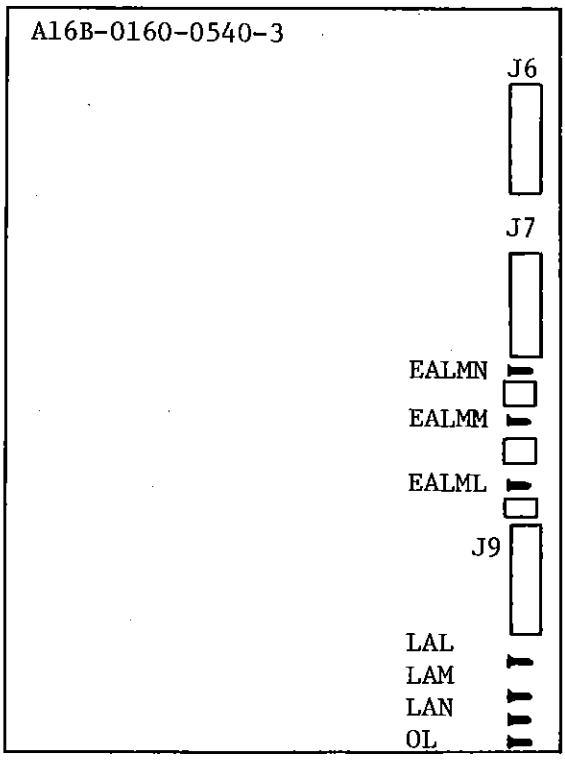
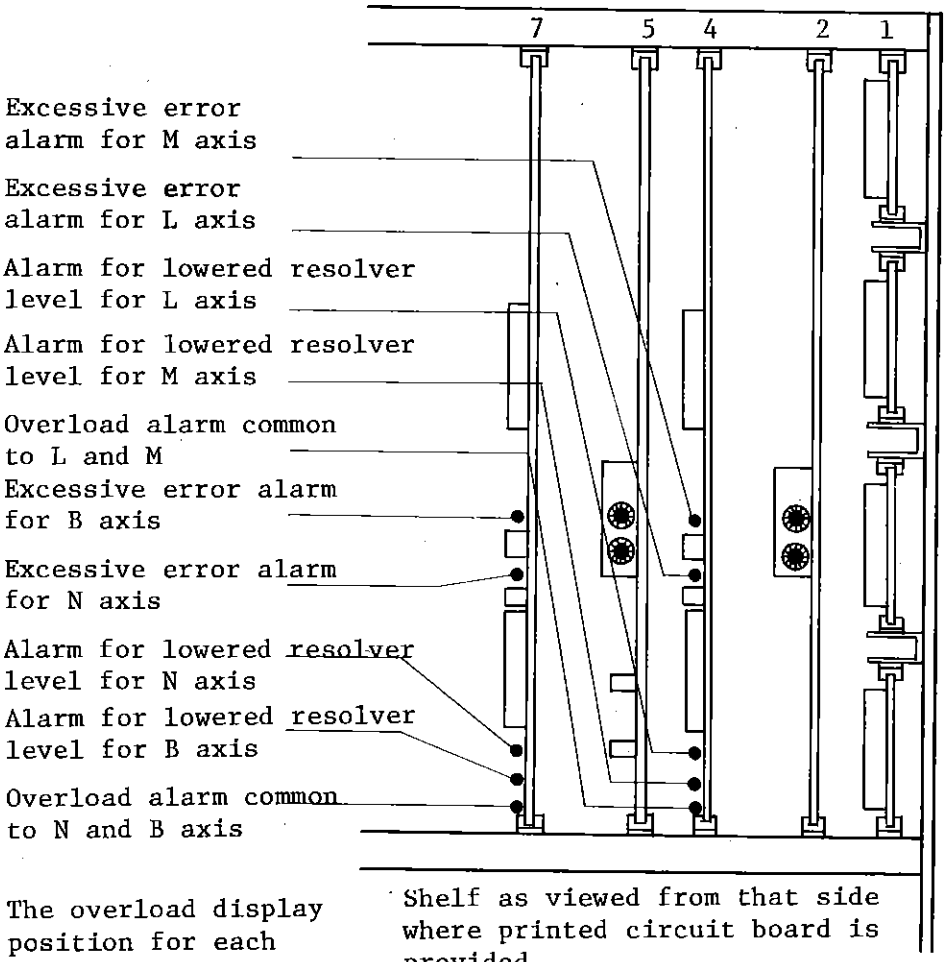


Fig. 5.2

Positions of alarm lamps (4 axes)



Shelf as viewed from that side where printed circuit board is provided.

The overload display position for each axis is shown in Fig. 4-4.

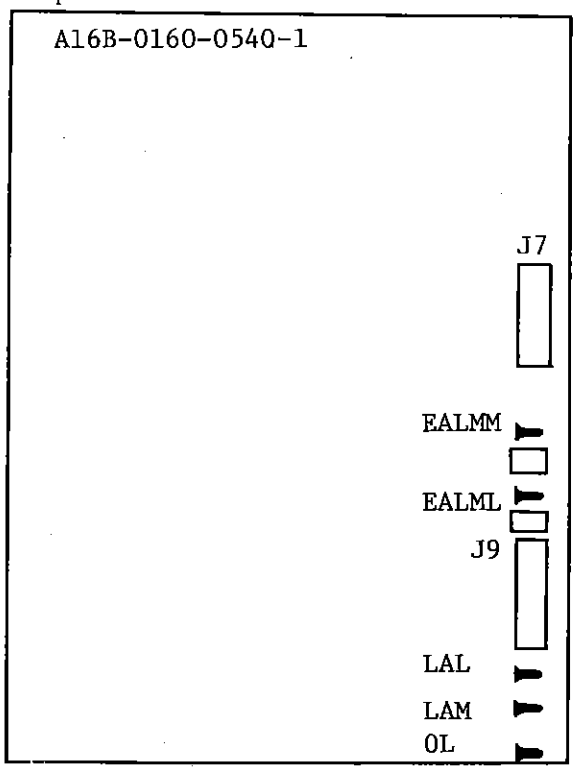
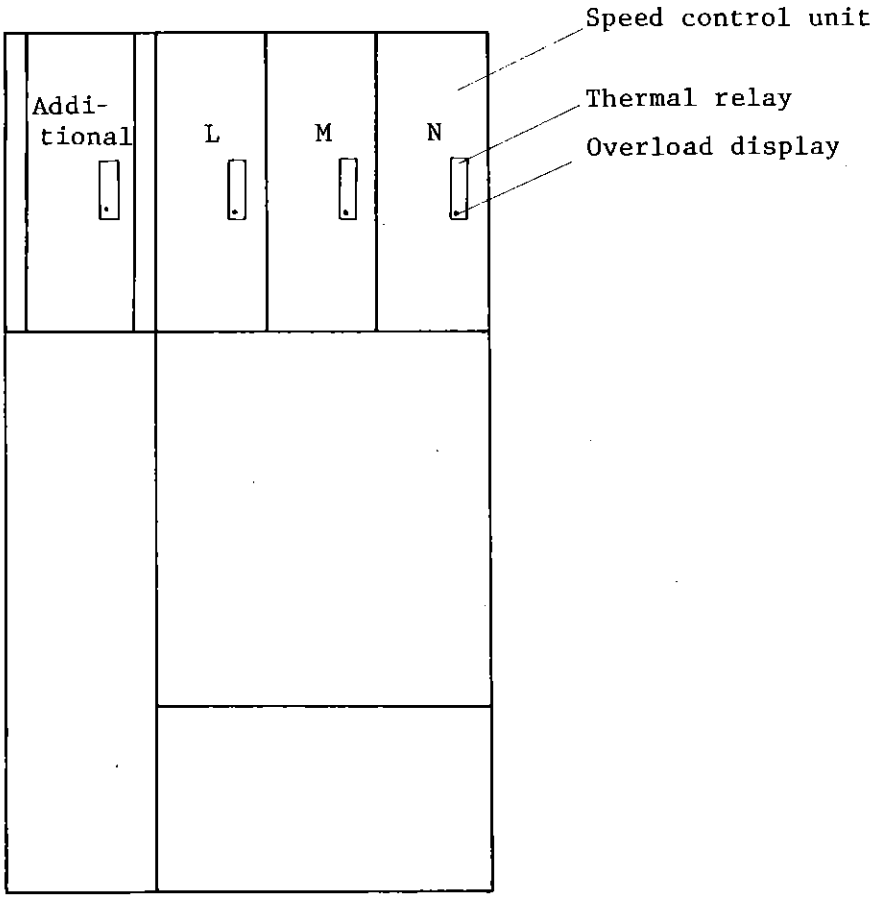
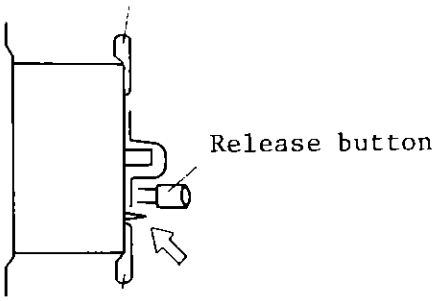


Fig. 5.3

Overload display positions



Rear view



If an excessive current flows through the DC motor, the point indicated by the mark "⇦" appears white.

Fig. 5.4

5.4 Replacing parts of feedback section

Replace parts of the feedback section as shown in Fig. 5.5.

1. Replacing flexible coupling

   1) Loosen the screw of clamp 1.
   (M3 bolt with a hexagonal hole)

   2) Remove the bolts for fixing the plate.
   (M4 bolt with a hexagonal hole)
   Remove from the motor the tachometer generator and resolver together with the plate.

   3) Loosen the drag screw for fixing the flexible coupling. Provide a gap of approx. 2mm between the screw head and washer and hit the screw head with a hammer to remove the tapered nut. Now the flexible coupling can be removed.

2. Replacing spur gear and pinion

   1) The gear can be removed by hoosening clamps 2 and 3 in state 1-2) above.

   2) Fix the spur gear so as to provide a gap of approx. 1mm from the plate.

   3) Fix the pinion, placing its surface onto surface A of the spur gear.

   4) Provide engagement for the pinion, setting the two gears fully off the neutral point and then bringing them one pitch back.

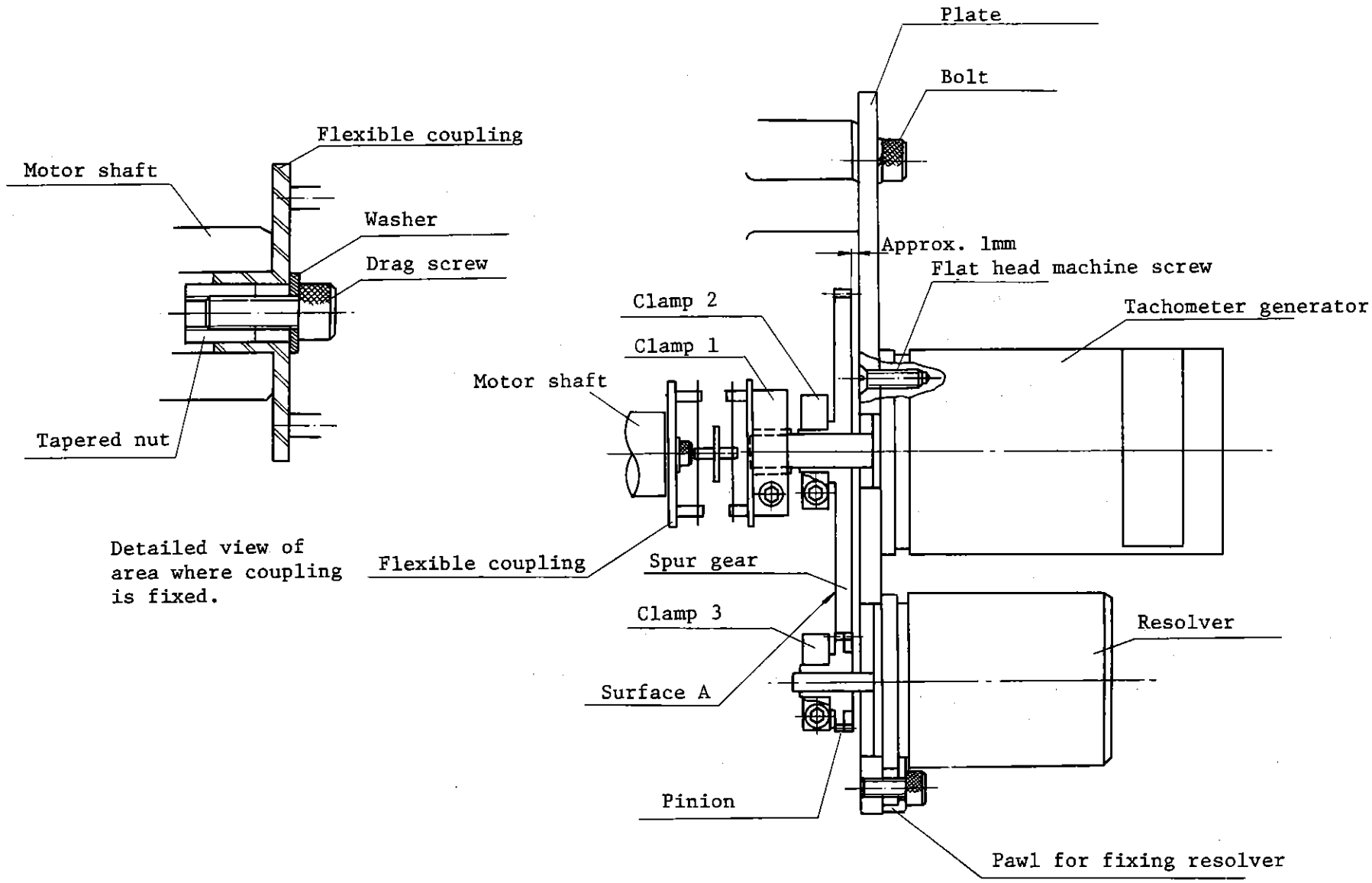


Plate
Bolt
Flexible coupling
Motor shaft
Washer
Drag screw
Approx. 1mm
Flat head machine screw
Clamp 2
Tachometer generator
Clamp 1
Motor shaft
Tapered nut
Detailed view of
area where coupling
is fixed.
Flexible coupling
Spur gear
Clamp 3
Resolver
Surface A
Pinion
Pawl for fixing resolver

Fig. 5.5

6. Connection of Servo Unit and Motor (For general-purpose model)

This section describes the procedure for extending feedback signal cables and power cables for motor drive between the servo unit and motor.

In a closed loop, incorrect connection would bring the system into an oscillatory state which may cause damage to the servo unit and motor. Make sure of proper connection.

6.1 Connection for resolver system

For a DC motor with a built-in resolver, either the regular or reverse connection should be made according to the direction of motor rotation as indicated in Fig. 6.1 and Fig. 6.2.

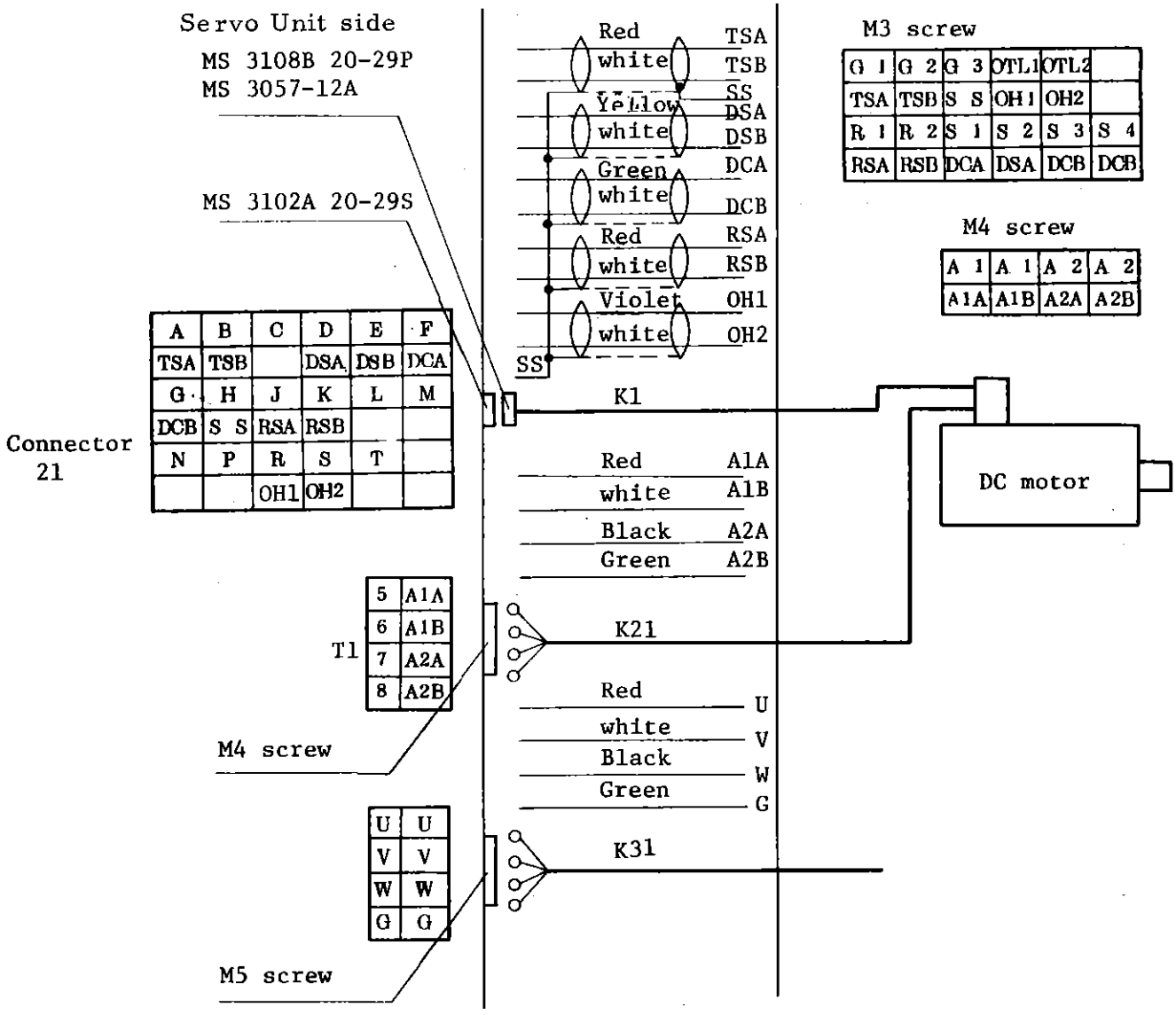


Fig. 6.1 Regular connection

Connector 21

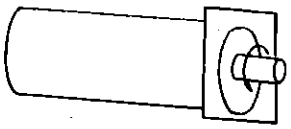
A	B	C	D	E	F
TSB	TSA		DSB	DSA	DCA
G	H	J	K	L	M
DCB	S S	RSA	RSB		
N	P	R	S	T	
		OH1	OH2		

T1

5	A2A
6	A2B
7	A1A
8	A1B

Fig. 6.2 Reverse connection

Regular connection (NC "+" move command)



Reverse connection (NC "-" move command)

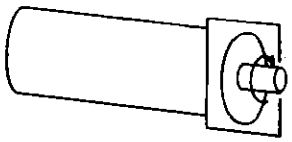
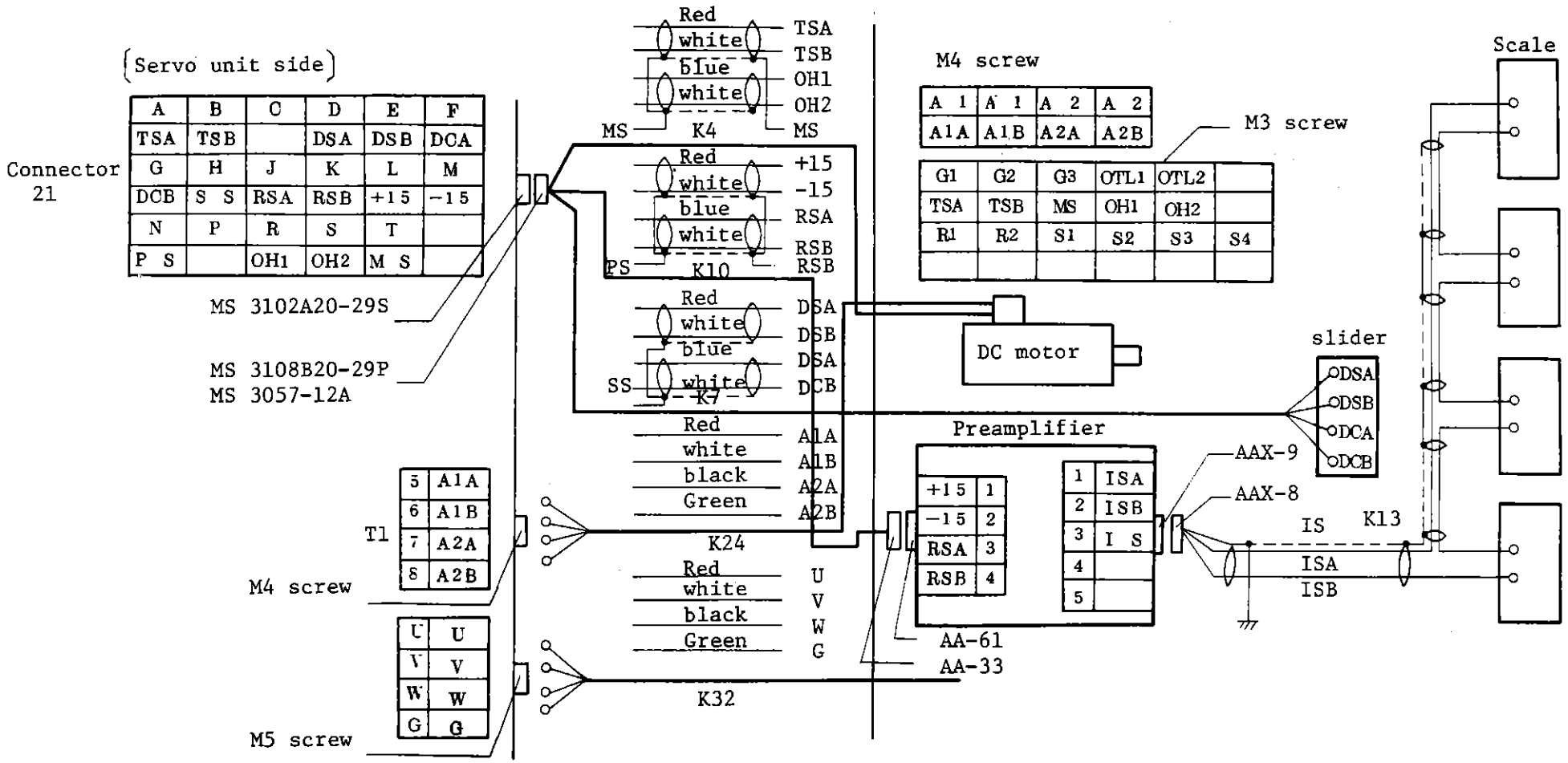


Fig. 6.3 Direction of motor rotation

6.2 Connection for Inductosyn

For the Inductosyn, either the regular or reverse connection should be made according to the direction of motor rotation as indicated in Fig. 6.4 and 6.5.



The connection and the direction of motor rotation are shown in Fig. 2.3.

Fig. 6.4 Regular connection

Connector 21

A	B	C	D	E	F
TCB	TSA		DSB	DSA	DCA
G	H	J	K	L	M
DCB	S S	RSA	RSB	+15	−15
N	P	R	S	T	
P S		OH1	OH2	M S	

T1

5	A2A
6	A2B
7	A1A
8	A1B

Fig. 6.5 Reverse connection

6.3 Terminal Positions and Cable Routes

A rear view of the servo unit specially designed for the NC device is provided in the figure below.
Be careful not to confuse the shaft of the motor power.

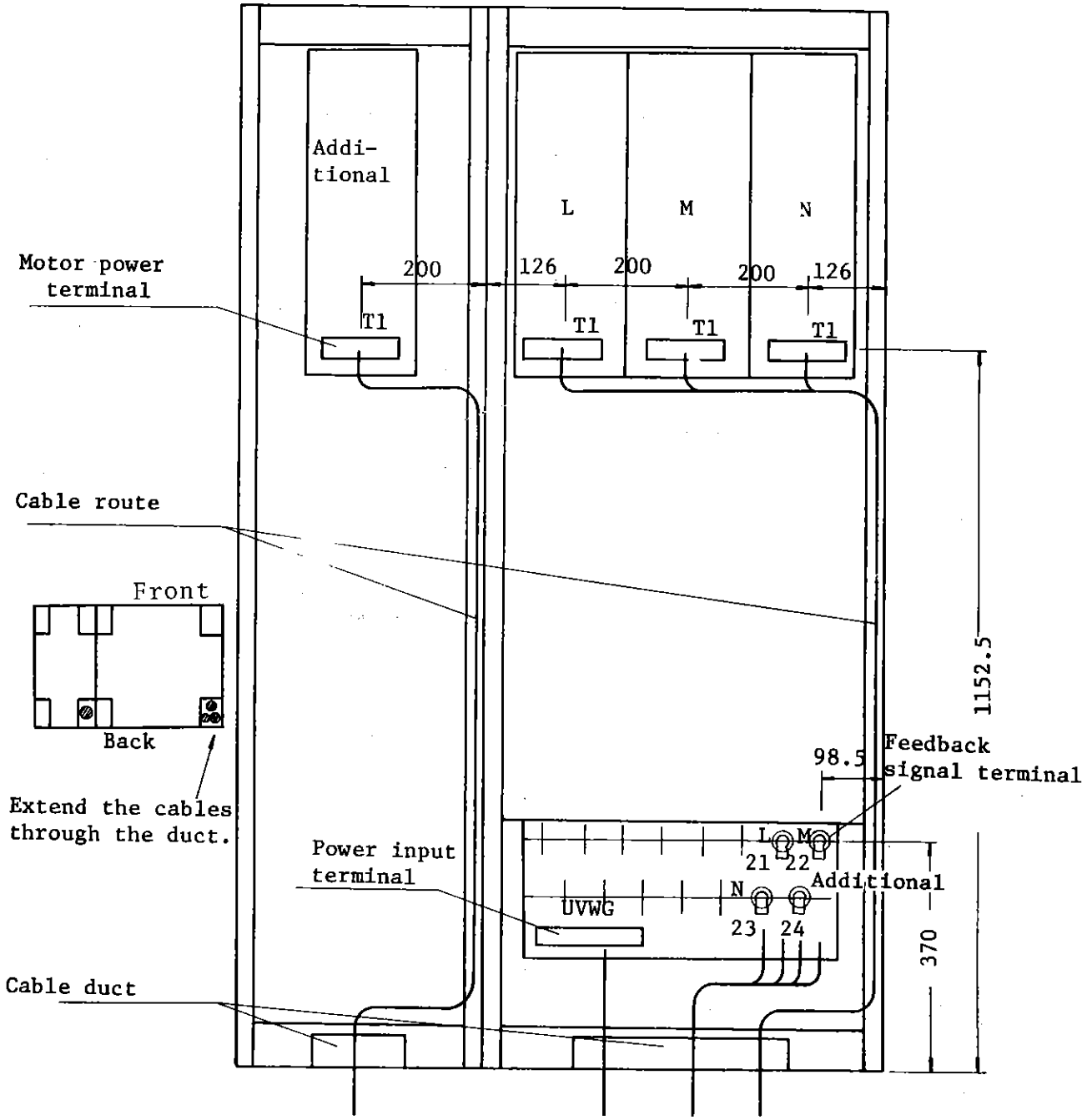
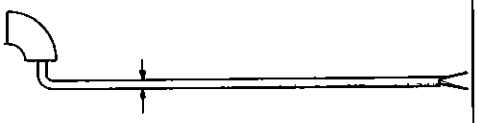
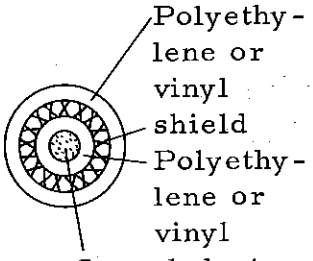
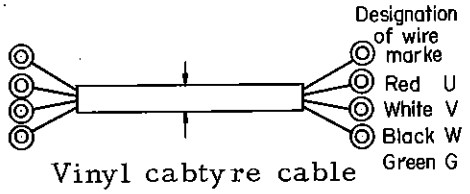
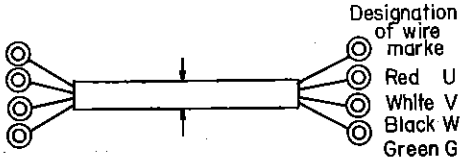

Addi-
tional
L
M
N
Motor power
terminal
200
126
200
200
126
T1
T1
T1
T1
Cable route
Front
Back
Extend the cables
through the duct.
1152.5
98.5
Feedback
signal terminal
Power input
terminal
L
M
21
22
Additional
N
UVWG
23
24
370
Cable duct

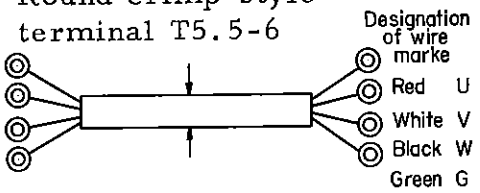
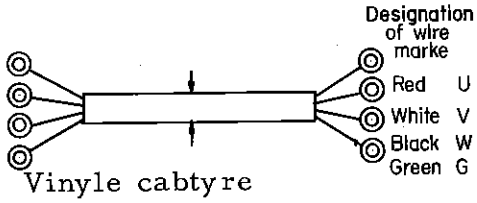
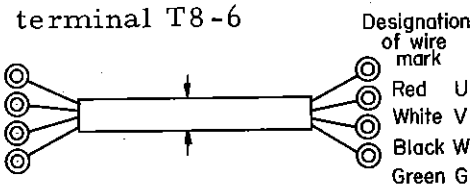
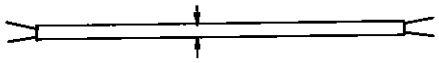
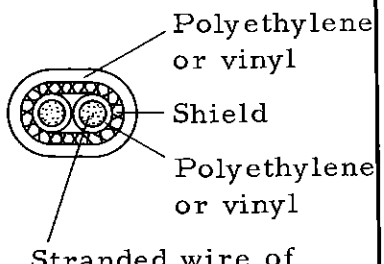
Fig. 6.7

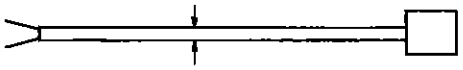
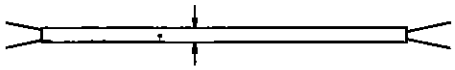
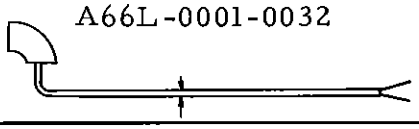
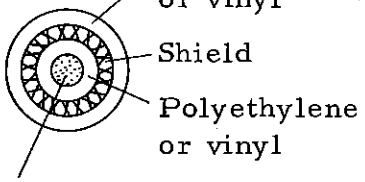
6.4 Connection Cables

Standard FANUC cables are recommended an connection cables, but other cables meeting the requirements shown in the column titled "Other cable" in Table 6.1 below.

Table 6.1

Use	Name	Standard FANUC cable	Other cable
Signal cable for DC servo motor (For resolver)	K1	MS3108B 20-29P Clamp MS 3057-12A 5-pair shielded cable ($0.3mm^2$) A66L-0001-0031 	 Fig. 3 of $0.3mm^2$ or more
Power cable for DC servo motor	K21 K24	Crimp-style terminal T5.5-4  Vinyl cabtyre cable 4-core JIS 3312 45/0.32 $3.5mm^2$	Breakdown voltage: AC240V or higher Conductor: $3.5mm^2$ or more
Power cable for servo unit 6KvA or less	K31 K32	Round crimp-style terminal T2-6  Vinyl cabtyre cable 4-core JIS 3312 37/0.26	Breakdown voltage: AC550v or higher Conductor: $1.9mm^2$ or more

Use	Name	Standard FANUC cable	Other cable
Power cable for servo unit 9KvA or less	K31 K32	Round crimp-style terminal T5.5-6  Vinyle cabtyre cable 4-core JIS C3312 45/0.32	Brakedown voltage: AC550v or higher Conductor: 3.6mm^2 or more
Power cable for servo unit 12KvA or less	K31 K32	Round crimp-style terminal T5.5-6  Vinyle cabtyre cable 4-core JIS C3312	Breakdown voltage: AC550v or higher Conductor: 5.6mm^2 or more
Power cable for servo unit 16KvA or less	K31 K32	Round crimp-style terminal T8-6  Cabtyre cable 4-core JIS C3312 50/0.45	Breakdown voltage: AC550v or higher Conductor: 7.9mm^2 or more
Inductosyn slider cable	K7	 2-pair shielded cable (0.5mm^2) A66L-D001-0032	 Stranded wire of 0.5mm^2 or more

Use	Name	Standard FANUC cable	Other cable
Cable for Inductosyn preamplifier	K10	 2-pair shielded cable (0.5mm^2) A66L-0001-0032	"
Inductosyn scale cable	K13	 1-pair shielded cable (0.5mm^2) FN454-7 PBCS 2w-20/0.18	"
Signal cable for DC servo motor (For Inducto-syn)	K4	MS 3108B 20-29P Clamp MS3057-12A  2-pair shielded cable (0.5mm^2) A66L-0001-0032	

For types of standard FANUC power cable are available. Select a suitable cable meeting the total need for those axes in respect of which rapid traverse speed is to be effected simultaneously, calculating the sum by applying a rate of 3KvA per axis for the Model 10 DC servo motor and a rate of 5KvA per axis for the Models 20 and 30 DC servo motors.

6.5 Maintenance area

The minimum required space to be secured for smooth maintenance is shown in Fig. 6.8.

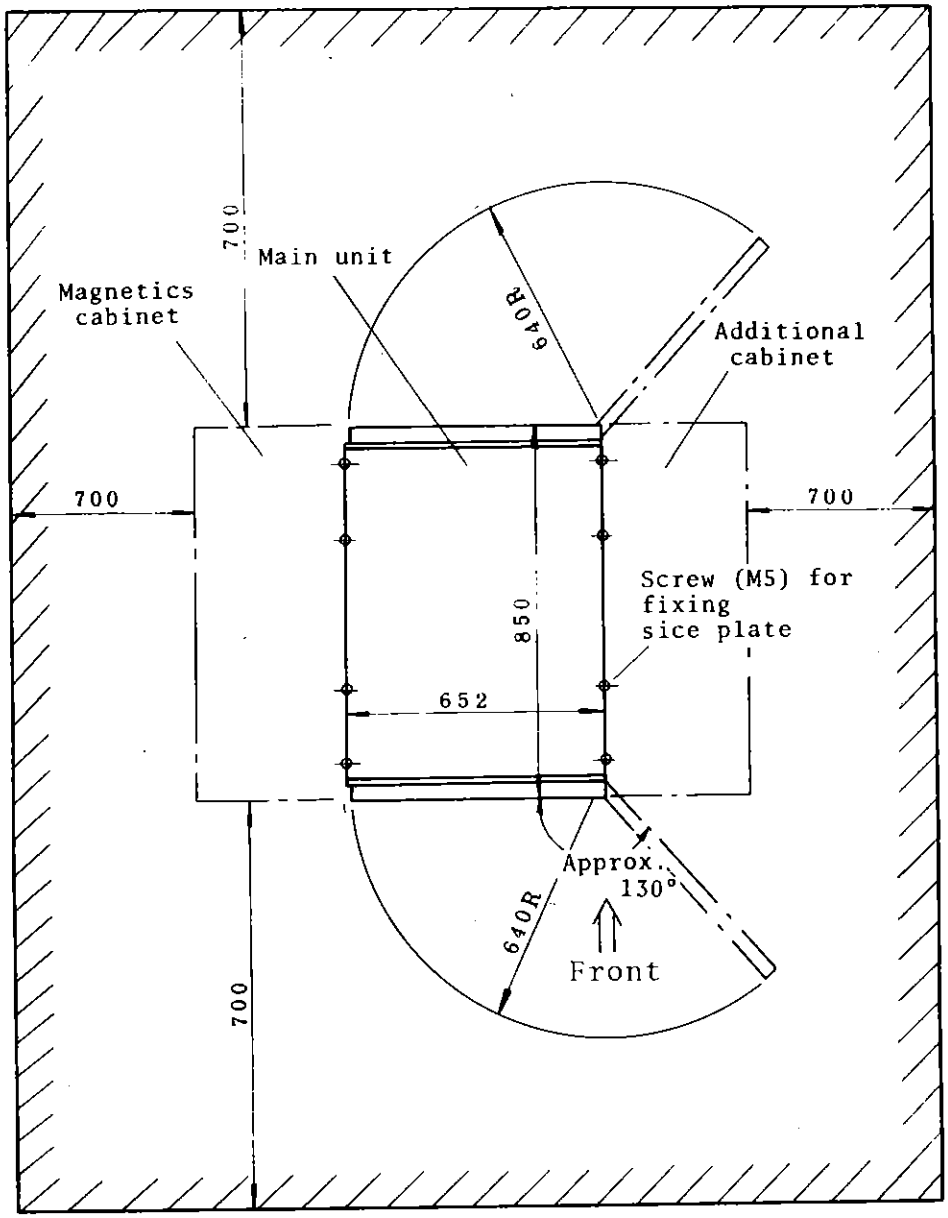


Fig. 6.8

7. Setting After Installation (For general-purpose model)

A closed-loop FANUC NC servo unit requires partial change in setting according to input power supply voltage and input frequency (50/60Hz).

7.1 Setting according to input power supply voltage

Set the input trans of the power transformers according to input power supply voltage.

The power transformer for the servo unit is provided for each axis. Condust the setting in respect of all the axes.

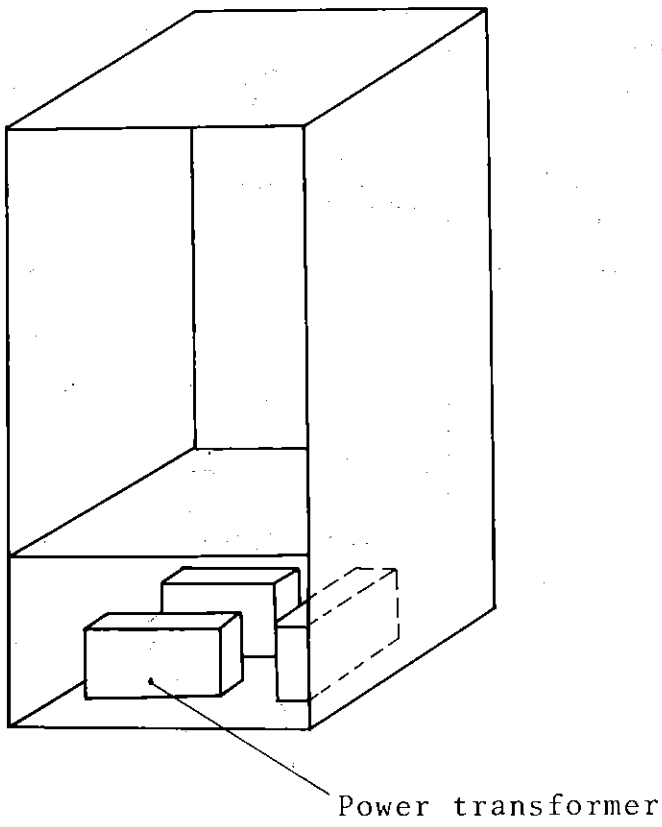


Fig. 7.1

1) Setting tap of transformer for servo unit

Make the connections specified in Table 7-1.
Make the connections at terminals of the power transformer and tighten them securely.
Cover the terminals fully with the furnished cap for insulation.

Table 7-1 Tap setting

Type	Input voltage (V)	Connection points for transformer		
		Cable with red tape	Cable with black tape	Transformer tap
For use in Japan	200 ±10%	2	1	
	220 "	3	1	
For use in other countries	200 "	13, 23	11, 21	
	220 "	15, 25	11, 21	
	230 "	16, 26	11, 21	
	240 "	17, 27	11, 21	
	380 "	22	11	12, 21
	415 "	24	11	14, 21
	440 "	25	11	15, 21
	460 "	26	11	16, 21
	480 "	27	11	17, 21
	550 "	28	11	18, 21

For use in countries other than Japan

For use in Japan

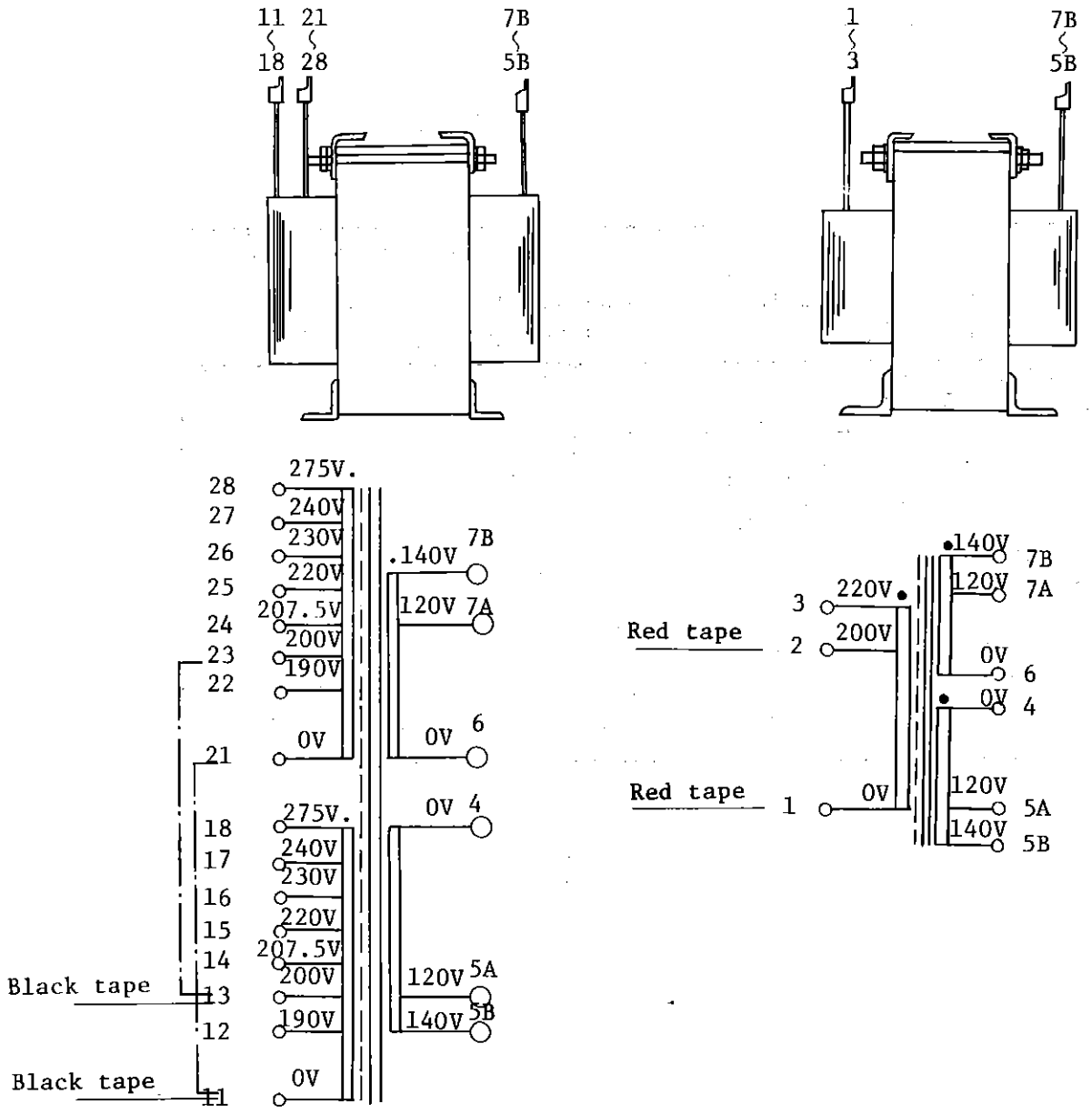


Fig.7.2 Power transformer for servo unit

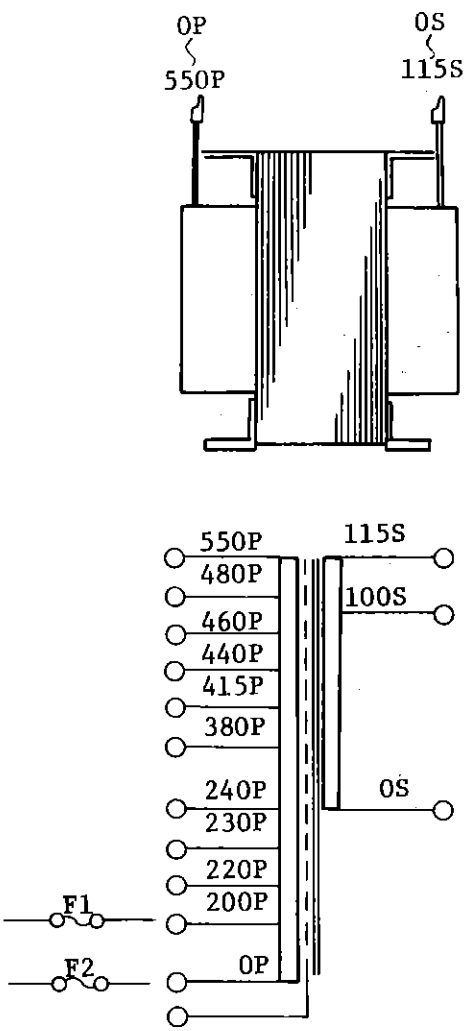
2) Setting tap of power transformer for control

Make the connections specified in Table 7-2.
Make the connections at terminals below fuse Fl. Tighten them securely.
Cover the terminals of the power transformer fully with the furnished cap for insulation.

Table 7-2

Type	Input voltage (V)	Connection at terminal below fuse Fl
For use in Japan	200 ±10%	200P
	220 "	220P
For use in other countries	200 "	200P
	220 "	220P
	230 "	230P
	240 "	240P
	380 "	380P
	415 "	415P
	440 "	440P
	460 "	460P
	480 "	480P
	550 "	550P

For use in countries other than Japan



For use in Japan

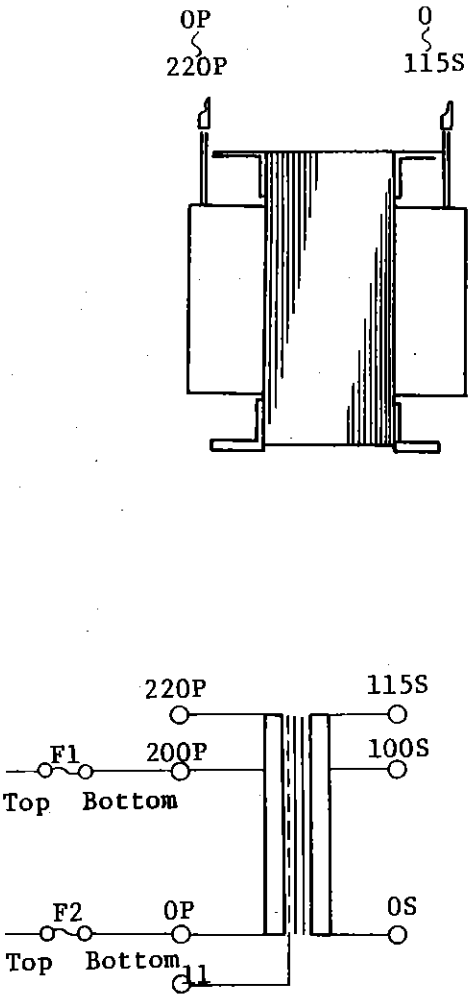


Fig. 7.3 Power transformer for control

7.2 Setting according to input power supply frequency

Set the dither and gain of the thyristor firing circuit of the speed control unit according to input power supply frequency, 50 or 60Hz.

One control speed unit is provided for each axis. Conduct similar setting for all the axes.

Black and red tapes are attached to the thyristor firing circuits to indicate they are for 50Hz and 60Hz respectively.

These circuits, when used at the specified frequency, do not require the setting described above.

Prior to setting

1) Connect to the NC device the feedback signal cable from the DC motor.

2) For the power cable for the DC motor, remove terminals 5 and 6 of the speed control unit. Then bring them back in their original position.

3) As the setting is to be conducted with the DC motor in inactive state, the table may be lowered by its own weight when the NC device is turned ON. Before conducting the setting, fix the table so that it will not lower.

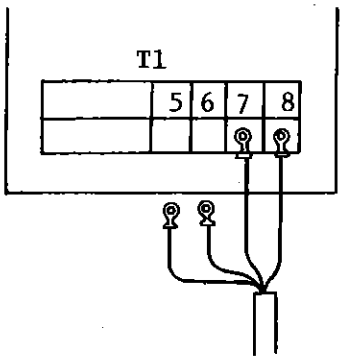


Fig.7.4 Rear view of speed control unit

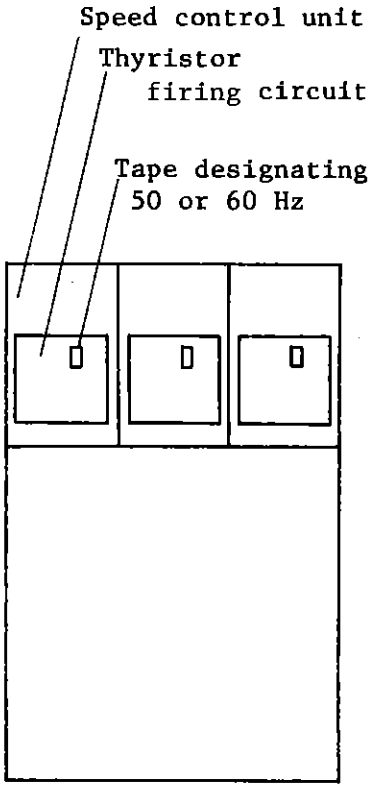
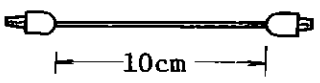


Fig.7.5 Front view of NC

7.2.1 Setting dither

1) Tools required for setting

Synchroscope	1
Small alligator clip	2



2) Setting procedure

a) Set the NC device and servo unit ON.

b) Short CH7 and CH12, and CH4 and CH12 of the thyristor igniting circuit with the clip.

c) Set the pulse width of CH11 at 1,000 μs with variable resistor RV7 when the frequency is 50Hz and at 830 μs when the frequency is 60Hz.
After the setting, remove the clip.

d) Short CH6 and CH12, and CH5 and CH12 of the thyristor firing circuit by using the clip.

e) Set the pulse width of CH11 at 1,000 μs with variable resistor RV8 when the frequency is 50Hz and at 830 μs when the frequency is 60Hz. After the setting, remove clip.

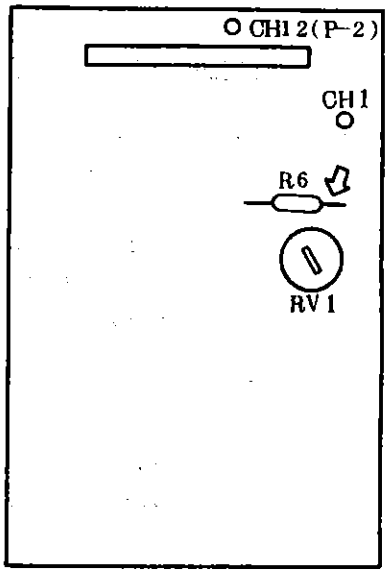


Fig.7.6 Thyristor firing circuit

Table 7-3 Setting level

Power supply frequency	Pulse width of CH11
50Hz	1,000 μs
60Hz	830 μs

7.2.2 Setting gain

1) Tool required for setting

Oscilloscope 1

2) Setting procedure

a) Set the NC device ahd servo unit ON.

b) Feed a "+" move command from the control panel so that CH1 of the thyristor circuit is set at +1v.

(Ground)

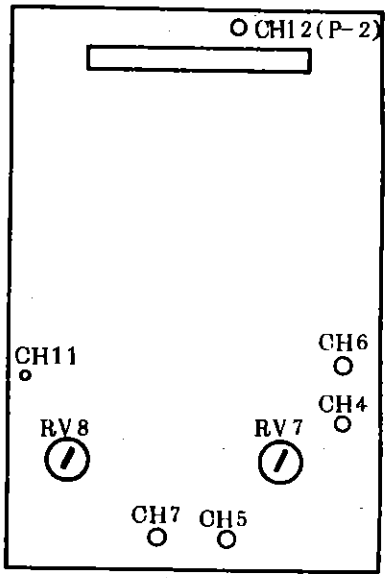


Fig.7.7 Thyristor firing circuit

The number of command pulses varies with the gear ratio. The number of pulses at the level of 10 μ pulses is 100.

c) Adjust variable resistor RV1 at the point marked " ⇦ EP" of R6 of the thyristor firing circuit. Set it at +0.7v when the frequency is 50Hz and at +1v when frequency is 60Hz.

Table 7-4

Power supply frequency	Voltage setting at point when +1v is applied to CH1
50Hz	+0.7v
60Hz	-1.0v

8. How to Use Zero Position Shift Function (For general-purpose model)

Zero return in a closed-loop FANUC NC device is effected by the grid system for stopping at a grid point of the position detector (resolver or Inductosyn) of the DC motor.

The zero position shift function can move the mechanical stoppage point by electrically shifting the grid point.

8.1 Setting procedure

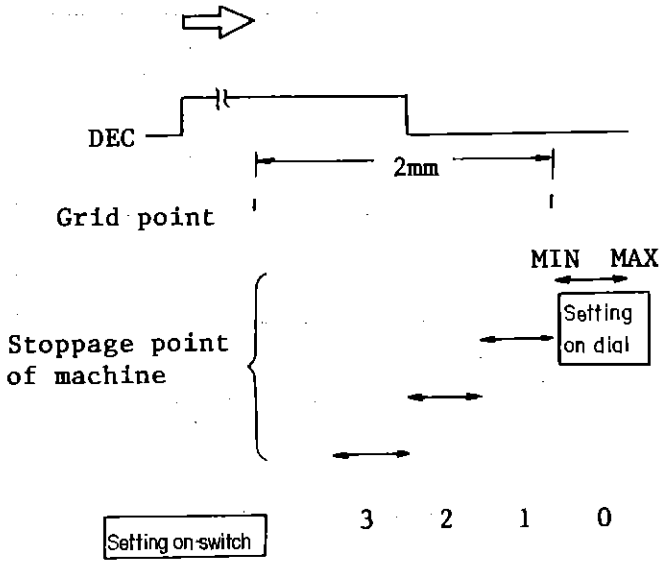
a) Set the switch in Fig. 8.2 at 0, set the control panel for zero return and set the dial in zero position.

b) If the setting range on the dial is too narrow, turn the power for the NC device OFF and set the switch at 0 to 3 for zero return again.

c) If the position is outside the setting range of the switch, change the dog position.

Fig.8.1

Setting range for zero position shift



Zero return at "-" move command

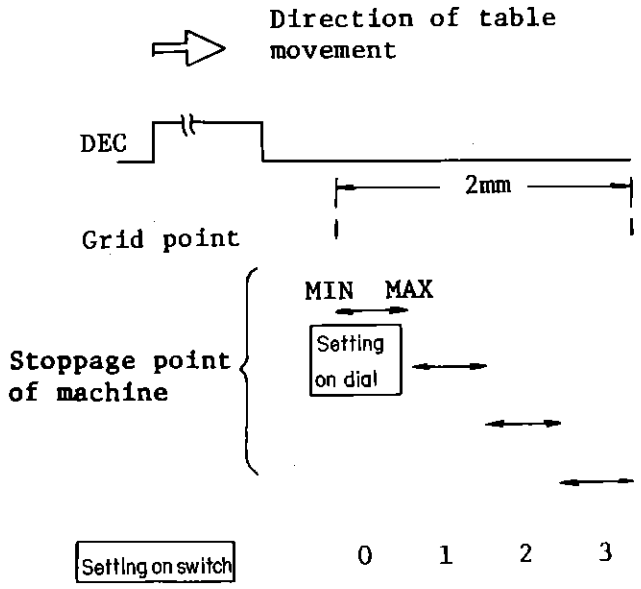
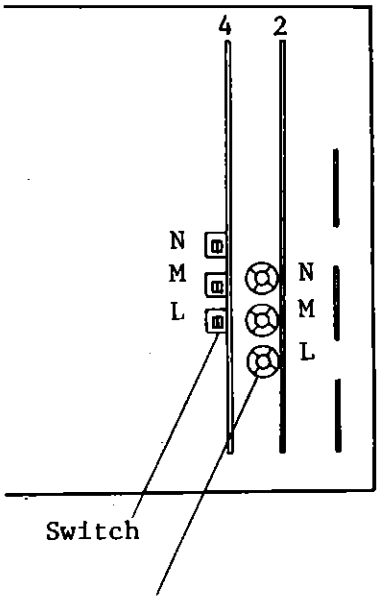


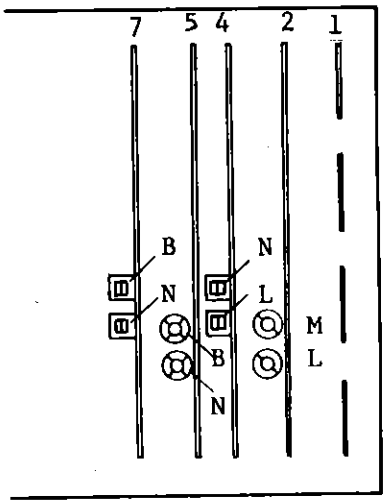
Fig.8.2

Positions of switch and dial

2/or 3 axes



4 axes



Open the front door and look at printed circuit board.

9. Steps in Case of Trouble (For general-purpose model)

The following three lamps to indicate the state of the DC servo unit are provided on the display panel of the NC device.

(1) READY — Indicates that both the NC device and DC servo unit are ready.

(2) ALARM OH — Indicates that either the NC device or servo unit is overheated.

(3) ALARM SV — Indicates that the DC servo unit is in alarm state.

The remedies in the following cases will be described here.

(1) READY does not light.

(2) ALARM OH lights.

(3) ALARM SV lights.

The operator should take the remedial steps indicated by a circled number. If its cause is not found out after these steps, please contact Fujitsu FANUC.

9.1 READY Lamp does not Light

Step	Item	Check point	Remedy
①	Is the servo alarm lamp lighted, YES ⇨ / NO ⇩		Refer to 5.3.
②	Is any phase of the AC input voltage lacking?	Check the voltages at the AC input terminals shown in Fig. 9.1.	Check the power supply side.
3	Has the AC input blown out?	Check the voltages (AC200/220v) among the output ends of fuses 3 to 10.	Replace the fuse.

Step	Item	Check point	Remedy
4	Has the input fuse of the speed control unit blown out?	Check the voltages between the output ends of fuses 12 and 13, 15 and 16, 13 and 19 and 21 and 22. (AC 240v)	
5	Has the +24v fuse of the speed control unit blown out?	Check the voltages at the output ends of fuses 23, 26 29 and 32 shown in Fig. 9. 9. (DC 24v)	Eliminate the cause and replace the fuse.
6	Is AC 115v applied to T2 of the speed control unit?	Check the voltages at T2(1) and (2) shown in Fig. 9. 7.	Check the NC power supply circuit.
7	Is the VELOCITY READY signal ON for the position control unit?	Check the voltages at J9-A3 shown in Fig. 9. 2 and 9. 3. (VELOCITY READY at 0v)	Check the cable between the speed control unit and position control unit inside the speed/position control unit.
8	Is SERVO READY from the position control unit ON?	Check the voltage at J7-AB in Fig. 9. 2 and 9. 3. (SERVO READY at +5v)	Check the interior of the position control unit.
9	Check the NC device side.	Refer to the maintenance manual of the NC device.	

9. 2 Overheat lamp lights

Table 9-2

Step	Item	Check point	Remedy
①	Is the DC motor overheated?	Check the temperature of the surface of the DC motor. (Overheat at approx. 80°C or highter level)	Turn the power OFF to cool the DC motor.

Step	Item	Check point	Remedy
②	Is the overheated cable from the DC motor disconnected?	Check the cable between the DC motor and servo unit.	Connect the cable securely.
3	Is the overheat signal ON for the position control unit?	Check the voltage at J1-A10 shown in Fig. 9.2 and 9.3 (Overheat at +20v)	Check the input cable in the servo unit.
4	Is the overheat signal from the position control unit?	Check the voltage at J7-B15 shown in Fig. 9.2 and 9.3. (Overheat at 0v)	Check the interior of the position control unit.
5	Check the NC device side.	Refer to the maintenance manual of the NC device.	

9.3 Servo alarm lamp lights

The servo alarm lamp lights inside the servo unit in the following cases.

1) Excessive error

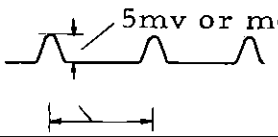
2) Lowered level

3) Overload

If the content of the error register reaches 8,000 pulses (each converted into 1, in length), the servo alarm lamp lights.

If the sine wave input from the position detector (resolver, Inductosyn) is at $3v_{p-p}$ or lower, this alarm lamp lights.

If an excessive current flows through the DC motor to activate the thermal relay in the speed control unit, the alarm lamp lights.

Step	Item	Check point	Remedy
①	Is the power cable of the DC motor disconnected? NO ⇩ YES ⇨	Check the power cable of the DC motor	Connect the cable securely.
②	Is the table of the machine braked?	Check the clutch of the machine.	Check the clutch, magnetics panel, etc.
3	Has the fuse of the speed control unit blown out?	For the L axis, check the voltage between the output ends of fuses 14 and 15 shown in Fig. 9.1. (AC 240v) Check the voltage between the output ends of fuses 15 and 16. (AC 240v) Check the voltage at the output end of fuse 29. (DC 24v) Check the voltage at the output end of fuse 30. (DC 15v) Check the voltage at the output end of fuse 31. (DC 15v)	Eliminate the cause of fuse blow-out and replace the fuse.
4	Is the speed control unit out of order?	Check the waveform between terminals of the thermal relay of the speed control unit shown in Fig. 9.4. The waveform shown below must be attained between terminals when the machine is moved at low speed. 	Replace or repair the printed circuit board of the speed control unit.

Step	Item	Check point	
5	Is the DA converter of the position control unit in order?	Check the voltages at J9-A5 (L axis), J9-B3(M axis) and J9-A2(N axis) shown in Fig. 9.2 and 9.3. Disconnect the power cable of the DC motor to prevent its rotation. The voltage at the terminal should be +1.25v when +1,000 pulses are applied to the error register for position control. This, however, is the value when the gear ratio is 1:5. If this ratio is at different levels, the voltage is inversely proportional to the gear ratio.	Replace or repair the printed circuit board of the position control unit.
6	Do feedback pulses return to the error register of the position control unit?	Check the amount of movement of the machine, applying +1,000 pulses (1 in, length) from the NC device. If feedback pulses are normal, the machine moves 1mm and stops. In case of trouble, it moves until an excessive error is detected.	Replace or repair the printed circuit board of the position control unit. Check if the gear of the resolver of the DC motor is loosened.
7	Is the NC device out of order with high-frequency pulses emitted?	Refer to the maintenance manual of the NC device.	

2) Alarm lamp for lowered level lights

Table 9.4

Step	Item	Check point	Remedy
①	Is any feedback signal cannon connector from the DC motor disconnected? YES ⇨ ON ⇩	Check the feedback signal cannon connectors shown in Fig. 6, 7.	Connect the connector securely.
②	Is any feedback cable from the DC motor broken?	Check the feedback cables from the DC motor.	Connect the cable securely.
3	Is the feedback signal from the resolver applied to the position control unit?	Check the levels of the sins waves of CH6L to CH6B shown in Fig. 9.2 and 9.3A level of $3v_{p-p}$ or higher is normal.	Check the feedback cables in the servo unit. Examine or replace the position control printed circuit board.
4	Is the circuit for detecting a lowered level inside the position control unit out of order?	Check the A 16B-0160-0540 to 0543 circuit for detecting a lowered level shown in Fig. 9.2 and 9.3. The level is lowered when comparator C41 (15), L axis, C41 (02), M axis, and C41 (03) N axis are at 5v.	Repair or replace the printed circuit board of the position control unit.

3) Overload lamp lights

Table 9.5

Step	Item	Check point	Remedy
①	Is the axis torque of the machine abnormally great? NO ⇩ YES ⇨	Check the clutch and others of the machine	Replace the brake.
②	Is continuous heavy cutting performed?		Refer to the over-load duty characteristics of the DC motor.
3	Is the overload signal to the position control unit ON?	Check the level at J9-A11 shown in Fig. 9.2 and 9.3. Over travel at +20v	Check the cable between the speed and position control units.
4	Is the receiver for overload inside the position control unit out of order?	Check the A16B-0160-0540 to 0543 receiver shown in Fig. 9.2 and 9.3. Overload when receiver D41 (30) is at +5v.	Repair or replace the printed circuit board of the position control unit.

Arrangement of fuses

Front view

Rear view

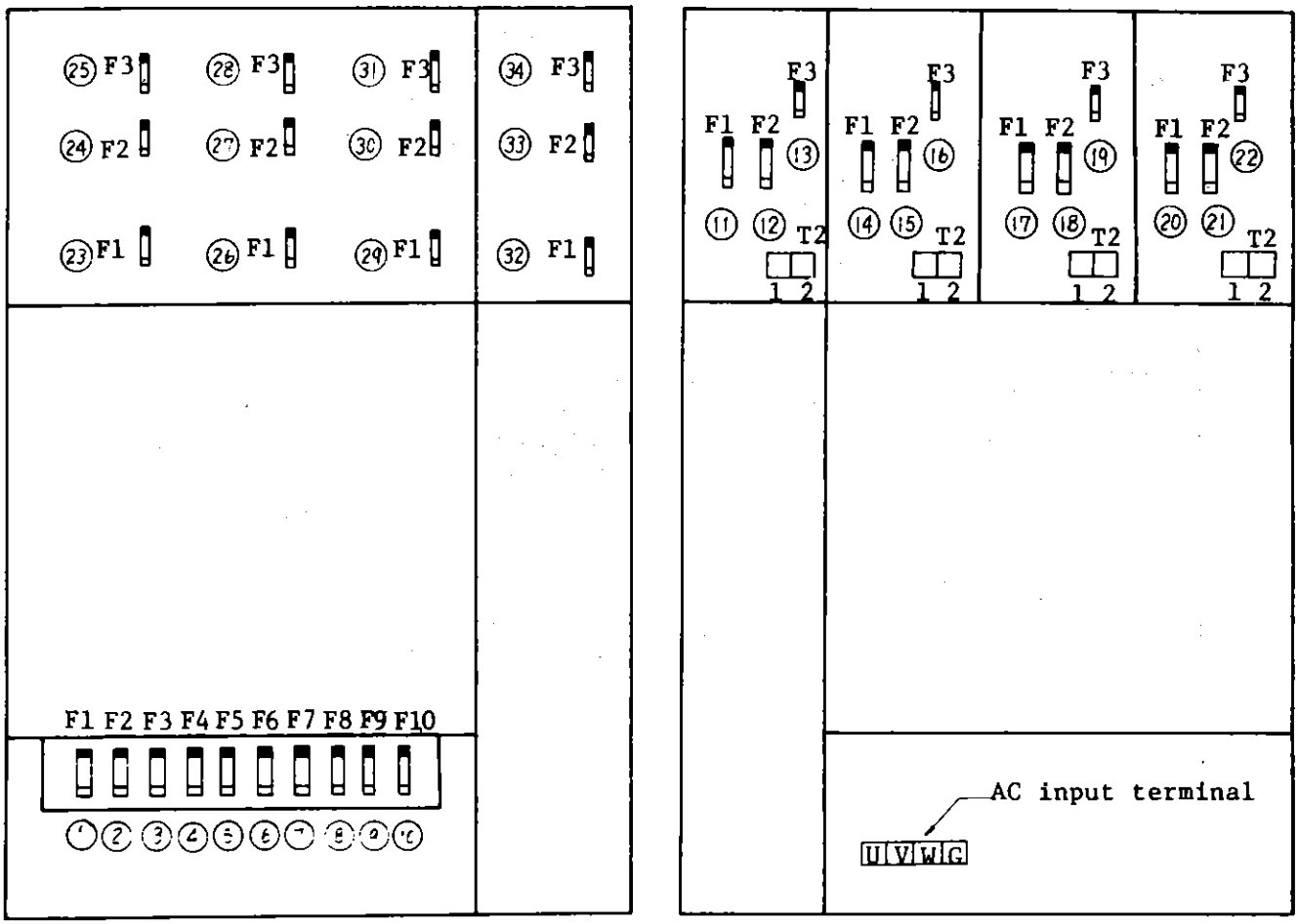


Fig. 9.1

Note 1  Input end

Output end

Note 2 For a description of the fuses, refer to Table 9.6.

Description of fuses

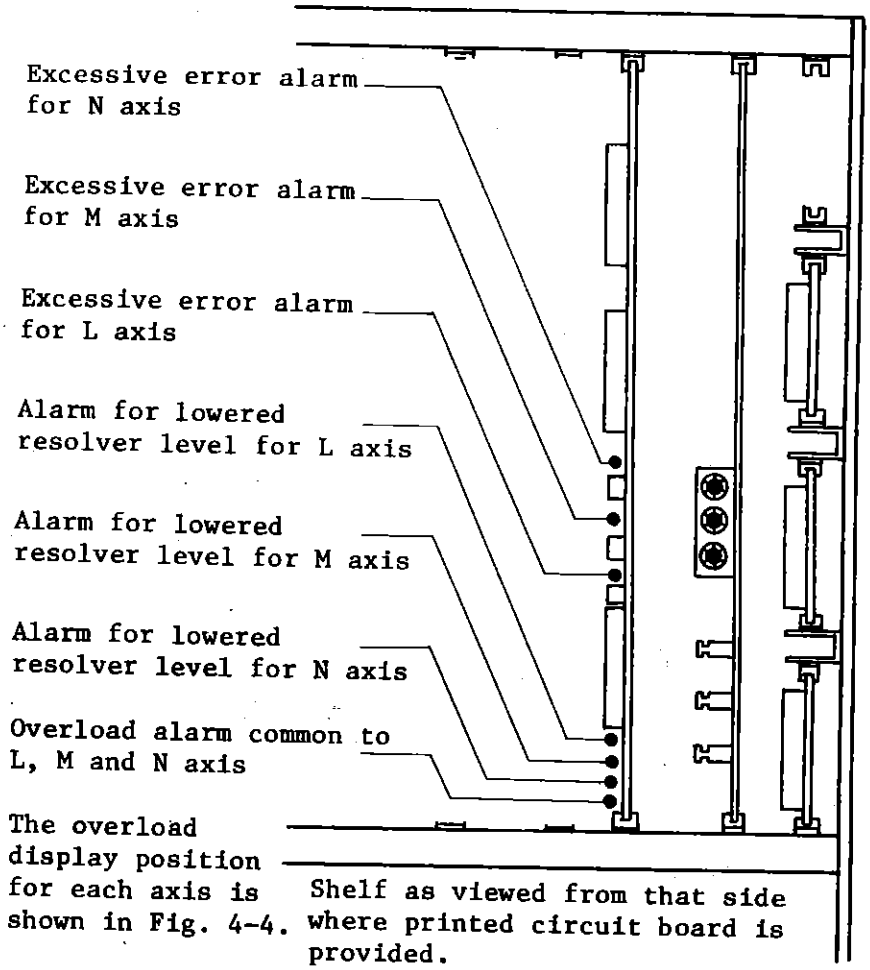
Table 9.6

Fuse No.	Use		FANUC specification No.	Remarks
	Location	Line voltage		
1 2	Input fuse of NC device proper	AC200/220V	A60L-0001-0036#PC1-15	15A
3 44	Input fuse of servo unit L axis	"	"	"
5 6	Input fuse of servo unit M axis	"	"	"
7 8	Input fuse of servo unit N axis	"	"	"
9 10	Input fuse of servo unit B axis	"	"	"
11 12	Speed control unit L axis	AC120V	"	"
13	Speed control unit L axis	AC240V	A60L-0001-0039#A-1	1A
14 15	Speed control unit M axis	AC120V	A60L-0001-0036#PC1-30	30A
16	Speed control Unit M axis	AC240V	A60L-0001-0039#A-1	1A
17 18	Speed control unit N axis	AC120V	A60L-0001-0036#PC1-30	30A
19	Speed control unit N axis	AC240V	A60L-0001-0039#A-1	1A
20 21	Speed control unit B axis	AC120V	A60L-0001-0036#PC1-30	30A

Fuse No.	Use		FANUC specification No.	Remarks
	Location	Line voltage		
22	Speed control unit B axis	AC240V	A60L-0001-0039#A-1	1A
23	Speed control unit L axis	+ 24V	A60L-0001-0041#R3A	0.3A
24	Speed control unit L axis	+ 15V	"	"
25	Speed control unit L axis	- 15V	"	"
26	Speed control unit M axis	+ 24V	"	"
27	Speed control unit M axis	+ 15V	"	"
28	Speed control unit M axis	- 15V	"	"
29	Speed control	+ 24V	"	"
30	Speed control unit N axis	+ 15V	"	"
31	Speed control unit N axis	- 15V	"	"
32	Speed control unit B axis	+ 24V	"	"
33	Speed control unit B axis	+ 15V	"	"
34	Speed control unit B axis	- 15V	"	"

Note 1 The positions of fuses 1 to 34 are shown in Fig. 9.1.

Positions of alarm lamps (2 or 3 axes)



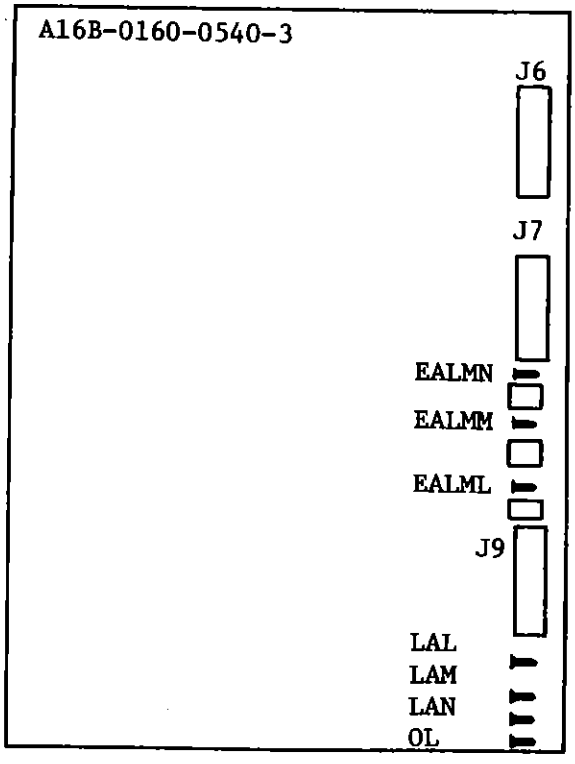
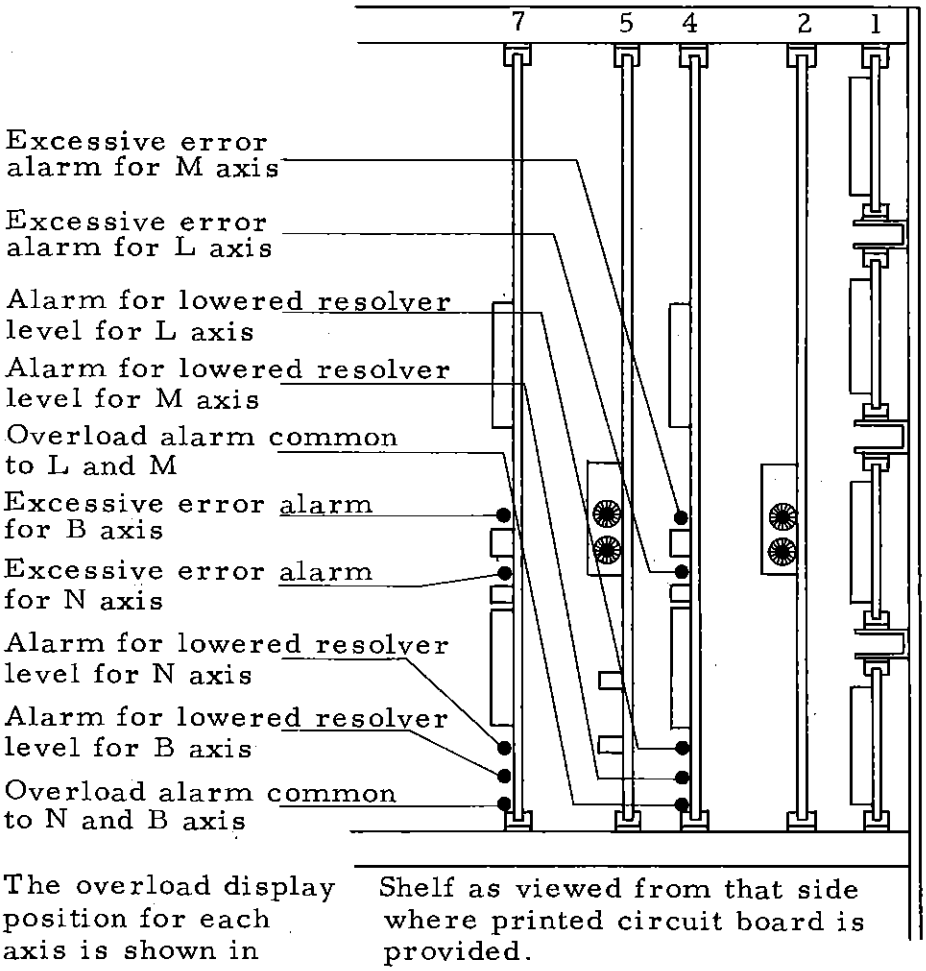


Fig. 9.2

Positions of alarm lamps (4 axes)



The overload display position for each axis is shown in Fig. 4-4.

Shelf as viewed from that side where printed circuit board is provided.

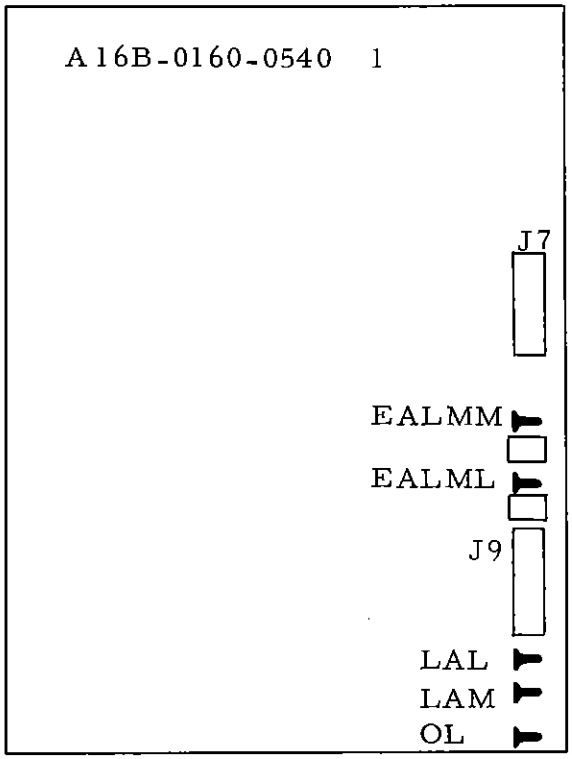
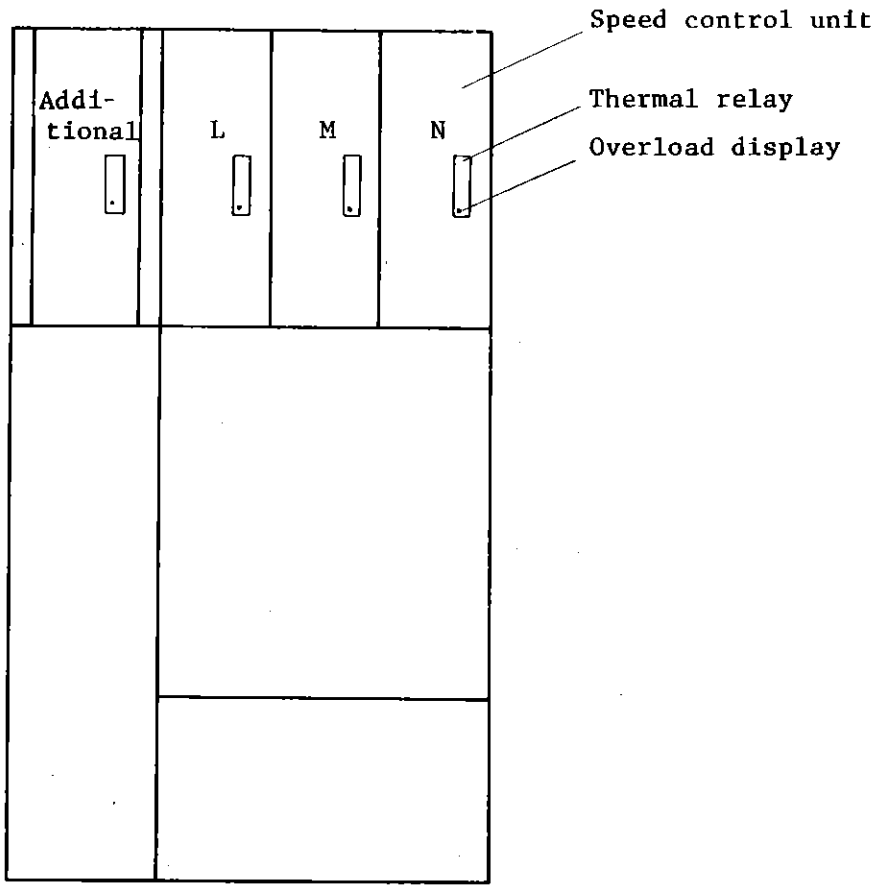
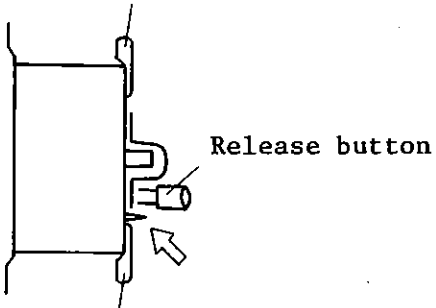


Fig. 9.3

Overload display positions



Rear view



If an excessive current flows through the DC motor, the point indicated by the mark "⇦" appears white.

Fig. 9.4

9.4 Replacing parts of feedback section

Replace parts of the feedback section as shown in Fig. 9.5.

1. Replacing flexible coupling

   1) Loosen the screw of clamp 1.
   (M3 bolt with a hexagonal hole)

   2) Remove the bolt for fixing the plate.
   (M4 bolt with a hexagonal hole)
   Remove from the motor the tachometer generator and resolver together with the plate.

   3) Loosen the drag screw for fixing the flexible coupling. Provide a gap of approx. 2mm between the screw head and washer and hit the screw head with a hammer to remove the tapered nut.
   Now the flexible coupling can be removed.

2. Replacing spur gear and pinion

   1) The gear can be removed by loosening clamps 2 and 3 in state 1-2) above.

   2) Fix the spur gear so as to provide a gap of approx. 1mm from the plate.

   3) Fix the pinion, placing its surface onto surface A of the spur gear.

   4) Provide engagement for the pinion, setting the two gears fully off the neutral point and then bringing them one pitch back.

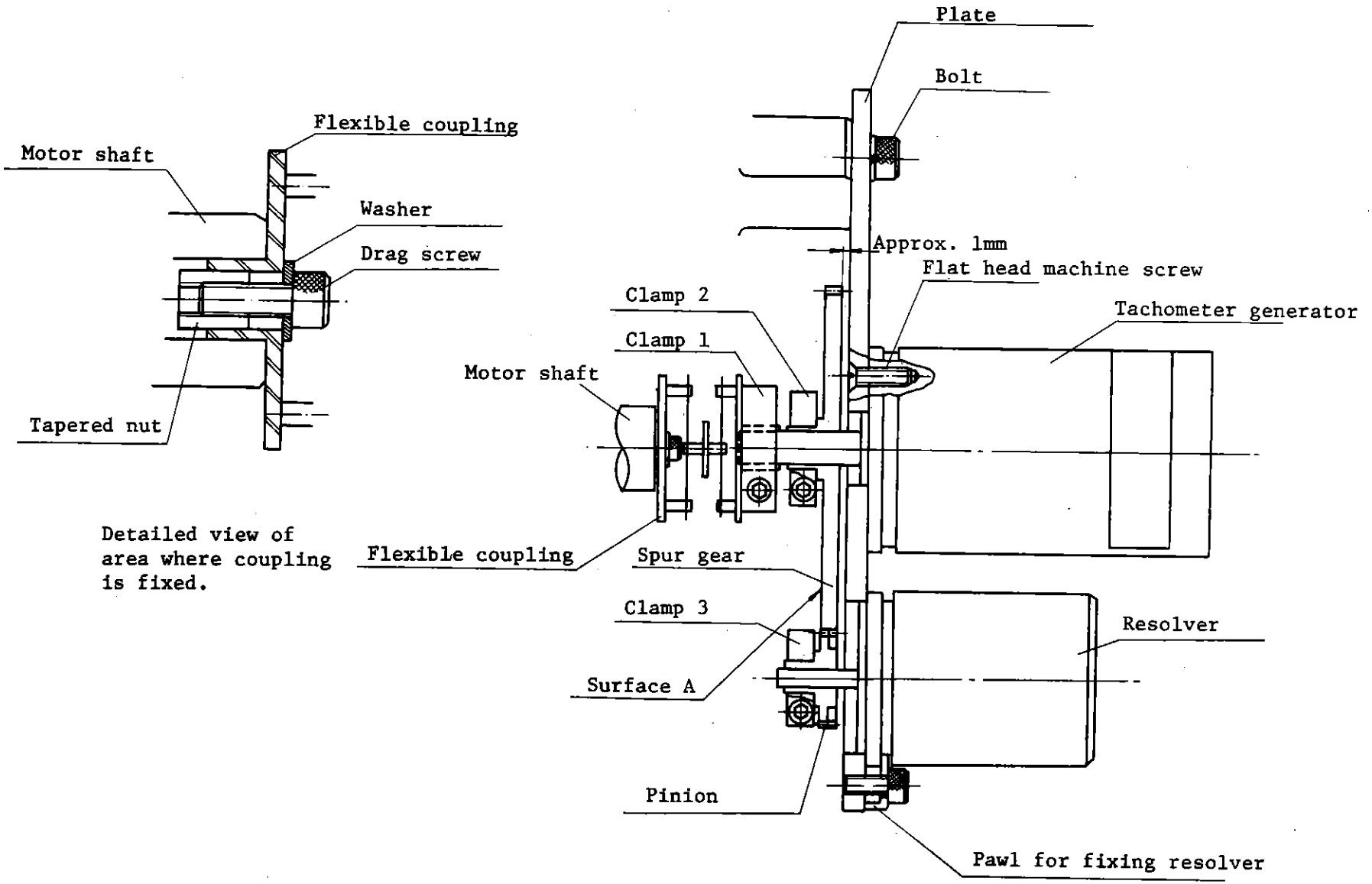

Flexible coupling
Motor shaft
Washer
Drag screw
Tapered nut
Detailed view of area where coupling is fixed.
Plate
Bolt
Approx. 1mm
Flat head machine screw
Tachometer generator
Clamp 2
Clamp 1
Motor shaft
Flexible coupling
Spur gear
Clamp 3
Resolver
Surface A
Pinion
Pawl for fixing resolver

Fig. 9.5

10. Periodical Maintenance (Common to Special-and general-purpose models)

10.1 Checking brush

Periodically check and replace the brush as instructed below.

1) Check-up interval

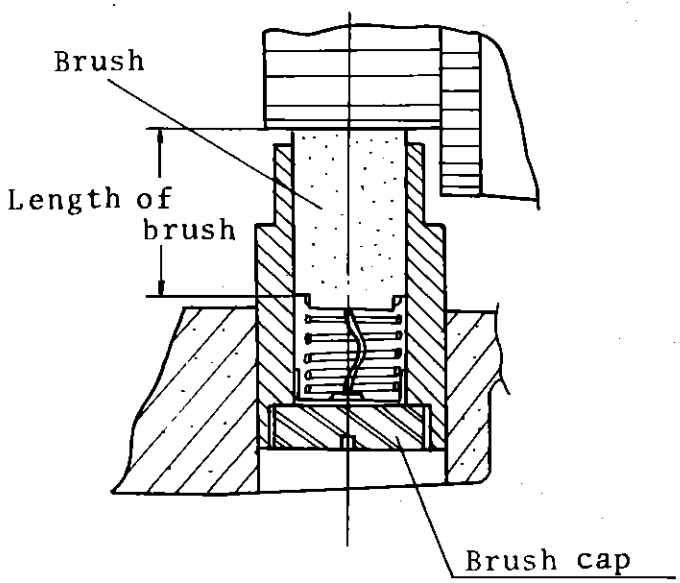
Once a year for general machine tools (lathe, milling machine, machining center, etc.)
Every two months for items with a high acceleration/ deceleration frequency.

2) Time to replace brush

Replace the brush when it is found worn to a length of 6mm or less.

3) Replacing procedure

Replace the brush as indicated in Fig. 10.1.



Remove the brush cap (screwed) and draw out the brush. When fixing the brush in position, tighten the brush cap fully.

Fig. 10. 1

SECTION 2

1. CONNECTIONS

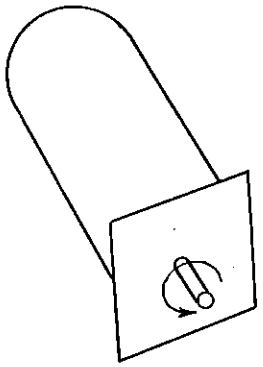
1.1 Connection of Cables

For DC servo unit there are connection cables of power supply, feedback signals and motor power.

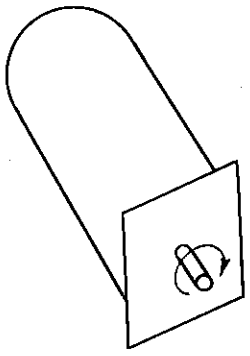
There are standard connection and reverse connection for the feedback signal cable and motor power cable according to the rotational direction which follows the feed command from the control unit.

The rotational direction corresponding to the (+) feed command

Standard connection

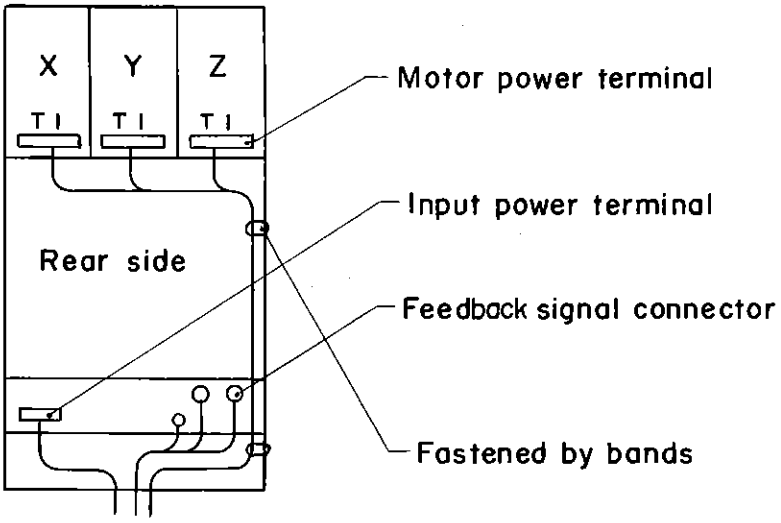


Reverse connection

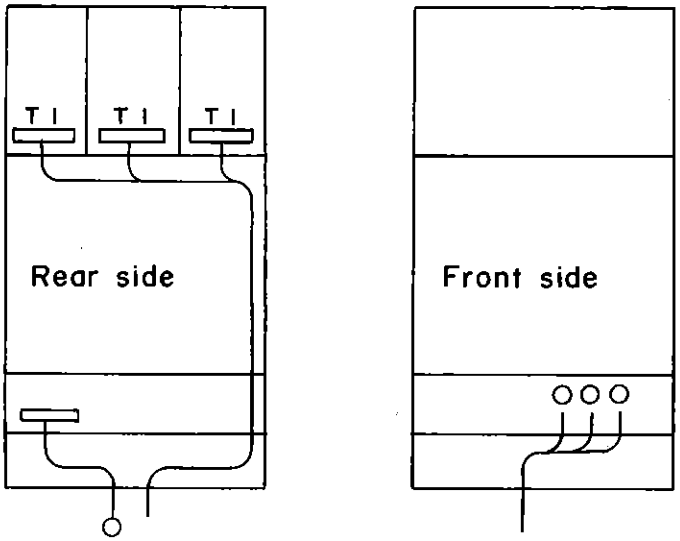


Location of cables and connectors

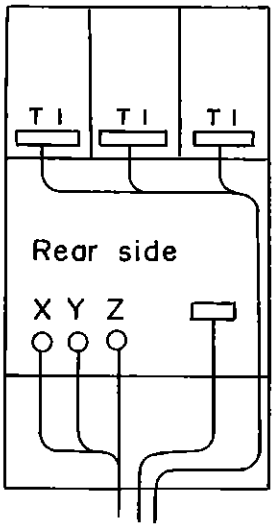
In case of F3000B, F2000A, F1000C, F200-0A



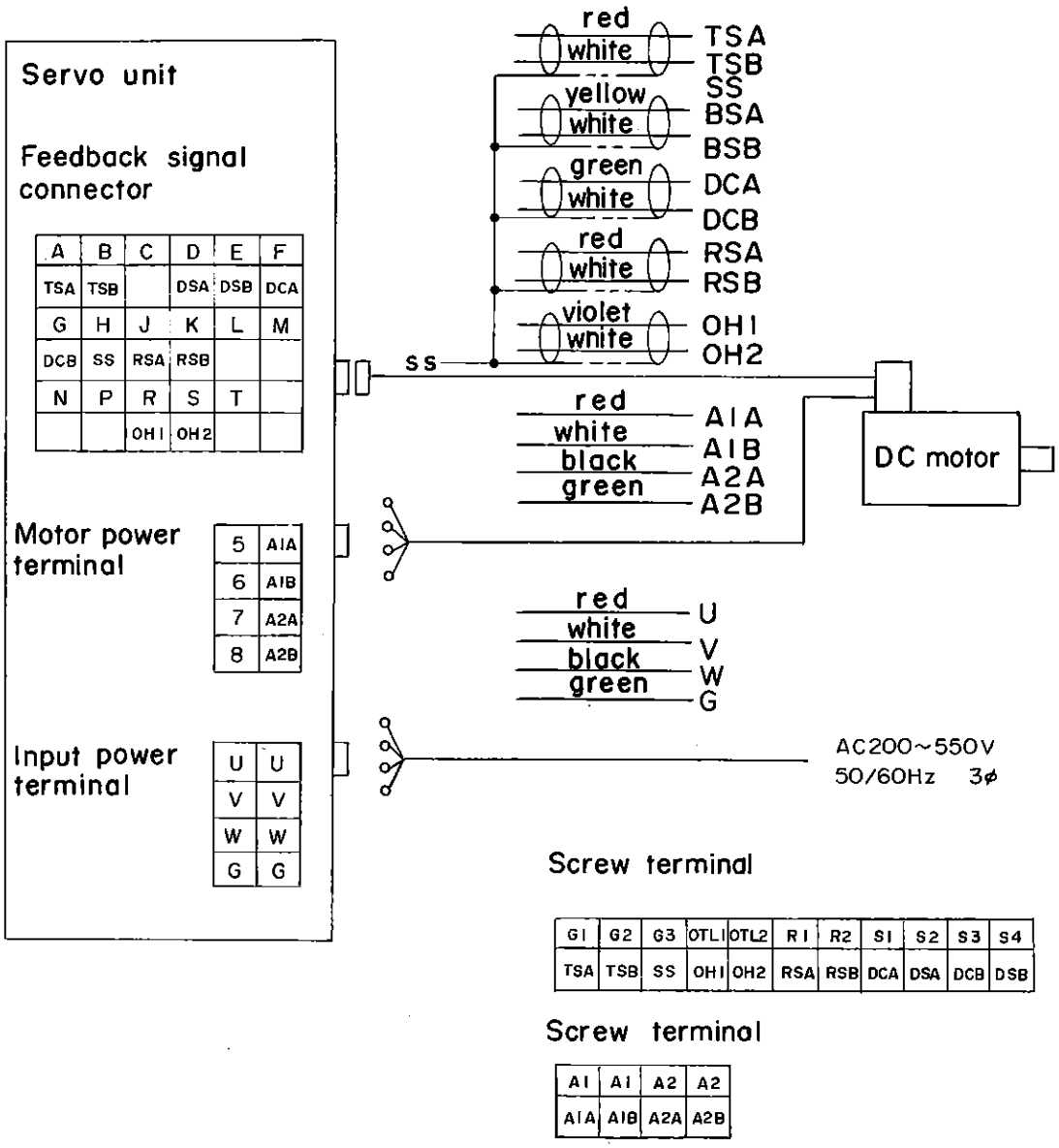
In case of F3000C, F2000C



In case of F200-0B, F220-0



Connection for resolver system (standard connection)



(Reverse connection)

Servo unit

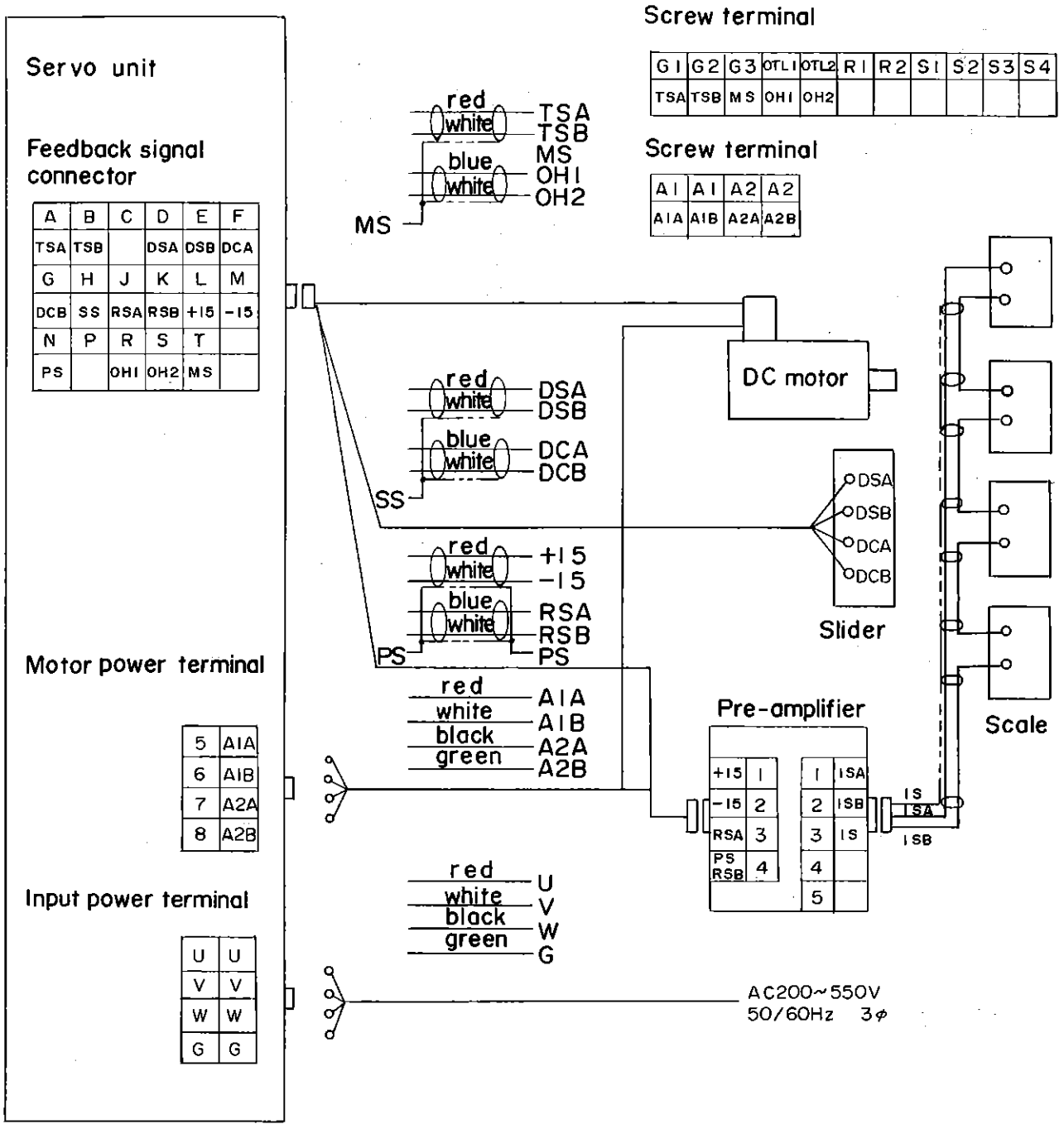
Feedback signal connector

A	B	C	D	E	F
TSB	TSA		DSB	DSA	DCA
G	H	J	K	L	M
DCB	SS	RSA	RSB		
N	P	R	S	T	
		OH1	OH2		

Motor power terminal

5	A2A
6	A2B
7	A1A
8	A1B

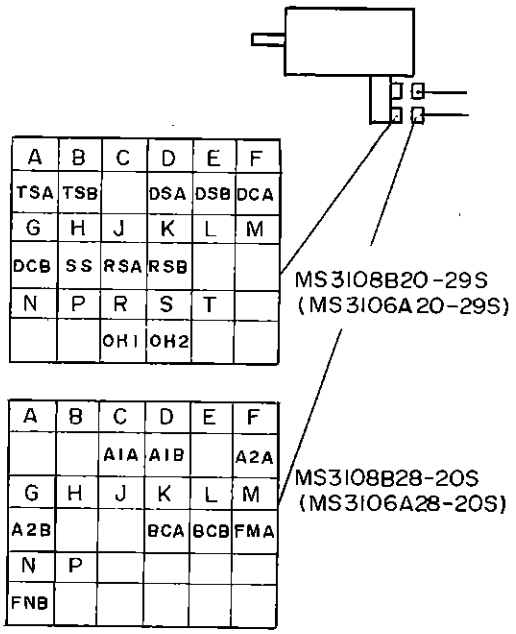
Connection for Inductosyn system (Standard connection)



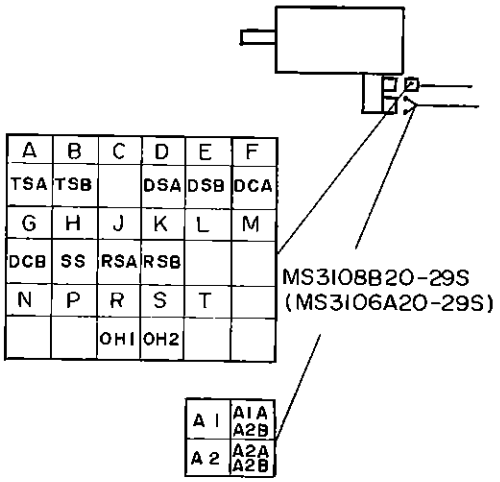
The reverse connection is same as resolver system.

Connection of DC motor with connector

Model 10, 20, 30,



Model 0, 5



1.2 Tap change for power transformers (Transformer system 1)

(1) Measure the voltage of input power supply.

(2) If the input voltage is outside of the allowable range for that tap, change to the appropriate tap.

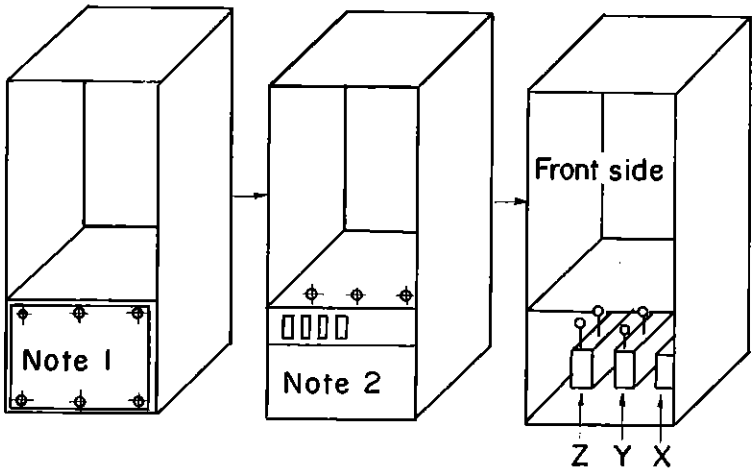
(3) Renew the data sheet of the DC servo unit about the set voltage.

Taps of input voltage and allowable voltage range

Power Transformer	Input tap V	Allowable voltage range (V)
For domestic use	200	180 ~ 220
	200	200 ~ 240
For export (A)	190	170 ~ 210
	230	210 ~ 250
	380	340 ~ 420
	420	380 ~ 460
	460	420 ~ 500
For export (B)	200	180 ~ 220
	550	500 ~ 600

Location of taps of transfarmer

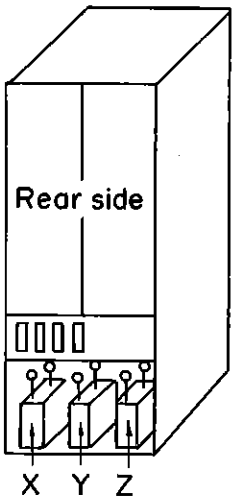
In case of F3000B, F2000A, F1000C, F200-0A



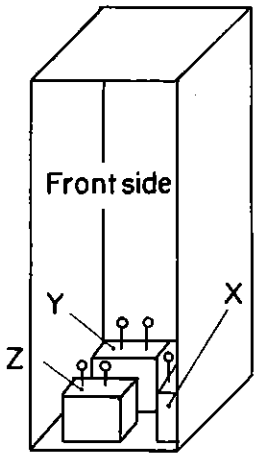
Note1. Remove 6 screws and take away a cover.

Note2. Remove 3 screws and take out a fuse panel.

In case of F3000C, F2000C



In case of F200-0B, F220-0



Connection of tap

In case of transformer for domestic use

Cable number	Wire mark of Cable				Wire mark of transformer	
	X axis	Y(Z) axis	Z axis	B axis	For input 200V	For input 220V
K7	1	4	7	10	2	1
	2	5	8	11	4	3
	3	6	9	12	6	5
K8	26		45		2	
	27		46		4	
	28		47		6	

Note: 45, 46 and 47 are connected for the 4th axis.

In case of transformer for export (380～480V)

Cable number	Wire mark of Cable				Wire mark of transformer				
	X axis	Y(Z) axis	Z axis	B axis	For input 200V	For input 220V	For input 380V	For input 420V	For input 460V
K7	1	4	7	10	2-5	1-4	2	2	1
	2	5	8	11	8-11	7-10	8	8	7
	3	6	9	12	14-17	13-16	14	14	13
					3-6-9-12-15-18		3-5	3-4	3-4
							9-11	9-10	9-10
							15-17	15-16	15-16
							6-12-18		
K8	26		45		5				
	27		46		11				
	28		47		17				

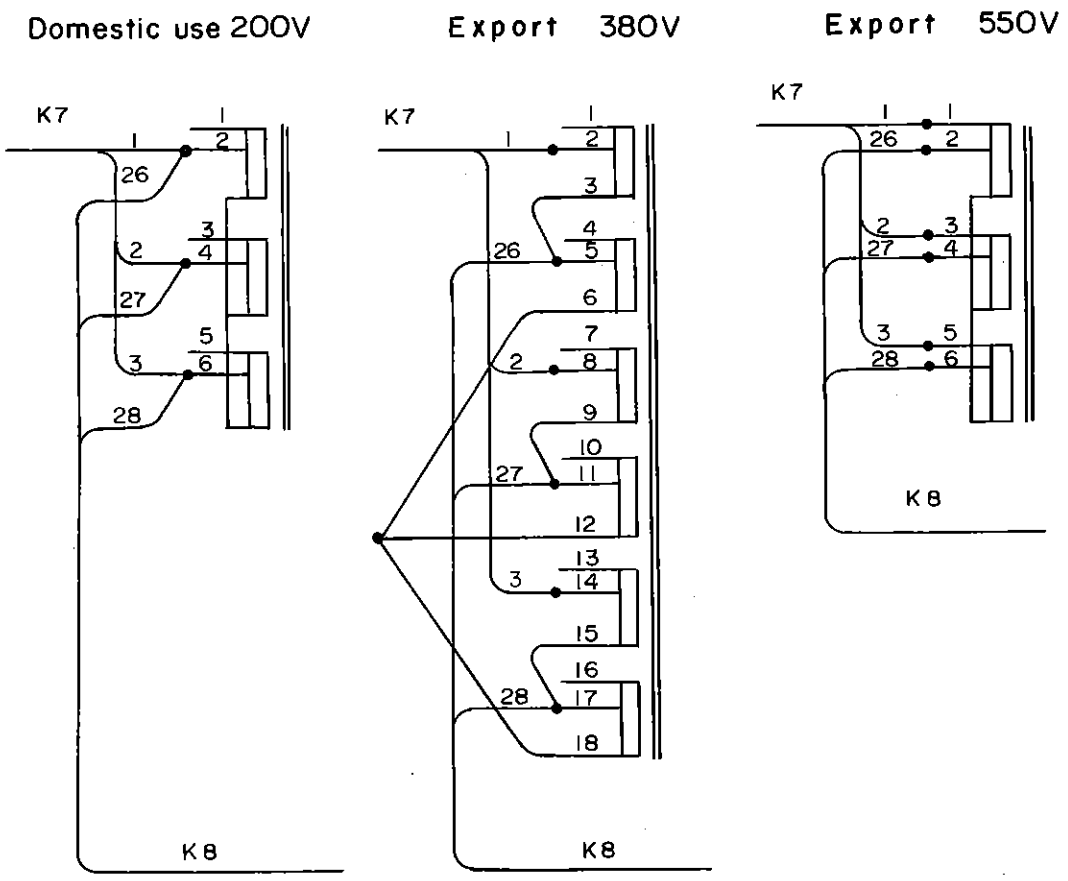
Note: 45, 46 and 47 are connected for the 4th axis

In case of transformer for export (550 V)

Cable number	Cable wire mark				Wire mark of transformer	
	X axis	Y(X) axis	Z axis	B axis	For input 200 V	For input 550 V
K7	1	4	7	10	2	1
	2	5	8	11	4	3
	3	6	9	12	6	5
K8	26		45		2	
	27		46		4	
	28		47		6	

Note: 45, 46 and 47 are connected for the 4th axis.

Example of connection



1.2 Tap change for power transformers (Transformer system 2 common transformer type)

(1) Measure the voltage of input power supply.

(2) If the input voltage is outside of the allowable range for that tap, change to the appropriate tap.

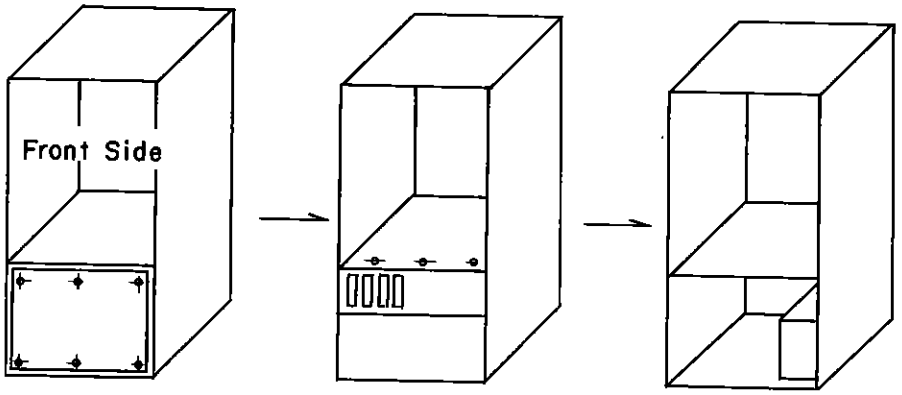
(3) Renew the data sheet of the DC servo unit about the set voltage.

Taps of input voltage and allowable voltage range

Power Transformer	Input tap V	Allowable voltage range (V)
For domestic use	200	170 ~ 220
	220	190 ~ 240
For export	190	160 ~ 210
	230	200 ~ 250
	380	320 ~ 420
	420	360 ~ 460
	460	390 ~ 520
	550	470 ~ 600

Location of taps of transformer

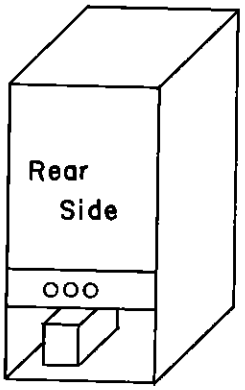
In case of F3000B, F2000A, F1000C, F200-0A



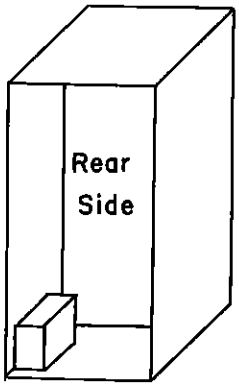
Note 1. Remove 6 screws and take away a cover.

Note 2. Remove 3 screws and take out a fuse panel.

In case of F3000C, F2000C



In case of F 5T, 5D, 5M



Tap connection

In case of transformer for domestic use

Cable number	Cable wire mark	Terminal number of transformer	
		For input 200V	For input 220V
K7	1	2	1
	2	4	3
	3	6	5
K8	26	2	
	27	4	
	28	6	

In case of transformer for export

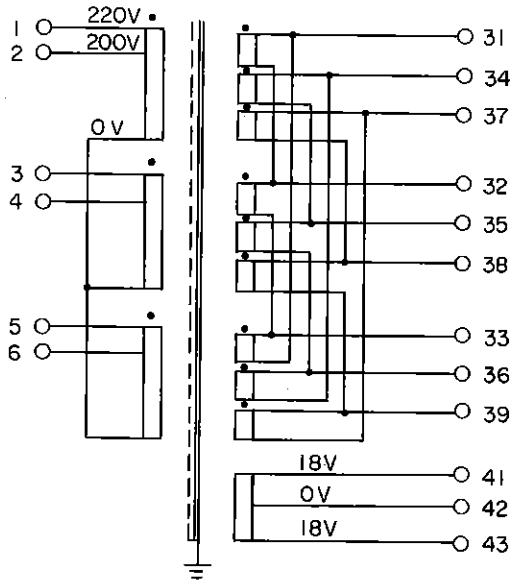
Cable number	Cable wire mark	Terminal number of transformer					
		Input 200V	Input 220V	Input 380V	Input 415V 440V	Input 460V 480V	Input 550V
K7	1	7	6	7	6	6	5
	2	15	14	15	14	14	13
	3	23	22	23	22	22	21
Strap wire	Connect between each terminal of trans-former	3-7	2-6				
		4-8	4-8	3-8	3-8	2-8	1-8
		11-15	10-14				
		12-16	12-16	11-16	11-16	10-16	9-16
		19-23	18-22				
		20-24	20-24	19-24	19-24	18-24	17-24
		4-12-20					

K8	26	3
	27	11
	28	19

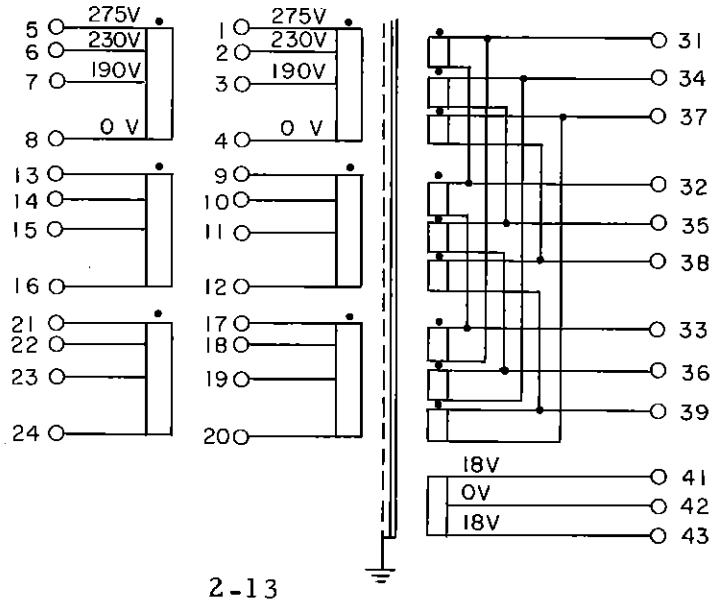
Remarks In case of 4-axis system or with large load torgue, 2 transformers are used. Each transformer should be done the tap connection as same manner.

Circuit diagram of transformer

For domestic use



For export



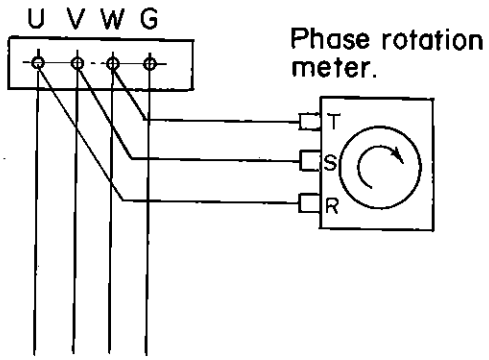
1.3 Checking of the phase rotation for the input power supply

For the 6-phase controlled servo unit, the phase rotation of input power supply must be in the order of U → V → W.
If this relation is not correct and when power is put on, fuse in velocity control unit may blow.

Method of phase checking

Connect a phase rotation meter to the power input terminal U, V, W and see whether a disc of the meter rotates in the clockwise direction.

Power input terminal

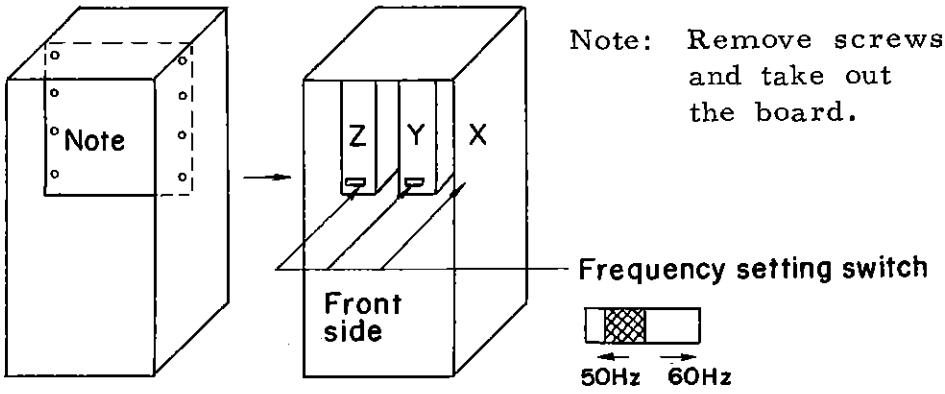


1.4 Setting of frequency for the Velocity Control Unit

Check the setting and switch if it is not correct.

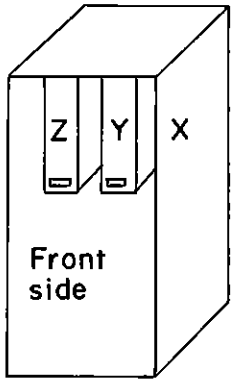
Location of frequency setting switch

In case of F3000C, F2000C

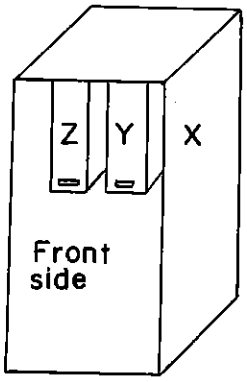


Note: Remove screws and take out the board.

In case of F3000B, F2000A, F1000C, F200-0A



In case of F200-0B, F220-0



2. MAINTENANCE

2.1 Periodical maintenance

Cleaning of air filter and checking of brushes of DC motor are necessary as the periodical maintenance.

Cleaning of air filter

Air filter must be cleaned out once a month.
The filter can be removed with a sliding action to the backward.
Recommended method of cleaning is to blow the compressed air to the filter element while appling slight vibration.
If it is too polluted, it is washed in a neutral cleanser and dried up in the shadow of the sun.

Checking and replacing of brushes of DC motor

(1) The period of Checking

General machine tools such as lathes, milling machines and machining centers ..... 1 year

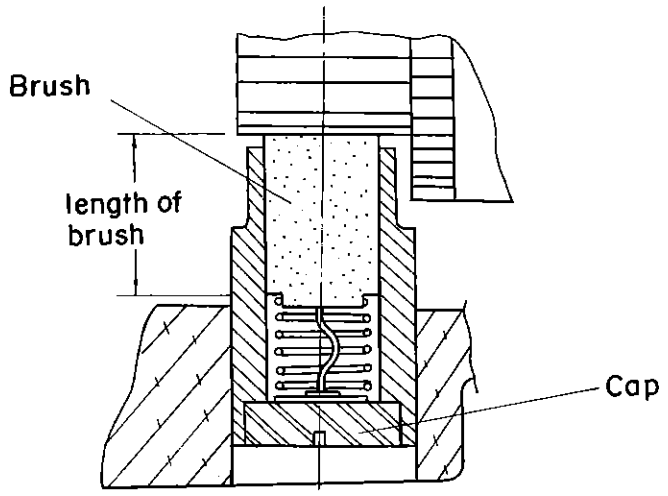
Frequent acceleration and deceleration machine tools such as punch press ..... 2 months

(2) The standard of replacement of brushes

The old brush should be replaced when it becomes less than 6mm in length.

(3) Method of replacement

Remove a brush cap and take out an old brush.
Set a new brush and put a cap and screw it tightly.



2.2 Troubles and Counteractions

Items of failure are provided below and each trouble can be checked up according to the following procedures.

(A) Ready lamp does not turn on.

(B) Over heat lamp lights on.

(C) Servo alarm lamp lights on.

(D) Fuse in Velocity Control blows.

(E) Machine runs away.

(F) Lack of accuracy.

(G) Big vibration and/or noise at stop.

(H) Big vibration and/or noise when running.

(I) Big vibration and/or noise during acceleration.

(J) Big overshoot.

(K) Lack of accuracy by 1 pulse feed.

(L) Lack of accuracy in positioning repeatability.

(M) Lack of stiffness in servo system.

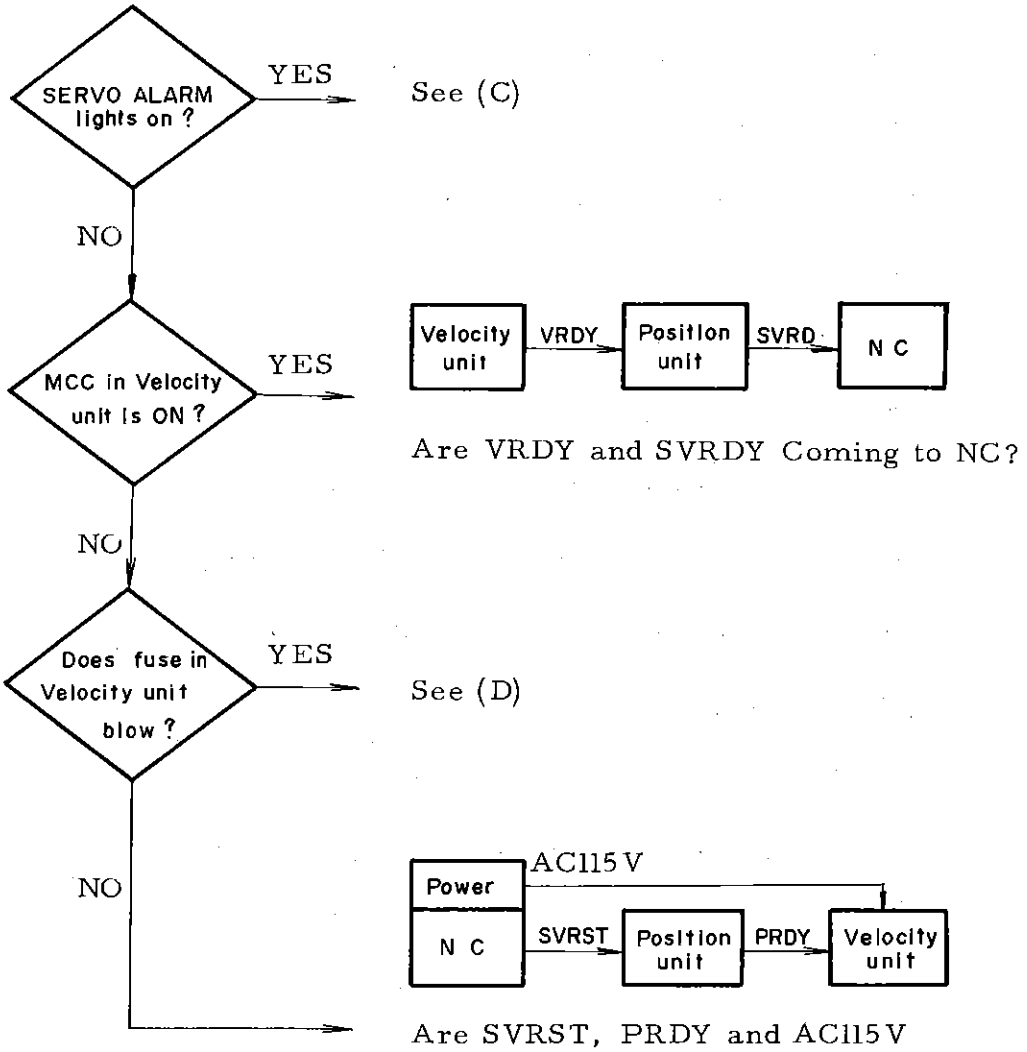
(N) Lack of accuracy in a circular arc cutting at the junction of quadrant.

(O) Cause texture on cutting surface.

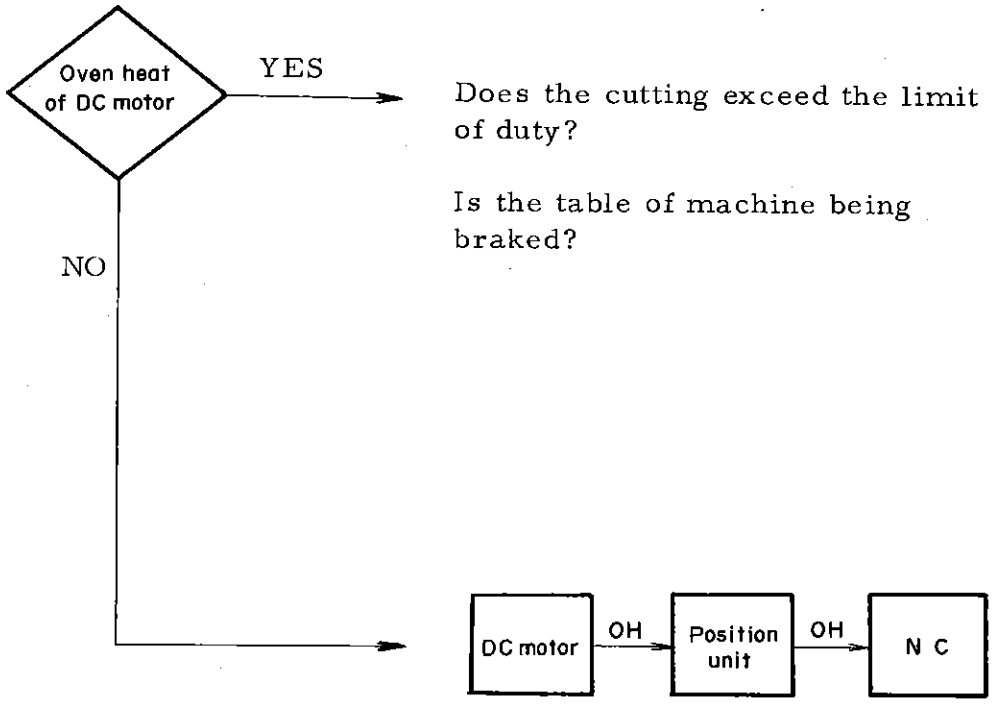
(P) Method of Checking out for the Veclocity Control Unit.

(Q) Method of checking out for the Position Control Unit.

(A) Ready lamp does not light on



(B) Over heat lamp lights on.



Is the cable between a DC motor and Position unit disconnected?

Is Over Heat signal going to NC?

Is Over Heat signal coming from NC control unit?

(C) Servo Alarm lamp lights on

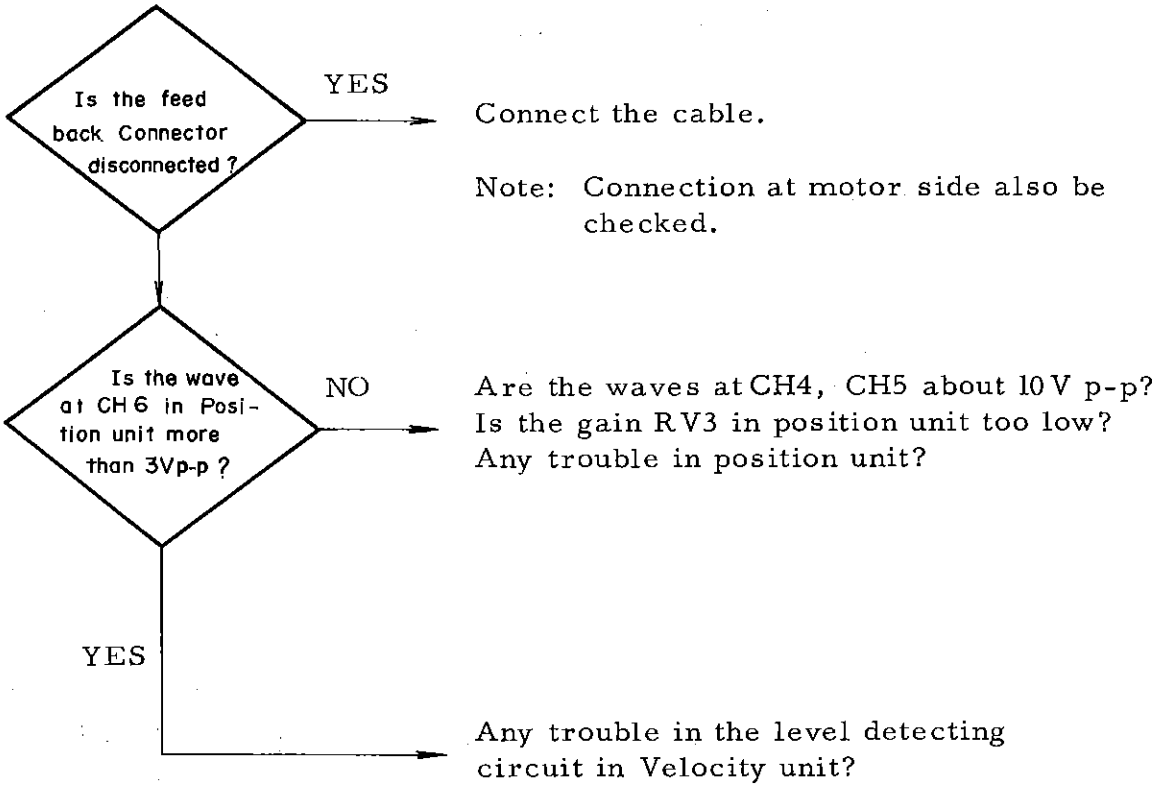
The Servo Alarm turns on in following cases.

a. When positioning error becomes more than 8000 pulses, the EALM lamp and Servo Alarm lamp light on.

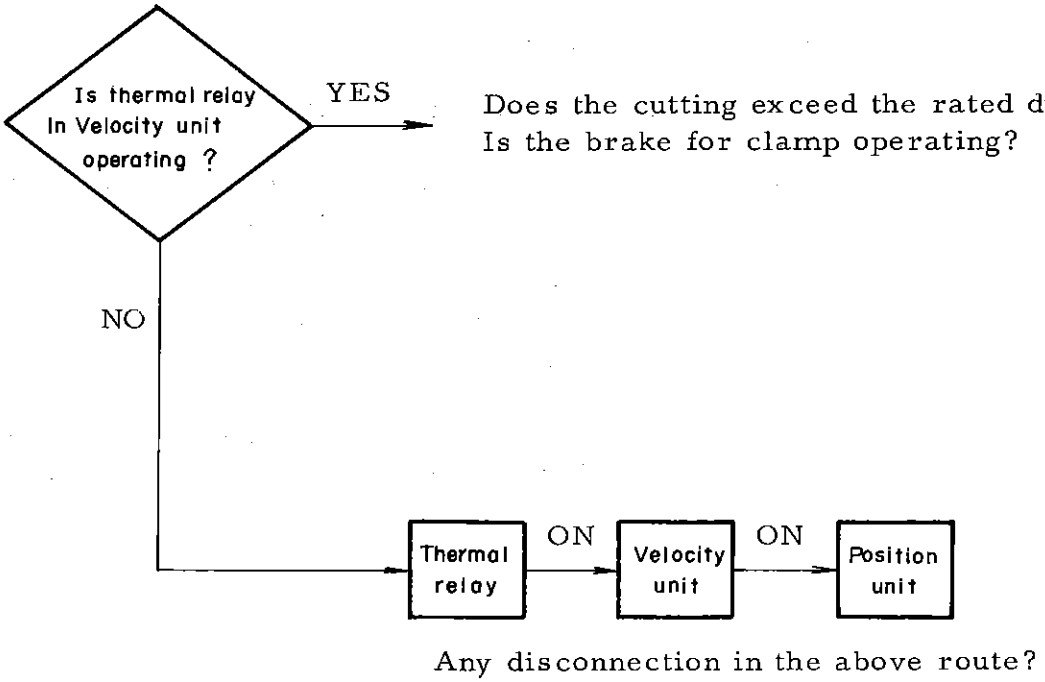
b. When the feedback signal from Resolver or Inductosyn becomes lower than 3V p-p at CH6, the LA Lamp and Servo Alarm lamp light on.

c. When the thermal relay in the Velocity unit operates by over current, the OL lamp and Servo Alarm lamp light on.

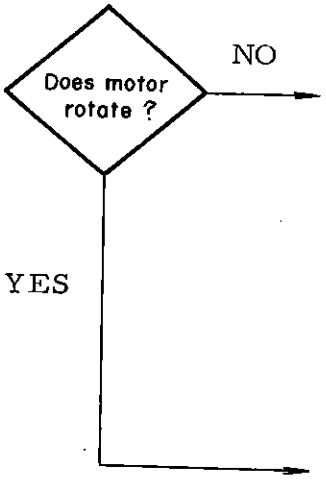
(b) The level alarm lamp lights on



(c) Over load lamp lights on



(a) Position error lamp lights on



Is power cable of DC motor disconnected?
Any trouble in position unit?
Any trouble in Velocity unit?

Wrong setting of position gain?

The correct setting

(1) Frequency for rapid traverse: Lower than 160 kpps (1 μ pulse)

(2) Input multiplier

(3) Position gain: 30 sec^{-1}

(4) Gear ratio of DC motor

DC motor 10, 20, 30

Gear ratio	1/5	1/4	1/3	2/5
Connection	No con-nection	SP6* SP9	SP6* SP7	SP8* SP9

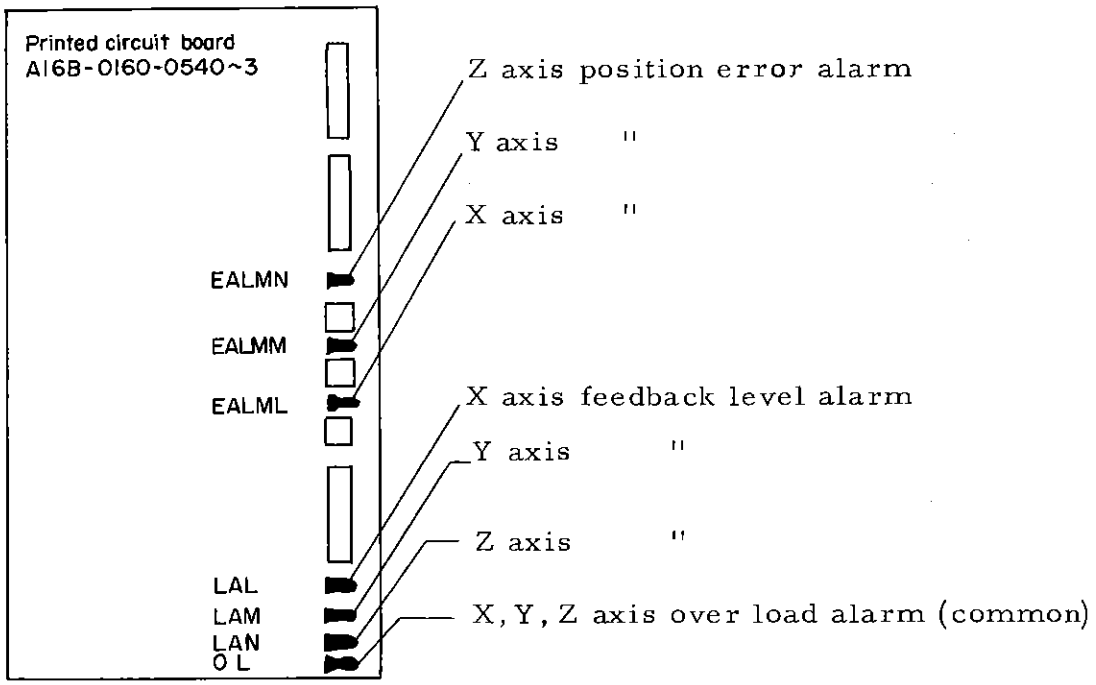
DC motor 5, 0

Gear ratio	1/3	2/5	1/2	2/3
Connection	No con-nection	No con-nection	SP6* SP9	SP6* SP7

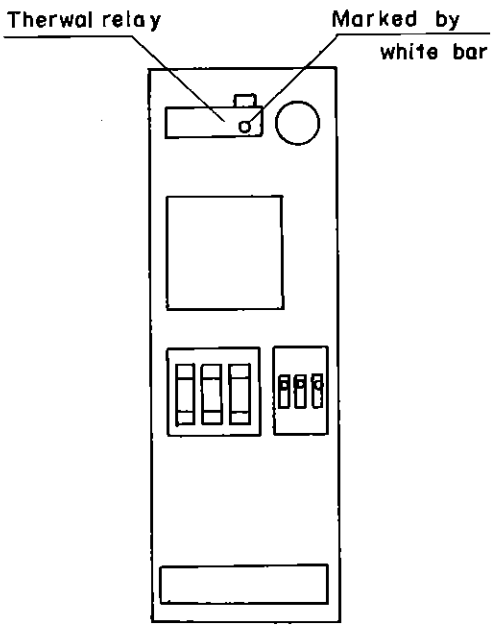
(5) Setting of tacho generator feedback resistance

For DC motors model 5, 0 wiring of SL5, SLO in the firing circuit in the Velocity Control should be cut.

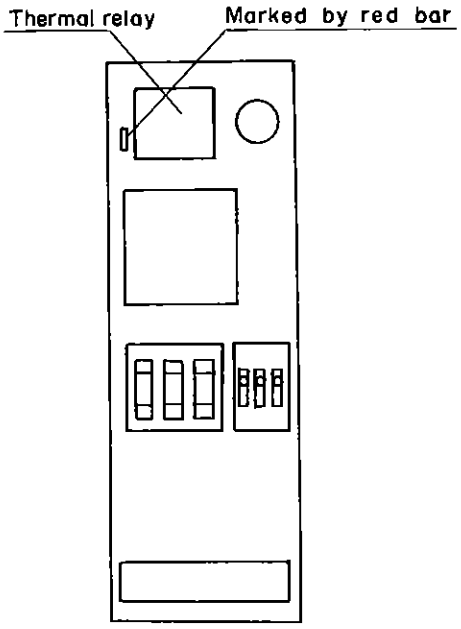
Location of alarm display



Location of over load alarm display for each axis

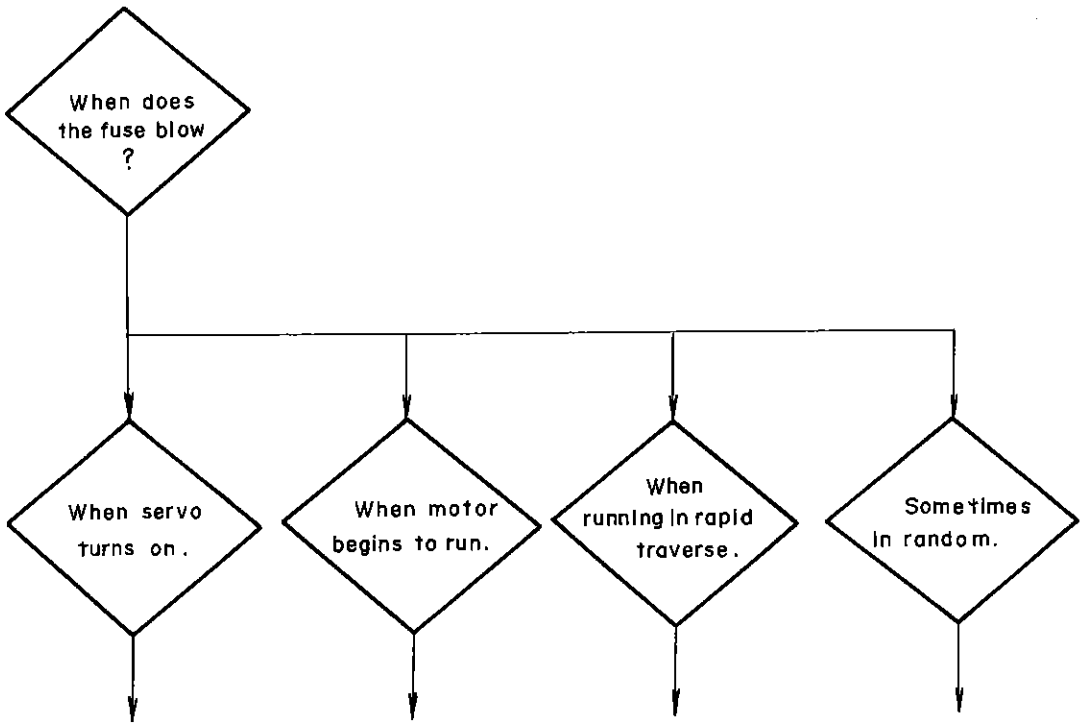


Velocity Unit for model 10, 20, 30



Velocity unit for model 0.5

(D) Fuse in Velocity unit blows



Is the phase rotation of input power correct?

Is the setting of 50/60 Hz in Velocity unit correct?

Are the wirings of feedback devices correct?

Is the gain setting in Position unit 30 sec^{-1}

Any damage in Velocity unit?

Same as left.

Is it mechanically clamping on braking?

Is the gain in Velocity unit too high?

Is the gain setting in position unit 30 sec^{-1}?

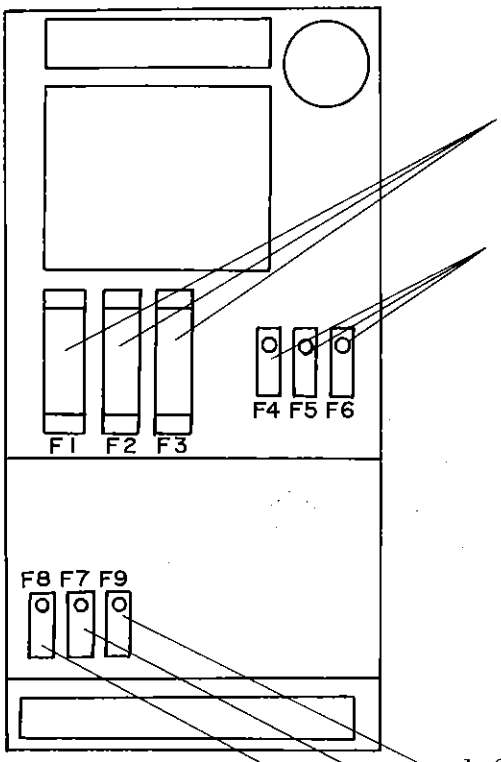
Is the over current detector operating?

Any damage in Velocity unit?

Any contact problem?

Any damage in Velocity unit?

Location of fuses



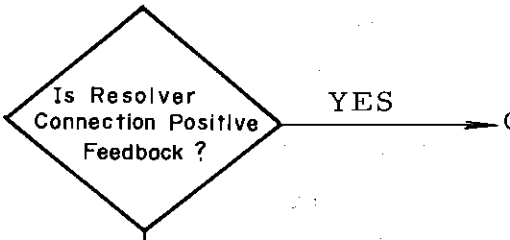
Main fuse (30A) A60L-0001-0036 #PC1-30
(10A) (" #PC1-10)

Alarm fuse(0.5A) connected parallel to Main fuse

F4 is parallel to F1 SF ab250/402aP405
F5 is parallel to F2
F6 is parallel to F3

1.3A Alarm fuse to -15V line SF ab250/402aP413
1.3A " +24V line "
1.3A " +15V line "

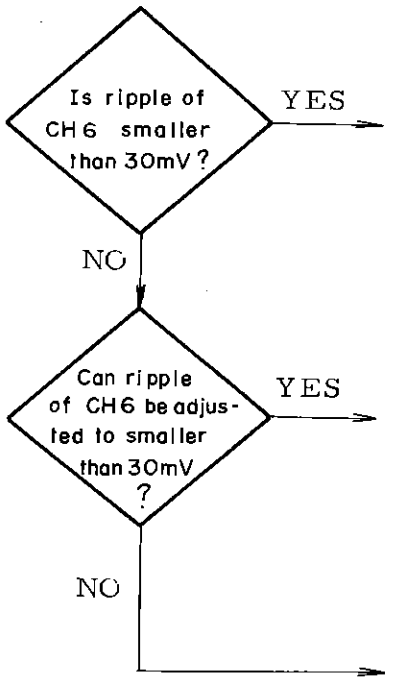
(E) Machine runs away



Loseness of coupling in DC motor
Position feedback does not apply correctly as failure of position unit.

Misconnection of feedback cable for other axis?

(F) Lack of accuracy

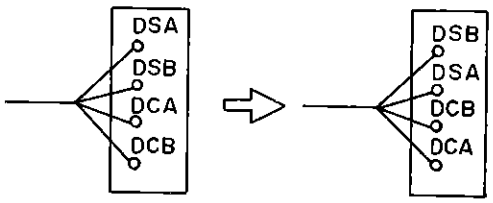


Is sield wire of Resolver connected to ground at NC?

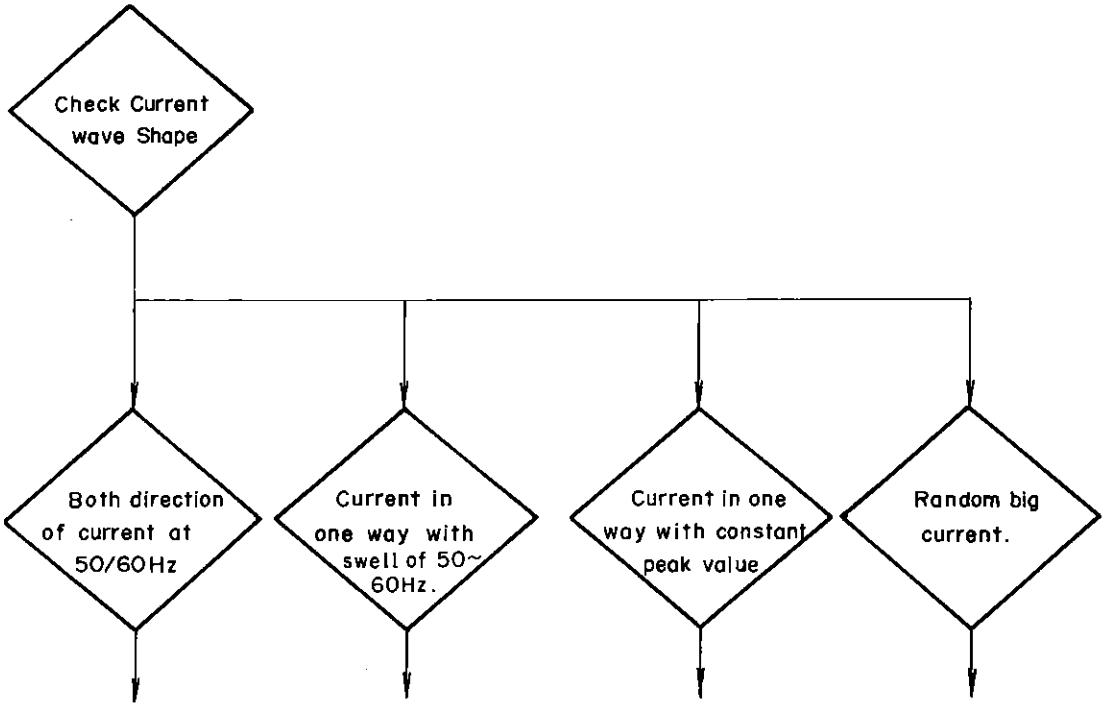
Is wiring of Resolver Shielded over full length?

Is wiring of Resolver isolated from machine cable?

In case of Inductosyn, try to change the terminals as follows.

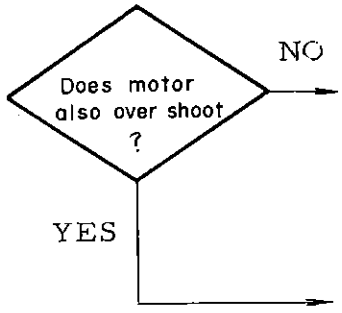


(G) Big vibration and/or noise at stop or running



Is frequency setting in velocity unit correct? Is dither too big? Is gain too big? Is input power wave shape normal? Is width of dither constant?	Same as left.	Can not be corrected by adjustment because of mechanical resonance between power frequency.	Damage of velocity unit.

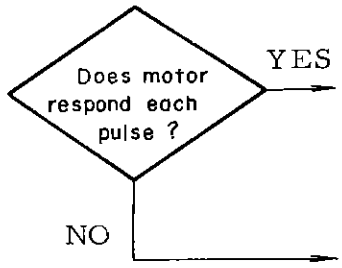
(J) Big overshoot



Trouble of machine

Is gain of velocity unit too low?

(K) Lack of accuracy by 1 pulse feed

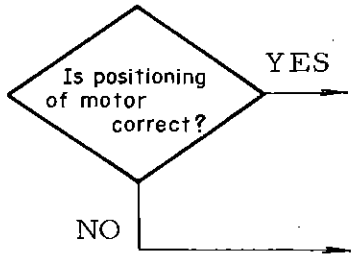


Trouble of machine

Is gain of velocity too low?

Is dither too small?

(L) Lack of accuracy in positioning repeatability



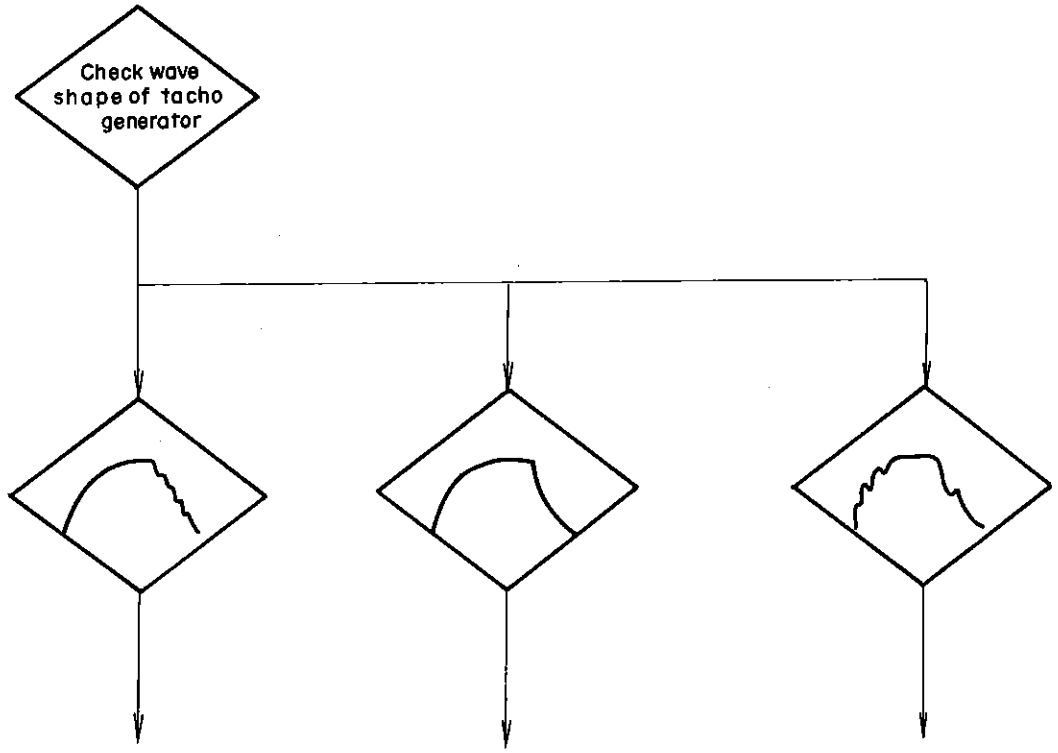
Trouble of machine

Is setting of acc-time for rapid traverse too small?

Is gain of velocity unit too low?

Is dither too small?

(I) Big vibration and/or noise during acceleration



Is gain too big?	Adjust acc. time longer. Can not be corrected by adjustment because of mechanical resonance between power frequency.	Damage of velocity unit.

(M) Lack of stiffness in servo system
Is gain of velocity unit too low?
Is position gain 30 sec^{-1}?

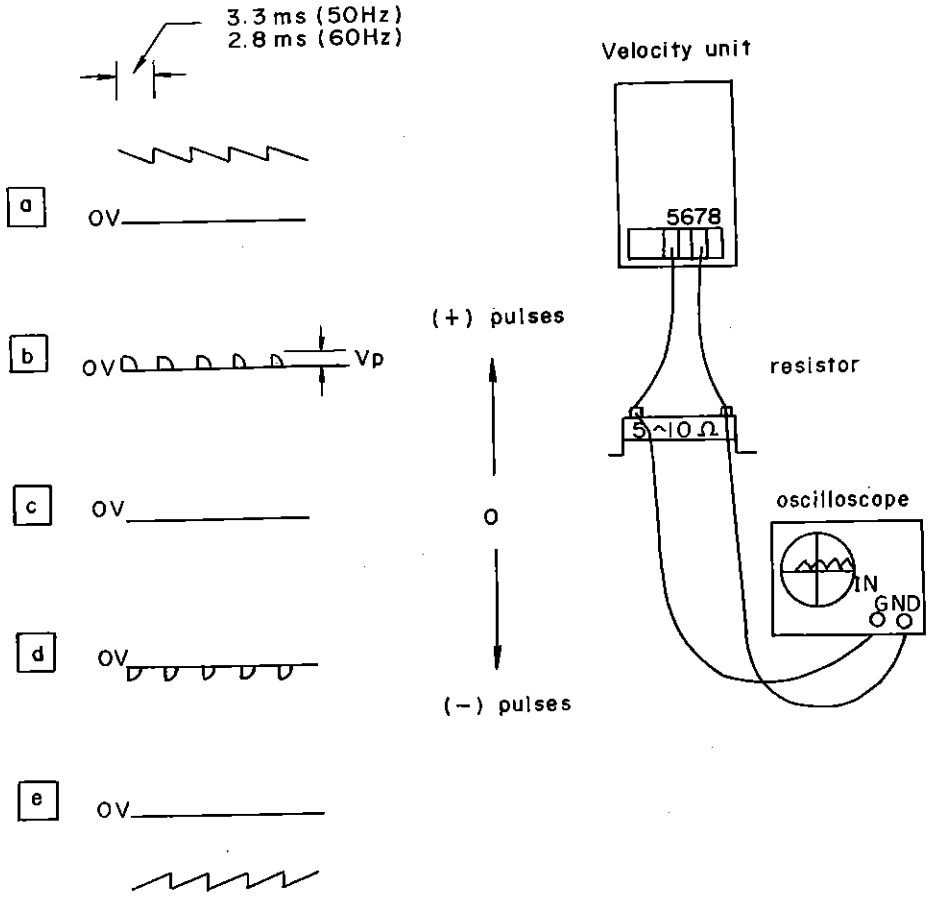
(N) Lack of accuracy in a circular arc cutting at the junction of quadrant
Is gain of velocity too low?
Is dithen of velocity too low?
Is position gain 30 sec^{-1}?
Is backlash compensation set proper value?

(O) Cause texture on cutting surface
Is pulse interpolation correct?

(P) Method of checking out for velocity unit

(1) Short circuit at between CH5 and CH6 on the PCB of Velocity Unit.
(2) Disconnect motor power cable and connect a resistor of 5 ~ 10 Ω , more than 150 W as following figure.
(3) Turn on NC and put pulses by Handle then observe wave shape of voltage drop across the resistor as the following figure.

Note: Be careful for the fall down of table as NC is turned on without motor power cable.

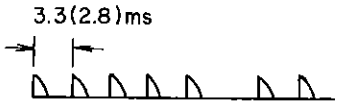
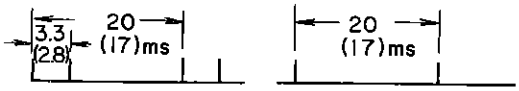
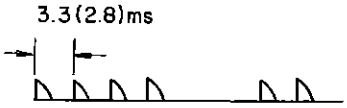
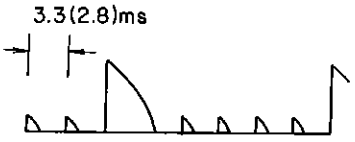


(1) The wave shape, when power is put on, must be one of b, c or d.

(2) In b and d, the period must be 3.3 ms (2.8 ms) when Vp is higher than 20 volts and if Vp is lower than 20 volts, the period could be different and it is normal.

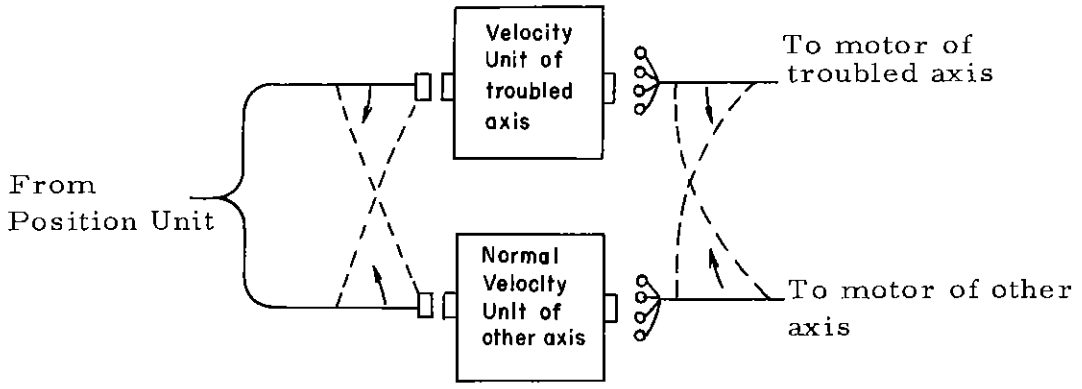
(3) Changing from b to d, or d to b must be obtained by command pulses less than 5 pulses (10 μ pulse) by Handle.

(4) The wave shape must be changed c to b to a, or c to d to e depending on number of pulses from handle.

Trouble	Cause
 Defect of one wave per 6.	 Fig.1 shows normal Thiristor gate signal. Fig.2 shows defect of one pulse, which results the wave shown left.
 Defect of 2 waves per 6.	There is no gate signal at all on one Thiristor per 6.
 Irregular wave.	The phase rotation of power input is not correct. Velocity unit is affected by noise.

Another method of checking

When one axis has trouble in servo system, it can be checked whether velocity unit is wrong or problem is in machine itself by interchanging velocity unit with that of other axis.



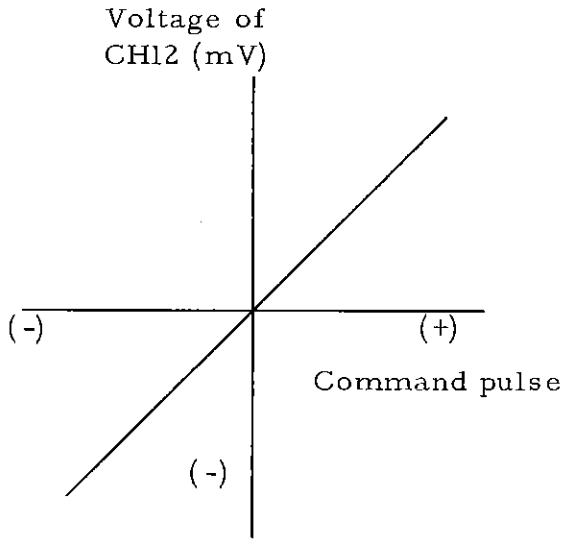
Note 1. Velocity unit for the motor Model 0 and 5 can not drive the motor Model 10, 20 or 30.

2. Feedback cable must not be changed.

(Q) Method of checking out for the Position Control Unit.

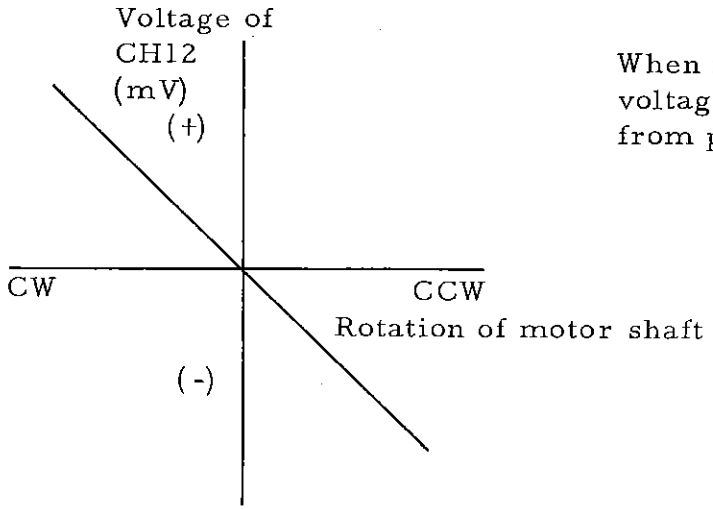
(1) Remove motor power cable
(2) Turn on NC and put pulses by Handle then check the voltage at CH12 in the Position Unit. (EP is Ground.)
(3) Rotate the shaft of motor by some means and check the voltage at CH12.

Note: Be careful for the fall down of table as NC is turned on without motor power cable.

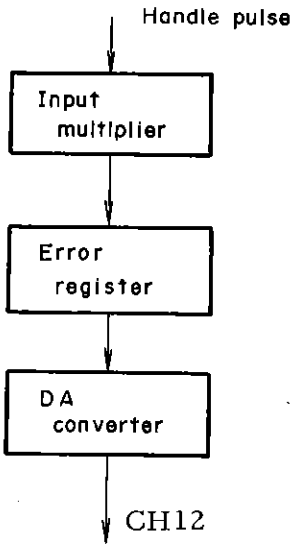
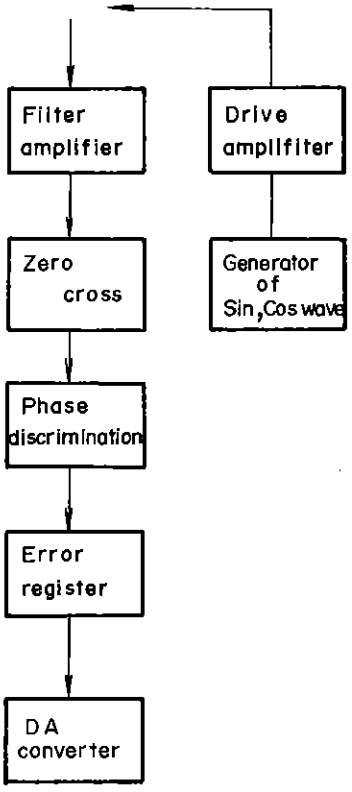


When pulses are put in by Handle, the voltage at CH12 varies continuously from positive to negative.

The rate is approximately 10mV/pulse. (1 pulse=10)

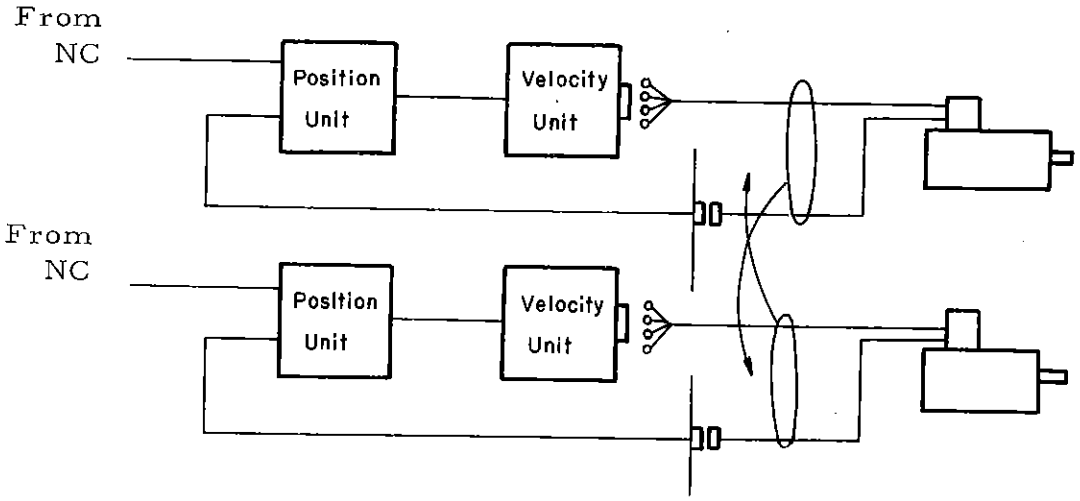


When motor shaft is rotated, the voltage at CH12 varies continuously from positive to negative.

Trouble	Cause
There is no voltage output at CH12 when pulses are put in by Handle	 Trouble is located at same part of above figure.
There is no voltage output at CH12 when motor shaft is rotated.	 Trouble is located at some part of above figure.

Another method of Checking

When one axis has trouble in servo system, it can be checked wheather unit (Position or Velocity) is wrong or problem is in machine itself by interchanging Position Unit and Velocity Unit with that of other axis.



Note 1. Velocity Unit for the motor Model 0 and 5 can not drive the motor Model 10, 20 or 30.

2. Both cables for motor power and feedback should be interchanged.

3. The position gain should also be changed when gear ratio of motor is different.

4. Be careful for command axis name as input is not changed.

APPENDIX : Zero position shift

The zero point by Zero Return function depends on the grid of Resolver or Inductosyn, and it can be adjusted and shifted up to 2mm if necessary.

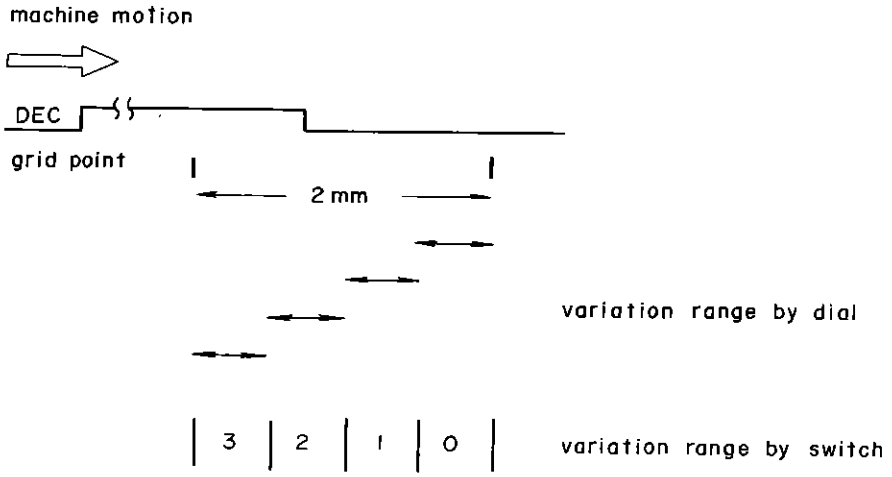
(1) Set the switch on the PCB of position control to "0" and execute the Zero Return.
Adjust the dial to get the appropriate position as the zero point.

(2) If the variation by the dial is too small, once put off power and change the switch to "1", "2" or "3", and then try Zero Return again.

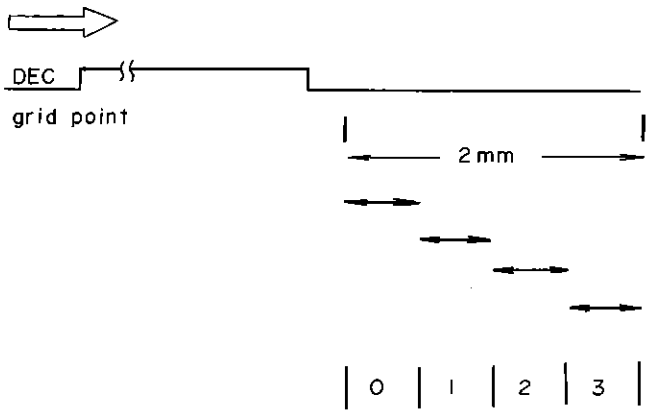
(3) If the variation is still not enough, then change the position of dog for deceleration.

Range of variation for the zero point

In case of (+) direction for Zero Return

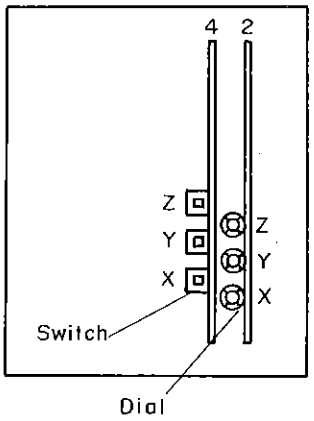


In case of (-) direction for Zero Return

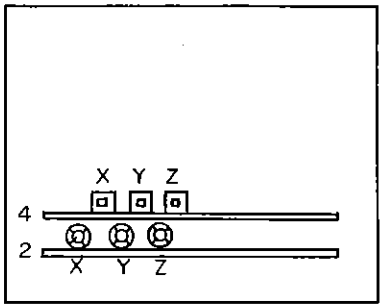


Location of switch and dial

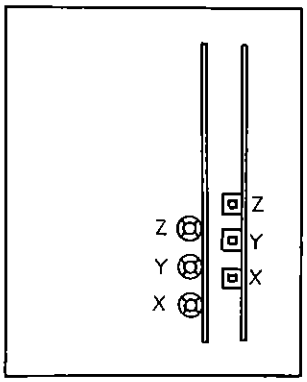
F3000B, F2000A
F1000C, F200-0A



F3000C, F2000C



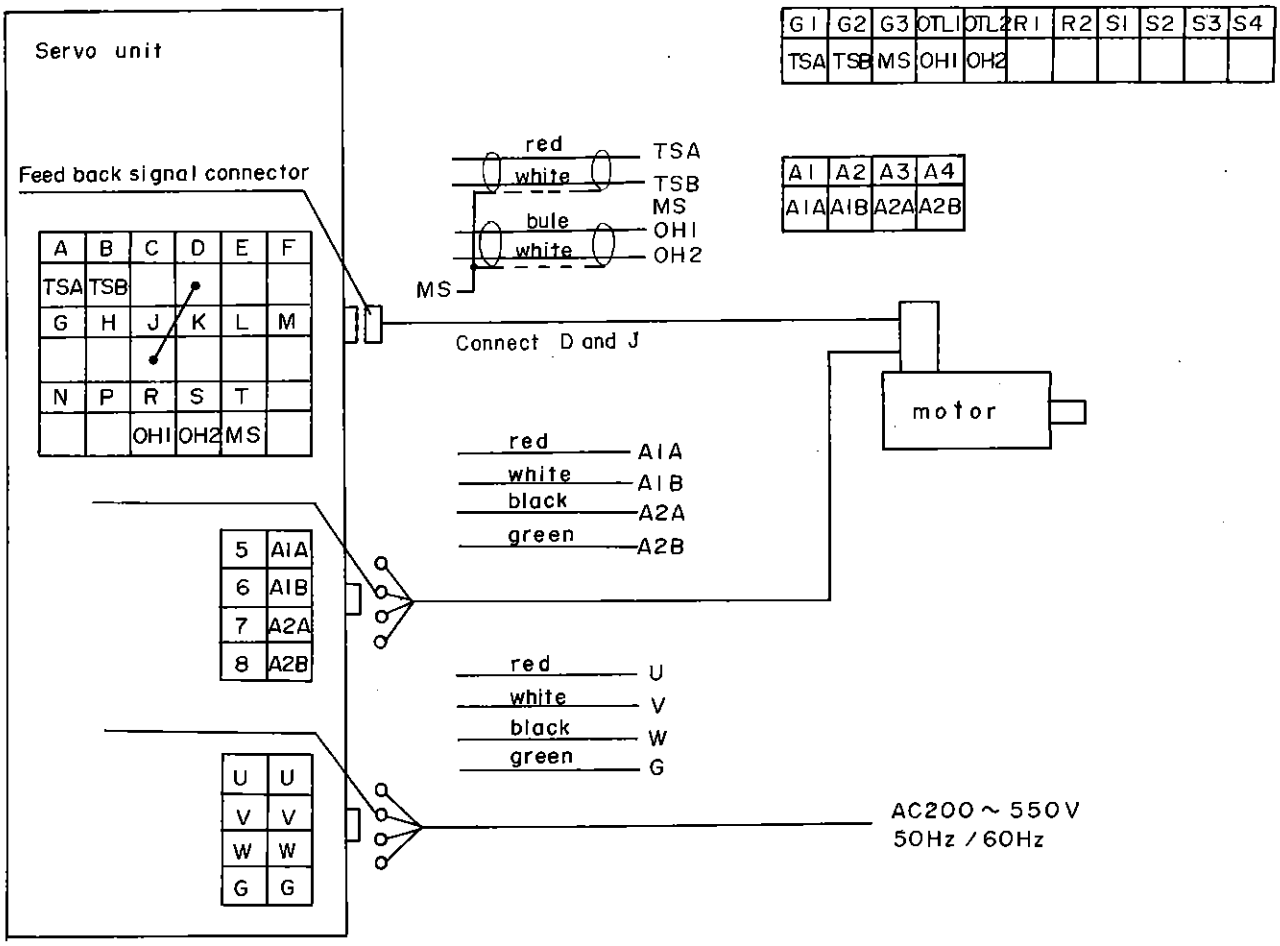
F200-0B, F220-0



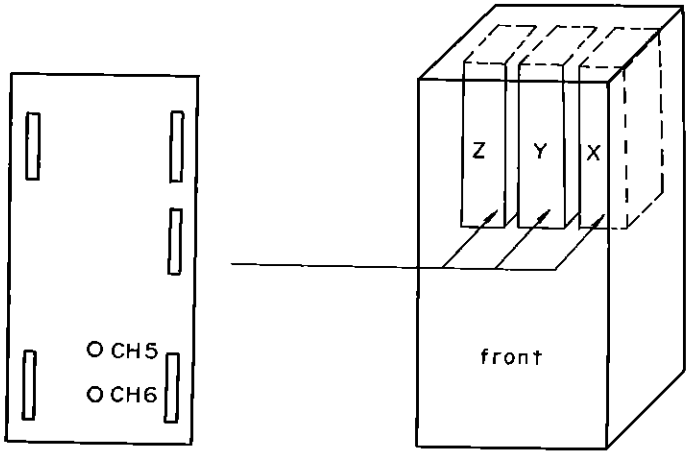
APPENDIX : Operation without inductosyn feedback

The machine table can be fed by open loop circuit if necessary when Inductosyn scale is not yet prepared.

(1) Connect cables as follows:



(2) Connect CH5 and CH6 on the PCB (20B-0003-0490) in the Velocity Unit of the axis where Inductosyn is applied.

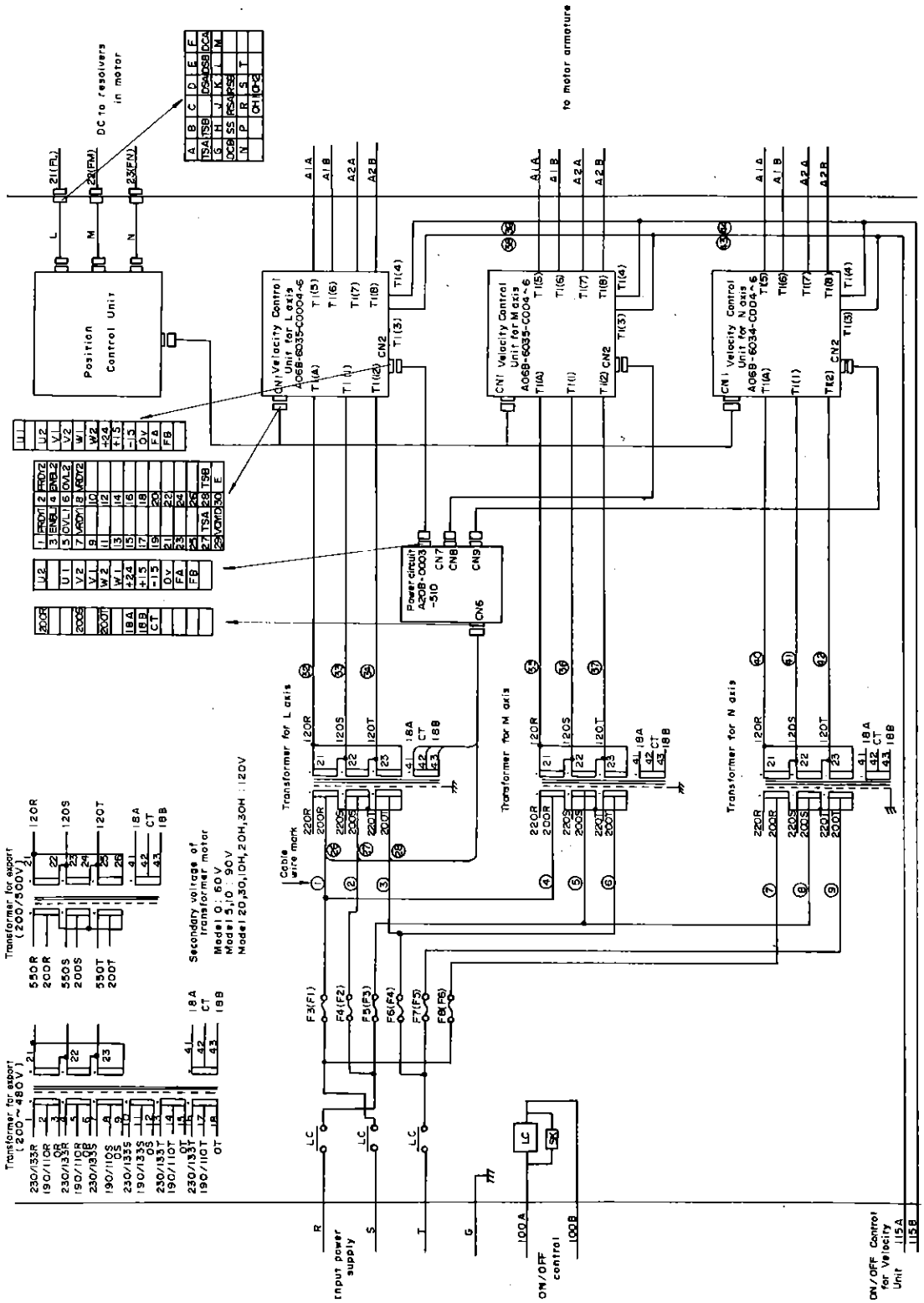


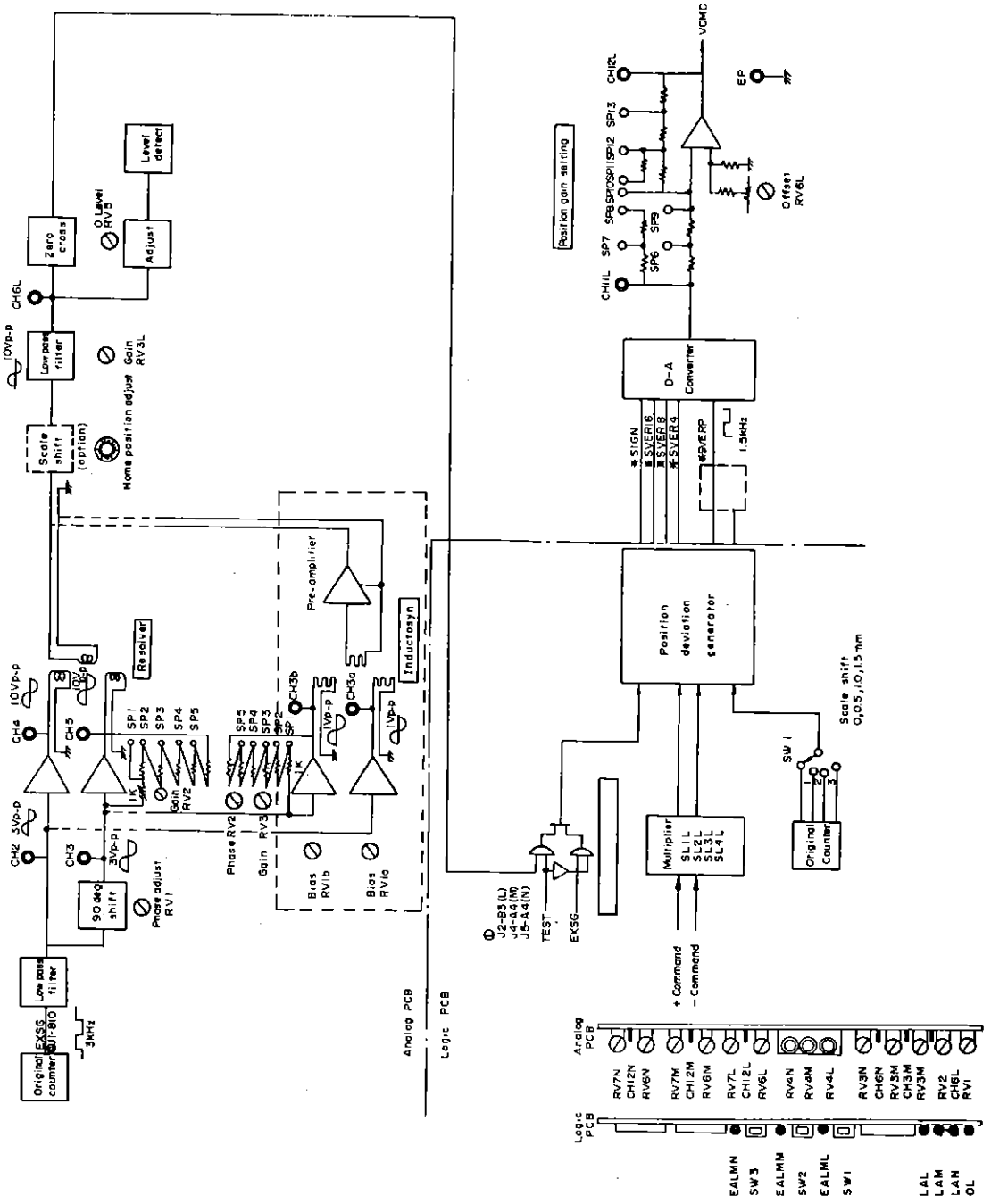
(3) Select the Handle mode for the specified axis and turn the Handle Slowly. The motor will begin to run. To stop the motor, turn the Handle in reverse direction until the motor stops.

Caution : Be carefull as no feedback in position loop. To stop the motor completely, it is necessary to turn off power. Be carefull for falling down of the table when power is put on.

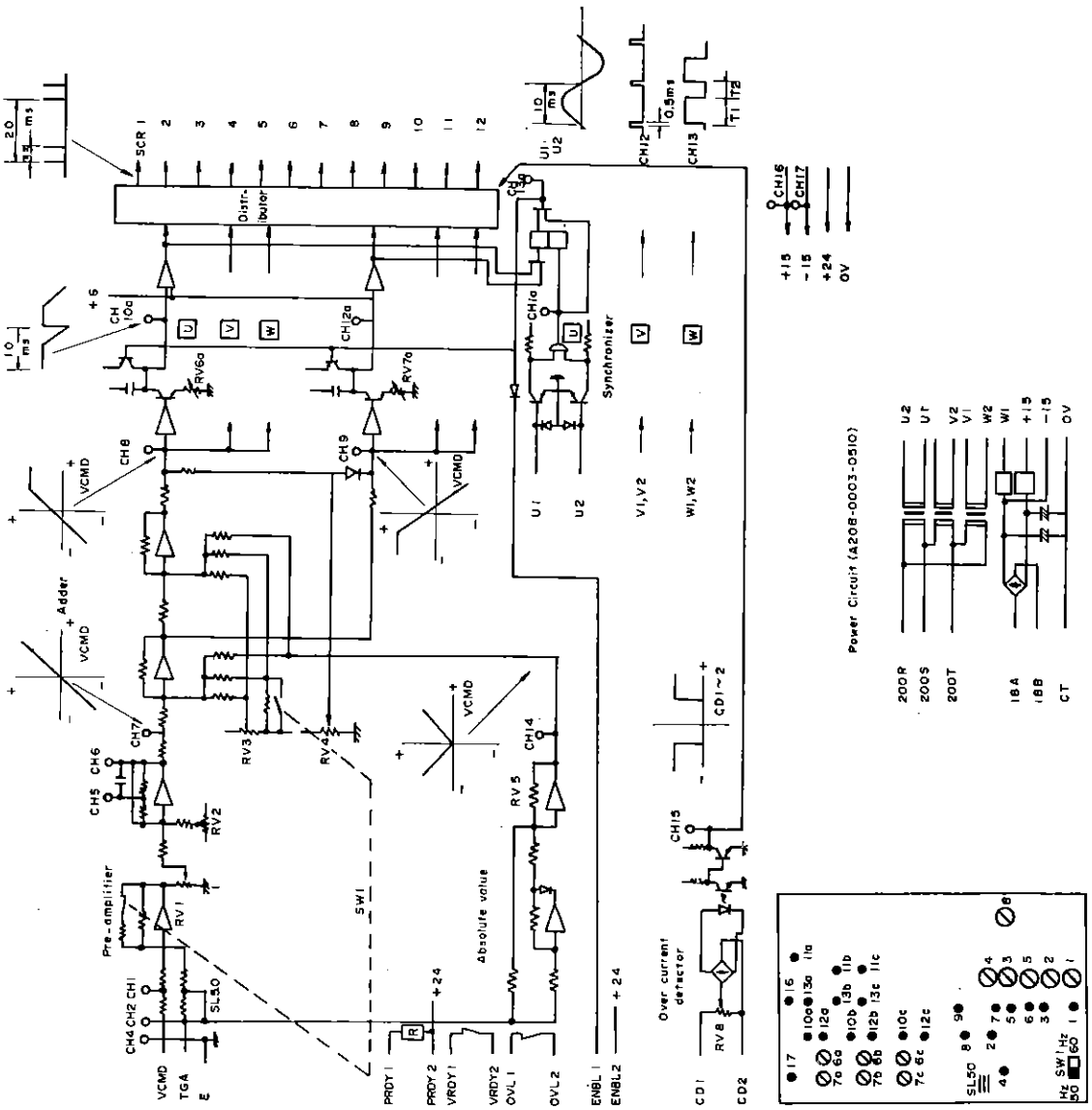
APPENDIX : BLOCK DIAGRAMS

1. General connection

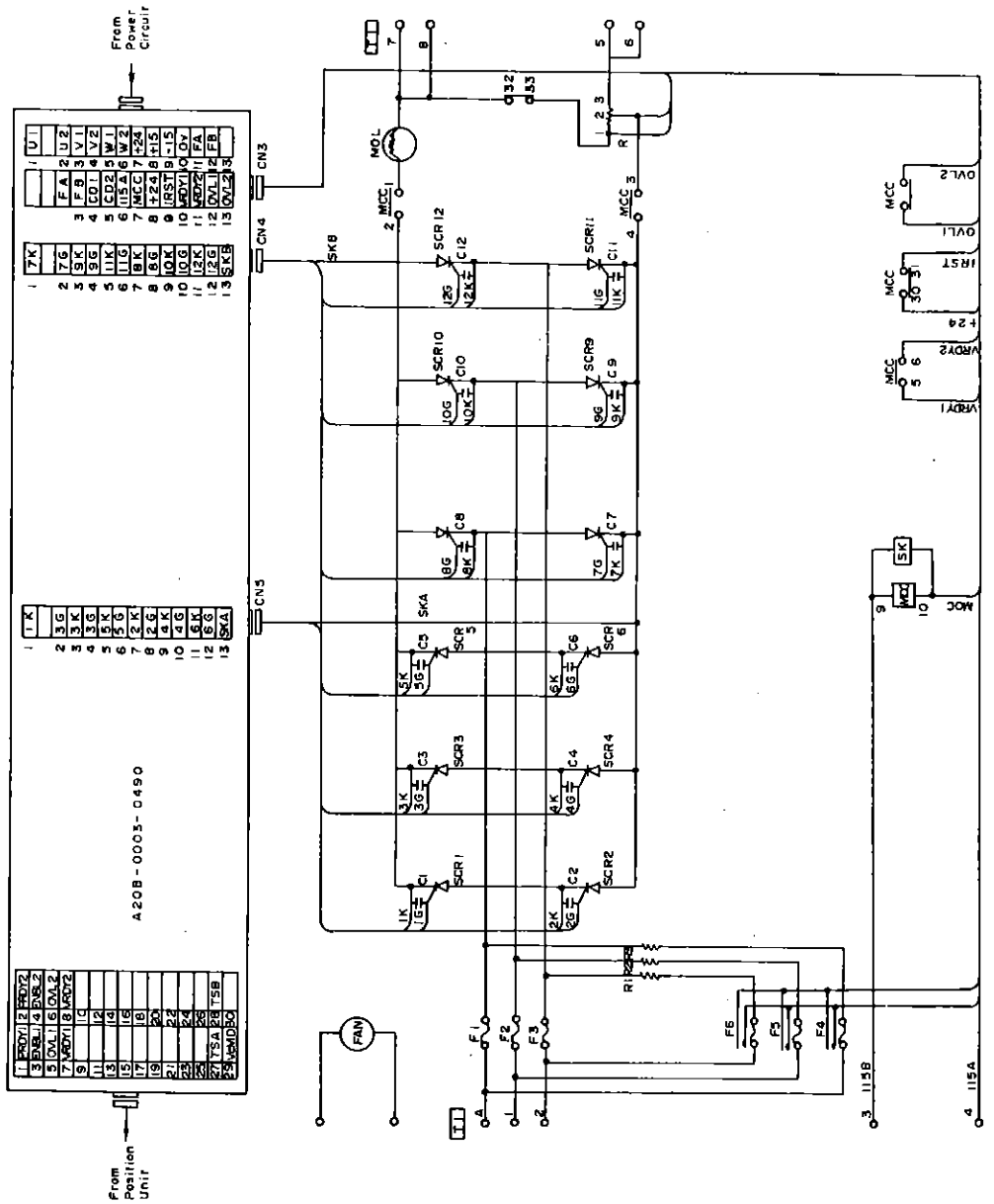



Zero cross
Level detect
Adjust
Low pass filter
Scale shift (option)
Home position adjust
Gain RV3L
Resolver
Pre-amplifier
Inductosyn
Phase RV2
Gain RV3
Bias RV1b
Bias RV1a
Phase adjust RV1
90 deg shift
Low pass filter
3KHz
Original EXSS counter
Position gain setting
D-A Converter
Offset RV6L
Position deviation generator
Multiplier
Original Counter
Scale shift 0,05,1,0,15mm
+ Command
- Command
TEST
EXSG
Analog PCB
Logic PCB
EALMN
SW3
EALMM
SW2
EALML
SW1
LAL
LAM
LAN
OL

3. Velocity unit



4. Firing circuit



APPENDIX : Method of adjustment

Note : These adjustment are not required for customers in general.
The values for adjustment are the standard values, and they might be adjusted to the different values according to the type of motor or the condition of load.
The actual values to be adjusted are written in the Data Sheet which is attached in each NC equipment.

1. Position unit

(1) Check the sinusoidal wave about 10V p-p at CH4 and CH5 on Analog PCB.
In case of Inductosyn, check the sinusoidal wave about 1V p-p at CH3a and CH3b on exiting circuit.

(2) Adjust RV3 so as to get 10V p-p at CH6 on Analog PCB.

(3) Drive the motor in low speed and adjust RV2, SP1 to SP5 and RV1 so as to get the ripple smaller than 30 mV p-p on the peak of sinusoidal wave at CH6.
In case of Inductosyn, the RV2, RV3 and SP1 to SP5 on exciting circuit. When both systems of Resolver and Inductosyn are used, first do the Resolver System.

Setting of input multiplier

Short wire / Multiplier	SL1	SL2	SL3	SL4
1	×	○	○	×
2	○	○	○	×
4	○	×	×	○
5	×	○	×	○
10	○	○	○	○

e.g. 10 μ of least command increment corresponds to multiplier 10.

Setting of position gain 30 sec^{-1}

For motor model 10, 20, 30, 10H, 20H, 30H

Gear ratio	1/5	1/4	1/3	2/5
Connection	Open	SP6* SP9	SP6* SP7	SP8* SP9

For motor model 0.5

Gear ratio	1/3	2/5	1/2	2/3
Connection	Open	Open	SP6* SP9	SP6* SP7

2. Velocity unit

The adjustment depends on the power frequency 50Hz or 60Hz.

(1) Connect CH7 to Ground (CH2) and adjust RV3 to get +0.8V (50Hz) or +0.95V (60Hz) at CH8.

(2) Connect CH7 and CH9 to Ground and adjust RV6a, b, c to set the pulse width T0 2.1 ms (50Hz) or 1.8 ms (60Hz) at CH13a, b, c.

See block diagram 3.

(3) Connect CH7 and CH8 to Ground and adjust RV7a, b, c to set the pulse width T0 2.1 ms (50Hz) or 1.8 ms (60Hz) at CH13 a, b, c.

See block diagram 3.

(4) Connect CH5 and CH6, and get +5V at CH7, then adjust RV4 to get the pulse width T1 2 ms (50Hz/60Hz) at CH13a.

See block diagram 3.

(5) Set RV1 to the 3rd point of its scale.

(6) Connect CH5 and CH6, and adjust RV2 to get 0V at CH17.

(7) The other potentiometers should never be changed.

APPENDIX: Spair parts

Name			Specification
Fuse	For domestic use and for export 550V	For Model 0, 5	" -K053
		For Model 10, 20, 30 10H	" -K054
		For Model 20H, 30H	" -K055
	For export (only 550V)	For Model 0, 5	" -K056
		For Model 10, 20, 30 10H	" -K057
		For Model 20H, 30H	" -K058
Semiconductor		For Model 0, 5	" -K059
		For Model 10, 20, 30 10H, 20H, 30H	" -K060
Printed Circuit Board	Velocity Control Unit		" -K061
	Position Control Unit	Zero point shift for 2 axes	" -K023
		Without Zero point shift	" -K024
		With Zero point shift for 3 axes	" -K025
		Without Zero point shift	" -K026
		With Zero point shift for 4 axes	" -K064
		Without Zero point shift	" -K065
	Inductosyn Exciter	Linear Inductosyn	A06B-6035-K031
		Rotary Inductosyn	" -K032
	Inductosyn Preamplifier		" -K033

Spair parts details

1. Fuse

K053	K054	K055	K056	K057	K058	Specification	Location used
3			3			A60L-0001-0036 #PC1-10	Velocity Unit
2	5			3		" -0036 #PC1-30	Velocity Unit and power input terminal (30A)
		3			3	" -0036 #PC2-40	Velocity Unit (40A)
		2				" -0036 #PC2-60	Power input fuse panel (60A)
			2	2		" -0042 #JG1-30	" (30A)
					2	" -0042 #JG2-60	" (60A)
3	3	3	3	3	3	S Fab 250/402a P405	Velocity Unit (0.5A)
1	1	1	1	1	1	" P413	" (1.3A)

2. Semiconductor (Thyristor)

Quantity			Specification	Location used
K059	K060			
1			A50L-5000-0006	Velocity Unit (25P4S)
	1		" -0005	Velocity Unit (50P5SF)

3. Printed Circuit Board

Quantity										Specification	Location
K061	K023	K024	K025	K026	K064	K065	K031	K032	K033		
1										A20B-0003-0490	Exciter in Velocity Unit
1										A20B-0003-0510	Power circuit in Velocity Unit
	1				1					A20B-0002-0940	Position Unit Analog Section
		1				1				" -0941	"
			1							" -0492	"
				1						" -0493	"
	1				1					A16B-0160-0540	Position Unit Digital Section
		1				1				" -0541	"
			1							" -0542	"
				1						" -0543	"
	1	1	1	1						A20B-0002-0870	Power Circuit in Position Unit
							1			" -0950	Exciter in Position Unit
								1		" -0951	"
									1	A06B-9001-C001	Pre-amplefier

SECTION 3 - 1

1. CONNECTIONS

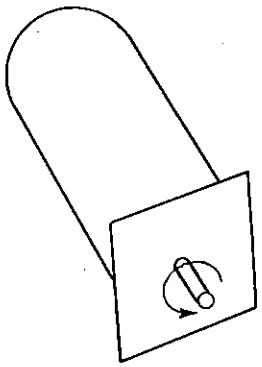
1.1 Connection of Cables

For DC servo unit there are connection cables of power supply, feedback signals and motor power.

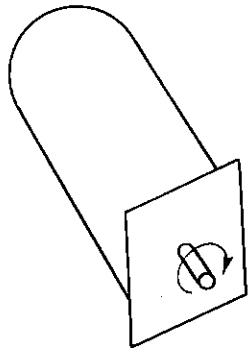
There are standard connection and reverse connection for the feedback signal cable and motor power cable according to the rotational direction which follows the feed command from the control unit.

The rotational direction corresponding to the (+) feed command

Standard connection

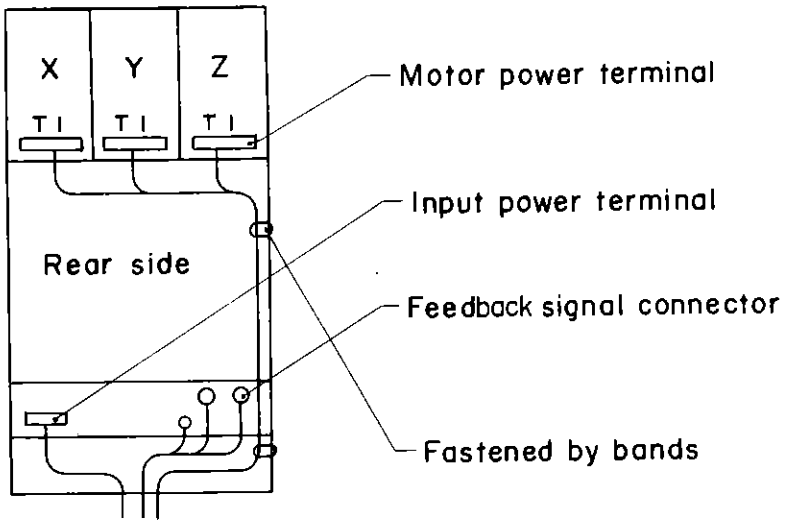


Reverse connection

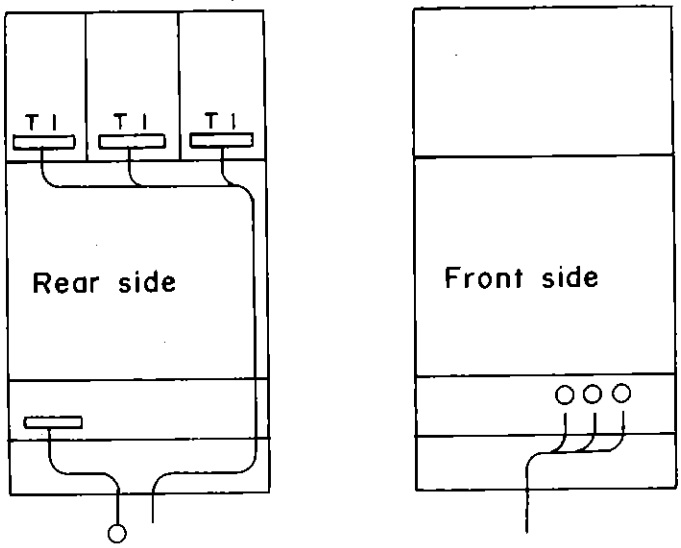


Location of cables and connectors

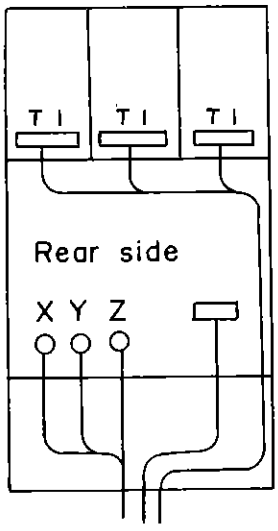
In case of F3000B, F2000A, F1000C, F200-0A



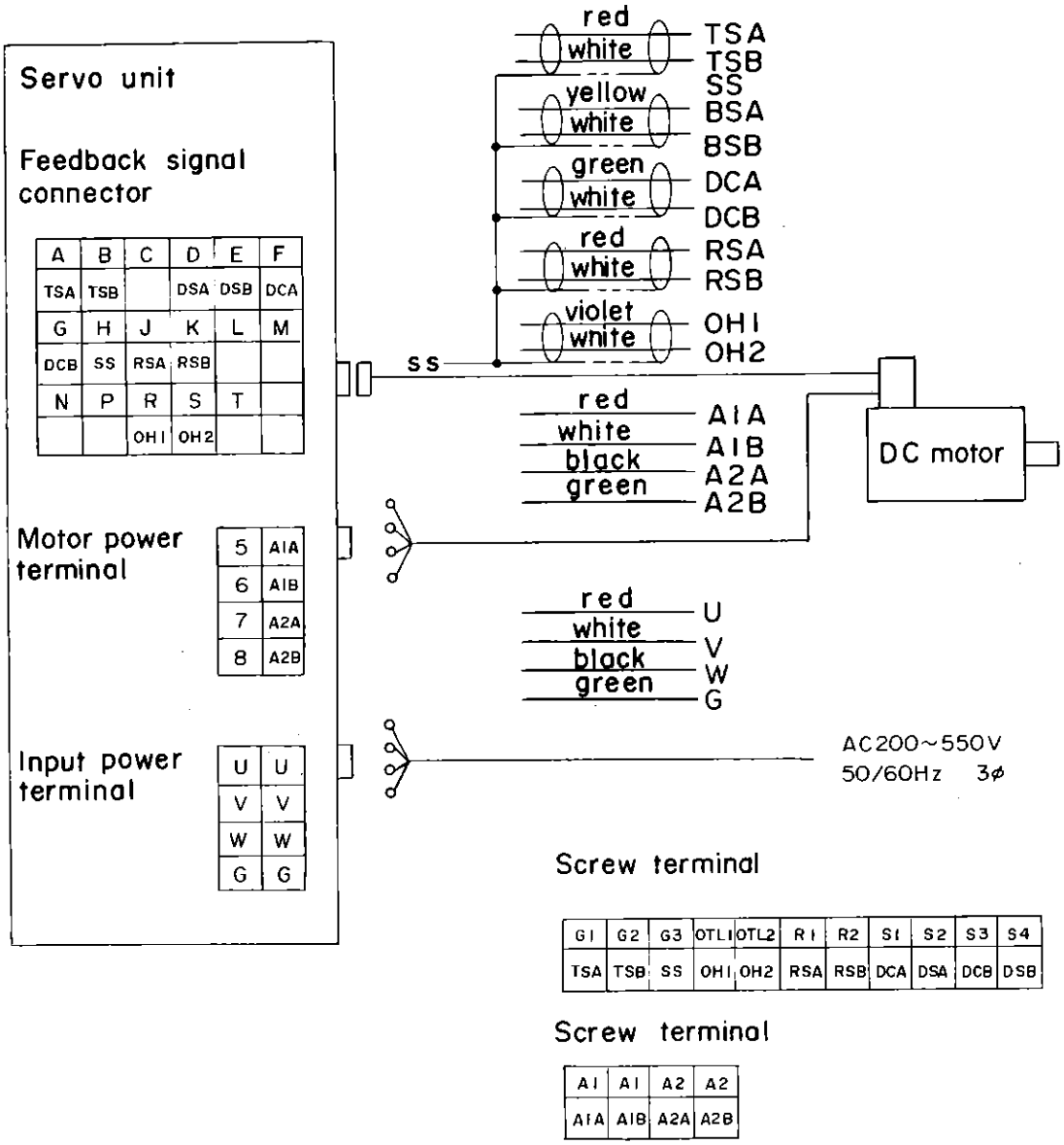
In case of F3000C, F2000C



In case of F200-0B, F220-0



Connection for resolver system (standard connection)



(Reverse connection)

Servo unit

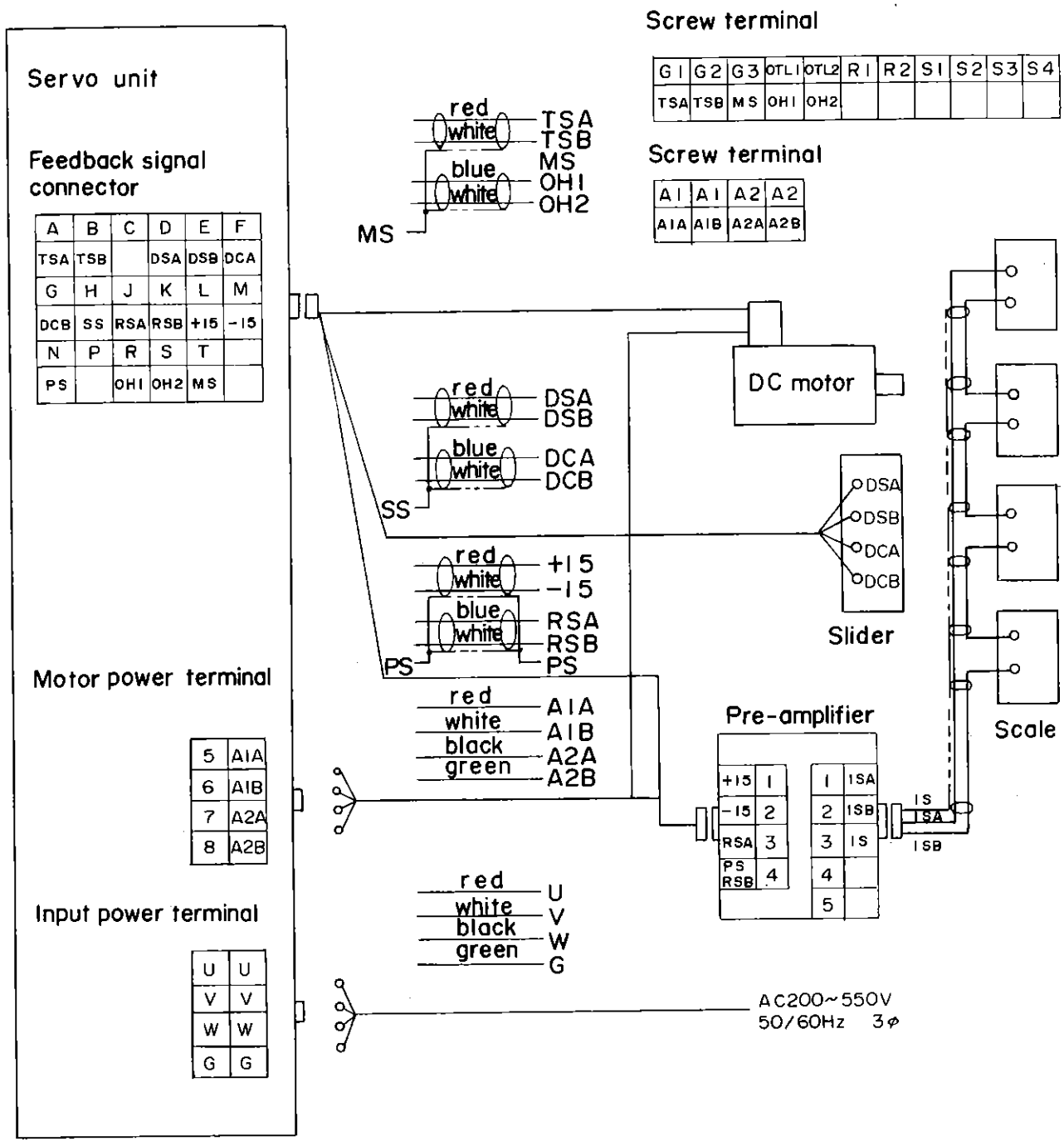
Feedback signal connector

A	B	C	D	E	F
TSB	TSA		DSB	DSA	DCA
G	H	J	K	L	M
DCB	SS	RSA	RSB		
N	P	R	S	T	
		OH1	OH2		

Motor power terminal

5	A2A
6	A2B
7	A1A
8	A1B

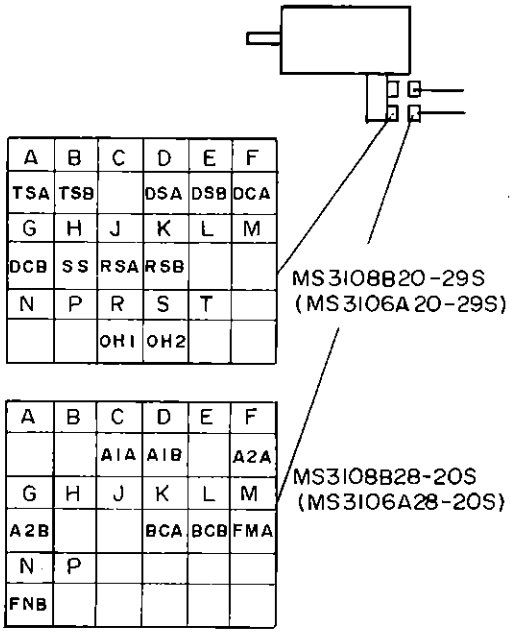
Connection for Inductosyn system (Standard connection)



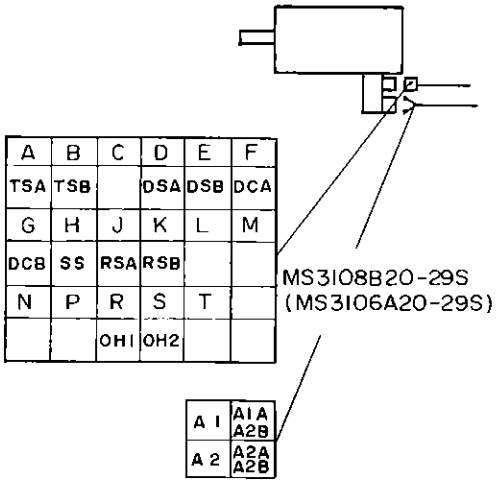
The reverse connection is same as resolver system.

Connection of DC motor with connector

Model 10, 20, 30,



Model 0, 5



1.2 Tap change for power transformers

(1) Measure the voltage of input power supply.

(2) If the input voltage is outside of the allowable range for that tap, change to the appropriate tap.

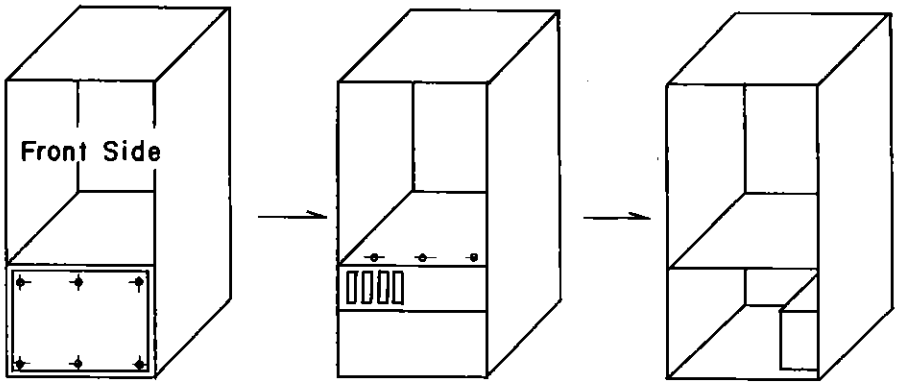
(3) Renew the data sheet of the DC servo unit about the set voltage.

Taps of input voltage and allowable voltage range

Power Transformer	Input tap V	Allowable voltage range (V)
For domestic use	200	170 ~ 220
	220	190 ~ 240
For export	190	160 ~ 210
	230	200 ~ 250
	380	320 ~ 420
	420	360 ~ 460
	460	390 ~ 520
	550	470 ~ 600

Location of taps of transformer

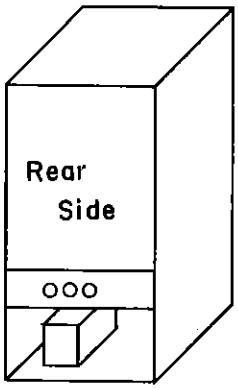
In case of F3000B, F2000A, F1000C, F200-0A



Note 1. Remove 6 screws and take away a cover.

Note 2. Remove 3 screws and take out a fuse panel.

In case of F3000C, F2000C



Tap connection

In case of transformer for domestic use

Cable number	Cable wire mark	Terminal number of transformer	
		For input 200V	For input 220V
K7	1	2	1
	2	4	3
	3	6	5
K8	26	2	
	27	4	
	28	6	

In case of transformer for export

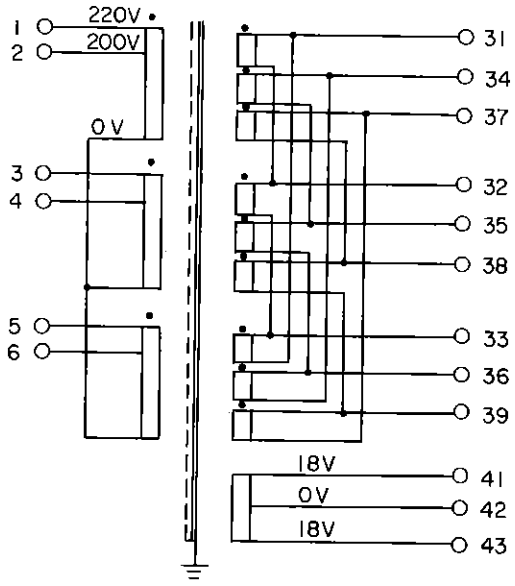
Cable number	Cable wire mark	Terminal number of transformer					
		Input 200V	Input 220V	Input 380V	Input 415V 440V	Input 460V 480V	Input 550V
K7	1	7	6	7	6	6	5
	2	15	14	15	14	14	13
	3	23	22	23	22	22	21
Strap wire	Connect between each terminal of trans-former	3-7	2-6				
		4-8	4-8	3-8	3-8	2-8	1-8
		11-15	10-14				
		12-16	12-16	11-16	11-16	10-16	9-16
		19-23	18-22				
		20-24	20-24	19-24	19-24	18-24	17-24
		4-12-20					

K8	26	3
	27	11
	28	19

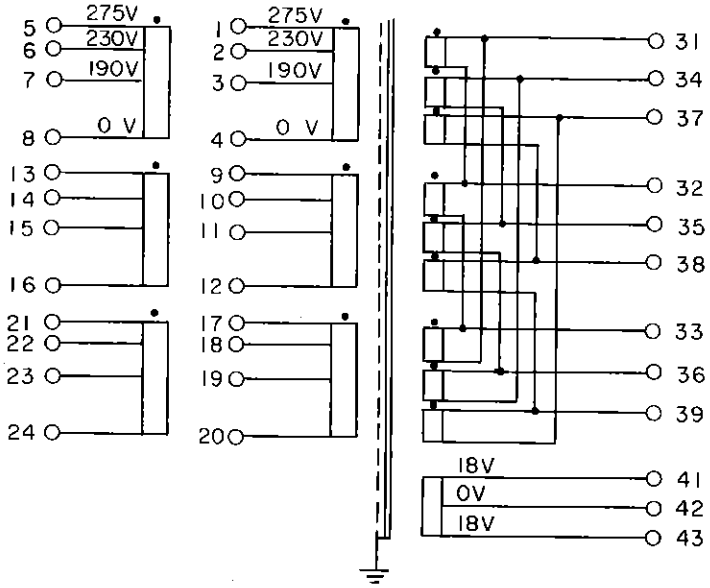
Remarks In case of 4-axis system or with large load torgue, 2 transformers are used. Each transformer should be done the tap connection as same manner.

Circuit diagram of transformer

For domestic use



For export



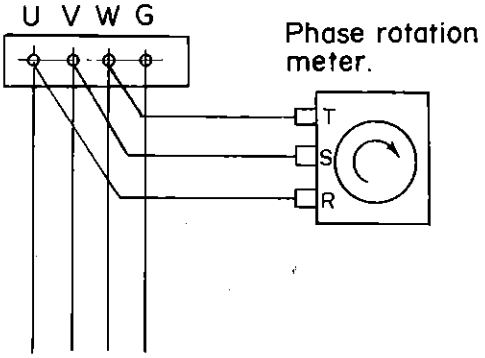
1.3 Checking of the phase rotation for the input power supply

For the 6-phase controlled servo unit, the phase rotation of input power supply must be in the order of U → V → W.
If this relation is not correct and when power is put on, fuse in velocity control unit may blow.

Method of phase checking

Connect a phase rotation meter to the power input terminal U, V, W and see whether a disc of the meter rotates in the clockwise direction.

Power input terminal

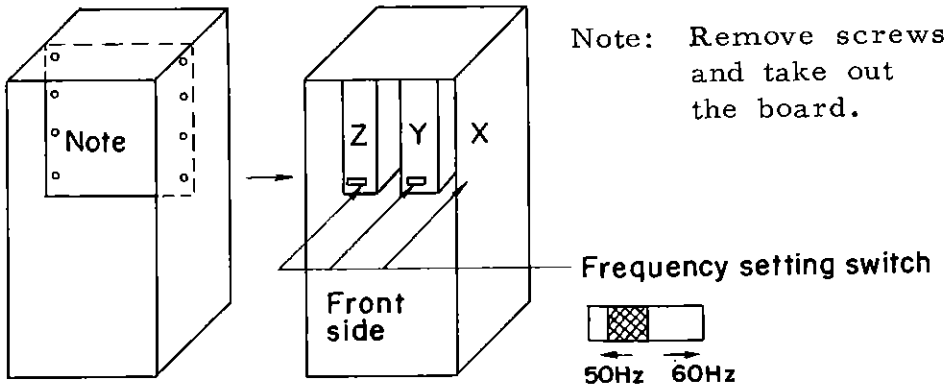


1.4 Setting of frequency for the Velocity Control Unit

Check the setting and switch if it is not correct.

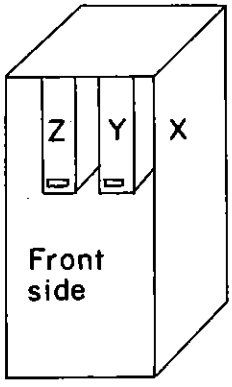
Location of frequency setting switch

In case of F3000C, F2000C

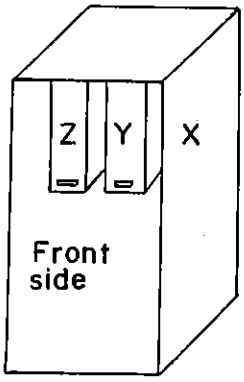


Note: Remove screws and take out the board.

In case of F3000B, F2000A, F1000C, F200-0A



In case of F200-0B, F220-0



2. MAINTENANCE

2.1 Periodical maintenance

Cleaning of air filter and checking of brushes of DC motor are necessary as the periodical maintenance.

Cleaning of air filter

Air filter must be cleaned out once a month.
The filter can be removed with a sliding action to the backward.
Recommended method of cleaning is to blow the compressed air to the filter element while appling slight vibration.
If it is too polluted, it is washed in a neutral cleanser and dried up in the shadow of the sun.

Checking and replacing of brushes of DC motor

(1) The period of Checking

General machine tools such as lathes, milling machines and machining centers ..... 1 year

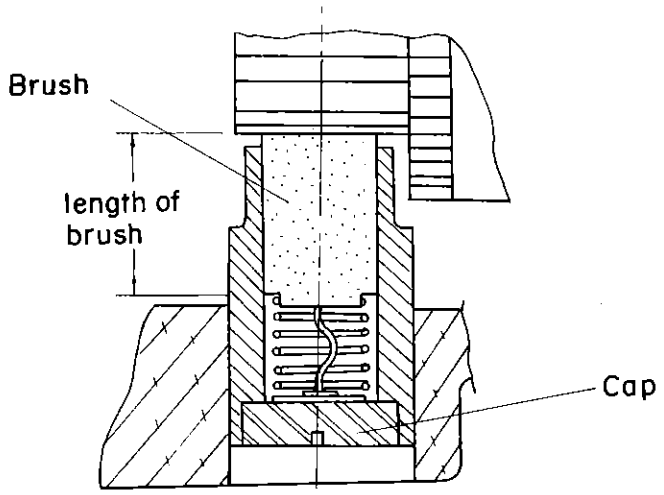
Frequent acceleration and deceleration machine tools such as punch press ..... 2 months

(2) The standard of replacement of brushes

The old brush should be replaced when it becomes less than 10mm in length.

(3) Method of replacement

Remove a brush cap and take out an old brush.
Set a new brush and put a cap and screw it tightly.



2.2 Troubles and Counteractions

Items of failure are provided below and each trouble can be checked up according to the following procedures.

(A) Ready lamp does not turn on.

(B) Over heat lamp lights on.

(C) Servo alarm lamp lights on.

(D) Fuse in Velocity Control blows.

(E) Machine runs away.

(F) Lack of accuracy.

(G) Big vibration and/or noise at stop.

(H) Big vibration and/or noise when running.

(I) Big vibration and/or noise during acceleration.

(J) Big overshoot.

(K) Lack of accuracy by 1 pulse feed.

(L) Lack of accuracy in positioning repeatability.

(M) Lack of stiffness in servo system.

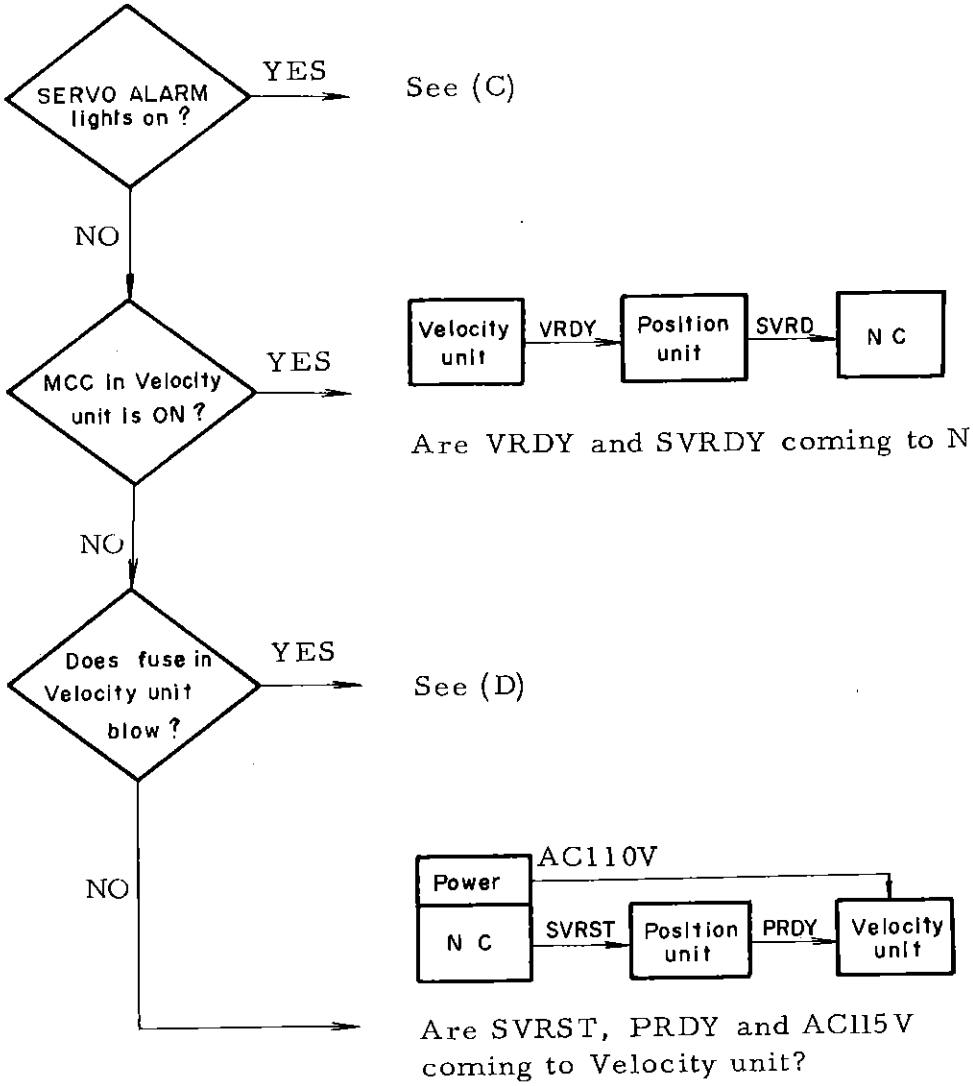
(N) Lack of accuracy in a circular arc cutting at the junction of quadrant.

(O) Cause texture on cutting surface.

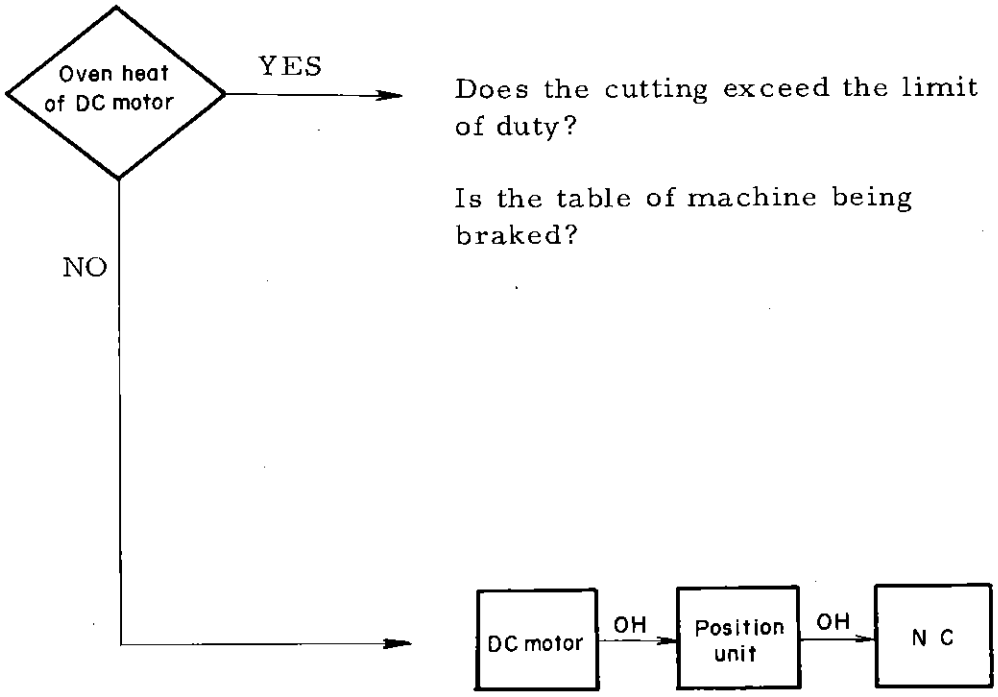
(P) Method of Checking out for the Veclocity Control Unit.

(Q) Method of checking out for the Position Control Unit.

(A) Ready lamp does not light on



(B) Over heat lamp lights on.



Is the cable between a DC motor and Position unit disconnected?

Is Over Heat signal going to NC?

Is Over Heat signal coming from NC control unit?

(C) Servo Alarm lamp lights on

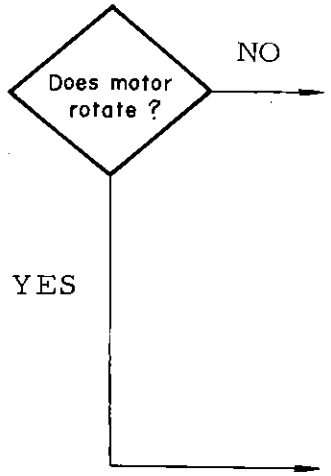
The Servo Alarm turns on in following cases.

a. When positioning error becomes more than 8000 pulses, the EALM lamp and Servo Alarm lamp light on.

b. When the feedback signal from Resolver or Inductosyn becomes lower than 3V p-p at CH6, the LA Lamp and Servo Alarm lamp light on.

c. When the thermal relay in the Velocity unit operates by over current, the OL lamp and Servo Alarm lamp light on.

(a) Position error lamp lights on



Is power cable of DC motor disconnected?
Any trouble in position unit?
Any trouble in Velocity unit?

Wrong setting of position gain?

The correct setting

(1) Frequency for rapid traverse: Lower than 160 kpps (1 μ pulse)

(2) Input multiplier

(3) Position gain: 30 sec^{-1}

(4) Gear ratio of DC motor

DC motor 10, 20, 30

Gear ratio	1/5	1/4	1/3	2/5
Connection	No con-nection	SP6* SP9	SP6* SP7	SP8* SP9

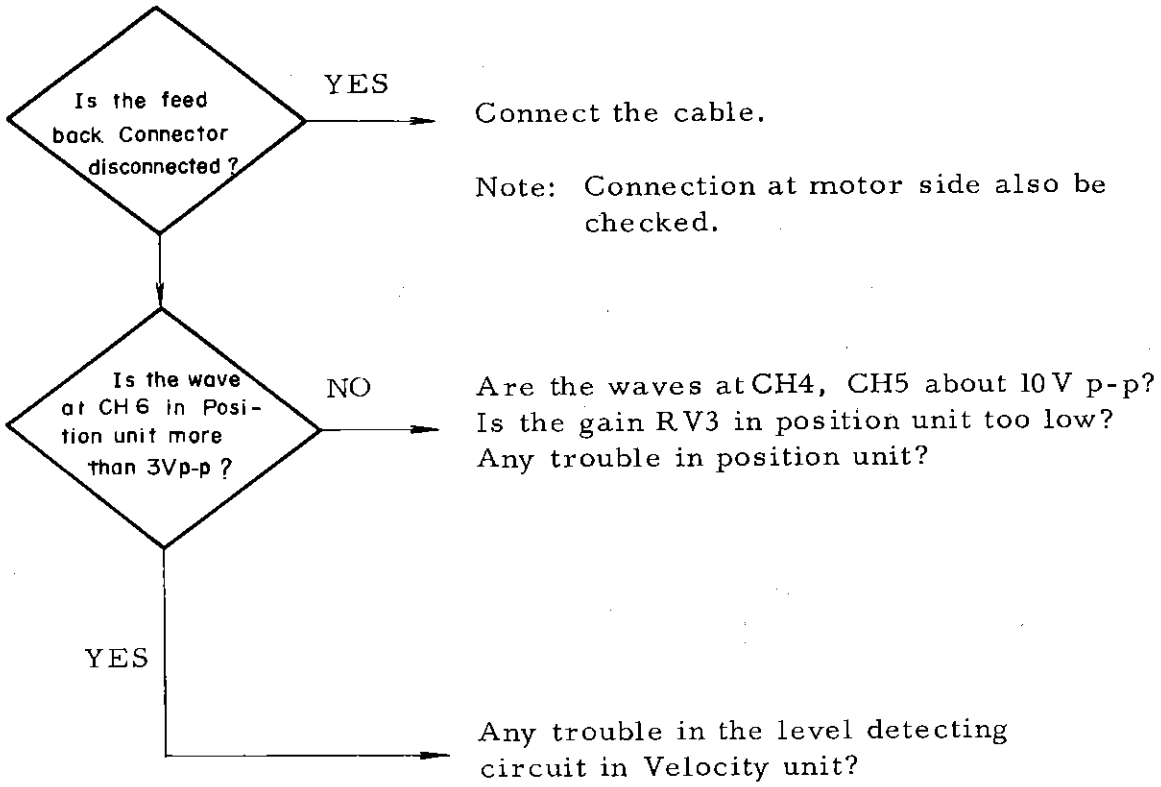
DC motor 5, 0

Gear ratio	1/3	2/5	1/2	2/3
Connection	No con-nection	No con-nection	SP6* SP9	SP6* SP7

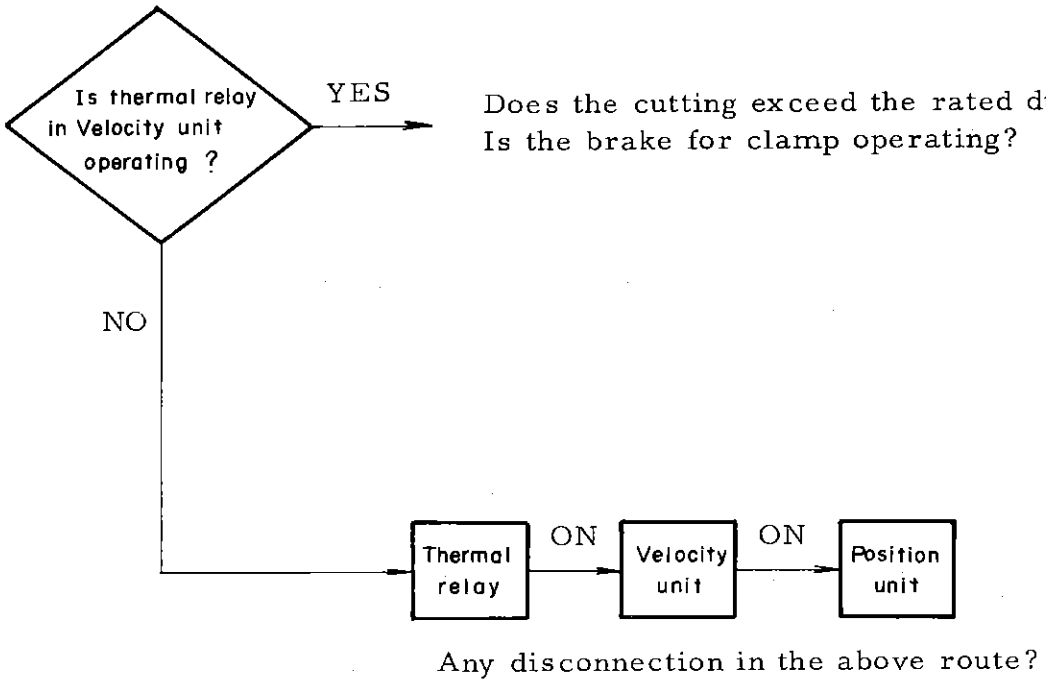
(5) Setting of tacho generator feedback resistance

For DC motors model 5, 0 wiring of SL5, SLO in the firing circuit in the Velocity Control should be cut.

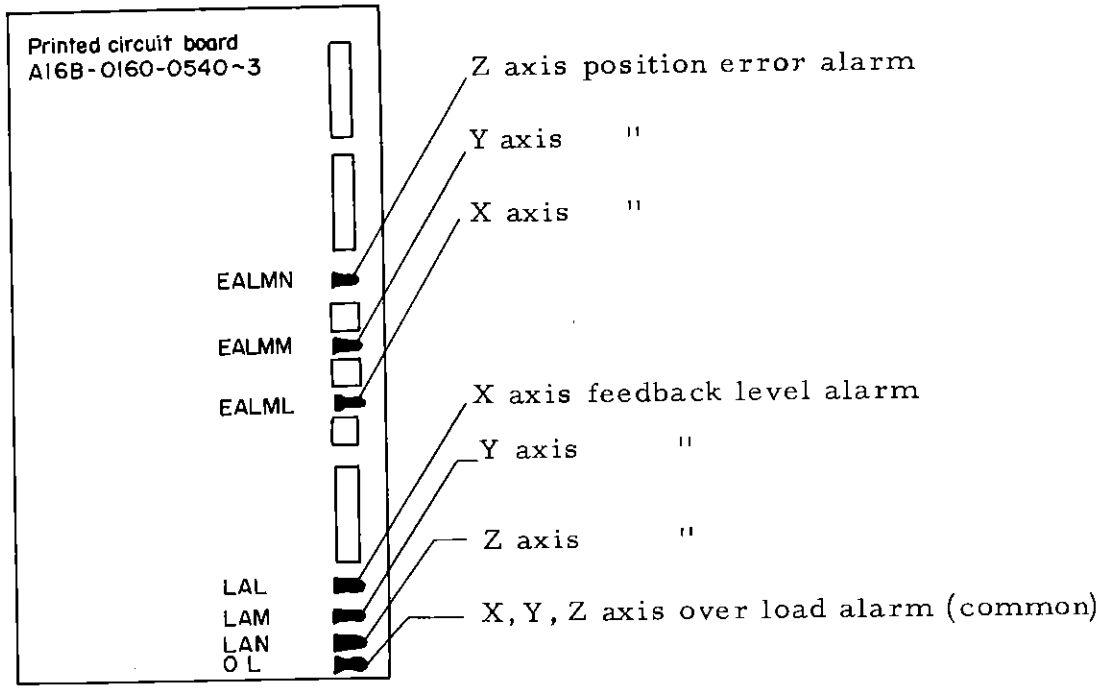
(b) The level alarm lamp lights on



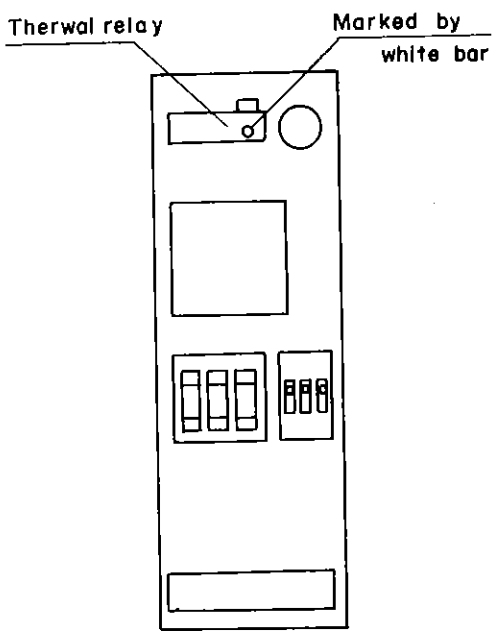
(c) Over load lamp lights on



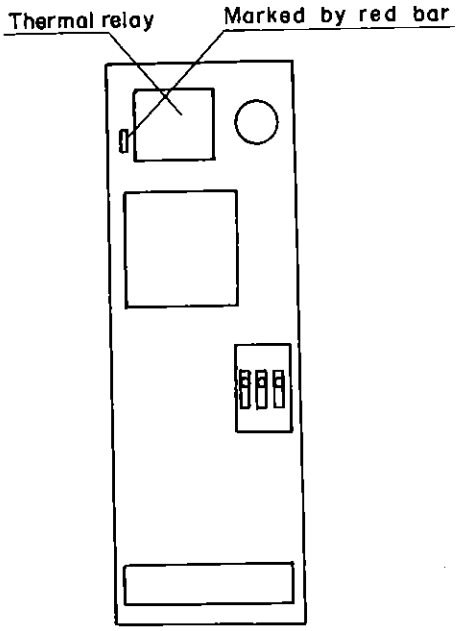
Location of alarm display



Location of over load alarm display for each axis

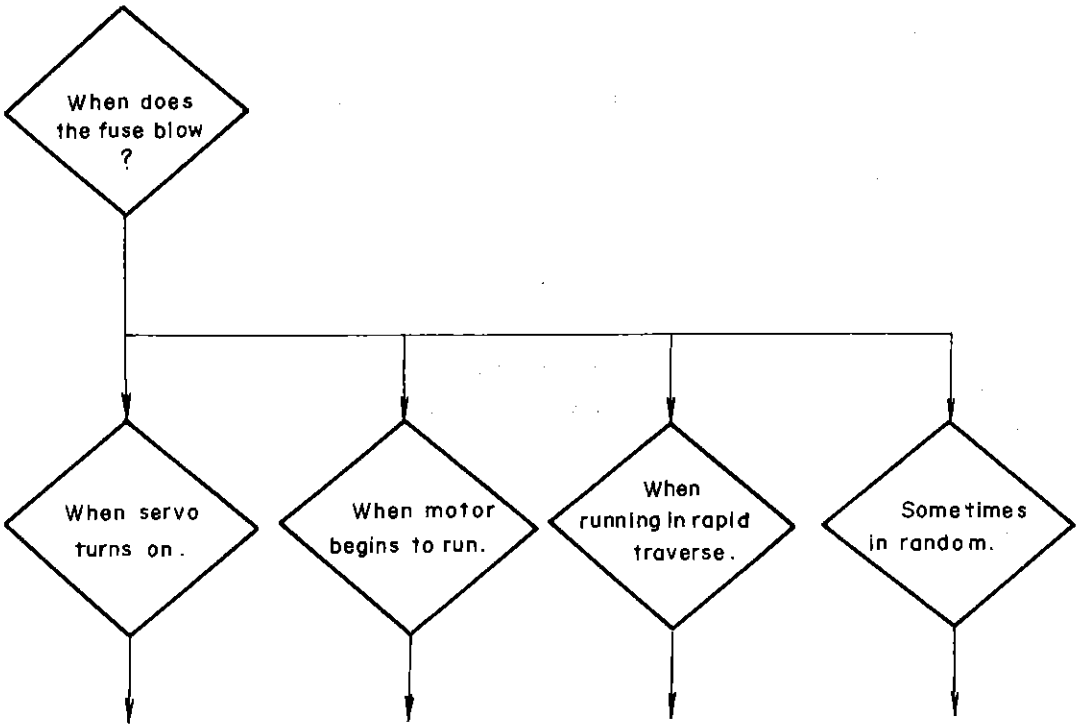


Velocity Unit for model 10, 20, 30



Velocity unit for model 0.5

(D) Fuse in Velocity unit blows



Is the phase rotation of input power correct?

Is the setting of 50/60 Hz in Velocity unit correct?

Are the wirings of feedback devices correct?

Is the gain setting in Position unit 30 sec^{-1}

Any damage in Velocity unit?

Same as left.

Is it mechanically clamping on braking?

Is the gain in Velocity unit too high?

Is the gain setting in position unit 30 sec^{-1}?

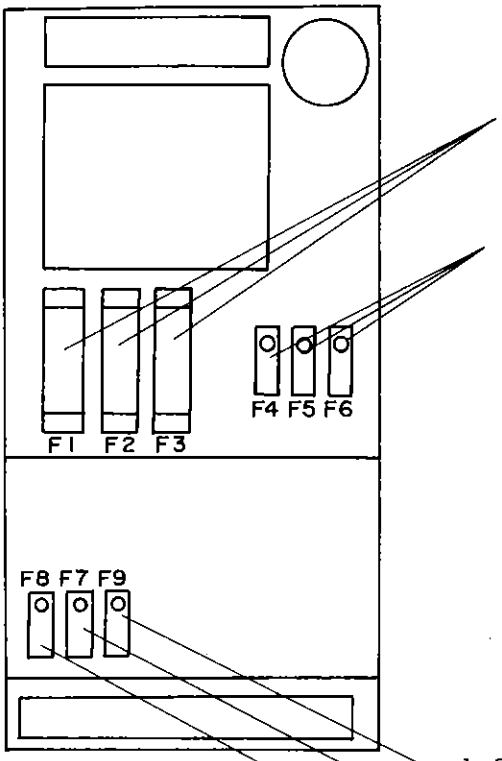
Is the over current detector operating?

Any damage in Velocity unit?

Any contact problem?

Any damage in Velocity unit?

Location of fuses



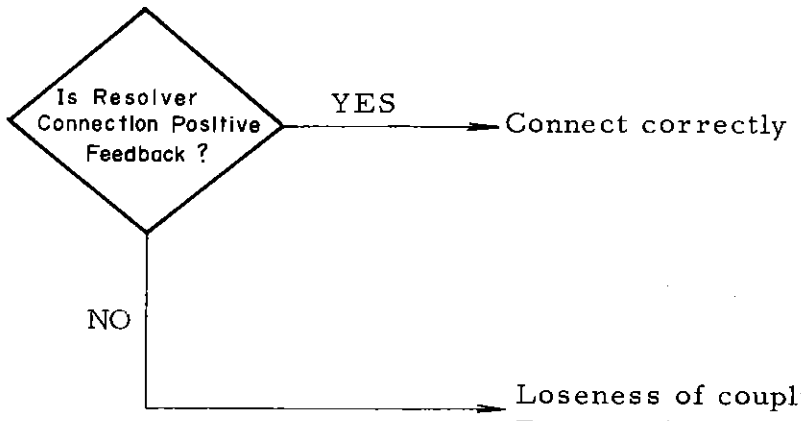
Main fuse (30A) A60L-0001-0036 #PC1-30
(10A) (" #PC1-10)

Alarm fuse (0.5A) connected parallel to Main fuse

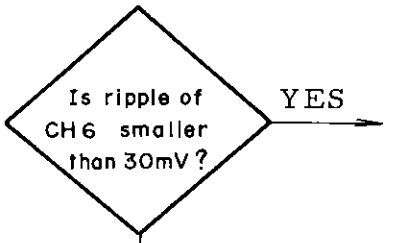
F4 is parallel to F1 SF ab250/402aP405
F5 is parallel to F2
F6 is parallel to F3

1.3A Alarm fuse to -15V line SF ab250/402aP413
1.3A " +24V line "
1.3A " +15V line "

(E) Machine runs away

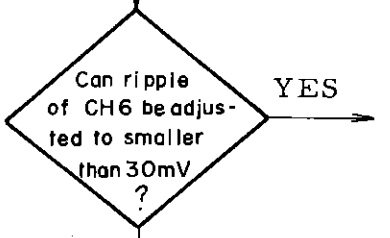


(F) Lack of accuracy



YES → Call FANUC

NO



YES → Accuracy will be improved

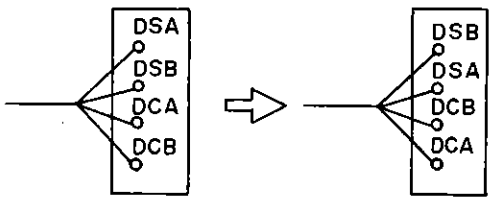
NO →

Is sield wire of Resolver connected to ground at NC?

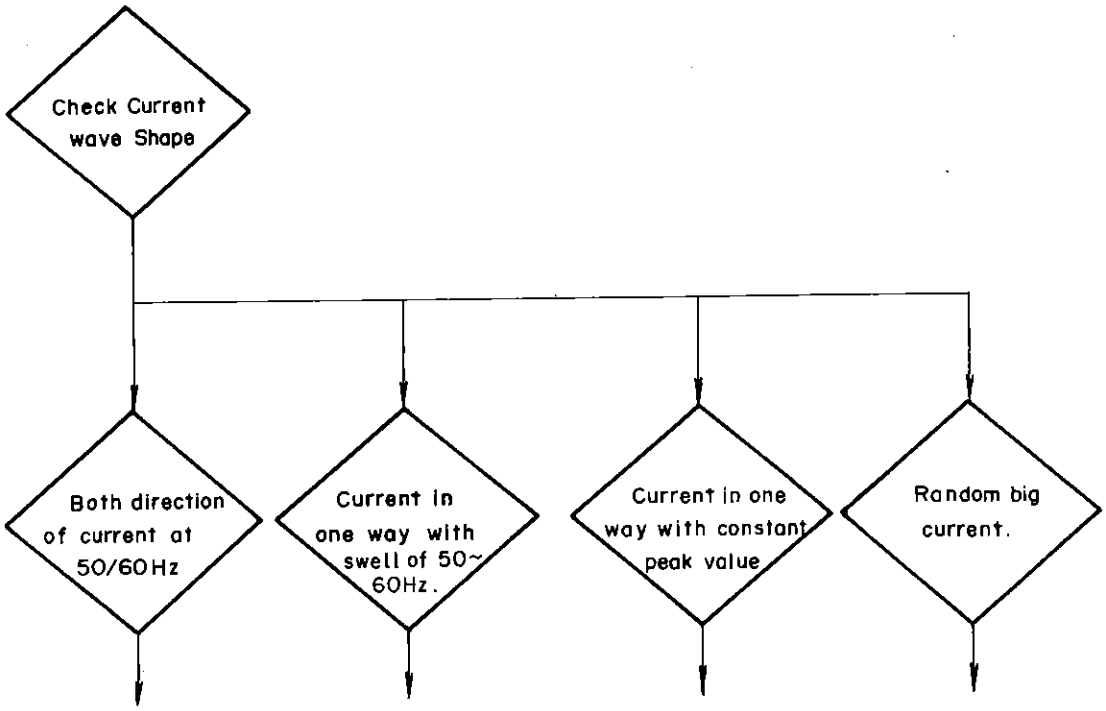
Is wiring of Resolver Shielded over full length?

Is wiring of Resolver isolated from machine cable?

In case of Inductosyn, try to change the terminals as follows.

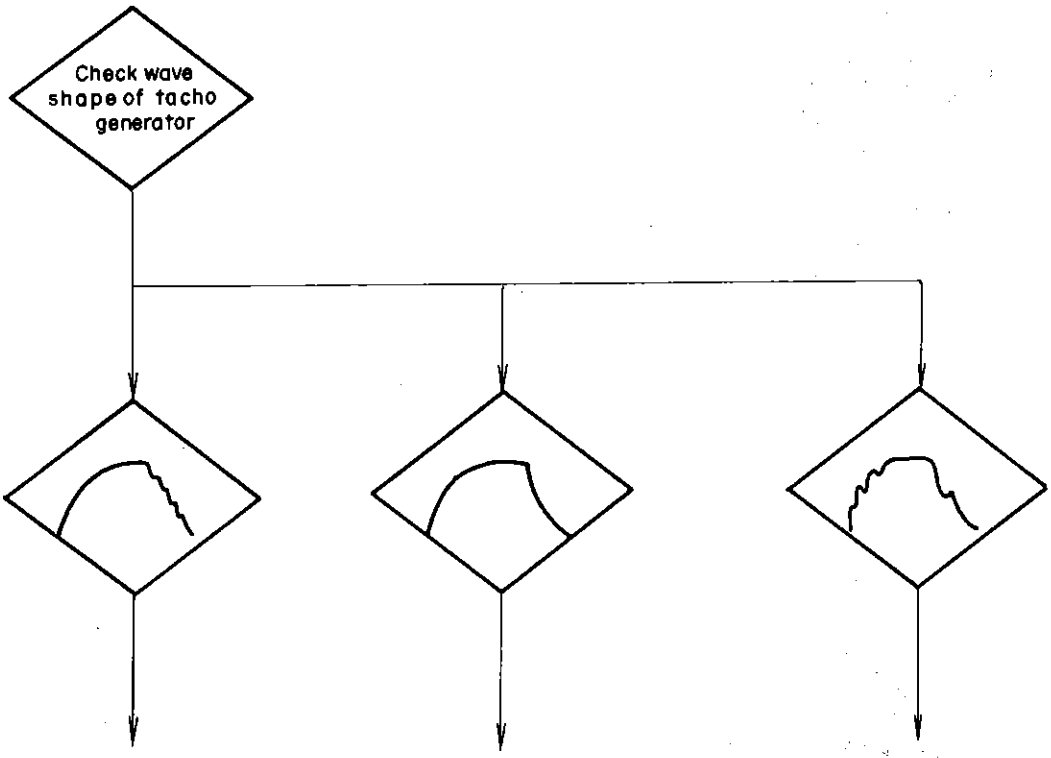


(G) Big vibration and/or noise at stop or running



Is frequency setting in velocity unit correct? Is dither too big? Is gain too big? Is input power wave shape normal? Is width of dither constant?	Same as left.	Can not be corrected by adjustment because of mechanical resonance between power frequency.	Damage of velocity unit.

(I) Big vibration and/or noise during acceleration



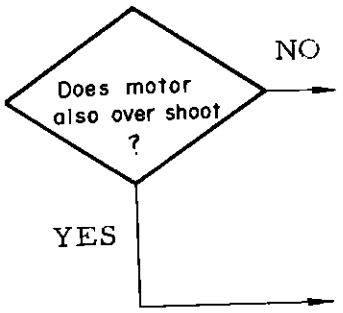
Is gain too big?

Adjust acc. time longer.

Can not be corrected by adjustment because of mechanical resonance between power frequency.

Damage of velocity unit.

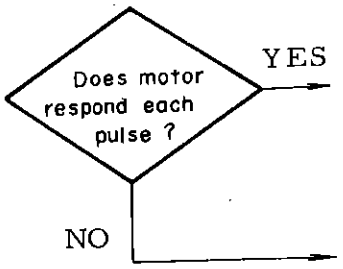
(J) Big overshoot



Trouble of machine

Is gain of velocity unit too low?

(K) Lack of accuracy by 1 pulse feed

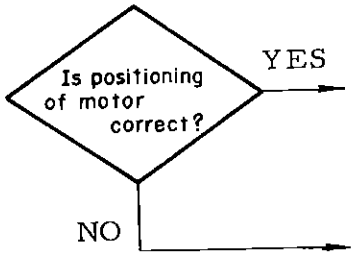


Trouble of machine

Is gain of velocity too low?

Is dither too small?

(L) Lack of accuracy in positioning repeatability



Trouble of machine

Is setting of acc-time for rapid traverse too small?

Is gain of velocity unit too low?

Is dither too small?

(M) Lack of stiffness in servo system
Is gain of velocity unit too low?
Is position gain 30 sec^{-1}?

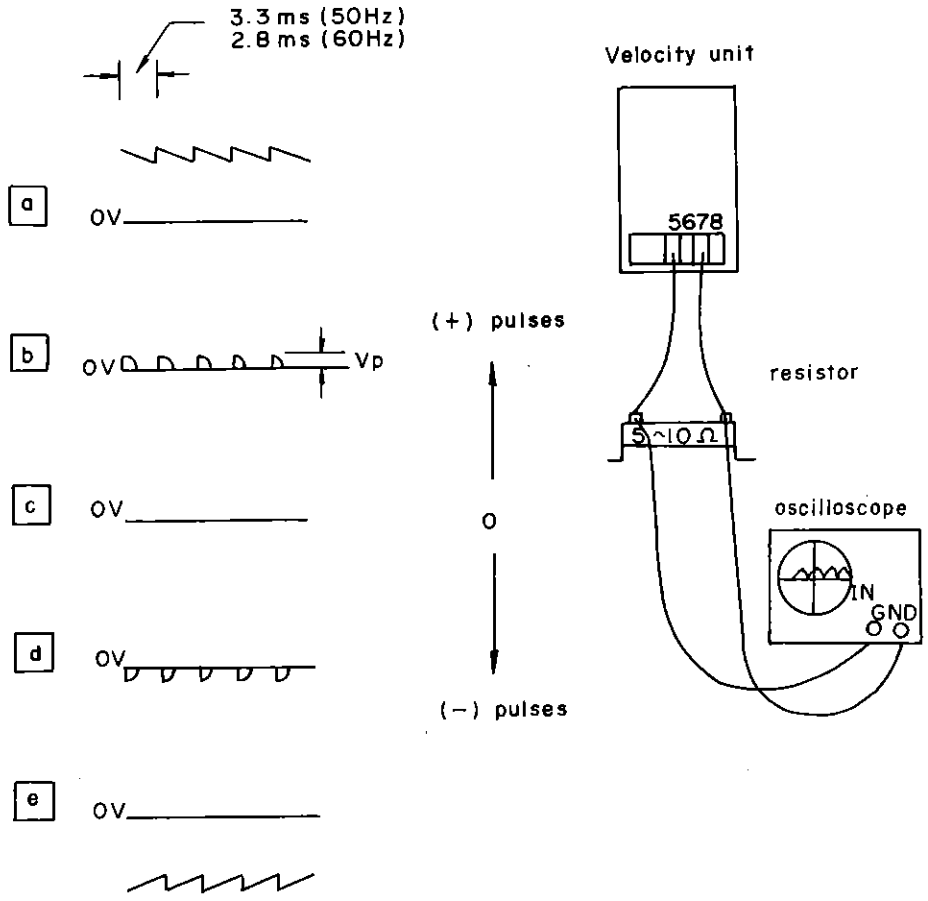
(N) Lack of accuracy in a circular arc cutting at the junction of quadrant
Is gain of velocity too low?
Is dithen of velocity too low?
Is position gain 30 sec^{-1}?
Is backlash compensation set proper value?

(O) Cause texture on cutting surface
Is pulse interpolation correct?

(P) Method of checking out for velocity unit

(1) Short circuit at between CH5 and CH6 on the PCB of Velocity Unit.
(2) Disconnect motor power cable and connect a resistor of $5 \sim 10\ \Omega$, more than 150 W as following figure.
(3) Turn on NC and put pulses by Handle then observe wave shape of voltage drop across the resistor as the following figure.

Note: Be carefull for the fall down of table as NC is turned on without motor power cable.

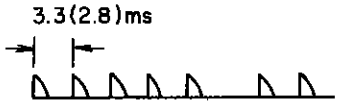
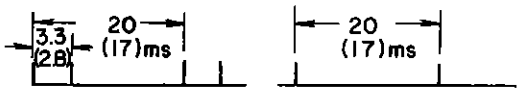
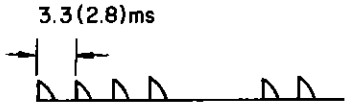
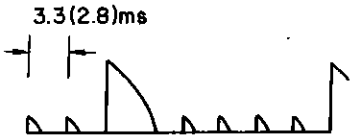


(1) The wave shape, when power is put on, must be one of b, c or d.

(2) In b and d, the period must be 3.3 ms (2.8 ms) when Vp is higher than 20 volts and if Vp is lower than 20 volts, the period could be different and it is normal.

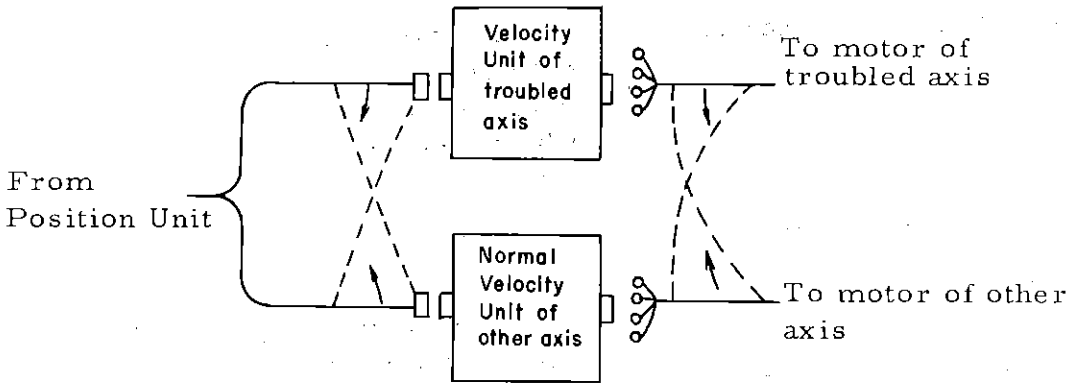
(3) Changing from b to d, or d to b must be obtained by command pulses less than 5 pulses (10 μ pulse) by Handle.

(4) The wave shape must be changed c to b to a, or c to d to e depending on number of pulses from handle.

Trouble	Cause
 Defect of one wave per 6.	 Fig.1 shows normal Thiristor gate signal. Fig.2 shows defect of one pulse, which results the wave shown left.
 Defect of 2 waves per 6.	There is no gate signal at all on one Thiristor per 6.
 Irregular wave.	The phase rotation of power input is not correct. Velocity unit is affected by noise.

Another method of checking

When one axis has trouble in servo system, it can be checked wheather velocity unit is wrong or problem is in machine itself by interchanging velocity unit with that of other axis.



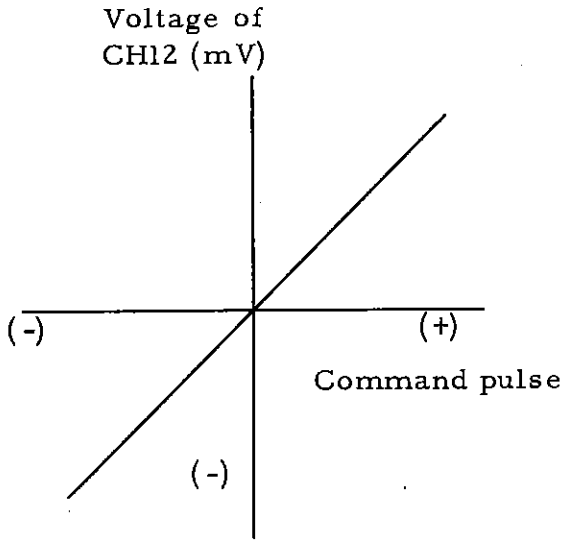
Note 1. Velocity unit for the motor Model 0 and 5 can not drive the motor Model 10, 20 or 30.

2. Feedback cable must not be changed.

(Q) Method of checking out for the Position Control Unit.

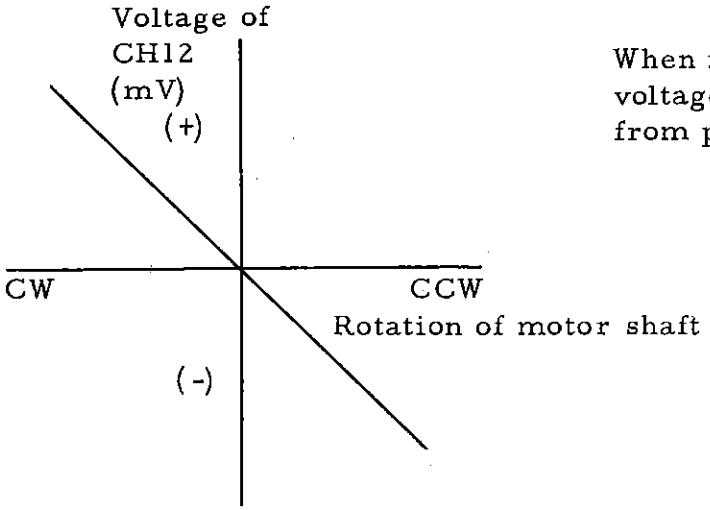
(1) Remove motor power cable
(2) Turn on NC and put pulses by Handle then check the voltage at CH12 in the Position Unit. (EP is Ground.)
(3) Rotate the shaft of motor by some means and check the voltage at CH12.

Note: Be carefull for the fall down of table as NC is turned on without motor power cable.

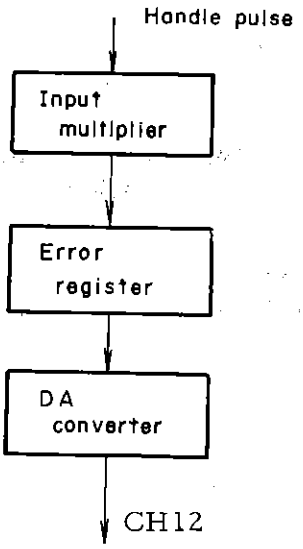
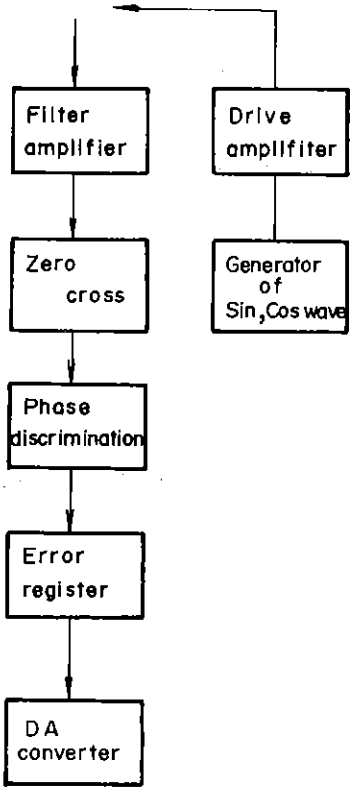


When pulses are put in by Handle, the voltage at CH12 varies continuously from positive to negative.

The rate is approximately 10mV/pulse. (1 pulse=10)

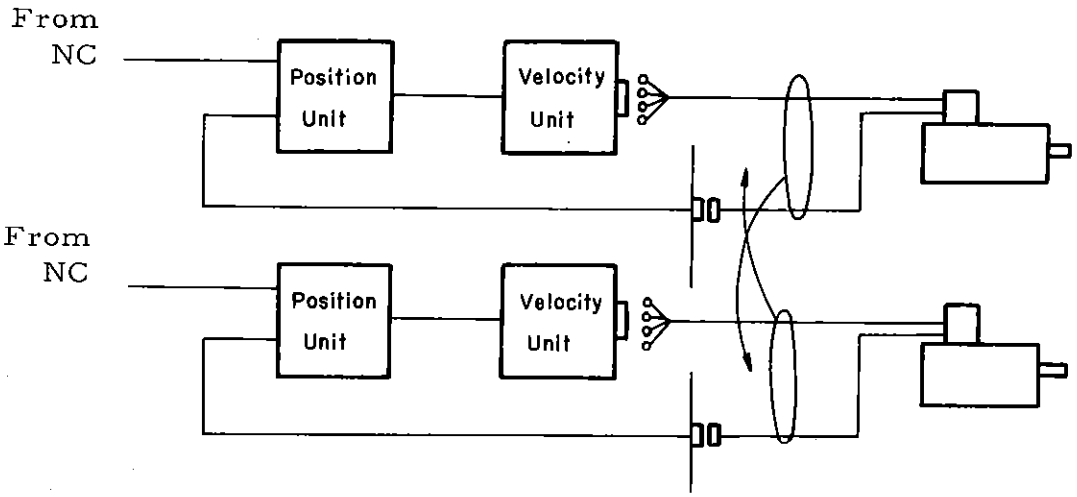


When motor shaft is rotated, the voltage at CH12 varies continuously from positive to negative.

Trouble	Cause
There is no voltage output at CH12 when pulses are put in by Handle	 Trouble is located at same part of above figure.
There is no voltage output at CH12 when motor shaft is rotated.	 Trouble is located at some part of above figure.

Another method of Checking

When one axis has trouble in servo system, it can be checked wheather unit (Position or Velocity) is wrong or problem is in machine itself by interchanging Position Unit and Velocity Unit with that of other axis.



Note 1. Velocity Unit for the motor Model 0 and 5 can not drive the motor Model 10, 20 or 30.

2. Both cables for motor power and feedback should be interchanged.

3. The position gain should also be changed when gear ratio of motor is different.

4. Be carefull for command axis name as input is not changed.

APPENDIX : Zero position shift

The zero point by Zero Return function depends on the grid of Resolver or Inductosyn, and it can be adjusted and shifted up to 2mm if necessary.

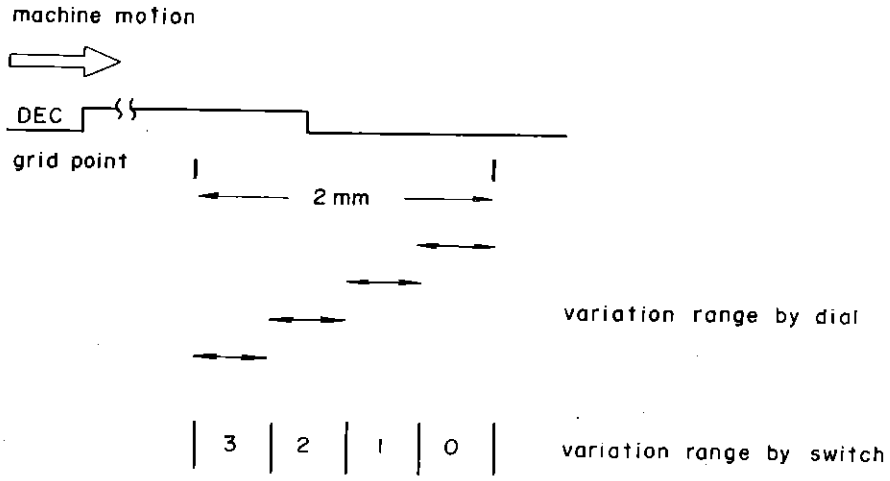
(1) Set the switch on the PCB of position control to "0" and execute the Zero Return.
Adjust the dial to get the appropriate position as the zero point.

(2) If the variation by the dial is too small, once put off power and change the switch to "1", "2" or "3", and then try Zero Return again.

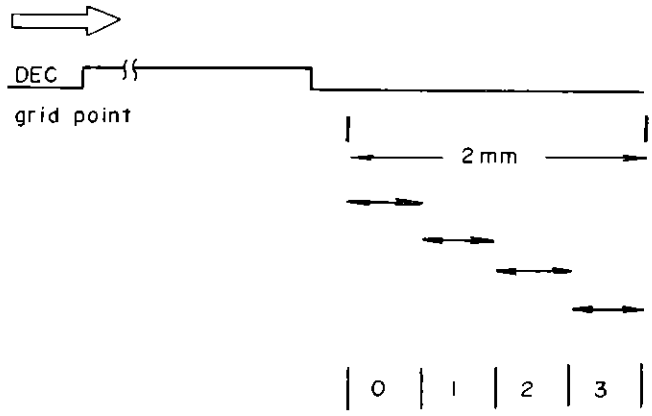
(3) If the variation is still not enough, then change the position of dog for deceleration.

Range of variation for the zero point

In case of (+) direction for Zero Return

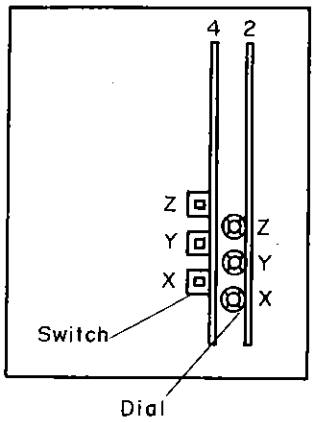


In case of (-) direction for Zero Return

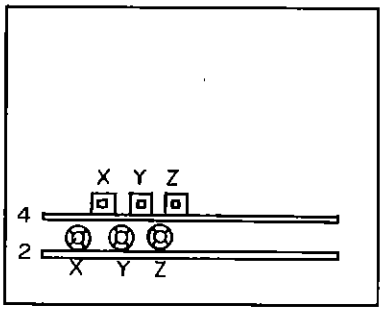


Location of switch and dial

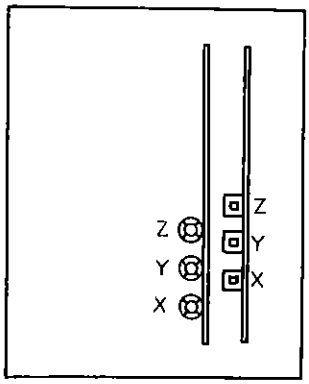
F3000B, F2000A
F1000C, F200-0A



F3000C, F2000C



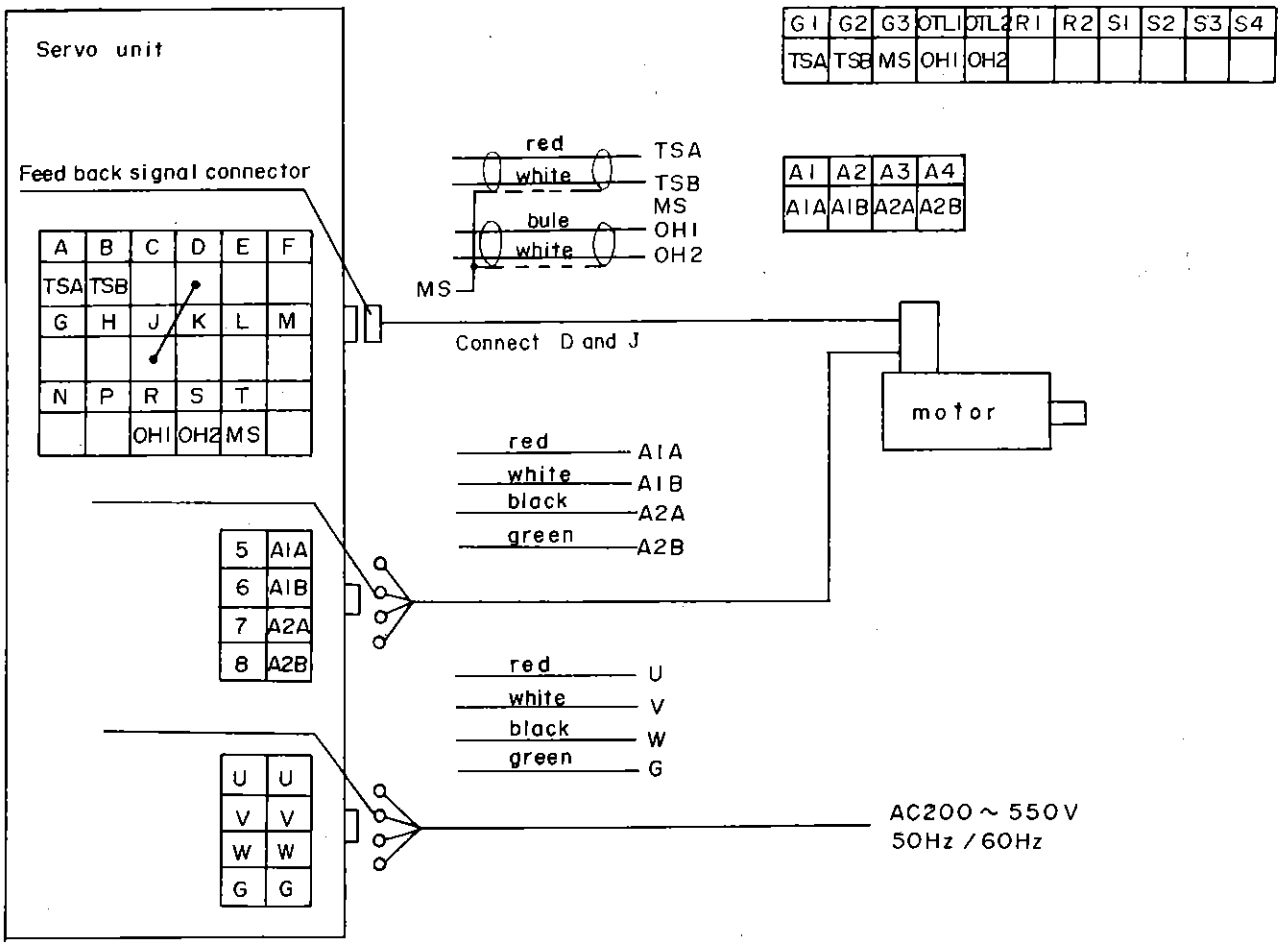
F200-0B, F220-0



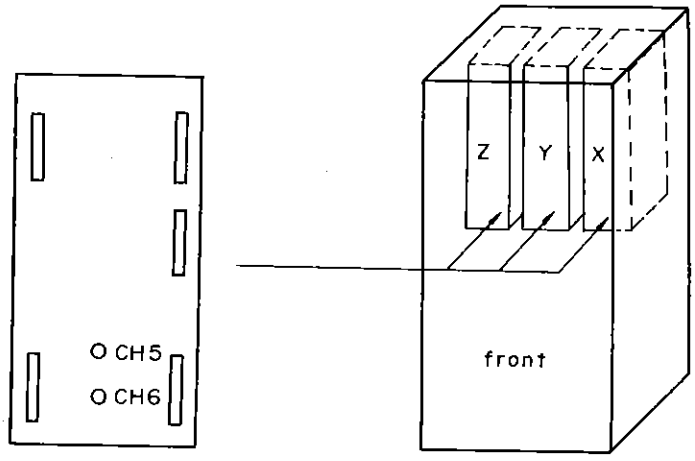
APPENDIX : Operation without inductosyn feedback

The machine table can be fed by open loop circuit if necessary when Inductosyn scale is not yet prepared.

(1) Connect cables as follows:



(2) Connect CH5 and CH6 on the PCB (20B-0003-0490) in the Velocity Unit of the axis where Inductosyn is applied.

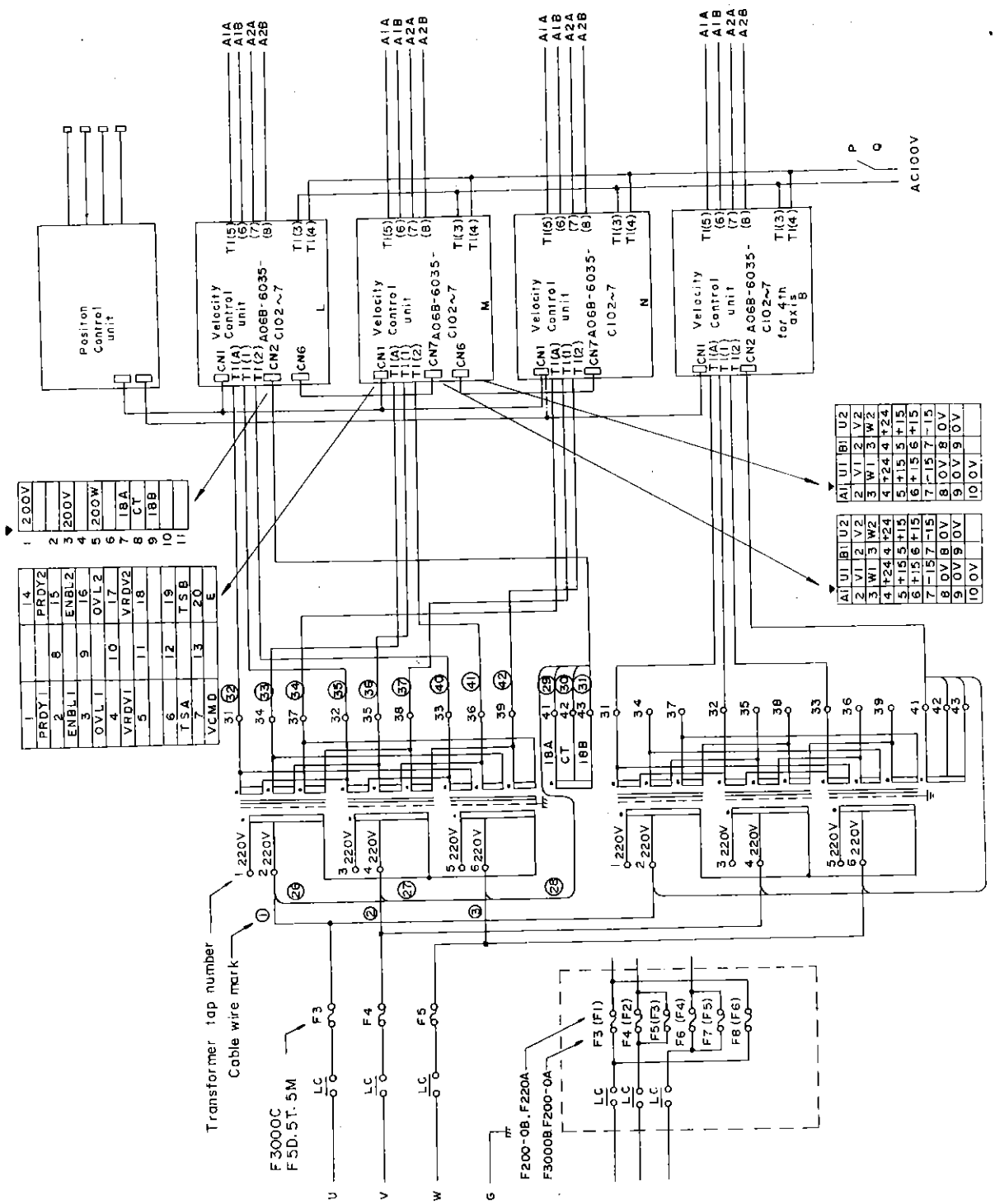


(3) Select the Handle mode for the specified axis and turn the Handle Slowly. The motor will begin to run. To stop the motor, turn the Handle in reverse direction until the motor stops.

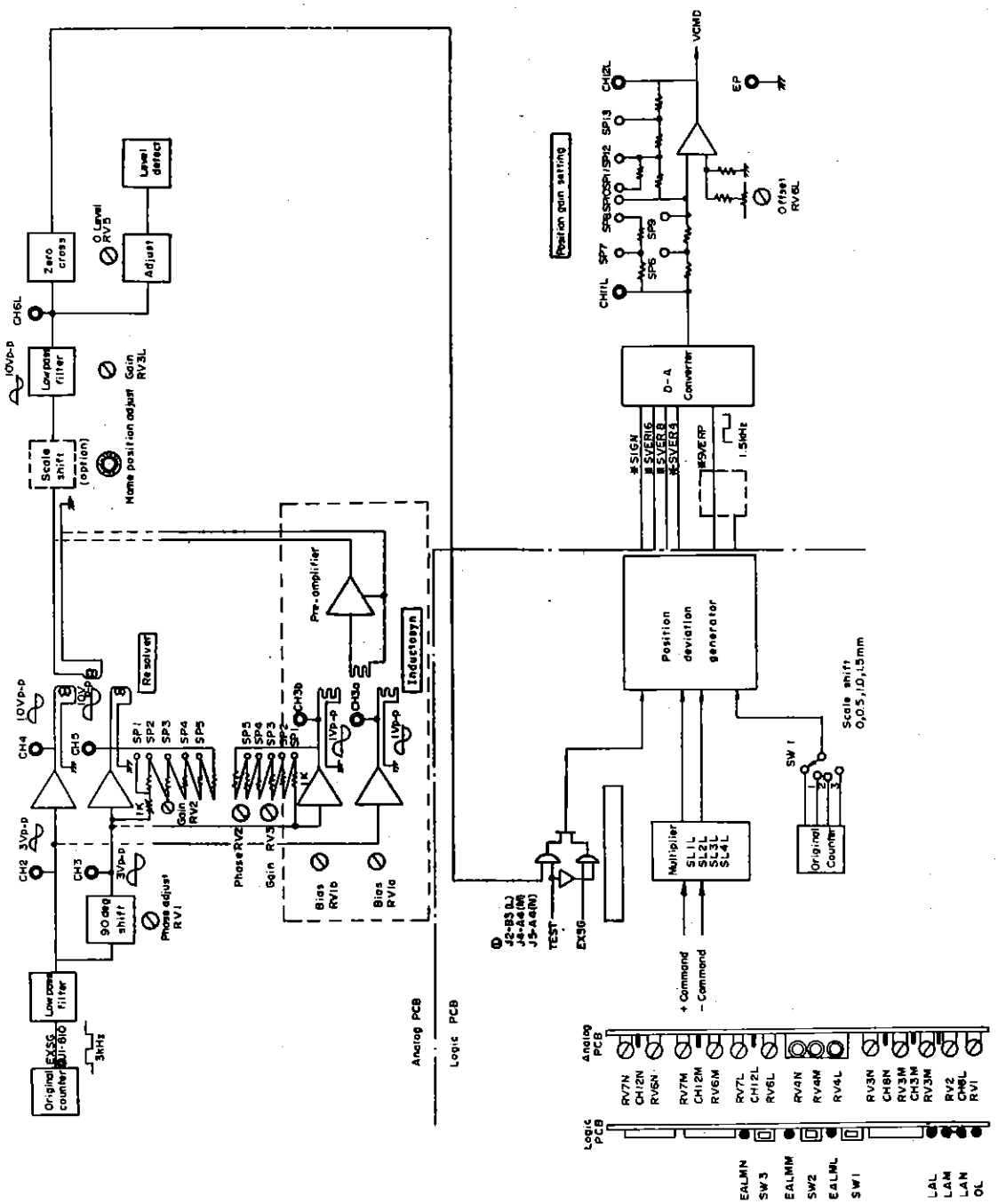
Caution : Be carefull as no feedback in position loop. To stop the motor completely, it is necessary to turn off power. Be carefull for falling down of the table when power is put on.

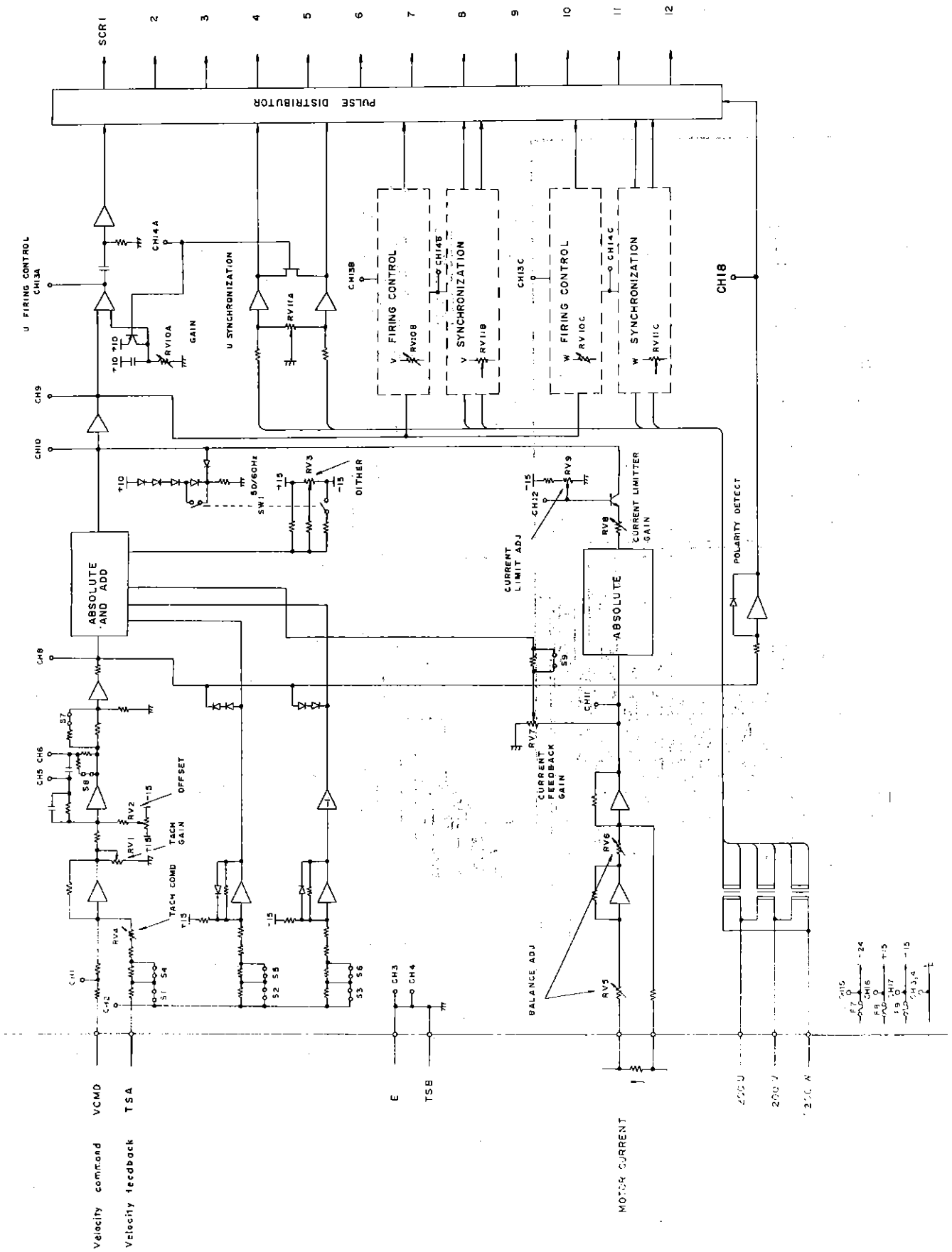
APPENDIX :BLOCK DIAGRAM

1. General Connection

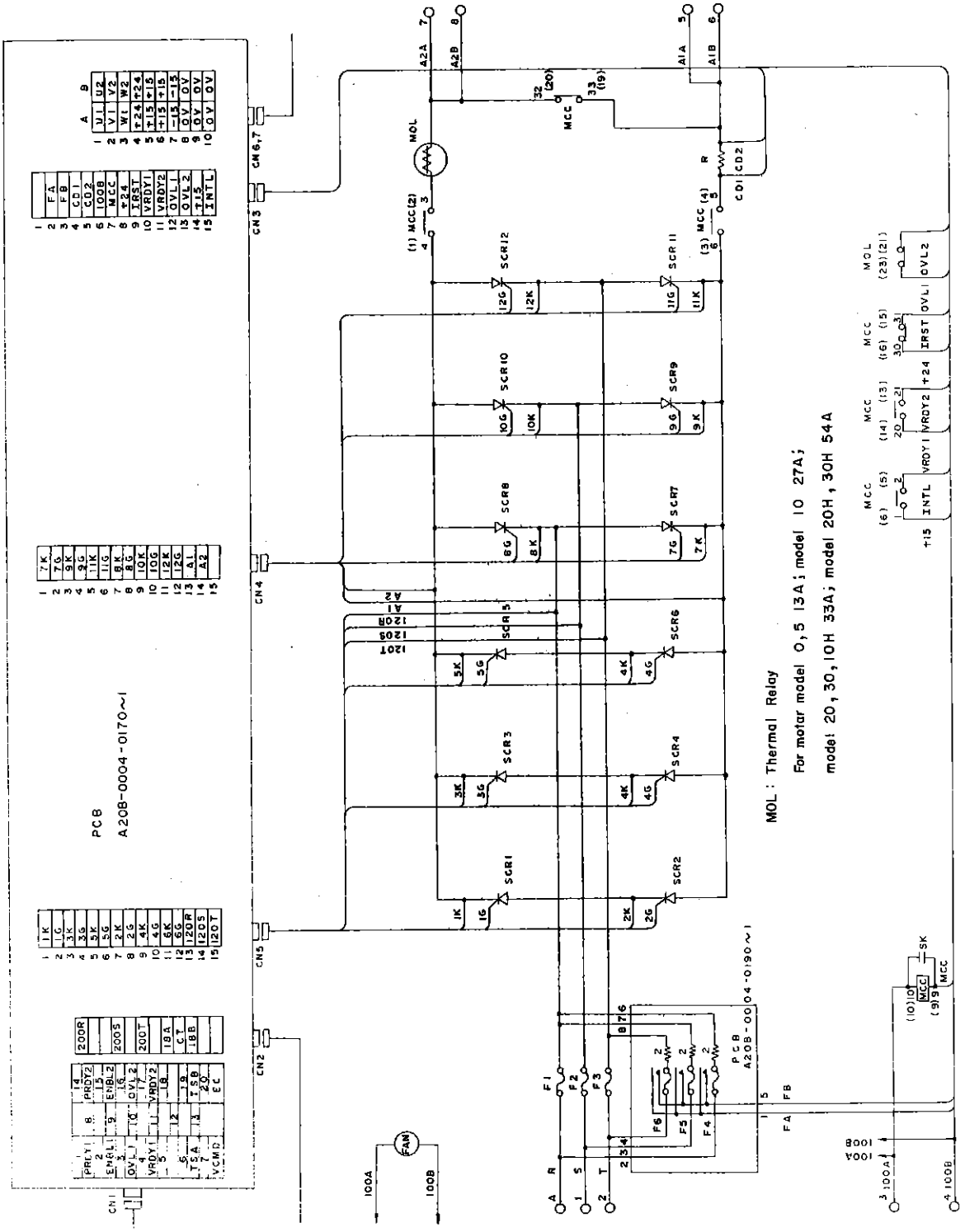


2. Position Unit




SCR 1
2
3
4
5
6
7
8
9
10
11
12
PULSE DISTRIBUTOR
U FIRING CONTROL
CH14
CH14A
U SYNCHRONIZATION
RV10A
GAIN
RV11A
CH15B
V FIRING CONTROL
RV10B
CH14B
V SYNCHRONIZATION
RV11B
CH13C
W FIRING CONTROL
RV10C
CH14C
W SYNCHRONIZATION
RV11C
CH18
CH9
CH10
+10
50/60Hz
SW1
+15
RV3
-15
DITHER
ABSOLUTE AND ADD
CH8
CH5 CH6
S7
S8
RV2
OFFSET
RV1
TACH GAIN
TACH COMD
RV4
S1 S4
S2 S5
S3 S6
CH1
CH2
CH3
CH4
E
TSB
CH12
RV9
CURRENT LIMIT ADJ
CURRENT LIMITTER GAIN
ABSOLUTE
S9
CH11
RV7
CURRENT FEEDBACK GAIN
RV6
BALANCE ADJ
RV5
MOTOR CURRENT
POLARITY DETECT
VCMD
TSA
Velocity command
Velocity feedback

4. Firing circuit



APPENDIX : Method of adjustment

Note : These adjustment are not required for customers in general.
The values for adjustment are the standard values, and they might be adjusted to the different values according to the type of motor or the condition of load.
The actual values to be adjusted are written in the Data Sheet which is attached in each NC equipment.

1. Position Contorol unit

(1) Check the sinusoidal wave about 10V p-p at CH4 and CH5 on Analog PCB.
In case of Inductosyn, check the sinusoidal wave about 1V p-p at CH3a and CH3b on exiting circuit.

(2) Adjust RV3 so as to get 10V p-p at CH6 on Analog PCB.

(3) Drive the motor in low speed and adjust RV2, SP1 to SP5 and RV1 so as to get the ripple smaller than 30 mV p-p on the peak of sinusoidal wave at CH6.
In case of Inductosyn, the RV2, RV3 and SP1 to SP5 on exciting circuit. When both systems of Resolver and Inductosyn are used, first do the Resolver System.

Setting of input multiplier

Short wire / Multiplier	SL1	SL2	SL3	SL4
1	×	○	○	×
2	○	○	○	×
4	○	×	×	○
5	×	○	×	○
10	○	○	○	○

e.g. 10 μ of least command increment corresponds to multiplier 10.

Setting of position gain

(1) Gin 30 sec^{-1} (Standard setting)

Motor type / Gear ratio	MODEL 10/20/30	MODEL 0/5
1:1.5		SP6-SP7
1:2	SP6-SP7-SP9	SP6-SP9
1:2.5	SP8-SP9	NO COnnection
1:3	SP6-SP7	SP6-SP9 SP10-SP12
1:4	SP6-SP9	
1:5	No Connection	

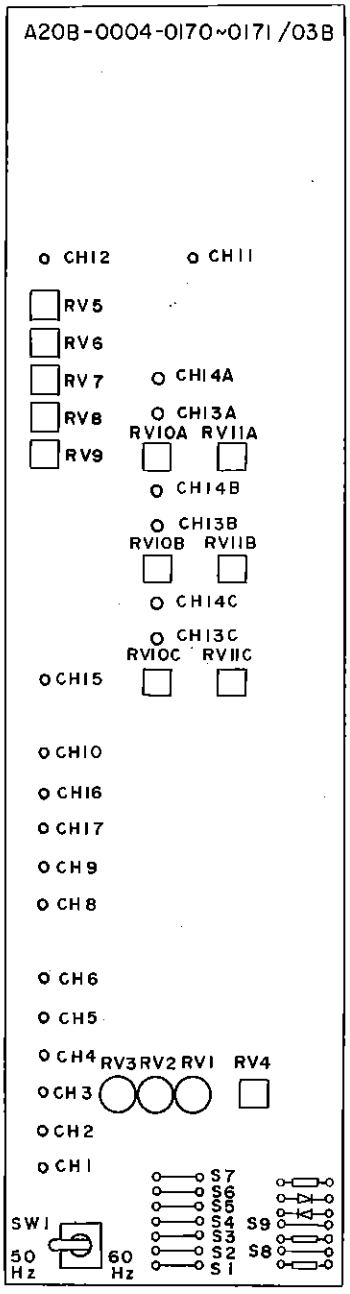
(2) Gain 40 sec^{-1}

Motor type / Gear ratio	MODEL 10/20/30	MODEL 0/5
1:1.5		⊛ SP6-SP7
1:2	SP10-SP12 CH11-SP6	SP6-SP7
1:2.5	⊛SP8-SP9	SP8-SP9 SP10-12
1:3	⊛SP6-SP7	SP6-SP7 SP10-SP12
1:4	SP6-SP7	
1:5	Sp8-SP9 Sp10-SP12	

Note Settingswith the symbol ⊛ require circuit modification A06R-603-0052 on the PCB.

2. Velocity Control Unit

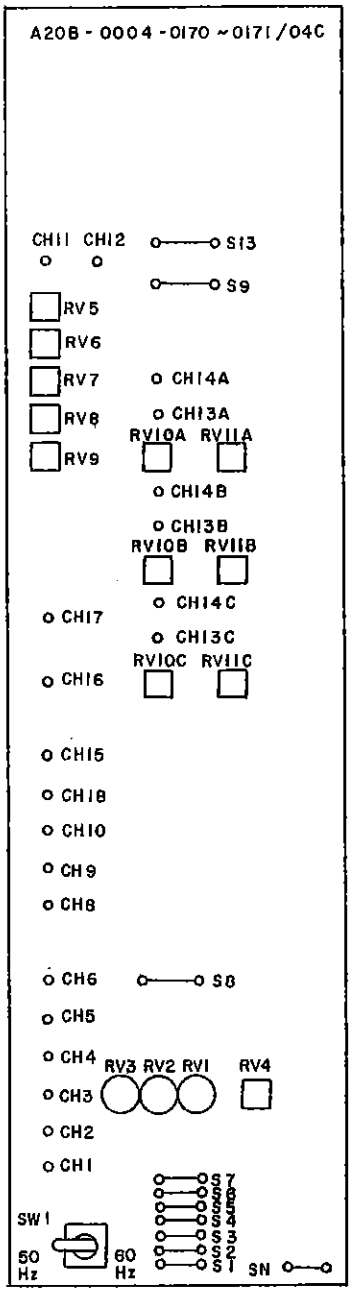
(1) Location of check terminals, adjustment trimmers and setting pins on the PCB.



Note ;

1. CH3,4 : 0V
   CH15 : +24V
   CH16 : +15V
   CH17 : -15V

2. Connection of setting pins (S1 to S9) is different depending on the type of motor and type of feedback device.
   They should be checked and connect correctly as same as before when the PCB is replaced.


A20B - 0004 - 0170 ~ 0171 / 04C
CH11 CH12
S13
S9
RV5
RV6
RV7
RV8
RV9
CH14A
CH13A
RV10A RV11A
CH14B
CH13B
RV10B RV11B
CH14C
CH13C
RV10C RV11C
CH17
CH16
CH15
CH18
CH10
CH9
CH8
CH6
S8
CH5
CH4
CH3
CH2
CH1
RV3 RV2 RV1
RV4
S7
S6
S5
S4
S3
S2
S1
SW1
50 Hz
60 Hz
SN

(2) Check the setting of power frequency 50Hz / 60Hz.

(3) Check DCvoltage +24, +15, -15 at the check terminal on the board.

(4) Connect CH8 to Ground (CH3), and adjust RV3 so as to get the voltage of CH9 1.5V (50Hz) or 2.8V (60Hz) .

(5) Adjust RV10A, B, C so as to get the high level of CH13A, B, C 2.1ms (50Hz) or 1.8ms (60Hz).
RV11A, B, C may be adjusted to get the correct wave form.
If adjustment by RV10 is difficult the voltege of CH3 may be changed in the range of ± 0.2V by RV9.

(6) Set the RV2 to the scale "5" on the dial .
Adjust RV2 if motor rotates when power is put on.

(7) Set the RV1 to the scale on the dial as follows.

Motor type	Scale
Model 0	6
5	6
other	6

(8) Set the RV4 to the scale "5".

(9) Set the RV7 to the scale as follows,

Motor type	Scale
Model 0, 5	9
others	5

(10) Set the RV8 to the scale "5" (50Hz) or "7" (60Hz).

(11) Set the RV9 to the scale "1" (50Hz) or "5" (60Hz).

SECTION 3 - 2

2.1 CONNECTIONS

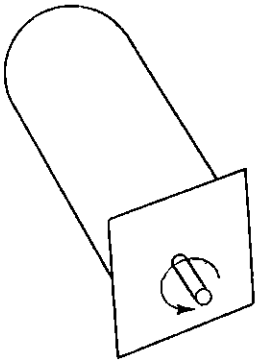
2.1.1 Connection of Cables

For DC servo unit there are connection cables of power supply, feedback signals and motor power.

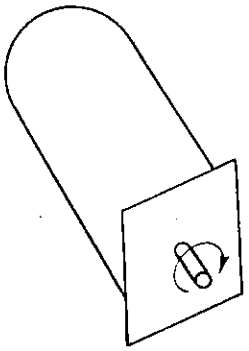
There are standard connection and reverse connection for the feedback signal cable and motor power cable according to the rotational direction which follows the feed command from the control unit.

The rotational direction corresponding to the (+) feed command

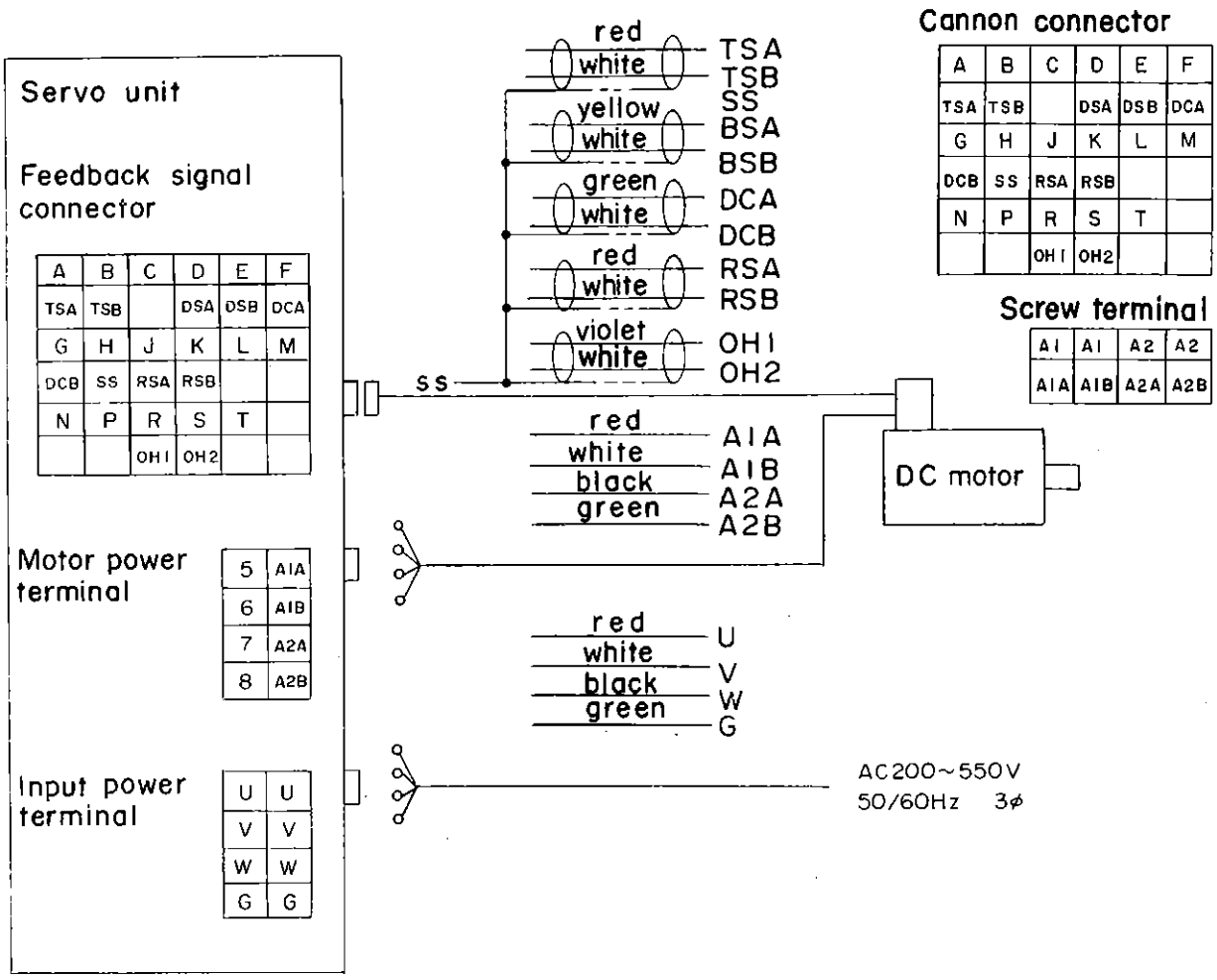
Standard connection



Reverse connection



Connection for resolver system (standard connection)



Screw terminal

A1	A1	A2	A2
A1A	A1B	A2A	A2B

(Reverse connection)

Servo unit

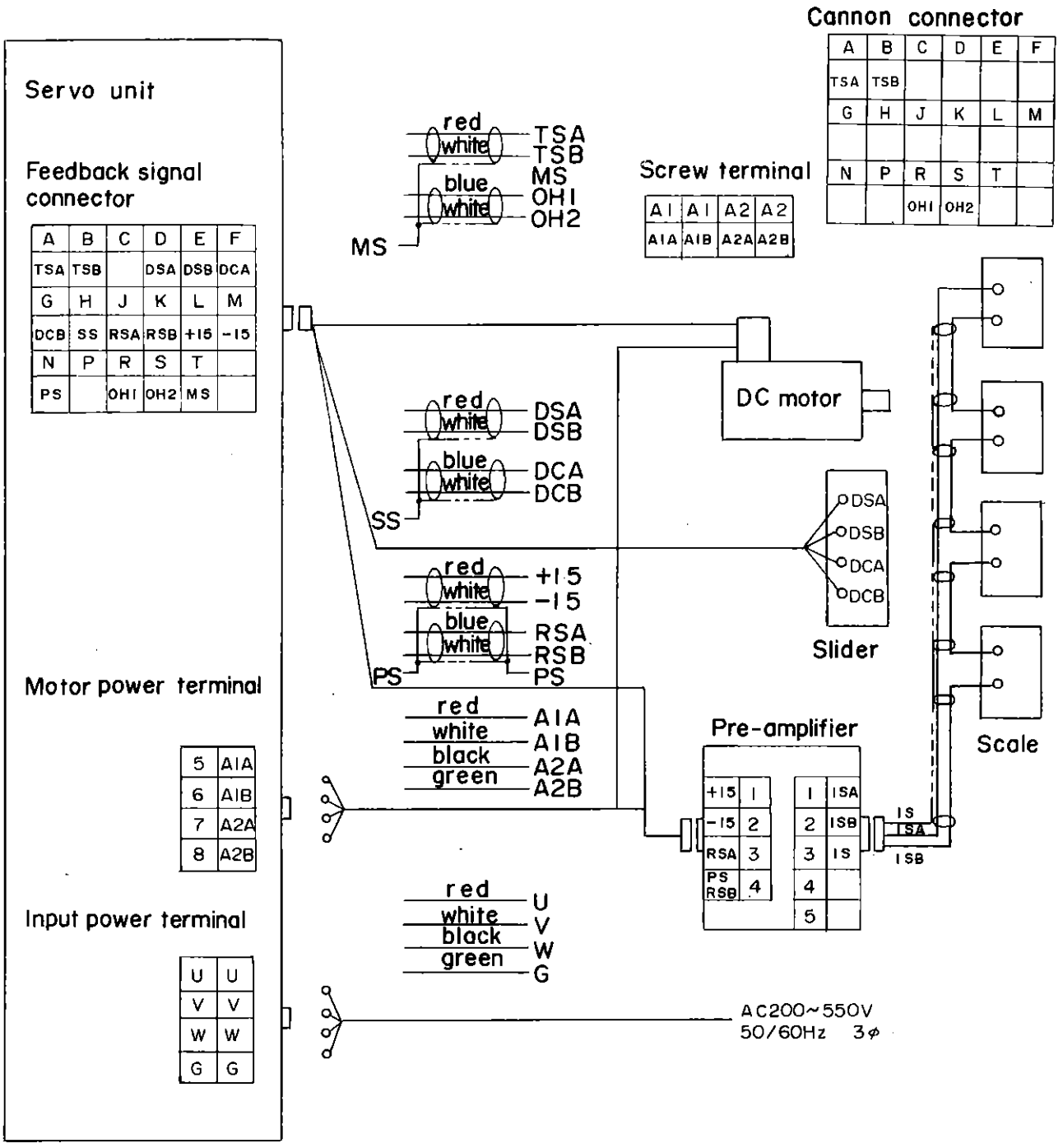
Feedback signal connector

A	B	C	D	E	F
TSB	TSA		DSB	DSA	DCA
G	H	J	K	L	M
DCB	SS	RSA	RSB		
N	P	R	S	T	
		OH1	OH2		

Motor power terminal

5	A2A
6	A2B
7	A1A
8	A1B

Connection for Inductosyn system (Standard connection)

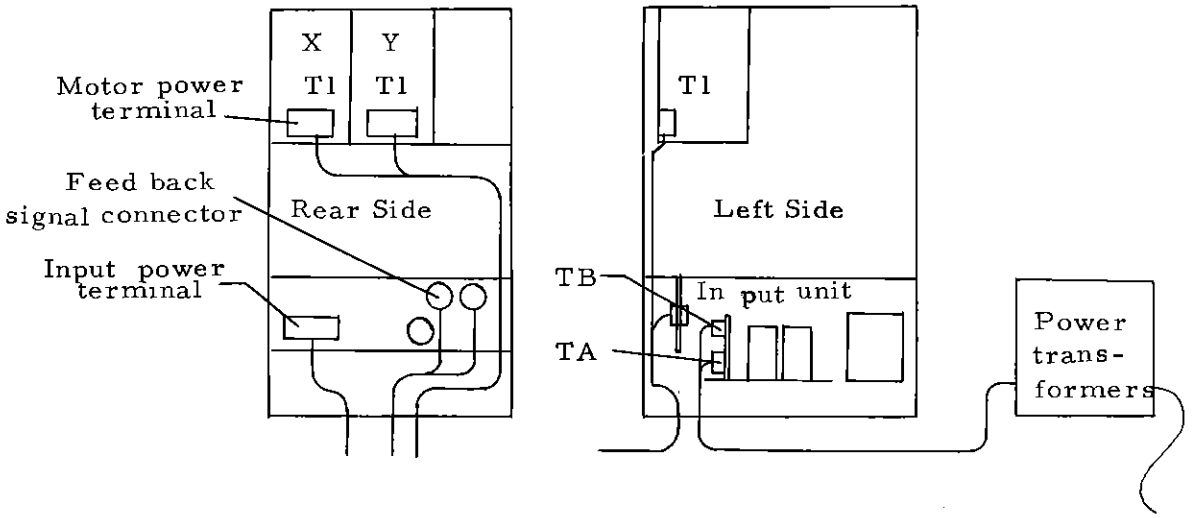


The reverse connection is same as resolver system.

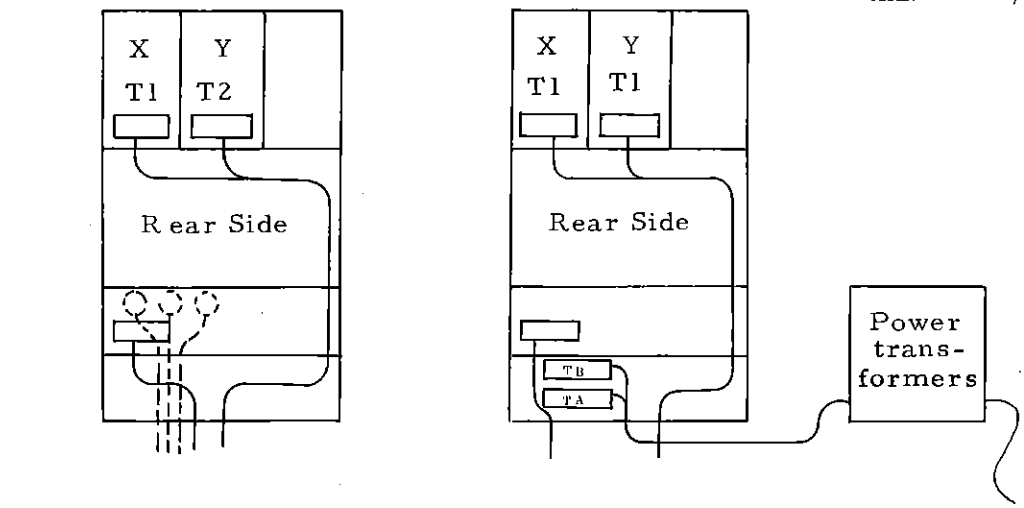
Location of cables and Connectors.

(1) Motor model 40

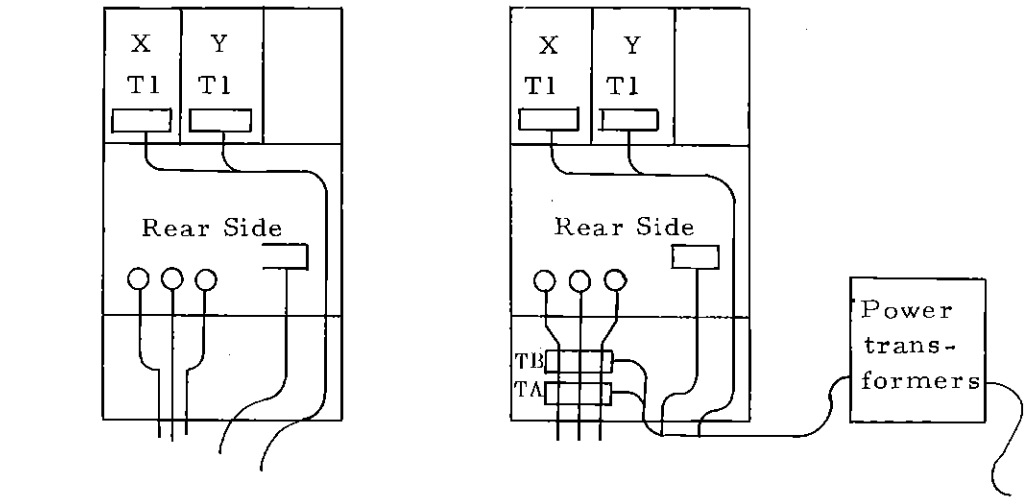
In case of F200A



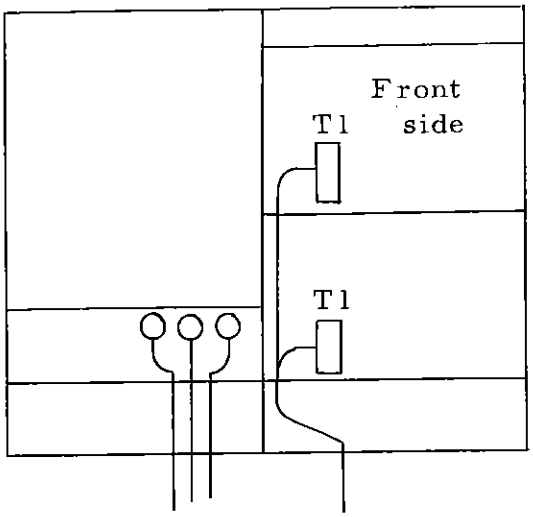
In case of F2000C F3000C

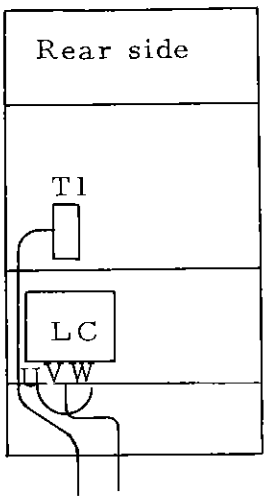


In case of F 200B

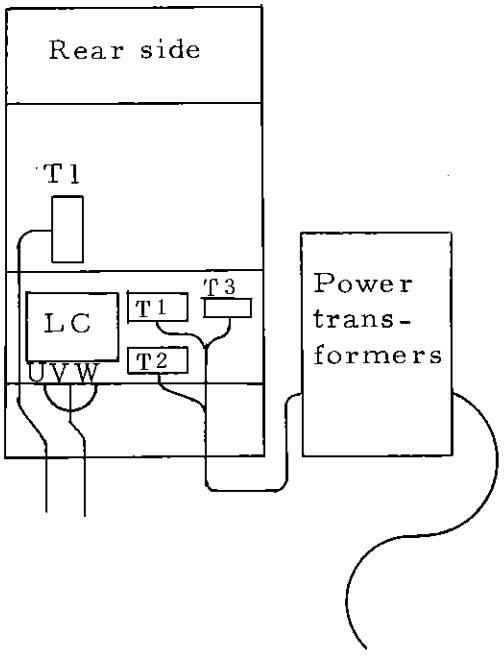


(2) Motor model 50, 60, 60H





200V/220V



other than
200V/220V

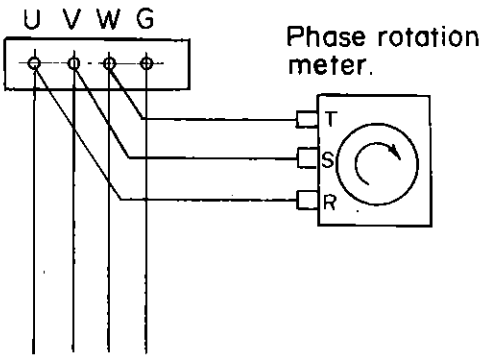
2.1.2 Checking of the phase rotation for the input power supply

For the 6-phase controlled servo unit, the phase rotation of input power supply must be in the order of U→V→W.
If this relation is not correct and when power is put on, fuse in velocity control unit may blow.

Method of phase checking

Connect a phase rotation meter to the power input terminal U, V, W and see whether a disc of the meter rotates in the clockwise direction.

Power input terminal



2.1 MAINTENANCE

2.2.1 Periodical maintenance

Cleaning of air filter and checking of brushes of DC motor are necessary as the periodical maintenance.

Cleaning of air filter

Air filter must be cleaned out once a month.
The filter can be removed with a sliding action to the backward.
Recommended method of cleaning is to blow the compressed air to the filter element while appling slight vibration.
If it is too polluted, it is washed in a neutral cleanser and dried up in the shadow of the sun.

Checking and replacing of brushes of DC motor

(1) The period of Checking

General machine tools such as lathes, milling machines and machining centers ..... 1 year

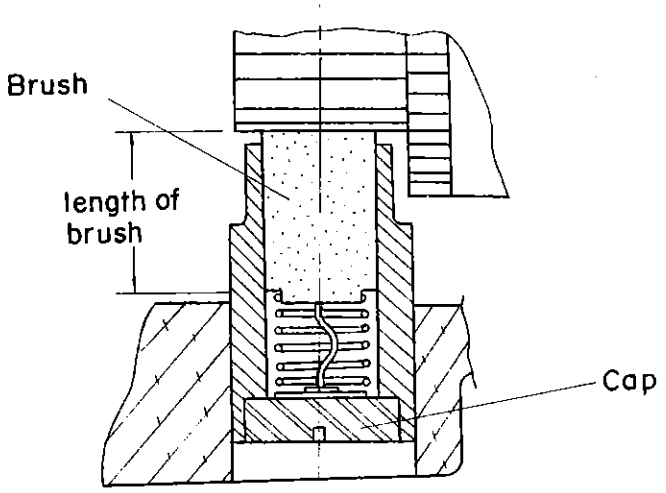
Frequent acceleration and deceleration machine tools such as punch press ..... 2 months

(2) The standard of replacement of brushes

The old brush should be replaced when it becomes less than 6mm in length.

(3) Method of replacement

Remove a brush cap and take out an old brush.
Set a new brush and put a cap and screw it tightly.



2.2.2 Troubles and Counteractions

Items of failure are provided below and each trouble can be checked up according to the following procedures.

(A) Ready lamp does not turn on.

(B) Over heat lamp lights on.

(C) Servo alarm lamp lights on.

(D) Fuse in Velocity Control blows.

(E) Machine runs away.

(F) Lack of accuracy.

(G) Big vibration and/or noise at stop.

(H) Big vibration and/or noise when running.

(I) Big vibration and/or noise during acceleration.

(J) Big overshoot.

(K) Lack of accuracy by 1 pulse feed.

(L) Lack of accuracy in positioning repeatability.

(M) Lack of stiffness in servo system.

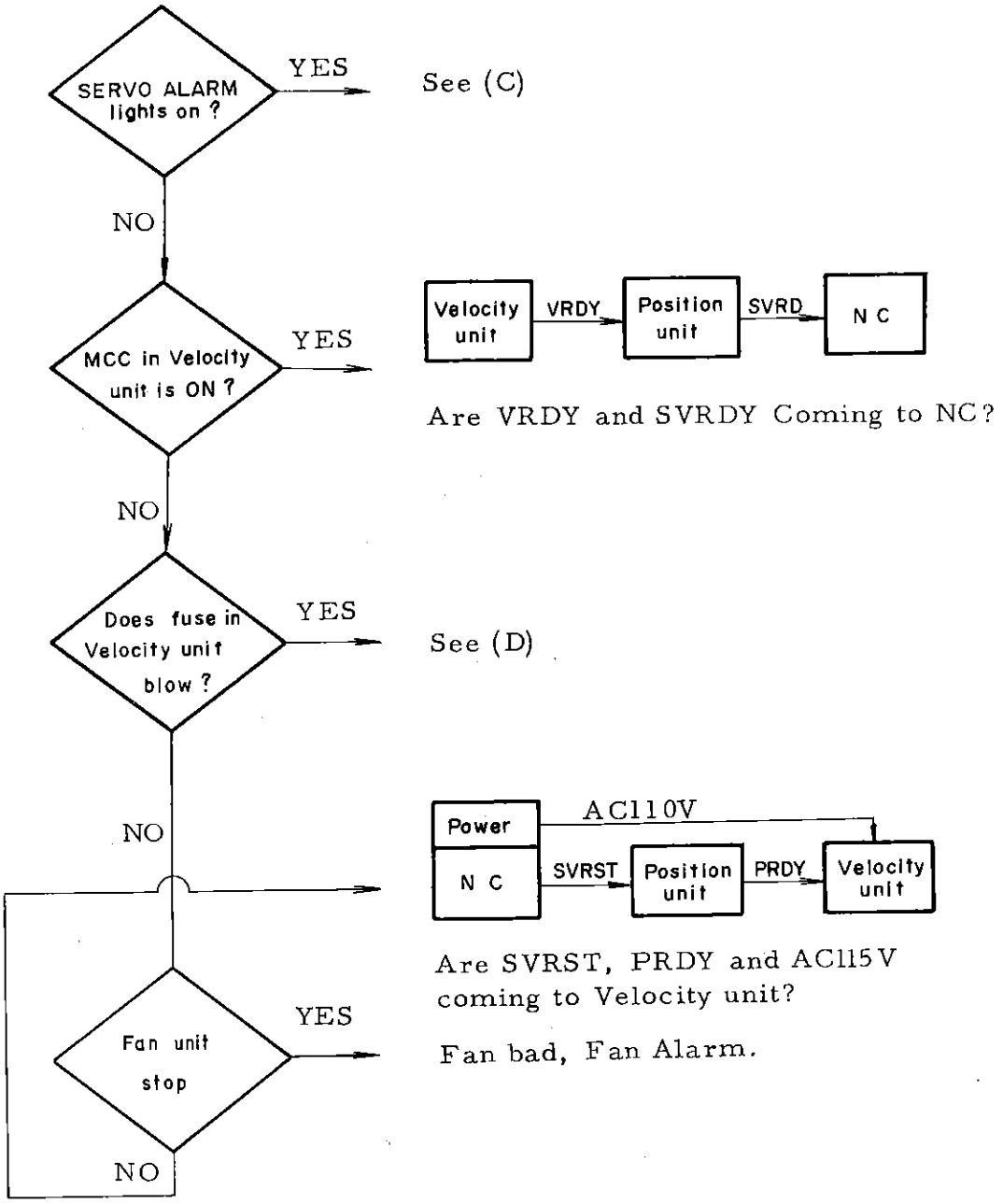
(N) Lack of accuracy in a circular arc cutting at the junction of quadrant.

(O) Cause texture on cutting surface.

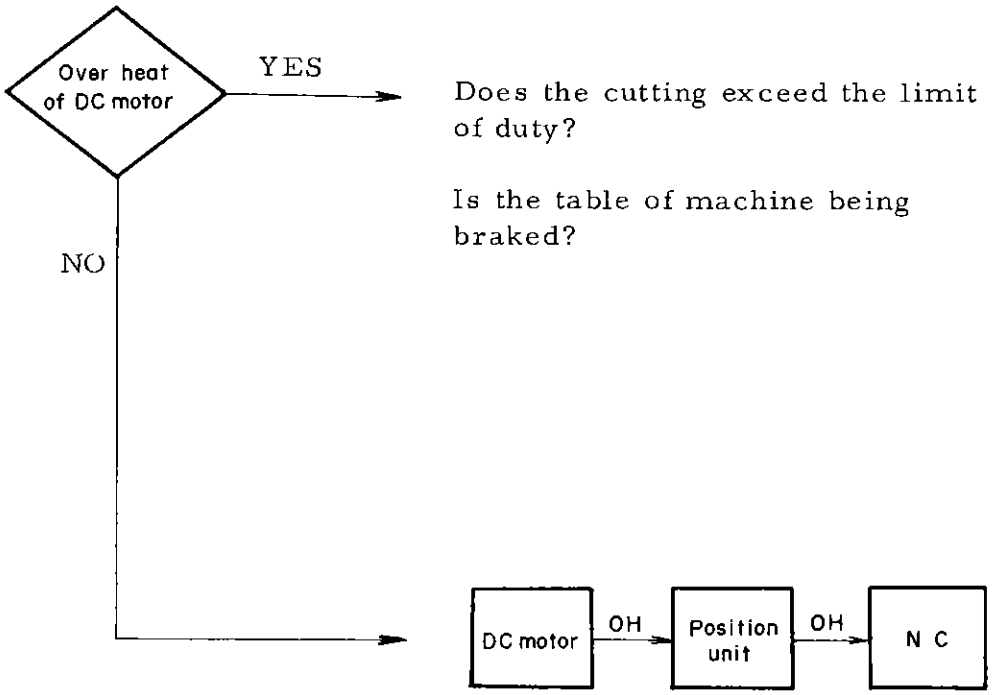
(P) Method of Checking out for the Veclocity Control Unit.

(Q) Method of checking out for the Position Control Unit.

(A) Ready lamp does not light on



(B) Over heat lamp lights on.



Is the cable between a DC motor and Position unit disconnected?

Is Over Heat signal going to NC?

Is Over Heat signal coming from NC control unit?

(C) Servo Alarm lamp lights on

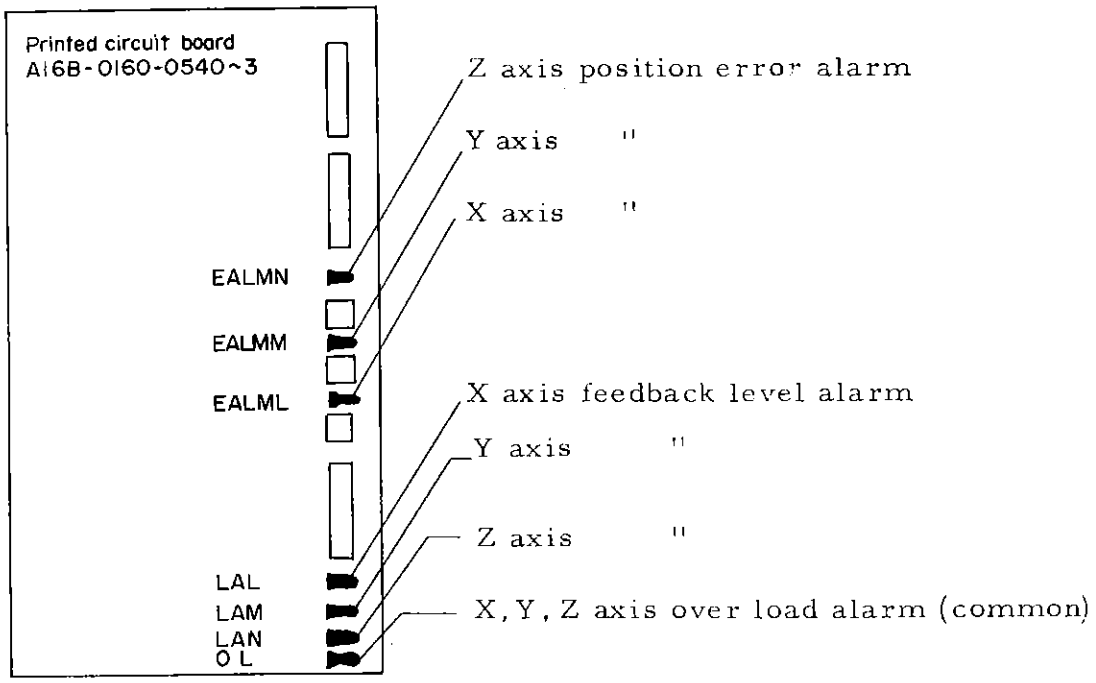
The Servo Alarm turns on in following cases.

a. When positioning error becomes more than 16000 pulses, the EALM lamp and Servo Alarm lamp light on.

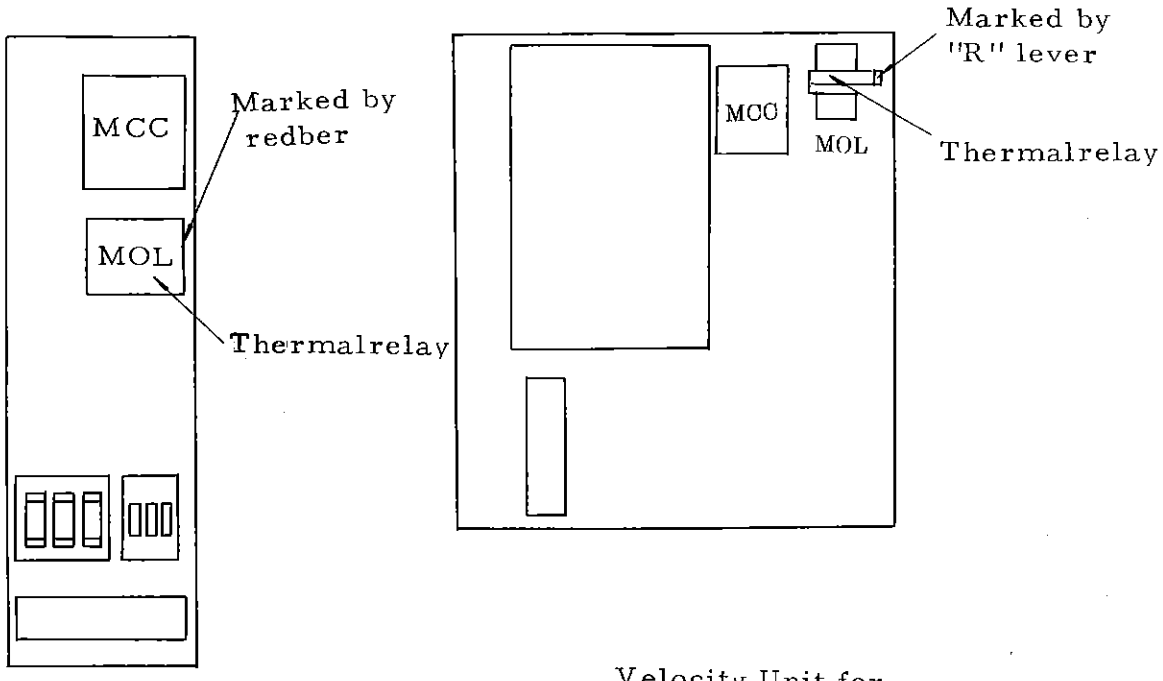
b. When the feedback signal from Resolver or Inductosyn becomes lower than 3V p-p at CH6, the LA Lamp and Servo Alarm lamp light on.

c. When the thermal relay in the Velocity unit operates by over current, or power transformer becomes overheat, the OL lamp and Servo Alarm lamp light on.

Location of alarm display



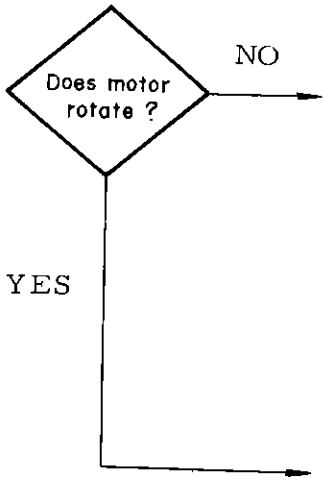
Location of over load alarm display for each axis



Velocity Unit for model 40

Velocity Unit for model 50, 60, 60H

(a) Position error lamp lights on



Is power cable of DC motor disconnected?
Any trouble in position unit?
Any trouble in Velocity unit?

Wrong setting of position gain?

The correct setting

(1) Frequency for rapid traverse: Lower than 160 kpps (1 μ pulse)

(2) Input multiplier

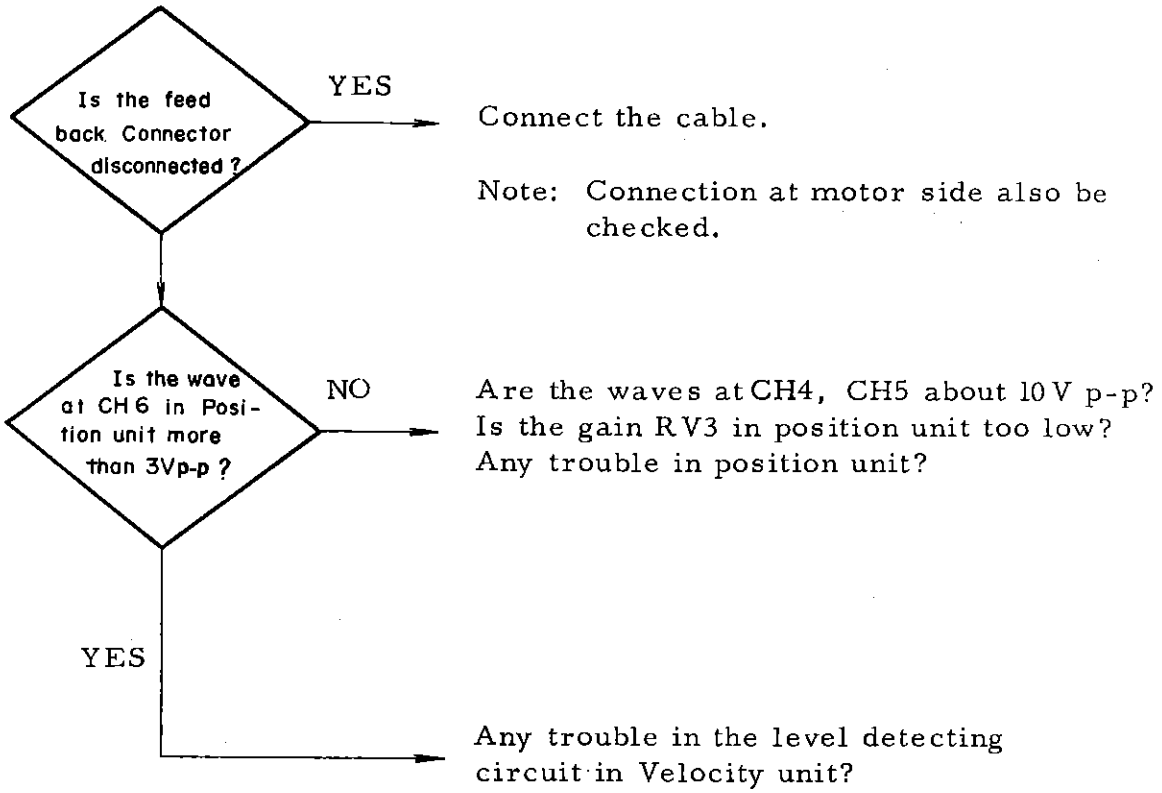
(3) Position gain: 20 sec^{-1}

(4) Gear ratio of DC motor

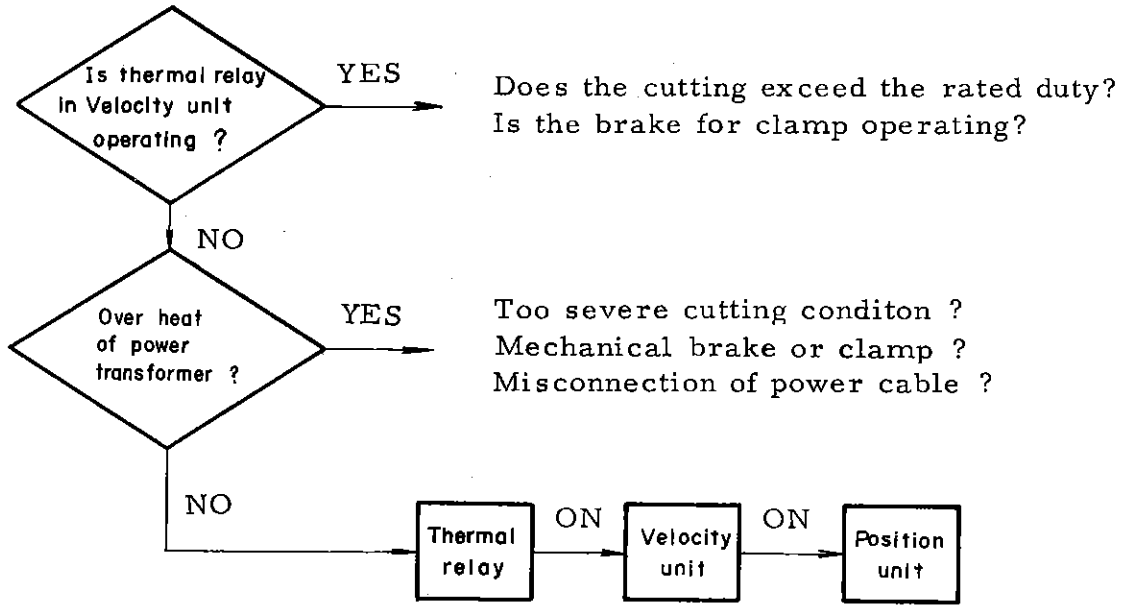
When gain is set smaller than 10, the Errar linit should be set 32000 instead of 16000.

(5) Strap wire of Velocity unit : S1 to S7

(b) The level alarm lamp lights on



(c) Over load lamp lights on



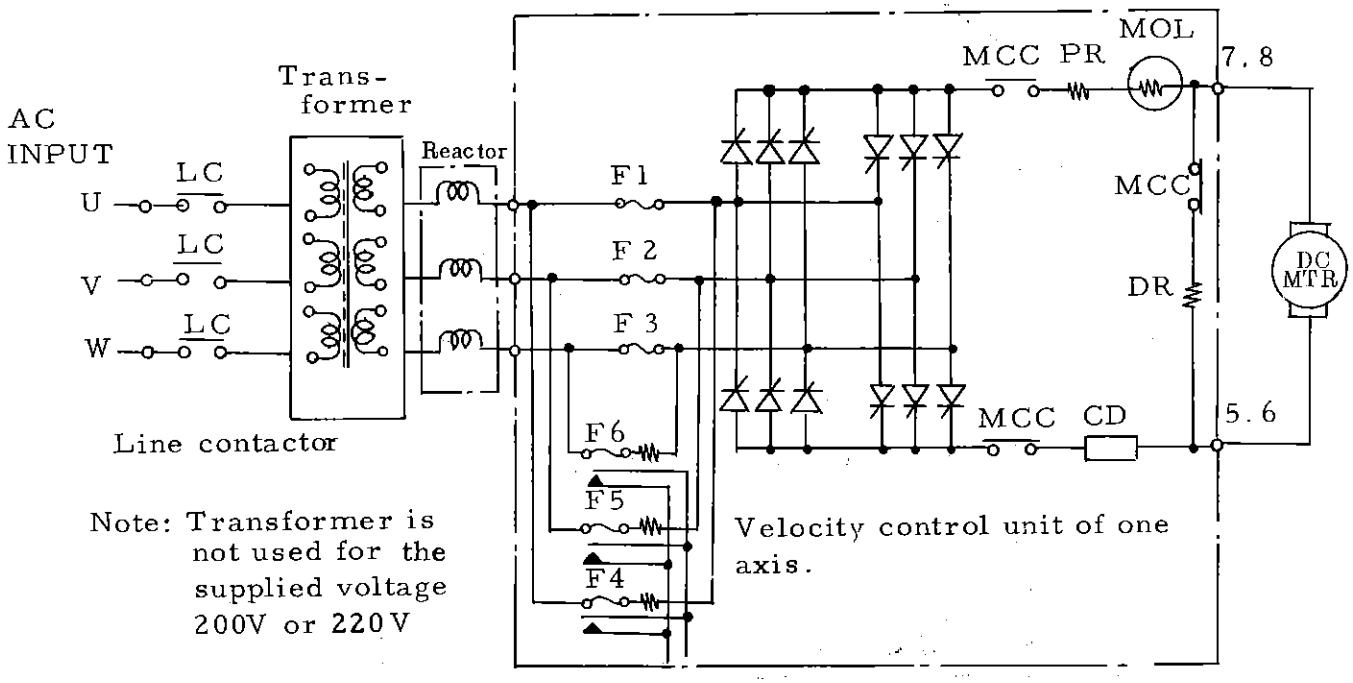
(D) Blow out of fuse on the Velocity unit

In addition to a malfunction of Velocity unit or DC motor there are following causes of blowing out fuse.

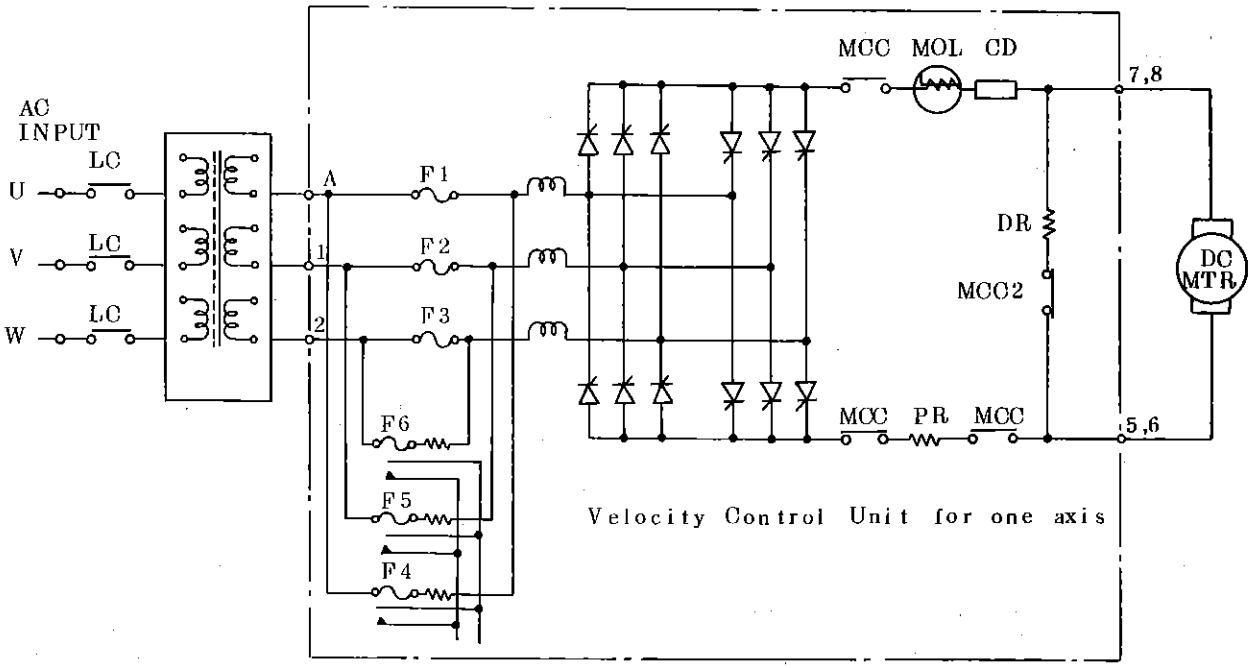
1. Malfunction of machine tool.
2. Incorrect cutting condition.
3. Incorrect setting of feedrate or acceleration/deceleration.
4. Malfunction of position control unit.
5. Incorrect cable wiring.

Location of fuses on the circuit.

1. For motor model 40

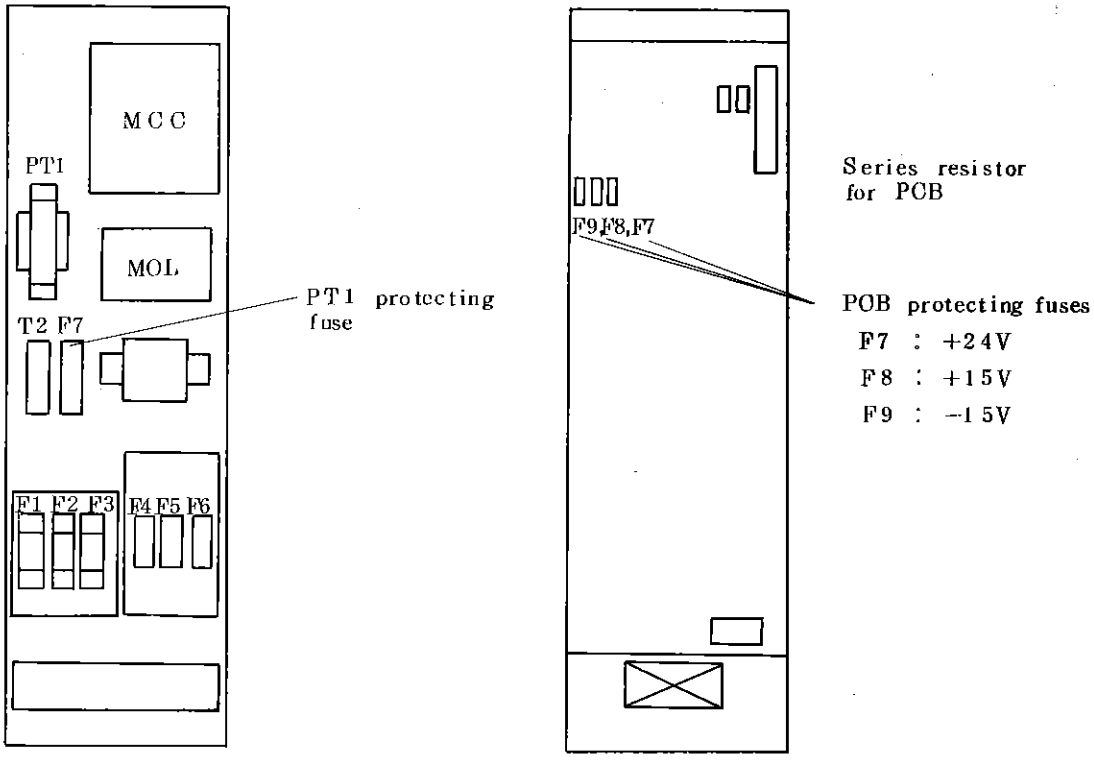


2 For motor model 50, 60, 60H

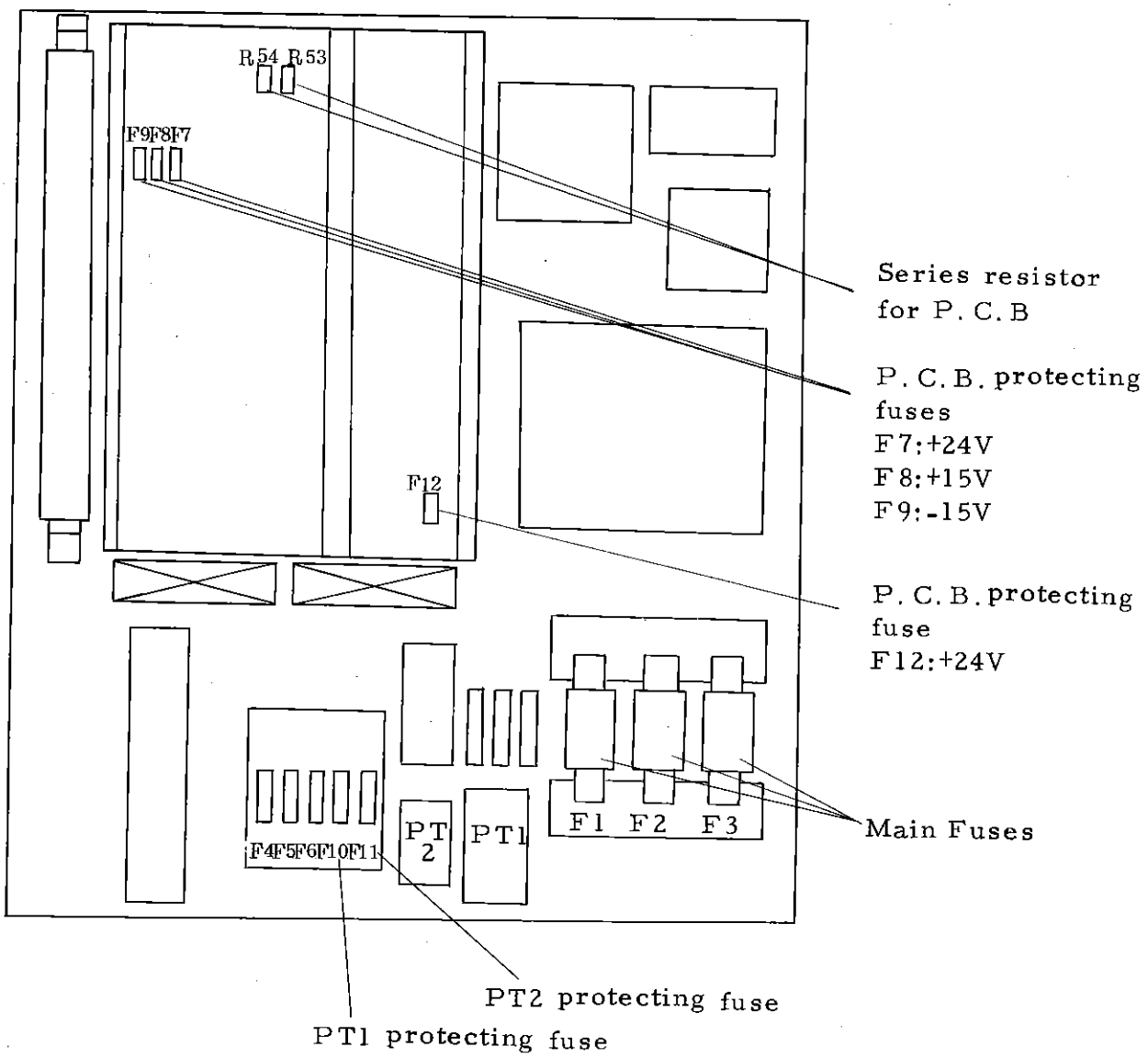


Location of fuses

(2) For motor model 40



2) For motor model 50, 60, 60H



Purpose of each fuse

F1,2,3 Protection of thyrister from over current

Protection of motor from over current in short time

F4,5,6 Alarm signal generation for blow out of F1,2,3

F7 for Model 40 Protection of transformer PT-1

F10 for Model 50,60,60H Protection of transformer PT-1

F11 Protection of transformer PT-2

Causes of blowing out of fuses

1. Malfunction of machine tool
   1. Partial abnormal big friction on the sliding surface
   2. Incorrect engaging of gear train
   3. Collision of work and tool
   4. Driving under the brake or clamp of machine

   Remarks 1. Check the current through the all stroke of movement.
   2. Check the variation of current in one revolution of lead screw.

2. Incorrect cutting condition
   1. Over current by too deep cutting
   2. Continuous heavy cutting over the rating

   Remarks : Temprature of motor would also increase higher.

3. Malfunction of Position control unit
   1. Over current at the time of putting on the power because of poor adjustment of offset.

4. Misconnection of wiromg
   1. Oscillation by positive feedback

5. Malfunction of motor
   1. Ocsillation by the malfunction of feedback device
   2. Over current caused by demagnetization of the field

6. Incorrent adjustment of Velocity control unit

   1. Incorrent wiring of short strap
   2. Setting of too big gain

7. Malfunction of Velocity control unit

Method of investigation

1. Blow out when power is put on

   1. Blow out even without motor power cable

      1. Velocity unit should be replaced

   2. Blow out only when with motor power cable

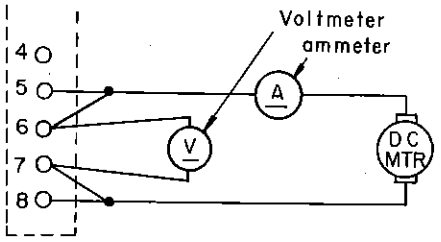
      Check the signal VCMD by oscilloscope when power put on, and if this signal has trangent variation connect CH1 to GND and put on power. If fuse blows again, Velocity unit should be replaced, or if not, Position unit bas trouble.

2. Blow out during operation

   1. Check the current wave shape with load and without load whether oscillating.

      If there is oscillation, reduce the velocity gain or check the position gain.

   2. There is a posibility of demagnetization of motor, and to check the demagnetization, measure motor speed N(rpm) , terminal voltage V(V) and current I(A) as follows.



If the value :

$$V = V - I \times Rm$$

is smaller than:

$$Ke \times \frac{N}{1000}$$

the motor is got demagnetized, where Rm and Ke are coefficient of motor as follows.

Type of motor	Rm±10%	Ke±10%	Kt ± 10%
Mdel 40	0.14 ohm	78V/1000rpm	7.1kg.cm/A
50	0.063 ohm	73V/1000rpm	7.1kg.cm/A
60, 60H	0.073 ohm	110V/1000rpm	10.7kg.cm/A

3. Are there abnormal noise or voltage variation on the power?

3. Blow out when emergency stop or when acceleration.

1. Check the strap wiring on the Velocity unit.

2. Check the gain setting on the Velocity unit.

4. Blow out of fuse in the process of installation

1. Check the input power voltage and transformer tap.

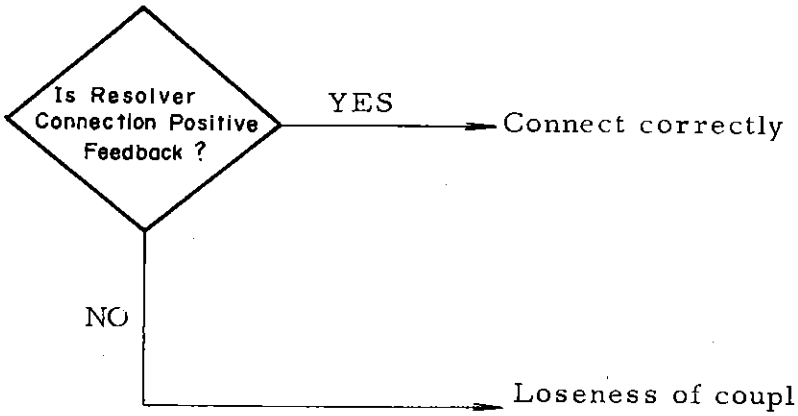
2. Check the phase rotation of power supply.

3. Check the setting of power frequency.

4. Check the polarity of motor power cable and feedback cable.

5. Check the adjustment of dither and gain on the Velocity unit.

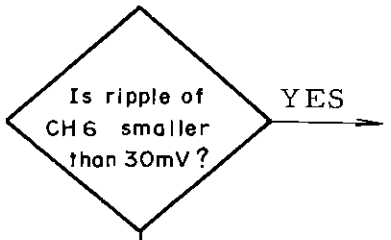
(E) Machine runs away



Loseness of coupling in DC motor
Position feedback does not apply correctly as failure of position unit.

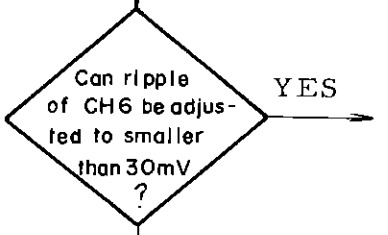
Misconnection of feedback cable for other axis?

(F) Lack of accuracy



YES → Call FANUC

NO



YES → Accuracy will be improved

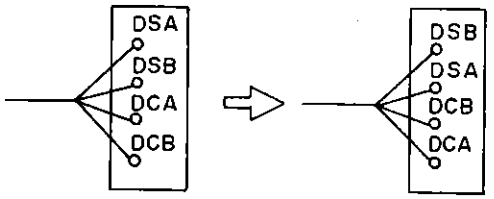
NO →

Is sield wire of Resolver connected to ground at NC?

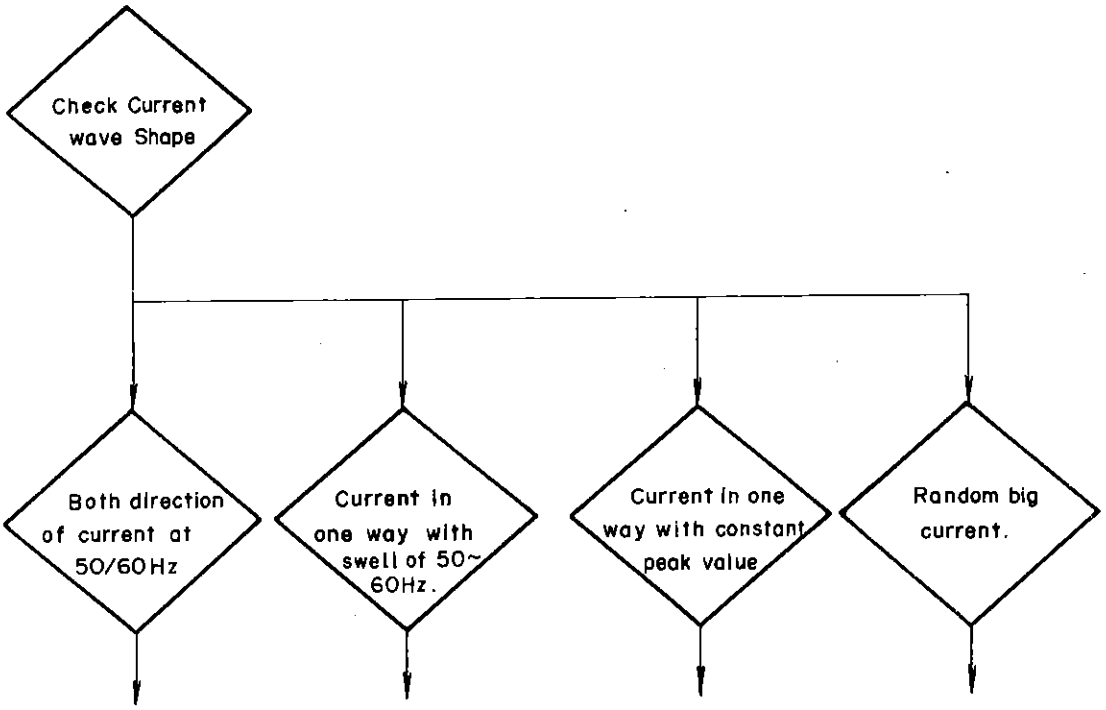
Is wiring of Resolver Shielded over full length?

Is wiring of Resolver isolated from machine cable?

In case of Inductosyn, try to change the terminals as follows.

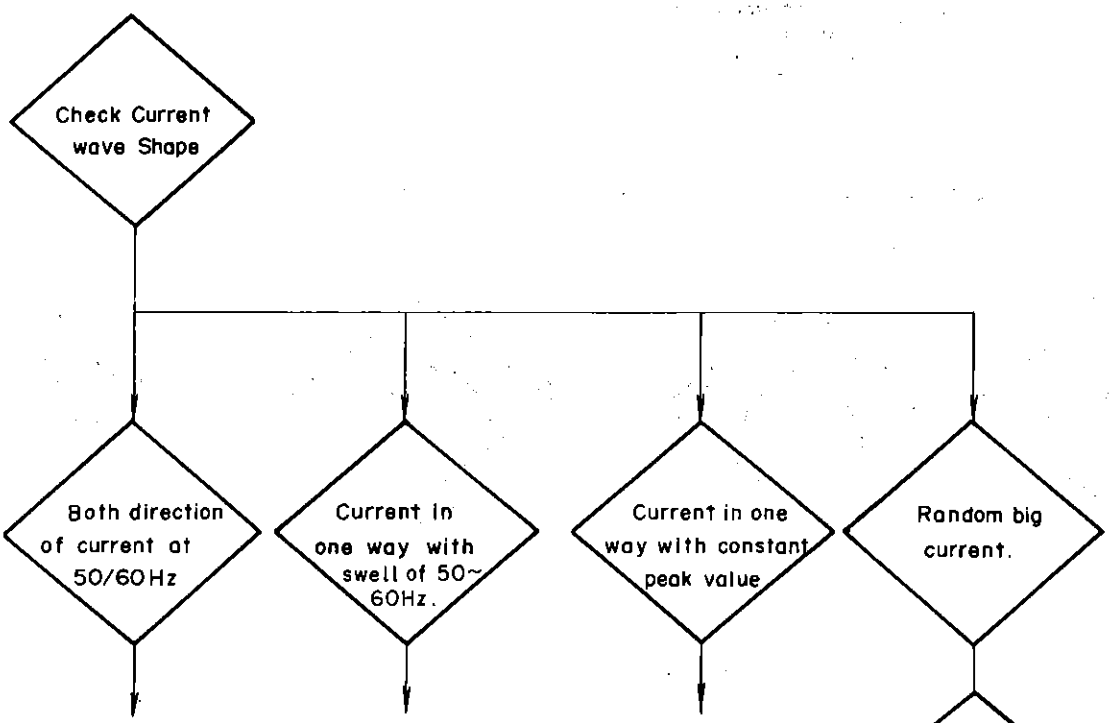


(G) Big vibration and/or noise at stop or running



Is frequency setting in velocity unit correct? Is dither too big? Is gain too big? Is input power wave shape normal? Is width of dither constant?	Same as left.	Can not be corrected by adjustment because of mechanical resonance between power frequency.	Damage of velocity unit.

(H) Big vibration and/or noise at stop or running



Is frequency setting in velocity unit correct?

Is dither too big?

Is gain too big?

Is input power wave shape normal?

Is width of dither constant?

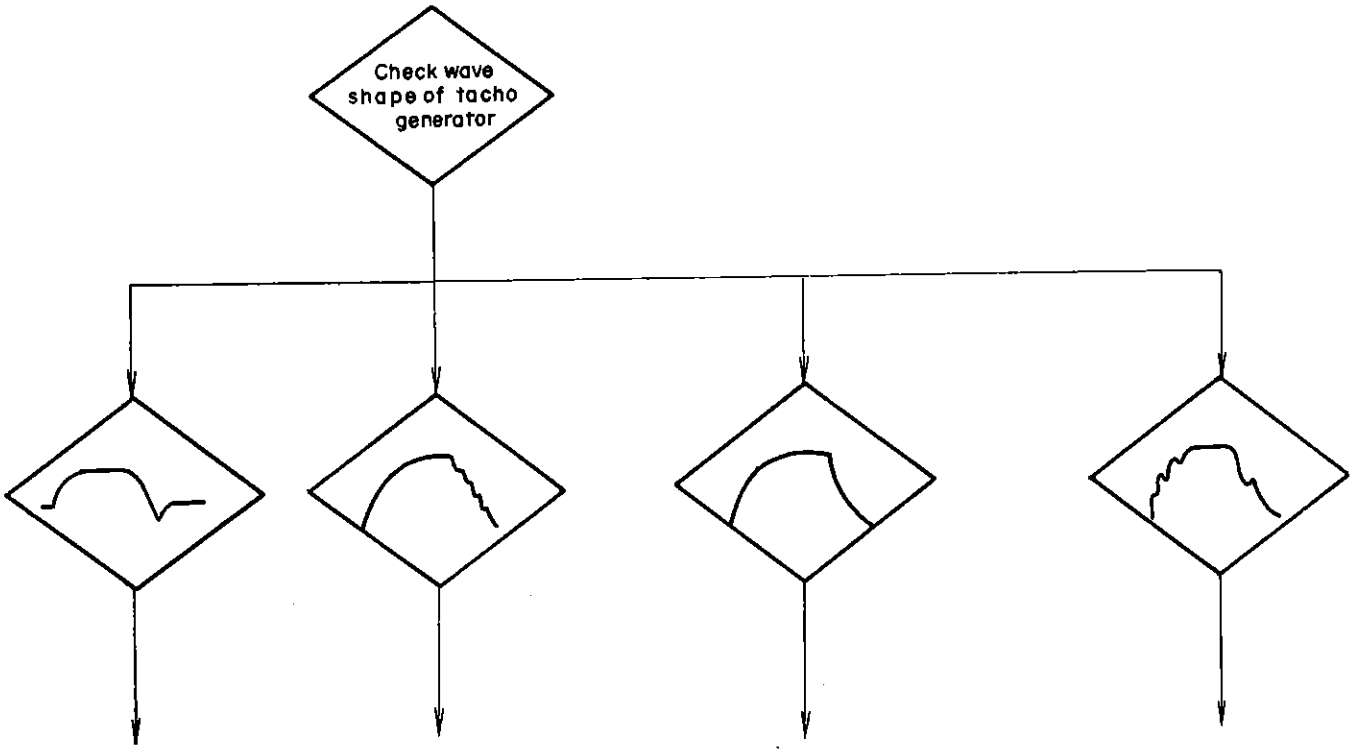
Same as left.

Can not be corrected by adjustment because of mechanical resonance between power frequency.

Tacho generator bad.

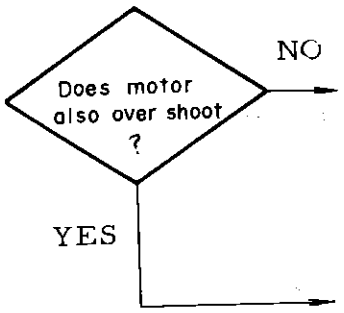
Damage of Velocity unit.

(I) Big vibration and/or noise during acceleration



° Current limit level is too low. ° Too heavy load. ° Too rapid acceleration.	Is gain too big?	Adjust acc. time longer. Can not be corrected by adjustment because of mechanical resonance between power frequency.	Damage of velocity unit.

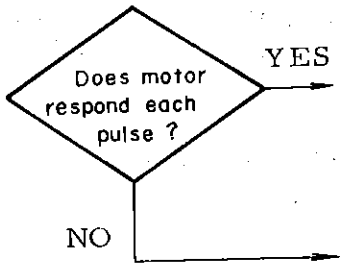
(J) Big overshoot



Trouble of machine

Is gain of velocity unit too low?
Current limit level too low ?
Too heavy load ?
Too rapid acceleration ?

(K) Lack of accuracy by 1 pulse feed

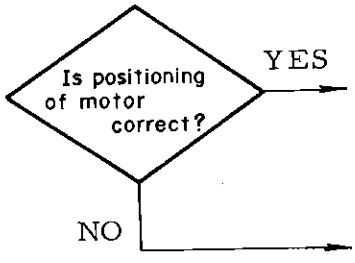


Trouble of machine

Is gain of velocity too low?

Is dither too small?

(L) Lack of accuracy in positioning repeatability



Trouble of machine

Is setting of acc-time for rapid traverse too small?

Is gain of velocity unit too low?

Is dither too small?

(M) Lack of stiffness in servo system
Is gain of velocity unit too low?
Is position gain 20 sec^{-1}?

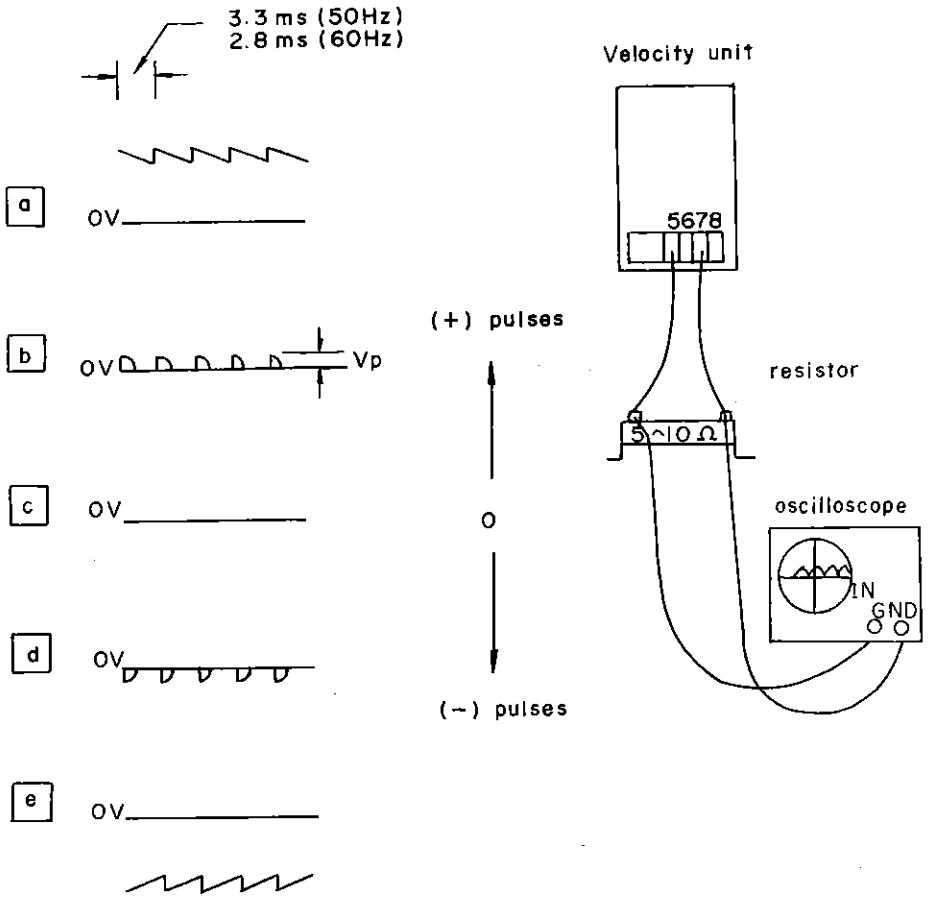
(N) Lack of accuracy in a circular arc cutting at the junction of quadrant
Is gain of velocity too low?
Is dithen of velocity too low?
Is position gain 20 sec^{-1}?
Is backlash compensation set proper value?

(O) Cause texture on cutting surface
Is pulse interpolation correct?

(P) Method of checking out for velocity unit

(1) Short circuit at between CH5 and CH6 on the PCB of Velocity Unit.
(2) Disconnect motor power cable and connect a resistor of $5 \sim 10\ \Omega$, more than 150 W as following figure.
(3) Turn on NC and put pulses by Handle then observe wave shape of voltage drop across the resistor as the following figure.

Note: Be carefull for the fall down of table as NC is turned on without motor power cable.

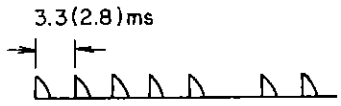
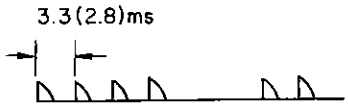
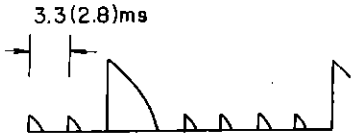


(1) The wave shape, when power is put on, must be one of b, c or d.

(2) In b and d, the period must be 3.3 ms (2.8 ms) when Vp is higher than 20 volts and if Vp is lower than 20 volts, the period could be different and it is normal.

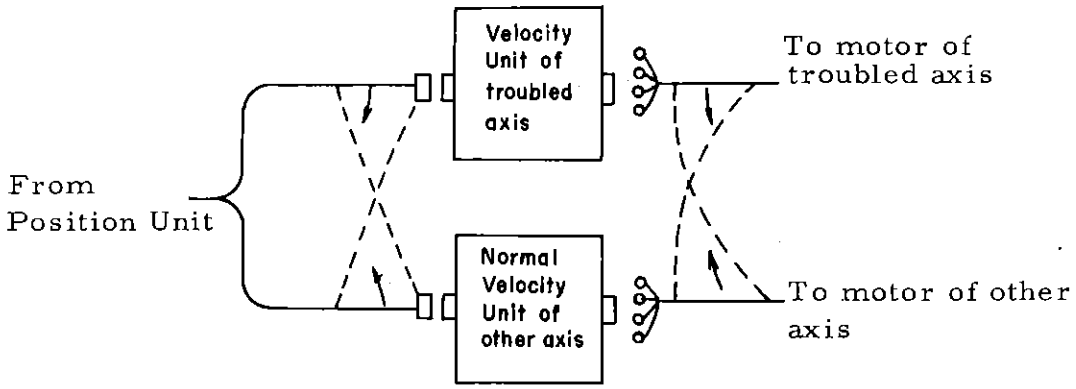
(3) Changing from b to d, or d to b must be obtained by command pulses less than 5 pulses (10 μ pulse) by Handle.

(4) The wave shape must be changed c to b to a, or c to d to e depending on number of pulses from handle.

Trouble	Cause
 Defect of one wave per 6.	 Fig.1 shows normal Thiristor gate signal. Fig.2 shows defect of one pulse, which results the wave shown left.
 Defect of 2 waves per 6.	There is no gate signal at all on one Thiristor per 6.
 Irregular wave.	The phase rotation of power input is not correct. Velocity unit is affected by noise.

Another method of checking

When one axis has trouble in servo system, it can be checked wheather velocity unit is wrong or problem is in machine itself by interchanging velocity unit with that of other axis.



Note 1. Velocity unit for the motor Model 0, 5, 10, 20 and 30 can not drive the motor Model 40, 50, 60, or 60H.

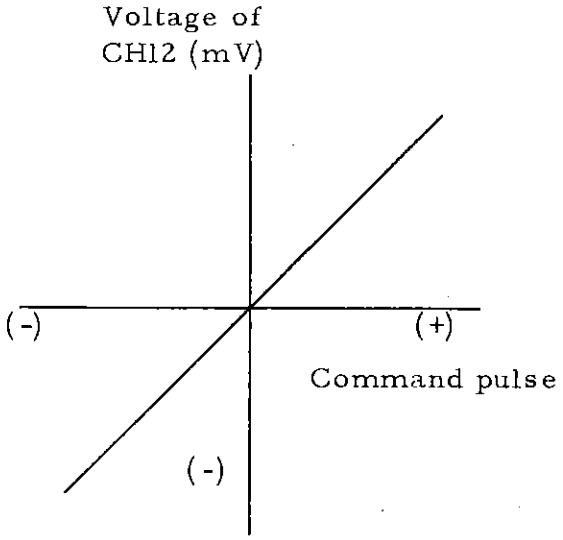
2. Feedback cable must not be changed.

3. Velocity unit for the motor Model 40, 50, 60, 60H can not drive the other type of motor.

(Q) Method of checking out for the Position Control Unit.

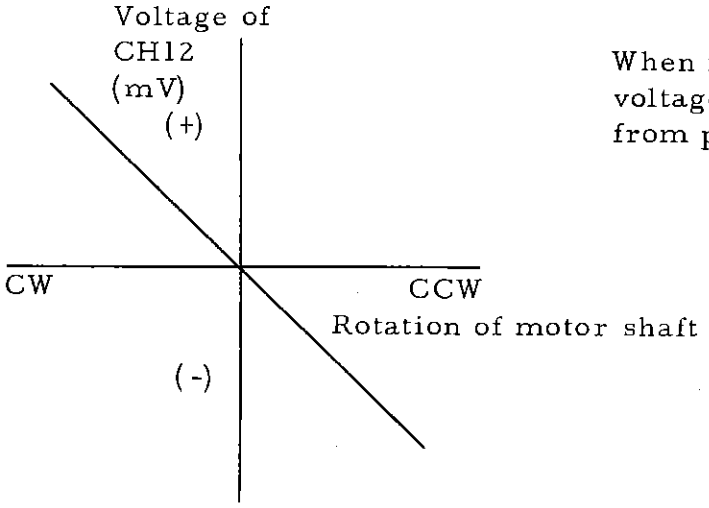
(1) Remove motor power cable
(2) Turn on NC and put pulses by Handle then check the voltage at CH12 in the Position Unit. (EP is Ground.)
(3) Rotate the shaft of motor by some means and check the voltage at CH12.

Note: Be carefull for the fall down of table as NC is turned on without motor power cable.

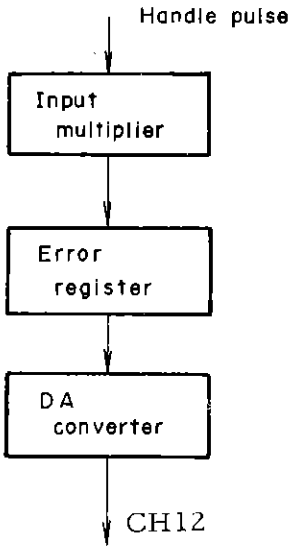
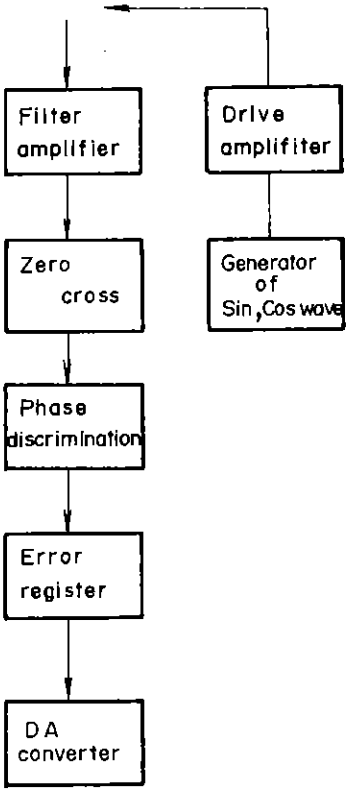


When pulses are put in by Handle, the voltage at CH12 varies continuously from positive to negative.

The rate is approximately 10mV/pulse. (1 pulse=10)

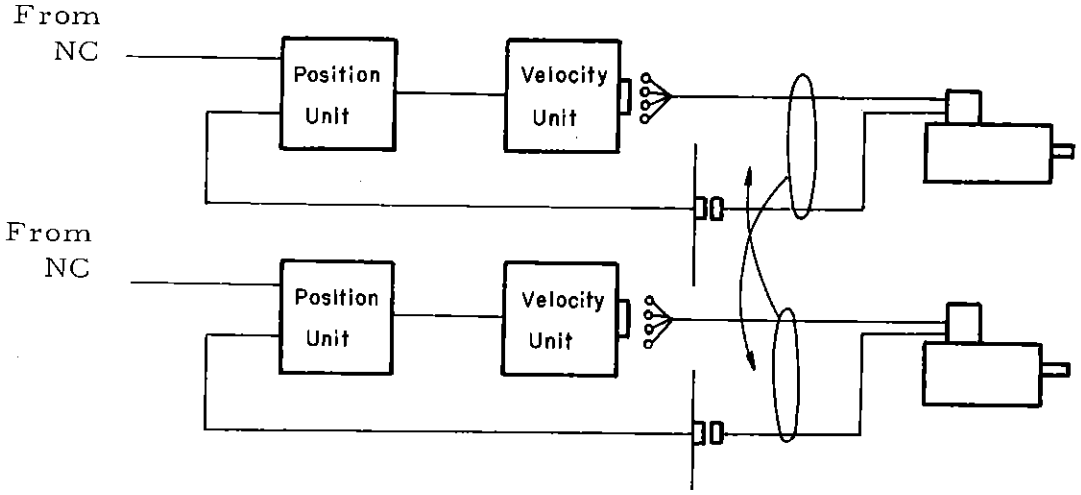


When motor shaft is rotated, the voltage at CH12 varies continuously from positive to negative.

Trouble	Cause
There is no voltage output at CH12 when pulses are put in by Handle	 Trouble is located at same part of above figure.
There is no voltage output at CH12 when motor shaft is rotated.	 Trouble is located at some part of above figure.

Another method of Checking

When one axis has trouble in servo system, it can be checked wheather unit (Position or Velocity) is wrong or problem is in machine itself by interchanging Position Unit and Velocity Unit with that of other axis.



Note 1. Both cables for motor power and feedback should be interchanged.

2. The position gain should also be changed when gear ratio of motor is different.

3. Be carefull for command axis name as input is not changed.

4. Velocity unit for motor model 0, 5, 10, 20, 30 can not drive the motor mode 40, 50, 60, 60H.

5. Velocity unit for motor model 40, 50, 60, 60H can not drive the other type of motor.

APPENDIX : Zero position shift

The zero point by Zero Return function depends on the grid of Resolver or Inductosyn, and it can be adjusted and shifted up to 2mm if necessary.

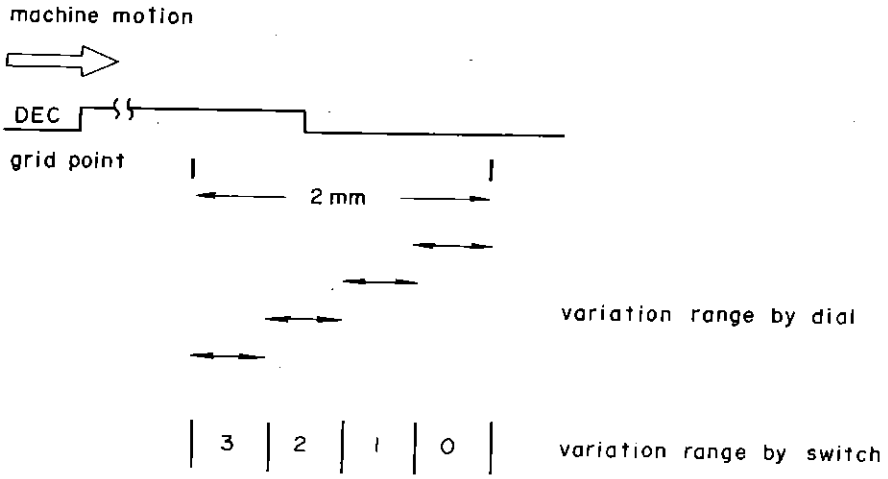
(1) Set the switch on the PCB of position control to "0" and execute the Zero Return.
Adjust the dial to get the appropriate position as the zero point.

(2) If the variation by the dial is too small, once put off power and change the switch to "1", "2" or "3", and then try Zero Return again.

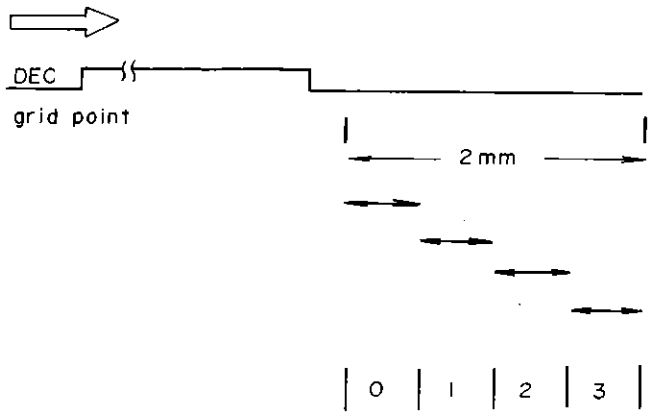
(3) If the variation is still not enough, then change the position of dog for deceleration.

Range of variation for the zero point

In case of (+) direction for Zero Return

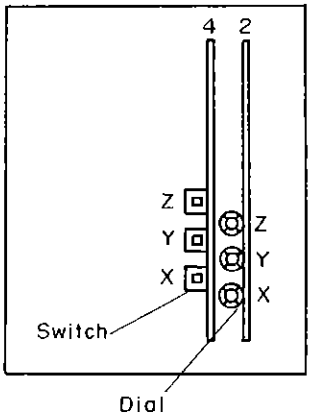


In case of (-) direction for Zero Return

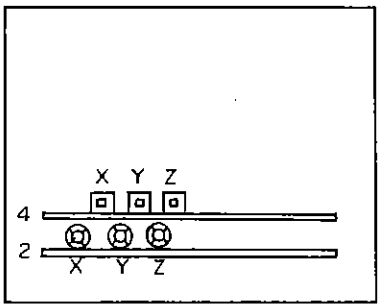


Location of switch and dial

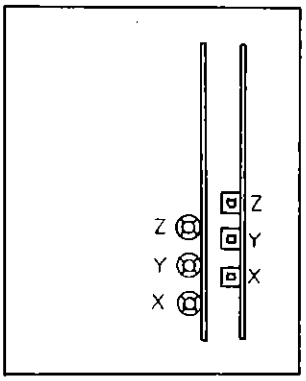
F3000B, F2000A
F1000C, F200-0A

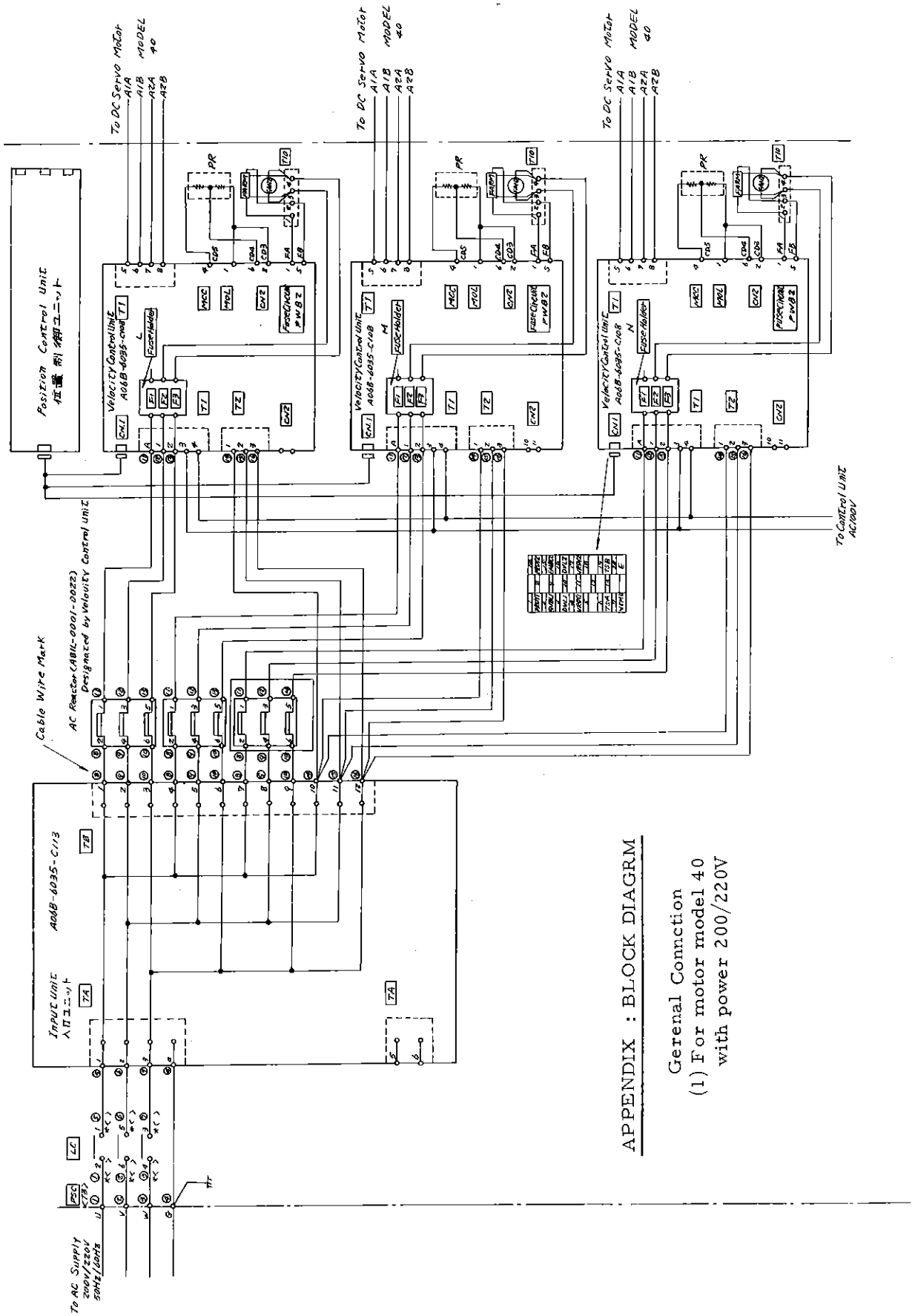


F3000C , F2000C



F200-0B , F220-0

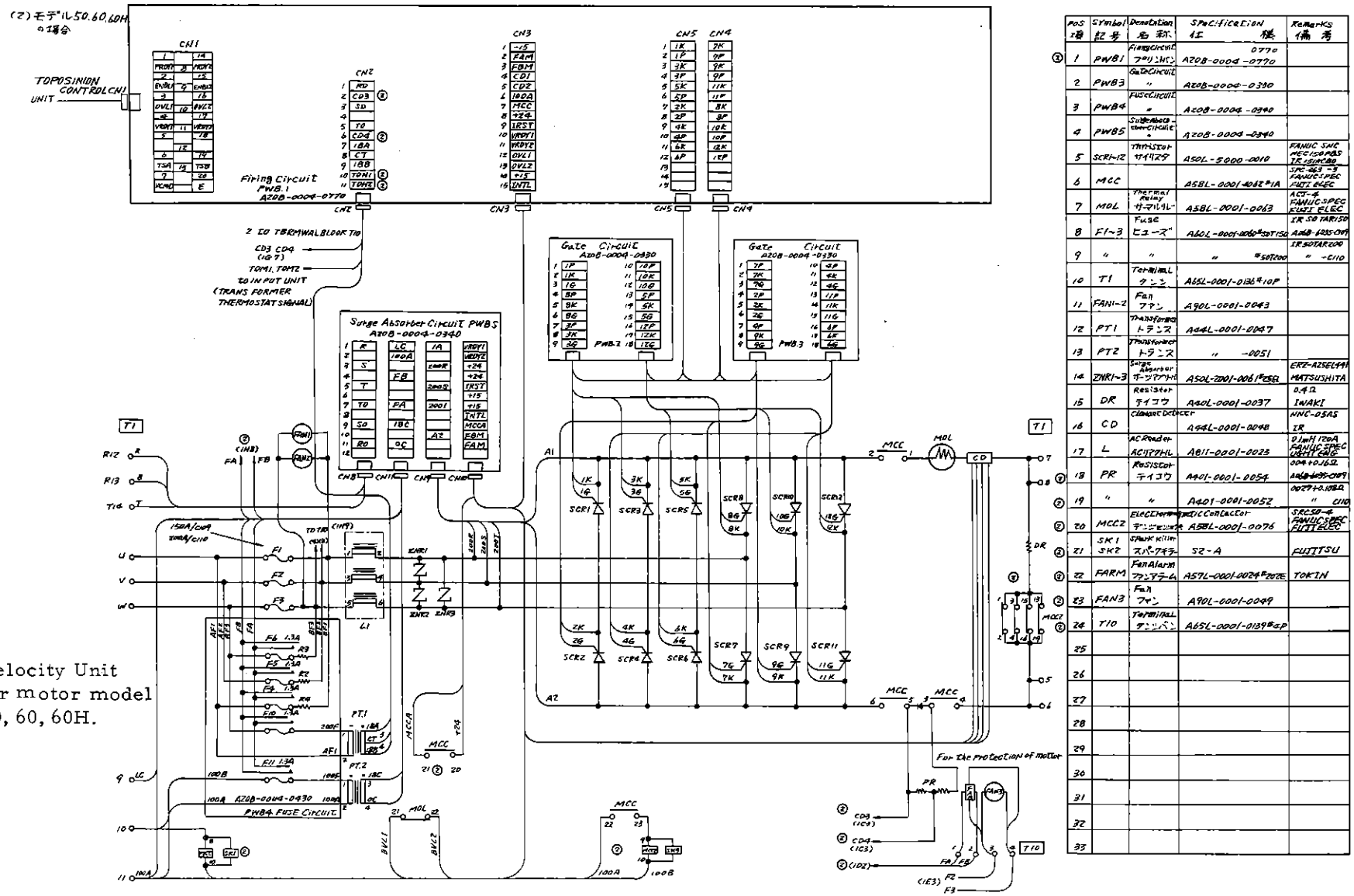




APPENDIX : BLOCK DIAGRM

Gerenal Connction
(1) For motor model 40
with power 200/220V

(2) Velocity Unit
for motor model
50, 60, 60H.



POS 項番	Symbol 記号	Denotation 名称	Specification 仕様	Remarks 備考
② 1	PWB1	Firing Circuit プリント板	A20B-0004-0770	
2	PWB3	Gate Circuit "	A20B-0004-0330	
3	PWB4	Fuse Circuit "	A20B-0004-0430	
4	PWB5	Surge Absorber Circuit "	A20B-0004-0340	
5	SCR1-12	Thyristor サイリスタ	A50L-5000-0010	FANUC SNC MEC 150 PBS IR 150MC80
6	MCC		A58L-0001-4082*1A	SNC-363-3 FANUC SPEC FUJI ELEC
7	MDL	Thermal Relay サーマルリレー	A58L-0001-0063	ACT-4 FANUC SPEC FUJI ELEC
8	F1~3	Fuse ヒューズ	A60L-0001-1056*30T150	IR 50 TARI50 A20B-4205-0190
9	"	"	" *50T200	IR 50TAR200 " →C110
10	T1	Terminal ターミナル	A65L-0001-0136*10P	
11	FAN1-2	Fan ファン	A90L-0001-0043	
12	PT1	Transformer トランス	A44L-0001-0047	
13	PT2	Transformer トランス	" →0051	
14	ZNR1-3	Surge Absorber サージアブソ	A50L-2001-0061*ESEL	ERZ-A25EL471 MATSUSHITA
15	DR	Resistor テイコウ	A60L-0001-0037	0.4Ω IWAKI
16	CD	Current Detector	A44L-0001-0048	NNC-05AS IR
17	L	AC Reactor AC197HL	A81L-0001-0023	0.1mH 120A FANUC SPEC CHOKE COIL
18	PR	Resistor テイコウ	A401-0001-0054	0.04+0.16Ω A40B-4001-0189
19	"	"	A401-0001-0052	0.027+0.108Ω " C110
② 20	MCC2	Electromagnetic Contactor デンジセンジ	A58L-0001-0076	SRC50-4 FANUC SPEC FUJI ELEC
② 21	SK1 SK2	Spark killer スパークキラー	S2-A	FUJITSU
② 22	FARM	Fan Alarm ファンアラーム	A57L-0001-0024*20DE	TOKIN
② 23	FAN3	Fan ファン	A90L-0001-0049	
② 24	T10	Terminal ターミナル	A65L-0001-0139*6P	
25				
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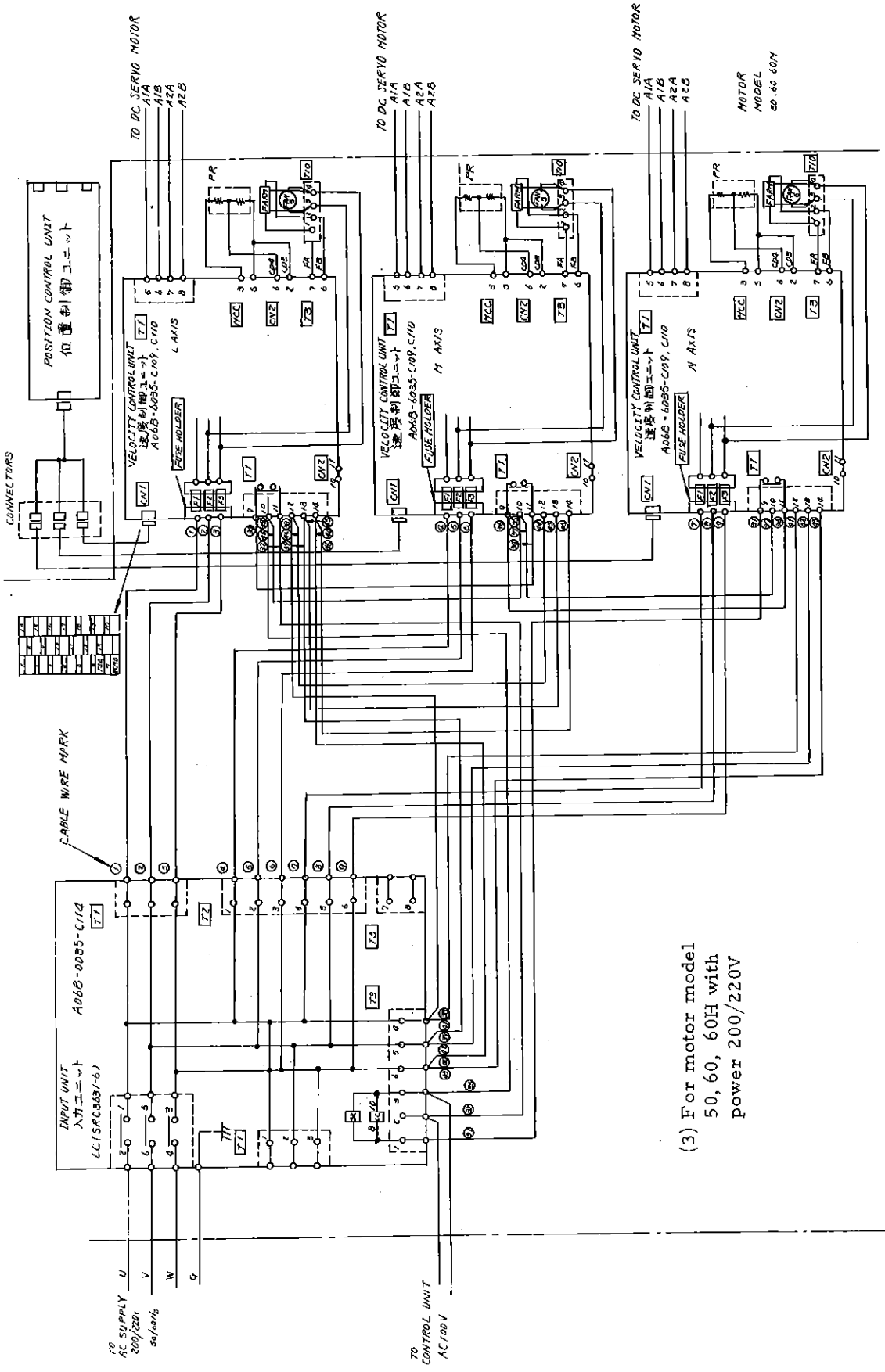
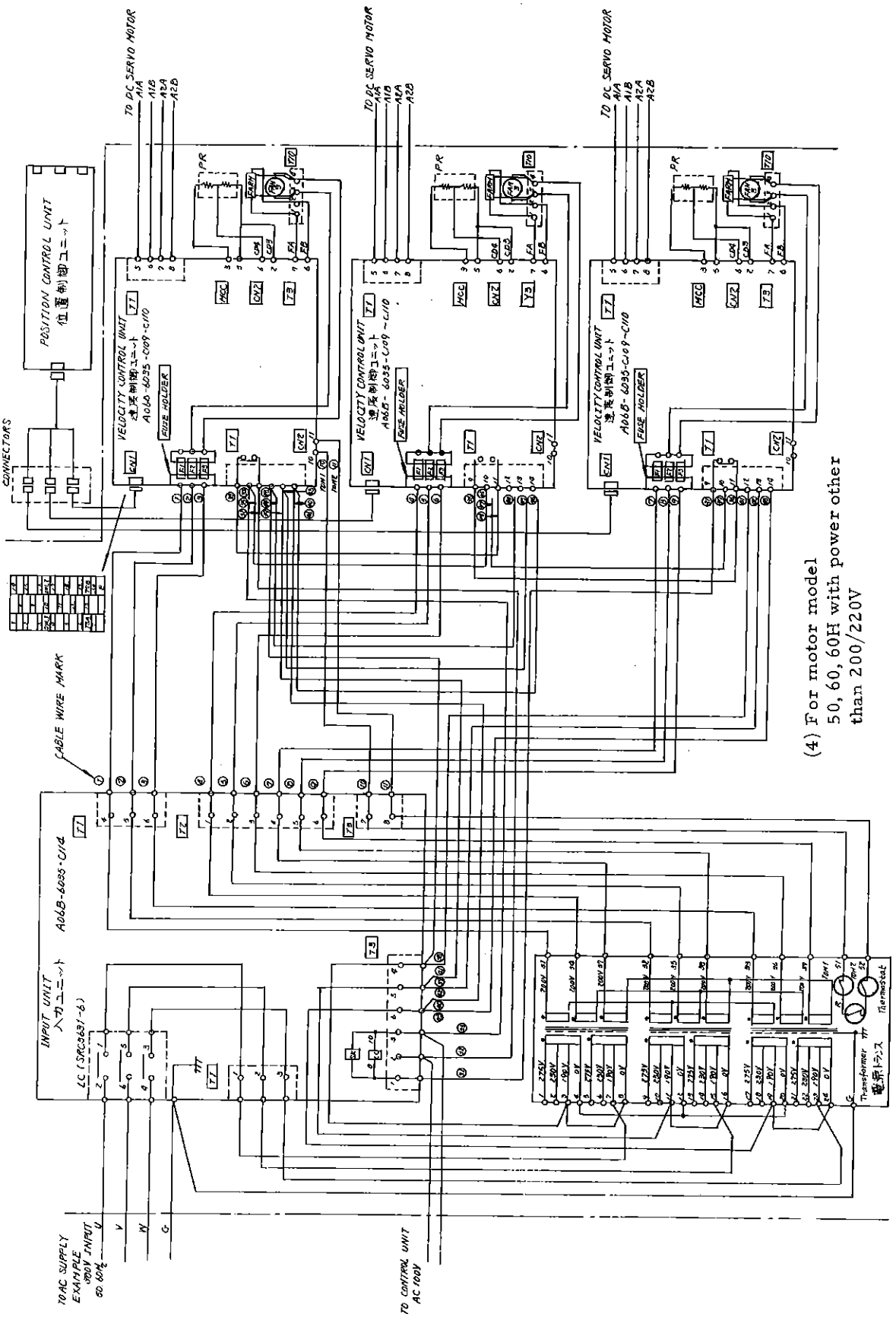
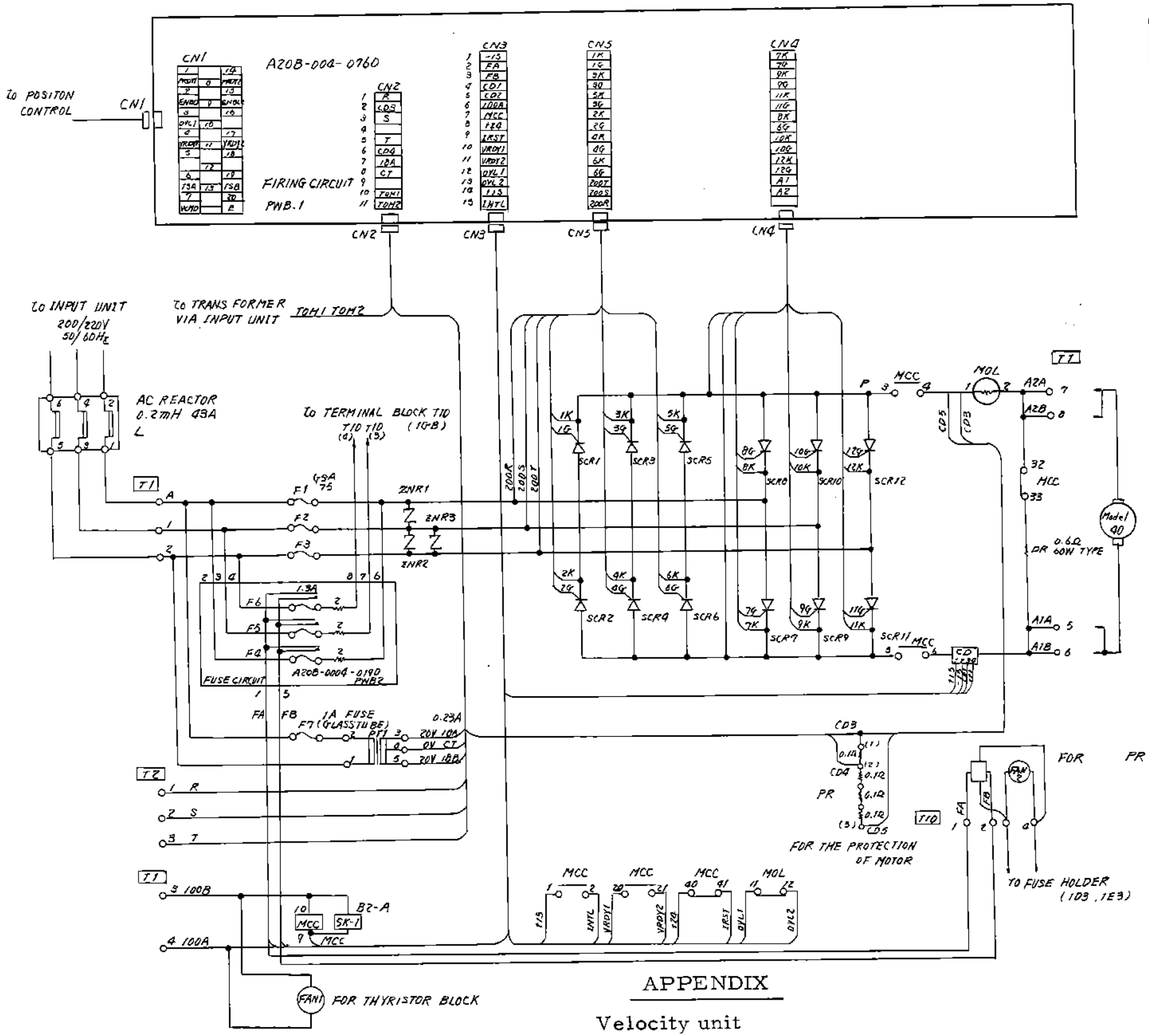
32				
33				



(3) For motor model
50, 60, 60H with
power 200/220V



(4) For motor model
50, 60, 60H with power other than 200/220V



APPENDIX

Velocity unit

(1) For motor model 40

POS 項	Symbol 記号	Denotation 名称	Specification 仕様	Remarks 備考
1	PWB1	Firing circuit プリントバン	A20B-0004-0760	
2	PWB2	Fuse circuit 〃	A20B-0004-0190	
3	SCR1 ~12	Thyristor サイリスター	59RC80N HIGH TA A50I-5000-0011	BG003-09 FUJI ELEC SP HEC
4	MCC	Magnetic contactor	Contacter A58L-0001-0029	CRC3691-2 FANUC SPEC FUJI ELEC
5	MOL	Thermal Relay サーマルリレー	A58L-0001-0064	RC9737-4 FANUC SPEC FUJI ELEC
6	F1~3	FUSE ヒューズ	A60L-0001-006 #GSA75	GSA75 ENGLISH ELEC
7	T1	Terminal タンシダイ	A65L-0001-0158 #38A-10P	
8	T2	〃	A65L-0001-0139 #3P	
9	T10	〃	A65L-0001-0139 #9P	
10	FAN1	FAN ファン	A90L-0001-0001	
11	FAN2	〃	AG-17956	
12	PT1	TRANS トランス	A44L-0001-0047	
13	ZNR1 -3	AN STER アレスタ	A50I-2001-0062 #Z	ENA441-12 FUJI ELEC
14	DR	Resistor テイコウ	A40L-0001-0056	0.6Ω 60W IWAKI TYPE
15	PR	〃	A40L-0001-0050	0.1Ω CR150 IWAKI TY
16	CD	Current Detector デンリュウ	A44L-0001-0048	NNC-05AS NIHON IR
17	L	AC Reactor ACリアクトル	A81L-0001-0012	0.2mH 43A FANUC SPEC LIGHT ENG
18	SK1	Spark Killer スパークキラー	S2-A	
19	FARM	Fan Alarm ファンアラーム	A57L-0001-0024 #202E	E6D-202E TOUHOKU KIN
20	F7	FUSE ヒューズ	A60L-0001-0039 #A1	1A GLASS TUBE ASAHI FUSE
21				
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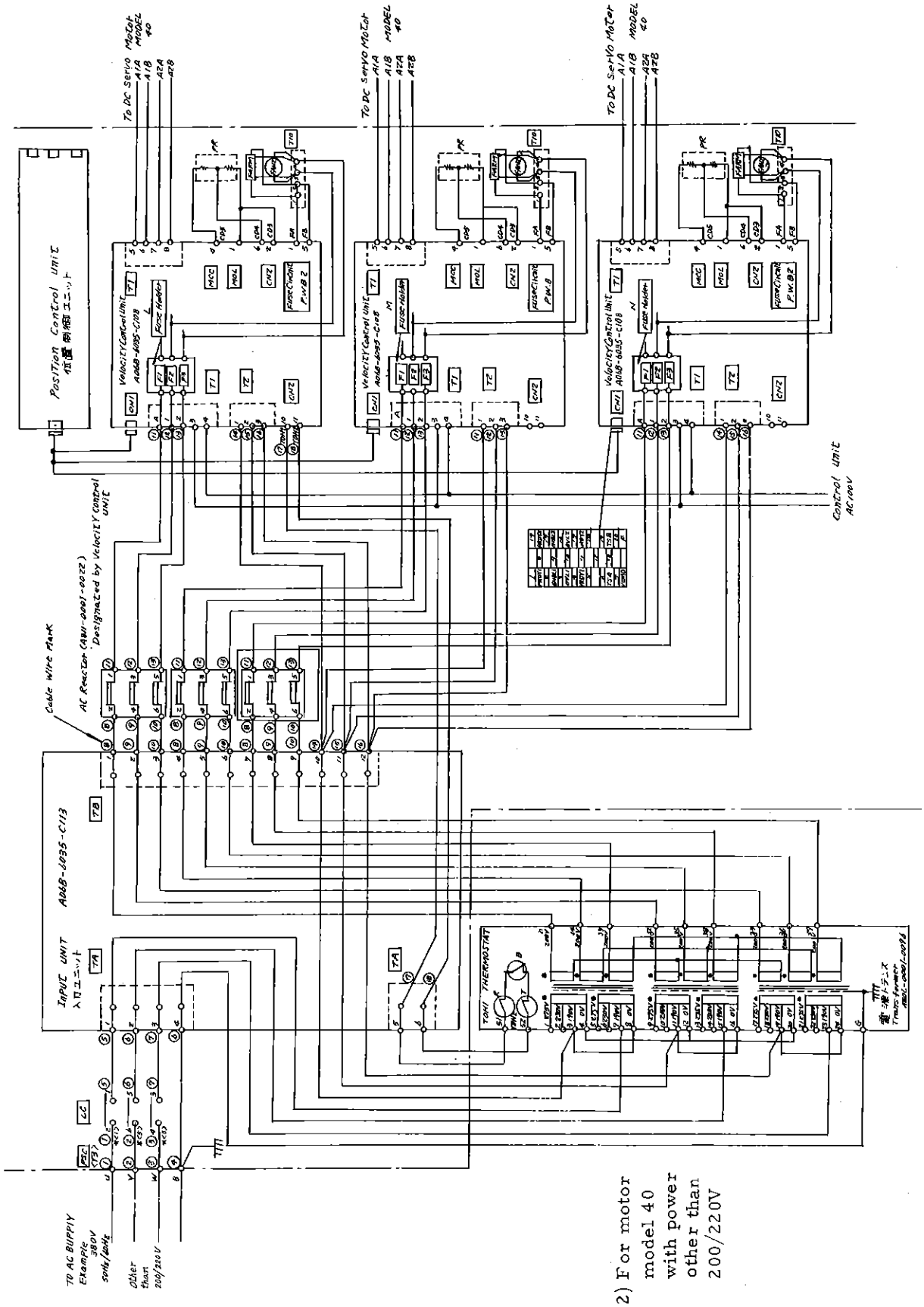
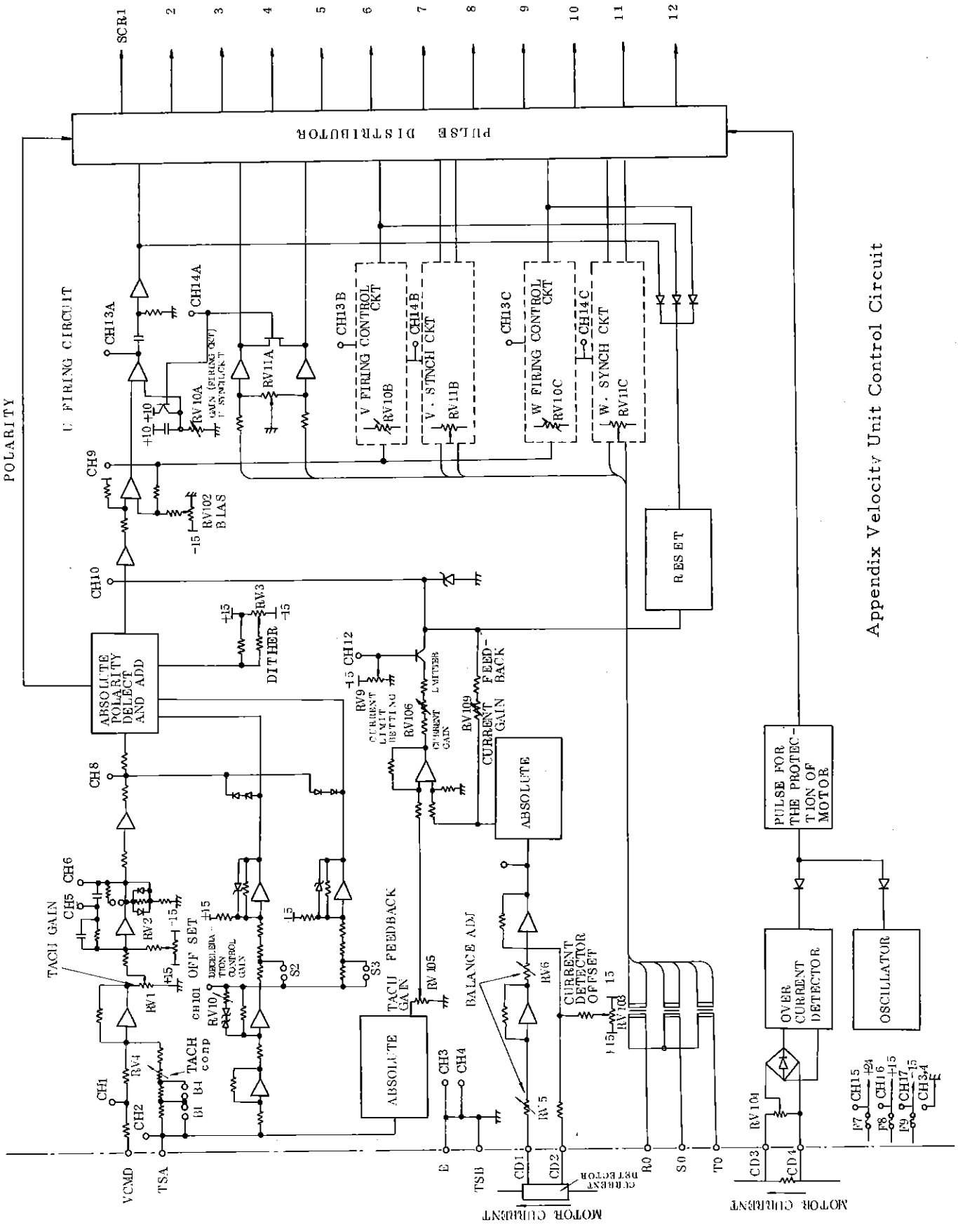


(2) For motor model 40 with power other than 200/220V

Location of primary winding taps of transformer (A811-0001-0097~0098)

			Terminal number of trnasformer					
			Input 100V	Input 110V	Input 380V	Input 415V 440V	Input 460V 480V	Input 550V
Cable	Connect between Input Unit and transformer	T1(1)	7	6	7	6	5	5
		T2(2)	15	14	15	14	14	13
		T1(3)	23	22	23	22	22	21
		T3(4)	3					
		T3(5)	11					
		T3(6)	19					
Strap Wire	Connect between each termi terminal of transformer		3-7	2-6				
			4-8	4-8	3-8	3-8	2-8	1-8
			11-15	10-14				
			12-16	12-16	11-16	11-16	10-16	9-16
			19-23	18-22				
			20-24	20-24	19-24	19-24	18-24	17-24
			4-12-20					

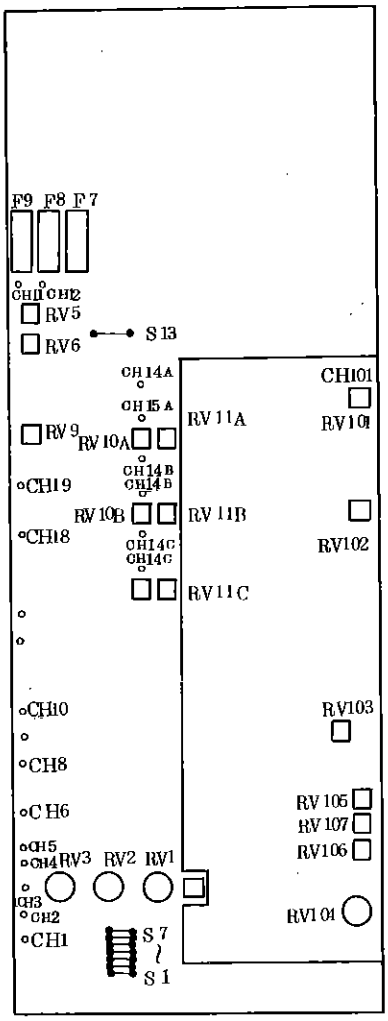
Appendix Tap connection for power transformer (FANUC made)



Appendix Velocity Unit Control Circuit

APPENDIX Method of standard adjustment

Printed circuit board in Velocity unit.



CH3.4 : 0V
CH15 : +24V
CH16 : +15V
CH17 : -15V

1. Checking of short bar

	3VTACH	6VTACH		3VTACH	6VTACH
S1	o		S6	o	o
S2	o		S7		
S3	o				
S4					
S5	o	o			

2. Checking of power voltage
Check the voltage of +24,+15 and -15

3. Setting of power frequency
1. Connect CH10 to CH3(GND).
2. Adjust RV102 to get CH9 0.6V(50Hz)or 1.8V(60Hz).
3. Adjust RV10A,B,C and RV11A,B,C to get the width of level "1" of CH13A,B,C = 1.2ms(50Hz) or ms(60Hz).
RV10 is for width adjustment
RV11 is for wave shape forming

4. Adjustment of dither
1. Connect CH8 to CH3(GND).
2. Adjust RV3 to get the width of level "1" of CH13A,B,C = 2.0ms(50Hz) or 1,8ms(60Hz).
Note : If it cannot be adjusted by RV3, the previous setting (3.3 power frequency) may be altered by within ±0.2ms on CH13.

5 Adjutment of offset
Set RV2 = scale 50%
(Adjust so as motor does not rotate.)

6. Adjustment of gain
Set RV1 = scale 30%(Model 40) or 50%(Model 50,60,60H)

7. Adjustment of velocity feedback voltage compensation
Set RV4 = scale 50%.

8. Adjustment of current feedback
It should not be readjusted. (RV107 = 50%)

9. Adjustment of current limiter gain
Set RV106 = 50%.

10. Setting of current limiter
It should not be **readjusted**. (RV9 = 60%(Model 40) or 40%(Model 50,60)

11. Setting of deceleration limit gain

(RV101)

12. Setting of current detecting offset

Adjust RV103 to get CH11 = ± 0.1V or smaller

13. Setting of overcurrent detecting level

It should not be readjusted.

(RV104=80% model 40; 75% model 50,60; 70% model 60H)

APPENDIX Spare parts

1) Fuse

Name	Specification	Remark
Fuse	A60L-0001-0061 #GSA75	75A For Model 40
"	A60L-0001-0061 #50T150	150A For Model 50, 60
"	A60L-0001-0061 #50T200	200A For Model 60H
Alarm fuse	S. Fab 250/402A P413	1.3A For Model 40, 50, 60, 60H
"	A60L-0001-0046 #1.0	1.0A For Model 50, 60, 60H
"	A60L-0001-0039 #A1	1.0A For Model 40
Fuse Resistor	A40L-0001-0038 #FR4700K	0.47

2) Printed Circuit Board

Name	Specification	Remark
Firing Circuit	A20B-0004-0760	For Model 40
"	A20B-0004-0770	For Model 50, 60, 60H
Fuse Circuit	A20B-0004-0190	For Model 40
"	A20B-0004-0430	For Model 50, 60, 60H
Gate Circuit	A20B-0004-0330	For Model 50, 60, 60H
Surge Absorber Circuit	A20B-0004-0340	For Model 50, 60, 60H

3) Semiconductor

Name	Specification	Location	Remark
Semiconductor (Thyristor)	A50L-5000-0011	Velocity unit	For Model 40
"	A50L-5000-0010	Velocity unit	For Model 50, 60, 60H

B-51401E/07

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