NOMURA

CONTENTS

1. ELECTRICAL SAFETY DEVICES - FUNCTIONS

1.1. No-fuse breakers

(1) Functions of no-fuse breaker (CB1):

CB1 is provided for switching on and off power and for protecting entire load circuits.

CB1 is tripped when very large current flows at source due to some causes, which possibly include the following:

a) Short-circuiting of main circuit, which causes large current to flow.

b) Grounding of main circuit, which causes large current to flow.

c) Momentary flow of large current in main motor (M5) circuit.

Check for cause and take corrective measure whenever CB1 has worked. Then , reset it.

Note: CB1 is located inside control panel. Source power can be switched on and off either internally or externally.

(2) Functions of no-fuse breaker (CB2):

CB2 is provided for protecting circuits of pump and feed motor cooling fan motor. Causes actuating CB2 include the following:

a) Short-circuiting, which causes large current to flow.

b) Grounding of circuit, which causes large current to flow.

c) Locking of motor (M1-M3 or M7) circuit, which causes large current to flow momentarily.

Check for causes and take corrective measures whenever CB2 has worked. Then, reset it.

Note: CB2 is provided with a trip contact so that, when it has worked, trouble indicator lamp (YL1) on control panel door glows.

(3) Functions of no-fuse breaker (CB3):

CB3 is provided for protection of control circuits. Once it has worked, operation control from pendant becomes impossible. CB3 may be caused to work by causes including the following:

a) Short-circuiting of control circuit.
b) Trouble with magnetic switches, magnetic contactors, auxiliary relays or timers.
c) Other circuit troubles.

Check for cause and take corrective measures, should CB3 have worked. Then, reset it.

1.2. Fuses

A set of fuses are accommodated together at one place at the left hand of the control panel. In addition to these, others are provided on the thyristor panel. They provide protection to the following: (FO)-source power indicator lamp circuit, (F1)-transfomer(T3), (F2)-transformer(T1), (F3)-pendant indicator lamp circuit, (F4)- illumination circuit, (F5)-plug socket circuits, (F6)-magnetic clutches, (F8)-transformer(T2) and (FU)-thyristor circuits. Fuses become broken due to faulty circuits. this means that causes of trouble should be corrected prior to replaciog them.

(1) functions of fuse(5A) for protection of transformer (T1 and T2) circuits:

As fuse(F2) melts, pendant indicator lamps(GL1 and WL1) fail to glow, brake fails to be applied while main motor is at a standstill, illumination light and bulbs of optical reders go out, and appliance hooked to plug socket stops operation.

Likely causes are the following:

a) Transformer is overloaded.
b) Insulation has become faulty due to overheating of transformer (Short-circuit).

c) Starting current has flowed to transformer.

(2) Functions of fuse(10A) for protection of magnetic clutch and brake circuits:
If fuse(F6) melts, feed becomes impposible. Brake fails to be applied while main motor is at a standstill. Likely causes include the following:
a) Short of DC circuit.
b) Mechanical locking of clutch.
c) Trouble with silicon rectifier, which supplies DC.

(3) Functions of fuse(2A) for protection of plug socket circuit:
Wten fuse(F5) melts and cuts off power, appliance hooked to plug socket(e.g. illumination for operation) stops functioning. This fuse breaks when short-circuiting occurs or an appliance larger in capacity than AC100/110V, 100W is connected to plug socket.

(4) Functions of fuse(2A) for protection of illumination circuits:
When fuse(F4) melts, illumination lamp fail to go on. This will take place if a chip gets into lamp socket and causes short-circuiting,or if wires No.32 and 51 are connected to each other accidentally. Should lamp (100V, 100W) fail to light, check for broken filaments.

(5) Functions of fuse(1A) for protection of pendant indicator lamp circuit:
If fuse(F3) melts, power to feed indicator lamps(CL1P and WL1P) on pendant go out. Likely cause is connection of wires No.1 or 2 and 30. Also, check for broken lamp (18V, 2W) filaments.

(6) Functions of fuse(1A) for protection of power indicator lamp:
If fuse(F0) snaps, power indicator lamp(WL0) fails to glow. Likely cause of this is short-circuiting or transformer(AC 220/18V) trouble. If lamp(18V, 2W) does not light, check for broken filament.

NOTE: In case of 440V power source this transformer is 440/18V one.

(7) Functions of fuse(50A) for protection of thyristor circuit:
If fuse(FU) snaps, DC feed motor stops running. (Trouble indicator lamp(YL3) goes on.)
Among likely cause of this trouble are:

a) Thyristor(or DC motor) has shorted.
b) DC motor is overloarded.
c) Thyristor has been destroyed.

1.3. Thermal relays for overload protection

As overload protectors, this machine is equipped with the following thermal relays: (OL1)-for motor of trochoid pump for lubrication inside headstock and bed gear box, (OL2)-for motor of trochoid pump for slideway lubrication, (OL3)-for motor of hydraulic pump for clamping, (OL5)-for boring spindle motor, and (OL7)-for fan motor cooling feed motor.
Each thermal relay is set at optimum current value for its respective motor. Should it work, motor is either faulty or overload. Be sure to check for cause and take corrective measures.

(1) Functions of thermal relay for main motor:
If boring spindle drive motor is overloaded for a protracted length of time or if it is switched on and off too frequently, thermal relay(OL5) functions and boring spindle stops running. Simultaneously, other motors are also switched off. (Trouble indicator lamp YL2 lights.)
Continued operation is dangerous if OL5 has worked. Reset it by pushing reset button at the left side of OL5 inside control panel only after removing cause of trouble.

(2) Functions of thermal relays for motors of trochoid pumps and others:

If, due to any cause, trochoid pump or other motors are overloaded for a protracted length of time, thermal relays(OL1-OL3 and OL7) located at lefthand bottom of control panel are actuated. Consequently, all motors (M1-M7) stop running. Boring spindle drive motor also ceases to revolve and control from pendant becomes impossible with trouble indicator lamp(YL2) glowing. Check for cause of trouble without fail prior to resetting relays by pushing reset button.

1.4. Feed motor protectors

In addition to fuses, the following DC feed motor protectors are provided for operation safety.

(1) Protection by current limiter:

With this safety system, load current can be set at any value within 0 to 150 % of rated current. It limits current during acceleration or under overloaded condition. (It works in 0.1 sec.)

(2) Protection by field loss relay(FLR):

If current flowing to field drops below 0.154A due to adecrease in power voltage or faulty field circuit, FLR falls and stops motors. At the same time, trouble indicator lamp(YL3) goes on.

(3) Protection by anti-plugging relay(AP):

This safety device prevents short-circuit when switching from normal to reverse rotation: contactor for reversing

operation is thrown to ON not immediately but with a delay. AP functions at an attracting voltage of more than 33.6V(3.6mA current) and a releasing voltage of lower than 17V(2,0mA current).

(4) Protection by acceleration timer:
Automatic acceleration control is possible by this device. Time to accelerate from zero to full speed can be set within a range of about 0.5 to 12 seconds so as to eliminate starting shock.

(5) Protection by thermostats(TH):
DC motor is protected against heat-seizure by being provided with thermostat which is built into surface of interpole coil. Its contact opens at amotor temperature of 150 ±15°C and closes at 130 ±10°C. As this thermostat functions, operation control circuit is cut off. lamp (YL3) lights, indicating trouble.
Note: For further drtails, please refer to operating manual provided separately.

1.5. Action of the over-run limit switches
When the over-run limit switch is "ON" by striking of it to the dog, the feed motor can not be rotated. When the "feeding" is stopped by the limit switch being "ON" while the machine is in operation, chage the feed direction to reverse and start the power feed to take off the limit switch acting and resume the feed.
Over-run limit switches are very important safety features of this machine. They should be checked regularly to confirm that they are functioning properly. (Push them by finger and see they can be actuated.)

2. MAINTENANCE and INSPECTION on ELECTRICAL PARTS

2.1. Contact points of magnetic switches and contactors

Frequent operation of motors will cause contact points to be worn rapidly. Check them at appropriate intervals and maintain them always in good working condition. Black stains on contact point surfaces or minor surface irregularities do not require maintanance at all, because these do not result in inferior contact.

Contact points become burr or localized irregularities may make their appearance due to fluctuations in power voltage or other causes. These should be corrected.

Just eliminate burrs and irregularities by filing lightly. Do not file soft contact points excessively. This will shorten their service life. Contact points become most markedly worn and deformed at the foremost part, whereas the rear part remains relatively intact. This offers the advantages of wipe retention and continued maintanance of a sufficiently large contact pressure. Do not attempt to file the contact points which have been worn normally with the intention of restoring their original shape.

Do not polish contact points with emery paper: sbrasive particles may become implanted and cause poor contact.

Check and maintain the contact points at six-months or shorter intervals.

2.2. Electrical parts which do not require frequent maintenance care

The auxiliary relays, time-limiting relays, over-run limit switches and three-phase induction motors have to be checked and maintained only at long intervals.

Depending upon operating environments,however, the intervals of regular inspection and mantenance should be shortened. Dust, humidity and salty ambiance are detrimental factors.

2.3. Maintenance of DC feed motor

(1) Inspection of carbon brushes:
Inferior or no contact of carbon brushes with commutators causes DC motor to run erratically or not to run at all. Check for worn carbon brushes and abnormal vibration at six- monthly intervals.
Note: If there is any carbon brush whose red mark has come to the top of its holder box, replace it with a new one.

(2) Inspection of filter for cooling fan motor:
A fan motor is used to cool the DC motor. It sends air through a filter which is provided to remove dust. Clean the filter regularly at six-monthly intervals. If the fan motor is operated without cleaning the filter of dust, it will become overheated and develop trouble. To clean, take off the filter and wash it with kerosene. After drying it by browing air at it, set it back in its place. Note that the filter can be taken off easily by loosening a pair of screws.
Do not operate the machine without this filter.

(3) Inspection of carbon brushes in tochometer generator(TG):
This tachometer generator is employed for tactometer feedback control with the purpose of improving DC motor speed variation. When its carbon brushes have become worn and fail to lose contact with the commutator, motor speed control will be impossible. Check the carbon brushes after six to twelve months of initial opration and at intervals of three to six months thereafter. If worn(to one third of the original size), replace them. The carbon brushes located horizonally at to places are accessible when the TG rear cover has been taken off. They can be pulled out after loosening the knurled bolts which fix them securely.

2.4. Inspection of thyristor controller
(Brand name: DS-11 conversion unit):
The SCR conversion unit(Con) accommodates in its compact sealed casting an AC-DC converter, DC output control and protector. Being solid-state, it is virtually maintenance free. Check the following regularly:

(1) Testpoint voltages

ITEM	TEST POINTS (on main card)	VOLTAGES(DC)
Power supply (+)	1	+15V
Power supply (-)	2	-15V
Reference signal	3	0~+7.5V
Linear time output	4	0~+7.5V
Main amp output	5	0~-6.5V
Driver input	6	0~+6.5V
Voltage feedback signal	7	0~-7.5V
Current feedback signal	8	0~+1V
TG amp output	9	0~-7.5V
Driver output #1	10	Pulse output
Common	13	0V

(2)At the time of regular inspection and maintenance, check contacts of all electrical systems and test contactors. Specifications of the DC feed motor and controls are given below for your reference.

DC motor Manufacturer: Sumitomo Shipbuilding and Machinery Co.,Ltd.

Type : Drip-proof, separately ventilated
Frame No. : CDL186AT, continuous rating 3.7KW
Base speed : 1750rpm
Max. speed : 2300rpm--rapid feed

Armature voltage: DC160/170V (50/60Hz)
Armature current: 26.2/25.0A (50/60Hz)
Field voltage: DC90/100V (50/60Hz)
Field current: 1.26/1.40A (50/60Hz)
Armature voltage control: (Torque constant) 1:50
Field voltage control: (Horsepower constant)
Top speed only
Insulation: Class F Separately excited and shunted, with built-in thermostat
Vibration: Less than V15
Noise: Lower than 80 phons
Accessories: Cooling fan motor 100W, 2P
Tacho meter generator 65V/1000rpm

Controls Manufacturer: Drive System Co.,Ltd.
Source power: Single-phase, AC200/220V (50/60Hz)
Ambient temp. : Lower than 40°C
Voltage fluctuations: ±10%
Speed variation: 1:50 (35-1750rpm) (Torque constant)
Top speed-2300rpm by reducing field intensity (Horsepower contact)
Fluctuations in speed: Less than 1% of base speed as against 100% load fluctuations (Fluctuations in speed will be less than 3% for changes of 10% in voltage, 2% in Frequency and 15°C in ambient temperature)

3. PROCEDURE for SETTING of DIRECT CURRENT MOTOR

3.1. Set atester to the resistance range and check with it to make sure that the terminal boards of the S.C.R. control board is not shorted to its casing. Do this without fail prior to switching on power. Also check for erronerous connections before turning on the main power switch.

3.2. Turn the feed speed setting volume knob on the pendant to '0' (viz. CCW as far as it moves).

3.3. Set mode selector switch(CS1) to power LOW FEED.

3.4. Prior to setting the DC motor speed, adjust the volume in the DS-11 power conversion unit.

1) As for power feed, by the adoption of tacometer feed-back set the IR COMP volume to '0'.
2) Motor speed acceleration time from zero to top seed can be set by adjusting the TIME volume, which is adjustable approximately 0.5-12seconds. Turning the pot CW increases the time.
3) Adjust the zero position of the feed speedometer on the pendant.

3.5. Set feed direction select switch(ML1) to SADDLE, and SW2 to RUN. Then, push PB3(normal) or PB4(reverse) to set the motor in motion.

3.6. Set the minimum speed of the motor just before it starts running by adjusting the MIN volume inside the power conversion unit.

3.7. Turn the S-MAX volume CCW to zero.

3.8. Set to MAX. the feed speed the setting volume on the pendant(by turning it CW as far as moves).

3.9. Adjust the S-MAX volume(by turning it slowly CW) untill the motor runs at a base speed of 1750rpm. To measure the speed, apply a hand tacometer to the motor output shaft.

Note: Read the voltage level on the voltmeter located on the control panel door to be sure whether armature voltage is 170V(source power:AC220V) or 160V(AC200V).

After going through the above-described step, the motor speed can be regulated by the speed setting volume within a range of 0 to 1750rpm. It should be noted that, the S-MAX volume has tobe readjusted.

3.10. First, take off the rear conver of the pendant. After removing the cap at the feed speedometer(SM). Then adjust the sensitivity volum untill the speedometer needle points to the maximum value(2 inch/min).

3.11. Push PB5(FEED STOP) to stop the motor.

3.12. If the motor turns in the opposite direction, exchange magnetic field connection(wirea No. 'J' and 'K'), necesarily after switching CB1 off.

3.13. Set mode selector switch(CS1) to RAPID FEED.

3.14. Go through the step described in paragraph(5) above and set the motor in action.

3.15. Adjust the field adjusting variable enamel resistor(R1) untill the reading of the hand tacometer, which is applied to the motor output shaft, becomes 2250rpm. For accurate measurement, insert an ammeter(DC) into the field circuit and set it slightly higher than 0.82A.
For rough measurement, connect a tester between terminals No. 'J' and 'K', and adjust voltage to approximately DC 60V.
After going through the above-described steps, watch the voltmeter and ammeter on the control panel door and be sure that their reading for the armature are DC170V and 25A(AC power source: AC220V,60Hz), or DC160V and 26A (AC200V,50Hz).

This HANDBOOK has been complied to give brief information on the operation control and maintenance of electrical parts and electrical safety devices. For greater details, please read operating manuals provided separately.

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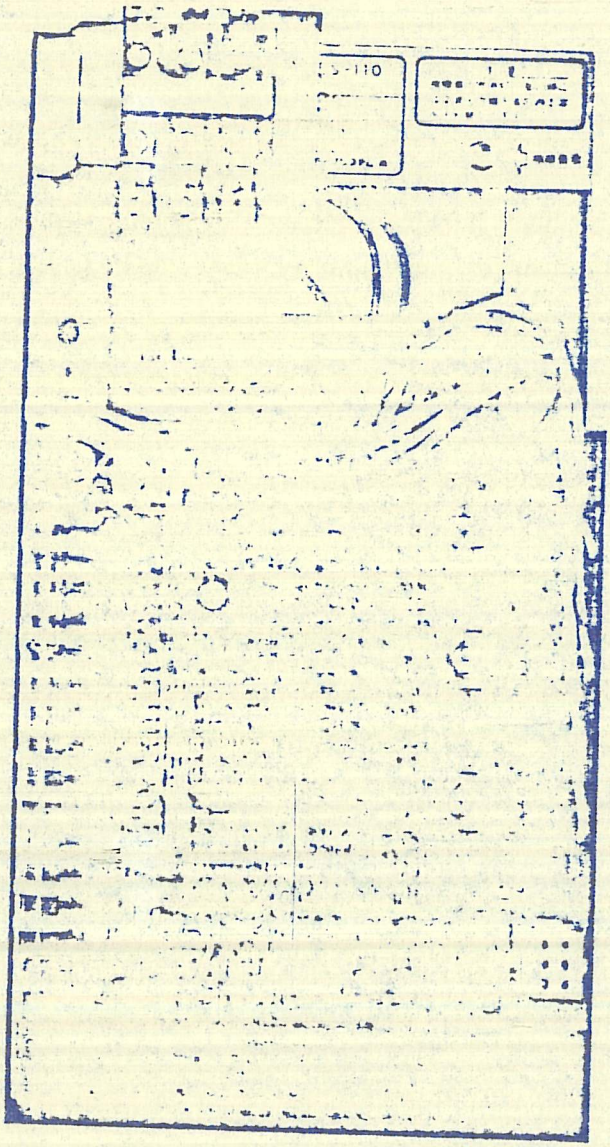
Attached documents:

1. INSTRUCTION DS-11,DS-110 CONVERSION UNIT
2. INSTRUCTION DIRECT CURRENT MOTOR & GENERATORS TYPE 180AT-680A

INSTRUCTIONS

DS-11. DS-110 CONVERSION UNIT

TECHNICAL SHEET
MH-167
8-1979



CONTENTS

This manual covers the installation, setup and operation. Before attempting to install or operate drive systems, read this instruction book carefully.

1. INTRODUCTION

DS-11, DS-110 conversion units convert AC power supply into adjustable DC power supply by using SCRs and SRs, and drive DC motors for various applications.

Since this instruction covers only conversion unit, if contactors and molded circuit breakers are used outside of the unit and starting up for total drive systems, refer to each elementary diagram and instruction book attached.

2. SPECIFICATIONS

Table 1 Standard Specifications

ITEM \ TYPE	DS-11	DS-110
POWER RATING	0.75~3.7KW	5.5~30KW
POWER SUPPLY	AC200/220V +10%, -5% 50/60HZ ±1HZ	AC200/220V +10%, -5% 50/60HZ ±1HZ
DC POWER OUTPUT	DC160V	DC220V
FIELD VOLTAGE	DC 95V	DC140V
SPEED RANGE	Voltage feedback 1:30 with DC TG Tacho meter feedback 1:100 with AC TG at more than looRPM	
SPEED REGULATION	Voltage feedback ±2% of rated base speed 100% load change Tachometer feedback ±0.5% of rated base speed (under base speed) ±0.5% of setting speed (above base speed)	
CURRENT LIMIT	150% at rated armature current (0~150% adjustable by connecting external resistor)	
OVER LOAD	150% 1 minute	
ACCEL. &DECEL TIME	0.5~12 seconds (standard)	
AMBIENT TEMPERATURE	-10~40°C	
HUMIDITY	Less than 90% without dew.	
CONTROL CIRCUIT	AC200/220V 50/60HZ	

3. CONSTRUCTIONS & FUNCTIONS

There are four kinds of conversion units with their ratings.

DS-11 (single phase)	0.75KW (natural convection)
	1.5~3.7KW (natural convection)
DS-110(three phase)	5.5~11KW (natural convection)
	15 ~ 30KW (forced cooled)

Each unit consists of main printed circuit card mounted on SCR stack. Following is its main parts and their functions.

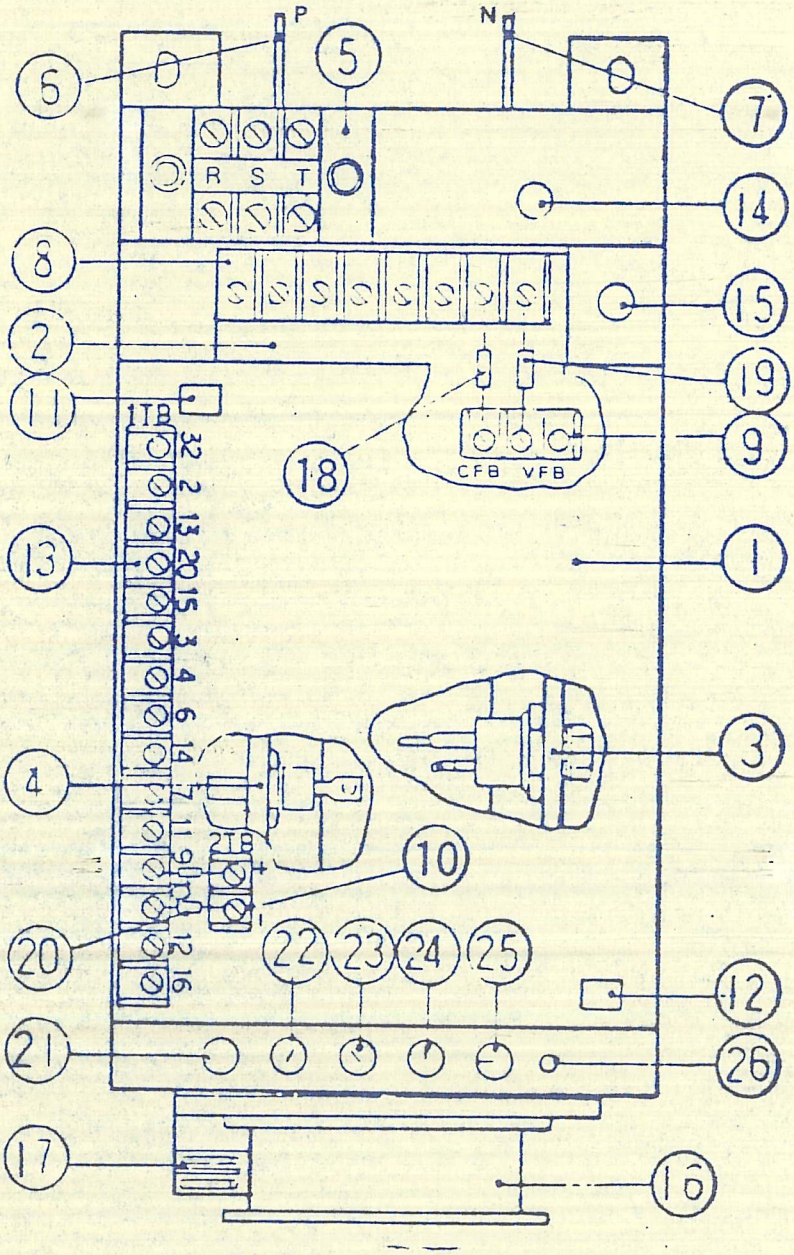


Fig. 1 Conversion Unit

Table 2 Conversion Unit Main Parts

NO	NAME	FUNCTION		REMARKS
1	MAIN CARD	Regulator card	193D121AA	DS-11(0.75~3.7KW)
			193D122AA	DS-110 (5.5~30KW)
2	Suppression Card	CR absorber Control trans	193D125BA	DS-11 (0.75~3.7KW)
			193D126BA	DS-110 (5.5~11KW)
			193D127AA	DS-110 (15~30KW)
3	Heat Sink	SCR cooling		
4	Heat Sink	SR cooling		
5	AC Input Terminal 3TB	R. S.		DS-11 (1.5~3.7KW)
		R. S. T.		DS-110(5.5~30KW)
6	P Terminal	DC output (+) terminal		For 1.5~30KW
7	N Terminal	DC output (−) terminal		For 1.5~30KW
8	4 T B	TB for R, S, T. P, N, P2		Main terminal for 0.75KW
9	5 T B	TB for voltage and current signal		
10	2 T B	Connector for TG output and TG feedback resistors		
11	CA-CONN	Connector for voltage and current feedback signals		
12	CB-CONN	For control signal connecting		
13	1 T B	Terminal for control circuit		
14	Phase lamp (white)	If phase sequence is correct lamp will light.		DS-110 (5.5~11KW)
15				DS-110 (15~30KW)
16	Cooling fan	SCRs and SRs cooling		DS-110 (15~30KW)
17	Fan fuses	Protection for fan short		DS-110 (15~30KW)
18	Fuses	Protection for current feedback short circuit		
19	Fuses	Protection for common short circuit		
20	Resistors	TG feedback signal level adjustment		
21	Potentiometers	M I N		Refer to item 5
22		S - M A X		
23		T I M E		
24		I R - C O M P		
25		J O G		
26	RUN lamp(red)	Lit at operating condition		

4. INTERCONNECTION

Folllowing connections are recommended, if only the conversion unit is supplied.

4-1 AC and DC Power Supply and Field Circuit Connection

① It is recommended to apply AC fuses or molded circuit breaker for protection, as the unit does not have any protection device by itself.

② Field circuit connection is made by connecting one of AC input terminals and DC output terminals, since there is no terminal specially made for field circuit. (Refer to Table 3)

Table 3 AC, DC and Field Circuit Connections

	AC POWER SUPPLY		MAIN DC OUTPUT		FIELD CIRCUIT		
	TB	NAME	TB	NAME	TB	NAME	FLD TB
DS-11 (0.75KW)	4TB	R	4TB	P(+)	4TB	S	F2 (−)
		S		N(−)		P	F1 (+)
DS-11 (1.5~3.7KW)	3TB	R	AT HEATSINK	P(+)	3TB	S	F2 (−)
		S		N(−)	AT HEATSINK	P	F1 (+)
DS-110 (5.5~30KW)	3TB	R	AT HEATSINK	P(+)	3TB	S	F2 (−)
		S		N(−)	AT HEATSINK	P	F1 (+)
		T					

③ Thicker wires than listed in Table 4 are recommended.

Table 4 Motor Ratings and Wire Sizes

KW	AC CURRENT (A)	WIRE SIZE (mm^2)	DC CURRENT (A)	WIRE SIZE (mm^2)	FLD CURRENT (A)	WIRE SIZE (mm^2)
0.75	8.6	3.5	6.5	3.5	0.9	2
1.5	15.5	5.5	11.2	5.5	1.2	2
2.2	23.3	5.5	17.5	5.5	1.3	2
3.7	33.3	8	26.2	8	1.3	2

Figure listed above are based on 1φ220V AC input 1750rpm base speed DPFG motor.

KW	AC CURRENT (A)	WIRE SIZE (mm^2)	DC CURRENT (A)	WIRE SIZE (mm^2)	FLD CURRENT (A)	WIRE SIZE (mm^2)
5.5	27	8	33	8	1.8	2
7.5	35	14	43	14	2.1	2
11	50	22	62	22	2.0	2
15	69	22	80	22	2.6	2
18.5	85	30	98	30	2.7	2
22	100	30	115	30	3.0	2
30	134	50	155	50	3.4	2

Figure listed above are based on 3φ220V AC input 1750rpm base speed DPFG motor.

4-2 DRS Resistors Selection

DRS resistor is used for current feed back signal (+1V per rated Ia). Select DRS resistor from Table 5. DRS resistor is not required when Isolator Unit (option) is used.

Table 5 Standard DRS Resistors

KW	DRS RESISTOR	CAPACITY	CONNECTION	VALUE'
0.75	R1 0.16Ω	30W	P R1 P2	0.16Ω
1.5	R1 0.06Ω R2 0.09Ω	150W	P R2 P2	0.09Ω
2.2			P R1 P2	0.06Ω
3.7			P R1 R2 P2	0.036Ω
5.5	R1 0.031Ω R2 0.014Ω R3 0.024Ω	225W	P R1 P2	0.031Ω
7.5			P R3 P2	0.024Ω
11			P R1 R2 R3 P2	0.017Ω
15	22PS 0.06Ω Coil resistor	600W	P 10PS P2 10PS	0.013Ω
18.5			P 8PS 8PS	0.01Ω
22			P 6PS P2 7PS	0.00867Ω
30	22PS 0.035Ω Coil resistor	600W	P 8PS P2 8PS	0.0065Ω

4-3 DRS(Current detecting resistor) and Current Feedback Wires Connections

Connect DRS resistor as shown in Fig. 2.

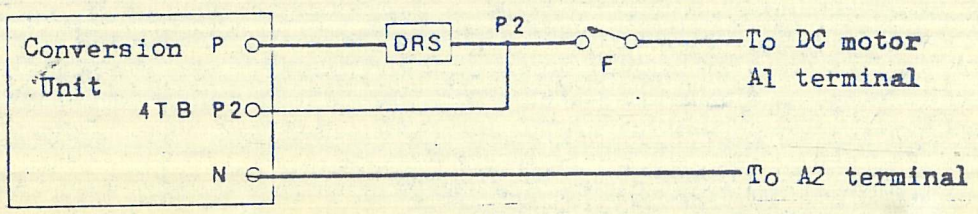


Fig. 2 DRS Resistor Connections

Connect current feedback wire(2mm²) between DRS resistor P2 and 4TB P2.

4-4 Terminal Board and Its Functions

Table 6 shows 1TB terminal board on main card and its functions. Connect control wires to each terminal to meet with function required.

Table 6 1TB Terminal Board and Its Functions

NO	SYMBOL	FUNCTION	REMARKS
32	REF(+)	REF. Power Supply	Refer to Fig. 3
2	REF	Reference input	
13	COM	Common (control circuit)	
14	COM	" " "	
6	JOG	Jog signal input	
20	RUN	Run	
3	AUX. IN	Auxiliary input	Input impedance 1K
4	TG-FBK	TG feedback signal input	Input impedance 20K
7	V-FBK	Voltage feedback input	Input impedance 20K
12	VFB	Voltage feedback signal	-7.5VDC/100% Va
16	CFB	Current feedback signal	+ 1VDC /100% Ia
11	TG-CUT	TG feedback signal	Refer to Table 8
9	TG-IN	TG input	Independently of the polarity
10			
15	CUR LIMIT	Current limit	Refer to Item 4-8

4-5 RUN, JOG Circuit

Use shielded wires or twisted wires for reference potentiometers as shown in fig. 3. Connect between 1TB 20 and 14 with twisted wires as short as possible. As for relays, use signal relays for dry circuit. (minute current circuit).

Connecting 1TB 20 to common makes the drive in operating condition,

Manufactures supplying signal relays are:

MATSUSHITA DENKO	HC4E AC200V (AP3145-44)	
OMRON	MY4-1293H	AC200/220V

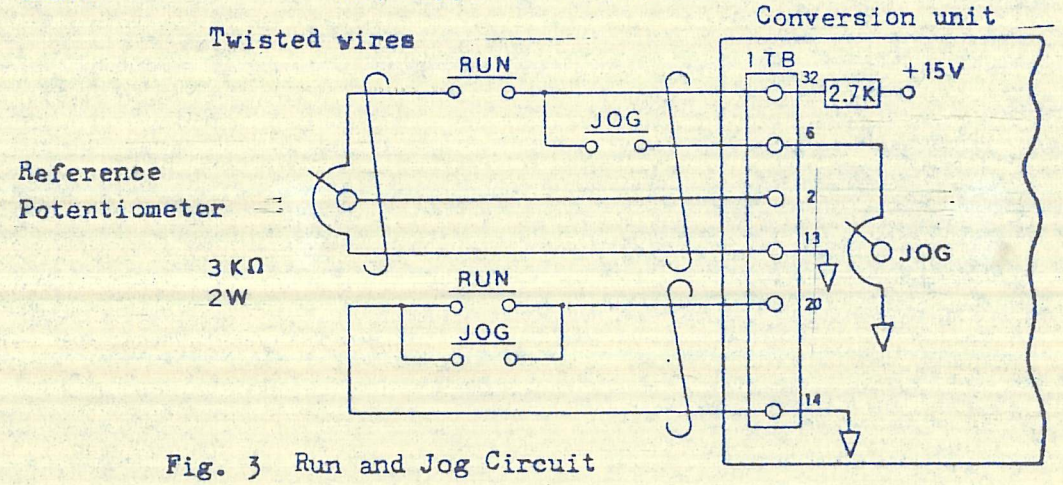


Fig. 3 Run and Jog Circuit

4-6 Voltage Control and Speed Control System

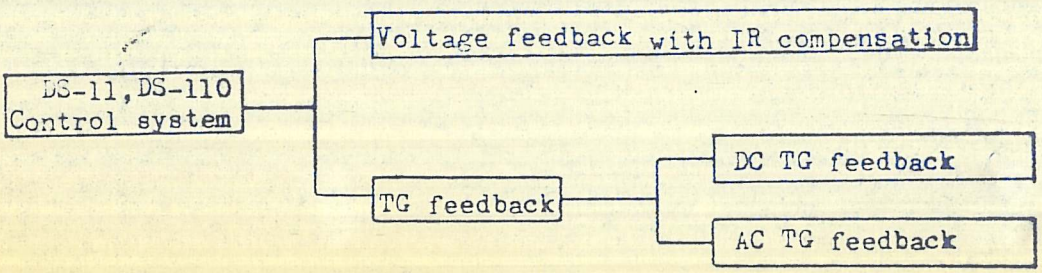


Fig. 4 Control System

Select recuired regulating system by connecting jumper wires or resistors with reffering to Table 7.

Table 7 Selection of Regulating System

SYSTEM / ITEM	VOLTAGE REGULATOR	SPEED REGULATOR	
		DC TG	AC TG
1TB TERMINAL CONNECTION	1TB ⑦ ⑫ Jumper wire	1TB ④ ⑪ Jumper wire	1TB ③ ⑪ 12KΩ 1/2 W
IR-COMP ADJUSTMENT	Refer to item 5-1	MAX CCW	MAX CCW
TG FEEDBACK RESISTORS	NONE	Refer to Table 8	Refer to Table 8

4-7 TG Feedback Resistor Selection

Connect TG output leads to 1TB9 and 1TB10 at main card. TG output signal is independent from the polarity of the TG output connection.
Select proper resistors from Table 8 which depends on applied motor's top speed and a type of tacho generator. Then connect these resistors across 1TB9 and 2TB(+) and 1TB10 and 2TB(-) as it is shown in Fig. 5.

An example caluculation for determing the resistors.

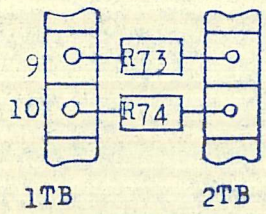


Fig. 5. TG feedback resistors selection

Motor top speed 1,750rpm , DC TG 65V/1000rpm
What is the value of resistors for R73 and R74?
Reffering to Fig. 11 and Fig. 12 TG IN and TG/SIG circuit in page 14 and 15;

$$\frac{39}{X+100} \times 65 \times \frac{1,750}{1,000} = 7.5\ (V)$$

Voltage gain — TG output at 1750rpm — Summing voltage

X=492K Standard resistor close to 492K is 475K . When 475K is used, summing voltage becomes 7.72V.

Table 8 TG feedback resistors

Max. speed (RPM)	DC-TG 30V / 1,000RPM		DC-TG 65V / 1,000RPM		AC-TG 45V / 1,000RPM	
	RESISTROR (KΩ)	*OUTPUT (V)	RESISTOR (KΩ)	*OUTPUT (V)	RESISTOR (KΩ)	*OUTPUT (V)
850	33.2	−7.5	182	−7.6	182	−5.1
1,150	82.5	−7.4	274	−7.8	332	−4.5
1,750	182	−7.3	475	−7.7	365	−5.2
2,500	275	−7.9	681	−8.2	681	−4.9
3,500	475	−7.2	1 MΩ	−8.1	1 MΩ	−4.8

* Output means the voltage at 1TB 11 or test point 9.

4-8 Current Limit

The value of current limit is fixed to 150% for standard conversion unit. but if external resistor or voltage applied across 1TB14 and 1TB15, the limit value is adjustable from 0~150%.

① By adding resistor

Connect resistor between 1TB14 and 1TB15. The relation between resistor and current limit is shown in Table 9.

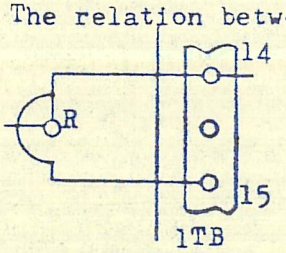


Fig. 6 Current Limit

② By applying current signal

Cut j4 jumper on main card, then apply DC voltage to 1TB15 (+) and 1TB14 (-). Limit value is proportional to input voltage.

Current reference voltage: 4.1V/100% Ia
Input impedance : 4.7K (1TB14 and 15 J4 cut)

Table 9 Current Limit by External Resistor

RESISTOR	% Ia
R(KΩ)1/2W	(% Ia)
∞	150
22	140
8.2	120
4.7	100
2.7	80
1.5	55
0.82	40
0.39	20
SHORT	0

4-9 Sequence Circuit

As for external sequence circuit, refer to Drive System Company or local sales agents.

5 ADJUSTMENTS

The conversion unit is already adjusted in the factory, however slight adjustment may be required for certain application.

5-1 Adjustment Potentiometers

Adjust system's operation by adjusting potentiometers on main card. Function of each potentiometer increases when it is turned to clockwise.

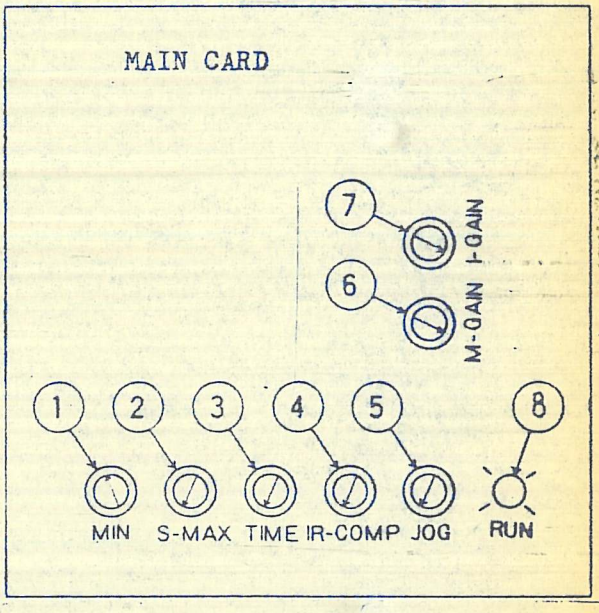


Fig. 7 Adjustment potentiometers

Table 10 Main Card Potentiometers

① MIN Minimum Speed
Adjust the minimum speed so that the motor just turns over. The speed is adjustable from 0~4% of the rated speed. Turning the pot clockwise increases the speed.
② S-MAX Maximum Speed
The maximum voltage or speed is set by this potentiometer. if rated voltage or required speed is not correct, adjust this pot. Turning the pot clockwise increases armature voltage and speed. This adjustment should be made after setting "MIN" minimum speed pot.
③ TIME Timed Acceleration and Deceleration
The time required to accelerate from standstill to top speed and to decelerate from top speed to stand still is adjustable approximately 0.5~12 sec . Turning the pot clockwise increases the time. If longer time than the standard , refer to Drive System Company.
④ IR-COMP IR Compensation
If the voltage feedback is used and optimum speed is required adjust this pot. In detail refer to Item 5-3. If the tachometer feedback is used, set the pot extreme counter-clockwise position.
⑤ JOG Jogging (Inching)
Adjust required jog speed by this pot. Turning the pot clockwise increases the speed. Adjustable speed range is 0~30% of rated base speed.
⑥ M-GAIN Main Amplifier Gain
This pot determines the gain of main amplifier. In detail refer to Item 5-3. Turning the pot clockwise increases the gain of main amplifier.
⑦ I-GAIN Minor Amplifier Gain
This pot determines the gain of current minor amplifier. In detail refer to Item 5-3. Turning the pot clockwise increases the gain of minor amplifier.
⑧ RUN Lamp
The lamp is "on" unless there is loss of 15V DC power supply, or external sequence circuit is not connected properly.

5-2 IR Compensation

This compensation is used for voltage feedback regulator, if TG feedback is used turn the potentiometer fully counter clockwise.

① Simplified Adjustment

Set the pot to the position between 1 to 3, for the following conditions.

a) Motor load changes at every moment and difficult to set.

b) It is difficult or impossible to change the driven machine load during setup procedure.
c) Where speed regulation (due to load change) of 5~10% is acceptable.

(2) Optimized Adjustment
a) Start the drive.
b) Set the motor speed to 50% of rated speed.
c) Adjust the drive for minimum load condition.
d) Read the motor speed by using the hand tachometer or other instruments.
e) Adjust the driven machine for maximum load (not exceeding 100% rated torque.)
f) If the "maximum-load" speed is less than the "minimum-load" speed, turn IR-COMP potentiometer clockwise until they are equal.
g) Repeat steps c~f.

5-3 M-GAIN, I-GAIN Adjustment

Refer to table 10 in page 9. M-GAIN adjustments should be considered from total drive systems and the optimum adjustment is needed practice and experiences. But simplified adjustment and system's characteristics are shown in below.

As it is shown in Fig. (A) when the speed reference is changed quickly to the rated speed or down to the certain speed, expected speed response is Fig. (B) or Fig. (C).

In case of Fig. (D) it indicates that the system is under dumped turn the "M-GAIN" pot counter-clockwise so that the drive response becomes Fig. (B) or Fig. (C).

In case of Fig. (E) the system is over dumped, turn the "M-GAIN" pot clockwise so that the response becomes Fig. (B) or Fig. (C). If the motor is over loaded, and current limit limits the armature current the response becomes Fig. (E).

In case of (F) turn "M-GAIN" and "I-GAIN" pots extreme counter clockwise and if it is still in the same condidtion, check motor and tachometer coupling.

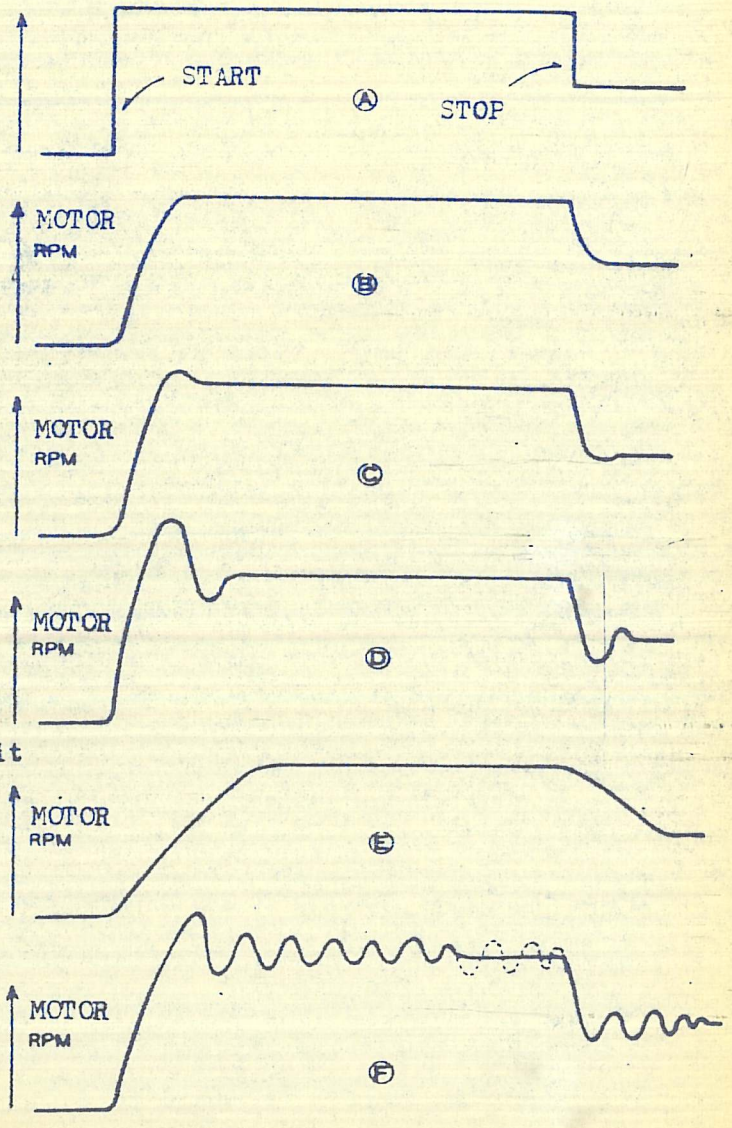


Fig. 8 M-GAIN, I-GAIN adjustment

5-4 Current Limit Setting

The current limit is adjusted to 150 % at factory. If the chahnge of current limit setting is required refer to item 4-8. Please note that exceed limit setting may damage motors or conversion modules, since they are guranteed under 150 % load 1 minute.

5-5 Test Points

There are thirteen test points (TP11 and TP12 are not used in DS-11) on main card to checking control circuit operation. Use high impedance tester, such as 10KΩ/V at DC range or osciloscope so that they may not affect operating condition. For this purpose, instrument panel is available as an option and it makes the points checking much easier.

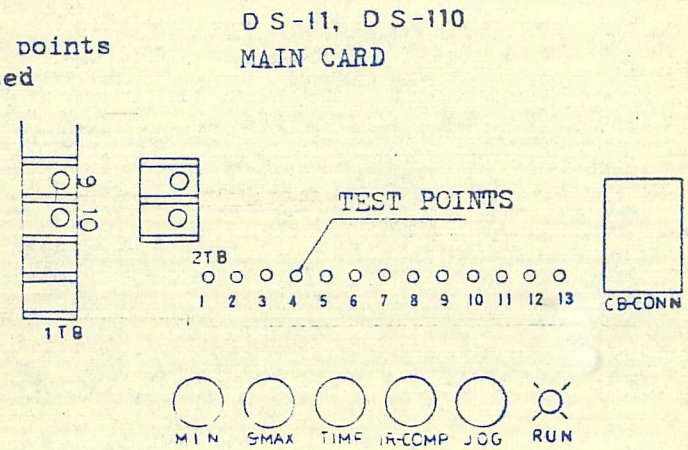


Fig. 9 Test Points

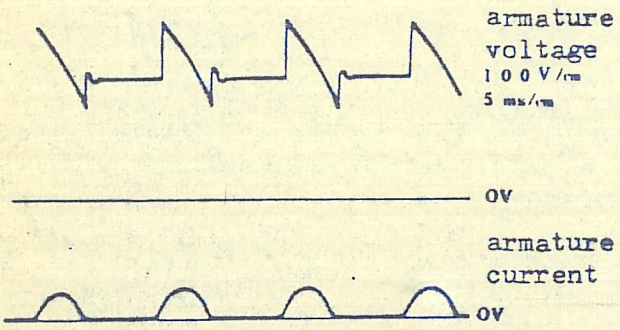
Table 11 Testpoint Voltages

ITEM	TEST POINTS □ TP	VOLTAGES (DC)
Power supply (+)	1	+15V
Power supply (-)	2	-15V
Reference signal	3	0 ~ +7.5V
Linear time output	4	0 ~ +7.5V
Main amp output	5	0 ~ -6.5V
Driver input	6	0 ~ +6.5V
Voltage feedback signal	7	0 ~ -7.5V
Current feedback signal	8	0 ~ +1V
TG amp output	9	0 ~ -7.5V
Driver output #1	10	Pulse output
Driver output #2	11	" (DS-110 only)
Driver output #3	12	" (")
Common	13	0V

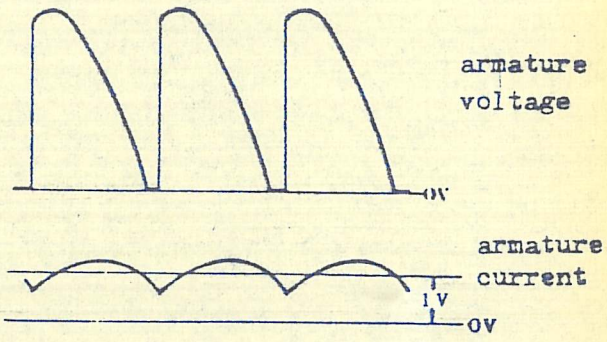
5-6 Armature Voltage and Current Wave Form

Typical DS-110 3 phase armature voltage and curent wave forms are shown in Fig. 10.

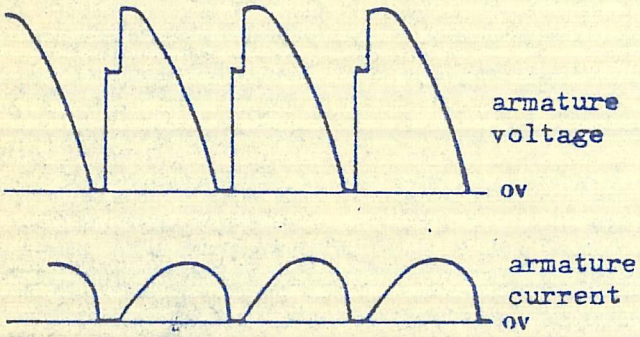
1. Higher speed with light load



3. Same speed as item 2 with 100 % load



2. Lower speed than item 1 with load



4. High speed with 100 % load

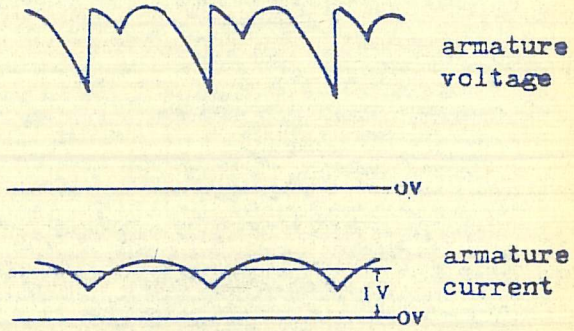


Fig. 10 Armature voltage and current wave forms

TROUBLE SHOOTING

If there is any fault occured in DS-11 and DS-110, check the operation of control system and locate mal functions by reffering to following chart.

This truouble shooting is made for standard DS-11 and DS-110 sequences, so if different sequences are applied, their symptoms may differ from the ones shown below.

PHENOMENON	POSSIBLE CAUSE	CHECK POINT AND COUNTER MEASURE
6-1 Applying Power Supply (Motor Armature Circuit Open)		
Phase sequence lamp does not light (DS-110 only)	AC fuses blow out	Main circuit short
		Check SCRs and SRs
		Armature circuit misconnection
		Check AC fuses
		External wire is grounded
	MCB trip	
	Wrong phase sequence	Exchange two of three wires.
6-2 Pushing START button, (Energizing RUN Relay, Armature Circuit Closed)		
RUN lamp does not light	+Power supply is low or none	Power supply fault

- RUN lamp fault → Check main card
- RUN sequence conditions are not satisfied → Check sequence circuit

6-3 Motor Runs

1 Motor does not respond to reference potentiomter
- Run conditions is not ready → Check sequence
- Defective reference signal circuit → Check ref. signal circuit
- No or low field voltage → Refer to Note B
- Control circuit defective → Check reference circuit and RUN sequence

2 Max speed is high
- S-MAX pot. is high → Readjust S-MAX pot
- Feedback (TG or Voltage) is low → Ref. Note A
- Field voltage is low → Ref. Note B

3 Max speed is low
- Ref. signal is low
- Over load → Check armature current limit circuit; Wrong DRS selection
- Field voltage is high
- S-MAX pot. is low → Readjust S-MAX pot
- Feedback (TG or Voltage) is high → Ref. Note A

4 Min speed is high
- MIN pot setting is high → Readjust MIN pot
- Noise introduction → Reduce noise
- Defective main card → Replace
- SCR failure → Replace

5 Motor speed jumps by slight increase of speed reference
- Low or no feedback signal → Ref. Note A
- Reference circuit fault → Check reference circuit

6 Motor speed is unstable
- Improper adjustment → Readjust, refer to item 5; Readjust M-GAIN, I-GAIN pot
- Noise introduction at feedback signal → Use twisted wires
- Poor motor and load coupling → Check coupling
- Inproper TG mounting → Check TG mounting
- Main card fault → Check test points, replace

7 Acceleration time is long
- Improper setting of TIME pot → Readjust
- Overload → Check current limit (Ref. item 4-8); Check current feedback (TP8) voltage

8 Motor stops after short running → Thermostat open → Reduce load, lower ambient temperature (less than 40°C)

Note A; For speed regulator, check TG feedback voltage TP9 (ref. item 4-7), for voltage regulator, check TP7 voltage (ref. item 5-5).

Note B; Check motor field voltage.

6-4 Motor overheats
- Overload → Measure armature current
- Blower motor fault → Check motor blower and its connection

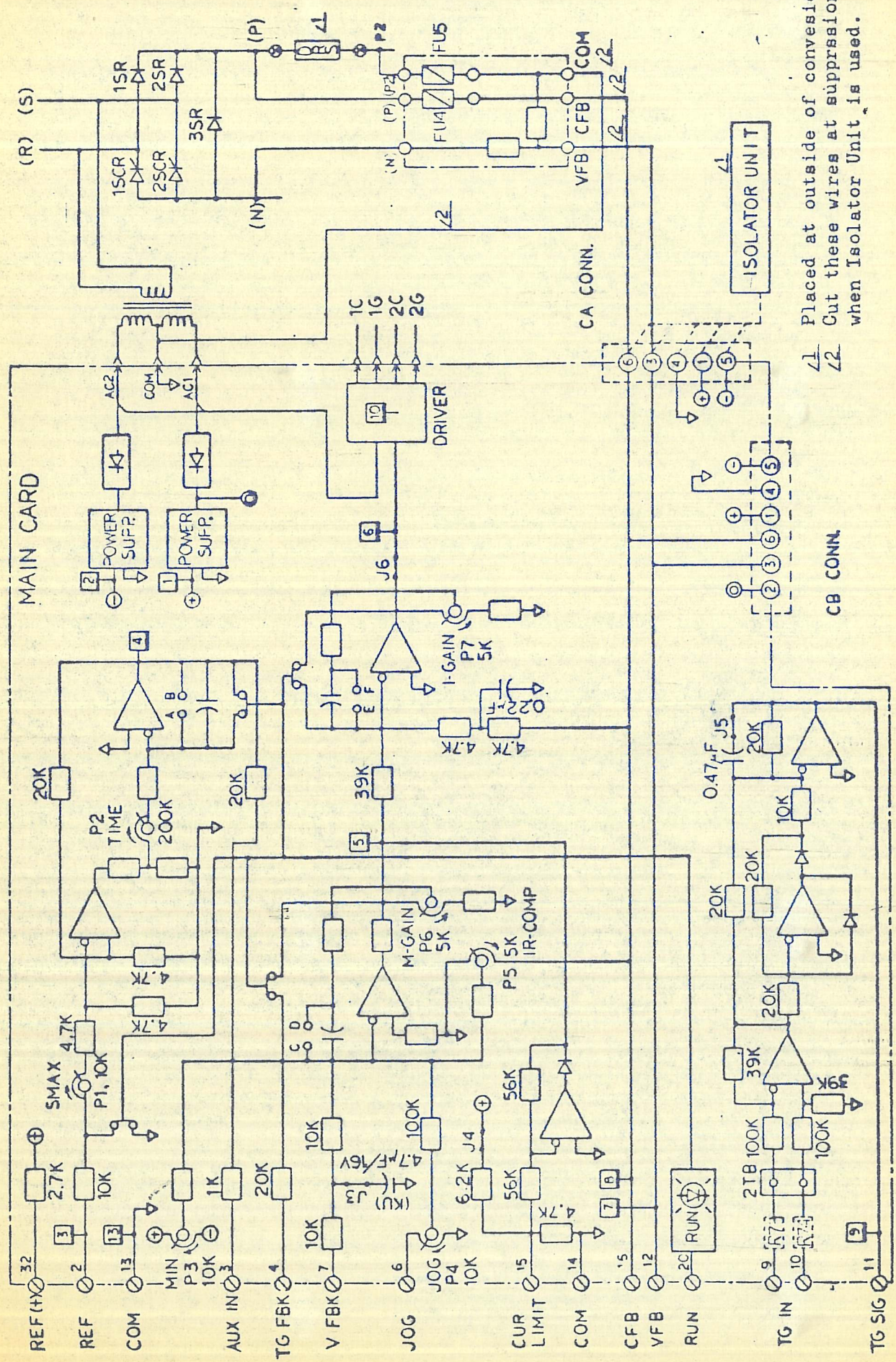


Fig. 11 DS-11 Conversion Unit Elementary Diagram

⚠1 Placed at outside of conversion unit.
⚠2 Cut these wires at suppression card when Isolator Unit is used.

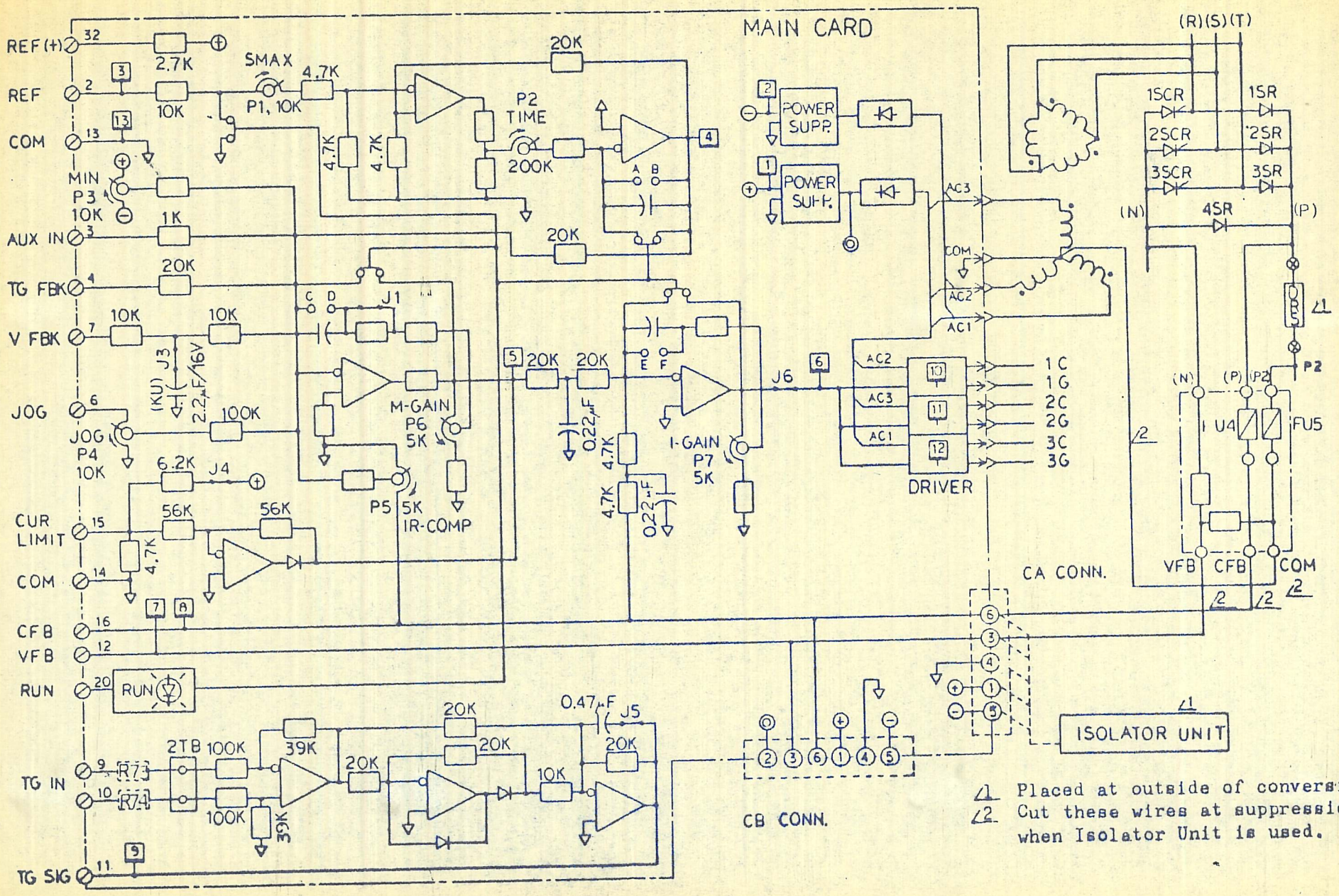
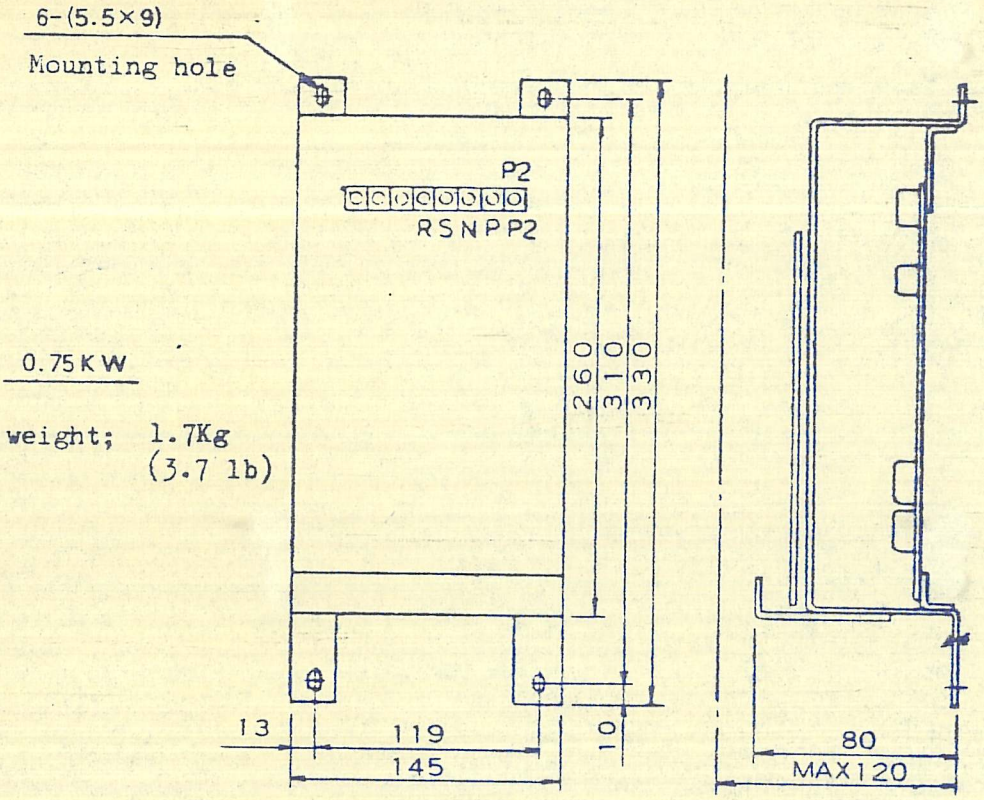


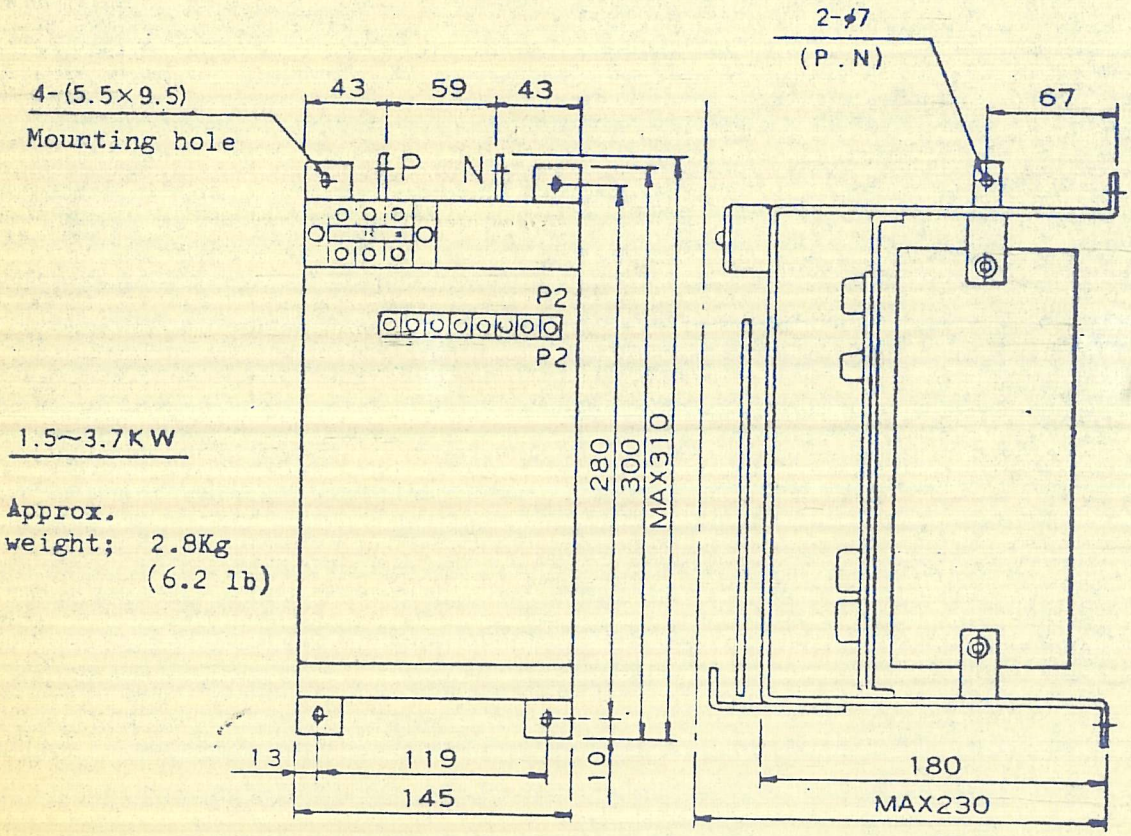
Fig. 12 DS-110 Conversion Unit Elementary Diagram

⚠1 Placed at outside of conversion unit.
⚠2 Cut these wires at suppression card when Isolator Unit is used.



0.75KW

Approx. weight; 1.7Kg
(3.7 lb)



1.5~3.7KW

Approx.
weight; 2.8Kg
(6.2 lb)

Fig. 13 DS-11 Conversion Unit Dimensions

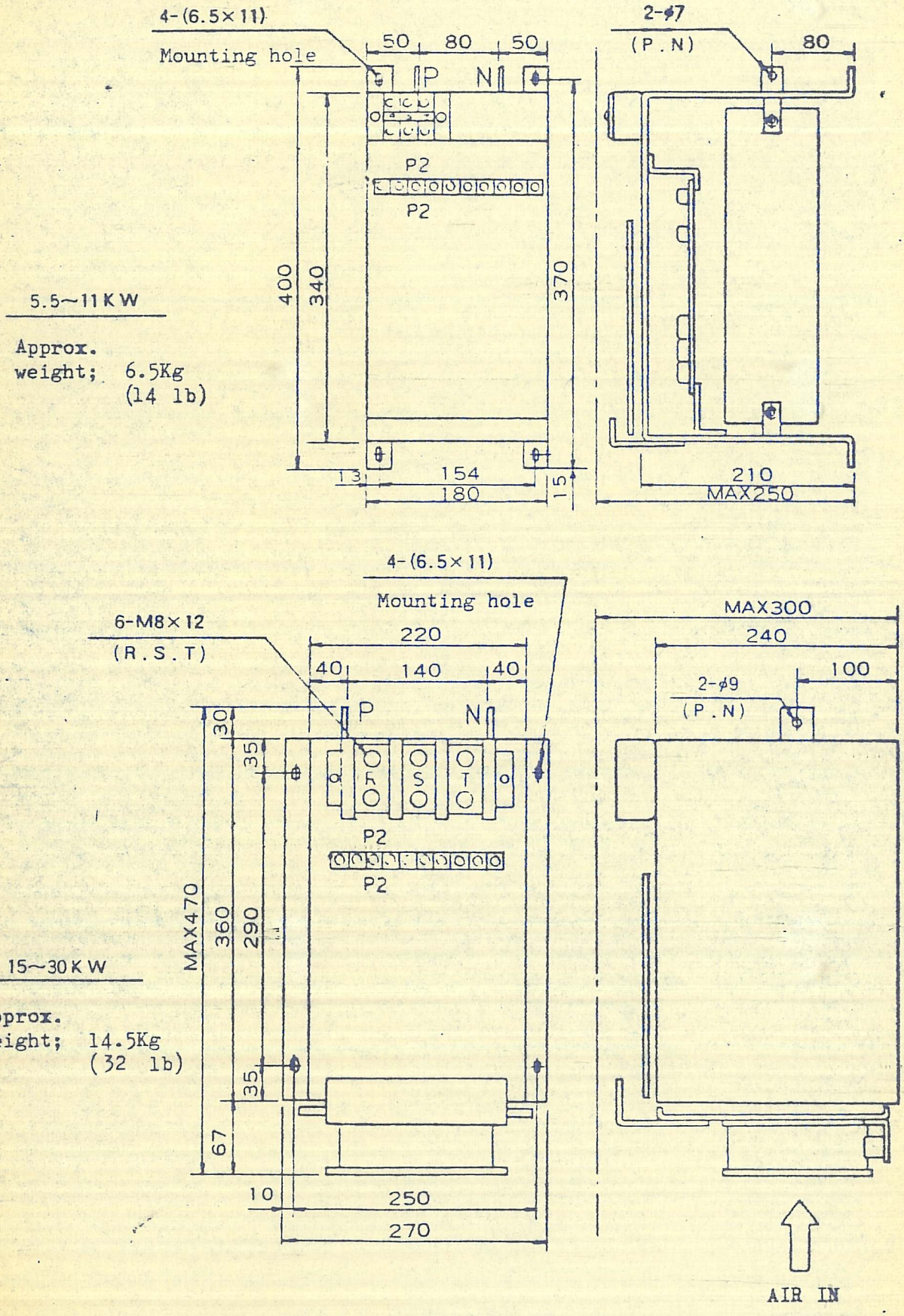


Fig. 14 DS-110 Conversion Unit Dimensions

2

DIRECT CURRENT MOTORS AND GENERATORS
TYPE 180AT～680A

INSTRUCTIONS

SUMITOMO
SHIPBUILDING & MACHINERY CO., LTD.

TABLE OF CONTENTS

1 . POWER SUPPLIES

Motors in these frame sizes are suitable for operation from m-g set power supplies and from full-wave rectified power supplies where the a-c voltage applied to the conversion unit does not exceed 150% of the d-c motor nameplate voltage. Unless specified on the nameplate, motors are not suitable for operation from one-half wave, single-phase, rectified power supplies, or from full-wave rectified power supplies where the a-c voltage exceeds the above. Refer to the Company for unusual rectifier applications.

2 . RECEIVING

Each shipment should be carefully examined upon arrival. Any damage should be reported promptly to the carrier and to the nearest office of sumitomo S.& M. Co.

3 . STORAGE

If a machine, or any part of a machine, is not to be installed immediately, it should be stored in a clean, dry place and protected from variations in temperature. high humidity, and dust. If possible, sudden changes in temperature and humidity should be avoided. If the temperature of the storage room varies to such an extent that the windings and coils are exposed to sweating or freezing conditions, the machine should be protected by a safe, reliable heating system which will keep the temperature of the machine slightly above that of the storage room. Brushes should not be allowed to remain in contact with the commutator during prolonged storage, otherwise corrosion may occur and later result in flat spots on the commutator, with corresponding poor and destructive commutation.

If the machine has been exposed to low temperature for an extended period of time, it should not be unpacked until it has reached room temperature, otherwise it will sweat. This condensation of moisture on the windings can cause short insulation life and premature armature failure.

4 . HANDLING

Complete motors or generators can be lifted by using hooks or slings in the lifting lugs on the frame. These lugs are designed to carry safely the weight of the individual machine and can be removed or turned down if not needed.

5 . LOCATION

Locate motors so that cool, clean air is available and intake and outlet air openings are not blocked.

6 . MOUNTING

Standard machines will operate successfully when mounted at any angle horizontal to vertical, shaft up or down, on floor, wall or ceiling.

7 . DRIVES

Standard machines will be suitable for coupled drive, V-belt drive, chain drive and pinion drive.

8. THRUST LOADS

Due to the mounting position or type of drive arrangement, a thrust load may be applied to the motor shaft. The dc motor is designed to permit a limited amount of thrust load. This permissible load will vary by mounting position and direction of the load due to the weight of the armature. The permissible load is tabulated below by frame diameter and mounting position.

For vertical mounting the data is tabulated with a plus or minus constant. If the force of the load is acting up (against gravity), then the constant should be plus. If the load is acting down (with gravity), then the constant should be minus.

THRUST CAPACITY IN kg

	HORIZONTAL MOUNTING				VERTICAL MOUNTING			
FRAME RPM	2500	1750	1150	850	2500	1750	1150	850
CD 180 AT	40	45	50	55	40 ± 5	45 ± 5	50 ± 5	55 ± 5
CD 210 AT	85	100	120	140	90 ± 30	110 ± 30	130 ± 30	150 ± 30
CD 250 AT	100	120	145	170	115 ± 40	130 ± 40	155 ± 40	175 ± 40
CD 280 AT	135	150	195	220	150 ± 60	170 ± 60	210 ± 60	240 ± 60
CD 320 AT	160	185	230	260	175 ± 85	210 ± 85	245 ± 85	280 ± 85
CD 360 AT	260	310	380	440	320 ± 150	370 ± 150	440 ± 150	500 ± 150
CD 400 AT	290	340	400	470	320 ± 240	370 ± 240	440 ± 240	500 ± 240
CD 500 AT	400	480	600	690	390 ± 300	430 ± 300	510 ± 300	560 ± 300
CD 680 A	480	580	700	810	440 ± 520	500 ± 520	580 ± 520	640 ± 520

9. BEARINGS AND LUBRICATION

1) Standard ball bearings for Sumitomo dc machines.

Frame	Drive End	Commutator End
CD 180 AT	6206LLB	6205LLB
CD 210 AT	6207LLB	6206LLB
CD 250 AT	6209LLB	6207LLB
CD 280 AT	6210LLB	6209LLB
CD 320 AT	6212LLB	6210LLB
CD 360 AT	6213	6212
CD 400 AT	6214	6213
CD 500 AT	6218	6216
CD 680 A	6220	6218

2) Ball-bearing housings are packed with grease at the factory. Greasing is not required before the motor is put into service. Since the oil in the grease will ultimately become depleted, it is necessary to relubricate ball-bearing motors periodically depending on size and type of service. (See Table below)
For best lubrication results, regrease with a lithium base ball-bearing grease.
Avoid mixing different kinds of grease.

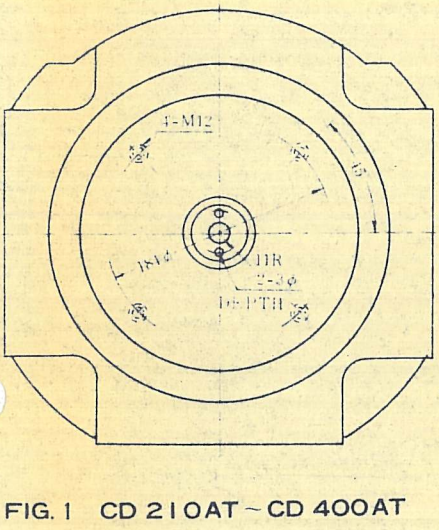
TYPICAL EXAMPLE	TYPE OF SERVICE	0.4-5.5kw	7.5-30kw	over 37kw
Motor operating infrequently (1 hr. / day)	EASY	10 yr.	7 yr.	5 yr.
Machine tools, fans, pumps, textile machinery	STANDARD	7 yr.	5 yr.	3 yr.
Motors for continuous operations in key locations subject to severe vibration, steel mill service, coal and mining machinery	SEVERE	4 yr.	2 yr.	1 yr.
Dirty and vibrating applications where end of shaft is hot, high ambient	VERY SEVERE	9 mo.	4 mo.	4 mo.

10. DIRECTION OF ROTATION

The standard shunt wound motor is capable of rotation in either direction by reversing either the armature or shunt field polarity without changing brushes. For compound wound motors, refer to the connection diagram.

11. ACCESSORY MOUNTING

Provisions for mounting accessories on the commutator end shield is a standard feature on frames 210AT to 500AT.



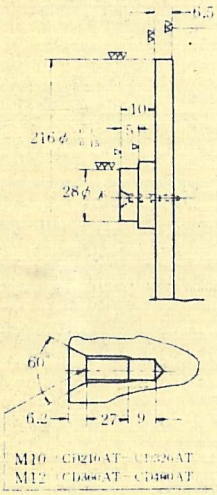
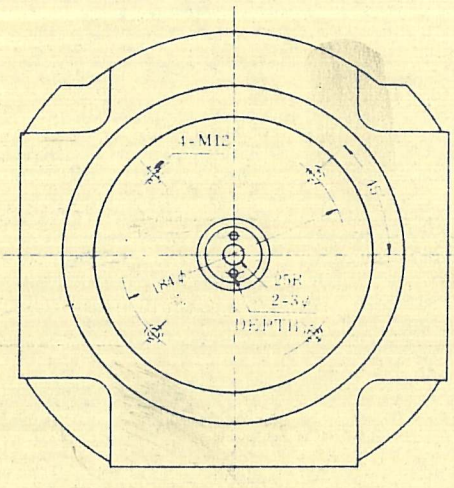


FIG. 1 CD 210AT ~ CD 400AT



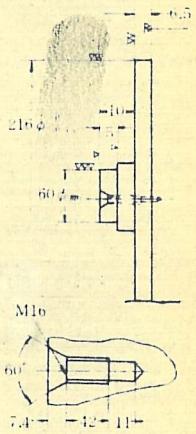


FIG. 2 CD 500AT

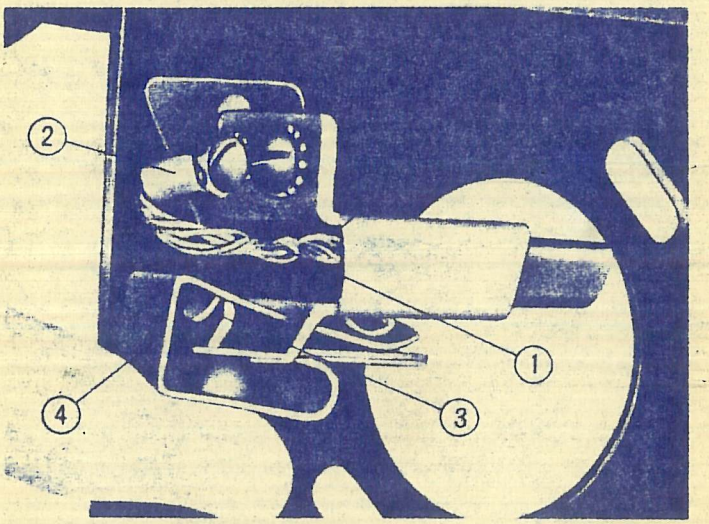
12. MAINTENANCE

Inspect motors at regular intervals, depending on service conditions. Periodically, check all brushes for ample remaining wear length. Be certain that ventilating openings are not obstructed. Correct the cause of abnormal vibration. Keep motor clean. Replace covers.

12-1 180AT BRUSH

1) BRUSHES

Brushes should be inspected for wear at regular intervals. Brush pigtails are provided with wear indicator markers (1). When marker reaches the top of the brush-holder box, the brush should be discarded. Continued use of worn-out brushes will result in damage to the commutator.



2) BRUSH REMOVAL

With machine stopped and power off.

1. Unfasten pigtail (2).
2. Push spring in and toward opposite side of brush-holder to disengage lock tab (3).
3. Lift spring out. Spring can either be completely removed from brushholder or left attached with outside bottom loop engaged in lock tab slot. Remove brush.

3) BRUSH INSTALLATION

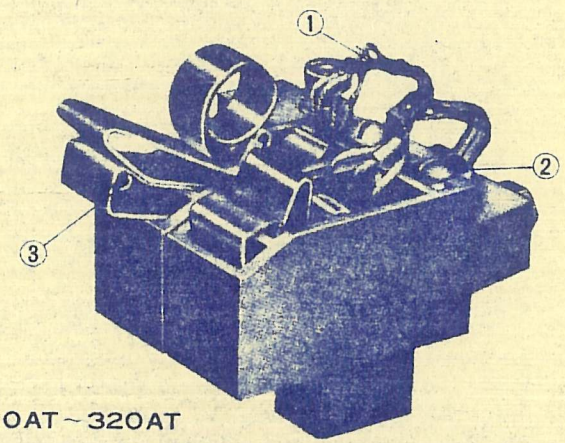
1. Place brush in holder with bevel towards spring. Brushes should move freely in holder.
2. Push spring into position until lock tab engages slot and locks.
3. Connect pigtail.

Fit brush to commutator contour using strip of coarse sandpaper. **Do not use emery cloth.** Keep the sand side turned to the brush face. After fitting brushes, clean the dust from the commutator, brushholder and adjacent parts with a vacuum cleaner or other suitable means.

12-2 210AT~680A BRUSH

1) BRUSHES

Brushes should be inspected for wear at regular intervals. Brush pigtalis are provided with wear indicator markers (1). When marker reaches the top of the brush-holder box, the brush should be discarded. Continued use of worn-out brushes will result in damage to the commutator.

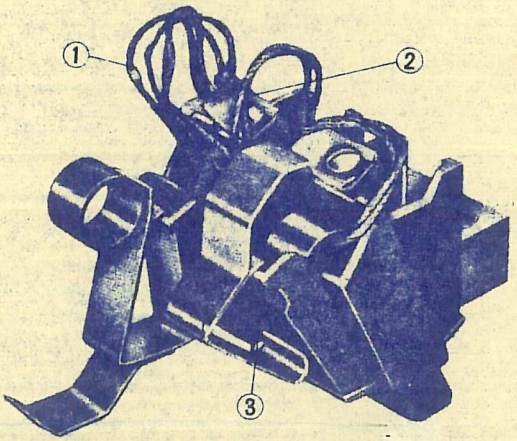


210AT~320AT

2) BRUSH REMOVAL

With machine stopped and power off.

1. Unfasten pigtail (2).
2. Push spring in and toward opposite side of brush-holder to disengage lock tab (3).
3. Lift spring out. Spring can either be completely removed from brushholder or left attached with outside bottom loop engaged in lock tab slot. Remove brush.



360AT~680A

3) BRUSH INSTALLATION

1. Place brush in holder with bevel towards spring. Brushes should move freely in holder.
2. Push spring into position until lock tab engages slot and locks.
3. Connect pigtail.

Fit brush to commutator contour using strip of coarse sandpaper. **Do not use emery cloth.** Keep the sand side turned to the brush face. After fitting brushes, clean the dust from the commutator, brushholder and adjacent parts with a vacuum cleaner or other suitable means.

12-3 COMMUTATOR

Keep the commutator clean. Ordinarily, the commutator will require only occasional wiping with a piece of canvas or other nonlinting cloth. Do not use lubricant or solvent on the commutator.

12-4 RENEWAL PARTS

Use only genuine Sumitomo renewal parts. When ordering, specify model number and serial number of motor. (Complete nameplate data is desirable.) Specify quantity and describe part.

1. Main coil and pole assembly
2. Conduit box
3. Comm. coil and pole assembly
4. Armature
5. Bearing bracket
6. Ball bearing
7. Armature fan
8. Brush holder
9. Carbon brush
10. Brush holder spring
11. Bearing bracket covers (Specify side, bottom or top)