TOSHIBA

E6580070

INSTRUCTIONS FOR

QUICK RESPONSE TRANSISTOR INVERTER DRIVE

SV PACK

TOSHIBA CORPORATION

MMVJ-8001

1. Introduction

Thank you for choosing a Toshiba SV PACK.

The SV PACK is a sine wave PWM control voltage type inverter unit using the giant transistor (G-TR), that has been developed by the Toshiba's latest semiconductor technology, and employing slip frequency control (SF control) by a microcomputer.

By combining the SV PACK with a custom-designed SV motor, a high precision and quick response variable speed drive system can be accomplished.

Before use of the SV PACK, read this manual carefully to let the SV PACK demonstrate its excellent functions correctly.

This manual should be retained by the operator at hand for maintenance and inspection.

2. Initial inspection

Upon unpacking, do not apply any impact or vibration.

After unpacking, check :

(1) if any part has been damaged during transportation.

(2) if the rated capacity indicated on the name plate is as specified.

If there is any problem, contact the dealer.

3. Standard specifications

Table 1 shows standard specifications of the SV PACK control unit. Table 2 indicates standard specifications of the SV motor. When there is any matter specified by the user, the detailed specification separately determined has priority over these specifications.

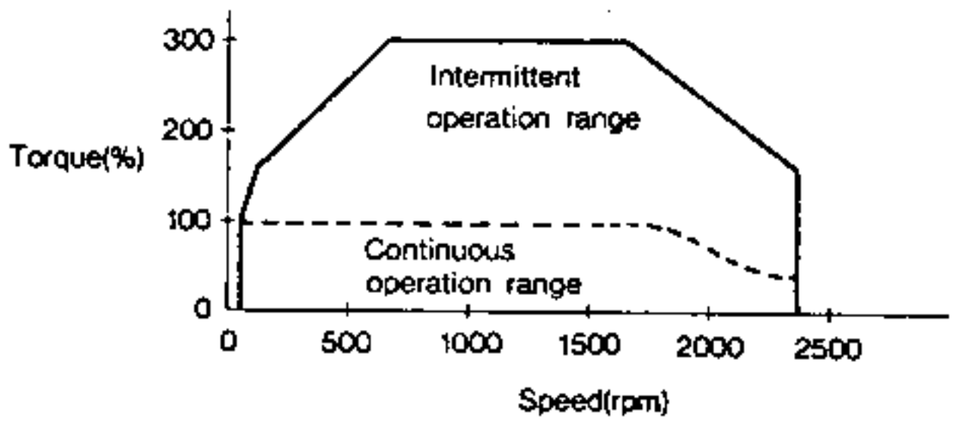
Table 1 SV PACK control unit standard specifications

Name			SV PACK								
SV motor (kW)			0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Model and rating	Type-form		SVS-2005B1	SVS-2008B1	SVS-2010B1	SVS-2020B1	SVS-2030B1	SVS-2040B1	SVS-2065B1	SVS-2090B1	SVS-2120B1
	Capacity (kVA)		0.5	0.8	1.0	2.0	3.0	4.0	6.5	9.0	12.0
	Rated current (A)		1.5	2.5	2.9	4.8	8.1	12.5	19.0	26.0	34.6
Power supply	Voltage Frequency	Main circuit	Three phase 200V-50Hz, 200/220V-60Hz								
		Control circuit	Single phase 200V-50Hz, 200/220V-60Hz								
	Allowable variation		Voltage: Within +/−10%, Frequency: Within +/−2Hz								
Control specifications	Control system		Sine wave PWM control (SF control)								
	Output voltage		Three phase 200/220V								
	Speed setting voltage		0 to + 12VDC or 0 to +/−12VDC								
	Speed control range		1 : 200 (Maximum speed 2,300rpm)								
	Overload capacity		150% −60sec.								
	Speed variation rate	Load variation (0~100%)	Within +/−0.2%								
		Voltage variation (200V±10%)	Within +/−0.2%								
		Temperature variation (25±25°C)	±0.25%								
	Speed feedback		A rotary photo encoder (500ppr phase A, B, 1ppr zero-marker, +12V) is used.								
	Applicable load GD^2		Twice or less of motor GD^2								
Operation performance	Acceleration/ deceleration time		Time limit switching through the jumper pin (acceleration and deceleration independently adjustable) J4 OFF : 0.1sec to 1.0sec J4 ON : 1.0sec to 20sec								
	Start		Operation retaining contact 1a								
	Brake		Brake by capacitor charge and power discharge								
	Forward/reverse rotation		Forward rotation for (+) speed setting signal, reverse rotation for (−) speed setting signal (J1 OFF) / Forward rotation for open contact 1a reverse rotation for closed contact 1a (J1 ON)								
Protection	Protective function		Stall prevention, overcurrent protection, shortcircuit protection, overvoltage protection, undervoltage protection, momentary power failure protection, overload protection, burn-out prevention (fuse protection).								
	Protective operation detecting signal (FL relay)		Relay contact 1c output (220VAC 2.5A) Output for overcurrent protection, short-circuit protection, overvoltage protection, voltage protection, and overload protectiction.								
	Capacitor charge indication		When the capacitor is charged, the 1amp on the circuit board lights.								
	Protective operation indication		When overcurrent protection, short-circuit protection, overvoltage protection, undervoltage protection, or overload protection works, "Oc", "Ov", "Uv" or "OL" is indicated on the frequency meter.								
	Reset		Through contact 1a, the protection detecting circuit and FL relay can be reset.								
	Output frequency indication		Indicated by a two-digit on the frequency meter.								
External input	Stop control signal		Through contact 1a, stop control can be performed. (0 to 100% torque)								

Table 1 SV PACK control unit standard specifications (continued)

Name		SV PACK								
SV motor (kW)		0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
External output	Position signal	90-degrees phase difference phase A and B 500ppr, zero marker 1ppr, open collector output								
	Low-speed signal	Open collector output, OFF:Below the setting value, ON:Above the setting value (10 to 300rpm)								
	Speed reaching signal	Open collector output, OFF:Below the setting value, ON:Above the setting value.								
	Speed indication signal	Analog output	0~+10V							
		Digitsl output	1000ppr, +15V							
Ambient condition	Location	Indoors (Places where is much dust or iron powder must be avoided.)								
	Ambient temperature	−10℃ to 40℃ (around the box), up to 50℃ acceptable when the cover is removed.								
	Ambient humidity	90% (relative) or less (no dew condension permissible)								
	Vibration	0.5G or less								
Construction		Box type (non-dustproof construction) -								
Panel mounting instrument		Frequency meter (digital), charge lamp.								
Accessories separately installed	Regenerative power discharge unit	PB2015		PB2035		PB2055		PB2120		
	Operating panel (option)	See optional specifications.								

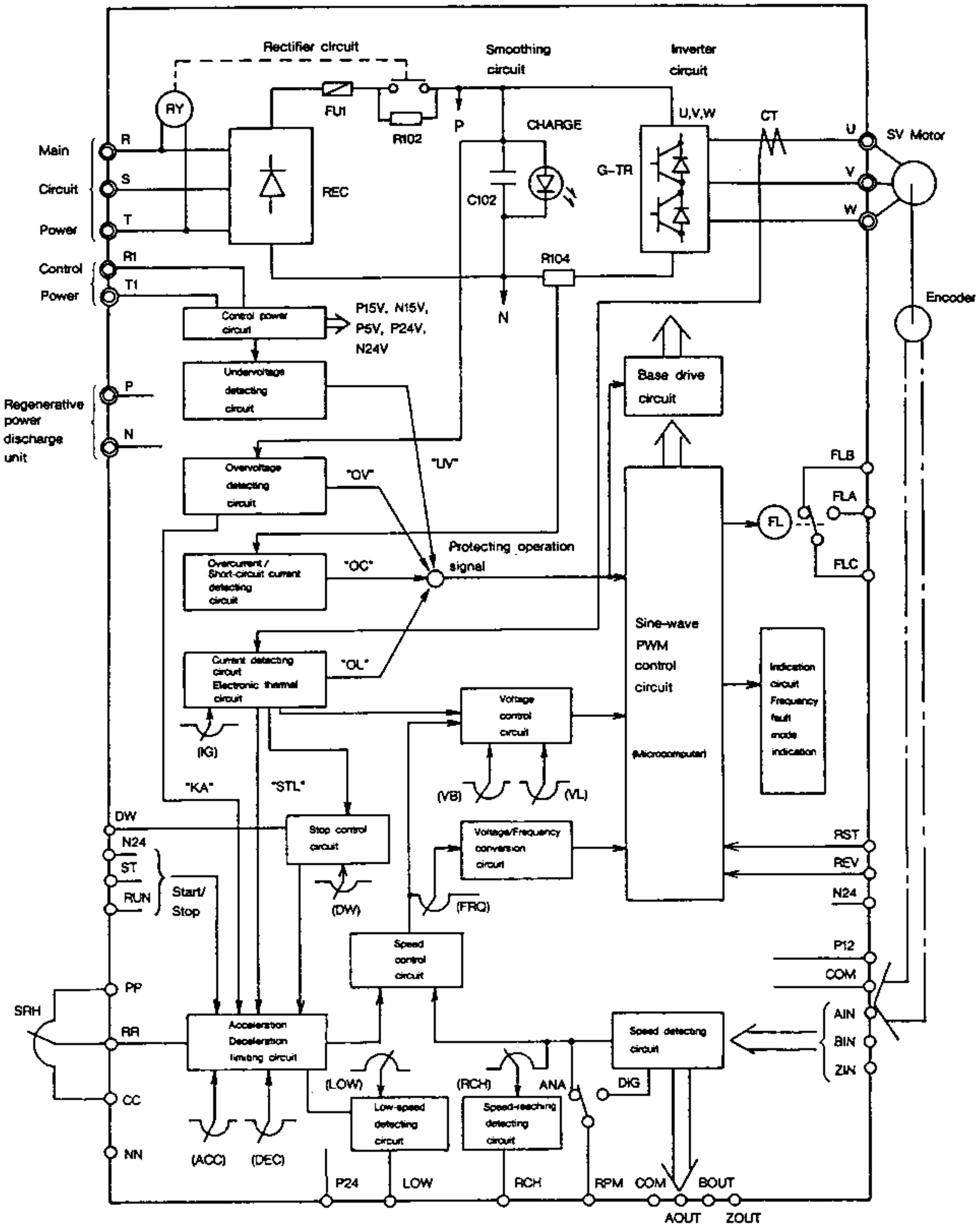
Table 2 SV motor standard specifications

Name	SV motor								
Type-form	IK-ECKL					IK-ECKLM			
Rated output (kW)	0.1	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5
Frame number	56T	56T	63T	71T	80T	80T	100T	112T	112T
Rated torque (kg·m)	0.06	0.12	0.24	0.44	0.89	1.30	2.19	3.25	4.43
Rated speed (rpm)	1,650								
Rated voltage (V)	180								
Maximum speed (rpm)	2,300								
Momentary maximum torque	Approx. 300%								
Speed-torque characteristics									
Power rate (kW/S)	0.97	2.3	3.2	7.9	13.1	28.2	52.8	45.8	72.4
Rotor inertia GD²/4(kg·cm²)	3.45	5.75	16.6	23.8	57.6	58.0	86.9	221	260
Insulation type	Type F								
Cooling method	Natural cooling					Forced cooling			
Cooling fan type (single phase 200V-50/60Hz)	———					HS4556L (22/20W)	6550 (45/42W)		
Speed sensor	A rotary photo encoder (500ppr, phase A and B, 1ppr zero marker, 12 V) is used.								
Weight (kg)	9	11	15	21	28	35	42	49	66

4. Circuit configuration

Figure 1 shows the block diagram of the SV PACK.

Figure 1 Block diagram



5. Precautions

When the SV PACK is used, care must be taken to the following points :

5-1 Precautions on SV motor

(1) The SV motor has a rotary photo encoder for speed detection at the anti-load side of the motor. To attach the coupling to the axle, force-fit the coupling by lightly knocking with a resin hammer after lubrication, A large shock will damage the rotary photo encoder, bearing, etc. .
When the motor is directly connected to a machine and used, align centers of axles in a straight line. When the belt is used, the motor and the machine should be put parallel, and the line connecting both pulley centers must be at a right angle to axles.

(2) Use the 5-conductor shielded cable for the connecting cable between the rotary photo encoder and the SV PACK. Connect the covering of the shielded cable to terminal E (grounding terminal) of the SV PACK.
When connection of the encoder power terminal and output terminal is wrong, the encoder is destroyed, so wiring should be carefully checked.

(3) The SV motor is designed so that the momentary maximum torque will be 300%. When a 300% torque is generated, current which is approximately three times of the rated current flows, so the size of the wire from the control panel to the SV motor must be considered.

(4) Except for (1) through (3) above, handling is same as that of stardard motors.

5-2 Precautions on SV PACK control unit

(1) As a protecting function of the SV PACK, the overload protecting function using the electronic thermal circuit is provided. The current setting level has been adjusted at a pair of the SV PACK and SV motor. Accordingly, use the SV PACK and SV motor, having the same capacity. For control performance, the SV PACK and SV motor have been adjusted as a pair, Do not combine a large capacity SV PACK with a small capacity SV motor.

(2) For short deceleration/acceleration, use the regeneratire power discharge unit (PB unit).

(3) For start/stop of a large GD^2 load, the acceleration time (set by rheostat ACC.) and deceleration time (set by rheostat DEC.) must be larger If the minimum time has been set, overcurrent protection or overvoltage protection activated to stop the function.

(4) The power factor improving capacitor cannot be attached to the output side of the SV PACK.

6. Installation

Install the SV PACK securely by using the mounting holes in its base. The setting direction must be vertically by putting the wiring hole downward. A sufficient space must be provided for ventilation as shown in Figure 5.

To select the place of installation, observe the following instructions.

(1) Ambient temperature : −10 to 50°C (around the box)

(Remove the cover if the device is used in a range of +40 to 50°C.)

Care must be taken to ventilation to purge heat.

Remove the cover if the SV PACK is put into the independent panel or large control panel.

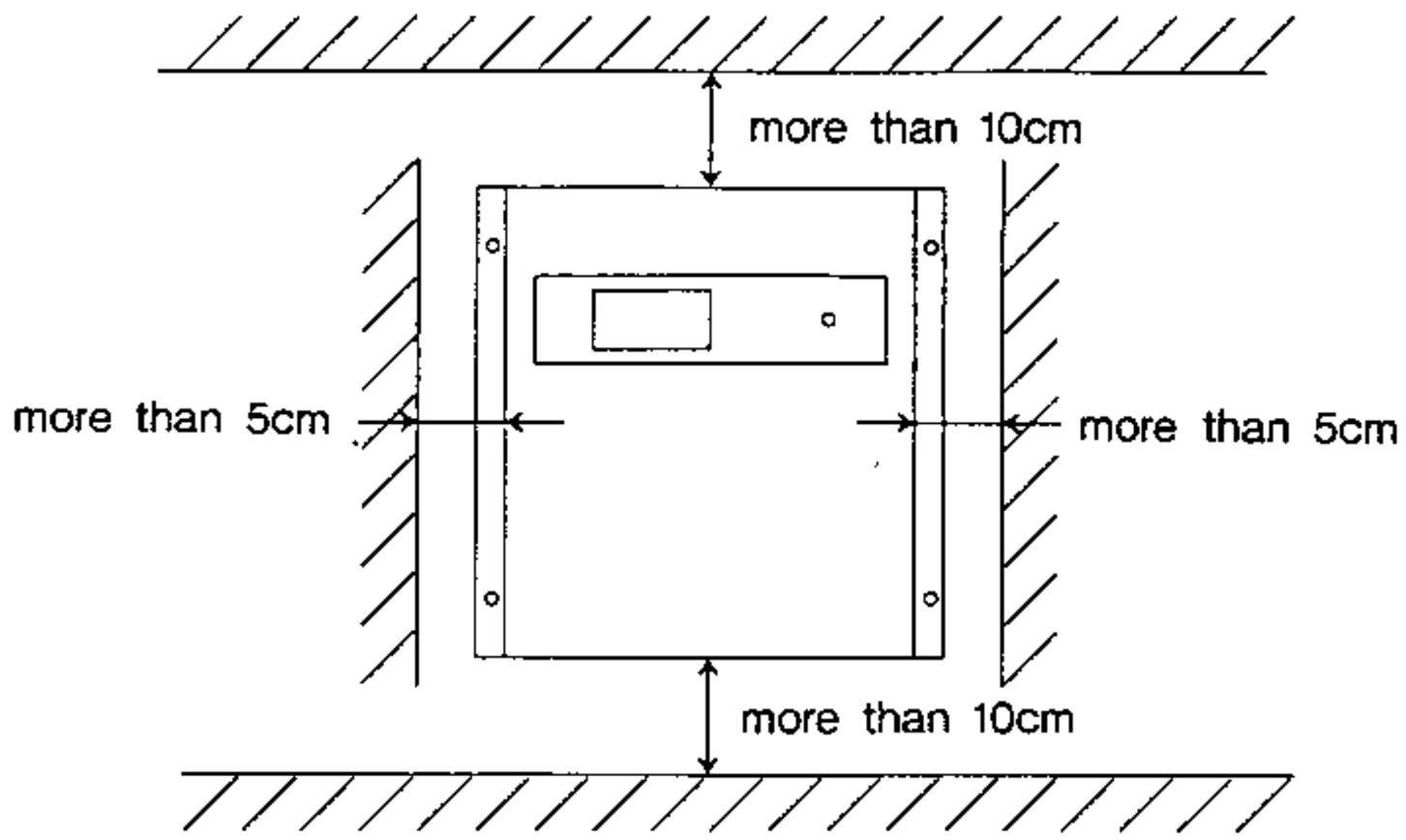


Figure 5 SV PACK Installation

(2) Avoid places at a high temperature or humidity, or having much dust or iron powder.

(3) Install the SV PACK at a place free of corrosive gases or grinding solution.

(4) Install the SV PACK at a place free of vibration and noise generating sources such as power switches.

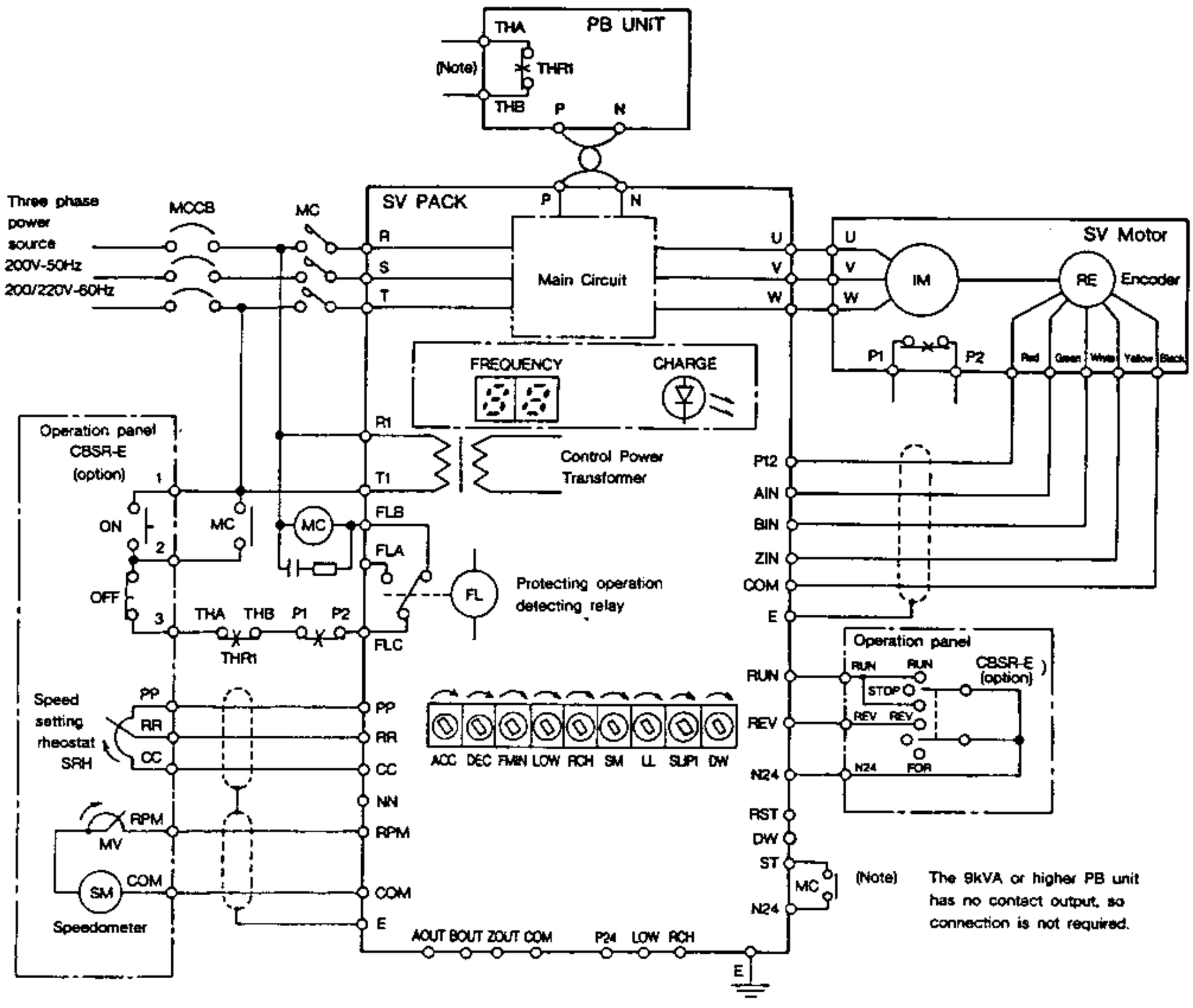
(5) The regeneratiue power discharge unit should be installed close the the SV PACK. Wiring should be short as much as possible.

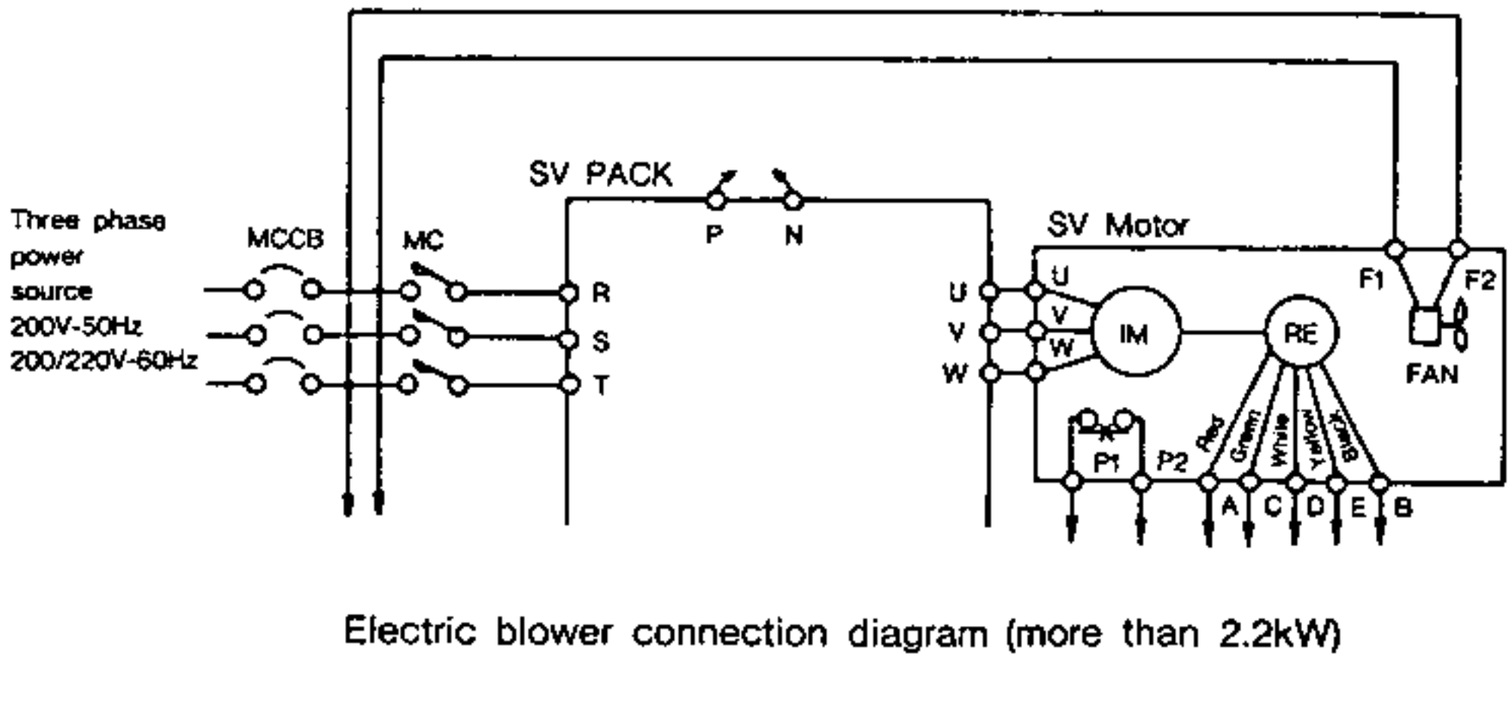
7. Wiring

7-1 Stand connection Diagram

Figure 6 shows the standard connection diagram.

Figure 6 Standard connection diagram





Electric blower connection diagram (more than 2.2kW)

(1) Ground the frame grounding terminal E with a 3.5mm² or larger wire.

(2) Connect the surge suppressor to the exciting coil of magnetic contactor MC.

Example : Marcon Electric. Co., Ltd. Model DCR2-10A25 Rating 250V 100 ohm x 0.1uF

When the SV PACK is incorporated into another control panel, connect the surge suppressor to other magnetic contactors and relays in the panel. In this case, select the surge suppressor according to the relay capacity.
Connect the surge suppressor close as the magnetic contactor and relay.

(3) For wiring of the speed setting rheostat (SRH), use the 3-conductor shielded cable and connect the covering of the shielded cable to grounding terminal E.

(4) For wiring of speedometer (SM), use the 2-conductor shielded cable, and connect the covering of the shielded cable to grounding terminal E.

(5) For wiring of the encoder, use the 5-conductor shielded cable, and connect the covering of the shielded cable to grounding terminal E.
For positioning, the wiring length should be maximum 30 meters.

(6) When the regenerative power discharge unit (PB unit) is used, terminals P and N of the PB unit should be connected to terminals P and N inside the SV PACK as close as possible using twisted wires. Connect the contact of overload relay THR1 in the PB unit to the ON-OFF sequence in a series.
The 9kVA or higher PB unit has no contact output of the overload relay, so connection is not required.

(7) Terminals P1 and P2 of the SV motor are terminals of the thermal protector that protects the SV motor from overheating. Connect terminals P1 and P2 to the ON-OFF sequence in series.

7-2 Precautions on circuit configuration

(1) Do not connect the power side terminals (R, S, T) and motor side terminals (U, V, W) of the main circuit incorrectly. If connection is wrong and the operation command is entered, the main circuit transistor (G-TR) and base drive circuit board will be burnt, so care must be taken.

(2) If the phase order is different between power side terminals (R, S, T) and motor side

terminals (U, V, W), operation can be normally performed. By replacing two of motor side terminals U, V and W, the motor rotating direction is changed.

(3) Use a circuit breaker or fuse having an appropriate capacity outside the SV PACK for protection of the input power side. Such protection is indispensable for protecting the power line and preventing the system from fire disasters.

(4) When a trouble occurs during operation due to any cause, power must be immediately disconnected (i.e. magnetic contactor opened) to avoid expansion of the trouble. As shown in Figure 6, prepare the external sequence that cut off the main power supply using protecting operation detecting relay FL (signal output terminals FLA, FLB and FLC).

(5) Do not put in a magnetic contactor between the SV PACK and SV motor. The load change due to the magnetic contactor may cause the device trouble.

(6) The main circuit power supply and control circuit power supply can be simultaneously turned ON/OFF, but the sequence must be such that the main circuit power will not be turned on first.

(7) Connect the auxiliary contact (contact a) of magnetic contactor MC in between terminals ST and N24. When the magnetic contactor has no auxiliary contact, use another auxiliary relay. Operation cannot be performed unless ST and N24 are connected.

(8) The SV PACK has the electronic thermal circuit for overload protection. The SV motor has also the thermal protector (terminals P1 and P2). Connection should be made as shown in Figure 6 for overload protection. Figure 7 shows an example of the electronic thermal circuit characteristics. The protecting operation works in approximately 60 seconds at 150% overload.

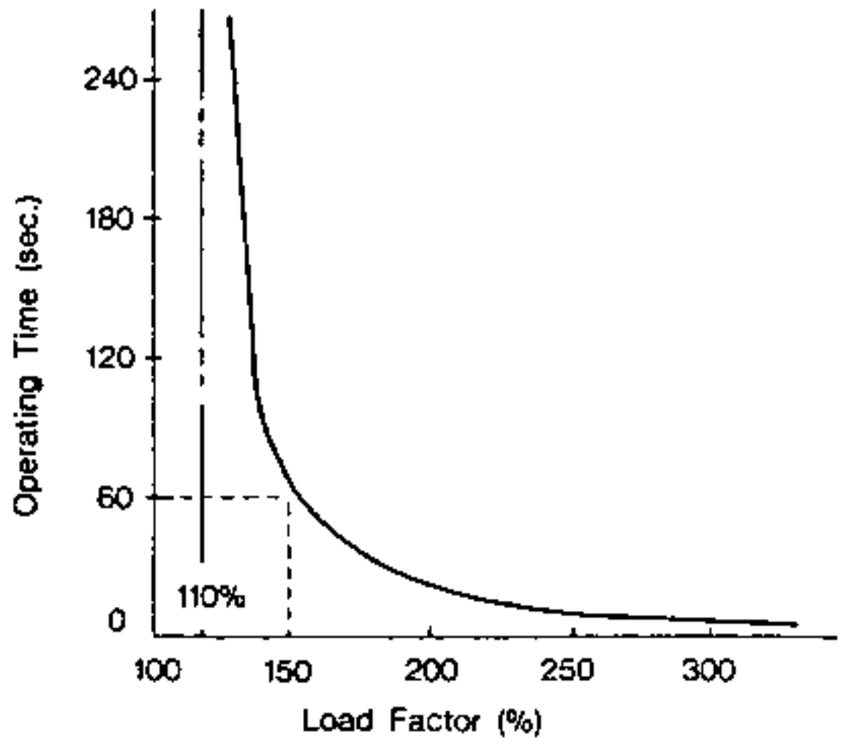


Figure 7 Characteristics of electronic thermal circuit

(9) Selection of speedometer and scale calibrating rheostat.

The speed of the SV motor can be detected as DC voltage between terminals RPM and CC. The RPM terminal voltage has been adjusted to 3V for 1000rpm. Use the speedometer SM as described below.

(Example) Speedometer (SM): Rectifier type DC voltmeter (⏭) full-scale 7.5V-1mA scale 0 to 2500 rpm.

When an operating panel (CBSR-E) is used, connect as shown in Figure 6. In this case, turn the scale calibrating rheostat (MV) fully in the arrow direction.

8. Operation

8-1 Check before operation

Check the following before operation :

(1) Is wiring correct? Check it again.

Check connections of power side terminals (R, S, T) and motor side terminals (U, V, W) carefully.

(2) Check whether voltage reduction at the end is considered for the maximum torque to select the wire size. Care must be taken when wiring is long.

(3) Check if the main circuit power supply (three phase) and control circuit power supply (single phase) are 200V-50Hz or 200/220V-60Hz.

8-2 Start

(1) Turn ON the circuit breaker MCCB and magnetic contactor MC. Check that the indicator lamp "CHARGE" on the SV PACK panel is lit red.

(2) Set the operation switch in Figure 6 to FOR. . When the speed setting rheostat is turned clockwise, the motor starts running. Check the rotating direction.

(3) Check the operating frequency through frequency meter "FREQUENCY" on the SV PACK panel.

(4) Turn the speed setting rheostat slowly so that the SV motor speed is 1000rpm. Before shipping, the speedometer is adjusted so that it will indicate 1000rpm (RPM terminal voltage 3V), using the meter calibrating rheostat "SM". If readjustment is required, use the meter calibrating rheostat "SM".

(5) Turn the speed setting rheostat (SRH) slowly for acceleration/deceleration. Check that

there is no large vibration on the SV motor and mounting base.

8-3 Forward/reverse operation

(1) PP-CC (+12VDC is used as the speed setting power source)

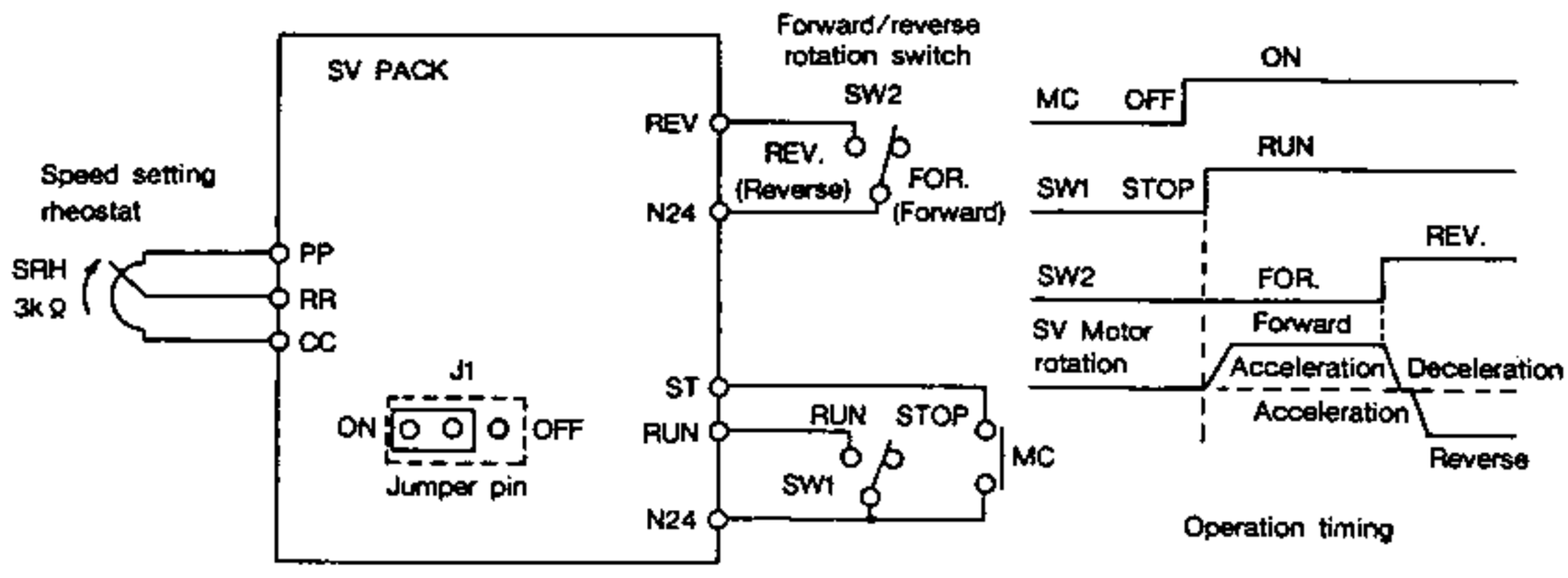


Figure 8 Forward/reverse operation (PP-CC power used)

When PP-CC (+12VDC) is used as the speed setting power supply, set jumper pin J1 to ON. As shown in Figure 8, connect the speed setting rheostat (SRH) to terminals PP, RR and CC, and connect the forward/reverse rotation switch SW2 in between REV and N24.

When the forward/reverse operation switch SW2 is set to FOR., forward rotation is performed. When the switch is set to REV., reverse rotation is performed. When SW2 is set to REV.(reverse rotation) during forward rotation, the SV motor is automatically decelerated, switched with the phase order, and accelerated to reverse rotation.

(2) PP-NN (+12VDC to −12VDC) is used as the speed setting power supply.

When PP-NN (+12VDC to −12VDC) is used as the speed setting power supply, set jumper pin J1 to OFF. As shown in Figure 9, connect the speed setting rheostat (SRH) to terminals PP, RR and NN. In this case, REV-N24 should be open. When the speed setting input (RR-CC) is positive, forward rotation is performed. When the input is negative, reverse rotation is performed.

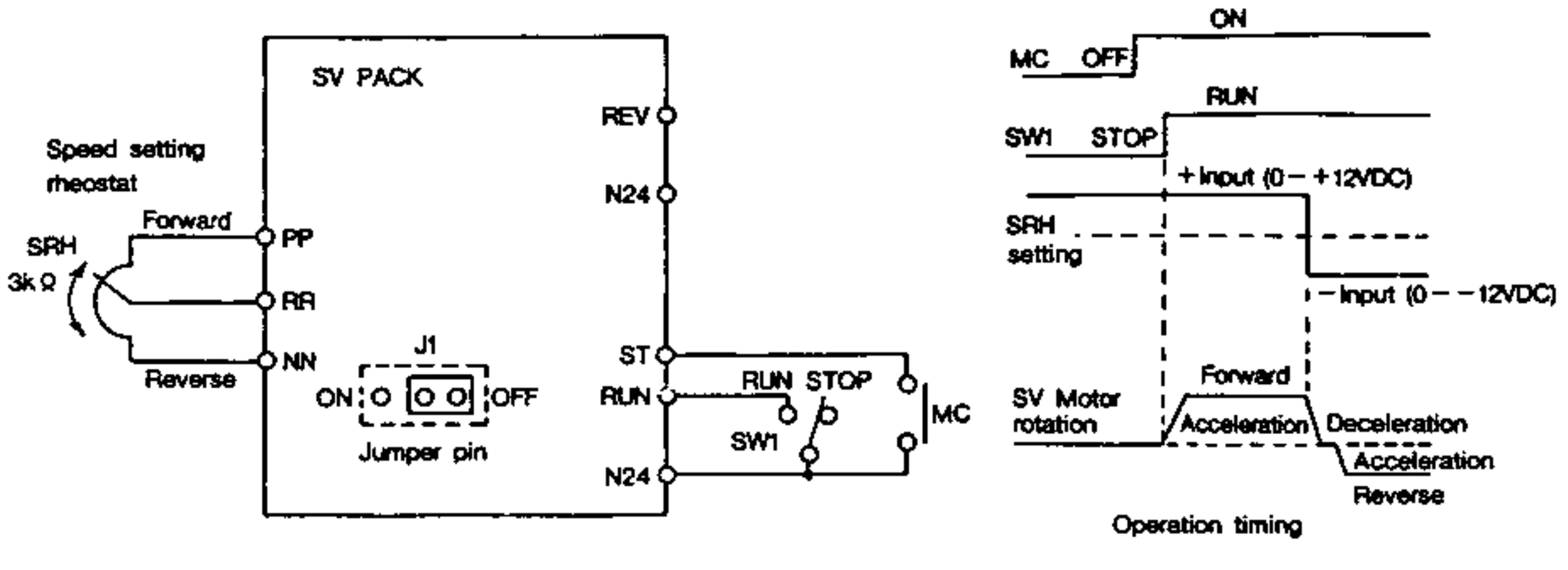


Figure 9 Forward/reverse operation (PP-NN power used)

8-4 Stop control operation

For Stop control, provide the stop control switch SW3 as shown in Figure 10.

(1) Set switch SW3 to ON and set the speed setting input (RR-CC) to zero, then start.

(2) Use 16RH (DW) for torque adjustment.

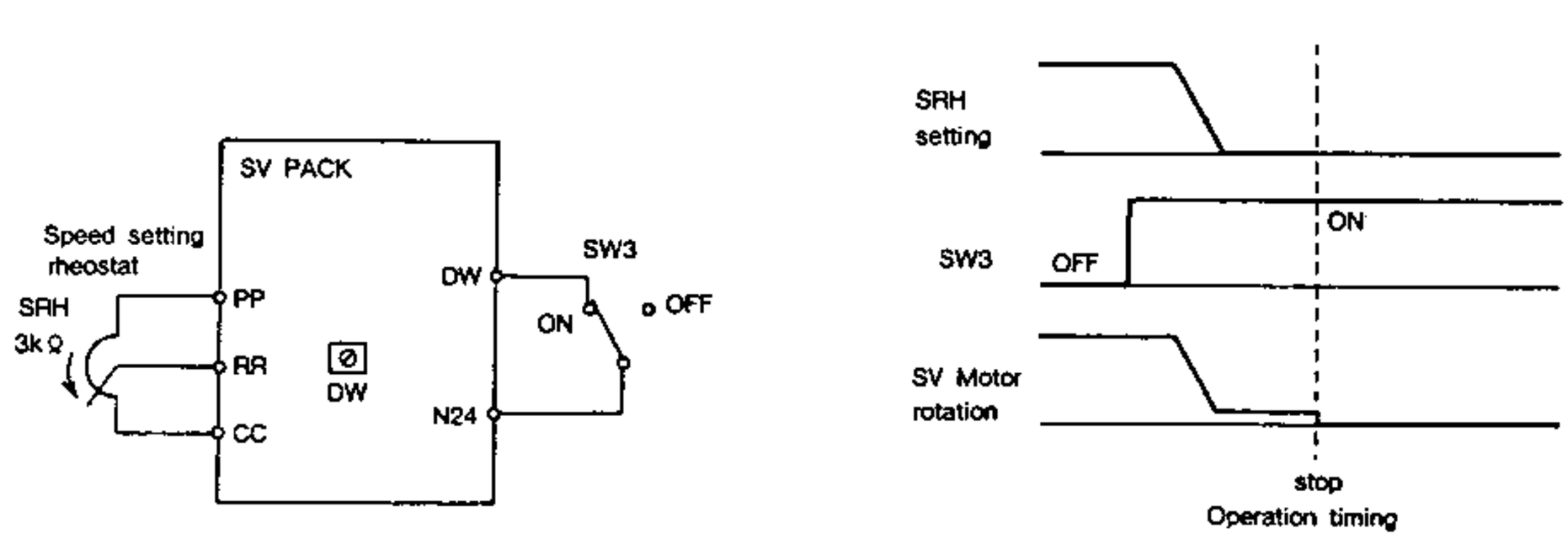


Figure 10 Stop control

(Note 1) Never perform this when the speed setting input is provided.

8-5 Stop

(1) When the speed setting input is reduced while the SV motor is operating, the SV motor is braked and decelarated, and a new setting speed is attained.

(2) When operation switch SW1 is set to STOP while the SV motor is operating, the SV motor decelarates and stops. When the load GD^2 is large, coast to stop at a low speed may occur if the decelaration time (DEC.) is set too short. In such a case, lengthen the decelaration time using the rheostat DEC..

(3) When the magnetic contactor or circuit breaker is turned OFF during the SV motor operation, the SV motor coasts to a stop.

(4) When the inverter protecting function (overcurrent/short-circuit protection, overvoltage protection, undervoltage protection, or overload protection) works, protecting operation detecting relay FL works, and magnetic contactor MC is automatically turned OFF. The SV motor coasts to a stop.

(5) When the protecting function works, the frequency meter indicates as shown below.
[Oc] : OC is indicated for the overcurrent/short-circuit protecting operation.
[Ou] : OV is indicated for the overvoltage protecting operation.
[Uu] : UV is indicated for the undervoltage protecting operation.
[OL] : OL is indicated for the overload protecting operation.

When OC, OV, UV or OL is indicated, turn off the control power supply and eliminate the cause, then restart the operation. For resetting, turn OFF the control power supply for more than 5 seconds.

(6) The protecting function can be compulsorily reset by providing reset switch (automatic recovery) SW4 in between terminals RST and N24 as shown in Figure 11.
When the reset switch is turned ON under the state the control power supply is ON, the inverter becomes operable. If the trouble cause is not eliminated, the protecting operation works again. If the device itself has the trouble cause, the trouble may be expanded. Operation should be started after power is disconnected and the trouble cause is found.

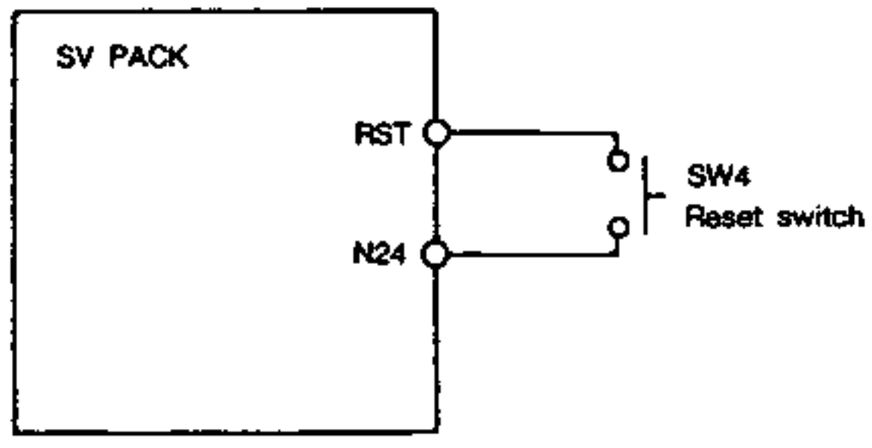


Figure 11

(7) When the SV PACK must be immediately stopped due to the trouble of the machine combined with the SV PACK, turn OFF magnetic contactor MC. In this case, the SV motor coasts to a stop.

9. Adjustment

9-1 Rheostat adjustment

Table 5 indicates rheostats adjustable by the user.

Rheostats shown in Table 6 are adjusted to the optimum position before shipping, and therofore must not be touched.

〈Precautions on adjustment〉

(1) Small precision rheostats are used. Use a Philips screwdriver having a sharp end and insulation for hand.

(2) After power is turned OFF, the charge voltage remains in the large capacity electrolytic capacitor, so care must be taken.

(Note 1) When the speed cannot be increased to the maximum speed in operation, the acceleration time must be increased. In some cases, the overload protecting circuit of the SV PACK may work.

If the load torque and inertia are known, the acceleration time can be calculated as described below. The acceleration time should be actually longer than the calculation result.

$$ta = \frac{\Sigma GD^2 \cdot N}{375\,(T_M - T_L)}$$

ta (sec.) : Acceleration time

ΣGD^2 (kg·m²) : Motor GD^2 + Load GD^2 (motor axle conversion)

N (rpm) : Maximum motor speed

T_M (kg·m) : Motor torque

T_L (kg·m) : Maximum load torque

Table 5 Rheostats adjustable

RH No.	Symbol	Adjusting function	RH turned clockwise (↷)			Shipping adjustment	
10	FMIN	Speed zero point adjustment	Notch4→Notch5: Speed zero point adjustment			Speed zero point	
		Minimum speed setting	Notch5→Notch10: 0 rpm-600 rpm setting				
11	ACC	Acceleration time	Acceleration time increased	J4 ON	1–20 sec	J4 OFF 0.5 sec	Note 1
				J4 OFF	0.1–1 sec		
12	DEC	Deceleration time	Deceleration time increased	J4 ON	1–20 sec	J4 OFF 0.5 sec	Note 2
				J4 OFF	0.1–1 sec		
8	SLIP1	Anti-haunting adjustment	The gain increases and haunting occurs			Optimum	Note 3
13	LOW	Low speed signal detection	The low speed detecting speed is increased			Notch 0	Max. 300rpm
14	RCH	Speed reaching signal detection	The speed for the speed detection comes close to the set value			Optimum	
5	SM	Meter calibration	The "RPM" terminal voltage increases. (Meter indicator movement increases)			3V for 1000rpm	
15	DW	Torque abjustment	Torque is increased			100% torque	
16	LL	Minimum frequency setting	Minimum output frequency in operation is increased			0 Hz	

(Note 2) A part of the regnerative power from the decelerating SV motor to the power supply becomes the loss inside the SV motor. The rest is charged in the capacitor. Deceleration time too short without the regenerative power discharge unit (PB unit), the capacitor voltage increases, overvoltage protection works, and trips (OV indicated). In such a case, the deceleration time should be increased. If the deceleration time cannot be increased, install the regenerative power discharge unit. If the deceleration time is set to the minimum when load GD^2 is large, the deceleration torque may be insufficient and may run free at low speed. In such a case, the deceleration time should be increased.

(Note 3) SLIP1 is adjusted to the optimum point for each capacity of the SV motor before shipping. According to the load, adjust SLIP1 for stable control. If load GD^2 exceeds twice of SV motor GD^2, SLIP1 may not be sufficient. In such a case, the circuit devices must be changed, so care must be taken.

Table 6 Rheostats non-adjustable by the user

RH No.	Symbol	Adjusting function	RH turned clockwise	Shipping adjustment	Remarks
1 RH	VL	V/F ratio (voltage/frequency ratio)	V/F ratio is increased.	Optimum	Note 1
3 RH	VB	Low frequency output voltage	Output voltage in the low frequency band is increased.	〃	
2 RH	FRQ	Maximum output frequency	Maximum output frequency is increased.	〃	Note 2
7 RH	FG	Speed/Voltage conversion gain	Speed feedback voltage is increased.	〃	
9 RH	SLIP2	Speed deviation amount	Speed deviation amount is increased.	〃	
4 RH	IG	Current/Voltage conversion gain	Current/voltage conversion gain is increased. OL operation is accelerated.	〃	Note 3
6 RH	ZADJ	Zero point adjustment	Multiplier offset adjustment.	Zero point	Note 4

(Note 1) VL and VB are adjusted to optimum values before shipping so that the permissible limit torque will be generated, so adjustment is not required.

(Note 2) FRQ, FG and SLIP2 are interrelating to each other, so they must not be toutched by the user. If they are changed, the device may become uncontrollable.

(Note 3) IG is the gain of the current-voltage conversion, If it is adjusted, characteristics (overload protecting operation characteristics, stall operation point, current/voltage calibration characteristics, stop control, etc.) relating to load current will be impaired, so never adjust it.

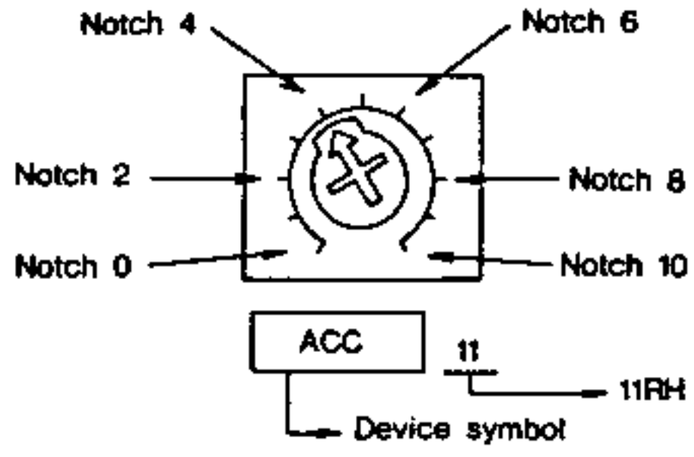
(Note 4) ZADI is offset adjustment of the multiplier. If it is adjusted, speed control will be impaired, so never adjust it.

Table 7 Referenes for scceleration / deceleration time adjustment

Jumper pin		J4 OFF		J4 ON	
Device symbol		ACC	DEC	ACC	DEC
Adjusting function		Acceleration time	Deceleration time	Acceleration time	Deceleration time
Adjustable range	Notch 0	36 msec	36 msec	0.55 sec	0.55 sec
	Notch 2	42 msec	42 msec	0.6 sec	0.6 sec
	Notch 4	54 msec	54 msec	0.8 sec	0.8 sec
	Notch 6	94 msec	94 msec	1.5 sec	1.5 sec
	Notch 8	0.25 sec	0.25 sec	4.3 sec	4.3 sec
	Notch 10	1.7 sec	1.7 sec	28.3 sec	28.3 sec

(Note 1) The table above indicates reference values.
Depending on the product, values may be slightly different.

(Note 2) The outline of the rheoatat is shown below.



(In this casu, Notch 4 is indicated)

Figure 12 Rheostat

9-2 Terminal board explanation

(1) Main circuit terminal board

R,S,T ·····Main circult terminal three phase 200V-50Hz or 200/220V-60Hz

U,V,W ·····SV motor connecting terminal

R1,T1 ·····Control power terminal single phase 200V-50Hz or 200/220V-60Hz

P,N ·····Regenerative power discharge unit (PB unit) connecting terminals (P : plus, N : minus)

(2) Control circuit terminal board

E ·····Grounding terminal

PP ·····Speed setting rheostat power supply. +12 V generated between PP and CC.

RR ·····Speed setting input. The 0 to +12V or 0 to +/−12V signal is fed between RR and CC or NN and CC.

CC ·····Control circuit 0V

NN ·····Speed setting rheostat power supply. −12V generated between NN and CC.

RPM ·····Speedometer terminal. The 0 to +10V voltage (analog) signal or 1000ppr, + 15V pulse (digital) signal is output between RPM and COM.

COM ·····Control circuit 0V (same as CC).

P24 ·····Plus side of 48V in control circuit P24-N24

LOW ·····By connecting a 24VDC relay between the low speed detecting signal terminal (open collector output max. 50mA) P24 and LOW, low speed can be detected.

RCH ·····By connecting a 24VDC relay between the speed reaching signal terminal (open collector output max. 50mA) P24 and RCH, the speed reaching signal can be obtained.

N24 ·····Minus side of 48V in control circuit P24-N24

RUN ·····Connection with N24 enables operation.

ST ·····Connection with N24 completes start preparation.

REV·····Connection with N24 sets reverse rotation.

RST·····Reset terminal. Connection with N24 is momentary made, the protecting

operation is reset, and the reoperable state is set.

DW ·····Stop control terminal. When the RR input is 0V, connection with N24 enables stop control.

FLA ·····Protecting operation detecting relay FL contact a output (FLA-FLC)

FLB ·····Protecting operation detecting relay FL contact b output (FLB-FLC)

FLC ·····Protecting operation relay FL output contact common terminal

P12 ·····The power supply for the SV motor encoder, +12V is generated between COM and P12.

AIN ·····Encoder phase A input

BIN ·····Encoder phase B input

ZIN ·····Encoder zero marker input

AOUT ·····Encoder phase A output (open collector output max, 50mA)

BOUT ·····Encoder phase B output (open collector output max, 50mA)

ZOUT ·····Encoder zero marker output (open collector output max, 50mA)

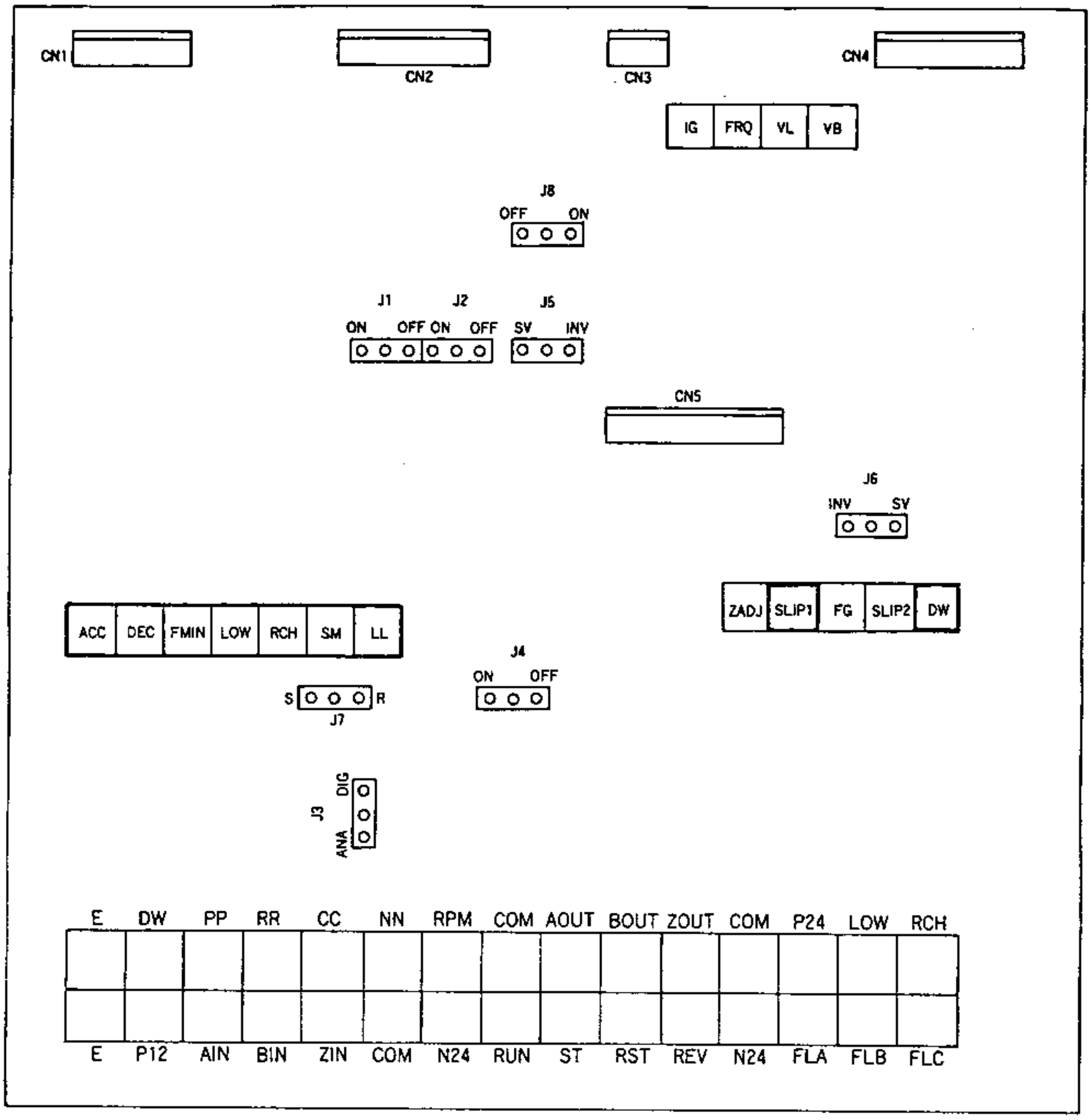


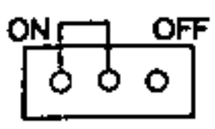
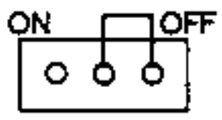
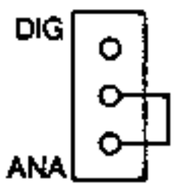
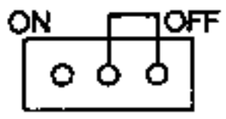
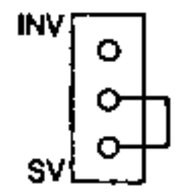
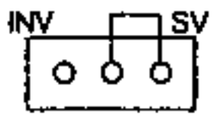
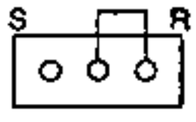
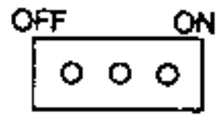
Figure 13 PC board parts layout and terminal board

9-3 Jumper pin connection

As shown in Table 8, jumper pins are connected before shipping.

Do not touch them unless necessary. See Figure 12 for jumper pin locations.

Table 8 Jumper pin explanation

No.	Indication on PC board	Function	Connection before Shippment
J1		(1) ON : speed setting input 0 to +12V, forward rotation for open N24-REV, reverse rotation for closed N24-REV (2) OFF : speed setting input 0 to +12V for forward rotation, 0 to −12V for reverse rotation	ON
J2		(1) OFF : maximum speed 2300rpm	OFF
J3		(1) Connection with ANA. supplies the DC voltage 0 to approx. +10V proportional to the speed on terminal RPM. (2) Connection to DIG. supplies the 1000ppr + 15V pulse output on terminal RPM.	ANA
J4		(1) OFF : acceleration/deceleration time settable in a range of 0.1 to 1 sec. (2) ON : acceleration/deceleration time settable in a range of 1 to 20 sec.	OFF
J5		(1) SV : Closed loop speed control (2) INV : open loop inverter control	SV
J6		(1) SV : SV mode voltage control (2) INV : INV mode voltage control	SV
J7		(1) S : low speed detection by SV motor rotation speed (2) R : low speed detection by the acceleration/deceleration command.	R
J8		(1) ON : 1KVA or lower PWM pattern	ON
		(2) OFF : 2KVA or higher PWM pattern	OFF

(Note 1) Turn off the control power before replacing the jumper pin.

(Note 2) Do not touch J2.

10. Maintenance and inspection

The SV PACK is a controller mainly consisting of semiconductor elements, so no particular maintenance is required because there is no mechanical wearing portion.

Check the following items :

The main circuit of the SV PACK uses a large capacity capacitor. After power is disconnected, the voltage remains for 4 minutes for 1kVA or less, 10 minutes for 2kVA, 15 minutes for 3kVA, 20 minutes for 4kVA, 25 minutes for 6.5kVA, and 40 minutes for 9 to 12kVA. In maintenance and inspection, confirm that the "CHARGE" lamp has gone out and check that there is no voltage in the capacitor using a tester.

(1) Any looseness of wiring terminals, and damaged wires.

(2) Ventilation hole clogged with dust.

(3) Dust on PC board and inside the main unit.

(4) If the SV PACK is not used long, power should be connected every 6 months and operations should be checked.

(5) In megger test, use the 500VDC megger for only the main circuit terminal board (R1, T1, R, S, T, U, V, W). Do not test terminals on the PC board.

(6) Do not perform the breakdown voltage test because the internal parts may be damaged.

As described above, maitain appropriate environment by periodic inspections.

11. Trouble-shooting and remedial measures

11-1 Checking for protecting operations

When there is any wrong setting, external wire shortcircuit, grounding fault, SV motor trouble or SV PACK trouble, the circuit protecting operation works, the protecting operation relay FL works, the trouble cause is indicated in the indicator, and the device emergency stops. In-such a case, it should be judged if restarting is possible or the device should be repaired, by grasping the cause according to the following inspection methods. Table 9 indicates trouble indications and causes for reference.

Inspection 1: "OV", "UV", or "OL" indicated

(1) Test operation

In test operation, "OV", "UV" or "OL" may appear because the test operation is started under the state that wrong adjustments, voltage setting and load setting are unclarified. The "OV"

indication in test operation often indicates short deceleration of the load. Istall the regenerative power discharge unit or lengthen the deceleration time by the rheostat DEC. (Jumper pin J4 ON, turn DEC, clockwise.) "UV" often indicates the inappropriate control power voltage. Using a tester, check if the R1-T1 voltage is 200V-50Hz or 200/220V-60Hz. "OL" often indicates mis-selection of the SV PACK and SV motor. Check the load current for judgement. Use a moving iron type current-meter (≸) for measurement of current. The gripping tester has a wide range of the error, so care must be taken.

(2) Normal operation

In this case, the "CHARGE" lamp should light red at the initial stage of a trouble. Turn off the control power supply for approximately 5 seconds, then restart. If restarting is possible, the device has no problem. Check for the cause according to Table 9 and eliminate the cause.

If restarting is impossible, check for the cause according to Table 9. Restart the device after the cause is eliminated. If the device cannot be started, the device trouble is considered.

Inspection 2 "OC" indicated

(1) Test operation

As an accident often seen in test operation, mis-connection of power terminals R, S and T and SV motor terminals U, V and W is raised. In this case, the device is momentarily broken, and repair in a factory is needed.

Other problems are short-circuit and grounding fault by miswiring. At the moment the operation is started, "OC" appears. If "OC" appears during acceleration, the acceleration time may be too short, overload has occurred, or load GD^2 is too large (exceeding twice of SV motor GD^2).

Lengthen the acceleration time. (Jumper pin J4 ON, Turn ACC. clockwise.) If the acceleration time is correct, overload or too large GD^2 is considered, so review the capacity.

(2) Normal operation

The remedial measures are different depending on if the "CHARGE" lamp has been lit or not in trouble.

When the "CHARGE" lamp has extinguished :

Possibility of the upper and lower arm G-TR short-circuit is considered. In such a case, the main circuit fuse blows at the same time.

G-TR short-circuit and fuse blowing are fatal troubles and repair in the factory is needed. As a cause, external wiring short-circuit, grounding fault, or thunder surge is considered, so checking must be performed.

When the "CHARGE" lamp has lit :

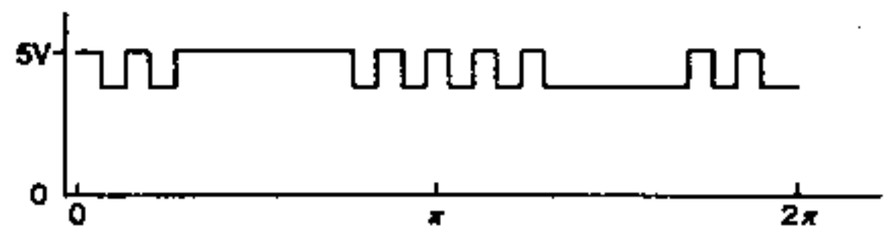
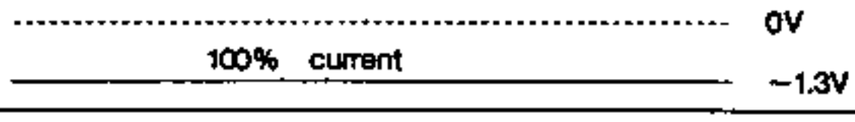
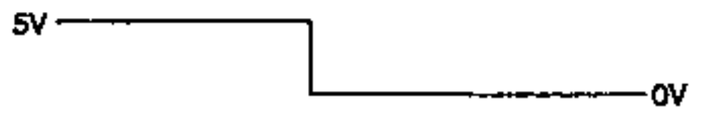
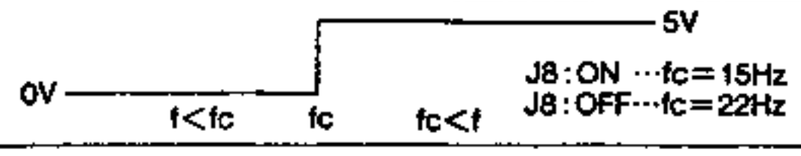
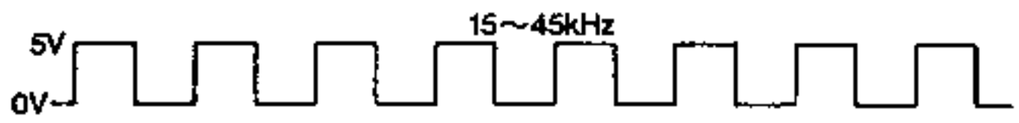
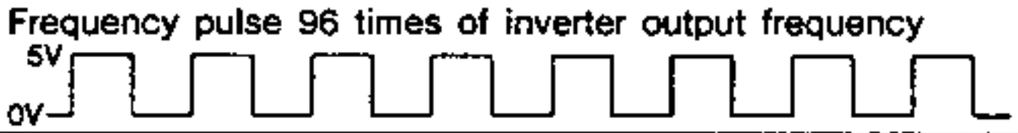
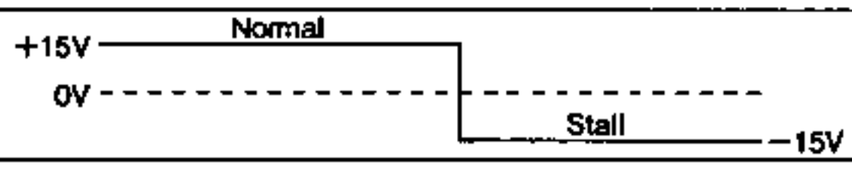
In this case, the device may be normal at a rate of 50% probability. Turn off the control power for approximately 5 seconds, then restart. If restarting is possible, the device is normal. Check for the cause according to Table 9 and eliminate the cause. When restarting is impossible and "OC" immediately appears, the G-TR trouble, external wiring short-circuit or grounding fault, SV motor trouble, or overload is considered, so checking must be performed.

Table 9 Trouble-shooting and cause

Indication	Possibe cause
"oc" indicated Over current/Short-circuit protection	○Mismatcing SV PACK capacity and SV motor capacity ○Wiring short-circuit or grounding fau1t ○Overload, abrupt load change, or too much GD^2 ○Too short acceleration/deceleration time ○SV PACK trouble (G-TR short-circuit, capacitor puncture,etc.) ○SV motor trouble (burning, short-circuit, grounding fault)
"ou" indicated Overvoltage protection	○Too short deceleration time ○Too much load GD^2 ○Too high power voltage
"uu" indicated Undervoltage protection	○Too low power voltage ○Occurrence of momentary power failure, momentary voltage reduction
"OL" indicated Overload protection	○Overload (approximately 150% of the rated current for 1minute) ○Mismatching of SV PACK capacity and SV motor capacity ○Over-excitation (too much voltage at low speed by VB)
Main circuit fuse blown	SV PACK main circuit trouble, particularly G-TR may be broken. (Note) The base drive circuit may also be broken.

11-2 Check terminal function and waveform

Table 10 Check terminal function and waveform

Test point symbol	Function	Waveform example
CN2— +U (5) +V (6) +W (7) X (2) Y (3) Z (4)	Base drive circuit input signal	Sine wave distribution PWM signal 
ACC	Speed command	Change in a range of 0 to −12V for 0 to maximum speed by rheostat
SLIP	Speed deviation signal	 (+) or (−) potential depending on the speed that has been set
IG	Current feedback amount adjustment	
VG	V/F ratio setting voltage	−1 to −10 VDC Voltage
OL	Overload operation output	
IV	Carrier frequency change	
INT	Voltage control clock	
FRQ	Frequency control clock	Frequency pulse 96 times of inverter output frequency 
STL	Stall signal	
VFG	Speed feedback amount	Voltage made by converting the encoder input signal (0 to −10V)
LL	Minimum frequency setting	Change in a range of 0 to −1.3V for minimum frequency LL (15RH) setting signal
+ 5V	Control voltage +5V	+ 5V DC voltage
+15V	Control voltage +15V	+15V DC voltage
−15V	Control voltage −15V	−15V DC voltage
0	Control voltage 0V	0V, same potential as terminal CC or COM

11-3 Giant transistor (G-TR) performance judgement

(1) G-TR performance judgement on main circuit terminal board (P, N, U, V, W)

This method provides an easy judging method for G-TR although troubles of the G-TR base cannot be precisely found.

Precautions for measurement.

(A) Using a tester, check the capacitor terminal voltage to see if the residual charge remains in the main circuit smoothing capacitor. Measurement should be started after ensuring there is no charge.

(B) Remove all connections of the SV motor and regenerative power discharge unit.

(C) Measure with a tester (resistance range).

(D) Measurement points are U, V, W, P and N of the main circuit terminal board.

Table 11 G-TR performance judgement

	Tester (−) terminal	Tester (+) terminal	Judgement	
			Good	Bad
Terminal board measuring points	P	U	More than 50 kΩ	Approximately Short
		V		
		W		
	U	P	Approximately Short	Resistance present or open
	V			
	W			
	N	U	Approximately Short	Resistance present or open
		V		
		W		
	U	N	More than 50kΩ	Approximately Short
	V			
	W			

(2) G-TR performance judgement

Using a tester (resistance range), measure the resistance of the G-TR emitter, collector and base terminals. Figure 15 shows correct element resistance values. Judge elements according to table 12 G-TR list.

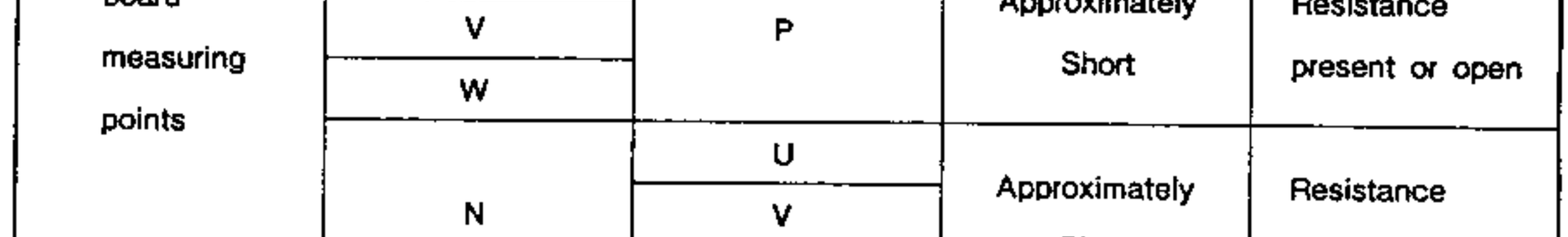


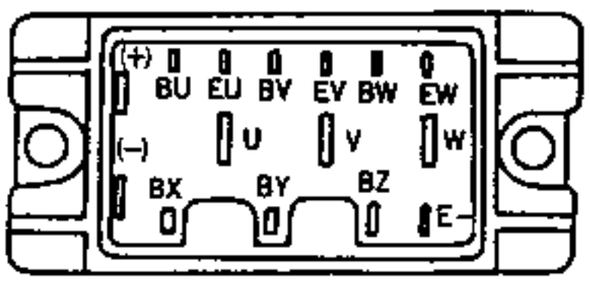
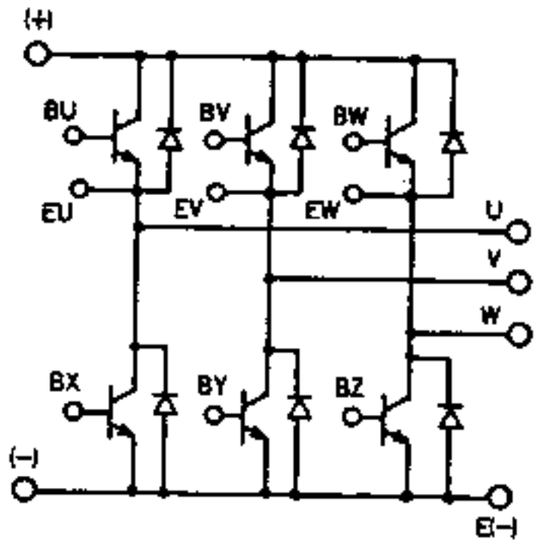
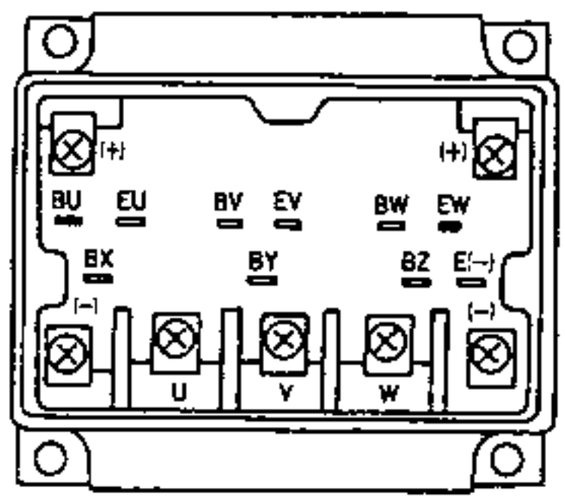
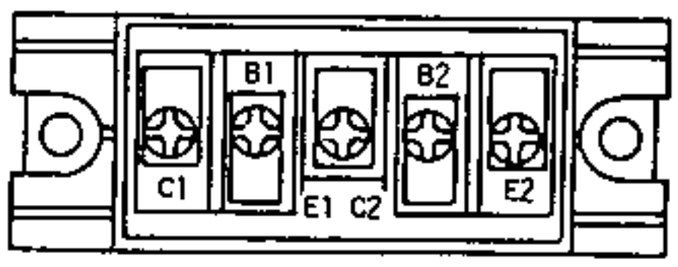
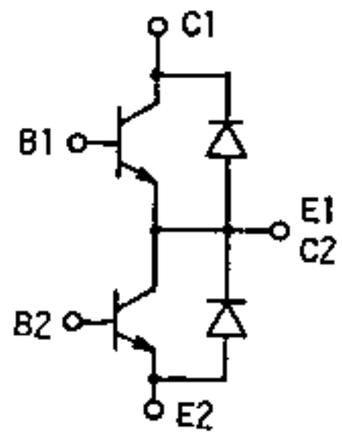
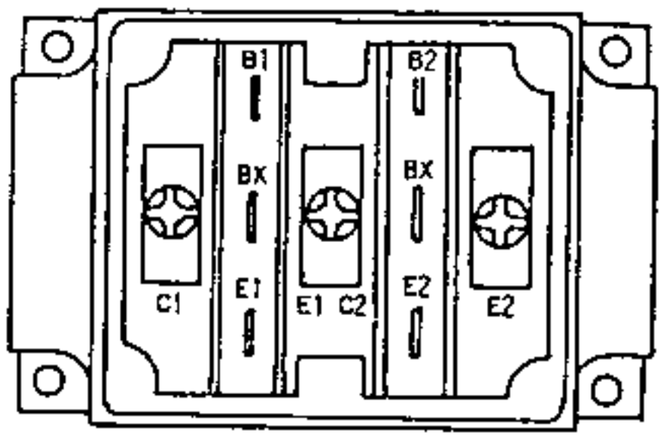
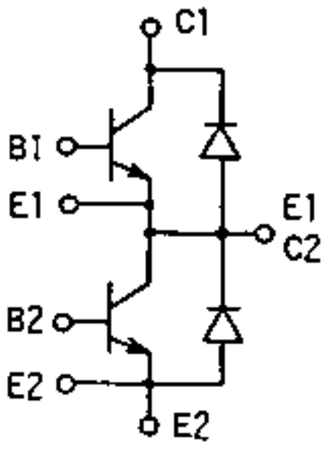
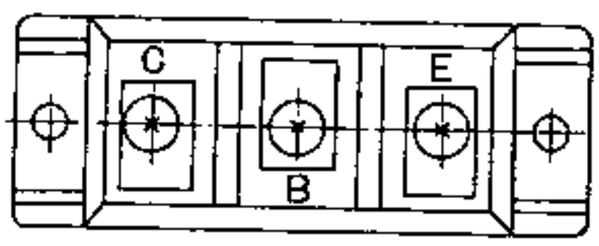
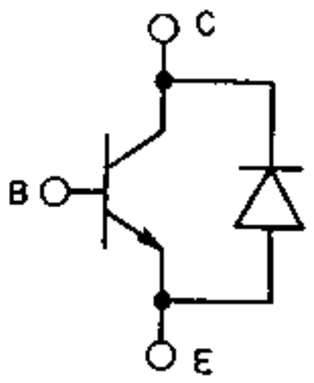
Figure 15 G-TR performance judgement

(normal resistance value)

When the G-TR is replaced, coat a heat-conductive silicon compound on the surface contacting the heatsink.

Silicon compound example: Jointal S-200 (made by Nikkei Kakoo Co., Ltd.) The G-TR tightening torque is 20kg.cm at the terminal and 30kg.cm at the mounting part.

Table 12 G-TR List

SV PACK Capacity	Type-form	Shape	Equivalent Circuit
0.5kVA 0.8kVA	MG15G6EL1		
1 kVA	MG30G6EL1		
2 kVA	MG50G6EL1		
3 kVA	MG75H2CL1		
4 kVA	MG100H2CL1		
6.5kVA	MG150H2CL1		
9 kVA 12 kVA	MG200H1AL2		

12. Recommended spare parts

To reduce the device down time, the following spare parts are recommended.

Table 13 Recommended spare parts

SV PACK		Rank A						Rank B			
Capacity	Type-form	G-TR	Quantity	Base drive board	Quantity	Fuse	Quantity	Control board	Quantity	Capacitor	Quantity
0.5 kVA	SVS-2005B1	MG15G6EL1	1	P6522528G1	1	ACD10 250V-10A	1	P6580129G1	1	400V-470μF	1
0.8	SVS-2008B1										
1.0	SVS-2010B1	MG30G6EL1	1	P6522528G2	1	ACD20 250V-20A	1				
2.0	SVS-2020B1	MG50G6EL1	1	P6522271G1	1	BLA030 30A	1	P6580129G3	1	400V-1000μF	1
3.0	SVS-2030B1	MG75H2CL1	3			BLA040 40A	1	P6580129G2	1	400V-1500μF	1
4.0	SVS-2040B1	MG100H2CL1	3	P6522479G1	1	BLA060 60A	1			400V-1000μF	2
6.0	SVS-2065B1	MG150H2CL1	3			BLA060 60A	1			400V-1800μF	2
9	SVS-2090B1	MG200H1AL2	6	P6522479G1	1	BLA100 100A	1	P6580129G4	1	400V-1800μF	2
12	SVS-2120B1	MG200H1AL2	6	P6522479G1	1	BLA100 100A	1	P6580129G4	1	400V-1800μF	3

(Note 1) Rank A indicates parts that are necessary, and Rank B indicates parts not so necessary.

(Note 2) When you purchase the control board, specify the SV PACK capacity.