6F3E014 5

TOSHIBA

取扱説明書 INSTRUCTIONS FOR

VF PACK-S

(TYPE FORM VF10S)

東京芝浦電気株式会社
TOSHIBA CORPORATION
TOKYO JAPAN

品名記号 CODE V.F.1.0.S.

CONTENTS

1. FOREWORD 2
2. INSPECTION AT PURCHASE 2
3. STANDARD SPECIFICATIONS 2
4. OPTIONAL SPECIFICATIONS 5
5. CIRCUIT COMPOSITION 6
6. PRECAUTIONS FOR APPLICATION 11
6.1 Precautions about Motor 11
6.2 Precautions about Inverter 12
7. INSTALLATION 13
8. WIRING 14
8.1 Standard Connection Diagram 14
8.2 Precautions about Circuit Composition 17
9. OPERATION 19
9.1 Check before Operation 19
9.2 Starting 19
9.3 Jogging 20
9.4 Reversing 21
9.5 Stopping 23
10. ADJUSTMENTS 24
10.1 Variable Resistor Adjustment 24
10.2 Jumper Reconnection 28
11. MAINTENANCE AND INSPECTION 29
12. TROUBLESHOOTING 30
13. EXTERNAL VIEW 35
14. SPARE PARTS 37

1. FOREWARD

Thank you very much for your purchase of the Toshiba general-purpose inverter VF PACK-S (VF10S).

VF PACK-S (VF10S) is a sinusoidal wave PWM controlled voltage type inverter which employs the giant transistor (G-TR), which was developed by the latest semiconductor technology of Toshiba, and a microcomputer.

VF PACK-S (VF10S) may be combined with a general-purpose induction motor to constitute a variable speed drive system that is easy to operate, is highly reliable, and permits automatic control operation, labor saving, and energy saving. Before using your VF PACK-S (VF10S), carefully read this manual so that your VF PACK-S (VF10S) will deliver its superb performance.

Please keep the manual on hand to refer to when checking and servicing your VF PACK-S (VF10S).

2. INSPECTION AT PURCHASE

Carefully handle VF PACK-S (VF10S) not to subject it to shock and vibration when uncrating it.

After uncrating, check:

(1) Whether there are any parts which might have been damaged during transit;

(2) Whether the rated capacity shown on the nameplate is the same as specified in your order.

Contact us if anything amiss is found.

3. STANDARD SPECIFICATIONS

The standard specifications of VF PACK-S (VF10S) are as shown in table 1.

Your specifications or different particulars, if ever, precede the standard specifications.

Table 1 Standard Specifications

Applicable motor power (kW)			0.2	0.4	0.75	1.5	2.2	3.7
Model and ratings	Model	With operation panel	VF10S-2015BO			VF10S-2030BO		VF10S-2050BO
		Without operation panel	VF10S-2015B			VF10S-2030B		VF10S-2050B
	Capacity (kVA)		1.5			3		5
	Rated current (A)		4.5			9		15
Power supply	Voltage, frequency		3-phase, 200 V, 50 Hz; 200/220 V, 60 Hz					
	Allowable variation		Voltage ±10%; frequency ±2 Hz					
Control specifications	Control system		Sinusoidal wave PWM control					
	Output voltage		3-phase, 200/220 V (maximum)					
	Output frequency		3 to 80 Hz					
	Frequency accuracy		±0.5% of highest frequency (at 25°C ±10°C)					
	Voltage/frequency ratio		3 to 60 Hz: V/F constant 60 to 80 Hz: V constant (adjustable with control knob)					
	Overload capacity		150% for 30 seconds; 110% continuous					
	Frequency setting signal		d.c. 0 to 12 V					
Operating function	Acceleration/ deceleration time		1 to 20 seconds (acceleration and deceleration individually adjustable)					
	Braking		By capacitor charge					
	Starting		By 1-a contact (hold)					
	Normal run, reverse		Reversing can be ordered via 1-a contact (hold)					
	Zero speed signal output		Open collector output					

(cont'd)

Protecting function	Protecting function	Stall prevention, overcurrent protection, shortcircuit protection, overvoltage protection, undervoltage protection, momentary power failure protection, burn-out prevention (fuse protection).
	Fault detecting signal	Relay 1-c contact (a.c. 250 V, 2.0 A) (This signal is output if overcurrent, shortcircuit, overvoltage, or undervoltage is detected.)
	Display	Lamp on panel lights when charging capacitor, or when overcurrent, shortcircuit, overvoltage, or undervoltage protection circuit has operated.
Ambient conditions	Place of installation	Indoor
	Ambient temperature	0 to 40°C
	Relative humidity	Less than 90%, no dew
	Vibration	Less than 0.5 G
Construction		non-dustproof type
Instruments installed on panel (where operation panel is provided)		Frequency meter, frequency setting resistor (3 kilohms, 1 W), RUN-STOP switch, pilot lamps (3 pcs)

4. OPTIONAL SPECIFICATIONS

The optional specifications shown in table 2 are available for VF PACK-S (VF10S).

Table 2 Optional Specifications

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Frequency increase</td><td>Maximum frequency can be raised to 160 Hz or 320 Hz by readjustment. In this case, V/F characteristic can be steplessly adjustable in a wide range.</td></tr>
<tr><td>Speed feedback control</td><td>Speed feedback control can be made by installing an optional circuit board. In this case, a motor with a tachometer generator (TG) is necessary.
TG specifications: Single-phase, 24P, 1800 rpm, 25 V</td></tr>
<tr><td>Regenerated power discharge unit</td><td>This unit is used for quick deceleration or stoppage, or where increased braking torque is desired at deceleration under a load with a great moment of inertia. This unit, to be separately installed, is available in some models corresponding to inverter capacities.
<table>
<tr><td>Inverter capacity</td><td>1.5 kVA</td><td>3 kVA</td><td>5 kVA</td></tr>
<tr><td>Discharge unit model</td><td>VF-PB15</td><td>VF-PB30</td><td>VF-PB50</td></tr>
</table></td></tr>
<tr><td>Operation panel</td><td>This is a remote control panel used where the operation panel is not provided. The panel has built-in controls, including a frequency meter, frequency setting resistor, and ON-OFF push-button switch.
Model VF10-CBN</td></tr>
<tr><td>Radio noise filter</td><td>Radios used around the inverter may generate noise. This filter is used for preventing such noise.</td></tr>
</table>

5. CIRCUIT COMPOSITION

Figure 1 shows a block diagram of VF PACK-S (VF10S).

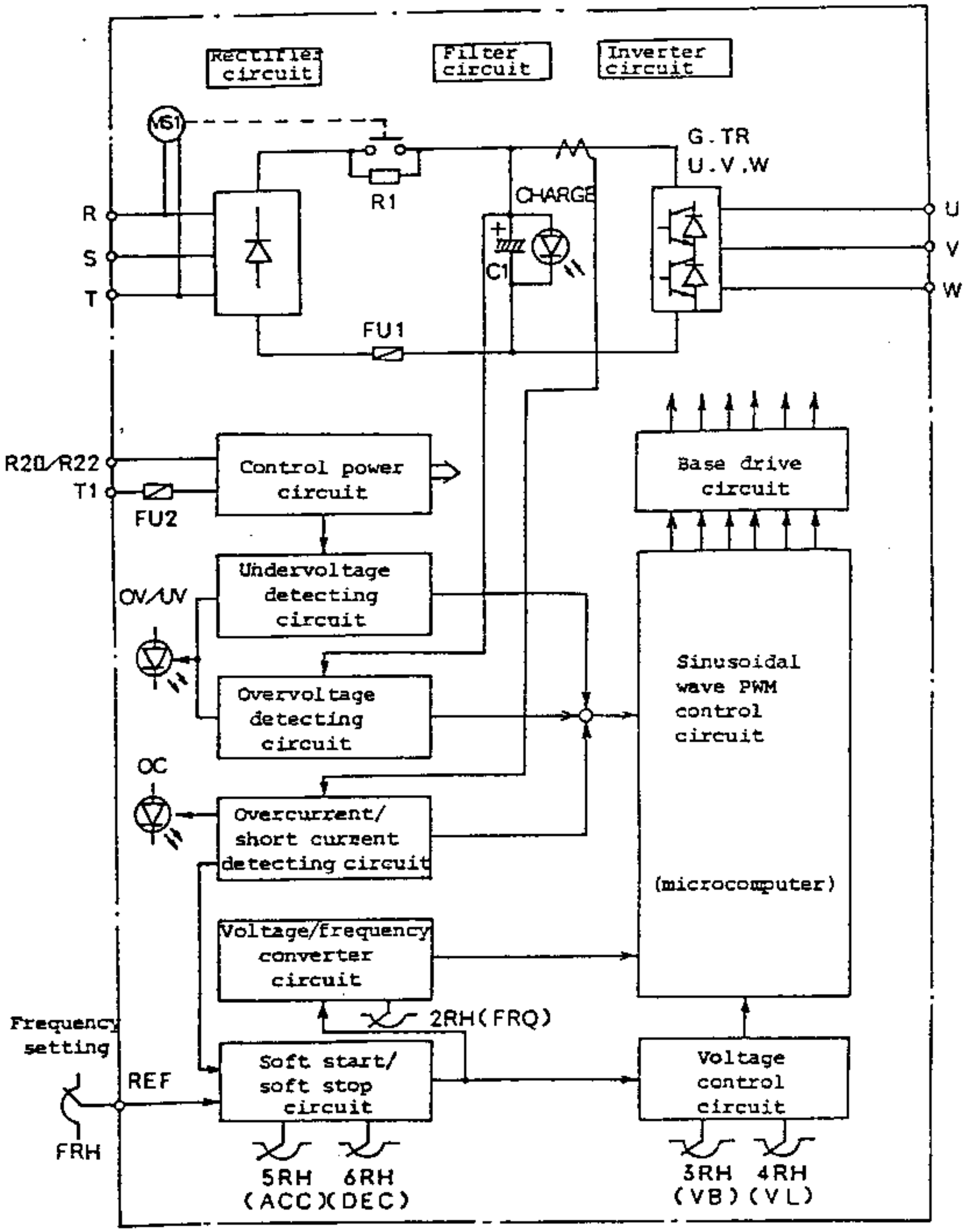


Figure 1 Block Diagram

The operation of each circuit is explained below.

Main circuit

Rectifier circuit — The 3-phase a.c. input is rectified full wage into a d.c. voltage by rectifier elements.

Filter circuit — The d.c. voltage rectified full wave has ripples so it is smoothed by capacitor C1.

Inverter circuit — The d.c. voltage is converted back into an a.c. voltage output by sequentially switching G-TR U, V, and W. In this case, an approximate sinusoidal wave is obtained by simultaneously controlling output voltage levels by changing the pulse width ratio of the output voltages.
This control system is called the sinusoidal wave PWM (Pulse Width Modulation) control system.

Control circuit

Soft start/ soft stop circuit — This circuit outputs a gentle voltage variation against a sharp variation of the frequency reference voltage. Acceleration and deceleration time can be independently set.

Control circuit (cont'd)

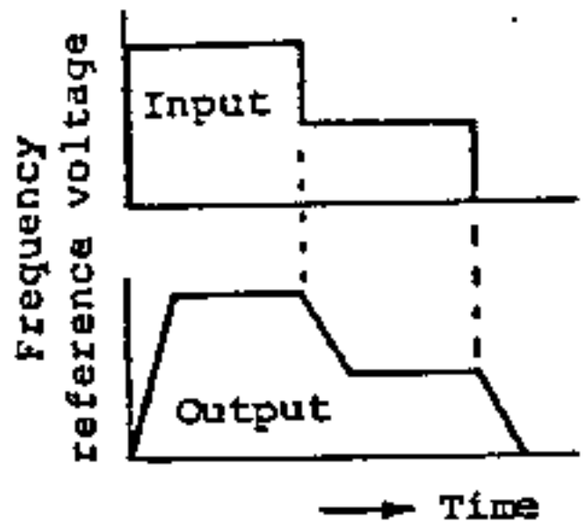


Figure 2 Soft Start/Soft Stop Circuit Input and Output Signals

Voltage/frequency converter circuit

This circuit sets an output frequency. Its input/output relationship is as shown in figure 3. That is, the circuit outputs a frequency directly proportionate to the frequency reference voltage.

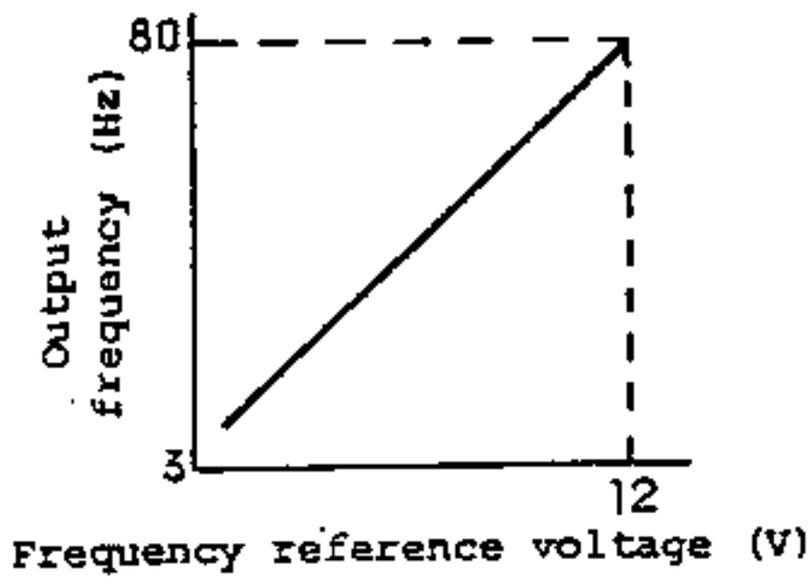


Figure 3

Voltage control circuit

This circuit sets an output voltage. As shown in figure 4, the circuit outputs a voltage directly proportionate to the frequency reference voltage.

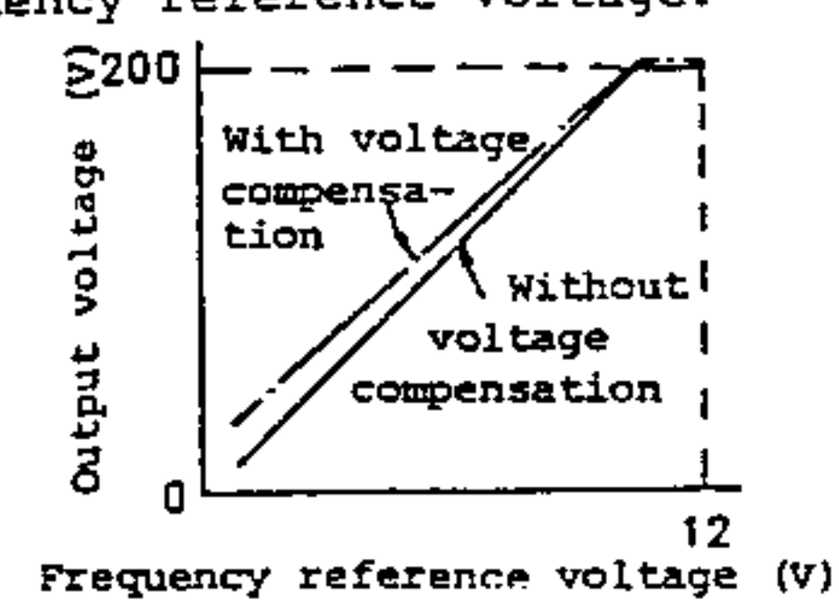


Figure 4

Control circuit

(cont'd)

Sinusoidal wave PWM control (microcomputer)

The microcomputer receives commands from the voltage/frequency converter circuit and voltage control circuit, calculates the pulse width from moment to moment, and outputs a PWM signal having a sinusoidal wave distribution pulse width.

Base drive circuit — This circuit speedily and efficiently drives the G-TR U, V, and W of the reverse converter circuit.

In addition, VF PACK-S (VF10S) has the following circuits for protection.

Protecting circuits

Overcurrent detecting circuit — This circuit detects the motor current, and keeps monitoring the load factor. If the circuit judges the inverter overloaded, it automatically adjusts the voltage and frequency (to prevent stalling). If the current is still higher, the circuit cuts off the G-TR base to protect the equipment, and simultaneously outputs a fault signal from relay FL. (The "OC" lamp lights.)

Protecting circuits (cont'd)

Short current detecting circuit

If the output terminal is accidentally shorted, the circuit immediately detects the abnormal current and cuts off the G-TR base to protect the equipment, and simultaneously outputs a fault signal from relay FL. (The "OC" lamp lights.)

Overvoltage detecting circuit

The d.c. circuit's voltage rises if the power generated from the load is high during deceleration. The circuit detects this overvoltage, and automatically adjusts deceleration.
If the voltage is still higher, the circuit cuts off the G-TR base to protect the equipment, and simultaneously outputs a fault signal from relay FL. (The OV/UV lump lights.)

Undervoltage detecting circuit

If the source voltage is below the rated level, the circuit cuts off the G-TR base to protect the equipment, and simultaneously outputs a fault signal from relay FL. (The OV/UV lamp lights.)

Main DC circuit fuse

The equipment can be protected from almost any kinds of trouble by the above-mentioned protecting circuits. In case the equipment cannot be protected by them due to some cause, the main circuit fuse blows out to protect the equipment.
If the fuse is burnt out, there must be some trouble with the equipment. Be sure to remove the cause of the trouble before operating the equipment again.

Protecting circuits (cont'd)

Control circuit fuse — This fuse protects the equipment from an overcurrent due to control circuit trouble.
If the fuse is burnt out, there must be something wrong with the equipment. Be sure to remedy the trouble before resuming equipment operation.

Momentary failure protection — In case of a momentary power failure, the equipment is kept in operation without operating fault signal relay FL.

6. PRECAUTIONS FOR APPLICATION

6.1 Precautions about Motor

a. VF PACK-S (VF10S) is a sinusoidal wave PWM control system, but its output voltage and current do not have a perfect sine waveform but a distorted waveform close to a sine wave. Therefore, the motor temperature, noise, and vibration increase to some extent as compared with the case of operating on a commercial power supply.

b. VF PACK-S (VF10S) is capable of variable frequency operation of about 1 to 25. When using a general-purpose motor, however, torque reduction is necessary for motor operation at low speed because of insufficient cooling effect.

c. In case of operating VF PACK-S (VF10S) in combination with a general-purpose motor, torque reduction is necessary at low speed, and because the load current falls as the rotating speed (frequency) falls, the equipment might not be protected by the overcurrent relay.

In that case, mount a thermal relay with a built-in winding on the motor beforehand.

d. Consult us if you are planning to operate the equipment in a high speed range exceeding 60 Hz because there are limitations on mechanical strength and bearings. In applications involving an optional frequency increase, use the high speed motor specially designed for the inverter.

e. In case of using a reduction gear or geared motor of oil lubrication type, contact the reduction gear manufacturer for information on the effective speed range because lubrication will be ineffective in the low speed range.

f. In case of using a brake motor, be sure to connect the brake power cable to the primary side of the inverter and switch the brake power on and off simultaneously with the inverter.

6.2 Precautions about Inverter

a. VF PACK-S (VF10S) has a protective function against overcurrent. It is set to a current level suitable to a motor of maximum applicable capacity.
If you are using an inverter of large capacity (kVA) in combination with a motor of small capacity (kW), the current level (for starting, for example, a high GD^2 load) may have to be readjusted depending on the application.

b. Do not use an inverter of small capacity (kVA) in combination with a motor of large capacity (kW) at small load level because, even if the meter reads less than the rated amperage of the inverter, current ripples will exceed the permissible level.

c. A capacitor for power factor improvement cannot be attached to the output end of the inverter. When using a motor with a power factor improving capacitor, remove the capacitor.

d. A specification change to 400/440 V cannot be made. If your power supply is 400/440 V, step it down to 200/220 V with a transformer, and operate your motor also on 200/220 V power.

7. INSTALLATION

Install VF PACK-S (VF10S) securely by using the mounting holes in its base. With the connecting terminal board down, install the inverter upright, and leave sufficient space around it for ventilation as shown in figure 5.

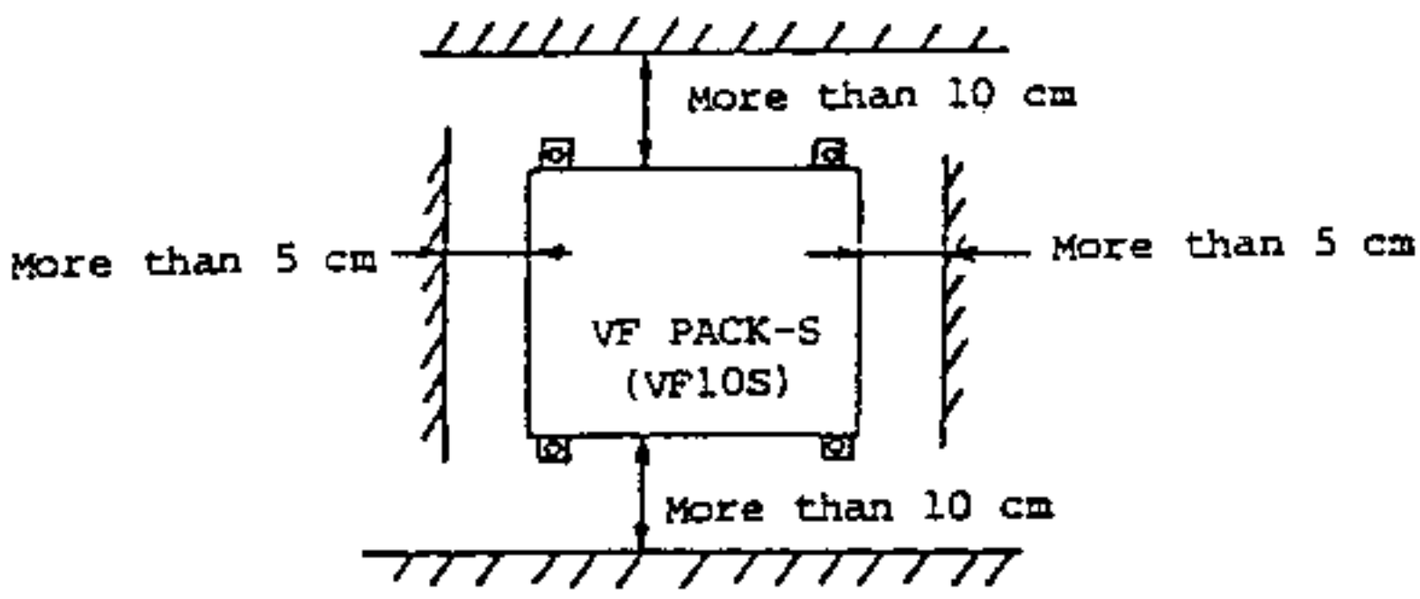


Figure 5 Inverter Installation

Observe the following instructions in selecting a place of installation.

(1) Ambient temperature: 0 to 40°C (around the box)
Be sure of sufficient ventilation to keep the place cool. If there is a separate heat source in case of installing the inverter inside a self-standing cabinet or in a large-sized control panel, it is recommended that the operation panel be mounted separately and that the covers be removed during use.

(2) Avoid a place where it is hot, moist, dusty, or has much iron dust.

(3) Choose a place free of corrosive gases and machine coolants.

(4) Choose a place free of vibration, other power switches nearby, noise sources, where it is easy to check and maintain.

(5) When using a regenerated power discharge unit (option), install it near the inverter to wire them over as short a distance as possible.

8. WIRING

8.1 Standard Connection Diagram

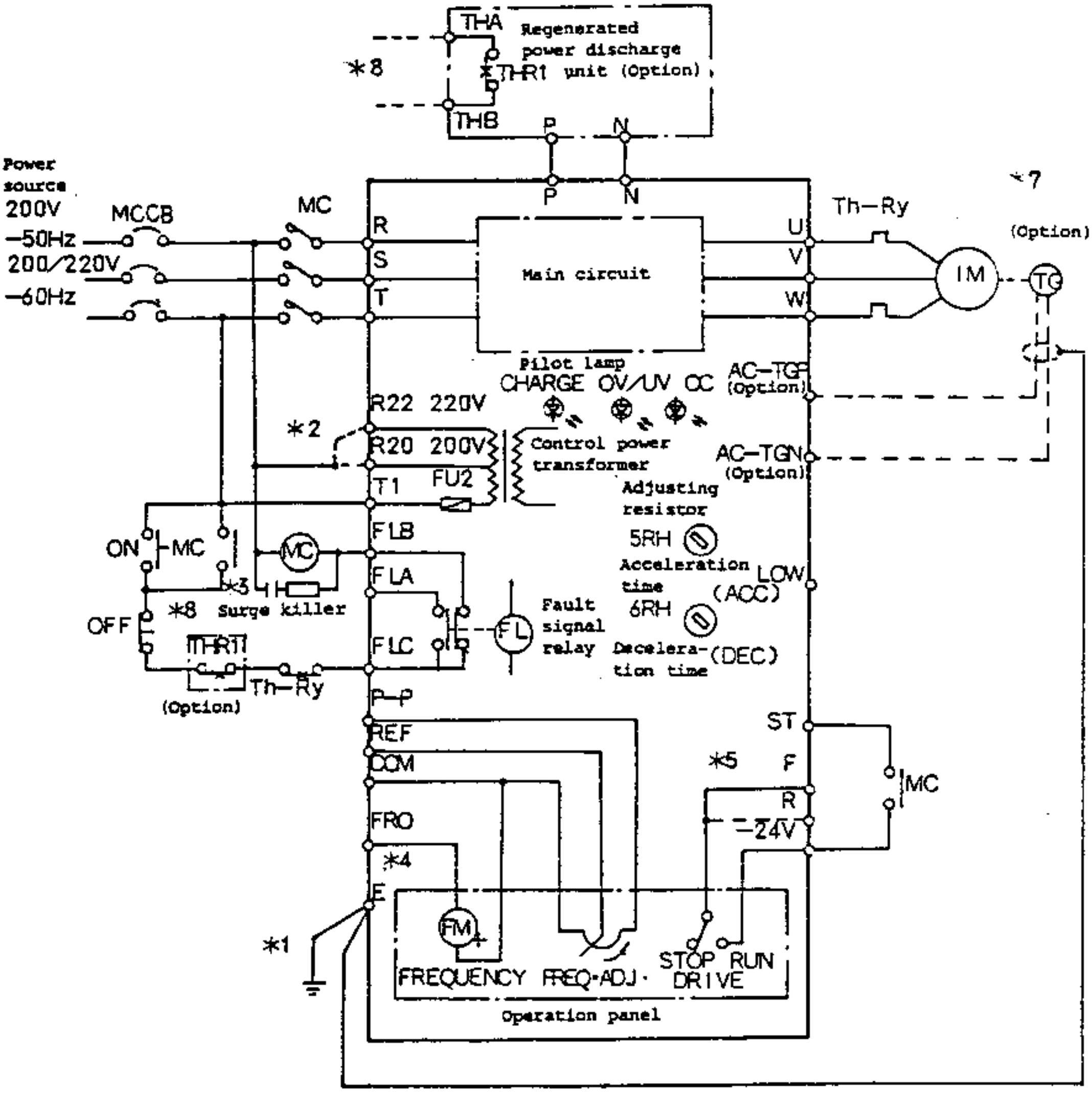


Figure 6 Standard Connection Diagram (with operation panel)

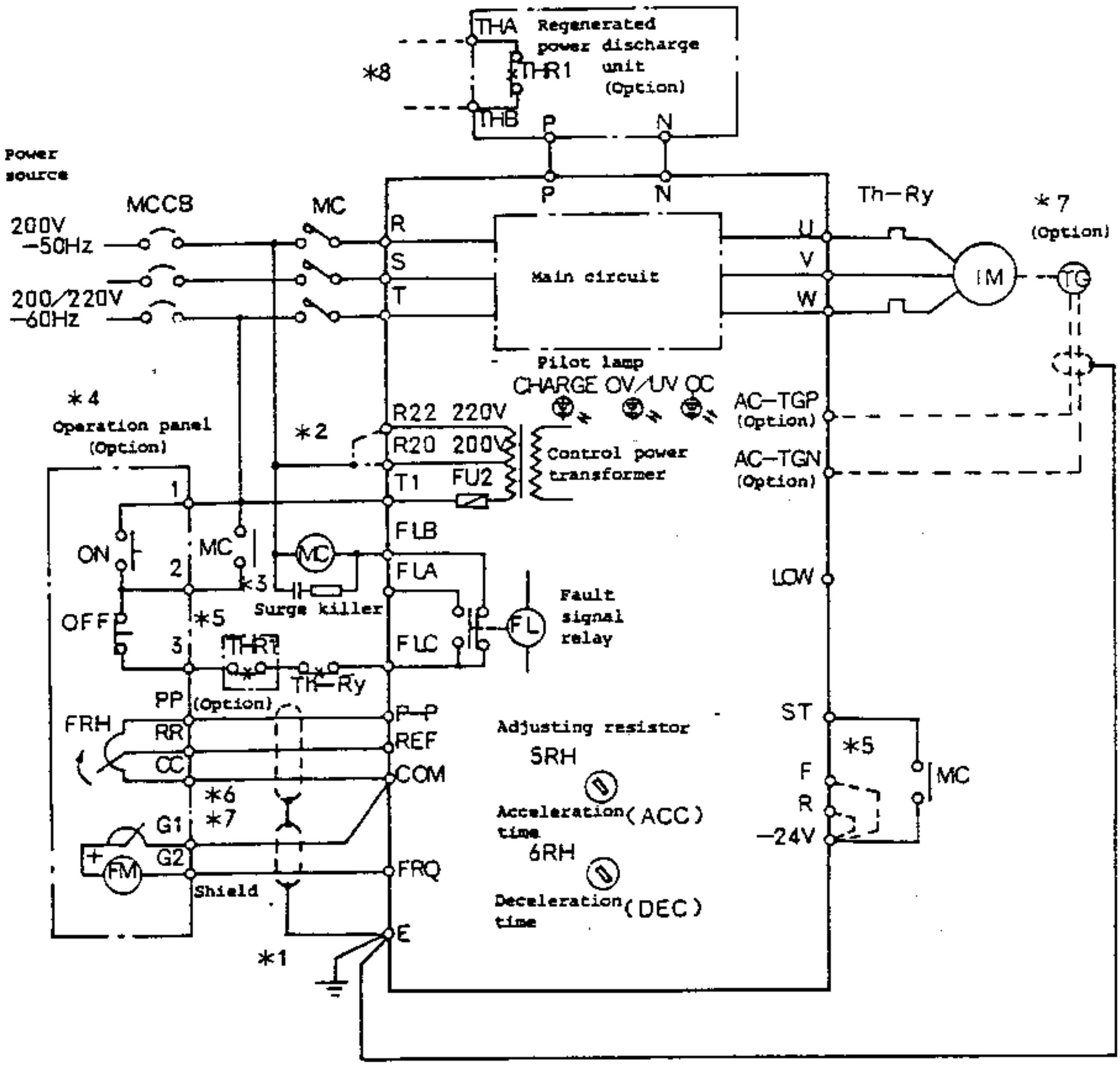
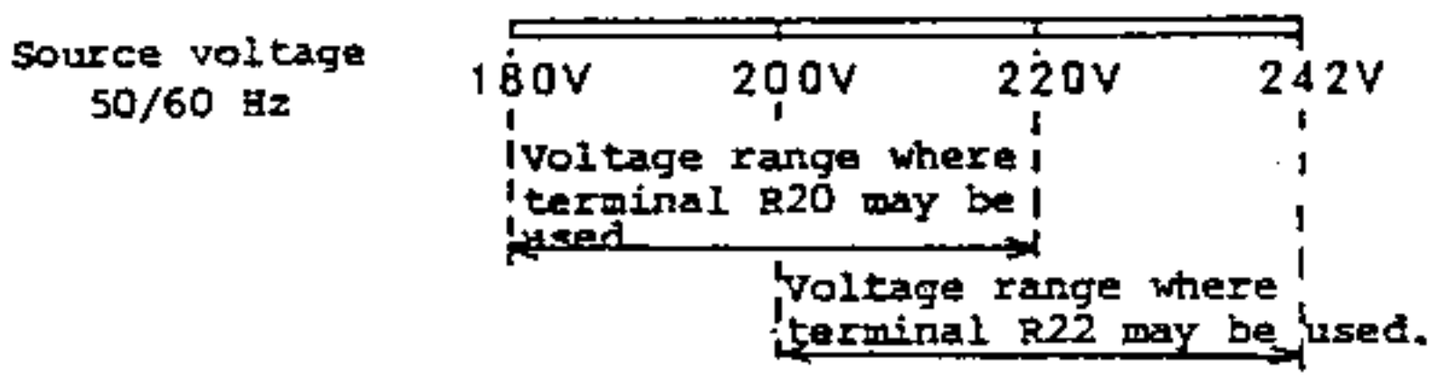


Figure 7 Standard Connection Diagram
(without operation panel)

*1 Be sure to ground the grounding terminal "E" with a wire 3.5 mm^2 or larger in sectional area.

*2 Connect the control power input terminal to either terminal "R20" or "R22" as suitable to the source voltage according to the following standard.
If the voltage will not drop below 200 V, terminal "R22" may be used in almost all cases.



*3 Be sure to connect a noise suppressor to the exciting coil of the electromagnetic contactor "MC".
In case of building VF PACK-S (VF10S) into your control panel, also connect noise suppressor to the other electromagnetic contactors and relays in the same control panel. In this area, select noise suppressor suitable to the relay capacities.
It is suggested that the noise suppressor be connected as close to the electromagnetic contactors and relays as possible.

*4 Where the operation panel is supplied, the operation block is built inside the inverter. Where no operation panel is supplied, it is necessary to have an optional separate operation panel ready.

*5 Connect either terminal "F" (normal run) or terminal "R" (reverse run). The inverter furnished with an operation panel has its terminal "F" (normal run) connected before shipment. If reverse run is desired, change the connection to terminal "R" (reverse run).

*6 Where no operation panel is supplied, use a 3-conductor shielded cable for wiring to a frequency setter "FRH" on the operation panel. Connect the shielded cable covering to grounding terminal "E".

*7 Where no operation panel is supplied, use a 2-conductor shielded cable for connecting a frequency meter "FM" on the operation panel. Connect the shielded cable covering to grounding terminal "E".
In case of speed feedback control (option), use a 2-conductor shielded cable for connecting a "TG" (tachometer generator), and connect the shielded cable covering to grounding terminal "E".

*8 In case of using the regenerated power discharge unit (PB unit) as an optional unit, connect terminals P and N on the PB unit to terminals P and N (large-capacitance electrolytic capacitor terminals) inside the inverter over as short a distance as possible.
Also connect the contact point of overcurrent relay THR1 that is built into the PB unit in series to the ON-OFF sequence block.

8.2 Precautions about Circuit Composition

(1) Be sure to connect the input terminals (R, S, T) and output terminals (U, V, W) of the main circuit correctly. Even if the phase order of the input terminals (R, S, T) or output terminals (U, V, W) is wrong, the equipment can be normally operated.
The motor will run backward if two of the three leads of output terminals U, V, W are reconnected.

(2) For protecting the input power supply, use a molded circuit breaker, "MCCB", or fuse suitable to the capacity outside the inverter. It is indispensable for protecting the power line from grounding or shorting, and for protecting the system from fires.

(3) If some trouble occurs due to some cause during operation, the power (electromagnetic contactor "MC") must be immediately switched off to prevent the trouble from spreading.
Be sure to prepare an external sequence to cut off the main power with the fault signal relay (signal output terminals "FLB", "FLC") as shown in figure 6.

(4) Do not use an electromagnetic contactor between the inverter and load motor. Switching the load on and off by the electromagnetic contactor between them can break down the equipment.

(5) The main circuit power supply and control circuit power supply may be simultaneously switched on and off, but the sequence must be such that the main circuit power will not be switched on first.

(6) Connect the auxiliary contact (contact a) of the electromagnetic contactor (MC) across terminal "ST"-("-24V").
If MC has no auxiliary contact, use a separate auxiliary relay.

(7) If the operation panel (option) is not used where no operation panel is supplied, adjust the frequency setter and frequency meter to the specifications of the operation panel (option).

(8) Do not bundle the cables of the main circuit and control circuit with other signal lines.
For protecting the motor from overloads by torque reduction at low speed, a thermal relay with a built-in winding must be attached to the motor.

(9) Table 3 shows examples of selecting molded circuit breakers ("MCCB"), electromagnetic contactors ("MC") and overcurrent relays ("TH-RY").

(10) The motor is protected from overloads by the overcurrent relay TH-RY installed between the inverter and motor. Connect the contact point of the overcurrent relay in series to the ON-OFF sequence. Select an overcurrent relay suitable to the motor.

Table 3 Main Circuit Wiring Device Selecting Examples

Inverter		Applicable motor output (kW)	Molded circuit breaker MCCB		Electromagnetic contactor MC		Overcurrent relay TH-RY	
Model	Capacity (kVA)		Rated current (A)	Toshiba type	Capacity (A)	Toshiba type	Adjusting current (A) (Reference value)	Toshiba type
VF10S -2015BC -2015B	1.5	0.2	5	S30B	12	(Note) C-10V	1.3	R10S
		0.4					2.3	
		0.75					3.6	
VF10S -2030BC -2030B	3	1.5	15	S30B	12	(Note) C-10V	6.6	R10S
		2.2					9.3	
VF10S -2050BC -2050B	5	3.7	20	S30B	18	C-20	15	R20

(NOTE) Use 5 A electromagnetic contactor for composition of contact.

9. OPERATION

9.1 Check before Operation

Check the following before starting operation.

(1) Check the wiring once again for errors.

(2) Check the source voltage whether it is 200 V/220 V ±10%.

(3) Check the control power transformer's terminals "R20" or "R22" (200 V or 220 V) whether it matches the source voltage.

9.2 Starting

(1) Close the molded circuit breaker "MCCB" and electromagnetic contactor "MC", and see that the alarm lamp "CHARGE" lights.

(2) If the inverter has the operation panel, set the DRIVE (RUN-STOP) switch to the RUN position. The motor starts running when the frequency setter FREQ ADJ is turned clockwise.

Check that the motor runs in the correct direction.
Check the operating frequency with the frequency meter FREQUENCY.
(If the inverter has no operation panel, there is no DRIVE switch. The motor starts running when the frequency setter FRH is turned clockwise. Check the operating frequency with the frequency meter "FM".

(3) If the inverter has the operation panel, the scale of the frequency meter FREQUENCY is calibrated before shipment from the factory.
If the inverter has no operation panel, calibrate the frequency meter to indicate the maximum frequency (standard setting: 80 Hz) when the frequency setter "FRH" is set to the maximum notch, using a calibration resistance. Switch power off before the zero calibration of the frequency meter. The pointer of the frequency meter may shift slightly to the negative when the DRIVE switch is set to the STOP position, but it signifies no trouble. Use the frequency meter as it is.

(4) The operating frequency (inverter output frequency) changes according to the preset acceleration time and deceleration time. Accordingly, the motor is accelerated and decelerated corresponding to the variation of the operating frequency.

(5) Slowly accelerate and decelerate the motor, and check that the load motor and its mounting base are free of much vibrating points.

9.3 Jogging

If the inverter has the operation panel, the DRIVE switch may be used for jogging.

If the inverter has no operation panel, a jog switch can be installed as shown in figure 8 for jogging.

The operating frequency varies with the preset acceleration time and deceleration time. Jogging over a short time can cause the overcurrent detecting circuit ("OC") or the overvoltage detecting circuit ("OV") to operate.

If the fault signal relay has operated, check for the cause, and increase the time setting or take other suitable steps.

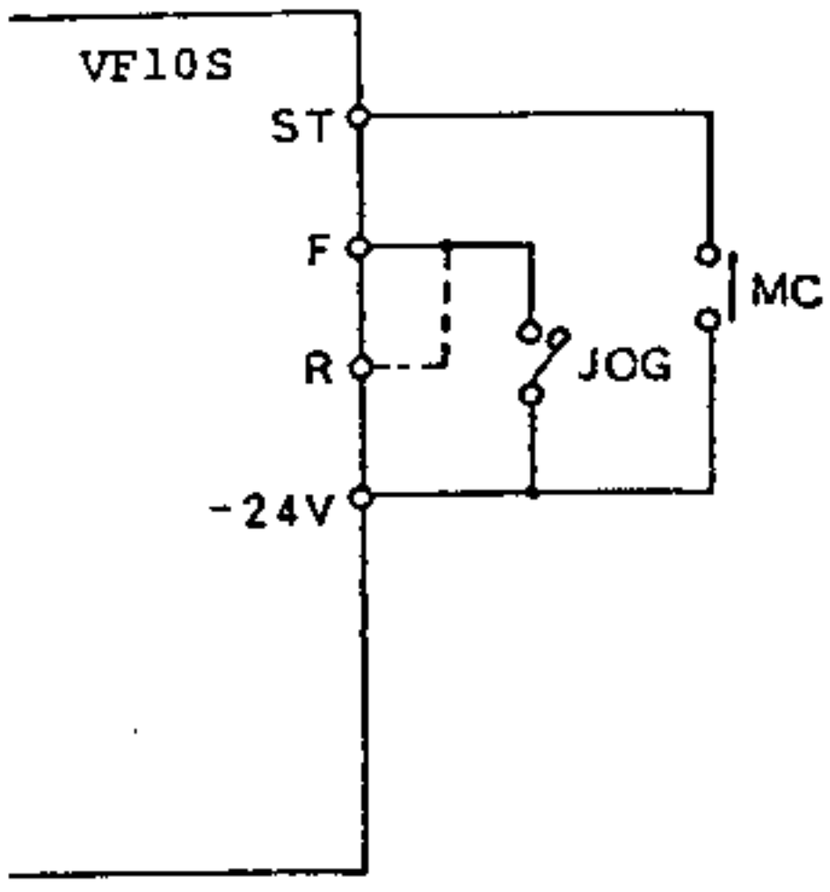


Figure 8

9.4 Reversing

If the inverter has the operation panel, install a reverse switch can be installed as shown in figure 9.

If the reverse mode is selected when the motor is running in normal direction, the motor slows down, the phase order is reversed, and the motor is accelerated reverse direction.

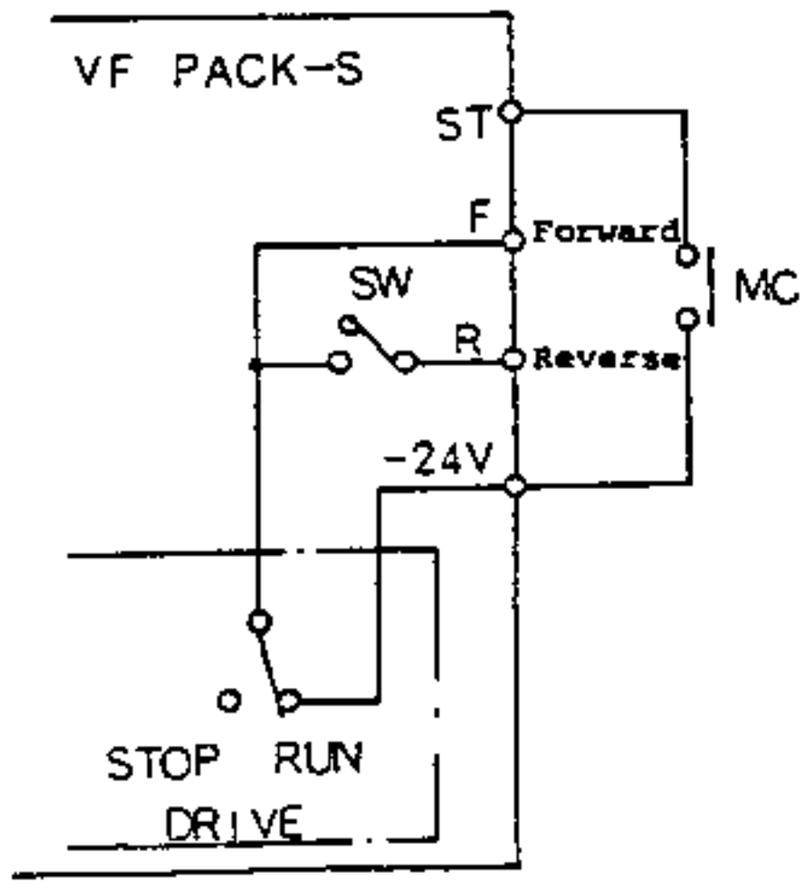


Figure 9

If the inverter has no operation panel, similarly reversing can be made if a reverse switch is installed as shown in figure 10.

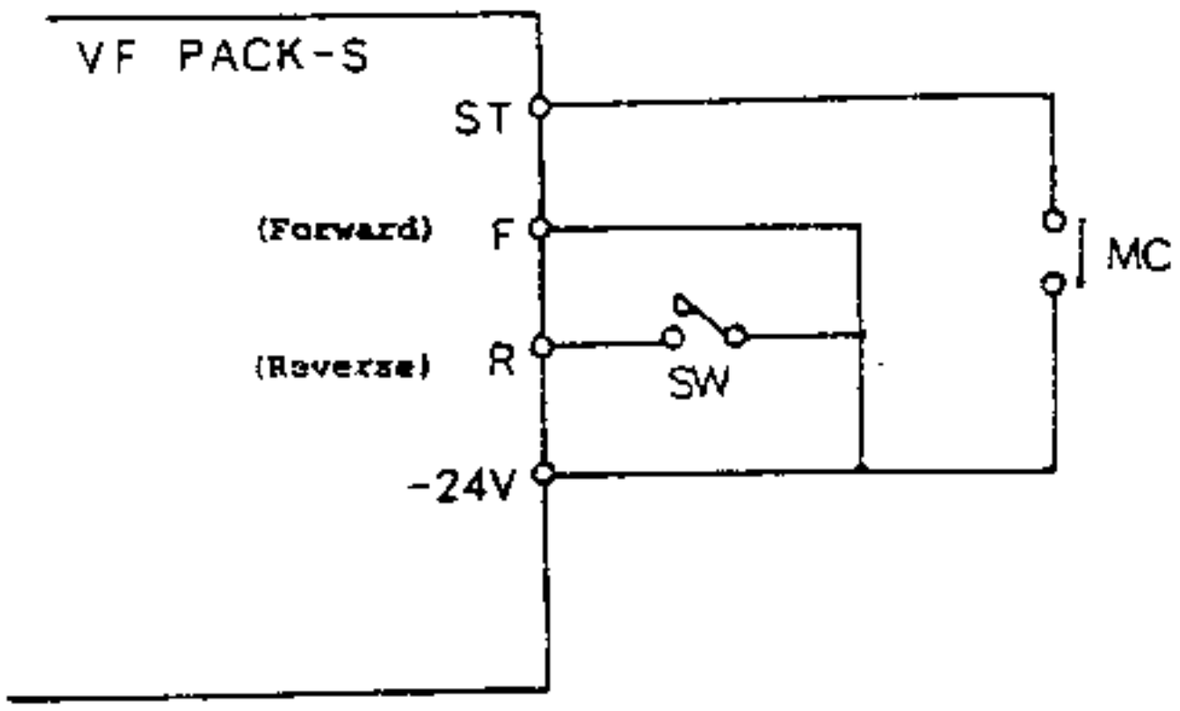
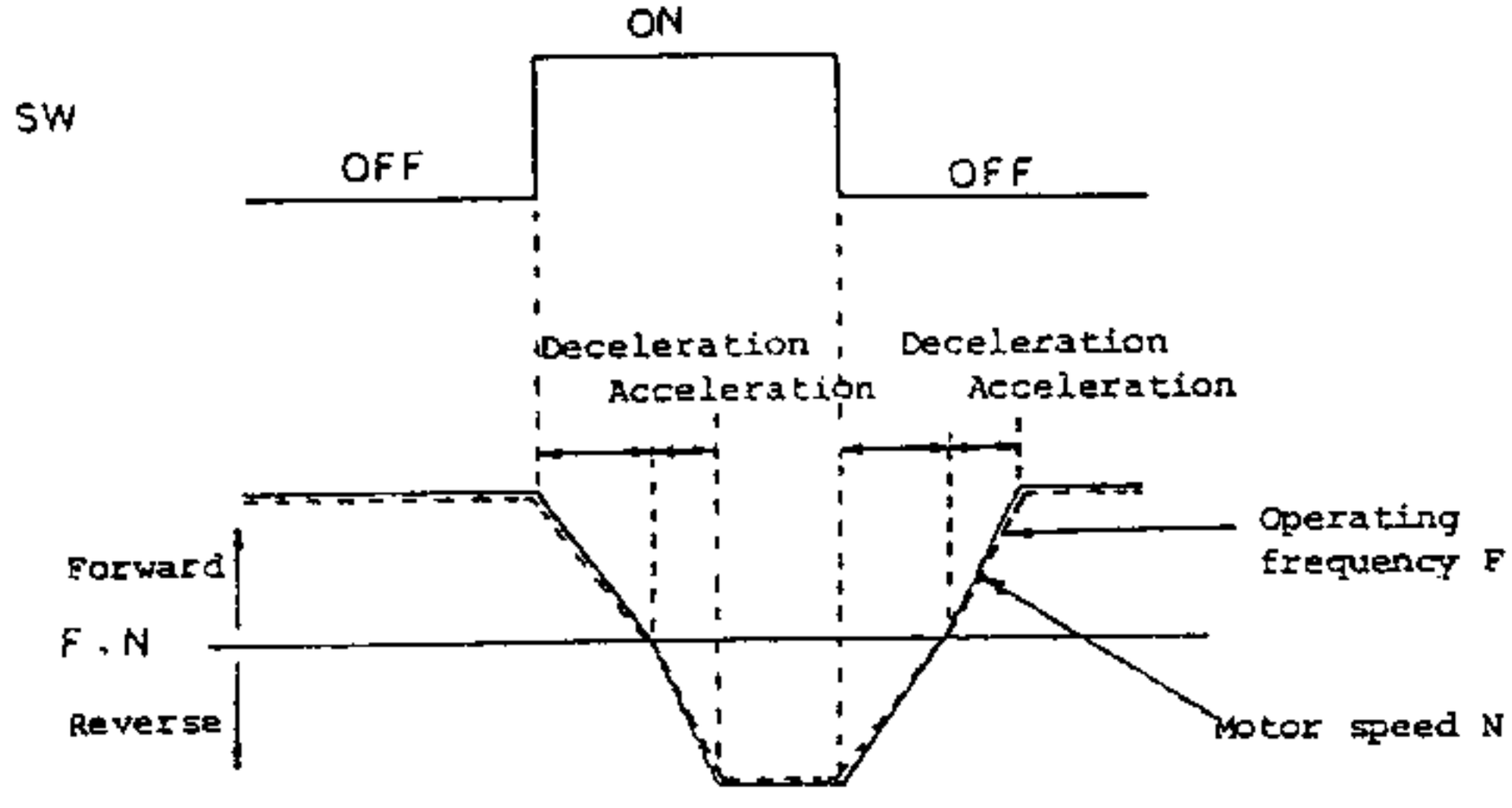


Figure 10

Reverse timing is as shown below.



Phase order reversing is controlled by the microcomputer. Acceleration and deceleration times are the same as the preset acceleration and deceleration times as in jogging. If both a forward signal (F) and a reverse signal (R) are applied, the motor runs backward.

9.5 Stopping

(1) If the frequency setting resistor is turned counter-clockwise during motor operation, the motor slows down due to braking.

(2) If the DRIVE switch is turned off during motor operation, the motor is braked down to 3 Hz, and runs free below 3 Hz until it comes to a stop.

(3) If the electromagnetic contactor or molded circuit breaker is opened during motor operation, the motor runs free and comes to a stop.

(4) If any protecting function (overcurrent, shortcircuit, overvoltage, undervoltage) of the inverter, or over-current relay "TH-RY" has operated, the inverter is brought to an emergency stop, automatically opening the electromagnetic contactor "MC" and setting the motor to free run.

(5) If any of the protecting function has operated, the alarm lamps light as follows:

OV/UV: Lights if the overvoltage or undervoltage detecting circuit has operated.

OC: Lights if the overcurrent or shortcircuit detecting circuit has operated.

If the OV/UV or OC lamp lights, switch power off, and remedy the trouble before restarting operation.
Keep the control power supply switched off for more than 5 seconds in resetting.

(6) If it is necessary to bring the inverter to an emergency stop in system applications, open the electromagnetic contactor MC. The motor runs free in this case.

10. ADJUSTMENTS

10.1 Variable Resistor Adjustment

The variable resistors are adjusted to the specifications before shipment from the factory, and therefore must not be touched unless necessary. If a readjustment is necessary, refer to table 4. The locations of the variable resistors (RHs) are shown in figure 11.

[Precautions for Adjustment]

(1) Small-sized precision variable resistors are employed. Use a screwdriver that has a slender tip and an insulated grip.

(2) When power is switched on, a high voltage (300 V d.c.) is applied to part of the printed circuit board. So good care must be exercised when making an adjustment. Care must also be taken because the large-capacitance electrolytic capacitors retain the charged voltage for about 15 minutes after power is switched off.

(3) A digital counter and synchroscope are necessary for readjustments. Do not ground the grounding terminal of the instruments when connecting them. Make sure that the input current to the instruments connected is 1 mA or less.

(4) When checking waveforms with a synchroscope or other probe, be sure to switch power off before connecting or removing the probe.

Table 4 Description of Variable Resistors (RHs)

RH No.	Symbol	Adjusting object	Turning RH in arrow direction	Adjustment before shipment	Remarks
1RH	OV	Overvoltage level	Overvoltage level decreases.	Optimum	
2RH	FRQ	Maximum output frequency	Output frequency increases.	80 Hz	
3RH	VB	Minimum output voltage	Minimum output voltage increases.		Note 1
4RH	VL	Maximum output voltage	Maximum output voltage increases.	100%	Note 2
5RH	ACC	Acceleration time	Acceleration time lengthens.	10 sec.	1 to 20 sec., adjustable (Note 2)
6RH	DEC	Deceleration time	Deceleration time lengthens.	10 sec.	1 to 20 sec., adjustable (Note 3)
7RH	FM ADJ	Frequency meter	Frequency meter pointer swings over wider range.	80 Hz	
TG Feedback Circuit Board (Option)					
8RH	TGR	Response speed	Response speed increases.		
9RH	TGV	Voltage feedback rate	Voltage feedback rate decreases.	1800 rpm 25 V	
Regenerated Power Discharge Unit (Option)					
1RH	OVL	Discharge voltage level	Discharge voltage level increases.	Optimum	

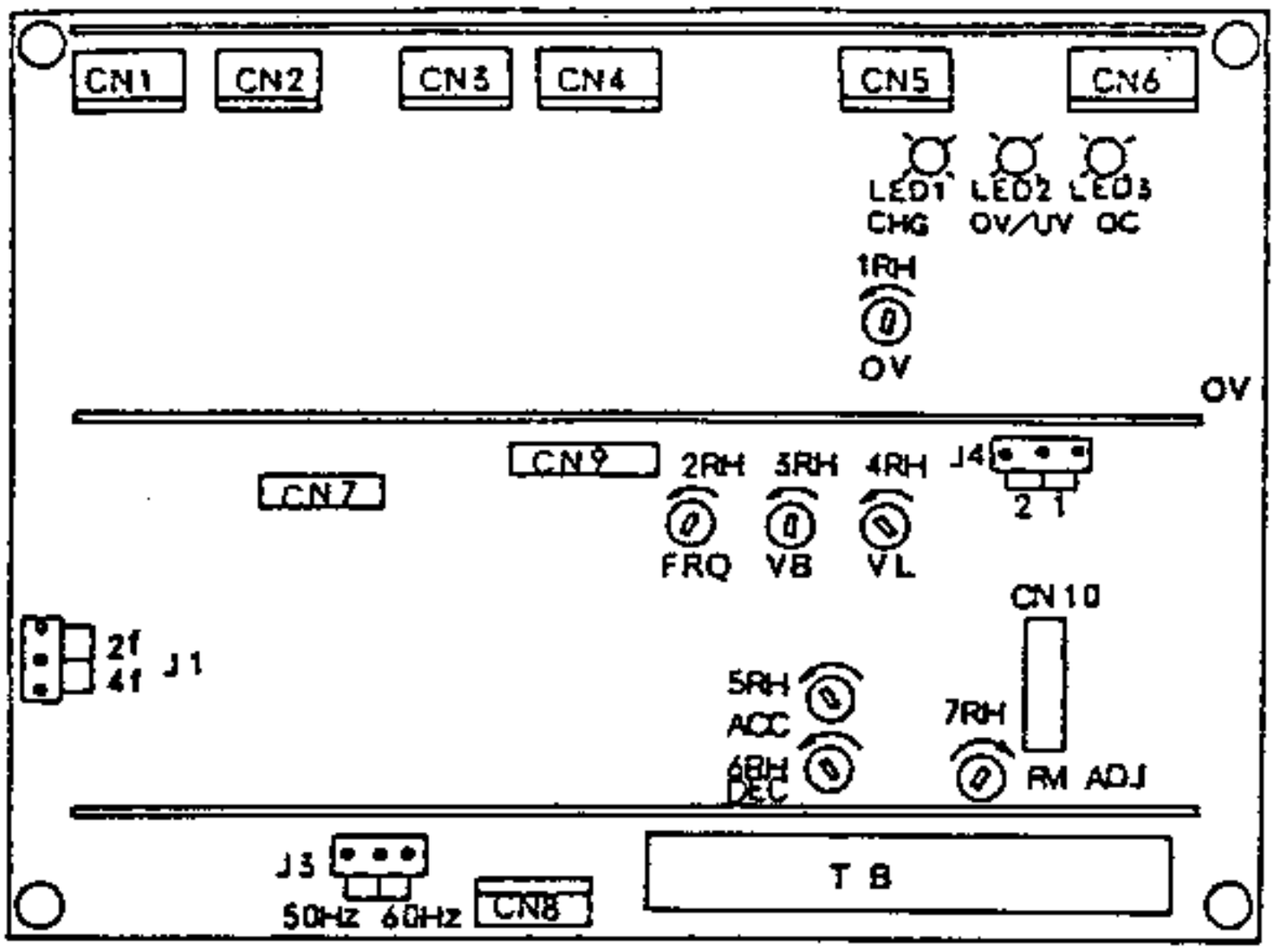
Note 1: If the motor cannot be started due to starting torque shortage, adjust 3RH to raise the minimum output voltage. This will raise the maximum output voltage so adjust 4RH to the maximum voltage at 60 Hz.

Note 2: If the speed does not increase as much as the maximum frequency, the acceleration time must be lengthened. Depending on cases, the overload relay might trip. If the load torque or the moment of inertia is known, the acceleration time can be calculated by the following equation. It is advised, however, that a longer acceleration time be selected for actual applications.

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

where ΣGD^2 (kg.m^2): (Motor GD^2) + Load GD^2 (in terms of motor shaft);
N (rpm): Maximum motor speed;
T_M (kg.m): Motor torque;
T_L (kg.m): Maximum load torque;
t_A (S): Acceleration time.

Note 3: Part of the regenerated power from the motor to the power supply during deceleration is lost in the motor and the remainder is charged into the capacitors.
If the motor is abrupted decelerated, the capacitor voltage rises to operate and trip the overvoltage detector (lighting the OV/UV lamp). In that case, lengthen the deceleration time setting (by turning 6RH in the arrow direction).
Do not touch the other RHs than the acceleration and deceleration time setting variable resistors (5RH, 6RH) because they are adjusted to optimum before shipment from the factory.



ST	F	R	-24V	P-P	REF	COM	FRQ	LOW	FLA	FLB	FLC
1	2	3	4	5	6	7	8	9	10	11	12

ST: Connect to terminal "-24V", and the inverter is ready for starting operation.

F.R.: Forward and reverse command input terminals. Connect either one of them to terminal "-24V".

P-P: Frequency setting resistor power supply, generating 12 V with "COM".

REF: Frequency setting resistor output terminal, generating 0 to 12 V with "COM".

COM: Control circuit OV

FRQ: Frequency meter terminal, generating 0 to -12 V with "COM".

LOW: Low-speed detecting signal terminal (open collector output 100 mA maximum). Connect a relay between it and terminal "-24V" for detecting low speed.

FLA: An a-contact output is produced between it and "FLC" if a failure occurs.

FLB: An b-contact output is produced between it and "FLC" if a failure occurs.

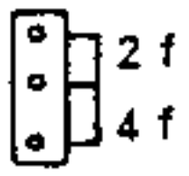
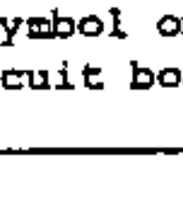
Figure 11 Printed Circuit Board Parts Arrangement Diagram with Enlarged View of Terminal Board

10.2 Jumper Reconnection

Do not touch the jumper wires unless necessary because they are connected to the specifications before shipment from the factory.

See figure 11 for the jumper locations. The functions of the individual jumpers are shown in table 5.

Table 5 Description of Jumpers

No.	Symbol on circuit board	Function	Connection before shipment	Remarks
J1		2f: Output frequency is raised twice as high. 4f: Output frequency is raised four times as high.	Not connected	
J3		60 Hz: Maximum output frequency 80 Hz 50 Hz: Maximum output frequency 67 Hz	Position 60 Hz	
J4		Voltage control amplifier gain switching Gain is doubled at Position 2.	Position 1	Note 1

Note 1: J4 and J1 are to be reconnected simultaneously. Do not touch these jumper unless necessary because their connecting method may differ with the characteristics of the motor used.

Note 2: Do not touch any other jumpers than mentioned in table 5 because they are connected only at our factory.

11. MAINTENANCE AND INSPECTION

VF PACK-S (VF10S) is a control device composed mainly of semiconductors so it has few mechanical parts that are subject to wear, and hardly requires special maintenance. However, the following must be checked.

> The inverter employs large-capacitance capacitors.
>
> The capacitors retain charged voltage for about 15 minutes after power is switched off.
>
> Before checking or servicing the inverter, be sure to check that the CHARGE lamp is off and check the capacitors with a tester that no voltage remains.

(1) Check the wire terminals for looseness and wire damage.

(2) Check the ventilation holes whether they are not clogged up with foreign matter.

(3) Check the printed circuit board and the inside of the inverter for dust and foreign matter.

(4) If the inverter is not used for a long period of time, it is suggested that it be switched on and checked for operation about once every six months.

(5) Use a d.c. 500-volt megger in a megger test on the main circuit terminal board (U, V, W, R, S, T, T1, R20, R22) only. Never conduct a megger test on the terminals on the printed circuit board.

(6) Do not conduct a dielectric strength test because it can break down the parts inside.

Periodically check your inverter, and keep it in a good environment.

12. TROUBLESHOOTING

If the inverter fails to function proper due to some failure, refer to the following inspection method, determine the cause, and remedy the trouble.

(1) If the equipment goes wrong, the fault signal relay "FL" is actuated by a protecting circuit, the alarm lamp lights, and the equipment is brought to an emergency stop. If this happens, check whether the inverter can be restarted or whether it requires repairs according to the inspection procedure mentioned below.

To reset relay "FL", switch the control power off for about 5 seconds. If relay "FL" operates again as soon as the inverter is restarted, it is due probably to some trouble with the inverter. Do not attempt to restart it repeatedly. It can aggravate the trouble.

(2) A burnt fuse is caused by some trouble with the inverter in most cases. Be sure to remove the cause of the trouble before restarting the inverter.

(3) Table 6 shows possible troubles that can cause operation of the protecting circuits.

(4) Figure 12 shows a check flow chart to be followed in case the motor fails to run when the inverter is put into operation.

(5) Table 7 shows the functions of the check terminals on the printed circuit board.

(6) Figure 13 shows the check procedure for G-TR.

Table 6 Trouble Indications and Causes

Indication	Possible trouble
Lamp OC lights.	Inverter capacity and motor specifications not properly selected. Wire shorted or grounded. Overload or abrupt load variations. Acceleration and deceleration time settings too short. Trouble inside inverter.
Lamp OV/UV lights.	Source voltage too high. Source voltage too low. Momentary power failure. Deceleration time too short.
Main circuit fuse (FU1) burnt	Inverter main circuit trouble, possibly G-TR breakdown (*1)
Control circuit fuse (FU2) burnt	Inverter control circuit power trouble.

*1 If G-TR breaks down, the base drive circuit on the printed circuit board can also break down.

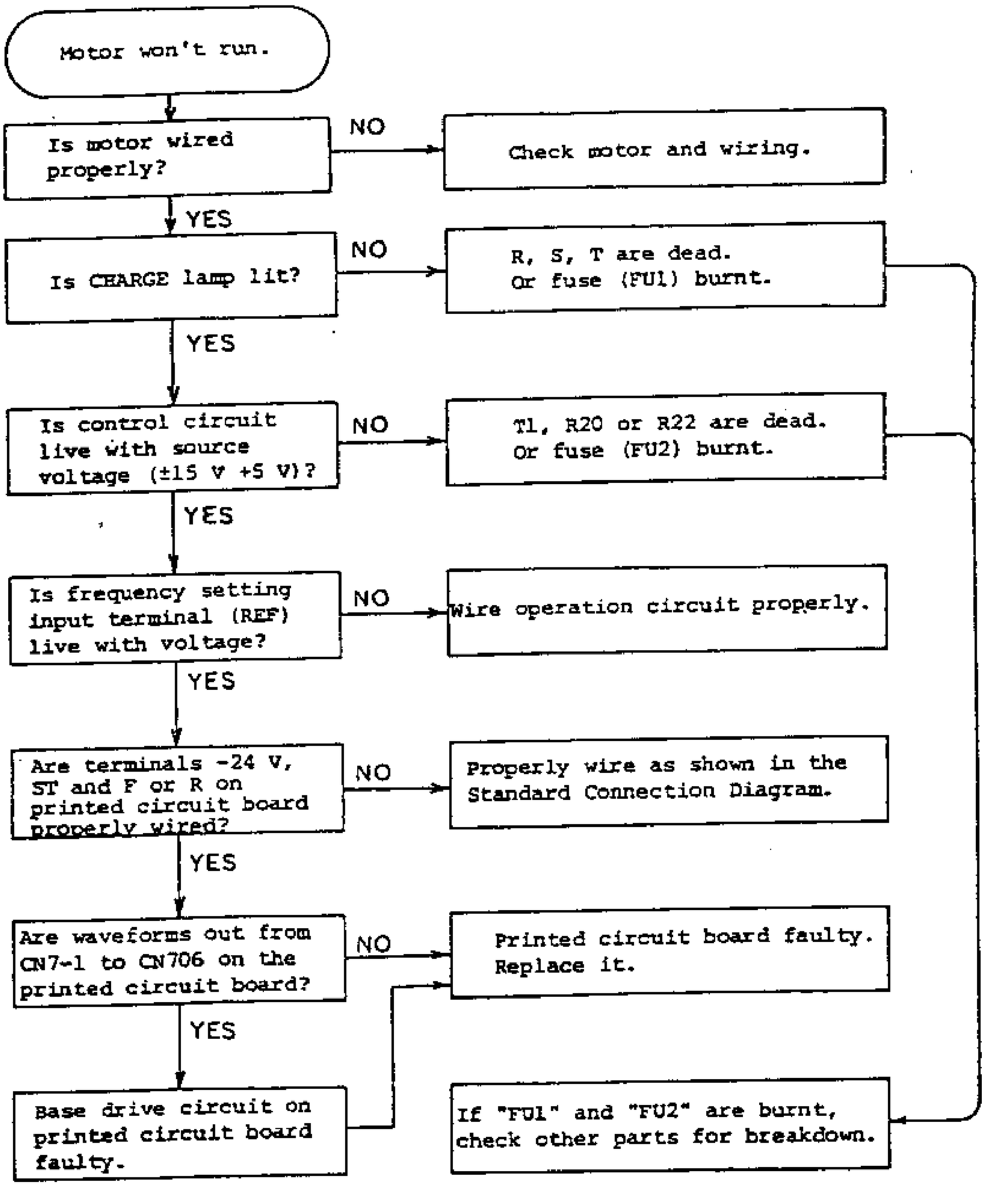
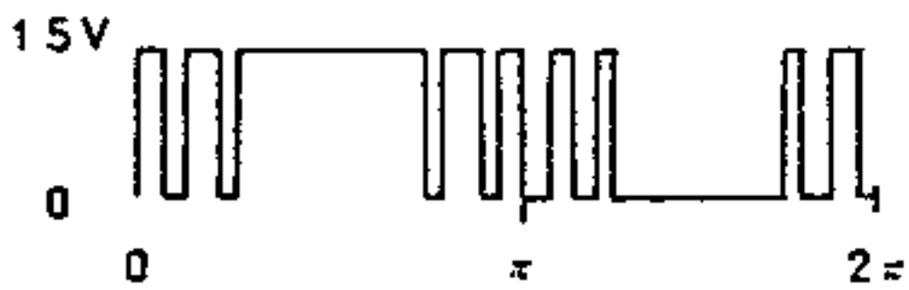
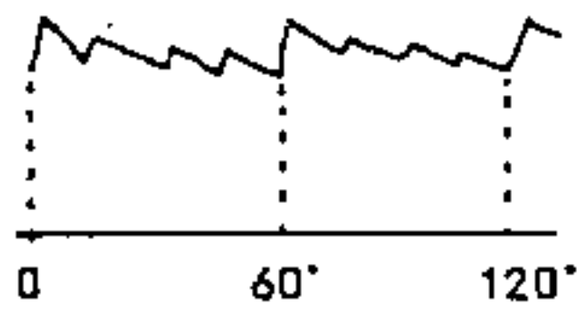
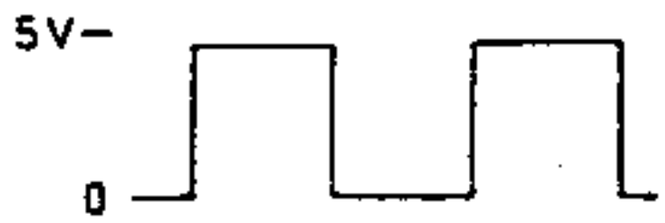
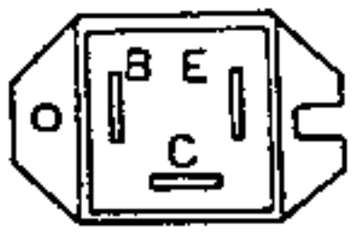
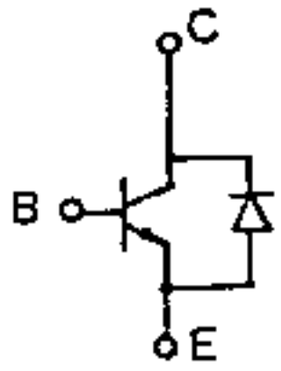
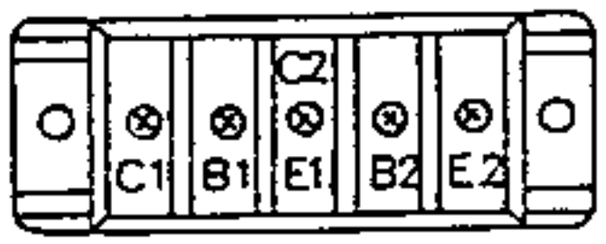
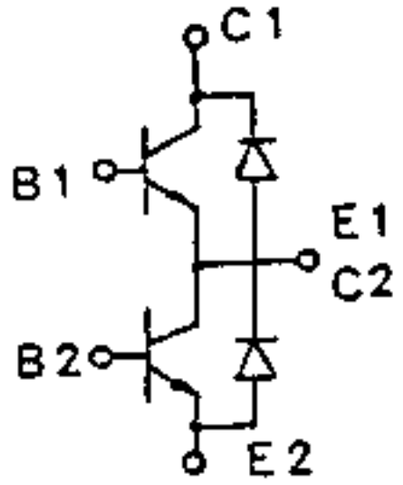
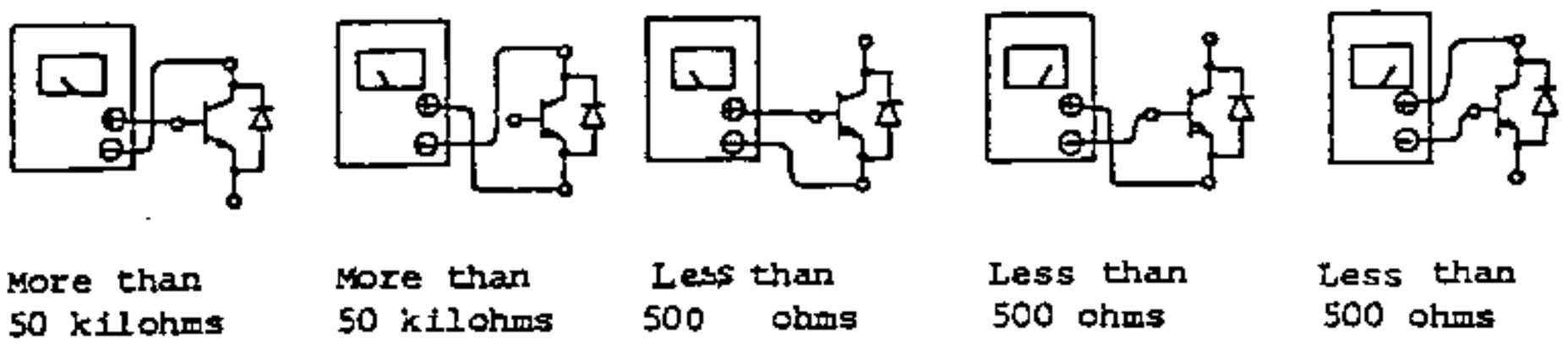


Figure 12 Check Flow Chart Where Motor Won't Run

Table 7 Check Terminal Functions and Waveforms

Test point symbol	Function	Waveform example
CN7-1 to 6 +U +V +W -U -V -W	Base drive circuit input signal	PWM signal of sinusoidal wave distribution 
CN9-1 1	Current feedback rate	Waveform repeated every 60°  Approx.3.5 V (under 100% load)
CN9-2 F	Voltage/frequency converter circuit output pulse	Pulse having a frequency 1152 times the inverter output frequency About 50% duty 
CN9-3 V	Voltage control circuit amplifier output voltage	Varies from 0 to +12 V with frequency setting resistor varied from 0 to maximum.
CN9-4 P15	Control voltage +15 V	d.c. voltage of +15 V
CN9-5 N15	Control voltage -15 V	d.c. voltage of -15 V
CN9-6 P5	Control voltage +5 V	d.c. voltage of +5 V
CN9-7 0	Control voltage 0 V	0 V COMMON

Name	Shape	Equivalent circuit
MG15G1AL2 or 1 (for 1.5 kVA)	 C: Collector B: Base E: Emitter	
MG30G2CL2 or 1 (for 3 kVA) MG50G2CL2 or 1 (for 5 kVA)		



More than 50 kilohms	More than 50 kilohms	Less than 500 ohms	Less than 500 ohms	Less than 500 ohms

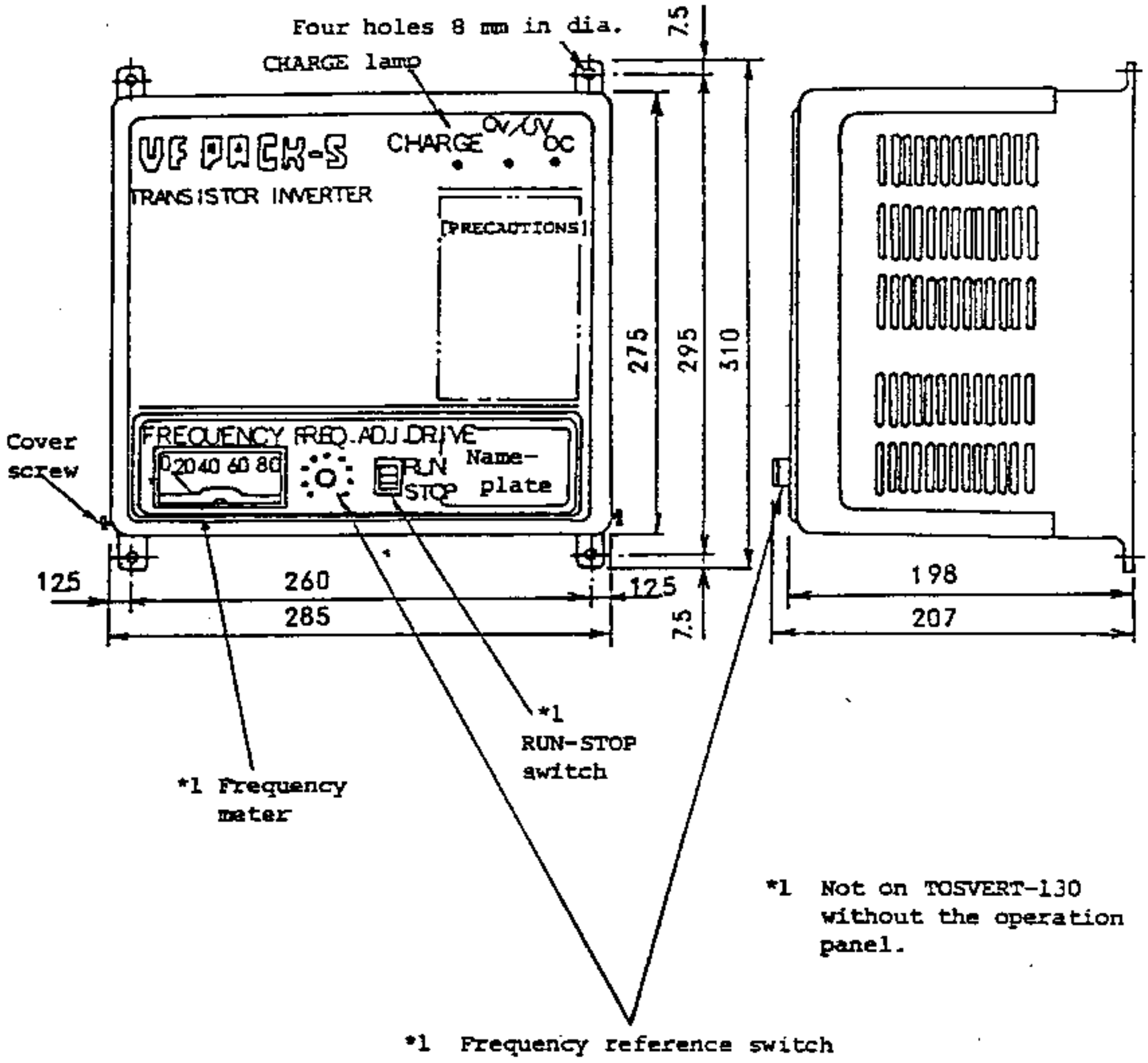
Figure 13 Judging Wehther G-TR is Good (Resistances where G-TR is in good condition.)

When replacing G-TR, be sure to apply a thin coat of a heat-conductive silicon compound to the surface to be in contact with the fins.

Tighten G-TR uniformly on the right and left.

13. EXTERNAL VIEW

Figure 14 shows an external view of VF PACK-S (VF10S).
The 1.5 kVA, 3 kVA, and 5 kVA models are the same size.



*1 Not on TOSVERT-130 without the operation panel.

Figure 14 Outline of TOSVERT-130 with Operation Panel

Model		Capacity (kVA)	Weight (kg)
With operation panel	Without operation panel		
VF10S-2015BO	VF10S-2015B	1.5	9
VF10S-2030BO	VF10S-2030B	3	9.5
VF10S-2050BO	VF10S-2050B	3	9.5

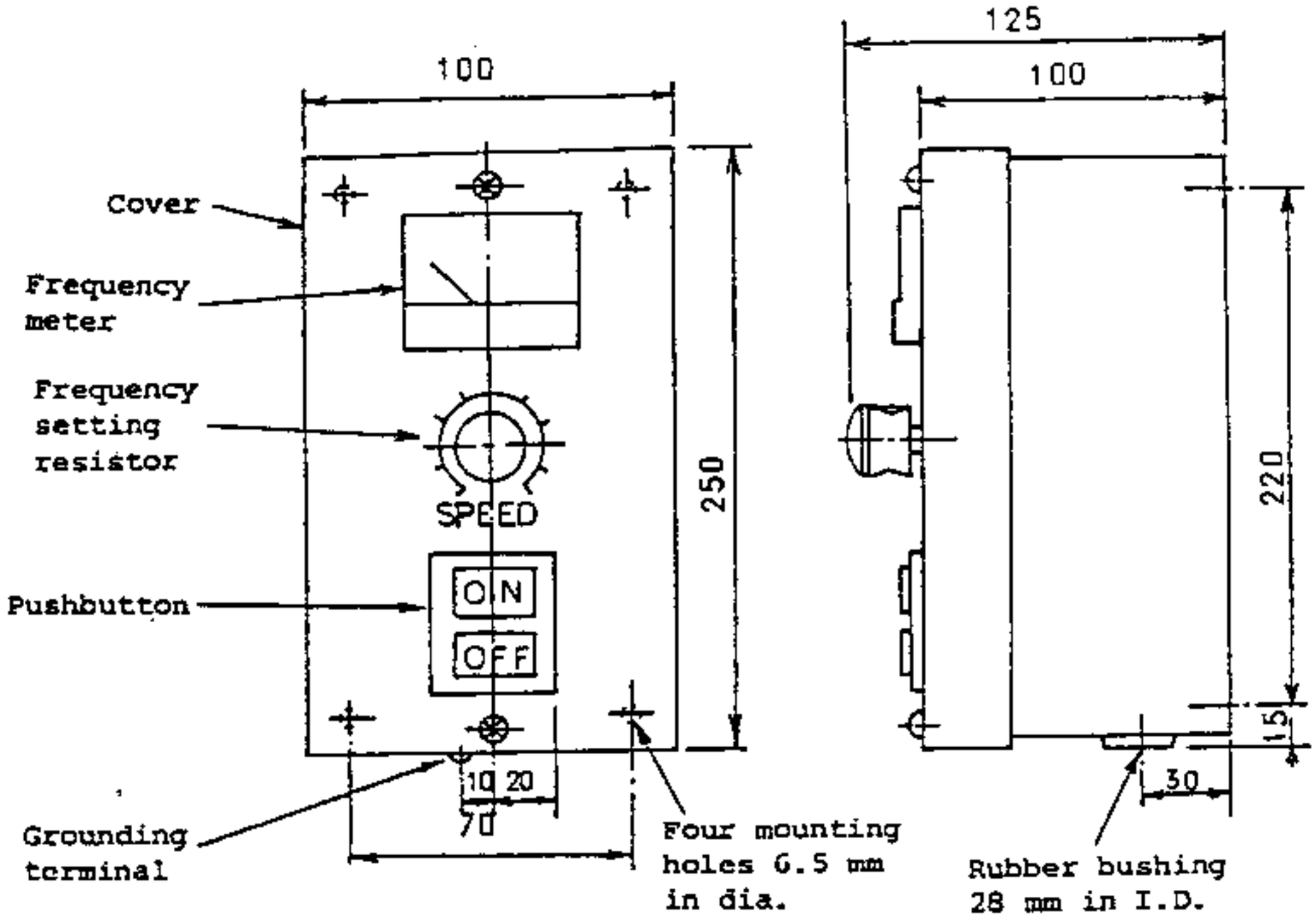
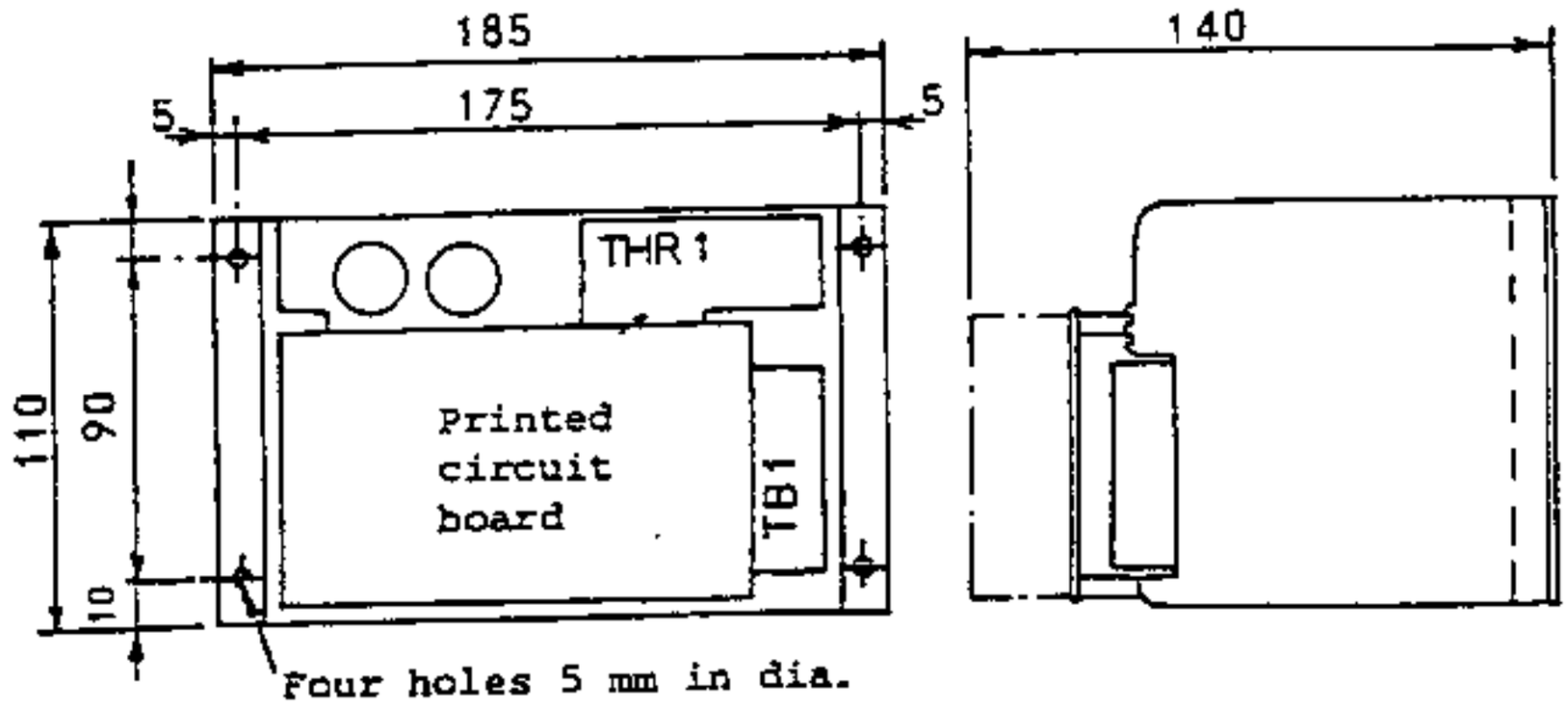


Figure 15 External View of Operation Panel



All models are the same size.

Figure 16 External View of Regenerated Power Discharge Unit

14. SPARE PARTS

It is recommended that the following parts be kept on hand in order to shorten system down time.

Rank A signifies parts of relatively high necessity.
Rank B signifies parts of relatively low necessity.

Rank A

Inverter model	Fuse		GTR	
VF10S	Model	Quantity used	Model	Quantity used
2015B0	Plug type BLA007	1	MG15G1AL2 or 1	6
2015B	Tube type 250V2A	1		
2030B0	Plug type BLA020	1	MG30G2CL2 or 1	3
2030B	Tube type 250V2A	1		
2050B0	Plug type BLA030	1	MG50G2CL2 or 1	3
2050B	Tube type 250V2A	1		

Rank B

Inverter model	Main circuit electrolytic capacitor		Printed circuit board	
VF10S	Rating	Quantity used	Model	Quantity used
2015B0 2015B	470μF - 400 V	1	ARN1 - 829A	1
2030B0 2030B	1500μF - 400 V	1	ARN1 - 829B	1
2050B0 2050B	2200μF - 400 V	1	ARN1 - 829C	1

APPROVED BY	CHECKD BY	DRAWN BY
K. Ishiara Apr.-8-'82	Y. Nomura Apr. 7 '82	Y. Moguro Mar. 30 '82
REGISTERED		