HITACHI HIGH-FREQUENCY INVERTER

HFC-VAH2 SERIES

INSTRUCTION MANUAL

Thank you very much for your purchase of Hitachi Inverter HFC-VAH2 Series. This Instruction Manual covers the handling and maintenance, etc. for the VAH Series. Before starting operation, read this Manual carefully for your installation, maintenance and check. After reading this Manual, file it for your later reference.

This Instruction Manual should be delivered to the opeator of the Hitachi Inverter.

HITACHI

NB4401BX

PRECAUTIONS

CAUTION 1: These instructions should be read and clearly understood before working on the HFC-VAH series.

CAUTION 2: Proper grounds, disconnecting devices and other safety devices and their location are the responsibility of the user and are not provided by Hitachi Ltd.

CAUTION 3: Be sure to connect any motor thermal switch or overload device back to the HFC-VAH series control circuit to assure that the inverter will shut down in the event of an overload or an overheated motor.

WARNING 1: This equipment should be installed, adjusted and serviced by qualified electrical maintenance personal familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in bodily injury.

WARNING 2: The user is responsible for ensuring that all driven machinery, drive train mechanisms not supplied by Hitachi Ltd., and process line material are capable of safe operation at an applied frequency of 150% of the maximum selected frequency range to the AC motor. Failure to do so can result in destruction of equipment are injury to personnel should a single point failure occur.

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1. INSPECTION UPON UNPACKING

Carefully handle the inverter so that it is not subjected to shock and vibration.

(1) No damage is found on each product during transportation;

(2) The product is as ordered (check the rated capacity, voltage and frequency). For any irregularity, contact your sales shop where purchased immediately.

2. STANDARD SPECIFICATIONS

Table 1 shows standard specifications. If there are specified items, they override the standard specifications.

Table 1 Standard Specifications

Series / Item	HFC-VAH series, 200 V class		
Model symbol	2.5LB2	5.5LB2	11LB2
Protection structure	Semi-enclosed, wall-mounting type		
Maximum applicable motor (kW)	1.5	3.7	7.5
Output capacity (kVA)	2.5	5.5	11
Input power supply	200 - 220 V ±10%/50 Hz ±5% 200 - 230 V ±10%/60 Hz ±5% three-phase		
Maximum output voltage	200 V, three-phase		
Rated output current (A)	7.5	16	32
Control method	Chopper method, PAM control		
Output frequency range	1:10 variable range		
Frequency resolution	Continuous		
Frequency precision	±0.5% of the maximum frequency at 25°C ±10°C		
Maximum output frequency	3333 Hz		
Maximum allowable overload	150%, 60 s		
Soft start and stop	3 - 150 s (Acceleration and deceleration times are set independently.)		
Braking torque	Approx. 20% or more (Regenerative braking by feedback to capacitor) With direct current damping below the minimum output frequency		

Item \ Series		HFC-VAH series, 200 V class
Input signals	Frequency setting	Voltage input: 0 - 10 VDC (Input impedance is 10 kΩ or more.) Current input: 4 - 20 mA (Input impedance is approx. 250 Ω.)
	Reset	Fault reset and instantaneous cut-off of output
	Forward rotation	Closed: Forward rotation. Open: Stop (1a contact command)
	Reverse rotation	Closed: Reverse rotation. Open: Stop (1a contact command)
Output signals	Frequency monitor	Digital frequency monitor by pulse output and frequency monitor by analog output
	Fault alarm relay	ON when inverter is abnormal (1c contact output).
Protective functions	Undervoltage (including instantaneous power failure)	The inverter stops when the input voltage drops to approx. 160 V or below.
	Momentary overcurrent	Protected by an electronic circuit
	Overvoltage	Trip at approx. 400 V of converter output voltage
	Fin overheat	Protection using thermal relay
	Stall prevention circuit	Circuits to provide protection against overcurrent and overvoltage are installed.
	Fault display	Undervoltage or instantaneous power failure (UV), overcurrent (OC), overvoltage (OV), and fin overheat (OH) are displayed individually.
Optional functions	Special voltage/frequency (V/F) command	When an optional PC board is attached, the special V/F command is available.
	Digital display of frequency	An optional PC board enables a frequency to be displayed with four digits.

Item \ Series		HFC-VAH series, 200 V class		
General specifications	Ambient temperature	-10°C - 50°C		
	Humidity	20% - 90% (no condensation)		
	Vibration	0.2 G or less		
	Place	At an altitude of 1000 m or less, indoor area free from corrosive gases and dust or dirt		
	Paint color	Munsell 5Y7/1		
Weight (kg)		13.0	13.5	-25

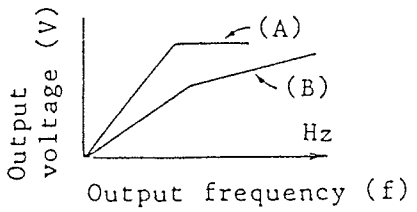
Use a Hitachi high-speed motor. Select an inverter whose rated output current is not less than the motor's current.

Note that when the motor which has been running with a sine wave power supply is operated using an inverter, the current is increased by approximately 10%.

3. SPECIFICATIONS OF OPTIONS

The options listed in Table 2 are available for the HFC-VAH2.
However, this manual does not explain these options.

Table 2 Specifications of Options

Option	Description
Operator box (installed separately) The meter is of analog type.	Enables a frequency to be set. Incorporates a frequency meter, a frequency setting device, an ON/OFF switch, a forward/reverse rotation switch, etc. OPE-4M: With 43° analog meter and Forward/Reverse rotation switch OPE-8M: With 80° analog meter and Forward/Reverse rotation switch
Digital frequency display (installed separately)	Displays the output frequency in a digital form with four digits. A frequency less than 1000 Hz is displayed up to one decimal place.
Special V/F command This option can be installed in the inverter unit. However, the inverter must be adjusted at the factory.	Sixty standard V/F characteristics are available as constant V/F ratio characteristics. When using other V/F characteristics, employ this option. (Example)  To use characteristics as indicated by (A) or (B) in the figure on the left.
Regenerative braking unit	Used to shorten the braking time.
Vernier dial	Multi-rotation control which increases the resolution of the speed setting control

Option	Description
Noise filter	Used to suppress noise from a radio near the inverter. Recommended filters; • TDK: ZCW series • Tohoku Metal: LF series
Speed setting variable resistor, nameplate, and control	Used to set a speed.
Power-factor reactor	Used to power factor improvement. (A general purpose inverter can be used.)

4. PRECAUTIONS

Before using the HFC-VAH2, read the following notes:

4.1 Protection of the High-speed Motor

(1) the Hitachi's high-speed inverter HFC-VAH2 has no overcurrent protective circuit for the high-speed motor. If it is necessary to protect the motor against overtemperatures and other effects, install protective circuits separately. To protect the motor against overtemperatures, it is best to detect the temperature at the motor coil. If such detection is not possible, use a protective device which fits the temperature rise characteristics of the high-speed motor.

High-speed motors may not use thermal relays for the general-purpose motors.

The SAO-Q and SAO-R relays manufactured by Omron Tateishi Electronics Co. are examples of overcurrent protective relays.

(2) The HFC-VAH2 uses PAM control to reduce motor noise and vibration. Output current forms distorted waves near sine waves rather than complete sine waves. Therefore, motor temperature rise and vibration are increased slightly compared with a case where the motor is operated using sine waves from a high-frequency generator. Also, the current is increased slightly (approx. 10%).

(3) When an induction motor (a normal high-speed motor is an induction motor) is operated at various frequencies, torque at a low frequency generally tends to decrease. When changing the speed in a wide range, note the torque characteristics. In addition, when the motor is cooled by a self-cooling fan, a lower speed reduces the cooling effect much more.

4.2 Inverter

(1) Be sure to install a cable protection breaker between the primary side of the inverter and the power source. Do not use a knife switch for the breaker. Otherwise, an open phase may be caused.

(2) When a transformer is inserted between the inverter and the motor to change the voltage, some impedance of the transformer may cause an overcurrent trip at start. In addition, the transformer may cause noise and heat output problems due to the higher harmonic. When using a transformer, consult your dealer.

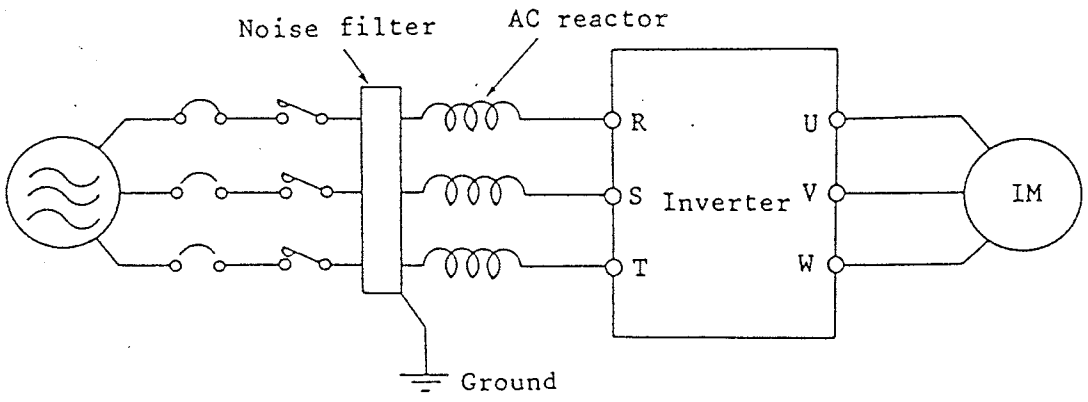
(3) For power factor improvement of the inverter, insert a reactor between the inverter and the power supply.

No capacitor can increase the power factor.

(4) Do not connect a phase advance capacitor or a surge absorber between the inverter and the motor. Otherwise, an overcurrent trip may be caused.

(5) The inverter output voltage is automatically controlled. When the input voltage is 220 V, for example, the maximum output voltage is 200 V. However, when the input voltage decreases to 190 V, the maximum output voltage is controlled to 190 V.

(6) When a radio or similar device placed near the inverter generates noise, use the following recommended noise filter.



	AC reactor No.	Noise filter
2.5 kVA	ALI-2.5L	ZCW2210-01 or LF 310
5.5 kVA	ALI-5.5L	ZCW2220-01 or LF 320
11 kVA	ALI-11L	ZCW2240-01 or LF 340

5. INSTALLATION

5.1 Inverter

The HFC-VAH2 is a wall-mounting inverter. Be sure to install it vertically while observing the notes described below. (It must not be installed horizontally.)

(1) Install the inverter in a well ventilated place and leave space at least 10 cm at the top and bottom of the inverter and at least 5 cm on the right and left sides, as shown in Figure 1.

(2) Install the inverter in a place free from dust, corrosive gases, and oil mists including cutting oil mists.

(3) Install the inverter in a place not subject to excessive vibration. (Vibration should be 0.2 G or less.)

(4) when the surface on which the inverter is to be installed is uneven, place plates under the installation leg. If the inverter is installed on an uneven surface, distortion caused by the unevenness is transferred to the main circuit elements and they may be damaged.

(5) Leave space so that the cover can be opened or closed with ease during maintenance.

(6) The inverter generates heat by approx. 5% of the rated capacity, so take care to maintain well ventilation when inverter is built in the box.

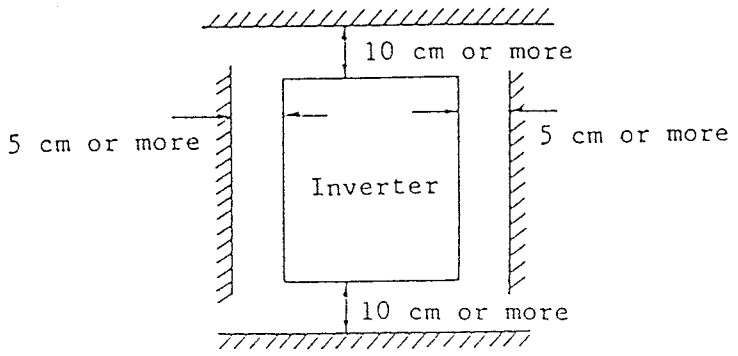


Figure 1 Installation of the Inverter

(7) When installing the HFC-VAH2 2.5LB2 or HFC-VAH 5.5LB2 inverter in a totally-enclosed control box, remove the four M6 screws which secure the installing leg to the main unit of the inverter as shown in Figure 2. Then, remove the cooling fin from the rear panel of the inverter and install it outside the control box. This allows temperature rise in the control box due to heat from the cooling fin to be reduced. However, be sure to install a fan in the control box for forcible convection so that the temperature in the control box does not exceed 50°C and is made uniform.

For the HFC-VAH2 11LB2 inverter, the cooling fin cannot be installed outside.

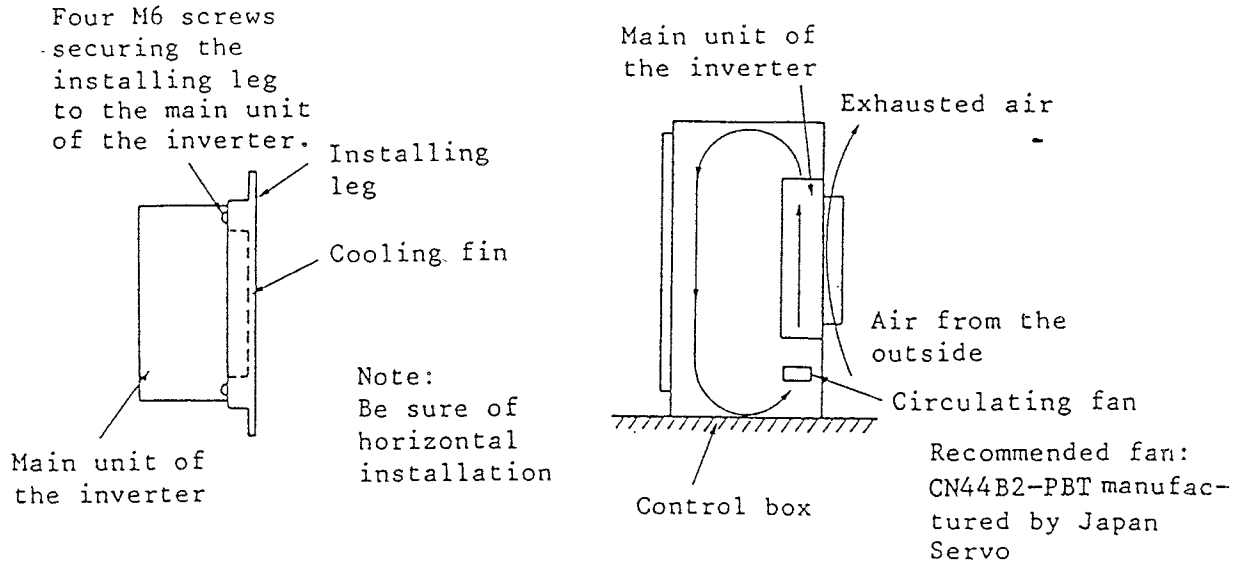


Figure 2 Inverter HFC-VAH2 2.5 kVA or HFC-VAH2 5.5kVA Installed in a Fully-Closed Control Box

- When installing the inverter in the control box, cut the panel as shown in Figure 3 and use the packing shown in Figure 4.

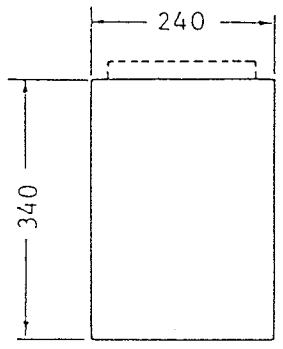


Figure 3 Panel cutting

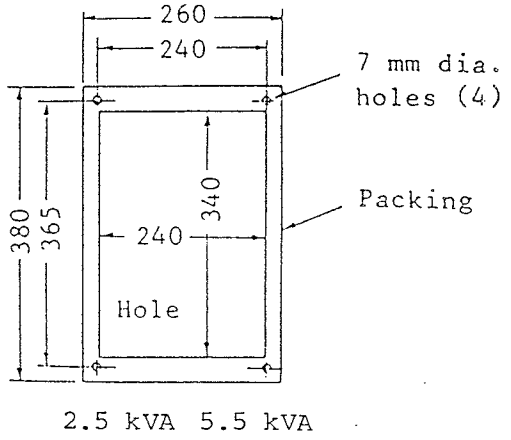


Figure 4 Packing

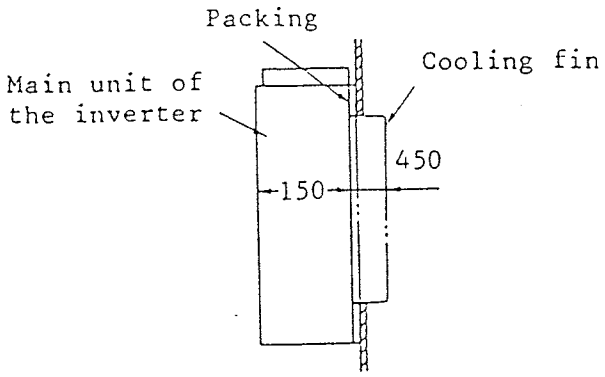


Figure 5 Installation Diagram for the HFC-VAH2 2.5kVA or HFC-VAH2 5.5kVA

For the HFC-VAH2 11kVA inverter, the fin cannot be installed outside the control panel.

(8) Heat output and cooling

When the inverter is installed in a totally-enclosed control box, heat is output as listed in Table 3. Take care to prevent the temperature in the control box does not exceed the allowable ambient temperature of the inverter (50°C). When studying temperature rise, consider heat output by other components in the control unit, too.

Table 3 Heat Output

		2.5LB2	5.5LB2	11LB2
Heat output (W)	Cooling fin	60	140	-
	Inside the unit	90	160	-
Total heat output		150	300	550

The temperature rise in the control box is calculated from heat output inside the control box and heat radiation from surface of the control box. The following equation can be used to roughly determine the dimensions of the control box.

$$A = \frac{P}{R \times deg} \ [m^2]$$

where
Radiation surface of the control box: A [m^2]
Heat output in the control box: P [W]
Temperature rise: deg.[deg] $\leq$ 10°C
Radiation coefficient of the control box chassis:

$$R \ (W/°C \cdot m^2) = \text{about } 4.5 - b$$

Assume R is 5, then

$$A = \frac{P}{5 \times 10} = 0.02 \times P \ [m^2]$$

6. WIRING

6.1 Terminals Description

Figure 6 shows a terminal layout. Table 5 explains the function of each terminal.

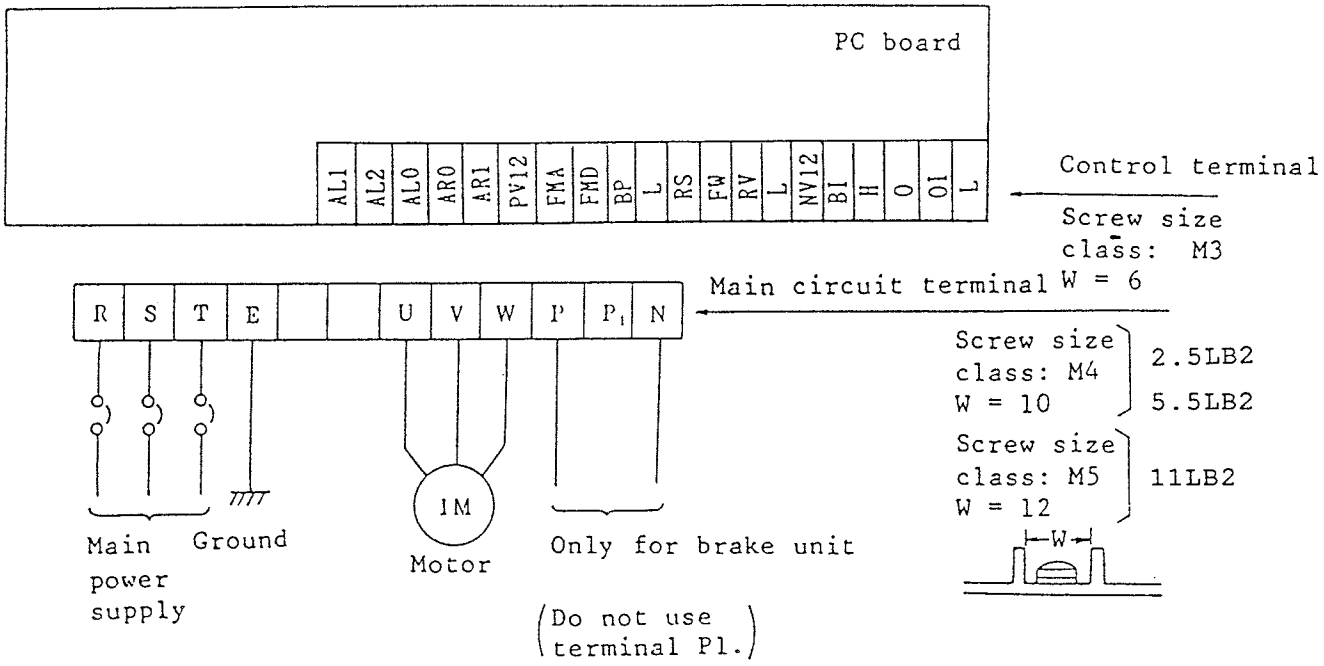


Figure 6 Terminal Layout

6.2 Wiring Tools

Table 4 lists wiring equipment. When a wire exceeds 20 m, reconsider the wire size.

Table 4 Standard Wiring Tools and Wiring

Reference value of kW

Applicable motor (kW)	Inverter model name	Wiring			Wiring tools	
		Input/output (R, S, T, U, V, W, P, and N) and ground	Signal line (H, O, OL, L, FW, RS, etc.)	Control line	Circuit breaker (MCB)	Electro-magnetic contact (Mg)
0.4	HFC-VAH2.5LB2	2 mm² or more	0.75 shielded wire or more	2mm² or more	F-30B (10A)	H10
0.75		Same as above	Same as above	Same as above	F-30B (10A)	H10
1.5		Same as above	Same as above	Same as above	F-30B (10A)	H10
2.2	HFC-VAH5.5LB2	Same as above	Same as above	Same as above	F-30B (15A)	H20
3.7		3.5 mm² or more	Same as above	Same as above	F-30B (20A)	H20
5.5	HFC-VAH11LB2	5.5 mm² or more	Same as above	Same as above	F-30B (30A)	H25
7.5		8 mm² or more	Same as above	Same as above	F-50B (50A)	H50

NOTE 1: The power (kW) of each motor is a reference value because it is a special motor. When determining a motor to be used, check the current.

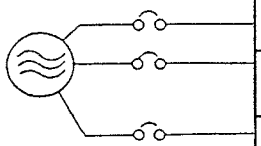
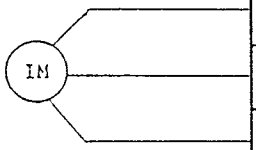
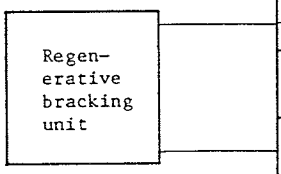
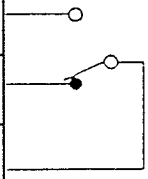
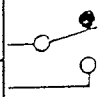
NOTE 2: When determining a circuit breaker, consider the interrupting capacity too.

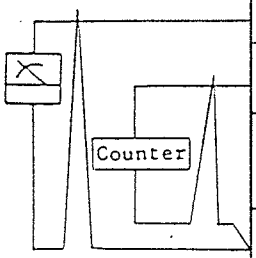
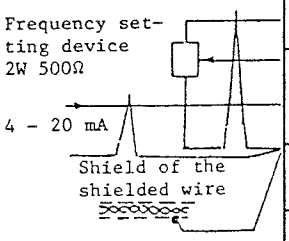
NOTE 3: When determining a motor protector, consider the protection characteristics of the motor.

NOTE 4: The leak current of each inverter is approx. 3 mA (excluding lines).

NOTE 5: A high-frequency motor cannot be protected by a thermal relay. Use the current sensor SAO-Q manufactured by Omron Tateishi Electronics Co. or an equivalent.

Table 5 Functions of Terminals

Connection to the outside	Terminal symbol	Function	Main circuit/ control circuit
	R	Input power supply connecting terminal (Three phase 200 - 220 V at 50 Hz or 200 - 230 V at 60 Hz).	Main circuit
	S		
	T		
	E	Ground terminal	
	U	Motor connecting terminal Three phase 200 V	
	V		
	W		
	P	Regenerative braking unit connecting terminal (Do not connect this terminal to P1.)	
	P1		
	N		
	AL1	 Alarm contact terminal — For alarm: AL_0-AL_1: Closed, AL_0-AL_2: Open	Control circuit
	AL2		
	AL0		
	AR0	 Frequency arrival terminal — At frequency arrival: AR_0-AR_1: Closed	For details, see pages 31 to 34.
	AR1		
	PV12	+12 V Power supply terminal	

Connection to the outside	Terminal symbol	Function		Main circuit/ control circuit
	FMA	Frequency analog monitor signal		
	FMD	Frequency digital monitor signal		
	BP	Used during regenerative braking operation. (Optional)		
	L	Common terminal (Not a ground terminal)		
	RS	Resets a fault signal.		
	FW	Closed: Forward rotation. Open: Stop (1a contact command)		
	RV	Closed: Reverse rotation. Open: Stop (1a contact command)		
	L	Common terminal (Not a ground terminal)		
	NV12	Used for current input	Short-circuit: 4 to 20 mA	
	BI		Open: 0 to 16 mA	
	H	10 V supply terminal for frequency setting		
	O	Voltage input terminal for frequency setting (0 to 10 V)		
	OI	Current input for frequency setting (0 to 20 mA)		
	L	Common terminal (Not a grounding terminal)		

- Alarm relay
- Contact ratings of frequency arrival relay

  { (250 VAC, 2.5 A (R load), 0.2 A (cos ø0.4)
  { (30 VDC, 3 A (R load), 0.7 A (cos ø0.4).

6.3 Notes for Wiring

(1) Be sure to insert a circuit breaker (MCB) on the power supply side. It protects the power line when a ground fault or contact trouble occurs, preventing a fire.

(2) Be sure to connect the power supply to R, S, T (input terminal), and the motor to U, V, W (output terminal).

Do not mistake these terminals for other terminals such as U, V, W, P, P1, and N.

- When the R, S and T terminals are connected incorrectly among them, the motor runs correctly.
- When the U, V and W terminals are connected incorrectly, the motor runs normally but in the reverse direction. To run the motor in the forward direction, change two of the wires with each other.
- Never supply single phase input.

  When the S terminal is not connected, the inverter control circuit operates but its service life is shortened. Restore the normal connection as soon as possible. When the R or T terminal is not connected, the inverter does not operate.

(3) Do not insert an electromagnetic contactor between the inverter and the motor. If it is opened and closed, a line start current flows and the inverter trips. When this operation is repeated, elements are damaged. If use of an electromagnetic contactor is unavoidable, insert it when both the inverter and the motor are stopped.

(4) Do not insert a phase advance capacitor between the inverter and the motor.

(5) To connect the inverter to the operator unit, use shielded wires shorter than 20 m.

(6) Separate the inverter signal line from the power line as shown in Figure 7 below. If cross-over is unavoidable, however, cross them at right angles.

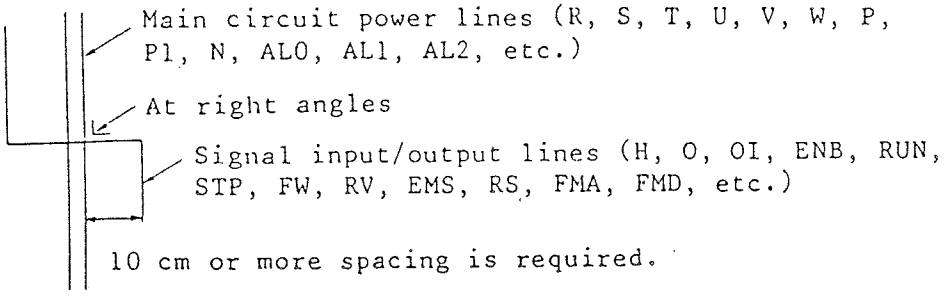


Figure 7 Separation of Lines

Connect the shields of the shielded wires to the ground terminal (E) at one point on one side.

(7) Connect ground wires with a size of 3.5 mm^2 or more.

(8) Connect a surge absorber to the electromagnetic contactor in parallel to the exciting coil. Also connect surge absorbers to other relays installed in the control panel.

(9) Since high-frequency motors are special motors, it is dangerous to estimate a current from its rated power (kW). When selecting an inverter and related equipments, check the rated current and start current of the motor. Select a motor protector according to the protection characteristics of the motor. The characteristics may change in some variable frequency range. For more information, contact the manufacturer of the motor.

Ground fault is out of warranty; therefore, note the wiring connections so that no ground fault accident occurs.

6.4 Standard Connection Diagram

Figures 8-1a and 8-2 show standard connection diagram.

In the sequence in Figure 8-2, fault alarms remain. To reset them, open the Mg relay on the input side or press the reset button (RS).

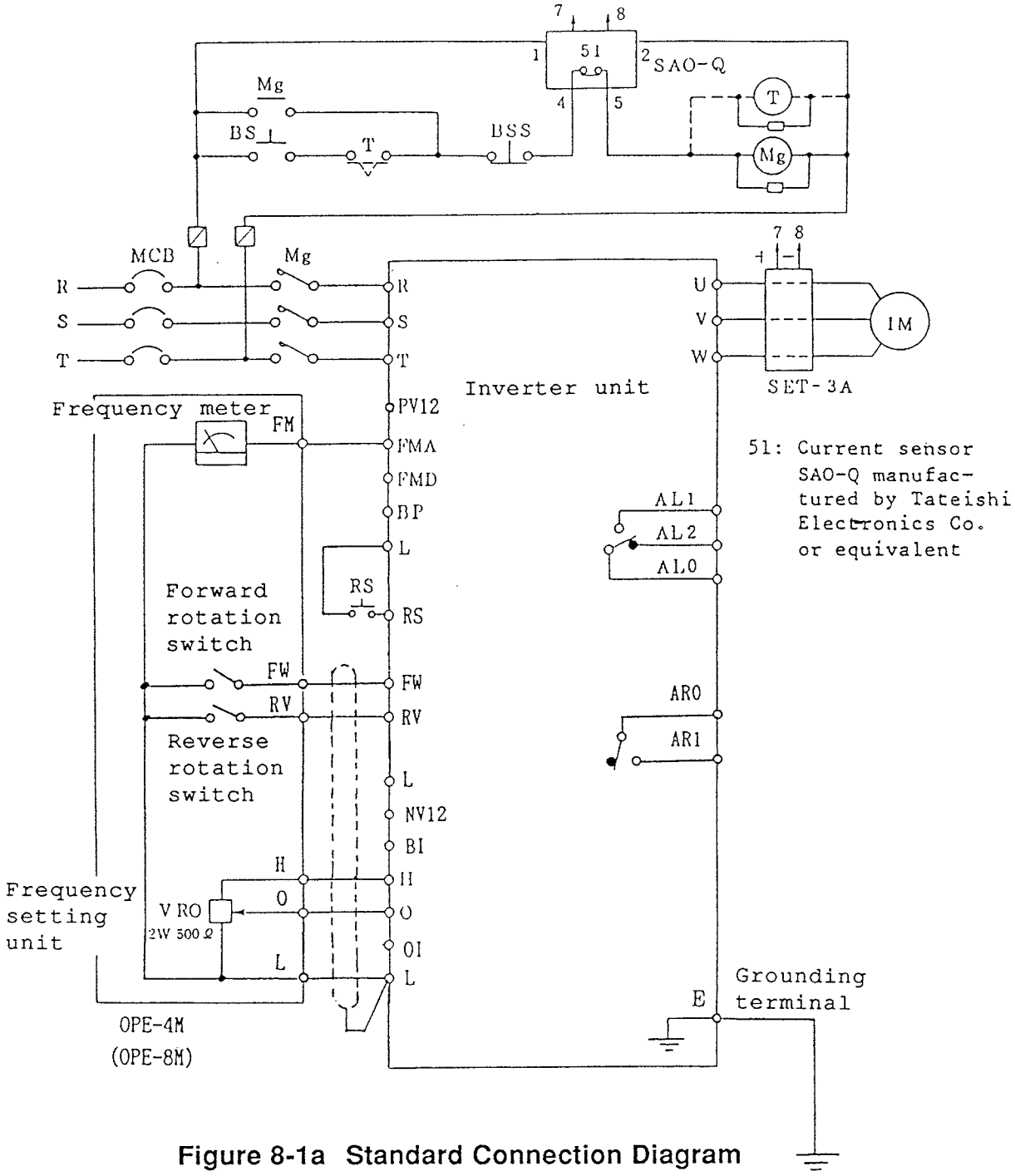


Figure 8-1a Standard Connection Diagram

When power is turned off, do not turn on power again until the motor stops. To prevent power from being turned on while the motor is running, insert timers as indicated by dotted lines.

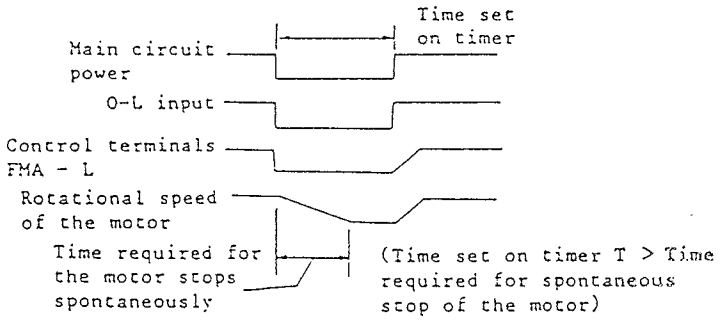


Figure 8-1b Timechart

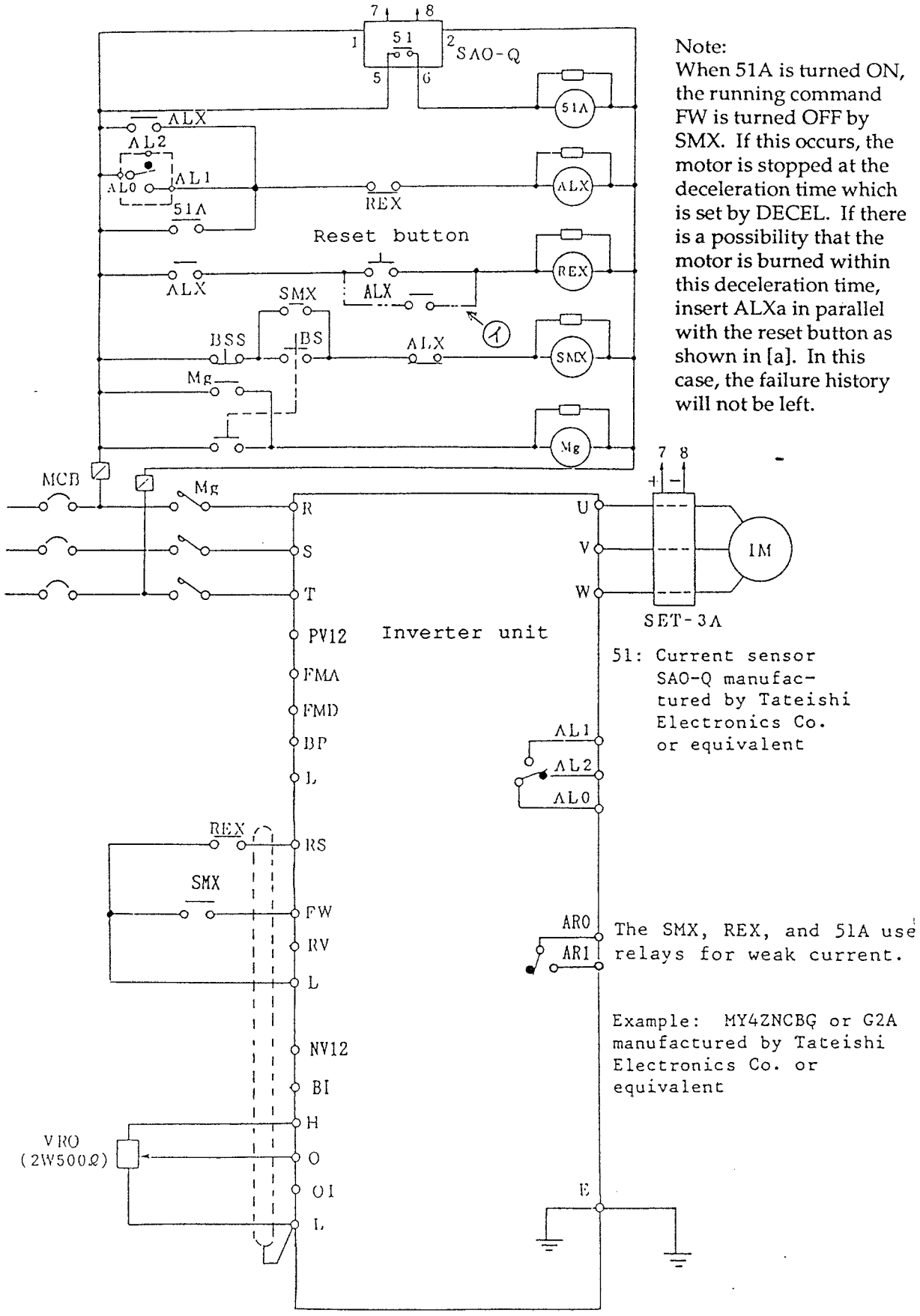


Figure 8-2 Standard Sequence 2 (The forward operation and fault alarms are retained.)

Frequency selector switches and other controls are arranged as shown in Figure 9.

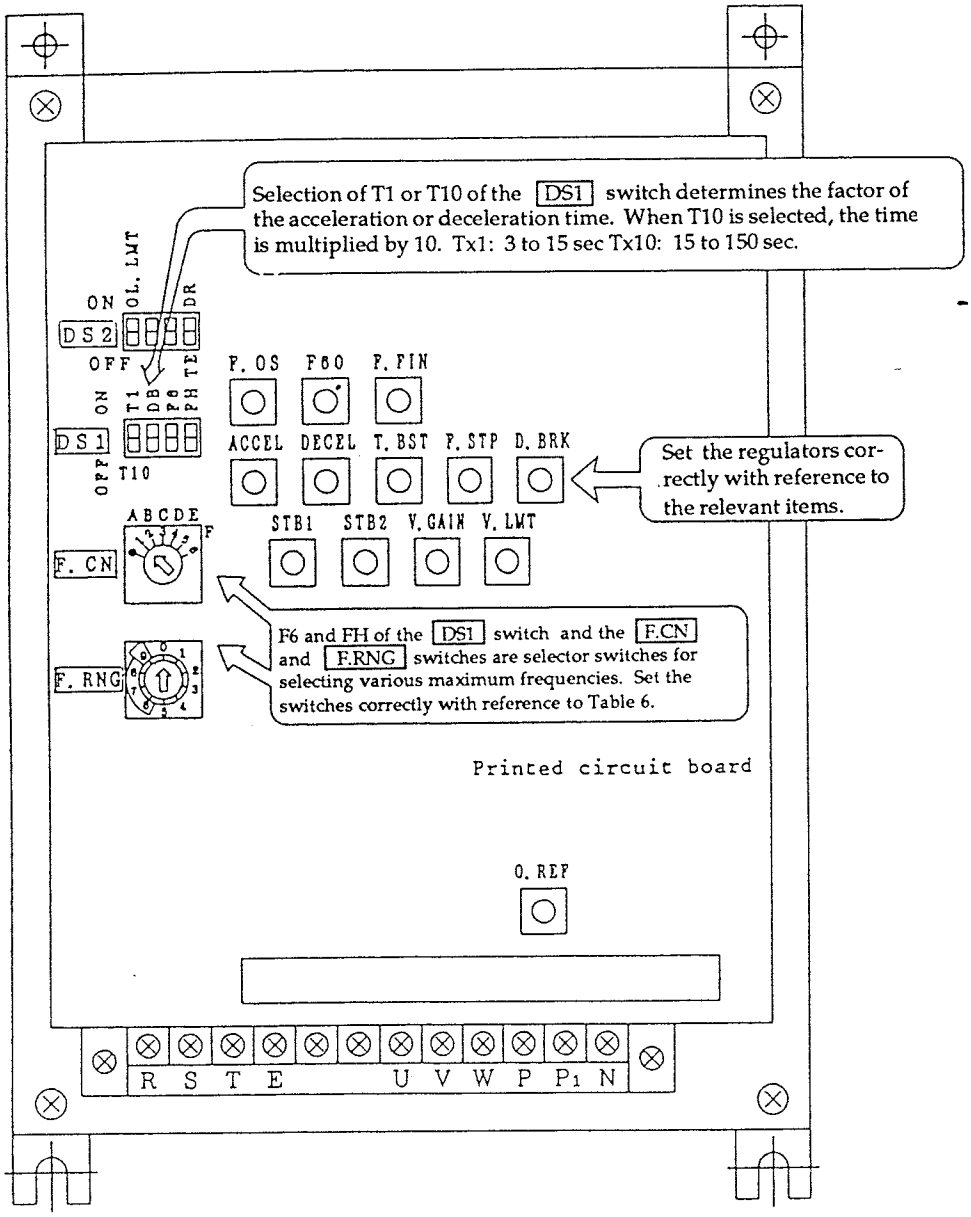
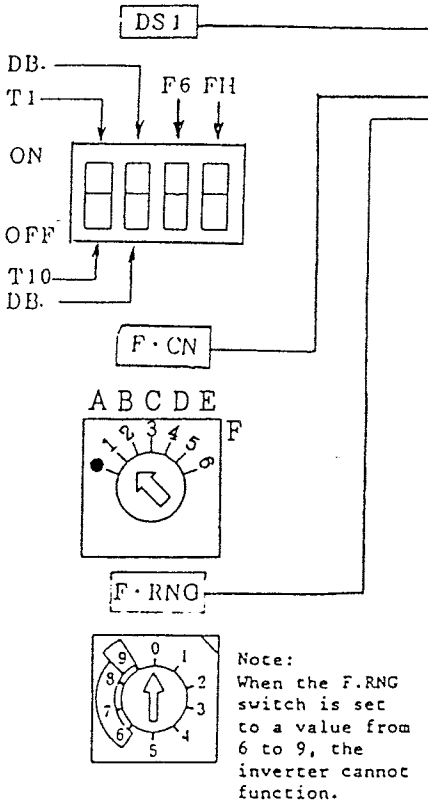


Figure 9 Layout of Frequency Selector Switches and Other Controls

7.1 Frequency Selector Switches

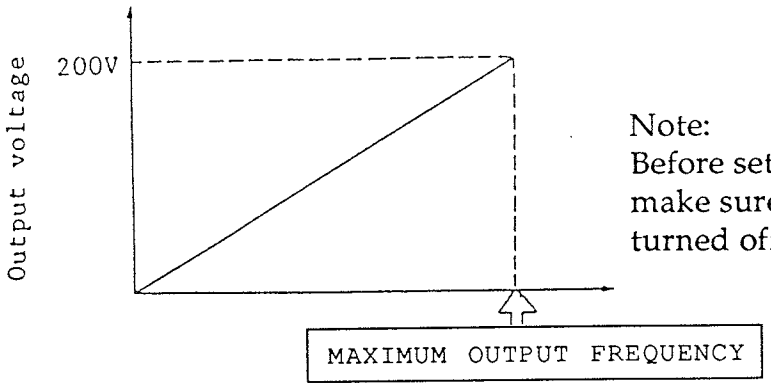
A frequency can be selected by the DS1, F.CN, and F.RNG switches as indicated in Table 6.

Table 6 Selection of Individual Maximum Frequency



Setting of F·CN	Settings of DS1		Maximum output frequency (Hz) Settings of F.RNG					
	F6	FH	0	1	2	3	4	5
A	OFF	OFF	50	100	200	400	800	1600
	ON	OFF	60	120	240	480	960	1920
	ON, OFF	ON	62.5	125	250	500	1000	2000
B	OFF	OFF	62.5	125	250	500	1000	2000
	ON	OFF	75	150	300	600	1200	2400
	ON, OFF	ON	78	156	313	625	1250	2500
C	OFF	OFF	71.5	143	286	573	1146	2293
	ON	OFF	86	172	344	688	1376	2752
	ON, OFF	ON	89	179	358	717	1433	2866
D	OFF	OFF	83	166	333	667	1333	2667
	ON	OFF	100	200	400	800	1600	3200
	ON, OFF	ON	104	208	416	833	1667	3333

- When the [F.CN] switch is set to the ● mark, the inverter will not operate.
- When the [F.RNG] switch is set to a position between 6 and 9, the inverter will not operate.
- The [F.RNG] switch is set at 9 at factory before shipment, and the inverter will not operate.
- Before starting operation, select the desired maximum output frequency with reference to the above output frequency selection table. Before setting the switches, be sure to check whether the power switch is off.
- The VF characteristics are as shown below.



Note:
Before setting a frequency, make sure that power is turned off.

Example: To select 300 Hz, set switches as follows:

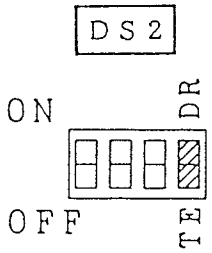
FH: OFF	F.CON: B
F6: ON	F.RNG: 2

Notes when changing a frequency

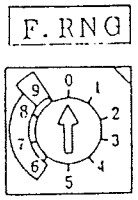
(1) Before changing a frequency, turn power off.

(2) To prevent accidents, check the frequency using the inverter alone without connecting it to the motor.

(3) When checking the frequency using only the inverter, set the right switch of the dip switch [DS2] to TE .



- After checking the frequency, set the test switch to DR .



- When the F.RNG switch is set to a value between 6 and 9, no frequency is output.

(4) If a frequency is checked with the test switch set to DR , DC voltage develops on the output side of the inverter. When the inverter is not connected to a motor, this voltage cannot be discharged immediately, preventing the inverter output frequency from being lowered (the overvoltage LADSTOP operates) or disabling restart (the interlock circuit for the residual voltage on the secondary side operates).

When this happens, turn the power off then wait for more than 5 minutes or connect a resistor (30 W, 500) between P and N terminals for at least 15 seconds to discharge the voltage.

Note: Do not change the setting of the test switch during inverter operation. Otherwise, the chopper transistor in the main circuit may be damaged.

(5) Checking the V/F characteristics of the high-frequency motor

The V/F characteristics of the HFC-VAH2 can be changed just by rotating a selector switch. After checking the V/F characteristics of the motor, operate the switch. If the switch is set incorrectly as shown in Figure 10, the motor may be burned.

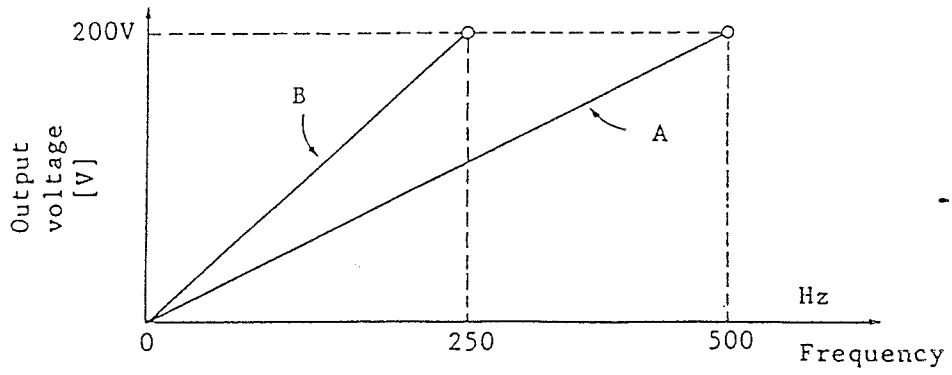
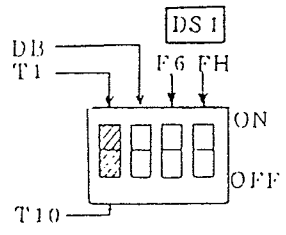


Figure 10

If the motor having the characteristics indicated by A in Figure 10 is operated with characteristics B, the motor causes an overexcitation and may be burned.

7.2 Adjusting Acceleration and Deceleration Times

2. Selection of acceleration and deceleration times  Adjustment of acceleration time	The acceleration and deceleration times can be set to either of two ranges, 3 - 15 seconds and 15 - 150 seconds, by the T1/T10 selector switch of DS1. In each range, acceleration and deceleration times can be adjusted with the ACCEL and DECEL switches individually. These times are factory-set to approx. 30 seconds with the T1/T10 selector switch set to T10.

When inertia moment of load (load GD^2) is large, setting a short time causes the inverter to trip due to regenerated energy which is power-backed from the motor. Set a longer time so that a regenerated overvoltage or an overcurrent does not occur.

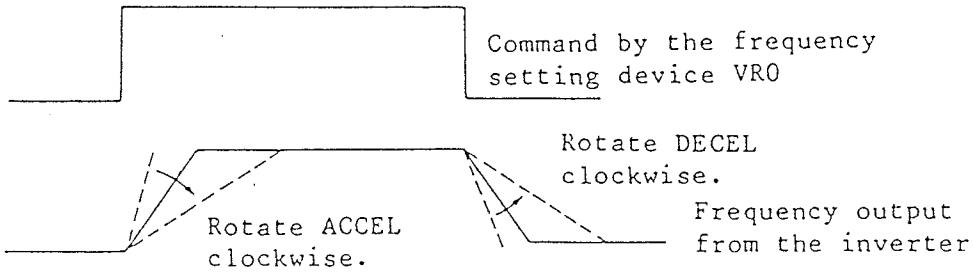
NOTE 1: Set an acceleration time so that it is longer than the time during which acceleration is made with 100% to 120% of the rated torque of the motor. When a command indicating an acceleration within a too short time is given, the inverter automatically prolong the time. However, the inverter may trip due to an overcurrent.

$$ta = \frac{J \cdot N}{9.55 (T_M - T_L)} \qquad tb = \frac{J \cdot N}{9.55 (T_B + T_L)}$$

GD^2: Motor shaft conversion effect of the total of motor and load torques ($kg \cdot cm^2$)
N: Maximum rotational speed of the motor (rpm)
TM: Motor torque (100 to 120% of the rated torque) (N·m)
TL: Load torque (N·m)
TB: Regenerative braking torque (N·m)
ta: Acceleration time (sec)
tb: Deceleration time (sec)

NOTE 2: When the motor speed is reduced by the inverter, the motor enters a regenerative braking operation. Some of this regenerated energy is lost in the motor but the remaining energy causes the voltage at the smoothing capacitor CB2 to be raised. If the raised voltage is too high, the inverter may trip or the inverter module may be destroyed. To prevent this, do not set a too short time with the DECEL switch.

The ACCEL and DECEL switches function as shown below.

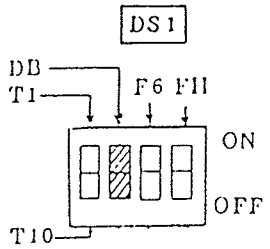


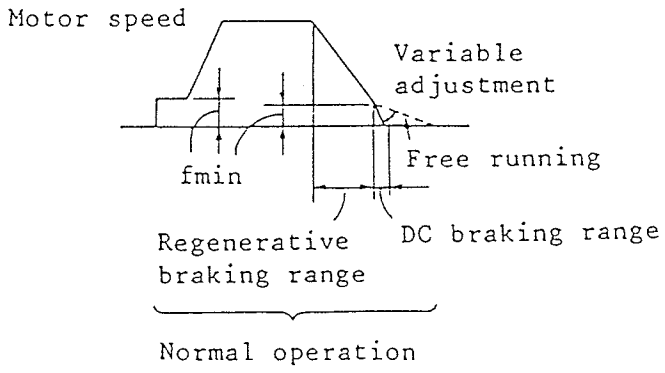
Adjustment with the ACCEL and DECEL switches

7.3 Adjusting Stability

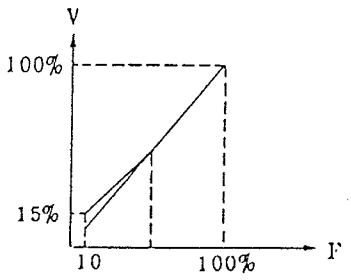
Controls STB1 and STB2	The STB1 and STB2 controls can be used to make the voltage control system stable. Various motors are operated by the HFC-VAH2 inverter. Therefore, some motors may cause hunting. When this happens, correct the problem with STB1 and STB2. Use the following settings as a guide: 1. When the inverter is used for a high-speed motor at a relatively low frequency range which is remodeled from a general-purpose motor or similar: Setting of STB1: 1/10 - 5/10 Setting of STB2: 5/10 - 10/10 2. When the inverter is designed exclusively for a high-speed motor or the motor capacity is small compared with the inverter capacity: Setting of STB1: 2/10 - 5/10 Setting of STB2: 2/10 - 10/10 Hunting with little current pulsation caused during noload operation is eliminated by applying a small load. The settings of STB1 and STB2 need not be changed. STB1 and STB2 are factory-set as follows: STB1: 10/10 for 2.5 - 11 kVA STB2: 5/10 for 2.5 - 5.5 kVA 3/10 for 11 kVA

7.4 Selecting and Adjusting DC Braking

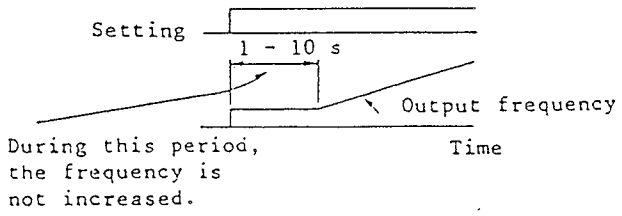
Selection of DC braking	The DC braking function is set by the DB.ON/DB.OFF switch of DS1 as follows:
	DB.OFF: Disables the DB braking function. DB.ON: Enables the DB braking function. DC braking is applied at one-twelfth of the maximum frequency. The braking power can be adjusted by the D.BRK control.
Adjustment of a DC braking power (D.BRK)	DC braking is a standard function. It is implemented at the minimum frequency or less during deceleration. The braking force can be varied by increasing or decreasing the average DC voltage to be applied to the motor. For the standard inverter, the setting is 0 (no braking power), being equivalent to DB.OFF.



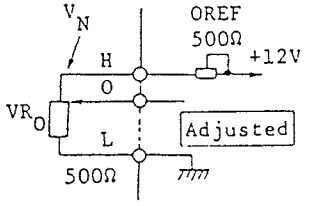
7.5 Adjusting Torque Boost

Torque boost adjustment (T.BST)	The motor torque can be adjusted by increasing or decreasing the output voltage in a low-frequency range. When the motor torque is insufficient, increase it while taking care so that the motor is not burned or the inverter does not trip. The acceleration characteristics are improved.  For the standard inverter, the setting is 5/10.

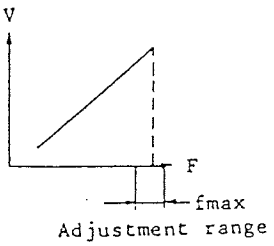
7.6 Adjusting the Frequency Increase Stop Time at Start

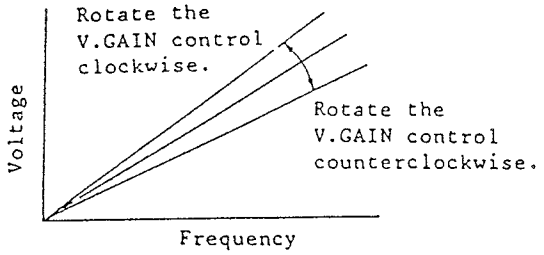
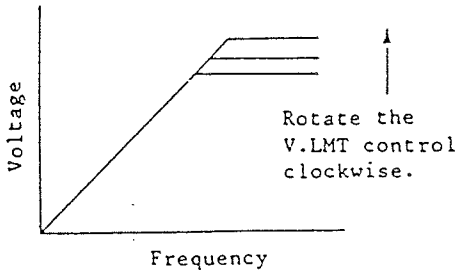
Adjustment of the frequency increase stop time at start (F.STP)	Increase of the frequency can be stopped temporarily at start so that the motor starts smoothly without Causing a trip. The time during which the frequency is not increased is set between 1 and 10 s. When the value of GD^2 is large, set a longer time.  For the standard inverter, the time is set to approx. 3 s.

7.7 Adjusting Voltage V_H at Terminal H (O.REF)

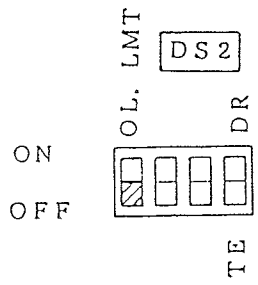
Adjustment of voltage V_M at terminal H (O.REF)	With the circuit shown below, the H terminal can be adjusted so that the voltage at the terminal is just 10 VDC. Usually, variable resistor VR_0 used for adjustment has a resistance of 500 ohms. Adjust the O.REF control with the VR_0 rotated fully clockwise.  Temporarily adjusted

7.8 Control which must not be Adjusted by the User

Control	Description	Remarks
F.FIN (maximum frequency adjustment)	Used for fine adjustment of the maximum frequency. It is factory-set precisely, so do not touch it. 	Fmax: Maximum frequency Since this control is Factory-adjusted, do not touch it.
F.OS (oscillator offset adjustment)	Used to adjust the offset of the oscillator. If it is adjusted incorrectly, the characteristics of the inverter are worsened or the inverter malfunctions. Do not touch the control.	Since this control is Factory-adjusted, do not touch it.
F60 (fine adjustment when 60 Hz is selected)	Used for fine adjustment when the output frequency is set at 60 Hz by setting the F6/F switch of DS1 to F6.	This control is Factory-adjusted, so do not touch it.

Control	Description	Remarks
V.GAIN (output voltage adjustment	Changes the gradient to the output frequency. It is factory-adjusted. This control is used when special V/F characteristics not listed in Table 6 are used. 	Since this control is Factory-adjusted , do not touch it. -
V.LMT (limitation of the maximum output voltage)	Restricts the maximum output voltage. 	This control is Factory-adjusted , For the standard inverter, the setting is 200 V.

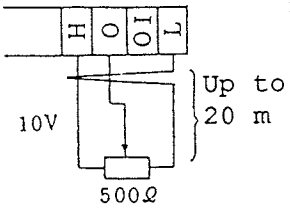
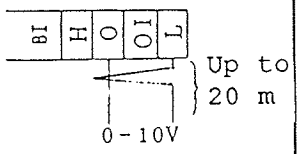
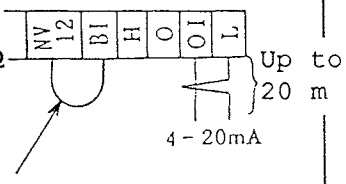
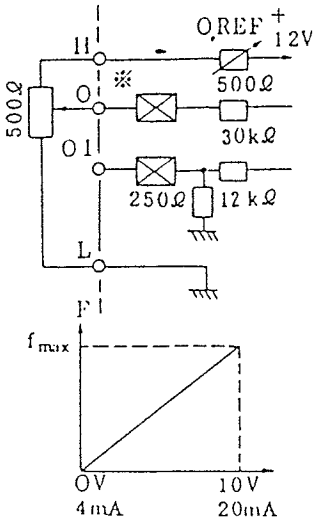
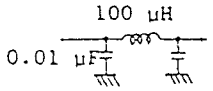
7.9 Selection of Overload Restriction

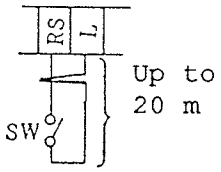
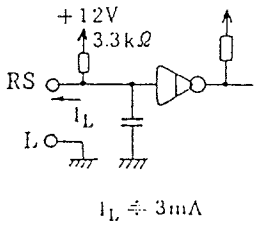
Selection of overload restriction 	• When an overload current of about 130% runs, the current is restricted in increase and the rotational speed decreases. • Whether or not to perform the overload restriction function can be selected by the DS2 switch. OL. LMT OFF; No overload restriction: Standard set (No restriction) OL. LMT ON; Overload restriction: The rotational speed decreases at about 130% of the rated current of the inverter. NOTE: When a sudden overload is applied, the current is not restricted but the OC may trip. When this status is continued, no thermal function is provided by the timing characteristics. Decrease the load or stop the inverter immediately.

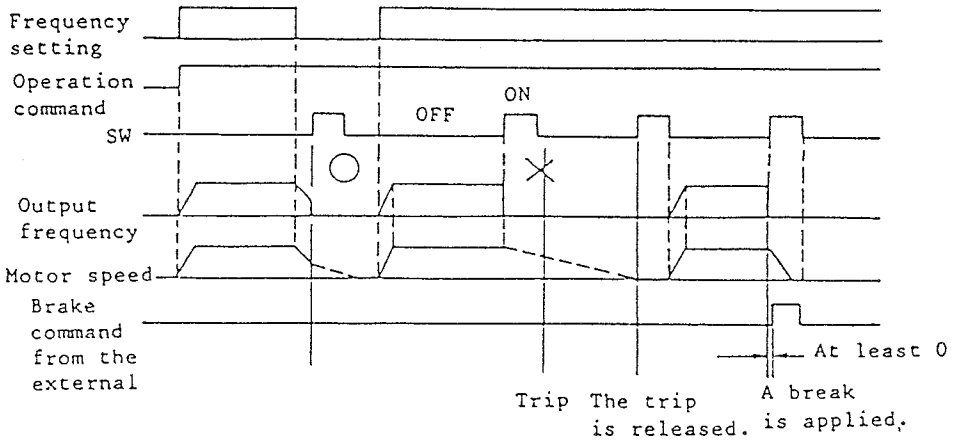
8. EXPALANATION OF INPUT/OUTPUT SIGNALS

8.1 Types and Functions of Input/Output Signals

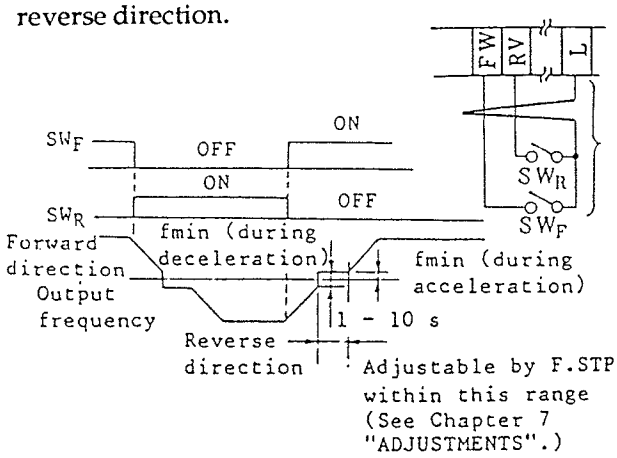
The following table lists input/output signals together with their functions and electrical characteristics:

	Input/output signal	Description	Remarks
Input signals.	Frequency setting O : (voltage input) OI: (current input)	Set a frequency (speed) as follows: (i) When using a variable resistor: When a 500 Ω resistance is connected between the H and L terminals, approx. 10 volts develop across these terminals. The OREF control can adjust the voltage precisely.  (ii) When using an external signal: • Voltage input connection : See the diagram on the right. Maximum voltage to be applied: 10 VDC input impedance: 30 kΩ  • Current input connection: See the diagram on the right. Input impedance: 250 Ω 	Input circuit  * The symbol ⊠ in the input circuit indicates a filter. The symbol applies to all drawings. 

	Input/output signal	Description	Remarks
Input signals.	RS (reset)	Connect the RS terminal to the L terminal as shown on the right.  When the relay is closed, the fault mode and emergency stop are reset. The relay can also be used for control of output cutoff. when the relay is closed, the output is cut off immediately and the motor stops spontaneously. When the frequency is set and an operation command is issued, operation is resumed from the minimum frequency. Do not open the relay while the motor is running by inertia. Otherwise, a large current flows due to displacement between the motor speed and the output frequency, causing a trip.	Input circuit  $I_L \fallingdotseq 3mA$



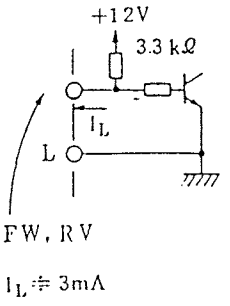
	Input/output signal	Description	Remarks
Input signals.	FW (forward operation) RV (reverse operation)	Connect the FW and RV terminals to the L terminal as shown on the right. The following timing chart indicates change of the motor rotation from the forward direction to the reverse direction.	Input circuit

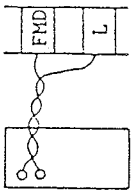
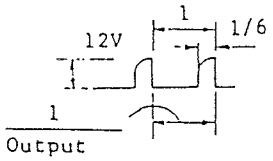
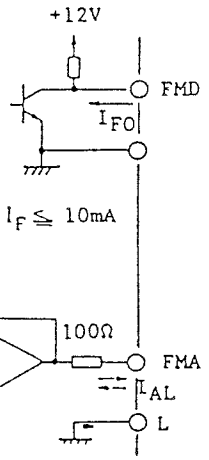
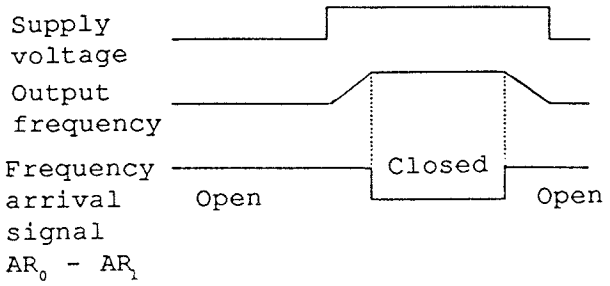
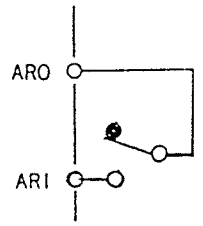


The inverter operates according to the status of the SW_F and SW_R switches (see the table below).

Operation modes set by SW_F and SW_R

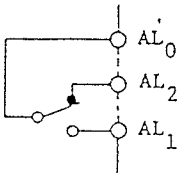
Switch status		When SW_F and SW_R are set as shown on the left during stoppage:	When SW_F and SW_R are set as shown on the left during rotation in the forward direction:	When SW_F and SW_R are set as shown on the left during rotation in the reverse direction:
SW_F	SW_R			
OFF	OFF	Kepts the motor stopped.	Stops the motor by LAD deceleration.	Stops the motor by LAD deceleration.
ON	OFF	Starts LAD acceleration in the forward direction.	Continues to run the motor in the forward direction.	Stops the motor by LAD decele-ration then runs the motor in the forward direction.
OFF	ON	Starts LAD acceleration in the reverse direction.	Stops the motor by LAD deceleration then runs the motor in the reverse direction.	Continues to run the motor in the reverse direction.
ON	ON	Kepts the motor stopped.	Stops the motor by LAD deceleration.	Stops the motor by LAD deceleration.



	Input/output signal	Description	Remarks
Output signals	FMD and FMA (frequency monitor)	FMD is a digital frequency monitor signal which outputs same frequency pulse train as the output frequency. Be sure to adjust the input level of the frequency counter correctly. Otherwise, correct display is not given.  Frequency counter Level is in inverse proportion to frequency.  The FMA frequency monitor signal outputs a voltage (0 - 10 VDC) proportional to the output frequency. It can be used as an input signal to the frequency meter on the operator box. (10 V at the maximum frequency)	Output circuit  $I_F \leqq 10mA$ $I_{AL} \leqq 3mA$ (Resistance of the load $\geqq 3.3$ kΩ)
	Frequency arrival signal AR_0 AR_1	When the set frequency is obtained, the contact is signal closed. 	 Contact specification 250 VAC, 2.5 A (R load), 0.2 A (cosø=0.4) 30 VDC, 3.0 A (R load), 0.7 A (cosø=0.4)
	AL_0, AL_1 and AL_2 (fault alarm signal)	AL_0, AL_1 and AL_2 are output when abnormal conditions.

Power	Operation status	AL_0 and AL_1	AL_0 - AL_2
ON	Normal	OFF	ON
ON	Abnormal	ON	OFF
OFF	-	OFF	ON

Output circuit



Contact specification

250 VAC, 2.5 A (R load),
0.2 A (cosø=0.4)
30 VDC, 3.0 A (R load),
0.7 A (cosø=0.4)

9. OPERATION

9.1 Check before Power On

Upon completion of installation and wiring, check the following before turning power on.

(1) Check whether wiring is done correctly with reference to terminal symbols.

NOTE: When checking the control circuit, do not apply a voltage exceeding the control circuit voltage, for example, during buzzer check.

(2) Check whether the terminals are connected securely.

(3) Check whether the motor protector is attached securely.

(4) For a high-speed motor, check whether the lubrication system and the cooling system are ready.

(5) Remove the front cover and check the control PC board as to whether:

- The control circuit terminals are connected correctly and shielded wires are used.
- The connectors are inserted securely.
- A frequency range is set correctly. (A frequency selection table is attached on the top cover.)
- The shield of each shielded wire is connected to the ground terminal in a one-side manner.
- Each control is set to a correct value.

(6) Remove the screws on the left side of the PC board, remove the plate which securing the PC board, and check whether:

- The main circuit terminals are connected correctly.
- The screws are tightened securely.
- Nuts, washers, chips, and other foreign materials enter the main circuit.
- The ground wires are connected securely.

NOTE:

The inverter is subjected to insulation resistance and withstand voltage tests before it is delivered. If these tests are required during operation, however, follow the procedure described in item (6) in Section 10-3.

Some motors may generate magnetic tones due to higher harmonics. When a tone becomes extremely high or vibration becomes extremely large, resonance may occur. To prevent this, confirm that the motor is installed securely and connected to the load correctly.

o Notes on inverter operations

(1) Restart of the motor

After power is turned off, the motor runs by inertia for a while. If an attempt is made to restart the motor during this period, an overvoltage is applied to the inverter and it may trip.

When the power is turned on once again, the motor may not start rotation for 20 to 60 seconds because some voltage remains in the DC circuit.

(2) Use of a private power supply

When a generator for private power supply is used to operate the inverter, harmonic current may distort voltage waveforms output from the generator or the generator may be overheated excessively.

(3) If the inverter is turned on then off in a short time, it may trip. Do not run the motor for an inching operation in this way.

(4) Start and stop of the motor

Use the FW/RV operation switch to start and stop the motor rather than turning on and off the electromagnetic contactor as far as possible.

(5) The converter module may be damaged when:

- The unbalance factor of the power supply voltage is 3% or more.
- The capacity of the power supply capacity is ten times that of the inverter capacity and 500 kVA or more.
- Severe power supply voltage transients occurring.

Examples:

- A number of inverters are connected together with low impedance line connections.
- Power factor improvement capacitors may be switched on line.

If one of the above conditions exists, damage may be avoided by using a reactor of approximately 2% of impedance (percentage of the voltage drop at the rated current) in series with the input power lines for each inverter.

9.2 Trial Operation

Trial operation of the motor alone is described below.

(1) Check whether the motor is disconnected from the converter. If not, disconnect it to run the motor alone.

(2) Check whether the protective cover is placed on the rotating section of the motor. Inform persons near the motor of start of the motor.

(3) Rotate the control on the frequency setting device to its extreme counterclockwise position to prevent a command from being issued.

(4) Set the FW/RV switch.

(5) Reset the circuit breaker (MCB) for the main circuit power.

(6) Press the power pushbutton BS and close the Mg relay. Confirm that the POWER lamp on the inverter lights.

(7) Select the forward or reverse direction in which the motor runs with the FW/RV switch.

(8) Turn the knob of the frequency setting unit slowly clockwise to check whether the motor rotates smoothly, including the following:

- Rotation direction
- Hunting (When the motor is hunted, the motor current pulsates and the motor vibrates slightly.
- Correct rotational speed?
- When the rotation direction is incorrect, turn the power off, check that no voltage remains in the DC circuit of the inverter, and interchange the two wires of the output terminal.
- When the inverter is hunted, adjust STB1 and STB2 as specified in Section 7.3.

(9) Check that the frequency matches the maximum frequency selected with the frequency setting control fully rotated clockwise.

(10) Confirm that the OV and OC lamps do not light when the frequency setting control is rotated clockwise and counterclockwise. If one or both lamps light, the acceleration time and/or deceleration time is too short. To prolong the time(s), rotate the ACCEL and/or DECEL control clockwise.

(11) To stop the motor, set the FW/RV switch to OFF.

(12) Set the frequency with the frequency setting unit first and turn the FW/RV signal ON. The motor is accelerated up to the set frequency. To stop the motor, turn the FW/RV signal OFF.

(13) Check that the motor is stopped and then turn the power stop button BSS OFF.

(14) Trip the circuit breaker.

10. MAINTENANCE AND CHECK

The HFC-VAH2 series inverters have a printed circuit board. In the DON'T TOUCH area on the PC board, the power supply voltage is applied with respect to the ground while the power switch is on. Also, a high voltage is applied to the smoothing capacitors CB.

During maintenance, an electric shock may occur. Before starting maintenance, confirm that:

(1) At least 20 minutes have passed after power was turned off to allow for natural discharge.

(2) The voltage across terminals P1 and N is 15 V or less. (Measure the voltage with a multimeter as shown in Figure 11.)

(3) After power off, a 30-watt, 500 Ω discharging resistor is connected between terminals P1 and N for at least 15 seconds.

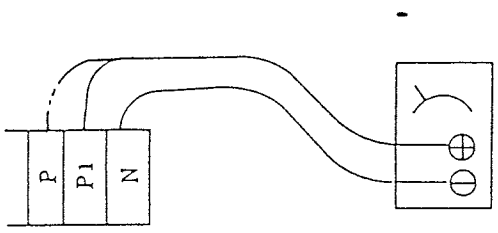


Figure 11

Figure 12 and 13 are circuit configuration diagrams which indicate connector layouts using symbols.

- General Notes

  Keep the inverter clean.
  Take sufficient care to prevent wire breakage and poor connection. Be sure to tighten the terminals securely.
  Electronics should be free from moisture and oil vapor. In addition, entrance of dust or iron chips into them deteriorate insulation. This may result in accidents.

10.1 Routing Check

(1) Power supply voltage

(2) Output frequency, output voltage, and output current

(3) Noise from the inverter and motor

(4) Ambient temperature and temperature rise in the inverter and motor

(5) Humidity

It must be 90% or less and there must be no condensation.

(6) Oil vapor and cutting oil mist in the inverter

10.2 Periodical Check

(1) Looseness of terminals

(2) Contaminants near the ventilating hole

(3) Cooling fan

(4) Cleanness of the printed circuit board and main circuits

(5) Insulation resistance

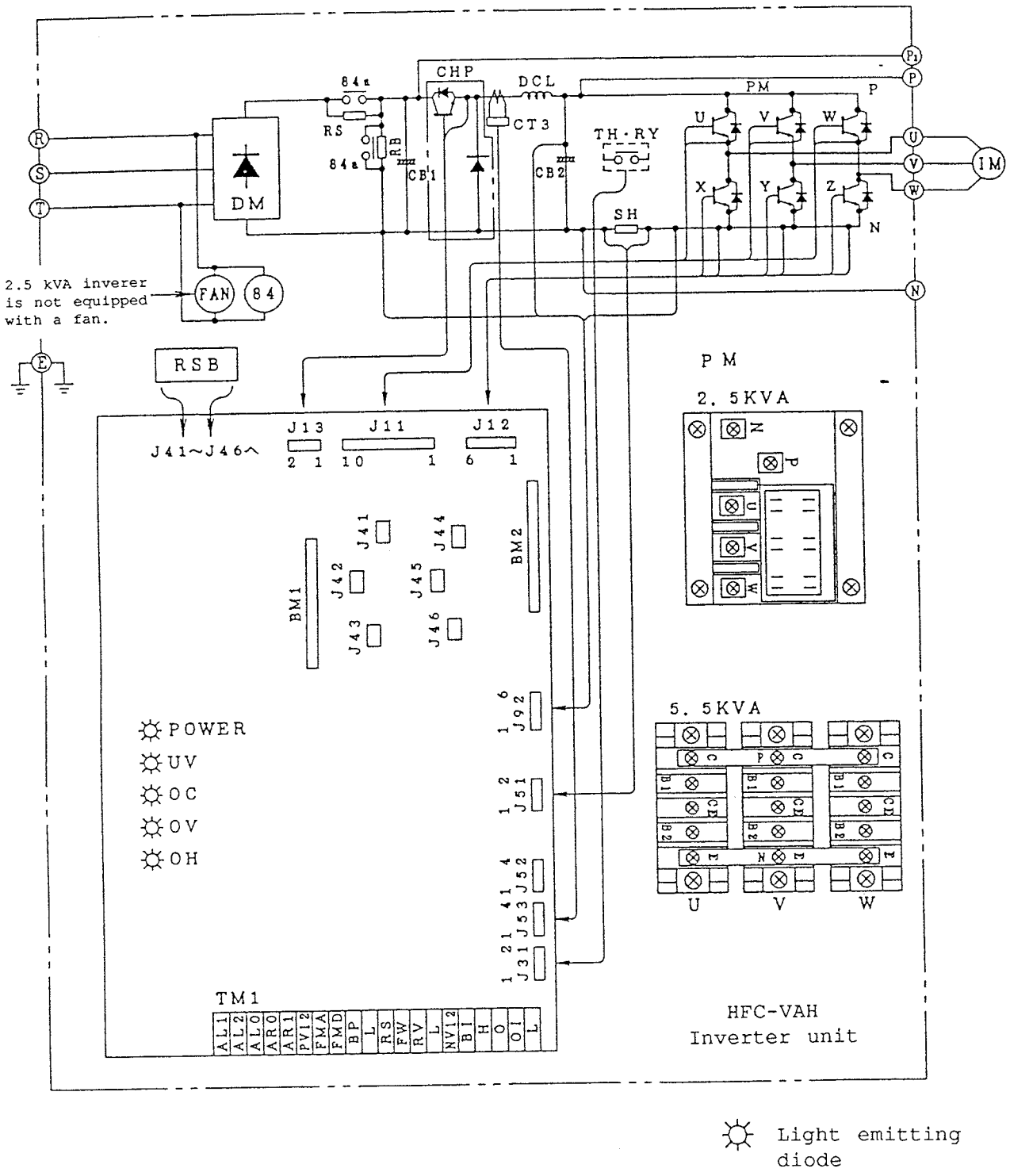


Figure 12 Schematic Diagram (2.5LB2 and 5.5LB2)

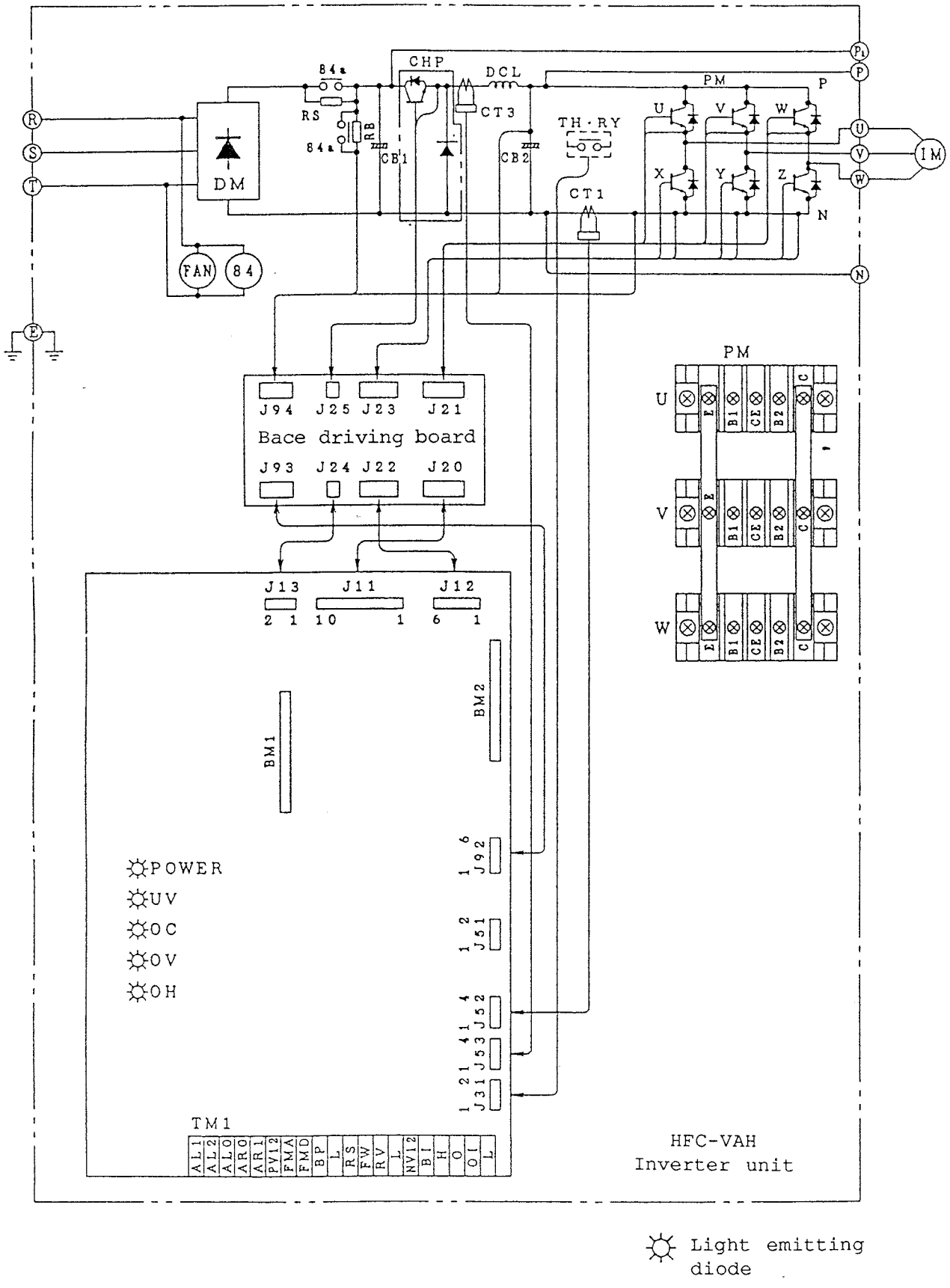


Figure 13 Schematic Diagram (11LB2)

10.3 Checking Method

(1) Measurement of output voltage, input and output currents, and input voltage

The voltage output from the inverter cannot be measured precisely with a moving-iron type meter.

However, the RMS value VAC of the fundamental wave, which directly contributes to motor torque, can be approximately measured using the circuit shown in Figure 14.

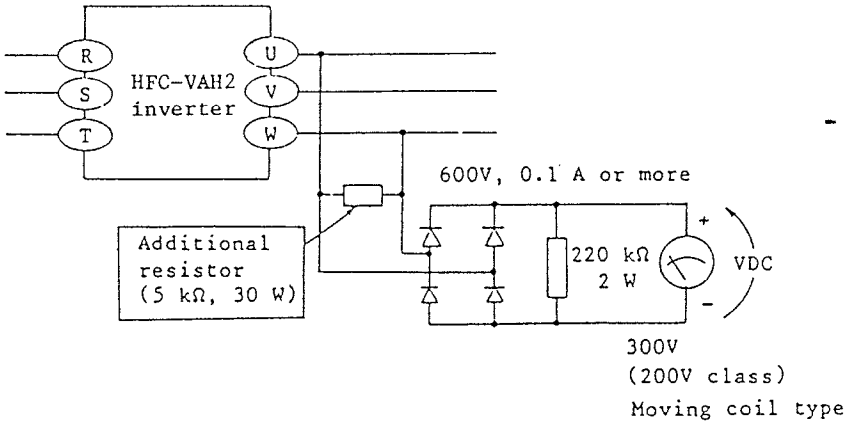


Figure 14 Output Voltage Measurement Circuit

Input and output currents can be measured with a moving-iron type meter. Measure input voltage with three single-phase electrodymometer type wattmeter.

When no load is connected to output terminals U, V, and W, DC voltages appear on these terminals due to leak current (approx. 2 mA) of semiconductors even when the output frequency command indicates zero.

Therefore, connect a voltmeter to output terminals, if necessary, as shown in Figure 15 to assure that the meter indicates correct values.

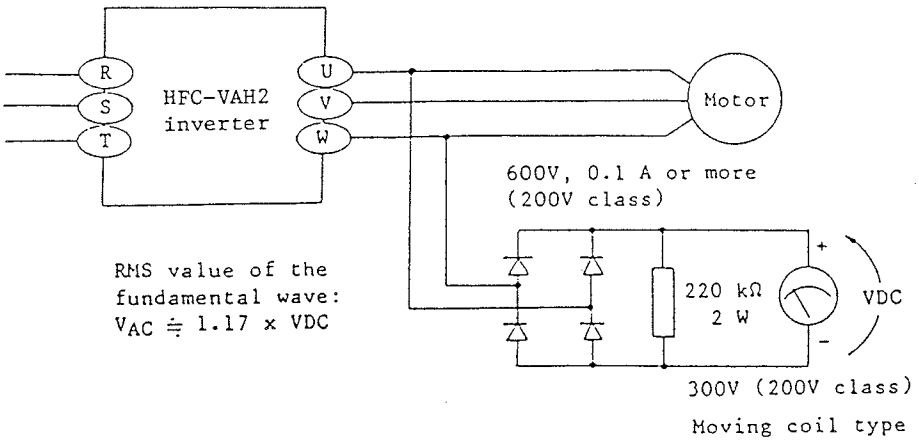


Figure 15 Output Voltage Measurement Circuit

(2) Maintenance of the printed circuit board

Usually, the components on the printed circuit board need not be serviced. If an abnormality occurs, contact the service station. If the user want to service the PC board, note the following point:

- Prevention of destruction due to static electricity

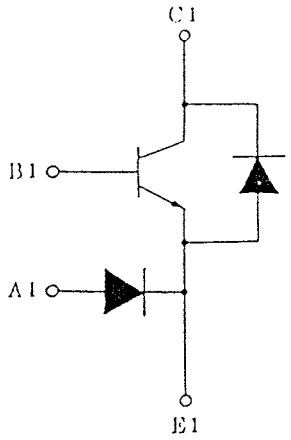
C-MOS ICs and other components on the PC board may be destroyed due to static electricity. Be sure to ground the working bench, soldering iron, and yourself.

(3) It is recommended that the smoothing capacitors CB and the cooling fan be replaced once very three years. However, shorten this interval when the inverter is used at high temperatures and under heavy load.

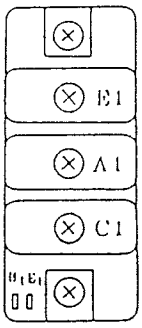
(4) Chopper module checking method

- Turn power off. Before starting work, confirm that voltage across terminals P and H and that across terminals P1 and H are 15 V or below.

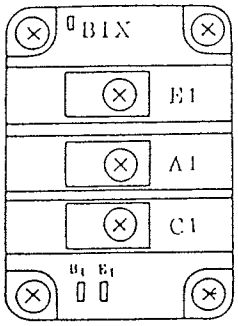
- Set the multimeter to the 1 Ω range.



Symbol



2.5LB2, 5.5LB2



11LB2

NOTE 1: Before operation, turn power off and wait until the voltage between P and N and P_1 and N falls below 15 V.

NOTE 2: When measuring a resistance of 50 Ω or less, set the range of the ohmmeter to 1 Ω.

Terminals on the tester (-) → (+)	Resistance (Ω)
C1 → B1	50 kΩ or more
B1 → C1	50 Ω or less
C1 → E1 E1 → A1	50 kΩ or more
E1 → C1 A1 → E1	50 Ω or less

If the resistance is outside the range listed in the above table, replace the chopper module.

- Symptoms at occurrence of failures
  - OC trip
  - The voltage across terminals P and N is 250 V or above even when no speed is set.
  - An abnormal tone is heard from the connected motor even when no speed command is issued. (The DC braking circuit operates and is ready to discharge.)

(5) Inverter module (PM) checking method

The inverter module can be roughly judged to be normal or abnormal through measurement at terminals.

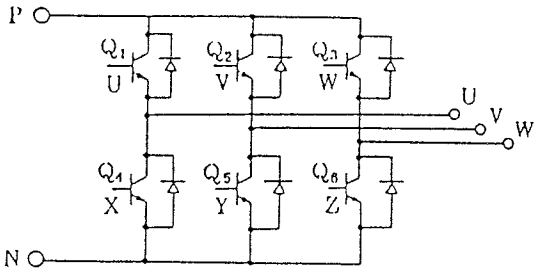
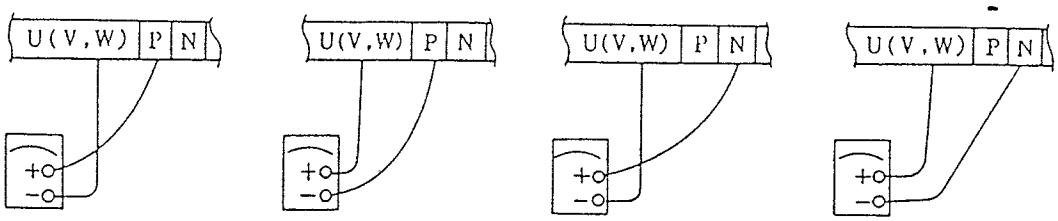


Figure 16 Schematic Diagram of the Inverter Module



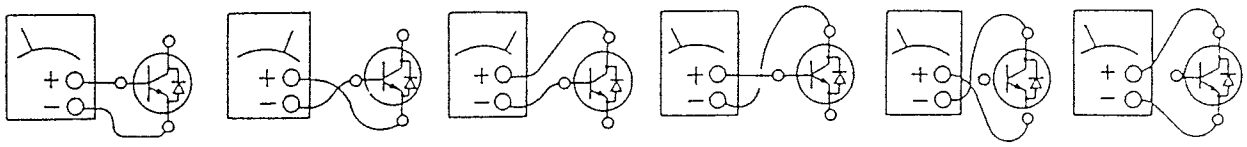
* Connect the tester for at least 10 s. A small resistance value may be indicated initially because of a capacitor charging effect.

* Measure with the ohmmeter set on a 1 Ω range.

Figure 17 Check of the Inverter Module at Terminals

For how to judge the inverter module, see Figure 18.

When replacing the inverter module, slightly apply thermal conductive silicone grease (KS61 manufactured by Shin-etsu Chemical Industry Co.,) to the cooling surface of the new module. If the inverter module is destroyed, the base driving module (BM1, BM2) on the PC board may also be destroyed. Visually check the base driving module.



50 - 200 Ω	100 Ω or less	50 Ω or less	50 Ω or more	50 kΩ or more	10 Ω or more

(When all conditions are met, the inverter module is normal.)

NOTE: Measure with the ohmmeter set on a 1 Ω range.

Figure 18 Judging the Inverter Module

(6) Insulation resistance and withstand voltage tests

To conduct insulation resistance and withstand voltage tests, connect terminals as shown in Figure 18 and perform measurements under the following conditions:

[Conditions]

a. Insulation resistance test

Measure the resistance between a terminal and the ground with a 500 VDC megger as shown in Figure 19. Confirm that the inverter withstands 5 MΩ or more.

b. Withstand voltage test

Apply 1500 VAC between a terminal and the ground for one minute as shown in Figure 19. Confirm that there is no abnormality.

* Do not use the terminals not shown in Figure 19 for withstand voltage test.

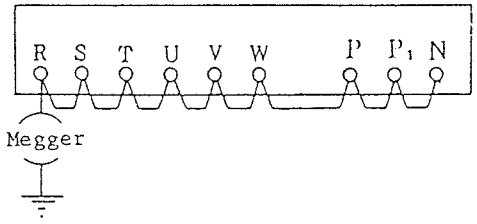


Figure 19 Terminal Connection for Insulation and Withstand Voltage Tests

11. FAULT MESSAGE DIAGNOSTICS

If a failure occurs in the inverter, its components operate as indicated in Table 7. When this happens, locate the faulty component and take action.

Table;e 7 Operation and Cause at Occurrence of a Failure

Symptom					Fault alarm relay (28)	Cause	Reset	Action	Remarks
Circuit breaker (MCB)	Electromagnetic contactor (Mg)	Current sensor	LED						
o						Shortcircuit on the power supply side, ground fault	A	Correct the cause.	
						Faulty inverter module	B	Repair the inverter module.	
	o					Power failure	A	-	
			Failure display	UV	o	Insufficient voltage (160 V or below), instantaneous power failure	C	Investigate the cause.	
				OC	o	Shortcircuit of the load, momentary overcurrent	C	Investigate the cause.	Acceleration Deceleration
				OV	o	Overvoltage	C	Investigate the cause.	
				OH	o	Overheated fan	C	Investigate the cause.	Fan stop, etc.
		o				Overloaded motor	A	Reduce the load.	

o: Component which may usually operate

A: Operate the circuit breaker and electromagnetic contactor.

B: Turn power off, Discharge the smoothing capacitors CB.

Then, replace the component.

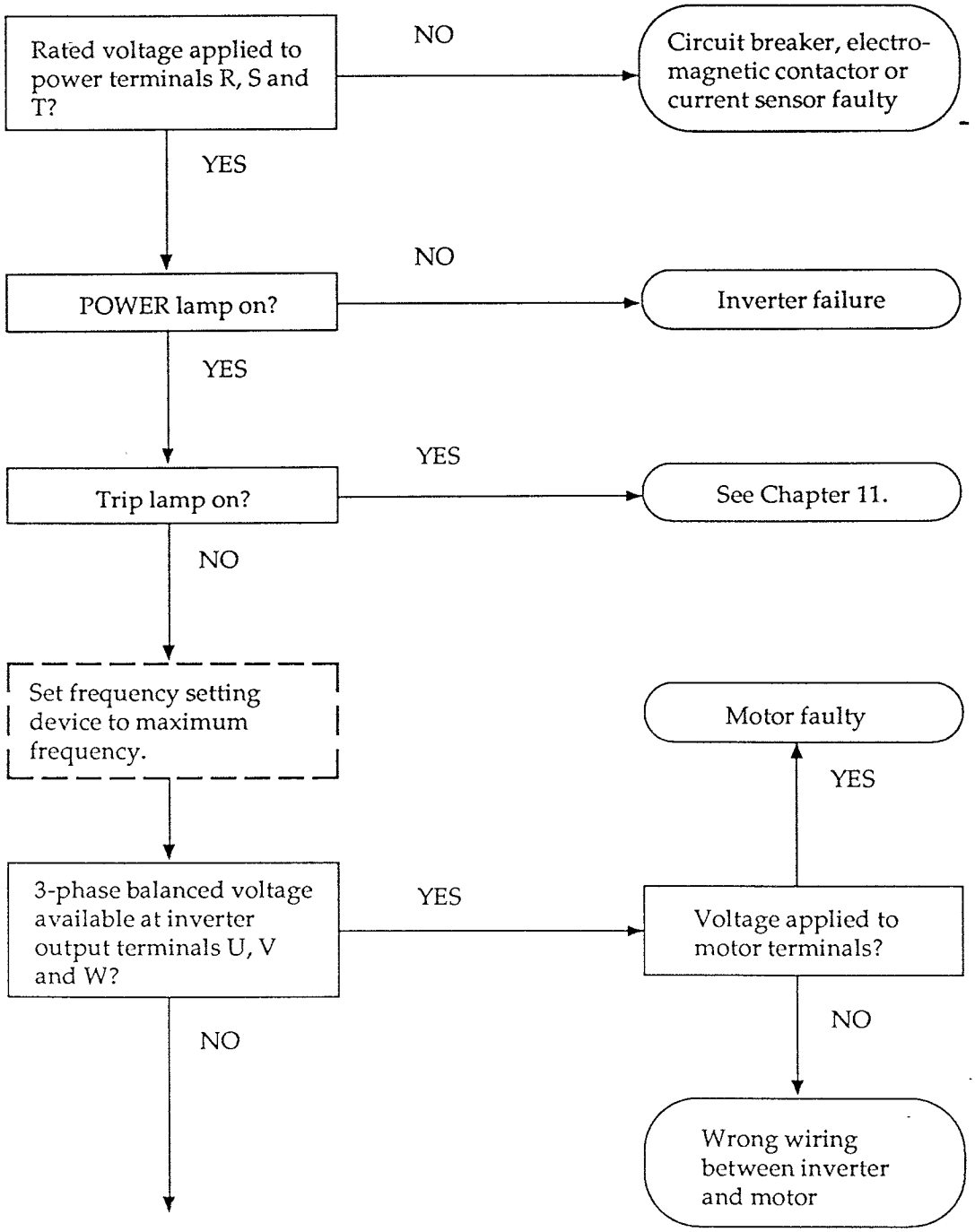
C: After the motor stops, close the circuit between the control terminals RS and L or open the electromagnetic contactor Mg.

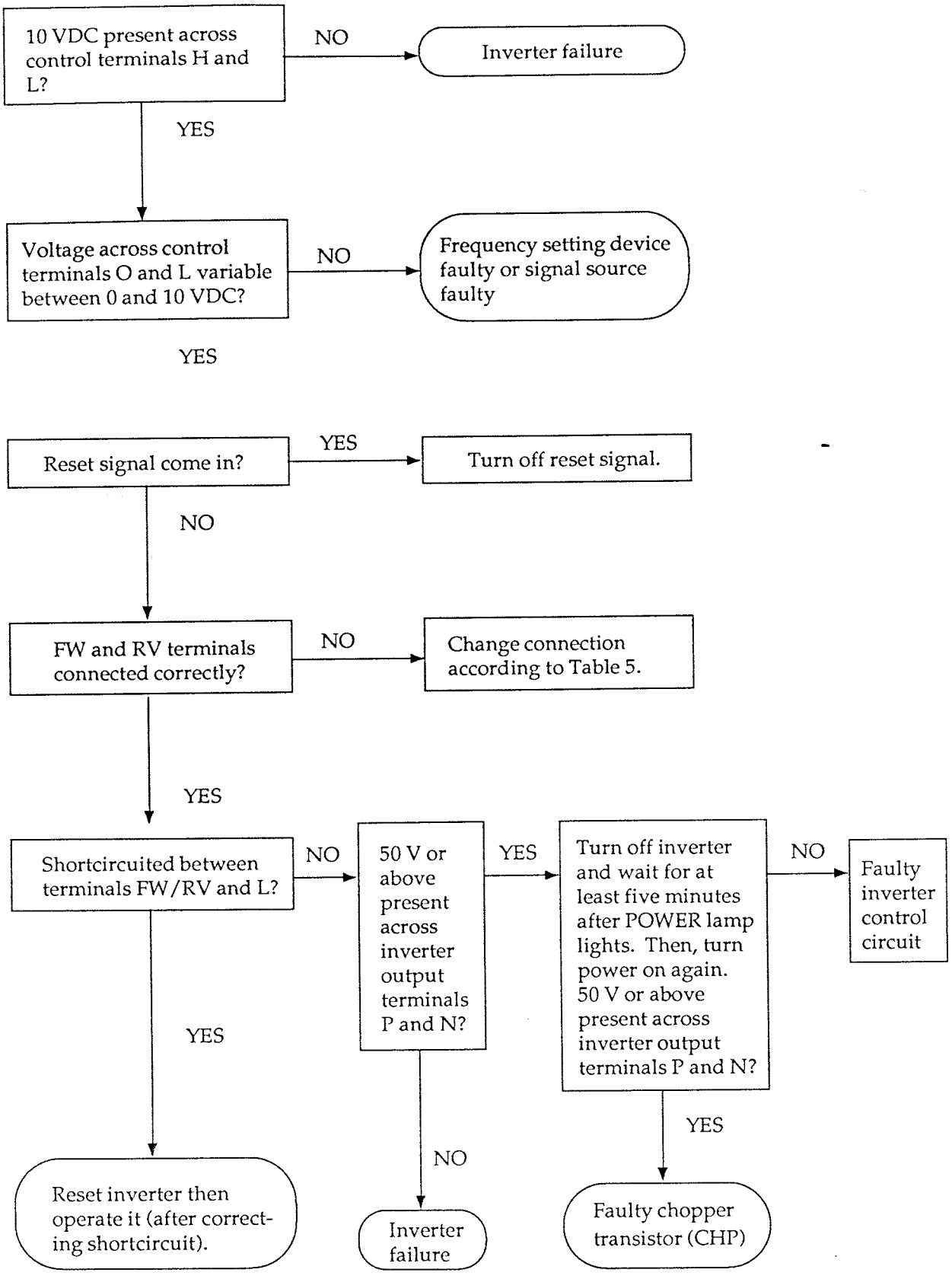
If a failure not listed above occurs, turn power off as shown as possible. Note that the inverter cannot be protected against ground faults.

12. TROUBLESHOOTING

If the trip lamp lights while the motor is running through the inverter or if the motor runs abnormally, check the cause according to the following troubleshooting procedure. If the cause cannot be found from the procedure, contact the Hitachi's service station.

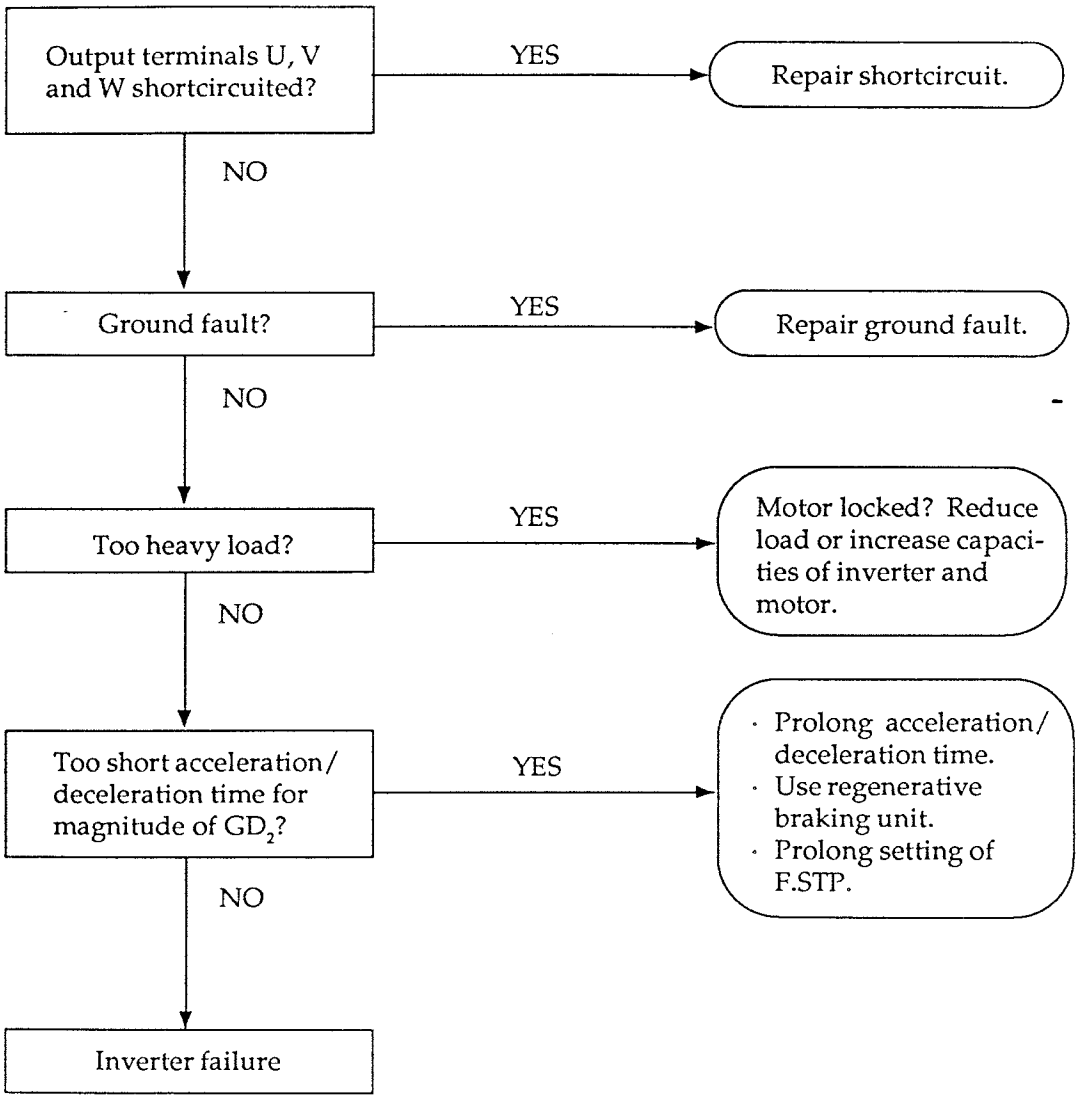
o The motor does not run.



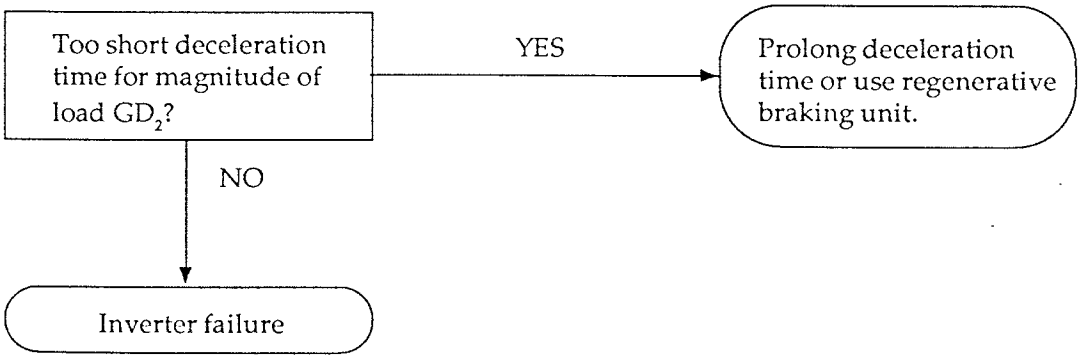

10 VDC present across control terminals H and L?
NO
Inverter failure
YES
Voltage across control terminals O and L variable between 0 and 10 VDC?
NO
Frequency setting device faulty or signal source faulty
YES
Reset signal come in?
YES
Turn off reset signal.
NO
FW and RV terminals connected correctly?
NO
Change connection according to Table 5.
YES
Shortcircuited between terminals FW/RV and L?
NO
50 V or above present across inverter output terminals P and N?
YES
Turn off inverter and wait for at least five minutes after POWER lamp lights. Then, turn power on again. 50 V or above present across inverter output terminals P and N?
NO
Faulty inverter control circuit
YES
Reset inverter then operate it (after correcting shortcircuit).
NO
Inverter failure
YES
Faulty chopper transistor (CHP)

- Troubleshooting by trip lamp

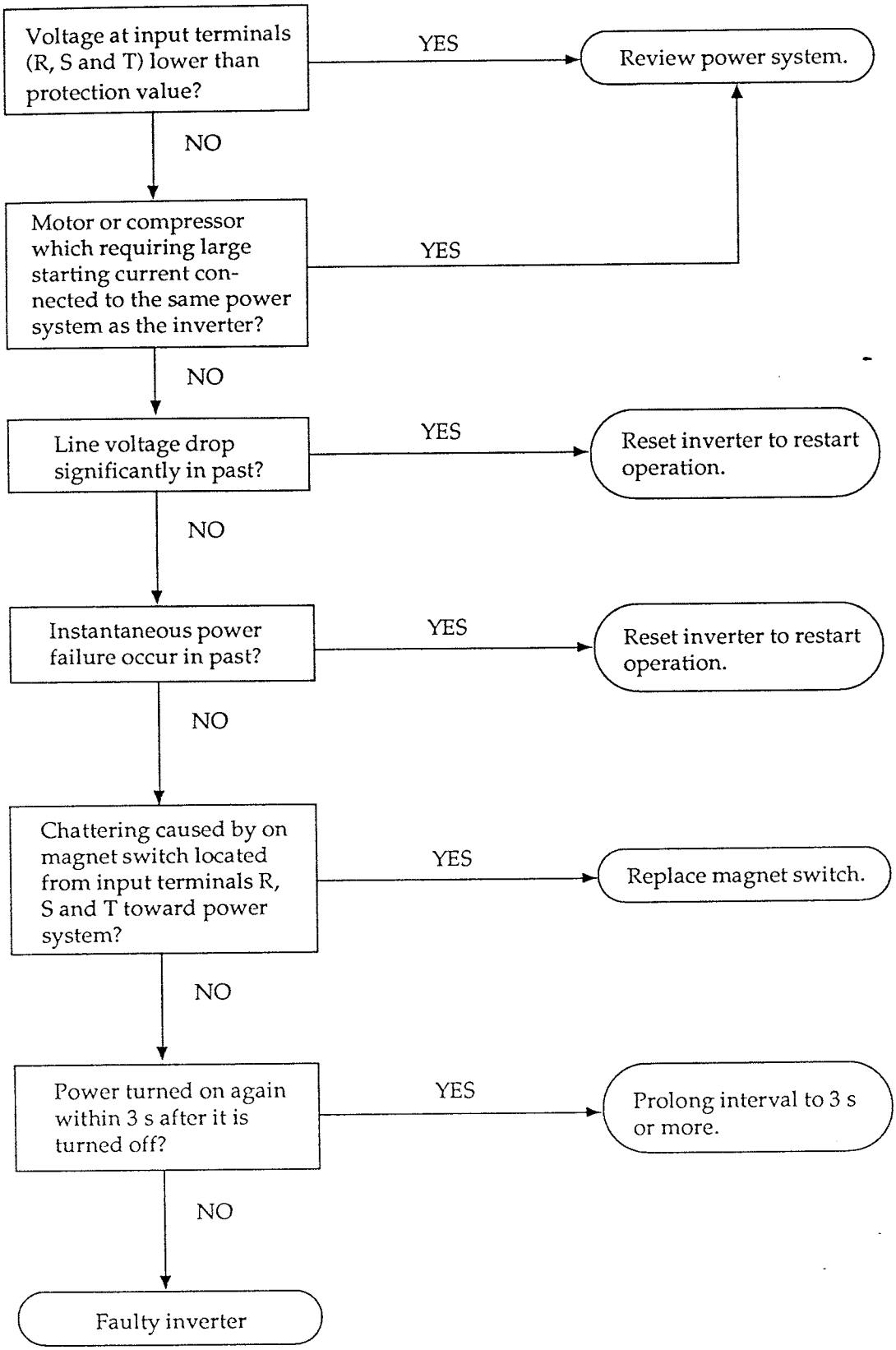
  - Inverter trips on overcurrent.



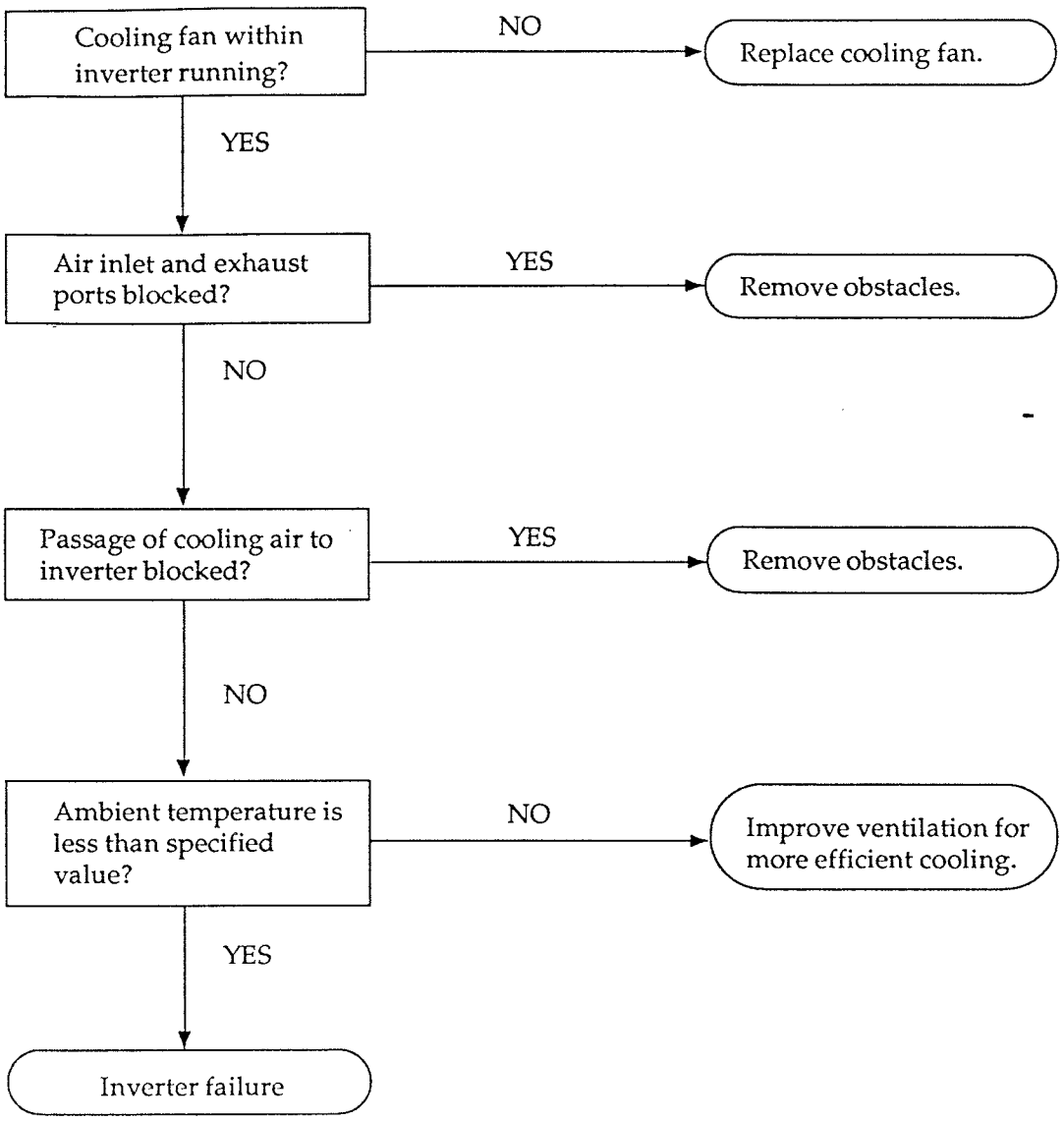
- Overvoltage trip functions.



- Inverter trips on undervoltage.



- Inverter trips on overheated.



When the S phase is missing on the power supply side of the inverter, large ripple current flow in the DC circuit and the motor may vibrate. If this status continues for a long time, the life of the smoothing capacitors in the DC circuit is shortened. Connect the S phase as soon as possible.

When the R or T phase is missing, power to the control circuit is not turned on, so the inverter does not operate.

13. WHEN ORDERING PARTS INQUIRING

Before ordering parts or inquire what to do when your inverter goes wrong, please check the following items:

(1) Type

(2) Output (kVA)

(3) Manufacturing serial number (MFG. NO)

(4) Symptom of failure

If the nameplate is too dirty to read the above information, please attach simple sketches of the parts that you want.

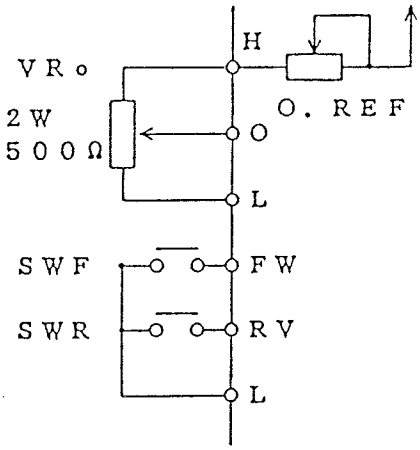
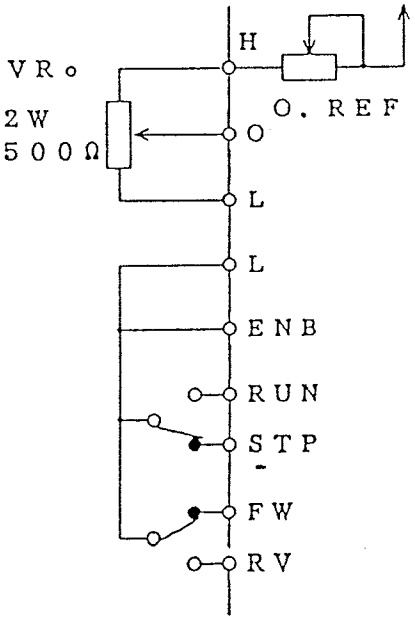
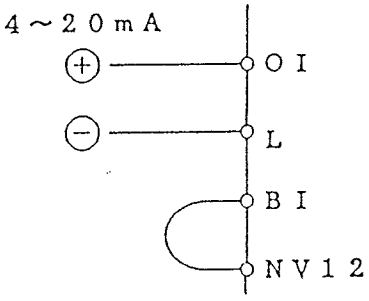
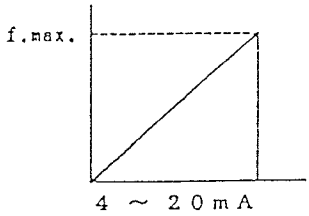
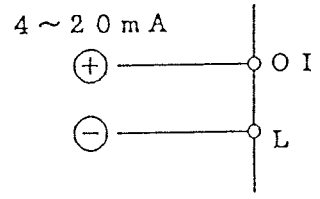
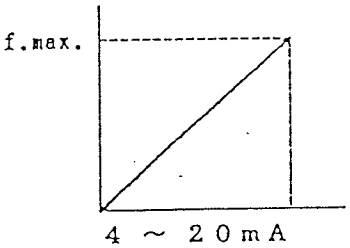
To minimize the idle time, it is recommended that the parts listed in Table 8 be stocked.

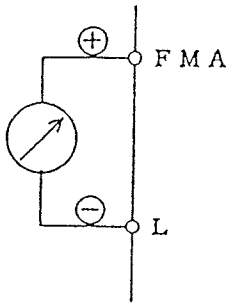
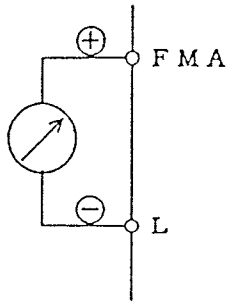
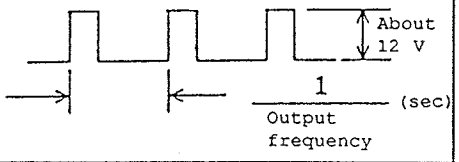
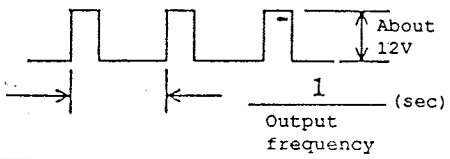
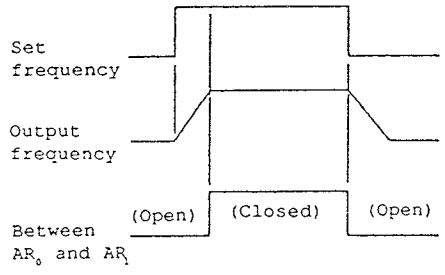
Table 8 Recommended Spare Parts

Model		2.5 kVA			5.5 kVA			11 kVA		
Part name	Circuit symbol	Type	In use	Spare	Type	In use	Spare	Type	In use	Spare
Chopper module	CHP	QM50E2YH	1	1	QM75E2YH	1	1	QM100E2YH	1	1
Inverter module	PM	6S30A	1	1	P50X	3	1	P75X	3	1
Converter module	DM	DF30CA80S	1	1	RM15TAH	1	1	RM30TAH	1	1
Base module	BM1,BM2	3T004584-3	2	1	3T004584-3	2	1	3T004584-3	2	1
Cooling fan	Fan	———	0	0	4T005293-1	1	1	4T005293-1	2	1
Smoothing capacitor	CB1,CB2	3T002652-4	2	1	3T000983-8	2	1	3T001358-8	2	1

Appendix 1 Terminal comparison and function comparison between VAH1 and VAH2

	Terminal name		Terminal symbol	
			VAH2	VAH2
Output signal	Failure indication terminal		AL1, AL2, AL0	AL1, AL2, AL0
	Frequency arrival terminal		AR0, AR1	-
	+12 V terminal		PV12	-
	Frequency monitor terminal		FMD (digital) FMA (analog)	FMD (digital) FMA (analog)
	BRD control terminal (optional)		BP	BP
Input signal	Common terminal		L	L
	Reset terminal		RS	RS
	Forward rotation		FW (Running/stop command)	FW
	Reverse rotation		RV (Running/stop command)	RV
	Common terminal		L	L
	-12 V terminal	Used for current input	NV12	-
	Bias terminal		BI	-
	Frequency setting		H	H
	Frequency setting voltage input (0 to 10 V)		O	O
	Frequency setting current input (4 to 20 mA)		OI	OI
	Common terminal		L	L
	Running		-	RUN
	Stop		-	STP
	Input enable		-	ENB
	Emergency stop		- (RS used)	EMS

Item	VAH2		VAH1	
Running - Stop command Forward - Reverse rotation command	H · O · L · FW · RV	 SWF ON : Forward rotation OFF : Stop SWR ON : Reverse rotation OFF : Stop When the switches SWF and SWR are simultaneously turned ON, the motor stops.	H · O · L · ENB · RUN · STP · FW · RV	 FW:ON and RUN:ON: Forward rotation FW:ON and STP:ON: Stop RV:ON and RUN:ON: Reverse rotation RV:ON and STP:ON: Stop
Frequency command (Voltage input)	O · L	$f_{max.}$ at 10 V between O and L (a) 10 V between H and L (b) 10 V when VR_0 is 500 Ω	O · L	$f_{max.}$ at 10 V between O and L (a) 10 V between H and L (b) 10 V when VR_0 is 500 Ω
Frequency command (Current input)	OI · BI · NV12 · L	 Input impedance 250 Ω  (When inputting a current of 4 to 20 mA between O and I, connect BI and NV12 beforehand.)	OI · L	 Input impedance 250 Ω 

Item	VAH2		VAH1	
Frequency monitor	FMA · L	Analog meter frequency terminal  Analog specification: 10 V, 1 mA, full scale	FMA · L	Analog meter frequency terminal  Analog specification: 10 V, 1 mA, full scale
	FMD · L		FMD · L	
Failure reset	RS · L	① An alarm can be reset or the output can be cut off. ② When the interval between RS and L is turned ON, the inverter is reset.	RS · L	① An alarm can be reset or the output can be cut off. ② When the interval between the terminals RS and L is turned ON, the inverter is reset.
Emergency stop command	-	None (For emergency interruption, short-circuit the terminals RS and L. In this case, the failure is reset.)	EMS	The inverter output can be cut off. When releasing it, press the Reset switch (RS). When the emergency stop command is received, a failure display signal (AL_0, AL_1, or AL_2) is outputted. In this case, no light emission diode is displayed.
Frequency arrival signal (Relay output)	AR_0 · AR_1	The frequency arrival signal is outputted when the frequency reaches the set value. 		None (Option correspondence)

Terminal layout

VAH2

AL1	AL2	AL0	AR0	AR1	PV12	FMA	FMD	BP	L	RS	FV	RV	L	NV12	BI	H	O	OI	L

VAH1

AL1	AL2	AL0					FMA	FMD	BP	L	EMS	RS	L	ENB	RUN	STP	FV	RV	L	H	O	OI	L	E