HFC-VWA SERIES
REMOTE OPERATOR, COPY UNIT

SERVICE MANUAL

ADJUSTMENT AND MAINTENANCE MANUAL

Models:

HFC-VWA1.5LB - VWA16LB
HFC-VWA1.5LB2 - HFCVWA16LB2
HFC-VWA5.5HB2 - HFC-VWA11HB2
DOP-03A, 1A, 3A DRW-1A

This manual is a compilation of malfunction diagnosis procedures (troubleshooting) for operation adjustments. Please use this manual in combination with the Hitachi Inverter HFC-VWA Series Operation Manual.

HITACHI

NBS4441X

PREFACE

This manual is specifically written for the VWA2 (type 2), however, it is also applicable to the VWA (type 1).

CONTENTS

CONTENTS - (cont'd)

SAFETY INSTRUCTION

The following safety instructions are basic safety items when you use the inverter, and these instructions for Hitachi inverter describes to assist the operator and maintenance personnel in performing good work safety procedure.
The personnel in charge of operation, maintenance and installation must read and understand the safety instructions carefully before doing work, investigating system/application.
Failure to follow safety instructions may cause a personal injury, damage to the inverter or malfunction.

1. Safety Management

(1) Appoint a person who is responsible to operate the inverter. Have the only qualified persons operate and perform maintenance.
(2) Train the operators and maintenance persons for the following.
. How to operate (start and stop)
. How to maintain the inverter.
(3) Keep the instruction manual and other documentation in relation to the inverter.
(4) Do not modify the inverters without manufacture's written permission.
(5) Keep the inverter clean to look the LCD and instruction on the inverter for everybody.
(6) Turn off the power supply to the inverter while not using it.
(7) Do not use the inverter for medical equipment such as pacemaker and fire pumps.

2. General Safety Instruction upon Receiving

(1) Check the model name of inverter on the box whether it is the same as your order before unpacking.
(2) In the case of receiving a different model from your order, do not use it and inquire to the vendor.

3. General Safety Instruction upon Unpacking and Storage

(1) Open the box and check whether the inverter has a damage or not.
(2) Check the specifications in the label on the cover whether they are the same as your order.
(3) If you do not use the uinverter for the time being.
Keep the inverter under the good condition.

4. General Safety Instruction upon Installation and Wiring

(1) Read and understand the installation and wiring section completely before installing the inverter.
(2) Put a LOCKOUT/TAGOUT to the power supply switch during maintenance and servicing working.
(3) The installation place must be wide enough space for maintenance.
(4) Provide emergency stop buttons at necessary places, and do not use the Free-Run-Stop and Reset functions of the inverter for emergency stop. In the case of emergency, the power supply to the inverter must be turned off.
(5) Install the specified grounding to the inverter and others which require it.
(6) Connect the wiring correctly to proper terminal.

5. General Safety Instruction upon Test-run

(1) Check the all wiring to the inverter and make sure everything in order before turning on the power supply.
(2) Make sure the programmed parameters whether they are in accordance with your specifications. For example maximum frequency, before operating.
(3) Make sure nobody is near motor and equipment before switch on.
(4) Put a sign board "ON TEST-RUN" around the inverter and equipment (Motor, machine ... etc.).

6. General Safety Instruction upon Inspection and Maintenance

(1) Put a sign board "ON MAINTENANCE" around the inverter and equipment.

(2) Put a LOCKOUT and TAGOUT on the power supply switch during working.

(3) After power turn off, wait for until the LED lamp on the printed circuit board goes off. This LED lamp is visible after the terminal cover is removed.
Measure the DC bus voltage on the + and - terminals by volt meter and make sure no voltage present on them before touching internal parts.

1. EXAMINING THE CONDITIONS

Before making any adjustments or repairs, check the inverter and motor specifications from the following.

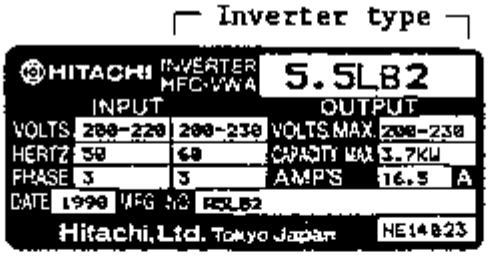
1.1 Checking the Inverter Product Name and Manufacturing No.

Inverter product name HFC-VWA

MFG. NO.

These are indicated on the label on the front cover.

Example of label used



Description of inverter types

HFC-VWA5.5LB2

- HFC: Hitachi inverter
- VWA: Control method (V: Voltage type); Output waveform (W: PWM control method); Functions/purpose (A: Low noise type)
- 5.5: Input voltage (L: (Three phase 200 V class), H: (Three phase 400 V class))
- LB: Structure type B: No digital operation panel.
- 2: Version number

1.2 Examining Inverter and Motor Specifications

(1) Inverter specifications

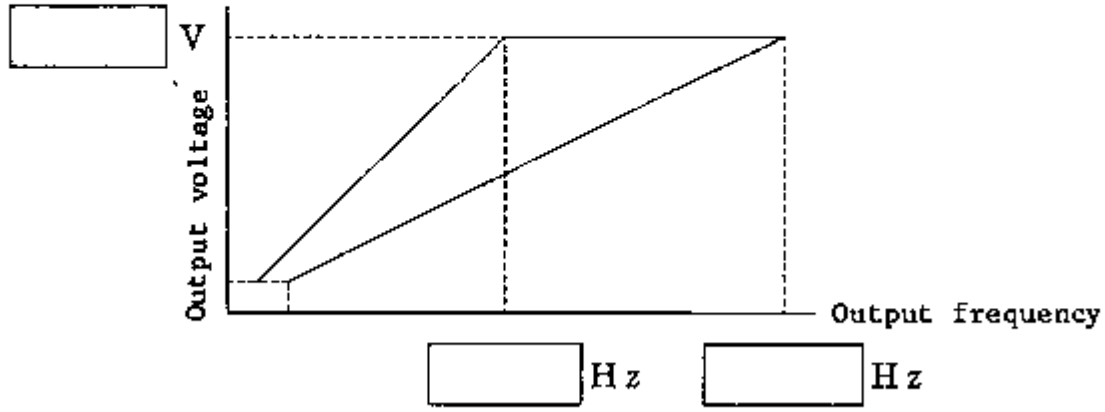
o Monitoring mode

Display sequence	Monitor name	Initial display contents	Remarks
1	Frequency setting and output frequency	FS 000.0 000.0Hz	
2	Frequency commanding method	F-SET-M Terminal	
3	Operation commanding method	F/R-SW Terminal	
4	Motor rotational speed display	RPM 4P 00000RPM	
5	Frequency conversion value display	/Hz00.0 00000.00	
6	Output current display	If----A Im000.0%	
7	Manual torque boost adjustment	V-Boost Code<31>	
8	Output voltage gain adjustment	V-Gain 100%	
9	Jogging frequency setting	Jogging 01.0Hz	
10	Parameter setting related check	CHECK +	
11	Parameter setting forced rewrite	FORCE SET +	
12	Terminal monitor	TERMINL 00000000	
13	Fault display	#	
14	Fault trace display	?ERR COUNT 000	

o Function mode

Display sequence	Function name	Standard setting	Remarks
1	V/f pattern setting	SLV1 060-060	
2	Acceleration time setting	10	
3	Deceleration time setting	10	
4	Maximum frequency setting	0	
5	Starting frequency setting	0.5	
6	Maximum frequency limiter setting	0	
7	Minimum frequency limiter setting	0	
8	Jump frequency 1 setting	0	
9	Jump frequency 2 setting	0	
10	Jump frequency 3 setting	0	
11	Multistage speed/process stepping selection	Speed	
	Multistage speed 1 setting	0	
	Multistage speed 2 setting	0	
	Multistage speed 3 setting	0	
	Multistage speed 4 setting	0	
	Multistage speed 5 setting	0	
	Multistage speed 6 setting	0	
12	Starting frequency stopping time adjustment	0	
13	Two-stage acceleration time setting	10	
14	Two-stage deceleration time setting	10	
15	DC braking frequency setting	0.5	
16	DC braking power setting	00	
17	DC braking time frequency	00	
18	Electronic thermal level adjustment	100	
19	Linear/curved acceleration selection	Linear	

(2) Motor specifications



Motor manufacturing number		
Motor output		kW
Number of motor poles		P
Rated motor rotational speed		min^{-1} (rpm)
Rated current		A
Rated voltage		V
Rated frequency		Hz
Starting current		A

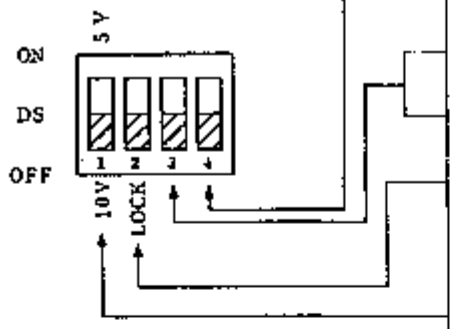
(3) Specifications of connected machines

Machine name		
Torque properties		
Required torque		N.m (kgf.m)
Load moment of inertia (load GD^2)		$kgf.m^2$
Required acceleration/ deceleration time		
Acceleration time		seconds
Deceleration time		seconds
Variation range		Hz – Hz

1.3 Variable Resistor Settings and Functions

Variable resistor name	Functions	Initial setting	Lock paint yes/no	Address
M.ADJ	Variable resistor for adjustment of analog meters for output frequency	7/10	No	8B

1.4 DIP Switch (Designation: DS) Settings and Functions



Leave off.

Used when returning to the initial setting.
Refer to section 4.13 for details.
Turn off after using.

Soft lock:
When this is turned on, none of the data can be modified. Refer to F-29 ⑦.

External frequency setting voltage switching:
5 V side DC 0 - 5 V/0 - F max
10 V side DC 0 - 10 V/0 - F max

1.5 Circuit Configuration Diagram

Figure 1 shows the circuit configuration diagram for the VWA_2 series.
[The configuration of the VWA (type 1) and VWA2 (type 2) circuits are the same, except for the following.]

Symbol: R
Part name: Cement resistor

Model	R
VWA3.5LB VWA5.5LB	Not included
VWA3.5LB2 VWA5.5LB2	Included

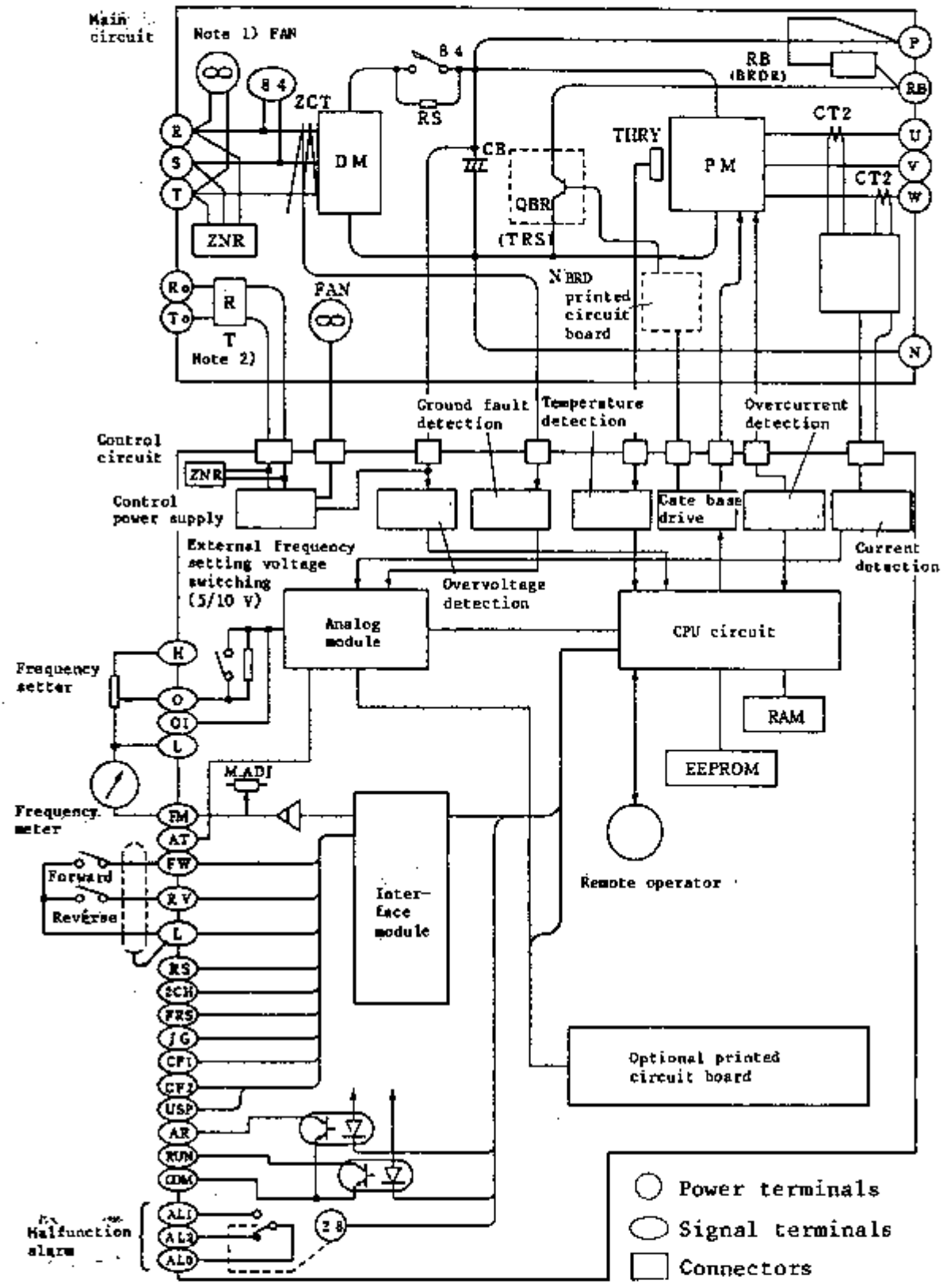


Figure 1 Circuit Configuration Diagram (For VWA$_2$)

(Notes) Legend

- o (84): Electromagnetic contactor (Not included with 1.5 - 2.5LB2.)
- o DM: Diode module (converter module)
- o CB: Smoothing capacitor
- o (28): Malfunction alarm relay
- o ZNR: Surge absorber
- o QBR: Braking transistor (1.5LB2 - 5.5LB2: on the BRD printed circuit board)
- o FAN: Fan (not included in the 1.5LB2)
  Note 1) Only the 16LB2.
  Note 2) Transformer for 5.5 - 11HB2.
- o [ ]: BRD printed circuit board
- o ZCT: Ground fault CT (current transformer)
- o RS: Current limiting resistor
- o PM: Power module (inverter module)
- o THRY: Temperature detection relay
- o CT2: Current transformer
- o RB: Built-in Braking resistor
- o R: Resistor; only 3.5 - 16LB2.
- o T: Transformer (only 400 V class)

1.6 Printed Circuit Board Layout Diagram

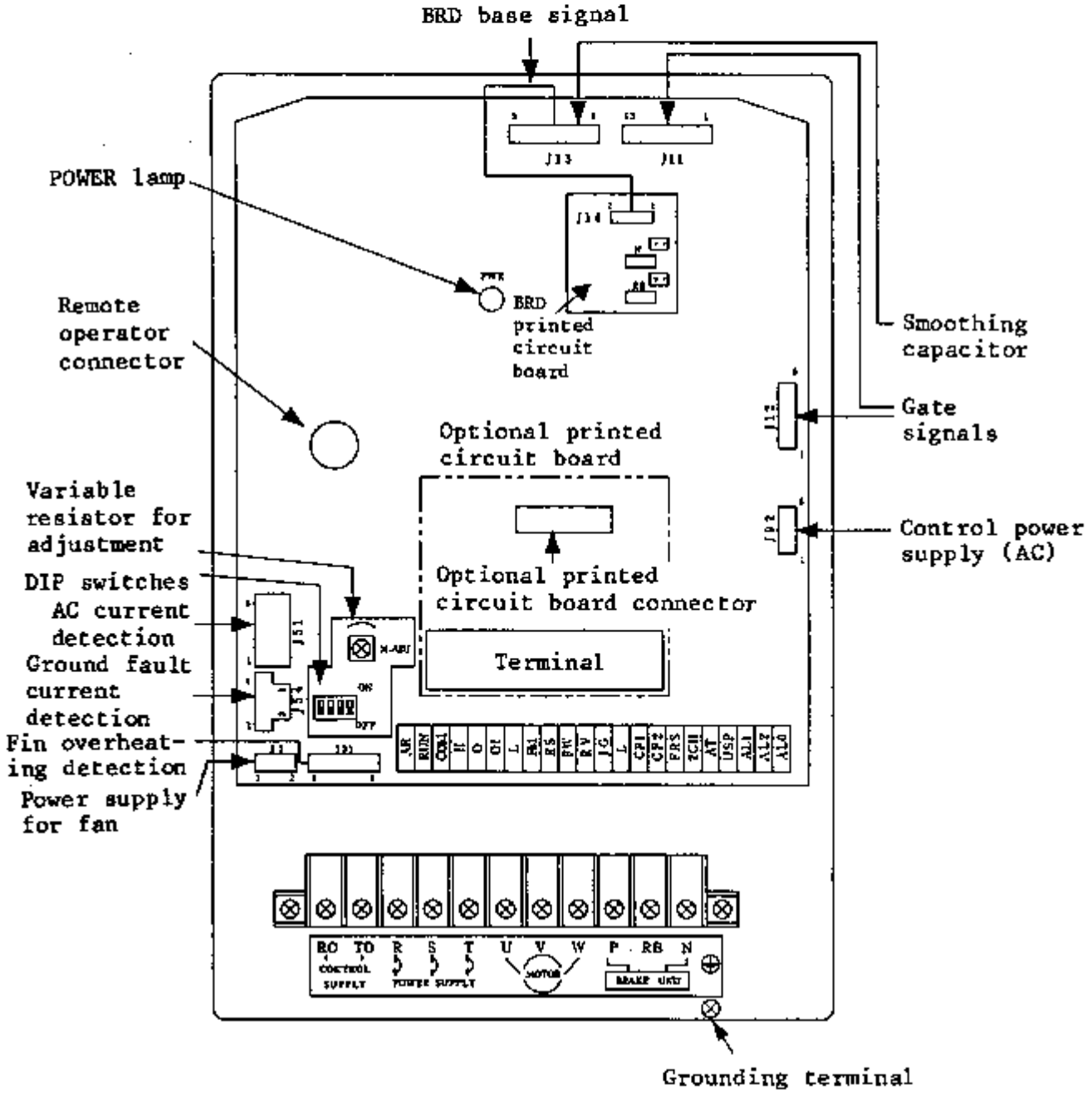


Figure 2 Printed Circuit Board Layout Diagram (Example: 2.5 - 5.5LB2)

2. FUNCTIONS AND ADDRESSES OF CHECK TERMINALS

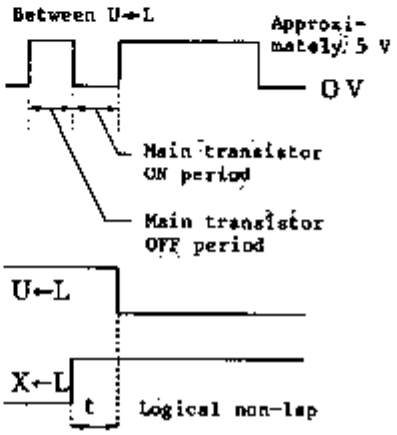
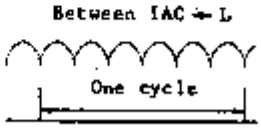
The table below shows the functions and addresses of the check terminals on the printed circuit board.

Table 2-1 Functions and Addresses of Check Terminals

Check terminal name	Operation contents	Observed waveform	Address
(Note 1) PV5	Mainly the power supply for digital circuits. (4.9 to 5.1 V)	DC voltage	3C
L	Reference electric potential for the above power supply.		2A, 8B
UL	Reference electric potential for the gate circuit of the U phase. DP7 Ⓚ ← Between UL 6.5 to 9.5 V (Beware of high voltages.)	DC voltage	2E
VL	Reference electric potential for the gate circuit of the V phase. DP8 Ⓚ ← Between VL 6.5 to 9.5 V (Beware of high voltages.)	DC voltage	3F
WL	Reference electric potential for the gate circuit of the W phase. DP9 Ⓚ ← Between WL 6.5 to 9.5 V (Beware of high voltages.)	DC voltage	4H
XL	Reference electric potential for the gate circuit of the X phase. DP10 Ⓚ ← Between XL 6.5 to 9.5 V (Beware of high voltages.)	DC voltage	5H

<table>
<tr><th>Check terminal name</th><th>Operation contents</th><th>Observed waveform</th><th>Address</th></tr>
<tr><td>(Note 1)
U
V
W
X
Y
Z</td><td>Logical signals of PWM waveforms:
Indicates the ON/OFF periods of main circuit transistors. If the following waveforms are observed in pairs, it will be possible to measure logical non-lap.

U phase and X phase
V phase and Y phase
W phase and Z phase

Allowed range of non-lapping
<table><tr><td></td><td>t</td></tr><tr><td>200 V class</td><td>3 ±1 μsec</td></tr><tr><td>400 V class</td><td>3 ±1 μsec</td></tr></table></td><td> 
</td><td>2D</td></tr>
<tr><td>CH</td><td>DC overcurrent signal
Between CH ◄— L</td><td> 
</td><td>2C</td></tr>
<tr><td>(Note 2)
IAC</td><td>The motor current detection signal (three phase, all waves smoothed), approxi-mately 2 V (IAC-L) current monitor during inverter rated current, and electronic thermal depend on this signal.</td><td> 
</td><td>6C</td></tr>
</table>

Note 1: This is a check land.

Note 2: Only for VWA_2 (type 2). VWA (type 1) does not have this.

3. INVESTIGATION PROCEDURES (TROUBLESHOOTING)

Connect the remote operator or copy unit, then execute troubleshooting according to the procedures below.

3.1 Malfunction Messages and Diagnosis

When the inverter malfunctions, it will operate in the manner shown in Table 3-1. Find the cause, correct it, then restart the unit.

Note 1: If changes in settings are necessary, be sure to obtain authorization from the customer.

Note 2: When inspecting and repairing inverter errors and malfunctions, be sure to refer to Chapter 4 and after.

Table 3-1 Malfunction Messages and Diagnosis

Resetting method: A — Operate the breaker and/or electromagnetic contactor.
B — Short-circuit terminals RS and L on the printed circuit board.

Phenomenon				Cause of malfunction	Resetting method	Contents of the inspection	Actions
MCB operation	Mg operation	(Note 1) Error display (?ERROR ▨▨)	Alarm relay				
✓	-	-	-	Error between the power supply MCB and inverter output terminals.	A	. Are there any short-circuits in the power supply? . Is the MCB capacity correct? . Is there are ground fault in the inverter or power supply unit?	. Fix the short-circuit. . Increase the capacity of the MCB. . Fix the ground fault.
						. Is there any damage to the converter module?	. Replace and repair.
						. Is the magnet switch in the inverter normal?	. Replace and repair.
						. Is the rush current limiting resistor in the converter normal?	. Replace and repair.
✓		OC Accel OC Decel OC Drive GND Flt	-		A	. Damage to the module on the inverter side. . Motor or connection line ground fault.	. Replace and repair. . Fix the ground fault.
	✓	-	-	Power failure	A	. Has there been a power failure?	. Reset the power supply.
						. Are there any bad contacts between the MCB and Mg?	. Replace MCB, Mg.
		Under.V	✓	Voltage error (deficient voltage)	A	. Has a directly supplied motor or large capacity motor started off of the same power supply system?	. Consider increasing the power supply capacity.
						. Are there any bad contacts between the MCB and Mg?	. Replace MCB, Mg.
		Inst.P-F	✓	Power supply error (Momentary power failure)	A	. Are there any bad contacts between the MCB and Mg? . After the power supply was turned off, was the power supply turned on again when the inverter display indicated "POWER OFF?"	. Replace MCB, Mg. . Turn on the power supply after the inverter display has been cleared. . When load is light, the display time for "POWER OFF" will become longer.

Note 1: If the optional remote operator or copy unit is connected, then the contents of the error will be displayed.

Phenomenon				Cause of malfunction	Resetting method	Contents of the inspection	Actions
MCB operation	Mg operation	(Note 1) Error display (?ERROR ▨)	Alarm relay				
		Over V.	✓	DC smoothing circuit overvoltage	B	. Is the received voltage greater than 253 V (200 V class) or 506 V (400 V class)? . Has there been any turning on or off of the phase advance capacitor? . Has there been any rapid deceleration operation?	. Lower the voltage that is received. . Do not turn on or off the phase advance capacitor. . Turn on the AC reactor on the input side. . Lengthen the deceleration time. . Set the time to match the GD^2 of the load. . Reconsider the usage percentage of regenerative braking.
		CT	✓	CT error	B	. Is there an error in the CT?	. Replace the CT.
		USP	✓	USP error	B	. Has the power supply been turned on after USP was selected? . Was an operation instruction input during a power supply error?	. Select USP after the power supply is turned on. . Reconsider the capacity of the power supply.
		OC.Accel	✓	Overcurrent during motor acceleration.	B	. Has there been any rapid acceleration? . Are there any short-circuits or ground faults in the output? . Is the starting or jogging frequency high? . Is the torque boost high? . Is the motor bound?	. Lengthen the acceleration time. . Fix any short-circuits or ground faults. . Lower the starting or jogging frequency. . Lower the torque boost. . Release the motor bound.
		OC.Decel	✓	Overcurrent during motor deceleration.	B	. Has there been any rapid deceleration? . Are there any short-circuits or ground faults in the output?	. Lengthen the deceleration time. . Set the time to match the GD^2 of the load. . Fix any short-circuits or ground faults.
		OC.Drive	✓	Overcurrent during constant speed operation of the motor.	B	. Has there been a sudden change in the load? . Are there any short-circuits or ground faults in the output?	. Replace and repair. . Fix any short-circuits or ground faults.
		Over.L	✓	Inverter overload (overload operation)	B	. Is the load too large? . Is the electronic thermal level appropriate?	. Lower the load. . Increases the applicable motor range.

Phenomenon				Cause of malfunction	Resetting method	Contents of the inspection	Actions
MCB operation	Mg operation	(Note 1) Error display (?ERROR ▨)	Alarm relay				
		Over.C	✓	Overcurrent detection immediately after the power supply is turned on.	B	. Are the current detector and printed circuit board circuit normal?	. Check the current detector and printed circuit board detection circuit.
		OH.Fin	✓	Large temperature increase. . Power element cooling fan . Regenerative brake discharge resistor . Rush current limiting resistor	B	. Is the cooling fan working? . Are the intake/outlet openings of the inverter cooling system open? . Is the ambient temperature too high? . Is the setting of the used time percentage of regenerative braking appropriate? . Is the electromagnetic contactor in the inverter normal?	. Replace the cooling fan. . Uncover the intake/outlet openings. . Lower the ambient temperature. . Reduce the BRDTCC setting. . Replace the electromagnetic contactor in the inverter.
		CPU	✓	(CPU error)	B	. Is there a large source of static noise nearby? . Inverter error	. Move the source of static noise. . Repair
		MG.Op	✓	Optional printed circuit board mounting error (when an option is used).	B	. Has the option printed circuit board been mounted correctly? . Are there any bad contacts?	. Remount . Replace the option printed circuit board.
		Op.ERR	✓	Option error	B	. Malfunction or defect in the option printed circuit board.	. Investigate the error in the option printed circuit board.
		NG.JOG	✓	Jogging error	B	. An attempt was made to switch the commercial power supply during jogging.	. No malfunction occurs.
		UV WAIT	N.A.	Power supply voltage error (insufficient voltage)	A	. When the restarting function is selected, the power supply voltage was decreased to the insufficient voltage level.	. Reset the power supply.
		OL.BRD	✓	The regenerative braking time has exceeded the setting of BRDTED.	B	. When the regenerative brake uses the resistor built into the inverter.	. Lengthen the deceleration time. . Lengthen the operation duty cycle. . Use the external optional resistor, and raise the setting of BRDTED.
						. When the external regenerative brake resistor is already added.	. Use the separate BRD-E regenerative brake unit.

Phenomenon				Cause of malfunction	Resetting method	Contents of the inspection	Actions
MCB operation	Mg operation	(Note 1) Error display (?ERROR ▨)	Alarm relay				
		EEPROM	✓	Software storage element (EEPROM) data error	–	. How many times a day is data written? . Refer to section 6.3 (3). (Inverter unit Operation Manual)	. Replace and repair component. There is a limit to the number of times data can be written to software storage elements (about 10,000 times). (About ten years when written to several times a day.)
		RESTART ↑ Number	N.A.	This is not an error. This counts down from TPS-R-T time.	–	. This is not an error.	–
		R-ERROR SYSTEM	N.A.	RAM error		. R/W mismatch error in the RAM in the digital operation panel.	. Replace the digital operation panel.
				ROM error		. Sum check error of the ROM in the digital operation panel.	
				Microcomputer error		. Abnormal microcomputer operation.	
		R-ERROR COMN(*)	N.A.	Communications error * = 1 — Parity framing overrun, BCC error, protocol error = 2 — Time out		. Communications error between the digital operation panel and inverter unit. . Refer to section 9.3(2)(a). (Inverter unit Operation Manual)	. Press a digital operation panel key. (Any key) . When a key is depressed, the unit will return to the state immediately before the error was generated.
		R-ERROR INV RUN	N.A.	During inverter operation		. A copy operation was executed during inverter operation.	
		R-ERROR INV TRIP	✓	Inverter trip		. A copy operation was executed in the inverter trip state.	
		R-ERROR INV TYPE	N.A.	Model code mismatch		. Mismatch in model codes during the copying operation.	
		R-ERROR DATA ROM	N.A.	EEPROM sum check error		. An EEPROM sum check error was generated when the inverter contents were transmitted by the copy unit.	
		R-ERROR RD LOCK	N.A.	–		. Read lock set during copy reading.	
		R-ERROR COPY ROM	N.A.	–		. After copying, mismatch in data comparison in the inverter unit.	

3.2 Life of Software Storage Elements

It is possible that the software storage elements on the printed circuit board have reached the end of their life in the following cases, so that the printed circuit board should be replaced.

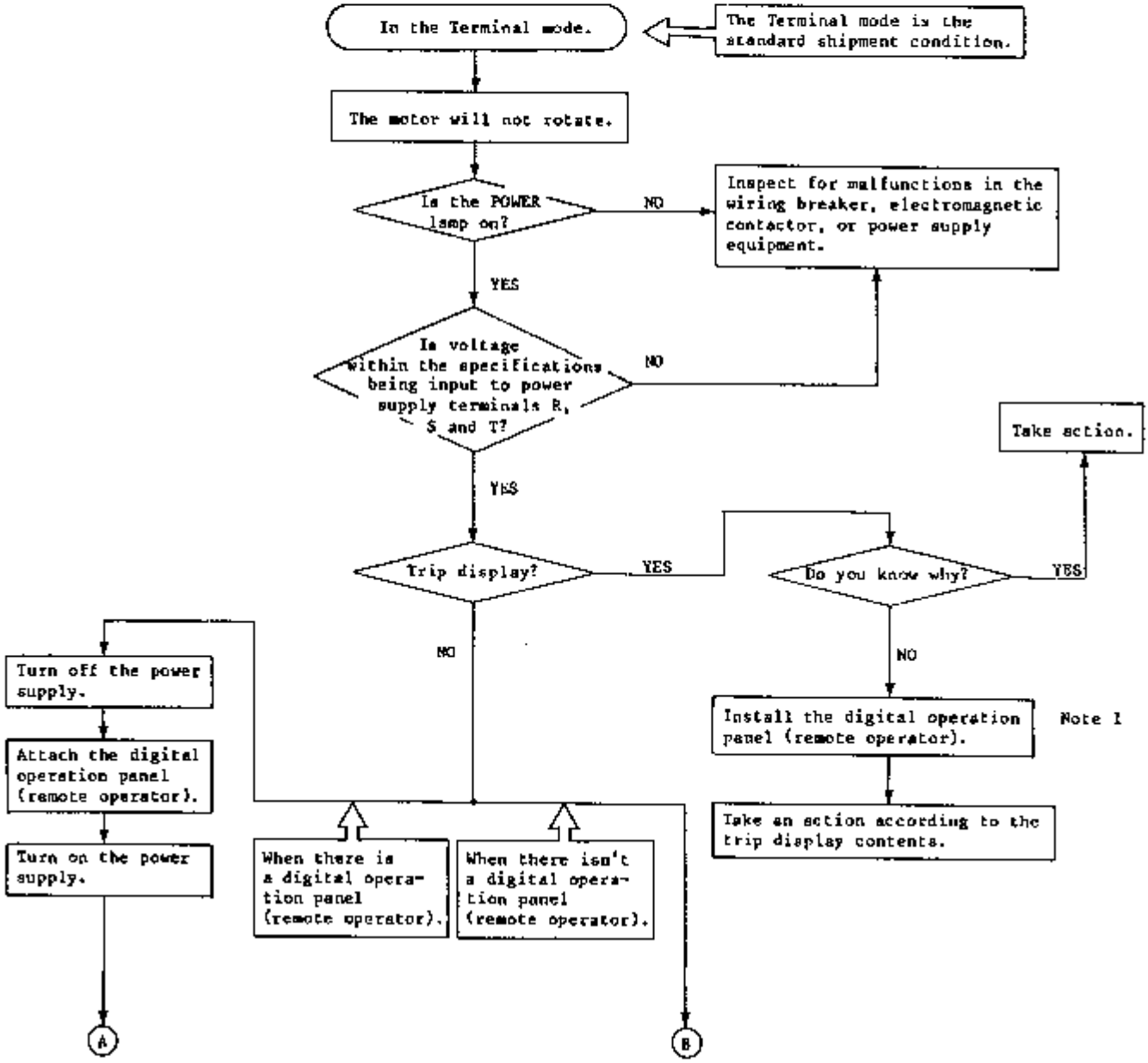
When "ERROR EEPROM" is displayed after the power supply is turned on and operation is not possible.

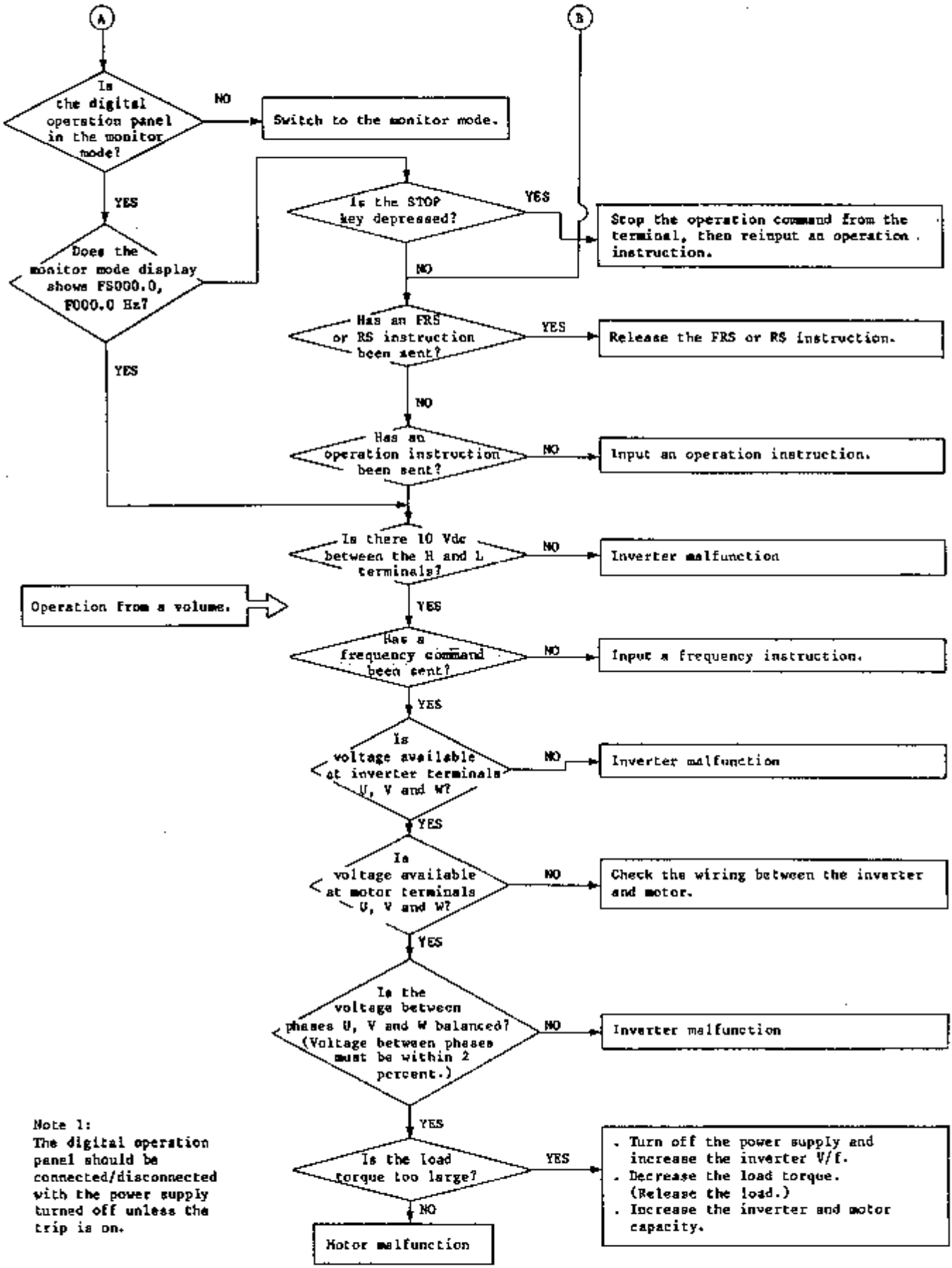
- o Operation is not possible even when forced resetting or reinitialization is executed.

Request: Starting and stopping should be executed with instructions to the control terminals, rather than by turning on and off the power supply. Software storage elements are elements which store data input from the digital operation panel when the inverter power supply is turned off.
There is a limit to the number of times these elements can be written to, and that limit is their life. In order to change and store data a number of times a day, the power supply must be turned on and off. This should lead to an element life of about 10 years.
If data is modified and the power supply is turned on/off every time, then the element life will be that much shorter. If there are many data modifications during trial runs, turn off the power supply after the final data is obtained, then store that data.

3.3 Troubleshooting

(1) The motor will not rotate.

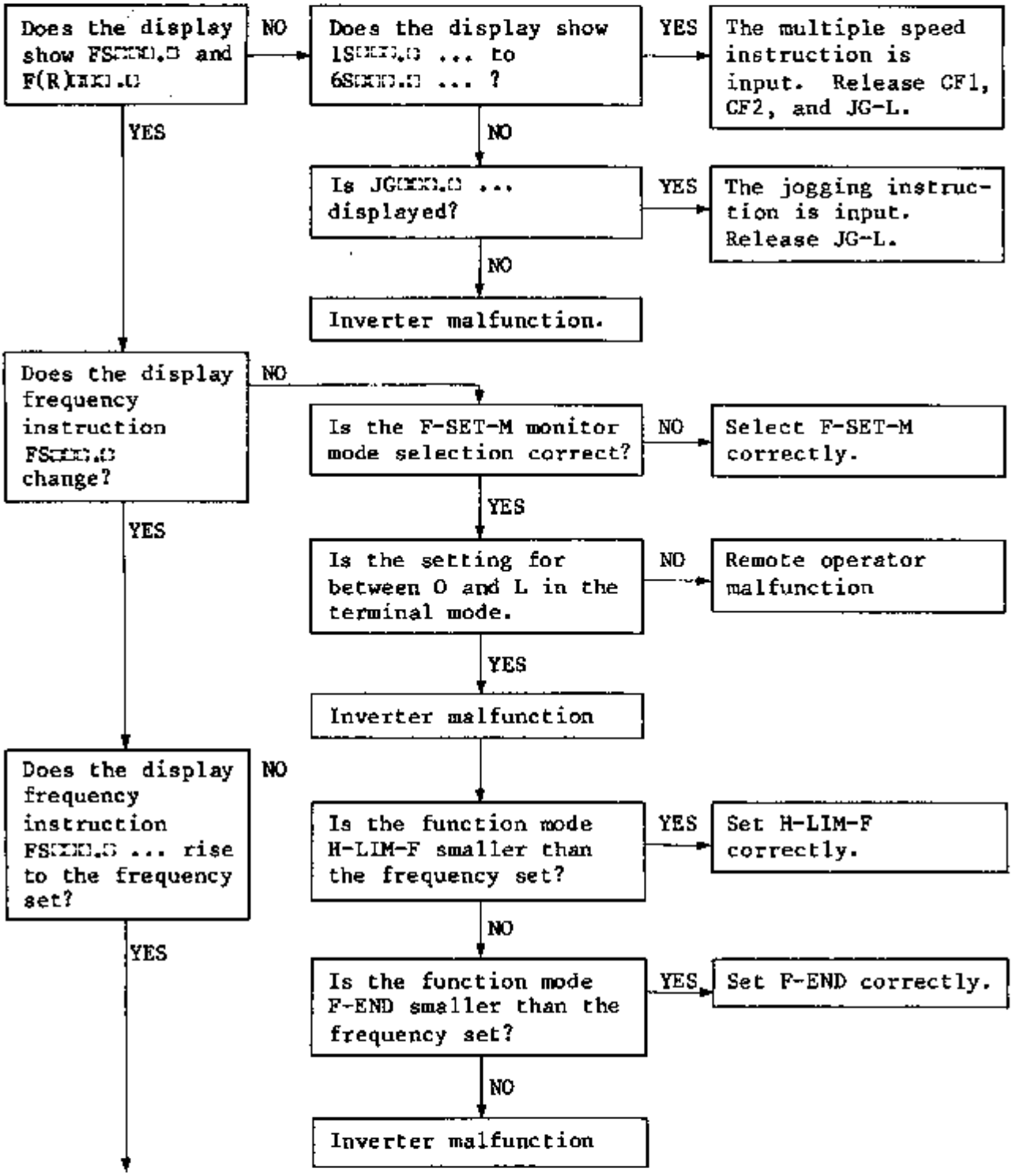


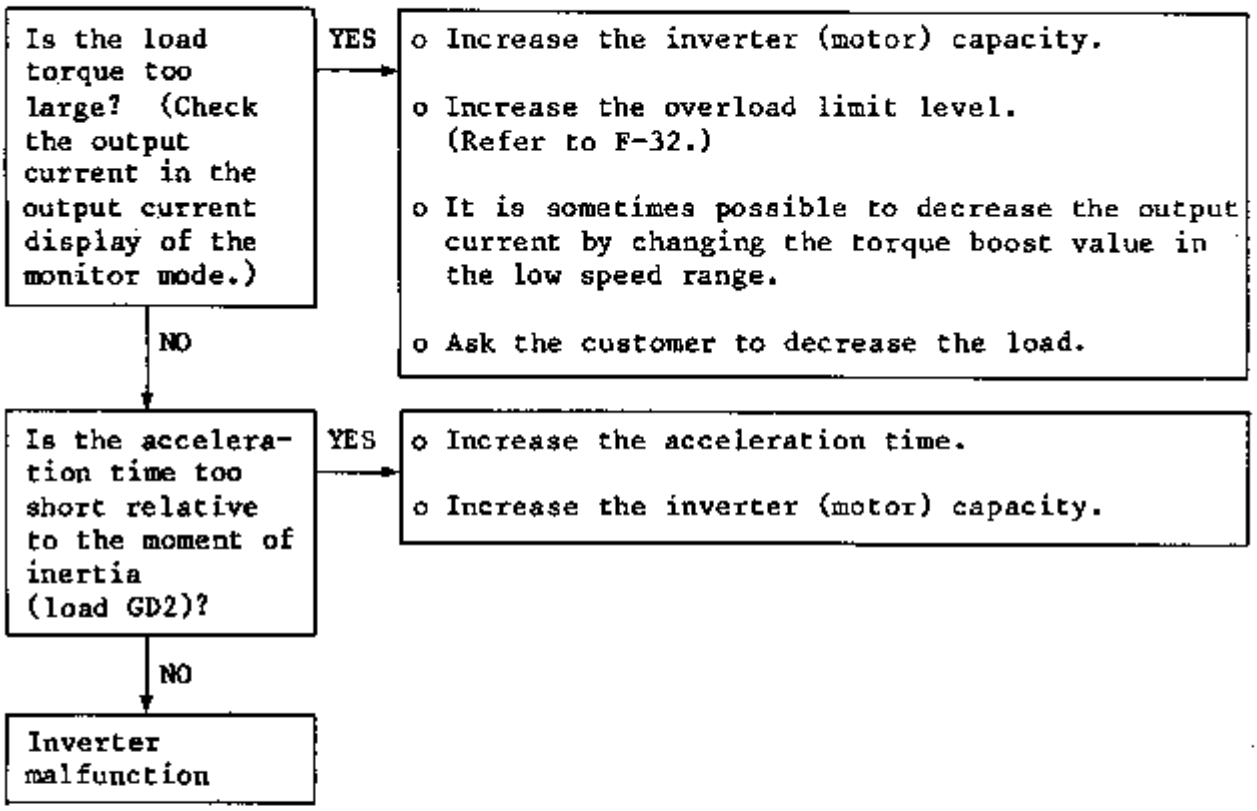


Note 1:
The digital operation panel should be connected/disconnected with the power supply turned off unless the trip is on.

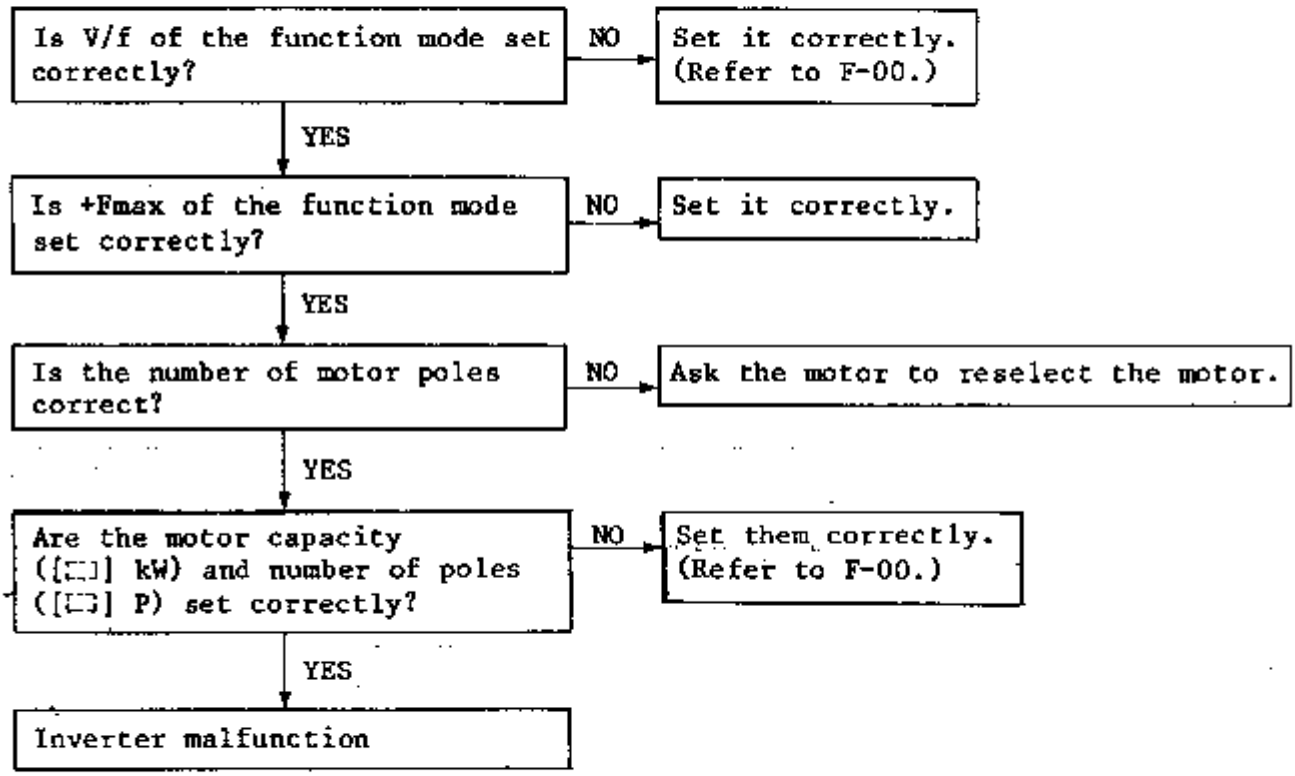
(2) The motor will not increase speed.

Connect the remote operator and select a monitor mode. (Press the FUNCTION key, then press the MONITOR key.)

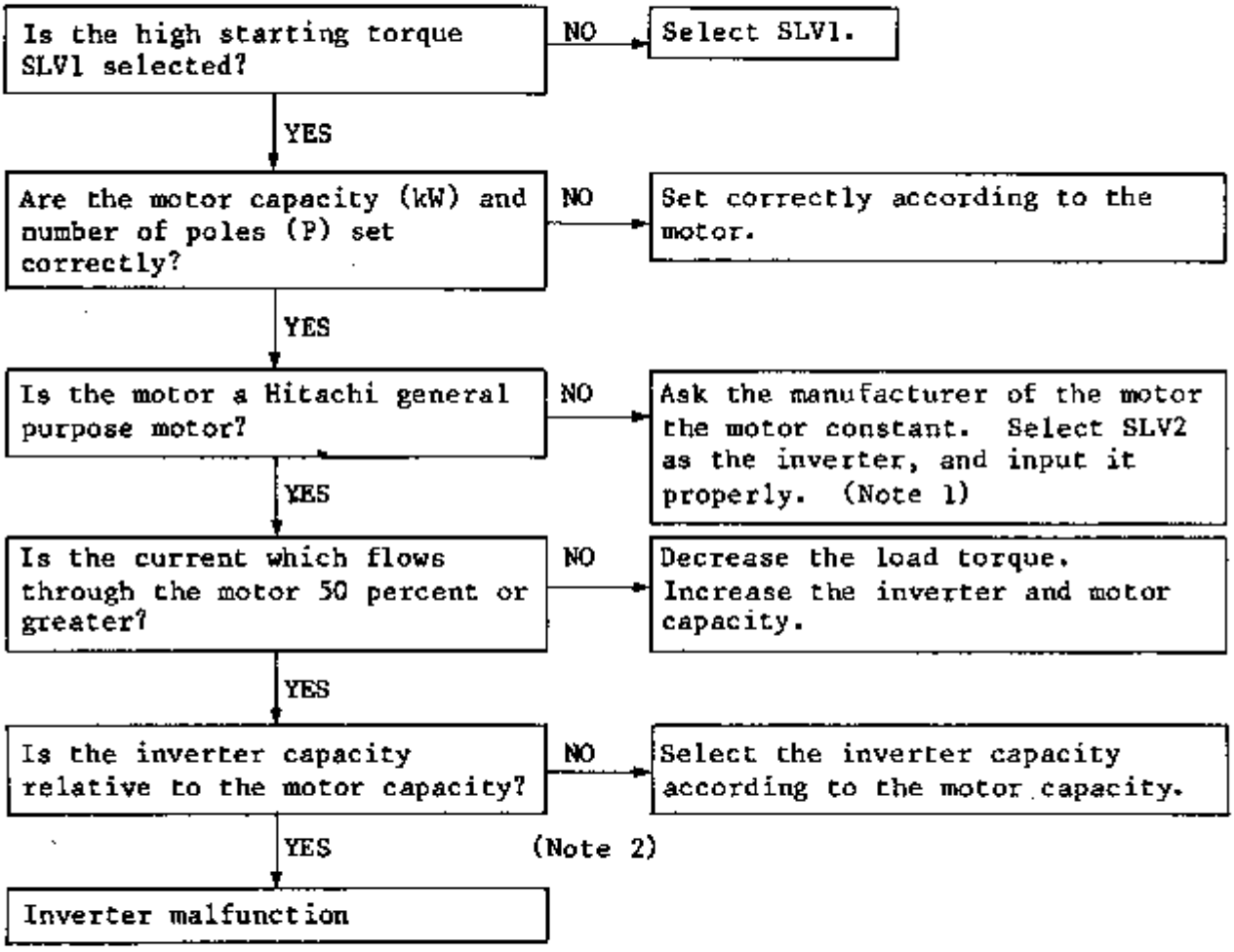




(3) The motor rotation is high.



(4) Motor torque is insufficient at low speeds (1 to 5 Hz).



Note 1: Motor constant A — Motor primary resistor
B — Motor secondary resistor
C — Motor excitation current

Note 2: When the motor capacity is smaller than the inverter capacity, the high starting torque properties may not operate correctly.

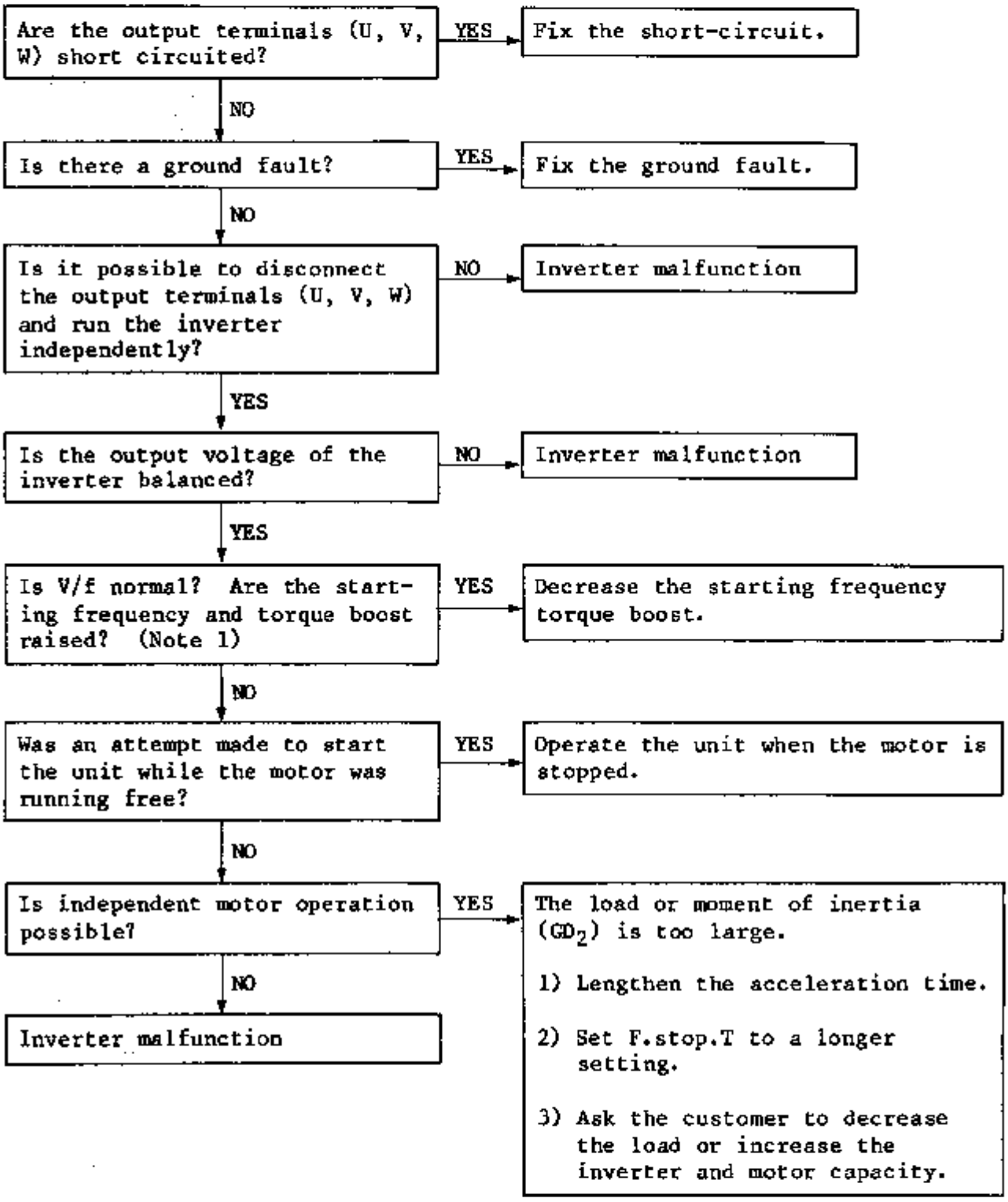
(5) Inverter operation is not possible.

Phenomenon	Contents to check	Action
Inverter operation is not possible.	Has the STOP key of the digital operation panel been depressed in the Terminal mode?	Stop the operation instruction from the Terminal, then reinput the operation instruction (or specify valid/invalid with SWITCH 2.)
	Is the DB instruction of the option printed circuit board (AOP-PCB) input?	Turn off the DB instruction, then input the operation instruction.
	Is the FRS instruction input?	Turn off the FRS instruction, then input the operation instruction.
	Is the frequency setting at zero?	Set the frequency setting to the desired frequency.
	Is the digital operation panel display set to the function mode?	Press the MONITOR key to set the monitor mode.
	Is tripping on?	Reset
	When the frequency instruction method (F-SET-M) is set to Terminal, is there a speed instruction input to between O and L, or OI and L?	Reexamine the speed instruction circuit.
	Is there input to the multiple speed input terminals (CF1, CF2), or are Speed 1 through Speed 3 set to 0 Hz?	Set Speed 1 through Speed 3 to the desired frequency, or stop the instruction to CF1/CF2.
	Is the RS instruction input?	Turn off the RS instruction.
	Is the internal instruction (Remote) mode selected and an instruction input from the outside, or is the external (Terminal) mode selected and an instruction input from the digital operation panel?	Check the operation mode. (Input the operation instruction according to the mode which is set.)

Phenomenon	Contents to check	Action
	o Are the FWD RUN and REV RUN keys depressed simultaneously in the internal instruction (Remote) mode?	Be sure that either forward or reverse are set, not both.
	o In the external instruction (Terminal) mode, is there simultaneous input to the FW terminal and RV terminal?	
	Is the frequency setting smaller than the minimum frequency?	Set the frequency so that it is equal to or higher than the minimum frequency.
	Is an operation instruction being input to the instruction mode (forward or reverse) which is not being used?	Check the operation mode. (Refer to F-28 (5).)
Jogging operation is not possible. When extended multiple speed is selected, multiple speed operation will be used rather than the jogging operation. The maximum setting is 9.9 Hz.	o Is the frequency set? o Is there input to multiple speed terminals CF1 and CF2?	o Set the frequency to 0. o Turn on CF1 and CF2.
	Is the relation between the jogging frequency setting (Fj) and minimum frequency setting (Fmin): Fj < Fmin?	Set so that Fj is greater than or equal to Fmin.
There is fluctuation in the motor rotation, so that the rotational speed does not increase.	o Is the motor current fluctuating?	o Remove the cause of fluctuation in the motor torque.
	o Is the motor no load current fluctuating and increasing?	o Decrease the inverter carrier frequency. (Refer to F-41.)
	o Are the motor capacity [□] (kW) and number of poles [□] (P) set correctly?	o Set correctly according to the motor used. (Refer to F-00.)

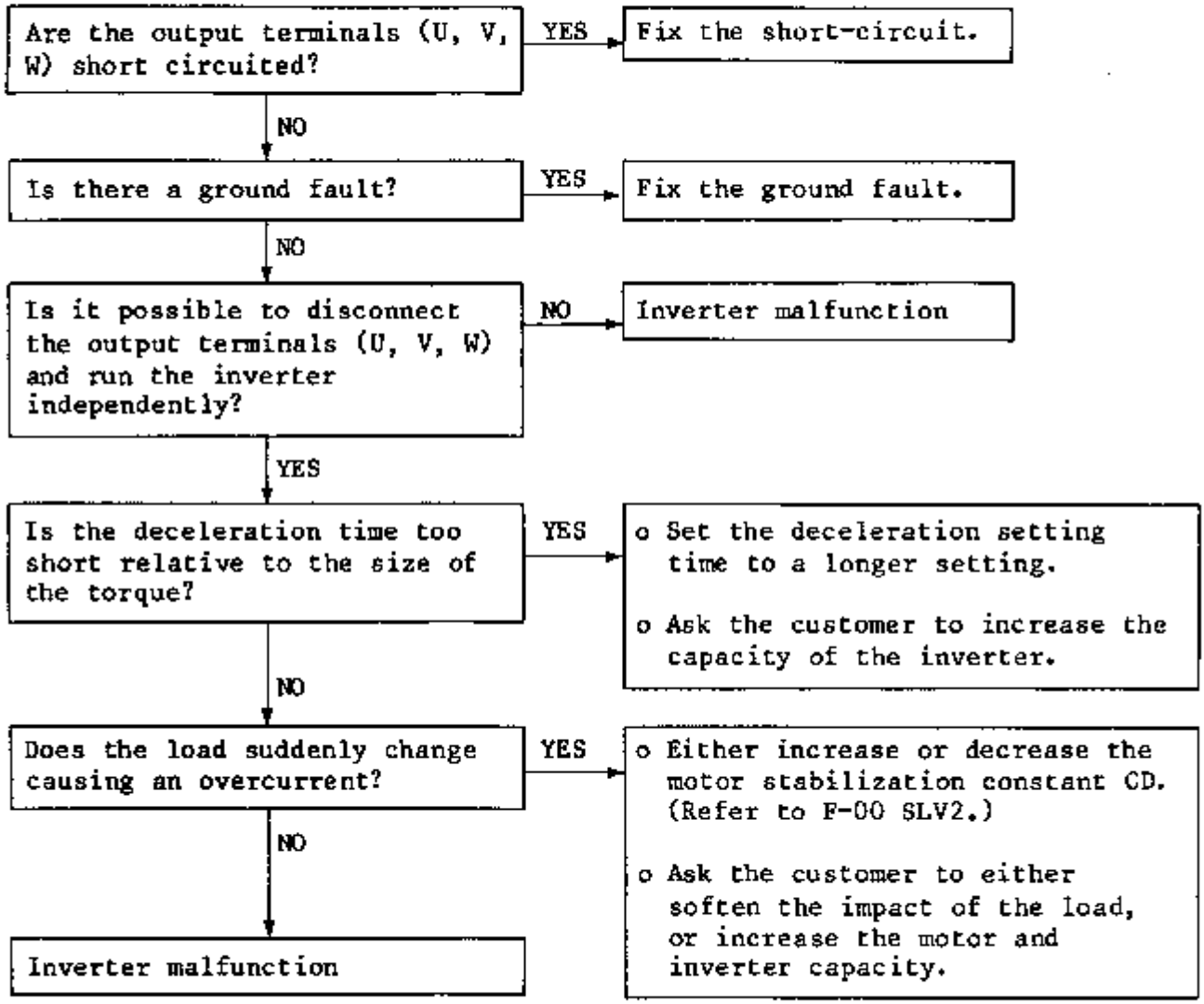
(6) Investigating causes through the trip display.

(a) The overcurrent trip (OC.Accel) is activated.

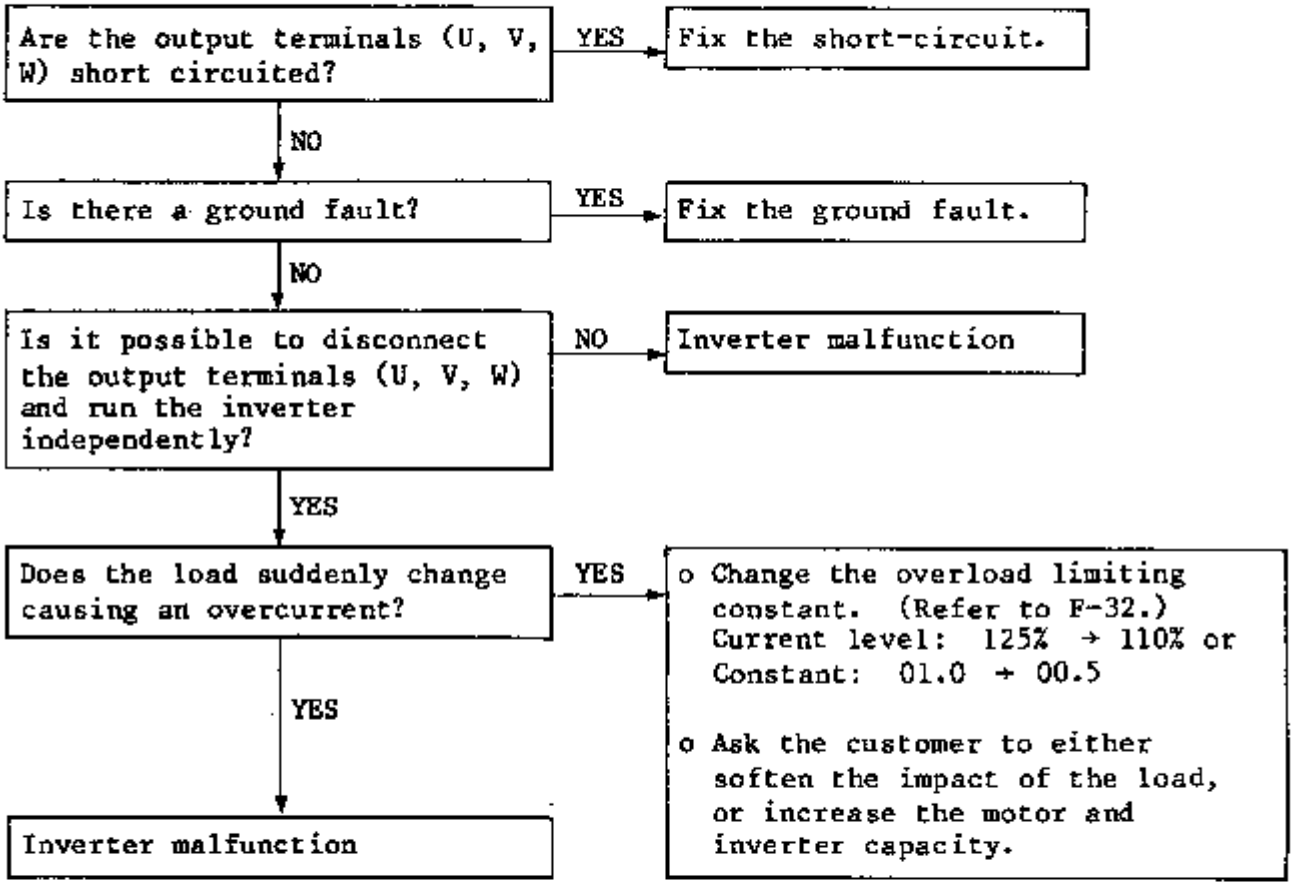


Note 1: When SLV1 or SLV2 is selected (refer to F-00), torque boost adjustment is not necessary.

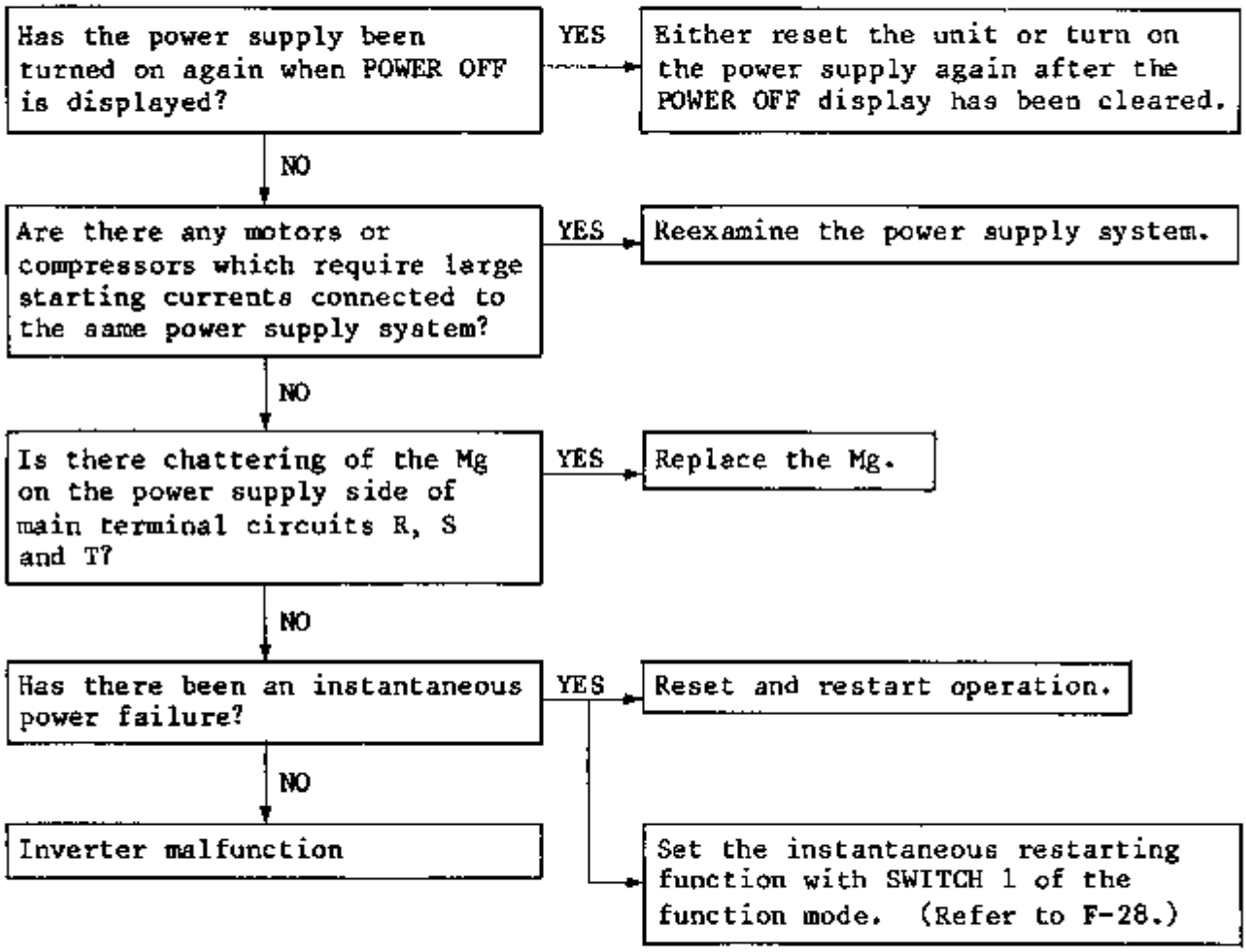
(b) The overcurrent trip (OC.Decel) is activated.



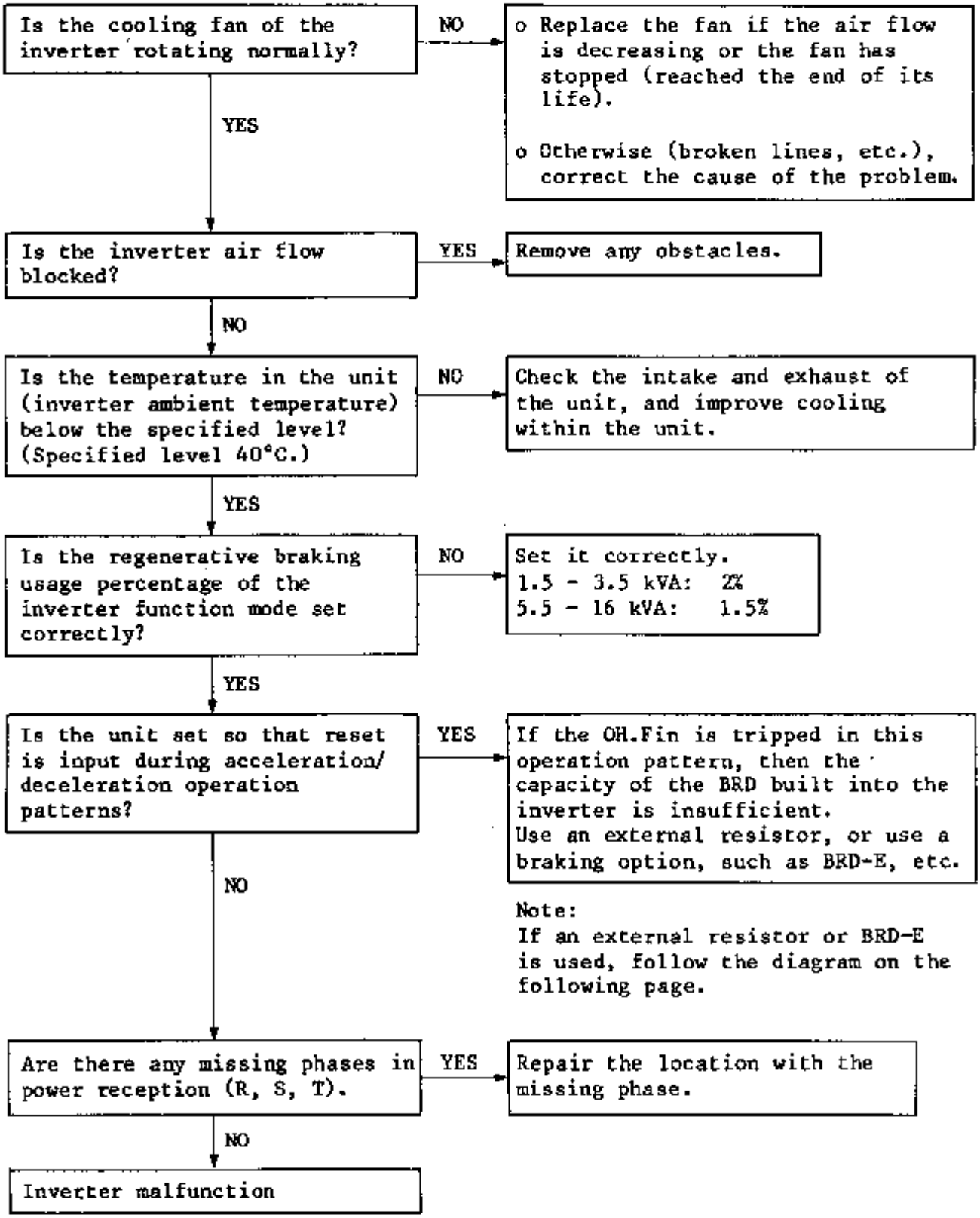
(c) The overcurrent trip (OC.Drive) is activated.



(d) The instantaneous power failure trip (Inst.P-F) is activated.



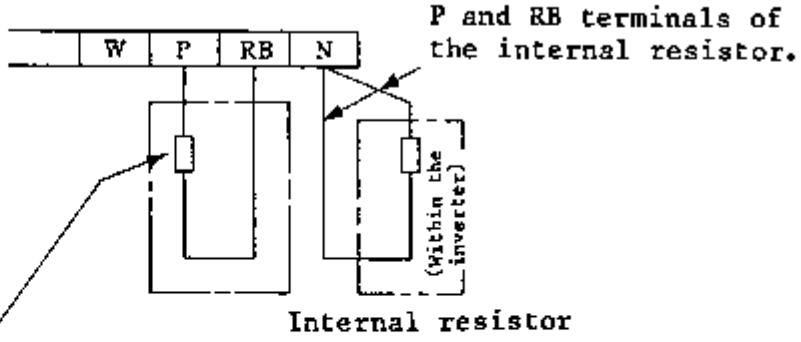
(e) The fin overheating trip (OH.Fin) is activated.



o Wiring external resistors (RB1, RB2, RB3) for regenerative braking

The P and PB terminals have internal resistors for regenerative braking, however, their specifications are for high frequency load operations, etc. If it becomes necessary to install an external braking resistor, remove the internal resistor, then connect the external resistor.

The terminals of the internal resistor which was removed should not be left as they are. Be sure to insulate the terminals, or fix them to the N terminal as shown in the diagram below.

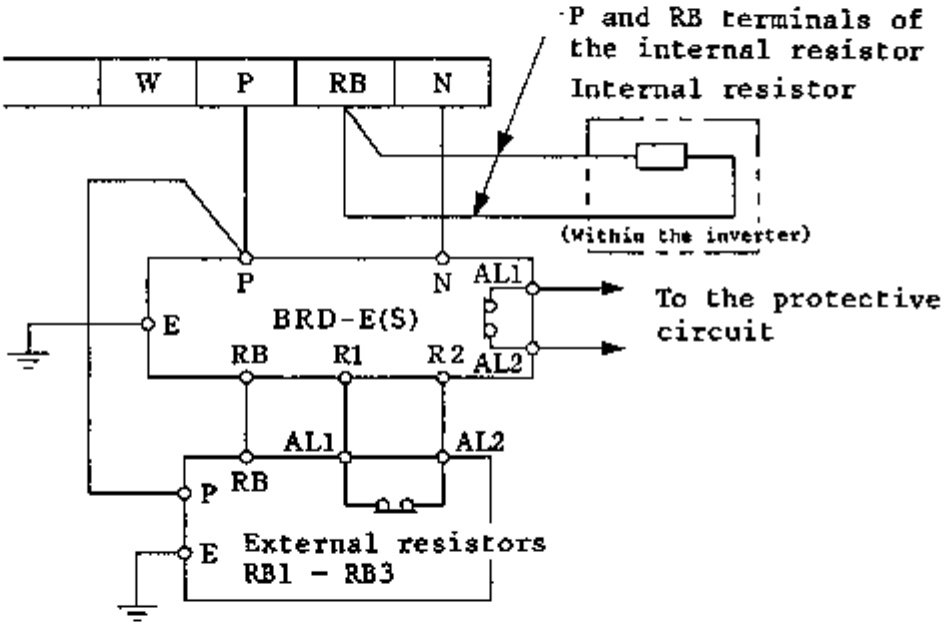


External resistors	
RB1 (50 ohms or greater)	1.5 - 5.5LB2
RB1 - RB3 (17 ohms or greater)	8 - 16LB2
200 ohms or greater	5.5HB2
RB2 x 2 in series (75 ohms or greater)	8 - 11HB2

The terminals of the internal resistors,P and RB, which were removed should be connected to the N terminal.

o Wiring the optional regenerative braking unit (BRD-E, BRD-S) (200 V class inverters)

If the optional regenerative braking unit is used because the braking time duty is large or for some other reason, wire as described below.

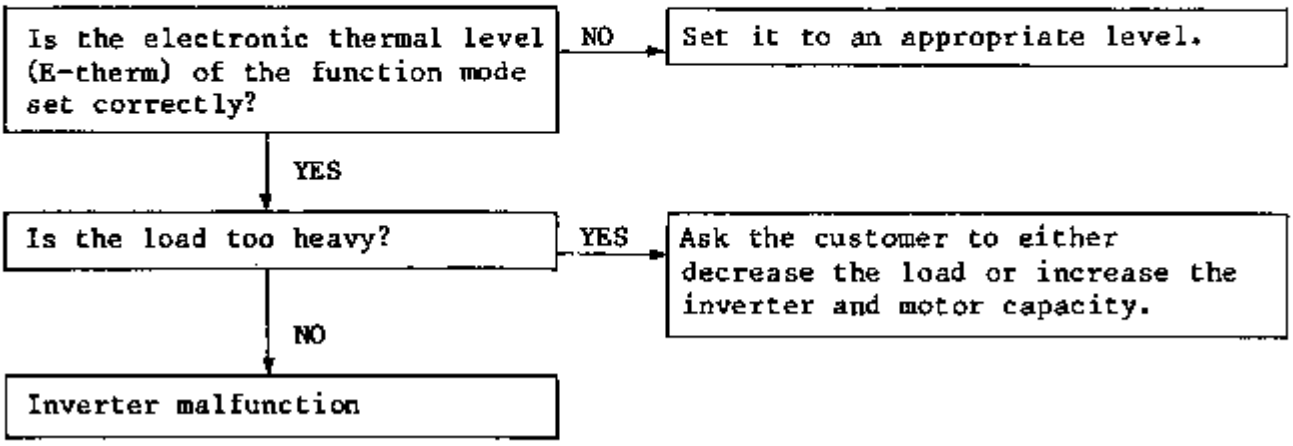


The terminals of the internal resistors, P and RB, which were removed should be connected to the RB terminal.

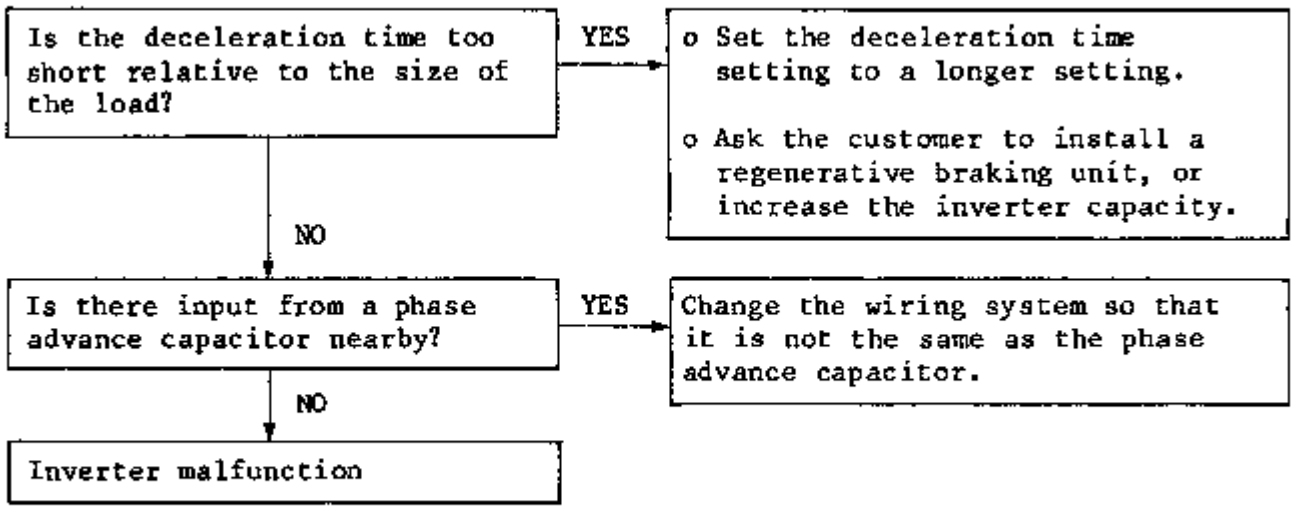
Note 1: Even if the inverter is stopped BRD and RB cannot be protected. Be sure to cut off the main power supply on the primary side of the inverter.

Note 2: The wiring distance between the inverter and BRD-E (S) and the external resistor should be 5 meters or less.

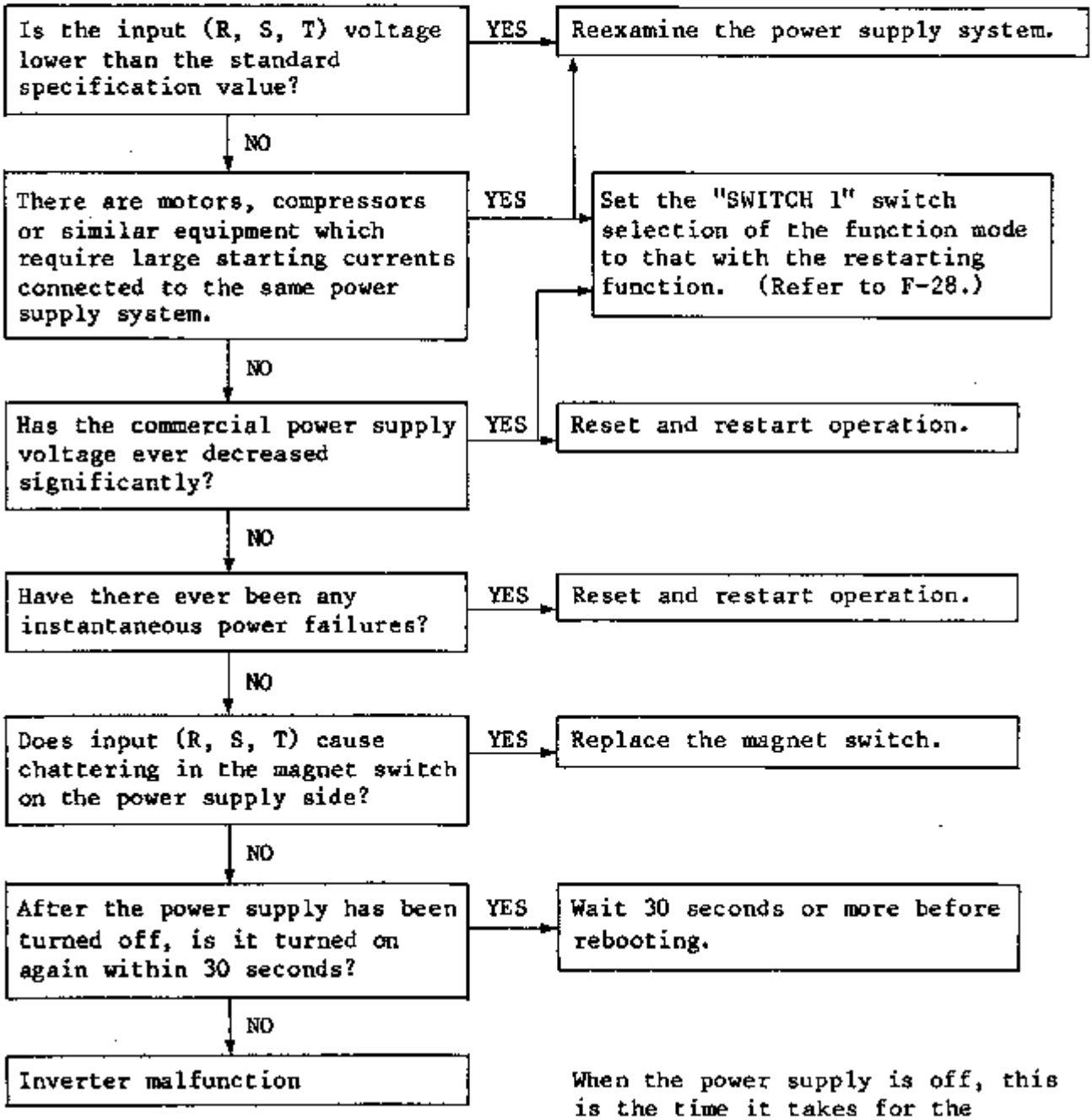
(f) Overload (Over.L) is activated.



(g) The overvoltage (Over V) trip is activated.



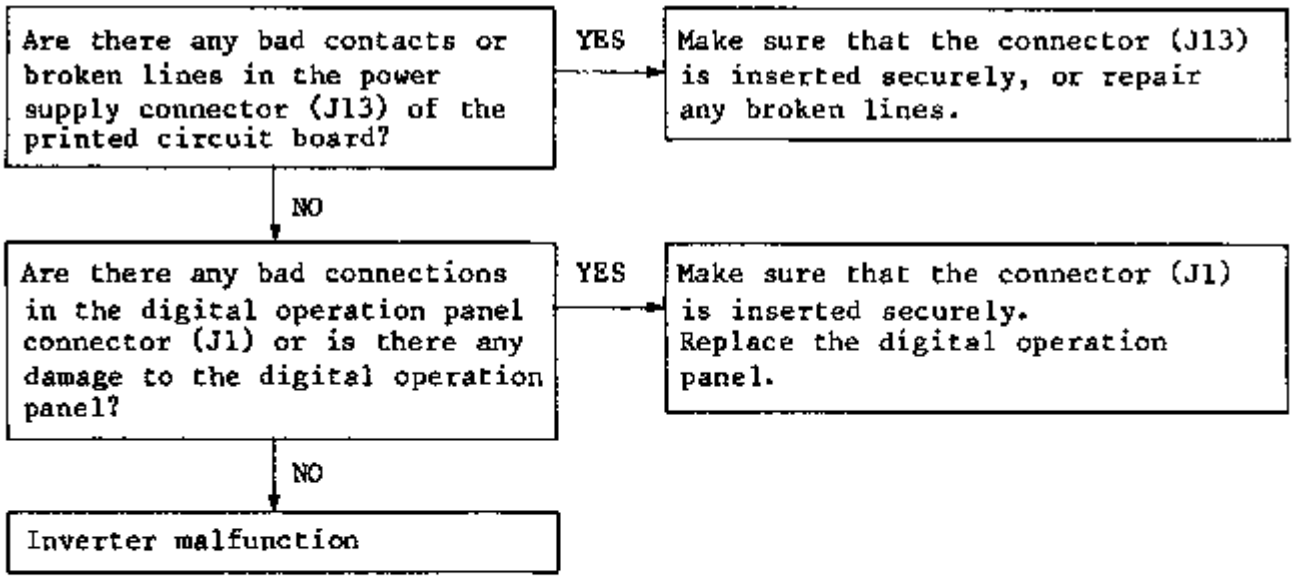
(h) The under voltage trip (Under V) is activated.



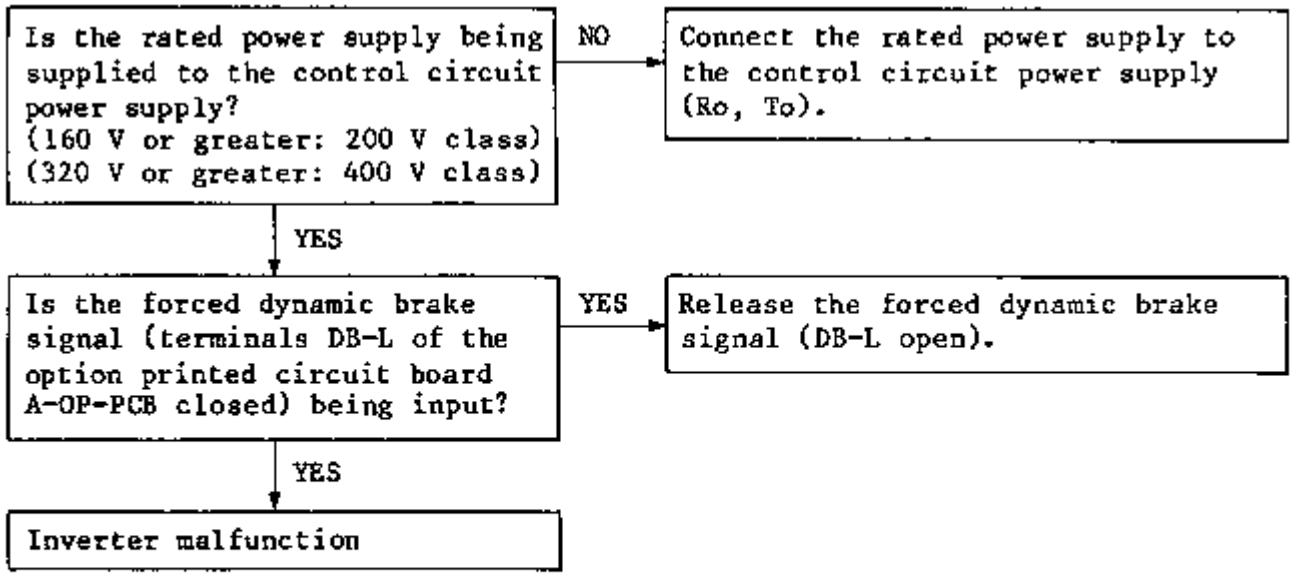
When the power supply is off, this is the time it takes for the inverter to be reset. This time will vary depending on the model load current, and it is between 3 to 30 seconds. The larger the capacity of the inverter, the longer this time will be.

(7) Investigating problems caused by digital operation panels (remote operators or copy units).

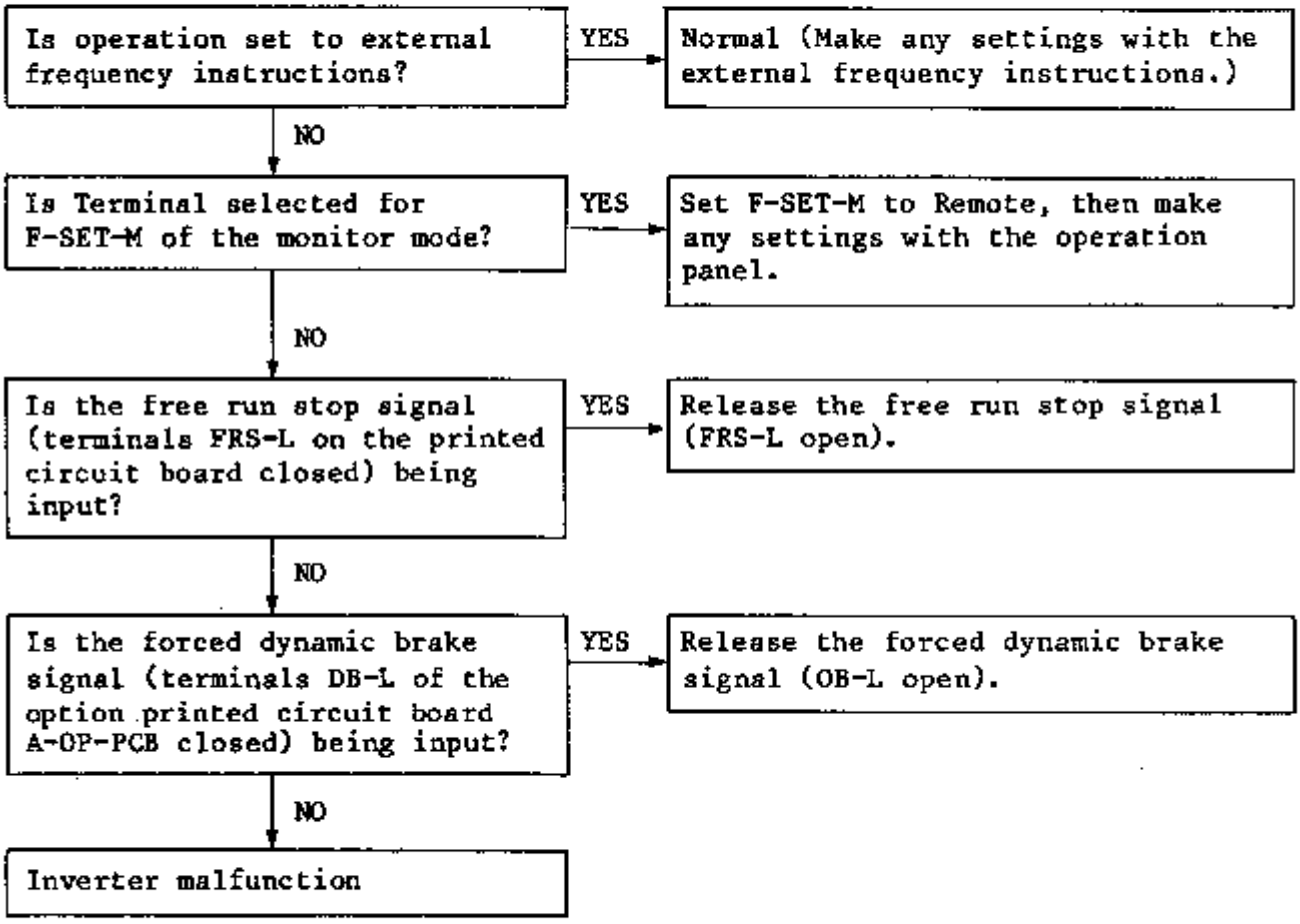
(a) Even if 160 V or more is impressed on the main circuit power supply (R, S, T), the digital operation panel does not light. (200 V class)
Even if 320 V or more is impressed on the control power supply (Ro, To), the digital operation panel does not light. (400 V class)



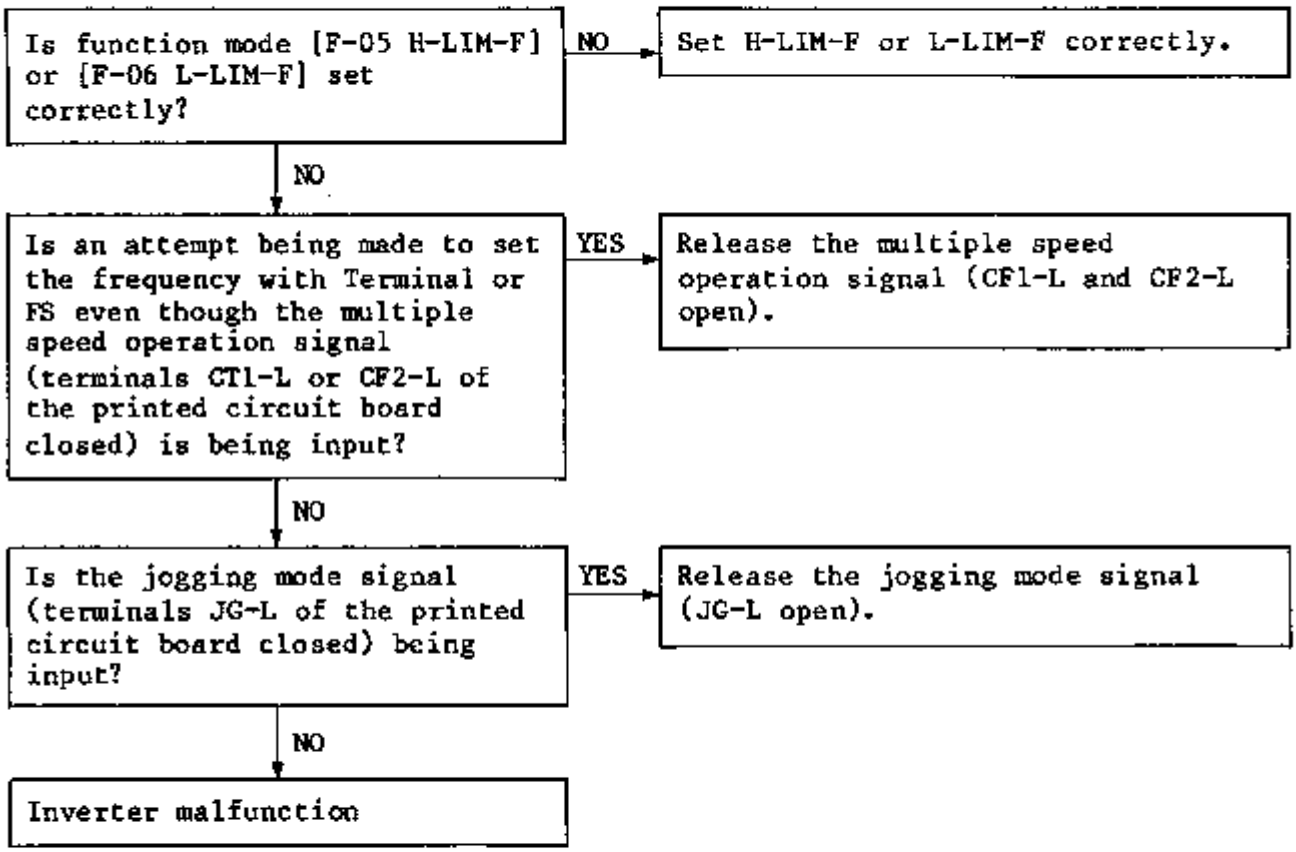
(b) The display stopped at [ADJUST 000.5S] during reactivation, and the unit does not start even after the restarting wait time has elapsed.



(c) The cursor in the monitor mode [FS] of the digital operation panel does not move. Or, the display remains at [FS000.0 Hz] and is not set.



(d) The setting value of the monitor mode "FS" of the digital operation panel does not increase or decrease.



(8) Other

(a) Missing phases on the input side

This inverter does not have a missing phase protection function on the input side, however, it will go into the following states when phases are missing.

a) 1.5LB2 - 2.5LB2 units

- o If there is almost no load then operation will be normal; however, the ripple current of the main capacitor will increase and the life of the main capacitor (CB) will be reduced significantly.

- o If there is a load, then overcurrent protection will be activated. In some cases, the resistor RS will overheat and the alarm OH.Fin will be activated. In rare cases the converter module (DM) may be damaged.

b) 3.5LB2 - 16LB2, 5.5HB2 - 11HB2 units

Missing phase	Model	Phenomenon
S phase or T phase	3.5 - 5.5LB2 5.5 - 11HB2	Because relay 84 will not go on, resistor RS will overheat, alarm OH-Fin will be activated, and wires may be broken.
R phase or S phase	8 - 16LB2	
R phase	3.5 - 5.5LB2 5.5 - 11HB2	Same as a).
T phase	8 - 16LB2	

c) The control power supply circuit on the printed circuit board may be damaged. (The circuit made up of Ro and To input.)
Inverter operation will be normal, but the alarm hold circuit will not operate.

(b) In the following cases the converter module may be destroyed, so please take care.

- o When the unbalance factor of the power supply voltage is 3 percent or greater.
- o When the power supply capacity is ten or more times greater than the inverter capacity, and it is 500 kVA or greater.
- o When sudden power supply voltage fluctuations occur.
  Examples: When multiple inverters are installed along a short bus.

When there is turning on and off of a phase advance capacitor. In the above cases we recommend installation of a reactor which is about 3 percent of the power supply voltage (voltage drop during rated currents) in the power supply side.

4. MEASUREMENT AND ADJUSTMENT OF CONTROL PROPERTIES

The following will be indicated, so please be sure to comply to the instructions.
During measurement, when the motor must not be connected: No M.
During measurement, when the main circuit power supply should not be supplied (main circuits R, S and T are connected): No R, S, T.
Connect the remote operator or copy unit, then follow the procedures below to take measurements and make adjustments.

4.1 Control Power Supply Voltage

Item	Allowed voltage range (V)	Measurement location	
		+	-
AVR1 (for +12 V) output voltage (PV12)	11.76 - 12.24	AVR1 ② pin (4E)	L terminal
AVR2 (for -12 V) output voltage (NV12)	-11.76 - 12.24	AVR2 ② pin (4E)	L terminal
AVR3 (for +5 V) output voltage (PV5)	4.9 - 5.1	AVR3 ② pin (3D)	L terminal
AVR4 (for +12 V) output voltage (AP12)	11.76 - 12.24	AVR4 ② pin (7F)	Transformer ⑯ pin (5F)
AVR5 (for +10 V) output voltage (H terminal)	19.6 - 10.4	H terminal	L terminal

* H terminal in the table: Printed circuit board terminals.
The parentheses indicate the address on the printed circuit board.

4.2 Overvoltage Detection Properties [No M] [No R, S, T]

Disconnect connector J13, then connect high voltage AVR between P(M)-N of printed circuit board J13. Impress DC voltage, then detect the various items.

Item	Detected voltage (Between P(M)-N on the printed circuit board)		Criteria
	200 V class	400 V class	
BRD ON	350 - 378 V	350 - 378 V	Between HC04 (6C) ② pin and L "L" → "H"
OFF	343 - 371 V	343 - 371 V	Between HC04 (6C) ② pin and L "H" → "L"
OV-TRIP	385 - 405 V	385 - 405 V	o Gate cut off; Logic printed circuit board check pin "U" is "L" → "H" o Alarm output; AL0-AL2 goes from ON → OFF o Overvoltage trip display; "?ERROR Over.V"

4.3 Overcurrent (Overload) Detection Properties [No M] [No R, S, T]

Supply only the control circuit power supply (Ro, To), remove the printed circuit board connectors, then impress the rated voltage from the AVR.

<table>
<tr><th>Item</th><th>Impressed voltage</th><th>Criteria</th><th>Remarks</th></tr>
<tr><td>Overload limiting level</td><td>Function mode
LM.CONS 125% 1.0

1) 50% level
LM.CONS 50% 1.0
J51(8A) ② ← ① pin,
1.6 - 2.0 Vdc
impressed

2) 150% level
LM.CONS 150% 1.0
J51(8A) ② ← ① pin,
3.5 - 5.1 Vdc
impressed</td><td>o The output frequency begins to decrease.</td><td>Standard
LM.CONS
125% 1.0</td></tr>
<tr><td>Overload trip</td><td>J51(8A) ② ← ① pin,
6.0 Vdc impressed</td><td>o Over.L tripped after about 10 to 15 seconds.</td><td>Function mode
Set to LM.CONS
125% 31.0
E-therm 100%</td></tr>
<tr><td>LAD STOP</td><td>J51(8A) ② ← ① pin,
5.1 - 5.8 Vdc</td><td>o During acceleration the output frequency of the monitor mode stops.</td><td>Same as above.</td></tr>
<tr><td>OC trip</td><td>J51 ② ← ① pin
(8 A)
<table><tr><th>Model</th><th>Impressed voltage</th></tr><tr><td>1.5 - 5.5LB2
5.5HB2</td><td>6.1 - 6.9
Vdc</td></tr><tr><td>8 - 16LB2
8 - 11HB2</td><td>7.2 - 8.8
Vdc</td></tr></table></td><td>o Overcurrent trip display
?ERROR OC Drive

o Gate cut off
Between ZD1 A
L...L → H
(3C)

o Alarm relay output
AL0 AL2...ON
→ OFF</td><td>Same as above.</td></tr>
<tr><td>Ground fault trip</td><td>J57(9A) ③ ← ① pin,
2.7 - 3.3 Vdc</td><td>Same as above.
(The display, however, is:
?ERROR GND Flt)</td><td></td></tr>
</table>

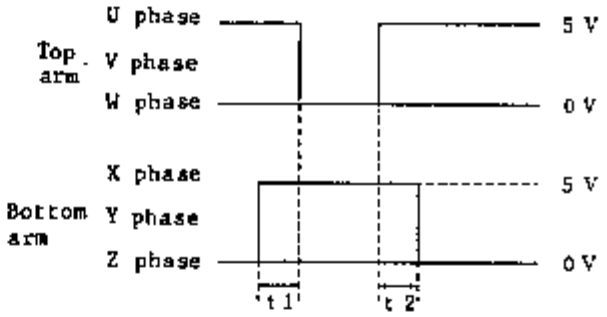
4.4 Non-lap and Gate Voltage Properties [No M] [No R, S, T]

(1) Non-lap time (dead time)

The inverter is operated at its maximum output frequency, and the top and bottom logic output waveforms are measured with a synchroscope.

CH1: Top arm

Phase	Measurement point
U	MS50 ⑦ pin (2D) ← L terminal
V	MS50 ⑤ pin (2D) ← L terminal
W	MS50 ③ pin (2D) ← L terminal



CH2: Bottom arm

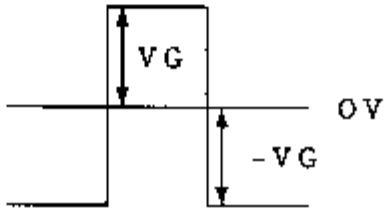
Phase	Measurement point
X	MS50 ⑨ pin (2D) ← L terminal
Y	MS50 ⑪ pin (2D) ← L terminal
Z	MS50 ⑭ pin (2D) ← L terminal

Item	Criteria
Non-lap time (t1, t2)	2 - 4 μsec

(2) Gate voltage properties

The inverter is operated at its maximum output frequency, and the top and bottom gate voltage waveforms are measured with a synchroscope.

Phase	Measurement point
U	RU (2E) ← UL (2E)
V	RV (3F) ← VL (3F)
W	RW (3G) ← WL (4H)
X	RX (2G) ← XL (5H)
Y	RY (2H) ← XL (5H)
Z	RZ (3H) ← XL (5H)



Item	Criteria
Gate voltage properties	14 V $\leq$ VG $\leq$ 16 V -11 V $\leq$ VG $\leq$ -7.5 V

Note 1: Make sure that the J11 and J12 connectors are connected.

Note 2: In the tables, UL, VL, WL and XL indicate check terminals; RU through RZ indicate the lead terminals of resistors; and the designations in the parentheses indicate the addresses on the printed circuit board.

4.5 Undervoltage Detection Properties

Operate the inverter at its maximum output frequency. The variable transformer reception voltage of the main circuit power supply (R, S, T) is decreased to trip the UV-TRIP. (Execute at the rated load.)

Item	Operating voltage (input voltage)		Criteria
	200 V class	400 V class	
Undervoltage	140 - 160 V	280 - 320 V	Gate cut off (The check terminal U on the printed circuit board should go from L to H.) Alarm output (AL0 ← AL2 output should go from ON to OFF.) Undervoltage display: (?ERROR Under.V OR ?ERROR UV WAIT)

Latch after detecting. After resetting (RS-L short-circuited), release the latch.

4.6 Temperature Sensor Detection Properties [No M]

Remove connector J31 on the printed circuit board, short-circuit ①-② of J31, then detect the temperature increase.

Item	Operation	Criteria
Temperature increase	Short-circuit ①-② of J31.	Gate cut off (The check terminal U on the printed circuit board should go from L to H.) Alarm output (AL0 ← AL2 output should go from ON to OFF.) Temperature increase display: (?ERROR OH.Fin)

Latch after detecting. After resetting (RS-L short-circuited), release the latch.

Sensor operation temperature: 100°C ±5°C (100M display on the unit.)

4.7 Forced Reset Properties

Item	Operation	Criteria
Forced reset	Short-circuit terminals RS-L on the printed circuit board.	The error mode should be reset.

4.8 Output Frequency Adjustment Properties

(in case of external frequency instructions: Select F-SET-M from "Terminal" with [MON] .) [No M]

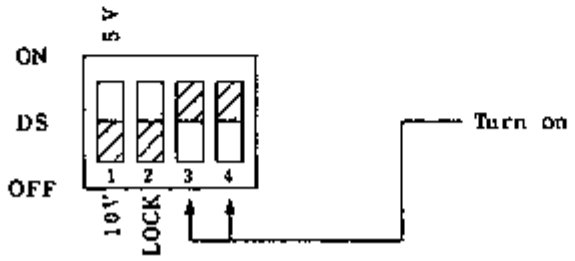
Adjust the setting frequency according to the following procedure.

(1) Set the frequency instruction method to Terminal with the monitor mode.

F-SET-M Terminal

(2) Impress 9.6 Vdc on control terminals 0 ← L.

(3) Turn on switches 3 and 4 of DIP switch DS (8A).



(4) Press [MON] 14 times to show the address display.

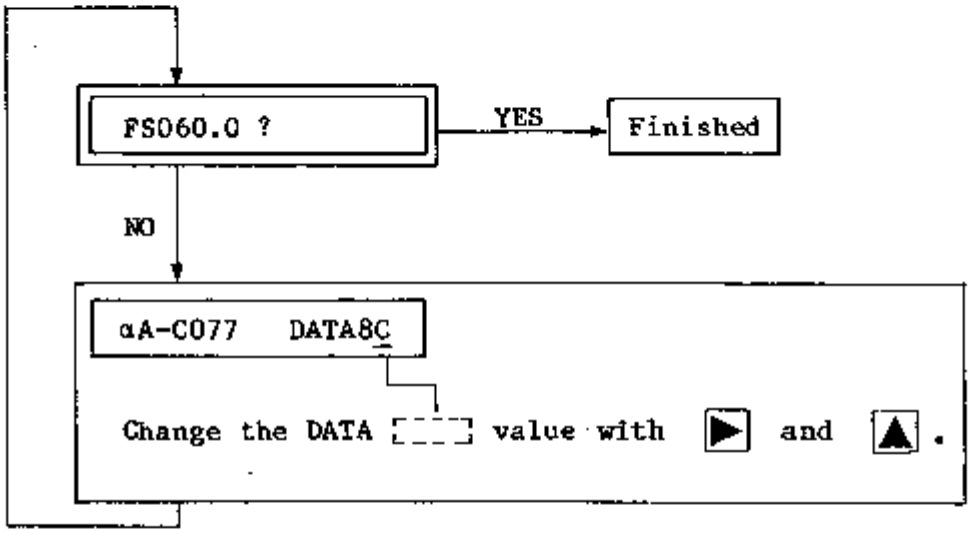
αA-0000 DATA00

(5) Use [▶] , [▲] and [▼] to set address αAC077.

αA-C077 DATA00

(6) Use ▶ , ▲ and ▼ to change the DATA [ ] value to FS060.0.

Operation Procedure

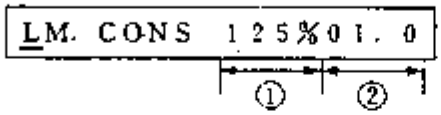


(7) Turn off switches 3 and 4 of DIP switch DS (8A).

(8) Impress 5.0 Vdc on control terminals 0 + L.
Make sure that the output frequency display at this time is FS029.0 through FS031.0 Hz at this time.

4.9 Overload Limiting Level Adjustment Properties (Function mode "LM.CONS")

o This function realizes the tenacity of the inverter.
By changing the setting of [F-32 LM.CONS] (50 to 150% variable ①), this function will be activated at 50 to 150% of the rated current of the inverter, and the inverter output V/f will be decelerated at a constant ratio (00.1 to 30.0 variable ②).



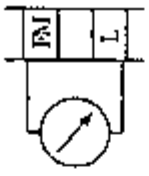
This function is only operable during acceleration or constant speed operation of the motor, and it cannot be used during motor deceleration.
When this function is activated, the speed of the motor will decelerate towards zero. If the load is decreased, the motor will increase speed to the speed specified by the preset acceleration speed.

- o When operated at a low frequency (about 5 Hz) below the setting frequency without tripping, it can be considered that this limiting function is operating. If ① is operated at 150% it will be difficult to execute the above phenomenon, however, because there is an overload, it will be necessary to ask the customer to reduce the load.

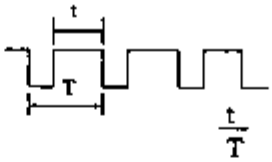
- o When the overload limiting function is not used set ② to 01.0 → 31.0.

4.10 External Frequency Meter (Analog Meter) Adjustment Properties (Variable Resistor "M.ADJ")

Select [F-28SWITCH1] with the function mode, then set SWITCH1 FM ANA. In this condition, (t/T) which is proportionate to the output frequency will be output to FM-L of the printed circuit board. Adjust the variable resistor "M.ADJ" so that the meter indicates maximum when the frequency is at maximum.



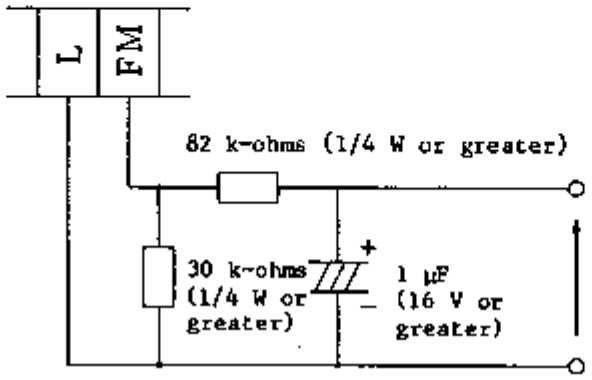
Analog meter



$\frac{t}{T}$: Change

Approximately 6.4 ms constant

If you wish to input data to the recorder, etc. from FM-L, use the filter circuit shown below. Although response will become slower, the change in frequency can be recorded.



Voltage ≒ 10 V
Adjust with "M.ADJ."

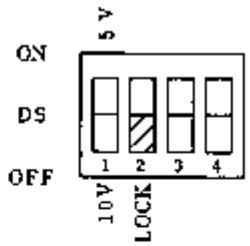
4.11 Motor Rotational Speed Detection Properties

Because this function makes reactivation possible when the motor is running free after instantaneous stopping and restarting, it detects the rotational speed of the motor from the residual voltage in the motor when it is running free.
Drive the motor with the inverter to execute resetting.
Set the motor to run free, measure CFB-5 ⑩ pin (6A) ← L with a synchroscope, then make sure that the pulse cycle of CFB-5 ⑩ pin ← L changes continuously.

4.12 Digital Operation Panel Lock Function (DIP "DS" Switch)

Confirm the function through the following:

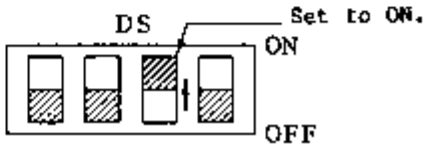
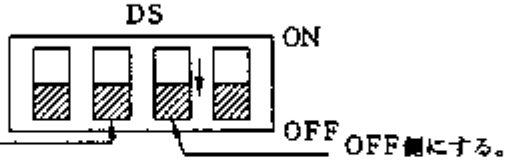
(1) Set the "DS" switch (②) "LOCK" to off, then make sure that the various data (for both the monitor mode and function mode) can be changed by the digital operation panel.



(2) Next, set the "LOCK" to on, then make sure that none of the data can be changed from the digital operation panel.

4.13 Returning to the Initial Settings (Factory Shipment State)

If you wish to return the unit to the factory shipment state, follow the procedure below.

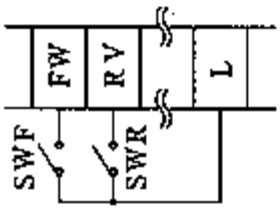
Operation procedure	Contents
Turn the power supply on.	When the power supply is turned on, the display before the power supply was turned off will be shown. FS000.0 000.0Hz
DIP switch selection	Set the second DIP switch from the right on the printed circuit board to ON. 
Select switch selection 3 of the function mode.	Press [FUN] once, [▲] 24 times, then [FUN] once. SWITCH 3 SLCT SPD Use [▶] to move the cursor to the S, then press [▲] three times. SWITCH 3 STDT RST Cursor movement
Select standard values.	Use [▶] to move the cursor to the R, then press [▲]. SWITCH 3 * STDT SET Cursor movement
Reset instruction	Press the [STR] key to record. Reset the terminal RS. (Switch SW closed.) 
Reset the DIP switch selection.	Return the DIP switch on the printed circuit board to OFF. 

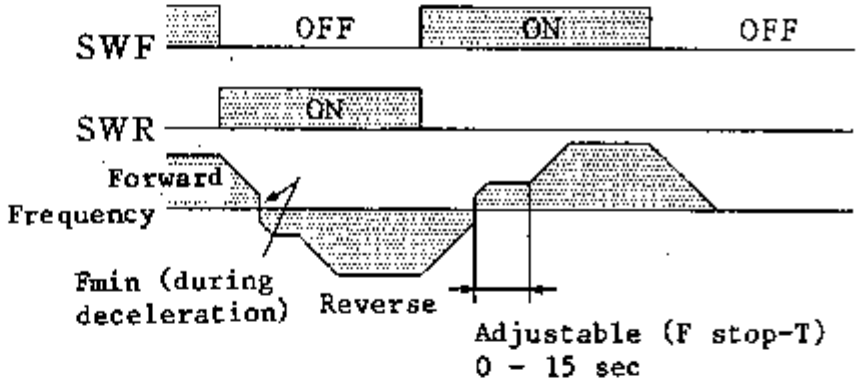
Note:
If the second DIP switch from the left (software lock) is set to ON (refer to section 4.12), the unit will not return to its initial state.

5. OPERATION ADJUSTMENT

5.1 Motor No Load, Forward/Reverse Operation

Operate the motor in forward, use the switching switch to decelerate and rotate in reverse. OC-TRIP should not be activated and the motor should accelerate.





5.2 Motor Load Operation (50 to 150% Load)

After starting motor operation with a load, gradually increase the load and make the following measurement.

Item	Operation	Criteria
Motor load operation	50 to 150% load operation	The current value should remain constant and the motor rotational speed should decrease.

5.3 Load Short-circuit

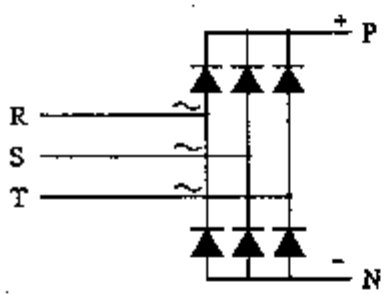
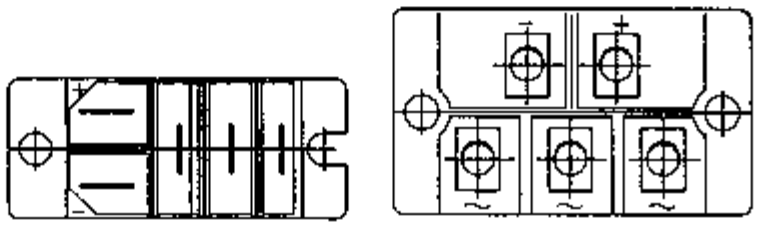
Start operation of the inverter with no load, then turn on the AC output short-circuit MCB and make the following measurement.

Item	Operation	Criteria
Load short-circuit	Load short-circuit	OC-TRIP display

6. COUNTERMEASURES FOR MALFUNCTIONS

6.1 Checking the Converter Module

A tester can be used to decide whether a module is good or not.

Circuit diagram	External view
	 200 V class: 5.5 kVA or less 200 V class: 8 to 16 kVA

Cut the power supply, then start work only after the voltage between P-N is 15 V or less.

Disconnect the converter module wiring, and check the converter independently. Tester measurements should be made in the 1 ohm range.

Tester terminals − → +	Resistance value
∿ → ∿ Three methods (R-S, S-T, R-T equivalent)	50 k-ohms or greater
P (+) → Each ∿	50 k-ohms or greater
Each ∿ → P (+)	50 k-ohms or less
N (-) → Each ∿	50 k-ohms or less
Each ∿ → N (-)	50 k-ohms or greater

∿: AC terminal

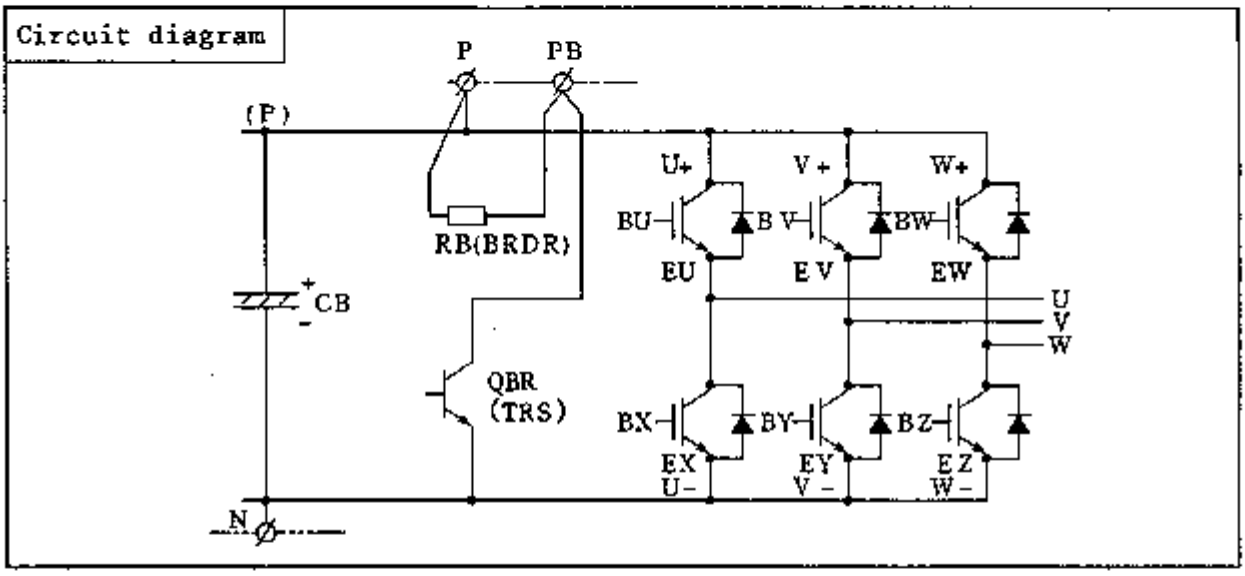
Modules which do not meet the above criteria should be replaced.

o Phenomena during malfunctions.

MCB tripping (power supply short-circuit)

6.2 Checking Methods for the Inverter Module and BRD Transistor Module

A tester can be used to decide whether a module is good or not.



Cut the power supply, then start work only after the voltage between P-N is 15 V or less.

Tester measurements should be made in the 1 ohm range. (Simple checking method with the unit assembled.)

Tester terminal colors Black - Red	Resistance value	Checking location
P - U	50 k-ohms or greater	U phase top arm
P - V		V phase top arm
P - W		W phase top arm
N - U	50 ohms or less	U phase bottom arm
N - V		V phase bottom arm
N - W		W phase bottom arm
U - P	50 ohms or less	U phase top arm
V - P		V phase top arm
W - P		W phase top arm
U - N	50 k-ohms or greater	U phase bottom arm
V - N		V phase bottom arm
W - N		W phase bottom arm
RB - N	50 k-ohms or greater	BRD transistor
N - RB	50 ohms or less	

(Disassembled checking method)

Note: There is a danger of damage by static electricity. Be sure to ground yourself before handling components.

Tester terminal colors Black - Red	Resistance value	Checking location
BU - U	100 ohms or less	U phase top arm
BV - V		V phase top arm
BW - W		W phase top arm
BX - U	100 ohms or less	U phase bottom arm
BY - V		V phase bottom arm
BZ - W		W phase bottom arm
U - BU	50 to 200 ohms or greater	U phase top arm
V - BV		V phase top arm
W - BW		W phase top arm
U - BX	50 to 200 ohms or greater	U phase bottom arm
V - BY		V phase bottom arm
W - BZ		W phase bottom arm
B - N	100 ohms or less	BRD transistor
N - B	50 to 200 ohms or greater	

Phenomena during malfunctions

1) Inverter module

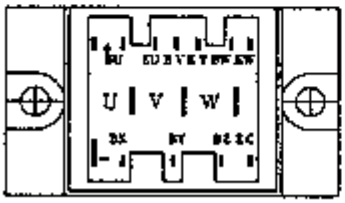
OC trip is activated even though the motor is not connected.

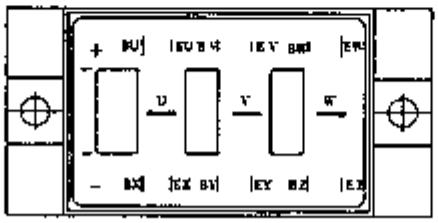
2) BRD transistor module

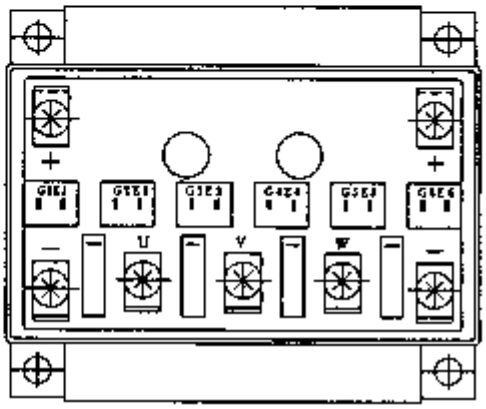
The BRD discharge resistor overheats. If the built-in discharge resistor is used, OH.Fin trip will be activated.

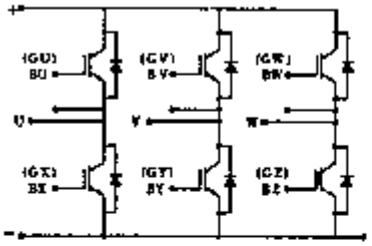
External View of the Inverter Module

Note: There is a danger of damage by static electricity. Be sure to ground yourself before handling components.

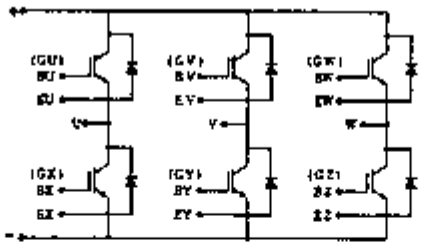




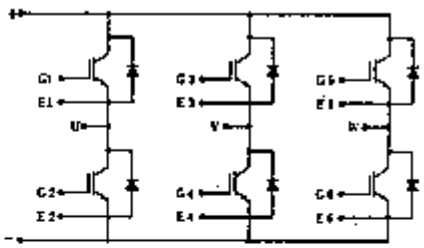




(200 V class: 2.5 kVA or less)

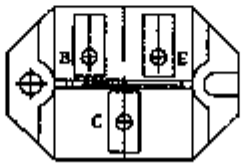


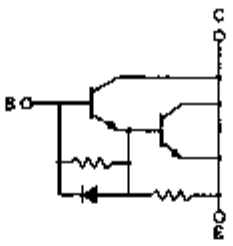
(200 V class: 3.5 kVA)



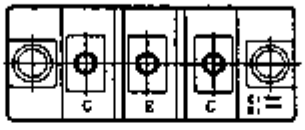
200 V class: 5.5 - 16 kVA
400 V class: 5.5 - 11 kVA

External View of the Braking Transistor (QBR, TRS)

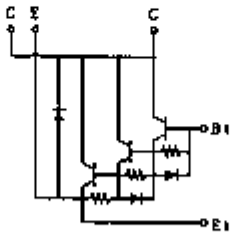




(200 V class: 8 - 16 kVA)
(400 V class: 5.5 kVA)



(400 V class: 8, 11 kVA)



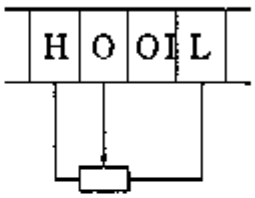
6.3 Printed Circuit Board Checking Method

Visually check the printed circuit boards which are installed. Take special care in making sure that the resistors, gate module (designation CM1.2.3T006203 ... [ ]), hybrid modules (designation CFB3T006160 ... [ ], designation VDM3T116231 ... [ ], designation IOM3T006230 ... [ ]), etc. are not damaged, that there are no short-circuits in the IC leads caused by foreign matter, and that the connectors are normal and securely connected.

6.4 Frequency Setting Checking Method

Connect the remote operator or copy unit, then check in the manner described below.

(1) Connect the frequency setter between terminals O-L of the printed circuit board.



Frequency setter
(500 ohms - 2 k-ohms)

(2) Make the following selections with the MON , ▶ , ▲ and ▼ of the remote operator.

F-SET-M Terminal

F/R-SW Remote

(3) Use MON to dispaly the frequenct setting and output frequency.

FS000.0 000.0Hz

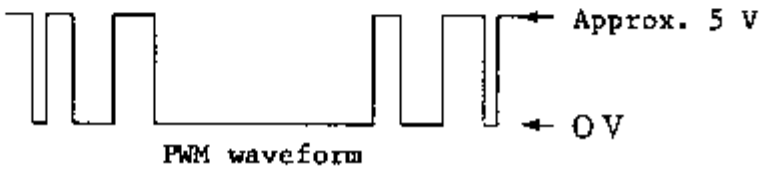
(4) Set the frequency setting to maximum (turn as far clockwise as possible), then press FWD RUN. Make sure that frequency setting ① and output frequency ② are at maximum.

Example:

FS060.0 F060.0Hz
① ②

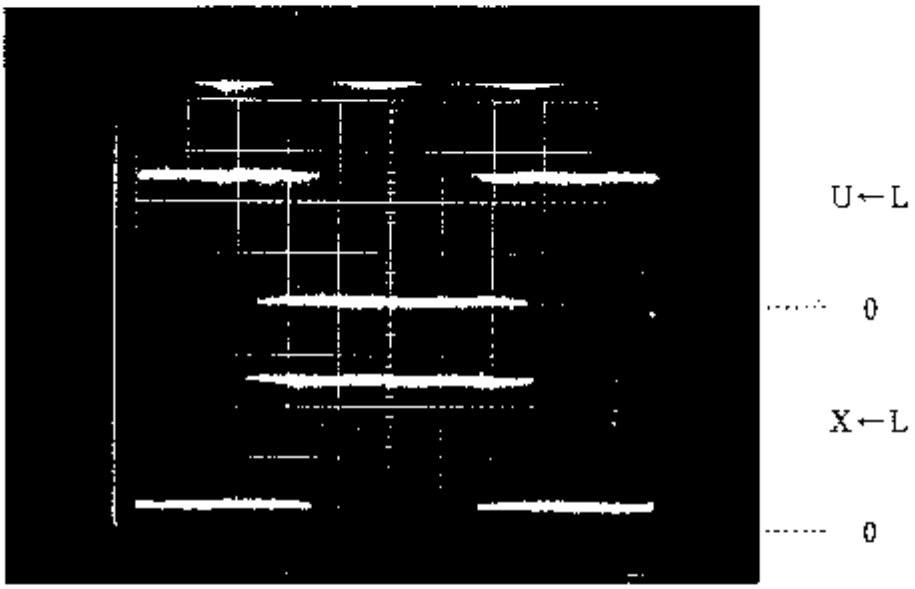
6.5 Control Signal Checking Method

When making the above settings (6-4), a PMW waveform will appear between check land "U" and "L" or "X" and "L."
This PMW waveform will differ according to the frequency which is set.
If the PMW waveform is not correct, replace the main control board.



PWM waveform

"U" ← "L", "X" ← "L"
"V" ← "L", "Y" ← "L"
"W" ← "L", "Z" ← "L"

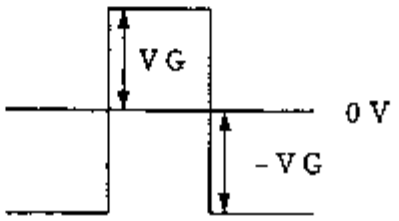


f=60Hz 2 ms/div 2 V/div

6.6 Gate Circuit Checking Method

Select "Remote" for FSET-M and F/R-SW with the [MON] key of the digital operation panel. Then, set [FS 060.0 Hz] for "FS," and press [FWD RUN]. This will allow measurement of the PWM signal.

Phase	Measurement point
U	RU (2E) ← UL (2E)
V	RV (3F) ← VL (3F)
W	RW (3G) ← WL (4H)
X	RX (2G) ← XL (5H)
Y	RY (2H) ← XL (5H)
Z	RZ (3H) ← XL (5H)



Item	Criteria
Gate voltage properties	14 V ≤ VG ≤ 16 V -11 V ≤ VG ≤ -7.5 V

Note 1: The above outputs have the same electric potential (high voltage) as the main circuit, so please be very careful.

Note 2: If an oscilloscope is used, be careful not to short-circuit the above terminals and grounding terminal.

Note 3: If output is not correct, replace the gate module or entire printed circuit board.

Note 4: Connect connectors J11 and J12.

6.7 Motor Operation

Make sure that the motor is operating normally.

7. INSPECTION AND MAINTENANCE PROCEDURES

7.1 Precautions

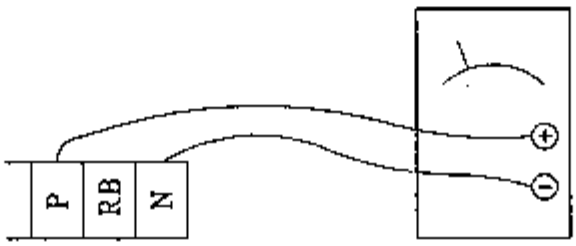
(1) Precautions to take before inspection and maintenance

There is always the danger of electrocution during inspection and maintenance, so confirm the following before starting work.

a) Turning the power off, and make sure that the charge lamp on the printed circuit board is also off. (About one minute for the 200 V class 16LB2, and about three minutes for the 400 V class 11HB2.)

b) Measure the voltage between terminal P and N with a tester as shown in the diagram on the right, and make sure that the voltage is 15 V or less.

c) After turning off the power supply, connect a discharge resistor (30 W, 500 ohm) between terminals P and N for 15 seconds or more.



(2) General precautions

Always keep the unit clean so that dust does not enter it. Always be careful about broken wires and bad connections, and be sure to securely fasten terminals. Moisture and oils are bad for electronic equipment, and dust and metal particles can damage insulation, resulting in unforeseen malfunctions.

7.2 Measuring Input/Output Voltage, Current and Power

Figure 7-3 and Table 7-4 show some general instruments used to measure input voltage, current and electricity. Measure the effective value of the reference wave of voltage, and all effective values for currents and electricity.

(1) Measuring output voltage

Output voltage cannot be measured accurately with moving iron type meters. Make the measurement with the circuits shown in Figure 7-1 and 7-2, and the shown in Figure 7-3 (Table 7-4).

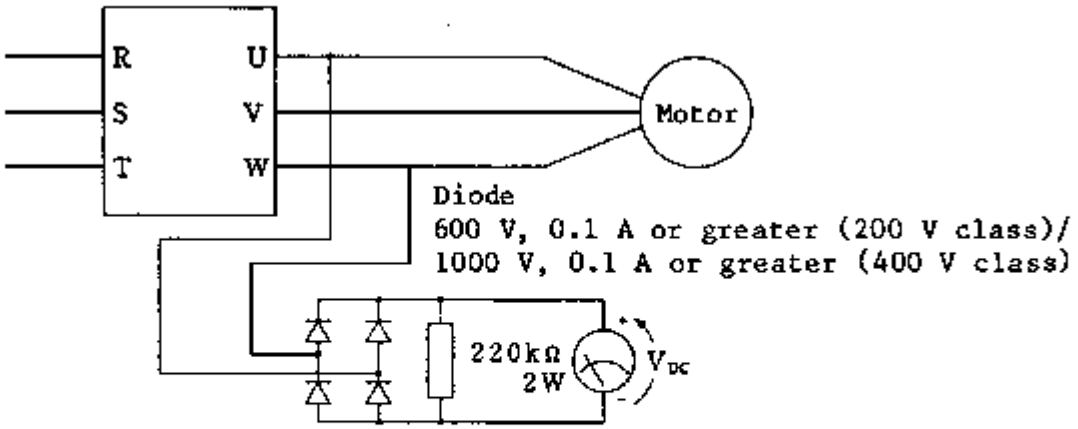


Figure 7-1 Output Voltage Measurement Circuit

When loads are not connected to outputs U, V and W, there will be voltage at terminals U, V and W even when the output frequency instruction indicates zero. This is because there are leaking currents from semiconductors (about 2 mA).
Even if voltmeters are connected to the output terminals in such cases, use the connection shown in Figure 7-2 in order to prevent mistaken readings by the meter.

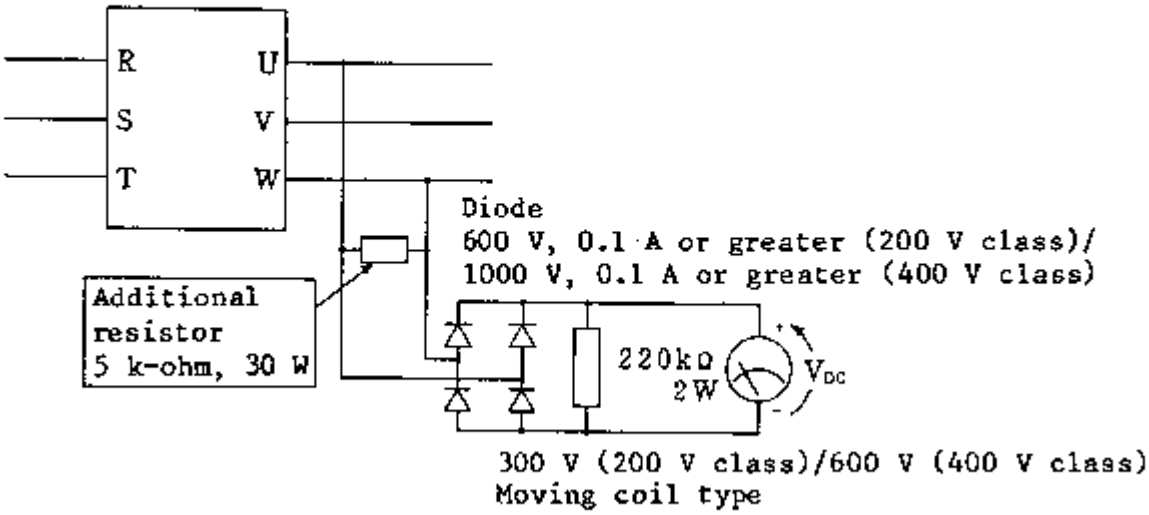


Figure 7-2 Output Voltage Measurement Circuit

(2) Measuring input voltage and input/output currents

Measure with a moving iron type meter. (Figure 7-3, Table 7-1) Be sure to measure all three phases for these.

(3) Measuring input/output input/output power

Measure with a electrodynamometer type wattmeter for single phases. If there is an unbalance between the voltage and current, measure all three phases.

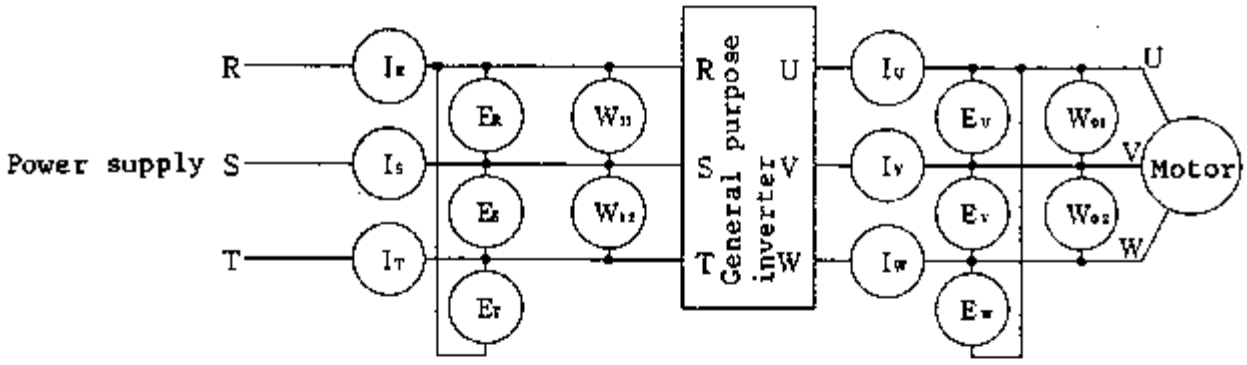


Figure 7-3 Measurement Locations

Table 7-1 Instruments

Measurement item	Measurement location	Instrument	Remarks
Power supply voltage E_1	Between R-S, S-T and T-R (E_R) (E_S) (E_T)	 Moving iron type voltmeter or rectifier type voltmeter	Effective value of reference wave
Power supply current I_1	Currents of R, S and T (I_R) (I_S) (I_T)	 Moving iron type ammeter	All effective values
Primary power W_1	Between R-S, S-T (W_{11}) (W_{12})	 Electrodynamometer type wattmeter	All effective values
Primary power factor Pf_1	Calculate from the measured values of power supply voltage E_1, power supply current I_1 and primary power W_1. $Pf_1 = \frac{W_1}{\sqrt{3} \cdot E_1 \cdot I_1} \times 100\ (\%)$		
Output voltage E_0	Between U-V, V-W and W-U (E_U) (E_V) (E_W)	 Refer to Figure 7-1 or rectifier type voltmeter	All effective values
Output current I_0	Current of U, V and W (I_U) (I_V) (I_W)	 Moving iron type ammeter	All effective values
Output electricity W_0	Between U-V and V-W (W_{01}) (W_{02})	 Electrodynamometer type wattmeter	All effective values
Output power factor Pf_0	Calculate from the effective values of output voltage E_0, output current I_0 and output power W_0. $Pf_0 = \frac{W_0}{\sqrt{3} \cdot E_0 \cdot I_0} \times 100\ (\%)$		

Note 1: Instruments which show the effective values of fundamental waves should be used for voltage, and instruments which show all effective values should be used for current and electricity.

Note 2: Because the inverter output waveform is a distorted wave, errors are especially common at low frequencies. The instruments in the table above and the method designated in Figure 7-3 will assure a relatively accurate reading.

Note 3: In recent years digital power meters (e.g., YWE2503, 2504, etc.) are being used for input/output currents and power.

7.3 Measuring Insulation Resistance and Withstand Voltage Testing Methods

Short-circuit the terminals as shown in the diagram below, and execute under the following conditions.

- Insulation resistance tests should be measured with a generator type 500 V megger between the following terminals and grounding terminal. Make sure that they indicate 5 M-ohms or greater. (Do not use a battery operated megger.)

- When executing withstand voltage tests, impress 1500 Vac for one minute between the following terminals and grounding terminal, and make sure that there are no problems. (Impress 2000 Vac for one minute for 400 V class units.)

- Do not execute withstand voltage tests for any terminals other than those indicated below.

- Gradually increase and decrease the impressed voltage during insulation resistance and withstand voltage tests, returning the voltage to 0 V. Sudden impression and release can lead to damage in the inverter module (PM).

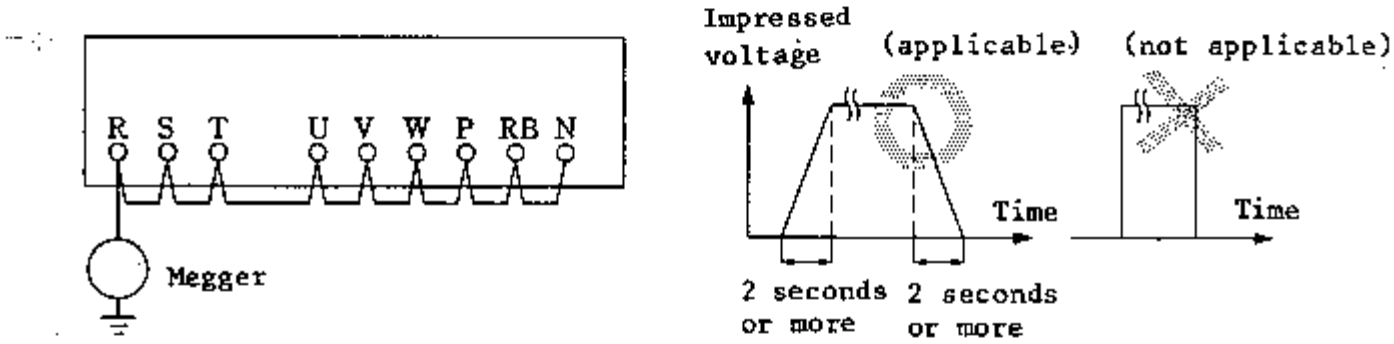


Figure 7-5 Insulation Resistance Test and Withstand Voltage Test

7.4 Component Maintenance

(1) Precautions in maintaining printed circuit board and inverter modules

Under normal usage conditions printed circuit boards will not require maintenance; however, if it becomes necessary to inspect a printed circuit board, be sure to prevent damage from static electricity, and follow the inspection procedures listed in "4. Measuring and Investigating Control Properties" and "5. Operation Adjustments."

- o Preventing damage from static electricity

  The IGBT in the inverter module and LSIs, MCUs, etc. on printed circuit boards can be destroyed by static electricity. Be sure to ground work benches, soldering irons, and yourself before handling them.

(2) Smoothing capacitor and cooling fan maintenance

Because of their operating life, we recommend that you replace smoothing capacitors CB and cooling fans with their spares once every three years. Their lives are especially shortened under high temperature and heavy load operation.

8. REMOTE OPERATORS AND COPY UNIT

8.1 Remote Operators and Copy Unit

Remote operators
- With 0.3 m cable — DOP-03A
- With 1 m cable — DOP-1A
- With 3 m cable — DOP-3A

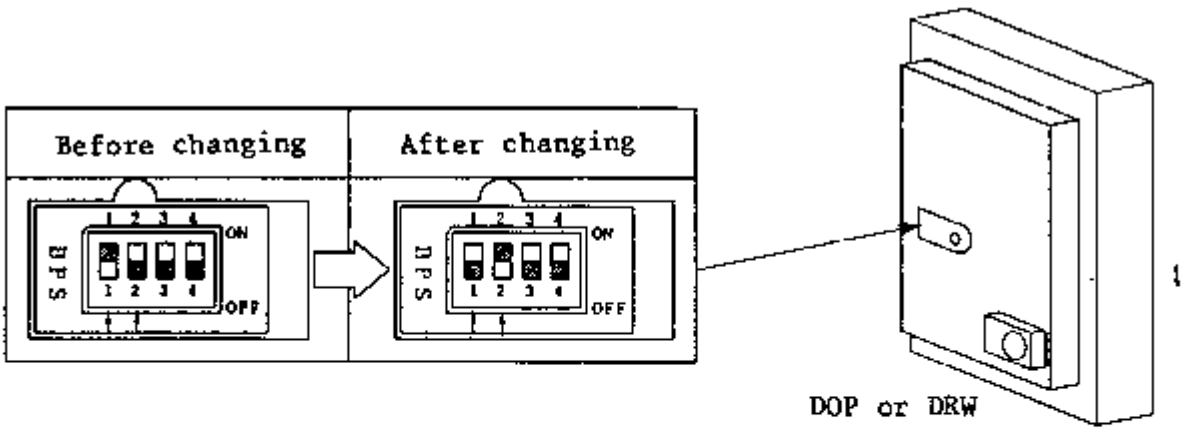
The label on the outside will have the designation REMOTE OPERATOR.

Remote operators are either installed in the inverter unit itself (using DOP-03A) or used remotely (using DOP-1A or DOP-3A).

Copy Unit [With 1 m cable — DRW-1A]

The label on the outside will have the designation COPY UNIT. The copy unit reads the data of the inverter unit which is the master, transfers the data to slave inverters. In addition to simple copy functions to store data, it also has the functions of a remote operator. Data which is read from a master inverter will not be erased even when the power supply is turned off.

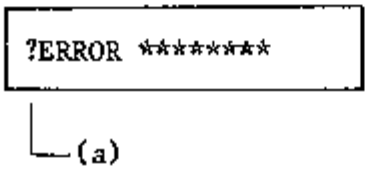
Note 1: Before using a remote operator (DOP) or copy unit:
If used for the HFC-VWA, change the settings of the switches in the back as follows: switch 1 ON → OFF; switch 2 OFF → ON. A remote operator or copy unit cannot be used unless the switch settings are changed.



8.2 Diagnosing Malfunctions and Countermeasures

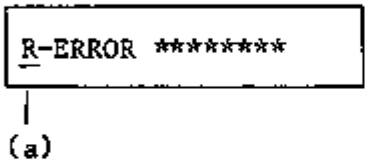
Error messages which are displayed consist of error messages output by the malfunction diagnosis of the inverter unit and error messages from the remote operator or copy unit. These error messages are displayed in the following manner.

(1) Error messages from the malfunction diagnosis of the inverter unit.



(Refer to the inverter operation manual for the details concerning the contents.)

(2) The (a) section of the error message will indicate "R-" when the message is from the malfunction diagnosis of the remote operator.



A: Restart the power supply. (Turn on the power supply of the inverter unit.) After restarting the power supply, execute after the display on the display panel is cleared.
B: Press a remote operator (copy unit) key.

Display R-ERROR********	Cause	Resetting method	Contents to check	Action
COMM <1>	The data quantity within the unit time does not match.	B	o Is there a source of static noise nearby? o Is the cable loose?	o Remove any sources of static noise by separating wiring, etc. o Check the cables.
COMM <2>	There is no signal from the inverter even after five seconds have elapsed.	B	o Resetting of the inverter unit. o Are any connectors loose or disconnected? Are there any broken cables?	o Do not send reset for five seconds or more. o Replace connectors or cables.
SYSTEM	o Malfunction caused by static noise. o Component malfunction	A	o Check the wiring. o Is there a source of static noise nearby?	o Remove any sources of static noise by separating wiring, etc. o If turning off and on the power supply or resetting the unit does not solve the problem, then replace the component.

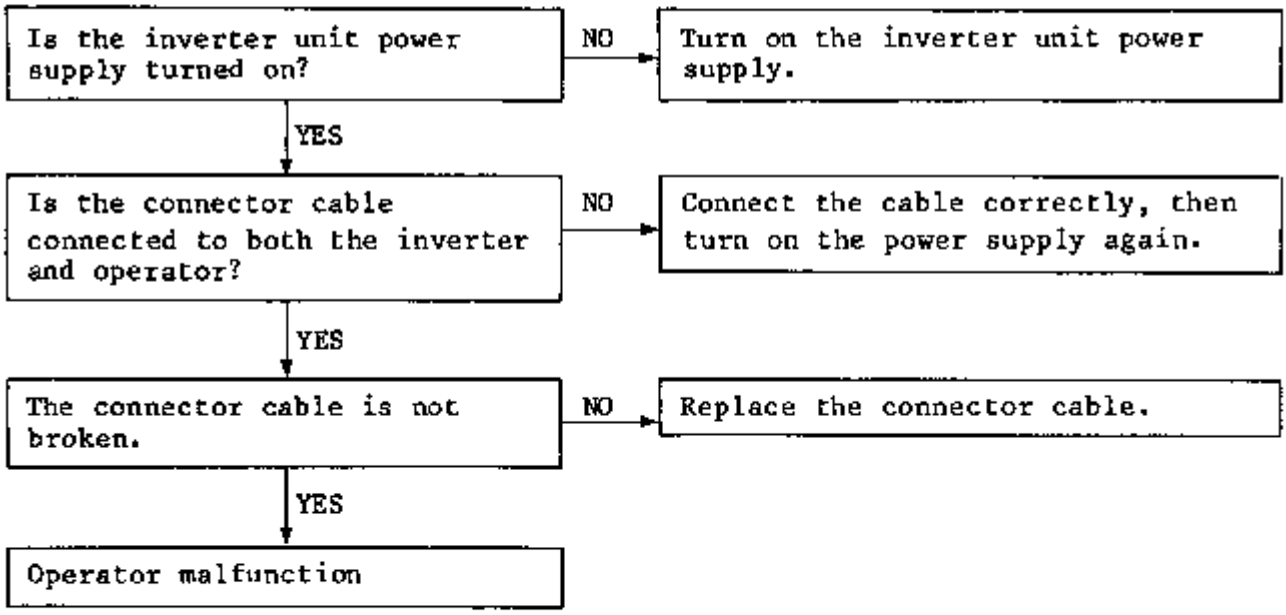
In addition to the above messages, the copy unit will add the following:

Display R-ERROR********	Cause	Resetting method	Contents to check	Action
INV.RUN	o READ or COPY was pressed while the inverter was operating. o Soft lock is on.	B	o Was READ or COPY pressed during inverter operation? o Was COPY pressed during soft lock?	o Use READ and COPY only when the inverter is not operating. o Release soft lock. (Soft lock of the inverter unit.)
INV.TRIP	o READ or COPY was pressed when the inverter was tripped.	B	o Has the inverter been tripped.	o Reset the inverter from the tripped status.
INV.TYPE	o An attempt was made to copy to a different inverter model.	B	-	o Copy the data to an inverter of the same model as the source inverter.
RD LOCK	o Reading is prohibited.	B	-	o Set switch (4) on the back of the copy unit to OFF.
DATA ROM	o The software storage element has exceeded the number of times it can be written to.	A	-	o If there is no change after turning off and on the power supply one or two times, the element has reached the end of its life. Replace it with a new element.
COPY ROM	o The data written to the inverter and the data in the copy unit do not match. o An attempt was made to turn ON the operation instruction and copy when the frequency setting was "0."	A	- o Is the operation instruction ON?	o Execute again, and if the same error is output, then there is an inverter malfunction. o Copy after turning off the operation instruction.

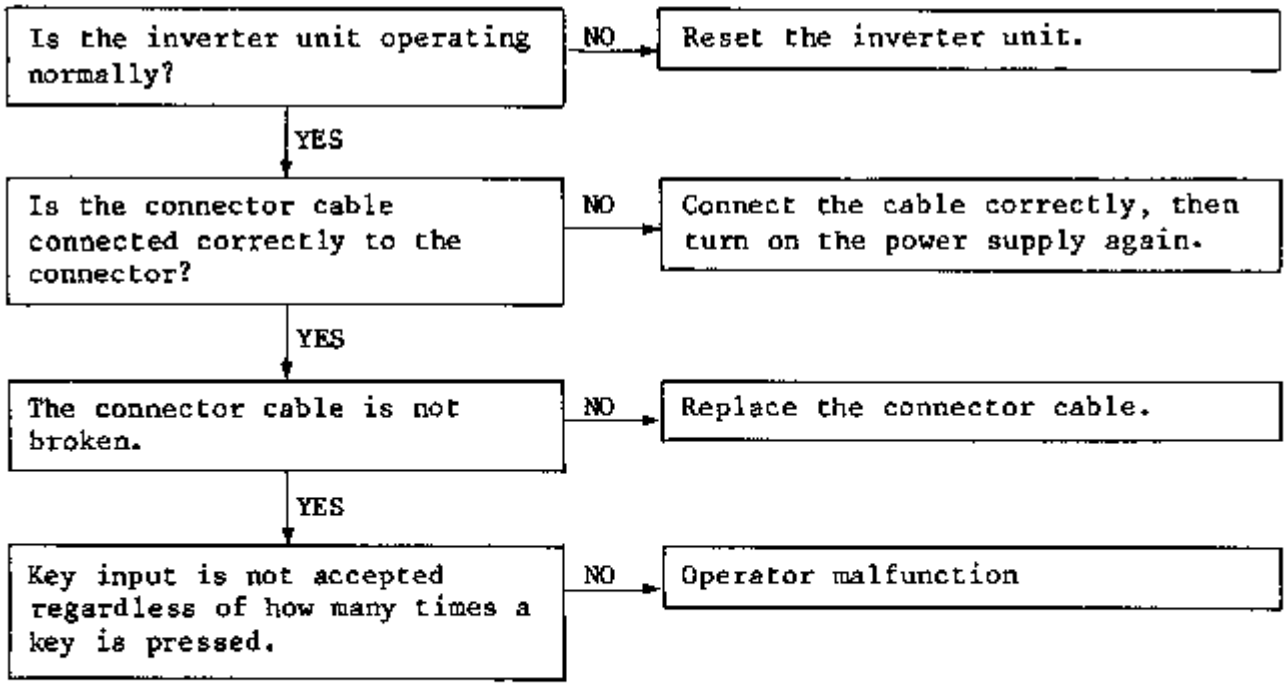
8.3 Troubleshooting

Refer to the inverter operation manual in regard to troubleshooting for the inverter unit itself. This section will only describe troubleshooting for operators. (Remote operator and copy unit will be abbreviated as operator.)

(1) Nothing is displayed.

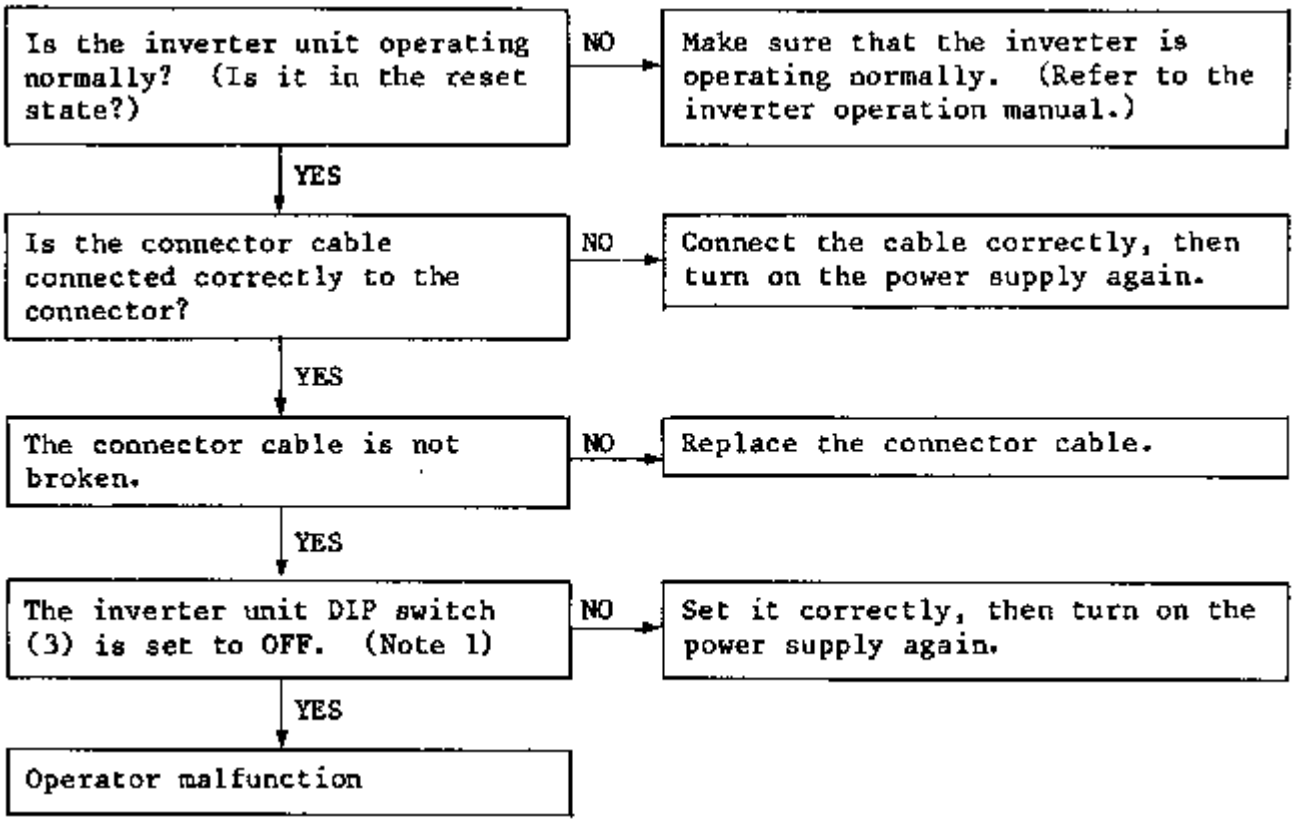


(2) Key input is not accepted.

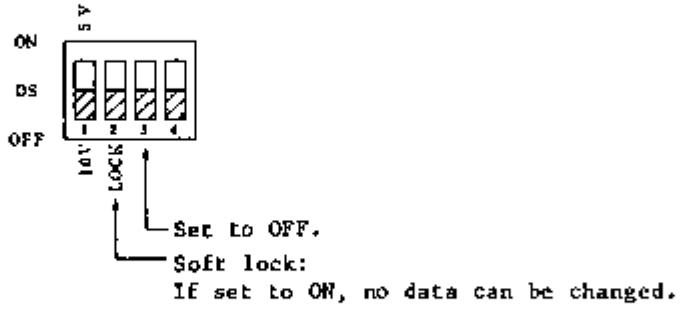


(3) If the inverter or operator display blacks out, characters are funny, or the cursor does not settle down during operation, the problem might be inductive static noise in the cables, so separate the operator cable from other cables by 15 cm or more. In order to reset a disrupted display, press any of the operator keys. If this does not correct the problem, disconnect the cables, then turn off the power supply of the inverter unit or reset it.

(4) An error occurs after the power supply is turned on.



8-6



Note 1: The DIP switches have a "soft lock" function to prevent data changing. If you wish to change data, then set this switch to OFF.

(5) The STOP key is not effective in the terminal mode. The STOP key can be effective or ineffective in the terminal mode. Refer to the inverter operation manual.

9. APPENDIXES

Appendix-1. HFC-VWA Main Circuit Diagram

Capacity (kVA)	Circuit diagram	
	200 V class	400 V class
1.5	3T007567	-
2.5	Same as above.	-
3.5	Same as above.	-
5.5	Same as above.	3T009041
8	3T808067	Same as above.
11	Same as above.	Same as above.
16	Same as above.	-

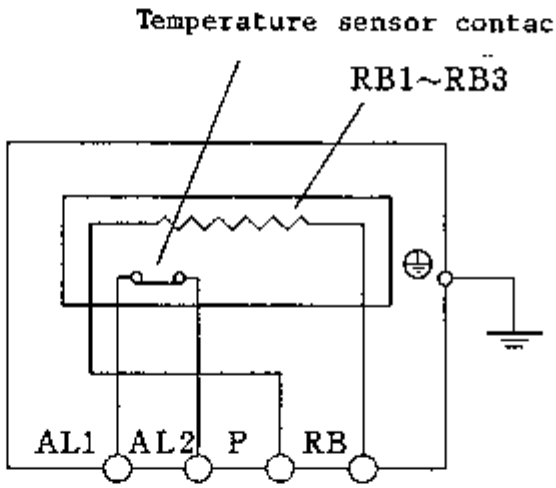
Appendix-2. HFC-VWA Structural Diagram

Capacity (kVA)	Structural diagram	
	200 V class	400 V class
1.5	3T806652	-
2.5	3T806653	-
3.5	3T806654	-
5.5	3T806655	3T807403
8	3T806873	3T807404
11	Same as above.	3T807405
16	3T806874	-

Appendix-3. External Resistor for Regenerative Braking

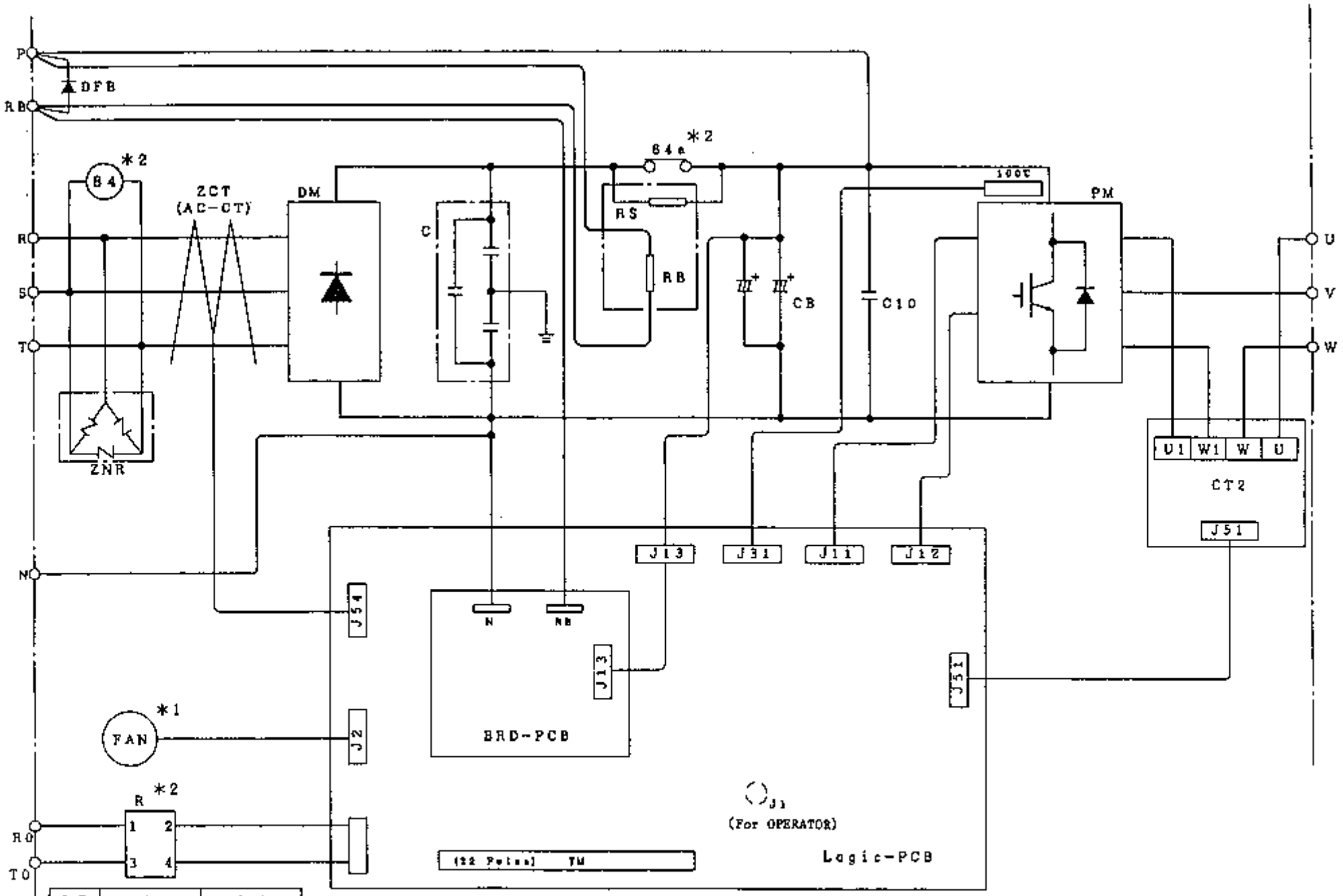
As the operation manual describes, there is an external resistor for high frequency loads and other operation specifications which will lengthen the time rating. Refer to the table below.

RB1, RB2 and RB3 Specifications

Internal connection			
Resistor name	RB1	RB2	RB3
Capacity, constant	400 W, 50 ohms	600 W, 35 ohms	1200 W, 17 ohms
Protective temperature sensor	During operation: 200°C ±10°C During return: 160°C ±10°C	Same as left.	Same as left.

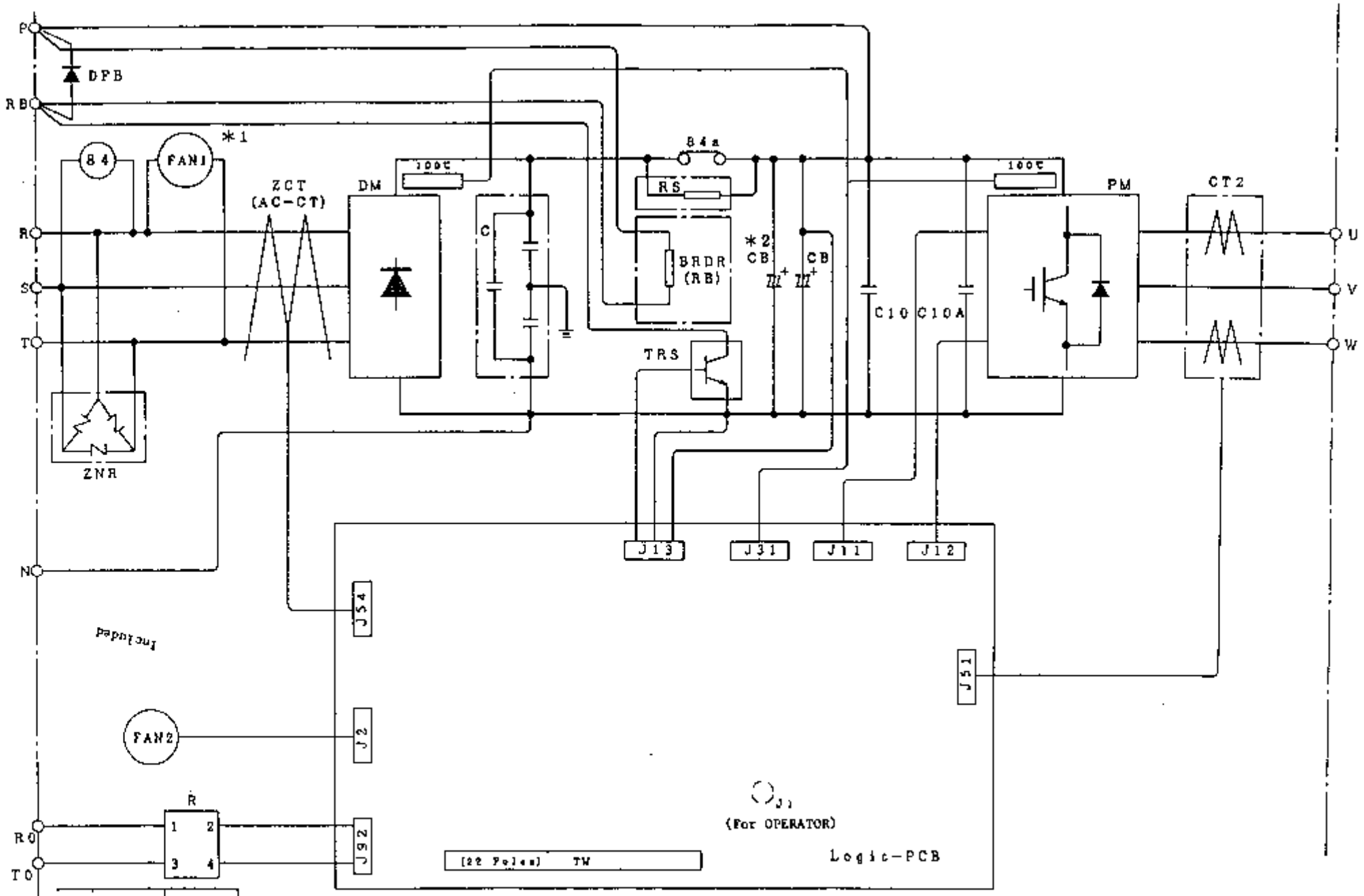
Note 1: This is a wall mounted model. Be sure that the unit is perpendicular.

Note 2: Resistors are sources of heat. There is a heat loss equivalent to a resistor's capacity, so separate it by at least 10 cm in all directions from other components and make sure that ventilation is good. With a high frequency of use the surface temperature of a resistor may reach 200°C, so be sure to install it on a non-combustible surface (metal, etc.).



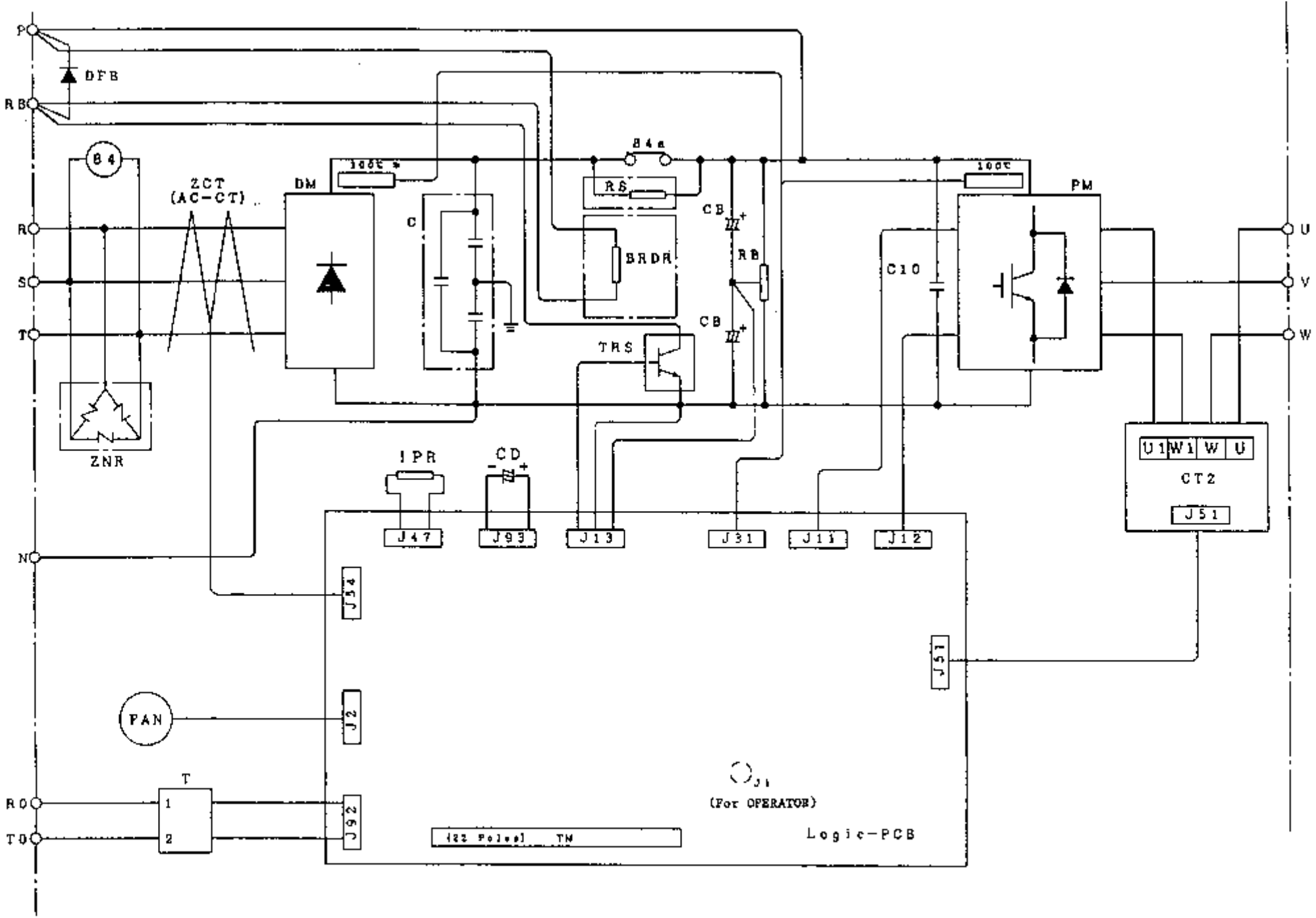
記号	有	Not included
*1	2, 5~5, 5L	1, 5L
*2	3, 5~5, 5L	1, 5~2, 5L

VWA1.5 - 5.5LB2 Main Circuit Diagram 324 3T007567

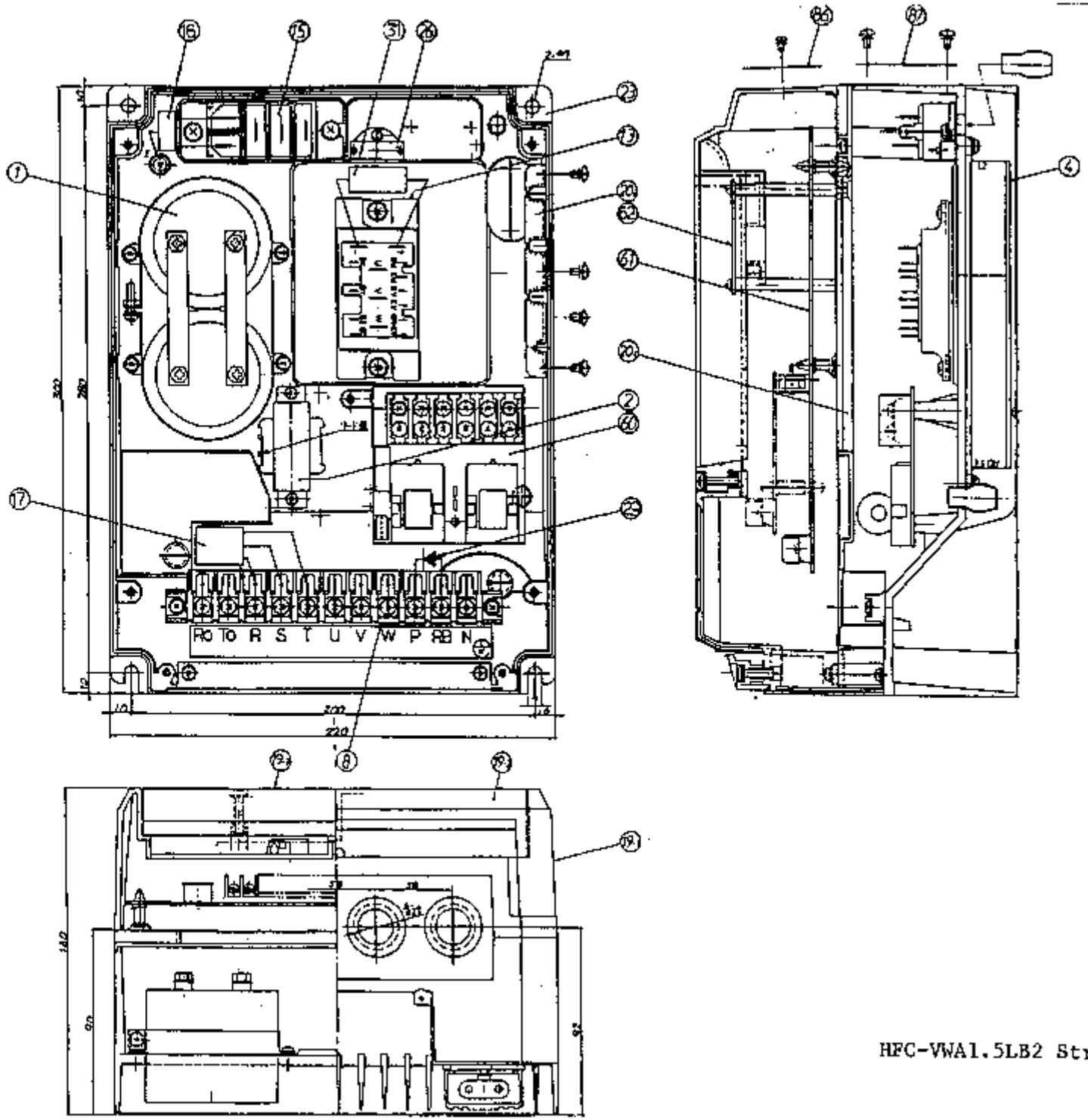


Symbol	有	無
*1	16L	8~11L
*2	16L	8~11L

VWA8 - 16LB2 Main Circuit Diagram 324 3T008067

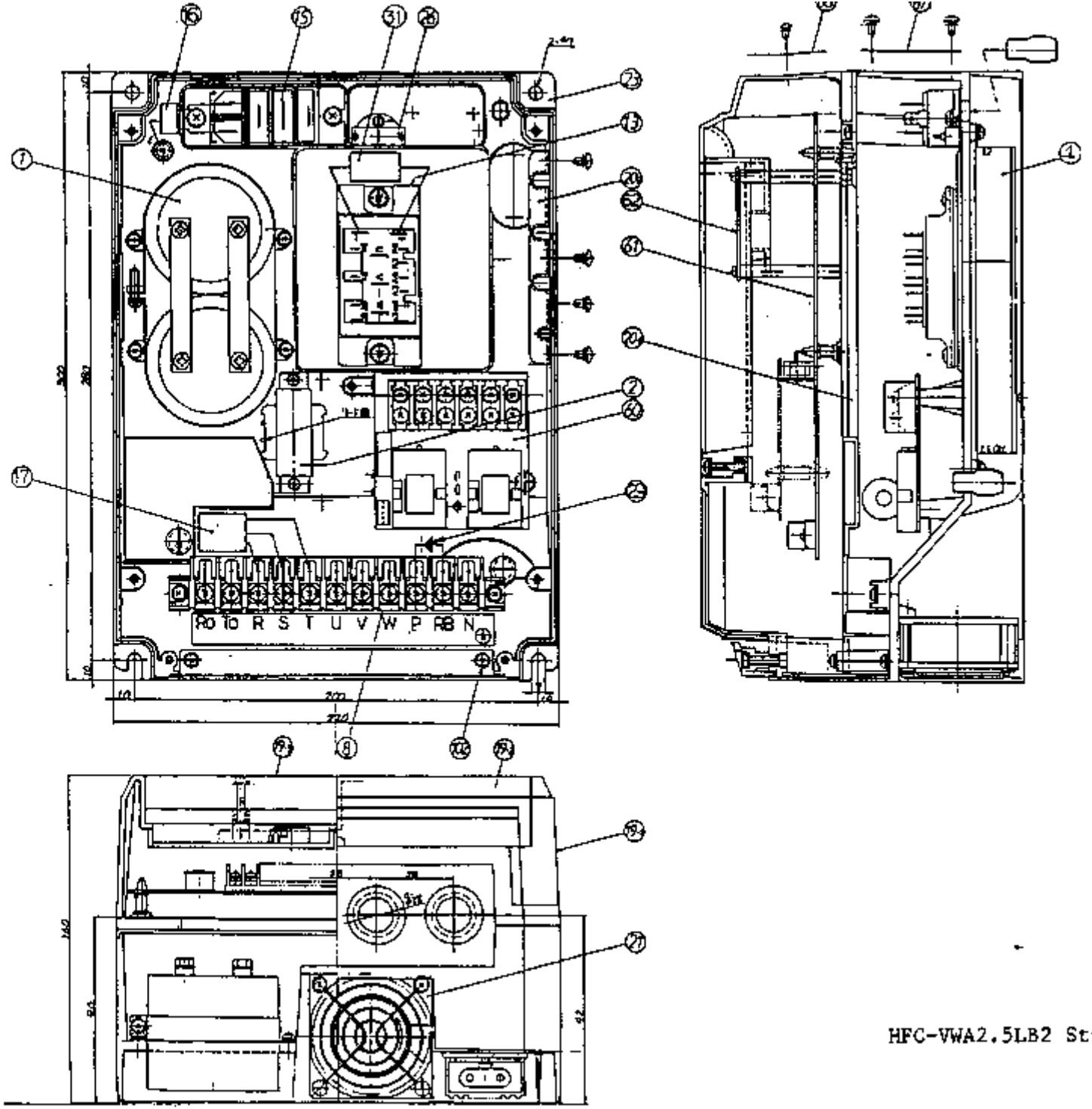


VWA5.5 - 11HB2 Main Circuit Diagram 324 3T009041



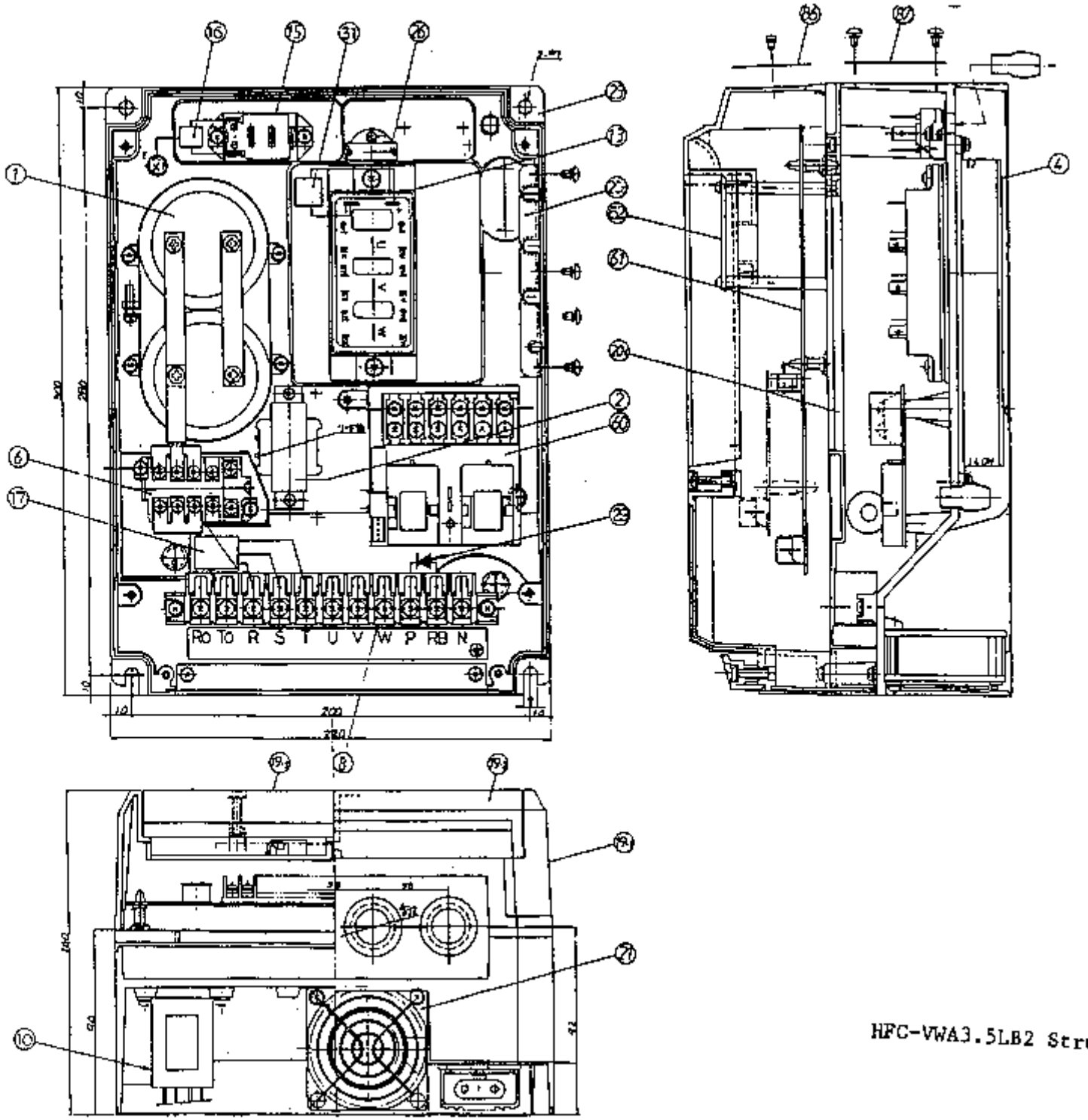
Part No.	Part abbreviation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	1
2	ZCT	Ground fault CT	1
4	RS, RB	Current limiting resistor	1
8	TM	Main circuit terminal block	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Terminal cover	1
19-3	CV	Front blind cover	1
20-1	FUDO	Air duct (shield plate)	1
20-2	PL	Cable bracket	1
23	CS	Case	1
29	DFB	Flywheel diode	1
31	C1D	Snubber capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1
62	PCB	BRD printed circuit board	1
86	PL	Blind cover	1
87	PL	Blind cover	1

HFC-VWA1.5LB2 Structural Diagram 324 3T806652



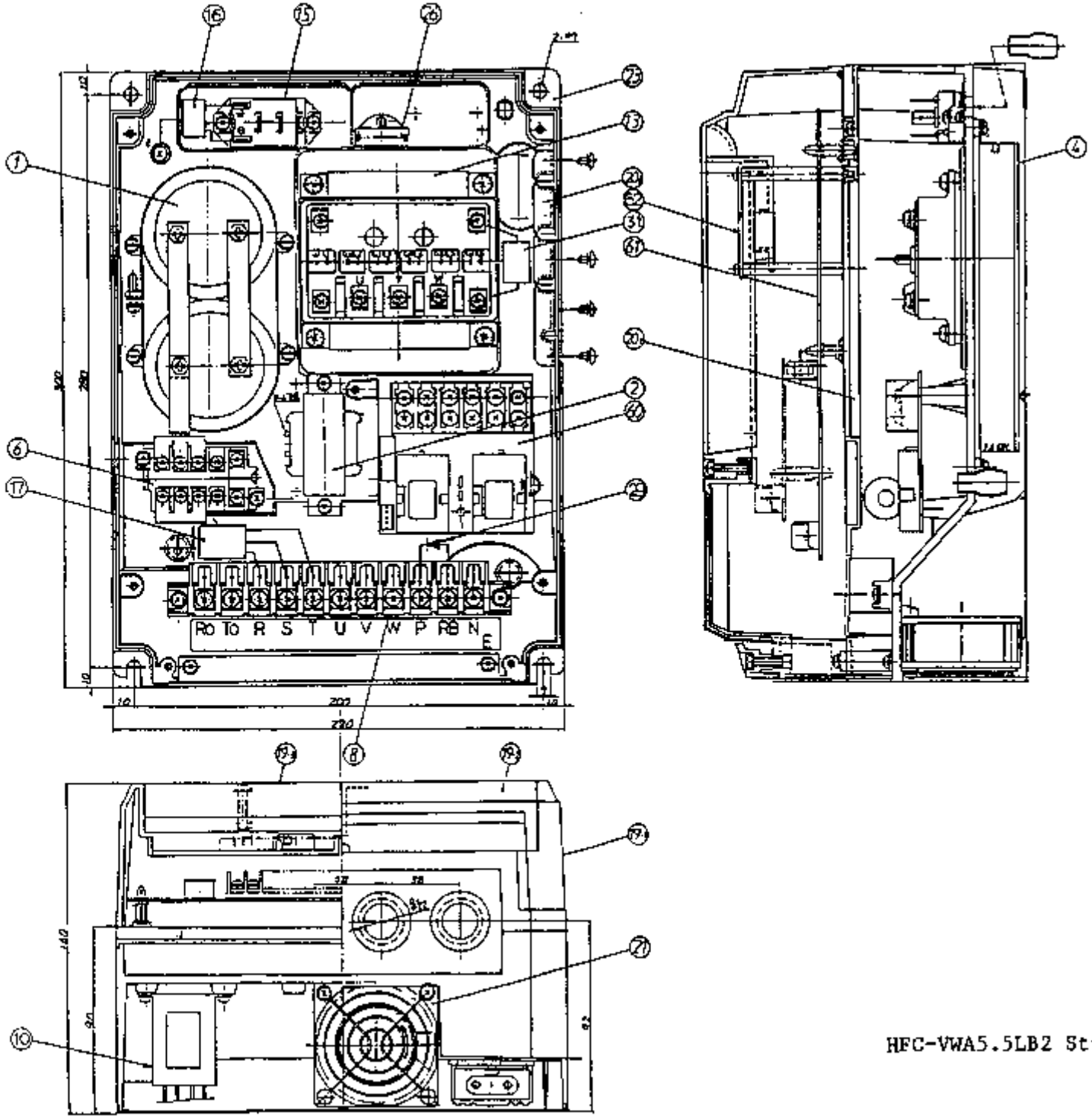
Part No.	Part abbre-viation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	1
2	ZCT	Ground fault CT	1
4	RS, RB	Current limiting resistor	1
8	TM	Main circuit terminal block	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Terminal cover	1
19-3	CV	Front blind cover	1
20-1	FUDO	Air duct (shield plate)	1
20-2	PL	Cable bracket	1
21	FAN	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	1
29	DFB	Flywheel diode	1
31	C10	Snubber capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1
62	PCB	BRD printed circuit board	1
86	PL	Blind cover	1
87	PL	Blind cover	1

HFC-VWA2.5LB2 Structural Diagram 324 3T806653



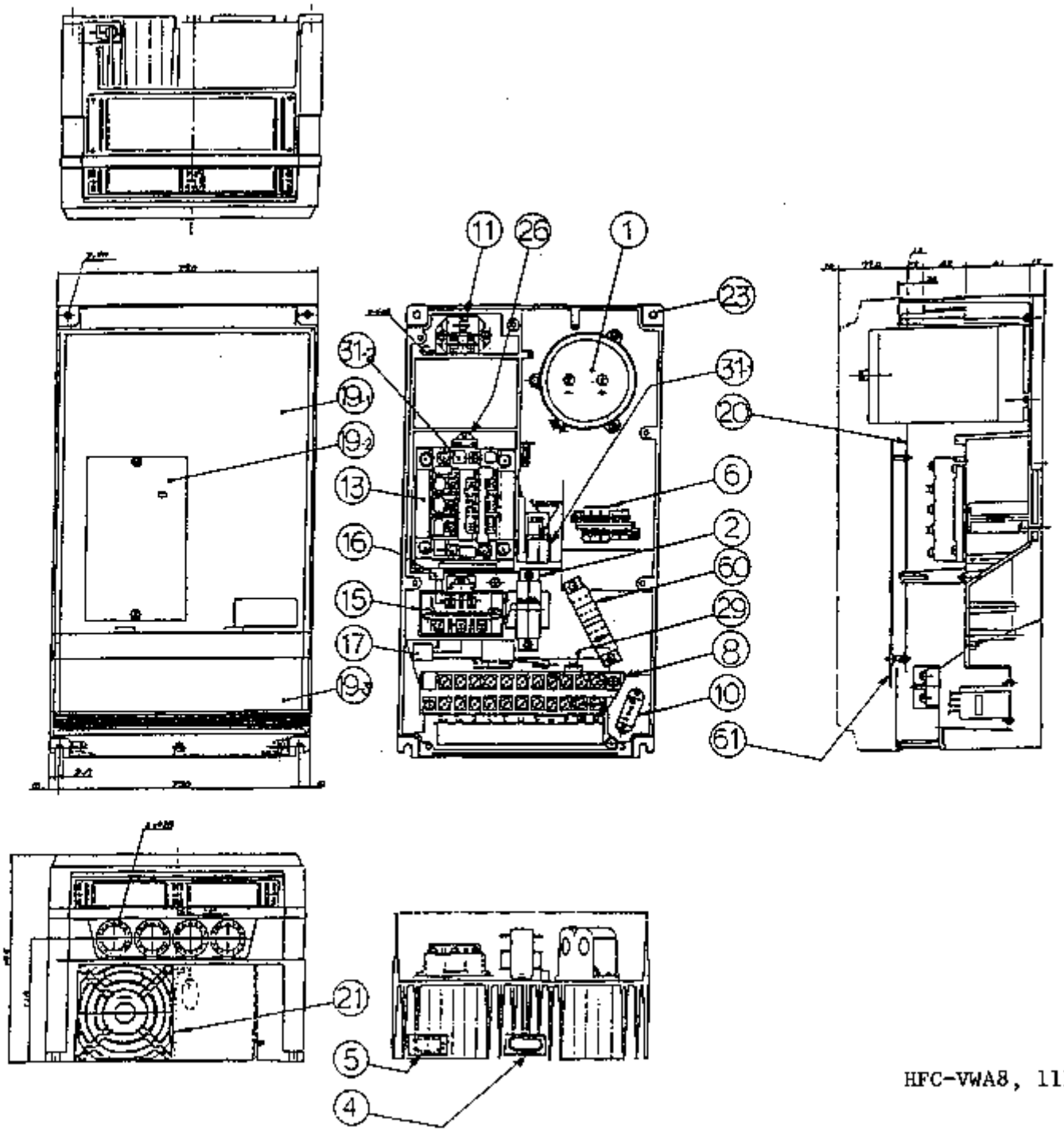
Part No.	Part abbreviation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	1
2	ZCT	Ground fault CT	1
4	RS, RB	Current limiting resistor	1
6	S4	Electromagnetic contactor	1
8	TM	Main circuit terminal block	1
10	R	Cement resistor	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Terminal cover	1
19-3	CV	Front blind cover	1
20-1	FUDO	Air duct (shield plate)	1
20-2	PL	Cable bracket	1
21	FAN	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	1
29	DFB	Flywheel diode	1
31	C10	Snubber capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1
62	PCB	BRD printed circuit board	1
86	PL	Blind cover	1
87	PL	Blind cover	1

HFC-VWA3.5LB2 Structural Diagram 324 3T806654



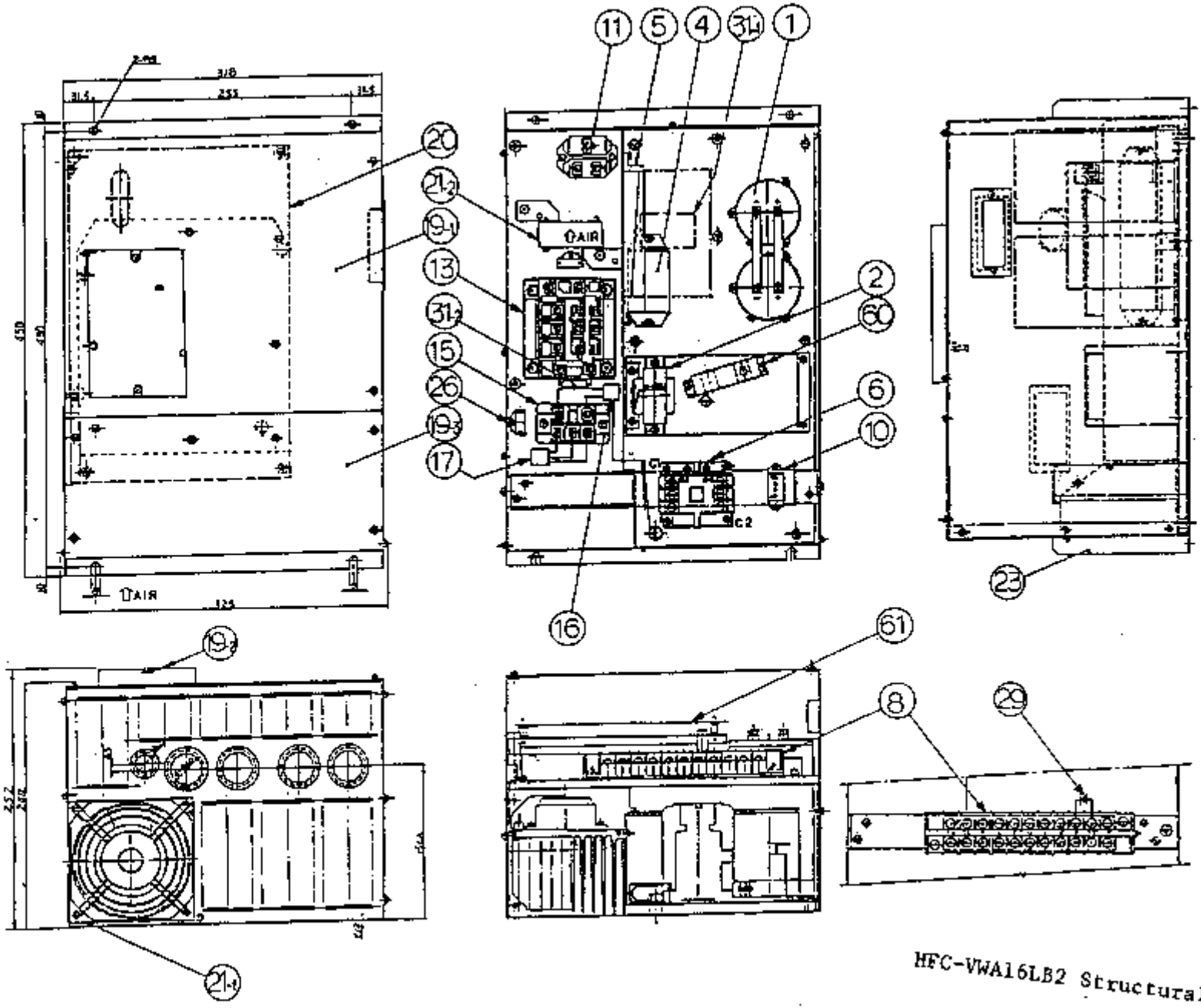
Part No.	Part abbreviation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	1
2	ZCT	Ground fault CT	1
4	RS, RB	Current limiting resistor	1
6	S4	Electromagnetic contactor	1
8	TM	Main circuit terminal block	1
10	R	Cement resistor	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Terminal cover	1
19-3	CV	Front blind cover	1
20-1	FUDO	Air duct (shield plate)	1
20-2	PL	Cable bracket	1
21	FAN	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	1
29	DFB	Flywheel diode	1
31	C10	Snubber capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1
62	PCB	BRD printed circuit board	1

HFC-VWA5.5LB2 Structural Diagram 324 3T806655



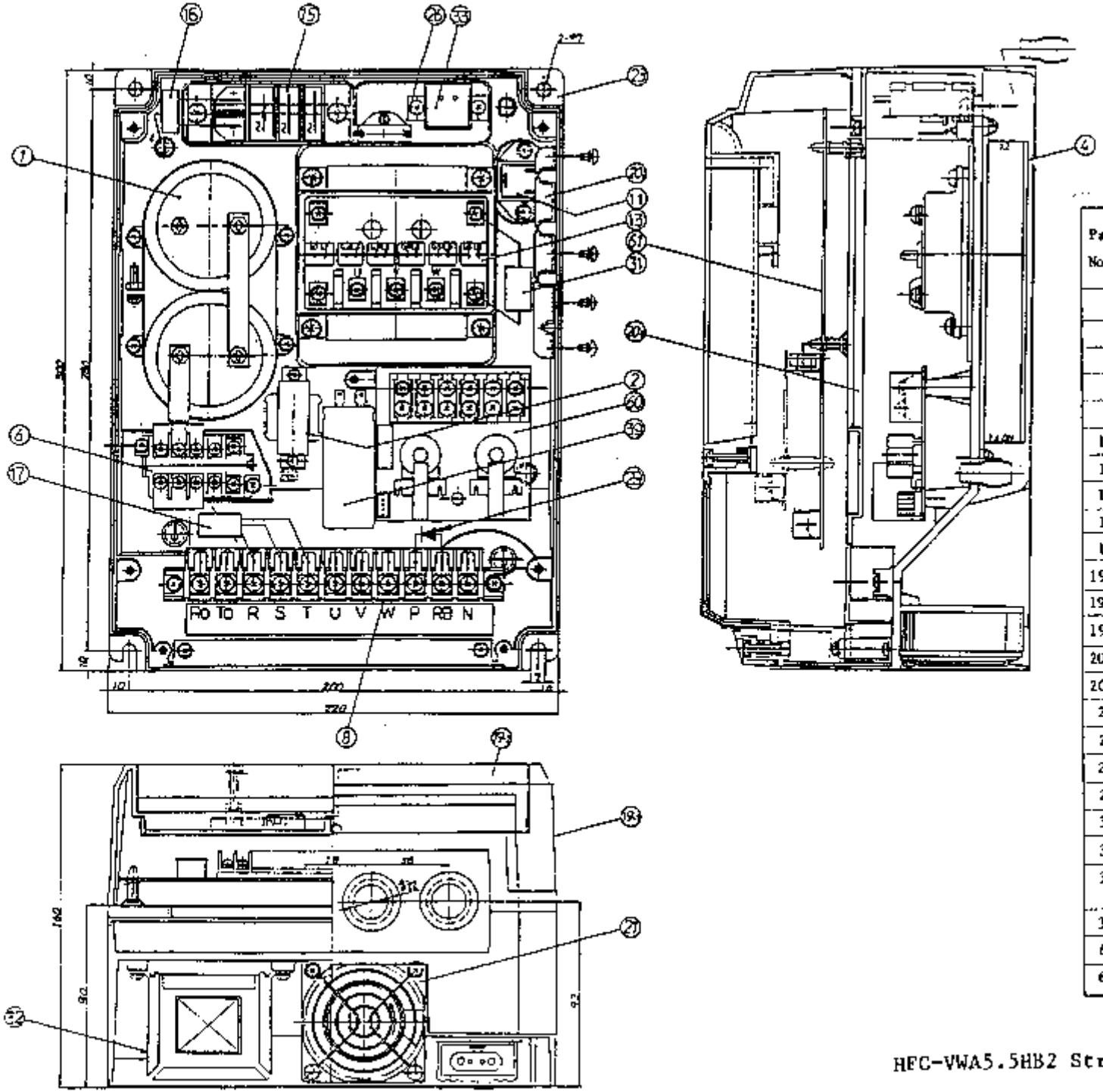
Part No.	Part abbre-viation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	1
2	ZCT	Ground fault CT	1
4	RS	Current limiting resistor	1
5	BRDR	Collected cement resistor	1
6	84	Electromagnetic contactor	1
8	TN	Main terminal block	1
10	R	Cement resistor	1
11	TRS	BRD transistor	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Front blind cover	1
19-3	CV	Terminal cover	1
20	PL	Shielding plate	1
21	FAN	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	2
29	DFB	Flywheel diode	1
31-1	C10	Snubber capacitor	1
31-2	C10A	Snubber capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1

HFC-VWA8, 11LB2 Structural Diagram 3T806873



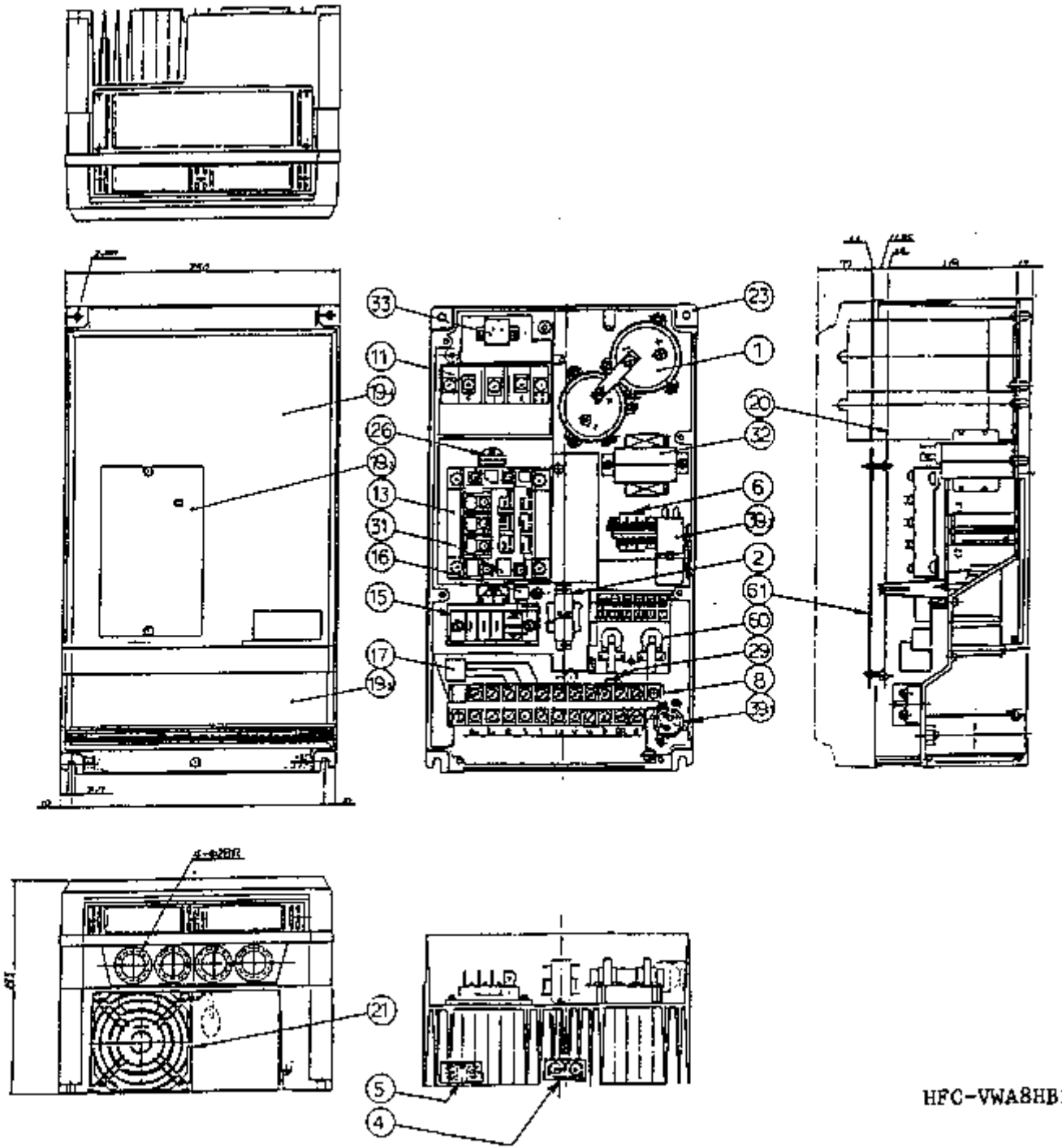
Part No.	Part abbreviation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	2
2	ZCT	Ground fault CT	1
4	RS	Current limiting resistor	1
5	RRDR	Current limiting resistor	1
6	84	Electromagnetic contactor	1
8	TM	Main terminal block	1
10	R	Cement resistor	1
11	TRS	BRD transistor	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Front blind cover	1
19-3	CV	Terminal cover	1
20	PL	Shielding plate	1
21-1	FAN 1	Cooling fan	1
21-2	FAN 2	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	2
29	DFB	Flywheel diode	1
31-1	C10	Snubber capacitor	1
31-2	C10A	Snubber capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1

HFC-VWA16LB2 Structural Diagram 324 3T806874



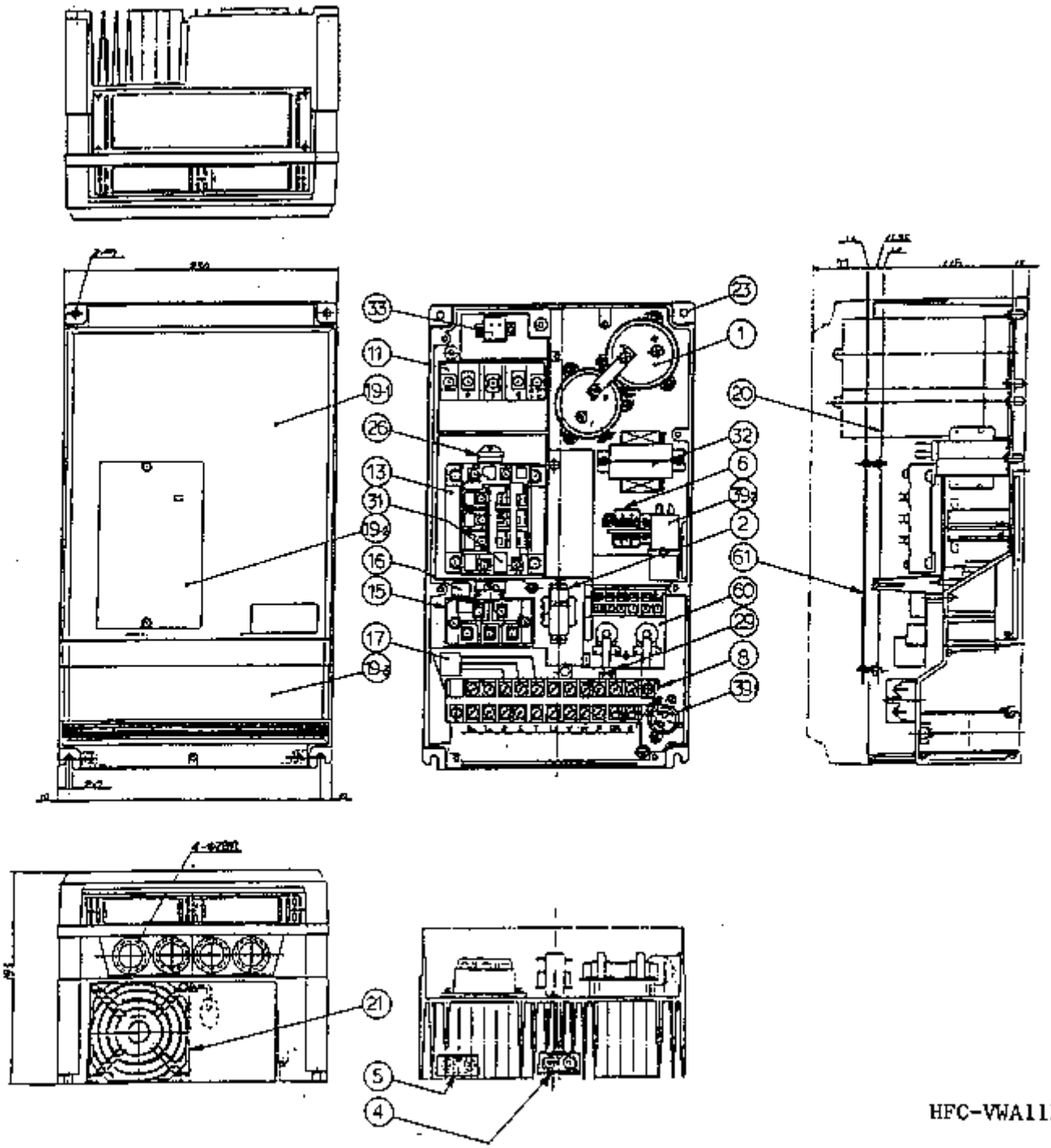
Part No.	Part abbre-viation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	1
2	ZCT	Ground fault CT	1
4	RS, RB	Current limiting resistor	1
6	S4	Electromagnetic contactor	1
8	TM	Main circuit terminal block	1
11	TRS	BRD transistor	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	2NR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Terminal cover	1
19-3	CV	Front blind cover	1
20-1	FUDO	Air duct (shield plate)	1
20-2	PL	Cable bracket	1
21	FAN	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	1
29	DFB	Flywheel diode	1
31	C10	Snubber capacitor	1
32	TRNS	Transformer	1
33	IPR	Instantaneous restarting resistor	1
39	CD	Power supply capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1

HFC-VWA5.5HB2 Structural Diagram 324 3T807403



Part No.	Part abbreviation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	2
2	ZCT	Ground fault CT	1
4	RS	Current limiting resistor	1
5	BRDR	Braking resistor	1
6	84	Electromagnetic contactor	1
8	TM	Main terminal block	1
11	TRB	BRD transistor	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
27	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Front blind cover	1
19-3	CV	Terminal cover	1
20	PL	Shielding plate	1
21	FAN	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	2
29	DFB	Flywheel diode	1
31	CIO	Snubber capacitor	1
32	TRNS	Transformer	1
33	IPR	Instantaneous restarting resistor	1
39-1	CD1	Power supply capacitor	1
39-2	CD2	Power supply capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1

HFC-VWA8HB2 Structural Diagram 324 3T807404



Part No.	Part abbreviation	Part name	Qty. used per unit
1	CB	Smoothing capacitor	2
2	ZCT	Ground fault CT	1
4	RS	Current limiting resistor	1
5	BRDR	Braking resistor	1
6	84	Electromagnetic contactor	1
8	TM	Main terminal block	1
11	TRS	BRD transistor	1
13	PM	Inverter module	1
15	DM	Diode module	1
16	C	Snubber capacitor	1
17	ZNR	Surge killer	1
19-1	CV	Front cover	1
19-2	CV	Front blind cover	1
19-3	CV	Terminal cover	1
20	PL	Shielding plate	1
21	FAN	Cooling fan	1
23	CS	Case	1
26	THR	Thermal relay	2
29	DFB	Flywheel diode	1
31	CIO	Snubber capacitor	1
32	TRNS	Transformer	1
33	IPR	Instantaneous restarting resistor	1
39-1	CD1	Power supply capacitor	1
39-2	CD2	Power supply capacitor	1
60	CT2	CT (AC side)	1
61	PCB	Main printed circuit board	1

HFC-VWA11HB2 Structural Diagram 324 3T807405