HITACHI INVERTER

HFC-VWS$_3$ EH SERIES

INSTRUCTION MANUAL

Thank you very much for your purchase of Hitachi Inverter HFC-VWS$_3$ Series. This Instruction Manual covers the handling and maintenance, etc. for the HFC-VWS$_3$ 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 operator of the Hitachi Inverter.

HITACHI

NB408BX

PRECAUTIONS

CAUTION 1: These instructions should be read and clealy understood before working on the HFC-VWS3 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-VWS3 sereies 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 and injury to personnel should a single point failure occur.

DANGER HIGH VOLTAGE 

Motor control equipment and electronic controllers are connected to hazardous line voltage. When servicing drives and electronic controllers, there may be exposed components with their cases and protrusions at or above line potential. Extreme care should be taken to protect against shock. Stand on an insulating pad and make it a habit to use only one hand when checking components. Always work with another person in case an emergency occurs. Disconnect power whenever possible to check controllers or to perform maintenance. Be sure equipment is properly grounded. Wear safety glasses whenever working on an electronic controller or electrical rotating equipment.

CAUTION:

Rotating shafts and above ground electrical potentials can be hazardous. Therefore, it is strongly recommended that all electrical work conform to National Electrical Codes and local regulations. Installation, alignment and maintenance should be performed only by qualified personnel.

Factory recommended test procedures, included in the instruction manual, should be followed. Always disconnect electrical power before working on the unit.

CONTENTS

1. INSPECTION UPON UNPACKING

Before installation and wiring, check to see:

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

(2) The product is as ordered (check the type name, voltage and frequency); and

(3) A set of inverter unit and instruction manual are contained together in the package upon unpacking.

For any irregularity, contact your sales shop where purchased immediately.

2. PRECAUTIONS

In operating the HFC-VWS$_3$ Series inverter, first check that there is no problem on the following: inadequate operation can result in damage to the inverter.

2.1 Environment around installation site and installation surface

(1) Avoid a high temperature, high humidity, easy-to-dew ambient environment and a place exposed to dust or dirt, corrosive gas and coolant mist, and set the unit in a well-ventilated room not exposed to direct sunlight.

(2) Avoid a place subjected to substantial vibration.

(3) When installing the unit within the box, remove the terminal cover and blind cover (refer to Fig. 1). In this case, the unit can be operated within the range of -10 to 50°C.

(4) Use a nonflammable material, such a steel sheet on the wall for installation. (The rear side will generate heat.)

(5) Install the unit always vertically with a marginal spacing around.

2.2 Check that the input power supply is 1-phase 220 to 240 V 50 Hz, 60 Hz for 200 V class, and 3-phase 380 to 415 V 50 Hz, 400 to 460 V 60 Hz for 400 V class.

2.3 Never supply single-phase input for 400 V class.

2.4 Connection

(1) Be sure to connect the power supply to L1.N or L1.L2.L3 (input terminal), and the motor to U.V.W (output terminal).
(Wrong connections damage to the unit.)

(2) Be sure to ground an earth terminal (PE) for personnel safety.

(3) For operation start and stop, use [FWD RUN], [REV RUN], [STOP] and FW/RV terminals. Never turn ON/OFF input power supply.

2.5 Maintenance and adjustment

(1) After cutting off power supply, do not touch the internal parts until the display on the digital operation panel goes off for 200 V class, and until the LED at the right side of terminal goes off after the terminal cover is removed for

400V class. (Since the capacitor charged voltage is still present, it is dangerous.)

(2) Static electricity may cause breakdown to MCU and IC on PC board. Handle these parts after grounding the work bench, soldering iron and person surely.

2.6 Insulation resistance test and withstand voltage test

Special care should be execised for the insulation resistance and withstand voltage tests. When conducting these tests actually, be sure to refer to "Insulation Resistance and Withstand Tests" given under section 11.4 (g).

2.7 Storage of setting data

The soft memory element is used to store data input from the digital operation panel when the inverter power supply is cut off. Turn power OFF once to store the data in memory when the setting data have been changed. It should be noted that the changed data are not stored in memory if reset is performed before power OFF.
Refer to page 74 how to return the setting data back to that before shipment and see page 94 regarding life of soft memory element.

2.8 Record of setting data

It is recommended to fill the setting data out the data sheet shown in appendix for service and maintenance.

2.9 Standard V/F setting: 50 Hz max. constant torque

See page 62, 75 when output frequency is set to 50 Hz max.

3. STANDARD SPECIFICATIONS

The standard specifications of HFC-VWS$_3$ Series are as shown in Table 1 and 2 below.

Table 1 Standard Specifications (1)

Item			VWS$_3$ Series Common SPEC	
Input power supply			1-phase 220∿240V±10%, 50/60 Hz±5%	3-phase 380∿415/400∿460V±10%, 50/60 Hz±5%
Output voltage (Max.) 3-phase			220∿240V	380∿460V
Control system			Voltage source type, sine coded PWM	
Output frequency range			1 ∿ 144 Hz (0.5 Hz start)	
Frequency accuracy			±0.5% (25±10°C) of the maximum frequency	
Voltage/frequency characteristics			**32 types selectable**	
Overcurrent capacity			**150%, 60 seconds (every 10 minutes)**	
Acceleration/deceleration time (Soft start/stop)			**Individual setting available** **Linear acceleration/deceleration: 0.1 ∿ 2999.9 seconds** **Curved acceleration/deceleration: 0.1 ∿ 230 seconds**	
Slip compensation			Approx. 1.5% (at based frequency) under condition of V/F constant and above 15 Hz	
Torque boost			Variable setting available	
Frequency resolution			0.01 Hz	
Braking torque		**Regenerative** braking	**Approx.** 10 ∿ 20% (Regenerative braking by feedback to capacitor)	
		Dynamic DC braking	Available below the minimum frequency (Minimum frequency, braking time and brake are adjustable.)	
Input signal	Speed setting	Digital operation panel	▶ ▲ ▼ Key operation	
		External signal	500 ∿ 2 KΩ potentiometer, DC 0 ∿ 5V, DC 0 ∿ 10V (Input impedance 0 ∿ 5V: 15 KΩ, 0 ∿ 10V: 30 KΩ), 4 ∿ 20 mA (Input impedance 250 Ω)	
	Forward/reverse operation stop	Digital operation panel	FWD RUN : Forward operation REV RUN : Reverse operation STOP : Stop operation	
		External signal	Forward operation/stop (normally open 1a contact command) Reverse operation/stop (1a contact command)	
	Reset		Fault reset, instantaneous cut-off of output (1a contact command)	
	Free-run stop		Instantaneous cut-off of output (1b contact command)	
	Jogging operation		Adjustable between 0.5 and 9.9 Hz (1a contact command)	
	Multistage speed operation		Up to 4 stages can be set up (2a contact command)	

Item		VWS$_3$ Series Common SPEC
Output signal	Frequency monitor	Pulse duty control output (Digital frequency counter, analog meter: 0 to 10V DC, 1 mA full scale connectable)
	Fault alarm relay	OFF when the inverter is abnormal or without input power supply (1c contact output)
Protective function	Overcurrent	Individual LCD display of overcurrent at acceleration, operation and deceleration
	Overvoltage	Trip at approx. 400V of converter output voltage (200V class), approx. 800V (400V class)
	Overload	Protection using electronic thermal relay (Settable to 50 to 100%)
	Fin overheat	Protection using thermal relay (Refer to Note 4.)
	Undervoltage	Trip at less than 150 to 160V of input voltage (200V class) / Trip at less than V1 of input voltage. V1: 280 to 320V (400V class: up to 75HF3EH), 320 to 360V (400V class: 100 to 180HF3EH)
	Instantaneous power failure	Operation continues for 15 ms or less power failure (When restart function is selected, restart is possible in 0.3 sec.) See Note 6.
	Stall prevention	Prevention of stall at overcurrent and overvoltage
	Overload limit	Inverter output current is detected, and current limit control is performed.
	Ground fault protection	Refer to Note 5.
Optional function	Relay output of frequency arrival signal	Contact OFF at frequency arrival (1b contact output)
	Relay output of running signal	Contact ON during running (1a contact output)
	Speed setting signal	0 ∿ 20 mA (Input impedance 250 Ω)
	Inverter output current signal	Output with DC voltage (4V DC output at inverter rated current)
	DC brake external command	DC braking operation with 1a contact command
General specification	Ambient temperature	-10 ∿ 40°C (33 - 180HF3E: -10 ∿ 50°C) (Without terminal cover : -10 ∿ 50°C, storage temperature : -20 ∿ 60°C)
	Humidity	20 ∿ 90% RH (No dew condensation allowed)
	Vibration	See Note 7) As per JISC0911 (1984)
	Operating site	1,000m or less in altitude, indoors (place free of corrosive gas and dust or dirt)
	External color	Munsell 5Y5/1, (1.5 ∿ 3.5SF3EH, 2.5 ∿ 11HF3EH diecast cases are black corresponding to Munsell N3.)

Table 2 Standard Specifications (2)

(200V Class)

VWS_3 Series Specifications							
Type (Model Abbreviation)	Protective Structure	Capacity (kVA)		Rated Ouput Current (A)	Max. Applicable Motor(KW)	Cooling System	Approx. Weight (kg)
		220V	240V				
1.5SF3EH	Semi-enclosed type (See Note 8.) (IP20)	1.9	2.1	5	0.75	Self-cooling	5.5
2.5SF3EH		2.9	3.1	7.5	1.5		6.0
3.5SF3EH		4.0	4.4	10.5	2.2	Forced air cooling	6.5

(400V Class)

VWS_3 Series Specifications							
Type (Model Abbreviation)	Protective Structure	Capacity (kVA)		Rated Output Current (A)	Max. Applicable Motor(KW)	Cooling System	Approx. Weight (kg)
		380V	415V				
2.5HF3EH	Semi-enclosed type (IP20)	2.5	2.7	3.8	1.5	Self-cooling	7.5
3.5HF3EH		3.5	3.8	5.3	2.2		7.5
5.5HF3EH		5.7	6.2	8.6	4.0		8.5
8HF3EH		8.6	9.3	13	5.5	Forced air cooling	14.5
11HF3EH		11	12	16	7.5		15
16HF3EH		15	17	23	11		22.5
22HF3EH		21	23	32	15		24.5
33HF3E	Open type (IP00)	32	35	48	22		30
40HF3E		38	42	58	30		40
50HF3E		49	54	75	37		48
60HF3E		59	65	90	45		56
75HF3E		72	79	110	55		58
100HF3E		98	107	149	75		105
120HF3E		116	126	176	90		105
150HF3E		143	156	217	110		150
180HF3E		171	187	260	132		160

Note 1) The applicable motor shown in the table above refers to Hitachi Standard 3-phase 4-pole squirrel-cage motor. When other types of motors are used, select suitable ones so that motor current does not exceed the inverter rated current value during inverter operation.

Note 2) When a general-purpose motor is operated at over 60Hz, contact the motor manufacturer.

Note 3) Output voltage also drops when supply voltage drops.

Note 4) This function is not provided for models (1.5 to 2.5SF3EH, 2.5 to 5.5HF3EH) not provided with a cooling fan.

Note 5) The ground fault protection circuit detects the output unbalance current caused by the short circuit between inverter output lines and the ground. As the detection level is nearly inverter rated current, the person cannot be saved, just inverter protection against its damage. Avoiding the electric shock and death, put the earth leakage current breaker on the input power supply lines. The start-up druing motor free running may cause the ground fault trip by the transient current.

Note 6) The restart function is standard equipped; however, it should be noted that the allowable instantaneous power failure time is 0.3 second.

Note 7) The amplitude by vibration is 0.5G (10 to 55 Hz) for 1.5 to 3.5SF3EH and 2.5 to 11HF3EH and 0.2G (10 to 55 Hz) for 16 to 22HF3EH and 33 to 180HF3EH.

Note 8) The protective system conforms to JEM1030-1977. A rubber bushing is inserted into the wiring hole. When IP20 protection is required, provide a conduit for wiring to block the hole.

4. INSTALLATION

4.1 Installation precautions

(1) When some looseness is found on the installation surface, place a plate under the inverter mounting legs to eliminate the looseness before installation. When the inverter is installed in loose conditions, strain caused by such an installation adversely affects the main circuit element, possibly causing damage to the unit.

(2) For the mounting wall surface, use a nonflammable material, such a steel sheet to avoid personal injury. and a fire. (The heating element is located at the rear.)

(3) Since the heat of approx. 5% of the rated capacity is generated from the inverter, special care should be given to the ventilation when the inverter is built in the box, for example.

(4) When a plurality of inverters are stored within the box, arrange those units in line. The ambient temperature of inverter may increase, and fin overheat may trip the inverter if the units are stacked inside.

(5) When installing the inverter inside the box, remove the terminal cover at the front lower part. (Refer to Fig. 1.)

(6) The roof cover is recommended to install above the top ventilating cover of the inverter with the specified space so that the conductive materials of 3 mm or smaller size cannot enter the inside of the inverter. Such the conductive materials inside may cause the inverter damage.

4.2 Installation direction and space

Be sure to install the HFC-VWS$_3$ inverter vertically for cooling.

Further, as shown in Fig. 2 below, always keep the unit away from other parts and the wall.

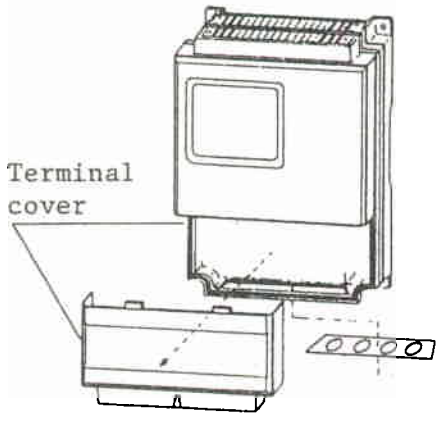


Fig. 1 Inverter Appearance
(For 1.5 ∿ 3.5SF3EH, 2.5 ∿ 11HF3EH)

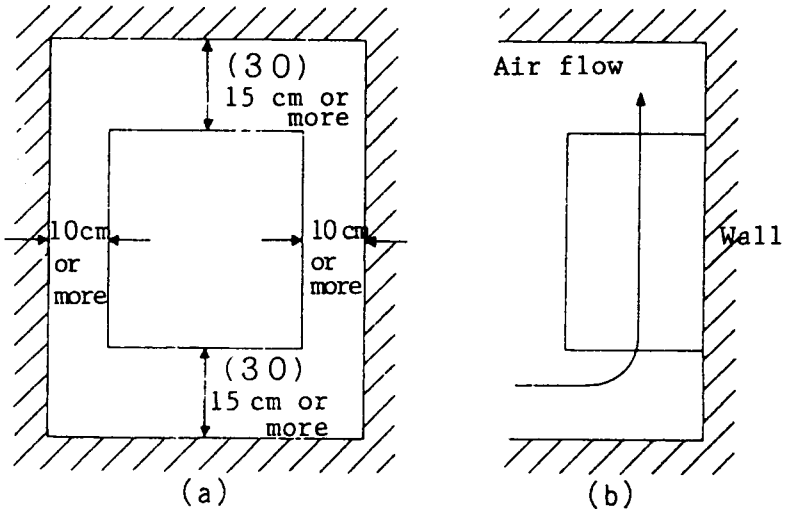


Fig. 2 Inverter Installation
(Values in parenthese apply to 50HF3EH or greater.)

5. CIRCUIT CONFIGURATION AND PC BOARD LOCATION

5.1 PC board location

The HFC-VWS$_3$ PC board location and its circuit configuration are shown in Fig. 3 and Fig. 4 below respectively.

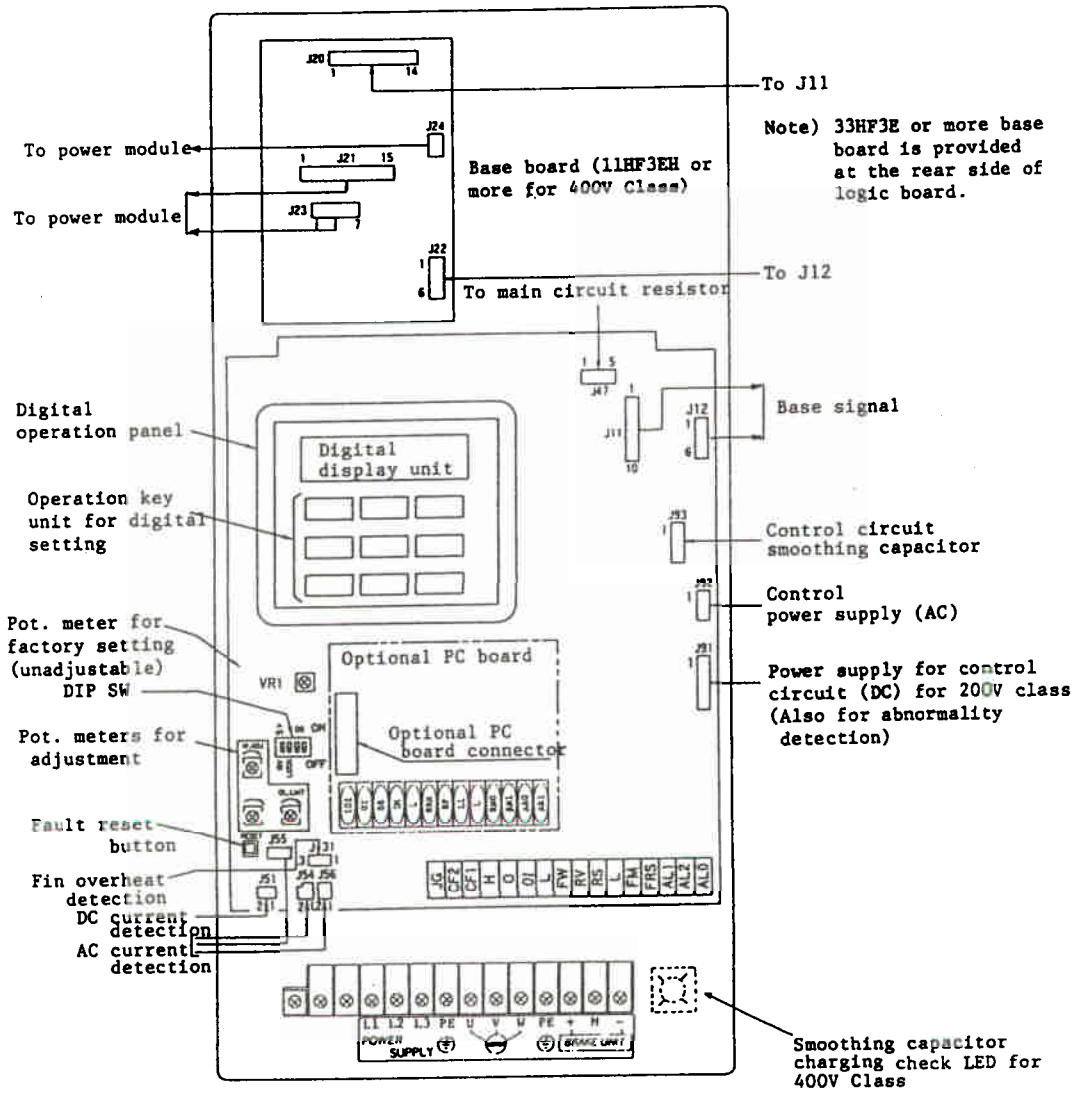
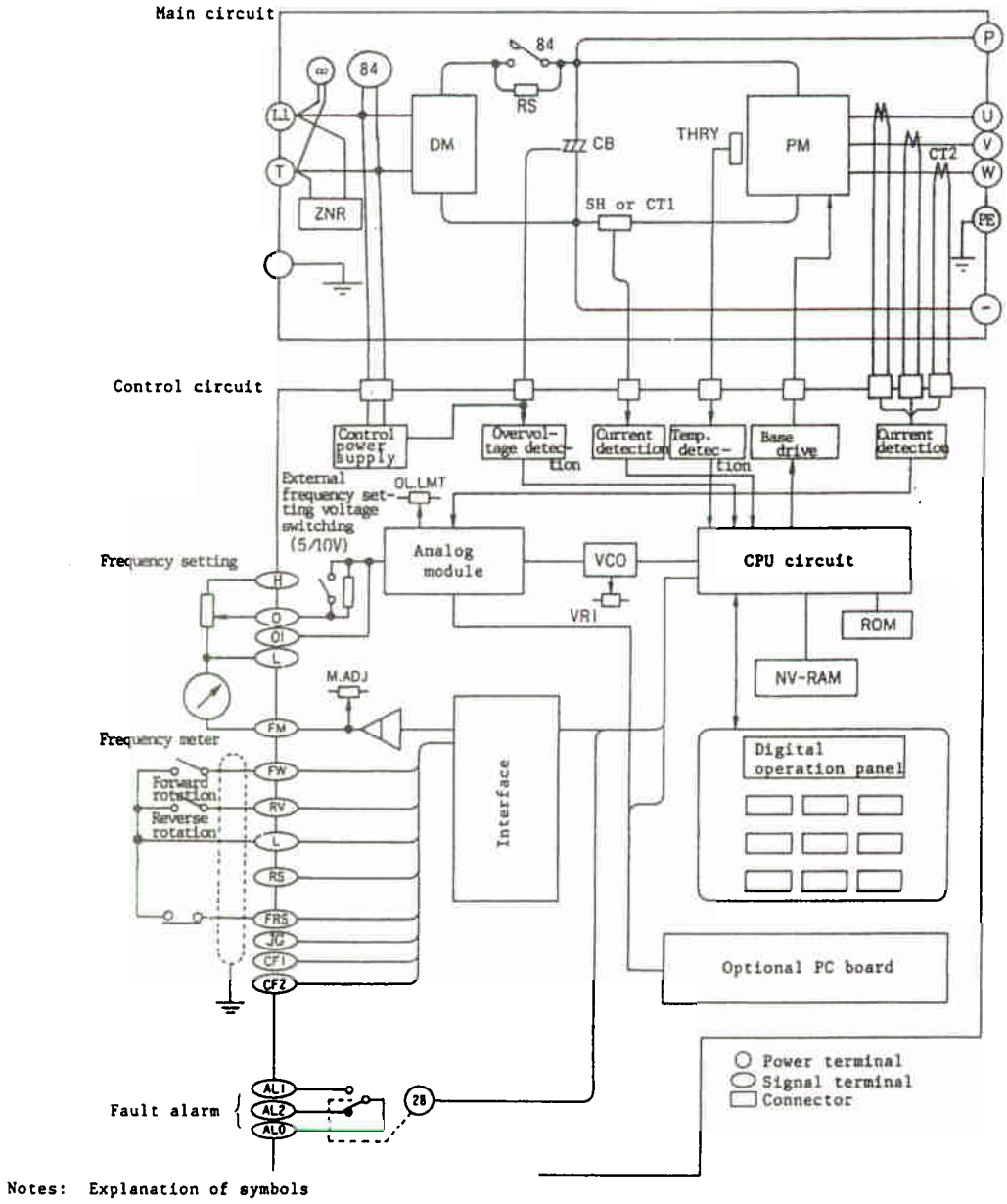


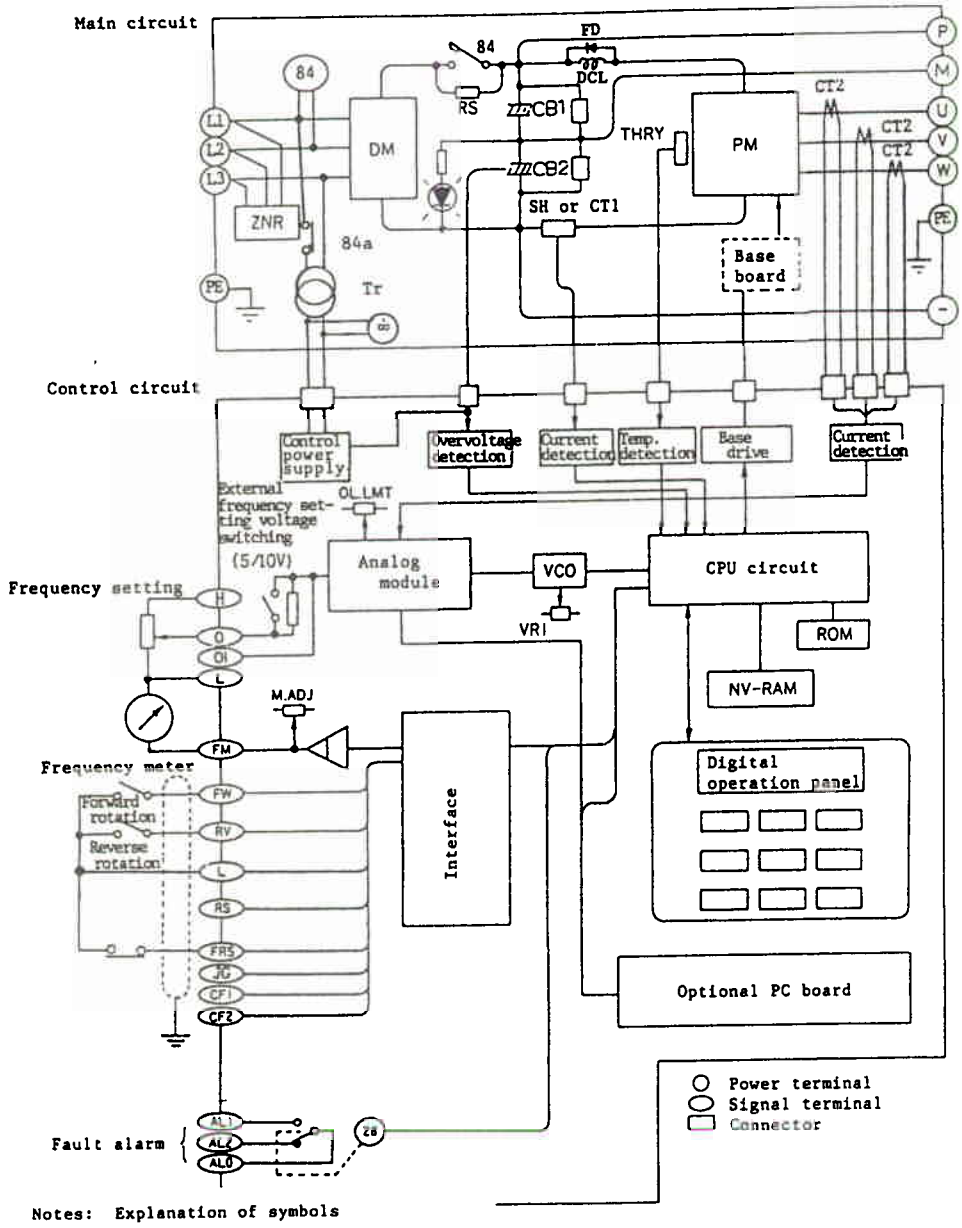
Fig. 3 PC Board Location (For 11HF3EH)



Notes: Explanation of symbols

- ○ (84) : Electromagnetic contactor (Not used to 1.5SF3EH)
- ○ (∞) : Fan (3.5SF3EH)
- ○ D M: Diode module (Converter module)
- ○ C B: Smoothing capacitor
- ○ (28) : Fault alarm relay
- ○ ZNR : Surge absorber
- ○ S H: Shunt resistor
- ○ R S: Current limiting resistor
- ○ P M: Power module (Inverter module)
- ○ THRY: Thermal relay
- ○ CT2 : Current transformer

Fig. 4 (a) Circuit Configuration (For 200V Class)



Notes: Explanation of symbols

- 84 : Electromagnetic contactor
- Tr : Transformer (Only for 400V Class)
- D M : Diode module (Converter module)
- C B : Smoothing capacitor
- 28 : Fault alarm relay
- ZNR : Surge absorber (Provided on the base board for 33HF3EH or more)
- ∞ : Fan (8HF3EH or more)
- FD : Fly-wheel diode
- : Base board (11HF3EH or more)
- S H : Shunt resistor (5.5HF3EH or less)
- CT1 : Current transformer (8HF3EH or more)
- R S : Current limiting resistor
- P M : Power module (Inverter module)
- THRY : Thermal relay
- CT2 : Current transformer
- : Smoothing capacitor charging check LED
- DCL : DC reactor

Fig. 4 (b) Circuit Configuration (For 400V Class: 22HF3EH or less)

5.2 Circuit description

5.2.1 Main circuit

(1) 3-phase AC input voltage is converted to DC voltage through full-wave rectifying diode module DM.

(2) DC voltage thus full wave rectified is smoothed through smoothing capacitor CB.

(3) DC voltage thus smoothed is inversely converted to AC voltage through inverter module PM. This circuit outputs a waveform similar to a sine wave due to sine-wave modulation (sine coded PWM control) by changing the pulse width of output voltage during inverse conversion.

5.2.2 Control circuit

(1) CPU circuit

- The output voltage/output frequency (V/F) characteristics conforming to motor characteristics are obtained. (32 types of V/F characteristics are built in.)
- This circuit allows soft start and soft stop of output frequency command linearly (or curved) preset.
- Sine coded PWM control for obtaining inverter output voltage is performed.
- Electronic thermal characteristics and overload limiting characteristics are obtained by means of output current detecting signals.

- This circuit receives operation, stop, forward operation, reverse operation and multistage speed commands for execution.
- This circuit commands the display on the digital operation panel.
- Stall is prevented when overcurrent and overvoltage occur.

(2) The analog module unit is an interface circuit for transmitting analog frequency command and analog detecting signal to CPU.

(3) The interface circuit unit transmits to CPU various external commands, including operation/stop commands, multistage speed command, jogging operation command and reset command given by a digital signal.

(4) The base drive circuit unit, receiving a sine coded PWM signal controlled by CPU, drives the inverter module.

(5) The digital operation panel unit allows various displays, using a 16-digit LCD, and also has a built-in control circuit which gives operation/stop instructions.

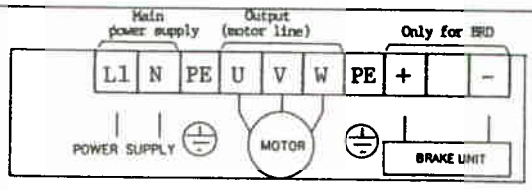
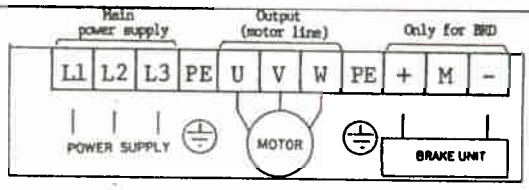
5.2.3 Protection description

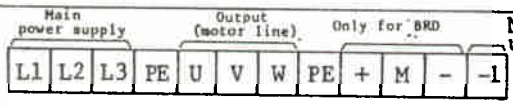
For HFC-VWS$_3$ protecting description and display contents, refer to the "Troubleshooting and Message Contents" paragraph given under para. 12.

6. WIRING AND ADJUSTMENT

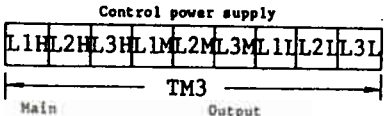
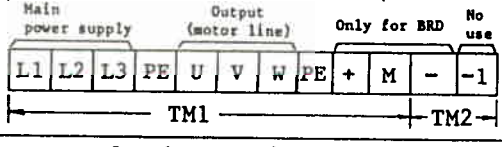
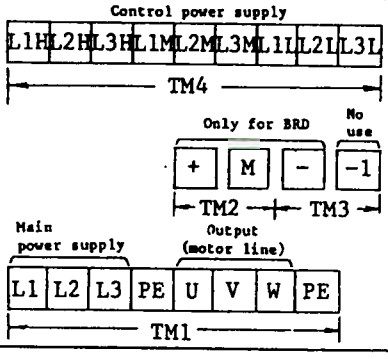
6.1 Terminals description

The main circuit terminal location and the description of terminals are shown in Fig. 5 and Table 3 respectively.

Model	Terminal Location	Terminal Screw Diameter	Terminal Width(mm)
1.5 ∿ 3.5SF3EH		European terminal	* Max. 5.5 mm²
2.5 ∿ 11HF3EH		European terminal	* Max. 5.5 mm²
16 ∿ 22HF3EH		European terminal	* Max. 8 mm²

Model	Terminal Location			
33HF3EH		TM1	TM2	
40,50HF3EH		TM1	TM2	
60,75HF3EH		TM1	TM2	

Terminal	Screw Diameter	Terminal Width(mm)	
TM1	TM2	TM1	TM2
M5	M6	13	17
M6	M8	17	23
M8	M8	23	23

Model	Terminal Location	Terminal	Screw Diameter	Terminal Width(mm)
100HF3EH		TM1	M8	23
		TM2	M10	33
		TM3	M3	8.5
120 ∿ 150HF3EH		TM1	M10	33
		TM2	M10	33
		TM3	M3	8.5
180HF3EH		TM1	M12	52
		TM2	M10	Individual
		TM3	M12	Individual
		TM4	M3	8.5

* × 3: Cross section area
PE : Ground

Fig. 5 Main Circuit Terminal Location

Table 3 Description of Terminals

	Terminal Code	Terminal Name	Function
Main circuit terminal	L1, N L1, L2, L3	Commercial power supply input terminal	1 φ 220 ∿ 240V/50 Hz, 60 Hz 3 φ 380 ∿ 415V/50 Hz, 400 ∿ 460V/60 Hz
	U, V, W	Inverter output terminal	Motor connecting terminal
	+, M, -	DC voltage terminal	Regenerative braking unit connecting terminal
	PE	Earth terminal	Grounding
	L1H, L2H, L3H L1M, L2M, L3M L1L, L2L, L3L	Control power supply input terminal	Only for 100HF3EH or greater L1H, L2H, L3H ..... 460V input L1M, L2M, L3M ..... 415 to 440V input L1L, L2L, L3L ..... 380 to 400V input
	-1	-	Not used (Never connect.)
Control circuit terminal	JG	Jogging terminal	Contact (close): jogging operation
	CF2	Multistage speed terminal	Contact (close): multistage speed operation
	CF1		
	H	Ref. voltage terminal for frequency setting	DC 10V
	O	Terminal for frequency setting	DC 0 ∿ 10V, DC 0 ∿ 5V (Changeable with DS switch) (Input impedance, 0 ∿ 5V (15 kΩ), 0 ∿ 10V (30 kΩ)
	OI	Terminal for frequency setting	4 ∿ 20 mA (Input impedance 250 Ω)
	L	Common terminal	Common of control terminal (not for grounding)
	FW	Forward operation/ stop terminal	Contact (close): forward operation Contact (open) : stop
	RV	Reverse operation/ stop terminal	Contact (close): reverse operation Contact (open) : stop
	RS	Fault reset terminal	Contact (close): fault signal reset
	L	Common terminal	Control terminal·common (not for grounding)
	FM	Frequency monitor terminal	Digital frequency counter or analog meter (0 ∿ 10V 1 mA full scale, impedance 10 ∿ 22 kΩ) selectable
	FRS	Free-run stop terminal	Contact (open): inverter stop, motor free-run stop (No fault is reset.)
	AL1	Fault alarm contact terminal	Trip, power off: AL0 - AL1 (open) AL0 - AL2 (close) Contact rating: AC 250V 2.5A (resistive load) 0.2A (COS φ 0.4) DC 30V 3A (resistive load) 0.7A (COS φ 0.4)
	AL2		
	AL0		

6.2 Wiring equipment

Select the wiring equipment and wiring size, refer to Table 4 below. It should be however noted that the wiring equipment and wiring size may change, depending on the wiring length and power capacity.

Table 4 Standard Applicable Equipment

(200V Class)

Applicable Motor (4P, KW)	Inverter Model	Wiring		Applicable Equipment			
		Power Line L1, L2 L3, N, PE U, V, W +, H, -	Signal Line JG, CF2 CF1, H, O, OI, L, FW, RV, RS FM, FRS	Control Line AL1 AL2 AL0	Circuit Breaker (MCB)	Electro-magnetic Contactor (Mg)	Thermal Relay (RC Value)
0.4	VWS1.5SF3EH	2 mm² or more	Shielded line for 0.75 mm² or more	2 mm² or more	F-30B(15A)	H20	TR20-1E(2.4A)
0.75	VWS1.5SF3EH	2 mm²		2 mm²	F-30B(15A)	H20	TR20-1E(3.8A)
1.5	VWS2.5SF3EH	2 mm²		2 mm²	F-30B(20A)	H20	TR20-1E(6.8A)
2.2	VWS3.5SF3EH	2 mm²		2 mm²	F-30B(30A)	H20	TR20-1E(9A)
1.5	VWS2.5HF3EH	2 mm²		2 mm²	F-50F(15A)	H10	TR20-1E(3.0A)
2.2	VWS3.5HF3EH	2 mm²		2 mm² or more	F-50F(15A)	H20	TR20-1E(3.8A)
3.7	VWS5.5HF3EH	2 mm²		2 mm²	F-50F(15A)	H20	TR20-1E(6.8A)
5.5	VWS8HF3EH	3.5 mm²		2 mm²	F-50F(30A)	H20	TR20-1E(9A)
7.5	VWS11HF3EH	3.5 mm²		2 mm²	F-50F(30A)	H20	TR20-1E(15A)
11	VWS16HF3EH	5.5 mm²		2 mm²	F-50F(50A)	H25	TR20-1E(20A)
15	VWS22HF3EH	8 mm²		2 mm²	F-50F(50A)	H35	TR40-1E(28A)
18.5	VWS33HF3EH	14 mm²		2 mm²	F-100G(75A)	H50	TR40-1E(40A)
22	VWS33HF3EH	14 mm²		2 mm²	F-100G(75A)	H50	TR40-1E(40A)
30	VWS40HF3EH	22 mm²		2 mm²	F-100G(75A)	K50N-EP	TR100-1E(55A)
37	VWS50HF3EH	22 mm²		2 mm²	F-225F(125A)	K60N-EP	TR100-1E(67A)
45	VWS60HF3EH	38 mm²		2 mm²	F-225F(150A)	K100N-EP	TR100-1E(80A)
55	VWS75HF3EH	60 mm²		2 mm² or more	F-225F(200A)	K120N-EP	TR100-1E(105A)
75	VWS100HF3EH	60 mm²		2 mm²	F-225F(200A)	K150N-EP	TR100-1E(130A)
90	VWS120HF3EH	100 mm²		2 mm²	F-225F(225A)	K200N-EP	TR20-1E(1.4A) with CT-100N
110	VWS150HF3EH	120 mm²		2 mm²	F-400F(300A)	K250N-EP	TR20-1E(2.4A) with CT-100N
132	VWS180HF3EH	150 mm² or more	Shielded line for 0.75 mm or more	2 mm² or more	F-400F(350A)	K300N-EP	TR20-1E(2.4A) with CT-100N

Note 1) The applicable equipment in the table above refers to Hitachi standard 3-phase 4-pole squirrel-cage motor.

Note 2) Select a circuit breaker while studying the breaking capacity.

Note 3) Adjust the RC value of thermal relay to the rated current value of motor.

Note 4) The inverter leak current is approx. 3 mA/unit. (Not including the wiring)

Note 5) No thermal relay is required when the standard applicable motor (Hitachi standard 3-phase 4-pole squirrel cage motor) is used at more than 10 Hz, less than 60 Hz.

Note 6) Select the breaking capacity with consideration given to the power supply and wiring system.

6.3 Wiring precautions

For wiring connections, note the following.

(1) If an electromagnetic contactor is inserted between the inverter and motor for start and stop, a rush start current flow is caused, letting excessive current flow, thereby giving rise to overcurrent tripping of the inverter. Repeated operation may damage the element; therefore, avoid inserting an electromagnetic contactor where applicable. When it is used, be sure to turn it ON after both the inverter and motor stop.

(2) Absolutely avoid connecting a phase-advance capacitor and surge absorber between the inverter and motor.

(3) Insert a circuit breaker into the power supply side to protect the wires.

Do not use a blade type switch only instead of the circuit breaker. Phase fault may result.

(4) Use a shielded wire for a signal line, and process it as shown in Fig. 6 below. The wire length should be less than 20m.

If the wire length unavoidably exceeds 20m, use optional VX application controller CVD-E (signal isolation converter).

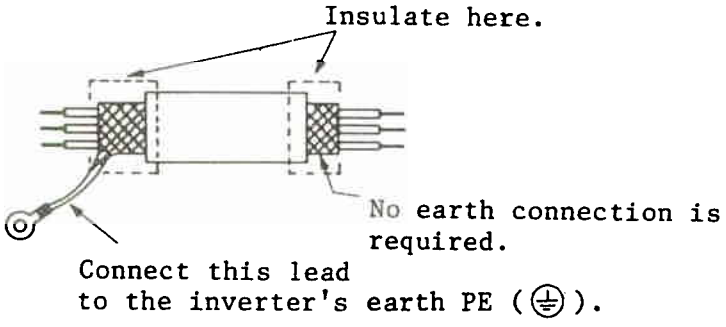


Fig. 6 Shield Processing

(5) Select a signal line switch or relay for weak current which can be used at 12V DC, 3 mA for control circuit terminals except for AL1, AL2 and ALO.

(6) Separate the inverter signal line from the power line as shown in Fig. 7 below. If cross-over is unavoidable, however, cross them perpendicularly each other.

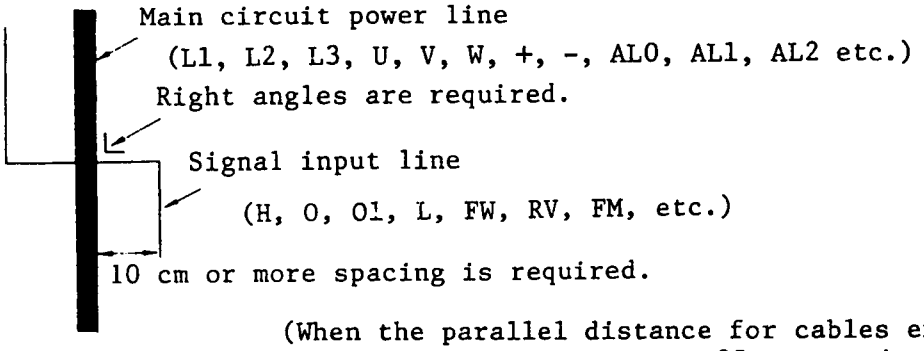


Fig. 7 Cable Separation

For the frequent ground fault, AC reacter is recommended to insert into the power supply side to reduce the electlic stress to the smoothing capacitors.

(7) Provide a grounding securely as follows.

- Provide Class 3 grounding (100Ω or less) for a terminal.
- Separate an inverter grounding cable from the grounding cable for other power electrical equipment. Absolutely avoid using the grounding pole together.
- When grounding several inverters, make connections as shown in Fig. 8 (b) below so that no loop is produced as shown in Fig. 8 (a) below.

(8) For 100HF3EH or greater, be sure the tap of control power supply terminals is suitable for input power supply voltage shown in Table 3.

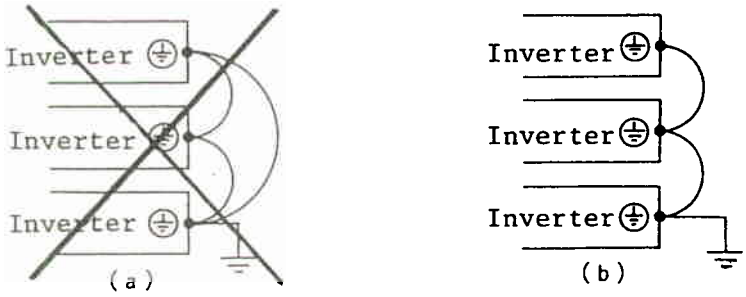


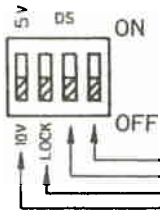
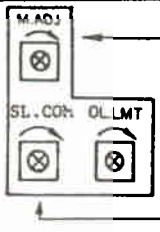
Fig. 8 Grounding

6.4 Adjustment

This inverter has almost no adjusting points on PC board. However, only some points to be adjusted are shown in Table 5 below.

For other functional setting, refer to the following paragraphs: all are to be set on the digital operation panel.

Table 5 Adjustments on PC Board

	Description	Contents
Pot. meters for factory setting	⊗ VR1 ⊗ VR2 (or not provided)	For factory adjustment. Never vary these VR's.
DIP SW		Factory setting: When operation is performed as per explanation given under 9.3 (5) with DIP SW set at "ON", the preset value before shipment is selected. After operation, turn it OFF. Not used. The switch should remain OFF. Soft lock: In "ON" position, all data cannot be changed. External frequency setting voltage switching: 5V side: 0 - 5V DC/0 - Fmax 10V side: 0 -10V DC/0 - Fmax
Pot. meters for adjustment		For external frequency meter (analog meter) adjustment (Refer to para. 8) For overload limiting level adjustment (Refer to 9.3 (3)) For slip compensation adjustment (Refer to 9.3 (3))
Fault reset	RESET □	Forced reset button

7. OPERATION

7.1 Before starting test run

Prior to test run, check the following.

(1) Check that all power lines (input terminals L1, L2, L3, output terminals U, V, W, braking unit terminals +, -) are connected correctly.

(2) Check the signal lines for wrong wiring.

(3) Check that the inverter case earth PE (⏚) is grounded.

(4) Check that other terminals than PE (⏚) are not grounded.

(5) Check that the inverter is mounted on the wall. Also check that non-flammable material, such steel sheet is used for the wall surface on which to install it.

7.2 Operation method

HFC-VWS$_3$ series inverter is capable of 4 types of operations. These operation patterns are shown in Table 6.

Table 6 Operation Pattern

Pattern	Frequency Command		Operation·Stop Command		Remarks
	Digital Operation Panel	External	Digital Operation Panel	External	
Operation pattern 1	o		o		
Operation pattern 2		o		o	Standard setting
Operation pattern 3	o			o	
Operation Pattern 4		o	o		

Operation pattern 1 ..... Operation is performed with frequency command and operation/stop command on the digital operation panel.

Operation pattern 2 ..... Operation is performed with frequency command and operation command at the outside.
In this manual, operation through the operation panel (OPE) is shown.

Operation pattern 3 ..... Operation is performed with frequency command on the digital operation panel and with operation/stop command at the outside.

Operation pattern 4 ..... Operation is performed with frequency command at the outside, and with operation/stop command on the digital operation panel.

7.3 Digital operation panel

Fig. 9 below shows the appearance of digital operation panel.

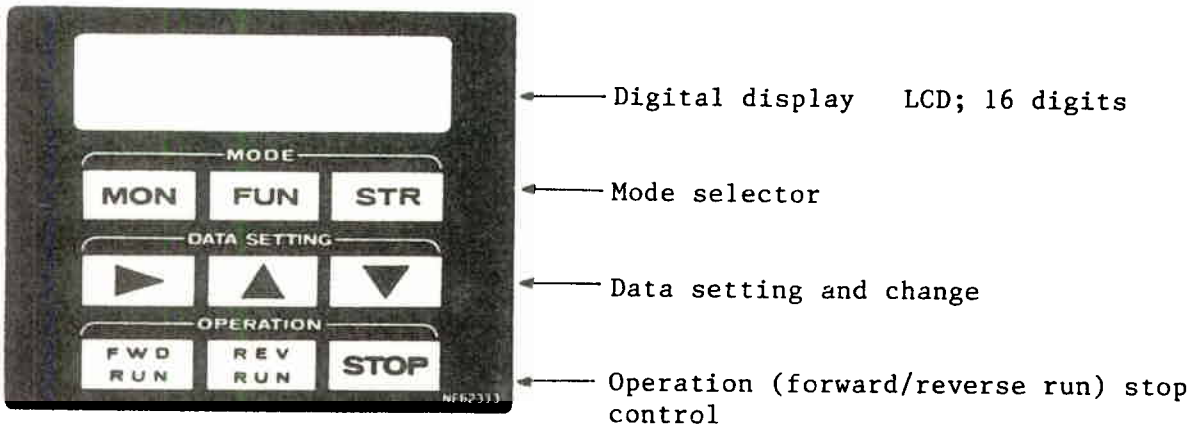


Fig. 9 Digital Operation Panel

The digital operation panel allows the monitor of output frequency and current as well as run/stop control and function setting/change. Table 7 shows the functions.

Table 7 Digital Operation Panel Function

Section	Key Name	Key Function	Description
Mode selection	MON	Monitor	• Selects the monitor mode, including the operating conditions, frequency setting and fault display. • For contents, refer to para. 9.2.
	FUN	Function	• Selects the function, such as V/F pattern and acceleration/deceleration time. • For detailed contents, refer to para. 9.3. F1 mode shows the item list, and F2 mode shows the changeable mode. In this F2 mode, data is changed. When FUN is depressed once, F1 mode is selected, and when it is depressed twice, F2 mode is selected. When it is pressed 3 times, the operation mode is returned to F1 mode.
	STR	Memory (Storage)	• Stores the data set and changed in the function mode.
Data setting/changing	▶	Cursor shift	• Moves the cursor to the data setting/changing position.
	▲ ▼	Data modification	• Sets and changes data, and changes the mode.
Operation/stop	FWD RUN	Forward run	• Commands forward run.
	REV RUN	Reverse run	• Commands reverse run.
	STOP	Stop	• Commands inverter operation stop. (The inverter stops operation according to the preset deceleration time.)

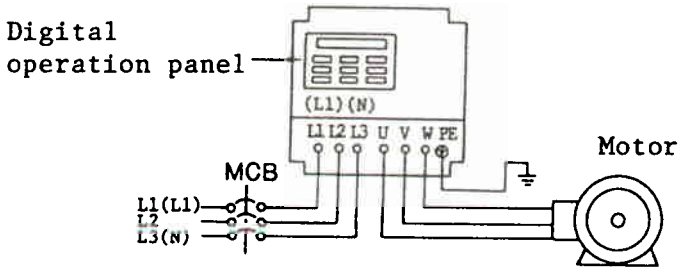
Precautions after Data Setting

The data changed, using the [FUN] key is stored in memory, using the [STR] key. Even after power is turned OFF, however, the data is further stored in the soft memory element: this is to provide for the case in which power is turned ON again. Therefore, after the [STR] key is ON or data is changed with the [MON] key, turn power OFF once. No data can be stored if resetting operation is performed before power is cut off. Power OFF is checked by no display of LCD on the digital operation panel.

7.4 Test operation

Description is given below of a simple operation on the digital operation panel.

Connection diagram



For the standard setting of this inverter, the frequency setting, run and stop are designed to be carried out on the digital operation panel.

When operation is performed on external operation panel, using external signal, refer to Fig. 12.

Standard setting (only main setting)

..... For others, refer to the "Monitor·Function Mode List" paragraph (para. 9).

Monitor mode:

• Frequency setting (FS)	0 Hz
• Frequency command method (F-SET-M)	Terminal
• Operation command method (F/R-SW)	Terminal

Function mode:

• V/F pattern (F-00)	Maximum frequency 50 Hz, constant torque characteristics	VF1-VC 050-050
• Acceleration time setting (F-01)	20 seconds	ACCEL-1 0020.0S
• Deceleration time setting (F-02)	20 seconds	DECEL-1 0020.0S

Note: For operation pattern 2 and 3, STOP key is valid even when RUN/STOP is set by external command (signal to terminal). Operation shall be done by releasing external command once or reset.

STOP key is valid even if software lock shown in Table 5 is "ON" position.

Step	Digital operation panel	Digital display	Remarks
Power ON		FM 000.0 Hz Cursor	Power ON, and output frequency (FM) is displayed.
Selection of frequency command method	Press MON or ▲ 2 times.	F-SET-M Terminal	Frequency setting by digital operation panel
	Move the cursor using ▶, and set to Ope.-key, using ▼ ▲.	F-SET-M Ope.-key	
Selection of operation command method	Press MON or ▲.	F/R-SW Terminal	Operation by digital operation panel
	Move the cursor using ▶, and set to Ope.-key, using ▼ ▲.	F/R-SW Ope.-key	
Frequency setting	Press MON or ▲. Move the cursor, using ▶, and set the frequency, using ▲ ▼.	Press MON to display FS.	The frequency setting (FS) mode is selected.
		FS 000.0 Hz	The ratio of set value to the maximum frequency (standard preset value 50 Hz) is indicated on part ①.
		Sample setting of 45 Hz FS■■■> 040.0 Hz FS■■■■ 045.0 Hz ①	
Operation	Press FWD RUN or REV RUN.		Press FWD RUN for forward operation and REV RUN for reverse operation. The motor starts to accelerate for operation.
When acceleration and deceleration are required	Select the frequency setting (FS) mode, and change the frequency setting using ▶ ▲ ▼.	The changes in frequency can be monitored in the output frequency (FM) mode.	If the setting is changed during motor operation, acceleration or deceleration are started, reaching the set value.
		FS■■> 030.0 Hz	
Stop	Press STOP.		The motor decelerates when the STOP is pressed, and stops operation.

7.5 Standard connection diagram and operation

For a typical standard connection diagram and operation method of 75HF3E or smaller, recommended in Figs. 10 to 15 (a) below in accordance with the operation patterns. For 100HF3E or greater, shown in Fig. 15 (b).

Note) Operate and stop the inverter, using a command from the control terminal.

The soft memory element is used to store data input from the digital operation panel when the inverter power is cut off.

There is a limit to the frequency of memory in this memory element; this frequency corresponds to the life span.

If power is turned ON and OFF several times/day to store the changed data in memory, its life will be approx. 10 years.

The inverter should be operated and stopped, using a control terminal command, not by turning power ON and OFF. It should be noted, therefore, that if the inverter is operated and stopped by turning power ON and OFF, whenever the setting data are changed, its life will be expired at earlier stages.

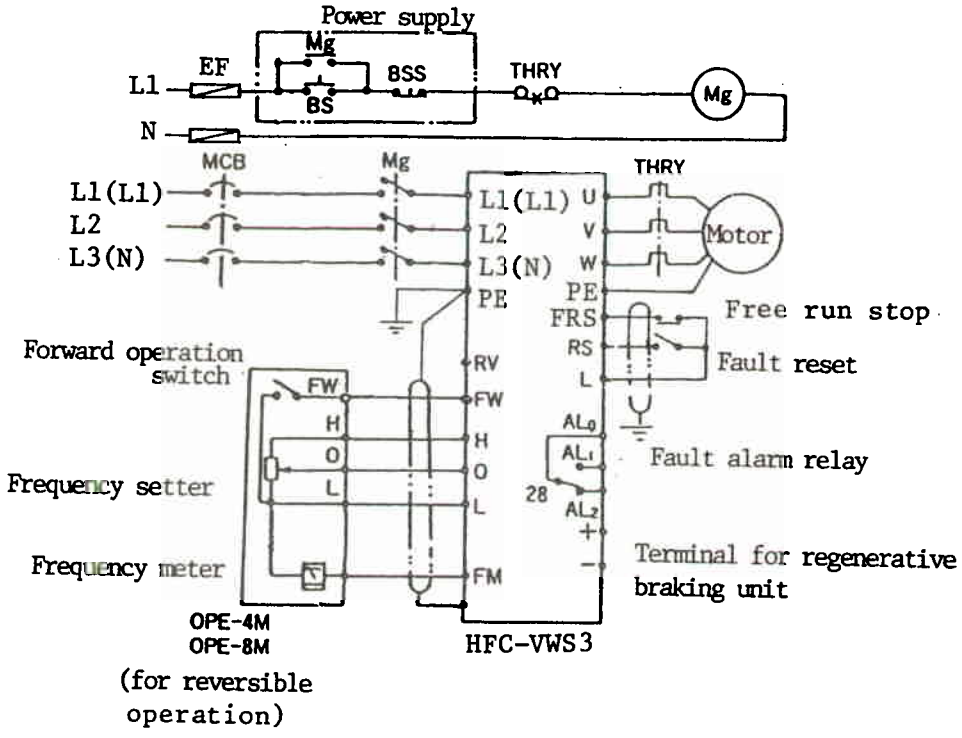


Fig. 10 Recommended Connection Diagram Example

Good operation example:

... Operate and stop the inverter with terminals FW-L ON/OFF, with Mg ON.

Bad operation example:

... Operate and stop the inverter with Mg ON/OFF, with terminals FW-L remaining ON.

Operation Pattern 1

When the frequency setting, operation and stop command are carried out on the digital operation panel

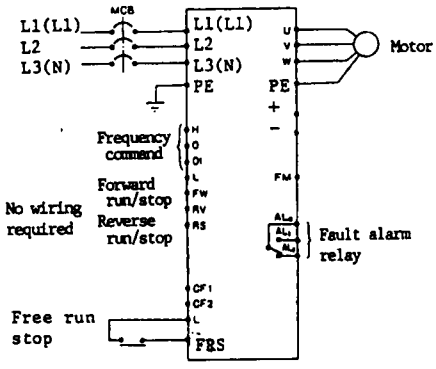


Fig. 11

Step	Description
Power ON	After power ON, the output frequency is displayed. F M 0 0 0 . 0 Hz Cursor
Selection of frequency setting mode	Press the [MON] or [▲] key once to select the frequency setting mode. F S 0 0 0 . 0 Hz Cursor
Frequency setting	Move the cursor, using [▶] , and input the preset value of frequency with [▲] [▼] . F S 0 4 0 . 5 Hz Cursor
Operation command	Press [FWD RUN] for forward operation. Press [REV RUN] for reverse operation.
Acceleration/ deceleration	Move the cursor with [▶] , and re-input the preset value of frequency with [▲] [▼] . When it is entered, acceleration or deceleration are started.
Stop	1. Press [STOP]. When this [STOP] key is depressed, the motor decelerates and stops according to the preset deceleration time. 2. Set the setting frequency to "0". Move the cursor with [▶] and set the frequency preset value to 0, using the [▼] key. The motor decelerates and stops according to the preset deceleration time.

Operation Pattern 2

When the frequency setting and operation/stop command are carried out externally; (FW/RV terminals)

Description is given here of the operation on the operation boxes (OPE-4M/8M).

Note : If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, however, it is recommended that Mg be inserted into the input side. Refer to Fig. 15.

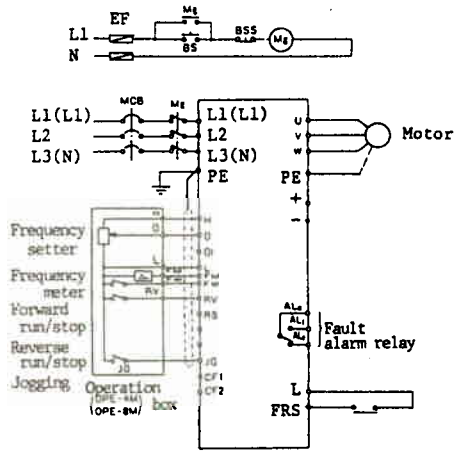


Fig. 12

Step	Description
Power ON	After power ON, the output frequency is displayed. F M 0 0 0 . 0 Hz Press MON or ▲ 2 times to select the frequency command method. F - S E T - M O p e - K e y Adjust the cursor to "O" position with the ▶ key, and press the ▲ key to select the terminal mode. F - S E T - M T e r m i n a l
Selection of frequency command method	
Selection of operation command method	Press MON or ▲ to select the operation command method. F / R - S W O p e - K e y Adjust the cursor to "O" position, using ▶ , and press ▲ to select the terminal mode. F / R - S W T e r m i n a l
Operation command	The above mentioned key operation makes it possible to operate the inverter on the operation box (OPE) "F" and "R" are displayed at frequency monitor mode, using Forward Operation (FWD) and Reverse Operation (REV) on the operation box respectively. (However, since the frequency setting is not entered, no motor is operated yet.)
Frequency setting	Turn the frequency setter on the operation box (OPE) for frequency setting: the motor will be operated. Set the switch (FWD or REV) on the operation box (OPE) to "STOP": the motor will decelerate and stop according to the preset deceleration time.
Stop	Even when the STOP on the operation panel is pressed, the motor decelerates and stops according to the preset deceleration time, but when restarting, set the switch on the operation box (OPE) to "STOP" once.

Operation Pattarn 3

When the frequency is set on the digital operation panel, and operation/stop command is carried out externally (FW/RV):

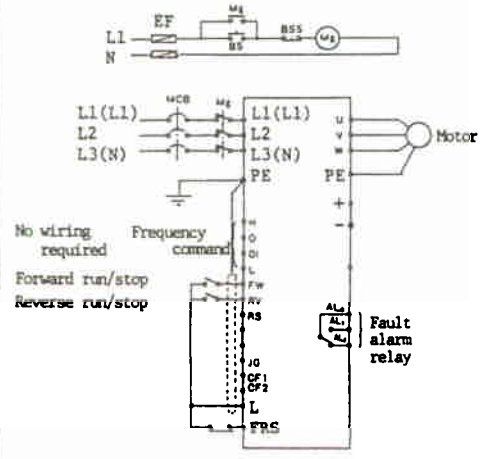


Fig. 13

Note : If the frequency and operation command are set during power failure, operation will be re-started at power ON. For safety, however, it is recommended that Mg be inserted into the input side. Refer to Fig. 15.

Step	Description
Power ON	After Power ON, the output frequency is displayed. F M 0 0 0 . 0 Hz
Selection of operation command method	Press [MON] or [▲] 3 times to select the operation command method. F / R - S W O p e - K e y Adjust the cursor to "O" position with [▶] to select the terminal mode by a push on [▲] .
Selection of frequency setting method	F / R - S W T e r m i n a l Press [MON] or [▼] to select the frequency setting mode.
Frequency setting	F S 0 0 0 . 0 Hz Move the cursor with [▶] and input the preset value of frequency with [▲] [▼] .
Operation command	F S 0 4 0 . 5 Hz Forward operation is performed with PC board terminals FW-L short-circuited. Reverse operation is performed with PC board terminals RV-L short-circuited.
Acceleration/ deceleration	Move the cursor, using the key, and re-enter the preset value of frequency with [▲] [▼] . When it is entered, acceleration or deceleration are started. (This operation is invalid even at a push on the keys [FWD RUN] [REV RUN].)
Stop	Keep the circuits between PC board terminals FW-L and RV-L open. The motor will decelerate and stop according to the preset deceleration time.

Operation Pattern 4

When the frequency is set externally and operation/stop command is carried out on the digital operation panel:

Note : If the frequency and operation command are set during power failuer, operation will be re-started at power ON. For safety, however, it is recommended that Mg be inserted into the input side. Refer to Fig. 15.

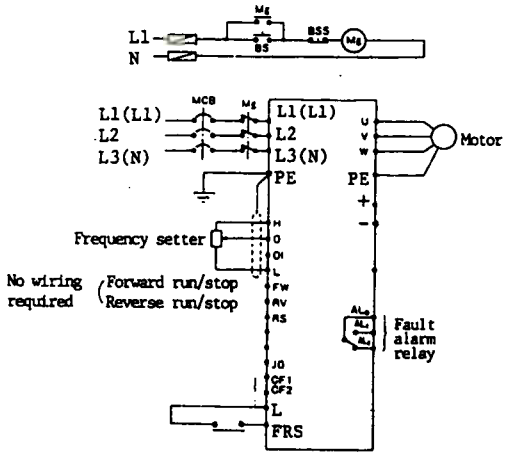
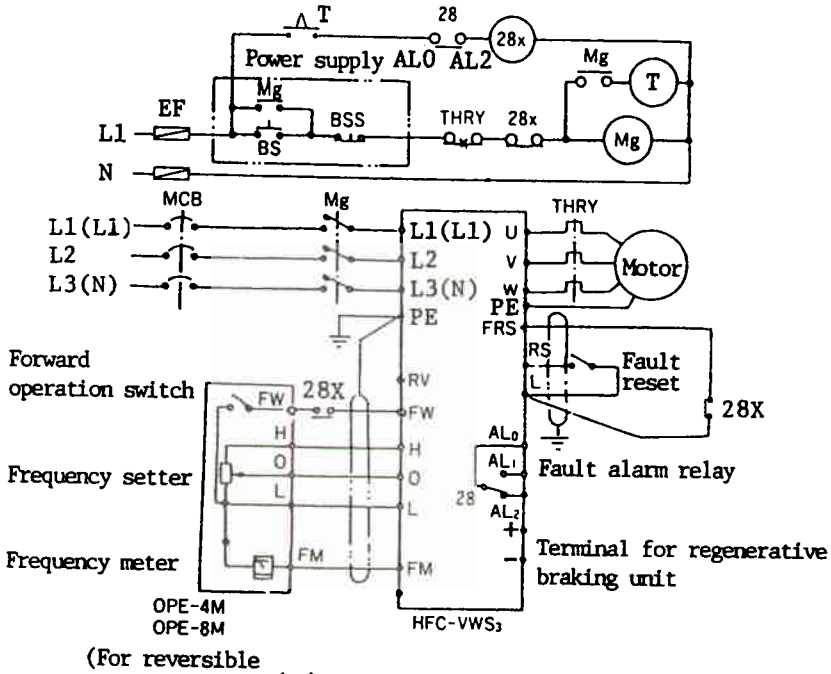


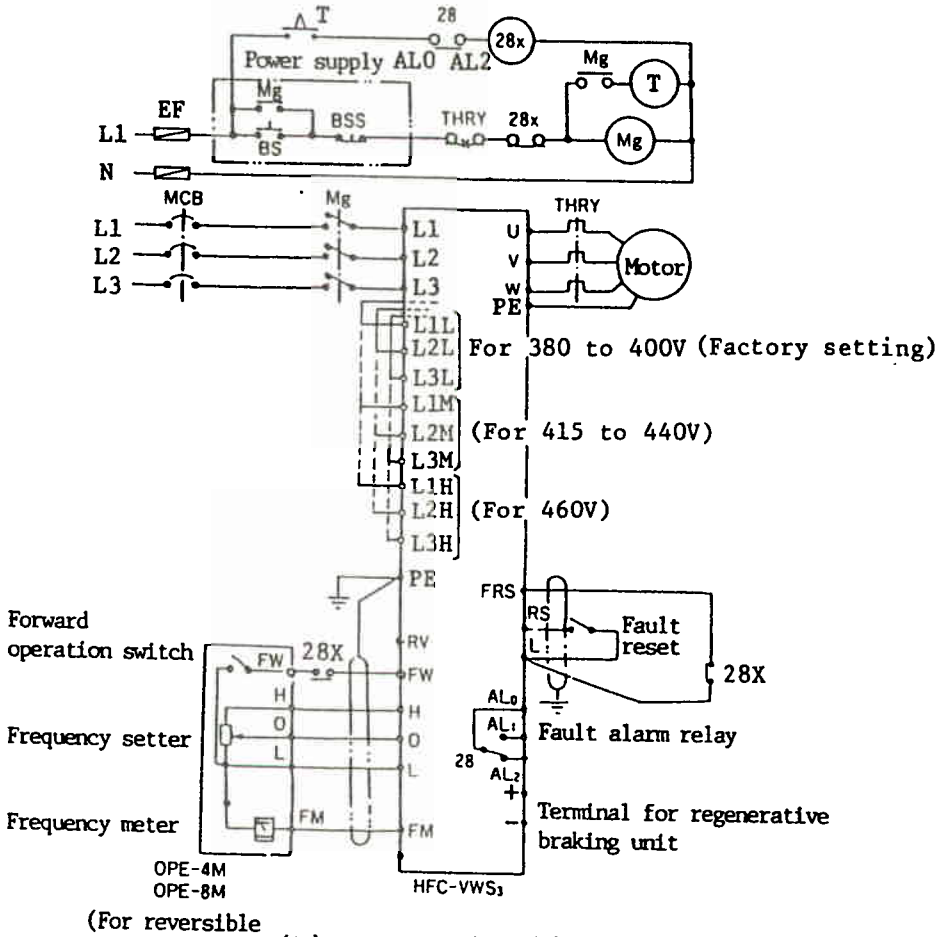
Fig. 14

Step	Description
Power ON	After power ON, the output frequency is displayed. F M 0 0 0 . 0 Hz
Selection of frequency setting method	Press [MON] or [▲] 2 times, to select the frequency command method. F - S E T - M O p e - K e y Adjust the cursor to "O" position, using the key [▶] , and press the key [▲] to select the terminal mode. F - S E T - M T e r m i n a l
Operation command	Press [▼] to display [FM]. F M F 0 0 0 . 0 Hz For forward operation, press [FWD RUN] : "F" is displayed. For reverse operation, press [REV RUN] : "R" is displayed. (However, since the frequency setting is not entered, no motor can be operated.)
Frequency setting	Input any one of the following: Frequency setter between H-O-L of terminals on PC board 0 - 10V DC or 0 - 5V DC between O-L of terminals on PC board DC 4 - 20 mA between OI-L of terminals on PC board
Stop	Press the [STOP] key.



(For reversible operation)

(a) Connection Diagram (75HF3EH or smaller)



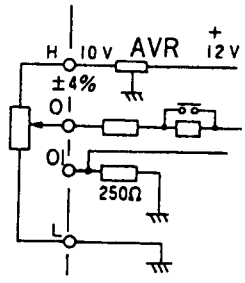
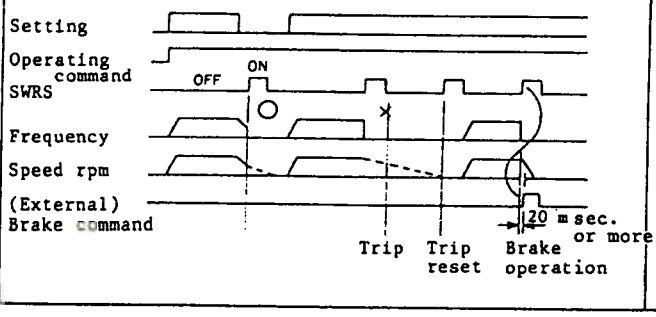
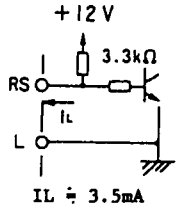
(For reversible operation)

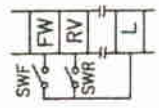
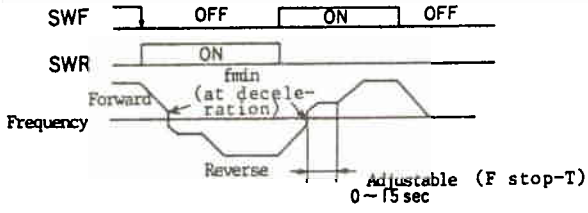
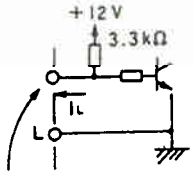
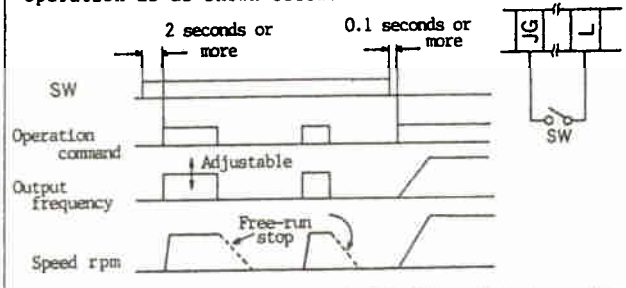
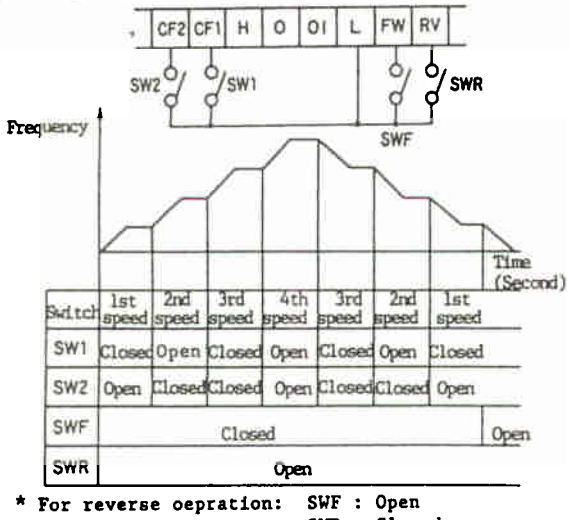
(b) Connection Diagram (100HF3EH or greater)

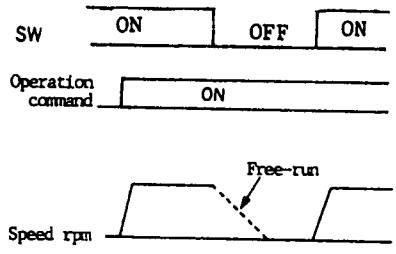
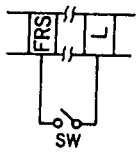
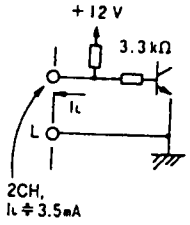
Fig. 15 Main Circuit Power Supply, Control Power Supply and Signal Make/Break Sequence (Forward operation)

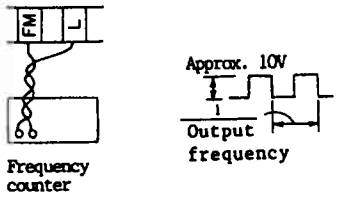
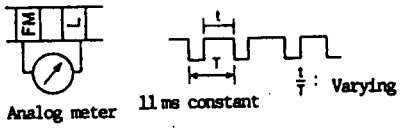
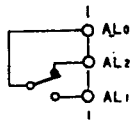
8. TYPE AND FUNCTION OF I/O SIGNALS

The type, function and electrical characteristics of input and output signals are as show in the table below.

	I/O signal	Description	Remarks
INPUT	Frequency setting command O : Voltage input OI: Current input	Set the frequency in the following manner. (a) When the variable resistor is used: Connect 1 kΩ (500Ω ∿ 2 kΩ available) resistor between H and L on PC board. (b) When external setting signal is used: o Voltage setting Connection: Make connections as shown on the right. Input impedance 0∿10V selection: 30 kΩ 0∿5V selection : 15 kΩ Note) Do not apply 12V DC or more voltage between O and L. o Current setting Connection: Make connections as shown on the right. Input impedance: 250Ω	 ① For switching 0∿10V and 0∿5V, refer to Table 5 in para. 6.4. ② When switching the frequency command to the terminal, refer to para. 9.1.
	Reset command (RS)	Make connections as shown on the right. When SWRS is closed, the output is immediately turned off, and the motor comes to free-run stop. When the SWRS is opened in the presence of setting and operation command, the motor accelerates from the lowest frequency. If the SWRS is opened during motor inertial rotation, a large current will flow, tripping the motor due to speed rpm and frequency deviation; therefore, avoid such an operation. • Use this terminal for a quick operating OFF brake, for example. 	 Minimum input pulse width ≥50 ms L level ≤ 0.3V H level ≥ 2.4 Note: When the SWRS is ON, the digital display is black, and no display appears. However, it is not a fault, but a normal operation.

I/O Signal	Description	Remarks
Forward operation command (FW) Reverse operation command (RV)	Make connection as shown on the right. The time chart during forward/ reverse operation is as shown below.  	Input circuit  FW, RV, JG, CF1, CF2 IL ≒ 3.5mA
Jogging operation command (JG)	Make connection as shown on the right. The time chart during jogging operation is as shown below.  Operation command: PC board terminals (FW, RV) or digital operation panel FWD RUN REV RUN	L level ≤ 0.3V H level ≥ 2.4V After 0.1 second at JG command OFF, turn the operation command ON. For 0.1 second or less, no operation is started even when the operation command is input. Minimum input pulse width ≥ 50 ms
Multistage speed operation command (CF1,CF2)	A combination of terminals (CF1,CF2) allows maximum 4-stage speed change operation.  Switch: 1st speed / 2nd speed / 3rd speed / 4th speed / 3rd speed / 2nd speed / 1st speed SW1: Closed / Open / Closed / Open / Closed / Open / Closed SW2: Open / Closed / Closed / Open / Closed / Closed / Open SWF: Closed / Open SWR: Open * For reverse oepration: SWF : Open SWR : Closed 1st speed: Frequency set by speed-1 2nd speed: Frequency set by speed-2 3rd speed: Frequency set by speed-3 * For speed-4 (SW1/SW2 open), operation is performed, using a command given by the frequency setter.	

	I/O Signal	Description	Remarks
	Free-run stop command (FRS)	When FRS-L is open circuited, the inverter turns off the output, and the motor runs freely. When it is closed, if the operation command is given, the motor starts from the zero speed again; therefore, after checking that the motor has stopped, release the free-run stop. Note 1: It should be noted that if an operation command is further given after FRS is turned OFF, then ON, operation is restarted. Note 2: The delay time up to the free-run after SW is OFF is approx. 100 ms. Note 3: When it is desired to turn off inverter output at less than 100 ms, using a motor with brake, use a reset (RS) terminal without using FRS terminal. In this case, the sample connection diagrams are shown in Figs. 16 (a), (b).  	Input circuit  Minimum input pulse width FRS ≥ 200 ms L level ≤ 0.3V H level ≥ 2.4V

I/O Signal	Description	Remarks
Frequency monitor signal (FM)	The frequency monitor signal (FM) can be transmitted by selecting 2 types of signals below. ① Digital monitor for frequency counter This monitor outputs the same frequency pulse train as the output frequency. The duty is approx. 50%.  ② Monitor for analog meter This monitor outputs the duty (t/T) proportional to the output frequency. Adjust the variable resistor (M.ADJ) and the variable resistor of frequency counter itself so that the meter is maximum at the highest frequency.  CAUTION: This signal is only for indicator. It cannot be therefore used as a line speed signal.	0 ∿ 10V Full scale (Load resistance: 10 ∿ 22 kΩ 1 mA max.)
Fault alarm signal (AL_0, AL_1, AL_2)	This signal is transmitted in abnormal conditions. <table><tr><th>Power supply</th><th>Operating conditions</th><th>AL_0 ∿ AL_1</th><th>AL_0 ∿ AL_2</th></tr><tr><td>ON</td><td>In normal conditions</td><td>OFF</td><td>ON</td></tr><tr><td>ON</td><td>In abnormal conditions</td><td>OFF</td><td>ON</td></tr><tr><td>OFF</td><td>-</td><td>OFF</td><td>ON</td></tr></table>	Output circuit  Contact specification AC 250V, 2.5A (resistance load) 0.2A (cosϕ=0.4) DC 30V, 3.0A (resistance load) 0.7A (cosϕ=0.4)

· Sample connection diagram when a motor with brake is used:

When the brake is actuated, the inverter output is turned off, thus placing the motor in free-run conditions, but when it is necessary to shorten the operating time for dc cut-off of a brake unit, for example, if FRS terminal is used, approx. 100 ms is required for signal receiving within the inverter; therefore, the motor may be momentarily braked, thus causing overcurrent trip.

Consequently, in such a case, use a reset terminal (RS). If RS terminal remains used, no setting can be changed, and no display can be changed as well; therefore, make connections in accordance with Figs. 16 (a), (b) below.

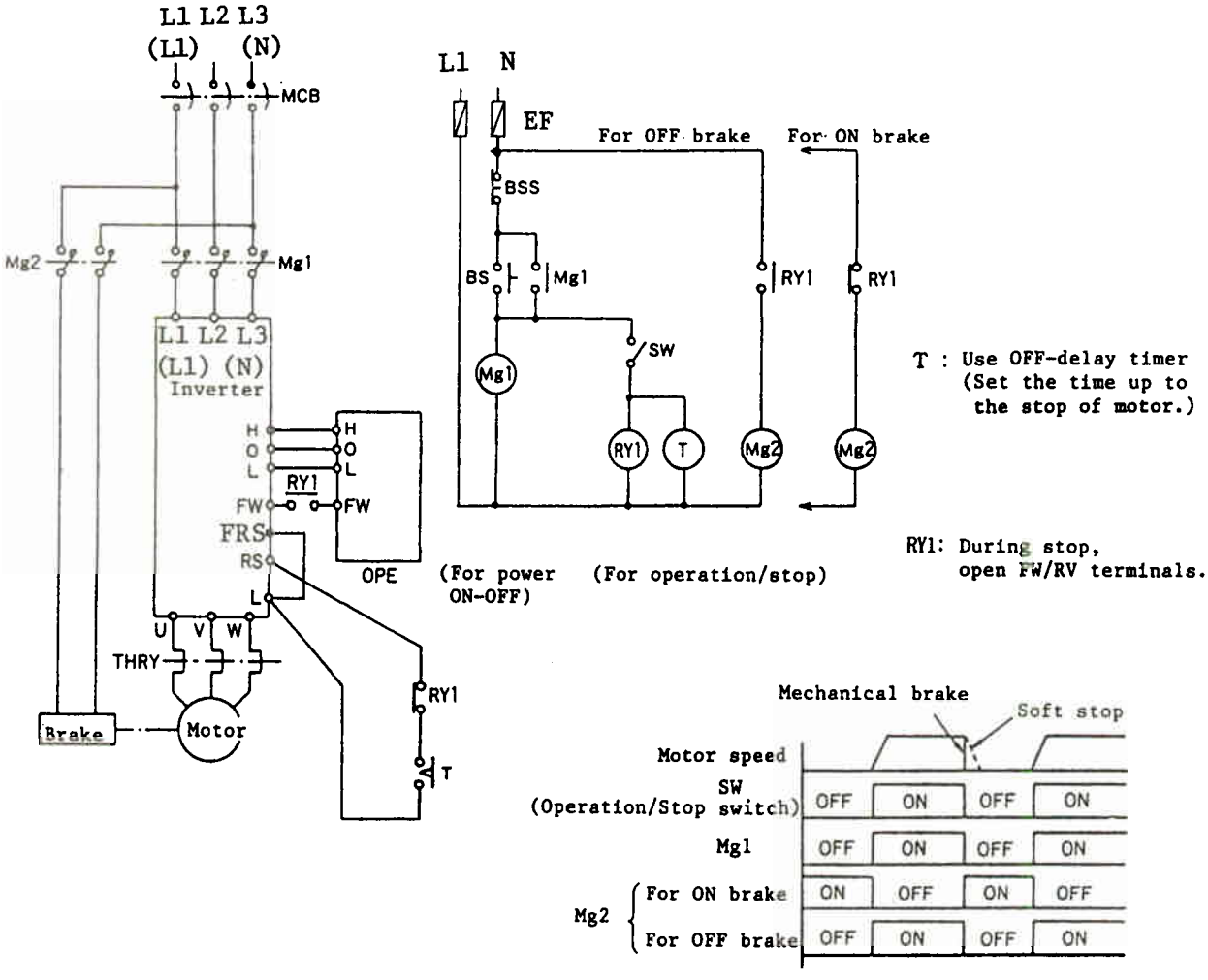

L1 L2 L3
(L1) (N)
MCB
Mg2
Mg1
L1 L2 L3
(L1) (N)
Inverter
H
O
L
RY1
FW
FRS
RS
L
U V W
THRY
Brake
Motor
OPE
RY1
T
(For power ON-OFF)
L1 N
EF
For OFF brake
For ON brake
BSS
BS
Mg1
RY1
RY1
SW
Mg1
RY1
T
Mg2
Mg2
(For operation/stop)
T : Use OFF-delay timer
(Set the time up to
the stop of motor.)
RY1: During stop,
open FW/RV terminals.
Mechanical brake
Soft stop
Motor speed
SW
(Operation/Stop switch)
Mg1
Mg2
For ON brake
For OFF brake
OFF
ON
OFF
ON
OFF
ON
OFF
ON
ON
OFF
ON
OFF
OFF
ON
OFF
ON

Fig. 16 - (a)

Note 1) When optional PC board (IA-TWK) is used:

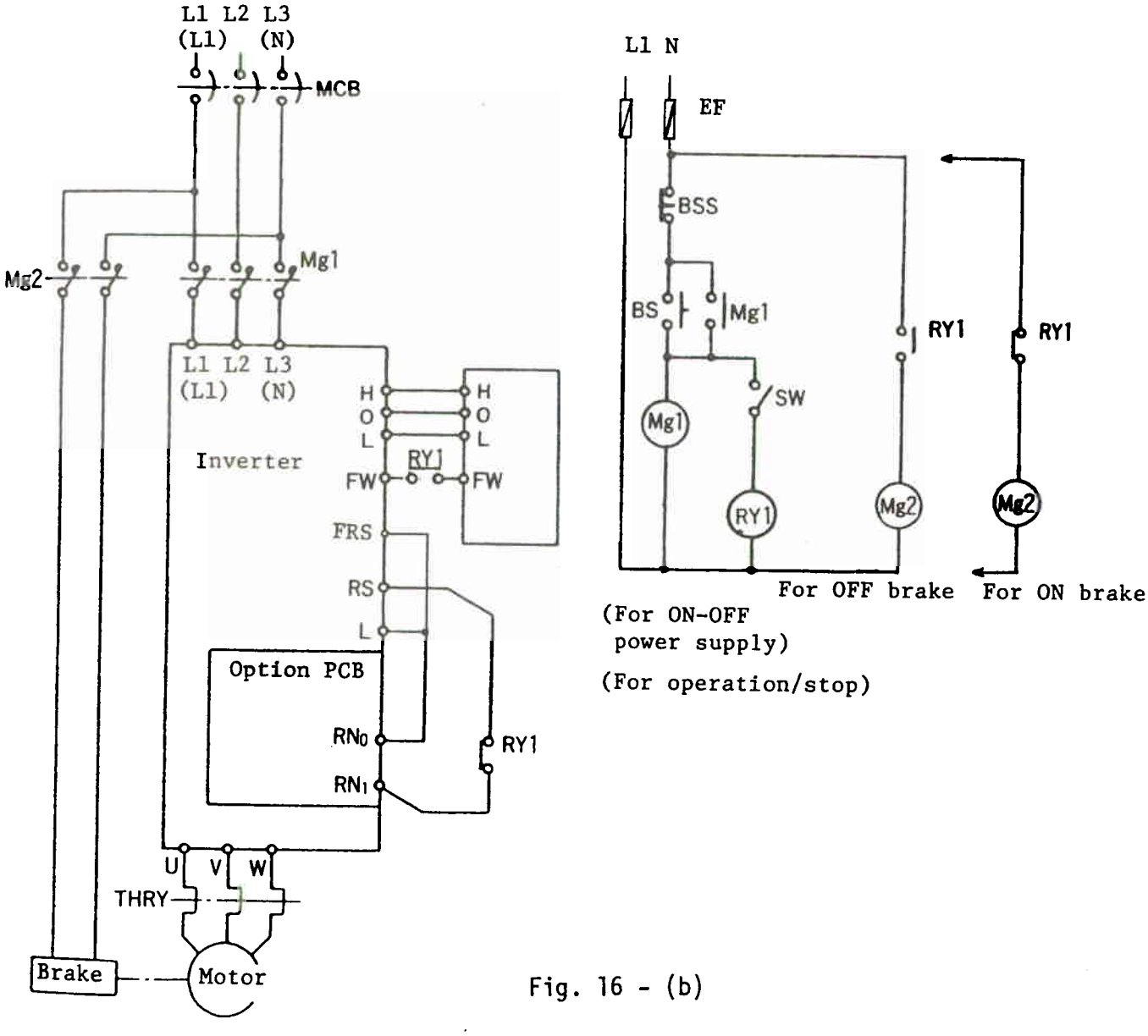


Fig. 16 - (b)

Fig. 16 Sample Connection Diagram When a Motor with Brake is Used

9. DIGITAL OPERATION PANEL HANDLING

9.1 Configuration of digital operation panel

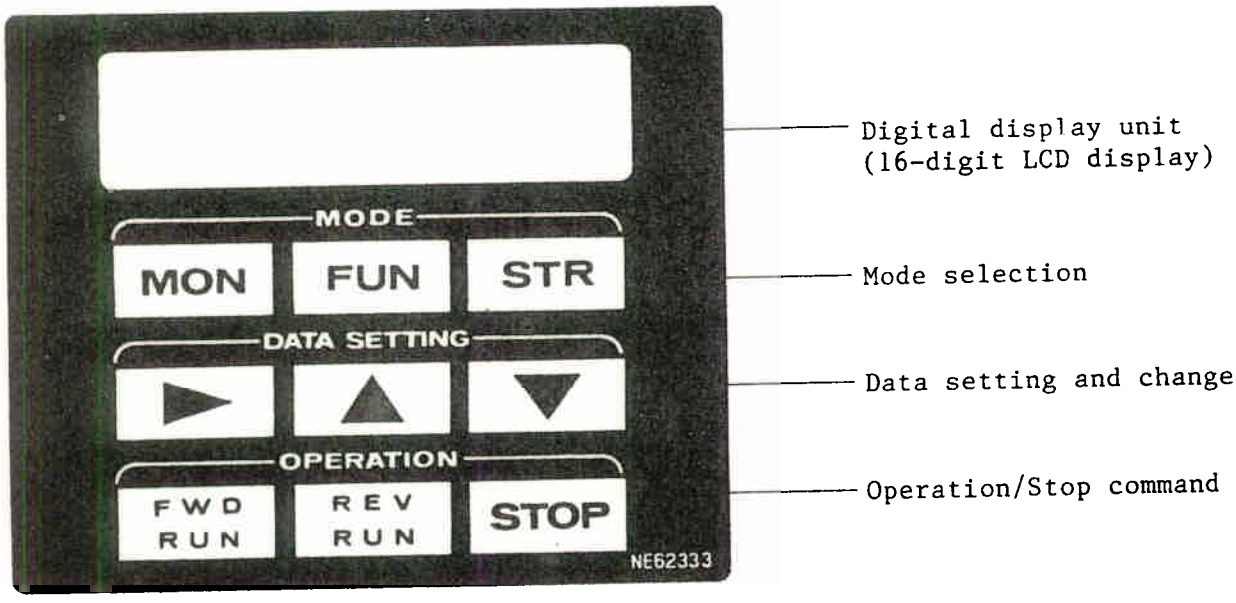


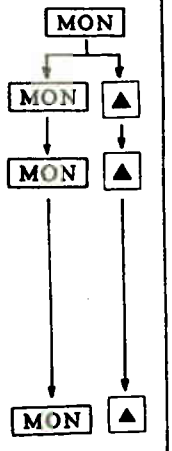
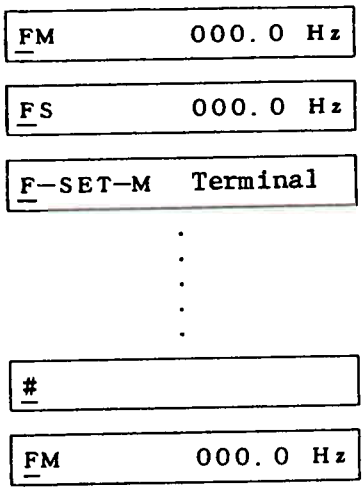
Fig. 17 Digital Operation Panel

Section	Key	Key Name	Function
Mode selection	MON	Monitor	Selects the monitor mode.
	FUN	Function	Selects the function mode. Function 1 mode: Selects the function name. Function 2 mode: Selects and changes data.
	STR	Memory	Stores the preset data in memory.
Data setting and change	▶	Cursor movement	Moves the cursor to the place in which the data is set and changed.
	▲	UP	Sets and changes data. The number is incremented by ▲ and decremented by ▼. The number is carried: 9 → 0 (0, 1, 2, ... 8, 9) For character: ▲ Next (A → B) ▼ Back (B → A) For code : ▲ Next (eg. Ope.-key → Terminal) ▼ Back (Terminal → Ope.-key) For mode : ▲ Next mode (eg. F-00 VF1-VC → F-01 ACCEL-1) ▼ Previous mode (eg. F-01 ACCEL → F-00 VF1-VC) (When the key is continuously pressed, data is changed continuously.)
	▼	DOWN	
Operation/ Stop	FWD RUN	Forward operation	Commands the forward operation.
	REV RUN	Reverse operation	Commands the reverse operation.
	STOP	Stop	Stops operation.

(1) Basic procedure of key operation

· Mode selection

Example 1: Monitor mode

Key Operation		Display	Explanation
When the operation mode advanced to the next mode	When the operation mode returns to the previous mode		
			The operation mode returns to its initial state after one cycle.

Example 2: Function mode

Key Operation		Display	Explanation
When the operation mode advanced to the next mode	When the operation mode returns to the previous mode		
		F—00 VF1-VC F—01 ACCEL—1 F—02 DECEL—1 . . . . . F—36 IPS—R—T F—00 VF1-VC	The operation mode returns to its initial state after one cycle.

(2) Data setting and change within the mode

1) Cursor movement using [▶]

Example: [▶] moves the cursor so that the data can be set and changed.

The cursor moves only left to right unidirectionally, and returns back to its original position.

Key Operation	Display
	FS 000.0 Hz FS 000.0 Hz FS 000.0 Hz FS 000.0 Hz FS 000.0 Hz FS 000.0 Hz

2) Data setting and change using ▲ ▼

· For numeral and character:

Set and change the numeral and character, using ▲ ▼

Example: Numeral

Key Operation		Display
Increment	Decrement	
		FS 000.0 Hz FS 010.0 Hz FS 020.0 Hz · · · · · FS 090.0 Hz FS 100.0 Hz

· For codes

Set and change the codes of numeral and character, using ▲ ▼ .

Example: Character code

Key Operation		Display
		F-SET-M Terminal F-SET-M Ope.-key F-SET-M Terminal

9.2 Monitor mode

(1) Monitor mode list

- Monitor mode table

The monitor mode initial display contents, standard preset value and changing range are as shown in the table below.

Display Sequence	Monitor Name	Initial Display	Standard Setting	Changing Range	Remarks
1	Output frequency display	FM 000.0Hz	—	—	
2	Frequency setting command	FS 000.0Hz	—	—	Setting and change are possible up to the maximum frequency of the selected V/F pattern.
3	Frequency command method	F-SET-M Terminal	Terminal	Ope.-key or Terminal	
4	Operation command method	F/R-SW Terminal	Terminal	Ope.-key or Terminal	
5	Motor speed display	RPM 4P 00000rpm	4	2~48	
6	Output current display	If---- A Im000.0%	—	3.0~260	
7	Manual torque boost adjustment	V-Boost Code(31)	31	00~99	
8	Output voltage gain adjustment	V-Gain 100%	100	100~50	
9	Jogging frequency setting	Jogging 00.5Hz	0.5	0.5~9.9	
10	Fault display	#	—	—	# shows normal operation. When the inverter fails, this display takes precedence over all displays, indicating faulty contents.

(2) Monitor mode operation

a) When power is supplied to the inverter, the monitor mode output frequency is displayed automatically.

b) The data which can be set and changed during inverter operation include:

(O: Possible x: Impossible -: Only display)

Monitor name	Data setting/ change	Remarks
Output frequency display	-	
Frequency setting command	O	
Frequency command method	x	Setting and change are possible only during inverter stop.
Operation command method	x	Setting and change are possible only during inverter stop.
Motor speed display	O	
Output current display	O	
Manual torque boost adjustment	O	
Output voltage gain adjustment	O	
Jogging frequency setting	O	
Fault display	-	

c) The monitor mode is effective even when the STR (store) is not pressed after data setting and change.

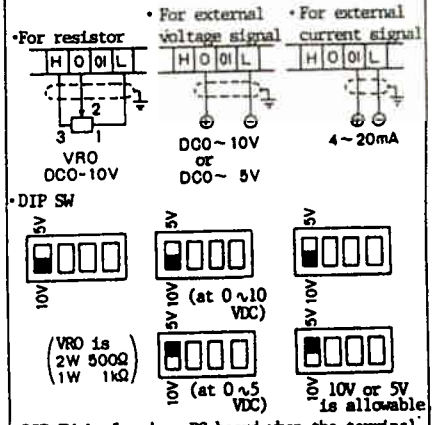
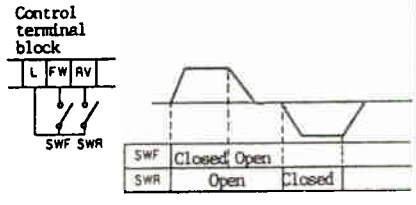
d) Monitor mode operating procedure

Operation Step	Key Operation	Explanation
Power ON ↓ Monitor mode selection ↓ Data setting/change	— MON (or ▲ ▼) (▶ ▲ ▼)	The output frequency in the monitor mode is displayed automatically. The required monitor mode is selected. Data is set and changed. For only display (output frequency display/fault display), no operation is required.

(3) Monitor mode display, setting, change and contents

Data can be changed where the cursor in the data setting column is present.

Display Sequence	Monitor Name	Key Operation	Display	Setting/ Change Range	Description
1	Output frequency display	Mode selection MON ▲ ▼	Initial display FM 000.0Hz ③ ② ①	—	The output frequency is displayed at part ①. F and R are displayed during forward and reverse operations respectively at part ②. The ratio of the output frequency to the maximum frequency is displayed in 10 stages at part ③. (■ 20%, ▷ 10%) 
		Display	FM■> F020.0Hz		
2	Frequency setting command	Mode selection MON ▲ ▼	Initial display FS 000.0Hz ③ ② ①	0 ∿ the maximum frequency of selected V/F pattern (every 0.1 Hz)	The frequency is set at part ①. The output frequency increases up to the frequency set at the same time when the operation command is entered. When increasing or decreasing the frequency during operation, change the frequency at part ①. Part ① only displays the set frequency; therefore, select the output frequency display mode when checking the frequency during operation. · This mode is valid only when the next frequency command method is set to OPE.-key (digital operation panel). Part ② displays F and R during forward and reverse operations respectively. Part ③ displays the ratio of the frequency preset value to the maximum frequency in 10 steps.
		Data setting ▶ ▲ ▼	FS F050.0Hz		

Display Sequence	Monitor Name	Key Operation	Display	Setting/ Change Range	Description
3	Frequency command method	Mode selection MON ▲ ▼	Initial display F-SET-M Terminal	Ope.-key or Terminal	This function selects whether the frequency command is given, using the digital operation panel (OPE.-key) or external input signal (Terminal). Perform this operation during inverter stop. <Frequency command of external input signal> External input signal employs voltage signals 0∿5 VDC, 0∿10 VDC and current signal DC 4∿20 mA. (Select voltage signals 0∿5 VDC, 0∿10 VDC, using DIP SW on PC board.)  DIP SW is found on PC board when the terminal cover is removed.
		Data setting ▶ ▲ ▼	F-SET-M Ope.-key		
4	Operation command method	Mode selection MON ▲ ▼	Initial display F/R-SW Terminal	Ope.-key or Terminal	This function selects whether forward operation/stop and reverse operation/stop are carried out by the digital operation panel (OPE.-key) or external input signal (terminal). Do this during inverter stop. 
		Data setting ▶ ▲ ▼	F/R-SW Ope.-key		
5	Motor speed rpm display	Mode selection MON ▶ ▲ ▼	Initial display RPM P 00000rpm ① ②	2~48	When the number of motor pole is selected at part ①, part ② displays the synchronizing speed rpm of motor in operation. Motor pole number code
		Data setting ▶ ▲ ▼	RPM 4P 01500rpm		

Display sequence	1	2	3	4	5	6	7	8	9	10	11	12	13	14
No. of pole	2	4	6	8	10	12	14	16	18	20	24	32	36	48

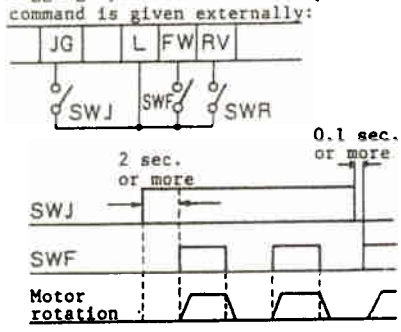
Display Sequence	Monitor Name	Key Operation	Display	Setting/ Change Range	Description
6	Output current display	Mode selection MON ▲ ▼	Initial display If A Im000.0% ① ②	3.0~260	Part ② displays the ratio to the inverter rated output current in % when the rated current is not entered at part ①. The rms value (A) of inverter output current is displayed at part ② if the inverter rated current in the table below is entered in part ①.
		Data setting ▶ ▲ ▼	If 5.0A Im004.5A		
		—	If----A Im080.0%		

■ Inverter Rated Current Code

Display sequence		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Inverter	Inverter rated current	3.0	3.8	5.0	5.3	7.5	8.6	10.5	13.0	16.0	16.5	23	24	32	46
	200V class	1.0		1.5		2.5		3.5			5.5		8	11	16
	400V class		2.5		3.5		5.5		8	11		16			

15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
48	58	64	75	90	95	110	121	145	149	176	182	217	220	260
		22			33		40	50			60		75	
33	40		50	60		75			100	120		150		180

7	Manual torque boost adjustment	Mode selection MON ▲ ▼	Initial display V-Boost Code<31>	00~99 (every 1 step)	In this mode, the output voltage is increased at start and in the low frequency zone, and boost is adjusted. Output voltage (%) V 100 Approx. 18% f/10 .... f/2 ....f(Hz)
		Data setting ▲ ▼ ◀	V-Boost Code<99>		
8	Output voltage gain adjustment	Mode selection MON ▲ ▼	Initial display V-Gain 100%	100~50 (every 1 step)	Gain for the output voltage frequency is varied. Output voltage (%) 100 50 0 Vari-able 1.....50 Output voltage (%) 100 50 0 Vari-able 1....50....144(Hz)
		Data setting ▶ ▲ ▼	V-Gain 50%		

Display Sequence	Monitor Name	Key Operation	Display	Setting/ Change Range	Description
9	Jogging frequency setting	Mode selection MON ▶ ▲ ▼	Initial display Jogging 00.5 Hz	0.5~9.9 (every 0.1 Hz)	·The jogging frequency is set. ·Since direct operation of jogging is readily tripped, set this frequency to less than 5 Hz where applicable. For operation command with external JOG command (short circuit between JG and L), forward and reverse operation are performed by either FWD RUN REV RUN on digital panel on switching of external terminals FW and RV. Jogging operation when the operation command is given externally:  Note 1: When JOG command is turned OFF during jogging, the inverter is stopped. When re-starting operation, turn FW/RV OFF once, then give the operation command. Note 2: Automatic restart action during jogging operation causes trip (NG-JOG).
		Data setting ▶ ▲ ▼	Jogging 08.0 Hz		
10	Fault display	Mode selection MON ▲ ▼	During normal operation #	—	# indicates normal operation. When the inverter fails, the faulty contents, taking precedence over all displays are displayed.
			? ERROR Over V. Display contents OC.ACCEL Overcurrent at acceleration OC.DECEL Overcurrent at deceleration OC.DRIVE Overcurrent during operation Over V. Overvoltage Over L. Overload OH Fin Inverter fin overheat Under V. Undervoltage CPU CPU error Inst.P-F Instantaneous power failure		

9.3 Function mode

(1) Function mode list

In Function 1 mode, the function name is selected. (No data setting or change is possible in this mode.)
In Function 2 mode, data is set and changed.

The table below shows the initial display contents, standard setting and changing range.

Display Sequence	Function Name	Function 1 Mode	Display Contents	Function 2 Mode	Initial Display Contents	Standard Setting	Setting/Changing Range	Remarks
1	V/F pattern setting	F-00	VF1-VC	VF1-VC	050-050	As described on the left		
2	Acceleration time setting	F-01	ACCEL-1	ACCEL-1	0020.0 S	20	0.1~2999.9 (S) At linear acceleration 0.1~230.0 (S) At S-character curved acceleration	
3	Deceleration time setting	F-02	DECEL-1	DECEL-1	0020.0 S	30	0.1~2999.9 (S) At linear deceleration 0.1~230.0 (S) At S-character curved deceleration	
4	Maximum frequency fine adjustment	F-03	+Fmax.	+Fmax.	000.0 HZ	0	0~15 (Hz)	
5	Starting frequency adjustment	F-04	+Fmin.	Fmin.	000.5 HZ	0.5	0.5~5.0 (Hz)	
6	Maximum frequency limiter setting	F-05	H-LIM-F	H-LIM-F	000.0 HZ	0	0~159 (Hz)	However, this frequency is effective up to the highest frequency of the selected V/F pattern. Error when the max. limit is smaller than the min. limit.
7	Minimum frequency limiter setting	F-06	L-LIM-F	L-LIM-F	000.0 HZ	0	0~159 (Hz)	
8	Jump frequency 1 setting	F-07	JUMP-F1	JUMP-F1	000.0 HZ	0	0~159 (Hz)	This frequency is effective up to the highest frequency of the selected V/F pattern.
9	Jump frequency 2 setting	F-08	JUMP-F2	JUMP-F2	000.0 HZ	0	0~159 (Hz)	"
10	Jump frequency 3 setting	F-09	JUMP-F3	JUMP-F3	000.0 HZ	0	0~159 (Hz)	"
11	Motor noise adjustment	F-10	CF-code	CF-code	<U>	U	C~U	
12	Adjustment of frequency stop time at start	F-11	Fstop-T	Fstop-T	001.0 S	0	0~15 (S)	
13	Multistage speed 1 setting	F-12	Speed-1	Speed-1	000.0 HZ	0	0~159 (Hz)	
14	Multistage speed 2 setting	F-13	Speed-2	Speed-2	000.0 HZ	0	0~159 (Hz)	However, this frequency is effective up to the highest frequency selected by V/F pattern.
15	Multistage speed 3 setting	F-14	Speed-3	Speed-3	000.0 HZ	0	0~159 (Hz)	"
16	DC braking frequency adjustment	F-20	F-DCB	F-DCB	001.0 HZ	1	0.5~15 (Hz)	"
17	DC braking power adjustment	F-21	V-DCB	V-DCB	010	10	00~20	Effective only when optional PC board is used.
18	DC braking time adjustment	F-22	T-DCB	T-DCB	005.0 S	5	00~15 (S)	
19	Electric thermal level adjustment	F-23	E-therm	E-therm	100%	100	100~50 (%)	
20	Linear/S-character curved acceleration selection	F-24	ACCline	ACCline	Linear	Linear	Linear or S-Curve	
21	Linear/S-character curved deceleration selection	F-25	DECline	DECline	Linear	Linear	Linear or S-Curve	
22	Start point frequency of external frequency setting	F-26	F-START	F-START	000.0 Hz	0	0~159 (Hz)	
23	End point frequency of external frequency setting	F-27	F-END	F-END	000.0 Hz	0	0~159 (Hz)	
24	Switch selection	F-28	SWITCH1	SWITCH1	00000101	As described on the left		
25	Overload limit time constant setting	F-30	LM.CONS	LM.CONS	0001.0	1.0	0.3~30	
26	Automatic torque boost adjustment	F-32	V-auto	V-auto	+00	00	00~20	
27	Stand-by time setting for restart after instantaneous power failure	F-36	IPS-R-T	IPS-R-T	0001.0 S	1	0.3~30 (S)	

(2) Function mode operation

a) Set and change the data in the function mode during inverter stop.
(No data can be set or changed during inverter operation.)

The conditions in which the inverter is stopping include:

① Conditions immediately after power is ON

② Conditions in which the inverter is stopped by a push on the [STOP] during operation on the digital operation panel

③ Conditions in which the inverter is stopped with the circuit open between control circuit terminals FW-L or RV-L on PC board

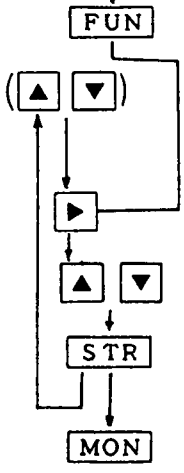
④ Conditions in which the inverter is stopped with the circuit between control circuit terminals RS-L short-circuited or FRS-L open-circuited on PC board.

b) After data setting and change, be sure to press the [STR] (memory).

(Otherwise, the data setting and change become invalid, and the previous data contents remain saved.)

c) In the function mode, no motor can be operated; therefore, press the [MON] and select the monitor mode again.

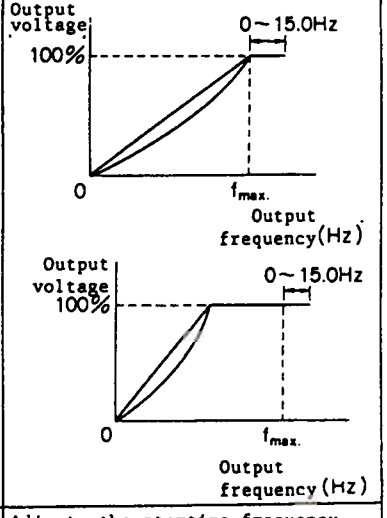
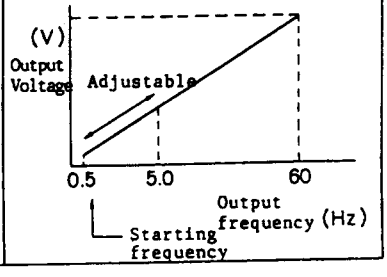
d) Function mode operating procedure

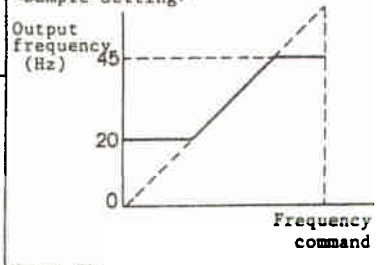
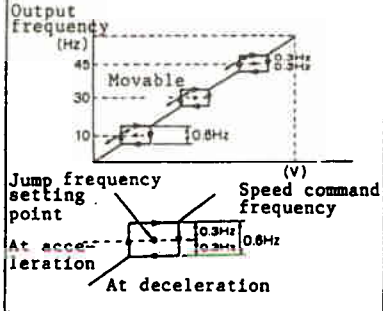
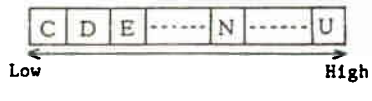
Operation Step	Key Operation	Description
Function 1 mode selection		Selects Function 1 mode. Selects the function name.
Function 2 mode selection Data setting/ change Store MON selection		Selects Function 2 mode. (When setting and changing data in another function mode after data memory, press the ▲ ▼ to select function 2 mode.) When the data is changed, asterisk "*" is displayed on the 8th digit. When the preset value limit is reached, exclamation"!" is displayed on the 8th digit. When the data is stored in memory, "*" on the 8th digit disappears. When operating the motor, select the monitor mode.

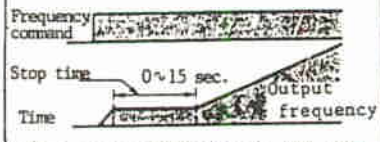
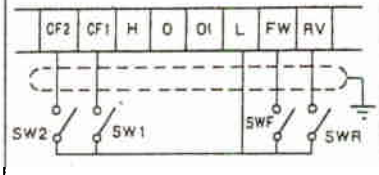
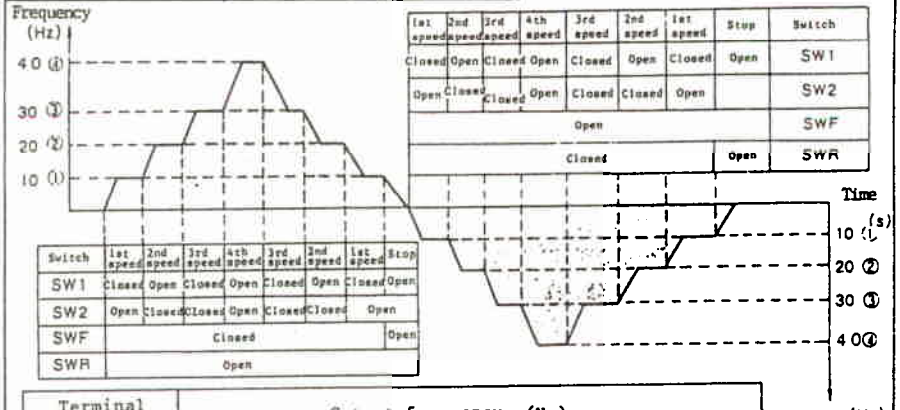
(3) Function mode display, setting, change and contents

Data can be changed on the cursor in the data setting column.

Display Sequence	Function code/ Function name	Key Operation	Display	Contents
1	(F-00) V/F pattern setting		Initial setting value VF1-VC 050-050 ① ② (※1) (※2) The setting value is displayed automatically by entering part ①. (※1) Basic frequency reaching maximum output voltage (※2) Maximum output frequency	Selects V/F pattern. By combination of part ① (Designation of output frequency range) with part ② (Designation of torque characteristics), 36 types of V/F patterns can be selected. ② VC ..... Constant torque VP1 ..... Reduced torque ($F^{1.5}$) VP2 ..... Reduced torque ($F^{1.7}$) VP3 ..... Reduced torque (F^{2})
		Data setting ① ▶ ▲ ▼	VF2-VC 050-144	
		Data setting ② ▶ ▲ ▼ STR	VF2-VP1 050-144	
				Setting/Changing Range ① \ ② VC VP1 VP2 VP3 1 2 3 4 5 6 7 8 V = Output voltage (%) f = Output frequency (Hz)

Display Sequence	Function code/ Function name	Key Operation	Display	Setting/ Changing Range	Contents
2	(F-01) Acceleration time setting		Initial setting value (20 sec.) ACCEL-L 0020.0 S	At linear selection 0.1~2999.9 (every 0.1) At curve selection 0.1 ∿ 230 (every 0.1)	Sets the acceleration time before the highest frequency is reached from operation start. (F-24) Note: The set time at curve selection is from start point to the set point frequency.
		Data setting ▶ ▲ ▼ STR	ACCEL-1 0150.0 S		
3	(F-02) Deceleration time setting		Initial setting value (30 sec.) DECEL-1 0020.0 S	At linear selection 0.1~2999.9 (every 0.1) At curve selection 0.1 ∿ 230 (every 0.1)	Sets the deceleration time before the operation is stopped from the highest frequency. (F-25) Note: The set time at curve selection is from startpoint to the set point frequency.
		Data setting ▶ ▲ ▼ STR	DECEL-1 0100.0 S		
4	(F-03) Maximum frequency adjustment		Initial setting value (0 Hz) +Fmax. 000.0 Hz	0~15 (every 0.1)	Increases the highest frequency. This adjustment is made within the range of constant output characteristics. 
		Data setting ▶ ▲ ▼ STR	+Fmax. 015.0 Hz		
5	(F-04) Starting frequency adjustment		Initial setting value (0.5 Hz) Fmin. 00.5 Hz	0.5~5.0Hz (every 0.1)	Adjusts the starting frequency. 
		Data setting ▶ ▲ ▼ STR	Fmin. 05.0 Hz		

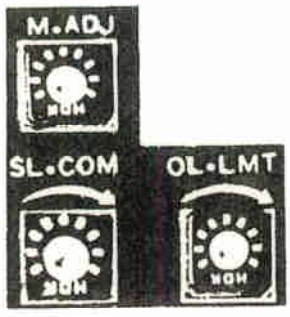
Display Sequence	Function code/ Function name	Key Operation	Display	Setting/ Changing Range	Contents
6 7	(F-05) (F-06)	■ Frequency upper limiter Initial setting value (0 Hz) Data setting ▶ ▲ ▼ STR	H-LIM-F 000.0 Hz H-LIM-F 045.0 Hz	0~159 (every 0.1)	The upper and lower limits of output frequency can be set separately. Upper limiter: Steps of 0.1 Hz between the lowest and highest frequencies Lower limiter: Steps of 0.1 Hz between the lowest and highest frequencies An error is produced when the upper limit is smaller than the lower limit. <Sample setting> 
		■ Frequency lower limiter Initial setting value (0 Hz) Data setting ▶ ▲ ▼ STR	L-LIM-F 000.5 Hz L-LIM-F 020.0 Hz	0~159 (every 0.1)	Note: The setting sequence should be as follows. Reverse sequence makes the setting impossible. At setting: Execute H-LIM-F, then execute L-LIM-F. At erasing: First execute L-LIM-F.
8 9 10	(F-07) (F-08) (F-09) Jump frequency ① setting Jump frequency ② setting Jump frequency ③ setting	Initial setting value (0 Hz) Data setting ▶ ▲ ▼ STR	JUNP-F1 000.0 Hz JUNP-F2 000.0 Hz JUNP-F3 000.0 Hz JUNP-F1 010.0 Hz JUNP-F2 030.0 Hz JUNP-F3 045.0 Hz	0~159 (every 0.1)	To avoid resonance with load, it is possible to jump up 3 frequencies. The setting sequence may be replaced.  Note: Jump frequency makes the setting impossible for the area of ±0.3 Hz of the preset frequency. When passing, the frequency is transmitted even in the jump area.
11	(F-10) Motor noise adjustment	Initial setting value Data setting ▶ ▲ ▼ STR	CF-code <U> CF-code <C>	C~U	The inverter carrier frequency is varied, making it possible to change the motor sound quality. 

Display Sequence	Function code/ Function name	Key Operation	Display	Setting/ Changing Range	Contents
12	(F-11) Frequency stop time adjustment at start	Data setting ▶ ▲ ▼ STR	Initial setting value (0.5S) Fstop-T 0.0 S Fstop-T 15.0 S	0 ~15 (every 0.1)	Stops the frequency temporarily to prevent motor overcurrent at start  ·The stop frequency is the one twelfth basic frequency or lowest frequency, whichever is higher.
13 14 15	(F-12) (F-13) (F-14) Multistage speed① setting Multistage speed② setting Multistage speed③ setting	Data setting ▶ ▲ ▼ STR	Initial setting value (0Hz) Speed-1 000.0 Hz Speed-2 000.0 Hz Speed-3 000.0 Hz ① Speed-1 010.0 Hz ② Speed-2 020.0 Hz ③ Speed-3 030.0 Hz ④ FS 040.0 Hz	0~159 (everry 0.1)	Up to 4 stages of operations are available, including the frequency command from the digital operation panel (or external panel). This setting is effective for pattern operation of carriage and conveyor, for example.   Switch: 1st speed, 2nd speed, 3rd speed, 4th speed, 3rd speed, 2nd speed, 1st speed, Stop SW1: Closed, Open, Closed, Open, Closed, Open, Closed, Open SW2: Open, Closed, Closed, Open, Closed, Closed, Open SWF: Closed, Open SWR: Open Terminal CF1 / CF2 — Output frequency (Hz) Open / Open — Frequency command from OPE-key or terminal mode Closed / Open — Value preset by Speed-1 Open / Closed — Value preset by Speed-2 Closed / Closed — Value preset by Speed-3

Display Sequence	Function code/ Function name	Key Operation	Display	Setting/ Changing Range	Contents
16	(F-20) DC braking frequency adjustment - Optional		Initial setting value (1.0 Hz) F—DCB 01.0 Hz	0.5~15 (every 0.1)	Adjusts the starting frequency for DC braking at deceleration when DC braking is selected. (Effective only when optional PC board is used.) (See ④ of F-28) Output frequency (Hz) 0.5~15Hz Time (S)
		Data setting ▶ ▲ ▼ STR	F—DCB 15.0 Hz		
17	(F-21) DC braking power adjustment		Initial setting value (10) V—DCB 010	0~20 (every 1)	Varies DC braking power. (See ④ of F-28)
		Data setting ▶ ▲ ▼ STR	V—DCB 020		
18	(F-22) DC braking time adjustment		Initial setting value (5S) T—DCB 05.0 S	0~15 (every 0.1)	Adjusts DC braking time. (See ④ of F-28) Output frequency (Hz) Time (S) 0~15S
		Data setting ▶ ▲ ▼ STR	T—DCB 15.0 S		
19	(F-23) Electronic thermal level adjustment		Initial setting value (100%) E—therm 100%	100~50 (every 1)	The electronic thermal level can be changed. (100 ~ 50%) Adjust to the current value for setting. When continuous operation is performed at less than 10 Hz, use the thermal relay. Time (sec.) 50% 100% Adjustable Inverter rated current 50 100 150 200(%) Current value (A) Adjusting level = Motor rated current / Inverter rated current x 100(%)
		Data setting ▶ ▲ ▼ STR	E—therm 050%		
20	(F-24) Linear/ Curved acceleration selection		Initial setting value (Linear) ACCline Linear	Linear or S-Curve	Selects linear acceleration (Linear) or curved acceleration (S-curve). Setting frequency Linear acceleration Curved acceleration Time (Note) The setting and changing range differs in acceleration time between the linear and curved accelerations. (See F-01.)
		Data setting ▶ ▲ ▼ STR	ACCline S-Curve		

Display Sequence	Function code/ Function name	Key Operation	Display	Setting/ Changing Range	Contents
21	(F-25) Linear/ curved decele-ration selec-tion		Initial setting value (Linear) DECline Linear	Linear or S-Curve	Selects linear deceleration (Linear) or curved deceleration (S-curve). ☞ (F-02)(F-22) (Note) The deceleration time set-ting and changing range differs between linear and S-curve deceleration.
		Data setting ▶ ▲ ▼ STR	DECline S-Curve		
22 23	(F-26) (F-27) External frequency setting start External frequency setting end		● External frequency setting start (F-26) Initial setting value (0 Hz) F-START 000.0 Hz	0~159 (every 0.1)	Sets the output frequency start and end for external analog fre-quency commands (0~10V DC, 0~5V DC 4~20 mA) to the inverter. Output frequency (Hz) End Start 0 ---------- 10V Frequency command 0 ---------- 5V 4 ---------- 20mA (Note 1) The frequency is 0 Hz at standard setting (initial preset value). In this case, the inverter is operated at the selected V/F pattern. (Note 2) When changing V/F pattern after start (F-START) and end (F-END) setting, re-adjust start (F-START) and END (F-END).
		Data setting ▶ ▲ ▼ STR	F-START 020.0 Hz		
			● External frequency setting end (F-27) Initial setting value (0 Hz) F-END 000.0 Hz	0~159 (every 0.1)	
		Data setting ▶ ▲ ▼ STR	F-END 040.0 Hz		
24	(F-28) Switch selection		Initial setting value (See below) SWITCHI 00000101 ⑥ ⑤ ④ ③ ② ①		Particular selection is made. ⑤ 00 Trips the inverter when the power supply is abnormal and outputs an alarm signal. 10 When the re-start function is used ☞ (F-36) ④ 0 Overload is restricted over the entire area. 1 No overload is restricted at start. ☞ (F-30) ③ 0 Frequency monitor (FM) When the digital frequency counter is connected. 1 Frequency monitor (FM) When an analog meter is connected. ② 0 No DC braking present 1 DC braking present ☞ (F-20)(F-21)(F-22) Do not use ① and ⑥. For further details, refer to page 70.
		Data setting ▶ ▲ ▼ STR	SWITCHI 00101001		

Display Sequence	Function code/ Function name	Key Operation	Display	Setting/ Changing Range	Contents
25	(F-30) Overload limit setting	—	Initial setting value (1.0 Hz) LM. CONS 001.0	0.3~30 (every 0.1)	· Constant for overload limit characteristics: reduce the preset value when OC tripping is liable to occur at the standard preset value. (See "Overload Alarm Level Adjustment" (F-31) and "Overload Limit Level Adjustment".) · For OC.ACCEL, do not change this constant, but increase the acceleration time. · When tripping is further liable to occur, turn the variable resistor OL.LMT (potentiometer) counterclockwise to reduce the limiting level.
		Data setting ▶ ▲ ▼	LM. CONS 000.5		
26	(F-32) Automatic torque boost adjustment		Initial setting value (00) V—auto +00	0~20 (every 1)	Only during acceleration, boost is applied automatically. The boost can be adjusted in 20 steps. The voltage is increased by approx. 10% at +20. Output voltage (%) 100 0 Output frequency(Hz) When acceleration is over, reaching a constant speed for automatic boost, the initial V/F is selected automatically. (No operation is continuously performed with the motor over-excited.) Output voltage (%) 100 Approx. 18 0 Output frequency (Hz) When manual boost is used together, the voltage is added as shown above (▨). Refer to "Monitor Mode 7" and "Manual Torque Boost".
		Data setting ▶ ▲ ▼	V—auto +20		
27	(F-36) Standby time setting for re-start after instantaneous power failure		Initial setting value (1.0S) IPS—R—T 001.0 S	0.3~3.0 (every 0.1)	The standby time between the instantaneous power failure restoration and operation re-start can be preset. When the power failure is reset within the allowable instantaneous stop time thus preset, the time before the inverter re-starts automatically is set. Main power supply Power failure time Allowable I.P.F. time Allowable I.P.F. time (=0.3s) Inverter output frequency 15mS Standby time Motor speed (F-28)
		Data setting ▶ ▲ ▼	IPS—R—T 003.0 S		

Display Sequence	Function code/ Function name	Key Operation	Display	Setting/ Changing Range	Contents
—	Overload limit level adjust-ment	—	Variable resistor (potentiometer) on PC board 		Change the overload limit level, using the OL.LMT (VR). Counterclockwise: 50~80% Center : 100% Clockwise : 150% For the level, the inverter rated current shall be 100%. The overload limit level variable resistor (OL.LMT) is located on PC board when the inverter terminal cover is removed. Standard setting is approx. 125%.
	Slip compen-sation	—			The slip compensation allows to reduce the natural speed loss of the asynchronous motor due to increased load. In the range under condition of V/F constant and above 15Hz, speed accuracies of approx. 1.5% n_N can be achieved without tacho generator feedback. Turning the "SL.COM" (VR) clock-wise, reduces the slip.

F-28	Switch	SWITCH1	00	00	0	1	0	1
			⑥	⑤	④	③	②	①

①		-	Not used.
②	0	No DC braking present	Refer to F-20 to F-22.
	1	DC braking present	
③	0	Frequency digital monitor	Refer to "Frequency Monitor Signal (FM)" given under para. 8.
	1	Frequency analog monitor	
④		-	Not used.
⑤	00	Trip	Standard setting: · An alarm signal is output for instantaneous power failure, undervoltage and other tripped contents.
	10	Restart function	This setting allows operation re-start when the following trips occur. · Overcurrent · Overvoltage · Undervoltage · Instantaneous power failure The frequency of operation re-start is 3 times/10 minutes except for instantaneous power failure and undervoltage. For instantaneous power failure, the time required for operation re-start corresponds to the time preset by F-36 (IPS-R-T).
⑥		-	Not used: Invalid even when set.

(4) Retry function

(a) Retry function

Retry function is performed without transmitting an alarm signal when tripping occurs due to overcurrent (OC), overvoltage (OV), undervoltage (UV) and instantaneous power failure (IP). The number of times of retry when tripping occurs due to overcurrent (OC) and overvoltage (OV) is 3 times/10 minutes.

This function is standard equipped in this inverter. However, the retry function can be selected by switch selection F-28 in the function mode; that is,

F-28	SWITCH	00	00	0101

(Standard setting)

00	Trip	An alarm signal is output when tripping occurs.	(Standard setting)
10	Restart by retry	Try operation restart when tripping occurs.	—

Note: Retry operation is the same as restart after instantaneous power failure.

(b) Restart function after instantaneous power failure

Retry function after tripping when instantaneous power failure (IP) corresponds to the restart function after instantaneous power failure.

In other words, when instantaneous power failure occurs and it is recovered, operation is restarted automatically. If the motor is rotating in free-run conditions, the frequency at which the motor is rotating is picked up, and operation is restarted with nearly the same speed rpm. (When "10" of switch selection F-28 in the function mode is selected) However, in the following cases, operation may be started from the lowest frequency (normally called zero start).

① When the standby time for restart after instantaneous power failure recovery (function mode F-36, IPS-R-T) is set to 3 seconds;

② When the output frequency exceeds 50 Hz;

③ When the output frequency is less than 1/2 of the basic frequency with 50 Hz max. setting; and

④ When the motor induced voltage attenuates earlier (for example, pump such that a motor decelerates in a few seconds, and load with high ratio gear).

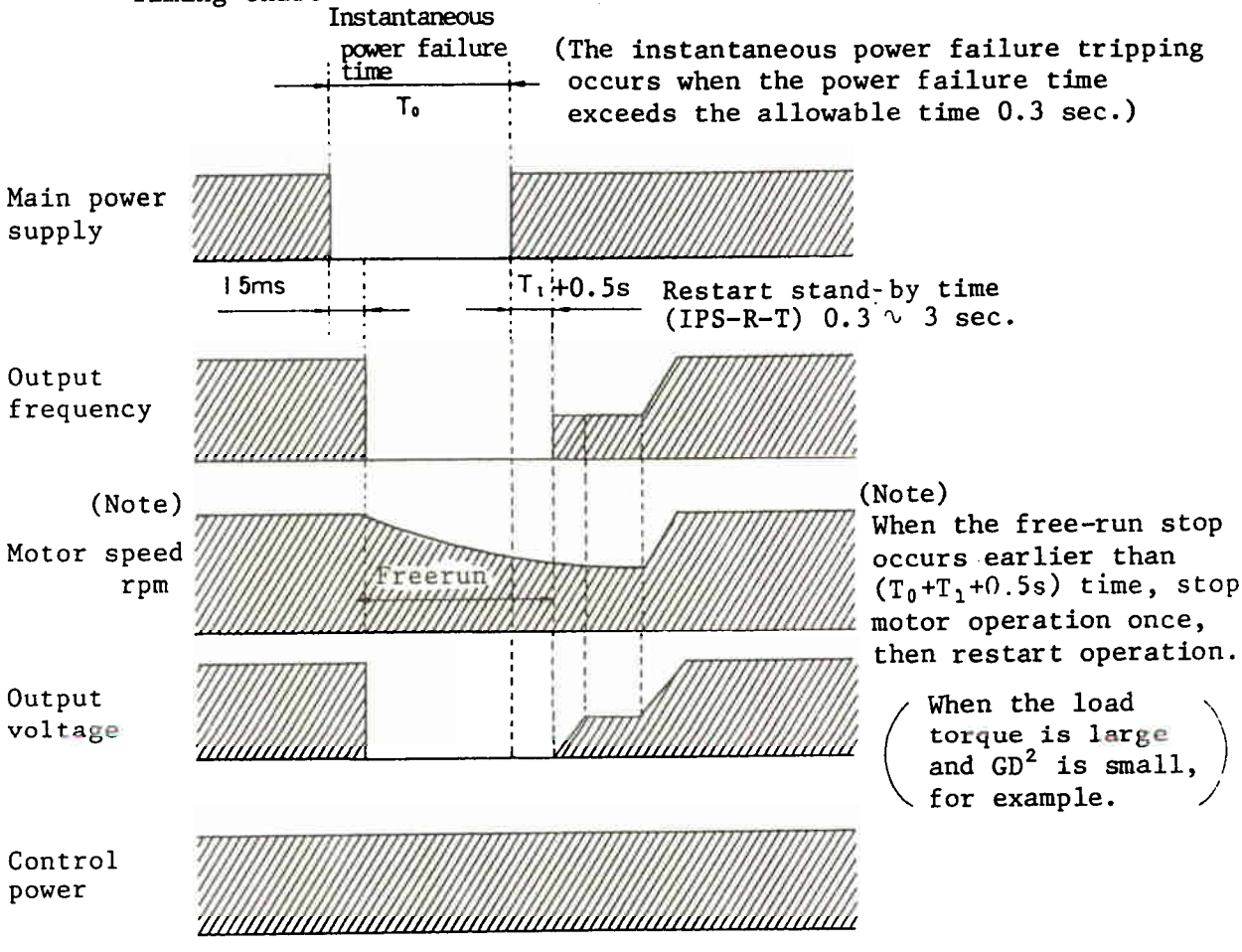
(c) Specification of restart function after instantaneous power failure

The allowable instantaneous power failure time is 0.3 second.

Note 1: The motor runs freely during retry operation time. This function should not be applied when the motor should be held with a mechanical brake during free running.

Note 2: The instantaneous power failure restart timing is shown below.

Timing Chart



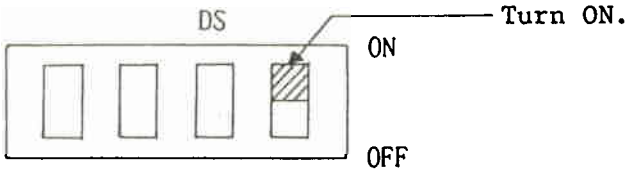
Instantaneous power failure restart timing

(5) Re-setting to initial setting (setting before shipment)

When returning the setting to its initial state (setting before shipment) for some reason, follow the steps below.

① Turn power ON.

② Set the right side of DIP SW on PC board to "ON".



(Refer to Table 5.)

③ With the [MON] [FUN] [STR] keys on the digital operation panel depressed at the same time, turn the forced reset button ON. (Refer to Table 5.)

④ After resetting, release these 3 keys thus depressed in 1 or 2 seconds.

At this time, [B00.....] (ROM No.) is displayed, and operation stops.

If the display unit displays [FM 000. 0Hz], it follows that these 3 keys have been released too early.

Repeat steps ② ∿ ④ above again.

⑤ Turn power OFF.

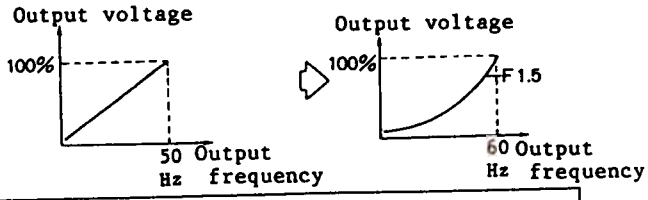
⑥ Turn the DIP SW OFF.

⑦ Turn power ON again, and check that the data corresponds to the standard preset value.

9.4 Sample setting and change operation

(1) V/F pattern setting and change

When changing the setting to the following V/F pattern:



Operation Step	Key Operation	Display	Explanation
1	FUN	F-00 VF1-VC	Selects Function Mode 1 and selects V/F pattern mode.
2	FUN	VF1-VC 050-050	Selects Function Mode 2.
3	▶	VF1-VC 050-050	Press ▶, and adjust it to the setting and changing position.
4	▲ or ▼	VF3-VC • 060-060	Press ▲ or ▼: the character will change. Adjust it to a desired one.
5	▶	VF3-VC • 060-060	Press ▶, and adjust it to the setting and changing position.
6	▲ or ▼	VF3-VP1* 060-060	Press ▲ or ▼: the code will change. Adjust it to a desired one.
7	STR	VF3-VP1 060-060	Stores the preset data in memory. "*" will disappear if stored in memory.
8	MON	FM 000.00H	Press MON: the monitor mode is selected again. The motor starts operation when the operation and frequency commands are entered.
9	Turn Power OFF	—	Data is stored in an element in which to store it even when power is interrupted.

(2) Acceleration/deceleration time change

When changing the setting as follows:

Acceleration time 20 sec. (standard preset value) → 120 sec.
Deceleration time 20 sec. (standard preset value) → 120 sec.

Operation Step	Key Operation	Display	Explanation
1	FUN	F--00 VF1-VC	Selects the function mode.
2	▲	F--01 ACCEL-1	Selects the acceleration time setting mode.
3	FUN	ACCEL-1 0020.0 S	Selects the function 2 mode of acceleration time setting mode.
4	▶	ACCEL-1 0020.0 S Cursor movable	Move the cursor and adjust it to the setting and changing position.
5	▲ or ▼	ACCEL-1* 0120.00S	Press ▲ or ▼, and adjust to a desired time. Note) "!" is displayed when the setting limit value is reached.
6	STR	ACCEL-1 0120.00S	Stores the preset data in memory. Note) When the data is saved, "*" disappears.
7	FUN	F-01 ACCEL-1	After completion of acceleration time storage, the step will return to step 2 above if FUN is depressed.
8	▲	F-02 DECEL-1	Selects the deceleration time setting mode.
9	FUN	DECEL-1 0020.0 S	Selects the function 2 mode of deceleration time setting mode.
10	▶	DECEL-1 0020.0 S Cursor movable	Move the cursor to the position in which to set and change the data.
11	▲ or ▼	DECEL-1* 0120.0 S	Press ▲ or ▼: the figure in the position at which the cursor is stopping will be changed. Adjust to the desired time. Note) "!" will be displayed if the preset value limit is reached.
12	STR	DECEL-1 0120.0 S	Stores the data in memory. Note) When the data is saved, "*" disappears.
13	MON	FM 000.0H	Press MON: the monitor mode is selected again. The motor is operated when the frequency and operation commands are entered.
14	Turn Power OFF	—	Data is stored in an element in which to save it even when power is cut off.

10. FUNCTION AND DESCRIPTION OF OPTIONAL UNIT

10.1 Operation box (OPE-4M/8M)

The standard specification of operation box is shown in Table 8 below. To connect the operation box and inverter, use a shielded cable.

Table 8 Standard Specification

Model No.	OPE-4M	OPE-8M
Protective structure	Enclosed type	
Frequency meter	43 mm square (0∿50 Hz, 0∿100 Hz; 0∿60 Hz, 0∿120 Hz, Co-used scale)	80 mm square (0∿50 Hz, 0∿100 Hz, 0∿200 Hz; 0∿60 Hz, 0∿120 Hz, 0∿240 Hz, Co-used scale)
Frequency setting device	0.5W 1 kΩ	
Switch	FWD/STOP, REV/STOP, JOG (DC 10V, 10 mA)	
Painting color	Munsell 5Y7/1	

Note 1: The frequency meter internal impedance should be 10 ∿ 22 kΩ.

Note 2: For frequency meter adjustment, use a variable resistor (M.ADJ) within the inverter and variable resistor of frequency counter itself.

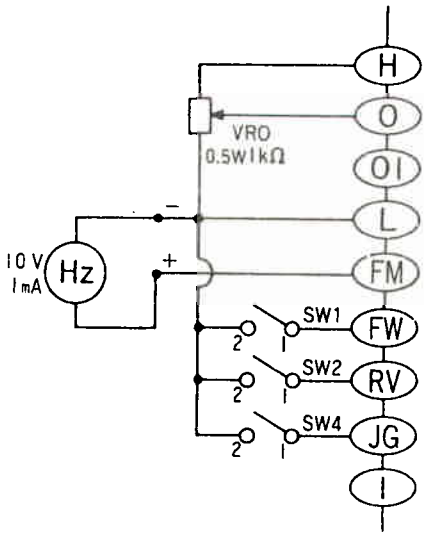


Fig. 17 Operation Box Internal Sequence

10.2 Optional function (IA-TWK)

5 functions can be expanded by mounting one optional PC board (IA-TWK)

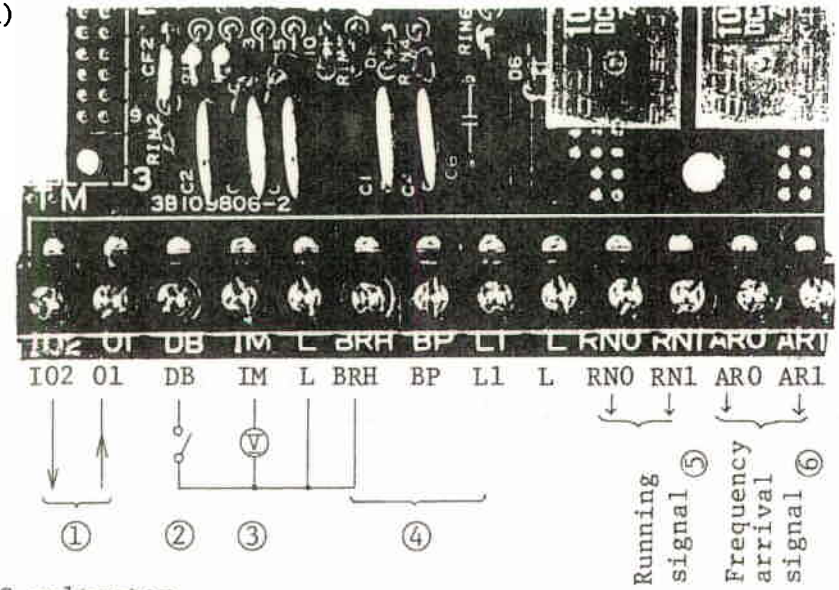
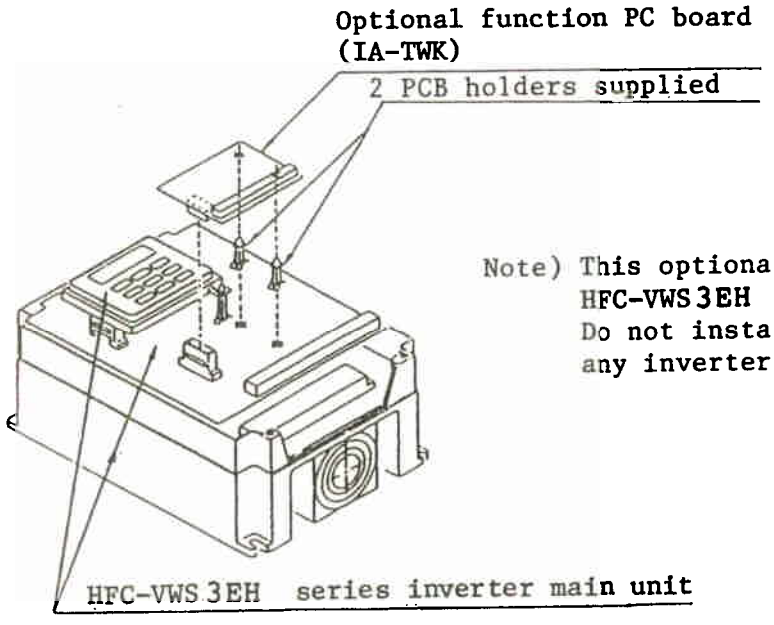


Fig. 18 Optional PC Board Terminal

· Installation

As shown below, install the IA-TWK securely so that no poor contact is found.



Note) This optional PC board is only for HFC-VWS3EH series.
Do not install this PC board on any inverter other than this series.

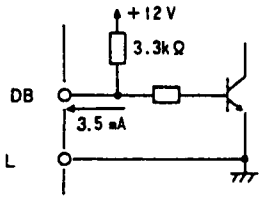
Fig. 19 PC Board (Optional) Installation

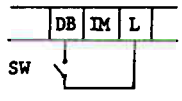
(1) Function

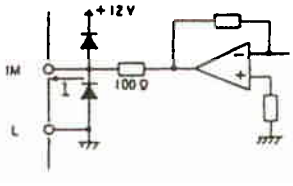
5 types of functions are available by installing this single PC board.

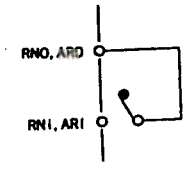
The respective functions are shown in Table 9.

Table 9 Function

<table>
<tr><th>Function No.</th><th>Function name</th><th>Terminal used</th><th>Contents</th><th>Terminal specification</th></tr>
<tr><td>①</td><td>Speed setting signal 0∿20mA</td><td>I02-L
01-0</td><td>· Connect 01 with 0 terminal of main PCB
· Input 0∿20mA between I02(+) and L(-).</td><td></td></tr>
<tr><td>②</td><td>DC braking external command</td><td>DB-L</td><td>· DC brake is applied forcedly during deceleration by short-circuiting the circuit between DB and L.
· The following adjustment can be made, using the digital operation panel.
<table>
<tr><th>Function mode No.</th><th>Function name</th><th>Variable range</th><th>Factory setting</th></tr>
<tr><td>F-20</td><td>DC braking start frequency</td><td>0.5 ∿15 Hz</td><td>1.0 Hz</td></tr>
<tr><td>F-21</td><td>DC braking power</td><td>0 ∿ 20</td><td>10</td></tr>
<tr><td>F-22</td><td>DC braking time</td><td>0 ∿ 15 sec</td><td>5 sec</td></tr>
</table>
· If power is turned ON and retry operation is performed with the circuit between DB-L short-circuited, "NG .DB" tripping occurs.</td><td> 



SW ON time should be shorter than setting time by T-DCB (F-22).</td></tr>
<tr><td>③</td><td>Inverter output current signal</td><td>IM-L</td><td>· The voltage proportional to inverter output current is transmitted.
· Output voltage at rated current = 4 VDC
Accuracy: ±0.4V (10 - 159 Hz)</td><td> 
</td></tr>
</table>

Function No.	Function name	Terminal used	Contents	Terminal specification
④	—	BRH-L BP-L1	Not used. · Connect BRH with L. · If BRH is not connected with L, "OV.BRD" tripping occures. · Never use BP and L1.	 Contact spec. AC 250 V, 2.5 A (R Load) 0.2 A (Cosϕ = 0.4) DC 30 V, 3.0 A (R Load) 0.7 A (cosϕ = 0.4)
⑤	Running signal relay output	RNO-RN1	· The contact is closed while the inverter is operating. · Refer to Fig. 20.	
⑥	Frequency arrival signal relay output	ARO-AR1	· When the preset frequency is reached, the contact is open. · Refer to Fig. 20.	

SWITCH I	00	00	0	1	0	1

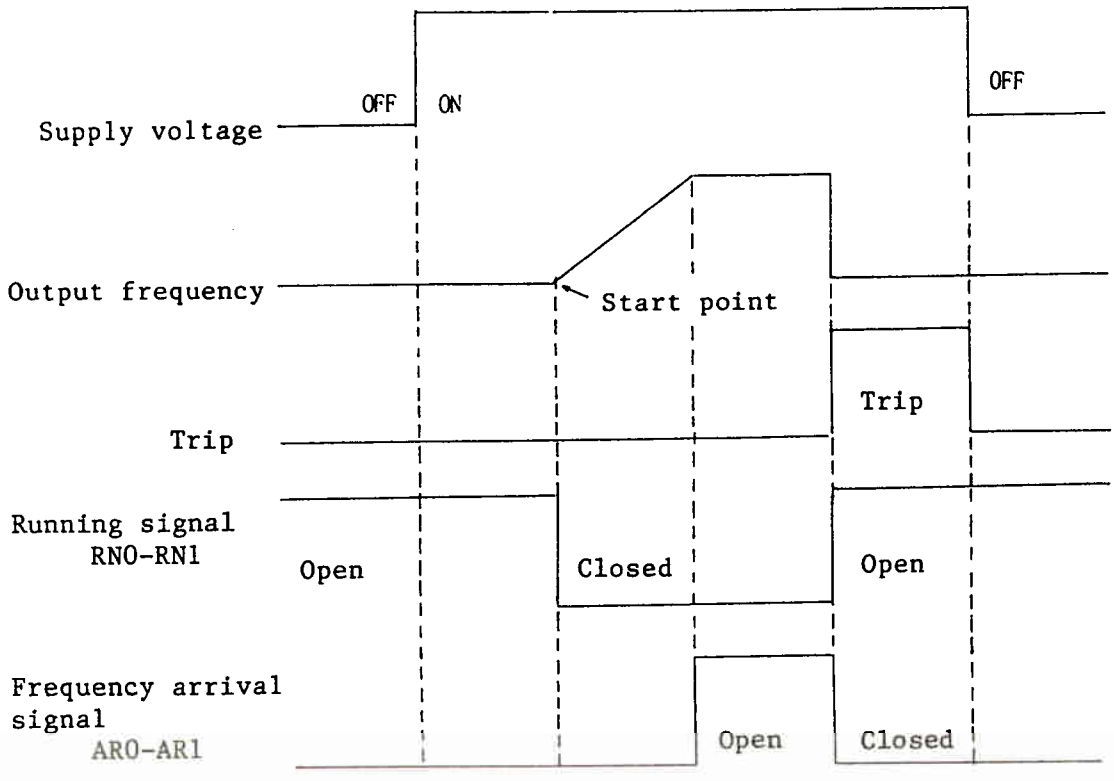


Fig. 20 Timing Chart

11. MAINTENANCE AND CHECK

Prior to maintenance and check, note the following.

(a) During maintenance and check, be sure to turn power OFF.

(b) For 200V class inverter, start this operation when the characters on the digital display unit disappear after power OFF. For 400V class inverter, the charge lamp beside the main circuit terminal block should go off before operation. (However, approx. 50 VDC still remains immediately after the display disappears.)

(c) When removing or re-installing a connector, do not pull the cable.

(d) Take special care not to mis-insert the connector.

11.1 General precautions

Always keep the unit clean to prevent entry of dust or dirt. Carefully note disconnector or poor contact. Be sure to tighten the terminals and connectors securely.

It should be noted that electronic equipment is not resistant to moisture and oil mist, and intrusion of dust or iron powder will damage the insulation, leading to an unexpected accident.

11.2 Routine check times

a. Supply voltage

b. Output frequency, output voltage and output current

c. Abnormal noise ..... Inverter and motor

d. Temperature ..... Ambient temperature, inverter temperature and motor temperature increase

e. Humidity ..... 90% Max. (no dew condensation is allowed)

f. Oil mist and coolant ..... Check that the oil mist or coolant do not enter the inverter unit.

11.3 Periodical check items

a. Loose wiring terminals and connectors

b. Dust or dirt in vent hole

c. PC board and main circuit cleaning (air blow)

d. Insulation resistance (See Fig. 26.)

11.4 Checking method

(a) Output voltage, I/O current and input power measuring method

The inverter output voltage cannot be measured accurately, using a moving iron type meter.

When measuring the fundamental wave rms value V_{AC} contributing direct to motor torque, it is possible to measure this value approximately, using Fig. 21 circuit.

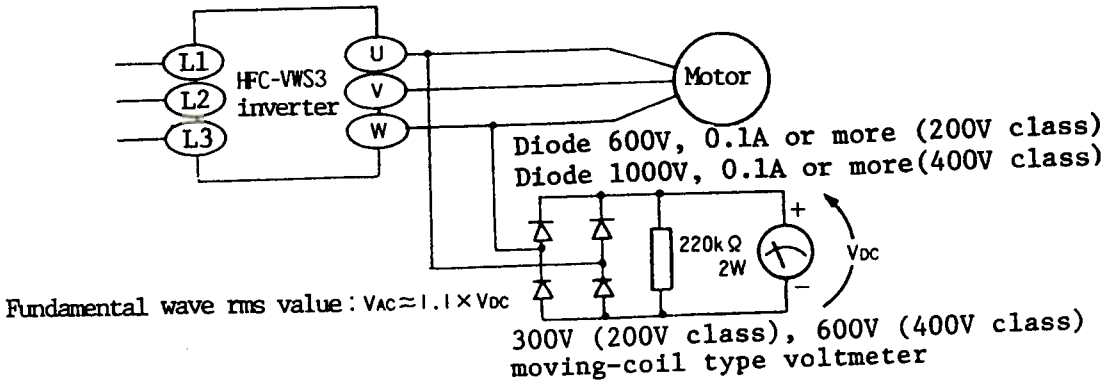


Fig. 21 Output Voltage Measuring Circuit

I/O current can be approximately measured, using a moving iron type meter. Measure input power, using 3 single-phase electrodynamic meters.

When no load is connected to outputs U.V.W, DC voltage will develop on terminals U.V.W due to leak current (approx. 2 mA) of a semiconductor even when the output frequency command is set to 0.

Even in such a case, when a voltmeter is connected to the output terminal, make connections as shown in Fig. 22 to prevent meter indication errors.

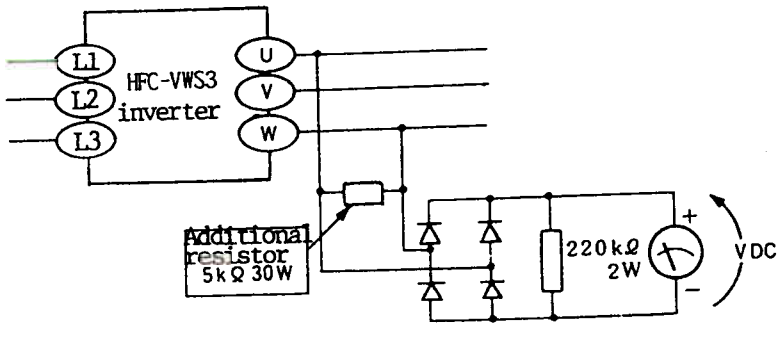


Fig. 22 Output Voltage Measuring Circuit

(b) Maintenance for PC board

No maintenance is required for parts on PC board under normal use; when abnormal conditions occur, however, contact your nearest service station.

When maintenance is required, note the following.

(i) Electrostatic breakdown prevention

MCU and IC on PC board may cause electrostatic breakdown; therefore, be sure to ground the workbench, soldering iron and human body before handling those parts.

(ii) IC socket

When IC socket is used, do not connect or disconnect it unnecessarily: poor contact may cause malfunctions to the unit.

(c) It is recommended that smoothing capacitor CB be replaced with a spare one at least once per 5 years in point of this expected service life. It should be noted that the life is significantly reduced when it is used under high temperature and heavy load conditions in particular. When the capacitor is replaced with a capacitor which has been stored more than 3 years, the aging is required under the following conditions before use.

① At first, apply voltage of 80% of the capacitor rated voltage under normal temperature for one hour.

② Next, increase the voltage up to 90% and apply it under normal temperature for one hour.

③ Finally, apply the rated voltage under normal temperature for 5 hours.

(d) It is recommended that the cooling fan be replaced with a spare one at least once per 2 or 3 years in point of its expected service life.

(e) The life span of digital operation panel is approx. 7 years. If the display is hard to see, the digital operation panel unit exchange is required. (The display unit may be hard to see depending on the viewing angle since it uses a liquid crystal (LCD): it is normal if the display can be read.)

(f) Inverter module checking method

Inverter module acceptability can be checked to some extent by measuring it at the terminal.

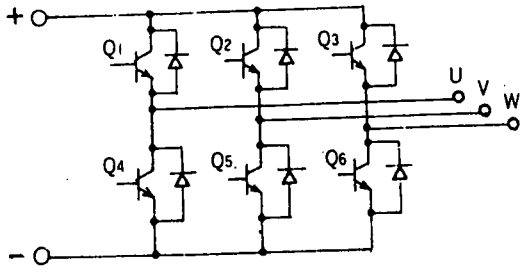
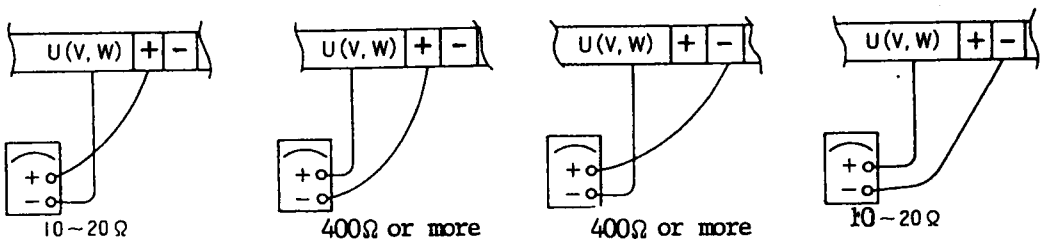


Fig. 23 Circuit Diagram at Inverter Module Unit



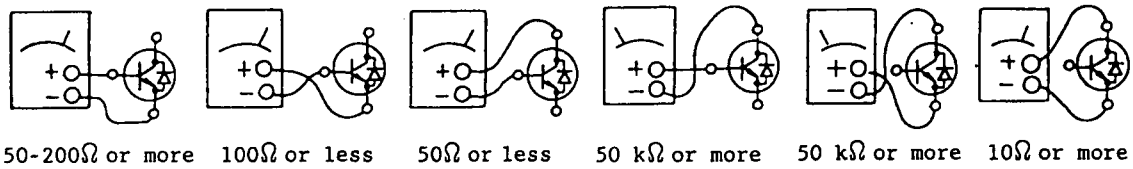
($Q_1 \sim Q_3$ acceptability checking) ($Q_4 \sim Q_6$ acceptability checking)

- Connect a tester for approx. 10 seconds. Immediately after the connection, the resistance value may be small due to a capacitor, such as a snubber.
- Make measurements with a tester in 1Ω range.

Fig. 24 Inverter Module Acceptability Checking at Terminal

A correct acceptability checking method is as shown in Fig. 25. The unit is acceptable if all numerical values below are satisfied. When replacing a module, apply a thin coat of conductive silicone grease onto the installation surface.

If the inverter module is damaged, the base drive modules (BM1 ∿ 2) on PC board may be also damaged; therefore, visually check the conditions.



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

Fig. 25 Inverter Module Acceptability Checking Method

(g) Insulation resistance test and withstand voltage test

As shown in Fig. 26 below, short-circuit the terminal, and conduct the test under the following conditions.

- In this test, measure insulation resistance between the following terminal and earth, using a 500 VDC megger; check that it is 5 MΩ or more.
- For withstand voltage test, apply 1500 VAC (200 V class), or 2000 VAC (400 V class) between Fig. 26 terminal and earth for one minute: Check that the no abormality is found.

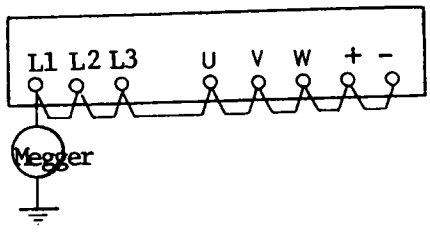


Fig. 26 Insulation Resistance Test and Withstand Voltage Test

12. TROUBLESHOOTING AND MESSAGE CONTENTS

The inverter will operate as shown in Table 10 below if abnormal. Locate the cause and take corrective measures promptly before re-starting operation.

Table 10 Fault Message and Diagnosis

Symptom of malfunction					Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit breaker MCB	Electromagnetic contactor Mg	Thermal relay THRY	Display on digital operation panel (?ERROR ▨)	Fault alarm relay				
			Over V.	○	DC smoothing circuit - Overvoltage	A	Check for sudden deceleration.	Increase the decele-ration time.
							Check that the motor is not rotated from the load side.	The motor cannot be applied to continuous regenerative load.
			OC.ACCEL	○	Overcurrent during motor acceleration (overcurrent at acceleration)	A	Check for sudden acceleration.	Increase the acceleration time.
							Check for output shortcircuit or ground fault.	Check for the output line (motor) and motor shortcircuit.
							Check that torque boost is not too high.	Reduce the torque boost.
							Check that the motor is not locked.	Check the motor or load.
							Check that jogging frequency is too high.	Reduce the jogging frequency.
			OC.DECEL	○	Overcurrent during motor deceleration (Overcurrent at deceleration)	A	Check for sudden deceleration.	Increase the deceleration time.
							Check for output shortcircuit or ground fault.	Check the output line motor shortcircuited.
			OC.DRIVE	○	Overcurrent during constant operation of motor (Overcurrent during operation)	A	Check for sudden change in load.	Eliminate sudden changes in load.
							Check for output shortcircuit and ground fault.	Check the output line motor shortcircuit.
			Over L.	○	Inverter overload (Overloaded operation)	A	Check that the load is not too heavy.	Reduce the load factor.
							Check that the electronic thermal level is correct (not changed).	Adjust to a proper level.

Symptom of malfunction					Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit Breaker MCB	Electromagnetic contactor Mg	Thermal relay THRY	Display on digital operation panel (?ERROR ▨)	Fault alarm relay				
			OH Fin	o	Temperature significantly increasing (Fin overheat)	A	Check that the cooling fan is rotating.	Replace the cooling fan.
							Check that the ambient temperature is not too high.	
			OVER C.	o	Overcurrent detection just after power ON	A	Check that the detector current circuit is normal.	Check abnormal conditions of current detector and PC board detector circuit.
			Under V.	o	Power supply abnormal (Undervoltage)	A	Check that no voltage drops.	Review the power supply system.
							Check that no poor contact of MCB and Mg is found.	Replace MCB and Mg.
							Check that power has been turned OFF or instantaneous power failure has occurred during jogging.	Do not turn power OFF during jogging operation.
							Check that 100 msec or less instantaneous power failure has occurred more than 10 times repeatedly for 10 minutes.	Re-check the power supply system.
			Inst.P-F	o	Power supply abnormal (instantaneous power failure)	A	Check that no voltage drop is found.	Review the power supply system.
							Check that no poor contact of MCB and Mg is found.	Replace MCB and Mg.
			NG·FRS	o	Free-run stop command abnormal	A	Check that the operation command is given during motor free-run, and that no FRS is entered.	Do not enter operation command, FRS during free run.
							With Free-run Stop applied, undervoltage or instantaneous power failure has occurred.	Re-start operation after reset.
							With Free-run Stop applied, power has been cut off.	Re-start operation after reset. With Free-run Stop applied, do not turn power OFF.
							With Free-run Stop applied, power has been turned ON or reset operation has been performed.	

Symptom of malfunction					Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit breaker MCB	Electromagnetic contactor Mg	Thermal relay THRY	Display on digital operation panel (?ERROR)	Fault alarm relay				
			CPU	o	(CPU error)	A	Check that no large noise source is found nearby.	Keep the noise source away from the unit.
							Inverter abnormal	Repair
			GND Flt	o	Ground fault	A	Check the short circuit between inverter output lines and the ground.	Repair the short circuited lines.
			NG-JOG	o	(The jogging mode is used inadvertently)	A	Check that power has been turned ON with the jogging mode ON, commercial power supply voltage has been switched or reset operation has been performed.	With the jogging mode ON, do not turn power ON, switch commercial power supply voltage or reset.
o			-	-	-	B	Power supply side shortcircuit and ground fault.	Repair the short-circuit and ground fault.
							Insufficient MCB capacity	Increase MCB capacity.
			-				Inverter module or converter module damaged.	Repair
	o		-	-	Power failure	B	Check for the power failure.	Review the power supply system.
							Check that no poor contact of MCB and Mg is found.	Replace MCB and Mg.
		o	-	-	-	C	Overload	Reduce the load factor.
							Thermal relay preset value faulty	Set the preset value to a proper one.
			NG.DB	o	DB terminal was used inadvertently.	A	With DB ON, power has been turned ON or reset operation has been performed.	With DB ON, do not turn power ON or reset.
			UV WAIT	-	Supply voltage abnormal (Undervoltage)	-	When restart function was selected, supply voltage dropped to undervoltage level or less.	Review the power supply system.
			OV.BRD	o	BRH terminal is not connected with L terminal.	A	Check BRH-L short-circuited.	Connect BRH with L.

Symptom of malfunction					Cause for fault (Message contents)	Reset	Check points	Suggested remedy
Circuit breaker MCB	Electromagnetic contactor MC	Thermal relay THRY	Display on digital opeation panel (?ERROR )	Fault alarm relay				
			OV.SRC	o	Overvotlage of DC bus voltage linked input voltage.	A	Check input voltage doesn't exceed rated voltage +10%.	Check the power supply system.
							Check for sudden or frequent deceler-ation.	Increase the deceler-ation time or use the BRD (regenerative braking unit).
			BOO Numeral		Refer to para. 12.2 on the following page.	–	Refer to para. 12.2 on the following page.	Refer to para. 12.2. on the following page.

o: shows the equipment which seems to operate in general.

12.1 Resetting method and explanation

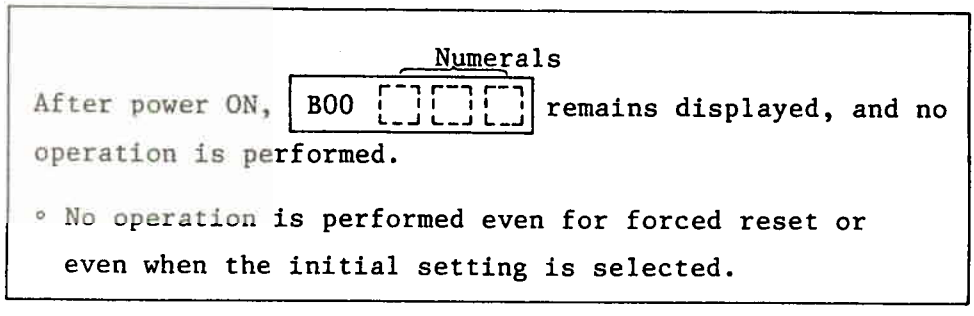
A: After motor operation stop, close the circuit between terminals RS and L on PC board or press the reset button (RESET) at the left lower part on PC board.

B: Operate the circuit breaker and electromagnetic contactor.

C: After motor stop, reset the terminal relay.

12.2 Life of soft memory element

In the following case, it is presumed that the expected service life of soft memory element mounted on PC board has been reached; therefore, replace it with a new PC board.



Note: Operation and stop should be performed, using a command from the control terminal.

The soft memory element is used to store date input from the digital operation panel when the inverter power supply is interrupted.

In this memory element, there is a limit to the frequency of memory, and its frequency corresponds to the life span.

If power is ON and OFF several times/day to store the changed data in memory, its service life will be approx. 10 years.

It is recommended that the inverter be operated and stopped, using a control terminal command, without turning power ON and OFF.

If abnormal conditions other than the above should occur, turn power OFF without any delay.

12.3

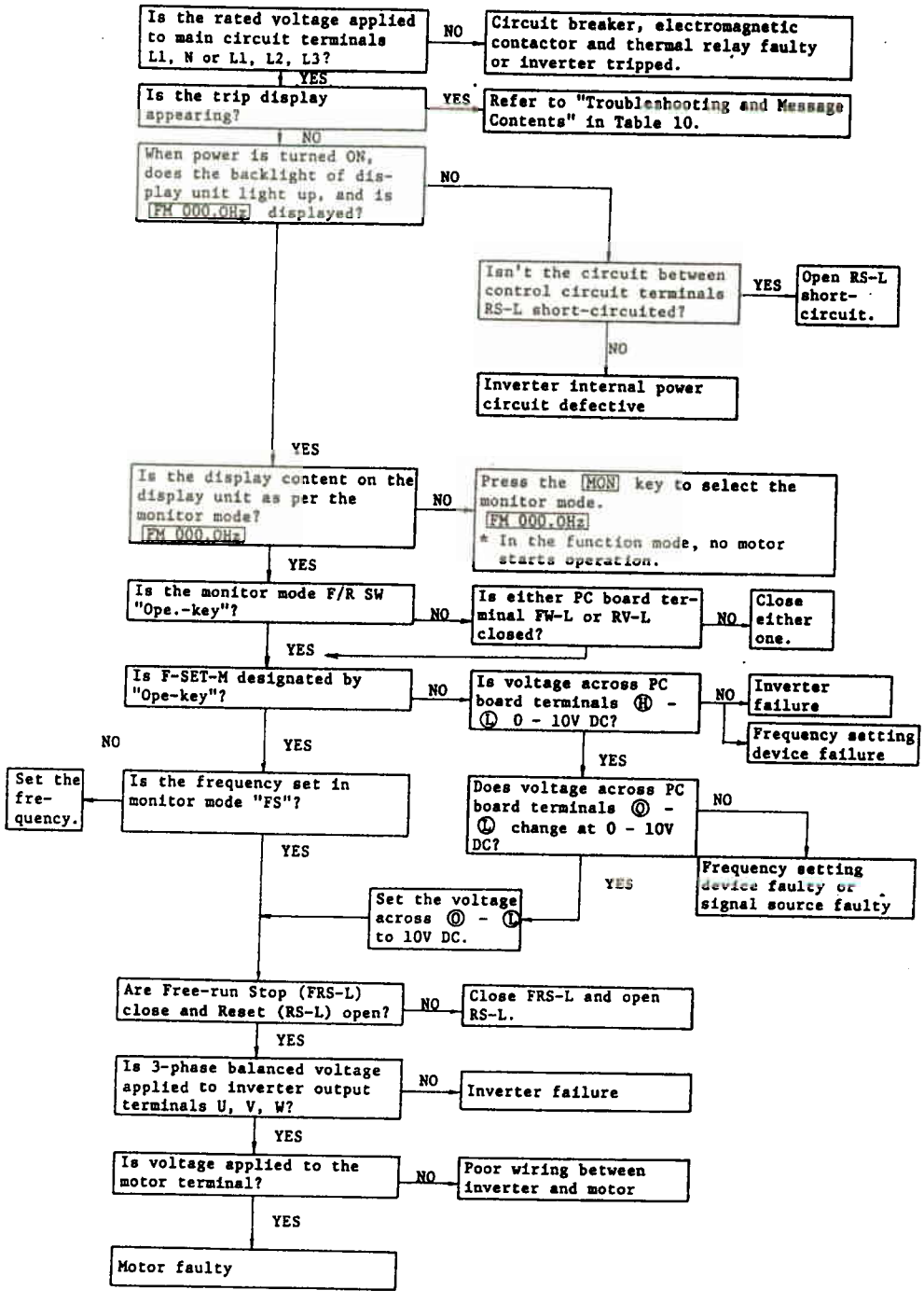
When no data is stored in memory after various operations are performed although the data is set and the [STR] is depressed, it should be noted that this abnormality is due to the following reason.

Reason ..... Set the data and press the [STR], then press the [Forced Reset] (or short-circuit RS-L terminals) and cut off the power supply.

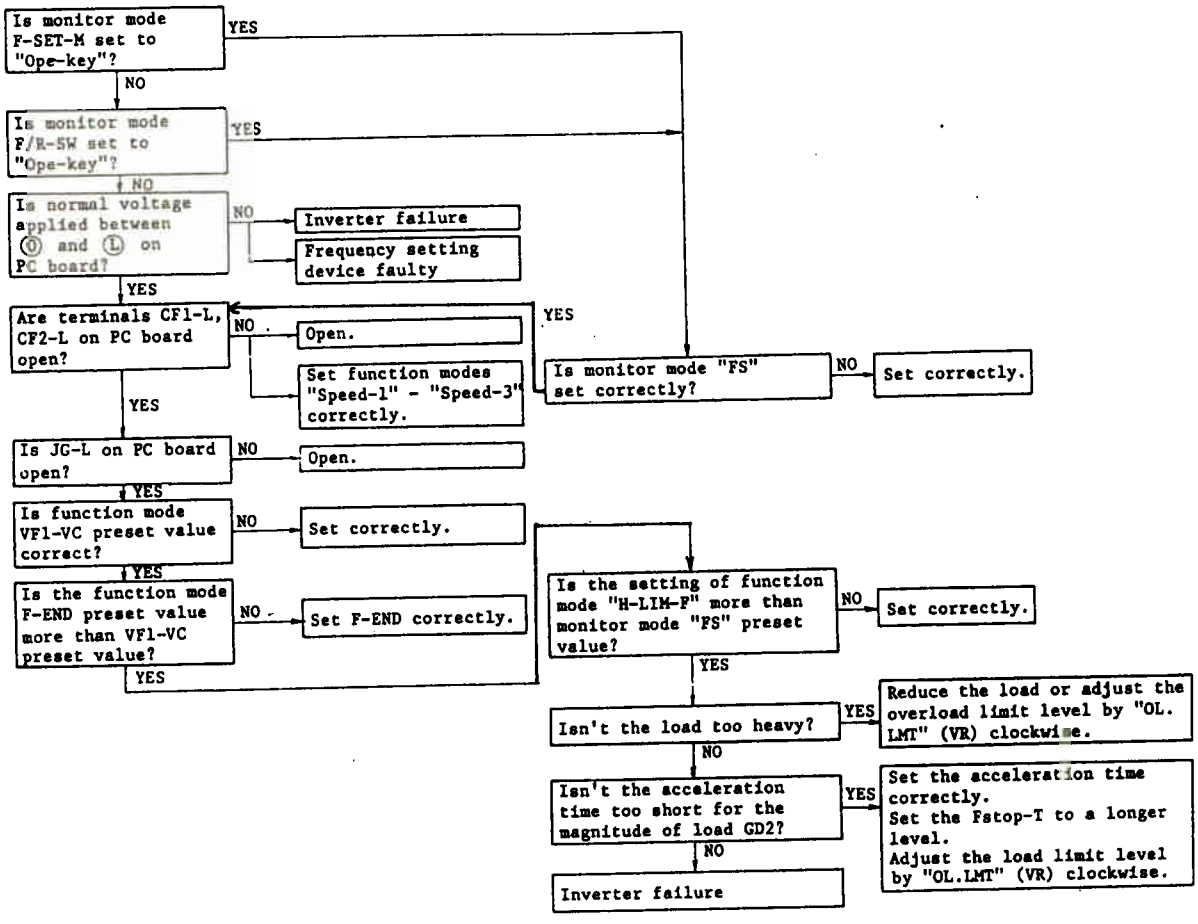
Countermeasures ... Set the data and press the [STR] to store it in memory, then turn power OFF once, and store the data in an element to save it even after power OFF. (Refer to page 27)

13. TROUBLESHOOTING FLOWCHART

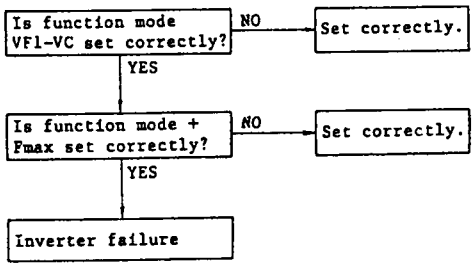
No motor rotates.



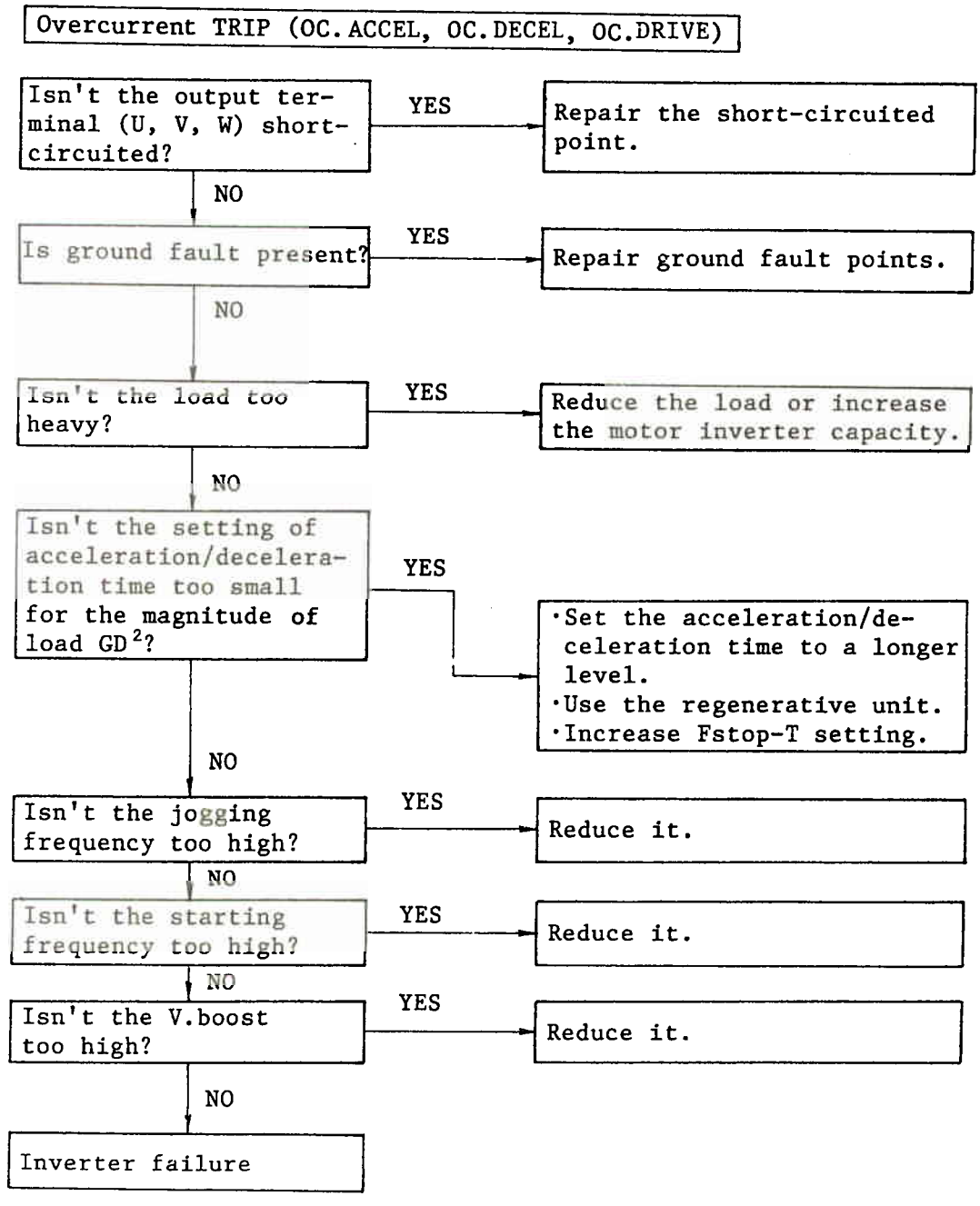
No motor accelerates.



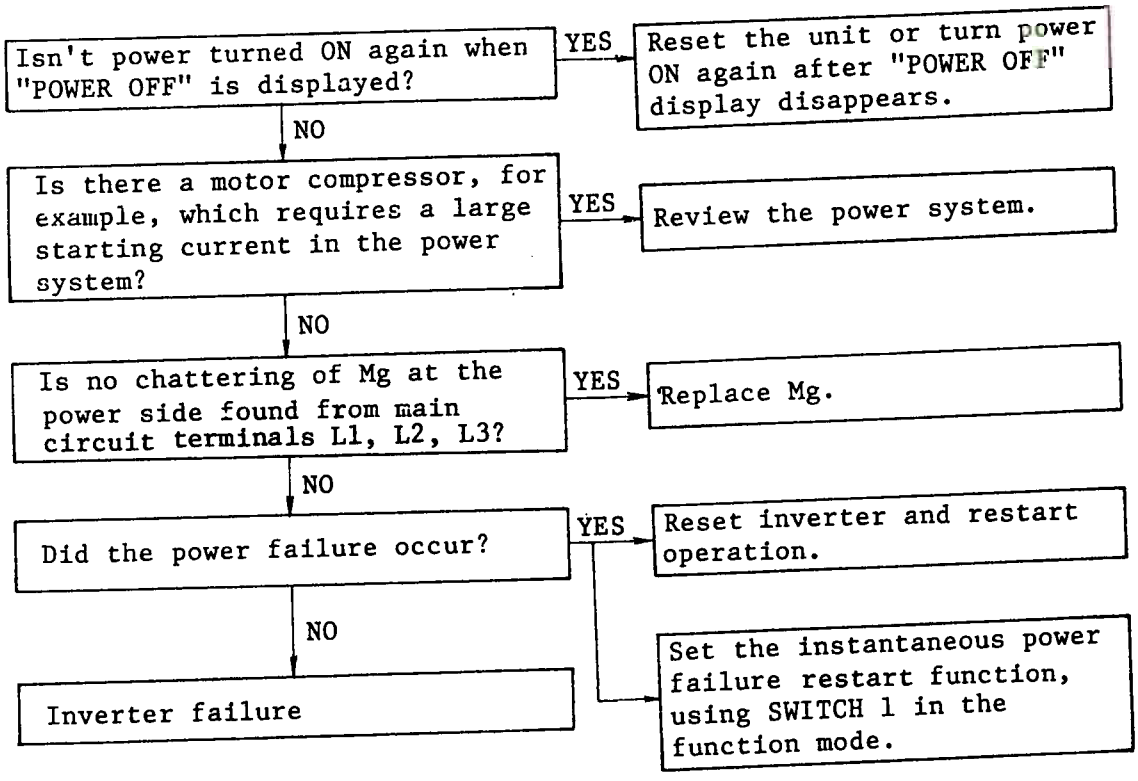
Motor rotation is high.

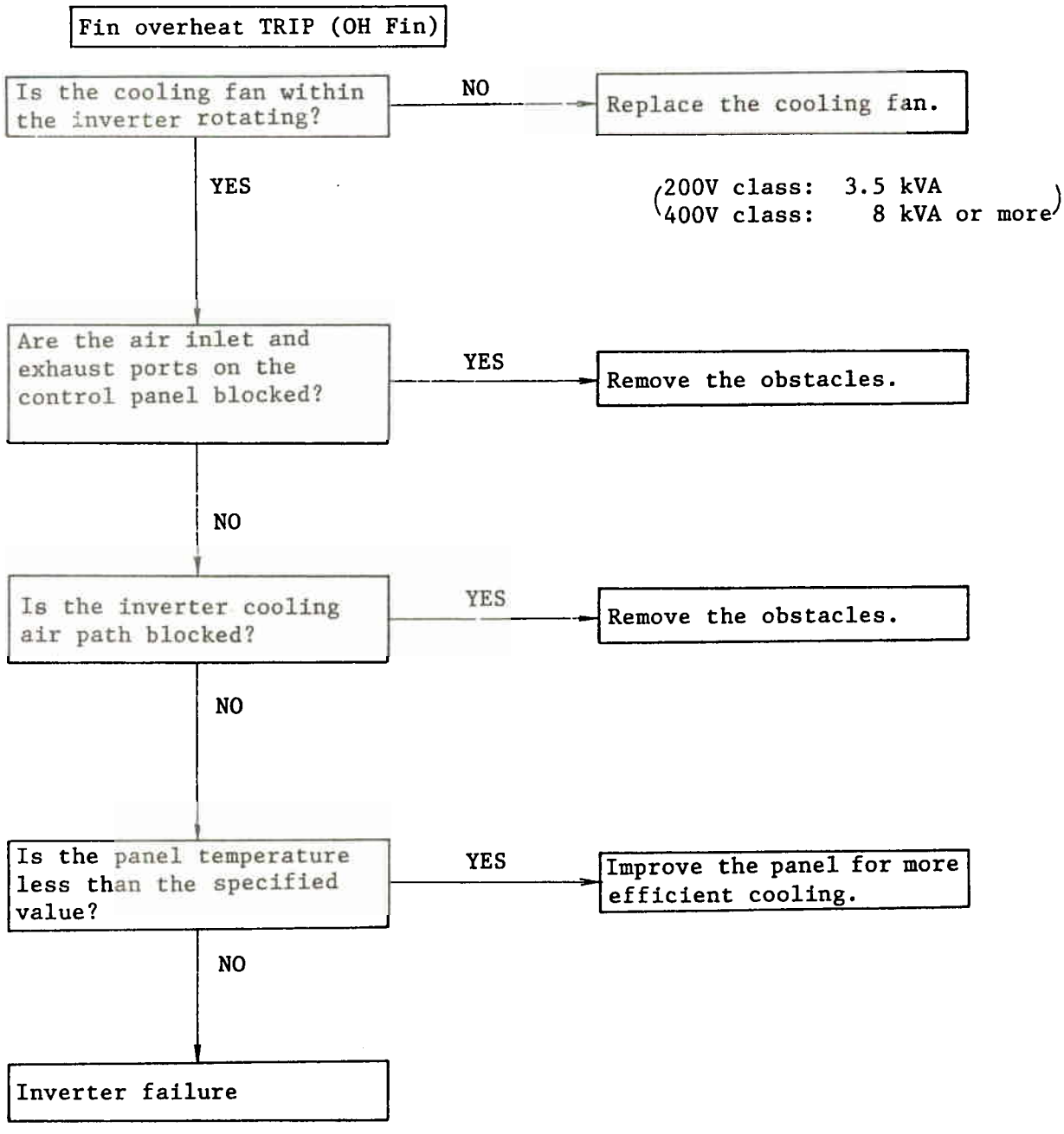


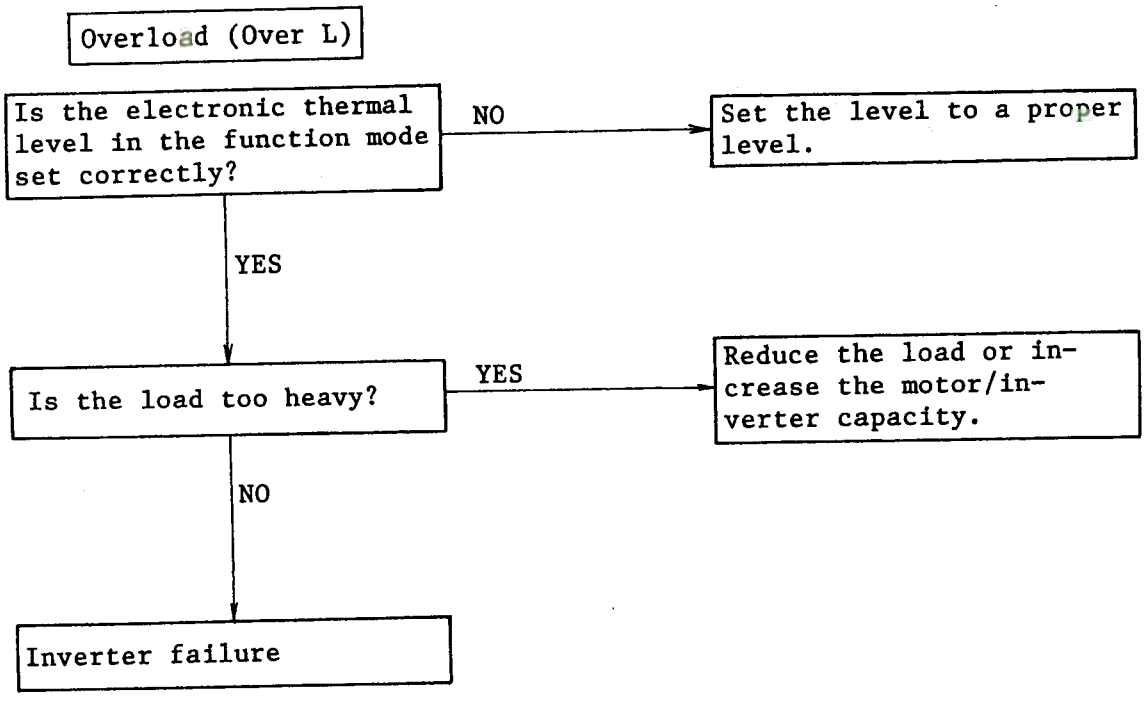
The causes on TRIP display

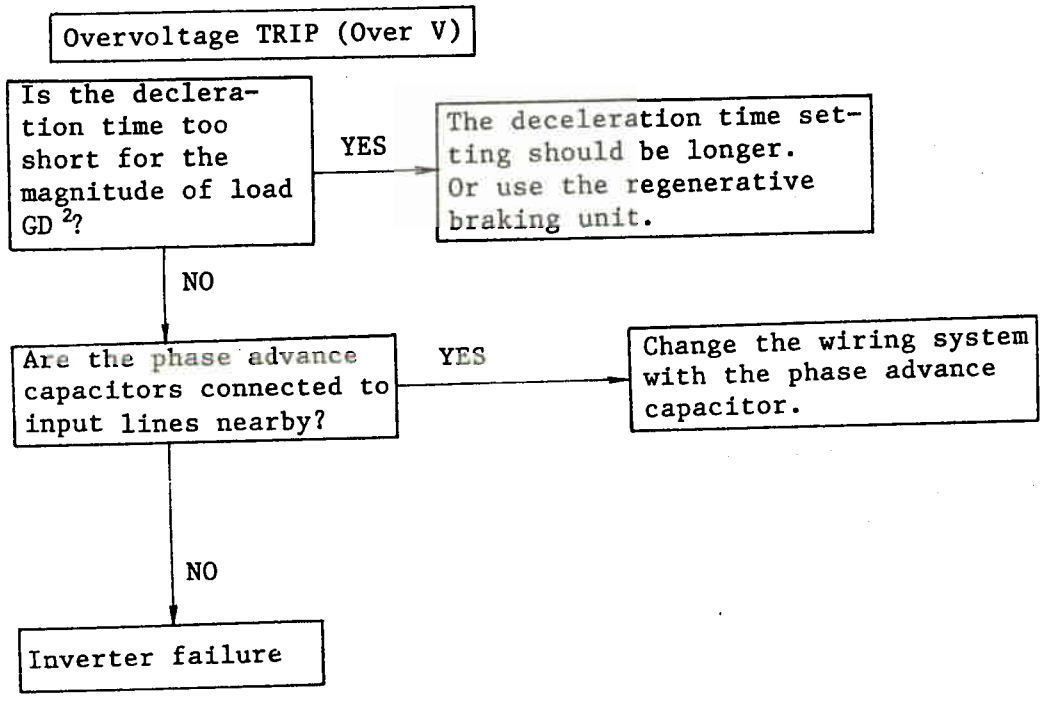


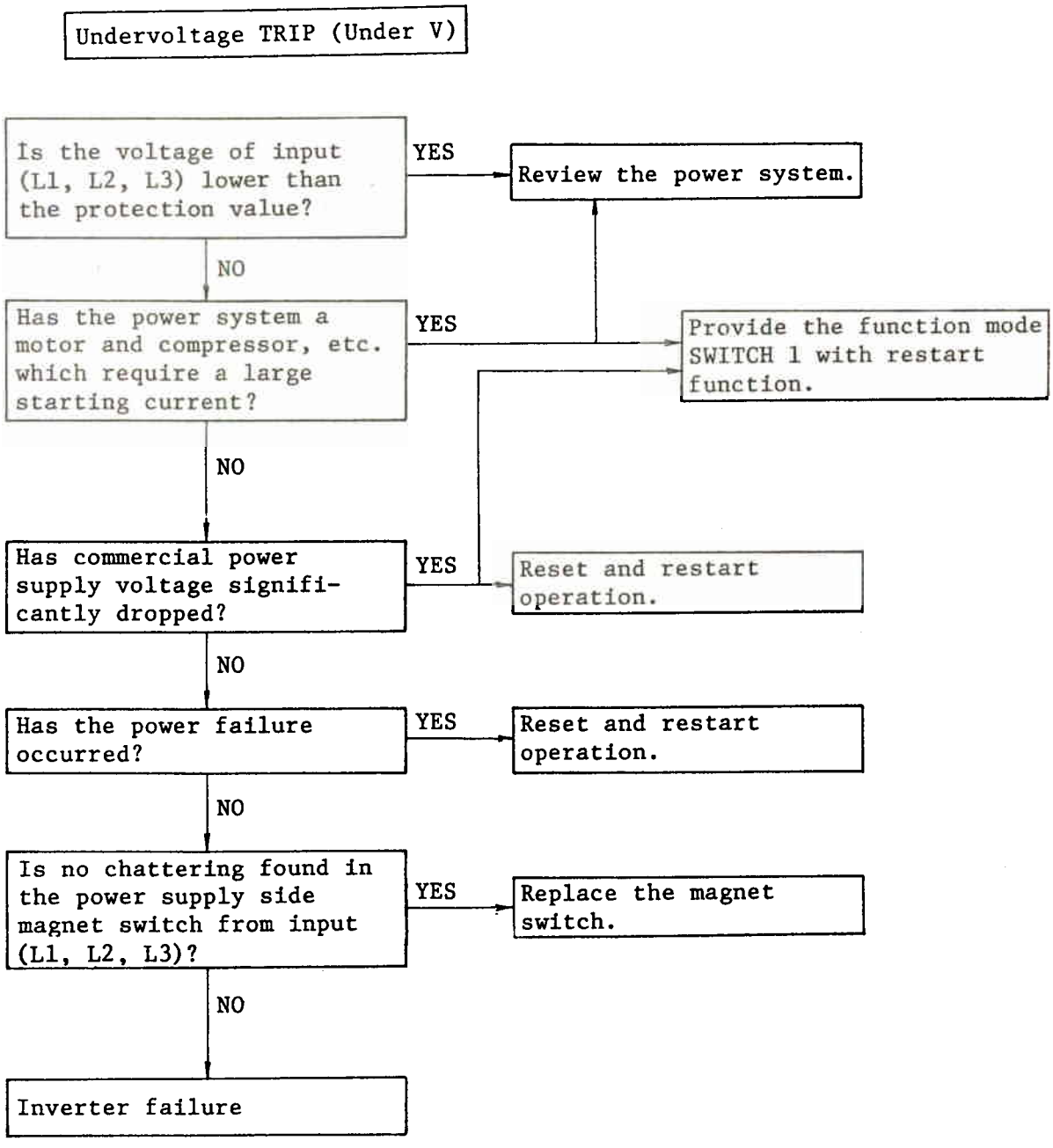
Instantaneous power failure TRIP (Inst. P-F)




Fin overheat TRIP (OH Fin)
Is the cooling fan within the inverter rotating?
NO
Replace the cooling fan.
(200V class: 3.5 kVA
400V class: 8 kVA or more)
YES
Are the air inlet and exhaust ports on the control panel blocked?
YES
Remove the obstacles.
NO
Is the inverter cooling air path blocked?
YES
Remove the obstacles.
NO
Is the panel temperature less than the specified value?
YES
Improve the panel for more efficient cooling.
NO
Inverter failure


Overload (Over L)
Is the electronic thermal level in the function mode set correctly?
NO
Set the level to a proper level.
YES
Is the load too heavy?
YES
Reduce the load or increase the motor/inverter capacity.
NO
Inverter failure


Overvoltage TRIP (Over V)
Is the declera-tion time too short for the magnitude of load GD 2?
YES
The deceleration time setting should be longer.
Or use the regenerative braking unit.
NO
Are the phase advance capacitors connected to input lines nearby?
YES
Change the wiring system with the phase advance capacitor.
NO
Inverter failure


Undervoltage TRIP (Under V)
Is the voltage of input (L1, L2, L3) lower than the protection value?
YES
Review the power system.
NO
Has the power system a motor and compressor, etc. which require a large starting current?
YES
Provide the function mode SWITCH 1 with restart function.
NO
Has commercial power supply voltage significantly dropped?
YES
Reset and restart operation.
NO
Has the power failure occurred?
YES
Reset and restart operation.
NO
Is no chattering found in the power supply side magnet switch from input (L1, L2, L3)?
YES
Replace the magnet switch.
NO
Inverter failure

Symptom of malfunction	Check point	Suggested remedy
No inverter operation is possible.	Check that the STOP key on the digital operation panel is not depressed in "Terminal" mode.	Stop the operation command from "Terminal" once, and input the operation command once again.
	Check that DB command is not input to optional PC board (IA-TWK).	After breaking DB command, input the operation command.
	Check that FRS command is not input.	After breaking FRS command, input the operation command.
	Check that the frequency setting is not 0.	Set the fequency to a desired one.
	Check that the digital operation panel display does not indicate the function mode.	Press the MON key to select the monitor mode.
	Check for tripping.	Reset.
	Check that the speed command is not input between 0 - L or 0I - L when the frequency setting designation method (F-SET-M) is "Terminal".	Review the speed command circuit.
	A command is input to multistage speed input terminal CF1, CF2, but check that SPEED 1 - SPEED 3 setting is not 0Hz.	Set SPEED 1 - 3 to a desired frequency or cut the command to CF1 and CF2.
	Check that RS command is not input.	Cut RS command.
	With internal command (ope-key) mode selected, is external command input or with external command (Terminal) mode selected, isn't the command input from the digital operation panel?	Check the operation mode. (Input the operation command in the preset mode.)
	Check that the jogging command is not interrupted during jogging operation.	· During internal command (ope-key) mode: Press the stop key, the press the FWD RUN or REV RUN for operation. · During external command (Terminal) mode: Stop the operation command once, and input the operation command again.
	Check that the operation command is not input within 100 ms after interrupting the jogging command.	The jogging command-OFF and operation command-ON timing should be more than 100 ms.
	· Check that the FWD RUN , REV RUN keys are not depressed at the same time in the internal command (ope-key) mode. · Check that the external command (Terminal) mode FW/RV terminals are not input simultaneously. · Check that the setting frequency is not less than the lowest frequency.	Be sure to make arrangements so as to perform either forward or reverse operation. Set the frequency to more than the lowest frequency.
No jogging operation is possible.	· Check that the jogging command is not input during normal operation.	Stop operation once, and turn the jogging command ON more than 2 seconds, then input either forward or reverse operation command.
	· Check that the relationship between the jogging frequency setting (JOG-F) and the lowest frequency setting (Fmin) is not JOG-F < Fmin.	The relation should be JOG-F ≥ Fmin.
	· Check that the relationship between the jogging frequency setting (JOG-F) and the frequency lower limiter setting (L-LIM-F) is not JOG-F < L-LIM-F.	The relation should be JOG-F ≥ L-LIM-F.

o When it is desired to return the value set on the digital operation panel to the initial setting when the unit is shipped from the factory, refer to para. 9.3 (5).

13.6 Others

(1) Open phase at input side

This inverter is protected from open phase at the input side. If this open phase occurs, the inverter does not work and no indication appears on the digital display unit.

(2) In the following case, it should be noted that the converter module may be damaged.

- When the unbalance percentage of supply voltage is more than 3%.
- When the power supply capacity is more than 10 times of the inverter capacity and more than 500 kVA.
- When sudden changes in supply voltage occur

(Example) When a plurality of inverters are provided mutually together, using a short bus bar; and when a phase advance capacitor is ON and released.

In the aforementioned cases, it is recommended that a reactor of approx. 3% (voltage drop at the rated current) for supply voltage be inserted into the power supply side.

14. WHEN ORDERING OR INQUIRING PARTS

When ordering parts of the defective product or inquiring, inform your shop where purchased or your nearest service station of the following.

(1) Type

(2) Output (kVA)

(3) Production No. (MFG. No.)

(4) Symptom of malfunction

If the contents are unclear due to an old nameplate, inform only the clear items, and furnish a simple sketch showing your required parts.

To reduce the non-operation time, the following parts is recommended to stock.

Table 11 Recommended Spare Parts

Parts Name	Sequence Symbol	Pcs.	Q'ty	Remarks
		Normally Used	Spare	
Inverter module	PM	1 ∿ 18	1 ∿ 18	
Coolig fan	FAN	1 ∿ 11	1 ∿ 11	
Converter module	DM	1 ∿ 3	1 ∿ 3	
Smoothing capacitor	CB	1 ∿ 10	1 ∿ 10	Store this capacitor at -20 ∿ +30°C
Digital operation panel	D.OPE	1	1	
Printed circuit (PC) board	Control PC board	1	1	All models (unusable in common)
Printed circuit (PC) board	Base PC board	1	1	11 ∿ 22HF3EH 33 ∿ 180HF3E

Warranty

The warranty period under normal installation and handling conditions shall be one (1) year after the date of delivery. The warranty shall cover the repair of only equipment main unit to be delivered.

1. The repair in the following cases even within the warranty period shall be charged to the purchaser.

   (a) Malfunction or damage caused by mis-operation or remodelling and improper repair

(b) Malfunction or damage caused by drop after your purchase and transportation

(c) Malfunction or damage caused by fire, earthquake, flood, falling or thunderbolt, natural calamities, pollution and abnormal voltage.

2. When repair is required for the product on your worksite, all expenses associated with field repair shall be charged to the purchaser.

3. This Manual is not re-issued. Always keep it handy. Do not lose it.

(APPENDIX 1)

HFC-VWS$_3$ Series DATA SETTING LIST

HFC-VWS$_3$ inverter has many functions so that the setting data can be changed by customers.

It is recommended to fill the setting data out the following data sheet for service, maintenance and investigation of trouble.

TYPE : HFC-VWS [ ]

MFG. No. : [ ]

} Described on spec. label on top cover

- Monitor Mode

Display Sequence	Monitor Name	Initial Display	Standard Setting	Setting Data
1	Output frequency display	FM 000.0Hz	—	
2	Frequency setting command	FS 000.0Hz	—	
3	Frequency command method	F—SET—M Terminal	Terminal	
4	Operation command method	F/R—SW Terminal	Terminal	
5	Motor speed display	RPM 4P 00000rpm	4	
6	Output current display	If----A Im000.0%	—	
7	Manual torque boost adjustment	V—Boost Code〈31〉	31	
8	Output voltage gain adjustment	V—Gain 100%	100	
9	Jogging frequency setting	Jogging 00.5Hz	0.5	
10	Fault display	#	—	—

● Function Mode

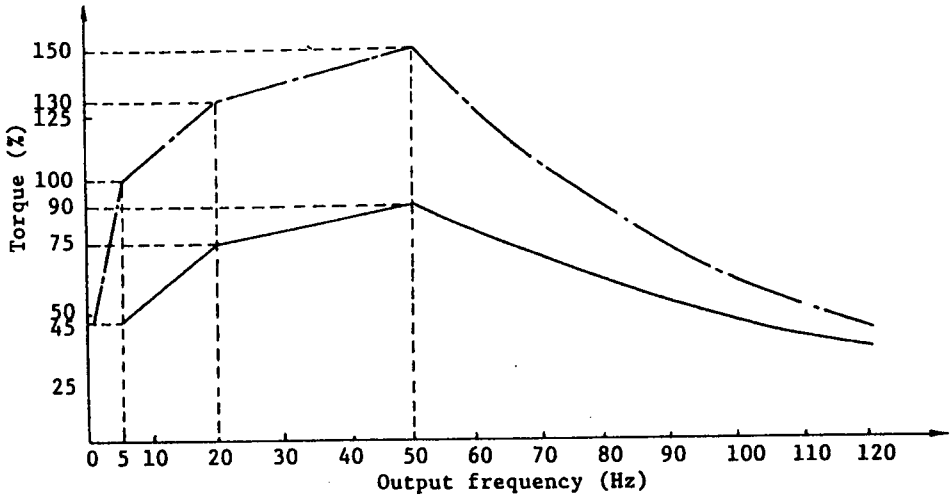
Display Sequence	Function Name	Function 1 Mode	Display Contents	Standard Setting	Setting Data
1	V/F pattern setting	F - 0 0	V F 1 - V C	VF1-VC 050-050	
2	Acceleration time setting	F - 0 1	A C C E L - 1	20	
3	Deceleration time setting	F - 0 2	D E C E L - 1	20	
4	Maximum frequency fine adjustment	F - 0 3	+ F m a x .	0	
5	Starting frequency adjustment	F - 0 4	+ F m i n .	0.5	
6	Maximum frequency limiter setting	F - 0 5	H - L I M - F	0	
7	Minimum frequency limiter setting	F - 0 6	L - L I M - F	0	
8	Jump frequency 1 setting	F - 0 7	J U M P - F 1	0	
9	Jump frequency 2 setting	F - 0 8	J U M P - F 2	0	
10	Jump frequency 3 setting	F - 0 9	J U M P - F 3	0	
11	Motor noise adjustment	F - 1 0	C F - c o d e	U	
12	Adjustment of frequency stop time at start	F - 1 1	F s t o p - T	0	
13	Multistage speed 1 setting	F - 1 2	S p e e d - 1	0	
14	Multistage speed 2 setting	F - 1 3	S p e e d - 2	0	
15	Multistage speed 3 setting	F - 1 4	S p e e d - 3	0	
16	DC braking frequency adjustment	F - 2 0	F - D C B	1	
17	DC braking power adjustment	F - 2 1	V - D C B	10	
18	DC braking time adjustment	F - 2 2	T - D C B	5	
19	Electric thermal level adjustment	F - 2 3	E - t h e r m	100	
20	Linear/S-character curved acceleration selection	F - 2 4	A C C l i n e	Linear	
21	Linear/S-character curved deceleration selection	F - 2 5	D E C l i n e	Linear	
22	Start point frequency of external frequency setting	F - 2 6	F - S T A R T	0	
23	End point frequency of external frequency setting	F - 2 7	F - E N D	0	
24	Switch selection	F - 2 8	S W I T C H 1	00000101	
25	Overload limit time constant setting	F - 3 0	L M . C O N S	1.0	
26	Automatic torque boost adjustment	F - 3 2	V - a u t o	00	
27	Stand-by time setting for restart after instantaneous power failure	F - 3 6	I P S - R - T	1	

(APPENDIX 2)

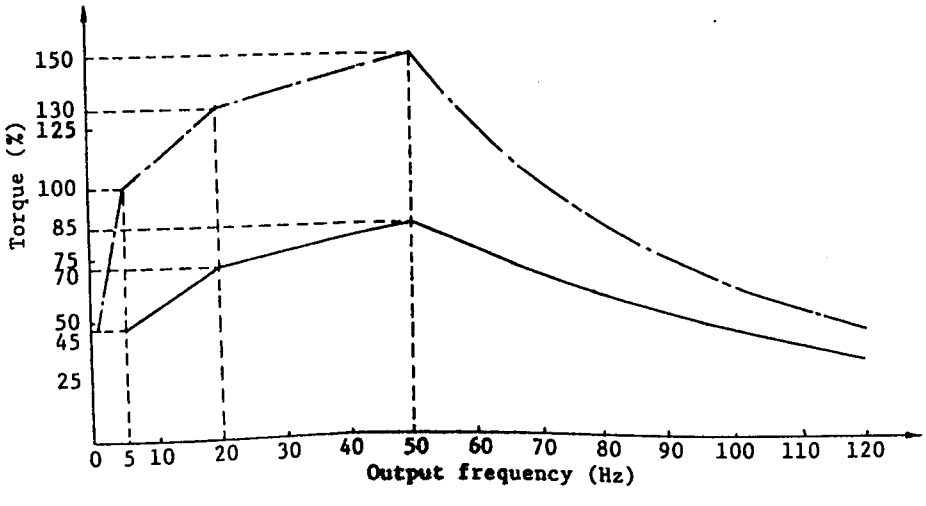
TORQUE-OUTPUT FREQUENCY CURVES OF HITACHI 4 POLE GENERAL-PURPOSE MOTORS

The following data show the reference values of torque characteristics of Hitachi 4 pole motor with HFC-VWS$_3$ series.

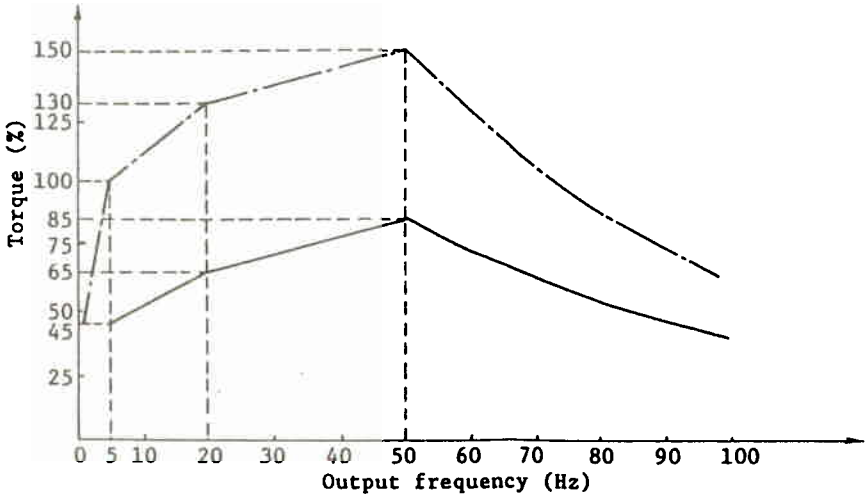
· Applicable motor: 0.4 ∿ 11 kW



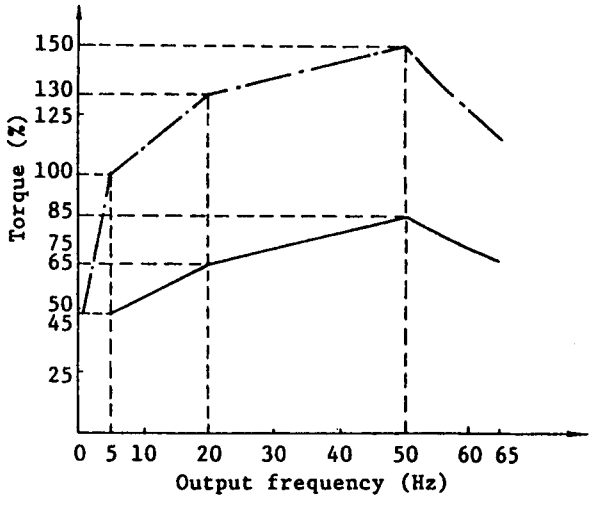
· Applicable motor: 15 ∿ 22 kW



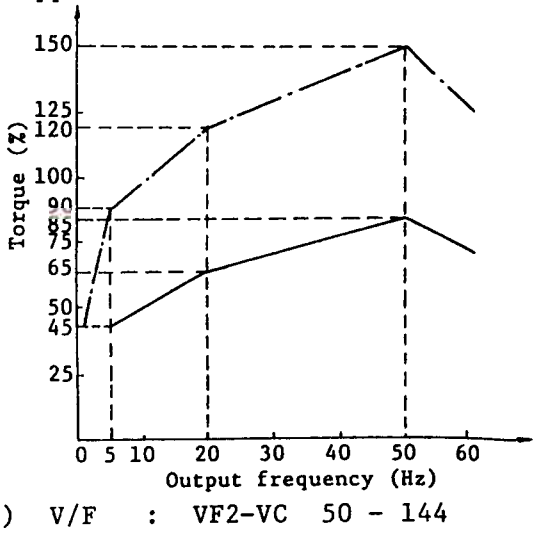
· Applicable motor: 30 ∿ 37 kW

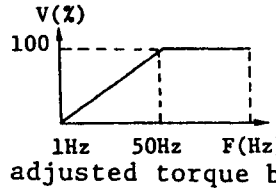


· Applicable motor: 45 ∿ 55 kW



· Applicable motor: 75 ∿ 132 kW





Note: 1) V/F : VF2-VC 50 - 144

2) ——— : Continuous working torque
—·—· : Max. torque for short time by adjusted torque boost

3) Max. torque is <u>not</u> starting torque (shaft locked torque).
This is generated in condition of slipping speed.