FOR HITACHI INVERTER

HFC-VWS3D SERIES

DUAL RATING INVERTER
INSTRUCTION MANUAL

Read safety instructions carefully and nuderstand
them before using your inverter.
Keep thisd instruction manual for future reference.

IMPORTANT INFORMATION

Thank you very much for purchasing Hitachi frequency inverter.
We request that you read this manual carefully and use the inverter correctly. Keep this manual for future reference.

DEFINITIONS AND SYMBOLS

Safety alert symbol, Dangers, Cautions, and Notes are used throughout this manual with the following definitions and symbols.

SAFETY ALERT SYMBOL

This is the industry "Safety Alert Symbol".
This symbol is used to call your attention to items of operations that could be dangerous to you or other person using the inverter.
Please read these messages and follow these instructions carefully.
It is essential that you read the instructions and safety regulations before you attempt to use the inverter.
A signal word-DANGER, WARNING or CAUTION-is used with the safety alert symbol.

DANGER: Indicates the most extreme danger which, if not avoided, will result in death or serious injury.

WARNING: Indicates any condition or practice which, if not avoided, could result in death or seriously injury.

CAUTION: Indicates any condition or practice which, if not avoided, may result in minor or moderate injury or damage to equipment.

NOTE: Indicates an area or subject emphasizing either the products capabilities or common errors in operation or maintenance.

NOTE

(1) Do not reprint a part or all of the contents of this manual without permissin of Hitachi.
(2) The contents of this manual are subject to change without prior notice without any obligation on the part of the manufacturer.
(3) All dimensions and speeds in this manual are specified by the metric system.

SAFETY INSTRUCTION

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

1. Safety Management

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

2. General Safety Instruction upon Receiving

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

3. General Safety Instruction upon Unpacking and Storage

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

4. General Safety Instruction upon Installation and Wiring

(1) Read and understand the installation and wiring section completely before installing the inverter.
(2) Put a LOCKOUT/TAGOUT to the power supply switch during maintenance and servicing working.
(3) The installation place must be wide enough space for maintenance.
(4) Provide emergency stop buttons at necessary places, and do not use the Free-Run-Stop and Reset functions of the inverter for emergency stop. In the case of emergency, the power supply to the inverter must be turned off.
(5) Install the specified grounding to the inverter and others which require it.
(6) Connect the wiring correctly to proper terminal.
(7) Insulation for power wiring should be in accordance to UL and CSA standards which are as following.
Inverters rated below 100 amps should have 65/75 degrees centigrade insulation.
Inverters rated above 100 amps should have 75 degree centigrade insulation. See section 5 and paragraph 10.6.

5. General Safety Instruction upon Test-run

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

6. General Safety Instruction upon Inspection and Maintenance.

(1) Put a sign board "ON MAINTENANCE" around the inverter and equipment.
(2) Put a LOCKOUT and TAGOUT on the power supply switch during working.
(3) After power turn off, wait for until bus capacitors are discharged. See section 7 and table 7-5.
Measure the DC bus voltage on the + and - terminals by volt meter and make sure no voltage present on them before touching internal parts.

7. General Safety Instruction upon Leakage Current and Electric Shock

Ground fault protection is intended for inverters. It is ineffective for preventing electric shock caused by leakage current. Use a leakage breaker and put it on power receiving side of inverter. See section 5.

CONTENTS

	Page
IMPORTANT INFORMATION	0-1
SAFETY INSTRUCTION	0-3
1. Safety Management	0-3
2. General Safety Instruction upon Receiving	0-3
3. General Safety Instruction upon Unpacking and Storage	0-4
4. General Safety Instruction upon Installation and Wiring	0-4
5. General Safety Instruction upon Test-run	0-5
6. General Safety Instruction upon Inspection and Maintenance	0-5
7. General Safety instruction upon Leakage Current and Electric Shock	0-5
1. INSPECTION UPON UNPACKING	1-1
2. PRECAUTIONS	2-1
2.1 Installation Environment and Location	2-1
2.2 Input Voltage	2-1
2.3 Connection	2-1
2.4 Maximum Output Frequency	2-2
2.5 Maintenance and Adjustment	2-2
2.6 Insulation Resistance Test and Withstand Voltage Test	2-2
2.7 Restart Function	2-3
2.8 Record of Setting Data	2-3
2.9 Data Storage	2-3
3. STRUCTURE	3-1
3.1 Appearance and Name of Each Part	3-1
3.2 Dimensions and Mass (Weight)	3-2
4. INSTALLATION	4-1
4.1 Transportation	4-1
4.2 Installation Environment and Location	4-1
5. WIRING	5-1
5.1 Selection of Power Wiring	5-1
5.2 Description of Main Circuit Terminals	5-3
5.3 Connecting Main Circuit Terminals	5-4
5.4 Grounding of Inverter	5-7
5.5 Connection of Control Circuit Terminals	5-8

CONTENTS (Cont'd)

		Page
6.	OPERATION	6-1
	6.1 Before Operation	6-1
	6.2 Operation Pattern	6-2
	6.3 Setting Functions before Trial Operation	6-3
	6.4 Example of Connection When a Motor with a Brake is Used	6-10
7.	MAINTENANCE AND CHECK	7-1
	7.1 Cautions on Maintenance and Check	7-1
	7.2 Checking Items	7-2
	7.3 Measuring Method of Input/Output Voltage, Current, and Power	7-6
	7.4 Checking the Converter Module and Inverter Module	7-9
8.	FAULT MESSAGE AND TROUBLESHOOTING	8-1
	8.1 Causes and Action	8-2
	8.2 Protection Functions	8-5
	8.3 Content of Check Points	8-7
	8.4 Life of Soft Memory Element (NV-RAM)	8-11
9.	DESCRIPTION OF DIGITAL OPERATION PANEL, MONITOR MODE AND FUNCTION MODE	9-1
	9.1 Configuration of Digital Operation Panel	9-1
	9.2 Returning to the Original Standard Setting	9-3
	9.3 Monitor Mode Description and Operation	9-5
	9.4 Function Mode	9-14
	9.5 Automatic Restart Function	9-35
10.	SPECIFICATIONS	10-1
	10.1 Block Diagram	10-1
	10.2 Layout on the Printed Circuit Board	10-3
	10.3 Standard Specifications	10-4
	10.4 Description of Terminals	10-7
	10.5 Potentiometers and DIP Switches	10-9
	10.6 Wires and Components	10-10
11.	OPTION	11-1

CONTENTS (Cont'd)

	Page
12. PARTS AND REPAIR	12-1
12.1 Parts Order	12-1
12.2 Repair	12-1
APPENDIX	
1. HFC-VWSHF3D Series Data Setting List	A-1

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)

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

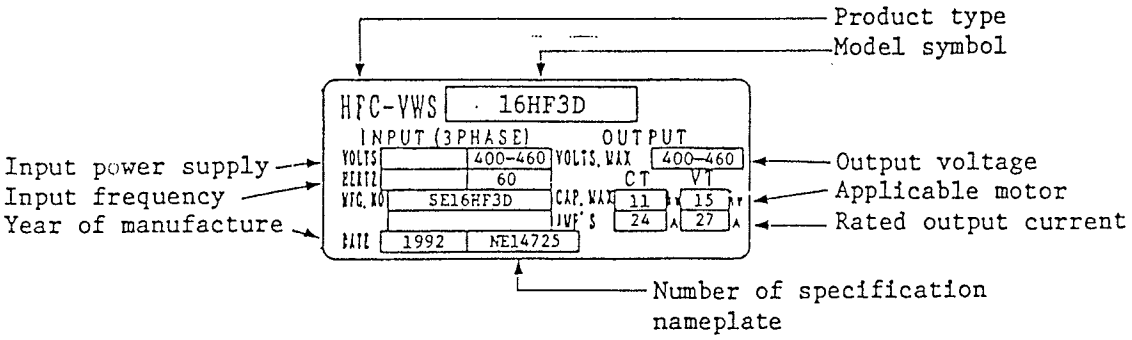
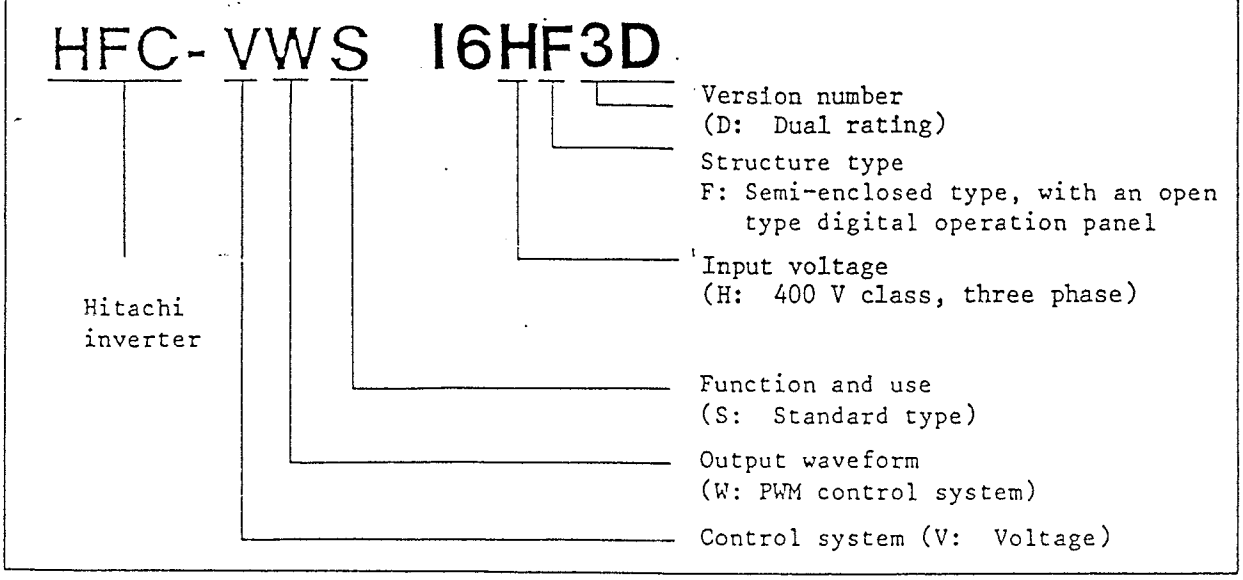


Figure 1-1 Details of Nameplate

For any irregularity, contact your sales shop immediately.

Explanation of the inverter type



2. PRECAUTIONS

In operating the HFC-VWS3D inverter, first check that there is no problem on the following: inadequate operation can result in damage to the inverter.

2.1 Installation Environment and Location

(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. In this case, he unit can be operated within the range of -10 to 50°C inside the box.

(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 clearance around.

2.2 Input Voltage

Check that the input power supply is 3-phase, 400 to 460 V, 60 Hz.

2.3 Connection

(1) Be sure to connect the power supply to L1, L2, L3 (input terminals), and the motor to T1, T2, T3 (output terminals). (Wrong connections damage to the unit.)

(2) Be sure to ground and earth terminal (⏚) for personnel safety. (earthing resistance; 10 Ω or less)

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

2.4 Maximum Output Frequency

The standard set (set by manufacturer) of the maximum output frequency is 60 Hz and constant torque (see Table 9-9).
The VWS3D series inverter allows a maximum frequency of 360 Hz (375 Hz, when using F-03) to be set when an appropriate V/F pattern is selected. Before you change the maximum output frequency or V/F pattern, check whether this frequency is allowable for motors and machines. If not so, select a suitable V/F characteristics.

2.5 Maintenance and Adjustment

(1) After cutting off power supply, do not touch the internal parts until bus capacitors are discharged. See table 7-5.
(Since the capacitor charged voltage is still present, it is dangerous.)

(2) Static electricity may cause breakdown to components 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 must be taken for insulation resistance and withstand voltage tests. When conducting these tests actually, be sure to refer to "Insulation Resistance and Withstand Tests", see paragraph 7.2.

2.7 Restart Function

While the restart function is in effect, the motor is in the free-run state. When it is necessary to hold the motor in the free-run state through mechanical braking, therefore, do not use the restart function.

2.8 Record of Setting Data

Though this inverter has various functions, it is recommended to fill in setting data on the data sheet shown in appendix 1 for service, maintenance and investigation.
Pass this record to the final end user.

2.9 Data Storage

The memory element called non-volatile RAM (NVRAM) is used to keep the data after power supply to the inverter is off.
The changed data is stored in the RAM area of NVRAM temporally and the inverter is operated under this new data. Since this new data can be kept only while the power supply is given, this new data must be re-stored into EEPROM area of NVRAM when power supply is turned off. Under the following procedure shown in Figure 2-1 (a) below, this procedure will be done automatically when power supply is turned off, but in the case of (b), it will not be done and when power is turned on again, the old data before changing appears again.

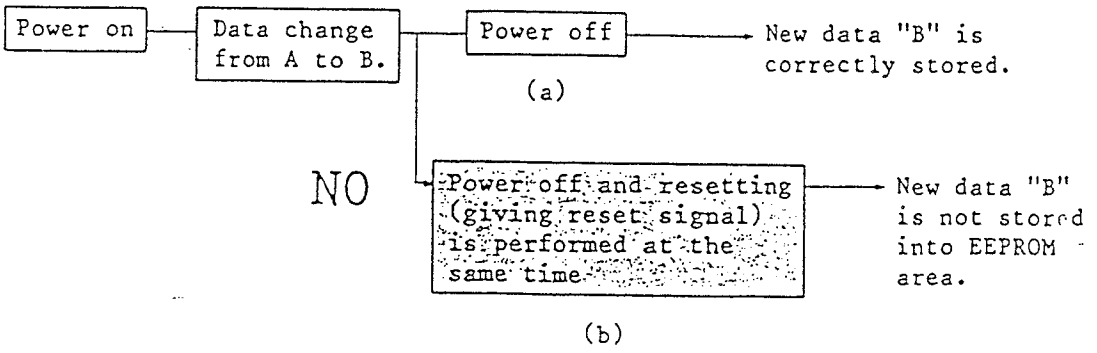
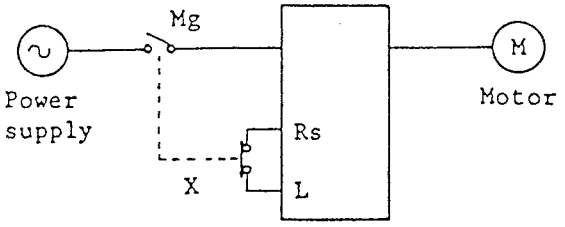


Figure 2-1 Storage of New Data

To avoid the loss of new data, turn off the reset signal once and turn power off to store the new data. This procedure is required only once. Take special care of this if the connection in Figure 2-2 is made.



x: Electronic relay with the same on/off timing as Mg, such as auxiliary contact of Mg.

Figure 2-2 Connection Diagram

3. STRUCTURE

This section provides the structure and VWS16HF3D is used as sample.

3.1 Appearance and Name of Each Part

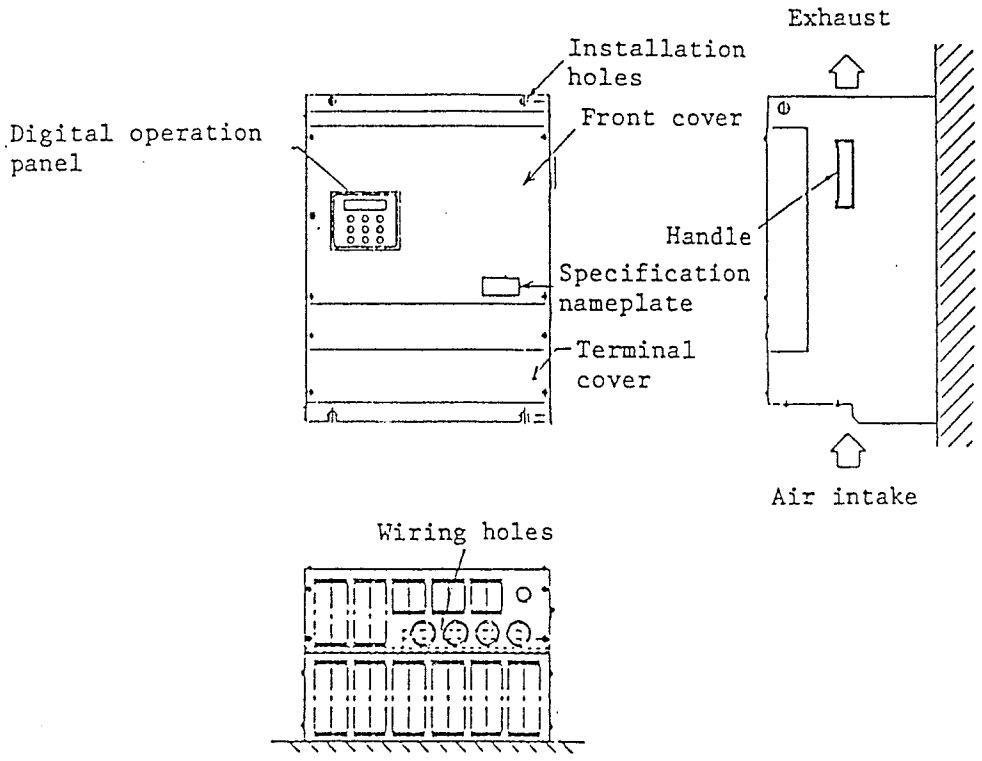
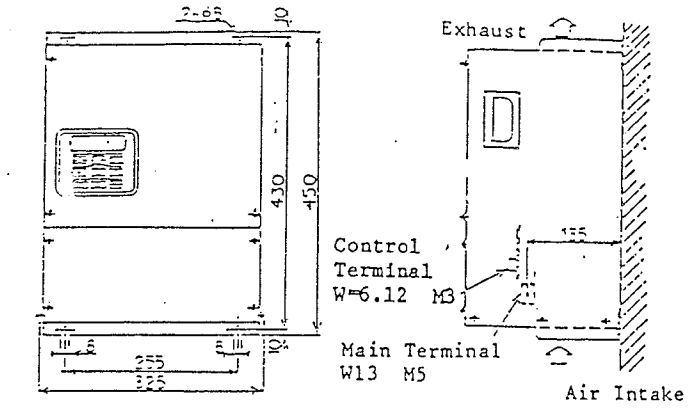


Figure 3-1 Appearance

⚠ CAUTION:	To avoid personal injury Front cover and terminal cover can be removed by loosening screws. In this case, do not slip a cover through your fingers.

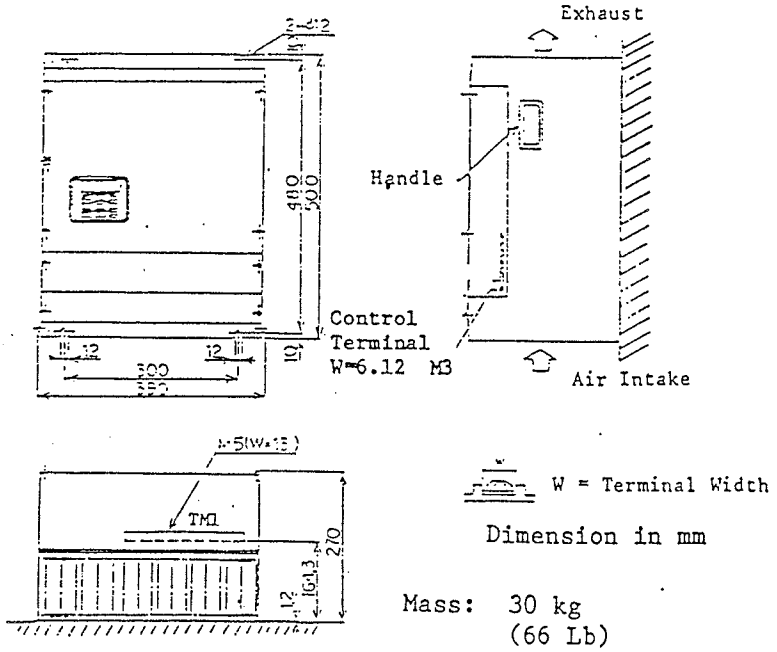


Dimension in mm

Table 3-1 Mass

16HF3D	22HF3D
22.5 Kg (50 Lb)	24.5 Kg (54 Lb)

Figure 3-2 HFC-VWS16,22HF3D



Dimension in mm

Mass: 30 kg
(66 Lb)

Figure 3-3 HFC-VWS33HF3D

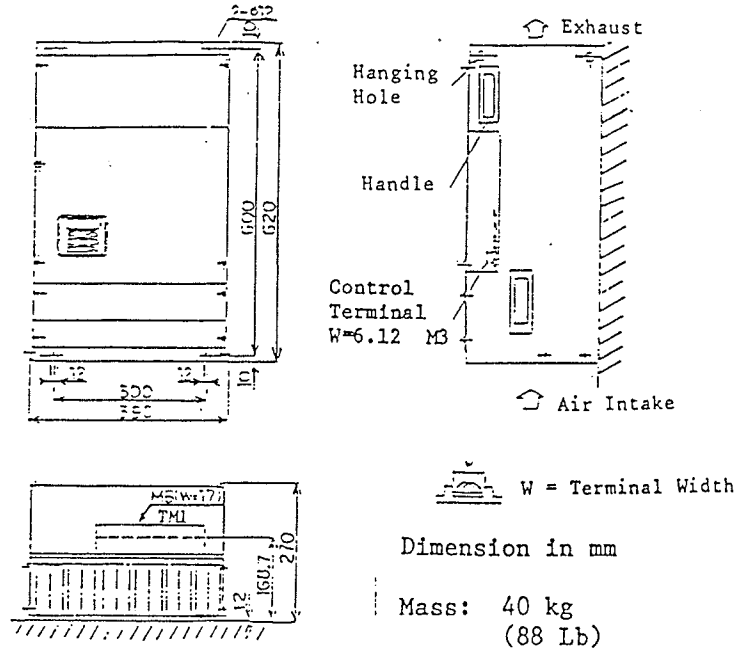


Figure 3-4 HFC-VWS40HF3D

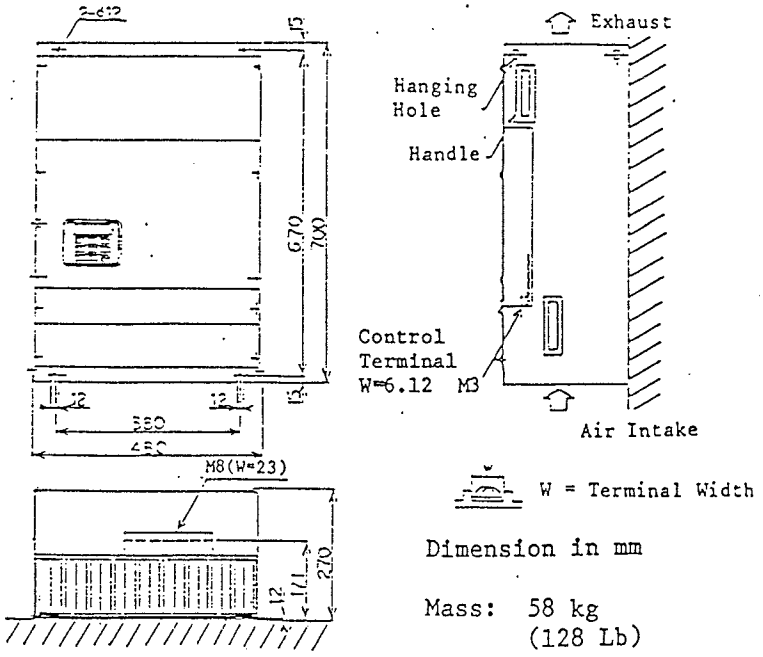


Figure 3-5 HFC-VWS50HF3D

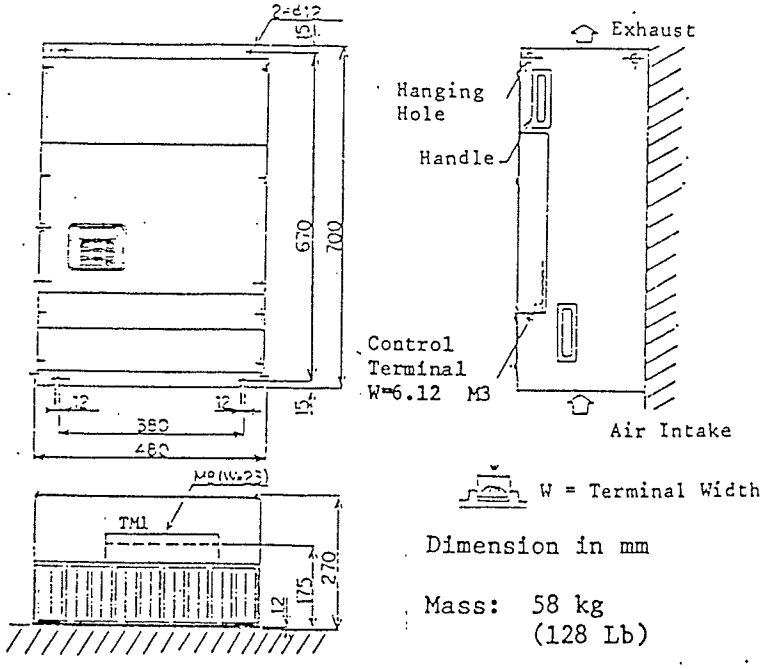


Figure 3-6 HFC-VWS60HF3D

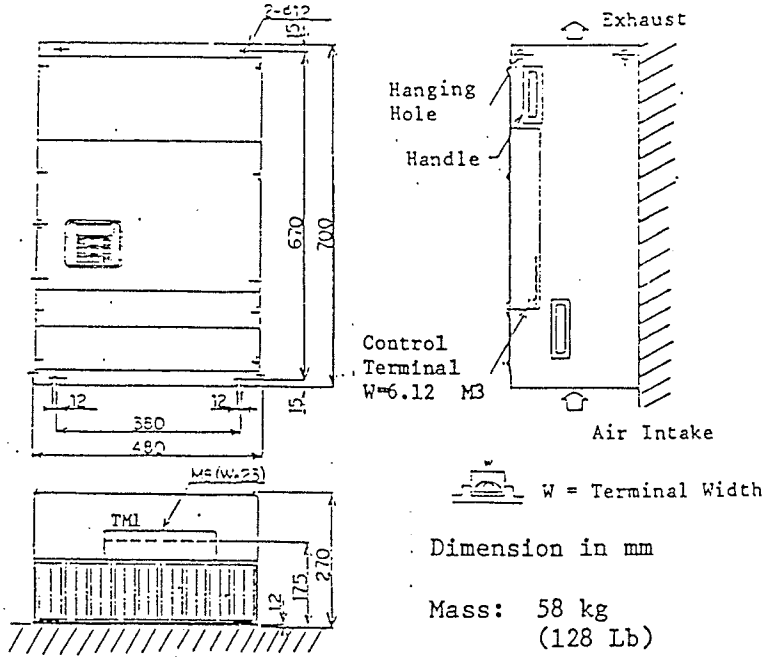


Figure 3-7 HFC-VWS75HF3D

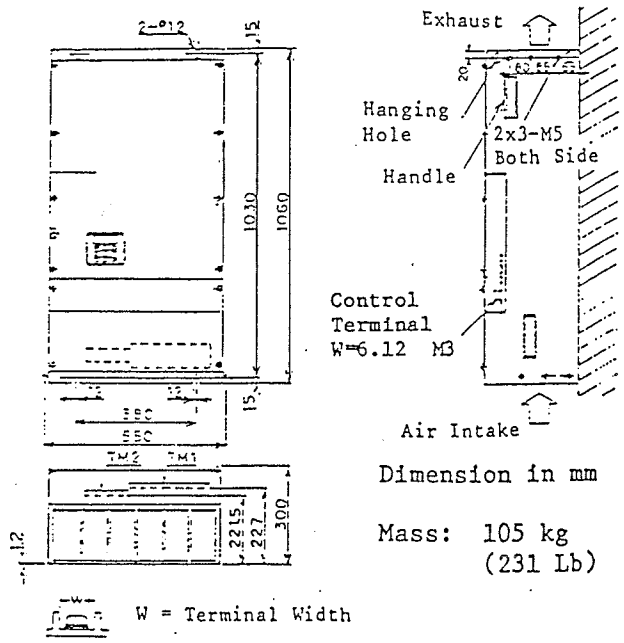


Figure 3-8 HFC-VWS100HF3D

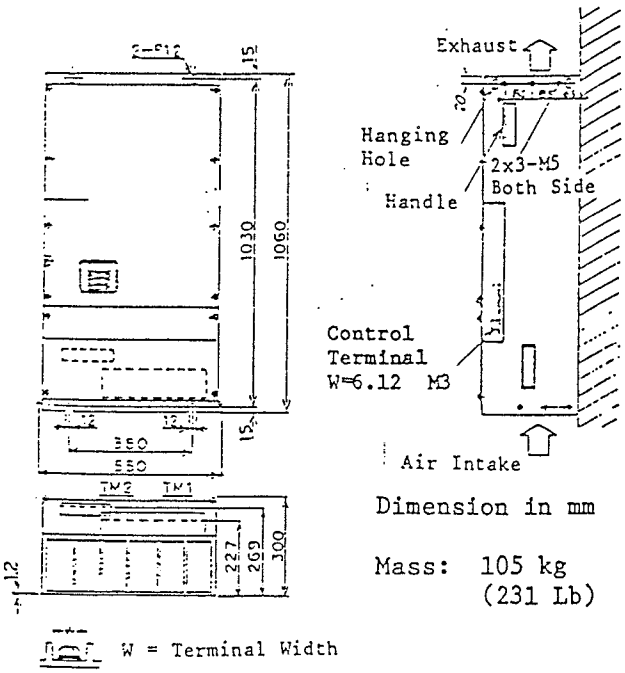


Figure 3-9 HFC-VWS120HF3D

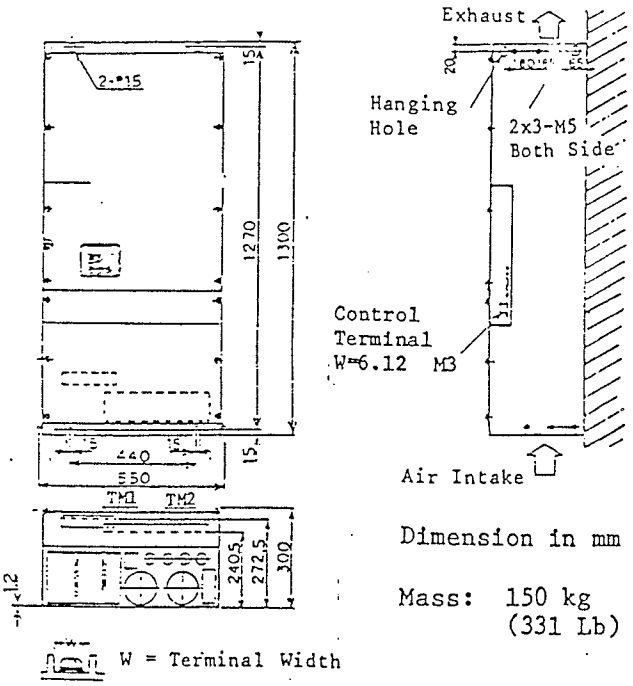


Figure 3-10 HFC-VWS150HF3D

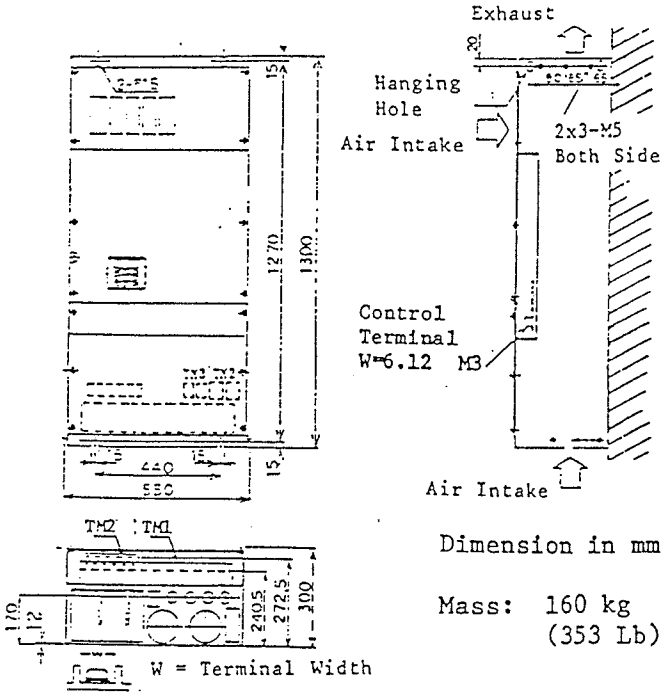
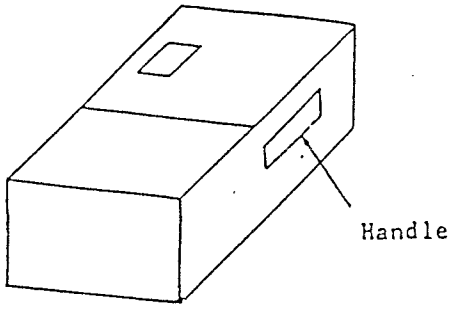


Figure 3-11 HFC-VWS180HF3D

4. INSTALLATION

4.1 Transportation

Handle with care to prevent the inverter from being damaged during transportation. Do not apply pressure to the cover of the inverter.



For 16 to 180 kVA

Figure 4-1 Handling the Inverter

4.2 Installation Environment and Location

This paragraph provides precautions for installation. For the details, see table 4-1.

(1) Installation surface must be flat and be used nonframmable material.
(2) Wide enough clearance for installation place
(3) The inverter must be installed vertically and when number of inverters are installed in the same place such as in the cabinet, they must be installed side by side.
(4) Install the inverter in a place not exposed to direct sunlight, corrosive gas, coolant mist and explosive enivronment.
(5) Be sure to attach the cover to protect the inverter when obstacles drop on it.
(6) Since the heat of approx. 5% of the rated capacity is generated from the inverter, special care must be given to the ventilation when the inverter is installed in the box.

Table 4-1 Environment and Location

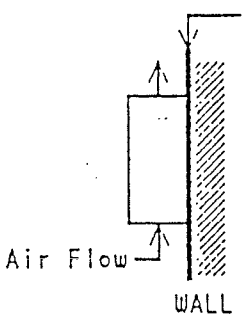
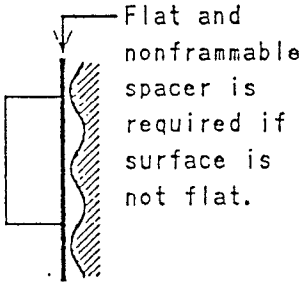
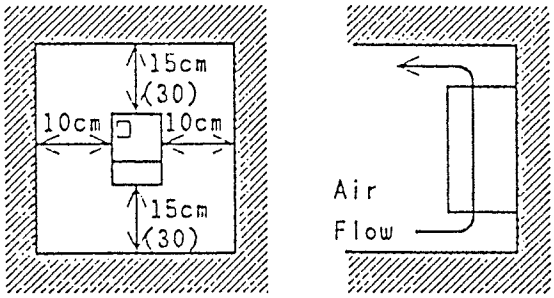
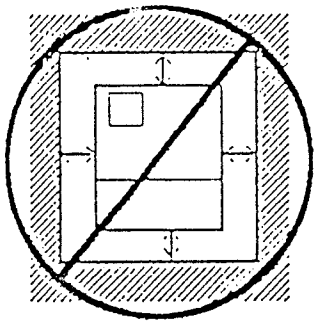
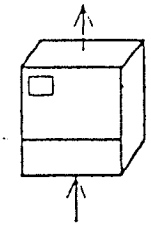
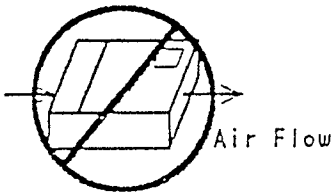
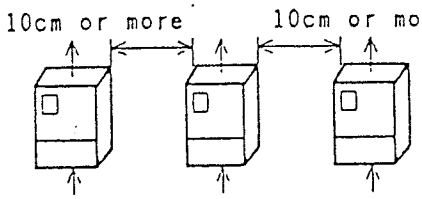
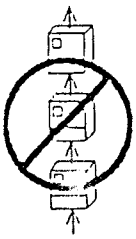
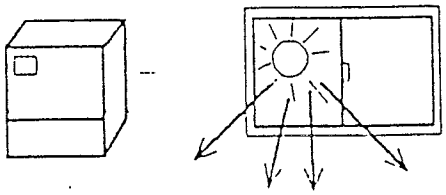
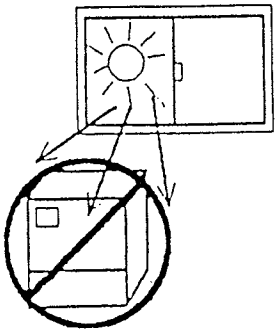
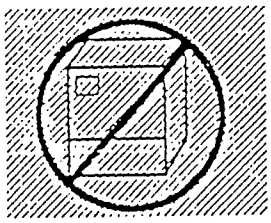
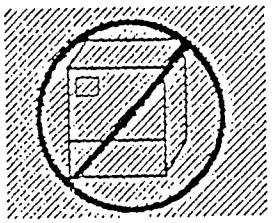
ITEM	16 to 60kVA		Remarks
Ambient Temperature	-10°C to +40°C		
Relative Humidity	20 to 90%		Non condensing
Vibration	0.2g or less		
Installation Surface			
Inverter Air Flow Requirments	 ( ) for 50kVA or more		Less clearance 
Installation of Single Unit	 Install Vertically		Do not install Holizontally 

Table 4-1 Environment and Location

ITEM	16 to 60kVA	Remark
Installation of Multi Units	 Keep the space more than 10cm	 Do not build up the inverters. Air Flow
Sunlight	 Install the inverter away from windows and do not expose to direct sunlight.	
Corrosive Gass and Coolant Mist	Install the inverter in a place not exposed to corrosive gass and coolant mist.	Corrosive Gass  Do not put inverter in a place exposed to corrosive gas and coolant mist.
Explosive Gass	Install the inverter in a place of no explosive environment.	Explosive Gass  Do not put the inverter in the explosive environment.

5. WIRING

⚠ WARNING: To avoid personal injury and damage to the inverter

An earth leakage breaker or an earth leakage detection device must be installed on the power receiving side.

⚠ WARNING: To avoid personal injury and damage to the inverter

Be sure the input power has been disconnected prior to beginning work.
Put a LOCKOUT and TAGOUT on the power supply switch during working.

⚠ CAUTION: Insulation for power wiring should be in accordance to UL and CSA standards which are as following.

Inverters rated below 100 amps should have 65/75 degrees centigrade insulation.
Inverters rated above 100 amps should have 75 degree centigrade insulation.

⚠ CAUTION: To avoid damage to the inverter

Connect the power and control signal correctly.
Power supply to L1, L2 and L3
Motor cable to T1, T2 and T3
Take care of the following notes.

5.1 Selection of Power Wiring

All wiring should be sized and installed in accordance with national and local electrical and safety codes. Use adequate size wire to compensate for the voltage drops when the distance from the inverter to the motor is long. This is very important when operating the motor at reduced speeds because the voltage is already reduced along with the frequency.

The voltage drop between the inverter and the motor should be limited to 2% or less. Voltage drop increases with wire length. A voltage drop reduces the motor torque, increases the current and often causes overheating.

The formula for figuring voltage drop is:

$$V = \frac{\sqrt{3} \times R \times L \times A}{1000}$$

Where:

V = Voltage drop__ L = Length of wire in meter

R = Resistance per meter in milli-ohms A = Current in amps

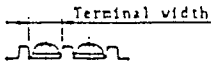
Insulation for power wiring should be in accordance to UL and CSA standards which are as following:

Inverters rated below 100 amps should have 65/75 degrees centigrade insulation

Inverters rated above 100 amps should have 75 degree centigrade insulation.

5.2 Description of Main Circuit Terminals

Table 5-1 Main Circuit Terminals Description



Model	Terminal screw diameter	Terminal width (mm)	Wire size	Terminal location
16HF3D	M5	13.0	AWG10	Terminal TM1 L1 L2 L3 G T1 T2 T3 G + M - Power supply Motor Ground Ground Terminal of DC bus circuit for braking device
22HF3D	M5	13.0	AWG8	
33HF3D	M6	22.5	AWG8	
40HF3D	M6	22.5	AWG4	
50HF3D	M8	28.5	AWG4	
60HF3D	M8	28.5	AWG2	
75HF3D	M8	28.5	AWG2/0	Terminal TM1 L1 L2 L3 G T1 T2 T3 G + M - -1 Power supply Terminal TM2 (CONTROL POWER) Output Brake Unit Only 180HF3D L1H L2H L3H L1M L2M L3M L1L L2L L3L For 460 V input use L1H, L2H and L3H For 415 to 440 V use L1M, L2M and L3M For 400 V input use L1L, L2L and L3L
100HF3D	M10	37	AWG2/0	
120HF3D	M10	37	AWG4/0	
150HF3D	M12	57	250 Kcmil	
180HF3D	M12	57	300 Kcmil	

Note 1: These terminals, ⊕ and ⊖, are for connecting a braking device. The minimum resistance of braking resistor is as follows.

5.3 Connecting Main Circuit Terminals

(1) Wiring for the power supply and motor

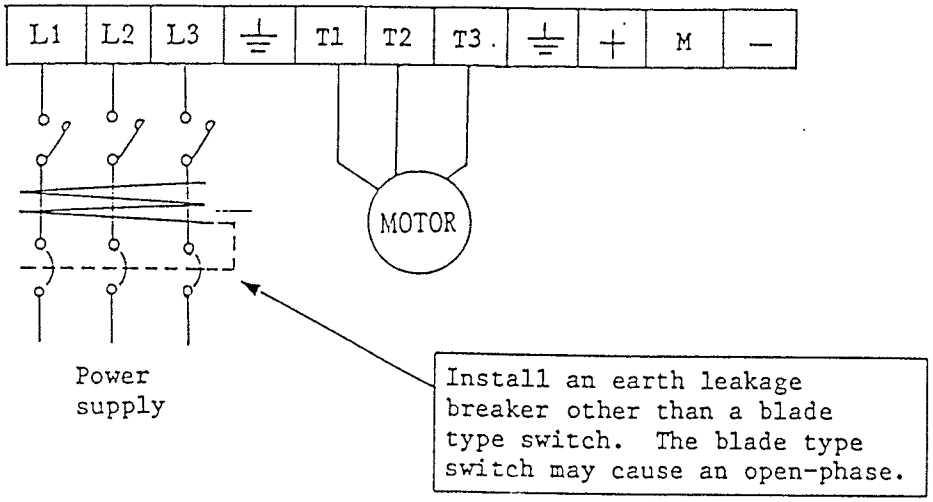


Figure 5-1 Power Line Wiring

Note 1: If line power supply is applied to output terminals T1, T2, and T3 instead of input terminals L1, L2, and L3, the inverter is damaged. This is also very dangerous to workers. When the motor is switched between the line voltage power supply and the inverter, a similar problem is likely to occur. To prevent such a mistake, be sure to use electromagnetic contactor with mechanical interlock features to Mg1 and Mg2.

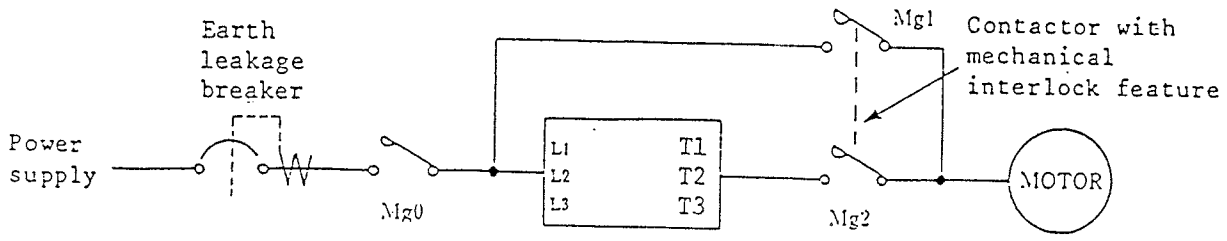


Figure 5-2 Bypass Circuit

Note 2: If the inverter is started and stopped by turning on and off Mg0 and Mg2, the inverter causes an OC trip because a rush current flows due to direct start. If Mg0 and Mg2 are turned on and off repeatedly, elements are damaged. For operation start and stop, use control terminals, the digital operation panel or the remote operator.

Note 3: Do not insert a capacitor for power factor improvement or a surge absorber between the inverter and the motor.

Note 4: An earth leakage breaker or an earth leakage detection device must be installed on the power receiving side. Each unit of HFC-VWS3D series leaks a current of about 3 mA. Therefore, when installing an earth leakage breaker on the power receiving side, the breaker must have a sensitivity which meets the formula below. (Sensitive current of breaker) 3 mA x (No. of inverters) + (Leakage current from motor and wiring)

Note 5: Do not install an earth leakage breaker on the output side of inverter because it will not operate correctly.

Note 6: Particular attention must be paid to installation at a location where sensitive current is restricted.

Note 7: Ground fault protection is intended for the inverter. It is ineffective for preventing shock hazard. So, be sure to add an earth leakage breaker for protection of the human body.

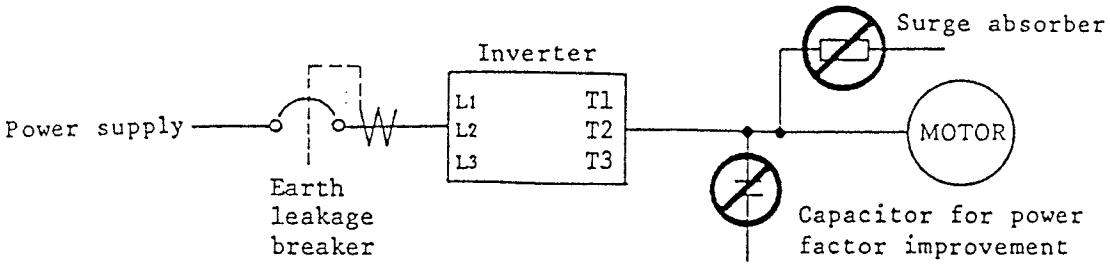
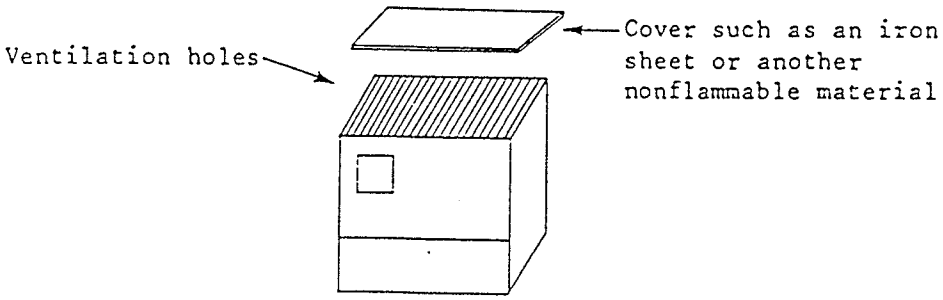


Figure 5-3 Absorber and Capacitor

Notes for wiring

During wiring or another job, place a cover on the slit ventilation holes so that chips of power cables, weld spatters, iron chips, dust, and other obstacles enter the inverter.



5.4 Grounding of Inverter

⚠ WARNING: To avoid personal injury and reliable operation

The ground wires must be the same size as the incoming power wires or sized according to NEC (National Electric Code) Table 250-95 and local legal requirements. Be sure of the quality of the your ground used.
A copper conductor must be used. The above is required on the inverter, motor and other equipment.

⚠ WARNING: To avoid personal injury

The ground fault protection circuit is not designed to protect personal injury. For protection, install a leak braker type of a high frequency sensitive current.

Note: Provide a grounding securely as follows:

- Provide grounding for a terminal.
  (earthing resistance; 10 Ω or less)

- 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 (b) below so that no loop is produced as shown in (a) below.

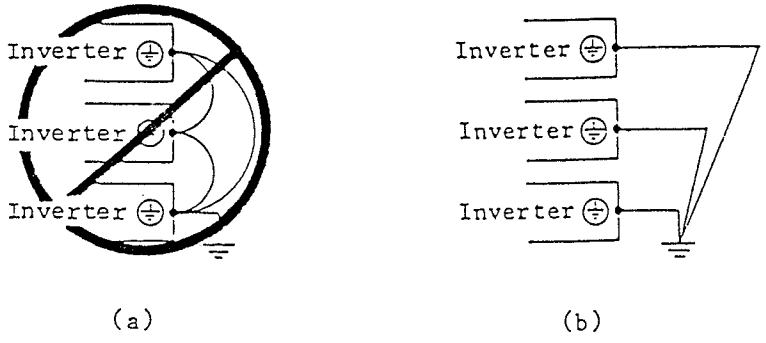


Figure 5-4 Grounding

5.5 Connection of Control Circuit Terminals

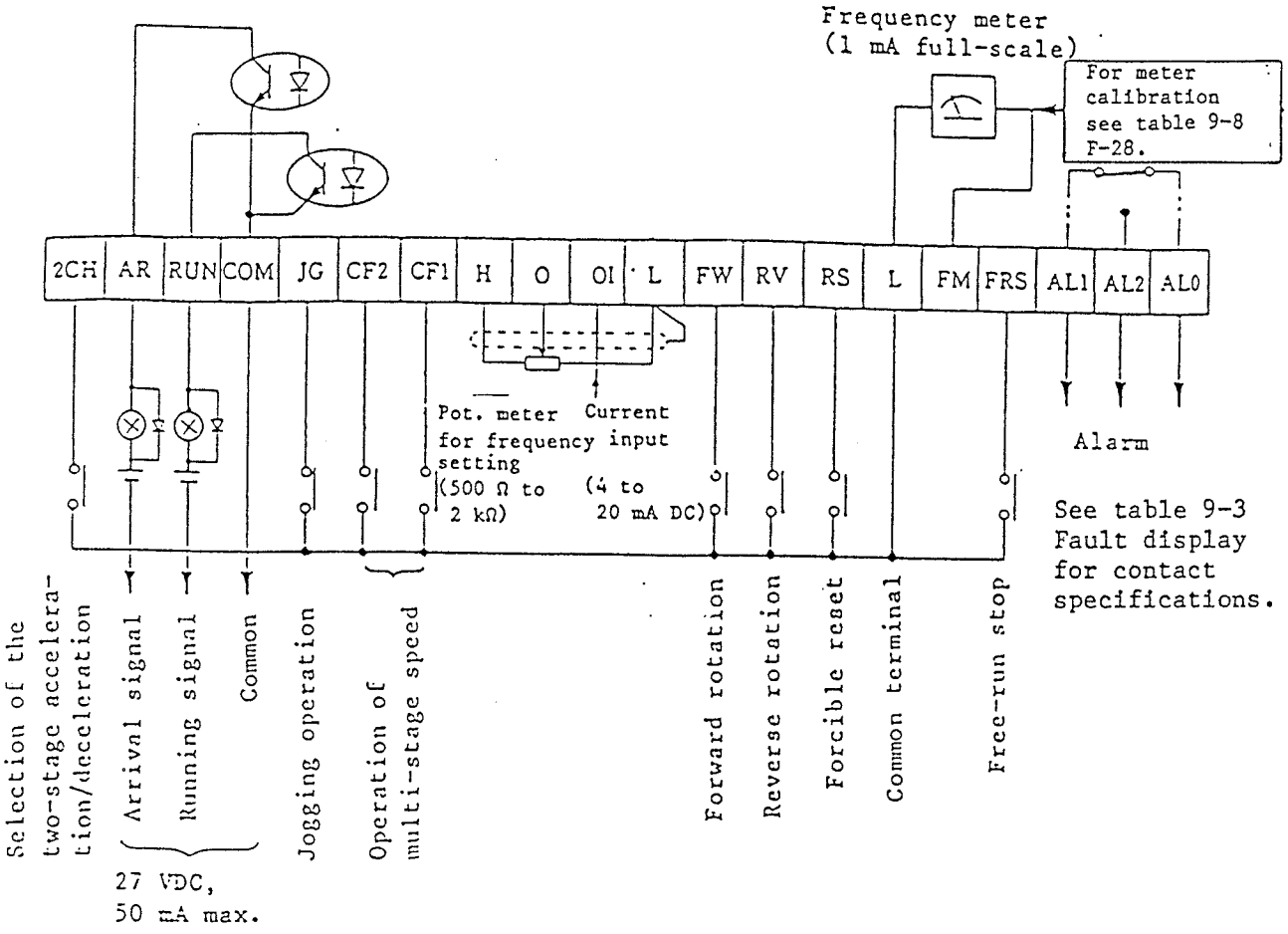


Figure 5-5 Wiring of Control Circuit Terminals

Note 1: COM is a common terminal only for AR and RUN terminals. It is insulated from the other terminals. Terminal L is a common terminal for the other terminals. Distinguish between these two common terminals. Do not connect them with ground.

Note 2: For connecting a relay between AR-COM and RUN-COM, attache a diode to the relay in parallel for surge absorbing.

Note 3: Use a shield wire for a signal line, and process it as shown below. The wire length should be less than 20 m. If the wire length unavoidably exceeds 20 m, use the optional VX application controller RCD-A (remote-control panel) or CVD-E (signal isolation converter).

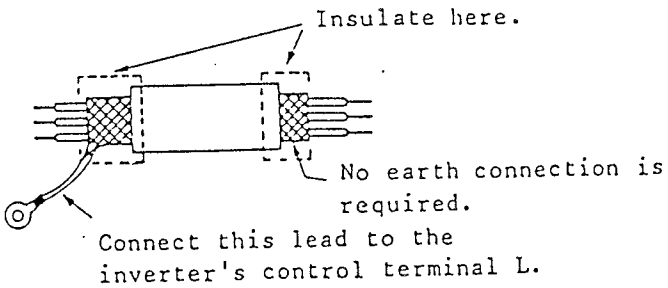


Figure 5-6 Signal Wire Shielding

Note 4: When a frequency setting signal is provided with a contact (on or off), use a relay which does not cause incomplete contact even at weak current or voltage (Use like the cross-bar twin contact).

Note 5: For other contacts, use a relay which does not cause incomplete contact at 12 VDC, 3 mA.

Note 6: Separate the inverter signal line from the power line as shown in below. If cross-over is unavoidable, cross them perpendicularly each other.

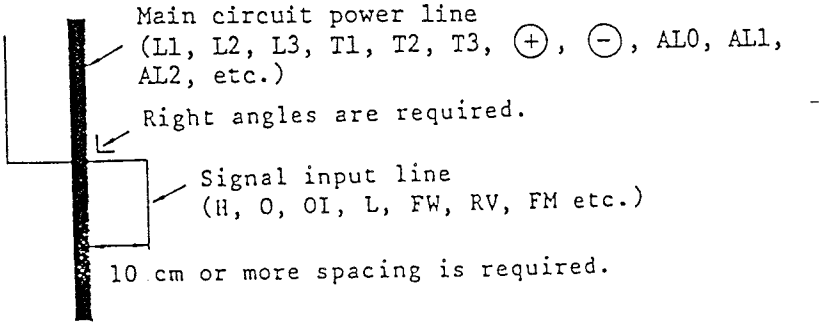


Figure 5-7 Wire Separation

6. OPERATION

⚠ WARNING: To avoid personal injury and damage to the inverter.

This inverter must be operated only by qualified personnel familiar with operation.
Failure to observe this precaution could result in personal injury and / or equipment damage.

⚠ WARNING: To avoid personal injury

Check the inverter parameters. Especially the maximum frequency of the inverter and allowable speed of motor and machine. The overspeed operation causes the mechanical damage of the motor and machine, and it could cause the fatal personal injury.

6.1 Before Operation

Prior to trial operation, check the following.

(1) Check that all power lines (input terminals L1, L2, L3, output terminals, T1, T2, T3 braking unit terminals +, -) are connected correctly. Need special care for input and output terminals have been connected correctly.

(2) Check the signal lines for wrong wiring.

(3) Check that the inverter case earth (⏚) is grounded. (earthing resistance; 10 Ω or less)

(4) Check that other terminals that (⏚) 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.

(6) Check that the terminals have not been short-circuited by cable crumbs or connectors after wiring. Do not leave the tools used.

(7) Check that neither short-circuit nor grounding occurs in output terminals.

(8) Check that the screws and terminals have been tightened firmly.

> Conduct the insulation test and withstand voltage test according to the procedure shown in Section 7 "Maintenance". Do not test other than the specified terminals.

6.2 Operation Pattern

The HFC-VWS3D series inverter provides the following patterns of operations, including the operations of the remote operator and copy unit (options).

Table 6-1 Combination of Operation Method

Command / Pattern	Frequency			Operation/stop command			Remarks	For details
	Digital operation panel	External	Digital remote operator	Digital operation panel	External	Digital remote operator		
1	∟			∟			Standard setting	Page 6-6
2		∟			∟			Page 6-7
3	∟				∟			Page 6-8
4		∟		∟				Page 6-9
5			∟ *			∟ *	Operation by remote operator (option)	
6			∟ *		∟			
7		∟				∟ *		

Note: * indicates the operations to be performed by the remote operator or copy unit. For details, read the respective instruction manual.

6.3 Setting Functions before Trial Operation

The functions of the inverter are factory-set to standard values.

Change the settings with reference to section 9 if necessary. Table 6-2 shows the standard settings of the functions which are usually used frequently.

Table 6-2 Value of Original Standard Setting

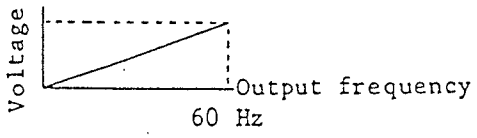
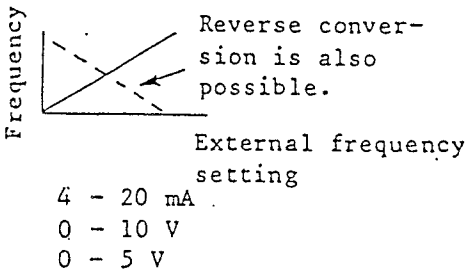
Function	Standard setting	Standard setting display	Setting change
V/F pattern setting (F-00)	Maximum frequency is 60 Hz, constant torque characteristics.  The relation between the reference signal and the output frequency is the following. [In the case of external signal] 0 - 10 V: A frequency of 60 Hz is set at 10 V. 0 - 5 V: A frequency of 60 Hz is set at 5 V. 4 - 20 mA: A frequency of 60 Hz is set at 20 mA.	VFE-VC 060-060	Set a new value in the function mode (see table 9-8 F-00.) Gain and bias adjustment are possible (see table 9-8 F-26 and 27.)
Acceleration time setting (F-01) and deceleration time setting (F-02)	30 seconds	ACCEL-1 30.0S DECEL-1 30.0S	Set a new value in the function mode (see table 9-8 F-01, 02.)
Frequency command, operation command	Ope.-key side (The setting can be changed to the terminal side or optionally to the remote operation side.)	F-SET-M Ope.-key F/R-SW Ope.-key	Set a new value in the monitor mode (see table 9-3.)

Table 6-2 Value of Original Standard Setting (Continued)

Function	Standard setting	Standard setting display	Setting change
Frequency setting	Set zero (0) Hz on the digital operation panel. (When the frequency is set with control terminals, set the frequency command switch to the terminal side.)	FS 000.0	Set a frequency in the monitor mode (see table 9-3.)
◎ Electronic thermal level adjustment (F-23)	The thermal level is set at the protection level of the general-purpose motor. However, the level is 100% of the rated current of the inverter. Adjust the thermal level setting by following equation; Thermal level setting $= \frac{\text{Motor nameplate current at 50 Hz}}{\text{Inverter rated current}} \times 100\ (\%)$ [Example] Inverter: Rated current 16.5 A Motor: Rated current 15 A Thermal level setting $= \frac{15}{16.5} \times 100 = 90\%$	E-therm 100%	Set a new value in the function mode (see table 9-8 F-23).
External frequency setting • Start (F-26) • End (F-27)	Start point or bias adjustment and end point or gain adjustment for external speed setting signal input, 4 - 20 mA, 0 - 10 V and 0 - 5 V. These frequencies are 0 Hz at standard setting. At 0 Hz, the inverter is operated at the selected V/F pattern.  	F-START 000.0Hz E-END 000.0Hz	Set new values in the function mode (see table 9-8 F-26, 27).

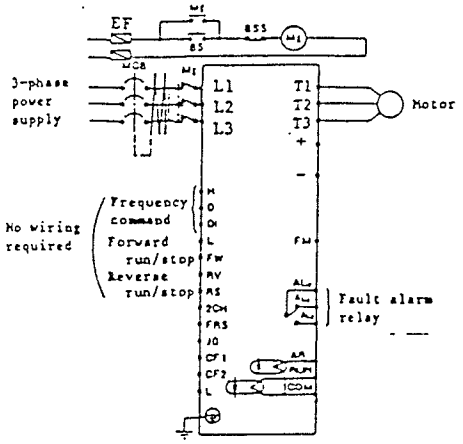
o Simple trial operation method for operation pattern 1

The most simple operation with no additional external device such as a potentiometer or switchs can be done by the operation patern 1 shown on page 6-6. To do this operation, however, some data change in monitor mode is required.

Step	Digital operation panel	Display	Remarks
Power ON		FS 000.0 000.0 Hz Cursor Frequency setting / Output frequency	Power on and the frequency setting (FS) and output frequency appears. In the second case and after, the previous display (before power off) appears.
Selection of frequency command method	Press [MON] or [▲].	F-SET-M Terminal	
	Move the cursor, using [▶], and set to Ope.-key using [▼] [▲].	F-SET-M Ope.-key Cursor movement	Frequency setting command is selected in digital operation panel.
Selection of operation command method	Press [MON] or [▲].	F/R-SW Terminal	
	Move the cursor, and set to Ope.-key using [▼] [▲].	F/R-SW Ope.-key Cursor movement	Operation command is selected in digital operation panel.
	Press [MON] to display [FS].	FS000.0 000.0Hz	
Frequency setting	Move the cursor, using [▶], and set the frequency, using [▲] [▼].	(Sample setting of 45 Hz) FS 040.0 000.0 Hz FS 045.0 000.0 Hz Cursor	Move the cursor left by one digit. For details, see page 9-7.
Operation	Press [FWD RUN] or [REV RUN].	Changes in frequency can be monitored at the right side of the same screen.	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 [▶] [▲] [▼].	(Sample setting of 30 Hz for deceleration) FS030.0 F030.0 Hz or R	If the setting is changed during motor operation, acceleration or deceleration are started, reaching the set value.
Stop	Press [STOP].		The motor decelerates when the [STOP] is pressed, and stops operation.

Operation pattern 1

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



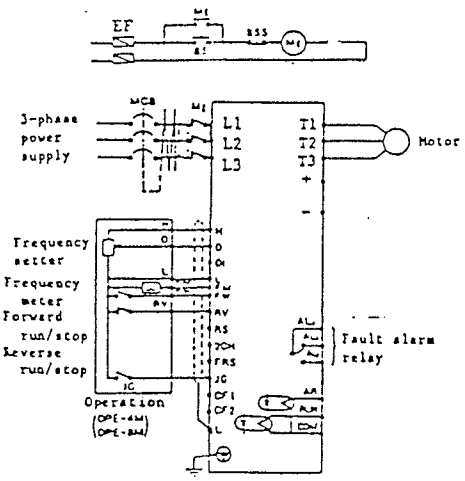
Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, however, it is recommended that Mg be inserted into the input side.

Step	Description
Power ON	After power ON, the previous display (before power off) appears. F S 0 0 0 . 0 0 0 0 . 0 H z Cursor
Selection of frequency setting mode	The new frequency can be set because the above mode is for frequency setting. F S 0 0 0 . 0 0 0 0 . 0 H z Cursor
Frequency setting	Move the cursor, using ▶, and input the preset value of frequency with ▲ ▼. F S 0 4 0 . 5 0 0 0 . 0 H z 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 pressed, the motor decelerates and stops according to the preset deceleration time. (F-01, F-02). 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. (F-01, F-02).

Operation pattern 2

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

The following description is given for operations on the operation boxes (OPE-4M/8M).

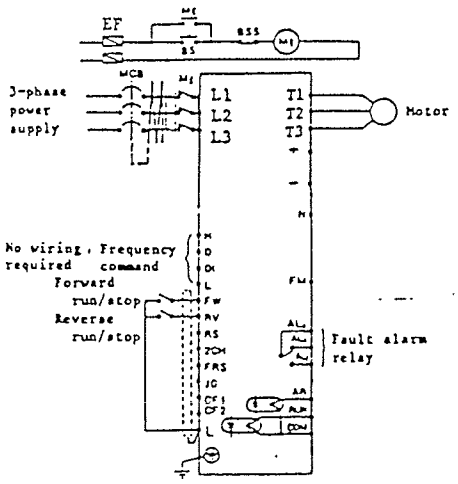


Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, however, it is recommended that Mg be inserted into the input side.

Step	Description
Power ON	After power ON, the previous display (before power off) appears. F S 0 0 0. 0 0 0 0 . 0 Hz
Selection of frequency command method	Press MON or ▲ once to select the frequency command method. F - S E T - M O p e . - K e y Cursor movement
Selection of operation command method	Adjust the cursor to "0" 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 Press MON to select the operation command method. F / R - S W O p e . - K e y Adjust the cursor to "0" position with the ▶ key, and press ▲ to select the terminal mode. F / R - S W T e r m i n a l
Operation command	(FS display) "F" and "R" are displayed, using Forward Operation (FWD) and Reverse Operation (REV) on the operation box respectively. 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. Even when STOP on the operation panel is pressed, the motor decelerates and stops according to the preset deceleration time. In this case, the switch on the operation box (OPE) should be off once and on again for restarting the inverter. In the terminal mode, it is possible to make STOP on the operation panel effective or ineffective (see descriptions on table 9-8 F-29 and field 3).
Frequency setting	
Stop	

Operation pattern 3

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

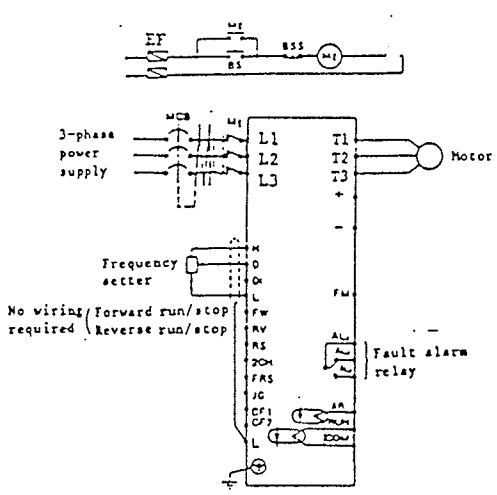


Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, it is recommended that Mg be inserted into the input side.

Step	Description
Power ON	After power ON, the previous display (before power off) appears. FS000.0 000.0 Hz
Selection of operation command method	Press MON or ▲ 2 times to select the operation command method. F/R-SW Ope.-Key
Selection of frequency setting mode	Adjust the cursor to "0" position with the ▶ key and select the terminal mode with the ▲ key. F/R-SW Terminal Cursor movement
Frequency setting	Press the MON or ▼ key any times to select the frequency setting mode. FS 000.0 000.0 Hz
Operation command	Move the cursor with the ▶ key and input the preset value of frequency with ▲ and ▼ keys. FS 040.5 000.0 Hz Forward operation is performed with FW-L ON. Reverse operation is performed with RV-L ON.
Acceleration/deceleration	Move the cursor with the ▶ key, and re-enter the preset value of frequency. Turn off the control terminals FW-L and RV-L, and the motor will decelerate and stop according to the preset deceleration time.
Stop	In the terminal mode, the motor can be stopped with the STOP key. The STOP key can be made effective or ineffective. (See descriptions table 9-8 F-29 and field ③.)

Operation pattern 4

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

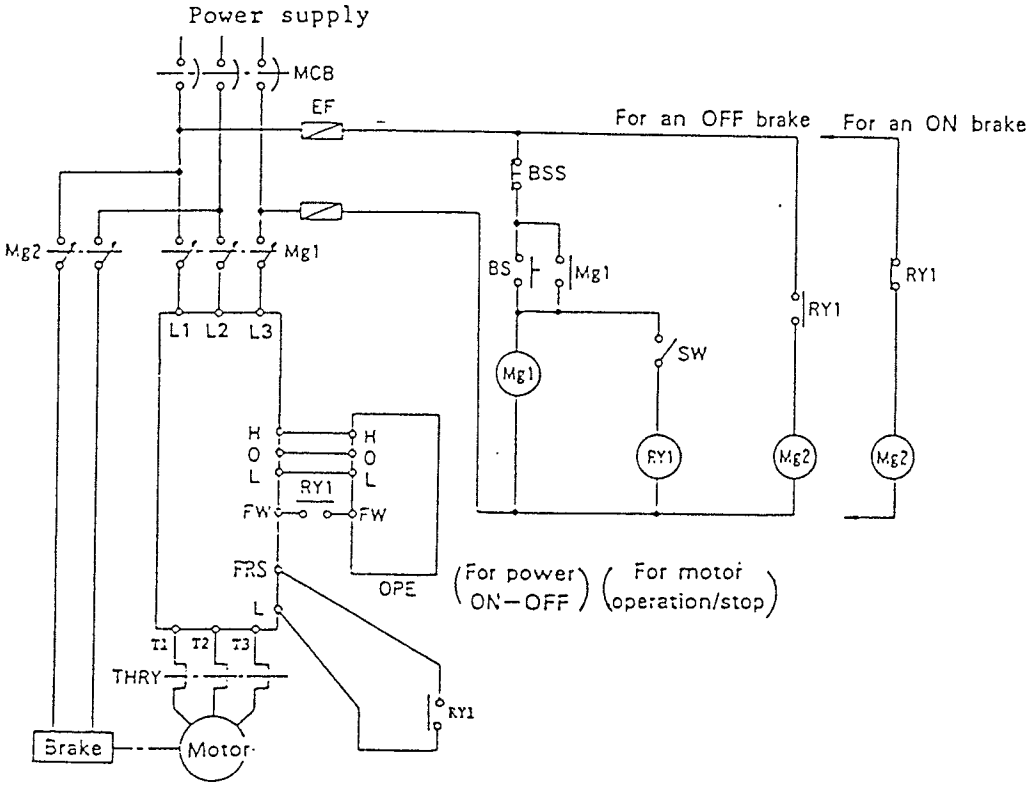


Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, it is recommended that Mg be inserted into the input side.

Step	Description
Power ON	After power ON, the previous display (before power off) appears. FS000.0 000.0 Hz
Selection of frequency setting method	Press MON or ▲ once to select the frequency command method. F-SET-M Ope.-Key Adjust the cursor to "0" position with the ▶ key, and press the ▲ key to select the terminal mode. F-SET-M Terminal
Operation command	Return the cursor to the previous position and press MON and ▼ keys any times for FS display. FS 000.0 F000.0 Hz For forward operation, press FWD RUN: "F" is displayed. For reverse operation, press REV RUN: "R" is displayed.
Frequency setting	(However, since the frequency setting is not entered, no motor can be operated.) Input any one of the following: • Turning the frequency setter. • Input 0 - 10 VDC or 0 - 5 VDC (see table 9-3 display sequence 2) between O-L terminals on the printed circuit board. • Input DC 4 - 20 mA between OI-L terminals on the printed circuit board.
Stop	Press the STOP key.

6.4 Example of Connection When a Motor with a Brake is Used

> ⚠ WARNING: To avoid personal injury
>
> When stops the inverter for emergency case not only using the function of free run stop (FRS) or reset (RS) but also the power supply to the inverter must be turned off.



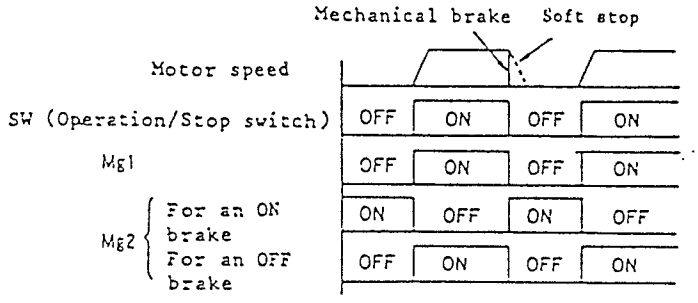


Figure 6-1 Example of Connection when a Motor with a Brake is Used

7. MAINTENANCE AND CHECK

The inverter consists of many components, and will not fulfill the function unless those parts operate normally. It is therefore necessary to find fault signs of the parts and equipment early by periodic inspection and to take measures for them.

Prior to maintenance and check, it is recommended to check the setting data because it may be changed before restart. (See Appendix 1.)

7.1 Cautions on Maintenance and Check

⚠ WARNING: To avoid personal injury

Hazardous voltage is present on the terminals and printed circuit board. Always disconnect power supply and put the TAGOUT, LOCKOUT beginning any service. After turning off power supply, do not touch the internal parts of inverter until the LED lamp on the printed circuit board (visible after the terminal cover is removed) goes out, and then measure the DC bus voltage ⊕ and ⊖ terminals with voltmeter, and make sure no voltage on them.

⚠ CAUTION: To avoid damage to the inverter

(1) Keep the unit clean to prevent entry of dust or dirt.

(2) Do not pull the cable when removing a connector.

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

(4) Be sure to tighten the terminals and connectors securely.

(5) Check no moisture and oil mist are present inside:

For details, see table 7-1.

7.2 Checking Items

(1) Routine check

(2) Periodical check (yearly)

(3) Insulation resistance and withstand voltage test

⚠ CAUTION: To avoid personal injury and damage to the inverter

To conduct insulation resistance and withstand voltage tests, connect the terminals as shown in Figure 7-1 and perform measurements under the following conditions:

- Measure the resistance between a terminal and the ground with a 500 VDC megohm-meter as shown in Figure 7-1. Confirm that the inverter withstands 5 MΩ or more.
- Apply 2000 VAC, between a terminal and ground for one minute as shown in Figure 7-1. Confirm that there is no abnormality.
- Do not perform insulation resistance and withstand voltage tests for the terminals not shown in Figure 7-1 such as printed circuit board.

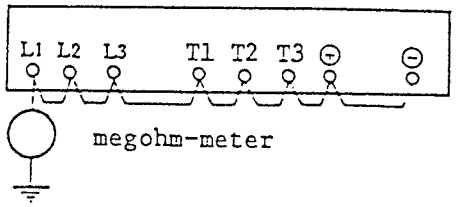


Figure 7-1 Terminal Connection for Insulation Resistance and Withstand Voltage Tests

Table 7-1 Routine and Periodic Inspections

Component to be checked	Check item	Details of check	Interval		Check method	Criterion	Standard period before replacement	Instrument
			Daily	Periodically				
All	Ambient environment	Measure the ambient temperature and humidity and check whether there are dust, noxious gases, and oil mists.	✓		See the notes described on section 2.	Ambient temperature range: -10°C - +40°C, no freezing	-	Thermometer
	Entire unit	Check whether there are abnormal vibration and noise.	✓		Audio-visually check vibration and noise.	Ambient humidity range: 20% - 90%, no condensation		Hygrometer
	Power supply voltages	Check whether the main circuit voltage and control voltage are at the correct levels.	✓		Measure voltages across the L1 and L2 terminals on the terminal board of the inverter.	360-506 V/60 Hz		Multimeter
Main circuit	All	1) Insulation resistance test (between a main circuit terminal and the ground terminal)		✓	1) See page 7-2.	1) See page 7-2.	-	500 V class megohm meter
		2) Looseness of tightened screws		✓	2) Retighten screws.	2) No abnormality		
		3) Trace of overheat on individual parts		✓	3) Visual check	3) No abnormality		
		4) Cleaning		✓				
	Connection conductor and wire	1) Strain of conductor		✓	1) Visual check	1) No abnormality	-	
		2) Teared or deteriorated wire sheath (cracks, discoloration, etc.)		✓	2) Visual check	2) No abnormality		
	Transformer	Nasty smell and abnormal swell tone	✓		Acoustic check	No abnormality		
	Terminal block	Damage		✓	Visual check	No abnormality		
	Transistor and diode modules	Resistance between terminals		✓	See paragraph 7.4.	See paragraph 7.4.		Analog multimeter
	Smoothing capacitor	1) Liquid leakage	✓		1) Visual check	1) No abnormality	Five years (Note 1)	Capacitance meter
		2) Safety valve protrusion and bulking	✓		2) Visual check	2) No abnormality		
		3) Capacitance		✓	3) Measure the capacitance with a capacitance meter.	3) At least 85% of the rated capacitance		

Table 7-1 Routine and Periodic Inspections (Continued)

Component to be checked	Check item		Details of check	Interval		Check method	Criterion	Standard period before replacement	Instrument
				Daily	Periodically				
Main circuit	Electromagnetic contactor		1) Abnormal tone during operation 2) Abnormality on the contact		✓ ✓	1) Acoustic check	1) No abnormality		
	Resistor		1) Large cracks and discoloration 2) Wire breakage		✓ ✓	1) Visual check 2) Disconnect either wire and measure the resistance with a multimeter.	1) No abnormality 2) The measured resistance must be the indicated resistance ±10%.		Multimeter
Control	Operation		1) Difference among inter-phase output voltages during operation of the inverter alone		✓	1) Measure the inter-phase voltages at the inverter output terminals T1, T2, and T3.	1) The inter-phase voltage difference must be 2% or less.	-	
	Parts including PC boards	General	1) Nasty smell and discoloration 2) Remarkable rust		✓ ✓	Visual check	No abnormality (Note 2)		
		Capacitors	Trace of liquid leakage and deformation	✓		Visual check			
Cooling	Cooling fan		1) Abnormal vibration and noise 2) Loose plugs and screws 3) Dust	✓ ✓	 ✓ 	1) Turn off the cooling fan and rotate it manually. 2) Retighten plugs and screws.	The cooling fan must rotate smoothly. No abnormality	2 - 3 years under normal condition	
Indication	Indication on the digital operation panel		1) Illegible display 2) Insufficiently connected or damaged connector	✓	 ✓	Visual	The display must be legible. (Note 3)	Seven years under normal condition	

Note 1: If the inverter is used under a heavy load at a high temperature, the life of the smoothing capacitor is significantly reduced. When replacing the smoothing capacitor with a one which has been stored for three or more years, perform aging under the following conditions before using it:

1) At first, apply 80% of the rated voltage to the capacitor for one hour at room temperatures.
2) Next, raise the voltage to 90% of the rated voltage and maintain the voltage for one hour at room temperature.
3) Finally, apply the rated voltage to the capacitor for five hours at room temperatures.

Note 2: Notes on handling printed circuit board
Usually, no maintenance is required for printed circuit board. If maintenance or check is required, note the following points:

- Prevention of damage due to ESD (Electrostatic Discharge)
The MCUs, ICs, and other components on the printed circuit board are sensitive parts against ESD. Precaution for ESD are required when testing, servicing or repairing. Be sure to ground the working bench, soldering iron, and human body before handling.

Note 3: Since the display is a liquid crystal display, it may be illegible at some viewing angles, however, it is normal.

To minimize the idle time, it is recommended that the parts listed in Table 7-2 be stocked.

Table 7-2 Recommended Spare Parts

Part name	Sequence symbol	Quantity		Remarks
		In use	Spare	
Inverter module	PM	3 - 18	1 - 6	
Cooling fan	FAN	1 - 11	1	
Converter module	DM	3	3	
Smoothing capacitor	CB	2-10	2-10	Store smoothing capacitors at -20°C to +30°C.
Digital operation panel	D.OPE	1	1	
PC (Printed circuit) board	Control PC board	1	1	
PC board	Base PC board	1	1	

7.3 Measuring Method of Input/Output Voltage, Current, and Power

General-purpose measuring instruments to measure input/output voltage, current, and power are listed below. For voltage, measure the effective value of the fundamental wave. For power, measure the total effective value.

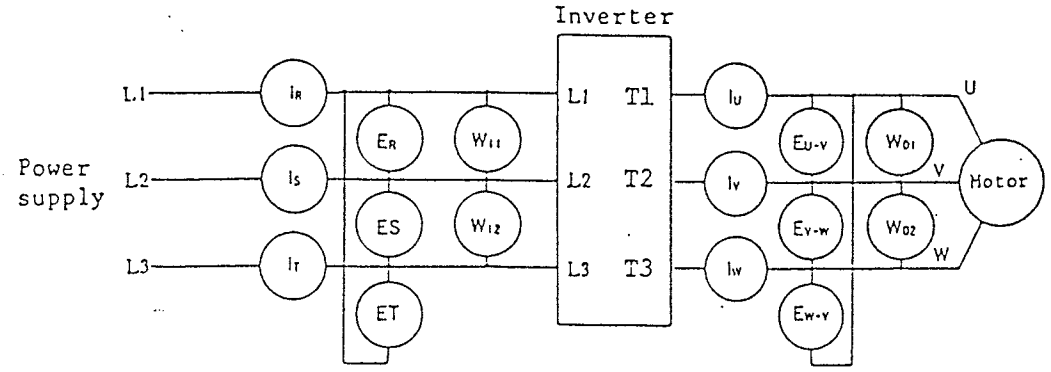


Figure 7-2 Measuring Method

Table 7-3 Measuring Location and Measuring Instruments

Measuring item	Measuring location	Measuring instrument	Measured value	Standard measurement value
Power supply voltage E_1	Between L1 and L2(ER), L2 and L3(ES), and L3 and L1(ET)	Moving-iron type voltmeter or rectifier type voltmeter	Effective value of the fundamental wave	400 to 460 V/60 Hz
Power supply current I_1	Current at L1, L2, and L3 terminals (IR) (IS) (IT)	Moving-iron type ammeter	Total effective value	
Primary power W_1	Between L1 and L2 and between L2 and L3 (W_{11}) (W_{12})	Electro-dynamometer type wattmeter	Total effective value	
Primary power factor Pf_1	Calculated from each measured value of power supply voltage E_1, power supply current I_1, and primary power W_1 by using the following formula: $Pf_1 = \frac{W_1}{\sqrt{3}\ E_1\ I_1} \times 100\ (\%)$			
Output voltage E_0	Between T1 and T2(EU), T2 and T3(EV), and T3 and T1(EW)	See table 7-4 or use a rectifier type voltmeter.	Total effective value	
Output current I_0	Current at T1(IU), T2(IV) and T3(IW) terminals	Moving-iron type ammeter	Total effective value	
Output power W_0	Between T1 and T2(W_{01}) and between T3 and W(W_{02})	Electro-dynamometer type wattmeter	Total effective value	
Secondary power factor	Calculated from each measured value of output voltage E_0, output current I_0, and output power W_0 by using the following formula: $Pf_0 = \frac{W_0}{\sqrt{3}\ E_0\ I_0} \times 100\ (\%)$			

Note 1: The voltmeter should indicate effective value of fundamental wave for voltage and total effective value for current and power.

Note 2: Since inverter output waves are distorted, errors are prone to occur particularly at low frequencies. However, measuring method and instruments which listed above provide comparatively accurate values.

Table 7-4 Output Voltage Measurement

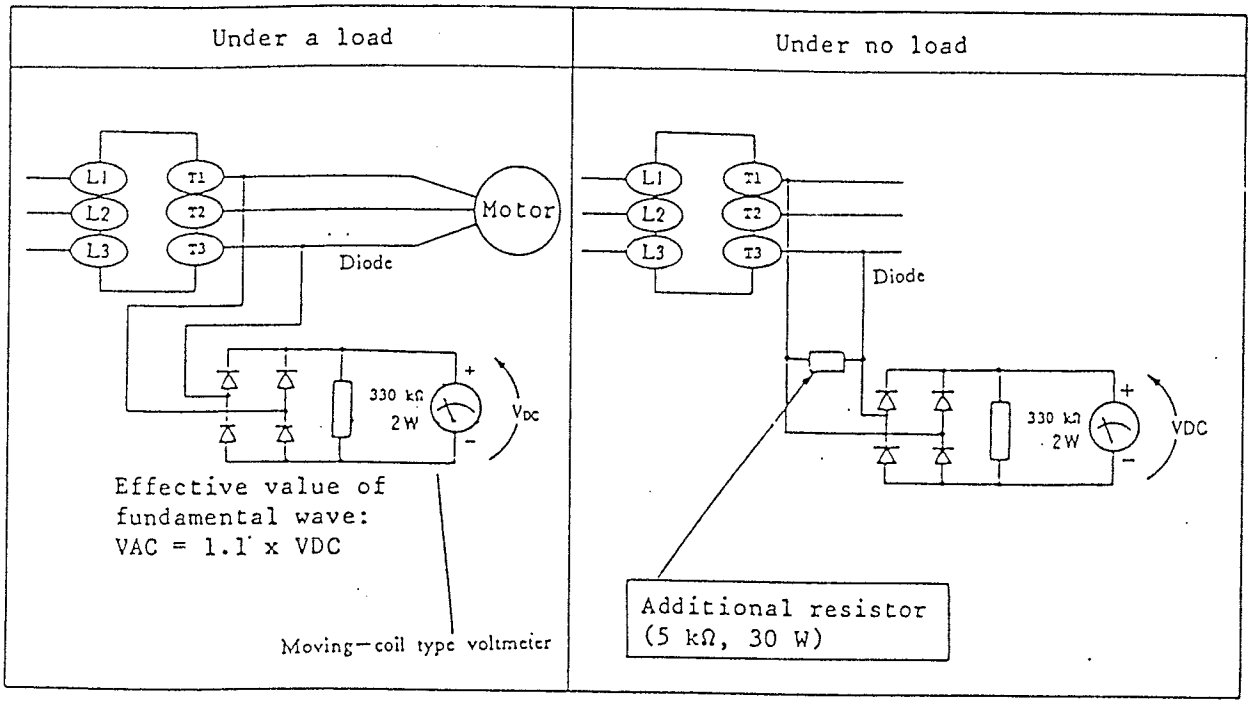


Table 7-5 Discharge Times

Inverter model name	Time in second for voltage to drop to 50 VDC
HFC-VWS16HF3D	160 sec.
HFC-VWS22HF3D	200 sec.
HFC-VWS33HF3D	140 sec.
HFC-VWS40HF3D	160 sec.
HFC-VWS50HF3D	160 sec.
HFC-VWS60HF3D	200 sec.
HFC-VWS75HF3D	240 sec.
HFC-VWS100HF3D	200 sec.
HFC-VWS120HF3D	220 sec.
HFC-VWS150HF3D	260 sec.
HFC-VWS180HF3D	330 sec.

Table 7-8 Inverter (Transistor) Module Check in the Assembly State

When measured in the assembly state			When measured in the disassembly state		
Ohmmeter terminal colors Black - Red (-) - (+)	Resistance	Place to check	Ohmmeter terminal colors Black - Red (-) - (+)	Resistance	Place to check
⊕ - T1	50 kΩ or more	U-phase upper frame (U^+)	BU - U^+	1000 Ω or less	U-phase upper frame (U^+)
⊕ - T2		V-phase upper frame (V^+)	BV - V^+		V-phase upper frame (V^+)
⊕ - T3		W-phase upper frame (W^+)	BW - W^+		W-phase upper frame (W^+)
⊖ - T1	50 Ω or less	U-phase lower frame (U^-)	BX - U^-	1000 Ω or less	U-phase lower frame (U^-)
⊖ - T2		V-phase lower frame (V^-)	BY - V^-		V-phase lower frame (V^-)
⊖ - T3		W-phase lower frame (W^-)	BZ - W^-		W-phase lower frame (W^-)
T1 - ⊕	50 Ω or less	U-phase upper frame (U^+)	U+ - BU	50 to 200 Ω or more	U-phase upper frame (U^+)
T2 - ⊕		V-phase upper frame (V^+)	V+ - BV		V-phase upper frame (V^+)
T3 - ⊕		W-phase upper frame (W^+)	W+ - BW		W-phase upper frame (W^+)
T1 - ⊖	50 kΩ or more	U-phase lower frame (U^-)	U- - BX	50 to 200 Ω or more	U-phase lower frame (U^-)
T2 - ⊖		V-phase lower frame (V^-)	V- - BY		V-phase lower frame (V^-)
T3 - ⊖		W-phase lower frame (W^-)	W- - BZ		W-phase lower frame (W^-)

8. FAULT MESSAGE AND TROUBLESHOOTING

This section provides a meaning of fault message and troubleshooting. If a fault has occurred, locate the cause and corrective measures before restarting operation. Also see the troubleshooting flow chart in this section. When no cause is found and not possible to restart the inverter, contact your distributor.

Note: When you contact with your distributor for a fault, clearly mention inverter model name, manufacturing number, kind of fault message, programmed data (use the data list of appendix 1) and whatever you did to solve a fault. Also see the section 7.

8.1 Causes and Action

Table 8-1 Causes and Action

Symptom of malfunction				Meaning of message	Re-set	Check points	Suggested remedy
Circuit breaker MCB	Electro-magnetic contactor Mg	Display on digital operation panel (?ERROR ▨)	Fault alarm relay				
↓	-	-	-	Abnormality between the MCB and an inverter output terminal	-	. Check for a shortcircuit on the power supply side. . Check the capacity of the MCB. . Check for a ground fault in the inverter or on the power supply side.	. Correct the shortcircuit. . Increase the MCB capacity. . Correct the ground fault.
						Check whether the converter module is damaged.	Replace the converter module.
						Check whether the magnet switch in the inverter operate correctly.	Replace the magnet switch.
						Check whether the current limiting resistor (RS) is normal.	Replace the resistance.
		OC. Ac .1 OC. D .1 OC. Drive GND Flt	↓	Overcurrent	*	Check whether the inverter module is damaged or the motor or a connection line has a ground fault.	• Replace the inverter module. • Correct the ground fault.
	↓	-	-	Power failure	-	Check whether there is a power failure.	Restore the power.
						Check whether the connections of the MCB and Mg are normal.	Replace the MCB and/or Mg.
		Under V.	↓	Under power supply voltage	*	Momentary power loss or voltage fluctuation.	Correct the problem in the power distribution system.
						Check input disconnect device and input contactor.	Replace the defective equipment.
		Inst. P-F	↓	Instantaneous power failure	*	. Check input disconnect device and input contactor. . Check whether the power was turned off then turned on again with POWER OFF still displayed on the inverter.	. Replace the defective equipment. . Be sure to turn on the power again after the POWER OFF display on the inverter dis-appears. When the load is lighter, the POWER OFF display stays on for a longer time.

* For releasing an fault (error), connect the RS terminal to the L terminal on the PC board or press the reset button at the left below on the PC board.
Fault releasing by power off is not effective. Until reset signal has been given, the fault will be remained.

Table 8-1 Causes and Action (Continued)

Symptom of malfunction				Meaning of message	Re-set	Check points	Suggested remedy
Circuit breaker MCB	Electro-magnetic contactor Mg	Display on digital operation panel (?ERROR ▨)	Fault alarm relay				
		Over V.	↓	DC bus voltage	*	. Check for incoming line voltage. . Check whether the capacitor for power factor improvement on the power source line is turned on and off. . Check whether the motor is decelerated rapidly.	. Lower the line voltage. . Avoid connecting capacitor, or insert an AC reactor on the input side. . Prolong the deceleration time. . Set a time that conforms to inertia of the load. . Using a proper regenerative braking device.
		OV SRC	↓	Overvoltage source (High line voltage)	*	Check for incoming line voltage.	. Correct the line voltage. . Insert an AC reactor on the input side.
		OC. Accel	↓	Overcurrent during motor acceleration	*	. Connected inertia is too large to be accelerated within the time set. . Check for output short-circuit or ground fault. . Check for start or jogging frequency set too high. . Check for torque boost set too high. . Check whether the motor is constrained.	. Prolong the acceleration time. . Correct the short-circuit or ground fault. . Reduce the start or jogging frequency adjustment. . Reduce the torque boost adjustment. . Release the motor from the constrained state.
		OC. Decel	↓	Overcurrent during motor deceleration	*	. Connected inertia is too large to be decelerated within the time set. . Check for output short-circuit or ground fault.	. Prolong the deceleration time. . Set a time that conforms to inertia of the load. . Correct the short-circuit or ground fault.
		OC. Drive	↓	Overcurrent during constant motor operation	*	. Check for overload caused by driven equipment. . Check for output short-circuit or ground fault.	. Correct the problem in the driven equipment. . Correct the short circuit the ground fault.
		Over L.	↓	Inverter overload (overloaded operation)	*	. Check whether the load is too heavy. . Check whether the electronic thermal level is correct.	. Reduce the load. . Adjust F-23 F-therm.

Table 8-1 Causes and Action (Continued)

Symptom of malfunction				Meaning of message	Reset	Check points	Suggested remedy
Circuit breaker MCB	Electromagnetic contactor Mg	Display on digital operation panel (?ERROR ▨)	Fault alarm relay				
		Over C.	⌞	Overcurrent detection just after power on	*	Check whether the current detector and the detection circuit on the PC board are correct.	Check the current detector and the detection circuit on the PC board.
		OH Fin	⌞	Fin overheat temperature rise	*	. Check the cooling fan. . Check whether inlet or outlet is blocked. . Check whether the ambient temperature is too high.	. Replace the cooling fan. . Do not block the inlet and outlet. . Reduce the ambient temperature.
		CPU	⌞	Microprocessor error	*	. Check for electrical noise source. . Defective PCB.	. Suppress the noise source. . Repair the inverter.
		UV WAIT	-	Low input voltage at automatic restart	-	. Check whether the power supply voltage drops to the minimum level when restart function is executed.	Restore the power.
		B2C number	⌞	Invalid data in soft memory element (NV-RAM)	-	Check the number of times to store the new data per day.	Replace the NV-RAM. The number of times data is written in soft storage device is limited to about ten thousands. (If data is stored several times per day, its life will approximately ten years.)
		ADJUST [---] S Number	-	This display does not mean an error. It indicates a time subtracted from IPS-R-T.	-	This display does not indicate an error.	-

8.2 Protection Functions

Table 8-2 Protection Functions

Name (Fault message)	Description
Under voltage (Under V.)	When the input line voltage drops, the control circuit does not function correctly, resulting in a failure due to insufficient base current to the main transistor, motor overheat or insufficient torque. To prevent this, when the input line voltage drops, the output is cut off.
Instantaneous power failure (Inst. P-F)	When a momentary power failure continues 15 ms or more, the output is cut off. In the case of automatic restart function is selected, a long power failure exhausts the control power and the failure signal is released. Note that operation is resumed if an operation command has been issued. In the restart mode, operation is also resumed if an operation command has been issued. (The inverter stops momentary then restarts.)
Overcurrent OC. Accel OC. Decel OC. Drive	When the inverter output side is shortcircuited or the motor is constrained, a large current flows in the inverter and semiconductors may be damaged. To prevent this, DC current and output current are detected. If a current exceed the limit value, the output is cut off. The type of operation, during acceleration (OC. ACCEL), during deceleration (OC. DECEL) or during constant speed operation (OC. DRIVE) is identified.
Overvoltage (Over V.)	When the DC bus voltage is raised beyond the limited value due to the regenerative energy from the motor, the protection circuit functions to cut off the output.
Overload (Over L.)	When the motor is overloaded, the output is cut off.
Overvoltage source (OV SRC)	When the incoming voltage rises the allowable value, the output is cut off and the OV SRC message appears on LCD. When incoming voltage is higher than the allowable value of parts, the parts will be damaged without indication.

Table 8-2 Protection Functions (Continued)

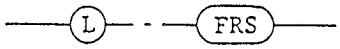
Name (Fault message)	Description
Fin overheat (OH Fin)	Inverter equipped with heat sinks using fan forced cooling include temperature sensing of the heat sink. This fault message is displayed when the fan cooled heat sink becomes abnormally warm. This message typically indicates a failed cooling fan or an obstruction to the flow of air.
Ground fault protection (GND. Flt)	When unbalanced current due to a ground fault is detected between the inverter output section and the motor, the inverter output is cut off. Therefore, this function protects the inverter but does not protect the human body. To protect the human body against electric shock, use an earth leakage breaker. Note that when a ground fault occurs, an overcurrent alarm, OC. ACCEL, OC. DECEL or OC DRIVE, may be indicated as well as GND. FIt.
Stall prevention circuit (—)	The motor is started in such a way that large current is automatically suppressed so that the inverter does not cause an overcurrent trip due to large start current. In addition, the motor is decelerated in such a way that overvoltage and overcurrent are automatically suppressed so that the inverter does not cause a trip due to overvoltage or overcurrent resulting from regenerative energy during deceleration.
Overload suppression (—)	The motor current (inverter output current) is suppressed. When the motor current exceeds the preset value by potentiometer due to an increased load, the inverter output frequency is reduced to suppress the current.

8.3 Content of Check Points

No motor rotates

- Check the wiring between inverter and motor.
- Check the input voltage whether it is rated voltage or not.
- Check the wiring between (FRS) and (L) on the circuit board

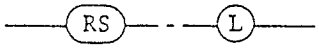
  * They should be open.

  normally open

- Check the wiring between (RS) and (L) on the circuit board

  * They should be open.

- Check the operation mode in the monitor mode whether it is set according to application system.

  F-SET-M: OPE-key/Terminal / COM-EA
  F/R-SW: OPE-key/Terminal / COM-EA

- Check the reference (freq. setting) signal
  - When F-SET-M "OPE-key" is selected, check the FS□□□.□ in the monitor mode.
  - When F-SET-M "Terminal" is selected, check the voltage or current signal on the terminal of printed circuit board.

    V_{O-L}: 0 to 10 VDC or 0 to 5 VDC
    I_{OI-L}: 4 to 20 mA

- Check whether setting frequency is less than minimum frequency

  *Set the frequency more than minimum frequency.

- Check whether LCD indication is in "Monitor" mode.

  * Select "Monitor" mode. In the function mode, the inverter cannot start.

- Check whether [STOP] key of digital operation panel is pushed when F/R-SW in "Monitor" mode is selected with "terminal".

  * Once, run command (FW/RV) must be turned off, and then turned on again from the terminal.

- Check the output voltage of T1-T2, T2-T3 and T3-T1 whether they are balanced or not.

- Check whether setting frequency of "SPEED1" to "SPEED3" is proper value when you use multi stage speed terminal (CF1, CF2).

  * "SPEED1 to 3" must be set or multi stage speed command (CF1, CF2) must be removed.

- Check whether [FWD RUN] key and [REV RUN] key of D-OPE are pushed together in "Ope-key" mode.

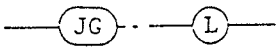
- Check whether forward operation command and reverse operation command are input together in "Terminal" mode.

* Only one signal should be input.

No motor accelerates

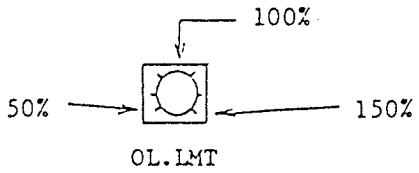
- Check the reference (freq. setting) signal
  - When F-SET-M "Ope-key" is selected, check the FS□□□.□ in the monitor mode.
  - When F-SET-M "Terminal" is selected, check the voltage or current signal on the terminal of printed board.

    V_{O-L}: 0 to 10 VDC or 0 to 5 VDC
    I_{OI-L}: 4 to 20 mA
  - When F-SET-M "COM-EA" is selected, check the communication system side such as PC or PLC.
- Check the F-05 (frequency upper limiter).
- Check whether the preset value of "F-END" in the function mode is more than maximum frequency.
- Check whether the wiring between (JG) and (L) on the printed circuit board is open.



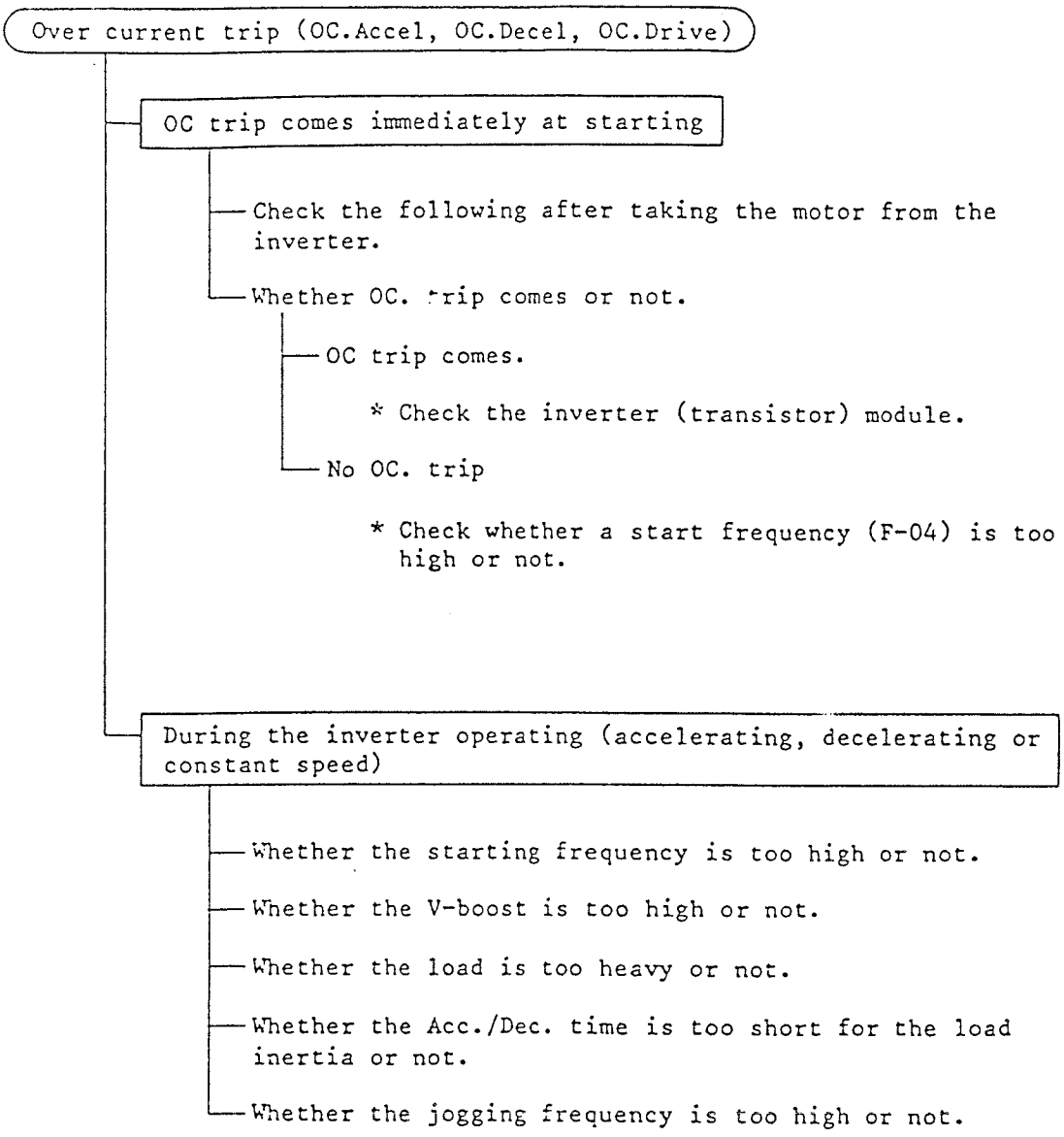
- Check the load whether it is too heavy or not.

  * Reduce the load or adjust the overload limit level by "OL.LMT" (VR) clockwise.



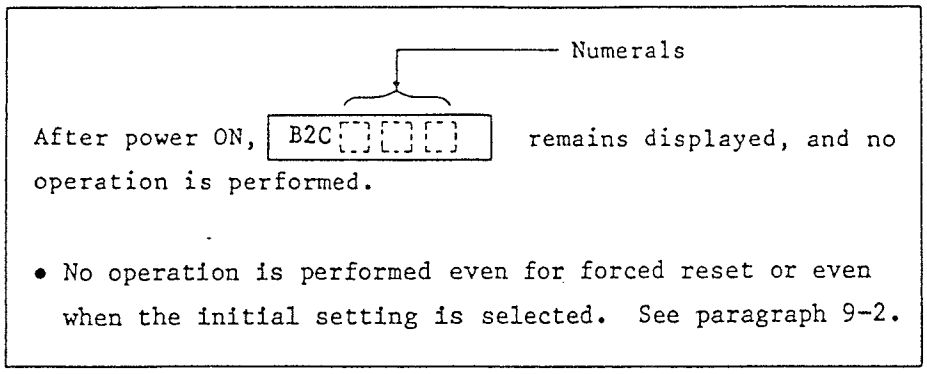
- Check whether setting frequency of "SPEED1" to "SPEED3" is proper value when you use multi stage speed terminal (CF1, cF2).

  * "SPEED1 to 3" must be set or multi stage speed command (CF1, CF2) must be removed.


Over current trip (OC.Accel, OC.Decel, OC.Drive)
OC trip comes immediately at starting
Check the following after taking the motor from the inverter.
Whether OC. trip comes or not.
OC trip comes.
* Check the inverter (transistor) module.
No OC. trip
* Check whether a start frequency (F-04) is too high or not.
During the inverter operating (accelerating, decelerating or constant speed)
Whether the starting frequency is too high or not.
Whether the V-boost is too high or not.
Whether the load is too heavy or not.
Whether the Acc./Dec. time is too short for the load inertia or not.
Whether the jogging frequency is too high or not.

8.4 Life of Soft Memory Element (NV-RAM)

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



Note 1: Operation and stop should be performed, using a command from the control terminal or digital operation panel.
The soft memory element is used to store parameter changes when incoming power supply is interrupted. See paragraph 2-9. If power is turned ON and OFF several times per day to store the changed data in memory, its life will be approx. 10 years.
It is recommended that the inverter is operated and stopped with a control terminal command or digital operation panel, without turning power ON and OFF; it should be noted that if the inverter is operated and stopped with power ON and OFF whenever the setting data is changed, it will not last longer.
(However, when the power has been turned on, changing data multiple times and pressing the STR key does not affect the life. Therefore, when test operation data is changed frequently, the power must be turned off for data storage after the last change to data.)

Note 2: 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) simultaneusly with power off. See paragraph 2-9.

Countermeasures ... Release the Forced Reset (or disconect RS-L) and turn power off once to store the changes. See paragraph 2-9.

Note 3: The following power supply conditions may damage the converter module:

- The unbalance ratio of the power supply voltage is 3% or more.
- The power capacity is ten times or more the inverter capacity and 500 kVA or more.
- The power supply voltage changes rapidly.

Examples:

- A number of inverters are connected together with very low impedance line connections.
- Capacitors for power factor improvement may be switched on line.

If one of the above conditions exists, it is recommended that a reactor of approximately 3% impedance (percentage of voltage drop at the rated current) be inserted on the power supply lines for each inverter.

9. DESCRIPTION OF DIGITAL OPERATION PANEL, MONITOR MODE AND FUNCTION MODE

This section contains a digital operation panel description, monitor mode description and function mode description. Read this section to gain a complete understanding of them prior to attempting operate the inverter.

Note: The digital operation panel with the inverter is used for inverter operation, so the inverter cannot be operated without this panel.

9.1 Configuration of Digital Operation Panel

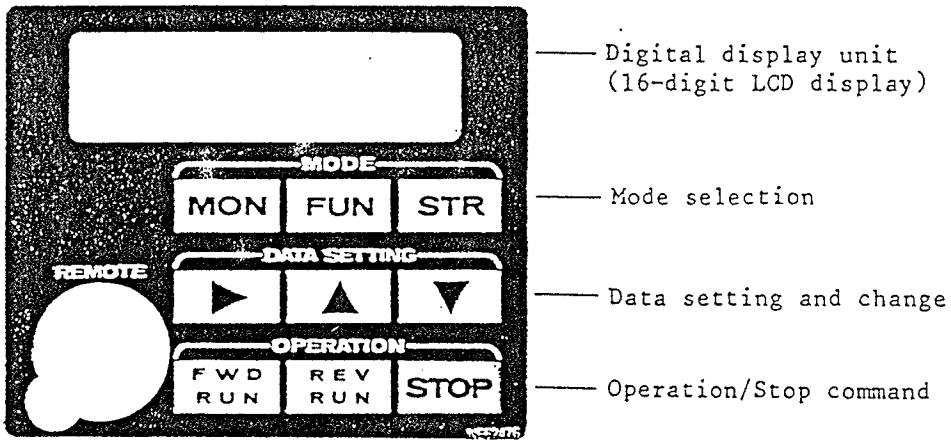


Figure 9-1 Configuration of Digital Operation Panel

Table 9-1 Description of Digital Operation Panel

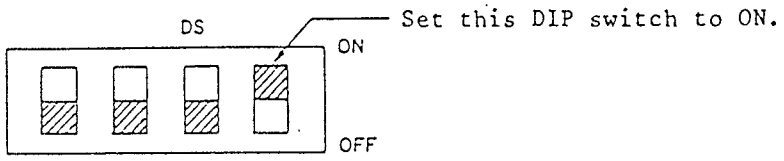
Section	Key	Key name	Description
Mode selection	MON	Monitor	Selects the monitor mode.
	FUN	Function	Selects the function mode. Function 1 mode: Selects the function name. Function 2 mode: Selects and changes data.
	STR	Store	Stores the preset data in memory.
Data setting and change	▶	Cursor movement	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 → COM-EA) ▼ Back (COM-EA → Terminal → Ope.-key) . For mode: ▲ Next mode (eg. F-00 VFE-VC → F-01 ACCEL-1) ▼ Previous mode (eg. F-01 ACCEL → F-00 VFE-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.

9.2 Returning to the Original Standard Setting

To return the inverter to the original standard setting, observe the following procedure:

(1) Turn the power on.

(2) Set the rightmost DIP switch on the printed circuit board to ON.



(3) Press the forcible reset button on the printed circuit board while holding down the [MON], [FUN], and [STR] keys on the digital operation panel at one time.

(4) Release the [MON], [FUN], and [STR] keys one to two seconds after reset. Then, [B2C.....] (ROM number) is displayed. If these keys are released earlier, [FS000.0 000.0 Hz] will be displayed. Retry steps (3) and (4).

(5) Turn the power off.

(6) Set the DIP switch to OFF.

(7) Turn the power on again and confirm that the data is set to the original standard setting values.

Note 1: If the DIP switch of the rightmost is set to ON, the following display appears next fault display.

Fault display

#1, 2, 3
a A-0000 DATA-41

This does not mean an error. The display is used for check at the factory. To suppress this display, replace the DIP switch to OFF.

Note 2: If soft lock switch LOCK is set to ON (see table 10-4), the inverter cannot be return to the original factory setting.

9.3 Monitor Mode Description and Operation

(1) Monitor mode list

The initial displays, original standard settings, and change ranges of standard settings in the monitor mode are listed below.

o: The setting can be changed during inverter operation.
x: The setting cannot be changed during inverter operation.
-: Only the display is given.

Table 9-2 Description of Monitor Mode

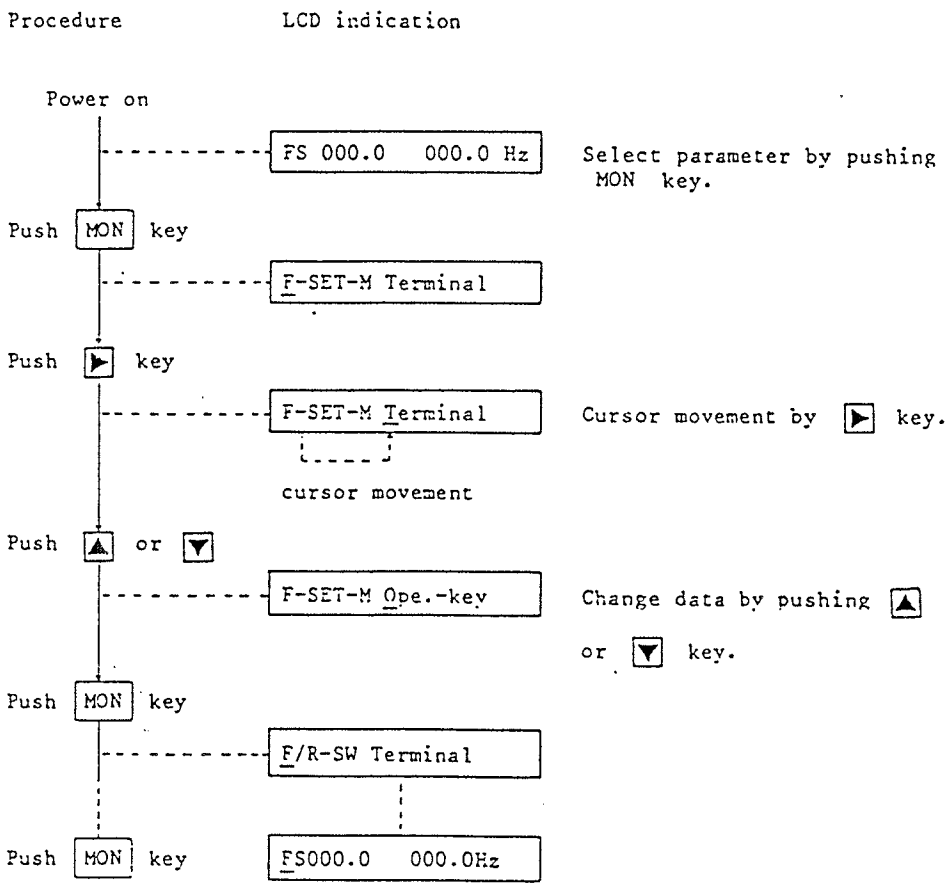
Display sequence	Monitor name	Initial display	Original standard setting	Change range	Data setting and change	Remarks
1	Frequency setting and output frequency	① ② FS000.0 [ ] 000.0Hz	000.0	000.0 -375.0	o	. Field ① indicates a set value. . Field ② indicates an output frequency. . The symbol [ ] indicates an operation command as follows: F: Forward rotation R: Reverse rotation . A multi-stage speed is displayed when the corresponding command is input to a terminal. . When the multi-stage speed mode is selected, jogging is one multi-stage speed and the inverter is soft-started and soft-stopped.
	Multi-stage speed setting and output frequency	1S000.0 [ ] 000.0Hz				
		2S000.0 [ ] 000.0Hz				
		3S000.0 [ ] 000.0Hz				
	Extended multi-stage speed setting	4S000.0 [ ] 000.0Hz				
		5S000.0 [ ] 000.0Hz				
		6S000.0 [ ] 000.0Hz				
	Jogging frequency setting and output frequency	JG000.5 [ ] 000.0Hz	0.5	0.5-9.9		
2	Frequency setting command	F-SET-M Terminal	Ope.-key	Ope.-key Terminal COM-EA	x	Ope. key: Command from the digital operation panel of the inverter Terminal: Terminal command from the inverter COM-EA: For PC communication (option)
3	Operation command	F/R-SW Terminal	Ope.-key	Ope.-key Terminal COM-EA	x	
4	Motor speed display	RPM 4P 00000rpm	4	2-48	o	A synchronized speed is displayed.
5	Transformed frequency display	/Hz00.0 00000.00	-	0.1-99.9	o	Any value can be displayed per Hz.
6	Output current display	① ② If---A Im000.0%	-	CT: 2.2-260 VT: 2.5-293	o	. Field ① indicates the rated current of the inverter. . Field ② indicates the output current. CT: Constant Torque VT: Variable Torque
7	Manual torque boost adjustment	V-Boost Code <31>	16-22HF3D 31 33-180HF3D 00	00-99	o	
8	Output voltage gain adjustment	V-Gain 100%	100	100-50	o	
9	Jogging frequency setting	Jogging 00.5Hz	1.0	0.5-9.9	o	
10	Fault display	Move the cursor right to display the fault corresponding to the number 1, 2, or 3. ↓ #1, 2, 3 [ ]	-	-	-	A fault history is recorded. 1: Newest fault 2: Previous fault 3: Fault before the previous fault These history can be released by switch 3 selection. See table 9-6 F-25.

(2) Procedures in the monitor mode

When the inverter is turned on, the display [FS000.0 ...] is given in the monitor mode. When the display before turning power off is in the monitor mode listed below, the same display appears as before power off when power is turning on. To understand how to change data, examples are provided here.

- Frequency, multi-speed, or jogging frequency setting
- Motor speed
- Output current
- Transformed frequency
- Jogging frequency

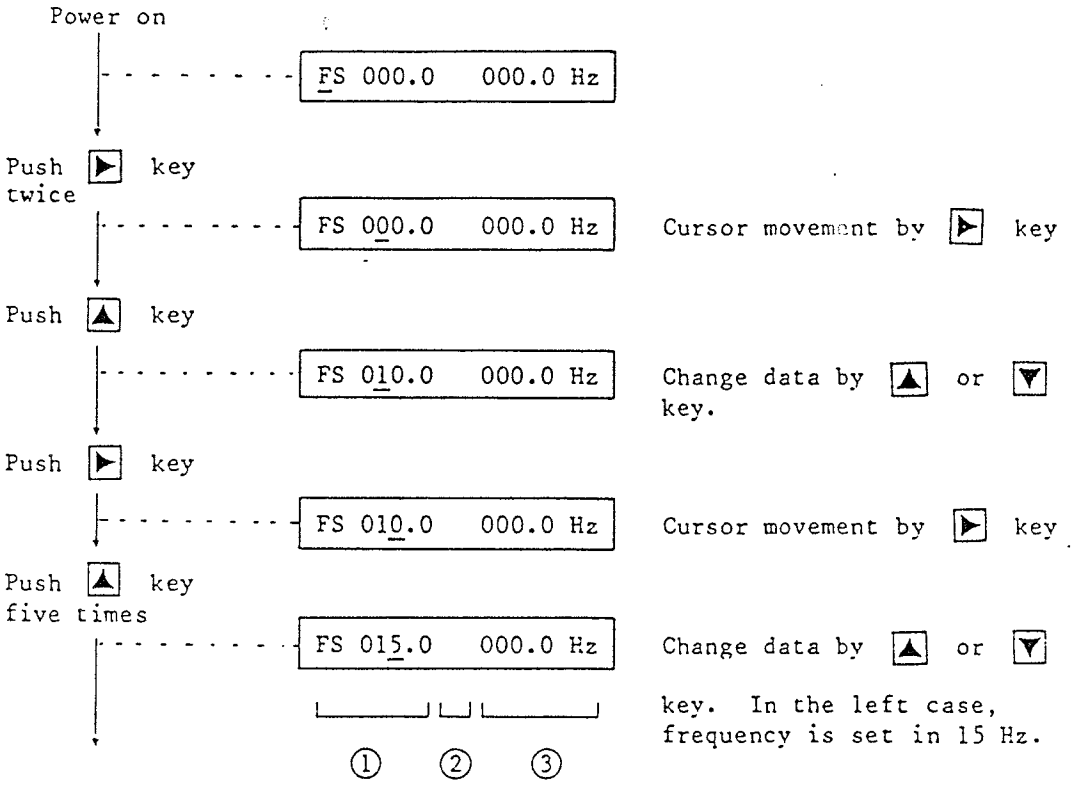
Example 1. Data change of frequency setting command in monitor mode



Note: Data change made under the monitor mode are effective when entered, without requiring use of the [STR] key. Other data can be changed with same procedure.
When soft lock is applied, the cursor cannot be moved.
For soft lock, see table 10-4.

Example 2. Data change of frequency setting value in monitor mode

To be able to change these values, the frequency set command must be in "Ope.-key" mode.

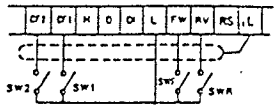
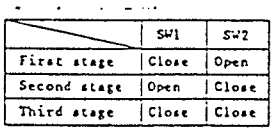
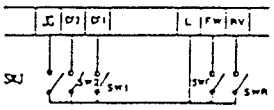
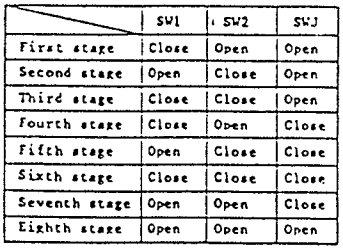


Note: The above shows when no operation command is given. If the operation command is already given, the inverter is drived at the same time when frequency is input into field ①. Field ② shows a direction of motor rotation and output frequencies in firled ③. It is also possible to give an operation command after frequencies input into the field ①.

(3) Setting in the monitor mode

Table 9-3 Monitor Mode Description

<table>
<tr><th>Display sequence</th><th>Monitor name</th><th>Key operation</th><th>Display</th><th>Description</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Frequency setting command and output frequency display</td><td>Mode selection
MON
▲ ▼</td><td>Initial display
FS000.0 000.0 Hz
① ② ③</td><td>. Frequency setting and frequency monitoring in the Ope.-key mode
. If the Ope.-key mode is not selected, the setting of FS..... is not possible. (In the terminal mode, the initial display appears but setting is not possible.)</td></tr>
<tr><td>Data setting
▶
▲ ▼

Operation command
FWD
RUN</td><td>FS050.0 F050.0 Hz</td><td>Set a frequency in the field indicated by ①. When an operation command is input, the output frequency is increased up to the set frequency. To increase or decrease the frequency during operation, change the frequency in field ① to a desired one.
In field ②, F is displayed during forward rotation and R during reverse rotation.
The data in field ③ is the output frequency.</td></tr>
<tr><td></td><td>When a multi-stage speed is set (the initial display is 0)
1S000.0 F000.0 Hz
First stage: 1 ┐ Extended stage speed setting cannot be selected.
Second stage: 2
Third stage: 3 ┘
Fourth stage: 4 ┐ Extended multi-stage speed setting can be selected.
Fifth stage: 5
Sixth stage: 6
Seventh stage: JG ┘
Eighth stage: FS
Notes:
① In the monitor mode, when SW1, SW2, or SWJ is turned on, the display shown above appears.
② The data set in the monitor mode can be changed during inverter operation.
③ Data can be set in the function mode. When the mode is changed to the monitor mode, the set data is displayed.
1S 010.0 000.0 Hz
When the setting of a multi-stage speed is determined in advance, it is convenient to set it in the function mode. When a speed is set in the function mode, and then changed in the monitor mode, the data set in the function mode is also changed.</td><td>. When a multi-stage speed is set
 
 
When an extended multi-stage speed is set
 
 
See also the description of multi-stage speeds in the function mode (table 9-8 F13 to 17).</td></tr>
</table>

	SW1	SW2
First stage	Close	Open
Second stage	Open	Close
Third stage	Close	Close

	SW1	SW2	SWJ
First stage	Close	Open	Open
Second stage	Open	Close	Open
Third stage	Close	Close	Open
Fourth stage	Close	Open	Close
Fifth stage	Open	Close	Close
Sixth stage	Close	Close	Close
Seventh stage	Open	Open	Close
Eighth stage	Open	Open	Open

Table 9-3 Monitor Mode Description (Continued)

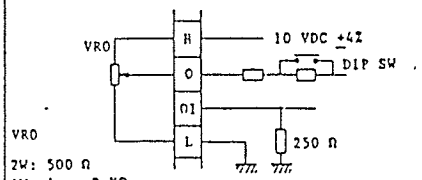
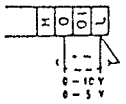
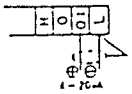
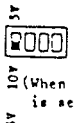
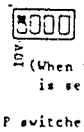
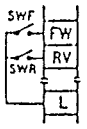
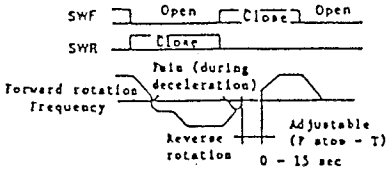
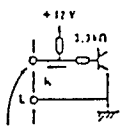
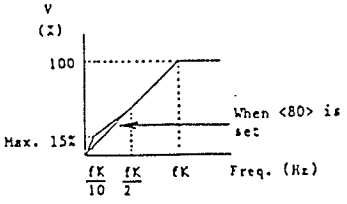
Display sequence	Monitor name	Key operation	Display	Description
2	Frequency setting command	Data setting ▶ ▲ ▼	Initial display F-SET-M Ope.-key	Select this mode to set a frequency with the Ope.-key on the digital operation panel.
		Mode selection MON ▲ ▼	F-SET-M Terminal	 VRO 2W: 500 Ω 1W: 1 or 2 KΩ Set a frequency in the following way: 1) When a variable resistor is used Insert a variable resistor (VRO) between terminals H, O and L on the printed circuit board. The input impedance is 30 kΩ. 2) When an external signal is used . Voltage setting Input impedance When the range 0 - 10 V is selected: 30 kΩ When the range 0 - 5 V is selected: 15 kΩ  Note: Do not apply a voltage of 12 VDC or more across terminals O and L. . Current setting Input impedance: 250 Ω  DIP switched  (When the range 0 - 10 VDC is selected.)  (When the range 0 - 5 VDC is selected.) DIP switches can be found on the printed circuit board when the terminal cover is removed.
			F-SET-M COM-EA	This is for PC communication mode. This mode can be displayed, but to use this mode, the optional device "COM-EA" is necessary.

Table 9-3 Monitor Mode Description (Continued)

<table>
<tr><th>Display sequence</th><th>Monitor name</th><th>Key operation</th><th>Display</th><th>Description</th></tr>
<tr><td>3</td><td>Operation command</td><td>Mode selection
MON
▲ ▼</td><td>Initial display
F/R-SW Ope.-key</td><td>These keys are valid when F/R-SW is in Ope.-key mode.
Forward rotation ⇨ FWD RUN
Reverse rotation ⇨ REV RUN</td></tr>
<tr><td></td><td></td><td>Data setting
▶
▲ ▼</td><td>F/R-SW Terminal</td><td>Forward rotation command (FW)
Reverse rotation command (RV)
 
 
Note:
The motor can be stopped by turning the SWF or SWR switch off. It can also be stopped by turning the STOP key. To disable the motor from being stopped with the STOP key, operate switch 2 as described in table 9-8 F-29. Switch 2 is factory set to 0, i.e., the motor can be stopped by the STOP key. When the motor is stopped by the STOP key, be sure to turn the SWF or SWR switch off once. Otherwise, the motor cannot be restarted.
 
FW, RV, JC, CF1, CF2, RS, FRS
L level ≤ 0.3 V
H level ≥ 2.4 V
Minimum input pulse width ≥ 50 ms</td></tr>
<tr><td></td><td></td><td></td><td>F/R-SW COM-EA</td><td>This is for PC communication mode. This mode can be displayed, but to use this mode, the optional device "COM-EA" is necessary.</td></tr>
<tr><td>4</td><td>Motor speed display</td><td>Mode selection
MON
▲ ▼</td><td>Initial display
RPM 4P 00000rpm
① ②</td><td>When the number of poles of the motor is set in the field indicated by ①, the synchronized motor speed is displayed in the field indicated by ②.
. Motor pole selection table</td></tr>
<tr><td></td><td></td><td>Data setting
▶
▲ ▼</td><td>RPM 4P 01500rpm</td><td></td></tr>
</table>

Display sequence	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Number of poles	2	4	6	8	10	12	14	16	18	20	24	32	36	48

Table 9-3 Monitor Mode Description (Continued)

<table>
<tr><th>Display sequence</th><th>Monitor name</th><th>Key operation</th><th>Display</th><th>Description</th></tr>
<tr><td>5</td><td>Transformed frequency display</td><td>Mode selection
MON
▲ ▼</td><td>Initial display
/Hz00.0 00000.00
① ②</td><td>Input a desired amount per Hz in the field indicated by ①.
The field indicated by ② displays the output frequency multiplied by the data in field ①.
② = ① x Output frequency</td></tr>
<tr><td></td><td></td><td>Data setting
►
▲ ▼</td><td>/Hz33.3 02000.00</td><td></td></tr>
<tr><td>6</td><td>Output current display</td><td>Mode selection
MON
▲ ▼</td><td>Initial display
If A Im 000.0I
① ②</td><td>When no rated current is input in the field indicated by ①, the field indicated by ② displays the ratio to the rated current of the inverter in percentage.
When an inverter rated current listed below is input in field ①, field ② displays the rms (root-mean-square) value of the inverter output current.</td></tr>
<tr><td></td><td></td><td>Data setting
►
▲ ▼</td><td>If 5.0A Im 004.5A</td><td></td></tr>
<tr><td></td><td></td><td>-</td><td>If A Im 090.0I</td><td></td></tr>
<tr><td></td><td></td><td colspan="3">o Rated current codes of the inverter
<table>
<tr><td>Display sequence</td><td></td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td></tr>
<tr><td rowspan="2">Inverter rated current</td><td>CT</td><td>2.2</td><td>3.8</td><td>5.3</td><td>8.6</td><td>13.0</td><td>16.0</td><td>23</td><td>32</td><td>48</td></tr>
<tr><td>VT</td><td>2.5</td><td>4.3</td><td>6.0</td><td>9.7</td><td>14.6</td><td>18.0</td><td>27</td><td>36</td><td>54</td></tr>
<tr><td>Display sequence</td><td></td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td></td></tr>
<tr><td rowspan="2">Inverter rated current</td><td>CT</td><td>58</td><td>75</td><td>90</td><td>110</td><td>149</td><td>176</td><td>217</td><td>260</td><td></td></tr>
<tr><td>VT</td><td>65</td><td>84</td><td>101</td><td>124</td><td>168</td><td>198</td><td>244</td><td>293</td><td></td></tr>
</table>
CT: Constant Torque
VT: Variable Torque</td></tr>
<tr><td>7</td><td>Manual torque boost adjustment</td><td>Mode selection
MON
▲ ▼</td><td>Initial display
V-Boost Code <31>
16,22HF3D
V-Boost Code <00>
33 to 180HF3D</td><td>Increase the output voltage at start or in the low frequency area for boost adjustment.
 

fk: Base frequency
For the detail, see table 9-8 and SWITCH2 function.
(Note that a larger boost value increases the current, making the inverter to be prone to cause an overcurrent trip.)</td></tr>
<tr><td></td><td></td><td>Data setting
►
▲ ▼</td><td>V-Boost Code <99></td><td></td></tr>
</table>

Table 9-3 Monitor Mode Description (Continued)

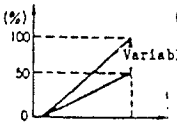
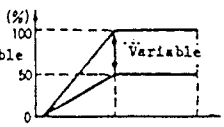
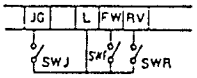
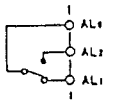
Display sequence	Monitor name	Key operation	Display	Description
8	Output voltage gain adjustment	Mode selection MON ▲ ▼	Initial display V-Gain 100%	Gain for the output voltage frequency is changed. Output voltage  1 ... 50 Output 1 ... 60 frequency 1 ... 100 (Hz) 1 ... 120 Outputvoltage  1 ... 50 ... 100 Output 1 ... 60 ... 100 frequency 1 ... 50 ... 120 (Hz) 1 ... 60 ... 120
		Data setting ▶ ▲ ▼	V-Gain 0 50%	
9	Jogging frequency setting	Mode selection MON ▲ ▼	Initial display Jogging 00.5Hz	• Set a jogging frequency. • Since direct operation of jogging is likely to cause a trip, set a frequency of 5 Hz or less as much as possible. • When the switch is turned off, the motor enters the free run state.  • Jogging operation when operation is commanded from the outside. F/R-SW should be in terminal mode. 
		Data setting ▶ ▲ ▼	Jogging 05.0Hz	• To provide an operation command from the digital operation panel, operate the FWD RUN or REV RUN key instead of the SWF switch. F/R-SW should be in Ope.-key mode. Note 1: Jogging operation is not possible in the following cases: 1) JG is selected as an extended multi-stage speed. 2) A frequency other than for jogging operation is set. 3) Terminal input, CF1, or CF2, for a multi-stage speed is turned on. 4) The set minimum frequency (Fmin) is greater than the jogging frequency. Note 2: The optional remote operator and copy unit cannot perform jogging. (The input is rejected and normal operation is performed.)

Table 9-3 Monitor Mode Description (Continued)

<table>
<tr><th>Display sequence</th><th>Monitor name</th><th>Key operation</th><th>Display</th><th>Description</th></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Fault display</td><td>Mode selection
[MON]
[▲] [▼]</td><td>During normal operation
#1, 2, 3</td><td>• For nature of fault, see section 8.2.
• The numbers 1 to 3 indicate a fault history.
① : Most recent fault
② : Previous fault
③ : Fault before the previous one
④ : Nature of the fault corresponding to the field at which the cursor is positioned is displayed.
(The example on the left indicates that the most recent fault is Over. L.)</td></tr>
<tr><td>To display nature of a fault
[►]</td><td>#1, 2, 3 Over. L
① ② ③ ④</td><td></td></tr>
</table>

When a fault occurs, its fault message is displayed and the fault alarm relay is turned on. The relay contact state and electrical specifications are the following:



Power supply	Operation status	AL0-AL1	AL0-AL2
ON	In normal condition	Close	Open
ON	In abnormal condition	Open	Close
OFF	N/A	Open	Close

Contact specifications:

Rating: Maximum 250 VAC, 2.5 A (resistive load) 0.2 A (cosϕ=0.4)
30 VDC, 3.0 A (resistive load) 0.7 A (cosϕ=0.4)
Minimum 100 VAC, 10 mA
5 VDC, 100 mA

9.4 Function Mode

(1) Function mode list

In function mode 1, a function name is selected but data can be neither set nor changed. In function mode 2, data is set or changed.
The table below indicates the initial display, original standard setting, and the range in which data can be set or changed for each function.

Table 9-4

Display sequence	Function name	Function 1 mode Display	Function 2 mode Initial display	Original setting	Setting/ changing range	Remarks
1	V/F pattern setting	F-00 VFE-VC	VFE-VC 060-060	Same as left	See table 9-9.	
2	Acceleration time setting	F-01 ACCEL-1	ACCEL-1 0030.0 S	30	0.1~2999.9(S)	
3	Deceleration time setting	F-02 DECEL-1	DECEL-1 0030.0 S	30	0.1~2999.9(S)	
4	Maximum frequency adjustment	F-03 *Fmax	*Fmax 000.0 HZ	0	0~15(Hz)	
5	Start frequency adjustment	F-04 Fmin	Fmin 000.5 HZ	0.5	0.5~5.0(Hz)	
6	Upper frequency limit setting	F-05 H-LIM-F	H-LIM-F 000.0 HZ	0	0~375(Hz)	Effective up to the maximum frequency of the selected V/F pattern.
7	Lower frequency limit setting	F-06 L-LIM-F	L-LIM-F 000.0 HZ	0	0~375(Hz)	
8	Jump frequency 1 setting	F-07 JUMP-F1	JUMP-F1 000.0 HZ	0	0~375(Hz)	Effective up to the maximum frequency of the selected V/F pattern.
9	Jump frequency 2 setting	F-08 JUMP-F2	JUMP-F2 000.0 HZ	0	0~375(Hz)	
10	Jump frequency 3 setting	F-09 JUMP-F3	JUMP-F3 000.0 HZ	0	0~375(Hz)	
11	Carrier frequency adjustment	F-10 CF-code	CF-code N	N	C-U	
12	Adjustment of frequency stop time at start	F-11 Fatop-T	Fatop-T 001.0 S	1.0	0~15(S)	
13	Multi-stage speed 1 setting	F-12 Speed-1	Speed-1 000.0 HZ	0	0~375(Hz)	Effective up to the maximum frequency selected by the V/F pattern.
14	Multi-stage speed 2 setting	F-13 Speed-2	Speed-2 000.0 HZ	0	0~375(Hz)	
15	Multi-stage speed 3 setting	F-14 Speed-3	Speed-3 000.0 HZ	0	0~375(Hz)	
16	Multi-stage speed 4 setting	F-15 Speed-4	Speed-4 000.0 HZ	0	0~375(Hz)	
17	Multi-stage speed 5 setting	F-16 Speed-5	Speed-5 000.0 HZ	0	0~375(Hz)	
18	Multi-stage speed 6 setting	F-17 Speed-6	Speed-6 000.0 HZ	0	0~375(Hz)	
19	Two-stage acceleration time setting	F-18 ACCEL-2	ACCEL-2 0030.0 S	30	0.1~2999.9(S)	
20	Two-stage deceleration time setting	F-19 DECEL-2	DECEL-2 0030.0 S	30	0.1~2999.9(S)	
21	DC braking frequency adjustment	F-20 F-DCB	F-DCB 001.0 HZ	1.0	0.5~375(Hz)	
22	DC braking power adjustment	F-21 V-DCB	V-DCB 000	0	00~20	
23	DC braking time adjustment	F-22 T-DCB	T-DCB 000.0 S	0	00~600(S)	
24	Electronic thermal level adjustment	F-23 E-therm	E-therm 100%	100	100~50(%)	
25	Linear/S-curved acceleration selection	F-24 ACCline	ACCline Linear	Linear	Linear or S curve	
26	Linear/S-curved deceleration selection	F-25 DECline	DECline Linear	Linear	Linear or S curve	
27	Start point frequency of external frequency setting	F-26 F-START	F-START 000.0 HZ	0	0~375(Hz)	
28	End point frequency of external frequency setting	F-27 F-END	F-END 000.0 HZ	0	0~375(Hz)	
29	Switch 1 selection	F-28 SWITCH1	SWITCH1 00000111	Same as left		
30	Switch 2 selection	F-29 SWITCH2	SWITCH2 00001000	Same as left		
31	Overload limit constant setting	F-30 LM.CONS	LM.CONS 0001.0	1.0	0.3~30	
32	Overload warning level adjustment	F-31 OL ALARM	OL alarm 100%	100	50~150%	Effective with option board
33	Automatic torque boost adjustment	F-32 V-auto	V-auto *00	00	00~20	
34	Allowable momentary power failure time setting	F-33 IPS-T	IPS-T 000.3 S	0.3 (1.0)	0.3~5.0(S)	
35	Switch 3 selection	F-34 switch 3	Switch 3 00000100	Same as left		
36	Communication mode selection	F-35 PARMSET	PARMSET INVERTER	INVERTER	Inverter COM-EA	For PC communication
37	Standby time setting for restart after momentary power failure	F-36 IPS-R-T	IPS-R-T 0001.0 S	1	0.3~100(S)	
38	DC braking waiting time adjustment	F-37 W-T-DCB	W-T-DCB 0000.0 S	0.0	0~55	
39	Arbitrary frequency setting for reached-speed signal	F-39 SPD-ARV	SPD-ARV 000.0HZ	0	0.5~375(Hz)	

(2) Procedures in the function mode

1) In the function mode, set or change data while the inverter is stopped.
(Data can be neither set nor changed during inverter operation.)
Under the following condition, however, data can be neither set nor changed even when the inverter is stopped.

a) The inverter is stopped by connecting control circuit terminal RS and L on the Printed circuit board.

b) The inverter is stopped by a trip.

2) Upon completion of data setting or change, be sure to press the [STR] key.
(Otherwise, the data is not entered and the old data remains stored.)

3) In the function mode, the motor cannot be started. To start the motor, press the [MON] key to return to the monitor mode.
(During operation, the function mode can be referenced.)

Table 9-5 Changing Function Mode Screens

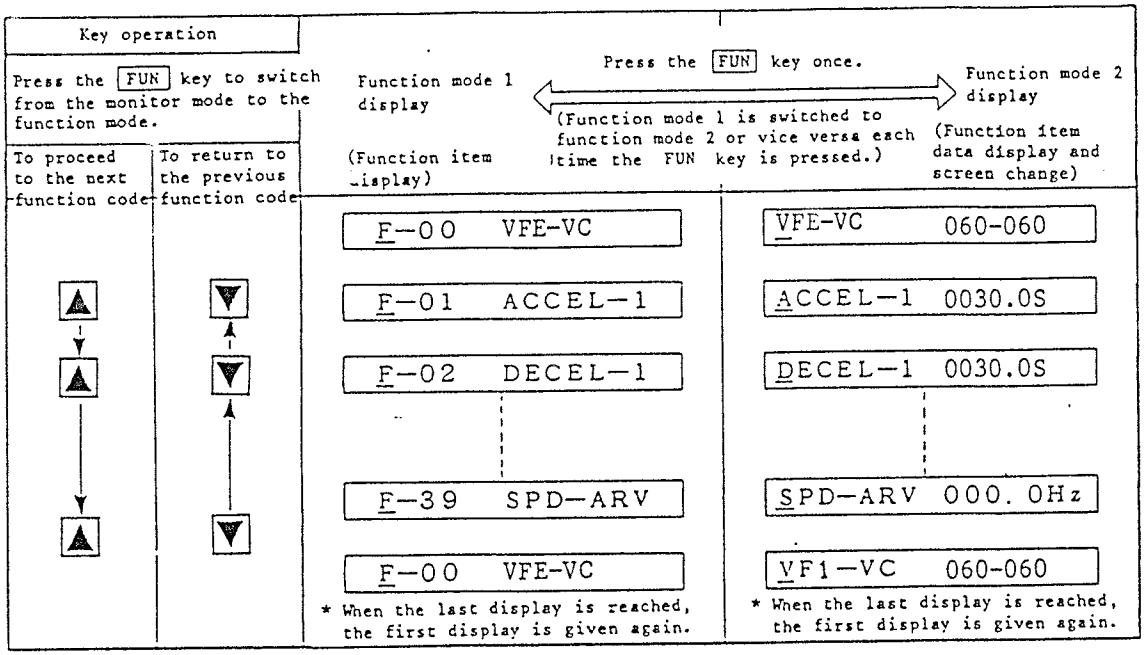


Table 9-6 Cursor Movement and Data Change

Key operation	Display	
	ACCEL-1 0030.0S	
Press the key once.	ACCEL-1 0030.0S	
Press the key once.	ACCEL-1 * 1030.0S	Note 1
Press the key twice.	ACCEL-1 * 1030.0S	
Press the key once.	ACCEL-1 * 1010.0S	Note 2
Press the STR key once.	ACCEL-1 1010.0S	

Note 1:
When the ▲ or ▼ key is held down, the data is incremented or decremented up to the limit.

Note 2:
In function mode 1, data can be neither set nor changed. (The cursor stays at the leftmost position.)

4) Sample of data change

To change the V/F pattern frequency from 60 Hz to 50 Hz

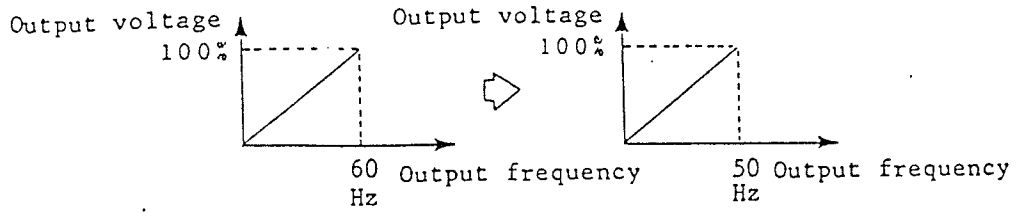


Table 9-7 Data Change Procedure

Operation step	Key operation	Display	Description
1	FUN	F-00 VFE-VC	Function mode 1 and the V/F pattern mode are selected.
2	FUN	VFE-VC 060-060	Function mode 2 is selected.
3	▶	VFE-VC 060-060	To move the cursor to the letter 1, press the ▶ key once.
4	▼	VFA-VC * 050-050	To set 3, press the ▲ key two times or hold down it until 3 appears once.
5	STR	VFA-VC 050-050	To store the new data, press the STR key. When it is stored, the asterisk (*) disappears.

Note: If a reset signal is input at power off, the set or new data after change is not stored. Do not input a reset signal at power off after data is set or changed.

(3) Display and setting in the function mode

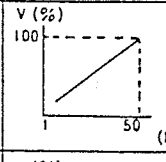
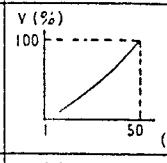
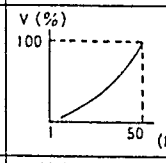
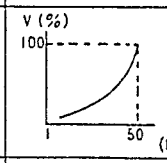
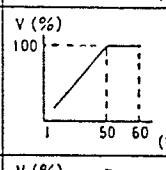
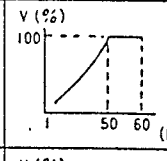
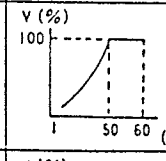
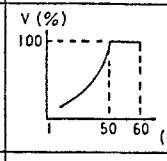
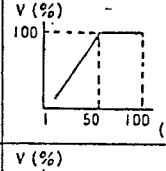
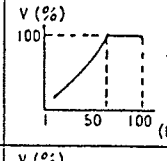
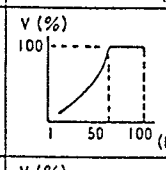
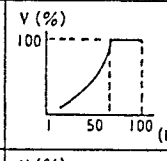
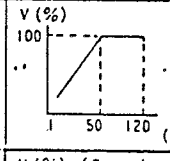
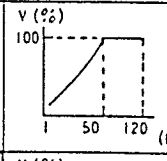
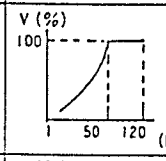
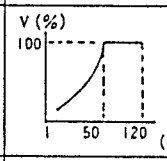
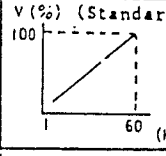
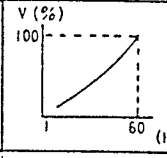
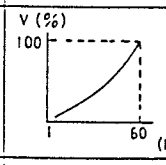
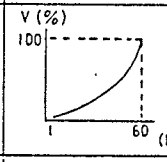
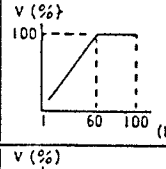
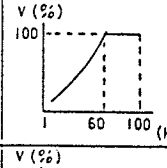
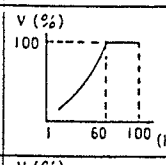
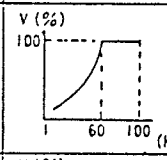
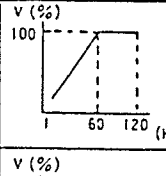
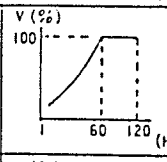
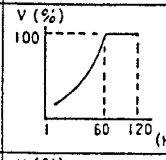
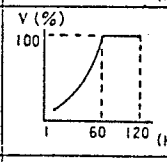
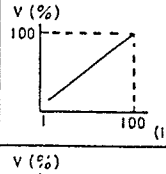
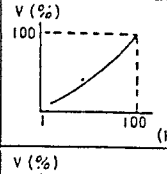
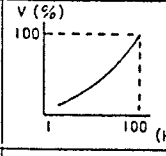
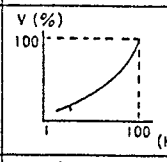
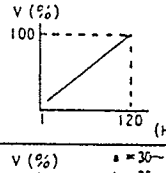
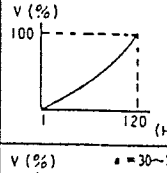
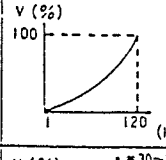
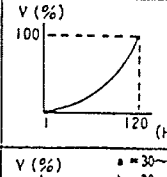
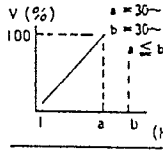
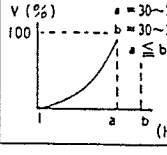
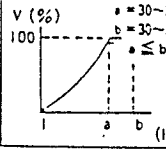
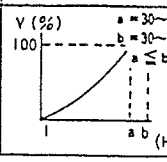
Data can be changed at the cursor position in the data set field.

Table 9-8 Description of Function Mode

Display sequence	Function code and function name	Key operation	Display	Description
1	(F-00) V/F pattern setting	See table 9-9	Initial setting VFE-VC 060-060 ① ② (*1)(*2) ③ When the value in the field indicated by ① is from 1 to 8, the predetermined value is automatically set in the field indicated by ③. When the value in field ① is Z, the set value is displayed. (*1) Base frequency (*2) Maximum output frequency	Of 36 V/F patterns, one is selected according to a combination of the data in field ① (output frequency range specification) and the data in field ② (torque characteristic specification). Setting in field ② VC: Constant torque (V = kF) VP1: Variable torque (V = $KF^{1.5}$) VP2: Variable torque (V = $KF^{1.7}$) VP3: Variable torque (V = KF^{2}) When Z is set in field ①, the cursor can move to field ③, enabling a base frequency and a maximum frequency to be set in field ③ in the following ranges. (Note 2) Setting ranges of a base frequency and maximum output frequency when Z is set in field ① Base frequency: 30 - 240 Maximum output frequency: 30 - 360 However, the base frequency must be smaller than or equal to the maximum output frequency. Note 1: When the base frequency exceeds 60 Hz, use a special motor rather than a general-purpose motor. Therefore, the maximum applicable motor differs. Usually, when the rated power (kW) of a special motor is the same as that of a general-purpose motor, the capacity of the inverter must be increased. Note 2: To set the V/F pattern to Z, set 0 in field ① of F-28. (Interlock when a high frequency is selected.) Note 3: When selecting a high frequency, sufficiently consider the mechanical strengths of the motor and load.
		Data setting ① ▶ ▲ ▼	VFZ-VC 060-060	
		Data setting ② ▶ ▲ ▼	VFZ-VC 060-060	
		Data setting ③ ▶ ▲ ▼ STR	VFZ-VC 060-360 Adjusted the following V 60 360 F Note: Data setting ③ is effective only when Z is set in data setting ①.	

V/F patterns

Table 9-9 V/F Patterns

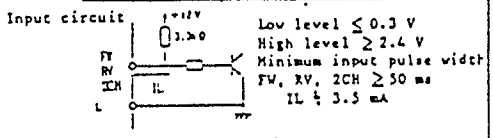
①＼②	Constant Torque	Variable Torque		
	VC	VP1	VP2	VP3
A				
B				
C				
D				
E				
F				
G				
H				
I				
Z				

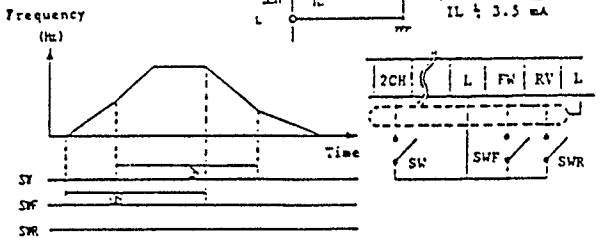
Normally, setting is not possible. (see table 9-8 F-00.)

Table 9-8 Description of Function Mode (Continued)

Display sequence	Function code and function name	Key operation	Display	Description
2	(F-01) Acceleration time setting		Initial setting (30 s) ACCEL-1 0030.0 S	Acceleration time: Time to start the motor and reach to the maximum frequency corresponding to the selected V/F pattern Deceleration time: Time required to stop the motor running at the maximum frequency corresponding to the selected V/F pattern The inverter can change the acceleration speed and deceleration speed of the motor at two stages separately during acceleration or deceleration as indicated in the table below. The motor can be started or stopped without shock. During acceleration or deceleration, a high speed or a low speed can be set. Second acceleration time: F-18 Second deceleration time: F-19
		Data setting ▶ ▲ ▼ STR	ACCEL-1 0150.0 S	
3	(F-02) Deceleration time setting		Initial setting (30 s) DECEL-10030.0 S	
		Data setting ▶ ▲ ▼ STR	DECEL-1 0100.0 S	

2CH-L	
Open	Value set by ACCEL-1 or DECEL-1
Connected	Value set by ACCEL-2 or DECEL-2

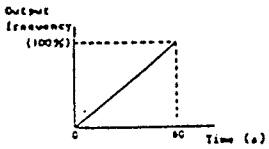




Sample combination of ACCEL1 and ACCEL2

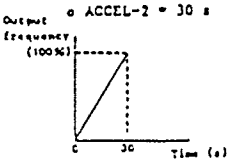
In this example, ACCEL1 is set to 60 s and ACCEL 2 to 30 s.

o ACCEL-1 = 60 s



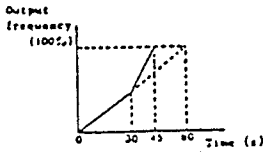
ACCEL-1 = 60 s

o ACCEL-2 = 30 s



ACCEL-2 = 30 s

④ When the switch is closed 30 s later



⑤ When the switch is closed 40 s later

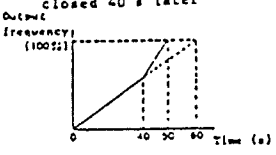


Table 9-8 Description of Function Mode (Continued)

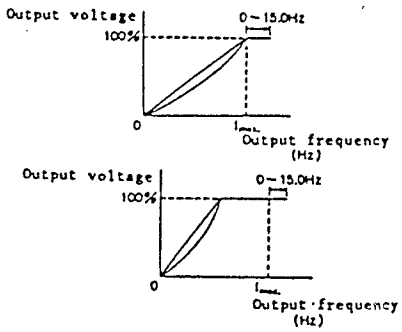
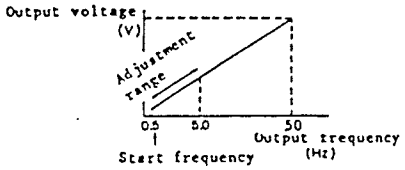
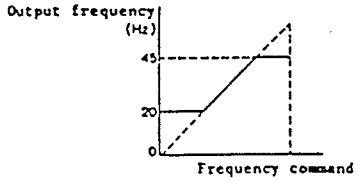
Display sequence	Function code and function name	Key operation	Display	Description
4	(F-03) Maximum frequency adjustment		Initial setting (0 Hz) +Fmax. 000.0 Hz	The maximum frequency is increased. (The acceleration/deceleration time is prolonged.) The adjustment is made within the range of constant output characteristics. 
		Data setting ▶ ▲ ▼ STR	+Fmax. 015.0 Hz	
5	(F-04) Starting frequency adjustment		Initial setting (0.5 Hz) Fmin. 00.5 Hz	The starting frequency is adjusted. (Increasing the starting frequency shortens the acceleration/deceleration time.) 
		Data setting ▶ ▲ ▼ STR	Fmin. 05.0 Hz	
6 7	(F-05) (F-06) Upper frequency limit setting Lower frequency limit setting		Initial setting of the upper frequency limit (0 Hz) H-LIM-F 000.0 Hz	The upper and lower frequency limits can be set separately in the following ranges: Upper limit: From the minimum frequency to the maximum frequency, 0.1 Hz steps. Lower limit: From the minimum frequency to the maximum frequency, 0.1 Hz steps. [Sample setting]  Note: The adjustable range must be set under the following condition: 0 Hz or Upper limit ≥ Lower limit When 0 Hz is set, the limiters do not operate.
		Data setting ▶ ▲ ▼ STR	H-LIM-F 045.0 Hz	
			Initial setting of the lower frequency limit (0 Hz) L-LIM-F 000.0 Hz	
		Data setting ▶ ▲ ▼ STR	L-LIM-F 020.0 Hz	

Table 9-8 Description of Function Mode (Continued)

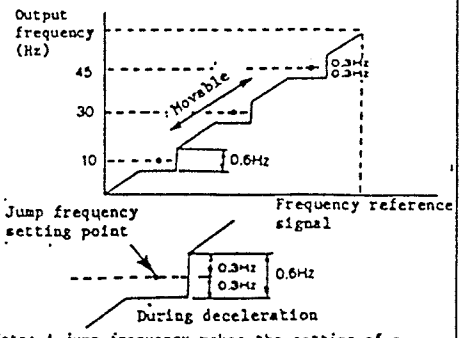
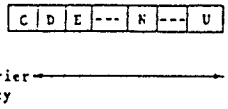
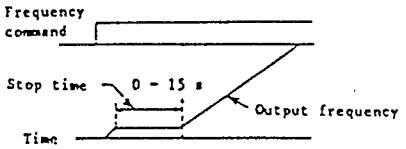
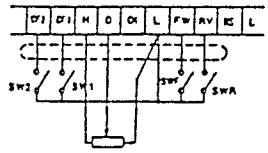
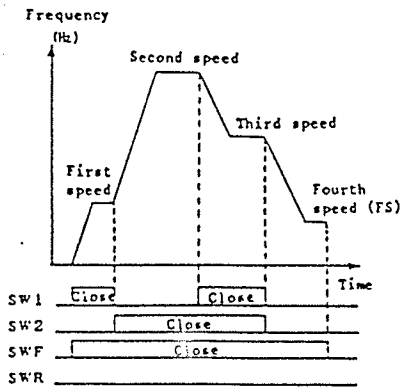
Display sequence	Function code and function name	Key operation	Display	Description
8 9 10	(F-07) (F-08) (F-09) Jump frequency 1 setting Jump frequency 2 setting Jump frequency 3 setting		Initial setting (0 Hz) JUMP-F1 000.0 Hz JUMP-F2 000.0 Hz JUMP-F3 000.0 Hz	To avoid resonance with the load, up to three jump frequencies can be set. The setting sequence is at freely.  Note: A jump frequency makes the setting of a frequency in the range of the set frequency ±0.3 Hz impossible. When a frequenc passes the jump area, it is output.
		Data setting ▶ ▲ ▼ STR	JUMP-F1 010.0 Hz JUMP-F2 030.0 Hz JUMP-F3 045.0 Hz	
11	(F-10) Motor noise adjustment		Initial setting CF-code <N>	The inverter carrier frequency is varied, making it possible to change the motor sound quality. 
		Data setting ▶ ▲ ▼ STR	CF-code <C>	
12	(F-11) Adjustment of frequency stop time at start		Initial setting (1.0 s) Fstop-T 001.0 S	To prevent motor overcurrent at start, output frequency increasing is temporarily stopped.  The stop frequency is about one-twelfth of the base frequency or the minimum frequency, whichever is higher. (This function is invalidated when S curve acceleration or deceleration is selected.)
		Data setting ▶ ▲ ▼ STR	Fstop-T 015.0 S	

Table 9-8 Description of Function Mode (Continued)

Display sequence	Function code and function name	Key operation	Display	Description
13 14 15 16 17 18	(F-12) (F-13) (F-14) (F-15) (F-16) (F-17) Multi-stage speed 1 setting to multi-stage speed 3 setting		Initial setting (0 Hz) Speed-1 000.0 Hz Speed-2 000.0 Hz Speed-3 000.0 Hz Speed-4 000.0 Hz Speed-5 000.0 Hz Speed-6 000.0 Hz	1) When the jogging/extended multi-stage speed selection flag in field ② of switch 2 of (F-29) is set to the jogging mode (0: standard setting), the motor can be run at up to four staged by a combination of a frequency command from the digital operation panel or outside and speed-1 to speed-3 settings. " See table 9-3 display sequence 1.
		Data setting ▶ ▲ ▼ STR	Speed-1 010.0 Hz Speed-2 020.0 Hz Speed-3 030.0 Hz Speed-4 025.0 Hz Speed-5 060.0 Hz Speed-6 040.0 Hz	





Switch		Set frequency (Hz)
SW1	SW2	
-	-	Frequency command from the Ope.-key or terminal mode
Close	Open	Value preset by speed-1 (1S)
Open	Close	Value preset by speed-2 (2S)
Close	Close	Value preset by speed-3 (3S)

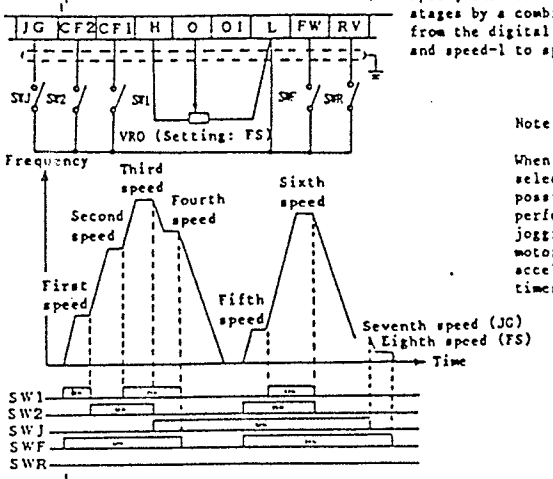
Table 9-8 Description of Function Mode (Continued)

<table>
<tr><th>Display sequence</th><th>Function code and function name</th><th>Key operation</th><th>Display</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td></td><td>2) When the jogging/extended multi-stage speed selection flag in field ② of switch 2 of (F-29) is set to the extended multi-stage speed, the motor can be run at up to eight stages by a combination of a frequency command from the digital operation panel or outside and speed-1 to speed-6 settings.

Note:

When the multi-stage speed mode is selected, jogging operation is not possible. (If operation is performed at a jogging frequency, jogging is not performed but the motor runs according to the set acceleration and deceleration times.)</td></tr>
<tr><td>19
20</td><td>(F-18)
(F-19)

Two-stage acceleration time setting and two-stage deceleration time setting</td><td></td><td>Initial setting (30 s)
ACCEL-2 0030.0 S
DECEL-2 0030.0 S</td><td>See table 9-8 F-01, 02.</td></tr>
<tr><td></td><td></td><td>Data setting
▶
▲ ▼
STR</td><td>ACCEL-2 0100.0 S
DECEL-2 0150.0 S</td><td></td></tr>
</table>



Switch			Set frequency (Hz)	
SW1	SW2	SWJ		
—	—	Open	Frequency command issued in the Ope. key or terminal mode	⇨ In the above example, FS is set in the terminal mode.
Close	Open	Open	Value set by speed-1 (1S)	
Open	Close	Open	Value set by speed-2 (2S)	
Close	Close	Open	Value set by speed-3 (3S)	
Close	Open	Close	Value set by speed-4 (4S)	
Open	Close	Close	Value set by speed-5 (5S)	
Close	Close	Close	Value set by speed-6 (6S)	
Open	Open	Close	Value set by jogging (JG)	⇨ Jogging in the monitor mode

Table 9-8 Description of Function Mode (Continued)

Display sequence	Function code and function name	Key operation	Display	Description
21	(F-20) DC braking frequency adjustment		Initial setting (1.0 Hz) F-DCB 001.0 Hz	When selecting DC braking, set a performing frequency for DC braking at deceleration. When F-DCB is set, the motor operates at the set frequency or below during deceleration if: 1) Both (F-21) V-DCB and (F-22) T-DCB are set. 2) Field ② of (F-28) is set to ① (with DC braking). See table 9-8 F-28. 3) A stop command is already input or the set frequency is 0 Hz. If none of the above conditions is met, the motor can operate up to the minimum frequency. See page 9-32: Field ② of F-28. See page 9-34: Field ① of F-29.
		Data setting ▶ ▲ ▼ STR	F-DCB 015.0 Hz	
22	(F-21) DC braking power adjustment		Initial setting (10) V-DCB 000	The DC braking power is varied. When 000 is set, DC braking operation is disabled.
		Data setting ▶ ▲ ▼ STR	V-DCB 020	
23	(F-22) DC braking time adjustment		Initial setting (0 s) T-DCB 000.0 S	The DC braking time is adjusted. When 00.0 s is set, DC braking operation is disabled. See table 9-8: Field ① of F-29. Output frequency (Hz) Time (s) 0-600S * Since long or continuous DC braking may cause burning of motor, set the braking time as short as possible.
		Data setting ▶ ▲ ▶ STR	T-DCB 600.0 S	
24	(F-23) Electronic thermal level adjustment		Initial setting (100 %) E-therm 100%	The electronic thermal level can be changed between 50% and 100%. Set a level to conform to the optimum current value of the motor. When operating the motor continuously at 10 Hz or below, use a thermal relay. Time (s) 50% 100% Inverter rated current Variable 50 100 150 180(%) Constant torque 160(%) Variable torque Current of the inverter (A) adjusted level = $\frac{\text{Motor rated current}}{\text{Inverter rated current}}$ x 100 (%)
		Data setting ▶ ▲ ▼ STR	E-therm 050%	

Table 9-8 Description of Function Mode (Continued)

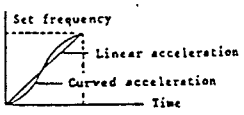
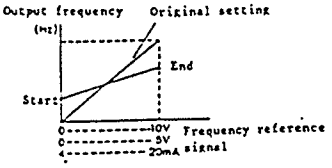
Display sequence	Function code and function name	Key operation	Display	Description
25	(F-24) Linear/ S-curved acceleration selection		Initial setting (linear) ACCline Linear	Select linear accelerator (Linear) or curved acceleration (S-curve).  Note: When s-curve is selected and a frequency reference signal is given from external, a signal fluctuation due to noise may result in an acceleration time longer than the set value by F-01.
		Data setting ▶ ▲ ▼ STR	ACCline S-Curve	
26	(F-25) Linear/ S-curved deceleration selection		Initial setting (linear) DECline Linear	Select linear deceleration (Linear) or curved deceleration (S-curve). Note: When S-curve is selected and a frequency reference signal is given from external, a signal fluctuation due to noise may result in a deceleration time longer than the set value by F-02.
		Data setting ▶ ▲ ▼ STR	DECline S-Curve	
27 28	(F-26) (F-27) External frequency setting start and external frequency setting end		Initial setting (0 Hz) of external frequency setting start (F-26) F-START 000.0 Hz	These are functions similar to a gain/bias adjustment for reference signal. The start and end output frequencies are set for analog frequency reference signal (0 - 10 VDC, 0 - 5 VDC, and 4 - 20 mA) issued from the outside to the inverter.  Note 1: The original factory setting is 0 Hz. Note 2: When changing the V/F pattern after the start frequency (F-START) and end frequency (F-END) are set, readjust these frequencies. Note 3: When F-START and F-END are set in such a way that the start frequency is higher than the end frequency or the frequency command is set at the minimum level (0 V or 4 mA), the output frequency may be 0.1 - 0.3 Hz lower than the frequency set by F-START. This is not an error because the reduction in frequency is due to noise on a signal line.
		Data setting ▶ ▲ ▼ STR	F-START 020.0 Hz	
			Initial setting (0 Hz) of external frequency setting end (F-27) F-END 000.0 Hz	
		Data setting ▶ ▲ ▼ STR	F-END 040.0 Hz	

Table 9-8 Description of Function Mode (Continued)

Display sequence	Function code and function name	Key operation	Display	Description
29	(F-28) Switch 1 selection		Initial setting (See below.) SWITCH1 0 0 0 0 0 1 1 1 ⑧ ⑦ ⑥ ⑤ ④ ③ ② ①	Fields ① to ⑥ are selectable areas. For details, See table 9-8 F-28. ① : Special V/F pattern (Z-pattern) selection ② : DC braking selection ③ : Frequency monitor selection ④ : Overload selection ⑤ : Automatic restart selection ⑥ : Selection of rotating direction
		Data setting ▶ ▲ ▼ STR	SWITCH1 0 0 1 0 1 0 0 0	
30	(F-29) Switch 2 selection		Initial setting (See below.) SWITCH2 0 0 0 0 1 0 0 0 ⑧ ⑦ ⑥ ⑤ ④ ③ ② ①	Fields ① to ⑧ are selectable areas. For details, see table 9-8 F-29. ① : Selection of DC braking trigger ② : Jogging selection ③ : Selection of STOP key effectiveness ④ : Do not change. Factory-set to 1. ⑤ : Derating of electronic thermal characteristics. ⑥ : Strength change of manual v.boost. ⑦ : Selection of speed detection after reset (RS) release ⑧ : Selection of FS setting soft-lock
		Data setting ▶ ▲ ▼ STR	SWITCH2 0 0 1 0 1 0 0 1	
31	(F-30) Overload limit constant setting		Initial setting (1.0) LM. CONS 0001.0	• Constant for overload limit characteristics. If an OC trip is likely to occur at the standard value, set a small value. • The overload limit level can be changed by variable resistor OL. LMT. Counterclockwise: 50% - 80% Center: 100% Clockwise: 150% The variable resistor is mounted at the lower left corner on the PC board. The level is measured, assuming that the rated current of the inverter is 100%. The standard setting is about 125%.
		Data setting ▶ ▲ ▼ STR	LM. CONS 0000.5	

Table 9-8 Description of Function Mode (Continued)

Display sequence	Function code and function name	Key operation	Display	Description
32	(F-31) Overload alarm level adjustment (optional)		Initial setting (100) OLalarm 100%	When the load reaches the level preset within the range 50% ~ 150% overload, an alarm is output. (Overload alarm signal relay output is possible when the optional PC board is used.) Optional board (S30P-PC8)
		Data setting ▶ ▲ ▼ STR	OLalarm 150%	
33	(F-32) Automatic torque boost adjustment		Initial setting (00) V-auto +00	Only during acceleration, boost is automatically applied. The boost can be adjusted in 20 steps. The voltage is increased about 10% at +20. Output voltage (%) 100 0 Base frequency During automatic boosting, the original V/F is automatically used when a constant speed is reached after acceleration. (Continuous operation is not performed with the motor overexcited.) When manual torque boost is performed together, the voltage is further increased as indicated by the hatched area. See table 9-3 display sequence 7. Output voltage (%) 100 0 Base frequency / 10 Base frequency Maximum frequency Output frequency (Hz)
		Data setting ▶ ▲ ▼ STR	V-auto +20	
34	(F-33) Allowable instantaneous power failure time setting		Initial setting (0.3 s) IPS-T 000.3 S	Set a time to restore the power after an instantaneous power failure. When field ⑤ of switch 1 is set to the retry function and the power is restored within the set time, the inverter restarts automatically. For the details, see paragraph 9.5. Note: When the inverter load is too heavy, the control power supply is turned off earlier. Therefore, the inverter display may disappear before power restoration even if the power would be restored within the set allowable instantaneous failure time. When this happens, the power is turned off and the inverter operates in the same way as when it is reset.
		Data setting ▶ ▲ ▼ STR	IPS-T 003.0 S	

Table 9-8 Description of Function Mode (Continued)

Display sequence	Function code and function name	Key operation	Display	Description
35	(F-34) Switch 3 selection		Initial setting below SWITCH 3 00000100 c ccc	Field ①, ② and ③ are selectable. The field ④ has no function and the cursor cannot move into ④. Field ①: Selection of speed detection after free run stop (FRS) release. 0 - Motor speed detection is possible. 1 - Inverter starts from the start (minimum) frequency. Field ②: Fault history releasing 0 - Recorded fault history cannot be released. 1 - Possible to release recorded fault history. Set "1" in the field ② and push the reset button on the printed circuit board. See the fault display on table 9-2 display sequence 10. Field ③: Selection of USP function 0 - USP function is uneffective 1 - USP function is effective
		Data setting ▶ ▲ ▼	SWITCH 3 00000111	
36	(F-35)		Initial setting (Inverter) PARMSET INVERTER	Keep the setting in "INVERTER" when inverter is operated as serial communication interface module (COM-EA). This function is used for PC communication, and in the case of communicating with PC or PLC, change the setting in "COM-EA". "COM-EA" is optional device.
		Data setting ▶ ▲ ▼ STR	PARMSET COM-EA	
37	(F-36) Standby time setting for restart after instantaneous power failure		Initial setting (1.0 s) IPS-R-T 0001.0 S	Set a standby time during which restart is awaited before the inverter is automatically restarted after power is restored from a instantaneous power failure within the allowable instantaneous failure time set by (F-33). For the details, see paragraph 9.5. Note: When the motor speed cannot be detected at restart of the motor, the speed detection is retried but the actual operation time is longer than the set time. If the speed cannot be detected after retry, the motor is started at the start frequency, assuming that the speed of the motor is zero.
		Data setting ▶ ▲ ▼ STR	IPS-R-T 0001.0 S	

Table 9-8 Description of Function Mode (Continued)

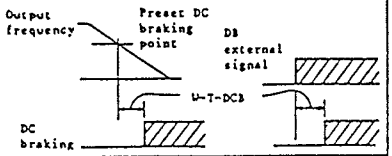
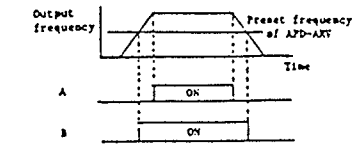
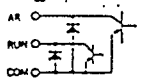
Display sequence	Function code and function name	Key operation	Display	Description
38	(F-37) DC braking wait time adjustment	Data setting ▶ ▲ ▼ STR	Initial setting (0.0) W-T-DCB 0000.0 W-T-DCB 0005.0	This is for waiting time adjustment of DC braking. In the case of using this function, the DC braking will perform with delay time after reaching DC braking frequency or from being given a DB external signal. Use this function when use DC braking at the high speed and adjust the waiting time longer. 
39	(F-39) Frequency setting for reached-speed signal at freely	Data setting ▶ ▲ ▼ STR	Initial setting (0 Hz) SPD-ARV 000.0 Hz SPD-ARV 051.5 Hz	Frequency arrival signal can be output at a desired frequency. The setting of 0 causes the signal to be output when the set frequency is reached.  A: In case that no preset frequency is entered in SPD-ARV, the signal is turned on when the output frequency is reached to set value. (The signal is turned on at set frequency +0.5 Hz and off at set frequency −1.5 Hz.) B: In case that non-zero is entered in SPD-ARV, the signal is turned on when the output frequency is reached to preset value. (The signal is turned on and off at set frequency ±0 Hz.)  * The RUN signal indicating that operation is in progress is output during inverter operation. Transister specification Open collector output 27 V, 50 mA max. Forward voltage drop About 1 V

Table 9-8 Description of Function Mode (Continued)

	SWITCH1	00	00	0	1	1	1
		⑥	⑤	④	③	②	①

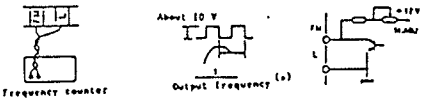
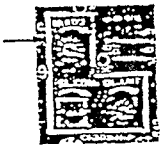
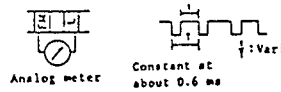
F-28	Switch 1	①	0	Special V/F.	Set 0 when selecting a V/F pattern (Z pattern), see table 9-8 F-00.
			1	Standard V/F	Set 1 when selecting a V/F pattern (A - I), see table 9-9.
		②	0	Without DC braking	See (F-20) to (F-22), F-37 and field ① of F-29 on table 9-8.
			1	With DC braking	
		③	0	Frequency digital monitoring	Digital monitoring for the frequency counter Pulse trains are output at the output frequency. The duty cycle is about 50%. 
			1	Frequency analog monitoring	Monitoring for the analog meter This monitor outputs the duty cycle (t/T) proportional to the output frequency. Adjust the M. ADJ variable resistor and the variable resistor in the frequency meter so that the analog meter indicates its maximum value at the maximum frequency.   (Load resistance: 10 - 22 kΩ 1 mA max 0 - 10 V full-scale) Note: This signal is only for indicator, therefore it cannot be used to provide a line speed signal.
		④	0	Overload limited	Overload limit function is enabled whenever and over the entire area.
			1	Overload not limited	Overload limit function is not enabled during acceleration and is enabled during reacceleration after once accelerated.
		⑤	00	Trip	Standard setting • An alarm signal is output when an instantaneous power failure, undervoltage, or another trip occurs.

Table 9-8 Description of Function Mode (Continued)

		⑤	10	Restart function	Automatic restart with synchronized start of spinning motor when one of the following trips occurs (however, when the frequency exceeds 50 Hz, restart out the start frequency): . Overcurrent . Overvoltage . Undervoltage . Instantaneous power failure The maximum number of restarts is 3 in 10 minutes (15 times within 10 minutes for undervoltage) except for instantaneous power failure. When an instantaneous power failure occurs, it takes a time by (F-36) IPS-R-T before operation is resumed. See paragraph 9.5 on page 9-35.
			11	Acceleration from zero speed	Automatic restart after instantaneous power failure or undervoltage with acceleration from zero speed Performance is similar to an automatic restart but in the case of setting "11", inverter is restarted from zero speed after a time delay set by (F-36) ISP-R-T. No synchronized restart is performed. This is not effective to overcurrent trip and undervoltage trip.
			01	-	Do not set 01.
		⑥	00 11	Forward/reverse rotation	The motor can run in both forward and reverse directions.
			01	Forward rotation	The motor can run only in the forward direction. No reverse rotation command can be accepted.
			10	Reverse rotation	The motor can run only in the reverse direction. No forward rotation command can be accepted.

Note: While the restart function is in effect, the motor is in the free-run state. When it is necessary to hold the motor in the free-run state through mechanical braking, therefore, do not use the restart function.

Table 9-8 Description of Function Mode (Continued)

SWITCH 2	0	0	0	0	1	0	0	0
	⑧	⑦	⑥	⑤	④	③	②	①

F-29	Switch 2	①	0	Edge operation	Output frequency / Operation command: During DB, T-DB During DB, Output frequency, Operation command, Stop, T-DB See F-20 to F-22
			1	Level operation	Output frequency / Operation command: During DB, T-DB, Effective in the terminal mode
		②	0	Jogging mode	Set "0" for usual jogging operation. See jogging mode on table 9-3.
			1	Extended multi-speed mode	Set "1" for extended multi-stage speed setting when using JG terminal for this purpose. See F-12 to F-17 on table 9-8.
		③	0	[STOP] key enabled	When an operation command comes from the terminal, the STOP key on the digital operation panel (or optional remote operator) is enabled.
			1	[STOP] key disabled	When an operation command comes from the terminal, the STOP key on the digital operation panel (or optional remote terminal) is disabled.
		④	0	With no stability control	"0" setting has no stability control. Do not set to "0".
			1	With stability control	Set "1" for stabilized inverter operation.
		⑤	0	With derating on electronic thermal characteristics	Output current: When 1 is set, electric thermal level has linear characteristics. When setting "0", the electronic thermal (F-23) has a derating to avoid motor overheat due to continuous operation at low speed. 50 Hz, Output frequency
			1	With no derating on electronic thermal characteristics	
		⑥	0	Standard boost pattern	Output voltage: Maximum value when 1 is set, For V-BOOST <80>, 152, 122, fb/3, fb/2, fb, Output frequency fb = base frequency
			1	Larger boost pattern	
		⑦	0	Without speed detection after reset	After reset is released, the inverter restart with acceleration from zero speed. The inverter starts outputting about 0.3 s after reset is released.
			1	With speed detection after reset	After reset is released, the inverter restart according to motor speed if the motor is still running. When using restart function, set "1". See paragraph 9.5.
		⑧	0	FS setting change inhibited	The FS setting cannot be changed when soft lock is applied (the LOCK DIP switch is set to ON).
			1	FS setting change allowed	The FS setting can be changed even soft lock is applied.

9.5 Automatic Restart Function

There are some different methods for restarting the inverter. This paragraph provides the explanation and differences between restart modes. Choose the suitable and proper method of restarting to your system.

> ⚠ WARNING: To avoid personal injury
>
> Since the restart mode is selected, the motor is restarted at occurrence of a trip due to overcurrent, overvoltage, undervoltage and instantaneous power failure. When the inverter trip, no fault alarm signal is given and automatically restarts after a certain time. Do not use the automatic restart function, therefore, when it is necessary to hold the motor in free-run state through mechanical braking.

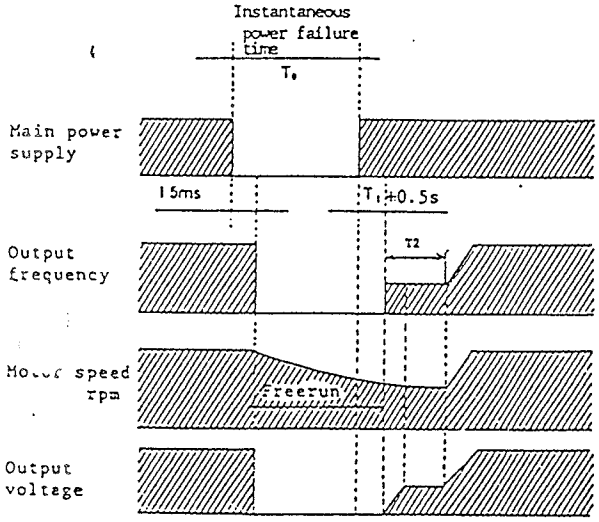
The following table shows the kinds of restart and functions in function mode to be set.

Table 9-10 Kind of Restart

Restart mode	F-28 switch 1 selection field ⑤ 00000101 ⑤	F-29 switch 2 selection field ⑦ 00110000 ⑦	Other functions in function mode to be set
Restart after instantaneous power failure or under voltage trip	10	1	F-33 (IPS-T) F-36 (IPS-R-T)
Restart after trip (OC, OV)	10	1	F-36 (IPS-R-T)
Restart from zero speed after power failure or under voltage trip	11	1	F-33 (IPS-T) F-36 (IPS-R-T)
Power source switching from commercial to inverter	10, 11, 00 Do not set in "01".	1	-

(1) Restart after instantaneous power failure, restart after trip

This is the function to restart the inverter automatically after instantaneous power failure. In the case of this restart mode, the inverter is restarted with synchronized speed, and possible to restart when the inverter trips due to overcurrent (OC), overvoltage (OV) and undervoltage (UV). The Figure 9-2 shows a time chart of performance when restart function after instantaneous power failure is performed.



T_0: Allowable power failure time set by F-33(ISP-T) The power failure trip occur when the power failure time is longer than T_0.

T_1: Restart stand-by time set by F-36(ISP-R-T)

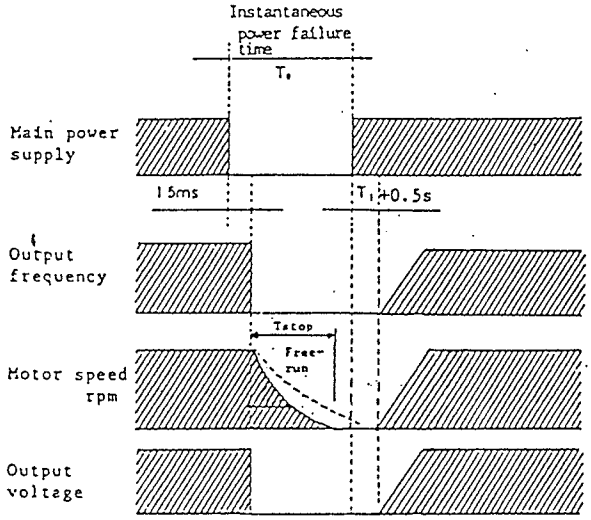
T2: Reseaching time of motor free-run speed. T_2 is not fixed, it is changable and depends on timing and load condition.

Figure 9-2 Timing Chart of Synchronized Restart

Note: The keeping time of control power supply of the control board depends on load condition. When power supply to the inverter is off with full (rated) load, it is approximately 0.3 second. When the longer power failure than 0.3 second occurs, the inverter may not be able to catch the motor speed when power comes again and may restart from zero speed.

(2) Restart from zero speed after failure

This is the function to restart the inverter from zero speed after power failure. In the case of this restart mode, the inverter is always restarted from zero speed.



T_0: Allowable power failure time set by F-33(IPS-T)
The power failure trip occurs when the power failure time is longer than T_0.

T_1: Restart stand-by time set by F-36(IPS-R-T) when T_1 is over, the inverter is restarted from zero speed.

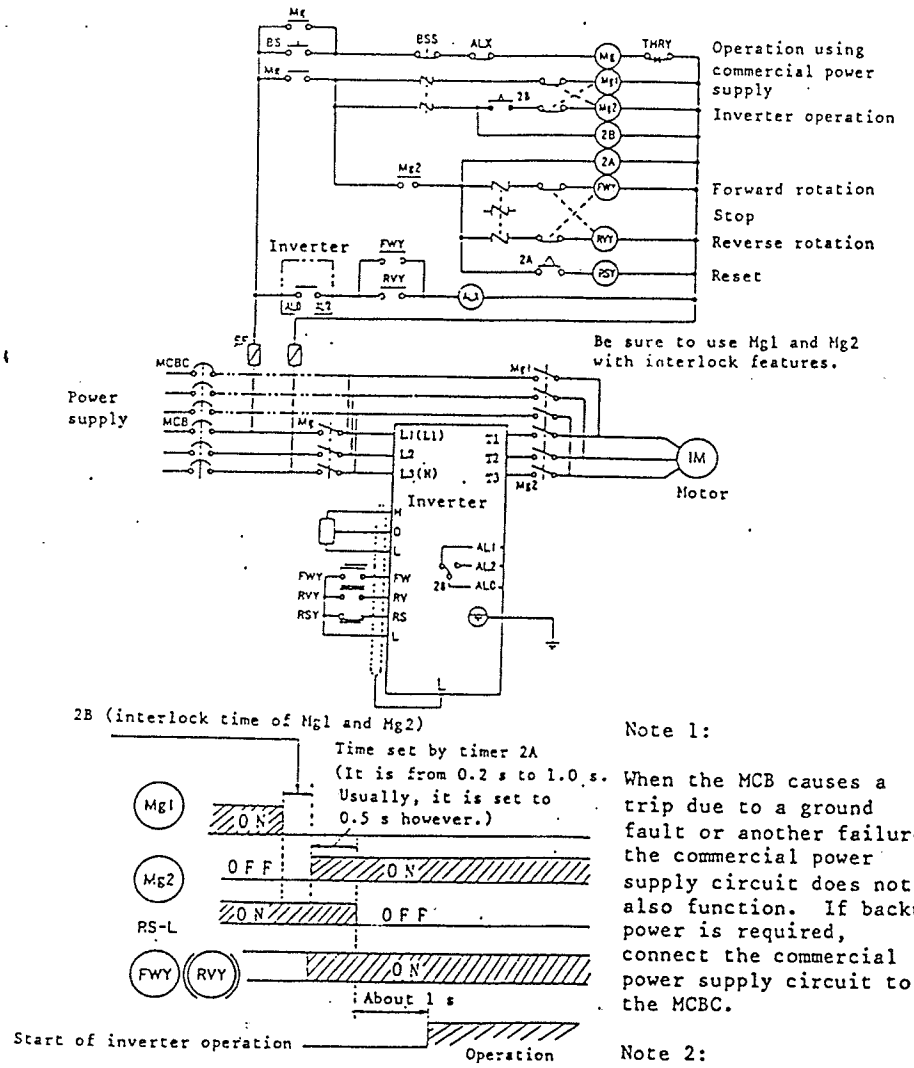
Figure 9-3 Restart Timing from Zero Speed

Note: When the inverter restarts from zero speed, the motor must be already stopped.

(3) Power source switching from commercial power supply to inverter when switches the power source with the motor from the commercial power supply over to the inverter, it must be noted that an interlock time of electromagnetic contactors, timing of reset signal releasing and timing of operation command appling.

⚠ CAUTION:	To avoid damage to inverter Failure to note the interlock time and so on described in Figure 9-4 could result in inverter damage.

Connection diagrams and timing charts for commercial power supply switching are shown below.



Note 1:

When the MCB causes a trip due to a ground fault or another failure, the commercial power supply circuit does not also function. If backup power is required, connect the commercial power supply circuit to the MCBC.

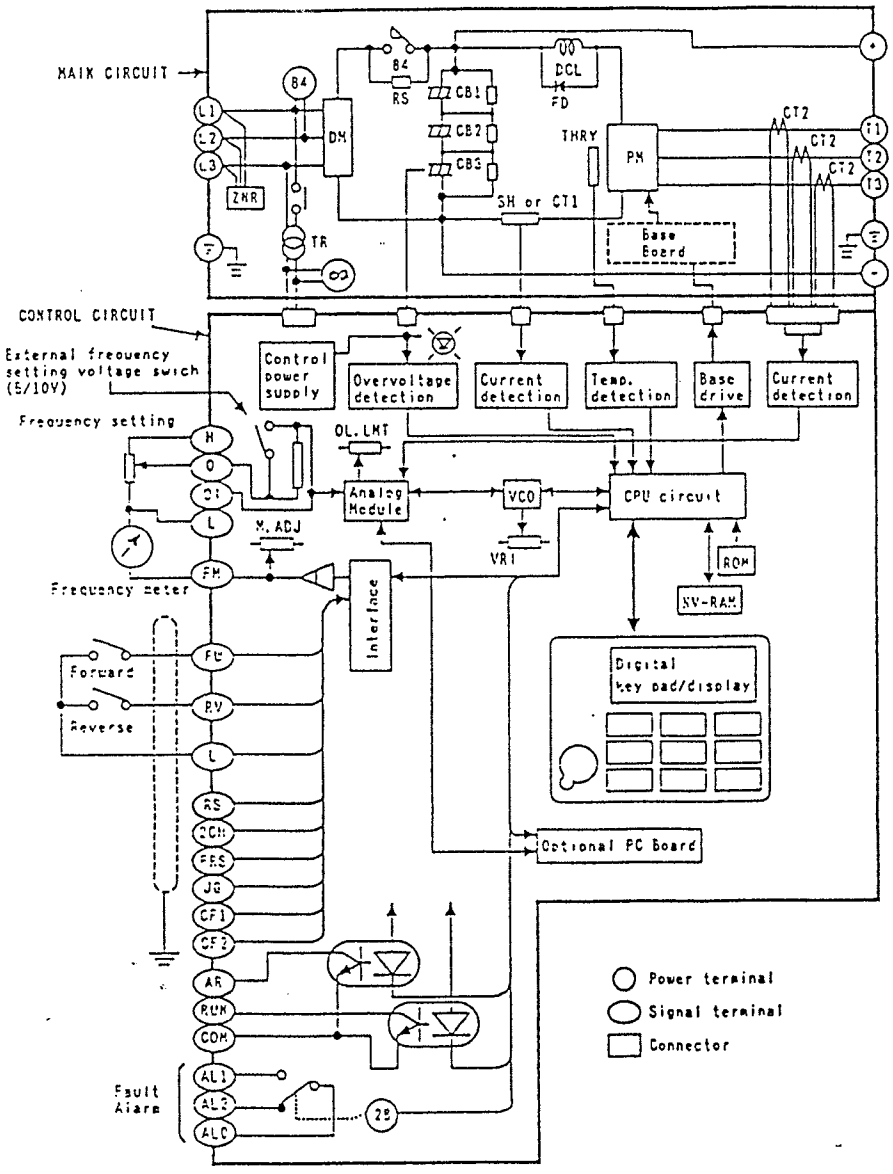
Note 2:

Use relays dedicated to electronics circuits as FWY, RVY, and RSY. Use separate relays for AC and DC. The sequences in this figure are reference data for timing charts.

Figure 9-4 Sample Connection and Timing Charts for Commercial Power Supply Switching

10. SPECIFICATIONS

10.1 Block Diagram



Notes: Explanation of symbols

- MC : Electromagnetic contactor
- FD : Flywheel diode
- TR : Transformer
- DM : Diode module (Converter module)
- CB : Smoothing capacitor
- 28 : Fault alarm relay
- ZNR : Surge absorber
- DCL : DC reactor
- Fan
- : Base board
- CTI: Current transformer
- RS: Current Limiting resistor
- PM: Power module (Inverter module)
- THRY:Thermal relay
- CT2: Current tranformer
- Smoothing capacitor charging check LED

Figure 10-1 Block Diagram

10.2 Layout on the Printed Circuit Board

Components of the printed circuit board of the HFC-VWSHF3A are mounted as shown below.

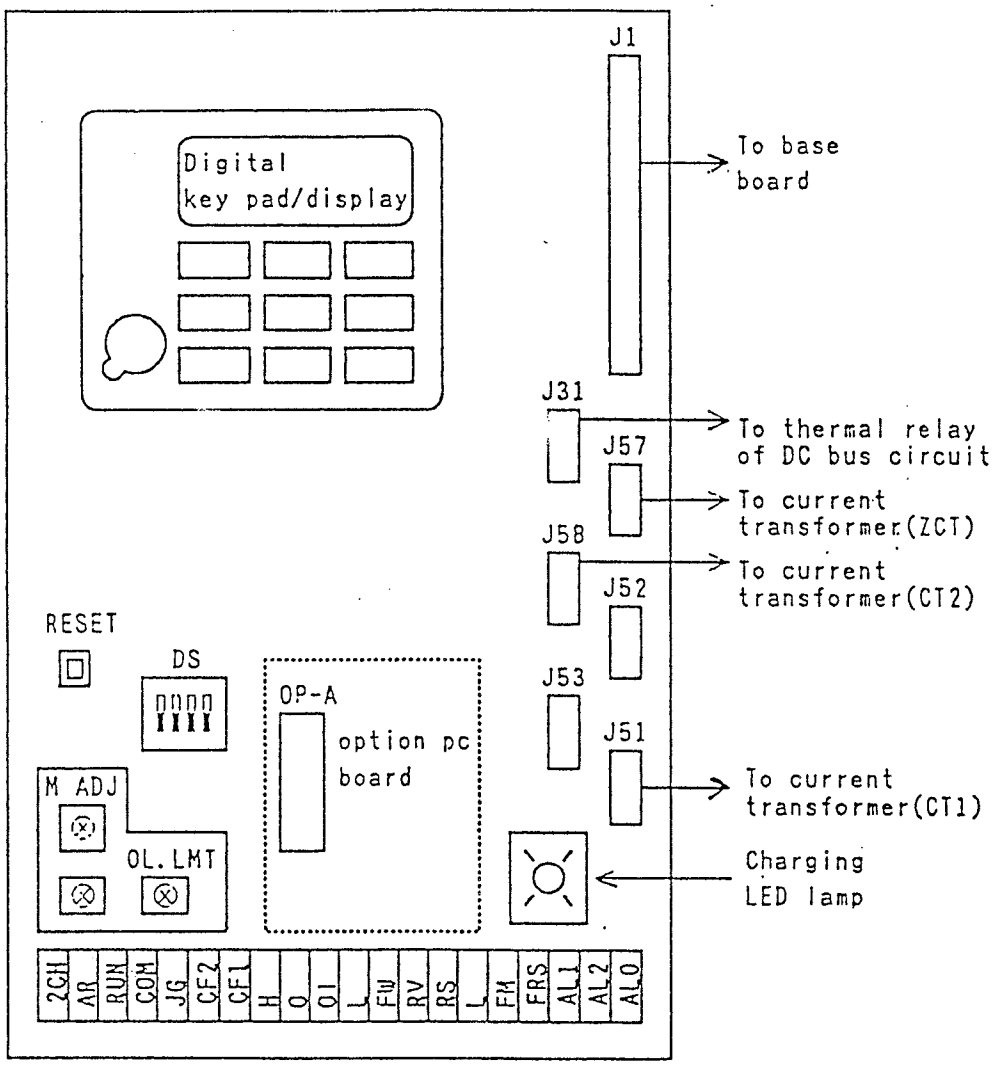


Figure 10-2 Layout on the Printed Circuit Board

10.3 Standard Specifications

Table 10-1 Standard Specifications

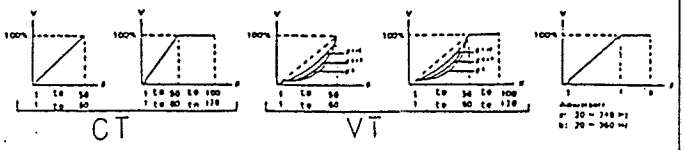
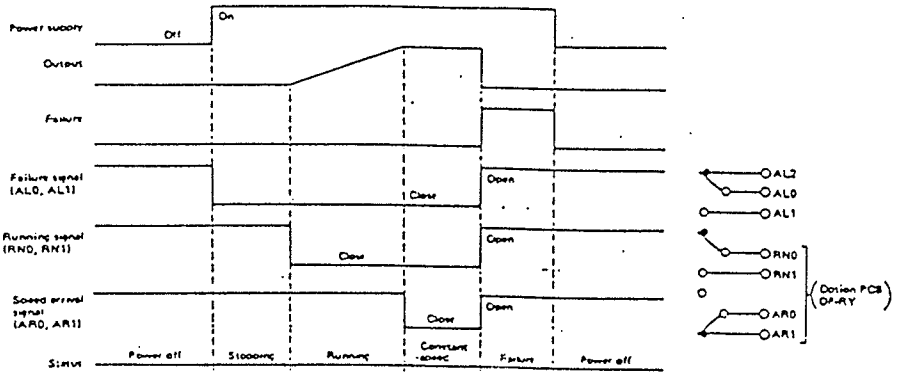
Item		VWSHF3D Series Common SPEC
Input power supply		Three-phase 400 to 460 V ±10%, 60 Hz ±5%
Output voltage (max.)		Three-phase, 400 to 460 V
Control	Control system	Sine-coded PWM (all digital control), Voltage source type
	Output voltage/output frequency characteristics	
	Starting frequency (Hz)	0.5 Hz (adjustable from 0.5 to 5 Hz, 0.1 Hz each)
	Frequency accuracy (%)	±0.5% (25°C ±10°C at max. frequency)
	Frequency resolution (Hz)	0.01 Hz
	Max./Min. frequency limiter	Fmin.: Fstart to Fmax./Fmax.: Fmax. to Fstart (in case of Fmax. <Fmin. setting error is indicated).
	Frequency jumping	Selectable for 3 points to escape resonance point
	Max. frequency fine adjustment	Available to add (+1 to +15 Hz) on max. frequency
	Soft start/stop	Individual setting for ACC/DEC., Selectable 0.1 sec. each, Linear curve: 0.1 to 2,999.9 sec., S-character curve: 0.1 to 2,999.9 sec.
	Braking torque	Regenerative braking: Approx. 10 to 20% Dynamic braking: Available below min. frequency (fmin.) Adjustable for fmin., braking time and braking value Selectable valid or invalid
	Manual torque boost	Adjustable (Effective below halt of based frequency reached 100% voltage)
	Automatic torque boost	Available at starting and selectable valid or invalid
	Overload capacity Overload limiter	Overload capacity (Thermal characteristics) · Adjustable · 150% 60 sec. (CT) · 125% 60 sec. (VT) (every 10 min.) 50% 75% 100% 200 150 100 50 0 t (sec) 1 = output current / rated current x 100(%) (CT) (VT) 50 100 150 200 1(%) CT 100 150 160 1(%) VT Derating of thermal characteristics Constant or with derating selectable 100% 80% 50% 10 20 Hz 50 Hz Output frequency
	Slip compensation	Approx. 1.5% (At based frequency), (Under condition of V/F constant and above 15 Hz)
	Carrier frequency	Adjustable

Table 10-1 Standard Specifications (Continued)

Item		VWSHF3D Series Common SPEC
Input/Output	Frequency setting (O)	Voltage setting: 0 to 10 VDC (input impedance: 30 kΩ or more) / 0 to 5 VDC (input impedance: 15 kΩ or more) — Gain and bias are adjustable by "F-START, F-END" (OI) Current setting: 4 to 20 mA (input impedance: 250 Ω) — Gain and bias are adjustable by "F-START, F-END" Digital setting: Programmable setting by digital operator panel
	Reset (RS)	Failure reset and instantaneous output cut-off (Normally open)
	Forward/reverse run (FW) (RV)	Forward and reverse run signals are selectable individually. (Inverter stops when both signals are ON or OFF.)
	Multistage speed (CF1, CF2)	Four kinds of speed setting including main speed setting are selectable.
	Jogging operation (JG)	Selectable from 0 to 9.9 Hz (0.1 Hz each)
	Free run stop (FRS)	When this command arrives, the output of inverter is cut off. (Normally close)
	Fault alarm relay (AL0, AL1, AL2)	Opened (AL0 to AL1) when inverter-trip and power off ("1c" contact output)
	Running signal (RUN)	Transistor output (Relay output is option PCB)
	Frequency arrival signal (AR)	Transistor output (Relay output is option PCB)
	Frequency monitor (FM)	0 to 10 VDC (Duty control for analog meter), Meter impedance (10 K to 22 kΩ) is acceptable.
	Two-stage accel/Decel (2CH)	When this command arrives, Accel/Decel time is changed.
	Motor current monitor (IM)	0 to 10 VDC (Analog), Inverter rated current = 4 VDC ±0.4 V (at above 10 Hz and No load-Full load) (Option PCB)
	Auto-restart	Auto-restart after instantaneous power failure
	Overload warning signal (OLO-OL1)	When preset value of overload is exceeded, relay contact is closed (Option PCB)
	Control signal of dynamic braking (DB)	Input to operate DC dynamic braking in force (Option PCB)
Protection	Undervoltage	Inverter trips at approx. 320 V of line voltage or lower
	Overvoltage	Inverter trips at approx. 800 V of converter output
	Overcurrent	Inverter trips at approx. 180% (CT), 150% (VT) of current
	Overload	Protected according to the thermal characteristics described in the item "overload capacity"
	Instantaneous power failure	Inverter trips if power failure lasts 15 msec. or longer
	Overheat	Standard
	CPU error	Inverter trips when CPU in control board is disabled.
	Stall prevention	Prevent the overcurrent and overvoltage trip by the prevention circuit
	Ground fault*4	Standard equipment
Monitor		By Dot matrix display (LCD, 16-digits) on digital operator panel (Output frequency, Output current, Synchronous RPM and failure contents)

Table 10-1 Standard Specifications (Continued)

	Item	VWSHF3D Series Common SPEC
General Specifications	Ambient temperature	-10 to 40°C (14 to 104°F) without cover: -10 to 50°C (14 to 122°F)
	Storage temperature	-20 to 60°C (-4 to 140°F)
	Ambient relative humidity	20 to 90% RH (with no condensation)
	Vibration	0.2 G (10 to 55 Hz)
	Altitude	1000 meters (3300 feet) or less above sea level, indoors (without the presence of dust or corrosive gas)
	Coating color	5Y7/1 (Munsell system)
		

*1 Output voltage goes down when power voltage becomes low.
*2 Applicable motor means Hitachi standard three phase 4 pole motor. Make sure motor rating current (50 Hz) does not exceed continuous output RMS current if other motors are used.
*3 -10 to +40°C (without cover: -10 to +50°C) (Storage temperature: -20 to +60°C)
*4 Ground fault detection circuit protects INVERTER against damage, but cannot guarantee safety of personnel. An earth leakage current circuit should be provided on the input power supply line.

• Ratings

Table 10-2 Ratings

VWSHF3D Series Specifications									
Type (Model Abbreviation)	Protective Structure	Capacity (kVA) 460 V		Rated Output Current (A)		Max. Applicable Motor (kW/Hp)		Cooling System	Approx. Weight (kg/Lb)
		CT	VT	CT	VT	CT	VT		
16HF3D	Semi-enclosed type (IP20)	19	22	24	27	(11/15)	(15/20)	Forced air cooling	(22.5/50)
22HF3D		25	29	32	36	(15/20)	(22/30)		(24.5/54)
33HF3D	Open type (IP00)	38	43	48	54	(22/30)	(30/40)		(30/66)
40HF3D		46	52	58	65	(30/40)	(37/50)		(40/88)
50HF3D		60	67	75	84	(37/50)	(45/60)		(58/128)
60HF3D		72	80	90	101	(45/60)	(55/75)		(58/128)
75HF3D		89	99	110	124	(55/75)	(75/100)		(58/128)
100HF3D		119	134	149	168	(75/100)	(90/125)		(105/231)
120HF3D		140	158	176	198	(90/125)	(110/150)		(105/231)
150HF3D		173	194	217	244	(110/150)	(132/200)		(150/331)
180HF3D		207	233	260	293	(132/200)	(160/ -)		(160/353)

CT: Constant torque
VT: Variable torque

10.4 Description of Terminals

Table 10-3 Designation of Terminals

	Terminal symbol	Terminal name	Description
Main circuit terminals	L1, L2, L3 (3-phase)	Commercial power supply input terminals	3-phase: 460 V, 60 Hz
	T1, T2, T3	Inverter output terminals	Motor connecting terminals
	⊕, ⊖	DC bus voltage terminals	Regenerative braking unit connecting terminals
Control circuit terminals	2CH	Two-stage acceleration/ deceleration terminal	Contact (close): Two-stage acceleration/deceleration
	AR	Frequency arrival signal terminal	When the set frequency is reached, the transistor output is ON. (27 VDC, 50 mA max)
	RUN	Running signal terminal	The transistor output is ON during operation. (27 VDC, 50 mA max)
	COM	Common terminal	Common terminal only for AR and RUN (This terminal is not a ground terminal.)
	JG	Jogging terminal	Contact (close): Jogging operation
	CF2	Multi-stage speed terminals	Contact (close): Multi-stage speed operation
	CF1		
	H	Frequency setting power supply terminal	10 VDC
	O	Frequency setting terminal	0 - 10 VDC or 0 - 5 VDC (selectable by a DIP switch) Input impedance: 15 kΩ in the 0 - 5 V range or 30 kΩ in 0 - 10 V range
	OI	Frequency setting terminal	4 - 20 mA (Input impedance is 250 Ω.)

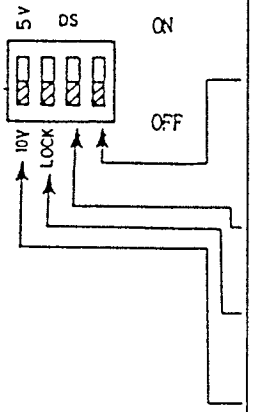
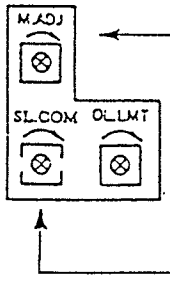
Table 10-3 Designation of Terminals (Continued)

	Terminal symbol	Terminal name	Description
	L	Common terminal of control terminals	Common terminal of control terminals (This terminal is not a ground terminal.)
	FW	Forward rotation/stop terminal	Contact (close): Forward rotation Contact (open): Stop
	RV	Reverse rotation/stop	Contact (close): Reverse rotation Contact (open): Stop
	RS	Failure reset terminal	Contact (close): The fault signal is released.
	L	Common terminal of control terminals	Common terminal of control terminals. (This terminal is not a ground terminal.)
	FM	Frequency monitor terminal	A digital frequency counter or an analog meter can be selected. (0 - 10 V, 1 mA full-scale. The load resistance is 10 to 22 kΩ.)
	FRS	Free-run stop terminal	Contact (close): The inverter stops and the motor stops in the free-run state. (The fault signal is not released.)
	AL1 AL2 AL0	Fault alarm contact terminal	During fault, power off AL0 - AL1: Open AL0 - AL2: Closed Contact rating 250 VAC, 2.5 A (resistive load) 0.2 A (cos ϕ = 0.4) 30 VDC, 3 A (resistive load) 0.7 A (cos ϕ = 0.4)

Use electronic relays (usable at 12 VDC, 3 mA) between control circuit terminals except the one between AL0 and AL2.

10.5 Potentiometers and DIP Switches

Table 10-4 Designation of Potentiometers and DIP Switches

	Name	Description
Pot. meter for factory setting		Factory-set. Do not change this setting.
DIP switches		To return the inverter to the original standard setting, set this DIP switch to ON. After resetting the inverter, return the DIP switch to OFF. For details, see paragraph 9-2. Leave this DIP switch off. If it is set to ON mistakenly, the optional remote operator does not function correctly. Soft lock: When this DIP switch is set to ON, no data can be changed. External frequency setting voltage switching 5 V: 0 - 5 VDC/0 - Fmax 10 V: 0 - 10 VDC/0 - Fmax
Pot. meters for adjustment		For external analog frequency meter adjustment. (For details, see page 9-32.) For overload limiting level adjustment. The standard setting is 125%. To increase the limit, rotate the pot, meter clockwise. See also (F-30) on table 9-8. No function
Fault reset button		Forced reset button

10.6 Wires and Components

Select appropriate wires and components with reference to the following table.
Note that the contents of the table may differ according to wire lengths and power supply capacities.

Table 10-5 Standard Applicable Equipment

Applicable motor (4P,kW)		Inverter model	Wiring		Applicable equipment			
			Power line L1,L2,L3, T1,T2,T3 +, M, - ⏚ (Ground)	Signal line JG,CF2,CF1, H,O,OI,L, FW,RV,RS, FM,FRS,2CH, AR,RUN,COM	Control line AL1 AL2 AL0	Circuit breaker (MCB)	Electro-magnetic contac-tor (Mg)	Thermal relay (RC value)
CT	VT							
11	15	VWS16HF3D	AWG10 (5.3 mm^2)			F-50F (50A)	H25	TR20-1E (20A)
15	22	VWS22HF3D	AWG8 (8.9 mm^2)	Shield wire	AWG14 (2 mm^2)	F-50F (50A)	H35	TR40-1E (28A)
22	30	VWS33HF3D	AWG6 (14 mm^2)	AWG18 (0.9 mm^2)		F-100G (75A)	H50	TR40-1E (40A)
30	37	VWS40HF3D	AWG4 (22 mm^2)			F-100G (75A)	K50N-EP	TR100-1E (55A)
37	45	VWS50HF3D	AWG4 (22 mm^2)			F-225F (125A)	K60N-EP	TR100-1E (67A)
45	55	VWS60HF3D	AWG2 (35 mm^2)			F-225F (150A)	K100N-EP	TR100-1E (80A)
55	75	VWS75HF3D	AWG2/0 (67 mm^2)			F-225F (200A)	K120N-EP	TR100-1E (105A)
75	90	VWS100HF3D	AWG2/0 (67 mm^2)			F-225F (200A)	K150N-EP	TR100-1E (130A)
90	110	VWS120HF3D	AWG4/0 (107 mm^2)			F-225F (225A)	K200N-EP	TR20-1E (1.4A) with CT-100N
110	150	VWS150HF3D	250 Kcmil (127 mm^2)			F-400F (300A)	K250N-EP	TR20-1E (2.4A) with CT-100N
132	160	VWS180HF3D	300 Kcmil (152 mm^2)			F-400F (350A)	K300N-EP	TR20-1E (2.4A) with CT-100N

Note 1: Insulation for power wiring should be in accordance to UL and CSA standards which are as following.
Inverters rated below 100 amps should have 65/75 degrees centigrade insulation.
Inverters rated above 100 amps should have 75 degree centigrade insulation.

Note 2: Applicable equipment are used for the Hitachi standard 4-pole, 3-phase squirrel-cage motor.

Note 3: When selecting a circuit breaker, consider the breaking capacity.

Note 4: The leakage current of a single inverter is about 3 mA. (The leakage current of wires is not included.)

Note 5: When the Hitachi standard 4-pole, 3-phase squirrel-cage motor is used at frequencies from 10 Hz to 60 Hz, no thermal relay is required.

Note 6: When determining the breaking capacity, consider the power system and wire system.

Note 7: For grounding, see paragraph 5.4.

11. OPTION

The following options are prepared for VWS3D series inverter.

For the details, see an individual manual.

Table 11-1 Options

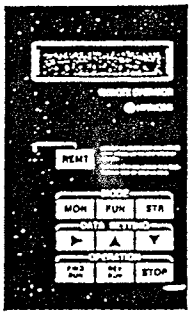
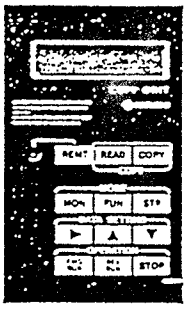
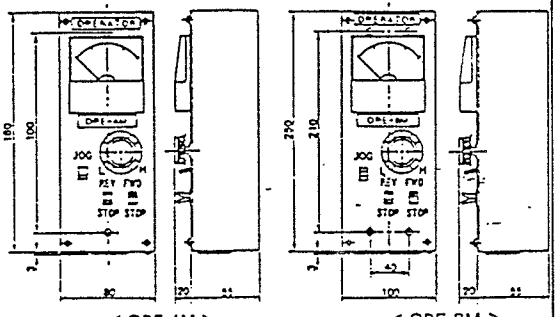
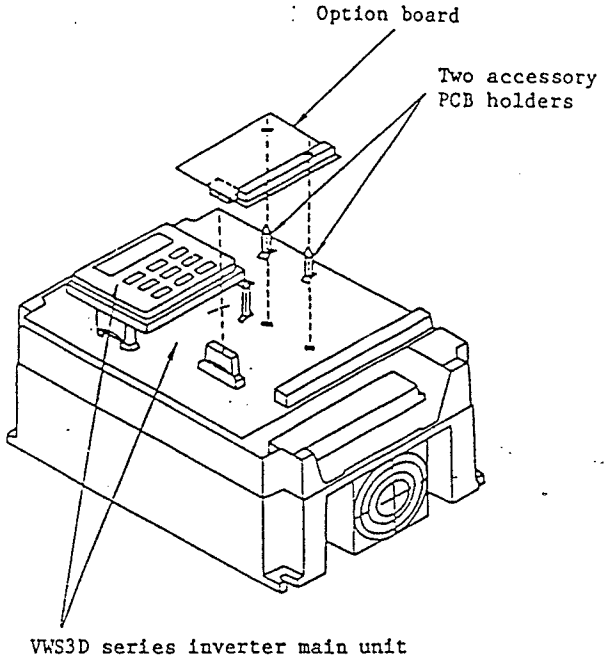
Option name	Type name	Description
Remote operator	DOP-1EA DOP-3EA	By this operator, remote operation is possible from a place 1 m or 3 m away, and data change is also possible the same as by the digital operation panel on the inverter cover. Cable length DOP-1EA: 1 m DOP-3EA: 3 m 
Copy unit	DRW-1EA	All data in the monitor mode and the function mode are read and transferred to other inverters. This unit is also able to operate the inverter the same as the remote operator. Cable length DRW-1EA: 1 m 
Operation box	OPE-4M OPE-8M	Analog type operation box for remote control. Meter scales OPE-4M 0 to 50 Hz 0 to 100 Hz 0 to 60 Hz 0 to 120 Hz OPE-8M 0 to 50 Hz 0 to 100 Hz 0 to 200 Hz 0 to 60 Hz 0 to 120 Hz 0 to 240 Hz  < OPE-4M > < OPE-8M >

Table 11-1 Options (Continued)

<table>
<tr><th>Option name</th><th>Type name</th><th>Description</th></tr>
<tr><td>Multi-function board</td><td>OP-RY
IA-TWK
S30P-PCB</td><td>These three option boards are possible to be installed into the inverter inside. (Plug in type). Each board has following functions.
<table>
<tr><th>Function name</th><th>Terminal used</th><th>Description</th><th>OP-RY</th><th>IA-TWK</th><th>S3-OP-PCB</th></tr>
<tr><td>Frequency reference signal 0 to 20 mA</td><td>IO2-L
OI-O</td><td>Connect OI with O of each PCB and input 0 to 20 mA current signal between IO2 (+) and L (-).</td><td>N/A</td><td>Available</td><td>N/A</td></tr>
<tr><td>DC dynamic braking external signal</td><td>DB-L</td><td>When SW is closed, DC dynamic braking can be effected during deceleration. Braking torque, braking time and frequency of braking start can be set at the digital operation panel.</td><td>N/A</td><td>Available</td><td>Available</td></tr>
<tr><td>Inverter output current signal</td><td>IM-L</td><td>A voltage is output in proportion to the inverter output current. (4 V DC is generated at the rated inverter current.)</td><td>N/A</td><td>Available</td><td>Available</td></tr>
<tr><td>Running signal relay output</td><td>RNO-RN1</td><td>A potential free contact is closed during inverter operation.</td><td>Available</td><td>Available</td><td>Available</td></tr>
<tr><td>Frequency arrival signal relay output</td><td>ARO-AR1</td><td>A potential free contact is close when the preset frequency has been attained.</td><td>Available</td><td>Available</td><td>Available</td></tr>
<tr><td>Overload warning alarm signal relay output</td><td>OLO-OL1</td><td>A potential free contact is closed when the load current exceeds the overload warning level preset at the digital operation panel (100 to 150%)</td><td>N/A</td><td>N/A</td><td>Available</td></tr>
</table>


</td></tr>
</table>

Table 11-1 Options (Continued)

Option name	Type name	Description
Serial communication interface module	COM-EA	This is the communication interface module to communicate with personal computer (PC) or programmable logic controller (PLC). This module is installed between an inverter and PC/PLC, and it is not plug in type like option board. The module cannot be used together with the remote operator or copy unit. Note: The COM-EA cannot do the following operations: 1) Setting and display of the current monitor code 2) Selection of the V/F pattern 3) Selection of the USP function

12. PARTS AND REPAIR

12.1 Parts Order

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

(1) Type
(2) Output (kVA)
(3) Manufacturing serial number
(4) Symptom of failure

If the nameplate is too dirty to read the above information, inform only the clear items and attach simple sketches of the parts that you want.

To minimize the idle time, it is recommended that the parts listed in Table 7-2 to stocked.

WARRANTY:	The warranty period under normal installation and handling conditions shall be one year after the date of delivery. The warranty shall cover only repair of the main unit of the inverter.

12.2 Repair

(1) The repair shall be charged to the purchaser even within the warranty period if a failure or damage is caused by:
   (a) Incorrect operation, remodeling, or improper repair
   (b) Drop after your purchase or accident in transit
   (c) Fire, earthquake, flood, thunderbolt, natural calamities, pollution, or abnormal voltage

(2) If you want that the inverter is repaired on your site, the expense associated with the travel and repair expense are charged to the purchaser.

(3) This manual is not re-issued. Always keep it handy. Do not lose it.

APPENDIX

APPENDIX 1 HFC-VWSHF3D Series Data Setting List

The HFC-VWSJF3A series inverter has many functions. The user can change standard-set values of those functions.

It is recommended that the user fills in the blanks on this data sheet for quick service, maintenance, and investigation of trouble.

Type HFC-VWS [ ]

MFG. No. [ ]

} Designated on the nameplate on the front cover

• Monitor mode

Display sequence	Monitor name	Initial display	Setting data
1	Frequency setting command and output frequency display	FS 000.0 000.0Hz	
2	Frequency command method	F-SET M Ope.-key	
3	Operation command method	F/R-SW Ope.-key	
4	Motor speed display	RPM 4P 00000rpm	
5	Transformed frequency display	/Hz000.0 00000.00	
6	Output current display	If----A Im000.0%	
7	Manual torque boost adjustment	V-Boost Code 80 (00)	
8	Output voltage gain adjustment	V-Gain 100%	
9	Jogging frequency setting	Jogging 01.0 Hz	

APPENDIX 2 Conversion Table

Conversion Table

Length	1 cm	0.3937 in
Weight	1 kg	2.2046 lb
Power	1 kW	1.3333 Hp

- Function mode

Function number	Monitor name	Original standard setting	Setting data
F-00	V/F pattern setting	VFE-VC 060-060	
F-01	Acceleration time setting	30	
F-02	Deceleration time setting	30	
F-03	Maximum frequency adjustment	0	
F-04	Start frequency adjustment	0.5	
F-05	Upper frequency limit setting	0	
F-06	Lower frequency limit setting	0	
F-07	Jump frequency 1 setting	0	
F-08	Jump frequency 2 setting	0	
F-09	Jump frequency 3 setting	0	
F-10	Carrier frequency adjustment	N	
F-11	Adjustment of frequency stop time at start	1.0	
F-12	Multi-stage speed 1 setting	0	
F-13	Multi-stage speed 2 setting	0	
F-14	Multi-stage speed 3 setting	0	
F-15	Multi-stage speed 4 setting	0	
F-16	Multi-stage speed 5 setting	0	
F-17	Multi-stage speed 6 setting	0	
F-18	Two-stage acceleration time setting	30	
F-19	Two-stage deceleration time setting	30	
F-20	DC braking frequency adjustment	1.0	
F-21	DC braking power adjustment	0	
F-22	DC braking time adjustment	0	
F-23	Electronic thermal level adjustment	100	
F-24	Linear/S-curved acceleration selection	Linear	
F-25	Linear/S-curved deceleration selection	Linear	
F-26	External frequency setting start	0	
F-27	External frequency setting end	0	
F-28	Switch 1 selection	00000111	
F-29	Switch 2 selection	00001000	
F-30	Overload limit constant setting	1.0	
F-31	Overload warning level adjustment	100	
F-32	Automatic torque boost adjustment	00	
F-33	Allowable momentary power failure time setting	0.3	
F-34	Switch 3 selection	00000100	
F-35	Communication mode selection	INVERTER	
F-36	Standby time setting for restart after momentary power failure	1	
F-37	DC braking wait time adjustment	0.0	
F-39	Frequency setting for reached-speed signal at freely	0	