

FOR HITACHI INVERTER

HFC-VWS3D SERIES

DUAL RATING INVERTER
INSTRUCTION MANUAL

Read safety instructions carefully and understand
them before using your inverter.
Keep this 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 permission 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.

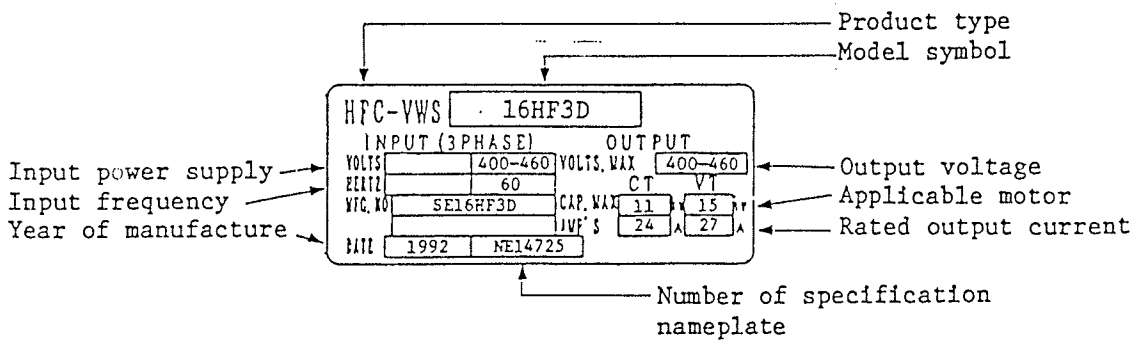
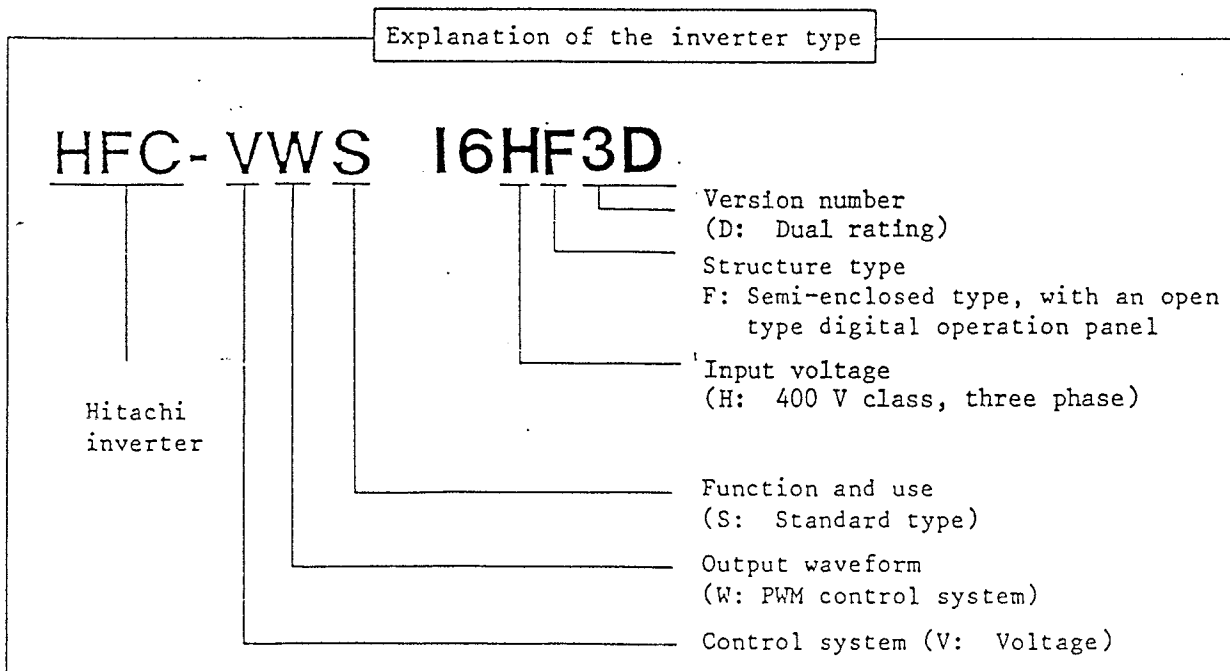


Figure 1-1 Details of Nameplate

For any irregularity, contact your sales shop immediately.



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, the 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.

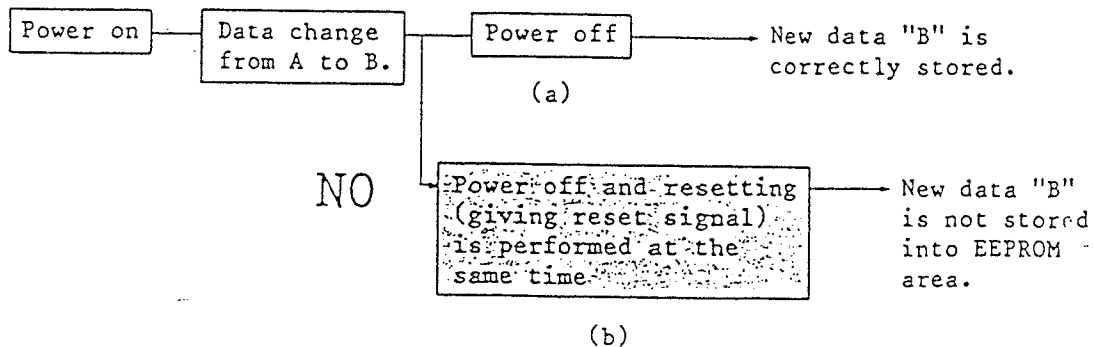


Figure 2-1 Storage of New Data

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.

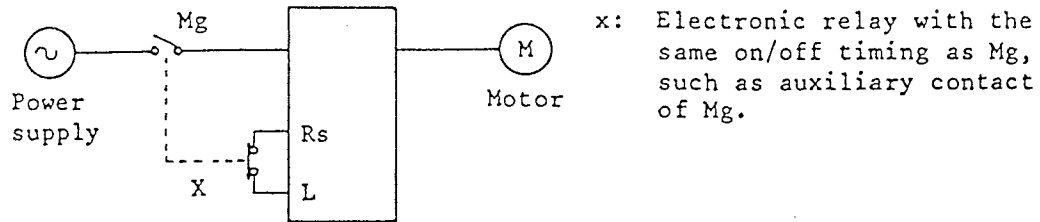


Figure 2-2 Connection Diagram

3. STRUCTURE

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

3.1 Appearance and Name of Each Part

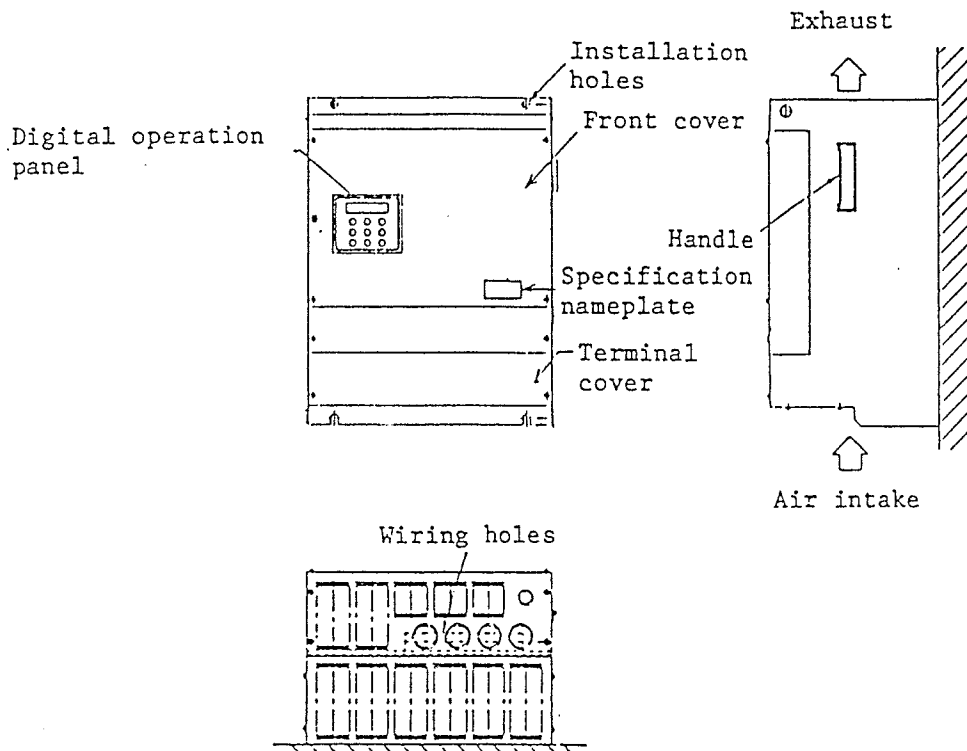


Figure 3-1 Appearance



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.

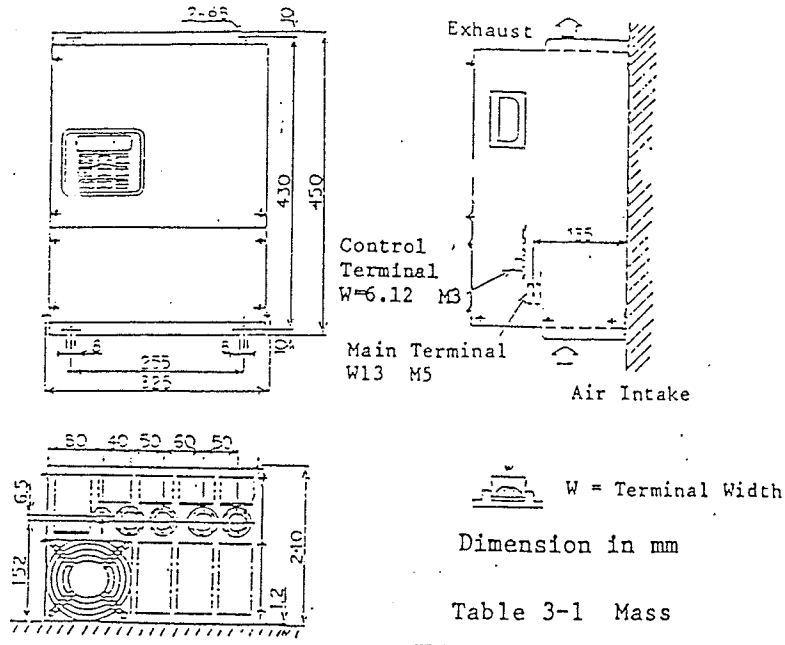


Table 3-1 Mass

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

Figure 3-2 HFC-VWS16,22HF3D

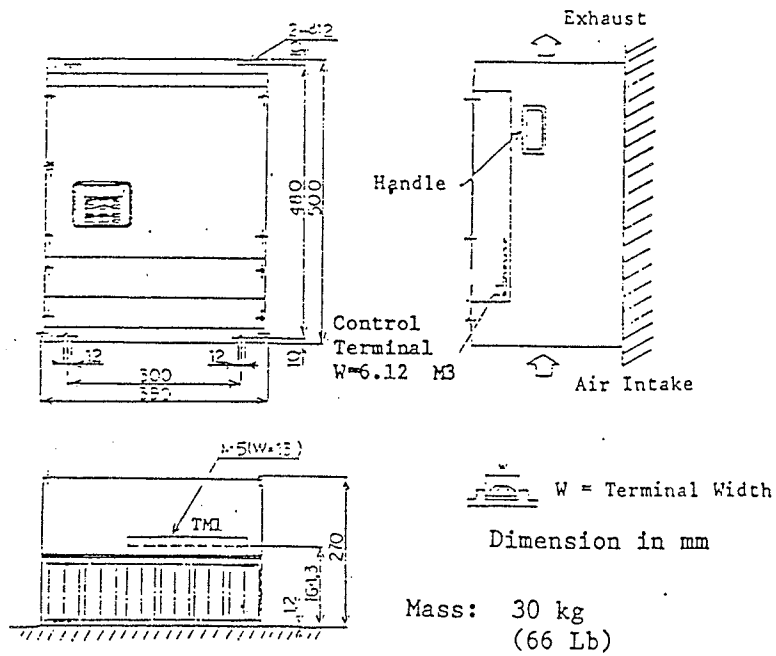


Figure 3-3 HFC-VWS33HF3D

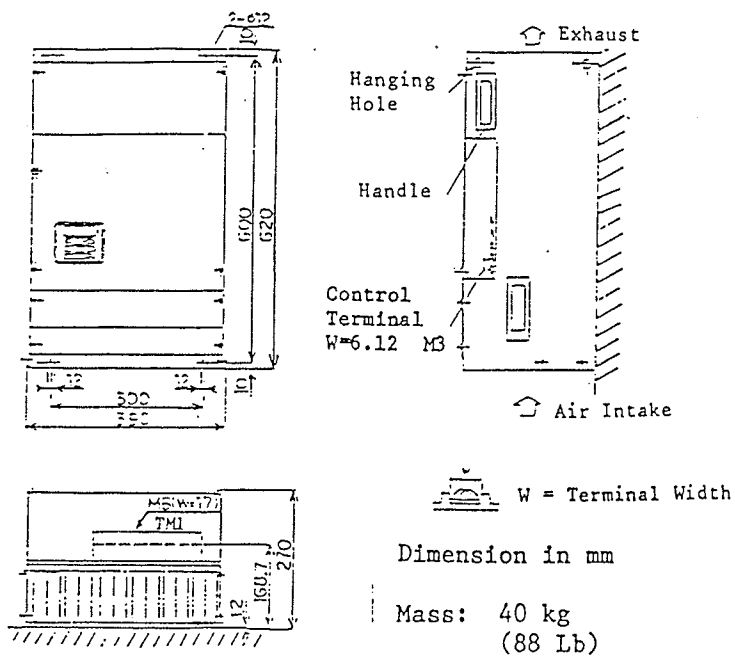


Figure 3-4 HFC-VWS40HF3D

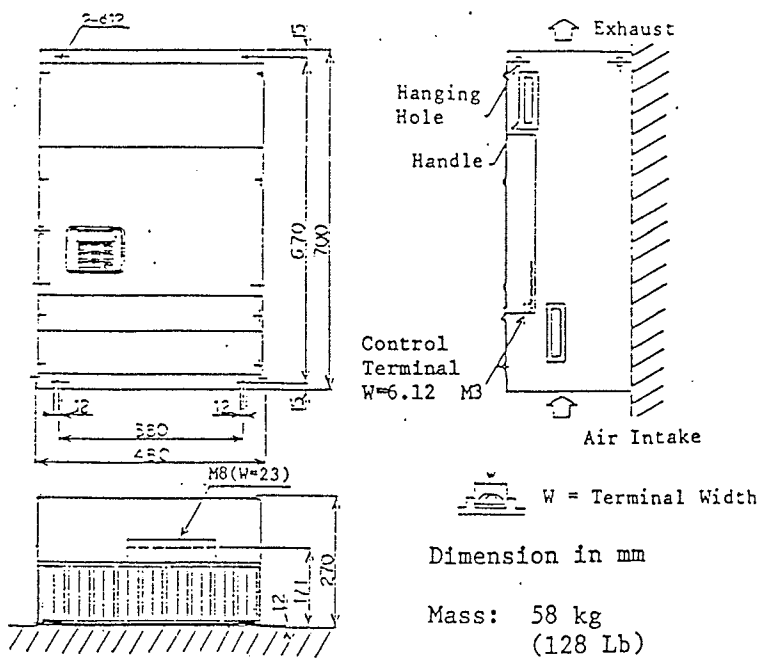


Figure 3-5 HFC-VWS50HF3D

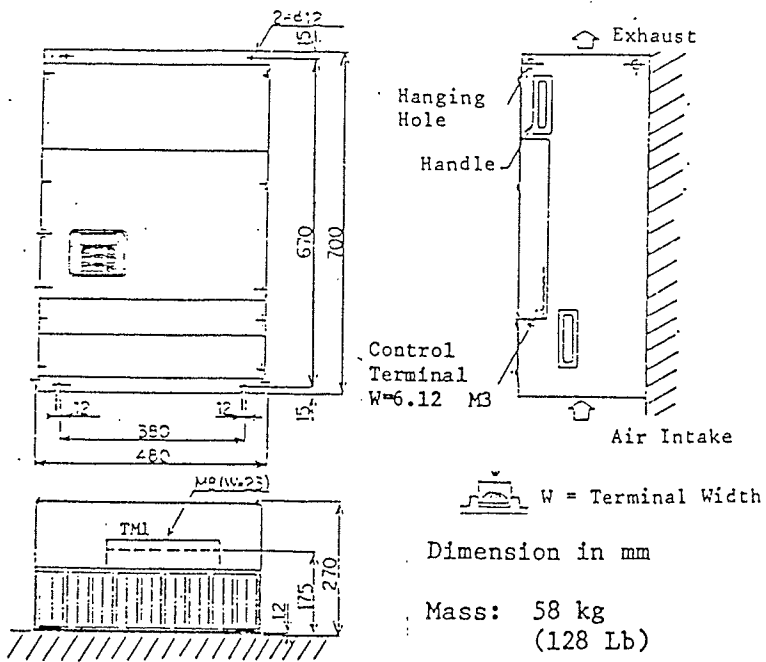


Figure 3-6 HFC-VWS60HF3D

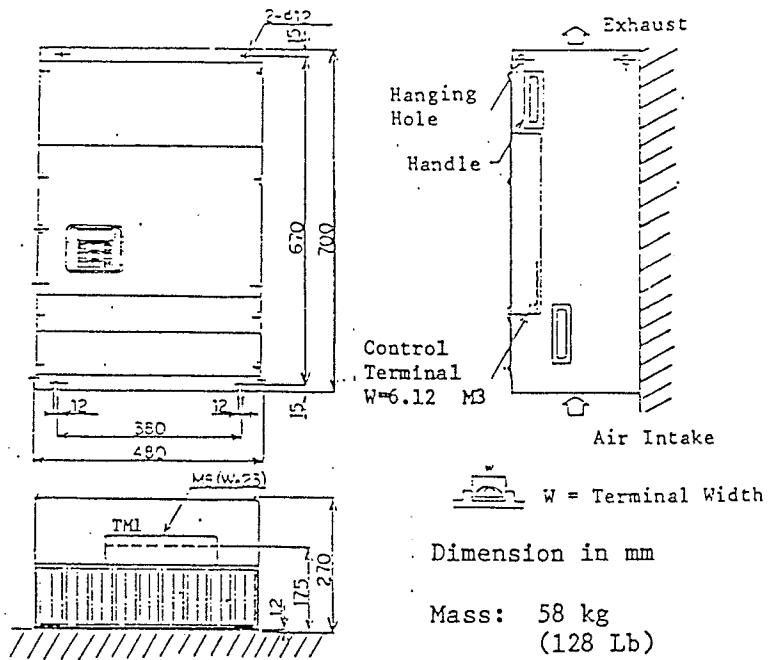


Figure 3-7 HFC-VWS75HF3D

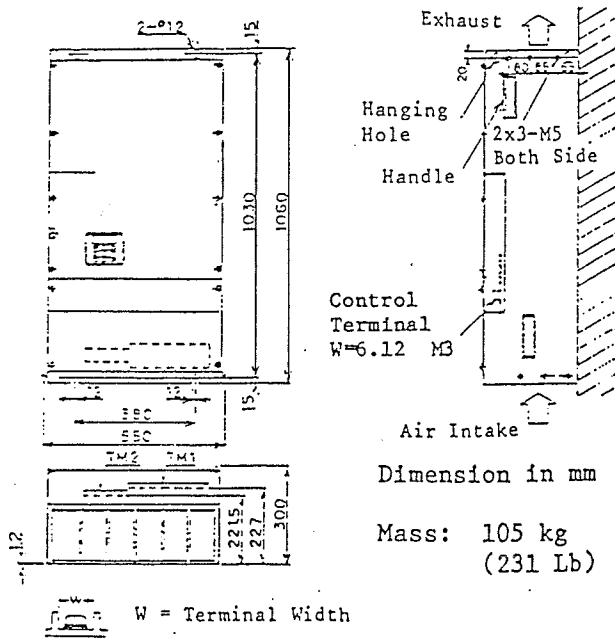


Figure 3-8 HFC-VWS100HF3D

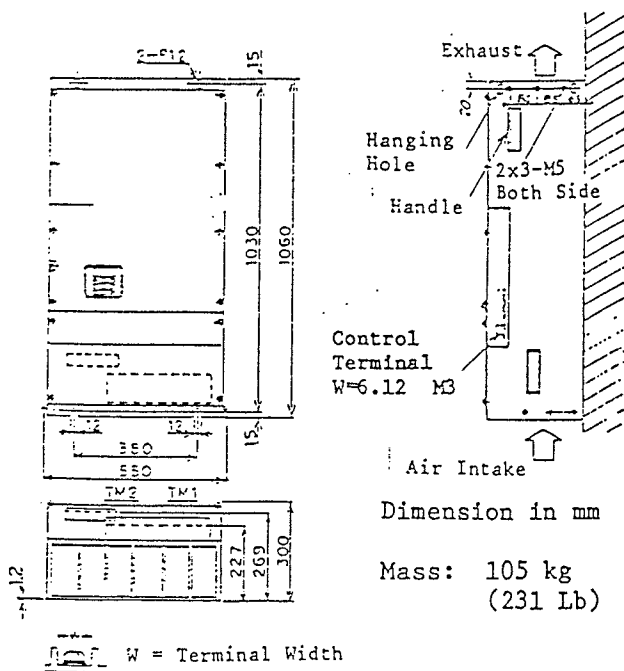


Figure 3-9 HFC-VWS120HF3D

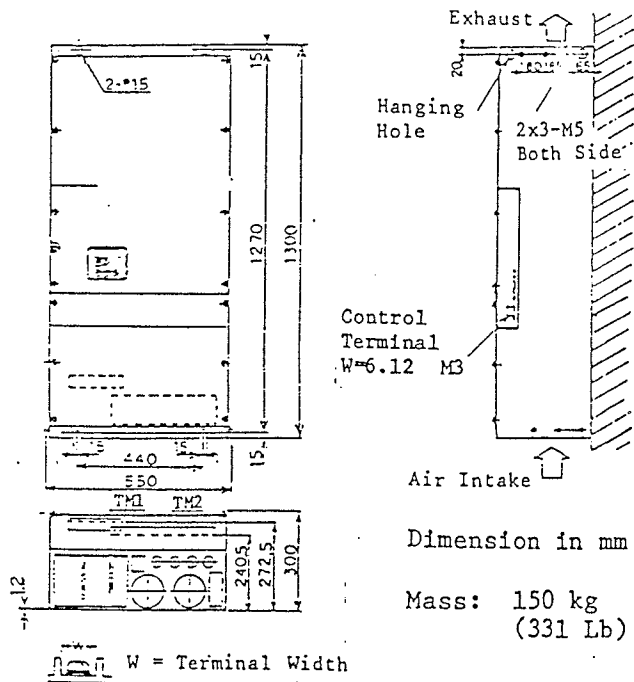


Figure 3-10 HFC-VWS150HF3D

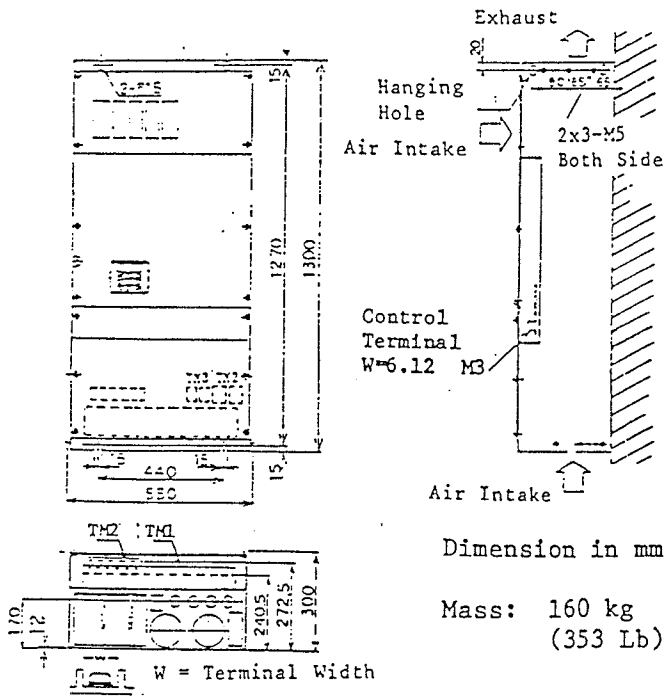
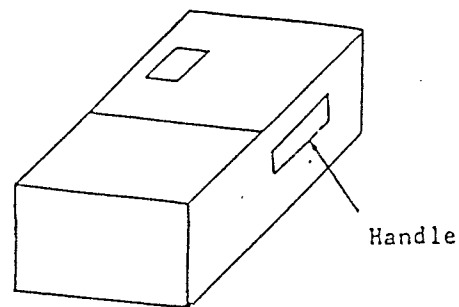


Figure 3-11 HFC-VWS180HF3D

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

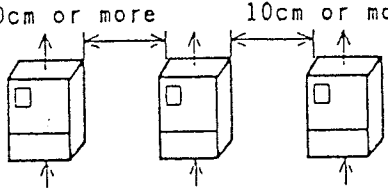
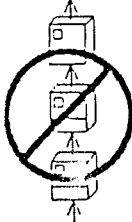
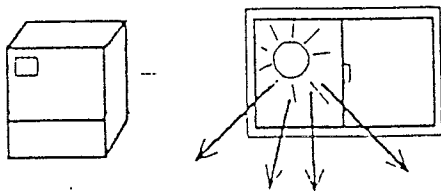
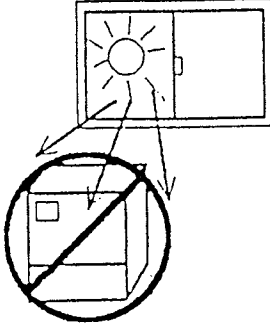
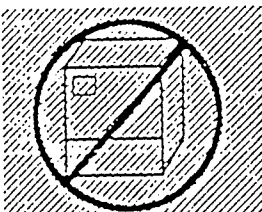
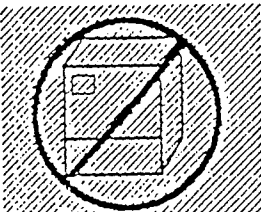
This paragraph provides precautions for installation. For the details, see table 4-1.

- (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 environment.
- (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	<p>Flat and nonframmable material is required.</p>		<p>Flat and nonframmable spacer is required if surface is not flat.</p>
Inverter Air Flow Requirements	<p>() for 50kVA or more</p>		<p>Less clearance</p>
Installation of Single Unit	<p>Install Vertically</p>		<p>Do not install Horizontally</p>


Table 4-1 Environment and Location


ITEM	16 to 60kVA		Remark
Installation of Multi Units	 <p data-bbox="386 567 836 630">Air Flow Keep the space more than 10cm.</p>		 <p data-bbox="1144 378 1299 514">Do not build up the inverters.</p> <p data-bbox="990 598 1112 630">Air Flow</p>
Sunlight	 <p data-bbox="365 892 933 955">Install the inverter away from windows and do not expose to direct sunlight.</p>		
Corrosive Gass and Coolant Mist	<p data-bbox="365 1039 925 1144">Install the inverter in a place not exposed to corrosive gass and coolant mist.</p>		<p data-bbox="1015 1039 1226 1060">Corrosive Gass</p>  <p data-bbox="966 1333 1299 1480">Do not put inverter in a place exposed to corrosive gas and coolant mist.</p>
Explosive Gass	<p data-bbox="365 1690 933 1753">Install the inverter in a place of no explosive environment.</p>		<p data-bbox="1031 1543 1242 1564">Explosive Gass</p>  <p data-bbox="974 1816 1323 1911">Do not put the inverter in the explosive environment.</p>

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

Terminal width

Model	Terminal screw diameter	Terminal width (mm)	Wire size	Terminal location
16HF3D	M5	13.0	AWG10	<div style="text-align: center;">Terminal TM1</div> <p>Power supply</p> <p>Motor</p> <p>Ground</p> <p>Ground</p> <p>Terminal of DC bus circuit for braking device</p>
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	<div style="text-align: center;">Terminal TM1</div> <p>Power supply Terminal TM2 (CONTROL POWER)</p> <p>Output</p> <p>Brake Unit Only 180HF3D</p> <p>-1</p> <div style="border: 1px solid black; padding: 2px; margin-top: 5px;"> L1H L2H L3H L1M L2M L3M L1L L2L L3L </div> <p>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</p>
100HF3D	M10	37	AWG2/0	
120HF3D	M10	37	AWG4/0	
150HF3D	M12	57	250 Kcmil	
180HF3D	M12	57	300 Kcmil	

Note 1: These terminals, \oplus and \ominus , 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

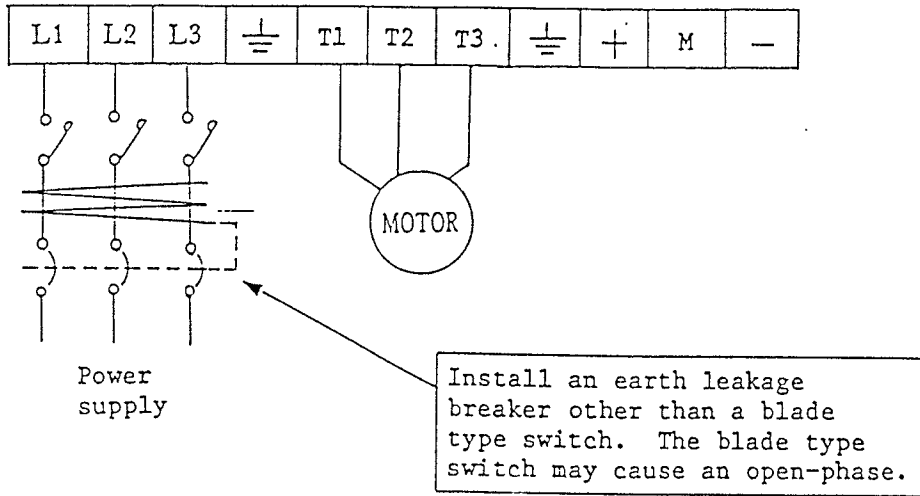


Figure 5-1 Power Line Wiring

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.

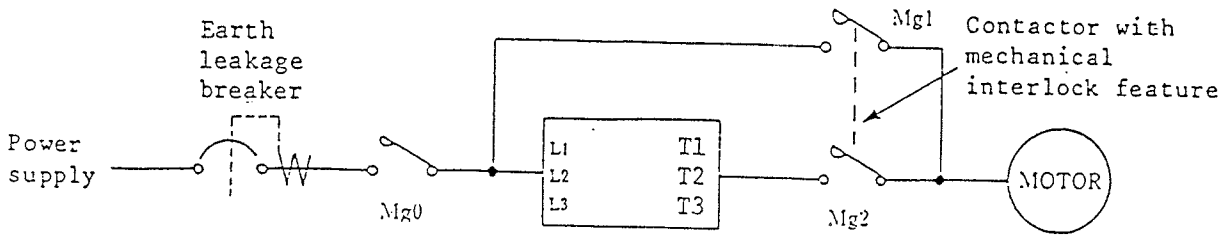


Figure 5-2 Bypass Circuit

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.

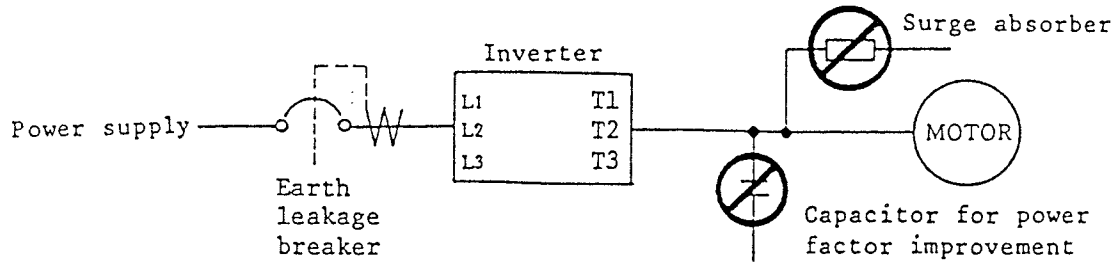
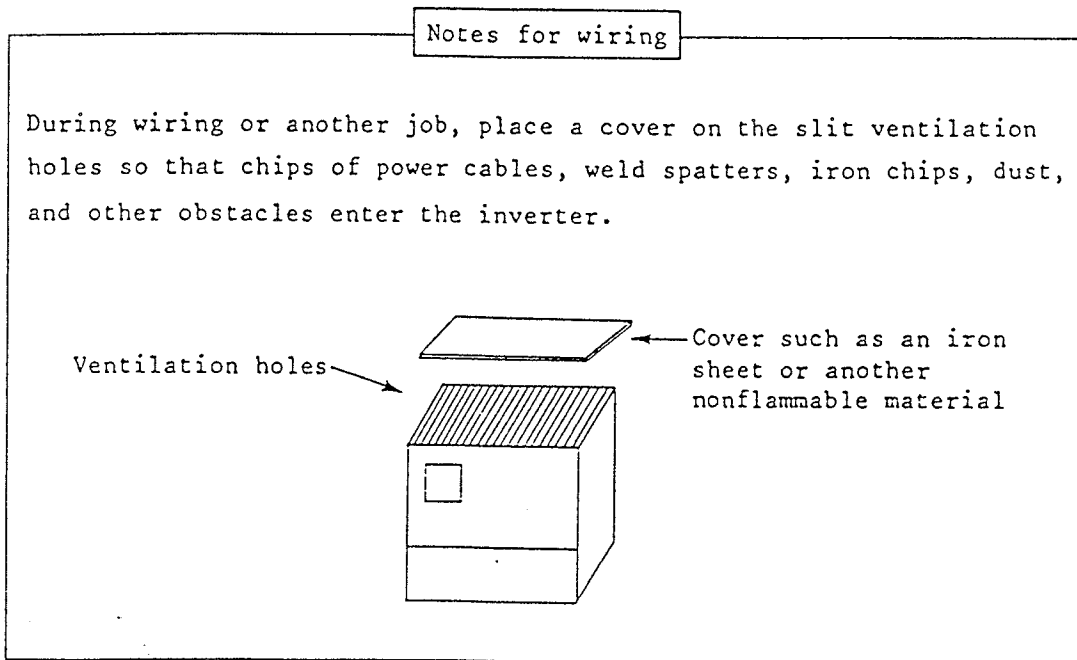


Figure 5-3 Absorber and Capacitor



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.

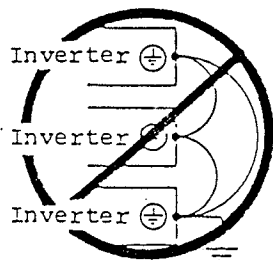


WARNING: To avoid personal injury

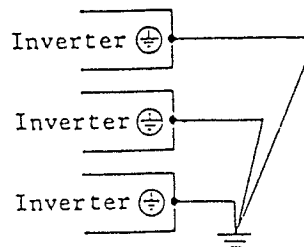
The ground fault protection circuit is not designed to protect personal injury. For protection, install a leak braker type of a high frequency sensitive current.

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.



(a)



(b)

Figure 5-4 Grounding

5.5 Connection of Control Circuit Terminals

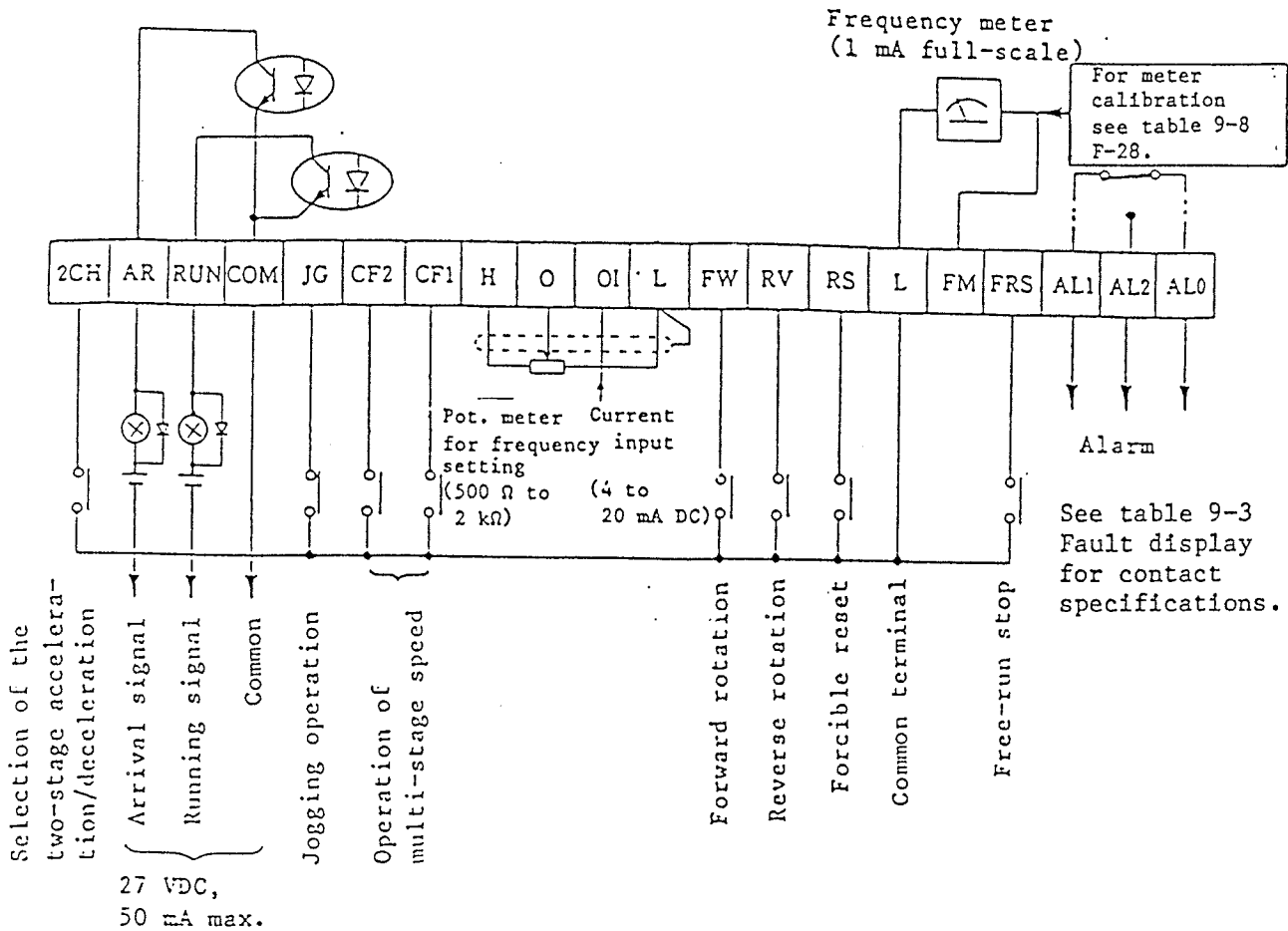


Figure 5-5 Wiring of Control Circuit Terminals

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, attach 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).

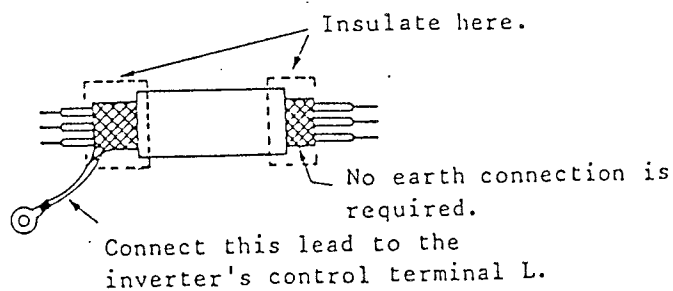


Figure 5-6 Signal Wire Shielding

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.

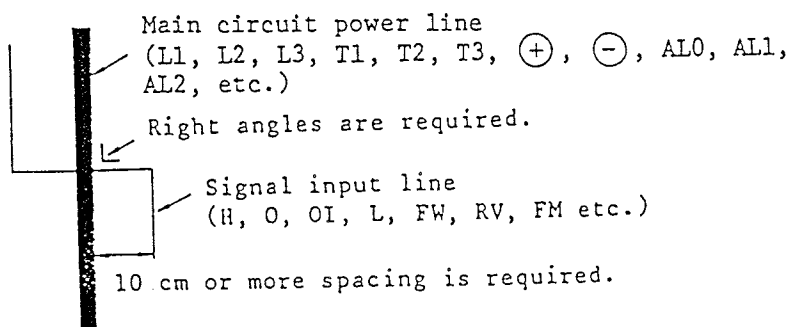




Figure 5-7 Wire Separation



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	Ex-ternal	Digital remote operator	Digital operation panel	Ex-ternal	Digital remote operator		
1	L	/	/	L	/	/	Standard setting	Page 6-6
2	/	L	/	/	L	/		Page 6-7
3	L	/	/	/	L	/		Page 6-8
4	/	L	/	L	/	/		Page 6-9
5	/	/	L *	/	/	L *	Operation by remote operator (option)	
6	/	/	L *	/	L	/		
7	/	L	/	/	/	L *		

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

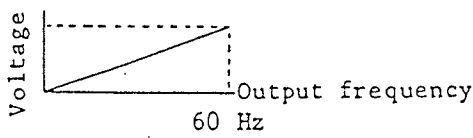
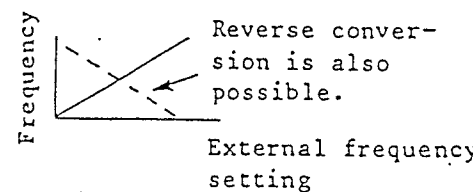
Function	Standard setting	Standard setting display	Setting change
V/F pattern setting (F-00)	<p>Maximum frequency is 60 Hz, constant torque characteristics.</p>  <p>The relation between the reference signal and the output frequency is the following.</p> <p>[In the case of external signal]</p> <p>0 - 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.</p>	VFE-VC 060-060	<p>Set a new value in the function mode (see table 9-8 F-00.)</p> <p>Gain and bias adjustment are possible (see table 9-8 F-26 and 27.)</p>
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)

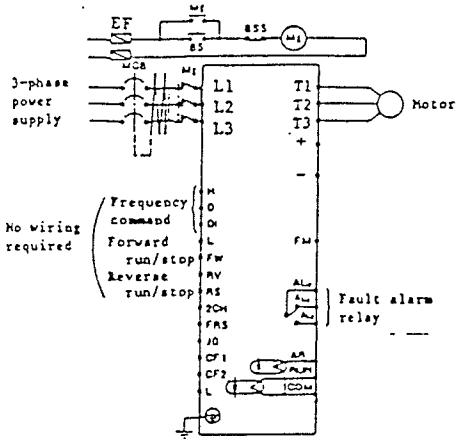
Function	Standard setting	Standard setting display	Setting change
Frequency setting	Set zero (0) Hz on the digital operation panel. (When the frequency is set with control terminals, set the frequency command switch to the terminal side.)	FS 000.0	Set a frequency in the monitor mode (see table 9-3.)
© 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.  External frequency setting 4 - 20 mA 0 - 10 V 0 - 5 V	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 switches can be done by the operation pattern 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		<p>FS 000.0 000.0 Hz Cursor</p> <p>Frequency setting Output frequency</p>	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 ▲ . Move the cursor, using ▶ , and set to Ope.-key using ▼ ▲ .	<p>F-SET-M Terminal</p> <p>F-SET-M Ope.-key Cursor movement</p>	Frequency setting command is selected in digital operation panel.
Selection of operation command method	Press MON or ▲ . Move the cursor, and set to Ope.-key using ▼ ▲ . Press MON to display FS .	<p>F/R-SW Terminal</p> <p>F/R-SW Ope.-key Cursor movement</p> <p>FS000.0 000.0Hz</p>	Operation command is selected in digital operation panel.
Frequency setting	Move the cursor, using ▶ , and set the frequency, using ▲ ▼ .	(Sample setting of 45 Hz) <p>FS 040.0 000.0 Hz FS 045.0 000.0 Hz Cursor</p>	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) <p>FS030.0 F030.0 Hz or R</p>	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



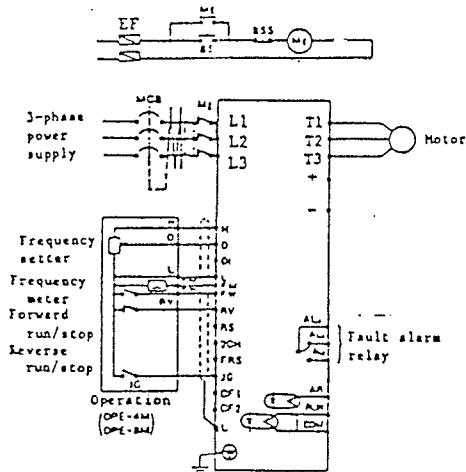
Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, however, it is recommended that Mg be inserted into the input side.

Step	Description
Power ON	After power ON, the previous display (before power off) appears.
Selection of frequency setting mode	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> F S 0 0 0 . 0 0 0 0 . 0 H z </div> Cursor
Frequency setting	The new frequency can be set because the above mode is for frequency setting.
Operation command	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> F S 0 0 0 . 0 0 0 0 . 0 H z </div> Cursor
Acceleration/ deceleration	Move the cursor, using , and input the preset value of frequency with .
Stop	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> F S 0 4 0 . 5 0 0 0 . 0 H z </div> Cursor
	Press for forward operation. Press for reverse operation.
	Move the cursor with , and re-input the preset value of frequency with . When it is entered, acceleration or deceleration are started.
	<ol style="list-style-type: none"> 1. Press . <li style="margin-left: 20px;">When this 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". <li style="margin-left: 20px;">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).



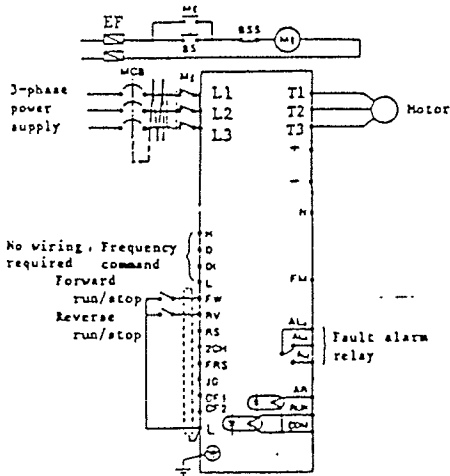
Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, however, it is recommended that Mg be inserted into the input side.

Step	Description
Power ON	After power ON, the previous display (before power off) appears. <div style="border: 1px solid black; padding: 2px; display: inline-block;"> F S 0 0 0 . 0 0 0 0 . 0 H z </div>
Selection of frequency command method	Press MON or ▲ once to select the frequency command method. <div style="border: 1px solid black; padding: 2px; display: inline-block;"> F - S E T - M O p e . - K e y </div> <div style="text-align: center; margin-left: 100px;"> </div>
Selection of operation command method	Adjust the cursor to "0" position with the ▶ key, and press the ▲ key to select the terminal mode. <div style="border: 1px solid black; padding: 2px; display: inline-block;"> F - S E T - M T e r m i n a l </div> Press MON to select the operation command method. <div style="border: 1px solid black; padding: 2px; display: inline-block;"> F / R - S W O p e . - K e y </div>
Operation command	Adjust the cursor to "0" position with the ▶ key, and press ▲ to select the terminal mode. <div style="border: 1px solid black; padding: 2px; display: inline-block;"> F / R - S W T e r m i n a l </div> (FS display) "F" and "R" are displayed, using Forward Operation (FWD) and Reverse Operation (REV) on the operation box respectively.
Frequency setting	Turn the frequency setter on the operation box (OPE) for frequency setting: the motor will be operated. Set the switch (FWD or REV) on the operation box (OPE) to "STOP": the motor will decelerate and stop according to the preset deceleration time. 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.
Stop	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).

Operation pattern 3

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

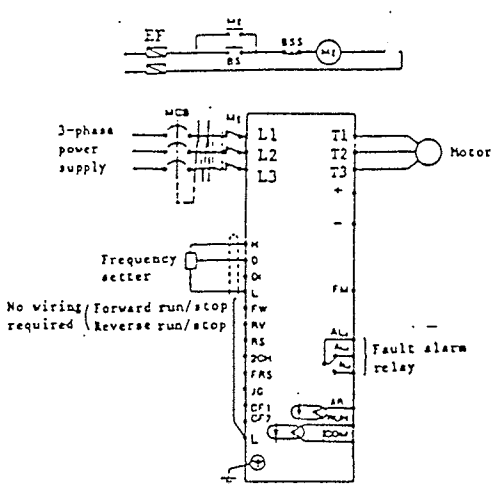
Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, it is recommended that Mg be inserted into the input side.



Step	Description
<p>Power ON</p>	<p>After power ON, the previous display (before power off) appears.</p> <p style="text-align: center;">FS 000.0 000.0 Hz</p>
<p>Selection of operation command method</p>	<p>Press [MON] or [▲] 2 times to select the operation command method.</p> <p style="text-align: center;">F / R - S W O p e . - K e y</p>
<p>Selection of frequency setting mode</p>	<p>Adjust the cursor to "0" position with the [▶] key and select the terminal mode with the [▲] key.</p> <p style="text-align: center;">F / R - S W T e r m i n a l</p> <p style="text-align: center;">└── Cursor movement ─┘</p>
<p>Frequency setting</p>	<p>Press the [MON] or [▼] key any times to select the frequency setting mode.</p> <p style="text-align: center;">F S 0 0 0 . 0 0 0 0 . 0 Hz</p>
<p>Operation command</p>	<p>Move the cursor with the [▶] key and input the preset value of frequency with [▲] and [▼] keys.</p> <p style="text-align: center;">F S 0 4 0 . 5 0 0 0 . 0 Hz</p>
<p>Acceleration/ deceleration</p>	<p>Forward operation is performed with FW-L ON.</p> <p>Reverse operation is performed with RV-L ON.</p>
<p>Stop</p>	<p>Move the cursor with the [▶] key, and re-enter the preset value of frequency.</p> <p>Turn off the control terminals FW-L and RV-L, and the motor will decelerate and stop according to the preset deceleration time.</p> <p>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 P-29 and field ③.)</p>

Operation pattern 4

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



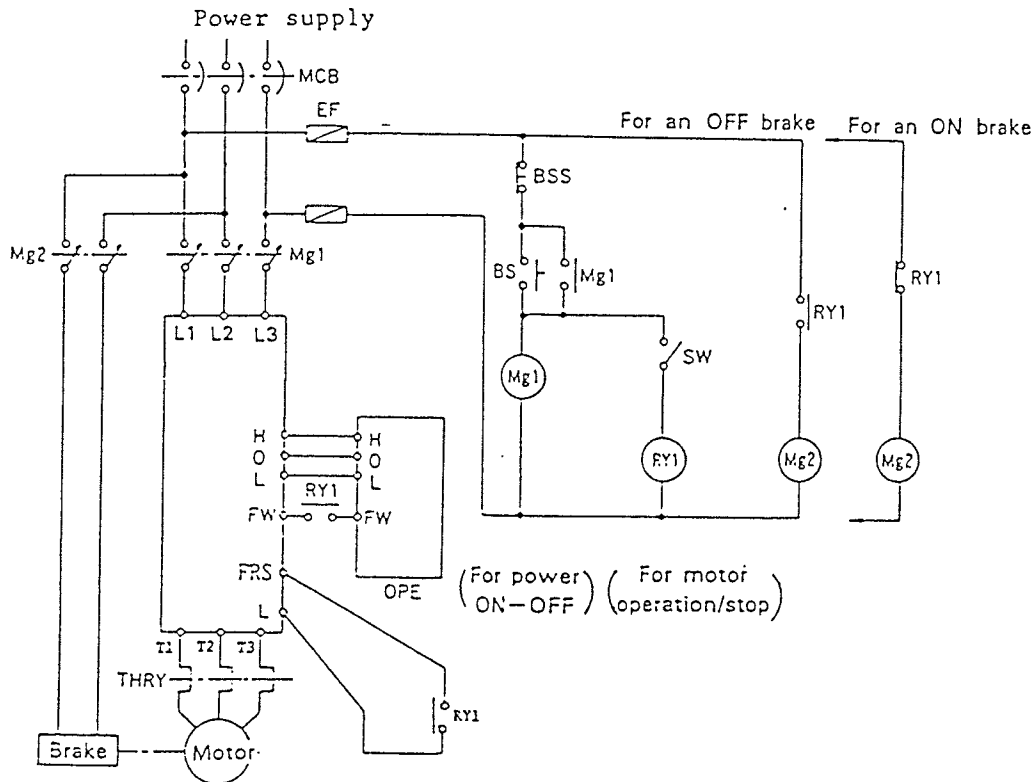
Note 1) If the frequency and operation command are set during power failure, operation will be restarted at power ON. For safety, it is recommended that Mg be inserted into the input side.

Step	Description
<p>Power ON</p>	<p>After power ON, the previous display (before power off) appears.</p> <p style="text-align: center;"> FS 000.0 000.0 Hz </p>
<p>Selection of frequency setting method</p>	<p>Press MON or ▲ once to select the frequency command method.</p> <p style="text-align: center;"> F - S E T - M O p e . - K e y </p>
<p>Operation command</p>	<p>Adjust the cursor to "0" position with the ▶ key, and press the ▲ key to select the terminal mode.</p> <p style="text-align: center;"> F - S E T - M T e r m i n a l </p>
<p>Frequency setting</p>	<p>Return the cursor to the previous position and press MON and ▼ keys any times for FS display.</p> <p style="text-align: center;"> FS 000.0 F 000.0 Hz </p> <p> { For forward operation, press FWD RUN: "F" is displayed. { For reverse operation, press REV RUN: "R" is displayed. </p> <p>(However, since the frequency setting is not entered, no motor can be operated.)</p>
<p>Stop</p>	<p>Input any one of the following:</p> <ul style="list-style-type: none"> • 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. <p>Press the STOP key.</p>

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.



Mechanical brake Soft stop

Motor speed				
SW (Operation/Stop switch)	OFF	ON	OFF	ON
Mg1	OFF	ON	OFF	ON
Mg2 {	For an ON brake	ON	OFF	ON
	For an OFF brake	OFF	ON	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 \oplus and \ominus 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 M Ω 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.

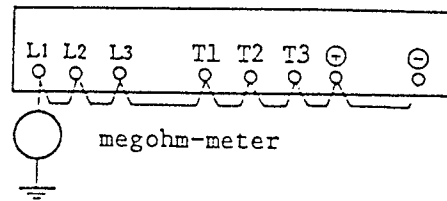


Figure 7-1 Terminal Connection for Insulation Resistance and Withstand Voltage Tests