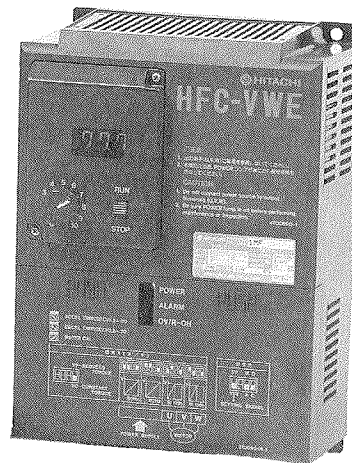


HITACHI INVERTER

HFC-VWE₂ SERIES

INSTRUCTION MANUAL

Single-phase input 200V class



Thank you very much for purchasing the Hitachi HFC-VWE2 series inverter.

This instruction manual is intended for use by the operator of the Hitachi inverter. It describes how to install, handle, and maintain the inverter.

Before starting operation, read this instruction manual carefully for installation, maintenance, and inspection.

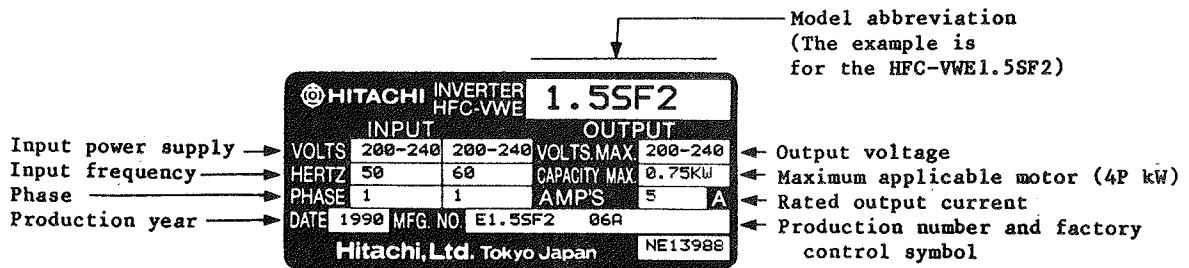
After reading this manual, keep it at hand for future reference.

N B 4 4 5

1. INSPECTION UPON UNPACKING

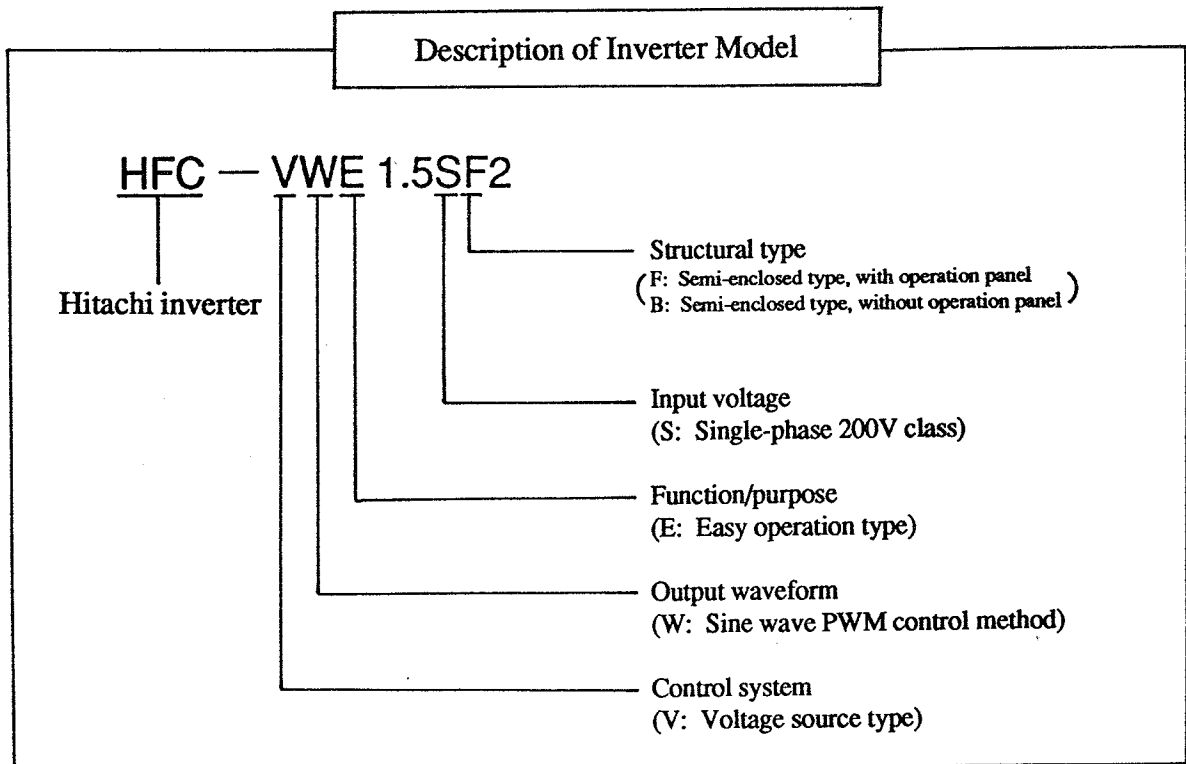
Before installation and wiring, be sure to check the following:

- (1) Make sure that there is no damage from transporting the unit.
- (2) After unpacking the unit, make sure that the package contains one inverter and one operation manual
- (3) Make sure that the product is the one you ordered by checking the specifications label on the front of the cover.



Contents of Specifications Label

If you discover any problems, contact your sales agent immediately.



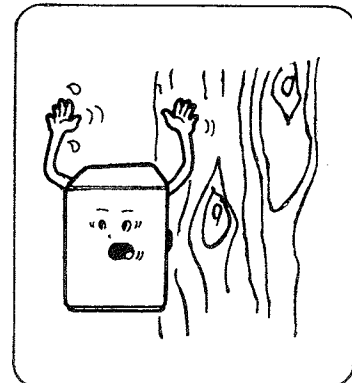
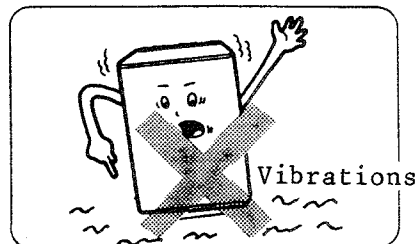
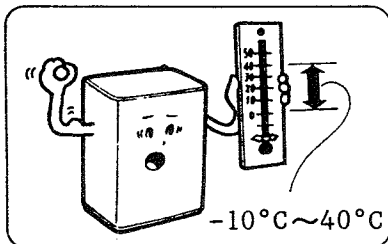
2. SAFETY PRECAUTIONS

2.1 Input voltage

- (1) Make sure that the input voltage is:
Single-phase 200 to 240 V, 50 Hz/60 Hz
- (2) Be sure to install a circuit breaker to protect the wiring.

2.2 Installation locations and surfaces

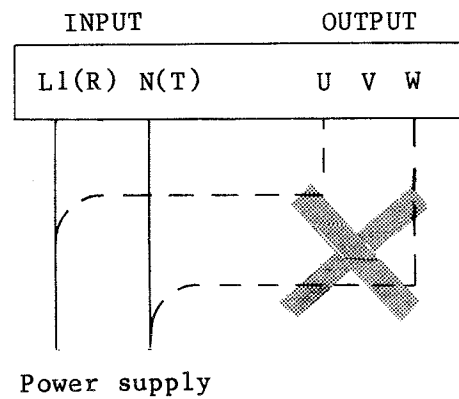
- (1) Avoid installing this unit in locations which are subjected to high temperatures, high humidity, and dew condensation. Also avoid locations exposed to dust and dirt, corrosive gases, coolant mist. The installation location should be a well-ventilated room which is not exposed to direct sunlight.
- (2) Be sure to install the unit on a perpendicular wall which is not subjected to vibrations.
- (3) The installation wall should be made of steel sheeting or other nonflammable material.



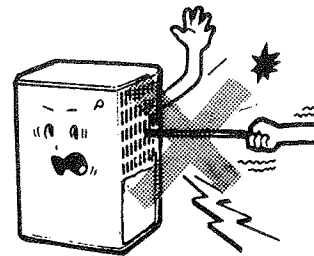
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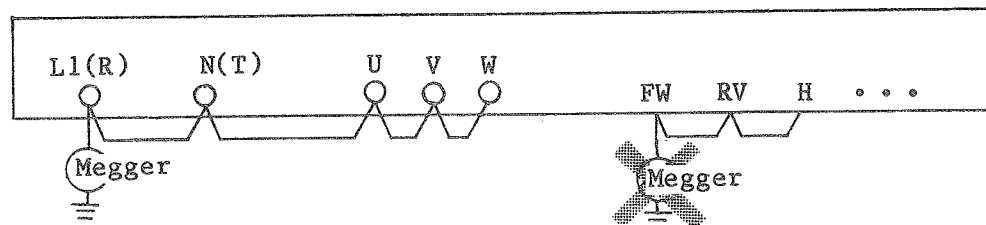
- 2.3 Do not connect the power supply to the output, this wrong connection damages the inverter.



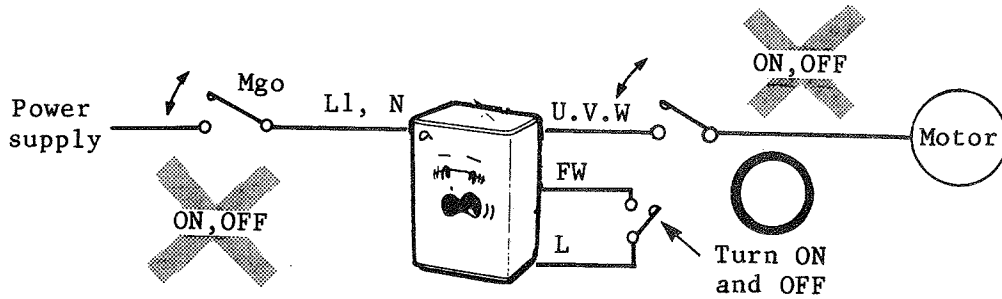
- 2.4 Do not touch the interior of the inverter or put rods or other objects inside it when power is being applied. Such action can lead to electrocution and can cause malfunctions.



- 2.5 When operating a general-purpose motor at a high frequency exceeding 60 Hz, be sure to confirm the allowed rotational speed of the motor and machine with the manufacturers.
- 2.6 Withstand voltage tests and insulation resistance tests (megger tests) are executed before the units are shipped, so that there is no need to conduct these tests before operation.
When conducting megger tests as a part of daily inspection, be sure that these tests are only executed between the main circuit and grounding. Do not execute megger tests on the control circuit.

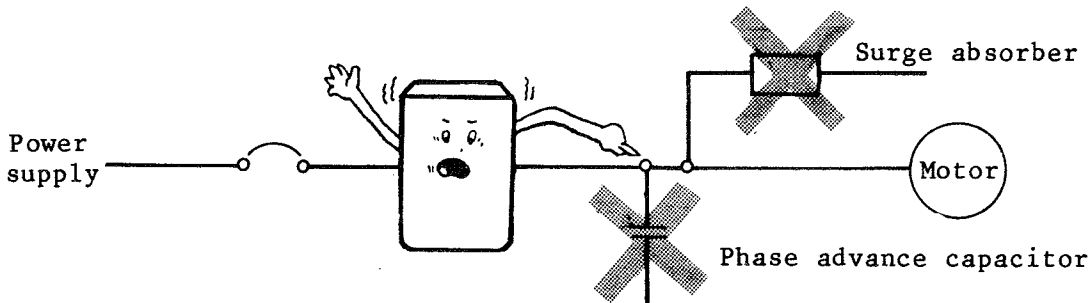



- 2.7 Do not attach or remove wiring and connectors when power is being applied. Also, do not check signals during operation.
- 2.8 Do not stop operation by turning on and off the electromagnetic contactors on the primary and secondary sides of the inverter.



Even if there is a short power failure, if an operation instruction has been given, then the unit may restart operation after the power failure has ended. If there is a possibility that such occurrences may harm humans, then install an electromagnetic contactor (Mgo) on the power supply side, so that the circuit does not allow automatic restarting after the power supply recovers. If the optional remote operator is used and the retry function has been selected, this will also cause automatic restarting if an operation instruction has been input, so please be careful.

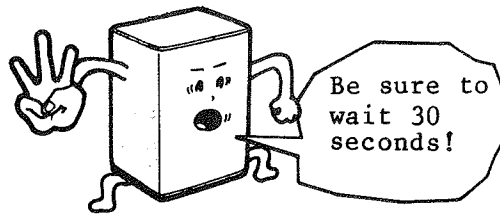
- 2.9 Do not insert phase advance capacitors or surge absorbers between the output terminals of the inverter and the motor.



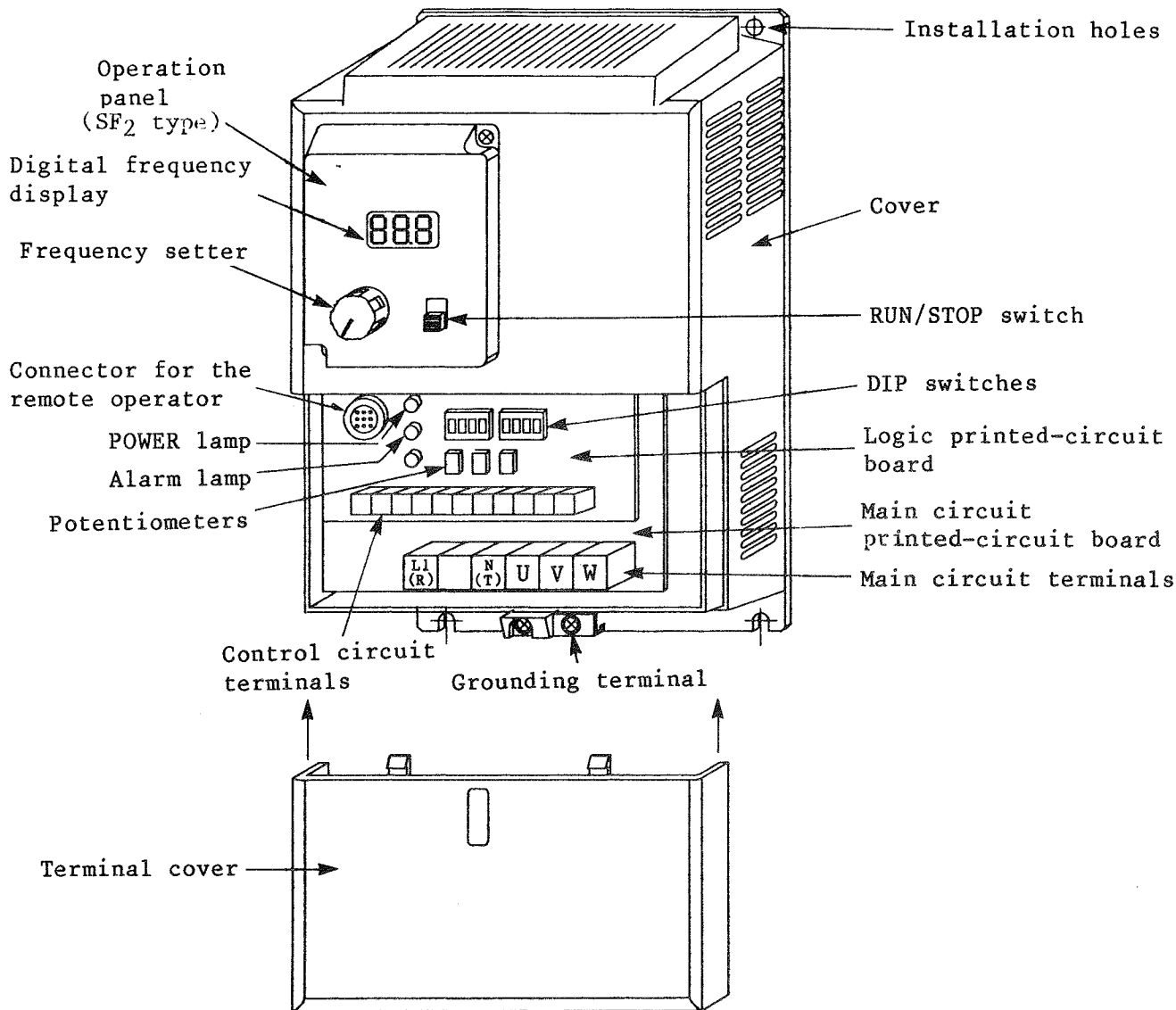
2.10 Be sure to ground any grounding terminals .

2.11 When inspecting the unit, be sure to wait for 30 seconds after turning the power supply off before opening the cover.

(The internal capacitor will have residual voltage which is dangerous.)



3. APPEARANCE AND NAMES OF PARTS



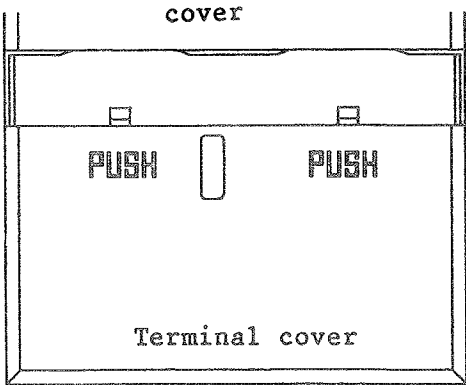
Removing and reattaching the terminal cover

Removal

Push the marks of **PUSH** on the terminal cover, and then slide it downward.

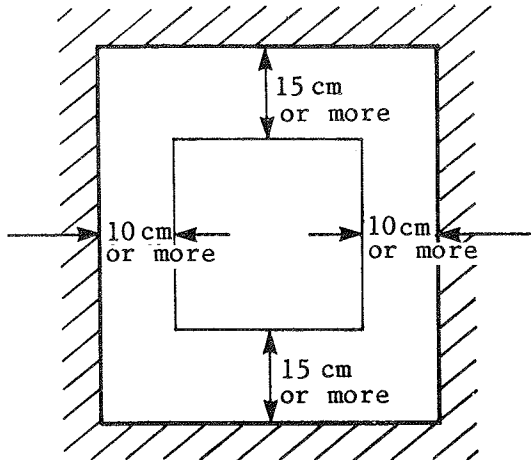
Reattachment

Put and slide the terminal cover upward.

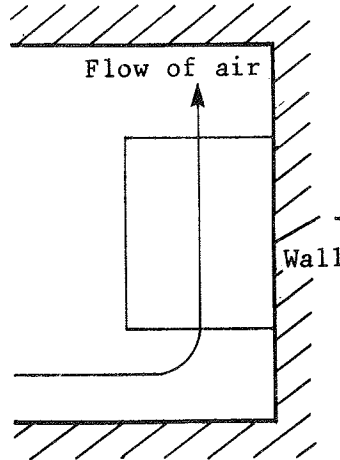


4. INSTALLATION

For cooling purposes, be sure that the inverter is installed vertically. In addition, be sure that it is separated from other components and walls. If foreign matter is introduced to the interior of the inverter, this may cause malfunctions, so make sure that no foreign matter can enter it.



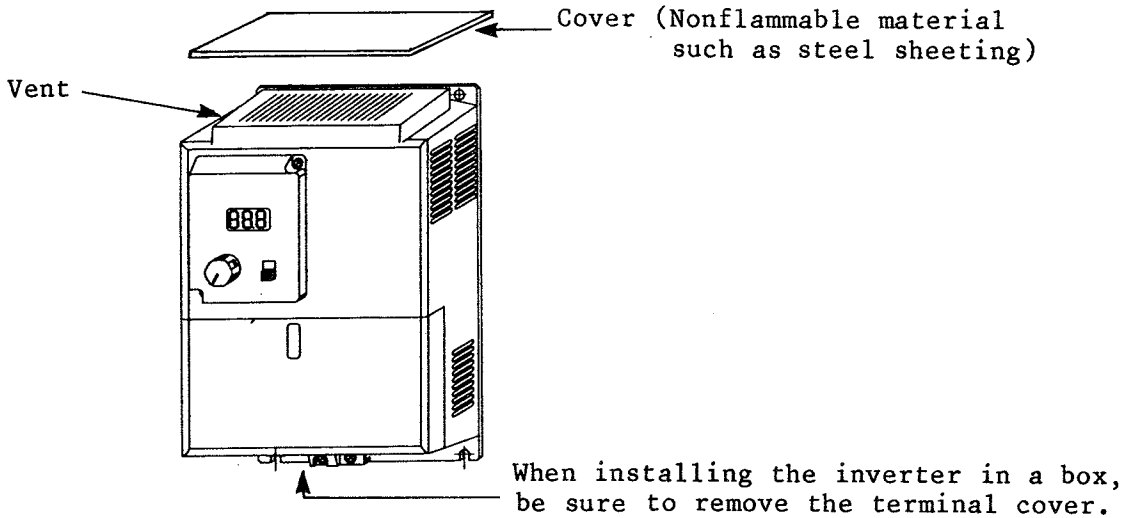
(a)



(b)

Be sure that the wall surface is a nonflammable material, such as steel sheeting.

At wiring work or other work, do not enter the wire scraps, welding fragment, iron scraps, dust, etc. into the inverter, so be sure to cover the top of the inverter with a cover or others before working.



Be sure to note the ambient temperature (-10 to 40 °C).
(Up to 50 °C with the terminal cover removed.)

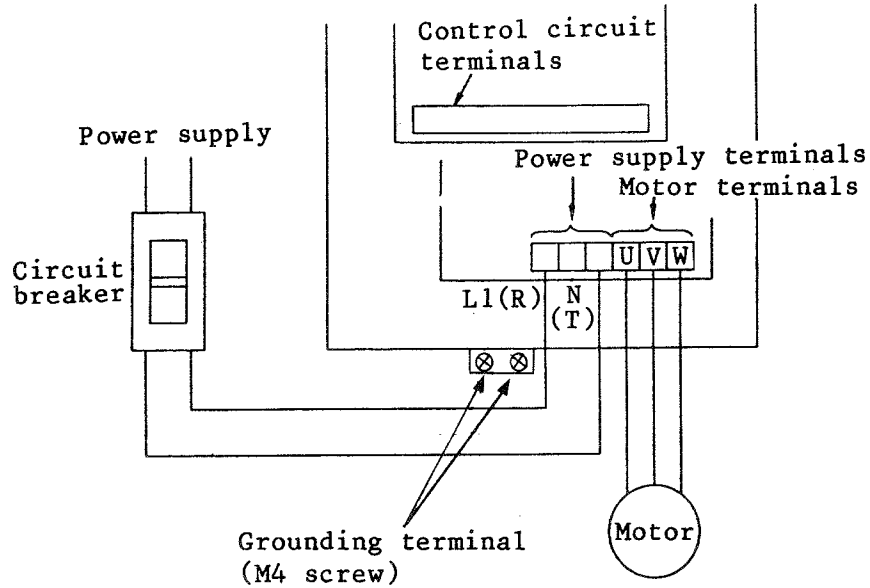
The higher the ambient temperature of the inverter, the shorter its usable life will be. If there is a heat generating unit near the inverter, try to keep it as far away as possible. Also, when installing the inverter in a box, be sure to carefully consider ventilation and the dimensions.

Inverter losses: 5% of the nominal power of the inverter

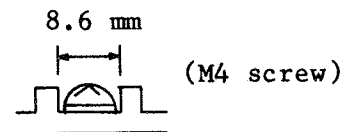
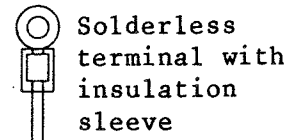
5. WIRING

The terminal board will be exposed when the terminal cover is removed. Wire the inverter in this state.

5.1 Wiring the power supply and motor



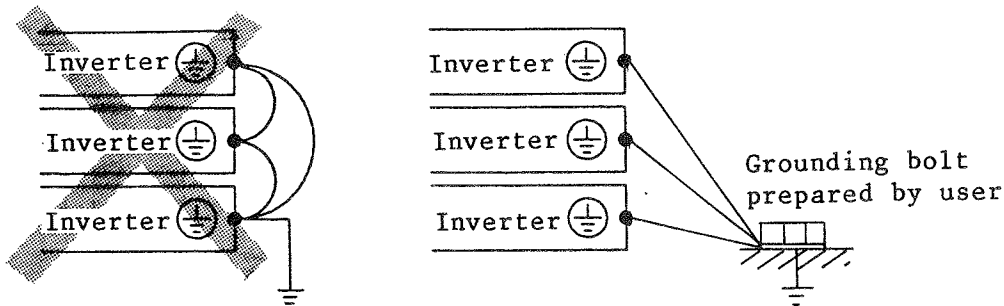
- The inverter will be damaged if the power supply is connected to the motor terminals U, V and W, so be sure not to make any mistakes.
- Because the terminals L1, N, U, V and W are very close to one another, be sure to cover the solderless terminals with insulation sleeve.
- If multiple motors are to be connected, be sure to attach thermal relays to each motor.



Note 1: The inverter does not have any facilities to protect humans from leak. If necessary, install a leak circuit breaker. (Select a circuit breaker with a large high frequency sensitivity current.)

Note 2: Be sure that the specified grounding is executed. Be sure to separate the grounding pole from those of other heavy electric machinery, and avoid using common grounding poles.

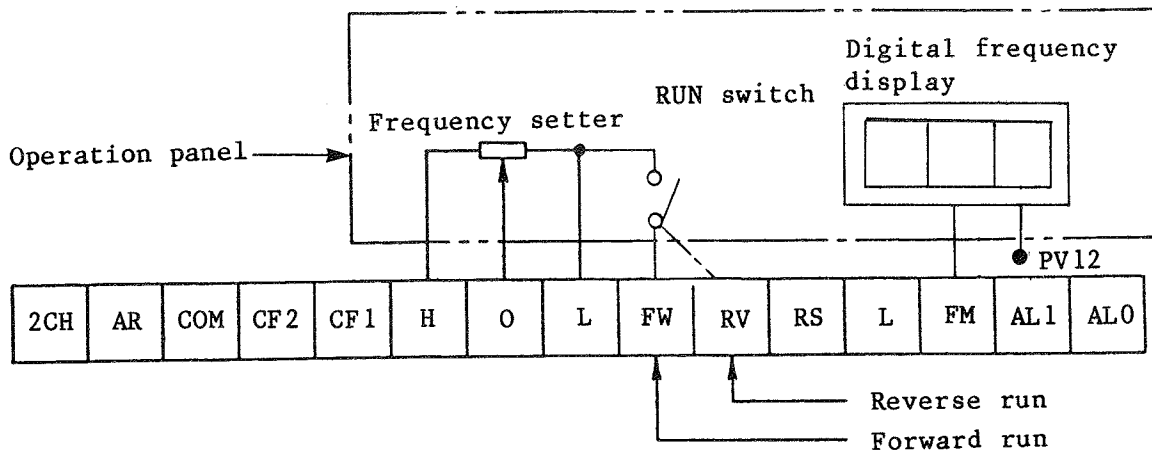
If multiple inverters are used, make sure that the grounding connections do not create a loop.



5.2 Control circuit terminal wiring

Inverter (SF2 type) provided with operation panel

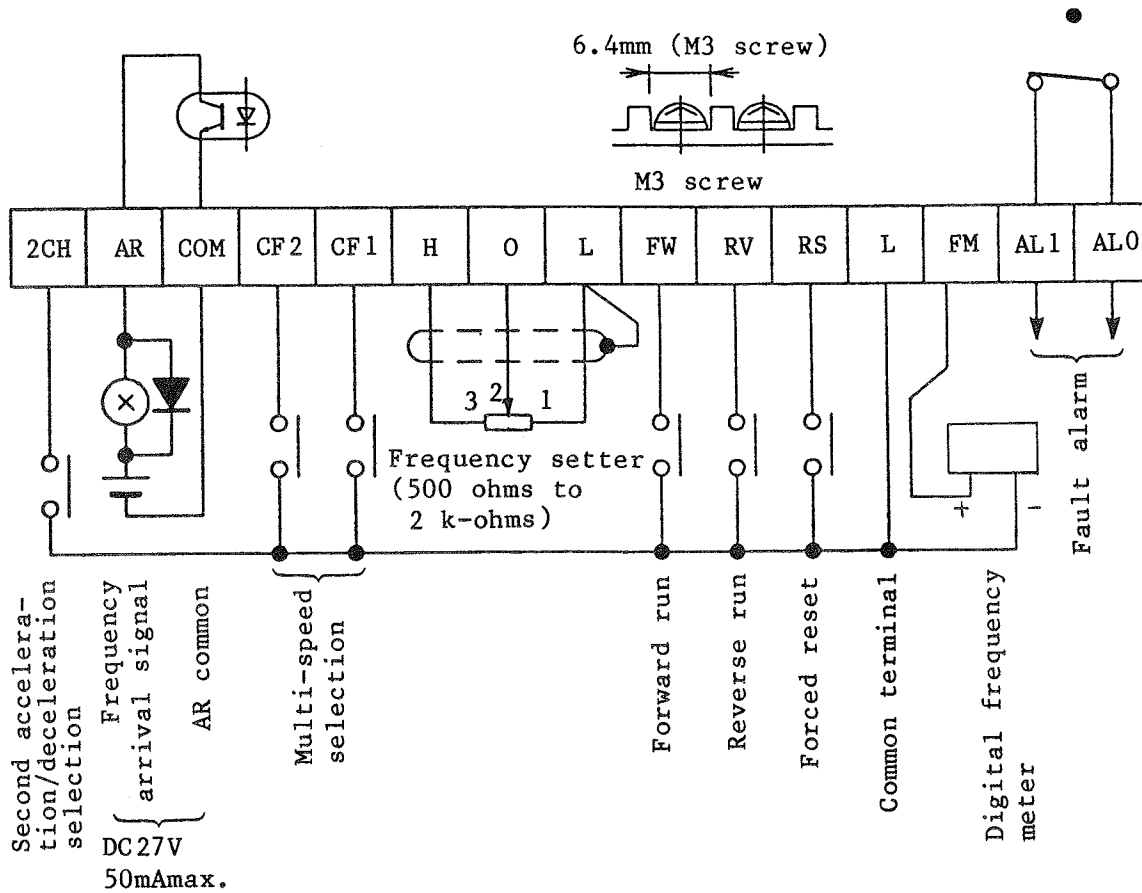
RUN switch is connected to forward run terminal (FW). To change it to reverse run, change the wire from FW to RV terminal.



Note 1: Do not connect an external frequency setter. Inverter may be damaged by the connection.

Note 2: If the frequency is set by an external signal, remove the wiring of O terminal and insulate the removed wire.

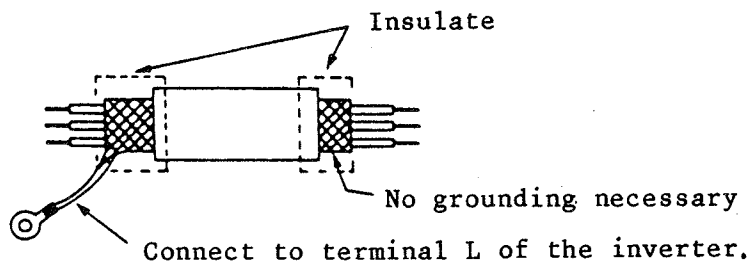
Inverter (SB2 type) without operation panel



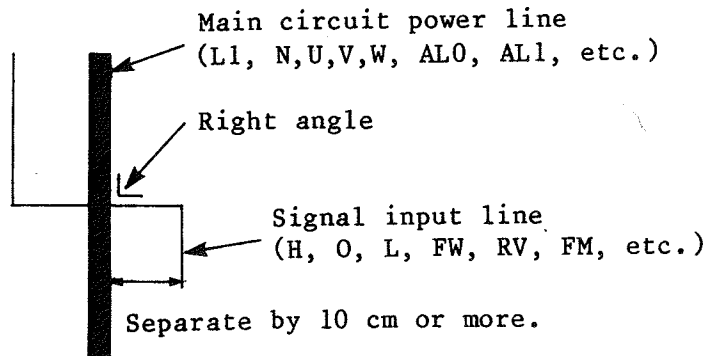
- Attach a surge absorbing diode in parallel to the relay
- The fault alarm is ON under normal conditions, and OFF under abnormal conditions. (OFF when the power supply is off.)

Note 1: When a frequency arrival signal is used, be sure to install a surge absorbing diode in parallel with the relay. Otherwise, the surge voltage created when the relay goes ON and OFF may damage the AR output circuit.

Note 2: Use a twisted and shielded wire for the signal line, and cut the shielded covering as shown in the diagram below. Make sure that the length of the signal line is 20 meters or less. If the line must be longer than 20 meters, please use the VX application control device RCD-A (remote control device) or CVD-E (insulated signal converter).



- Note 3: When the frequency setting signal is turned on and off with a contact, use a relay which will not cause contact malfunctions, even with the extremely weak currents and voltages of crossbar twin contacts, etc.
- Note 4: Use relays which do not cause contact defects at DC 12V, 3 mA for the other terminals.
- Note 5: Separate the main circuit wiring from the relay control circuit wiring. If they must cross, be sure that they cross at a right angle.



Note 6: Terminal 2CH, AR, CF1 and CF2 are described below.

Terminal	Terminal function	Factory setting
2CH	When 2CH-L is turned ON, the preset second acceleration/deceleration time will be used. When 2CH-L is not ON, this time will depend on the potentiometer adjustment on the printed circuit board.	Acceleration/deceleration 1 second
AR	When the set frequency is attained, AR-COM will go to the low level.	When the setting is attained this goes ON. ON: Setting ± 0.5 Hz OFF: Setting ± 1.5 Hz
CF1 CF2	CF1-L ON: First speed CF2-L ON: Second speed CF1/CF2-L simultaneously ON: Third speed	First speed: 5 Hz Second speed: 20 Hz Third speed: 40 Hz

The remote operator (optional) can be used to change a setting.

5.3 Wiring equipment

Maximum motor size (4P, kW)	Inverter model	Wiring			Applicable equipment	
		Power lines L1, N, U, V, W	Signal lines 2CH,AR,COM, RS,FM,CF2, CF1,H,O,L, FW,RV	Control lines AL0,AL1	Circuit breaker (MCB)	Electro-magnetic contactor (Mg)
0.4 kW	VWE1SF2 (SB2)	2 mm ² or greater. The longer the wiring distance, the thicker this line should be.	0.75 mm ² or greater. Twisted, shielded wire.	2 mm ² or greater.	F30B (10 A)	H10C
0.75 kW	VWE1.5SF2 (SB2)				F30B (15 A)	H20
1.5 kW	VWE2.5SF2 (SB2)				F30B (20 A)	

Note 1: The applicable equipment shown is for a Hitachi standard four-pole squirrel-cage motor.

Note 2: Be sure to consider the capacity of the circuit breaker to be used.

Note 3: The leakage current per inverter is approximately 3 mA. (This does not include wiring.)

Note 4: When used at 20 Hz or greater to 60 Hz or less with a standard motor (Hitachi standard four-pole squirrel-cage motor), a thermal relay is not necessary.

Note 5: Be sure to consider the power supply and wiring systems when selecting the circuit breaking capacity.

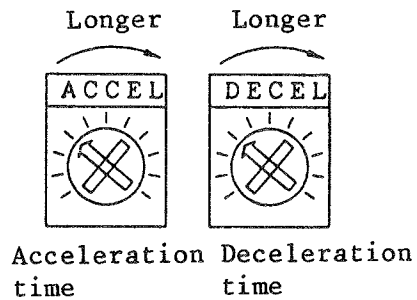
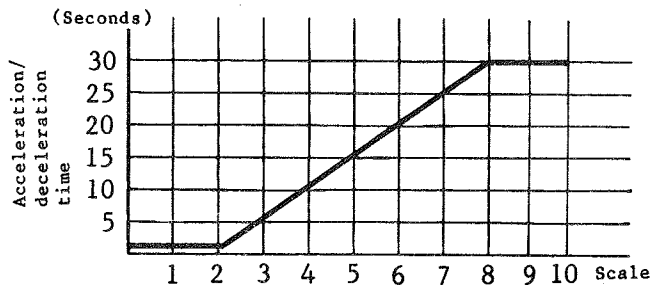
Note 6: Be sure to use a grounding wire which is the same diameter as the power line.

6. ADJUSTMENTS AND SETTINGS

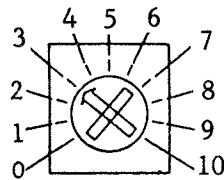
6.1 Adjusting acceleration/deceleration time

Acceleration/deceleration time from minimum to maximum frequency is adjusted with the potentiometers on the printed circuit board.

[Approximately 5 seconds when the unit is shipped from the factory; 3 on the scale.]



Adjustment range: 0.2 to 30 seconds



Shows an example of 3 on the scale.

6.2 Setting the V/F pattern (maximum frequency)

The V/F pattern is set with DIP switch DS1.

DS1 (V/F)

When shipped from the factory, the unit is set to rated torque characteristics at a maximum frequency of 60 Hz.

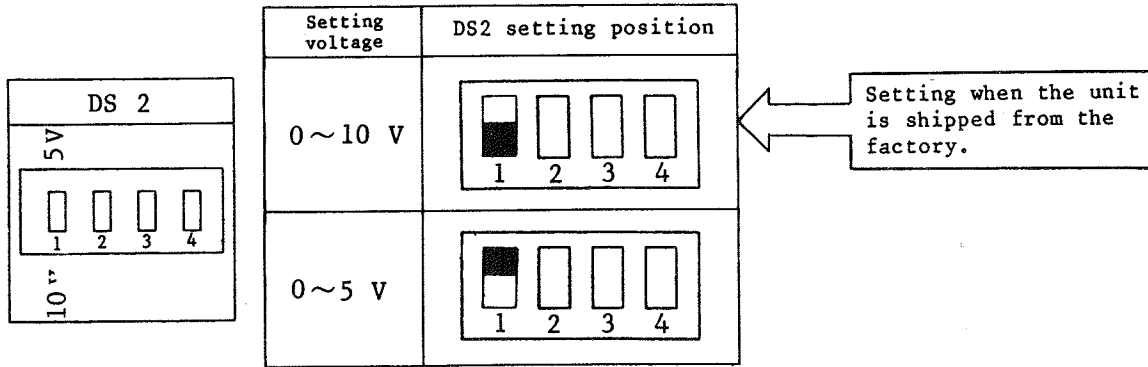
Maximum output frequency	setting of DS1 (V/F)	V/F pattern	
50			Constant torque characteristics (VC)
60			
100			
120			
* 50			Reduced torque characteristics (VP)
* 60			
* 100			
* 120			

* When reduced characteristics are necessary, set switch 4 of DS1 (V/F) to the VP side.

Note:
Do not change the DIP switches during operation.

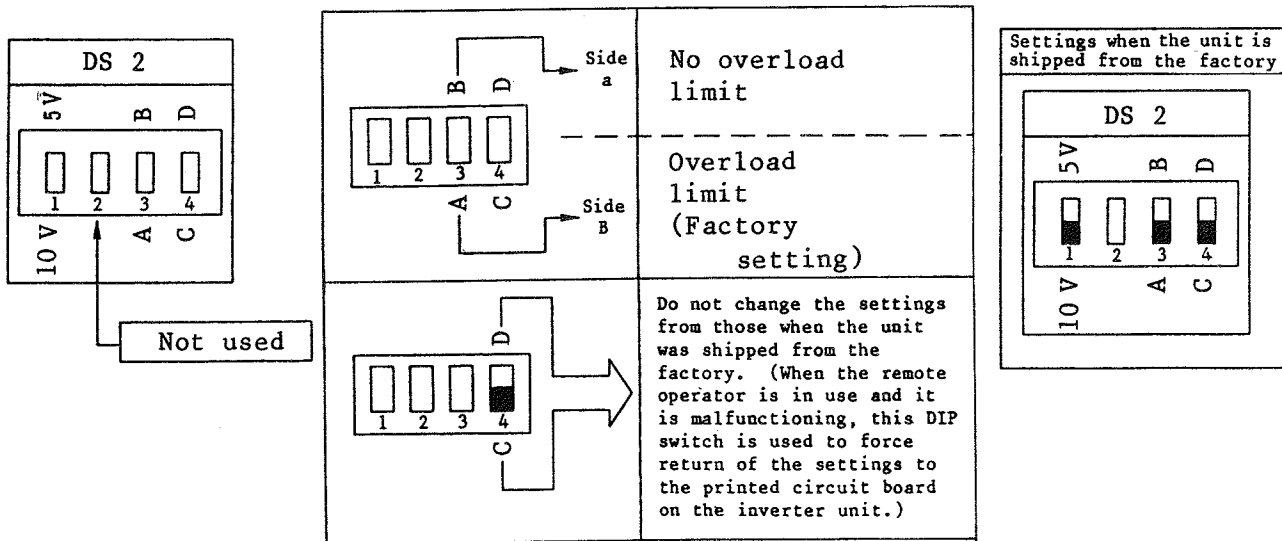
6.3 Frequency reference signal

DIP switch DS2 can be used to switch the frequency setting voltage between 0 to 5 V and 0 to 10 V.



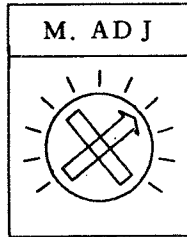
6.4 DS2 and other settings

In addition to the settings described in section 6.3, DIP switch DS2 can be used to set the following.



6.5 Adjusting monitoring frequency (potentiometer M.ADJ)

When the frequency monitor signal is changed from for the digital frequency meter to for the analog frequency meter by the optional remote operator, this can adjust the analog frequency meter connected between terminals FM-L.

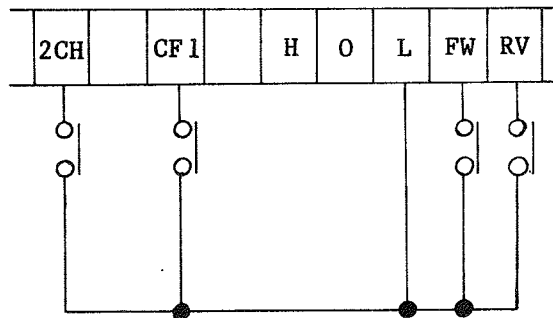


Turning the potentiometer clockwise will cause the frequency meter to move drastically.

When shipped from the factory, the 1 mA 10 V full-scale (even scale) frequency meter is adjusted to indicate the maximum value.

Note 1: Because the signal between FM-L is duty controlled by a pulse signal, the indicated value may vary slightly depending on the type of meter or the wiring distance.

6.6 Jogging Operation

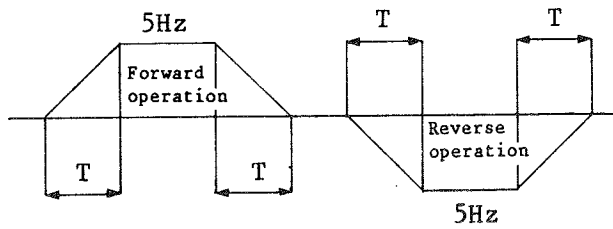


After 2CH-L and CF1 are on, FW-L or RV-L will cause operation.

Standard setting when shipped from the factory.

First speed: 5 Hz

First speed (CF1) is used as the jogging frequency.

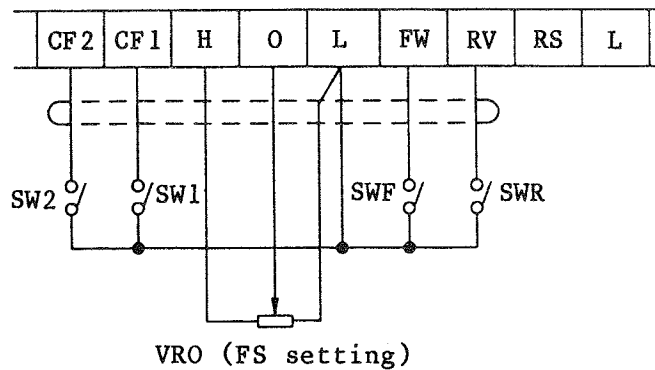


Time T will change according to the selection of the maximum frequency.

Maximum frequency (Hz)	50, 60	100, 120
Time T (seconds)	Approximately 0.1	Approximately 0.05

- When FW(RV)-L is OFF, the motor will not go to free running.
- The remote operator is necessary to change time T and the jogging frequency 5 Hz.

6.7 Multi-speed operation



Standard setting when shipped from the factory.

First speed: 5 Hz
 Second speed: 20 Hz
 Third speed: 40 Hz

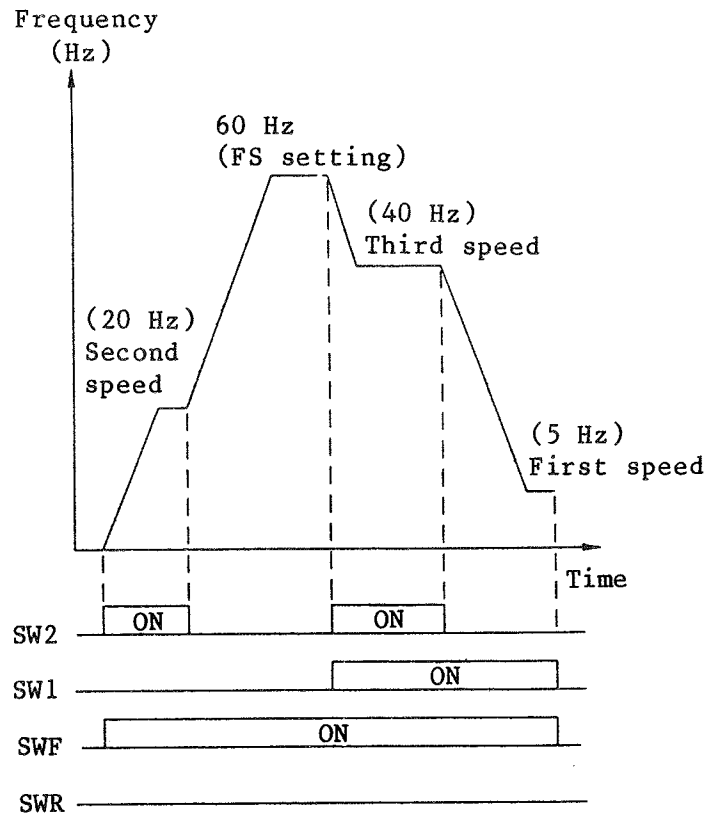
First speed: SW1 ON

Second speed: SW2 ON

Third speed: SW1/SW2 ON simultaneously

FS setting: Arbitrarily set by VRO

The remote operator is necessary to change first, second and third speeds.



6.8 Making settings with the remote operator (optional)

Even more functions can be set by using the remote operator or copy unit. If this is necessary, see item 12. (The list of functions is shown.)

7. OPERATION

7.1 Before starting operation

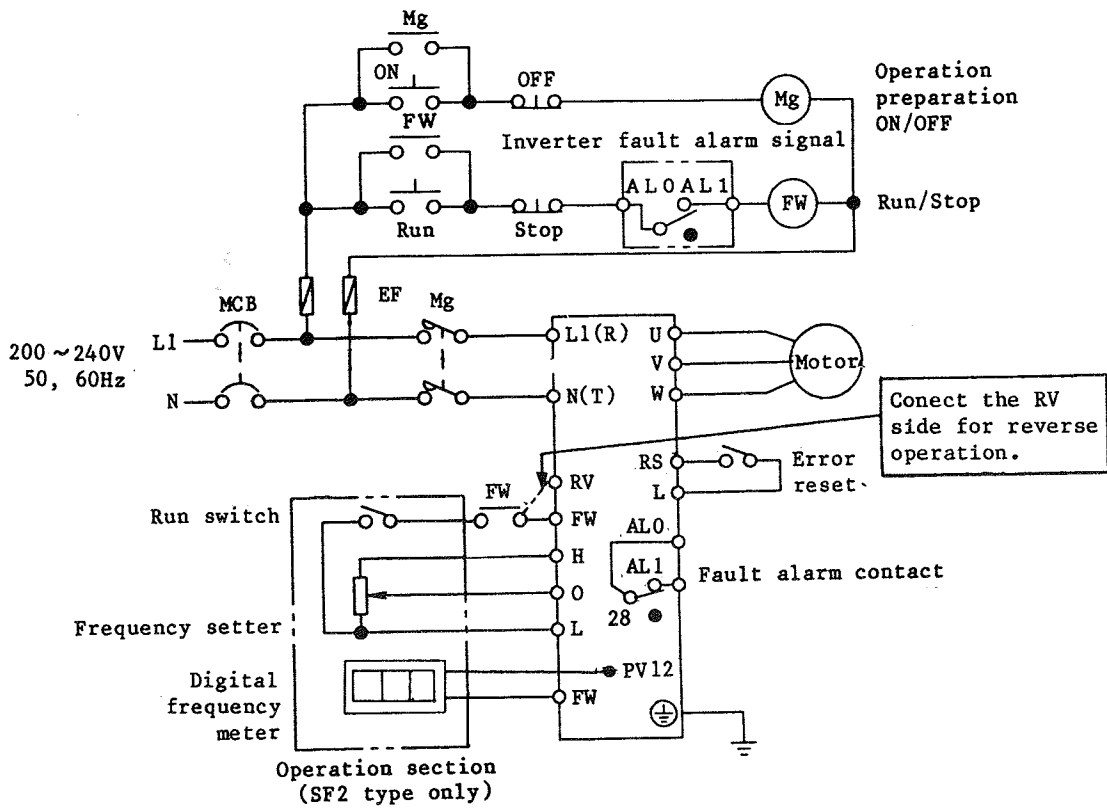
Prior to the test run, check the following.

- (1) Make sure that the power lines (input power supply L1, and N, and output terminals U, V and W) are connected correctly.
- (2) Make sure that there are no mistakes in the signal line connections.
- (3) Make sure that the inverter case grounding terminal (\oplus) is grounded.
- (4) Make sure that terminals, other than the grounding terminal, are not grounded.
- (5) Make sure that the inverter is installed on a wall. Also, make sure that the wall surface is a nonflammable material, such as steel sheeting.
- (6) Make sure that there are no short-circuits caused by stray pieces of wire, solderless terminals or other objects left from wiring work. Also, make sure that no tools have been left behind.
- (7) Make sure that there are no short-circuits or ground-faults in the output wiring.
- (8) Make sure that there are no loose screws or terminals.
- (9) Make sure that the maximum frequency setting matches the machine specifications.

Be sure to refer to page 30 when conducting insulation resistance tests and withstand voltage tests. Never test terminals other than those which are indicated.

7.2 Test run

An example of a general connection diagram is shown below.

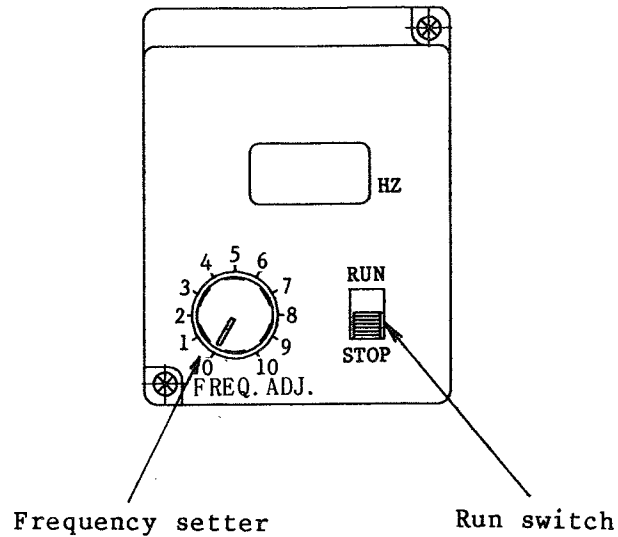


Note 1: Do not stop operation with Mg repeatedly, but with the run switch.

Note 2: When the operation is normal, the relay contact between AL0 and AL1 will be closed.

[Procedure]

- (1) Turn ON MCB and Mg to turn on the power supply of the inverter. Make sure that the **POWER** LED on the printed-circuit board goes ON.
- (2) Turn the run switch on the operation section to **RUN**.
- (3) Slowly turn the frequency setter (FREQ. ADJ.) clockwise, then confirm the output frequency and direction of rotation.
- (4) If the frequency setter is turned counterclockwise or the run switch is turned **STOP** during operation, the motor will decelerate and stop.
 - When the frequency setter is turned counterclockwise as far as it will go, and the frequency goes to 0.5 Hz or less, the motor will go to free running and stop.
 - When the frequency setter is left at its operational setting and the run switch is turned **STOP**, when the frequency becomes 0.5 Hz or less, braking will be activated for about one second, and the motor will stop.



Operation panel

Check the following after the test run is complete.

- Was the rotational direction of the motor correct?
- Was the inverter tripped during acceleration or deceleration?
- Were the rotational speed and frequency meter correct?
- Were there any abnormal motor vibrations or noise?

When overcurrent tripping or overvoltage tripping occur during the test run, increase the acceleration time or deceleration time.

Note that when forward and reverse operation are ON at the same time, that the unit will stop.


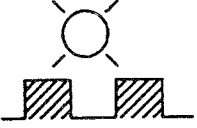

When shipping from the factory:

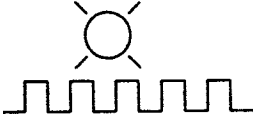
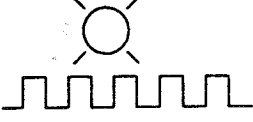
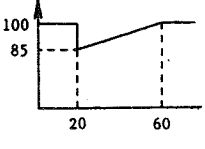
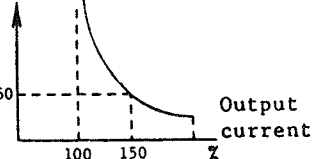
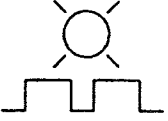
Maximum frequency: 60 Hz
Forward operation (SF2 type only)

8. PROTECTION FUNCTION

In order to protect the inverter there are various protection functions for overcurrents, overvoltages, undervoltages, etc.

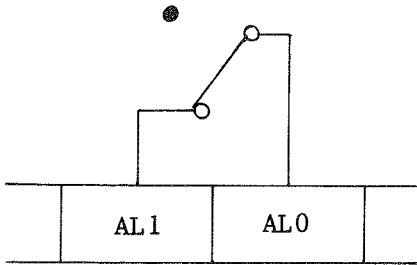
When these functions are activated, the inverter output is cut off, and the motor will run freely. In addition, these conditions are maintained until forced resetting is executed.

Protection name	Display	Content	Remarks
Over-current	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">ALARM</div>  <p>Continuously ON</p> </div>	<p>A large current has flowed through the inverter.</p> <ul style="list-style-type: none"> . Short-circuit or ground-fault on the output side. . Motor shaft has locked. . Acceleration or deceleration time is too short. . The input or output contactor has been turned ON/OFF. 	<p>By using the remote operator (optional), overcurrents during acceleration, deceleration and operation can be identified separately.</p> <p>Ground fault damages the inverter.</p>
Over-voltage	<div style="text-align: center;"> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">ALARM</div>  <p>ON: 5 seconds OFF: 5 seconds</p> <div style="border: 1px solid black; padding: 2px; width: fit-content; margin: 0 auto;">OV R-OH</div>  <p>Continuously ON</p> </div>	<p>Regenerative energy from the motor has caused the voltage of the DC bus intermediate circuit to increase.</p> <ul style="list-style-type: none"> . Acceleration/deceleration time is too short. . Input line voltage is too high. . Load GD^2 is too large. . Overhauling load. . A run signal has been sent while the motor was running freely. . There are any large sources of electrical noise. (During CPU errors) 	<p>Sometimes during deceleration an overvoltage and overcurrent will be generated at the same time. In such cases, the ALARM LED may be on continuously. When the power supply is turned on when the unit is in the reset signal input (RS-L: closed) state, OV/R-OH will light. In this case, release reset. When there is a CPU error, OV/R-OH will go out.</p>

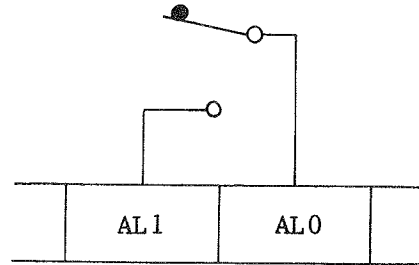
Protection name	Display	Content	Remarks
Under-voltage	<p style="text-align: center;">ALARM</p>  <p>ON: 1.5 seconds OFF: 1.5 seconds</p>	<p>Low input line voltage</p> <ul style="list-style-type: none"> . The incoming line voltage is too low. . Momentary power failure or voltage fluctuation. . There are any loose or disconnected terminals. 	
Overload	<p style="text-align: center;">ALARM</p>  <p>ON: 0.3 seconds OFF: 0.3 seconds</p>	<p>An overload current flowed through the inverter output for a certain amount of time.</p> <ul style="list-style-type: none"> . Motor overload by the driven equipment . Over motor rating vs output current rating of inverter. 	<p>Electronic thermal characteristics (Note 1)</p> <p>Output current (%)</p>  <p>Electronic thermal-to-frequency characteristics</p> <p>Time (seconds)</p>  <p>When shipped from the factory, the electronic terminal characteristics are set to a level of: Rated output current of inverter x 0.9.</p>
Storage element error	<p style="text-align: center;">ALARM</p>  <p>ON: 5 seconds OFF: 0.3 seconds</p>	<p>End of the life of the data storage element has been reached.</p>	<p>Replace defective inverter.</p>

Note 1: When you wish to change this with the current value of the motor, or when you wish to change the electronic thermal-to-frequency characteristics to constant torque, the changes must be made with the optional remote operator.

- When an fault is generated, alarm signal will be output to terminals AL0 and AL1.



Normal power-on status

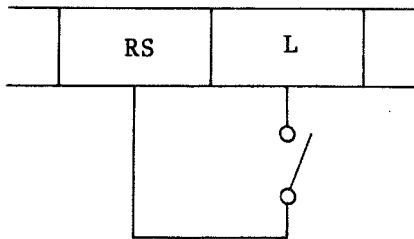


Alarm signal output during power-on. This is also the status when the power supply is cut off.

- Saving alarm signals

When the inverter input power supply is cut when alarm signal is being output, the alarm signal cannot be saved because the inverter control power supply is turned off. If you wish to save the alarm signal, the signal should be sent to an external sequence, then after they are saved the inverter power supply should be turned off. After power is reapplied, the remote operator (optional) can be used to check the contents of the fault.

- Resetting



Reset by either short-circuiting terminals RS-L of the printed-circuit board, or turning OFF the input power of the inverter.

9. BEFORE ASSUMING A MALFUNCTION HAS OCCURRED

If your problem persists even after checking the following table, contact your sales agent or your nearest servicing station. In such cases, be sure to have (1) the model, (2) the production number, (3) the malfunction symptoms, (4) the purchase date, and other pertinent information at hand.

Symptoms		Probable cause	Countermeasure
The motor will not run.	The inverter outputs U, V and W are not supplying voltage.	Is the input power supply to inverter terminals L1 and N being supplied? If it is, the POWER lamp should be on.	<ul style="list-style-type: none"> . Check terminals L1 and N. . Turn on the power supply.
		Is the ALARM lamp on?	<ul style="list-style-type: none"> . If it is on, reset the inverter.
		<ul style="list-style-type: none"> . Is operation instruction RUN ON? . Is terminal FW (or RV) connected to terminal L? 	<ul style="list-style-type: none"> . Set to ON. . Connect terminal L to terminal FW (or RV) on the printed-circuit board.
		<ul style="list-style-type: none"> . Has the frequency setter (potentiometer) been turned clockwise? . Are the printed-circuit board terminals H, O and L connected to the potentiometer? 	<ul style="list-style-type: none"> . Turn the potentiometer clockwise. . Firmly connect the potentiometer to the terminals.
		Has reset been left ON? If the power supply is applied with the reset signal being input, OV/R-OH will light.	Release reset.
	Inverter outputs U, V and W are supplying voltage.	<ul style="list-style-type: none"> . Release seizure or lighten the load. . Test the motor independently. 	
	The optional remote operator is used.	Are the operational settings between the remote operator and inverter unit correct?	Check the operation of the optional remote operator.
The rotational direction of the motor is backwards.		<ul style="list-style-type: none"> . Are the connections of output terminals U, V and W correct? . Is the phase sequence of the motor forward or reverse in respect to U, V and W? 	Make the connections according to the phase sequence of the motor. (In general, forward should be in the sequence: U, V and W.)
		<ul style="list-style-type: none"> . Are the terminals on the printed-circuit board correct? 	Terminal FW for forward, and RV for reverse.

Symptoms		Probable cause	Countermeasure
The rotational speed of the motor will not increase.		<ul style="list-style-type: none"> After checking the wiring of the frequency setter, the rotational speed still does not increase when the setter is turned. 	Replace the frequency setter.
		<ul style="list-style-type: none"> Are terminals CF1-L and CF2-L ON? 	<ul style="list-style-type: none"> Turn off CF1 and CF2. (When CF1 and CF2 are fixed at a given frequency, the speed reference signal will be invalid.)
		Is load too great?	<ul style="list-style-type: none"> Decrease the load. When the load is too great, the limiting function will be activated, so that the rotational speed will be lower than the setting.
Rotation is unstable.		<ul style="list-style-type: none"> Is the fluctuation in load too great? Is the power supply voltage fluctuating? Is some peculiar frequency causing? 	<ul style="list-style-type: none"> Increase the capacity. (Both for the motor and inverter.) Decrease the fluctuation. Change the output frequency slightly.
The rotational speed of the motor does not match the inverter.		<ul style="list-style-type: none"> Is the maximum frequency setting correct? Are the number of motor poles, the gear ratio, and pulley ratio correct? 	<ul style="list-style-type: none"> Check the V/F pattern against the motor specifications. Check the speed-change ratio.

10. MAINTENANCE AND INSPECTION

10.1 Maintenance and inspection precautions

- (a) Be sure to turn off the power supply during maintenance and inspection.
- (b) After the power supply has been turned off, start maintenance and inspection after 30 seconds or more since the POWER lamp on the printed-circuit board has gone out. (Immediately after the lamp has gone out, there will be a residual voltage of about DC 50 V in the DC bus intermediate circuit.)
- (c) When removing connectors, never pull the wires.
- (d) Take special care not to mistake connections.

• General precautions

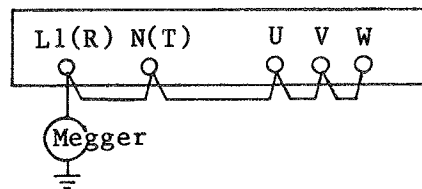
Always keep the unit clean so that dust or other foreign matter does not enter the inverter. Take special care in regard to breaking lines and connection mistakes. Firmly connect terminals and connectors. Keep electronic equipment away from moisture and oil. Dust, steel filings and other foreign matter can damage insulation, causing unexpected accidents, so take special care.

10.2 Inspection items

- (1) Daily inspection
- (2) Periodic inspection (Approximately once a year)
- (3) Insulation resistance tests, withstand voltage tests

Conduct these tests by short-circuiting the terminals as shown below, and by following the conditions described.

- In regard to insulation resistance tests, measure the terminals below and the grounding at DC 500 V meggers, and make sure that 5 M-ohms or greater is indicated.
- In regard to withstand voltage tests, impress the terminals below and the grounding with AC 1500 V for one minute, and make sure that there are no abnormalities.
- Do not conduct insulation resistance tests and withstand voltage tests for terminals other than those indicated below.



Insulation Resistance Tests and Withstand Voltage Tests

Note 1: If the inverter is used under high temperature and heavy load conditions, its operating life will be significantly reduced. Also, if the inverter has been stored for three years or more, apply rated input voltage for about five hours.

Note 2: Precautions in handling printed-circuit boards.
When maintenance and inspection of printed-circuit boards is necessary, be sure to follow the precautions below.

- Preventing damage caused by static electricity. The MCUs and ICs on a printed-circuit board can be destroyed by static electricity, so be sure to ground work benches, soldering irons, and yourself before working on a printed-circuit board.

We also recommend that spare inverters are prepared to reduce the amount of down time.

Note 3: Be careful of the following conditions because the converter module may be damaged.

- When the power supply capacity is ten times that of the inverter, and it is 500 kVA or greater.
- When a drastic power supply voltage change is generated.

Examples:

When multiple inverters are connected to a short bus.

When a phase advance capacitor is turned on/off.

In the cases above, we recommend inserting a reactor of about 3 percent (voltage drop at the rated current) of the power supply voltage on the power supply side.

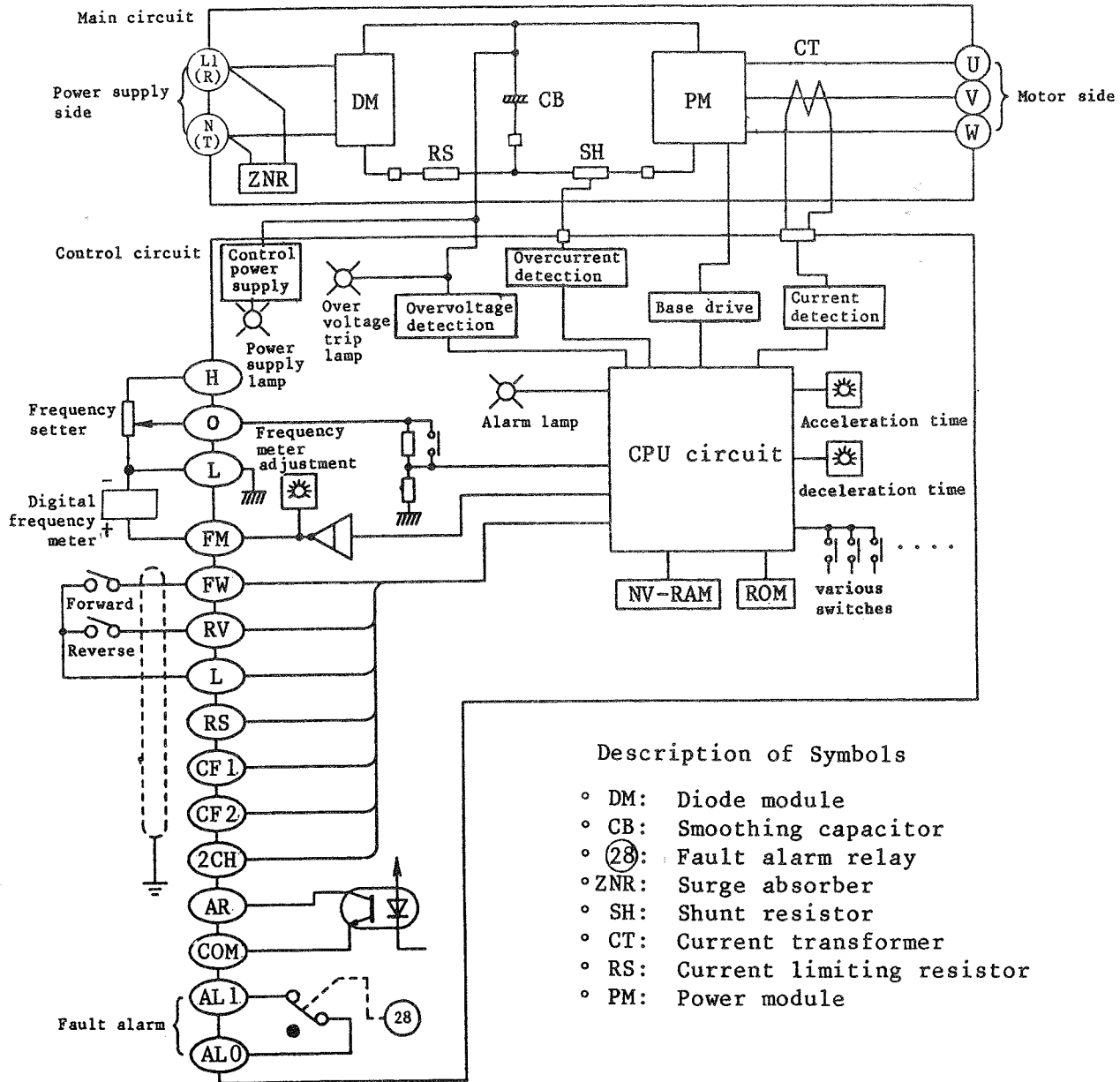
Daily Inspection and Periodic Inspection

Inspection location	Inspection item	Inspection content	Inspection cycle		Inspection method	Criteria	Standard replacement period	Instruments	
			Daily	Periodic					
Overall	Ambient environment	Check ambient temperature, humidity, dust, corrosive gases, oil mist, etc.	o			Ambient temperature between -10 to +40°C; no icing.	-	Thermometer	
	Devices overall	Check for abnormal vibrations and noise.	o		Visual and aural inspection.	Ambient humidity 20 to 90%; no dew condensation.		Hygrometer	
	Power supply voltage	Check the input line voltage.	o		Measure the voltage between inverter terminals L1 and N.	No abnormalities. 180 - 253 V 50 Hz 180 - 253 V 60 Hz		Tester	
Main circuit	Overall	(1) Insulation resistance test (between main circuit terminals and grounding terminal) (2) Check installation for looseness. (3) Check for evidence of overheating in the various components. (4) Clean.	o			No abnormalities in (1) and (2).	-	500 V class megger	
			o		(1) Tighten.				
			o		(2) Visual inspection.				
			o						
Connecting conductors, wires		(1) No distortion in conductors. (2) Check for breaks and deterioration (cracks, color changes, etc.) in wire insulation.	o		Visual inspection of (1) and (2).	No abnormalities in (1) and (2).	-		
			o						
Terminal board		No damage.	o		Visual inspection	No abnormalities.			

Inspection location	Inspection item	Inspection content	Inspection cycle		Inspection method	Criteria	Standard replacement period	Instruments
			Daily	Periodic				
	Smoothing capacitor	(1) Check for leaking	o		Visual inspection of (1) and (2). (3) Measure with a capacity meter.	No abnormalities in (1) and (2). (3) 85% of more of rated capacity.		Capacity meter
		(2) Check for swelling	o					
		(3) Measure the static electricity capacity.		o				
	Relays	(1) Check for stuttering noise when operating		o	(1) Aural inspection.	(1) No abnormalities.		
	Resistors	(1) Check for large cracks and change in color (2) Check for line breaks.		o	(1) Visual inspection. (2) Remove the connections on one side and measure with a tester.	(1) No abnormalities. (2) The difference must be within $\pm 10\%$ of the indicated resistance value.		Tester
Control circuit Protection circuit	Operation check	(1) Check the balance of the output voltage of individual phases when operating the inverter independently.		o	(1) Measure the voltage between the phases of inverter output terminals U, V, and W. (2) Simulate operation of the inverter protection circuit.	(1) Within 2% voltage difference between phases. (2) Operate without any abnormalities.	-	
		(2) Conduct a sequence protection operation test, and make sure that there are no errors in the protection and display circuits.		o				
	Component check, including printed-circuit boards	(1) No abnormal odor or changes in color.		o	Visual inspection	No abnormalities		
		(2) No significant corrosion.		o				
	Capacitor	No fluid leakage or deformation.	o		Visual inspection			

11. SPECIFICATIONS

11.1 Block diagram



11.2 Standard specifications (200 V class VWE2 series)

Model designation		with operation panel	HFC-VWE1SF2	HFC-VWE1.5SF2	HFC-VWE2.5SF2
		without operation panel	HFC-VWE1SB2	HFC-VWE1.5SB2	HFC-VWE2.5SB2
Protective structure			Open type (1P00)		
Maximum motor size (4P, kW)			0.4	0.75	1.5
Maximum capacity (kVA)	200 V		1.0	1.7	2.6
	220 V		1.1	1.9	2.9
Rated input AC voltage (V)			Single-phase 200 - 230 $\pm 10\%$, 240 $+5/-10\%$ 50/60 Hz $\pm 5\%$		
Rated output voltage (V) (Note 1)			Three-phase 200 - 240 (Corresponds to input voltage.)		
Rated output current (A)			3.0	5.0	7.5
Control method			Sine wave PWM method, voltage control method		
Output frequency range			1 - 120 Hz (0.5 Hz starting) (To 360 Hz when using the remote operator.)		
Frequency accuracy			$\pm 0.5\%$ of the maximum frequency (25 $\pm 10^\circ\text{C}$)		
Frequency setting resolution			0.2 Hz/50 Hz, 0.25 Hz/60 Hz, 0.4 Hz/100 Hz, 0.5 Hz/120 Hz		
Voltage/frequency characteristics			8 types (constant torque, and reduced torque individually set.) (Forty-eight types up to 360 Hz when using the remote operator.)		
Overload current capacity			150%, 60 seconds (once every ten minutes)		
Acceleration/deceleration time			0.2 to 30 seconds, individually set (individually setting between 0.1 to 300 seconds possible when remote operator is used.)		
Torque boost			(When remote operator is used, setting of manual boost and automatic boost possible.)		
Starting torque (Note 2)			Approximately 70% or more (120% or greater when remote operator used.)		
Braking torque	Regenerative braking (note 3) Feedback to capacitor		Approx. 100% (200V 50 Hz) Approx. 50% (200V 60 Hz)	Approx. 70% (200V 50 Hz) Approx. 30% (200V 60 Hz)	
	Voltage injection braking		When operation instructions are OFF, braking at 0.5 Hz or less. No braking when speed reference voltage is OFF. (When the remote operator is used, starting frequency, time, etc. can be set.)		
Input Signals	Frequency setting	Operation panel (SF2 only)	Settings with the potentiometer.		
		External signals	DC 0 - 5 V, 0 - 10 V (Input impedance 10 k-ohms, 20 k-ohms, respectively.) Potentiometer: 500 ohms to 2 k-ohms		
	Forward/reverse operation, stop	Operation panel (SF2 only)	RUN / STOP switch (The forward operation (FW) when shipped from the factory)		
		External signal	Forward operation/stop (1a contact), reverse operation/stop (1a contact) simultaneously ON equals stop.		
	Multi-speed operation		Maximum four speeds. First speed, 5 Hz; second speed, 20 Hz; third speed, 40 Hz (Can be arbitrarily set when using the remote operator.)		
	Second acceleration/deceleration		1 second (Second acceleration/deceleration time instructions. Individual setting between 0.1 to 300 seconds possible when using the remote operator.)		
	Reset		Fault reset, output immediately cut off (1a contact instruction)		

Output signals	Frequency arrival signal (Note 4)		ON when frequency attained (open collector output) (Arbitrary attained frequency can be set when using the remote operator.)
	Frequency monitoring		Digital frequency meter (Monitoring with analog meter: Note 5)
	Fault alarm contact		OFF when inverter abnormal (ON when normal, OFF when power supply cut off.)
Other characteristics			When the optional remote operator is used: frequency maximum/minimum limiter; maximum frequency adjustment; motor operation sound adjustment; electronic thermal level adjustment; set bias gain; output frequency display; motor rotational speed display; output current display; output voltage gain adjustment; frequency conversion setting; error display; retry function (retry when tripped at overcurrent, undervoltage).
Protection functions			Undervoltage, momentary overcurrent, overvoltage, overload, output short-circuit, overload limit function, electronic thermal (Note 6)
General specifications	Ambient temperature (Note 7)		-10 to 40°C (-10 to 50°C when cover removed.) (Storage temperature -10. to 60°C.)
	Humidity		20 to 90% RH (no dew condensation)
	Vibrations		0.5G (10 - 55 Hz)
	Operation location		1,000 meter or less altitude, indoors (no corrosive gas or dust)
	Paint color		Black
Options	Remote operator	Digital operation/setting unit	Remote control operator 1 meter/3 meters (DOP-1EA, DOP-3EA)
		Digital operation copy unit	Reading and transfer of setting data, 1 meter (DRW-1EA)
Estimated mass (kg)			2.0 2.6 2.7

Note 1: The output voltage will decrease if input voltage decreases.

Note 2: If starting torque is insufficient, it can be set with the remote operator.

Note 3: Without a regenerative braking circuit. This is an example for the Hitachi standard four-pole motor. This may change depending on the motor.

Note 4: DC 27 V, 50 mA maximum.

Note 5: Can be selected with the optional remote operator.

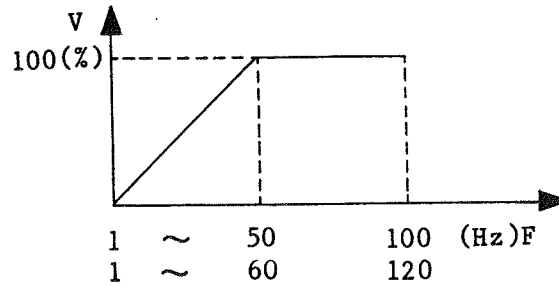
Note 6: Effective with an output frequency range of 20 to 60 Hz.

Note 7: Storage temperature refers to temporary periods, such as during transportation.

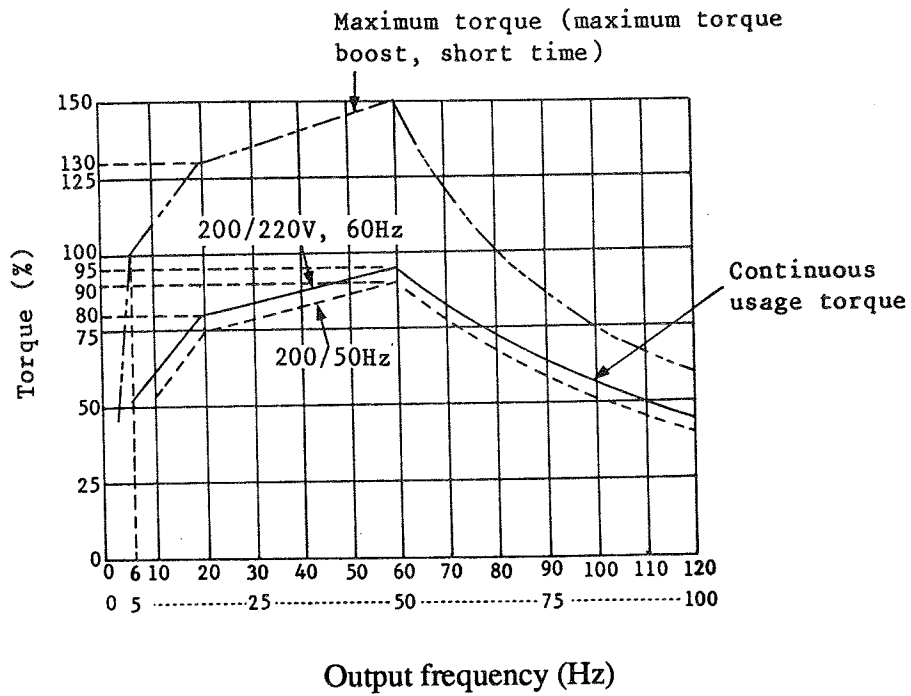
Torque Characteristics with Inverter Operation

Torque characteristics

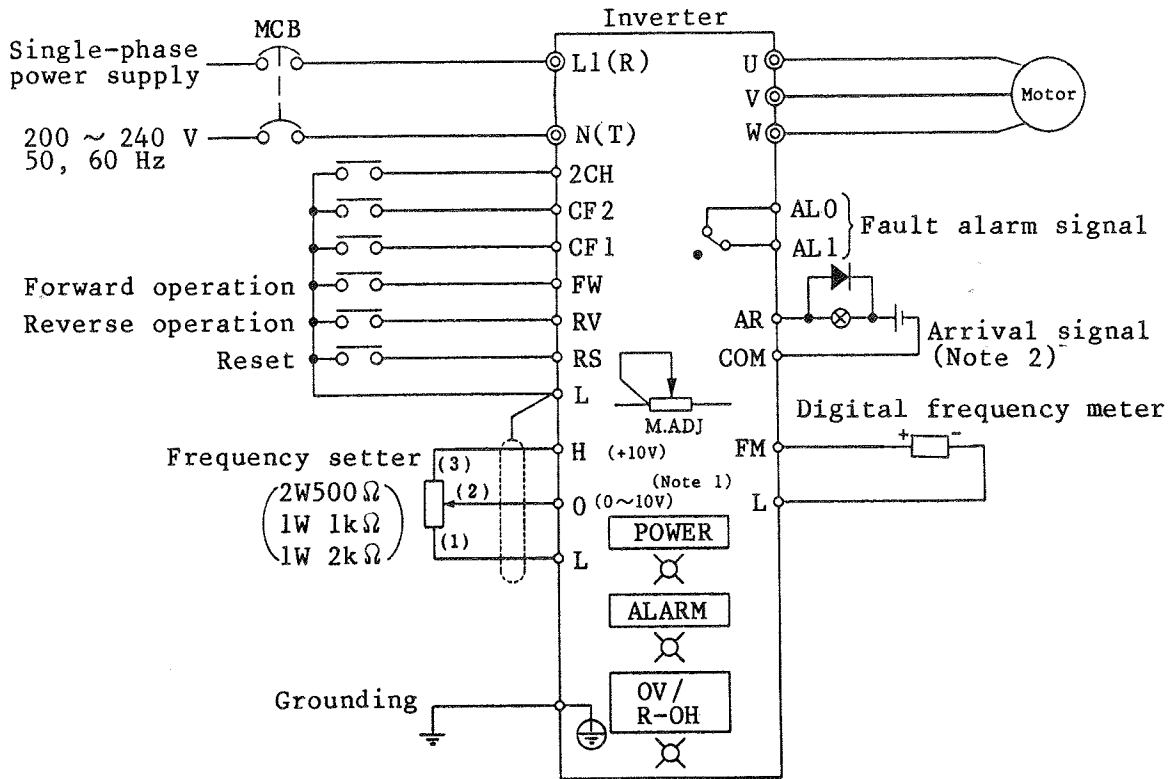
The torque characteristics for the V/F pattern in the diagram below are indicated (for the Hitachi totally-enclosed, fan-cooled, four-pole motor.)



- Applicable motor: 0.4 to 1.5 kW




11.3 Terminal connection diagram



Note 1: Maximum frequency is attained at about 9.6V.

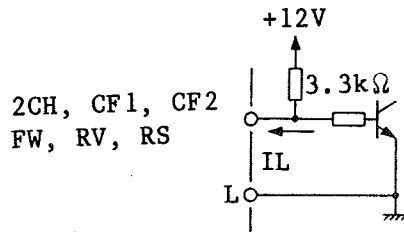
Note 2: When the arrival signal is received by a relay, absorb the surge from the relay going ON and OFF with a anti-parallel diode, etc.

11.4 Description of terminals

	Terminal designation	Terminal circuit	Description	Input level	
Main circuit terminals (M4 screw)	L1(R) N(T)	Commercial power supply input terminals	Connect to single-phase 200 - 240 V 50, 60 Hz.		
	U,V,W	Interver output terminals	Connect to three-phase squirrel-cage motor.		
		Grounding terminal	Ground the case grounding terminal.		
Control circuit terminals (M3 screw)	2CH	Second acceleration/ deceleration terminal	Contact (closed): Second acceleration/deceleration	L level \leq 0.3 V (Note 3) H level \geq 2.4 V Minimum input Pulse width \geq 50 ms	
	AR	Frequency arrival terminal	Transistor output ON when the output frequency attains the setting frequency (DC 27 V 50 mA maximum).		
	COM	Common terminal	Specialized AR common terminal (not for grounding).		
	CF2 CF1	Multi-speed terminals	Contact (closed): Multi-speed operation		L level \leq 0.3 V (Note 3) H level \geq 2.4 V Minimum input Pulse width \geq 50 ms
	H	Frequency setting power supply terminal	DC 10 V 20 mA maximum		
	O	Frequency setting terminal	DC 0 - 10 V, DC 0 - 5 V (switchable with DIP switches) Input impedance: 0 - 5 V (10 k-ohm) 0 - 10 V (20 k-phm)		
	L	Control common terminal	Control terminal common (not for grounding)		
	FW	Forward operation/ stop terminal	Contact (closed): Forward operation Contact (open) : Stop		L level \leq 0.3 V (Note 3) H level \geq 2.4 V Minimum input Pulse width \geq 50 ms
	RV	Reverse operation/ stop terminal	Contact (closed): Reverse operation Contact (open) : Stop		
	RS	Reset terminal	Contact (closed): Fault reset		
	L	Control common terminal	Control terminal common (not for grounding)		
	FM	Frequency monitor terminal	. Signal for digital frequency meter: factory setting . Signal for analog meter (0 to 10 V, 1 mA full scale, load resistance 10 to 22 k Ω): setting by a remote operator		
	AL1	Fault alarm terminal	Normal: AL0-AL1 (closed) Fault: AL0-AL1 (open) Power supply OFF: AL0-AL1 (open) Contact rating: AC 250 V 2.5 A (resistance load) 0.2 A (cos ϕ 0.4) DC 30 V 3 A (resistance load) 0.7 A (cos ϕ 0.4)		
AL 0					

- Note 1: Relays used for control circuit terminals other than AL0-AL1 should be weak electric relays (DC 12 V, 3 mA usable).
- Note 2: Stopped when FW and RV are on at the same time. (Decelerates and stops when activated during operation.)
- Note 3: Input circuit

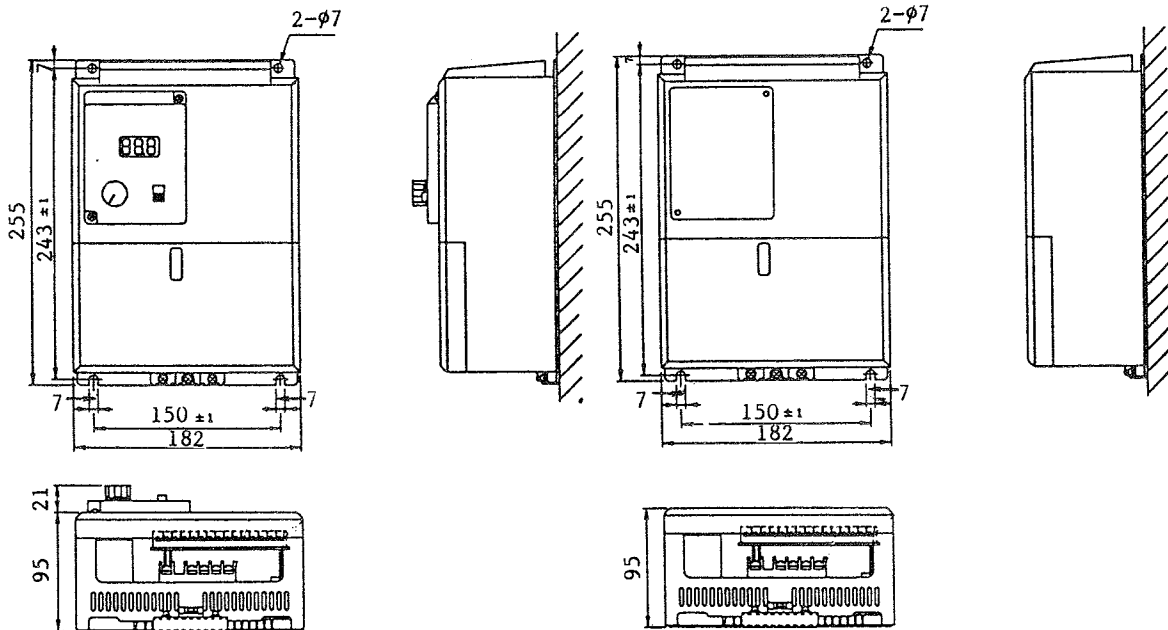
IL \approx 3.5mA



11.5 Dimension diagram (units: mm)

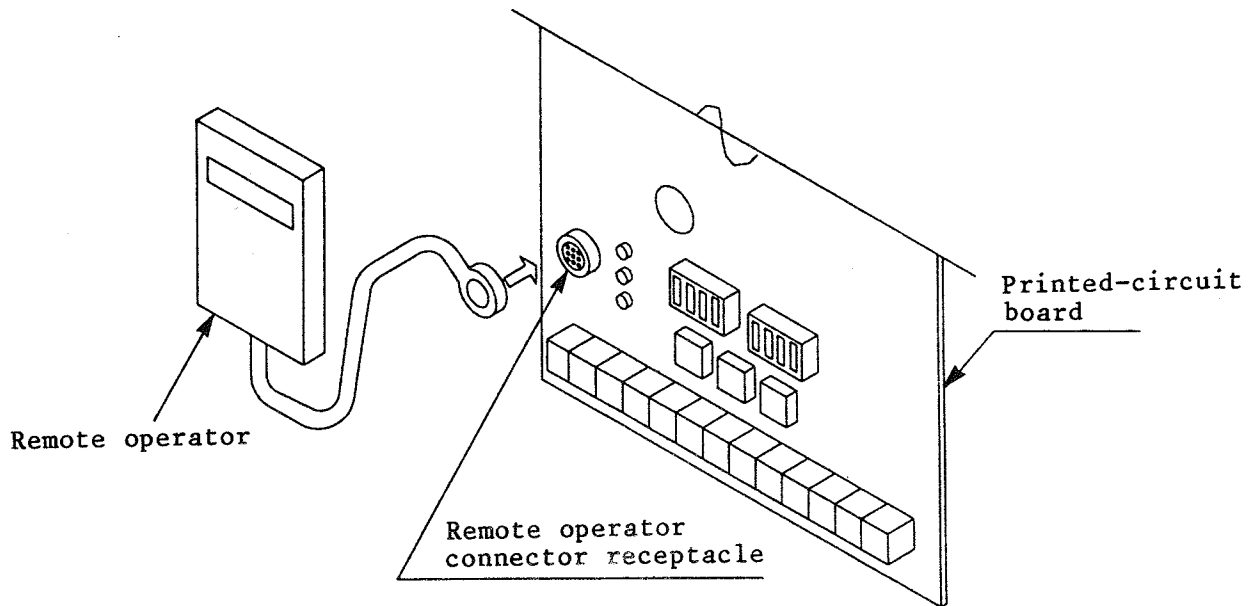
VWE1SF2
VWE1.5SF2
VWE2.5SF2

VWE1SB2
VWE1.5SB2
VWE2.5SB2



12. FUNCTIONS WHEN USING THE OPTIONAL REMOTE OPERATOR

12.1 Connecting the remote operator



Be sure to turn the power supply off when connecting the connector.

- (1) Insert the connector straight into the remote operator and inverter unit printed-circuit board.
- (2) Turn on the power supply.
- (3) Make sure that the liquid crystal display of the remote operator is lit.

When the power supply of the inverter is turned on, FS000.0..... of the monitoring mode will be displayed. If, however, the following were displayed when the inverter was turned off, they will be displayed when power is turned on again.

- ° Frequency setting, multi-speed setting and other frequency displays, motor rotational speed display, frequency conversion display, and output current display.

12.2 Functions when using the remote operator

A list of functions and their items is given below. There are two modes. The monitoring mode is mainly used for displaying frequencies, currents, etc. There are, however, items which can be changed on a real-time basis during operation (some items cannot be changed in this manner). The function mode includes the functions other than those included in the monitoring mode, and these cannot be changed during operation.

See the operation manual of the remote operator for details on its various functions.
(Operation manuals after NB425BX)

Monitoring Mode (When the optional remote operator is used.)

Display sequence	Monitor name	Display content	Standard setting	Contents of modification	Settings can be modified during operation	Remarks
1	Frequency setting and output frequency	(1) FS***.* #***.Hz	000.0	000.0 - 375.0	0	(1) displays the setting. (2) displays the output. "F" "R" or " " is displayed at the pound mark (#) F: Forward R: Reverse Displayed during multi-speed operation.
		(2) 1S***.* #***.Hz	5			
		2S***.* #***.Hz 3S***.* #***.Hz	20 40	000.0 - 375.0		
2	Output frequency instruction	F-SET-M Terminal	Terminal	Terminal REMOTE	X	Terminal: Instruction from inverter terminals (O-L, FW-L, RV-L). REMOTE : Instruction from the remote operator.
3	Operation instruction method	F/R-SW Terminal	Terminal	Terminal REMOTE	X	
4	V/F pattern selection	V/F-SET INVERTER	INVERTER	INVERTER REMOTE	X	INVERTER: Setting from the inverter DIP switches. REMOTE : Setting from the remote operator.
5	Acceleration/deceleration time setting	TIME INVERTER	INVERTER	INVERTER REMOTE	X	INVERTER: Setting from the inverter potentiometer. REMOTE : Setting from the remote operator.
6	Rotational speed display	RPM *** #***rpm	4	2 - 48 (14 types)	0	120f (rpm): Synchronized speed display according to the p
7	Frequency conversion value display	(1) (2) Hz**.* #***.Hz	99.9	99.9 - 99.9	0	When the amount per 1 Hz is input into section (1), section (2) is displayed the value of the output frequency multiplied by section (1).
8	Output current display	(1) (2) If A I***.Hz		3.0 - 16.5 (10 types)	0	When the rated current of the inverter is selected for section (1), section (2) will change to the output current display.
9	Manual torque boost adjustment	V-Boost Code (**)	55	00 - 99	0	Torque improvement at low frequency
10	Output voltage gain adjustment	V-Gain ***%	100	50 - 100	0	Makes output voltage gain variable.
11	Fault display	#1,2,3			0	Records the history of faults (displayed by moving the cursor to the specified position). 1. Last fault 2. Fault before 1. 3. Fault before 2.

Function Mode (When the optional remote operator is used.)

Display sequence	Function name	Function mode 1 display content	Function mode 2 display content	Setting range	Standard	Remarks
1	V/F pattern display	F-00 VFE-VC	VFE-VC ***-***	A - I, Z VC,VP1 VP2,VP3,IX	060-060	48 pattern switching. When INVERTER is selected, the frequency display changes to INVERTER.
2	Acceleration time setting	F-01 ACCEL-1	ACCEL-1 ****.*S	0.1 - 300	5	When INVERTER is selected, the time display changes to INVERTER.
3	Deceleration time setting	F-02 DECEL-1	DECEL-1 ****.*S	0.1 - 300	5	
4	Maximum frequency adjustment	F-03 +Fmax.	+Fmax. ***.* Hz	0 - 15	0	
5	Starting frequency adjustment	F-04 Fmin.	Fmin. ***.* Hz	0.5 - 5	0.5	
6	Frequency maximum limiter adjustment	F-05 H-LIM-F	H-LIM-F ***.* Hz	0 - 375	0	
7	Frequency minimum limiter adjustment	F-06 L-LIM-F	L-LIM-F ***.* Hz	0 - 375	0	
8	Motor operation sound adjustment	F-10 CF-Code	CF-Code (*)	C - U	N	
9	Starting frequency stop time adjustment	F-11 Fstop-T	Fstop-T ***.* S	0 - 15	0	
10	Multi-speed first speed selected	F-12 Speed-1	Speed-1 ***.* Hz	0 - 375	5	
11	Multi-speed second speed selected	F-13 Speed-2	Speed-2 ***.* Hz	0 - 375	20	
12	Multi-speed third speed selected	F-14 Speed-3	Speed-3 ***.* Hz	0 - 375	40	
13	Second acceleration time setting	F-18 ACCEL-2	ACCEL-2 ****.* S	0.1 - 300	1	
14	Second deceleration time setting	F-19 DECEL-2	DECEL-2 ****.* S	0.1 - 300	1	
15	Voltage injection braking frequency adjustment	F-20 F-DCB	F-DCB ***.* Hz	0.5 - 375	0.5	
16	Voltage injection braking adjustment	F-21 V-DCB	V-DCB ***	0 - 20	20	
17	Voltage injection braking time adjustment	F-22 T-DCB	T-DCB ***.* S	0 - 15	1	
18	Electronic thermal level adjustment	F-23 E-therm	E-therm ***%	50 - 100	90	
19	External frequency start	F-26 F-START	F-START ***.* Hz	0 - 375	0	
20	External frequency end	F-27 F-END	F-END ***.* Hz	0 - 375	0	
21	Switch selection 1	F-28 SWITCH1	SWITCH1 *****	-	00000001	
22	Switch selection 2	F-29 SWITCH2	SWITCH2 *****	-	00011000	
23	Overload limit constant setting	F-30 LM.CON	LM.CONS ****.*	0.1 - 30	0.3	
24	Automatic torque boost adjustment	F-32 V-auto	V-auto ***	0 - 20	0	
25	Restart wait time setting after undervoltage trip	F-36 IFS-R-T	IFS-R-T ***.* S	0.3 - 15	1	Only effective at undervoltage trip.
26	Arbitrary frequency setting for frequency arrival signal	F-39 SPD-ARV	SPD-ARV ***.* Hz	0 - 375	0	0: Output when the speed setting value is attained. 0.5 - 375: Output when the specified arbitrary frequency is attained.

13 SERVICE

When inquiring about the inverter trouble, inform your shop where purchased or your nearest service station of the following.

- (1) Type
- (2) Output (kVA)
- (3) Production No. (MFG. No.)
- (4) Symptom of malfunction

If the contents are unclear due to an old nameplate, inform only the clear items. To reduce the non-operation time, the spare inverter is recommended to stock.

Warranty

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

1. The service in the following cases even within the warranty period shall be charged to the purchaser.
 - (a) Malfunction or damage caused by mis-operation or remodelling and improper repair
 - (b) Malfunction or damage caused by drop after your purchase and transportation
 - (c) Malfunction or damage caused by fire, earthquake, flood, falling or thunderbolt, natural calamities, pollution and abnormal voltage.
2. When service is required for the product on your worksite, all expenses associated with field repair shall be charged to the purchaser.
3. This Manual is not re-issued. Always keep it handy. Do not loose it.

