FREQROL

MITSUBISHI

VVVF TRANSISTOR INVERTER

FREQROL-Z024-UL

— INSTRUCTION MANUAL —

MITSUBISHI ELECTRIC

Introduction

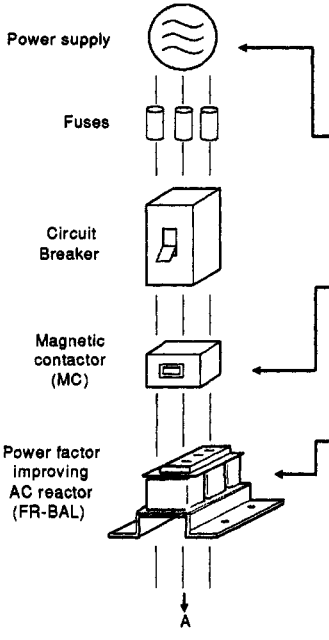
Thank you for your purchase of Mitsubishi Micro-Inverter FREQROL-Z024-UL.
Before operating the inverter, read this manual carefully. Please deliver this instruction manual to the actual user of the inverter.

CONTENTS

Instructions

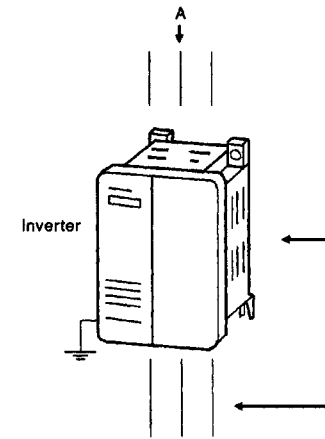
Handling Instructions

Improper use and operation may cause malfunction of the inverter or considerable reduction in service life. In an extreme case, the inverter might be damaged. Handle the unit correctly, following descriptions and notes in each section of this manual.



Instructions	Refer to:
Power Supply Specification Use the inverter within its allowable power supply range.	P.113
Use of Magnetic Contactor The magnetic contactor is not necessarily required. Do not use the magnetic contactor for start/stop-Inverter may be damaged!	P.18
Installation of Reactor For power factor improvement, or when installing the inverter close to a power source of 500kVA or larger, and a wiring distance of 10 m or shorter, use of a reactor is recommended. Choose a reactor according to the inverter model and size.	P.135

Handling Instructions



Installation Location The service life of the inverter depends on ambient temperature. Ambient temperature should be as low as possible, so that the allowable range may not be exceeded. When housing the inverter in an enclosure, this point should be considered.	P.9,15,16
Wiring Miswiring might cause damage to the inverter. Keep a sufficient distance between the control signal lines and the main circuit so as not to cause noise interference.	P.9,20

Equipment Connected to the Output Circuit
Do not connect power capacitors, radio noise filters (unless specially designed) to the output.
Use of such equipment may cause damage to either inverter or the connected equipment.

Ground the motor securely

1. PRECAUTIONS

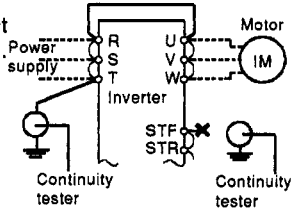
Use the inverter within the allowable ambient temperature range.

The service life of the inverter depends on ambient temperature. Ambient temperature should be as low as possible, such that the allowable range is not exceeded. Care should be taken for installation direction and the environment.

(See page 15,16.)

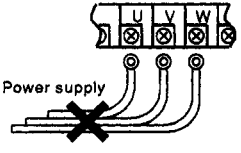
Do not perform inverter continuity test.

When measuring isolation resistance of power line or motor, disconnect connections to the inverter or short-circuit across terminals as follows. Do not perform a continuity test on the control circuit.



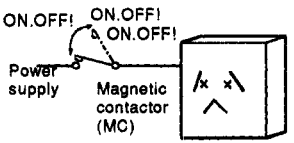
If power voltage is applied to the output circuit of the inverter, it will be damaged.

If the power voltage is applied to terminals U, V, W, the inverter will be damaged. Check to ensure that wiring and operation sequence (such as commercial power source selector circuit) are correct. Do not supply a voltage exceeding the allowable voltage range.



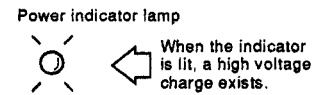
Do not use the magnetic contactor at the power supply side to start or stop the motor (or the inverter).

Repeated magnetic contactor switching for start/stop may cause inverter failure.



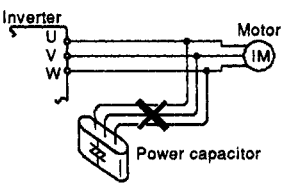
Do not access the inside of the inverter during operation.

The inverter has dangerous high voltage circuits. When checking the inverter, disconnect the power supply and ensure that the power indicator (commonly used as an electric charge indicator) is off.



Do not connect a power capacitor or surge suppressor on the output circuit of the inverter.

Such installation might cause inverter trip or damage to the capacitor or surge suppressor. If such a device is connected, remove it.



About Radio Noise

The inverter output and input circuits (main circuits) contain high frequency harmonics that may cause interference with communication equipment (AM radios). If so, use of a noise filter FR-BIF (only for input circuit) or a line noise filter FR-BLF help to reduce the effects of noise.

Please contact your mitsubishi supplier for additional information.

IMPORTANT

COVER

Power must be removed for at least 3 minutes, before removing any covers.

Removal of any covers exposes the operator to live terminals.

Please ensure power supply is removed.

PRECAUTIONS ON USE

Carefully read the entire instruction manual.

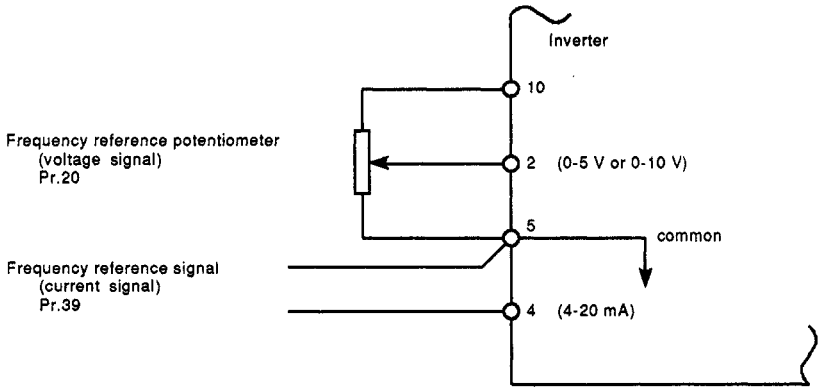
1. These parameters refer to maximum frequency when the inverter is supplied.

When the inverter is supplied, the inverter output frequency is 60 Hz when the external frequency reference signal is DC 5 V (10V) or 20 mA. However, parameters (see below) that set the maximum output frequency have a set value over 60 Hz.

Parameter number	Parameter name	Control variable at shipment
20	Frequency for 5 V input	*60.5-63 Hz
39	Frequency for 20 mA input	

* The parameter at shipment (60 Hz) that appears on pages 69,70 and 71 of this instruction manual should be interpreted to be the above.

Note: To adjust the relationship between the frequency reference signal and output frequency, follow the setting procedures described on page 29 of this instruction manual.

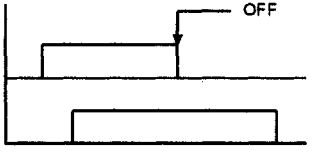

Inverter
10
Frequency reference potentiometer
(voltage signal)
Pr.20
2
(0-5 V or 0-10 V)
5
common
Frequency reference signal
(current signal)
Pr.39
4
(4-20 mA)

2. Operation of the Parameter Unit When Using the Output shutoff Function

When using the parameter unit in the external signal operation mode, pressing the PU OP key on the parameter unit **cannot** select the PU operation mode if the output shutoff signal (MRS terminal) and start signal (STF or STR terminal) are in the following conditions.

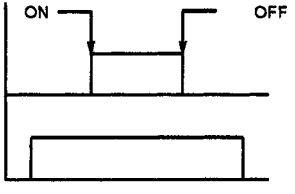
1. After the operator turned the output shutoff signal ON while the start signal was ON, the operator has turned off the start signal alone.

   Start signal .....
   across terminals STF (STR) and SD
   Output shutoff signal .....
   across terminals MRS and SD



2. In the condition that the output shutoff signal alone was ON, the operator turned the start signal from ON to OFF.

   Start signal .....
   across terminals STF (STR) and SD
   Output shutoff signal .....
   across terminals MRS and SD



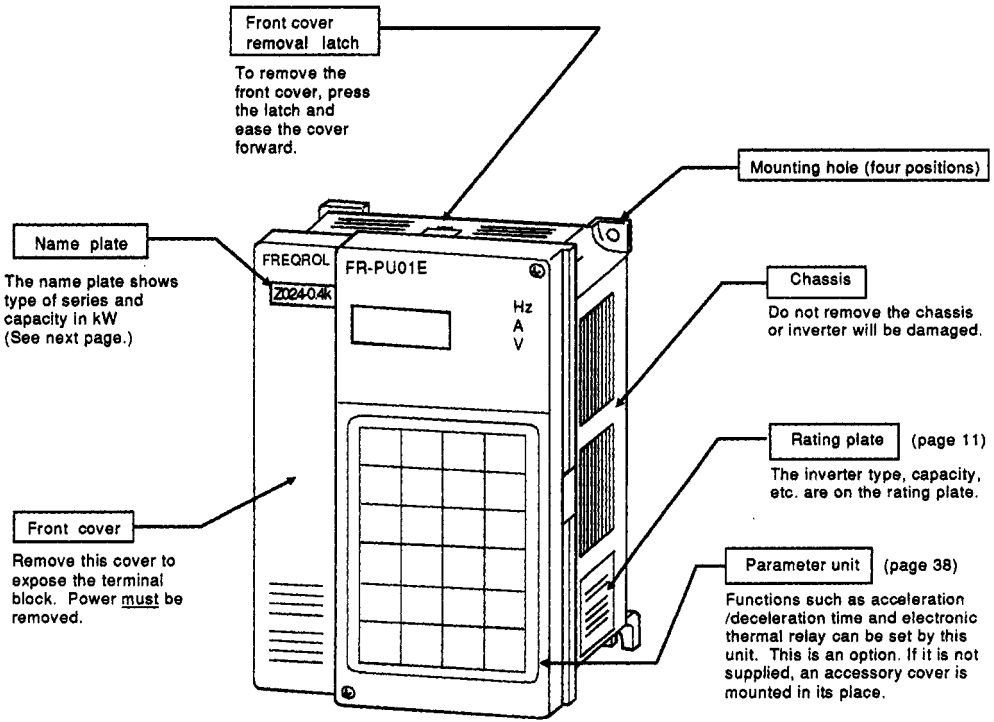
- **To select the PU operation mode:**
  First, break connection between terminals MRS and SD, then press the PU OP key.

Note: When the operator has changed the function of terminal MRS from 'output shutoff' to 'second acceleration/deceleration time selection', it is possible to select the PU operation mode on the condition that the start signal is OFF.

3. Attaching the Front Cover

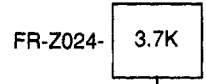
When attaching the front cover, locate the lower lugs first, into the main cover.
Bring the upper part of front cover to the main cover and press firmly.
It will "click" when in the correct position.

2. Block Diagram and Description



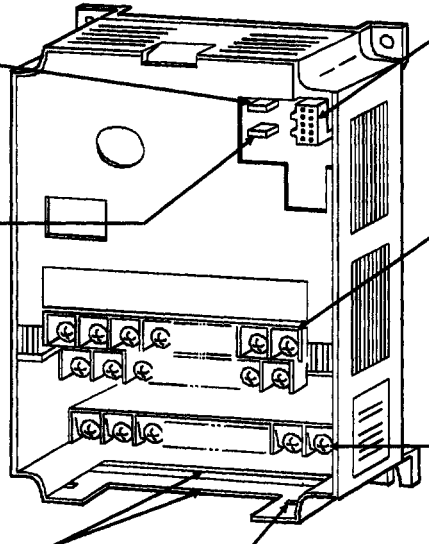
2. Block Diagram and Description

Model Size



Symbol	Applicable motor capacity
0.1K to 3.7K	Inverter capacity is shown in kW.

Inverter with the Front Cover Removed



Power indicator lamp (POWER)

Lights up when power is supplied. (Commonly used for indicating capacitor charge.)

Alarm lamp (ALARM) (page 124)

Lights up when the protective circuit is activated.

Slots for wiring

Socket for the front cover (two positions)

Parameter unit connector (page 41)

The parameter unit or connection cable is connected through this connector.

Terminal block for control signals (page 22)

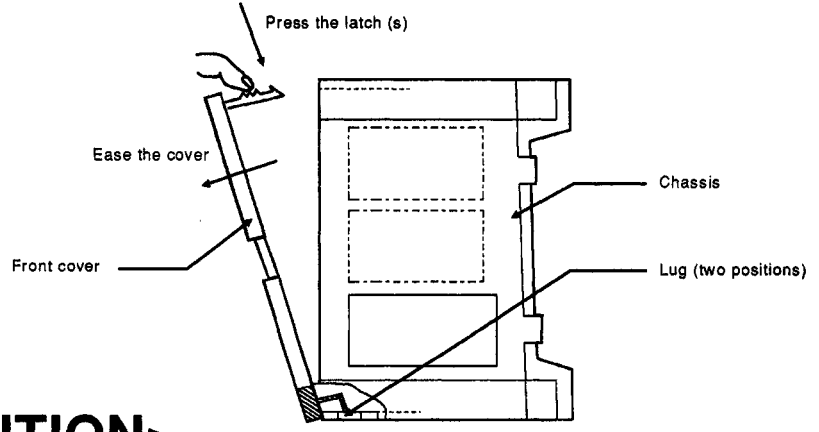
Signals such as the start and frequency reference signals are transmitted through connections to this terminal block.

Terminal block for power supply and motor (page 20)

The input power source and motor are connected to this terminal block. The block also contains terminals for grounding and brake resistor.

How to Remove the Front Cover

While pressing the removal latch(s) at the top of the front cover, ease the cover forward to remove it. To attach the front cover, insert the lugs (two positions) at the bottom of of the front cover into the sockets at the chassis bottom and press the cover against the chassis.



<CAUTION>

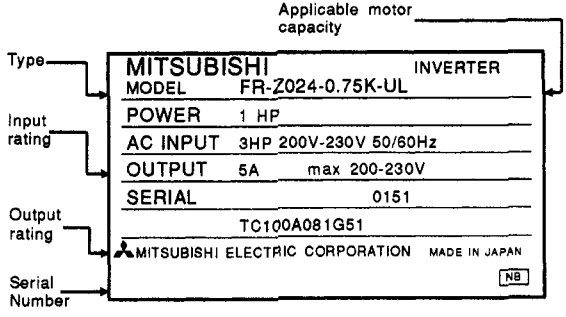
Do not remove the chassis from the body or the inverter will be damaged.

3. Preparation before Operation

1. Unpacking and Checking the Product

After unpacking the inverter, check the rating plate at the right side of the inverter to make sure that the model and rating meet your order. Also check that the inverter has not been damaged.

- Accessories, Instruction Manual



2. Preparation of Apparatus and Components Needed for Operation

Apparatus and Components to be prepared differ depending on how you operate the inverter. Prepare necessary components referring to operation methods on page 13.

(Next page)

3.	Installation
	Install the inverter paying attention to the installation location, installation direction, and surrounding space so as not to cause a reduction in the inverter service life or performance.

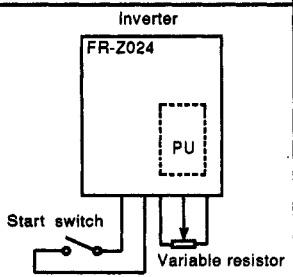
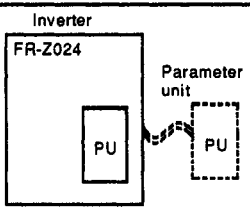
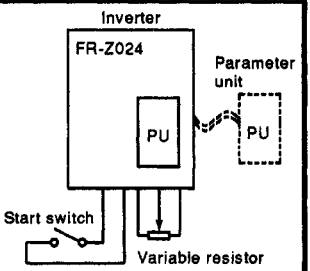
4.	Wiring
	Connect the power source, motor, and operation signal (control signals) to the terminal block. Improper wiring may cause damage to the inverter.

4. Apparatus and Components to Be Prepared before Operation

The FR-Z024 inverter permits the following types of operation. Select type of inverter that is optimum for your purposes and operating conditions.

Mode	External signal operation	PU operation *	Common use of external and PU operation
Operation method	Controls the inverter by external operation signal with the signal lines connected to the terminal block. (General operation)	Controls the inverter through key operation on the parameter unit. As this operation does not require connection of operation signal lines, it is used to begin operation immediately.	Controls the inverter commonly using both methods, external signal and PU operations described on the left.
Apparatus and components to be prepared	Prepare at least the following: • Start signal Switches, relays, etc. • Frequency reference signal Variable resistor or external signals of 0-5 VDC, 0-10 VDC, 4-20 mA	• Parameter unit (FR-PU01) • Connection cable FR-CBL (Prepare according to your needs.)	• Start signal Switches, relays, etc. • Frequency reference signal Variable resistor, etc. • Parameter unit (Prepare the connection cable according to your needs.)

(Table continued on next page)

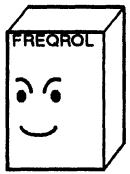
<table>
<tr><th>Mode</th><th>External signal operation</th><th>PU operation *</th><th>Common use of external and PU operation</th></tr>
<tr><td>Connection Example</td><td> 
</td><td> 
</td><td> 
</td></tr>
<tr><td>Notes</td><td>1. A start signal and a frequency reference signal are required to run the inverter.
2. Connection of the parameter unit allows for PU operation, as well.</td><td>1. See page 30 for parameter unit operating procedures.
2. When the inverter is shipped, factory settings allow external signal operations. For PU operation only set parameter 79 to 2.</td><td>When using both operation modes, setting is as follows:
<table><tr><th>Signal Operation mode</th><th>Operation A</th><th>Operation B</th></tr><tr><td>Start</td><td>External</td><td>PU</td></tr><tr><td>External</td><td>PU</td><td>External</td></tr></table>
Note: Selection of operation mode A or B is made by setting parameter number 79.</td></tr>
</table>

Note: * The parameter unit is abbreviated as 'PU'.

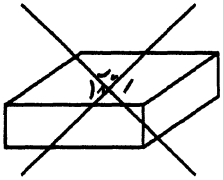
5. INSTALLATION

Install the inverter vertically.

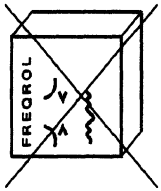
If the inverter is installed in a position other than the vertical position, the inverter heat convection effect may be reduced causing unforeseen troubles or failure.



Vertical installation



Horizontal installation



Lateral installation

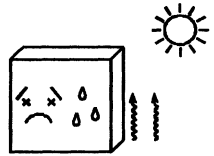
Keep the ambient temperature within the permissible temperature range.

If installed in vicinity of a heating element or in an enclosure, the ambient temperature increases resulting in considerable reduction in service life of the inverter.

When housing the inverter in an enclosure, give sufficient consideration to cooling method and dimensions of the enclosure.

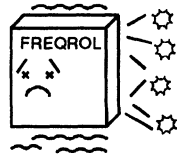
Avoid installing the inverter in the following environment.

- In direct sunlight, high humidity.



- Location with floating oil mist, dust, corrosive gases, or salt breeze.

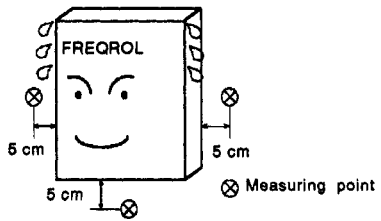
- Location with vibration.



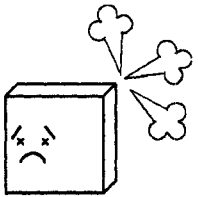
Pay attention to a truck or pressing machine.

(Continued on next page)

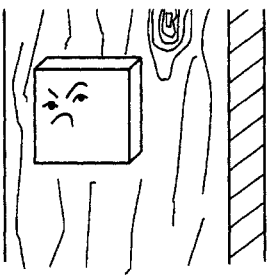
- Permissive ambient temperature:–10 to +50°C
- Measuring points of the ambient temperature.



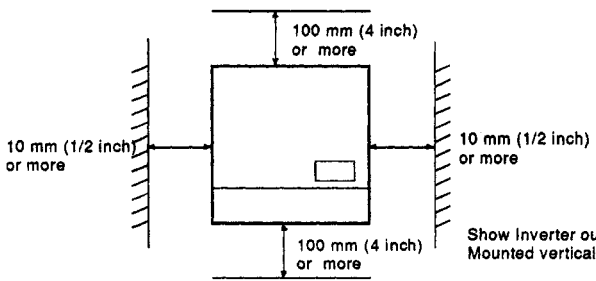
- Location with explosive gases.



- On surface of flammable material such as wood.



- Clearance around inverter.



Show Inverter outline
Mounted vertically-Not Horizonally!

6. WIRING

- **Wiring**
  When wiring the inverter, pay attention to the following points so as to avoid miswiring or misuse.

Wiring

(1) Do not connect power supply to the output terminals (u,v,w), because such miswiring causes damage to the inverter.

(2) Connect nothing across terminals P and PR **except** the discharging resistor for increased braking (option). Never short-circuit these terminals.

(3) Use sleeved, shoulderless terminals for the terminals for power supply and motor.

(4) Common terminals SD, 5, and SE on the control circuit terminal block are insulated from each other. **Do not ground these terminals.**

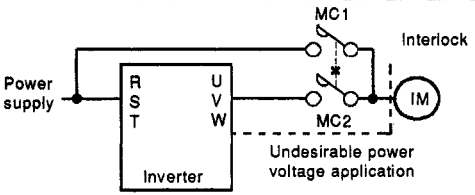
(5) Use shielded or twisted cables for wires connecting the control circuit terminals, and keep sufficient distance from the main or high voltage circuits (e.g., 200 V relay sequence circuit).

(6) When wiring, temporarily cover the vents on top of the inverter, to prevent pieces of wire from entering the inverter.

(7) When doing work such as rearrangement of wiring after operating the inverter, make sure that the power indicator lamp is extinguished and at least two minutes has elapsed before working on the inverter.

Check the Following Design Details

(1) In addition to paying attention to miswiring, check the commercial power source selector circuit shown in the figure on the right. If undesirable application of power voltage occurs through such a circuit, the inverter will be damaged. Ensure electrical and mechanical interlock of MC 1 and 2.



(2) At power failure, retaining the start signal (start switch) ON automatically starts the inverter when power supply is restored. If you need to prevent the inverter from automatically restarting, install a magnetic contactor MC at the inverter primary side and set a sequence so that the start signal will not be turned on.

(3) Input signals to the control circuit are at low level. If these signals are input through contacts, use two units of contact for at low level signals or use twin contacts in order to prevent defective contacting.

(4) Do not apply a voltage to contact input terminals (e.g., STF) of the control circuit.

(5) Do not apply voltage directly to the alarm output terminals (B,C) without a relay coil or lamp.

(Continued on next page)

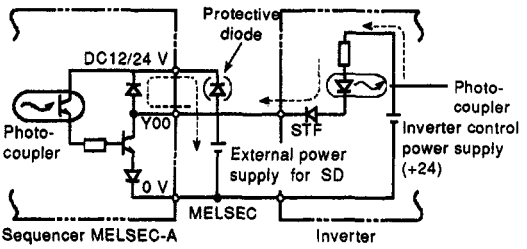
(6) If you connect an open collector output such as a sequencer directly to the inverter input terminal, make sure that undesirable current may not be generated.

- Measures

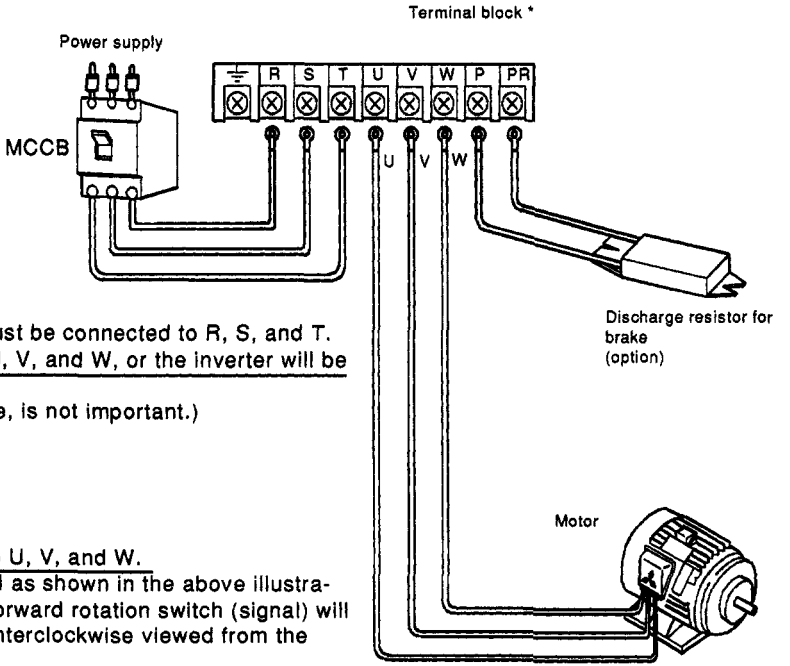
  (1) Insert a diode for preventing undesirable current.

  (2) Use an independent output unit.

  (example: AY40A, etc.)



- **Wiring of Power Supply and Motor**



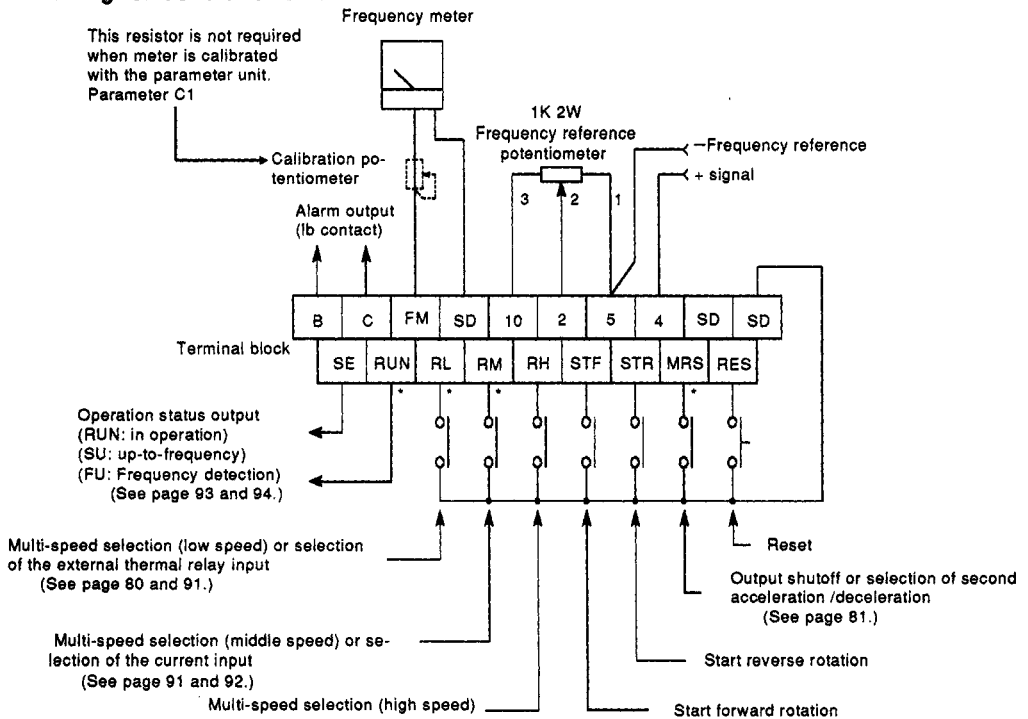
The power supply must be connected to R, S, and T. Never connect it to U, V, and W, or the inverter will be damaged.
(The phase sequence, is not important.)

Connect the motor to U, V, and W.
With wires connected as shown in the above illustration, turning on the forward rotation switch (signal) will rotate the motor counterclockwise viewed from the loading shaft side.

Notes:

1. Terminal block
   Terminal arrangement .....as shown on the previous page.
   Screw size .....M3.5 screws (FR-Z024-0.1 K to 1.5 K), M4 screw (FR-Z024-2.2 K, 3.7 K)
   Terminal specification .....see description of terminal specification (page 120).
2. Using wire size See Selection of Peripheral Devices (page 133).
3. The shape of terminal block differs according to inverter capacity.
4. Motor overload protection must be provided in accordance with the National Electrical Code.
5. This drive is not intended to provide overspeed protection.

• Wiring for Control Circuit



Notes: 1. Terminal block
Terminal arrangement .....as shown in the above illustration (two-row).
Screw size .....M3 screws
2. Input and output specifications for terminals marked with an asterisk '*' may be controlled via the parameter unit.
3. Three terminals named SD are connected in the inverter.

- **FOR USE WITH SINGLE-PHASE POWER SUPPLY**
  When the inverter is used with the single-phase power input, the ripple current of the capacitor increases as compared to the use with the three-phase power input, raising the temperature of the converter and capacitor. Hence, the inverter cannot be used with a rated output single-phase power supply but may be used with the single-phase power input which is lower in output current than the three-phase power input.

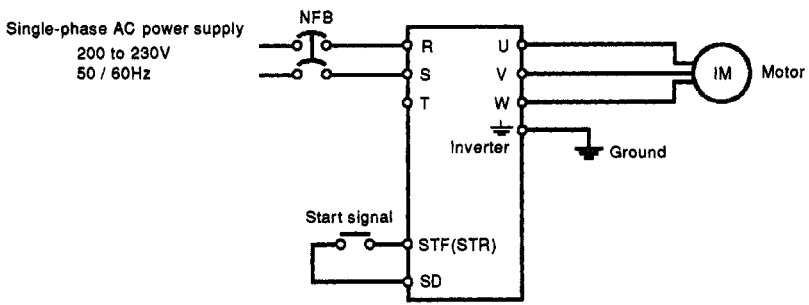
- **Ratings of the Inverters Used with Single-Phase Power Supply Input**

Type	FR-Z024 -0.1K	FR-Z024 -0.2K	FR-Z024 -0.4K	FR-Z024 -0.75K	FR-Z024 -1.5K	FR-Z024 -2.2K	FR-Z024 -3.7K
Rated output current (A)	0.4	0.8	1.5	3	4	5	7
Rated output voltage	Three-phase, 200 to 230VAC, 50/60Hz						
Power supply voltage	Single-phase, 200 to 230VAC, 50/60Hz						
Power supply capacity (kVA)	0.4	0.8	1.5	2.5	4.5	5.5	9
AC input current (A)	1.1	2.4	4.5	7.6	11.2	12.9	17.4

- **Notes on Use with Single-Phase Power Supply**

(1) The single-phase power supply must be connected to the power supply side terminals R and S of the inverter.

(2) The inverter must be used with the power supply of sufficient power supply capacity. If the power supply capacity is small, the output voltage will be varied greatly by the load.

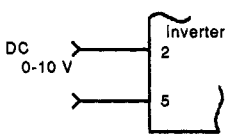
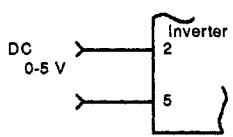


Circuit Example

7. PRE-OPERATION SETTINGS

Principal parameters and descriptions are as follows. Set these parameters according to operational requirements.

- Setting Method: Use the parameter unit for setting parameters. See page 30 for descriptions of settings.

<table>
<tr><th>Parameters</th><th>Description</th><th>Related Functions</th></tr>
<tr>
<td>Frequency reference signal
Select 5V or 10V</td>
<td>Set the frequency reference voltage signals input across terminals 2 and 5.
<table>
<tr><th>DC 0-10 V</th><th>DC 0-5 V</th></tr>
<tr>
<td>Set parameter number 73 to 1.
 
</td>
<td>Set parameter number 73 to 0.
 

The inverter is set as shown above when it is shipped.</td>
</tr>
</table>
Note: Be sure to select the 0-5 VDC input if you connect a frequency reference potentiometer (variable resistor).</td>
<td>Input selection 5 V/10 V (parameter number 73)</td>
</tr>
</table>

(Continued on next page)

Parameters	Description	Related Functions
Maximum output frequency	Set this parameter when you operate the inverter with a value other than that set when the inverter is shipped. See below for control variables set at shipment. If it is necessary to obtain output frequency higher than 60Hz, the maximum output frequency reference must be changed. (Control Variables Set at Shipment) • Voltage signal ..... 60 Hz at 5 VDC (or 10 VDC) • Current signal ..... 0 Hz at 4 mADC, 60 Hz at 20 mA • PU operation ..... up to the maximum frequency of 120 Hz	• Frequency for input voltage signal of 5 V (parameter number 20) • Frequency for input current signal of 20 mA (parameter number 39) • Maximum frequency at PU operation (parameter number 1)
Maximum frequency Minimum frequency	Set this parameter only when you set the maximum or minimum frequency. Although it is possible to set the maximum frequency within the range indicated above, the inverter may not operate correctly if the maximum frequency is set incorrectly. Note:If the minimum frequency is set, the motor will run at the minimum frequency by just turning the start signal on.	• Maximum frequency (parameter number 1) • Minimum frequency (parameter number 2)

(Continued on next page)

Parameters	Description	Related Functions
Electronic thermal relay	Set the relay in accordance with the rated current at the base speed of the motor. Note:Operation characteristics, are based on operation with a standard squirrel cage motor. They are not applicable to special motors. If you use a special motor, mount an external thermal relay to protect your motor. This also applies to mutiple motors.	• Electronic thermal relay (parameter number 9) • Selection of applicable load (parameter number 14) • External thermal relay Input selection (parameter number 46)
Acceleration/ Deceleration time	If you perform acceleration/deceleration operation with a time other than the value set when the inverter is shipped, change the acceleration/deceleration time. Value set at shipment: 5 sec. Note:The set value is the time from start to the maximum output frequency stated before.	• Acceleration time (parameter number 7) • Deceleration time (parameter number 8) • Second acceleration /deceleration time (parameter number 17) • Second deceleration time 26 (parameter number 47)

Frequency Meter Calibration

In order to monitor the output status accurately, calibrate the frequency meter before operation. Use of the parameter unit allows precise adjustment. (See page 64 for calibration procedures.)

Changing usage of an inverter (Previouly set up)

Because such an inverter might have parameters set previously according to a specific operation, reset parameters before operation (reset parameters to values set when the inverter was supplied by Mitsubishi).

The inverter may be factory reset on the parameter unit. (See page 61 for initialization.)

Note, however, that the parameters that follow may not be initialized even if you all clear parameters using the parameter unit. Read each control variable and change it to a needed value.

- Parameter number 20 'frequency for 5 V input signal'
- Parameter number 39 'frequency for 20 mA input signal'
- Parameter number C-2 'frequency reference voltage bias'
- Parameter number C-3 'frequency reference voltage gain'
- Parameter number C-4 'frequency reference current bias'
- Parameter number C-5 'frequency reference current gain'

8. OPERATION

Check Points before Switching Power On

- Check that the power lines are connected to terminals R, S, T. Also check that terminals are tight.
- Check that the source voltage meets the rated value, and is not exceeding the specification of the inverter. (See page 113 for specifications.)
- Check that the setting of the maximum output frequency is within the load (machine) specification range. (See page 78 for setting conditions.)
- Check that short-circuit or ground fault do not exist in the output circuit or sequence.

Basic Operating Procedures

After the inverter has been wired, follow the procedures on pages 31, 32 and 33 to check that it operates correctly.

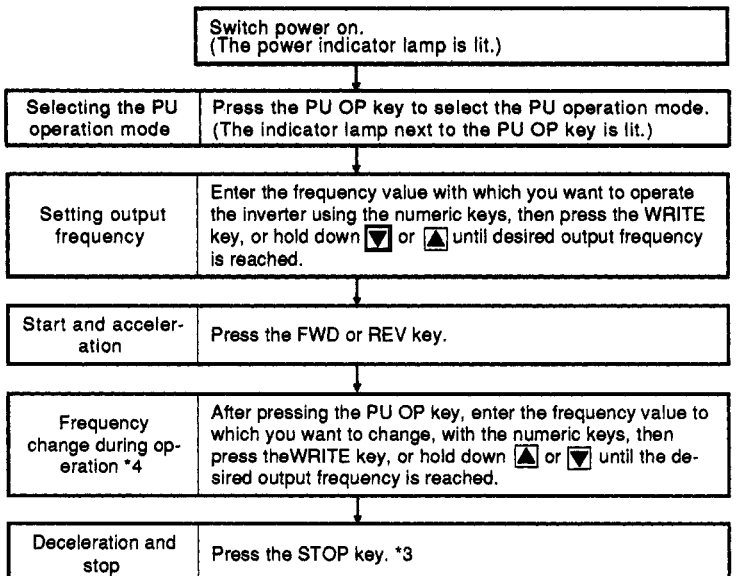
Operation with External Signals

- Example of setting frequency with a voltage signal

	Switch power on. (The power indicator lamp is lit.)
Start	Turn the start switch on. (Short-circuit across terminals STF and SD or STR and SD.) * 1
Acceleration ↓ Constant speed	Slowly turn the variable resistor (frequency reference potentiometer) clockwise to the maximum position.
Deceleration	Slowly turn the variable resistor (frequency reference potentiometer) counterclockwise to the maximum position * 2, * 3
Stop	Turn the start switch off. (Open across terminals STF and SD or STR and SD.) * 1

Operation with the Parameter Unit

- Using the parameter unit.



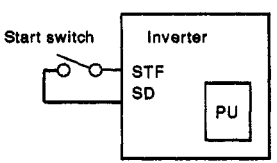
Notes:

* 1. The inverter will not start if both forward and reverse rotation switches are turned on. If both switches are turned on during operation, the inverter will decelerate and stop the motor.
* 2. If the start switch is turned off with the variable resistor turned clockwise to the maximum position, the inverter will decelerate and stop the motor.
* 3. A high pitch sound is generated just before the motor stops, this is normal. The sound is generated because the DC dynamic brake is in operation.
* 4. If the parameter unit is removed from the inverter during operation, normal operation will continue, however, the motor cannot stop, therefore, do not remove the parameter unit during operation.

- **Using both External Signals and PU Operation**
  The Z024 inverter permits use of both external signal and PU operations. The details are as follows:

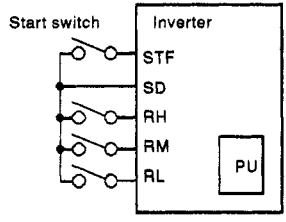
- The start signal is controlled externally, while the output frequency is set on PU.
  1. To select this configuration, first, set parameter number 79 'operation mode selection' to 11. (See page 51 and 52 for detailed procedures.)
  2. After turning the start switch on, output frequency is set on PU during operation. (See page 44 and 45 for detailed procedures.)

  Notes:
  1. The external frequency reference signal or PU forward/reverse rotation and stop keys are not accepted.
  2. The operation mode lamp indicates PU operation. The external signal operation mode cannot be selected.
  3. If the start switch is turned on, the inverter is not switched to the monitoring mode automatically. To monitor data, press the MONITOR key.



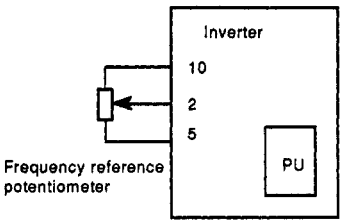
- The start and multi-speed selection signals are externally controlled, while setting of multi-speed is done by using the PU.
  When the inverter is supplied, setting allows for this configuration.
  1. After turning the start switch on, select multi-speed signal needed for operation (short-circuit terminals RH-SD, RM-SD, or RL-SD).
  2. Control multi-speed frequency on PU during operation.
     If you selet high speed (short-circuit RH and SD), for example, a change in value of parameter number 4 'third speed setting (high speed)' alters speed during operation. (See page 48 and 49 for detailed operations.)

  Note: Control variables of multi-speed other than those in-operation, may be changed during operation.

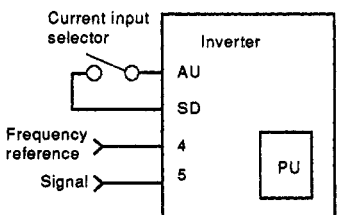


- The output frequency is controlled externally, while start/stop is controlled using the PU.

1. To select this configuration, first, set parameter number 79 'operation mode selection' to 12. (See page 43 and 44 for detailed operations.)
2. While inputting output frequency (analog or multi-speed selection stated above) signal externally, run/stop is controlled by the FWD/REV and STOP key on PU.



Notes:
1. The start terminals (STF, STR) on the inverter are disabled.
2. The operation mode lamp indicates PU operation. The external signal operation mode cannot be selected.
3. When not in the monitoring mode, the PU display shows the frequency corresponding to the external frequency setting signal. Note that this frequency is not displayed unless the PU OP key is pressed.



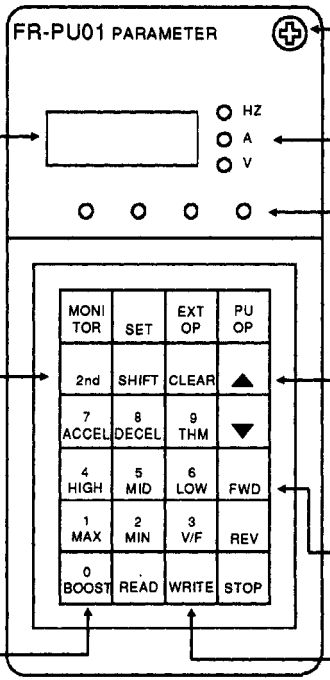
4. The inverter may also be started by pressing the FWD or REV key of the PU, with the external frequency setting signal set to 0, and then increasing the frequency setting signal. (Note that 0.01Hz is displayed when the set frequency is called by pressing the PU OP key after the FWD or REV key of the PU has been pressed.)

In-operation Check Points

- Check that the motor rotates in the correct direction.
- Check that the motor does not generate unusual noises or vibration.
- Check that the pointer of the frequency meter swings smoothly and correctly.
- Check if the ALARM lamp lights, and the inverter stops (inverter trip).
  See page 109 and 110 for causes and measures.

9. How to Use the Parameter Unit

Parameter unit, model FR-PU01, is attached to the inverter (FR-Z series), or connected to the inverter with the cable (option). The parameter unit permits the operator to set (read and write) various control variables (parameters), and to monitor operational status and alarm messages through its readout.
In this manual, parameter unit FR-PU01 is abbreviated as 'PU'.



DISPLAY(READOUT)
Frequency, motor current, preset control variables, alarm message, etc. are displayed by this 7-segment 4-digit readout.

2nd or 3rd group function key (2nd)
Press this key after pressing the SET key to read or change (write) control variables for the 2nd group function. The 3rd group function is selected by SHIFT KEY after this key is pressed.

SHIFT KEY
Variable (frequency, motor current, alarm message) to be monitored is shifted or 3rd group function is selected.

CLEAR KEY
If incorrect key is pressed during setting, it can be cancelled by pressing this key.

FUNCTION/NUMERAL KEYS
Parameter No. of 1st group function and value or frequency can be specified.

MOUNTING SCREW
By loosening two screws, the unit can be separated from the inverter.

VARIABLE INDICATOR LAMP
Control variable to be monitored (frequency, motor current, etc.) is indicated.

OPERATION MODE KEYS
Operation mode can be selected from: operation by the parameter unit, operation by external signals, read/write of control variables, monitoring frequency, motor current, alarm messages.
Note: The parameter unit is abbreviated as 'PU'

FREQUENCY ADJUST KEYS
Whilst it is held down, frequency continuously increases or decreases.

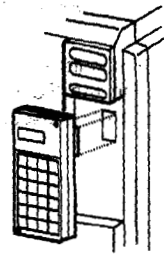
OPERATION KEYS
Direction of motor rotation can be selected and operation can be stopped.

READ/WRITE KEYS
Variable setting can be read (checked) by pressing WRITE after SET key is pressed.

10. INSTALLATION

The PU can be attached directly to the inverter, or connected to the inverter with the approved cable for remote installation on an enclosure or control with the parameter unit held in the opetator's hands. It can be attached or connected even when the inverter is in-operation.

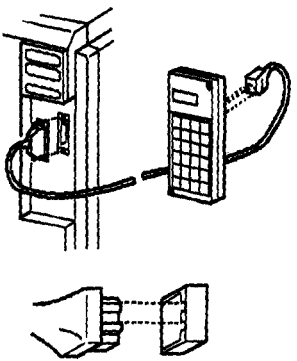
- **Direct Attachment to Inverter**
  Attach PU to the inverter front cover for use (it is electrically connected through the plug and receptacle).
  For inverters without PU, replace the accessory cover on the inverter front cover.



(1) Connection
Engage the plug of PU with the inverter receptacle and gently press the PU against the inverter.

(2) Securing the PU in position
Lightly tighten two screws to secure the PU in position.

- **Remote Installation Using the Approved Cable Connector**
  In addition to attaching PU to the inverter, it is possible to install it to an enclosure or to control it held by hand for adjustment or maintenance. In this case, use the approved cable (option) to connect PU and the inverter.



Fit the guides to the grooves.

(1) Connection

Plug one end of the cable into the receptacle of inverter, and the other end into PU. When plugging, fit the guides to the grooves. (See the illustration on the left.) (Improper connection may damage the inverter.)

(2) Locking of Plugs

The plug on the inverter side should be locked with screws as shown on the left. On the PU side, secure the cable so that the cable cannot be disconnected by its own weight.

Note: The extension cable, must be a Mitsubishi type, and is available as an option.

11. OUTLINE OF FUNCTIONS

Monitoring

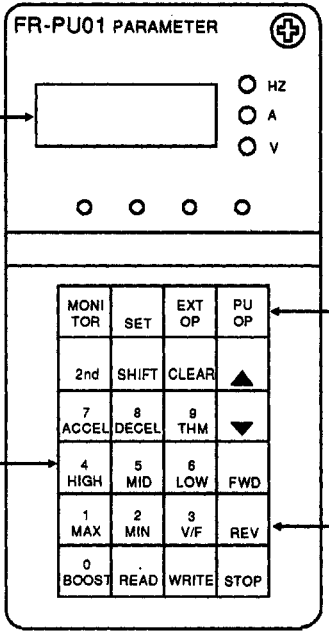
Operation status and alarm message can be monitored.

- Output frequency
- Direction of motor rotation
- Motor current
- Operation mode
- Alarm information
- See page 55 for operating procedures

Setting of control variables

Additional control variables can be accessed and changed.

- See page 51 and 52 for operating procedures.



Selection of operation mode

It is possible to select the external signal operation or PU operation mode.

- See page 43 for operating procedures.

Motor control

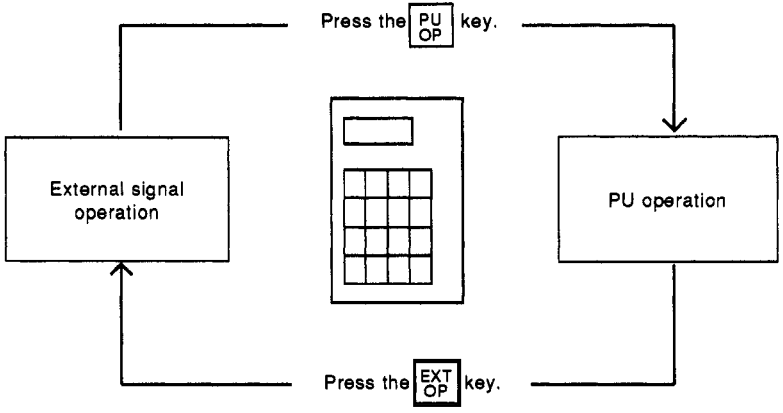
The motor starts or stop or output frequency can be set by key operation on PU.

Jog operation is also available.

- See page 51 and 52 for operating procedures.

How to Select Operation Mode:

1. Operating the Inverter with External Signals (External Signal Operation)
   When the inverter is supplied, it is set to this operation mode (when power is turned on, external signal operation function), so it is not necessary to select operation mode on PU.
   To select the PU operation mode from the external signal operation mode, press the PU/OP key. •
2. Operating the Inverter with the Parameter Unit (PU Operation)
   Press the PU/OP key to select the PU operation mode.
   To select the external signal operation mode from the PU operation mode, press the EXT/OP key. •
3. Operating the Inverter Using both the External and PU Operation Modes To control the inverter using the external and PU operation modes, for example, the start signal is input externally and output frequency is set on PU, set parameter number 79 to 11 or 12. Such operation is available only by this setting. See page 26 for detailed operating procedures.



How to Set Operation Mode

It is possible to set only one mode of operation using either external signal or PU oparation. When power is turned on, the set operation mode is selected, and selection of other operation mode is prohibited.

* Note: 1. Caution at changing operation mode
Operation mode cannot be changed when the start signal is on (STF-SD or STR-SD is closed).

2. Caution for removing PU during operation
In the PU operation mode, do not remove PU during operation. The inverter will stay in operation even if PU is removed. In that case, the operator cannot stop the inverter from operating the motor.

OPERATING THE MOTOR WITH THE PARAMETER UNIT

The operator can start/stop the motor with PU, without any external frequency reference potentiometer, or start switch. JOG operation is also available with PU. Follow the key operation below to control the motor.

Operating Procedures

(1) Direct Output Frequency Setting

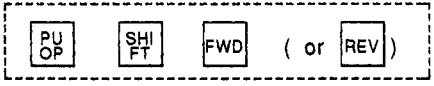
Frequency setting.....By repeating this procedure during operation, it is possible to vary the rotation rate.

(2) Output Frequency Setting Using ▲ or ▼ key for Continuous Variation (Step Setting)

While ▲ or ▼ key is held down, frequency increases (or decreases) continuously. Select the desired frequency with these keys.
The increase (or decrease) of frequency is slow initially, after the key is pressed, but increases as the key is held depressed.

Note: Be sure to press the EXT/OP key when desired frequency is set, otherwise the set frequency is not stored.

(3) JOG Operation



The motor starts and runs only while the FWD or REV key is held down. If the key is released, the motor stops.
JOG operation frequency is the value set with the parameter unit. (Parameter number 15)

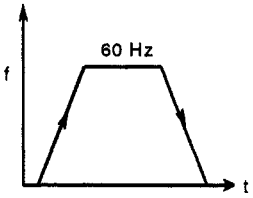
To return to external signal operation, press the EXT OP key, then press the key after the motor has stopped.
(If the external signal operation cannot be selected, see page 69 and 70.)

(4) Method to Vary Speed with PU during Multi-speed Operation.

Operating procedure (1) or (2) on page 51 and 52 permits such variation. Note, however, that pressing the PU OP key is unnecessary.

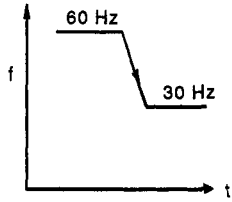
Example of Operation

· Example where 60 Hz is set for desired output frequency (from start to 60 Hz)



	Set to 60 Hz		Start	Stop
Key	PU OP 6 0	WRITE	FWD or REV	STOP
Indi-cation	60 Hz A V	60.00 Alternate F	60.00 Hz A V	0.00 Hz A V

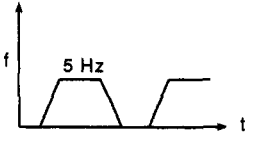
· Example where speed is changed during operation (from 60 Hz to 30 Hz):



	(Set to 60 Hz)		Set to 30 Hz	
Key	———	PU OP	3 0	WRITE
Indication	60.00 Hz A V	60.00	30	30.00 Alternate F

Note: Direct setting of output frequency is impossible while the MONITOR mode indicator lamp is lit. To set output frequency, press the PU OP key to cancel the MONITOR mode.

· JOG Operation



	JOG mode selection	Operation
Key	PU OP SHIFT	FWD (or REV)
Indication	J00 Hz A V	5.00 Hz A V

Notes: 1. The JOG mode cannot be selected while the motor is in operation. Press the [STOP] key to stop the motor, then select the JOG mode.
2. To cancel the JOG mode operation, press the [PU OP] key.
3. Desired frequency and acceleration/deceleration time (acceleration and deceleration times are the same) for the JOG mode operation can be set by specifying the corresponding parameter (control variable). (See page 90.)
When the inverter is shipped, the JOG frequency and acceleration/ deceleration time are set to 5 Hz and 0.5 sec., respectively (it takes 0.04 sec. for increase of frequency up to 5 Hz).
4. If the motor does not start, check the starting frequency.

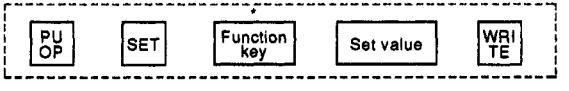
- When the motor is started by pressing the start key ([FWD] or [REV]), the MONITOR mode is automatically selected and output frequency is displayed.
- While the inverter output is on (motor in rotation), the mode indicator lamp just above the [PU OP] key flickers (the same occurs during DC dynamic brake operation).

SETTINGS OF CONTROL VARIABLES (PARAMETERS)

The inverter has a variety of control functions. It is possible to choose individual parameters to alter or check control variables.
The parameters(control variables) are factory-set to run a standard AC induction motor, therefore parameters should only reguire adjustment to suit individual application requirements.
Such as: Accel/Decel rates or min/max frequency are grouped into three categories, from 1st to 3rd functions.
Setting procedures that follow differ according to this classification.

Setting procedures

(1) Setting of 1st functions (parameter numbers 0-9) .....These are main function and are the most often used.

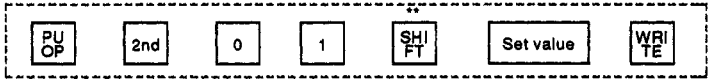


* Parameter name (abbreviations) are indicated on the numeral keys (0-9).

(2) Setting of 2nd functions (parameter numbers 10-) .....These are used in advanced applications.

Use the numeral keys to enter parameter numbers.

(3) Setting of 3rd functions .....Calibration



** Desired parameter may be called by pressing the SHI FT key several times. See page 49 for details.

To read a set value:
In the above procedure, press the READ key instead of the WRI TE key without entering a set value.

(Example) SET → 2nd → Function number → READ (The case of 2nd function)

To end or cancel settings:
To control the motor with PU at the middle of setting, or when setting is complete, press the PU OP key.

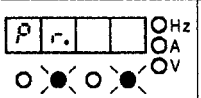
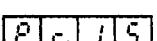
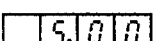
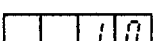
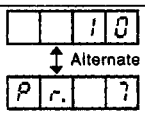
Examples of Operation

(1) Setting of 1st Function (acceleration time setting) .....To change from 5 sec. to 10 sec.

	Selection of 1st function	Setting of acceleration time	Read present value	Change to 10 sec.	Write
Key	SET	7 ACCEL	READ	1 0	WRITE
Indi-cation	PR Hz A V	PR 7	5.0 (5 sec.) Initial setting	10 (10 sec.)	10 ↕ Alternate PR.15

Note: When another 1st function is to be set after setting a 1st function, the new desired parameter can be called by just pressing the corresponding parameter key, so repressing the SET key is unnecessary.

(2) Setting of 2nd function (frequency reference for JOG operation) .....To change from 5 Hz to 10 Hz:

	Setting of 2nd function	Setting of frequency for JOG operation	Read present value	Change to 10 Hz	Write
Key	SET 2nd	1 5	READ	1 0	WRITE
Indication			 (5 Hz) Initial setting	 (10 Hz)	

Note: 1. A dot is placed after P_{1-} when the 2nd function is selected, ex. ($P_{r.}$)
2. When another 2nd function is to be set after setting a 2nd function, the new desired parameter can be called by just pressing the 2nd key and specifying the parameter number, so repressing the SET key is unnecessary.

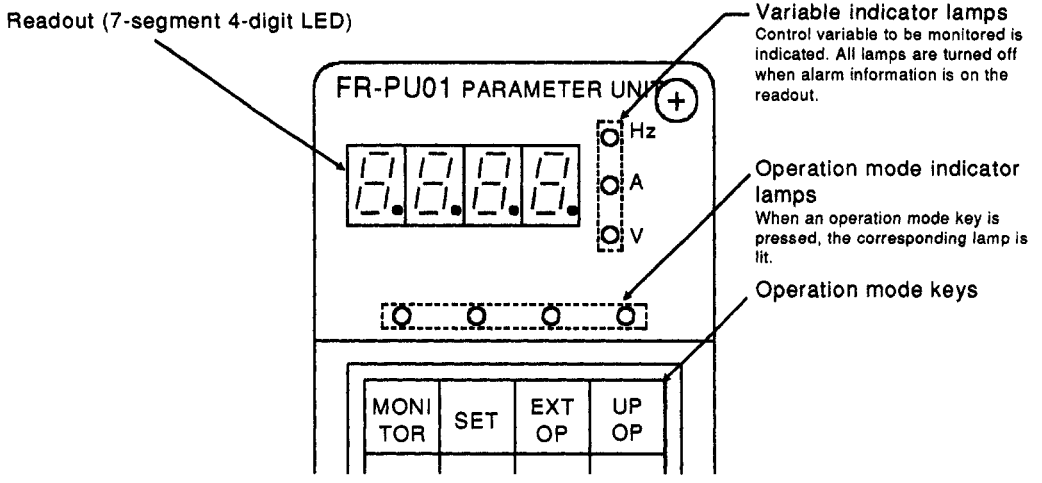
* If changing parameter or reading is impossible:
See page 71 when an error message is displayed and a new value cannot be written.

MONITOR

Conditions of load such as output frequency and motor power, and information about activated protective function at occurrence of an abnormality can be monitored with PU (by segment display and LED lamps).

Type of Monitored Information

Type of monitored information	Unit	Indicator device	Display/operation/setting in brief, etc.
Output frequency	Hz	Readout and variable indicator lamp	In the MONITOR mode shift the display information with the SHIFT key
Output current	A		
Engineering Display Unit	rpm, etc.	Indicator lamp	Switched from the monitoring of the output frequency when the function number 37 is set.
Direction of rotation	–	Variable indicator lamp	The lamp is lit at forward rotation and is flickering at reverse rotation.
In-operation	–	Operation mode indicator lamps	The lamp above the operation mode key corresponding to the selected mode is lit. When the motor is running, the lamp flickers, when stopping, the lamp is just lit.
External signal/PU operation mode	–		
MONITOR mode	–		
Setting mode	–		
JOG mode	–	Readout	If the JOG operation mode is selected, 'JOG' is displayed.



Parameter Unit

Indicator Lamp in the MONITOR Mode

In this manual, the variable indicator lamps are described in the following layout.

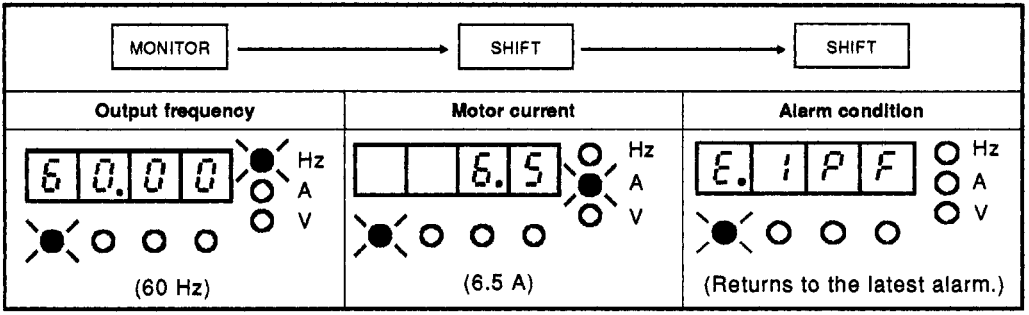
 is a "lit" lamp, and ○ is an extinguished lamp. The same is applicable to the operation mode indicator lamps.

Indication	Description	
○ Hz	Frequency is displayed.	If the stall prevention function is activated during MONITOR mode, all MODE lamps except that selected flicker. If the motor is in forward or reverse rotation, these lamps are lit or flicker, respectively.
○ A	Motor current is displayed.	
○ V	Not used.	

Note 1: The engineering display unit is displayed when the function number 37 is set to any value other than 0.

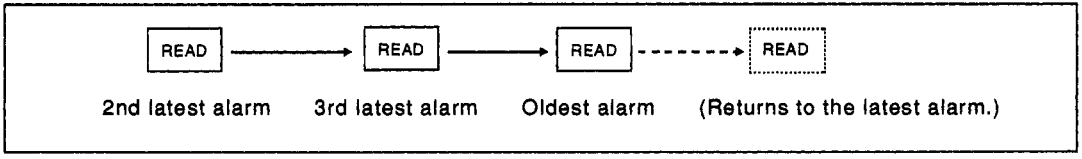
Example of Operation

- Output frequency, motor current (constant), alarm condition (checking)



Note: By pressing the SHIFT key when an alarm condition is indicated, the output frequency at the time of the alarm is displayed.

- To check the stored alarm information:
  Up to four alarm codes are stored. To check them follow the procedure below in the above alarm condition displaying status.

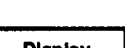
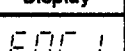
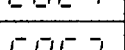
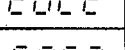
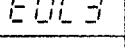
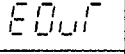
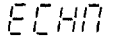


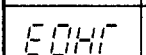
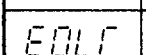
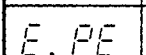
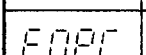
Notes : 1. To erase an alarm code: With an alarm code displayed, press the CLEAR key, the displayed code will be erased from memory, and the next code will be displayed.

2. To check operation conditions immediately before occurrence of an alarm: At occurrence of an alarm, the parameter unit automatically displays the activated protective function. In this condition if you press the SHIFT key (without resetting), output frequency is displayed. Thus it is possible to check output frequency immediately before the alarm occured. Motor current will also be checked similarly, but these values will not be stored.

Alarm Display

If failure occurs during operation of the inverter, an alarm code is automatically displayed on the PU readout as follows (See page 124 for details):

Display	Code	Description
	EOC1	Inverter output current exceeded the overcurrent limit during acceleration.
	EOC2	Inverter output current exceeded the overcurrent limit during constant-speed operation.
	EOC3	Inverter output current exceeded the overcurrent limit during deceleration.
	EOVT	Braking regenerative power from motor exceeded the regenerative overvoltage limit.
	ETHM	Electronic thermal relay in the inverter was activated (current is below 150% of preset current).
	ETHT	Electronic thermal relay in the inverter was activated (current is over 150% of preset current).
	E. BE	Brake transistor in the inverter fault detection.

Display	Code	Description
	EOHT	External thermal relay was activated.
	EOLT	Stall prevention function was activated during constant-speed operation and stopped the motor.
	E.PE	Data memory in the inverter and corresponding to parameter number is corrupted.
	EOPT	Indicates that the retry function has been activated or any error other than the error selected by the retry selection has occurred and stopped the inverter.

Characters Appearing in Readout

The alphanumeric which appear in the readout are listed below.

Letter	Display
0	
1	
2	
3	
4	
5	
6	
7	
8	
9	

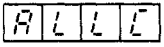
Letter	Display
A	
B	
C	
E	
F	
G	
H	
I	
J	
L	

Letter	Display
M	
N	
O	
P	
T	
U	
V	
r	
-	

It is possible to reset (initialize) control variables to those set when the inverter is supplied except for some parameters. This procedure is called 'ALL CLEAR'.

Operating procedure

PU OP → SET → 2nd → 8 → READ → 9 → READ → WRITE

When writing is complete,  is displayed and flickers.

Note : The following control variables are **not** initialized through the all clear operation stated above.

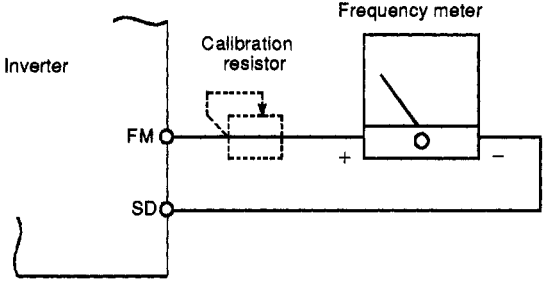
Parameter number	Parameter name
*20	Frequency for 5 V input signal
*39	Frequency for 20 mA input signal
C-1	Frequency meter calibration
C-2	Frequency reference voltage bias
C-3	Frequency reference voltage gain
C-4	Frequency reference current bias
C-5	Frequency reference current gain

*These control variables set the maximum output frequency using external signal operation, and also are reference frequencies for acceleration/deceleration time. After carrying out ALL CLEAR, check these values and reset to optimum values.

FREQUENCY METER CALIBRATION

It is possible to calibrate any frequency meter connected to the frequency meter connection terminals, FM and SD on the inverter, by operating the PU. If it is a digital indicator, pulse train signal frequency may be adjusted.

Preparation (1) Connect the frequency meter across terminals FM and SD on the inverter. (Pay attention to polarity matching.)
(2) If a calibration resistor has already been connected, remove it or adjust it so that its resistance reads zero.



Operating Procedure

1. Operate PU to set the frequency for meter full-scale reading. (*)
2. Select the meter calibration mode.
3. Calibrate the meter.

(Set to 60 Hz when the inverter is shipped.)

PU OP → Set value → WRITE → FWD (or REV)

PU OP → 2nd → 0 → 1

While observing the pointer of the frequency meter, press ▼ or ▲, reading will increase or decrease.
When the meter has been calibrated, press the WRITE key.

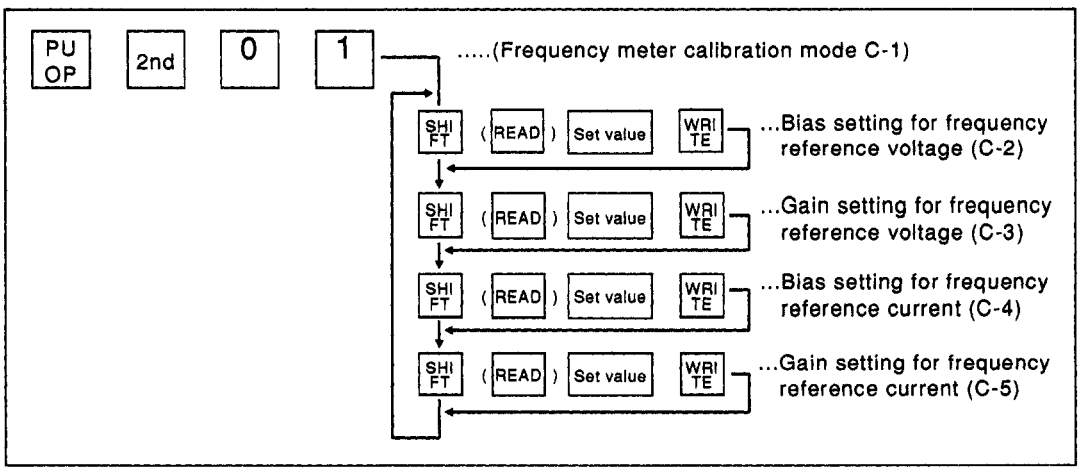
*The motor need not be connected.

Note: If a signal relative to magnitude of motor current is to be output from the FM terminal (see page 95), install a calibration resistor at the position shown on the previous page. Output of the FM terminal is not adjusted with the above procedure.

ADJUSTING BIAS AND GAIN FOR FREQUENCY REFERENCE SIGNAL

Using 'bias' and 'gain', the operator can adjust the relationship between output frequency and reference input signals such as 0-5 VDC, 0-10 VDC, or 4-20 mA DC, which set the output frequency. This function is classified as 3rd function and is set through the procedure that follows:

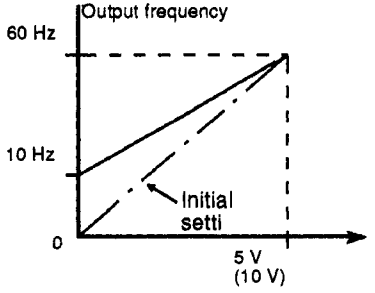
SETTING PROCEDURE



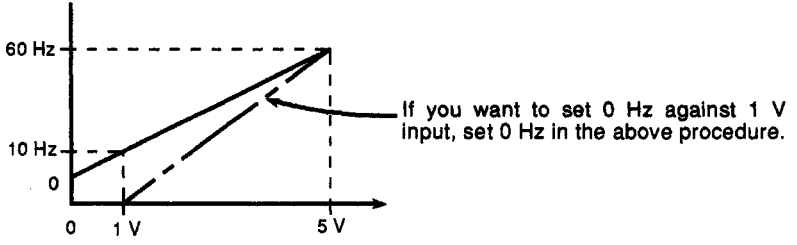
Example of Adjustment

- Bias setting for frequency reference voltage .....when the reference voltage is 0 V, the output frequency will be 10 Hz.

	Selection of 3rd function	Bias	Read	Set to 10 Hz	Write
Key	PU OP / 2nd / 0 / 1	SHI FT	READ	1 / 0	WRI TE
Indi-cation	C - 1 ○Hz ○A ○V	C - 2	0 (0 Hz)	10 (10 Hz)	10 ↕ Alternate C - 2



Note: Setting should be made with voltage across the frequency reference input terminals 2 and 5 using 5 V (or 10 V) or with input lines disconnected. (When setting characteristics shown in the illustration on the previous page.)
If a voltage is being applied, output frequency relative to that voltage is set. In the above procedure, for example, if 1 V is being applied across terminals 2 and 5, output characteristics become as shown in the illustration below (solid line).



CAUTIONS FOR PU OPERATION

Pay attention to the following points so as to avoid incorrect setting or entry of a wrong value during PU operation.

Operation	Cautions
Motor control by PU Operation	1. Becomes effective only after pressing the PU/OP key. 2. When PU is in the monitor mode (when the indicator lamp above the MONITOR key is lit), setting the output frequency is impossible. Press the PU/OP key to leave the monitor mode and enter a new value. 3. An error indication (Err.) will be displayed, or the value you entered will not be written under the conditions that follow : (1) When you have entered a value exceeding the maximum or minimum frequency (setting value for parameter number 1 or 2) ; (2) When prohibition of parameter entry is effective (parameter number 77 is set to 1) ; (3) When PU is in the external signal operation mode (the indicator lamp above the EXT/OP key is lit) ; (4) When PU is in the monitor mode (stated above). (Note, however, step setting is possible.) 4. JOG Operation (1) The JOG Operation is not available when the motor is running.First, stop the motor to perform the JOG Operation. (2) If the motor does not start, check whether the JOG Operation frequency is lower than the start frequency (parameter number 13).

Operation	Cautions
Writing values	1. Writing is effective only when PU is in the PU Operation mode, accordingly, it is ineffective in the external signal Operation mode. (Set values can be read in either mode.) 2. Writing is impossible when the motor is running. First, stop the motor to write values. The following parameters, however, may be written even when the motor is running. (1) Multi-speed setting (speed 1-7) ..... Parameters number 4-6, 24-27 (2) PWM mode ..... parameter number 10 (only in the PU Operation mode) 3. Setting values cannot be written under the conditions that follow (an error message will be displayed) : (1) When PU is in the external signal Operation mode; (2) When the motor is running (except the above two parameters); (3) When prohibition of parameter entry is effective; (4) When a number not on the parameter list is selected: (5) When a value exceeding the setting range is entered; (6) When a value exceeding the maximum or minimum frequency is set.
Writing values	1 When an error message is displayed, press the CLEAR key, or repeat the procedures from the first step.

Operation	Cautions
Reading values	1. It is possible to read the set values for the 1st and 2nd functions in both PU and external Operation modes. In addition, reading is possible if the motor is running. 2. Reading the set values for the 3rd functions is possible only when the inverter is in PU Operation mode.
Monitor	1. When the Operator uses the PU to control the motor, pressing the start key (FWD or REV) after setting frequency automatically selects the monitor mode.
Common -Operation mode. Maximum number of digits stored and the decimal point.	1. Selecting PU or external signal Operation Pressing the [PU OP] key (or [EXT OP] key) is not allowed for mode change under the conditions that follow : (1) When the motor is running ; (2) When the start signal (across terminals STF and SD or STR and SD) for the external signal Operation is ON. (3) When Operation mode (parameter number 79) is set to PU operation or external signal Operation. 2. Switching on the power of the inverter after switching it off or resetting (across terminals RES and SD) the external Operation mode. (Initial setting) 3. The maximum number of digits for entry is four. If this is exceeded, the first digit is disregarded. (Example : Pressing 12345 will be set as 2345.) 4. Pressing. 1 for 0.1, as is done for a calculator, is regarded as 1, and the decimal point will be disregarded. **Do not omit a 0.**

13. DETAILS OF EACH PARAMETER

PARAMETER LIST

Parameter No.		Parameter	Setting range	Initial setting	Refer to page:
1st function	0	Torque boost (manual)	0~30%	6%	85
	1	Max. frequency limit	0~120 Hz	120 Hz	79
	2	Min. frequency limit	0~60 Hz	0 Hz	
	3	V/F (base frequency)	50~360 Hz	60 Hz	84
	*4	3-speed setting (high speed)	0~360 Hz	60 Hz	91
	*5	3-speed setting (middle speed)	0~360 Hz	30 Hz	
	*6	3-speed setting (low speed)	0~360 Hz	10 Hz	
	7	Acceleration time	0, 0.1~3600 sec.	5 sec.	81
	8	Deceleration time	0, 0.1~3600 sec.	5 sec.	
	9	Motor thermal relay	0~999.9 A	(*1)	80
2nd function	*10	PWM mode	0~15, 20~33	3	98
	11	DC dynamic braking time	0~10 sec.	0.5 sec.	89
	12	DC dynamic braking voltage	0~10%	8%	
	13	Starting frequency	0.5~10 Hz	0.5 Hz	85
	14	Applied load selection	0, 1, 2, 3, 10, 11, 12, 13	0	86, 87
	15	JOG frequency	0~360 Hz	5 Hz	90

Parameter No.		Parameter	Setting range	Initial setting	Refer to page:
2nd function	16	Jog acceleration/deceleration time	0, 0.1~3600 sec.	0.5 sec.	90
	17	2nd acceleration/deceleration time	0, 0.1~3600 sec., 9999	9999	81
	18	High-speed maximum frequency	120~360 Hz	120 Hz	78
	19	Base frequency voltage	0 to 500V, 9999	9999	84
	20	Frequency a 5 V input voltage	1~360 Hz	60 Hz	78
	21	Stall prevention level	0~200%	150%	88
	*24	Multi-speed setting (speed 4)	0~360 Hz, 9999	9999	91
	*25	Multi-speed setting (speed 5)	0~360 Hz, 9999	9999	
	*26	Multi-speed setting (speed 6)	0~360 Hz, 9999	9999	
	*27	Multi-speed setting (speed 7)	0~360 Hz, 9999	9999	
	29	Acceleration/deceleration pattern selection	0, 1, 2	0	82
	37	Engineering display unit display	0, 2, 4, 6, 8, 10, 11 to 9998	0	101
	39	Frequency at 20 mA input	1~360 Hz	60 Hz	78
	42	Up-to-frequency sensitivity	1~100%	10%	94

Parameter No.		Parameter	Setting range	Initial setting	Refer to page:
2nd function	43	Output frequency detection	0.5~360 Hz	6 Hz	94
	44	Output frequency detection at reverse rotation	0.5~360 Hz, 9999	9999	
	45	DC dynamic braking frequency	0~60 Hz	3 Hz	89
	46	External thermal relay input selection	0, 1	0	80
	47	2nd deceleration time	0, 0.1~3600 sec., 9999	9999	81
	48	2nd torque boost	0~30%, 9999	9999	85
	49	2nd V/F (base frequency)	50~360 Hz, 9999	9999	84
	50	Retry selection	0, 1, 2, 3	0	99
	51	Retry count at alarm occurrence	0, 1 to 10, 101 to 110	0	99
	52	Retry execution wait time	0.01 to 360 seconds	1 second	100
	53	Retry execution count display erase	0	0	100
	69	Parameter set by the manufacturer. Must not be set.			
	70	FM output terminal function selection	0, 1	0	95
	72	Current monitoring output gain	0~200%	150%	

Parameter No.		Parameter	Setting range	Initial setting	Refer to page:
2nd function	73	5 V/10 V input selection	0, 1	0	77
	74	Current input selection	0, 1	0	92
	75	Reset selection	0, 1	0	92
	76	Output signal selection	0, 1, 2	0	93
	79	Operation mode selection	0, 1, 2, 11, 12	0	83
	77	Selection of prohibition of parameter writing	0, 1, 2	0	97
	78	Reverse rotation prevention selection	0, 1, 2	0	79
	79	Operation mode selection	0, 1, 2, 11, 12	0	83
3rd function	*C-1	Frequency meter calibration	———	———	96
	C-2	Bias for frequency reference voltage	0~120 Hz	0 Hz	97
	C-3	Gain for frequency reference voltage	1~360 Hz	60 Hz	
	C-4	Bias for frequency reference current	0~120 Hz	0 Hz	
	C-5	Gain for frequency reference current	1~360 Hz	60 Hz	

Notes : *1. Set values differ depending on inverter capacity.

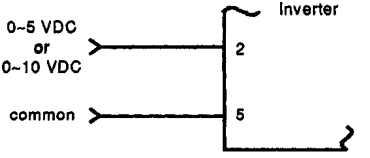
2. For parameters marked with a star, it is possible to change set values during operation. (Initial setting)
3. Minimum setting step
   - Frequency..... 0.01 Hz. Note, however, if frequency is 100 Hz or higher, the minimum setting step is 0.1 Hz.
   - Time..... 0.1 seconds. Note, however, if 0 is entered, 0.04 seconds is set.
   - Current..... 0.1 A
   - %..... 1%
4. The set value of 9999 indicates that "the function is inactive."

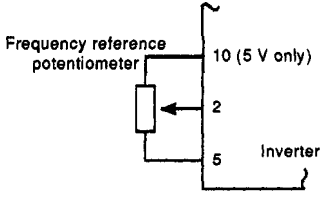
SELECTING FREQUENCY REFERENCE SIGNAL (5 V/10 V)

5 V/10 V Input Selection 73

It is possible to switch the input (terminal 2) specification according to the frequency reference voltage signal.
When you input 0-10 VDC, be sure to select appropriately.

Set value 0	For 0~5 VDC input (initial setting)
Set value 1	For 0~10 VDC input





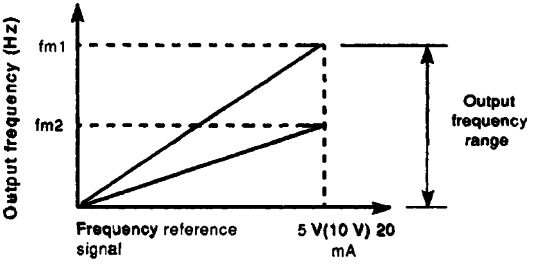
MAXIMUM OUTPUT FREQUENCY SETTING

Frequency with Reference Voltage Signal at 5 V : 20

Frequency with Reference Current Signal at 20 mA : 39

It is possible to set frequency for a frequency reference signal of 5 VDC (or 10 VDC) or 20 mA from external equipment. Accordingly, this is the maximum output frequency in the external signal operation mode.

Several acceleration/deceleration times can be set for JOG operation or multi-speed setting is the time (ramp) taken for acceleration or deceleration up to the maximum frequency.



<Initial Setting>

- Voltage signal .....60 Hz at 5 VDC (or 10 VDC)
- Current signal .....0 Hz at 4 mA DC, 60 Hz at 20 mA DC
- PU operation .....Up to the maximum frequency of 120 Hz

Note: The set maximum frequency changes automatically if you change setting of 'gain for frequency reference voltage signal' or 'gain for frequency reference current signal' included in the 3rd functions (see page 43). Since this function has the same priority level as that of 3rd function (C-3, C-5), priority is given to the latest set function.

Maximum Frequency at High Speed : 18

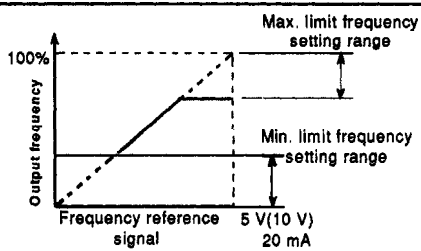
This is to be set when running at 120 Hz or higher. The maximum frequency, parameter number 1 of the 1st function is automatically updated to this frequency.

SETTING THE FREQUENCY LIMIT FUNCTION

Maximum Frequency Limit : 1

Minimum Frequency Limit : 2

Output frequency can be changed to desired maximum and/or minimum frequency.



Notes: 1. When performing an operation that requires setting of the minimum frequency limit, the limit should be higher than the starting frequency (see page 85). The maximum frequency limit may not be higher than 120 Hz.

2. When the minimum frequency limit is set, the motor will run at that frequency by switching the start signal on.

Note: Set these limits only when you want to restrict higher or lower output frequency.

Selection of Reversing Prevention : 78

This parameter is set to prevent problems caused by inappropriate reversing of motor rotation.

Note: If this selection is made, it prevents forward or reverse rotation in the PU operation mode as well as in the external signal operation mode.

Setting	Direction of rotation
0	Both forward and reverse rotation are available (initial setting).
1	Reverse rotation is prevented.
2	Forward rotation is prevented.

SETTING PROTECTION OF MOTOR FROM OVERHEATING

Electronic Thermal Relay : 9

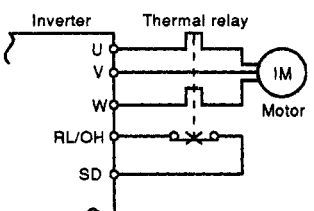
To protect the motor from overheating, the motor's rated current value should be set directly in amperage (A). If 0 A is set, the motor protection will not function.
For this function, set the motor rated current value at 60 Hz.
When the inverter is shipped, it is set to the rated output current of the inverter. Note, however, that it is set to 85% of the inverter rated current (A) for models FR-Z024-0.1 K to 0.75 K.
<Electronic Thermal Relay Setting for Constant Torque Motors>

When using Mitsubishi "constant torque motor" that is exclusive for the inverter drive, it is possible to set electronic thermal relay for this motor. If you set parameter number 14 to one of the values listed on the right consider the characteristics of the load, the value set for electronic thermal relay 9 is set for this motor.

Set value 10	Constant torque load	
Set value 11	Reduced torque load	
Set value 12	For constant torque elevation	Boost 0% at reverse rotation
Set value 13		Boost 0% at forward rotation

Selection of Motor Thermal Relay Input :46

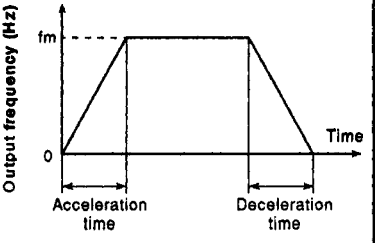
To protect the motor from overheating, inverter output is stopped and held when the thermal relay, (built in relay, etc.) or a relay outside the motor is activated. (An alarm signal is also output.) If the contact point of the thermal relay is reset, the motor will not restart unless the inverter is reset.
When terminals RL/OH and SD are open, the inverter will stop.
Note: If you use terminal RL/OH for the external thermal relay input, set parameter number 46 to 1.



ACCELERATION/DECELERATION TIME SETTING

Acceleration Time : 7

Deceleration Time : 8



The acceleration/deceleration time can be set to 0.04 sec. * or within a broad range from 0.1 sec. to 3,600 sec. The acceleration time is the time (ramp) taken for acceleration to the frequency (fm) set by the "frequency at 5 V input voltage" (see page 14). Time for acceleration in the JOG operation and for 2nd acceleration/ deceleration time is similarly set. Initial setting: 5 sec.

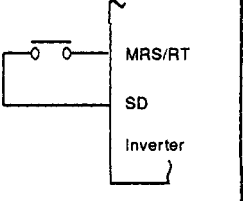
* If 0 is entered for acceleration time, 0.04 seconds is set.

Note: Time for S-shape acceleration/deceleration A (see the illustration on the following page) is the time (ramp) taken for reaching base frequency.

2nd Acceleration/Deceleration Time : 17

2nd Deceleration Time : 47

Selection of 2nd acceleration/ deceleration time



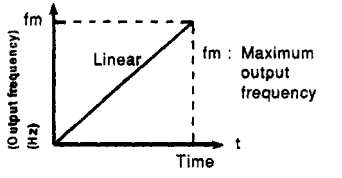
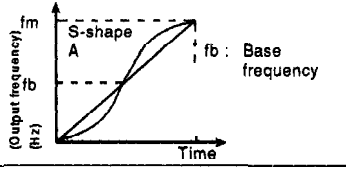
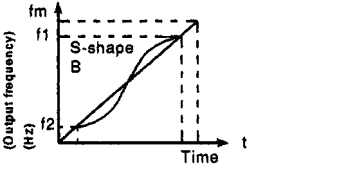
It is possible to select 2nd acceleration/ deceleration time by an external contact point signal. To do so, set the 2nd acceleration/deceleration time and close terminals RS and SD. Initial setting : 9999 (Terminal MRS/RT is used for output shutoff.)

- To set deceleration time different from acceleration time : Set the acceleration time and deceleration time by parameter number 17 and 47, respectively.

Note: If parameter number 47 is set to 9999 (initial setting), acceleration and deceleration are carried out in the same time set by parameter number 17.

SELECTING ACCELERATION/DECELERATION PATTERN

Acceleration/Deceleration Pattern : 29

Set value 0 [Linear acceleration/ deceleration] (Initial Setting)	It is the general acceleration/deceleration mode in which acceleration deceleration is linear up to the frequency at 5 V input (fm).	
Set value 1 [S-shape acceleration/ deceleration A]	The acceleration/deceleration ramp is steep where the motor output torque is large and is gradual where the motor output torque is small. The acceleration/deceleration time may be reduced.	
Set value 2 [S-shape acceleration/ deceleration B]	Acceleration/deceleration show S-shape characteristics between output frequencies f1 and f2. The time taken for the acceleration/deceleration from f1 to f2 is the same as that taken for linear acceleration/deceleration. The S-shape acceleration/deceleration B is characteristically smooth.	

OPERATION MODE SELECTION (EXTERNAL SIGNAL OR PU OPERATION)

Operation Mode Selection : 79

The external signal and parameter unit operation modes are available for operation of the inverter. Operation mode can be fixed to either operation mode, or both operation modes may be used.

Set value 0	**The parameter** unit and external signal operation modes are alternately used (initial setting).
Set value 1	Only the PU operation is available.
Set value 2	Only the external signal operation is available.
Set value 11*	**Output frequency is** set by the parameter unit. The start signal is input as an external input signal.
Set value 12*	Output frequency is set by the external input signal. The start signal is input from the parameter unit.

Notes: 1. It is possible to update values for this parameter number even in the external signal operation mode.

*2. **In this operation mode, output frequency setting and control of the start signal are** performed by using the external signal and parameter unit. When set value is 12, output frequency is for analog signals and multi-speed setting.

3. Refer to page 30 - 37 for details of operation.

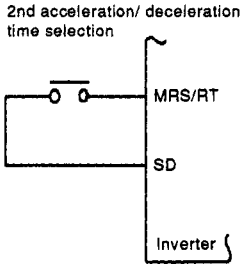
SETTING FREQUENCY FOR THE MOTOR RATED TORQUE (BASE FREQUENCY)

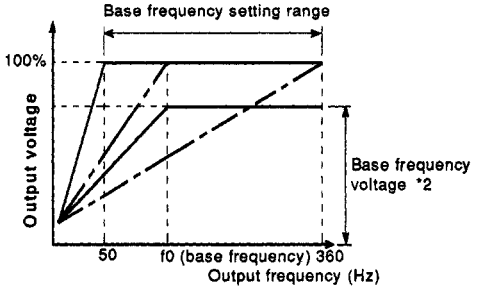
· V/F (Base Frequency) : 3

· Base frequency voltage 19

· 2nd V/F (Base Frequency) : 49

The base frequency (reference frequency at rated motor torque) can be set in accordance with the motor rating within the 2nd acceleration/deceleration time, parameter number 17 is set and terminals RT and SD are closed. *





Note: *1: If the 2nd acceleration/deceleration time, parameter number 14 (0 or 0.1 to 3600 sec.) is not set, this function is not effective despite the 2nd V/F is set and terminals RT and SD are closed.

*2: At the setting of 9999 (factory setting), the maximum output voltage is the power supply voltage.

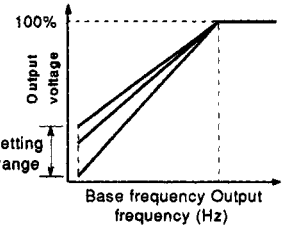
MOTOR TORQUE ADJUSTMENT (TORQUE BOOST)

Torque Boost (manual) : 0

2nd Torque Boost (manual) : 48

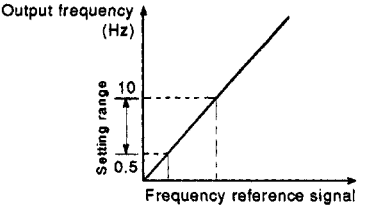
Motor torque in the low-frequency range can be adjusted to motor load.

Note: If the set value is excessively large, overcurrent protection may be activated. It is possible to adjust motor torque while observing motor current, using the monitor function. The 2nd torque boost is effective when the 2nd acceleration/deceleration time 17 is set and terminals RT and SD are closed.*



Start Frequency : 13

The starting frequency can be set in a range from 0.5 Hz to 10 Hz.



SETTING APPLICABLE LOAD

Selection of Applicable Load : 14

It is possible to select output characteristics (V/F characteristics) that are optimum for the application or load characteristics.
If you use the Mitsubishi constant torque motor, set values from 10 to 13 which are listed in the right-hand table. By setting one of these values, it is possible to set electronic thermal relay exclusively for the constant torque motor in the electronic thermal relay parameter number 9.

Set value	Output characteristics	
0	Constant torque load (initial setting)	
1	Reduced torque load	
2	Elevation load (zero boost setting at reverse rotation)	
3	Elevation load (zero boost setting at forward rotation)	
10	Constant torque load	For the constant torque motor
11	Reduced torque load	
12	Elevation load (same as that of set value 2)	
13	Elevation load (same as that of set value 3)	

Set value 0 (initial setting)

Set value 1

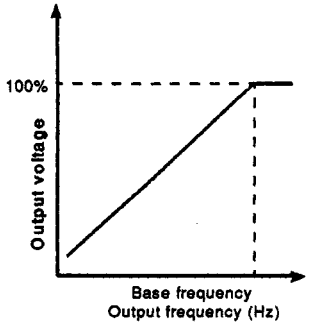
Set value 2 or 12....0% boost setting only at reverse rotation

Set value 10

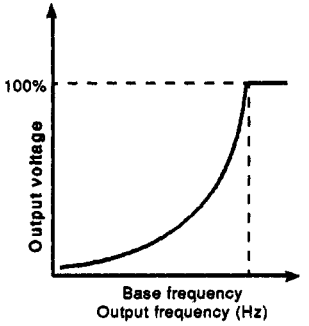
Set value 11

Set value 3 or 13....0% boost setting only at foward rotation

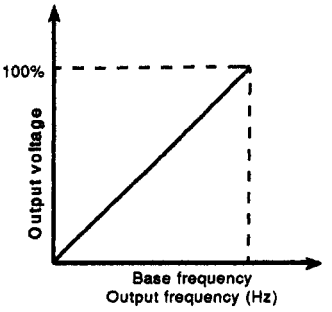
For constant torque load
(conveyor, carriage, etc.)



For reduced torque load
(fan, pump, etc.)



For elevation, constant torque load

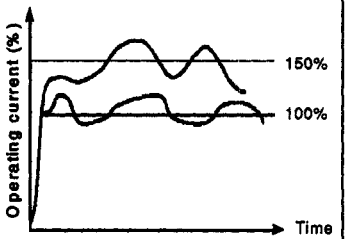


STALL PREVENTION LEVEL SETTING

Stall Prevention Level : 21

When a small-capacity motor (when compared with capacity of inverter) is driven by a large-capacity inverter, overload (excessively large torque) can be prevented by changing current level at which the stall prevention function is activated.

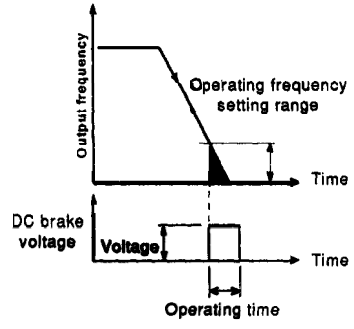
Initial setting : 150%



Notes: 1. Operating current (%) is a ratio of the set current to the rated output current of the inverter.
2. When setting value is 0, the stall prevention function is not activated.
3. If the stall prevention is activated, an alarm signal is not output.

DC DYNAMIC BRAKE ADJUSTMENT

- DC Dynamic Brake Time : 11
- DC Dynamic Brake Voltage : 12
- DC Dynamic Braking Frequency : 45



Accuracy of the stop position can be adjusted by setting the DC dynamic brake torque (voltage), braking time, and braking start frequency match the load.

Notes: 1. When the DC dynamic brake is not required, set brake time to 0.

2. If speed is decelerated by decreasing frequency reference signal voltage (or by pressing), the DC dynamic brake starts operating at 0.5 Hz of output frequency. (initial setting)

3. Initial setting of DC dynamic brake voltage : 8%

SETTING FOR JOG OPERATION

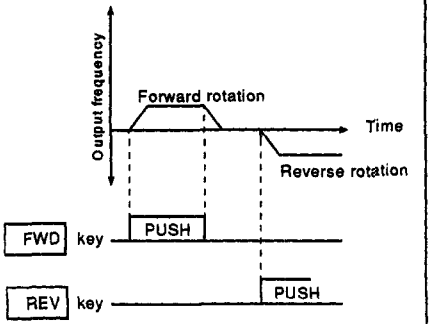
· JOG Frequency : 15

· JOG Accel./Decel. Time : 16

Use of the parameter unit permits JOG operation. JOG operation by external signal operation is not available.

Initial setting : JOG frequency: 5 Hz
JOG acceleration/ deceleration time : 0.5 sec.

Note: Refer to page 46 for PU operation.

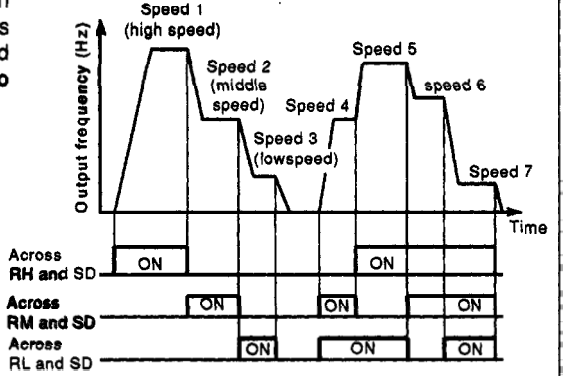


MULTI-SPEED OUTPUT FREQUENCY SETTING

- 3-Speed Setting (high speed) : 4
- 3-Speed Setting (middle speed) : 5
- 3-Speed Setting (low speed) : 6
- Multi-speed Setting (speed 4) :24
- Multi-speed Setting (speed 5) :25
- Multi-speed Setting (speed 6) :26
- Multi-speed Setting (speed 7) :27

By changing the external contact signal, each speed can be selected (across terminals RH-SD, RM-SD, and RL-SD). Each speed (frequency) can be set ranging from 0 Hz to 360 Hz.

▲ and ▼ are not effective for this setting.



Notes: 1. If speed 4 to 7 is set to9999 (initial setting), these speeds are not selected.

2. With 3-speed setting, if two or three **speeds are simultaneously selected, priority is given to frequency of** lower signal.

Example: If RH and SD, and RL and SD are simultaneously turned on with high speed (RH) and low speed (RL) set to 40 Hz and 50 Hz, respectively, 50 Hz will be selected.

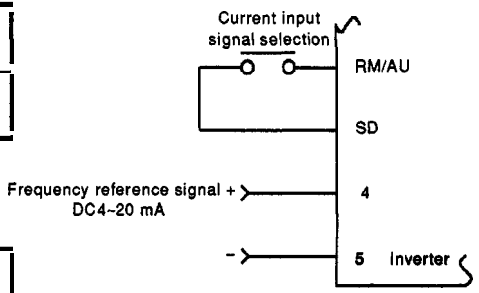
3. Selection of the external thermal relay input makes the three-speed setting (low speed) invalid. To perform three-speed operation, set the function number 26. (RH RM)
4. When the multi-speed signal and external frequency setting signal are input, the frequency setting for the multi-speed signal has priority.

SETTING INPUT SIGNAL FUNCTION

Current Input Signal Selection : 74

It is possible to operate the inverter using frequency reference current signal (4 to 20 mA DC). To do so, select current input signal for the function of terminal RM/AU and close terminals RM/AU and SD.

Set value 0	Terminal RM/AU is used as multi-speed selection. (initial setting)
Set value 1	Terminal RM/AU is used as current input signal selection.



Reset Selection : 75

Reset (terminal RES) function can be selected.

Set value 0	The reset signal can be input at any time. *1 (initial setting)
Set value 1	The reset signal can be input only after a protective function has been activated. *2

Notes: *1. If the reset signal is input during operation, inverter output is shut off as long as the signal is present. The electronic thermal relay is initialized.

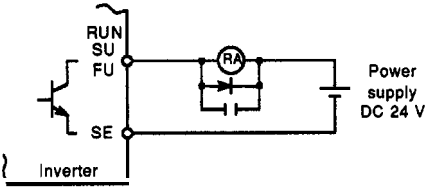
*2. When 1 is set for this parameter, the inverter continues normal operation even if terminals RES and SD are closed during operation.

SELECTING OUTPUT SIGNAL FUNCTION

Output Signal Selection : 76

Any one of "in-operation", "up-to-frequency", and "frequency detection" can be selected and output as the open collector output signal (terminal RUN/SU/FU).

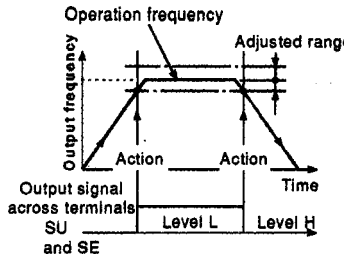
Set value 0	In-operation signal (RUN) (initial setting)
Set value 1	Up-to-frequency signal (SU)
Set value 2	Frequency detection signal (FU)



OUTPUT SIGNAL THRESHOLD LEVEL SETTING

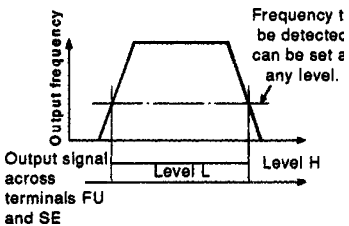
Up to frequency Threshold Level : 42

When output frequency reaches the operation frequency, an output frequency value that shifts the level of output signal can be adjusted in a range of ±100% of the operation frequency.



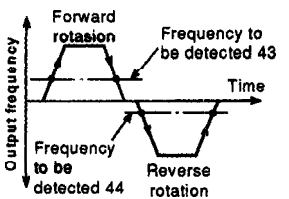
Output Frequency Detection : 43

The user can set an output frequency to be detected in a range from 0 to 360 Hz.
When output frequency exceeds the set frequency value, an output signal from terminals FU and SE is set to level L. If output frequency is under the set value, output signal is set to level H.
This feature can be used as a signal
for actuation and release of a mechanical brake.



Output Frequency Detection at Reversing Rotation : 44

With this function, it is possible to set a different actuating timing with electromagnetic brake for reverse rotation (down) from that for forward rotation (up) in applications such as elevation. The initial value is 9999 that detects output frequency of 6 Hz for both forward and reverse rotation.

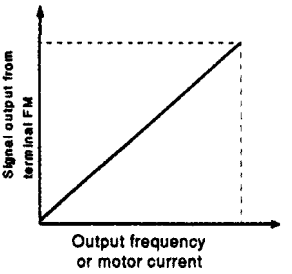


SETTING AND ADJUSTMENT OF OUTPUT SIGNAL FOR MONITORING

FM Output Terminal Function Selection : 70

Output terminal FM is used to connect an indicator that monitors operating status. Output frequency or motor current (output current) can be indicated by selecting either one.

Set value 0	Frequency to be detected. (initial setting)
Set value 1	Motor current (output current)

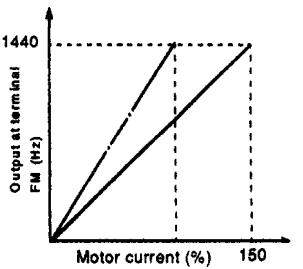


Output Gain for Current Monitoring : 72

If motor current is selected as the output from terminal FM, the relationship between motor current and output signal can be adjusted. Set current (%) against terminal FM's output of 1440 Hz. Output frequency from terminal FM varies in proportion to the current.

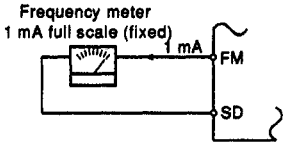
Set value 0–200	Ratio to the rated output current of inverter (%)

Initial setting : 150%



SETTING AND ADJUSTMENT OF OUTPUT SIGNAL FOR MONITORING

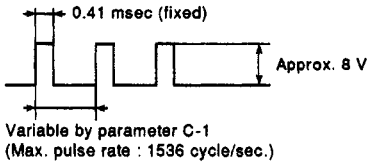
· Frequency Meter Calibration : C-1

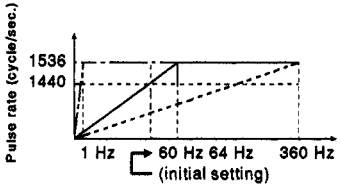


Frequency meter connected to the inverter can be calibrated, without using a calibration potentiometer, by operating PU. (See page 64 for details of the method.)
In function number C-1, press ▲ or ▼ to vary the pulse train cycle. Then average output voltage changes, and the frequency meter is calibrated. (See diagrams below.)

Notes: 1. When the inverter is shipped, it is set so that terminal FM outputs 1440 Hz signal at 60 Hz of output frequency.
2. When measured with a multimeter, voltage across terminals FM and SD indicates approximately 5 V at the maximum output frequency. (Without the frequency indicator.)

· Pulse Signal Output from Terminal FM
Connection of a digital counter allows for digital indication of frequency (Hz) and speed (m/min). (Not actual speed.)





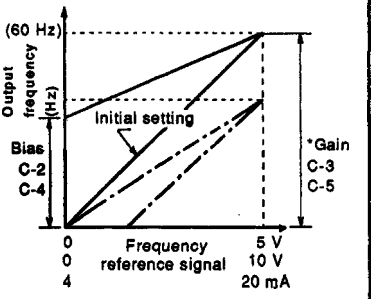
SETTING BIAS AND GAIN FOR FREQUENCY REFERENCE SIGNAL

Bias for frequency reference voltage : C-2

Gain for frequency reference voltage : C-3

Bias for frequency reference current : C-4

Gain for frequency reference current : C-5



The user can set any level of output frequency for frequency (ramp) reference signal (0-5 VDC, 0-10 VDC, or 4-20 mA).

<Bias>

Output frequency can be set for frequency reference signal input through terminals 2 and 5 (or 4 and 5).

<Gain>

Output frequency can be set for frequency reference signal input through terminals 2 and 5 (or 4 and 5). When frequency reference signal is 0, the signal is judged to be 5 V (or 10 V) or 20 mA. Refer to page 29 for details of the setting method.

*When this gain is specified, value set for "frequency at 5 V input voltage" (paremeter number 20) or "frequency at 20 mA input current" (parameter number 39) is changed automatically.

SETTING PARAMETER WRITE PROHIBITION

Parameter WRITE Prohibition : 77

Writing can be prohibited with each parameter, by operating PU.

Note : *Parameter number 77 and 79 can still be written.

Set value 0	Parameter WRITE is possible. (Only when stopped.) (initial setting)
Set value 1	Parameter WRITE is prohibited. *
Set value 2	Parameter WRITE is possible during operation.

ADJUSTMENT OF TONE OF MOTOR SOUND

PWM Mode : 10

Set value	Characteristics of tone of motor sound	
0~6	Constant tone irrespective of output frequency	**Monotone** (the same sound as is generated by other FR-Z series inverter) **Fixed frequency.**
7~13	Tone is constant in the low frequency range, and changes above that range.	
14, 15	Tone changes according to output frequency.	
20~26	Constant tone irrelevant of output frequency	Complex sound
27~33	Tone is constant in low frequency range, and changes above that range.	

SETTING RETRY FUNCTION

Retry Selection 50

Set value 0	No retry function (factory setting)
Set value 1	Retry is made at occurrence of regenerative overvoltage shut-off (OVT)
Set value 2	Retry is made at occurrence of overcurrent shut-off (OCT)
Set value 3	Retry is made at occurrence of regenerative overvoltage shut-off (OVT) and overcurrent shut-off (OCT)

Retry Count at Alarm Occurrence 51

Set Value	Alarm-Time Alarm Signal Output		Retry Count
	Output	Not output	
0	—	—	Retry is not made.
1 to 10	×	○	1 to 10
101 to 110	○	×	1 to 10

Retry Execution Wait Time 52

Wait time for restart after the occurrence of the inverter alarm can be set.

Retry Execution Count Display Erase 53

Reading this parameter provides the accumulative number of restarts made by retry. The set value of 0 erases this accumulative number.

Note: 1. At the time of retry, the PU monitor display changes depending on the operation mode.

External operation: Running frequency is displayed.

PU operation: At the time of retry, the monitor display for the PU operation changes to the set frequency display for the PU operation.

2. If any error other than the error selected by Pr. 50 (retry selection) has occurred during retry execution wait time, OPT remains displayed at a stop after the retry execution wait time has elapsed. (The error code can be read by switching to the error monitoring using the PU.)

3. After the time set in Pr. 52 (retry execution wait time) has elapsed, the inverter automatically starts operation. When this function is used, therefore, the operator must be protected from hazard.

4. The error code (OVT, OCT) that has occurred during retry is not stored. Only the error code at the end of the retry execution count is stored.

SETTING ENGINEERING DISPLAY UNIT DISPLAY

Engineering Display Unit 37

Instead of the frequency (Hz), the monitoring display can be changed to the motor speed (rpm), load shaft speed, line speed (m/min), etc. The motor speed displayed is the synchronous speed converted into the output frequency and does not match the actual speed.

Set value 0	Output frequency (Hz) display (factory setting)
Set values 2 to 10 (number of motor poles is input)	Motor speed (rpm) display
Set values 11 to 9998	Load speed display*

Example

1. Speed display
   When a four-pole motor is driven
   Set value → 4

   Note: As the set value, input an even number (number of motor poles) between 2 and 10. Input of an odd number results in an error.

   * Input the speed at 60Hz. The display may not match the actual speed due to the influence of motor slip. When the motor speed or load speed display has been selected, any function to be set in frequency (Hz) must be set in frequency.

2. Line speed display
   55m/min at 60Hz
   Set value → 5 5

   Note: The line speed at 60Hz must be set. Any value outside the set value range from 11 to 9998 cannot be input. For example, if 10 is input, the speed of a 10-pole motor is displayed.

14. MAINTENANCE AND INSPECTION

The general purpose inverter is a piece of equipment consisting mainly of semiconductor elements. To prevent troubles occurring due to environmental conditions such as high temperature, humidity, dust, intense vibration, etc. or component deterioration, it is necessary to carry out periodic inspection.

- **Precaution during Maintenance and Inspection**

  After the power is switched off, the capacitor remains charged at high voltage for a while. Remove the front cover and wait until the POWER lamp (see page 9) on the printed circuit board is turned off, then (approximately 2 minutes later) begin maintenance and inspection.

- **Inspection Points**

  (1) Daily Inspection

  In general, check the following points during operation.

  (a) The motor operates properly.
  (b) The environment is normal.
  (c) The cooling system is normal.
  (d) There is no unusual vibration or noise.
  (e) There is no overheating or discoloration in any component.

  During operation, check inverter input/output voltage with a multimeter.

  (2) Periodic Inspection

  Check the following periodically with the inverter removed from mains circuit.

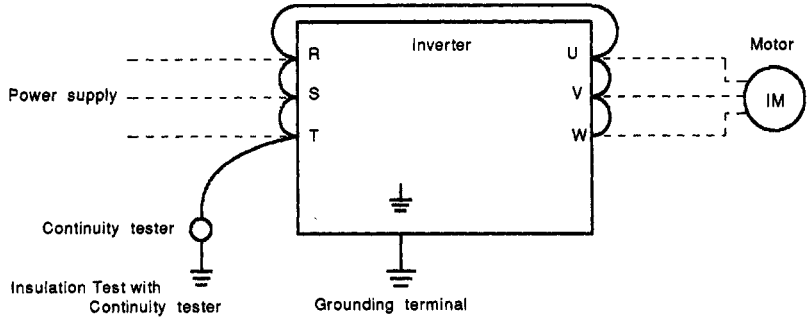
  (a) Check that the cooling system is in good condition. Clean air filters, of cabinet, etc.
  (b) Screws, bolts, nuts, and other fasteners may become loose with time due to vibration, thermal expansion/retraction etc. Check carefully and tighten loose screws and other fasteners.
  (c) Check if any conductor or insulator is corroded or damaged.
  (d) Measure insulation resistance.
  (e) Check the cooling fan, smoothing capacitor, and relay. If any component is defective, replace it.

• Insulation Resistance Test with Continuity tester (Power must be turned off)

(a) Before checking insulation resistance of the external circuit with a continuity tester, disconnect wires from all inverter terminals so that test voltage is not applied to the inverter circuits.

(b) Conduct the insulation resistance test on the inverter main circuit only. Do not conduct the test on the control circuits.

(c) To check the control circuits for continuity, use a multimeter (high resistance range). Do not use a continuity tester or buzzer to check.



- **Replacement of Parts**

  The inverter is assembled using many electronic components such as semiconductor elements. From their physical properties, it is expected that the following parts will deteriorate with time leading to failure or degradation in performance of the inverter. Replace these parts periodically for maintenance purpose.

  (1) Cooling Fan

  The cooling fan is used to cool down heating elements such as semiconductor elements in the main circuit. It has bearings of rated service life of 20,000 hours, however, this varies from 10,000 to 35,000 hours depending on ambient temperature. Accordingly, if your system is continuously operated, it is necessary to replace the cooling fan every two or three years. As well, if an abnormal sound or vibration is detected during inspection, the cooling fan should be replaced.

  (2) Smoothing Capacitor

  A large capacity aluminum electrolytic capacitor is used in the direct current circuit of the main circuit. The capacitor performance degradation is affected by ripple current. Although this degradation depends on ambient temperature and operating conditions, it should be replaced after 5 years of operation if the inverter is used in an air-conditioned, normal environment.

  As degradation of capacitor is greatly accelerated after a specific period, check the capacitor at least once a year (if it is close to the end of service life, it is recommended to check the capacitor every 6 months at the longest). The criteria for visual checking are as follows.

  1. Case condition : expansion of the case side or bottom
  2. Sealing condition : conspicuous curvature, heavy cracks
  3. Safety valve condition : too much expansion or actuation.
  4. Other conditions such as cracks in exterior, discoloration, or leakage.

As a quantitative method, if measured static capacity is 85% of the rated capacity, the capacitor should be replaced. Equipment for measuring capacitance is commercially available.

(3) Relays

Because imperfect contact occurs, relays should be replaced according to total make/break operations (service life).

Refer to the table below for the criteria for replacement of parts used in the inverter. In addition, such components have a short service life, for example, lamps, should be replaced during periodic inspection.

Table 1. Inverter Parts for Replacement

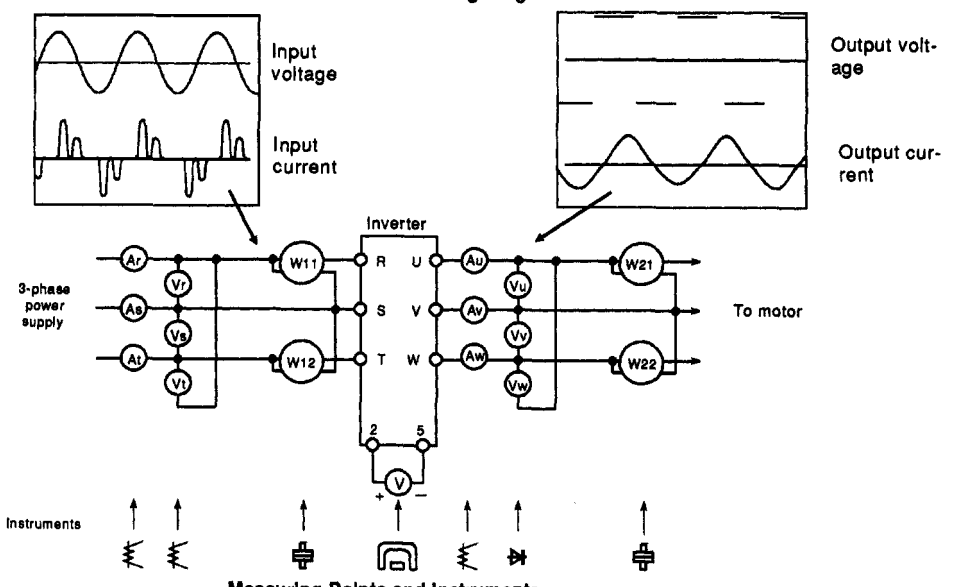
Parts	Typical replacement cycle	Replacement Procedure
Cooling	2-3 years	Replace the parts. (Determine after inspection.)
Smoothing capacitor	5 years	Replace the parts. (Determine after inspection.)
Relays		Determine after inspection.

METHOD OF MEASURING MAIN CIRCUIT VOLTAGE, CURRENT, AND POWER

Voltage and Current Measurements

Since the inverter input, output voltage and current include high harmonic components, data (measurement results) depend on the instruments and circuits used in measurement.

To measure voltage and current with an instrument for commercial frequency application, use the instrument selected from Table 2, and the circuits in the following diagram.



Measuring Points and Instruments

Table 2. Measuring Points and Instruments

Item	Measuring Point	Instrument	Remarks (Criterion)
Line voltage V_1	Across R and S, S and T, and T and R	Moving-iron type	Commercial voltage 180~253V 50/60Hz
Input current I_1	R, S, and T line current	Moving-iron type	
Input power P_1	On R, S, and T, and across R and S, and S and T	Electrodynamic type	$P_1 = W_{11} + W_{12}$
Input power factor Pf_1	To be calculated from the equation shown below, after line voltage, input current and input power are measured. $Pf_1 = \frac{P_1}{\sqrt{3}V_1 - I_1} \times 100\%$		
Output voltage V_2	Across U and V, V and W, and W and U	Rectifier type (Moving-iron type is not acceptable)	Difference between phases is ±1% or less of the maximum output voltage.
Output current I_2	U, V, and W line current	Moving-iron type	Current should be equal to or less than the inverter rated current. Difference between phases is 10% or less.
Output power P_2	On U, V, and W, and across U and V, and V and W	Electrodynamic type	$P_2 = W_{21} + W_{22}$
Input power factor Pf_2	To be calculated from the equation shown below similarly to the case of the input power factor. $Pf_2 = \frac{P_2}{\sqrt{3}V_2 - I_2} \times 100\%$		

Item	Measuring Point	Instrument	Remarks (Criterion)	
Frequency reference signal	Across 2 and 5	Moving coil type (multimeter, etc.) (resistance:50k ohm or larger)	DC0~5 V/0~10 V	'5' for common
	Across 4 and 5		DC4~20 mA	
Power supply for frequency reference	Across 10 and 5	"	DC5 V	
Frequency meter signal	Across FM and SD	"	Approx. 5 VDC at the maximum frequency (without frequency meter)	SD for common
Start signal Selecting signal	Across STF and SD, STR and SD, RH and SD, RM and SD, RL and SD, OH and SD, RT and SD, and AU and SD	"	When opened, 20 to 30 VDC: when closed, 1 VDC or less.	
Reset signal	Across RES and SD			
Output shutoff signal	Across MRS and SD			
Error alarm signal	Across B and C	Moving coil type (such as multimeter)	Continuity checking When normal, B-C is closed: when error, B-C is opened.	

15. TROUBLESHOOTING

If a fault occurs and the inverter does not work properly, determine the cause referring to the following troubleshooting list and apply the remedy. If the cause cannot be identified in accordance with the list, the inverter has a fault, a component is damaged, or if you have any inquiry, contact the nearest service representative.

TROUBLESHOOTING

(1) Troubleshooting by the Parameter Unit Display.

The Parameter Unit Display will indicate the following error codes and possible causes;

Display	Possible cause	Checkup	Remedy
OC1: Acceleration overcurrent *1	Overcurrent	Is acceleration too fast? Is output short-circuited or grounded?	Prolong acceleration time.
OC2: Constant speed overcurrent *1		Is load changed suddenly? Is output short-circuited or grounded?	Eliminate sudden load change.
OC3: Deceleration overcurrent *1		Is deceleration too fast? Is output short-circuited or grounded?	Prolong deceleration time.
OVT: Regenerative overvoltage shutoff (deceleration time set improperly)	Overvoltage in DC output circuit	Is deceleration too fast?	Prolong deceleration time. (It should meet load GD^2.)
THM: Overload alarm	Motor thermal relay	Is motor overloaded?	Lighten load. Change motor/inverter capacity.
THT: Overload alarm	Inverter thermal relay		

(Continued on next page)

Display	Possible cause	Checkup	Remedy
BE: Brake transistor fault *2	The brake transistor is defective.	Is brake operating duty correct?	Reduce load WK^2 and brake operating duty.
OOT: External thermal relay activated	The external thermal relay is activated.	Is motor overheated?	Reduce load and operating duty.
OLT: Stall prevention	Long-lasting action of stall prevention function	Is motor overloaded?	Lighten load. Change motor/inverter capacity.
PE: Parameter memory element error	Capacity of the memory element (EEPROM) is exceeded or the memory element has trouble.	Too many WRITE cycles?	Replace the inverter.

* 1. Overload protection functions when the cooling fan stops (for FR-Z024-1.5K to 3.7K), check the cooling fan, as well (If the cooling fan is normal, it rotates when power is supplied).

* 2. This error is displayed if the system includes the optional brake resistor.

Note: When undervoltage or instantaneous power failure has occurred, alarm display and alarm output are not provided but the inverter itself is protected from faults. Depending on the operating status (load magnitude, during acceleration/deceleration, etc.), overcurrent protection, etc. may be activated when the power is restored.

Problems and Check Points

Problem	Checkups
Motor does not start	(1) Check the main circuit. • Is power applied? (Is the POWER lamp lit?) • Is motor connected correctly? (2) Check input signals. • Is the start signal present? • Are both start signals for forward and reverse rotation present? • Is the frequency reference signal zero? • Are terminals AU and SD closed when the frequency reference signal is in the range from 4 to 20 mA? • Is the output shutoff (across terminals MRS and SD) or reset signal (across terminals RES and SD) ON? (3) Check parameter set values. • Is prevention of reversing rotation (Pr. 78) set? • Is operation mode setting (Pr. 79) correct? • Is bias/gain setting (C-2 to C-5) correct? • Is starting frequency (Pr. 13) higher than the output frequency? • Is any frequency value set for each operation (such as 3-speed operation) zero? Especially check if the maximum frequency is zero. (4) Check load. • Is load too heavy? Is the shaft physically locked? (5) Others • Is an ALARM lamp lit?

Problem	Checkups
Motor rotates in the wrong direction	• Is output phase sequence (U, V, W) correct? • Are 'FWD' and 'REV' signal lines connected to correct terminals?
Motor speed is too high or low with regard to the set frequency	• Is the frequency reference signal correct? (Measure the input signal level.) • Are values set for the following parameter correct? Maximum frequency (Pr.1), frequency at 5 V input (Pr. 20), frequency at 20 mA input (Pr. 39), bias/gain (C-2 to C-5) • Are input signal lines affected by external noise? (If so, use shielded wires.)
Motor acceleration or deceleration is erratic.	• Is time for acceleration or deceleration too short? • Is load too heavy? • Is stall protection activated from excessively large value set for torque boost?
Motor speed is unstable	• Is load changing? • Is the frequency reference signal stable?
Motor current is too large	• Is load too heavy? • Is torque (manual) setting value too large?
Motor speed is not accelerated.	• Is the maximum frequency setting value correct? Is it too small? • Is load too heavy? • Is stall protection activated from excessively large value set for torque boost?

Note: Parameter is abbreviated as Pr.

16. SPECIFICATIONS

Standard Specifications

Model FR-Z024		0.1K	0.2K	0.4K	0.75K	1.5K	2.2K	3.7K
Applicable motor capacity HP (kW) *1		1/8(0.1)	1/4(0.2)	1/2(0.4)	1(0.75)	2(1.5)	3(2.2)	5(3.7)
Output ratings	Rated capacity (kVA) *2	0.3	0.6	1.2	2	3.2	4.4	6.8
	Rated output current (A)	0.8	1.5	3	5	8	11	17
	Rated overload current *3	150% for 60 seconds, 200% for 0.5 seconds (inverse time characteristics)						
	Rated output voltage *4	3-phase 200~230 V						
Power supply	Rated input AC voltage	3-phase 200~230 V, 50/60 Hz						
	Permissive voltage	180~253 V, 50/60 Hz						
	Permissive frequency regulation	±5%						
	Power supply capacity (kVA) *5	0.4	0.8	1.5	2.5	4.5	5.5	9
	Rated input current (A)	1.2	2.1	4.3	7.1	11.4	15.7	24.3
Protective structure (JEM 1030)		Enclosed type (IP 20)						
Cooling system		Self-cooling				Fan cooling		
Weight (Kg)		0.7	0.7	0.9	1.1	1.5	2.2	2.2

Notes :

*1. The listed values are the maximum applicable capacity for a standard squirrel-cage type motor (4P).
In general, the rated current of applicable motor shall not exceed the rated output current.

*2. The listed rated capacity is for 230 V output voltage.

*3. The value (%) for the rated overload current is its ratio to the rated output current of the inverter.

*4. The output voltage cannot exceed the supply voltage.

*5. The power supply capacity varies depending on impedance of the power circuit (including input reactor and power line). Provide power supply capacity of the specified value or larger.

Common Specifications

Controller specifications	Control method		Sinusoidal PWM control system
	Output frequency		0.5 to 360 Hz (starting frequency: 0.5 to 10 Hz variable)
	Frequency resolution	Digital input	0.01 Hz (less than 100 Hz), 0.1 Hz (100 Hz or higher), when set on PU
		Analog input	1/500 of maximum frequency (at 5 V input), 1/1000 of maximum frequency (at 10 V or 4~20 mA input)
	Frequency accuracy	Digital setting	Max. 0.01% of preset output frequency (−10 to +50 °C), when set on PU
		Analog setting	Max. ±0.5% of maximum output frequency (25°C ±10°C)
	Voltage/frequency characteristic		Base frequency selectable within 50~360 Hz, constant torque or reduced torque pattern is selectable.
	Torque boost		Manual torque boost setting (0~30%) available
	Acceleration/deceleration characteristic		0.04 seconds and from 0.1 to 3600 seconds can be set. (Acceleration and deceleration times may be set individually.) Linear or S-shape modes are selectable.
	Braking torque	Regenerative braking torque *6	0.1K, 0.2K...150% Min., 0.4K, 0.75K...100% Min., 1.5K...50% Min., 2.2K, 3.7K...20% Min.
		Dc dynamic brake	Actuation frequency (0 to 60 Hz), actuation time (0 to 10 sec.), and voltage (0 to 10%) can be set.
	Stall prevention actuation level		Actuation current level (0 to 200%) can be set.

Operational specifications	Frequency reference signal		0 to 5 VDC, 0 to 10 VDC, 4 to 20 mA
	Input signals	Start signal	Forward and reverse rotation can be individually set.
		Multi-speed selection	Up to 7 speeds can be selected (frequency can be varied during operation).
		Second acceleration/ deceleration time setting	0.04 seconds and 0.1 to 3600 seconds can be set. (Acceleration and deceleration times may be set individually.)
		Current input selection	Selection of input of frequency reference current signal from 4 to 20 mA
		External thermal relay input selection	Selection of input of external thermal relay actuating signal
		Output shutoff	Inverter output shutoff
		Reset	Actuated and retained protective function is canceled.
	Output signal	Operation status	In-operation (RUN), up-to-frequency (SU), and frequency detection (FU) can be selected.
		Alarm	1b contact point signal output
		Monitor *7	For analog (full scale 1 mA) or digital (1440 Hz/60 Hz) indicator
	Built-in function		Max./Min. frequency limit setting, bias/gain setting, electronic thermal relay for constant torque motor, operation mode setting, output thermal function selection, output signal actuating point setting. FM thermal output selection, sub-motor second basic function setting (torque boost, base frequency, acceleration/deceleration time), frequency meter calibration, etc.

Display	Parameter unit	Operation status	Output frequency, motor current *8, setting frequency, direction of rotation
		Alarm	Information on actuated protective function is displayed. For alarm codes all stored.
	LED display		Power on (POWER), actuated protective function (ALARM)
Protective, alarm and warming functions			Overcurrent shut-off (during acceleration, deceleration, constant-speed), regenerative overvoltage shut-off, overload shut-off (electronic overcurrent protector), brake transistor alarm, undervoltage*10, instantaneous power failure*10, external thermal relay activation, stall prevention
Environmental conditions	Ambient temperature		−10 to +50°C (non-freezing)
	Ambient humidity		90% RH (non-condensing)
	Storage temperature *9		−20 to +65°C
	Atmosphere		To be free from corrosive gases, inflammable gases, oil mist, or dust.
	Altitude, vibration		Below 1000 m above the sea level, less than 5.9 m/s^2 (0.6 G). (Conforms to JIS C0911.)

*6. Magnitude of braking torque is not continuous regenerative torque, but shown as the average deceleration torque (which varies according to motor loss) when the motor alone was decelerated from 60 Hz in the shortest time. BU type brake unit is not compatible. If a brake resistor is used, braking torque for models 0.4K to 1.5K is approximately 150%, and that for models 2.2K and 3.7K is approximately 100%.

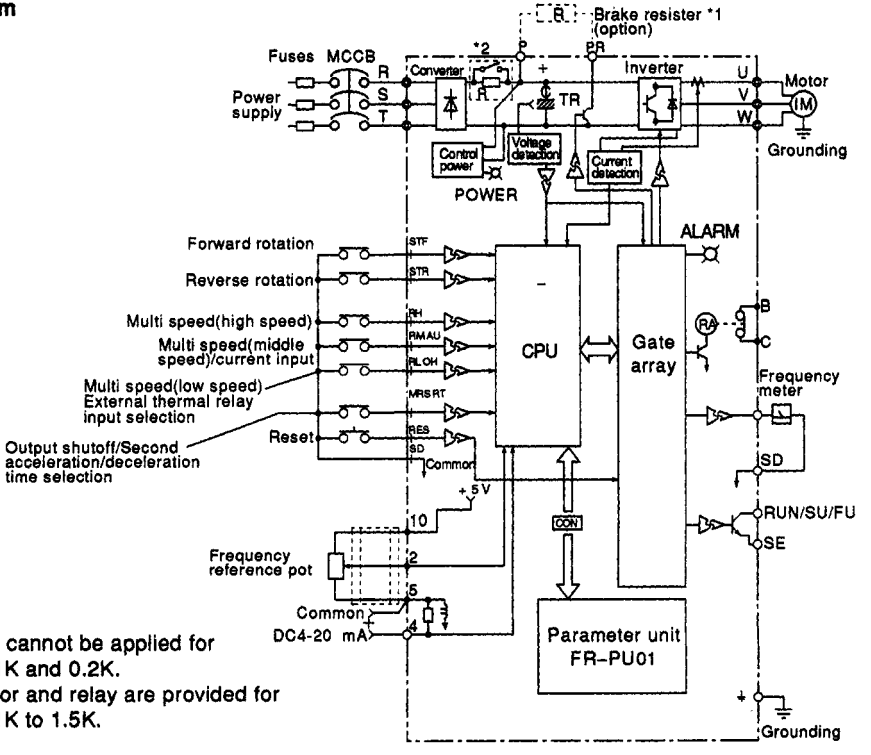
*7. Monitor signal for output frequency or for motor current can be selected. Use the parameter unit (parameter number 70) to select output signal specification.

*8. Motor current may not be correctly indicated depending on operation status (during acceleration/deceleration, light load, etc.).

*9. This temperature range is applicable for short time temperature change such as transportation.

*10. When undervoltage or instantaneous power failure has occurred, alarm display and alarm output are not provided but the inverter itself is protected.

Block Diagram



*1 This resistor cannot be applied for FR-Z024-0.1K and 0.2K.

*2 These resistor and relay are provided for FR-Z024-0.1K to 1.5K.

Terminals for Wiring

	Symbol	Terminal name	Description
Main circuit	R.S.T	AC power supply input terminals	Connected to commercial power supply of 200~ 230 V, 50/60 Hz
	U.V.W	Inverter output terminals	Connected to three-phase squirrel cage motor.
	P.PR	Brake resistor terminals	Connected to exclusive external brake resistor (option).
	⏚	Grounding terminal	Inverter chassis grounding terminal
Control circuit (input signal)	STF	Forward start input signal terminal	Motor starts rotating in forward direction when STF and SD are short-circuit. Stops when opened.
	STR	Reversal start input signal terminal	Motor starts rotating in reverse direction when STR and SD are short-circuit. Stops when opened.
	RH	Multi-speed selection terminal (high speed)	Up to 7 operation speeds are available from combinations of short-circuiting across terminals RH and SD, RM and SD, and RL and SD. Terminals RM and RL are used as a current input selection (AU) and external thermal relay selection (OH), respectively. When the inverter is shipped, multi-speed setting is selected. Operation by frequency reference signal of 4 to 20 mADC is possible only when terminals AU and SD are short-circuited. (See page 92.) If an external thermal relay contact point signal is input across terminals OH and SD, the inverter stop is controlled by thermal relay operation (contact point open). (See page 80.)
	RM/AU*	Multi-speed selection terminal (middle speed) or current input selection terminal	
	RL/OH*	Multi-speed selection terminal (low speed) or external thermal relay selection terminal	

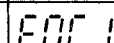
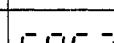
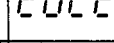
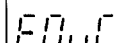
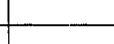
	Symbol	Terminal name	Description
Control circuit (input signal)	MRS/RT *	Inverter output shutoff or 2nd acceleration/deceleration time selection	Inverter output is shut off by short-circuiting terminals MRS and SD. Terminal MRS is commonly used as the 2nd acceleration/deceleration time selection (RT). When the inverter is shipped, it is set to output shutoff. By short-circuiting terminals RT and SD, 2nd acceleration/deceleration time can be selected. (See page 81.)
	RES	Reset signal input terminal	Used to cancel actuated and retained protective circuit. Short-circuit terminals RES and SD for more than 0.1 seconds, then open them.
	SD	Common terminal for contact input	Common for contact output signal and frequency indicator. Insulated from common circuit of inverter control circuit.
	10	Power supply terminal for frequency reference	5 VDC. Allowable maximum load current: 10 mA
	2	Frequency reference terminal (voltage signal)	When 0 to 5 VDC (or 0 to 10 VDC) is input, the output frequency is at the maximum at 5 V (or 10 V) of the input voltage. The output is in proportion to the input. To select 5 V or 10 V, use the parameter unit. (See page 77.) Input resistance: 10k ohm. Allowable max. voltage: 10 V (or 20 V)
	5	Common terminal for frequency reference	Common for frequency reference input signal. Not insulated from common circuit of the control circuit. Do not ground this terminal.
	4	Frequency reference terminal (current signal)	4 to 20 mADC input. When the inverter is shipped, it is adjusted to output 0 Hz at 4 mA and 60 Hz at 20 mA. Allowable max. input current: 30 mA. Input impedance: 250 ohm.

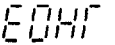
	Symbol	Terminal name	Description
Control circuit (output signals)	B.C	Error alarm output terminal	'1b' contact output indicating that base has been shut off by the inverter protection function. Error: B and C open, normal: B and C close. Contact capacity: 230 VAC, 0.3 A: 30 VDC,0.3A
	RUN SU FU	Operating status output terminals	One of the following three types of output can be selected and used. • For the inverter in-operation (RUN) signal terminal, the signal is 'L' when the inverter output frequency is higher than start frequency, and 'H' without output and during DC dynamic brake operation. • For the up-to-frequency signal terminal, the signal is 'L' when the inverter output frequency reaches the preset frequency. The signal is 'H' during acceleration/deceleration, or stopped. • For frequency detection terminal, the signal falls to 'L' if current exceeds the optionally set detection frequency, and 'H' if current is under that frequency. Open collector output. Allowable load: 24 VDC, 0.1A
	SE	Open collector common terminal	Common to RUN, SU, and FU. Insulated from common circuit of the inverter control circuit.
	FM	Frequency indicator connection terminal	When the inverter is shipped, the signal is set so that about 5 VDC (FM•SD opened) is output when the inverter output frequency is 60 Hz. The output voltage is proportional to the output frequency and has pulse train waveform that allows connection of a digital indicator. Pulse of 8 V is output at a frequency of 1440 Hz/60 Hz (See page 95.)

Note : * With these terminals, select required specification from two types of input specifications for use. The selection is made from the parameter unit. Multi-speed selection has priority over the frequency reference analog signal.

Protective Functions

The inverter has the following protective function built in it to protect itself. If a protective function is activated, inverter output is shut off, an alarm message is displayed, and an alarm signal is output. The motor stops after coasting. To restart the motor, the inverter should be reset.

Function		Description		Indication (Parameter unit)
Overcurrent shut off		When 200% or more of the inverter rated output current flows during acceleration, deceleration or constant speed operation, this protective circuit is activated to stop the inverter. This protective function is also activated when the cooling fan in the inverter fails.	In acceleration	 (OC1)
			In constant speed operation	 (OC2)
			In deceleration	 (OC3)
Regenerative overvoltage shut off		If regenerative energy at braking causes DC voltage of the main circuit in the inverter to exceed the rated value, the protective circuit will be activated to shut off the inverter output.		 (OVT)
Overload shut off Electronic thermal relay (*1)	Motor	The electronic thermal relay in the inverter detects overheating of motor caused by overload or reduction in cooling capacity during constant speed operation, and shuts off inverter output. Provide a thermal relay on the inverter output side when running a multipole motor or several motors.		 (THM)
	Inverter	When 150% or more of the inverter rated output current flows but the overcurrent shut off is not activated (under 200%), the electronic thermal relay functions and shuts off inverter output to protect the output transistor.		 (THT)

Function	Description	Indication (Parameter unit)
External thermal relay signal input (*2)	When an external thermal relay for motor overheat protection or thermal relay embedded in motor is activated (contact open), inverter output will be shut off. Even if the relay contact point is restored, the inverter will not be restarted unless it is reset.	 (OHT)
Brake transistor fault detection (*3)	If trouble occurs with brake transistor, for example, amount of regenerative energy from the motor is excessively large when connecting the optional brake resistor, this function detects it and shuts off inverter output.	 (BE)
Stall prevention	When 150% (*4) or more of the inverter rated current flows to the motor during acceleration (or constant speed operation), this function stops increasing frequency (or reduces frequency) until the load current decreases, to prevent the inverter from overcurrent tripping. When the load current has decreased below 150%, this function allows the inverter to return to and continue the previous operation. During deceleration, in contrast, if braking duty exceeds the rated value, this function stops reducing frequency to prevent the regenerative overvoltage shut off from being activated. When the regenerative energy is lower, this function continues deceleration again.	Monitor mode indicator lamp flickers.
Memory Error	Memory in the inverter is corrupted.	(PE)

Notes : *1. By resetting the inverter, the electronic thermal relay is initialized.

*2. This function is effective only when 'external thermal relay input' is selected. (See page 80.)

*3. This function is activated only when the optional brake resistor is connected.

*4. The user can change the stall prevention threshold level, which is set to 150% when the inverter is supplied.

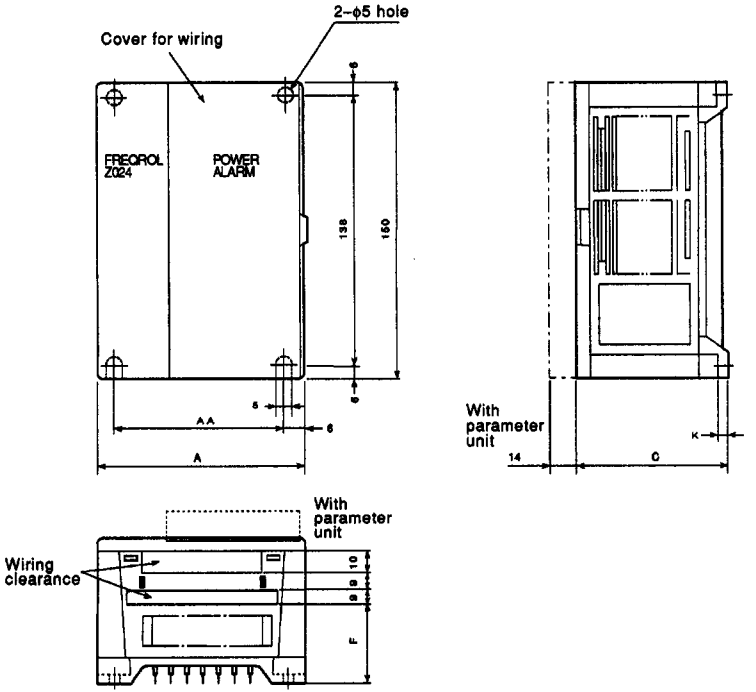
Retainment of alarm output signal ... If the user opens the magnetic contactor (MC) at the power supply side of the inverter when a protective function has been activated, power supply for the control circuit of the inverter is disconnected and alarm output is not retained. If the alarm output must be maintained, arrange a sequence that externally maintains the alarm output signal.

Alarm indication ... When a protective function is activated, the ALARM indicator lamp will be lit. If the user use the parameter unit, the readout displays the above indication automatically.

Resetting method ... When a protective function is activated, inverter output shut off is maintained, and the inverter will not restart unless it is reset. Turn off the power supply, then turn it on again, or close reset terminals RES and SD for more than 0.1 seconds, then open them. If terminals RES and SD are kept closed. 'Err." flickers on the readout signaling reset condition.

17. DIMENSIONS

EXTERNAL DIMENSIONS

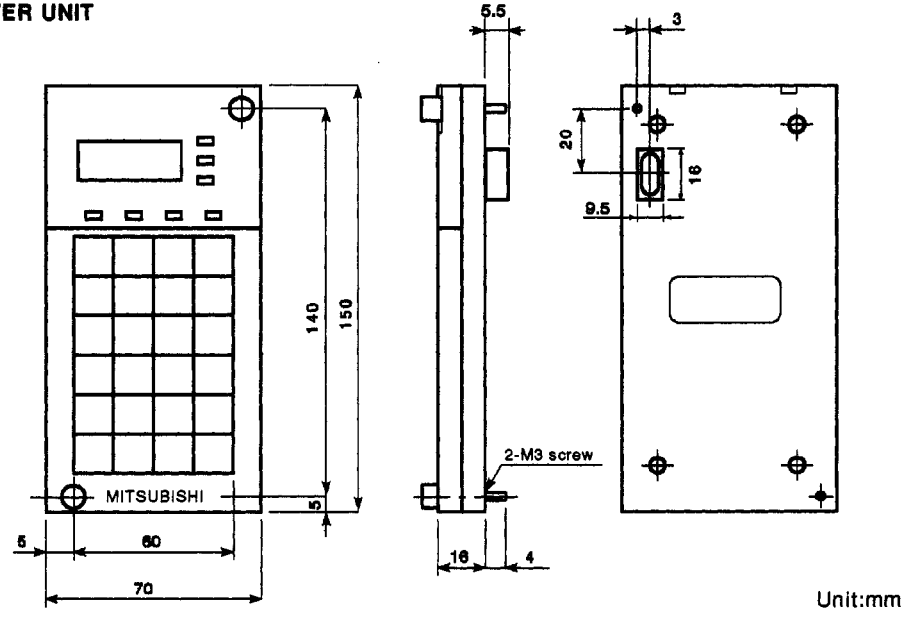


(unit:mm)

Inverter modes	A	AA	C	F	K
FR-Z024-0.1K	105	93	66	31	4
FR-Z024-0.2K	105	93	66	31	4
FR-Z024-0.4K	105	93	76	41	5
FR-Z024-0.75K	140	128	86	51	5
FR-Z024-1.5K	140	128	116	81	5
FR-Z024-2.2K	200	188	126	84.5	5
FR-Z024-3.7K	200	188	126	84.5	5

Note : FR-Z024-1.5K., 2.2K and 3.7K have a cooling fan.

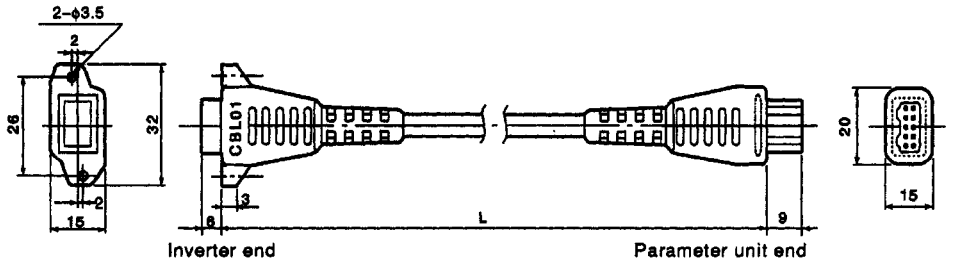
PARAMETER UNIT



Unit:mm

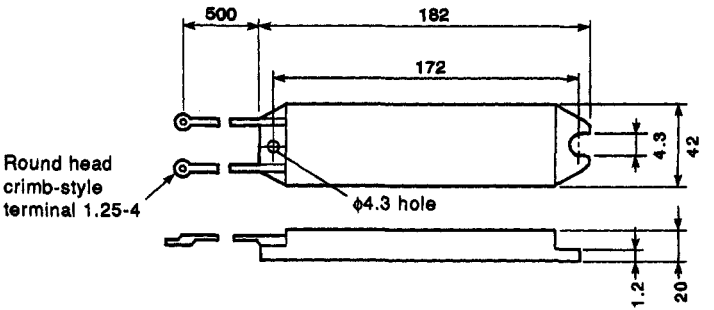
Item	Description		
Ambient temperature	Operating temperature	-10~+50°C	
	Storage temperature	-20~+65°C	
Ambient humidity	Less than 90% RH		To be free from condensation
Environment	To be free oil mist, corrosive gas, and dense dust		
Cooling method	Self-cooling		
Connect to	FR-Z series inverter or special cable (FR-CBL)		
Power supply	Fed from FR-Z series inverter		
Connection	Direct installation to FR-Z series inverter or connection with special cable		
Display	4-digit 7-segment LED readout and indicator lamps		
Operation	24 operation keys (protected with polyurethane film)		
Outside dimensions	150 mm (high)× 70 mm (wide)× 16 mm (deep)		
Weight	0.1 kg		
Max. WRITE cycles	100,000 cycles		

Connection Cable (option)



Model	L (m)
FR-CBL01	1
FR-CBL03	3
FR-CBL05	5

Brake Resistor MRS type



Inverter modes	Brake resistor model	Allowable braking duty
FR-Z024-0.4K	MRS 120 W 200	3%
FR-Z024-0.75K	MRS 120 W 100	
FR-Z024-1.5K	MRS 120 W 60	
FR-Z024-2.2K	MRS 120 W 60	
FR-Z024-3.7K	MRS 120 W 40	

Note : FR-Z024-0.1K and 0.2K cannot use any brake resistor

18. SELECTION OF PERIPHERAL DEVICES

Selection of Peripheral Devices Devices

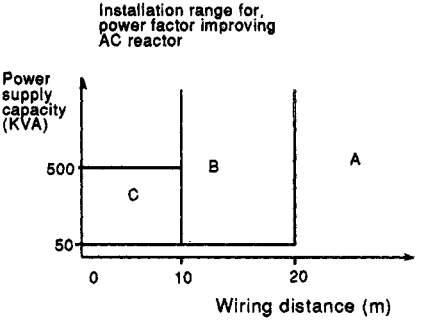
Inverter model	Input Fuses*			MCCB	Magnetic contactor (MC)			Wire size (AWG)
	Type of Fuses(manufactur)	Class	Amps		A	B	C	R.S.T.U.V .W
FR-Z024-0.1K	NON-3 (Buss)	K5	3	NF30 5A	S-K11	S-K18	S-K20	14
FR-Z024-0.2K	NON-5 (Buss)		5	NF30 5A	S-K18	S-K20	S-K20	
FR-Z024-0.4K	NON-10 (Buss)		10	NF30 5A	S-K18	S-K21	S-K21	
FR-Z024-0.75K	NON-20 (Buss)		20	NF30 10A	S-K18	S-K21	S-K21	
FR-Z024-1.5K	NON-30(Buss) or OT1(GOULD)		30	NF30 15A	S-K21	S-K25	S-K50	
FR-Z024-2.2K	NON-40(Buss) or OT2(GOULD)		40	NF30 15A	S-K11,S-K12			
FR-Z024-3.7K	NON-60(Buss) or OT6(GOULD)		60	NF30 30A	S-K20			12

* Use UL recognized fuses.

Notes : 1. Select MCCB model according to the power supply capacity.

2. Motor cable size applies to 20 m or less wiring distance.

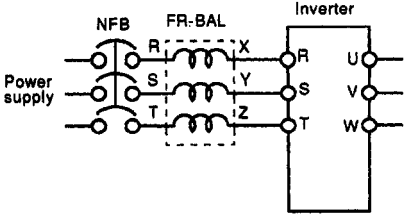
3. The inverter power supply circuit does not require an MC, however, if you install an MC, it should be selected in accordance with power supply capacity and wiring distance as shown in the illustration on the right. Applicable ranges A, B, and C should be observed. For FR-Z024-0.1K to 1.5K, select S-K 10 if a power factor improving AC reactor FR-BAL is used.



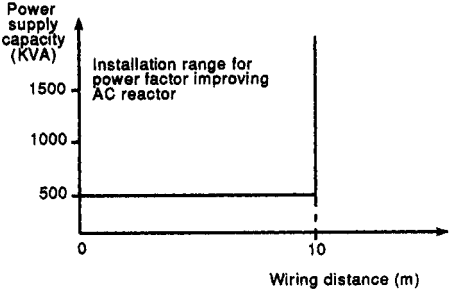
*Motor wiring distance must be under 200 m.

Note : It is assumed that the above recommended wire size is used for the power supply circuit.

- If the inverter is connected close to a large capacity power transformer (capacity: 500 kVA or larger, wiring distance: 10 m or smaller) or a phase advancer capacitor is used, an excessive peak current may flow in the power supply input circuit. That may cause damage to converter: In such a case be sure to install the power factor improving AC reactor FR-BAL (option).



Note : For FR-Z024-0.1K and 0.2K, use a 0.4 kW power factor improving reactor.



REGENERATIVE BRAKING TORQUE (REFERENCE VALUES)

- Without External Brake Resistor

Inverter Capacity (K)	Short-Duration Regenerative Braking Torque (%) Boost Factory Setting						
	6(Hz)	10(Hz)	20(Hz)	30(Hz)	40(Hz)	50(Hz)	60(Hz)
0.1	280	280	260	160	130	120	110
0.2	320	320	300	150	120	100	90
0.4	320	320	250	130	100	70	65
0.75	250	250	200	100	70	55	50
1.5	160	160	80	50	40	35	30
2.2	250	230	110	55	40	35	25
3.7	190	190	55	35	25	20	20

- With MRS External Brake Resistor (Option)

Inverter Capacity (K)	Brake Resistor Type	Short-Duration Regenerative Braking Torque (%) Boost Factory Setting						
		6(Hz)	10(Hz)	20(Hz)	30(Hz)	40(Hz)	50(Hz)	60(Hz)
0.4	MRS 120W 200	290	290	150	150	150	150	150
0.75	MRS 120W 100	250	250	130	130	130	110	100
1.5	MRS 120W 60	160	160	110	110	110	90	80
2.2	MRS 120W 60	250	240	160	160	160	130	120
3.7	MRS 120W 40	190	190	120	130	110	100	90

Note: 1. The braking torque depends on the efficiency, etc of the motor.

2. The above data indicates reference values for use of the inverter with the Mitsubishi's standard squirrel-cage motor (4P).

3. The FR-Z024-0.1K and 0.2K cannot used with the brake resistor.

Field wiring reference table

Inverter model	Type of Terminal blocks	Screw torque (Pound-inch)	Wire Size	Crimping terminals(*1)	Crimping tools
FR-Z024-0.1K	Main circuit	9.7	AWG14	32957 or 32958	47387
	Control circuit	7.3	AWG24	321017	46121
FR-Z024-0.2K	Main circuit	9.7	AWG14	32957 or 32958	47387
	Control circuit	7.3	AWG24	321017	46121
FR-Z024-0.4K	Main circuit	9.7	AWG14	32957 or 32958	47387
	Control circuit	7.3	AWG24	321017	46121
FR-Z024-0.75K	Main circuit	9.7	AWG14	32957 or 32958	47387
	Control circuit	7.3	AWG24	321017	46121
FR-Z024-1.5K	Main circuit	9.7	AWG14	32957 or 32958	47387
	Control circuit	7.3	AWG24	321017	46121
FR-Z024-2.2K	Main circuit	14.6	AWG14	32959	47387
	Control circuit	7.3	AWG24	321017	46121
FR-Z024-3.7K	Main circuit	14.6	AWG10	32968	59239
	Control circuit	7.3	AWG24	321017	46121

Note (*1): Manufacturer : AMP INCORPORATED, HARRISBURG, PA 17105
Phone : 717-564-0100 TWX : 510-657-4

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