

MITSUBISHI VECTOR INVERTER

FREQROL-V 200

HIGH PRECISION & HIGH RESPONSE VECTOR INVERTER

FR-V220E-1.5K~45K

FR-V240E-1.5K~45K

FREQROL

— INSTRUCTION MANUAL —

Thank you for choosing the Mitsubishi Vector Inverter.

This instruction manual gives handling information and precautions for use of this equipment. Incorrect handling might cause an unexpected fault. Before using the inverter, please read this manual carefully to use the equipment to its optimum.

Please forward this manual to the end user.

This section is specifically about safety matters

Do not attempt to install, operate, maintain or inspect the inverter until you have read through this instruction manual and appended documents carefully and can use the equipment correctly. Do not use the inverter until you have a full knowledge of the equipment, safety information and instructions.

In this instruction manual, the safety instruction levels are classified into "WARNING" and "CAUTION".

 **WARNING**

Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.

 **CAUTION**

Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

SAFETY INSTRUCTIONS

1. Electric Shock Prevention

WARNING

-  While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
-  Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals and charging part and get an electric shock.
-  If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
-  Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for no residual voltage with a tester or the like.
-  Use a class 3 or higher earthing method to earth the inverter.
-  Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
-  Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
-  Operate the switches with dry hands to prevent an electric shock.
-  Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock

2. Fire Prevention

CAUTION

-  Mount the inverter on an incombustible. Installing the inverter directly on or near a combustible could lead to a fire.
-  If the inverter has become faulty, switch power off on the inverter's power supply side. A continuous flow of a large current could cause a fire.
-  Do not connect the resistor directly to the DC terminals P (+), N (-). This could cause a fire.

3. Injury Prevention

CAUTION

-  Apply only the voltage specified in the instruction manual to each terminal to prevent burst, damage, etc.
-  Ensure that the cables are connected to the correct terminals. Otherwise, burst, damage, etc. may occur.
-  Always make sure that polarity is correct to prevent burst, damage, etc.
-  While power is on or for some time after power-off, do not touch the inverter as it is hot and you may get burnt.

4. Additional instructions

To prevent injury, damage or product failure, please note the following points.

(1) Transportation and mounting

CAUTION

-  Take care when carrying products, use correct lifting gear.
-  Do not stack the inverter boxes higher than the number recommended.
-  Ensure that installation position and material can withstand the weight of the inverter. Install according to the information in the Instruction Manual.
-  Do not operate if the inverter is damaged or has parts missing.
-  Do not lift the inverter with the front cover attached. It may fall off.
-  Do not stand or reset heavy objects on the inverter.
-  Check the inverter mounting orientation is correct.
-  Prevent any dust, wire fragments or other foreign bodies from dropping into the inverter during wiring up and commissioning.
-  Do not drop the inverter, or subject it to impact.
-  Use the inverter under the following environmental conditions:

Environment	Conditions
Ambient temperature	-10°C to +50°C (14°F to 122°F) (non-freezing) (-10°C to +40°C (14°F to 104°F) when the dust-protection structure attachment is used)
Ambient humidity	90%RH or less (non-condensing)
Storage temperature	-20 to +65°C* (4°F to 149°F)
Ambience	Indoors, free from corrosive gas, flammable gas, oil mist, dust and dirt.
Altitude, vibration	Max. 1000m (3280.8 feet) above sea level, 5.9m/s ² (0.6G) or less (conforming to JIS C 0911)

* Temperatures applicable for a short time, e.g. in transit.

(2) Wiring

CAUTION

-  Do not fit capacitive equipment such as a power factor correction capacitor, noise filter or surge suppressor to the output of the inverter.
-  The connection orientation of the output cables U, V, W to the motor will affect the direction of rotation of the motor.

(3) Trial run

CAUTION

-  Check all parameter, and ensure that the machine will not be damaged by sudden start-up.

(4) Operation

⚠ CAUTION

- ⚠ The stop key is valid only when function setting has been made. Prepare an emergency stop switch separately.
- ⚠ Switch off the start signal when resetting the inverter. Failure to do so may start the motor immediately after reset.
- ⚠ The load used must be a three-phase induction motor. If any other electrical equipment is connected to the inverter output, the equipment may be damaged.
- ⚠ Do not modify the equipment.

⚠ CAUTION

- ⚠ The electronic motor thermal protection does not guarantee to prevent motor burn out.
- ⚠ Do not use a contactor on the inverter input for frequent starting/stopping of the inverter. Use control signals.
- ⚠ To reduce the effect of mains conducted electromagnetic interference, use a RFI noise filter. Take care to ensure that electromagnetic radiation from the inverter does not damage or affect the operation of nearby electrical equipment.
- ⚠ An inverter-driven 400V class motor should be insulation-enhanced. Surge voltages attributable to the wiring constant may occur at motor terminals, deteriorating the insulation of the motor.
- ⚠ When parameter clear or all parameter clear is performed, each parameter returns to the factory setting. Re-set the required parameters before starting operation.
- ⚠ The inverter can be easily set for high-speed operation. Before changing its setting, fully examine the performances of the motor and machine.
- ⚠ In addition to the inverter's holding function, install a holding device to ensure safety.

(5) Emergency stop

⚠ CAUTION

- ⚠ Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter fails.

(6) Maintenance, inspection and parts replacement

⚠ CAUTION

- ⚠ Do not carry out a megger (insulation resistance) test on the control circuit of the inverter.

(7) Disposing of the inverter

⚠ CAUTION

- ⚠ Treat as industrial waste.

(8) General instructions

Many of the diagrams and drawings in this instruction manual show the inverter without a cover, or partially open. Never run the inverter like this. Always replace the cover and follow this instruction manual when operate the inverter.

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1. OUTLINE

2. OPERATION

3. PARAMETERS

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6. PRECAUTIONS FOR SELECTING

7. SPECIFICATIONS

1. OUTLINE

This chapter provides the “outline” of this product.
Always read the precautions, etc. before starting use.

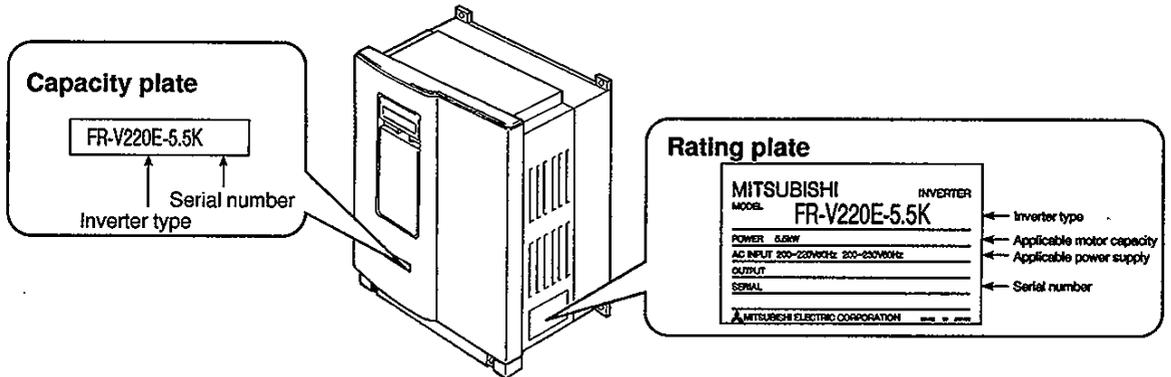
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1.1 PRECAUTIONS FOR OPERATION

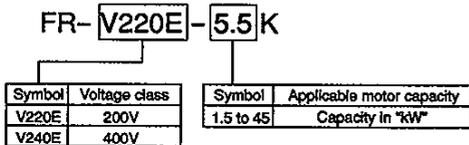
1.1.1 Pre-operation Procedure

1. Unpacking and product check

Unpack the inverter and check the capacity plate on the front cover and the rating plate on the inverter side face to ensure that the type and output rating agree with your order and the inverter is intact.

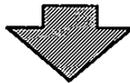


• Type definition



• Accessory Instruction manual

If you have found any discrepancy, damage, etc., please contact your sales representative.



2. Preparations of instruments and parts required for operation

Instruments and parts to be prepared depend on how the inverter is operated. For required parts, etc. see Section 2 "Instruments and parts to be prepared for operation".



3. Installation

To operate the inverter with high performance for a long time, install the inverter in a proper place, in a correct direction, and with proper clearances. (See page 9.)

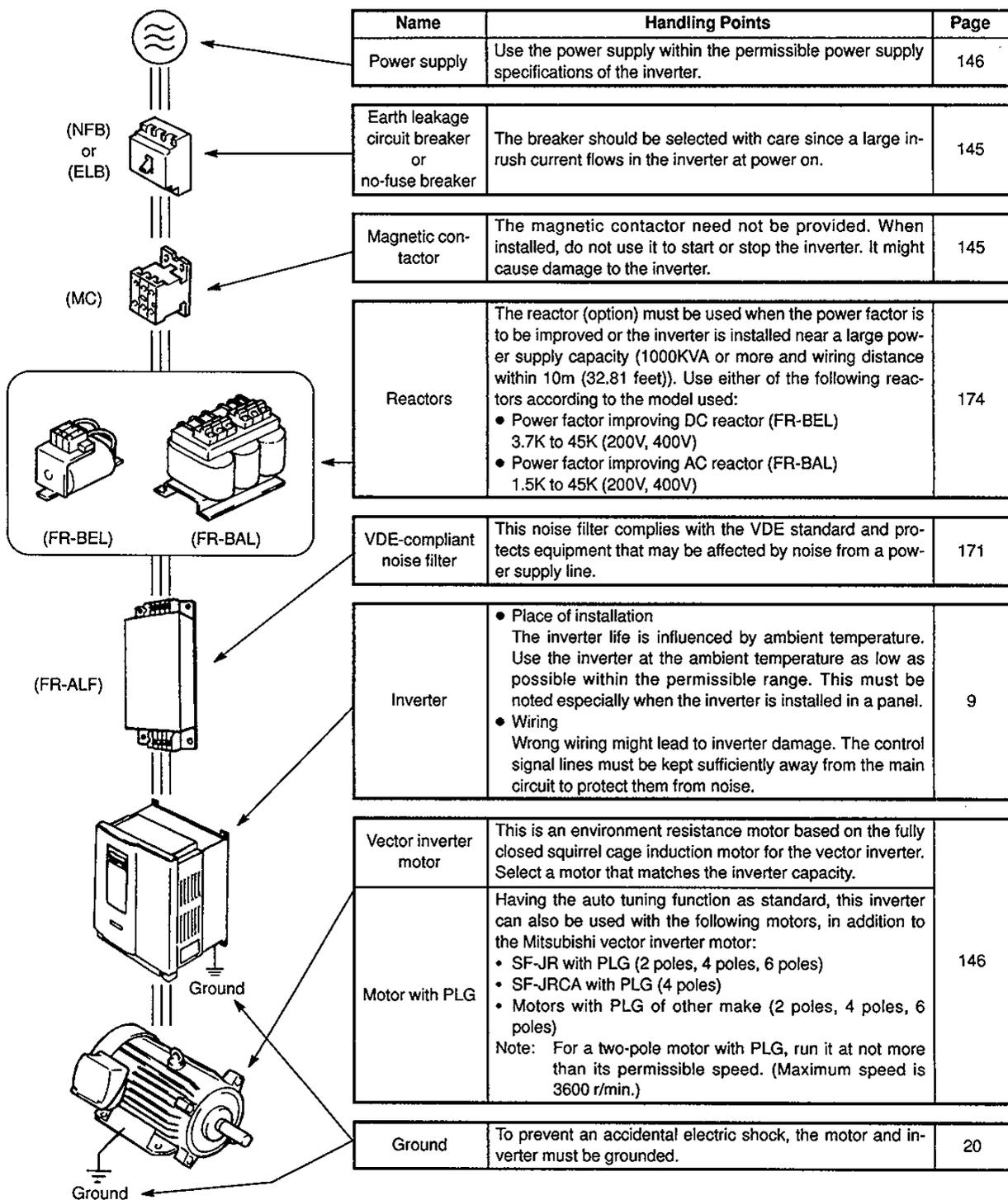
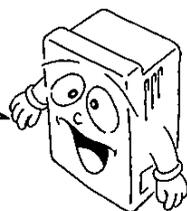


4. Wiring

Connect the power supply, motor and operation signals (control signals) to the terminal block. If they are connected improperly, the inverter itself may be damaged. (See page 11.)

1.1.2 Precautions for Handling the Inverter

Incorrect handling might cause the inverter to operate improperly, its life to be reduced considerably, and in the worst case, the inverter to be damaged. Please handle the inverter properly in accordance with the information on each section as well as the precautions and instructions of this manual.

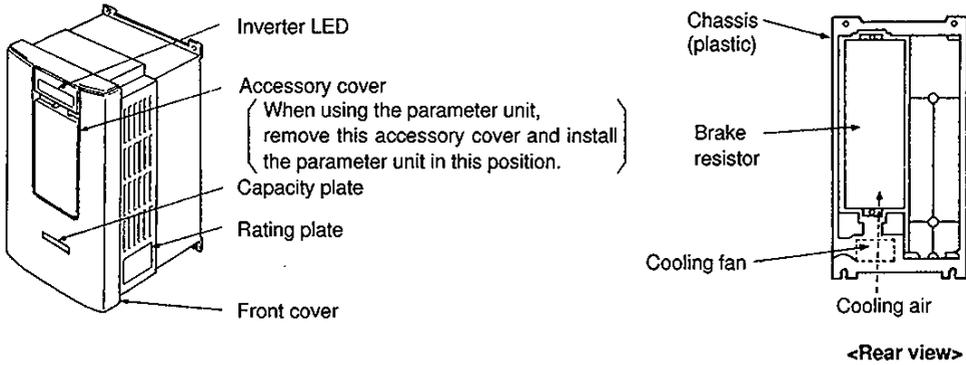


1.2 STRUCTURE

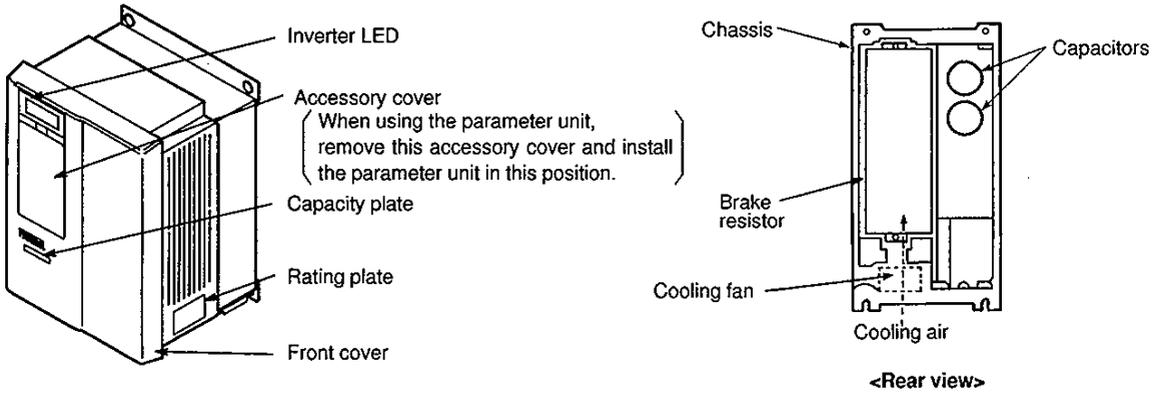
1.2.1 Structure

For the location of the charge lamp, see the terminal block layout diagram on page 155.

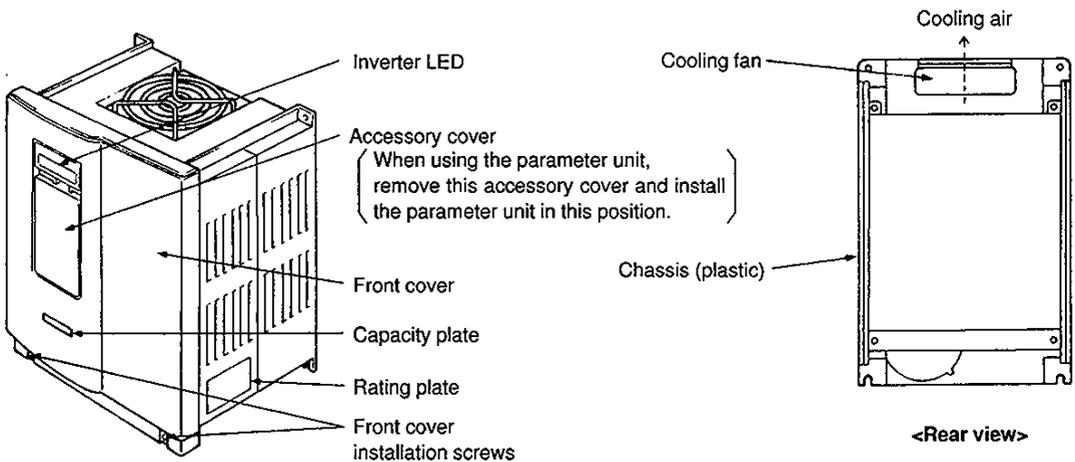
■ FR-V220E-1.5K, 2.2K, FR-V240E-1.5K, 2.2K



■ FR-V220E-3.7K to 7.5K, FR-V240E-3.7K, 5.5K (7.5K is not equipped with the brake resistor.)

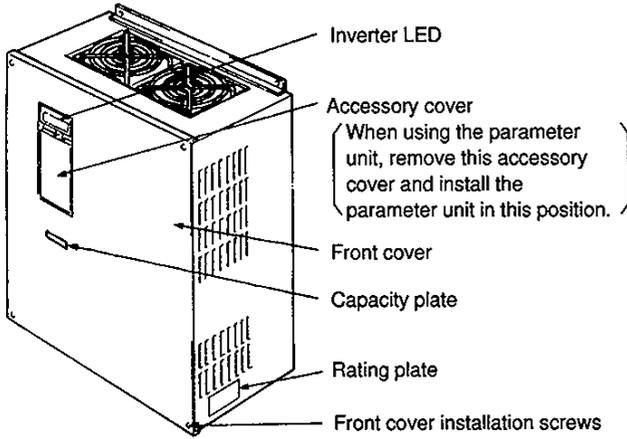


■ FR-V220E-11K to 18.5K, FR-V240E-7.5K to 18.5K (Not equipped with the brake resistor.)



■ **FR-V220E-22K to 45K, FR-V240E-22K to 45K**

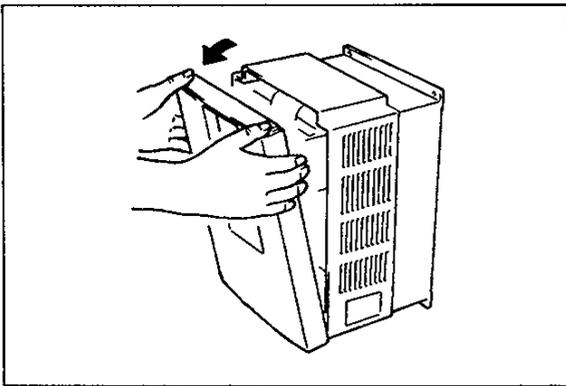
(The chassis and cover are made of steel. These models are not equipped with the brake resistor.)



1.2.2 Removal and Reinstallation of the Front Cover

■ **FR-V220E-1.5K to 7.5K, FR-V240E-1.5K to 5.5K**

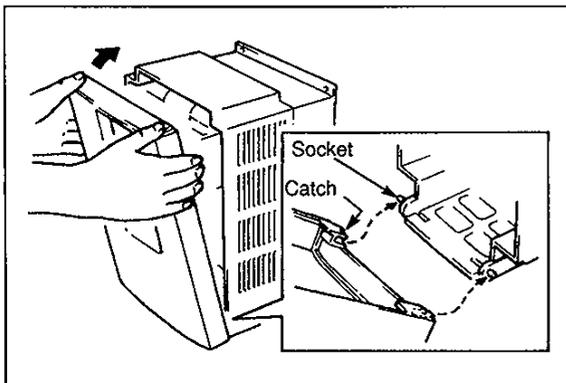
● **Removal**



- 1) Hold both sides of the front cover top.
- 2) Pull the cover toward you.

(The cover may be removed with the parameter unit on.)

● **Reinstallation**

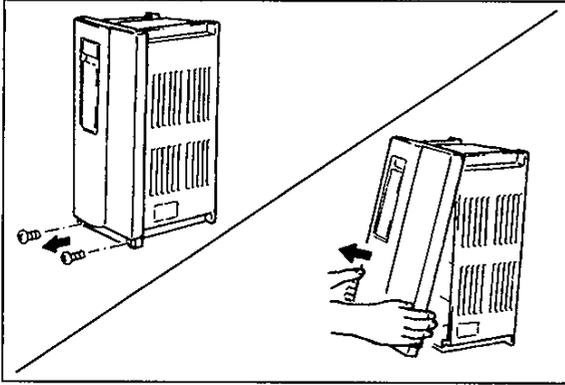


- 1) Fit the sockets at the cover bottom onto the catches of the inverter.
- 2) Using the catches as supports, securely press the cover against the inverter.

(The cover may be reinstalled with the parameter unit on.)

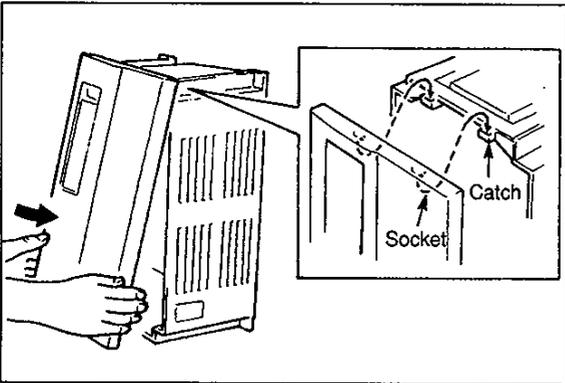
■ FR-V220E-11K to 18.5K, FR-V240E-7.5K to 18.5K

● Removal

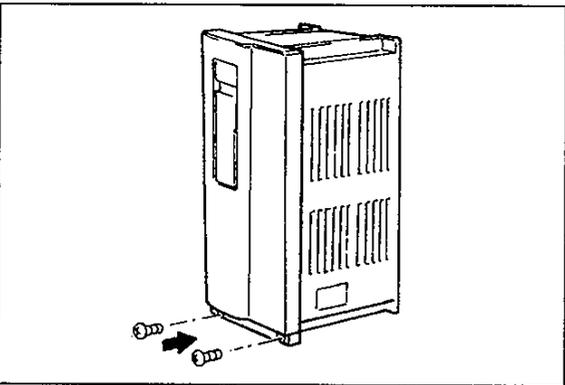


- 1) Remove the two installation screws at the bottom of the front cover.
- 2) Hold both ends of the front cover bottom and pull the cover toward you.

● Reinstallation



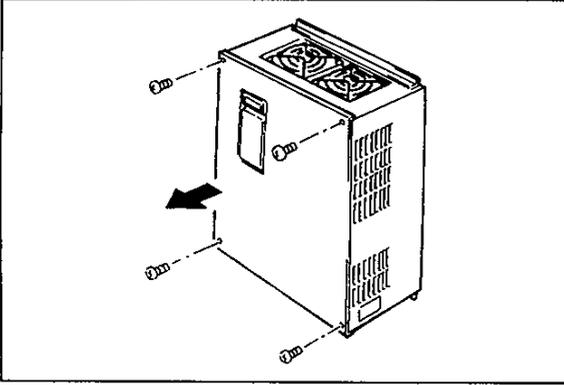
- 1) Fit the catches on the inside of the front cover top into the sockets of the inverter.
- 2) Securely press the cover against the inverter.



- 3) Fix the cover with the bottom installation screws.

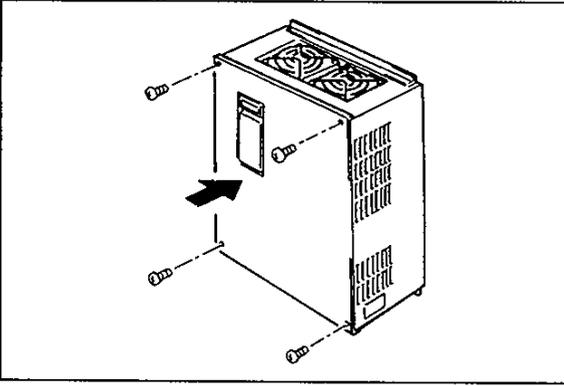
■ FR-V220E-22K to 45K, FR-V240E-22K to 45K

● Removal



1) Remove the front cover installation screws.

● Reinstallation



1) Fix the front cover with the installation screws.

Note: 1. Check that the front cover has been reinstalled securely.

2. The serial number is printed on the capacity plate on the front cover and the rating plate on the inverter side face. Before reinstalling the front cover, check the serial numbers are the same.

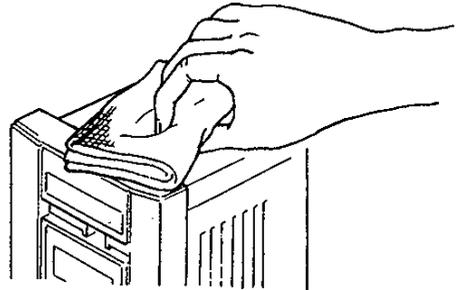
Example:

Capacity plate A46152
Rating plate A46152 001

↑
3-digit serial number

If the inverter surface is stained with fingermarks, oil, etc. during removal and/or reinstallation work, gently clean it with a cloth soaked with a neutral detergent or ethanol.

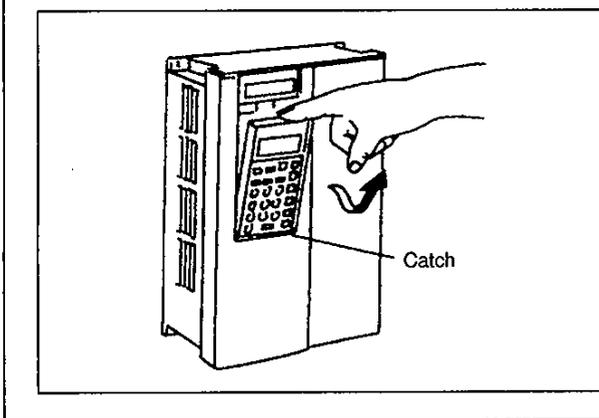
Note: 1. Do not use any solvent, such as acetone, benzene, toluene and alcohol, that will cause the inverter surface to dissolve and the paint to peel.
2. Do not clean the lens of the inverter LED with a detergent or alcohol.



1.2.3 Removal and Reinstallation of the Parameter Unit

When using the FR-PU02V (optional parameter unit), install and remove with the following method. To ensure safety, remove and reinstall the parameter unit after switching the power off.

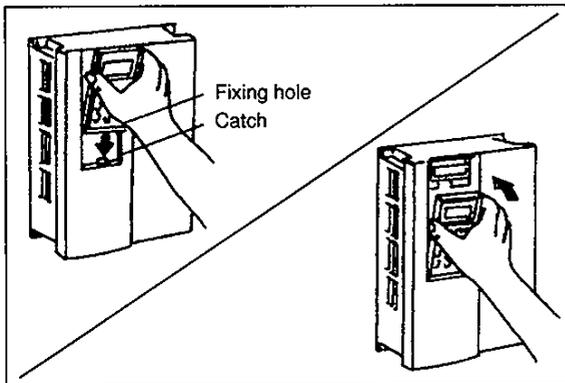
■ Removal



- 1) Hold down the top of the parameter unit and pull the parameter unit toward you, using the catch as a support.

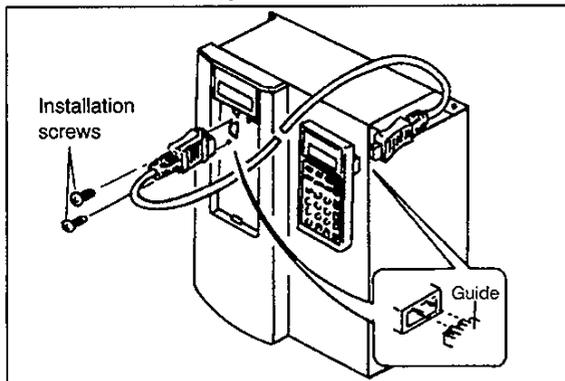
■ Reinstallation

● Direct installation onto the inverter



- 1) After fitting the fixing hole of the parameter unit (PU) on the catch of the cover, push the parameter unit into the inverter, using the catch as a support.

● Installation using the cable (option)



- 1) Securely insert one connector of the cable into the connector of the inverter and the other cable connector into the PU connector. Insert the cable connector along the guides of the inverter or PU connector. (If the orientation is incorrect, the inverter may be damaged.)
- 2) After plugging the cable connector into the inverter connector, fix it securely with the installation screws.

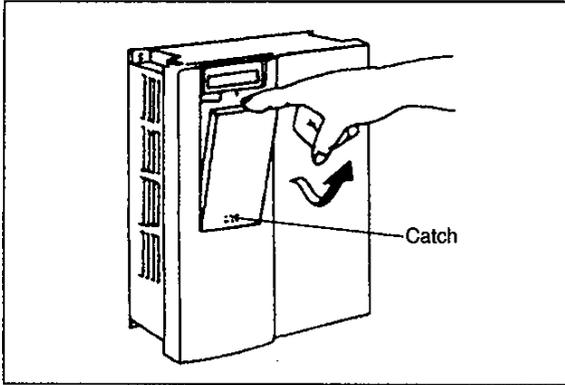
Note: 1. The parameter unit must only be installed on the inverter when the front cover is fitted.
2. During installation, do not apply force to the display (liquid crystal).

1.2.4 Removal and Reinstallation of the Accessory Cover

To ensure safety, remove and reinstall the accessory cover after switching the power off.

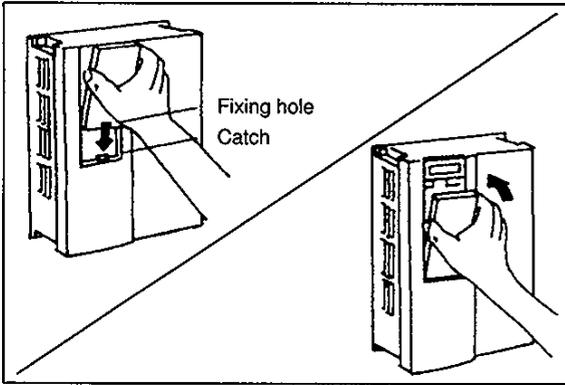
■ Removal

● Removal



- 1) As in the removal of the parameter unit, hold down the top and pull the accessory cover toward you, using the catch as a support.

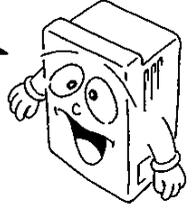
● Reinstallation



- 1) After fitting the fixing hole onto the catch of the cover, push it into the inverter.

1.3 INSTALLATION AND WIRING

Incorrect installation may cause the inverter to fail. Install in accordance with the instructions in this section.



1.3.1 Operating Environmental Conditions

Always install the inverter in the environmental conditions described below.

When mounting the inverter on a machine, etc., take special measures to prevent vibration.

Item	Specifications
Ambient temperature	-10°C to +50°C (14°F to 122°F) (non-freezing), -10°C to +40°C (14°F to 104°F) when the dust-protection structure attachment (FR-ACV) is used.
Ambient humidity	90%RH or less (non-condensing)
Storage temperature	-20°C to +65°C (4°F to 149°F) (Temperature applicable to short duration such as in transit)
Ambience	Indoors (No corrosive gas, flammable gas, oil mist, dust and dirt.)
Altitude/vibration	Below 1000m (3280.80 feet), 0.6G or less (conforms to JIS C 0911)

1.3.2 Direction and Clearance

(1) Direction of Installation

Install the inverter vertically so that the letters "FR-V200E" are located at the front.

(2) Space

For adequate heat dissipation, leave sufficient space around the inverter.

(3) It is possible to place the heat sink of the inverter outside the panel to greatly reduce heat generated.

Note: 1. Use the optional mounting bracket (FR-ACN) (see page 170). The mounting area should be machined to the panel cutting dimensions on page 159.

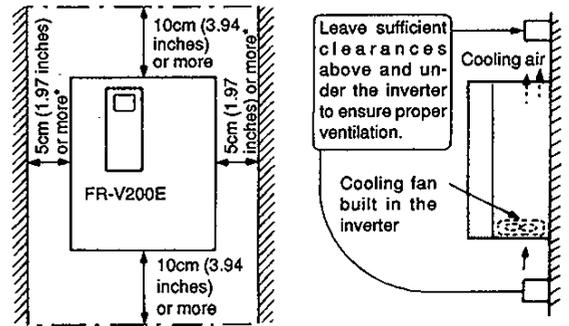
2. The cooling section outside the panel has a cooling fan. Do not use the inverter in damp, oil mist or dust environments.

(4) When the inverter is installed in a panel

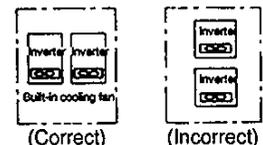
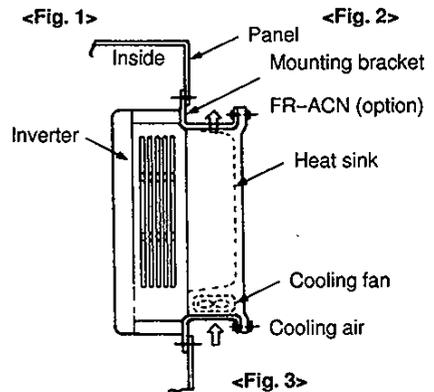
Note: 1. When the inverter is installed in a panel, determine the cooling method and panel dimensions so that the ambient temperature of the inverter is within the permissible range.

2. When two or more inverters are installed or a ventilation fan is mounted in the panel, extreme care must be taken to keep the ambient temperature of the inverter below the permissible value. If the inverters and/or ventilation fan is installed in an improper position, the ambient temperature will rise and ventilation will be reduced.

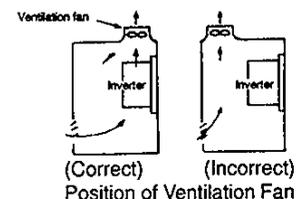
3. Like the inverter, protect the parameter unit from direct sunlight, high temperature and high humidity. Also avoid oil mist, flammable gases, etc.



*: 1cm (0.39 inches) or more for model 2.2K or less

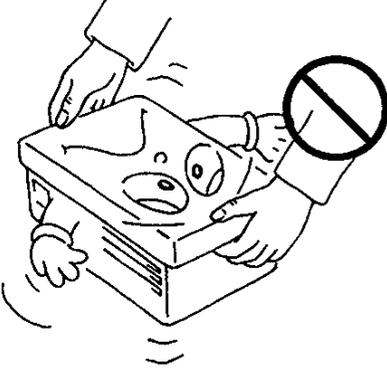


Installation of Two or More Inverters



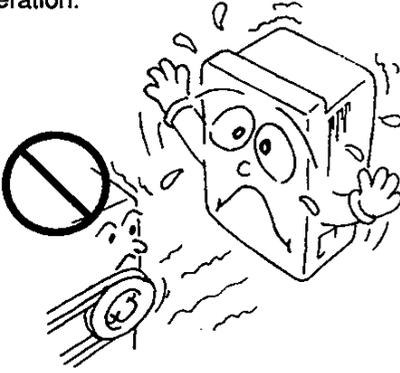
Handle the unit carefully.

The inverter is made of plastic parts. Handle the inverter gently to protect it from damage. Also, hold the unit carefully so that force is not applied to its front cover only.



Install the inverter where it is not subjected to vibration.

Also take the vibration of a trolley, press, etc. into consideration.



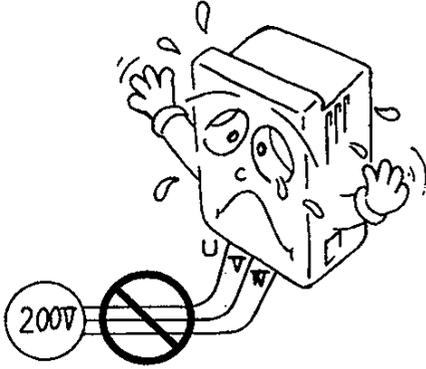
Install the inverter on a non-combustible surface.

The discharge resistor for brake is fitted on the rear side of the 5.5K or lower model. If high-duty operation is repeated, the surface temperature of the discharge resistor may rise to high temperature (approx. 150°C (302°F) maximum). Install the above models on a non-combustible surface (e.g. metal). For the 7.5K or higher model, also install it on a non-combustible surface to prepare for an unlikely accident.

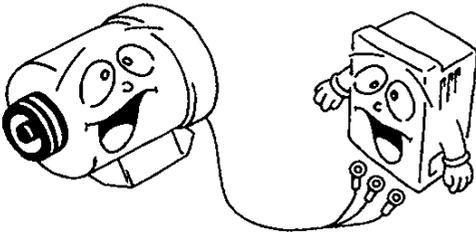


1.3.3 Wiring Instructions

The power must not be applied to the output terminals (U, V, W), otherwise the inverter will be damaged.

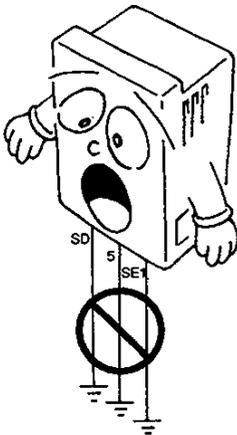


Use sleeved solderless terminals for the power supply and motor cables.



The following terminals, which are isolated from each other, must not be grounded.

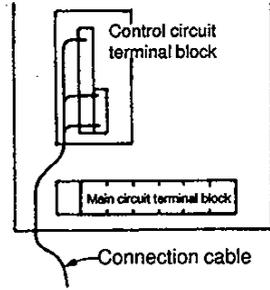
Common terminals SD, 5 and SE1 of the control circuit



Use shielded or twisted cables for connection to the control circuit terminals.

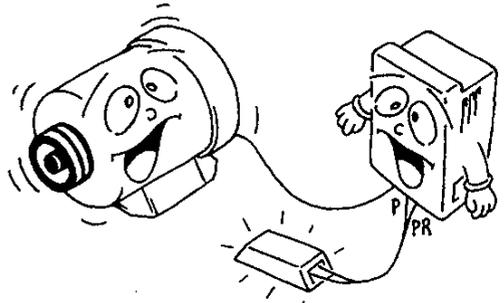
Run them away from the main and power circuits (such as the 200V relay sequence circuit).

Run the connection cable using the space on the left-hand side of the main circuit terminal block.



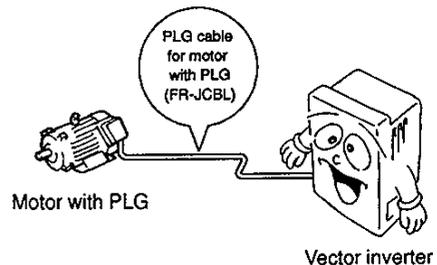
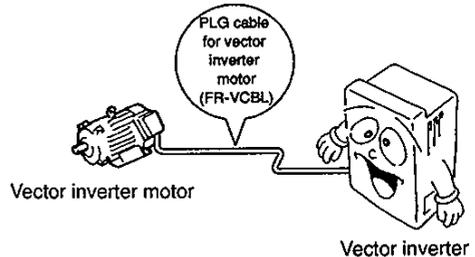
Connect only the recommended optional brake resistor between the terminals P and PR. (1.5K to 5.5K)

In addition, these terminals must not be shorted.



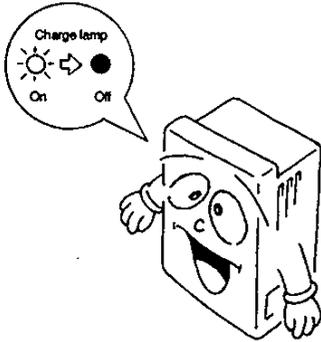
Use the adequate PLG cable to connect the motor and inverter.

Use the PLG cable (FR-VCBL) for connection of the vector inverter motor (SF-VR series) and the inverter. Use the PLG cable (FR-JCBL) for connection of the Mitsubishi motor with PLG and the inverter.



When rewiring after operation, make sure that the inverter LED has gone off and that the charge lamp on the printed circuit board or beside the terminal block has gone off.

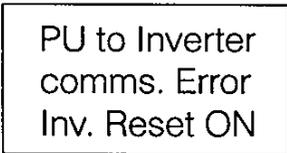
After the power is shut off, there is a dangerous voltage in the capacitor. Before starting work, ensure that the charge lamp is off.



The cable size for connection to the control circuit terminals should be 0.75mm².

If the cable size used is 1.25mm² or more, the front cover may expand, resulting in a contact fault of the parameter unit. This fault is indicated by the following message displayed on the parameter unit and disables operation from the parameter unit. Run the cables so that they do not occupy much of the control box terminal block space.

Parameter unit display

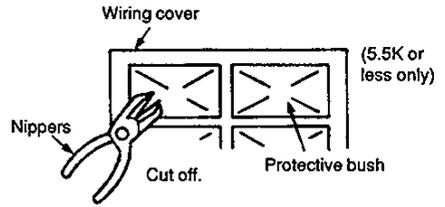


During wiring, do not leave wire off-cuts in the inverter.

Wire offcuts will cause an alarm, failure or fault. Keep the inverter clean. The inverter should always be clean.

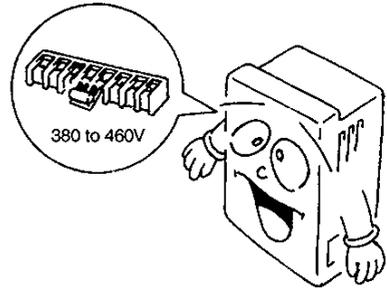


Cut off the wiring cover (protective bush) windows using nippers or a cutter when running the cables.



When the power supply voltage is special (380 to 460V), change the connection of the jumper in the internal transformer. (400V class 7.5K to 45K)

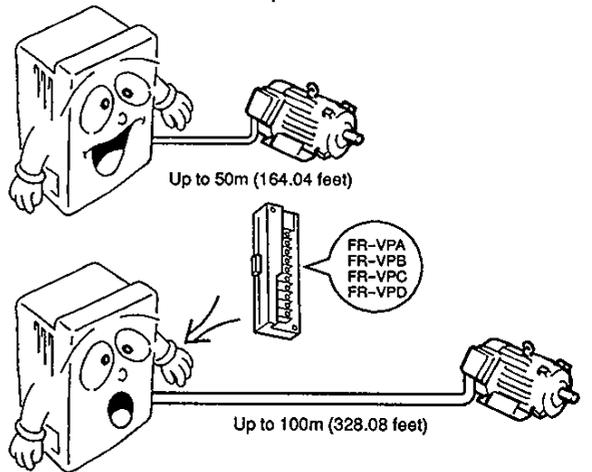
If the connection is not changed, the inverter will be damaged. (Refer to page 18.)



For the main circuit, use large diameter cables to keep a voltage drop within 2%.

When the wiring distance between the inverter and motor is long, especially during low frequency output, a voltage drop over the main circuit cables will reduce the motor torque.

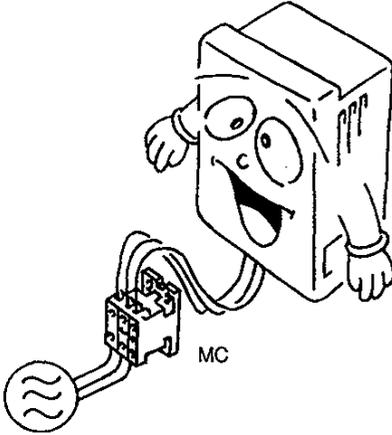
Due to a voltage drop, the maximum wiring length of the PLG signal line should be 50m (164.04 feet). For longer distances up to 100m (328.08 feet), use the FR-VPA, VPB or VPC option.



1.3.4 Design Information to be Checked

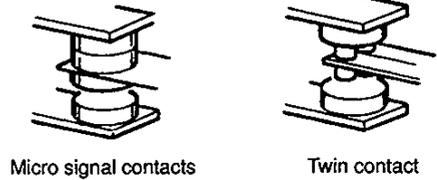
When a machine restart is to be prevented at power restoration after a power failure, provide a magnetic contactor MC in the primary circuit of the inverter and also make up a sequence which will not switch on the start signal.

If the start signal (start switch) remains on after a power failure, the inverter will automatically restart as soon as the power is restored.

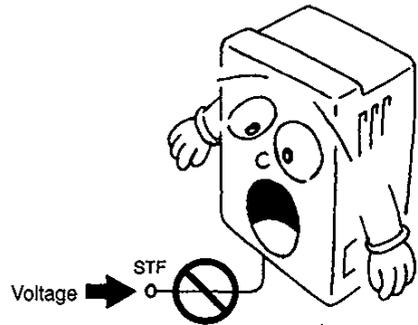


When connecting the control circuit to a power supply separately from the main circuit, make up a circuit so that when the power supply terminals R1 (L₁₁), S1 (L₂₁) for the control circuit are switched off, the main circuit power supply terminals R (L₁), S (L₂), T (L₃) are also switched off.

Since input signals to the control circuit are at a low level, use two parallel micro signal contacts or twin contact for contact inputs to prevent a contact fault.

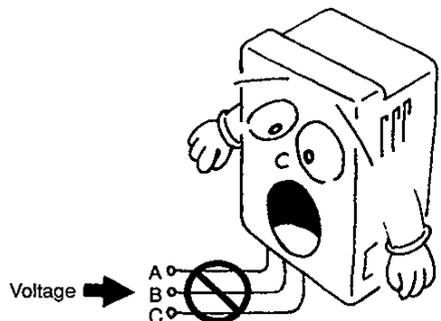


Do not apply a voltage to the contact input terminals (e.g. STF) of the control circuit.



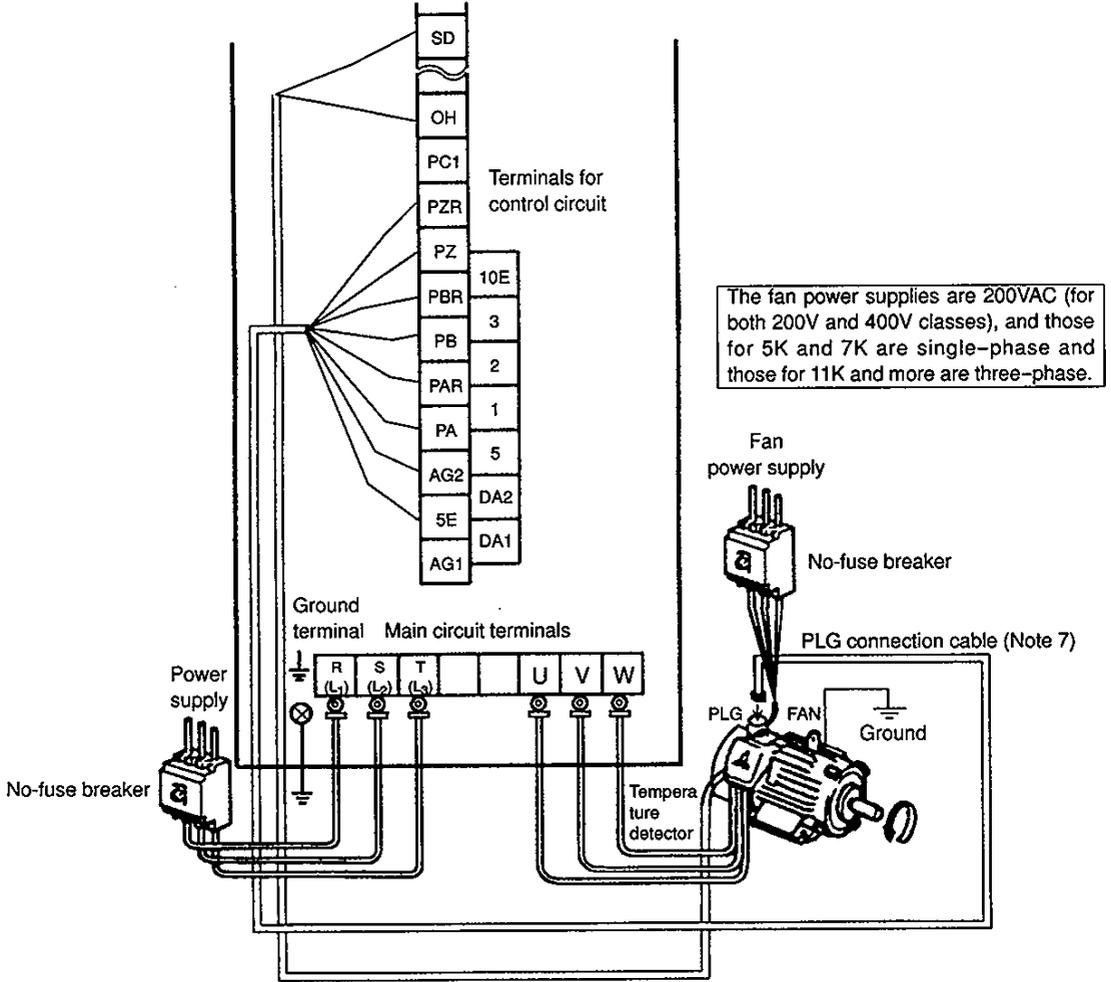
Do not apply a voltage directly to the alarm output signal terminals (A, B, C).

Apply a voltage via a relay coil, lamp, etc. to these terminals.



1.3.5 Wiring of the Main Circuit (For the terminal block arrangement, see page 155.)

Connection of the power supply and motor



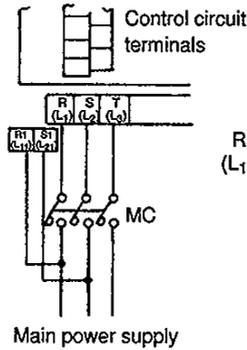
- Note: 1. The power supply cables must be connected to R (L₁), S (L₂), T (L₃).
 2. If they are connected to U, V, W, the inverter will be damaged. (Phase sequence need not be matched.)
 3. Connect the motor to U, V, W.
 4. In the above connection, turning on the forward rotation switch (signal) rotates the motor in the counterclockwise (arrow) direction when viewed from the motor shaft.
 5. Wrong connection of terminals U, V, W will cause wrong rotation.
 6. Please connect the FAN power supply, the phase order must be checked to ensure the air is flowing over the motor from the back.
 7. Use the PLG connection cable adequate for the motor.
 1) Use the FR-VCBL (option) for connection with the vector inverter motor (SF-VR series).
 2) Use the FR-JCBL (option) for connection with the Mitsubishi motor with PLG.

Connecting the control circuit to a power supply separately from the main circuit

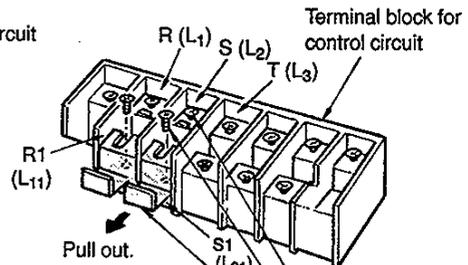
If the magnetic contactor (MC) in the inverter power supply is opened when the protective circuit is operated, the inverter control circuit power is lost and the alarm output signal cannot be kept on. To keep the alarm signal on, terminals R1 (L₁₁) and S1 (L₂₁) are available. In this case, connect the power supply terminals R1 (L₁₁) and S1 (L₂₁) of the control circuit to the primary side of the MC.

• **Model FR-V220(V240)E-1.5K/2.2K**

<Circuit diagram>



<Connection procedure>

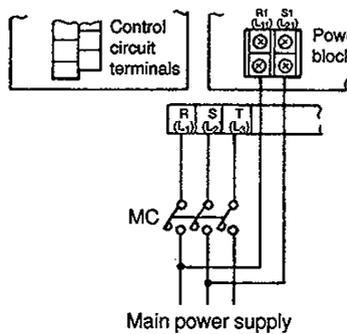


- 1) Loosen the upper screw.
- 2) Remove the lower screw.
- 3) Pull out the jumper.
- 4) Connect the cable of the other power supply to the lower terminal (R1 (L₁₁), S1 (L₂₁)). (Note 2)

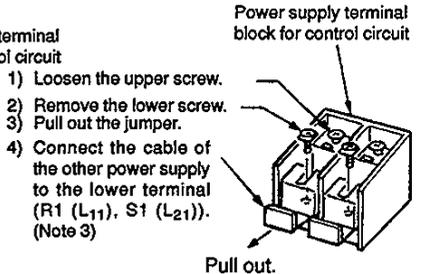
Note: 1. When the main circuit power (terminals R (L₁), S (L₂), T (L₃)) is on, do not switch off the control power (terminals R1 (L₁₁), S1 (L₂₁)), otherwise the inverter will be damaged.
 2. To use a separate power supply, the jumpers between R (L₁) and R1 (L₁₁), S (L₂) and S1 (L₂₁) must be removed.

• **Model FR-V220(V240)E-3.7K to 45K**

<Circuit diagram>



<Connection procedure>



- 1) Loosen the upper screw.
- 2) Remove the lower screw.
- 3) Pull out the jumper.
- 4) Connect the cable of the other power supply to the lower terminal (R1 (L₁₁), S1 (L₂₁)). (Note 3)

Note: 1. The jumpers between R (L₁) and R1 (L₁₁), S (L₂) and S1 (L₂₁) must be removed.
 2. For a different power supply system which takes the power of the control circuit from other than the primary side of the MC, this voltage should be equal to the main circuit voltage.
 3. The power supply cable must not be connected only to the upper terminal to protect the inverter from damage. To use a separate power supply, the jumpers between R (L₁) and R1 (L₁₁), S (L₂) and S1 (L₂₁) must be removed.

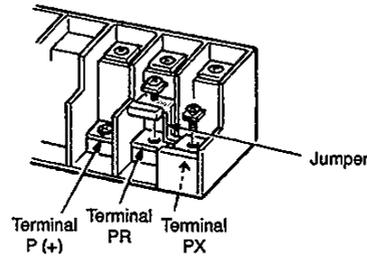
Connection of the dedicated brake resistor (1.5K to 5.5K)

The built-in brake resistor is connected across terminals P (+) and PR. Only when the built-in brake resistor cannot thermally accept operation at high duty, disconnect the jumper from across terminals PR and PX, and connect the dedicated brake resistor (option) across terminals P (+) and PR.

Note: 1. Do not connect any brake resistor other than the dedicated brake resistor.
2. Do not connect the external brake resistor with the terminals between PR and PX shorted, otherwise the inverter might be damaged.

● **Model FR-V220(V240)E-1.5K/2.2K**

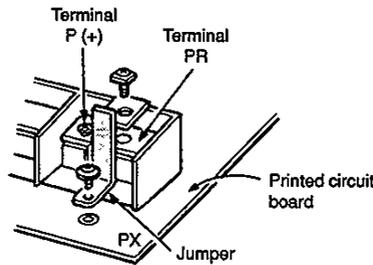
<Connection procedure>



- 1) Remove the screw from terminal PR.
- 2) Remove the screw from terminal PX and remove the jumper.
- 3) Connect the brake resistor between terminals P (+) and PR (with the jumper removed).

● **Model FR-V220(V240)E-3.7K/5.5K**

<Connection procedure>

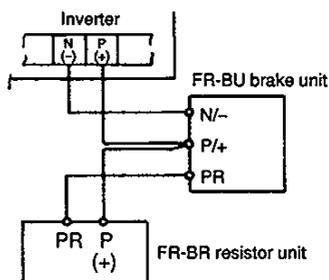


- 1) Remove the screw from terminal PR.
- 2) Remove the screw from PX on the printed circuit board and remove the jumper.
- 3) Connect the brake resistor between terminals P (+) and PR (with the jumper removed).

Connection of the FR-BU brake unit (option)

Connect the optional FR-BU brake unit as shown below to improve the braking capability during deceleration.

<Connection method>

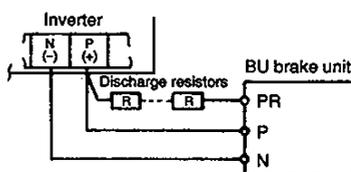


- Note: 1. Connect the inverter terminals (P (+), N (-)) and FR-BU brake unit terminals so that their symbols match with each other. (Incorrect connection will damage the inverter.) Also, the jumper across terminals PR and PX must be removed for 5.5K or less.
2. The wiring distance between the inverter, brake unit and resistor unit should be within 5m (16.40 feet). If twisted wires are used, the distance should be within 10m (32.81 feet).

Connection of the conventional BU brake unit (option)

Connect the BU brake unit correctly as shown below. Incorrect connection will damage the inverter.

<Connection method>



- Note: 1. On the model of 5.5K or less, the jumper across terminals PR and PX must be removed.
2. The wiring distance between the inverter, brake unit and discharge resistors should be within 2m (6.56 feet). If twisted wires are used, the distance should be within 5m (16.40 feet).

Where the power supply is special (342V or below, 484V or above) for the 400V class 7.5K to 45K inverters

Change the connection of the jumper to the internal transformer according to the operating power supply voltage. (This change is not required for inverters 5.5K and less.)

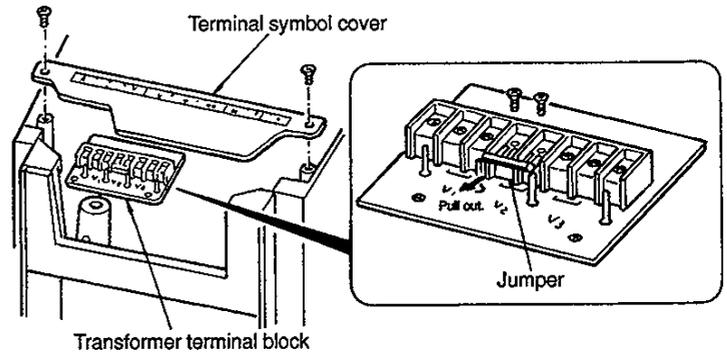
■ Voltage Range vs. Jumper Position

Jumper Position	Operating Power Supply Voltage		Note
	50Hz	60Hz	
V1	323V (380V-15%) to 456.5V (415V+10%)	As on the left	
V2	342V (380V-10%) to 484V (440V+10%)	342V (380V-10%) to 506V (460V+10%)	Factory setting
V3	391V (460V-15%) to 506V (460V+10%)	As on the left	

Note: Change the jumper position according to the operating power supply voltage. Otherwise the inverter will be damaged.

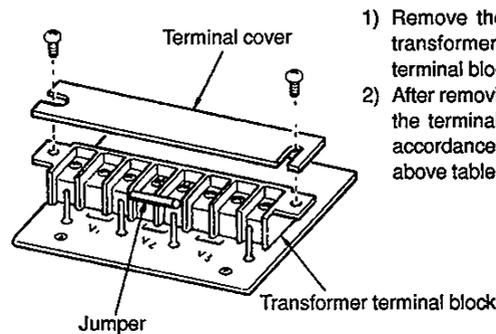
■ Changing the jumper position

● Model FR-V240E-7.5K to 18.5K



- 1) Remove the mounting screws of the terminal symbol cover and remove the cover.
- 2) This reveals the terminal block of the internal transformer. After removing the screws from the jumper in the terminal block, reconnect the jumper in accordance with the operating voltage in the above table.

● Model FR-V240E-22K to 45K

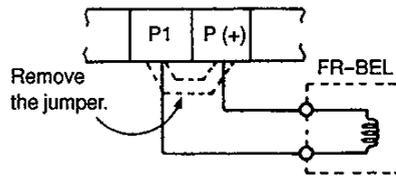


- 1) Remove the terminal cover of the internal transformer located under the main circuit terminal block (R (L₁), S (L₂), T (L₃)).
- 2) After removing the screws from the jumper in the terminal block, reconnect the jumper in accordance with the operating voltage in the above table.

**Connection of the power factor improving DC reactor (option)
(Model: 3.7K to 45K)**

Connect the FR-BEL power factor improving DC reactor between terminals P1 and P (+). In this case, the jumper connected across terminals P1 and P (+) must be removed. Otherwise, the reactor will not operate.

<Connection method>

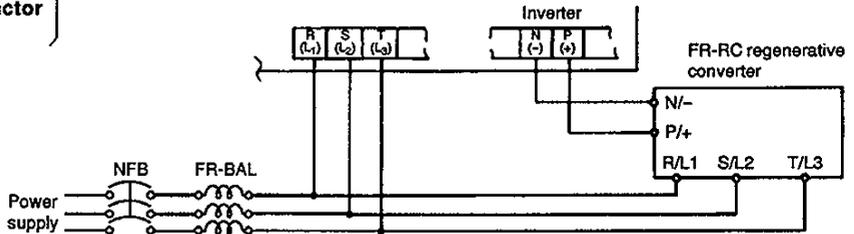


- Note: 1. The wiring distance should be within 5m (16.40 feet).
 2. The size of the cables used should be identical to or larger than that of the power supply cables (R (L₁), S (L₂), T (L₃)).
 3. The DC reactor cannot be used with the inverters of 2.2K and less.

Connection of the FR-RC regenerative converter (option)

Connect the FR-RC regenerative converter as shown below so that the inverter terminals (P (+), N (-)) and FR-RC regenerative converter terminals match with each other.

<Connection method>



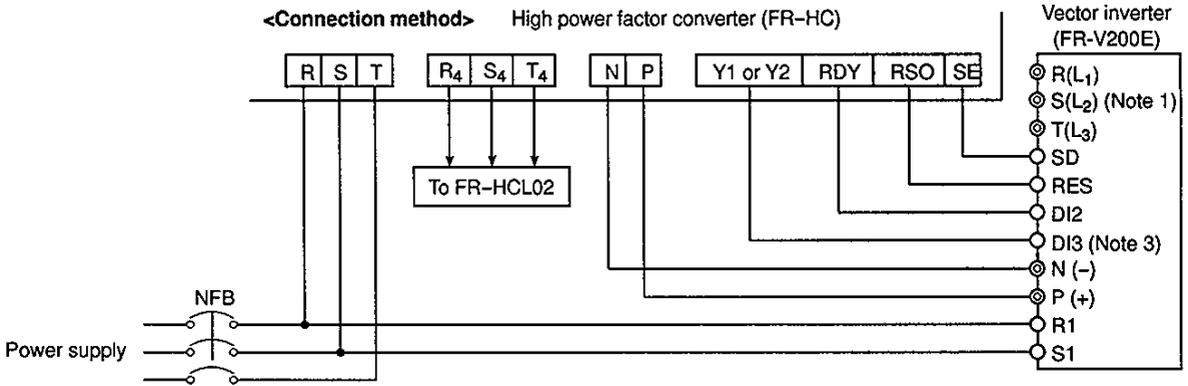
- Note: On the models of 5.5K and less, the jumper across terminals PR and PX must be removed.

(For power coordination, always install the power factor improving reactor (FR-BAL).)

Method of connecting the FR-BAL power factor improving AC reactors (option)
 If wiring impedances between the inverters are small in a system where two or more inverters are used, a return current from the regenerative converter may sneak into the other inverters, resulting in an overcurrent alarm. To prevent this, install the power factor improving AC reactors on the power supply side.

Connection of the FR-HC high power factor converter (option unit)

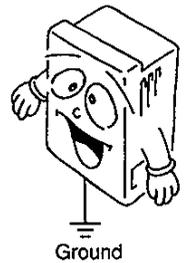
When connecting the high power factor converter (FR-HC) for power harmonic suppression, wire it securely as shown below. Incorrect wiring will cause the high power factor converter and inverter to be damaged. After connecting it securely, set "3" or "4" in Pr. 30 "regenerative brake duty change selection/high power factor converter connection selection". (Refer to page 74.)



- Note:
1. Always keep the inverter's power input terminals R (L₁), S (L₂), T (L₃) open. Accidental connection will damage the inverter. Also, incorrect polarity of terminals N (-), P (+) will damage the inverter.
 2. When connecting the FR-HC converter, always match the voltage phases of terminals R, S, T and terminals R₄, S₄, T₄.
 3. For the high power factor converter's terminal Y1 or Y2 and the inverter's terminal DI3, set 4 in Pr. 30 "regenerative brake duty change selection/high power factor converter connection selection".
 - When the high power factor converter (FR-HC) is connected, the inverter's terminals DI2 and DI3 are unavailable for Pr. 17 "input terminal assignment" setting. In this case, terminals DI2, DI3 function as set in Pr. 30 "regenerative brake duty change selection/high power factor converter connection selection".
 - When Pr. 30 = 4, set "2" (instantaneous power failure detection) to Y1 or Y2 in Pr.40 "output terminal assignment" for the high power factor converter (FR-HC).
 4. The high power factor converter (FR-HC) has a regenerative converter capability and cannot be used with the FR-RC regenerative converter.

Notes on Grounding

- The leakage current of the FR-V200E series is larger than that of the other series (Z200, F400). To prevent an accidental electric shock, the motor and inverter must be grounded (200V class...class 3 grounding, grounding resistance must be 100Ω or less, 400V class...special class 3 grounding, grounding resistance must be 10Ω or less).
- Ground the inverter by connecting it to the dedicated ground terminal. (Do not use the screw in the case, chassis, etc.)
- Use the largest possible gauge for the ground cable. The gauge should be equal to or larger than those indicated in the following table. The grounding point should be as near as possible to the inverter to minimize the ground cable length.

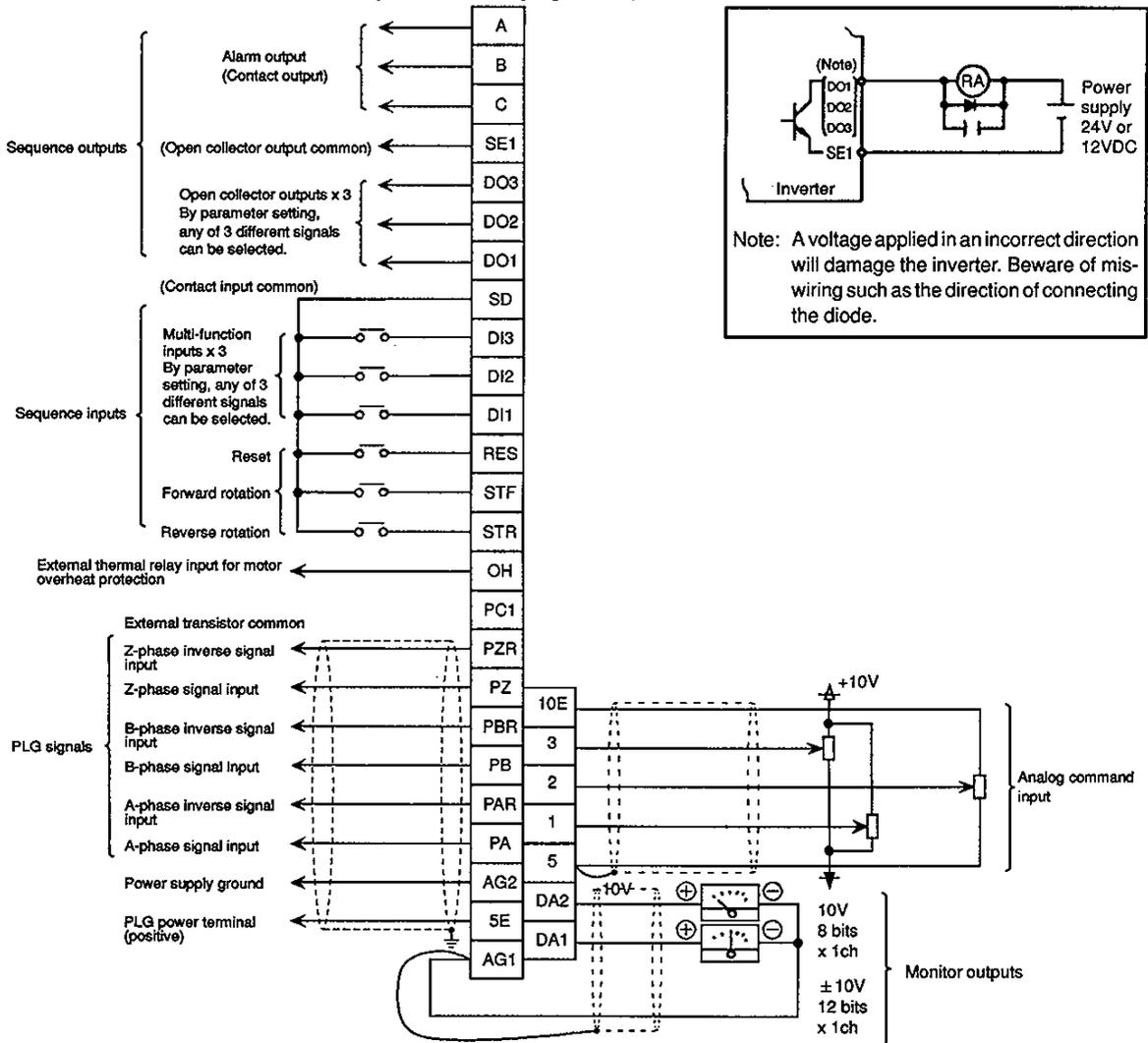


(Unit: mm²)

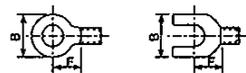
MotorCapacity	Ground Cable Gauge	
	200V class	400V class
3.7kW (5 HP) or less	3.5	2
5.5, 7.5kW (7.5, 10 HP)	5.5	3.5
11 to 15kW (15 to 20 HP)	14	8
18.5 to 37kW (25 to 30 HP)	22	14
45kW (60 HP)	38	22

- Ground the motor on the inverter side using one wire of the 4-core cable.

1.3.6 Wiring of the Control Circuit (For the terminal block arrangement, see page 155.)



- Note 1.** Terminals SD, SE1 and 5 are the common terminals of the I/O signals and are isolated from each other. These common terminals must not be connected to each other or grounded.
- Use shielded or twisted cables for connection to the control circuit terminals and run them away from the main and power circuits (including the 200V relay sequence circuit).
 - Since the control circuit input signals are micro currents, use two parallel micro signal contacts or a twin contact to prevent a contact fault.
 - When two crimping terminals are to be connected to one of the control terminals, round or square, open-end crimping terminals of the size shown on the right should be used back-to-back.

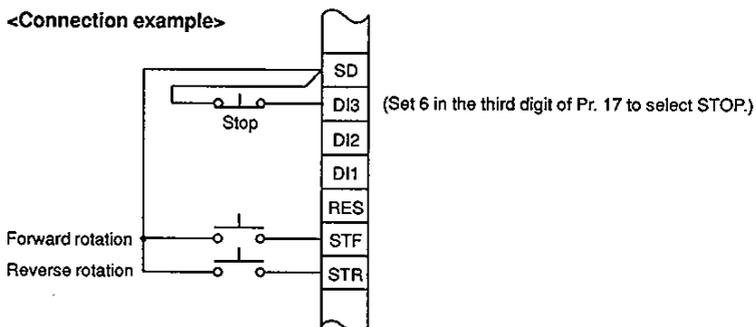


Designation	B (mm/inches)	F (mm/inches)
1.25-3	6.4/0.25 or less	5.3/0.21 or more

Using the STOP terminal

Self-holding of the start signal (forward rotation, reverse rotation) is possible only when the DI1, DI2 and DI3 terminals are set to the STOP terminal.

<Connection example>

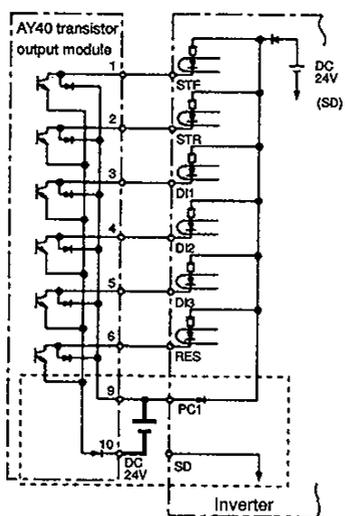


Using the PC1 terminal

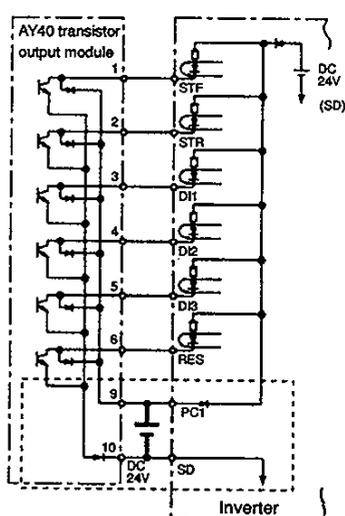
This terminal is used to connect transistor output (open collector output) such as a programmable logic controllers (PLCs). Connecting the external power supply common for transistor output to the PC1 terminal prevents a faulty operation caused by a sneak current.

The power supply voltage of the PLC connected should be 24VDC.

<Correct connection>

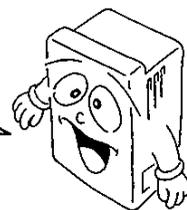


<Incorrect connection>

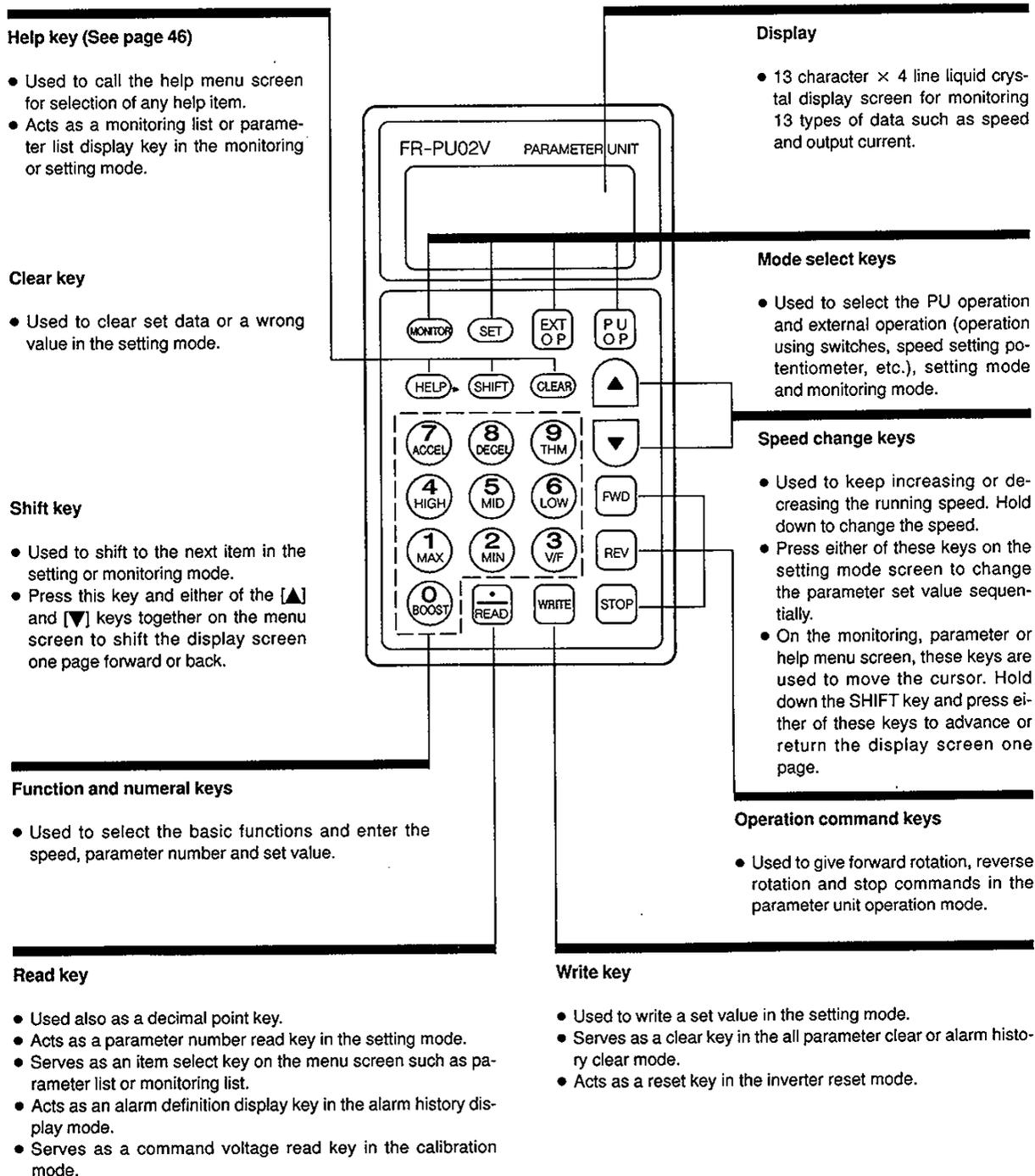


1.4 PARAMETER UNIT

The FR-PU02V parameter unit (option) is installed directly to the FR-V series inverter or connected to it by a cable (option) and allows operation to be performed, functions to be selected (set values to be read/written), the operating status to be monitored, and alarm definition to be displayed. The FR-PU02V parameter unit is hereinafter referred to as the PU.



1.4.1 Structure of the Parameter Unit



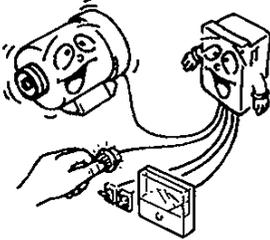
1.4.2 Overview of the Parameter Unit Functions

By using the PU, the following operations can be performed.

Setting of operation mode (Page 30)

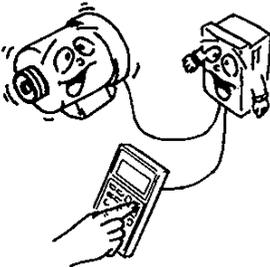
- External operation mode

(Operation is performed from the speed setting potentiometer, start switch or the like provided outside the inverter.)

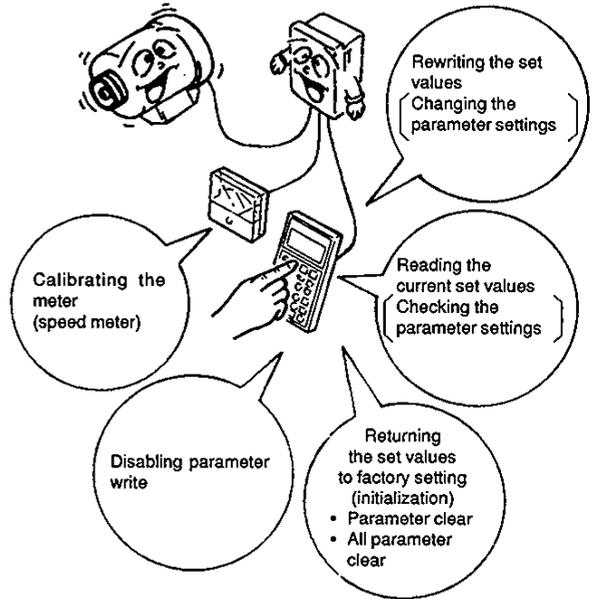


- PU operation mode

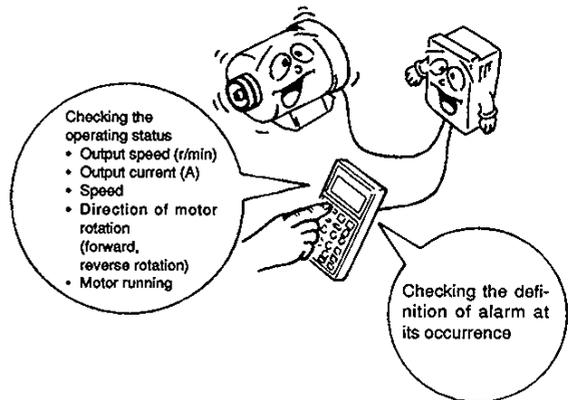
(Operation is only performed from the key pad of the PU.)



Setting of parameters (Page 59)



Monitoring (Page 42)



1.4.3 Precautions for Using the Parameter Unit

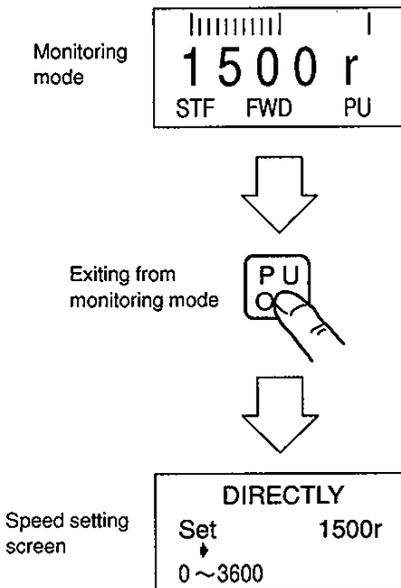
When using the PU, note the following points to make proper settings and enter correct values.

Instructions for operation performed from the PU

- Operation from the PU is only valid when the [PU OP] key is pressed with "0" (factory setting) set in parameter 79.



- In the monitoring mode, the running speed cannot be set by direct numeral setting (by entering the speed directly from the key pad). To set the running speed, perform step setting (change the speed sequentially by pressing the [▲/▼] key) and press the [WRITE] key, or press the [PU OP] key to exit from the monitoring mode, and set with the number pad.



Note: Jog operation cannot be performed when the motor is running.

Instructions for monitoring

- When the motor is to be run in the PU operation mode, setting the running speed and then pressing the start key ([FWD] or [REV]) automatically switches the inverter to the monitoring mode.

Instructions for the operation modes

- If the [PU OP] (or [EXT OP]) key is pressed, the mode cannot be switched when:
 - (1) The motor is running;
 - (2) The external operation start signal (across terminals STF or STR and SD) is on; or
 - (3) The set value of the operation mode select parameter (Pr. 79) is either 1 or 2.
- When "0" is in the operation mode select parameter (Pr. 79), switching the inverter power off, then on or resetting the inverter switches it to the external operation mode.

Instructions for the number of digits and decimal point of an input value

- An input value of up to five digits may be entered. If the value entered is in more than five digits, the most significant digit is ignored.

12345.6 ⇨ 2345.6
 (Entered) ↑ Ignored

Instructions for writing set values

- Write the set values when the inverter is at a stop in the PU operation mode. They cannot be written in the external operation. (They may be read in both modes.) Note that some parameters may be written in the external operation mode or during operation. See the following table:

Operation Mode	Write Enabled during Operation	Write Enabled during Stop
External operation mode	Pr. 4 to 6 "three-speed setting" Pr. 24 to 27 "multi-speed setting" Pr. 34 to 38 "torque limit level" Pr. 51 to 58 "display function"	Pr. 4 to 6 "three-speed setting" Pr. 24 to 27 "multi-speed setting" Pr. 34 to 38 "torque limit level" Pr. 51 to 58 "display function" Pr. 79 "operation mode selection"
PU operation mode	Pr. 4 to 6 "three-speed setting" Pr. 24 to 27 "multi-speed setting" Pr. 34 to 38 "torque limit level" Pr. 51 to 58 "display function" Pr. 900 "DA1 terminal calibration" Pr. 901 "DA2 terminal calibration"	All parameters

- In addition to the above, set values cannot be written when:
 - Parameter write disable (Pr. 77) has been selected;
 - Any parameter number that does not exist in the parameter list (see page 60) has been selected; or
 - The value entered is outside the setting range.
- If write is disabled and error "E" is displayed, press the [SET] (or [CLEAR]) key and restart operation from the beginning.

(Example: Pr. 7 "acceleration time")

```

7 Acc. t1
Setting Error
E 2000S
↓ CLEAR
  
```

Instructions for setting the running speed

- When using the [▲]/[▼] key to set the speed (step setting), the speed may only be set within the range of the maximum and minimum speeds.

Other instructions

- When the input power is switched on (or the inverter is reset), the following message is given on the display of the PU for about 1 second. This message indicates that the inverter and FR-PU02V parameter unit are performing communication checks with each other and does not indicate an alarm. Note that if this message does not disappear in about 1 minute, see "TROUBLESHOOTING" (page 128).

PU to Inverter
comms. Error
Inv. Reset ON

The above message is also displayed when the control circuit power is switched on later than the main circuit power in a system where the control circuit is connected to a power supply separately from the main circuit.

Similarly, FR-U is displayed on the unit LED instantaneously at power on but it is not an alarm. If this display is kept provided, see "TROUBLESHOOTING" (page 128).

Note: This screen is displayed in English if Japanese has been selected in Pr. 59 "language switching."

Use of the FR-PU02(E)

- The "FR-PU02(E)-1" is designed for use with the FR-A series inverters and cannot be used with the FR-V series basically. However, though the parameter names, setting ranges, etc. are different from those of the FR-PU02V, the FR-PU02(E)-1 may be used to set parameters and perform operation.

2. OPERATION

This chapter provides details on the “operation” of this product.

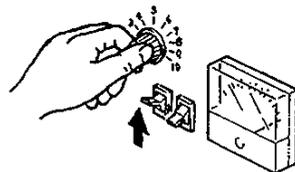
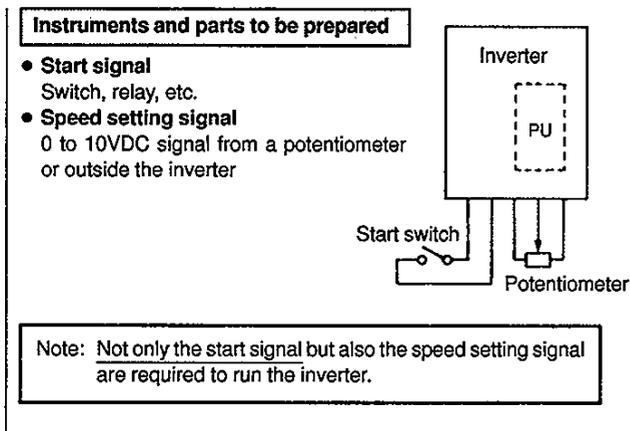
Always read the precautions, etc. before starting use.

2.1 OPERATION	27
2.2 CONTROL MODES	37

2.1 OPERATION

2.1.1 Instruments and Parts to be Prepared for Operation

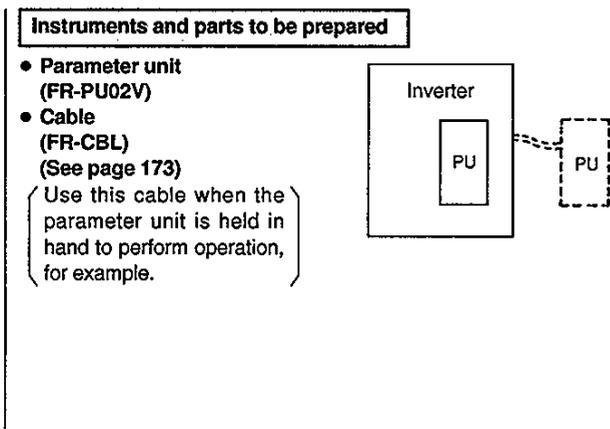
The FR-V200E inverter can be operated in either of two modes. Select the appropriate mode for an application and running conditions, and prepare required instruments and parts.



- Operation is performed from the speed setting potentiometer and start switch provided outside the inverter.

1. External operation mode

(The inverter is operated under the control of external operation signals connected to the terminal block.)



- Started from the PU.
- Direct setting of the speed
- Step setting of the speed
- Jog operation
Hold down the FWD or REV key to run the motor.

2. PU operation mode

The inverter is operated from the keypad of the parameter unit.

(This mode does not require the operation signals and is useful for an immediate start of operation.)

* "PU" is the abbreviation for parameter unit.

2.1.2 Pre-operation Settings

The main items to be set before operation are as follows. Set the required items according to the load and operational specifications. For simple variable-speed operation or the like, use the inverter with the factory setting. For more information and the explanation of the other parameters, see page 60.

Note that a parameter will be referred to as "Pr."

■ Setting method

In the PU operation mode, use the parameter unit for setting. (See page 30.)

The start signal (STF or STR) must be off to switch from the external operation mode to the PU operation mode.

Language setting

- Pr. 59 "Language switching"

Used to set the screen display of the "FR-PU02V" parameter unit. Pr. 59 "language switching" is factory-set to 9999 (Japanese). Set 0 (English) to switch the screen display to English.

Setting of control mode

- Pr. 14 "control mode"

Please set the control mode.
Factory setting: Speed control

Setting of speed setting voltage gain (maximum output speed)

- Pr. 903 "speed setting second gain"

Setting of torque setting voltage gain (maximum output torque)

- Pr. 905 "torque command third gain"
- "Pr. 1 "maximum speed"

When the speed or torque used for operation is equal to or higher than the factory setting given below, change the setting of the corresponding parameter.

Parameter	Factory Setting	
Pr. 903 "speed setting second gain"	10V	1500r/min
Pr. 905 "torque command third gain"	0V	150%
Pr. 1 "maximum speed"	1500r/min	

When the parameter unit is used for operation, the output speed is up to the maximum speed (factory setting: 1500r/min) set in Pr. 1. (For details of Pr. 903, see page 113.)

Setting of maximum speed

- Pr. 1 "maximum speed"

Set this parameter to define the upper limit of the output speed or to perform operation at a speed above 1500r/min.

Change the setting of this parameter only when the speed must be limited in addition to the setting of the above-mentioned "speed setting second gain" which allows the speed to be restricted to below the set value.

Factory setting: 1500r/min

Setting of minimum speed

- Pr. 2 "minimum speed"

Use this parameter to specify the lower limit of the output speed. When the minimum speed has been set, merely turning on the start signal starts the motor running at the set speed.

Factory setting: 0r/min

Setting of acceleration and deceleration times

- Pr. 7 "acceleration time"
- Pr. 8 "deceleration time"
- Pr. 44 "second acceleration/deceleration time"
- Pr. 45 "second deceleration time"

When acceleration/deceleration time other than the factory setting is used, change the values of these parameters.

Parameter	Factory Setting
Pr. 7 "acceleration time"	5.5K and down...5 seconds, 7.5K and up...15 seconds
Pr. 8 "deceleration time"	5.5K and down...5 seconds, 7.5K and up...15 seconds
Pr. 44 "second acceleration/deceleration time"	5 seconds
Pr. 45 "second deceleration time"	9999 (same as the value set in Pr. 44)

Calibration of speed meter

To monitor the output status correctly, calibrate the speed meter before operation.

Use the parameter unit for calibration to make adjustment with higher accuracy.

(See page 116 for the adjustment procedure.)

When the inverter is to be used again for a different application

It is assumed that the factory set parameters have been changed for the previous application, therefore perform a parameter all clear operation to return all the parameters to their factory settings. (For the operation procedure, see page 55.) From this "factory state" new parameter values can be set.

Note that the following parameters will not be initialized with parameter clearing. Either read out the set values and change to the required values, or return the values to the factory settings with the all clear operation.

Parameter No.	Name	Screen Display	Setting Range	Factory Setting
900	DA1 terminal calibration	D/A1 Calibration	-	-
901	DA2 terminal calibration	D/A2 Calibration	-	-
902	Speed setting second bias	Command 2 bias	0 to 10V : 0 to 3600 r/min	(0V) : 0 r/min
903	Speed setting second gain	Command 2 gain	0 to 10V : 0 to 3600 r/min	(10V) : 1500 r/min
904	Torque command third bias	Command 3 bias	0 to 10V : 0 to 400 %	(0V) : 0 %
905	Torque command third gain	Command 3 gain	0 to 10V : 0 to 400 %	(10V) : 150 %

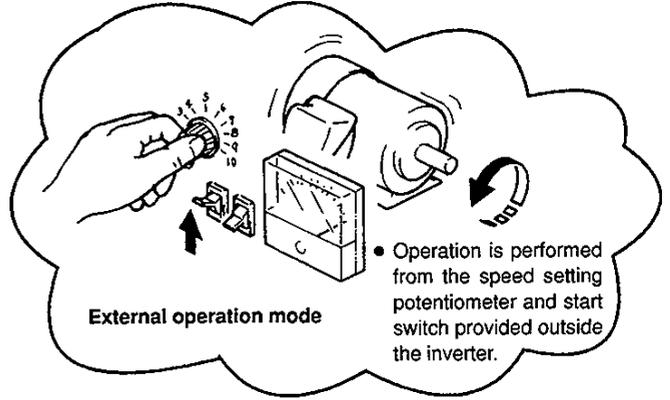
2.1.3 Operation Mode

The inverter has two operation modes: "operation using the external input signals" (external operation mode) and "operation using the PU" (PU operation mode).

■ Factory-set operation mode

When the input power is switched on (or the inverter is reset), the inverter is set to the mode of "operation using the external input signals". Therefore, as soon as the input power is switched on, the inverter is ready for operation using the external input signals. In this state, turn the start signal (across STF or STR and SD) on to start operation.

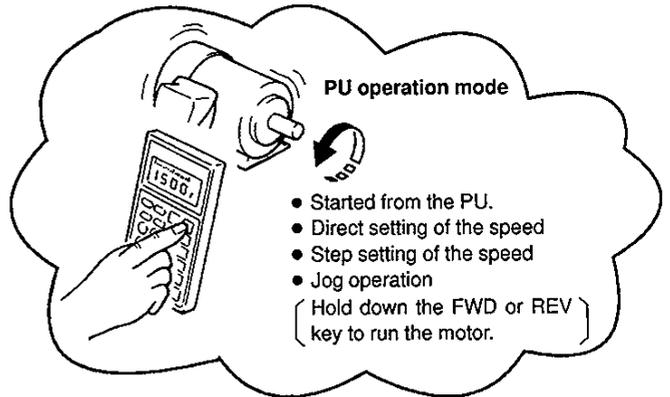
(Default control mode is speed control,
change Pr. 14 if torque control is re-
quired.)



■ Fixing the operation mode

The operation mode at power on may be limited, e.g. operation from the PU is enabled at power on without switching the operation mode with the PU's mode select key.

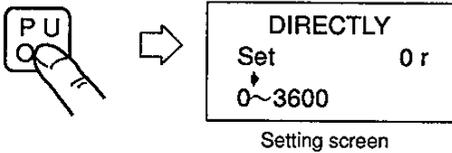
For full information on the setting procedure, see page 31.



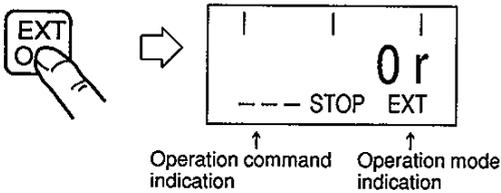
2.1.4 Selection of the Operation Mode

The inverter is factory-set to allow the operation mode to be switched between “external operation” and “PU operation”. At power-on, the inverter is placed in the “external operation” mode. Use the PU to switch to the other operation mode.

- **Switching from the external operation mode to the PU operation mode** Check that the external input signal is off (across STF or STR and SD).
Then, press the [PU OP] key to switch to the PU operation mode, in which the setting screen is displayed.



- **Switching from the PU operation mode to the external operation mode** Check that the external input signal is off (across STF or STR and SD) and that the operation command indication is “---”.
Then, press the [EXT OP] key to switch to the external operation mode, in which “EXT” is displayed at the operation mode indication.



Note: If the operation mode cannot be switched, check the following:

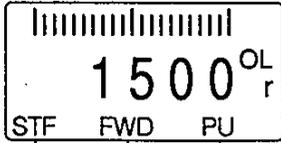
1. External input signal (across STF or STR and SD) ————— Check that the signal is off. If it is on, the operation mode cannot be switched.
2. Parameter setting ————— Check the set value of Pr. 79 “operation mode selection”.

Set Value	Description
0	Operation can be performed with the mode switched between PU operation and external operation. (Factory setting)
1	PU operation can only be performed. (Cannot be switched to the other mode.)
2	External operation can only be performed. (Cannot be switched to the other mode.)

3. Limiting of operation mode ————— If the Pr. 79 “operation mode selection” set value is “0” (factory setting), the external operation mode will be entered when the input power is turned on. The PU operation mode can be entered when the [PU OP] key is pressed.
When other set values (1, 2) are set, the operation mode will be limited to the respective details.

2.1.5 Operation Mode, Command and Status Indications

The currently selected operation mode, operation status, etc. are displayed at the bottom of the display screen of the parameter unit.

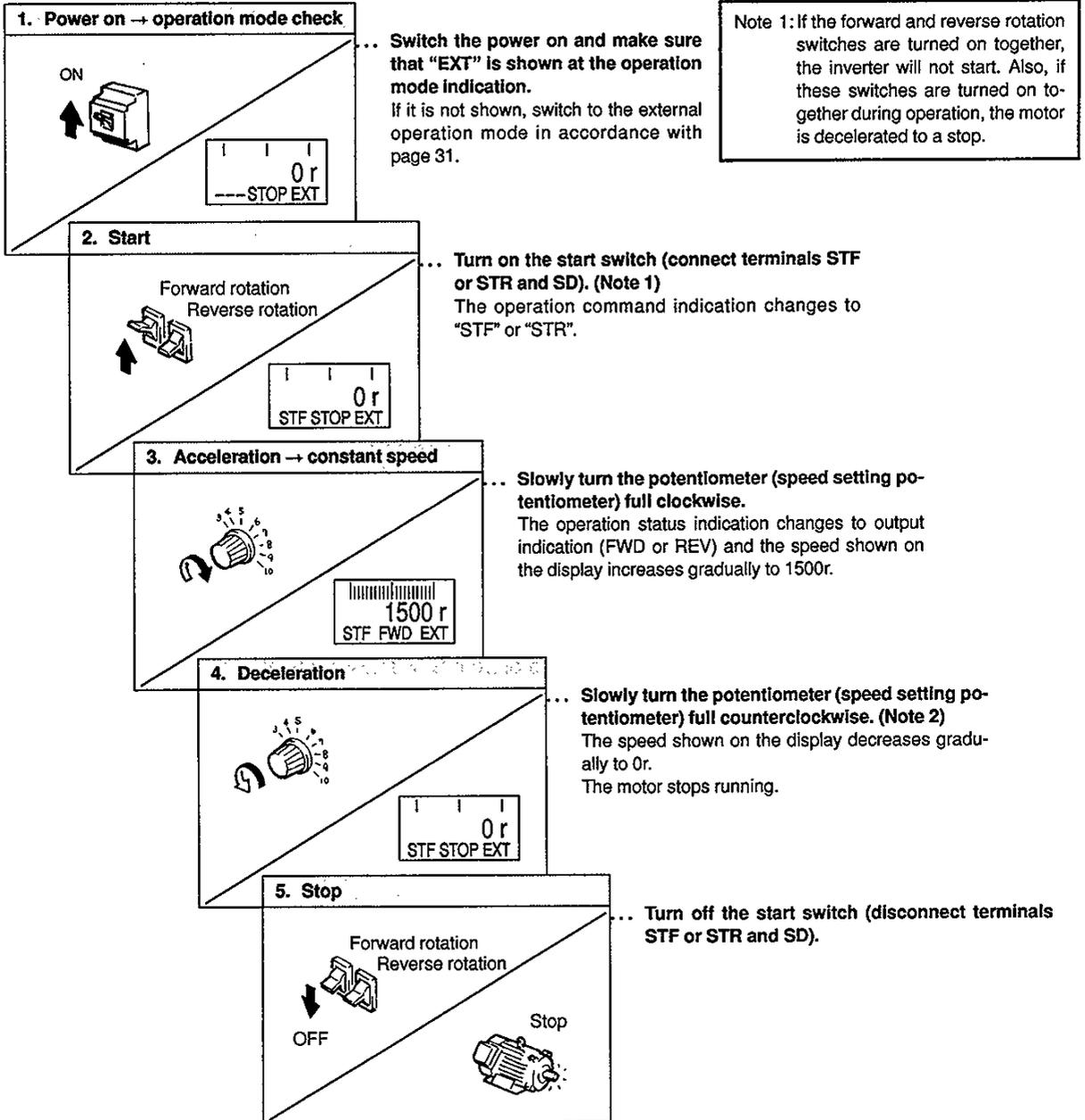


- **Operation mode indication**
 - PU: PU operation
 - EXT: External operation
 - PUj: PU jog operation
 - EXTj: External jog operation
 - NET: Computer link operation (FR-VPB)
- **Operation status indication**
 - FWD: Forward rotation in progress
 - REV: Reverse rotation in progress
 - STOP: At a stop
 - JOGf: Jog forward rotation in progress
 - JOGr: Jog reverse rotation in progress
- **Operation command indication**
 - STF: Forward rotation
 - STR: Reverse rotation
 - : No command or both STF and STR "ON"

2.1.6 External Operation Mode (Operation using the external input signals) <Speed control>

(1) Ordinary operation

• Operation procedure (Operation at 1500r/min)



Note 1: If the forward and reverse rotation switches are turned on together, the inverter will not start. Also, if these switches are turned on together during operation, the motor is decelerated to a stop.

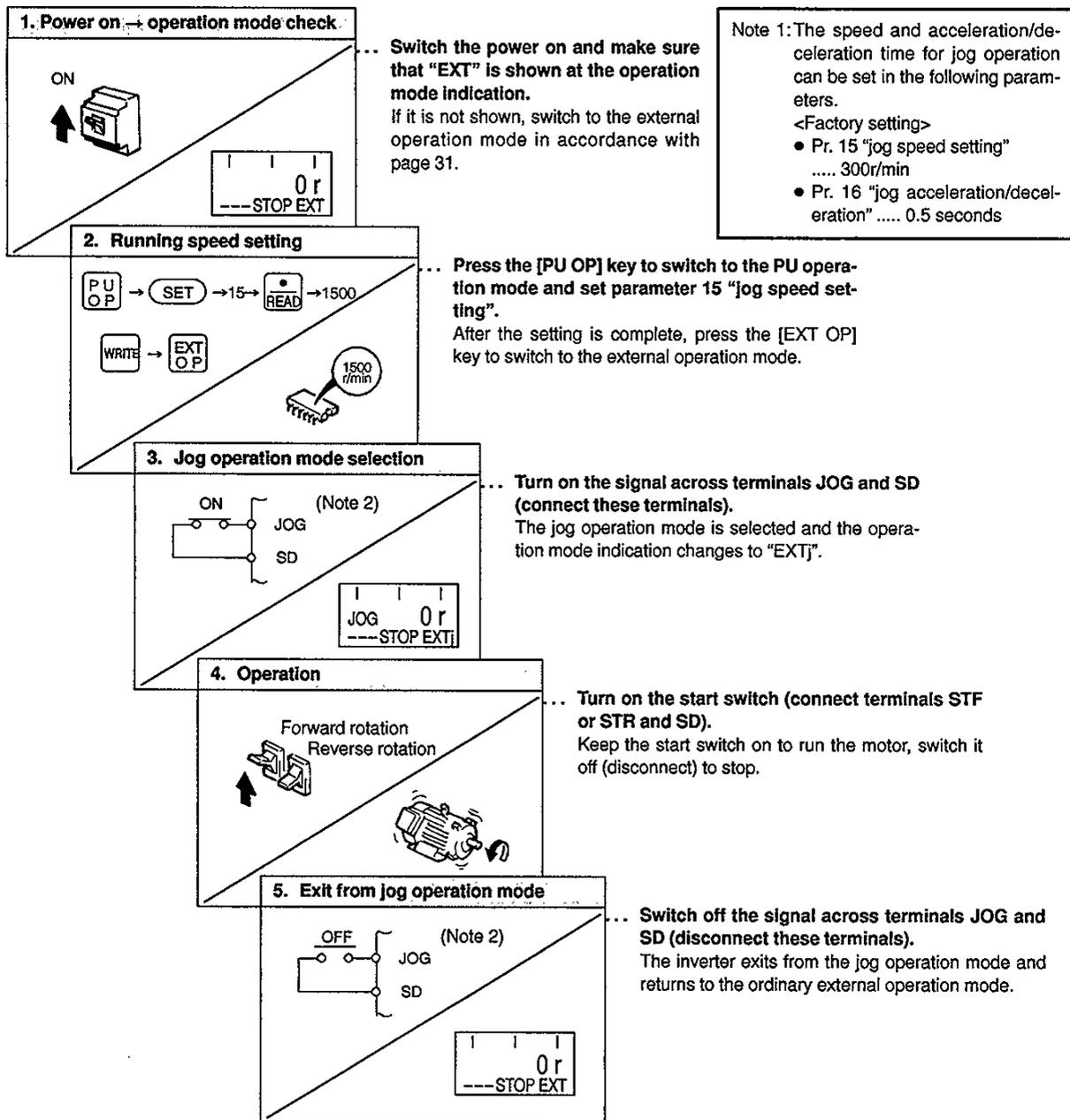
Note 2: If the start switch is turned off with the potentiometer in the full clockwise position, the motor is decelerated to a stop. The DC dynamic brake operated at this time generates high-frequency noise immediately before the stop, but it is not a fault.

Note 3: If the start switch is turned on with the potentiometer in the full counterclockwise position (speed command 0), the motor may run at a low speed due to the noise caused by the wiring length of the potentiometer. To stop the motor, adjust the setting of Pr. 13 "starting speed", and set a non-sensitivity range for starting.

(2) External jog operation

Keep the start switch on (connect terminals STF or STR and SD) to perform operation, and switch it off to stop. For details of changing the parameter setting, see page 59.

● Operation procedure (Operation at 1500r/min)



Note 1: The speed and acceleration/deceleration time for jog operation can be set in the following parameters.

<Factory setting>

- Pr. 15 "jog speed setting" 300r/min
- Pr. 16 "jog acceleration/deceleration" 0.5 seconds

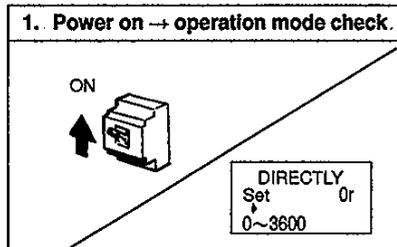
Note 2: JOG terminal function is set with Pr. 17.

2.1.7 PU Operation Mode (Operation using the PU)

(1) Ordinary operation

By repeating the above steps 2 and 3 during motor operation, speed can be changed.

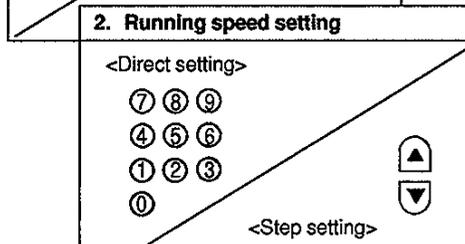
● Operation procedure (Operation at speed)



... Switch the power on, press the [PU OP] key, and make sure that the speed setting screen is shown on the display.

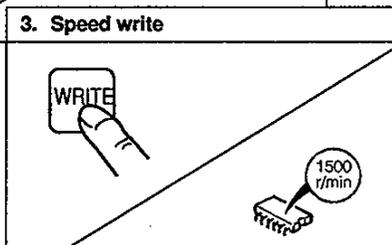
If it is not shown, switch to the PU operation mode in accordance with page 31.

Note 1: After pressing the [PU OP] key, enter the speed directly with the numeral keys. This setting is not available in the monitoring mode. Press the [PU OP] key to leave the monitoring mode before setting.



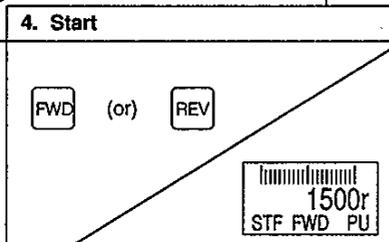
... Set the running speed to 1500r/min.

- Direct setting (Note 1)
- Step setting (Note 2) (Note 3)



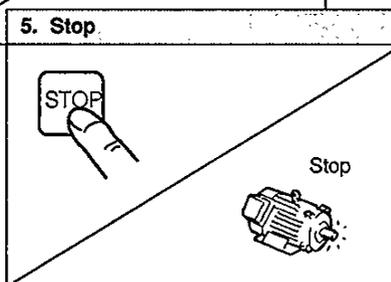
... Press the [WRITE] key.

The [WRITE] key must be pressed, otherwise the speed is not stored into memory.



... Press the [FWD] or [REV] key.

The motor starts running. The inverter is automatically placed in the monitoring mode and the actual output speed is displayed.



... Press the [STOP] key.

The motor is decelerated to a stop.

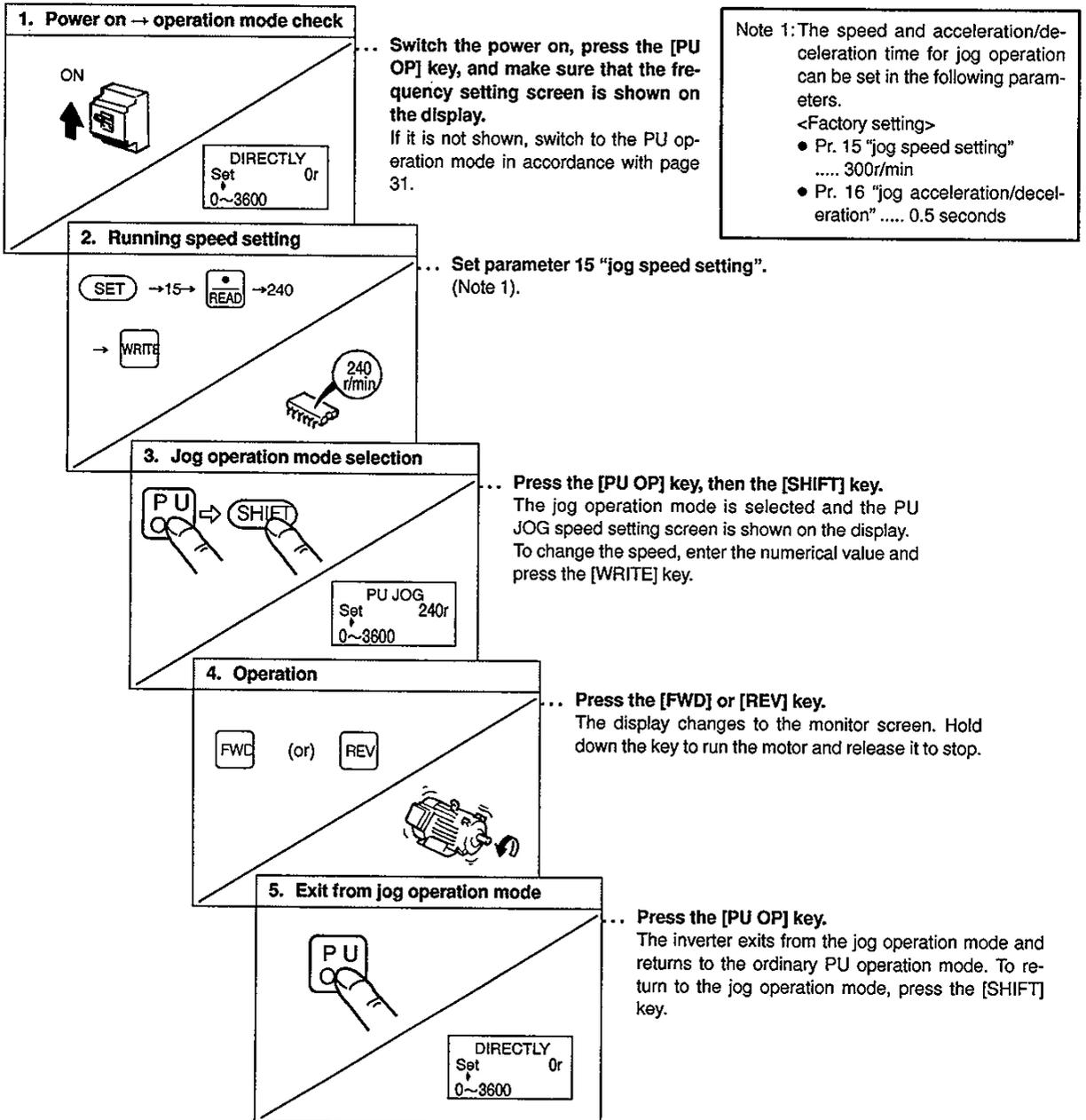
Note 2: Hold down the [▲]/[▼] key to keep the speed changing. At the beginning, the speed changes slowly and this may be used for fine adjustment.

Note 3: Step setting can also be made during inverter operation. However, if the [▲] (or [▼]) key is pressed in the monitoring mode, the speed does not stop changing when the key is released and rises (or falls) further. (Since the [▲] (or [▼]) key changes the set speed, output does not match the actual speed change.)

(2) PU jog operation

Hold down the [FWD] or [REV] key to run the motor, and release it to stop. For details of changing the parameter setting, see page 59.

• Operation procedure (Operation at 240r/min)



2.2 CONTROL MODES

2.2.1 Speed control

When Pr. 14 "control mode" is set to 0, 2 or 3 to select speed control mode ("0" is factory-set), the input and output signals and operation are performed as described below.

(1) Forward and reverse rotation commands (terminals STF, STR)

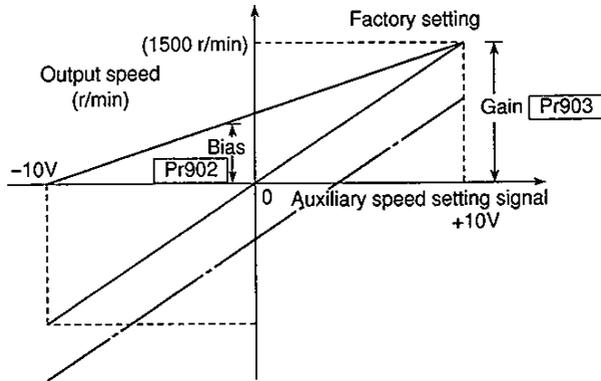
The forward/reverse signal (terminal STF, STR) is used to start and stop the motor. The motor stops when both terminals STF and STR are switched on or off.

(2) Speed command

1) External analog command (terminals 1, 2)

An analog signal entered into terminal 2 (or terminal 1) is used to provide the speed command.

Use Pr. 73 "speed setting signal" to set the main speed and override terminals and signals. Also, use Pr. 902 "speed setting No. 2 bias" and Pr. 903 "speed setting No. 2 gain" to set an analog signal ramp.



2) Multi-speed command

The speed command may also be set from the external terminal. How to set the speed command to either external analog command (terminal 2) or multi-speed command (terminals RH, RM, RL) is indicated in the following table. Use Pr. 17 "input terminal assignment" to allocate terminals RH, RM, RL to terminals DI1 to DI3. (These terminals are factory set to: DI1=RH, DI2=RM, DI3=RL)

Speed command		RH	RM	RL
Multi-speed command	High speed (Pr.4)	ON	OFF	OFF
	Middle speed (Pr.5)	OFF	ON	OFF
	Low speed (Pr.6)	OFF	OFF	ON
	Speed 4 (Pr.24)	OFF	ON	ON
	Speed 5 (Pr.25)	ON	OFF	ON
	Speed 6 (Pr.26)	ON	ON	OFF
	Speed 7 (Pr.27)	ON	ON	ON
External analog command		OFF	OFF	OFF

(3) Torque restriction

During speed control, output torque can be restricted. Set Pr. 33 "torque control mode" to restrict torque by external input or parameter setting.

(4) Overload (OL)

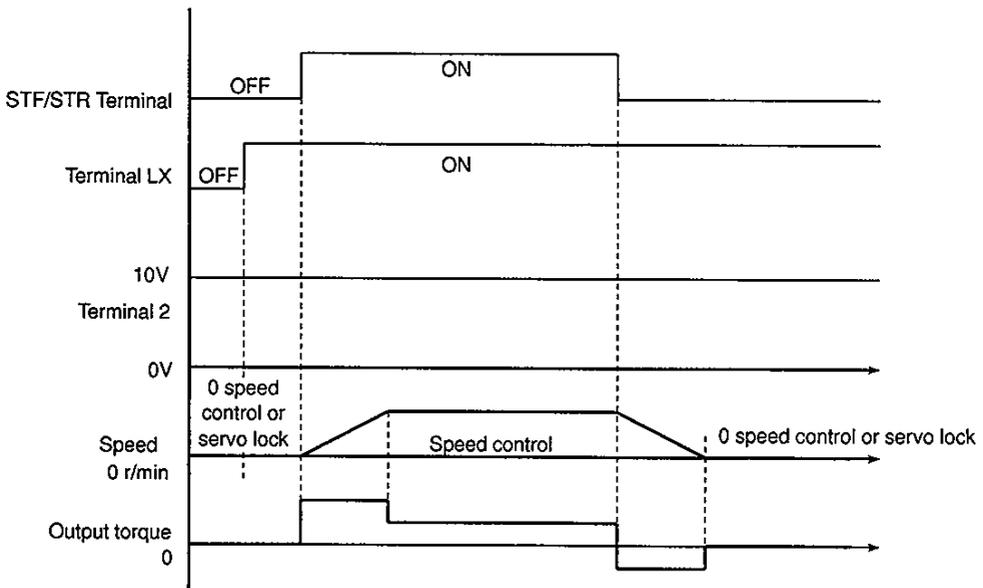
This signal switches on when the output torque reaches the preset torque restriction value. Use Pr. 40 "output terminal assignment" to assign OL to any of terminals DO1 to DO3.

(5) Up to speed (SU)

This signal switches on when the speed is within the range set in Pr. 41 "up-to-speed sensitivity". The signal is off during deceleration. Use Pr. 40 to assign su to any of the terminals DO1 to DO3.

(6) Operation

When stopped, the motor is in a no-excitation status. When terminal LX is switched on (use Pr. 17 to assign terminal LX to any of terminals DI1 to DI3), the motor is put under zero speed control if 0 is set in Pr. 62 "auxiliary excitation selection", or servo-locked if 1 is set in Pr. 62. When terminal LX and STF (or STR) signals are switched on at the same time, the motor is no longer under zero speed control (nor is it servo-locked) but is under speed control.



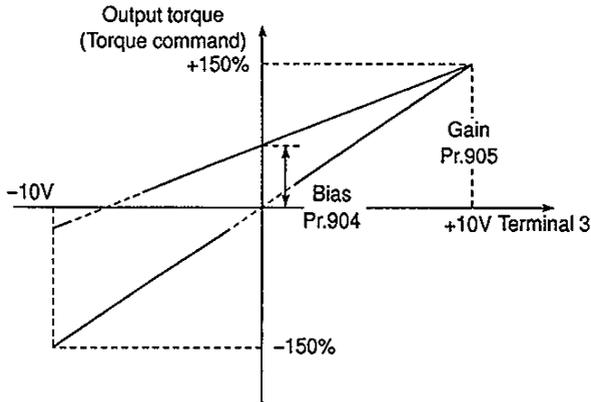
2.2.2 Torque control

When Pr. 14 "control mode" is set to 1 or 2 to select torque control mode, the input and output signals and operation are performed as described below.

(1) Torque command (terminal 3), forward and reverse rotation commands (terminals STF, STR)

The voltage level of terminal 3 and the torque generated by the motor have the relationships shown below. Motor generated torque varies with motor temperature. The variation of motor generated torque (compared to torque signal) is about 0.5%/°C, and is motor design dependent.

By using a Mitsubishi Vector motor equipped with a thermistor connected to the FR-VPC option unit, torque variation caused by motor temperature change is improved. Total torque variation $\pm 3\%$.



There are the following relationships between the polarity of the torque command (terminal 3) and the direction in which torque is generated by the forward/reverse rotation signal (terminal STF, STR).

When both terminals STF and STR are switched on or off, no torque is generated.

Torque Command Terminal 3 Polarity	Torque Generation Mode	
	Terminal STF ON	Terminal STR ON
+, positive polarity	Forward rotation in driving mode Reverse rotation in regenerative mode	Reverse rotation in driving mode Forward rotation in regenerative mode
-, negative polarity	Reverse rotation in driving mode Forward rotation in regenerative mode	Forward rotation in driving mode Reverse rotation in regenerative mode

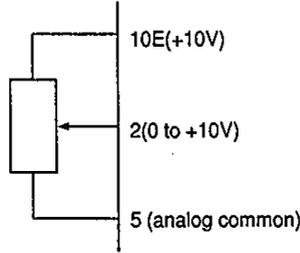
The torque control command input is factory-set to $\pm 10\text{V}/150\%$ torque. This setting may be changed using Pr. 904 "torque command No. 3 bias" and Pr. 905 "torque command No. 3 gain". (see page 114.)

(2) Speed restriction (maximum speed limit in Torque control mode)

The motor will misoperate if the load torque falls below the torque command value. To prevent this, set the speed restriction value.

1) External speed restriction (terminal 2)

Use the 0 to +10V signal entered into terminal 2 to provide the speed restriction signal.



(Calibrate bias and gain with Pr. 902, Pr 903)

2) Multi-speed restriction (terminals RH, RM, RL)

How to set the speed restriction command to either external speed restriction (terminal 2) or multi-speed restriction (terminals RH, RM, RL) is indicated in the following table. Use Pr. 17 to allocate terminals RH, RM, RL to terminals DI1 to DI3. (These terminals are factory set to: DI1=RH, DI2=RM, DI3=RL)

Speed restriction command		RH	RM	RL
Multi-speed command	High speed (Pr.4)	ON	OFF	OFF
	Middle speed (Pr.5)	OFF	ON	OFF
	Low speed (Pr.6)	OFF	OFF	ON
	Speed 4 (Pr.24)	OFF	ON	ON
	Speed 5 (Pr.25)	ON	OFF	ON
	Speed 6 (Pr.26)	ON	ON	OFF
	Speed 7 (Pr.27)	ON	ON	ON
External analog speed restriction		OFF	OFF	OFF

3) Others

If the above speed restriction value is higher than Pr. 1 "maximum speed", the speed restriction value is as set in Pr. 1 "maximum speed". If the speed restriction command value is lower than Pr. 2 "minimum speed", the speed restriction value is as set in Pr. 2 "minimum speed". If the speed restriction command value is lower than Pr. 13 "starting speed", the speed restriction value is 0r/min.

(3) Speed restriction in progress (OL)

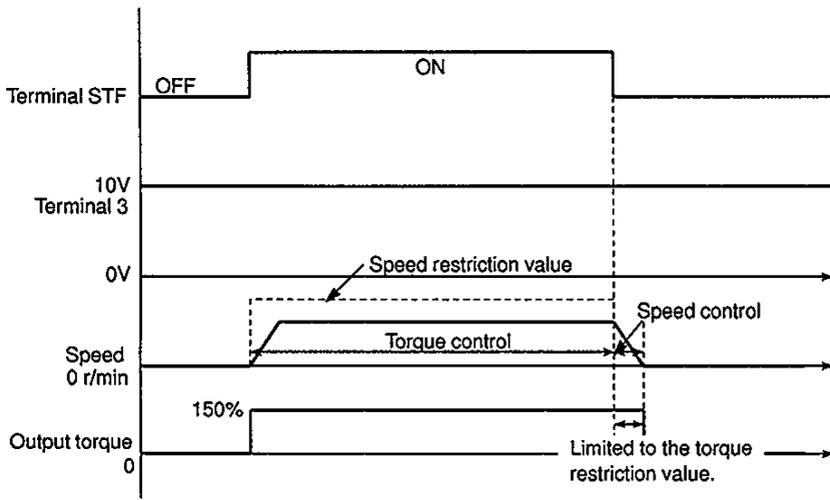
This signal switches on when the load becomes lighter and the motor speed reaches the preset speed restriction value. Use Pr. 40 "output terminal assignment" to allocate terminal OL to any of terminals DO1 to DO3.

(4) Low speed output (LS)

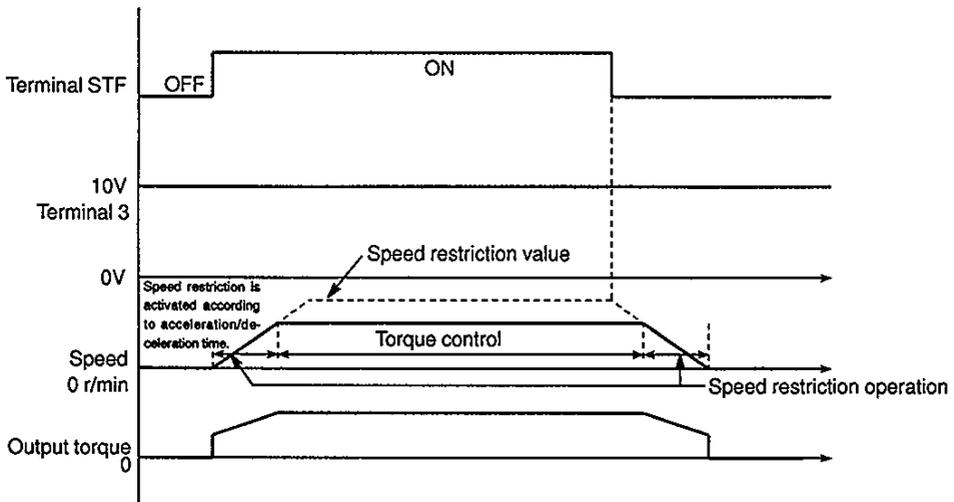
This signal switches on when the motor speed falls to or below the value set in Pr. 43 "low speed detection". Use Pr. 40 "output terminal assignment" to allocate terminal LS to any of terminals DO1 to DO3.

(5) Operation

1) Acceleration/deceleration time (Pr. 7, Pr. 8) setting = 0



2) Acceleration/deceleration time (Pr. 7, Pr. 8) setting = other than 0



3. PARAMETERS

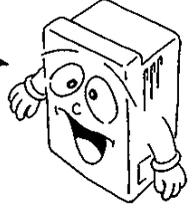
This chapter presents details on the “parameters” of this product.

Always read the precautions, etc., before starting use.

3.1 MONITORING FUNCTION	42
3.2 HELP FUNCTION	45
3.3 SETTING AND CHANGING THE VALUES IN THE PARAMETERS	59
3.4 PARAMETER LIST	60
3.5 SETTING OF PARAMETERS TO IMPROVE THE CORRESPONDING OPERATIONAL FUNCTIONS	63
3.6 INVERTER RESET	115

3.1 MONITORING FUNCTION

The inverter can be monitored by either the LED (red light emitting diode) display on the inverter, the 5-digit liquid crystal display on the PU (PU main monitor) or the PU level meter. These displays are selected by the following method:

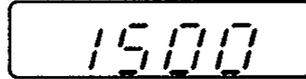


PU level meter

Setting Pr.53 on the PU allows selection from 8 types of data. (See page 84.)

- Factory setting...Pr.53 = "1"

Output speed indication



Inverter LED display

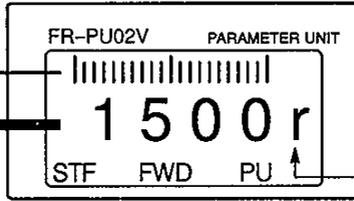
Setting Pr.51 on the PU allows selection from 8 types of data. (See page 84.)

- Factory setting...Pr.51 = "1"

Output speed indication

PU main monitor

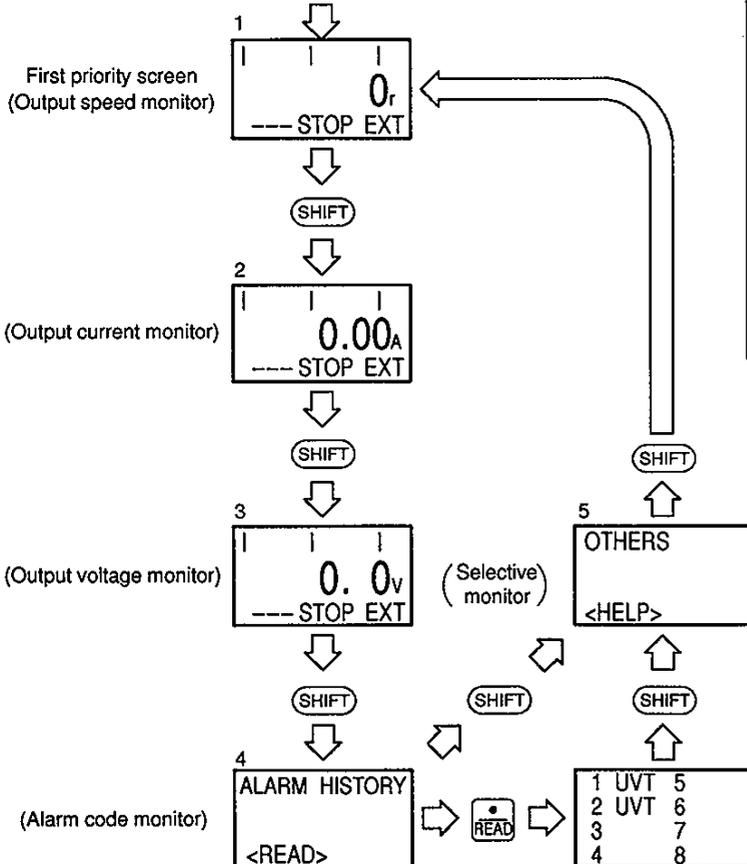
5 types of data can be selected in sequence by the [SHIFT] key.



3.1.1 SHIFT Operation Sequence on the PU Main Monitor

When "0" (factory setting) is set in Pr.52 "PU main display data selection", merely pressing the [SHIFT] key calls five types of data in sequence. Among the five monitor screens, the fifth monitor screen (selective monitoring) allows selection from four types of data such as the speed set value and running speed.

Switch the power on or press the [MONITOR] key.

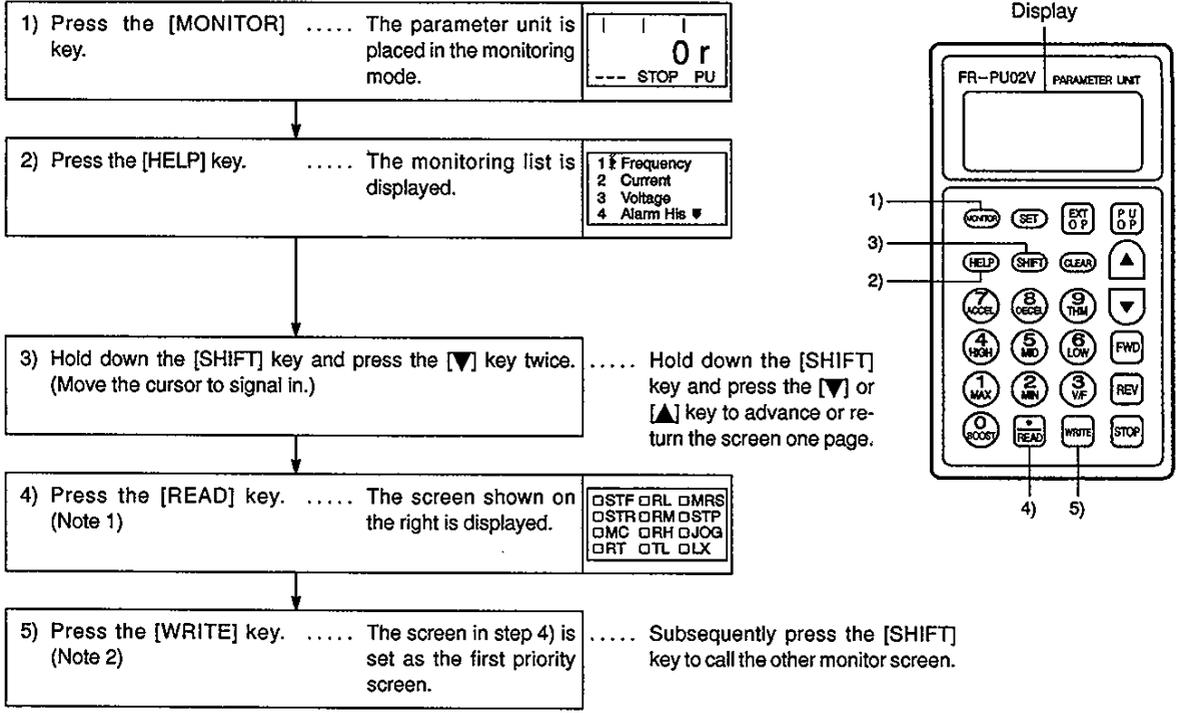


Note: 1. By pressing the [WRITE] key on any of the monitor screens shown on the left, that screen is given the first priority (first priority screen). When the [MONITOR] key is pressed immediately after power-on or in the setting or other mode to enter the monitoring mode, the first priority screen is displayed first.

2. When "17" (load meter) is selected in Pr.52, the "output current monitor" shown on the left is switched to the "load meter". When "20" is selected, "output voltage monitor" is switched to "cumulative energization time".

3.1.2 Selecting the Other Monitor Item in the Selective Monitoring Mode

● Selection procedure (Example: Select the input terminal state screen.)

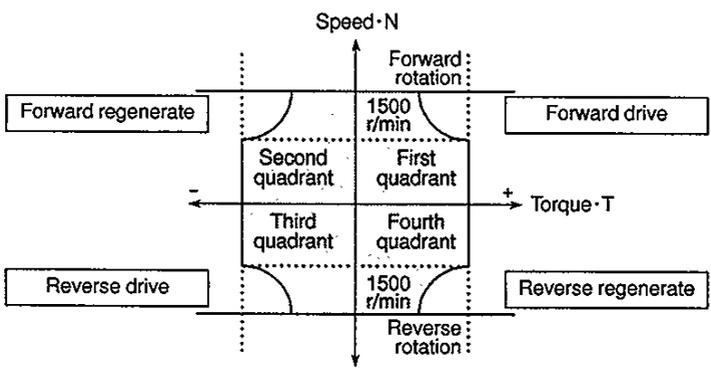


Note 1: As the selected monitor screen is not a first priority screen in the above step 4), the selected data is erased from the memory as soon as the power is shut off or the other operation mode (such as external operation) is selected. In this case, the selective monitoring mode must be selected again with the above procedure. When the first monitor screen has been set by pressing the [WRITE] key, the selected data remains intact in the memory.

Note 2: In step 5) where the [WRITE] key has been pressed in the above setting example, the "I/O terminal states" selected here are displayed first when the operation mode is switched to the monitoring mode. To give first priority to other data, press the [WRITE] key when the monitor screen needed is displayed. The first priority screen then switches to that monitor screen.

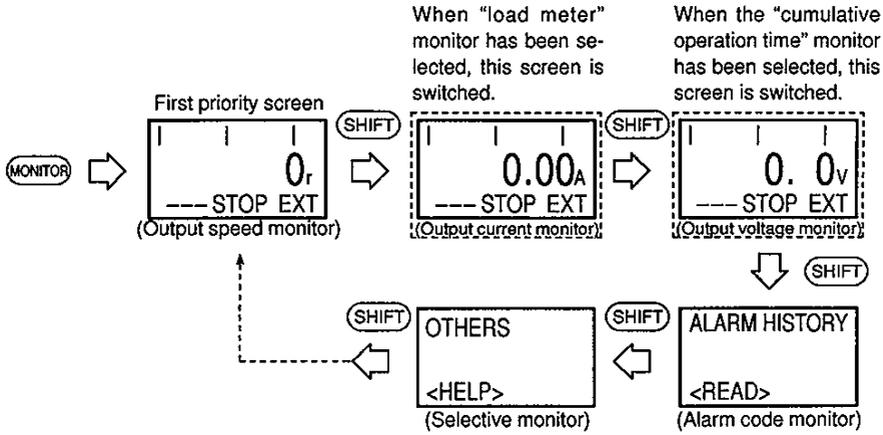
● When torque mode is selected

The following will be displayed on the parameter unit's monitor screen.
 (The first quadrant and fourth quadrant will be +. The second quadrant and third quadrant will be -.)



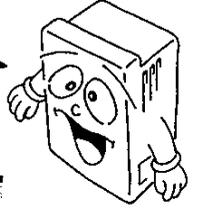
● **Selecting either of the monitoring items “load meter” and “cumulative energization time”**

When the “load meter” has been selected, the output current monitor screen is switched to a corresponding screen. When the “cumulative energization time” has been selected, the output voltage monitor screen is switched to a corresponding screen. When either of these two items has been selected, the output current or output voltage monitor screen cannot be used.

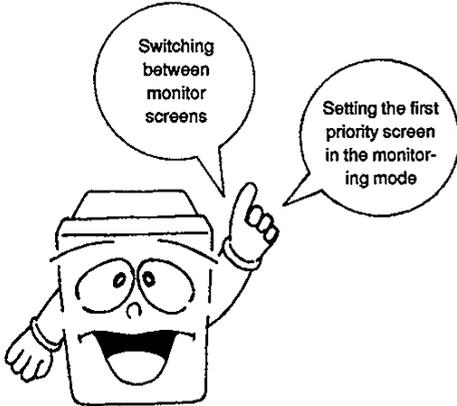


3.2 HELP FUNCTION

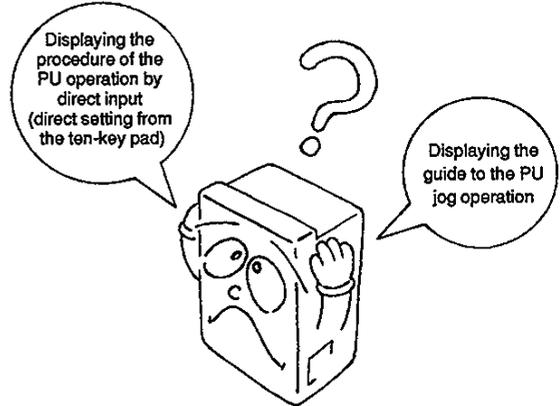
The FR-V200E inverter has a help function to assist you in performing the following.



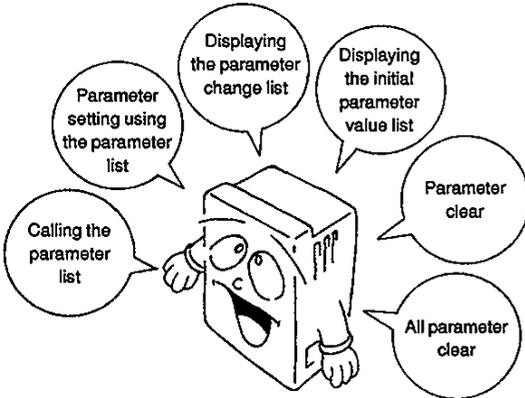
Monitor list display



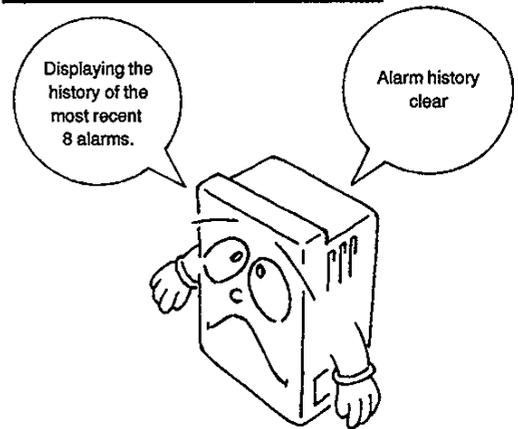
PU operation guide display



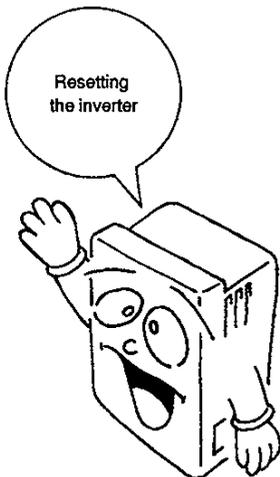
Various parameter settings



Alarm history



Inverter reset



In addition, press the [HELP] key in any of the PU operation modes to call a guide to the operation procedure.

3.2.1 Help Function Menu

Press the [HELP] key twice in any operation mode to call the help menu, with which various functions can be executed. (See page 47.)

• Menu screen page 1

- 1 **MONITOR**
- 2 PU Oper
- 3 Pr. List
- 4 Pr. Clear

1 MONITOR

Displays the monitoring list and allows the monitor screen to be changed and the first priority screen to be set.

2 PU OPERATION

Informs how to select the PU operation mode and PU jog operation mode via direct input (direct setting from the ten-key pad) and how to operate the keys.

3 PARAMETER

Displays the parameter menu and allows any of the following four items to be selected and executed:

- 1 Setting
- 2 Pr. List
- 3 Set Pr. List
- 4 Def. Pr. List

4 PARAMETER CLEAR

Displays the parameter menu and allows any of the following three items to be selected and executed:

- 1 Clear Pr.
- 2 Clear All
- 3 Clear None

Press [SHIFT] and [▼] together to proceed to the next page.

• Menu screen page 2

- 5 **Alarm Hist**
- 6 Alarm Clear
- 7 Inv. Reset

5 ALARM HISTORY

Displays the history of eight past alarms.

6 ALARM HISTORY CLEAR

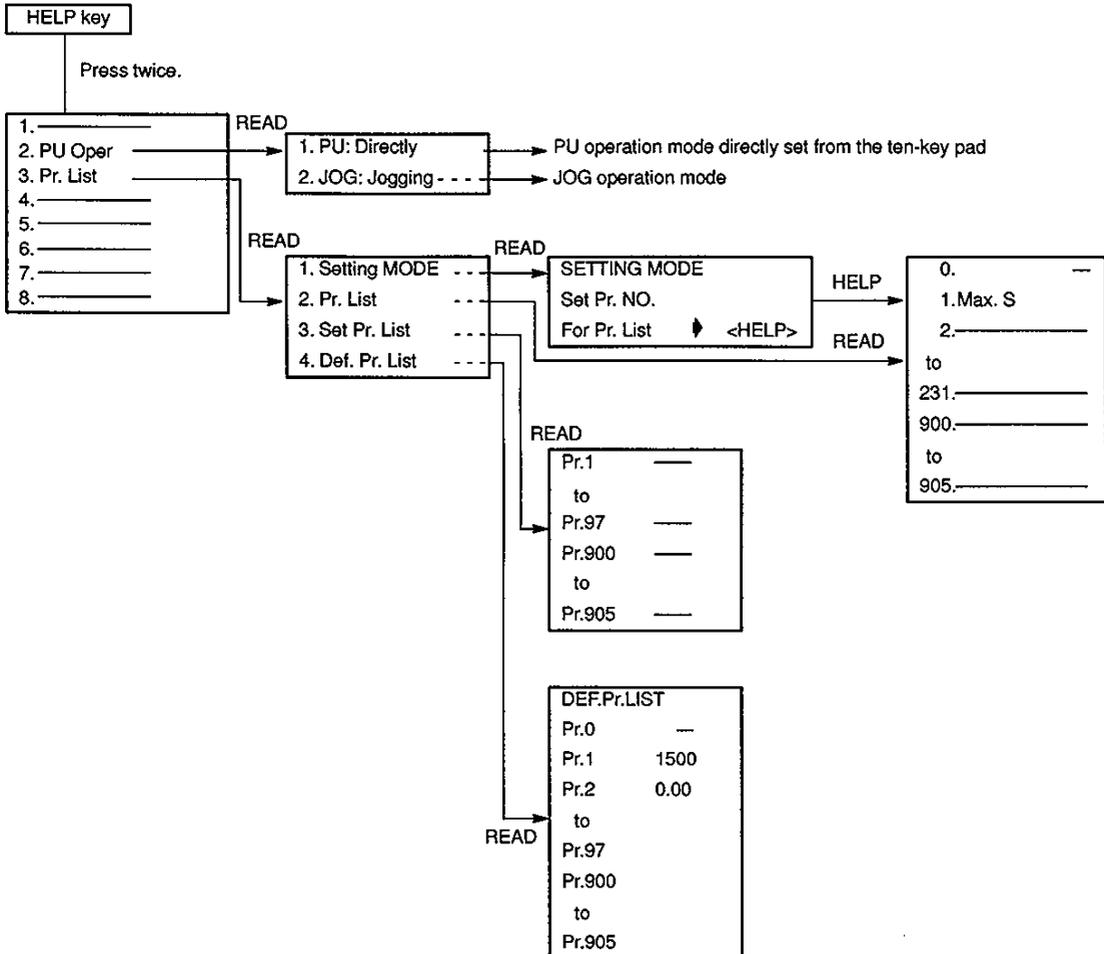
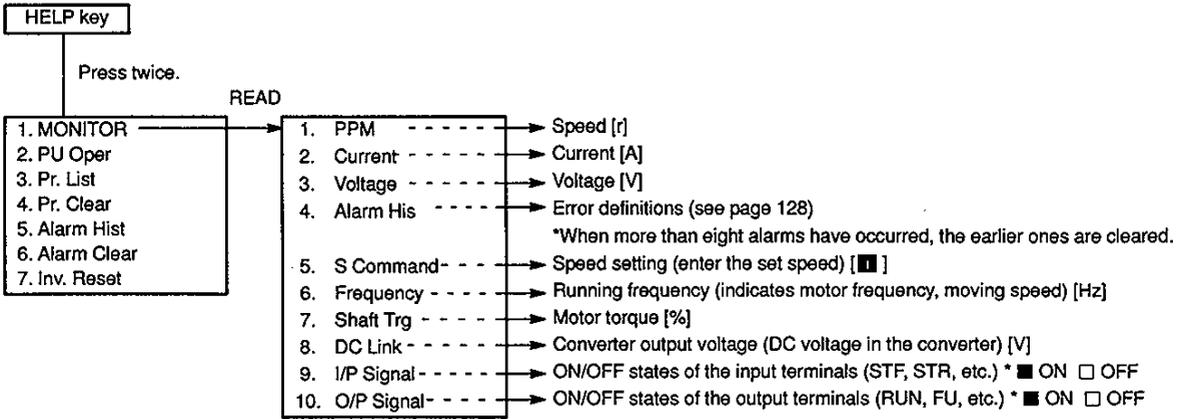
Clears all the alarm history.

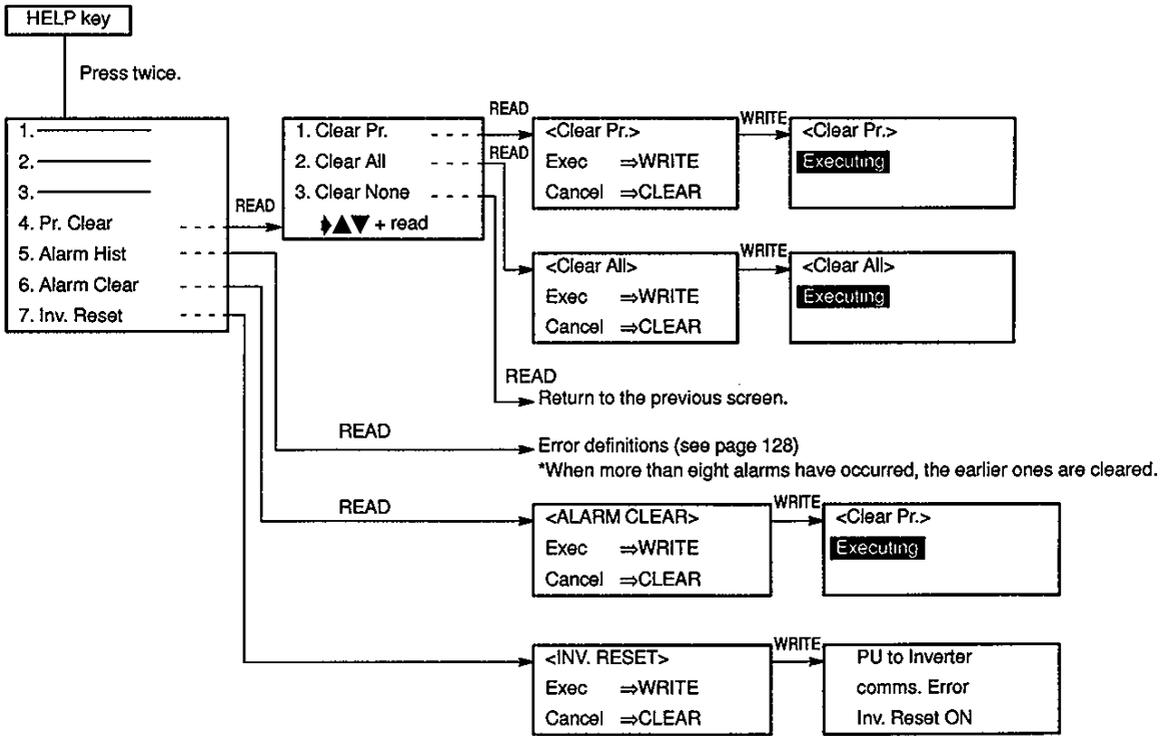
7 INVERTER RESET

Resets the inverter.

Press any of [MONITOR], [SET], [EXT OP] and [PU OP] to switch to the corresponding mode.

3.2.2 Definitions of the Help Function Displays



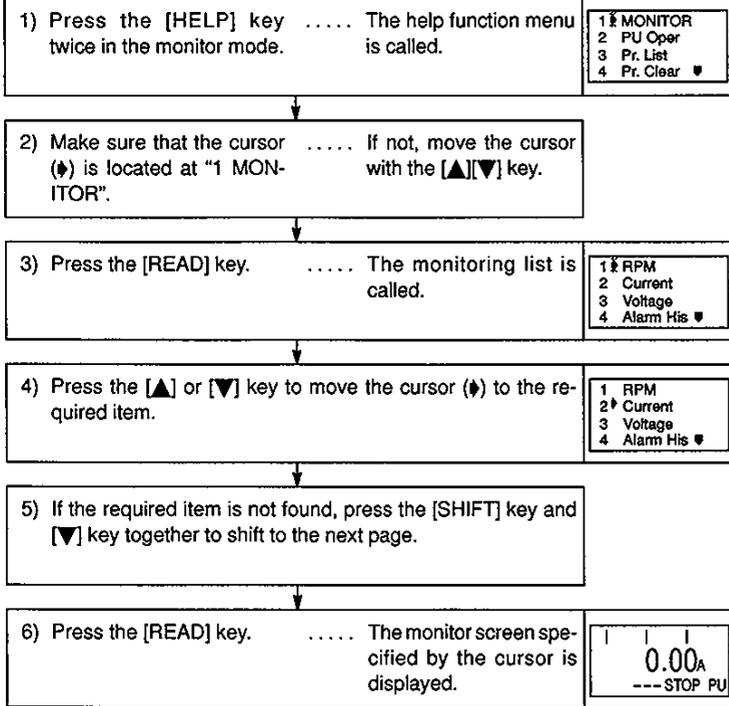


3.2.3 Help Function Guide

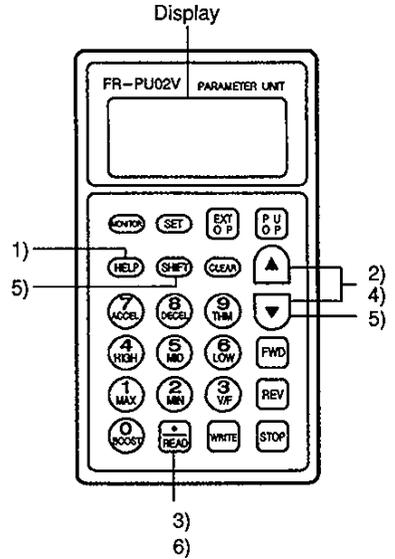
1 MONITOR

Displays the monitoring list and allows the monitor screen to be changed and the first priority screen to be set.

• Operation procedure 1 (To call the monitoring list from the help function menu)

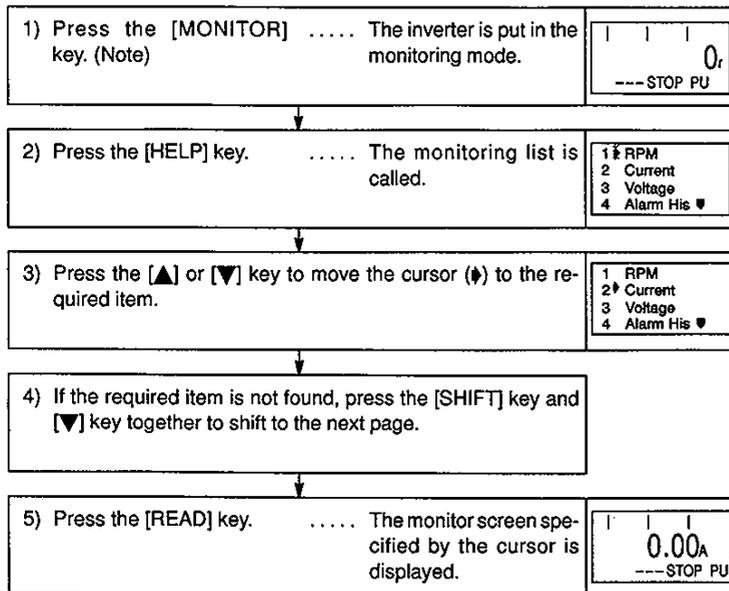


Press any of the [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.

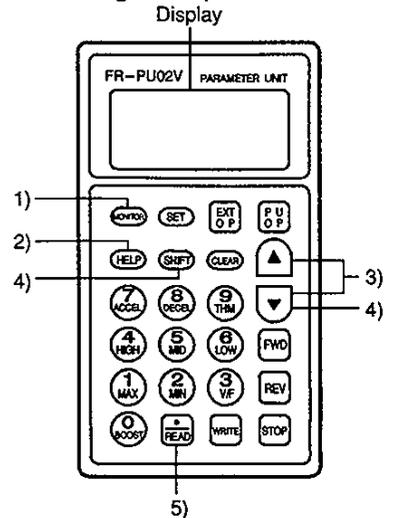


..... After pressing the [READ] key, press the [WRITE] key to set that monitor screen as the first priority screen.

• Operation procedure 2 (To call the monitoring list directly in the monitoring mode)



Press any of the [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



..... After pressing the [READ] key, press the [WRITE] key to set that monitor screen as the first priority screen.

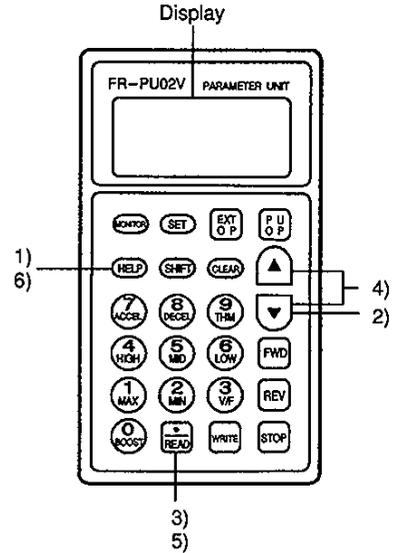
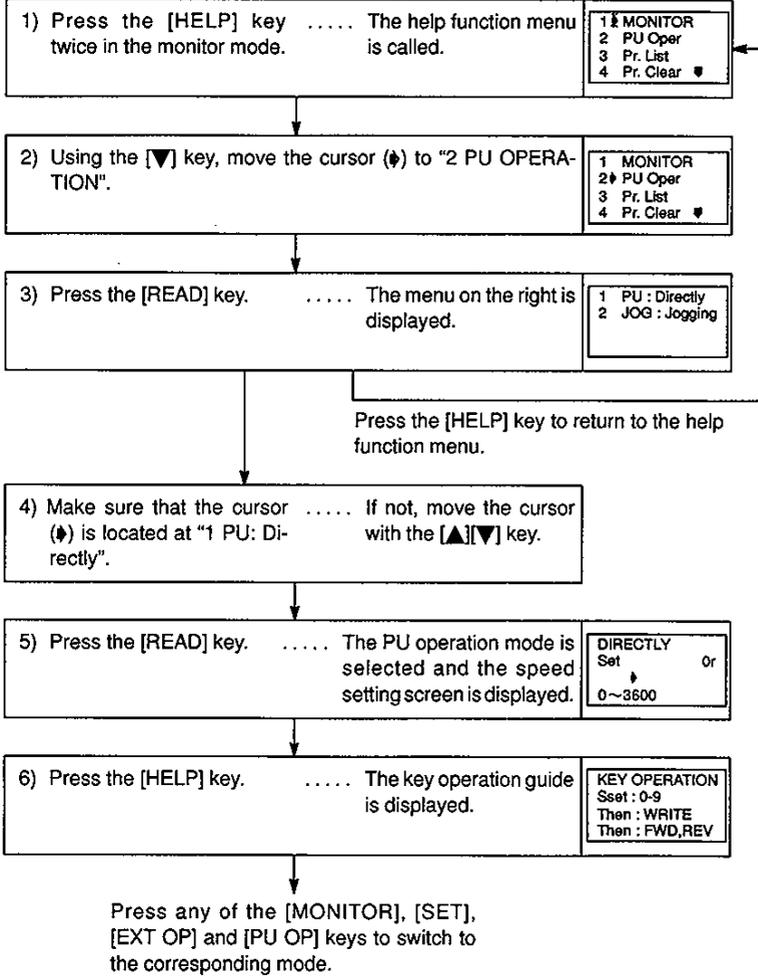
Note: This [MONITOR] key need not be pressed if the inverter is already in the monitoring mode.

2 PU OPERATION

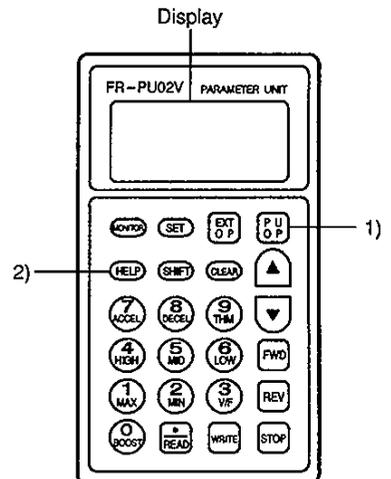
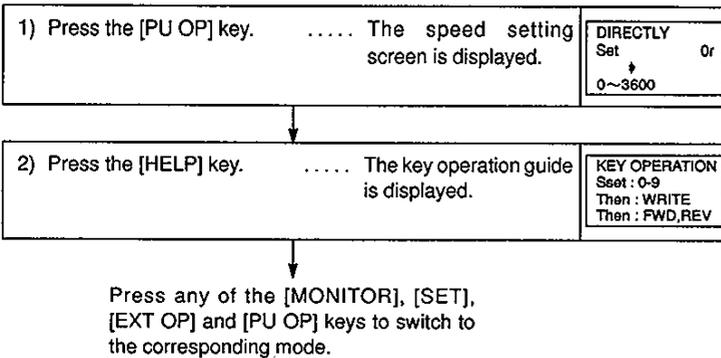
Inform how to select the PU operation mode and PU jog operation mode via direct input (direct setting from the ten-key pad) and how to operate the keys.

■ Selection of the PU operation mode (direct input)

● Operation procedure 1 (To access from the help function menu)

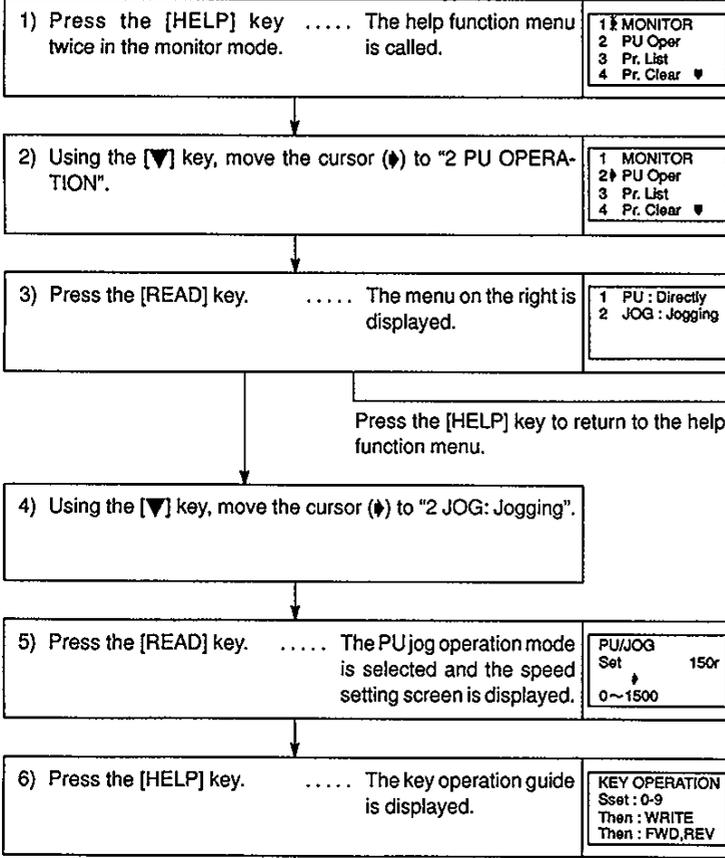


● Operation procedure 2 (To call the key operation guide directly)

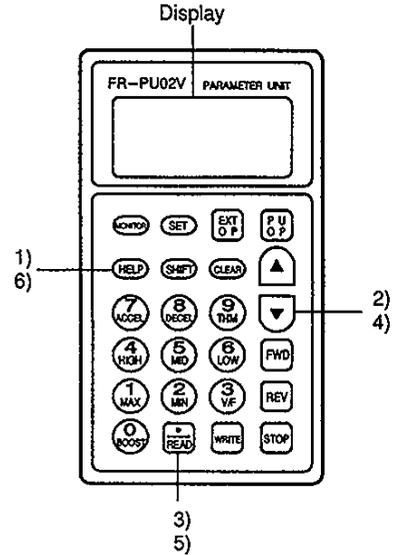


■ Selection of the PU jog operation mode

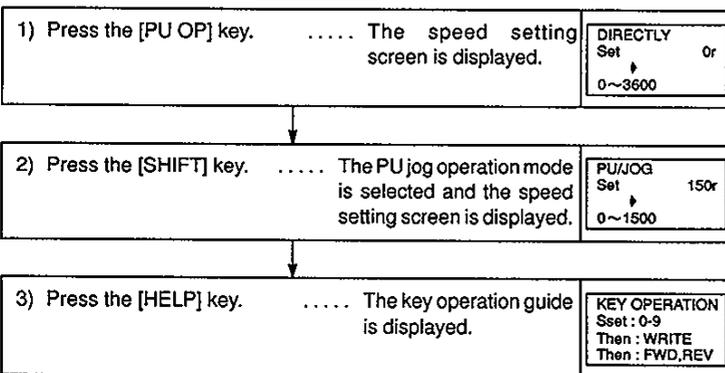
● Operation procedure 1 (To call from the help function menu)



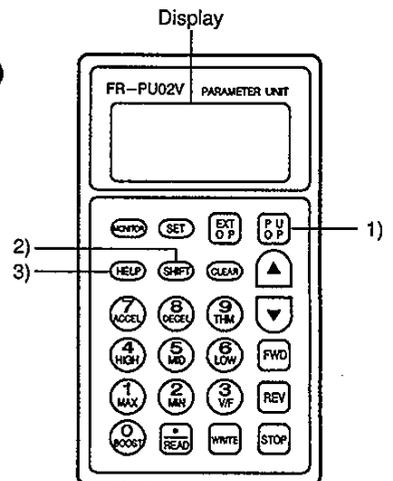
Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



● Operation procedure 2 (To call the key operation guide directly)



Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.

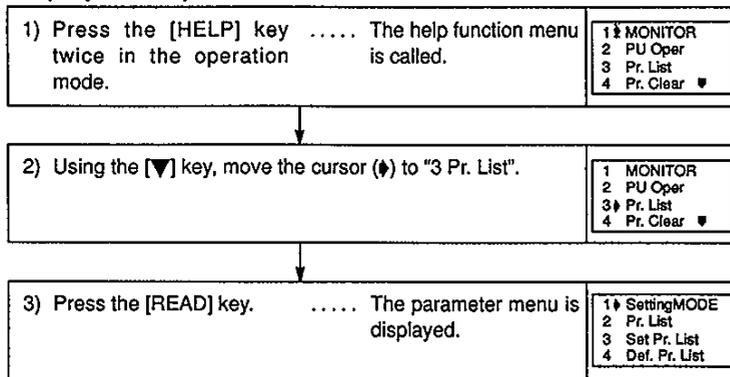


3 PARAMETER

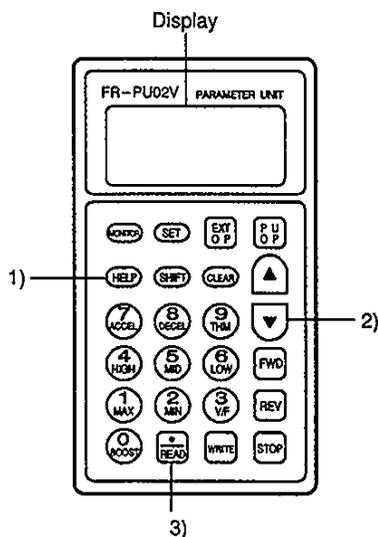
Displays the parameter menu and allows any of the following four items to be selected and executed:

- 1 Setting: Switches to the parameter setting mode.
- 2 Pr. List: Displays the parameter list in numerical order and allows the values of individual parameters to be read and written.
- 3 Set Pr. List: Displays a list of Pr. numbers and set values of only the parameters that have been changed from the factory setting. (For the parameters that have not been changed, their Pr. number only is displayed.)
- 4 Def. Pr. List: Displays a list of the initial values (default factory setting) of parameters.

● Display of the parameter menu

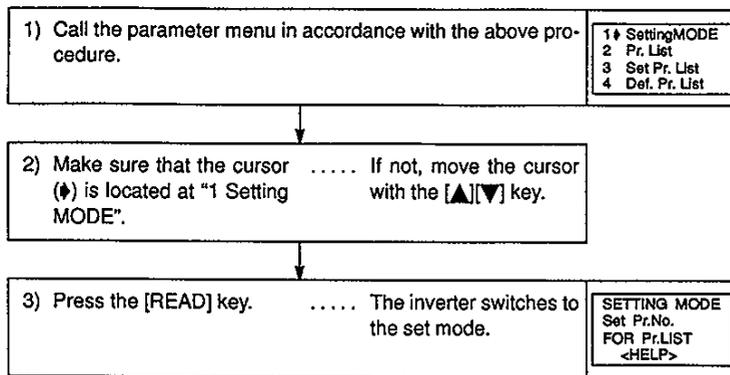


Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.

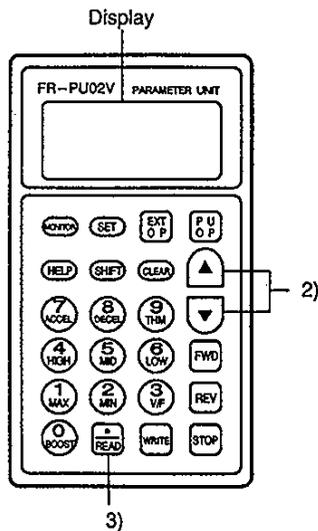


■ Selection and execution of "1 Setting"

● Operation procedure

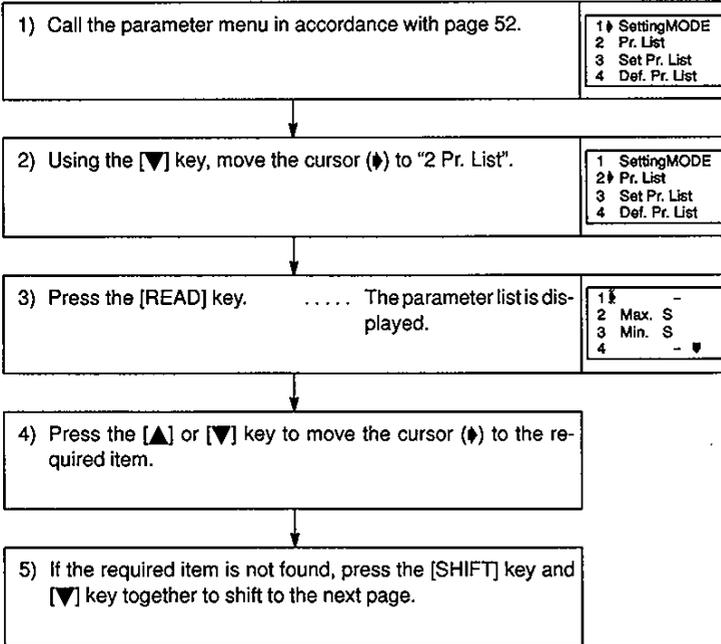


Press any of the [MONITOR], [EXT OP] and [PU OP] keys to switch to the corresponding mode.

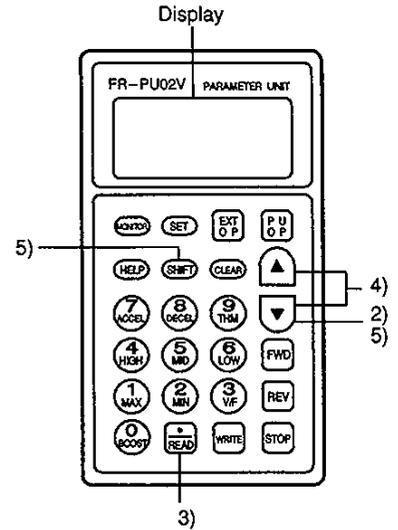


■ Selection and execution of "2 Pr. List"

● Operation procedure

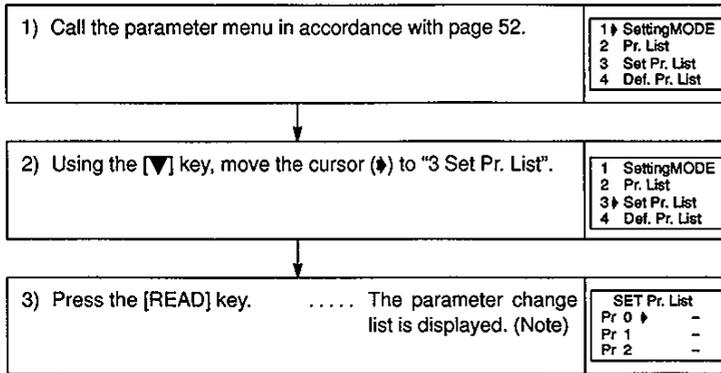


Press any of the [MONITOR], [EXT OP] and [PU OP] keys to switch to the corresponding mode.

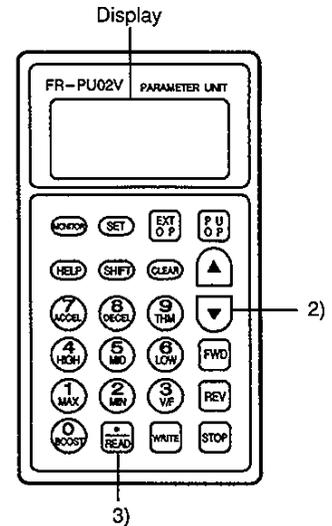


■ Display of "3 Set Pr. List"

● Operation procedure 1 (To call from the help function menu)



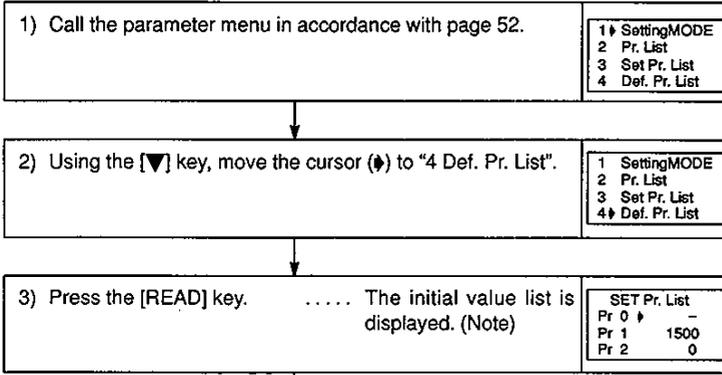
Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



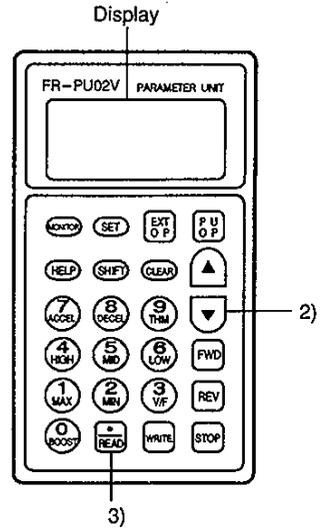
Note: Press the [SHIFT] key and [▼] key together to move to the next page.

■ Display of "4 Def. Pr. List"

● Operation procedure



Press any of the [MONITOR], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



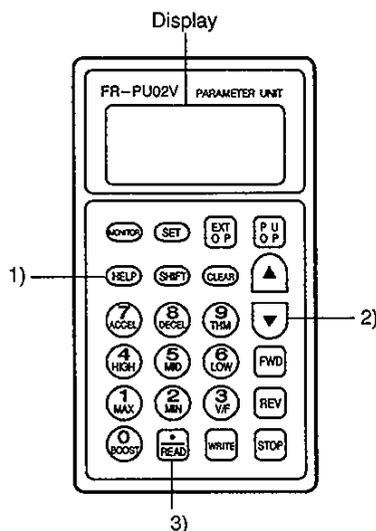
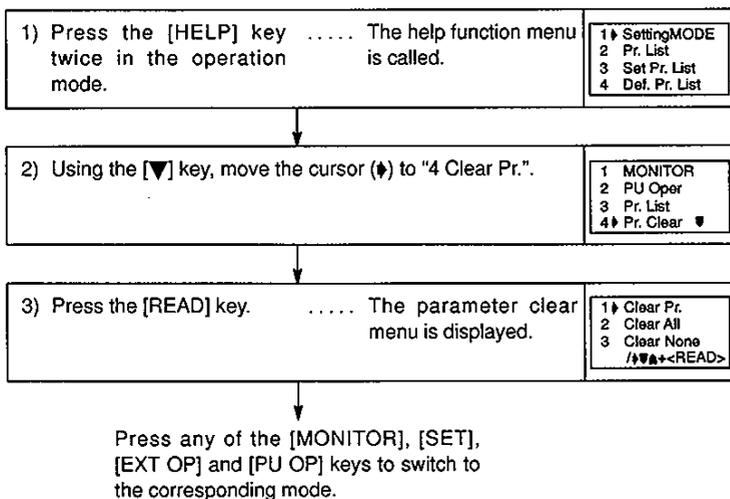
Note: Press the [SHIFT] key and [▼] key together to move to the next page.

4 PARAMETER CLEAR (To be performed in the PU operation mode)

Displays the parameter menu and allows any of the following three items to be selected and executed:

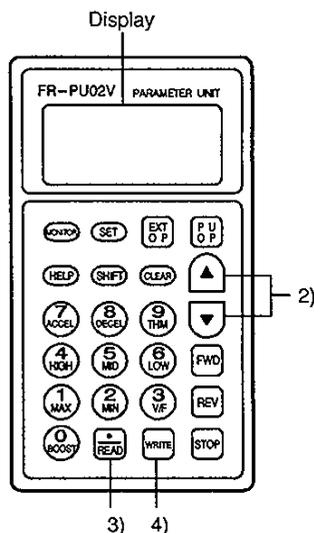
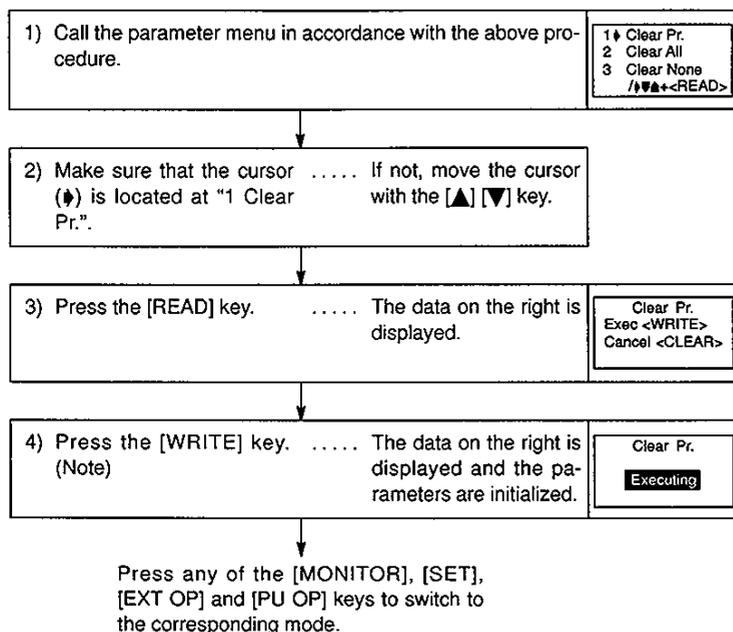
- 1 Clear Pr.: Returns (initializes) the parameter values to the factory setting with the exception of the calibration values in Pr. 900 to 905.
- 2 Clear All: Initializes all parameters.
- 3 Clear None: Does not initialize.

● Display of the parameter clear menu



■ Selection and execution of "1 Clear Pr."

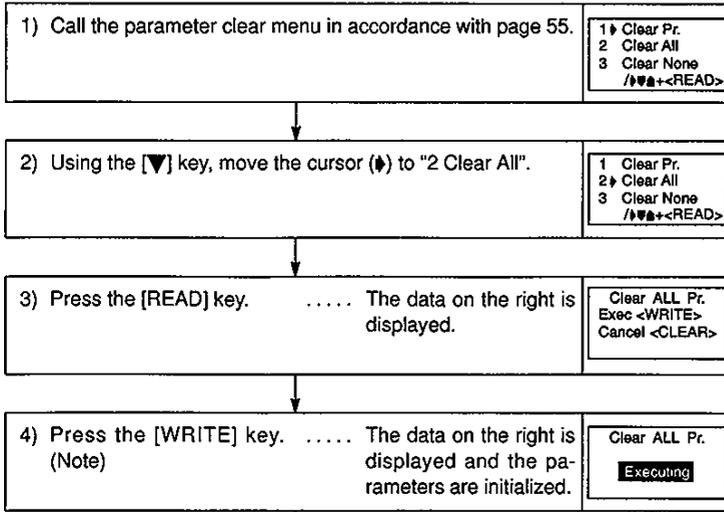
● Operation procedure



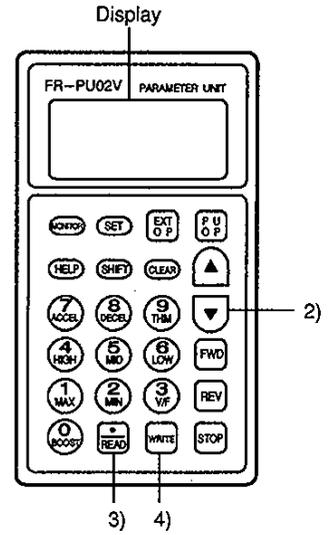
Note: Press the [CLEAR] key to disable parameter clear.

■ Selection and execution of “2 Clear All”

● Display of the parameter clear menu



Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



Note: Press the [CLEAR] key to disable Clear All.

■ “Clear None”

When “3 Clear None” is selected, the parameters are not initialized.

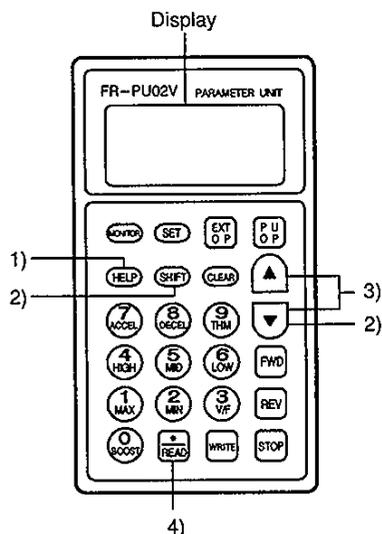
5 ALARM HISTORY

Displays the history of eight past alarms.

● Operation procedure

1) Press the [HELP] key twice in the operation mode.	..... The help function menu is called.	1 MONITOR 2 PU Oper 3 Pr. List 4 Pr. Clear ▼
2) Press the [SHIFT] key and [▼] key together.	..... The screen moves to the next page.	5 Alarm Hist ▼ 6 Alarm Clear 7 Inv. Reset
3) Make sure that the cursor (♦) is located at "5 Alarm Hist".	..... If not, move the cursor with the [▲] [▼] key.	5 Alarm Hist ▼ 6 Alarm Clear 7 Inv. Reset
4) Press the [READ] key.	..... The alarm history is displayed.	1 OV3 5 UVT 2 UVT 6 3 UVT 7 4 UVT 8

Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



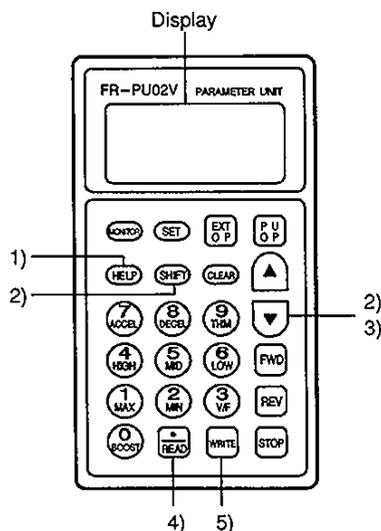
6 ALARM HISTORY CLEAR

Clears all the alarm history.

● Operation procedure

1) Press the [HELP] key twice in the operation mode.	..... The help function menu is called.	1 MONITOR 2 PU Oper 3 Pr. List 4 Pr. Clear ▼
2) Press the [SHIFT] key and [▼] key together.	..... The screen moves to the next page.	5 Alarm Hist ▼ 6 Alarm Clear 7 Inv. Reset
3) Using the [▼] key, move the cursor (♦) to "6 Alarm Clear".		5 Alarm Hist ▼ 6 Alarm Clear 7 Inv. Reset
4) Press the [READ] key.	..... The data on the right is displayed.	ALARM CLEAR Exec <WRITE> Cancel <CLEAR>
5) Press the [WRITE] key. (Note)	..... The data on the right is displayed and the alarm history is cleared.	ALARM CLEAR Completed

Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



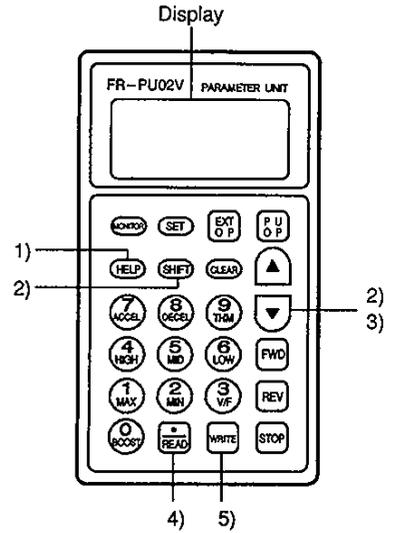
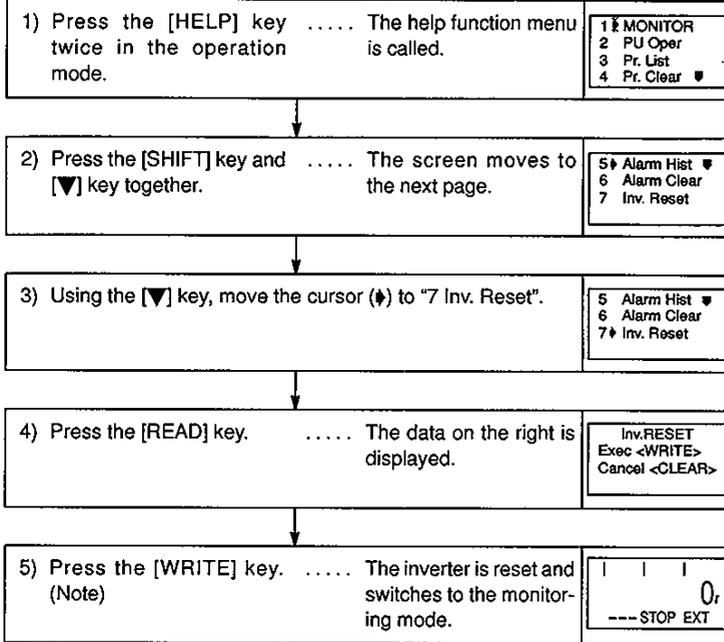
Note: Press the [CLEAR] key to disable Alarm History Clear.

7 INVERTER RESET

If the protective function of the inverter is activated (tripped) to protect the inverter, the trip state can be reset by the following operation.

The trip state can also be reset by switching the power off or connecting terminals RES and SD.

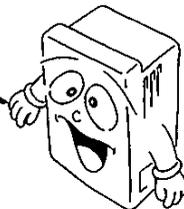
● Operation procedure



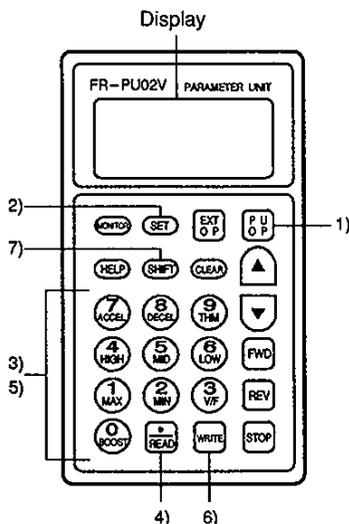
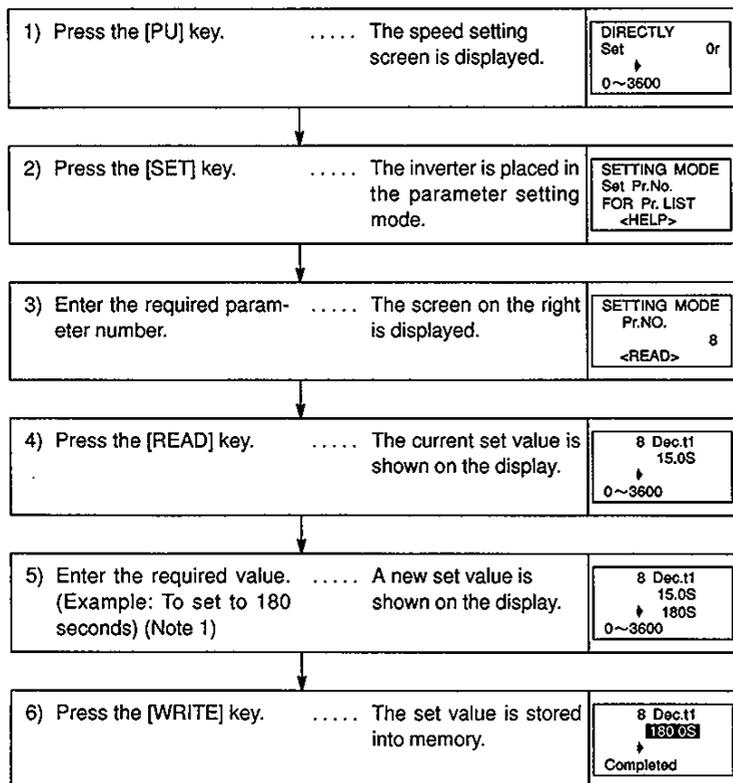
Note: By pressing the [CLEAR] key, the inverter is not reset and is switched to the monitoring mode.

3.3 SETTING AND CHANGING THE VALUES IN THE PARAMETERS

The inverter has many parameters. Using the PU, the required parameters can be selected and their values set and/or changed as appropriate according to the load and running conditions. For more information, see the "Parameter List" (page 60). Set "1" in Pr.77 "parameter write disable" to disable write. (See page 102.)



● Operation procedure (Reading and writing the value of Pr.8 "deceleration time")



..... If an error is displayed by pressing the [WRITE] key, see page 25.

7) Press the [SHIFT] key to move to the next parameter (Pr.9) and call the current set value. Then, press the [SHIFT] key to advance to the next parameter.

Note 1: If a setting error has occurred during the entry of a set value, press the [CLEAR] key to return to the status before that set value was entered.

Note: Set and/or change the parameter values in the PU operation mode. When the PU operation display is not provided, switch to the PU operation mode in accordance with page 31.
The values of the following parameters may be set and/or changed in the external operation mode:

- 3-speed setting Pr.4 to 6
- Multi-speed setting Pr.24 to 27
- Display function Pr.51 to 58
- Calibration function Pr.900 to 905

In addition to the above procedure, the help function may be used to call the parameter list for setting. For more information, see page 52.

3.4 PARAMETER LIST

Function	Parameter No.	Name	Screen Display	Setting Range	Minimum Setting Increment	Factory Setting	Customer Set Value	See page
Basic functions	1	Maximum speed	Max.S	0 to 3600r/min	1 r/min	1500r/min		63
	2	Minimum speed	Min.S	0 to 3600r/min	1 r/min	0 r/min		63
	4	Multi-speed setting (high speed)	Preset S1	0 to 3600r/min	1 r/min	1500r/min		63
	5	Multi-speed setting (middle speed)	Preset S2	0 to 3600r/min	1 r/min	750r/min		63
	6	Multi-speed setting (low speed)	Preset S3	0 to 3600r/min	1 r/min	150r/min		63
	7	Acceleration time	Acc.t1	0 to 3600 sec.	0.1 sec.	5 sec./15 sec. (Note 1)		64
	8	Deceleration time	Dec.t1	0 to 3600 sec.	0.1 sec.	5 sec./15 sec. (Note 1)		64
	9	Electronic thermal O/L relay		0 to 500A	0.01A	Rated motor current/0A (Note 2)		64
	Application functions	10	DC injection brake operation speed	DC Br.S	0 to 1500r/min,9999	1 r/min	90r/min		65
11		DC injection brake operation time	DC Br.t	0 to 10 sec.	0.1 sec.	0.5 sec.		65
12		DC injection brake voltage	DC Br.V	0 to 30%	0.1%	3%		65
13		Starting speed	Start S	0 to 1500r/min	1 r/min	15r/min		66
14		Control mode	Ctrl Mode	0 to 6,11,12,16,101,102,106	Integer	0		67
15		Jog speed setting	JOG S	0 to 1500r/min	1 r/min	300r/min		68
16		Jog acceleration/deceleration time	JOG t	0 to 3600sec	0.1 sec.	0.5 sec.		68
17		Input terminal assignment	Set Dig1	0 to 999	Integer	12		69
18		S acceleration pattern 1		0 to 50%	1%	0%		71
19		S deceleration pattern 1		0 to 50%	1%	0%		71
20		Acceleration/deceleration reference speed	Acc/Dec.S	0 to 3600r/min	1 r/min	1500r/min		64
21		S acceleration pattern 2		0 to 50%	1%	0%		71
22		S deceleration pattern 2		0 to 50%	1%	0%		71
23		Thermal protector input		0,1	Integer	0		73
24		Multi-speed setting (speed 4)	Preset S4	0 to 3600r/min,9999	1 r/min	9999		63
25		Multi-speed setting (speed 5)	Preset S5	0 to 3600r/min,9999	1 r/min	9999		63
26		Multi-speed setting (speed 6)	Preset S6	0 to 3600r/min,9999	1 r/min	9999		63
27		Multi-speed setting (speed 7)	Preset S7	0 to 3600r/min,9999	1 r/min	9999		63
28		Multi-speed compensation selection	Pre.Comp	0,1	Integer	0		73
29	Acceleration/deceleration pattern	Acc./DecP	0,1,2,10,11,12,100,101,102,110,111,112	Integer	0		71	
Protective functions	30	Regenerative brake duty change selection/high power factor converter connection selection	Br.Set	0,1, 3, 4	Integer	0		74
	31	Speed deviation level	SDev Lv1	0 to 1500r/min,9999	1 r/min	9999		76
	32	Overspeed detection level	OvrSLV1	0 to 3600r/min	1 r/min	3000r/min		76
Torque restriction	33	Torque restriction mode	TL Mode	1,2,3,4	Integer	3		77
	34	Torque restriction level	TL Lvl.1	0 to 400%	0.1%	150%		77
	35	Torque restriction level (Regeneration)	TL Lvl.2	0 to 400%,9999	0.1%	9999		77
	36	Torque restriction level (No. 3 quadrant)	TL Lvl.3	0 to 400%,9999	0.1%	9999		77
	37	Torque restriction level (No. 4 quadrant)	TL Lvl.4	0 to 400%,9999	0.1%	9999		77
	38	Torque restriction level 2	2nd TL	0 to 400%,9999	0.1%	9999		77
Torque detection	39	Torque detection	Trq. Det	0 to 400%	0.1%	150%		80
	40	Output terminal assignment	Set Dig0	0 to 999	Integer	12		81
	41	Up-to-speed sensitivity	SU Range	0 to 100%	0.1%	10%		82
	42	Speed detection	Set FU S	0 to 3600r/min	1 r/min	300r/min		82
	43	Low speed detection	LS Det.	0 to 1500r/min	1 r/min	45r/min		82
Second functions	44	Second acceleration/deceleration time	Ac/Dec2	0 to 3600 sec	0.1 sec.	5 sec.		83
	45	Second deceleration time	Dec.t2	0 to 3600 sec,9999	0.1 sec.	9999		83
	46	Second multi-function input selection		0 to 999,9999	Integer	9999		71
	47	Torque boost	Trq. Bst	0 to 30%	0.1%	3%		83
	48	Base frequency	VF base F	50 to 200Hz	0.01Hz	60Hz		83
	49	Base frequency voltage	VF base V	0 to 500V,9999	0.1V	9999		83

Note 1: The set value depends on the inverter capacity: (5.5K or less)/(7.5K or more).

Note 2: The set value depends on the inverter capacity: (3.7K or less)/(5.5K or more).

Note 3: The parameters hatched allow their set values to be changed during operation if 0 (factory setting) has been set in Pr.77 (parameter write disable selection).

Function	Parameter No.	Name	Screen Display	Setting Range	Minimum Setting Increment	Factory Setting	Customer Set Value	See page
Display function	51	Inverter LED display data	Set LED	1 to 8,17	Integer	1		84
	52	PU main display data	Set PU	0,17,20	Integer	0		84
	53	PU level display data	Set Lv1.	0 to 3,5 to 8,17	Integer	1		84
	54	DA1 terminal function selection	Set D/A1	1 to 3,5 to 8,17,21	Integer	1		84
	55	DA2 terminal function selection	Set D/A2	1 to 3,5 to 8,17,21	Integer	7		84
	56	Speed monitoring reference	CalbAM S	0 to 3600r/min	1 r/min	1500r/min		84
	57	Current monitoring reference	CalbAM I	0 to 500A	0.01A	Rated value		84
	58	Torque monitoring reference	CalbAM T	0 to 400%	0.1%	150%		84
59	Language switching	PU Lang	0,9999	Integer	9999		86	
Operation selection functions	60	Speed deviation time	SDev Time	0 to 100 sec.	0.1 sec.	12 sec.		76
	61	Restart coasting time	RestrT	0,0.1 to 5 sec., 9999	0.1 sec.	9999		86
	62	Pre-excitation selection	Set LX	0,1	Integer	0		88
	63	Torque command selection	Set TRef	0,1	Integer	0		88
	64	Motor capacity		0 to 55kW,9999	0.01kW	9999		89
	65	Number of motor poles		2,4,6,9999	Integer	9999		89
	66	Rated motor speed		0 to 3600r/min	1r/min	Rated motor speed		89
	67	Open motor circuit detection level	I Dt. Lv1	0 to 50%	0.1%	5%		94
	68	Open motor circuit detection time	I Dt. T	0.05 to 1 sec., 9999	0.01 sec.	9999		94
	69	Number of PLG pulses		0 to 4096	1	1024/1000 (Note 8)		89
	70	Regenerative brake duty	Br.Duty	0 to 30%/0% (Note 6)	0.1%	0%		74
	71	Applied motor		0,1	Integer	0		96
	*72	PWM frequency selection	PWM Mode	0 to 6	Integer	6		96
	73	Speed setting signal	ExtS/10V	0 to 3	Integer	0		97
	74	Torque characteristic selection		0,1	Integer	0		98
	75	PU stop key selection	Stop Mode	0,1,2,3	Integer	1		100
	76	Alarm definition	Trb1. Def	0,1	Integer	0		101
	77	Parameter write disable selection	Enable Wr	0,1,2	Integer	0		102
	78	Reverse rotation prevention selection	Enable FR	0,1,2	Integer	0		102
79	Operation mode selection	Ope. Mode	0,1,2	Integer	0		102	
Speed control system functions	80	Speed control P gain 1	S Gain 1	0 to 1000%	1%	30%		103
	81	Speed control I gain 1	S IComp 1	0 to 1000%	0.1%	3%		103
	82	Speed setting filter 1	SStFil.1	0 to 5 sec.	0.001 sec.	0 sec.		103
	83	Speed detection filter 1	SDtFil.1	0 to 5 sec.	0.001 sec.	0 sec.		104
	84	Torque control P gain 1	T Gain 1	0 to 1000%	1%	100%		104
	85	Torque control I gain 1	T Icomp 1	0 to 1000%	1%	100%		104
	86	Torque setting filter 1	TStFil.1	0 to 5 sec.	0.001 sec.	0 sec.		104
	87	Torque detection filter 1	TDtFil.1	0 to 5 sec.	0.001 sec.	0 sec.		105
	88	Droop gain		0 to 100%,9999	0.01%	9999		105
	89	OLT level setting		0 to 200%	0.1%	150%		106
	90	Speed control P gain 2	S Gain 2	0 to 1000%	1%	30%		103
	91	Speed control I gain 2	S Icomp 2	0 to 1000%	0.1%	3%		103
	92	Speed setting filter 2	SStFil.2	0 to 5 sec.	0.001 sec.	0 sec.		103
	93	Speed detection filter 2	SDtFil.2	0 to 5 sec.	0.001 sec.	0 sec.		104
	94	Torque control P gain 2	T Gain 2	0 to 1000%	1%	100%		104
	95	Torque control I gain 2	T Icomp 2	0 to 1000%	1%	100%		104
	96	Torque setting filter 2	TStFil.2	0 to 5 sec.	0.001 sec.	0 sec.		104
	97	Torque detection filter 2	TDtFil.2	0 to 5 sec.	0.001 sec.	0 sec.		105
	98	Auto tuning setting		0,1	Integer	0		89
	99	Motor constant selection		0 to 3,9999	Integer	9999		89
103	Torque bias selection		0 to 3,9999	Integer	9999		107	
104	Torque bias 1		600 to 1400%,9999	1%	9999		107	
105	Torque bias 2		600 to 1400%,9999	1%	9999		107	
106	Torque bias 3		600 to 1400%,9999	1%	9999		107	
147	Torque bias filter		0 to 5 sec.,9999	0.001 sec.	9999		107	
148	Torque bias operation time		0 to 5 sec.,9999	0.01 sec.	9999		107	
149	Torque bias balance compensation		0 to 10V,9999	0.1V	9999		107	

Function	Parameter No.	Name	Screen Display	Setting Range	Minimum Setting Increment	Factory Setting	Customer Set Value	See page
Speed control system functions	151	Secondary resistance compensation selection		0 to 200°C,9999	Integer	9999		111
	152	Fall-time torque bias No. 3 bias		0 to 400%,9999	1%	9999		107
	153	Fall-time torque bias No. 3 gain		0 to 400%,9999	1%	9999		107
	154	Droop filter time constant		0.00 to 1.00 sec.,9999	0.01sec.	9999		105
	155	Speed indication		11 to 9998,9999	1	9999		111
	156	PLG rotation direction		0,1	1	0		112
	157	Excitation ratio		0 to 100%	1%	100%		112
	158	Deceleration torque limit		0 to 400%,9999	1%	9999		77
	159	Acceleration torque limit		0 to 400%,9999	1%	9999		77
Calibration functions	900	DA1 terminal calibration	DA1 Tune	-	-	-		113
	901	DA2 terminal calibration	DA2 Tune	-	-	-		113
	902	Speed setting second bias	Ext Bias 2	0 to 10V, 0 to 3600r/min	1 r/min	(0V), 0r/min		113
	903	Speed setting second gain	Ext Gain 2	0 to 10V, 0 to 3600r/min	1 r/min	(10V), 1500r/min		113
	904	Torque command third bias	Ext Bias 3	0 to 10V, 0 to 400%	0.1%	(0V), 0%		114
	905	Torque command third gain	Ext Gain 3	0 to 10V, 0 to 400%	0.1%	(10V), 150%		114

Note 4: The parameter marked * cannot be written during operation even if Pr.77 "parameter write disable selection" is set to "2".

Note 5: Pr.100 to Pr.120 are parameters for the option unit.

Note 6: The setting range depends on the inverter capacity: (5.5K or less)/(7.5K or more).

Note 7: In the Screen Display section, S indicates a speed, f a frequency, V a voltage, I a current, t time, and T torque.

Note 8: The factory setting depends on the inverter capacity: (3.7K or less)/(5.5K or more).

3.5 SETTING OF PARAMETERS TO IMPROVE THE CORRESPONDING OPERATIONAL FUNCTIONS

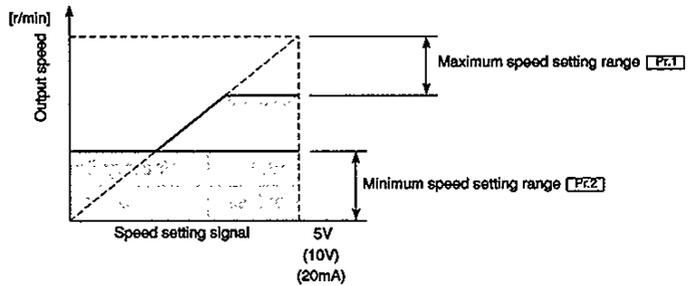
To set the upper and lower limits of motor speed

▷ Pr. 1 “maximum speed”, Pr. 2 “minimum speed”

The upper and lower limits of the output speed can be clamped.

- To set the upper limit within 3600r/min.
Using Pr. 1 “maximum speed”, set the upper limit of the output speed.
- To run the motor at the set speed by turning the start signal on
Using Pr. 2 “minimum speed”, set the lower limit of the output speed.

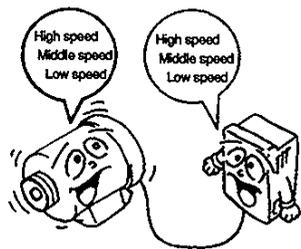
Parameter Number	Factory Setting	Setting Range
1	1500r/min	0 to 3600r/min
2	0r/min	0 to 3600r/min



⚠ CAUTION

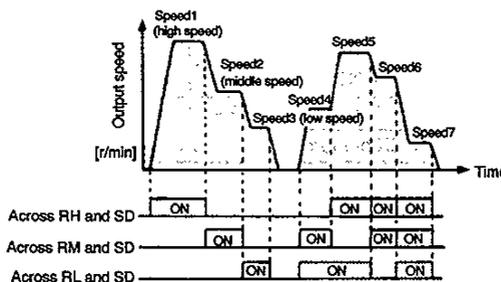
⚠ Note that when the minimum speed is set, a start signal will start the motor at the set speed, without the speed command.

To set multiple speeds



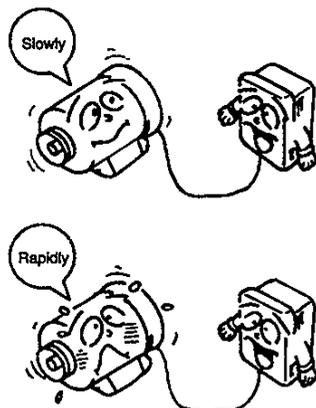
▷ Pr. 4 “3-speed setting (high speed)”, Pr. 5 “3-speed setting (middle speed)”, Pr. 6 “3-speed setting (low speed)”, Pr. 24 “multi-speed setting (speed 4)”, Pr. 25 “multi-speed setting (speed 5)”, Pr. 26 “multi-speed setting (speed 6)”, Pr. 27 “multi-speed setting (speed 7)”

- Allows any speed to be selected by switching the external contact signal (across terminals RH/RM/RL and SD). Use Pr. 17 “input terminal assignment” to set terminals RH, RM and RL.
- Each speed may be specified as appropriate between 0 and 3600r/min during inverter operation. The speed may also be set using the [▲] and [▼] keys. (On releasing the [▲] and [▼] keys, the set speed is stored, i.e. the [WRITE] key need not be pressed.)
- By using these functions with jog speed setting (Pr. 15), maximum setting (Pr. 1) and minimum setting (Pr. 2), up to 10 speeds can be set.



Note: 1. Speeds 4 to 7 are not selected if the setting of Pr. 24 to Pr. 27 is “9999” (factory setting).
2. These speeds have priority over the main speed (across terminals 2 and 5).
3. This setting may also be made during PU operation or external operation.
4. With 3-speed setting, if two or three speeds are simultaneously selected, priority is given to the speed of lower signal.

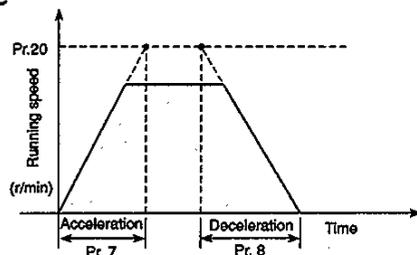
To accelerate/decelerate slowly or rapidly



⇨ Pr. 7 “acceleration time”, Pr. 8 “deceleration time”, Pr. 20 “acceleration/deceleration reference speed”

(1) Setting of acceleration time

Set the period of time required to reach the acceleration/deceleration reference speed (Pr. 20) from 0Hz. Set a longer time to accelerate more slowly, and a shorter time to accelerate more rapidly. (Note)



(2) Setting of deceleration time

Set the period of time required to reach 0Hz from the acceleration/deceleration reference speed (Pr. 20). Set a longer time to decelerate more slowly, and a shorter time to decelerate more rapidly. (Note)

Model	Factory Setting	Setting Range
5.5K or less	5 sec.	0 to 3600 sec.
7.5K or more	15 sec.	0 to 3600 sec.

Note: 1. If Pr. 20 (acceleration/deceleration reference speed) setting is changed, the set values of calibration Pr. 903 and Pr. 905 (speed setting second (torque command third) gain) remain unchanged. To adjust the gains, adjust calibration functions Pr. 903 and Pr. 905.

2. When load GD^2 is large, the overvoltage alarm may be activated if the parameter value remains as set in the factory, without the regenerative brake option being installed.

Motor overheating protection

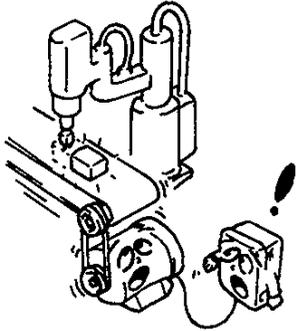


⇨ Pr. 9 “electronic thermal overload protection”

- For use of a general-purpose motor with PLG, the set value for motor overheating protection may be set as a current value (A). Normally set the rated current value of the motor at 50Hz. This function provides an optimum protective characteristic including a reduction in motor cooling capability in low-speed operation. (The factory setting of 3.7K or less is the rated motor current of the SF-JR (with PLG).)
- Setting of “0” makes the motor protective function invalid. (The inverter output transistor protective function is valid.)
- When Mitsubishi’s constant-torque motor is used, set “1” in Pr. 71 (applied motor) to select the 100% continuous torque characteristic in the low speed range, and set the rated motor current in Pr. 9 (electronic thermal overload protection).

Model	Factory Setting		Setting Range
	200V	400V	
1.5K	6.2A	3.1A	0 to 500A
2.2K	9.0A	4.5A	
3.7K	14.2A	7.1A	
5.5K or more	0A		

To adjust the stopping accuracy of positioning operation, etc. according to the load



▷ Pr. 10 “DC injection brake operation speed”, Pr. 11 “DC injection brake operation time”, Pr. 12 “DC injection brake voltage”

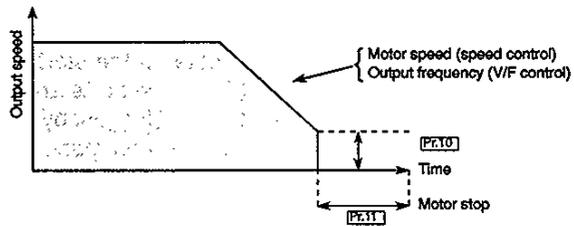
- Accurate positioning is possible by adjusting the injection braking start speed, duration and voltage.

DC Injection Braking Possible	DC Injection Braking Not Possible
<ul style="list-style-type: none"> • Speed control • V/F control 	<ul style="list-style-type: none"> • Torque control • Position control (with FR-VPB positioning control option)

Note: Use Pr. 14 “control mode” to set the control mode.

• Parameters used

Parameter	Name	Setting Range	Factory Setting	Remarks
10	DC injection brake operation speed	0 to 1500, 9999	90r/min	9999: Same as starting speed
11	DC injection brake operation time	0 to 10 sec.	0.5 sec.	
12	DC injection brake voltage	0 to 30%	3%	Valid during V/F control



• Speed control

When the motor speed reduces to less than the value set in Pr. 10 “DC injection brake operation speed” during deceleration, the output speed is reduced to 0 and zero speed control is exercised for the period of time set in Pr. 11 “DC injection brake operation time”.

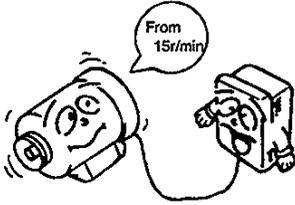
When the time set in Pr. 11 elapses, the motor will coast to a stop. When the Pr. 62 “pre-excitation selection” setting is 0 (zero speed control) and the signal across LX (allocated using Pr. 17 “input terminal assignment”) and SD is on, zero speed control is exercised while the signal across LX and SD is on.

When the Pr. 62 setting is 1 (servo lock) and the signal across LX and SD is on, the motor is servo-locked to keep the current position if the motor speed reduces to less than the value set in Pr. 10 “DC injection brake operation speed” during deceleration.

⚠ CAUTION

⚠ Install a mechanical brake. DC brake does not have holding torque while the inverter is shut off.

To limit the speed of motor start



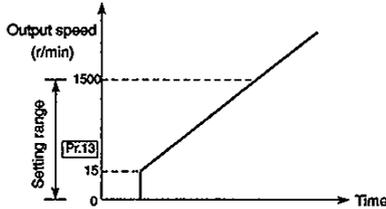
● V/F control

When the frequency is lower than the value in Pr. 10, DC injection braking starts for the duration of Pr. 11 at a level of Pr. 12. If the Pr. 11 setting time is exceeded, the motor will coast to a stop.

⇒ Pr. 13 "starting speed"

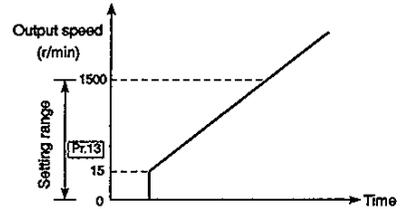
- Allows the starting speed to be set between 0 and 1500r/min. The factory setting is 15r/min and the motor will not start until a speed setting signal equivalent to 15r/min is input. The operation pattern after the input of the speed setting signal is as set in Pr. 29 "acceleration/deceleration pattern". (See below)

Pr. 29 "acceleration/deceleration pattern" = "0, 1, 2, 100, 101, 102"



Forward rotation ON

Pr. 29 "acceleration/deceleration pattern" = "10, 11, 12, 110, 111, 112"



Forward rotation ON

Note: If the starting speed is set too low during speed operation with the analog voltage command, the motor may start rotating just by the input of the starting signal even if the voltage command is zero. An adjustment can be made by using the calibration function Pr. 902.

To set the torque mode by the MC switching terminal

⇒ Pr. 14 “control mode”

- Speed, torque or V/F control can be selected with this parameter, and switched between with the MC terminal (DI1, DI2 or DI3). Refer to Pr. 17 (page 69) for input terminal assignment.

Set Value	Control Mode	Switching Method (Note 1)
0 (Factory setting)	Speed control	MC unconnected
1	Torque control	MC unconnected
2	Speed-torque control switching	MC OFF: Speed, MC ON: Torque
3	Speed-V/F control switching (Note 2)	MC OFF: Speed, MC ON: V/F control
4 (Note 3)	Position control	MC unconnected
5 (Note 3)	Speed-position control switching	MC OFF: Speed, MC ON: Position
6 (Note 3)	Position-torque control switching	MC: OFF position, MC: ON torque
11	Torque control (torque limit external input)	MC unconnected
12	Speed-torque control switching (torque limit external input)	MC: OFF speed, MC: ON torque
16 (Note 3)	Position-torque control switching (torque limit external input)	MC: OFF position, MC: ON torque
101	Torque control (deceleration at polarity reversal)	MC unconnected
102	Speed-torque control switching (deceleration at polarity reversal)	MC: OFF speed, MC: ON torque
106 (Note 3)	Position-torque control switching (deceleration at polarity reversal)	MC: OFF position, MC: ON torque

Note: 1. Set terminal MC with Pr. 17 “input terminal assignment”.

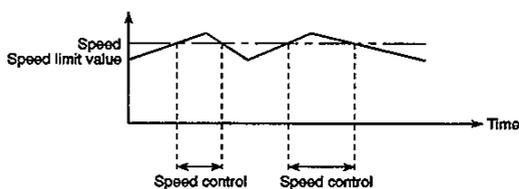
2. When V/F control is selected, the current limit (torque limit) function and automatic restart after instantaneous power failure are invalid.

3. If this setting is made without the option “FR-VPB, FR-VPD (position control function) being fitted, “NO OPTION” is displayed and the function is invalid.

- Torque limit external input (Pr. 14 = 11, 12, 16)

When the actual speed exceeds the speed limit value in the torque control mode, the torque control mode is switched to the speed control mode and the torque limit is activated.

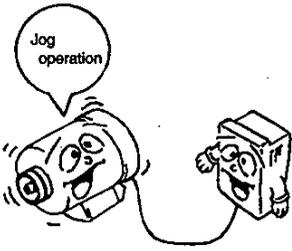
At this time, the torque limit value is the setting of the external No. 3 terminal input independently of the Pr. 33 “torque limit mode” value. When Pr. 14 = 1, 2, 6, 101, 102 or 106, the torque limit value is the value in the mode set in Pr. 33 “torque limit mode”.



- Deceleration at polarity reversal (Pr. 14 = 101, 102, 106)

When the polarity of the torque command is reversed, the speed limit is lowered to 0rpm once and the speed is increased again.

To set the speed and acceleration/deceleration time for jog operation



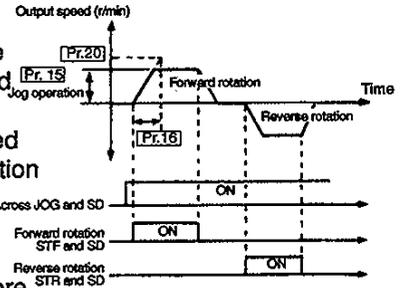
◇ Pr. 15 “jog speed”, Pr. 16 “jog acceleration/deceleration time”, Pr. 20 “acceleration/deceleration reference speed”

- For jog operation, select the jog mode (connect JOG and SD) and turn on/off the start signal (terminals STF,STR). Jog operation may also be performed by using the parameter unit. For full information on the operation procedure, see page 45. Assign terminals JOG to any of DI1, DI2 and DI3 with Pr. 17 “input terminal assignment”.

• Setting of acceleration/deceleration time

(1) Setting of speed and acceleration/deceleration time

In Pr. 16, set acceleration/deceleration time for jog operation. Acceleration time is the period of time required to reach the acceleration/deceleration reference speed (Pr. 20) from 0Hz. Deceleration time is the period of time required to reach 0Hz from Pr. 20. Set a longer time to accelerate or decelerate more slowly, and a shorter time to accelerate or decelerate more rapidly. (Note)



Factory Setting	Setting Range
0.5 sec.	0 to 3600 sec.

Note: If Pr. 20 (acceleration/deceleration reference speed) setting is changed, the set values of calibration Pr. 903 and Pr. 905 (adjust the gains) remain unchanged.

(2) Setting of speed

In Pr. 15 (jog speed), set the running speed for jog operation.

Factory Setting	Setting Range
300r/min	0 to 1500r/min

To select and set the functions

⇒ Pr. 17 "input terminal assignment"

- Any of 10 functions can be assigned to the DI1, DI2 and DI3 input terminals.

Pr. 17: First digit Second digit Third digit

Terminal: DI1 DI2 DI3

Example: Pr. 17 = (factory setting)

DI1=RH

DI2=RM

DI3=RL

Set Value	Symbol	Name	Function
0	RH	Multi-speed setting 1	Speed set in Pr. 4
1	RM	Multi-speed setting 2	Speed set in Pr. 5
2	RL	Multi-speed setting 3	Speed set in Pr. 6
3	JOG	Jog operation	Speed set in Pr. 15, acceleration/deceleration time in Pr. 16
4	RT	Second function switching	Second function selected
5	MRS	Coasting terminal	MRS and SD is switched on to shut off output.
6	STOP	Operation signal holding	Used with STF/STR to enable 3-wire speed command.
7	LX	Pre-excitation	LX and SD is switched on to provide pre-excitation: 0 speed control or servo lock at a stop (according to set value in Pr. 62).
8	MC	Control mode switching	Control mode is switched between speed, torque and position (according to set value in Pr. 14).
9	TL	Torque restriction selection	Torque restriction value can be changed with Pr. 38.

Note: 1. Even if the set value is "0" in the first digit of the three digits, it will not be displayed. However, if "0" is set in only the first digit, it will indicate the set value "000".

2. If any of 1 to 3 is set in any digit of Pr. 46 "second multi-function input selection", the Pr. 46 setting is made valid for the multi-function input terminal corresponding to that digit and the Pr. 17 setting is made invalid.

- Multi-speed setting

Select the speeds given below by selecting and combining RH, RM and RL with DI1, 2 and 3.

A setting can be made even if all RH, RM and RL are not selected with DI1, 2 and 3.

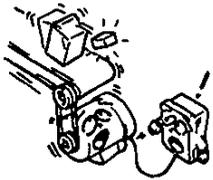
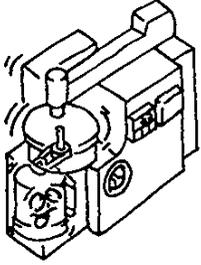
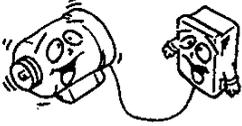
RH	RM	RL	Speed
OFF	OFF	OFF	External setting
ON	OFF	OFF	High speed (Pr. 4)
OFF	ON	OFF	Middle speed (Pr. 5)
OFF	OFF	ON	Low speed (Pr. 6)
OFF	ON	ON	Speed 4 (Pr. 24)
ON	OFF	ON	Speed 5 (Pr. 25)
ON	ON	OFF	Speed 6 (Pr. 26)
ON	ON	ON	Speed 7 (Pr.27)

* When Pr. 28 "multi-speed correction selection" = 1, all the speeds can be adjusted by auxiliary speed command signal entered to analog speed input terminal "1".

Note: 1. When "3" or "4" is set in Pr. 30 "regenerative brake duty change selection/high power factor converter connection selection", the function of terminal DI2 set in Pr. 17 "input terminal assignment" is made invalid and terminal DI2 acts as the "output shut-off signal input terminal".

2. When "4" is set in Pr. 30 "regenerative brake duty change selection/high power factor converter connection selection", the function of terminal DI3 set in Pr. 17 "input terminal assignment" is made invalid and terminal DI3 serves as the terminal to accept the IPF signal (instantaneous power failure detection signal) from the high power factor converter (FR-HC).

To select the optimum acceleration/deceleration pattern for application



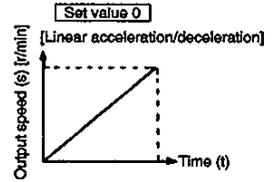
- Pr. 18 "S acceleration pattern 1", Pr. 19 "S deceleration pattern 1"
- Pr. 21 "S acceleration pattern 2", Pr. 22 "S deceleration pattern 2"
- Pr. 29 "acceleration/deceleration pattern", Pr. 46 "second multi-function input selection"

- The acceleration/deceleration pattern can be changed according to applications. Use the following parameter to set any of the acceleration/deceleration patterns shown below:

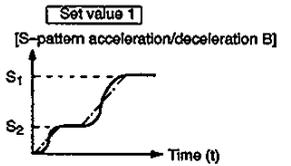
Parameter No.	Name	Setting Range	Factory Setting
29	Acceleration/deceleration pattern	0, 1, 2, 10, 11, 12, 100, 101, 102, 110, 111, 112	0

● Acceleration/deceleration pattern

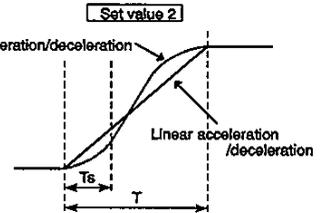
- Set "0, 10, 100, 110" in Pr. 29 to select linear acceleration/deceleration. This is a general pattern and generally use this setting for operation.



- Set "1, 11, 101, 111" in Pr. 29 to select S-pattern acceleration/deceleration as shown on the right. As an S-pattern acceleration/deceleration is made from S2 (current speed) to S1 (target speed), acceleration/deceleration shock can be eased to ensure smooth operation.



- Set "2, 12, 102, 112" in Pr. 29 to select S-pattern acceleration/deceleration as shown on the right. An acceleration/deceleration curve during S-pattern acceleration/deceleration can be set with the corresponding parameter and the setting of this curve can be changed with the external terminal.



- The "starting speed" and "deceleration operation" change with the Pr. 29 setting. For Pr. 13 "starting speed", refer to the section of Pr. 13.

Starting speed	Pr.29="0,1,2,100,101,102"	Pr.29="10,11,12,110,111,112"
Deceleration operation	Pr.29="0,1,2,10,11,12"	Pr.29="100,101,102,110,111,112"

Parameter No.	Name	Setting Range	Factory Setting
18	S acceleration pattern 1	0 to 50%	0%
19	S deceleration pattern 1	0 to 50%	0%
21	S acceleration pattern 2	0 to 50%	0%
22	S deceleration pattern 2	0 to 50%	0%
46	Second multi-function input selection	0 to 999, 9999	9999

In Pr. 18, Pr. 19, Pr. 21 and Pr. 22, set the ratio of S-pattern time (Ts) to acceleration/deceleration time (T) in %.

$$\text{Pr. 18} = (T_s/T) \times 100(\%)$$

- To change the acceleration/deceleration curve with the external terminal, the S-pattern switching terminal must be assigned to any of terminals DI1 to DI3. DI1 to DI3 have been assigned to the three digits of Pr. 46 as indicated below:

Pr.46 =

First digit

Second digit

Third digit

DI1 DI2 DI3

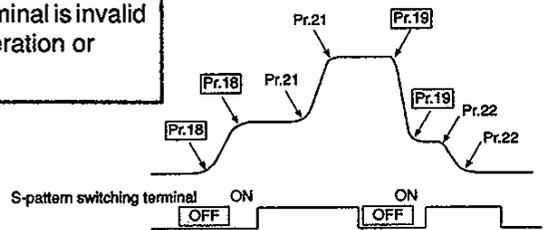
If 1 is set in any of the digits, the terminal corresponding to that digit functions as the S-pattern switching terminal and switching can be made as shown below.

For the set values of 2 and 3, refer to the torque bias function (page 107).

If the value set is other than 1, 2, 3 the set value is ignored and DI1 to DI3 function as set in Pr. 17.

Operation S-Pattern Switching Terminal	During Acceleration	During Deceleration
OFF	Pr. 18 "S acceleration pattern 1"	Pr. 19 "S deceleration pattern 1"
ON	Pr. 21 "S acceleration pattern 2"	Pr. 22 "S deceleration pattern 2"

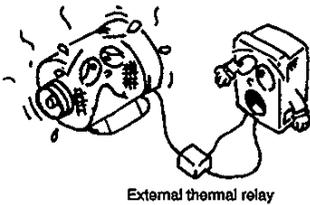
Note: Switching by the S-pattern switching terminal is invalid during acceleration or deceleration.



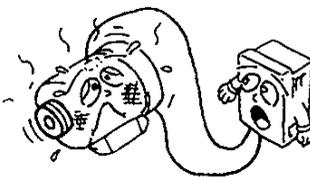
Pr. 46 Setting	Function Name	Description
1	S-pattern switch-over terminal	Terminal is used to set the acceleration/deceleration curve provided when Pr. 29 "acceleration/deceleration pattern" = 2.
2	Torque bias selection 1	Torque bias selection signal is given when torque bias function using contact signals (DI1 to DI3) are selected.
3	Torque bias selection 2	Torque bias selection signal is given when torque bias function using contact signals (DI1 to DI3) are selected.
9999	—	Without second multi-function input assignment

Note: When the value set in Pr. 46 is other than the above, the Pr. 17 setting is made valid for the functions of terminals DI1 to DI3.

To install an external thermal relay or the like



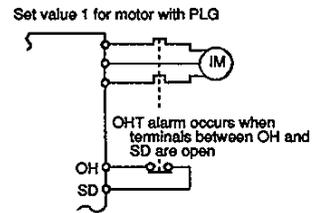
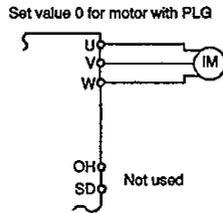
Temperature sensor



◇ Pr. 23 “thermal protector input”

- When a motor with PLG is used, a contact signal such as a thermal relay can be input to terminal OH to protect the motor.

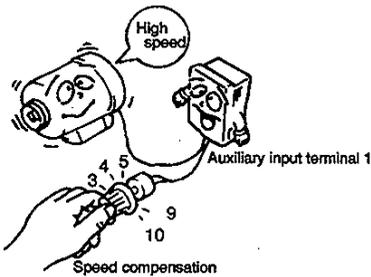
Pr. 23 Setting	Motor	
	Vector inverter motor (SF-VR)	Motor with PLG (SF-JR, etc.)
0 (factory setting)	No relation	Thermal relay, etc. not used.
1	No relation	Thermal relay, etc. used.



Note: To distinguish between vector inverter motor and motor with PLG, see the setting of Pr. 99 “motor constant selection”.

■<Pr. 24, Pr. 25, Pr. 26, Pr. 27 ◇ Refer to the section of Pr. 4>

To compensate for speed during multi-speed operation

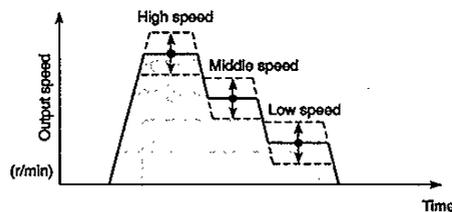


◇ Pr. 28 “multi-speed input compensation selection”

- By entering a signal into the auxiliary input terminal 1 (Note), the speeds of multi-speed settings selected by the RH, RM and RL terminals can be compensated for.

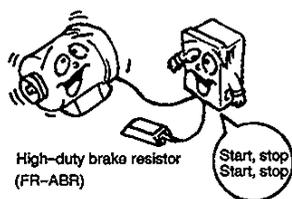
Set Value	Compensation by Auxiliary Input
0	No compensation (factory setting)
1	Compensation available

Note: When 2 or 3 is set in Pr. 73, the compensation signal is entered into terminal 2.



■<Pr. 29 ◇ Refer to the section of Pr. 18>

To make frequent starts and stops by using the optional high-duty brake resistor



➤ Pr. 30 “regenerative brake duty change selection/high power factor converter connection selection”, Pr. 70 “regenerative brake duty”

- Set these parameters when it is necessary to increase the regenerative brake duty for frequent start/stop operations. In this case, as a higher brake resistor capacity is required, use the optional FR-ABR high-duty brake resistor.

<Setting method>

After setting “1” in Pr. 30 “regenerative brake duty change selection/high power factor converter connection selection”, set the duty in Pr. 70 “regenerative brake duty”.

<Regenerative brake duty when Pr. 30 = 0>

FR-V220E-1.5K to 3.7K 3%

FR-V220E-5.5K 2%

FR-V220E-1.5K to 5.5K 2%

<Pr. 70 can be set in the following range when Pr. 30 = 1>

Model	Factory Setting	Setting Range
1.5 to 5.5K	0%	0 to 30%
7.5K or more	0%	0%

- Note: 1. When the Pr. 70 setting is increased from the factory setting, the set value must be matched to the permissible brake duty of the external brake resistor (FR-ABR) (see page 169).
 2. Setting is invalid for models 7.5K and up.
 3. The brake duty indicates %ED of the built-in brake transistor operation.
 4. When Pr. 30 is “0”, Pr. 70 is not displayed.

⚠ WARNING

- ⚠ There is a risk of overheating, so do not set the brake duty to higher than the permissible value of the brake resistor.

- When the high power factor converter (FR-HC) is connected for power harmonic suppression, Pr. 30 “regenerative brake duty change selection/high power factor converter connection selection” functions as described in the following table. Set this parameter according to your operating conditions.

	Pr. 30 = 3	Pr. 30 = 4
Operation	Other than the right	Pr. 127 “link starting mode selection” = 2 in computer link operation mode (using FR-VPB option)
Terminals	1) DI2 (output shut-off signal input)	1) DI2 (output shut-off signal input) 2) DI3 (terminal for accepting IPF signal from high power factor converter)
UVT detection	3) Disabled	3) Disabled
Brake resistor	4) Disabled	4) Disabled
IPF detection	5) Disabled	5) Disabled
Option error	Error occurs when voltage is supplied to terminals R (L ₁), S (L ₂).	Error occurs when voltage is supplied to terminals R (L ₁), S (L ₂).

1) Connect terminal RDY of the high power factor converter (FR-HC) and terminal DI2 of the inverter. The inverter is made ready to operate when the inverter operation enable (RDY) signal of the high power factor converter (FR-HC) is turned off. If the inverter operation enable signal of the high power factor converter is turned on during operation of the inverter, the inverter stops running within 3ms.

2) When 4 is set in Pr. 30, connect terminal Y1 or Y2 of the high power factor converter and terminal DI3 of the inverter. The IPF signal incoming from terminal DI3 serves as an instantaneous power failure detection signal to store the operation command for automatic restart after instantaneous power failure during computer link operation.

Note: 1. This signal is not used as an instantaneous power failure detection signal for IPF processing.

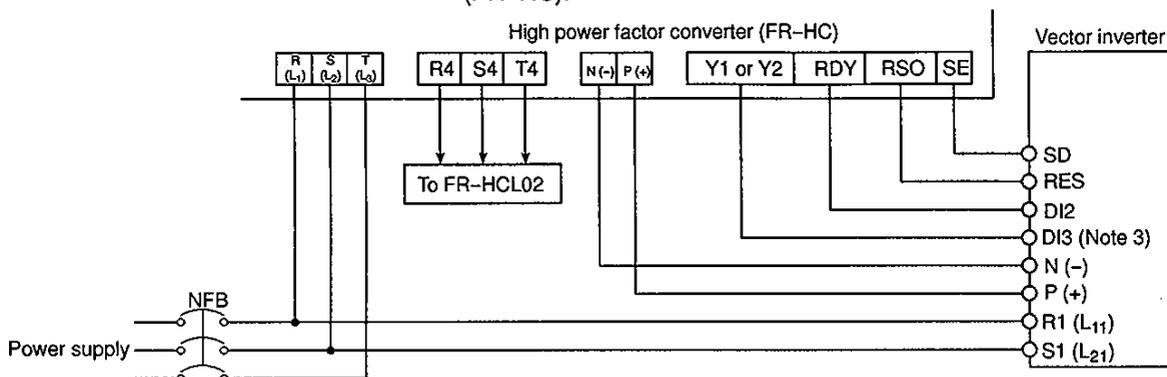
2. The operation command is stored under the following conditions:

- Pr. 30 = 4
- Pr. 127 "link starting mode selection" = 2 (link mode for automatic restart after instantaneous power failure)
- Pr. 61 "restart coasting time" ≠ 9999 (automatic restart after instantaneous power failure valid)
- IPF signal from terminal DI3 is off

3) UVT (undervoltage protection) detection is made by the high power factor converter (FR-HC).

4) In the regenerative mode, power is returned through the high power factor converter (FR-HC) to power supply.

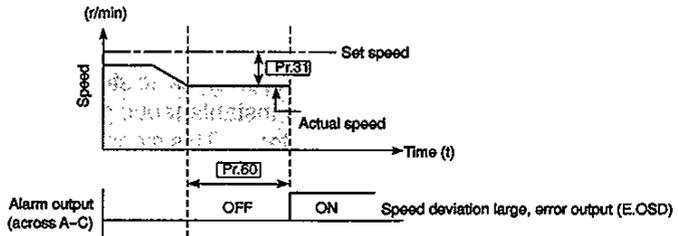
5) When an instantaneous power failure occurs, instantaneous power failure alarm output is provided by the high power factor converter (FR-HC).



To adjust the speed deviation level

⇒ Pr. 31 “speed deviation level”, Pr. 60 “speed deviation time”

- If a difference (absolute value) in velocity between set value and actual motor speed is higher than the value set in Pr. 31 “speed deviation level” for longer than the value set in Pr. 60 “speed deviation time”, speed deviation becomes large, error “E.OSD” is displayed, and the motor comes to a stop.



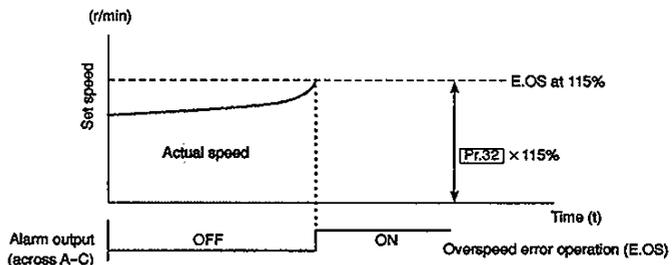
Parameter No.	Name	Setting Range	Factory Setting	Remarks
31	Speed deviation level	0 to 1500 r/min, 9999	9999	9999: Invalid
60	Speed deviation time	0 to 100 sec.	12 sec.	Can be read when Pr. 31 is not 9999.

Note: 1. Set this parameter when a speed difference could pose a problem.
 2. This function is invalid for torque control.
 3. If the Pr. 69 “number of PLG pulses” setting is different from the actual number of PLG pulses when the motor with PLG is driven, control may become unstable, resulting in “E.OSD” (Even if Pr. 31 = 9999).

To determine the valid level of torque restriction

⇒ Pr. 32 “overspeed detection level”

- Used to restrict the maximum speed.
- When $Pr. 32 \times 115\%$ speed is reached, i.e. overspeed detection level, an overspeed alarm occurs and error “E.OS” is displayed.



Setting Range	Factory Setting
0 to 3600r/min	3000r/min

Note: 1. This parameter is invalid for V/F control.
 2. If the Pr. 69 “number of PLG pulses” setting is different from the actual number of PLG pulses when the motor with PLG is driven, control may become unstable, resulting in “E.OS”.

To set torque restriction level

- ◇ Pr. 33 “torque restriction mode”, Pr. 34 “torque restriction level”, Pr. 35 “torque restriction level (regeneration)”, Pr. 36 “torque restriction level (3 quadrant)”, Pr. 37 “torque restriction level (4 quadrant)”, Pr. 38 “torque restriction level 2”, Pr. 158 “deceleration torque limit”, Pr. 159 “acceleration torque limit”

(1) Parameters used

Pr. No.	Name	Setting Range	Factory Setting	Remarks
33	Torque restriction mode	1, 2, 3, 4	3	1: External input 2: External input (option (VPA, VPB) No. 4 terminal) 3, 4: Parameter set value
34	Torque restriction level	0 to 400%	150%	-----
35	Torque restriction level (regeneration)	0 to 400%, 9999	9999	Pr. 33=3, 4 regeneration, 9999=Pr. 34
36	Torque restriction level (3 quadrant)	0 to 400%, 9999	9999	Pr. 33=3, 3 quad, 9999=Pr. 34
37	Torque restriction level (4 quadrant)	0 to 400%, 9999	9999	Pr. 33=3, 4 quad, 9999=Pr. 35
38	Torque restriction level 2	0 to 400%, 9999	9999	Valid with TL terminal input.

Note1: Pr. 34 to Pr. 38 can be used during PU operation or external operation.

2: When Pr. 14 “control mode” = “11”, “12” or “16” (external input of torque limit), set “11” in Pr. 33.

- Output torques during acceleration and deceleration can be limited independently.

Pr. No.	Name	Setting Range	Factory Setting	Remarks
158	Deceleration torque limit	0 to 400%, 9999	9999	Same value as at constant speed when the setting is 9999.
159	Acceleration torque limit	0 to 400%, 9999	9999	Same value as at constant speed when the setting is 9999.

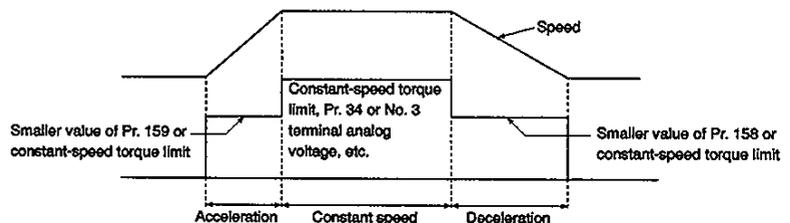
<Setting method>

Example: To set the deceleration torque limit to 150%

Set 150% in Pr. 158 “deceleration torque limit”.

During acceleration/deceleration, torque is limited at the lowest value of the above acceleration/deceleration torque limit value, the Pr. 34 to Pr. 38 value and the torque limit value using terminal No. 3, 4.

Enter “9999” to return Pr. 158 and Pr. 159 to their factory settings.

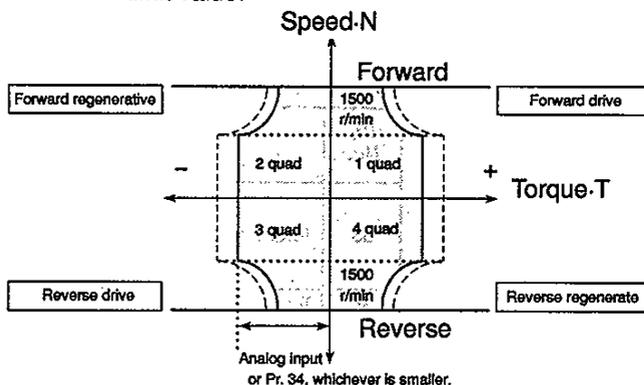


(2) Detail

1) Torque control and speed control

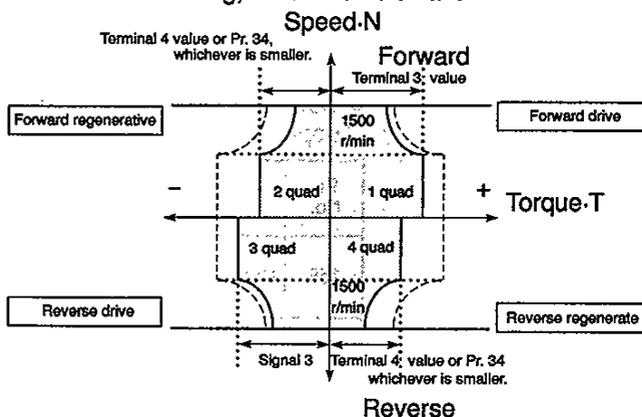
● Pr. 33 = 1

The absolute value of the external analog input No. 3 is validated, and the smaller of the Pr. 34 and terminal No. 3 will be used as the limit value.



● Pr. 33 = 2

In the driving mode, the absolute value of external analog input No. 3 is made valid (refer to Pr. 33 = 1). In the regenerative mode, the analog input terminal No. 4 of the inboard option (VPA, VPB) is made valid and the torque limit value is the terminal 4 input or Pr. 34 setting, whichever is smaller.



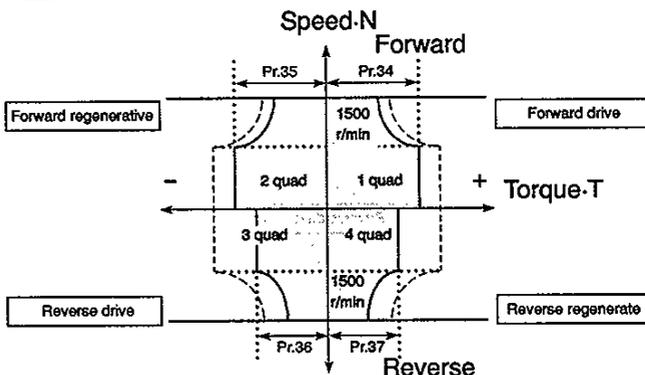
- Note: 1. The terminal 4 input is limited when Pr. 33 = 2 and the inboard option (VPA, VPB) is fitted.
2. Pr. 34 value will be used if it is smaller than terminal 4 value.

⚠ CAUTION

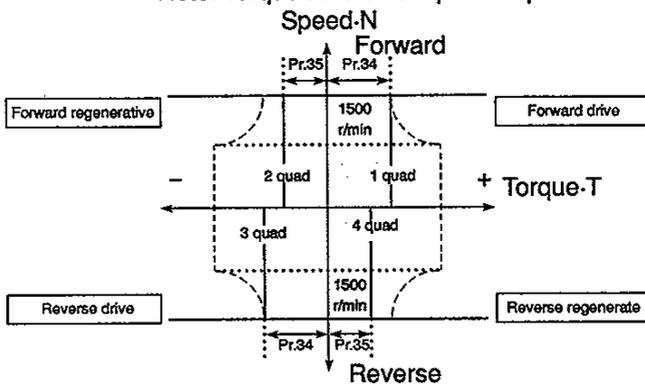
- ⚠ Special caution should be exercised when the external torque limit is used with lifts or vertical conveyors as the control cables will be broken, or without the option fitted, no torque will be developed. Use the internal torque limit when there is a possibility of an accident on lifts due to overrun, etc.

- Pr. 33 = 3
Using Pr. 34, Pr. 35, Pr. 36 and Pr. 37 values

Quadrant		Effective Parameters	
		Pr.	When 9999 value set to the Pr.
1	Forward drive	Pr. 34	-----
2	Forward regenerate	Pr. 35	Pr. 34
3	Reverse drive	Pr. 36	Pr. 34
4	Reverse regenerate	Pr. 37	Pr. 35



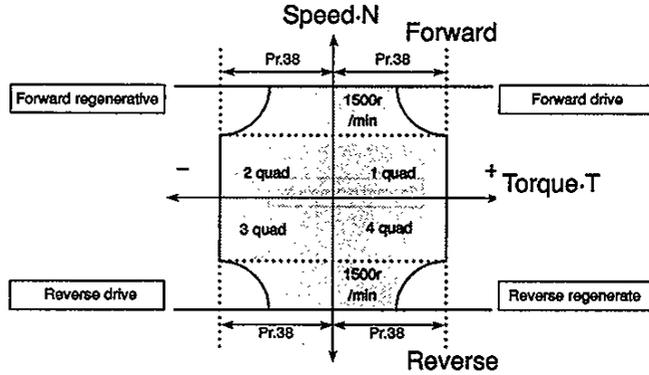
- Pr. 33 = 4
Torque restriction in kg · m.
Pr. 35 and Pr. 34 used. (Setting can be made between 0 and 400%.)
Pr. 35 = 9999 makes the setting the same as Pr. 34. (Pr. 36 and Pr. 37 are not effective.)
Note: Torque limit is not speed dependent.



2) Second torque restriction level

The value in Pr. 38 is used when TL and SD is connected. Allocate with Pr. 17 to terminal DI1, DI2 or DI3.

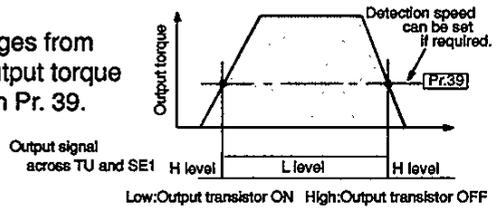
Note: When Pr. 38 = 9999, setting value = Pr. 34.



To obtain the motor torque signal

⇒ Pr. 39 "torque detection"

- Terminal TU state changes from high to low when the output torque exceeds the value set in Pr. 39.



Note: Select TU terminal allocation with Pr. 40 "output terminal assignment".

To change the functions of the output terminals DO1, DO2, DO3



▷ Pr. 40 “output terminal assignment”

- Any of 10 functions can be reassigned to the DO1, DO2 and DO3 output terminals.

Set a 3-digit integer in Pr. 40. The value of each digit indicates the function of the corresponding terminal.

Pr. 40: First digit, Second digit, Third digit (Factory setting: 12)

Terminal: DO1, DO2, DO3

(Ex.) When Pr. 40 “output terminal assignment” is 562

Terminal DO1: OL (overload alarm) signal

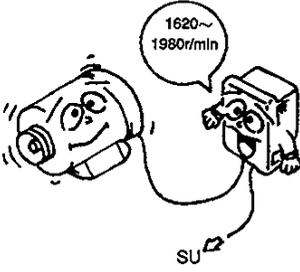
Terminal DO2: IPF/UVT (instantaneous power failure/undervoltage alarm) signal

Terminal DO3: LS (low-speed output)

Note: Even if the setting value “0” is set in the first digit of the three digits, it will not be displayed. However, if “0” is set in only one digit, it will indicate the setting value “000”.

No.	Symbol	Function Name	Operation
0	ER	Minor fault output	When an alarm defined in Pr. 76 “alarm definition” occurs, state = ON.
1	SU	Up to speed	When the output speed is within the range set in Pr. 41, state = ON. OFF during deceleration
2	LS	Low-speed output	When the output speed is less than the value set in Pr. 43, state = ON.
3	FU	Speed detection	When the output speed is greater than the value set in Pr. 42, state = ON.
4	RUN	Inverter running	When forward run or reverse run signal is ON, state = ON. Note that this turns OFF during pre-excitation.
5	OL	Overload	When torque or speed restriction is activated, state = ON.
6	IPF/UVT	Instantaneous power failure/undervoltage	When instantaneous power failure or under voltage alarm occurs, state = ON.
7	PU	PU operation	When PU OP is selected, state = ON. (Changes into open motor circuit detection signal by Pr. 68 setting.)
8	TU	Torque detection	When output torque is greater than the value set in Pr. 39, state = ON.
9	RY	Ready	When pre-excitation is completed, state = ON. When pre-excitation is not executed, state = ON at output start.

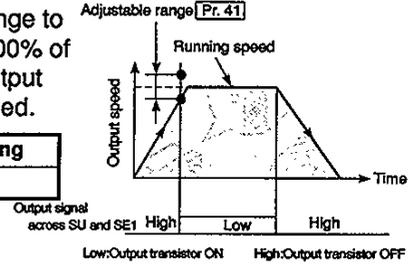
To adjust the ON range of the up-to-speed signal



⇒ Pr. 41 “up-to-speed sensitivity”

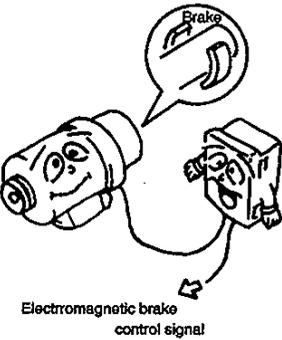
- Allows the output signal ON range to be adjusted between 0 and ±100% of the running speed when the output speed reaches the running speed.

Setting Range	Factory Setting
0 to 100%	10%



Note: Select SU terminal allocation with Pr. 40.

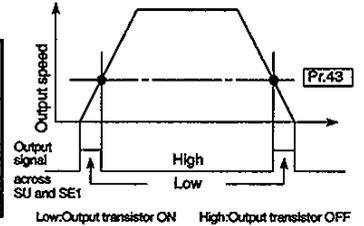
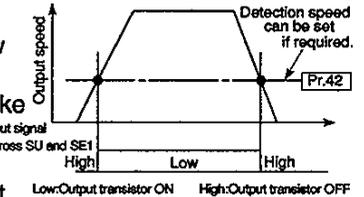
To set the operation and open signals of the electromagnetic brake, etc.



⇒ Pr. 42 “speed detection”, Pr. 43 “low-speed detection”

- The signal across terminals FU and SE1 is switched low when the output speed reaches or exceeds the value set in “speed detection”, Pr. 42, and is switched high when it drops below the detection speed. This function can be used for electromagnetic brake operation, open and other signals.
- The signal across terminals LS and SE1 is switched low when the output speed is less than the value set in Pr. 43, and is switched high when the speed is higher than Pr. 43.

Pr. No.	Setting Range	Factory Setting
42	0 to 3600r/min	300r/min
43	0 to 1500r/min	45r/min



Note: Select FU or LS terminal allocation with Pr. 40.

To switch between two motors different in operations

◇ Pr. 44 “second acceleration/deceleration time”, Pr. 45 “second deceleration time”

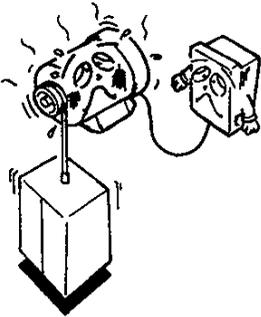
- The external contact signal (across terminals RT and SD) allows the acceleration time and deceleration time to be changed together. Effective for switching between two motors different in parameter setting, e.g. elevating and traversing.

Set Function	Parameter number	Signal across Terminals RT and SD	
		OFF	ON
Acceleration time	Pr. 7	○	-
	Pr. 44	-	○
Deceleration time	Pr. 8	○	-
	Pr. 45	-	○

- Note: 1. Setting “9999” (factory setting) in Pr. 45 causes both the second acceleration time and deceleration time to be the value set in Pr. 44.
2. The second acceleration/deceleration time is the time taken for acceleration to the speed set in Pr. 20 “acceleration/deceleration reference speed”, as in Pr. 7 “acceleration time” and Pr. 8 “deceleration time”.
3. Select RT input allocation for terminals DI1, DI2 or DI3 with Pr. 17.

■ <Pr. 46 ◇ Refer to the section of Pr. 18>

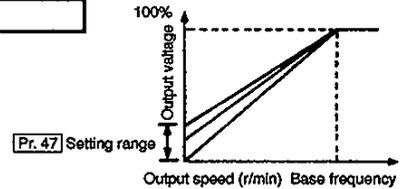
Large starting torque operations



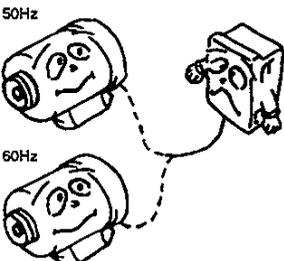
◇ Pr. 47 “torque boost”

- Used to adjust the output voltage during low-speed operation for V/F control, thereby increasing the motor torque at the time of starts.

Setting Range	Factory Setting
0 to 30%	3%

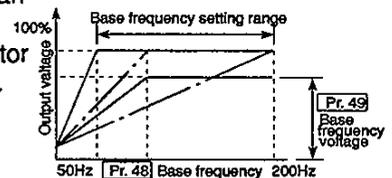


To set the reference frequency (base frequency) at the rated torque of the motor according to the motor rating



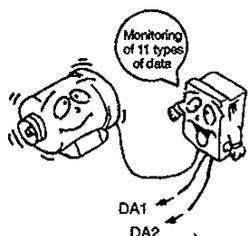
◇ Pr. 48 “base frequency”, Pr. 49 “base frequency voltage”

- For V/F control, the base frequency (reference frequency at the rated motor torque) can be set as appropriate between 50 and 200Hz according to the motor rating.
- A motor of lower voltage rating than the inverter can be used to the optimum when Pr. 49 is set to motor voltage between 0 and 500V (e.g. 200V motor on 230V supply).



Note: If vector control is not possible due to an encoder fault, operation with V/F control is possible by setting Pr. 14 “control mode” to “3”. (Refer to page 129.)

Selection of monitor and output signals



- ◇ Pr. 51 “inverter LED display data”, Pr. 52 “PU main display data”
- Pr. 53 “PU level meter display data”, Pr. 54 “DA1 terminal function selection”
- Pr. 55 “DA2 terminal function selection”
- Pr. 56 “speed monitoring reference”, Pr. 57 “current monitoring reference”
- Pr. 58 “torque monitoring reference”

- By setting any of the numbers in the following table, the required signal can be selected from among the 11 signals for the monitor and output signals.
- There are two types of signal outputs: DA1 terminal and DA2 terminal. Different signals can be output at the same time. Select the signals using Pr. 54.

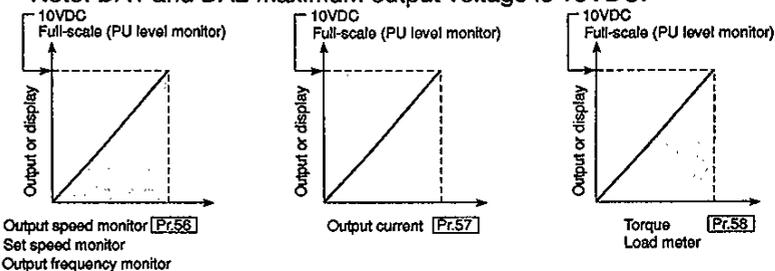
<Factory setting>

Pr. 51...“1”, Pr. 52...“0”, Pr. 53...“1”, Pr. 54...“1”, Pr. 55...“7”

Monitor Method Monitor Details	Inverter LED Pr. 51	PU main monitor Pr. 52	PU level meter Pr. 53	DA1 12 bit Pr. 54	DA2 8 bit Pr. 55	Full-Scale Value of Level Meter, Analog Output
No display	×	×	0	×	×	—
Motor speed r/min	1	0	1	1★	1	Pr. 56
Output current A	2	0	2	2	2	Pr. 57
Output voltage V	3	0	3	3	3	400V or 800V
Alarm display	4	0	×	×	×	—
Set speed r/min	5	*	5	5	5	Pr. 56
Output frequency Hz	6	*	6	6★	6	Pr. 56
Torque %	7	*	7	7★	7	Pr. 58
DC bus voltage V	8	*	8	8	8	400V or 800V
Input terminal status	×	*	×	×	×	—
Output terminal status	×	*	×	×	×	—
Load meter %	17	17	17	17★	17	Pr. 58
Cumulative operation time Hr	×	20	×	×	×	—
Reference voltage	×	×	×	21	21	

Note: 1. Monitoring of items marked × is not possible.
 2. “set speed” to “output terminal status” on the PU main monitor are selected by “other monitor selection” of PU operation.
 3. For torque, the value monitored is the ratio of torque to its absolute value. For the load meter, the value monitored is the ratio of load to constant-output torque in the constant-output region.
 4. Monitored values marked ★ are output in ± values.

- Setting with Pr. 56, Pr. 57 and Pr. 58
 Set so that the PU level meter displays the full scale.
 Note: DA1 and DA2 maximum output voltage is 10VDC.



Adjust the response level of DA1 output

- The response level of the output voltage of output signal DA1 can be adjusted by setting the required value in Pr. 50 "DA1 output filter".

- (1) Set "801" in Pr. 77 "parameter write disable selection".
- (2) Set the required value in Pr. 50 "DA1 output filter".

Parameter Number	Name	Setting Range	Minimum Setting Increment	Factory Setting
50	DA1 output filter	0 to 5 sec., 9999	0.001 sec.	9999

- (3) Return the setting of Pr. 77 "parameter write disable selection" to the original value "any of 0 to 2".

Note: When Pr. 50 "DA1 output filter" = 9999, the output voltage response of terminal DA1 is approx. 50ms.

 **CAUTION**

-  When the setting of Pr. 77 "parameter write disable selection" is changed to "801", special parameters other than Pr. 50 may be set. However, since the special parameters are reserved for the manufacturer, do not change the setting of the parameters other than Pr. 50 "DA1 output filter".

To change the language displayed on the parameter unit

⇒ Pr. 59 “language switching”

- Set Pr. 59 to select the language displayed on the PU screen.

Set Value	Language Displayed
9999 (factory setting)	Japanese
0	English

Note: Only use the FR-PU02V parameter unit.

■ <Pr. 60 ⇒ Refer to the section of Pr. 31>

To automatically restart operation after instantaneous power failure/commercial power supply-inverter switch-over

⇒ Pr. 61 “coasting time for automatic restart after instantaneous power failure”

- The inverter can be started without stopping the motor (with the motor coasting) after the changing from commercial operation to inverter operation or after an instantaneous power failure state has been restored. (If restarting operation is validated, the error output signals UVT and IPF will not function even if an instantaneous power failure occurs.)
- Pr. 61 “coasting time for automatic restart after instantaneous power failure”

Parameter	Name	Setting Range	Factory Setting	Remarks
61	Restart coasting time	0, 0.1 to 5 sec, 9999	9999	9999: Restart after instantaneous power failure not possible

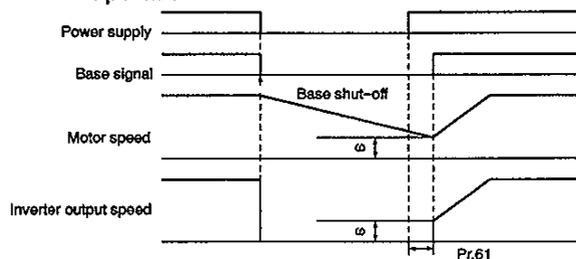
Set Value	Automatic Restart Operation Enable/Disable
9999 (factory setting)	Disable
0, 0.1 to 5 sec.*	Enable

Coasting time indicates a waiting time for automatic restart after power restoration.

* When Pr. 61 is set to “0”, the coasting time will be set to the standard time shown below. Normally, there will be no problem with this setting. However, this time can be adjusted between 0.1 sec. and 5 sec. according to the load’s moment of inertia (GD^2) and torque size.

All capacities 0.1 sec.

● Operation



Note: Restarting after instantaneous power failure is possible during speed control and torque control. However, restarting after instantaneous power failure will not be possible during V/F control even if it is selected.

 **CAUTION**

-  The motor will start suddenly (after restart coasting time has passed) when an instantaneous power failure occurs. When the restart after instantaneous power failure function is selected, stay away from the motor or machine. Place a warning label in an easily identifiable place when the restart after instantaneous power failure function is selected.

To select the control method for the selected pre-excitation current detection

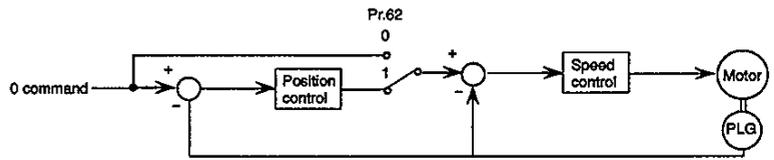
◇ Pr. 62 “pre-excitation selection”

- When pre-excitation is executed, select whether to control the 0 speed or to use servo lock.

Parameter No.	Name	Setting Range	Factory Setting	Remarks
62	Pre-excitation selection	0, 1	0	0: 0 speed control 1: Servo lock
133	Position loop gain	0 to 150	25	This parameter can be read when option FR-VPB is mounted or the servo lock is selected.

● Operation

Block diagram for pre-excitation



- (1) Pre-excitation will be executed according to Pr. 62 “pre-excitation selection” for speed control and torque control.
- (2) When using position control, the servo will be locked and the position will be retained regardless of Pr. 62 “pre-excitation selection”.

To select the torque command method

◇ Pr. 63 “torque command selection”

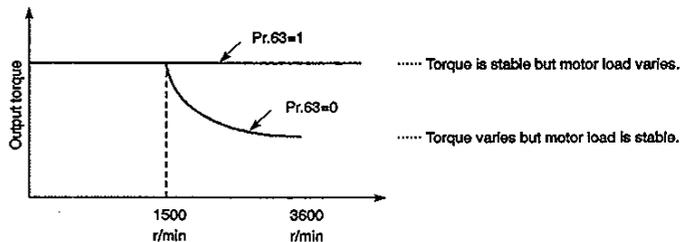
- Whether to set the torque command with an absolute value (kg·m) or load (%) is selected.

Parameter No.	Name	Setting Range	Factory Setting	Remarks
63	Torque command selection	0, 1	0	0: Load command 1: Absolute value command

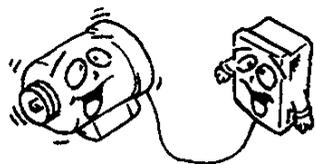
● Operation

When Pr. 63 is set to 0, the No. 3 terminal input will be a load (%) command.

When Pr. 63 is set to 1, the No. 3 terminal input will be an absolute torque value (kg·m) command.



To exercise vector control using the motor with PLG (auto tuning)



- ⇒ Pr. 9 “electronic thermal overload protection”
 Pr. 48 “base frequency”, Pr. 49 “base frequency voltage”
 Pr. 64 “motor capacity”, Pr. 65 “number of motor poles”
 Pr. 66 “rated motor speed”, Pr. 69 “number of PLG pulses”
 Pr. 98 “auto tuning setting”, Pr. 99 “motor constant selection”

- As the inverter itself measures the necessary motor constants by auto tuning, the FR-V200E can be used with the following motors in addition to the Mitsubishi vector inverter motor (SF-VR):

- SF-JR with PLG (4 poles, 6 poles)
- SF-JRCA with PLG (4 poles)
- Other manufacturers’ motors with PLG (4 poles, 6 poles)

Note: 1. The condition that one motor may be auto-tuned by one inverter should be satisfied.

2. For a two-pole motor with PLG, run it at not more than its permissible speed. (Maximum speed: 3600r/min)

● Parameters used

Parameter	Name	Setting Range	Factory Setting	Remarks
9	Electronic thermal overload protection	0 to 500A	Rated motor current (1.5K to 3.7K)/0A (5.5K to 45K)	When Pr. 9=0, electronic thermal overload protection is invalid.
48	Base frequency	50 to 200Hz	60Hz	
49	Base frequency voltage	0 to 500V, 9999	9999	
64	Motor capacity	0 to 55kW, 9999	9999	
65	Number of motor poles	2, 4, 6, 9999	9999	
66	Rated motor speed	0 to 3600r/min	1710r/min (1.5K to 3.7K) 1720r/min (5.5K, 11K) 1730r/min (7.5K, 15K) 1750r/min (18.5K to 30K) 1760r/min (37K, 45K)	
69	Number of PLG pulses	0 to 4096	1024 (3.7K or less) 1000 (5.5K or more)	Set the number of pulses before it is multiplied by 4.
98	Auto tuning setting	0, 1	0	Set 1 in Pr. 98 for auto tuning.
99	Motor constant selection	0 to 3, 9999	9999	9999: Mitsubishi vector inverter motor 0 to 3: Motor with PLG

● Parameters for motor with PLG

In addition to the above parameters, set the specifications of the motor with PLG.

Parameter	Name	Setting Range	Factory Setting	Remarks
23	Thermal protector input	0, 1	0	Set 1 for use of a thermal protector with the motor with PLG.
71	Applied motor	0, 1	0	Set 1 for use of the constant-torque motor with PLG.
74	Torque characteristic selection	0, 1	0	0: Cyclic operation mode 1: Continuous operation mode

Note: The PLG should be connected directly to the motor shaft without looseness.

- Use Pr. 99 “motor constant selection” to change the control constants of the motor used for vector control.

Pr. 99 Setting	Used Control Constants	Remarks
9999	Vector control constants for Mitsubishi vector inverter motor	Constants of SF-JR motor with PLG (4 poles) for 1.5K (2HP) to 3.7K (5HP).
0	Auto tuning constants for motor with PLG	
1	Y connection direct setting constants for motor with PLG	
2	Δ connection direct setting constants for motor with PLG	
3	Constant of SF-JR5.5K to 45K (4 poles) motor with PLG	Can be set when Pr. 77 = 801.

- Parameter setting
 - 1) Set 801 in Pr. 77 “parameter write disable selection”.
 - 2) Change the Pr. 99 “motor constant selection” setting to “3”.
 - 3) Return Pr. 77 “parameter write disable selection” to the original value “0 to 2”.

Note: When 801 is set in Pr. 77 “parameter write disable selection”, you can set values to the special parameters. However, since they are parameters for manufacturer setting, do not change the settings of the special parameters other than Pr. 99.

- Torque characteristic
 When Pr. 99 “motor constant selection” = “3”, the torque characteristic is that of the SF-JR motor with PLG. Use Pr. 74 “torque characteristic selection” to choose the continuous operation mode and cyclic operation mode.

(1) For use in auto tuning mode

- 1) Checking the wiring and load
 - Make sure that the motor is connected. Also, the motor must be at a stop at the start of tuning.
 - The motor should be tuned without load, i.e. should not be connected with load (e.g. frictional stationary load), but may be connected with an inertia load (such as a coupling).

2) Parameter setting

- Set the parameters listed on the preceding page.

Pr. 9 “electronic overcurrent protection” Pr. 48 “base frequency” Pr. 49 “base frequency voltage” Pr. 64 “motor capacity” Pr. 65 “number of motor poles” Pr. 66 “rated motor speed” Pr. 69 “number of PLG pulses”	}	⇒ Set the rated values of the motor. (When there are more than one rated value on the motor’s rating plate, set the value for 200V/60Hz or 400V/60Hz.)
Pr. 98 “auto tuning setting” = 1 Pr. 99 “motor constant selection” = 0	}	⇒ Set the number of PLG pulses. When the above conditions are all satisfied, the tuning mode is entered. When frequency monitoring is then selected with the PU, TUNE is displayed.

Note: As a difference between Pr. 48 “base frequency” and Pr. 66 “rated motor speed” is calculated as rated slip, the settings of these parameters should not be the same.

$$[\text{Reference}] \quad \frac{\text{Pr. 48} \times 120}{\text{Pr. 65}} > \text{Pr. 66}$$

3) Auto tuning command

In the PU operation mode, press the [FWD] or [REV] key.

In the external operation mode, turn on the start switch (connect terminals across STF and SD or STR and SD). The following operation is then performed:

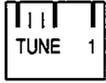
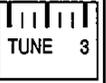
- (a) 3-phase AC excitation (R2, ℓ ($\ell 1$, $\ell 2$) tuning)
- (b) 2-phase DC excitation (R1 tuning)
- (c) Speed is increased up to 75% of Pr. 48 “base frequency”.
- (d) Constant-speed operation (for about 5 seconds) (L1 tuning)
- (e) Deceleration to stop
- (f) Tuning end

4) Tuning state monitoring

When the PU main monitor is switched to the frequency monitor during tuning, the value of Pr. 98 “auto tuning setting” is displayed on the main monitor and level meter of the PU as indicated below.

The value is also displayed on the inverter LED (when Pr. 51 “inverter LED display data” = 1 (factory setting)):

TUNE is not displayed on the speed monitor.

	Initial value	Setting	Tuning in progress	Completion	Error-activated end	Forced end
Pr.98	0	1	2	3	9	8
PU display						

When Pr. 98 “auto tuning setting” is 8 or 9, auto tuning has not successfully ended and the motor constants are not set.

5) Instructions

- Even after auto tuning has ended, the inverter is still running. Press the [STOP] key once in the PU operation mode, or switch STF/STR off in the external operation mode.
- During auto tuning, the only external terminals valid are OH, MRS, RES, STF and STR, all the others are invalid.

(2) For use in direct setting mode

When 1 or 2 is set in Pr. 99 “motor constant selection” and 801 set in Pr. 77 “parameter write disable selection”, the following parameters are accessible as motor constant parameters. (The ordinary parameter values do not change.)

Parameter	Name	Setting Range	Factory Setting	Pr. 77 ≠ 801 (Ordinary parameter)
0	Primary resistance R1	0 to 10Ω, 9999	9999	—————
1	Secondary resistance R2	0 to 10Ω, 9999	9999	Maximum setting
2	Primary leakage inductance ℓ1	0 to 500mH, 9999	9999	Minimum setting
3	Secondary leakage inductance ℓ2	0 to 500mH, 9999	9999	—————
4	Mutual inductance M	0 to 500mH, 9999	9999	3-speed setting (high speed)
5	Exciting current (no-load current) ID	0 to 500A, 9999	9999	3-speed setting (middle speed)

Note: When 801 is set in Pr. 77 “parameter write disable selection”, parameters from Pr. 6 onward will be displayed. As they are parameters for manufacturer setting, do not change their values.

- (3) **To select the motor constants of the SF–JR5.5K to 45K (7.5HP to 60HP) (4–pole) with PLG**
 The SF–JR5.5K to 45K (7.5HP to 60HP) (4–pole) motor equipped with a PLG can be driven under vector control without auto tuning being performed.
 Vector control may also be exercised by performing auto tuning operation as previously explained. For the torque characteristics at this time, refer to "torque control" on page 39.
- 1) Set 801 in Pr. 77 "parameter write disable selection". (note previous setting)
 - 2) Set 3 in Pr. 99 "motor constant selection".
 - 3) Return Pr. 77 "parameter write disable selection" to previous setting, any of 0 to 2.

(4) **Utilization of auto tuning data**

By setting the following parameters, the auto tuning data of a (source) motor–inverter combination can be used for subsequent combinations, if they are made up of the same motor and inverter without repeating autotuning.

1) Retrieval of data of source inverter

• Parameter setting

- (a) Set 801 in Pr. 77 "parameter write disable selection". (note previous setting)
- (b) Parameters used

Parameter Number	Name	Setting Range	Factory Setting	Pr.77≠801
41	Primary inductance	0 to 65535	9999	Up-to-speed sensitivity
42	Secondary inductance	0 to 65535	9999	Speed detection
43	Primary inductance	0 to 65535	9999	Low speed detection
44	Secondary inductance	0 to 65535	9999	Second acceleration/deceleration time
45	Mutual inductance	0 to 65535	9999	Second deceleration time
46	Exciting current	0 to 65535	9999	Second input terminal assignment
47	Torque current	0 to 65535	9999	Torque boost

(c) Read and record the values of Pr. 41 to 47.

(d) Return Pr. 77 "parameter write disable selection" to the previous value, any of 0 to 2.

2) Writing data to destination inverter

Write the auto tuning data of the source inverter.

• Parameter setting

1) Set the auto tuning data of the source inverter in the following parameters:

Parameter Number	Name	Setting Range	Factory Setting
64	Motor capacity	0 to 55kW, 9999	9999
65	Number of motor poles	2 to 6, 9999	9999
66	Rated motor speed	0 to 3600 r/min	1800 r/min
99	Motor constant selection	0 to 2, 9999	9999
74	Torque characteristic selection	0, 1	0

2) Set 801 in Pr. 77 "parameter write disable selection" (note previous setting).

3) Set the recorded data of the source inverter in Pr. 41 to 47.

4) Return Pr. 77 "parameter write disable selection" to the previous value, any of 0 to 2.

5) Perform power OFF/ON or reset.

⚠ CAUTION

⚠ When the setting of Pr. 77 "parameter write disable selection" is changed to "801", special parameters other than the above may be set. However, since the special parameters are reserved for the manufacturer, do not change the setting of such parameters.

To output a signal when the output current value is "0"

◇ Pr. 67 "open motor circuit detection level", Pr. 68 "open motor circuit detection time"

- When using the inverter for elevation applications, a torque may not be generated when the output current reaches "0", causing the lifter to drop.
When the output current reaches "0", the inverter can output a "0" signal to prevent this.
- The output current is detected during motor operation. If the detected value is lower than the value set in Pr. 67 "open motor circuit detection level" for longer than the time set in Pr. 68 "open motor circuit detection time", an open motor circuit detection signal will be output from the inverter's output terminal PU (Pr. 40 (output terminal assignment) = 7) as the open collector signal.
If the alarm "speed deflection value excessive (E.OSD)" is being output, the motor will coast simultaneously with the open collector signal output, and "E.OSD" will occur.

Parameter No.	Name	Setting Range	Factory Setting	Remarks
67	Open motor circuit detection level	0 to 50%	5%	100% rated current value
68	Open motor circuit detection time	0.05 to 1 sec., 9999	9999	9999: Zero current detection disabled
31	Speed deflection level	0 to 1500r/min, 9999	9999	9999: No OSD alarm

(1) Setting of open motor circuit detection level

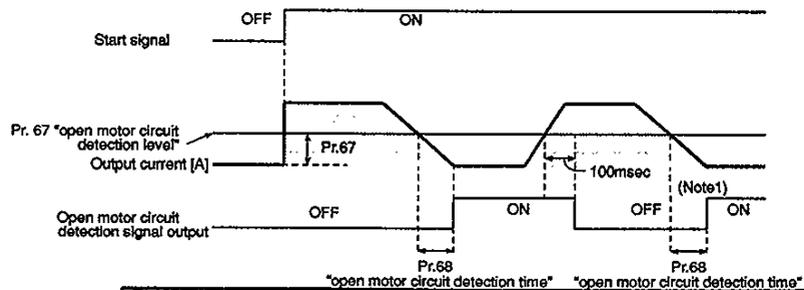
In Pr. 67 "open motor circuit detection level", set at what rated current percent from 0 "A" to detect the output current value is to be detected as a zero current.

(2) Setting of open motor circuit detection time

Set the time to output the alarm "speed deviation value excessive (E.OSD)" from the terminal PU after Pr. 67 "open motor circuit detection level" is entered.

Pr. 68	Open Collector	Alarm	
9999	PU signal (Pr. 40=7)	None	
Other than 9999	PU signal is used as open motor circuit detection.	Pr. 31=9999	E.OSD display disabled
		Pr. 31 ≠ 9999	E.OSD display enabled

● Timing chart



Note: 1. The open motor circuit detection signal will hold the signal for approx. 100ms even if the set detection level is exceeded and the conditions are not established.
2. The sum of delay times such as current detection delay and transistor operation delay is up to 10msec.

 **CAUTION**

-  Do not set the open motor circuit detection level too high or the open motor circuit detection time too long. In such settings, the detection signal may not be output when the output current is small and torque is not generated.
-  A safety back-up device such as an emergency brake should be provided to prevent the machine and equipment from resulting in hazardous conditions if the open motor circuit detection signal is used.

■ <Pr. 69 ⇨ Refer to the section of Pr. 64>

■ <Pr. 70 ⇨ Refer to the section of Pr. 30>

To match the thermal characteristic of electronic overcurrent protection with that of the motor used



⇨ Pr. 71 “applied motor”

- When a motor with PLG is used, match the thermal characteristic of electronic overcurrent protection with that of the motor.

Pr. 71 Setting	Motor	
	Vector inverter motor (SF-VR)	Motor with PLG (SF-JR, etc.)
0 (factory setting)	No relation	Thermal characteristic matching that of the standard motor
1	No relation	Thermal characteristic matching that of the Mitsubishi constant-torque motor

Note: To distinguish between vector inverter motor and motor with PLG, see the setting of Pr. 99 “motor constant selection”.

⚠ CAUTION

⚠ Set this parameter properly according to the motor used. Incorrect setting will cause the motor to overheat and burn.

To lower the PWM carrier frequency so that noise and leakage current are reduced

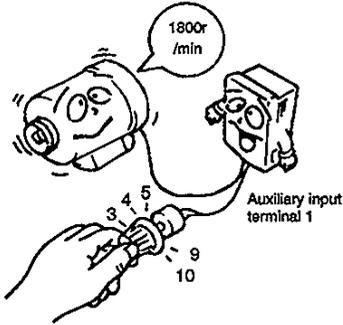


⇨ Pr. 72 “PWM frequency”

- Use Pr. 72 to set the PWM carrier frequency of the FR-V200 series. This frequency can be changed by using Pr. 72 when trying to reduce the effects of motor-mechanical system resonance. Lowering the PWM carrier frequency will increase motor noise but reduce inverter-generated noise and leakage current.
- Change the carrier frequency when the motor is at a stop.
- Parameter

Pr. 72 Setting	Carrier Frequency
0	
1	
2	
3	
4	
5	
6		High

To perform main speed setting using the auxiliary frequency setting terminal 1



◇ Pr. 73 “speed setting signal”

- When the override function is selected, the main speed can be set with the speed setting auxiliary terminal 1. Set the usage of terminals 1, 2 and 3 and the validity of the override function with Pr. 73.

Pr. 73	Control Mode	Function	Terminal 1 (±10V)*1	Terminal 2 (0 to 10V)	Terminal 3 (±10V)
☆0	Speed control	Analog uni-direction	Additional speed setting	Main speed setting	Torque restriction
1		Analog bi-direction			
2		Override uni-direction	Main speed setting	Override signal	
3		Override bi-direction*2			
☆0	Torque restriction	Speed restriction	Speed restriction correction	Speed restriction	Torque command
1					
2					
3					

*1: Terminal 1 (additional speed setting input) is added to terminal 2's main speed setting signal.

*2: When override is selected, terminal 1 becomes the main speed setting, and terminal 2 becomes the override signal (50 to 150% at 0 to 10V).

Note: 1. When changing the max. output speed when the max. speed command voltage is input, set the speed setting voltage gain Pr. 903 (Pr. 905).
 The command voltage need not be input at this time.
 The acceleration/deceleration time is sloped to the acceleration/deceleration reference speed and is not affected by changes of the Pr. 73 setting.

2. The setting marked ☆ is the factory setting.

To change torque characteristics according to machine characteristics

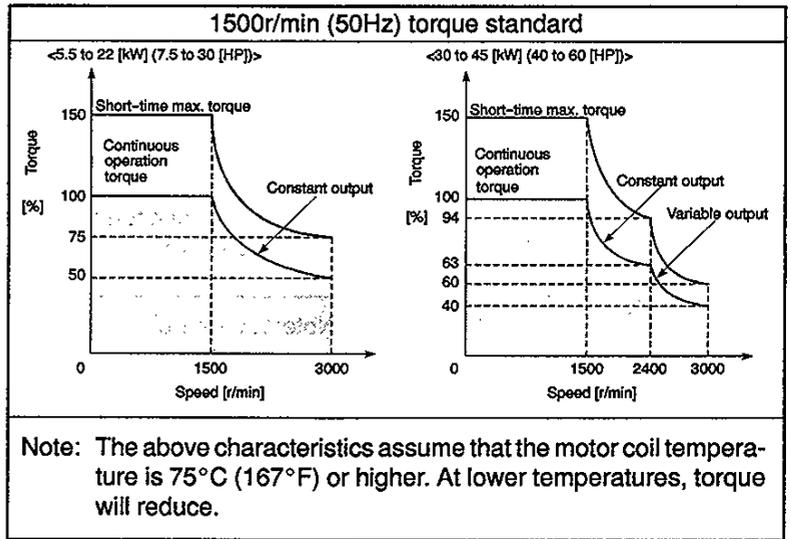
⇒ Pr. 74 “torque characteristic selection”

- When the motor with PLG is used, torque characteristics can be selected.

Pr. 74 Setting	Motor	
	Vector inverter motor (SF-VR)	Motor with PLG (SF-JR, etc.)
0 (factory setting)	Vector inverter motor torque characteristics	Cyclic operation mode
1		Continuous operation mode

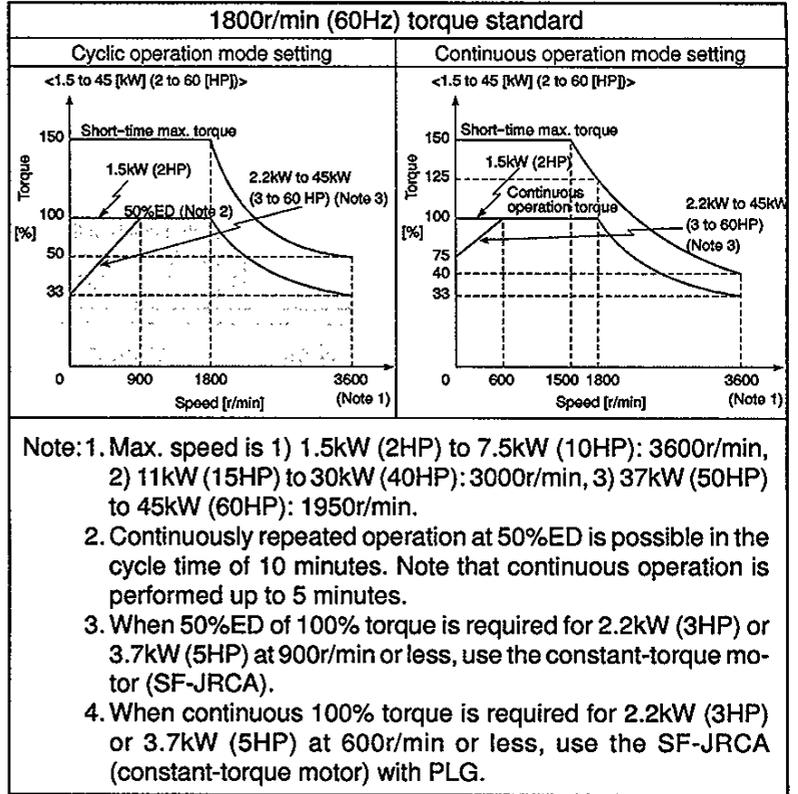
Note: To distinguish between vector inverter motor and motor with PLG, see the setting of Pr. 99 “motor constant selection”.

- Torque characteristics of vector inverter motor
The torque characteristics of the motor used with the inverter of the same capacity when the rated voltage is input



- Torque characteristics of motor with PLG (Example: SF-JR with PLG (4 poles))

The torque characteristics of the motor used with the inverter of the same capacity when the rated voltage is input



To decelerate the motor to a stop by pressing the stop key during external operation

⇒ Pr. 75 “PU stop key selection”

- Operation can be stopped by pressing the PU [STOP] key in other than the PU operation mode.

Set Value	PU Stop Key Function	PU Disconnection Detection
0	Operation continues if PU is disconnected.	PU stop key is valid in PU operation mode only.
1 (Factory setting)	PU stop key is always valid.	
2	PU stop key is valid in PU operation mode only.	When PU is disconnected, inverter LED shows error and inverter shuts off output.
3	PU stop key is always valid.	

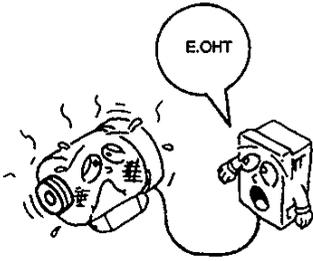
Note: 1. When the motor is decelerated to a stop with the PU [STOP] key during external operation, turn the terminal STF (STR) off once, press the PU [EXT OP] key, and then turn the terminal on again to restart operation.

2. Pr. 75 can be set any time regardless of the Pr. 77 “parameter write disable selection” value.

3. When 2 or 3 is set in Pr. 75

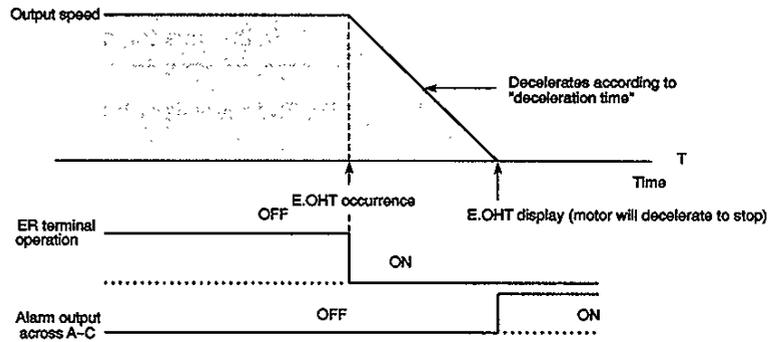
- (a) When the PU is not connected in the connector from the beginning, it is not regarded as an alarm.
- (b) The PU is judged as disconnected when it is kept disconnected for more than 1 second.
- (c) To make a restart, make sure that the PU is connected, then reset the inverter.
- (d) The Pr. 75 value can be set any time and this setting does not return to the initial value if parameter clear or all clear is performed.

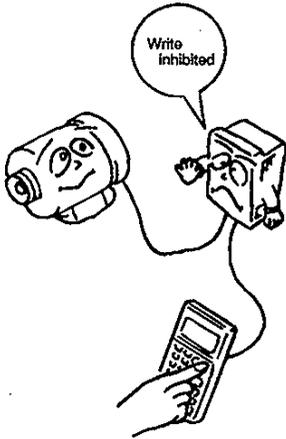
To decelerate the motor to a stop at alarm occurrence



⇒ Pr. 76 “alarm definition”

- Alarms are classified into major and minor faults. When a major fault has occurred, the motor is immediately coasted.
- A minor fault indicates “E.OHT”. A major fault indicates any alarm other than “E.OHT”.
- Operation
 - (1) Pr. 76 = 0: Normal operation is performed.
When any alarm occurs, the inverter will shut off its output and coast the motor. If the ER terminal is assigned with Pr. 40 “output terminal assignment”, the ER terminal will also turn on.
 - (2) Pr. 76 = 1: Fault definition selection
 - 1) When an alarm other than OHT occurs, the inverter will shut off its output and coast the motor. The ER terminal will also turn on.
 - 2) When an OHT alarm occurs, the motor will decelerate according to Pr. 8 “deceleration time”. The ER terminal will also turn on.
If DC braking is applied after decelerating, the inverter will shut off its output and coast the motor.



To set parameter write disable⇨ **Pr. 77 “parameter write disable selection”**

- Prevents parameter values from being written from the parameter unit.

Set Value	Write Disable Function
0 (factory setting)	Parameter write enable (only at stop in PU operation mode) (Note 1)
1	Parameter write disable (Note 2)
2	Parameter write also enabled during operation (Note 3)

- Note: 1. Monitor-related parameters Pr. 51 to Pr. 58 can be set at any time.
 2. Write is allowed for Pr. 77 and Pr. 79 “operation mode selection”.
 3. Pr. 72 cannot be written during operation.

⚠ CAUTION

- ⚠ If the setting is changed during operation, an alarm may occur in the inverter, causing the motor to coast.

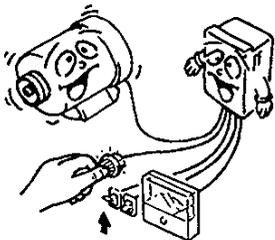
To prevent reverse rotation⇨ **Pr. 78 “reverse rotation selection”**

- Set Pr. 78 in accordance with the following table to prevent any reverse rotation fault resulting from the mis-input of the start signal.

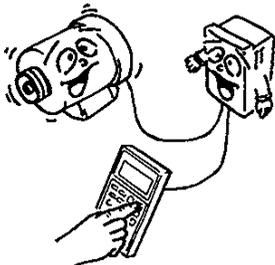
Set Value	Direction of Rotation
0	Both forward and reverse rotations allowed (factory setting)
1	Reverse rotation disallowed
2	Forward rotation disallowed

To select the operation mode

External operation mode



PU operation mode

⇨ **Pr. 79 “operation mode selection”**

- Allows operation to be performed in either or both of the external signal and parameter unit operation modes of the inverter.

Set Value	Description
0 (factory setting)	Operation can be switched between the parameter unit and external operation modes.
1	Operation is only allowed in the parameter unit operation mode.
2	Operation is only allowed in the external operation mode.

***Note that if the following parameters Pr. 80 to Pr. 97 are changed carelessly, motor vibration may occur and the response may drop.**

To set the proportional gain of the speed loop

- ◇ Pr. 80 “speed control P gain 1” (when RT terminal is OFF)
Pr. 90 “speed control P gain 2” (when RT terminal is ON)

- The proportional gain of the speed loop is set.
The speed response will increase when the setting is increased, but when set too high, vibration or noise may be generated.
- The setting range for Pr. 80 “speed control P gain 1” and Pr. 90 “speed control P gain 2” is 0 to 1000%. The factory setting is 30%.
Generally these parameters are adjusted between 10 and 100 %.

- (Remarks) 1. When executing positioning, increase the setting value to improve the precision.
2. Decrease the setting value when gear backlash, etc. occurs.

Note:1. If there is any looseness in the couplings, the response has deteriorated.
2. When limiting the speed during torque control, refer to Pr. 73 “speed setting signal”.

To set the integral compensation gain of the speed loop

- ◇ Pr. 81 “speed control I gain 1” (when RT terminal is OFF)
Pr. 91 “speed control I gain 2” (when RT terminal is ON)

- The integral compensation gain of the speed loop is set.
When this setting is increased, the return time during speed fluctuation will be shortened. However, if set too high, speed overshooting may occur.
- The setting range for Pr. 81 “speed control I gain 1” and Pr. 91 “speed control I gain 2” is 0 to 1000%. The factory setting is 3%.
Generally these parameters are adjusted between 1 and 10 %.

- (Remarks) 1. The stability of the operation will increase when the setting value is decreased, but the return time (response time) will lengthen, and undershooting may occur.
2. The adequate value to be set in Pr. 81 and Pr. 91 is approx. one-tenth of Pr. 80 and Pr. 90.

- ◇ Pr. 82 “speed setting filter 1” (when RT terminal is OFF)
Pr. 92 “speed setting filter 2” (when RT terminal is ON)

- To prevent noise in the speed setting signal line from affecting the speed control, this smoothing filter can be set.
When the follow-up to the speed command is to be delayed, or when the analog input voltage is unstable, etc., increase the time constant.
- The setting range for Pr. 82 “speed setting filter 1” and Pr. 92 “speed setting filter 2” is 0 to 5 sec. The factory setting is 0 sec. (no filter).

To remove noise in the speed setting circuit

To remove noise with speed detection

- ⇒ Pr. 83 “speed detection filter 1” (when RT terminal is OFF)
Pr. 93 “speed detection filter 2” (when RT terminal is ON)

- To prevent noise in the speed feedback signal from affecting the speed control, this smoothing filter can be set.
The speed loop response will drop, but the speed ripple will be reduced.
Set the time constant when the motor rotation needs to be stable.
Note that if the value is too high, the motor operation will be unstable.
- The setting range for Pr. 83 “speed detection filter 1” and Pr. 93 “speed detection filter 2” is 0 to 5 sec. The factory setting is 0 sec. (no filter).

(Remarks) If the speed ripple is large, the operation can be stabilized by setting Pr. 83 and Pr. 93.

To improve the response with torque control

- ⇒ Pr. 84 “torque control P gain 1” (when RT terminal is OFF)
Pr. 94 “torque control P gain 2” (when RT terminal is ON)

- The current loop proportional gain for torque control is set.
When the value is increased, the torque response will increase. However, if the value is too high, the operation will be unstable and a high harmonic torque vibration will occur.
- The setting range for Pr. 84 “torque control P gain 1” and Pr. 94 “torque control P gain 2” is 0 to 1000%. The factory setting is 100%.
Generally these parameters are adjusted between 50 and 200 %.

To set the response with the integral compensation gain during torque control

- ⇒ Pr. 85 “torque control I gain 1” (when RT terminal is OFF)
Pr. 95 “torque control I gain 2” (when RT terminal is ON)

- The current loop integral compensation gain during torque control is set.
The return time during torque fluctuation will be shortened when this value is increased, but if it is set too high, torque overshooting may occur.
- The setting range for Pr. 85 “torque control I gain 1” and Pr. 95 “torque control I gain 2” is 0 to 1000%. The factory setting is 100%.
Generally these parameters are adjusted between 50 and 200 %.

(Remarks) 1. The value set in Pr. 85 and Pr. 95 should be approx. the same as Pr. 84 and Pr. 94.

To remove noise with torque setting filter

- ⇒ Pr. 86 “torque setting filter 1” (when RT terminal is OFF)
Pr. 96 “torque setting filter 2” (when RT terminal is ON)

- To prevent noise in the torque setting signal line from affecting torque control, this smoothing filter can be set.
When the follow-up to the torque command is to be delayed, set the time constant.
- The setting range for Pr. 86 “torque setting filter 1” and Pr. 96 “torque setting filter 2” is 0 to 5 sec. The factory setting is 0 sec. (no filter).

To remove noise with torque detection

- ◇ Pr. 87 “torque detection filter 1” (when RT terminal is OFF)
Pr. 97 “torque detection filter 2” (when RT terminal is ON)

- To prevent noise in the torque feedback signal from affecting torque control, this smoothing filter can be set.
The current loop response will drop, but the torque vibration will be reduced.
Set the time constant when the torque is to be generated stably.
- The setting range for Pr. 87 “torque detection filter 1” and Pr. 97 “torque detection filter 2” is 0 to 5 sec. The factory setting is 0 sec. (no filter).

To provide a droop characteristic for the speed in response to the load balance

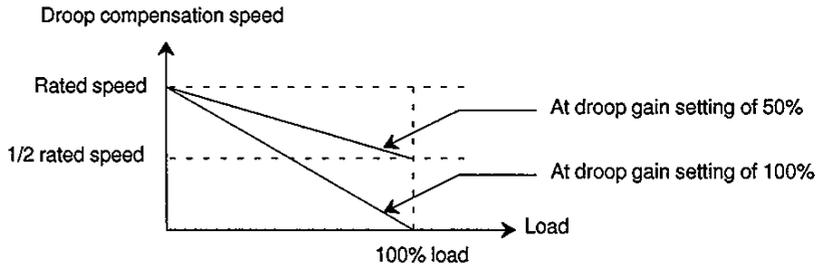
- ◇ Pr. 88 “droop gain”, Pr. 154 “droop filter time constant”

- This function balances the load in proportion to the load torque to provide a droop characteristic for the speed.
- The speed command is variable according to the magnitude of the motor load (inverter’s load meter). As the droop gain, set the rated-torque droop amount in % with reference to the rated speed. The droop filter time constant is the time constant of the torque current filter.

$$\text{Droop compensation speed} = \frac{\text{After-filtering load meter}}{100\% \text{ load meter}} \times \frac{\text{Rated speed} \times \text{droop gain}}{100}$$

Parameter Number	Factory Setting	Setting Range
88	9999	0 to 100%, 9999
154	9999	0.01 to 1.00 sec., 9999

- Pr. 88 “droop gain”
Set the droop amount at rated torque in % to the rated motor frequency. When Pr. 88 ≠ “0” or “9999”, droop control is made valid.
- In Pr. 154 “droop filter time constant”, set the time constant of the primary delay filter for the torque current.



- Operating status: Made valid during acceleration operation.
- Droop compensation speed:
3600r/min or Pr. 1 (maximum speed) setting.

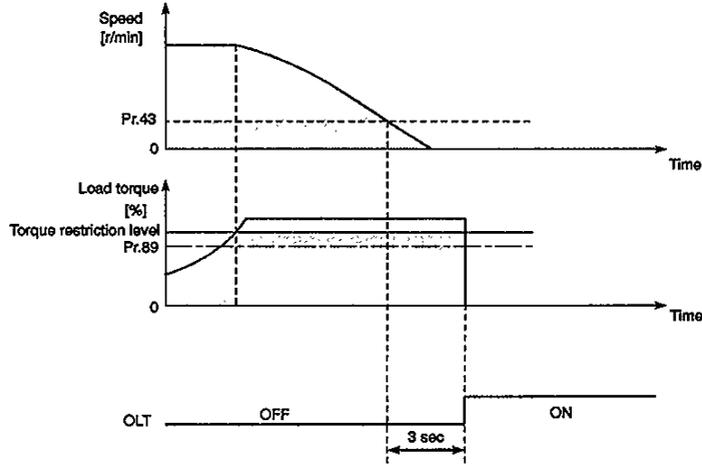
To set the load level at which OLT will occur

◇ Pr. 89 "OLT level setting"

- Set this parameter to determine the load level of the motor at which OLT will occur.

Setting Range	Factory Setting
0 to 200%	150%

- When the torque restriction is applied during operation to make the motor speed lower than Pr. 43 "low speed detection", the OLT alarm will occur if the load applied to the motor is larger than the Pr. 89 setting for more than 3 seconds.



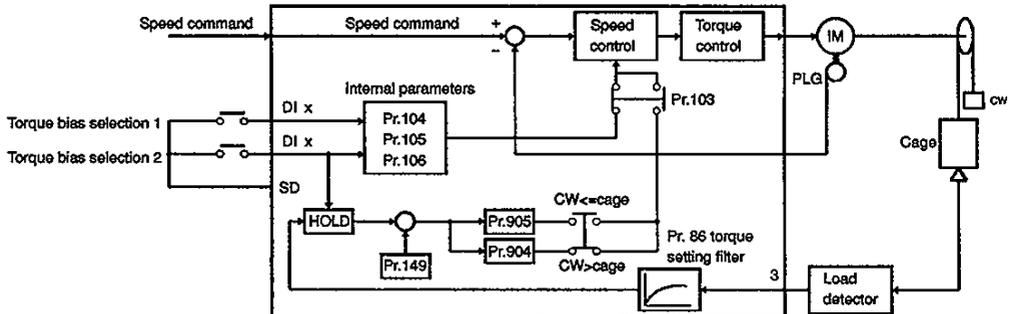
■ <Pr. 98, Pr. 99 ◇ Refer to the section of Pr. 64>

To set the motor starting torque with contact signals or analog signal

- ◇ Pr. 103 “torque bias selection”, Pr. 104 “torque bias 1”
Pr. 105 “torque bias 2”, Pr. 106 “torque bias 3”
Pr. 147 “torque bias filter”
Pr. 148 “torque bias operation time”
Pr. 149 “torque bias balance compensation”
Pr. 152 “fall-time torque bias No. 3 bias”
Pr. 153 “fall-time torque bias No. 3 gain”

- Use the contact signals or analog signal to adjust an output torque rise at the time of a motor start.

(1) Block diagram



(2) Parameters used

Parameter Number	Name	Setting Range	Factory Setting
46	Second multi-function input selection	0 to 999, 9999	9999
103	Torque bias selection	0 to 3, 9999	9999
104	Torque bias 1	600 to 1400%, 9999	9999
105	Torque bias 2	600 to 1400%, 9999	9999
106	Torque bias 3	600 to 1400%, 9999	9999
147	Torque bias filter	0 to 5 sec., 9999	9999
148	Torque bias operation time	0 to 5 sec., 9999	9999
149	Torque bias balance compensation	0 to 10V, 9999	9999
152	Fall-time torque bias No. 3 bias	0 to 400%, 9999	9999
153	Fall-time torque bias No. 3 gain	0 to 400%, 9999	9999
904	Torque setting No. 3 bias	0 to 10V 0 to 400%	0V 0%
905	Torque setting No. 3 gain	0 to 10V 0 to 400%	10V 150%

(3) Terminals

- DI1 to DI3 terminals to which “2” or “3” has been assigned using Pr. 46 “second function input selection” (refer to page 71)
- No. 3 terminal

(4) Parameter details

1) Pr. 103 “torque bias selection”

Used to select the torque bias setting method.

Pr. 103 Setting	Description
0	In Pr. 104 to Pr. 106, make torque bias amount setting by contact signals (DI1 to DI3).
1	Cage rises when motor runs in forward rotation direction. In Pr. 904 and Pr. 905, make torque bias amount setting by No. 3 terminal as desired.
2	Cage rises when motor runs in reverse rotation direction. In Pr. 904 and Pr. 905, make torque bias amount setting by No. 3 terminal as desired.
3	In Pr. 904, Pr. 905 and Pr. 149, torque bias amount setting by No. 3 terminal can be made automatically according to load.
9999	Without torque bias

<Operation chart>

● When Pr. 103 = 0

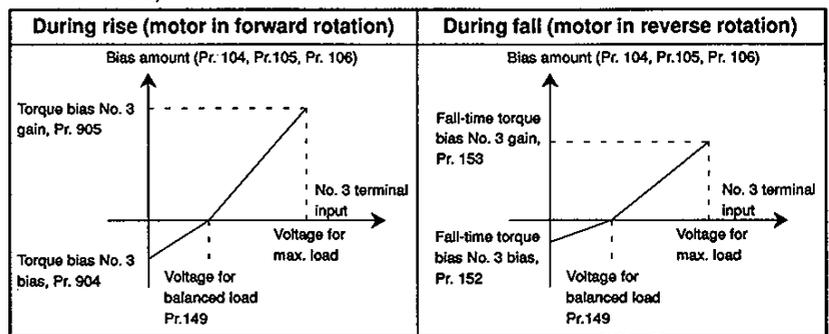
Set any of the following torque bias amounts (Pr. 104 to Pr. 106) by the combination of contact signals (DI1 to DI3):

Pr. 46 = 2 (Torque bias selection 1)	Pr. 46 = 3 (Torque bias selection 2)	Torque Bias (Pr. 104 to Pr. 106)
OFF	OFF	No selection
ON	OFF	Pr. 104 1000 to 1400%: Positive value 600 to 999%: Negative value
OFF	ON	Pr. 105 1000 to 1400%: Positive value 600 to 999%: Negative value
OFF	ON	Pr. 106 1000 to 1400%: Positive value 600 to 999%: Negative value

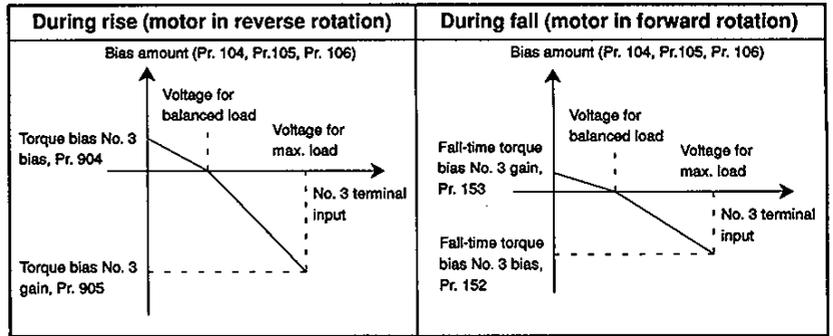
Example: 25% when Pr. 104 = 1025, -25% when Pr. 105 = 975, -75% when Pr. 106 = 925
Midpoint is 1000.

● When Pr. 103 = 1

From the analog input value of No. 3 terminal, calculate the torque bias as shown below and set the torque command gain and bias (Pr.904, Pr. 905):



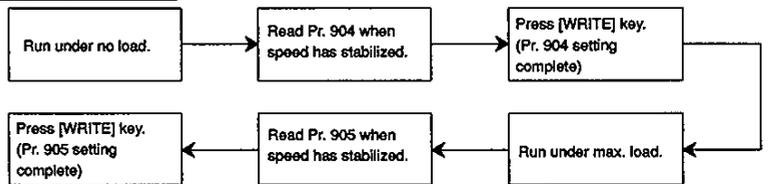
● When Pr. 103 = 2



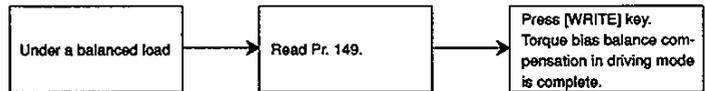
● When Pr. 103 = 3

Pr. 904 “torque command No. 3 bias”, Pr. 905 “torque command No. 3 gain” and Pr. 149 “torque bias balance compensation” can be set automatically according to the load.

Pr. 904, Pr. 905 settings



Pr. 149 setting



Note: When performing torque bias operation after completion of automatic setting, set “1” or “2” in Pr. 103.

2) Pr. 104 “torque bias 1”, Pr. 105 “torque bias 2”, Pr. 106 “torque bias 3”

The rated torque is defined as 100%, the torque bias setting of 1000% is used as the center value of the torque, and the bias value is “0”.

Setting	Description
600 to 999%	Negative torque bias amount
1000 to 1400%	Positive torque bias amount
9999	Without torque bias setting

3) Pr. 147 “torque bias filter”

Can make a gentle torque rise. Torque rising operation at this time acts as the time constant of the primary delay filter.

Setting	Description
0 to 5 sec.	Time until torque rises.
9999	Same operation as in 0 sec.

4) Pr. 148 “torque bias operation time”

Used to set the time until the torque set to the torque bias amount is generated.

Setting	Description
0 to 5 sec.	Time until torque bias amount is reached.
9999	Same operation as in 0 sec.

5) Pr. 149 “torque bias balance compensation”

Used to set the voltage of the torque bias analog input value entered into No. 3 terminal to compensate for the balance of the torque bias amount.

Setting	Description
0 to 10V	Set the voltage under balanced load.
9999	Same operation as in 0V.

6) Pr. 152 “fall-time torque bias No. 3 bias”

Used to set the torque bias amount at the time of fall (motor in reverse rotation).

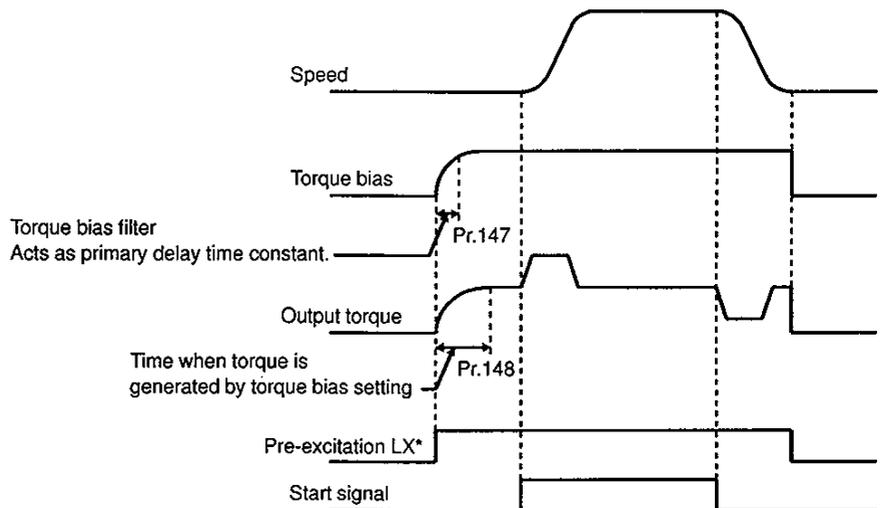
Setting	Description
0 to 400%	The setting is the bias value of the torque command.
9999	Same as in rise (Pr. 904).

7) Pr. 153 “fall-time torque bias No. 3 gain”

Used to set the torque bias amount at the time of fall.

Setting	Description
0 to 400%	The setting is the gain value of the torque command.
9999	Same as in rise (Pr. 905).

(5) Torque bias operation



* When pre-excitation is not made, the torque bias functions simultaneously with the start signal.

■ <Pr. 147, Pr. 148, Pr. 149 ⇨ Refer to the section of Pr. 103>

Reduces temperature drift after auto tuning.

⇨ Pr. 151 “secondary resistance compensation selection”

- Reduces the temperature drift of the output torque caused by temperature change after auto tuning.

Parameter Number	Function	Setting Range	Factory Setting	Remarks
151	Secondary resistance compensation function selection	0 to 200°C, 9999	9999	Permissible temperature rise 75°C (167°F) for insulation class E Permissible temperature rise 80°C (176°F) for insulation class B Permissible temperature rise 100°C (212°F) for insulation class F No compensation for 9999

● Details

Make selection whether R2 is compensated for by estimation of heat generated. When making temperature compensation, set the upper limit of temperature rise in Pr. 151 according to the type of motor insulation.

1) Pr. 151 = 9999

The internal inverter constant remains unchanged and no compensation is made.

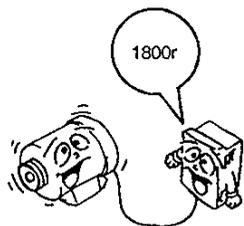
2) Pr. 151 = other than 9999

Compensation is made on the basis of the heat generation amount estimated from the internal inverter constant.

■ <Pr. 152, Pr. 153 ⇨ Refer to the section of Pr. 103>

■ <Pr. 154 ⇨ Refer to the section of Pr. 88>

To change the running speed indication from motor speed indication (r/min) or machine speed indication (m/min)



⇨ Pr. 155 “speed indication”

- To change the inverter LED indication

- (1) Set “1” (speed) in Pr. 51 “inverter LED indication data selection”.
- (2) Refer to the following table and set the Pr. 155 “speed indication” value:

Pr. 155 Setting	Running Speed Indication
11 to 9998	● Set the machine speed for operation at 1500r/min. Example: When the setting is 150 (m/min), 150 (without display unit) is displayed at the output of 1500r/min.
9999 (factory setting)	● Motor speed is displayed.

Note: 1. When the motor is run without the PLG in the V/F control mode, the speed indication is 0.

2. When the speed is 5 digits, the LED display alternates between flickering 0 and 9999.

- To change the PU main monitor (PU main display)

- (1) Set “0” (factory setting) in Pr. 52 “PU main display data selection”.
- (2) The speed monitor screen appears.
- (3) Then press the [WRITE] key to change the speed monitor screen to the first priority screen.

⚠ CAUTION

⚠ The motor may result in overspeed, damaging the machine.

To change the rotation direction of the PLG

⇒ Pr. 156 “PLG rotation direction”

- The rotation direction of the PLG can be set as listed below:

Setting	Motor Rotation Direction	PLG Rotation Direction
0 (factory setting)	Counterclockwise (ccw)	Forward rotation
	Clockwise (cw)	Reverse rotation
1	Counterclockwise (ccw)	Reverse rotation
	Clockwise (cw)	Forward rotation

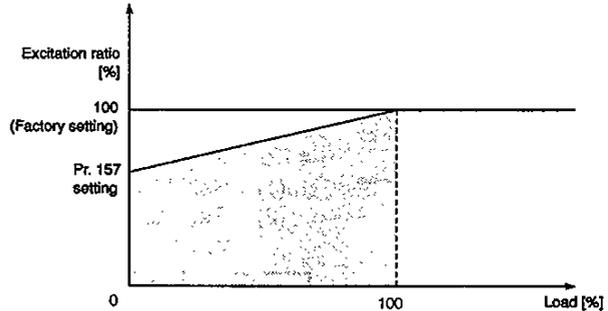
Note: The forward rotation of the PLG rotation direction indicates that the A-phase signal leads the B-phase signal by a phase angle of 90°.

- The rotation direction monitor screen of the parameter unit shows the rotation direction of the encoder.
 - When the command is STF, FWD is displayed.
 - or
 - When the command is STR, REV is displayed.
- Using Pr. 156, set the rotation direction to satisfy the left condition.

To reduce the exciting current under light load

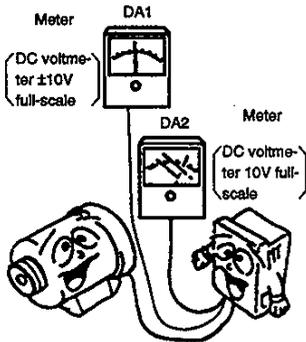
⇒ Pr. 157 “excitation ratio”

- Set the light-load exciting current command in the parameter.



■ <Pr. 158, Pr. 159 ⇒ Refer to the section of Pr. 33>

To make the output calibration of terminals DA1, DA2



◇ Pr. 900 “DA1 terminal calibration”, Pr. 901 “DA2 terminal calibration”

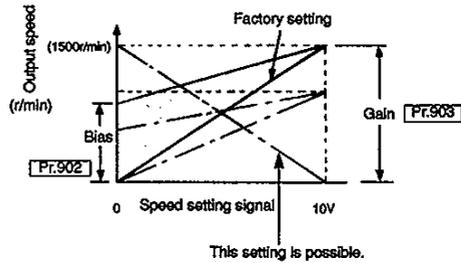
- As explained in Pr. 54 and Pr. 55, the items to be monitored are selected and set in Pr. 54 “DA1 terminal function selection” and Pr. 55 “DA2 terminal function selection”, and each monitor item is 10VDC with the full-scale at factory setting. However, with these parameters, the output voltage ratio (gain) can be adjusted to the meter’s scale. Note that the max. output voltage is 10VDC. (Terminal DA1 can output DC-10V output.) (Refer to Pr. 54 and Pr. 55.)

Note: DA1 will continue to output the voltage even when an alarm occurs and the operation stops. DA2 will not output the voltage after an alarm occurs and the operation stops.

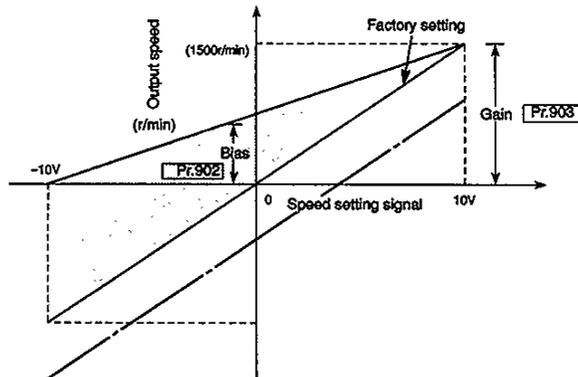
To adjust the gain and bias of the speed setting signals

◇ Pr. 902 “speed setting second bias”, Pr. 903 “speed setting second gain”

- Allows the output speed to be set in relation to the speed setting signal (0 to 10VDC). (For the adjustment method, see page 119.)



- The terminal 1 (speed setting auxiliary input) setting is also inclined as set in Pr. 902 and Pr. 903.

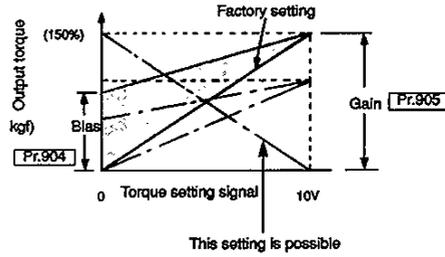


Note: 1. If the gain adjustment (Pr. 903) is changed, the acceleration/deceleration reference speed (Pr. 20) does not change. The signal to the terminal 1 (aux. input) is added to the speed setting signal.
 2. Positive value may only be set in Pr. 902 “speed setting second bias” and Pr. 903 “speed setting second gain”.

To adjust the gain and bias of the torque setting signals

▷ Pr. 904 “torque setting third bias” Pr. 905 “torque setting third gain”

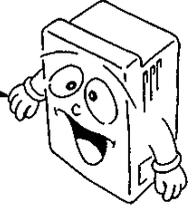
- The size (inclination) of the output to the torque setting signal (0 to 10VDC) can be set randomly.
(Refer to page 119 for the adjustment methods.)
- When using the torque bias function, the parameters serve as Pr. 904 “rise-time torque bias No. 3 bias” and Pr. 905 “rise-time torque bias No. 3 gain”. Refer to page 107.



Note: Even if the gain adjustment (Pr. 905) is changed, the acceleration/deceleration reference speed (Pr. 20) will not change. The input of terminal 1 (speed setting auxiliary input) will be added to the speed setting signal.

3.6 INVERTER RESET

The inverter can be reset by any of the following three operations. Note that resetting clears (erases) the cumulative internal heat value of the electronic overcurrent protection and the number of retries.



Operation 1

Using the help function, reset the inverter. For details, see "7 INVERTER RESET" on page 58.

Operation 2

Switch the power off for more than 0.1 seconds, then switch it on again.

Operation 3

Connect the reset terminal RES and SD for more than 0.1 seconds, then disconnect.

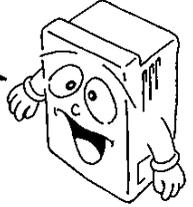
4. FUNCTIONS

This chapter offers details on the “functions” of this product.
Always read the precautions, etc. before starting use.

4.1 CALIBRATION OF THE METER (SPEED METER)	116
4.2 ADJUSTMENT OF THE SPEED SETTING SIGNALS “BIAS” AND “GAIN”	119

4.1 CALIBRATION OF THE METER (SPEED METER)

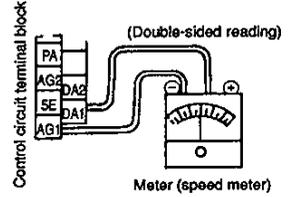
The PU allows the calibration (adjustment) of a meter (speed meter) connected across the meter connection terminal DA1 and AG1 or DA2 and AG1 of the inverter. The motor need not be connected.



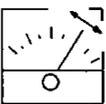
4.1.1 Calibration of the DA1 and AG1 Output

● Preparation

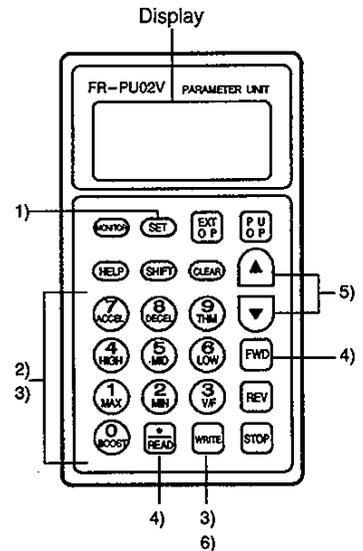
- (1) Connect a meter (speed meter) across inverter terminals DA1 and AG1. (Note the polarity. DA1 is the positive terminal.)
- (2) When a calibration resistor has already been connected, adjust the resistance value to zero or remove the resistor.
- (3) Set any of 1 to 3, 5 to 8, 17 and 21 in Pr.54 "DA1 terminal function selection". When the speed or inverter output current has been selected as the output signal, preset in Pr.56 or Pr.57 the speed or rated current value at which the output signal is 1500r/min. This 1500r/min or rated current is normally meter full-scale deflection.



● Calibration procedure (Example: To calibrate the meter to the speed of 1500r/min)

1) Press the [SET] key in the PU operation mode.	..... The inverter is placed in the parameter setting mode.	SETTING MODE Set Pr.No. FOR PR.LIST <HELP>
2) Type 900 and press the [READ] key.	..... The current PU set speed is displayed.	900 D/A1 Tune Run Inverter Set ↑ 0r PU
3) Type 1500 and press the [WRITE] key.	..... The value shown on the right is displayed.	900 D/A1 Tune Run Inverter Set ↑ 1500r PU
4) Press the [FWD] key to start forward operation at 1500r/min. (*1)	..... The motor need not be connected.	900 D/A1 Tune MntrF 1500r ◀▶▲◀ -WRITE>PU
5) Using the [▲] or [▼] key, adjust the meter reading to a predetermined position.	..... The meter reading moves. (It takes a long time until the meter reading moves.)	
6) Press the [WRITE] key.	..... Calibration is complete.	900 D/A1 Tune Completed <MONITOR>

Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.



Note: This calibration (Pr.900) is only valid when any of 1 to 3, 5 to 8, 17 and 21 has been set in Pr.54 to output a signal to terminal DA1.

(*1) The meter's needle will move in the reverse direction (minus side) when [REV] is pressed to start reverse operation.

(*2) The terminal DA1 output will display the monitor even when the inverter stops due to an alarm.

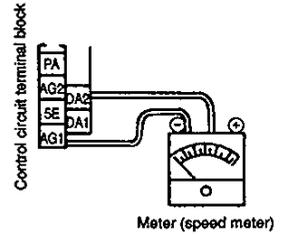
Note: 1. When the speed meter is connected across terminals DA1 and AG1 to monitor the speed, the output of terminal DA1 is saturated if the maximum output speed reaches or exceeds 1500r/min, with the factory-set value unchanged. Hence, the setting of Pr.56 "speed monitoring reference" must be changed to the maximum output speed (see page 117).

2. -10V will be output momentarily across terminals DA1 and AG1 when the inverter power is turned on or when turned off, thus care is required for the meter used.

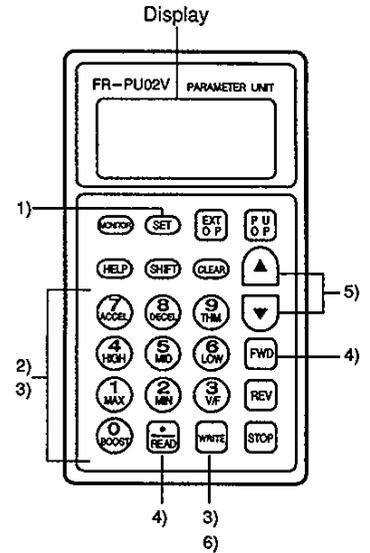
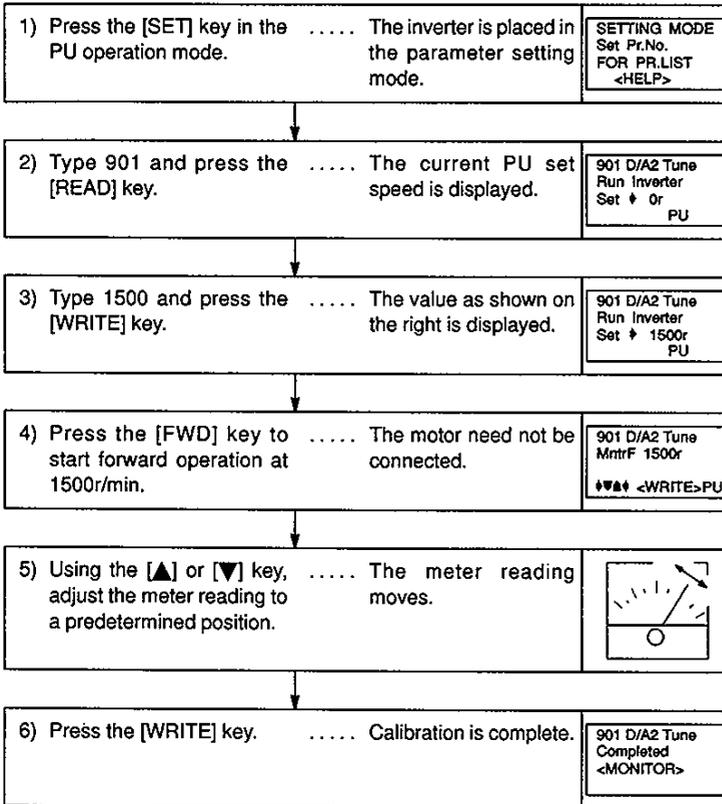
4.1.2 Calibration of the DA2 and AG1 Output

• Preparation

- (1) Connect a meter (speed meter) of 0–10VDC across inverter terminals DA2 and AG1. (Note the polarity. DA2 is the positive terminal.)
- (2) Set any of 1 to 3, 5 to 8, 17 and 21 in Pr.55. When the speed or inverter output current has been selected as the output signal, preset in Pr.56 or Pr.57 the speed or current value at which the output signal is 10V.



• Calibration procedure 1 (Example: To calibrate the meter to the speed of 1500r/min)

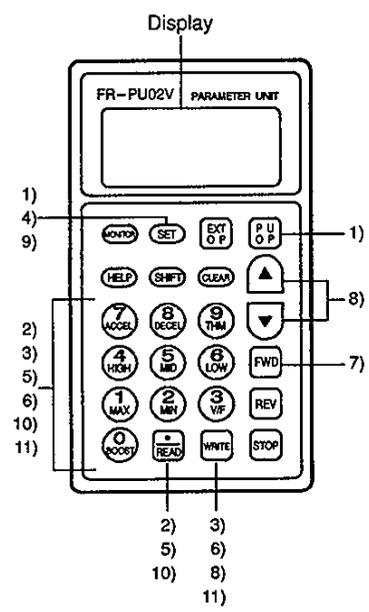
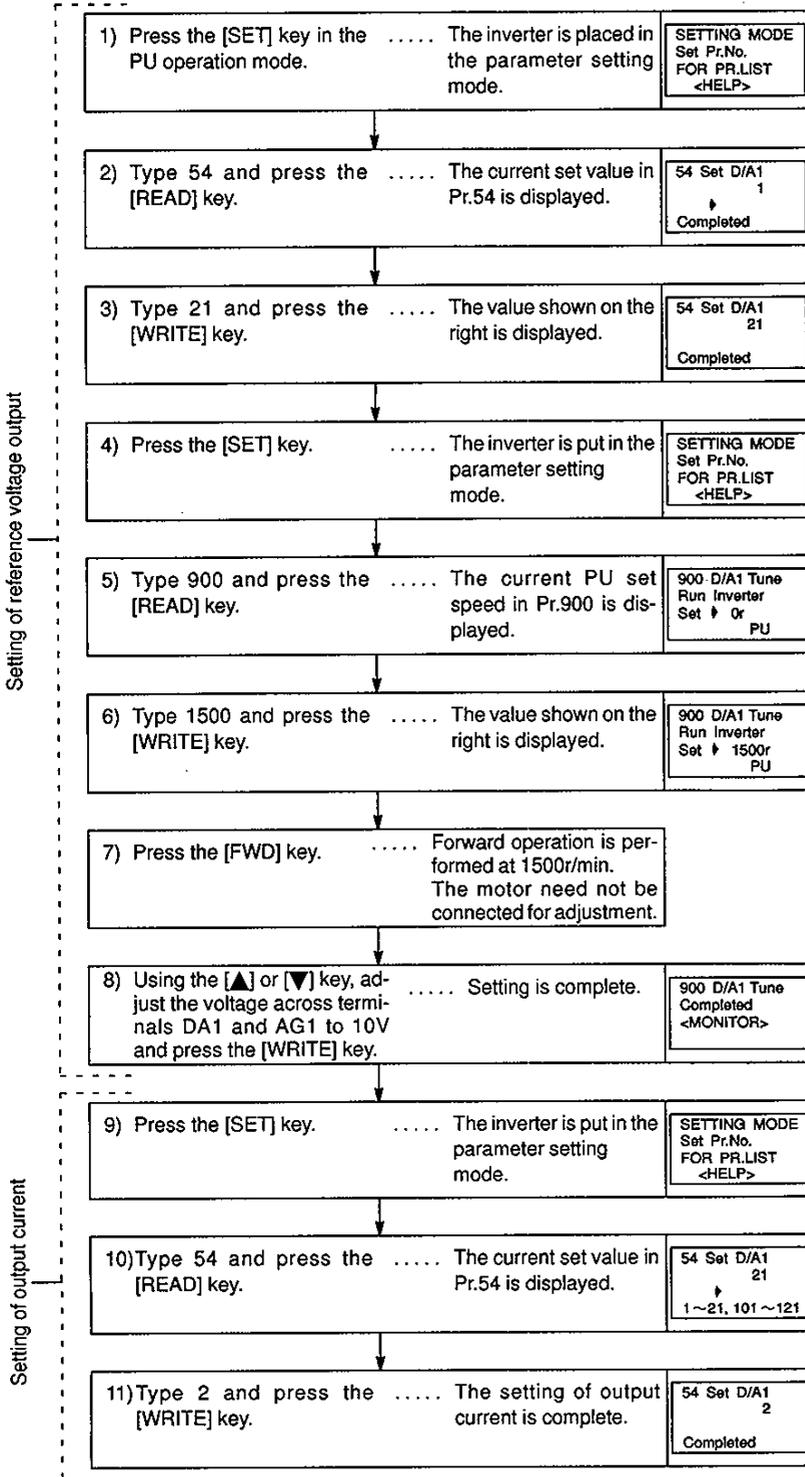


- * The terminal DA2 output will not display the monitor when the inverter stops due to an alarm (The DC bus bar voltage and reference voltage will be displayed.)

Press any of the [MONITOR], [SET], [EXT OP] and [PU OP] keys to switch to the corresponding mode.

● Calibration procedure 2 (Example: Output current)

To output the output current or other item which is not easily allowed to reach 100% if operation is performed, adjust the reference voltage output (when the set value of Pr.54 "DA1 terminal function selection" is "21"), then select any of the choices displayed.



... When the output is 100%, the output voltage is 10V. The voltage is not stored unless the [WRITE] key is pressed.

... The current value set in Pr.57 "current monitoring reference" is 100% and the output at this point is 10V.

4.2 ADJUSTMENT OF THE SPEED SETTING SIGNALS "BIAS" AND "GAIN"

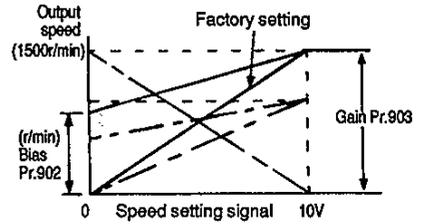
The bias and gain functions are used to adjust the relationship between the 0–10VDC setting input signal entered from outside the inverter and the output speed.

The following parameters are used for this adjustment:

- Pr. 902 "speed setting second bias"
- Pr. 903 "speed setting second gain"

Any of three procedures may be used for the adjustment.

Adjustment is made without a voltage applied across terminals 2 and 5 (adjustment procedure 1); any point is adjusted with a voltage applied (adjustment procedure 2); or any point is adjusted without a voltage applied (adjustment procedure 3).



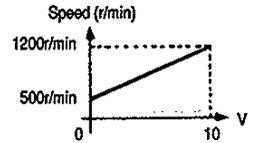
■ Adjustment example

Example: Pr. 902 "speed setting second bias"

..... Set the output speed to 500r/min at the set voltage of 0V.

Pr. 903 "speed setting second gain"

..... Set the output speed to 1200r/min at the set voltage of 10V.

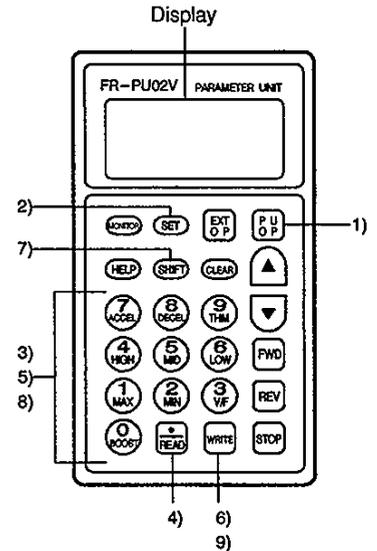


● Adjustment procedure 1 (without a voltage applied across terminals 2 and 5)

(1) Setting of the speed setting voltage bias

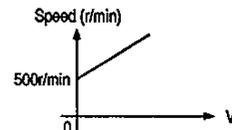
1) Press the [PU OP] key. The speed setting screen is displayed.	DIRECTLY Set 0~3600 Or
2) Press the [SET] key. The inverter is put in the parameter setting mode.	SETTING MODE Set Pr.No. FOR PR.LIST <HELP>
3) Using the numeral keys, enter 902. The data on the right is displayed.	SETTING MODE Pr.NO. 902 <READ>
4) Press the [READ] key. The current set value of Pr. 902 is displayed.	902 EXTvbias Set 500r Or EXT <WRITE> <READ>
5) Using the numeral keys, enter 500. The data on the right is displayed.	902 EXTvbias 500r Set <WRITE> EXT <READ>
6) Press the [WRITE] key. The set value is stored into memory and bias setting is complete.	902 EXTvbias 500r Completed

(To the next page)



... The voltage need not be applied across terminals 2 and 5.

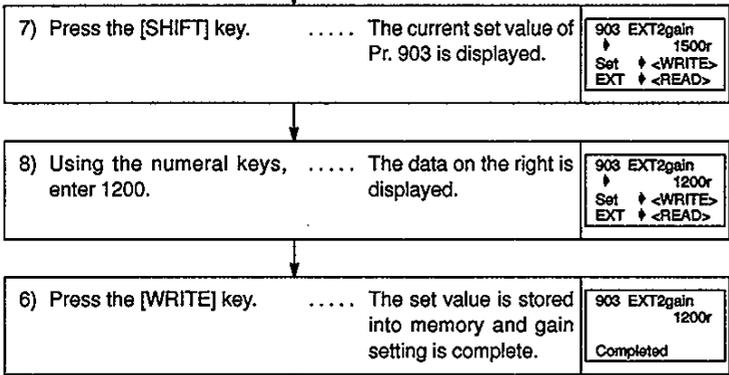
... The bias setting is 500r/min.



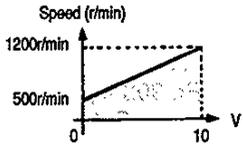
If the voltage is being applied across terminals 2 and 5 at this time, the bias setting as shown above.

(2) Setting of the speed setting voltage gain

(From the preceding page)



... The voltage need not be applied across terminals 2 and 5. At this time, 10V in the inverter is used as the set voltage.



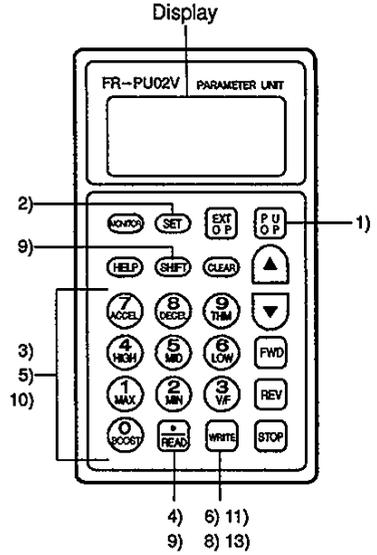
The adjustment of the speed setting voltage bias and gain is complete.

Note: 1. The torque command input (Pr. 904, Pr. 905) can also be set in a similar manner.
 2. The speed setting second gain Pr. 903 remains unchanged if the value set in Pr. 20 "acceleration/deceleration reference speed" is changed.

● Adjustment procedure 2 (any point is adjusted with a voltage applied across terminals 2 and 5)
 (1) Setting of the speed setting voltage bias

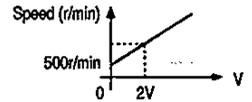
1) Press the [PU OP] key. The speed setting screen is displayed.	DIRECTLY Set Or ↓ 0~3600
2) Press the [SET] key. The inverter is put in the parameter setting mode.	SETTING MODE Set Pr.No. FOR PR.LIST <HELP>
3) Using the numeral keys, enter 902. The data on the right is displayed.	SETTING MODE Pr.NO. 902 <READ>
4) Press the [READ] key <u>twice</u> The current set value of Pr. 902 is displayed.	902 EXT2bias ↓ 250r - 0.5% EXT 20.0%
5) Using the numeral keys, enter 500. The data on the right is displayed.	902 EXT2bias ↓ 500r - 0.5% EXT 20.0%
6) Press the [WRITE] key. The cursor (c) moves to the set voltage.	902 EXT2bias ↓ 500r - 0.5% EXT 20.0%
7) Apply the voltage of 0V. Forward operation is performed at 1500r/min. Adjustment is possible even if the motor is not connected.	902 EXT2bias ↓ 500r - 0.5% EXT 20.0%
8) Press the [WRITE] key. The set value is stored into memory and bias setting is complete.	902 EXT2bias - 500r 0.2% Completed

(To the next page)



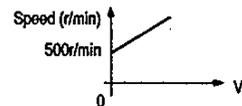
The preceding set value is displayed.
 The current set voltage across terminals 2 and 5 is displayed in %. The displayed value is changed according as the set voltage.
 (In this example, the voltage of 2V is applied)
 (The value "0" selected in Pr. 73 (10V in this example) is 100%)

... Adjust the set voltage.
 When the voltage set is 2V, the bias setting is as shown below:



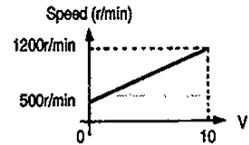
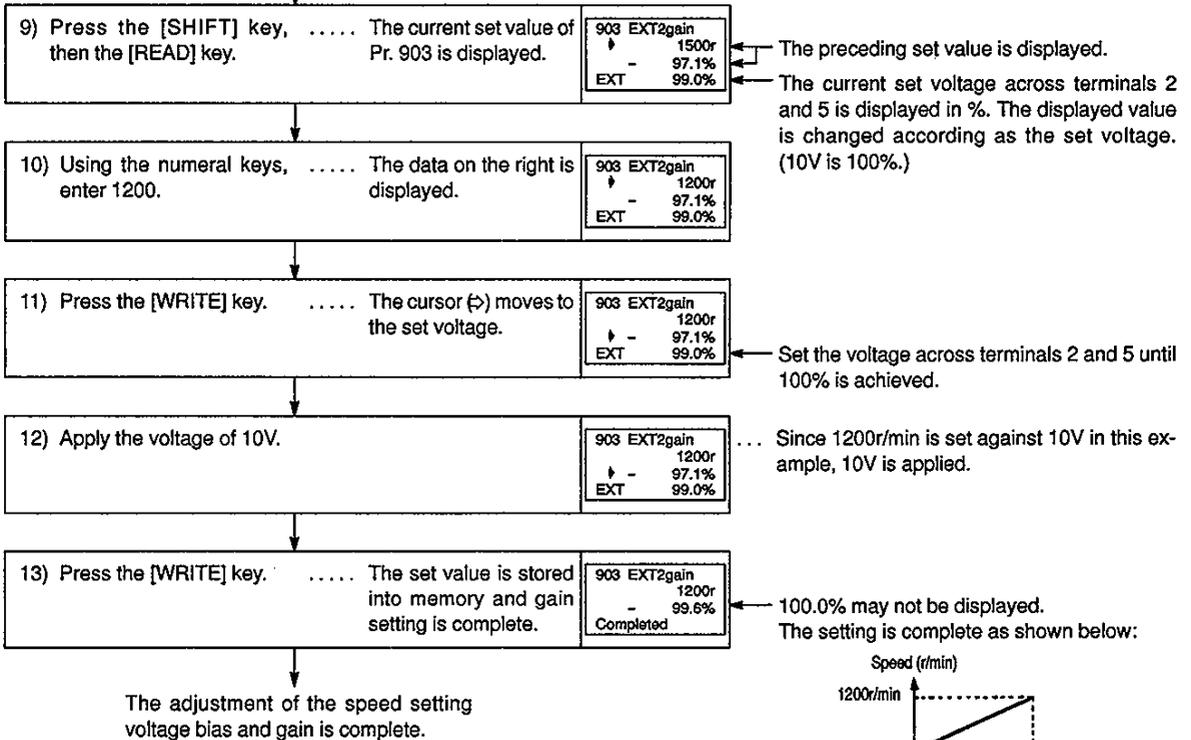
... Since 500r/min is set against 0V in this example, 0V is applied.
 (The 0% value for EXT changes.)

0.0% may not be displayed.
 The bias setting is as shown below:



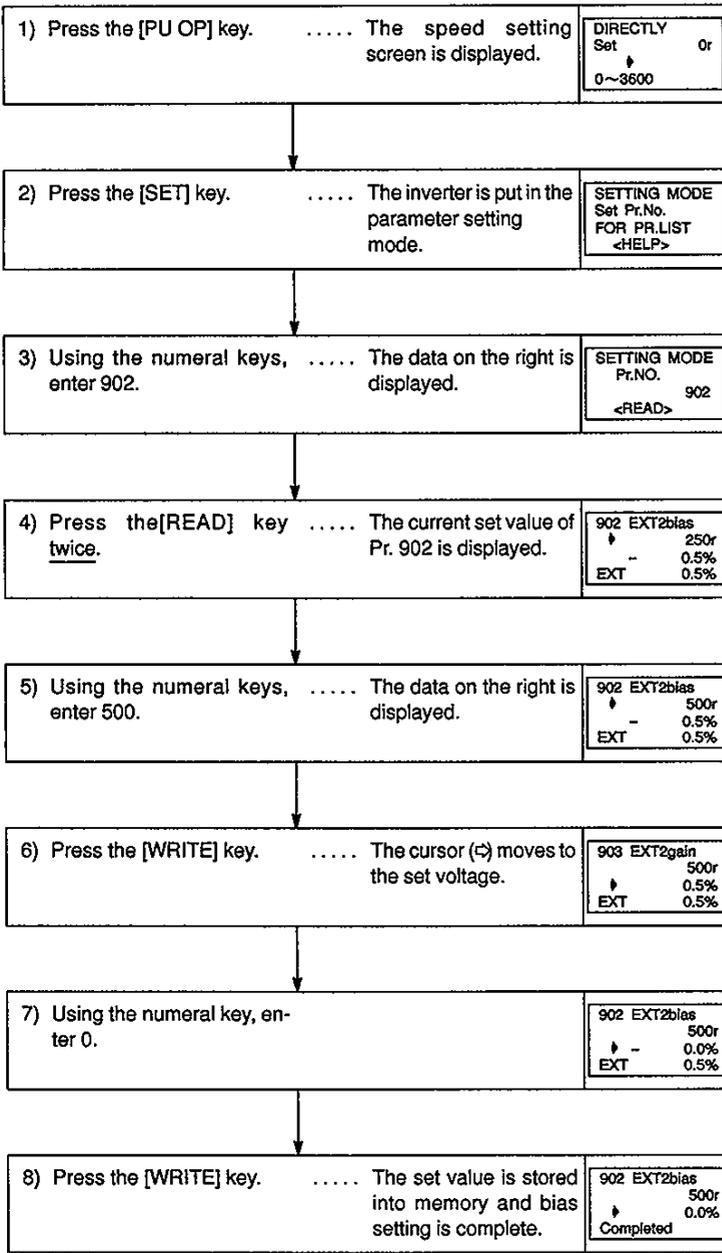
(2) Setting of the speed setting voltage gain

(From the preceding page)

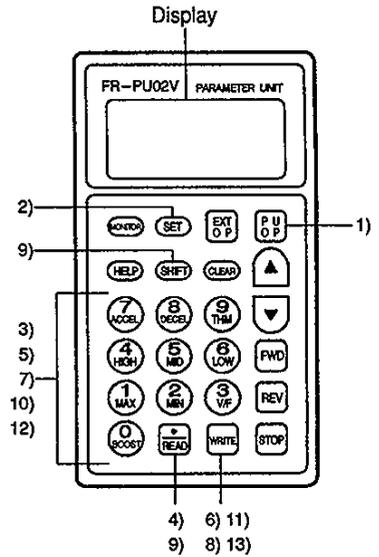


Note: 1. The torque command input (Pr. 904, Pr. 905) can also be set in a similar manner.
 2. The speed setting second gain Pr. 903 remains unchanged if the value set in Pr. 20 "acceleration/deceleration reference speed" is changed.

● Adjustment procedure 3 (any point is adjusted without a voltage applied across terminals 2 and 5)
 (1) Setting of the speed setting voltage bias



(To the next page)

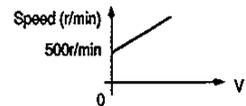


← The preceding set value is displayed.
 ← The current set voltage across terminals 2 and 5 is displayed in %. The displayed value is changed according as the set voltage. (10V)

... The voltage need not be applied across terminals 2 and 5.

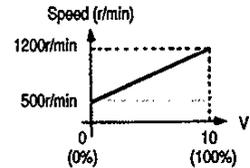
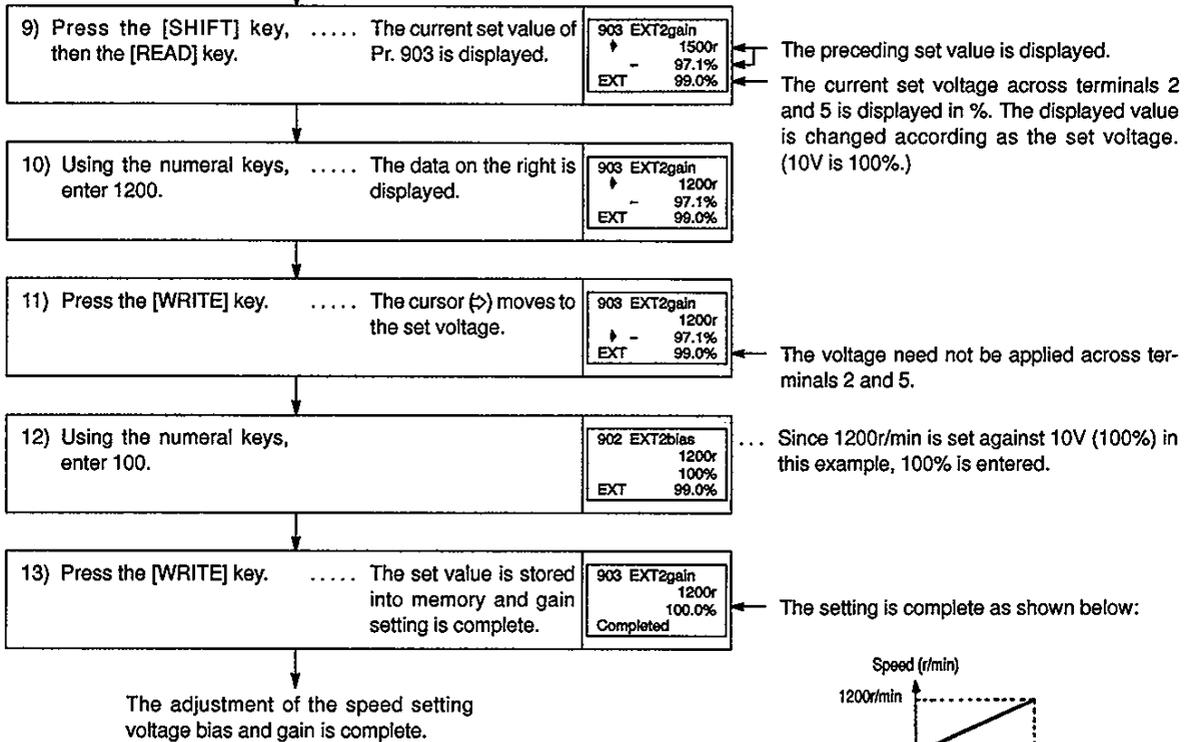
... Since 500r/min is set against 0V (0%) in this example, 0% is entered.

← The bias setting is as shown below:



(2) Setting of the speed setting voltage gain

(From the preceding page)



Note: 1. The torque command input (Pr. 904, Pr. 905) can also be set in a similar manner.
2. The speed setting second gain Pr. 903 remains unchanged if the value set in Pr. 20 "acceleration/deceleration reference speed" is changed.

5. PROTECTIVE FUNCTIONS

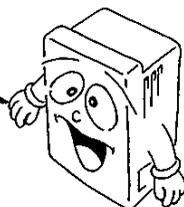
This chapter provides details the “protective functions” of this product.

Always read the precautions, etc. before starting use.

5.1 ALARMS	125
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5.3 MAINTENANCE AND INSPECTION	131

5.1 ALARMS

If any fault has occurred with the inverter, the corresponding protective function is activated to bring the inverter to an alarm stop and automatically give the corresponding alarm indication on the PU display and inverter LED. When the protective function is activated, reset the inverter in accordance with page 115.



5.1.1 Alarms

Display		Description	Alarm Output (Across B - C)
Parameter unit	Inverter LED		
OC During Acc	<i>E.OC1</i>	If the inverter output current reaches or exceeds 200% of the rated current, the protective circuit is activated to stop the inverter. When any main circuit device is overheated or a ground fault occurs, the protective circuit is also activated to stop the inverter output.	Provided (Open)
Stedy Spd Oc	<i>E.OC2</i>		
OC During Dec	<i>E.OC3</i>		
Ov During Acc	<i>E.OV1</i>	If the converter output voltage is excessive due to the regenerative energy from the motor, the protective circuit is activated to stop the transistor output. This may also be activated by a surge voltage generated in the power supply system.	Provided (Open)
Stedy Spd Ov	<i>E.OV2</i>		
Ov During Dec	<i>E.OV3</i>		
Motor Overload	<i>E.FHN</i> (Motor protection)	The electronic overcurrent protection in the inverter detects inverter overload or motor overheat and activates the protective circuit to stop the inverter output. When a multi-pole motor or more than one motor is driven, for example, the motor(s) cannot be protected by the electronic overcurrent protection. Provide a thermal relay in the inverter output circuit. In this case, setting the electronic overcurrent protection value to 0A activates the inverter protection only. (Activated at a current 150% or more of the rated current.)	Provided (Open)
Inv. Overload	<i>E.FHF</i> (Inverter protection)		
Inst. Pwr. Loss	<i>E.IPF</i>	If an instantaneous power failure has occurred for longer than 15msec (this applies also to inverter input power shut-off), this function is activated to stop the inverter output to stop the inverter output. (If the power failure is within 15msec, the control circuit operates without fault. If the power failure persists for more than about 100msec, the protective circuit is reset.)	Provided (Open)
Under Voltage	<i>E.UVF</i>	If the inverter power supply voltage has reduced, the control circuit cannot operate properly, resulting in the decrease in motor torque and/or the increase in heat generation. To prevent this, if the power supply voltage reduces below about 150V (300V for the 400V class), this function stops the inverter output. When there is no jumper across P-P1, the undervoltage protective function is activated.	Provided (Open)
Br. Cct. Fault (Note)	<i>E.bE</i>	If the brake transistor fault has occurred due to extremely large regenerative brake duty, etc., this function detects that fault and stops the inverter output.	Provided (Open)
OH Fault	<i>E.OHF</i>	If the internally mounted temperature relay or the like in the motor has been switched on (relay contacts "open"), this function stops the inverter output and keeps it stopped.	Provided (Open)
PU Leave Out	<i>E.PUE</i>	Stops the inverter output if the parameter unit is disconnected. This protective function is only activated when "2" or "3" is set in Pr. 75 "PU stop key selection".	Provided (Open)

Note: Displayed only for the FR-V220E-5.5K or less and FR-V240E-5.5K or less.

Display		Description	Alarm Output (Across B - C)
Parameter unit	Inverter LED		
OL is shown during motor rotation. Still Prev STP is shown to indicate that motor speed is lower than low-speed detection setting.	<i>E.OLT</i>	When torque restriction is activated during operation and motor speed has become lower than Pr. 43 "low-speed detection", the output is stopped if load applied to the motor is higher than Pr. 89 "OLT level setting" for longer than 3 seconds.	Provided by OLT display (Open)
Option Fault	<i>E.OPF</i>	Stops the inverter output if the dedicated option used in the inverter results in setting error or connection (connector) fault.	Provided (Open)
Corrupt Memry	<i>E.PE</i>	Stops the output at occurrence of the device fault of E ² PROM which stores the function set values.	Provided (Open)
CPU Fault	<i>E.CPU</i>	If the arithmetic operation of the built-in CPU does not end within a predetermined period of time, the inverter self-determines it as an alarm and stops its output.	Provided (Open)
Overspeed occurrence	<i>E.OS</i>	Indicates that the motor speed has exceeded the set over-speed level.	Provided (Open)
Excessive speed deflection	<i>E.OSd</i>	Indicates that deflection between the speed setting and motor speed has exceeded the deflection level. This is also displayed when the current does not flow in the motor after the forward rotation (reverse rotation) command is turned on.	Provided (Open)
No encoder signal	<i>E.ECF</i>	The PLG pulse is not being input.	Provided (Open)
Excessive position error	<i>E.Od</i>	Indicates that the difference between the position command and position feedback has exceeded the reference.	Provided (Open)
No encoder A signal	<i>E.ECA</i>	The PLG pulse for the FR-VPA is not being input.	Provided (Open)

● **To know the operating status at the occurrence of alarm**

When any alarm has occurred, the display automatically switches to the indication of the corresponding protective function. By pressing the [MONITOR] key at this point without resetting the inverter (see page 115), the display shows the speed. In this way, it is possible to know the running speed at the occurrence of the alarm. It is also possible to know the current in the same manner. These values are not stored in memory and are erased when the inverter is reset.

5.1.2 Correlation between Digital and Actual Characters

There are the following correspondences between the alphanumeric characters and actual characters given in the display examples of this manual.

Actual	Digital
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

Actual	Digital
A	A
B	b
C	C
D	d
E	E
F	F
G	G
H	H
I	I
J	J

Actual	Digital
L	L
M	M
N	n
O	O
P	P
T	T
U	U
V	V
r	r
-	-

5.1.3 Alarm History (History of alarm definitions)

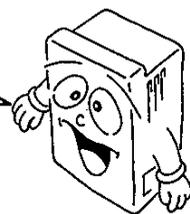
Up to eight most recent alarms (alarm definitions) are stored in memory. To check these, use the help function. For more information, see "5 ALARM HISTORY" on page 57.

5.1.4 Erasing the Alarm History (History of alarm definitions)

To erase the alarm history (history of alarm definitions), use the help function. For more information, see "6 ALARM HISTORY CLEAR" on page 57.

5.2 TROUBLESHOOTING

If any function of the inverter is lost due to occurrence of a fault, establish the cause and make correction in accordance with the following inspection procedure. Contact your sales representative if the corresponding fault is not found below, the inverter has failed, a part has been damaged, or any other fault has occurred.



5.2.1 Checking the Parameter Unit Display

The displays of the parameter unit and inverter LED are switched as follows to indicate the cause of a faulty operation.

Display		Cause of Fault	Check Point	Remedy
Parameter unit	Inverter LED			
OC During Acc	OC1: Overcurrent during acceleration	Overcurrent Main circuit device overheat	<ul style="list-style-type: none"> Acceleration too fast? Check for output short circuit or ground fault. Check for cooling fan stop. 	<ul style="list-style-type: none"> Increase acceleration time. Change fan. Remove obstacle to cooling fan. (Note 1)
Stedy Spd Oc	OC2: Overcurrent during constant speed		<ul style="list-style-type: none"> Sudden load change? Check for output short circuit or ground fault. Check for cooling fan stop. 	<ul style="list-style-type: none"> Keep load stable. Change fan. Remove obstacle to cooling fan. (Note 1)
OC During Dec	OC3: Overcurrent during deceleration		<ul style="list-style-type: none"> Deceleration too fast? Check for output short circuit or ground fault. Check for cooling fan stop. Mechanical brake of motor operate too fast? 	<ul style="list-style-type: none"> Increase deceleration time. Change fan. Remove obstacle to cooling fan. (Note 1) Check brake operation.
Ov During Acc	OV1: Overvoltage during acceleration	Overvoltage on DC bus (terminals P (+) and N (-))	Acceleration too fast?	Increase acceleration time.
Stedy Spd Ov	OV2: Overvoltage during constant speed		Sudden load change?	Keep load stable.
Ov During Dec	OV3: Overvoltage during deceleration		Deceleration too fast?	<ul style="list-style-type: none"> Increase deceleration time. (Set deceleration time which matches load GD².) Reduce braking duty.
Motor Overload	THM: Overload alarm	Thermal relay for motor	Motor used under overload?	<ul style="list-style-type: none"> Reduce load. Increase motor and inverter capacities.
Inv. Overload	THT: Overload alarm	Thermal relay for inverter		
Inst. Pwr. Loss	IPF: Instantaneous power failure	Instantaneous power failure	Check the cause of instantaneous power failure.	
Under Voltage	UVT: Undervoltage	<ul style="list-style-type: none"> Drop of power supply voltage No jumper across terminals P (+)-P1. 	<ul style="list-style-type: none"> Large-capacity motor started? Check for jumper across terminals P (+)-P1. 	<ul style="list-style-type: none"> Check power system equipment such as power supply capacity. Install jumper if disconnected.
Br. Cct. Fault	BE: Brake transistor alarm	Brake transistor fault (only 5.5K or less)	Braking duty proper?	<ul style="list-style-type: none"> Reduce load GD². Reduce braking duty.
Overspeed occurrence	OS: Overspeed occurrence	The motor speed exceeded the set overspeed level.	Pr. 69 "number of PLG pulses" setting correct?	Set Pr. 69 "number of PLG pulses" value correctly.
OH Fault	OHT: External thermal relay operation	Temperature detector in motor operated.	Check motor for overheat.	Reduce load and frequency of operation.
Still Prev STP	OLT: Stall prevention	Stall prevention or current limit function activated too long.	Motor used under overload?	<ul style="list-style-type: none"> Reduce load. Increase motor and inverter capacities.
Option Fault	OPT: Inboard option connection alarm	Option and inverter connected improperly.	Check for loose connector.	Securely connect.
Corrupt Memry	PE: Parameter storage device alarm	Storage device (E ² PROM) faulty.	Number of parameter write times too many?	Change inverter.
Excessive speed deflection	OSD: Excessive speed deflection	The deflection between the speed setting and motor speed exceeded the deflection level.	<ul style="list-style-type: none"> Is the load too large? Pr. 69 "number of PLG pulses" setting correct? 	<ul style="list-style-type: none"> Lighten the load. Set Pr. 69 "number of PLG pulses" value correctly.
PU Leave Out	PUE: PU disconnected	PU disconnected from connector.	Check for loose PU fitting.	Fit PU securely.
CPU Fault (Note 2)	CPU: CPU error	Internal CPU malfunction	Check for loose connector.	Change inverter.

Note: 1. This alarm does not occur due to the cooling fan stop, but it will occur to prevent the main circuit devices from overheating due to the cooling fan stop.

2. If a CPU alarm has occurred, other alarms cannot be detected.

*1: The parameter unit display remains unchanged but operation may be performed in the external operation mode.

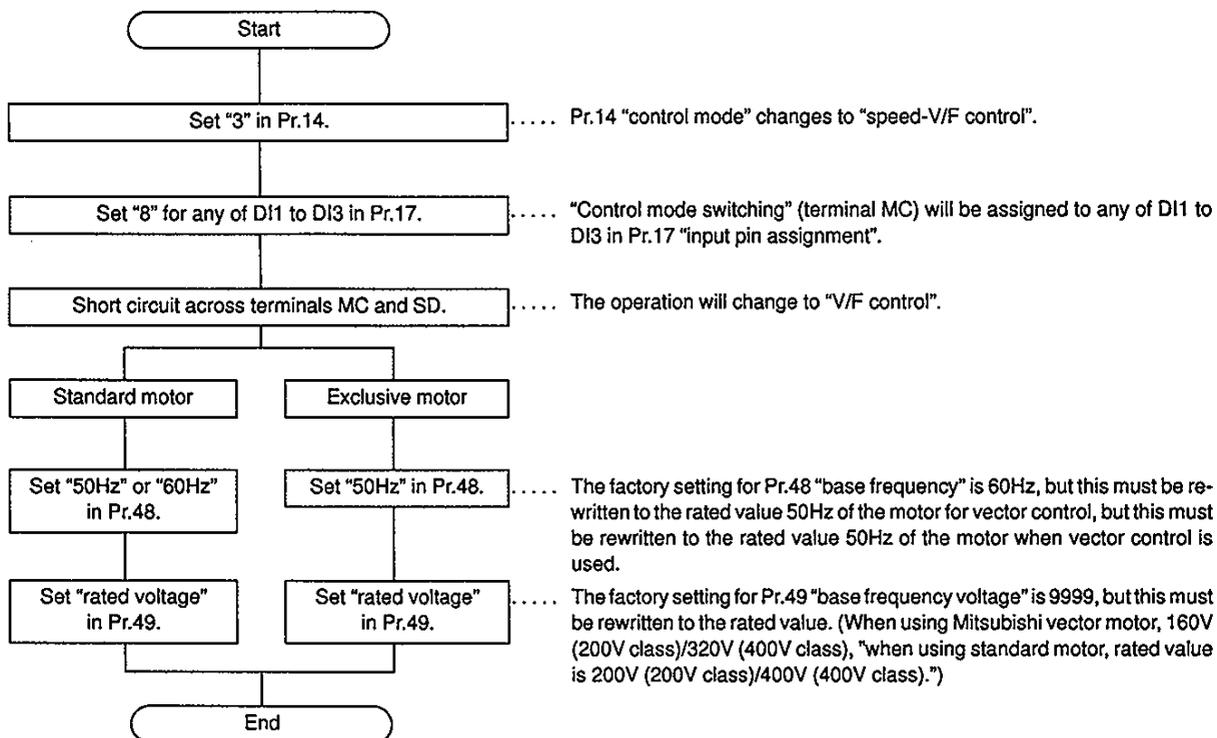
*2: When the protective function is activated, remove the cause, then reset the inverter, and resume operation.

*3: If the alarm is kept displayed on the parameter unit and unit LED after remedy, the internal circuit may be faulty. Consult your sales representative.

Display		Cause of Fault	Check Point	Remedy
Parameter unit	Inverter LED			
No encoder signal	ECT: No encoder signal	The PLG pulse is not being input.	<ul style="list-style-type: none"> • Check for loose connector. • Check for wire breakage in cable. 	<ul style="list-style-type: none"> • Securely connect. • Replace cable.
PU to Inverter comms. Error Inv. Reset ON	0.00 (LED display proper)	<ul style="list-style-type: none"> • Reset signal ON • Loose connection between PU and inverter • Communication circuit fault 	<ul style="list-style-type: none"> • Check for miswiring to reset terminal. • Check for loose connector. 	<ul style="list-style-type: none"> • Turn the reset signal off. • Securely connect. • Change inverter.
Excessive position error	OD: Position error large	Difference between position command and position feedback exceeded detection level.	<ul style="list-style-type: none"> • Check that the installation direction of the encoder for position detection and parameters match. • Is the load too large? • Pr. 69 "number of PLG pulses" setting correct? 	<ul style="list-style-type: none"> • Check the parameters. • Lighten the load. • Set Pr. 69 "number of PLG pulses" value correctly.
No encoder A signal	ECA: No encoder signal	The PLG pulse for the FR-VPA is not being input.	<ul style="list-style-type: none"> • FR-VPA connected properly? • Check for loose connector. • Check for wire breakage in cable. • Check for detector fault. 	<ul style="list-style-type: none"> • Securely connect. • Replace cable. • Replace the detector.

5.2.2 Temporary Measures for PLG Fault

Vector control may be disabled and the motor may not rotate when a PLG fault occurs. In this case, V/F control operation can be used to rotate the motor as a temporary measure until the PLG is replaced with a good one.



V/F control operation is possible with the above settings.

Note: During V/F control operation, torque control and position control will be disabled. Also, the current limit (torque restriction) function and automatic restart after instantaneous power failure are invalid.

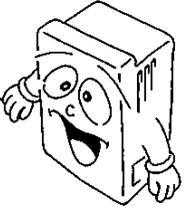
5.2.3 Faults and Check Points

Fault	Typical Check Point
Motor does not rotate.	(1) Checking the main circuit <ul style="list-style-type: none"> ● Check that a proper power supply voltage is applied (inverter LED display is lit). ● Check that the motor is connected properly. (2) Checking the input signals <ul style="list-style-type: none"> ● Check that the start signal is present. ● Check that both the forward and reverse rotation start signals are not present simultaneously. ● Check that the speed setting signal is not zero. ● Check that the output stop signal (across terminals DI and SD) or reset signal (across RES and SD) is not on. (3) Checking the parameter set values <ul style="list-style-type: none"> ● Check that the reverse rotation prevention (Pr.78) is not set. ● Check that the operation mode (Pr.79) setting is correct. ● Check that the bias and gain (Pr.902 to Pr.905) settings are correct. ● Check that various operational functions (such as three-speed operation), especially the maximum frequency, are not zero. (4) Checking the load <ul style="list-style-type: none"> ● Check that the load is not too heavy and the shaft is not locked. (5) Others <ul style="list-style-type: none"> ● Check that the inverter LED display (alarm such as E.OC1) is not lit.
Motor does not operate properly.	<ul style="list-style-type: none"> ● Check that the PLG wiring is connected properly. ● Check that the PLG signal is input properly.
Motor rotates in opposite direction.	<ul style="list-style-type: none"> ● Check that the start signals (forward rotation, reverse rotation) are connected properly. ● Check that the phase sequences of the output terminals U, V, W and PLG signal (phases A, B) are correct.
Speed greatly differs from the set value.	<ul style="list-style-type: none"> ● Check that the speed setting signal is proper. (Measure the input signal level.) ● Check that the following parameter settings are proper: Maximum setting (Pr.1), minimum setting (Pr.2), bias, gain (Pr.902 to Pr.905). ● Check that the input signal lines are not affected by external noise. (Use of shielded cables)
Acceleration/deceleration is not smooth.	<ul style="list-style-type: none"> ● Check that the acceleration/deceleration time set value is not too short. ● Check that the load is not too heavy.
Motor current is large.	<ul style="list-style-type: none"> ● Check that the load is not too heavy.
Speed does not increase.	<ul style="list-style-type: none"> ● Check that the maximum frequency set value is proper, i.e. it is not too small. ● Check that the load is not too heavy.
Speed varies during operation.	(1) Inspection of load <ul style="list-style-type: none"> ● Check that the load is not varying. (2) Inspection of input signal <ul style="list-style-type: none"> ● Check that the speed setting signal is not varying.
PU to Inverter comms. Error Inv. Reset ON	<ul style="list-style-type: none"> ● Check that the reset signal (across terminals RES and SD) is not ON. ● Check that the parameter unit is connected to the connector correctly.
Motor current is unbalanced.	<ul style="list-style-type: none"> ● Check that there are no open phases.

Note: Pr. indicates a parameter.

5.3 MAINTENANCE AND INSPECTION

The transistorized inverter is a static unit consisting mainly of semiconductor devices. Daily inspection must be performed to prevent any fault from occurring due to adverse influence by the installation environment, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.



5.3.1 Precautions for Maintenance and Inspection

For some short time after the power is switched off, the smoothing capacitor remains at a high voltage. Before accessing the inverter for inspection, make sure that the charge lamp is off and check that the voltage across the main circuit terminals P (+) and N (-) of the inverter is 30VDC or less using a tester, etc. (For the location of the charge lamp, see the terminal block arrangement on page 155.)

5.3.2 Check Items

(1) Daily inspection

- Check the following:
 - (1) Motor operation fault
 - (2) Improper installation environment
 - (3) Cooling system fault
 - (4) Unusual vibration and noise
 - (5) Unusual overheat and discoloration
- During operation, check the inverter input voltage using a tester.

(2) Periodic maintenance and inspection

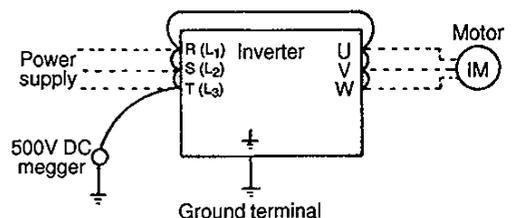
- Check the areas inaccessible during operation and requiring period inspection.
 - (1) Cooling system: Clean the air filter, etc.
 - (2) Screws and bolts: Check that they are securely tightened and retighten as necessary.
 - (3) Conductors and insulating materials: Check for corrosion and damage.
 - (4) Insulation resistance: Measure.
 - (5) Cooling fan, smoothing capacitor, relay: Check and change if necessary.

Note: Have a proper understanding of the definitions of power and alarm indications provided for the vector inverter. Also, have a proper understanding of the settings of multi-speed setting, acceleration/deceleration time, etc. and record proper set values. (Enter the values into the Customer Set Value section of the "Parameter List" on page 60.)

See the next page for the Inspection List.

(3) Insulation resistance test using megger

- (1) Before performing the insulation resistance test using a megger on the external circuit, disconnect the cables from all terminals of the inverter so that the test voltage is not applied to the inverter.
- (2) For the continuity test of the control circuit, use a tester (high resistance range) and do not use the megger or buzzer.
- (3) For the inverter, conduct the insulation resistance test on the main circuit only as shown on the right and do not perform the test on the control circuit. (Use a 500VDC megger.)



Daily and Periodic Inspection

Area of Inspection	Inspection Item	Description	Interval			Method	Criterion	Instrument
			Daily	Periodic				
				1 year	2 years			
General	Surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			See note on page 9.	Ambient temperature: -10°C to +50°C (14°F to 122°F), non-freezing. Ambient humidity: 90% or less, non-condensing.	Thermometer, hygrometer, recorder
	Overall unit	Check for unusual vibration and noise.	○			Visual and auditory checks.	No fault.	
	Power supply voltage	Check that main circuit voltage is normal.	○			Measure voltage across inverter terminals R (L ₁) and S (L ₂) and T (L ₃).	170 to 242V (323 to 506V) 50Hz 170 to 253V (323 to 506V) 60Hz	Tester, digital multimeter
Main circuit	General	(1) Check with megger (across main circuit terminals and ground terminal). (2) Check for loose screws and bolts. (3) Check for overheat on each part. (4) Clean.		○	○	(1) Disconnect all cables from inverter and measure across terminals R (L ₁), S (L ₂), T (L ₃), U, V, W and ground terminal with megger. (2) Retighten. (3) Visual check.	(1) 5MΩ or more. (2), (3) No fault.	500VDC class megger
	Conductors, cables	(1) Check conductors for distortion. (2) Check cable sheaths for breakage.		○		(1), (2) Visual check.	(1), (2) No fault.	
	Terminal block	Check for damage.		○		Visual check	No fault	
	Inverter module Converter module	Check resistance across terminals.			○	Disconnect cables from inverter and measure across terminals R (L ₁), S (L ₂), T (L ₃)-P (+), N (-), and across U, V, W-P (+), N (-) with tester × 1Ω range.	(See the next page.)	Analog tester
	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulge. (3) Measure electrostatic capacity.	○	○		(1), (2) Visual check. (3) Measure with capacity meter.	(1), (2) No fault. (3) 85% or more of rated capacity.	Capacity meter
	Relay	(1) Check for chatter during operation. (2) Check for rough surface on contacts.		○		(1) Auditory check. (2) Visual check.	(1) No fault. (2) No fault.	
	Resistor	(1) Check for crack in resistor insulation. (2) Check for open cable.		○		(1) Visual check. Cement resistor, wire-wound resistor. (2) Disconnect one end and measure with tester.	(1) No fault. (2) Error should be within ± 10% of indicated resistance value.	Tester, digital multimeter
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently. (2) Perform sequence protective operation test to make sure of no fault in protective and display circuits.		○		(1) Measure voltage across inverter output terminals U and V and W. (2) Simulatively connect or disconnect inverter protective circuit output terminals.	(1) Phase-to-phase voltage balance within 4V (8V) for 200V (400V). (2) Fault must occur because of sequence.	Digital multimeter, rectifier type voltmeter
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose connection.	○			(1) Turn by hand with power off. (2) Retighten.	(1) Smooth rotation. (2) No fault.	
Display	Display	(1) Check for LED lamp blown. (2) Clean.	○			(1) Lamps indicate indicator lamps on panel. (2) Clean with rag.	(1) Check that lamps are lit.	
	Meter	Check that reading is normal.	○			Check reading of meters on panel.	Must satisfy specified and management values.	Voltmeter, ammeter, etc.
Motor	General	(1) Check for unusual vibration and noise. (2) Check for unusual odor.	○	○		(1) Auditory, sensory, visual checks. (2) Check for unusual odor due to overheat, damage, etc.	(1), (2) No fault.	
	Insulation resistance	Check with megger (across terminals and ground terminal).			○	Disconnect cables from U, V, W, including motor cables.	5MΩ or more.	500V megger

Note: The value for the 400V class is indicated in the parentheses.

* : Ask your sales representative for periodic inspection.

● **Checking the inverter and converter modules**

<Preparation>

- (1) Disconnect the external power supply cables (R (L₁), S (L₂), T (L₃)) and motor cables (U, V, W).
- (2) Prepare a tester. (Use 1Ω range.)

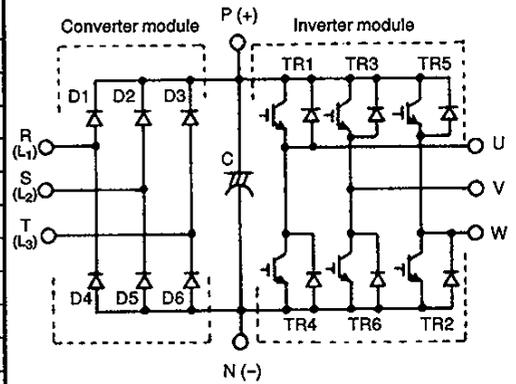
<Checking method>

Change the polarity of the tester alternately at the inverter terminals R (L₁), S (L₂), T (L₃), U, V, W, P (+) and N (-), and check for continuity.

Note: 1. Before measurement, check that the smoothing capacitor is discharged.
 2. At the time of discontinuity, the measured value indicated is a nearly infinite value. Due to the influence of the smoothing capacitor, continuity may be instantaneously established and infinite not indicated. At the time of continuity, the measured value is several to several ten ohms depending on the module type, tester type, etc. If all measured values are almost the same, the modules are without fault.

<Module device numbers and terminals to be checked>

		Tester Polarity		Measured Value			Tester Polarity		Measured Value
		⊕	⊖				⊕	⊖	
Converter module	D1	R (L ₁)	P (+)	Discontinuity	D4	R (L ₁)	N (-)	Continuity	
		P (+)	R (L ₁)	Continuity		N (-)	R (L ₁)	Discontinuity	
	D2	S (L ₂)	P (+)	Discontinuity	D5	S (L ₂)	N (-)	Continuity	
		P (+)	S (L ₂)	Continuity		N (-)	S (L ₂)	Discontinuity	
	D3	T (L ₃)	P (+)	Discontinuity	D6	T (L ₃)	N (-)	Continuity	
		P (+)	T (L ₃)	Continuity		N (-)	T (L ₃)	Discontinuity	
Inverter module	TR1	U	P (+)	Discontinuity	TR4	U	N (-)	Continuity	
		P (+)	U	Continuity		N (-)	U	Discontinuity	
	TR3	V	P (+)	Discontinuity	TR6	V	N (-)	Continuity	
		P (+)	V	Continuity		N (-)	V	Discontinuity	
	TR5	W	P (+)	Discontinuity	TR2	W	N (-)	Continuity	
		P (+)	W	Continuity		N (-)	W	Discontinuity	



5.3.3 Replacement of Parts

The inverter consists of many electronic parts such as semiconductor devices.

The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or failure of the inverter. For preventive maintenance, the parts must be changed periodically.

(1) Cooling fan

The cooling fan cools heat-generating parts such as the main circuit semiconductor devices. The life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be changed every 2 to 3 years if the inverter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must be changed immediately.

(2) Smoothing capacitors

A large-capacity aluminum electrolytic capacitor is used for smoothing the DC in the main circuit, and an aluminum electrolytic capacitor is also used for stabilizing the control power in the control circuit. Their characteristics are adversely affected by ripple current, etc. When the inverter is operated in ordinary, air-conditioned environment, change the capacitors about every 5 years.

When 5 years have elapsed, the capacitors will deteriorate more rapidly. Check the capacitors at least every year (less than six months if the life will be expired soon). Check the following:

- 1) Case (side faces and bottom face for expansion)
- 2) Sealing plate (for remarkable warp and extreme crack)
- 3) Explosion-proof valve (for excessive valve expansion and operation)
- 4) Appearance, external crack, discoloration, leakage.

When the measured capacitance of the capacitor has reduced below 85% of the rating, change the capacitor. For capacitance measurement, it is recommended to use a handy device available on the market.

(3) Relays

To prevent a contact fault, etc., relays must be changed according to the number of accumulative switching times (switching life). See the following table for the inverter parts replacement guide. Lamps and other short-life parts must also be changed during periodic inspection.

Replacement Parts of the Inverter

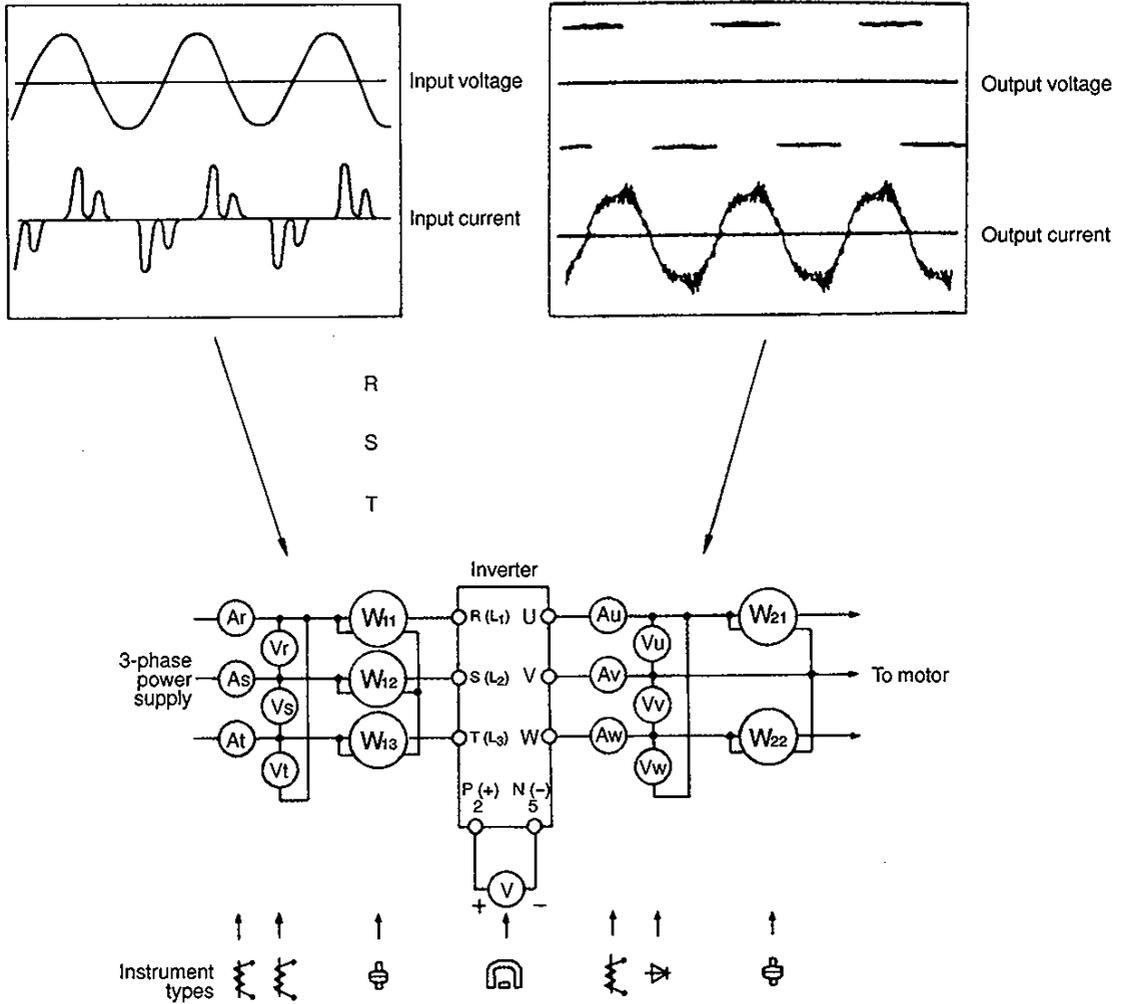
Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Change (as required)
Smoothing capacitor in main circuit	5 years	Change (as required)
Smoothing capacitor on control board	5 years	Change the board (as required).
Relays	—	Change as required.

5.3.4 Measurement of Main Circuit Voltages, Currents and Powers

- **Measurement of voltages and currents**

Since the voltages and currents on the inverter power supply and output sides include harmonics, accurate measurement depends on the instruments used and circuits measured.

When instruments for commercial speed are used for measurement, measure the following circuits using the instruments given on the next page.



Typical Measuring Points and Instruments

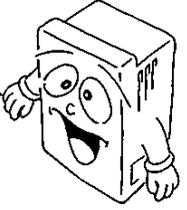
6. PRECAUTIONS FOR SELECTION

This chapter presents details on “precautions for selection” in using this product.
Always read the precautions, etc. before starting use.

6.1 PRECAUTIONS FOR SELECTING PERIPHERAL DEVICES	137
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6.1 PRECAUTIONS FOR SELECTING PERIPHERAL DEVICES

Trouble caused by noise and leakages are increasing with the widespread use of electronic devices. Due to its operation principle, the inverter generates noise, and may adversely affect neighboring devices. The following types of measures can be taken depending on the installation place, so refer to these when making your selection.



6.1.1 Measures Against Noises

Some noises enter the inverter to adversely affect it and others are radiated by the inverter to adversely affect peripheral devices. Though the inverter is designed to be immune to noises, it handles low-level signals, so it requires the following basic measures to be taken. Also, since the inverter chops output at high carrier frequency, it could generate noises. If these noises affect peripheral devices, measures should be taken to suppress noises. The measures differ slightly depending on noise propagation paths.

1) Basic measures

- Do not run the power cables (I/O cables) and signal cables of the inverter in parallel with each other and do not bundle them.
- Use twisted shield cables for the detector connecting and control signal cables and connect the sheathes of the shield cables to terminal SD.
- Ground the inverter, motor, etc. at one point.

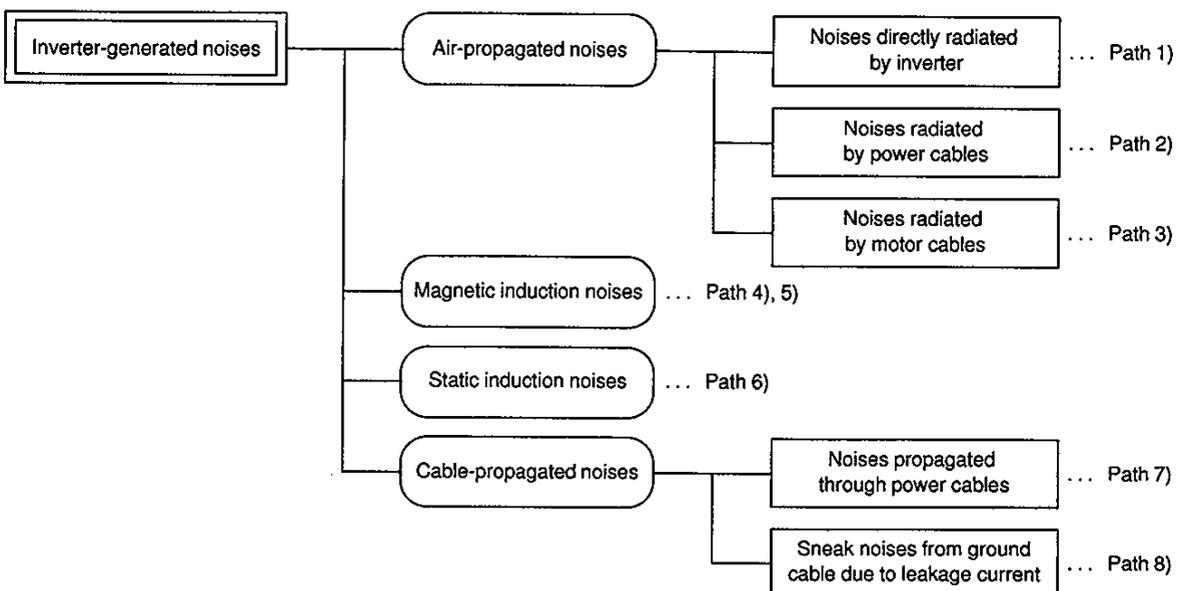
2) Measures against noises which enter and affect the inverter

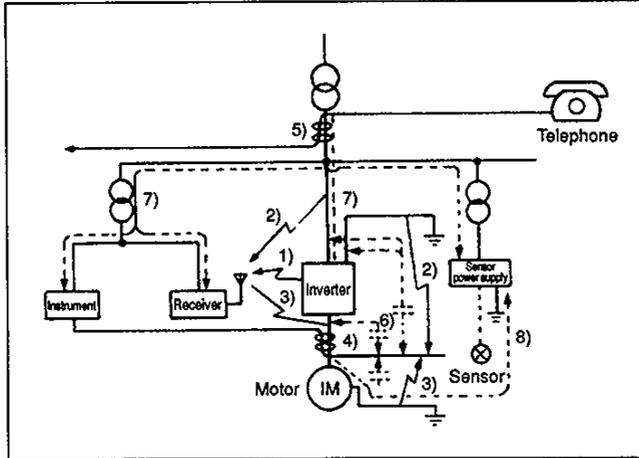
When devices which generate many noises (which use magnetic contactors, magnetic brakes, many relays, for example) are installed near the inverter and the inverter may be affected by noises, the following measures must be taken:

- Provide surge suppressors for devices that generate many noises to suppress noises.
- Fit data line filters to signal cables.
- Ground the shields of the detector connection and control signal cables with a metal cable clamp.

3) Measures against noises which are radiated by the inverter to affect peripheral devices

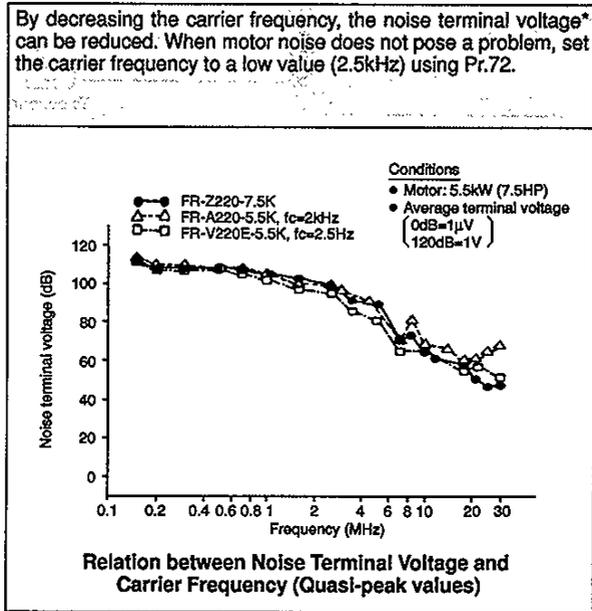
Inverter-generated noises are largely classified into those radiated by the cables connected to the inverter and inverter main circuit (I/O), those electromagnetically and electrostatically inducted to the signal cables of the peripheral devices close to the main circuit power supply, and those transmitted through the power supply cables.



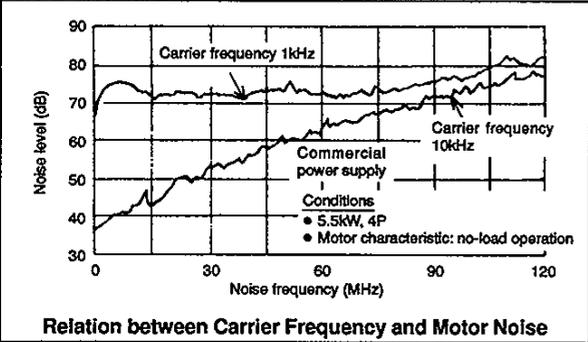


Noise Path	Measures
1), 2), 3)	<p>When devices which handle low-level signals and are susceptible to noises (such as instruments, receivers and sensors) are installed near the inverter and their signal cables are contained in the same panel as the inverter or are run near the inverter, the devices may be affected by air-propagated noises and the following measures must be taken:</p> <ol style="list-style-type: none"> (1) Install easily affected devices as away as possible from the inverter. (2) Run easily affected signal cables as away as possible from the inverter. (3) Do not run the signal cables and power cables in parallel with each other and do not bundle them. (4) Insert line noise filters into I/O and radio noise filters into input to suppress cable-radiated noises. (5) Use shield cables for signal cables and power cables and run them in individual metal conduits to produce further effects.
4), 5), 6)	<p>When the signal cables are run in parallel with or bundled with the power cables, magnetic and static induction noises may be propagated to the signal cables to affect the devices and the following measures must be taken:</p> <ol style="list-style-type: none"> (1) Install easily affected devices as away as possible from the inverter. (2) Run easily affected signal cables as away as possible from the inverter. (3) Do not run the signal cables and power cables in parallel with each other and do not bundle them. (4) Use shield cables for signal cables and power cables and run them in individual metal conduits to produce further effects.
7)	<p>When the power supplies of the peripheral devices are connected to the power supply of the inverter in the same line, inverter-generated noises may flow back through the power supply cables to the devices and the following measures must be taken:</p> <ol style="list-style-type: none"> (1) Install the radio noise filter (FR-BIF) to the power cables (input cables) of the inverter. (2) Install the line noise filter (FR-BLF, FR-BSF01) to the power cables (I/O cables) of the inverter.
8)	<p>When a closed loop circuit is formed by connecting the peripheral device wiring to the inverter, leakage current may flow through the ground cable of the inverter to affect the device. In such a case, disconnection of the ground cable of the device may cause the device to operate properly.</p>

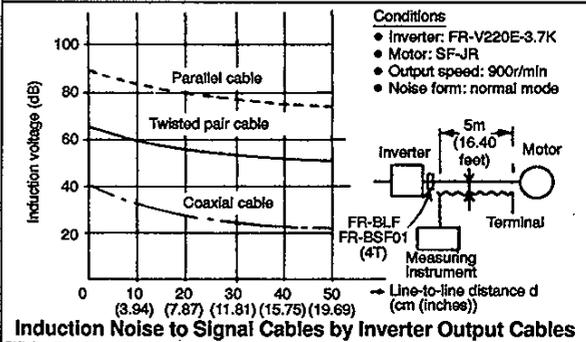
● Data example



By increasing the carrier frequency of the inverter, motor noise reduces. Since the sound generated by the motor with PLG reduces at low speed, the motor can be run more silently by the inverter than by commercial power supply.

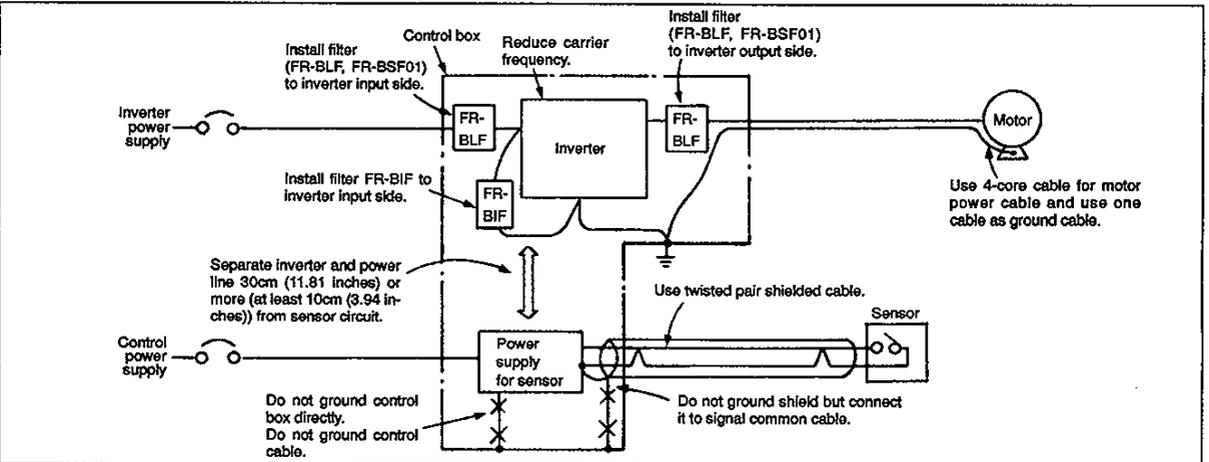


By using shield cables for signal cables, induction noise can be reduced greatly (to 1/10 - 1/100). Induction noise can also be reduced by separating the signal cables from the inverter output cables. (Separation of 30cm (11.81 inches) reduces noise to 1/2-1/3.) By fitting the FR-BSF01 or BLF on the inverter output side, induction noise to the signal cables can be reduced.



* Noise terminal voltage: Represents the magnitude of noise propagated from the inverter to the power supply.

● Example of measures against noises



6.1.2 Leakage Current

Because of static capacitances existing in the inverter I/O wiring and motor, leakage current flows through them. Since its value depends on the static capacitances, carrier frequency, etc., leakage current increases when the low-noise type inverter is used. In this case, take the following measures.

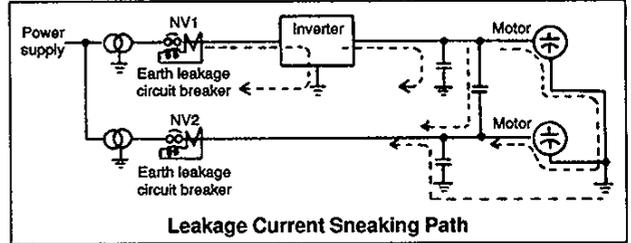
1) To-ground leakage current

Leakage current may flow into not only the inverter's own line but also the other line through the ground cable, etc.

This leakage current may operate earth leakage circuit breakers and earth leakage relays unnecessarily.

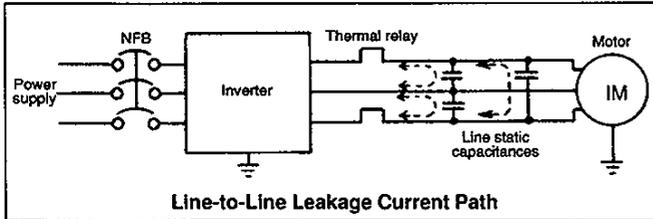
• Countermeasures

- Decrease the carrier frequency (Pr.72) of the inverter. Note that motor noise increases.
- By using earth leakage circuit breakers compatible with harmonics and surges (e.g. Mitsubishi's New Super NV series) in the inverter's own line and other line, operation can be performed with low noise (with the carrier frequency kept high).
- * For information on selecting the earth leakage circuit breaker, refer to the peripheral device list (page 145).



2) Line-to-line leakage current

Harmonics of the leakage current flowing in the static capacitances between the inverter output cables may operate the external thermal relay unnecessarily. When the wiring length of a 400V class small-capacity model (especially 7.5kW (10HP) or less) is long (50m (164.04 feet) or more), the external thermal relay is liable to operate unnecessarily because the ratio of the leakage current to the rated motor current increases.



• Line-to-line leakage current data example (200V class)

Motor Capacity [kW (HP)]	Rated Motor Current (A)	Leakage Current (mA)	
		Wiring length 50m (164.04 feet)	Wiring length 100m (3280. feet)
5.5 (7.5)	27.7	490	680
7.5 (10)	36.3	535	725

- Motor SF-VR 4P
- Carrier frequency: 10kHz
- Cable used: 2mm², 4-core cabtyre cable

* The leakage current of the 400V class is twice larger.

• Countermeasures

- Use the electronic overcurrent protection of the inverter.
- Decrease the carrier frequency. Note that motor noise increases.

To protect the motor securely from the line-to-line leakage current, it is recommended to use a temperature sensor to directly detect the temperature of the motor.

6.1.3 Selecting the Rated Sensitivity Current for the Earth Leakage Circuit Breaker

When using the earth leakage circuit breaker with the inverter circuit, select its rated sensitivity current as follows:

- Progressive Super Series (Type SP, CP)
Rated sensitivity current: $I\Delta n \geq 10 \times (I_{g1} + I_{g2} + I_{gm})$
- Conventional NV series (Type CA, CS, SS)
Rated sensitivity current:

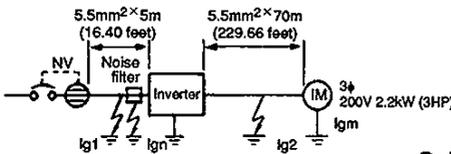
$$I\Delta n \geq 10 \times \{I_{g1} + I_{gn} + 3 \times (I_{g2} + I_{gm})\}$$

where, I_{g1} , I_{g2} : leakage currents of cable path during commercial power supply operation

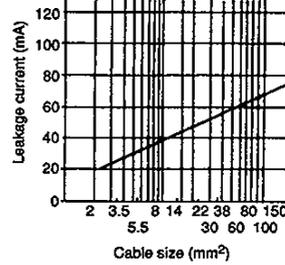
I_{gn}^* : leakage current of noise filter on inverter input side

I_{gm} : leakage current of motor during commercial power supply operation

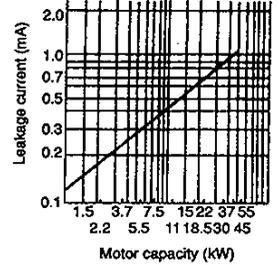
<Example>



Leakage Current Example of Cable Path during Commercial Power Supply Operation When the CV Cable Is Routed in Metal Conduit (200V 60Hz)



Leakage Current Example of 3-Phase Induction Motor during Commercial Power Supply Operation (200V 60Hz)



Selection Example (for the diagram shown on the left) (mA)

	Progressive Super Series (Type SP, CP)	Conventional NV (Type CA, CS, SS)
Leakage current I_{g1}	$33 \times \frac{5m(16.40\text{feet})}{1000m(3280.80\text{feet})} = 0.17$	
Leakage current I_{gn}	0 (without noise filter)	
Leakage current I_{g2}	$33 \times \frac{70m(229.66\text{feet})}{1000m(3280.80\text{feet})} = 2.31$	
Motor leakage current I_{gm}		0.18
Total leakage current	2.66	7.64
Rated sensitivity current ($\geq I_g \times 10$)	30	100

Note: 1. The NV should be installed to the primary (power supply) side of the inverter.

2. Ground fault in the secondary side of the inverter can be detected at the running frequency of 120Hz or lower.

3. In the Y connection neutral point grounded system, the sensitivity current is purified against ground fault in the inverter secondary side. Hence, the protective ground resistance of the load equipment should be 10Ω or less.

4. When the breaker is grounded on the secondary side of the inverter,

it may be unnecessarily operated by harmonics if the effective value is less than the rating. In this case, note that the eddy current and hysteresis loss increase and temperature rises.

* For the leakage current value of the noise filter installed on the inverter input side, contact the corresponding filter manufacturer.

(For Mitsubishi's dedicated filters, see page 171.)

6.1.4 Power Supply Harmonics

Power supply harmonics may be generated from the converter section of the inverter, affecting the generator, power capacitor, etc. Power supply harmonics are different in generation source, frequency band and transmission path from noises and leakage currents. Take the following measures.

- The differences between harmonics and noises are indicated below:

Item	Harmonics	Noises
Frequency	Normally 40 to 50%, 3kHz or less	High frequency (several 10kHz to MHz order)
Environment	To wire paths, power impedance	To spaces, distance, laying paths
Quantitative understanding	Logical computation is possible	Occurs randomly, quantitative understanding is difficult.
Generated amount	Approximately proportional to load capacity	According to current fluctuation rate (larger with higher speed switching)
Immunity of affected device	Specified in standards for each device.	Differs according to maker's device specifications.
Examples of measures	Install a reactor (L).	Increase the length (ℓ).

• Countermeasures

The harmonic current generated from the inverter to the power supply side differs according to various conditions such as the control method (PWM, PAM), use of power-factor improving reactor, output frequency on load side, and output current size.

The adequate method is to obtain the output frequency and output current under the conditions of the rated load at the maximum operating frequency.

Note: The power factor improving capacitor and surge suppressor on the inverter's output side may be damaged due to overheating caused by the harmonics of the inverter output. Also, when an overcurrent flows in the inverter, the overcurrent protection is activated. Hence, when the motor is driven by the inverter, do not install the capacitor or surge suppressor on the inverter's output side. To improve the power factor, insert the power factor improving reactor in the inverter's primary side or DC circuit. (The reactor cannot be inserted in the DC circuits of the 1.5K and 2.2K.)

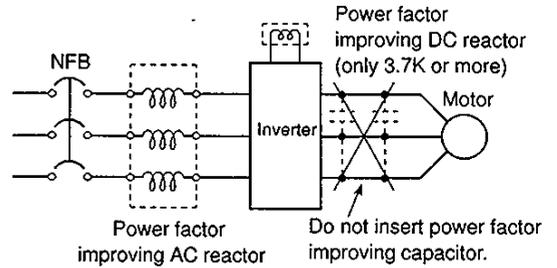


Fig. 5.2 Inverter Power Factor Improvement

6.1.5 Power harmonic guidelines

Harmonic currents generated by the inverter flow to a power receiving point via a power transformer. Since these outgoing harmonic currents affect other consumers, power harmonic suppression guidelines were established.

1) "Household appliance and general-purpose product guideline"

200V class inverters of 3.7kW and less are covered by this guideline. Install a power factor improving reactor to comply with this guideline.

2) "Specific consumer guideline"

This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or specially high-voltage consumer who will install, add or renew harmonic generating equipment. If any of the maximum values is exceeded, this guideline requires that the consumer takes certain suppression measures.

Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW Contract Power

Received Power Voltage	5th	7th	11th	13th	17th	19th	23rd	Over 23rd
6.6kV	3.5	2.5	1.6	1.3	1.0	0.9	0.76	0.70
22kV	1.8	1.3	0.82	0.69	0.53	0.47	0.39	0.36
33kV	1.2	0.86	0.55	0.46	0.35	0.32	0.26	0.24

(1) Application of the specific consumer guideline

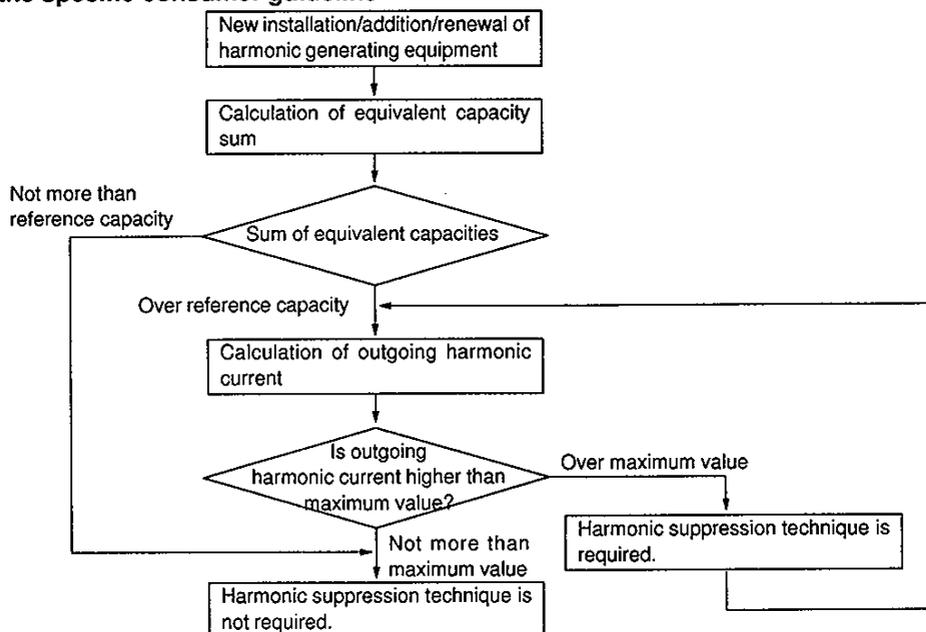


Table 2 Conversion Factors for FREQROL-V200E Series

Classification	Circuit Type		Conversion Factor
3	Three-phase bridge (capacitor smoothing)	Without reactor	K31=3.4
		With reactor (AC side)	K32=1.8
		With reactor (DC side)	K33=1.8
		With reactor (AC/DC side)	K34=1.4
5	Self-exciting three-phase bridge	When high power factor converter is used	K5=0

Table 3 Equivalent Capacity Limits

Received Power Voltage	Reference Capacity
6.6kV	50kVA
22/33kV	300kVA
66kV or more	2000kVA

Table 4 Harmonic Content (Values at the fundamental current of 100%)

Reactor	5th	7th	11th	13th	17th	19th	23rd	25th
Not used	65	41	8.5	7.7	4.3	3.1	2.6	1.8
Used (AC side)	38	14.5	7.4	3.4	3.2	1.9	1.7	1.3
Used (DC side)	30	13	8.4	5.0	4.7	3.2	3.0	2.2
Used (AC, DC sides)	28	9.1	7.2	4.1	3.2	2.4	1.6	1.4

1) Calculation of equivalent capacity P0 of harmonic generating equipment

The "equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of a consumer's harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated in the following procedure:

$$P0 = \sum (Ki \times Pi) \text{ [kVA]}$$

Ki: Conversion factor (refer to Table 2)

Pi: Rated capacity of harmonic generating equipment* [kVA]

i: Number indicating the conversion circuit type

* Rated capacity: Determined by the capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

2) Calculation of outgoing harmonic current

$$\text{Outgoing harmonic current} = \frac{\text{fundamental wave current (value converted from received power voltage)} \times \text{operation ratio} \times \text{harmonic content}}{\text{operation ratio}}$$

- Operation ratio: = actual load factor × operation time ratio during 30 minutes
- Operation ratio
- Harmonic content: Found in Table 4.

Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive

Applied Motor (kW)	Rated Current [A]		Fundamental Wave Current Converted from 6.6kV (mA)	Rated Capacity (kVA)	Fundamental Wave Current Converted from 6.6kV (mA) (No reactor, 100% operation ratio)							
	200V	400V			5th	7th	11th	13th	17th	19th	23rd	25th
0.4	Not applied	0.81	49	0.57	31.85	20.09	4.165	3.773	2.107	1.519	1.274	0.882
0.75		1.37	83	0.97	53.95	34.03	7.055	6.391	3.569	2.573	2.158	1.494
1.5		2.75	167	1.95	108.6	68.47	14.20	12.86	7.181	5.177	4.342	3.006
2.2		3.96	240	2.81	156.0	98.40	20.40	18.48	10.32	7.440	6.240	4.320
3.7		6.50	394	4.61	257.1	161.5	33.49	30.34	16.94	12.21	10.24	7.092
5.5	19.1	9.55	579	6.77	376.1	237.4	49.22	44.58	24.90	17.95	15.05	10.42
7.5	25.6	12.8	776	9.07	504.4	318.2	65.96	59.75	33.37	24.06	20.18	13.97
11	36.9	18.5	1121	13.1	728.7	459.6	95.29	86.32	48.20	34.75	29.15	20.18
15	49.8	24.9	1509	17.6	980.9	618.7	128.3	116.2	64.89	46.78	39.24	27.16
18.5	61.4	30.7	1860	21.8	1209	762.6	158.1	143.2	79.98	57.66	48.36	33.48
22	73.1	36.6	2220	25.9	1443	910.2	188.7	170.9	95.46	68.82	57.72	39.96
30	98.0	49.0	2970	34.7	1931	1218	252.5	228.7	127.7	92.07	77.22	53.46
37	121	60.4	3660	42.8	2379	1501	311.1	281.8	157.4	113.5	95.16	65.88
45	147	73.5	4450	52.1	2893	1825	378.3	342.7	191.4	138.0	115.7	80.10
55	180	89.9	5450	63.7	3543	2235	463.3	419.7	234.4	169.0	141.7	98.10

3) Judgment of harmonic suppression technique requirement

If the outgoing harmonic current is higher than the maximum value per 1kW contract power × contract power, a harmonic suppression technique is required.

4) Harmonic suppression techniques

No.	Item	Description
1	Reactor installation (ACL, DCL)	Install a reactor (ACL) in the AC side of the inverter or a reactor (DCL) in its DC side or both to suppress harmonic currents.
2	High power factor converter (FR-HC)	The converter circuit is switched on-off to convert an input current waveform into a sine wave, suppressing harmonic currents substantially. The high power factor converter (FR-HC) is used with the standard accessory.
3	Installation of power factor improving capacitor	When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents.
4	Transformer multi-phase operation	Use two transformers with a phase angle difference of 30° as in Y-Δ, Δ-Δ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents.
5	AC filter	A capacitor and a reactor are used together to reduce impedance at specific frequencies, producing a great effect of absorbing harmonic currents.
6	Active filter	This filter detects the current of a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress a harmonic current at a detection point, providing a great effect of absorbing harmonic currents.

6.1.6 Peripheral Device List

Voltage	Motor Output (kW (HP))	Applicable Inverter Type	No-Fuse Breaker (NFB) or Earth Leakage Circuit Breaker (NV)		Magnetic Contactor (MC)	Cables (mm ²)	
			Standard	With power factor improving reactor		R (L ₁), S (L ₂), T (L ₃)	U, V, W
200V class	1.5 (2)	FR-V220E-1.5K	Type NF30, NV30 15A	Type NF30, NV30 15A	S-N10	2	2
	2.2 (3)	FR-V220E-2.2K	Type NF30, NV30 20A	Type NF30, NV30 15A	S-N11,N12	2	2
	3.7 (5)	FR-V220E-3.7K	Type NF30, NV30 30A	Type NF30, NV30 30A	S-N20	3.5	3.5
	5.5 (7.5)	FR-V220E-5.5K	Type NF50, NV50 50A	Type NF50, NV50 40A	S-N25	5.5	5.5
	7.5 (10)	FR-V220E-7.5K	Type NF100, NV100 60A	Type NF50, NV50 50A	S-N35	14	8
	11 (15)	FR-V220E-11K	Type NF100, NV100 75A	Type NF100, NV100 75A	S-K50	14	14
	15 (20)	FR-V220E-15K	Type NF225, NV225 125A	Type NF100, NV100 100A	S-K65	22	22
	18.5 (25)	FR-V220E-18.5K	Type NF225, NV225 150A	Type NF225, NV225 125A	S-K80	30	30
	22 (30)	FR-V220E-22K	Type NF225, NV225 175A	Type NF225, NV225 150A	S-K95	38	30
	30 (40)	FR-V220E-30K	Type NF225, NV225 225A	Type NF225, NV225 175A	S-K125	60	50
	37 (50)	FR-V220E-37K	Type NF400, NV400 250A	Type NF225, NV225 225A	S-K150	80	80
45 (60)	FR-V220E-45K	Type NF400, NV400 300A	Type NF400, NV400 300A	S-K180	100	80	
400V class	1.5 (2)	FR-V240E-1.5K	Type NF30, NV30 10A	Type NF30, NV30 10A	S-N10	2	2
	2.2 (3)	FR-V240E-2.2K	Type NF30, NV30 15A	Type NF30, NV30 10A	S-N11,N12	2	2
	3.7 (5)	FR-V240E-3.7K	Type NF30, NV30 20A	Type NF30, NV30 15A	S-N20	2	2
	5.5 (7.5)	FR-V240E-5.5K	Type NF30, NV30 30A	Type NF30, NV30 20A	S-N20	3.5	2
	7.5 (10)	FR-V240E-7.5K	Type NF30, NV30 30A	Type NF30, NV30 30A	S-N20	3.5	3.5
	11 (15)	FR-V240E-11K	Type NF50, NV50 50A	Type NF50, NV50 40A	S-N20	5.5	5.5
	15 (20)	FR-V240E-15K	Type NF100, NV100 60A	Type NF50, NV50 50A	S-N25	14	8
	18.5 (25)	FR-V240E-18.5K	Type NF100, NV100 75A	Type NF100, NV100 60A	S-N35	14	8
	22 (30)	FR-V240E-22K	Type NF100, NV100 100A	Type NF100, NV100 75A	S-K50	22	14
	30 (40)	FR-V240E-30K	Type NF225, NV225 125A	Type NF100, NV100 100A	S-K65	22	22
	37 (50)	FR-V240E-37K	Type NF225, NV225 150A	Type NF225, NV225 125A	S-K80	30	22
45 (60)	FR-V240E-45K	Type NF225, NV225 175A	Type NF225, NV225 150A	S-K80	38	30	

7. SPECIFICATIONS

This chapter offers details on the “specifications” of this product.

Always read the precautions, etc. before starting use.

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7.1 SPECIFICATIONS

7.1.1 Standard Specifications

200V class (for use of the [SF-VR] vector inverter motor)

Motor type	SF-VR5K	SF-VR7K	SF-VR11K	SF-VR15K	SF-VR18K	SF-VR22K	SF-VR30K	SF-VR37K	SF-VR45K	
Rated output [kW (HP)]	5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)	
Rated torque [kg·m(lbs·feet)]	3.57 (27.12)	4.87 (35.22)	7.15 (51.72)	9.75 (70.52)	12.0 (86.80)	14.3 (103.43)	19.5 (141.04)	24.0 (173.59)	29.2 (211.20)	
	(N·m)	35.0	47.7	70.1	95.6	118	140	191	235	286
Maximum torque [kg·m(lbs·feet)]	5.35 (38.70)	7.31 (52.87)	10.7 (77.39)	14.6 (105.60)	18.0 (130.19)	21.5 (155.51)	29.3 (211.92)	36.0 (260.92)	43.8 (316.80)	
150% 60sec. (N·m)	52.4	71.6	105	143	176	211	287	353	429	
Rated speed (r/min)	1500									
Maximum speed (r/min)	3000									
Frame No.	132S	132M	160M	160L	180M	180M	200L	200L	200L	
GD ² (kg·m ²)	0.11	0.16	0.30	0.35	0.69	0.75	1.30	1.45	1.45	
Noise	75dB or less						80dB or less			
Cooling fan	Voltage	Single-phase 200V/50Hz Single-phase 200 to 230V/60Hz		Three-phase 200V/50Hz, three-phase 200 to 230V/60Hz						
	Input	34/28W (0.17/0.13A)			55/71W (0.39/0.39A)		100/156W (0.47/0.53A)			
Type	FR-V220E	5.5K	7.5K	11K	15K	18.5K	22K	30K	37K	45K
Rated capacity (kVA)	9.6	12.6	18.3	24.6	30.1	35.8	44.0	57.8	67.5	
Rated current (A)	27.7	36.3	52.7	71.0	87.0	103.5	126.5	166.8	192.0	
Overload current rating ¹⁾	150% 60 seconds, 200% 0.5 seconds (inverse-time characteristics)									
Voltage ²⁾	Three-phase, 200V to 220V 50Hz, 200 to 230V 60Hz									
Regenerative braking torque	Maximum value/time	100%/5 seconds								
	Permissible duty	2%ED								
		20% ³⁾								
		Continuous ³⁾								
Rated input AC voltage, frequency	Three-phase, 200V to 220V 50Hz, 200 to 230V 60Hz									
Permissible AC voltage fluctuation	170V to 242V 50Hz, 170 to 253V 60Hz									
Permissible frequency fluctuation	±5%									
Instantaneous voltage drop immunity	Operation continues at 165V or higher. If voltage drops from rated voltage to less than 165V, operation continues for 15msec.									
Power supply capacity (kVA) ⁴⁾	12	17	20	28	34	41	52	66	80	
Protective structure (JEM 1030)	Enclosed type (IP20)		Open type (IP00)							
Cooling system	Forced air cooling									
Approximate weight [kg (lbs)]	7.7 (3.49)	7.7 (3.49)	14.5 (6.58)	17 (7.71)	17 (7.71)	33 (14.97)	54 (24.49)	54 (24.49)	72 (32.66)	

400V class (for use of the [SF-VRH] vector inverter motor)

Motor type	SF-VR5K	SF-VR7K	SF-VR11K	SF-VR15K	SF-VR18K	SF-VR22K	SF-VR30K	SF-VR37K	SF-VR45K
Rated output [kW (HP)]	5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)
Rated torque [kg·m(lbs·feet)]	3.57 (27.12)	4.87 (35.22)	7.15 (51.72)	9.75 (70.52)	12.0 (86.80)	14.3 (103.43)	19.5 (141.04)	24.0 (173.59)	29.2 (211.20)
	(N·m)	35.0	47.7	70.1	95.6	118	140	191	235	286
Maximum torque [kg·m(lbs·feet)]	5.35 (38.70)	7.31 (52.87)	10.7 (77.39)	14.6 (105.60)	18.0 (130.19)	21.5 (155.51)	29.3 (211.92)	36.0 (260.39)	43.8 (316.80)
150% 60sec. (N·m)	52.4	71.6	105	143	176	211	287	353	429
Rated speed (r/min)	1500								
Maximum speed (r/min)	3000								
Frame No.	132S	132M	160M	160L	180M	180M	200L	200L	200L
GD ² (kg·m ²)	0.11	0.16	0.30	0.35	0.69	0.75	1.30	1.45	1.45
Noise	75dB or less						80dB or less		
Cooling fan	Voltage	Single-phase 200V/50Hz ⁵⁾ Single-phase 200 to 230V/60Hz		Three-phase 200V/50Hz, three-phase 200 to 230V/60Hz ⁵⁾					
	Input	34/28W (0.17/0.13A)			55/71W (0.39/0.39A)		100/156W (0.47/0.53A)		

Type		FR-V240E	5.5K	7.5K	11K	15K	18.5K	22K	30K	37K	45K
Output	Rated capacity (kVA)		9.6	12.6	18.3	24.6	30.1	35.8	44.0	57.8	67.5
	Rated current (A)		13.9	18.2	26.4	35.5	43.5	51.8	63.3	83.5	97.5
	Overload current rating ^{*1}		150% 60 seconds, 200% 0.5 seconds (inverse-time characteristics)								
	Voltage ^{*2}		Three-phase, 380V to 460V 50Hz/60Hz								
	Regenerative braking torque	Maximum value/time		100%/5 seconds	20% ^{*3}						
Permissible duty			2%ED	Continuous ^{*3}							
Power supply	Rated input AC voltage, frequency		Three-phase, 380V to 460V 50Hz/60Hz								
	Permissible AC voltage fluctuation		323V to 506V 50Hz/60Hz ^{*6}								
	Permissible frequency fluctuation		±5%								
	Instantaneous voltage drop immunity		Operation continues at 320V or higher. If voltage drops from rated voltage to less than 320V, operation continues for 15msec.								
Power supply capacity (kVA) ^{*4}		12	17	20	28	34	41	52	66	80	
Protective structure (JEM 1030)		Enclosed type (IP20)	Open type (IP00)								
Cooling system		Forced air cooling									
Approximate weight [kg (lbs)]		7.7 (3.49)	16 (7.26)	16 (7.26)	20 (9.07)	20 (9.07)	33 (14.97)	54 (24.49)	54 (24.49)	72 (32.66)	

■ 200V class (for use of the [SF-JR(4P)] motor with PLG)

Motor type		SF-JR	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW	11kW	15kW	18.5kW	22kW	30kW	37kW	45kW
Rated output [kW (HP)]			1.5 (2)	2.2 (3)	3.7 (5)	5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)
	Rated torque [kg·m(lbs·feet)]		0.81 (5.86)	1.19 (8.61)	2.0 (14.47)	2.98 (21.55)	4.06 (29.37)	5.96 (43.11)	8.12 (58.73)	10.0 (72.33)	11.9 (86.07)	16.2 (117.17)	20.0 (144.66)	24.4 (176.48)
Maximum torque [kg·m(lbs·feet)]			7.9	11.7	19.6	29.2	39.8	58.4	79.6	98	116	159	196	239
	150% 60sec. (N·m)		11.96	17.54	29.4	43.8	59.7	87.2	119.7	147	175	238	294	359
Rated speed (r/min)		1800												
Maximum speed (r/min)		3600				3000				1950				
Frame No.		90L	100L	112M	132S	132M	160M	160L	180M	180M	180L	180L	200L	200L
GD ² (kg·m ²)		0.027	0.032	0.065	0.11	0.16	0.28	0.40	0.69	0.83	1.1	1.5	1.8	
Noise		75dB or less										80dB or less		

Type		FR-V240E	1.5K	2.2K	3.7K	5.5K	7.5K	11K	15K	18.5K	22K	30K	37K	45K
Output	Rated capacity (kVA)		3.1	4.5	6.9	9.6	12.6	18.3	24.6	30.1	35.8	44.0	57.8	67.5
	Rated current (A)		9.0	13.0	20.0	27.7	36.3	52.7	71.0	87.0	103.5	126.5	166.8	192.0
	Overload current rating ^{*1}		150% 60 seconds, 200% 0.5 seconds (inverse-time characteristics)											
	Voltage ^{*2}		Three-phase, 200V to 220V 50Hz, 200 to 230V 60Hz											
	Regenerative braking torque	Maximum value/time		100%/5 seconds	100%/5 seconds	20% ^{*3}								
Permissible duty			3%ED	2%ED	Continuous ^{*3}									
Power supply	Rated input AC voltage, frequency		Three-phase, 200V to 220V 50Hz, 200 to 230V 60Hz											
	Permissible AC voltage fluctuation		170V to 242V 50Hz, 170 to 253V 60Hz											
	Permissible frequency fluctuation		±5%											
	Instantaneous voltage drop immunity		Operation continues at 165V or higher. If voltage drops from rated voltage to less than 165V, operation continues for 15msec.											
Power supply capacity (kVA) ^{*4}		4.5	5.5	9	12	17	20	28	34	41	52	66	80	
Protective structure (JEM 1030)		Enclosed type (IP20)						Open type (IP00)						
Cooling system		Forced air cooling												
Approximate weight [kg (lbs)]		3.7 (1.59)	3.7 (1.68)	7.5 (3.40)	7.7 (3.49)	7.7 (3.49)	14.5 (6.58)	17 (7.71)	17 (7.71)	33 (14.97)	54 (24.49)	54 (24.49)	72 (32.66)	

■ 400V class (for use of the [SF-JR(4P)] motor with PLG)

Motor type		SF-JR	1.5kW	2.2kW	3.7kW	5.5kW	7.5kW	11kW	15kW	18.5kW	22kW	30kW	37kW	45kW
Motor with PLG	Rated output [kW (HP)]		1.5 (2)	2.2 (3)	3.7 (5)	5.5 (7.5)	7.5 (10)	11 (15)	15 (20)	18.5 (25)	22 (30)	30 (40)	37 (50)	45 (60)
	Rated torque [kg·m(lbs·feet)]		0.81 (5.86)	1.19 (8.61)	2.0 (14.47)	2.98 (21.55)	4.06 (29.37)	5.96 (43.11)	8.12 (58.73)	10.0 (72.33)	11.9 (86.07)	16.2 (117.17)	20.0 (144.66)	24.4 (176.48)
		(N·m)	7.9	11.7	19.6	29.2	39.8	58.4	79.6	98	116	159	196	239
	Maximum torque [kg·m(lbs·feet)]		1.22 (8.82)	1.79 (12.95)	3.0 (21.70)	4.47 (32.33)	6.09 (44.05)	8.9 (64.37)	12.2 (88.24)	15.0 (108.49)	17.9 (129.47)	24.3 (175.76)	30.0 (216.99)	36.6 (264.72)
		(N·m)	11.96	17.54	29.4	43.8	59.7	87.2	119.7	147	175	238	294	359
	Rated speed (r/min)		1800											
	Maximum speed (r/min)		3600						3000				1950	
	Frame No.		90L	100L	112M	132S	132M	160M	160L	180M	180M	180L	200L	200L
	GD ² (kg·m ²)		0.027	0.032	0.065	0.11	0.16	0.28	0.40	0.69	0.83	1.1	1.5	1.8
	Noise		75dB or less											80dB or less
Type		FR-V240E	1.5K	2.2K	3.7K	5.5K	7.5K	11K	15K	18.5K	22K	30K	37K	45K
Output	Rated capacity (kVA)		3.1	4.5	6.9	9.6	12.6	18.3	24.6	30.1	35.8	44.0	57.8	67.5
	Rated current (A)		4.5	6.5	10.0	13.9	18.2	26.4	35.5	43.5	51.8	63.3	83.5	97.5
	Overload current rating ^{*1}		150% 60 seconds, 200% 0.5 seconds (inverse-time characteristics)											
	Voltage ^{*2}		Three-phase, 380V to 460V 50Hz/60Hz											
	Regenerative braking torque	Maximum value/time		100%/5 seconds						20% ^{*3}				
Permissible duty			2%ED						Continuous ^{*3}					
Power supply	Rated input AC voltage, frequency		Three-phase, 380V to 460V 50Hz/60Hz											
	Permissible AC voltage fluctuation		323V to 506V 50Hz/60Hz ^{*6}											
	Permissible frequency fluctuation		±5%											
	Instantaneous voltage drop immunity		Operation continues at 320V or higher. If voltage drops from rated voltage to less than 320V, operation continues for 15msec.											
	Power supply capacity (kVA) ^{*4}		4.5	5.5	9	12	17	20	28	34	41	52	66	80
Protective structure (JEM 1030)		Enclosed type (IP20)						Open type (IP00)						
Cooling system		Forced air cooling												
Approximate weight [kg (lbs)]		4.5 (2.04)	4.5 (2.04)	7.5 (3.40)	7.7 (3.49)	16 (7.26)	16 (7.26)	20 (9.07)	20 (9.07)	33 (14.97)	54 (24.49)	54 (24.49)	72 (32.66)	

- *1: The overload current rating % value indicates the percentage to the inverter's rated output current. For repeated use, it is necessary to wait until the inverter and motor return to less than the temperature under 100% load.
- *2: The max. output voltage cannot be higher than the power supply voltage. The max. output voltage can be set as desired below the power supply voltage.
- *3: Indicates the average torque when the motor is decelerated to a stop from 60Hz. This will change according to the motor loss.
- *4: The power supply capacity will change according to the value of the power supply side impedance (including input reactor and wiring).
- *5: The power supply of the fan is also 200V for the 400V class inverter.
- *6: If the power supply voltage fluctuation is 342V or less or 484V or more when using the 400V class inverter, the internal transformer's tap must be changed.
- *7: When the SF-JR motor with PLG is driven, the number of PLG pulses is 1024P/R.
- *8: The specifications of the motor with PLG are those of the SF-JR(4P) with PLG. For the other motors with PLG, refer to the corresponding motor catalogs.
- *9: The specifications of the inverters are the same independently of the motors.
- *10: When driving the motor with PLG (4P or 6P), perform auto tuning operation. When driving the motor with PLG (2P), run it at or less than its permissible speed. (Maximum speed is 3600 r/min.) However, auto tuning operation is not required for the SF-JR 1.5kW to 3.7kW (2 to 5 HP) (4P) motors with PLG as the motor constants are factory-set to these motors.

Common Specifications

Control specifications	Control system		High carrier frequency PWM control, full digital vector control		
	Speed control range		1 to 1500r/min (constant torque), 1500 to 3000r/min (constant output) (when vector inverter motor is used)		
	Speed setting resolution	Digital input	0.03% to the maximum setting (minimum setting in 1r/min increments)		
		Analog input	0.1% of the maximum set speed		
	Acceleration/deceleration time		0 to 3600 seconds (acceleration and deceleration can be set individually in 0.1 sec. increments)		
	Acceleration/deceleration pattern		Linear or S-pattern acceleration/deceleration mode can be selected.		
Torque limit level		Torque limit value can be set (0 to 200% variable)			
Input signals	Analog setting signals	Terminal number	Setting range	Speed control	Torque control
		2	0 to 10VDC (resolution 0.1%)	Main speed setting	Speed limit
		1	0 to ± 10VDC (resolution 0.2%)	Auxiliary speed setting	Speed limit compensation
		3	0 to ± 10VDC (resolution 0.2%)	Torque limit (regeneration/drive)	Torque command
		4	0 to 10VDC (resolution 0.1%)	Torque limit (regeneration only)	—
	6	0 to ± 10VDC (resolution 0.01%)	Main speed setting (At this time, terminals 1, 2 are invalid)	Torque command (At this time, terminal 3 is invalid)	
7	0 to ± 10VDC (resolution 0.05%)				
Contact signals	Fixed function terminal 4 points	Forward rotation command, reverse rotation command, alarm reset, thermal protector: total 4 points			
	Multi-function terminal 3 points	3 points can be selected with parameters from among multi-speed setting (max. 7 speeds), jogging operation selection ^{*1} , second function selection, pre-excitation, coasting terminal, running signal holding, S-pattern switching and control mode switching.			
Output signals	Contact signals		Alarm output, change-over contact (230V 0.3A AC, 30V 0.3A DC)		
	Open collector signals		3 points can be selected from among up-to-speed, overload detection, instantaneous power failure, undervoltage detection, inverter running, minor fault, torque detection, ready, low-speed signal or open motor circuit detection, speed detection and parameter unit operation signal.		
	Analog output		2 points can be selected from among speed, output current, output voltage, speed setting, output frequency, output torque, DC bus voltage and load meter.		
	Digital output (PLG output)		A-phase, B-phase, Z-phase (Division of A-phase and B-phase is possible) (when option FR-VPA, VPB, VPC, VPD is mounted) ^{*2}		
Operation functions		Upper/lower limit speed setting, external protection (thermal relay) input, forward/reverse rotation prevention, auto tuning function			
Display	Parameter unit		PU02V, various monitors (11 types: alarm, input/output terminal monitors in addition to the above analog outputs)		
	LED (7-segment)		7-segment, 4-character display (8 types of data can be selected)		
Protective functions		Overcurrent, output short circuit protection (acceleration, deceleration, constant speed), regenerative overvoltage, undervoltage, no signal, excessive speed deviation, overload (electronic thermal overload protection), brake transistor alarm ^{*3} , overspeed, motor overheat, etc.			
Environment	Ambient temperature		-10°C to +50°C (14°F to 122°F) (non-freezing)		
	Ambient humidity		90%RH or less (non-condensing)		
	Storage temperature ^{*4}		-20°C to +65°C (4°F to 149°F)		
	Ambience		Indoors. No corrosive gases, flammable gases, oil mist, dust and dirt.		
Altitude, vibration		Below 1000m (3280.80 feet), 5.9m/S2 (0.6G) or less (conforms to JIS C 0911)			
Vector inverter motor	Ambient temperature, humidity		-10°C to +40°C (14°F to 104°F), 90%RH or less		
	Structure		Totally enclosed forced draft system		
	Detector		PLG 1000P/R, B, B, Z +5VDC power supply		
	Equipment		PLG, thermal protector, fan		
	Insulation		Class F		
	Vibration rank		V10		

*1: Jogging operation can also be performed from the parameter unit.

*2: VPC and VPD provide the outputs of phases A and B only.

VPA, VPB and VPC cannot identify the rotation direction at the time of division.

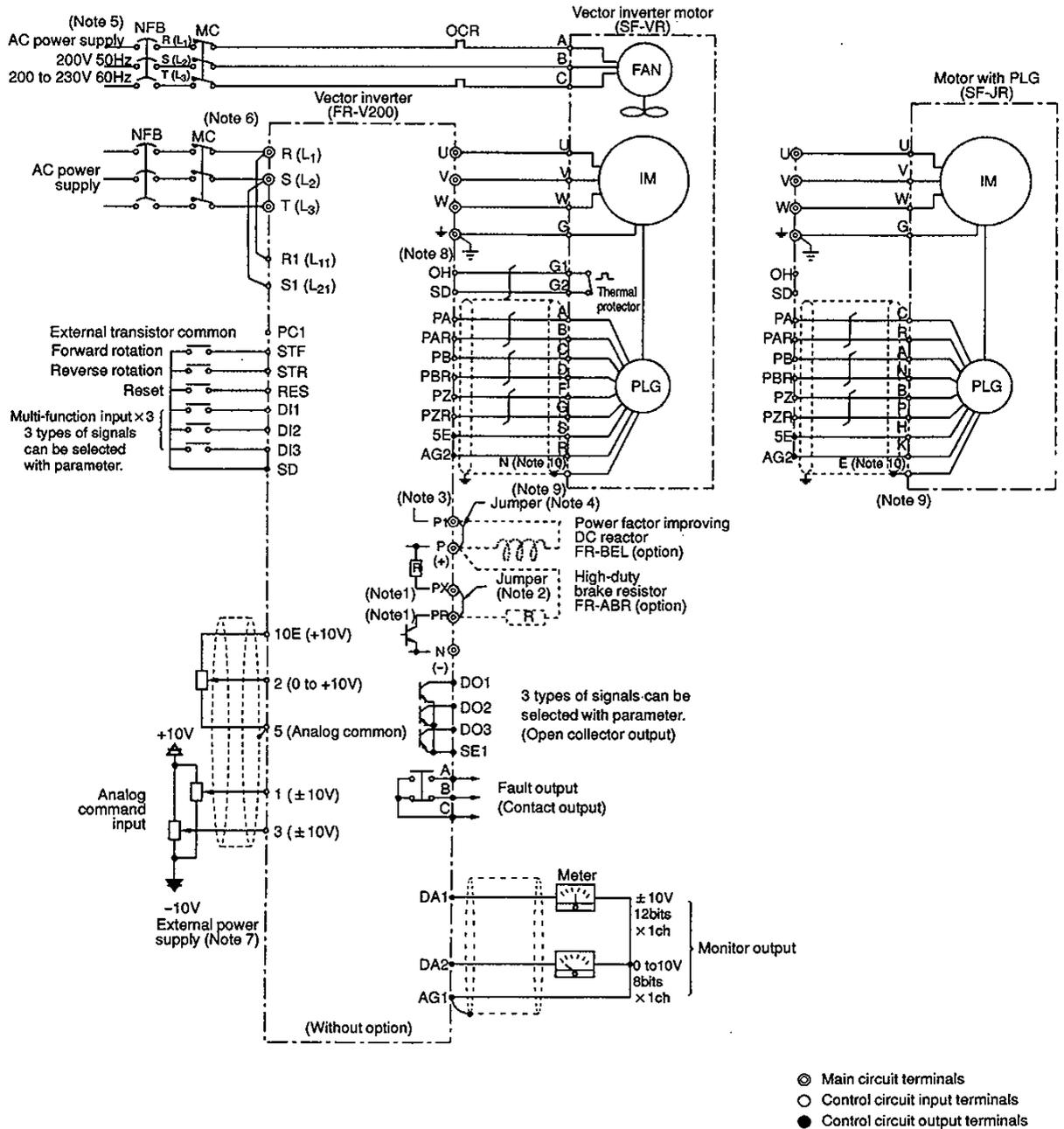
VPD can identify the rotation direction at the time of division.

*3: Not provided for the FR-V220E-7.5K to 45K and FR-V240E-7.5K to 45K which do not have a built-in brake circuit.

*4: Temperature applicable for a short period in transit, etc.

7.1.2 Connection Diagrams

■ Connection diagram (standard specifications)



Note:1. Terminals PR and PX are provided for the 5.5K or less.

2. When using the FR-ABR, remove this jumper.

3. Terminal P1 is provided for the FR-V220E-3.7K to 45K and FR-V240E-3.7K to 45K.

4. When using the FR-BEL, remove this jumper.

5. The fan power supply is single-phase for the 5.5kW/7.5kW (7.5 HP/10 HP) vector inverter motor.

6. Avoid frequent power on-off because repeated inrush currents at power-on will shorten the converter life.

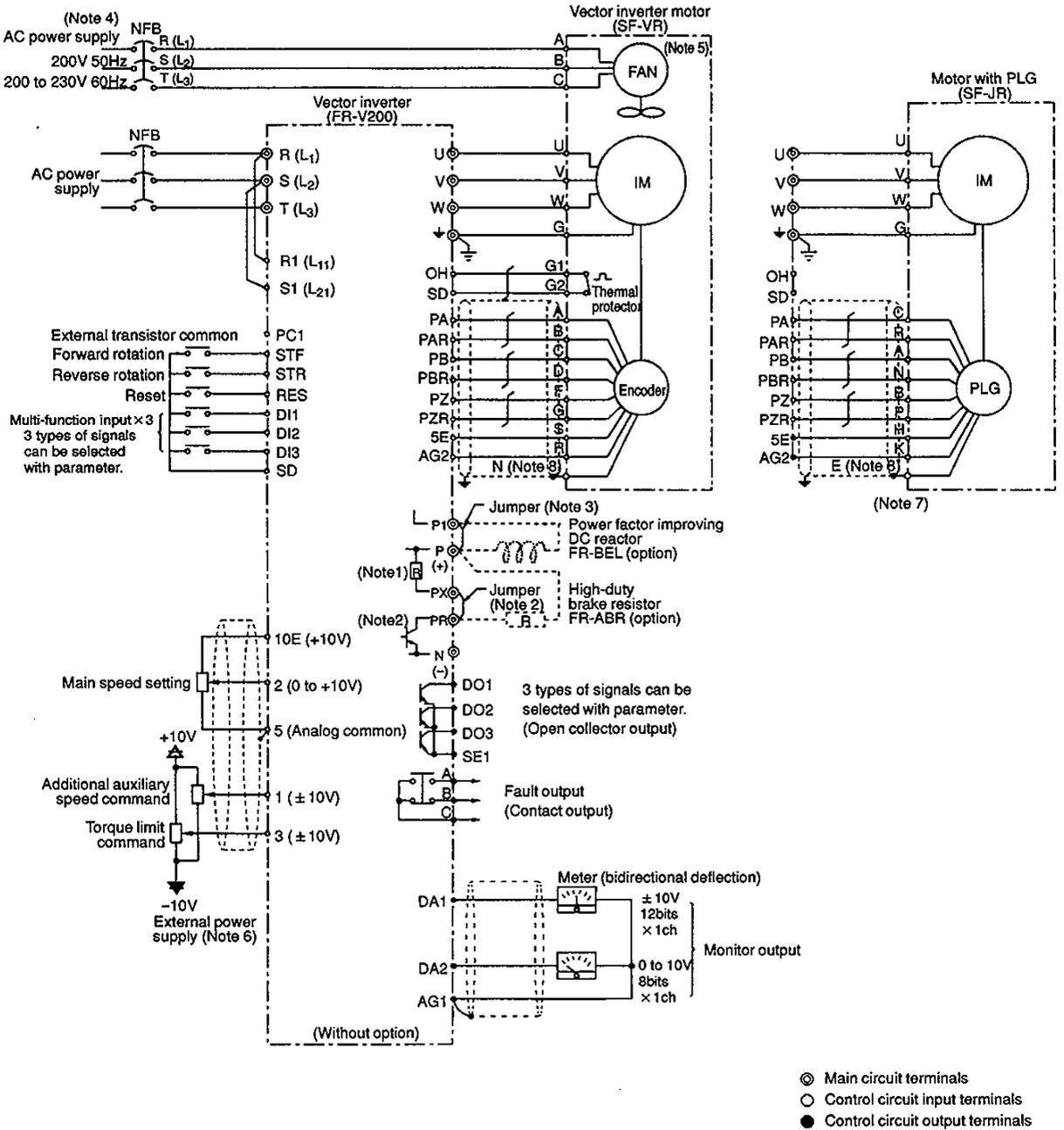
7. Prepare a $\pm 10V$ external power supply for terminals 1, 3.

8. When using a motor without thermal protector, open inverter terminals OH and SD.

9. The pin numbers differ when the motor used is other than the vector inverter motor or SF-JR motor with PLG.

10. Pin N of the PLG for exclusive motor and pin E of the PLG for motor with PLG are to be case-earthed. To reduce radiated noise, connect the shield wire of the PLG cable to the case earth pin.

■ Standard connection diagram for speed control operation



Note: 1. Terminals PR and PX are provided for the 5.5K or less.

2. When using the FR-ABR, remove this jumper.

3. When using the FR-BEL, remove this jumper.

4. The motor fan power supply is single-phase for 5.5kW or 7.5kW (7.5 HP or 10 HP).

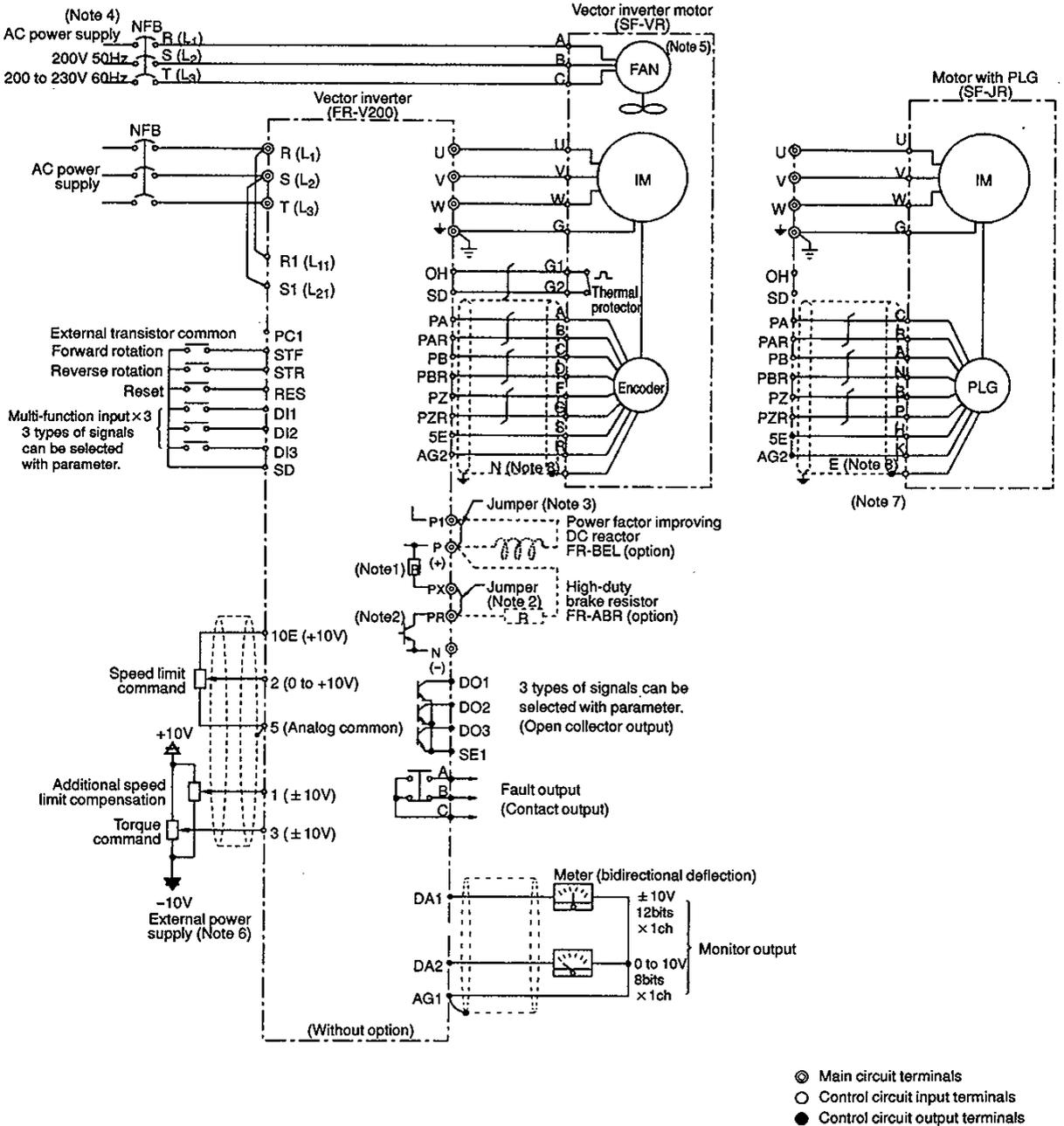
5. Take care to connect the cooling fan power supply cables in the correct phase sequence.

6. Prepare a ±10V external power supply for terminals 1, 3.

7. The pin numbers differ when the motor used is other than the vector inverter motor or SF-JR motor with PLG.

8. Pin N of the PLG for exclusive motor and pin E of the PLG for motor with PLG are to be case-earthed. To reduce radiated noise, connect the shield wire of the PLG cable to the case pin.

Standard connection diagram for torque control operation



Note: 1. Terminals PR and PX are provided for the 5.5K or less.

2. When using the FR-ABR, remove this jumper.

3. When using the FR-BEL, remove this jumper.

4. The motor power supply is single-phase for 5.5kW or 7.5kW (7.5 HP or 10 HP).

5. Take care to connect the cooling fan power supply cables in the correct phase sequence.

6. Prepare a ±10V external power supply for terminals 1, 3.

7. The pin numbers differ when the motor used is other than the vector inverter motor or SF-JR motor with PLG.

8. Pin N of the PLG for exclusive motor and pin E of the PLG for motor with PLG are to be case-earthed. To reduce radiated noise, connect the shield wire of the PLG cable to the case earth pin.

7.1.3 Terminals

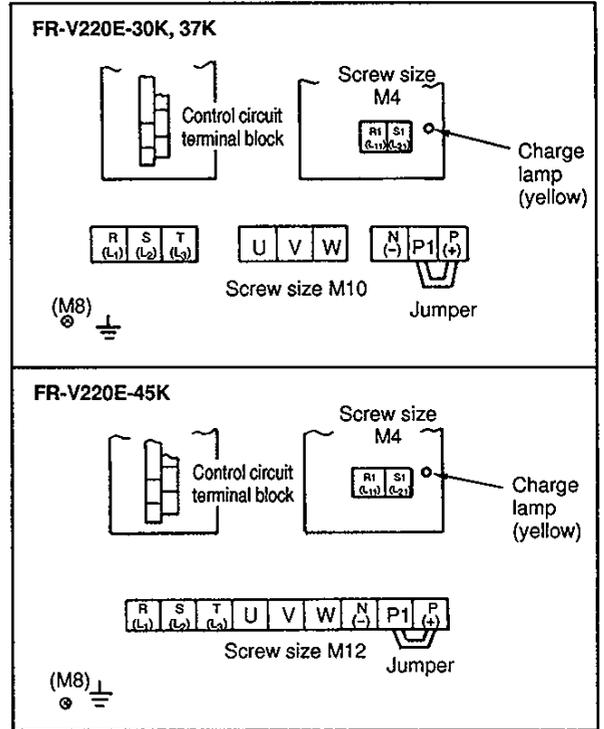
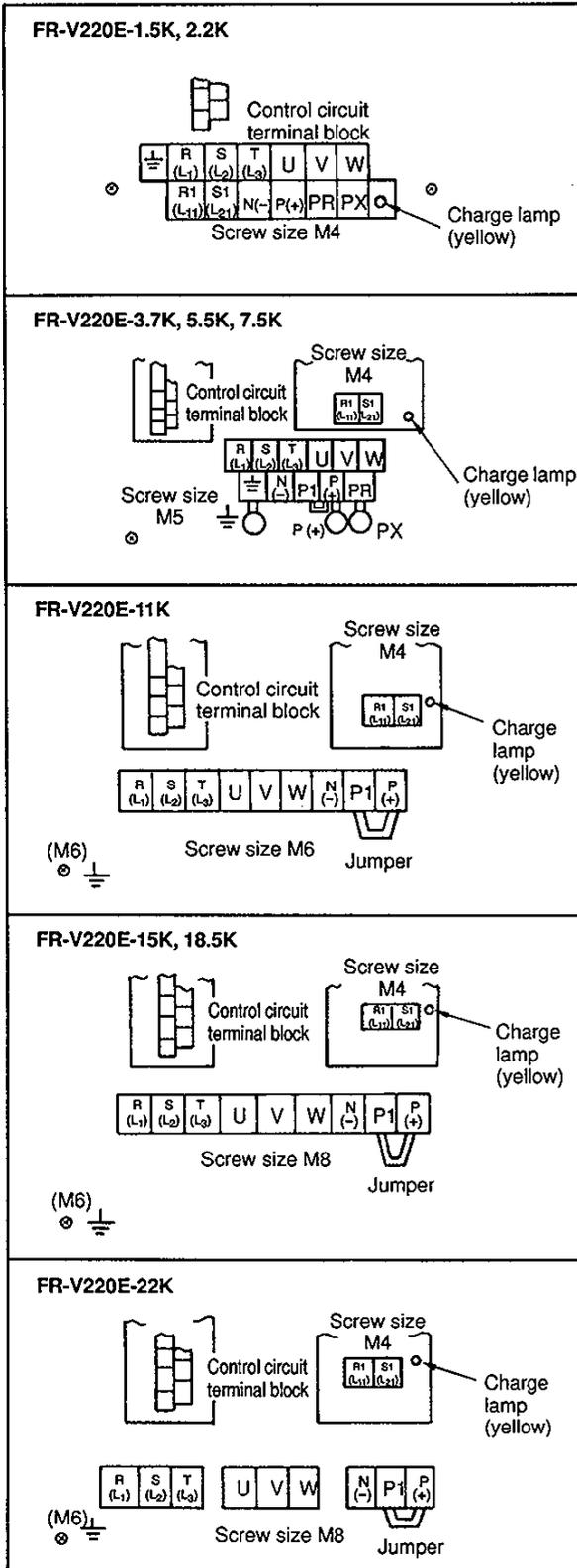
Type	Symbol	Terminal Name	Description		
Main circuit	R (L ₁), S (L ₂), T (L ₃)	AC power input	Connect to the commercial power supply.		
	U, V, W	Inverter output	Connect a vector control motor or a motor with PLG.		
	R1 (L ₁₁), S1 (L ₂₁)	Control power input	Connected to the AC power supply terminals R (L ₁) and S (L ₂). Connect a single-phase AC power supply as a backup for control circuit power. To retain the alarm display and alarm output, remove the jumper from the terminal block and apply external power to these terminals.		
	P (+), PR	Brake resistor connection	Disconnect the jumper from terminals PR and PX, connect the optional brake resistor (FR-ABR) across terminals P (+) and PR. Only the inverter of 5.5K or less can be provided with regenerative braking force by connecting the resistor.		
	P (+), N (-)	Brake unit connection	Connect the optional brake unit or power return converter (FR-RC).		
	P (+), P1	DC reactor connection	Disconnect the jumper from terminals P (+) and P1, connect the optional power factor improving reactor (FR-BEL). As 2.2K or less is not equipped with terminal P1, the DC reactor cannot be connected.		
	PR, PX*	Built-in brake circuit connection	When the jumper is connected across terminals PX and PR (factory setting), the built-in brake resistor is valid.		
		Ground terminal	For grounding the inverter chassis. Must be grounded.		
Control circuit (input signals)	Contact (start, function selection, etc.)	STF	Forward rotation/stop command	Turn on the signal across STF and SD for forward rotation and turn it off to stop.	When the signals across terminals STF and SD. STR and SD are turned on simultaneously, the stop command is given.
		STR	Reverse rotation/stop command	Turn on the signal across STR and SD for reverse rotation and turn it off to stop.	
		OH	Thermal protector input	Temperature detector terminal input for motor overheat protection.	
		DI1	Digital input 1 terminal	Input and select three types of signals from among RH (high speed), RM (middle speed), RL (low speed), JOG (jog operation), RT (second function selection), MRS (output stop), STOP (start self-holding selection), LX (pre-excitation), MG (control mode switching) and TL (torque control selection). The input signal is selected with Pr. 17.	
		DI2	Digital input 2 terminal		
		DI3	Digital input 3 terminal		
		RES	Reset	Used to reset the protective circuit activated. Turn on the signal across terminals RES and SD for more than 0.1 sec, then turn it off.	
	SD	Contact input common	Common to the contact inputs. Isolated from the common terminal of the control circuit.		
	PC1	External transistor common	When transistor output (open collector output), such as a programmable controller (PC), is connected, connect the external power supply common for transistor output to this terminal to prevent a fault caused by a sneak current. The power supply voltage of the PC connected should be 24VDC.		
	Analog speed setting	10E	Setting power supply	10VDC, permissible load current 10mA, 1KΩ power supply for the setting potentiometer (variable resistor).	
2		Speed setting	By entering 0 to 10VDC, the maximum speed is reached at 10V and I/O are proportional. Input resistance 10kΩ, max. permissible voltage 20VDC.		
3		Torque setting terminal	This is the torque setting signal for torque control, and is the torque limit signal for speed control and position control. Acts as the input terminal when the torque bias function by external analog signal is selected. 0 to ±10VDC input, input resistance 10kΩ, max. permissible voltage ±20VDC.		
1		Auxiliary speed setting terminal for auxiliary speed torque input	By entering 0 to ±10VDC, this signal is added to the setting signal of terminal 2. Input resistance 10kΩ, max. permissible voltage ±20VDC.		
5		Analog input common	Common to the speed setting signals (terminals 2, 1 or 3). Not isolated from the common circuit of the control circuit. Do not ground.		
PLG signals	PA	A-phase signal input terminal	The A-, B- and Z-phase signals are input from the PLG.		
	PAR	A-phase inverse signal input terminal			
	PB	B-phase signal input terminal			
	PBR	B-phase inverse signal input terminal			
	PZ	Z-phase signal input terminal			
	PZR	Z-phase inverse signal input terminal			
	5E	PLG power supply terminal (+ side)	5VDC, a 5V power supply for PLG.		
AG2	Power supply ground terminal	Common terminal for PLG power supply. Not isolated from the common terminal of the control circuit. Do not ground.			

Control circuit (output signals)	Contact	A, B, C	Alarm output	Contact output indicating that the output has been stopped by the inverter protective function activated. 200VAC 0.3A, 30VDC 0.3A. Alarm: discontinuity across B-C (continuity across A-C), normal: continuity across B-C (discontinuity across A-C).		
	Open collector	DO1	Digital output 1 terminal	Three types of signals are output from among ER (minor fault output), SU (up to speed), LS (low speed output), FU (speed detection), RUN (running), OL (overload), IPF/UVT (instantaneous power failure/undervoltage occurrence), PU (parameter operation or open motor circuit detection), TU (torque detection) and RY (ready). Permissible load 24VDC 0.1A.		
		DO2	Digital output 2 terminal			
		DO3	Digital output 3 terminal			
		SE1	Open collector output common	Common to the DO1, DO2 and DO3 terminals. Isolated from the common circuit of the control circuit.		
	Analog	DA1	Analog signal output	One selected from nine different monitoring items, such as speed, is output. The output signal is proportional to the magnitude of each monitoring item.	Factory-set output item: speed monitor Output signal 0 to ± 10 VDC, permissible load current 1mA	
		DA2	Analog signal output		Factory-set output item: torque monitor Output signal 0 to 10VDC, permissible load current 1mA	
		AG1	Analog signal output common	Common terminal for DA1 and DA2. Not isolated from the common circuit of the control circuit. Do not ground.		

* Terminals PR and PX are provided for the FR-V220E-1.5K to 5.5K and FR-V240E-1.5K to 5.5K.

7.1.4 Terminal Block Layout

Terminal Block for Main Circuit <200V class>

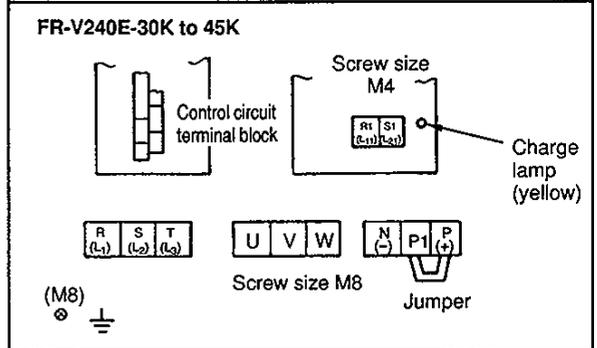
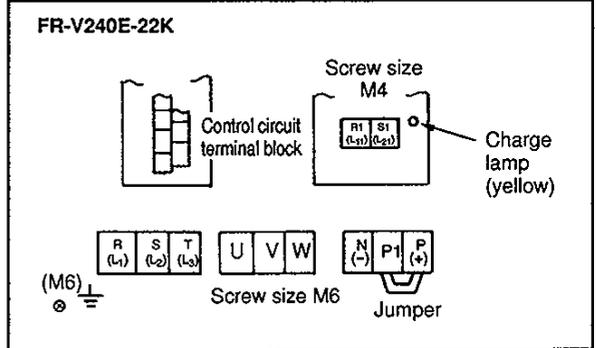
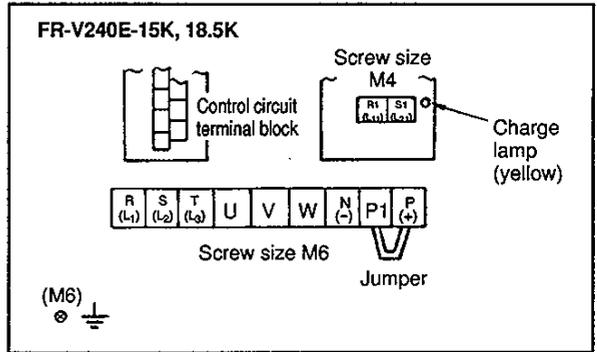
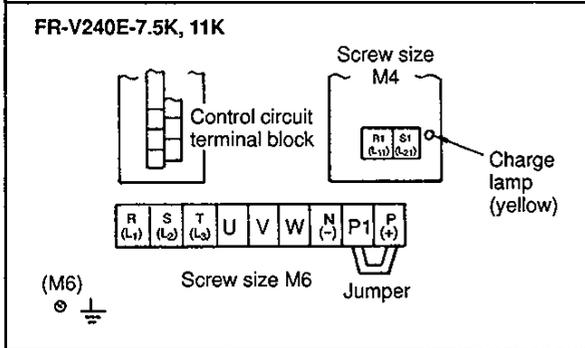
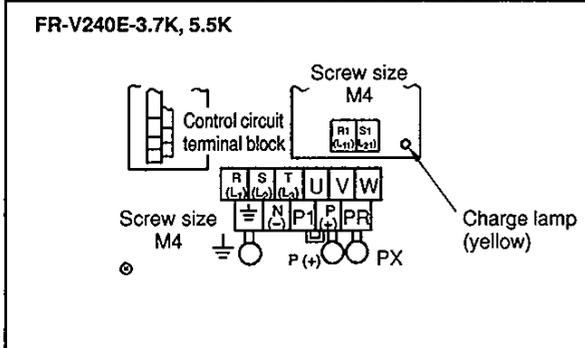
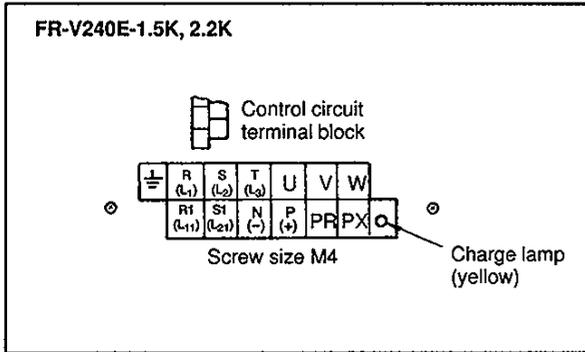


Terminal Block for Control Circuit

Common to all models
Structure . . . 2-stage molded
terminals
Screw size . . M3

A	
B	
C	
SE1	
DO3	
DO2	
DO1	
SD	
D13	
D12	
D11	
RES	
STF	
STR	
OH	
PC1	
PZR	
PZ	10E
PBR	3
PB	2
PAR	1
PA	5
AG2	DA2
5E	DA1
AG1	

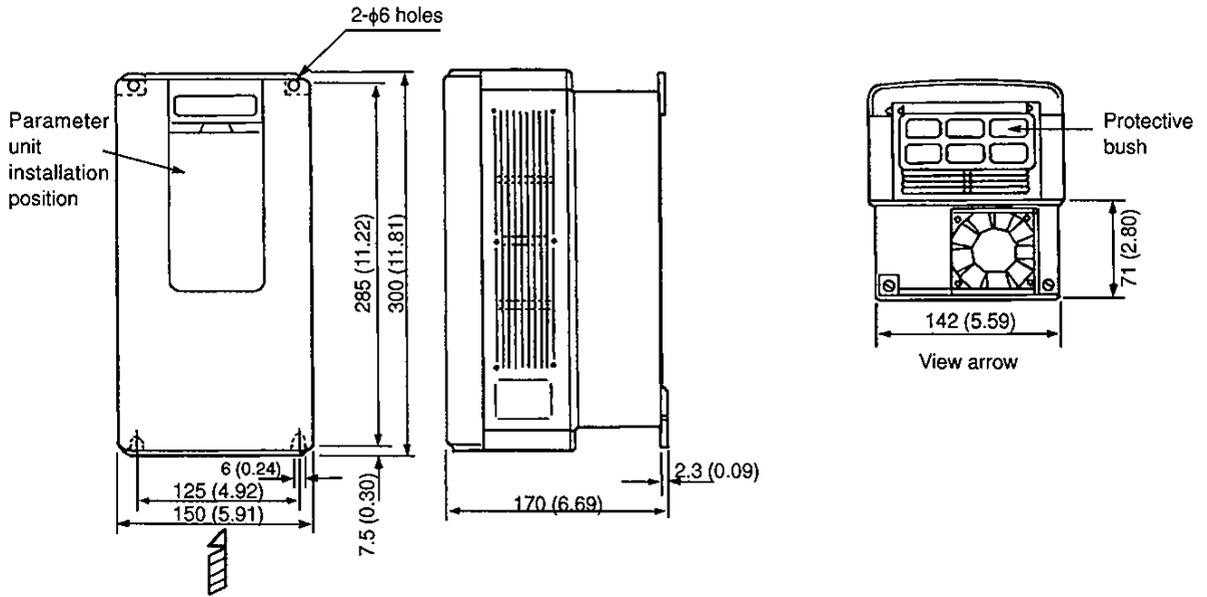
Terminal Block for Main Circuit <400V class>



7.1.5 Outline Drawings

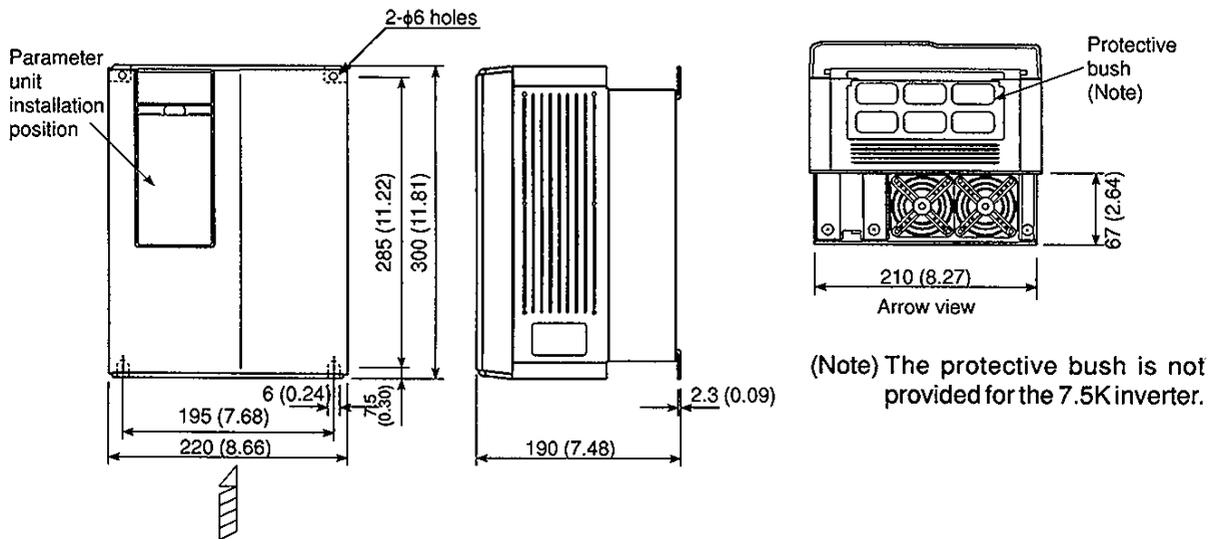
- FR-V220E- 1.5K , 2.2K
- FR-V240E- 1.5K , 2.2K

[Unit: mm (inches)]



- FR-V220E- 3.7K , 5.5K , 7.5K
- FR-V240E- 3.7K , 5.5K

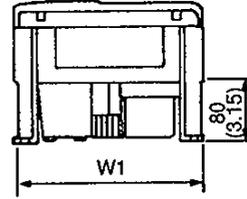
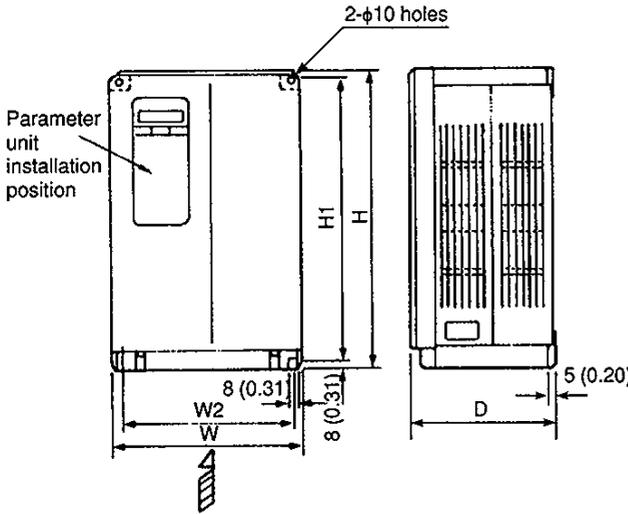
[Unit: mm (inches)]



● FR-V220E- 11K , 15K , 18.5K

● FR-V240E- 7.5K , 11K , 15K , 18.5K

[Unit: mm (inches)]



View arrow

● 200V class

Inverter Type	W	W1	W2	H	H1	D
FR-V220E-11K	250 (9.84)	242 (9.53)	230 (9.06)	400 (15.75)	380 (14.96)	190 (7.48)
FR-V220E-15K	300 (11.81)	292 (11.50)	280 (11.02)	450 (17.72)	430 (16.93)	195 (7.68)
FR-V220E-18.5K	300 (11.81)	292 (11.50)	280 (11.02)	450 (17.72)	430 (16.93)	195 (7.68)

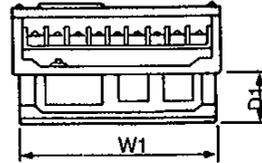
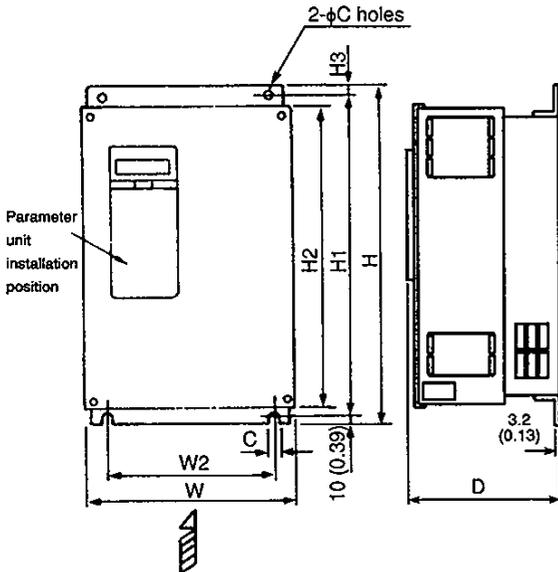
● 400V class

Inverter Type	W	W1	W2	H	H1	D
FR-V240E-7.5K	250 (9.84)	242 (9.53)	230 (9.06)	400 (15.75)	380 (14.96)	190 (7.48)
FR-V240E-11K	250 (9.84)	242 (9.53)	230 (9.06)	400 (15.75)	380 (14.96)	190 (7.48)
FR-V240E-15K	300 (11.81)	292 (11.50)	280 (11.02)	450 (17.72)	430 (16.93)	195 (7.68)
FR-V240E-18.5K	300 (11.81)	292 (11.50)	280 (11.02)	450 (17.72)	430 (16.93)	195 (7.68)

● FR-V220E- 22K , 30K , 37K , 45K

● FR-V240E- 22K , 30K , 37K , 45K

[Unit: mm (inches)]



View arrow

● 200V class

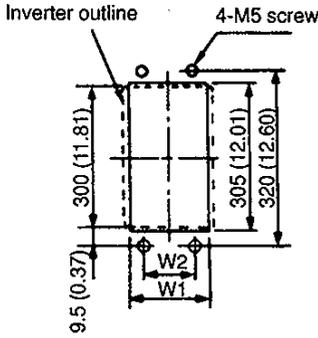
Inverter Type	W	W1	W2	H	H1	H2	H3	D	D1	C
FR-V220E-22K	340 (13.39)	324 (12.76)	270 (10.63)	550 (21.65)	530 (20.87)	510 (20.08)	10 (0.39)	195 (7.68)	78 (3.07)	10 (0.39)
FR-V220E-30K	450 (17.72)	434 (17.09)	380 (14.96)	550 (21.65)	525 (20.67)	495 (19.49)	15 (0.59)	250 (9.84)	130 (5.12)	12 (0.47)
FR-V220E-37K	450 (17.72)	434 (17.09)	380 (14.96)	550 (21.65)	525 (20.67)	495 (19.49)	15 (0.59)	250 (9.84)	130 (5.12)	12 (0.47)
FR-V220E-45K	480 (18.90)	464 (18.27)	410 (16.14)	700 (27.56)	675 (26.57)	645 (25.39)	15 (0.59)	250 (9.84)	130 (5.12)	12 (0.47)

● 400V class

Inverter Type	W	W1	W2	H	H1	H2	H3	D	D1	C
FR-V240E-22K	340 (13.39)	324 (12.76)	270 (10.63)	550 (21.65)	530 (20.87)	510 (20.08)	10 (0.39)	195 (7.68)	78 (3.07)	10 (0.39)
FR-V240E-30K	450 (17.72)	434 (17.09)	380 (14.96)	550 (21.65)	525 (20.67)	495 (19.49)	15 (0.59)	250 (9.84)	130 (5.12)	12 (0.47)
FR-V240E-37K	450 (17.72)	434 (17.09)	380 (14.96)	550 (21.65)	525 (20.67)	495 (19.49)	15 (0.59)	250 (9.84)	130 (5.12)	12 (0.47)
FR-V240E-45K	480 (18.90)	464 (18.27)	410 (16.14)	700 (27.56)	675 (26.57)	645 (25.39)	15 (0.59)	250 (9.84)	130 (5.12)	12 (0.47)

7.1.6 Panel Cutting Dimension Diagrams (For using the heat sink outside mounting attachment)

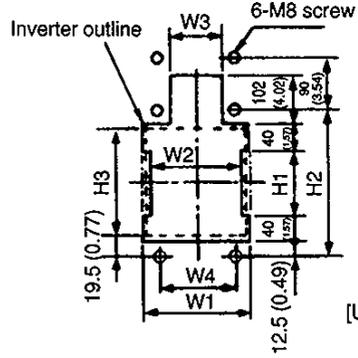
- FR-V220E-1.5K to 7.5K
- FR-V240E-1.5K to 5.5K



[Unit: mm (inches)]

Inverter Type	W1	W2
FR-V220E-1.5K, 2.2K	144 (5.67)	125 (4.92)
FR-V220E-3.7K to 7.5K	212 (8.35)	195 (7.68)
FR-V240E-1.5K, 2.2K	144 (5.67)	125 (4.92)
FR-V240E-3.7K to 5.5k	212 (8.35)	195 (7.68)

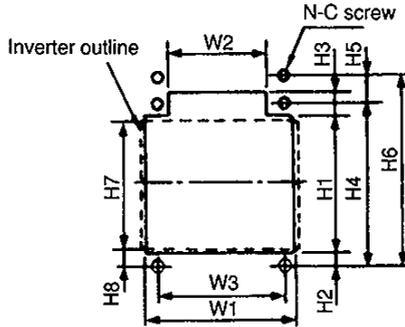
- FR-V220E-11K to 18.5K
- FR-V240E-7.5K to 18.5K



[Unit: mm (inches)]

Inverter Type	W1	W2	W3	W4	H1	H2	H3
FR-V220E-11K	260 (10.24)	244 (9.61)	200 (7.87)	230 (9.06)	335 (13.19)	440 (17.32)	400 (15.75)
FR-V220E-15K to 18.5K	310 (12.20)	294 (11.57)	250 (9.84)	280 (11.02)	385 (15.16)	490 (19.29)	450 (17.72)
FR-V240E-7.5K to 11K	260 (12.24)	244 (9.61)	200 (7.87)	230 (9.06)	335 (13.19)	440 (17.32)	400 (15.75)
FR-V240E-15K to 18.5K	310 (12.20)	294 (11.57)	250 (9.84)	280 (11.02)	385 (15.16)	490 (19.29)	450 (17.72)

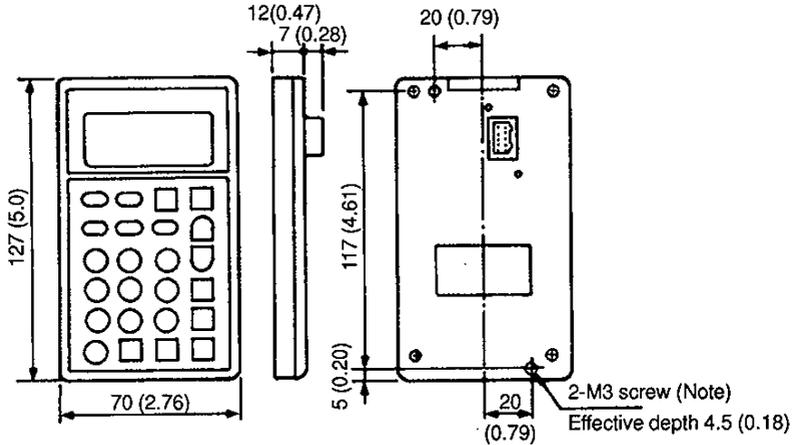
- FR-V220E-22K to 45K
- FR-V240E-22K to 45K



(Unit: mm (inches))

Inverter Type	W1	W2	W3	H1	H2	H3	H4	H5	H6	H7	H8	N	C
FR-V220E-22K	330 (12.99)	265 (10.43)	290 (11.42)	516 (20.31)	12 (0.47)	95 (3.74)	540 (21.26)	85 (3.35)	—	510 (20.08)	15 (0.59)	6 (0.23)	M8
FR-V220E-30K, 37K	440 (17.32)	380 (14.96)	410 (16.14)	510 (20.08)	15 (0.59)	70 (2.76)	—	—	590 (23.22)	495 (19.49)	32.5 (1.28)	4 (0.16)	M10
FR-V220E-45K	470 (18.50)	390 (15.35)	430 (16.93)	650 (25.59)	15 (0.59)	70 (2.76)	—	—	730 (28.74)	645 (25.39)	24.5 (0.96)	4 (0.16)	M10
FR-V240E-22K	330 (12.99)	265 (10.43)	290 (11.42)	516 (20.31)	12 (0.47)	95 (3.74)	540 (21.26)	85 (3.35)	—	510 (20.08)	15 (0.59)	6 (0.23)	M8
FR-V240E-30K, 37K	440 (17.32)	380 (14.96)	410 (16.14)	510 (20.08)	15 (0.59)	70 (2.76)	—	—	590 (23.22)	495 (19.49)	32.5 (1.28)	4 (0.16)	M10
FR-V240E-45K	470 (18.50)	390 (15.35)	430 (16.93)	650 (25.59)	15 (0.59)	70 (2.76)	—	—	730 (28.74)	645 (25.39)	24.5 (0.96)	4 (0.16)	M10

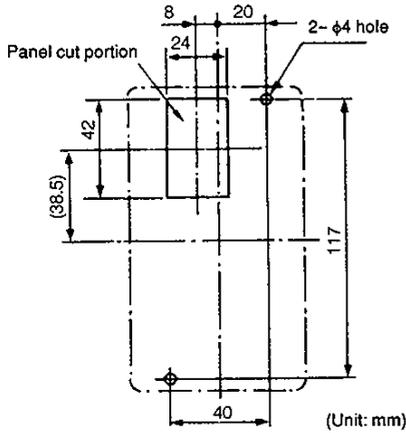
7.1.7 FR-PU02V Parameter Unit Dimension Diagram



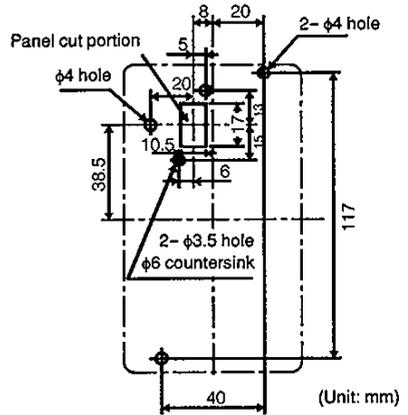
Note: The length of the installation screw should be selected so that it does not exceed the effective installation screw depth of the parameter unit.

■ Panel cutting dimensions for installation of the parameter unit to a panel, etc.

- When parameter unit cable (straight type) is not fixed to the panel



- When parameter unit cable (L type) is fixed to the panel



(Front view of the parameter unit)

■ FR-PU02V Specifications

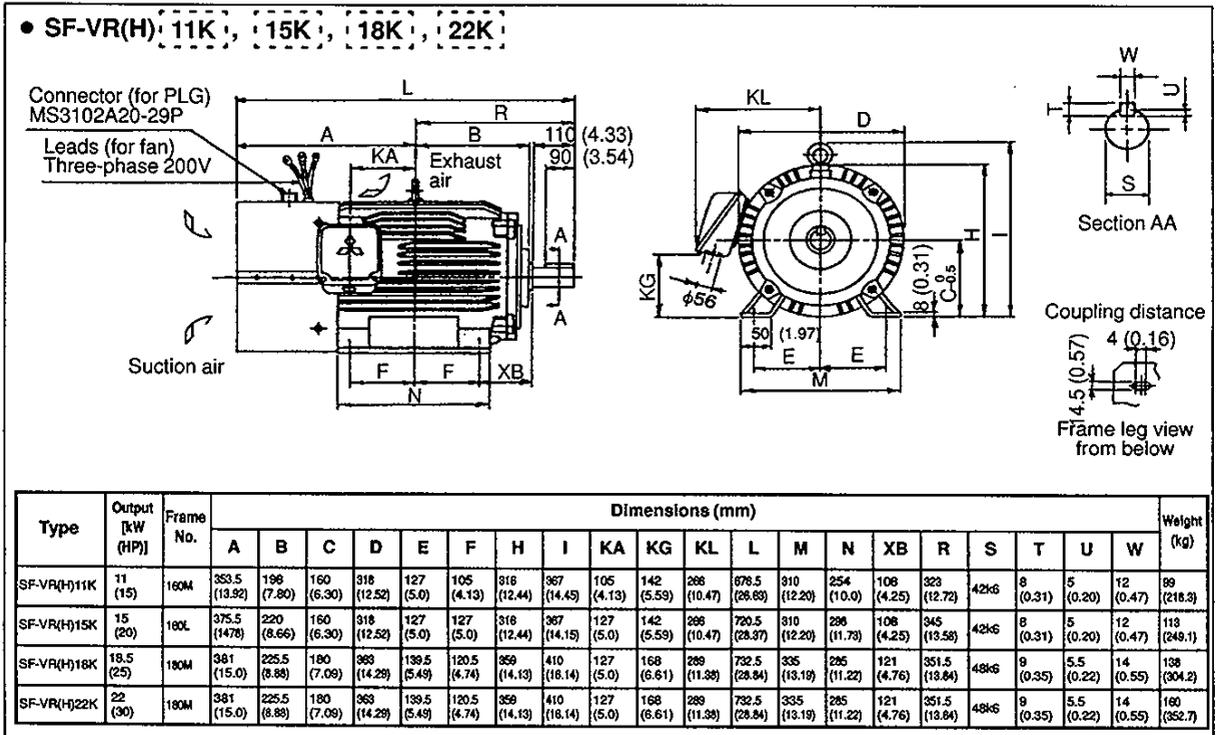
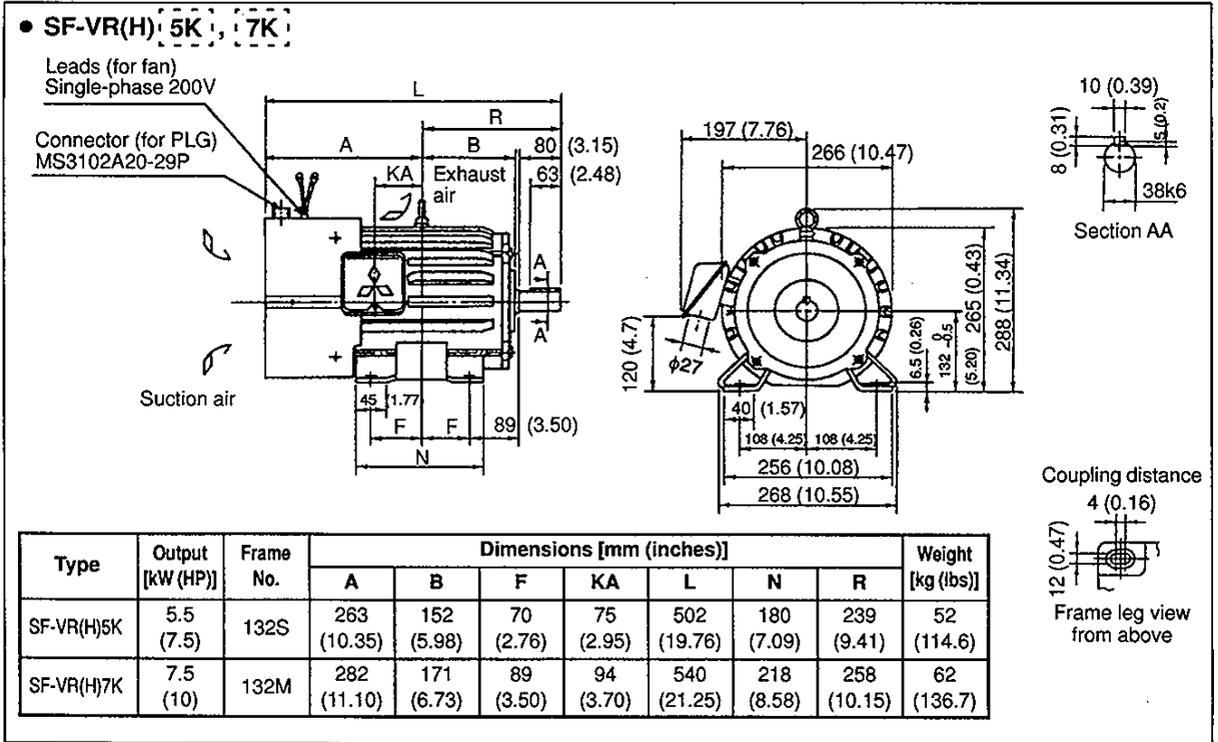
Item	Specifications	
Ambient temperature	Operating	-10 to +50°C (14°F to 122°F) (Note)
	Storage	-20 to +65°C (4°F to 149°F)
Ambient humidity	90%RH	Non-condensing
Operating ambience	No oil mist and corrosive gases. Minimal dust and dirt.	
Connected object	FR-V series inverter or dedicated cable (FR-CBL)	
Power supply	Power is supplied from the inverter.	
Connection	Loaded to the inverter directly or connected by the cable.	
Display	LCD (liquid crystal display, 13 characters × 4 lines)	
Keyboard	24 operation keys (covered with polyurethane film)	
Size	127 (5.0) (H) × 70 (2.76) (W) × 12 (0.47) (D)	

Note: 1. When the temperature is less than about 0°C (32°F), the liquid crystal display (LCD) may be slower in operation. And high temperature may reduce the LCD life.

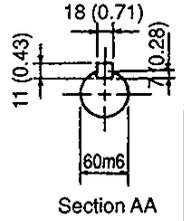
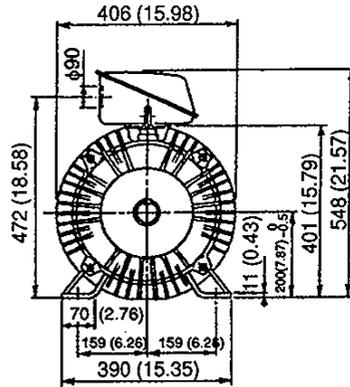
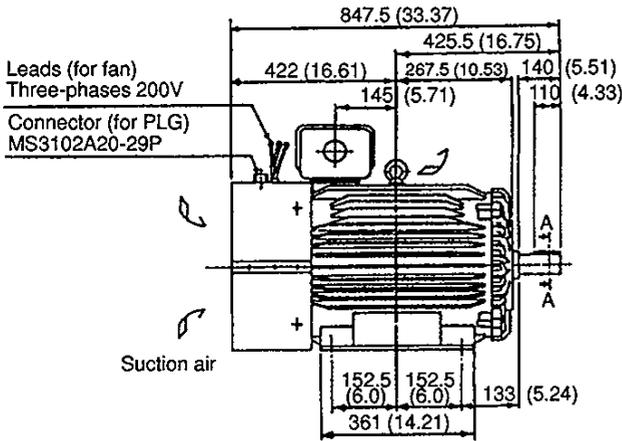
2. Do not expose the liquid crystal display directly to sun light.

7.1.8 Vector Control Inverter Motor Outline Drawings

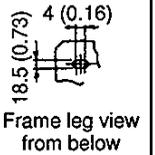
- The outline dimensions of the 200V and 400V classes are the same.
- Install the motor on the floor and set the shaft horizontally.
- Leave a sufficient clearance between the fan suction port and wall to ensure adequate cooling.
- The type codes of the 400V class have "H".
- The outline drawings of flange type motors and motors with brake are available separately.



• SF-VR(H) 30K, 37K, 45K



Coupling distance

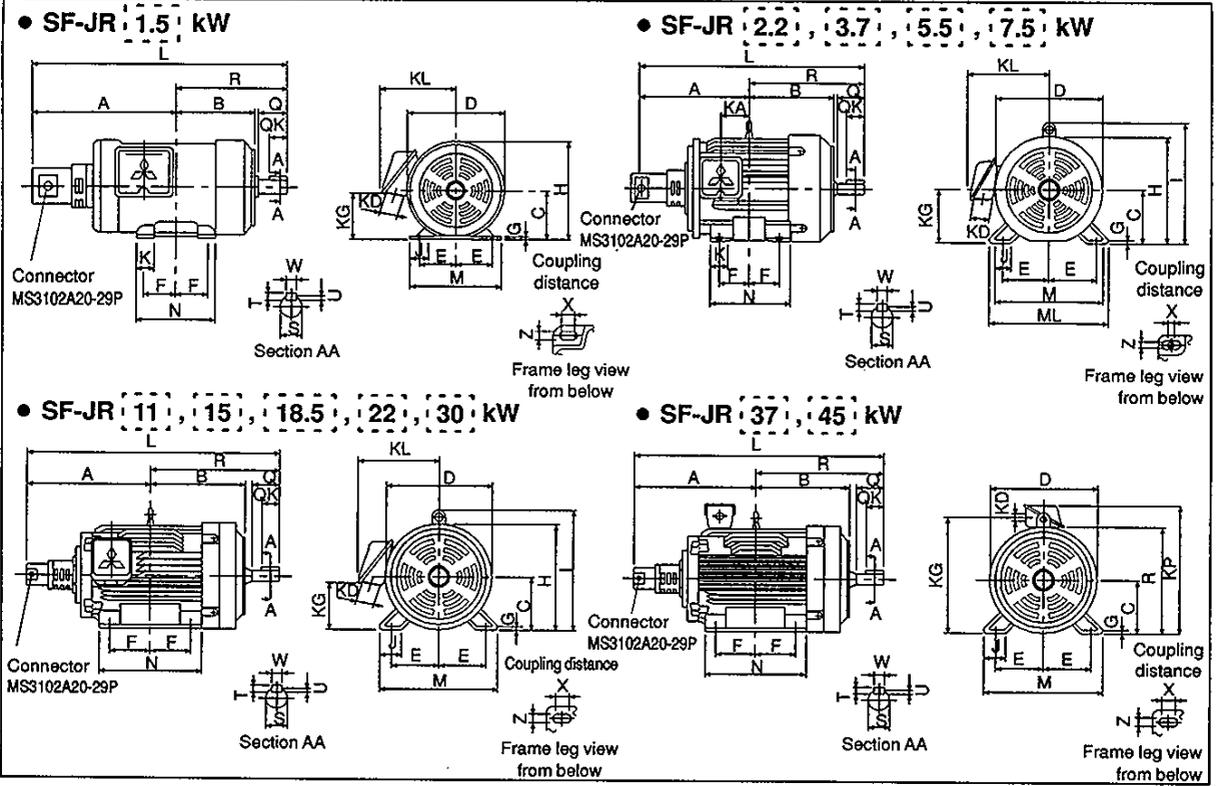


Type	Output [kW (HP)]	Frame No.	Weight [kg (lbs)]
SF-VR(H)30K	30 (40)	200L	238 (524.7)
SF-VR(H)37K	37 (50)	200L	255 (562.2)
SF-VR(H)45K	45 (60)	200L	255 (562.2)

[Unit: mm (inches)]

7.1.9 Motors With PLG (SF-JR[4P])

- The vertical dimensional difference of the shaft center height C marked * is -0.5 .
- As the outline drawing shown is the one of the typical model, it may differ slightly in appearance according to the frame number.



• Dimension List

[Unit: mm (inches)]

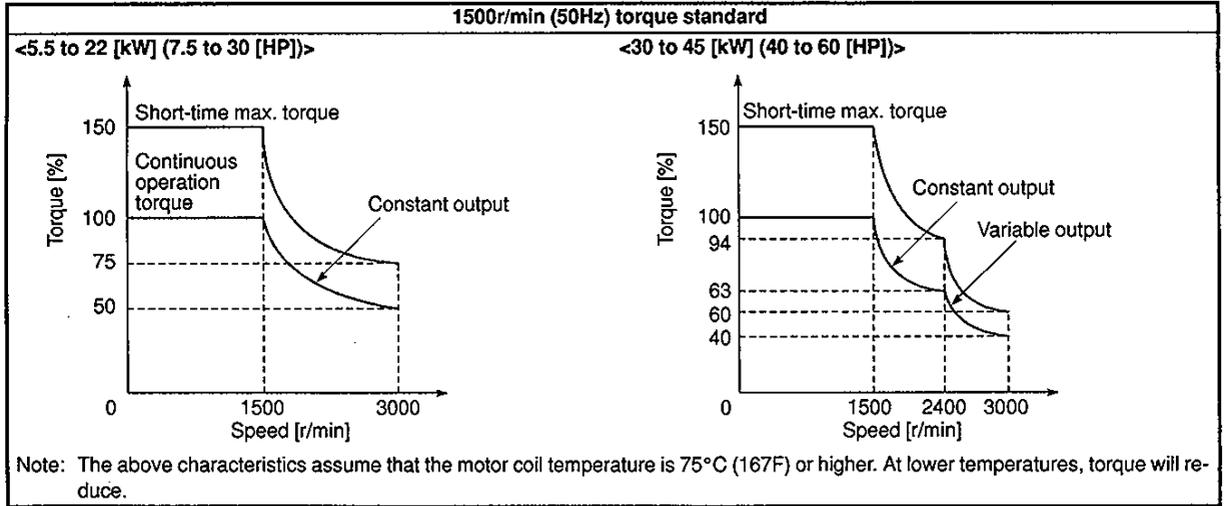
Type	Output [kW (HP)]	Frame No.	Weight (kg)	Motor																				
				A	B	*C	D	E	F	G	H	I	J	K	KD	KG	KL, KP	L	M	ML	N	X	Z	
SF-JR (with PLG)	1.5 (2)	90L	27 (59.5)	310 (12.20)	143 (5.63)	90 (3.54)	183.6 (7.23)	70 (2.76)	62.5 (2.46)	4 (0.16)	180.3 (7.10)	—	—	—	27 (1.06)	78 (3.07)	159 (6.26)	515 (20.28)	175 (6.89)	—	150 (5.91)	15 (0.59)	9 (0.35)	
	2.2 (3)	100L	32 (70.5)	340 (13.38)	172 (6.77)	100 (3.94)	207 (8.15)	80 (3.15)	70 (2.76)	6.5 (0.26)	203.5 (8.01)	230 (9.06)	40 (1.57)	45 (1.77)	27 (1.06)	86 (3.38)	189 (7.44)	590 (23.23)	200 (7.87)	212 (8.35)	180 (7.09)	4 (0.16)	12 (0.47)	
	3.7 (5)	112M	43 (94.8)	345 (13.58)	181 (7.12)	112 (4.41)	228 (8.97)	108 (4.25)	92 (3.62)	8.5 (0.33)	226 (8.90)	239 (9.41)	45 (1.77)	50 (1.97)	27 (1.06)	103 (4.05)	190 (7.48)	595 (23.43)	230 (9.09)	242 (9.53)	180 (7.09)	4 (0.16)	12 (0.47)	
	5.5 (7.5)	132S	58 (127.0)	370 (14.57)	211 (8.31)	132 (5.20)	255 (10.47)	126 (4.96)	102 (4.02)	9.5 (0.37)	265 (10.39)	266 (10.47)	45 (1.77)	50 (1.97)	27 (1.06)	120 (4.72)	197 (7.75)	675 (26.57)	260 (10.24)	268 (10.53)	180 (7.09)	4 (0.16)	12 (0.47)	
	7.5 (10)	132M	63 (138.0)	390 (15.35)	230 (9.05)	132 (5.20)	268 (10.47)	108 (4.25)	89 (3.50)	8.5 (0.33)	265 (10.39)	268 (10.53)	45 (1.77)	50 (1.97)	27 (1.06)	120 (4.72)	197 (7.75)	675 (26.57)	260 (10.24)	268 (10.53)	180 (7.09)	4 (0.16)	12 (0.47)	
	11 (15)	180M	100 (220.0)	405 (15.94)	252 (9.92)	180 (7.09)	318 (12.52)	127 (5.0)	105 (4.13)	8 (0.31)	316 (12.44)	318 (12.52)	50 (1.97)	—	—	56 (2.20)	142 (5.59)	268 (10.47)	805 (31.61)	310 (12.20)	—	254 (10.0)	4 (0.16)	14.5 (0.57)
	15 (20)	180L	120 (265.0)	427 (16.81)	274 (10.79)	180 (7.09)	318 (12.52)	127 (5.0)	127 (5.0)	8 (0.31)	316 (12.44)	307 (12.13)	50 (1.97)	—	—	56 (2.20)	142 (5.59)	268 (10.47)	805 (31.61)	310 (12.20)	—	254 (10.0)	4 (0.16)	14.5 (0.57)
	18.5, 22 (25, 30)	180M	147, 182 (324, 357)	441 (17.36)	292.5 (11.52)	180 (7.09)	363 (14.29)	139.5 (5.49)	120.5 (4.74)	8 (0.31)	359 (14.13)	359 (14.13)	50 (1.97)	—	—	56 (2.20)	168 (6.61)	289 (11.38)	881 (34.68)	335 (13.19)	—	285 (11.22)	4 (0.16)	14.5 (0.57)
	30 (40)	180L	192 (420)	460 (18.11)	311.5 (12.26)	180 (7.09)	363 (14.29)	139.5 (5.49)	139.5 (5.49)	8 (0.31)	359 (14.13)	359 (14.13)	50 (1.97)	—	—	56 (2.20)	168 (6.61)	289 (11.38)	881 (34.68)	335 (13.19)	—	285 (11.22)	4 (0.16)	14.5 (0.57)
	37, 45 (50, 60)	200L	240, 280 (529, 573)	497 (19.57)	370.5 (14.59)	200 (7.87)	408 (15.98)	159 (6.26)	152.5 (6.0)	11 (0.43)	401 (15.79)	401 (15.79)	50 (1.97)	—	—	60 (2.36)	202 (7.95)	348 (13.70)	1039.5 (40.93)	390 (15.35)	—	361 (14.21)	4 (0.16)	18.5 (0.73)

Type	Output [kW (HP)]	Frame No.	Shaft End									
			Q	OK	R	S	Tolerance	T	U	W		
SF-JR (with PLG)	1.5 (2)	90L	50 (1.97)	40 (1.57)	205 (8.07)	24 (0.94)	js	7 (0.28)	4 (0.16)	8 (0.31)		
	2.2 (3)	100L	60 (2.36)	45 (1.77)	240 (9.44)	28 (1.10)	js	7 (0.28)	4 (0.16)	8 (0.31)		
	3.7 (5)	112M	60 (2.36)	45 (1.77)	250 (9.84)	28 (1.10)	js	7 (0.28)	4 (0.16)	8 (0.31)		
	5.5 (7.5)	132S	80 (3.15)	63 (2.48)	305 (12.01)	38 (1.50)	ks	8 (0.31)	5 (0.20)	10 (0.39)		
	7.5 (10)	132M	80 (3.15)	63 (2.48)	324 (12.75)	38 (1.50)	ks	8 (0.31)	5 (0.20)	10 (0.39)		
	11 (15)	180M	110 (4.33)	90 (3.54)	368 (14.49)	42 (1.65)	ks	8 (0.31)	5 (0.20)	12 (0.47)		
	15 (20)	180L	110 (4.33)	90 (3.54)	420 (16.54)	42 (1.65)	ks	8 (0.31)	5 (0.20)	12 (0.47)		
	18.5, 22 (25, 30)	180M	110 (4.33)	90 (3.54)	440 (17.32)	48 (1.89)	ks	9 (0.35)	5.5 (0.22)	14 (0.55)		
	30 (40)	180L	110 (4.33)	90 (3.54)	459 (18.07)	55 (2.17)	ms	10 (0.39)	6 (0.24)	18 (0.63)		
	37, 45 (50, 60)	200L	140 (5.51)	110 (4.33)	542.5 (21.36)	60 (2.36)	ms	11 (0.43)	7 (0.28)	18 (0.71)		

7.1.10 Torque Characteristics

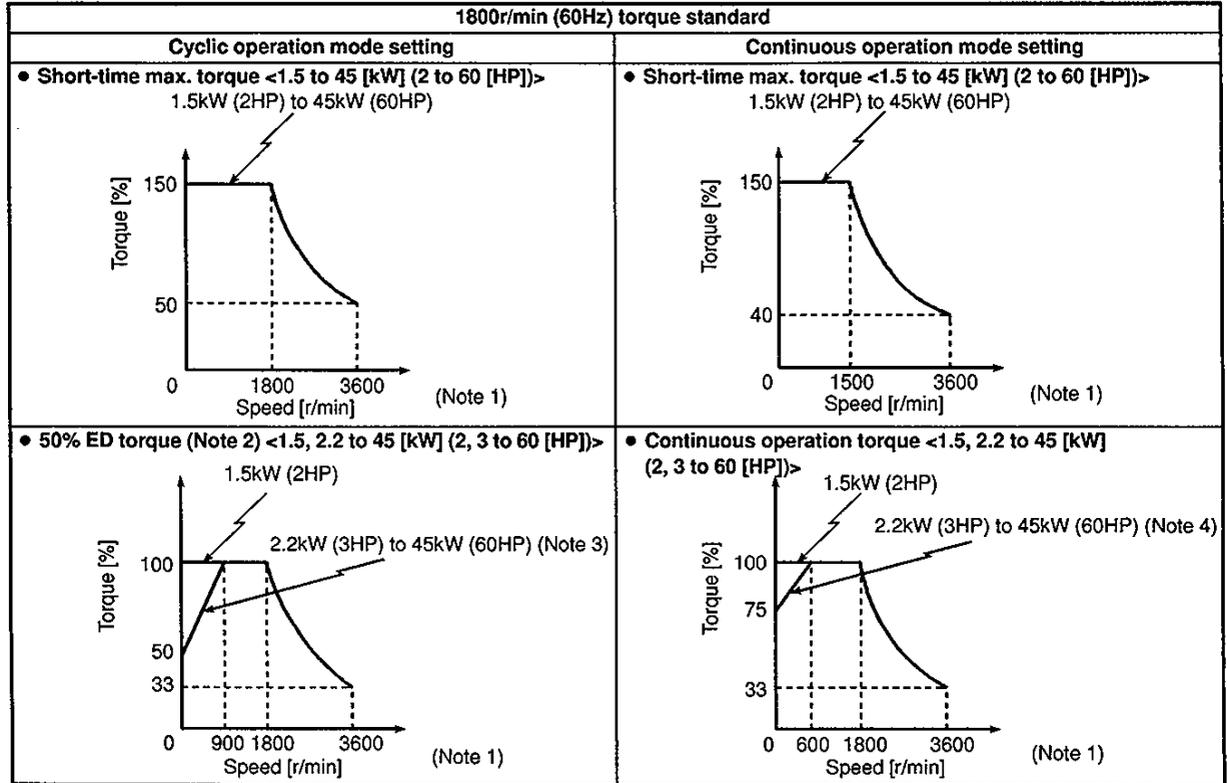
● Vector inverter motor (SF-VR [H])

When the rated voltage is input, the torque characteristics of the motor used with the inverter of the same capacity are as shown below:



● Motor with PLG (Example: SF-JR [4P])

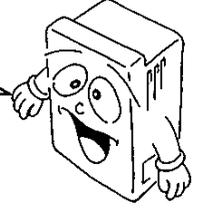
When the rated voltage is input, the torque characteristics of the motor used with the inverter of the same capacity are as shown below:



- Note: 1. Max. speed is 1) 1.5kW (2HP) to 7.5kW (10HP): 3600r/min, 2) 11kW (15HP) to 30kW (40HP): 3000r/min, 3) 37kW (50HP) to 45kW (60HP): 1950r/min.
 2. Continuously repeated operation at 50%ED is possible in the cycle time of 10 minutes. Note that continuous operation is performed up to 5 minutes.
 3. When 50%ED of 100% torque is required for 2.2kW (3HP) or 3.7kW (5HP) at 900r/min or less, use the constant-torque motor (SF-JRCA).
 4. When continuous 100% torque is required for 2.2kW (3HP) or 3.7kW (5HP) at 600r/min or less, use the constant-torque motor (SF-JRCA).

7.2 OPTIONS

By using the following options, the functions of the FR-V200 “vector inverter” can be increased.
Make a correct selection and handle the option correctly.



7.2.1 Option List

Name		Type	Application, Specifications, Etc.	Applicable Inverter
Inboard type (dedicated to FR-V)	Extension input/output function	FR-VPA	<ul style="list-style-type: none"> • Orientation control (orientation PLG input) • Extension input • Extension output • PLG pulse output (open collector) • Power for extension cable • Extension analog input 	Common to all models
	Position control function	FR-VPB	<ul style="list-style-type: none"> • Position control (pulse train input) • Extension analog input • Power for extension cable • PLG pulse output (line driver) • RS485 interface 	
	12-bit digital input function	FR-VPC	<ul style="list-style-type: none"> • 12-bit digital command • High-resolution analog input • Motor thermistor interface • Power for extension cable • PLG pulse output (line driver) 	
	PLG pulse division output function	FR-VPD	<ul style="list-style-type: none"> • Position control (pulse train input) • Extension input • Extension output • Extension analog input • PLG pulse division output (open collector) • Power for extension cable 	
External option (dedicated to FR-V)	Parameter unit	FR-PU02V	Interactive parameter unit using LCD display	
	PLG cable (for vector inverter motor)	FR-VCBL□□	Cable for connection of inverter and vector inverter motor PLG	
	PLG cable (for motor with PLG)	FR-JCBL□□	Cable for connection of inverter and PLG of Mitsubishi motor with PLG	
	Accessory cover	—	Blind cover fitted after the parameter unit is removed from the inverter.	
	Serial communication unit	FR-CU01	RS-485 interface for computer link (serial communication)	
	Heat sink outside mounting attachment	FR-ACN	Used to place only the heat generating section of the inverter in the back of the control box.	1.5K to 45K According to capacity
	Dirt-protection structure attachment	FR-ACV	By installing this option, the inverter meets the totally enclosed structure specifications (IP40).	1.5K to 18.5K According to capacity
	Conduit connection attachment	FR-AFN	Used to connect a conduit pipe directly to the inverter. (7.5K to 45K meet IP20 by installing this option.)	1.5K to 45K According to capacity
	High-duty brake resistor	FR-ABR-(H)□□*	Used to improve the braking capability of the brake built in the inverter.	1.5K to 5.5K According to capacity
EMC Directive-compliant noise filter	SF□□	Noise filter compliant with the EMC Directive (EN50081-2)(for 400V class only)	1.5K to 45K According to capacity	

	Name	Type	Application, Specifications, Etc.	Applicable Inverter
External option	Power factor improving DC reactor	FR-BEL-(H)□□*	Used to improve the inverter input power factor (overall power factor about 95%) and cooperate with the power supply.	3.7K to 45K According to capacity
	Power factor improving AC reactor	FR-BAL-(H)□□*	Used to improve the inverter input power factor (overall power factor about 90%) and cooperate with the power supply.	1.5K to 45K According to capacity
	Radio noise filter	FR-BIF-(H)□□*	For radio noise reduction	Common to all models
	Line noise filter	FR-BLF	For line noise reduction	
		FR-BSF-01	For line noise reduction (for small capacity)	
	Parameter unit cable	FR-CBL□□	Cable for connection with the parameter unit or parameter copy unit. Straight or L shape type available.	Common to all models
	BU brake unit	BU-1500 to 15K BU-H7.5K to H30K	Used to improve the braking capability of the inverter (for high-inertia load or negative load).	According to capacity
	Brake unit	FR-BU-15 to 55K FR-BU-H15K to H55K	Used to improve the braking capability of the inverter (for high-inertia load or negative load). Use the brake unit and resistor unit together.	
	Resistor unit	FR-BR-15 to 55K FR-BR-H15K to H55K		
	Power return unit	FR-RC-15 to 55K, FR-RC-H15K to H55K	Energy-saving, high-performance brake unit which can return the motor-generated braking energy to the power supply.	
High power factor converter	FR-HC-7.5K, 15K, 30K, 55K FR-HC-H7.5K, H15K, H30K, H55K	The high power factor converter is used with the standard accessory. Since the converter circuit is switched on-off to change the input current waveform into a sine wave, harmonic currents are suppressed substantially.		
VDE Standard-compliant noise filter	FR-ALF-(H)*	Noise filter conforming to the VDE Standard (VDE0871 Class A noise terminal voltage).		

FR series controllers and setters	Manual controller	FR-AX	For independent operation. With frequency meter, frequency setting potentiometer and start switch.	Common to all models
	DC tach. follower	FR-AL	For joint operation using external signals (0 to 5VDC, 0 to 10VDC) (1VA)**	
	Three speed selector	FR-AT	For three-speed (high, middle, low) switching operation (1.5VA)	
	Motorized speed setter	FR-FK	For remote operation. Allows operation to be controlled from several places. (5VA)	
	Ratio setter	FR-FH	For ratio control. Allows ratios to be set to five inverters. (3VA)	
	PG follower	FR-FP	For follow-up operation using the signal of a pilot generator (PG). (2VA)	
	Master controller	FR-FG	For parallel operation of several (up to 35) inverters. (5VA)	
	Soft starter	FR-FC	For soft start and stop. Allows parallel operation and acceleration/deceleration. (3VA)	
	Deviation detector	FR-FD	For synchronous operation. Used with a deviation sensor and synchro. (5VA)	
Others	Preamplifier	FR-FA	Can be used as A/V conversion or operational amplifier. (3VA)	
	Pilot generator	QVAH-10	For follow-up operation. 70V/35VAC 500Hz (at 2500rpm)	
	Deviation sensor	YVGC-500W-NS	For synchronous operation (mechanical deviation detection). Output 90VAC/90° (194°F)	

* The type code for 400VAC class has H. Power supply specifications of the FR series controllers and setters:
200VAC 50Hz, 200/220VAC 60Hz
115VAC 60Hz

** Rated power consumption.

7.2.2 Inboard Dedicated Options

Option	Function													
	Orientation control (Orientation PLG input)	Position control (Pulse train input)	Extension input	Extension output	Extension analog input		High-resolution analog input		PLG pulse output		Power for long distance cable	RS-485 interface	Motor thermistor interface	12-bit digital input
					0 to 10V 10 bits	±10V 14 bits	±10V 12 bits	Open collector	Line driver					
FR-VPA (Extension input/output function)	○		○	○	○				○					
FR-VPB (Position control function)		○			○				○	○	○			
FR-VPC 12-bit digital input function						○			○	○			○	○
FR-VPD (PLG pulse division function)		○	○	○				○	○	○				

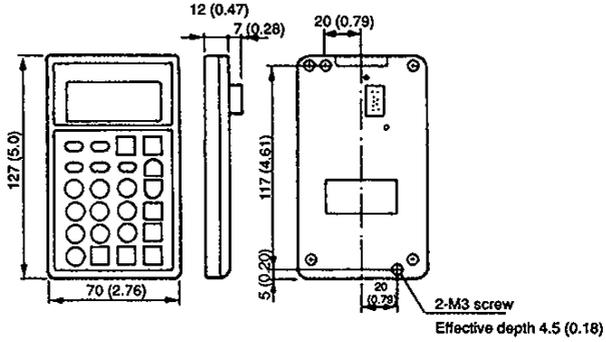
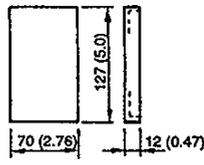
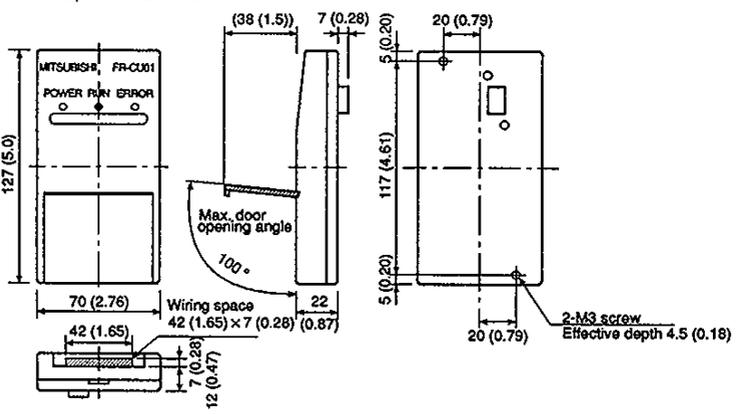
○ indicates the functions provided.

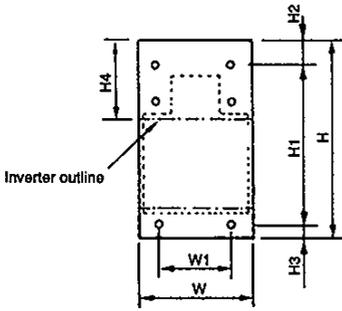
Out of the above option units, only one can be installed in the inverter.
Each option unit has several functions as listed above.

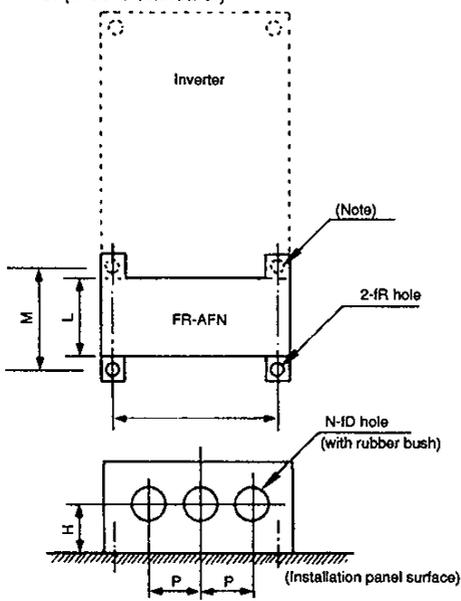
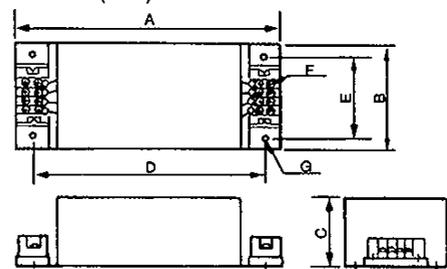
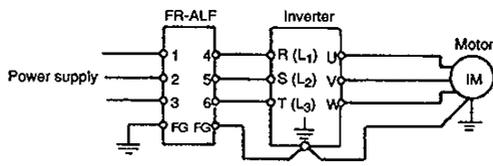
Function	Description	Remarks	
Orientation control (Orientation PLG input)	<ul style="list-style-type: none"> Used with a position detector (PLG) installed to a machine tool spindle to allow the spindle to be stopped at a predetermined position (orientation function). 	<ul style="list-style-type: none"> Positioning accuracy: $\pm 1^\circ$ PLG specifications: Three-phase Differential output 1024P/rev 5VDC power supply 	
Position control (Pulse train input)	<ul style="list-style-type: none"> Positioning control is possible by inputting a pulse train from an external source. Connection with the MELSEC-A (positioning module AD75) is also possible. 	<ul style="list-style-type: none"> Max. permissible number of pulses: 200kpps Input interface: differential receiver or open collector 	
Extension input	<ul style="list-style-type: none"> Up to six input terminal points can be extended (FR-VPA). When not using the orientation function, six points of multi-function input terminals can be selected as with the standard specifications. 	<ul style="list-style-type: none"> When the orientation function is valid, the input terminals are fixed to orientation start input (DI11) and stop position command input (DI12 to 16). 	
Extension output	<ul style="list-style-type: none"> Up to three output terminal points can be extended (FR-VPA). When not using the orientation function, three points of multi-function output terminals can be selected as with the standard specifications. 	<ul style="list-style-type: none"> When the orientation function is valid, the terminal output DO11 is fixed to the orientation end output. 	
Extension analog input	<ul style="list-style-type: none"> One analog command option input (0 to +10V) point can be extended. 	<ul style="list-style-type: none"> This is used to set the torque limit exclusive for regeneration when using speed control. 	
High-resolution analog input	<ul style="list-style-type: none"> Used to set the analog setting signal with high resolution (0.01% resolution). 		
PLG pulse output	Open collector	<ul style="list-style-type: none"> The spindle end PLG pulse input can be output only for the FR-VPA. The motor end PLG pulse input can be output by changing the parameters. 	<ul style="list-style-type: none"> The output can also be provided by dividing the number of pulses into 1/2, 1/4, 1/8 or 1/16 times. (Note)
	Line driver	<ul style="list-style-type: none"> The motor end PLG pulse input can be output. 	<ul style="list-style-type: none"> The output can also be provided by dividing the number of pulses into 1/2, 1/4, 1/8 or 1/16 times. (Note)
Power for long distance cable	<ul style="list-style-type: none"> This is used as the power for the spindle end PLG cable or for motor end PLG cable having a length of 50m (164.04 feet) or more (100m (328.08 feet) or less). 	<ul style="list-style-type: none"> Power supply voltage: 5.5V (55E-AG2) 	
RS485 interface	<ul style="list-style-type: none"> Using the communication cable, the inverter can be connected to a computer such as a personal computer or FA controller. The inverter can be run and monitored, and the parameters can be read and written from the computer using a user program. 	<ul style="list-style-type: none"> Conforming standards: EIA Standards 	
Motor thermistor interface	<ul style="list-style-type: none"> When the vector inverter motor (with thermistor) is used, the motor temperature is detected by the thermistor and the temperature fluctuation of generated torque can be reduced. 		
12-bit digital input	<ul style="list-style-type: none"> Input interface used to set the inverter frequency accurately using external BCD or binary digital signals. The external contact signal is used to make 12-bit digital speed setting. 	<ul style="list-style-type: none"> Input voltage, current: 24VDC, 5mA (per circuit) Input signal format: contact signal input or transistor open collector (sink type) input 	

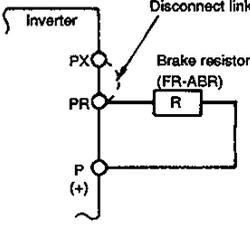
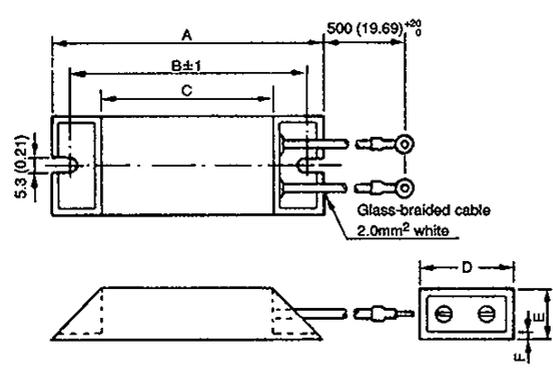
Note: If 1/16 times division is used when the number of PLG pulses is 1000 pulses, the output pulses per revolution may not be stable. (Because rounding off of 1000/16 is not possible). Thus, caution is required when using this function.

7.2.3 External Dedicated Options

Option (Type)	Specifications, Structure, Etc.
Parameter unit FR-PU02V	<ul style="list-style-type: none"> Allows operation to be performed, parameters to be set (set values to be written and read), operating status to be monitored, and alarm definition to be displayed.  <p style="text-align: right;">[Unit: mm (inches)]</p>
Accessory cover	<ul style="list-style-type: none"> When the parameter unit is removed from the inverter, this cover is fitted to that position. This cover can be fitted and removed by a single action.  <p style="text-align: right;">[Unit: mm (inches)]</p>
Serial communication unit FR-CU01	<ul style="list-style-type: none"> An add-on unit which can be fitted after removal of the parameter unit. Allows the inverter to be run/monitored and the parameters to be set from an FA controller or the like via the RS485 interface. Multidrop link system, up to 32 inverters connected. Communication speed: 1200 baud  <p style="text-align: right;">[Unit: mm (inches)]</p>

Option (Type)	Specifications, Structure, Etc.																																																																																																		
Heat sink outside mounting attachment FR-ACN□□	<ul style="list-style-type: none"> By using this attachment, the heat sink acting as the heat generator of the inverter can be placed at the back of the control box. Since the inverter-generated heat can be dissipated to the outside of the control box, the control box can be made compact. For the mounting state and panel cut dimensions, refer to page 159. <p>Note: Since the cooling fan exists in the cooling section placed out of the box, do not use this attachment in environments subjected to water drop, oil mist, dust, etc.</p> <p>Dimensions after mounting of the attachment</p> 	<table border="1"> <thead> <tr> <th rowspan="2">Type</th> <th colspan="2">Applicable Inverter</th> </tr> <tr> <th>200V class</th> <th>400V class</th> </tr> </thead> <tbody> <tr> <td>FR-ACN02</td> <td>FR-V220E-1.5K/2.2K</td> <td>FR-V240E-1.5K/2.2K</td> </tr> <tr> <td>FR-ACN03</td> <td>FR-V220E-3.7K to 7.5K</td> <td>FR-V240E-3.7K/5.5K</td> </tr> <tr> <td>FR-ACN04</td> <td>FR-V220E-11K</td> <td>FR-V240E-7.5K/11K</td> </tr> <tr> <td>FR-ACN05</td> <td>FR-V220E-15K/18.5K</td> <td>FR-V240E-15K/18.5K</td> </tr> <tr> <td>FR-ACN06</td> <td>FR-V220E-22K</td> <td>FR-V240E-22K</td> </tr> <tr> <td>FR-ACN07</td> <td>FR-V220E-30K/37K</td> <td>FR-V240E-30K/37K</td> </tr> <tr> <td>FR-ACN08</td> <td>FR-V220E-45K</td> <td>FR-V240E-45K</td> </tr> </tbody> </table> <table border="1"> <thead> <tr> <th rowspan="2">Type</th> <th colspan="7">[Unit: mm (inches)]</th> </tr> <tr> <th>W</th> <th>W1</th> <th>H</th> <th>H1</th> <th>H2</th> <th>H3</th> <th>H4</th> </tr> </thead> <tbody> <tr> <td>FR-ACN02</td> <td>150 (5.91)</td> <td>125 (4.92)</td> <td>336 (13.23)</td> <td>320 (12.60)</td> <td>8 (0.31)</td> <td>8 (0.31)</td> <td>17 (0.67)</td> </tr> <tr> <td>FR-ACN03</td> <td>220 (8.66)</td> <td>195 (7.68)</td> <td>336 (13.23)</td> <td>320 (12.60)</td> <td>8 (0.31)</td> <td>8 (0.31)</td> <td>17 (0.67)</td> </tr> <tr> <td>FR-ACN04</td> <td>280 (11.02)</td> <td>230 (9.06)</td> <td>554 (21.81)</td> <td>530 (20.87)</td> <td>12 (0.47)</td> <td>12 (0.47)</td> <td>122 (4.80)</td> </tr> <tr> <td>FR-ACN05</td> <td>330 (12.99)</td> <td>280 (11.02)</td> <td>604 (23.78)</td> <td>580 (22.83)</td> <td>12 (0.47)</td> <td>12 (0.47)</td> <td>122 (4.80)</td> </tr> <tr> <td>FR-ACN06</td> <td>340 (13.39)</td> <td>290 (11.42)</td> <td>682 (26.85)</td> <td>625 (24.61)</td> <td>19 (0.75)</td> <td>38 (1.50)</td> <td>111 (4.37)</td> </tr> <tr> <td>FR-ACN07</td> <td>460 (18.11)</td> <td>410 (16.14)</td> <td>625 (24.61)</td> <td>590 (23.23)</td> <td>15 (0.59)</td> <td>20 (0.79)</td> <td>80 (3.15)</td> </tr> <tr> <td>FR-ACN08</td> <td>490 (19.29)</td> <td>430 (16.93)</td> <td>775 (30.51)</td> <td>730 (28.74)</td> <td>17 (0.67)</td> <td>28 (1.10)</td> <td>80 (3.15)</td> </tr> </tbody> </table>	Type	Applicable Inverter		200V class	400V class	FR-ACN02	FR-V220E-1.5K/2.2K	FR-V240E-1.5K/2.2K	FR-ACN03	FR-V220E-3.7K to 7.5K	FR-V240E-3.7K/5.5K	FR-ACN04	FR-V220E-11K	FR-V240E-7.5K/11K	FR-ACN05	FR-V220E-15K/18.5K	FR-V240E-15K/18.5K	FR-ACN06	FR-V220E-22K	FR-V240E-22K	FR-ACN07	FR-V220E-30K/37K	FR-V240E-30K/37K	FR-ACN08	FR-V220E-45K	FR-V240E-45K	Type	[Unit: mm (inches)]							W	W1	H	H1	H2	H3	H4	FR-ACN02	150 (5.91)	125 (4.92)	336 (13.23)	320 (12.60)	8 (0.31)	8 (0.31)	17 (0.67)	FR-ACN03	220 (8.66)	195 (7.68)	336 (13.23)	320 (12.60)	8 (0.31)	8 (0.31)	17 (0.67)	FR-ACN04	280 (11.02)	230 (9.06)	554 (21.81)	530 (20.87)	12 (0.47)	12 (0.47)	122 (4.80)	FR-ACN05	330 (12.99)	280 (11.02)	604 (23.78)	580 (22.83)	12 (0.47)	12 (0.47)	122 (4.80)	FR-ACN06	340 (13.39)	290 (11.42)	682 (26.85)	625 (24.61)	19 (0.75)	38 (1.50)	111 (4.37)	FR-ACN07	460 (18.11)	410 (16.14)	625 (24.61)	590 (23.23)	15 (0.59)	20 (0.79)	80 (3.15)	FR-ACN08	490 (19.29)	430 (16.93)	775 (30.51)	730 (28.74)	17 (0.67)	28 (1.10)	80 (3.15)
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Dirt-protection structure attachment FR-ACV□□	<ul style="list-style-type: none"> By installing this option in the slits at the top, bottom, right and left of the inverter, the inverter can be changed to be an enclosed structure model (IP40). (The box-shaped attachment is added to the wiring section of 7.5K to 18.5K.) Adequate for wall mounting application, etc. <p>IP40 (JEM1030): Structure which prevents a wire, copper band or the like in excess of 1mm (0.04 inches) in diameter or thickness from entering into the inverter.</p> <p>Note 1: This structure is not protected from water and fluid entry and is therefore not appropriate for environments often exposed to water drop and oily smoke.</p> <p>2: When this attachment is used, the permissible ambient temperature of the inverter is -10 to +40°C (14°F to 104°F).</p>	<table border="1"> <thead> <tr> <th rowspan="2">Type</th> <th colspan="2">Applicable Inverter</th> </tr> <tr> <th>200V class</th> <th>400V class</th> </tr> </thead> <tbody> <tr> <td>FR-ACV02</td> <td>FR-V220E-1.5K/2.2K</td> <td>FR-V240E-1.5K/2.2K</td> </tr> <tr> <td>FR-ACV03</td> <td>FR-V220E-3.7K to 7.5K</td> <td>FR-V240E-3.7K to 5.5K</td> </tr> <tr> <td>FR-ACV04</td> <td>FR-V220E-11K</td> <td>FR-V240E-7.5K/11K</td> </tr> <tr> <td>FR-ACV05</td> <td>FR-V220E-15K/18.5K</td> <td>FR-V240E-15K/18.5K</td> </tr> </tbody> </table>	Type	Applicable Inverter		200V class	400V class	FR-ACV02	FR-V220E-1.5K/2.2K	FR-V240E-1.5K/2.2K	FR-ACV03	FR-V220E-3.7K to 7.5K	FR-V240E-3.7K to 5.5K	FR-ACV04	FR-V220E-11K	FR-V240E-7.5K/11K	FR-ACV05	FR-V220E-15K/18.5K	FR-V240E-15K/18.5K																																																																																
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Conduit connection attachment FR-AFN□□	<ul style="list-style-type: none"> Used to connect a conduit pipe directly to the bottom of the inverter. By installing this attachment, 7.5K to 45K (200V, 400V) are changed in structure specification to IP20. (IP00 is standard.)  <p>Note: Secured in a total of four places: by two installation screws at the bottom of the inverter and in two places at the bottom of the FR-AFN.</p>	<table border="1"> <thead> <tr> <th rowspan="2">Type</th> <th colspan="2">Applicable Inverter</th> </tr> <tr> <th>200V class</th> <th>400V class</th> </tr> </thead> <tbody> <tr> <td>FR-AFN04</td> <td>FR-V220E-1.5K/2.2K</td> <td>FR-V240E-1.5K/2.2K</td> </tr> <tr> <td>FR-AFN05</td> <td>FR-V220E-3.7K/5.5K/7.5K</td> <td>FR-V240E-3.7K/5.5K</td> </tr> <tr> <td>FR-AFN06</td> <td>FR-V220E-11K</td> <td>FR-V240E-7.5K/11K</td> </tr> <tr> <td>FR-AFN07</td> <td>FR-V220E-15K/18.5K</td> <td>FR-V240E-15K/18.5K</td> </tr> <tr> <td>FR-AFN08</td> <td>FR-V220E-22K</td> <td>FR-V240E-22K</td> </tr> <tr> <td>FR-AFN09</td> <td>FR-V220E-30K/37K</td> <td>FR-V240E-30K/37K</td> </tr> <tr> <td>FR-AFN10</td> <td>FR-V220E-45K</td> <td>FR-V240E-45K</td> </tr> </tbody> </table> <p>Attachment Outline Drawing [Unit: mm (inches)]</p> <table border="1"> <thead> <tr> <th>Type</th> <th>L</th> <th>H</th> <th>P</th> <th>N</th> <th>D</th> <th>M</th> <th>R</th> </tr> </thead> <tbody> <tr> <td>FR-AFN04</td> <td>45 (1.77)</td> <td>115 (4.53)</td> <td>48 (1.89)</td> <td>3 (0.12)</td> <td>35 (1.38)</td> <td>60 (2.36)</td> <td>6 (0.24)</td> </tr> <tr> <td>FR-AFN05</td> <td>55 (2.16)</td> <td>115 (4.53)</td> <td>60 (2.36)</td> <td>3 (0.12)</td> <td>44 (1.73)</td> <td>70 (2.76)</td> <td>6 (0.24)</td> </tr> <tr> <td>FR-AFN06</td> <td>70 (2.76)</td> <td>115 (4.53)</td> <td>68 (2.68)</td> <td>3 (0.12)</td> <td>51 (2.01)</td> <td>90 (3.54)</td> <td>10 (0.39)</td> </tr> <tr> <td>FR-AFN07</td> <td>145 (5.71)</td> <td>115 (4.53)</td> <td>68 (2.68)</td> <td>4 (0.16)</td> <td>51 (2.01)</td> <td>165 (6.50)</td> <td>10 (0.39)</td> </tr> <tr> <td>FR-AFN08</td> <td>145 (5.71)</td> <td>95 (3.74)</td> <td>68 (2.68)</td> <td>4 (0.16)</td> <td>50 (1.97)</td> <td>102.5 (4.04)</td> <td>10 (0.39)</td> </tr> <tr> <td>FR-AFN09</td> <td>285 (11.22)</td> <td>120 (4.72)</td> <td>113 (4.45)</td> <td>3 (0.12)</td> <td>91 (3.58)</td> <td>227.5 (8.96)</td> <td>12 (0.47)</td> </tr> <tr> <td>FR-AFN10</td> <td>285 (11.22)</td> <td>120 (4.72)</td> <td>113 (4.45)</td> <td>4 (0.16)</td> <td>91 (3.58)</td> <td>227.5 (8.96)</td> <td>12 (0.47)</td> </tr> </tbody> </table> <p>* Same dimensions as those of the inverter.</p>	Type	Applicable Inverter		200V class	400V class	FR-AFN04	FR-V220E-1.5K/2.2K	FR-V240E-1.5K/2.2K	FR-AFN05	FR-V220E-3.7K/5.5K/7.5K	FR-V240E-3.7K/5.5K	FR-AFN06	FR-V220E-11K	FR-V240E-7.5K/11K	FR-AFN07	FR-V220E-15K/18.5K	FR-V240E-15K/18.5K	FR-AFN08	FR-V220E-22K	FR-V240E-22K	FR-AFN09	FR-V220E-30K/37K	FR-V240E-30K/37K	FR-AFN10	FR-V220E-45K	FR-V240E-45K	Type	L	H	P	N	D	M	R	FR-AFN04	45 (1.77)	115 (4.53)	48 (1.89)	3 (0.12)	35 (1.38)	60 (2.36)	6 (0.24)	FR-AFN05	55 (2.16)	115 (4.53)	60 (2.36)	3 (0.12)	44 (1.73)	70 (2.76)	6 (0.24)	FR-AFN06	70 (2.76)	115 (4.53)	68 (2.68)	3 (0.12)	51 (2.01)	90 (3.54)	10 (0.39)	FR-AFN07	145 (5.71)	115 (4.53)	68 (2.68)	4 (0.16)	51 (2.01)	165 (6.50)	10 (0.39)	FR-AFN08	145 (5.71)	95 (3.74)	68 (2.68)	4 (0.16)	50 (1.97)	102.5 (4.04)	10 (0.39)	FR-AFN09	285 (11.22)	120 (4.72)	113 (4.45)	3 (0.12)	91 (3.58)	227.5 (8.96)	12 (0.47)	FR-AFN10	285 (11.22)	120 (4.72)	113 (4.45)	4 (0.16)	91 (3.58)	227.5 (8.96)	12 (0.47)
Type	Applicable Inverter																																																																																											
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FR-AFN08	FR-V220E-22K	FR-V240E-22K																																																																																										
FR-AFN09	FR-V220E-30K/37K	FR-V240E-30K/37K																																																																																										
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VDE Standard-compliant noise filter FR-ALF□□□*	<ul style="list-style-type: none"> This noise filter conforms to VDE 0871 Class A (noise terminal voltage). Manufacturer: Fuji Electrochemical (FDK) Outline drawing  <p>Note: Secured in a total of four places: by two installation screws at the bottom of the inverter and in two places at the bottom of the FR-AFN.</p>	<p>[Unit: mm (inches)]</p> <table border="1"> <thead> <tr> <th>Filter Type</th> <th>Applicable Inverter</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> <th>E</th> <th>F</th> <th>G</th> <th>Weight (kg)</th> <th>Leakage Current</th> </tr> </thead> <tbody> <tr> <td>FR-ALF-0.75K</td> <td>-</td> <td>340 (13.39)</td> <td>120 (4.72)</td> <td>80 (3.15)</td> <td>295 (11.61)</td> <td>100 (3.94)</td> <td rowspan="4">M4</td> <td>φ4.5</td> <td>4 (8.8)</td> <td>1</td> </tr> <tr> <td>FR-ALF-2.2K</td> <td>FR-V200E-1.5K</td> <td>390 (15.35)</td> <td>150 (5.91)</td> <td>100 (3.94)</td> <td>345 (13.58)</td> <td>120 (4.72)</td> <td>φ5.5</td> <td>7 (15.4)</td> <td>1</td> </tr> <tr> <td>FR-ALF-3.7K</td> <td>FR-V200E-2.2K</td> <td>490 (19.29)</td> <td>185 (7.28)</td> <td>115 (4.53)</td> <td>435 (17.13)</td> <td>150 (5.91)</td> <td rowspan="2">M5</td> <td rowspan="2">φ6.5</td> <td rowspan="2">12 (26.5)</td> <td rowspan="2">1</td> </tr> <tr> <td>FR-ALF-7.5K</td> <td>FR-V200E-3.7K/5.5K</td> <td>390 (15.35)</td> <td>150 (5.91)</td> <td>100 (3.94)</td> <td>345 (13.58)</td> <td>120 (4.72)</td> </tr> <tr> <td>FR-ALF-H0.75K</td> <td>-</td> <td>390 (15.35)</td> <td>150 (5.91)</td> <td>100 (3.94)</td> <td>345 (13.58)</td> <td>120 (4.72)</td> <td rowspan="3">M4</td> <td rowspan="3">φ5.5</td> <td>6 (13.2)</td> <td>3.5</td> </tr> <tr> <td>FR-ALF-H2.2K</td> <td>FR-V240E-1.5K</td> <td>6 (13.2)</td> <td>3.5</td> </tr> <tr> <td>FR-ALF-H3.7K</td> <td>FR-V240E-2.2K</td> <td>6 (13.2)</td> <td>3.5</td> </tr> </tbody> </table> <ul style="list-style-type: none"> For the filters used with the 200V 11K or more (filters 18.5K, 30K, 55K) and 400V class (filters 11K, 15K, 30K, 55K) inverters, contact your sales representative. Wiring supply  <p>If the earthing method is not as shown above, the noise reduction effect may reduce.</p>	Filter Type	Applicable Inverter	A	B	C	D	E	F	G	Weight (kg)	Leakage Current	FR-ALF-0.75K	-	340 (13.39)	120 (4.72)	80 (3.15)	295 (11.61)	100 (3.94)	M4	φ4.5	4 (8.8)	1	FR-ALF-2.2K	FR-V200E-1.5K	390 (15.35)	150 (5.91)	100 (3.94)	345 (13.58)	120 (4.72)	φ5.5	7 (15.4)	1	FR-ALF-3.7K	FR-V200E-2.2K	490 (19.29)	185 (7.28)	115 (4.53)	435 (17.13)	150 (5.91)	M5	φ6.5	12 (26.5)	1	FR-ALF-7.5K	FR-V200E-3.7K/5.5K	390 (15.35)	150 (5.91)	100 (3.94)	345 (13.58)	120 (4.72)	FR-ALF-H0.75K	-	390 (15.35)	150 (5.91)	100 (3.94)	345 (13.58)	120 (4.72)	M4	φ5.5	6 (13.2)	3.5	FR-ALF-H2.2K	FR-V240E-1.5K	6 (13.2)	3.5	FR-ALF-H3.7K	FR-V240E-2.2K	6 (13.2)	3.5																					
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FR-ALF-3.7K	FR-V200E-2.2K	490 (19.29)	185 (7.28)	115 (4.53)	435 (17.13)	150 (5.91)		M5	φ6.5	12 (26.5)	1																																																																																	
FR-ALF-7.5K	FR-V200E-3.7K/5.5K	390 (15.35)	150 (5.91)	100 (3.94)	345 (13.58)	120 (4.72)																																																																																						
FR-ALF-H0.75K	-	390 (15.35)	150 (5.91)	100 (3.94)	345 (13.58)	120 (4.72)	M4	φ5.5	6 (13.2)	3.5																																																																																		
FR-ALF-H2.2K	FR-V240E-1.5K	6 (13.2)	3.5																																																																																									
FR-ALF-H3.7K	FR-V240E-2.2K	6 (13.2)	3.5																																																																																									

Option (Type)	Specifications, Structure, Etc.								Wiring, Etc.			
High-duty brake resistor FR- ABR-(H)□□K*	[Unit: mm (inches)]											
	Brake Resistor Type	Permissible Brake Duty	External Dimensions							Resistance(Ω) Rated Power(W)	Approx. Weight [kg (lbs)]	
	200V class	FR-ABR-2.2K*	10%	240 (9.45)	225 (8.86)	200 (7.87)	50 (1.97)	25 (0.98)		2.0 (0.08)	60 250	0.5 (1.1)
		FR-ABR-3.7K	10%	215 (8.46)	200 (7.87)	175 (6.89)	60 (2.36)	30 (1.18)		2.5 (0.10)	40 300	0.8 (1.8)
		FR-ABR-5.5K	10%	335 (13.19)	320 (12.60)	295 (11.61)	60 (2.36)	30 (1.18)		2.5 (0.10)	25 500	1.3 (2.9)
	400V class	FR-ABR-H1.5K	10%	215 (8.46)	200 (7.87)	175 (6.89)	40 (1.57)	20 (0.79)		2.5 (0.10)	350 150	0.4 (0.9)
		FR-ABR-H2.2K	10%	240 (9.45)	225 (8.86)	200 (7.87)	50 (1.97)	25 (0.98)		2.0 (0.08)	250 250	0.5 (1.1)
		FR-ABR-H3.7K	10%	215 (8.46)	200 (7.87)	175 (6.89)	60 (2.36)	30 (1.18)		2.5 (0.10)	150 300	0.8 (1.8)
		FR-ABR-H5.5K	10%	335 (13.18)	320 (12.60)	295 (11.61)	60 (2.36)	30 (1.18)		2.5 (0.10)	110 500	1.3 (2.9)
	* Common to 1.5K and 2.2K											
												

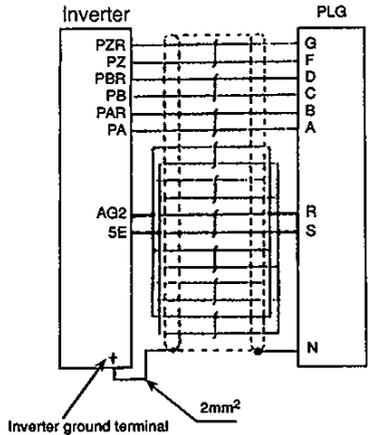
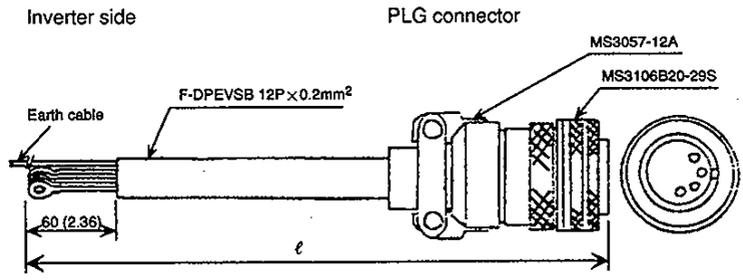
- Note: 1. When the FR-ABR brake resistor is used, disconnect the link from terminals PR and PX. If it is not disconnected, the built-in brake resistor will overheat. (The built-in brake resistor need not be removed.)
2. The setting of the regenerative brake duty should be 10% or less.
3. Note the installation and heat dissipation of the brake resistor since its temperature may rise to higher than 300°C (572°F) depending on the frequency of operations.
4. The MYS resistor can be used. The permissible brake duty is 6%.

Option (Type)

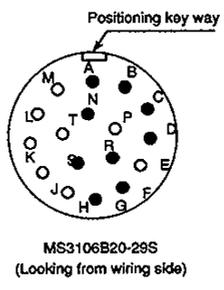
Specifications, Structure, Etc.

[Unit: mm (inches)]

PLG cable
(for vector in-
verter motor)
FR-VCBL□□

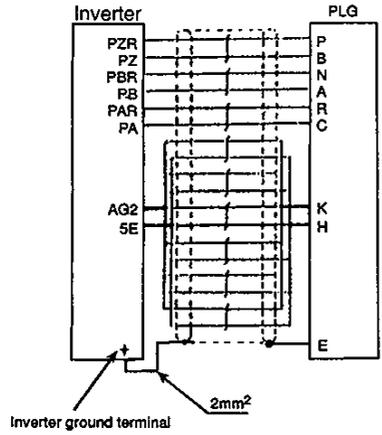
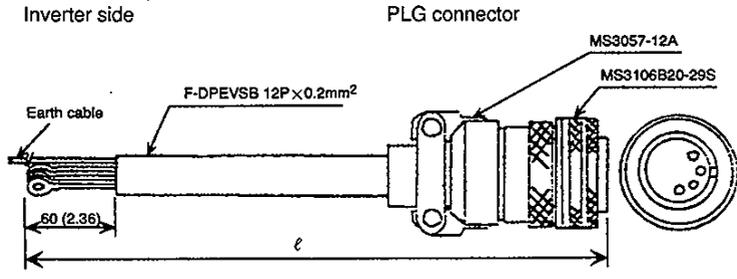


Type	Length ℓ[m(feet)]
FR-VCBL5	5 (36.16)
FR-VCBL15	15 (108.49)
FR-VCBL30	30 (216.99)

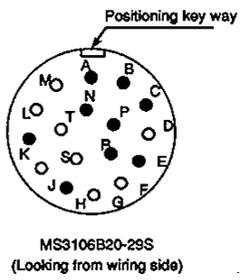


PLG cable
(for motor with
PLG)
FR-JCBL□□

[Unit: mm (inches)]



Type	Length ℓ[m(feet)]
FR-JCBL5	5 (36.16)
FR-JCBL15	15 (108.49)
FR-JCBL30	30 (216.99)



Option (Type)

Power factor improving DC reactor
(for power coordination)
(for harmonic reduction)
FR-BEL-(H)□□K*

Specifications, Structure, Etc.

[Unit: mm (inches)]

Type	A	B	C	D	E	F	G	H	Weight [kg (lbs)]	Fig.
3.7K	150 (5.91)	75 (2.95)	102 (4.02)	2 (0.08)	135 (5.31)	6 (0.24)	M4	40 (1.57)	1.7 (3.8)	1
5.5K	150 (5.91)	75 (2.95)	126 (4.96)	2 (0.08)	135 (5.31)	6 (0.24)	M5	40 (1.57)	2.2 (4.9)	1
7.5K	150 (5.91)	75 (2.95)	126 (4.96)	2 (0.08)	135 (5.31)	6 (0.24)	M5	40 (1.57)	2.3 (5.1)	1
11K	170 (6.69)	93 (3.66)	132 (5.20)	2.3 (0.09)	155 (6.10)	6 (0.24)	M5	50 (1.97)	3.1 (6.8)	1
15K	170 (6.69)	93 (3.66)	170 (6.69)	2.3 (0.09)	155 (6.10)	6 (0.24)	M8	56 (2.20)	3.8 (8.4)	2
18.5K	185 (7.28)	94 (3.70)	184 (7.24)	2.6 (0.10)	165 (6.50)	7 (0.28)	M8	56 (2.20)	5.1 (11.2)	2
22K	185 (7.28)	119 (4.69)	182 (7.17)	2.6 (0.10)	165 (6.50)	7 (0.28)	M8	70 (2.76)	5.4 (11.8)	2
30K	185 (7.28)	119 (4.69)	201 (7.91)	2.6 (0.10)	165 (6.50)	7 (0.28)	M8	70 (2.76)	6.7 (14.8)	2
37K	195 (7.68)	136 (5.35)	215 (8.46)	2.6 (0.10)	175 (6.89)	7 (0.28)	M10	70 (2.76)	7.4 (16.3)	2
45K	195 (7.68)	136 (5.35)	215 (8.46)	2.6 (0.10)	175 (6.89)	7 (0.28)	M10	70 (2.76)	8.0 (17.6)	2
H3.7K	150 (5.91)	75 (2.95)	102 (4.02)	2 (0.08)	135 (5.31)	6 (0.24)	M4	40 (1.57)	1.7 (3.8)	1
H5.5K	150 (5.91)	75 (2.95)	124 (4.88)	2 (0.08)	135 (5.31)	6 (0.24)	M4	40 (1.57)	2.2 (4.9)	1
H7.5K	150 (5.91)	75 (2.95)	124 (4.88)	2 (0.08)	135 (5.31)	6 (0.24)	M4	40 (1.57)	2.3 (5.1)	1
H11K	170 (6.69)	93 (3.66)	132 (5.20)	2.3 (0.09)	155 (6.10)	6 (0.24)	M5	50 (1.97)	3.1 (6.8)	1
H15K	170 (6.69)	93 (3.66)	160 (6.30)	2.3 (0.09)	155 (6.10)	6 (0.24)	M6	56 (2.20)	3.7 (8.2)	2
H18.5K	185 (7.28)	94 (3.70)	173 (6.81)	2.6 (0.10)	165 (6.50)	7 (0.28)	M6	56 (2.20)	4.8 (10.6)	2
H22K	185 (7.28)	119 (4.69)	171 (6.73)	2.6 (0.10)	165 (6.50)	7 (0.28)	M6	70 (2.76)	5.0 (11.0)	2
H30K	185 (7.28)	119 (4.69)	189 (7.44)	2.6 (0.10)	165 (6.50)	7 (0.28)	M6	70 (2.76)	6.7 (14.8)	2
H37K	195 (7.68)	136 (5.35)	199 (7.83)	2.6 (0.10)	175 (6.89)	7 (0.28)	M8	70 (2.76)	7.0 (15.4)	2
H45K	195 (7.68)	138 (5.43)	219 (8.62)	3.2 (0.13)	175 (6.89)	9 (0.35)	M8	80 (3.15)	8.6 (19.0)	2

Note 1: The numeral in the type indicates a motor capacity (kW).
2: Use the FR-BAL AC reactor for inverter capacities of 1.5K to 3.7K.

Wiring, Etc.

● Input power factor: about 95%

Note: 1. The input power factor is improved to about 95%.
2. The link across inverter terminals P (+) and P1 must be disconnected. (If it is not disconnected, there is no power factor improvement.)
3. The wiring distance from the inverter should be within 5m.
4. The size of the cable used should be identical to or larger than that of the power supply cable (R (L₁), S (L₂), T (L₃)). (See page 145.)
5. Select the reactor according to the motor capacity. (If the inverter capacity is greater than the motor capacity, select the reactor according to the motor capacity.)
6. Note that this reactor cannot be connected to the inverter of 2.2K or less.

Power factor improving AC reactor
(for power coordination)
(for harmonic reduction)
FR-BAL-(H)□□K*

Specifications, Structure, Etc.

[Unit: mm (inches)]

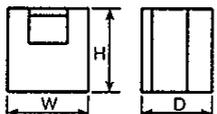
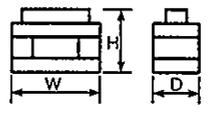
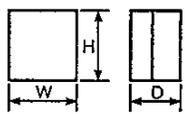
Capacity	FR-BAL(200V)						Weight [kg (lbs)]	FR-BAL-H(400V)						Weight [kg (lbs)]
	A	B	C	D	E	F		A	B	C	D	E	F	
1.5kW	160 (6.30)	76 (2.99)	145 (5.71)	145 (5.71)	55 (2.17)	M4	4	150 (5.91)	92 (3.62)	145 (5.71)	145 (5.71)	70 (2.76)	M4	5.3 (11.7)
2.2kW	160 (6.30)	96 (3.78)	145 (5.71)	145 (5.71)	75 (2.95)	M4	6	150 (5.91)	96 (3.78)	145 (5.71)	145 (5.71)	75 (2.95)	M4	5.9 (13.0)
3.7kW	220 (8.66)	95 (3.74)	200 (7.87)	200 (7.87)	70 (2.76)	M5	8.5 (20.9)	220 (8.66)	95 (3.74)	195 (7.68)	200 (7.87)	70 (2.76)	M5	8.5 (18.7)
5.5kW	220 (8.66)	101 (3.98)	200 (7.87)	200 (7.87)	75 (2.95)	M5	9.5 (24.0)	220 (8.66)	101 (3.98)	200 (7.87)	200 (7.87)	75 (2.95)	M5	9.5 (20.9)
7.5kW	220 (8.66)	125 (4.92)	205 (8.07)	200 (7.87)	100 (3.94)	M5	14.5 (36.0)	220 (8.66)	125 (4.92)	200 (7.87)	200 (7.87)	100 (3.94)	M5	14 (30.9)
11kW	280 (11.02)	140 (5.51)	245 (9.65)	255 (10.04)	100 (3.94)	M6	19 (41.9)	280 (11.02)	140 (5.51)	235 (9.25)	255 (10.04)	100 (3.94)	M6	18.5 (40.8)
15kW	295 (11.61)	155 (6.14)	280 (11.02)	270 (10.63)	110 (4.33)	M6	27 (59.5)	295 (11.61)	155 (6.14)	270 (10.63)	270 (10.63)	110 (4.33)	M8	27 (59.5)
22kW	290 (11.42)	200 (7.87)	300 (11.81)	240 (9.45)	170 (6.69)	M8	35 (77.2)	290 (11.42)	200 (7.87)	300 (11.81)	240 (9.45)	170 (6.69)	M8	35 (77.2)
30kW	290 (11.42)	220 (8.66)	300 (11.81)	240 (9.45)	190 (7.48)	M8	43 (94.8)	290 (11.42)	220 (8.66)	300 (11.81)	240 (9.45)	190 (7.48)	M8	43 (94.8)
37kW	330 (12.99)	240 (9.45)	360 (14.17)	270 (10.63)	190 (7.48)	M10	50 (110.0)	330 (12.99)	220 (8.66)	360 (14.17)	270 (10.63)	190 (7.48)	M10	50 (110.0)
45kW	330 (12.99)	240 (9.45)	360 (14.17)	270 (10.63)	190 (7.48)	M10	60 (132.0)	330 (12.99)	220 (8.66)	410 (16.14)	270 (10.63)	190 (7.48)	M10	60 (132.0)

Wiring, Etc.

● Input power factor: about 90%

Note: 1. The input power factor is improved to about 90%.
2. Select the reactor according to the motor capacity.
3. Use the reactor for 22kW when a 18.5K inverter is used.

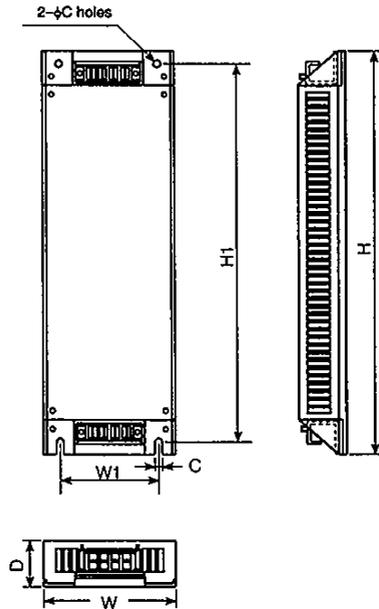
Option (Type)	Specifications, Structure, Etc.	Remarks														
Radio noise filter FR-BIF...200V class FR-BIF-H ...400V class	<p style="text-align: center;">[Unit: mm (inches)]</p>	<p>Note: 1. This filter cannot be connected to the output side of the inverter. 2. The cables should be as short as possible and connected to the terminal block of the inverter.</p>														
Line noise filter FR-BSF01 (for small capacity) FR-BLF	<p style="text-align: center;">[Unit: mm (inches)]</p>	<p>Note: 1. Wind the cable 4 or more times in the same direction in each phase. (A greater effect is produced as the winding times increase.) 2. If the cable size is too large to wind, use four or more filters in series and wind the cable in the same direction in each phase. 3. This filter can also be used on the output side as on the input side. The winding on the output side should be within 3 turns. 4. Use the FR-BSF01 with the inverter of 3.7kW or less capacity. A thick cable (38mm² or more) cannot be used. In such a case, use the FR-BLF.</p>														
Parameter unit cable FR-CBL□	<table border="1"> <thead> <tr> <th colspan="2">Type</th> <th rowspan="2">Length ℓ(m/feet)</th> </tr> <tr> <th>Straight type</th> <th>L</th> </tr> </thead> <tbody> <tr> <td>FR-CBL01</td> <td>FR-CBL-L1</td> <td>1 (7.23)</td> </tr> <tr> <td>FR-CBL03</td> <td>FR-CBL-L3</td> <td>3 (21.70)</td> </tr> <tr> <td>FR-CBL05</td> <td>FR-CBL-L5</td> <td>5 (36.16)</td> </tr> </tbody> </table>	Type		Length ℓ(m/feet)	Straight type	L	FR-CBL01	FR-CBL-L1	1 (7.23)	FR-CBL03	FR-CBL-L3	3 (21.70)	FR-CBL05	FR-CBL-L5	5 (36.16)	<p>The PU side connector of this L type can be fixed to an enclosure with the accessory screws.</p> <p style="text-align: right;">[Unit: mm (inches)]</p>
Type		Length ℓ(m/feet)														
Straight type	L															
FR-CBL01	FR-CBL-L1	1 (7.23)														
FR-CBL03	FR-CBL-L3	3 (21.70)														
FR-CBL05	FR-CBL-L5	5 (36.16)														

Option (Type)	Specifications, Structure, Etc.												
High power factor converter FR-HC□□	<ul style="list-style-type: none"> Capable of improving the input power factor to about 1 (at the load factor of 100%), this converter can reduce the power supply capacity to approx. 2/3. This converter has a power return function as standard to provide large braking capability. (100% continuous return possible) More than one inverter can be connected to one high power factor converter. Use the high power factor converter with the standard accessories of external box, reactor 1 and reactor 2. 												
Specifications													
Model FR-HC-□□	200V				400V								
Applicable inverter capacity (Note 1)	7.5K	15K	30K	55K	H7.5	H15K	H30K	H55K					
	3.7K to 7.5K	7.5K to 15K	15K to 30K	30K to 55K	3.7K to 7.5K	7.5K to 15K	15K to 30K	30K to 55K					
Rated input voltage/frequency	3-phase, 200V to 220V 50Hz 200V to 230V 60Hz				3-phase, 380V to 460V 50/60Hz								
Rated input current (A)	33	61	115	215	17	31	57	110					
Rated output voltage (V) (Note 2)	DC293V to 335V				DC558V to 670V								
Approx. weight	Unit (kg (lbs))												
Total weight of accessories (reactors 1, 2, external box) (kg (lbs))	8 (17.6)	15 (33.1)	29 (63.9)	70 (154.3)	9 (19.8)	16 (35.3)	35 (77.2)	72 (158.7)					
Note 1: The applicable capacity is the sum total of the capacities of the inverters used with the high power factor converter.													
Note 2: The output voltage varies with the value of the input voltage.													
Outline dimensions [Unit: mm (inches)]													
Voltage	Capacity	High Power Factor Converter FR-HC			Reactor 1 FR-HCL01			Reactor 2 FR-HCL02			External Box FR-HCB		
		W	H	D	W	H	D	W	H	D	W	H	D
200V	7.5K	220 (8.66)	300 (11.81)	190 (7.48)	160 (6.30)	155 (6.10)	100 (3.94)	240 (9.45)	230 (9.06)	160 (6.30)	190 (7.48)	320 (12.60)	165 (6.50)
	15K	250 (9.84)	400 (15.75)	190 (7.48)	190 (7.48)	205 (8.07)	130 (5.12)	260 (10.24)	270 (10.63)	170 (6.69)			
	30K	340 (13.39)	550 (21.65)	195 (7.68)	220 (8.66)	230 (9.06)	170 (6.69)	340 (13.39)	320 (12.60)	180 (7.09)	270 (10.63)	450 (17.72)	203 (7.99)
	55K	490 (18.90)	700 (27.56)	250 (9.84)	210 (8.27)	260 (10.24)	225 (8.86)	430 (16.93)	470 (18.50)	360 (14.17)			
400V	7.5K	220 (8.66)	300 (11.81)	190 (7.48)	160 (6.30)	150 (5.91)	100 (3.94)	240 (9.45)	220 (8.66)	160 (6.30)	190 (7.48)	320 (12.60)	165 (6.50)
	15K	250 (9.84)	400 (15.75)	190 (7.48)	190 (7.48)	195 (7.68)	130 (5.12)	260 (10.24)	260 (10.24)	170 (6.69)			
	30K	340 (13.39)	550 (21.65)	195 (7.68)	220 (8.66)	215 (8.46)	140 (5.51)	340 (13.39)	310 (12.20)	180 (7.09)	270 (10.63)	450 (17.72)	203 (7.99)
	55K	490 (18.90)	700 (27.56)	250 (9.84)	280 (11.02)	255 (10.04)	190 (7.48)	400 (15.75)	380 (14.96)	285 (11.22)			
<div style="display: flex; justify-content: space-around; align-items: flex-start;"> <div style="text-align: center;"> <p>High Power Factor Converter</p>  </div> <div style="text-align: center;"> <p>Reactor 1, 2</p>  </div> <div style="text-align: center;"> <p>External Box</p>  </div> </div>													

EMC Directive-compliant noise filter
SF□□

- This noise filter complies with the European EMC Directive.
- Outline dimension drawing

Noise Filter Model	Applicable Inverter Model	Noise Filter Outline Dimensions [Unit: mm (inches)]						Approx. Weight [kg (lbe)]	Loss (W)	
		H	D	W	H1	W1	C			
400V	SF1197	FR-V240E-1.5K/2.2K	360 (14.17)	47.5 (1.87)	144 (5.67)	340 (13.39)	117 (4.61)	6 (0.24)	1.5 (3.3)	9.7
	SF1174B	FR-V240E-3.7K/5.5K	360 (14.17)	38 (1.50)	213 (8.39)	340 (13.39)	180 (7.09)	6 (0.24)	1.8 (4.0)	51
	SF1175	FR-V240E-7.5K/11K	530 (20.86)	60 (2.36)	253 (9.96)	505 (19.88)	220 (8.66)	10 (0.39)	4.7 (10.4)	56
	SF1176	FR-V240E-15K/18.5K	600 (23.62)	60 (2.36)	303 (11.93)	575 (22.64)	260 (10.24)	10 (0.39)	5.9 (13.0)	71
	SF1177	FR-V240E-22K	700 (27.56)	80 (3.15)	327 (12.87)	675 (26.57)	280 (11.02)	10 (0.39)	9.4 (20.7)	65
	SF1178	FR-V240E-30K/37K	770 (30.31)	80 (3.15)	450 (17.72)	735 (28.94)	384 (15.12)	12 (0.47)	16 (35.3)	74
	SF1179	FR-V240E-45K	920 (36.22)	80 (3.15)	467 (18.39)	895 (35.24)	410 (16.14)	12 (0.47)	19 (41.9)	125



INSTRUCTIONS FOR COMPLIANCE WITH THE EUROPEAN DIRECTIVES

(Only the 400V class products comply with the Directives. The products which comply with the Low Voltage Directive carry the CE mark.)

1. EMC DIRECTIVE

(1) Our view of vector inverters and the EMC Directive

A vector inverter does not function independently. It is a component designed for installation in a control box and for use with other equipment to control a machine or equipment. Therefore, we do not think that the EMC Directive applies directly to vector inverters. For this reason, we do not place the CE mark on the vector inverters themselves. The European power drive manufacturers' organization (CEMEP) also holds this point of view.

(2) Compliance

We do not think that the vector inverters themselves are covered directly by the EMC Directive. However, the EMC Directive applies to machines and equipment into which vector inverters have been incorporated, and these machines and equipment must carry the CE mark. Hence, we have prepared a technical document "EMC Installation Guidelines" (manual number BCN-A21041-202) so that machines and equipment incorporating vector inverters may conform to the EMC Directive more easily.

(3) Outline of installation method

It is recommended to install an inverter in the following method:

- * Use the inverter with an European Standard-compliant noise filter (for 400V class only).
- * For wiring between the inverter and motor use, shielded cables or run cables in metal conduit and ground the cables or conduit at the inverter and motor ends. Use the shortest possible cable length.
- * Install the inverter in an earthed metal enclosure. The enclosure should prevent radiated noise leakage.

Use the no-fuse breaker and magnetic contactor which comply with EN or IEC.

- * Insert a line noise filter and ferrite core into the power and control lines as required.

Full information including the European Standard-compliant noise filter (for 400V class only) specifications are published in the "EMC Installation Guidelines" (information number BCN-A21041-202). Please contact your sales representative.

2. Low Voltage Directive

(1) Our view of vector inverters for the Low Voltage Directive

Vector inverters are covered by the Low Voltage Directive.

(2) Compliance

The European verification institution has approved that our inverters conform to DIN VDE0160. Therefore, the CE mark is placed on the inverters.

(3) Instructions

To conform to DIN VDE0160, the following specifications and instructions listed are different from those of the standard models.

- * In the 400V class inverters, the rated input voltage range is 3-phase, 380V to 415V, 50/60Hz.
- * Connect the equipment to the earth securely. Do not use an earth leakage circuit breaker as an electric shock protector without connecting the equipment to the earth.
- * Wire the earth terminal independently. (Do not connect two or more cables to one terminal.)
- * Only use EN or IEC compliant no-fuse breaker and magnetic contactors.
- * In the input of the inverter, insert an EN or IEC Standard-compliant isolation transformer or surge suppressor (Not required when the operating place falls within the overvoltage category II set forth in IEC664).
- * For the input and output of the inverter, only use cables of the type and size set forth in EN60204 Appendix C.

INSTRUCTIONS FOR COMPLIANCE WITH THE UL STANDARD

1. UL STANDARD

The UL Standard is the most general standard for motor control equipment in the U.S.A. This standard sets forth the safety of equipment, instruments and materials to protect lives and properties from fire, electric shock and other accidents. Inverters are covered by UL508C (Power Conversion Equipment) as part of power conversion equipment.

2. REQUIREMENT OF UL LISTING

In the U.S.A., laws are multiplexed, i.e. there are the federal law and state, municipal and other local laws. The Federal Government provides for only the least required legal regulations and the local governments provide for particulars. Therefore, we are not compelled by the federal law to comply with the UL Standard. It should be noted that the laws of several local governments require products to be certified as safe by the UL or other testing institution, and in local governments which do not have legal regulations, the minimum requirement of the federal law that "products should be safe" must be fulfilled.

3. INSTRUCTIONS

When using the UL-listed FR-V200, refer to the following:

(1) Installation

The FR-V200 is UL-listed as a product used in an enclosure. Install it in an enclosure.

(2) Wiring of power supply and motor

When wiring the input (R, S, T) and output (U, V, W) terminals of the inverter, refer to the following list and use the UL-listed round crimping terminals. Use a crimping tool recommended by your terminal manufacturer to crimp the crimping terminals.

Applicable Inverter Model	Screw Size	Tightening Torque N·m	Crimping Terminals		Wires (Note)			
					mm ²		AWG	
			R, S, T	U, V, W	R, S, T	U, V, W	R, S, T	U, V, W
FR-V220E-1.5K/2.2K	M4	1.47	2-4	2-4	2	2	14	14
FR-V220E-3.7K	M5	2.55	3.5-5	3.5-5	3.5	3.5	12	12
FR-V220E-5.5K			5.5-5	5.5-5	5.5	5.5	10	10
FR-V220E-7.5K			14-5	8-5	14	8	6	8
FR-V220E-11K	M6	4.41	14-6	14-6	14	14	6	6
FR-V220E-15K	M8	7.85	22-8	22-8	22	22	4	4
FR-V220E-18.5K	M8	7.85	30-8	30-8	30	30	2	2
FR-V220E-22K			38-8	30-8	38	30	2	2
FR-V220E-30K	M10	14.7	60-10	50-10	60	50	1/0	0
FR-V220E-37K	M10	14.7	80-10	80-10	80	80	3/0	3/0
FR-V220E-45K	M12	24.5	100-12	80-12	100	80	4/0	3/0
FR-V240E-1.5K/2.2K/3.7K	M4	1.47	2-4	2-4	2	2	14	14
FR-V240E-5.5K	M5	2.55	3.5-5	2-5	3.5	2	12	14
FR-V240E-7.5K	M6	4.41	3.5-6	3.5-6	3.5	3.5	12	12
FR-V240E-11K	M6	4.41	5.5-6	5.5-6	5.5	5.5	10	10
FR-V240E-15K/18.5K	M6	4.41	14-6	8-6	14	8	6	8
FR-V240E-22K	M6	4.41	22-6	14-6	22	14	4	6
FR-V240E-30K	M8	7.85	22-8	22-8	22	22	4	4
FR-V240E-37K	M8	7.85	38-8	22-8	30	22	2	4
FR-V240E-45K					38	30	2	2

Note: Use 75copper wires.

(3) Short circuit ratings

Having been put to the short-circuit test of the UL in the AC circuit whose peak current is limited to * A max. and whose voltage is limited to 500V max., this vector inverter conforms to this circuit.

Inverter Capacity	*
1.5kW to 37kW	5,000
45kW	10,000

REVISIONS

* The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Jun., 1996	IB (NA)-66658-A	First edition
Sep., 1996	IB (NA)-66658-B	<p>Additions</p> <ul style="list-style-type: none"> ● Connection of the FR-HC option ● Control modes ● Pr. 30 setting range ● Pr. 66 setting range ● Information on Low Voltage Directive ● Power harmonic guidelines ● Addition of EMC filter ● Instructions for compliance with the UL Standard ● Instructions for compliance with the European Directives ● Warranties
Nov., 1997	IB (NA)-66658-C	<p>Partly modified</p> <ul style="list-style-type: none"> ● Page 75 (on acceleration/deceleration torque limit) ● Page 87 (Pr. 66 factory setting) ● Page 148 (outline dimension drawing) <p>Partly add</p> <ul style="list-style-type: none"> ● Pages 60, 61 (parameter list) ● Page 65 (Pr. 14 setting range) ● Page 87, 88 (Pr. 99 setting range) <p>Additions</p> <ul style="list-style-type: none"> ● Pages 102, 103 (on Pr. 155 to 159)
Jul., 1998	IB (NA)-66658-D	<p>Modifications</p> <ul style="list-style-type: none"> ● Pr. 29 "acceleration/deceleration pattern" setting range ● Pr. 34 to Pr. 39 (torque limit level) setting ranges ● Pr. 58 "torque monitoring reference" setting range ● Pr. 69 (PLG pulse count) factory setting ● Pr. 75 (PU stop key selection) setting range ● Pr. 904, Pr. 905 (torque command No. 3 bias, gain) setting ranges <p>Torque characteristics of motor with PLG</p> <p>Additions</p> <ul style="list-style-type: none"> ● Pr. 88, Pr. 154 (droop control function) ● Pr. 103 to Pr. 106, Pr. 147 to Pr. 149, Pr. 152 to Pr. 153 (torque bias function) ● Pr. 151 (secondary resistance compensation selection)