FR-S 500

Frequency Inverter

Instruction Manual (Basic)

FR-S 520 S EC/ECR, FR-S 540 EC/ECR

MITSUBISHI ELECTRIC INDUSTRIAL AUTOMATION

MITSUBISHI

TRANSISTORIZED INVERTER

FR-S500

INSTRUCTION MANUAL (BASIC)

Thank you for choosing this Mitsubishi Transistorized inverter.
If this is the first time for you to use the FR-S500 series, please read through this instruction manual (basic) carefully and use the inverter safely.
If you are going to use the inverter for higher-level applications, the FR-S500 instruction manual (detailed) [IB(NA)-0600027] is separately available from where you purchased the inverter or your Mitsubishi sales representative.

CONTENTS

This instruction manual (basic) provides handling information and precautions for use of the equipment.

Please forward this instruction manual (basic) to the end user.

This instruction manual uses the International System of Units (SI). The measuring units in the yard and pound system are indicated in parentheses as reference values.

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 (basic) 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 (basic), 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 even 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.

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 or the charging part of the circuitry 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, check for residual voltages with a meter etc. more than 10 minutes after power-off.
- 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.
- Perform setting dial and key operations 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.
- Do not change the cooling fan while power is on.
  It is dangerous to change the cooling fan while power is on.
- When you have removed the front cover, do not touch the connector above the 3-digit monitor LED display. You will get an electric shock.

2. Fire Prevention

⚠ **CAUTION**
● Mount the inverter to incombustible material. Mounting it to or near combustible material can cause a fire.
● If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.
● Do not connect a 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 damage etc.
● Ensure that the cables are connected to the correct terminals. Otherwise, damage etc. may occur.
● Always make sure that polarity is correct to prevent damage etc.
● While power is on and for some time after power-off, do not touch the inverter as it is hot and you may get burnt.

4. Additional instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.

(1) Transportation and installation

⚠ **CAUTION**
● When carrying products, use correct lifting gear to prevent injury.
● 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.
● When carrying the inverter, do not hold it by the front cover or setting dial; it may fall off or fail.
● Do not stand or rest heavy objects on the inverter.
● Check the inverter mounting orientation is correct.
● Prevent screws, wire fragments, other conductive bodies, oil or other flammable substances from entering the inverter.
● Do not drop the inverter, or subject it to impact.

⚠ CAUTION

● Use the inverter under the following environmental conditions:

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	-20°C to +65°C (-4°F to 149°F) *
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude, vibration	Maximum 1000m (3280.80feet) above sea level for standard operation. After that derate by 3% for every extra 500m (1640.40feet) up to 2500m (8202.00feet) (91%). $5.9m/s^2$ or less (conforming to JIS C 0040)

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

(2) Wiring

⚠ CAUTION

● Do not fit capacitive equipment such as power factor correction capacitor, radio 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 parameters, and ensure that the machine will not be damaged by a sudden start-up.
● When the load GD^2 is small (at the motor GD^2 or smaller) for 400V from 1.5K to 3.7K, the output current may vary when the output frequency is in the 20Hz to 30Hz range.
   If this is a problem, set the Pr.72 "PWM frequency selection" to 6kHz or higher.
   When setting the PWM to a higher frequency, check for noise or leakage current problem and take countermeasures against it.

(4) Operation

⚡ WARNING

● When you have chosen the retry function, stay away from the equipment as it will restart suddenly after an alarm stop.
● The [STOP] key is valid only when the appropriate function setting has been made. Prepare an emergency stop switch separately.
● Make sure that the start signal is off before resetting the inverter alarm. A failure to do so may restart the motor suddenly.
● The load used should be a three-phase induction motor only. Connection of any other electrical equipment to the inverter output may damage the equipment.
● Do not modify the equipment.

⚠ **CAUTION**

- The electronic overcurrent protection does not guarantee protection of the motor from overheating.
- Do not use a magnetic contactor on the inverter input for frequent starting/stopping of the inverter.
- Use a noise filter to reduce the effect of electromagnetic interference. Otherwise nearby electronic equipment may be affected.
- Take measures to suppress harmonics. Otherwise power harmonics from the inverter may heat/damage the power capacitor and generator.
- When a 400V class motor is inverter-driven, it should be insulation-enhanced or surge voltages suppressed. Surge voltages attributable to the wiring constants may occur at the motor terminals, deteriorating the insulation of the motor.
- When parameter clear or all 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.
- Before running an inverter which had been stored for a long period, always perform inspection and test operation.

(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 (basic) show the inverter without a cover, or partially open. Never run the inverter in this status. Always replace the cover and follow this instruction manual (basic) when operating the inverter.
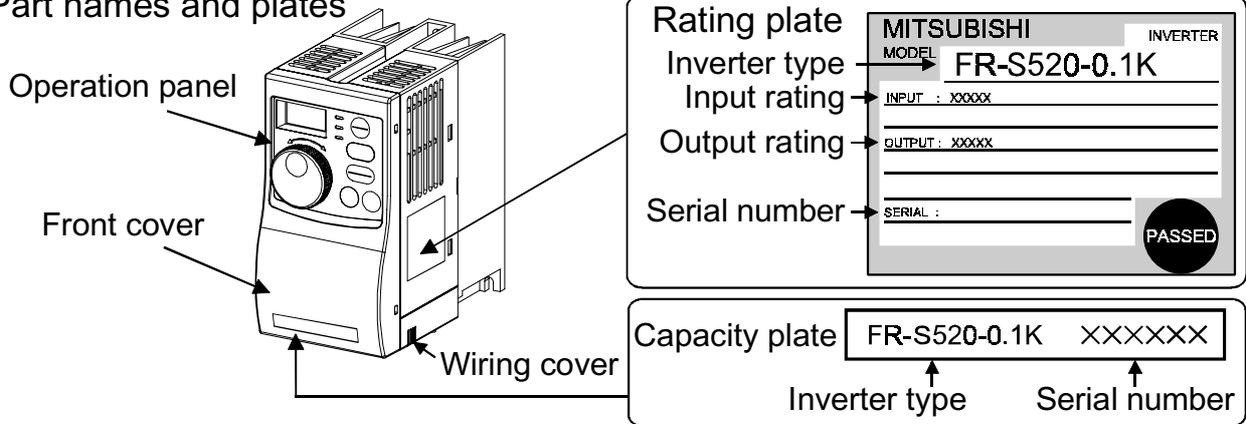
Japanese Power Supply Harmonic Suppression Guideline

The "harmonic suppression guideline for household appliances and general-purpose products" issued by the Ministry of Economy, Trade and Industry (formerly Ministry of International Trade and Industry) in September 1994 applies to the FR-S500 series other than the three-phase 400V class. By installing the FR-BEL or FR-BAL power factor improving reactor, this product complies with the "harmonic suppression techniques for transistorized inverters (input current 20A or less)" established by the Japan Electrical Manufacturers' Association.

Product Checking and Parts Identification

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 product agrees with your order and the inverter is intact.

● Part names and plates

Operation panel

Front cover

Wiring cover

Rating plate

MITSUBISHI   INVERTER
MODEL FR-S520-0.1K
INPUT : XXXXX
OUTPUT : XXXXX
SERIAL :
PASSED

Inverter type →
Input rating →
Output rating →
Serial number →

Capacity plate   FR-S520-0.1K   ××××××

Inverter type   Serial number

● Inverter type

FR - [S520] - [0.1] K - [ ] [ ]

Symbol	Voltage Class
S520	Three-phase 200V class
S540	Three-phase 400V class
S520S	Single-phase 200V class
S510W	Single-phase 100V class

Represents the inverter capacity "kW ".

Symbol	Version
None	Japanese specification
NA	North American specification
EC	European specification

Symbol	Protective Structure
None	Standard structure
R	With RS-485 communication function
C	Totally enclosed structure IP40 Only for Japanese version

- Removal and reinstallation of the front cover
  Remove the front cover by pulling it toward you in the direction of arrow.
  To reinstall, match the cover to the inverter front and install it straight.

FR-S520(S)-0.1K to 0.75K
FR-S510W-0.1K to 0.4K

FR-S520(S)-1.5K
FR-S520-2.2K, 3.7K
FR-S540-0.4K to 3.7K
FR-S510W-0.75K

- Removal and reinstallation of the wiring cover
  The cover can be removed easily by pulling it toward you.
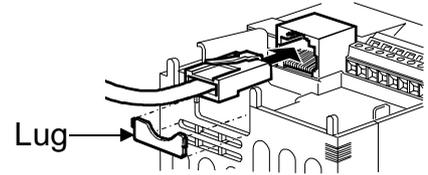 To reinstall, fit the cover to the inverter along the guides.

Wiring cover
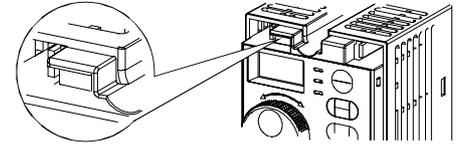
1
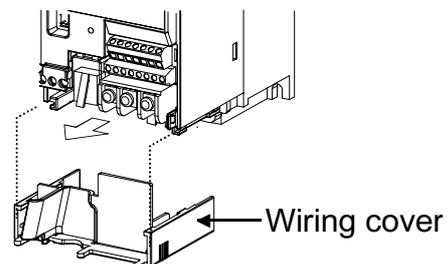
< Type with RS-485 communication function >
When using the RS-485 connector to wire the
cable, you can cut off the lug of the wiring cover
to wire it. (Cutting off the lug provides protective
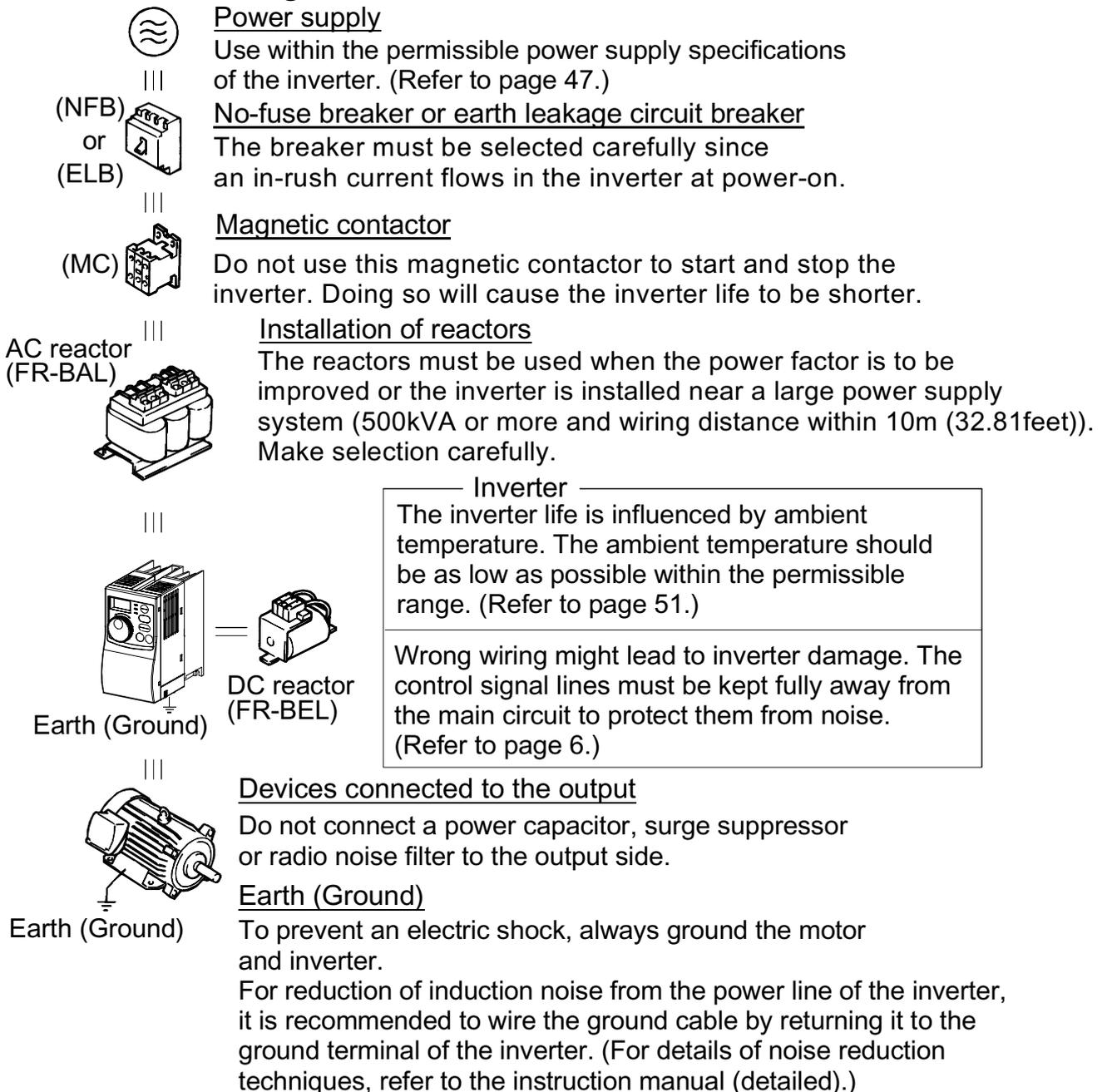structure IP10.)

Lug

=== **CAUTION** ===

The connector above the operation panel is for
manufacturer use. Do not touch it as doing so
may cause an electric shock.

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1. CONNECTION OF PERIPHERAL DEVICES
1.1 Basic Configuration

Power supply
Use within the permissible power supply specifications
of the inverter. (Refer to page 47.)

(NFB)
or
(ELB)
No-fuse breaker or earth leakage circuit breaker
The breaker must be selected carefully since
an in-rush current flows in the inverter at power-on.

(MC)
Magnetic contactor
Do not use this magnetic contactor to start and stop the
inverter. Doing so will cause the inverter life to be shorter.

AC reactor
(FR-BAL)
Installation of reactors
The reactors must be used when the power factor is to be
improved or the inverter is installed near a large power supply
system (500kVA or more and wiring distance within 10m (32.81feet)).
Make selection carefully.

DC reactor
(FR-BEL)

Earth (Ground)

--- **Inverter** ---
The inverter life is influenced by ambient
temperature. The ambient temperature should
be as low as possible within the permissible
range. (Refer to page 51.)

Wrong wiring might lead to inverter damage. The
control signal lines must be kept fully away from
the main circuit to protect them from noise.
(Refer to page 6.)

Devices connected to the output
Do not connect a power capacitor, surge suppressor
or radio noise filter to the output side.

Earth (Ground)
Earth (Ground)
To prevent an electric shock, always ground the motor
and inverter.
For reduction of induction noise from the power line of the inverter,
it is recommended to wire the ground cable by returning it to the
ground terminal of the inverter. (For details of noise reduction
techniques, refer to the instruction manual (detailed).)

Selection of peripheral devices (Selection changes with the power supply input specifications of the inverter.)

● FR-S520-0.1K to 3.7K(-R)(-C)
● FR-S520-0.1K to 3.7K-NA

Motor Output (kW (HP))	Inverter Type	Rated current of Circuit Breaker (*1)	Power Factor Improving AC Reactor	Power Factor Improving DC Reactor	Magnetic Contactor (MC)	Cables (mm^2) (*2)	
						R, S, T	U, V, W
0.1 (1/8)	FR-S520-0.1K	30AF/5A	FR-BAL-0.4K (*3)	FR-BEL-0.4K (*3)	S-N10	2	2
0.2 (1/4)	FR-S520-0.2K	30AF/5A	FR-BAL-0.4K (*3)	FR-BEL-0.4K (*3)	S-N10	2	2
0.4 (1/2)	FR-S520-0.4K	30AF/5A	FR-BAL-0.4K	FR-BEL-0.4K	S-N10	2	2
0.75 (1)	FR-S520-0.75K	30AF/10A	FR-BAL-0.75K	FR-BEL-0.75K	S-N10	2	2
1.5 (2)	FR-S520-1.5K	30AF/15A	FR-BAL-1.5K	FR-BEL-1.5K	S-N10	2	2
2.2 (3)	FR-S520-2.2K	30AF/20A	FR-BAL-2.2K	FR-BEL-2.2K	S-N11, S-N12	2	2
3.7 (5)	FR-S520-3.7K	30AF/30A	FR-BAL-3.7K	FR-BEL-3.7K	S-N20	3.5	3.5

● FR-S540-0.4K to 3.7K(-R)
● FR-S540-0.4K to 3.7K-EC(R)
● FR-S540-0.4K to 3.7K-NA(R)

Motor Output (kW (HP))	Inverter Type	Rated current of Circuit Breaker (*1)	Power Factor Improving AC Reactor	Power Factor Improving DC Reactor	Magnetic Contactor (MC)	Cables (mm^2) (*2)	
						R, S, T	U, V, W
0.4 (1/2)	FR-S540-0.4K	30AF/5A	FR-BAL-H0.4K	FR-BEL-H0.4K	S-N10	2	2
0.75 (1)	FR-S540-0.75K	30AF/5A	FR-BAL-H0.75K	FR-BEL-H0.75K	S-N10	2	2
1.5 (2)	FR-S540-1.5K	30AF/10A	FR-BAL-H1.5K	FR-BEL-H1.5K	S-N10	2	2
2.2 (3)	FR-S540-2.2K	30AF/15A	FR-BAL-H2.2K	FR-BEL-H2.2K	S-N20	2	2
3.7 (5)	FR-S540-3.7K	30AF/20A	FR-BAL-H3.7K	FR-BEL-H3.7K	S-N20	2	2

● FR-S520S-0.1K to 1.5K(-R)
● FR-S520S-0.2K to 1.5K-EC(R)

Motor Output (kW (HP))	Inverter Type	Rated current of Circuit Breaker (*1)	Power Factor Improving AC Reactor (*3)	Power Factor Improving DC Reactor (*3)	Magnetic Contactor (MC)	Cables (mm^2) (*2)	
						R, S <L$_1$, N>	U, V, W
0.1 (1/8)	FR-S520S-0.1K	30AF/5A	FR-BAL-0.4K	FR-BEL-0.4K	S-N10	2	2
0.2 (1/4)	FR-S520S-0.2K	30AF/10A	FR-BAL-0.4K	FR-BEL-0.4K	S-N10	2	2
0.4 (1/2)	FR-S520S-0.4K	30AF/10A	FR-BAL-0.75K	FR-BEL-0.75K	S-N20	2	2
0.75 (1)	FR-S520S-0.75K	30AF/15A	FR-BAL-1.5K	FR-BEL-1.5K	S-N20	2	2
1.5 (2)	FR-S520S-1.5K	30AF/20A	FR-BAL-2.2K	FR-BEL-2.2K	S-N21	2	2

● FR-S510W-0.1K to 0.75K(-R)
● FR-S510W-0.1K to 0.75K-NA

Motor Output (kW (HP))	Inverter Type	Rated current of Circuit Breaker (*1)	Power Factor Improving AC Reactor (*3)	Power Factor Improving DC Reactor (*4)	Magnetic Contactor (MC)	Cables (mm^2) (*2)	
						R, S	U, V, W
0.1 (1/8)	FR-S510W-0.1K	30AF/10A	FR-BAL-0.75K	—	S-N10	2	2
0.2 (1/4)	FR-S510W-0.2K	30AF/15A	FR-BAL-1.5K	—	S-N10	2	2
0.4 (1/2)	FR-S510W-0.4K	30AF/20A	FR-BAL-2.2K	—	S-N20	2	2
0.75 (1)	FR-S510W-0.75K	30AF/30A	FR-BAL-3.7K	—	S-N20	3.5	2

*1 For installations in the United States or Canada, the circuit breaker must be inverse time or instantaneous trip type.

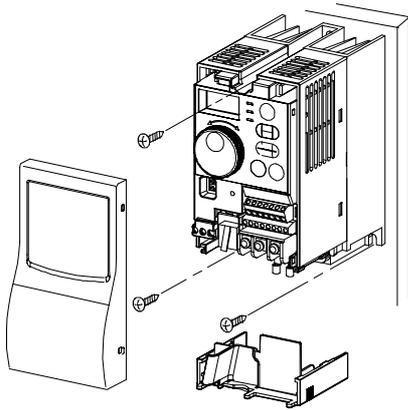*2 The size of the cable indicated assumes the wiring length of 20m (65.62feet).

*3 The power factor may be slightly lower.

*4 The single-phase 100V power input model does not allow the power factor improving DC reactor to be fitted.
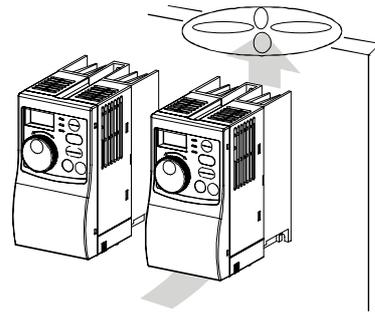
2. INSTALLATION METHOD

2.1 Installation of the Inverter

Enclosure surface mounting

Mounting inside enclosure

Fix the front cover and wiring cover after removing them.

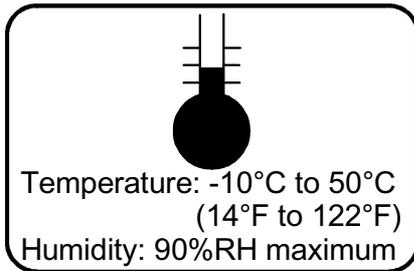Leave enough clearances and provide cooling measures.

When containing two or more inverters, install them in parallel and provide cooling measures.

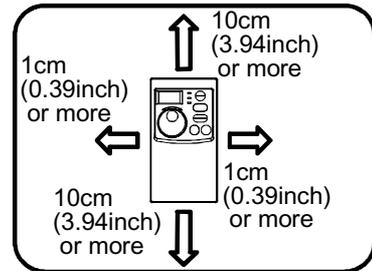- Install the inverter under the following conditions.

Vertical mounting
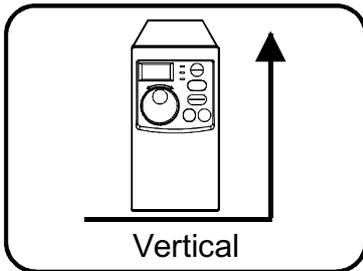
Ambient temperature and humidity

Enough clearances

Vertical

Temperature: -10°C to 50°C
(14°F to 122°F)
Humidity: 90%RH maximum

10cm (3.94inch) or more

1cm (0.39inch) or more

1cm (0.39inch) or more

10cm (3.94inch) or more

These clearances are also necessary for changing the cooling fan. (1.5K or more)

- The inverter consists of precision mechanical and electronic parts. Never install or handle it in any of the following conditions as doing so could cause an operation fault or failure.
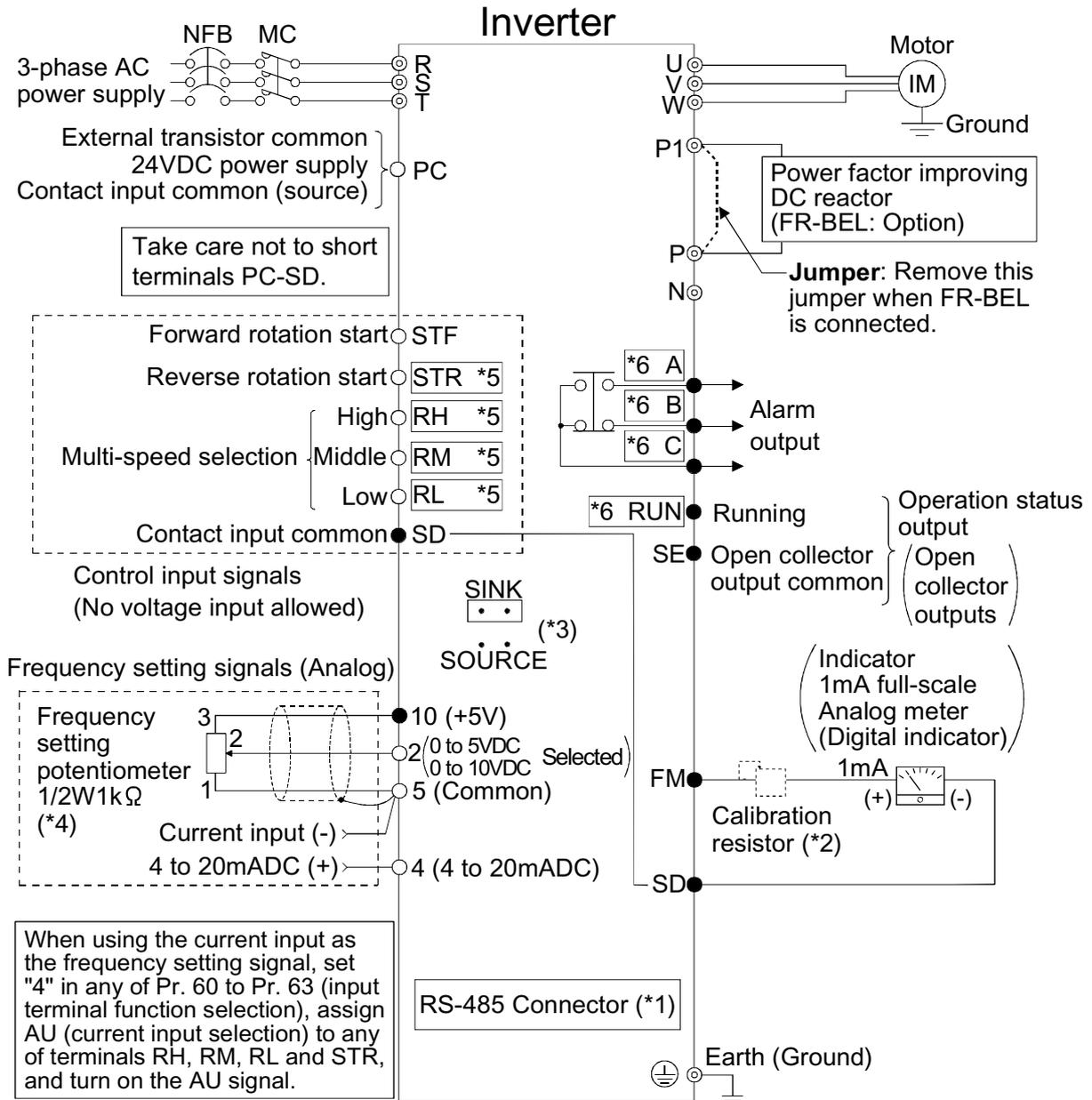
Direct sunlight	Vibration ($5.9m/s^2$ or more)	High temperature, high humidity	Horizontal placement
Vertical mounting (When mounted inside enclosure)	Transportation by holding front cover or dial	Oil mist, flammable gas, corrosive gas, fluff, dust, etc.	Mounting to combustible material

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3. SPECIFICATIONS OF WIRING AND TERMINALS

3.1 Terminal connection diagram (Japanese version)

● FR-S520-0.1K to 3.7K (-R) (-C)
● FR-S540-0.4K to 3.7K (-R)

Inverter

3-phase AC power supply — NFB — MC — R, S, T

External transistor common / 24VDC power supply / Contact input common (source) — PC

Take care not to short terminals PC-SD.

Forward rotation start — STF
Reverse rotation start — STR *5
Multi-speed selection — High — RH *5
Middle — RM *5
Low — RL *5
Contact input common — SD

Control input signals (No voltage input allowed)

SINK / SOURCE (*3)

Frequency setting signals (Analog)

Frequency setting potentiometer 1/2W1kΩ (*4)
10 (+5V)
2 (0 to 5VDC / 0 to 10VDC Selected)
5 (Common)
Current input (-)
4 to 20mADC (+) — 4 (4 to 20mADC)

When using the current input as the frequency setting signal, set "4" in any of Pr. 60 to Pr. 63 (input terminal function selection), assign AU (current input selection) to any of terminals RH, RM, RL and STR, and turn on the AU signal.

RS-485 Connector (*1)

Motor — U, V, W — IM — Ground

P1 — Power factor improving DC reactor (FR-BEL: Option)
P
N

Jumper: Remove this jumper when FR-BEL is connected.

*6 A / *6 B / *6 C — Alarm output
*6 RUN — Running
SE — Open collector output common
Operation status output (Open collector outputs)

Indicator 1mA full-scale Analog meter (Digital indicator)

FM — 1mA — Calibration resistor (*2) — (+) (-)
SD

Earth (Ground)

◎ Main circuit terminal, ○ Control circuit input terminal, ● Control circuit output terminal

Remarks

*1 Only the type with RS-485 communication function
*2 Not needed when the setting dial is used for calibration. Used when calibration must be made near the frequency meter for such a reason as a remote frequency meter. However, the frequency meter needle may not deflect to full-scale if the calibration resistor is connected. In this case, use this resistor and setting dial together.
*3 You can switch between the sink and source logic positions. For details, refer to the instruction manual (detailed).
*4 When the setting potentiometer is used frequently, use a 2W1kΩ potentiometer.
*5 The terminal functions change with input terminal function selection (Pr. 60 to Pr. 63). (Refer to page 38) (RES, RL, RM, RH, RT, AU, STOP, MRS, OH, REX, JOG, X14, X16, (STR) signal selection)
*6 The terminal functions change with output terminal function selection (Pr. 64, Pr. 65). (Refer to page 38) (RUN, SU, OL, FU, RY, Y12, Y13, FDN, FUP, RL, LF, ABC signal selection)
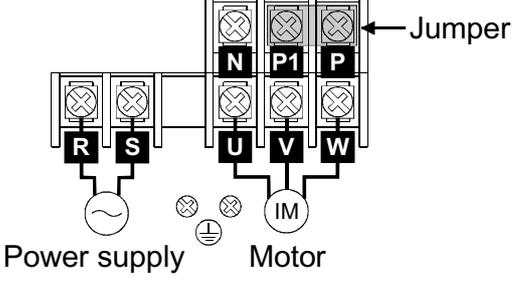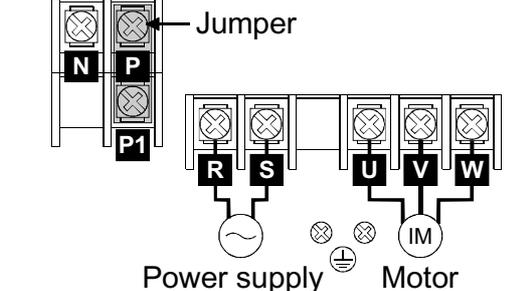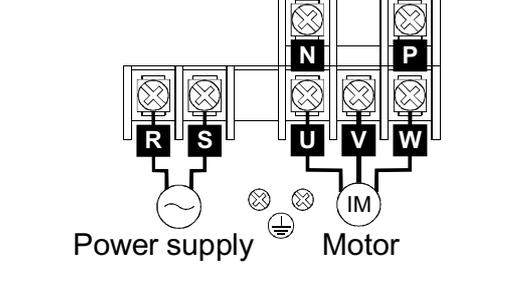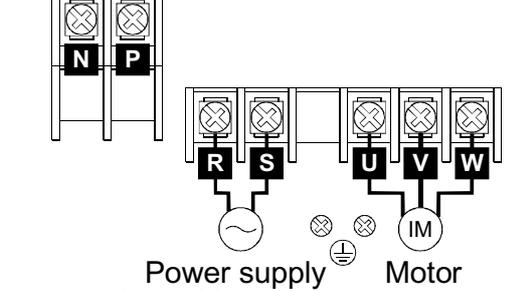
● FR-S520S-0.1K to 1.5K (-R) (-C)
● FR-S510W-0.1K to 0.75K (-R)
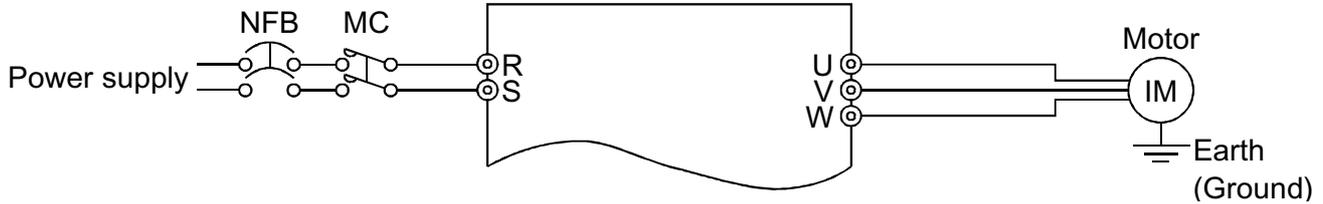
Remarks

• To ensure safety, connect the power input to the inverter via a magnetic contactor and earth leakage circuit breaker or no-fuse breaker, and use the magnetic contactor to switch power on-off.
• The output is three-phase 200V.

3.1.1 Layout and wiring of main circuit terminals

● **FR-S520-0.1K, 0.2K, 0.4K, 0.75K (-R) (-C)**

Jumper

N P1 P

R S T U V W

Power supply   Motor

● **FR-S520-1.5K, 2.2K, 3.7K (-R) (-C)**
● **FR-S540-0.4K, 0.75K, 1.5K, 2.2K, 3.7K (-R)**

Jumper

N P

P1

R S T U V W

Power supply   Motor
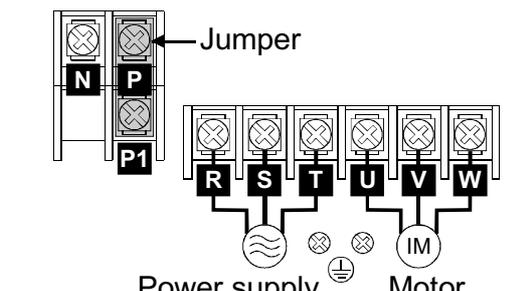
● **FR-S520S-0.1K, 0.2K, 0.4K, 0.75K (-R)**

Jumper

N P1 P

R S U V W

Power supply   Motor

● **FR-S520S-1.5K (-R)**

Jumper

N P

P1

R S U V W

Power supply   Motor

● **FR-S510W-0.1K, 0.2K, 0.4K (-R)**

N P

R S U V W

Power supply   Motor

● **FR-S510W-0.75K (-R)**

N P

R S U V W

Power supply   Motor

☞ Screw size: M3.5
☞ Recommended cable size:
        $2mm^2$ (14 AWG)
☞ Crimping terminal: 2-3.5
☞ Screw tightening torque: 1.2 N·m
☞ Overall wiring length*:
        100m (328.08feet) maximum

═══ **CAUTION** ═══

If the wiring length of the 0.1K or 0.2K is 30m
(98.43feet) or more, use the carrier
frequency of 1kHz.

☞ Screw size: M4
☞ Recommended cable size:$2mm^2$ (14 AWG)
    FR-S520-3.7K: $3.5mm^2$ (12 AWG)
    FR-S510W-0.75K: $3.5mm^2$ (R, S),
                $2mm^2$ (U, V, W)
☞ Crimping terminal: 2-4
    FR-S520-3.7K: 5.5-4
    FR-S510W-0.75K: 5.5-4 (R, S), 2-4 (U,V, W)
☞ Screw tightening torque: 1.5N·m
☞ Overall wiring length*:
        100m (328.08feet) maximum
(50m (164.04feet) maximum for the FR-S540-
0.4K.)

═══ **CAUTION** ═══

If the wiring length of the FR-S540-0.4K,
0.75K is 30m (98.43 feet) or more, use the
carrier frequency of 1kHz.

* When automatic torque boost is selected in Pr. 98 "automatic torque boost selection
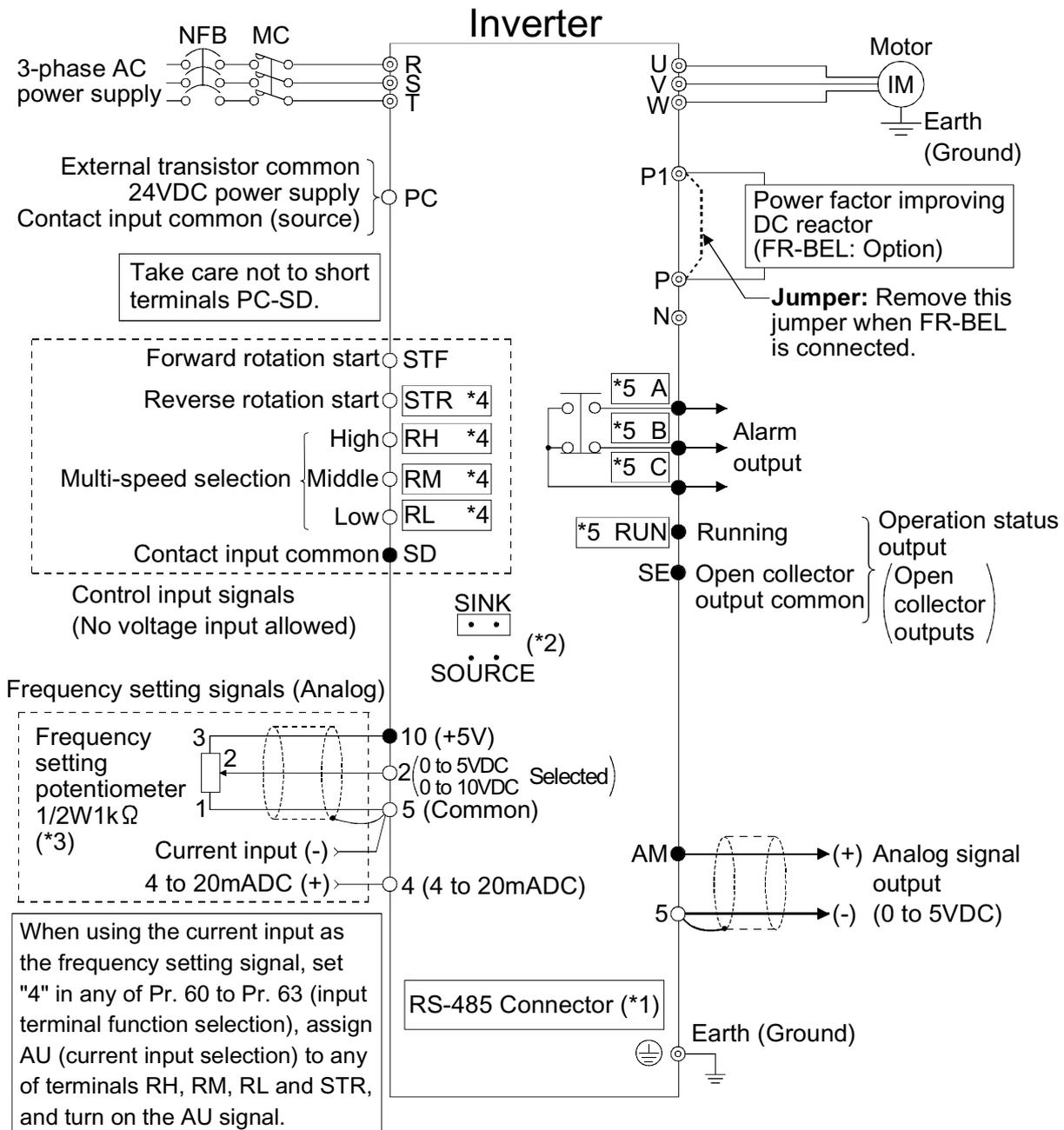(motor capacity)": 30m (98.43feet) maximum.

═══ **CAUTION** ═══

- The power supply cables must be connected to R, S, T. If they are connected to U, V,
  W, the inverter will be damaged. (Phase sequence need not be matched.)
  (For use with a single-phase power supply, the power supply cables must be
  connected to R and S.)
- Connect the motor to U, V, W. Turning on the forward rotation switch (signal) at this
  time rotates the motor counterclockwise when viewed from the load shaft.

3.2 Terminal connection diagram (North America version)

● FR-S520-0.1K to 3.7K-NA

● FR-S540-0.4K to 3.7K-NA (R)

⊚ Main circuit terminal, ○ Control circuit input terminal, ● Control circuit output terminal

Remarks
*1 Only the type with RS-485 communication function
*2 You can switch between the sink and source logic positions. For details, refer to the instruction manual (detailed).
*3 When the setting potentiometer is used frequently, use a 2W1kΩ potentiometer.
*4 The terminal functions change with input terminal function selection (Pr. 60 to Pr. 63). (Refer to page 38) (RES, RL, RM, RH, RT, AU, STOP, MRS, OH, REX, JOG, X14, X16, (STR) signal selection)
*5 The terminal functions change with output terminal function selection (Pr. 64, Pr. 65). (Refer to page 38) (RUN, SU, OL, FU, RY, Y12, Y13, FDN, FUP, RL, LF, ABC signal selection)

══ **CAUTION** ══
To prevent a malfunction due to noise, keep the signal cables more than 10cm (3.94inches) away from the power cables.
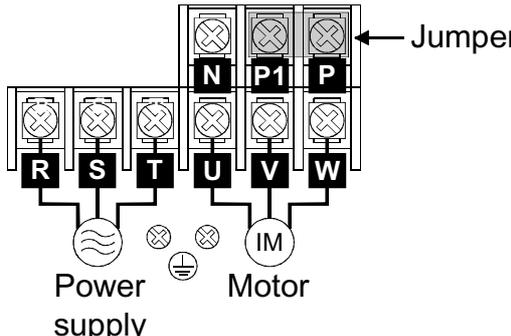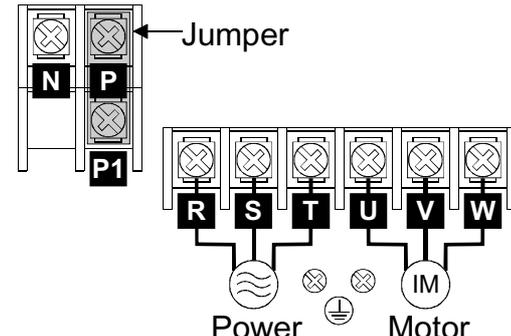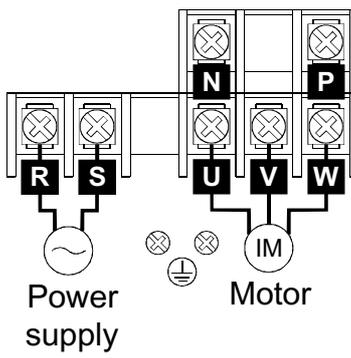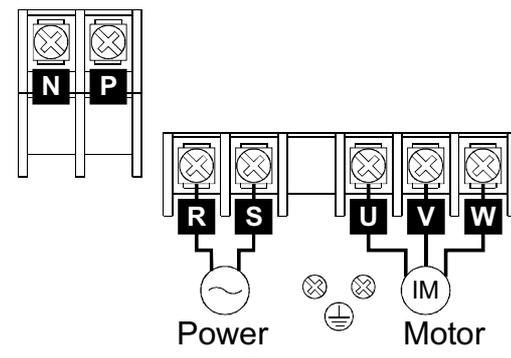
● FR-S510W-0.1K to 0.75K-NA
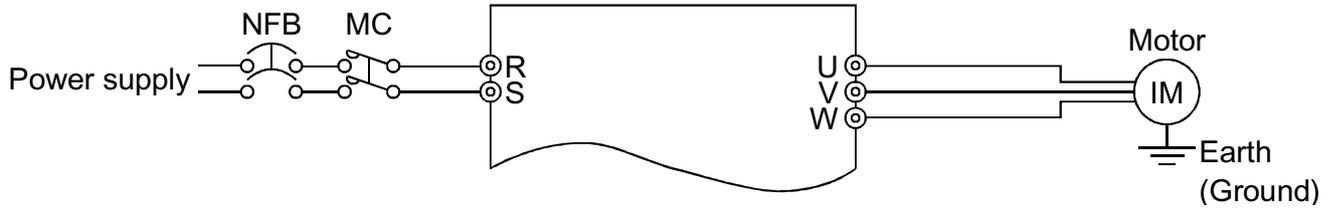
Power supply — NFB — MC — R S [inverter] U V W — Motor IM — Earth (Ground)

Remarks

- To ensure safety, connect the power input to the inverter via a magnetic contactor and earth leakage circuit breaker or no-fuse breaker, and use the magnetic contactor to switch power on-off.
- The output is three-phase 200V.

3.2.1 Layout and wiring of main circuit terminals

● **FR-S520-0.1K, 0.2K, 0.4K, 0.75K-NA**

● **FR-S510W-0.1K, 0.2K, 0.4K-NA**

☞ Screw size: M3.5
☞ Recommended cable size:
        $2mm^2$ (14 AWG)
☞ Crimping terminal: 2-3.5
☞ Screw tightening torque: 1.2 N·m
☞ Overall wiring length*:
        100m (328.08feet) maximum

══ **CAUTION** ══

If the wiring length of the 0.1K or 0.2K is 30m (98.43feet) or more use the carrier frequency of 1kHz.

● **FR-S520-1.5K, 2.2K, 3.7K-NA**
● **FR-S540-0.4K, 0.75K, 1.5K, 2.2K, 3.7K-NA (R)**

● **FR-S510W-0.75K-NA**

☞ Screw size: M4
☞ Recommended cable size:
        $2mm^2$ (14 AWG)
  FR-S520-3.7K-NA: $3.5mm^2$ (12 AWG)
  FR-S510W-0.75K-NA: $3.5mm^2$ (R, S),
                 $2mm^2$ (U, V, W)
☞ Crimping terminal: 2-4
  FR-S520-3.7K-NA: 5.5-4
  FR-S510W-0.75K-NA: 5.5-4 (R, S),
              2-4 (U, V, W)
☞ Screw tightening torque: 1.5N·m
☞ Overall wiring length*:
        100m (328.08feet) maximum
(50m (164.04feet) maximum for the FR-S540-0.4K-NA)

══ **CAUTION** ══

If the wiring length of the FR-S540-0.4K, 0.75K-NA is 30m (98.43 feet) or more, use the carrier frequency of 1kHz.

* When automatic torque boost is selected in Pr. 98 "automatic torque boost selection (motor capacity)": 30m (98.43feet) maximum.

══ **CAUTION** ══

- The power supply cables must be connected to R, S, T. If they are connected to U, V, W, the inverter will be damaged. (Phase sequence need not be matched.)
- Connect the motor to U, V, W.
  Turning on the forward rotation switch (signal) at this time rotates the motor counterclockwise when viewed from the load shaft.

<When single-phase power input is provided for three-phase power input inverter (FR-S520-0.1K to 3.7K-NA only)>

- Reduce the output current.

FR-S520-☐K-NA inverter	0.1	0.2	0.4	0.75	1.5	2.2	3.7
Rated output current (A)	0.4	0.8	1.5	2.5	4.0	5.0	7.0
Power supply capacity (kVA)	0.4	0.8	1.5	2.5	4.5	5.5	9.0
AC input current (A)	1.1	2.4	4.5	6.4	11.2	12.9	17.4

- Set m9 (Pr. 637) "current detection filter".
  Setting "801" in the manufacturer setting parameter C8 enables you to set the m9 parameter.

=== **CAUTION** ===

Parameters other than m9 can also be made to be displayed, but never alter these since they are manufacturer setting parameters.
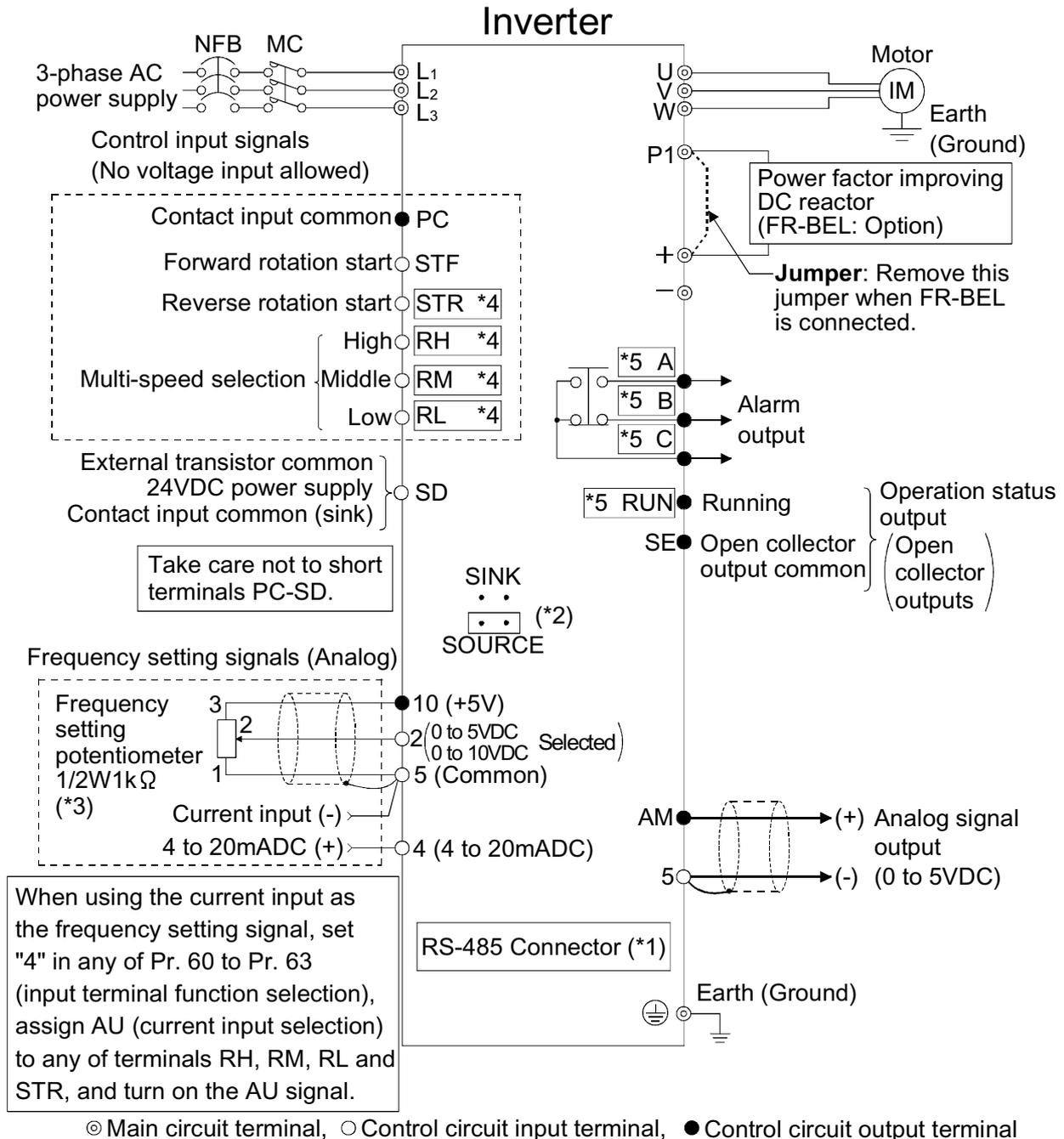
m9 Setting	Description
0	Single-phase power input
- - - (Factory setting)	Three-phase power input

=== **CAUTION** ===

Always return the C8 parameter to 0 (factory setting) after you have finished the setting of m9.

# 3.3 Terminal connection diagram (European version)
● FR-S540-0.4K to 3.7K-EC (R)

Inverter

3-phase AC power supply — NFB — MC — L₁ L₂ L₃

Control input signals (No voltage input allowed)

Contact input common — PC
Forward rotation start — STF
Reverse rotation start — STR *4
Multi-speed selection — High — RH *4
Middle — RM *4
Low — RL *4

External transistor common
24VDC power supply — SD
Contact input common (sink)

Take care not to short terminals PC-SD.

SINK
(*2)
SOURCE

Frequency setting signals (Analog)

Frequency setting potentiometer 1/2W1kΩ (*3)
3 — 10 (+5V)
2 — 2 (0 to 5VDC / 0 to 10VDC Selected)
1 — 5 (Common)
Current input (-)
4 to 20mADC (+) — 4 (4 to 20mADC)

When using the current input as the frequency setting signal, set "4" in any of Pr. 60 to Pr. 63 (input terminal function selection), assign AU (current input selection) to any of terminals RH, RM, RL and STR, and turn on the AU signal.

RS-485 Connector (*1)

U V W — Motor IM — Earth (Ground)

P1
Power factor improving DC reactor (FR-BEL: Option)
Jumper: Remove this jumper when FR-BEL is connected.
+
—

*5 A
*5 B — Alarm output
*5 C

*5 RUN ● Running
SE ● Open collector output common
Operation status output (Open collector outputs)

AM ● (+) Analog signal output
5 (-) (0 to 5VDC)

Earth (Ground)

◎ Main circuit terminal, ○ Control circuit input terminal, ● Control circuit output terminal

Remarks
*1 Only the type with RS-485 communication function
*2 You can switch between the sink and source logic positions. For details, refer to the instruction manual (detailed).
*3 When the setting potentiometer is used frequently, use a 2W1kΩ potentiometer.
*4 The terminal functions change with input terminal function selection (Pr. 60 to Pr. 63). (Refer to page 38) (RES, RL, RM, RH, RT, AU, STOP, MRS, OH, REX, JOG, X14, X16, (STR) signal selection)
*5 The terminal functions change with output terminal function selection (Pr. 64, Pr. 65). (Refer to page 38) (RUN, SU, OL, FU, RY, Y12, Y13, FDN, FUP, RL, LF, ABC signal selection)

══ CAUTION ══
• To prevent a malfunction due to noise, keep the signal cables more than 10cm (3.94inches) away from the power cables.
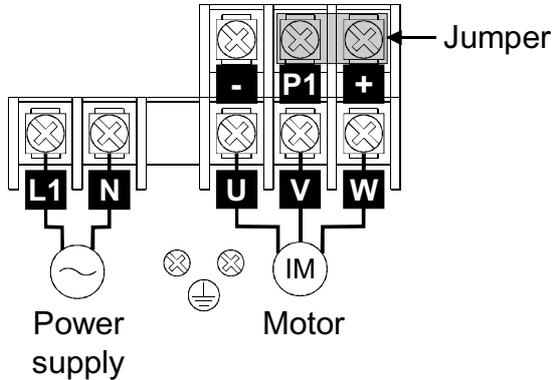
● FR-S520S-0.2K to 1.5K-EC (R)
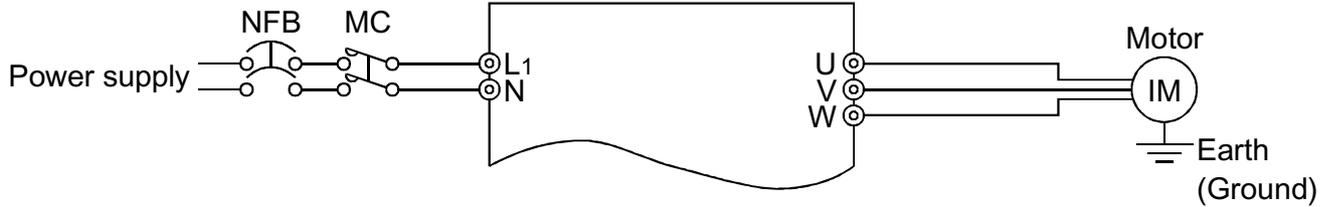
Remarks
- To ensure safety, connect the power input to the inverter via a magnetic contactor and earth leakage circuit breaker or no-fuse breaker, and use the magnetic contactor to switch power on-off.
- The output is three-phase 200V.

3.3.1 Layout and wiring of main circuit terminals

● FR-S520S-0.2K, 0.4K, 0.75K-EC (R)

Jumper

Power supply   Motor

☞ Screw size: M3.5
☞ Recommended cable size:
    2mm^2 (14 AWG)
☞ Crimping terminal: 2-3.5
☞ Screw tightening torque: 1.2 N·m
☞ Overall wiring length*:
    100m (328.08feet) maximum

=== **CAUTION** ===

If the wiring length of the 0.1K or 0.2K is 30m (98.43feet) or more, use the carrier frequency of 1kHz.

● FR-S540-0.4K, 0.75K, 1.5K, 2.2K, 3.7K-EC (R)
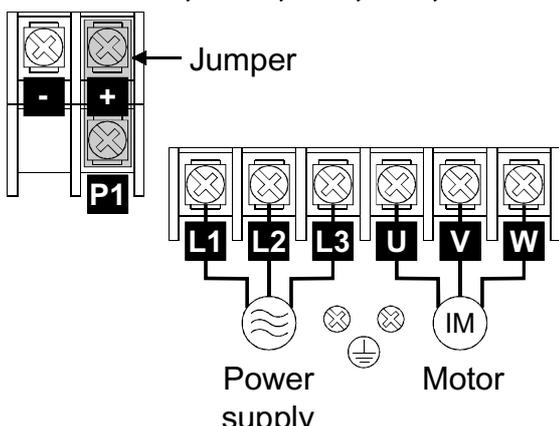
Jumper

Power supply   Motor

● FR-S520S-1.5K-EC (R)
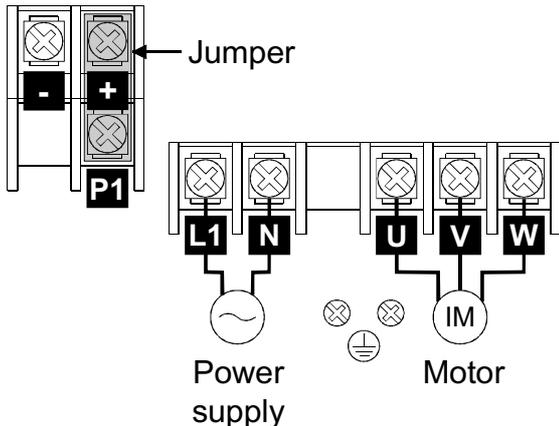
Jumper

Power supply   Motor

☞ Screw size: M4
☞ Recommended cable size:
    2mm^2 (14 AWG)
☞ Crimping terminal: 2-4
☞ Screw tightening torque: 1.5N·m
☞ Overall wiring length*:
    100m (328.08feet) maximum

(50m (164.04feet) maximum for the FR-S540-0.4K-EC)

=== **CAUTION** ===

If the wiring length of the FR-S540-0.4K, 0.75K-EC is 30m (98.43 feet) or more, use the carrier frequency of 1kHz.

* When automatic torque boost is selected in Pr. 98 "automatic torque boost selection (motor capacity)": 30m (98.43feet) maximum.

=== **CAUTION** ===

• The power supply cables must be connected to L1, L2, L3. If they are connected to U, V, W, the inverter will be damaged. (Phase sequence need not be matched.)
• Connect the motor to U, V, W.
  Turning on the forward rotation switch (signal) at this time rotates the motor counterclockwise when viewed from the load shaft.
• Do not connect the power supply to U, V and W.

3.4 Main Circuit
3.4.1 Explanation of main circuit terminals

Symbol	Terminal Name	Description
R, S, T* <L$_1$, L$_2$, L$_3$>	AC power input	Connect to the commercial power supply.
U, V, W	Inverter output	Connect a three-phase squirrel-cage motor.
N <->	DC voltage common	DC voltage common terminal. Not isolated from the power supply and inverter output.
P <+>, P1	Power factor improving DC reactor connection	Remove the jumper from across terminals P <+> -P1 and connect the optional power factor improving DC reactor (FR-BEL). (The single-phase 100V power input model cannot be connected.)
⏚	Earth (Ground)	For grounding the inverter chassis. Must be earthed.

* R, S, <L$_1$, N> terminals for single-phase power input.

═══ **CAUTION** ═══

< > Terminal names in parentheses are those of the EC version.

3.5 Control Circuit
3.5.1 Explanation of control circuit terminals

		Symbol	Terminal Name	Description		
Input signals	Contact input	STF	Forward rotation start	Turn on the STF signal to start forward rotation and turn it off to stop.	A stop command is given if STF and STR signal turn ON at the same time.	The terminal function changes with the setting of input terminal function selection (Pr. 60 to Pr. 63). (*4)
		STR	Reverse rotation start	Turn on the STR signal to start reverse rotation and turn it off to stop.		
		RH RM RL	Multi-speed selection	You can select multiple speeds by shorting any of terminals RH, RM and RL signal. The priorities of the speed commands are in order of jog, multi-speed setting (RH, RM, RL, REX) and AU.		
	SD (*1)		Contact input common (sink)	Common terminal for contact inputs (terminals STF, STR, RH, RM, RL) and indicator connection (terminal FM). Isolated from terminals 5 and SE.		
	PC (*1)		External transistor common / 24VDC power supply / Contact input common (source)	When connecting the transistor output (open collector output) of a programmable controller (PLC) etc., connect the positive external power supply for transistor output to this terminal to prevent a malfunction due to undesirable current. It can be used as a 24V 0.1A DC power supply across PC-SD terminals. Acts as the common terminal of the contact input signals when source logic is selected.		
	10		Frequency setting power supply	5VDC, permissible load current 10mA.		
	Frequency setting	2	Frequency setting (Voltage signal)	Inputting 0 to 5VDC (0 to 10V) provides the maximum output frequency at 5V (10V) and makes input and output proportional. Use Pr. 73 "0 to 5V, 0 to 10V selection" to switch between 5V and 10V. Input resistance 10kΩ. Maximum permissible input voltage 20V.		
		4	Frequency setting (Current signal)	Input 4 to 20mA DC. Factory-adjusted to be 0Hz at 4mA and 60Hz <50Hz for EC version> at 20mA. Maximum permissible input current 30mA. Input resistance approximately. 250Ω. Turn ON signal AU for current input. Use any of Pr. 60 to Pr. 63 (input terminal function selection) to set the AU signal.		

	Symbol	Terminal Name	Description	
Input signals	5	Frequency setting input common	Common terminal for the frequency setting signals (terminals 2, 4) and indicator connection (terminal AM). Isolated from terminals SD and SE. Do not connect this terminal to the ground.	
Output signals	A B C	Alarm output	1 contact output which indicates that the protective function of the inverter is activated to stop output. 230V 0.3A AC, 30V 0.3A DC. No conduction across B-C (conduction across A-C) when alarm (error) state. Conduction across B-C (no conduction across A-C) when normal. (*6)	The terminal function changes with the setting of output terminal function selection (Pr. 64, Pr. 65). (*5)
Output signals / Open collector	RUN	Inverter running	Low when the inverter output frequency is the starting frequency or higher (factory-set to 0.5Hz and changeable), and High during stop or DC injection brake operation (*2). Permissible load 24V 0.1A DC	
	SE	Open collector common	Common terminal for inverter running terminal RUN. Isolated from terminals 5 and SD.	
Indicator / Pulse FM \<Japanese\>		For meter	One selected from output frequency and motor current is output. The output signal is proportional to the magnitude of each monitoring item.	Factory setting of output item: Frequency Permissible load current 1mA 1440 pulses/s at 60Hz
Indicator / Analog AM \<NA, EC\>		Analog signal output		Factory setting of output item: Frequency Output signal 0 to 5VDC Permissible load current 1mA
Communication	—	RS-485 connector (*3)	Using the parameter unit connection cable (FR-CB201 to 205), the parameter unit (FR-PU04) can be connected. Communication operation can be performed using RS-485.	

*1. Do not connect terminals SD and PC each other or to the ground.
   For sink logic, terminal SD acts as the common terminal of contact input. For source logic, terminal PC acts as the common terminal of contact input.
*2. Low indicates that the open collector output transistor is on (conducts). High indicates that the transistor is off (does not conduct).
*3. Compatible with only the type having the RS-485 communication function. For details, refer to the separately available instruction manual (detailed).
*4. RL, RM, RH, RT, AU, STOP, MRS, OH, REX, JOG, RES, X14, X16, (STR) signal selection
*5. RUN, SU, OL, FU, RY, Y12, Y13, FDN, FUP, RL, LF, ABC signal selection
*6. For compatibility with the European Directive (Low Voltage Directive), the operating capacity of relay output (A, B, C) should be 30V, 0.3A DC.

3.5.2 Arrangement and wiring of control circuit terminals

<div style="border">

Control circuit terminal block

| PC | SE | RUN | 10 | 2 | 5 | 4 |

| SD | SD | STF | STR | RL | RM | RH | FM \<AM\> | ....Japanese version
....NA, EC version |

| A | B | C |

Loosen the terminal screw and insert the cable into the terminal.

☞ Screw size: M3 (A, B, C terminals), M2 (other than on the left)

☞ Tightening torque: 0.5N·m to 0.6N·m (A, B, C terminals)
0.22N·m to 0.25N·m (other than the above)

═══ **CAUTION** ═══

Undertightening can cause cable disconnection or malfunction. Overtightening can cause a short circuit or malfunction due to damage to the screw or unit.

☞ Cable size: 0.3mm^2 to 0.75mm^2

☞ Screwdriver: Small flat-blade screwdriver
(Tip thickness: 0.4mm (0.02inches)/
tip width: 2.5mm (0.10inches))

Cable stripping size

Wire the stripped cable after twisting it to prevent it from becoming loose.
In addition, do not solder it.*

|	ℓ (mm (inches))
A, B, C terminals	6 (0.24)
Other than the above	5 (0.20)

</div>

*Information on bar terminals

Introduced products (as of June, 2000): Phoenix Contact Co.,Ltd.

Terminal Screw Size	Bar Terminal Model (With Insulation Sleeve)	Bar Terminal Model (Without Insulation Sleeve)	Wire Size (mm^2)
M3 (A, B, C terminals)	Al 0.5-6WH	A 0.5-6	0.3 to 0.5
	Al 0.75-6GY	A 0.75-6	0.5 to 0.75
M2 (Other than the above)	Al 0.5-6WH	A 0.5-6	0.3 to 0.5

☞ Bar terminal crimping terminal: CRIMPFOX ZA3 (Phoenix Contact Co., Ltd.)

═══ **CAUTION** ═══

When using the bar terminal (without insulation sleeve), use care so that the twisted wires do not come out.
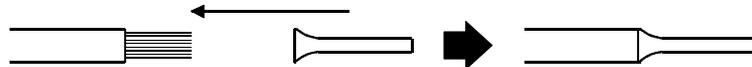
3.5.3 Connection to RS-485 connector (only the inverter with RS-485 communication function)

(1) When connecting the parameter unit (FR-PU04)

Use the optional FR-CB2☐.

(2) RS-485 communication

Use the RS-485 connector to perform communication operation from a personal computer etc. By connecting the RS-485 connector to a computer such as a personal computer, Factory Automation or other computer, by the communication cable, you can operate/monitor the inverter and read/write the parameter values using user programs. For further details, refer to the instruction manual (detailed).

- Conforming standard : EIA Standard RS-485
- Transmission format   : Multi-drop link
- Communication speed: Maximum 19200 bps
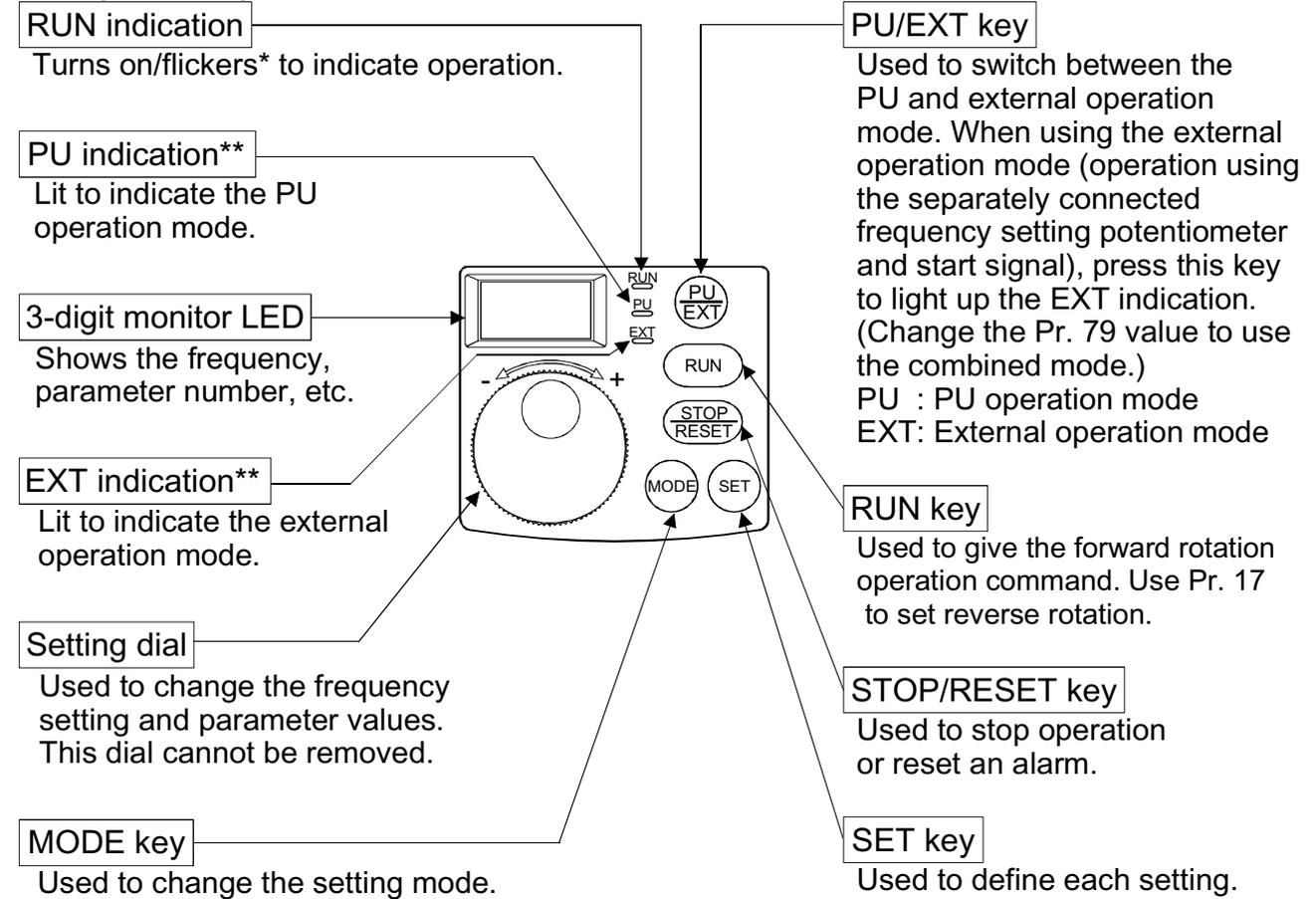- Overall extension   : 500m (1640.42feet)

═══ **CAUTION** ═══

Do not plug the connector to a computer LAN board, fax modem socket, telephone modular connector etc. As they are different in electrical specifications, the inverter may be damaged.

4. OPERATION/CONTROL

<Control panel>

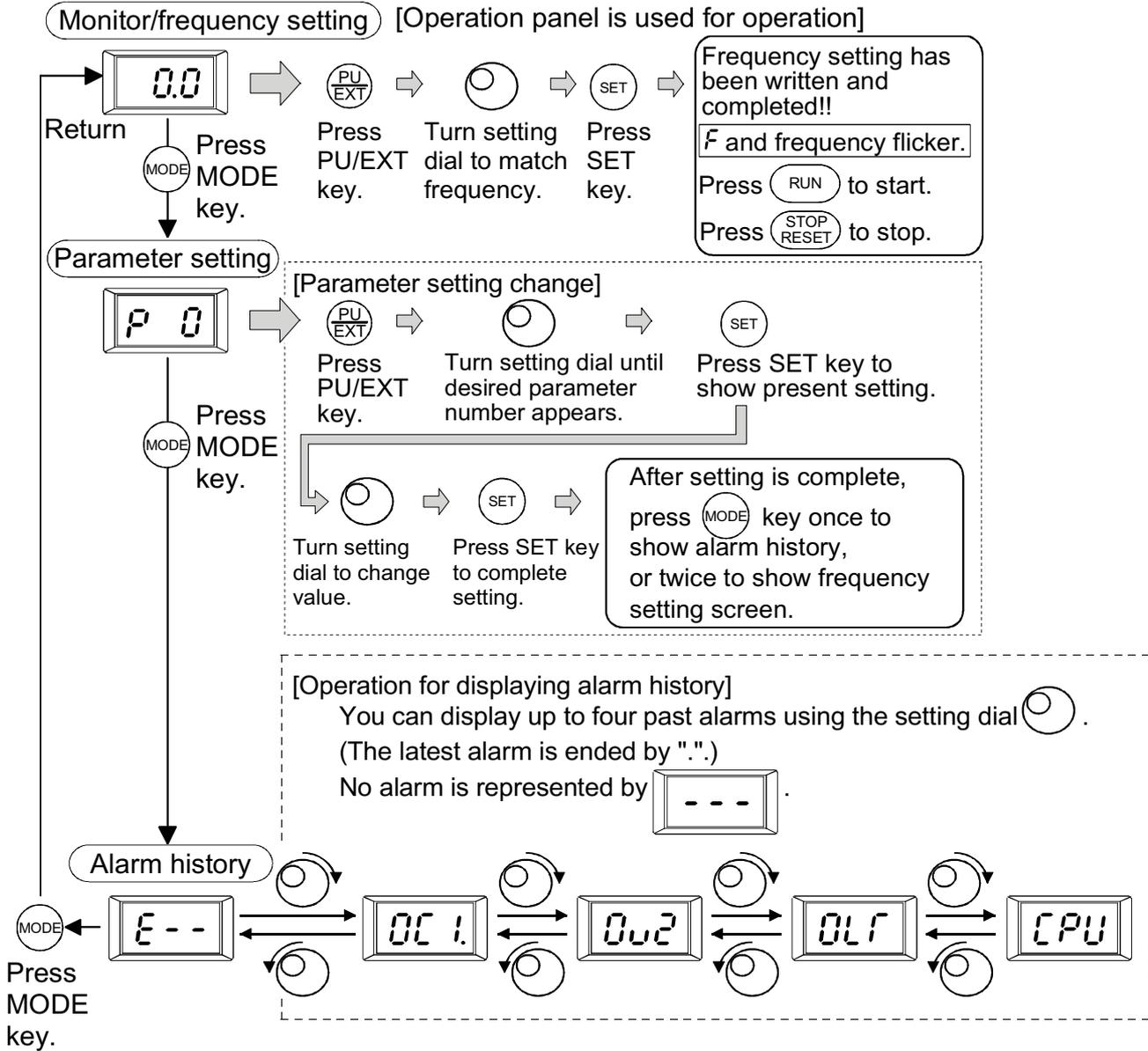The operation panel cannot be removed from the inverter.

RUN indication
Turns on/flickers* to indicate operation.

PU indication**
Lit to indicate the PU operation mode.

3-digit monitor LED
Shows the frequency, parameter number, etc.

EXT indication**
Lit to indicate the external operation mode.

Setting dial
Used to change the frequency setting and parameter values. This dial cannot be removed.

MODE key
Used to change the setting mode.

PU/EXT key
Used to switch between the PU and external operation mode. When using the external operation mode (operation using the separately connected frequency setting potentiometer and start signal), press this key to light up the EXT indication. (Change the Pr. 79 value to use the combined mode.)
PU : PU operation mode
EXT: External operation mode

RUN key
Used to give the forward rotation operation command. Use Pr. 17 to set reverse rotation.

STOP/RESET key
Used to stop operation or reset an alarm.

SET key
Used to define each setting.

*RUN indication
On: Indicates that forward rotation operation is being performed.
Slow flickering (1.4 s cycle): Indicates reverse rotation.
Fast flickering (0.2 s cycle) : Indicates that operation is not being performed but the (RUN) key was pressed or the start command was given.

**PU/EXT indication
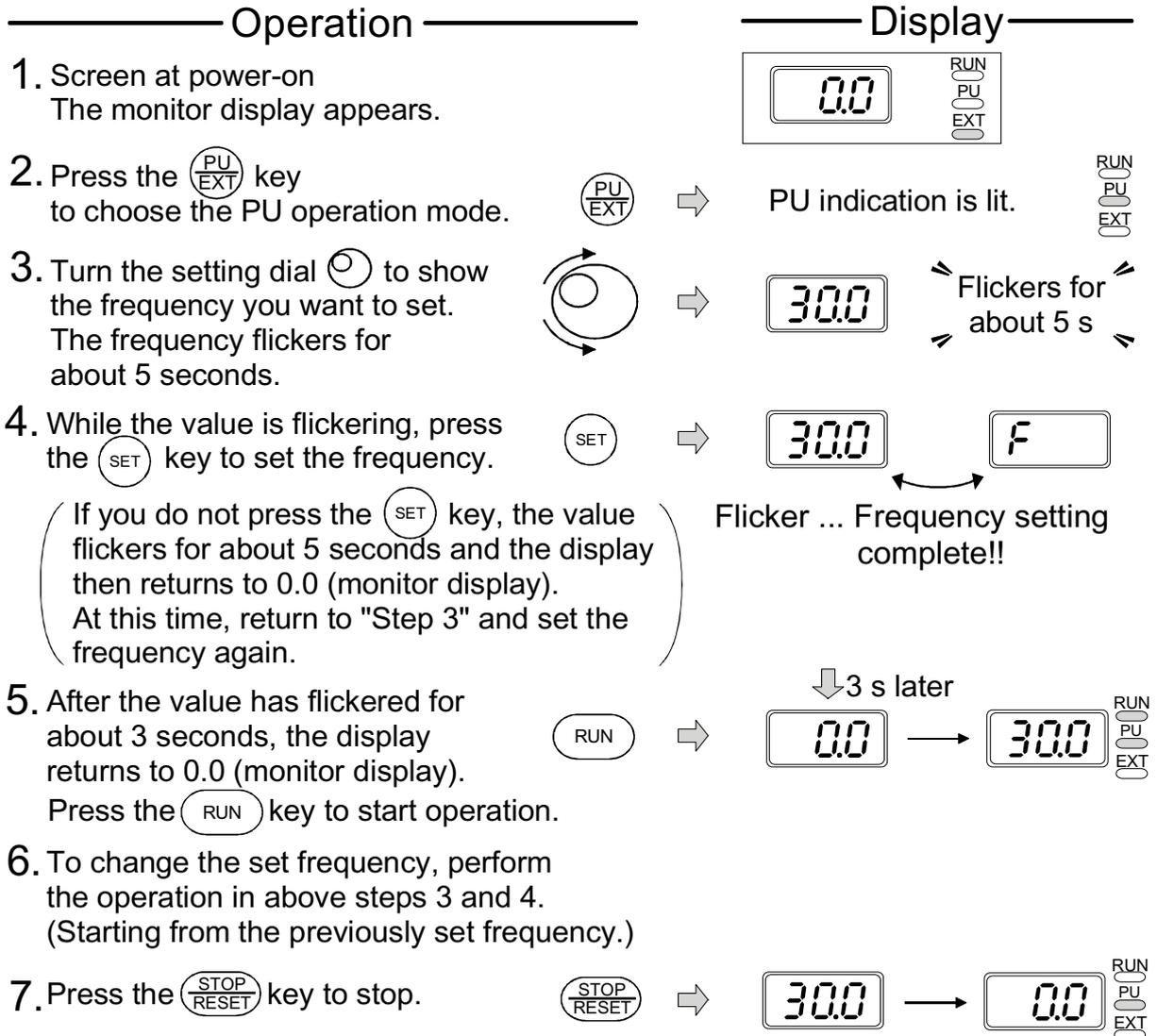Flickers slowly in the computer link operation mode.

<Basic operation> (Factory setting)

Monitor/frequency setting [Operation panel is used for operation]

| 0.0 |

Return

Press MODE key.

Press PU/EXT key.

Turn setting dial to match frequency.

Press SET key.

Frequency setting has been written and completed!!

F and frequency flicker.

Press RUN to start.

Press STOP/RESET to stop.

Parameter setting

| P 0 |

[Parameter setting change]

Press PU/EXT key.

Turn setting dial until desired parameter number appears.

Press SET key to show present setting.

Press MODE key.

Turn setting dial to change value.

Press SET key to complete setting.

After setting is complete, press MODE key once to show alarm history, or twice to show frequency setting screen.

[Operation for displaying alarm history]
You can display up to four past alarms using the setting dial.
(The latest alarm is ended by ".".)
No alarm is represented by | - - - |.

Alarm history

| E - - | ⇄ | OC 1. | ⇄ | Ou2 | ⇄ | OLr | ⇄ | CPU |

Press MODE key.

21

4.1 Setting the Frequency to Perform Operation (Example: Performing Operation at 30Hz)

> **POINT**
> - Set "0" (setting dial frequency setting mode) in Pr. 53 "frequency setting operation selection".

——————— Operation ———————   —— Display ——

1. Screen at power-on
   The monitor display appears.

   | Display: | 0.0 | RUN / PU / EXT |

2. Press the (PU/EXT) key to choose the PU operation mode.

   (PU/EXT) ⇨ PU indication is lit.

3. Turn the setting dial ⊙ to show the frequency you want to set.
   The frequency flickers for about 5 seconds.

   ⇨ 30.0   Flickers for about 5 s

4. While the value is flickering, press the (SET) key to set the frequency.

   (SET) ⇨ 30.0 ⟷ F

   > If you do not press the (SET) key, the value flickers for about 5 seconds and the display then returns to 0.0 (monitor display). At this time, return to "Step 3" and set the frequency again.

   Flicker ... Frequency setting complete!!

5. After the value has flickered for about 3 seconds, the display returns to 0.0 (monitor display).
   Press the (RUN) key to start operation.

   ↓ 3 s later

   (RUN) ⇨ 0.0 ⟶ 30.0

6. To change the set frequency, perform the operation in above steps 3 and 4. (Starting from the previously set frequency.)

7. Press the (STOP/RESET) key to stop.

   (STOP/RESET) ⇨ 30.0 ⟶ 0.0

? Operation cannot be performed at the set frequency ... Why?
☞ Did you carry out step 4 within 5 seconds after step 3? (Did you press the (SET) key within 5 seconds after turning the dial?)

? Setting of higher than 60Hz cannot be made ... Why?
☞ Check to see if the Pr. 1 "maximum frequency" setting is 60Hz.

? The frequency does not change by turning the dial ... Why?
☞ Check to see if the operation mode selected is the external operation mode.

> **Remarks**
> ⊙ Pressing the setting dial shows the set frequency.
> - The setting dial can also be used like a potentiometer to perform operation. (Refer to page 23)

4.2 Using the setting dial like a potentiometer to perform operation

```
┌─ POINT ──────────────────────────────────────────────────┐
│ • Set "1" (extended function parameter valid) in Pr. 30 "extended function │
│   display selection".                                     │
│ • Set "1" (setting dial potentiometer mode) in Pr. 53 "frequency setting   │
│   operation selection".                                   │
└──────────────────────────────────────────────────────────┘
```

| Operation example | Changing the frequency from 0Hz to 60Hz during operation

──────── Operation ────────   ─── Display ───

1. Mode/monitor check

   ● Choose monitor/frequency monitor.
      (MODE key)

   ● The inverter must be in the PU operation
      mode. (Press the PU/EXT key.)
   ● Pr. 30 must be set to "1".
   ● Pr. 53 must be set to "1".

2. Press the RUN key to start the inverter.   RUN ⇨

3. Turn the setting dial ⊙ clockwise
   until "60.0" appears. The flickering
   frequency is the set frequency.
   You need not press the SET key.

        ⇨   0.0 → 60.0

   Flickers for 3s.

```
┌─ Remarks ─┐
```
• If flickering "60.0" turns to "0.0", the Pr. 53 "frequency setting operation
  selection" setting may not be "1".
• Independently of whether the inverter is running or at a stop, the frequency
  can be set by merely turning the dial.

4.3 Setting the Parameters
4.3.1 Example: Changing the Pr. 7 setting from "5s" to "10s"
(For parameter details, refer to the instruction manual (detailed).)
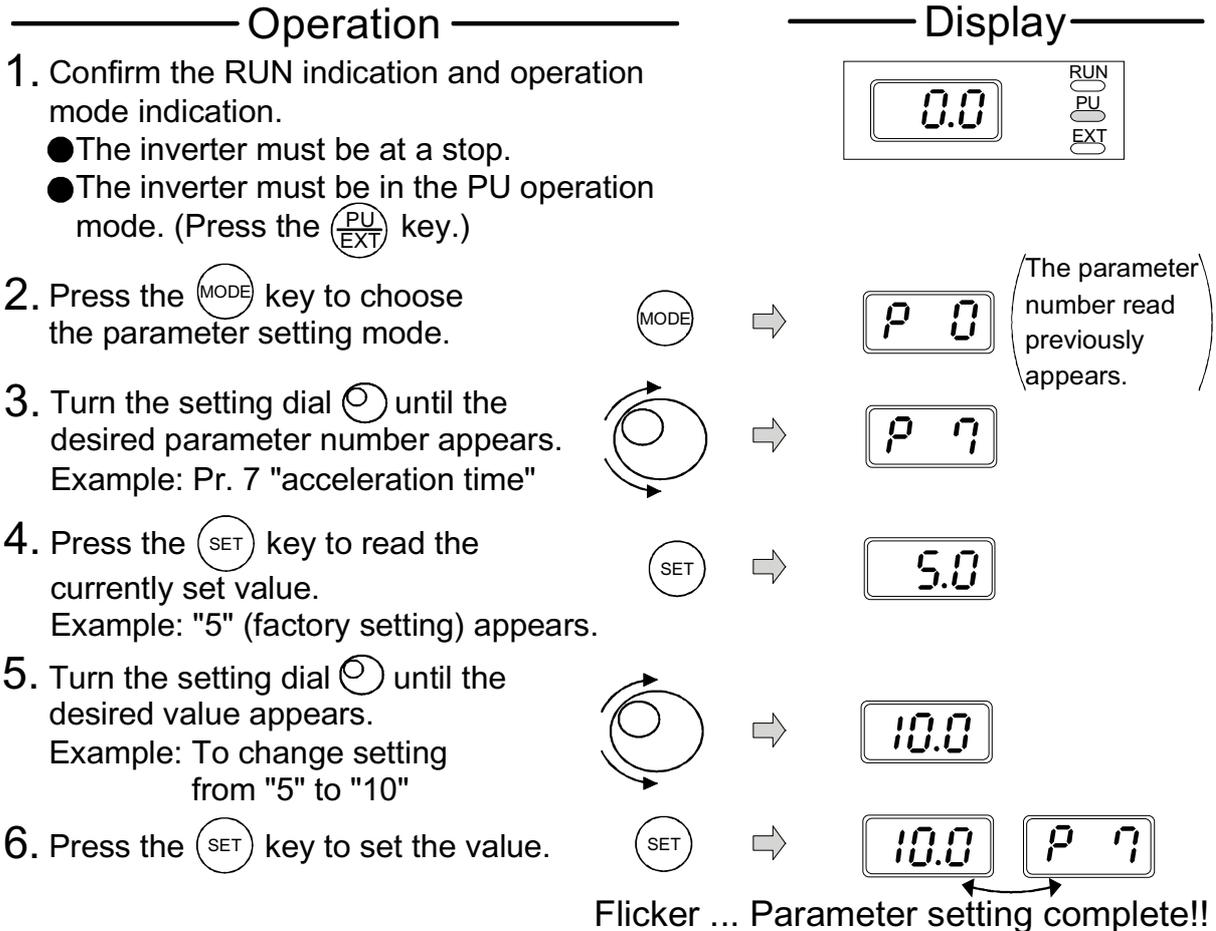
──────── Operation ────────   ──── Display ────

1. Confirm the RUN indication and operation mode indication.
   - ● The inverter must be at a stop.
   - ● The inverter must be in the PU operation mode. (Press the (PU/EXT) key.)

   Display: `0.0`   RUN / PU / EXT

2. Press the (MODE) key to choose the parameter setting mode.

   (MODE) ⇨ `P 0` (The parameter number read previously appears.)

3. Turn the setting dial ⊙ until the desired parameter number appears.
   Example: Pr. 7 "acceleration time"

   ⇨ `P 7`

4. Press the (SET) key to read the currently set value.
   Example: "5" (factory setting) appears.

   (SET) ⇨ `5.0`

5. Turn the setting dial ⊙ until the desired value appears.
   Example: To change setting from "5" to "10"

   ⇨ `10.0`

6. Press the (SET) key to set the value.

   (SET) ⇨ `10.0` ⟷ `P 7`

   Flicker ... Parameter setting complete!!

- ● By turning the setting dial ⊙, you can read another parameter.
- ● Press the (SET) key to show the setting again.
- ● Press the (SET) key twice to show the next parameter.

After parameter setting is complete, press the (MODE) key once to show the alarm history or twice to return to the monitor display. To change the setting of another parameter, perform the operation in above steps 3 to 6.

? Error display?
- ☞ Er.1
  - ● If write was performed with "1" set in Pr. 77
  - ● If the operation panel does not have the write precedence (only for the type with RS-485 function)
- ☞ Er.2
  - ● If write was performed during operation
  - ● If write was performed in the external operation mode

Remarks
- If the setting has not been changed, the value does not flicker and the next parameter number appears.
- Either step 1 or 2 may be carried out first.
- Convenient usage
  After carrying out steps 1 and 2 to choose the parameter setting mode, you can read a series of parameter numbers in due order every time you press the (SET) key.

4.3.2 Example: Changing the Pr. 30 setting from "0" to "1"

(The extended parameters are made valid by setting "1" in Pr. 30 "extended function display selection". Refer to page 34 for the extended function parameter list and to the instruction manual (detailed) for details.)
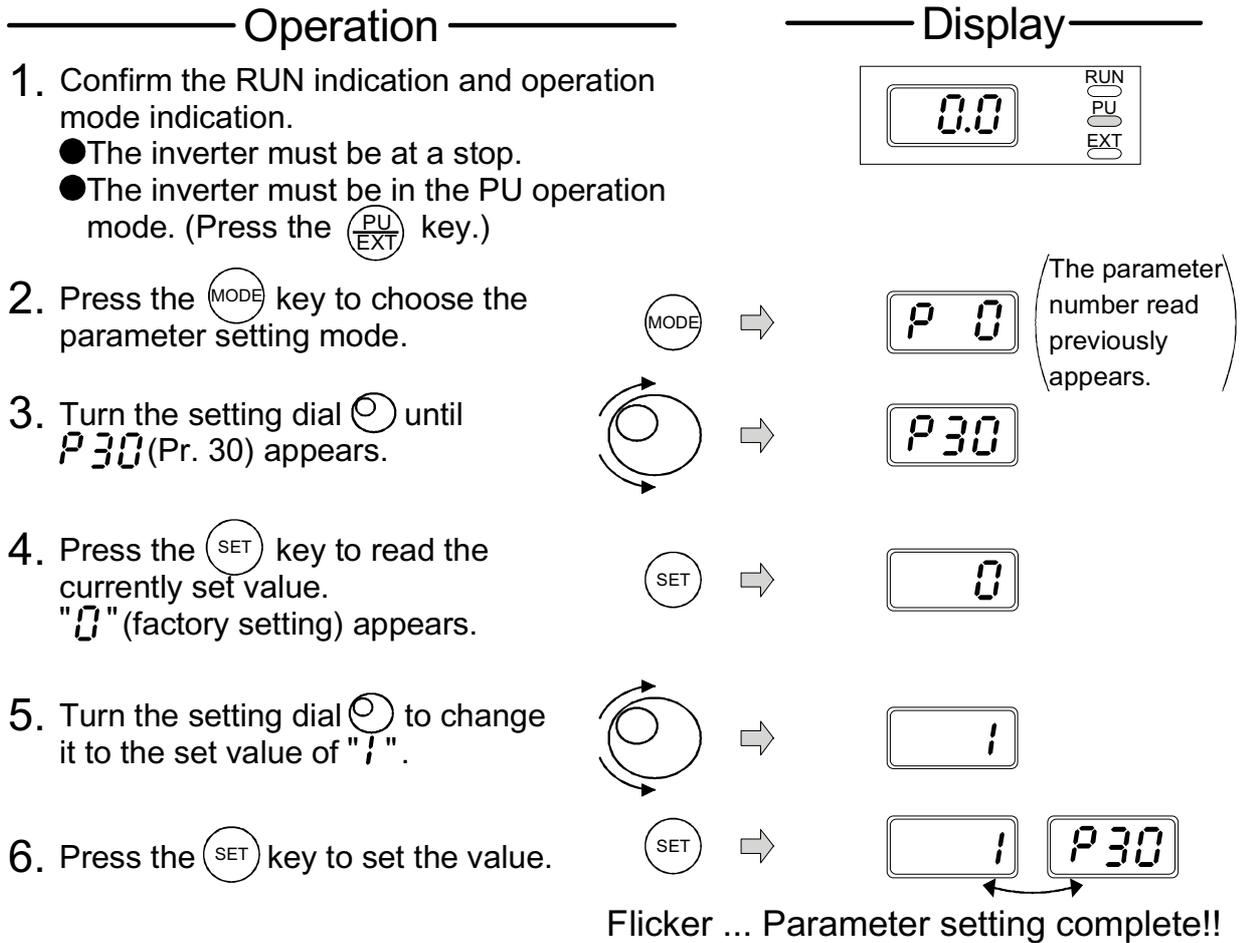
——————Operation——————   ——Display——

1. Confirm the RUN indication and operation mode indication.
   ● The inverter must be at a stop.
   ● The inverter must be in the PU operation mode. (Press the (PU/EXT) key.)

   Display: `0.0`   RUN / PU / EXT

2. Press the (MODE) key to choose the parameter setting mode.

   (MODE) ⇨   `P 0`   The parameter number read previously appears.

3. Turn the setting dial ⊙ until `P30` (Pr. 30) appears.

   ⇨   `P30`

4. Press the (SET) key to read the currently set value.
   "`0`"(factory setting) appears.

   (SET) ⇨   `0`

5. Turn the setting dial ⊙ to change it to the set value of "`1`".

   ⇨   `1`

6. Press the (SET) key to set the value.

   (SET) ⇨   `1` `P30`

   Flicker ... Parameter setting complete!!

- ● By turning the setting dial ⊙ , you can read another parameter.
- ● Press the (SET) key to show the setting again.
- ● Press the (SET) key twice to show the next parameter.

After parameter setting is complete, press the (MODE) key once to show the alarm history or twice to return to the monitor display. To change the setting of another parameter, perform the operation in above steps 3 to 6.

? **Error display?**

☞ *Er 1* • If the operation panel does not have the write precedence (only for the type with RS-485 communication function)

☞ *Er 2* • If write was performed during operation
   • If write was performed in the external operation mode

Remarks

If the setting has not been changed, the value does not flicker and the next parameter number appears.

4.4 Clearing the Parameters

> **POINT**
>
> - The clear parameter CLr is an extended parameter. Set "1" in Pr. 30 and turn the dial to show it. (Refer to page 25.)
> - The parameters can be cleared by setting "1" in CLr "parameter clear".

──────── Operation ──────── ──── Display ────

1. Confirm the RUN indication and operation mode indication.
   - ●The inverter must be at a stop.
   - ●The inverter must be in the PU operation mode. (Press the $\frac{PU}{EXT}$ key.)

   Display: `0.0` RUN / PU / EXT

2. Press the (MODE) key to choose the parameter setting mode.

   (MODE) ⇨ `P 0` (The parameter number read previously appears.)

3. Turn the setting dial ⊙ until CLr "clear" appears.
   - ●The Pr. 30 value must be "1". (Refer to steps 3 to 6 on page 25 for the parameter setting method.)

   ⊙ ⇨ `CLr`

4. Press the (SET) key to show "0".

   (SET) ⇨ `0`
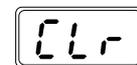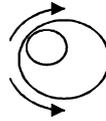
5. Turn the setting dial ⊙ to change it to "1".

   ⊙ ⇨ `1`

6. Press the (SET) key.

   (SET) ⇨ `1` `CLr`
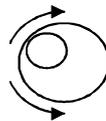
   Flicker ... Parameter clear complete!!
   - ● By turning the setting dial ⊙, you can read another parameter.
   - ● Press the (SET) key to show Pr. 0 (`P 0`).

CLr Setting	Description
0	Not executed.
1	Parameter clear *1 (Calibration parameters C1 to C7 are not cleared.)
10	All clear *2 (All set values including those of calibration parameters C1 to C7 are returned to factory settings.)

*1. Parameters are not cleared when "1" is set in Pr. 77 "parameter write disable selection".
Pr. 75 "reset selection/PU stop selection", Pr. 38, Pr. 39, Pr. 53, Pr. 60 to Pr. 65, Pr. 99, calibration parameters C1 to C7 and communication parameters n13, 15 are not cleared.

*2. Pr. 75 "reset selection/PU stop selection" and communication parameter n13 "PU language switching" are not cleared.

4.5 Monitoring the Output Current

─────── Operation ───────   ──── Display ────

1. Press the (MODE) key to choose the output frequency monitor mode.

$$\boxed{60.0}$$

2. Independently of whether the inverter is running in any operation mode or at a stop, the output current appears while the (SET) key is pressed.

(SET) ⇨ $\boxed{1.0A}$ (1.0A)

Hold down

3. Release the (SET) key to return to the output frequency monitor mode.

⇨ $\boxed{60.0}$

Remarks

When Pr. 52 = "1", the output current is displayed in the monitor mode and the output frequency appears while the (SET) key is pressed.

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5. ADJUSTMENT OF THE FREQUENCY SETTING POTENTIOMETER AND INDICATOR

- Related parameters

Parameter	Name	Setting Range	Factory Setting <EC Version>
38	Frequency setting voltage gain frequency	1 to 120Hz	60Hz <50Hz>
39	Frequency setting current gain frequency	1 to 120Hz	60Hz <50Hz>
C2	Frequency setting voltage bias frequency	0 to 60Hz	0Hz
C3	Frequency setting voltage bias	0 to 300%	0%*
C4	Frequency setting voltage gain	0 to 300%	96%*
C5	Frequency setting current bias frequency	0 to 60Hz	0Hz
C6	Frequency setting current bias	0 to 300%	20%*
C7	Frequency setting current gain	0 to 300%	100%*

* Settings may differ because of calibration parameters.
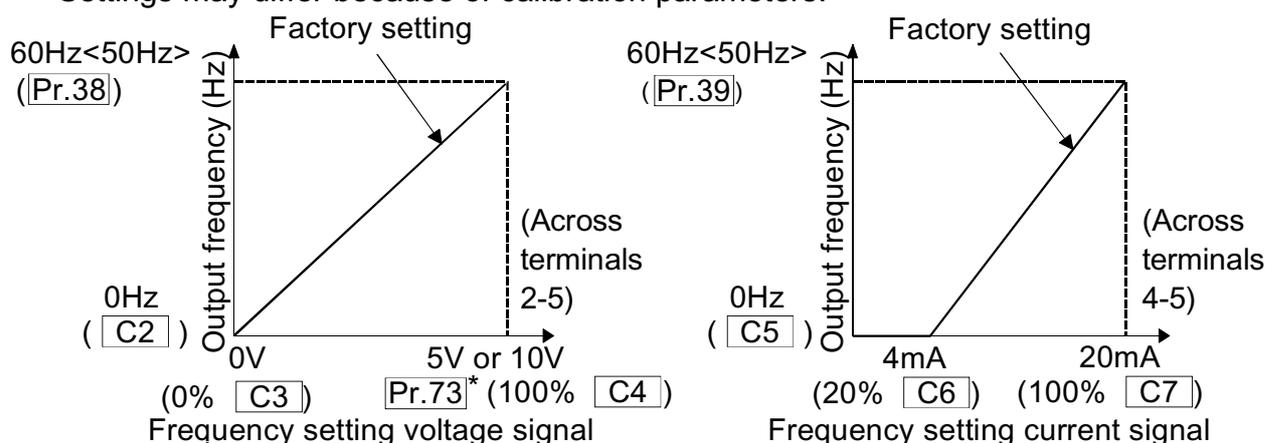
* Pr. 73 "0-5V/0-10V selection" changes the specifications of terminal "2".

POINT

- Bias setting for 0 to 5VDC (0 to 10VDC) input ➡ Use the calibration parameter C2, C3 for setting.

- Gain setting for 0 to 5VDC (0 to 10VDC) input ➡ Use Pr. 38, calibration parameter C4 for setting.

- Bias setting for 4 to 20mADC input ➡ Use calibration parameter C5, C6 for setting.

- Gain setting for 4 to 20mADC input ➡ Use Pr. 39, calibration parameter C7 for setting.

(For 4 to 20mADC input, set "4" in any of Pr. 60 to Pr. 63 (input terminal function selection) and assign AU (current input selection) to any of terminals RH, RM, RL and STR, and turn on the AU signal.)

5.1 Changing the Output Frequency Setting of the Frequency Setting Potentiometer (Bias and gain of frequency setting voltage (current))

POINT

- Pr. 38, Pr. 39 and calibration parameters "C1 to C7" can be made to be read by setting "1" (extended function parameter valid) in Pr. 30 "extended function display selection".

The bias/gain of the frequency setting voltage (current) may be adjusted in any of the following methods:

1) Changing the highest frequency

2) Adjusting the deviation of the highest frequency from the Pr. 38 (Pr. 39) setting.
2)-1 Make adjustment with a voltage applied directly across terminals 2-5 (with a current flowing across terminals 4-5)
2)-2 Make adjustment at any point without a voltage applied across terminals 2-5 (without a current flowing across terminals 4-5) (For the setting method, refer to the instruction manual (detailed).)

| Changing example | When you want to use the 0 to 5VDC input frequency setting potentiometer to change the 5V-time frequency from 60Hz to 50Hz

POINT

- Pr. 38 is an extended function parameter. Pr. 30 must be set to "1". (Refer to page 25.)
- Change Pr. 38 "frequency setting voltage gain frequency" to 50Hz.

1) Changing the highest frequency.

———————— Operation ————————   ———— Display ————

1. Confirm the RUN indication and operation mode indication.
   - The inverter must be at a stop.
   - The inverter must be in the PU operation mode. (Press the (PU/EXT) key.)

   `0.0`   RUN / PU / EXT

2. Press the (MODE) key to choose the parameter setting mode.

   (MODE) ⇨ `P 0`   (The parameter number read previously appears.)

3. Turn the setting dial ☺ until the parameter number 38 "frequency setting voltage gain frequency" appears.
   - Pr. 30 must be set to "1". (For the parameter setting method, refer to steps 3 to 6 on page 25.)

   ☺ ⇨ `P 38`

4. Press the (SET) key to show the currently set value. (60Hz)

   (SET) ⇨ `60.0`

5. Turn the setting dial ☺ to change the set value to "50.0". (50Hz)

   ☺ ⇨ `50.0`

6. Press the (SET) key to set the value.

   (SET) ⇨ `50.0` `P 38`

   Flicker ... Parameter setting complete!!

   - By turning the setting dial ☺ , you can read another parameter.
   - Press the (SET) key to show the setting again.
   - Press the (SET) key twice to show the next parameter.

? **The monitor/frequency setting indication cannot be changed to just 50Hz ... Why?**
   ☞ The calibration parameter C4 "frequency setting voltage gain" value must be set. (Refer to page 30.)

Remarks

To change the value to more than 60Hz <50Hz>, Pr. 1 "maximum frequency" must be set to more than 60Hz <50Hz>.

<u>Changing example</u> Changing the calibration parameter C4 "frequency setting voltage gain"

> **POINT**
>
> The calibration parameter C4 is an extended function parameter. Pr. 30 must be set to "1".

2) Adjusting a deviation of the highest frequency from the Pr. 38 (Pr. 39) setting.
  2)-1 Making adjustment with a voltage applied directly across terminals 2-5 (with a current flowing across terminals 4-5)

———————Operation————————   ——Display——

1. Confirm the RUN indication and operation mode indication.
   ● The inverter must be at a stop.
   ● The inverter must be in the PU operation mode.(Press the (PU/EXT) key.)

   Display: `0.0` RUN / PU / EXT

2. Press the (MODE) key to choose the parameter setting mode.

   (MODE) ⇨ `P 0`   *The parameter number read previously appears.*

3. Turn the setting dial ⊙ until "`C . .`" appears.
   ● Pr. 30 must be set to "1".
   (For details, refer to steps 3 to 6 on page 25.)
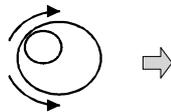
   ⊙ ⇨ `C . .`

4. Press the (SET) key to show "`C  -`"

   (SET) ⇨ `C  -`

When adjusting Pr. 38

5. Turn the setting dial ⊙ until the calibration parameter C4 "frequency setting voltage gain" appears.

   ⊙ ⇨ `C 4`
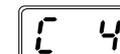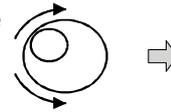
6. Press the (SET) key to show the analog voltage analog-to-digital conversion value (%).

   (SET) ⇨ `0.0`   *Analog voltage analog-to-digital conversion value (%) across terminals 2-5*

7. Apply a 5V voltage.
   (Turn the external potentiometer connected to across terminals 2-5 to the maximum (any position).)

   `100`*

   *The value is nearly 100 (%) in the maximum position of the potentiometer.

═══CAUTION═══
After performing operation in step 7, do not touch the setting dial ⊙ until completion of calibration.

8. Press the (SET) key to set the value.

   (SET) ⇨ `100`* ⟷ `C 4`

Flicker ... Parameter setting complete!!
(Adjustment complete)
*The value is nearly 100 (%) in the maximum position of the potentiometer.

● By turning the setting dial ⊙, you can read another parameter.

● Press the (SET) key to return to the "`C  -`" indication (step 4).

● Press the (SET) key twice to show the next parameter (`CLr`).
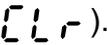
? **The frequency meter (indicator) connected to across terminals FM-SD (AM-5) does not indicate just 50Hz ... Why?**
  ☞ The calibration parameter C1 "FM (AM) terminal calibration" value must be set. (Refer to page 31.)

? **When write is performed, an error (`Er 3`) is displayed.**
  ☞ The gain and bias frequency settings are close.

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5.2 Adjustment (Calibration) of the Frequency Meter (Indicator)

Changing example Deflecting the meter (analog indicator) to full-scale (across FM-SD: 1mA, across AM-5: 5V) at the preset frequency of 60Hz. (Refer to page 22 for frequency setting)

> **POINT**
> - The calibration parameters "C1" can be made to be read by setting "1" (extended function parameter valid) in Pr. 30 "extended function display selection".
> - Set the value of the calibration parameter C1 "FM (AM) terminal calibration".

──────── Operation ────────　　　　──────── Display ────────

In PU operation mode

1. Press the (MODE) key to choose the parameter setting mode.

   (MODE) ⇨ | P 0 |　(The parameter number read previously appears.)

2. Turn the setting dial ⊙ to show "C . . ".
   - Pr. 30 must be set to "1". (For details, refer to steps 3 to 6 on page 25.)
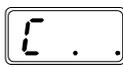
   ⊙ ⇨ | C . . |

3. Press the (SET) key to show "C - ".

   (SET) ⇨ | C - |
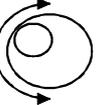
4. Turn the setting dial ⊙ until the calibration parameter C1 "FM (AM) terminal calibration" appears.

   ⊙ ⇨ | C 1 |
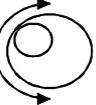
5. Press the (SET) key to enable setting.

   (SET) ⇨ | 0.0 |

6. If the inverter is at a stop, press the (RUN) key to start it. (The motor need not be connected.)

   (RUN) ⇨ | 0.0 |→| 60.0 |　RUN / PU / EXT

7. Turn the setting dial ⊙ to adjust the indicator needle to the desired position.
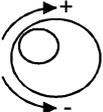
   ⊙ ⇨ | (analog indicator) | Analog indicator

8. Press the (SET) key. Setting is complete.
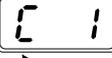
   (SET) ⇨ | 60.0 | | C 1 |

   Flicker ... Parameter setting complete!!

- By turning the setting dial ⊙, you can read another parameter.
- Press the (SET) key to return to the "C　-" indication (step 3).
- Press the (SET) key twice to show the next parameter (C L r).

> **Remarks**
> - Depending on the set value, it may take some time for the needle to move.
> - If "1" is set in Pr. 30 "extended function display selection", the calibration parameter C1 "FM (AM) terminal calibration" can also be set in the external operation mode.

> **POINT**
> By setting the Pr. 54 "FM (AM) terminal function selection" value, preset Pr. 55 "frequency monitoring reference" or Pr. 56 "current monitoring reference" to the running frequency or current value at which the output signal is 1440 pulses/s (5V). At 1440 pulses/s (5V), the meter generally deflects to full-scale.

6. FUNCTION LIST

6.1 Basic Function Parameter List

Pa-rame-ter	Name	Indica-tion	Setting Range	Minimum Setting Increments	Factory Setting <EC Version>	Customer Setting
0	Torque boost	P 0	0 to 15%	0.1%	6%/5%/4%*	
1	Maximum frequency	P 1	0 to 120Hz	0.1Hz	60Hz <50Hz>	
2	Minimum frequency	P 2	0 to 120Hz	0.1Hz	0Hz	
3	Base frequency	P 3	0 to 120Hz	0.1Hz	60Hz <50Hz>	
4	Multi-speed setting (high speed)	P 4	0 to 120Hz	0.1Hz	60Hz <50Hz>	
5	Multi-speed setting (middle speed)	P 5	0 to 120Hz	0.1Hz	30Hz	
6	Multi-speed setting (low speed)	P 6	0 to 120Hz	0.1Hz	10Hz	
7	Acceleration time	P 7	0 to 999s	0.1s	5s	
8	Deceleration time	P 8	0 to 999s	0.1s	5s	
9	Electronic thermal O/L relay	P 9	0 to 50A	0.1A	Rated output current	
30	Extended function display selection	P30	0, 1	1	0	
79	Operation mode selection	P79	0 to 4, 7, 8	1	0	

* The factory setting varies with the inverter capacity: 5% for FR-S540-1.5K and 2.2K, 4% for FR-S540-3.7K.

Remarks

- The extended function parameters are made valid by setting "1" in Pr. 30 "extended function display selection". (Refer to page 25)
- The decimal places of a value of 100 or more (3 digits or more) cannot be set to be displayed.

6.2 Explanation of the Basic Function Parameters

For details, refer to the instruction manual (detailed) separately available.

Pr. 0 "torque boost"

- Allows the motor torque in the low speed range to be adjusted according to the load.
  Make adjustment when stall prevention is operated when starting.
- When a constant-torque motor is used, set the following value:

	0.1K to .075K	1.5K	2.2K, 3.7K
100V class 200V class	6%	4%	4%
400V class	6%	4%	3%
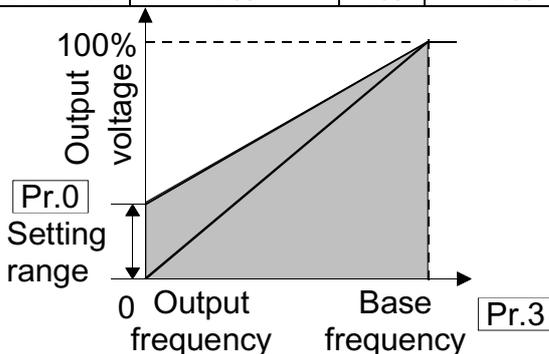
Pr. 1 "maximum frequency", Pr. 2 "minimum frequency"

- Clamp the upper and lower limits of the output frequency.

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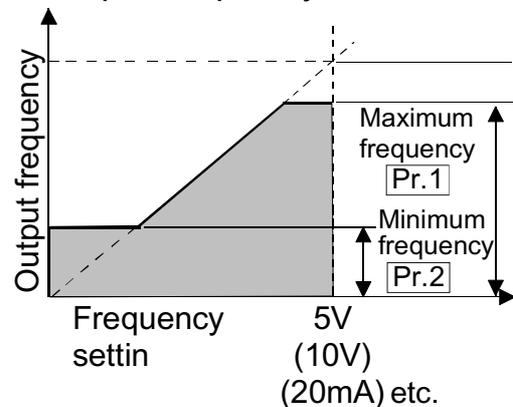
Pr. 3 "base frequency"

- Set the base frequency (reference frequency at rated motor torque) within the range 0 to 120Hz according to the motor.

Pr. 7 "acceleration time", Pr. 8 "deceleration time"

- As the acceleration time, set the time taken to reach the acceleration/deceleration reference frequency in Pr. 20 from 0Hz, and as the deceleration time, set the time taken to reach 0Hz from the Pr. 20 value.
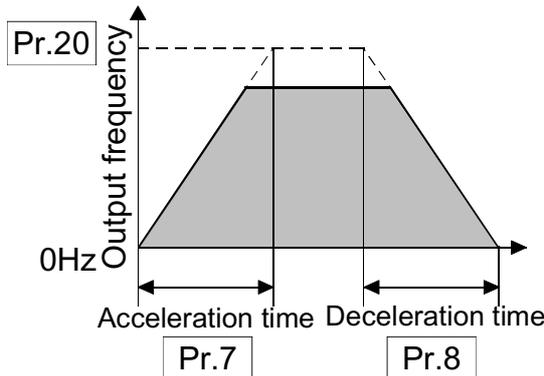
Pr. 30 "extended function display selection"

- Set this parameter when showing/setting the extended function parameters.

Setting	Description
0	Only basic functions are displayed.
1	All parameters are displayed.

Pr. 4 "multi-speed setting (high speed)" Pr. 5 "multi-speed setting (middle speed)" Pr. 6 "multi-speed setting (low speed)"

- You can select any speed (RH, RM, RL) by simply changing the external contact signal.

	RH	RM	RL
High speed	ON	OFF	OFF
Middle speed	OFF	ON	OFF
Low speed	OFF	OFF	ON

- Each speed (frequency) can be set to any value within the range 0 to 120Hz if the inverter is running.
- The extended functions enable setting of up to 15 speeds.

Pr. 9 "electronic thermal O/L relay"

- You can set a current value for protection of the motor from overheat. Normally, set the rated motor current at 50Hz as it is.
- At the setting of 0A, motor protection does not function. (The output transistor protection of the inverter functions.)
- When connecting multiple motors to the inverter, provide external thermal relays to individual motors.
- For the 0.1K to 0.75K, this value is factory-set to 85% of the rated inverter current.

Pr. 79 "operation mode selection"

- The inverter has two different operation modes: operation under control of external signals and operation from the PU (setting dial, (RUN) key). You can use either or both operation modes.

Setting	Description	
0	PU (setting dial, (RUN) key) operation or external operation can be selected by the (PU/EXT) key.	
1	Only PU (setting dial, (RUN) key) operation may be performed.	
2	Only external operation may be performed.	
3	**Running frequency**	**Start signal**
	• Setting made by setting dial • Multi-speed selection • 4 to 20mA (Made valid when AU signal turns on)	External terminal (STF/STR)
4	**Running frequency**	**Start signal**
	External terminal signals (multi-speed, 0 to 5VDC, etc.)	(RUN) key
7	PU operation interlock (Switching to PU operation mode is enabled/disabled by turning MRS signal ON/OFF)	
8	Operation mode external signal switching (disabled during operation) Turn X16 signal ON/OFF to choose operation mode.	

6.3 EXTENDED FUNCTION PARAMETER LIST

Setting "1" in Pr. 30 "extended function display selection" makes the extended function parameters valid. (Refer to the separately available instruction manual (detailed).)

Parameter	Indica-tion	Name	Outline	Factory Setting <EC Version>
For parameters 0 to 9, refer to the basic function parameters.				
10	P 10	DC injection brake operation frequency	Set the timing of switching to DC injection brake (0 to 120Hz), the time to apply DC injection brake (0 to 10s), and the braking torque at DC injection brake start (0 to 15%). (Set Pr. 12 to 4% when a constant-torque motor is used.)	3Hz
11	P 11	DC injection brake operation time		0.5s
12	P 12	DC injection brake voltage		6%
13	P 13	Starting frequency	Frequency which is output by the inverter first at a start and gives great influence to the starting torque. About 1 to 3Hz for vertical lift applications, or up to 5Hz to the maximum. For other than vertical lift applications, factory setting of about 0.5Hz is recommended. 0 to 60Hz	0.5Hz
14	P 14	Load pattern selection	Choose the output frequency and output voltage patterns according to the application (load characteristic). 0: For constant-torque loads (when relatively large torque is needed at low to high speeds) 1: For variable-torque loads (for applications where torque is small at low speed, e.g. fans and pumps) 2: For vertical lifts (for elevators at reverse rotation boost of 0%) 3: For vertical lifts (for elevators at forward rotation boost of 0%)	0
15	P 15	Jog frequency	Speed command (0 to 120Hz) and acceleration/deceleration slope (0 to 999s) for jog (inching) operation Can be read as the basic parameters when the FR-PU04 is connected to the type having the RS-485 communication function.	5Hz
16	P 16	Jog acceleration/ deceleration time		0.5s
17	P 17	RUN key rotation direction selection	The (RUN) key of the operation panel can be used to choose the direction of rotation for operation. 0: forward rotation, 1: reverse rotation	0
19	P 19	Base frequency voltage	Indicates the magnitude of the output voltage at the base frequency (Pr. 3). 888: 95% of power supply voltage (1.9 times greater than the power supply voltage for the 100V class) - - -: Same as power supply voltage (Twice greater than power supply voltage for 100V class) 0 to 500V, 888, - - - (0 to 800V, 888, - - - for the 400V class.)	- - - <888>
20	P 20	Acceleration/ deceleration reference frequency	Indicates the frequency to be referenced for acceleration from or deceleration to 0Hz in the time set in Pr. 7 "acceleration time" or Pr. 8 "deceleration time". 1 to 120Hz	60Hz <50Hz>

Parameter		Name	Outline	Factory Setting <EC Version>
	Indica-tion			
21	P21	Stall prevention function selection	Stall prevention is a function designed to suspend a frequency increase during acceleration or suspend a frequency decrease during deceleration if the preset current (0 to 200%) is exceeded, in order to prevent an overcurrent alarm.	0
22	P22	Stall prevention operation level	Pr. 21 allows you to select whether to use stall prevention or not according to the acceleration/deceleration status. Since the fast-response current limit value is 170%, torque will not be developed if Pr. 22 is set to more than 170%. In that case, set "1" in Pr. 21.	150%
23	P23	Stall prevention operation level compensation factor at double speed	Used to reduce the stall prevention level at or above the base frequency. Setting other than "- - -" specifies the current level at 120Hz which is lower than the Pr. 22 value of the stall prevention level at base frequency. 0 to 200%, - - -	- - -
24	P24	Multi-speed setting (speed 4)	Setting other than "- - -" specifies speeds 4 to 7. By combining ON and OFF of the contact signals (RH, RM, RL signals), the running speed can be changed step-by-step.	- - -
25	P25	Multi-speed setting (speed 5)		- - -
26	P26	Multi-speed setting (speed 6)		- - -
27	P27	Multi-speed setting (speed 7)	0 to 120Hz, - - -	- - -

	RH	RM	RL
Speed 4	OFF	ON	ON
Speed 5	ON	OFF	ON
Speed 6	ON	ON	OFF
Speed 7	ON	ON	ON

Parameter		Name	Outline	Factory Setting <EC Version>
28	P28	Stall prevention operation reduction starting frequency	You can reduce the stall prevention level in the high frequency range. 0 to 120Hz	60Hz <50Hz>
29	P29	Acceleration/ deceleration pattern	Used to determine the frequency changing pattern at acceleration/deceleration. 0: Linear acceleration/deceleration 1: S-pattern acceleration/deceleration A (e.g. machine tool spindle applications) 2: S-pattern acceleration/deceleration B (e.g. load collapse preventing applications for conveyors and so on)	0
For parameter 30, refer to the basic function parameters.				
31	P31	Frequency jump 1A		- - -
32	P32	Frequency jump 1B	Set the frequency range you want to evade during constant-speed operation to avoid resonance with a machine. 0 to 120Hz, - - -	- - -
33	P33	Frequency jump 2A		- - -
34	P34	Frequency jump 2B		- - -
35	P35	Frequency jump 3A		- - -
36	P36	Frequency jump 3B		- - -
37	P37	Speed display	You can convert the frequency monitor/set frequency of the operation panel into the load speed and display it. Setting 0 shows the output frequency, and setting 0.1 to 999 shows the load speed. (Set the speed for 60Hz operation.) 0, 0.1 to 999	0

Parameter		Name	Outline	Factory Setting <EC Version>
	Indica-tion			
38	P38	Frequency setting voltage gain frequency	You can set as desired the magnitude (slope) of the output frequency to the external frequency setting voltage signal (0 to 5V or 0 to 10V). 1 to 120Hz	60Hz <50Hz>
39	P39	Frequency setting current gain frequency	You can set as desired the magnitude (slope) of the output frequency to the external frequency setting current signal (4 to 20mA). 1 to 120Hz	60Hz <50Hz>
40	P40	Start-time ground fault detection selection	Set whether a ground fault is to be detected or not at a start. 0: Not detected 1: Detected	0 <1>
41	P41	Up-to-frequency sensitivity	You can adjust the ON range of the up-to-frequency signal (SU) to be output when the output frequency reaches the running frequency. You can use this function to ensure that the running frequency has been reached or use it as the operation start signal etc. for related equipment. Use Pr. 64 or Pr. 65 to assign the terminal used for SU signal output. 0 to100%	10%
42	P42	Output frequency detection	Set the reference value at which the signal (FU) is output when the output frequency rises to or above a certain value. This function can be used for electromagnetic brake operation, open signal, etc. Use Pr. 64 or Pr. 65 to assign the terminal used for the FU signal. 0 to 120Hz	6Hz
43	P43	Output frequency detection for reverse rotation	Set the reference value at which the signal (FU) is output when the output frequency rises to or above a certain value. This function is valid for reverse operation. 0 to 120Hz, - - -	- - -
44	P44	Second acceleration/ deceleration time	Second function for the acceleration/ deceleration time set in Pr. 7 or Pr. 8. 0 to 999s	5s
45	P45	Second deceleration time	Second function for the deceleration time set in Pr. 8. 0 to 999s, - - -	- - -
46	P46	Second torque boost	Second function for the torque boost set in Pr. 0. 0 to 15%, - - -	- - -
47	P47	Second V/F (base frequency)	Second function for the base frequency set in Pr. 3. 0 to 120Hz, - - -	- - -
48	P48	Output current detection level	Set the level at which the output current detection signal (Y12) is output. 0 to 200%	150%
49	P49	Output current detection signal delay time	When the output current is at or above the output current detection level (Pr. 48) for longer than this period (Pr. 49), the output current detection signal (Y12) is output. 0 to 10s	0s

Parameter		Name	Outline	Factory Setting <EC Version>
	Indica-tion			
50	P50	Zero current detection level	Set the level at which the zero current detection signal (Y13) is output. 0 to 200%	5%
51	P51	Zero current detection time	When the output current is at or below the zero current detection level (Pr. 50) for longer than this period (Pr. 51), the zero current detection signal (Y13) is output. 0.05 to 1s	0.5s
52	P52	Control panel display data selection	You can choose the data displayed on the operation panel. 0: Output frequency 1: Output current 100: Set frequency during stop/output frequency during operation	0
53	P53	Frequency setting operation selection	You can use the setting dial like a potentiometer to perform operation. 0: Setting dial frequency setting mode 1: Setting dial potentiometer mode	0
54	P54	FM (AM) terminal function selection	You can choose the indicator connected to the FM (AM) terminal. 0: Output frequency monitor 1: Output current monitor	0
55	P55	Frequency monitoring reference	Set the reference value of frequency monitoring. 0 to 120Hz	60Hz <50Hz>
56	P56	Current monitoring reference	Set the reference value of current monitoring. 0 to 50A	Rated output current
57	P57	Restart coasting time	At power restoration after an instantaneous power failure, you can restart the inverter without the motor being stopped (with the motor coasting). The inverter begins to restart after this period (Pr. 57) has elapsed after power restoration. When you set "- - -", a restart is not made. "0" setting generally does not pose a problem but you can adjust the time (0 to 5s, - - -) according to the magnitude of the load.	- - -
58	P58	Restart cushion time	When the restart coasting time (Pr. 57) has elapsed, the output voltage is risen gradually. Set this cushion time (0 to 60s). Operation may be performed generally at the factory setting, but you can adjust the time according to the magnitude of the load.	1s
59	P59	Remote setting function selection	You can set the remote setting function which is used when the operation panel is away from the control box, for example. 0: Without remote setting function 1: With remote setting function With frequency setting storage function 2: With remote setting function Without frequency setting storage function	0

Parameter	Indica-tion	Name	Outline	Factory Setting
60	P60	RL terminal function selection	You can choose the following input signals: 0: RL (multiple low-speed operation command) 1: RM (multiple middle-speed operation command) 2: RH (multiple high-speed operation command)	0
61	P61	RM terminal function selection	3: RT (second function selection) 4: AU (current input selection) 5: STOP (start self-holding selection) 6: MRS (output stop)	1
62	P62	RH terminal function selection	7: OH (external thermal relay input) 8: REX (15 multi-speed selection) 9: JOG (jog operation selection) 10: RES (reset)	2
63	P63	STR terminal function selection	14: X14 (PID control valid terminal) 16: X16 (PU operation/external operation switching) - - -: STR (reverse rotation start (may be assigned to only STR terminal))	- - -
64	P64	RUN terminal function selection	You can choose the following output signals: 0: RUN (inverter running) 1: SU (up-to-frequency) 3: OL (overload warning) 4: FU (output frequency detection) 11: RY (operation ready) 12: Y12 (output current detection)	0
65	P65	A, B, C terminal function selection	13: Y13 (zero current detection) 14: FDN (PID lower limit signal) 15: FUP (PID upper limit signal) 16: RL (PID forward/reverse rotation signal) 98: LF (minor failure output) 99: ABC (alarm output)	99
66	P66	Retry selection	You can choose the retry alarm to be activated when the protective function is activated. 0: OC1 to 3, OV1 to 3, THM, THT, GF, OHT, OLT, PE, OPT 1: OC1 to 3, 2: OV1 to 3, 3: OC1 to 3, OV1 to 3	0
67	P67	Number of retries at alarm occurrence	You can set the number of retries to be made when the protective function is activated. 0: No retry 1 to 10: Without alarm output during retry operation 101 to 110: With alarm output during retry operation	0
68	P68	Retry waiting time	You can set the waiting time from when the protective function is activated until a retry is made. 0.1 to 360s	1s
69	P69	Retry count display erase	You can display the cumulative number of successful restarts made by retries when the protective function is activated. 0: Cumulative count erase	0

Parameter	Indica-tion	Name	Outline	Factory Setting
70	P70	Soft-PWM setting	You can choose whether Soft-PWM control is to be exercised or not. When Soft-PWM is valid, you can change the metallic motor tone into an unoffending complex tone. 0: Soft-PWM invalid, 1: Soft-PWM valid	1
71	P71	Applied motor	Set the motor to be used. 0: Thermal characteristic for Mitsubishi standard motor 1: Thermal characteristic for Mitsubishi constant-torque motor	0
72	P72	PWM frequency selection	You can change the PWM carrier frequency. Increasing this value reduces the motor audible noise, but increases noise and leakage current. The setting is in [kHz]. 0: 0.7kHz, 15: 14.5kHz 0 to 15 (Remarks) Metallic sound may be generated from the motor at sudden deceleration but it is not a fault.	1
73	P73	0-5V/0-10V selection	You can set the input voltage specification of terminal "2". 0: For 0 to 5VDC input, 1: For 0 to 10VDC input	0
74	P74	Input filter time constant	Valid for eliminating noise of the frequency setting circuit. A larger set value increases the time constant.	1
75	P75	Reset selection/PU stop selection	You can choose the function of the (STOP/RESET) key on the operation panel. |	Reset Input	PU Stop Key Input
---	---	---
0	Normally enabled	Invalid (Valid only in the PU operation mode or combined operation mode (Pr. 79=4))
1	Enabled only when the protective function is activated	
14	Normally enabled	Valid
15	Enabled only when the protective function is activated			14
76	P76	Cooling fan operation selection	You can control the operation of the cooling fan built in the inverter. (Operates in power-on status.) 0: The fan normally operates at power-on of the inverter. 1: The fan is normally on during inverter operation. The fan switches on/off according to the temperature during a stop of the inverter whose status is monitored.	1
77	P77	Parameter write disable selection	You can choose whether to enable or disable parameter write. 0: Write is enabled only during a stop in the PU operation mode 1: Write disabled (except some parameters) 2: Write during operation enabled (external mode and during operation)	0
78	P78	Reverse rotation prevention selection	You can prevent trouble during reverse operation due to false input of the start signal. 0: Both forward rotation and reverse rotation enabled 1: Reverse rotation disabled 2: Forward rotation disabled	0

For parameter 79, refer to the basic function parameters.

Parameter		Name	Outline	Factory Setting
	Indica-tion			
80	P80	Multi-speed setting (speed 8)	Setting other than "- - -" specifies speeds 8 to 15. By combining ON and OFF of the contact signals (RH, RM, RL, REX signals), the running speed can be changed step-by-step. Use Pr. 63 to assign the REX signal.	- - -
81	P81	Multi-speed setting (speed 9)		- - -
82	P82	Multi-speed setting (speed 10)		- - -
83	P83	Multi-speed setting (speed 11)		- - -
84	P84	Multi-speed setting (speed 12)		- - -
85	P85	Multi-speed setting (speed 13)		- - -
86	P86	Multi-speed setting (speed 14)		- - -
87	P87	Multi-speed setting (speed 15)	0 to 120Hz, - - -	- - -

	RH	RM	RL	REX
Speed 8	OFF	OFF	OFF	ON
Speed 9	OFF	OFF	ON	ON
Speed 10	OFF	ON	OFF	ON
Speed 11	OFF	ON	ON	ON
Speed 12	ON	OFF	OFF	ON
Speed 13	ON	OFF	ON	ON
Speed 14	ON	ON	OFF	ON
Speed 15	ON	ON	ON	ON

Parameter		Name	Outline	Factory Setting
88	P88	PID action selection	Used to choose the operation of PID control. 20: PID reverse action, 21: PID forward action	20
89	P89	PID proportional band	Used to set the proportional band for PID control. 0.1 to 999%, - - -	100%
90	P90	PID integral time	Used to set the integral time for PID control. 0.1 to 999s, - - -	1s
91	P91	PID upper limit	Used to set the upper limit value for PID control. 0 to 100%, - - -	- - -
92	P92	PID lower limit	Used to set the lower limit value for PID control. 0 to 100%, - - -	- - -
93	P93	PID action set point for PU operation	Used to set the PID action set point for PU operation. 0 to 100%	0%
94	P94	PID differential time	Used to set the differential time for PID control. 0.01 to 10s, - - -	- - -
95	P95	Rated motor slip	Used to set the rated motor slip to make slip compensation. 0 to 50%, - - -	- - -
96	P96	Slip compensation time constant	Used to set the response time of slip compensation. 0.01 to 10s	0.5s
97	P97	Constant-output region slip compensation selection	Used to choose whether slip compensation is made or not in the constant-output region. 0, - - -	- - -
98	P98	Automatic torque boost selection (Motor capacity)	You can set the motor capacity and exercise automatic torque boost control. When you set "- - -", V/F control is exercised. Set the motor capacity used. • The motor capacity should be equal to or one rank lower than the inverter capacity. • The number of motor poles should be 2, 4 or 6. (Only 4 poles for constant-torque motor) • Single-motor operation (one motor run by one inverter) should be performed. • Wiring length from inverter to motor should be within 30m (98.43feet). When using a constant-torque motor, set "1" in Pr. 71. <Example> For 1.5kW, set "1.5". 0.1 to 3.7kW, - - - (0.2 to 3.7kW, - - - for the 400V class.)	- - -
99	P99	Motor primary resistance	You can set the motor's primary resistance value. (Normally, this parameter need not be set.) 0 to 50Ω, - - -	- - -

Calibration Parameter	Indication	Name	Outline	Factory Setting
C1 (FM:900) (AM:901)	C 1	FM (AM) terminal calibration	You can calibrate the indicator connected to across terminals FM-SD (AM-5). ―――	―――
C2 (902)	C 2	Frequency setting voltage bias frequency	You can set as desired the magnitude (slope) of the output frequency to the external frequency setting voltage signal (0 to 5V or 0 to 10V). (Bias frequency) 0 to 60Hz	0Hz
C3 (902)	C 3	Frequency setting voltage bias	Used to adjust the analog-to-digital converted voltage value of the frequency set in calibration parameter C4. (Bias %) 0 to 300%	0%*
C4 (903)	C 4	Frequency setting voltage gain	Used to adjust the analog-to-digital converted voltage value of the frequency set in Pr. 38. (Gain %) 0 to 300%	96%*
C5 (904)	C 5	Frequency setting current bias frequency	You can set as desired the magnitude (slope) of the output frequency to the external frequency setting current signal (4 to 20mA). 0 to 60Hz	0Hz
C6 (904)	C 6	Frequency setting current bias	Used to adjust the analog-to-digital converted voltage value of the frequency set in calibration parameter C5. (Bias %) 0 to 300%	20%*
C7 (905)	C 7	Frequency setting current gain	Used to adjust the analog-to-digital converted voltage value of the frequency set in Pr. 39. (Gain %) 0 to 300%	100%*
C8 (269)	C 8	Parameter for manufacturer setting. Do not set.		
CLr	CLr	Parameter clear	0: Not executed 1: Initialization of parameters other than calibration values (parameter clear) 10: Initialization of parameters including calibration values (all clear)	0
ECL	ECL	Alarm history clear	0: Not cleared 1: Alarm history clear	0

*Settings may differ because of calibration parameters.

- Parameters which can be read on only the type having the RS-485 communication function. (When the parameter unit (FR-PU04) is used, operation from the operation panel is not accepted.)

For details of the program, etc., refer to the instruction manual (detailed) separately available.

POINT
To make RS-485 communication between the inverter and personal computer, the operation mode must be set to the "computer link operation mode". Pr. 79 "operation mode selection" ≠, "1, 3, 4" and communication parameter n10 "link start mode selection" = "1"

Communi-cation Parameter	Indica-tion	Name	Outline	Factory Setting <NA, EC Version>
n1 (331)	n 1	Communication station number*	Set the station number for communication from the RS-485 connector. 0 to 31: Specify the station number of the inverter.	0
n2 (332)	n 2	Communication speed*	48: 4800bps 96: 9600bps 192: 19200bps	192
n3 (333)	n 3	Stop bit length*	0: Stop bit length 1 bit/data length 8 1: Stop bit length 2 bits/data length 8 10: Stop bit length 1 bit/data length 7 11: Stop bit length 2 bits/data length 7	1
n4 (334)	n 4	Parity check presence/absence*	0: Absent 1: With odd parity check 2: With even parity check	2
n5 (335)	n 5	Number of communication retries	Set the permissible number of retries at occurrence of a data receive error. When you set "- - -", the inverter will not come to an alarm stop if a communication error occurs. 0 to 10, - - -	1
n6 (336)	n 6	Communication check time interval	Set the interval of communication check time. If a no-communication status persists for longer than the permissible time, the inverter will come to an alarm stop. 0: No communication 0.1 to 999s - - -: Check suspended To make communication, set any value other than 0 in the communication parameter n6 "communication check time interval".	0s <- - ->
n7 (337)	n 7	Wait time setting*	Set the waiting time from when data is transmitted to the inverter until response is made. 0 to 150ms - - -: Set in communication data	- - -
n8 (338)	n 8	Operation command write	You can choose whether the operation command is given by the computer or external terminal. 0: Command write from computer 1: Command write from external terminal	0

Communication Parameter	Indication	Name	Outline	Factory Setting <NA, EC Version>
n9 (339)	$n\ 9$	Speed command write	You can choose whether the speed command is given by the computer or external terminal. 0: Command write from computer 1: Command write from external terminal	0
n10 (340)	$n\ 10$	Link start mode selection	You can choose the operation mode at power-on or at power restoration after instantaneous power failure. Set "1" to select the computer link operation mode. 0: Mode set in Pr. 79 is established. 1: Started in computer link mode.	0
n11 (341)	$n\ 11$	CR/LF selection*	0: Without CR/LF 1: With CR, without LF 2: With CR/LF	1
n12 (342)	$n\ 12$	E^2PROM write selection	0: Write to RAM and E^2PROM 1: Write to RAM only (When reset is performed, the parameter value will be the value of E^2PROM.)	0
n13 (145)	$n\ 13$	PU display language	0: Japanese 1: English 2: German 3: French 4: Spanish 5: Italian 6: Swedish 7: Finish	0 <1>
n14 (990)	$n\ 14$	PU buzzer sound control	0: Without sound, 1: With sound	1
n15 (991)	$n\ 15$	PU contrast adjustment	0 (bright) → 63 (dark)	58
n16 (992)	$n\ 16$	PU main display screen data selection	0: Selectable between output frequency and output current 100: Set frequency (during stop) Output frequency (during operation)	0
n17 (993)	$n\ 17$	PU disconnection detection/PU setting lock	0: Without PU disconnection error/PU operation valid 1: Error at PU disconnection/PU operation valid 10: Without PU disconnection error/ PU operation invalid	0

* Perform a reset after parameter setting. The set values are reflected after the reset is performed.

Remarks

- The parameter numbers within parentheses are those for use of the parameter unit (FR-PU04).
- Set "9999" when setting a value "- - -" using the parameter unit (FR-PU04).
- Pr. stands for a parameter number.

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7. ERRORS AND PROTECTIVE FUNCTIONS
7.1 About Errors (Definitions)

When an alarm occurs in the inverter, the protective function is activated to bring the inverter to an alarm stop and the PU display automatically changes to any of the following error (alarm) indications.

For details, refer to the instruction manual (detailed) which is separately available.

(1) Major failures

Control Panel Indication	Function Name	Definition
OC I (OC1)	Overcurrent cut-off during acceleration	The inverter output current rose to or above about 200% of the rated inverter current during acceleration.
OC 2 (OC2)	Overcurrent cut-off during constant speed	The inverter output current rose to or above about 200% of the rated inverter current during constant-speed operation.
OC 3 (OC3)	Overcurrent cut-off during deceleration	The inverter output current rose to or above about 200% of the rated inverter current during deceleration.
Ou I (OV1)	Regenerative overvoltage cut-off during acceleration	Excessive regenerative energy or surge voltage occurred during acceleration.
$Ou2$ (OV2)	Regenerative overvoltage cut-off during constant speed	Excessive regenerative energy or surge voltage occurred during constant speed.
$Ou3$ (OV3)	Regenerative overvoltage cut-off during deceleration or stop	Excessive regenerative energy or surge voltage occurred during deceleration or stop.
THM (THM)	Motor overload cut-off (Electronic thermal overcurrent protection) (*1)	Overload or reduced cooling capability during low-speed operation. Protection from burning due to motor temperature rise
THT (THT)	Inverter overload cut-off (Electronic thermal overcurrent protection) (*1)	Current more than 150% of the rated output current flew and overcurrent shut-off did not occur. Output transistor protection from overheat
FIn (FIN)	Fin overheat	Temperature rise of the heat sink.
GF (GF)	Start-time output side ground fault overcurrent protection (*2)	Ground fault occurred on the inverter's output side.
OHT (OHT)	External thermal relay (*3)	External thermal relay provided for protection from overheat was actuated (contact open).
OLT (OLT)	Stall prevention (overload)	Stall prevention was activated to drop the running frequency to 0. (OL appears while stall prevention is activated.)
OPT (OPT)	Communication error	• Communication errors occurred consecutively more than the permissible number of retries when the RS-485 connector is used and communication parameter n5 = "- - -". • RS-485 communication error occurred. • Communication was broken for a period set in communication parameter n6. (Only for the type with RS-485 function.)
PE (PE)	Parameter error	Error occurred in the parameter stored.

Control Panel Indication	Function Name	Definition
PUE (PUE)	PU disconnected	PU was disconnected when communication parameter n17 = "1". This function is valid for only the type with RS-485 communication function.
rEr (RET)	Retry count	Operation could not be resumed properly within the preset number of retries.
CPU (CPU)	CPU error	Arithmetic operation of the built-in CPU does not end within the predetermined time.

*1. Resetting the inverter initializes the internal thermal integral data of the electronic overcurrent protection.

*2. Activated only when "1" is set in Pr. 40 "start-time ground fault detection selection".

*3. Activated only when any of Pr. 60 to Pr. 63 (input terminal function selection) is set to OH.

(2) Minor failures

Control Panel Indication	Function Name	Definition
Fn (FN)	Fan trouble	The cooling fan built in the inverter failed (stopped).

Remarks

In this product, the cooling fan does not start until the start signal (RUN key, STF, STR signal) turns on. (Refer to Pr. 76 "cooling fan operation selection".)

(3) Warnings

Control Panel Indication	Function Name	Definition
OL (OL)	Stall prevention (overcurrent) (*4)	Current more than 150% of the rated inverter current flew in the motor and operation is being performed to prevent the inverter from resulting in overcurrent shut-off.
oL (oL)	Stall prevention (overvoltage)	Regenerative energy of the motor became excessive and operation is being performed to stop the frequency from decreasing to prevent overvoltage shut-off.
PS (PS)	PU stop (Stopped with PU STOP key)	Pr. 75 "PU stop selection" had been set and a stop was made by pressing the STOP/RESET key of the operation panel or parameter unit (FR-PU04) during operation in the external operation mode.
Uu (UV)	Undervoltage	Power supply voltage of the inverter dropped.
Err (Err)	During reset	During inverter reset (RES signal is ON)

* 4. The stall prevention operation current may be set to any value. It is factory-set to 150%.

(4) Write errors

Control Panel Indication	Function Name	Definition
$E_r \, I$ (Er1)	Write disable error	• Write was performed with "1" set in Pr. 77. • Frequency jump setting range overlapped. • Parameter write was performed though the operation panel does not have the write precedence. (Only the type having RS-485 communication function)
$E_r \, 2$ (Er2)	Write-while-running error/mode designation error	• Write was performed during operation. • An attempt was made to change the Pr. 79 setting to the operation mode where the operation command has been input. • Write was performed in the external operation mode.
$E_r \, 3$ (Er3)	Calibration error	Analog input bias and gain calibration values are too close.

- Major failure: When the protective function is activated, the inverter output is shut-off and an alarm output is provided.
- Minor failure: When the protective function is activated, the output is not shut-off. The minor failure signal can be output by making parameter setting. (Set "98" in Pr. 64 or Pr. 65 (output terminal function selection). Refer to page 38)

7.2 Inverter Reset

Performing any of the following operations resets the inverter. Note that performing reset clears (erases) the internal thermal integral value of the electronic overcurrent protection and the number of retries.

Operation 1 .... Using the operation panel, perform reset with the (STOP/RESET) key. (Enabled only when the inverter protective function is activated (major failure))

Operation 2 .... Cut (off) power once, then switch it on again.

Operation 3 .... Turn on the reset signal (RES). (Assign this signal to any of Pr. 60 to Pr. 63.) (Refer to page 38)

8. SPECIFICATIONS

8.1 Ratings

(1) 3-phase 200V power supply
● Japanese version
   FR-S520-0.1K to 3.7K(-R)(-C)
● NA version
   FR-S520-0.1K to 3.7K-NA

Model FR-S520-□K(-R)(-C)			0.1	0.2	0.4	0.75	1.5	2.2	3.7
Applicable motor capacity (*1)		kW	0.1	0.2	0.4	0.75	1.5	2.2	3.7
		HP	1/8	1/4	1/2	1	2	3	5
Output	Rated capacity (kVA) (*2)		0.3	0.5	1.0	1.6	2.8	4.0	6.6
	Rated current (A)		0.8	1.4	2.5	4.1	7.0	10	16.5
	Overload capacity (*3)		150% 60s, 200% 0.5s (Inverse-time characteristics)						
	Voltage (*4)		Three-phase 200 to 240V 50Hz/60Hz						
Power supply	Rated input AC voltage/frequency		Three-phase 200 to 240V 50Hz/60Hz						
	Permissible AC voltage fluctuation		170 to 264V 50Hz/60Hz						
	Permissible frequency fluctuation		Within ±5%						
	Power supply equipment capacity (kVA) (*5)		0.4	0.7	1.2	2.1	4.0	5.5	9
Protective structure (JEM1030)			Enclosed type (IP20). IP40 for totally-enclosed structure series.						
Cooling system			Self-cooling				Forced air cooling		
Approximate weight (kg (lbs))			0.5 (1.1)	0.5 (1.1)	0.8 (1.76)	0.9 (1.98)	1.5 (3.3)	1.5 (3.3)	2.1 (4.62)

*1. The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.

*2. The rated output capacity indicated assumes that the output voltage is 230V.

*3. The % value of the overload capacity indicates the ratio of the overload current to the inverter's rated output current.
   For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*4. The maximum output voltage does not exceed the power supply voltage. You can set the maximum output voltage to any value below the power supply voltage. However, the PWM pulse voltage value of the inverter output side voltage remains unchanged at about $\sqrt{2}$ that of the power supply.

*5. The power supply capacity changes with the values of the power supply side impedances (including those of the input reactor and cables).

(2) 3-phase 400V power supply

● Japanese version
  FR-S540-0.4K to 3.7K(-R)
● NA version
  FR-S540-0.4K to 3.7K-NA(R)
● EC version
  FR-S540-0.4K to 3.7K-EC(R)

Model FR-S540-□K(-R)		0.4	0.75	1.5	2.2	3.7
Applicable motor capacity (*1)	kW	0.4	0.75	1.5	2.2	3.7
	HP	1/2	1	2	3	5
Output	Rated capacity (kVA) (*2)	0.9	1.6	2.7	3.7	5.9
	Rated current (A)	1.1	2.1	3.5	4.8	7.7
	Overload capacity (*3)	150% 60s, 200% 0.5s (Inverse-time characteristics)				
	Voltage (*4)	Three-phase 380 to 480V 50Hz/60Hz				
Power supply	Rated input AC voltage/frequency	Three-phase 380 to 480V 50Hz/60Hz				
	Permissible AC voltage fluctuation	325 to 528V 50Hz/60Hz				
	Permissible frequency fluctuation	Within ±5%				
	Power supply equipment capacity (kVA) (*5)	1.5	2.5	4.5	5.5	9.5
Protective structure (JEM1030)		Enclosed type (IP20).				
Cooling system		Self-cooling		Forced air cooling		
Approximate weight (kg (lbs))		1.5 (3.3)	1.5 (3.3)	1.5 (3.3)	1.6 (3.53)	1.7 (3.75)

*1. The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.
*2. The rated output capacity indicated assumes that the output voltage is 440V.
*3. The % value of the overload capacity indicates the ratio of the overload current to the inverter's rated output current.
  For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
*4. The maximum output voltage does not exceed the power supply voltage. You can set the maximum output voltage to any value below the power supply voltage. However, the PWM pulse voltage value of the inverter output voltage remains unchanged at about $\sqrt{2}$ that of the power supply.
*5. The power supply capacity changes with the values of the power supply side impedances (including those of the input reactor and cables).

(3) Single-phase 200V power supply
● Japanese version
   FR-S520S-0.1K to 1.5K(-R)
● EC version
   FR-S520S-0.2K to 1.5K-EC(R)

Model FR-S520S-□K(-R)		0.1	0.2	0.4	0.75	1.5
Applicable motor capacity (*1)	kW	0.1	0.2	0.4	0.75	1.5
	HP	1/8	1/4	1/2	1	2
Output — Rated capacity (kVA) (*2)		0.3	0.5	1.0	1.6	2.8
Output — Rated current (A)		0.8	1.4	2.5	4.1	7.0
Output — Overload capacity (*3)		150% 60s, 200% 0.5s (Inverse-time characteristics)				
Output — Voltage (*4)		Three-phase 200 to 240V 50Hz/60Hz				
Power supply — Rated input AC voltage/frequency		Single-phase 200 to 240V 50Hz/60Hz				
Power supply — Permissible AC voltage fluctuation		170 to 264V 50Hz/60Hz				
Power supply — Permissible frequency fluctuation		Within ±5%				
Power supply — Power supply equipment capacity (kVA) (*5)		0.5	0.9	1.5	2.5	4.4
Protective structure (JEM1030)		Enclosed type (IP20).				
Cooling system		Self-cooling				Forced air cooling
Approximate weight (kg (lbs))		0.5 (1.1)	0.6 (1.32)	0.8 (1.76)	1.0 (2.2)	1.5 (3.3)

*1. The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.

*2. The rated output capacity indicated assumes that the output voltage is 230V.

*3. The % value of the overload capacity indicates the ratio of the overload current to the inverter's rated output current.
For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.

*4. The maximum output voltage does not exceed the power supply voltage. You can set the maximum output voltage to any value below the power supply voltage. However, the PWM pulse voltage value of the inverter output voltage remains unchanged at about $\sqrt{2}$ that of the power supply.

*5. The power supply capacity changes with the values of the power supply side impedances (including those of the input reactor and cables).

(4) Single-phase 100V power supply
● Japanese version
　FR-S510W-0.1K to 0.75K(-R)
● NA version
　FR-S510W-0.1K to 0.75K-NA

Model FR-S510W-□K(-R)		0.1	0.2	0.4	0.75
Applicable motor capacity (*1)	kW	0.1	0.2	0.4	0.75
	HP	1/8	1/4	1/2	1
Output	Rated capacity (kVA) (*2)	0.3	0.5	1.0	1.6
	Rated current (A)	0.8	1.4	2.5	4.1
	Overload capacity (*3)	150% 60s, 200% 0.5s (Inverse-time characteristics)			
	Voltage	Three-phase 200 to 230V 50Hz/60Hz (*4, 6)			
Power supply	Rated input AC voltage/frequency	Single-phase 100 to 115V 50Hz/60Hz			
	Permissible AC voltage fluctuation	90 to 132V 50Hz/60Hz			
	Permissible frequency fluctuation	Within ±5%			
	Power supply equipment capacity (kVA) (*5)	0.5	0.9	1.5	2.5
Protective structure (JEM1030)		Enclosed type (IP20).			
Cooling system		Self-cooling			
Approximate weight (kg (lbs))		0.6 (1.32)	0.7 (1.54)	0.9 (1.98)	1.6 (3.53)

*1. The applicable motor capacity indicated is the maximum capacity applicable for use of the Mitsubishi 4-pole standard motor.
*2. The rated output capacity indicated assumes that the output voltage is 230V.
*3. The % value of the overload capacity indicates the ratio of the overload current to the inverter's rated output current.
　　For repeated duty, allow time for the inverter and motor to return to or below the temperatures under 100% load.
*4. For single-phase 100V power input, the output voltage provided cannot be twice or more than the power supply voltage.
*5. The power supply capacity changes with the values of the power supply side impedances (including those of the input reactor and cables).
*6. For single-phase 100V power input, the application of motor load reduces the output voltage about 10 to 15%. Therefore, the load must be reduced when a general-purpose motor is used.

8.2 Common Specifications

<table>
<tr><td rowspan="20">Control specifications</td><td colspan="3">Control method</td><td>Selectable between Soft-PWM control and high carrier frequency PWM control, V/F control or automatic torque boost control selectable.</td></tr>
<tr><td colspan="3">Output frequency range</td><td>0.5 to 120Hz (starting frequency variable between 0 and 60Hz)</td></tr>
<tr><td colspan="3">Frequency setting resolution</td><td>5VDC input: 1/500 of max. set frequency, 10V, 4 to 20mADC input: 1/1000 of max. set frequency. Digital input: 0.1Hz (less than 100Hz), 1Hz (100Hz or higher)</td></tr>
<tr><td colspan="3">Frequency accuracy</td><td>Analog input: Within ±1% of max. output frequency (25°C ± 10°C (77°F ± 18°F))
Digital input: Within ±0.5% of set output frequency (When setting dial is used)</td></tr>
<tr><td colspan="3">Starting torque</td><td>150% (at 6Hz) under automatic torque boost control</td></tr>
<tr><td colspan="3">Acceleration/ deceleration time setting</td><td>0, 0.1 to 999s (may be set individually for acceleration and deceleration), linear or S-pattern acceleration/deceleration mode selectable.</td></tr>
<tr><td rowspan="2">Braking torque</td><td colspan="2">Regenerative (*2)</td><td>0.1K, 0.2K....150%, 0.4K, 0.75K.....100%, 1.5K.....50%, 2.2K, 3.7K....20%</td></tr>
<tr><td colspan="2">DC braking</td><td>Operation frequency (0 to 120Hz), operation time (0 to 10s), operation voltage (0 to 15%)</td></tr>
<tr><td colspan="3">Input signal</td><td>Frequency setting signal (0 to 5(10)VDC), 4 to 20mA, digital setting with dial, start signal, alarm reset, multi-speed selection, second function selection, output stop, current input selection, external thermal relay input, start self-holding selection, jog signal, PID control valid, PU operation-external operation switching.</td></tr>
<tr><td colspan="3">Operational function</td><td>Maximum and minimum frequency settings, frequency jump operation, external thermal relay input selection, automatic restart after instantaneous power failure, forward/reverse rotation prevention, slip compensation, operation mode selection, PID control, computer link operation (RS-485) (*3)</td></tr>
<tr><td rowspan="3">Output signal</td><td colspan="2">Running status</td><td>1 open collector signal can be selected from among inverter running, up-to-frequency, frequency detection, overload warning, zero current detection, output current detection, PID upper limit, PID lower limit, PID forward/reverse rotation, operation ready, minor failure and alarm. 1 contact output (1 contact, 230V 0.3AAC, 30V 0.3ADC) signal can be selected.</td></tr>
<tr><td rowspan="2">For meter</td><td>Japanese</td><td>1 signal can be selected from output frequency and motor current.
Pulse train output (1440 pulses/s, 1mA full scale)</td></tr>
<tr><td>NA, EC</td><td>1 signal can be selected from output frequency and motor current.
Analog output (0 to 5VDC, 1mA full scale)</td></tr>
<tr><td colspan="3">Protective/warning function</td><td>Overcurrent shut-off (during acceleration, deceleration, constant speed), regenerative overvoltage shut-off (during acceleration, deceleration, constant speed), overload shut-off (electronic overcurrent protection), fin overheat, fan failure (*4), stall prevention, start-time output side ground fault protection (*5), external thermal relay (*6), PU disconnection (*3), retry count excess, communication error (*3), CPU error, undervoltage (*1)</td></tr>
</table>

Environment	Ambient temperature	-10°C to +50°C (14°F to 122°F) (non-freezing) (-10°C to +40°C (14°F to 104°F) for totally-enclosed structure feature)
	Ambient humidity	90%RH maximum (non-condensing)
	Storage temperature	-20°C to +65°C (-4°F to +149°F)
	Atmosphere	Indoors (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
	Altitude/vibration	Maximum 1000m (3280.80feet) above seal level, 5.9m/s^2 or less (conforms to JIS C 0040)

*1. When undervoltage occurs, no alarm output is provided but the output is shut off. After power restoration, the inverter may be run as it is. Depending on the running status (e.g. load magnitude), however, overcurrent, regenerative overvoltage or other protection may be activated at power restoration. (In external operation mode.)

*2. The magnitude of braking torque indicates the short-duration average torque (which changes with the motor loss) developed when the motor alone is decelerated from 60Hz in the shortest period, and is not continuous regenerative torque. Deceleration made from a high speed above the base frequency will reduce the value of average deceleration torque.

*3. This function is valid for only the type with RS-485 communication function.

*4. Compatible with only the product having the built-in cooling fan.

*5. Activated only when "1" is set in Pr. 40 "start-time ground fault detection selection".

*6. Activated only when external thermal relay input (OH) is selected in any of Pr. 60 to Pr. 63 (input terminal function selection).

9. OUTLINE DRAWINGS

(Remarks) For the dimensions of the type having RS-485 communication function and the totally enclosed structure type, refer to those of the standard type inverter of the same capacity.

- FR-S520-0.1K, 0.2K, 0.4K, 0.75K (-NA)
- FR-S520S-0.1K
- FR-S520S-0.2K, 0.4K, 0.75K (-EC)
- FR-S510W-0.1K, 0.2K, 0.4K (-NA)
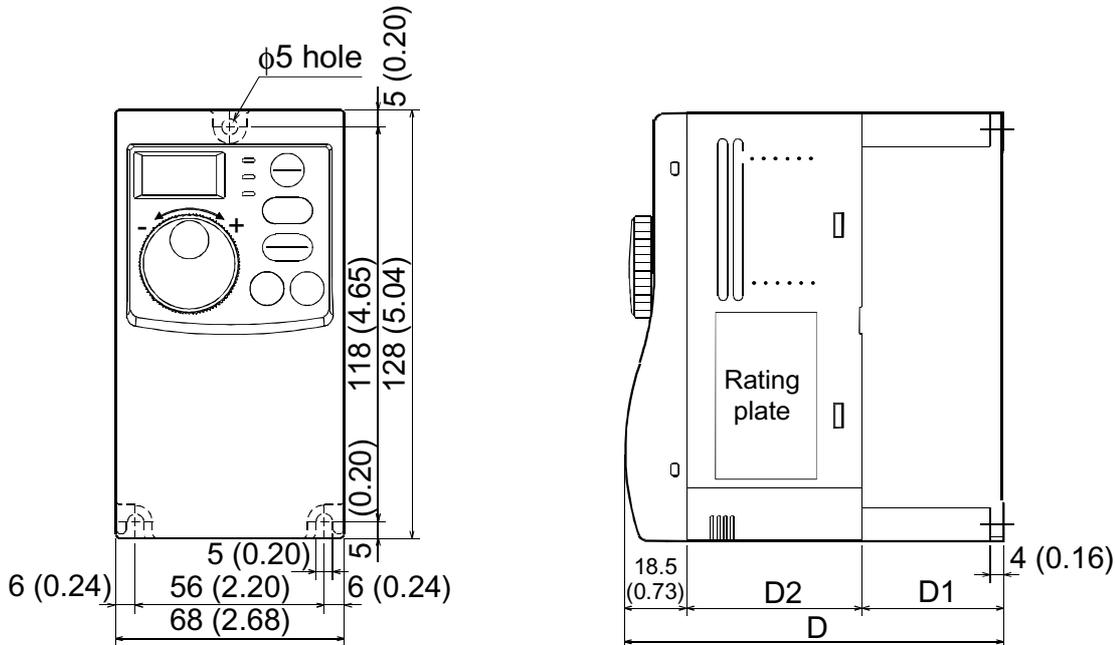
·3-phase 200V power supply

Capacity	D	D1	D2
0.1K, 0.2K	80.5 (3.17)	10 (0.39)	52 (2.05)
0.4K	112.5 (4.43)	42 (1.65)	52 (2.05)
0.75K	132.5 (5.22)	62 (2.44)	52 (2.05)

·Single-phase 200V power supply

Capacity	D	D1	D2
0.1K, 0.2K	80.5 (3.17)	10 (0.39)	52 (2.05)
0.4K	142.5 (5.61)	42 (1.65)	82 (3.23)
0.75K	162.5 (6.40)	62 (2.44)	82 (3.23)

·Single-phase 100V power supply

Capacity	D	D1	D2
0.1K	80.5 (3.17)	10 (0.39)	52 (2.05)
0.2K	110.5 (4.35)	10 (0.39)	82 (3.23)
0.4K	142.5 (5.61)	42 (1.65)	82 (3.23)

(Unit: mm (inches))

- FR-S520-1.5K, 2.2K, 3.7K (-NA)
- FR-S540-0.4K, 0.75K, 1.5K, 2.2K, 3.7K (-NA) (-EC)
- FR-S520S-1.5K (-EC)
- FR-S510W-0.75K (-NA)
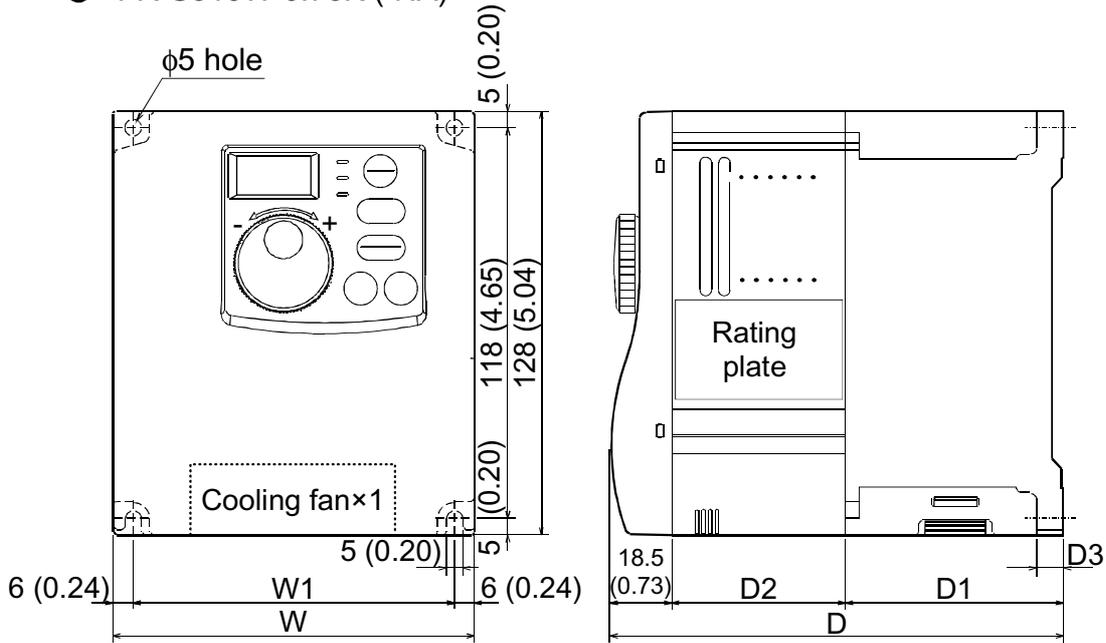
·3-phase 200V power supply

Capacity	W	W1	D	D1	D2	D3
1.5K, 2.2K	108 (4.25)	96 (3.78)	135.5 (5.33)	65 (2.56)	52 (2.05)	8 (0.31)
3.7K	170 (6.69)	158 (6.22)	142.5 (5.61)	72 (2.83)	52 (2.05)	5 (0.20)

·3-phase 400V power supply

Capacity	W	W1	D	D1	D2	D3
0.4K, 0.75K	108 (4.25)	96 (3.78)	129.5 (5.10)	59 (2.32)	52 (2.05)	5 (0.20)
1.5K	108 (4.25)	96 (3.78)	135.5 (5.33)	65 (2.56)	52 (2.05)	8 (0.31)
2.2K	108 (4.25)	96 (3.78)	155.5 (6.12)	65 (2.56)	72 (2.83)	8 (0.31)
3.7K	108 (4.25)	96 (3.78)	165.5 (6.52)	65 (2.56)	82 (3.23)	8 (0.31)

·Single-phase 200V power supply

Capacity	W	W1	D	D1	D2	D3
1.5K	108 (4.25)	96 (3.78)	155.5 (6.12)	65 (2.56)	72 (2.83)	8 (0.31)

·Single-phase 100V power supply

Capacity	W	W1	D	D1	D2	D3
0.75K	108 (4.25)	96 (3.78)	149.5 (5.89)	59 (2.32)	72 (2.83)	5 (0.20)

(Unit: mm (inches))

* The FR-S540-0.4K, 0.75K (-NA) (-EC) and FR-S510W-0.75K (-NA) do not have a cooling fan.

Appendix 1 Instructions for Compliance with the European Standards

(The products conforming to the Low Voltage Directive carry the CE mark.)

(1) EMC Directive

1) Our view of transistorized inverters for the EMC Directive

A transistorized inverter is a component designed for installation in a control box and for use with the other equipment to control the equipment/device. Therefore, we understand that the EMC Directive does not apply directly to transistorized inverters. For this reason, we do not place the CE mark on the transistorized inverters. (The CE mark is placed on inverters in accordance with the Low Voltage Directive.) The European power drive manufacturers' organization (CEMEP) also holds this point of view.

2) Compliance

We understand that the transistorized inverters are not covered directly by the EMC Directive. However, the EMC Directive applies to machines/equipment into which transistorized inverters have been incorporated, and these machines and equipment must carry the CE marks. Hence, we prepared the European Standard-compliant noise filters and the technical information "EMC Installation Guidelines" (information number BCN-A21041-202) so that machines and equipment incorporating transistorized inverters may conform to the EMC Directive more easily.

3) Outline of installation method

Install an inverter using the following methods:

* Use the inverter with an European Standard-compliant noise filter.
* For wiring between the inverter and motor, use shielded cables or run them in a metal piping and ground the cables on the inverter and motor sides with the shortest possible distance.
* 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 specifications are written in the technical information "EMC Installation Guidelines" (BCN-A21041-202). Please contact your sales representative.

(2) Low Voltage Directive

1) Our view of transistorized inverters for the Low Voltage Directive
   Transistorized inverters are covered by the Low Voltage Directive (Standard to conform to: EN50178).

2) Compliance
   We have self-confirmed our inverters as products compliant to the Low Voltage Directive and place the CE mark on the inverters.

3) Outline of instructions
   * In the 400V class inverters, the rated input voltage range is three-phase, 380V to 415V, 50Hz/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.)
   * Use the cable sizes on pages 8, 11 and 15 under the following conditions.
     • Ambient Temperature: 40°C (104°F) maximum
     • Wire installation: On wall without ducts or conduits
   If conditions are different from above, select appropriate wire according to EN60204 ANNEX C TABLE 5.
   * Use the no-fuse breaker and magnetic contactor which conform to the EN or IEC Standard.
     Design notice: Where residual-current-operated protective device (RCD) is used for protection in case of direct or indirect contact, only RCD of Type B is allowed on the supply side of this Electronic Equipment (EE). Otherwise another protective measure shall be applied such as separetion of the EE from the environment by double or reinforced insulation or isolation of EE and supply system by a transformer. (Extract from EN51078)
   * Use the inverter under the conditions of overvoltage category II and contamination level 2 or higher specified in IEC664.
   * Use the breaker of type B (breaker which can detect both AC and DC). If not, provide double or enhanced insulation between the inverter and other equipment, or put a transformer between the main power supply and inverter.
   * On the input and output of the inverter, use cables of the type and size set forth in EN60204 Appendix C.
   * The operating capacity of the relay outputs (terminal symbols A, B, C) should be 30VDC, 0.3A.
   * The terminals indicated as the control circuit input and output terminals on page 6 are separated safely from the main circuit.
   * Environment

	During operation	In storage	During transportation
Ambient Temperature	-10°C to +50°C (14°F to 122°F)	-20°C to +65°C (-4°F to +149°F)	-20°C to +65°C (-4°F to +149°F)
Ambient Humidity	90% RH or less	90% RH or less	90% RH or less
Muximum Altitude	1,000m (3280.80feet)	1,000m (3280.80feet)	10,000m (32808.40feet)

Details are given in the technical information "Low Voltage Directive Conformance Guide" (BCN-A21041-203). Please contact your sales representative.

Appendix 2 Instructions for compliance with U.S. and Canadian Electrical Codes

(Standard to comply with :UL 508 C (200V,
100V class),
UL 840 (400V class))

1. General Precaution

The bus capacitor discharge time is 10 minutes. Before starting wiring or inspection, switch power off, wait for more than 10 minutes, and check for residual voltage between terminal P (+) and N (-) with a meter etc., to avoid hazard of electrical shock.

2. Environment

Before installation, check that the environment meets following specifications.

Ambient temperature	-10°C to +50°C (14°F to 122°F) (non-freezing)	
Ambient humidity	90%RH or less (non-condensing)	
Storage temperature (Note 2)	-20°C to +65°C (-4°F to 149°F)	
Ambience	Indoors (No Corrosive and flammable gases, oil mist, dust and dirt.)	
Altitude vibration	Below 1000m (3280.80feet), 5.9m/s^2 or less	

3. Installation

The below types of inverter have been approved as products for use in enclosure and approval tests were conducted under the following conditions. Design the enclosure so that the ambient temperature, humidity and ambience of the inverter will satisfy the above specifications.

Branch circuit protection

For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes. For installation in Canada, branch circuit protection must be provided in accordance with the Canada Electrical Code and any applicable provincial codes.

4. Short circuit ratings

Suitable For Use in A Circuit Capable of Delivering Not More Than 5kA rms Symmetrical Amperes.

5. Wiring of the power supply and motor

For wiring the input (R, S, T) and output (U, V, W) terminals of the inverter, use the UL-listed copper wires (rated at 75°C) and round crimping terminals. Crimp the crimping terminals with the crimping tool recommended by the terminal maker.

6. Motor overload protection

These inverters provide solid state motor overload protection.
Set parameter 9 using the following instructions,
(Pr. 9 "electronic thermal O/L relay").

\<Setting\>

- Set the rated current [A] of the motor.
  (Normally set the rated current at 50Hz.)
- Setting "0" makes the electronic overcurrent protection (motor protective function) invalid. (The inverter's protective function is valid).
- When using a Mitsubishi constant-torque motor, first set "1" in Pr. 71 to choose the 100% continuous torque characteristic in the low-speed range. Then, set the rated motor current in Pr. 9.

═══ **CAUTION** ═══

- When two or more motors are connected to the inverter, they cannot be protected by the electronic overcurrent protection. Install an external thermal relay to each motor.
- When the difference between the inverter and motor capacities is large and the setting is small, the protective characteristics of the electronic overcurrent protection will be deteriorated.
  In this cause, use an external thermal relay.
- A special motor cannot be protected by the electronic overcurrent protection. Use an external thermal relay.

Reference: Motor overload protection characteristics
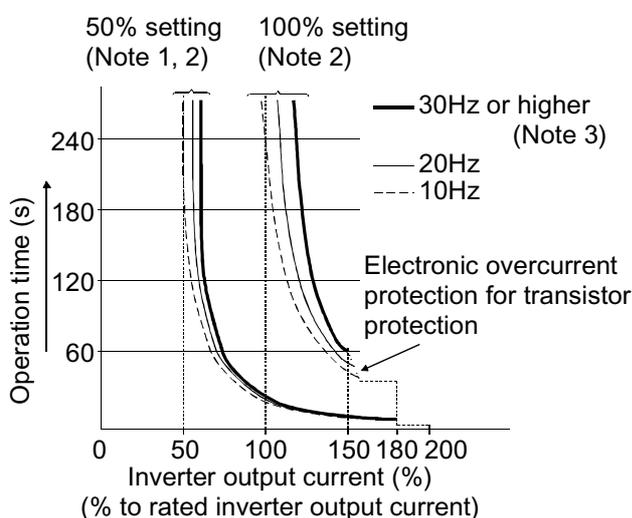
- Protection activating range
  Range on the right of characteristic curve
- Normal operating range
  Range on the left of characteristic curve

(Note 1) When you set the 50% value (current value) of the rated inverter output current.
(Note 2) The % value denotes the percentage of the current value to the rated inverter output current, not to the rated motor current.
(Note 3) This characteristic curve will be described even under operation of 6Hz or higher when you set the electronic overcurrent protection dedicated to the Mitsubishi constant-torque motor.

REVISIONS

*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Mar., 2000	IB(NA)-0600026-A	First edition
Jun., 2000	IB(NA)-0600026-B	Addition Single-phase 100V power input specifications.
Jan., 2001	IB(NA)-0600026-C	Partial additions • Instructions for compliance with U.S. and Canadian Electrical Codes • Procedure in which the setting dial is used like a potentiometer to perform operation.
Mar., 2001	IB(NA)-0600026-D	Addition Three-phase 400V power input specifications.

MITSUBISHI ELECTRIC