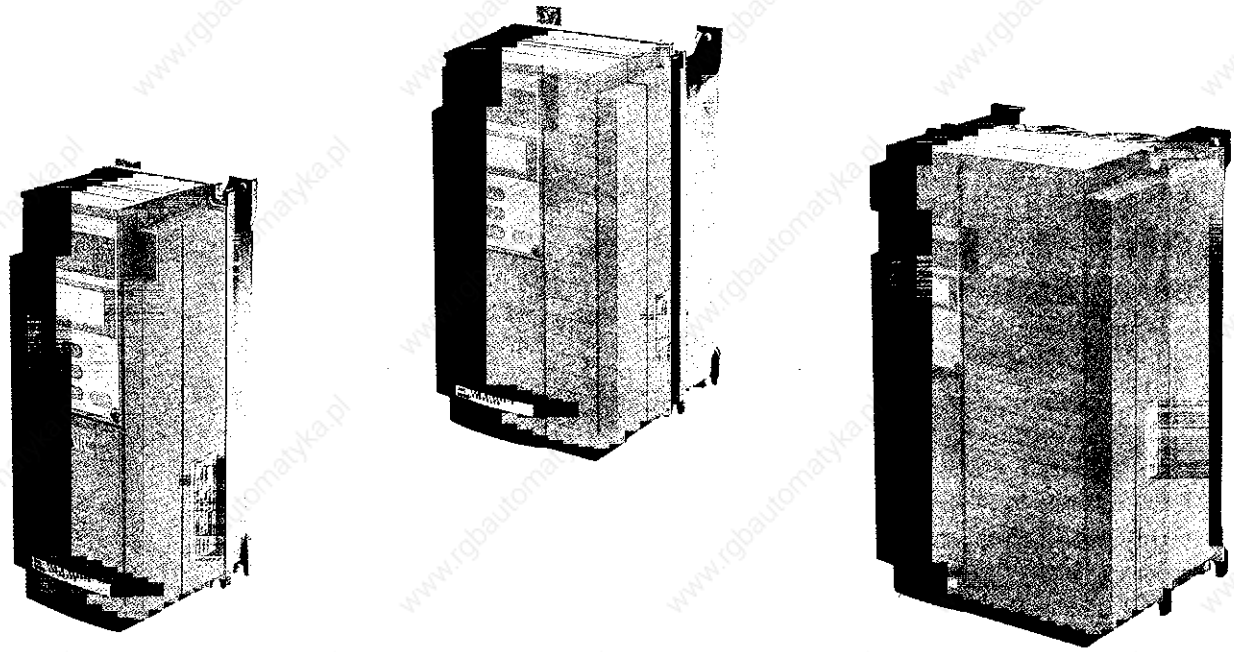
FRENIC 5000G9S/P9S

High-performance, low-noise inverter

200 V 0.2 - 22 kW (G9S series)
7.5 - 22 kW (P9S series)

400 V 0.4 - 22 kW (G9S series)
7.5 - 22 kW (P9S series)

INSTRUCTION MANUAL



- This instruction manual is shipped with the inverter and equipment, and is provided for the convenience of the end user. If installing the inverter to an inverter switchboard or other equipment, please make sure that this instruction manual is accompanied with the inverter.
- The contents of this manual are subject to changes for improvement without notice.

Fuji Electric Co., Ltd.

Si47-0231

Contents

1. Safety Precautions

WARNING, CAUTION AND NOTE

WARNING: Denotes operating procedures and practices that may result in personal injury or loss of life if not correctly followed.

CAUTION: Denotes operating procedures and practices that, if not strictly observed, may result in damage to, or destruction of the equipment.

NOTE: Notes call attention to information that is especially significant in understanding and operating the equipment.

WARNING, CAUTION AND NOTE PARAGRAPHS WITHIN THIS INSTRUCTION

The following paragraphs list some general safety reminders and safety recommendations to be followed when operating or installing this equipment. These safety precautions will be repeated throughout this instruction book where applicable.

WARNING - MECHANICAL MOTION HAZARD: Inverter systems cause mechanical motion. It is the responsibility of the user to insure that any such motion does not result in an unsafe condition. Factory provided interlocks and operating limits should not be bypassed or modified.

WARNING - ELECTRICAL SHOCK AND BURN HAZARD: When using instruments such as oscilloscopes to work on live equipment, the oscilloscope's chassis should be grounded and a differential amplifier input should be used. Care should be used in the selection of probes and leads and in the adjustment of the oscilloscope so that accurate readings may be made. See instrument manufacturers instruction book for proper operation and adjustments to the instrument.

WARNING - STRAIN HAZARD: Improper lifting practices can cause serious or fatal injury. Lift only with adequate equipment and trained personnel.

WARNING - FIRE AND EXPLOSION HAZARD: Fires or explosions might result from mounting inverters in hazardous areas such as locations where flammable or combustible vapors or dusts are present. Inverters should be installed away from hazardous areas, even if used with motors suitable for use in these locations.

WARNING - ELECTRICAL SHOCK HAZARD: All motor bases and equipment enclosure housings should be grounded in accordance with the National Electric Code or equivalent. The inverter leakage current to ground is higher than 3mA. VDE 160 prescribes two ground wires or a wire cross-section of at least 10 mm^2.

WARNING - MOTOR OVERSPEED HAZARD: With 400 Hz inverter output possible, the inverter could cause the motor to run up to 6 - 7 times its base speed. Never operate the motor above its top mechanical speed or a catastrophic failure may occur.

WARNING - ELECTRICAL SHOCK HAZARD: Do not touch the electrical parts of the inverter when the power supply is connected, and after the power supply has been disconnected wait at least "CRG" lamp turns off before touching the inverter.

WARNING - MOTOR OVERSPEED HAZARD: Bias is operational when the data of Function No "00" is 1 or 2. When the inverter does not have a RUN command, the reference frequency will flash on the display. When Bias is operational and the speed reference is zero, the display will flash zero. When a RUN command is given, the motor will run at the Bias setting even though zero is flashing on the display.

CAUTION: Do not connect power supply voltage that exceeds the standard specification voltage fluctuation permissible. If excessive voltage is applied to the inverter, damage to the internal components will result.

CAUTION: Do not connect power supply to the output terminals (U, V, W). Connect power supply only to the power terminals (R, S, T).

CAUTION: Do not connect power supply to the braking resistor connection terminals (P(+)-DB). Never short-circuit between P(+)–N(–) or P(+)-DB terminals, and do not connect any resistance with a resistance value less than the standard application braking resistor.

CAUTION: Do not connect power supply to the control circuit terminals.

CAUTION: For RUN and STOP, use the FWD-CM (forward) and REV-CM (reverse) terminals. Avoid using a contactor (ON/OFF) installed on the line side of the inverter for RUN and STOP.

CAUTION: Do not use a switch on the output side of the inverter for ON/OFF operation.

CAUTION: Use only power capacity within the inverter capacity range of 1.5 times to 500 KVA. If a power capacity greater than 500 KVA is to be used, install a reactor (ACR or DCR optional).

CAUTION: Do not connect filter capacitors on the output side of the inverter.

CAUTION: Do not operate the inverter without the ground wire connected.

CAUTION: If the inverter's Fault Alarm is activated, consult the TROUBLESHOOTING sec ion of this instruction book, and after correcting the problem, resume operation. Do not reset the alarm automatically by external sequence, etc.

CAUTION: Do not perform a megger test between the inverter terminals or on the control circuit terminals.

CAUTION: Do not disconnect any power terminals while the unit is powered up.

CAUTION: Motor Thermal Overload protection must be provided, either by motor thermoswitch, motor overload relay, or inverter electronic thermal overload.

CAUTION: Because the ambient temperature greatly affects inverter life and reliability, do not install the inverter in any location that exceeds the allowable temperature. Leave the ventilation cover attached for temperatures of 40 degrees C or below, and remove the cover for temperatures of between 40 and 50 degrees C. **If the cover needs to be removed, another type of enclosure may be required for safety purposes.**

CAUTION: For inverters without an internal DB transistor, the external braking resistor cannot be used except for inverters below 7.5 KW. (For inverters greater than 11 KW, a braking unit and braking resistor are required.)

CAUTION: When using an external braking resistor with inverters of less than 7.5 KW, first remove the inverter internal braking resistor terminals from P(+) and DB, then connect the external DB braking resistor to the P(+) and DB terminals. The internal braking resistor terminals that have been removed must be protected with insulation.

CAUTION: Be sure to remove the desicant dryer packet(s) when unpacking inverter. (If not removed these packets may become lodged in the fan or air passages and cause the inverter to overheat.)

CAUTION: The mounting wall for the inverter must be of heat resistant material because during operation, the temperature of the inverter's cooling fins rises to approximately 90 degrees C (194 F).

NOTE: *Always read the complete instructions prior to applying power or troubleshooting the equipment and follow all procedures step by step.*

NOTE: *The motor chassis should be grounded to earth through a separate ground lead from all other equipment ground leads to prevent noise coupling.*

2. Introduction

Thank you for purchasing the FUJI "FRN-G9S" inverter. This inverter uses 16 bit CPU for multi-function and high performance in a variety of applications.

This instruction manual is included with the inverter and equipment, and is provided for the convenience of the end user. Please be sure it accompanies the inverter.

3. Inspection Points upon Delivery

Please inspect the following points after unpacking your inverter.
If you have any problems or questions regarding the inverter, please contact the nearest Fuji sales office or the distributor you purchased the unit from.

① Check the nameplate on the inverter cover to ensure that the specifications correspond to those you ordered.

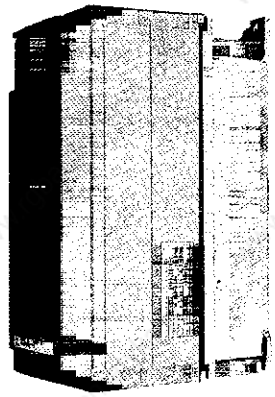


Fig. 3-1 Name plate location

Inverter type
Input voltage
Rated capacity, rated output current, output frequency range
Serial No.

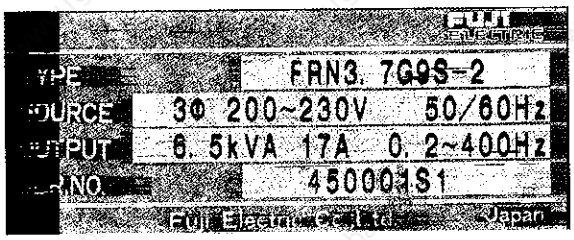


Fig. 3-2 Name plate

Inverter type

FRN 3.7 G9S - 2

- Power supply voltage system: 2 → 200 V grade, 4 → 400 V grade
- Series name: G9S or P9S
- Nominal applied motor: 0.2 → 0.2 kW - 22 → 22 kW
- Product type: FRENIC5000

② Inspect visually if during shipping the unit have got any damage or disconnection on the parts or bent on cover on main unit panels.

3-1 Product inquiries and warranty information

If you have any troubles or questions regarding the inverter, please make a note of it and contact the nearest Fuji sales office or the distributor where you purchased the unit.

(a) Inverter type
(b) Serial No.
(c) Date of purchase
(d) The nature of the trouble (for instance, the location and extent of damage, the point which is unclear or the circumstances under which the malfunction occurred)

3-2 Product warranty

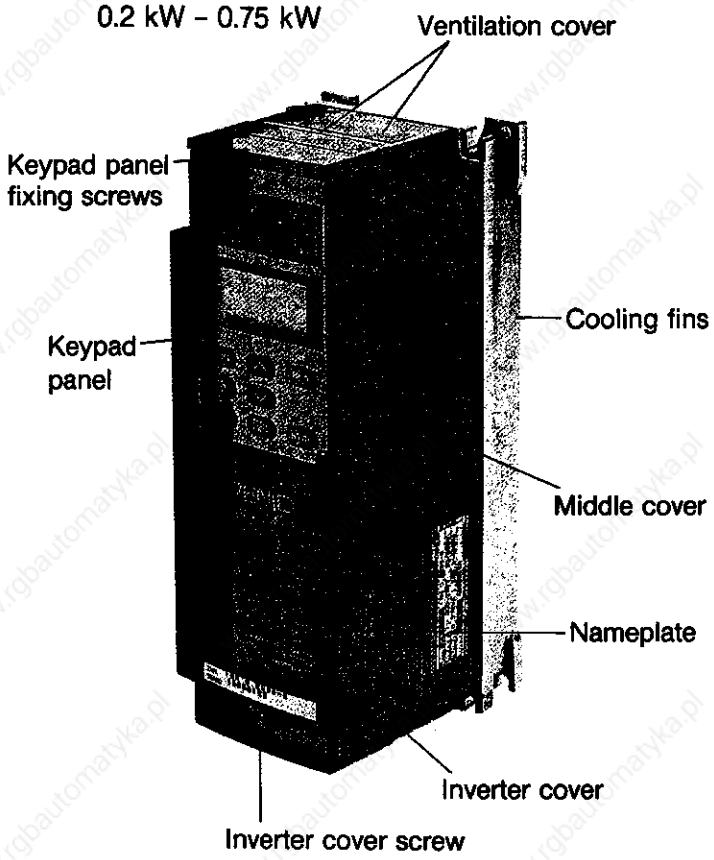
This product is guaranteed against defects in workmanship for 18 months from the manufacturing date indicated on the nameplate. However, the troubles caused by the following reasons are not covered by this warranty even in warranty period.

① Problems caused by incorrect operation or by unauthorized repairs or modifications
② Problems resulting from using the inverter in the range outside the standard specification
③ Damage to the inverter after purchase or during delivery
④ Damage caused by earthquakes, fire, floods, lightning, abnormal voltage fluctuations or other natural disasters and secondary disasters

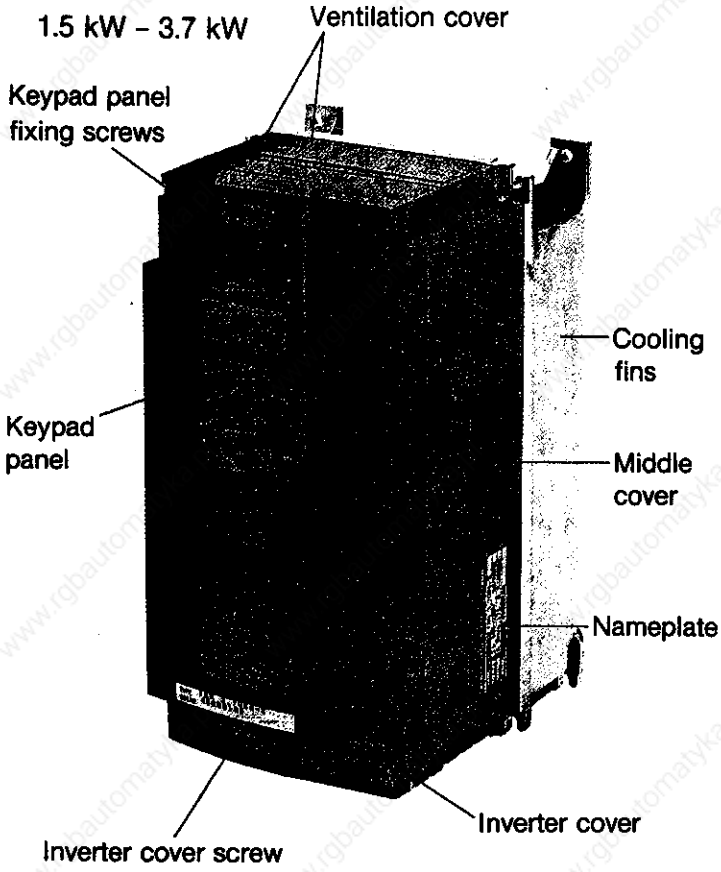
4. Construction and Handling

4-1 Part names

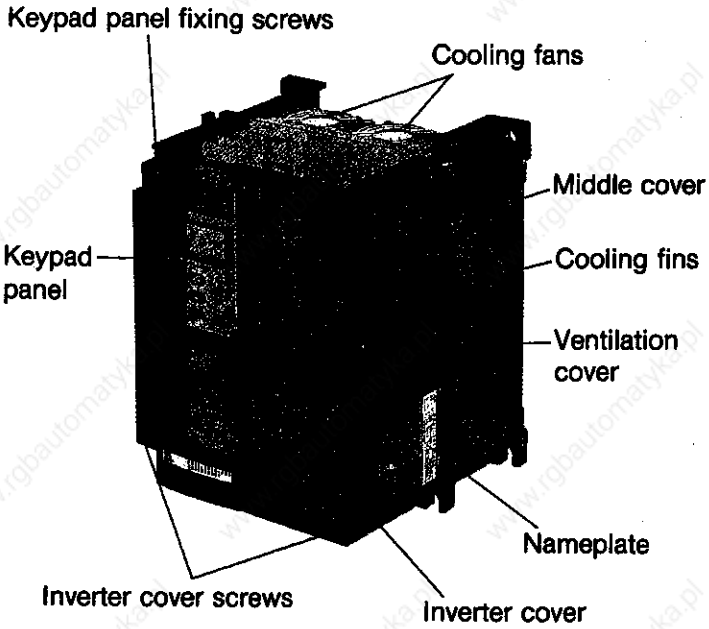
0.2 kW – 0.75 kW



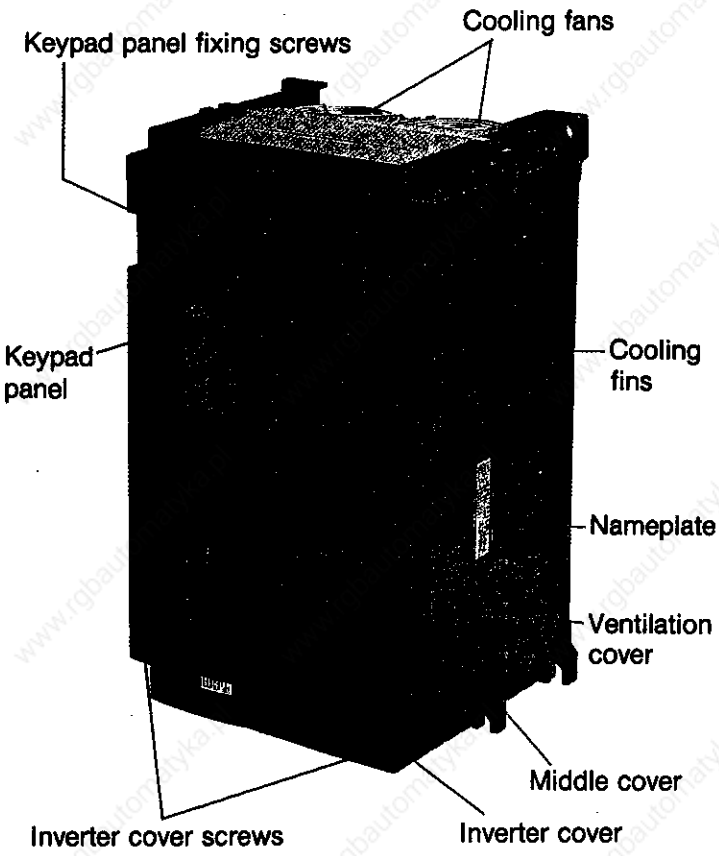
1.5 kW – 3.7 kW



5.5 kW – 7.5 kW



11 kW – 22 kW



4-2 Handling

① Removing the inverter cover

Loosen the inverter cover screw or screws (1 screw for models rated at 3.7 kW or less and 2 screws for models rated at 5.5 kW or higher), and then remove the cover as shown in Fig. 4-2-1 and 4-2-2. The cover can be removed and installed with the keypad panel stayed on the cover.

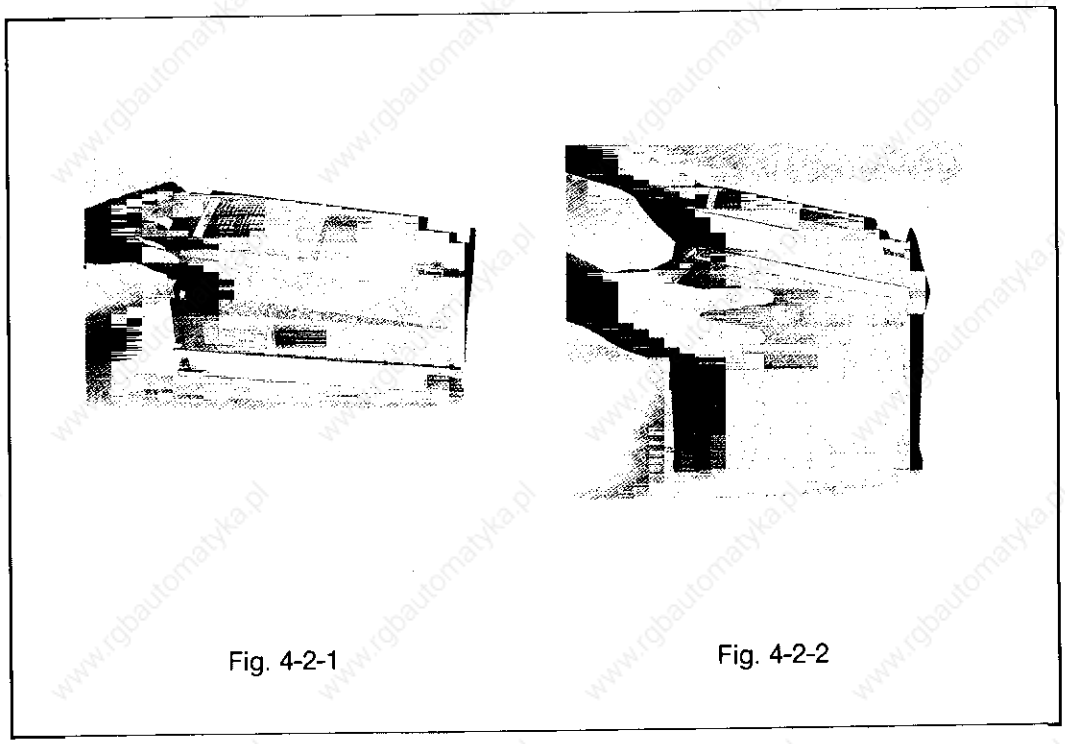


Fig. 4-2-1

Fig. 4-2-2

② Removing the keypad panel

Loosen the two keypad panel fixing screws and then remove the keypad panel as shown in Fig. 4-2-3.

If the optional connection cable (sold separately) is used, remote control operation is possible.

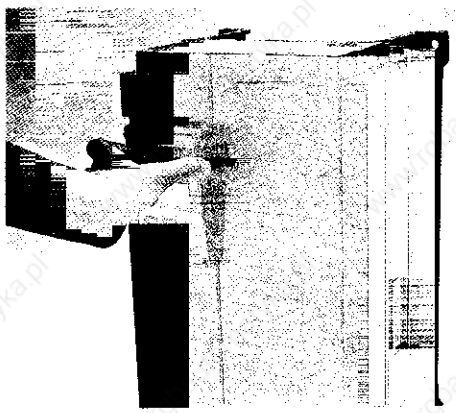


Fig. 4-2-3

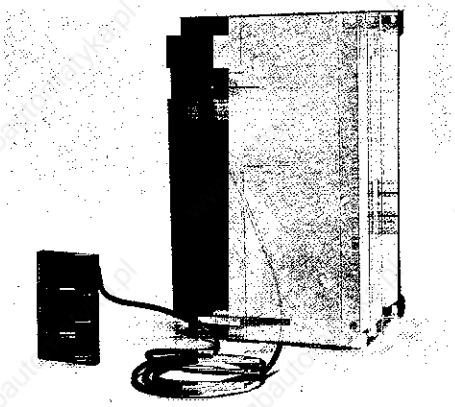


Fig. 4-2-4

③ Transportation

Be sure to hold the main unit when carring the inverter.

Caution
If you hold the cover or other parts, the inverter may be damaged.
Because the inverter cover is made from plastic, be careful not to apply too much force to it during transportation.

4-3 Storage condition

Store under the conditions listed in Table 4-3-1.

Table 4-3-1 Storage condition

Item	Conditions	
Ambient temperature	-10 - +50°C	Avoid places where sudden changes in temperature occur which could cause condensation or freezing.
Storing temperature *1	-20 - +65°C	
Relative humidity	20 - 90% *2	
Environment	The place should be away from direct sunlight and free from dust, corrosive gases, inflammable gases, oil mists, steam, dripping water or vibration. Salty environments should preferably be avoided.	

*1 The storing temperature indicates short-term temperature conditions for transportation.

*2 Condensation or freezing may occur in places where large variations in temperature occur, even if the relative humidity is within the specified range. Such places should be avoided.

① Do not place the inverter directly onto the floor. It should always be placed on top of a stand or shelf.

② If the inverter is being stored in a less-than-ideal environment, cover it with a plastic sheet to protect it.

③ If you are worried about humidity affecting the inverter, place some desiccating agent (such as silica gel) into the inverter, and then cover it as explained in ② above.

5. Installation

5-1 Installation environment

Install the inverter in a location that meets the following requirements:

- The ambient temperature is between -10°C and +50°C (+14°F to +122°F). (Remove the ventilation cover when the temperature exceeds +40°C [+104°F].)
- The relative humidity is between 20% and 90%. Avoid any location subject to condensation, freezing, or where the inverter would come in contact with water.
- Do not install in any location subject to direct sunlight, dust, corrosive gas, inflammable gas, or oil mist.
- The inverter should be installed at an elevation below 1000 meters (3281 feet) and vibration should be less than 0.6G.

INSTALLATION MOUNTING CLEARANCE

CAUTION: Because the ambient temperature greatly affects inverter life and reliability, do not install the inverter in any location that exceeds the allowable temperatures.

5-2 Installation method

① Place the inverter vertically so that the "FRENIC5000G9S" or the "FRENIC5000P9S" letters can be seen at the front, and then bolt it firmly to a steady structure.

Caution
Do not install the inverter upside down or horizontally.

② The inverter will generate heat during operation. Allow sufficient space around the unit as shown in Fig. 5-2-1 to ensure adequate ventilation.

Caution
Because the air heated by the inverter is let out upwards by the built-in cooling fans, do not place the inverter underneath low heat resistance material.

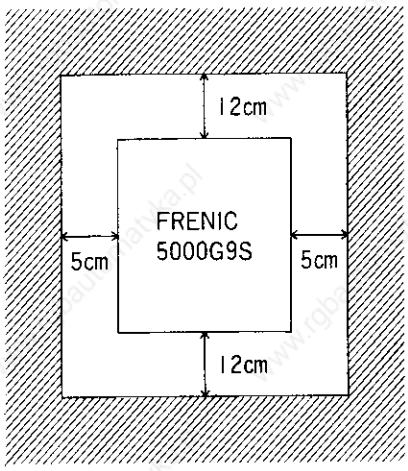


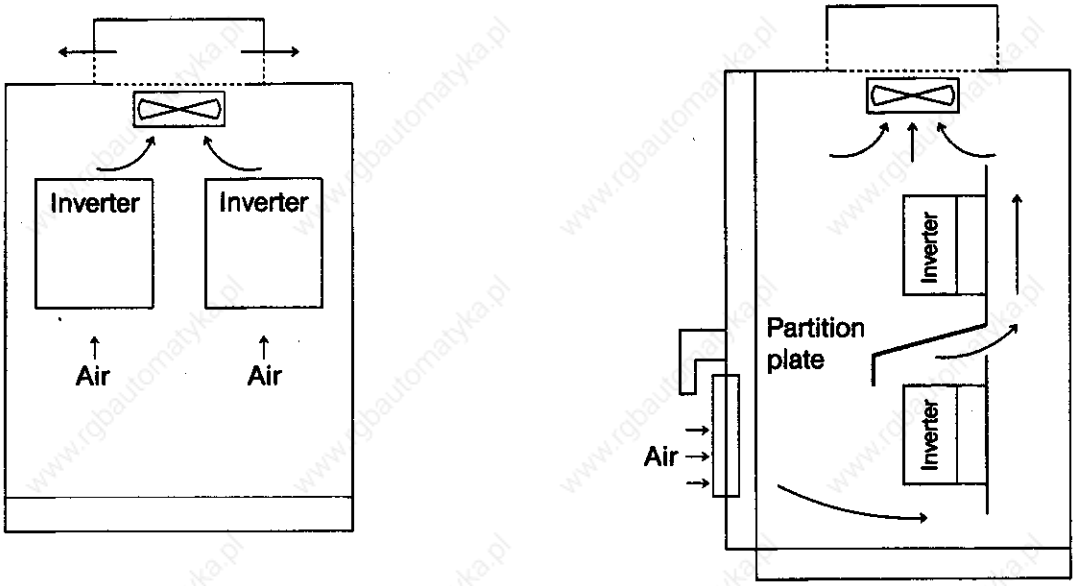
Fig. 5-2-1 Installation direction & mounting space

Caution
③ The cooling fin temperature will reach around 90°C during operation. Please use thermostable material for the inverter mounting plate.

For models of 7.5 kW or less, the temperature of the braking resistor may become as high as 150°C, so the inverter should be installed on a metal mounting plate.

④ If placing the inverter in a inverter panel, be sure to allow adequate ventilation to prevent the ambient temperature for inverter from becoming over the specified temperature. Do not place the inverter into small enclosed areas which do not allow proper ventilation.

⑤ When two or more inverters are installed in an inverter panel, locate them side by side in order to avoid the influence in terms of heat generated by other inverters. If the inverters must be installed in a vertical row, provide a partition plate between them to prevent the heat from the lower inverter from affecting the upper inverter.



(a) Horizontal placement (b) Vertical placement

Fig. 5-2-2 Installation method for two or more inverters

⑥ The inverter is prepared for installation to an inverter panel at the time of shipment. However, if an optional mounting adapter is added, it can be used as an externally-cooled inverter.
With externally-cooled inverters, the cooling fins which removed up to about 70% of the gross generated losses operate outside the panel, thus making it possible to reduce the heat dissipated inside the panel.
However, do not place the outside cooling fins at the places where they could become clogged with waste threads or dust with moisture.

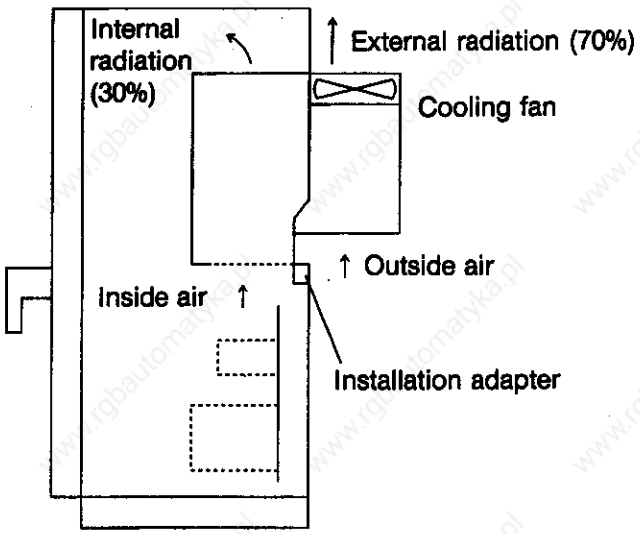


Fig. 5-2-3 Installation method for externally-cooled inverters

6. Wiring Procedures

Remove the inverter cover to expose the terminal block. Pay attention to the following point during wiring to avoid making incorrect connections.

Caution

① Always connect the power supply to the main power supply terminals R, S, and T. Connecting the power supply to any other terminals will damage the inverter.

② Be sure to make the ground connection in order to prevent accidents of electrical shocks or fire and to reduce noise.

③ Always use crimped wires to connect the terminals and wires for high reliability.

④ Once the wiring has been completed, check the following.
(a) Have all wires been connected correctly?
(b) Have any connections been omitten?
(c) Are there any shorts between terminals and wires or to ground?

⑤ If changing the wiring after the power has been turned on, note that it takes some time for the smoothing capacitor in the DC section of the main circuit to be fully discharged. To avoid danger, wait until the charge lamp has been switched off, and then use a circuit tester to check that the voltage has dropped to a safe level (25 V DC or lower) before changing the wiring.
Furthermore, sparks may be generated when short circuit occurs with some voltage remained. To avoid this, wait until the voltage has disappeared before doing any work.

6-1 Main circuit wiring and ground terminal wiring

Table 6-1-1 Explanation of main circuit terminal and ground terminal functions

Terminal Symbol	Terminal Name	Explanation
R, S, T	Main circuit power terminals	Connect 3-phase power supply.
U, V, W	Inverter output terminals	Connect a 3-phase motor.
P1, P(+)	DC reactor connection terminals	Connect a power factor correcting DC reactor (option).
P(+), DB	External braking resistor terminals	Connect an external braking resistor (option). (7.5 kW or less)
P(+), N(−)	External braking unit terminals	Connect an external braking unit (option)
E(G)	Inverter ground terminal	Ground terminal for inverter chassis.

(1) Main power supply terminals [R, S, T]

① Connect the power supply to the main power supply terminals R, S and T via a circuit braker or a leakage current braker. There is no need to match the phase when connecting.

② It is recommended that the main power supply is fed to the inverter through a magnet contactor to prevent further problems or damage to the inverter in the event of a failure.

Caution

③ Do not start or stop the inverter by turning the main power switch on or off. Use the control circuit terminals FWD and REV or the RUN and STOP keys on the keypad panel to start and stop the inverter.

④ Do not connect the inverter to a single-phase power supply. If a single-phase power supply must be used, use an inverter dedicated for single-phase.

(2) Inverter output terminals [U, V, W]

① Connect a 3-phase motor to the inverter output terminals U, V and W in correct order. If the operation commands do not match the direction of motor rotation, interchange any two of the U, V, W connections.

② Do not connect a power factor correcting capacitor or a surge absorber to the output side of the inverter.

(3) DC reactor terminals [P1, P(+)]

① These terminals are used to connect an optional power factor correcting DC reactor. These terminals are connected by a short-circuiting conductor at the time of shipment from the factory, so remove this conductor before connecting the DC reactor. (Fig. 6-1-1)

② Make sure that the short circuiting conductor between terminals P1 and P(+) in fastend when the DC reactor is not used.

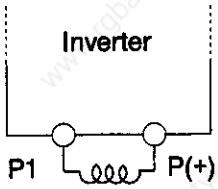


Fig. 6-1-1

(4) External braking resistor terminals [P(+), DB] (7.5 kW or less)

For the inverters of 7.5 kW rating or less, the built-in braking resistor is connected to the P(+) and DB terminals. If the thermal capacity of the built-in braking resistor is insufficient (if frequent braking or high-torque braking are required, for example), it is necessary to connect an optional external braking resistor to increase the braking capability. (Fig. 6-1-2).

① Remove the terminals of the built-in braking resistor which are connected to the P(+) and DB terminals. Insulate the ends of the removed terminals by covering them with tape.

② Connect the P(+) and DB terminals of the external braking resistor to the P(+) and DB terminals of the inverter.

③ Use two twisted wires with a length of less than 5 meters.

7.5 kW or less

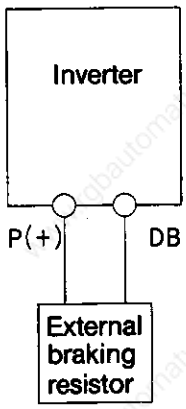


Fig. 6-1-2 Connection diagram

(5) Braking unit and braking resistor terminals [P(+), N(−)] (11 kW or higher)

Models which are rated at 11 kW or above do not have an built-in braking resistor. In order to increase the braking capability, it is necessary to connect an optionally-available braking unit and a braking resistor. Connect according to the following procedure. (Fig. 6-1-3)

① Connect the P(+) and N(-) terminals of the braking unit to the P(+) and N(-) terminals of the inverter respectively.
Use two twisted wires with a length of less than 5 meters.

② Connect the P(+) and N(-) terminals of the braking resistor to the P(+) and N(-) terminals of the braking unit respectively.
Use wires with a length of less than 10 meters.
If not using the P(+) and N(-) terminals of the inverter, leave them opened. The P(+) and N(-) terminals should never be shorted or connected directly to a braking resistor, as this could damage the terminals.

11 kW or more

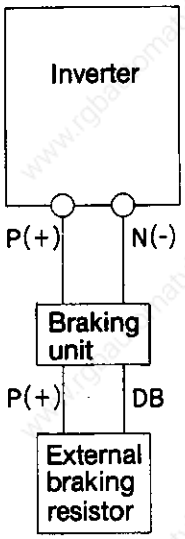


Fig. 6-1-3 Connection diagram

(6) Ground terminal [E(G)]

The ground terminal should always be connected to the ground for safety reasons and to reduce noise.

Caution

① The grounding wire should be as thick and as short as possible, and it should be connected to a grounding terminal which is provided for use with inverter systems.

② It is the responsibility of the user or the person installing the inverter to provide proper grounding according to national and local codes.

6-2 Control circuit wiring

Refer to Table 6-2-1 (on page 11) for explanations of the control circuit terminals.
The connection methods for the control circuit terminals differ according to the function settings. Connect according to the functions being used.

(1) Control input terminals

The circuit configuration is shown in Fig. 6-2-1. If you use a contactor for input, use a contactor of high reliability which does not have any closing defects, for example the HH54PW control relay manufactured by Fuji Electric.
Items (2) and (3) below have been wired at the time of shipment for easy operation.

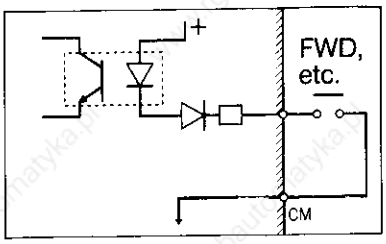


Fig. 6-2-1

(2) RUN and STOP command terminals [FWD, REV]

The RUN and STOP command terminals FWD and CM are shorted with a shorting bar at the time of shipment. (Fig. 6-2-2) In this condition, the invertor starts when the RUN key on the keypad panel is pressed, and it stops when the STOP key is pressed.
To reverse the direction of operation, connect as shown in Fig. 6-2-3.

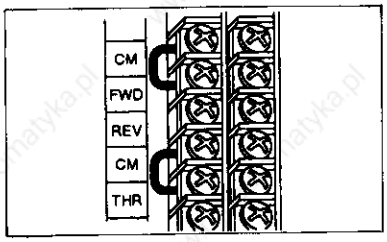


Fig. 6-2-2

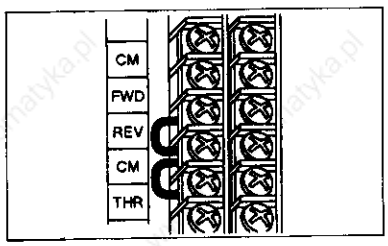


Fig. 6-2-3

(3) External alarm input terminal [THR]

The THR and CM terminals are shorted with a shorting bar at the time of shipment. To use the THR terminal, remove the shorting bar and connect a relay which turns off when there is an abnormality in the external unit. (Fig. 6-2-4)

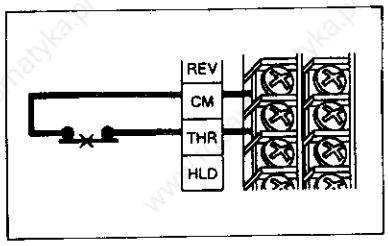


Fig. 6-2-4

(4) Analog frequency setting terminals [13, 12, 11, C1]

These terminals are used for connecting analog voltage, analog current and frequency setting potentiometer (control). If adding a contact to this circuit, use twin contact relay. However, do not connect a relay to terminal 11.

(5) Open collector output terminal

The circuit configuration is shown in Fig. 6-2-5. When connecting a control relay, connect surge absorption diodes across the solenoid coil. For the allowable load, refer to page 60.

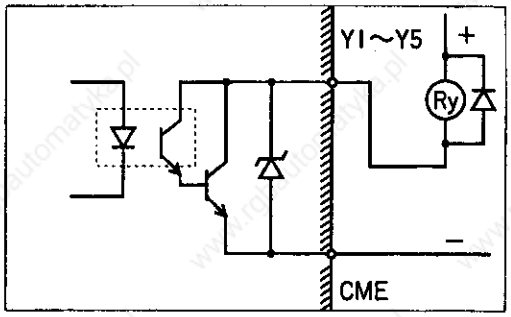


Fig. 6-2-5

Note
Terminal CME is isolated from terminal CM or 11.

6-3 Notes when wiring

Take note of the following points when carrying out wiring.

(1) Connecting the surge absorbers

The sudden changes in current which are caused by the solenoid coils in magnet contactors and relays in the control circuit and other inverter circuits may cause surge voltages (noise), and such surge voltages can cause malfunction of the control circuit and other inverter circuits. In such cases, connect surge absorbers directly across the solenoid coil which is producing the surge voltage. (Fig. 6-3-1)

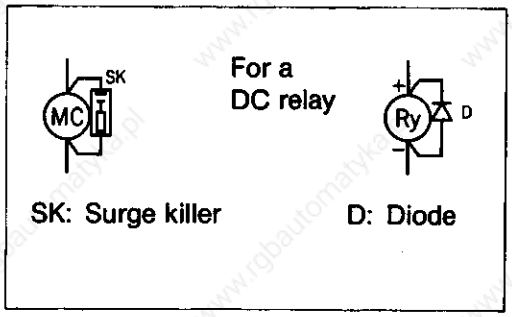


Fig. 7-3-1 Surge absorber connection diagram

(2) Control circuit wiring

① The wires which are connected to the control circuit terminals should be shielded wires or twisted plastic-coated wires of a 0.75 mm² cross-section.

② The control circuit wiring should be kept as far away as possible from the main circuit and external sequence circuit wiring. If the control circuit wiring must cross the main circuit or other wiring, it should be so arranged that the wiring cross at a right angle.

③ If long wires are being used, they should be twisted and shielded wires.

(3) Shield covering connection

On end of the shield of shielded wires or twisted and shielded wires shall be connected to a common terminal (CM, CME or 11) as shown in Fig. 6-3-2.
The other end shall be left opened.

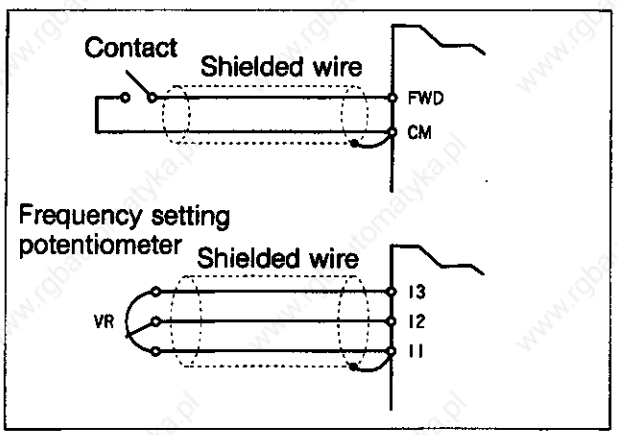
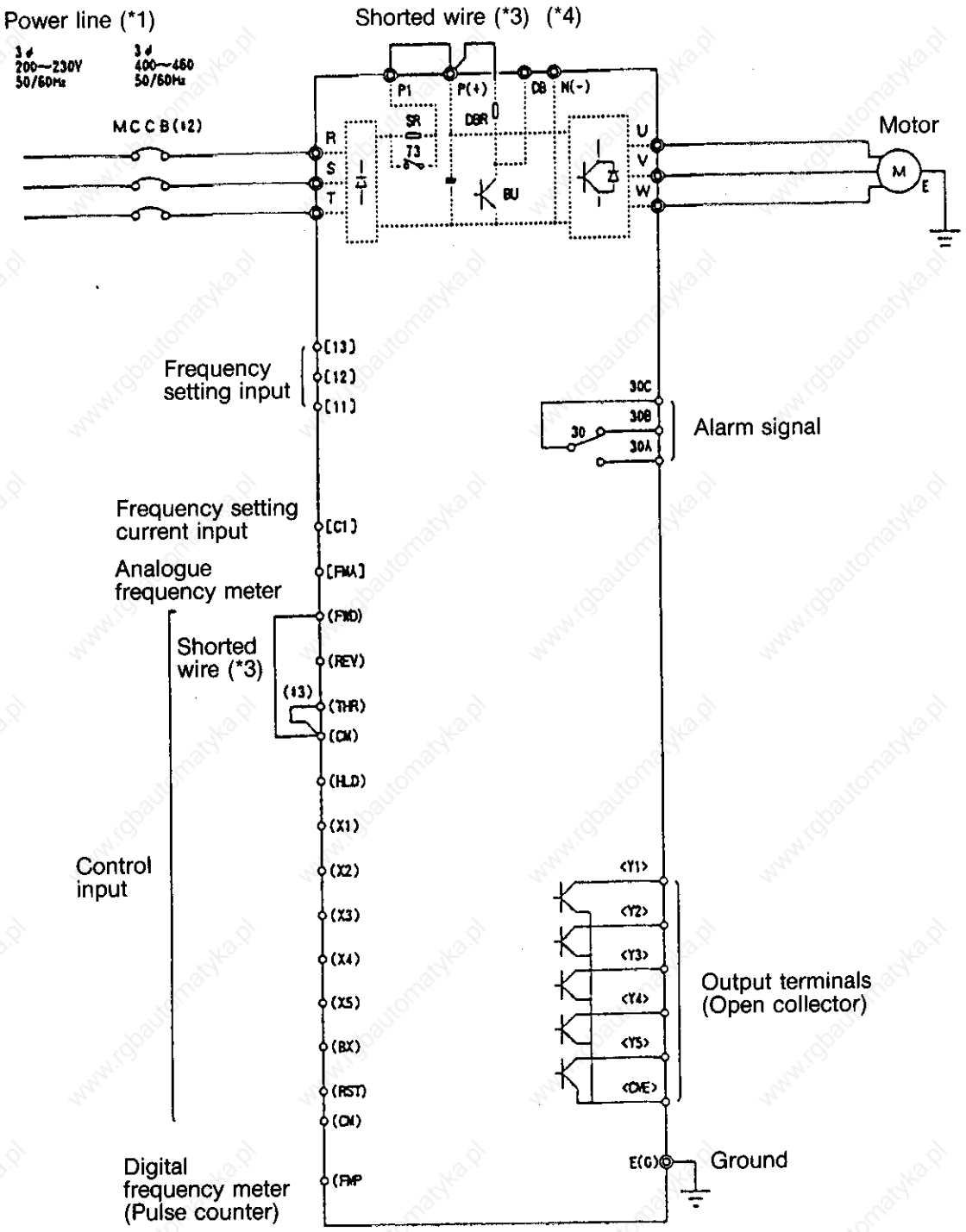


Fig. 6-3-2 Connection of the shielded wire covering

6-4 Basic wiring diagram (1)

(1) – 1 200V/400V FRN-G9S 0.2 ~ 22 kW
FRN-P9S 7.5 ~ 22 kW

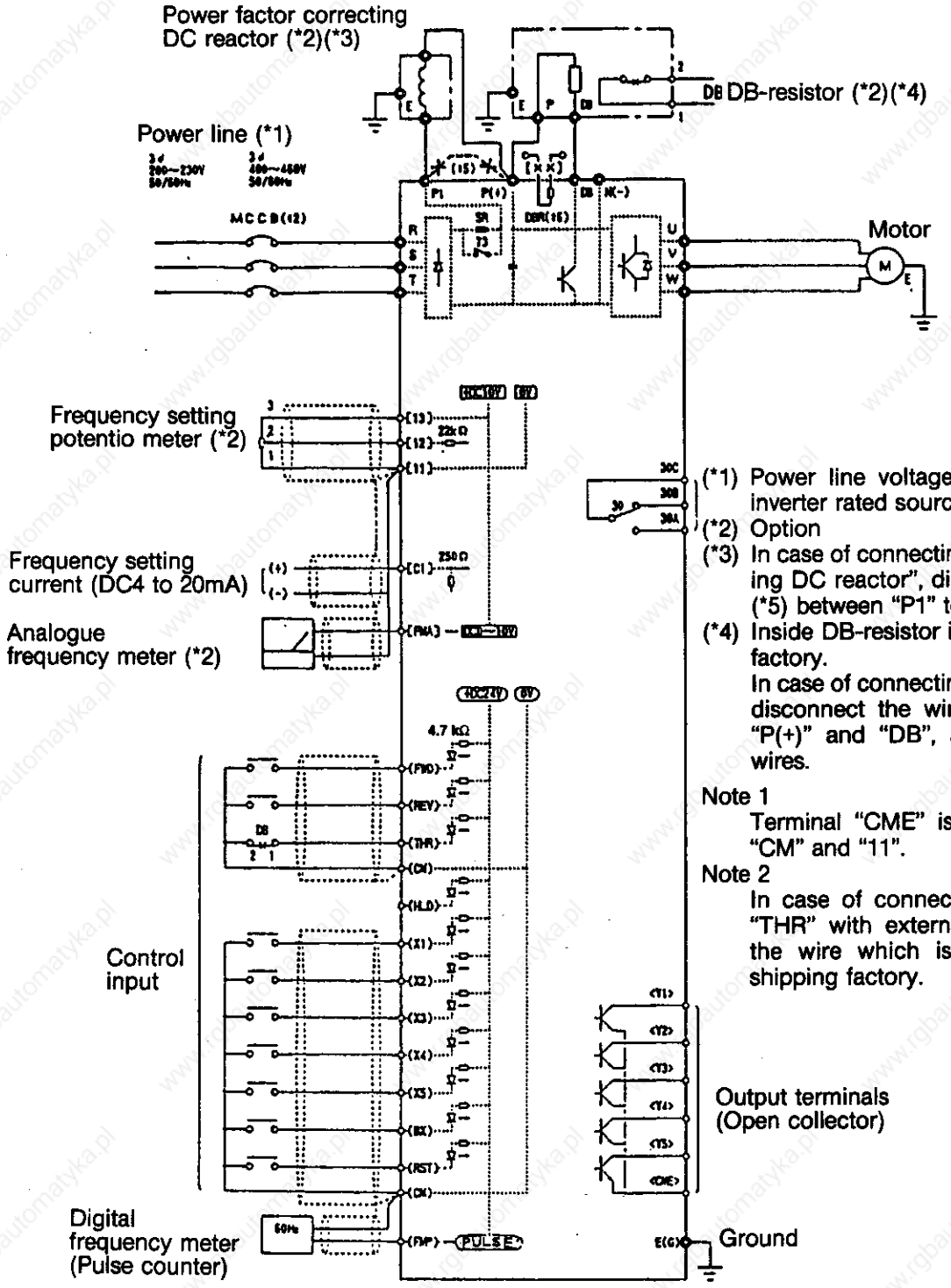


(*1) Power line voltage must be equal to the inverter rated source voltage.
(*2) Option
(*3) Connected by shorted wire at factory.
(*4) G9S, 11~22 kW and P9S, 15~22 kW do not have terminal DB and do not have DBR and BU in inverter.

Note: Terminal "CME" is isolated from terminal "CM" and "11".

Basic wiring diagram (2)

(2) – 1 200V/400V FRN-G9S 0.2 ~ 7.5 kW
FRN-P9S 7.5 ~ 11 kW



(*1) Power line voltage must be equal to the inverter rated source voltage.
(*2) Option
(*3) In case of connecting "Power factor correcting DC reactor", disconnect a shorted wire (*5) between "P1" to "P(+)".
(*4) Inside DB-resistor is connected at shipping factory.
In case of connecting an option DB-resistor, disconnect the wire of inside DB-resistor "P(+)" and "DB", and insulate these two wires.

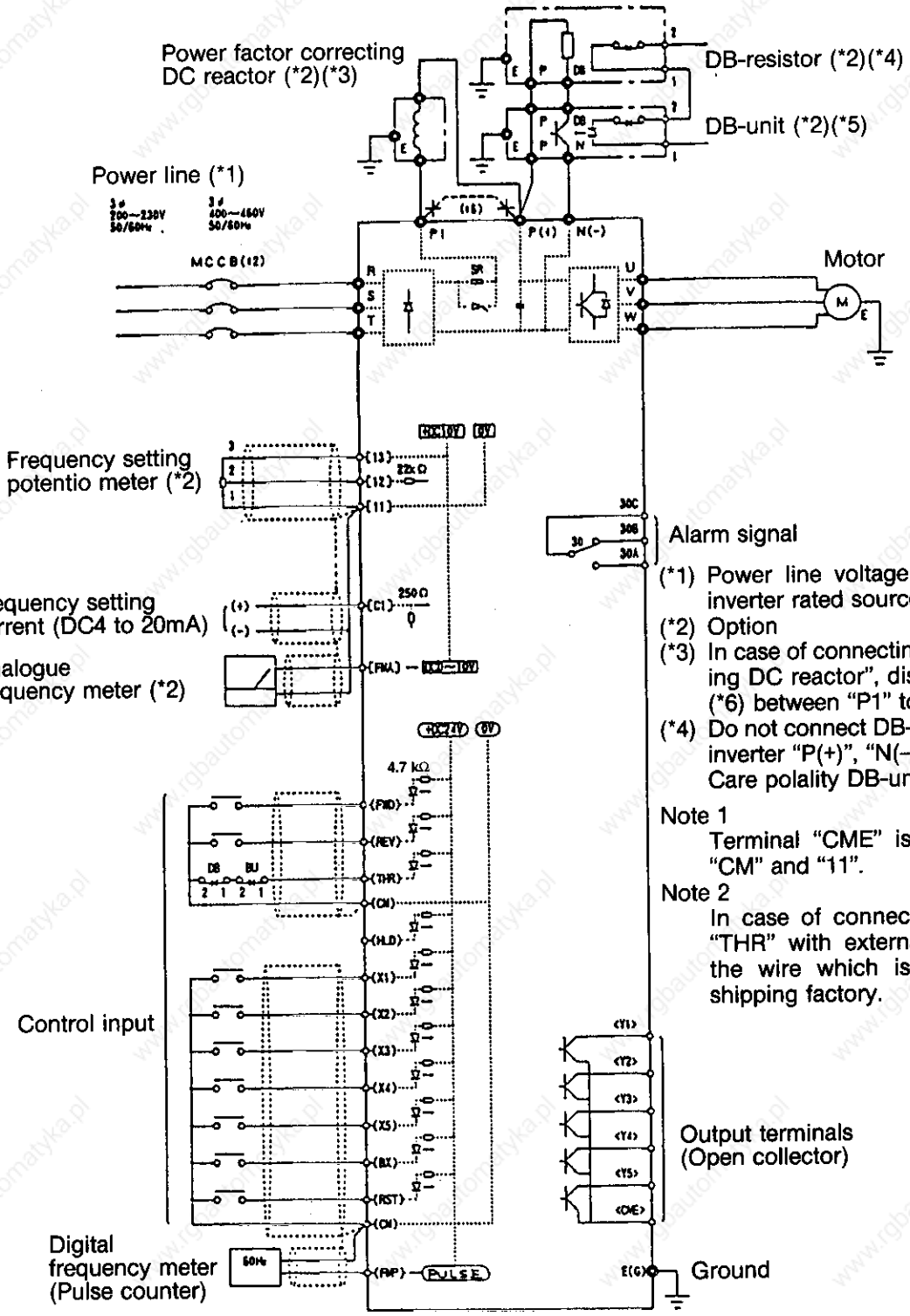
Note 1
Terminal "CME" is isolated from terminal "CM" and "11".

Note 2
In case of connecting terminal "FWD" or "THR" with external switches, disconnect the wire which is connected already at shipping factory.

1 – 1 4

Basic wiring diagram (3)

(2) – 3 200V/400V FRN-G9S 11 ~ 22 kW
FRN-P9S 15 ~ 22 kW



(*1) Power line voltage must be equal to the inverter rated source voltage.
(*2) Option
(*3) In case of connecting "Power factor correcting DC reactor", disconnect a shorted wire (*6) between "P1" to "P(+)".
(*4) Do not connect DB-resistor directly terminal inverter "P(+)", "N(–)".
Care polality DB-unit at connection.

Note 1
Terminal "CME" is isolated from terminal "CM" and "11".

Note 2
In case of connecting terminal "FWD" or "THR" with external switches, disconnect the wire which is connected already at shipping factory.

1 – 1 6

7. Inverter Operation

7-1 Pre-operation inspection

Check the following items before supplying power to the inverter.

① Check the wiring for errors.
In particular, check that inverter terminals U, V and W are not connected to the power supply, and also check that the ground terminal E(G) is connected to a secure ground. (Fig. 7-1-1)

② Make sure that there are no short circuits or accidental ground connections between the terminals or between uncovered charging sections.

③ Make sure that all screw and terminal connections are tight.

④ Make sure that the motor and the machine are separated.

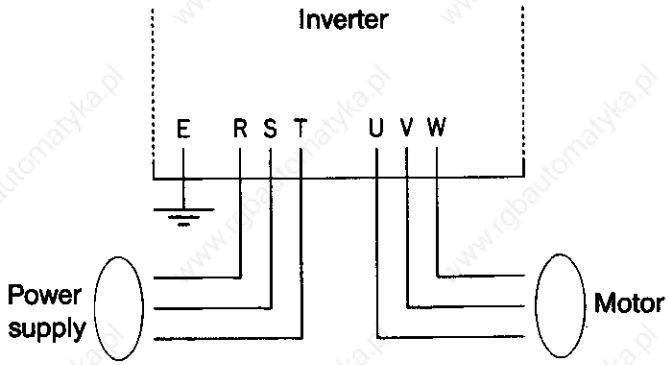


Fig. 7-1-1 Wiring connection diagram for inverter

⑤ Turn all switches off before turning on the power to make sure that the inverter doesn't start up or operate incorrectly when the power is turned on.

⑥ Check the following after turning on the power supply:

(a) Is the charging indicator illuminated?

(b) Does the keypad panel appear as shown in Fig. 7-1-2 (with no abnormality being indicated)?

(c) Are the inverter fans operating? (1.5 kW or above)

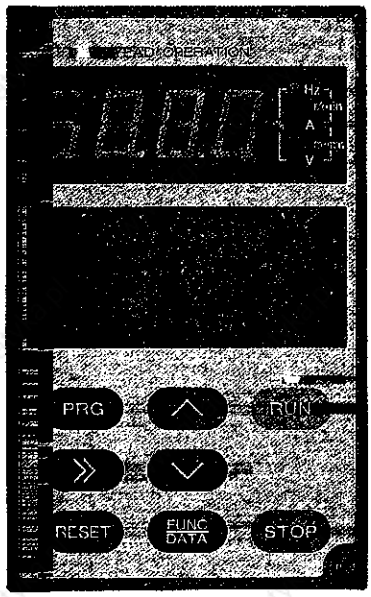


Fig. 7-1-2 Keypad panel display when power supply is turned on

7-2 Operation method

There are several operation methods which are available. Refer to Select the most appropriate method to suit your application and operating specifications, while referring to "8. Keypad panel operation and explanation" on page 18.
Table 7-2-1 shows the most commonly-used operation methods.

Table 7-2-1 Common operation methods

Operation method	Frequency setting	Operation commands
Operation using the keypad panel	∧, ∨	RUN, STOP
Operation using external signal terminals	∧, ∨	Contact input (switch) FWD-CM terminals REV-CM terminals
	Setting controls, analog voltage or analog current	

Apart from the combinations given in Table 7-2-1, combinations where frequency settings care made using setting controls and operation commands are given using the keypad panel are also possible.

7-3 Check operation and check points

If frequency settings and operation commands are input from either the keypad panel or external signal terminals, the motor will operate. Operate according to the instructions in Table 7-3-1.
Test operation should be carried out at a low frequency of not greater than 5 Hz.

If the length of the wiring between the inverter and the motor is greater than 50 m, set the carrier frequency (function code: 81) to "0" during use in order to reduce the effects of leakage current at high frequencies.
Consult Fuji Electric before using wiring with lengths of greater than 100 m.

Table 7-3-1 Operation commands

Operation method	Frequency setting	Operation commands
Operation using the keypad panel	(When using the ∧ and ∨ keys) When ∧ is pressed, the frequency setting increases. When ∨ is pressed, it decreases. If ∧ is pressed while the motor is running, the motor accelerates, and if ∨ is pressed, the motor decelerates.	If RUN is pressed, the inverter starts. If STOP is pressed, the inverter decelerates to a stop.
Operation using external signal terminals	(When using a frequency setting potentiometer) When the potentiometer is turned clockwise, the frequency setting increases, and when it is turned counterclockwise, the frequency setting decreases. If the potentiometer is turned clockwise while the motor is running, the motor accelerates, and if it is turned counterclockwise, the motor decelerates.	When FWD(REV)-CM is on, the inverter starts. When it is off, the inverter decelerates to a stop.

Note: After changing the frequency setting, press the FUNC DATA key to store the change.

Check the following points.

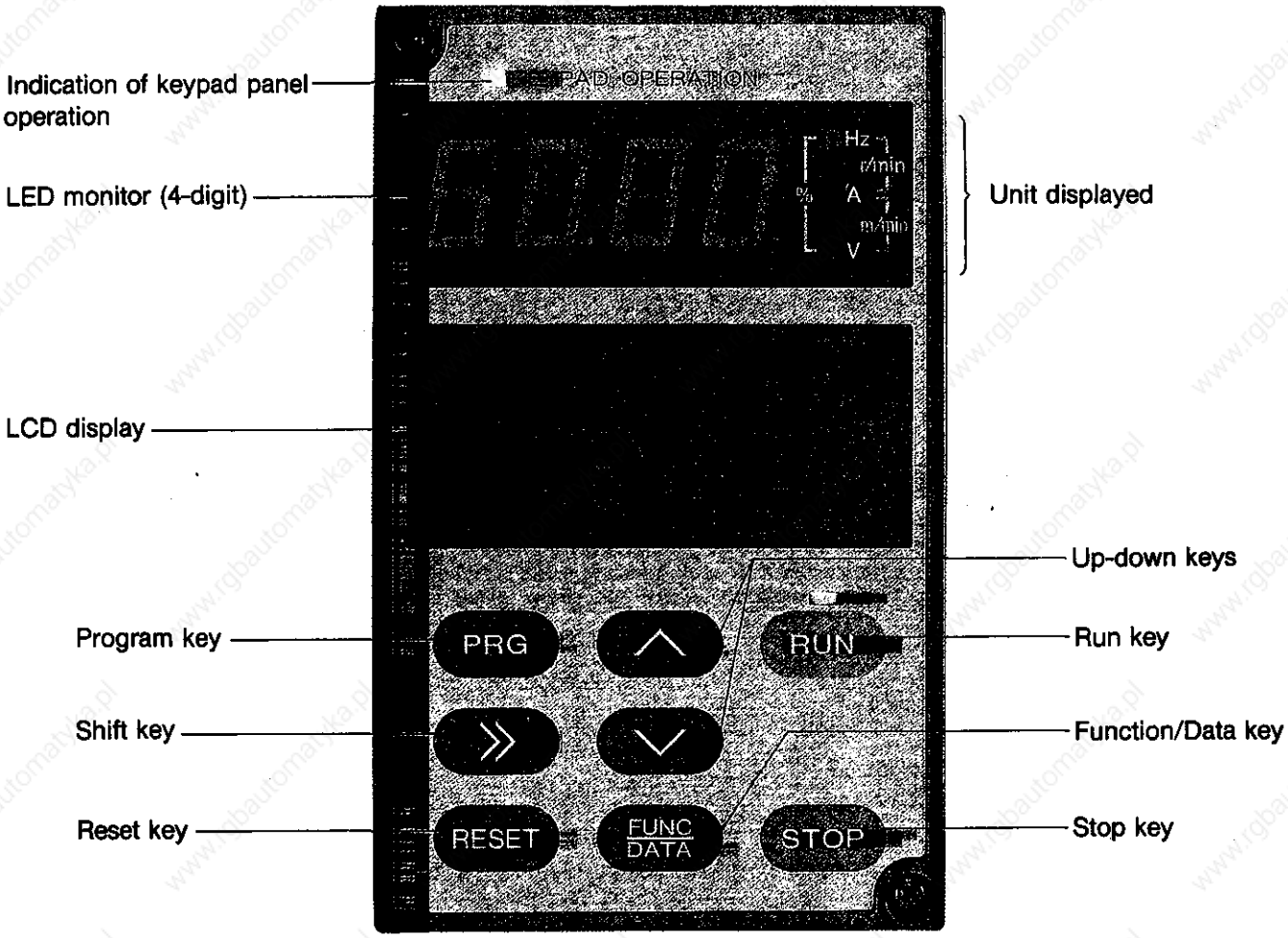
1. Direction of operation
2. Whether operation is smooth (without abnormal noise or vibration)
3. Whether acceleration and deceleration are smooth

   If there are no problems, increase the operation speed and check again.
   If an abnormality occurs in inverter or motor operation, stop operation immediately and check the cause of the problem by referring to "11. Troubleshooting".

Warning
If voltage is still being applied to the main circuit power supply terminals R, S and T, you will get an electric shock if you touch inverter output terminals U, V and W, even if the inverter output has stopped.
In addition, the smoothing capacitor will still be charged when the power supply is turned off, and it takes some time for it to fully discharge. To avoid any danger, wait until the charge lamp has switched off, and then use a circuit tester to check that the voltage has dropped to a safe level before touching the power supply circuit.
If the above test operation does not indicate any abnormality, you can then proceed to normal operation.

8. Keypad Panel Operation

8-1 Component identification



8-2 Keypad panel keys

(≫) ● This key is used for switching display (frequency, current, voltage, torque, etc.) of the digital monitor and graphic display in normal mode. It can be used whether the inverter is running or stopped.

● During program setting mode, it can be used to move to a different column in the setting value.

(∧) ● These keys are used to move the cursor and when selecting a function No.

(∨) ● When setting data, the (∧) key increases the setting value, and the (∨) key decreases the setting value.

● In normal mode, the frequency setting is increased when (∧) is pressed and is decreased when (∨) is pressed.

(STOP) ● This key is used for stopping operation. (It is only valid during keypad panel operation.)

(RUN) ● This key is used for starting operation. (It is only valid during keypad panel operation.)

(PRG) ● Normal mode or program setting mode selection key.

(FUNC DATA) ● This key is used for data read-out and writing for each function. Also, when setting data on the graphic display, it can be used to read data to the screen or write data from the screen.

● This key is also used to store changes to frequency settings.

(RESET) ● This key resets an abnormal stop condition when the keypad panel is in normal mode.
Also changes from data update mode to function selection mode in program setting mode.

● It can be used to cancel writing of setting data.

8-3 Explanation of displays

(1) Digital monitor

- In normal mode, the digital monitor displays values such as the frequency, current, voltage and torque.
  (The LEDs flash when the inverter is stopped.)
- If a protective STOP occurs, the cause of the problem will be displayed as a code.
- The unit information for the 7-segment LED section are indicated by LEDs in the unit display.

(2) LCD monitor

① Operation monitoring screen

The screen at it appears at above at the time of shipment is called the operation monitoring screen.

* The operation monitoring screen can be replaced by a F64 LCD monitor. For details, refer to the function explanation on page 00.

② Selection screen

```
00 FREQ COMND
01 OPR METHOD
02 MAX Hz
03 BASE Hz-1
```

The screen which is used to select the function is called the selection screen.

③ Setting screen

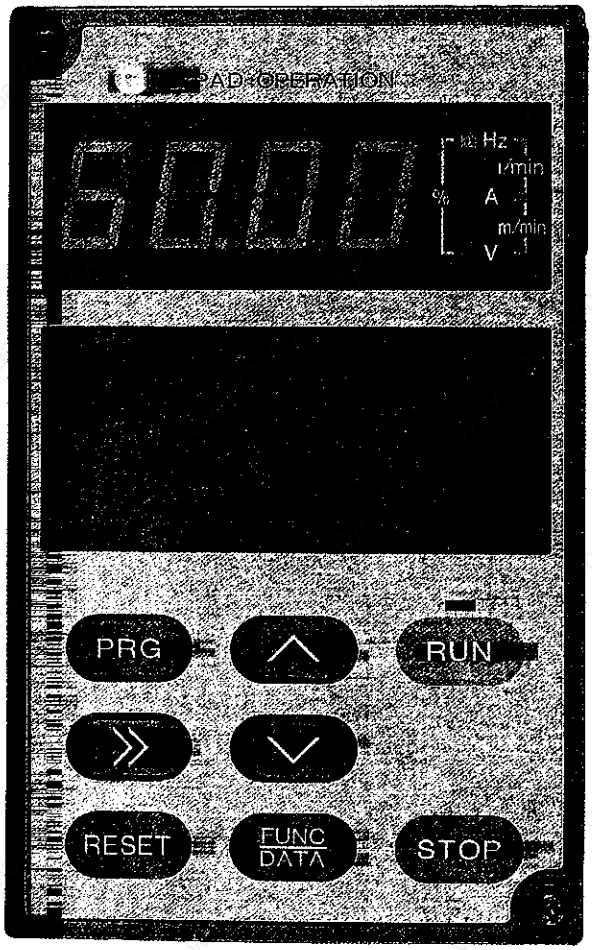
```
00 FREQ COMND


Range: 0 - 2
```

The screen for changing setting values for data is called the setting screen.

8-4 Explanation of keypad panel operation

(1) Changing the frequency, current or voltage on the LED monitor



At the operation monitoring screen shown above, press the ≫ key.

STOP
PRG – DATA SET
>> – LED SEL

↓ Press the ≫ key.

<LED monitor>
OUTPUT FREQUENCY
Output frequency (Hz)

↓ Press the ≫ key.

<LED monitor>
OUTPUT CURRENT
Output current (A)

↓ Press the ≫ key.

<LED monitor>
OUTPUT VOLTAGE
Output voltage (V)

↓ Press the ≫ key.

<LED monitor>
MOTOR SPEED
Motor speed (r/min)

↓ Press the ≫ key.

<LED monitor>
LINE SPEED M/MIN
Line speed (m/min.)

↓ Press the ≫ key.

<LED monitor>
MACHINE SPEED R/MIN
Load speed (r/min)

↓ Press the ≫ key.

<LED monitor>
TORQUE LIMIT (DRIVING)
Driving torque limiter (%)

↓ Press the ≫ key.

<LED monitor>
TORQUE LIMIT (BRAKING)
Braking torque limiter (%)

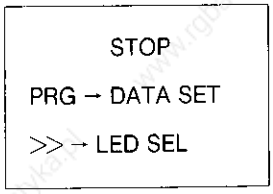
↓ Press the ≫ key.

<LED monitor>
MOTOR TORQUE
Torque (%)

↓ Press the ≫ key. → STOP

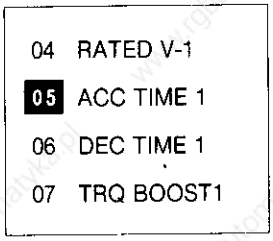
(2) Data setting method

The method of changing function 05 "Acceleration time" is given below as a general example of the data setting method.



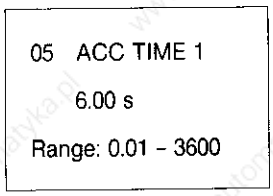
Changes from the operation monitoring screen to the selection screen

↓ Press the PRG key.



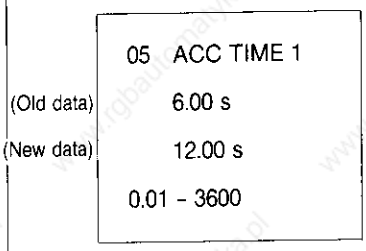
Use the ∧ and ∨ keys to move the cursor to the desired function to change.

↓ Press the FUNC DATA key.



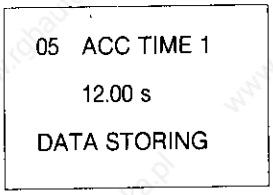
↓

Press ∧ or ∨ to change the setting data. You can press the ≫ key to change to a different column at this time.



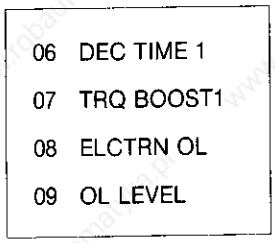
When you have made the setting, press the FUNC DATA key to store the data.

↓ Press the FUNC DATA key.

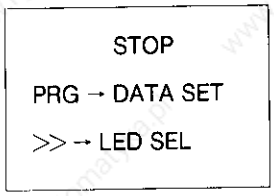


Once the data has been stored, the display will automatically return to the selection screen.

↓



↓ Press the PRG key.



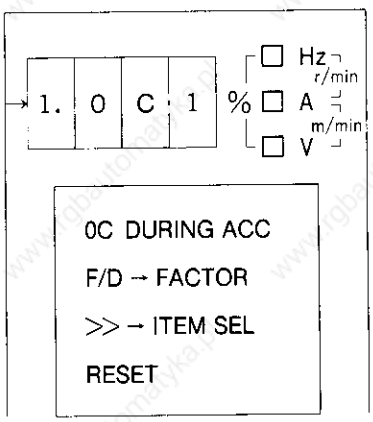
The display changes from the selection screen to the normal screen.

When setting data, you can change the settings to the highest precision, but when saving the changes, the precision will be restricted by the size of the data. Any data below the allowable precision will be truncated.

(3) Troubleshooting guidance

① Finding the cause of trips

The ☐ section will be either blank of contain flashing numerals from 1 -7 depending on the problem condition.



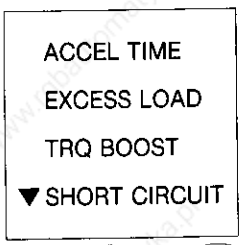
LEDs will flash

Press the FUNC DATA key.

→ ←

Press the PRG key to return to the operation monitoring screen.

The factor of the trip will be displayed on the LCD monitor.
The information displayed on the LCD monitor will differ according to the trip.

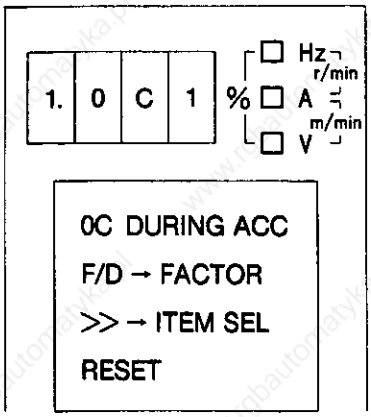


→

Press the ≫ key to change to the next screen.

Press ∨ or ∧ to change the screen of the factor.

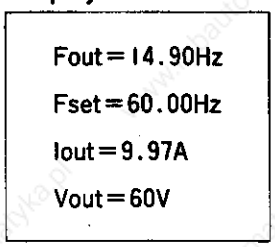
② Operation conditions at the time of the trip



↓ Press the (≫) key.

Trip condition 1 :

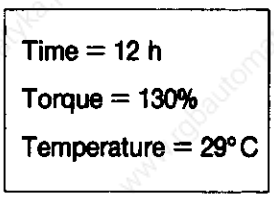
The output frequency, frequency setting, output current and output voltage when the trip occurred are displayed.



↓ Press the (≫) key.

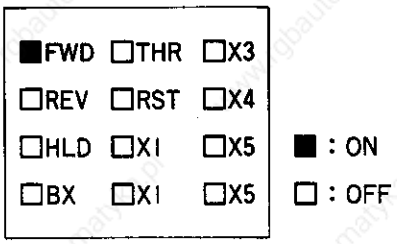
Trip condition 2 :

The calculated operation time, calculated torque value and the cooling fin temperature at the time of the trip are displayed.



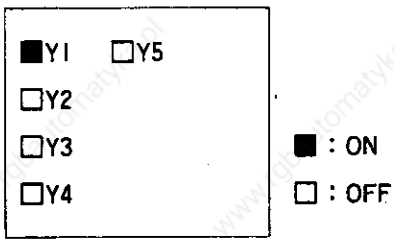
↓ Press the (≫) key.

The input terminal conditions are displayed on the LCD.



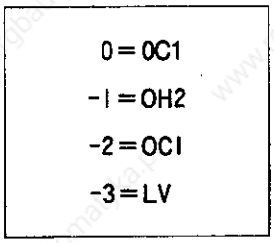
↓ Press the (≫) key.

The output terminal conditions are displayed on the screen.

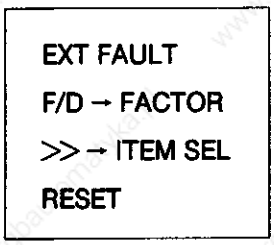


↓ Press the (≫) key.

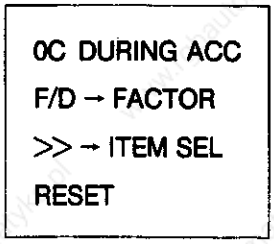
The history of the past three trips is displayed on the LCD.



↓ Press the (≫) key.



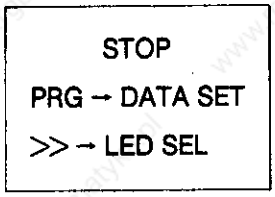
③ Resetting



After eliminating the cause of the problem, press the (RESET) key.

* The (RESET) key for resetting the trip is only valid when this screen is displayed.

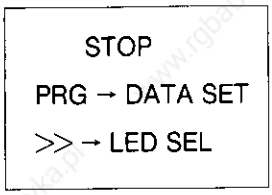
→



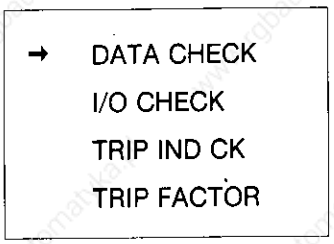
The display will change from the trip screen to the operation monitoring screen.

(4) Explanation of the menu screen

The screen which lets you set items 1. to 4. below and monitor them is called the menu screen.



↓ Press the FUNC DATA key.



Use the ∧ and ∨ keys or the ≫ key to move the cursor to the desired item to select, and then press the FUNC DATA key.

1. Data check

   Each function code and the data setting value for that code are displayed. You can change the data setting values at this time too. Move the cursor to the function code No. you would like to change, and then press the FUNC DATA key. Then continue as for normal data setting.

2. I/O check

   If this item is selected, you can check the input terminal conditions, output terminal conditions, voltage command terminal conditions, FM terminal conditions and maintenance information in that order.

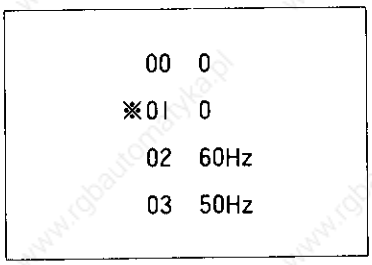
   In this case pressing ≫ will change the screen and pressing RESET will return the display to the menu screen.
   To return to the operation monitoring screen, press the PRG or RESET key.

3. Trip check

   If this item is selected, you can find out the operation conditions at the time a trip occurred as explained on page 22. For details, refer to page 22.
   The latest trip information will be displayed on the monitor.

4. Trip factor

   If this item is selected, the factor of the trip will be displayed as explained on page 21. For details, refer to page 21.



Note: Settings which are different from the factory settings are indicated with a "※".

9. Function

9-1 Function table

	Function No.	Function Name	LCD Monitor	Setting range (Up to 22kW)	Unit	Min. unit
Basic Functions	00	Frequency command	00 FREQ COMND	0 : KEYPAD operation (△ or ▽ key) 1 : Voltage input (terminal 12 and V1) 2 : Voltage and Current input (terminal 12 and V1 and C1)	–	–
	01	Operation method	01 OPR METHOD	0 : KEYPAD operation (RUN or STOP key) 1 : FWD or REV command signal operation (Terminals)	–	–
	02	Maximum frequency	02 MAX Hz	G9S : 50 to 400 z P9S : 50 to 120 Hz	Hz	1
	03	Base frequency 1	03 BASE Hz-1	G9S : 50 to 400 z P9S : 50 to 120 Hz	Hz	1
	04	Rated voltage 1 (Maximum output voltage 1)	04 RATED V-1	0 (Free), 80 to 240 V 0 (Free), 320 to 480 V	V	1
	05	Acceleration time 1	05 ACC TIME 1	0.01 to 3600 s	s	0.01
	06	Deceleration time 1	06 DEC TIME 1	0.00 (Coasting), 0.01 to 3600 s		
	07	Torque boost 1	07 TRQ BOOST1	0.0 (Auto setting), 0.1 to 20.0 (Manual setting)	–	0.1
	08	Electronic thermal overload relay (for motor) (Select)	08 ELECTRN OL	0 : Inactive 1 : Active (for 4 poles standard motor) 2 : Active (for 4 poles FUJI-inverter motor)	–	–
	09	(Level)	09 OL LEVEL	Approx. 20 to 105% of inverter rated current	A	0.01
	10	Restart after momentary power failure	10 RESTART	0 : Inactive 1 (Trip and alarm when power failure occurs) 1 : Inactive 2 (Trip and alarm when power recovers) 2 : Active (smooth recovery) 3 : Active (momentary stops and restarts at setting frequency) 4 : Active (momentary stops and restarts at starting frequency)	–	–
	11	Frequency limitter (High)	11 H LIMITER	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	1
	12	(Low)	12 L LIMITER	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	1
	13	Bias frequency	13 FREQ BIAS	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	1
	14	Gain for frequency setting signal	14 FREQ GAIN	0.0 to 200.0 %	%	0.1
	15	Torque limiter (Driving)	15 DRV TORQUE	20 to 180, 999 % (999: No limit)	%	1
	16	(Braking)	16 BRK TORQUE	0, 20 to 180, 999 % (999: No limit)	%	1
	17	DC brake (Starting freq.)	17 DC BRK Hz	0.0 to 60.0 Hz	Hz	0.1
	18	(Braking level)	18 DC BRK LVL	0.0 to 100%	%	0.1
	19	(Braking time)	19 DC BRK t	0.0 (DC brake inactive), 0.1 to 30.0 s	s	0.1
	20	Multistep frequency setting (Freq. 1)	20 MULTI Hz-1	G9S : 0.00, 0.20 to 400.0 Hz P9S : 0.00, 0.20 to 120.0 Hz	Hz	0.01
	21	(Freq. 2)	21 MULTI Hz-2			
	22	(Freq. 3)	22 MULTI Hz-3			
	23	(Freq. 4)	23 MULTI Hz-4			
	24	(Freq. 5)	24 MULTI Hz-5			
	25	(Freq. 6)	25 MULTI Hz-6			
	26	(Freq. 7)	26 MULTI Hz-7			
	27	Electronic thermal overload relay (for braking resistor)	27 DBR OL	0 : Inactive 1 : Active (for internal braking registor, up to 7.5 kW) 2 : Inactive	–	–
	28	Slip compensation control	28 SLIP COMP	–9.9 Hz to +5.0 Hz	Hz	0.1
	29	Torque vector control	29 TRQ VECTOR	0 : Inactive 1 : Active	–	–
	30	Number of motor poles	30 MTR POLES	2 to 14 (even number)	–	2

	Function No.	Function Name	LCD Monitor	Setting range Up to 22kW	Unit	Min. unit
	31	Function block (32–41)	31 ■ 32–41 ■	0 : Does not display FUNCTION CODE 32 to 41 1 : Displays FUNCTION CODE 32 to 41	–	–
Input Terminal Functions	32	X1–X5 terminal function selection	32 X1–X5 FUNC	0000 ~ 2222 X1 and X2 terminal function changeable by 1st code. 32/0### : multistep speed selection 32/1### : UP/DOWN control 1 32/2### : UP/DOWN control 2 X3 terminal function changeable by 2nd digit. 32/#0## : Multistep speed selection 32/#1## : Switching operation from line to inverter (for 50 Hz line) 32/#2## : Switching operation from line to inverter (for 60 Hz line) X4 terminal function changeable by 3rd digit. 32/##0# : Acc./Dec. time selection 32/##1# : Current input signal selectionn (4 to 20 mA DC) 32/##2# : DC brake command X5 terminal function changeable by 4th digit. 32/###0 : Acc./Dec. time selection (4 steps using X4 and X5) 32/###1 : 2nd motor selection 32/###2 : Data protection	–	–
Acc./Dec. Times	33 34 35 36 37 38	Acceleration time 2 Deceleration time 2 Acceleration time 3 Deceleration time 3 Acceleration time 4 Deceleration time 4	33 ACC TIME 2 34 DEC TIME 2 35 ACC TIME 3 36 DEC TIME 3 35 ACC TIME 4 36 DEC TIME 4	0.01 ~ 3600 s 0.00 (Coasting), 0.01 ~ 3600 s	s	0.01
For 2nd motor	39	Base frequency 2	39 BASE Hz–2	G9S : 50 to 400 Hz P9S : 50 to 120 Hz	Hz	1
	40	Rated voltage 2 (Maximum output voltage 2)	40 RATED V–2	0 (Free), 80 to 240 V 0 (Free), 320 to 480 V	V	1
	41	Torque boost 2	41 TRQ BOOST2	0.1 to 20.0	–	0.1
	42	Function block (43–51)	42 ■ 43–51 ■	0 : Does not display FUNCTION CODE 43 to 51 1 : Displays FUNCTION CODE 43 to 51	–	–
Analog Monitor Output	43	FMP (Pulse rate multiplier) terminal	43 FMP PULSES	6 to 100	–	1
	44	(Voltage adjust)	44 FMP V-ADJ	50 to 120	–	1
	45	FMA (Voltage adjust) terminal	45 FMA V-ADJ	65 to 200	–	1
	46	(Function)	46 FMA FUNC	0 : Output frequency 1 : Output current 2 : Output torque 3 : Load factor	–	–
Output Terminal Functions	47	Y1–Y5 terminal function	47 Y1–Y5 FUNC	0000 – FFFF Each 5 digits setting for 5 terminals separately selectable to following functions. (code) (function) 0 : Inverter running (RUN) 1 : Frequency equivalence signal (FAR) 2 : Frequency level detection signal (FDT) 3 : Overload early warning signal (OL) 4 : Under voltage detection signal(LU) 5 : KEYPAD operation mode 6 : Torque limitting 7 : Inverter stopping 8 : Auto-restart 9 : Auto-reset C : Time-up signal (TP) at pattern operation d : Cycle completion signal (TO) at pattern operation E : Stage No. indication signal at pattern operation (uses 3-output terminal Y3, Y4 and Y5) F : Cause of trip signal at alarm tripping (uses 4-output terminal Y2, Y3, Y4 and Y5)	–	–

	Function No.	Function Name	LCD Monitor	Setting range (Up to 22kW)	Unit	Min. unit
Output Terminal Functions	48	FAR function (Hysteresis) signal	48 FAR HYSTR	0.0 to 10.0 Hz	Hz	0.1
	49	FDTfunction (Level)	49 FDT LEVEL	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	1
	50	(Hysteresis)	50 FDT HYSTR	0.0 to 30.0 Hz	Hz	0.1
	51	OL function signal (Level)	51 OL WARNING	Approx. 20 to 105% of inverter rated current	A	0.01
	52	Function block (53–59)	52 ■ 53–59 ■	0 : Does not display FUNCTION CODE 53 to 59 1 : Displays FUNCTION CODE 53 to 59	–	–
Frequency Control	53 54 55	Jump frequency (Jump freq. 1) (Jump freq. 2) (Jump freq. 3)	53 JUMP Hz 1 54 JUMP Hz 2 55 JUMP Hz 3	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	1
	56	(Hysteresis)	56 JUMP HYSTR	0 to 30 Hz	Hz	1
	57	Starting frequency (Freq.)	57 START Hz	0.2 to 60.0 Hz	Hz	0.1
	58	(Holding time)	58 HOLDING t	0.0 to 10.0 s	s	0.1
	59	Freq. setting signal filter	59 FILTER	0.01 to 5.00 s	s	0.01
	60	Function block (61–79)	60 ■ 61–79 ■	0 : Does not display FUNCTION CODE 61 to 79 1 : Displays FUNCTION CODE 61 to 79	–	–
LED & LCD Monitor	61	LED Monitor (Function)	61 LED MNTR 1	0 to 8 (9 kinds selectable)	–	–
	62	(Display at STOP mode)	62 LED MNTR 2	0 : Setting value 1 : Output value	–	–
	63	Coefficient for machine speed and line speed	63 SPEED COEF	0.01 to 200.00 (Multiplier to Hz value)	–	0.01
	64	LCD Monitor (Function)	64 LCD MNTR	0 : displays RUN or STOP 1 : Bar graph (Setting freq. and Output freq.) 2 : Bar graph (Output freq. and Output current) 3 : Bar graph (Output freq. and Motor torque)	–	–
Pattern Operation	65	Pattern operation (Mode select)	65 PATTERN	0 : Inactive 1 : Mono cycle 2 : Continuous cyclic 3 : Mono cycle with continuous 7th speed	–	–
	66 67 68 69 70 71 72	(Stage 1) (Stage 2) (Stage 3) (Stage 4) (Stage 5) (Stage 6) (Stage 7)	66 STAGE 1 67 STAGE 2 68 STAGE 3 69 STAGE 4 70 STAGE 5 71 STAGE 6 72 STAGE 7	Operation time : 0.00 ~ 6000 s Code FWD/REV ACC/DEC F1 : FWD , ACC 1 / DEC 1 F2 : FWD , ACC 2 / DEC 2 F3 : FWD , ACC 3 / DEC 3 F4 : FWD , ACC 4 / DEC 4 R1 : REV , ACC 1 / DEC 1 R2 : REV , ACC 2 / DEC 2 R3 : REV , ACC 3 / DEC 3 R4 : REV , ACC 4 / DEC 4	s –	0.01 –
		*Setting for operation time and FWD/REV rotation and ACC/DEC time				
	73	Acc./Dec. pattern (Mode select)	73 ACC PTN	0 : Linear 1 : S-curve 2 : Non-linear (for variable torque load)	–	–
Special Functions 1	74	Series brake motor driving	74 SERIES BRK	0 : Not available	–	–
	75	Energy-saving operation	75 ENERGY SAV	0 : Inactive 1 : Active	–	–
	76	Rev. phase sequence lock	76 REV LOCK	0 : Inactive 1 : Active	–	–
	77	Data initializing (Data reset)	77 DATA INIT	0 : Manual setting value 1 : Return to factory setting value	–	–
	78	Language (JPN / ENG)	78 LANGUAGE	0 : Japanese 1 : English	–	–
	79	LCD monitor (Brightness)	79 BRIGHTNESS	0 (Bright) to 10 (Dark)	–	–

	Function		LCD Monitor	Setting range		Unit	Min. unit
	No.	Name		Up to 22kW			
	80	Function block (81–94)	80 ■ 81–94 ■	0 : Does not display FUNCTION CODE 81 to 94 1 : Displays FUNCTION CODE 81 to 94		–	–
Special Functions 1	81	Motor sound (Carrier frequency)	81 MTR SOUND	0 (Low carrier) to 10 (High carrier)		–	–
	82	Auto-restart (Restart time)	82 RESTART t	0.0 to 5.0 s		s	0.1
	83	(Freq. fall rate)	83 FALL RATE	0.00 to 100.00		Hz/s	1
	84	Auto-reset (Times)	84 AUTO-RESET	0 to 7		–	–
	85	(Reset interval)	85 RESET INT	2 to 20 s		–	–
Motor Characte-ristic	86	Motor 1 (Capacity)	86 MOTOR CAP	0 : 1-frame up capacity 2 : 1-frame down capacity	1 : Standard capacity 3 : 2-frame down capacity	–	–
	87	(Rated current)	87 MOTOR 1-Ir	Current value (A) setting	0.00 to 2000A	A	0.1
	88	(No-load current)	88 MOTOR 1-Io	Current value (A) setting	0.00 to 2000A	A	0.1
	89	Motor 2 (Rated current)	89 MOTOR 2-Ir	Current value (A) setting	0.00 to 2000A	A	0.1
	90	Motor 1 (Tuning)	90 TUNING	0 : Inactive	1 : Active	–	–
	91	impedance (%R1 setting)	91 %R1 SET	Percent value setting	0.00 to 50.00%	%	0.01
	92	(%X setting)	92 %X SET	Percent value setting	0.00 to 50.00%	%	0.01
Special Functions	93	Dedicated function for manufacturer	93 DD FUNC 1			–	–
	94		94 DD FUNC 2			–	–
	95	Data protection	95 DATA PRTC	0 : Data changeable	1 : Change inhibited	–	–

9-2 Description of functions

Frequency command FREQ COMND

- The frequency setting method can be selected from the following.
  - 0: Setting from keypad panel (using the and keys)
  - 1: Setting by means of analog voltage (terminals 12-11 and V1-11)
    When "1" is selected, if signals are input from terminals 12 and VI simultaneously, the signals will be added together to produce the output frequency.
  - 2: Setting by means of analog voltage and analog current (terminals 12-11, V1-11 and C1-11)
    When "2" is selected, if both analog voltage and analog current are input simultaneously, the signals will be added together to produce the output frequency.

Operation method OPR METHOD

- The input method for operation commands can be selected as follows.
  - 0: Operation command input using the keypad panel (RUN and STOP keys)
  - 1: Operation command input by means of external signal terminals (FWD, REV)

Maximum frequency MAX Hz

- The maximum operation frequency can be set within the range of 50 - 400 (120) Hz in steps of 1 Hz.

Base frequency 1 BASE Hz-1

- This sets the base frequency so that the output voltage of V/F pattern for the inverter is constant. The setting range is 50 - 400 Hz in steps of 1 Hz.
- If the base frequency is greater than the maximum frequency, the output voltage will not rise to the rated voltage.

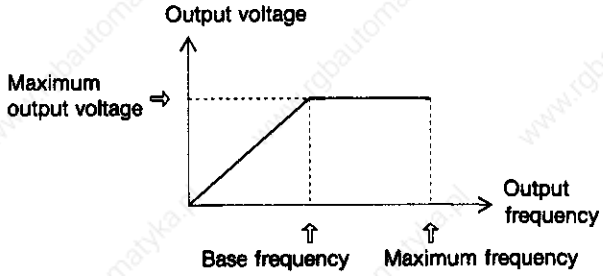
Rated voltage 1 (Maximum output voltage 1) RATED V-1

- This sets the maximum output voltage for the inverter in steps of 1 V. (However, the voltage output cannot be higher than the input voltage.)
  - 0: AVR function OFF (output voltage proportional to input voltage)

  Other than 0: AVR function operates.

Setting range: 200-V systems 80 - 240 V
400-V systems 320 - 480 V

■ Explanation



Acceleration time 1 ACC TIME 1
Deceleration time 1 DEC TIME 1

- The time from start to maximum frequency and from maximum frequency to stop can be set within the range of 0.01 - 3600 seconds.

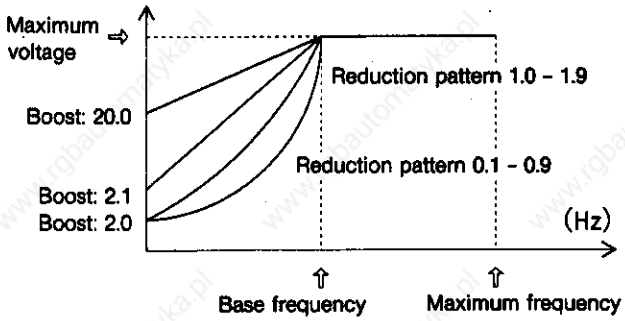
Setting range	Setting units
0.01 - 9.99s	0.01s
10.0 - 99.9s	0.1s
100 - 999s	1s
1000 - 3600s	10s

* The deceleration time only can be set starting from 0.00.
  0.00: Coasting

* For S-curve acceleration and deceleration, refer to Function No. 73 on page 39.

Torque boost 1 TRQ BOOST 1

- You can switch between automatic torque boost and manual torque boost mode, and adjust the torque boost value in manual mode.
  - 0.0: Torque boost is automatically controlled to compensate for the primary resistance of the motor.
  - 0.1 - 20.0: The torque boost can be set according to the graph below.



Fine adjustment is possible by setting the units as follows:
Strong: 1
Weak: 0

Fine adjustment is possible between □ .0-□ .9.

08

09

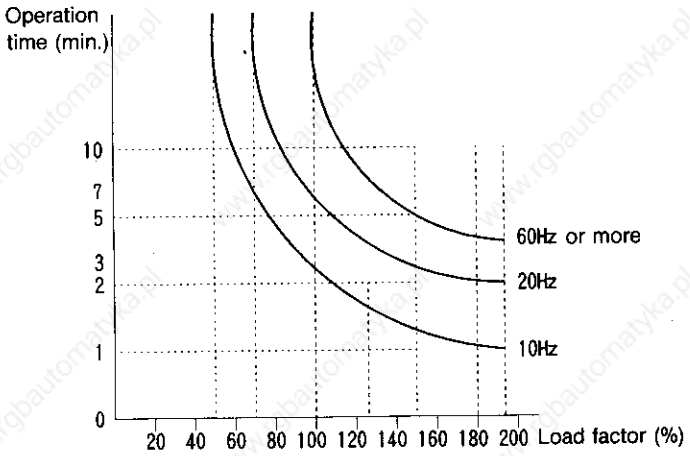
Electronic thermal overload relay (Select)
ELECTRN OL
Electronic thermal overload relay (Level)
OL LEVEL

- Selects whether the electronic thermal overload relay is active or inactive, what kind of motor is being used, and what the operation level is.

Select: 0: Inactive
1: Active (standard motor)
2: Active (Fuji inverter motor)

Level: The setting value is by current. The setting range is within 20 – 105% of the inverter rating.

Electronic thermal overload relay characteristics



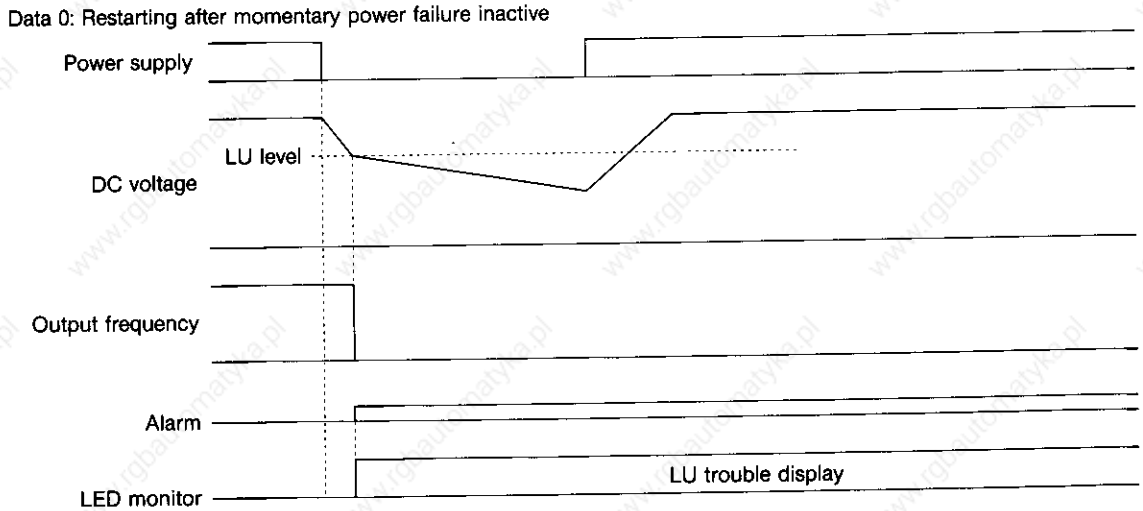
10

Restart after momentary power failure
RESTART

- This function sets the operation in the case of a momentary power failure and the power recovery time after a failure occurs.

0: Inactive (immediate LU trip)
1: Inactive (LU trip after recovery)
2: Active (Smooth recovery, for high inertial loads and normal loads)
3: Active (Restarting at frequency at time of power failure, for normal loads)
4: Active (Restarting at starting frequency, for low inertial loads)

Data 0: Restarting after momentary power failure inactive



■ **Example of setting:** Setting for 3.7 kW inverter

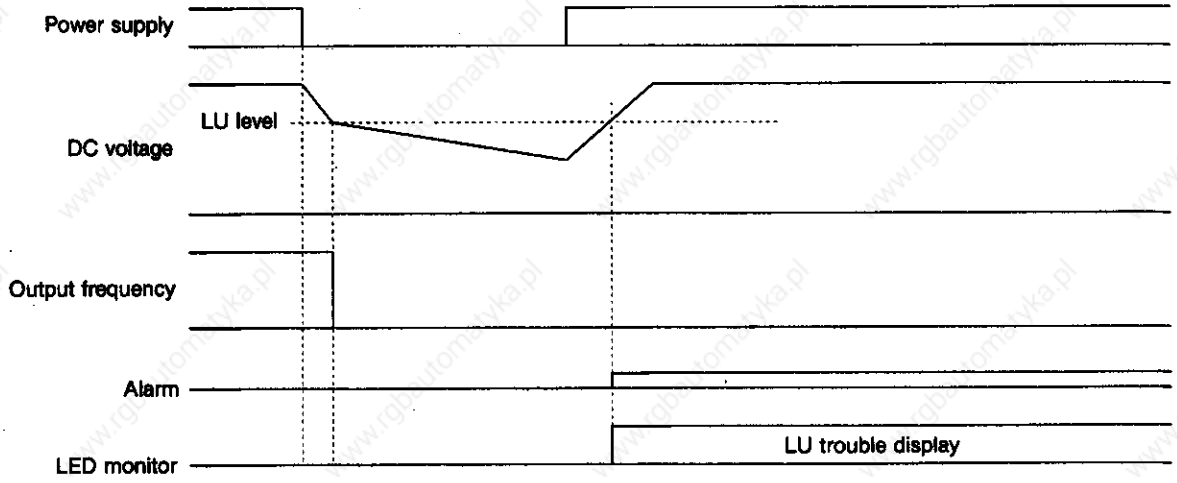
The rated current for a 3.7 kW inverter is 17 A. If the setting range is 20 – 105% of the rated current, then the setting range becomes 3.4 – 17.9 A

* The possible setting range is automatically restricted by the inverter capacity.

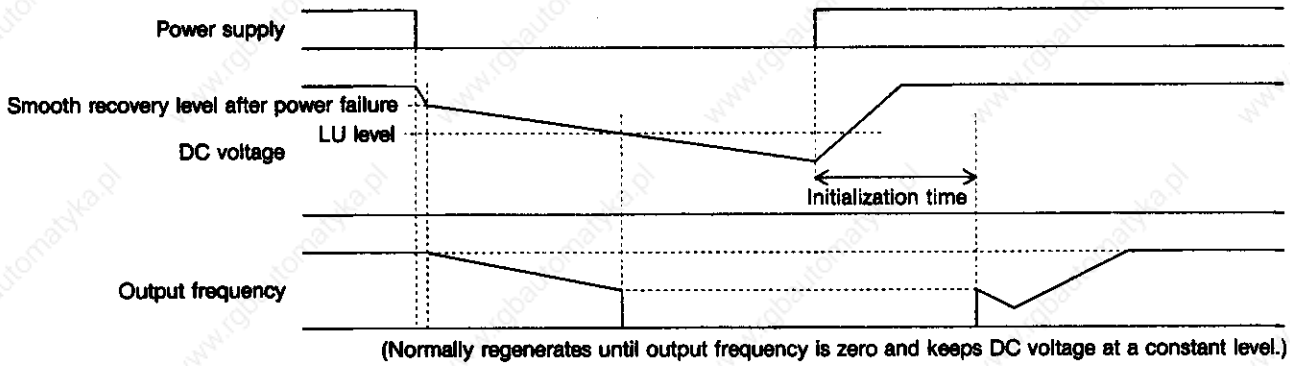
- The setting precisions are indicated in the table below.

Setting range	Setting units
0.01 – 9.99A	0.01A
10.0 – 99.9A	0.1A
100 – 999A	1A
1000 – 3600A	10A

Data 1: Restarting after momentary power failure inactive

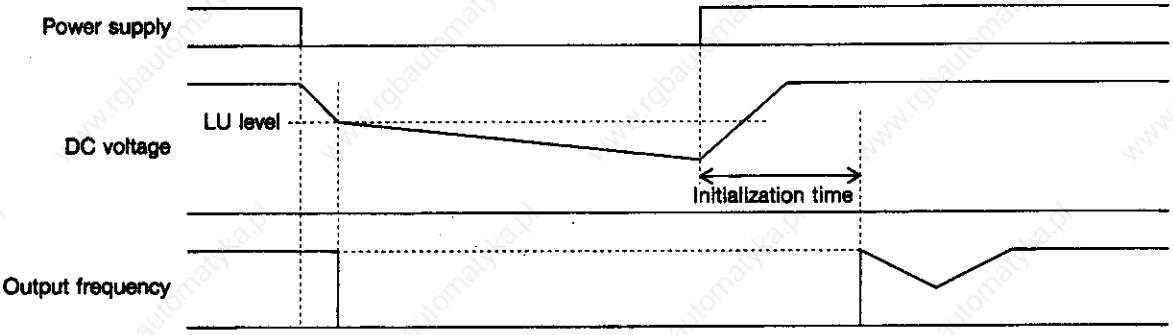


Data 2: Restarting after momentary power failure active (Smooth recovery)

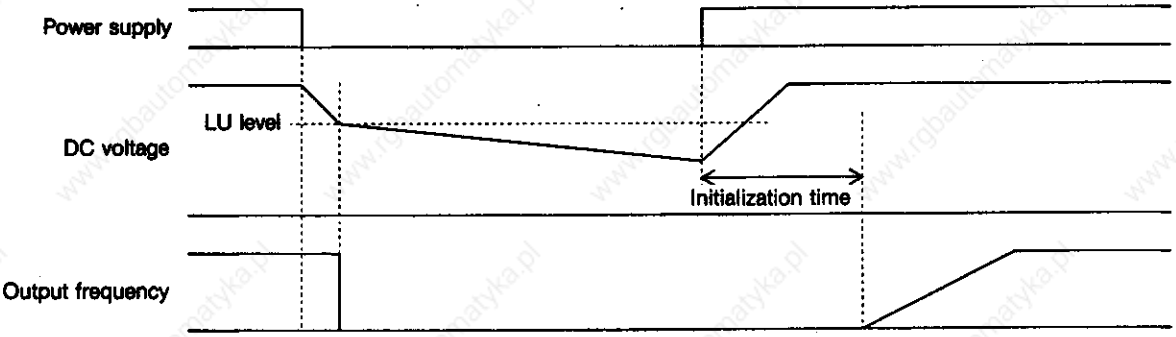


(Normally regenerates until output frequency is zero and keeps DC voltage at a constant level.)

Data 3: Restarting after momentary power failure active (At frequency at time of power failure)



Data 4: Restarting after momentary power failure active (At starting frequency)

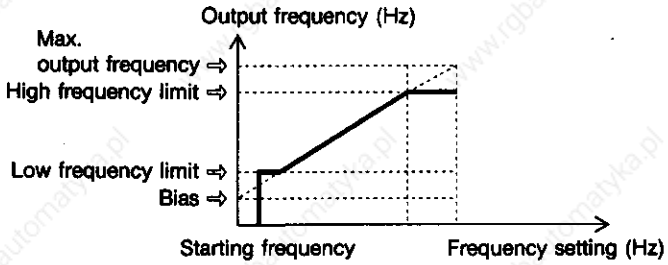


Frequency limiter (High)
H LIMITER
Frequency limiter (Low)
L LIMITER

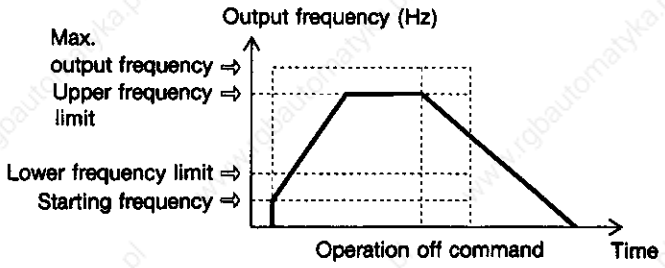
- The high and low limits for the output frequency can be set within a range of 0 - 400 (120) Hz.

■ Explanation

Relationship between frequency setting and output frequency during operation



Relationship between frequency setting and output frequency during acceleration and deceleration

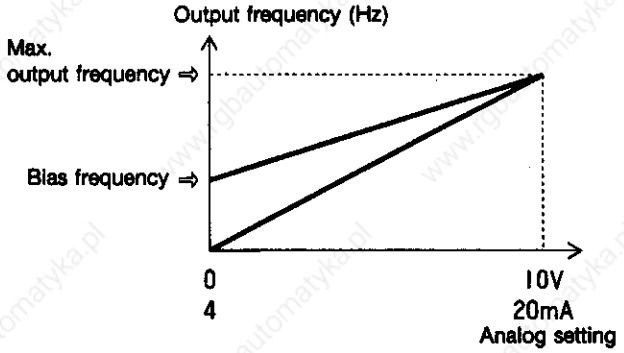


■ Example of setting:

Lower limit > upper limit ..... upper limit has priority
Starting frequency > frequency setting
..... inverter stops
Frequency setting > upper limit
..... operates at upper limit

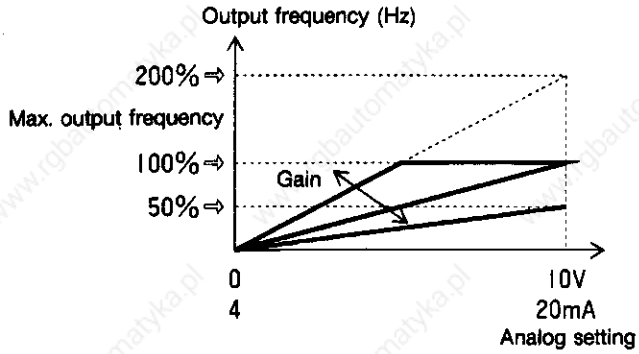
Bias frequency
FREQ BIAS

- This function generates the output frequency by adding a bias frequency to the analog frequency setting. Setting range: 0 - 400 (120) Hz
  The analog frequency setting can be either voltage input (12) or current input (C1)



Gain for frequency setting signal
FREQ GAIN

- This is set as a percentage of the output corresponding to the analog frequency setting.
  Analog frequency setting =
  Voltage input (12-11)
  Current input (C1-11)



Torque limiter (Driving)
DRV TORQUE
Torque limiter (Braking)
BRK TORQUE

- This sets the limits for the driving torque and braking torque.
  (Setting range for driving: 20 - 180, 999 [no limit])
  (Setting range for braking: 0 (limitation of regeneration power), 20 - 180, 999 [no limits])
- The output frequency is lowered at the driving side and the output frequency is raised at the braking side so that the torque doesn't increase above the set value.
  However, the upper limit is +5 Hz with respect to the frequency setting.

DC brake (Starting frequency)
DC BRK Hz
DC brake (Braking level)
DC BRK LVL
DC brake (Braking time)
DC BRK t

- Starting frequency:
  This sets the frequency at which to start DC brake operation during deceleration.
  Setting range: 0.0 - 60.0 Hz
  * If set to 0.0, operation will start at the minimum frequency (0.20 Hz).
- Braking level:
  This adjusts the DC brake output.
  Setting range: 0 - 100%
- Braking time:
  This sets the operation time for the DC brake.
  Setting range: 0.0 - 30.0 s
  * If set to 0.0, the motor will decelerate to the DC brake starting frequency, and will then coast to a stop.

Multistep frequency setting value 1
MULTI Hz-1

Multistep frequency setting value 2
MULTI Hz-2

Multistep frequency setting value 3
MULTI Hz-3

Multistep frequency setting value 4
MULTI Hz-4

Multistep frequency setting value 5
MULTI Hz-5

Multistep frequency setting value 6
MULTI Hz-6

Multistep frequency setting value 7
MULTI Hz-7

- Multistep frequencies 1 to 7 can be set by setting control terminals X1, X2 and X3 to on.
- These settings are valid if X1, X2 and X3 have been defined using Function 32: X1-X5 terminal function select (that is, if terminals X1, X2 and X3 are all set for multistep frequencies).
  However, if the definitions for X1, X2 and X3 have been changed using Function 32: X1-X5 terminal function select (if they have been changed to settings other than multistep frequencies), these settings will remain off.
  * Settings which are higher than the maximum frequency are possible, but the frequency will only go as high as the maximum during operation.

X1	X2	X3	Frequency setting
OFF	OFF	OFF	Setting according to F00: Frequency command
ON	OFF	OFF	Multistep frequency setting 1
OFF	ON	OFF	Multistep frequency setting 2
ON	ON	OFF	Multistep frequency setting 3
OFF	OFF	ON	Multistep frequency setting 4
ON	OFF	ON	Multistep frequency setting 5
OFF	ON	ON	Multistep frequency setting 6
ON	ON	ON	Multistep frequency setting 7

  * These settings are also used as the speed settings when F65: Pattern operation has been selected. During pattern operation, multistep operation has priority if control terminals X1, X2 and X3 have been set to on.

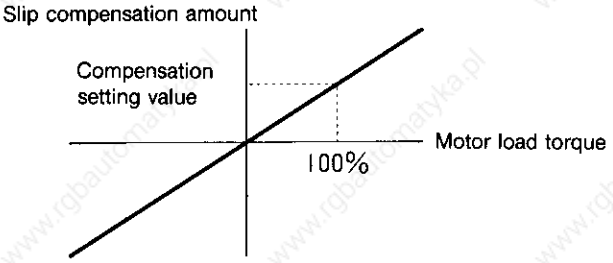
Electronic thermal overload relay (for braking resistor)
DBR OL

- This function monitors the frequency of operation and continuous operation time for the braking resistor and trips operation when necessary to protect the braking resistor.

0: Inactive
1: Active (for internal braking resistor)
2: Inactive
* Braking resistors of the inverter rated at 11 kW or higher are controlled by the optional braking unit, and so they are not affected by this function. Therefore, the data is fixed at "0" for the inverter rated 11 kw or above.

Slip compensation control
SLIP COMP

- This sets the rated compensation frequency for slip compensation. The setting range is -9.9 to 5.0. ("0" means no compensation.)



(If a negative value is set, drooping characteristics can be obtained.)

■ **Explanation:** What is slip compensation control?

When the motor load becomes great, it tends to slow down the rotation speed of the motor. Slip compensation regulates the frequency to match this drop in rotation speed in order to maintain the motor rotation speed at a constant level.

Torque vector control
TRQ VECTOR

- This sets whether torque vector control is active or not.
  0: Inactive
  1: Active

■ **Explanation:** What is torque vector control?

In order to get the maximum amount of motor torque under a variety of operation conditions, the output torque is accurately calculated in accordance with the load conditions and the voltage vector are controlled to the optimum values based on the result of calculation. Torque vector control can only be used for a single motor with the same or lower rating than the inverter. For further details, refer to page 42.

Number of motor poles
MTR POLES

- This sets the number of poles for the motor being used.
- This setting should be made so that the synchronized rotation speed of the motor will be displayed properly.

Function block (32 - 41)
■ 32-41 ■

- 0: Function codes 32 to 41 are not displayed
- 1: Function codes 32 to 41 are displayed

X1 - X5 terminal function select
X1-X5 FUNC

These settings are only changeable if F31 "Function block (32 - 41) selection" has been set to "1".

- This sets the functions for input terminals X1 to X5.

Data	X1 · X2	X3	X4	X5	(Setting range) 0000-2222

	Data 0	Data 1	Data 2
X1 X2	Multistep frequency setting	UP/DOWN control (Initial value = 0)	UP/DOWN control (Initial value = previous value)
X3		Change over operation from line to inverter (for 50 Hz line)	Change over operation from line to inverter (for 60 Hz line)
X4	Acceleration/ deceleration time selection Acceleration (3 steps) Deceleration (3 steps)	Current input selection	DC brake command
X5		2nd motor selection	Data protection

■ UP/DOWN control

Increasing and decreasing the output frequency is made possible by the signals from terminals X1 and X2. However, this key changes the frequency between the minimum and maximum frequency, and does not change the direction of rotation.
If the frequency setting is below the starting frequency, the inverter will not operate. When X1 is continuously on, the frequency setting rises. The output frequency is lowered by the signal from X2.
If the frequency is set to below the minimum frequency, the inverter will stop at the point where the frequency command becomes lower than the minimum frequency. The direction of rotation is determined by the FWD/REV terminals on the terminal block.

Data 1	The initial value for the restarting time after an step command is set to zero. The restarting time after a momentary power failure is also set to zero.
Data 2	The initial value for the restarting time after stop command is set back to the value before the stop. The restarting time after a momentary power failure is set back to the value before the power failure occurred.

■ Changing over operation from line to inverter

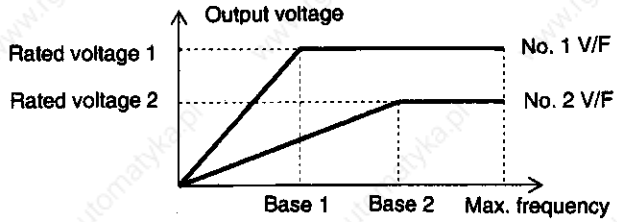
This command is used to switch motor power source from a commercial power over to inverter output.
If the inverter's frequency setting is "0", the inverter outputs 50 Hz or 60 Hz momentarily, and then decelerates to a stop.
The timing for signal input to terminal X3 and the switching of the motor power supply from commercial power to inverter can be simultaneous.

■ Current input selection

If "1" is selected for F00: Function command and current input has been selected, the analog voltage input (terminal 12) will be invalid and the analog current input (terminal C1) will become valid.

■ 2nd motor selection

2nd motor selection is used to switch one motor to the other when a single inverter is driving two motors which have different V/F pattern each other.
However, the 2nd motor selection function is limited function. i.e., The 2nd motor capacity should be either the same or lower than the primary motor.



① Function changes
If 2nd motor selection is made, the following functions will be changed, and the V/F and boost patterns will also be changed. Moreover, the current detection gain will be changed according to the motor rated current and current calculations is done to adjust all data to optimum values.

Function changes	Setting range
F07 Torque boost 1 → F41 Torque boost 2	0.1 - 20.0
F03 Base frequency 1 → F39 Base frequency 2	50 - 400
F04 Rated voltage 1 → F40 Rated voltage 2	80 -230 320 - 480
F87 Rated current → F89 Rated current	0.01 - 2000

② Functions which are rendered invalid
Since the inverter does not have the motor constant of the No. 2 motor registered, the following controls will not be available.

- Torque vector: torque vector control is set to inactive.
- Automatic torque boost: Inactive (manual only)
- Torque limiter is canceled
- Limitation of regeneration power is canceled
- Operation after momentary power failure: Restarting after momentary power failure is active
- Electronic thermal overload relay: 1st motor only

③ Functions which suffer drops in performance
Since the inverter does not have the motor constant for the No. 2 motor registered, the motor constant for the No. 1 motor will be used. The following functions will become poor in performance as the result.

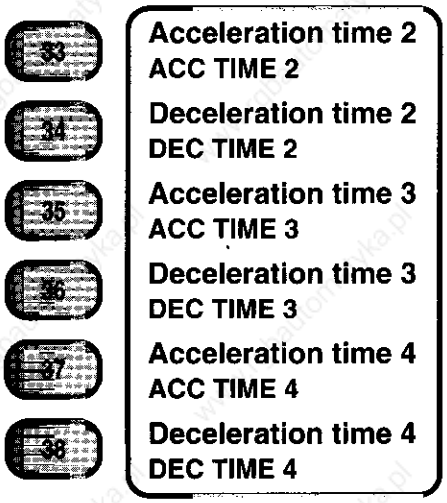
- Torque calculation output (display): large degree of effor
- Energy saving: Insufficient energy saving results, insufficient starting torque
- Slip compensation: Excessive or insufficient compensation

■ DC braking command

DC braking operates at the DC braking start frequency or lower while the motor is decelerating or stopped. The braking is on while the braking command is on. If the inverter has an operation command from outside, such operation command has the priority.

■ Data protection

When this function is on, function data can be changed. When off, function data cannot be changed.



This function is only changeable if F31 "Function block (32 - 41) selection" has been set to "1".

- This function is used when you want to change the acceleration and/or deceleration times to multistep operation.
  If X4 and X5 have been set to "0" using F32 "X1 - X5 terminal function select", F33 - F38 are valid. If F32 has been used to set X4 and X5 to a setting other than "0", any signals which are input will be invalid.
  The input from X1 - X5 during acceleration and deceleration can also be changed to polygonal line shape.

X4	X5	Acceleration and deceleration time settings
OFF	OFF	Acceleration time 1/Deceleration time 1
ON	OFF	Acceleration time 2/Deceleration time 2
OFF	ON	Acceleration time 3/Deceleration time 3
ON	ON	Acceleration time 4/Deceleration time 4

Setting range:

- Acceleration time: 0.01 - 3600 s
- Deceleration time: 0.00 - 3600 s (0.00: Coasting)

This function is only changeable if F31 "Function block (32 - 41) selection" has been set to "1".

- This function sets the frequency so that the output V/F pattern voltage is kept at a constant level when 2nd motor selection has been made.

This function is only changeable if F31 "Function block (32 - 41) selection" has been set to "1".

- This function sets the maximum output voltage for the inverter when 2nd motor selection has been made.
  A voltage output cannot be higher than the input power supply voltage.

This function is only changeable if F31 "Function block (32 - 41) selection" has been set to "1".

- This function sets the torque boost (manual) when 2nd motor selection has been made. Automatic torque boost cannot be selected at this time.
  * For details on torque boost, refer to "Torque boost 1" on page 28.

- 0: Function codes 43 to 51 are not displayed
  1: Function codes 43 to 51 are displayed

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".
This function sets the pulse frequency which is output from the FMP terminal. (The setting is made by the following formula.)
FMP frequency =
output frequency × pulse rate multiplier (6 to 100)
The upper limit is 6 kHz.

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".
This function adjusts the DC voltage output from the FMP terminal.

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".
This function adjusts the DC voltage output from the FMA terminal.
The voltage level can be adjusted within the following range when the item selected by F46 is at the maximum level (100%).
100% = 6.5 - 10.3 V DC

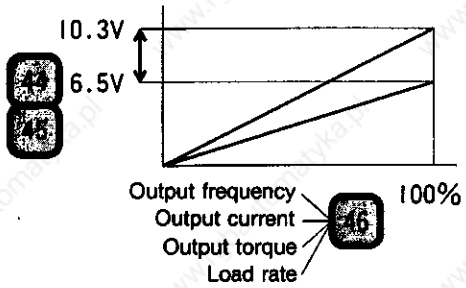
FMA terminal (Function)
FMA FUNC

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".

This function is used to select one parameter you would like to monitor at the output of FMA terminal out of the following parameters.

Data	Object	Meaning of 100%
0	Output frequency	Maximum frequency
1	Output current	Inverter rated current × 2.0
2	Output torque	Rated torque × 2.0
3	Load rate	Rated load × 2.0

■ Explanation



Y1 - Y5 terminal function
Y1-Y5 FUNC

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".
This function is used to select the output terminal function for terminals Y1 to Y5 from the table below. The setting can be made for each terminal individually. The same output function can also be assigned to two different terminals at the same time.

Data	Output terminal function	Symbol
0	Inverter running	RUN
1	Frequency equivalence signal (refer to F48)	FAR
2	Frequency level detection (refer to F49 and F50)	FDT
3	Overload early warning (refer to F51)	OL
4	Under voltage detection	LU
5	Keypad operation mode	
6	Torque limiting	
7	Inverter stopping	STP
8	Auto-restart mode	RES
9	Auto-reset mode	
A	(Not available)	
B	(Not available)	
C	Time-up signal (100-ms pulse) at pattern operation	
D	Cycle completion signal (100-ms pulse) at pattern operation	
E	Stage No. indication signal (3-bit signal) at pattern operation (uses three output terminals Y3, Y4 and Y5)	
F	Cause of trip signal (4-bit signal) at alarm trip mode (uses four output terminals Y2, Y3, Y4 and Y5)	

■ Explanation

Y1: Inverter running
Y2: Overload early warning
Y3 - Y5: Stage indication signal

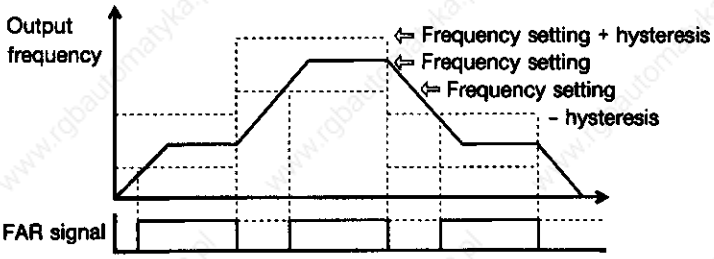
03EEE →

0	3	E	E	E
Y1	Y2	Y3	Y4	Y5

The relationship between Y2 - Y5 and trip causes when data has been selected is shown in Table 11-1-2 (refer to page 47).

FAR function signal (Hysteresis)
FAR HYSTR

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".
- This function sets the FAR signal hysteresis in steps of 0.1 Hz.



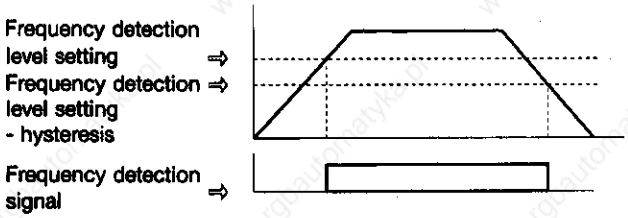
FDT function signal (Level)
FDT LEVEL

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".
- This function sets the frequency detection signal level in steps of 1 Hz.

FDT function signal (Hysteresis)
FDT HYSTR

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".
- This function sets the hysteresis for the frequency detection signal (FDT) in steps of 0.1 Hz.

■ Explanation



51 OL function signal (Level) OL WARNING

This function is only changeable if F42 "Function block (43 - 51) selection" has been set to "1".

- This function sets the alarm level for the motor overload. Because it has the same inverse time characteristic as the electronic thermal overload relay, it is possible to use it as an overload early warning by setting the value lower than the electronic thermal overload relay level setting (F09).

  * For details of settings, refer to F09 "Electronic thermal overload relay" on page 29.

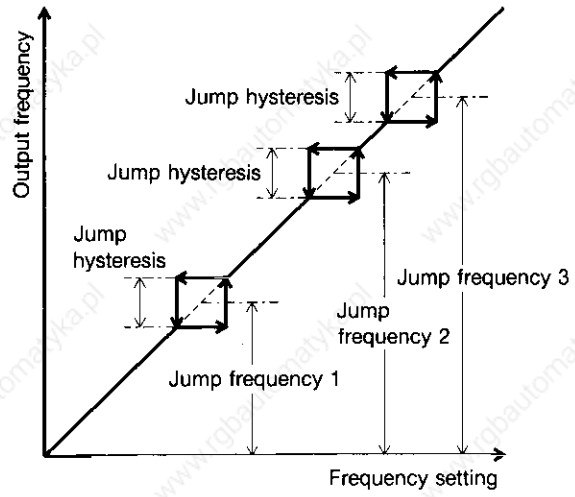
52 Function block (53 - 59) selection ■ 53-59 ■

- 0: Function codes 53 to 59 are not displayed
  1: Function codes 53 to 59 are displayed

53 Jump frequency 1 JUMP Hz 1
54 Jump frequency 2 JUMP Hz 2
55 Jump frequency 3 JUMP Hz 3
56 Jump frequency (Hysteresis) JUMP HYSTR

This function is only changeable if F52 "Function block (53 - 59) selection" has been set to "1".

- The midpoints for the jump frequency values can be set in 1 Hz step.
  3 jump points can be set.
- The jump hysteresis can be set in 1 Hz step.



Even if jump frequencies have been set, they will be omitted during acceleration and deceleration.
Set so that the space between jump frequencies is larger than the jump hysteresis.

- If a jump frequency is set to zero, the jump function will become inactive.

57 Starting frequency START Hz

This function is only changeable if F52 "Function block (53 - 59) selection" has been set to "1".

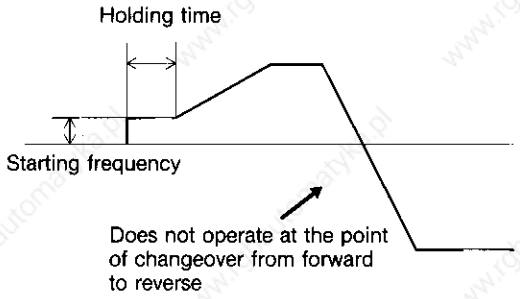
- This function sets the starting frequency in 0.1 Hz step (minimum setting is 0.2 Hz).

58 Starting frequency (Holding time) HOLDING t

This function is only changeable if F52 "Function block (53 - 59) selection" has been set to "1".

- This function sets the holding time for the starting frequency in 0.1 second step for meter start (maximum setting is 10 seconds). This time is not included in the acceleration time.

■ Explanation



This function also operates when pattern operation has been selected using F65, and includes the timer time.

59 Frequency setting signal filter FILTER

This function is only changeable if F52 "Function block (53 - 59) selection" has been set to "1".

- This function is used to set the time constant for the input filter in order to eliminate the effects of noise included in the analog setting signal (voltage and current commands). Settings can be made in 0.01 second step.
  If the time constant setting is too long, the compliance to analog commands will become poor.

60 Function block (61 - 79) selection
■ 61-79 ■

- 0: Function codes 61 to 79 are not displayed
- 1: Function codes 61 to 79 are displayed

61 LED digital monitor selection 1
LED MNTR 1

62 LED digital monitor selection 2
LED MNTR 2

These functions are only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- These functions are used to select which information is displayed on the LED monitor of the keypad panel.
  (The information on the display is different by mode, i.e. running mode, stop mode and frequency setting mode.) F62 is used to select the display information in stop mode.

	F62=0				F62=1
F61	Running	Stopping	Frequency setting	Units	Stopping
0	Output frequency	Frequency setting	Frequency setting	Hz	Output frequency
1	Output current		Frequency setting	A Hz	Output current
2	Output voltage		Frequency setting	V Hz	Output voltage
3	Synchronous rotation speed	Set synchronous rotation speed	Set synchronous rotation speed	r/min	Synchronous rotation speed
4	Line speed	Set line speed	Set line speed	m/min	Line speed
5	Machine rotating speed	Set machine rotating speed	Set machine rotating speed	r/min	Machine rotating speed
6	Drive torque limiter setting		Frequency setting	% Hz	Torque setting
7	Braking torque limiter setting		Frequency setting	% Hz	
8	Calculated torque		Frequency setting	% Hz	Calculated torque

63 Coefficient for machine speed and line speed
SPEED COEF

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- This function is used to set the coefficient for machine speed and line speed if you want the line speed and machine speed to be displayed on the LED monitor. The calculation is carried out in 0.01 step based on the formula below.

  Line speed or machine speed displayed
  = Frequency × Speed coefficient

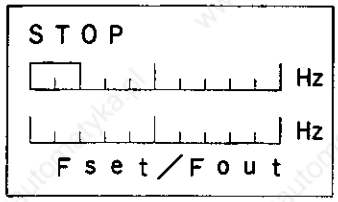
64 LCD monitor selection
LCD MNTR

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

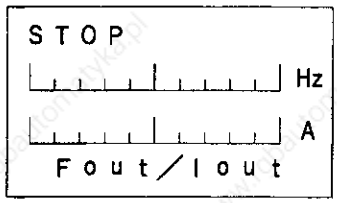
- This function is used to select which information is displayed on the LCD monitor of the keypad panel.

  0: Running condition and operation guidance
  The picture will switch to the operation monitor screen described on page 19.

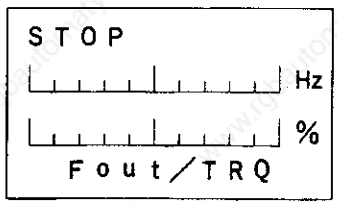
1: Frequency setting/output frequency



2: Output frequency/output current



3: Output frequency/output torque



65 **Pattern operation (Mode select)**
PATTERN

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- This function is used to select the pattern operation from the following choices.

  0: Inactive
  1: Mono cycle
  2: Continuous cyclic
  3: Mono cycle with continuous final speed

66 **Pattern operation (Stage 1)**
STAGE 1

67 **Pattern operation (Stage 2)**
STAGE 2

68 **Pattern operation (Stage 3)**
STAGE 3

69 **Pattern operation (Stage 4)**
STAGE 4

70 **Pattern operation (Stage 5)**
STAGE 5

71 **Pattern operation (Stage 6)**
STAGE 6

72 **Pattern operation (Stage 7)**
STAGE 7

These functions are only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- The frequencies for pattern operation are assigned as shown below.

  1st stage = Setting for multistep frequency 1 = (F20)
  2nd stage = Setting for multistep frequency 2 = (F21)
  ⋮ ⋮
  7th stage = Setting for multistep frequency 7 = (F26)

- For each stage in pattern operation
  Select forward or reverse operation and set acceleration and deceleration time by the following combinations.

  F1: Acceleration/deceleration time 1 setting for forward operation (= F05, F06)
  F2: Acceleration/deceleration time 2 setting for forward operation (= F33, F34)
  F3: Acceleration/deceleration time 3 setting for forward operation (= F35, F36)
  F4: Acceleration/deceleration time 4 setting for forward operation (= F37, F38)
  R1: Acceleration/deceleration time 1 setting for reverse operation (= F05, F06)
  R2: Acceleration/deceleration time 2 setting for reverse operation (= F33, F34)
  R3: Acceleration/deceleration time 3 setting for reverse operation (= F35, F36)
  R4: Acceleration/deceleration time 4 setting for reverse operation (= F37, F38)

- The final stop will be after the deceleration time set by means of F06. In the event of a forced stop, operation will stop at the end of the deceleration time for the pattern operation currently being used.
- Settings for each stage
  Set by means of the timer setting (0.00 - 3600 seconds) and the above symbols.

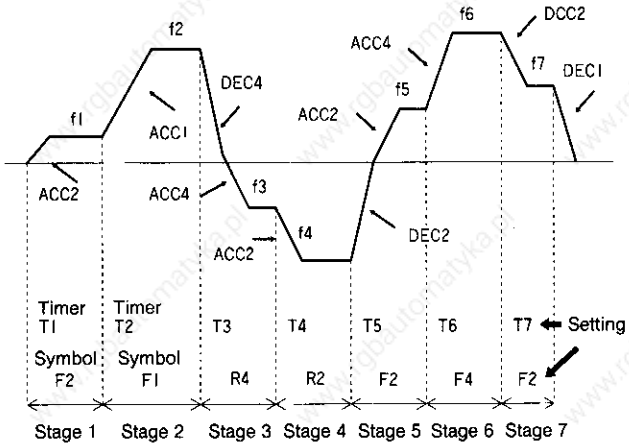
  Timer setting : Symbol

  If the timer is set to "0.00", that stage sill be skipped.

■ Explanation

The following example shows a setting of [T1:F2, T3:R4, T4:R2 ...] for each stage.

If F65 = 1

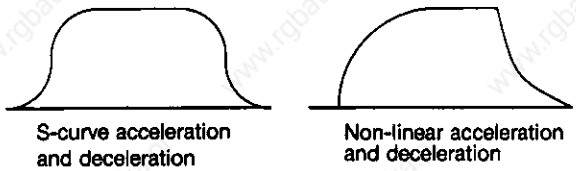


When making running and stopping using the RUN and STOP keys, the FWD and REV terminals or the BX terminals, the stop command will be treated as a pause command, and the timer will not increment.
When a restart command is input, the rest of the operation will continue at the original speed.
To clear pattern operation before it has finished, press the RESET key.

Acceleration/deceleration pattern (Mode select)
ACC PTN

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

0: Linear acceleration and deceleration
1: S-curve acceleration and deceleration
2: Non-linear acceleration and deceleration (for variable torque load)

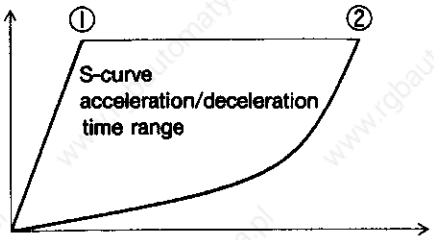


■ S-curve acceleration and deceleration

During frequency setting, this makes the changes in the output frequency smooth, producing jog-free acceleration and deceleration. However, the possible range for S-curve acceleration and deceleration is restricted to the following.

① $\dfrac{\text{Maximum frequency [Hz]}}{\text{Acceleration/deceleration time [s]}} < 1896$

② $\dfrac{(\text{Acceleration/deceleration time [s]})^2}{\text{Maximum frequency [Hz]}} < 700$



■ Non-linear acceleration and deceleration

This is used for acceleration and deceleration of a variable torque load such as a fan. Non-linear acceleration and deceleration are suitable for maximum frequencies of 60 Hz or less.

Series brake motor driving
SERIES BRK

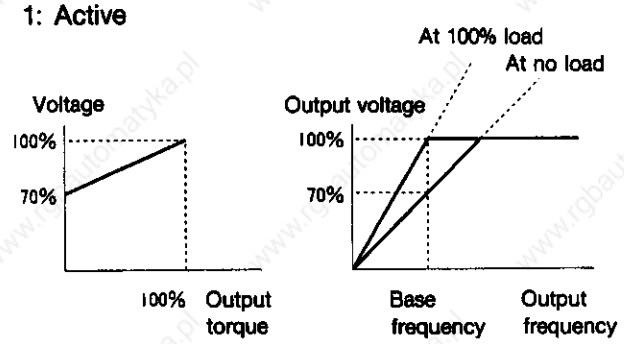
● Not available

Energy-saving operation
ENERGY SAV

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

● This function automatically weakens the V/F pattern during light load operation, reduces the energizing losses and motor losses.

0: Inactive
1: Active



● This function is inactive during acceleration and deceleration.

76 Reverse phase sequence lock REV LOCK

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- The motor will only run in the forward direction, even if a reverse direction command or a reverse operation analog command (option) is input. In the case of a command from terminal, the reverse command is ignored, but in the case of the analog command, the result is the same as a frequency setting 0 Hz.
  In addition, during pattern operation, a reverse command will cause operation to stop (0.00 Hz) but the timer works during this mode.

77 Data initialization DATA INIT

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- 0: Inactive
  1: Return to factory setting value
  If "1" is set and then the key is pressed, the data for all functions will be initialized (reset back to the factory setting values).

78 Language (JPN/ENG) LANGUAGE

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- This function is used to change the display on the LCD of the keypad panel over to Japanese or to English.

  0: Japanese
  1: English

79 LCD Monitor (brightness) BRIGHTNESS

This function is only changeable if F60 "Function block (61 - 79) selection" has been set to "1".

- This function is used to adjust the brightness of the LCD of the keypad.

  0 (bright) - 10 (dark)

80 Function block (81 - 94) selection ■ 82-94 ■

- 0: Function codes 81 to 94 are not displayed
- 1: Function codes 81 to 94 are displayed

81 Carrier frequency (motor sound) MTR SOUND

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- This function is used to adjust the carrier frequency between "high" and "low frequency" to reduce the noise generated by the motor.

  0 (low carrier frequency) - 10 (high carrier frequency)

82 Auto-restart (Restart time) RESTART t

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- This function sets the time duration between the input power restoration and the output power restoration when F10 "Restart after momentary power failure" is active and a momentary power failure occurs.

83 Auto-restart (Frequency fall rate) FALL RATE

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

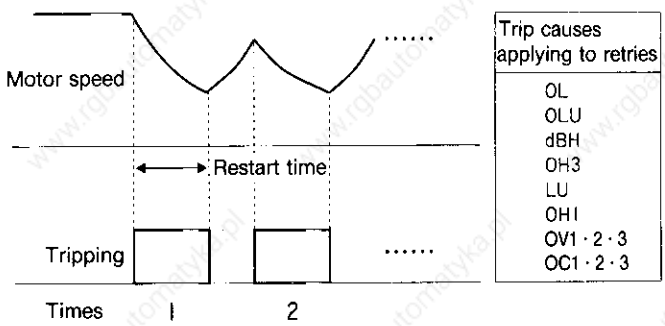
- This function sets the deceleration rate to pull in motor when F10 "Restart after momentary power failure" is active and a momentary power failure occurs.
  * 0: Deceleration occurs for the set deceleration time
  Other setting:Deceleration occurs for the value set in Hz/s.

84 Auto-reset (Times) AUTO-RESET
85 Auto-reset (Reset interval) RESET INT

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- This function is used to set the maximum number of retries and the reset interval when a trip occurs.
  If normal operation is restored through a retry attempt, the cause of the trip is not recorded.

■ Explanation



Motor 1 (Capacity)
MOTOR CAP
Motor 1 (Rated current)
MOTOR 1-Ir
Motor 1 (No-load current)
MOTOR 1-Io

These functions are only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- These functions are used to set the capacity, rated current (A) and no-load current (A) for the motor which is connected to the inverter.

  R1 and X1 for a standard Fuji motor are selected automatically by setting F86 "Motor 1 (Capacity)".
  "F86" :
  0: 1-frame up capacity for nominal applied motor
  1: Standard capacity for nominal applied motor
  2: 1-frame down capacity for nominal applied motor
  3: 2-frame down capacity for nominal applied motor

Motor 2 (Rated current)
MOTOR 2-Ir

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- This function is used to set the rated current (A) for a second motor when the No. 2 motor selection has been made.

Motor 1 Impedance (Tuning)
TUNING

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- 0: Inactive
  1: Active

  This function is used to tune the inverter to the primary resistance and leakage reactance of the motor.
  After the motor and inverter have been connected correctly, if the function data is set to "1" during stop mode and the F/D key is then pressed, tuning will start and will be completed in 10 seconds. The results of tuning (%R1 and %X) can be confirmed using F91 and F92.

Motor 1 impedance (%R1 setting)
%R1 SET

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- This function manually sets the primary resistance of the motor. The data can be changed automatically by auto tuning using F90, or by setting the motor capacity.

■ **Calculation method for %R1**

R1, cable R: Ω

$$\%R1 = \frac{R1 + \text{cable } R}{V / (\sqrt{3} \cdot I)} \times 100\ [\%]$$

Motor 1 impedance (%X setting)
%X SET

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- This function manually sets the leakage reactance of the motor. The data can be changed automatically by auto tuning using F90, or by setting the motor capacity.

■ **Calculation method for %X**

X1, cable X: Ω

$$\%X = \frac{X1 + X2 \cdot XM/(X2 + XM) + \text{cable } X}{V / (\sqrt{3} \cdot I)} \times 100\ [\%]$$

Dedicated function for manufacturer 1
DD FUNC 1
Dedicated function for manufacturer 2
DD FUNC 2

These functions are only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

- These function settings should not be changed.

Data protection
DATA PRTC

- 0: Function data can be changed
  1: Function data cannot be changed

  *1) The setting for this function can only be changed using the keypad.

  Push ＞ and ∧ at the same time: data will change from 0 to 1
  Push ＞ and ∨ at the same time: data will change from 1 to 0

■ **Explanation**

Some things to know when using torque vector control (F29)

● If torque vector control is selected, the following values will be changed from those of present settings.

① Rated voltage (F40)
If "0" (free) is set, the following will automatically be applicable:

200-V systems = 200 V/AVR control
400-V systems = 400 V/AVR control

If a value other than "0" is set, the current setting will be applicable.

② Slip compensation control (F28)
If "0.0" (no slip compensation) is set, the slip compensation amount for a standard Fuji motor will be applicable.
If a value other than "0.0" is set, motor will be operated at the slip compensation control amount which is currently set.

③ Torque boost (F07)
Automatic torque boost will be applicable. Thus, any other setting which is different from this will be ignored.

● Conditions for selecting torque vector control

④ Only one motor should be connected to a single inverter.
⑤ The motor used should be a Fuji standard motor with the same or one-size lower capacity than the inverter, or it should be a Fuji inverter motor. (*1)
However, a motor rated at lower than 0.2 kW should not be used.
⑥ The motor should have either 2, 4 or 6 poles.
⑦ The cable connecting the motor and inverter should be within 50 m in length. (*1)
⑧ There should be no filter or reactor connected between the inverter and the motor. (*1)

(*1) If using a motor which is not manufactured by Fuji or if the impedance between the inverter and the motor cannot be ignored, use the auto-tuning function (F90) to find the constant before using torque vector control.
However, it may not be possible to obtain the full performance or tuning may not be possible under some conditions. In such cases, use V/F control (no torque vector control).

10. Maintenance and Inspection

In order that the inverter may provide long periods of trouble-free operation and to prevent future problems, the following items should be inspected at least once between the indicated interval.

10-1 Daily inspection

During operation and charging, check the operation of the inverter visually without removing any covers to confirm there are no abnormalities.
The following points should always be checked.

① Check that the expected level of performance is being obtained (that performance meets specifications).
② Check that the ambient conditions satisfy the specifications.
③ Check that the keypad displays are normal.
④ Check that there are no abnormal noises, vibrations or odors.
⑤ Check that there are no signs of overheating or discoloration.

10-2 Periodic inspection

Before carrying out periodic inspections, stop the inverter, disconnect it completely from the power supply and then take off the front cover.
Inspection shall be carried out according to the items given in the periodic inspection list in Table 10-2-1.

WARNING
The smoothing capacitor will still be charged even after the power supply is turned off, and it takes some time for it to fully discharge. To avoid any danger, wait until the charge lamp has switched off, and then use a circuit tester to check that the voltage has dropped to a safe level (25 V DC or lower) before touching the power supply circuit.

Table 10-2-1 Inspection items

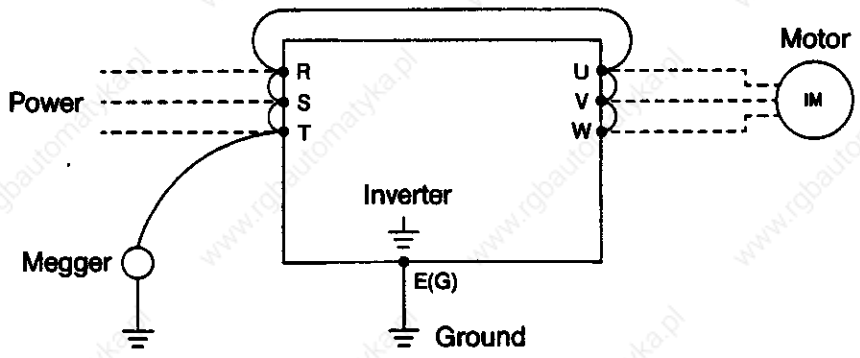
Inspection point	Inspection item	Object of inspection	Correction
Condition	Power source voltage	Within permissible limits*	Adjust the power supply voltage.
	Ambient temperature	Within permissible range (-10°C to 50°C)	After investigating the cause, correct to within the specification limits
	Ambient humidity	Permissible range (20 to 90% RH)	
		Dew condensation / Freezing	
	Vibration	Within permissible limit [5.8m/s² (0.6G) or less]	
Other	Noise	Noise from cooling fan, etc.	Contact the distributor where the unit was purchased.
	Odor	Smell of burning	
	Dust	Dust accumulation on cooling fins, cooling fan Dust accumulation on control board	Cleaning Blow out with compressed air
	Connectors	Loose connectors	Tighten connectors
	Screws	Loose screws	Tighten screws

* 400V series

10-3 Megger test

① When conducting an external circuit megger test, disconnect all inverter terminals making sure to never apply test voltage to the inverter.
② When conducting a megger test on the inverter itself, perform the test only on the main circuit as shown in the diagram below. Do not conduct a megger test on the control circuits.
③ When conducting a continuity test on the control circuits, use a tester (high resistance range type) and not a megger or a buzzer.

Megger Test Outline



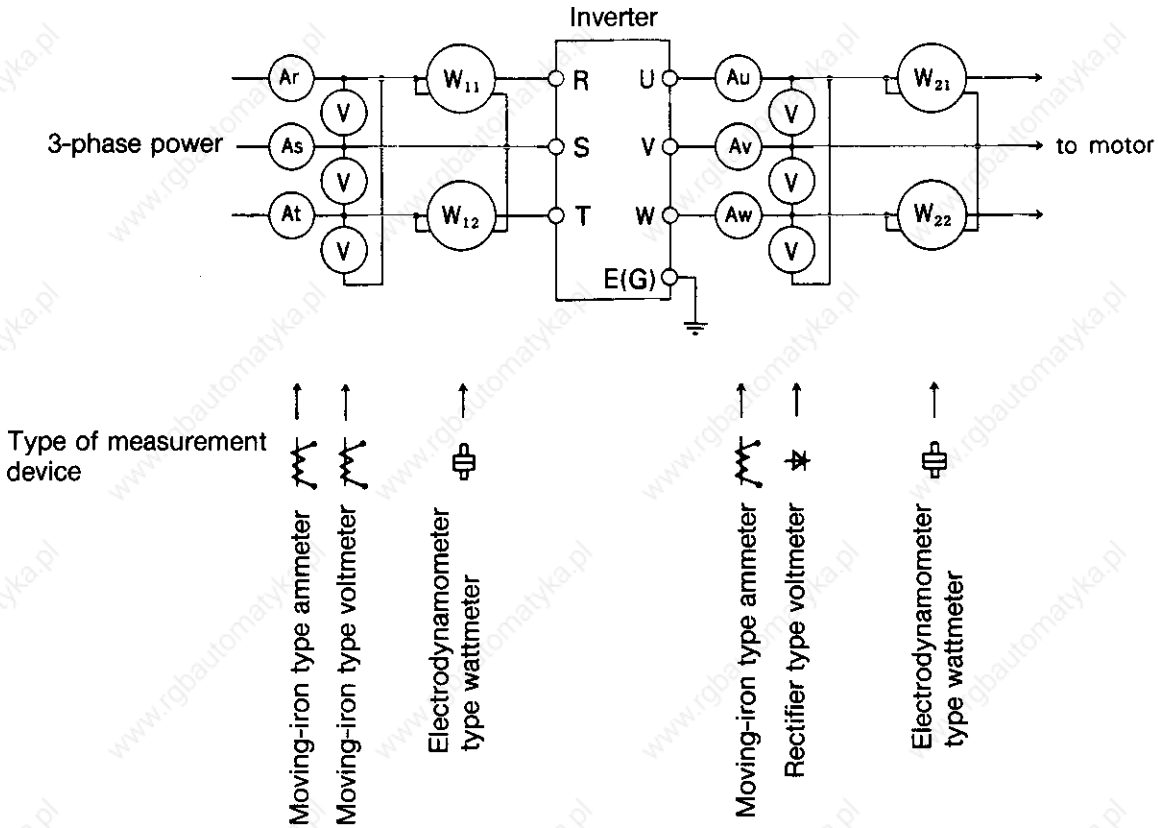
10-4 Measurement points and meters

Since the inverter input/output voltage and current contains high harmonic frequencies, selection of the wrong measuring device can lead to gross miscalculations. When using a CT (current-detection transformer) to measure the current. If the frequency is low the amount of error will be great. For this reason always use a CT with large capacity as much as possible.

Measurement items and types of devices

Item		Simple measurement	Precision measurement
Input	Voltage	Tester	Moving-iron type voltmeter
	Current	Clamp meter	Moving-iron type ammeter
	Power	—	Electrodynamometer type wattmeter
Output	Voltage	Tester	Rectifier type voltmeter
	Current	Clamp meter	Moving-iron type voltmeter
	Power	—	Electrodynamometer type wattmeter

Example of measurement (Locations & Devices)



10-5 Replacement parts

The life of parts used in the inverter will vary according to the type of parts. The life of these parts will also vary according to the environmental conditions installed and the conditions of usage. It is recommended that you use the information in Table 10-5-1 as a guide for parts replacement.

Table 10-5-1 Parts replacement

Part name	Standard replacement interval	Replacement method/ Remarks
Cooling fan	3 years	Replace with new parts
Smoothing capacitor	5 years	Replace with a new part (Determine after inspection)
Aluminum capacitor on printed circuit board	7 years	Replace with a new part (Determine after inspection)
Fuse	10 years	Replace with a new part
Other parts	—	Determine after inspection

11. Troubleshooting

If the protection function acts to trip the inverter (stop output) or if some other abnormality occurs, investigate the cause of the trouble referring to the following explanation.
If you cannot troubleshoot the problem in this way, or if you think the inverter may get damaged, please contact the nearest Fuji sales office or the distributor where you purchased the unit.

11-1 Protective function

When the protective function is activated, the inverter is immediately tripped, the cause of the problem is displayed on the LED monitor and the motor coasts to a stop.
For the detail of the alarm and the displays thereof, please refer to Table 11-1-1.
The trip condition will continue until the tripping conditions is removed and the RESET key is pressed or a reset command is input from the RST terminals of the control circuit terminals.

Table 11-1-1 Detail of alarm and displays thereof

Protective Function	Keypad Panel Display		Protective Operation	
	LED	LCD		
Overcurrent protection	OC1	OC DURING ACC	During acceleration	Operates if overcurrent flows to the motor or the output circuit is shorted and the inverter output current momentarily exceeds the overcurrent detection level.
	OC2	OC DURING DEC	During deceleration	
	OC3	OC AT SET SPD	During steady state operation	
Overvoltage protection	OU1	OV DURING ACC	During acceleration	Operates if the DC voltage in the main circuit exceeds the overvoltage detection level by regenerating power. However, this protection is not possible if excessive voltage (high voltage) is applied by mistake.
	OU2	OV DURING DEC	During deceleration	
	OU3	OV AT SET SPD	During steady state operation	
Undervoltage protection	LU	UNDERVOLTAGE	Operates if the power supply voltage drops and the DC voltage in the main circuit becomes less than the undervoltage detection level. If the restart after momentary power failure mode has been activated, operation will resume automatically when the power is restored. In this case, no signal will be output to the alarm output terminal. If the voltage drops to a level where operation of the inverter control circuit cannot be maintained, all protective functions will be automatically reset.	
Fin overheating	OH1	FIN OVERHEAT	Operates if there is a problem with cooling fan and the temperature of the cooling fin for the rectifying diode and IGBT rises.	
External alarm input	OH2	EXT FAULT	Operates according to the THR signal of control circuit terminal from the alarm contact of external equipment such as a braking unit, braking resistor or electronic thermal overload relay.	
Inverter overheating	OH3	HIGH AMB TEMP	Operates if the air temperature inside of the inverter (principally the control portion) rises too high because of poor air circulation.	
Braking resistor overheating	dbH	DBR OVERHEAT	Operates when the internal braking resistor overheats.	
Motor overload	OL	MOTOR OL	Operates when the motor current (inverter output current) exceeds the electronic thermal overload relay setting (F09). This function can protect a standard 4-pole 3-phase motor. Other motors may not be protected, so check the characteristics of the motor before use. In addition, if using more than one motor, install a separate thermal relay.	
Inverter overload	OLU	INVERTER OL	Operates when the output current exceeds the specified overload current rating.	
Blown fuse	FUS	DC FUSE OPEN	Operates when a fuse blows in the main circuit DC section due to a short circuit in the smoothing capacitor or IGBT circuit. (for only 11 kW or above)	
Memory error	Er1	MEMORY ERROR	Operates when a memory error occurs due to a data writing error, etc.	
Communication error	Er2	KEYPD COM ERROR	Operates when a RUN or STOP command is input from the keypad but the data from keypad and the controller is incorrect, or if a halt in transmission is detected. (*1)	
CPU error	Er3	CPU ERROR	Operates when an error occurs in CPU due to noise, etc.	
	Er4 Er5	—	Error when using optional card.	
Tuning error	Er7	TUNING ERROR	Operates when there is an open circuit or poor contact in the inverter output wiring during automatic tuning.	

(*1) If operating from the control circuit terminals, the inverter continues to operate without an alarm signal, even if "Er2" appears on the display.
When communication is restored, the "Er2" display will be cleared.

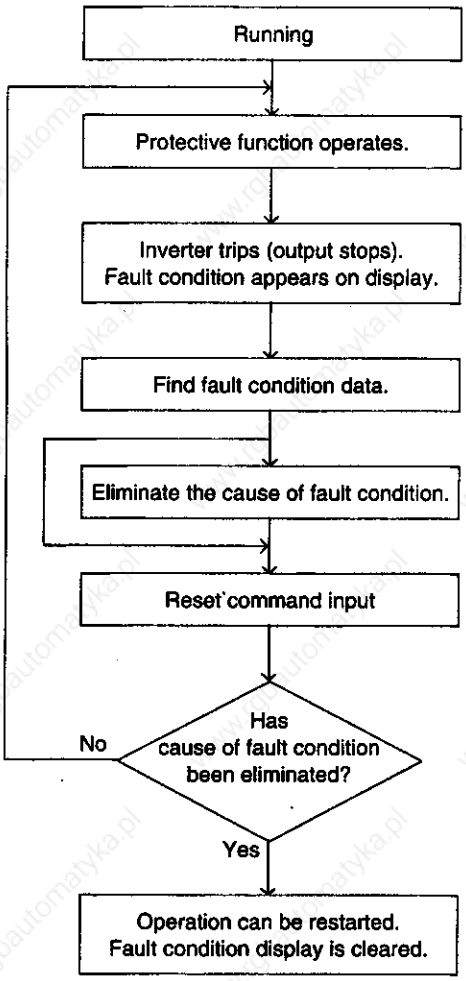


Fig. 11-1-1
Protective function operation and resetting

Table 11-1-2 Fault condition and output terminals (Y2 - Y5)

No.	Fault condition	Open collector output			
		Y2	Y3	Y4	Y5
0	Normal	–	–	–	–
1	OC1	–	–	–	○
2	OC2	–	–	○	–
3	OC3 (EF)	–	–	○	○
4	OU1, OU2, OU3	–	○	–	–
5	LU	–	○	–	○
6	OL	–	○	○	–
7	OLU	–	○	○	○
8	OH1, OH3	○	–	–	–
9	OH2, dbH	○	–	–	○

No.	Fault condition	Open collector output			
		Y2	Y3	Y4	Y5
10	FUS	○	–	○	–
11	Er1, Er3	○	–	○	○
12	Er2	○	○	–	–
13	Er4	○	○	–	○
14	Er5	○	○	○	–
15	Er6, Er7	○	○	○	○

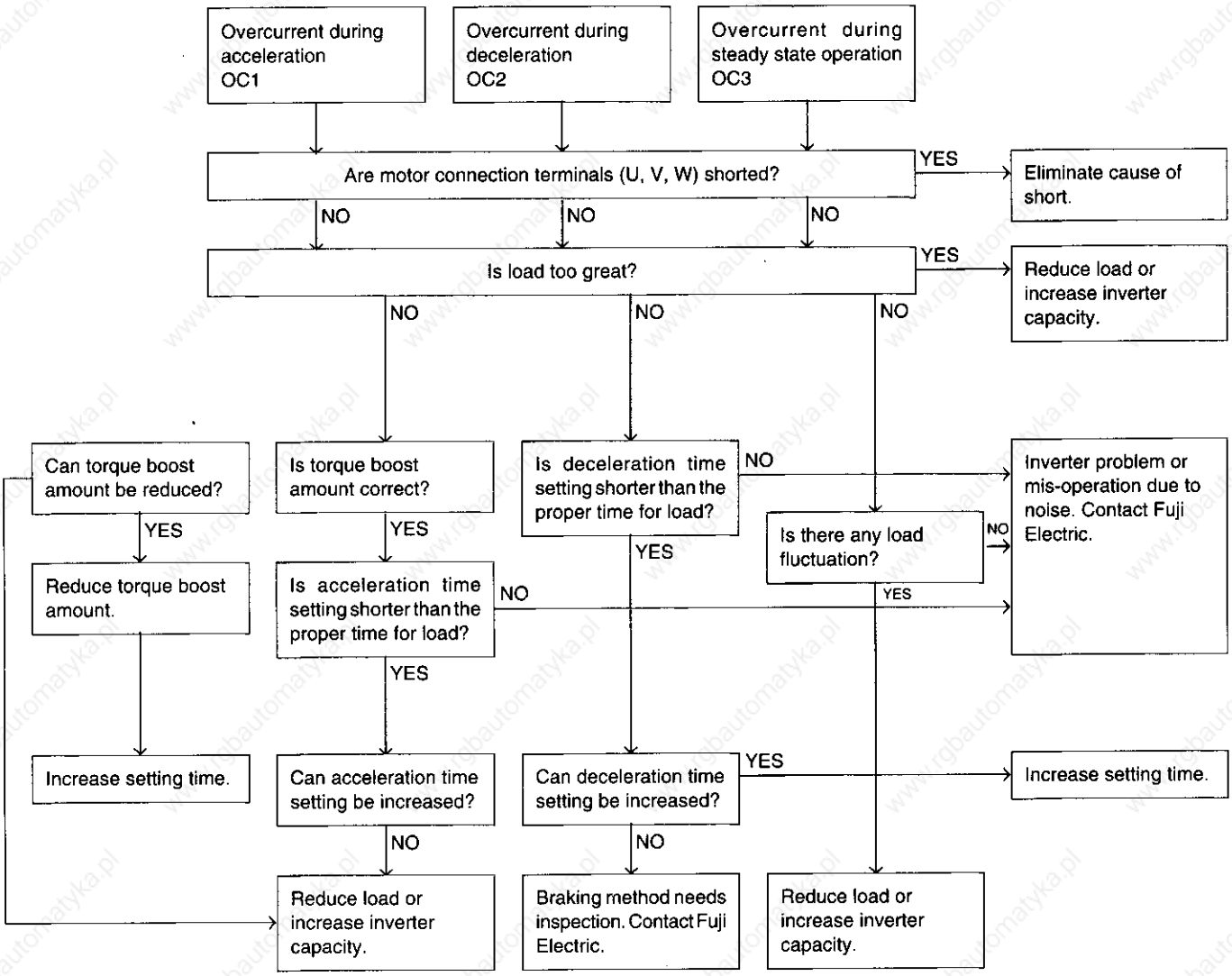
–: OFF, ○: ON

Table 11-1-3 Protective functions that avoid trips

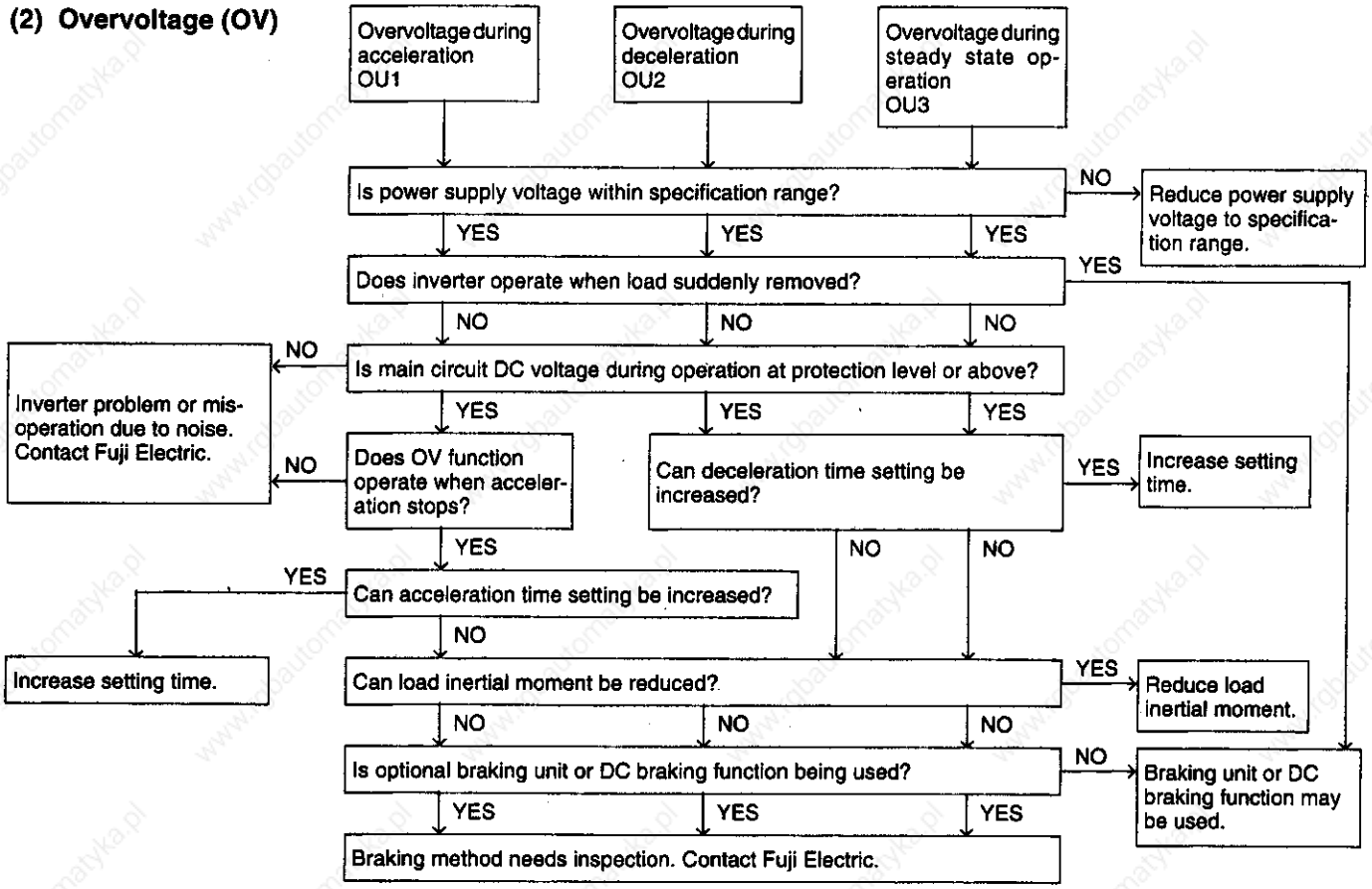
Function	Protective Operation
Stall prevention	When the inverter output current, intermediate DC voltage or torque exceeds the limit value during acceleration or deceleration, the acceleration or deceleration is stopped. If the same things happen during steady state operation, the output frequency is reduced. The inverter then waits for reduction in current thus tripping is avoided. However, if the duration of above operation is too long, the inverter overload (OLU) function will operate and the inverter will be tripped. Furthermore, if this function operates during acceleration or deceleration, the acceleration or deceleration time will become longer than the setting time.
Input surge	This protects the inverter from the following surge voltages on the power supply by means of a surge absorber which is connected to the main power supply terminals (R, S and T) and the control power supplementary input terminals (R0 and T0, optional) To earth: 7 kV (1.2 x 50) μs Between wires: 5 kV (10 x 200) μs

11-2 Troubleshooting

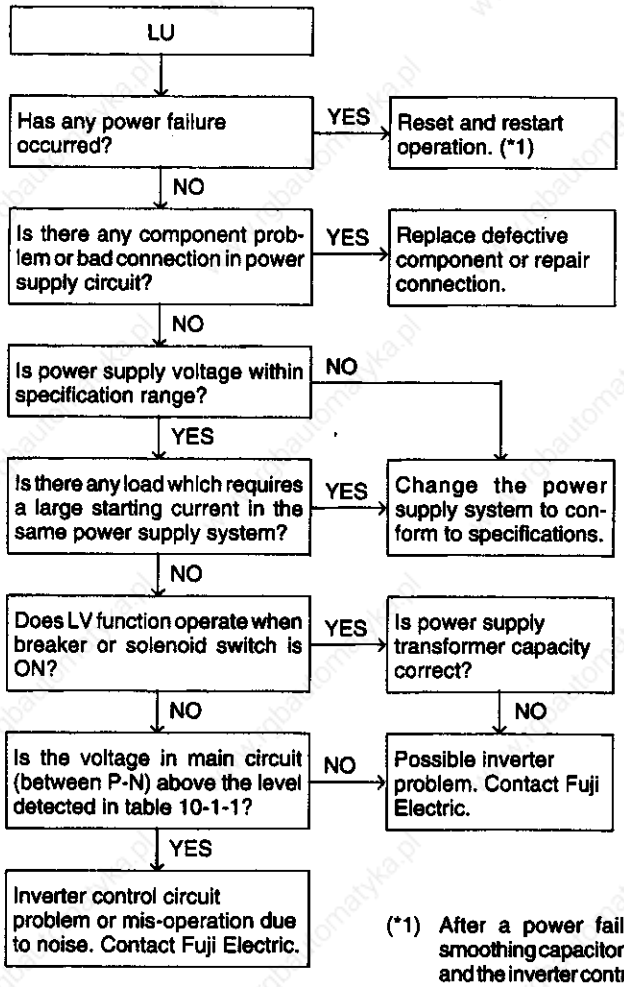
(1) Overcurrent (OC)



(2) Overvoltage (OV)

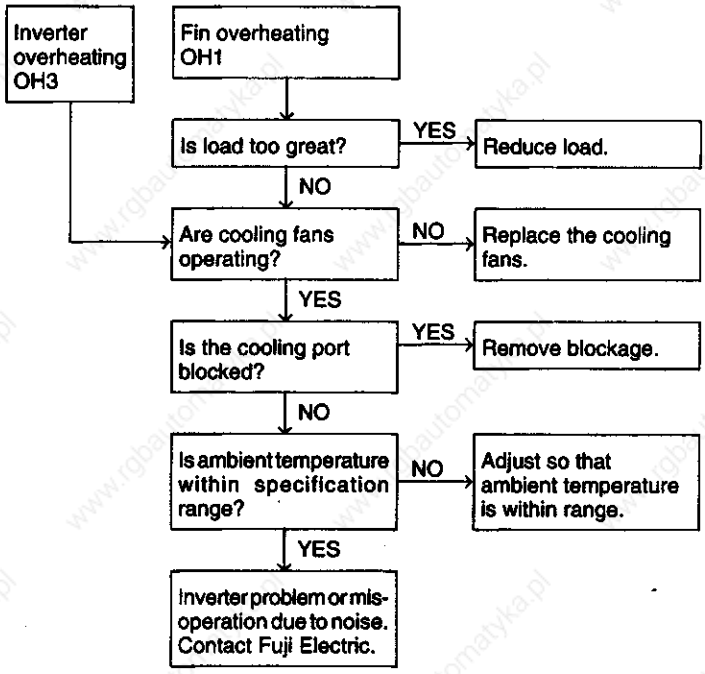


(3) Undervoltage protection (LU)

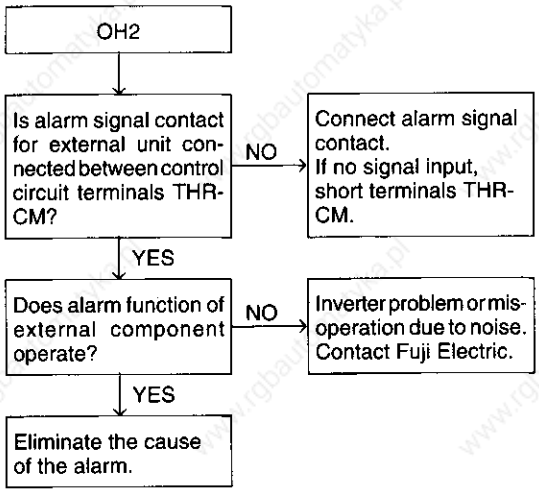


(*1) After a power failure, once the smoothing capacitor has discharged and the inverter control power supply has dropped, restarting will be made automatically.

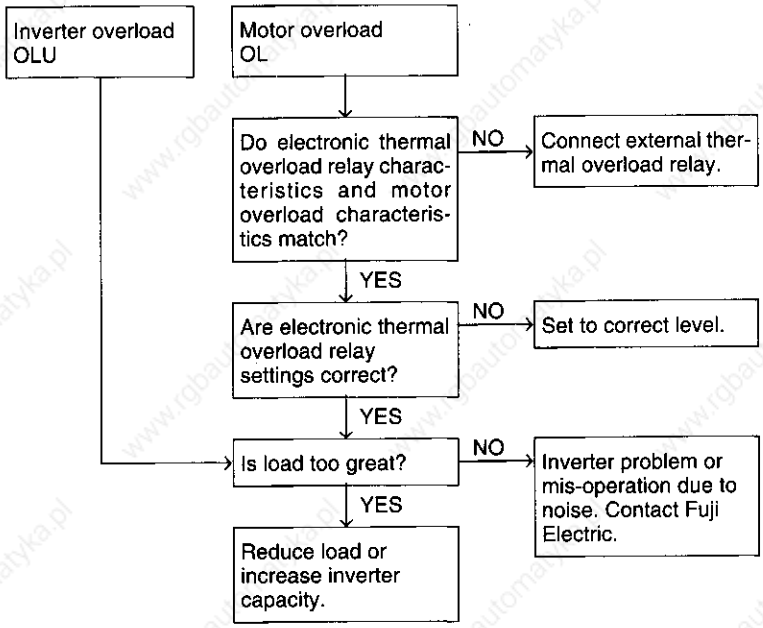
(4) Fin overheating (OH1) or inverter overheating (OH3)



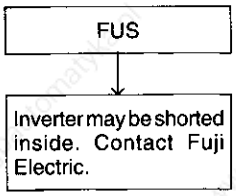
(5) External alarm input (OH2)



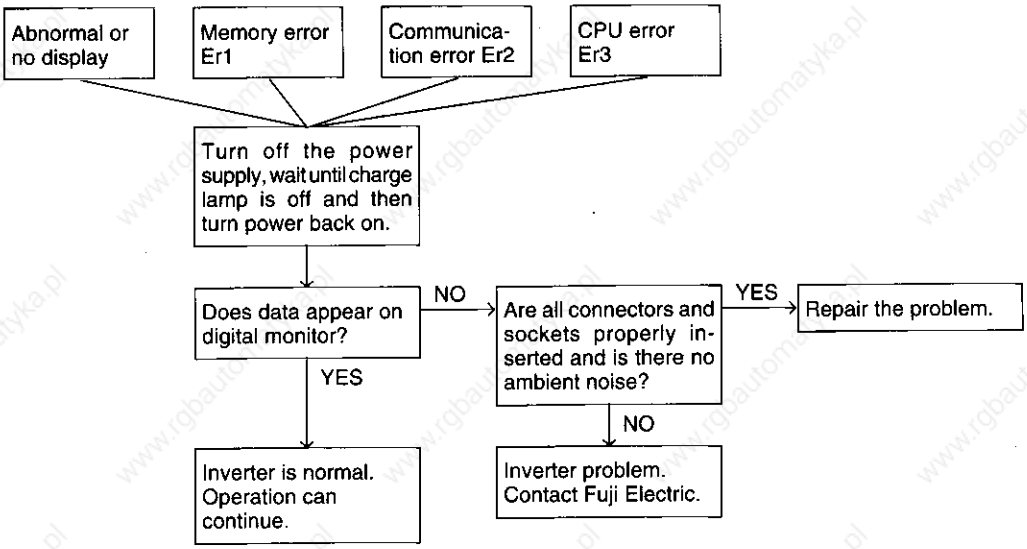
(6) Motor overload or inverter overload (OL)



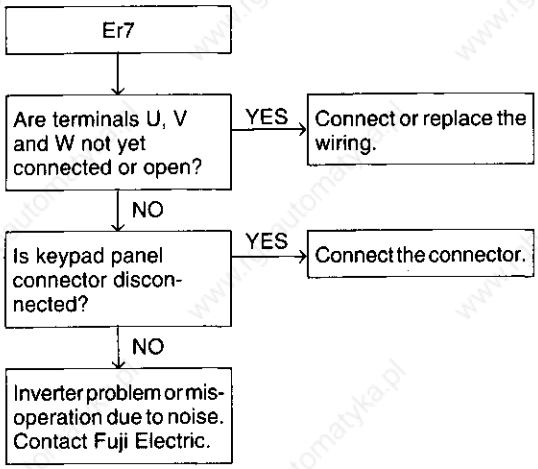
(7) Blown fuse (FUS)



(8) Memory error (Er1), communication error (Er2) or CPU error (Er3)

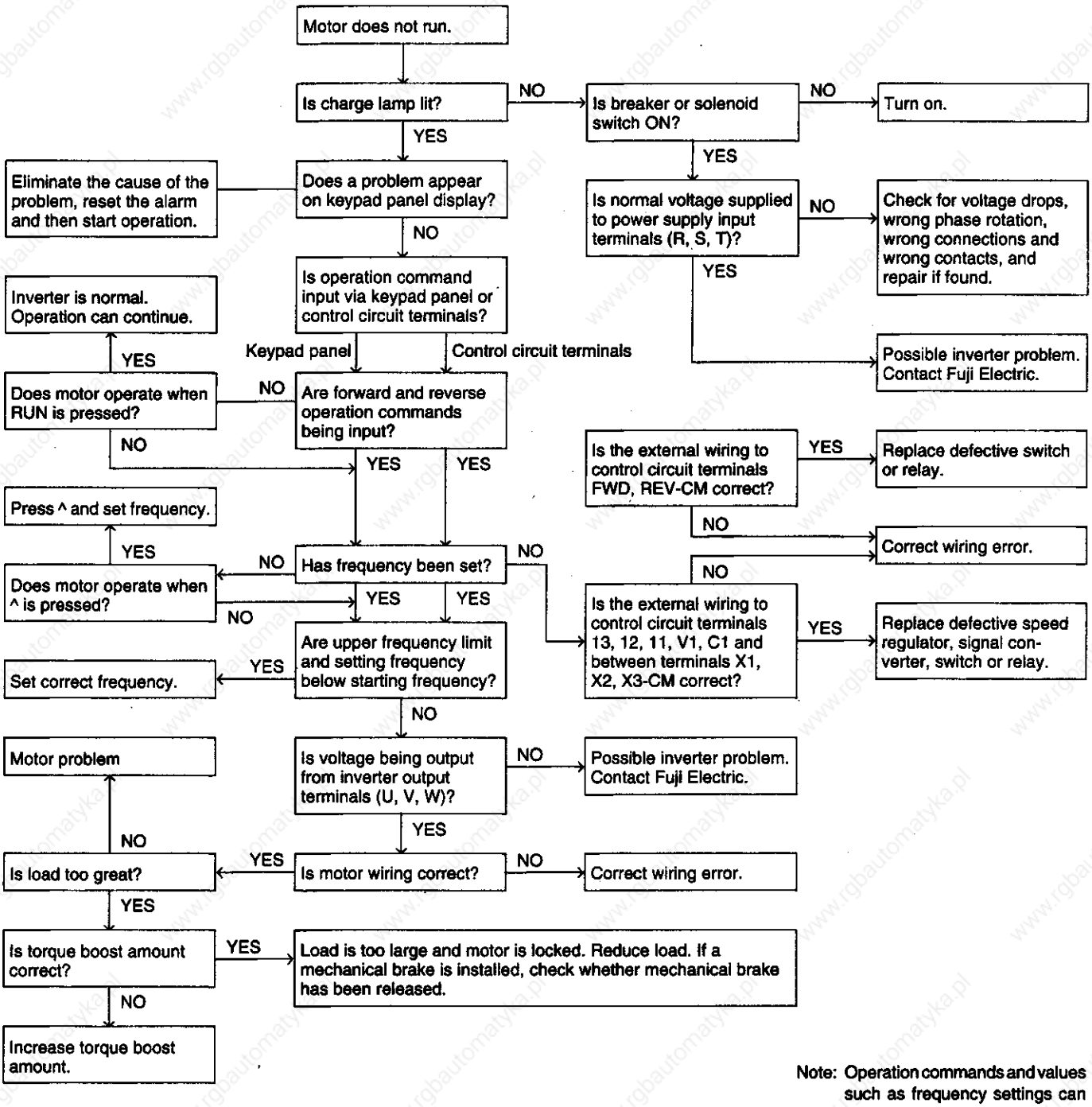


(9) Inverter output circuit error (Er7)



11-3 Motor troubleshooting

(1) Motor does not run



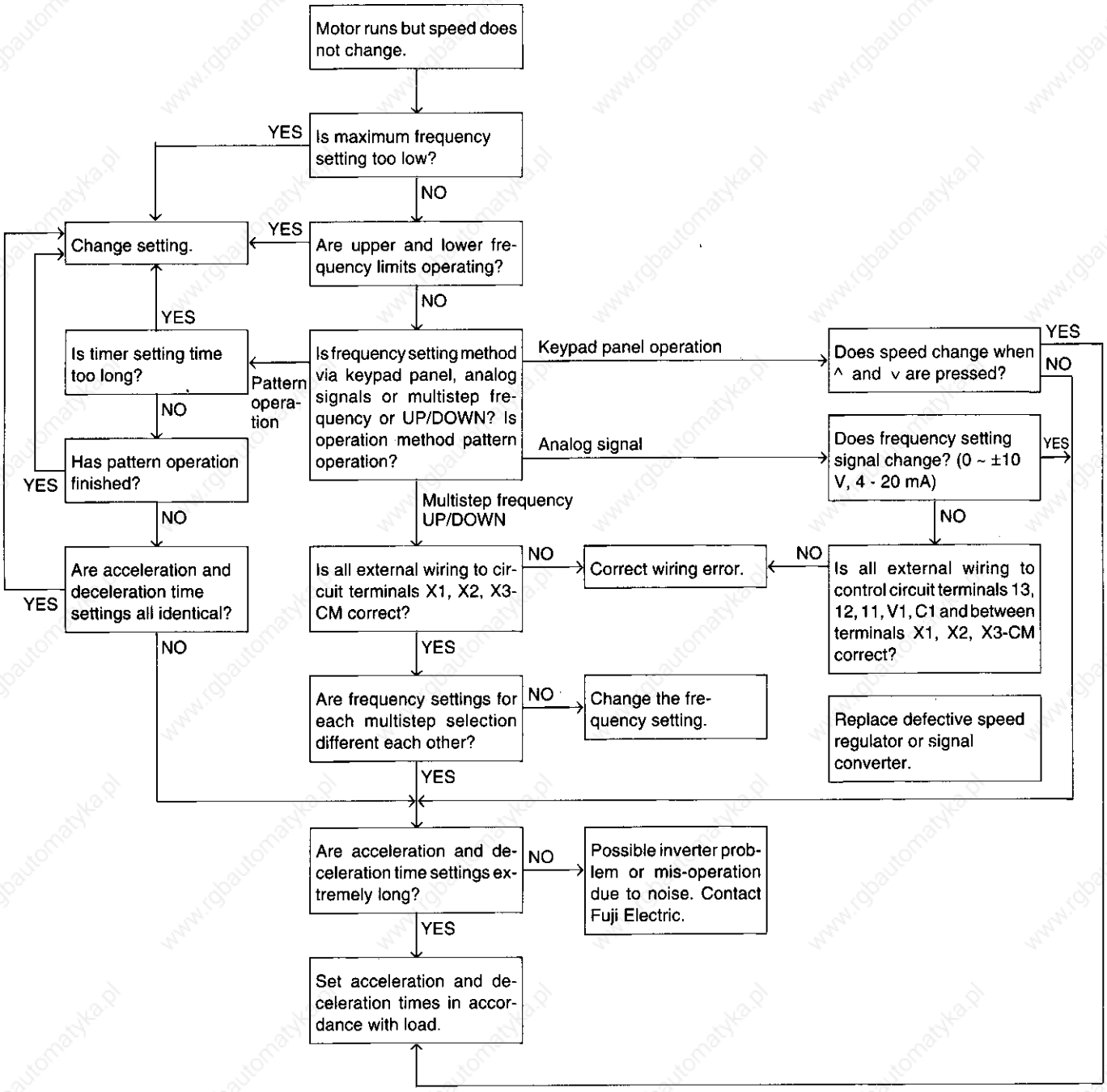
Note: Operation commands and values such as frequency settings can be monitored on the LED monitor and LCD monitor by selecting the corresponding functions.

The motor will not start even if the following commands are input.

① When an operation command is input while coasting command or DC braking command is input, or when a reverse operation command is input while F76 "Reverse phase sequence lock" is set to "1".

② If the settings for any one of F87 or F89 "Motor 1 (rated current)", F88 "Motor 1 (No-load current)", F91 "Motor 1 impedance (%R1 setting)" or F92 "Motor 1 impedance (%X setting)" is wrong by far when F07 "Torque boost 1" is set to "0.0" or F29 "Torque vector control" is set to "1".

(2) Motor runs but speed does not change



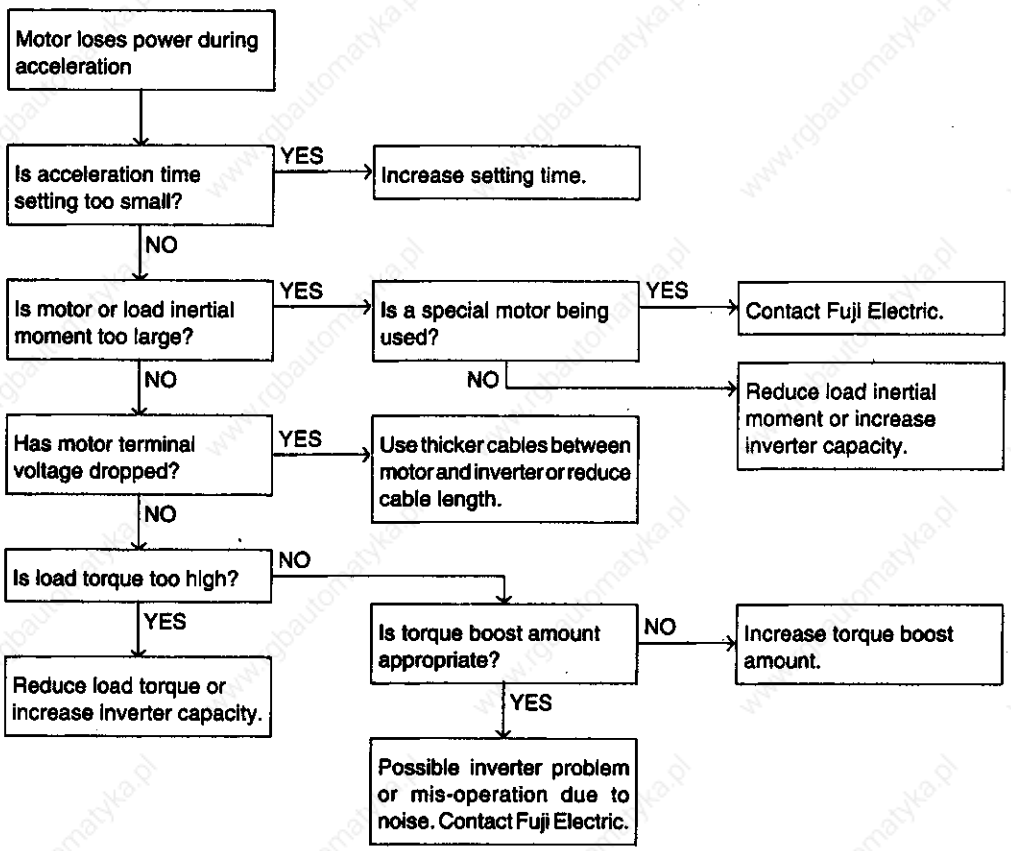
Changes in motor operation speed will be shown in the following cases also.

① If settings for F13 "Bias frequency", F14 "Gain for frequency setting signal" and other control system functions are incorrect.

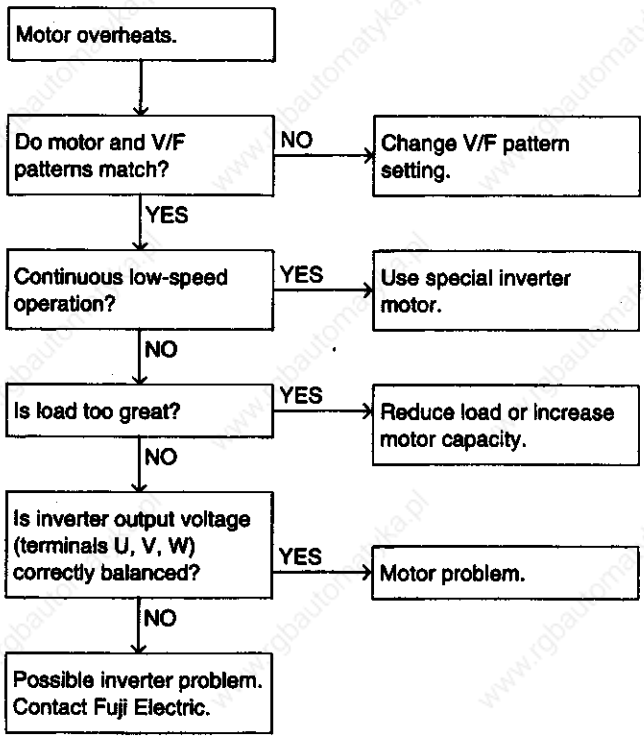
② If signals are input from both control circuit terminals 12 and V1 and there is no change in the calculated value.

③ If the load is too large and the torque limiter and current limiter functions are operating.

(3) Motor loses power during acceleration



(4) Motor overheats



Note:
If a special high-speed inverter motor overheats, the current pattern needs to be changed. Contact Fuji Electric.

12. Appendix

12-1 Standard specifications

(1) 200-V system specifications

	Nominal applied motor [kW]	0.2	0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22
G9S series	Inverter model number	FRN0.2 G9S-2	FRN0.4 G9S-2	FRN0.75 G9S-2	FRN1.5 G9S-2	FRN2.2 G9S-2	FRN3.7 G9S-2	FRN5.5 G9S-2	FRN7.5 G9S-2	FRN11 G9S-2	FRN15 G9S-2	FRN18.5 G9S-2	FRN22 G9S-2
	Inverter output [kVA] *1	0.57	1.1	1.9	3.0	4.2	6.5	9.5	13	18	22	28	33
	Output current [A]	1.5	3.0	5.0	8.0	11	17	25	33	46	59	74	87
	Overload capacity	150% of rated current for 1 minute, 200% for 0.5 s (Inverse time characteristic)											
	Starting torque	150% of rated torque or more for nominal applied motor (during torque vector control)											
	Weight [kg]	2.4	2.4	2.4	3.2	3.2	3.2	4.9	4.9	10.6	10.6	10.6	10.6
P9S series	Inverter model number	—	—	—	—	—	—	—	FRN7.5 P9S-2	FRN11 P9S-2	FRN15 P9S-2	FRN18.5 P9S-2	FRN22 P9S-2
	Inverter output [kVA] *1	—	—	—	—	—	—	—	11	16	21	25	29
	Output current [A]	—	—	—	—	—	—	—	29	42	55	67	78
	Overload capacity	120% of rated current for 1 minute, (Inverse time characteristic)											
	Starting torque	50% of rated torque or more for standard applicable motor (during torque vector control)											
	Weight [kg]	—	—	—	—	—	—	—	4.6	4.9	10.6	10.6	10.6
Output	Rated voltage and frequency	3-phase 200 V/50 Hz, 200-220-230 V/60 Hz *2											
	Voltage/frequency (V/f) characteristics	80 - 230 V setting possible at base frequency (with AVR control)											
Power supply	Voltage and frequency	3-phase, 200 - 230 V, 50/60 Hz											
	Allowable variation	Voltage: +10 % to −15%, Voltage Unbalance within 3%, Frequency: ±5%											
	Capability for voltage dips	165V > continuous operation, 165V < 15 ms continuous operation *4											

(2) 400-V system specifications

		0.4	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22
G9S series	Inverter model number	FRN0.4 G9S-4	FRN0.75 G9S-4	FRN1.5 G9S-4	FRN2.2 G9S-4	FRN3.7 G9S-4	FRN5.5 G9S-4	FRN7.5 G9S-4	FRN11 G9S-4	FRN15 G9S-4	FRN18.5 G9S-4	FRN22 G9S-4
	Inverter output [kVa] *1	1.1	1.9	2.8	4.2	6.9	10	14	18	23	30	34
	Output current [A]	1.5	2.5	3.7	5.5	9.0	13	18	24	30	39	45
	Overload capacity	150% of rated current for 1 minute, 200% for 0.5 s (Inverse time characteristics)										
	Starting torque	50% of rated torque or more for nominal applied motor (during torque vector control)										
	Weight [kg]	2.4	3.2	3.2	3.2	3.2	5.3	5.3	10.6	10.6	10.6	10.6
P9S series	Inverter model number	—	—	—	—	—	—	FRN7.5 P9S-4	FRN11 P9S-4	FRN15 P9S-4	FRN18.5 P9S-4	FRN22 P9S-4
	Inverter output [kVA] *1	—	—	—	—	—	—	12.5	17.5	22.8	28.2	33.5
	Output current [A]	—	—	—	—	—	—	16.5	23	30	37	44
	Overload capacity	120% of rated current for 1 minute, (Inverse time characteristic)										
	Starting torque	50% of rated torque or more for nominal applied motor (during torque vector control)										
	Weight [kg]	—	—	—	—	—	—	5.3	5.3	10.6	10.6	10.6
Output	Rated voltage and frequency	3-phase 380-400 V/50 Hz, 380-400-440-460 V/60 Hz *2										
	Voltage/frequency (V/f) characteristics	320 - 480 V setting possible at base frequency (with AVR control)										
Power supply	Voltage and frequency	3-phase, 380 - 480 V, 50/60 Hz										
	Allowable variation	Voltage: +10 % to −15%, Voltage Unbalance within 3%, Frequency: ±5%										
	Capability for voltage dips	310V > continuous operation, 310V < 15 ms continuous operation *4										

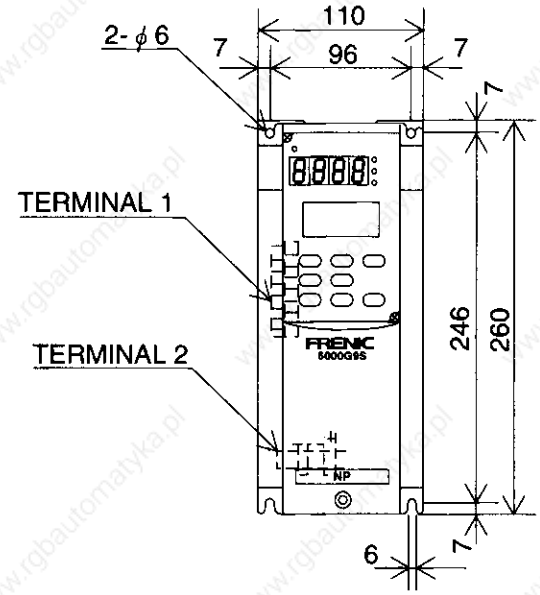
COMMON SPECIFICATIONS

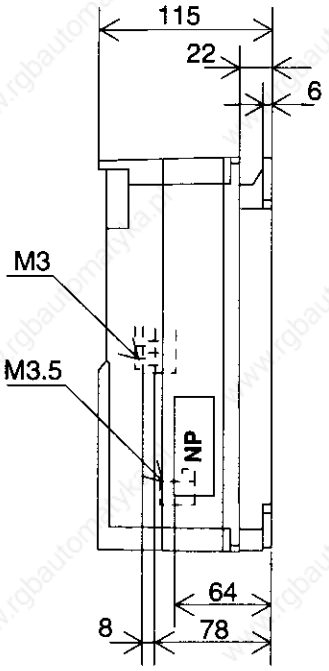
Control	Control method	Sinusoidal PWM control (with torque-vector control)
	Operation method	KEY operation : RUN or STOP KEY Input signal : Forward/Reverse command, Coast-to-stop command, Trip command (External fault), Alarm reset, 3 Wire control, Multistep speed selection, Acc./Dec. time selection, 2nd V/f selection
	Frequency setting	KEY operation : △ or ▽ key Potentiometer : 1 to 5 kΩ (1/2 W) Analog input : 0 to 5Vdc, 0 to 10Vdc, 4 to 20mAdc (0 to 5 Vdc setting can be used by making FUNC. 14/200I.0) Reversible operation with signal polarity UP/DOWN control : Output frequency increases during X1:ON, and decreases during X2:ON. Multistep frequency : 8 different frequencies can be selected by terminal X1, X2 and X3.
	Running status signal	Open collector output : RUN, FAR, FDT, OL, LU and etc. (14 kings selectable) Analog output : Output frequency, Output current, Output torque, Load factor
	Acceleration time Deceleration time	0.2 to 3600s (Independentry adjustableacceleration and deceleration, 4 kinds selectable) * Mode select : Linear, S-curve and Non-linear acceleration/deceleration
	Frequency limitter	High Limitter : 0 to 400 (120) Hz, Low Limitter : 0 to 400 (120) Hz
	Bias frequency	0 to 400 Hz adjustable
	Gain for frequency setting	0 to 400 (120) Hz adjustable
	Frequency jump control	The jumping frequency (3 points) and jumping hysteresis width (1 point) can be preset.
	Rotating motor pick up	A rotating motor can be picked up without stopping the motor
	Auto-restart after momentary power failure	Automatic restart is available after a momentary power failure
	Switching operation from line to inverter	Control terminals are provided for smooth switching from commercial power supply to inverter supply
	Slip compensation	To keep a motor speed constant, the inverter output frequency is controlled according to load torque. If the slip frequency sets to minus value, the motor speed variation is magnified.
	Torque limitting control	When the motor torque reaches a preset limiting level, this function automatically lowers the output frequency to prevent the inverter from tripping due to an overcurrent.
	Regenerating avoid control control	When braking torque limitter sets to 0, the deceleration time is automatically extended for trip-less operation.
	2nd V/f setting	This function uses 2 motor switching operation. 2nd motor's base frequency and rated voltage can be preset. (FUNC. 39 and 40)
	Energy saving operation	This function minimizes inverter and motor losses at light load. (FUNC. 75)
Indication	Running or Stopping mode	Output Frequency, Output Current, Output Voltage, Output Torque, Motor Synchronous Speed, Line Speed *Tester function (indicates signal existence or not of logical I/O, and signal voltage of analog I/O)
	Setting mode	Function Code and Function Name, Data or Data Code
	Trip mode	Indication of trip cause code (ex. OC1, OC2, OC3, OU1, OU2, OU3, OH1, OH2, OL, LU, Er1 --- Er5, ---)
Protection	Overload	Electronic thermal overload relay and heat sink over temperature detection
	Overvoltage	Overvoltage detection of DC link circuit (200V series: 400V, 400V series: 800V)
	Surge input	Inverter protection from surge voltage input
	Undervoltage	Undervoltage detection of DC link circuit (200V series: 200V, 400V series: 400V)
	Overheating	Inverter overheating protection by temperature detection
	Short circuit	The short circuit protection of inverter output circuit
	Grounding fault	The grounding fault protection of inverter output circuit
	Motor overheating	The electronic thermal overload relay can be select for general purpose motor or FUJI inverter motor.
	DB resister overheating	10HP or less: Internal electronic thermal overload relay (Function code: 27) 15HP or more: Over temperature detection relay (installed in DBR unit)
Condition	Installation location	Do not install in a dusty location or expose to corrosive gasses, oil splashes or direct sunlight or outdoor.
	Ambient temperature	-10°C to +40°C (when mounted inside the switchboard, the cover can be removed to allow use at ambient temperature +50°C)
	Ambient humidity	20 to 90 %RH (non-condensing)
	Vibration	5.9 m/s²(0.6G) or less
	Stored temperature	-20 to +65°C
Enclosure		IP40
Cooling method		0.2 - 0.75 kW : Natural cooling 1.5 - 22 kW : Fan cooling

(*1) Indicates rated capacity when rated output voltage is 220V or 440V.
(*2) It is not possible for output voltage to exceed power supply voltage.
(*3) Connect the power factor correcting AC reactor when the voltage unbalance of the power supply exceed 3%.
(*4) Under the condition of about 85% load of nominal applied motor.

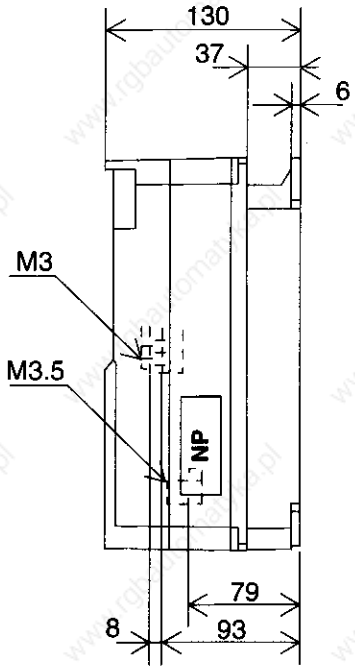
12-2 External dimensions

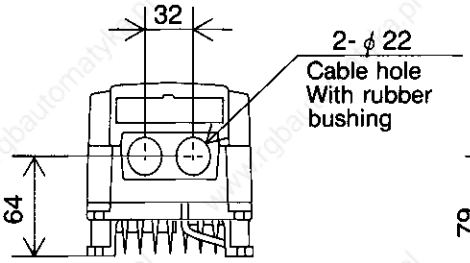
FRN0.2~0.4G9S-2

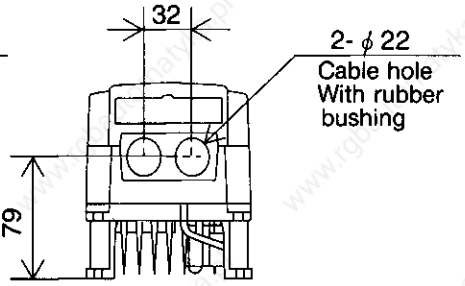




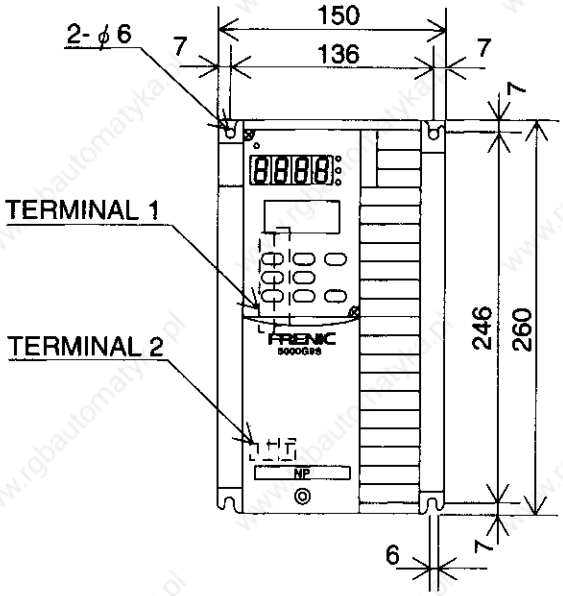
FRN0.75G9S-2 FRN0.4G9S-4

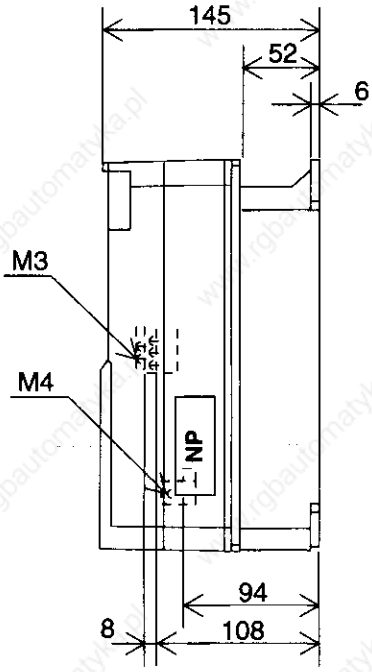


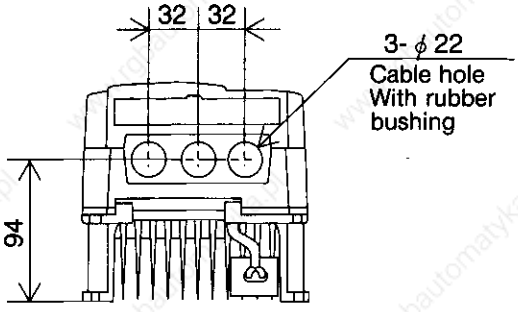




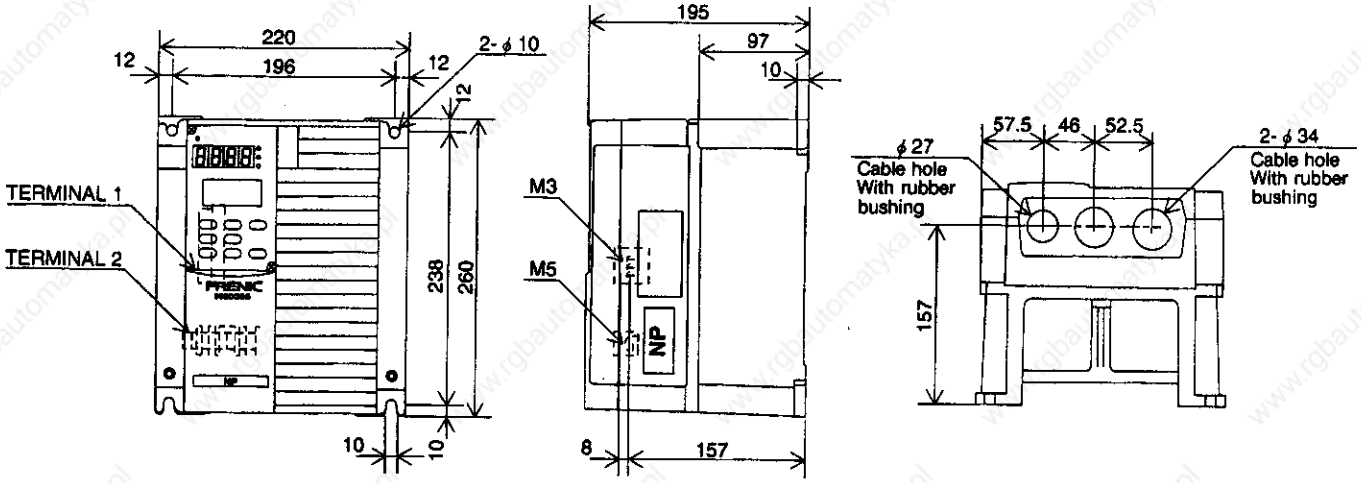
FRN1.5~3.7G9S-2 FRN0.75~3.7G9S-4



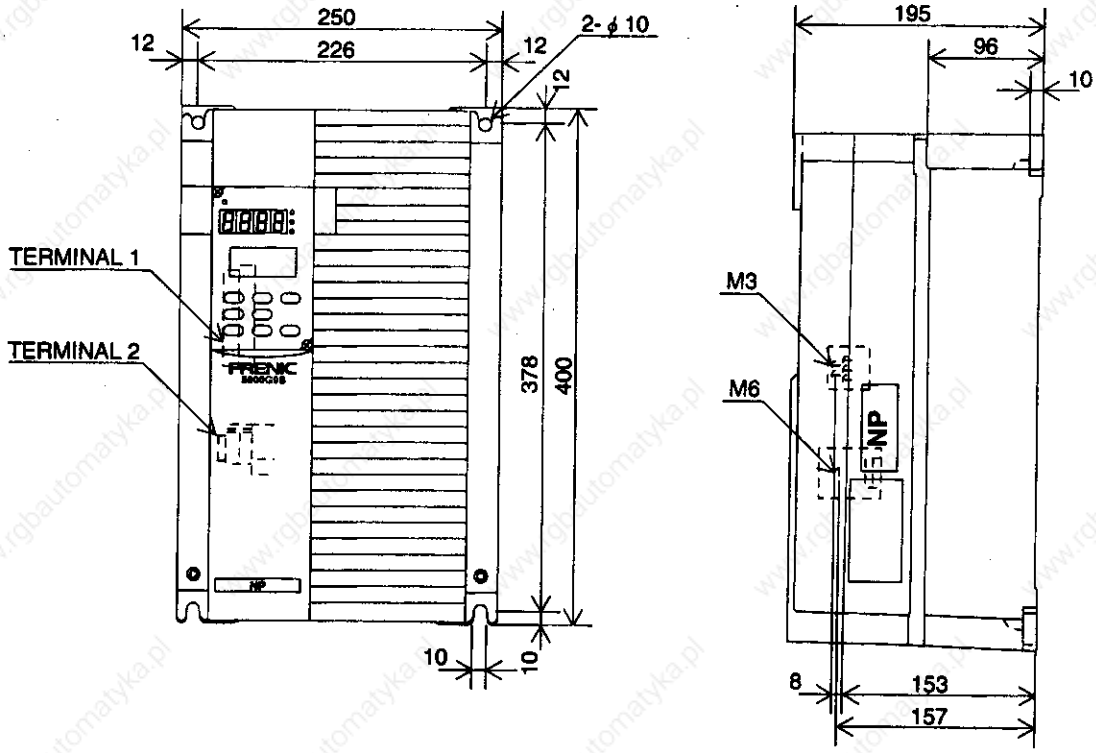


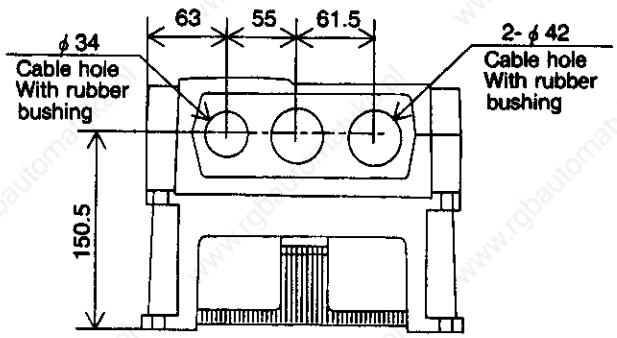


FRN5.5~7.5G9S-2 FRN5.5~7.5G9S-4 FRN7.5~11P9S-2 FRN7.5~11P9S-4

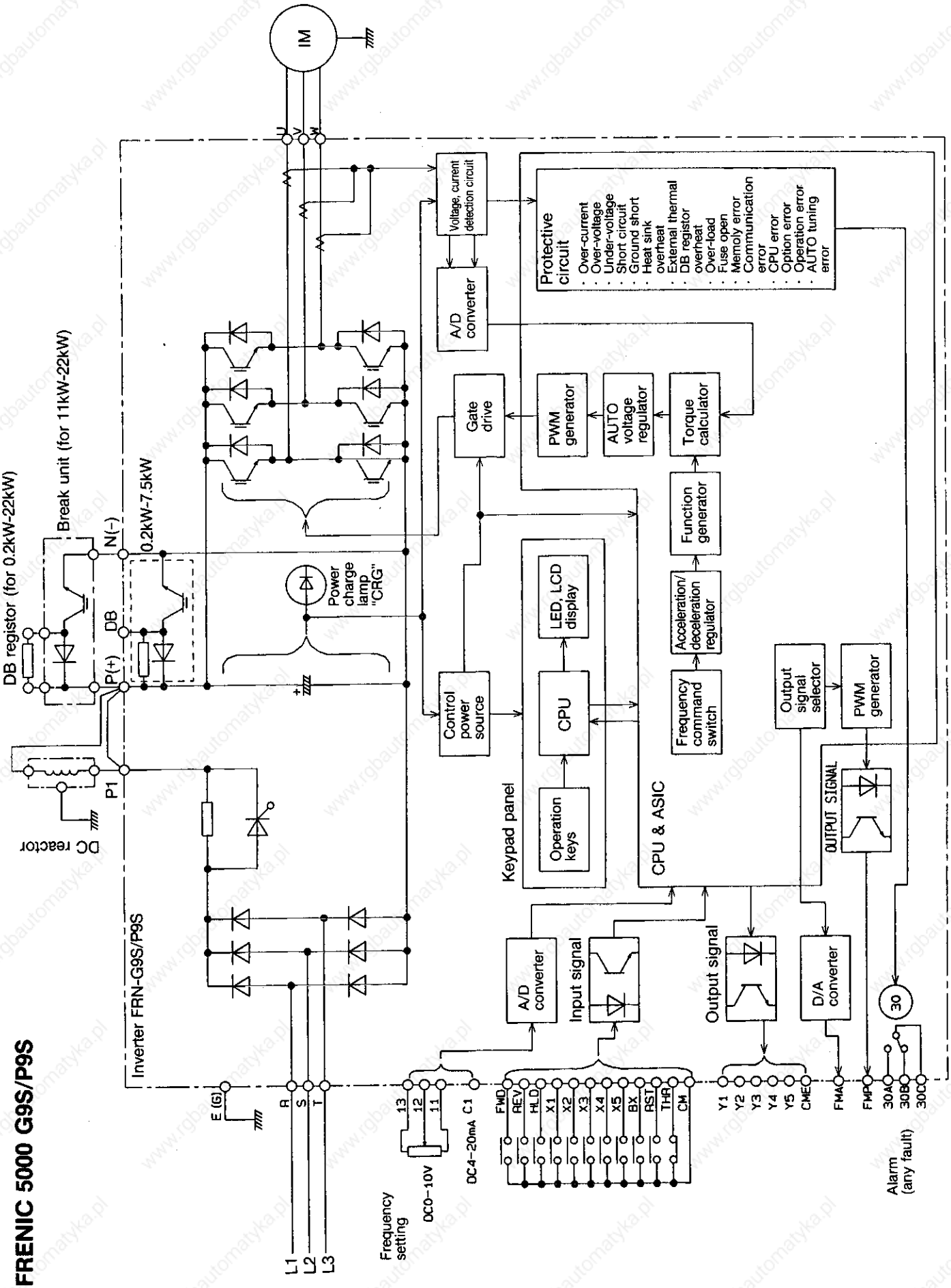


FRN11~22G9S-2 FRN11~22G9S-4 FRN15~22P9S-2 FRN15~22P9S-4





12-3 Control block diagram



12-4 Terminal identification and function

	Symbol	Temrinal name	Description	
Power circuit	L1, L2, L3	Power input	Connect a 3-phase power supply.	
	U, V, W	Inverter output	Connect a 3-phase induction motor.	
	P(+), P1	for DC REACTOR	Connect the DC REACTOR for power-factor correcting.	
	P(+), N(–)	for BRAKING UNIT	Connect the BRAKING UNIT (option). (for 11 kW or more capacity inverter unit)	
	P(+), DB ★	for EXTERNAL BRAKING RESISTOR	Connect the EXTERNAL BRAKING RESISTOR (option) (for 7.5 kW or less capacity inverter unit)	
	E(G)	Grounding	Ground terminal for inverter chassis (housing).	Be sure to ground the chassis to prevent electrical shock and to reduce radio noise.
	R0, T0 ★ ★	Auxiliary control power supply	Connect a single-phase AC power supply to back up the control circuit power supply.	
Frequency setting	13	Potentiometer power supply	+10V DC power supply for frequency setting POT. (maximum output current : 10 mA)	These signals are selected by FUNC. 00 as follows. 00/0 KEYPAD operation (△ or ▽ key) 00/1 Voltage input (Terminal 12 and V1) 00/2 Voltage and Current input (Terminal 12 and V1 and C1)
	12	Voltage input	0 to +10 Vdc / 0 to (maximum output frequency)	
	C1	Current input	+4 to +20 mAdc / 0 to (maximum output frequency)	
	V1 ★	Auxiliary input (Voltage input)	0 to ±10 Vdc / 0 to ±(maximum output frequency) ‡ Relation to FWD/REV signal polarity of V1: + → FWD: Forward rotation, REV: Reverse rotation polarity of V1: – → FWD: Reverse rotation, REV: Forward rotation	
	11	common	Common terminal for terminals 12, 13, C1 and V1.	
Command input	FWD	Forward operation command	FWD-CM: CLOSE The motor runs forward direction. OPEN The motor decelerates and stops.	NOTE: During both FWD and REV are CLOSE, the motor decelerates and stops.
	REV	Reverse operation command	REV-CM: CLOSE The motor runs reverse direction. OPEN The motor decelerates and stops.	
	HLD	3-wire operation Stop command	When HLD-CM is closed, pulse signal input from FWD or REV terminals is self-hald. Operation from momentary pushbuttons is enabled.	
	BX	Coast-to-stop command	Motor will coast-to-stop with BX-CM closed. No alarm signal will be output.	NOTE: If BX-CM is open with FWD or REV closed, the inverter will start to operate.
	THR	Trip command (External fault)	With THR-CM open, OH2 trip will occur and motor will coast-to-stop. The alarm signal (OH2) is held.	
	RST	Alarm reset	Fault are reset when a momentary contact is made between the RST-CM terminals for more than 0.1 seconds are short-circuited.	
Monitor output	FMA–11	Analog monitor	Outputs 0 to +10V DC voltage proportional to following function, selected by making FUNC. 46/0 to 46/3. 0 : Output frequency 2 : Load factor 1 : Output current 3 : Torque (calculated	The voltage can be adjusted by FUNC. 45 (6.5 to 10 V max.) Two voltmeters each having an internal resistance of 10 kΩ, can be connected.
	FMP–CM	Frequency monitor (pulse output)	Pulse rate = (FUNC. 43) ‡ (Inverter output freq.)	The voltage can be adjusted by FUNC. 44 (6.5 to 10 V max.) Two voltmeters each having an internal resistance of 10 kΩ, can be connected.
Contact output	30A, 30B, 30C	Alarm output (Any fault)	Outputs a contact signal when a protective function is activated. (Contact rating : 250V AC, 0.3A, cos ϕ=0.3)	

<table>
<tr><th></th><th>Symbol</th><th>Temrinal name</th><th>Description</th><th></th><th></th></tr>
<tr><td rowspan="9">Control input</td><td>X1, X2, X3</td><td>Multistep freq. select</td><td>8 different frequencies can be selected by ON/OFF combinations of terminal X1, X2 and X3.
<table><tr><th></th><th>KEYPAD or terminal</th><th>MSS1</th><th>MSS2</th><th>MSS3</th><th>MSS4</th><th>MSS5</th><th>MSS6</th><th>MSS7</th></tr><tr><td>X1-CM</td><td>–</td><td>○</td><td>–</td><td>○</td><td>–</td><td>○</td><td>–</td><td>○</td></tr><tr><td>X2-CM</td><td>–</td><td>–</td><td>○</td><td>○</td><td>–</td><td>–</td><td>○</td><td>○</td></tr><tr><td>X3-CM</td><td>–</td><td>–</td><td>–</td><td>–</td><td>○</td><td>○</td><td>○</td><td>○</td></tr></table></td><td>This function can be obtained by making FUNC. 32/00##.</td><td></td></tr>
<tr><td>(X1, X2)</td><td>Up-Down control</td><td>The output frequency increases during X1-CM : CLOSE and decreases during X2-CM : CLOSE.</td><td>Function of terminal X1 and X2 changes by making FUNC. 32//1### or 32/2###.
32/1### :
32/2### :</td><td></td></tr>
<tr><td>(X3)</td><td>Switching operation from line to inverter</td><td>The inverter is ready when PU-CM and FWD (or REV) are closed. Turning off The PU-CM after 0.1 seconds, changes over from line to inverter.</td><td>Function of terminal X3 changes by making FUNC.32/#1### or 32/#2##.
32/#1##: for 50Hz, 32/#2##: for 60Hz</td><td></td></tr>
<tr><td>X4, X5</td><td>Acc./Dec. time 2, 3 or 4 selection</td><td>4 different acc./dec. times can be selected by ON/OFF combinations of terminal X4 and X5.
<table><tr><th></th><th>Acc1/Dec1</th><th>Acc2/Dec2</th><th>Acc3/Dec3</th><th>Acc4/Dec4</th></tr><tr><td>X4-CM</td><td>–</td><td>○</td><td>–</td><td>○</td></tr><tr><td>X5-CM</td><td>–</td><td>–</td><td>○</td><td>○</td></tr></table>○ : ON
– : OFF</td><td>This function can be obtained by making FUNC. 32/##00.</td><td></td></tr>
<tr><td>(X4)</td><td>Current process signal selection</td><td>X4-CM ON : Selects current input setting (Terminal input C1 only)
X4-CM OFF : Selects without C1 terminal setting (Terminal input 12 or V1 or KEYPAD)</td><td>Function of terminal X4 changes by making FUNC. 32/##1#.</td><td></td></tr>
<tr><td>(X4)</td><td>DC brake command</td><td>X4-CM ON : Active (DC brake operates)
X4-CM OFF : Inactive</td><td>Function of terminal X4 changes by making FUNC. 32/##2#.</td><td></td></tr>
<tr><td>(X5)</td><td>2-nd motor selection</td><td>X5-CM ON : Selects 2-nd voltage/frequency setting (by FUNC. 39, 40, 41) for 2-nd motor.</td><td>Function of terminal X5 changes by making FUNC. 32/###1.</td><td></td></tr>
<tr><td>(X5)</td><td>Data protection</td><td>X5-CM OFF : Change inhibited (All FUNCTION's data)
X5-CM ON : Data changeable</td><td>Function of terminal X5 changes by making FUNC. 32/###2.</td><td></td></tr>
<tr><td>CM</td><td>Common terminal</td><td colspan="3">Common terminal for contact input signal and pulse output signal (FMP).</td></tr>
<tr><td rowspan="6">Open collector output</td><td>Y1</td><td>output 1</td><td rowspan="5">Each terminal function can be selected by FUNC. 47
(code) (function)
0 : Inverter running mode (RUN)
1 : Frequency equivalence signal (FAR)
2 : Frequency level detection (FDT)
3 : Overload early warning (OL)
4 : Undervoltage detection (LU)
5 : KEYPAD operation mode
6 : Torque limitting mode
7 : Inverter stopping mode
8 : Auto-restart mode
9 : Auto-reset mode
C : Time-up signal (TP) at pattern operation
d : Cycle completion signal (TO) at pattern operation
E : Stage indication signal at pattern operation (used 3-output terminals Y3, Y4 and Y5)
F : Alarm indication signal at alarm trip mode (used 4-output terminals Y2, Y3, Y4 and Y5)</td><td rowspan="5">NOTE: Factory setting are
Y1 : RUN
Y2 : FAR
Y3 : FDT
Y4 : OL
Y5 : LU</td><td rowspan="6">DC 50mA max.
27V max.</td></tr>
<tr><td>Y2</td><td>output 2</td></tr>
<tr><td>Y3</td><td>output 3</td></tr>
<tr><td>Y4</td><td>output 4</td></tr>
<tr><td>Y5</td><td>output 5</td></tr>
<tr><td>CME</td><td>Common (for open collector output)</td><td>Common terminal or open-collector output signals.</td><td></td></tr>
</table>

Function Code Table (Factory setting)

Function LCD Display	Setting range	Unit	Factory setting (*1)
00 FREQ COMMND	0 : KEYPAD operation (△ or ▽ key) 1 : Voltage input (terminal 12 and V1) 2 : Voltage and Current input (terminal 12 and V1 and C1)	–	0
01 OPR METHOD	0 : KEYPAD operation (RUN or STOP key) 1 : FWD or REV command signal operation	–	0
02 MAX Hz	G9S : 50 to 400 Hz P9S : 50 to 120Hz	Hz	50
03 BASE Hz-1	G9S : 50 to 400 Hz P9S : 50 to 120Hz	Hz	50
04 RATED V-1	0 (Free), 80 to 240 V	V	220
	0 (Free), 320 to 480 V		380
05 ACC TIME 1 06 DEC TIME 1	0.01 to 3600 s 0.00 (Coasting), 0.01 to 3600 s	s	6.00 6.00
07 TRQ BOOST1	0.0 (Auto setting), 0.1 to 20.0 (Manual setting)	–	0.0 (0.1)
08 ELCTRN OL	0 : Inactive 1 : Active (for 4 poles standard motor) 2 : Active (for 4 poles FUJI-inverter motor)	–	1
09 OL LEVEL	Current value (A) setting	A	***
10 RESTART	0 : Inactive 1 1 : Inactive 2 2 : Active (smooth recovery method) 3 : Active (momentary stops and restarts at setting frequency) 4 : Active (momentary stops and restarts at starting frequency)	–	3
11 H LIMITER	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	70
12 L LIMITER	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	0
13 FREQ BIAS	G9S : 0 to 400 Hz	Hz	0
14 FREQ GAIN	0.0 to 200.0%	%	100.0
15 DRV TORQUE	20 to 180, 999% (999: No limit)	%	180 (120)
16 BRK TORQUE	0, 20 to 180, 999% (999: No limit)	%	150 (100)
17 DC BRK Hz	0.0 to 60.0 Hz	Hz	0.0
18 DC BRK LVL	0 to 100	–	0
19 DC BRK t	0.0 (DC brake inactive), 0.1 to 30.0 s	s	0.0
20 MULTI Hz-1 21 MULTI Hz-2 22 MULTI Hz-3 23 MULTI Hz-4 24 MULTI Hz-5 25 MULTI Hz-6 26 MULTI Hz-7	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	5.00 10.00 20.00 30.00 40.00 50.00 60.00
27 DBR OL	0 : Inactive 1 : Active (for internal braking registor) 2 : Inactive	–	*2 (0)
28 SLIP COMP	–9.9 Hz to +5.0 Hz	Hz	0.0
29 TRQ VECTOR	0 : Inactive 1 : Active	–	0
30 MTR POLES	2 to 14 (even number)		4

*** : Standard value of FUJI 4P motor
*1 : Value in ( ) is setting for P9S series.
*2 : 1 for up to 7.5kW, 0 for 11 to 22 kW

Function LCD Display	Setting range	Unit	Factory setting
31 ■ 32-41 ■	0 : Not displays FUNCTION CODE 32 to 41 1 : Displays FUNCTION CODE 32 to 41	–	0
32 X1-X5 FUNC	0000 ~ 2222 X1 and X2 terminal function changeable by 1st code. 32/0### : Multistep speed selection 32/1### : UP/DOWN control 1 32/2### : UP/DOWN control 2 X3 terminal function changeable by 2nd code. 32/#0## : Multistep speed selection 32/#1## : Switching operation from line to inverter (for 50 Hz line) 32/#2## : Switching operation from line to inverter (for 60 Hz line) X4 terminal function changeable by 3rd code. 32/##0# : Acc./Dec. time selection 32/##1# : Current process signal selection 32/##2# : DC brake command X5 terminal function changeable by 4th code. 32/###0 : Acc./Dec. time selection (Can be select 4 steps using X4 and X5) 32/###1 : 2nd motor selection 32/###2 : Data protection	–	0000
33 ACC TIME 2 34 DEC TIME 2 35 ACC TIME 3 36 DEC TIME 3 37 ACC TIME 4 38 DEC TIME 4	0.01 ~ 3600 s 0.00 (Coasting), 0.01 ~ 3600 s	s	10.0 10.0 15.0 15.0 3.0 3.0
39 BASE Hz-2	G9S : 50 to 400 Hz P9S : 50 to 120Hz	Hz	50
40 RATED V-2	0 (Free), 80 ~ 240 V	V	220
	0 (Free), 320 ~ 480 V		380
41 TRQ BOOST2	0.1 to 20.0	–	2.0
42 ■ 43-51 ■	0 : Not displays FUNCTION CODE 43 to 51 1 : Displays FUNCTION CODE 43 to 51	–	0
43 FMP PULSES	6 to 100	–	24
44 FMP V-ADJ	50 to 120	–	100
45 FMA V-ADJ	65 to 200	–	100
46 FMA FUNC	0 : Output frequency 1 : Output current 2 : Output torque 3 : Load factor	–	0
47 Y1-Y5 FUNC	0000 – FFFF Each 5 digits setting for 5 terminals separately selectable to following functions. (code) (function) 0 : Inverter running mode (RUN) 1 : Frequency equivalence signal (FAR) 2 : Frequency level detection (FDT) 3 : Overload early warning (OL) 4 : Under voltage detection (LU) 5 : KEYPAD operation mode 6 : Torque limitting mode 7 : Inverter stopping mode 8 : Auto-restart mode 9 : Auto-reset mode C : Time-up signal (TP) at pattern operation d : Cycle completion signal (TO) at pattern operation E : Stage indication signal at pattern operation (uses 3-output terminal Y3, Y4 and Y5) F : Alarm indication signal at alarm trip mode (uses 4-output terminal Y2, Y3, Y4 and Y5)	–	01234

Function LCD Display	Setting range	Unit	Factory setting (*1)
48 FAR HYSTR	0.0 to 10.0 Hz	Hz	2.5
49 FDT LEVEL	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	50
50 FDT HYSTR	0.0 to 30.0 Hz	Hz	1.0
51 OL WARNING	About 20 to 105% of motor rated current	A	***
52 ■ 53-59 ■	0 : Not displays FUNCTION CODE 53 to 59 1 : Displays FUNCTION CODE 53 to 59	–	0
53 JUMP Hz 1 54 JUMP Hz 2 55 JUMP Hz 3	G9S : 0 to 400 Hz P9S : 0 to 120 Hz	Hz	0 0 0
56 JUMP HYSTR	0 to 30 Hz	Hz	3
57 START Hz	0.2 to 60.0 Hz	Hz	0.5
58HOLDING t	0.0 to 10.0 s	s	0.0
59 FILTER	0.01 to 5.00 s	s	0.05
60 ■ 61-79 ■	0 : Not displays FUNCTION CODE 61 to 79 1 : Displays FUNCTION CODE 61 to 79	–	0
61 LED MNTR 1	0 to 8 (9 kinds selectable)	–	0
62 LED MNTR 2	0 : Setting value 1 : Output value	–	0
63 SPEED COEF	0.01 to 200.00 (Multiplier to Hz value)	–	0.01
64 LCD MNTR	0 : Displays RUN or STOP 1 : Bar graph (Setting freq. and Output freq.) 2 : Bar graph (Output freq. and Output current) 3 : Bar graph (Output freq. and Motor torque) 4 : Bar graph (Driving torque and Braking torque)	–	0
65 PATTERN	0 : Inactive 1 : Mono cycle 2 : Continuous cyclic 3 : Mono cycle with continuous 7th speed	–	0
66 STAGE 1 67 STAGE 2 68 STAGE 3 69 STAGE 4 70 STAGE 5 71 STAGE 6 72 STAGE 7	Operation time : 0.00 – 6000 s Code FWD/REV ACC/DEC F1 : FWD , ACC 1 / DEC 1 F2 : FWD , ACC 2 / DEC 2 F3 : FWD , ACC 3 / DEC 3 F4 : FWD , ACC 4 / DEC 4 R1 : REV , ACC 1 / DEC 1 R2 : REV , ACC 2 / DEC 2 R3 : REV , ACC 3 / DEC 3 R4 : REV , ACC 4 / DEC 4	s –	0.00 F1
73 ACC PTN	0 : Linear 1 : S-curve 2 : Non-linear	–	0
74 SERIES BRK	0 : Inactive 1 : Active	–	0
75 ENERGY SAV	0 : Inactive 1 : Active	–	0 (1)
76 REV LOCK	0 : Inactive 1 : Active	–	0
77 DATA INIT	0 : Manual setting value 1 : Return to factory setting value	–	0
78 LANGUAGE	0 : Japanese 1 : English	–	1
79 BRIGHTNESS	0 (Bright) to 10 (Dark)	–	5

*** : Standard value of FUJI 4P motor
*1 : Value in ( ) is setting for P9S series.

Function LCD Display	Setting range	Unit	Factory setting
80 ■ 81-94 ■	0 : Not displays FUNCTION CODE 81 to 94 1 : Displays FUNCTION CODE 81 to 94	–	0
81 MTR SOUND	0 (Low carrier) to 10 (High carrier)	–	10
82 RESTART t	0.0 to 5.0 s		0.1
83 FALL RATE	0.00 to 100.00	Hz	10
84 AUTO-RESET	0 to 7	–	0
85 RESET INT	2 to 20 s	–	5
86 MOTOR CAP	0 : 1-frame up capacity 1 : Standard capacity 2 : 1-frame down capacity 3 : 2-frame down capacity	–	1
87 MOTOR 1-Ir	Current value (A) setting	A	***
88 MOTOR 1-Io	Current value (A) setting	A	***
89 MOTOR 2-Ir	Current value (A) setting	A	***
90 TUNING	0 : Inactive 1 : Active	–	0
91 %R1 SET	Percent value setting	%	***
92 %X SET	Percent value setting	%	***
93 DD FUNC 1		–	
94 DD FUNC 2		–	
95 DATA PRTC	0 : Data changeable 1 : Change inhibited	–	0

A REVISED SHEET

P. 27

	Function		LCD Monitor	Setting range	Unit	Min. unit
	No.	Name		Up to 22kW		
Special Function 1	81	Motor sound (Carrier frequency)	81 MTR SOUND	0 (Low carrier) to 10 (High carrier) 11 (Lowest carrier)	– –	– –

P. 29

08

09

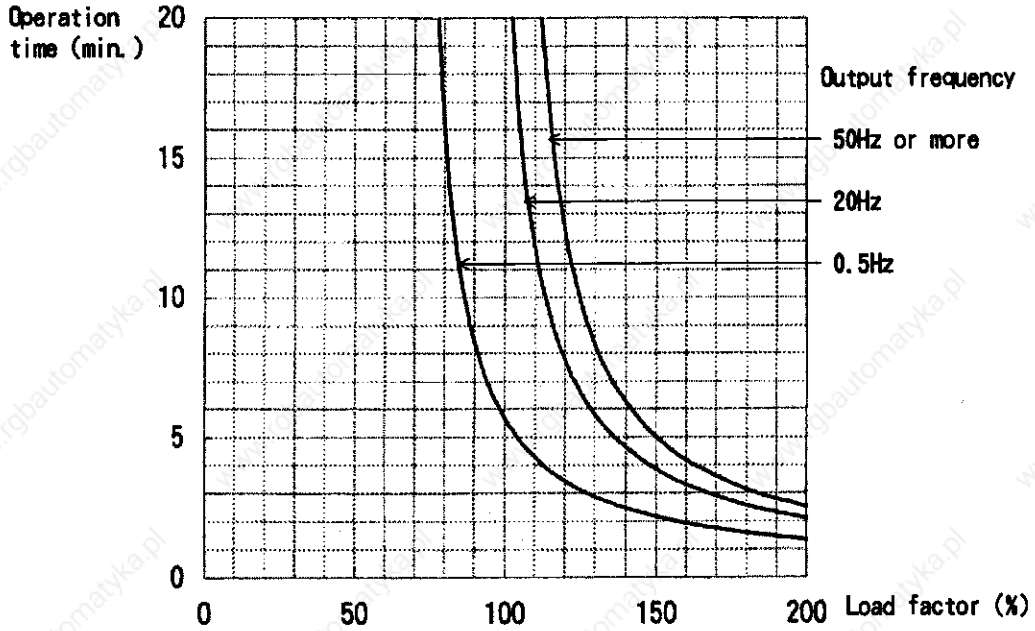
Electronic overload protection (Select)
ELECTRN OL
Electronic overload protection (Level)
OL LEVEL

● Selects whether the electronic overload protection is active or inactive, what type of motor is being used, and what the operation level is.

Select: 0: Inactive
1: Active (For Standard motor) Protection characteristic is Fig. 1.
2: Active (For Fuji inverter motor) Protection characteristic is only "50Hz or more" in Fig. 1 at every output frequency.

Level: The setting range is between 20 - 105% of the inverter's rated current.

Fig. 1 Electronic overload protection characteristic



P. 41

81

Carrier frequency (motor sound)
MTR SOUND

This function is only changeable if F80 "Function block (81 - 94) selection" has been set to "1".

● This function is used to adjust the carrier frequency for changing the motor sound noise and high-frequency noise.

0 (low carrier frequency) - 10 (high carrier frequency), 11 (lowest carrier frequency)
- When you want to reduce to the motor sound, set to 8 - 10.
- When you want to reduce to the high-frequency noise, set to 0 - 3 or 11.

⚠ CAUTION

When F81 "Carrier frequency (motor sound)" set to "11", the inverter output current contains a lot of higher harmonics, so should to reduce to the continuous output torque minimum 10 - 15%.

Si47-0326

12-6 Main circuit components and wire sizes

voltage	Nomal applied motor (kw)	Inverter type		MCCB, ELCB rated current			Input circuit MC			Output circuit M C	Recommended wire size (mm²)				
		G9S	P9S	Using DCR	Using ACR	Without DCR and ACR	Using DCR	Using ACR	Without DCR and ACR		Input circuit (R, S, T)		Output circuit (U, V, W)	DCR circuit (P1, 9(+))	DB circuit (P(+), DB P(-))
											Using DCR or ACR	Without DCR and ACR			
3 φ 200V Series	0.2	FVR0.2G9S-2	—	5	5	5	SC-05		SC-05	SC-05	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)
	0.4	FVR0.4G9S-2		5	5	5									
	0.75	FVR0.75G9S-2		5	5	10									
	1.5	FVR1.5G9S-2		10	10	15						3.5 (2.0)			
	2.2	FVR2.2G9S-2		10	15	20									
	3.7	FVR3.7G9S-2		20	20	30	SC-5-1		SC-5-1	SC-5-1	3.5 (2.0)	5.5 (2.0)	3.5 (2.0)	3.5 (2.0)	
	5.5	FVR5.5G9S-2	FVR5.5P9S-2	30	30	40	SC-1N		SC-1N	SC-1N	5.5 (2.0)	14 (3.5)	5.5 (2.0)	5.5 (3.5)	
	7.5	FVR7.5G9S-2	FVR7.5P9S-2	40	40	60	SC-2N		SC-2N	SC-2N	8 (3.5)	14 (5.5)	8 (3.5)	8 (5.5)	
	11	FVR11G9S-2	FVR11P9S-2	50	60	75	SC-2SN		SC-2SN	SC-2SN	14 (5.5)	38 (14)	14 (5.5)	22 (8)	
	15	FVR15G9S-2	FVR15P9S-2	75	75	100	SC-3N		SC-3N	SC-3N	22 (8)	60 (14)	22 (8)	38 (14)	
	18.5	FVR18.5G9S-2	FVR18.5P9S-2	100	100	125	SC-4N		SC-4N	SC-4N	38 (14)	60 (22)	38 (14)	38 (22)	3.5 (2.0)
	22	FVR22G9S-2	FVR22P9S-2	100	125	150	SC-5N		SC-5N	SC-5N		38 × 2(38)		60 (22)	
3 φ 400V Series	0.4	FVR0.4G9S-4	—	5	5	5	SC-05		SC-05	SC-05	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)	2.0 (2.0)
	0.75	FVR0.75G9S-4		5	5	5									
	1.5	FVR1.5G9S-4		5	5	10									
	2.2	FVR2.2G9S-4		10	10	15									
	3.7	FVR3.7G9S-4		10	15	15						3.5 (2.0)			
	5.5	FVR5.5G9S-4	FVR5.5P9S-4	15	15	20	SC-5-1		SC-5-1	SC-5-1	3.5 (2.0)	5.5 (2.0)	3.5 (2.0)	3.5 (2.0)	
	7.5	FVR7.5G9S-4	FVR7.5P9S-4	20	20	30									
	11	FVR11G9S-4	FVR11P9S-4	30	30	40	SC-1N		SC-1N	SC-1N	5.5 (2.0)	8 (3.5)	5.5 (2.0)	5.5 (3.5)	
	15	FVR15G9S-4	FVR15P9S-4	40	40	50	SC-2N		SC-2N	SC-2N	8 (2.0)	14 (5.5)	8 (2.0)	8 (3.5)	
	18.5	FVR18.5G9S-4	FVR18.5P9S-4	40	50	60	SC-2SN		SC-2SN	SC-2SN	14 (3.5)	22 (8)	14 (3.5)	14 (5.5)	
	22	FVR22G9S-4	FVR22P9S-4	50	60	75					14 (5.5)	38 (14)	14 (5.5)	14 (8)	

Notes :
- Series or frame size of MCCB or ELCB depends on the power source capacity. Select appropriate ones by referring to relevant product catarog or technical literature. Select the ELCB sensitive current accoding to the technical literature as well.
- The rated current of the MCCB, ELCB on this table indicates when MCCB SA□B/□ or ELCB SA□R/□ is used.
- The wire size recommended under the 50℃ panel inside temperature is indicated.
- The data of 600V IV insulation wires are indicated. Values surrounded with parentheses ( ) are those for 600V cross-linking polyethylene wires.
- The power impedance without DCR or ACR is assumed equivalent to 0.1% when converted to the inverter capacity. Current unbalance accompanying voltage unbalance is estimated at 10%.
- If conditions like ambient temperature or the power supply voltage are different, the data on the above table may differ.
- For the crimping terminals, use Crimp terminal CB150-10 for Low voltage Equipment under JEM 1399.

Circuit breaker	Used to protect the main circuit up to the inverter and turn the power on and off. The rated current and the interrupting capacity depend on the power supply specifications.
Line side AC reactor (AC reactor)	Use a line side AC reactor : ① When the power supply capacity exceeds 500kVA. ② When a thyristor converter acd the inverter unit are connected to the same bus, or ON/OFF of power-factor correcting capacitor connected on power supply side is necessary. ③ When imbalance in power supply voltage exceeds 3%. Imbalance rate of input power supply voltage (%). $= \frac{\text{Max. voltage (V)} - \text{Min. voltage(V)}}{\text{3-phase average voltage (V)}}$ ④ Correct inverter power power-factor so that it will be between 0.75 to 0.85.
Magnetic contactor	Inverter can be operated even when a magnetic contactor is not cannected. The magnetic contactor is used to turn the power off for safety when inverter protective function is activated.
Surge suppressor	Connected to suppress surge generated when the exciting coil of magnetic contactor or control relay is energized.
RFI suppressing reactor	Used to suppress radio frequency noise when radios or electronic devices nearby inverter receives noise interference.
Power-factor correcting DC reactor (DC reactor)	Correct inverter power power-factor so that it will be between 0.94 to 0.95.
Braking unit and braking resistor	Connected when large braking torque is required.
Frequency setting POT	Connected to the control circuit terminals to set frequency.
Extension cable for keypad panel	Used when the keypad panel is removed from the inverter and mounted on the switchboard.
Main ircuit wiring	Used to connect power supply, inverter output, DC reactor, braking unit • braking resistor, grounding terminals.