

Instruction Manual

FUJI INVERTERS

FRENIC **5000G9S**

**For general industrial
machines**

200V series FRN30G9S-2
 FRN37G9S-2
 FRN45G9S-2
 FRN55G9S-2
 FRN75G9S-2
 FRN90G9S-2

400V series FRN30G9S-4
 FRN37G9S-4
 FRN45G9S-4
 FRN55G9S-4
 FRN75G9S-4
 FRN90G9S-4
 FRN110G9S-4
 FRN132G9S-4
 FRN160G9S-4
 FRN200G9S-4
 FRN220G9S-4

FRENIC **5000P9S**

For fans and pumps

200V series FRN30P9S-2
 FRN37P9S-2
 FRN45P9S-2
 FRN55P9S-2
 FRN75P9S-2
 FRN90P9S-2
 FRN110P9S-2

400V series FRN30P9S-4
 FRN37P9S-4
 FRN45P9S-4
 FRN55P9S-4
 FRN75P9S-4
 FRN90P9S-4
 FRN110P9S-4
 FRN132P9S-4
 FRN160P9S-4
 FRN200P9S-4
 FRN220P9S-4
 FRN280P9S-4

Information in this manual is subject to change without notice.
Units used in this manual are SI UNIT (International System of Units).

Should further information be desired or should particular problems arise which are not covered sufficiently for the purchasers purposes, the matter should be referred to Fuji Electric Co.,Ltd.

Foreword

The FRENIC5000G9S and FRENIC5000P9S inverters are used to operate motor in variable speed. Read carefully all of this Instruction Manual before use and preserve it for use.

Use this equipment correctly. Misuse may result in abnormal operation or cause troubles and reduction of life. When necessary, read this Instruction Manual repeatedly even if after reading. Therefore, keep this Instruction Manual where the operator can refer to it.

This Instruction Manual does not purport to cover the treatment of the inverter when using such as the control option cards. The treatment of the option including the inverter is described on Instruction Manuals of the options

Safety

The following format is used on the equipment or found in this manual. Read all of safety information and follow the directions on them whenever working on the equipment.

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 MANUAL

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

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1 Safety Precautions

WARNING

Improper lifting practices can cause serious or fatal injury. Lift only with adequate equipment and trained personnel.

Carry the inverter only by the body, not by the terminals or top cover. Equipment movement should only be performed by trained personnel.

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.

Before disassembling for connection, inspection and removing abnormality cause, disconnect and lock out power from the inverter. Failure to disconnect power may result in death or serious injury. A DC link circuit charge light provides visual indication that DC link voltage is present with the charged DC link capacitor; verify the DC link voltage level by measuring the voltage between power terminals P(+) and N(-) using an analog meter. Do not attempt to service the inverter until the charge indicator has extinguished and DC link voltage has discharged to zero volts.

All motor bases and equipment enclosure housings should be grounded through ground terminals E(G) in accordance with the National Electric Code or equivalent to avoid a disaster such as electric shock and fire.

Replace all covers before applying power to the inverter. Failure to do so may result in death or serious injury.

Do not touch the electrical circuits or parts, or do not insert foreign bodies through the openings when applying power. It may result in electrical shock, burn by generated arc, and damage of the equipment.

When an abnormality occurs and is spreading, disabling to insure safety, or causing or being afraid of causing a disaster such as fire, promptly switch OFF the circuit breaker on the power supply side.

Inverter systems cause mechanical motion and are located in various locations. It is the responsibility of the user to insure that such motion does not result in an unsafe condition. Factory provided interlocks and operating limits should not be bypassed or modified.

Mis-setting of the function data may cause dangerous conditions. Therefore, after setting and writing the data, verify the data again.

Because the maximum output frequency is 400 Hz in G9S series, and 120 Hz in P9S series, mis-setting of the frequency may lead to several times (7 to 8 times in G9S series and 2 to 2.4 times in P9S series) as large as the rated speed of motors of general market. Never operate the motor above its top mechanical speed or a catastrophic failure may occur. Take a safety measure such as writing the safety frequency in the function "11 Frequency limiter (Upper)" to insure safety.

Bias is operational only when frequency setting method is analog (the data of "01 Frequency command" is 1 or 2). When bias is operational (the data of "13 Bias frequency" is other than zero) and the analog setting frequency is zero, the LED indicates the bias frequency. When a RUN command is given, the motor runs at the bias setting though the set frequency is zero.

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 manufacturer's instruction book for proper operation and adjustment to the instrument.

 **CAUTION**

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

Do not install the inverter up-side-down, horizontally or slantwise, heat build-up will occur.

Incorrect connections may cause damages the inverter as well as its improper operation.

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.

Do not connect power supply to the output terminals (U, V, W), the DC link terminals (P1, P(+)), or the Braking unit terminals (P(+), N(-)). Connect only to the main power supply terminals (R, S, T).

Do not connect filter capacitors on the output side of the inverter. The capacitors and inverter will be overheated and damaged due to harmonics.

Do not connect the inverter to an AC power supply of a larger capacity than 10 times of the inverter rated capacity (the inverter for 30 kW motor not to a power supply of larger than 500kVA), or of larger imbalance of voltages than 3 %. If connecting the inverter to these power supply, optional DC link reactors will have to be installed in P1 & P(+) power leads of the inverter.

Use only the ground terminal E(G) for grounding. The other grounding method causes a grounding defect.

Do not connect the auxiliary control power input terminals (R0, T0) to the other power supply system than that of the main circuit. The power supply capacity supplied through the terminals (R0, T0) is for operating the protection function and displaying. Therefore, if this voltage is higher than that of the main power supply voltage, the control power supply may overheat because of supplying power also to the control circuit.

Do not connect a power supply to the control circuit terminals (except 30A, B, C, AX1 and AX2, maximum rating 250 volts).

When using the open-collector output terminals (Y1, Y2, Y3, Y4, Y5 and CME), verify that the polarity of the power supply connections are correct. Damage due to voltage, etc, may occur, if polarity is incorrect.

Connect a braking resistor to a braking unit. If connecting the braking resistor directly to the inverter, the inverter and braking resistor may overheat and cause a disaster such as fire.

Use care when applying DC braking since motor currents and temperature can build up to very high levels in a short period of time possibly resulting in motor damage.

Motor may overheat if the DC braking is left ON for too long.

If the alarm cause is not recovered though resetting the alarm, repeating reset may enlarge the damage. The data of "84 Auto-reset (Times)" should be as few as possible.

AC induction motors require that they shall be sized based on the applications speed range and associated torque requirements for the motor-inverter system. This is to avoid excessive motor heating. Observe motor manufacturers recommendations when operating any AC induction motor with the inverter. Also observe motor manufacturer's recommended voltage/torque boost at lower operating frequencies.

For RUN and STOP, use the FWD-CM (forward) and REV-CM (reverse) terminals, or the RUN and STOP keys on the keypad panel. Do not use a contactor (ON/OFF) installed on the line side of the inverter for RUN and STOP.

If the inverter's Fault Alarm is activated, consult the Troubleshooting section of this instruction manual, and after correcting the problem, resume operation. Do not reset the alarm automatically by external sequence, etc.

The cooling fins of the inverter are heated to a high temperature in inverter operation, and touching the fins may cause burn. Keep a sufficient time after stopping the inverter when touching the fins.

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

⚠ CAUTION

This assembly contains parts and sub-assemblies that are sensitive to electrostatic discharge. Static control precautions are required when servicing this assembly. Component damages may result if you ignored electrostatic discharge control procedures.

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

2 Inspection Procedure upon Delivery

⚠ WARNING

Improper lifting practices can cause serious or fatal injury. Lift only with adequate equipment and trained personnel.

Upon receipt of your inverter, unpack and inspect the equipment for the following items:

- Check the nameplate on the front cover to insure that the specifications correspond to those ordered.
- Inspect if shipping damage such as damage or fall-off of the parts and depression of the cover or body.

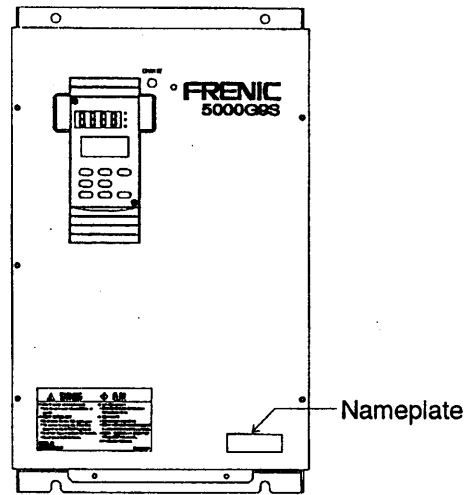


Fig. 2-2 Position of the nameplate

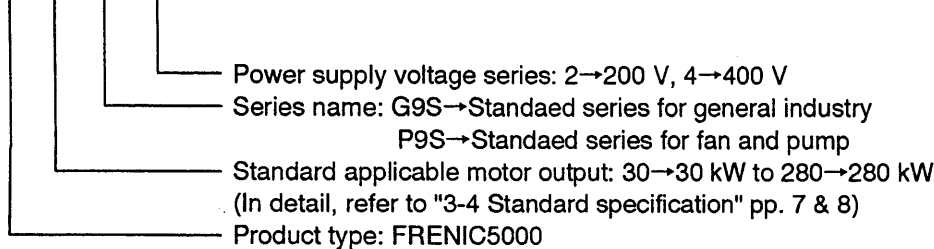
Fig. 2-1 Nameplate

TYPE	FRN30G9S-2		FUJI	
SOURCE	3φ	200-210/200-230V	50/60Hz	
OUTPUT	44	kVA	115	A 0. 2-400 Hz
MASS	31	kg		
SER.NO	57HB12345R678-9H			
Fuji Electric Co.,Ltd.		Made in Japan		

- ← Inverter type
- ← Rated input voltage and frequency
- ← Rated capacity, rated output current and output frequency range
- ← Mass
- ← Manufacturer's serial number

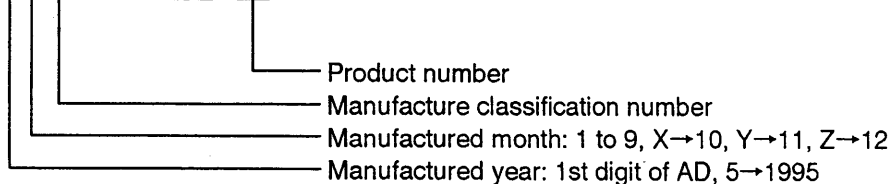
Inverter type designation

FRN 30 G9S - 2



Manufacturer's serial number

5 7 HB12345R678 - 9H



3 Description, Specification and Component Identification

3-1 Description

FRENUC5000G9S and FRENIC5000P9S serieses were developed on the concept that the inverters are "Human-friendly, Wise, and Powerful". The features of these inverters are shown as follows:

The data necessary for the inverter operation are set and written with the keypad panel attached on the front cover of the inverter, and monitored with the interactive display. The display consists of LED and LCD. LED display indicates operation data and alarm names (codes), and LCD display indicates operation guides, function data, input/output signal status , maintenance information, alarm data, etc. The inverter is operated by these data written from the keypad panel and input signals or commands from the control terminals.

Fuji Electric has developed an exclusive "Torque vector control" based on the inverter vector control to improve torque characteristics. By adoption of this torque vector control, the motor can powerfully operate since the motor torque is utilized to the maximum extent. Furthermore, when using the built-in auto-tuning function, the motor constants necessary for torque vector control are automatically measured in a short time without rotating the motor.

Motor operating sound can be reduced and selected by adjustment of a carrier frequency owing to adoption of the latest IGBT.

Scopes of these serieses are shown as follows:

FRENIC5000G9S series: for general industrial machines

Voltage series	Standard applicable motor
200V	0.2~90kW
400V	0.4~220kW

FRENIC5000P9S series: for fans and pumps

Voltage series	Standard applicable motor
200V	5.5~110kW
400V	5.5~280kW

NOTE : This instruction manual describes about both serieses for standard applicable motors of 30 kW or greater. As to the equipment for the motors of 22 kW or smaller, refer to the instruction manual No. Si47-0231.

3-2 Wishes for reference

If there are any problems such as damage or failure of the equipment and questions, contact the distributor where the inverter was purchased or the Company's sales office nearby with following items.

- Inverter type
 - Manufacturer's serial number
 - Purchased time
 - Content of inquiry
- For example, indicating the location and degree of the damage, the phenomenon and conditions of the failure, the questions, etc.

3-3 Product warranty

The warranty term of the product is till earlier time either after 12 months from mounting by the customer or after 24 months from delivery of the Company.

However, even during the warranty term, the repair is paid for a counter value in the following cases:

- Caused by misusage or inadequate repair and alternation
- Used in the range over the standard specification
- Caused by damage by dropping or during transportation after purchase
- Caused by earthquake, fire, storm and flood, lightning, abnormal voltage, the other natural disaster, and their secondary disaster

3-4 Standard specifications

Table 3-4-1 Standard specifications of 200 V series

Standard applicable motor [kW]		30	37	45	55	75	90	110
G9S series	Type	FRN30 G9S-2	FRN37 G9S-2	FRN45 G9S-2	FRN55 G9S-2	FRN75 G9S-2	FRN90 G9S-2	————
	Rated capacity [kVA]*1)	44	55	69	82	108	132	————
	Rated output current [A]	115	145	180	215	283	346	————
	Overload capability	150% of rated current for 1min, 180% of rated current for 0.5s						
	Starting torque	150% or more (at torque vector control)						
	Watts loss [kW]	1.3	1.6	1.9	2.2	2.9	3.4	————
	Mass [kg]	31	40	53	56	75	140	————
P9S series	Type	FRN30 P9S-2	FRN37 P9S-2	FRN45 P9S-2	FRN55 P9S-2	FRN75 P9S-2	FRN90 P9S-2	FRN110 P9S-2
	Rated capacity [kVA]*1)	44	55	69	82	108	132	158
	Rated output current [A]	115	145	180	215	283	346	415
	Overload capability	120% of rated current for 1min						
	Starting torque	50% (at torque vector control)						
	Watts loss [kW]	1.3	1.6	1.9	2.2	2.9	3.4	4.0
	Mass [kg]	31	31	41	53	75	140	140
Output ratings	Voltage, Frequency	3-phase 200V/50Hz 200, 220, 230V/60Hz *2)						
	Volt/Freq characteristic	160 to 240V at base frequency, adjustable						
Input ratings	Voltage, Frequency	3-phase, 200 to 210V/50Hz, 210 to 230V/50Hz, 200 to 230V/60Hz						
	Variations	Voltage: +10 to -15%, Imbalance in power supply voltage: 3% or less, *3) Frequency: +5 to -5%						
	Momentary voltage dip *4)	When the input voltage dips to 165 V AC or higher, the inverter continuously operate. When the input voltage dips from the rated voltage to lower than 165 V AC, the inverter can operate for 15 ms with 85% full load applied.						

Table 3-4-2 Standard specifications of 400 V series

Standard applicable motor [kW]		30	37	45	55	75	90	110	132	160	200	220	280
G9S series	Type	FRN30 G9S-4	FRN37 G9S-4	FRN45 G9S-4	FRN55 G9S-4	FRN75 G9S-4	FRN90 G9S-4	FRN110 G9S-4	FRN132 G9S-4	FRN160 G9S-4	FRN200 G9S-4	FRN220 G9S-4	————
	Rated capacity [kVA]*1)	46	57	69	85	114	134	160	193	232	287	316	————
	Rated output current [A]	60	75	91	112	150	176	210	253	304	377	415	————
	Overload capability	150% of rated current for 1min, 180% of rated current for 0.5s											
	Starting torque	150% or more (at torque vector control)											
	Watts loss [kW]	1.2	1.4	1.6	1.9	2.3	2.7	3.0	3.4	4.0	4.6	5.0	————
	Mass [kg]	33	34	40	43	56	85	85	115	120	172	172	————
P9S series	Type	FRN30 P9S-4	FRN37 P9S-4	FRN45 P9S-4	FRN55 P9S-4	FRN75 P9S-4	FRN90 P9S-4	FRN110 P9S-4	FRN132 P9S-4	FRN160 P9S-4	FRN200 P9S-4	FRN220 P9S-4	FRN280 P9S-4
	Rated capacity [kVA]*1)	46	57	69	85	114	134	160	193	232	287	316	400
	Rated output current [A]	60	75	91	112	150	176	210	253	304	377	415	520
	Overload capability	120% of rated current for 1min											
	Starting torque	50% (at torque vector control)											
	Watts loss [kW]	1.2	1.4	1.6	1.9	2.3	2.7	3.0	3.4	4.0	4.6	5.0	6.0
	Mass [kg]	33	33	34	40	43	56	85	85	115	120	172	172
Output ratings	Voltage, Frequency	3-phase 380, 400V/50Hz 380, 400, 440, 460V/60Hz *2)											
	Volt/Freq characteristic	320 to 480V at base frequency, adjustable											
Input ratings	Voltage, Frequency	3-phase, 380V/50Hz, 400 to 420V/50Hz 380 to 420V/60Hz, 440 to 460V/60Hz											
	Variations	Voltage: +10 to -15%, Imbalance in power supply voltage: 3% or less, *3) Frequency: +5 to -5%											
	Momentary voltage dip *4)	When the input voltage dips to 310 V AC or higher, the inverter continuously operate. When the input voltage dips from the rated voltage to lower than 310 V AC, the inverter can operate for 15 ms with 85% full load applied.											

Table 3-4-3 Common specification

Control	Control method	Sinusoidal PWM control (with torque vector control)	
	Output frequency	Maximum Freq.	G9S: 50 to 400Hz P9S: 50 to 120Hz
		Base Freq.	G9S: 50 to 400Hz, P9S: 50 to 120Hz
		Starting Freq.	0.2 to 60Hz
		Accuracy (Stability)	Analog setting: $\pm 0.2\%$ of maximum frequency (at $25 \pm 10^\circ\text{C}$) Digital setting: $\pm 0.01\%$ of maximum frequency (at -10 to $+50^\circ\text{C}$)
		Setting resolution	Analog setting: 1/3000 of maximum frequency (EX. 0.02Hz/60Hz, 0.05Hz/150Hz) Digital setting: 0.01Hz at maximum frequency of up to 99.99Hz, 0.1Hz at maximum frequency of 100.0Hz or more
	Acceleration/ deceleration time	0.01 to 3600s : Independently adjustable acceleration and deceleration, 4 kinds selectable Mode select: Linear, S-curve and Non-linear acceleration/deceleration	
Torque boost	Automatic: Optimum adjustment according to load torque (Motor impedance is set with auto-tuning) Manual: Code selection (0.1 to 20.0), including the save energy pattern for variable torque load		
Standard functions	Frequency limiter, Bias frequency, Gain for frequency setting, Frequency jump control, Rotating motor pick up, Auto-restart after momentary power failure, Switching operation from line to inverter, Slip compensation, Torque limiting, Automatic deceleration control, 2nd V/f setting, Energy saving operation		
Braking	Standard	Capacitor regenerative braking: 10 to 15% of standard applicable motor rated torque DC injection braking: Starting frequency: 0 to 60Hz, Braking time: 0 to 30s, Braking level: 0 to 100% of rated current	
	Option	Using braking unit and braking resistor: 100% of standard applicable motor rated torque, Duty cycle: 5% ED, Time: 5 s, Using regenerative braking unit: 150%, 1 min, 75% continuous	
Operation	Operation method	Key operation: RUN or STOP key, Terminal input: Forward/Reverse commands, Coast-to-stop command, etc. Remote operation: Serial signals using option card.	
	Frequency setting	Key operation: UP or DOWN key, Terminal input: Multi-step frequency, UP/DOWN control, Analog signals: Potentiometer, DC 0 to ± 10 V, DC 4 to 20 mA Digital signals: 12 bits parallel signal and serial signal using option cards	
	Running status signal	Contacts: Magnet contactor open command, Alarm output (Any fault) Open correctors: RUN, FAR, FDT LEVEL, etc. (15 kinds selectable) Analog: Output frequency, Output current, Torque, Load factor selectable (DC 0 to 10 V) Pulse: Output frequency (Pulse frequency output)	
Indication	Digital display (LED)	In operation: Output frequency, Output current, Output voltage, Rotating speed, etc. (8 kinds selectable) In frequency setting: Setting frequency In alarm mode: Alarm code	
	LCD display	Operation information, Operation guide, Function code, Name, Data, Alarm information, etc.	
	Lamp indication (LED)	Charging (Voltage exists), Units of operation data, Operation right of keypad panel, Operation indication	
Protection		Overcurrent, Grounding, Fuse blown, Overvoltage, Undervoltage, Overload, Overheat, Motor overload, External alarm, CPU/Memory error, Keypad panel communication error, Inverter output circuit abnormal, Protection from stalling, Surge protection	
Condition	Installation location	Indoor, less than 1000 m elevation, not in contact with corrosive gas, inflammable gas, oil mist, dust, and direct sunlight	
	Ambient temperatur	-10 to $+50^\circ\text{C}$	
	Ambient humidity	20 to 90% RH (non-condensing)	
	Vibration	5.9m/s ² {0.6G} or less	
	Storage temperature	-20 to $+65^\circ\text{C}$ (Short period like transportation)	
Enclosure		IP00 (with protection case), IP20 is option	
Cooling method		Forced ventilation	

NOTE: *1) indicates rated capacity for 200V series when rated output voltage is 220V, and for 400V series when rated output voltage is 440V.

*2) Output voltage cannot exceed the power supply voltage.

*3) When the imbalance of the power supply voltage exceeds 3%, install DC link reactors (reactor for power supply coordination) in U, V & W power leads of the inverter.

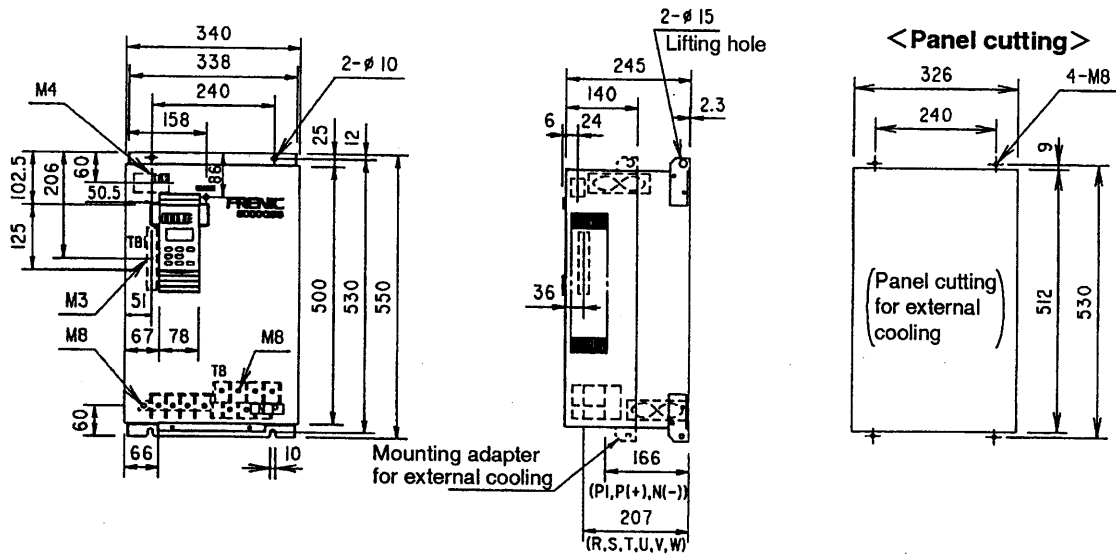
$$\text{Imbalance of the power supply voltage [\%]} = \frac{\text{Max. voltage [V]} - \text{Min. voltage [V]}}{\text{Average 3-phase voltage [V]}} \times 100$$

*4) This values are defined for testing at standard load condition by JEMA (85% of standard applicable motor load).

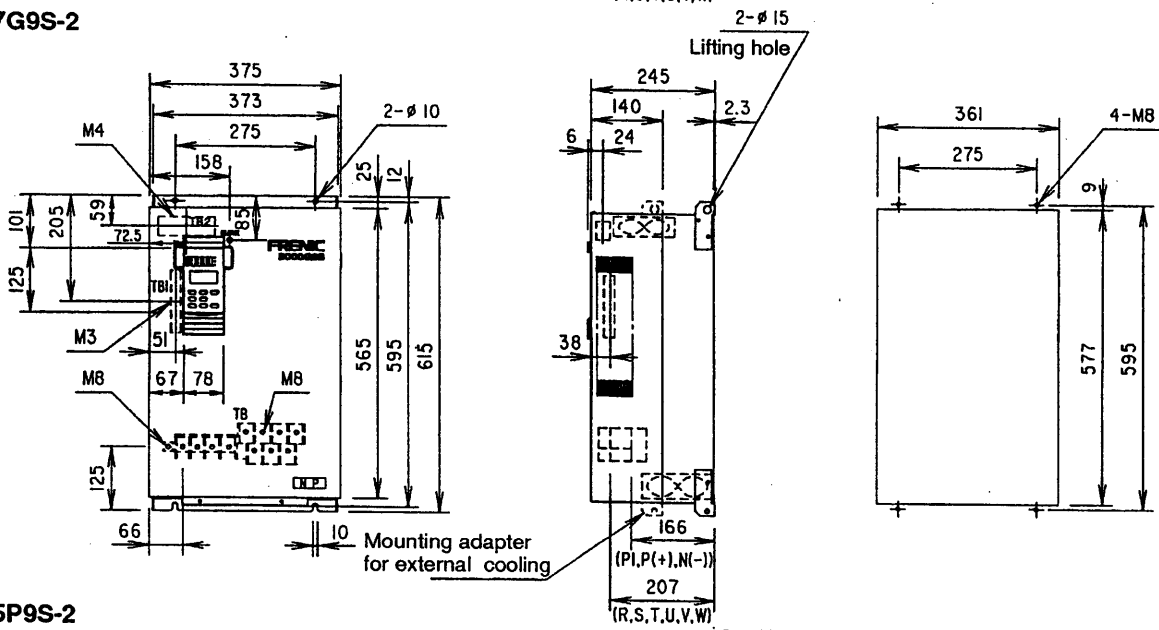
*5) The inverters for standard applicable motor of 75 kW or more attach a DC link reactor as standard (out-of-supply unit).

3-5 200V series dimensions

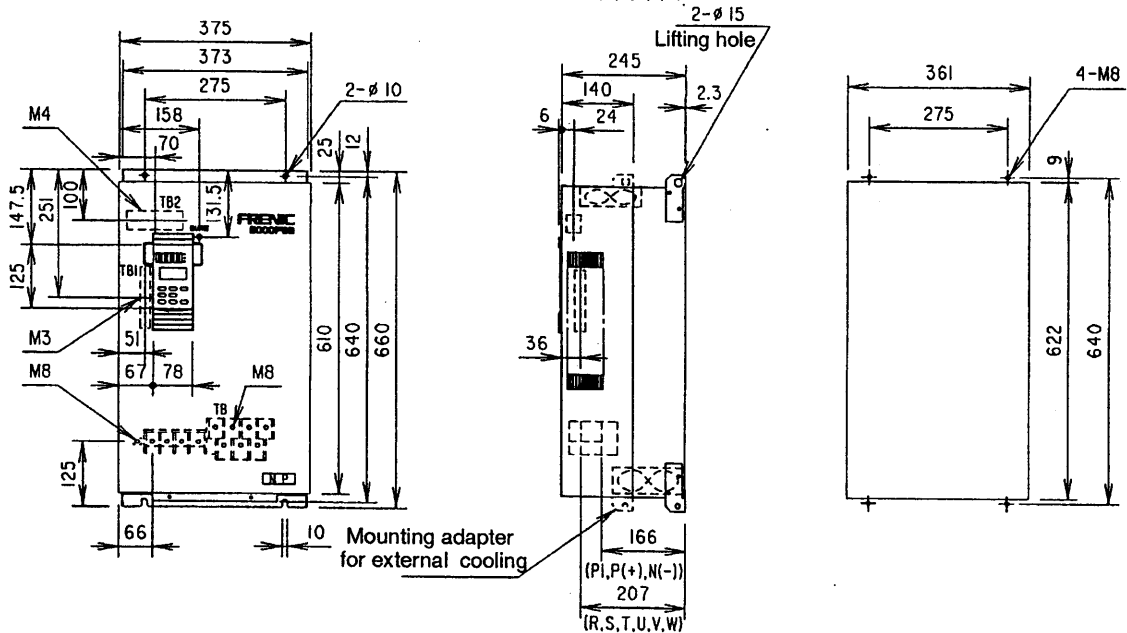
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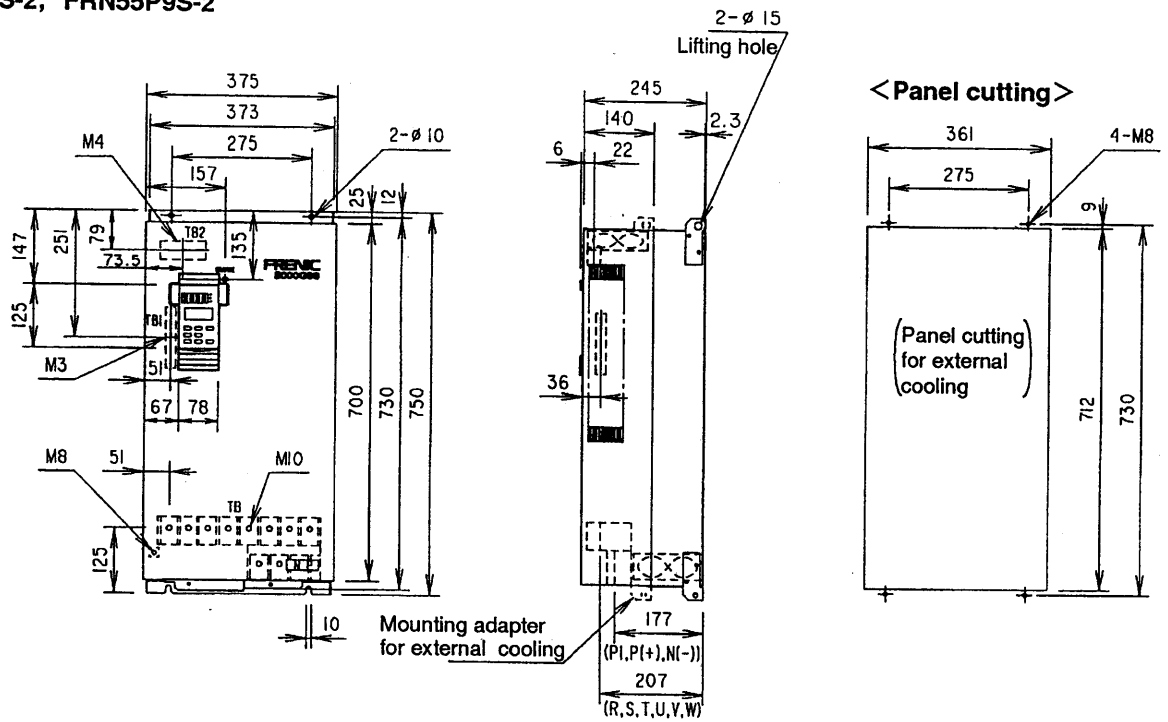
2) FRN37G9S-2



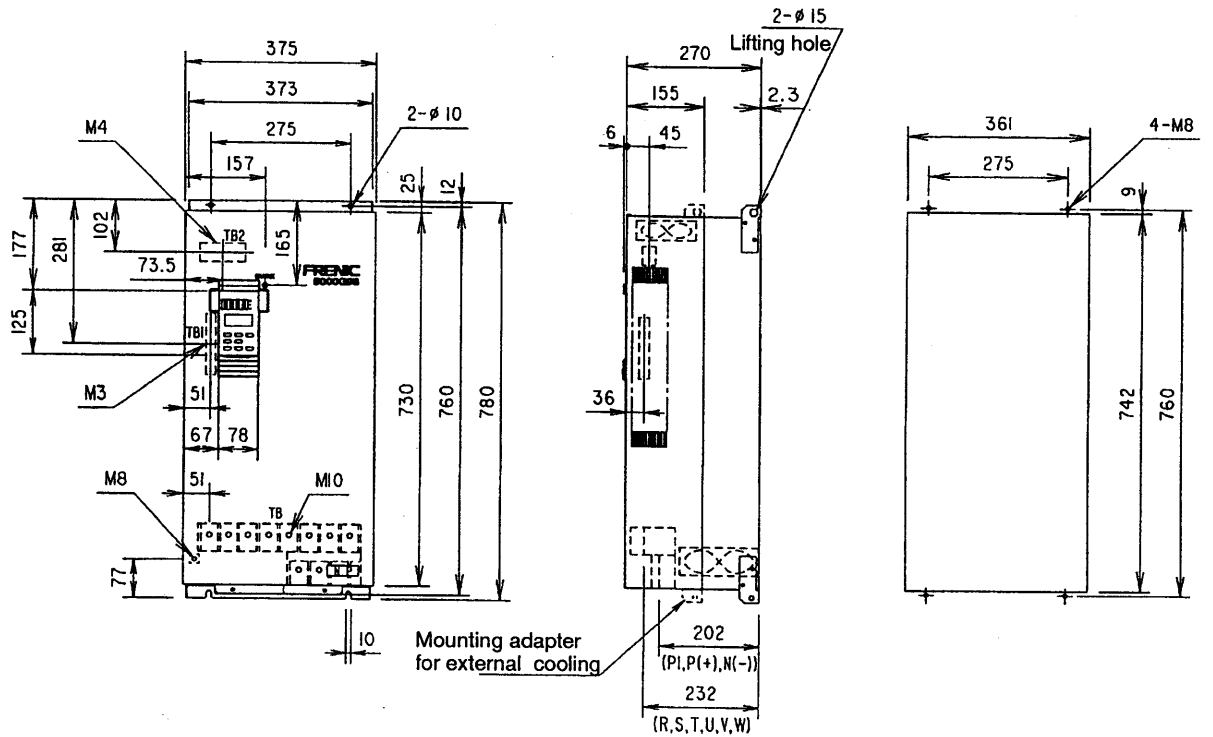
3) FRN45P9S-2



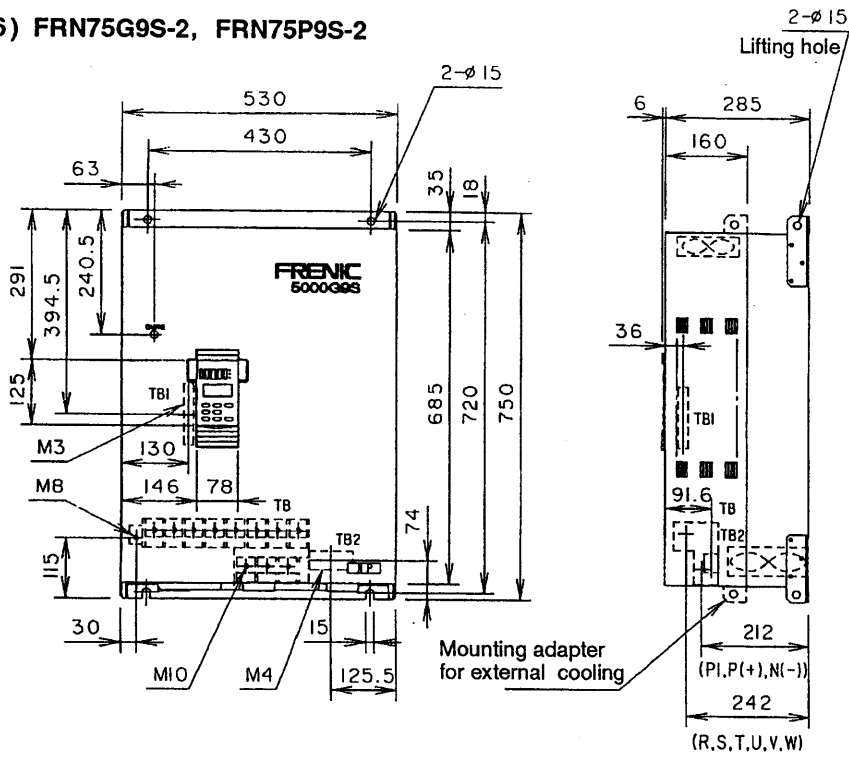
4) FRN45G9S-2, FRN55P9S-2



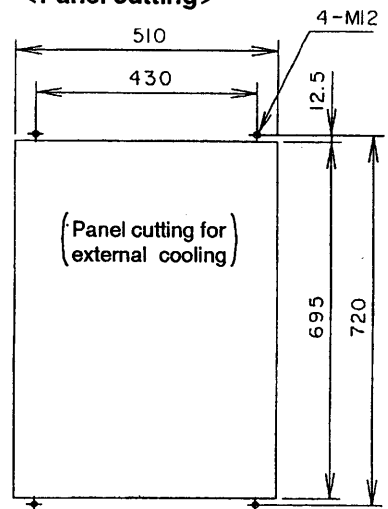
5) FRN55G9S-2



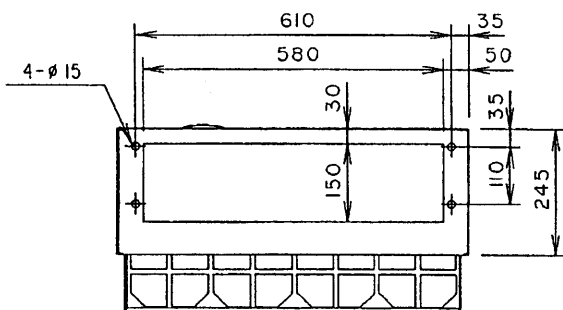
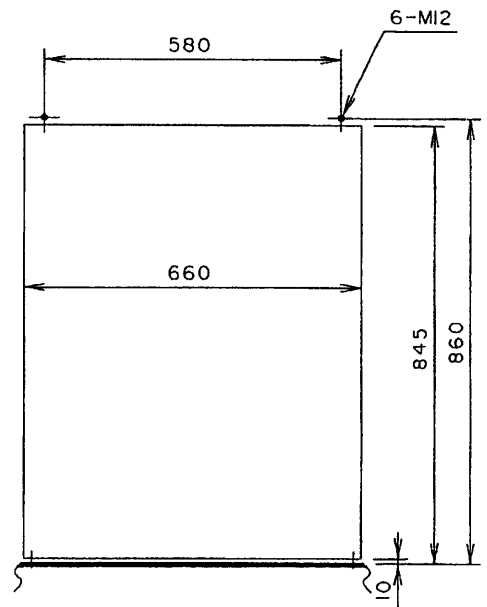
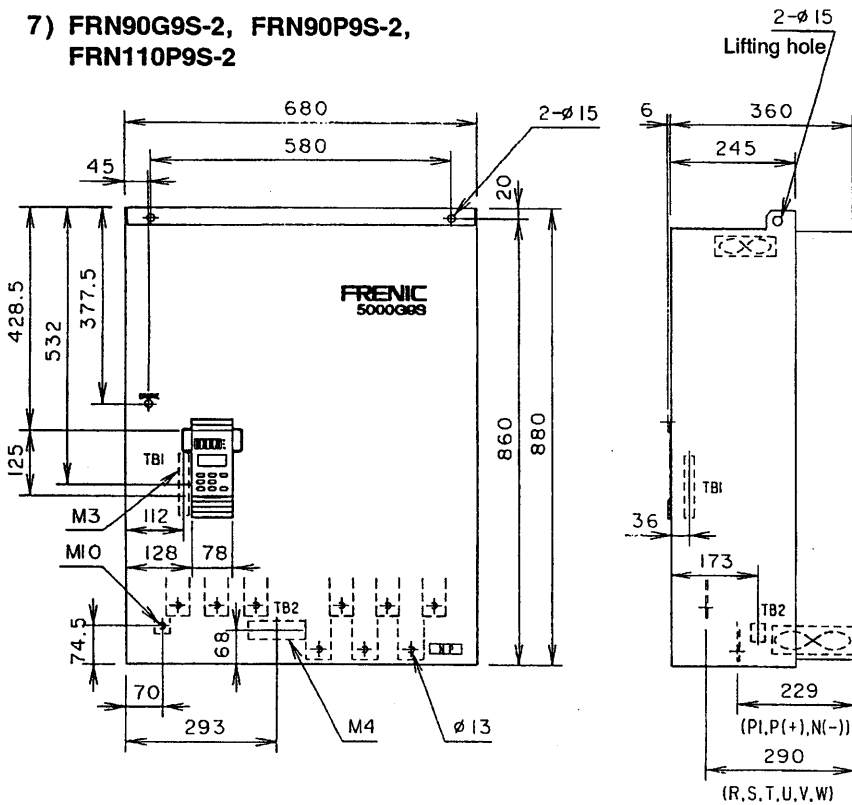
6) FRN75G9S-2, FRN75P9S-2



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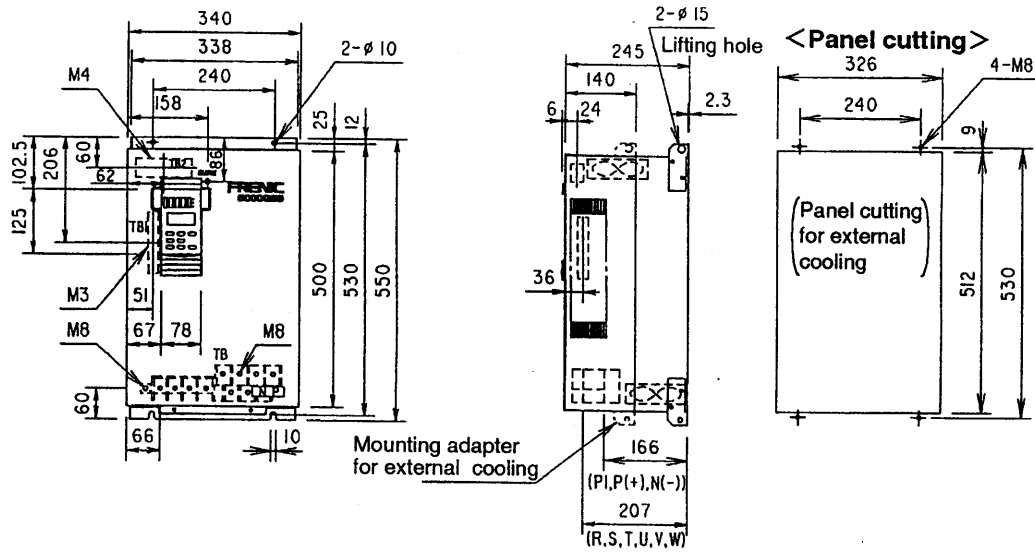


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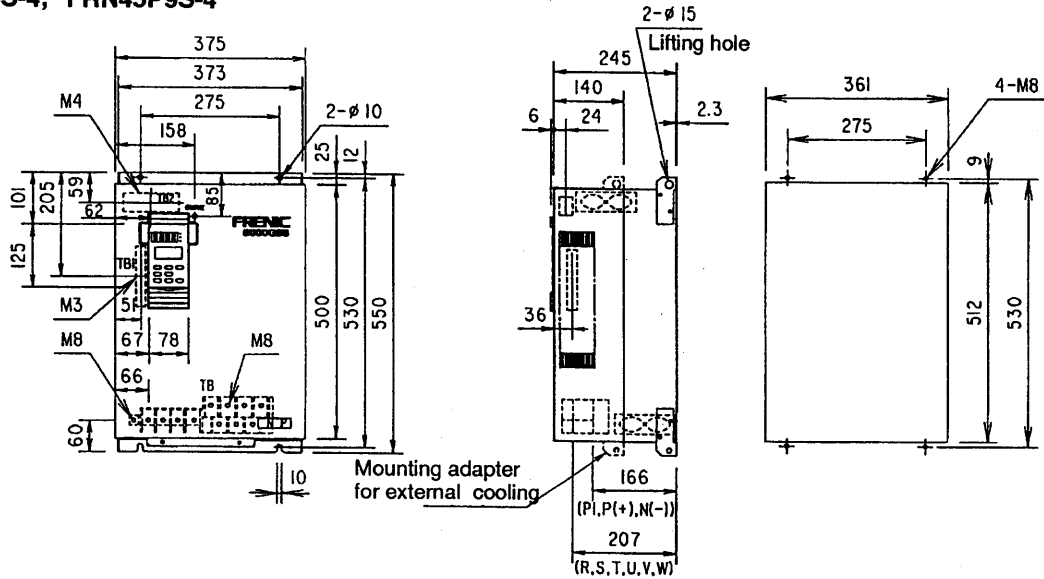


3-6 400V series dimensions

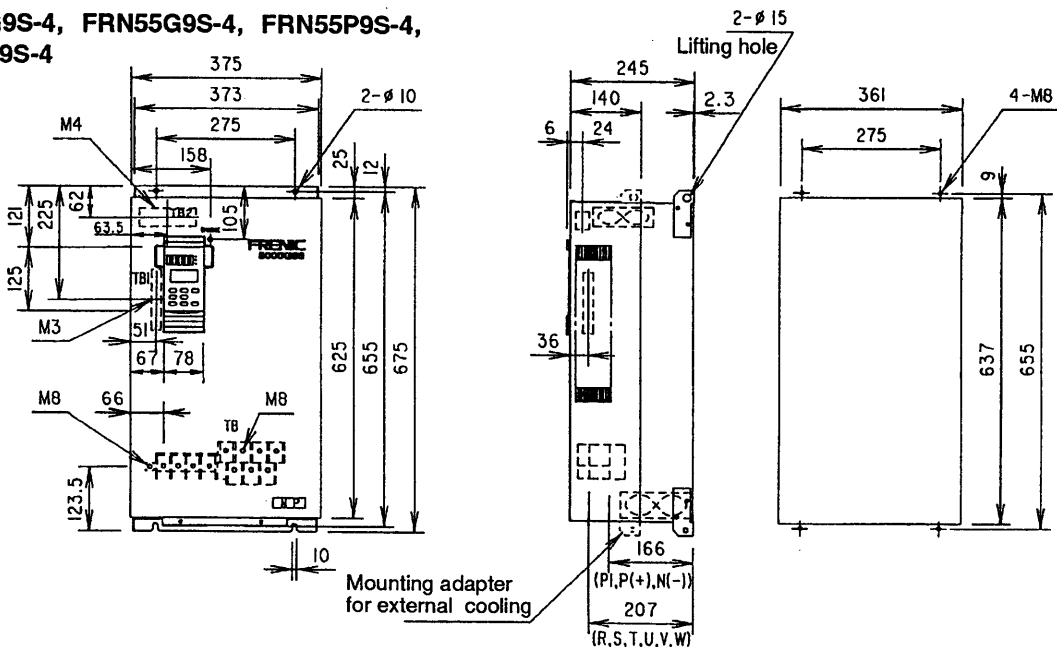
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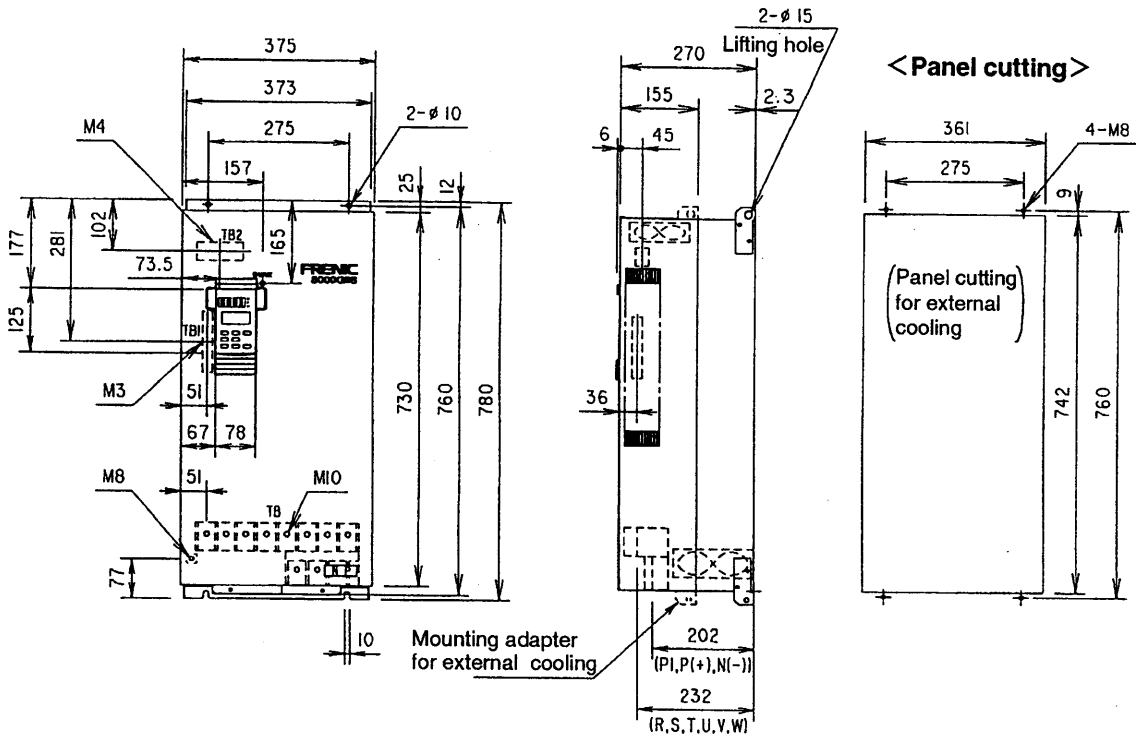
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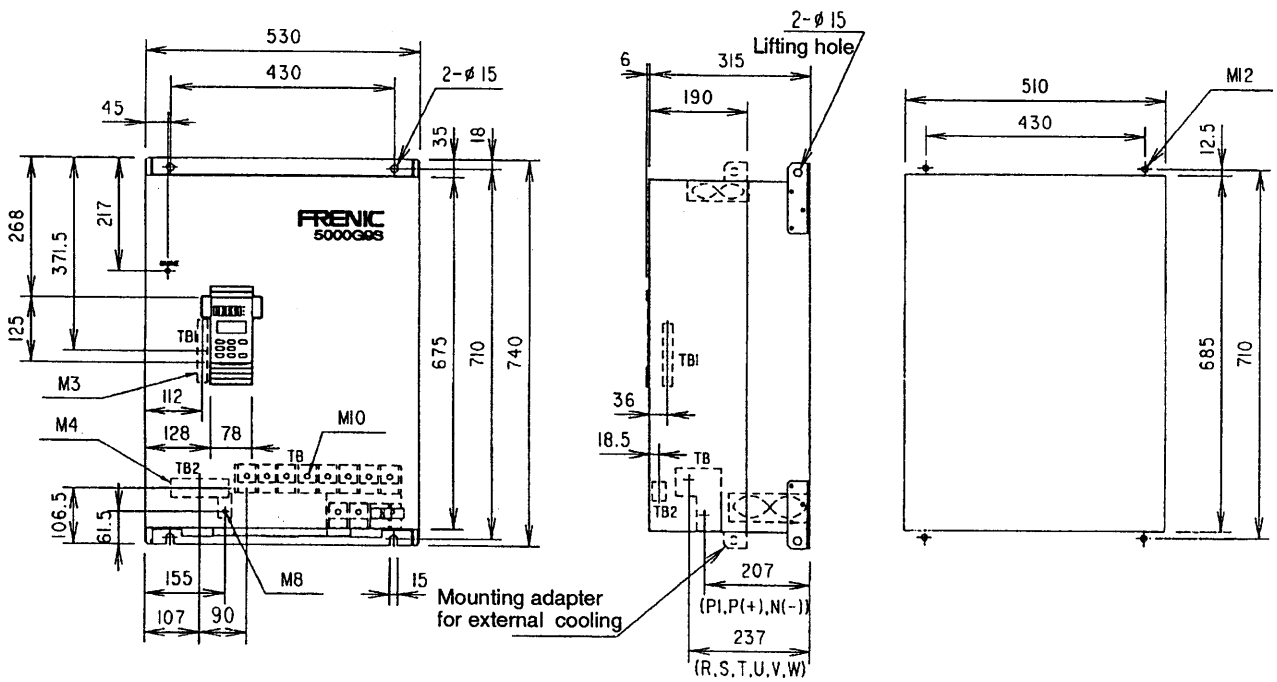
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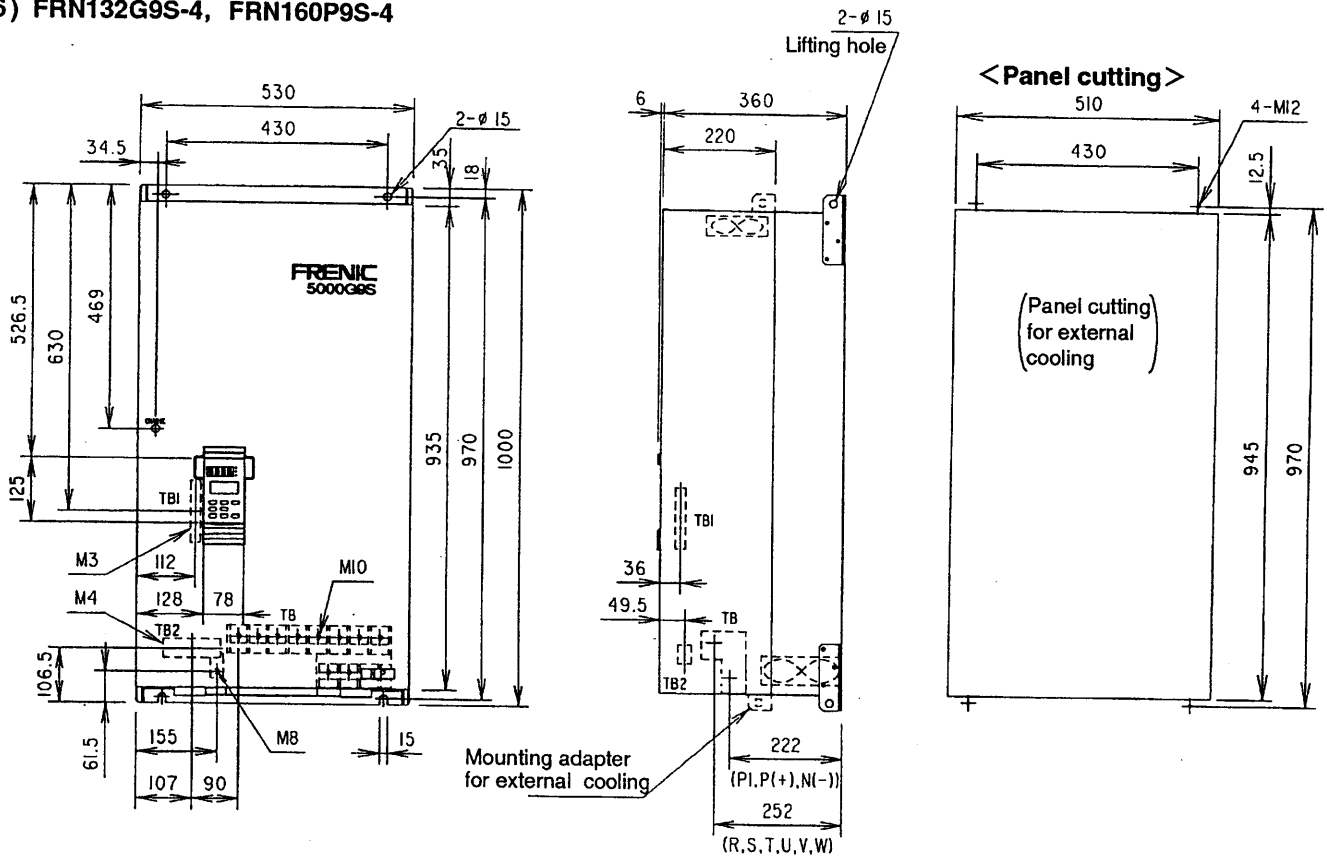
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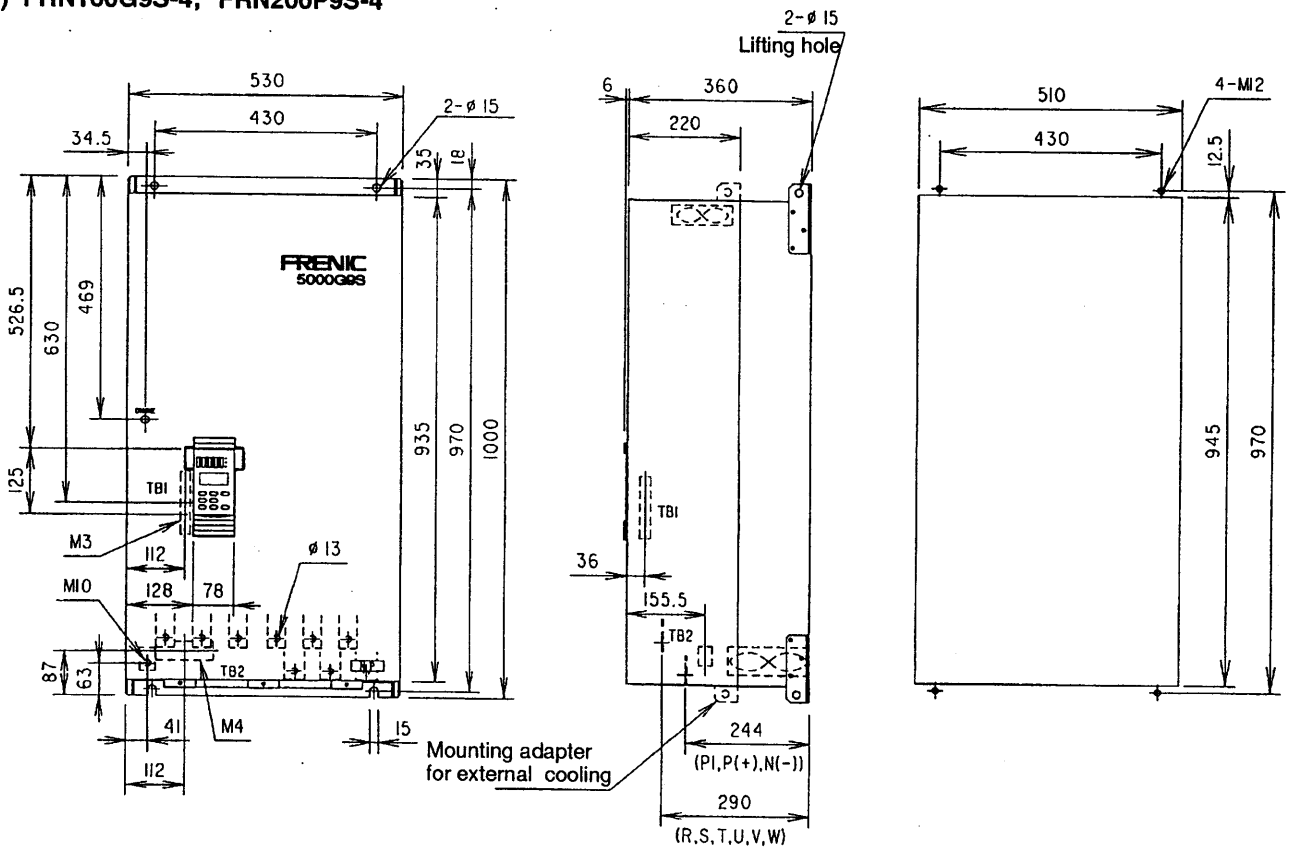
5) FRN90G9S-4, FRN110G9S-4, FRN110P9S-4, FRN132P9S-4



6) FRN132G9S-4, FRN160P9S-4

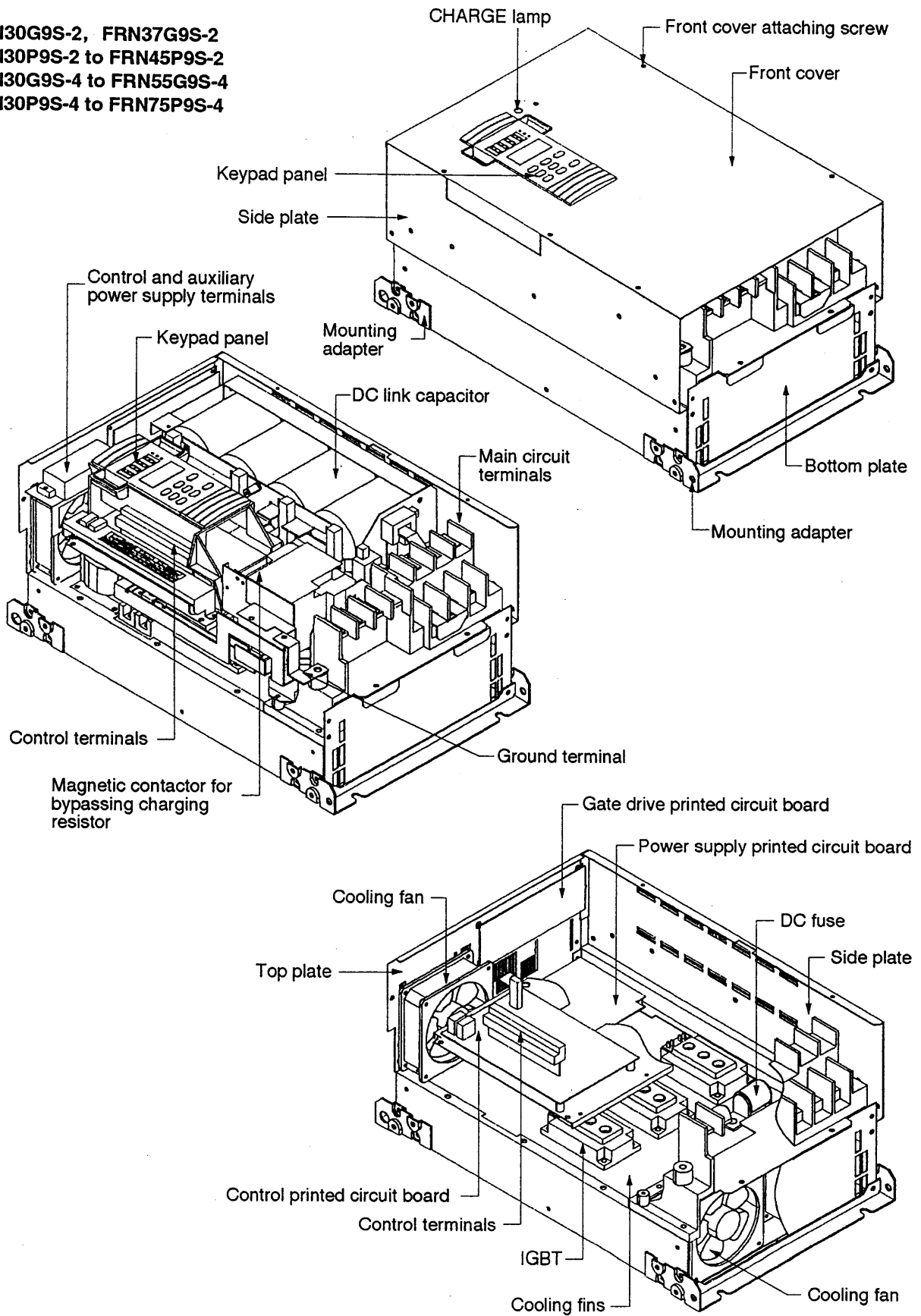


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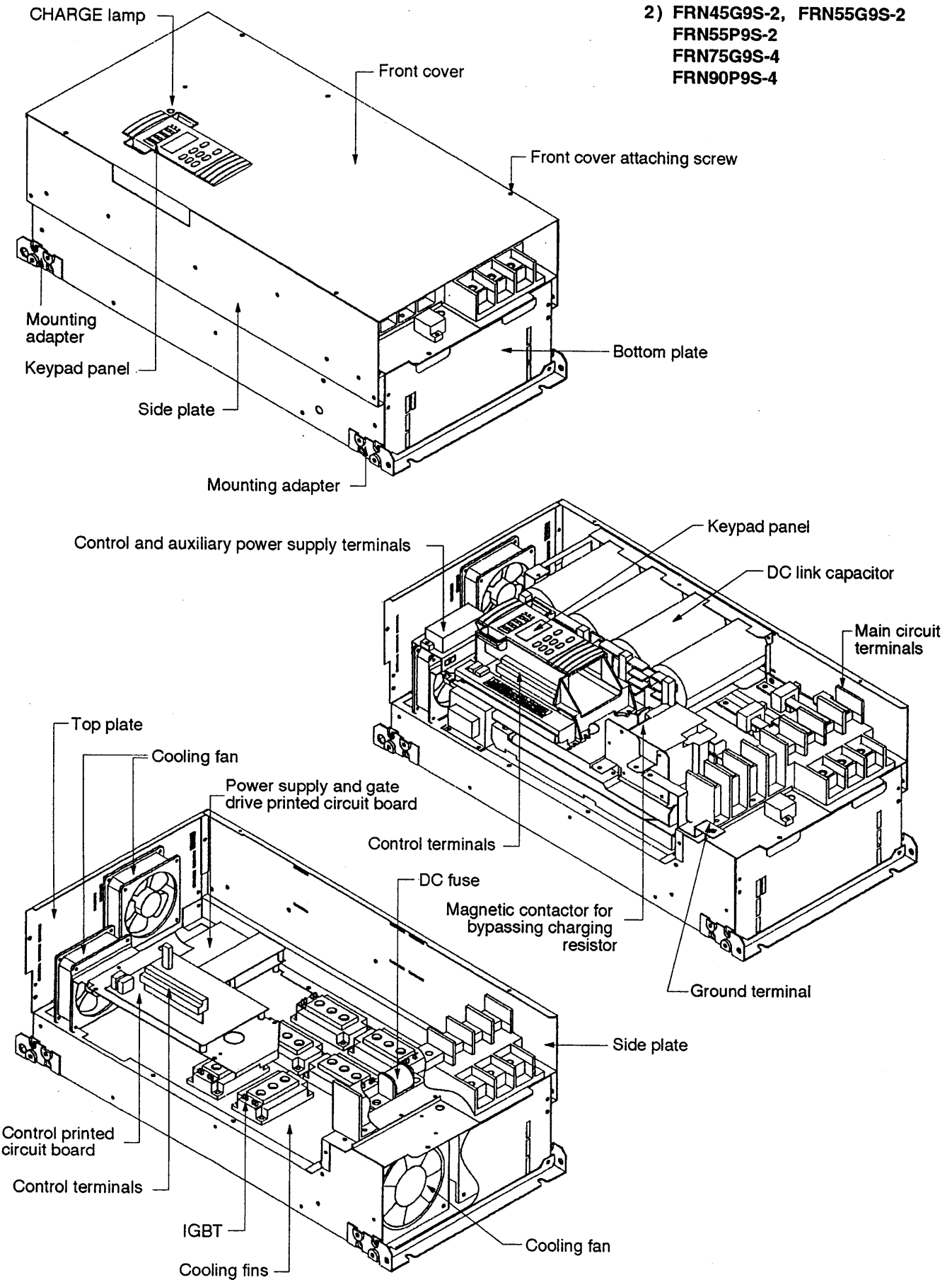


3-7 View, construction and components

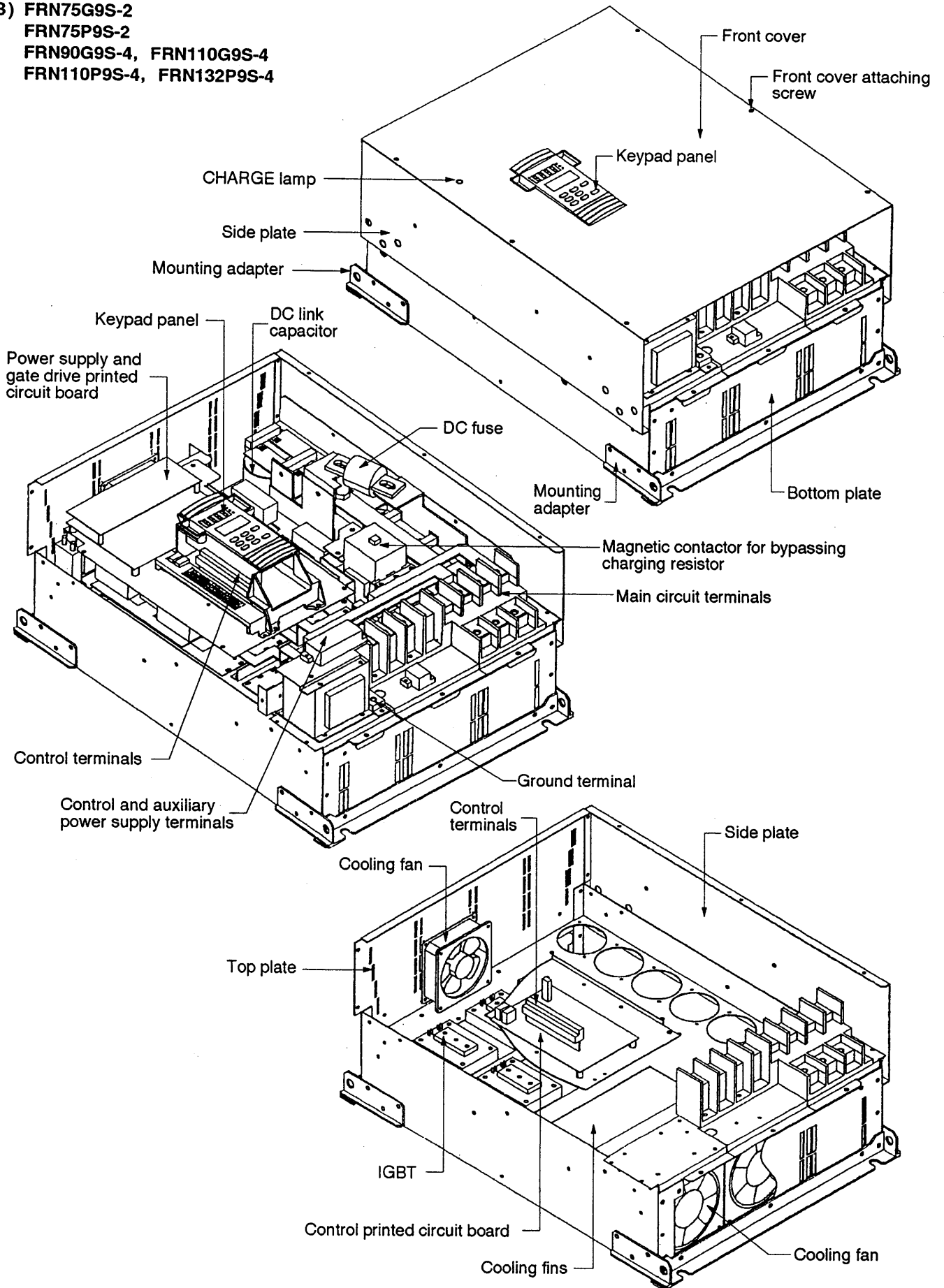
- 1) FRN30G9S-2, FRN37G9S-2
 FRN30P9S-2 to FRN45P9S-2
 FRN30G9S-4 to FRN55G9S-4
 FRN30P9S-4 to FRN75P9S-4



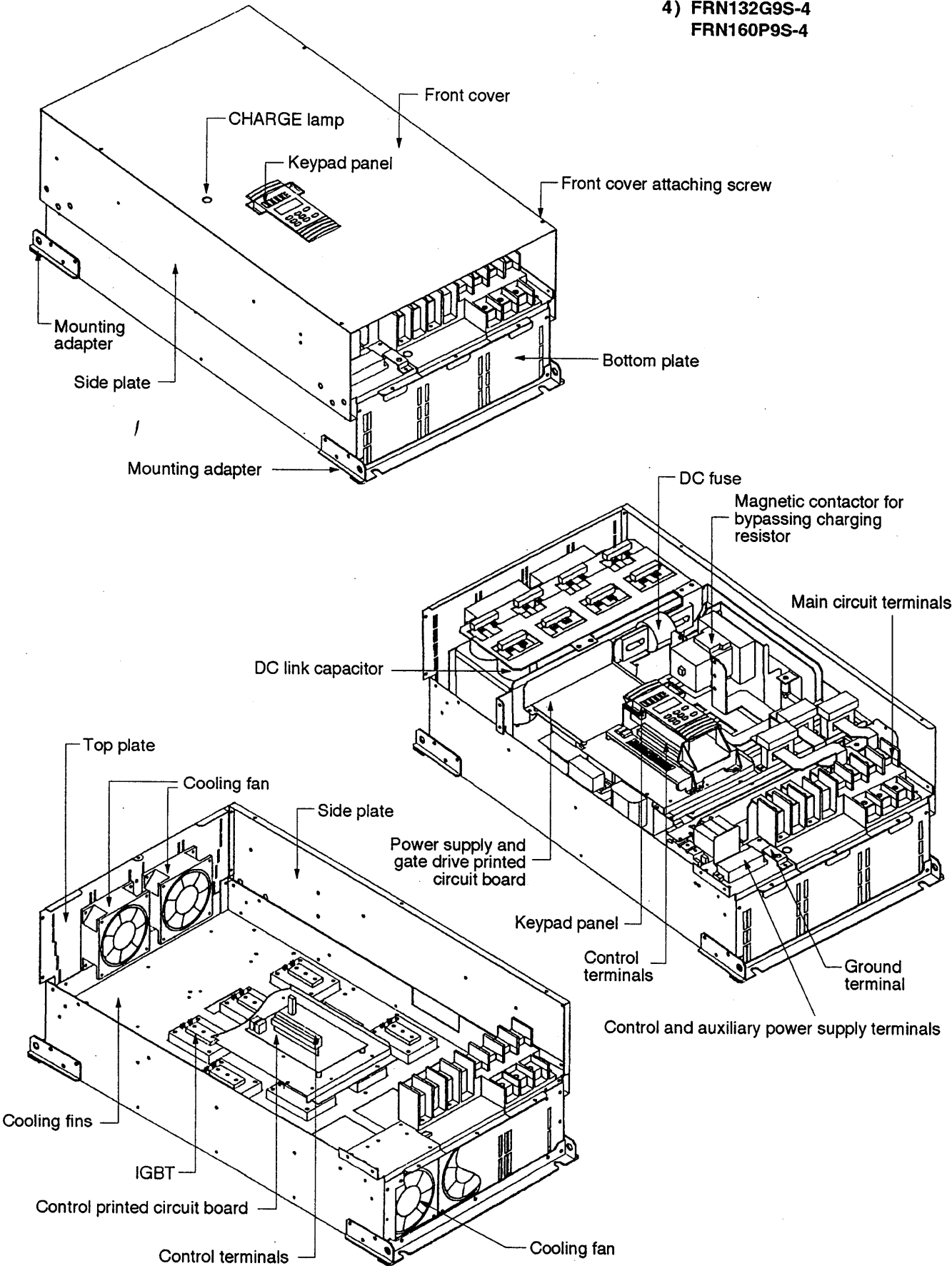
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 FRN55P9S-2
 FRN75G9S-4
 FRN90P9S-4



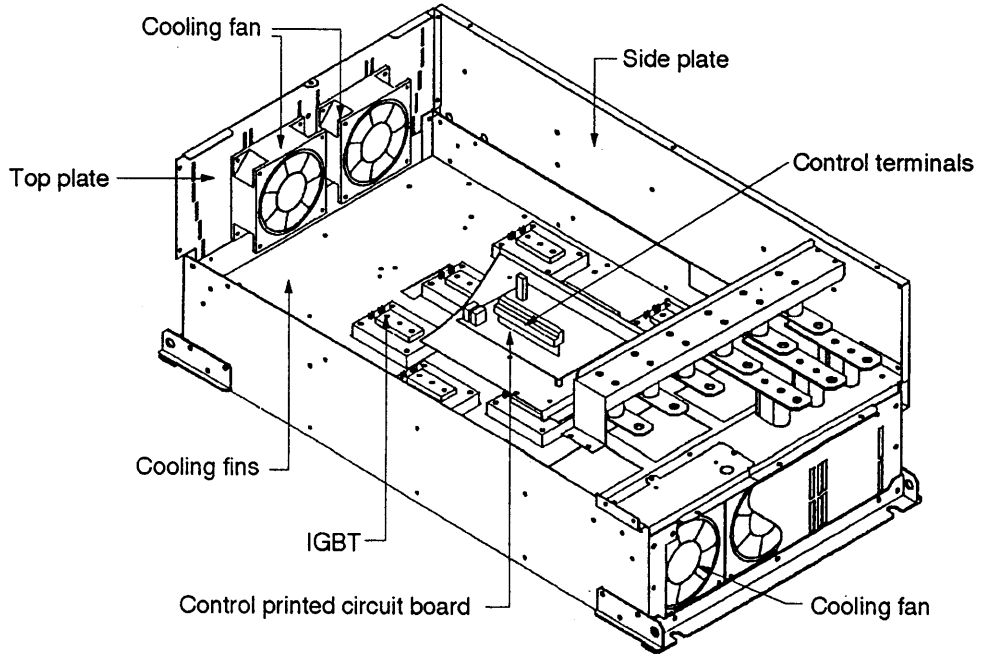
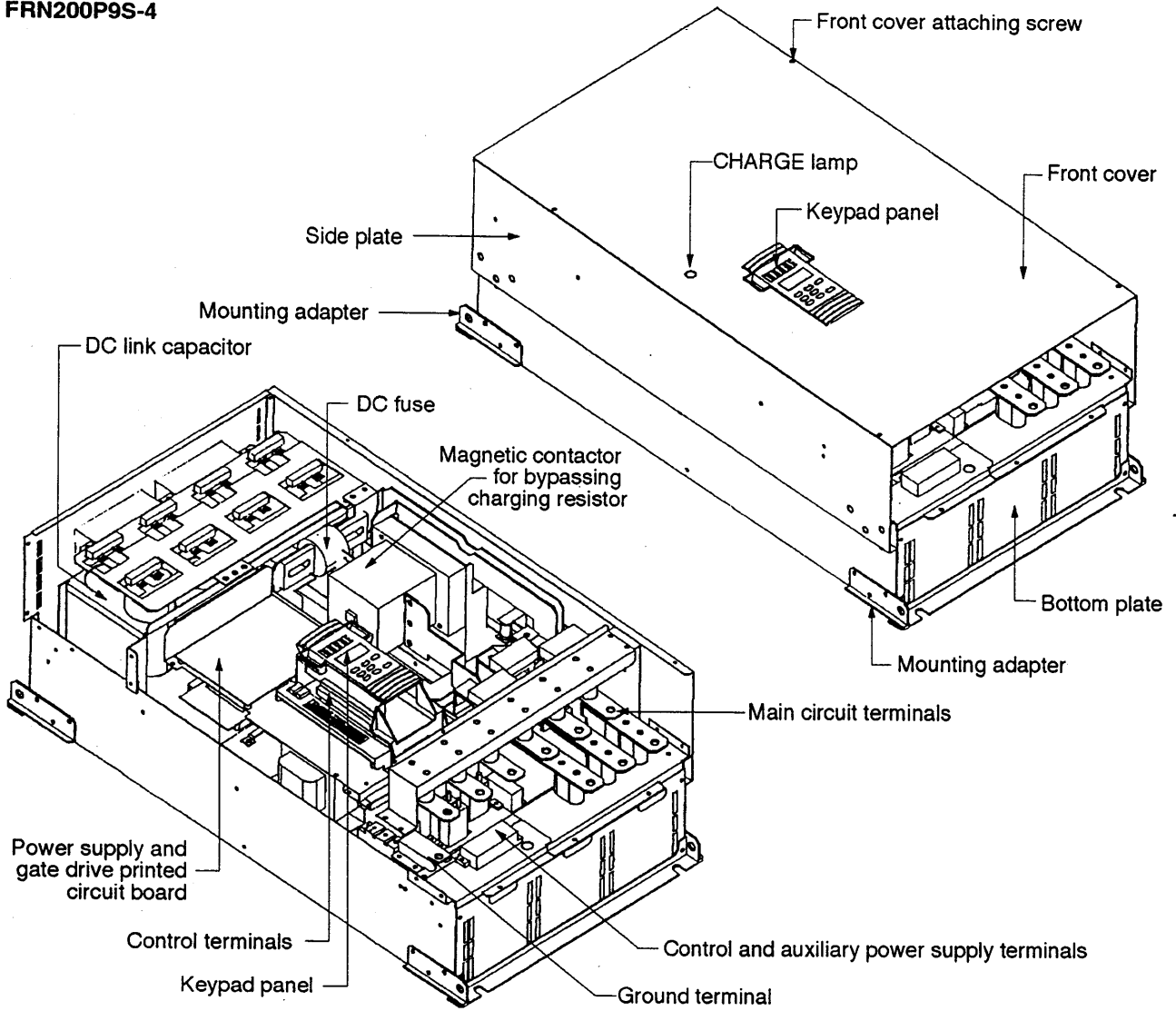
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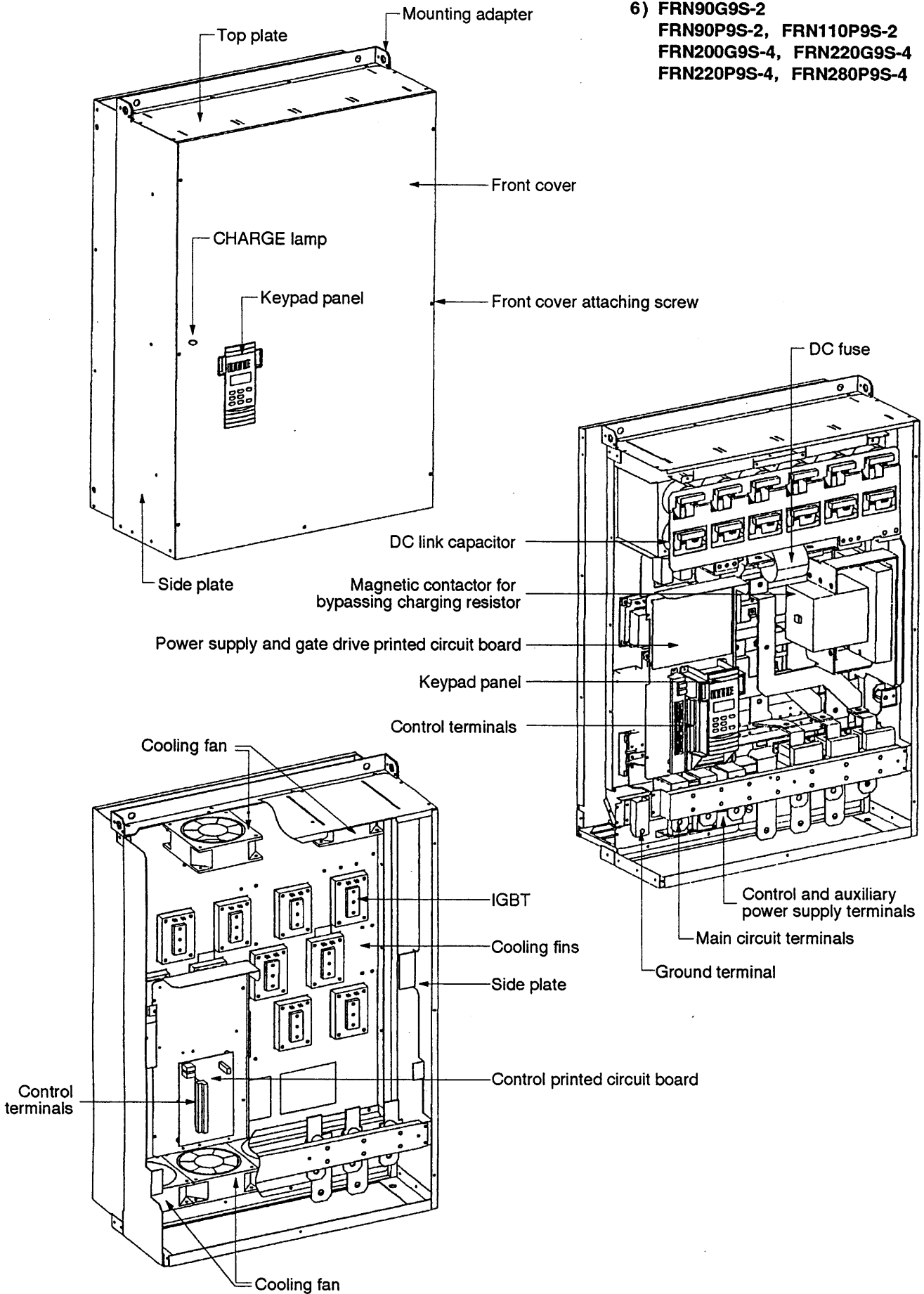
4) FRN132G9S-4
FRN160P9S-4



5) FRN160G9S-4
FRN200P9S-4



6) FRN90G9S-2
 FRN90P9S-2, FRN110P9S-2
 FRN200G9S-4, FRN220G9S-4
 FRN220P9S-4, FRN280P9S-4



NOTES

4 Movement and Storage

WARNING

Improper lifting practices can cause serious or fatal injury. Lift only with adequate equipment and trained personnel.

Carry the inverter only by the body, not by the terminals or top cover. Equipment movement should only be performed by trained personnel.

When the inverter is temporarily stored after reception, the following guidelines should be followed.

- 1) Store the inverter in an indoor area that meets the following requirements:
 - The ambient temperature is between -10 and +50°C
 - The storage temperature is between -25 and +65°C.
 - The relative humidity is between 20% and 90%.
 - Do not store in any location subject to direct sunlight, dust, corrosive gas, inflammable gas, oil mist, vapor, vibration or salt.

NOTE

- The storage temperature is available for a short term such as the movement term.
- Even though the relative humidity is within the specified value, large temperature change cause dew condensation or freezing. Avoid placing the inverter in such a area.

2) Do not place the inverter directly on a floor. Place it on a stand or shelf.

3) When storing the inverter in an unsuitable atmosphere, pack it with vinyl-sheet or polyethylene film for packing.

4) When being afraid of humidity affection, pack the inverter as 3) after inserting a desiccant (silica-gel etc.) inside.

If you do not use the inverter after purchasing it, the storage method remarkably changes according to the environment in the storage location. When a severe storage is necessary, refer to the distributor where the inverter was purchased or the Company's sales office nearby indicating concrete environment specifications.

5 Installation

WARNING

Carry the inverter only by the body, not by the terminals or top cover. Equipment movement should only be performed by trained personnel.

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.

CAUTION

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

Do not install the inverter up-side-down, horizontally or slantwise, heat build-up will occur.

5-1 Installation environment

Install the inverter in an indoor location that meets the following requirements:

- The ambient temperature is between -10 and +50°C.
- The relative humidity is between 20% and 90%.
- Do not install in any location subject to dust, direct sunlight, corrosive gas, inflammable gas, oil mist, vapor, or salt.
- The inverter should be installed at an elevation below 1000 meters.
- Vibration should be less than 5.9 m/s² {0.6G}.

NOTE :

- The storage temperature is available for a short term such as the movement term.
- Even though the relative humidity is within the specified value, large temperature change cause dew condensation or freezing. Avoid placing the inverter in such a area.

5-2 Installation mounting and arrangement

Install the inverter perpendicular to the ground and with lettering "FRENIC5000G9S" or "FRENIC5000P9S" right side up.

NOTE :

- Mounting screws or bolts should be of appropriate size for weight of inverter.
- See appropriate view in Section 3-5 and 3-6 pp. 9 to 15 for the location of mounting holes.

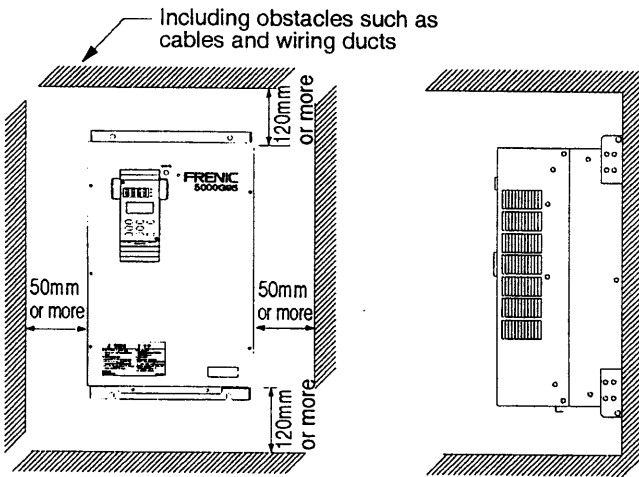


Fig. 5-2-1 Inverter mounting direction and clearance

Install at a sufficient distance from other equipment, walls or wiring ducts as shown in Fig. 5-2-1 (these clearances are required to allow the heat generated by the inverter to escape).

NOTE: The allowable maximum ambient temperature is 50°C. A sufficient ventilation is required to allow the heat to escape when installing in a control panel etc. For example, do not contain the inverter into an enclosure such as a small sealed box of poor heat discharge.

Since the generated heat is moved upward by the cooling fan, do not arrange the inverter under equipment weak in heat.

When installing two or more inverters within the same equipment enclosure or a cubicle, arrange them in a horizontal row to negate the heat generated from affecting each other. If they must be arranged in a vertical column, provide a partition board between them to negate the heat generated by the lower inverter from affecting the upper one.

Inverters are shipped with the adapter mounted for "cooling inside the enclosure". If "cooling outside the enclosure" is required, the adapter must be positioned otherwise. With the "cooled outside the enclosure" method, the cooling fins is mounted externally and approximately 70% of the total heat generated by the inverter is discharged outside the unit, so that the heat generated in the enclosure is reduced.

1) Horizontal arrangement 2) Vertical arrangement

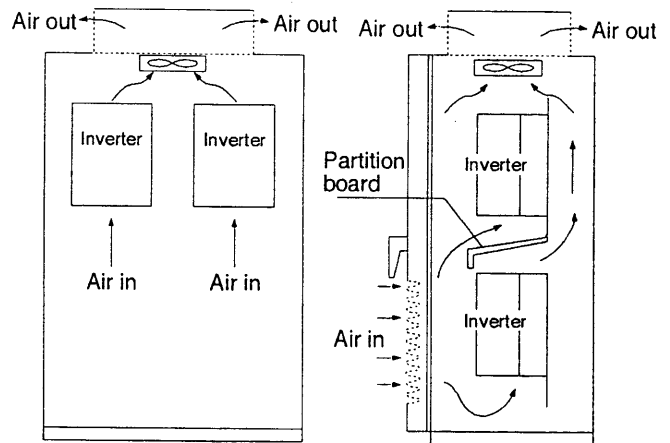


Fig. 5-2-2 Mounting arrangements of two or more inverters

1) Inverter cooled inside the enclosure 2) Inverter cooled outside the enclosure

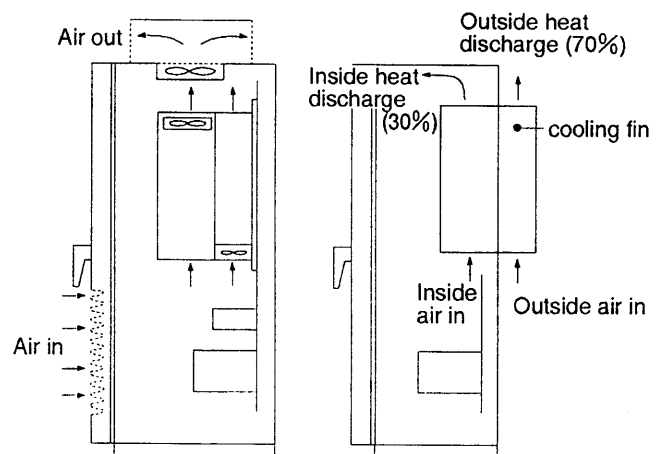
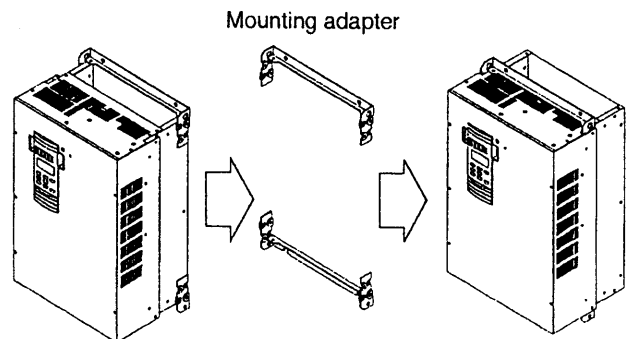


Fig. 5-2-3 Change of mounting method

NOTE : The "cooled outside the enclosure" method should be avoided in a location where fibre chips or humid dusts may cause choking of the cooling fin.

6 Connection and Wiring

⚠ WARNING

Before disassembling for connection, disconnect and lock out power from the inverter. Failure to disconnect power may result in death or serious injury. A DC link circuit charge light provides visual indication that DC link voltage is present with the charged DC link capacitor; verify the DC link voltage level by measuring the voltage between power terminals P(+) and N(-) using an analog meter. Do not attempt to service the inverter until the charge indicator has extinguished and DC link voltage has discharged to zero volts.

All motor bases and equipment enclosure housings should be grounded through ground terminals E(G) in accordance with the National Electric Code or equivalent to avoid a disaster such as electric shock and fire.

⚠ CAUTION

Incorrect connections may cause damages the inverter as well as its improper operation.

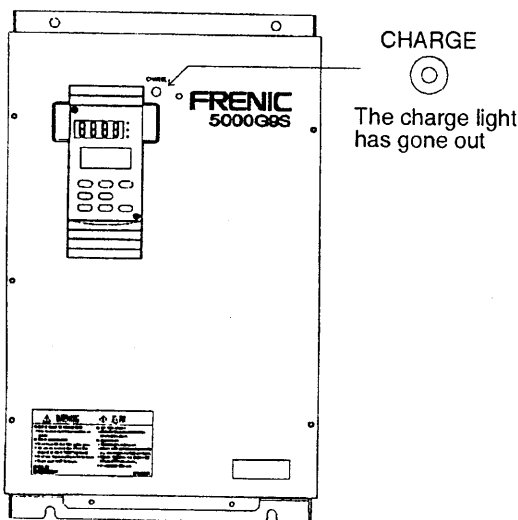


Fig. 6-1-1 Charge lamp

Remove the front cover attaching screws as shown in Fig. 6-1-2, and remove the front cover. Then, the terminals for connecting wires appear.

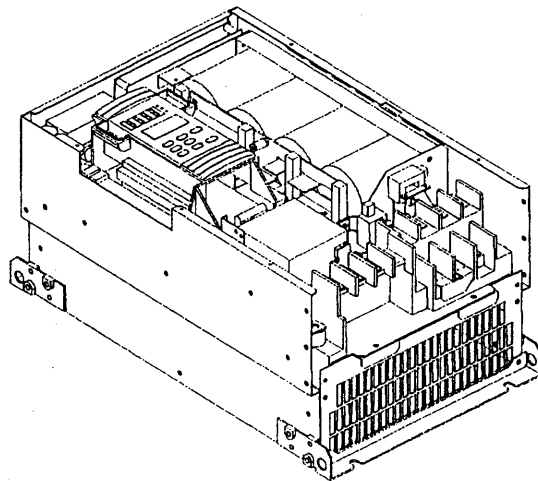
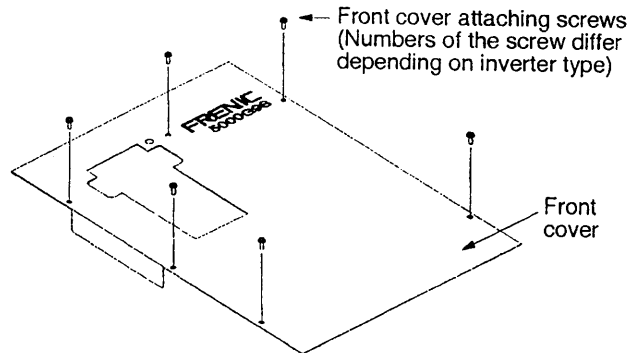


Fig. 6-1-2 Front cover handling

Connect the wires to the terminals according to the descriptions thereafter. The arrangements of the terminals are roughly classified into 4 kinds as shown in Fig. 6-1-3.

NOTE: Refer to the exact terminal positions shown in "3-5 200V series dimensions" and "3-6 400V series dimensions"(PP.9 to 15).

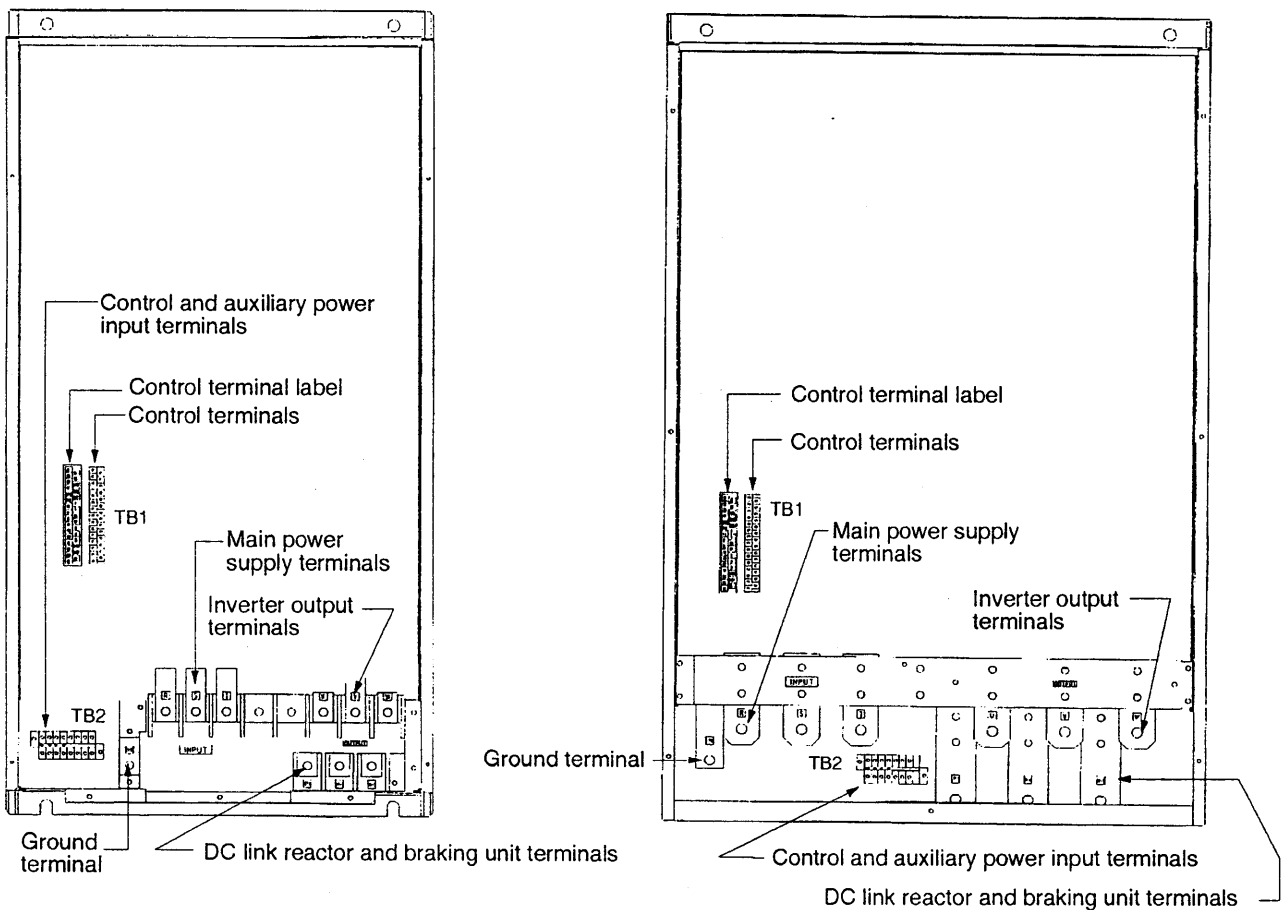
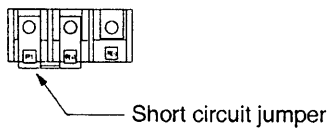
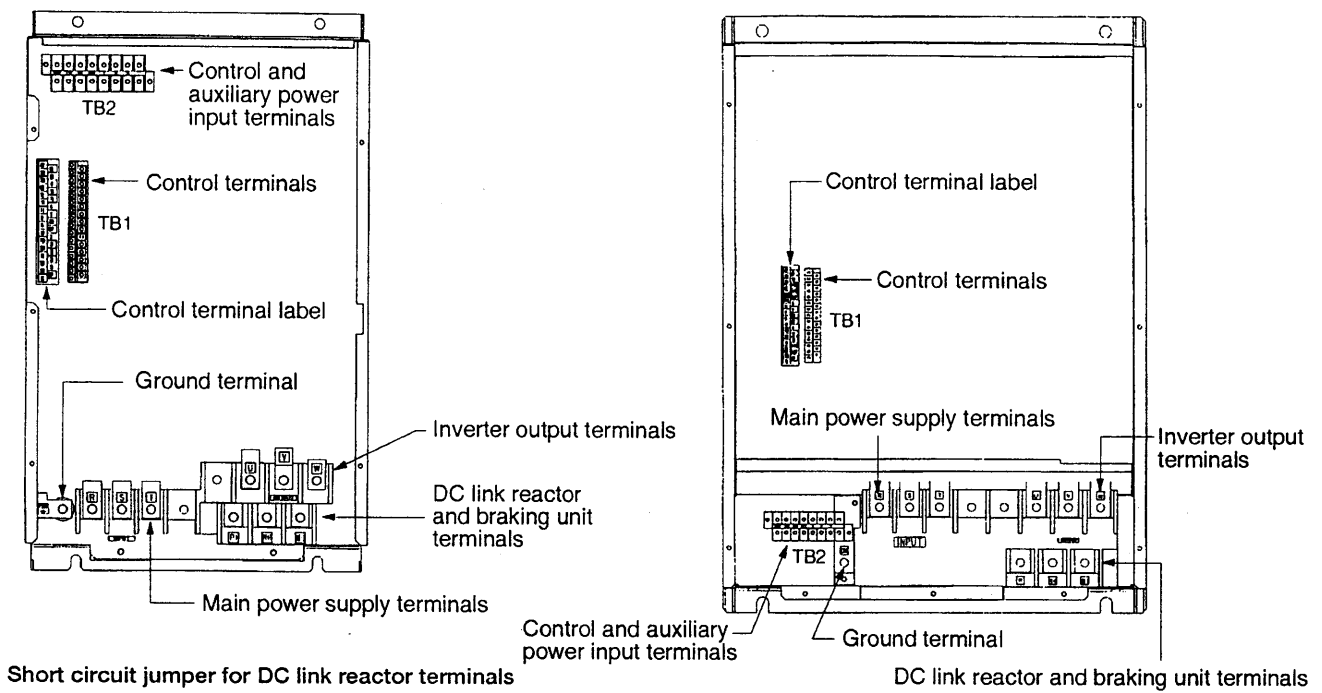


Fig. 6-1-3 Terminal arrangement

6-1 Description of terminal functions

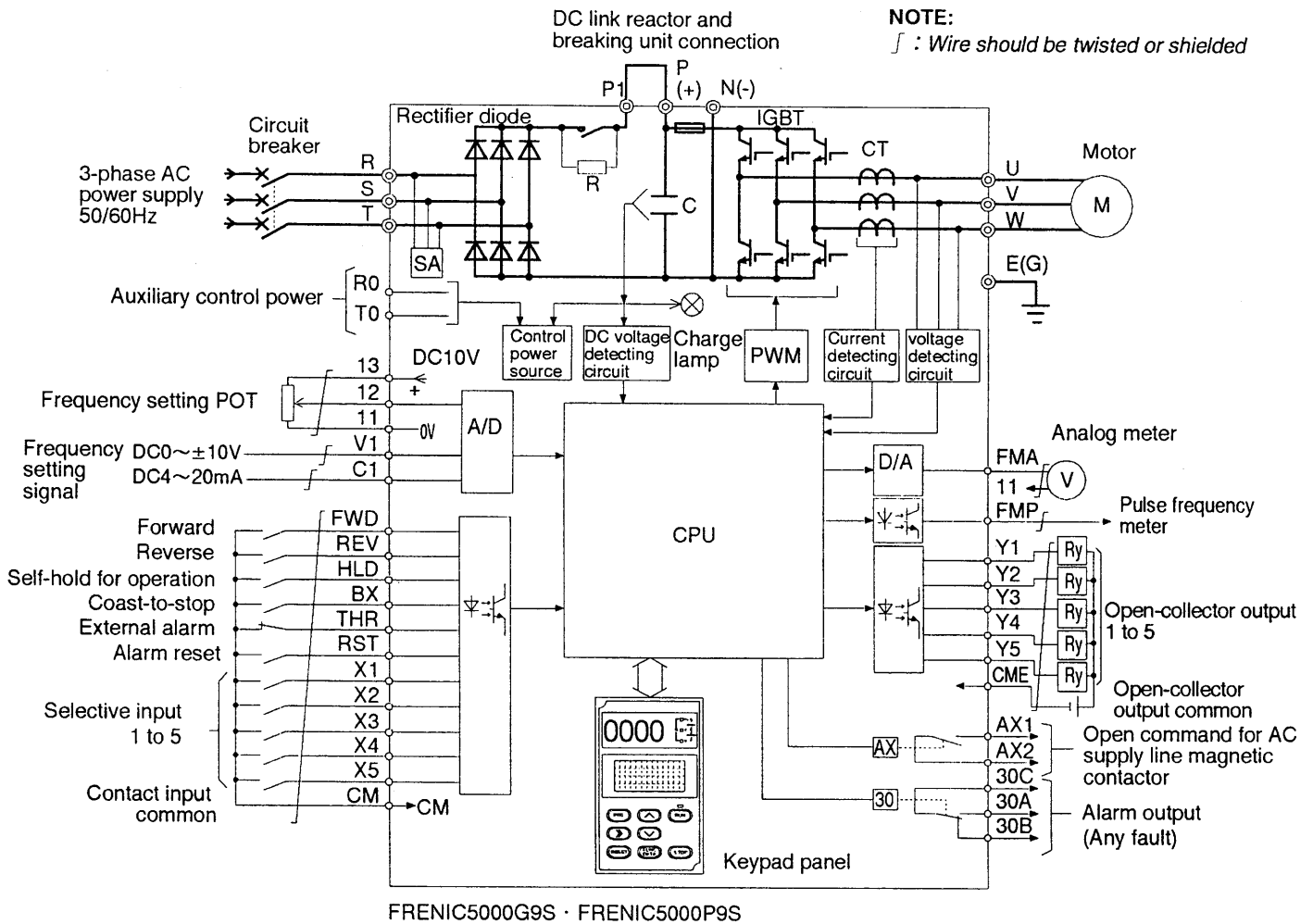


Fig. 6-1-4 Basic circuit configuration and terminals

Table 6-1-1 Main circuit and ground terminals

Terminal label	Terminal name	Description
R, S, T	Main power supply	Connection for 3-phase power supply.
U, V, W	Inverter output	Connection for 3-phase motor.
P1, P(+)	DC link reactor connection	Connection for DC link reactor.
P(+), N(-)	Braking unit connection	Connection for power regenerating unit or braking unit. (The braking resistor must be connected via the braking unit.)
E(G)	Ground terminal	Inverter connection for ground.

Table 6-1-2 Control and auxiliary power supply terminals

Terminal label		Terminal name	Description
200V series	400V series		
R0, T0		Auxiliary control power input	Back up terminals for control power to be connected to AC power supply. Connect to the AC power supply system same as the main circuit power supply system.
—	U1, U2	Auxiliary power input terminals	Connection for cooling fan and transformer of magnetic contactor to bypass charging resistor. Connected in factory. Re-connect when AC power supply voltage is 380 to 395V/50Hz, 380 to 430V/60Hz, or when parts are replaced.
1, 2, 3		Cooling fan input terminals	Terminals for cooling fan in the inverter.

Table 6-1-3 Control terminals

Item	Terminal label	Terminal name	Description	
Analog frequency setting	11	Frequency setting common	Common terminal for frequency setting signals (terminals 12, V1, C1) and common standard voltage terminal for analog meter (FMA terminal)	
	13	Frequency setting power supply	Regulated +10 VDC power supply for frequency setting POT (1 to 5k Ω)	
	12	Frequency setting input terminal	When 0 to +10 VDC is inputted, the maximum frequency is reached at +10 VDC. Input impedance is 22k Ω	The frequency based on the sum of setting signal 12, V1 and C1 is output.
	V1	Voltage input auxiliary	When 0 to ± 10 VDC is inputted, the maximum frequency is reached at +10 VDC. Polarity of input voltage (+, -) changes direction of rotation (+ is forward direction and - is reverse direction). Input resistance is 22 k Ω .	
	C1	Current input auxiliary	When 4 to 20mA DC is inputted, the maximum frequency is reached at 20mA. Input resistance is 250 Ω .	
Control input (Contact)	CM	Contact input common	Common terminal for contact input signals and pulse frequency meter (FMP).	
	FWD	Forward operation and stop command	FWD-CM ON: forward, OFF: stop	The stop command is issued when both FWD-CM and REV-CM are ON in the same time.
	REV	Reverse operation and stop command	REV-CM ON: reverse, OFF: stop	
	HLD	FWD/REV command hold	HLD-CM ON: Self-holds FWD and REV signals of pulse shape. A stop command releases this self-hold. (pulse width: 50 ms or more)	
	BX	Coast-to-stop command	BX-CM ON: Instantaneous stop of inverter output with no alarm signals. Since the self-hold function does not work, turning off BX will restore the inverter if FWD or REV are still on.	
	THR	External alarm input	THR-CM OFF: Stops the inverter by alarm through the activation of a protection-function (BH2 trip). This input signal is self-hold internally.	
	RST	Alarm reset	RST-CM ON: Releases the activated protection after removal of fault condition alarmed by the protection.	
	X1	Selective input 1	Multi-step frequency setting or UP/DOWN control command can be selectively made (Multi-step frequency setting).	By changing data of Function "32 X1-X5 terminal function selection", the terminal functions are changed. () shows factory-shipped data.
	X2	Selective input 2		
	X3	Selective input 3	Multi-step frequency setting or power line or inverter output can be selectively made (Multi-step frequency setting).	
	X4	Selective input 4	Acceleration/deceleration command, current setting signal terminal CI command or DC braking command can be selectively made (Acceleration/Deceleration commands).	
X5	Selective input 5	Acceleration/deceleration, second torque boost selection command or data protection command can be selectively made. (Acceleration/Deceleration commands)		
Meter output	FMA	Analog meter connection	Output frequency, output current, motor torque and load factor can be selectively outputted. Provides an output of 0 to +10VDC/2mA.	
	FMP	Pulse frequency meter connection	Outputs a digital pulse frequency proportional to output frequency. Pulse rate: 6 to 100, Average voltage: +10 VDC (adjustable)	
Open-collector output	CME	Open-collector common	Common terminal for output of open-collectors.	
	Y1	Open-collector output 1	By changing data in Function "47 Y1-Y5 terminal function selection", 16 signal scan be independently outputted. In detail, refer to "9 Function". Factory shipped data are as follows: Y1: Inverter running Y2: Frequency equivalence signal Y3: Frequency level detection signal Y4: Overload early warning signal Y5: Undervoltage detection signal	Open-collector output: 27VDC, 50mA max.
	Y2	Open-collector output 2		
	Y3	Open-collector output 3		
	Y4	Open-collector output 4		
Y5	Open-collector output 5			
Contact output	AX1, AX2	Open command for AC power line mag. contactor	When the inverter output stops, OFF command for the mag. contactor is output. (One make contact, ON at the inverter output)	
	30A 30B 30C	Alarm output (Any fault)	Activated state of the protection is outputted. After removal of fault cause the activation is released by the alarm reset command. (One changeover contact, Activated: 30C-30A ON, Not-activated: 30C-30B ON)	

6-2 Main Circuit

a) Power supply connections

⚠ 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.

Do not connect power supply to the output terminals (U, V, W), the DC link terminals (P1, P(+)), or the Braking unit terminals (P(+), N(-)). Connect only to the main power supply terminals (R, S, T).

Connect a circuit breaker between the three-phase AC power supply and main circuit input terminals R, S, T. It is not necessary to pay attention to phase rotation due to AC/DC conversion in the inverter.

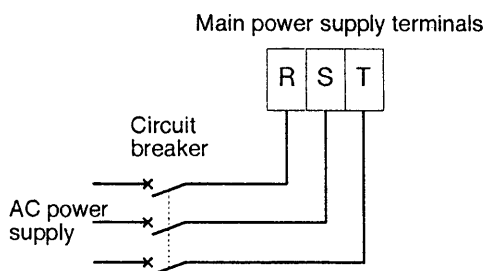


Fig. 6-2-1 Power supply connections

NOTE : Do not connect the inverter to a single phase AC power supply. A single phase power supply will drop the main circuit DC voltage, even though the voltage within specified allowance is supplied. This may cause trip of the inverter protection (undervoltage detection). The rated capacity of the motor applied should be reduced, if the inverter protection has not tripped.

The inverter can be operated without a magnetic contactor on the power supply side. However, connecting a magnetic contactor is recommended since, when a protection function of the inverter activates, it separates the inverter from the power supply, and prevents the inverter from spread of failure or fault.

NOTE: As to the control terminals, refer to "6-4" a) (p.32).

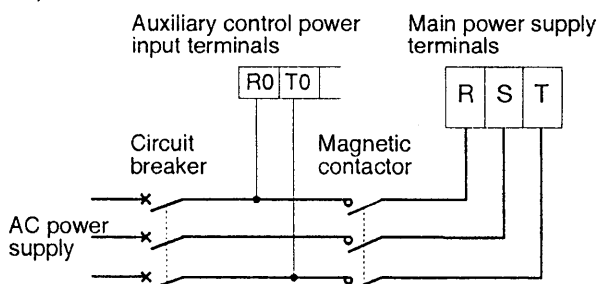


Fig. 6-2-2 Magnetic contactor connections

When using a radio-noise suppressing reactor, it is necessary to connect their terminals between the circuit breaker and the inverter as shown in Fig. 6-2-3.

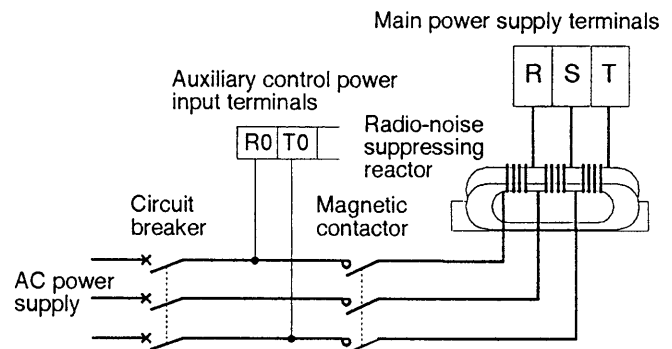


Fig. 6-2-3 Radio-noise suppressing reactor connections

b) Inverter output connections (Motor side)

⚠ CAUTION

Do not connect filter capacitors on the output side of the inverter. The capacitors and inverter will be overheated and damaged due to

The inverter output is a three-phase, three wire system. Connect the inverter to a 3-phase motor.

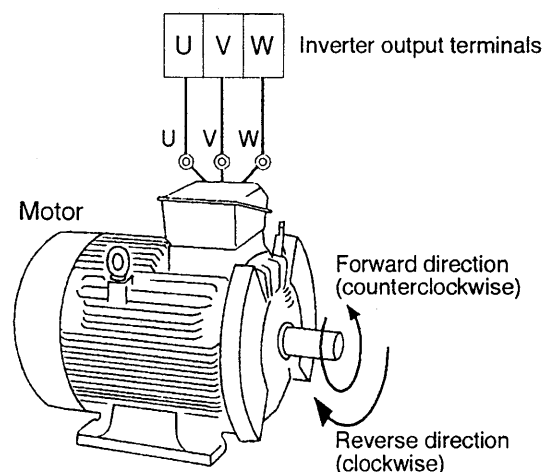


Fig. 6-2-4 Motor connections

NOTE : Match the output terminals U, V and W of the inverter to phase sequence of the motor. If the rotating direction does not coincide with that of the command, replace any two phases of U, V and W each other.

In case the motor is driven by a power line or the inverter, connect switches such as magnetic contactors to prevent applying line voltages to the terminals U, V and W of the inverter. When applying outside voltages (power line) to the terminals U, V and W, the inverter will be damaged. Therefore, connect magnetic contactors MC-2 and MC-3 into the motor circuit as shown in Fig. 6-2-5. And, interlock electrically or mechanically so that the MC-2 is not closed at driving by the power line.

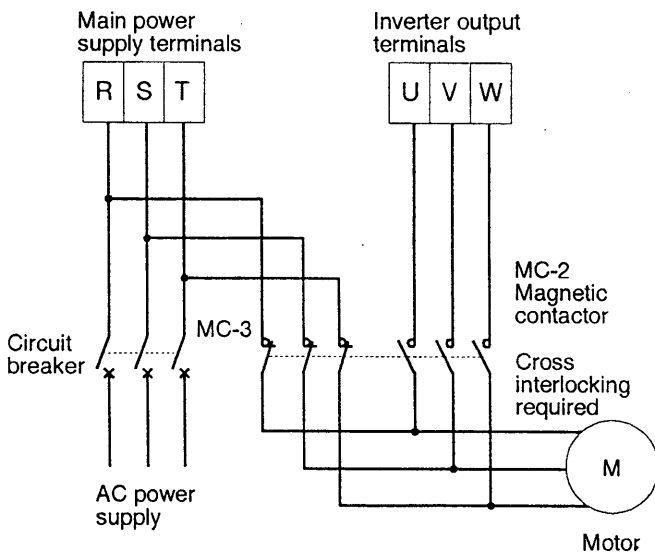


Fig. 6-2-5 Motor operation by AC power line or by inverter

NOTE:

- Connect the terminals so that the phase sequence of the AC power line and the the inverter output may meet.
- When connecting the magnetic contactors, make a circuit that they can switch only during inverter stop. If switching during operation, the inverter does not trip, however, it relates to the cause of failure or reduction of life due to a rapid change of current.

In case the wires between the inverter and the motor are long, if setting the data of the function code "81 Motor sound (Carrier frequency)" higher (Low noise specification), leakage current increases, or radio-noise generated by the inverter propagates stronger, or motor insulation withstand voltage goes down because the motor voltage oscillates stronger due to the inductance in the wires.

If the wire is longer than 50m, connect the output circuit filter provided as a option to the inverter output circuit. As for the connection methode, refer to the instruction manual of the output circuit filter (Manual number INR-HF50802).

NOTE : Under certain wiring conditions, even if the wire length is less than 50m, some damages may happen. In this case, connect the output circuit filter also.

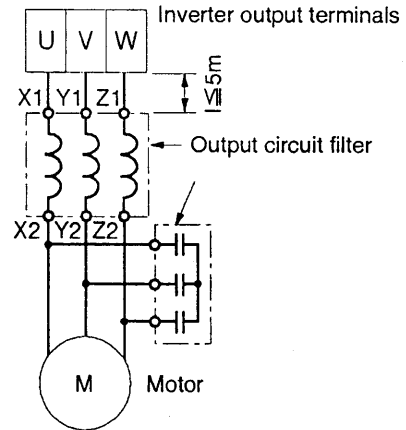


Fig. 6-2-6 Output circuit filter connections

c) DC link reactor connection

CAUTION

Do not connect the inverter to an AC power supply of a larger capacity than 10 times of the inverter rated capacity (the inverter for 30 kW motor not to a power supply of lager than 500kVA), or of larger imbalance of voltages than 3%. If connecting the inverter to these power supply, optional DC link reactors will have to be installed in P1 & P(+) power leads of the inverter.

Provide DC link reactor in the following cases:

- Capacity ratio of the power supply transformer to the inverter is as shown is Fig. 6-2-7 .

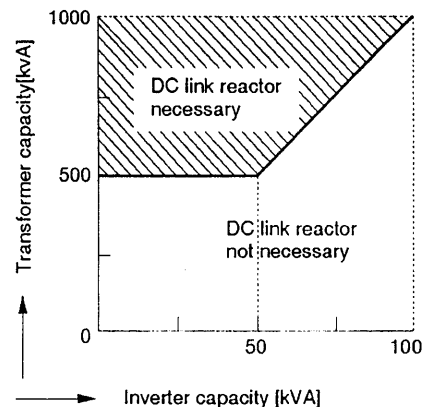


Fig.6-2-7 Application DC link reactor(1)

- A thyristor load or a power capacitor with ON/OFF control is parallel connected to the same power source.

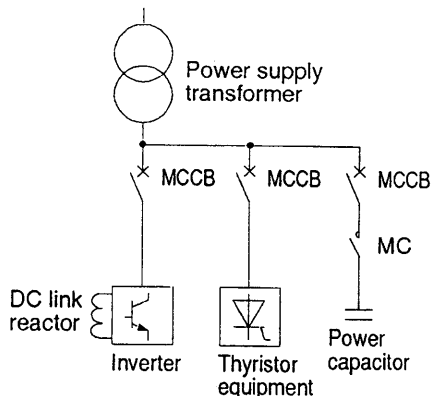


Fig.6-2-8 Application DC link reactor(2)

- 3-phase power supply voltage is unbalanced 3% or more.

Unbalance factor [%]

$$\frac{\text{Maximum voltage[V]} - \text{Minimum Voltage[V]}}{\text{3-phase mean voltage[V]}} \times 100$$

- Improvement of input power factor is required. The power factor will increase to 0.94.

Connect DC link reactor between the P1 and P(+) terminals as shown in Fig. 6-2-9.

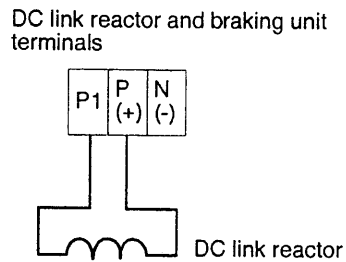


Fig. 6-2-9 DC link reactor connections

NOTE:

- In the inverter not attaching DC link reactor as standard (out-of-supply unit), connect an optional reactor as above after detaching a short-circuit jumper connected between terminals P1 and P(+).
- In the inverters of standard applicable motor 75 kW or larger, make sure to connect the DC link reactor attached as standard (out-of-supply unit).

6-3 Grounding circuit

⚠ CAUTION

Use only the ground terminal E(G) for grounding. The other grounding method causes a grounding defect.

Grounding is necessary not only for disaster prevention but for a noise reduction measure. From the view point of a noise reduction measure, it is necessary that the circuit impedance is reduced to suppress noise generation, and together that the mutual influence between equipments dose not occur. Then, the grounding wire should be as thick as possible and its length as short as possible and be connected to the exclusive ground terminal.

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

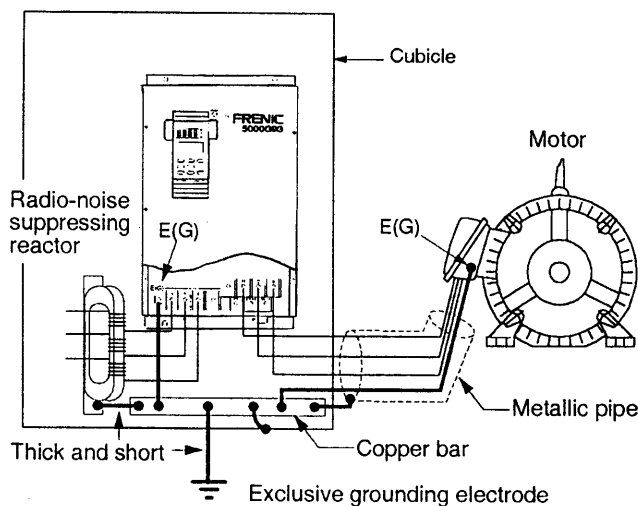
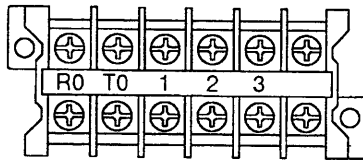


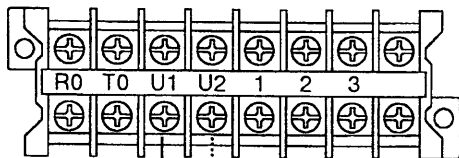
Fig. 6-3-1 Grounding of inverter system

6-4 Control and auxiliary power input circuit

1) 200V series



2) 400V series



Other supply voltage When the supply voltage is Table 6-4-1, change the terminal, U2.

Fig. 6-4-1 Control and auxiliary power input terminals

a) Auxiliary control power input terminals

⚠ CAUTION

Do not connect the auxiliary control power input terminals (R0, T0) to the other power supply system than that of the main circuit. The power supply capacity supplied through the terminals (R0, T0) is for operating the protection function and displaying. Therefore, if this voltage is higher than that of the main power supply voltage, the control power supply may overheat because of supplying power also to the control circuit.

Control power is supplied from the inverter DC link circuit. Accordingly, the control power is lost when the trip of the inverter protection has occurred and the magnetic contactor has been turned off. This makes the protection selfholding and alarm indication impossible. If this problem needs to be avoided, connect the R0 and T0 terminals between the circuit breaker and magnetic contactor as shown in Fig. 6-4-2.

By these connection, even if the DC link circuit source is cut off, the control power is supplied from AC power supply.

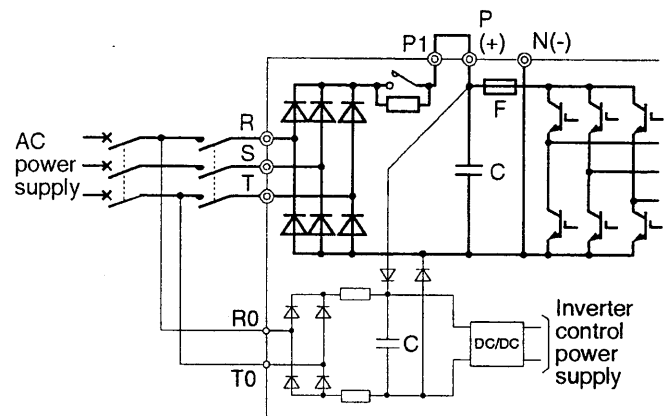


Fig. 6-4-2 Control power supply circuit

b) Auxiliary power input terminals

These terminals are provided for the 400 V series. When the main circuit input voltage is specified as shown in Table 6-4-1, remove the wire connected to the U2 terminal and connect it to the U1 terminal.

NOTE : In the other case, do not change the factory shipped condition.

Table 6-4-1 Voltages for which auxiliary power input terminal connection is changed

Frequency[Hz]	Power supply voltage [V]
50	380 to 395
60	380 to 430

c) Cooling fan power input terminals

These terminals is used for maintenance or replacement of the inverter cooling fan. In other case, do not touch these terminals.

NOTE : On replacement of the cooling fan, follow the procedure of the separate replacement manual. Request the replacement manual from the distributor where the inverter was purchased or the Company's sales office nearby.

6-5 Control circuit

⚠ CAUTION

Do not connect a power supply to the control circuit terminals (except 30A, B, C, AX1 and AX2, maximum rating 250 volts).

When using the open-collector output terminals (Y1, Y2, Y3, Y4, Y5 and CME), verify that the polarity of the power supply connections are correct. Damage due to voltage, etc, may occur, if polarity is incorrect.

NOTE :

- Use shielded wires for \int marked wiring. When using vinyl insulated wires, twist the wires.
- Common terminals 11, CM and CME are mutually insulated. Do not connect between these terminals. When connecting, a malfunction may occur due to a mutual interference. Further, do not connect these common terminals to ground.

The connections of control terminals vary depending upon the data of the function. Regarding the function dependant connections, refer to "9 Function" (p. 66).

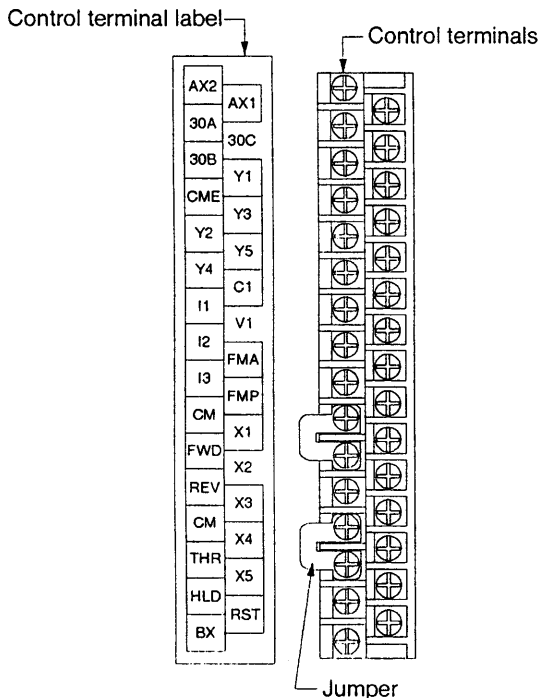


Fig. 6-5-1 Control terminals

a) Analog frequency setting terminals

The terminal connections should be selected according to input frequency setting signal referring to Fig. 6-5-2.

NOTE : It is desired to use shielded twist wires for wiring since induced noise on the wire may cause a fault.

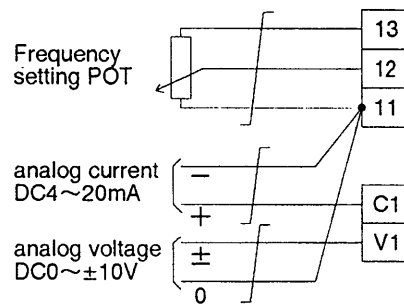


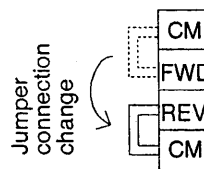
Fig. 6-5-2 Analog frequency setting terminals

b) Operation command terminals

A short-circuit conductor is connected between the forward and stop command terminals FWD-CM. This connection is applicable to the forward operation per keypad command. For other operations, change connections as shown in Fig. 6-5-3.

In the case of the reverse operation per keypad panel, change the jumper connection as shown in Fig. 6-5-3 1) and when inputting the operation commands per the control circuit terminals, connect the control circuit as shown in Fig. 6-5-3 2).

1) Reverse operation from keypad panel



2) Control circuit terminal operation

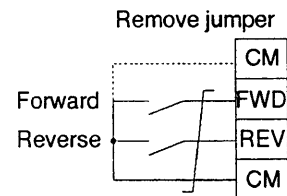


Fig. 6-5-3 Operation command terminals

c) External alarm input terminal

Detach the factory installed jumper between THR and CM terminals, and then connect to these terminals a contact which is OFF on fault of the external devices.

d) Alarm reset terminal

It is possible to reset the inverter protection, inputting a signal to the alarm reset terminal in stead of pressing the reset key. Since the alarm reset signal and the reset key input can be input in parallel as shown in Fig. 6-5-4, the alarm data are erased even if before identifying the data when inputting the signal to the alarm reset terminal.

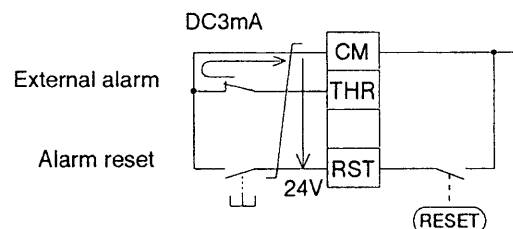


Fig. 6-5-4 Contact input terminal connection

e) Contacts connected to the contact input terminals

Connect the contacts (no-voltage 1b contact), which are opened by inputting the operation signals, to the contact input terminals HLD and THR, and the contacts (no-voltage 1a contact), which are closed by inputting the operation signals, to the other contact input terminals.

Since low voltage and small current are applied on the contacts as shown in Fig. 6-5-4, faultless and reliable contacts must be used.

f) Open-collector output terminal connections

It is recommended to use an optional relay card (OPC-G9S-RY) when using the signal of the open-collector output terminal. When not using the optional relays, care should be taken not to mistake polarity of power source or not to damage due to surge voltage.

NOTE : When connecting a control relay, a surge suppressing diode should be directly connected across the magnetic coil.

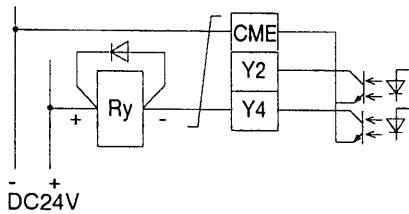


Fig. 6-5-5 Open-collector output terminals

g) Surge suppressor connections

When the magnetic coil of the magnetic contactor, control relay etc. of the control circuit or inverter peripheral circuit is switched, the current will sharply fluctuate resulting in a voltage spike (or noise).

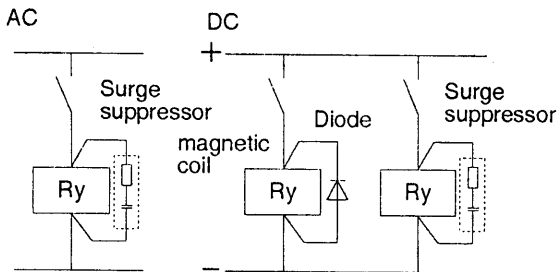


Fig. 6-5-6 Surge suppressor connections

NOTE : A surge suppressor should be directly connected across the magnetic coils which generate voltage spike.

See "13-3 Auxiliary parts" p. 122 for the surge suppressors to be applied.

h) Control circuit wiring

Use a shielded wire or twisted polyvinyl-insulated wires for the control circuit wiring. Use twisted wire with shield when the wiring is long. Further, when wiring length is longer than 20 m, connect an insulated signal converter to the analog circuit, or a control relay to the contact signal circuit. The noise influence is reduced by this insulation from the external circuit.

Wires connected to control circuit terminals should be aligned along the left side plate of the inverter as shown in Fig. 6-5-7.

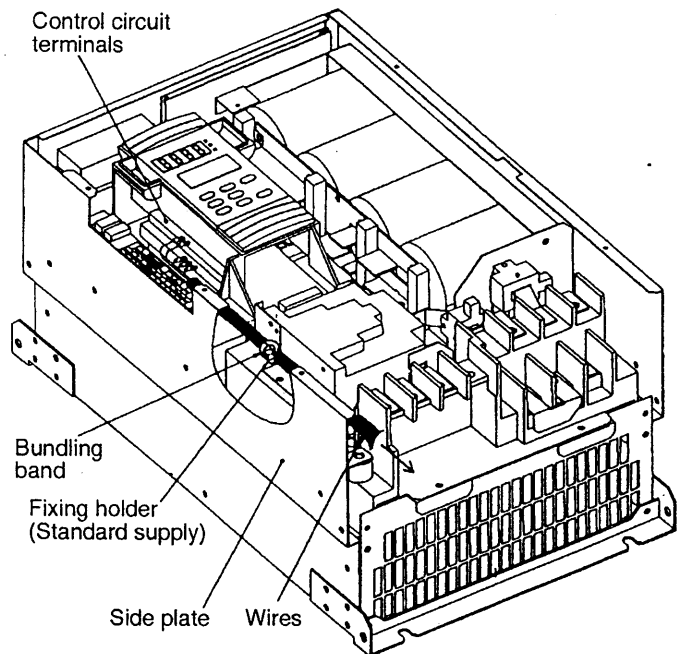


Fig. 6-5-7 Control circuit wire routing

The wires should be fixed with a bundling band and a fixing holder. Give the wire a margin with slack etc. not to strain the wires between the terminals and the fixing holder.

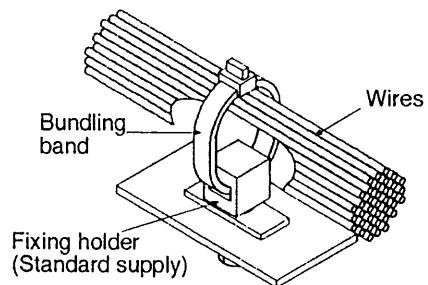


Fig. 6-5-8 Detail of wire holder

NOTE : The bundling band should be less than 3.8 mm wide and 1.5 mm thick to pass through the small fixing holder hole.

The control circuit wiring should be kept as far away as possible from the main circuit wiring and relay sequence circuit wiring. If the control circuit wiring must cross these, it should cross at right angle.

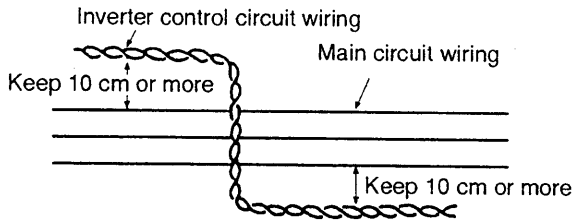


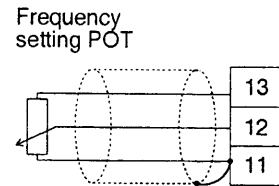
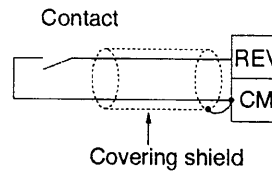
Fig. 6-5-9 Control circuit wiring

i) Shielded wire connections

Connect the end of the covering shield of the shielded wires or twisted wire with shield to the circuit common terminal but not to the ground terminal nor to the earth. (Fig. 6-5-10)

NOTE : Leave the other end of the covering shield open.

1) Good sample



2) No-good sample

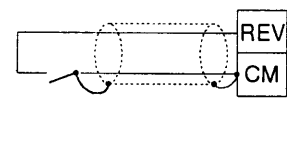
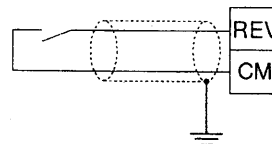


Fig. 6-5-10 Covering shield connection

6-6 Braking circuit

⚠ CAUTION

Connect a braking resistor to a braking unit. If connecting the braking resistor directly to the inverter, the inverter and braking resistor may overheat and cause a disaster such as fire.

NOTE : Number of braking unit and braking resistor varies per the inverter to be applied. Connect them with the direction of "13-2 Braking unit and braking resistor" (p.119).

a) Main circuit

Connect the main circuit terminals P(+), N(-) and DB as shown in Fig. 6-6-1.

Connect between the terminals the inverter and the braking unit so that the terminal markings P(+) and N(-) may meet each other.

NOTE :

- The wiring length between the inverter and the braking unit should be 2 m or less. In order to reduce the inductance, the wires connected to the P(+) and N(-) terminals should be arranged as close and parallel as possible.
- The wiring length between the braking unit and the braking resistor should be 10m or less.

When the braking unit and the braking resistor are not connected, the inverter P(+) and N(-) terminals should be open.

b) Control circuit

Connect the control circuit terminals THR and CM to the thermal contact terminals 1 and 2 of the braking unit and braking resistor as shown in Fig. 6-6-1.

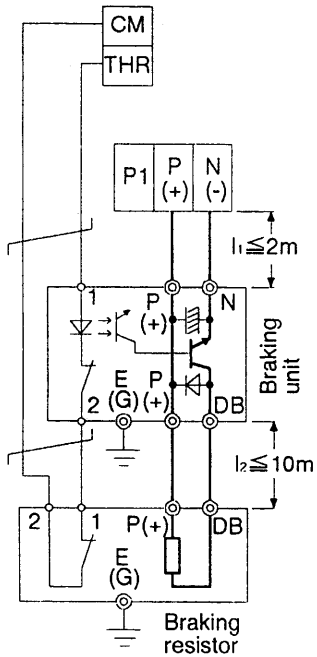
Remove the jumper between the THR and CM terminals. Connect the braking unit and braking resistor through the terminals 1 and 2 respectively in series as 1 → 2 → 1 → 2 to THR and CM.

When two braking units are used, connect the parallel braking input and output terminals I1, I2, O1, O2 as shown in Fig. 6-6-1 3).

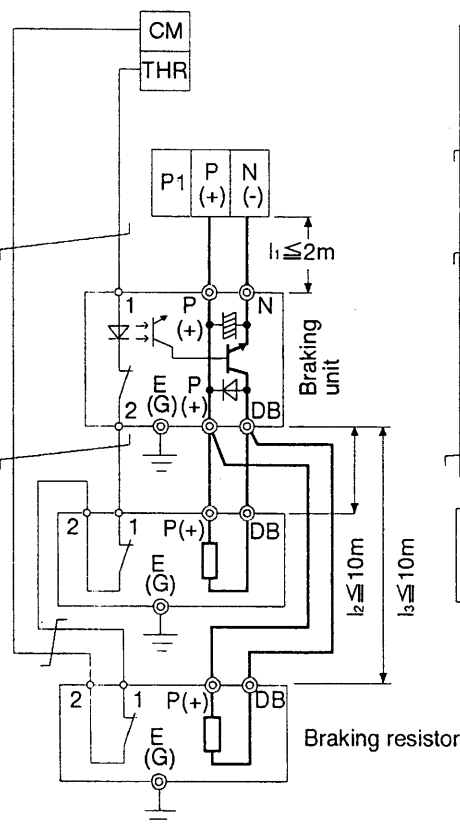
Keep the wiring distance between the braking units 50 cm or less.

Then, set switch SW1 on the printed circuit board of the braking unit as shown in Fig. 6-6-2 1). The switch SW1 is set as shown in Fig. 6-6-2 2) at factory shipping.

1) 1 Braking unit
1 Braking resistor



2) 1 Braking unit
2 Braking resistors



3) 2 Braking units
2 Braking resistors

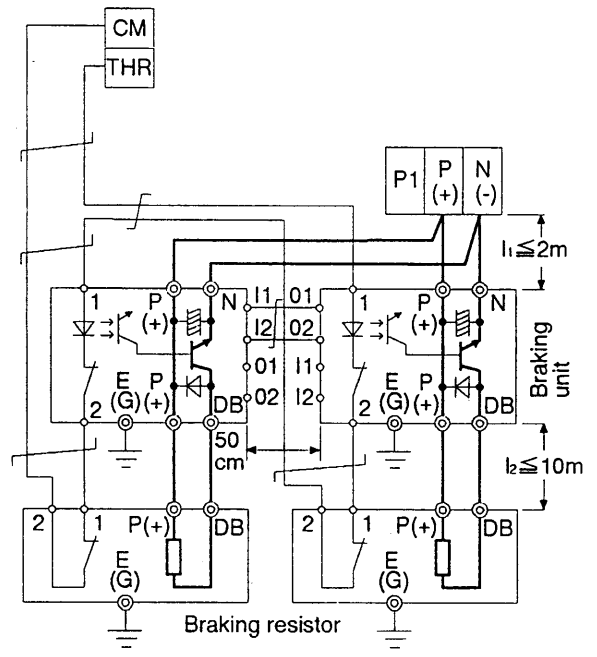
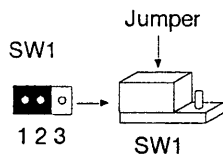


Fig. 6-6-1 Braking unit and braking resistor connections

1) Braking unit to be connected to I1 and I2 terminals.



2) Braking unit to be connected to O1 and O2 terminals.

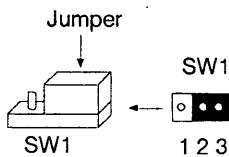


Fig. 6-6-2 Change of SW1 Setting

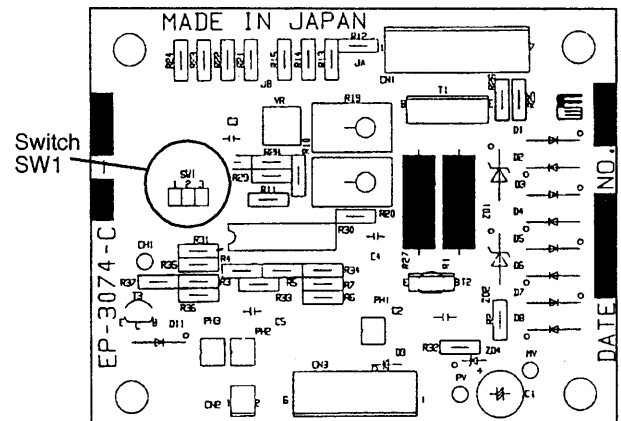


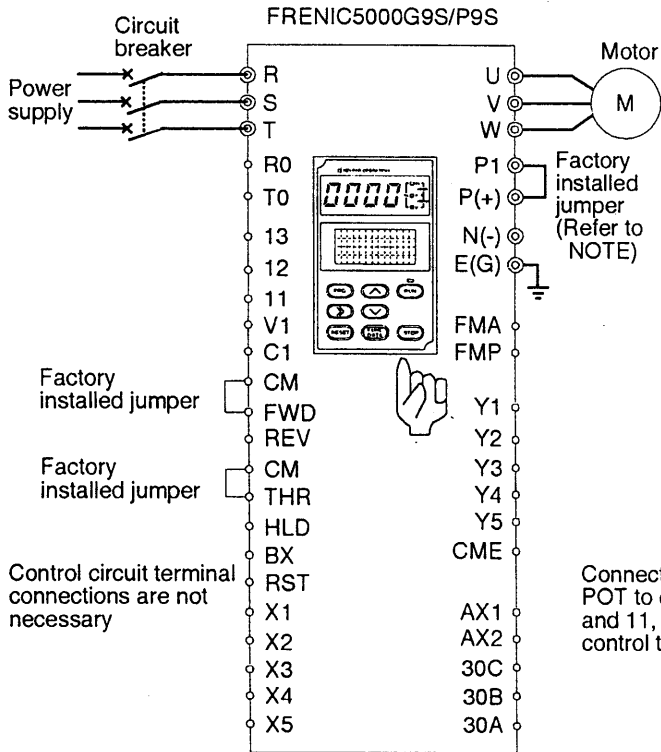
Fig. 6-6-3 Control printed circuit board of braking unit

6-7 Basic connection

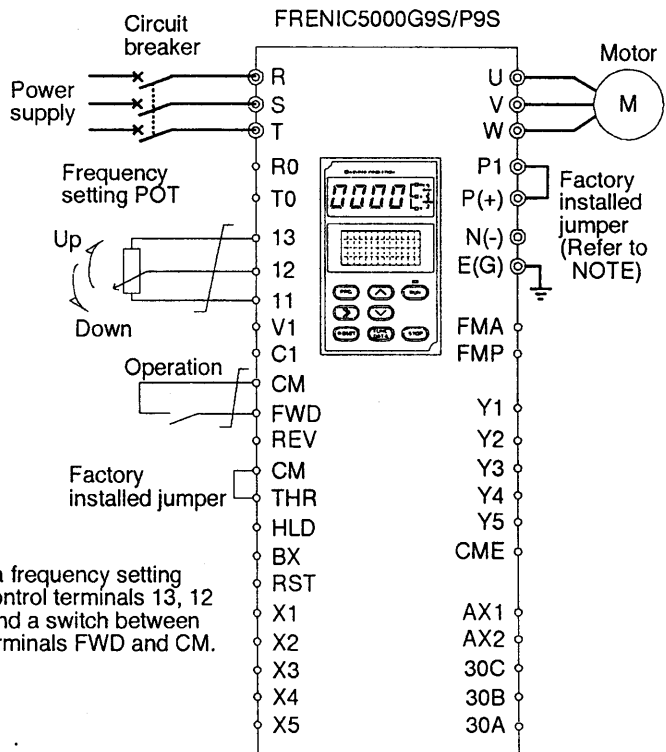
The connection of the inverter varies depending on the operation conditions. Make the most suitable connection for purpose and operation specification referring to "6-1 Description of terminal functions" and "9 Function".

An example for the simplest and ordinary used operations by the commands per keypad panel and per control terminals are shown.

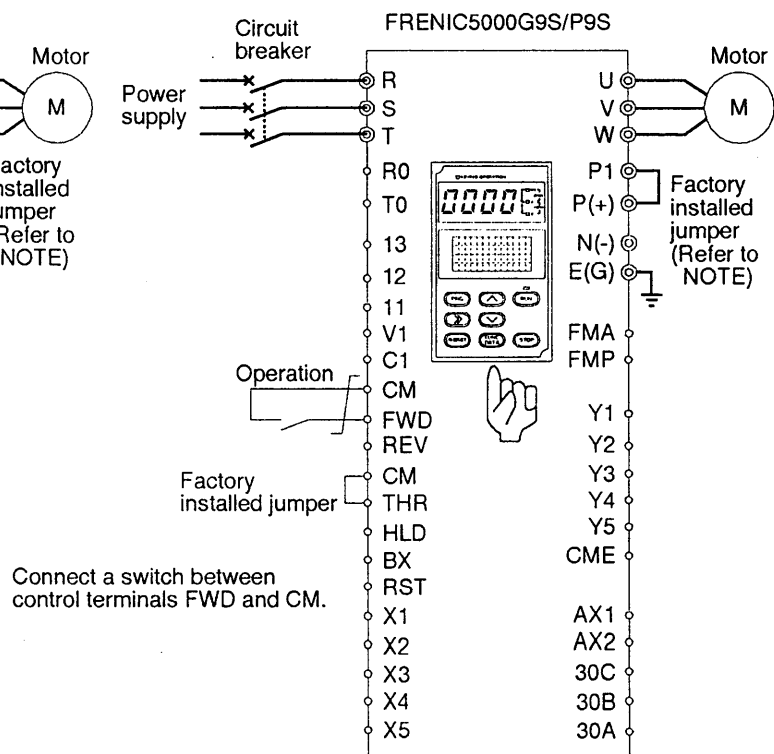
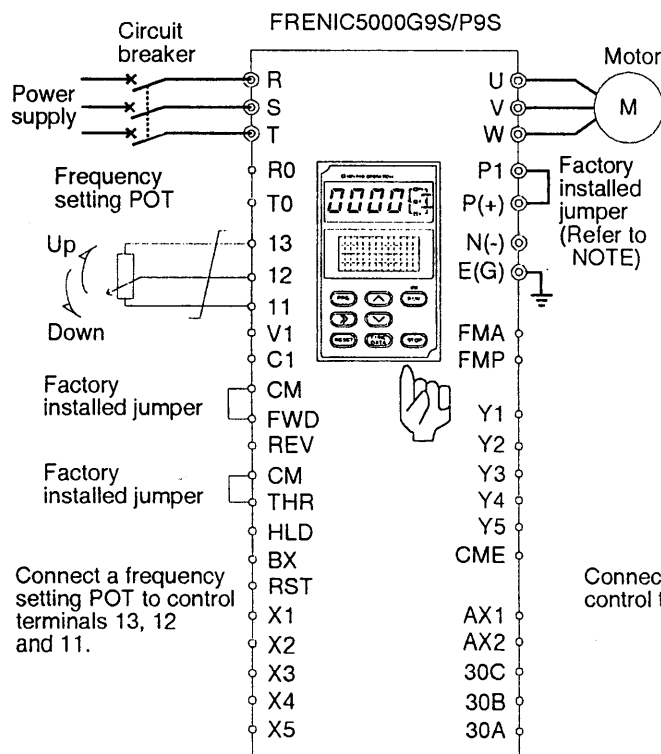
1) Keypad panel operation



2) Control circuit terminal operation



3) Keypad panel and Control circuit terminal operation are combined



NOTE: On the inverter to which DC link reactor is attached as standard (out-of-supply unit), connect the DC link reactor between terminals P1 and P(+). In this case, a jumper has been not connected between terminals P1 and P(+).

Fig. 6-7 Basic connections

7 Pre-operation Inspection

⚠ WARNING

Replace all covers before applying power to the inverter. Failure to do so may result in death or serious injury.

Do not touch the electrical circuits or parts, or do not insert foreign bodies through the openings when applying power. It may result in electrical shock, burn by generated arc, and damage of the equipment.

Before inspection and removing abnormality cause, disconnect and lock out power from the inverter. Failure to disconnect power may result in death or serious injury. A DC link circuit charge light provides visual indication that DC link voltage is present with the charged DC link capacitor; verify the DC link voltage level by measuring the voltage between power terminals P(+) and N(-) using an analog meter. Do not attempt to service the inverter until the charge indicator has extinguished and DC link voltage has discharged to zero volts.

When an abnormality occurs and is spreading, disabling to insure safety, or causing or being afraid of causing a disaster such as fire, promptly switch OFF the circuit breaker on the power supply side.

After mounting and wiring has been completed, check and work the inverter for the following items before starting operation. Correct errors or problems to normal status if mistake or bad condition exists.

After connection (wiring) has been completed, check the inverter for the following:

- Check for wiring errors.
- Check for leaving connection.
- Check for short-circuit or grounding of terminals and wires.

Attach the front cover.

Make ON (close) the circuit breaker on the power supply side.

When a magnet contactor is connected on the power supply side, make ON (close) it also.

The inverter can be operated after about 2 seconds from supplying AC power to the main power supply terminals R, S and T.

Check for the following:

- The CHARGE lamp is turned ON.
- Verify that the LCD display of the keypad panel displays STOP indication on the operation mode screen as shown in Fig. 7-1 (not alarm mode screen).
- All of the cooling fans in the inverter are running.
- Observe for a while and verify that smoking, abnormal sound, vibration, heating or smell do not generate. If any abnormality exists, make OFF (open) the circuit breaker and remove the cause of the abnormality.

Example : In the case of data = 0 in the function "64 LCD monitor"

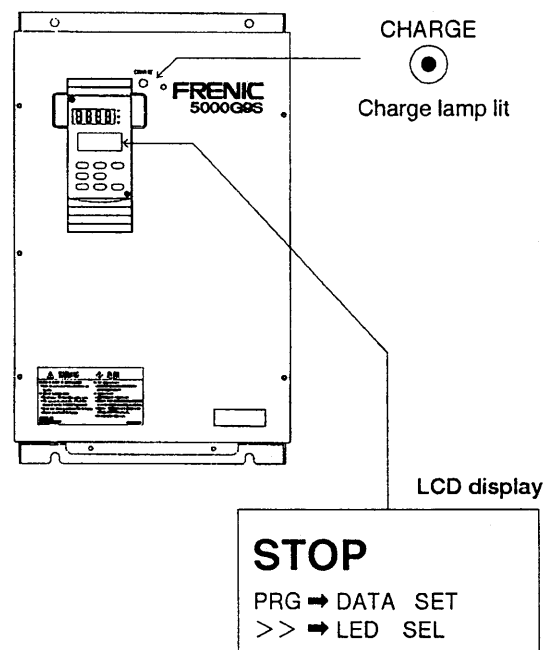


Fig. 7-1 Display when AC power is supplied

Write the data into each function so as to match the operation method, motor and driven mechanical equipment referring to "8 Keypad panel operation" and "9 Function" (pp. 39 to 97).

NOTE: In general, do not perform a megger test since it was performed at factory shipping. If necessary, for megger testing method, refer to "11-4 Insulation checks" (p.103).

8 Keypad Panel Operation

8-1 Keypad panel function

The inverter of FRENIC5000G9S/P9S serieses is operated by the commands from keypad panel and the control circuit terminals. The keypad panel has the following functions:

- Selection of operation
- Input of operation command, setting of frequency
- Selection of function and writing and reading data
- Protection of the written data
- Initializing of data
- Reading out of operation and alarm information
- Adjustment of instrument output value (Calibration of instrument scale)
- Auto-tuning
- Input of reset command for preset data and alarm

Keypad operation indicator

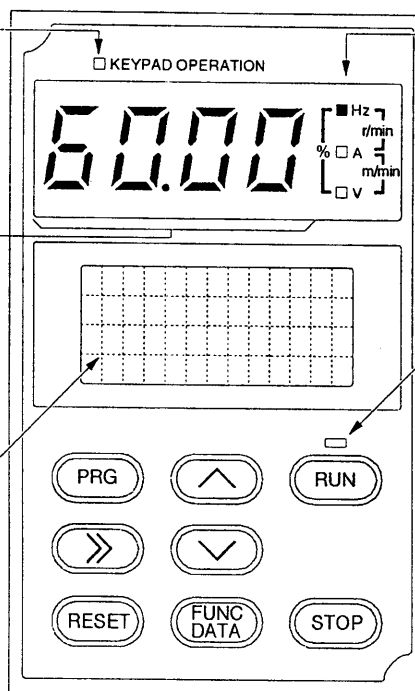
This indicator lights when the run and stop commands can be inputted per the Run and Stop keys.

Digital indicator (LED)

This indicator displays the operation data, preset frequency and alarm code.

Liquid crystal display (LCD)

The function data, operating instruction, operation and alarm information, etc. are displayed per 13 characters or 4 rows on the LCD



Unit indicator

The LED on the left of each unit symbol corresponds to the contents of the data display. when the alarm code is indicated, all 3 LEDs are turned OFF.

Operation indicator

This indicator lights when the inverter is operation (outputting). Even if the stop command is inputted, this indicator lights during deceleration.

Fig. 8-1 Keypad panel

Program key (PRG)

This key selects the operation mode, program mode and alarm mode (on inverter protection active).

Shift key (»)

This key shifts the figure of the data on the data setting operation, and selects the LED/LCD display on the operation mode, data monitoring mode and alarm mode.

Reset key (RESET)

This key cancels the data on the data setting operation, selects the data retrieval display on the data monitoring mode, and release the activation of the inverter protection on the alarm mode.

Up key (▲) , Down key (▼)

These keys are used to increase or decrease values on the data setting operation, frequency setting and alarm code retrieval, and to select function code and to shift the cursor on the data monitoring mode screen. The figure will change in one per one press or gradually per continuous push.

▲ : Increase ▼ : Decrease

Funcion/data key (FUNC DATA)

This key is used to select the data monitoring mode, the LCD display on each mode and to write the data on the program mode.

Run key (RUN) , Stop key (STOP)

These keys are used to input the run and stop commands. These functions are active when the data of "01 Operation mode" is set at 0.

8-2 Operation and display of keypad panel

After AC power is applied and the control power supply is established, the data during stopping are indicated on each display of the keypad panel.

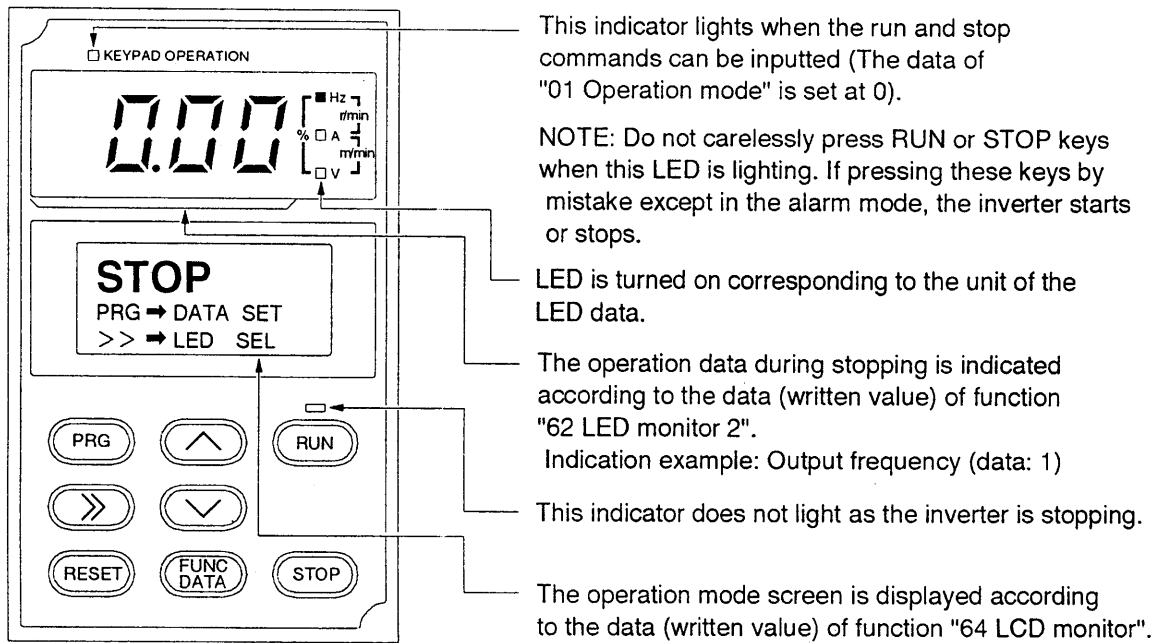


Fig. 8-2-1 Keypad panel display when power supply is turned on

When these indications have appeared, you can operate the keypad panel.

This status is called operation mode, and its liquid crystal display is called operation mode screen.

In detail, refer to "9 Function" (p. 66).

When the inverter starts operation, the liquid crystal display shown in Fig. 8-2-1 changes as shown in Fig. 8-2-2.

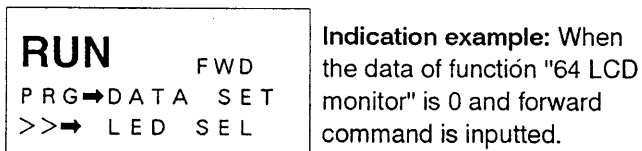


Fig. 8-2-2 LCD indication when inverter is started up

The following 3 modes are provided for normal operation, during which the data can be written and read out.

- Program mode
- Data monitoring mode
- Operation mode

When the inverter protection has been tripped, the alarm mode starts and the liquid crystal display and digital indicator change displays.

In this mode, auto-tuning can be conducted to measure the parameters of the inverter output circuit.

The relations of the operation mode, liquid crystal display and operation key are as shown in Fig. 8-2-4 and 5. These figures describe the fundamental operation of the keypad panel.

For simplicity, the following abbreviations are used:

- Digital indicator and liquid crystal display are abbreviated as LED, and LCD respectively.
- Each function is expressed with code number and abbreviation of function name expressed on the LCD display.

Example : Function 00 Frequency setting
"00 FREQ COMND"

- Unit indicator, keypad operation indicator and operation indicator are expressed as Fig. 8-2-3.

■ or ■ : Turned on □ or □ : Turned off

Fig. 8-2-3 Expression for indicators

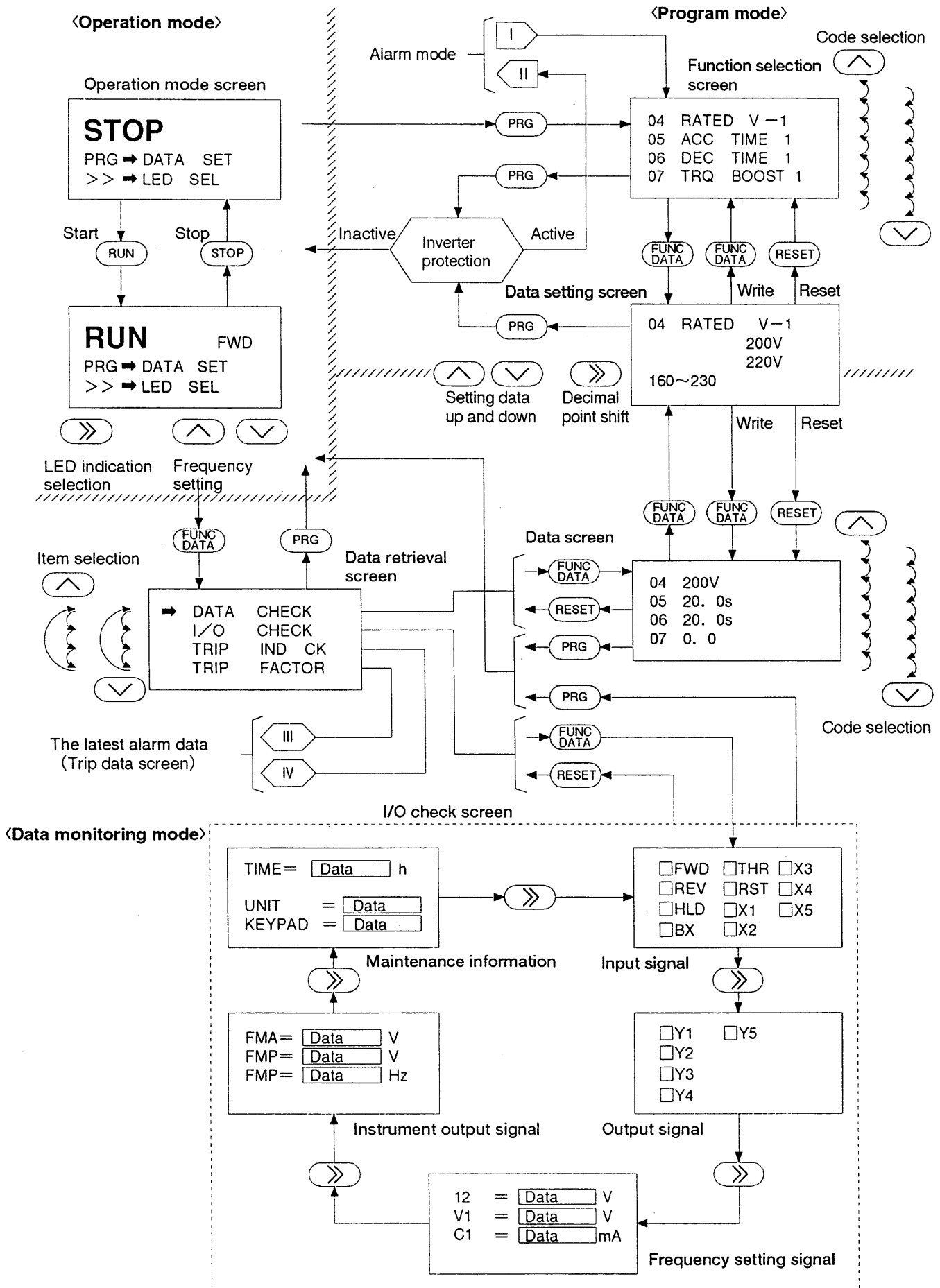


Fig. 8-2-4 keypad panel operation and LCD indication (1)

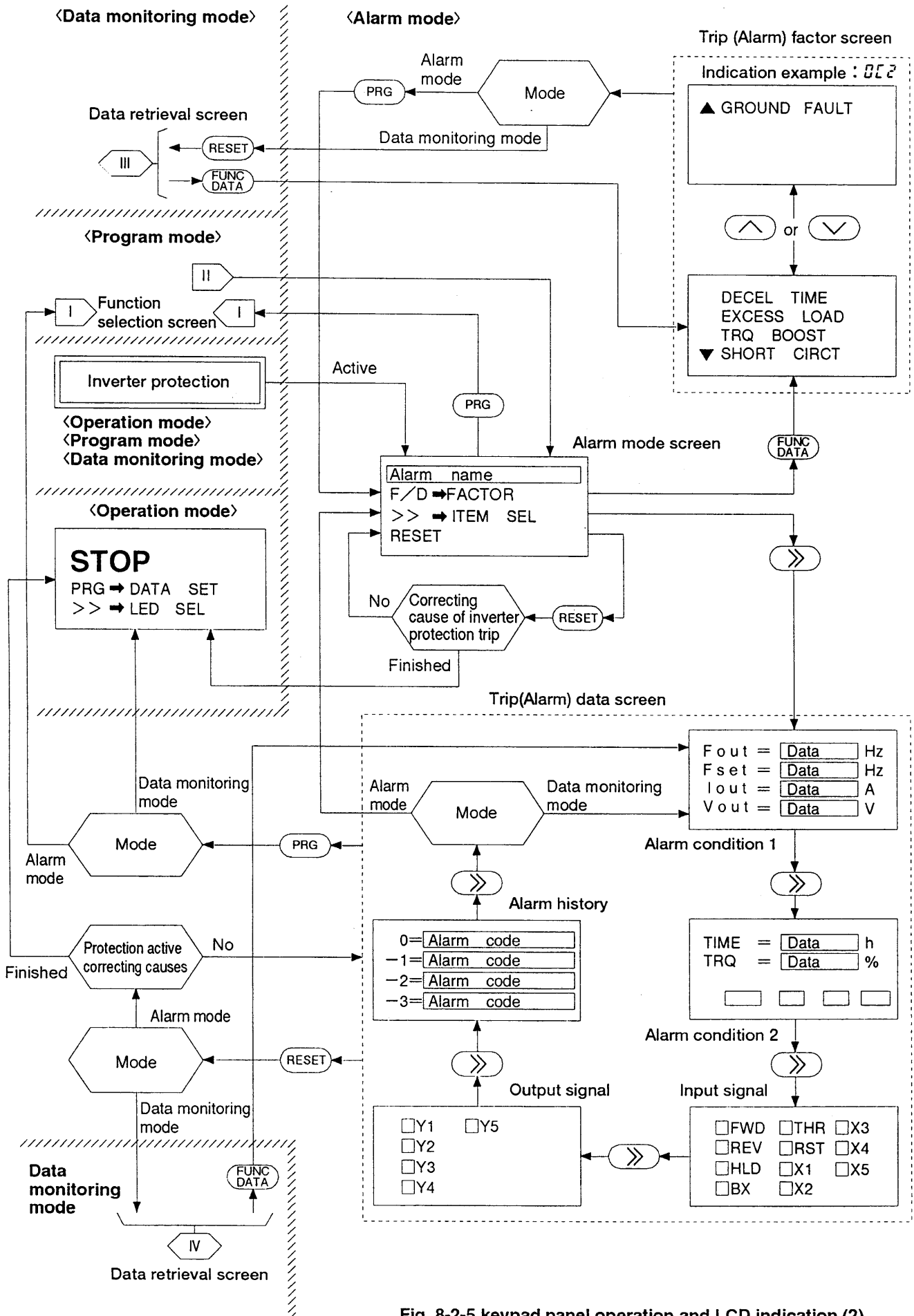


Fig. 8-2-5 keypad panel operation and LCD indication (2)

8-3 Program mode

Before starting operation, write the data necessary for the motor and equipment into the functions. The functions and their data are indicated on LCD.

LED indicates displays depending on the data of "61 LED MNTR 1" and "62 LED MNTR 2". These displays do not change by the operation in this subsection.

Writing starts from selection of the function.

Indication example : When changing the data of "04 RATED V" from 200 V to 220 V.

STOP

PRG → DATA SET

>> → LED SEL

33 From alarm mode (p. 61)

Function code Function name

0 0	FREQ COMND
0 1	OPR METHOD
0 2	MAX Hz
0 3	BASE Hz-1



Calling for function selection screen

Call for the function selection screen by pressing **PRG** key. In the screen, four function codes and their names are listed. There appears the screen per the latest selecting operation including that of the data screen of the data monitoring mode.

From function selection (p. 45)

6

Function of the setting data?

Yes

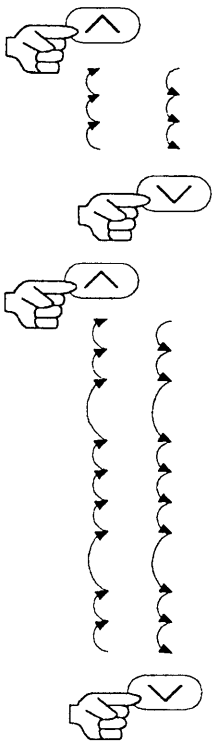
1

To data setting screen (p. 44)

No

Blinking (cursor)

0 0	FREQ COMND
0 1	OPR METHOD
0 2	MAX Hz
0 3	BASE Hz-1



Selecting the function code

Press **▲** or **▼** key, then the blinking function code moves as shown in the figure.

0 1	OPR METHOD
0 2	MAX Hz
0 3	BASE Hz-1

0 4	RATED V-1
0 5	ACC TIME 1
0 6	DEC TIME 1
0 7	TRQ BOOST 1

0 8	ELCTR N OL
0 9	OL LEVEL
1 0	RESTART

2

When continuing to press the key at the upper or lower end, the screen is scrolled showing new function codes and their names. Release the **▲** or **▼** key if the function to be set appears.

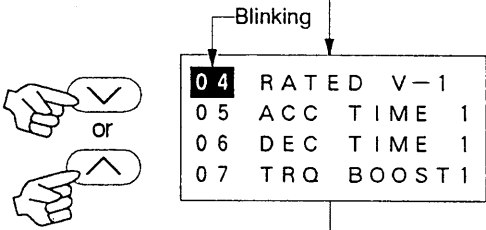
NOTE : If the data of function block selection is set at 0, the functions "32 X1-X5 FUNC" or above will not appear on the display. Select the function code of Function block selection. And after rewriting its data from 0 to 1 by the operation described afterward, select the function again.

Top. 44

From the function selection screen (p. 43)

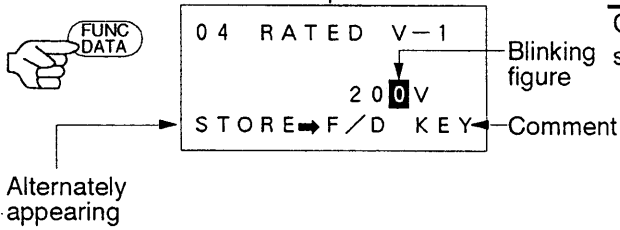
2 From p. 43

1



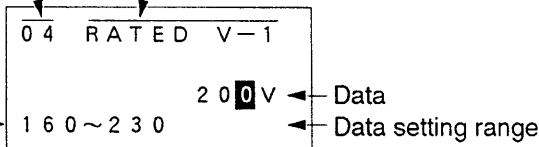
Setting function code	The blinking code is the function code to beset. For data setting, set the function code by pressing \wedge or \vee key.
-----------------------	--

14 From data monitoring mode (p. 48)

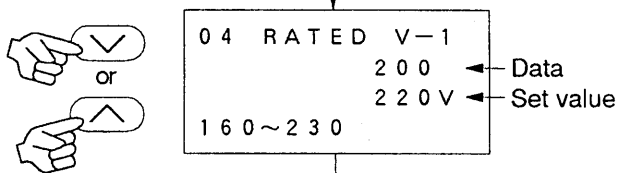
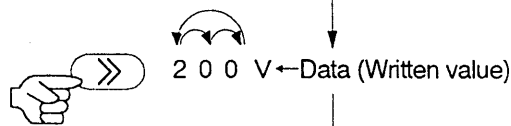


Calling for data setting screen	Press FUNC DATA key. The data setting screen appears and the lowest digit of the data blinks. Identify the lower comment row. You can set the data only when the indications of data setting range and STORE -> F/D KEY appear alternately in the comment row. When the indication in the comment row is as shown in Table 8-3-1, you cannot set the data.
---------------------------------	---

Function code Function name



Setting the data	You can set the data at the blinking digit. Press \gg key and select the digit to set.
------------------	--



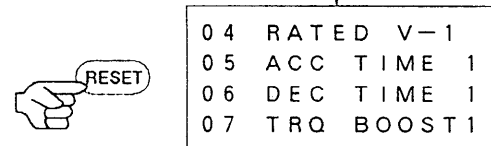
	Press \wedge or \vee key to set the data. Based on the blinking digit, the numeral increases or decreases. Then, the written value is shifted to the upper row. The numerals of outline letter on a black background under the written value indicate the set value, and the digit to set will continue blinking.
--	---

Mode? Data monitoring mode → 3 To writing data (p. 48)

Program mode
Alarm mode

Writing data? Yes → 4 To writing data (p. 45)

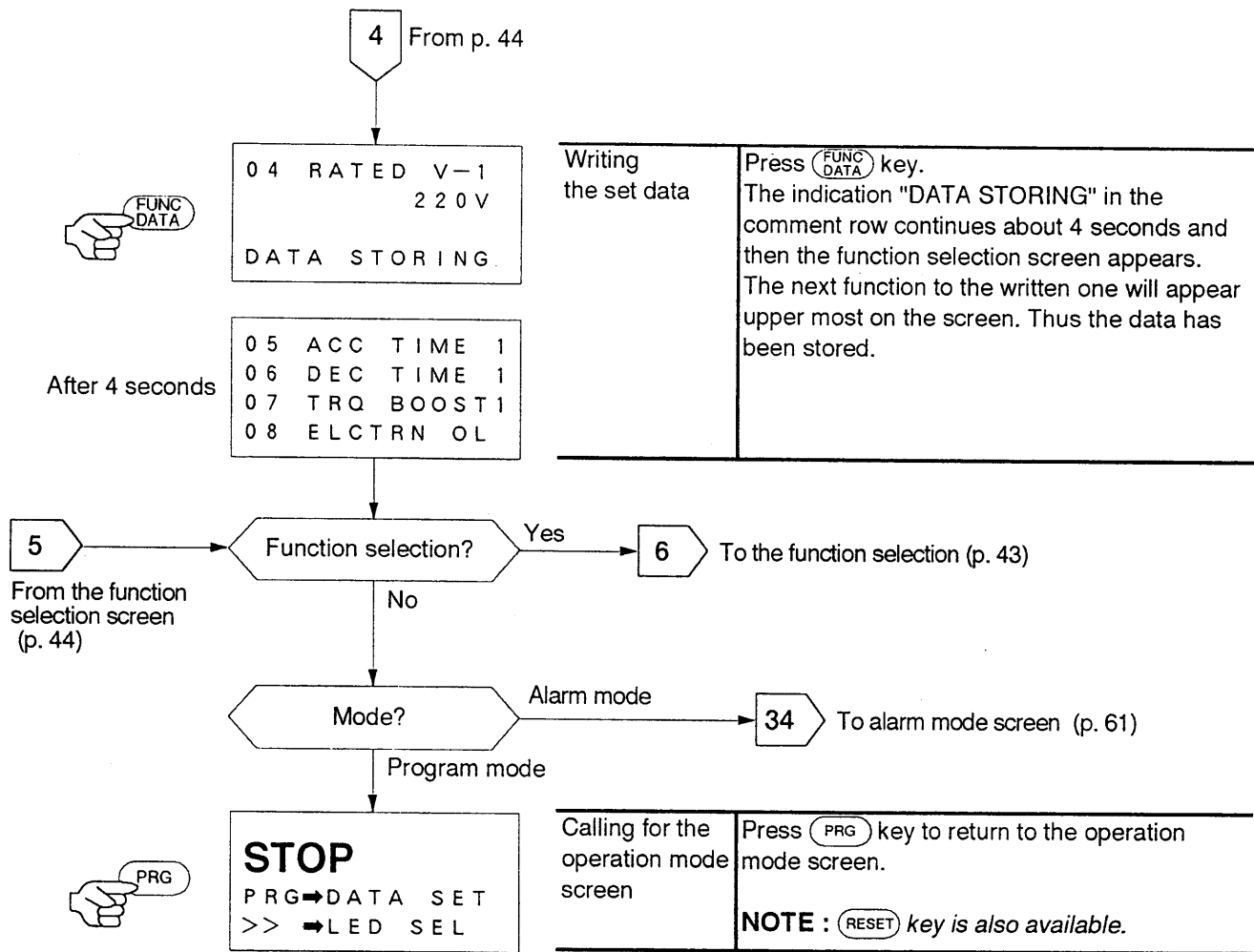
No



Not writing the data	Press RESET key. The set data is cancelled, and the screen changes to function selection screen. The set function will appear uppermost on the LCD.
----------------------	--

5 To p. 45

NOTE : Pressing PRG key does not write the data, but it makes to appear the operation mode screen in the program mode and alarm mode screen in alarm mode.



NOTE:

- In the data setting screen, if the indication appears as shown in Table 8-3-1, you cannot conduct data setting.
- "32 X1-X5 FUNC" and above are not displayed if the data of the function block selection is set at 0.
- Data exceeding the setting range cannot be set or written, since the set data is limited at upper and lower limit.
- If about 5 minutes has passed after the program mode operation, the screen will automatically return to the mode before the operation.

- Data setting only will not make operation data (operation condition). It is only a data on LCD. After storing the data into memory, the data becomes operation data. You should therefore press **FUNC DATA** key to rewrite the memoried data.
When setting frequency using **^** or **v** key from the keypad panel, the inverter operates with the set frequency. However, since the data in the memory is not rewritten, the original memoried data is the set frequency value when the control power supply is lost.

Table 8-3-1 Indications which do not allow data setting or writing

Indication in comment row	Cause	Countermeasure
INV RUNNING	Function is not changeable while running because currently operating	Input the stop command, then inverter stops
FWD/REV ON	Run command is inputted to the control terminal FWD or REV, so that "01 OPR METHOD" and "65 PATERN" cannot be changed	Open the input signal
OPTION ACTIVE	Optional side has operation priority	Change so that inverter side has the priority
DATA STORING	Now writing other data The X5 data of "32 X1-X5 FUNC" is 2 and the control terminal X5 is OFF	Wait until the data is stored Make X5 ON
TUNING	Now auto-tuning is active	Wait until the auto-tuning is completed
DATA PRTCTD	The data of "95 DATA PRTCTD" is 1 (Not changeable)	Rewrite the data 1 to 0

8-4 Data monitoring mode

This mode displays the data in Table 8-4-1 on the LCD and LED.

Table 8-4-1 Data indication

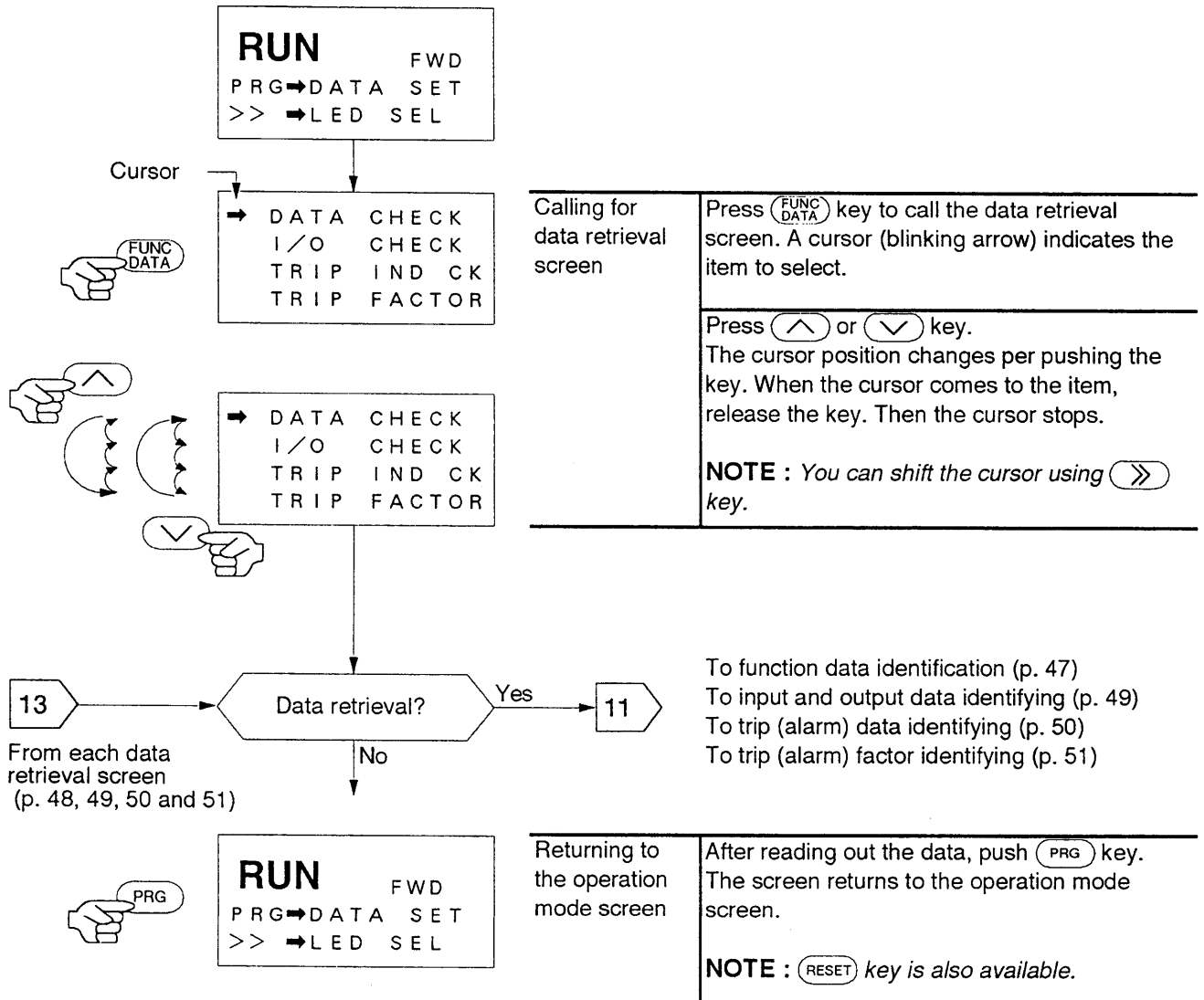
Data retrieval	LCD	LED
Data identification	Function code and data (Written value)	Indication corresponding to "61 LED MNTR 1" and "62 LED MNTR 2"
I/O identification	In- and output signal status. Maintenance information	
Trip identifying	Data and alarm history on the latest inverter protection trip	The latest alarm code
Trip factor identifying	Presumption of cause on the latest inverter protection trip	The latest alarm code and alarm detection order

NOTE : The operation mode screen appears by pushing **(PRG)** key even if in any data monitoring mode screen.

a) Data retrieval selection

For reading out data, call the data retrieval screen on the LCD at first and select the item to read out.

The LED displays the data based on "61 LED MNTR 1" and "62 LED MNTR 2". The LED data does not change during operation on the data retrieval screen.

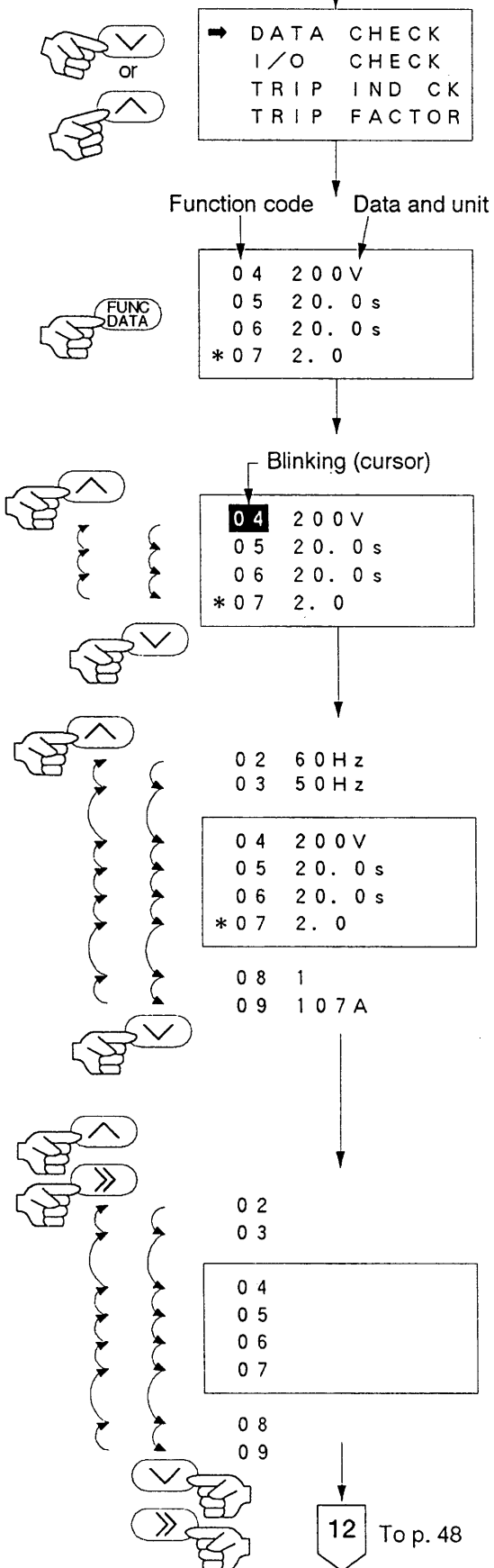


b) Function data (written data) identification

From data retrieval screen (p. 46)

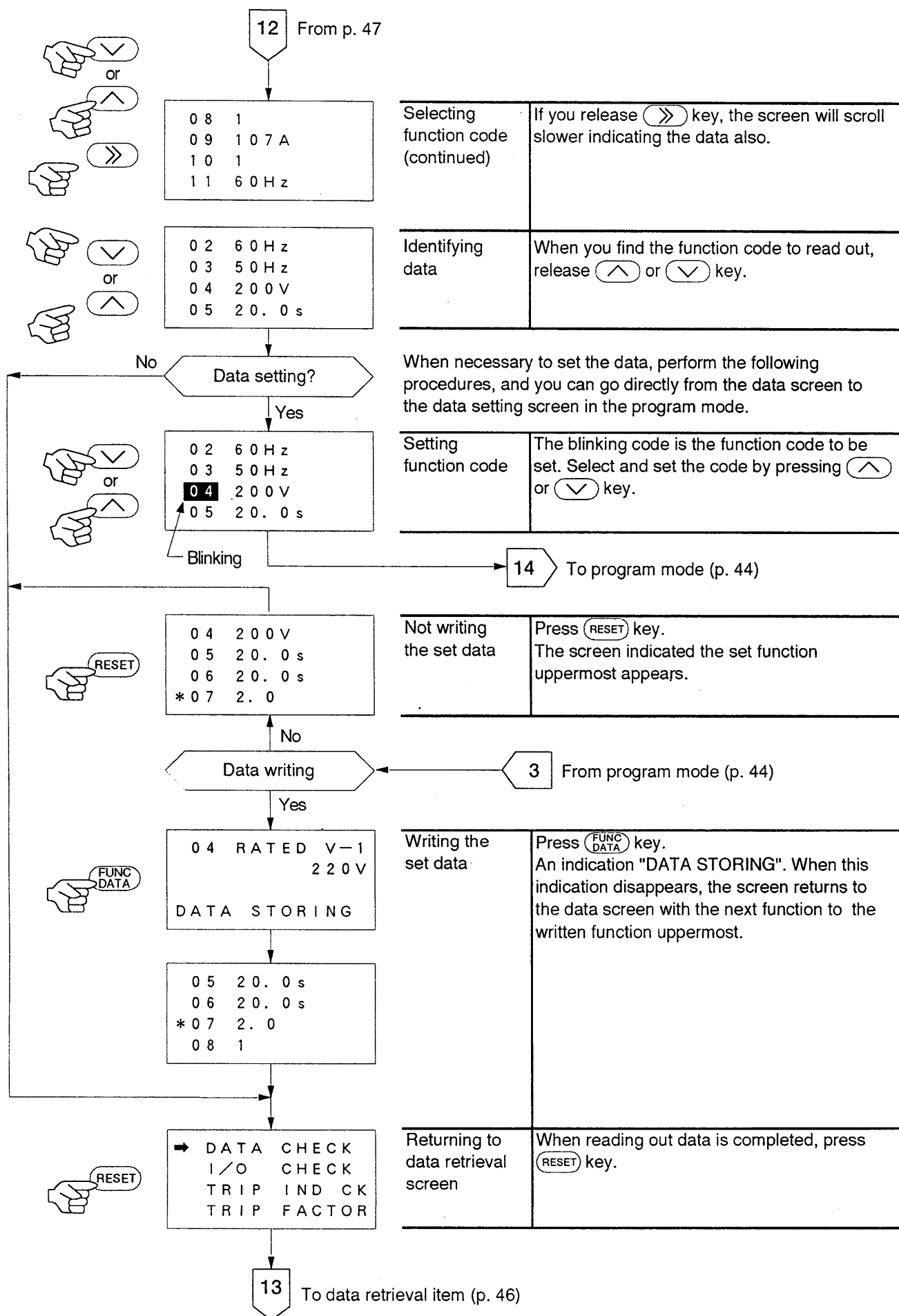
11

NOTE : A * mark is indicated on the left side of the code on the data identifying screen when the data is other than the written value at factory shipping.



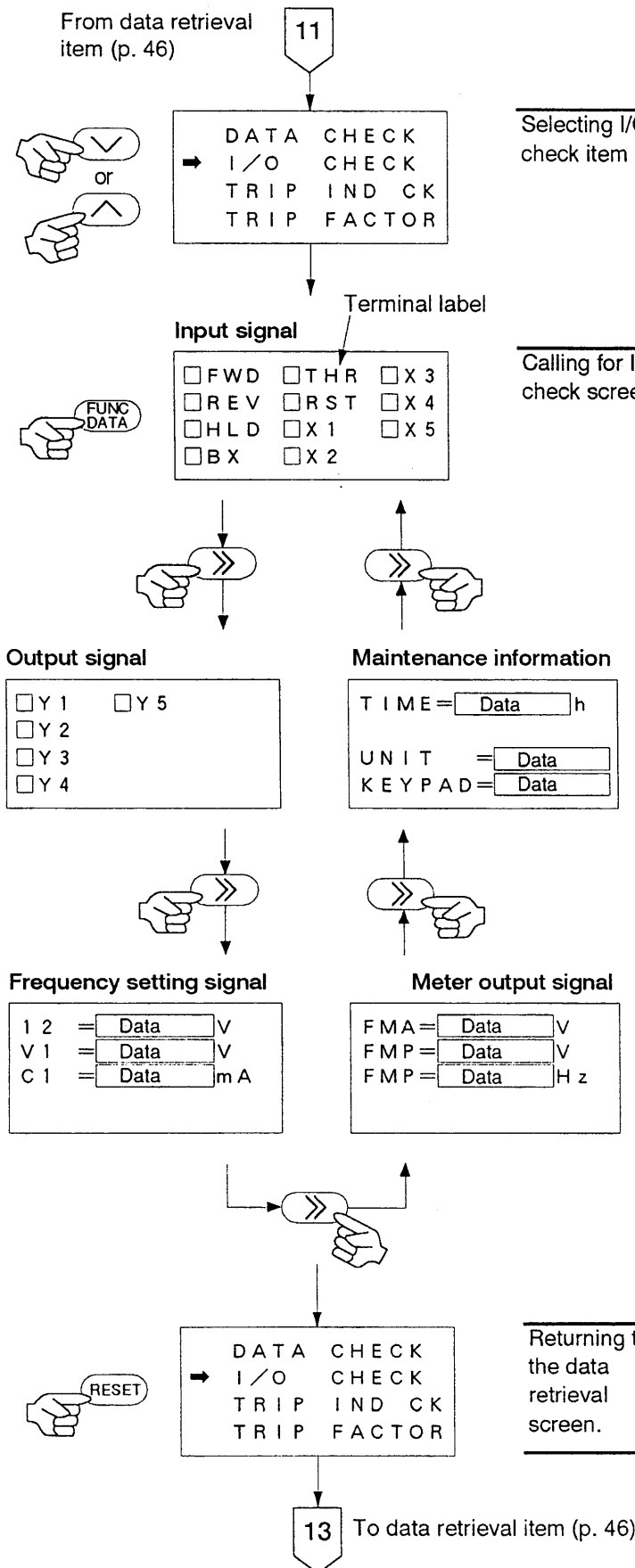
<p>Selecting the data identifying item</p>	<p>Press or key to shift the cursor to "DATA CHECK" on the data retrieval screen.</p>
<p>Indicating the data screen</p>	<p>Press key. The data screen appears. On this screen, four function codes and their data (written values) are indicated. There appears the screen selected by the latest operations, including selection of the function in the program mode.</p>
<p>Selecting function code</p>	<p>Press or key, then the blinking function code moves as shown in the figure.</p>
	<p>When continuing to press the key at the upper or lower end, the screen is scrolled showing new function codes and their data.</p>
	<p>When pressing or key and key at the same time, the screen will scroll faster indicating function codes only.</p>

12 To p. 48



c) Input/output data identification

You can read out the current input/output status. Select five screens of I/O CHECK on LCD per the following procedures.



Selecting I/O check item

Press \wedge or \vee key, and set the cursor to "I/O CHECK".

Calling for I/O check screen

Press FUNC DATA key.
Input signal screen appears

Press \gg key, and the screen will change in the following order per each press.

Input signal screen:
indicates the contact input terminal status.

Output signal screen:
indicates open-collector terminal status

Frequency setting signal screen:
indicates the input value (set value) of the analog frequency setting terminal.

Meter output signal screen:
indicates the output value of the meter output terminal.

Maintenance information screen:
indicates the total running time of the inverter and the reference number.

Returning to the data retrieval screen.

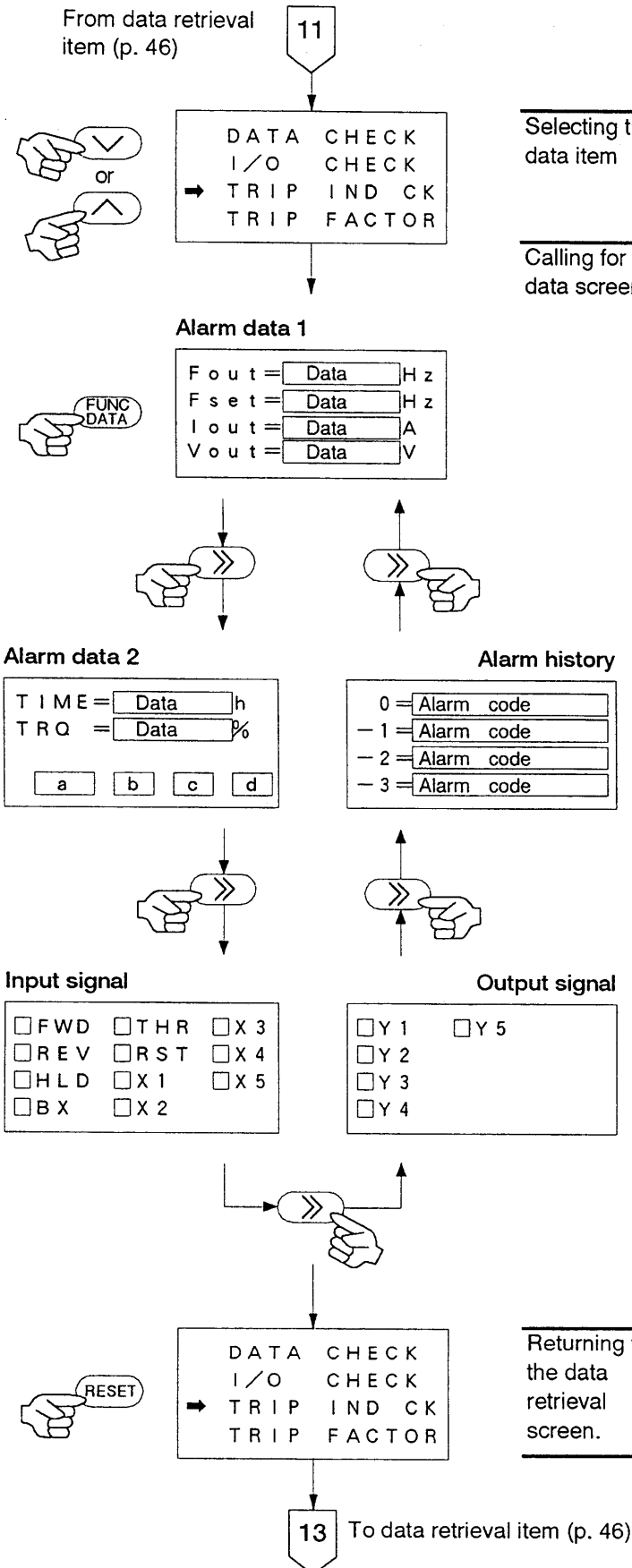
After reading out, press RESET key. Then any screen returns to the data retrieval screen.

d) Trip (alarm) data identifying

For the latest trip (alarm) data, 5 screens will appear on LCD.

The relevant alarm code will be indicated on LED. When two or more alarm codes exist, only the alarm code detected at first is indicated.

NOTE : This item is to identify the alarm data that is temporarily stored in the memory after alarm reset. Therefore, when the power supply of the inverter is cut off, the alarm data is erased and cannot be indicated.

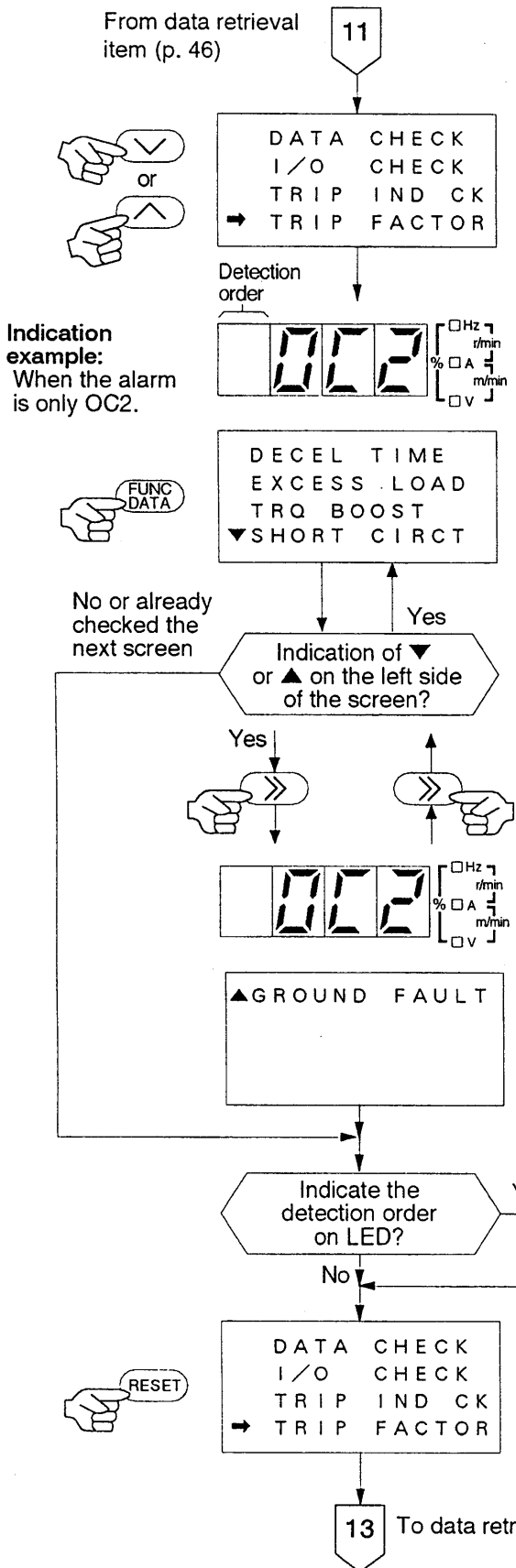


Selecting trip data item	Press or key, and set the cursor to "TRIP IND CHECK".															
Calling for trip data screen	Press key. Alarm data 1 screen appears. Press key, and the screen will change as shown in the figure per each press.															
<p>Alarm data 1</p> <p>F o u t : Output frequency F s e t : Setting frequency I o u t : Output current V o u t : Output voltage</p> <p>Alarm data 2</p> <p>T I M E : Total operation time of protection trip T R Q : Calculated torque</p> <table border="1"> <thead> <tr> <th>Code</th> <th>Content (on alarm)</th> <th>Indication</th> </tr> </thead> <tbody> <tr> <td>a</td> <td>Rotating direction</td> <td>Blank: Stop FWD: Forward rotation REV: Reverse rotation</td> </tr> <tr> <td>b</td> <td>Current limiting</td> <td>Blank: Inactive IL: Active</td> </tr> <tr> <td>c</td> <td>Link circuit DC voltage level</td> <td>Blank: Normal U V : Undervoltage condition V L : Voltage limit reached</td> </tr> <tr> <td>d</td> <td>Torque limiting</td> <td>Blank: Inactive T L : Active</td> </tr> </tbody> </table> <p>Input/output signal screen Input/output statuses of contact input terminals and open-collector output terminal are indicated.</p> <p>Alarm history screen The previous trip codes are indicated. When two or more alarms occur at the same time, only the alarm code detected at the first is indicated.</p>		Code	Content (on alarm)	Indication	a	Rotating direction	Blank: Stop FWD: Forward rotation REV: Reverse rotation	b	Current limiting	Blank: Inactive IL: Active	c	Link circuit DC voltage level	Blank: Normal U V : Undervoltage condition V L : Voltage limit reached	d	Torque limiting	Blank: Inactive T L : Active
Code	Content (on alarm)	Indication														
a	Rotating direction	Blank: Stop FWD: Forward rotation REV: Reverse rotation														
b	Current limiting	Blank: Inactive IL: Active														
c	Link circuit DC voltage level	Blank: Normal U V : Undervoltage condition V L : Voltage limit reached														
d	Torque limiting	Blank: Inactive T L : Active														
Returning to the data retrieval screen.	After reading out, press key. Then any screen returns to the data retrieval screen.															

e) Trip (alarm) factor identifying

Latest trip (alarm) factor will appear on LCD, and the detection order and the relevant alarm code will be indicated on LED.

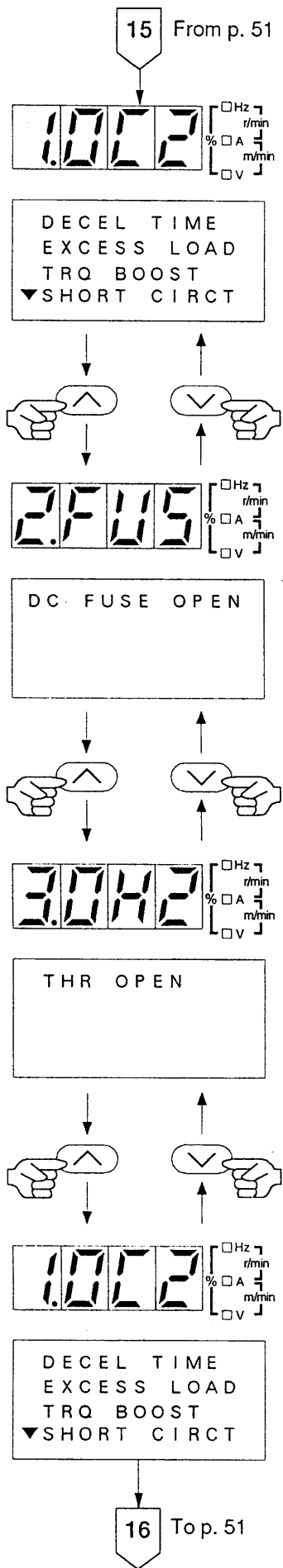
NOTE : This item is to identify the alarm data that is temporally stored in the memory after alarm reset. Therefore, when the power supply of the inverter is cut off, the alarm data is lost and cannot be indicated.



Selecting the trip factor item	Press or key, and set the cursor to "TRIP FACTOR".
Calling for trip factor screen	Press key. The trip factor screen appears on LCD, and the relevant alarm code on LED. When the complex alarm factors exist, the detection order for the complex factors will be also indicated on LED.

Selecting the next trip factor screen	Press key since the presumed cause is indicated on the next screen also.
---------------------------------------	---

Returning to the data retrieval screen.	After reading out, press key.
---	--------------------------------



Indication example:

Detection order	Alarm name
1	Overcurrent during deceleration
2	Fuse blow-out
3	External alarm

Retrieval of alarm contents

When the detection order is indicated, it shows that the protection was activated owing to complex causes.

Press \wedge key. LED indicates the detection order 2, and LCD indicates the presumed cause for the second alarm code.

The detection order will change from 2 to 3 per pressing \wedge key, indicating the relevant alarm code and its presumed cause, and return to the detection order 1 if all causes have been indicated.

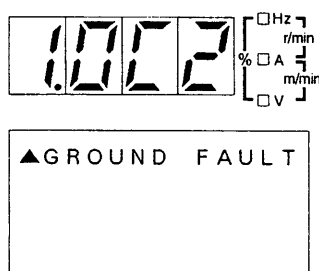
When pressing \vee key, the detection order will be indicated in reverse order, for instance, 1→3→2→1.

Selecting the next trip factor

If ▼ mark is found under-left on LCD, presumed cause is also indicated on the next screen.

Press \gg key.

The screen changes to the next screen per pressing \gg key.



8-5 Operation mode

The data while the inverter operating are indicated on LCD and LED.

The LED data selected in this mode are indicated also on the data screens in the program mode and the data monitoring mode, and on the I/O check screen.

Further, the frequency setting and the RUN and STOP commands can be inputted from the keypad panel.

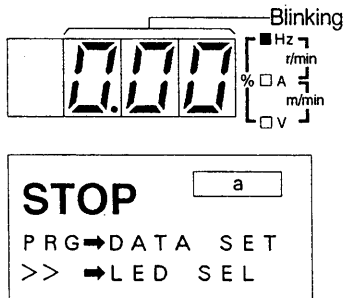
a) Operation mode screen selection

Call for the operation mode screen on LCD referring to Fig. 8-2-4 (p.41).

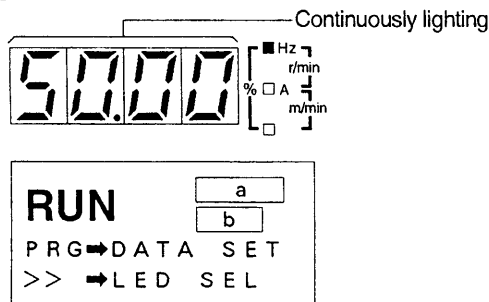
The screen according to the data of "64 LCD MNTR" is displayed on LCD.

As to LED, refer to "(3) LED indication selection". The data on LED in the operation mode blinks while the inverter is in stopping, and continuously lights while it is in running.

1) Stopping



2) Running



a. LED indication factor

Blank : 1 time

×10 : 10 times

×100 : 100 times

b. Motor rotation

FWD: Forward rotation

REV: Reverse rotation

b) Display content selection for operation mode screen

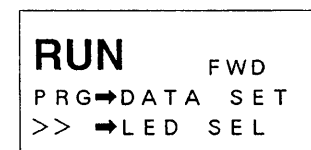
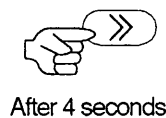
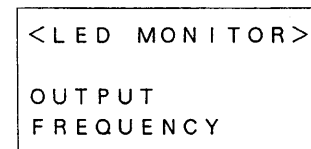
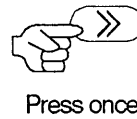
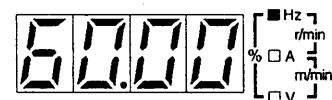
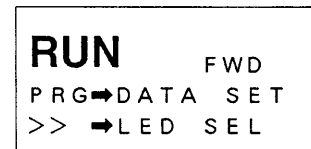
Rewriting the data of "64 LCD-MNTR", you can change the display content of the LCD screen, for instance, to a bar chart.

Refer to "8-3 Program mode" (p.43) for changing the data, and "9 Function" (p.66) for display content.

c) LED indication selection

LED indicates the data according to "62 LED MNTR 2" while the inverter is in stopping, and according to "61 LED MNTR 1" while it is in running or setting frequency.

Indication example: When the output frequency is 60 Hz in forward rotation



Press key for selecting the data.

— Identify the data name.

Press key once, and then the LCD screen changes from the data to the name monitored currently.

— Selecting the other data

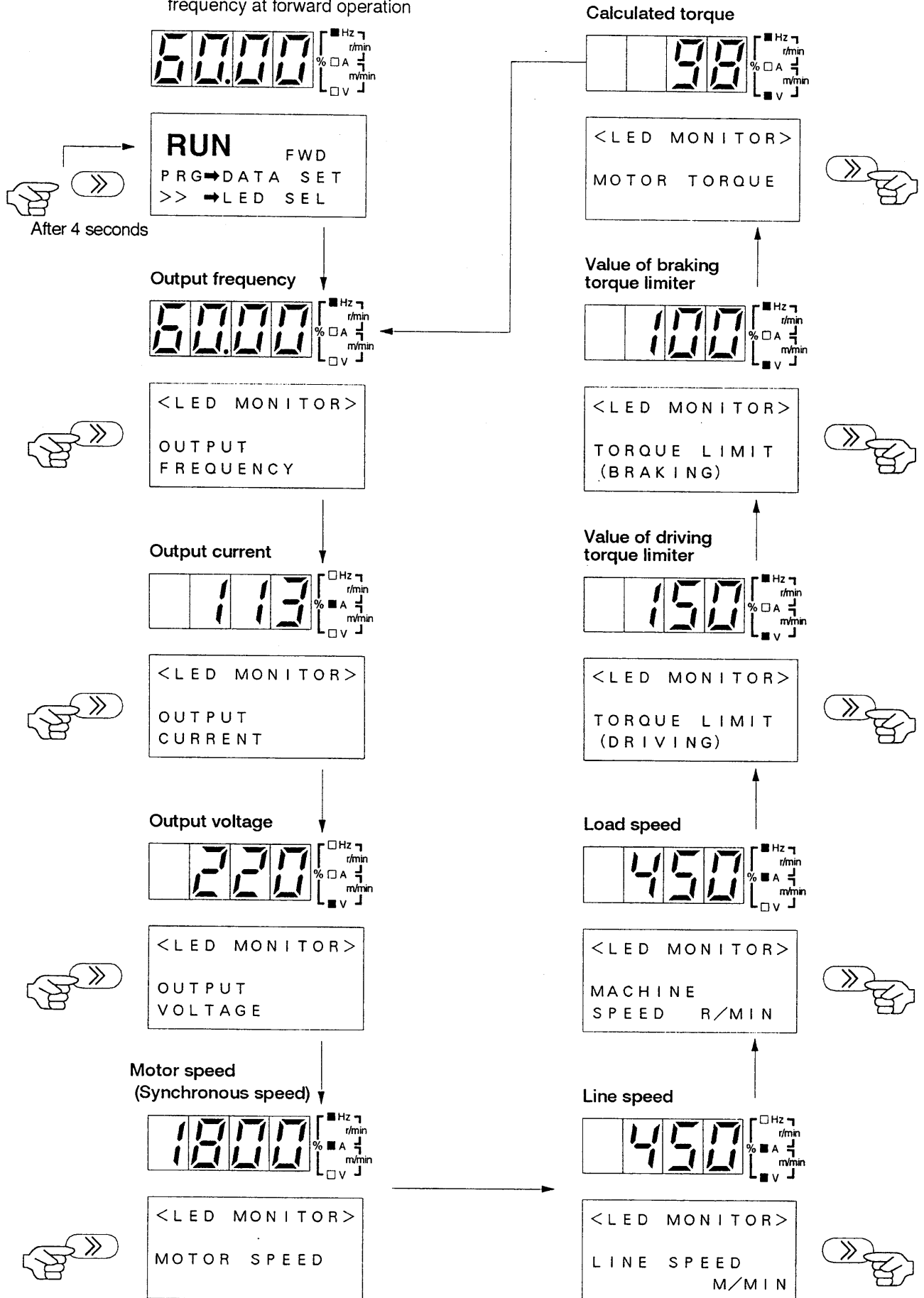
Press key. The indicated data changes as shown in the figure in p. 54 per each press of key.

— Finish selecting the data

The LCD screen returns to the operation mode screen 4 seconds after the key is released.

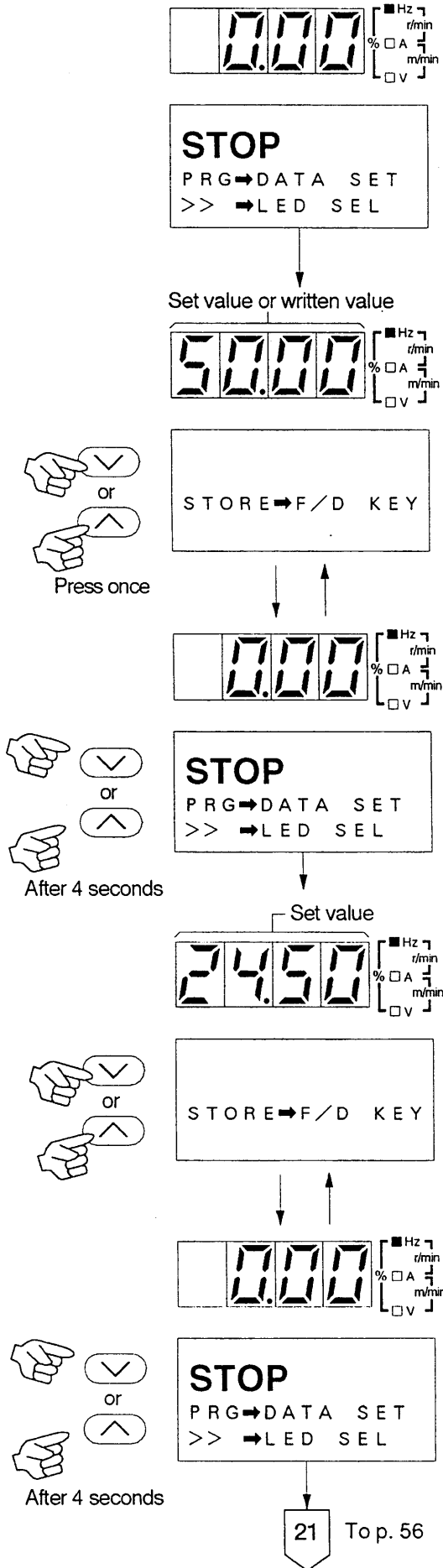
The LED continues to indicate the selected data until the next operation is selected. However, this selection is not stored into memory. When AC power is turned off, the selected data is lost.

Indication example: The LED data is the output frequency at forward operation



d) Frequency setting

You can set the output frequency with keypad panel if the data of "00 FREQ COMND" is 0.



NOTE : The inverter will operate with the frequency set with \wedge or \vee key without pressing FUNC DATA key. However, the set frequency will be erased when AC power turned off, since the data have not been written (stored) into memory.

Indication example: When the set frequency is changed from 50 Hz to 24.5 Hz during inverter stopping and the output frequency is selected for the LED indication.

Identifying the set frequency

Press \wedge or \vee key once.
LED indicate the current frequency setting about 4 seconds. At the same time, LCD is changed to operation guide.

NOTE : The LED data is blinking while the inverter is stopping.

After 4 seconds, both LED and LCD return to the display before.

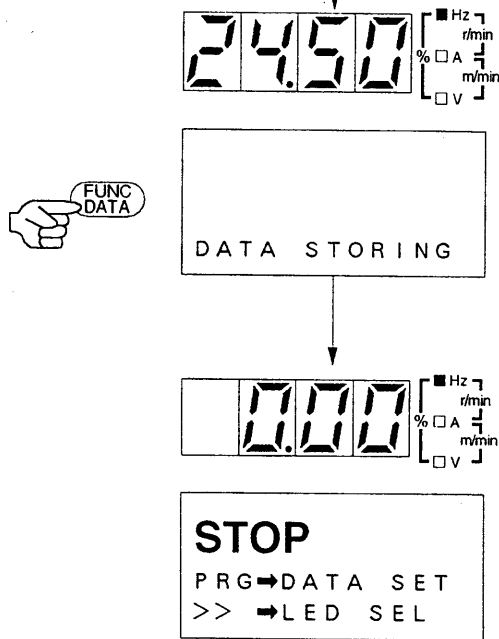
Changing the set frequency

Press \wedge key for increasing frequency and \vee key for reducing frequency.
The set value is indicated on LED, and the operation guide is indicated on LCD.

After 4 seconds, both LED and LCD return to the display before.

From p. 55

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Writing the set frequency into memory

Press **FUNC DATA** key when LED is indicating the set value. If LED is not indicating the set value, press **▲** or **▼** key once. Then, press **FUNC DATA** key.

The LCD display will change from "DATA STORING" to the operation mode screen, then writing the set frequency has been completed.

e) Input run and stop commands.

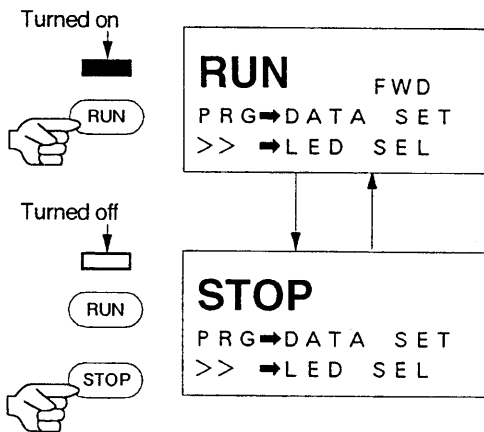
You can input run and stop commands from **RUN** and **STOP** keys on the keypad panel when the keypad operation indicator is turned on by setting the data of "01 OPR METHOD" at 0.

☐ Turned on: Command can be input.

■ **KEYPAD OPERATION**

☐ **KEYPAD OPERATION**

☐ Turned off: Command cannot be input.



Starting

Press **RUN** key.

The inverter will accelerate the motor with the selected acceleration time. The operation indication lamp turns on.

Stopping

Press **STOP** key.

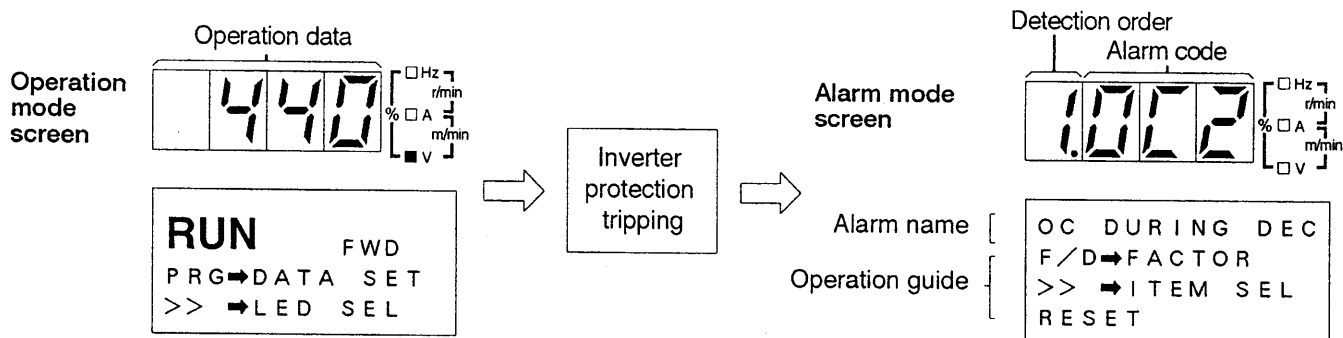
The inverter will decelerate and stop the motor with the selected deceleration time. The operation indication lamp turns off, and the LCD screen changes when the motor stops.

NOTE : The operation commands can be inputted by **RUN** and **STOP** keys in the case of the program mode and the data monitoring mode.

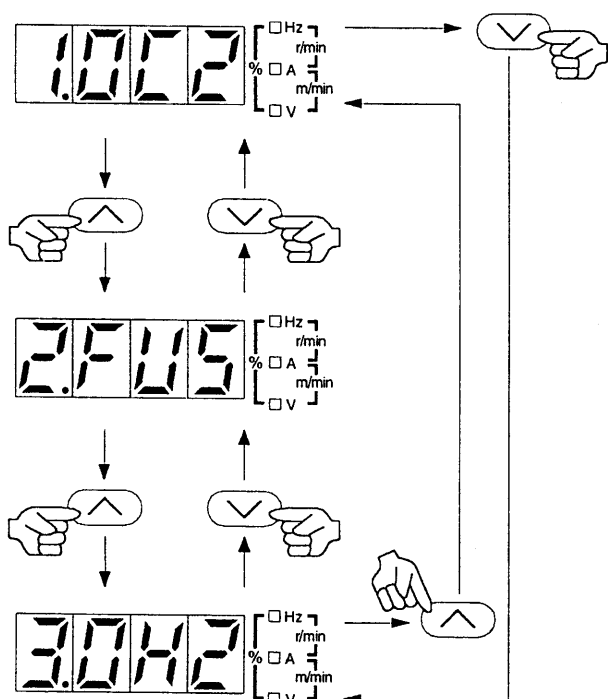
8-6 Alarm mode

If inverter protection is activated and the inverter has been tripped, the alarm mode will immediately start with the alarm mode screen on LCD. LED will display alarm code for one tripping cause or detection order and alarm

code for complex tripping causes. An operation guide will appear on the alarm mode screen. In addition, alarm code retrieval and program mode (writing data) can be selected in the case of the complex tripping causes.



a) Alarm code retrieval on complex tripping causes



Indication example :

Detection order	Alarm name
1	Overcurrent during deceleration
2	Fuse blow-out
3	External alarm

Identify the alarm code that the inverter protection has detected at first and then press \uparrow key. The detection order will change from 2 to 3 per pressing \uparrow key and each alarm code is indicated. The screen returns to the alarm code of the detection order 1 if all causes have been indicated.

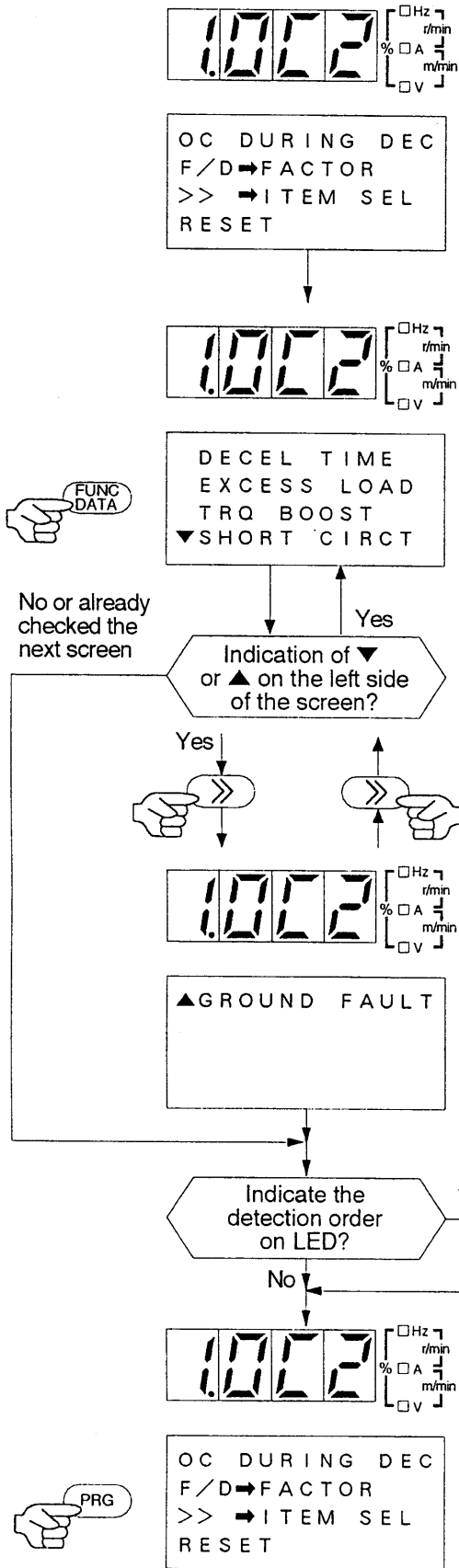
If \downarrow key is pressed, the detection order will be indicated in reverse order, for instance, 1→3→2→1. The LCD screen does not change during retrieval by pressing \uparrow or \downarrow key. The alarm name of the first detection order is continuously indicated.

LCD screen during alarm code retrieval

OC DURING DEC
F/D → FACTOR
>> → ITEM SEL
RESET

b) Trip (alarm) factor identifying

The presumable protection trip factor is indicated on LCD.



Indication example :

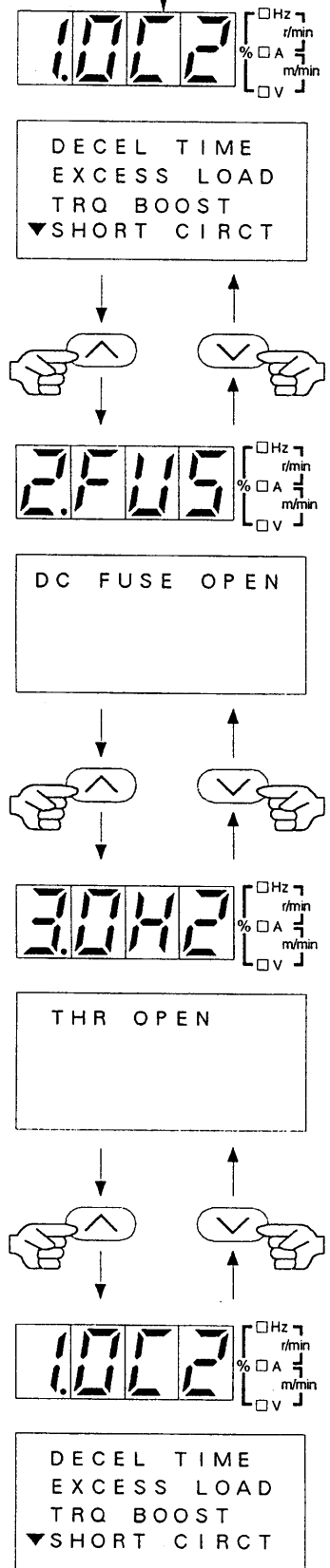
Detection order	Alarm name
1	Overcurrent during deceleration
2	Fuse blow-out
3	External alarm

Calling for trip factor screen	Press (FUNC DATA) key following the operation guide on the alarm mode screen. LCD will change to the trip factor screen. The LED indication does not change.
--------------------------------	--

Selecting the next trip factor screen	Press (>>) key since the presumable cause is indicated on the next screen also.
---------------------------------------	---

Returning to the alarm mode screen.	After identifying the factor, press (PRG) key to return to the alarm mode screen.
-------------------------------------	---

From p. 58 31

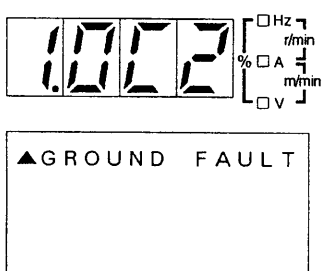


Retrieval of alarm contents

Press key.
 LED indicates the detection order 2, and LCD indicates the presumable cause for the second alarm code.
 The detection order will change from 2 to 3 per pressing key, indicating the relevant alarm code and its presumable cause, and return to the detection order 1 if all causes have been indicated.
 When pressing key, the detection order will be indicated in reverse order, for instance, 1→3→2→1.

Selecting the next trip factor screen

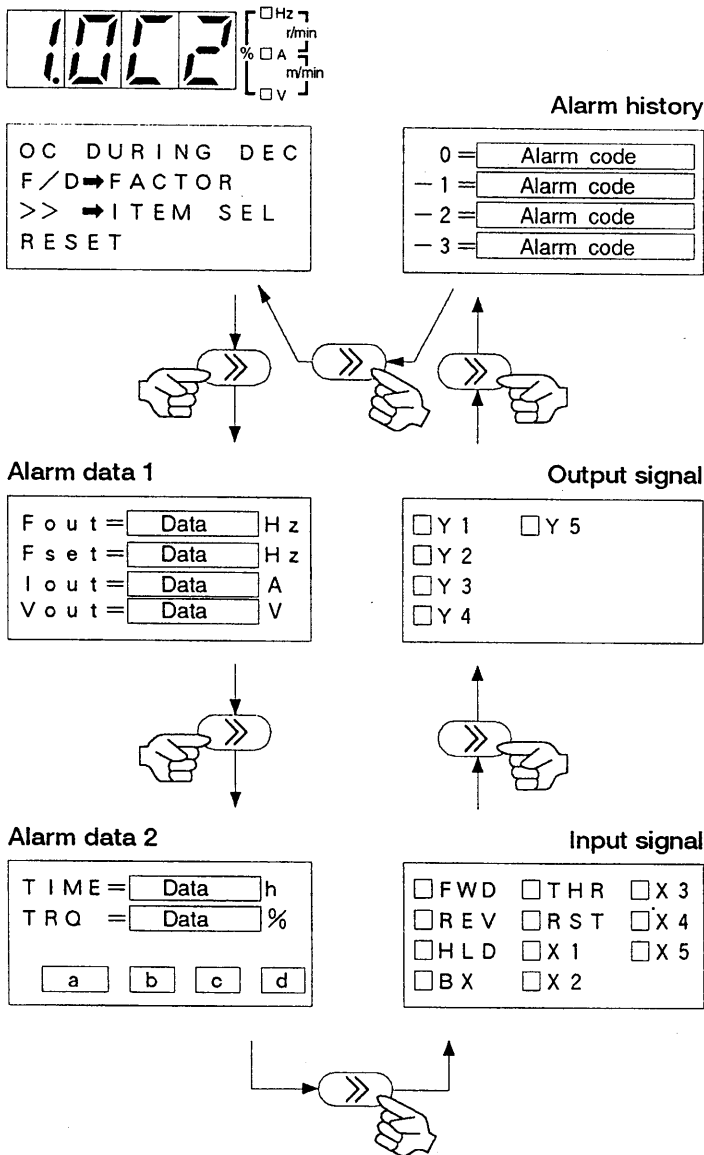
If ▼ mark is found under-left on LCD, the presumable cause is also indicated on the next screen.
 Press key.
 The screen changes to the next screen per pressing key.



32 To p. 58

c) Trip (alarm) data identifying

Five screens can be selected and indicated for the trip (alarm) data on LCD.



Press \gg key following the guide of the alarm mode screen. At first, the alarm data 1 screen is displayed. Press \gg key further. The screen will change as shown in the figure per pressing \gg key. If the displays of 5 screens are completed, the screen returns to the alarm mode screen. The indication of LED does not change even by pressing \gg key.

Alarm history screen

When the inverter protection function is activated, the alarm histories are rewritten. The alarm histories of the past 4 times are indicated with the alarm codes on the alarm history screen of LCD. If the alarm is owing to the complex causes, the first detected alarm code is indicated. The alarm histories are successively rewritten per activation of the inverter protection function, and the fourth or more previous alarm code is lost on the screen.

Alarm data 1

F o u t: Output frequency I o u t: Output current
F s e t: Setting frequency V o u t: Output voltage

Alarm data 2

T I M E: Total operation time of protection trip
T R Q : Calculated torque

Code	Content (on alarm)	Indication
a	Rotating direction	Blank: Stop FWD: Forward rotation REV: Reverse rotation
b	Current limiting	Blank: Inactive IL: Active
c	Link circuit DC voltage level	Blank: Normal U V: Undervoltage condition V L: Overvoltage limit reached
d	Torque limiting	Blank: Inactive T L: Active

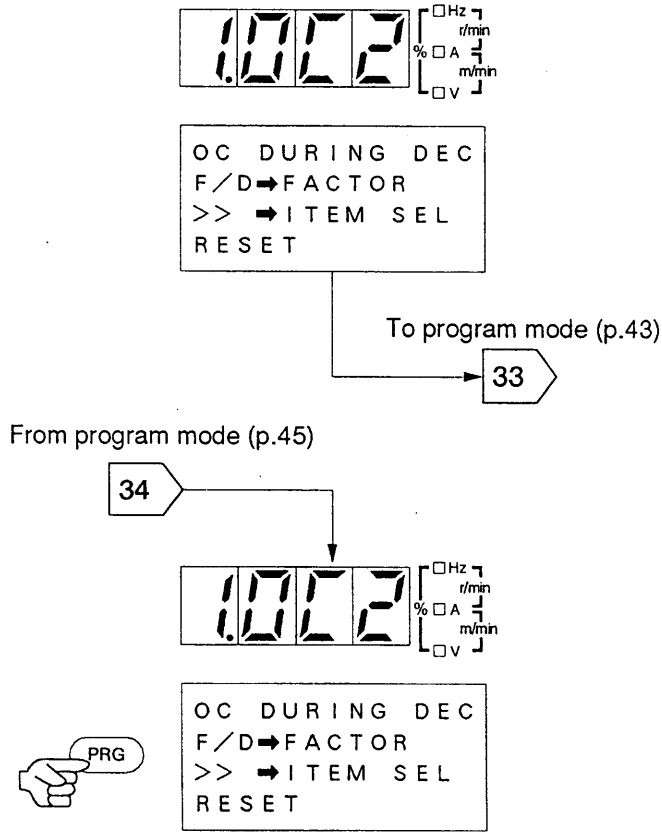
Input/output screen

Input/output statuses of contact input terminals and open-collector output terminals are indicated.

- NOTE :** Following selections can be conducted on any screen of the 5 trip data screens:
- The program mode can be selected by pressing PRG key, and the trip (alarm) factor can be selected by pressing FUNC DATA key.
 - Though on the way of the LCD screen selection, the alarm code retrieval can be conducted by pressing \wedge or \vee key without changing the LCD screen.
 - When RESET key is pressed after correcting the alarm generating causes, the reset command is inputted and the operation mode will restart.

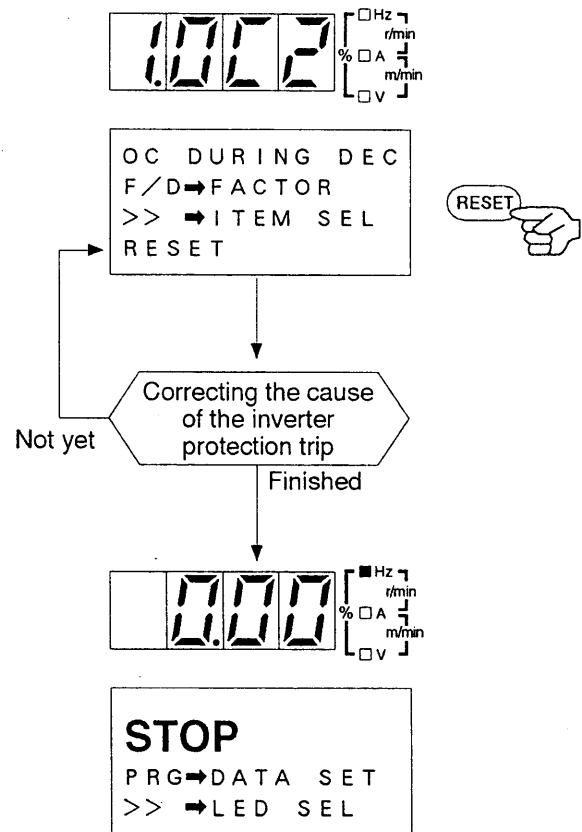
d) Program mode selection

The data setting method is same as that in "8-3 Program mode". Refer to p. 43.



e) Reset command input

After reading out data and correcting the cause of the inverter protection trip, press **RESET** key. Then the protection activated status is released and the operation mode will start.



8-7 Auto-tuning

The auto-tuning automatically measures the output circuit parameters necessary for FERENIC5000G9S/P9S series inverter and write the measured values into the functions "91 %R1 SET" and "92 %X SET" to acquire the operation data (operation conditions).

You can read out the tuning data from LCD. LED will indicate the data based on the data of "62 LED MNTR 2", but not be changed by the auto-tuning operations.

a) Preparation

Ensure the following items before conducting the auto-tuning.

- Identify that the motor is correctly connected.
- Set the data of "04 RATED V-1", "87 MOTOR 1-Ir" and "88 MOTOR 1-Io" to the rated values of the connected motor.
- Identify that the motor is stopping.

NOTE :

- Conduct the auto-tuning when the motor is not rotating. If the auto-tuning is conducted at motor rotating, the data may be mis-measured.
- When auto-tuning is conducted at a light load like one motor only, the motor may slightly rotate, but the data is correct in this case.
- Resistance value changes with temperature. It is recommended to conduct the auto-tuning at the motor operating temperature. If the measurement has been made at a low temperature such as before motor starting, it should be conducted again at a higher temperature such as soon after motor stopping and the correct values must be written.
- Since the measurement is conducted with a DC current corresponding to the no load current, transformer such as instrument transformer may be overheated and burned out if these are connected in the inverter output circuit.

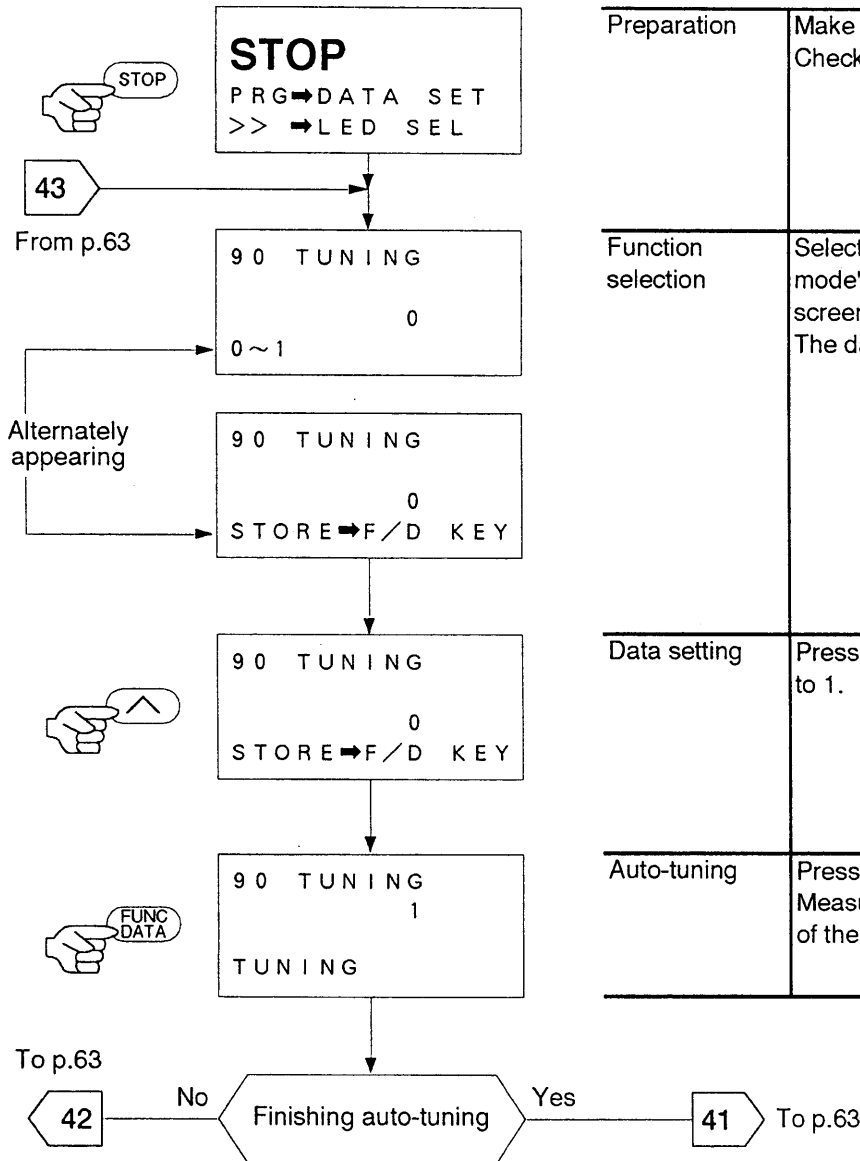
b) Operation

The motor does not rotate even after the auto-tuning starts by the auto-tuning command. The auto-tuning is carried out under motor stopping condition and completed in about 5 sec.

It is practicable even when a reactor or a output filter is connected between the inverter output terminals and the motor.

However, if the resistance or the reactance is beyond the range of the data of "91 %R1 SET" or "92 %X SET", it goes to the auto-tuning impossible, i.e. alarm mode and stops.

Conduct the auto-tuning by the following procedure.



Preparation	Make run command (FWD or REV) off. Check the motor stop.
Function selection	Select "90 TUNING" referring to "8-3 Program mode" (p. 43) and call for the data setting screen. The data will be indicated as 0.
Data setting	Press key, and then the data will be set to 1.
Auto-tuning	Press key. Measurement of the resistance and inductance of the inverter output circuit will start.

c) Finishing auto-tuning

When the auto-tuning is completed, shifting is possible to any mode of program mode, data monitoring mode and operation mode.

Further, identify the written data on the data setting screen in "8-3 Program mode"(p.43) or the data screen in "8-4 Data monitoring mode"(p.46).

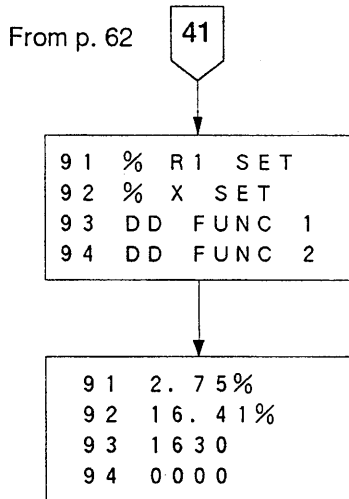
When the auto-tuning has failed, the function date has not been rewritten because the data measurement failed.

Therefore, resume the auto-tuning, after taking the measures for the cause of failure.

As for the auto-tuning failure, the following causes are considered.

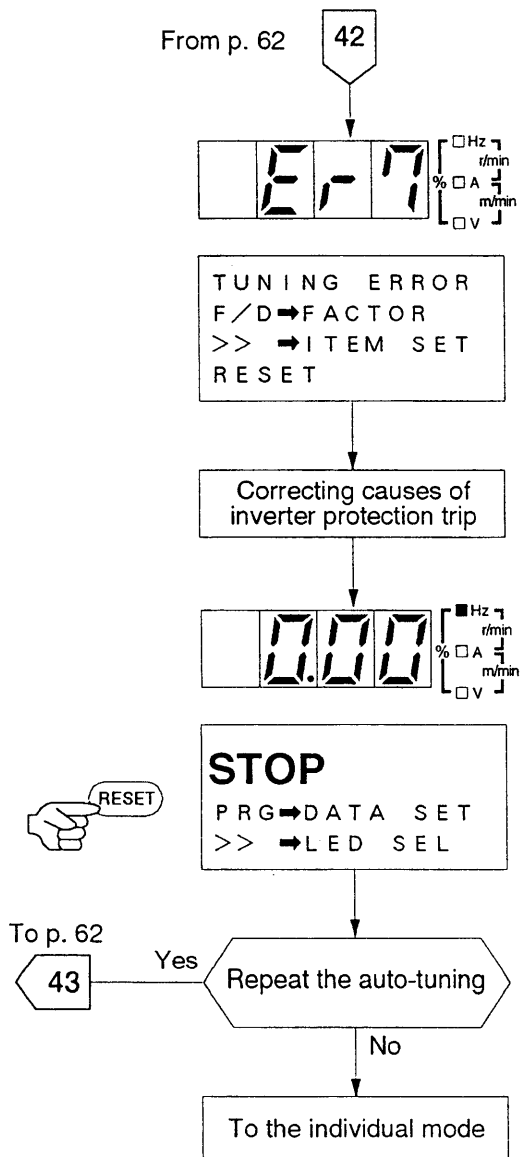
- Breakage or too large impedance of the inverter output circuit.
- Making the key ON when stopping the auto-tuning.
- FWD or REV are made ON while the auto-tuning conducting.
- When the Coast-to-stop command is still ON or inputted while the auto-tuning conducting.
- When the inverter output current is excessively large.

1) Finishing auto-tuning



Finishing auto-tuning	After about 20 seconds the function code selection screen will appear. Then the measured values have been written into the functions "91 %R1 SET" and "92 %X SET" and the auto-tuning finishes.
Identifying the measured data	Identify the data calling for the program mode or the data monitoring mode screen.

2) Auto-tuning failure



Auto-tuning impossible	Goes to the alarm mode and the LED will display "Er 7".
------------------------	---

Return to the operation mode	Press (RESET) key. Inverter is released from activating the protection function and goes to the operation mode.
------------------------------	---

8-8 Keypad panel handling

The inverter is shipped with the keypad panel mounted. When dismantling the keypad panel and connecting the optional extension cable, you can use the keypad panel mounting it on the equipment or carrying it in hands.

NOTE : You can dismantle the keypad panel during operation or applying AC power to the inverter. However, dismantling it while the run command is inputted from the keypad panel will stop the inverter.

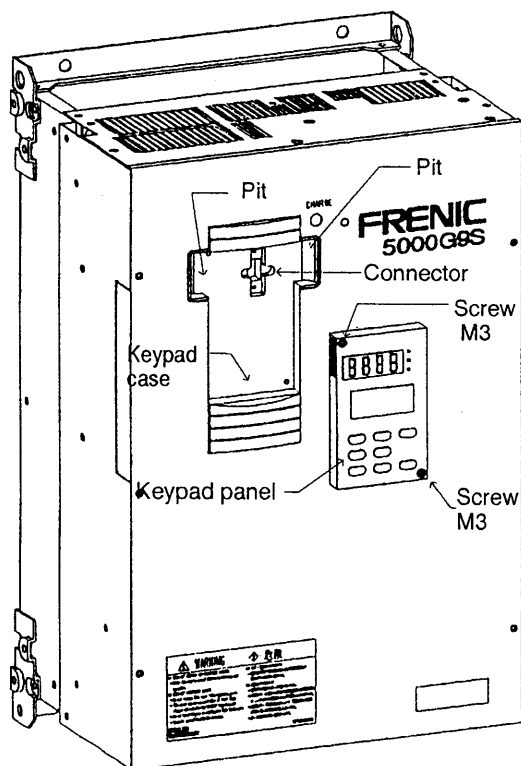


Fig 8-8-1 keypad panel dismounting

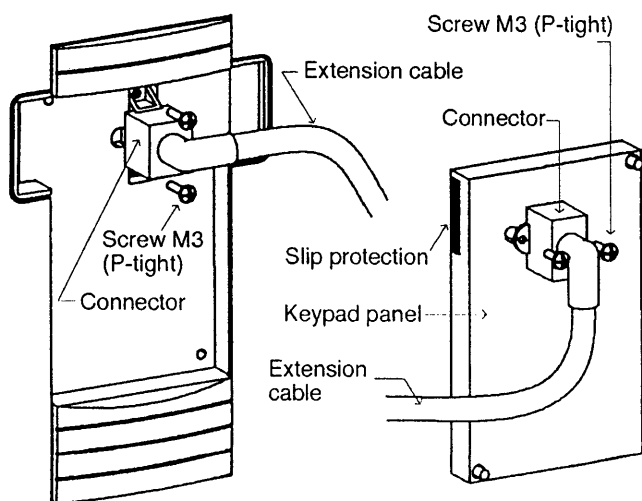


Fig 8-8-2 Extension cable connection

a) Dismounting for separate use

Loosen two screws(M3) mounting the keypad panel to the keypad case. These screws are not detachable from the keypad panel.

Hold the keypad panel with fingers and slowly pull it out to your side.

If the keypad is roughly extracted, the connector of the keypad may be damaged.

Use the above screws to mount the keypad panel to the equipment.

b) Attaching method of the extension cable

When using the extension cable, connect the cable ends to the connectors to the keypad panel and the keypad case.

Make the connector guides meet correctly and couple the connectors.

If the guides do not meet, the connectors may be damaged.

Check the connectors are completely inserted.

Tighten the two attached screws (M3 P-tight screws) of each connector to fix the the connector so that the connectors may not come out due to the weight of the cable or that a contact defect may not occur.

NOTE : Grasp the connector itself for inserting and removing. When grasping the extension cable, the core wires of the cable may be torn off or the connector may be damaged.

c) Removing method of the extension cable

Loosen and detach the screws (M3 P-tight screws) of each connector fixing the extension cable.

Pull out slowly the extension cable connectors from the keypad panel and the keypad case.

d) Remounting the key pad panel

When the keypad panel is attached on the equipment, loosen the two attached screws (M3), and detach the keypad panel from the equipment.

Insert slowly the keypad panel to the keypad case grasping its slip protection.

After checking that the connectors are completely inserted, tighten two screws of the keypad panel.

NOTES

9 Function

Table 9-1-1 Function table

Function		LCD Monitor	Data range	Increment	Setting (*1) during operation	Factory writing	Field writing	Ref. page
Code	Name							
00	Frequency command	00 FREQ COMND	0, 1, 2	—	×	0		71
01	Operation method	01 OPR METHOD	0, 1	—	×	0		75
02	Maximum frequency	02 MAX Hz	G9S: 50 to 400Hz P9S: 50 to 120Hz	1Hz	×	60		73
03	Base frequency 1	03 BASE Hz-1	G9S: 50 to 400Hz P9S: 50 to 120Hz	1Hz	×	50		81
04	Rated voltage 1 (Max. output voltage 1)	04 RATED V-1	200V: 160 to 240V 400V: 320 to 480V	1V	×	200 400		
05	Acceleration time 1	05 ACC TIME 1	0.01 to 3600s	(*3)	○	20.0		76
06	Deceleration time 1	06 DEC TIME 1	0.01 to 3600s	(*3)	○	20.0		
07	Torque boost 1	07 TRQ BOOST 1	0.0 to 20.0	0.1	○	G9S: 0.0 P9S: 0.1		80
08	Electronic thermal (Select)	08 ELCTRN OL	0, 1, 2	—	○	1		85
09	overload relay (Level) (for motor)	09 OL LEVEL	20 to 120 % of rated output current	(*3)	○	100 % of motor rating		
10	Restart after momentary power failure	10 RESTART	0, 1, 2, 3, 4	—	×	3		89
11	Frequency limiter (Upper)	11 H LIMITER	G9S: 0 to 400Hz P9S: 0 to 120Hz	1Hz	○	70		73
12	(Lower)	12 L LIMITER	G9S: 0 to 400Hz P9S: 0 to 120Hz	1Hz	○	0		
13	Bias frequency	13 FREQ BIAS	G9S: 0 to 400Hz P9S: 0 to 120Hz	1Hz	○	0		
14	Gain for frequency setting signal	14 FREQ GAIN	0.0 to 200.0%	0.1%	○	100.0		
15	Torque limiter (Driving)	15 DRV TORQUE	G9S: 20 to 180%, 999 P9S: 20 to 150%,	1%	○	G9S: 150 P9S: 120		82
16	(Braking)	16 BRK TORQUE	G9S: 20 to 180%, 0, P9S: 20 to 150%, 999,	1%	○	G9S: 100 P9S: 75		
17	(Starting frequency)	17 DC BRK Hz	0.0 to 60.0Hz	0.1Hz	○	0.0		88
18	DC brake (Braking level)	18 DC BRK LVL	0 to 100%	1%	○	0		
19	(Braking time)	19 DC BRK t	0.0 to 30.0s	0.1s	○	0.0		
20	Multi-step frequency setting (Freq.1)	20 MULTI Hz-1	G9S: 0.00, 0.20 to 400.00Hz	0.01Hz	○	5.00		72
21	(Freq.2)	21 MULTI Hz-2	P9S: 0.00, 0.20 to 120.00Hz			10.00		
22	(Freq.3)	22 MULTI Hz-3				20.00		
23	(Freq.4)	23 MULTI Hz-4				30.00		
24	(Freq.5)	24 MULTI Hz-5				40.00		
25	(Freq.6)	25 MULTI Hz-6				50.00		
26	(Freq.7)	26 MULTI Hz-7				60.00		
(*2) 28	Slip compensation control	28 SLIP COMP	-9.9 to 5.0Hz	0.1Hz	○	0.0		83
29	Torque vector control	29 TRQ VECTOR	0, 1	—	×	0		82
30	Number of motor poles	30 MTR POLES	2 to 14	2	×	4		95

(*1) Indicates whether the data can be set and written during operation.

○: Possible during running and stopping ×: Possible during stopping

(*2) Function Codes 27 and 74 are void.

(*3) For increment, refer to description of functions.

(*4) Rated values for the FUJI standard 3-phase motors are written at factory based on their capacity.

Table 9-1-1 Function table (continued)

Function		LCD Monitor	Data range	Incre- ment	Setting (*1) during operation	Factory writing	Field writing	Ref. page
Code	Name							
31	Function block (32-41)	31 ■ ■ 32-41 ■ ■	0, 1	—	○	0		96
32	X1-X5 terminal function selection	32 X1-X5 FUNC	Each four digit is independently: 0, 1, 2	—	×	0000		92
33	Acceleration time 2	33 ACC TIME 2	0.01 to 3600s	(*3)	○	100		76
34	Deceleration time 2	34 DEC TIME 2	0.01 to 3600s	(*3)	○	100		
35	Acceleration time 3	35 ACC TIME 3	0.01 to 3600s	(*3)	○	100		
36	Deceleration time 3	36 DEC TIME 3	0.01 to 3600s	(*3)	○	100		
37	Acceleration time 4	35 ACC TIME 4	0.01 to 3600s	(*3)	○	100		
38	Deceleration time 4	36 DEC TIME 4	0.01 to 3600s	(*3)	○	100		
39	Base frequency 2	39 BASE Hz-2	G9S: 50 to 400Hz P9S: 50 to 120Hz	1Hz	×	50		81
40	Rated voltage 2 (Max. output voltage 2)	40 RATED V-2	200V: 160 to 240V 400V: 320 to 480V	1V	×	200 400		
41	Torque boost 2	41 TRQ BOOST 2	0.1 to 20.0	0.1	○	2.0		
42	Function block (43-51)	42 ■ ■ 43-51 ■ ■	0, 1	—	○	0		96
43	FMP (Pulse rate multiplier) terminal (Voltage adjust)	43 FMP PULSES 44 FMP V-ADJ	6 to 100 50 to 120	1	○	24 100		94
44	FMA (Voltage adjust) terminal (Function selection)	45 FMA V-ADJ 46 FMA FUNC	65 to 200 0, 1, 2, 3	1	○	100 0		
45								
46								
47	Y1-Y5 terminal function selection	47 Y1-Y5 FUNC	Each five digit is independently set Hexadecimal code 0 to F	—	×	01234		92
48	FAR function signal (Detection width)	48 FAR HYSTR	0.0 to 10.0Hz	0.1Hz	○	2.5		93
49	FDT function signal (Level)	49 FDT LEVEL	G9S: 0 to 400Hz P9S: 0 to 120Hz	1Hz	○	60		
50	(Hysteresis)	50 FDT HYSTR	0.0 to 30.0Hz	0.1Hz	○	1.0		
51	Overload function signal (Level)	51 OL WARNING	20 to 120 % of rated output current	(*3)	○	100% of motor rating		87
52	Function block (53-59)	52 ■ ■ 53-59 ■ ■	0, 1	—	○	0		96
53	Jump frequency 1	53 JUMP Hz-1	G9S: 0 to 400Hz P9S: 0 to 120Hz	1Hz	×	0		74
54	Jump frequency 2	54 JUMP Hz-2	G9S: 0 to 400Hz P9S: 0 to 120Hz	1Hz	×	0		
55	Jump frequency 3	55 JUMP Hz-3	G9S: 0 to 400Hz P9S: 0 to 120Hz	1Hz	×	0		
56	Jump frequency hysteresis	56 JUMP HYSTR	0 to 30Hz	1Hz	×	3		
57	Starting (Freq.)	57 START Hz	0.2 to 60.0Hz	0.1Hz	×	0.5		
58	frequency (Holding time)	58 HOLDING t	0.0 to 10.0s	0.1s	×	0.0		
59	Freq. setting signal filter	59 FILTER	0.01 to 5.00s	0.01s	○	0.05		

(*1) Indicates whether the data can be set and written during operation.

○ : Possible during running and stopping × : Possible during stopping

(*2) Function Codes 27 and 74 are void.

(*3) For increment, refer to description of functions.

(*4) Rated values for the FUJI standard 3-phase motors are written at factory based on their capacity.

Table 9-1-1 Function table (continued)

Function		LCD Monitor	Data range	Incre- ment	Setting (*1) during operation	Factory writing	Field writing	Ref. page
Code	Name							
60	Function block (61-79)	60 ■ ■ 61-79 ■ ■	0, 1	—	○	0		96
61	LED monitor 1 (Function)	61 LED MNTR 1	0, 1, 2, 3, 4, 5, 6, 7, 8,	—	○	0		95
62	LED monitor 2 (Display at STOP mode)	62 LED MNTR 2	0, 1	—	○	0		
63	Coefficient for machine speed and line speed	63 SPEED COEF	0.01 to 200.00	0.01	○	0.01		
64	LCD monitor (Function)	64 LCD MNTR	0, 1, 2, 3	—	○	0		
65	Pattern operation (Mode selection)	65 PATTERN	0, 1, 2, 3	—	×	0		78
66	Stage 1	66 STAGE 1	0.00 to 6000s/F1 to F4, R1 to R4	(*3)	○	0.00/F1		
67	Stage 2	67 STAGE 2	0.00 to 6000s/F1 to F4, R1 to R4	(*3)	○	0.00/F1		
68	Stage 3	68 STAGE 3	0.00 to 6000s/F1 to F4, R1 to R4	(*3)	○	0.00/F1		
69	Stage 4	69 STAGE 4	0.00 to 6000s/F1 to F4, R1 to R4	(*3)	○	0.00/F1		
70	Stage 5	70 STAGE 5	0.00 to 6000s/F1 to F4, R1 to R4	(*3)	○	0.00/F1		
71	Stage 6	71 STAGE 6	0.00 to 6000s/F1 to F4, R1 to R4	(*3)	○	0.00/F1		
72	Stage 7	72 STAGE 7	0.00 to 6000s/F1 to F4, R1 to R4	(*3)	○	0.00/F1		
73	ACC/DEC pattern (Mode selection)	73 ACC PTN	0, 1, 2	—	×	0		77
(*2) 75	Energy-saving operation	75 ENERGY SAV	0, 1	—	×	G9S: 0 P9S: 1		81
76	Rev. phase sequence lock	76 REV LOCK	0, 1	—	×	0		75
77	Data initializing	77 DATA INIT	0, 1	—	×	0		97
78	Language (Japanese/English)	78 LANGUAGE	0, 1	—	○	0		96
79	LCD monitor (Brightness)	79 BRIGHTNESS	0 to 10	1	○	5		
80	Function block (81-94)	80 ■ ■ 81-94 ■ ■	0, 1	—	○	0		96
81	Motor sound (Carrier freq.)	81 MTR SOUND	0 to 11	1	○	10		83
82	Auto-restart (Restart time)	82 RESTART t	0.0 to 5.0s	0.1s	×	0.5		90
83	(Freq. fall rate)	83 FALL RATE	0.00 to 100.0Hz/s	0.01 Hz/s	×	10.00		
84	Auto-reset (Times)	84 AUTO-RESET	0 to 7	1	○	0		91
85	(Reset interval)	85 RESET INT	2 to 20s	1s	○	5		
86	Motor 1 (Capacity)	86 MOTOR CAP	0, 1, 2, 3	—	×	1		84
87	(Rated current)	87 MOTOR 1-ir	0.00 to 2000A	(*3)	×	(*4)		
88	(No-load current)	88 MOTOR 1-lo	0.00 to 2000A	(*3)	×	(*4)		
89	Motor 2 (Rated current)	89 MOTOR 2-ir	0.00 to 2000A	(*3)	×	(*4)		
90	Motor 1 (Tuning)	90 TUNING	0, 1	—	×	0		85
91	(%R1 setting)	91 %R1 SET	0.00 to 50.00%	0.01%	○	(*4)		
92	(%X1 setting)	92 %X SET	0.00 to 50.00%	0.01%	○	(*4)		
93	Dedicated function for manufacturer	93 DD FUNC 1	0 to 8192	1	○	1638		97
94		94 DD FUNC 2	0 to 32767	1	○	0000		
95	Data protection	95 DATA PRTC	0, 1	—	×	0		97

(*1) Indicates whether the data can be set and written during operation.

○ : Possible during running and stopping × : Possible during stopping

(*2) Function Codes 27 and 74 are void.

(*3) For increment, refer to description of functions.

(*4) Rated values for the FUJI standard 3-phase motors are written at factory based on their capacity.

9-1 Control block diagram

To simplify the diagram, the following abbreviations are used.

— For function codes, "F" is attached before code numbers.

Example: Function code 12 → F12

— For data (written values), "#" is attached before the data.

Example: Written value 123 → #123

NOTE : COC → Changeover command

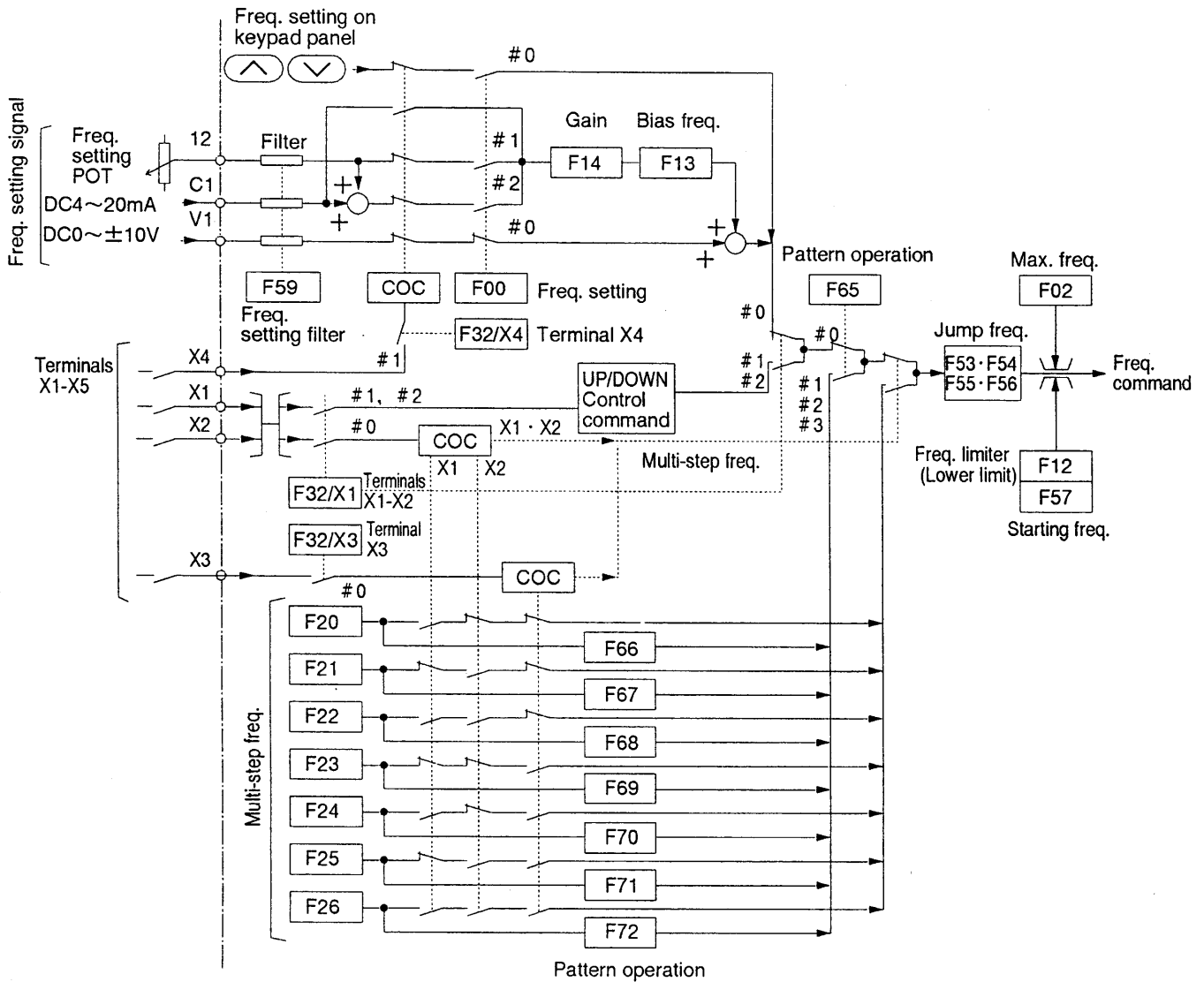


Fig. 9-1-1 Control block diagram of frequency setting section

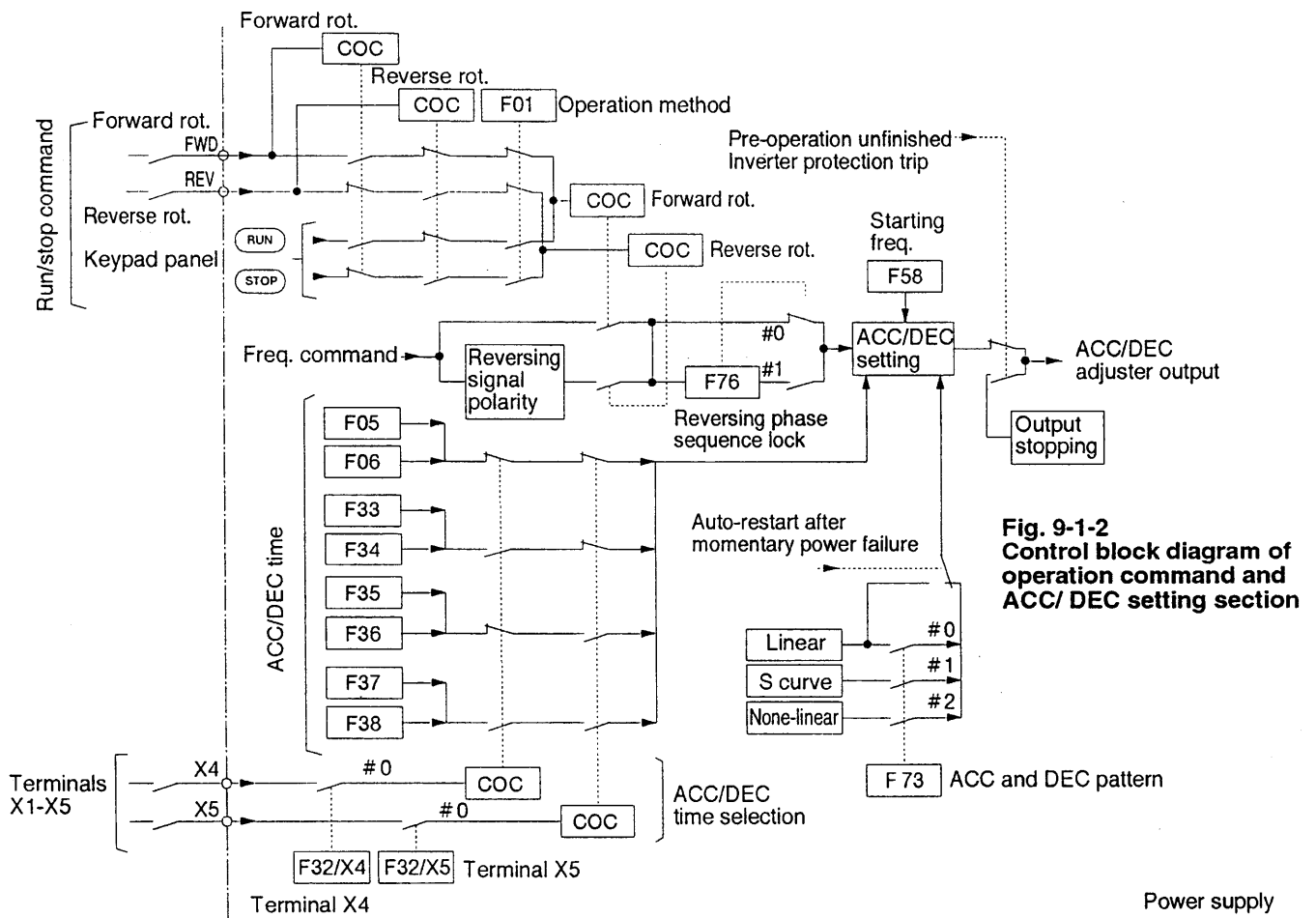


Fig. 9-1-2 Control block diagram of operation command and ACC/DEC setting section

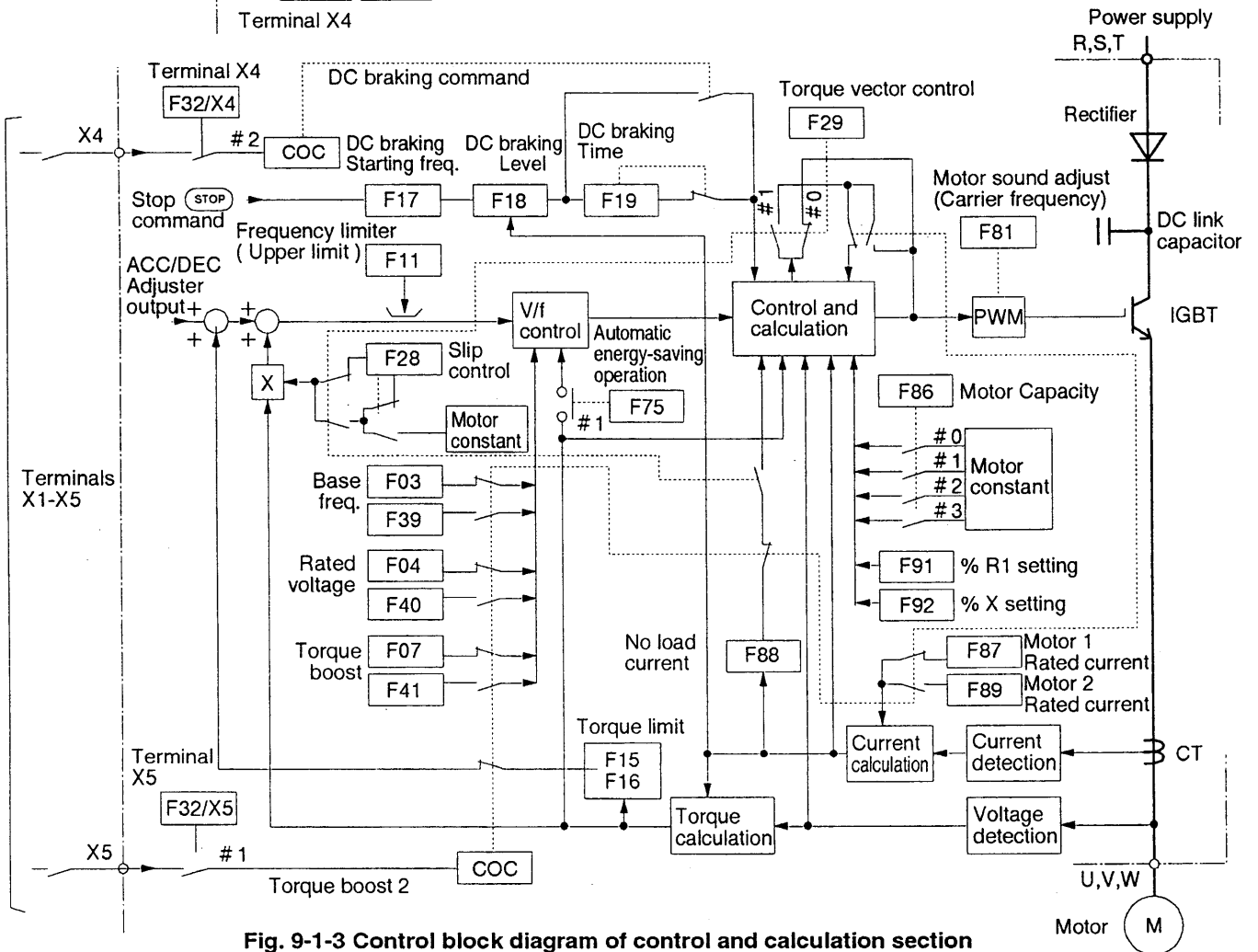


Fig. 9-1-3 Control block diagram of control and calculation section

9-2 Frequency setting

⚠ WARNING

Because the maximum output frequency is 400 Hz in G9S series, and 120 Hz in P9S series, mis-setting of the frequency may lead to several times (7 to 8 times in G9S series and 2 to 2.4 times in P9S series) as large as the rated speed of motors of general market. Never operate the motor above its top mechanical speed or a catastrophic failure may occur. Take a safety measure such as writing the safety frequency in the function "11 Frequency limiter (Upper)" to insure safety.

Bias is operational only when frequency setting method is analog (the data of "01 Frequency command" is 1 or 2). When bias is operational (the data of "13 Bias frequency" is other than zero) and the analog setting frequency is zero, the LED indicates the bias frequency. When a RUN command is given, the motor runs at the bias setting though the set frequency is zero.

The frequency can be set with following four methods:

- Data selection in "00 FRQ COMD"
- Independent setting at control terminal C1
- Control terminal V1
- Multi-step frequency function

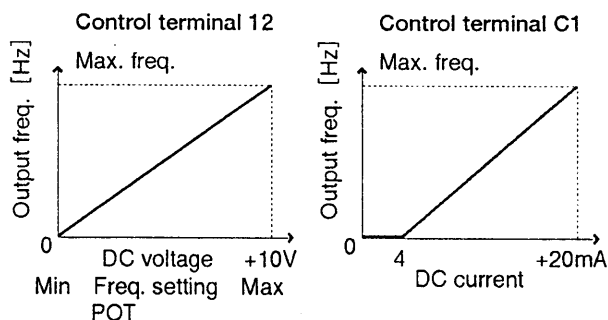
It may be impossible to adopt a part of the selection priority order and the function in these methods. Refer to the control block diagram and the description. In addition, there are functions which variously process the output frequency based on the setting frequency.

00 Frequency setting FRQ COMD

Selects the frequency setting method.

Data	Frequency setting method
0	UP or DOWN key on keypad panel
1	Signal from control terminal 12 (Frequency setting POT or DC voltage 0 to +10 V)
2	Signal from control terminals 12 and C1 (Data 1 input plus DC current 4 to 20 mA)

When the data is set at 2, sum of simultaneous input from terminals 12 and C1 will make the output frequency. However, if the frequency setting values are summed up, the output frequency over the data of "02 MAX Hz" or "11 H LIMITER" is not outputted.

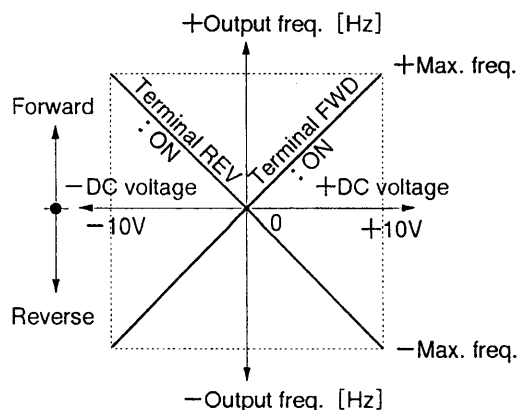


Independently setting with control terminal C1

Make the X4 data of "32 X1-X5 FUNC" 1 and input ON signal to the control terminal X4. You can input only the frequency setting signal (DC 4 to 20 mA) of the control terminal C1 regardless of the data of "00 FRQ COMD".

Setting with control terminal V1

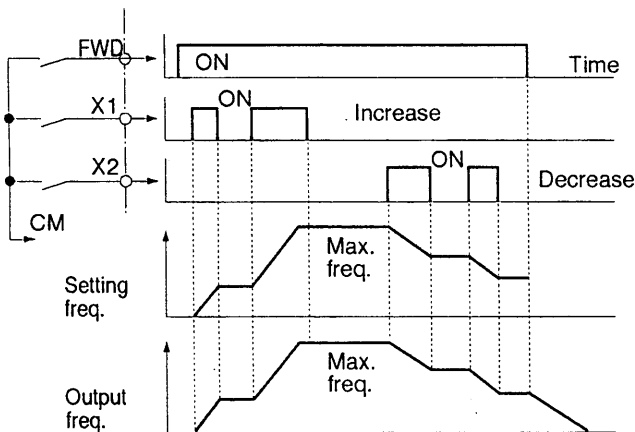
You can input both + and - polarity of DC voltage (0 to 10 V). The rotating direction of the motor is changed with this polarity. This can be inputted when the data of "00 FRQ COMD" is 1 or 2. If the signal of the data 1 or 2 is simultaneously inputted with the signal of the control terminal V1, the sum of both signals are inputted as the setting frequency. However, if the frequency setting values are summed up, the output frequency over the data of "02 MAX Hz" or "11 H LIMITER" is not outputted.



UP/DOWN control

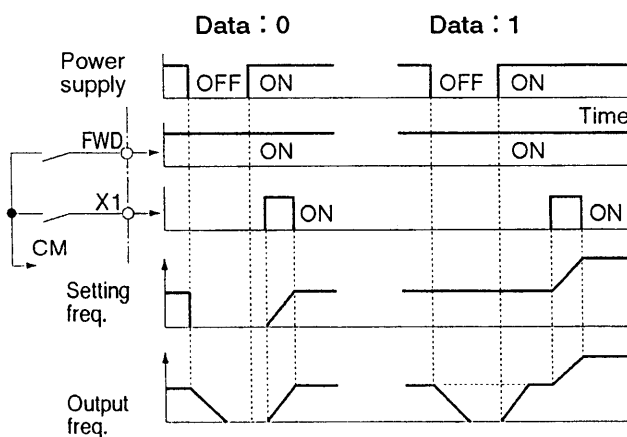
You can increase or decrease the setting frequency when the X1 and X2 data of "32 X1-X5 FUNC" are set at 1 or 2 and the contact signals are inputted to the control terminals X1 and X2. When the control terminal X1 is made on, the frequency is increased. When the control terminal X2 is made on, the frequency is decreased. If the control terminals X1 and X2 are simultaneously made on or off, the frequency has not be changed (constant).

The increasing or decreasing speeds of the setting frequency follow the selected acceleration or deceleration time.



In the data 1 and 2 of "32 X1-X5 FUNC", the restart setting frequency values after stopping with the stop command or main circuit power failure differ as shown in the following table.

Data at terminals X1 & X2	Restart setting frequency value
1	0
2	The set value before the stop command input or the main circuit power failure



20 Multi-step frequency setting 1 MULTI Hz-1

21 Multi-step frequency setting 2 MULTI Hz-2

22 Multi-step frequency setting 3 MULTI Hz-3

23 Multi-step frequency setting 4 MULTI Hz-4

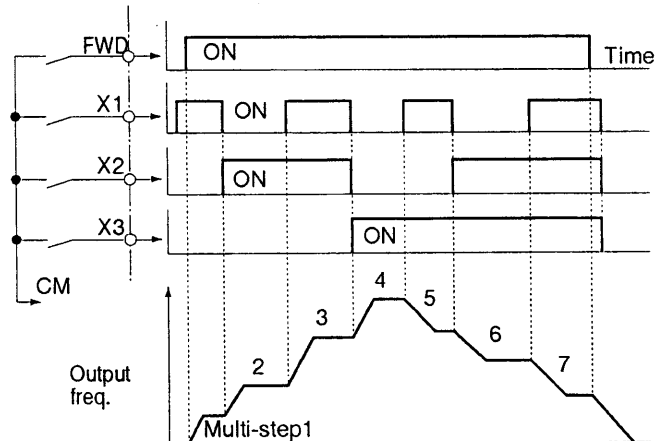
24 Multi-step frequency setting 5 MULTI Hz-5

25 Multi-step frequency setting 6 MULTI Hz-6

26 Multi-step frequency setting 7 MULTI Hz-7

You can select seven kinds of setting frequencies when writing the frequencies into each function.

Range of data : 0.00 to 400.00



Make the data of X1 & X2 and X3 in "32 X1-X5 FUNC" 0 when using these functions. And input the contact signal to the each control terminal selectively.

The operation frequency shifts to the selected frequency according to the acceleration/deceleration time.

You can select either the control terminals X1 & X2 or X3.

When inputting no contact signal to the control terminals, the inverter operates with the other setting frequency than the multi-step frequency function.

The inverter can be operated in various operation patterns when combining this with acceleration or deceleration time selection and forward and reverse commands.

Use these functions at jogging operation also.

NOTE : The multi-step frequency setting functions are also used in "66 to 72 Pattern operation".

53 Jump frequency 1
JUMP Hz-1

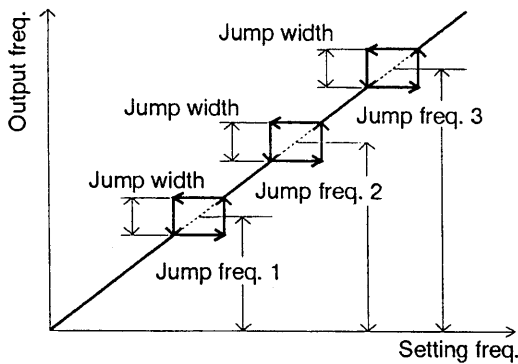
54 Jump frequency 2
JUMP Hz-2

55 Jump frequency 3
JUMP Hz-3

56 Jump frequency hysteresis
JUMP HYSTR

When changing the output frequency by changing the setting frequency, the frequency jumps to avoid specific frequencies. Three jump frequencies and their jump frequency width (common for the 3 frequencies) can be inputted.

Function	Data range
Jump frequency	G9S: 0 to 400 Hz P9S: 0 to 120 Hz
Jump frequency width	0 to 30 Hz



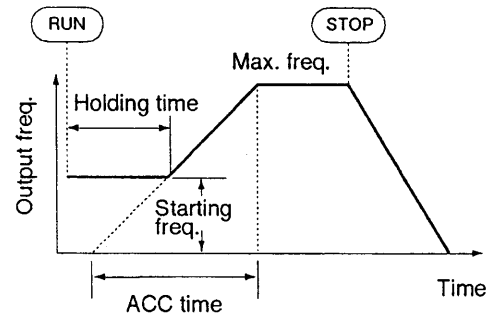
These functions are not active during acceleration and deceleration by the operation commands. When not using the jump function, set the data of "Jump frequency 1, 2 and 3" at 0.

57 Starting frequency (Frequency)
START Hz

58 Starting frequency (Holding time)
HOLDING t

These functions specify the output frequency at start of the inverter and its holding time.

Function	Data range
Starting frequency	0.2 to 60.0 Hz
Holding time	0.0 to 10.0 s



This operation is activated only at starting and is ignored at stop command and changing frequency.

59 Frequency setting signal filter
FILTER

The frequency setting signal inputted to control terminal 12 and C1 may include noise which makes the control unstable. The time constant of the filter is adjusted to avoid the effect of the noise.

Data range: 0.01 to 5.00 s

If the time constant is set larger, control is more stable but response is slower. If it is set smaller, response is quicker but control is less stable. If the data to set is not clear, adjust the data when control is less stable or response is slow.

The data are commonly used for the control terminals 12, C1 and V1.

9-3 Operation command

01 Operation method OPR METHOD

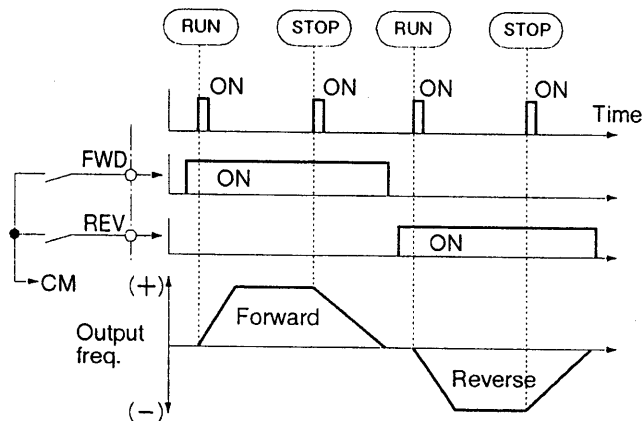
This function selects input method of run and stop commands

Data	Command input method
0	RUN and STOP keys on keypad panel
1	Control terminals FWD or REV

Keypad panel RUN and STOP

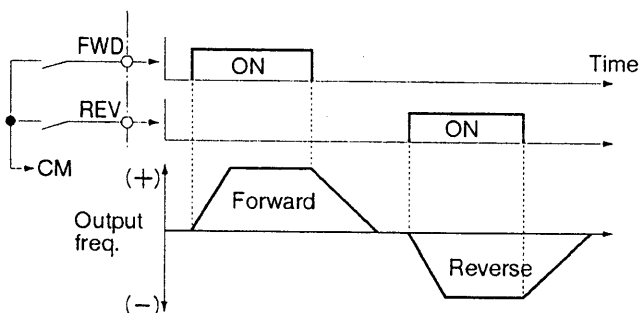
When the control terminal FWD or REV has been made ON, pressing **RUN** key starts and pressing **STOP** key decelerates and stops the motor. If these terminals have been made OFF, pressing **RUN** key cannot start the motor. If the terminal is made off during running, the motor will decelerate and stop.

The rotating direction of the motor can be changed by changeover of the control terminals FWD and REV.

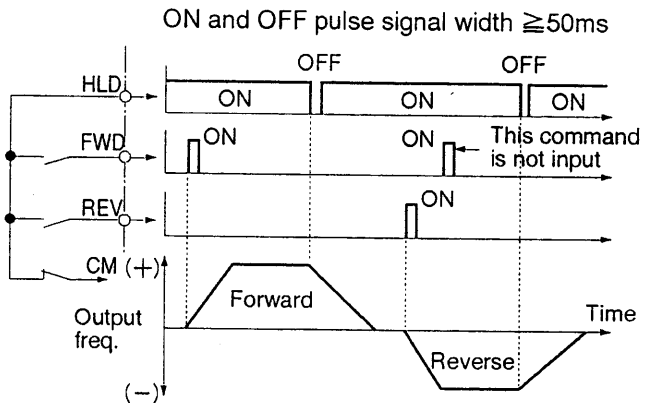


Control terminals FWD and REV

ON and OFF of the control terminal FWD or REV is the run and stop commands. The rotating direction of the motor is changed by changeover of the control terminals FWD and REV.



If a control terminal HLD is connected as shown in the following figure, momentary switches can input continuous operation commands.



NOTE : When the data is 0 and a jumper is connected from control terminal FWD or REV to CM, the data cannot be rewritten to 1. Rewrite it after removing the jumper.

76 Reverse phase sequence lock REV LOCK

This function is to prevent the motor from rotating reversely. When necessary to prevent from troubles due to mis-input of the operation command, use this function.

Data	Operation
0	Both forward and reverse possible
1	Forward possible but reverse impossible

If the data is set at 1, the reverse command cannot be input. Then the motor cannot start in the following cases:

- When the control terminal REV is made ON. But, the motor rotates in forward direction when the frequency setting voltage of the control terminal V1 is in - (minus) polarity.
- When the frequency setting voltage of the control terminal V1 is in - polarity and the terminal FWD is made ON.
- When the inverter operates in pattern operation where the data of "66 to 72 Pattern operation" are set to R1, R2, R3 and R4.

9-4 Acceleration and deceleration

You can independently select 4 kinds of acceleration time from start to the maximum frequency and deceleration time from the maximum frequency to stop, and select 3 kinds of acceleration and deceleration mode.

- 05 Acceleration time 1
ACC TIME 1
- 06 Deceleration time 1
DEC TIME 1
- 33 Acceleration time 2
ACC TIME 2
- 34 Deceleration time 2
DEC TIME 2
- 35 Acceleration time 3
ACC TIME 3
- 36 Deceleration time 3
DEC TIME 3
- 37 Acceleration time 4
ACC TIME 4
- 38 Deceleration time 4
DEC TIME 4

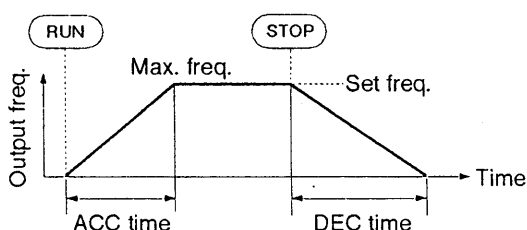
Acceleration time is the time taking from start to the maximum frequency, and deceleration time is the time taking from the maximum frequency to stop. Four kinds of each time can be written into the memory.

Function	Data range
Acceleration time	0.01 to 3600 s
Deceleration time	0.01 to 3600 s

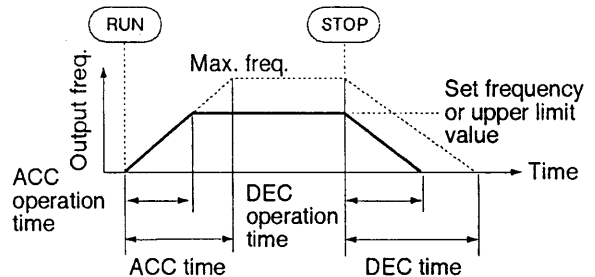
Since the data range is too wide, the increment of data change depending on the values.

Ac- and deceleration time	Increment
0.01 to 9.99 s	0.01 s
0.0 to 99.9 s	0.1 s
100 to 999 s	1 s
1000 to 3600 s	10 s

Setting frequency = Maximum frequency
The operation time is same as the data.



Setting frequency < Maximum frequency
Frequency limiter (Upper) < Maximum frequency



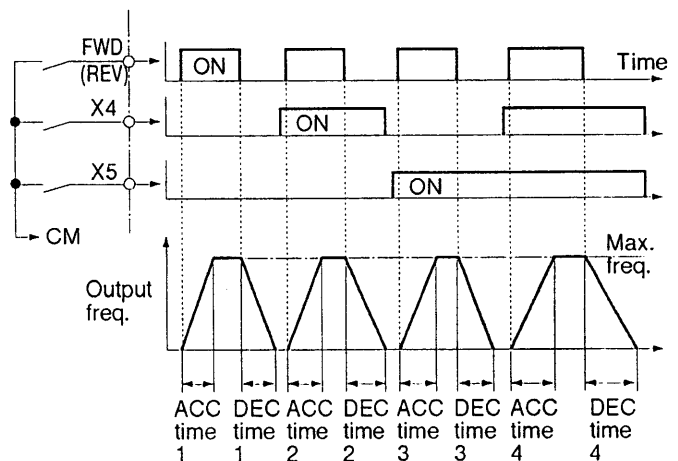
Since the acceleration and deceleration times are based on the maximum frequency, if the set frequency or the data of "11 H LIMITER" is lower than the maximum frequency, the actual operation time differs from the set data.

$$\text{Acceleration/deceleration operation time} = \frac{\text{Set frequency}}{\text{Max. frequency}} \times \text{Acceleration/deceleration time (Written value)}$$

NOTE : If the short acceleration and deceleration times are set in spite of large load torque or large load inertia, torque limit function or stall prevention function may operate. The operation time is elongated in these cases.

Set the X4 and X5 data of "32 X1-X5 FUNC" at 0 when selecting the data of the acceleration and deceleration times 2 to 4, and input contact signals to the control terminals X4 and X5.

Then, the acceleration and deceleration times 2 to 4 can be changed over in any status of acceleration, deceleration and steady speed running.



When the signals are not input to the control terminals X4 and X5, the inverter is operated by the data of the acceleration time 1 and deceleration time 1. You can select either the control terminal X4 or X5.

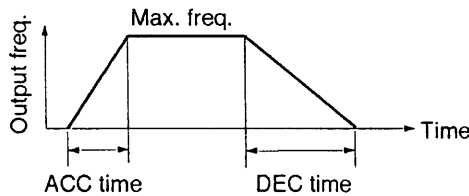
73 Acceleration/deceleration pattern (Mode selection) ACC PTN

This function selects 3 kinds of mode at acceleration and deceleration as follows:

Data	Operation
0	Linear acceleration/deceleration
1	S curve acceleration/deceleration
2	Non-linear acceleration/deceleration

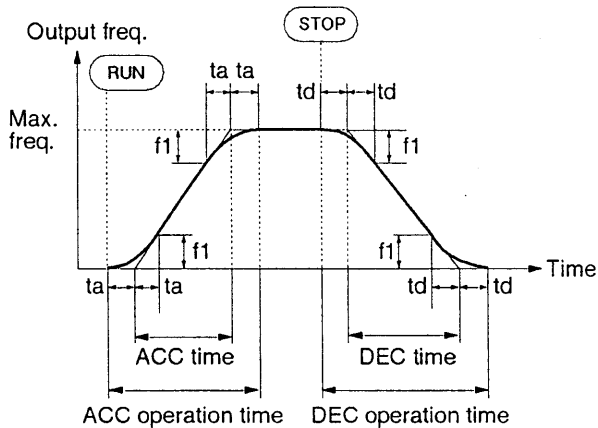
Linear acceleration/deceleration

The output frequency changes in constant ratio to time.



S curve acceleration/deceleration

The output frequency changes at start, end of acceleration/deceleration and stop in curved state. Then the acceleration/deceleration is smooth with less shock.



$$ta = 0.1 \times \text{Acceleration time} \quad td = 0.1 \times \text{Deceleration time}$$

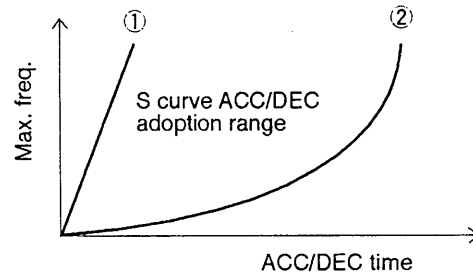
$$f1 = 0.1 \times \text{Max. frequency}$$

NOTE :

- The acceleration/deceleration operation times become 1.2 times as large as the data.
- When using the S curve acceleration/deceleration, satisfy the following conditions. If not satisfying, use the linear acceleration/ deceleration.

Adopted conditions:

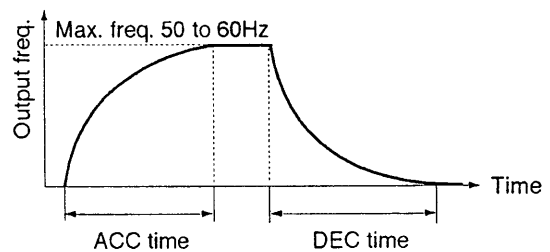
- ① $\frac{\text{Max. frequency [Hz]}}{\text{Acceleration/deceleration time [s]}} < 1896$
- ② $\frac{(\text{Acceleration/deceleration time [s]})^2}{\text{Max. frequency [Hz]}} < 700.4$



Non-linear acceleration/deceleration

This is suitable to accelerate/decelerate for a square-law torque characteristic load such as fan and pump in a short time.

In acceleration, the frequency is quickly increased at low frequency region and is slowly changed as approaching the maximum frequency to relax the increase of output current due to increase of the acceleration torque. In deceleration, the frequency is changed with a characteristic so as to suppress the increase of regenerative power (regenerative overvoltage) as in the acceleration.



NOTE : This mode can be selected when the maximum frequency is in the range of 50 to 60 Hz. Outside this range, the inverter operates with the linear acceleration and deceleration.

9-5 Pattern operation

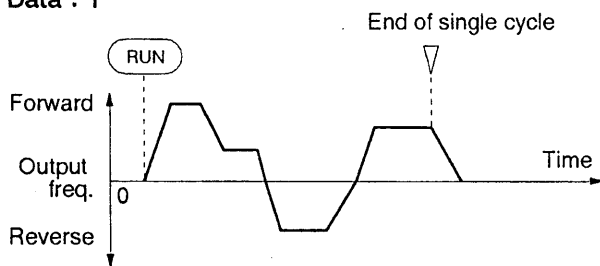
When the operation has a constant pattern, this function is enable to operate following the written pattern.

65 Pattern operation (Mode selection) PATTERN

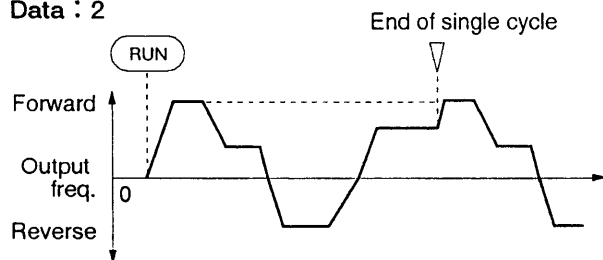
This function selects the operation modes as follows:

Data	Operation
0	Inactive
1	Stop after single cycle patern operation (only once)
2	Patern operation is repeated continuously untill the stop command is input
3	Operation is continued with the last set frequency after single cycle patern operation(only once)

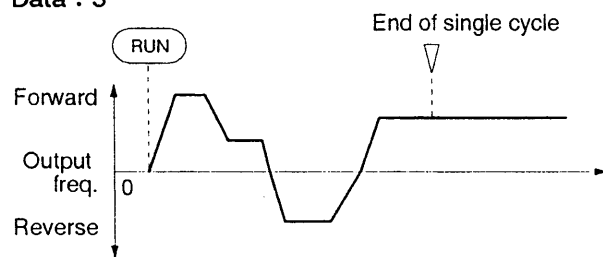
Data : 1



Data : 2



Data : 3



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

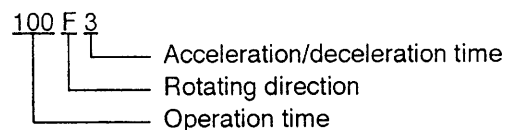
72 Pattern operation (Stage 7) STAGE 7

The inverter is operated in sequence of the data written into from "66 STAGE 1" to "72 STAGE 7". This course is one cycle. The data include writing of the operation time per stage (pattern) and the rotating direction of the motor, and allocation of the acceleration and deceleration time.

Item	Data range
Operation time	0.00 to 6000 s
Rotating direction	F: Forward, R: Reverse
Acceleration/ deceleration time	1: 05 Acceleration time 1 (ACC 1) 06 Deceleration time 1 (DEC 1)
	2: 33 Acceleration time 2 (ACC 2) 34 Deceleration time 2 (DEC 2)
	3: 35 Acceleration time 3 (ACC 3) 36 Deceleration time 3 (DEC 3)
	4: 37 Acceleration time 4 (ACC 4) 38 Deceleration time 4 (DEC 4)

Data example:

In the case of Operation time: 100 s, Motor rotating direction: Forward, and acceleration/deceleration time: 3, following indication is displayed on LCD:



The increment of operation time changes depending on the values:

Operation time	Increment
0.01 to 9.99 s	0.01 s
0.0 to 99.9 s	0.1 s
100 to 999 s	1 s
1000 to 3600 s	10 s

Set the operation time at 0.00 for unused function. Then the operation moves skipping the unused function to the next.

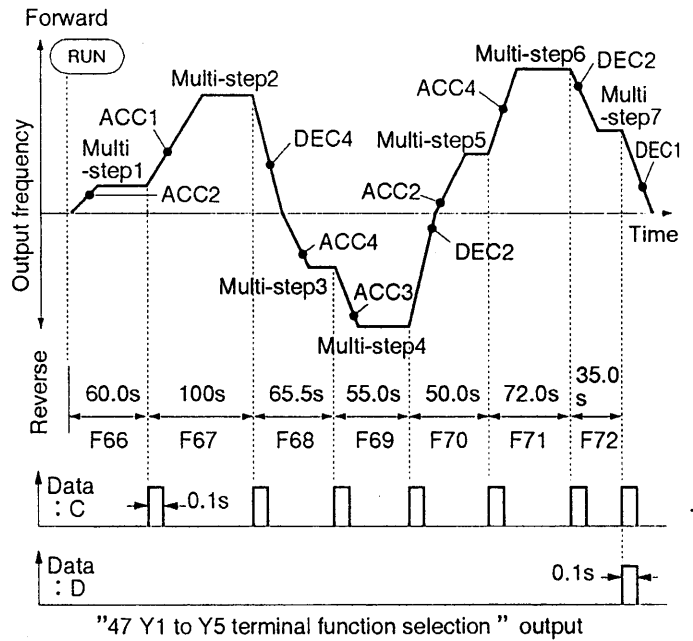
The setting frequencies use the data of the multi-step frequency setting functions. Their combinations are shown as follows:

Function	Written (operation) frequency
66 (Stage 1)	20 Multi-step frequency setting 1
67 (Stage 2)	21 Multi-step frequency setting 2
68 (Stage 3)	22 Multi-step frequency setting 3
69 (Stage 4)	23 Multi-step frequency setting 4
70 (Stage 5)	24 Multi-step frequency setting 5
71 (Stage 6)	25 Multi-step frequency setting 6
72 (Stage 7)	26 Multi-step frequency setting 7

Example of the data of each function and operation pattern

Function code	Data	Written (operation) frequency
65	1	
66	60.0 F2	20 Multi-step frequency setting 1
67	100 F1	21 Multi-step frequency setting 2
68	65.5 R4	22 Multi-step frequency setting 3
69	55.0 R3	23 Multi-step frequency setting 4
70	50.0 F2	24 Multi-step frequency setting 5
71	72.0 F4	25 Multi-step frequency setting 6
72	35.0 F2	26 Multi-step frequency setting 7

This operation pattern is shown in the following figure.



Input the run or stop commands with **RUN** or **STOP** key on the keypad panel and with the control terminal FWD (impossible with REV and HLD). The run command starts and the stop command stops the progress of the pattern operation. If inputting the run command after stopping, the progress of the pattern operation resumes. When stopping by alarm, press **RESET** key to release activation of the protection, and then input the run command to resume the progress of the pattern operation.

If needing to operate from the original pattern "66 STAGE 1" on the way of operation, input the stop command and then press **RESET** key. When stopping by alarm, press **RESET** key to release activation of the protection function, and then press **RESET** key again. After finishing one cycle, the motor decelerates and stops according to the data of "06 DEC TIME 1".

9-6 V/f (Output voltage/output frequency) control

The inverter output voltage is controlled so as to be in a constant ratio to the output frequency. If changing this ratio, the motor torque at low frequency (low speed) can be adjusted.

There are two kinds of torque boost (V/f control) function and either one of them can be used by changeover. For instant, this is used to drive two motors of different characteristics by one inverter with changeover. However, when changing over the torque boost functions, it may occur that some functions are automatically changed over, data limits are necessary, or operations of some functions stops.

Functions changed over automatically

Torque boost 1	Torque boost 2
03 Base frequency 1	39 Base frequency 2
04 Rated voltage 1	40 Rated voltage 2
87 Motor 1 (Rated current)	89 Motor 2 (Rated current)

Data change at torque boost 2

Function	Data
28 Slip compensation control	0.0 Hz
75 Energy-saving operation	0 (Inactive)

Change the data as described above. If not changing the data as above, rewrite the data of "91 Motor 1 (%R1 setting)" and "92 Motor 1 (%X setting)" when changing over the torque boost 1 and 2.

Stopping functions

The data of the functions in the next table are fixed for motor 1 though motor 2 operating since the data for motor 2 do not exist. Since these data are not rewritten, when changing over to the torque boost 1, the data automatically return to the data of the torque boost 1.

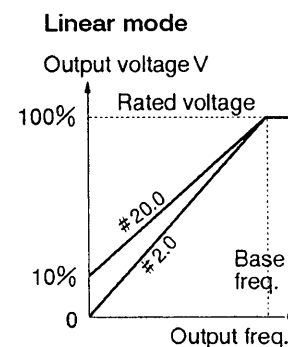
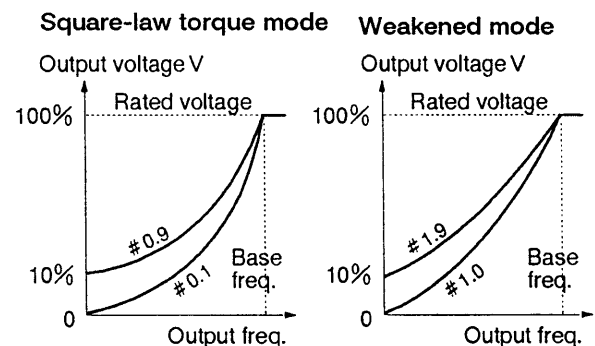
Function	Data
08 Electronic thermal overload relay (Selection)	0
10 Restart after momentary power failure (Selection)	3 *
15 Torque limiter (Driving)	999
16 Torque limiter (Braking)	999
29 Torque vector control	0
88 Motor 1 (No-load current)	Inactive

* : This data is fixed at 3 only when the data of "10 Restart after momentary power failure(selection)" has been set at 2. In the cases of the other data, the inverter operates as the data.

07 Torque boost 1 TRQ BOOST 1

The following torque boost values can be used when needing to strength torque in low frequency (low speed) region or when intending to save energy for driving square-law torque load such as fan and pump.

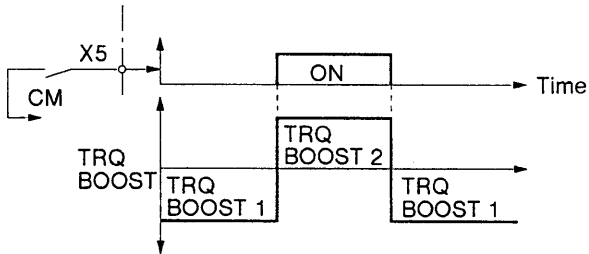
Data	Operation and characteristics
0.0	Automatically adjusts the torque boost value to meet the load (Automatic torque boost function)
0.1 to 0.9	Square-law torque mode (for fan and pump)
1.0 to 1.9	Weakened mode (between square-law torque and linear modes, for proportional torque loads)
2.0 to 20.0	Linear mode (for constant torque loads)



NOTE : If operating motor continuously with a large torque boost value in low speed, the motor may be overheated. The data should be matched the motor.

41 Torque boost 2 TRQ BOOST 2

Set the X5 data of "32 X1-X5 FUNC" at 1 and input a contact signal to the control terminal X5. The torque boost 1 is changed over to the torque boost 2.



Except data 0.0 (automatic torque boost) not existed, the other data are same as those in torque boost 1.

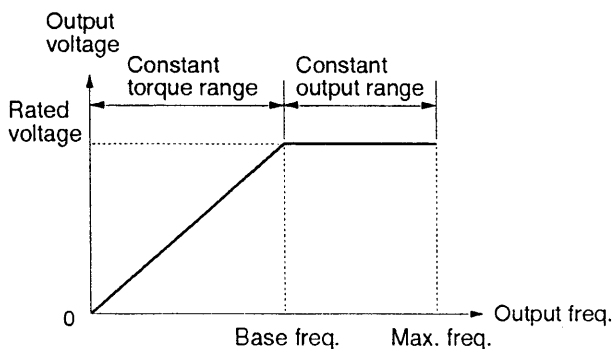
Data	Operation and characteristics
0.1 to 0.9	Square-law torque mode
1.0 to 1.9	Weakened mode
2.0 to 20.0	Linear mode

03 Base frequency 1 BASE Hz-1

39 Base frequency 2 BASE Hz-2

Base frequency is the highest frequency in the constant torque region of the motor in the output frequency range of the inverter, that is, the frequency where the voltage of the V/f characteristic becomes constant. Match the base frequency the rating of the driven motor.

Data range : G9S: 50 to 400 Hz
P9S: 50 to 120 Hz



NOTE : If the base frequency is set over the maximum frequency, the output voltage cannot rise up to the rated voltage since the output is limited to the maximum frequency.

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

40 Rated voltage 2 (Maximum output voltage 2) RATED V-2

This is the maximum voltage output with the inverter. Match this the motor.

Voltage series	Data range
200 V	160 to 240 V
400 V	320 to 480 V

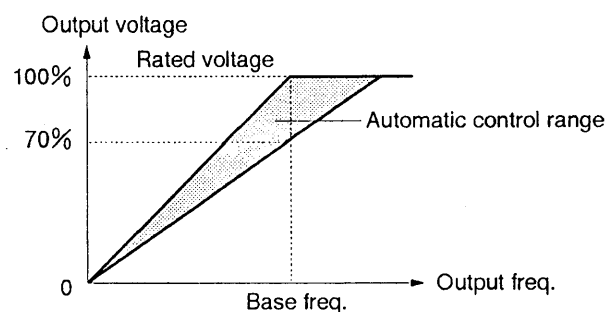
NOTE : The voltage over the power supply (input) voltage cannot be output

75 Energy-saving operation ENERGY SAV

Energy-saving operation is implemented by automatically reducing the output voltage during light load operation.

Data	Operation
0	Inactive
1	Active

When using this together with the torque boost for square-law torque load such as fan and pump, a large energy-saving effect is obtained. However, it operates only during steady speed running, not in acceleration and deceleration. If using it for constant torque load, the control response becomes a little slower.



9-7 Calculation control

This is an inverter control function section that receives and calculates the various data such as commands, setting values and detected values.

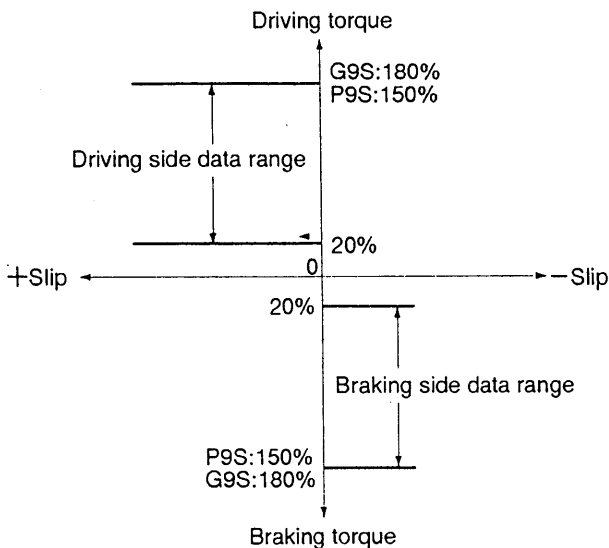
15 Torque limiter (Driving) DRV TORQUE

16 Torque limiter (Braking) BRK TORQUE

These torque limiting operations calculate the motor torque from the output voltage and current, the motor resistance, etc. and limits the calculated value so as not to exceed the limit values. The inverter can continue to operate at rapid load change without tripping. Select the limit values of driving and braking torques.

Function	Data range
Torque limit value (Driving)	G9S: 20 to 180 % . 999 P9S: 20 to 150 % . 999
Torque limit value (Braking)	G9S: 20 to 180 % . 0, 999 P9S: 20 to 150 % . 0, 999

The data 999 selects inactive limit operation (no limit). The braking torque limit value 0 makes regenerative electric power zero, and then the decelerating motor is in a coast-to-stop state.



When these functions are activated, the acceleration and deceleration times become longer than their set data. If the operation time exceeding 100 % torque becomes long, the overload protection may be activated.

NOTE : Do not set the acceleration and deceleration times far apart from the normal values even though not tripping, and match them the motor or load.

29 Torque vector control TRQ VECTOR

This function most suitably controls the voltage and current vectors by correctly calculating motor torque responding to the load for utilizing the motor torque to the full extent.

Select the operation of the torque vector control.

Data	Operation
0	Inactive
1	Active

When the data is set at 1 (active), the data of following functions are changed from the written values:

- "07 TRQ BOOST 1"
The data automatically change to 0.0 (Automatic torque boost).
- "28 Slip compensation control"
When the data is set at 0.0, the slip frequency of Fuji standard 3-phase motor is applied. When the data is other than 0.0, the written value is applied to the slip frequency.

The operation conditions for using the torque vector control

- One motor should be coupled with one inverter. If being coupled to two or more motors, the correct control is difficult.
- The data of the functions of motor 1, "87 (Rated current)", "88 (No-load current)", "91 (%R1 setting)" and "92 (%X setting)" should be correct.
- The rated current of the motor should be not too smaller than that of the inverter. It is recommended to apply the smaller motor by about two ranks than the standard applicable motor for the inverter somewhat differed by motor series.
- The wiring between the inverter and motor should be 50 m or less. If the wiring length is too long, the correct control is difficult owing to the leakage current through the capacitance between the wire and the ground.
- When an AC reactor is connected between the inverter and motor or the wiring impedance is not negligibly large, these data should be written into "91 (%R1 setting)" and "92 (%X setting)". If these data are not clear, use "90 TUNING" and rewrite the data.

If these conditions cannot be fulfilled, make the data of this function "29 TRQ VECTOR" 0 (inactive).

NOTE :

- When selecting "41 Torque boost 2", the torque vector function is automatically stopped (the data: 0).
- An incorrect setting in the functions of motor 1, "87 (Rated current)", "88 (No-load current)", "91 (%R1 setting)" and "92 (%X setting)" will cause an error in the torque calculation. This could result in motor hunting or abnormal vibration. If a stop command is applied, the motor could decelerate at a slow rate and if the rate exceeds three (3) times the deceleration time setting, the torque limit value (braking) of "16 BRK TORQUE" will be ignored.

**81 Motor sound (Carrier frequency)
MTR SOUND**

This function adjust the carrier frequency (pulse number) so that the motor sound and vibration due to the resonance with the mechanical system are reduced. When reducing the leakage current through the wiring on output side or the noise generated by the inverter, set the data at small.

Data	0, 1, 2,.....8, 9, 10	11
Carrier frequency	Low ←————→ High	Lowest
Motor sound	Large ←————→ Smal	Large
Output current wave form	A little bad ←——→ Good	Bad
Leakage current	Small ←————→ Large	Small
Generated noise	Small ←————→ Large	Small

FRENIC5000G9S series

Standard applicable motor	Range of carrier frequency. () : Data
30 to 55kW	2kHz(0) to 10kHz(10), 0.7kHz(11)
75kW or more	2kHz(0) to 6kHz(10), 0.7kHz(11)

FRENIC5000P9S series

Standard applicable motor	Range of carrier frequency. () : Data
200V series 30 to 55kW	2kHz(0) to 6kHz(10), 0.7kHz(11)
400V series 30 to 75kW	
200V series 75kW or more	2kHz(0) to 4kHz(10), 0.7kHz(11)
400V series 90kW or more	

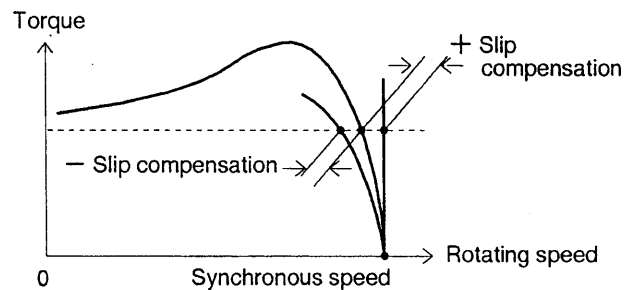
NOTE : If operating the carrier frequency at the data 11 (0.7 kHz), the harmonic components of inverter output current increase and then the loss of the motor becomes greater. Accordingly, reduce the motor load (torque) by 15% so that the temperature of the motor does not rise highly.

The adjustable range of the carrier frequency varies in accordance with the inverter capacity above-mentioned.

**28 Slip compensation control
SLIP COMP**

The motor speed drops with increasing the load torque. A frequency is added to the output frequency to adjust this drooping rate. This function is to adjust the motor speed variation with the load variation so as to reduce (constant speed characteristic) or increase (drooping characteristic).

Data range: -9.9 to 5.0 Hz



Set the data on + side to reduce the speed variation. For instance, setting the data at the rated slip frequency of the motor can keep nearly the synchronous speed in spite of load variation.

When making the speed variation large, that is, intending to obtain a drooping characteristic, set the data on - side. This is applied to parallel running of motors for balancing the loads.

NOTE :

- If the data is set at over the slip frequency, the motor speed exceed the synchronous speed.
- When the data of "02 MAX Hz" and "11 H LIMITER" are made equal, the + data cannot operate being limited by the frequency limiter (upper). In the such case, set the data of the frequency limiter (upper) at the following value.

$$\text{Upper value of the frequency limiter} = \text{Max. frequency} + \text{Slip frequency} \times K$$

Here, K should be 1 when the data of "15 DIV TORQUE" is 100 % or less, but K should be added the increased part when exceeding 100 %.

9-8 Motor data

Motor 1 presents the data for "07 TRQ BOOST 1", and motor 2 presents the data for "41 TRQ BOOST 2". The data of motor 1 are also used as the calculating data for the torque calculation, torque limit control, torque vector control, slip compensation control and saving-energy operation functions.

86 Motor 1 (Capacity) MOTOR CAP

This function specifies the rated capacity (output) of the driven motor.

Data	Rated capacity of motor
0	Capacity of 1 rank above the standard applicable motor
1	Capacity of the standard applicable motor
2	Capacity of 1 rank below the standard applicable motor
3	Capacity of 2 rank below the standard applicable motor

This function automatically writes the data of Fuji 3-phase motor (200V series : 200V, 50Hz, 4 Poles. 400V series : 400V, 50Hz, 4 Poles) into the functions of motor 1, "87 (Rated current)", "88 (No-load current)", "91 (%R1 setting)" and "92 (%X setting)".

In such a case as precisely controlling the inverter by using a motor other than Fuji 3-phase motor, individually write the data into the function when the motor data are known, and conduct the auto-tuning when they are unknown.

NOTE : If the data of "86 Motor 1 (Capacity)" are rewritten, data of motor system are automatically rewritten to the the data of Fuji standard 3-phase motor.

87 Motor 1 (Capacity) MOTOR 1-Ir

89 Motor 2 (Capacity) MOTOR 2-Ir

These are the rated currents of motor 1 and 2.

Data range: 0.00 to 2000 A

Current value	Increment
0.00 to 9.99 A	0.01 A
10.0 to 99.9 A	0.1 A
100 to 999 A	1 A
1000 to 2000 A	10 A

Since the data range is wide, the increments are changed depending on the values.

88 Motor 1 (No-load current) MOTOR 1-Io

This is the no-load current of motor 1.

Data range: 0.0 to 2000A

The increment are changed depending on the values as in the rated current.

90 Motor 1 (Tuning: %R1, %X) TUNING

This function measures the resistance and leakage reactance at the base frequency in the inverter output circuit, and automatically writes the measured data into the functions, "91(%R1 setting)" and "92(%X setting)".

Data	Operation
0	Inactive
1	Conducts tuning

The auto-tuning should be conducted in the case where the data previously written in "91 motor1(%R1 setting)" and "92 motor2(%X setting)" differ from the data of the real output circuit.

When conducting the tuning in the case as follows, the control and calculation precision will be improved.

- When needing the correct data to control the inverter and motor precisely in the case where a motor other than Fuji 3-phase motor is applied.
- When the output circuit impedance is not-negligibly changed due to long output circuit wiring or an AC reactor connected in output circuit.
- When %R or %X is unknown in the case when a non-standard motor or a special motor is applied.

NOTE :

- Even if "40 TRQ BOOST 2" is selected, the measurement on the inverter output circuit can be conducted, but the measured values are written only into the data of the motor 1 and cannot be used for the motor 2. However, if the motor 2 differs from the motor 1, when changing over from torque boost 2 to torque boost 1 after measuring the data under torque boost 2, the measured data under torque boost 2 can be used as the data for torque boost 1.
- When activating function "77 Data initializing" after tuning, the tuning data is also initialized and changed to the factory setting.

91 Motor 1 (%R1 setting)

%R1 SET

92 Motor 1 (%X setting)

%X SET

In the case when using a motor other than Fuji 3-phase motor, write the data into the functions when the output resistance and reactance are known.

NOTE : When writing the different data after conducting the auto-tuning, the tuning data are erased.

Calculate the data with following formulas:

% Resistance value (%R1)

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

R1 : Primary winding resistance of the motor [Ω]

Cable R: Resistance of the cable on the output side [Ω]

V : Rated voltage [V]

I : Rated current of the motor [A]

% Reactance value (%X)

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

X1 : Primary leakage reactance of the motor [Ω]

X2 : Secondary leakage reactance of the motor [Ω]

XM: Exciting reactance [Ω]

Cable X: Reactance of the cable [Ω]

V : Rated voltage [V]

I : Rated current of the motor [A]

Function	Data range
%R1 setting	0.00 to 50.00 %
%X setting	0.00 to 50.00 %

When connecting an AC reactor or a filter into the output circuit of the inverter, add their values. If the values of the cable is negligible small, set the values at 0.

NOTE : As for the reactance, use the data written in "03 Base frequency 1".

9-9 Motor protection and overload warning

These functions select and output motor overload protection and warning before operating overload protection of the motor and inverter. However, since the functions may not protect the motor and inverter in the cases such as follows, check the characteristics. If the protection is impossible, connect a protection device such as thermal relay.

- Special motor such as submersible motor and high speed motor, multi-pole motor and non-standard motor
- Driving motor for load of long starting time, such as a blower and acentrifuge
- Motor for special operation, such as frequently accelerating/ decelerating operation and intermittent operation
- Two or more motors driven by one inverter

08 Electronic thermal overload relay

(Selection)

ELCTRON OL

09 Electronic thermal overload relay

(Level)

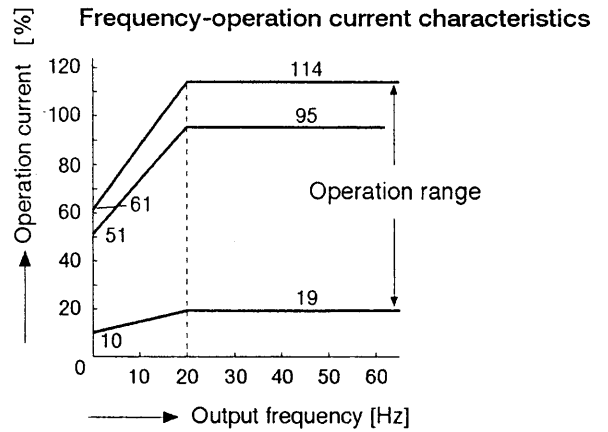
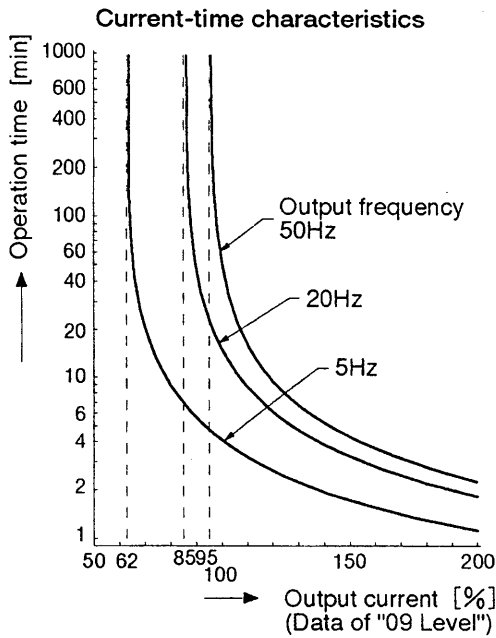
OL LEVEL

"08 (Selection)"

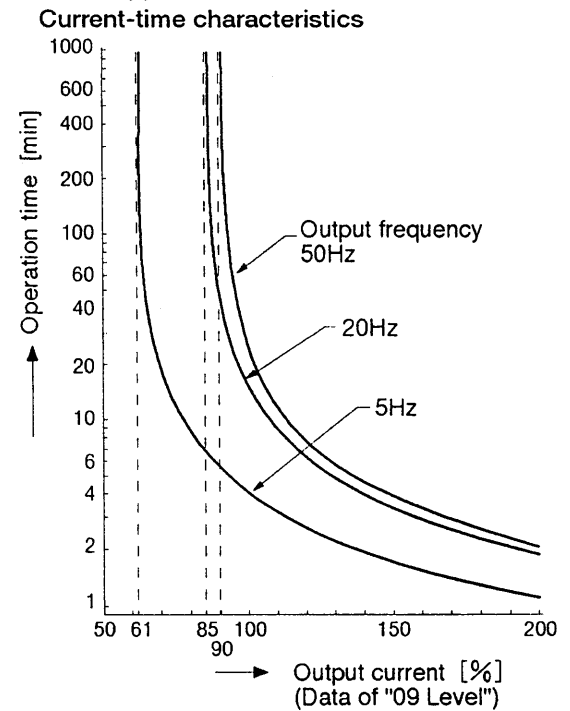
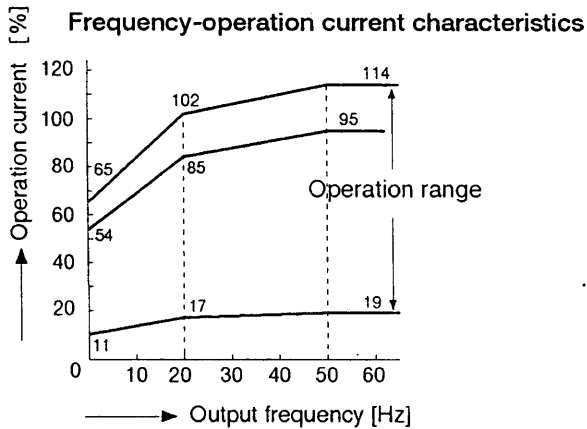
Data	Operation
0	Inactive (Unused)
1	Standard 3-phase motor
2	Forced ventilated motor (Fuji inverter motor etc.)

Data : 1

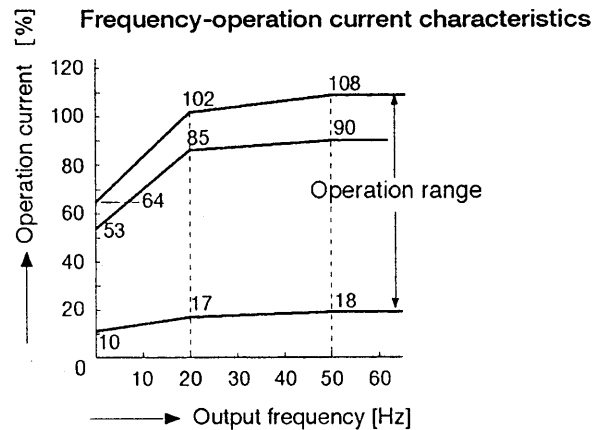
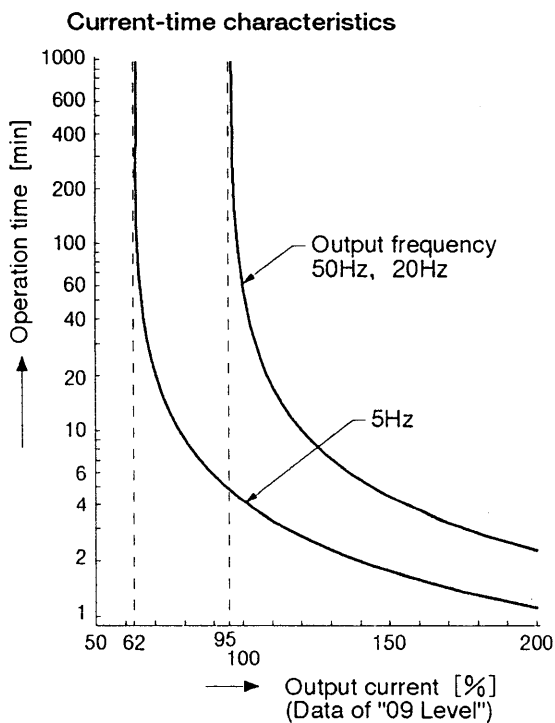
1) Standard applicable motor : 30kW to 45kW



3) Standard applicable motor : 110kW or more



2) Standard applicable motor : 55kW to 90kW



Data : 2

Both the current—time characteristics and the frequency—operation current characteristics are fixed to the frequency 50Hz characteristics.

"09 (level)"

The operation level becomes a little lower than the written value.

This is due to the influence of long time flowing of the inverter output current including harmonics and high frequency components.

- As for the special motor for 50Hz or 60Hz, write individually the rated current value.
- As for the common motor for 50/60Hz, write the rated value of 50Hz.

Data range:

Inverter rated output current × (20 to 120%)/100 [A]

Since the data range is wide, the minimum units are changed depending on the value.

Current value	Increment
0.00 to 9.99 A	0.01 A
10.0 to 99.9 A	0.1 A
100 to 999 A	1 A
1000 to 2000 A	10 A

Example of written data

Inverter : FRN 30G9S-2 (Rated output current 115 A)
 Motor : Fuji standard 3-phase motor MLA6187
 (30 kW, 4 poles)
 Power supply: 220 V/60 Hz

The data is 1 because of standard 3-phase motor.
 The operation level is written with the current value.
 The data range of the inverter is as follows:
 Operation level range = $115 \times (20 \text{ to } 120) / 100$
 = 23.0 to 138 A

When the motor MLA6187 is connected power supply of 220 V, 60 Hz, the rated current is 97 A.
 In general, the motor current value = the operation level

Then the data becomes as follows:

"08 ELCTRON OL": 1, "09 OL LEVEL": 97.0 A

**51 Overload function signal (level)
 OL WARNING**

This function can select and output overload warning signals, before operation of the electronic thermal protection for the motor and the inverter overload protection for the inverter, to the open-collector output terminals with a common signal (OR signal).

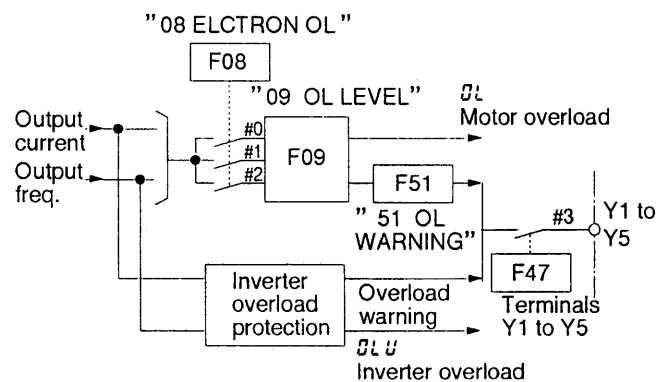
The overload function signal is output by using the data of "08 ELCTRON OL". Although the electronic thermal overload relay is unused when the data of "08 ELCTRON OL" is at 0, the overload function signal is output.

Data of "08 ELCTRON OL"	Operation characteristics
1	Standard 3-phase motor
0 and 2	Forced ventilated motor

Data range: Inverter rated output current
 × (20 to 120%)/100 [A]

The operation level is same as in "09 OL LEVEL". The data should be lower than that of "09 OL LEVEL" to operate as the overload warning.

For the inverter, 80 % of the inverter overload characteristics (p. 110) is the overload warning level. Adjustment of the overload warning level is impossible.



9-10 DC braking

⚠ CAUTION

Use care when applying DC braking since motor currents and temperature can build up to very high levels in a short period of time possibly resulting in motor damage.

Motor may overheat if the DC braking is left ON for too long.

When DC voltage and DC current (frequency: 0 Hz) are given to a rotating motor, the motor generates a braking torque to decelerate and stop. This is called DC braking.

NOTE : *The braking force does not generate at stopping motor, If needing to brake the motor at stopping, use a mechanical brake.*

17 DC brake (Starting frequency)

DC BRK Hz

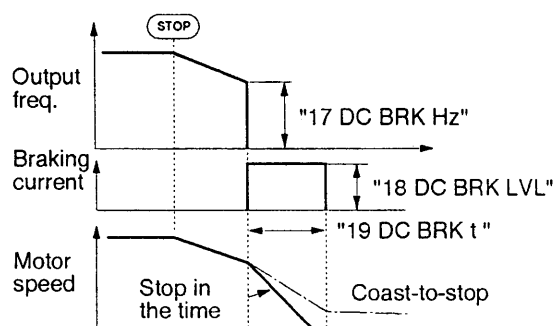
18 DC brake (Braking level)

DC BRK LVL

19 DC brake (Braking time)

DC BRK t

When inputting stop command, the output frequency is decreased. When the frequency reaches "17 DC BRK Hz", a DC braking current of "18 DC BRK LVL" is outputted for "19 DC BRK t" and the motor is decelerated and stopped.



Function	Data range
Starting frequency	0.0 to 60 Hz
Level	0 to 100 %
Time	0.0 to 30.0 s

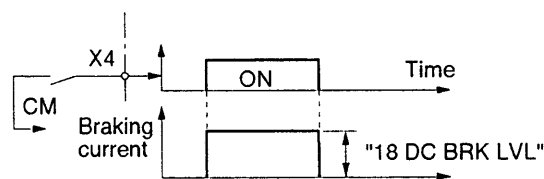
If the data of "17 DC BRK Hz" is set at 0, the DC braking is inactive.

The data of "18 DC BRK LVL" is indicated with %. Set 100% at the rated current.

When the data of "17 BRK t" is set at 0.0, the inverter stops output at the time point when the output frequency decreases to the starting frequency and the motor transfers to coast-to-stop.

When the motor does not stop in the braking time, the motor transfers to coast-to-stop.

If the X4 data of "32 X1 to X5 FUNC" is set at 2 and a contact signal (DC brake command) is input, the DC braking current of "18 DC BRK LVL" is output during the signal ON.



NOTE :

- *If the DC brake works frequently, the motor will be overheated.*
- *Use the DC brake within the motor rated capacity.*
- *When reactor, power transformer or others are connected to the inverter output circuits, they have the possibility of overheat or burn if the DC brake works for a longer time or more frequently.*

9-11 Momentary power failure, restart and operation changeover from power line to inverter

When momentary power failure occurs and power is recovered, the coast to-stop motor is automatically restarted. Motor driving power source can be changed over from power line to the inverter without stopping the motor in a short time.

10 Restart after momentary power failure RESTART

This function specifies whether the inverter is to be restarted automatically when momentary power failure occurs and power is recovered, and selects the starting methods.

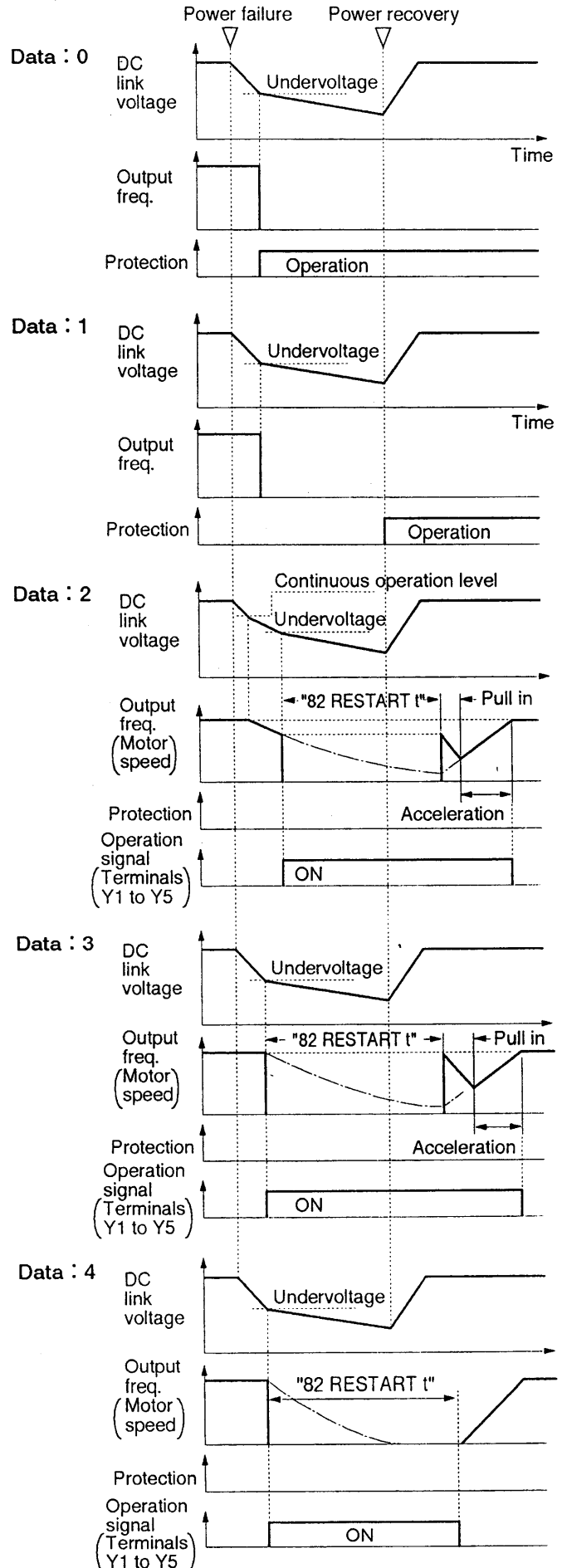
Data	Power failure	Power recovery	Operation summary
0	UV active Output stop	No restart	Restart function inactive
1	UV inactive Output stop	UV active No restart	Restart function inactive
2	UV inactive Output stop	Restart	Extends continuous operation time using inertia
3	UV inactive Output stop	Restart	Restart with the frequency at the power failure
4	UV inactive Output stop	Restart	Restart with the written value of "57 START Hz".

Remark: UV shows undervoltage of the inverter protection and Output stop means stopping output of the inverter.

Operation command at restart

- Keypad command
Possible to start if stop command is not input at the power failure.
- Control terminal command
When using HLD for the switch of momentary type, restart is possible if stop command is not input during the power failure.
When not using HLD (using the switch of alternate type), restart needs switching ON, but if the switch has been ON at power recovery the inverter automatically restart.

NOTE : When the operation command has been input by STOP or switch of momentary type, if the power failure time is so long that the control power supply is lost, an operation command is necessary to input at power recovery.



Remark: The single dotted line shows the motor speed.

82 Auto-restart (Restart time) RESTART t

This is a time from undervoltage detection level to restart command. Write data when the data of "10 RESTART" is set at 2, 3 or 4.

Data range: 0.0 to 5.0 s

When the data of auto-restart time is shorter than that of power failure, the inverter will restart after about 0.5 second from power recovery.

83 Auto-restart (Frequency fall rate) FALL RATE

The output frequency is decreased from the starting frequency for synchronization to match the output frequency the motor rotating speed when the data of "10 RESTART" is set at 2 or 3. This function specifies the frequency fall rate, that is, the speed of pull-in.

Data range: 0.00, 0.01 to 100.00 Hz/s

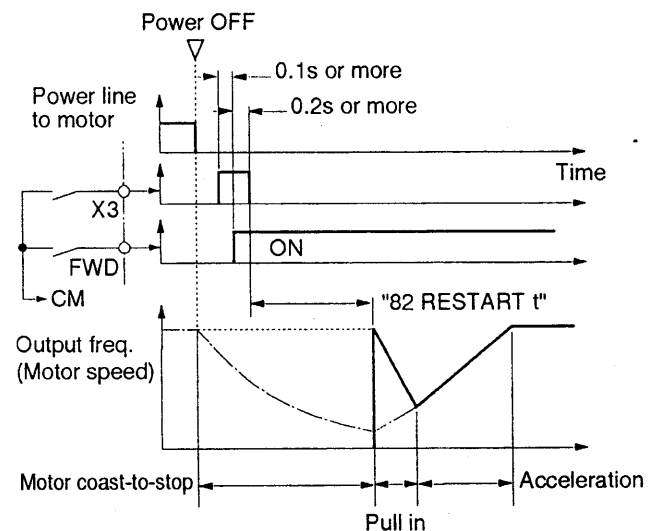
If the data is set at 0.00, the output frequency is decreased depending on the present setting deceleration time.

NOTE : If a large fall rate is selected, the overvoltage protection may activate owing to temporary large regenerative energy from the load. If a too small fall rate is selected, the overload protection of the inverter may activate owing to long operation time exceeding the thermal relay operation time.

Changeover from power line to inverter

When running motor supplied from power line is changed over to inverter operation without stopping the motor, "82 RESTART t" and "83 FALL RATE" are used. Rewrite the data of "32 X1 to X5 FUNC" to following data according to the frequency of the power line.

Data of terminal X3	Power line frequency
1	50 Hz
2	60 Hz



Remark: The single dotted line shows the motor speed.

After power line voltage has not been applied to the inverter output terminal, input a contact signal and command in the sequence shown in the figure. A timer for "82 RESTART t" starts to count time from the signal OFF of X3 terminal. The inverter outputs the power line frequency at the time up. Then the inverter performs pull in operation as same as in auto-restart after power failure, and acceleration or deceleration to the output setting frequency. The acceleration or deceleration is performed with the present setting acceleration or deceleration time.

NOTE : If the operation command is input before the command to the control terminal X3, the inverter starts normally as the work of the changeover from power line to inverter does not function. Input the operation command 0.1sec or more later after the command has been input to the terminal X3.

9-12 Auto-reset function

⚠ CAUTION

If the alarm cause is not recovered though resetting the alarm, repeating reset may enlarge the damage. The data of "84 Auto-reset (Times)" should be as few as possible.

This is to reset the inverter protection and restart the inverter automatically when detecting following alarms:

Alarms starting the auto-reset function

OC 1, OC 2, OC 3: Overcurrent

OV 1, OV 2, OV 3: Overvoltage

OH 1: Inverter overheating

OL: Motor overload

OLU: Inverter overload

Operation signal of auto-reset operation can be selectively output from open-collector terminals (Y1 to Y5).

84 Auto-reset (Times) AUTO-RESET

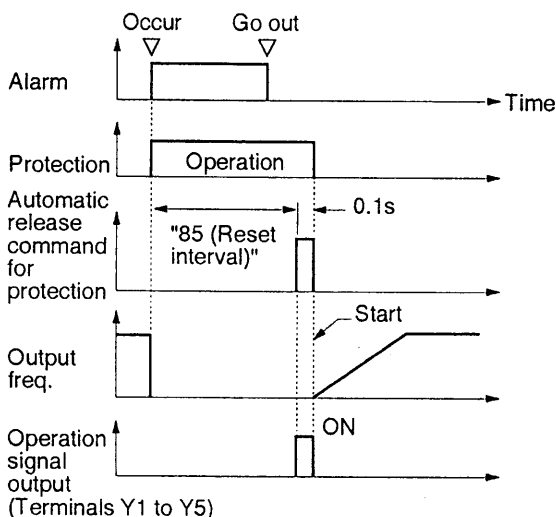
85 Auto-reset (Reset interval) RESET INT

Function	Data range
Times	0 to 7 times
Reset interval	0 to 20 s

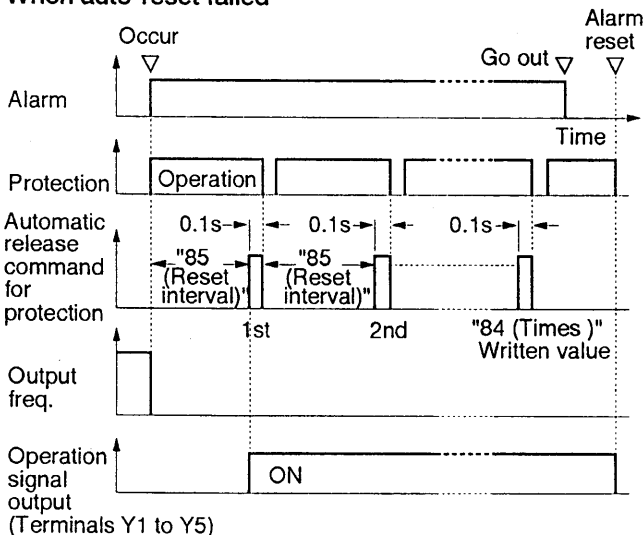
When not using auto-reset function, set the data of "84 (Times)" at 0. When setting the data of "84 (Times)" at 1 to 7, the auto-reset operation starts after detecting the alarms starting auto-reset function. At first, after passing "85 (Reset interval)", the protection is automatically released and the inverter starts. Then, if the alarm cause was recovered, the inverter is not transferred to the alarm mode but continues running. If the alarm cause remains, the auto-reset operates again. When this procedure is repeated and the alarm cause does not yet go out, the inverter is transferred to the alarm mode after exceeding the set number of times of repeating.

When the alarm cause went out within the set number of times, alarm indication is not output and the alarm history is not rewritten. If the inverter was transferred to the alarm mode, the signal output and history rewrite are performed.

When reset succeeded



When auto-reset failed



9-13 Control terminal function selection

These functions allocate input signals for control and output signals for control and monitoring, and adjust detection level of output frequency.

32 X1 to X5 terminal function selection X1-X5 FUNC

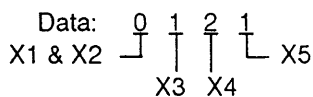
The functions of control terminals (X1 to X5) are selected as shown in following table.

Data	Control terminal function			
	X1 & X2	X3	X4	X5
0	Multi-step frequency selection (P. 72)	Multi-step frequency selection (P. 72)	ACC & DEC time selection (P. 76)	ACC & DEC time selection (P. 76)
1	UP/DOWN control (P. 72)	Changeover from power line (50 Hz) (P. 90)	Freq. setting (only C1 terminal) (P. 71)	Torque boost 2 selection (P. 81)
2	UP/DOWN control (P. 72)	Changeover from power line (60 Hz) (P. 90)	DC braking command (P. 88)	Data protection (P. 97)

When using the functions in the table, write the data into the function and input a contact signal to each terminal. The data have 4 digits. Then, write the data into the function with the order of X1 & X2, X3, X4 and X5.

Data example :

When Multi-step frequencies are allocated in X1 & X2, changeover from power line (50 Hz) in X3; DC braking in X4; and torque boost 2 in X5, the data are written as follows:



NOTE : In detail for operation etc., refer to the description of each function.

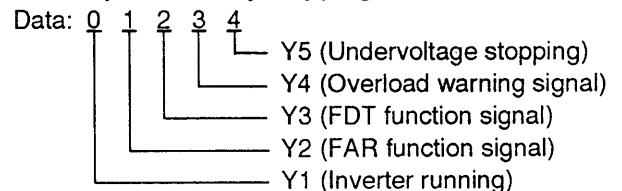
47 Y1 to Y5 terminal function selection Y1-Y5 FUNC

Signals for control and monitoring shown in following table can be selectively output to the open-collector terminals.

Data	Output signal	Ref. page
0	Inverter running	92
1	FAR (Frequency at reference) function signal	93
2	FDT (Frequency level detection) function signal	
3	Overload warning signal	87
4	Undervoltage stopping	93
5	Keypad operation mode	
6	Torque limiting	82
7	Inverter stopping	93
8	Restarting after momentary power failure	89
9	Auto-resetting	91
A	(Not allocated)	—
B	(Not allocated)	—
C	Stage transferring at pattern operation	Pulse signal of 100 ms 79
D	Cycle completion signal at pattern operation	
E	Stage number indication at pattern operation	93
F	Alarm indication (Operated item of inverter protection)	

The data have 5 digits. The terminals are allocated at each digit as shown in data example at factory shipping.

Data example at factory shipping.



When the data are E and F, the signal is output with combination of Y2 (or Y3) to Y5 terminals.

Inverter running (Data : 0)

The inverter running means that the main IGBTs are activating and in this case the ON signal is output. However, even though they are under the active state, the ON signal is not output when the DC brake is activating.

Undervoltage stopping (Data : 4)

Regardless of the activating state of the inverter protective function, when the DC voltage in the DC link circuit becomes less than the undervoltage detection level, ON signal is output.

When the DC voltage is restored and becomes higher than the detection level, OFF signal is output.

Undervoltage detection level :

200V series : 200v. 400v series : 400v

Keypad operation mode (Data : 5)

In such a case that "01 OPR METHOD" is 0, ON signal is output when the run and stop commands are able to be input from **(RUN)** and **(STOP)** key on the keypad.

Inverter stopping (Data : 7)

The inverter stopping means that the main IGBTs are inactivating and in this case the ON signal is output.

Stage number indication at pattern operation (Data: E)

Operation stage No.	Output terminal		
	Y3	Y4	Y5
Pattern 1	—	—	○
Pattern 2	—	○	—
Pattern 3	—	○	○
Pattern 4	○	—	—
Pattern 5	○	—	○
Pattern 6	○	○	—
Pattern 7	○	○	○

○ Marks show outputs of ON signal.

Alarm indication (Data : F)

Alarm		Output terminal			
Code	Name	Y2	Y3	Y4	Y5
OC1	Overcurrent during acceleration	—	—	—	○
OC2	Overcurrent during deceleration	—	—	○	—
OC3	Overcurrent at steady state running	—	—	○	○
EF	Ground fault	—	—	○	○
OU1	Overvoltage during acceleration	—	○	—	—
OU2	Overvoltage during deceleration	—	○	—	—
OU3	Overvoltage at steady speed	—	○	—	—
UV	Undervoltage	—	○	—	○
OL	Motor overload	—	○	○	—
OLU	Inverter overload	—	○	○	○
OH1	Cooling fin overheat	○	—	—	—
OH3	Inverter overheating	○	—	—	—
OH2	External alarm input	○	—	—	○
FUS	DC link fuse blown-out	○	—	○	—
Er1	CPU error	○	—	○	○
Er3	Keypad communication error	○	○	—	—
Er2	Keypad communication error	○	○	—	—
Er7	Tuning error	○	○	○	○

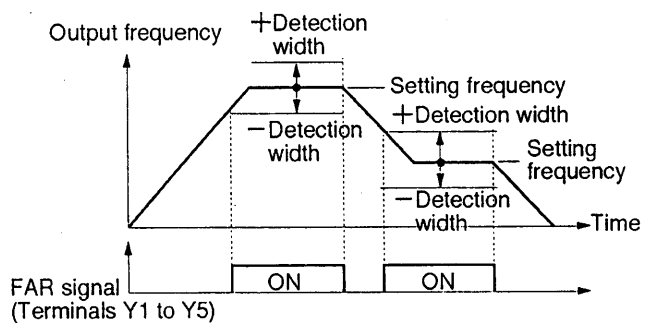
○ Marks show outputs of ON signal.

48 FAR function signal (Detection width) FAR HYSTR

This function adjusts the detection width (signal output operation width) when the output frequency equals the setting (reference) frequency.

Data range: 0.0 to 10.0 Hz

When the output frequency enters within the setting frequency \pm detection width, ON signal is output from the selected open-collector terminal.



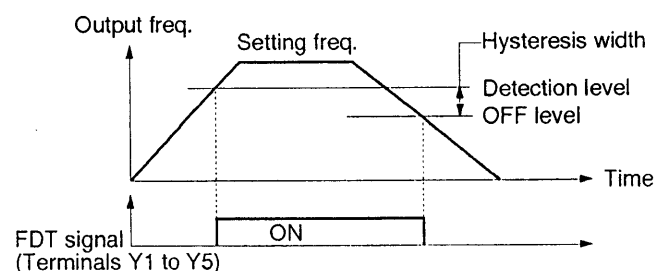
49 FDT function signal (Level) FDT LEVEL

50 FDT function signal (Hysteresis) FDT HYSTR

These functions specify the level of the output frequency to be detected and the detection hysteresis width to set OFF level.

Function	Data range
JumDetection level	G9S: 0 to 400 Hz P9S: 0 to 120 Hz
Hysteresis width	0.0 to 30.0 Hz

When the output frequency is equal or higher than the data level, ON signal is output from the selected open-collector terminal.



9-14 Output for instruments

Functions perform matching between the inverter and instruments and selecting indicating function.

43 FMP terminal (Pulse rate multiplier) FMP PULSES

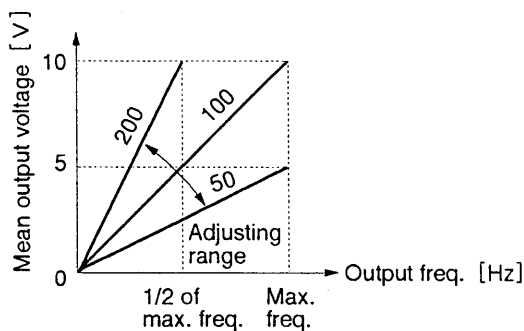
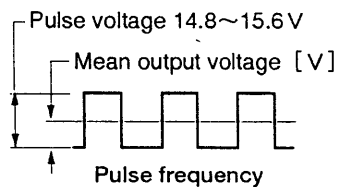
44 FMP terminal (Voltage adjust) FMP V-ADJ

A pulse frequency proportional to the output frequency is output from terminal FMP for frequency meter. This function adjusts this pulse frequency and mean output voltage.

Function	Data range
Pulse rate multiplier	06 to 100
Voltage adjust	50 to 200

$$\begin{aligned} \text{Pulse frequency} &= \text{Pulse rate multiplier} \times \text{Output} \\ &\quad \text{frequency [Hz]} \\ &\leq 6000 \text{ [Hz]} \text{ (Max. pulse frequency)} \end{aligned}$$

Mean output voltage of the pulse frequency output should be matched to the used meter and its scale.



Digital meter

The frequency can be indicated on a digital counter. Match the pulse rate the counter.

Analog meter

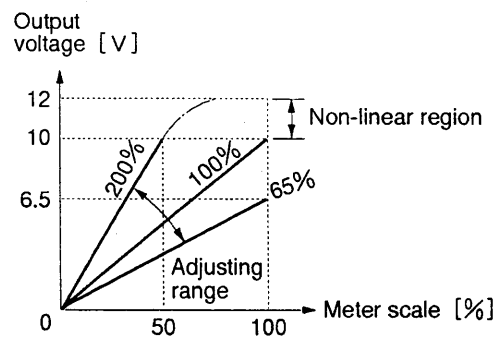
A DC voltmeter of moving coil type (10 V, 1 mA max.) can be connected as a frequency meter. Conduct scale matching with the meter specification.

45 FMA terminal (Voltage adjust) FMA V-ADJ

46 FMA terminal (Function selection) FMA FUNCJ

These functions perform adjusting voltage for analog meter (DC voltmeter of moving coil type) and selecting indicating function.

Data range of voltage adjustment: 65 to 200 %



The used meter has the specification of 10 V, 2 mA max. The voltage is output up to about 12 V but the characteristic is non-linear over 10 V.

NOTE : The terminal FMA is exclusive for meter. Do not use for control. It may cause a problem owing to response or ripple.

Function selection

Data	Indicating function	Meter scale (at 100 %)
0	Output frequency	Maximum frequency
1	Output current	2 × Inverter rated current
2	Torque	2 × Rated torque
3	Load factor (Load meter)	2 × Rated load factor

9-15 Monitoring data selection

These function select the data indicated on LED and LCD.

61 LED monitor 1 (Function) LED MNTR 1

62 LED monitor 2 (Display at stop mode) LED MNTR 2

The display items on LED change depending on the inverter operation modes (running, stopping and frequency setting).

"62 LED MNTR 2" selects the data at inverter stopping. The data on inverter running and frequency setting are indicated by the selection through the data of "61 LED MNTR 1".

Data of "61 LED MNTR 1"	Indication item			
	At running	At stopping		At frequency setting
			Data of "62 LED MNTR 2"	
		0	1	
0	Output frequency	Set frequency	Output frequency	Set frequency
1	Output current			
2	Output voltage			
3	Motor speed	Set motor speed	Motor speed	Set motor speed
4	Line speed	Set line speed	Line speed	Set line speed
5	Machine speed	Set machine speed	Load speed	Set machine speed
6	Torque limit (Driving)			Set frequency
7	Torque limit (Braking)			
8	Calculated torque			

NOTE :

- The motor speed is the calculated value with number of motor poles and the output frequency. Then, it indicates the synchronous speed.
- When selecting "41 Torque boost 2", the calculated torque value is not correct.

30 Number of motor poles MTR POLES

This function sets the motor poles to be driven. Write the data to indicate motor speed (synchronous speed) on LED correctly.

Data range: 2, 4, 6, 8, 10, 12, 14

63 Coefficient for machine speed and line speed SPEED COEF

This function sets coefficients for indicating load speed and line speed on LED. Write the values from calculation with following formula:

$$\text{Coefficient for speed indication} = \frac{\text{Line speed or machine speed [m/min]}}{\text{Output frequency [Hz]}}$$

Data range: 0.01 to 200.00

Data writing example :

When driving load with output frequency of 60 Hz, motor speed of 1755 r/min, reduction gear of reduction ratio 1/3, the coefficients for speed indication is:

$$\begin{aligned} \text{Machine speed} &= 1755 \times 1/3 \\ &= 585 \text{ r/min} \end{aligned}$$

$$\begin{aligned} \text{Coefficients for speed indication} &= 585/60 \\ &= 9.75 \end{aligned}$$

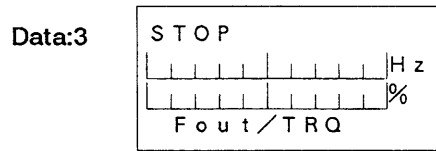
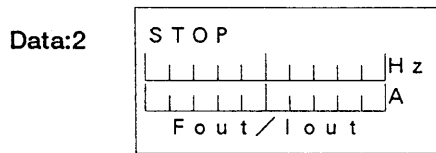
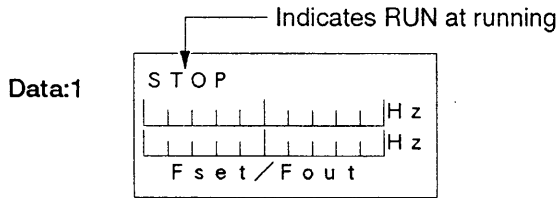
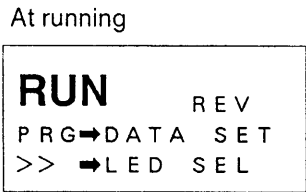
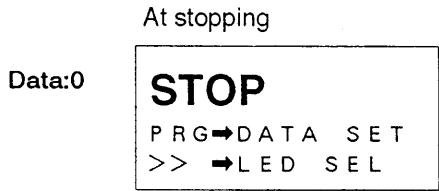
Write 9.75 as the data.

NOTE : Since the coefficient is used for line speed and machine speed, it is applied to either one of them when both coefficients differ.

64 LCD monitor (Function) LCD MNTR

This function selects which information is displayed on LCD.

Data	Indication item
0	Operation status and operation guide
1	Set frequency and output frequency
2	Output frequency and output current
3	Output frequency and torque



The full scale values are as follows:

Indication item	Full scale
Output frequency, Set frequency	Max. frequency
Output current, Torque	2 X Rated value

NOTE : The scales cannot be adjusted.

78 Language (Japanese/English) LANGUAGE

This function selects language on LCD.

Data	Language
0	Japanese
1	English

NOTE : The LCD language in this instruction manual is all in English.

79 LCD monitor (Brightness) BRIGHTNESS

This function adjusts the brightness of LCD. Select large numeral for bright and small numeral for dark.

Data	0, 1, 2, 8, 9, 10
Screen	Dark ← → Bright

31 Function block (32-41)

■ ■ 32-41 ■ ■

42 Function block (43-51)

■ ■ 43-51 ■ ■

52 Function block (53-59)

■ ■ 53-59 ■ ■

60 Function block (61-79)

■ ■ 61-79 ■ ■

80 Function block (81-94)

■ ■ 81-94 ■ ■

These functions select whether or not the functions in () or sandwiched between ■ ■ and ■ ■ will be displayed on LCD and available for adjustment.

Data	Display
0	Display
1	Not display

NOTE : The written data of each function are the operation data (operation condition) if the data are not displayed.

9-16 Data processing and data for manufacturer

77 Data initializing DATA INIT

This function returns (initializes) the data rewritten by the user to the data factory setting.

After setting the data of this function at 1, pressing **(FUNC DATA)** key initializes the data of all functions.

After initializing, the data of this function returns to 0.

Data	Rewrite
0	Inactive
1	Active

93 Dedicated function for manufacturer 1 DD FUNC 1

94 Dedicated function for manufacturer 2 DD FUNC 2

These functions are used by the Company for test etc. before factory shipping. Do not use.

95 Data Protection DATA PRTC

This function is used to forbid to rewrite the data.

Data	Rewrite
0	Possible
1	Forbidden

This function can be conducted with the command from both of the keypad panel and the control terminal.

Keypad panel

Call for the data setting screen of the program mode, and perform following operation:

Press **(>>)** and **(v)** keys together: 0

(Rewrite possible)

Press **(>>)** and **(^)** keys together : 1

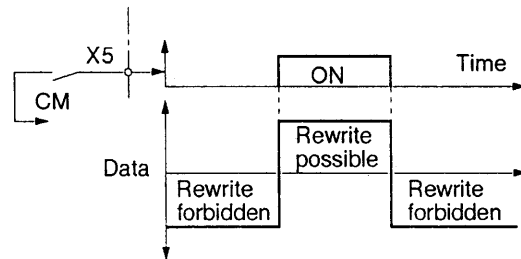
(Rewrite forbidden)

Control terminal

Set the X5 data of "32 X1-X5 FUNC" at 2.

Terminal X5 ON : 0 (Rewrite possible)

Terminal X5 OFF : 1 (Rewrite forbidden)



NOTES

10 Inverter Operation

⚠ WARNING

Inverter systems cause mechanical motion and are located in various locations. It is the responsibility of the user to insure that such motion does not result in an unsafe condition. Factory provided interlocks and operating limits should not be bypassed or modified.

When an abnormality occurs and is spreading, disabling to insure safety, or causing or being afraid of causing a disaster such as fire, promptly switch OFF the circuit breaker on the power supply side.

Replace all covers before applying power to the inverter. Failure to do so may result in death or serious injury.

Do not touch the electrical circuits or parts, or do not insert foreign bodies through the openings when applying power. It may result in electrical shock, burn by generated arc, and damage of the equipment.

Mis-setting of the function data may cause dangerous conditions. Therefore, After setting and writing the data, verify the data again.

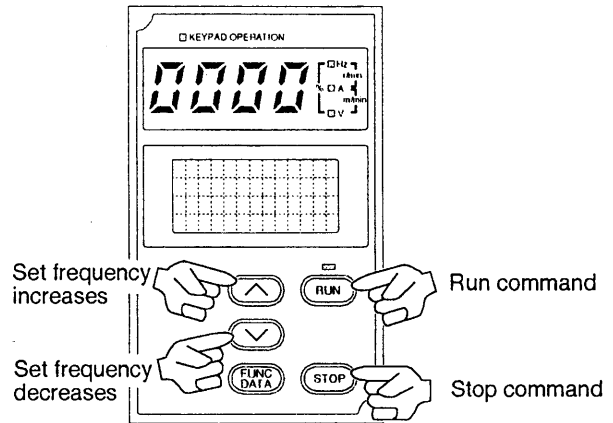
⚠ CAUTION

For RUN and STOP, use the FWD-CM (forward) and REV-CM (reverse) terminals, or the RUN and STOP keys on the keypad panel. Do not use a contactor (ON/OFF) installed on the line side of the inverter for RUN and STOP.

If the inverter's Fault Alarm is activated, consult the Troubleshooting section of this instruction manual, and after correcting the problem, resume operation. Do not reset the alarm automatically by external sequence, etc.

The cooling fins of the inverter are heated to a high temperature in inverter operation, and touching the fins may cause burn. Keep a sufficient time after stopping the inverter when touching the fins.

a) Operation command per keypad panel



b) Operation command per control circuit terminal

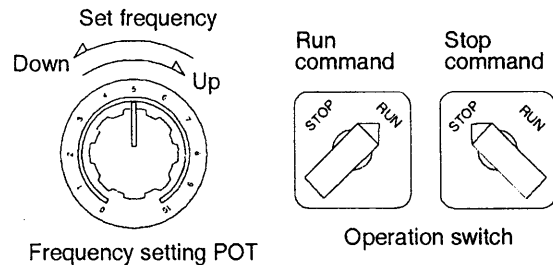








Fig. 10-1 Operation command method

Basic procedures are shown in Table 10-1 (Refer to Fig. 6-7 Basic connection p. 37). Operate the inverter as follows referring to this table. The operation data can be displayed on the digital indicator (LED) of the keypad panel. Refer to "8-5 Operation mode" (p. 53) and functions "61 LED MNTR 1" and "62 LED MNTR 2" (p. 95).

- 1) Before operating in conjunction with the mechanical equipment, check the inverter and motor individually with trial operation.
- 2) After verifying that no problems are detected to them, combine them with the mechanical equipment. Be sure to review and understand the operation of the mechanical equipment by the relevant instruction manual.

Table 10-1 Operation command method

Operation	Frequency setting	Operation command	Function data
Keypad panel	Press  key, then the set frequency increases. Press  key, then the set frequency decreases. Press  key during operation, then the motor speed increases. Press  key during operation, then the motor speed decreases.	Press  key, then the motor starts. Press  key, then the motor decelerate and stops.	"00 FREQ COMND":0 "01 OPR METHOD":0
Control circuit terminal	Turn the frequency setting POT knob clockwise, then the set frequency increases. Turn the knob counterclock-wise, then the frequency decreases. Turn the knob clockwise during operation, then the motor speed increases. Turn the knob counterclock-wise during operation, the motor speed decreases.	Make the switch "ON," then the motor starts. Make the switch "OFF," then the motor decelerates and stops.	"00 FREQ COMND":1 "01 OPR METHOD":1

3) Verify correct rotating direction of motor promptly. When using both of forward and reverse directions, verify matching the directions commands.

NOTE : When mis-matching the direction the commands, change the connection referring to "6 Connection and Wiring" (p. 25).

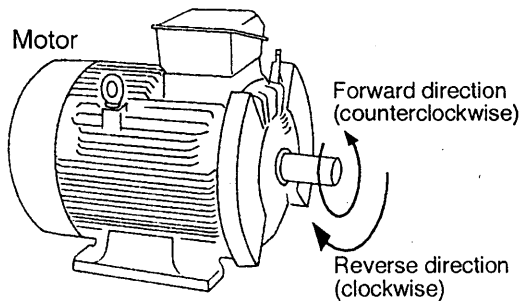


Fig. 10-2 Rotating direction of motor

4) After checking correct direction of rotation, set a low frequency to ensure the motor safety operation. And check for the following:

- Smooth rotation of motor
- Any abnormal vibrations or noises in the motor
- Items prescribed in the relevant "Motor instruction manual."

5) Checking for 4), raise the set frequency gradually up to the maximum frequency if no abnormality exists. Verify that the output frequency reaches the data of "02 MAX Hz" or "11 H LIMITER".

6) Observing for 4), lower the set frequency gradually to stopping or very low speed.

7) Repeat raising and lowering of the set frequency, and check for that no problem exists on the motor. Repeat forward or reverse running alternately, if specified.

8) Continuously run the motor for a while at maximum frequency. And observe for 4) during running. Conduct this test for forward and reverse direction, if specified.

9) Give a stop command.

Then the individual test trial operation of the inverter and motor is completed.

If there is no problem, couple the motor with the mechanical equipment, and operate them according to the instruction of the mechanical equipment.

When needing change of the data of functions, write the data again.

11 Inspection and Maintenance

⚠ WARNING

Before disassembling for connection, inspection and removing abnormality cause, disconnect and lock out power from the inverter. Failure to disconnect power may result in death or serious injury. A DC link circuit charge light provides visual indication that DC link voltage is present with the charged DC link capacitor; verify the DC link voltage level by measuring the voltage between power terminals P(+) and N(-) using an analog meter. Do not attempt to service the inverter until the charge indicator has extinguished and DC link voltage has discharged to zero volts.

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 manufacturer's instruction book for proper operation and adjustment to the instrument.

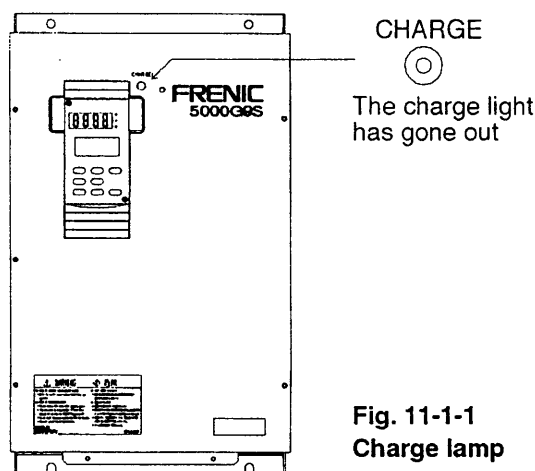


Fig. 11-1-1
Charge lamp

⚠ CAUTION

The cooling fins of the inverter are heated to a high temperature in inverter operation, and touching the fins may cause burn. Keep a sufficient time after stopping the inverter when touching the fins.

In order to prevent potential problem from occurring and for the inverter to be given long period of high-reliable operation, conduct inspection daily and periodically. The inspection items should be referred to Table 11-1-1. If any thing is found, remove abnormal section or cause of abnormality or replace and repair abnormal parts and cause of abnormality.

NOTE : After the inspection, record the inspected state. This record is useful for history of the inverter system and as reference to the next inspection.

Table 11-1-1 Inspection items chart

Item	Inspection criteria	Corrective action
Power supply voltage	Within permissible limits (170-253 V AC) for 230 V AC inverters; or (323-506 V AC) for 460 V AC inverters.	Adjust the power supply voltage
Ambient temperature	Within permissible limits (-10° to +50°C)	Investigate cause and make corrections until environment is within permissible limits.
Ambient humidity	Within permissible limits (20-90% RH), No dew condensation or freezing	Investigate cause and make corrections until environment is within permissible limits.
Vibration	Within permissible limit [5.9 m/s ² (0.6 G)] or less	Investigate cause and make adjustments until within permissible limit.
Noise	Abnormal audio noise from cooling fan, etc.	Contact the supplier where the inverter was purchased.
Odor	Smell or burning	Contact the supplier where the inverter was purchased.
Dust	Dust accumulation on cooling fins, fan or on the control board.	Clean and blow out with compressed air.
Screws/ connectors	Check for any loosening	Re-tighten as needed.

NOTE : Check internal connectors and screws only during periodic inspections or when cover is removed.

11-1 Daily inspections

For daily inspection, it is not necessary to remove the cover of the inverter operating or applied power supply. Check visually the inverter from the outside for the abnormal items in operating condition.

NOTE : If any abnormality found, check for the location and degree of the abnormality promptly. And investigate the possibility to continue the operation.

11-2 Periodic inspection

For periodic inspections, switch the inverter OFF and remove its front cover, and conduct mainly visual and finger inspection.

Check the inverter for howl, abnormal noise and vibration during operation of the inverter before and after the inspection and for odor promptly after stopping the inverter.

NOTE : Periodic inspection intervals will vary per the inverter environment, application, used years and importance in the system. Pick an interval that best suits to the particular application (semi-annually, annually, etc.).

11-3 Measurement points and meters

Since the inverter's input/output voltage (power supply side/motor side) and current contain high frequencies, selection of the measuring device could lead to gross difference of indications. When using the measuring device for power frequency use, refer to the recommended measuring device as shown in Fig. 11-3-1.

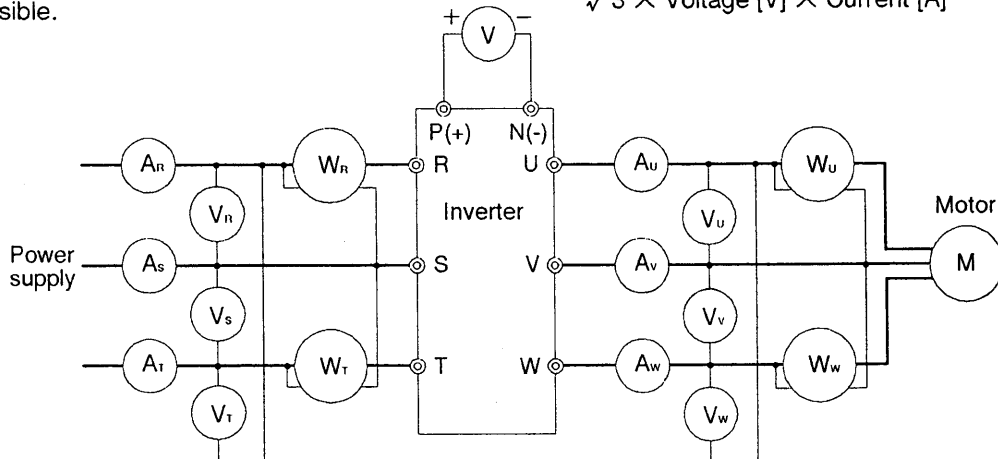
When using a CT (current transformer) to measure the current, the amount of error will be large if the frequency is low. Because of this, always use a CT with as large a capacity as possible.

For power factor measurement, the market-available power factor meter measuring the phase difference between voltage and current cannot be used.

The power factor should be calculated from the measurement of power, voltage and current on the input/output side as given below.

Power factor

$$= \frac{\text{Power [kW]} \times 1000}{\sqrt{3} \times \text{Voltage [V]} \times \text{Current [A]}} \times 100 [\%]$$



Item	Simple measurement	Precision measurement
Input voltage	Tester	Moving-iron type voltmeter
Input current	Clamp meter	Moving-iron type ammeter
Input power	—	Electrodynamometer type wattmeter
DC link voltage	Tester	Moving-coil type voltmeter
Output voltage	Tester	Rectifier type voltmeter
Output current	Clamp meter	Moving-iron type ammeter
Output power	—	Electrodynamometer type wattmeter

Remark: When the currents on both input/output sides are largely unbalanced, use the wattmeters with three-wattmeter-method.

Fig. 11-3-1 Measurement devices and points

11-4 Insulation checks

CAUTION

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

Keep strictly the test procedure described below, otherwise the inverter may be damaged.

a) Main circuit

Provide a 250 VDC megger for the 200 V series, or a 500 VDC megger for the 400 V series.

NOTE : *If the inverter for 200 V series is tested with the 500 VDC megger, indications may be inaccurate due to the leakage current caused by the surge suppressor of the main power supply side.*

When existing locations necessary to be cleaned, wipe with chemically neutral cloth or suck up duct with an electric cleaner etc.

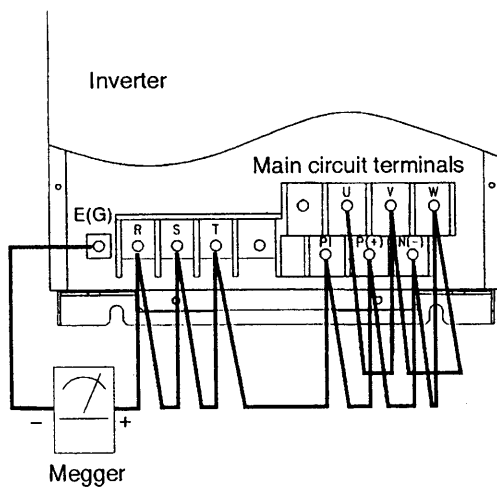


Fig. 11-4-1 Main circuit megger test connections

Disconnect the wires connected to the main circuit terminals R, S, T, P1, P(+), N(-), U, V and W, and connect them with a common wire as shown in Fig. 11-4-1.

NOTE : *If megger test is carried out under the condition that the external circuit wires are connected to the main circuit terminals, it leads to measuring the insulation resistance including the one of the external circuit. So in this case it is difficult to measure correctly the insulation resistance of an inverter itself.*

The megger value $5\text{M}\Omega$ or more is normal.

b) Control circuit

Provide a tester set on a high resistance range.

Disconnect outside wiring at all inverter terminals as of the main and control circuits.

Conduct the continuity test between the control circuits and the ground.

Measured value $1\text{M}\Omega$ or more is normal.

11-5 Parts replacement

⚠ CAUTION

This assembly contains parts and sub-assemblies that are sensitive to electrostatic discharge. Static control precautions are required when servicing this assembly. Component damages may result if you ignored electrostatic discharge control procedures.

The parts of the inverter cannot use permanently but have each period (life) determined with their kind. However, the life of the parts will vary according to the installation environment and application condition, then it is difficult to set the life of the parts. Therefore, it is recommended for preventive maintenance policy that some parts should be replaced periodically or depending on the investigation in the periodic inspection.

An example of recommended years for parts replacement is given in Table 11-5-1. In this case, it is assumed that yearly ambient temperature is 30°C, loading factor is less than 80%, and daily operation is 12 hours per day.

Table 11-5-1 Recommended years for parts replacement

Parts	Recommended years for replacement	Replacement method
Cooling fan	3 years	New
DC link capacitor	5 years	New (Investigated)
Aluminum capacitor on printed circuit board	7 years	New printed circuit board (Investigated)
Fuse	10 years	New
Other	————	Investigated

NOTE : When needing replacement of parts, contact the distributor where the inverter was purchased or the Company's sales office nearby with the inverter type, part name, part type, rating and quantity referring to the next "Replacement parts list".

NOTE :

— When pulling out connector at replacing printed circuit board etc., hold the connector itself. If the wire is pulled, the core wire may be torn off or the connector may be damaged.

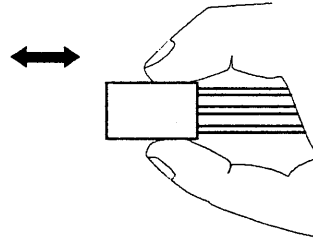


Fig. 11-5-1 Holding method of connector

— When inserting connector, match the Nos. of the connector to avoid inserting into miss-location. Insert the connector holding the connector itself. If pushing with strong force, the printed circuit board may be bent and the circuit may be damaged. Push not forcibly the connector holding the printed circuit board.

Table 11-5-2 200V series replacement parts list

Part name	Part type	Rating	Inverter type /Quantity												
			G9S series						P9S series						
			FRN30G9S-2	FRN37G9S-2	FRN45G9S-2	FRN55G9S-2	FRN75G9S-2	FRN90G9S-2	FRN30P9S-2	FRN37P9S-2	FRN45P9S-2	FRN55P9S-2	FRN75P9S-2	FRN90P9S-2	FRN110P9S-2
IGBT	HF5A5367	600V 400A	3	3	6	6	9	12	3	3	3	6	9	12	12
Control printed circuit board	EP-3496□ □	—	1	1	1	1	1	1	1	1	1	1	1	1	1
Power supply and gate drive printed circuit board	EP-3564□	—	1	1	—	—	—	—	1	1	1	—	—	—	—
	EP-3519□	—	1	1	—	—	—	—	1	1	1	—	—	—	—
	EP-3520□	—	—	—	1	1	—	—	—	—	—	1	—	—	—
	EP-3604□-C-1	—	—	—	—	—	1	—	—	—	—	—	1	—	—
	EP-3604□-C-2	—	—	—	—	—	—	1	—	—	—	—	—	1	1
Cooling fan	4715PS-22T-B30	AC220V	3	1	1	2	1	—	3	3	2	1	1	—	—
	2750MTP-15	—	—	2	2	—	—	—	—	—	2	2	—	—	—
	6250MG1	—	—	—	—	2	3	6	—	—	—	—	3	6	6
DC link capacitor	HF5A2892 4700 μF	4700 μF 400VDC	4	—	—	—	—	—	4	4	—	—	—	—	—
	HF5A5037 6800 μF	6800 μF 400VDC	—	4	—	—	—	—	—	—	4	—	—	—	—
	HF5A5037 8200 μF	8200 μF 400VDC	—	—	4	4	4	6	—	—	—	4	4	6	6
DC fuse	CR2L-200	200A AC250V	—	—	—	—	—	—	1	—	—	—	—	—	—
	CR2L-225	225A AC250V	1	—	—	—	—	—	—	1	—	—	—	—	—
	CR2L-300	300A AC250V	—	1	—	—	—	—	—	—	1	—	—	—	—
	CR2L-400	400A AC250V	—	—	1	1	1	—	—	—	—	1	1	—	—
	A50P600-4	600A AC500V	—	—	—	—	—	1	—	—	—	—	—	1	1

NOTE : When purchasing following parts, add a postscript of type.

— Add the alphabet described on the printed circuit board to be replaced into □ in the part types of the control printed circuit board and power supply and gate drive printed circuit board.

— Add the inverter type of the printed circuit board to be replaced into □ in the control printed circuit board.

Remark: When purchasing the parts described above, require the replacement manual together.

Table 11-5-3 400V G9S series replacement parts list

Part name	Part type	Rating	Inverter type /Quantity											
			FRN30G9S-4	FRN37G9S-4	FRN45G9S-4	FRN55G9S-4	FRN75G9S-4	FRN90G9S-4	FRN110G9S-4	FRN132G9S-4	FRN160G9S-4	FRN200G9S-4	FRN220G9S-4	
IGBT	HF5B0276	1200V 200A	3	—	—	—	—	—	—	—	—	—	—	—
	HF5A5365	1200V 200A	—	3	—	—	6	—	—	—	—	—	—	—
	HF5A5366	1200V 300A	—	—	3	3	—	6	6	9	9	12	12	—
Control printed circuit board	EP-3496□ □	—	1	1	1	1	1	1	1	1	1	1	1	1
Power supply and gate drive printed circuit board	EP-3563□-C1	—	1	—	—	—	—	—	—	—	—	—	—	—
	EP-3563□-C2	—	—	1	—	—	—	—	—	—	—	—	—	—
	EP-3515□	—	1	1	—	—	—	—	—	—	—	—	—	—
	EP-3531□-C-1	—	—	—	1	1	—	—	—	—	—	—	—	—
	EP-3531□-C-2	—	—	—	—	—	1	—	—	—	—	—	—	—
	EP-3603□-C-1	—	—	—	—	—	—	1	1	—	—	—	—	—
	EP-3603□-C-2	—	—	—	—	—	—	—	—	1	1	—	—	—
EP-3603□-C-3	—	—	—	—	—	—	—	—	—	—	—	1	1	
Cooling fan	4715PS-22T-B30	AC220V	3	3	1	1	2	1	1	—	—	—	—	—
	2750MTP-15	—	—	—	2	2	—	—	—	2	2	—	—	—
	6250MG1	—	—	—	—	—	2	3	3	3	3	6	6	—
DC link capacitor	HF5A2892 4700 μF	4700 μF 400VDC	4	—	—	—	—	—	—	—	—	—	—	—
	HF5A5037 6800 μF	6800 μF 400VDC	—	4	—	—	—	6	—	8	—	—	—	—
	HF5A5037 8200 μF	8200 μF 400VDC	—	—	4	—	4	—	6	—	8	12	12	—
	HF5A5037 5600 μF	5600 μF 400VDC	—	—	—	6	—	—	—	—	—	—	—	—
DC fuse	CR6L-150/UL	150A AC600V	1	1	—	—	—	—	—	—	—	—	—	—
	CR6L-200/UL	200A AC600V	—	—	1	—	—	—	—	—	—	—	—	—
	CR6L-300/UL	300A AC600V	—	—	—	1	1	—	—	—	—	—	—	—
	A70Q-400-4	400A AC700V	—	—	—	—	—	1	1	—	—	—	—	—
	A70Q-500-4	500A AC700V	—	—	—	—	—	—	—	1	—	—	—	—
	A70Q-600-4	600A AC700V	—	—	—	—	—	—	—	—	1	1	—	—
	A70QS-800-4	800A AC700V	—	—	—	—	—	—	—	—	—	—	—	1

NOTE : When purchasing following parts, add a postscript of type.

— Add the alphabet described on the printed circuit board to be replaced into □ in the part types of the control printed circuit board and power supply and gate drive printed circuit board.

— Add the inverter type of the printed circuit board to be replaced into □ in the control printed circuit board.

Remark: When purchasing the parts described above, require the replacement manual together.

Table 11-5-4 400V P9S series replacement parts list

Part name	Part type	Rating	Inverter type /Quantity												
			FRN30P9S-4	FRN37P9S-4	FRN45P9S-4	FRN55P9S-4	FRN75P9S-4	FRN90P9S-4	FRN110P9S-4	FRN132P9S-4	FRN160P9S-4	FRN200P9S-4	FRN220P9S-4	FRN280P9S-4	
IGBT	HF5B0276	1200V 200A	3	3	—	—	—	—	—	—	—	—	—	—	—
	HF5A5365	1200V 200A	—	—	3	—	—	6	—	—	—	—	—	—	—
	HF5A5366	1200V 300A	—	—	—	3	3	—	6	6	9	9	12	12	
Control printed circuit board	EP-3496□ □	—	1	1	1	1	1	1	1	1	1	1	1	1	1
Power supply and gate drive printed circuit board	EP-3563□-C1	—	1	1	—	—	—	—	—	—	—	—	—	—	—
	EP-3563□-C2	—	—	—	1	—	—	—	—	—	—	—	—	—	—
	EP-3515□	—	1	1	1	—	—	—	—	—	—	—	—	—	—
	EP-3531□-C-1	—	—	—	—	1	1	—	—	—	—	—	—	—	—
	EP-3531□-C-2	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	EP-3603□-C-1	—	—	—	—	—	—	—	1	1	—	—	—	—	—
	EP-3603□-C-2	—	—	—	—	—	—	—	—	—	1	1	—	—	—
	EP-3603□-C-3	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Cooling fan	4715PS-22T-B30	AC220V	3	3	3	1	1	2	1	1	—	—	—	—	—
	2750MTP-15		—	—	—	2	2	—	—	—	2	2	—	—	—
	6250MG1		—	—	—	—	—	2	3	3	3	3	6	6	
DC link capacitor	HF5A2892 4700 μF	4700 μF 400VDC	4	4	—	—	—	—	—	—	—	—	—	—	—
	HF5A5037 6800 μF	6800 μF 400VDC	—	—	4	—	—	—	6	—	8	—	—	—	
	HF5A5037 8200 μF	8200 μF 400VDC	—	—	—	4	—	4	—	6	—	8	12	12	
	HF5A5037 5600 μF	5600 μF 400VDC	—	—	—	—	6	—	—	—	—	—	—	—	
DC fuse	CR6L-150/UL	150A AC600V	1	1	1	—	—	—	—	—	—	—	—	—	—
	CR6L-200/UL	200A AC600V	—	—	—	1	—	—	—	—	—	—	—	—	
	CR6L-300/UL	300A AC600V	—	—	—	—	1	1	—	—	—	—	—	—	
	A70Q-400-4	400A AC700V	—	—	—	—	—	—	1	1	—	—	—	—	
	A70Q-500-4	500A AC700V	—	—	—	—	—	—	—	—	1	—	—	—	
	A70Q-600-4	600A AC700V	—	—	—	—	—	—	—	—	—	1	1	—	
	A70QS-800-4	800A AC700V	—	—	—	—	—	—	—	—	—	—	—	1	

NOTE : When purchasing following parts, add a postscript of type.

— Add the alphabet described on the printed circuit board to be replaced into □ in the part types of the control printed circuit board and power supply and gate drive printed circuit board.

— Add the inverter type of the printed circuit board to be replaced into □ in the control printed circuit board.

Remark: When purchasing the parts described above, require the replacement manual together.

12 Troubleshooting

If the protection has tripped the inverter, or any abnormalities have occurred, investigate the cause referring to the following descriptions and try to correct the cause.

If the problem is not relevant to the description, the inverter is out of order, or the parts are damaged, it is recommended to consult the distributor where the inverter was purchased, or the Company's sales office nearby.

12-1 Inverter protection

Two types of protection are provided, one transferring to alarm mode and tripping and the other not indicating alarm and avoiding tripping.

a) Protection transferring to alarm mode.

If this protection has been active, the inverter trip will occur (the inverter will stop output), the alarm mode screen will appear on LCD, and LED will indicate the alarm code.

On tripping, the motor will be released from the inverter and coast until stopped.

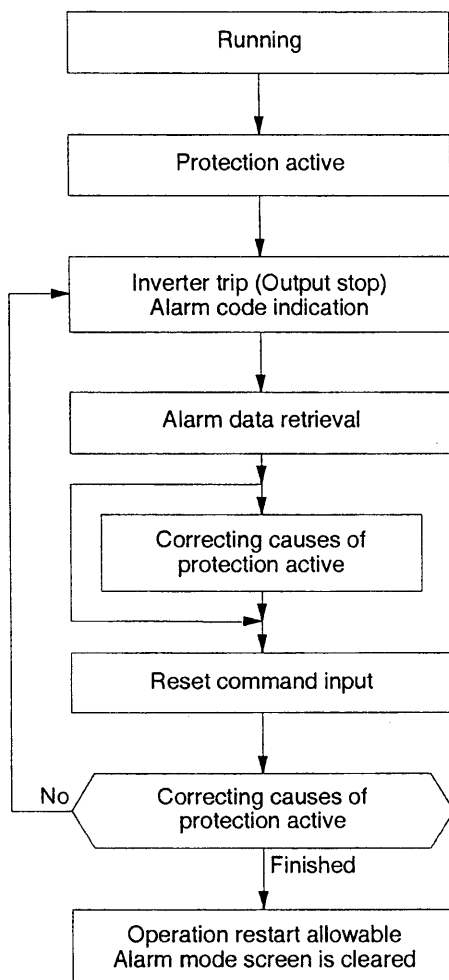
The active status (tripping status) of the protection continues to reset command input. After performing corrective actions or replacing the parts, press **RESET** key.

The active status is released transferring to the operation mode, and the operation of the inverter can be restarted.

NOTE : As to the operation method of the alarm mode, refer to "8-6 Alarm mode" (p. 57).

Indication example:

When overvoltage protection is active during operation at the output frequency of 60 Hz.



1) Running

Operation data

Operation mode screen

2) Inverter trip and alarm code indication

Alarm code

Alarm mode screen

3) Operation restart allowable

Operation data

Operation mode screen

Fig. 12-1-1 Protective function operating and resetting

Table 12-1-1 Protection transferring to alarm mode

Protective function	Keypad panel display		Protective operation	
	LED	LCD		
Overcurrent	$\overline{OC} 1$	OC DURING ACC	At 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.
	$\overline{OC} 2$	OC DURING DEC	At deceleration	
	$\overline{OC} 3$	OC AT SET SPD	At steady speed	
Ground fault	\overline{EF}	GROUND FALT	Operates at the ground detection of inverter output circuit. Excessive ground fault current will also operate overcurrent protection. Provide Earth leakage relay or Earth leakage circuit breaker for preventing burn or fire hazzard.	
Fuse blow-out	\overline{FUS}	DC FUSE OPEN	Operates when a fuse blows in the DC link circuit due to a short-circuit in the DC link capacitor or IGBT circuit.	
Overvoltage	$\overline{OV} 1$	OV DURING ACC	At acceleration	Operates if the DC voltage in the DC link circuit exceeds the overvoltage detection level by regenerating power. However, this protection is not possible if excessive voltage (high voltage) is applied by error. Overvoltage detection level; • 200V series: 400V • 400V series: 800V
	$\overline{OV} 2$	OV DURING DEC	At deceleration	
	$\overline{OV} 3$	OV AT SET SPD	At steady speed	
Undervoltage	\overline{LU}	UNDERVOLTAGE	Operates if the power supply voltage drops and the DC voltage in the DC link circuit becomes less than the undervoltage detection level. If the data 2, 3 or 4 of "10 RESET" has been selected, operation will resume automatically when the power is resorted. In this case, no signal will be output to the alarm output terminal. Refer to "9-11 Momentary power failure, restart and operation changeover from power line to inverter" (p. 89). Undervoltage detection level: 200V series: 200V 400V series: 400V	
Cooling fin overheat	$\overline{OK} 1$	FIN OVERHEAT	Operates if there is a problem with cooling fan and the temperatures of the cooling fin for the rectifier diode and IGBT and the power supply printed circuit board area rise.	
External alarm input	$\overline{OK} 2$	EXT FAULT	Operates according to the signal of control terminal THR through the alarm contacts in the external equipment such as a braking unit and braking resistor if connected.	
Inverter overheating	$\overline{OK} 3$	HIGH AMB TEMP	Operates if the air temperature inside of the inverter (principally the control portion) rises too high because of poor ventilation.	
Motor overload	\overline{OL}	MOTOR OL	Operates when the motor current (inverter output current) exceeds the electronic thermal overload relay setting through "09 OL LEVEL". In detail, refer to "9-9 Motor protection and overload warning" (p. 85).	
Inverter overload	\overline{OLU}	INVERTER OL	Operate when the output current exceeds the inverse-time overload characteristics shown in Fig. 12-1-2.	
Memory error	$\overline{Er} 1$	MEMORY ERROR	Operates when a memory error occurs due to a data writing error, etc.	
Communication error	$\overline{Er} 2$	KEYPD COM ERR	Operates when RUN or STOP command is input from the keypad panel if a transmission error between the keypad panel and the control part, or a halt in transmission is detected. NOTE : <i>If operating from the control terminals, the inverter continues to operate without an alarm indication and alarm output (any fault). The indication is fixed at error detection state (not changed).</i>	
CPU error	$\overline{Er} 3$	CPU ERROR	Operates when an error occurs in CPU due to noise, etc.	
Tuning error	$\overline{Er} 7$	TUNING ERROR	Operates when there is an open circuit or poor contact in the inverter output wiring, putting out of the connector of the keypad panel, or inputting signal to the control terminals FWD, REV and BX during auto-tuning.	

NOTE :

— If the control power supply voltage drops until not holding the operation of the inverter control circuit, all of protection is automatically reset.

— If the indication on the keypad panel is not included in this table, refer to the instruction manual of the using control option.

1) G9S series

2) P9S series

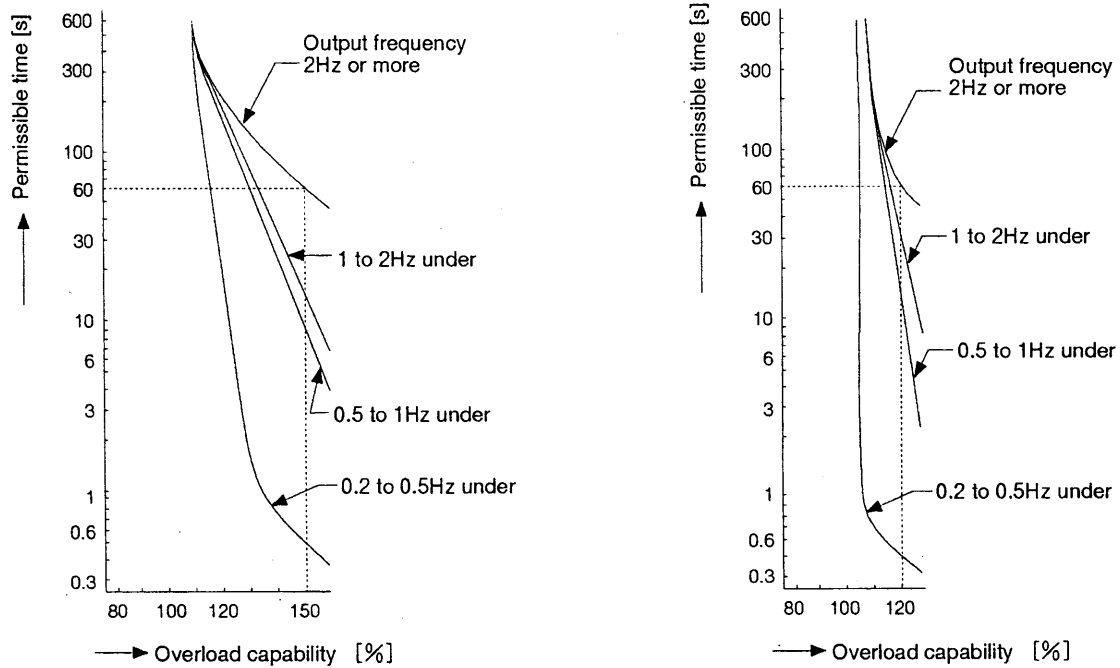


Fig. 12-1-2 Inverter overload

b) Protection not transferring to alarm mode

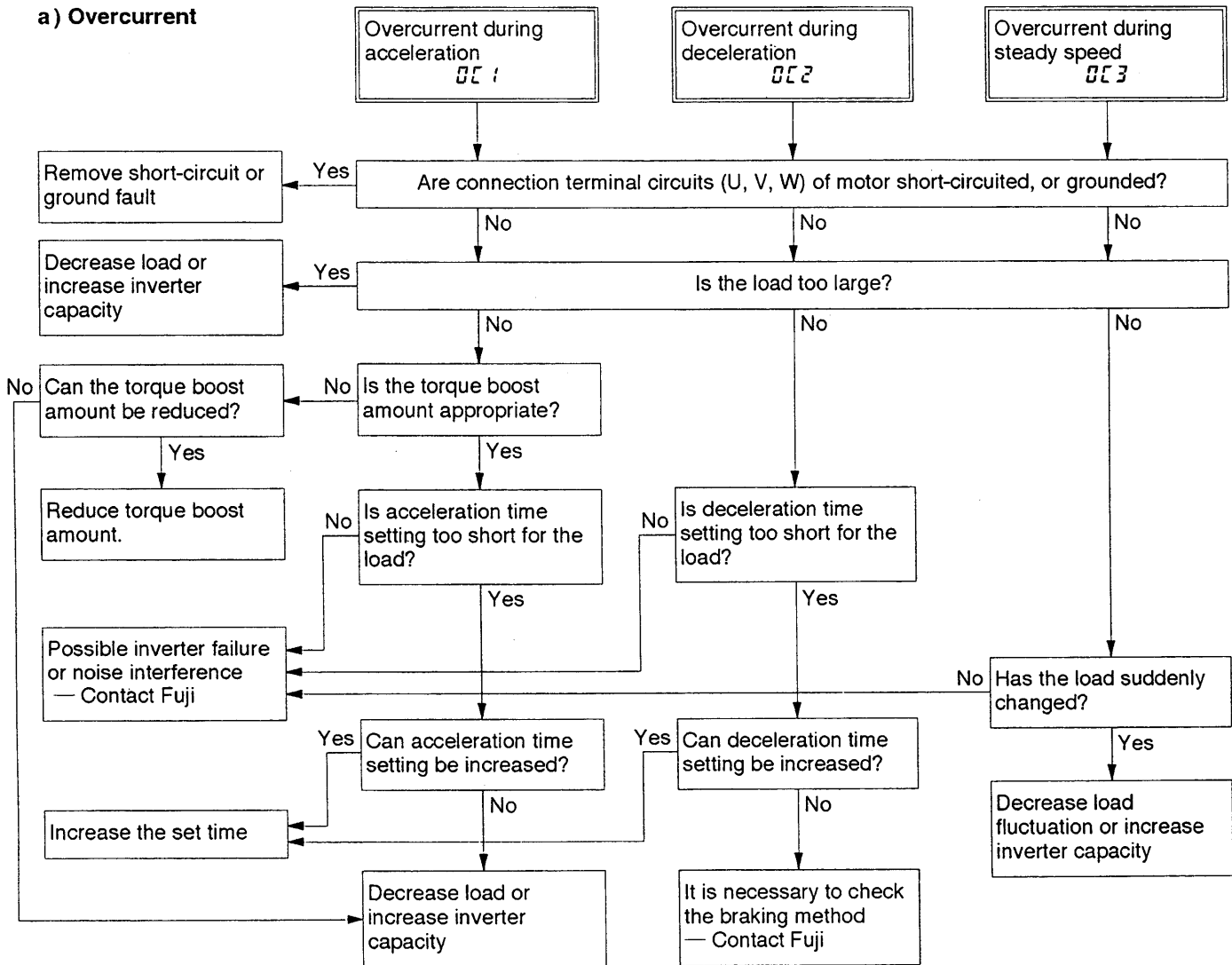
This function controls the inverter and prevents its breakage avoiding protective tripping and, in some cases, not indicating that it has been active.

Table 12-1-2 Protection not transferring to alarm mode

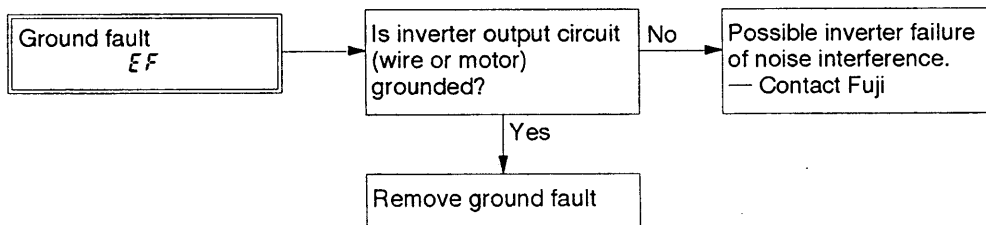
Function name	Protective operation
Stall prevention	Acceleration or deceleration temporarily stops, if the inverter current or voltage exceeds the limit level. Output frequency is reduced if the inverter current or voltage exceeds the limit level on the steady speed. The function avoids tripping of the inverter waiting till the current or voltage decreases. However, inverter overcurrent function (OLU) will trip if the above function is active for a longer time and the overload exceeds the inverter overload characteristics shown in Fig. 12-1-2. If the function is active, the acceleration/deceleration time will be longer than the preset one.
Surge suppression	The inverter is protected against the incoming surges with the surge suppressers, which are connected to the main circuit input terminals (R,S,T) and auxiliary control power input terminals (R0,T0). Between line and ground: 7 kV (1.2×50 μs) Between lines : 5 kV (10×200 μs)

12-2 Diagnosis and remedy in case protective function activation

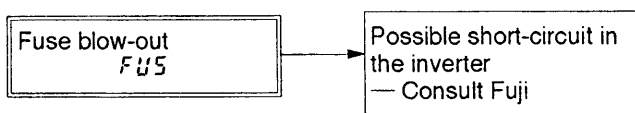
a) Overcurrent



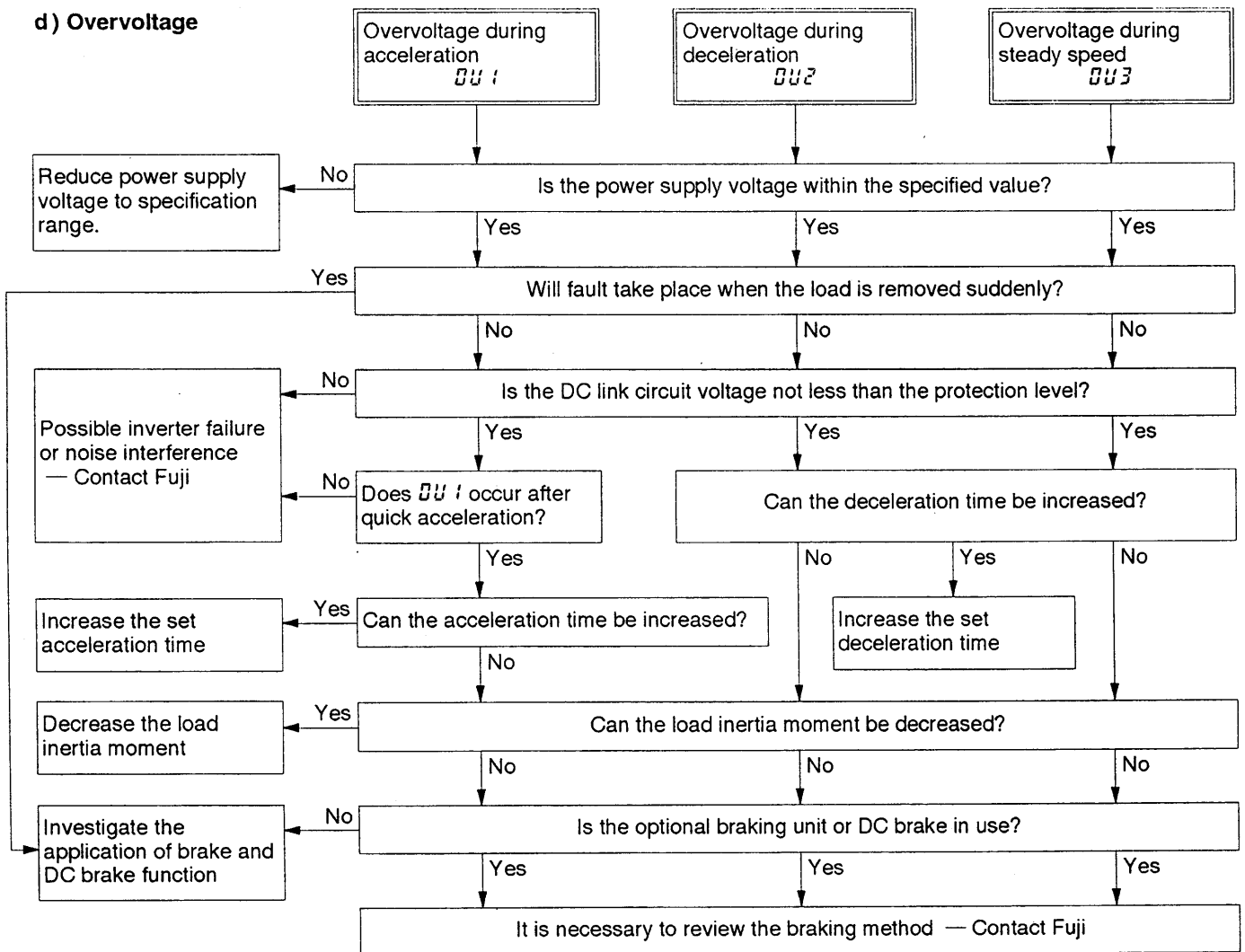
b) Ground fault



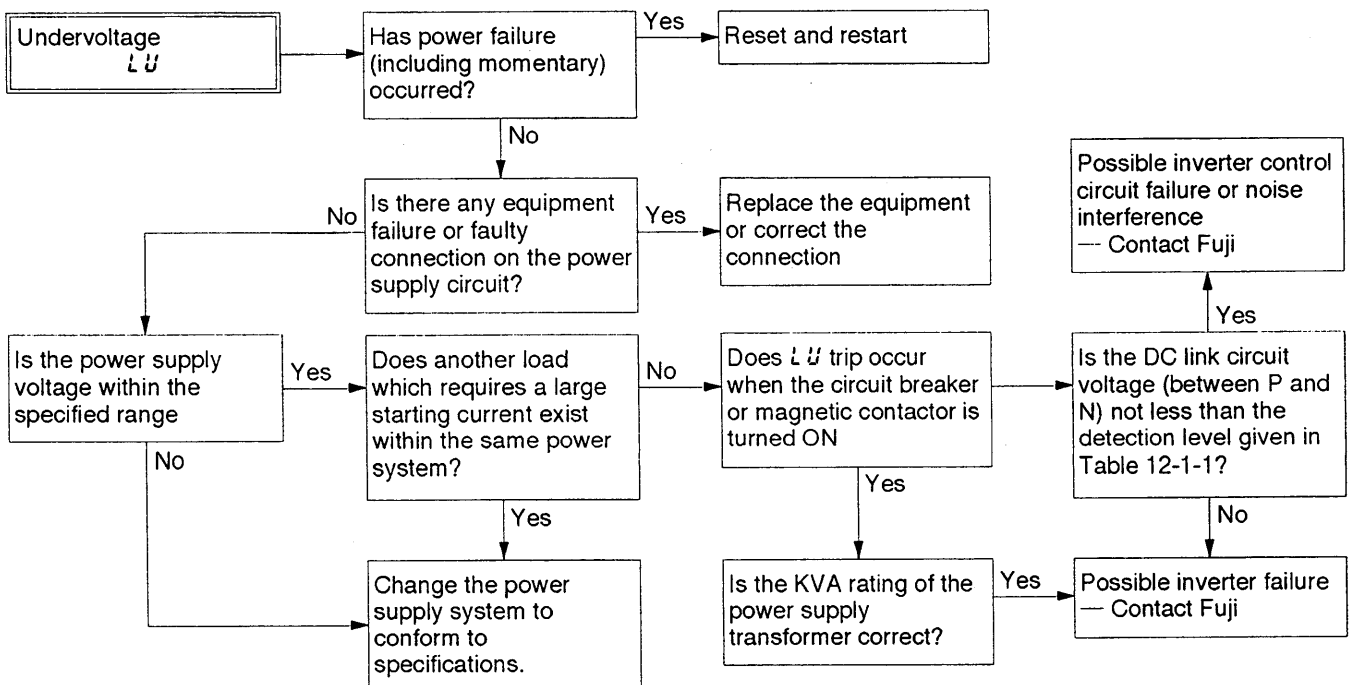
c) Fuse blow-out



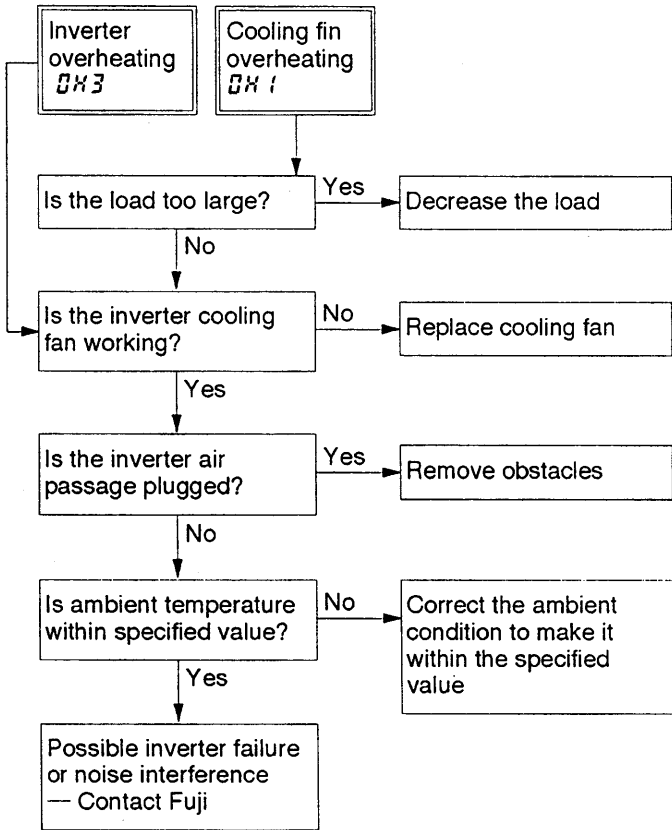
d) Overvoltage



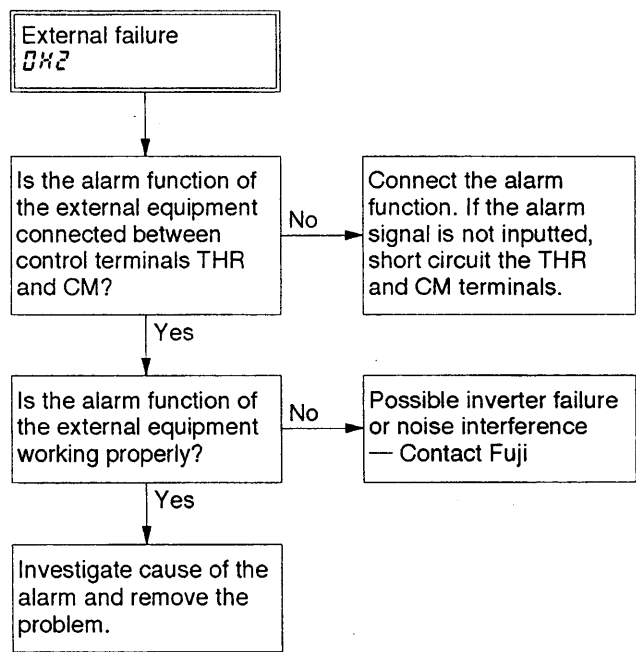
e) Undervoltage



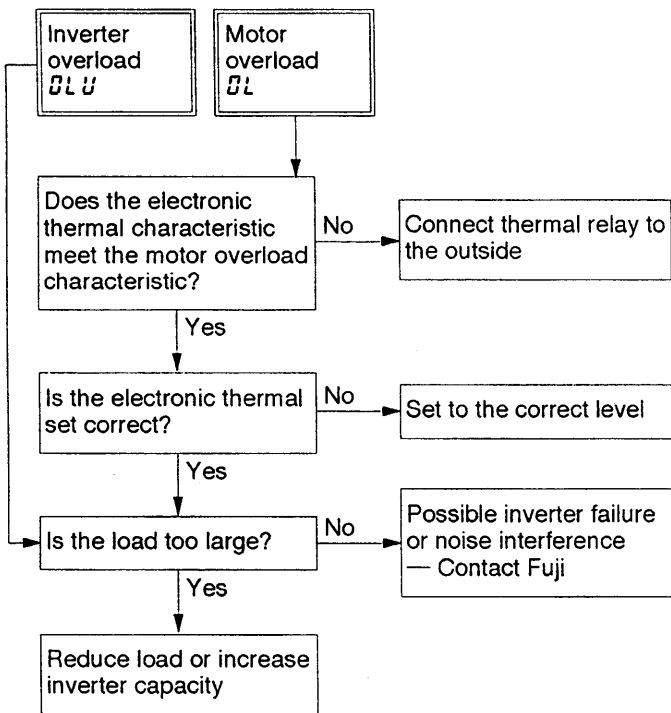
f) Inverter over heating, Cooling fin overheating



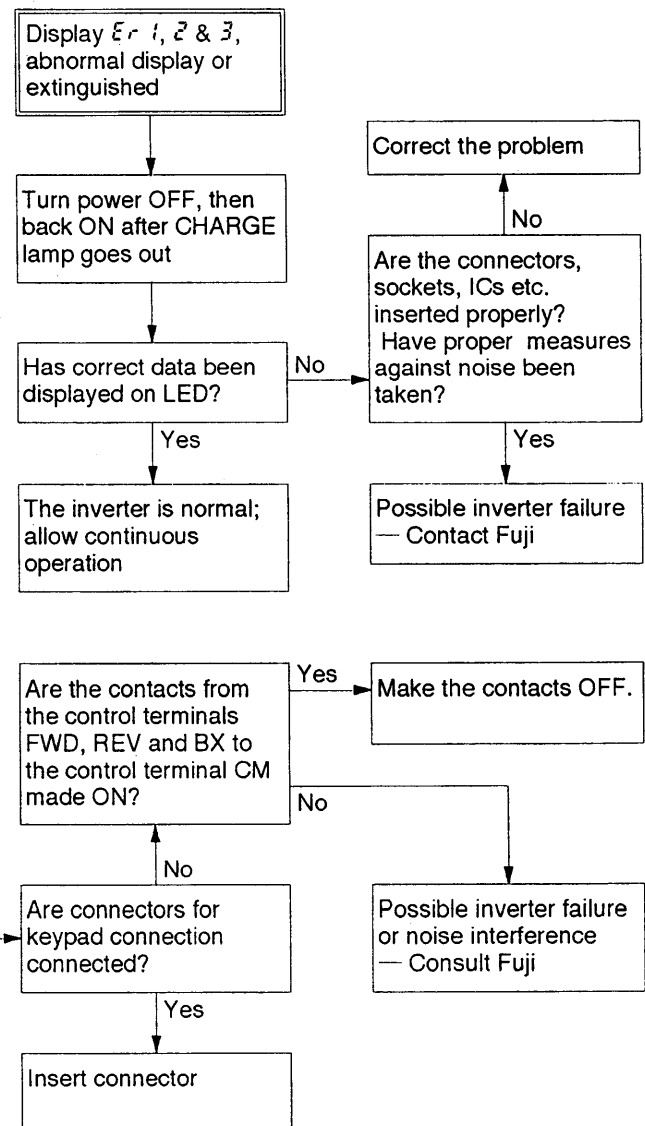
g) External failure



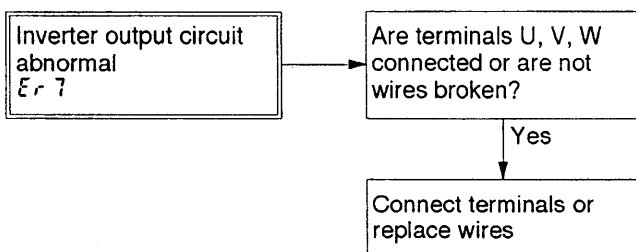
h) Inverter overload, Motor overload



i) Memory error, Keypad panel communication error, CPU error

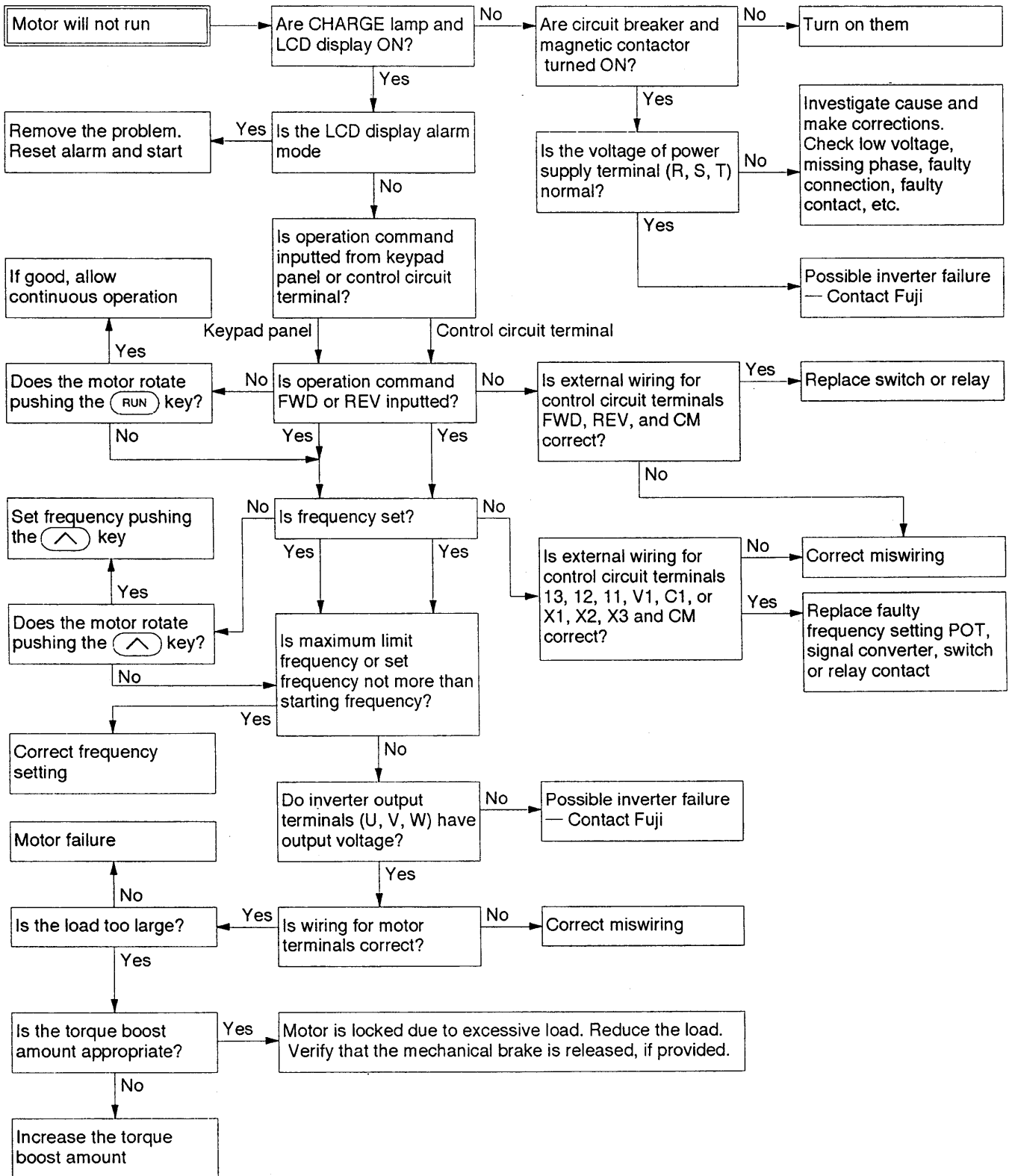


j) Inverter output circuit abnormal



12-3 Diagnosis and remedy in case motor abnormal

a) Motor will not run

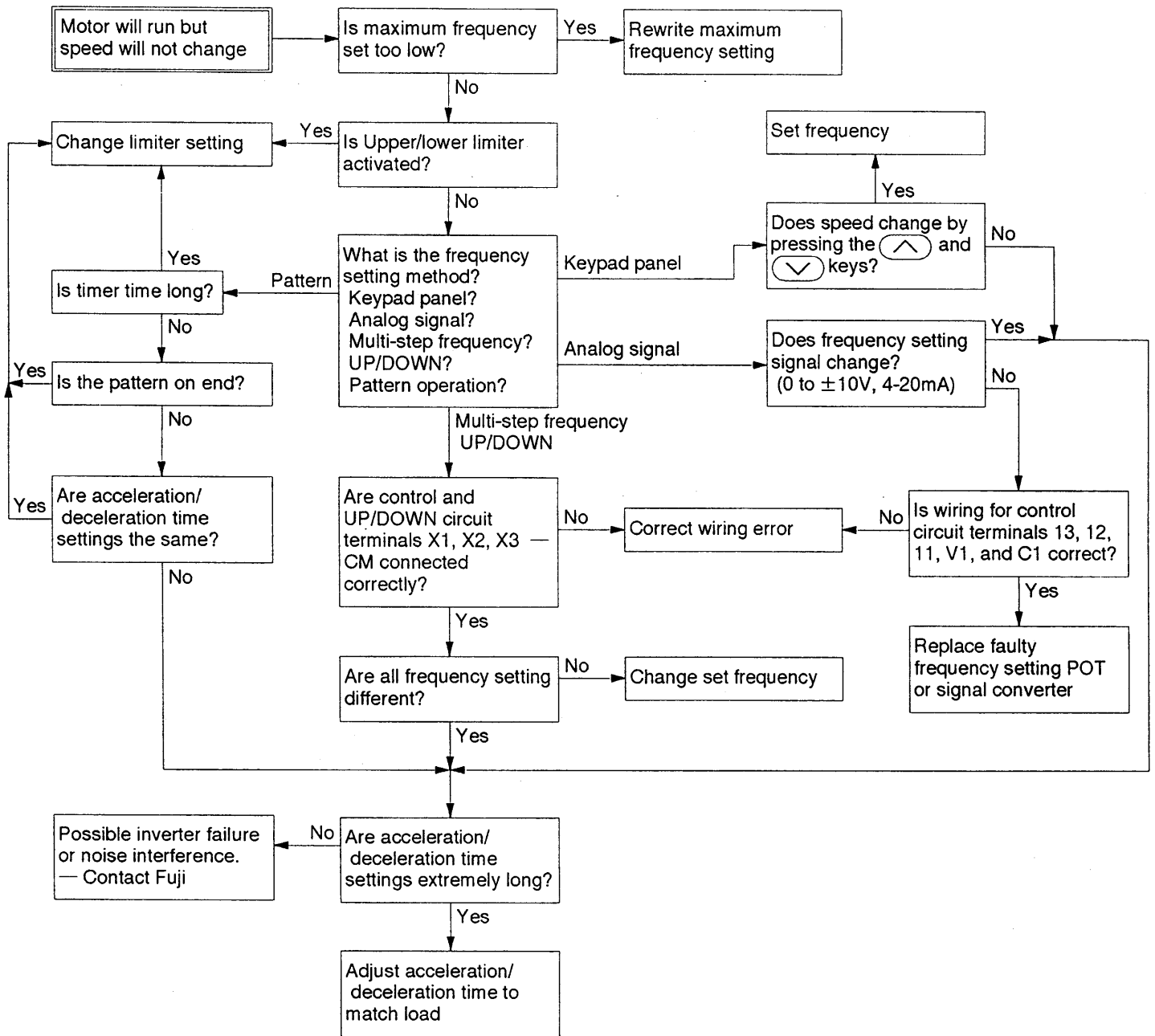


Motor will not run under these conditions:

- When RUN command is inputted during inputting coast-to-stop command or DC braking command to the control terminals.
- When REV command is inputted during setting the data of "76 REV LOCK" at 1.

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

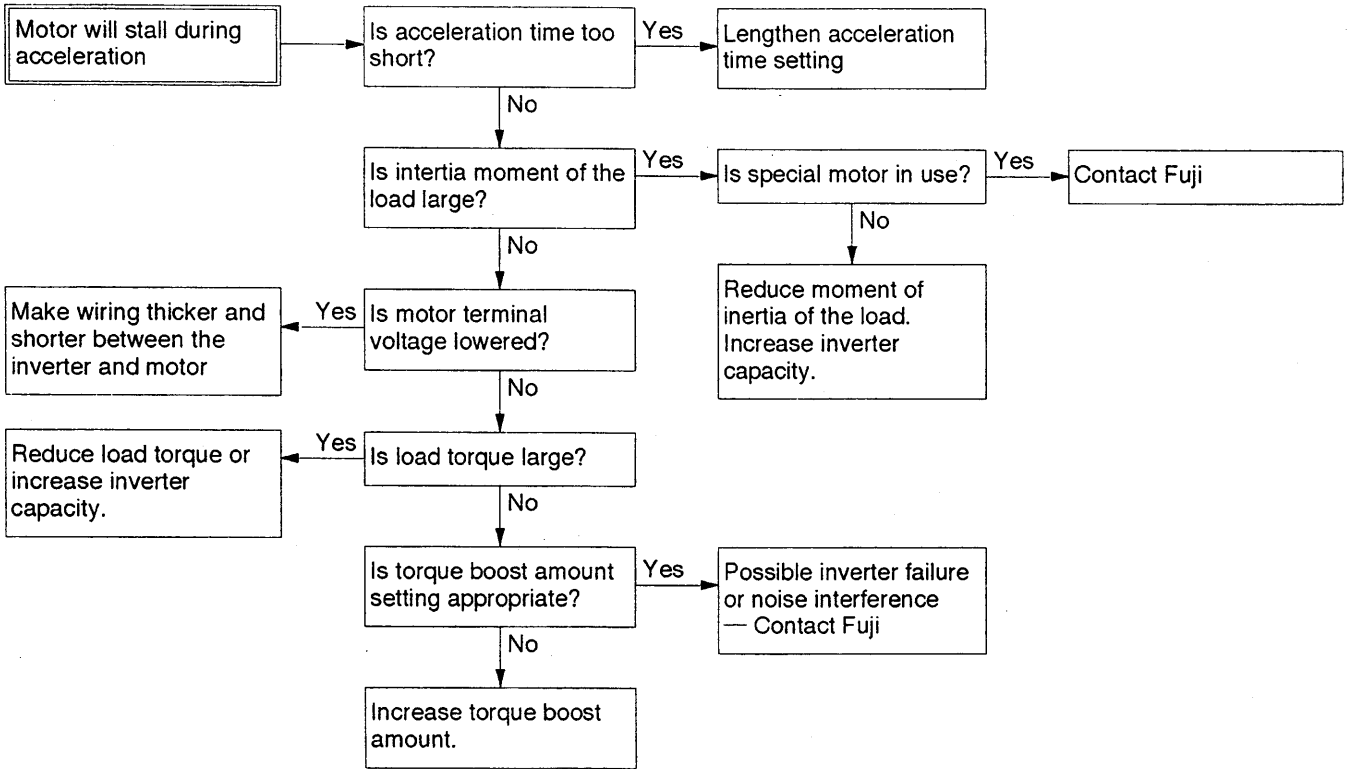
b) Motor will run but speed will not change



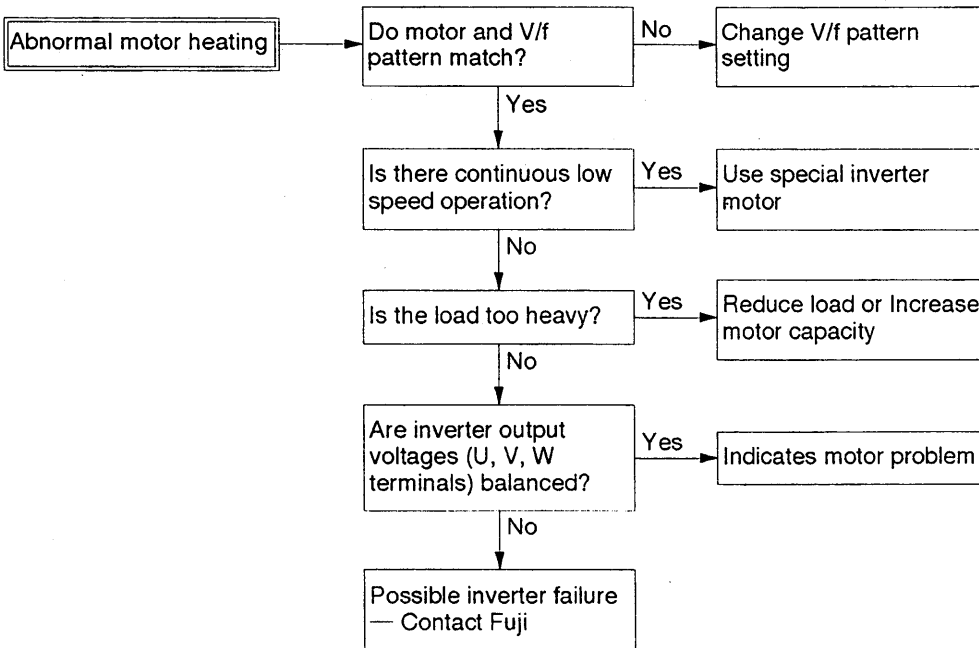
The motor rotation speed changes little in the following cases;

- The data of " 13 FREQ BIAS" , " 14 FREQ GAIN" and the other functions are incorrectly written in.
- The signals are inputted from the control circuit terminals 12, C1 and V1, but the sum does not change.
- The load is too large and the torque limiter or the current limiter has been actuated.

c) Motor will stall during acceleration

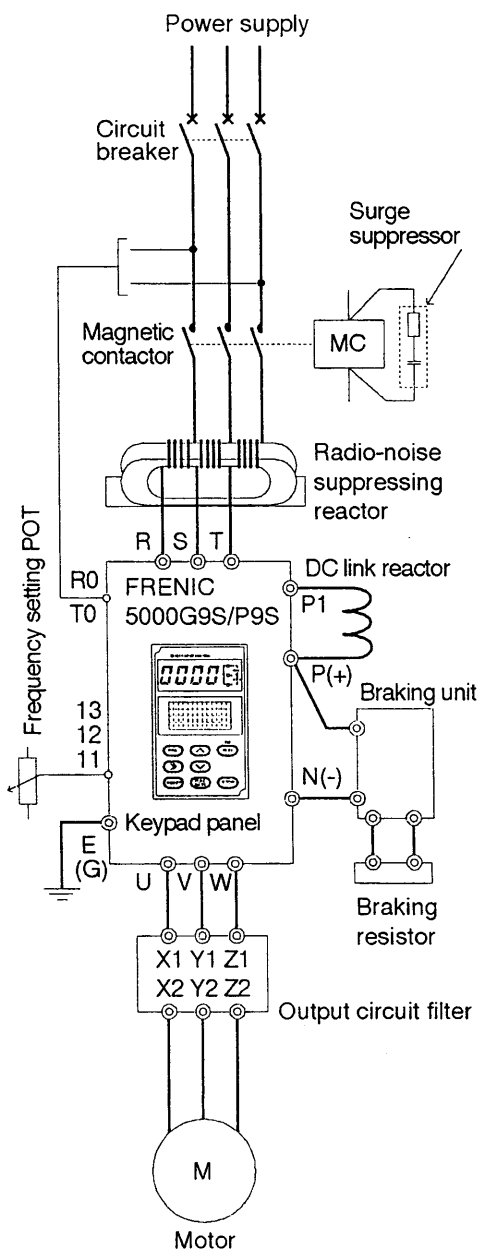


d) Motor heating abnormal



13 Option

Fig. 13-1-1 Option



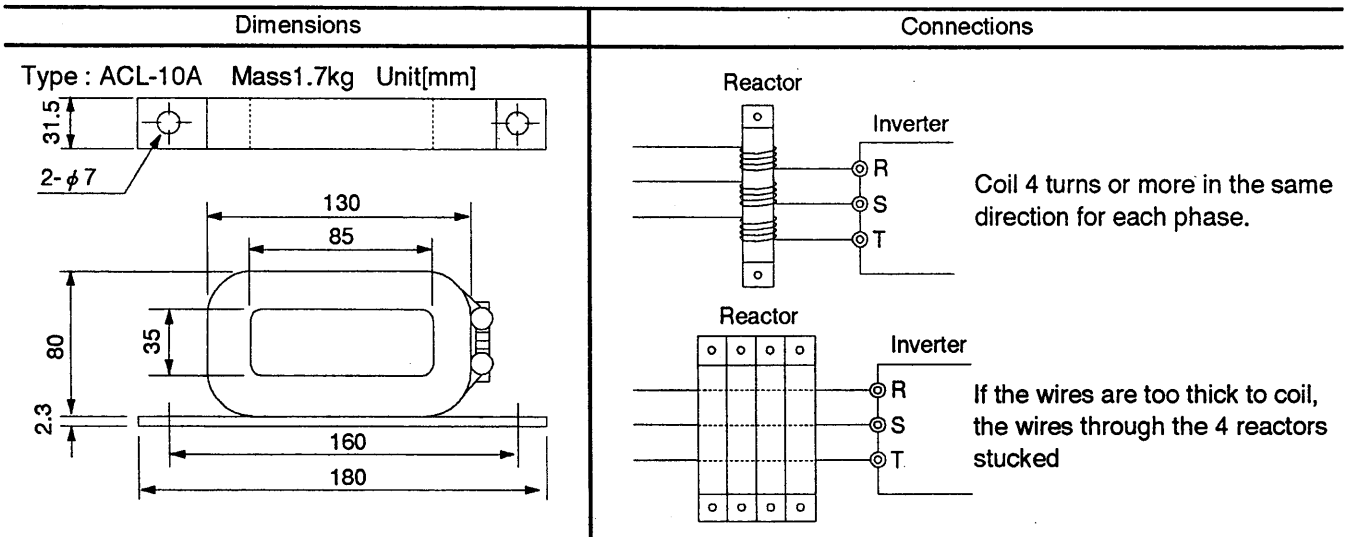
Output circuit filter

As for the connection method, refer to the instruction manual of the output circuit filter (Manual number INR-HF50802).

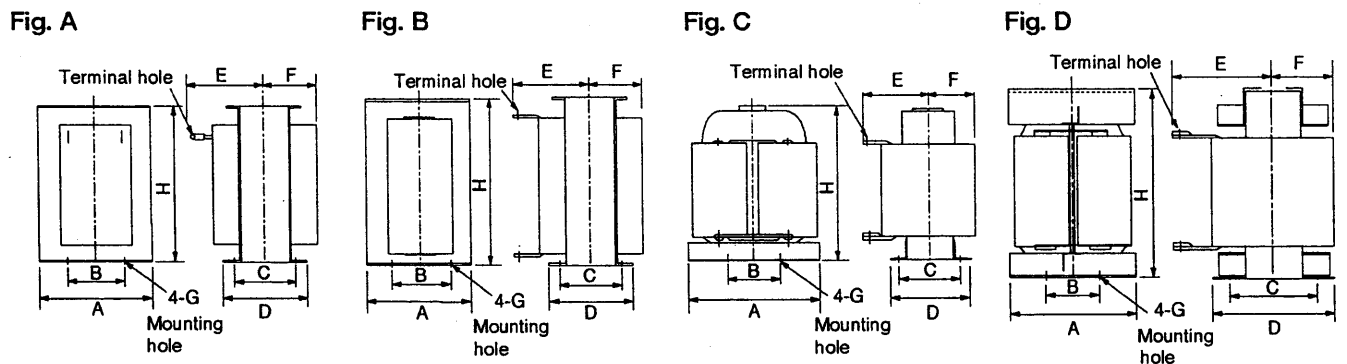
Circuit breaker	Circuit breaker (MCCB) is connected to the power supply side of the inverter in order to prevent damage to equipment or wiring and switch the power supply. Its rated current and rated breaking capacity will vary depending on the power supply specifications.
Magnetic contactor	Magnetic contactor is not necessarily needed to operate the inverter. For safety, however, it protects the inverter by shutting the power supply off in response to the inverter protection trip.
Surge suppressor	Connect surge suppressor to suppress surges due to switching exciting coils of the magnetic contactor, relay, etc.
Radio-noise suppressing reactor	Connect when noise interference to nearby radios and electronic equipment is required to suppress.
DC link reactor	Provide DC link reactor when the standard applicable motor with the capacity less than 55kW is applied in the following cases. <ul style="list-style-type: none"> Capacity ratio of the power supply transformer to the inverter is as shown in Fig. (a). A thyristor load or a power capacitor with ON/OFF control is parallel connected to the same power source. 3-phase power supply voltage is unbalanced 3% or more. <p>Unbalance factor [%]</p> $= \frac{\text{Maximum voltage[V]} - \text{Minimum Voltage[V]}}{\text{3-phase mean voltage[V]}} \times 100$ <ul style="list-style-type: none"> Improvement of input power factor is required. The power factor will increase to 0.94. <p>Fig. (a) Fig. (b)</p>
Braking unit and braking resistor	Connect braking unit and braking resistor when large braking torque is needed.
Frequency setting POT	Connect for frequency setting per control circuit terminal. Power is supplied from the inverter.
Keypad panel and extension cable	Extension cable is used when the keypad panel is used apart from the inverter.

13-1 Reactor

a) Radio-noise suppressing reactor



b) DC link reactors



Voltage	Inverter type	Reactor type	Figure	Dimensions [mm]								Terminal hole diameter	Mass [kg]
				A	B	C	D	E	F	G	H		
200V series	FRN30G9S/P9S-2	DCR2-30	A	146	75	100	126	130	70	9×15	210	10.5	16
	FRN37G9S/P9S-2	DCR2-37	B	156	80	100	126	110	70	9×15	260	10	19
	FRN45G9S/P9S-2	DCR2-45	B	156	80	110	136	130	75	9×15	260	10	23
	FRN55G9S/P9S-2	DCR2-55	B	170	85	110	136	130	75	9×15	300	10	28
	FRN75G9S/P9S-2	DCR2-75	C	200	80	95	126	180	75	10×16	240	12	19
	FRN90G9S/P9S-2	DCR2-90	D	180	100	100	131	150	75	10×15	275	15	22
	FRN110P9S-2	DCR2-110	D	200	100	120	141	150	80	10×15	290	15	25
400V series	FRN30G9S/P9S-4	DCR4-30	A	150	75	85	111	155	70	9×15	210	8.4	14
	FRN37G9S/P9S-4	DCR4-37	A	146	75	100	126	155	70	9×15	210	8.4	17
	FRN45G9S/P9S-4	DCR4-45	A	146	75	115	141	180	75	9×15	210	10.5	21
	FRN55G9S/P9S-4	DCR4-55	A	146	75	130	156	190	85	9×15	210	10.5	25
	FRN75G9S/P9S-4	DCR4-75	D	200	70	120	151	160	80	10×16	250	10.5	25
	FRN90G9S/P9S-4	DCR4-90	D	220	70	140	171	165	85	10×16	280	13	32
	FRN110G9S/P9S-4	DCR4-110	D	220	70	150	181	170	95	10×16	290	13	36
	FRN132G9S/P9S-4	DCR4-132	D	190	80	146	177	180	90	11	360	13	40
	FRN160G9S/P9S-4	DCR4-160	D	220	90	140	171	200	90	12×20	350	12	45
	FRN200G9S/P9S-4	DCR4-200	D	230	100	140	181	180	110	12×20	310	15	50
	FRN220G9S/P9S-4	DCR4-220	D	230	100	150	201	180	110	12×20	320	15	50
FRN280P9S-4	DCR4-280	D	230	100	160	211	180	110	12×20	340	15	58	

13-2 Braking unit and braking resistor

Tabl2 13-2-1 Standard specifications of braking units and braking resistors

G9S series

voltage	Standard applicable motor [kW]	Inverter Type	Braking unit		Braking resistor		Max. braking torque [%]	Braking time	Duty factor [%ED]
			Type	Qty.	Type	Qty.			
200V series	30	FRN30G9S-2	BU30-2B	1	DB30-2B	1	100	10	10
	37	FRN37G9S-2	BU55-2B		DB37-2B				
	45	FRN45G9S-2			DB45-2B				
	55	FRN55G9S-2			DB55-2B				
	75	FRN75G9S-2	BU75-2B		DB37-2B				
	90	FRN90G9S-2	BU55-2B	DB45-2B					
400V series	30	FRN30G9S-4	BU37-4B	1	DB30-4B	1	100	10	10
	37	FRN37G9S-4			DB37-4B				
	45	FRN45G9S-4	BU55-4B		DB45-4B				
	55	FRN55G9S-4			DB55-4B				
	75	FRN75G9S-4	BU110-4B	2	DB37-4B	2			
	90	FRN90G9S-4			DB45-4B				
	110	FRN110G9S-4			DB55-4B				
	132	FRN132G9S-4	BU132-4B	2					
	160	FRN160G9S-4	BU110-4B						
	200	FRN200G9S-4							
220	FRN220G9S-4								

P9S series

voltage	Standard applicable motor [kW]	Inverter Type	Braking unit		Braking resistor		Max. braking torque [%]	Braking time	Duty factor [%ED]
			Type	Qty.	Type	Qty.			
200V series	30	FRN30P9S-2	BU3-220-2	1	DB22-2	1	100	6	3.5
	37	FRN37P9S-2	BU30-2B		DB30-2B		75	8	8
	45	FRN45P9S-2	BU55-2B		DB37-2B		2	7	7
	55	FRN55P9S-2			DB45-2B				
	75	FRN75P9S-2			DB55-2B				
	90	FRN90P9S-2	BU75-2B		DB37-2B		2	8	8
	110	FRN110P9S-2	BU55-2B		2		DB45-2B		
400V series	30	FRN30P9S-4	BU3-220-4	1	DB22-4	1	100	6	3
	37	FRN37P9S-4	BU37-4B		DB30-4B		75	8	8
	45	FRN45P9S-4			DB37-4B		2	7	7
	55	FRN55P9S-4	BU55-4B		DB45-4B				
	75	FRN75P9S-4		DB55-4B					
	90	FRN90P9S-4	BU110-4B	2	DB37-4B	2	8	8	
	110	FRN110P9S-4			DB45-4B				
	132	FRN132P9S-4			DB55-4B				
	160	FRN160P9S-4	BU132-4B						
	200	FRN200P9S-4	BU110-4B	2					
220	FRN220P9S-4								
280	FRN280P9S-4								

a) Braking unit

Fig. A

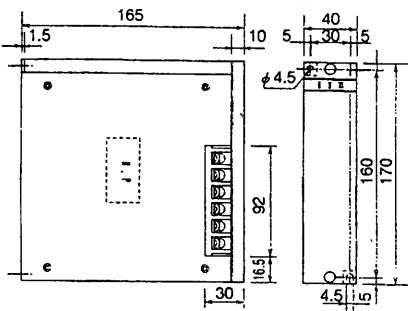


Fig. B

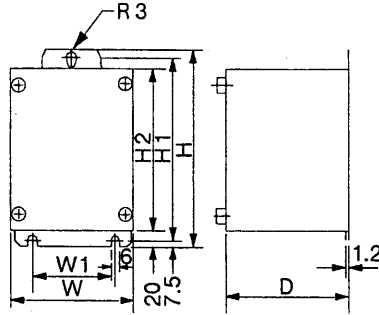


Fig. C

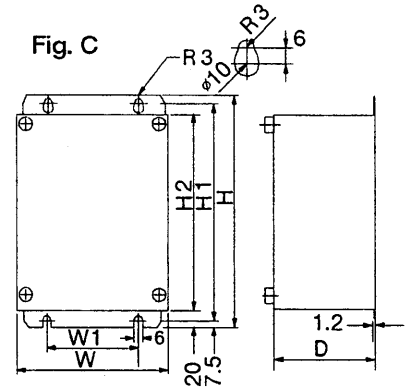


Fig. D

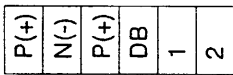


Fig. E

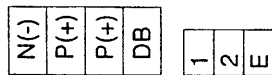


Fig. F

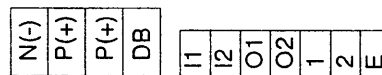
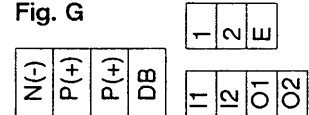


Fig. G



Voltage	Type	Figure	Dimensions [mm]						Terminal arrangement and screw size		Mass [kg]	
			W	W1	H	H1	H2	D	Figure	P(+), N(-), DB, E(G)		
200V series	BU3-220-2	A	Ref. to Fig. A						D	M4	M4	1.2
	BU30-2B	B	150	100	240	225	200	150	E	M5		5
	BU55-2B	C	230	130	240	225	200	170	F	M6		7
	BU75-2B		250	150	370	355	330	170	E	M8		11
400V series	BU3-220-4	A	Ref. to Fig. A						D	M4	M4	1.1
	BU37-4B	C	180	100	280	265	240	160	E	M5		6
	BU55-4B		230	130	280	265	240	160				6
	BU110-4B		250	150	400	385	360	170	F	M6		12
	BU132-4B	G							G	M8		

b) Braking resistor

Fig. A

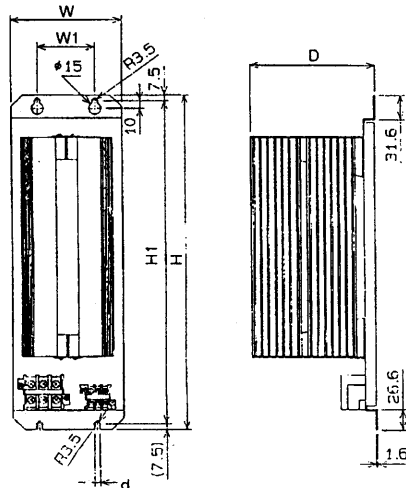


Fig. B

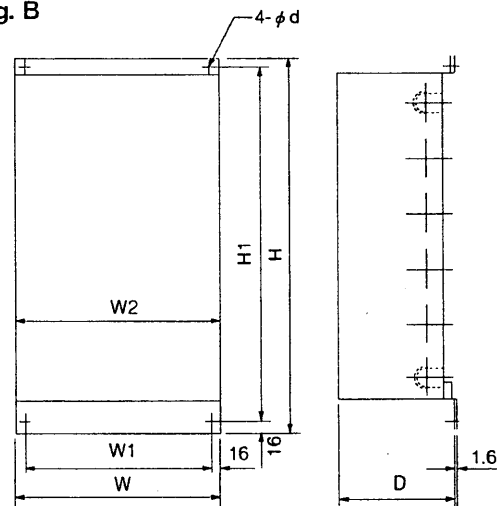


Fig. C



Fig. D

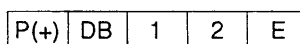
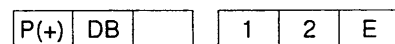


Fig. E



Voltage	type	Dimensions [mm]							Terminal arrangement and screw size			Mass [kg]
		Figure	W	W1	W2	H	H1	D	Figure	P, DB	1, 2, E	
200V series	DB22-2	A	142	74	—	510	495	160	C	M5	M3.5	8.7
	DB30-2B	B	400	380	400	660	628	140	E	M6	M4	11
	DB37-2B							240				15
	DB45-2B	B	400	380	400	660	628	140	E	M6	M4	20
	DB55-2B											405
400V series	DB22-4	A	142	74	—	510	495	160	C	M5	M3.5	8.7
	DB30-4B	B	420	388	420	660	628	140	D	M4	M4	11
	DB37-4B							240				15
	DB45-4B	B	420	388	420	660	628	140	E	M5	M4	20
	DB55-4B											425

13-3 Auxiliary parts

Fig. 13-3-1 Keypad panel

Type : TP-G9S

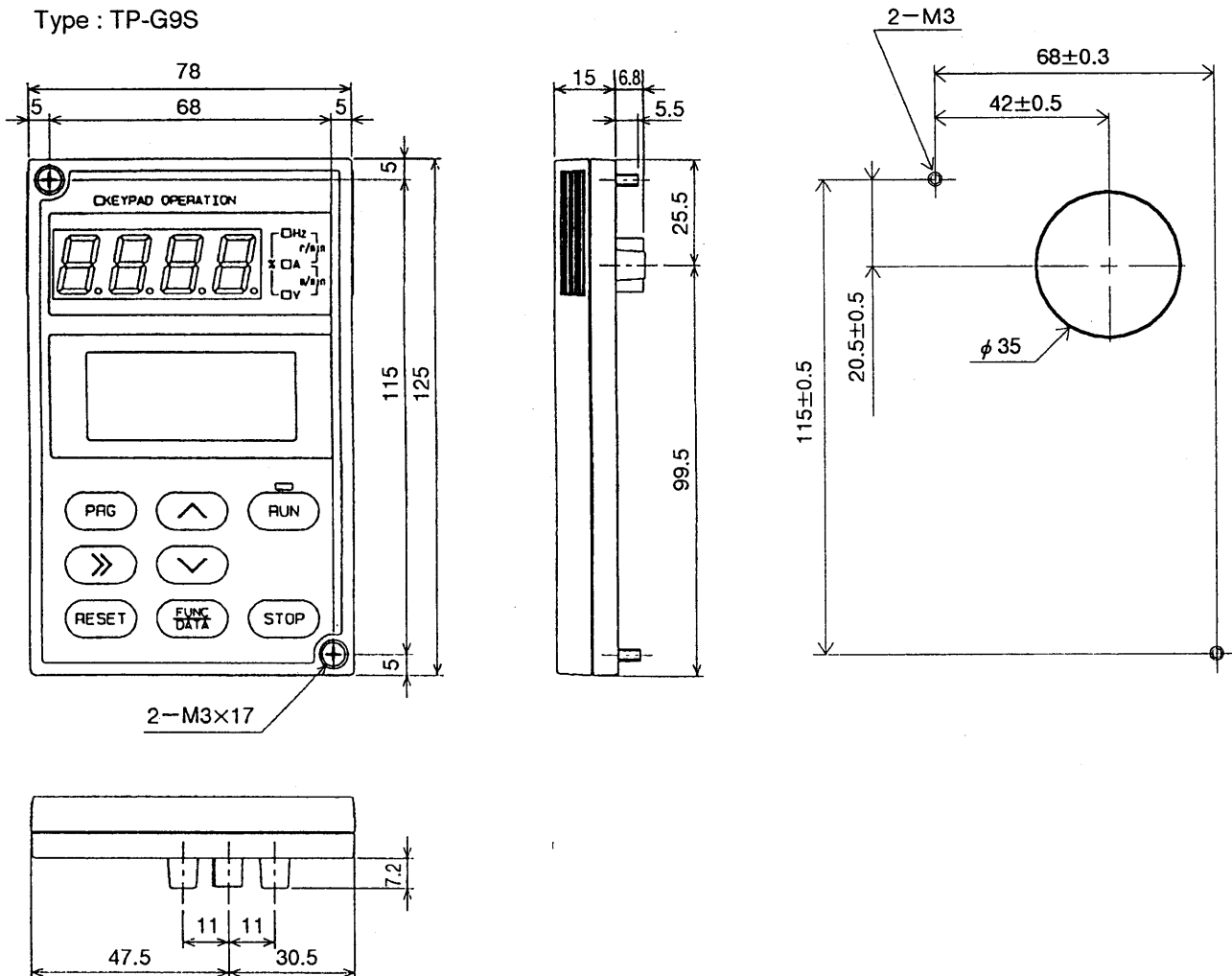
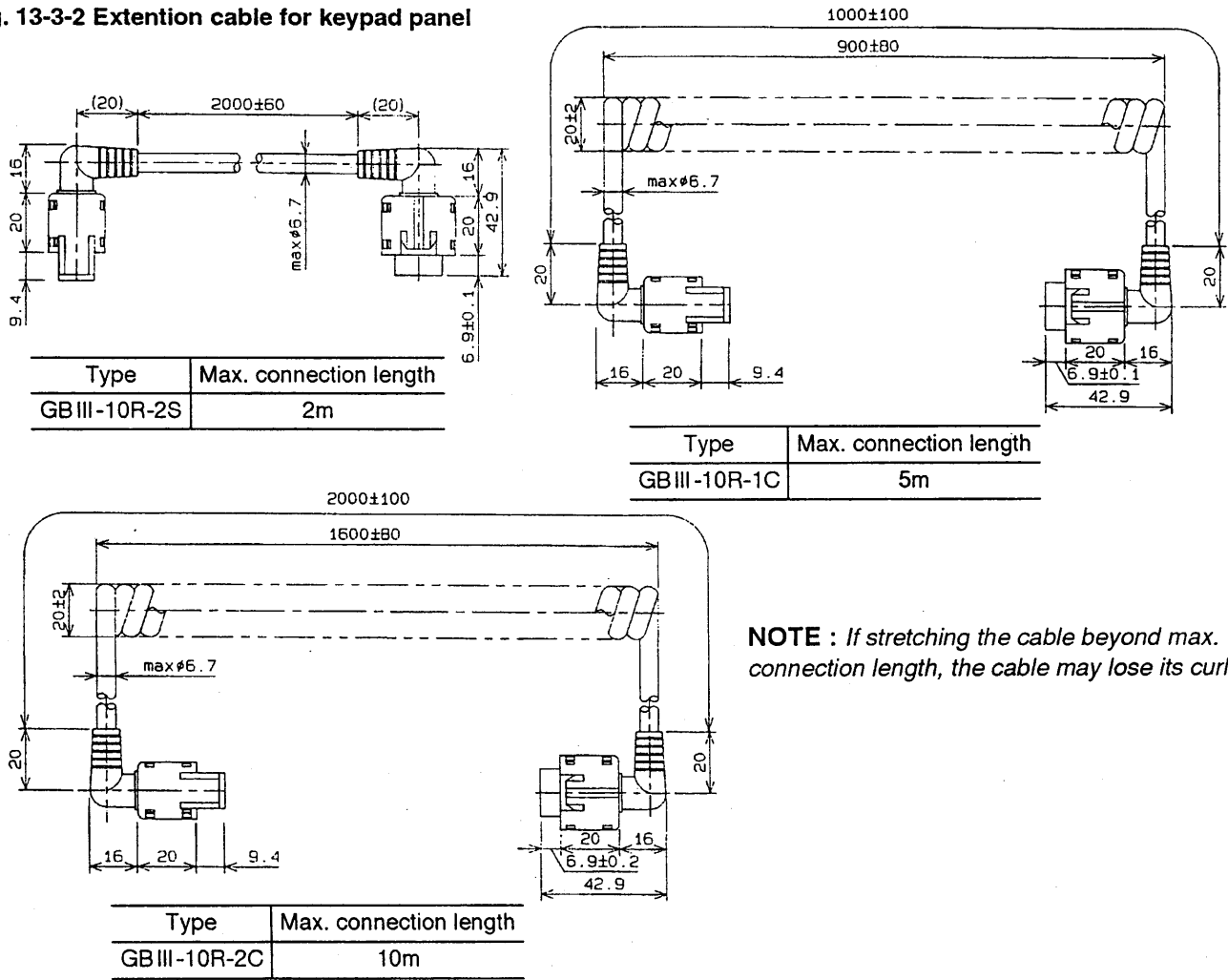


Fig. 13-3-2 Extention cable for keypad panel



NOTE : If stretching the cable beyond max. connection length, the cable may lose its curl.

Fig. 13-3-3 Frequency Setting POT

Type: WAR3W-1kΩ (3W) B-characteristics Scale plate Type: 60P
(made by Japan Resistor Mfg.)

Knob Type: 40N

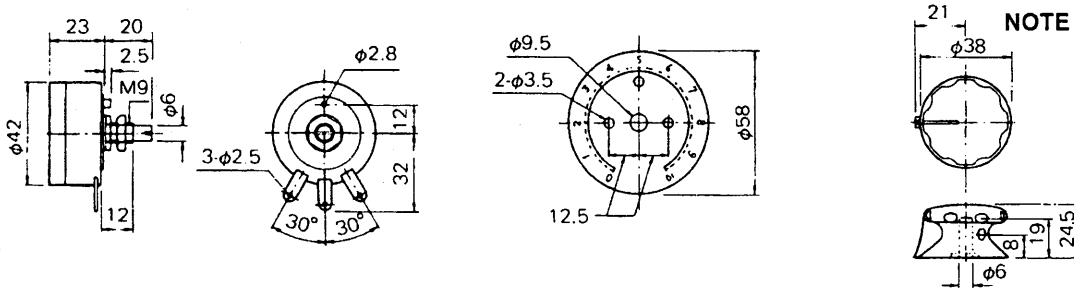
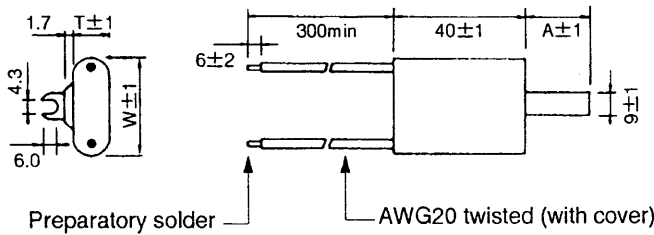


Fig. 13-3-4 Surge suppressor



Circuit voltage less than 250V
(made by Okaya Electric)

Type	Use with	Capacitance (μF)	Resistance (Ω)	Dimensions, [mm]			
				W	H	T	A
S1-B-0	Control relay or timer	0.1	200 (1/2W)	17.5	40	9.1	20.0
S2-A-0	Magnetic contactor	0.2	500 (1/2W)	27.5	40	10.4	30.0

13-4 Instructions for selecting main circuit equipment and wire sizing

Table 13-4-1 Main circuit current (For selecting main circuit equipment and wire sizing)

Unit[A]

voltage	Standard applicable motor [kW]	Inverter type	Main circuit power supply 50Hz Voltage 200V series : 200V 400V series : 400V			Main circuit power supply 60Hz Voltage 200V series : 220V 400V series : 440V			Braking circuit current	Rated output current
			Input current (Total r.m.s value)		DC link reactor circuit current	Input current (Total r.m.s value)		DC link reactor circuit current		
			With DCR	Without DCR		With DCR	Without DCR			
200V series	30	FRN30G9S/P9S-2	110	191	131	100	174	120	82	115
	37	FRN37G9S/P9S-2	134	234	161	122	214	147	102	145
	45	FRN45G9S/P9S-2	162	283	194	148	259	178	124	180
	55	FRN55G9S/P9S-2	197	345	237	180	315	216	151	215
	75	FRN75G9S/P9S-2	268	—	321	244	—	293	206	283
	90	FRN90G9S/P9S-2	320	—	384	292	—	349	247	346
	110	FRN110P9S-2	386	—	462	351	—	421	302	415
400V series	30	FRN30G9S/P9S-4	55	96	66	51	88	61	40	60
	37	FRN37G9S/P9S-4	67	117	81	61	107	74	49	75
	45	FRN45G9S/P9S-4	81	142	97	74	130	89	60	91
	55	FRN55G9S/P9S-4	99	173	119	90	158	108	73	112
	75	FRN75G9S/P9S-4	134	—	161	122	—	147	99	150
	90	FRN90G9S/P9S-4	160	—	192	146	—	175	119	176
	110	FRN110G9S/P9S-4	193	—	231	176	—	211	145	210
	132	FRN132G9S/P9S-4	231	—	276	210	—	252	174	253
	160	FRN160G9S/P9S-4	278	—	333	253	—	303	211	304
	200	FRN200G9S/P9S-4	345	—	414	314	—	376	264	377
	220	FRN220G9S/P9S-4	379	—	455	345	—	414	291	415
	280	FRN280P9S-4	483	—	579	439	—	527	370	520

Remarks :

1) Input current is calculated per the following conditions :

- Inverter efficiency is 95 %.
- Impedance of power supply without DCR is assumed as 0.1% on inverter capacity base. Unbalance in phase current due to voltage unbalance is assumed as 10%.
- For power supply voltage 230V or 380V, current is inversely proportional to voltage approximately.
- "With DCR" means the case in which DC link reactor is connected.
- "Without DCR" means the case in which no DC link reactor is connected.

2) Braking circuit current corresponds to 150% braking torque.

Table 13-4-2 JIS C 3307 600V Polyvinyl chloride insulated wires permissible current

Wire size [mm ²]	Ambient temperature		
	30°C	40°C	50°C
3.5	37	30	21
5.5	49	40	28
8	61	50	35
14	88	72	51
22	115	94	66
38	162	132	93
60	217	177	125
100	298	244	172
150	395	323	229
200	469	384	272
250	556	455	322
325	650	533	377

NOTE :

- Maximum permissible temperature of conductor: 60°C
- Single wiring in air is assumed.

Table 13-4-3 JCS 360 600V Cross-linked polyethylene insulated wires permissible current

Wire size [mm ²]	Ambient temperature		
	30°C	40°C	50°C
3.5	45	41	36
5.5	60	54	48
8	74	68	61
14	113	103	92
22	154	140	125
38	218	199	178
60	296	271	242
100	423	386	345
150	532	486	434
200	644	588	525
250	735	671	600
325	873	797	713

NOTE :

- Maximum permissible temperature of conductor: 90°C
- Single wiring in air is assumed.

Table 13-4-4 Main circuit terminal (R, S, T, U, V, W, P1, P(+), N(-))

Voltage	Standard applicable motor [kW]	Inverter type	Maximum wire size [mm ²]	Terminal screw dia. [mm]	
200V series	30	FRN30G9S/P9S-2	60	M8	
	37	FRN37G9S/P9S-2			
	45	FRN45P9S-2 FRN45G9S-2			
	55	FRN55G9S/P9S-2	100	M10	
	75	FRN75G9S/P9S-2	100 *		
	90	FRN90G9S/P9S-2	325	M12	
	110	FRN110P9S-2			
400V series	30	FRN30G9S/P9S-4	60	M8	
	37	FRN37G9S/P9S-4			
	45	FRN45G9S/P9S-4			
	55	FRN55G9S/P9S-4			
	75	FRN75P9S-4	100	M10	
		FRN75G9S-4			
	90	FRN90G9S/P9S-4	100	M10	
	110	FRN110G9S/P9S-4			
	132	FRN132G9S/P9S-4			
	160	FRN160P9S-4	100 *	200	M12
		FRN160G9S-4			
	200	FRN200P9S-4	325	325	
		FRN200G9S-4			
220	FRN220G9S/P9S-4				
280	FRN280P9S-4				

NOTE :

- Maximum wire is based on JIS C 2805 "Crimp-type terminal lugs for copper conductors".
- * For terminals P1, P(+), P(-), CB150-10 specified by JEM1399 "Crimp type terminal for low voltage switching device" allows use of 150mm² wire.

NOTES

NOTES



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