FUJI ELECTRIC

INR-HF50700c-E

Instruction Manual

FUJI VECTOR CONTROLLED INVERTERS

FRENIC 5000VG5S

Standard series

200V series

PG sensor type

0.75kW / FRN0.75VG5S-2A
to 90kW / FRN90VG5S-2A

PG sensorless type

0.75kW / FRN0.75VG5S-2N
to 90kW / FRN90VG5S-2N

400V series

PG sensor type

3.7kW / FRN3.7VG5S-4A
to 220kW / FRN220VG5S-4A

PG sensorless type

3.7kW / FRN3.7VG5S-4N
to 220kW / FRN220VG5S-4N

FRENIC 5000VG5N

Low noise series

200V series

PG sensor type

0.75kW / FRN0.75VG5N-2A
to 45kW / FRN45VG5N-2A

PG sensorless type

0.75kW / FRN0.75VG5N-2N
to 45kW / FRN45VG5N-2N

400V series

PG sensor type

3.7kW / FRN3.7VG5N-4A
to 45kW / FRN45VG5N-4A

PG sensorless type

3.7kW / FRN3.7VG5N-4N
to 45kW / FRN45VG5N-4N

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

Foreword

The FRENIC5000VG5S and FRENIC5000VG5N inverters are used to operate three phase squirrel cage motor in variable speed by vectol control. 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 RS485 communication function and 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.

Contents

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.

Missetting of the function data may cause dangerous conditions. Therefore, verify the data again before operation.

Since stop command is inputted according to the data of function "02 Operation command", it may not be inputted from the keypad panel at emergency. Under this condition, turn OFF (open) the power supply circuit breaker.

The motor and machine or equipment repeat to run and stop when starting auto-tuning. Therefore, conduct the auto-tuning after confirming safety.

If mistaking speed setting, the motor may run at speed exceeding withstand-overspeed of the motor, and the equipment may be damaged and cause difficulties by damage. Match the data of function "03 Maximum speed" with the specification of whole equipment to keep a safe speed.

When summing up result of function "83 Speed bias setting" and speed auxiliary setting 2 (Ai1, Ai2 Function select) is higher than function "65 Zero speed detection", the equipment continues running of the speed of the above-mentioned summing up result even if the operation commands (FWD and REV) are made OFF. Take care so as not to cause accident.

When having selected restart-active after momentary voltage failure, the inverter automatically starts at power recovery, and the motor automatically starts running. Take care not to cause accident.

⚠ 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 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. Otherwise, heat build-up will occur.

Incorrect connections may cause damage to 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 and the Braking resistor (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 or less 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.

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, RYA and RYC maximum rating 250 volts).

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

Do not connect the braking resistor between the main circuit terminals P(+) and N(-).If being so connected, the inverter may overheat, and the braking resistor may overheat and burn out, then, a disaster such as fire may occur.

When summing up result of function "83 Speed bias setting" and speed auxiliary setting 2 (Ai1, Ai2 Function select) is higher than function "65 Zero speed detection", the equipment continues running of the speed of the above-mentioned summing up result even if the operation commands (FWD and REV) are made OFF. Take care so as not to cause accident.

⚠ CAUTION

The automatic speed regulator (ASR) does not function during pre-excitation. Therefore, the motor may run by external load disturbance, etc. When using the pre-excitation, use a mechanical brake together with electrical brake.

If the adequate data of functions related to ASR are not written, for example making suddenly the gain high, the motor causes hunting, and then the motor and equipment may be damaged and cause difficulties by the damage.

Do not suddenly make the data of functions "15 ASR1 (I constant)" and "38 ASR2 (I constant)" large. Further, do not suddenly make the data of functions "14 ASR1 (P constant)" and "37 ASR2 (P constant)" small.

If the data of functions related to torque control are made large by mistake, the motor output an excessive force over necessity, and then, the motor and equipment may be damaged and cause difficulties by the damage. Set the data of function "179 Overload capacity" at the specification of whole equipment to keep safe torque output.

If the cause of alarm has not been removed, the inverter cannot operate even if trying to restart. When repeating the restart in this state, the damage of the equipment will is expanded. The data of function "81 Auto-restart (Restart times) should be as small as possible.

For RUN and STOP, use the FWD-CM (forward) and REV-CM (reverse) terminals, or the FWD/RUN,REV/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.

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.

This assembly contains parts and sub-assemblies that are sensitive to electrostatic discharges. 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.

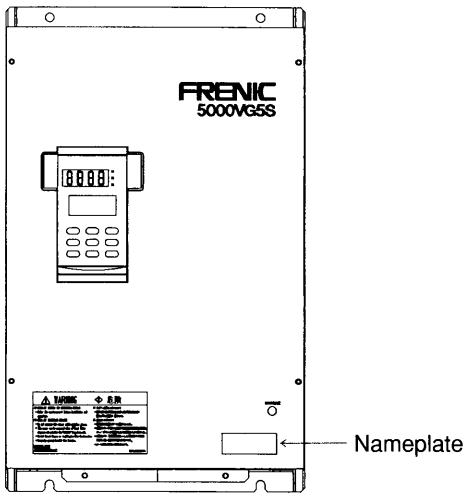
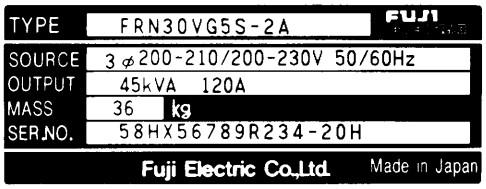


Fig. 2-2 Nameplate position



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

Fig. 2-1 Nameplate

Inverter type designation

FRN 30 VG5S - 2 A

- A: Applied motor : A→with PG Sensor (with Encorder) : N→PG-sensorless (without Encorder)
- 2: Power supply voltage series: 2→200 V, 4→400 V
- VG5S: Series name: VG5S→Standard series, VG5N→Low Noise series
- 30: Standard applicable motor output : 0.75→0.75kW to 220→220kW (In detail, refer to "3-4 PG sensor type standard specification, 3-5 PG-sensorless type standard specification" pp. 9 to 12)
- FRN: Product type: FRENIC5000

Manufacturer's serial number

5 8 HX56789R234 - 20H

- 20H: Product number
- HX56789R234: Manufacture classification number
- 8: Manufactured month: 1 to 9, X→10, Y→11, Z→12
- 5: Manufactured year: 1st digit of AD, 5→1995

NOTES

3 Description, Specification and Component Identification

3-1 Description

Since induction motors have no separated field circuit and armature circuit as direct current (DC) motors, it is difficult for general inverters to control an exciting current component (field circuit) and a torque current component (armature circuit) individually. Therefore, a wide variable speed range and a high-accurate control characteristics such as in DC motors cannot be achieved with induction motors driven by the inverters. However, since DC motors has brushes and a commutator, they are inferior to induction motors in an aspect of maintenance. It is "Vector control inverters" to similarly control induction motors of superior maintainability as in DC motors.

Vector control inverter FERNIC5000VG5S and FERNIC5000VG5N serieses individually control exciting current component and torque current component, which are calculated from output voltage and current, by our specific transvector control technology. And, both of the components are synthesized, and supplied to the motor as a current. Therefore, a high torque and high response are realized. Furthermore, these inverters control a wide speed range from low speed region to high speed region with high accuracy.

The operation is executed by the data written into a dialog type keypad panel and by the commands from control terminals. In this keypad panel, there are keys for setting and writing the data, and a display for monitoring. An operator can input selections of monitoring data visible on the screen, set and write the data necessary for operation, and input the operation commands. Further, since an RS485 communication function is equipped as standard, the inverter can directly communicate with personal computer etc. Moreover, an auto-tuning function can be used from the keypad panel.

The auto-tuning function automatically conducts adjustment of automatic speed regulator (ASR) system and measurement of motor constants to most suitably control the motor. Therefore, when driving standard 3-phase (general use) motors, the tuning can be easily conducted without an exclusive tool such as a personal computer, and the data are automatically written into the relevant functions.

Apply FRENIC5000VG5S (standard series) to general industry system and FRENIC5000VG5N (low noise series) to environment in which noise is problematic. Three-phase 200 V series and 400 V series are arranged for power supply systems, and the PG sensor type inverters for dedicated motors and the PG-sensorless type inverters are also arranged.

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 PG sensor type vector control inverter standard specification

Table 3-4-1 PG sensor type vector control inverter 200 V series

	Item	Specification																*2)
Dedicated motor	Rated output 〔kw〕	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	
	Type MVK□A-C *1)	6096	6097	6107	6115	6133	6135	6165	6167	6184	6185	6206	6207	6208 9221	9250	9252	9280	
	Rated continuous torque [N・m]	4.77	9.55	14.0	23.5	35.0	47.7	70.0	95.5	117	140	191	235	286	350	477	572	
	Rated current [A]	4.8	7.0	11	18	27	37	49	63	74	90	116	143	170 189	222	294	345	
	Base speed [r/min]	1500																
	Max. Speed [r/min]	3600										3000		3000 (2400)	2400		2000	
Inverter	Standard series type FRN□VG5S-2A *1)	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75 *6)	90	
	Low noise series type FRN□VG5N-2A *1)	0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	—	—	—	
	Rated capacity [kVA]	1.6	2.3	3.6	5.9	8.8	12	16	21	24	29	38	47	55	66	89	105	
	Overload capacity	Rated continuous torque×150%, 1 min																
	Power supply: Voltage/frequency	3-phase, 200 to 220 V/50Hz, 200 to 230 V/60 Hz																
	Power supply: Allowable variation	Voltage: +10 to -15% *3), imbalance in power supply voltages: 3% or less *4), frequency: ±5%																
	Power supply: Momentary voltage dip	When the input voltage dips to 170 V AC or higher, the inverter continuously operates (necessary output reduction). When the input voltage dips to lower than 170 V AC, the inverter can operate for 15 ms with 85% of the full load. *5)																

Table 3-4-2 PG sensor type vector control inverter 400 V series

	Item	Specification																	*2)
Dedicated motor	Rated output 〔kw〕	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220
	Type MVK□A-C *1)	6115	6133	6135	6165	6167	6184	6185	6206	6207	6208 9221	9250	9252	9280	9282	9310	9312	9316	9318
	Rated continuous torque [N・m]	23.5	35.0	47.7	70.0	95.5	117	140	191	235	286	350	477	572	700	840	1018	1273	1400
	Rated current [A]	9.0	13.5	18.5	24.5	32	37	45	58	71	85 91	108	147	173	206	248	297	369	409
	Base speed [r/min]	1500																	
	Max. Speed [r/min]	3600							3000		3000 (2400)	2400		2000					
Inverter	Standard series type FRN□VG5S-4A *1)	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75 *6)	90	110	132	160	200	220
	Low noise series type FRN□VG5N-4A *1)	3.7	5.5	7.5	11	15	18.5	22	30	37	45	—	—	—	—	—	—	—	—
	Rated capacity [kVA]	5.9	8.8	12	16	21	24	29	38	47	55	66	89	105	125	150	180	225	248
	Overload capacity	Rated continuous torque×150%, i min																	
	Power supply: Voltage/frequency	3-phase, 400 to 420 V/50Hz, 400 to 480 V/60 Hz *8)																	
	Power supply: Allowable variation	Voltage: +10 to -15% *3), imbalance in power supply voltages: 3% or less *4), frequency: ±5%																	
	Power supply: Momentary voltage dip	When the input voltage dips to 340 V AC or higher, the inverter continuously operates (necessary output reduction). When the input voltage dips to lower than 340 V AC, the inverter can operate for 15 ms with 85% of the full load. *5)																	

*1) Write a numerical value in the table into□
*2) Two kinds of 45 kW motor exist and selectable. In ( ), the max. speed of type MVK9221A-C is shown.
*3) When the voltage variation is in - range, the motor output and inverter capacity reduce.
*4) When the applied inverter is for motor with rated output 55kW or less and the power supply voltage imbalance ratio exceeds 3%, connect an DC link reactor.

$$\text{Power supply voltage imbalance ratio [\%]} = \frac{\text{Max. voltage [V]} - \text{Min. voltage}}{\text{Average 3-phase voltage [V]}} \times 100$$

*5) This values are defined for testing at standard load condition by JEMA (85% of standard applicable motor load).
*6) The inverters of rated output of 75 kW or more are delivered with a DC link reactor supplied separately.

Table 3-4-3 Inverter common specification

Item		Specification
Main circuit system		Voltage type IGBT sine wave PWM inverter
Control *7)	Control system	Vector control, ASR control with AC minor loop
	Speed control range	1.5 to base speed to max. speed [r/min]
	Speed control accuracy	Digital setting: ±0.01% (-10 to +50℃), Analog setting: ±0.1% (25±10℃)
	Speed setting resolution	0.005% of max. speed
	Speed control response	Response frequency 50 Hz max. (-3dB)
	Speed-torque characteristics	4 quadrants operation (FWD running, FWD braking, REV running and REV braking) Torque limit control: Unified or individual 4 quadrants, Torque command (ASR output), etc.selectable, limiting value 0 to ±250% Max. torque: 150%, 1 min, Stalling torque: 100% continuous (1 Hz or more), 80% continuous (less than 1 Hz)
	Acceleration and deceleration	Linear, S curve, Torque limit, Acc. and dec. modes selectable 2 kinds of acc. and dec. time (0 to 1200s) setting possible and selectable
Braking	Standard attachment	DC braking: Braking force (10 to 100%), Braking time (0 to 10 s)/variable setting
	Option	Resistance discharge braking: Braking torque 150%, Braking frequency 5% ED/10% ED (selectable), Braking resistor necessary, Braking unit also necessary for 200 V 75 kW or more, 400 V 90 kW or more
Operation	Operation command	Keypad panel: FWD/RUN, REV/RUN, STOP keys Terminal input: FWD and STOP command, REV and STOP command Remote operation: Data communication (RS485), Serial signals from control option
	Speed setting	Keypad panel: Up and down keys, Terminal input: Multistep speed select, UP/DOWN adjust Analog signal: Speed setting POT, 0 to ±10VDC Digital signal: Data communication (RS485), serial and parallel signals from control option (16 bit binary or BCD 4 digits)
	Input signal	Terminal input: Alarm reset, Operation command changeover, Torque limit, Pre-excitation, etc. 5 points selectable Analog signal: Speed aux. setting, Torque command, Torque current command, Magnetic flux command, etc. 2 points selectable Digital signal: Data communication (RS485) and Control option (refer to each Instruction Manual for output signals)
	Running status output signal	Transistor output and contact output: In operation,In acc. and dec., In braking, Overload early warning, etc. 4 points selectable Analog signal: Motor speed, Speed setting value, Torque current, Motor temperature, etc. 3 points selectable Digital signal: Data communication (RS485) and Control option (refer to each Instruction Manual for output signals)
Indication	Digital indication (LED)	In operation: Motor speed, Output frequency,Torque, Output voltage and current, Motor temperature, etc. 1 point selectable In speed setting: Motor or load speed setting value, In alarm mode: Alarm code
	LCD indication (LCD)	In operation: Operation information, Operation guide, In data setting and data monitoring: Code, Name and Data of function In alarm mode: Alarm information
	Lamp indication (LED)	In charging, Units of operation data, Operation right of keypad panel, Input status of FWD/RUN and REV/RUN commands
Protection		Overcurrent, Grounding, DC fuse blown-out, Overvoltage, Undervoltage, Overspeed, Inverter overload and overheating, Printed circuit board overheating, Motor overload and overheating, NTC thermistor break, External alarm, CPU/memory error,Keypad panel communication error, RS485 error,Inverter output circuit abnormal, Surge protection, etc.
Condition	Installation location	Indoor, Altitude 1000m or less, not in contact with corrosive gas, inflammable gas,dusts, and direct sunlight
	Ambient temperature /humidity	-10 to +50℃/20 to 90% RH, non-condensation
	Vibration	5.9 m/s² {0.6 G} or less
	Storage temperature	-20 to +65℃ (Short period like transportation)
Protection/cooling		IP00 (with protection case), Forced ventilation

*7) The control specification of this inverter common specification is different from that of PG-sensorless type
*8) Driving torque is insufficient for 380V/50, 60Hz power supply voltage in a high-speed region (more than speed of base) of the motor only for the standard. The tap switch of the internal transformer shown in page 38 is nessessary for 440V/60Hz, 380V/50,60Hz power supply voltage.

3-5 PG-sensorless type vector control inverter standard specification

Table 3-5-1 PG-sensorless type vector control inverter 200 V series

Item		Specification															
Motor rated output [kW] *1)		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90
Standard series type FRN□VG5S-2N *2)		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75 *8)	90
Lown noise series type FRN□VG5N-2N *2)		0.75	1.5	2.2	3.7	5.5	7.5	11	15	18.5	22	30	37	45	—	—	—
Rated capacity [kVA] *3)		1.9	3.0	4.2	6.9	10	14	19	25	29	34	45	56	69	82	108	136
Rated output current [A]		5.0	8.0	11	18	27	37	49	64	77	90	120	147	180	215	283	357
Overload current [A] *4)		7.5	12	16	26	39	54	73	95	114	137	177	220	270	322	424	525
Rated output voltage/frequency		3-phase, 200 V/50 Hz, 200 - 220 - 230 V/60 Hz *5)															
Power supply	Voltage/frequency	3-phase, 200 to 210 V/50 Hz, 200 to 230 V/60 Hz															
	Allowable variation	Voltage: +10 to -15%, imbalance in power supply voltages: 3% or less *6), frequency: ±5%															
	Momentary voltage dip	When the input voltage dips to 170 V AC or higher, the inverter continuously operates (necessary output reduction). When the input voltage dips to lower than 170 V AC, the inverter can operate for 15 ms with 85% of the full load. *7)															

Table 3-5-2 PG-sensorless type vector control inverter 400 V series

Item		Specification																	
Motor rated output [kW] *1)		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75	90	110	132	160	200	220
Standard series type FRN□VG5S-4N *2)		3.7	5.5	7.5	11	15	18.5	22	30	37	45	55	75 *8)	90	110	132	160	200	220
Lown noise series type FRN□VG5N-4N *2)		3.7	5.5	7.5	11	15	18.5	22	30	37	45	—	—	—	—	—	—	—	—
Rated capacity [kVA] *3)		6.9	10	14	21	25	30	35	46	57	69	85	114	134	160	193	232	287	358
Rated output current [A]		9.0	13.5	18.5	27	33	39	46	60	75	91	112	150	176	210	253	304	377	470
Overload current [A] *4)		13	19	27	39	49	58	68	90	112	136	168	225	264	315	380	456	566	623
Rated output voltage/frequency		3-phase,380 - 400 V/50 Hz, 380 -400 - 440 - 460 V/60 Hz *5)																	
Power supply	Voltage/frequency	3-phase, 400 to 420 V/50 Hz, 400 to 480 V/60 Hz *9)																	
	Allowable variation	Voltage: +10 to -15%, imbalance in power supply voltages: 3% or less *6), frequency: ±5%																	
	Momentary voltage dip	When the input voltage dips to 340 V AC or higher, the inverter continuously operates (necessary output reduction). When the input voltage dips to lower than 340 V AC, the inverter can operate for 15 ms with 85% of the full load. *7)																	

*1) Motor rated output is only for reference. Select PG-sensorless type inverter type from the rated output current and overload current.
*2) Write a numerical value in the table into □ of inverter type.
*3) Rated capacity is the value of 220 V at rated output voltage 200 V series; and 440 V at 400 V series.
*4) Overload current is a current correspond to 150% of rated continuous current of the motor and its time is 1min.
*5) Higher voltage than the power supply voltage cannot be output.
*6) When the applied inverter is for motor with rated output 55kW or less and the power supply voltage imbalance ratio exceeds 3%, connect an DC link reactor

$$\text{Power supply voltage imbalance ratio [\%]} = \frac{\text{Max. voltage [V]} - \text{Min. voltage [V]}}{\text{Average 3-phase voltage [V]}} \times 100$$

*7) This values are defined for testing at standard load condition by JEMA (85% of standard applicable motor load)
*8) The inverters of rated output of 75 kW or more are delivered with a DC link reactor supplied separately.
*9) The tap switch of the internal transformer shown in page 38 is nessessary for 440V/60Hz, 380V/50,60Hz power supply voltage.

Table 3-5-3 Inverter common specification

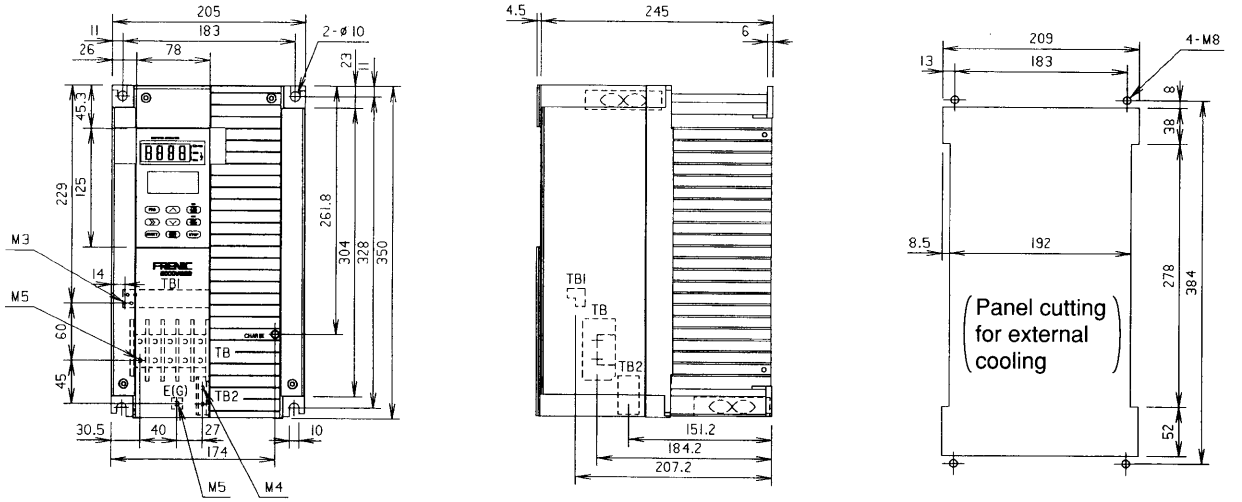
Item		Specification
Main circuit system		Voltage type IGBT sine wave PWM inverter
Control *10)	Control system	Sensorless vector control, ASR control with ACR minor loop
	Speed control range	Min. speed/base speed : 1/50(30 to 1500r/min in the case of a base speed 1500r/min) Base speed/max. speed : 1/2(1500 to 3000 r/min in the case of a base speed 1500r/min)
	Speed control accuracy	With NTC thermistor: ±0.2%, Without NTC thermistor: ±0.5% (25±10℃)
	Speed setting resolution	0.005% of max. speed
	Speed control response	Response frequency 10 Hz max. (-3dB)
	Speed-torque characteristics	4 quadrants operation (FWD running, FWD braking, REV running and REV braking) Torque limit control: Unified or individual 4 quadrants, Torque command (ASR output), etc.selectable, limiting value 0 to ±250% Max. torque: 150%, 1 min, Stalling torque: Output disable
	Acceleration and deceleration	Linear, S curve, Torque limit, Acc. and dec.modes selectable 2 kinds of acc. and dec. time (0 to 1200s) setting possible and selectable
Braking	Standard attachment	DC braking: Braking force (10 to 100%), Braking time (0 to 10 s)/variable setting
	Option	Resistance discharge braking: Braking torque 150%, Braking frequency 5% ED/10% ED (selectable), Braking resistor necessary, Braking unit also necessary for 200 V 75 kW or more, 400 V 90 kW or more
Operation	Operation command	Keypad panel: FWD/RUN, REV/RUN, STOP keys Terminal input: FWD and STOP command, REV and STOP command Remote operation: Data communication (RS485), Serial signals from control option
	Speed setting	Keypad panel: Up and down keys, Terminal input: Multistep speed select, UP/DOWN adjust Analog signal: Speed setting POT, 0 to ±10VDC Digital signal: Data communication (RS485), serial and parallel signals from control option (16 bit binary or BCD 4 digits)
	Input signal	Terminal input: Alarm reset, Operation command changeover, Torque limit, Pre-excitation, etc. 5 points selectable Analog signal: Speed aux. setting, Torque command, Torque current command, Magnetic flux command, etc. 2 points selectable Digital signal: Data communication (RS485) and Control option (refer to each Instruction Manual for output signals)
	Running status output signal	Transistor output and contact output: In operation,In acc. and dec., In braking, Overload early warning, etc. 4 points selectable Analog signal: Motor speed, Speed setting value, Torque current, Motor temperature, etc. 3 points selectable Digital signal: Data communication (RS485) and Control option (refer to each Instruction Manual for output signals)
Indication	Digital indication (LED)	In operation: Motor speed, Output frequency,Torque, Output voltage and current, Motor temperature, etc. 1 point selectable In speed setting: Motor or load speed setting value, In alarm mode: Alarm code
	LCD indication (LCD)	In operation: Operation information, Operation guide, In data setting and data monitoring: Code, Name and Data of function In alarm mode: Alarm information
	Lamp indication (LED)	In charging, Units of operation data, Operation right of keypad panel, Input status of FWD/RUN and REV/RUN commands
Protection		Overcurrent, Grounding, DC fuse blown-out, Overvoltage, Undervoltage, Overspeed, Inverter overload and overheating, Printed circuit board overheating, Motor overload and overheating, NTC thermistor break, External alarm, CPU/memory error,Keypad panel communication error, RS485 error,Inverter output circuit abnormal, Surge protection, etc.
Condition	Installation location	Indoor, Altitude 1000m or less, not in contact with corrosive gas, inflammable gas,dusts, and direct sunlight
	Ambient temperature /humidity	-10 to +50℃/20 to 90% RH, non-condensation
	Vibration	5.9 m/s^2 {0.6 G} or less
	Storage temperature	-20 to +65℃ (Short period like transportation)
Protection/cooling		IP00 (with protection case), Forced ventilation

*10) The control specification of this inverter common specification is different from that of PG sensor type

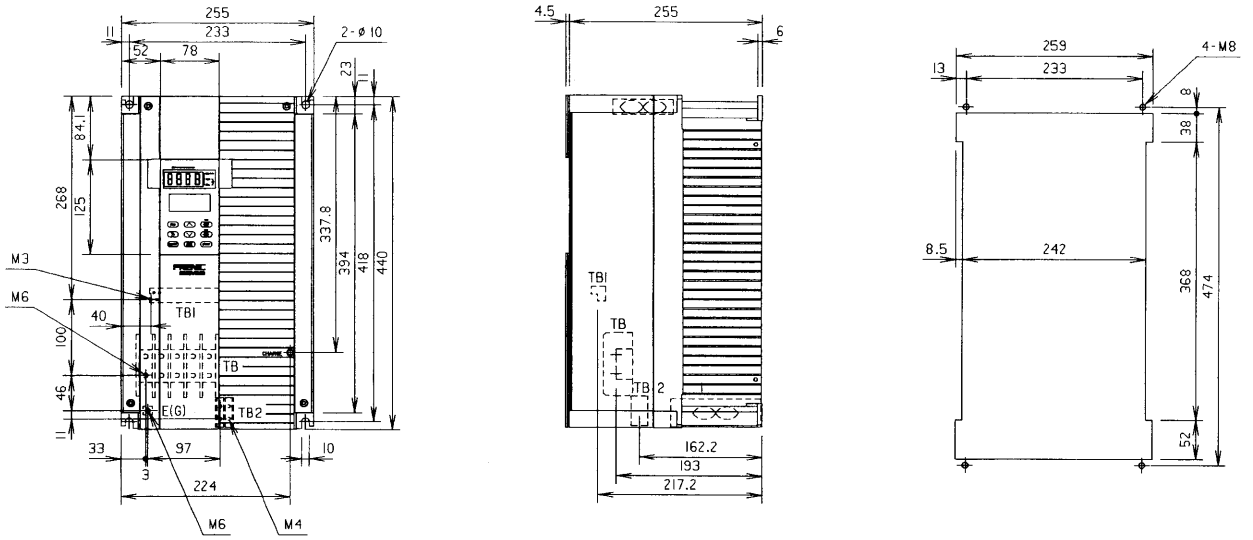
3-6 200V series dimentions

Fig. 3-6 200V series outline

1) FRN0.75VG5S-2 to FRN3.7VG5S-2, FRN0.75VG5N-2 to FRN2.2VG5N-2 Mass : 10kg
FRN5.5VG5S-2 to FRN7.5VG5S-2, FRN3.7VG5N-2 to FRN5.5VG5N-2 Mass : 11kg



2) FRN11VG5S-2, FRN7.5VG5N-2 Mass : 17kg



3) FRN15VG5S-2 to FRN22VG5S-2, FRN11VG5N-2 to FRN18.5VG5N-2 Mass : 25kg

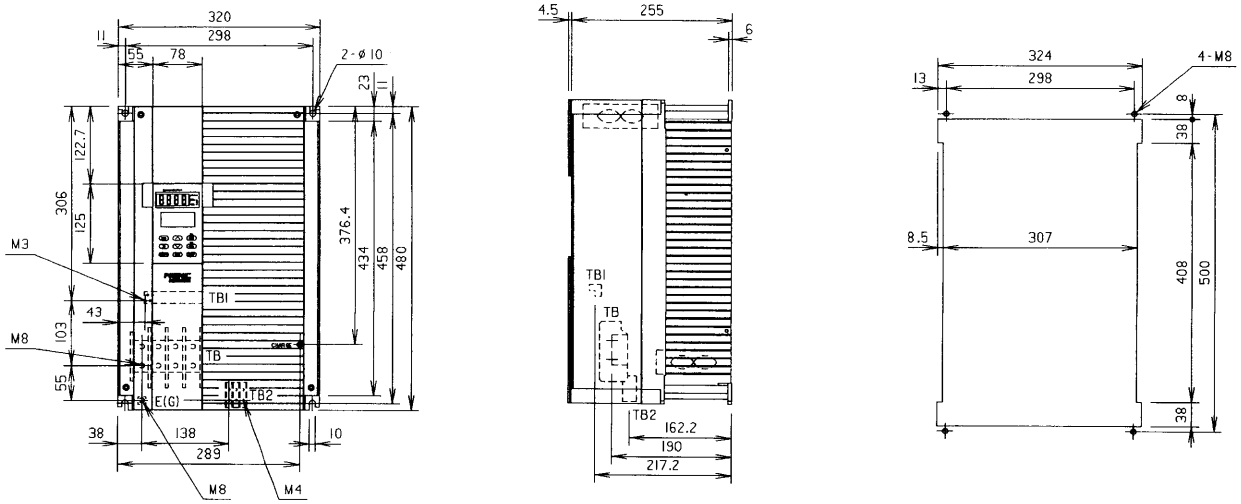
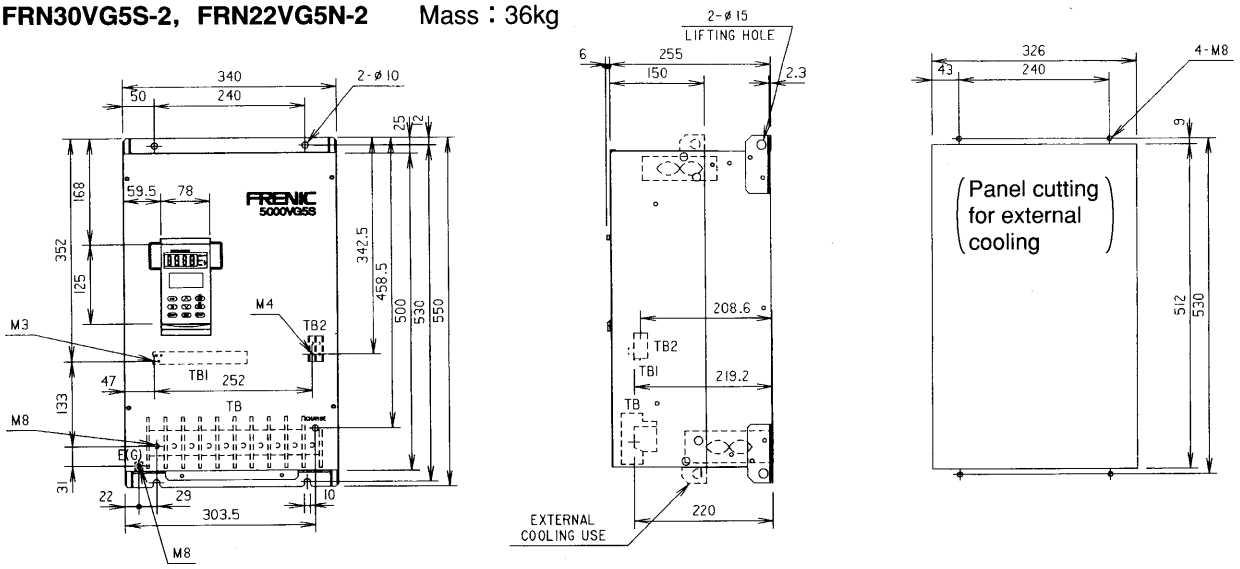
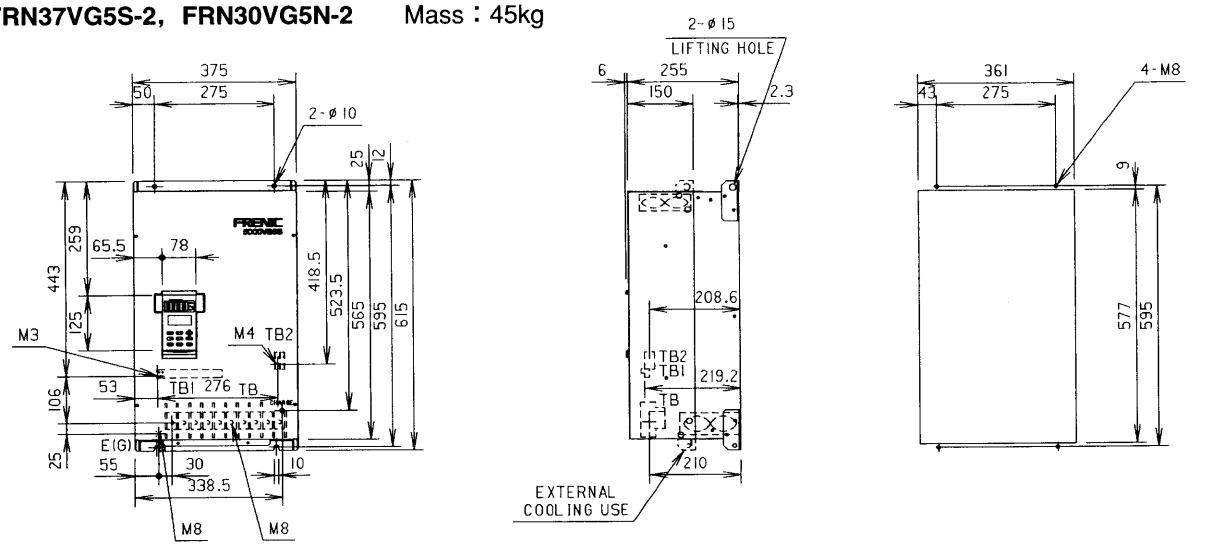


Fig. 3-6 200V series outline (continued)

4) FRN30VG5S-2, FRN22VG5N-2 Mass : 36kg



5) FRN37VG5S-2, FRN30VG5N-2 Mass : 45kg



6) FRN45VG5S-2, FRN37VG5N-2 Mass : 58kg

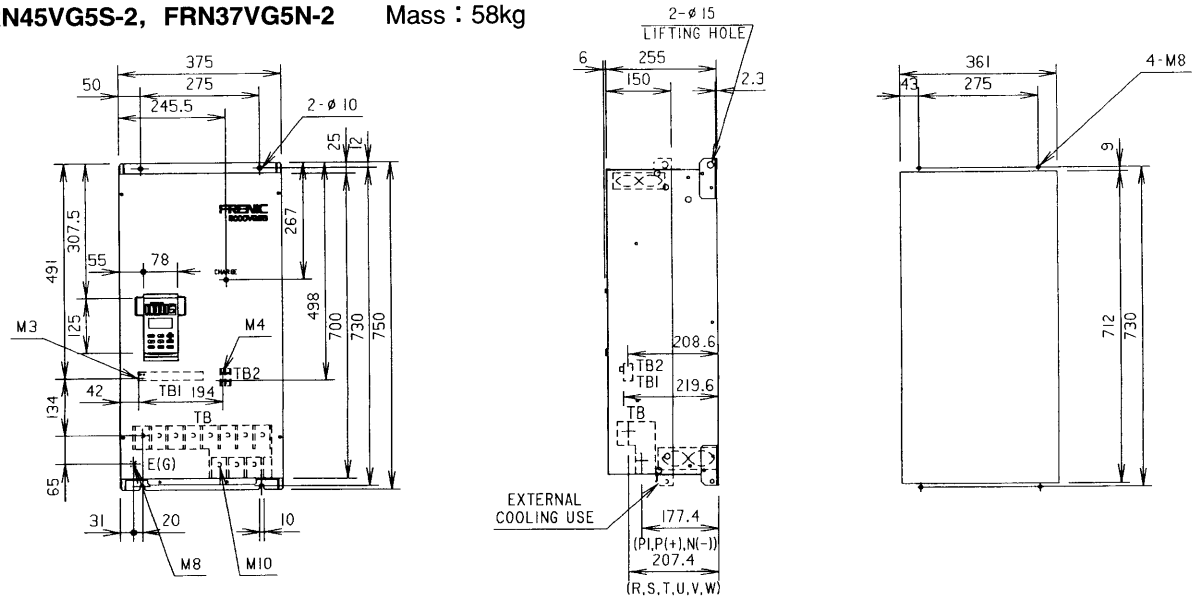
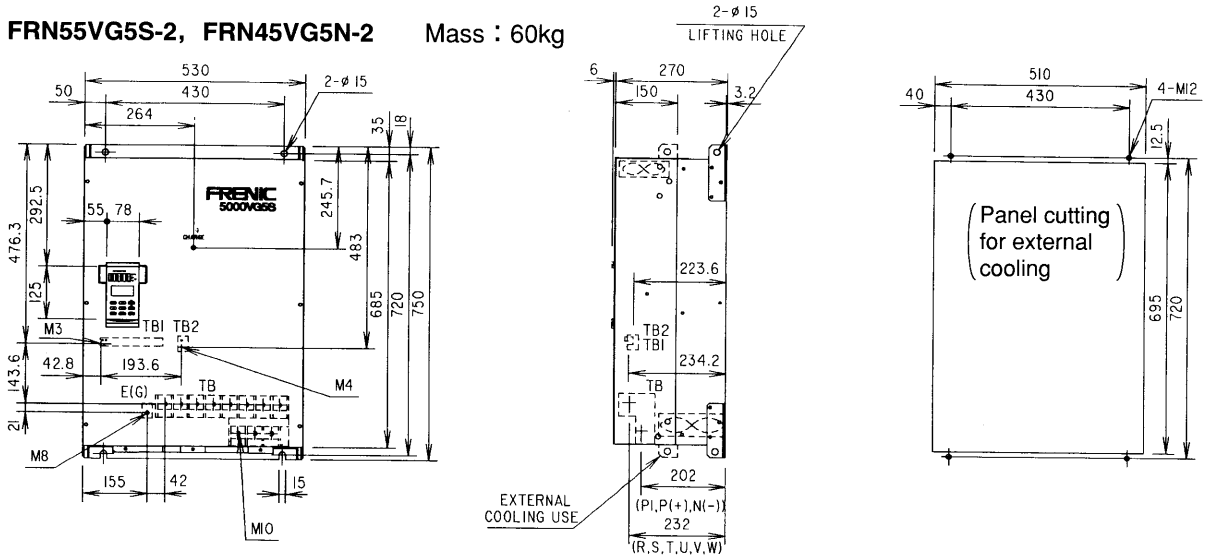
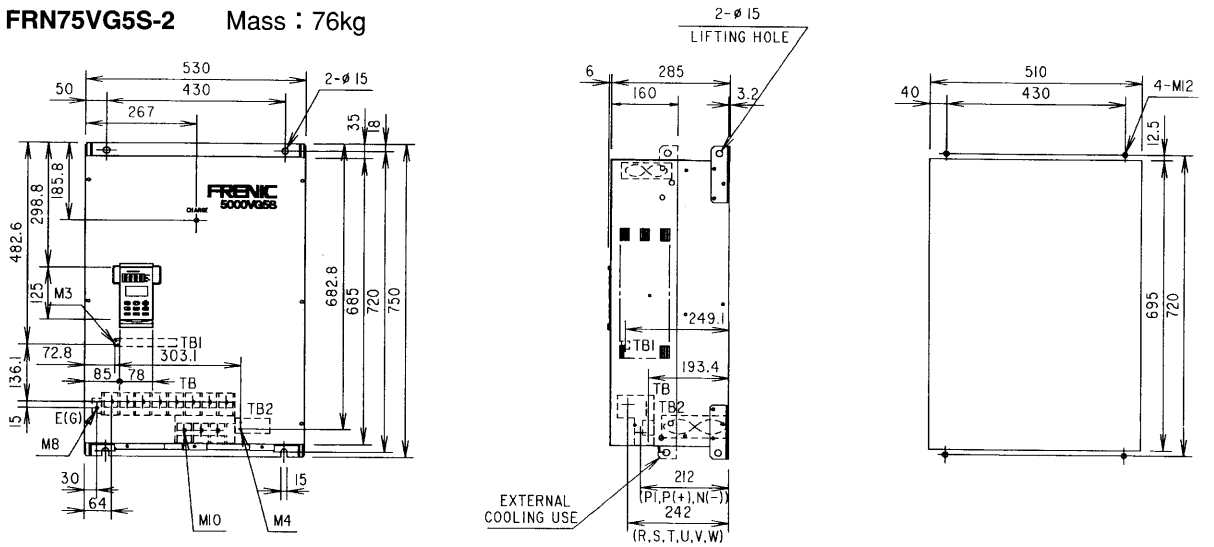


Fig. 3-6 200V series outline (continued)

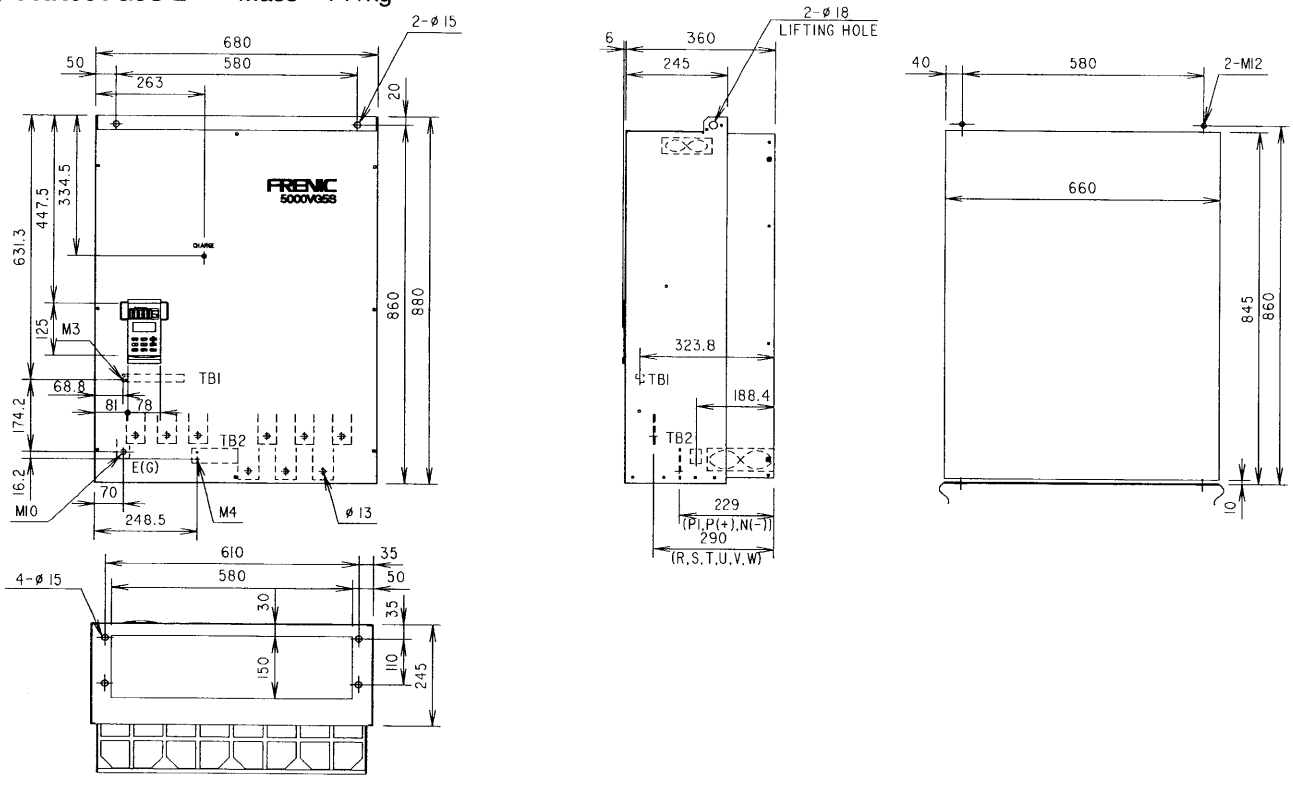
7) FRN55VG5S-2, FRN45VG5N-2 Mass : 60kg



8) FRN75VG5S-2 Mass : 76kg



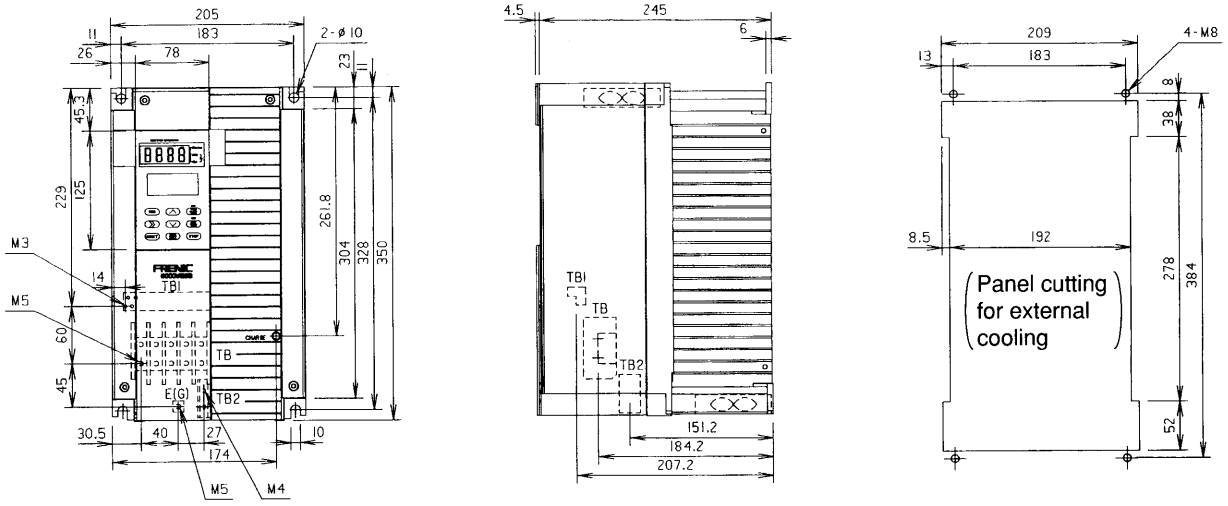
9) FRN90VG5S-2 Mass : 141kg



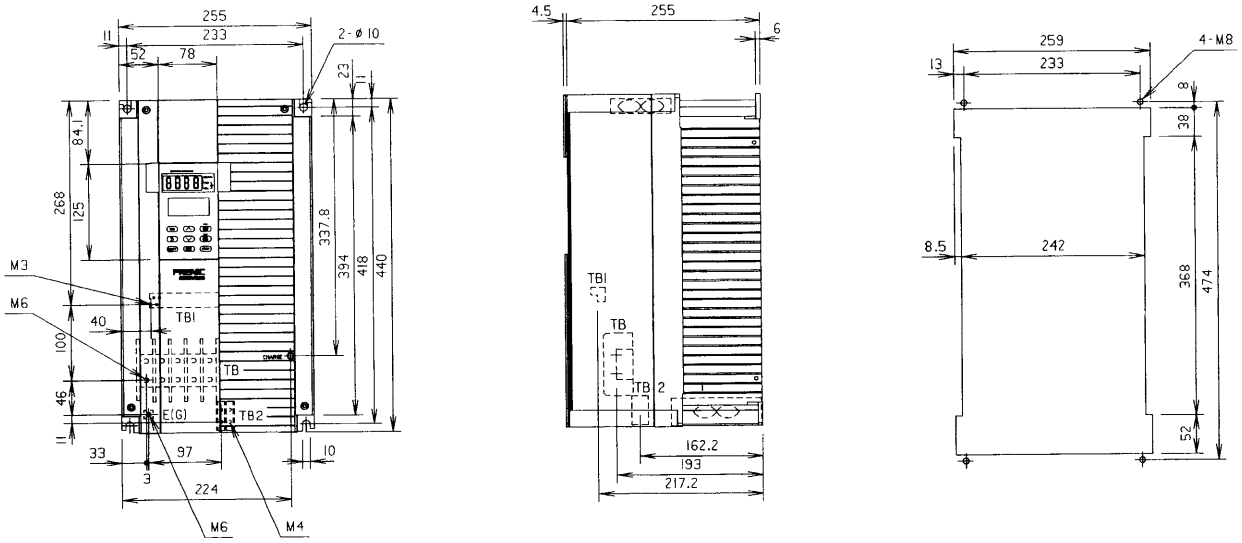
3-7 400V series dimentions

Fig. 3-7 400V series outline

1) FRN3.7VG5S-4 Mass : 10kg
FRN5.5VG5S-4, FRN7.5VG5S-4, FRN3.7VG5N-4, FRN5.5VG5N-4 Mass : 11kg



2) FRN11VG5S-4, FRN15VG5S-4, FRN7.5VG5N-4, FRN11VG5N-4 Mass : 17kg



3) FRN18.5VG5S-4, FRN22VG5S-4, FRN15VG5N-4, FRN18.5VG5N-4 Mass : 25kg

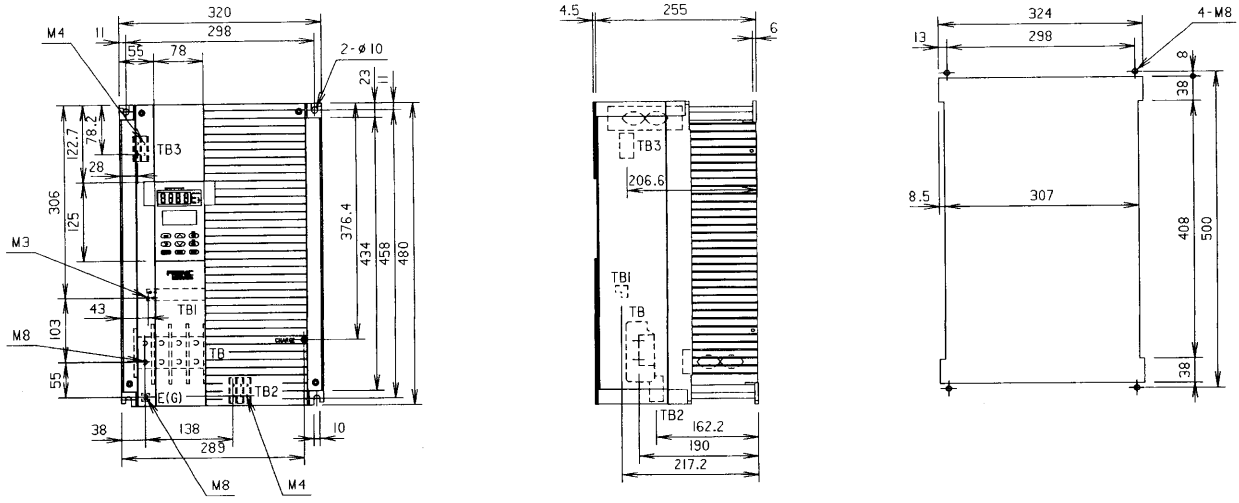
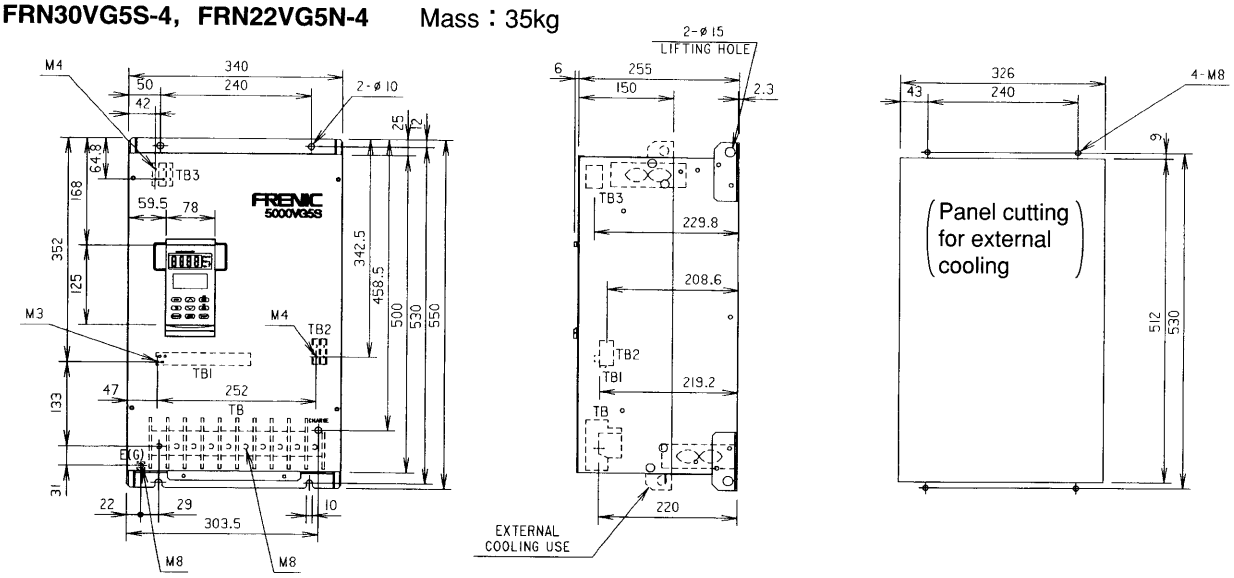
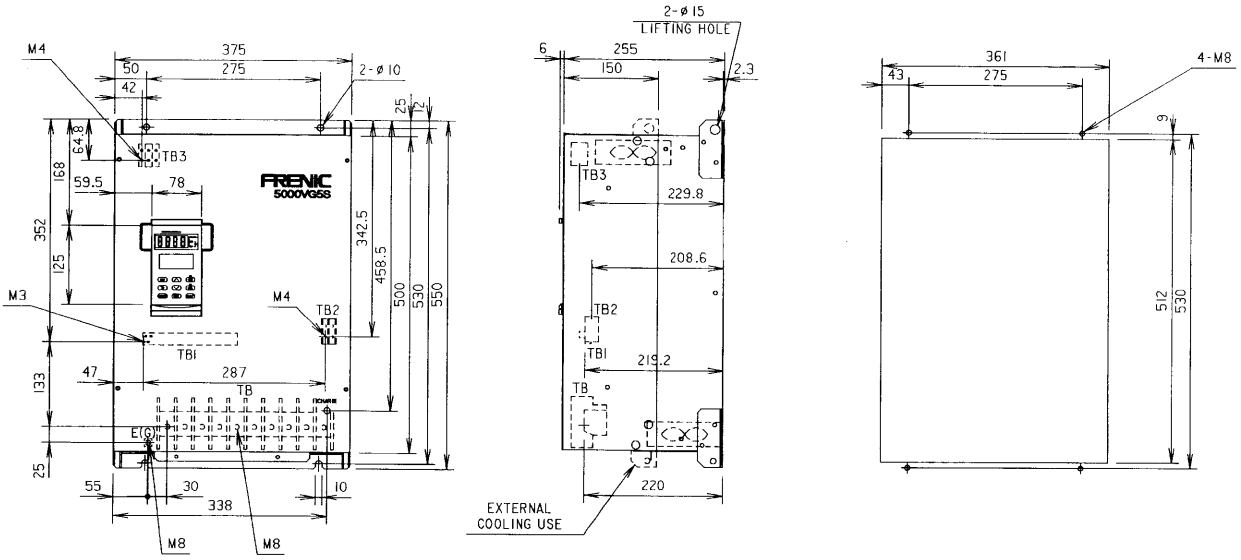


Fig. 3-7 400V series outline (continued)

4) FRN30VG5S-4, FRN22VG5N-4 Mass : 35kg



5) FRN37VG5S-4, FRN30VG5N-4 Mass : 36kg



6) FRN45VG5S-4, FRN37VG5N-4 Mass : 43kg

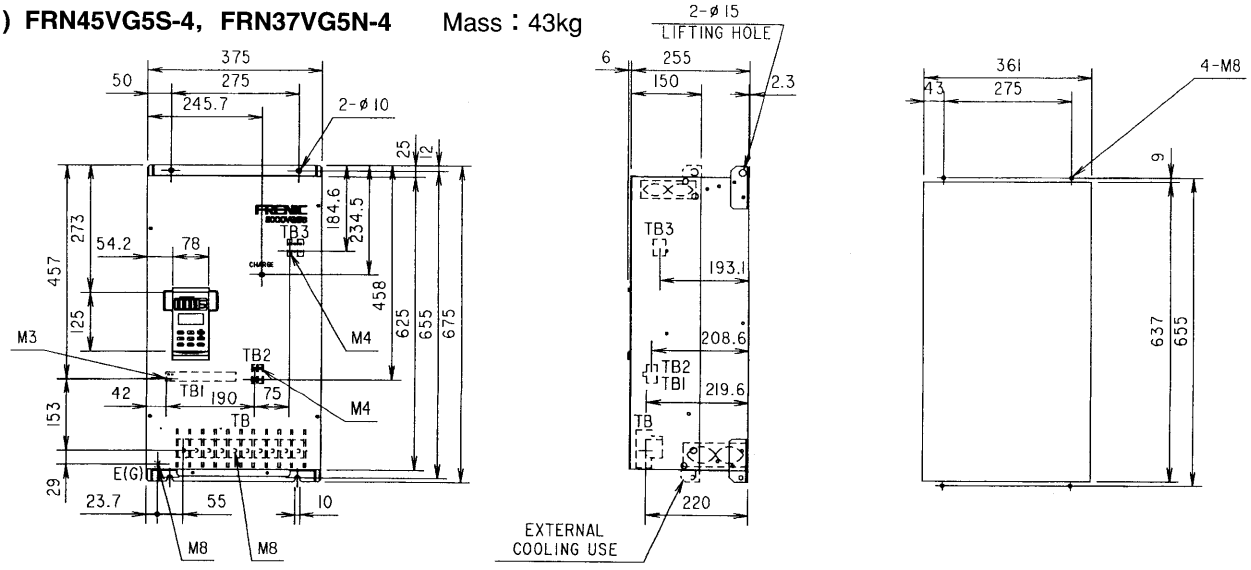
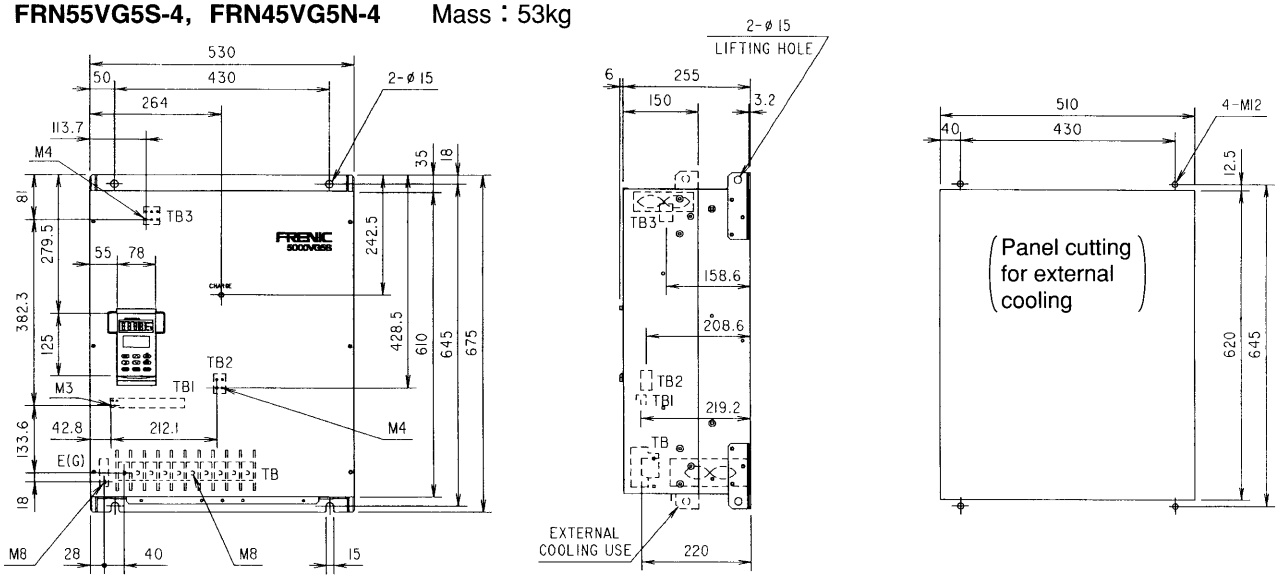
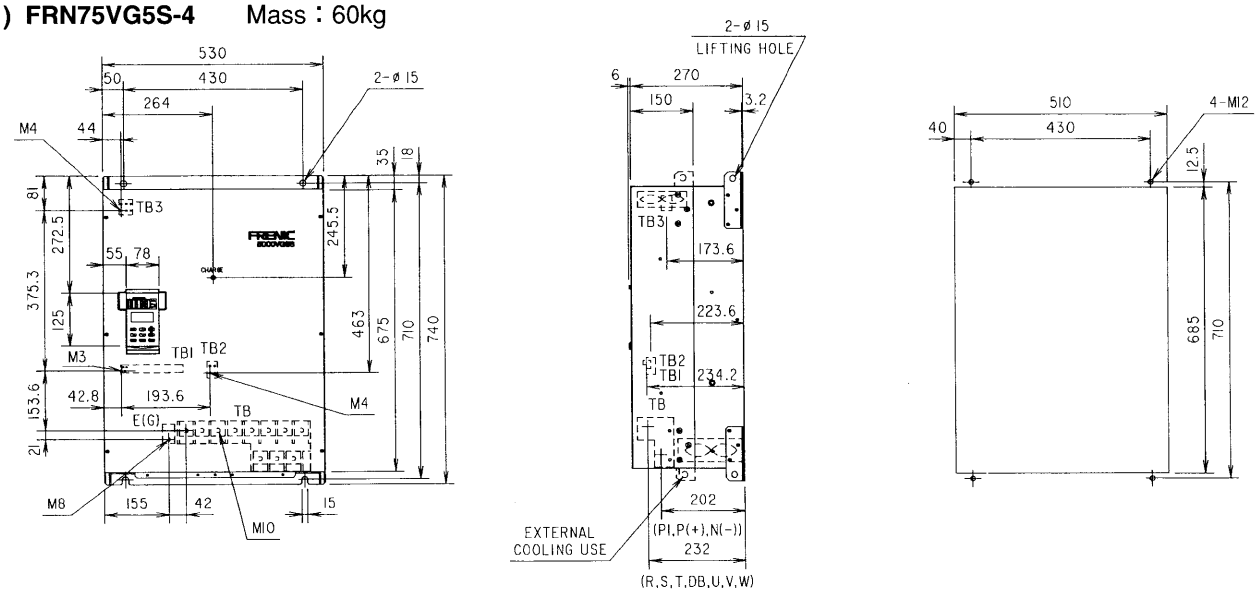


Fig. 3-7 400V series outline (continued)

7) FRN55VG5S-4, FRN45VG5N-4 Mass : 53kg



8) FRN75VG5S-4 Mass : 60kg



9) FRN90VG5S-4, FRN110VG5S-4 Mass : 86kg

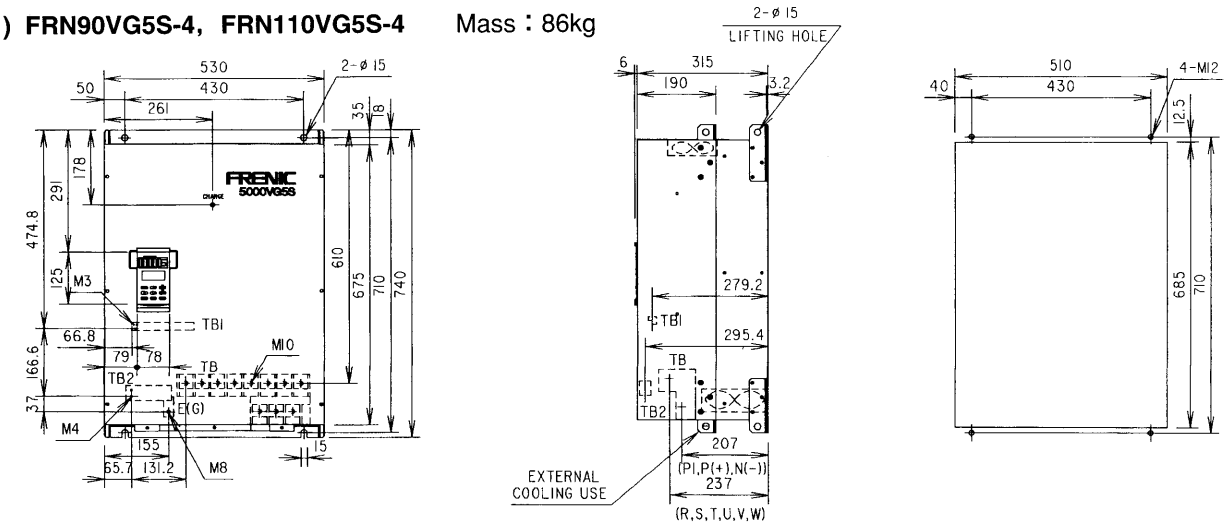
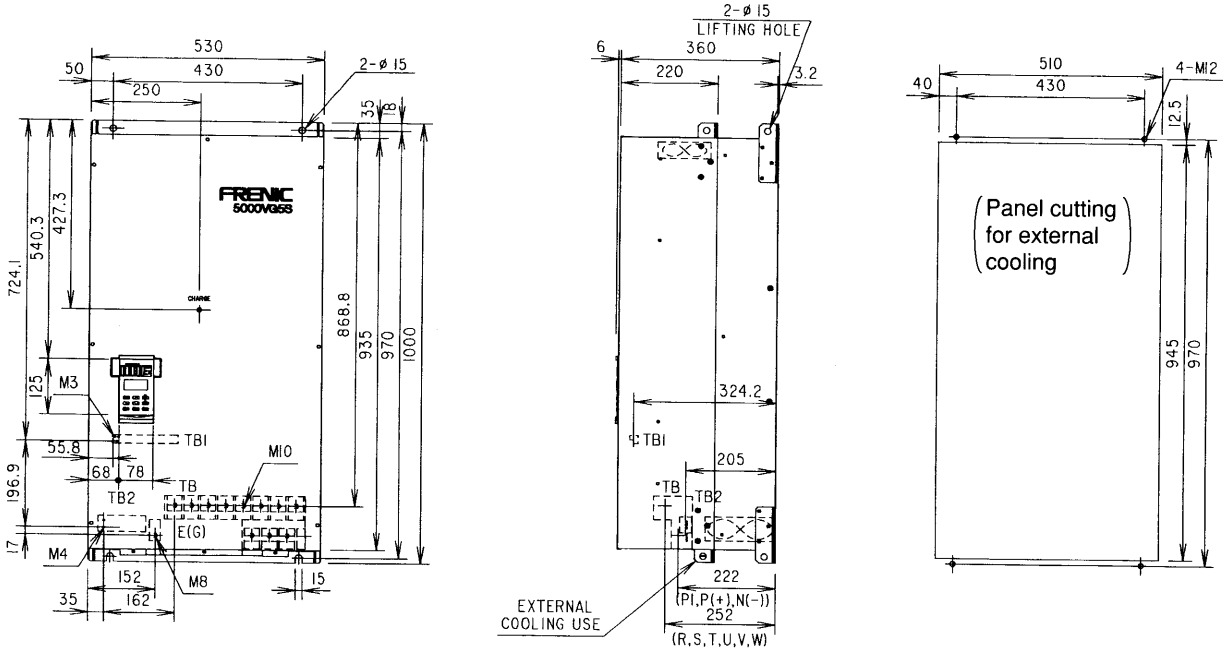


Fig. 3-7 400V series outline (continued)

10) FRN132VG5S-4 Mass : 116kg



11) FRN160VG5S-4 Mass : 121kg

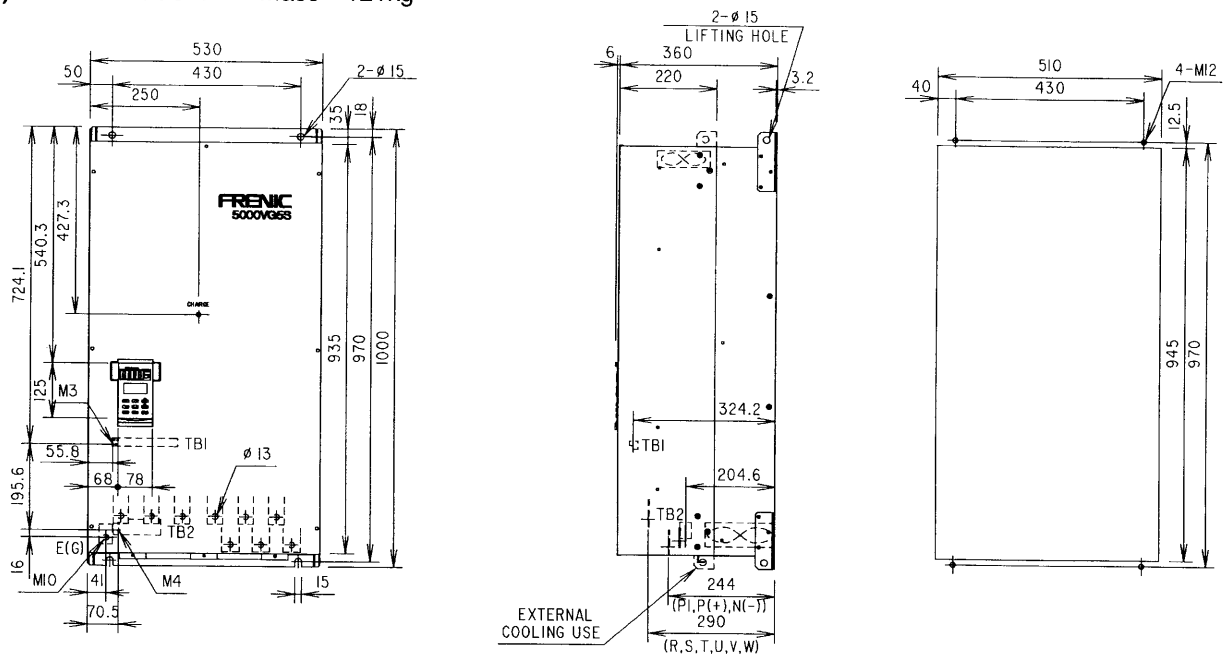
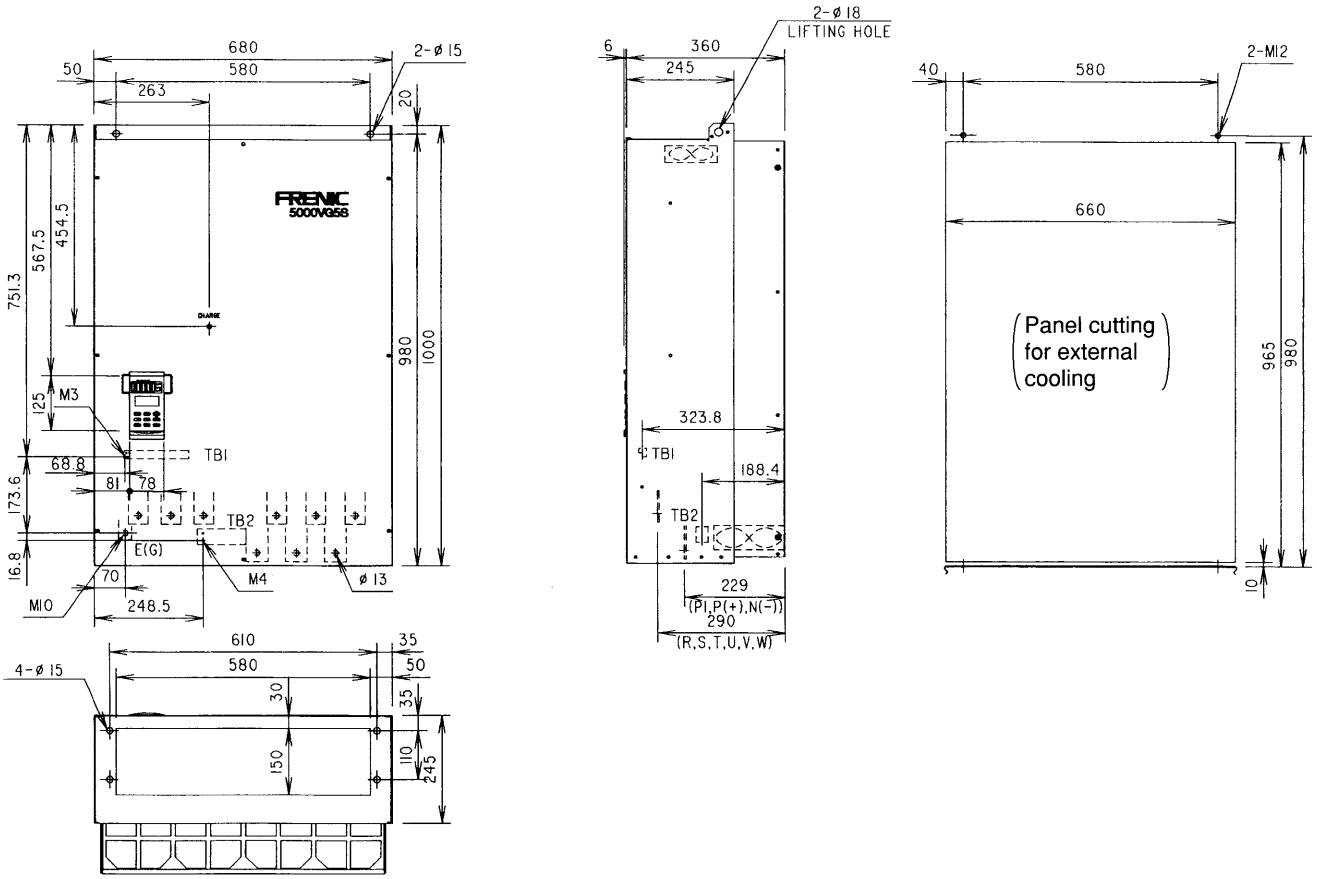


Fig. 3-7 400V series outline (continued)

12) FRN200VG5S-4, FRN220VG5S-4 Mass : 173kg

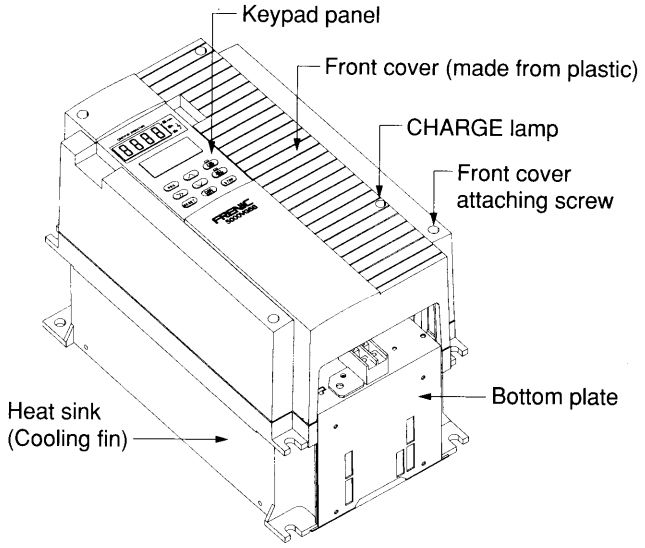


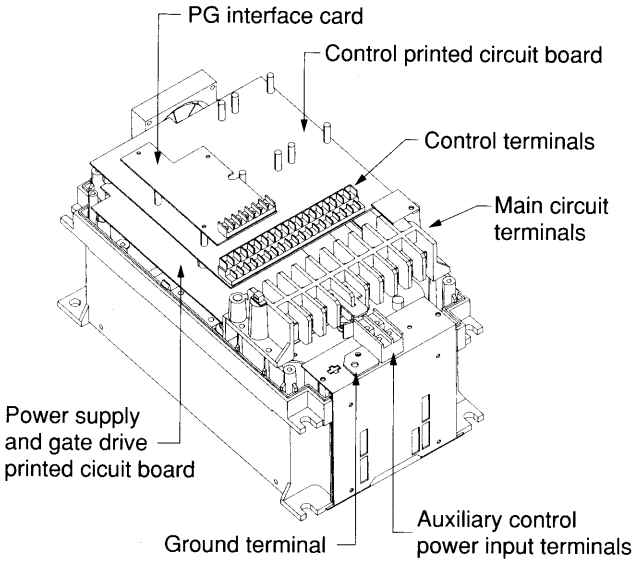
3-8 View, construction and components

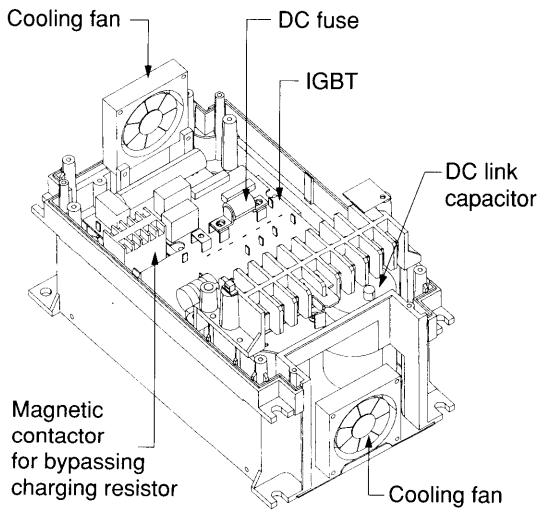
NOTE : *The PG interface card as shown in the following figure is applicable to the PG Sensor type and not to the PG-sensorless type.*

Fig. 3-8 Inverter view, construction and components

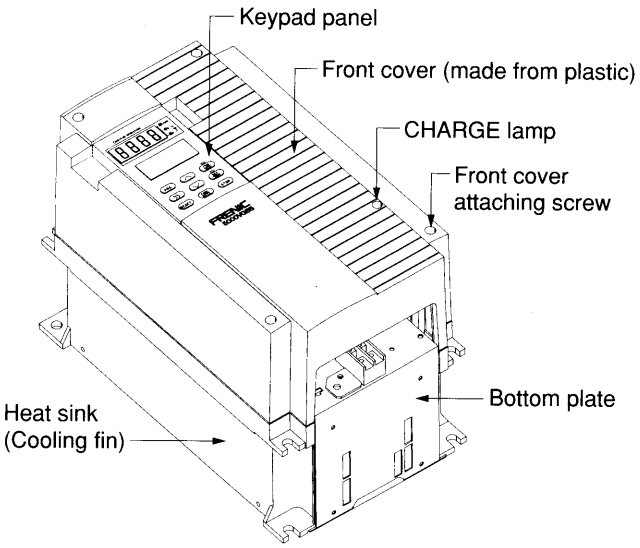
1) FRN0.75VG5S-2 to FRN3.7VG5S-2
FRN0.75VG5N-2 to FRN2.2VG5N-2
FRN3.7VG5S-4

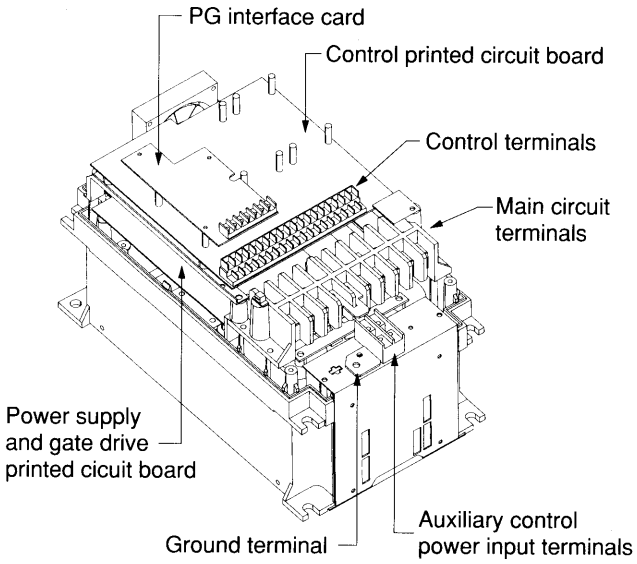






2) FRN5.5VG5S-2, FRN7.5VG5S-2
FRN3.7VG5N-2, FRN5.5VG5N-2
FRN5.5VG5S-4, FRN7.5VG5S-4
FRN3.7VG5N-4, FRN5.5VG5N-4





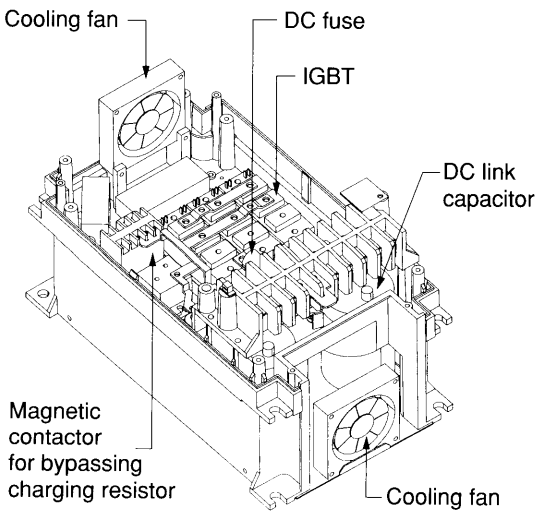
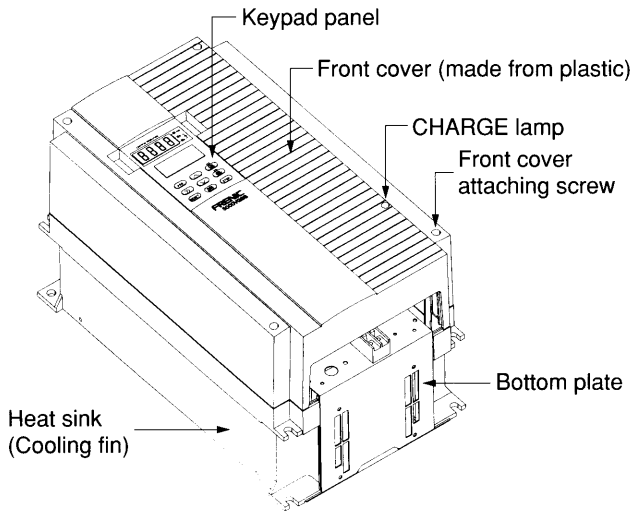
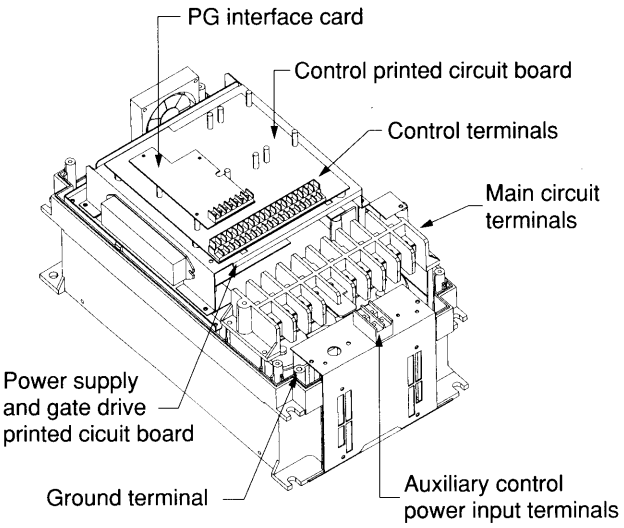
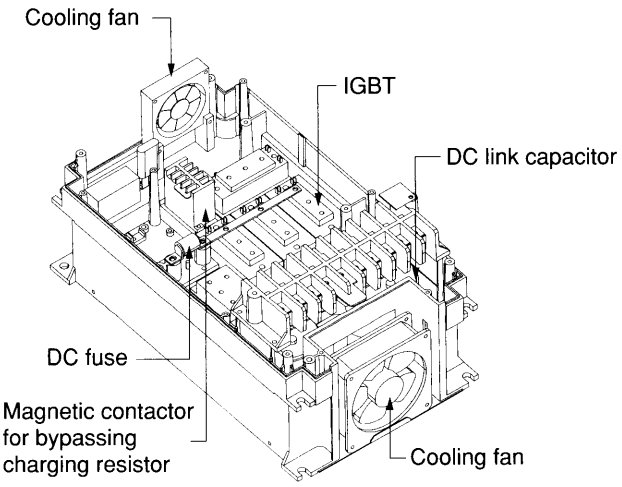


Fig. 3-8 Inverter view, construction and components (continued)

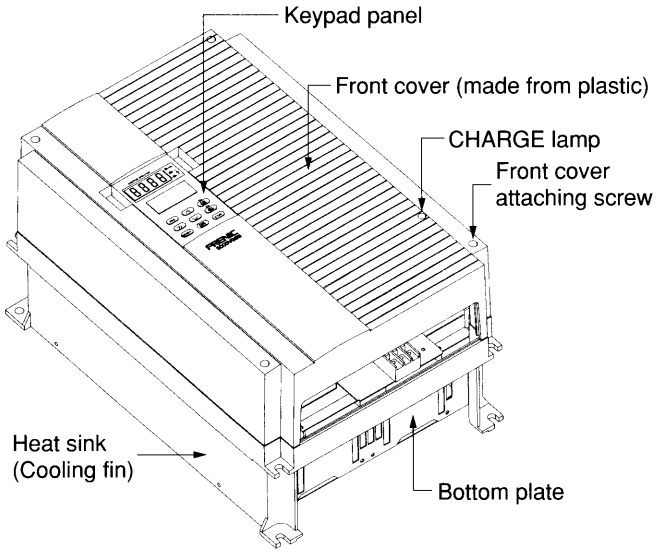
3) FRN11VG5S-2, FRN7.5VG5N-2
FRN11VG5S-4, FRN15VG5S-4
FRN7.5VG5N-4, FRN11VG5N-4

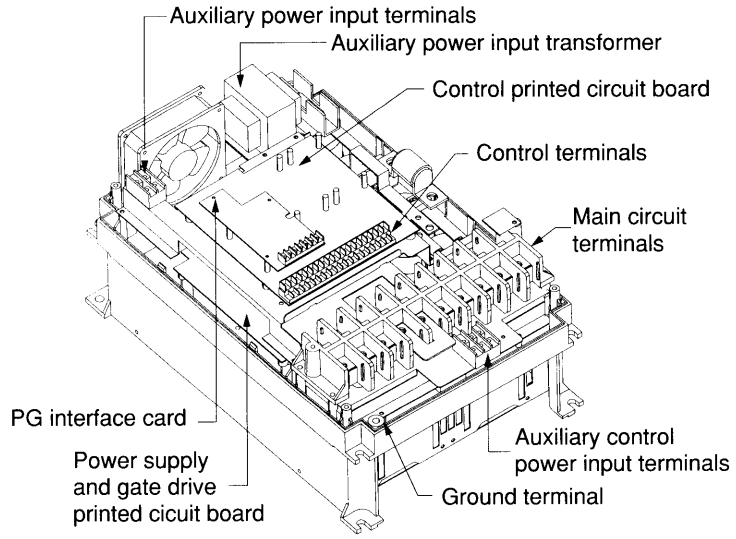


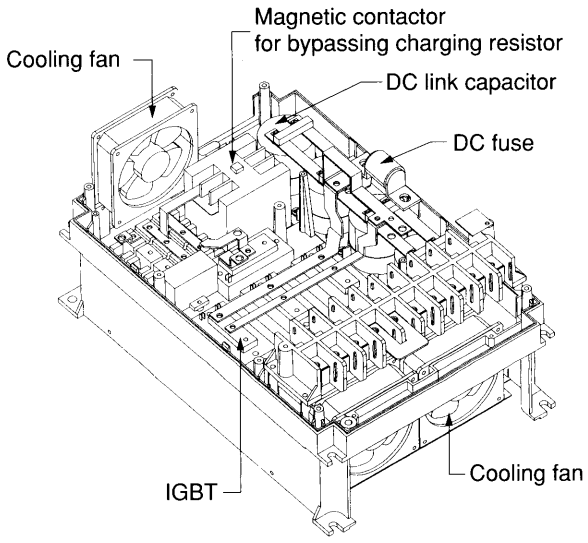




4) FRN15VG5S-2, FRN22VG5S-2
FRN11VG5N-2, FRN18.5VG5N-2
FRN18.5VG5S-4, FRN22VG5S-4
FRN15VG5N-4, FRN18.5VG5N-4



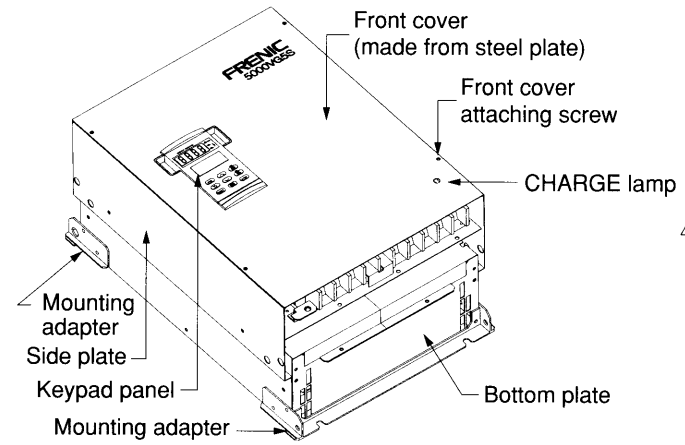


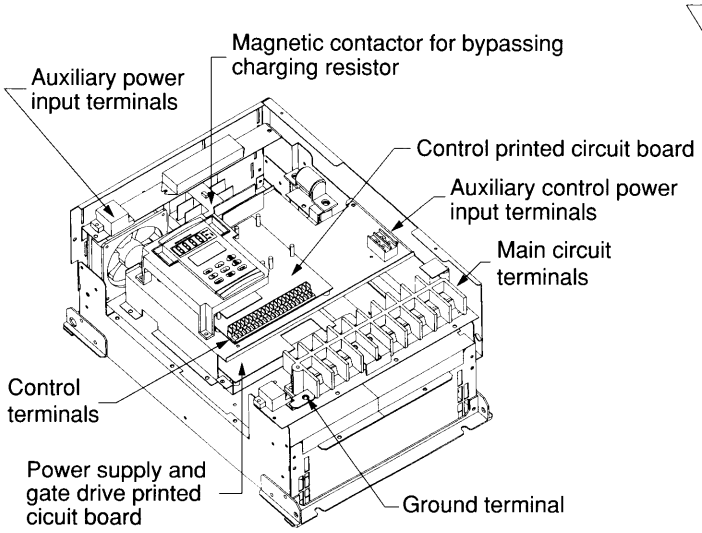


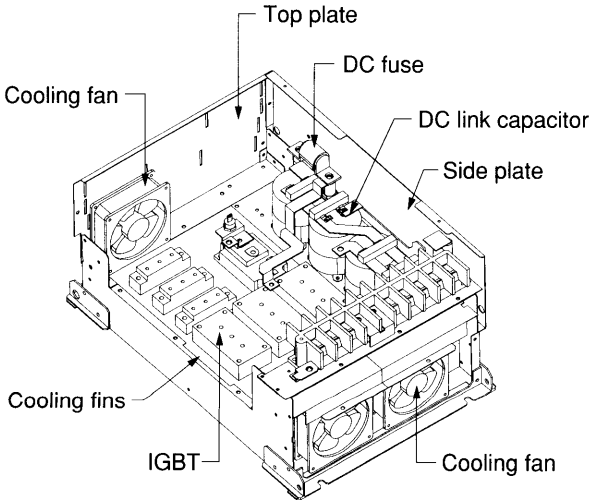
NOTE : *200V series inverters are not equipped with auxiliary power input terminals and transformer*

Fig. 3-8 Inverter view, construction and components (continued)

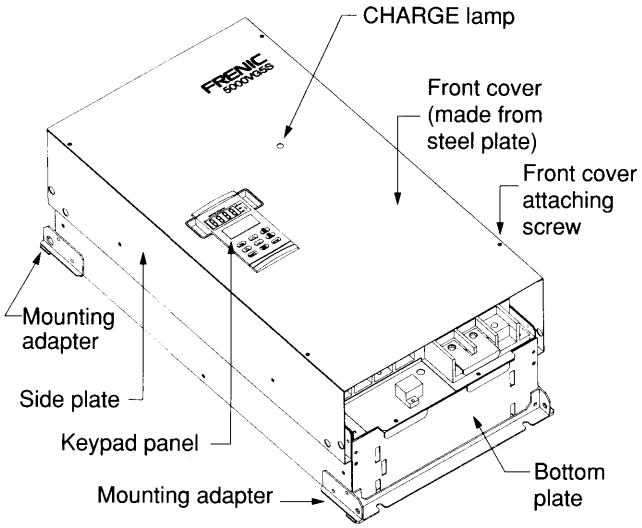
5) FRN30VG5S-2, FRN22VG5N-2
FRN30VG5S-4, FRN37VG5S-4
FRN22VG5N-4, FRN30VG5N-4

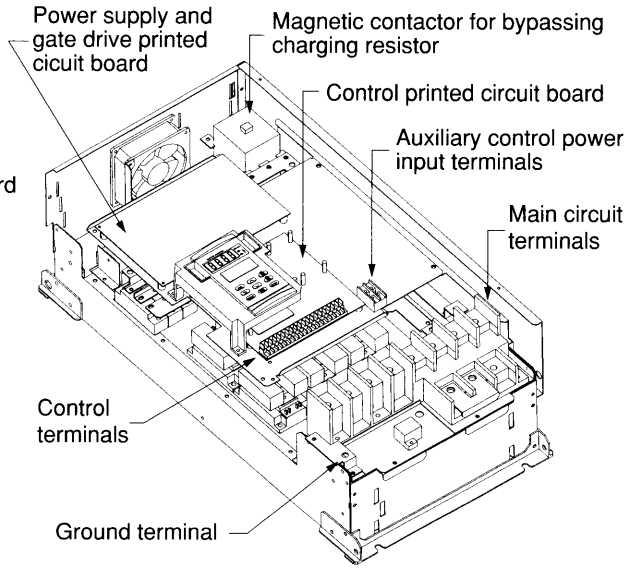


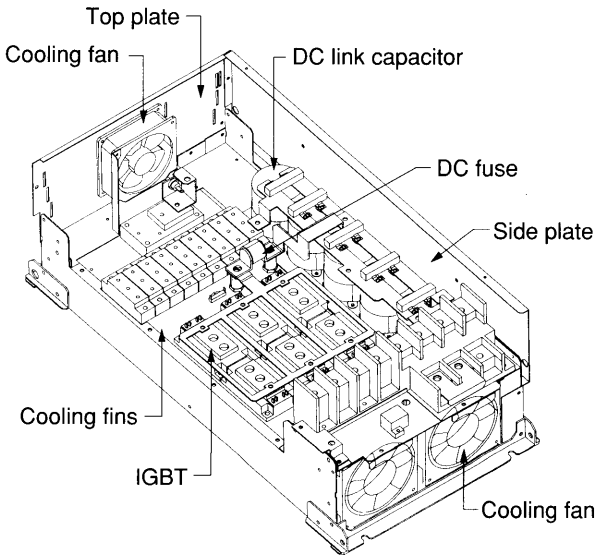




6) FRN37VG5S-2, FRN45VG5S-2
FRN30VG5N-2, FRN37VG5N-2



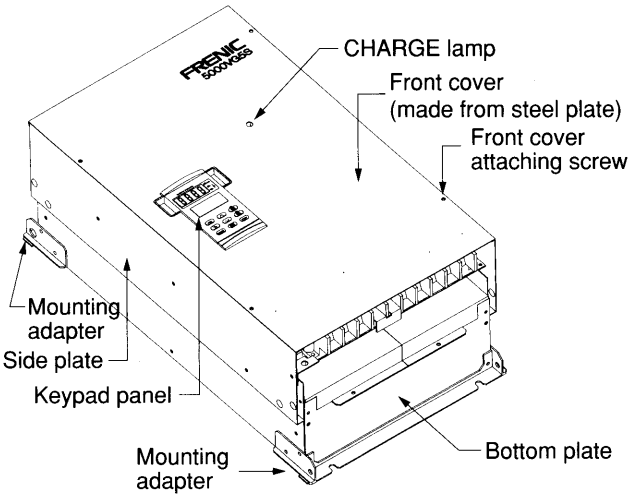


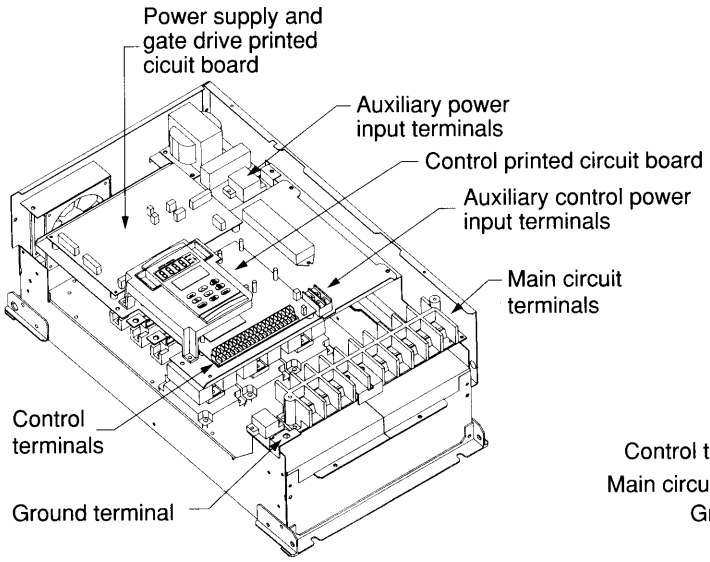


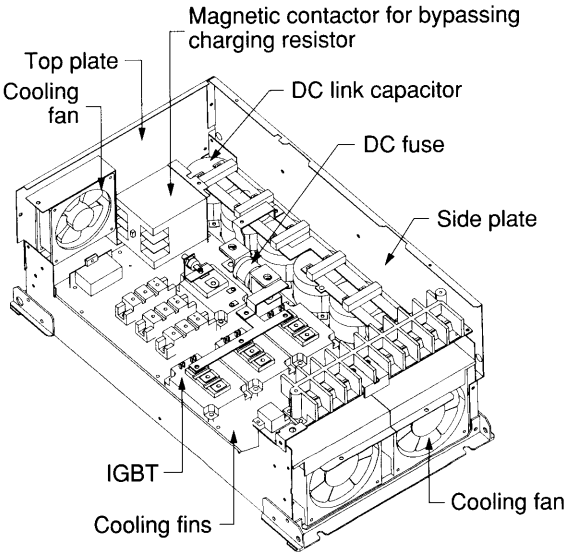
NOTE : *200V series inverters are not equipped with auxiliary power input terminals.*

Fig. 3-8 Inverter view, construction and components (continued)

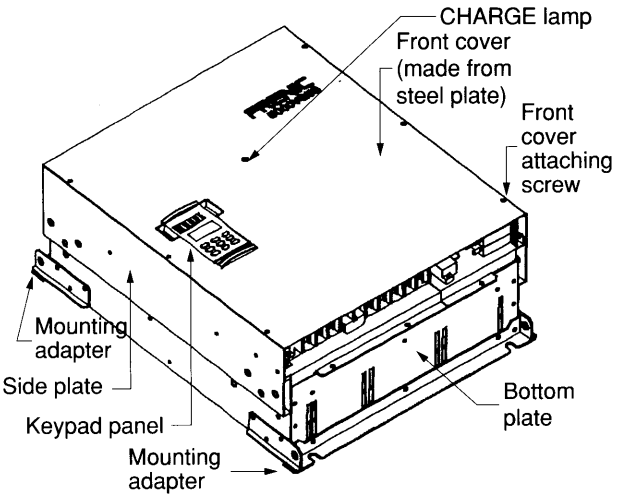
7) FRN45VG5S-4, FRN37VG5N-4

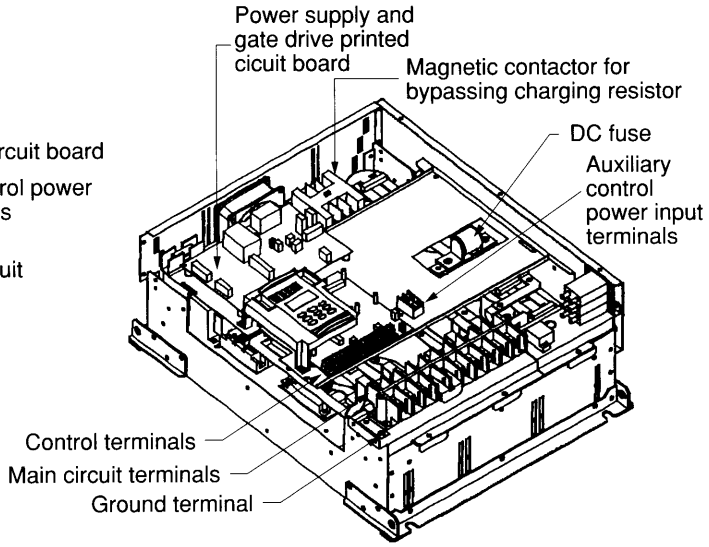






8) FRN55VG5S-4, FRN45VG5N-4





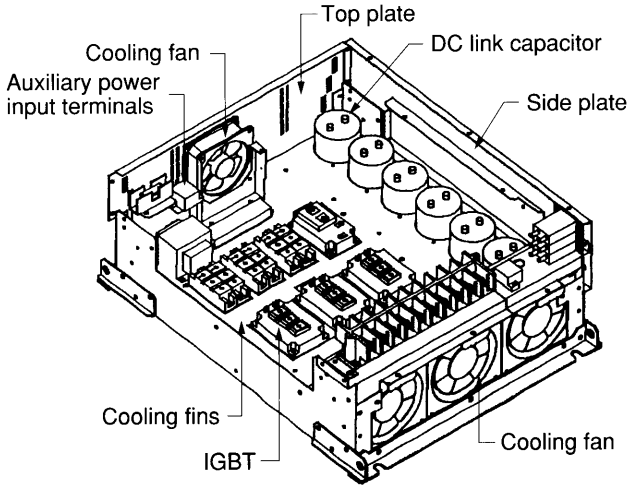
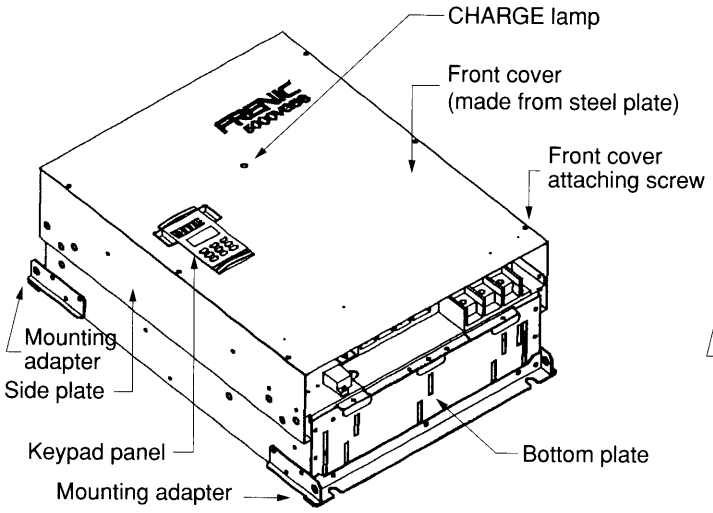
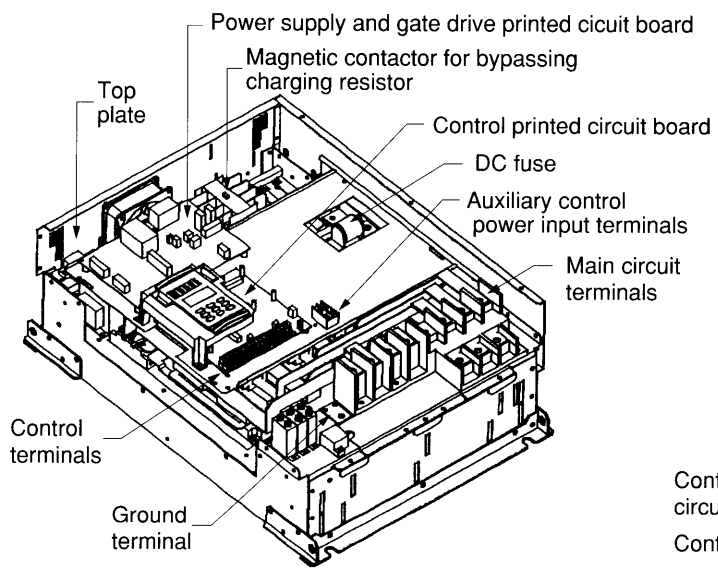
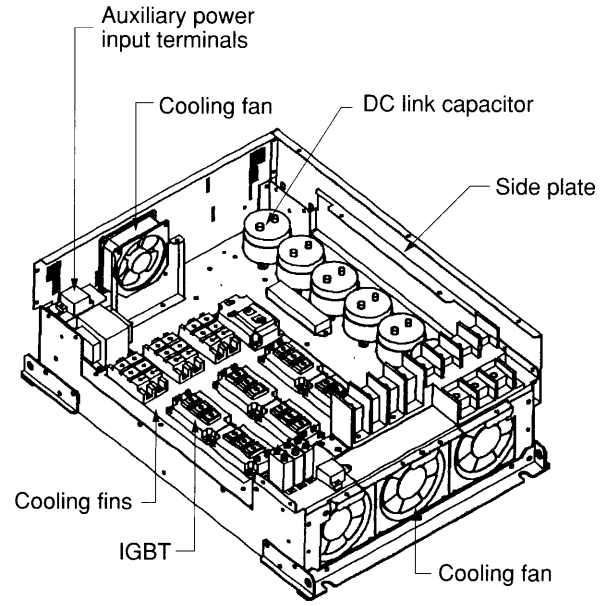


Fig. 3-8 Inverter view, construction and components (continued)

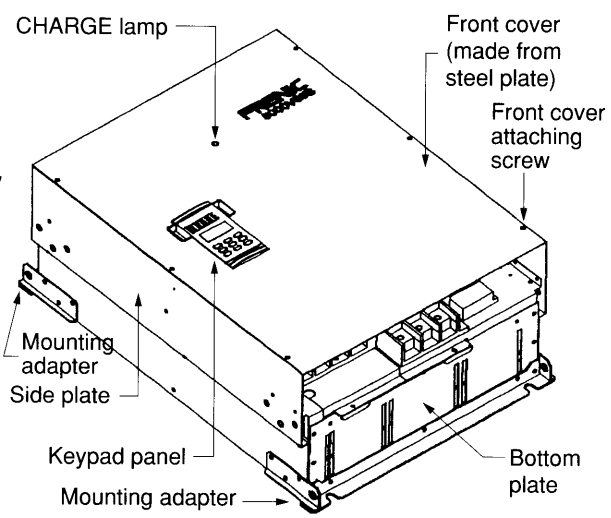
9) FRN55VG5S-2, FRN45VG5N-2
FRN75VG5S-4

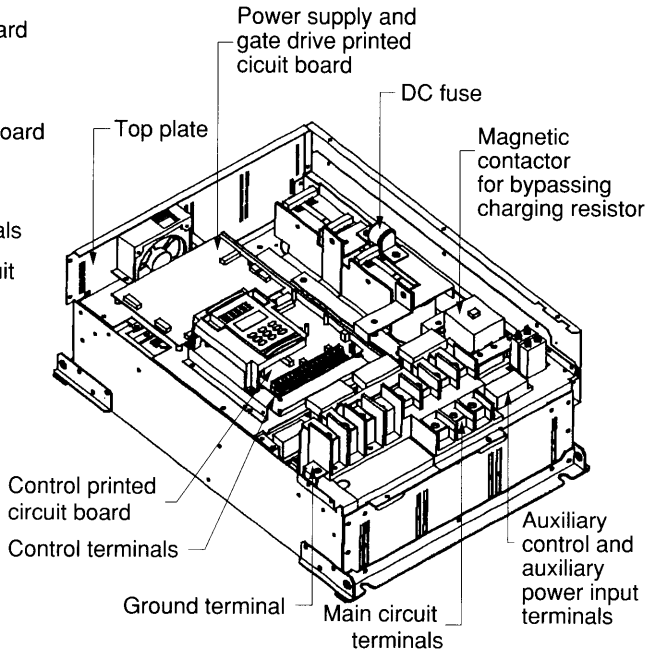


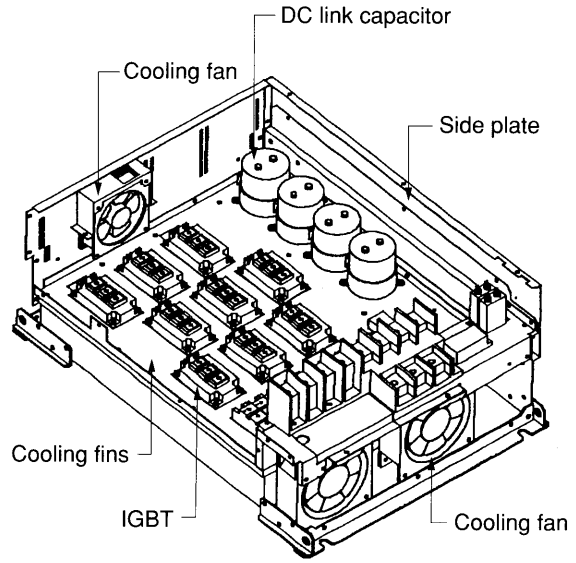




10) FRN75VG5S-2



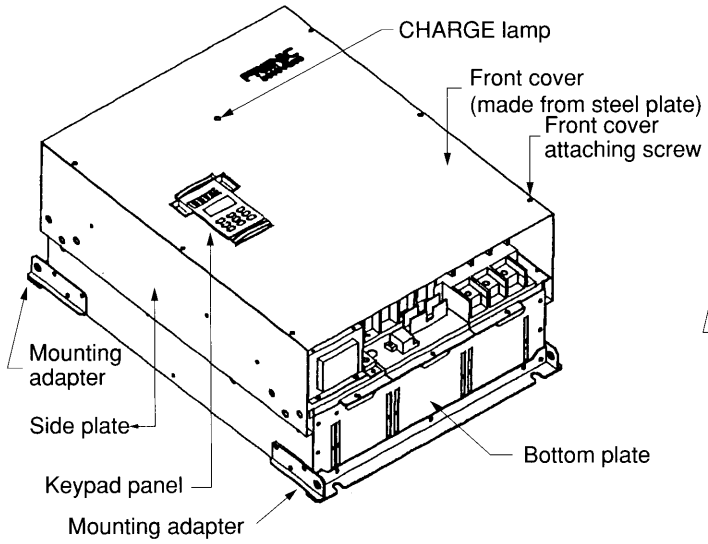


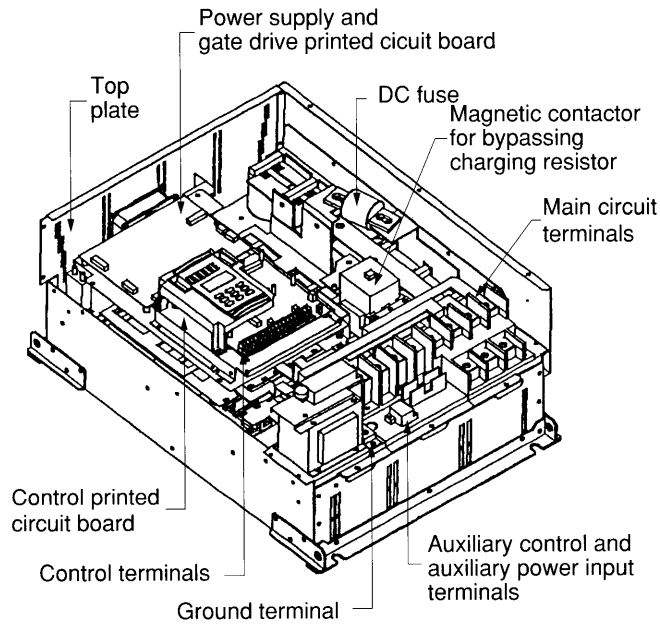


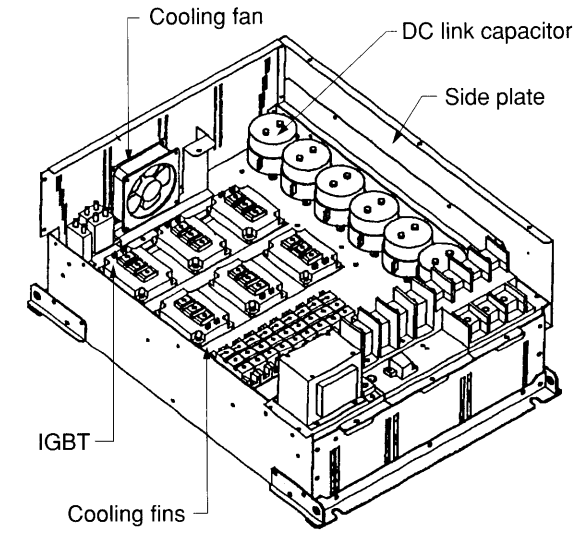
NOTE : *200V series inverters are not equipped with auxiliary power input terminals .*

Fig. 3-8 Inverter view, construction and components (continued)

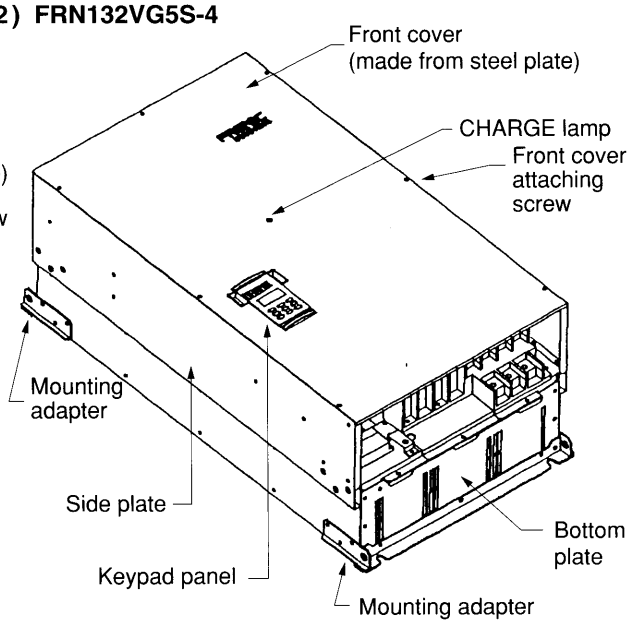
11) FRN90VG5S-4, FRN110VG5S-4

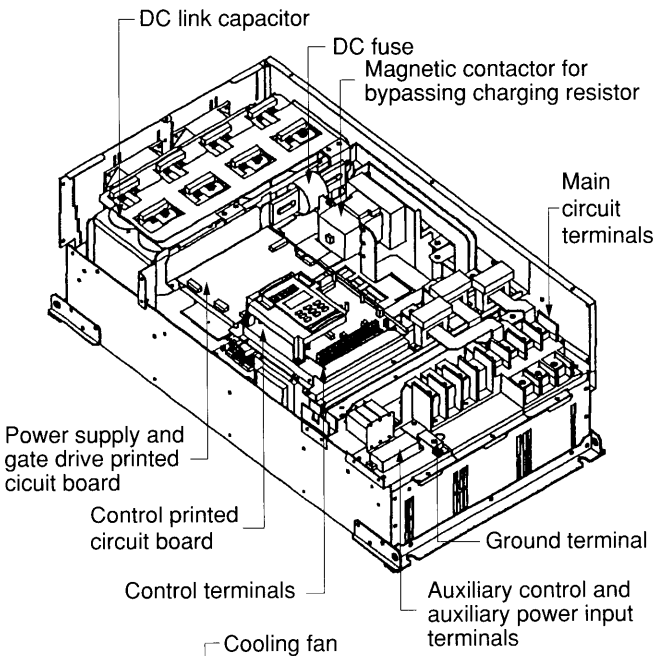






12) FRN132VG5S-4





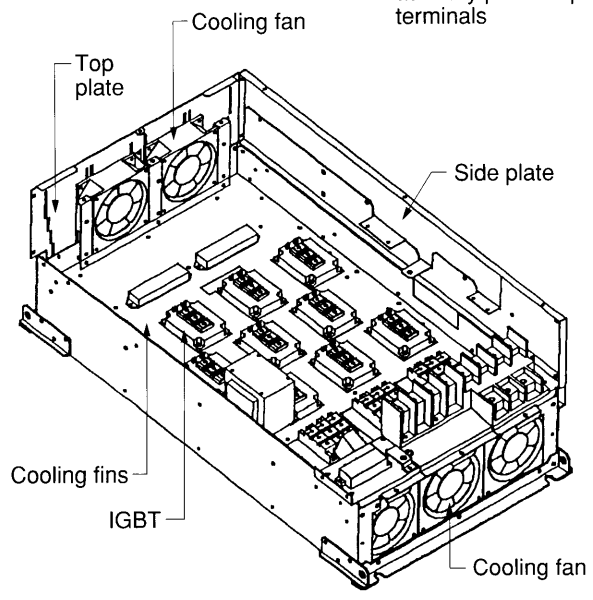
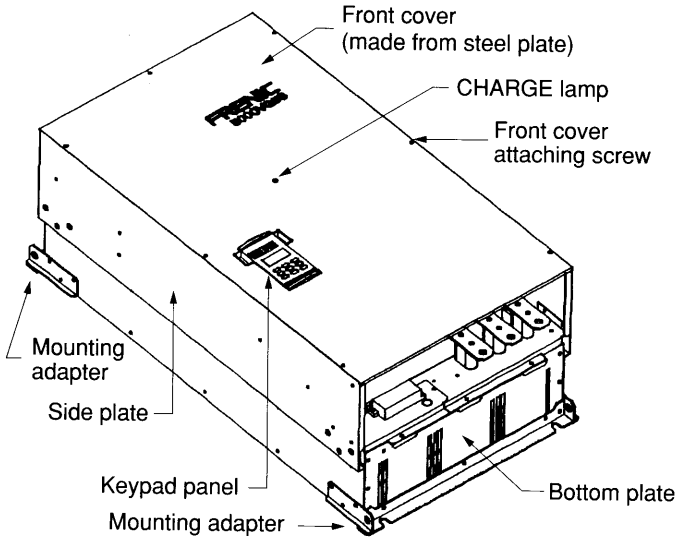
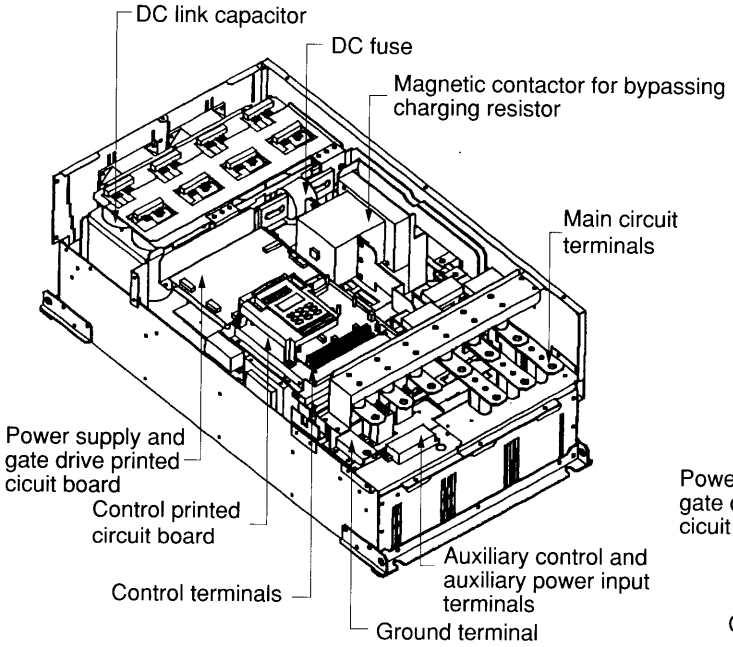
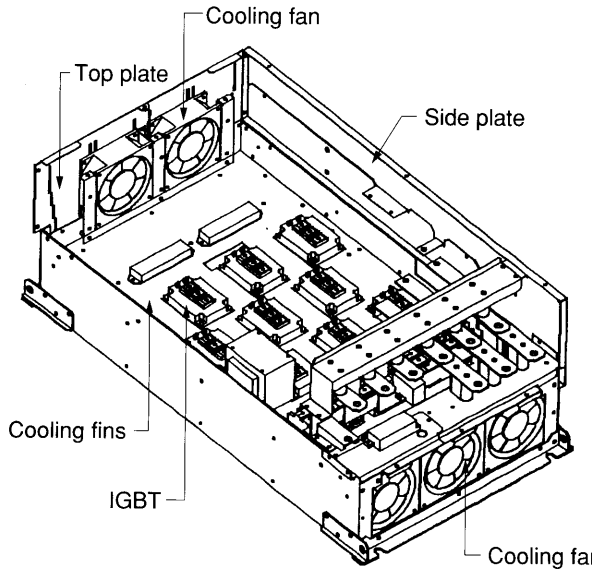


Fig. 3-8 Inverter view, construction and components (continued)

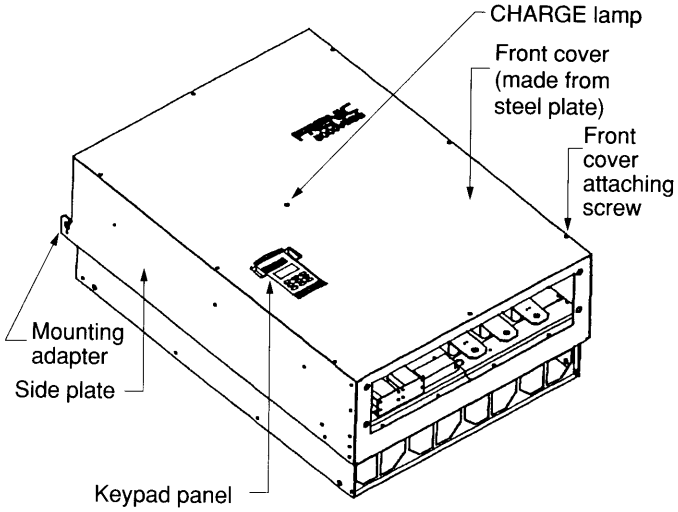
13) FRN160VG5S-4

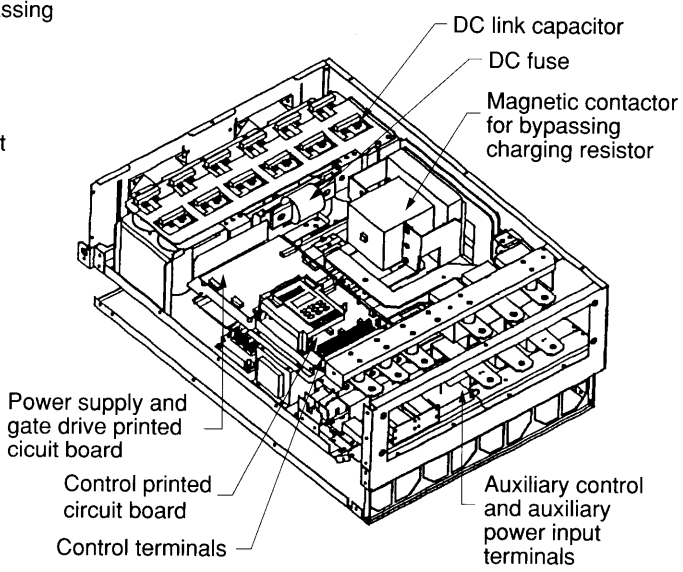


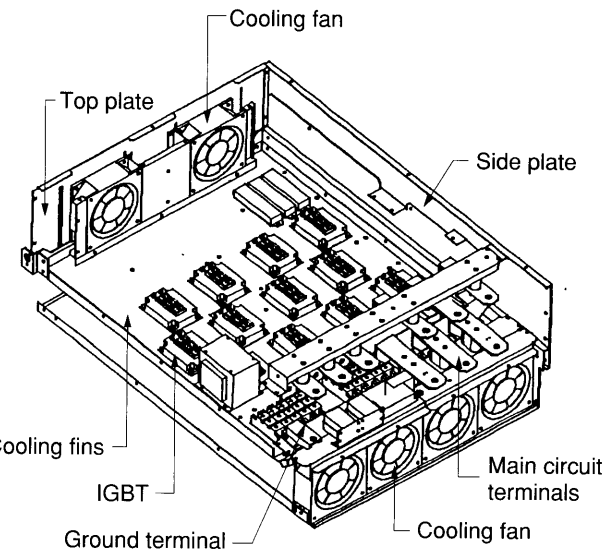




14) FRN90VG5S-2
FRN200VG5S-4, FRN220VG5S-4







NOTE : *200V series inverters are not equipped with auxiliary power input terminals.*

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℃
— The storage temperature is between -25 and +65℃.
— 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 temparature 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. Otherwise, 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℃.
— 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/s^2 {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 temparature 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
" FRENIC5000VG5S " or " FRENIC5000VG5N " right side up.

NOTE :
— *Mounting screws or bolts should be of appropriate size for weight of inverter.*
— *See appropriate view in Section 3-6 and 3-7 pp. 13 to 20 for the location of mounting holes.*

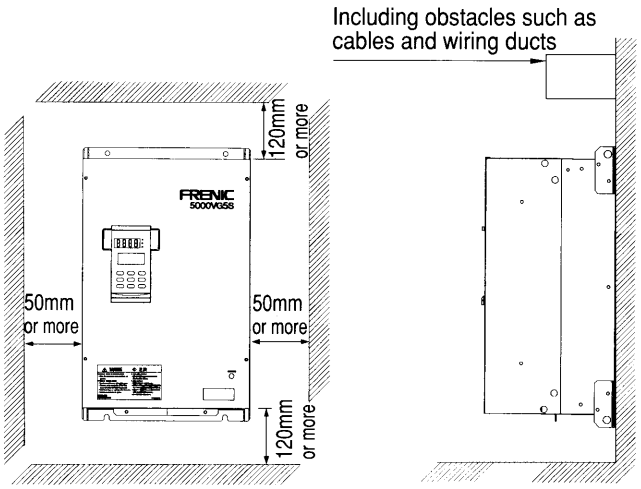


Fig. 5-2-1 Inverter mounting direction and clearance

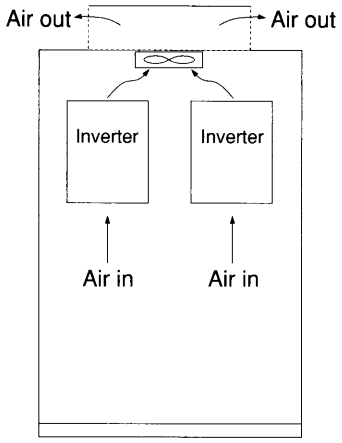
Operating inverter generates heat. Provide sufficient space as shown in Fig.5-2-1 to ventilate cooling air. Do not install wiring and duct in this space.

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

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

When two or more inverters are installed in a same equipment enclosure or a control panel, locate them side by side in order to negate the heat generated from affecting each other. If the inverters must be arranged vertically, provide a partition board between the inverters to negate the heat by the lower unit from affecting the upper unit.

1) Horizontal arrangement



2) Vertical arrangement

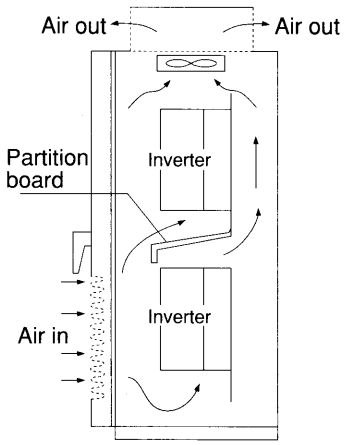
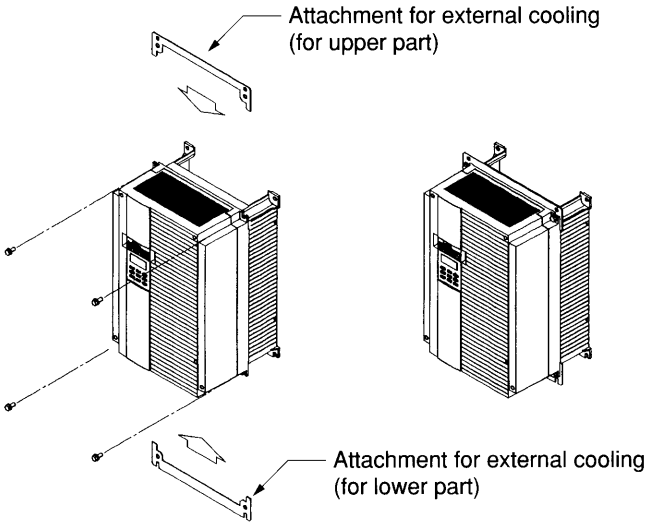


Fig. 5-2-2 Mounting arrangements of two or more inverters

Inverters are shipped with the adapter mounted for internal cooling type. If external cooling type is required, the adapter must be positioned otherwise as shown in Fig. 5-2-3. With the external cooling type, the cooling fin 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 and the control panel is reduced.

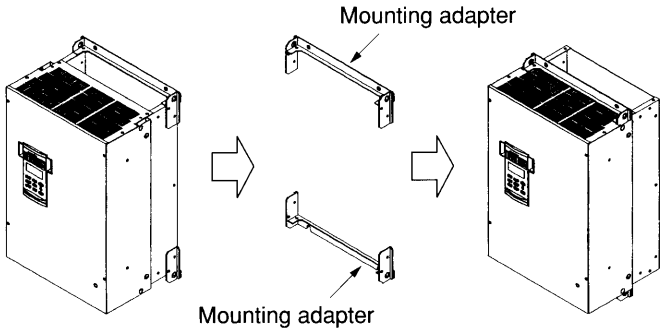
NOTE : *The external cooling type should be avoided in a location where fibre chips or humid dusts may cause choking of the cooling fin.*

1) Standard series : Inverter with capacity of FRN22VG5S and below
Low noise series : Inverter with capacity of FRN18.5VG5N and below



Fix the attachments for external cooling for optional use
(Fixing screws are not attached and especially prepared)

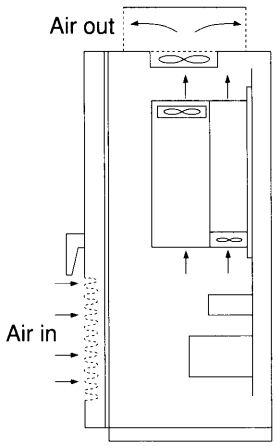
2) Standard series : Inverter with capacity of FRN30VG5S and above
Low noise series : Inverter with capacity of FRN22VG5N and above



Change the fixed position of the mounting adapters on the enclosure
(Fixing screws are applicable)

3) Example of mounting method

〈Inverter cooled inside the enclosure〉



〈Inverter cooled outside the enclosure 〉

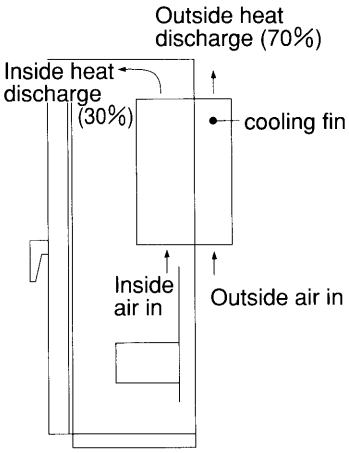


Fig. 5-2-3 Change of mounting method

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.

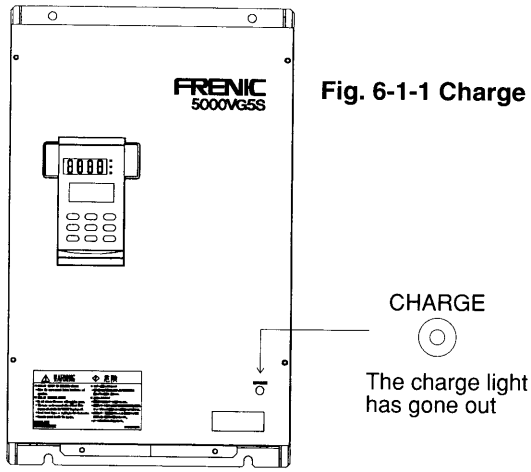


Fig. 6-1-1 Charge lamp

⚠ CAUTION

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

Remove a front cover, referring to Fig. 6-1-2. Then, terminals for connecting wire appear. Connect wires to the terminals according to following description.

a) In the case of front cover of plastic
Remove the keypad panel according to the instruction in "8-2 Keypad panel handling" (p. 49).

After removing the keypad panel, loosen the 4 front panel attaching screws. Then, remove the front panel.

NOTE : *In the case of the inverters with a plastic front cover (inverters for applicable motors of rated output 22 kW or less in standard series; 18.5 kW or less in low noise series), remove the front cover after detaching a keypad panel. If being removed the front cover attaching the keypad panel, connector of the keypad panel may be damaged. As for detaching the keypad panel, see "8-2 Keypad panel handling" (p. 49).*

b) In the case of front cover of steel plate
Loosen the front cover attaching screws (the number differs with the inverter capacity) and remove the front cover.
Since the keypad panel is fixed to the front cover, it is unnecessary to remove the keypad panel.

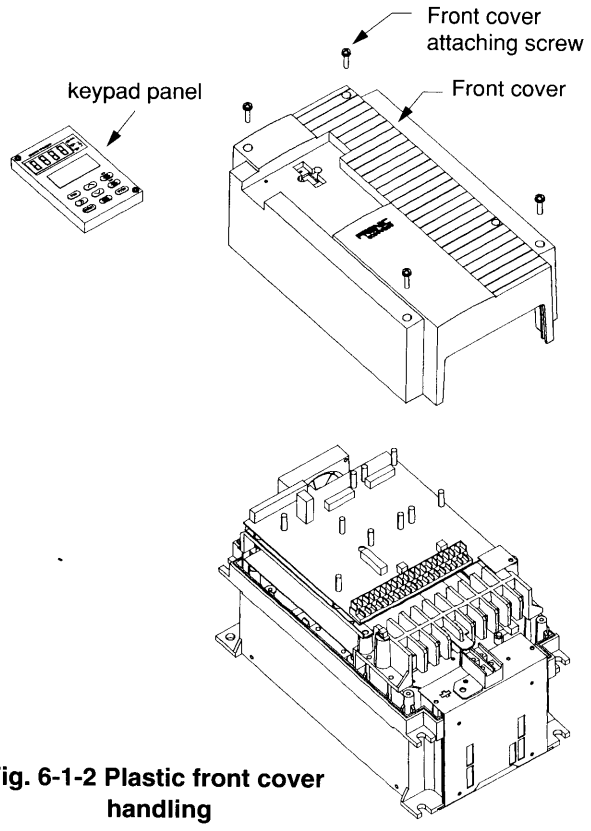


Fig. 6-1-2 Plastic front cover handling

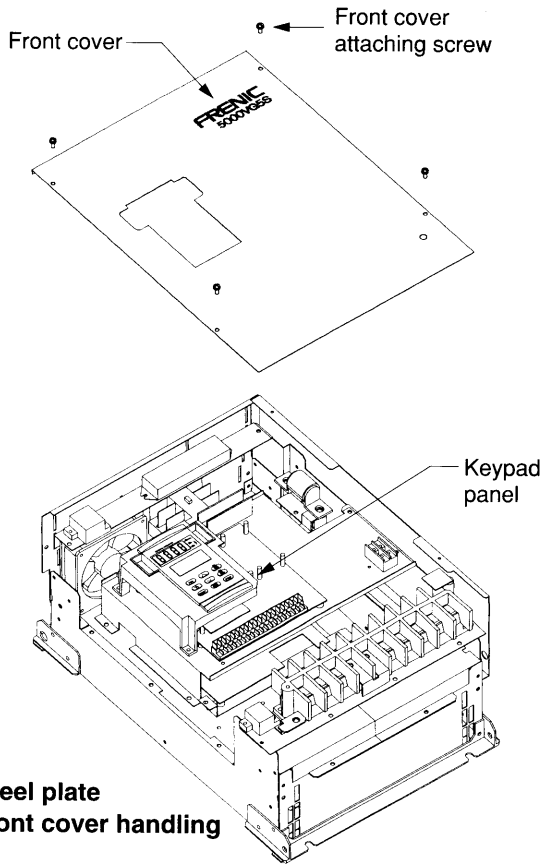
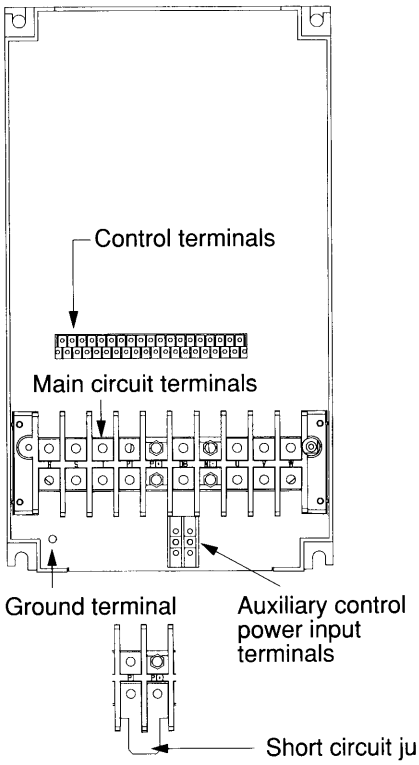


Fig. 6-1-3 Steel plate front cover handling

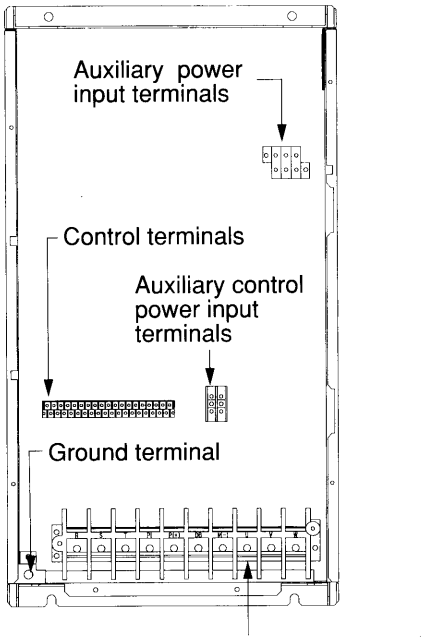
Connect the wires to the terminals according to the descriptions thereafter. The arrangements of the terminals are roughly classified into 5 kinds as shown in Fig. 6-1-4.

NOTE : *Refer to the exact terminal positions shown in "3-6 200V series dimensions" and "3-7 400V series dimensions"(PP.13 to 20).*

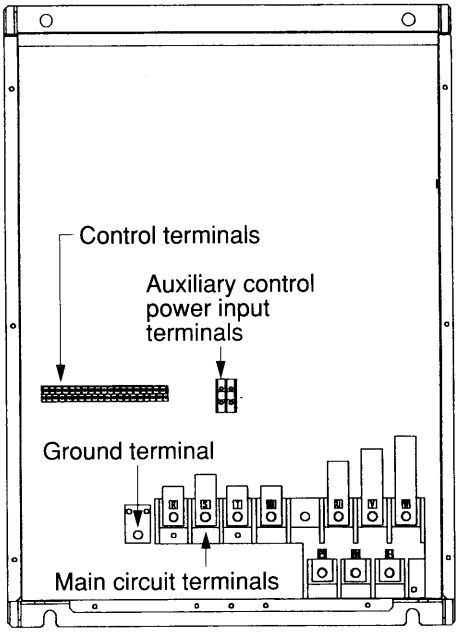
1) FRN15VG5S-4



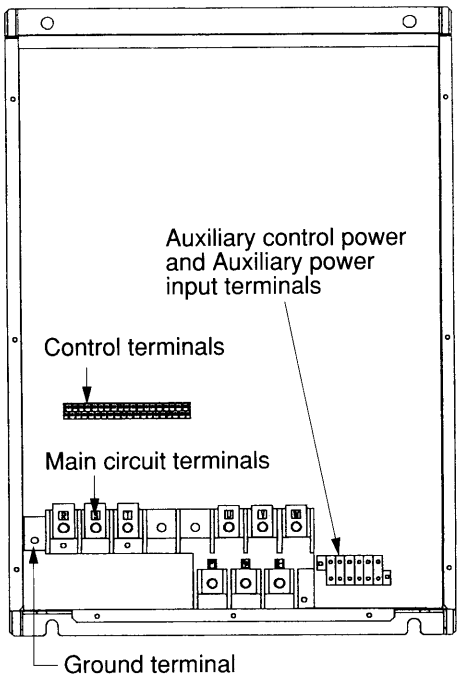
2) FRN45VG5S-4



3) FRN55VG5S-2



4) FRN75VG5S-2



5) FRN90VG5S-2, FRN200VG5S-4, FRN220VG5S-4

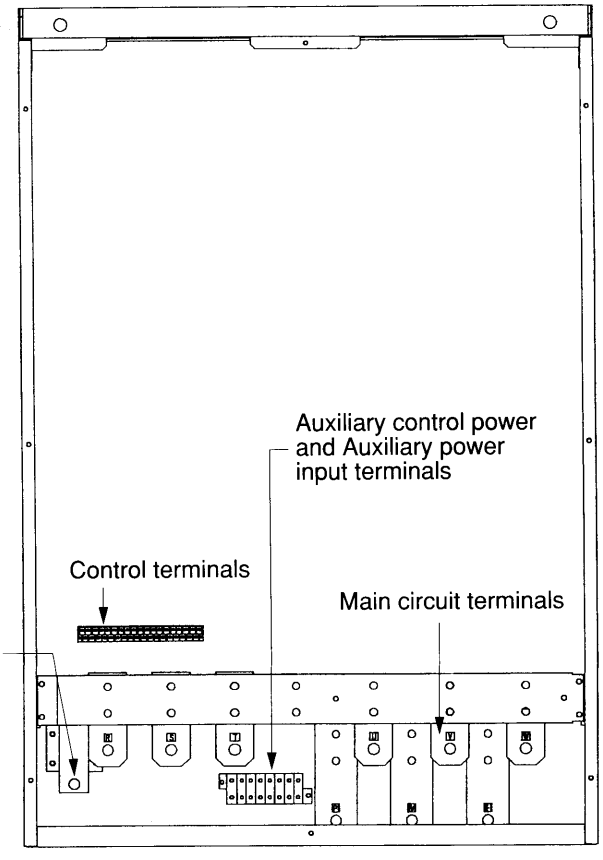
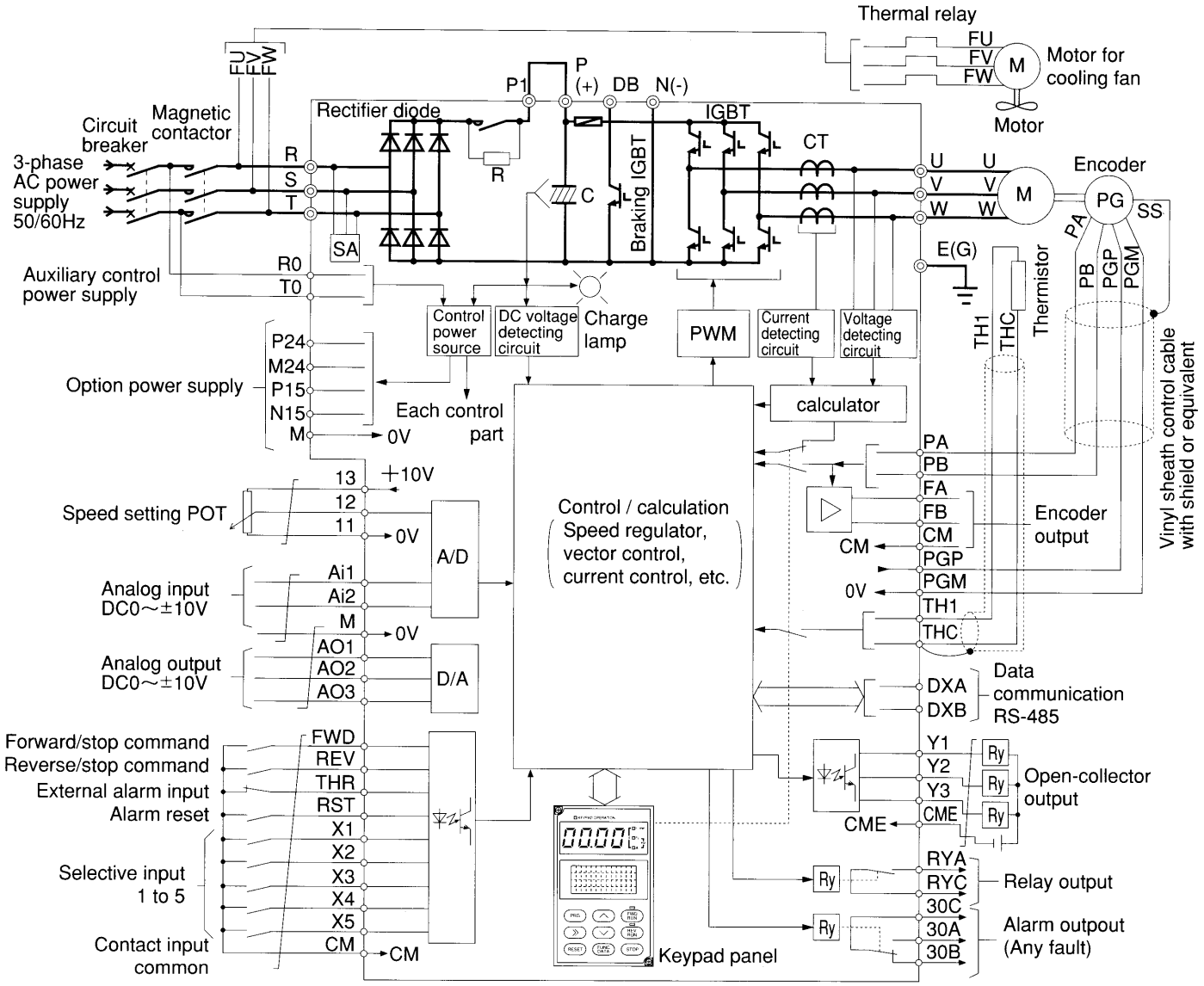


Fig. 6-1-4 Terminal arrangement

6-1 Description of terminal functions



NOTE :

— *This figure shows an example that braking IGBTs are built in an inverter, and an encoder, a thermistor for detecting temperature and a motor for cooling fan are attached to the dedicated motor.*

— *Use sealed wires for wires with ∫ mark. When using vinyl wires, these wires should be twisted.*

Table 6-1-1 Main circuit and ground terminals

Label	Name	Description
R, S, T	Main circuit power supply	Connection to 3-phase power supply
U, V, W	Inverter output	Connection to 3-phase motor
P1, P(+)	DC link reactor connection	Connection to DC link reactor, if necessary
P(+), DB	Braking resistor connection	Connection to optional braking resistor terminal DB is attached to inverters for standard applicable motor for 55 kW or less of 200 V series and 75 kW or less of 400 V series
P(+), N(-)	Braking unit connection	Connection to optional regenerative braking unit or braking unit
E(G)	Ground terminal	Terminal for grounding inverter , connection to ground

Table 6-1-2 Control terminals

Item	Label	Name	Description		
Analog signal	11	Speed setting common	Reference potential of terminal 12 (0 V line)		
	12	Speed setting input	Input voltage: 0 to ±10 V DC, + polarity: FWD, - polarity: REV, Input resistance; 10 kΩ		
	13	Speed setting power supply	Output: + 10 V DC, 10 mA max.		
	M	Analog common	Common reference potential of terminal Ai1, Ai2, AO1, AO2, AO3, P15, N15 (0 V line)		
	Ai1	Analog input1	When allocating data of function "117 Ai1,Ai2 function select", analog signals can be selectively inputted	Input voltage: 0 to ±10 V DC Input resistance: 10 kΩ	
	Ai2	Analog input2			
	AO1	Analog output1	When allocating data of function "126 AO1, AO2, AO3 function select", analog signals can be selectively outputted	Output voltage: 0 to ±10 V DC Load resistance: 3 kΩ or more	
	AO2	Analog output2			
	AO3	Analog output3			
Control input (Contact)	CM	Contact input common	Common terminal of contact input terminals		
	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		
	THR	External alarm input	THR-CM OFF: Activation of protection function and stop of alarm, ON: Operation possible		
	RST	Alarm reset	RST-CM ON: Release of the activated protection after removal of fault condition alarmed by the protection		
	X1	Selective input 1	When allocating data of functions "111 to 113 X1-X5 function select", control signals can be selectively inputted		
	X2	Selective input 2			
	X3	Selective input 3			
	X4	Selective input 4			
	X5	Selective input 5			
Control and monitoring output	CME	Open-collector common	Common terminal for Y1, Y2 and Y3 terminals	Allowable load: 27 V DC 50 mA max.	
	Y1	Open-collector output 1	When allocating data of function "115 and 116 Y1-Y3, RY function select", control and indication signals can be selectively outputted		
	Y2	Open-collector output 2			
	Y3	Open-collector output 3			
	RYA	Relay output		Contact capacity:220 V AC 0.5 A ($\cos\phi$ =0.3)	
	RYC				
	30A	Alarm output (Any fault)	Output of activated state of protection One changeover contact Activated: 30A-30C: ON Not activated: 30B-30C: ON		
	30B				
	30C				
Dedicated motor connection	TH1	Thermistor connection	Connection terminals for thermistor built into a dedicated motor		
	THC				
	PGM	Encoder common	Common reference potential for terminals PGP, PA and PB		Terminals are on an interface card (Not existed on PG-sensorless type)
	PGP	Encoder power supply	Output: +15 V DC		
	PA	Encoder A-phase	Two-phase signal connection terminals for detection of motor speed and rotating direction		
	PB	Encoder B-phase			
	FA	Output of encoder A-phase	Output terminals of encoder A- and B-phase signal output (Output in the same phases of terminals PA and PB)	Allowable load: 27 V DC, 15 mA max. Inner voltage drop: 1.8 V at 15 mA Max. frequency: 100 kHz	
	FB	Output of encoder B-phase			
	CM	Encoder output common	Common terminal for terminals FA and FB		
Commu -nication	DXA	For data communication	Connection terminals of communication lines of Interface standard RS485 (In detail, refer to RS485 Communication Function Instruction Manual INR-HF50730)		
	DXB				
Option power supply	P24	+24 V DC power supply	Output: +24 V, 200 mA max	Connected when using control option cards. Refer to instruction manual of each option	
	M24	+24 V DC power supply common	Common reference potential for terminal P24 (0 V)		
	P15	+15 V DC power supply	Output: +15 V, 150 mA max		
	N15	-15 V DC power supply	Output: -15 V, 150 mA max		

Table 6-1-3 Auxiliary control power and auxiliary power input terminals

Label		Name	Description	
200 V series	400V series			
R0, T0		Auxiliary control power input	Terminals for back-up of control power supply Connected to the same power supply system as main circuit	
—	U1, U2	Aux. power input terminal	Attached to the inverter for standard applicable motor of 18.5 kW or more of 400V series, and used for power supply transformer for cooling fan and magnetic contactor for bypass of charging resistor	Connected at factory delivery When main circuit voltage is 380 V, or parts are exchanged, connection work is necessary.

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 and the Braking resistor (P(+), DB, 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 power supply terminals R, S, T. It is not necessary to pay attention to phase rotation due to AC/DC conversion in the inverter.

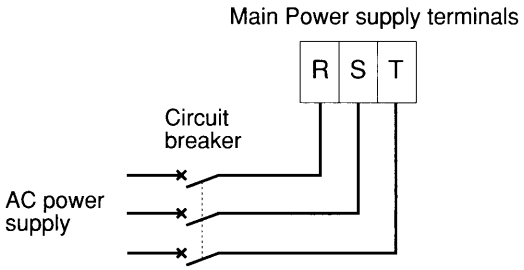


Fig. 6-2-1 Power supply connections

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 auxiliary control power input terminals, refer to "6-4" a) (p.38).*

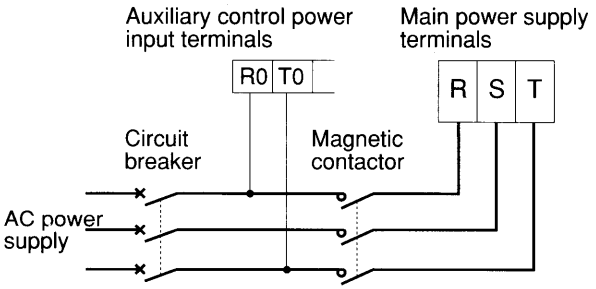


Fig. 6-2-2 Magnetic contactor connections

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.

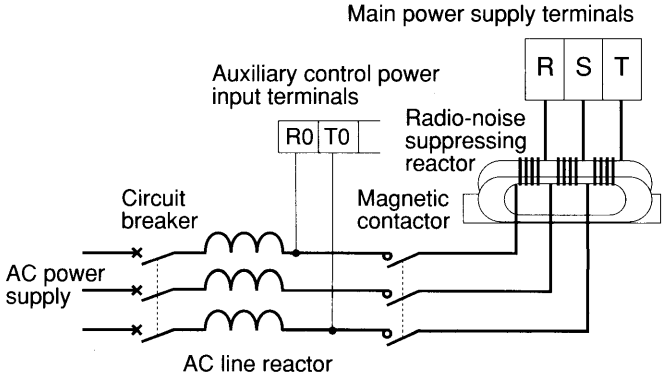


Fig. 6-2-3 Radio-noise suppressing reactor connections

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 harmonics.

Match the output terminals U, V and W of the inverter to the terminals U, V and W of the motor respectively.

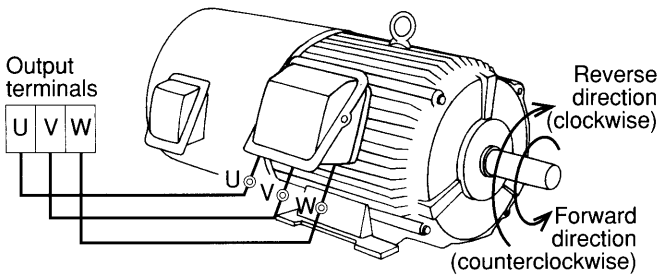


Fig. 6-2-4 Motor connections

NOTE : *If not matching the phases, the statuses of the motors with and without encoder are different.*

— *With encoder*
The motor may reversely rotate against the running command. Connect the terminals correctly.

— *Without encoder*
The rotation direction may not match the command. In this case, replace any 2 phases of the U, V and W phases each other.

When connecting a magnetic contactor, make a circuit possible to switch only when the inverter stopping.
If switching it during the inverter outputting, the inverter does not trip, but it may become the cause of failure or reduction of life by sudden current change.

In the case of motor with encoder, keep the wiring distance between the inverter and motor 100 m or less. This is because of restriction based on the specification of an encoder.

If connecting a reactor except the radio-noise suppressing reactor, it may cause a trouble such as reduction of motor torque etc. When necessary to connect reactor, inquire at the Company.

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 or less 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. 6-2-5

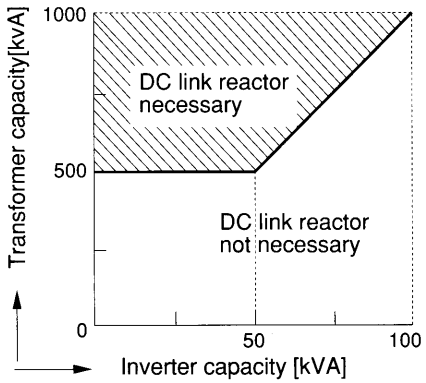


Fig.6-2-5 Application DC link reactor(1)

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

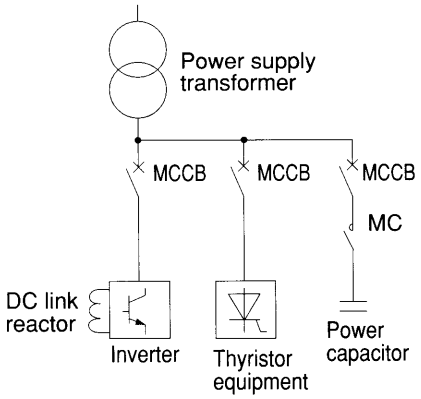


Fig.6-2-6 Application DC link reactor(2)

— 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. 6-2-7.

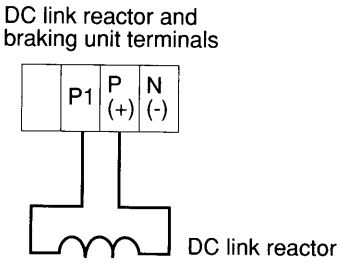


Fig. 6-2-7 DC link reactor connections

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

⚠ WARNING

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

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.*

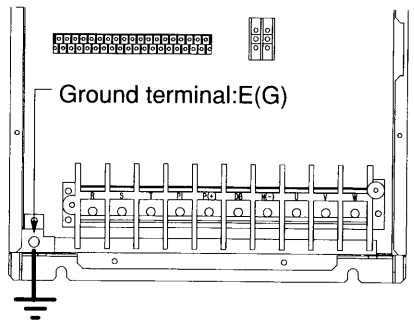


Fig. 6-3-1 Grounding of ground terminal

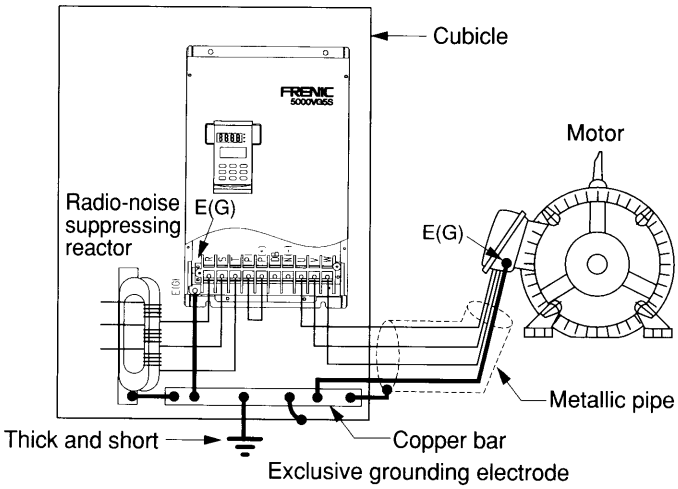
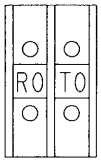


Fig. 6-3-2 Grounding of inverter system

6-4 Auxiliary control power and auxiliary power input circuit



FRN55VG5S-2, FRN45VG5N-2 or less
FRN75VG5S-4, FRN45VG5N-4 or less

Fig. 6-4-1 Auxiliary control power input terminals

1) FRN18.5VG5S-4 to FRN22VG5S-4 2) FRN30VG5S-4 to FRN75VG5S-4
FRN15VG5N-4 to FRN18.5VG5N-4 FRN22VG5N-4 to FRN45VG5N-4

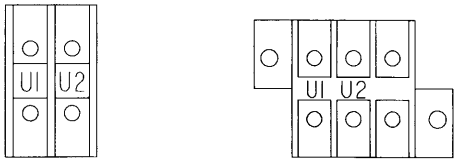
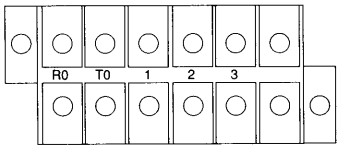


Fig. 6-4-2 Auxiliary power input terminals

1) FRN75VG5S-2 or more (200V series)



2) FRN90VG5S-4 or more (400V series)

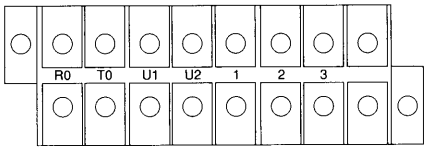


Fig. 6-4-3 Auxiliary control power and auxiliary power input terminals

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. 6-4-4.

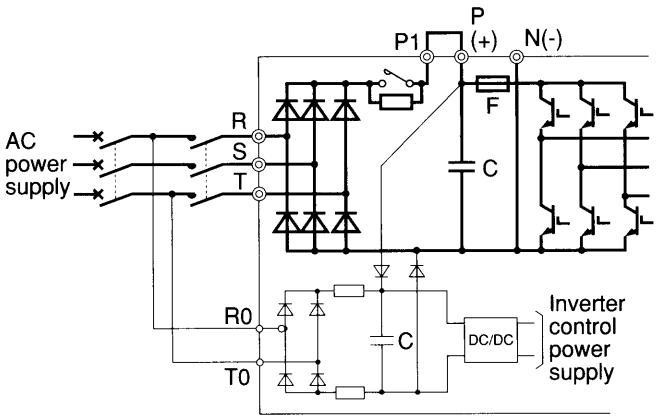


Fig. 6-4-4 Control power supply circuit

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

b) Auxiliary power input terminals

These terminals are provided for the 400 V series. When the AC power supply voltage is specified as shown in Table 6-4-1, remove the wire connected to the U1 terminal and connect it to the U2 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) Terminal label 1,2 and 3 terminals

These terminals are attached to the inverter for a motor with rated output capacity which is 75kW or more in 200V series and 90kW or more in 400V series. Since these terminals are used for jointing with the inverter inner crcuits and the option units, please do not connect any wire to these terminals unless otherwise states.

d) Power supply terminals for cooling fan of a dedicated motor

These terminals are not attached on an inverter. Connect the terminals FU, FV and FW of the cooling fan motor of the dedicated motor to the power supply of the inverter.

NOTE :

— *In a part of motor, even if the power supply is for 400 V series, but the voltage of the cooling fan motor is for 200 V system. In this case, connect a transformer for voltage matching.*

— *The specification of cooling fan motor varies depending on motor capacity. Connect the circuit following the instructions of the motor.*

6-5 Control circuit

⚠ CAUTION

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

When using the open-collector output terminals (Y1, Y2, Y3 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 ⌠ 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.*

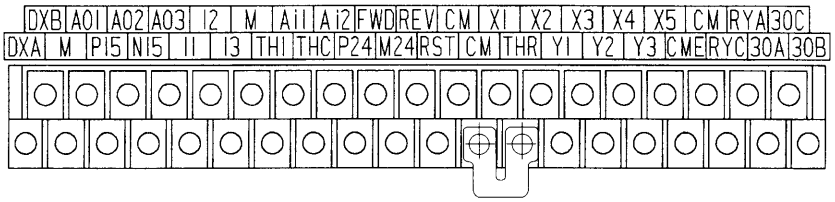


Fig. 6-5-1 Control terminals (Terminals on a control printed circuit board)

The connections of control terminals vary depending upon the data of the function. Regarding the function dependant connections, refer to "9 Function" (p. 83).

a) Analog signal terminals

Connect analog signal terminals according to data of functions.
When using a variable resistor for speed setting POT (Potentiometer), connect it to terminals 13, 12 and 11.

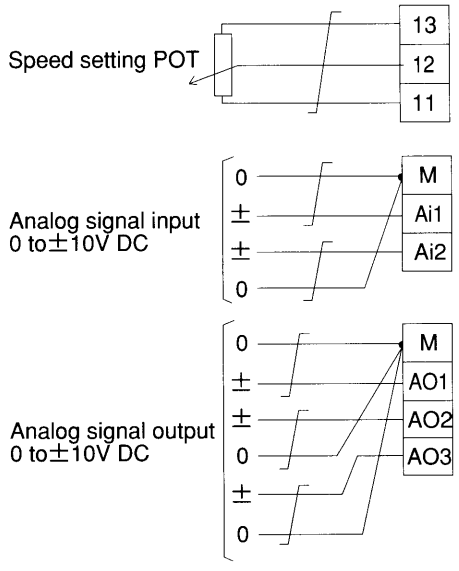


Fig. 6-5-2 Connection of analog signal terminals

NOTE :

— *The common terminals 11 and M are not isolated each other. They are connected in the printed circuit board.*

— *Since troubles may occur by inducing noise into the wiring, it is recommended to use twisted wires with shield.*

b) Control (contact) input terminals

These are in weak-signal circuits of 24 V DC, 3 mA. Connect contacts for weak-signal to avoid contact error. Connecting contacts should be make contacts, which make ON by signal (command) input except contact connected to the external alarm input terminal THR.

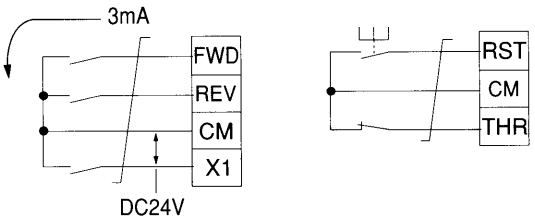


Fig. 6-5-3 Connection of contact input terminals

A short-circuit jumper is connected between the external alarm terminal THR and contact input common terminal CM at factory delivery. When using them, remove this jumper, and connect a contact making OFF in the abnormal (alarm) case between these terminals.

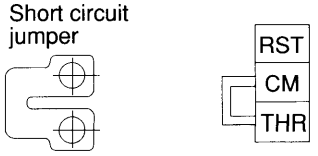


Fig. 5-4-4 Short circuit jumper for control terminals

Reset command can be inputted from both of the terminal RST and RESET key.

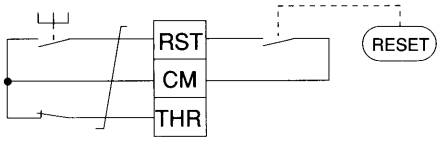


Fig. 6-5-5 Connection of terminals RST and THR

c) Open-collector output terminal connections

It is recommended to use an optional relay card (OPC-VG5-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.*

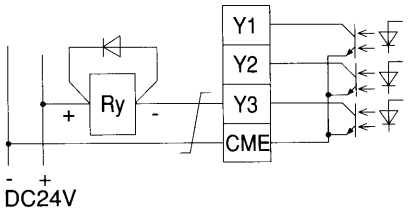


Fig. 6-5-6 Open-collector output terminals

d) Contact output terminals for control and monitoring

Specification of contact connected these terminals is 220 V AC, 0.5 A (cos ϕ =0.3)/life 200,000 times, and 24 V DC, 1 A (T=7 ms)/life 15,000 times. When exceeding this specification, amplify contact capacity by using a relay of larger capacity.

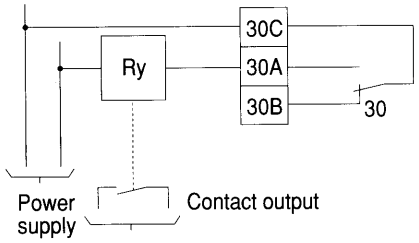


Fig. 6-5-7 Amplification of contact capacity

e) Terminals for connection of dedicated motor

Use these terminals when using the dedicated motor.

NOTE : *As for wiring, use Vinyl sheath cable with shield for control (CVVS) of 2 mm^2 or equivalent.*

Match labels of the terminal THC and TH1 for connecting thermistor to those of motor terminals THC and TH1.

There is a terminal TH2 for a spare thermistor on the motor.
When the thermistor with the terminal TH1 has become disabled by wire break etc, connect the terminal TH2 to the terminal TH1 of the inverter.

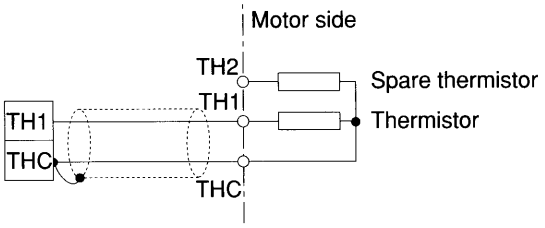


Fig. 6-5-8 Connection of thermistor

Terminals for encoder are positioned on PG interface card.

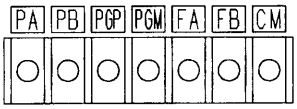


Fig. 6-5-9 Terminals for encoder

When connecting to terminals of the encoder, match the labels of terminals on motor side and encoder side.

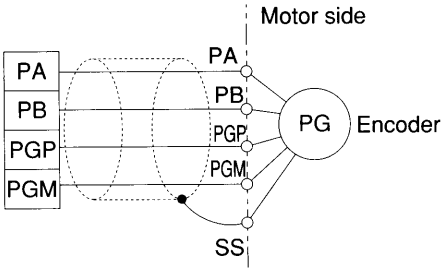


Fig. 6-5-10 Connection of encoder

NOTE : *Keep the wiring distance between the inverter and the motor 100 m or less. If the distance is long, it becomes difficult to transfer correct pulses. Connect the shield sheath to a terminal SS in encoder terminal box. Do not connect it to ground or the other terminals.*

The output signal of the encoder becomes an output of open collector output of a transistor. Connect the circuit as shown in Fig. 6-5-11.

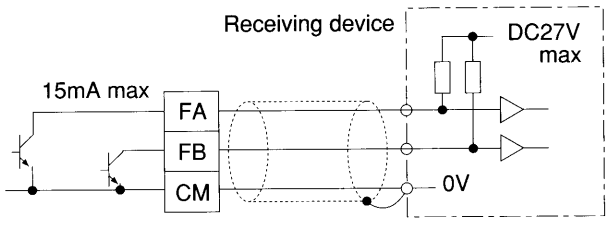


Fig. 6-5-11 Connection of output terminals of encoder

NOTE: *Connect the shield sheath to the reference potential terminal of receiving device. Do not connect to ground.*

f) Option power supply

Terminals P24, M24, P15 and N15 can be used for control power supply other than the options also. However, they are not able to use beyond the specification. As for the consumed current of the option, refer to the Instruction Manual of the control option.

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).

See "13-3 Auxiliary parts" p. 154 for the surge suppressors to be applied.

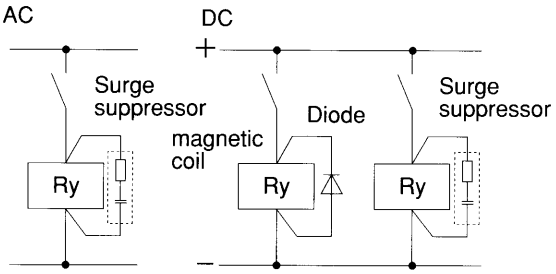


Fig. 6-5-12 Surge suppressor connections

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

h) Control circuit wiring

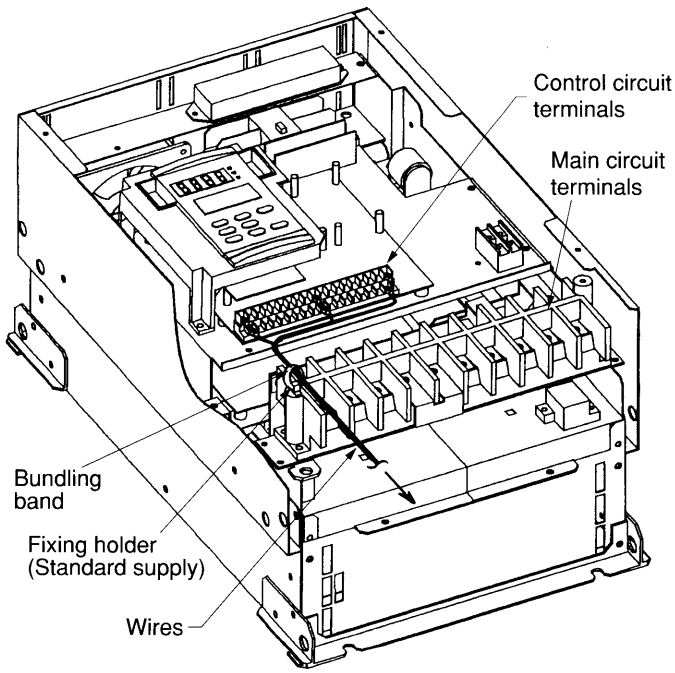


Fig. 6-5-13 Control circuit wire routing

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 then 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. 6-5-13.

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.

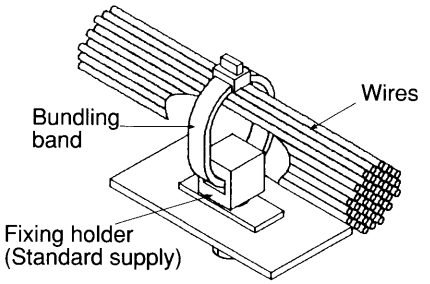


Fig. 6-5-14 Detail of wire holder

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.

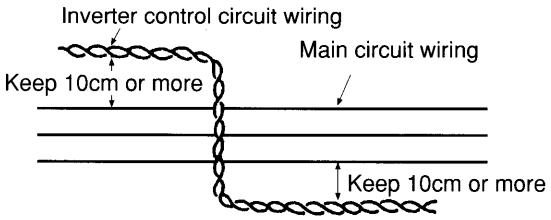


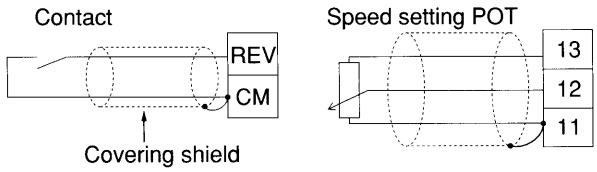
Fig. 6-5-15 Control circuit wiring

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. 6-5-16)

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

1) Good sample



2) No-good sample

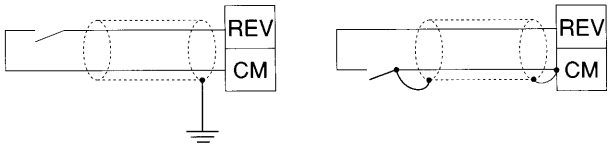


Fig. 6-5-16 Covering shield connection

6-6 Braking circuit

⚠ CAUTION

Do not connect the braking resistor between the main circuit terminals P(+) and N(-). If being so connected, the inverter may overheat, and the braking resistor may overheat and burn out, then, a disaster such as fire may occur.

When connecting a braking resistor to an inverter, the braking resistor is connected either directly or through a braking unit to the inverter. Further, in some cases, it is needed to connect two or more resistors. Connect these according to the instruction of "13-1 Braking unit and braking resistor" (p. 148).

a) Main circuit

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

NOTE : *Figure 6-6-1 3) is applied to a non-standard series. Connect the devices according to the instruction at purchasing.*

1) When connecting the braking resistor and the inverter, perform the work as follows.

In the inverter to which a braking resistor is directly connected, a main circuit terminal DB is attached. Connect an end of the braking resistor to this terminal.

When not connecting a braking resistor, open between terminals P(+) and N(-). If short-circuiting these terminals, the inverter is damaged.

Keep the wiring distance between the braking resistor and the inverter or the braking unit 10 m or less.

2) When connecting the braking unit, perform the work as follows.

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

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

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 a short-circuit jumper between the control terminals THR and CM. Connect the braking resistor terminals 1 and 2, or the braking unit terminals 1 and 2 and the braking resistor terminals 1 and 2 respectively in series as 1→2→1→2 to terminals 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).

Then, set switch SW1 on the printed circuit board of the braking unit with terminal I1 and I2 connected as shown in Fig. 6-6-2 1). The switch SW1 is set as shown in Fig. 6-6-2 2) at factory shipping.

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

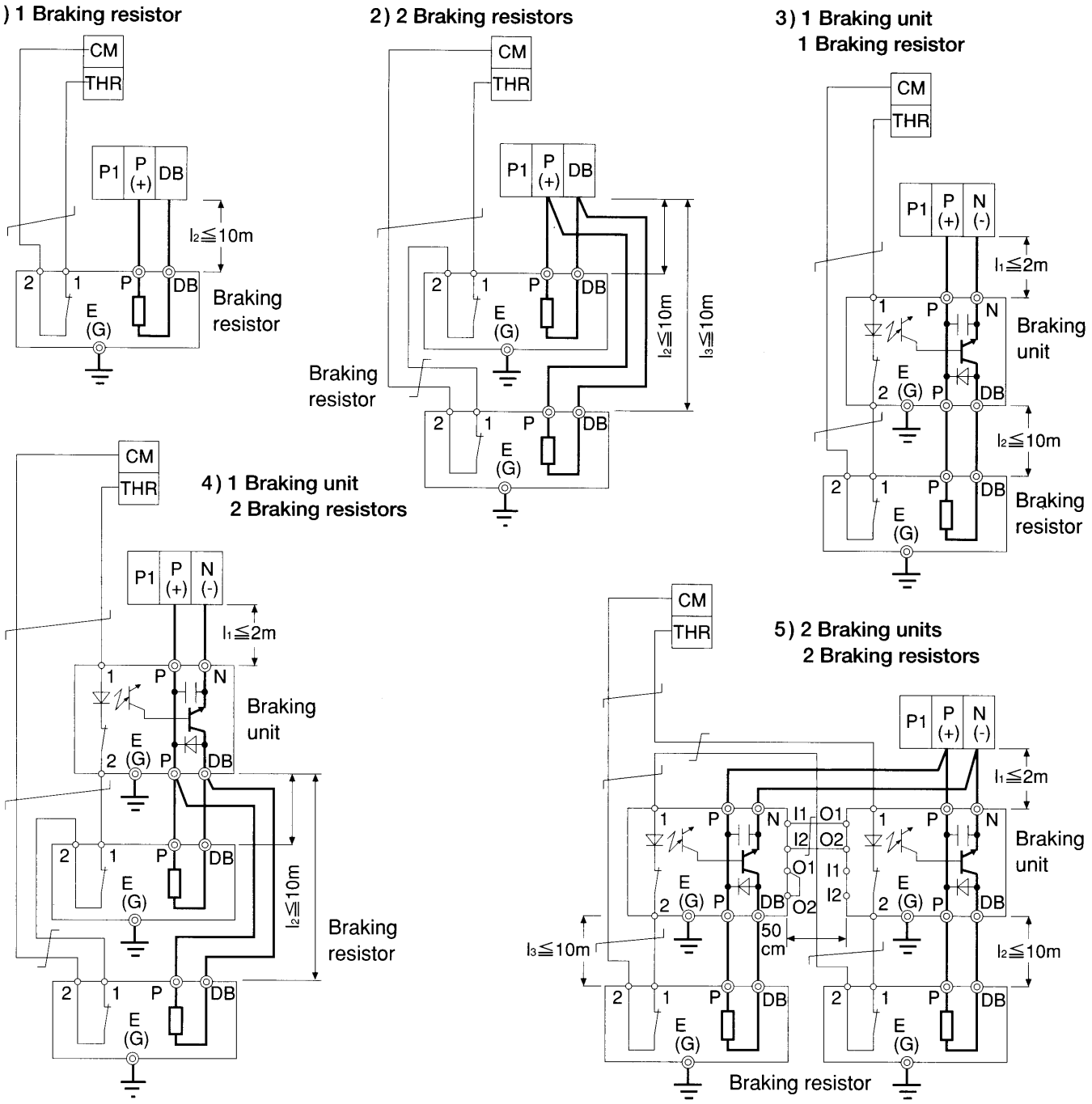
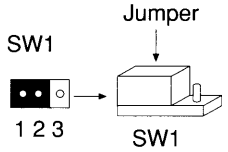


Fig. 6-6-1 Braking unit and braking resistor connections

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



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

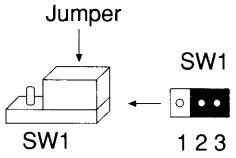


Fig. 6-6-2 Change of SW1 Setting

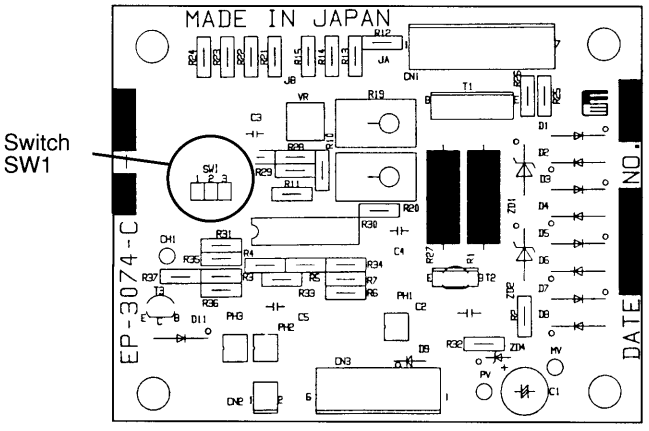


Fig. 6-6-3 Control printed circuit board of braking unit

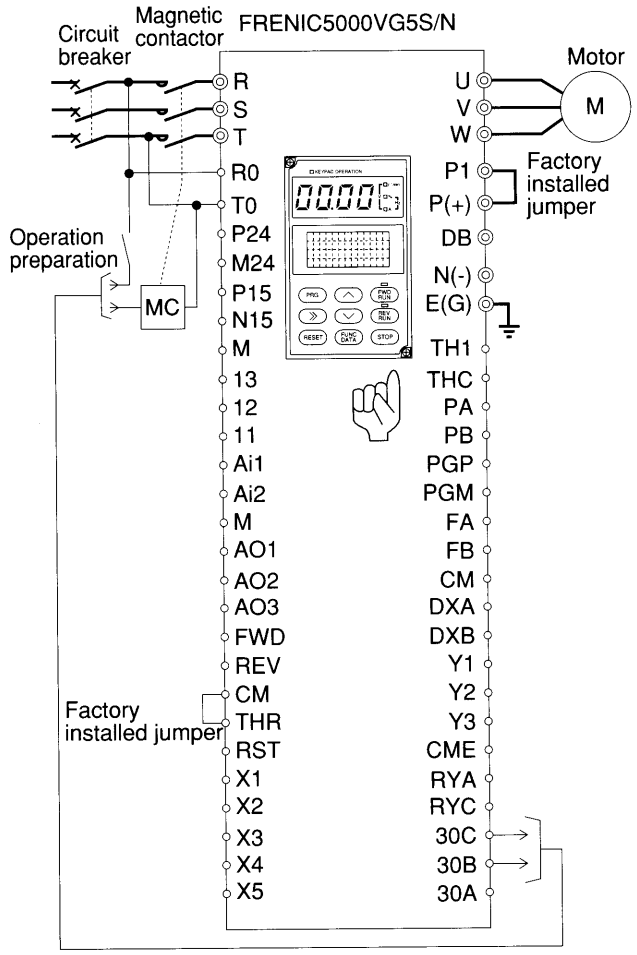
6-7 Basic connection

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" (p.33) and" 9-2 Description of functions" (p.91). Examples for the simplest and ordinarily used operation by the commands per keypad panel and control terminals are shown in Fig. 6-7-1. However, in these examples, a circuit that a magnetic contactor is made OFF by activation of the inverter protection function and, further, in addition, by activation of the thermal relay of the cooling fan motor in PG sensor type is provided from an aspect of safety.

As the other combination than those shown in Fig. 6-7-1, it can be used that the speed setting per the speed setting POT and the operation command per the keypad panel are combined, or that the speed setting per the keypad panel and the operation command per a switch are combined.

NOTE : *For the inverters attached with a DC link reactor as standard (out-of-supply unit), connect the DC link reactor to the terminals P1 and P(+). In this case, the terminals P1 and P(+) are not connected with a short-circuit jumper.*

1) PG-sensorless type operation with keypad panel



2) PG-sensorless type operation with control terminals

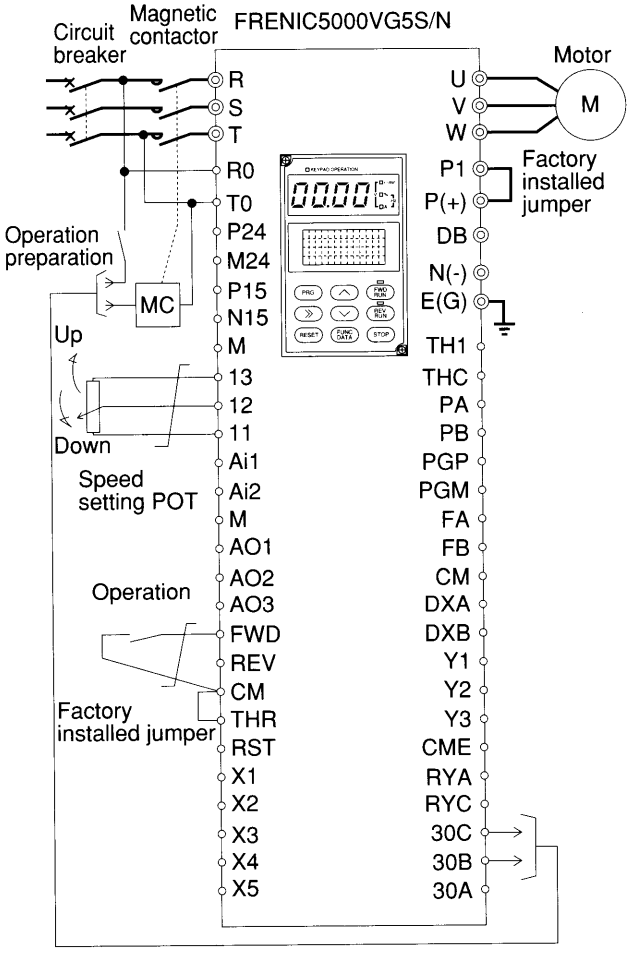
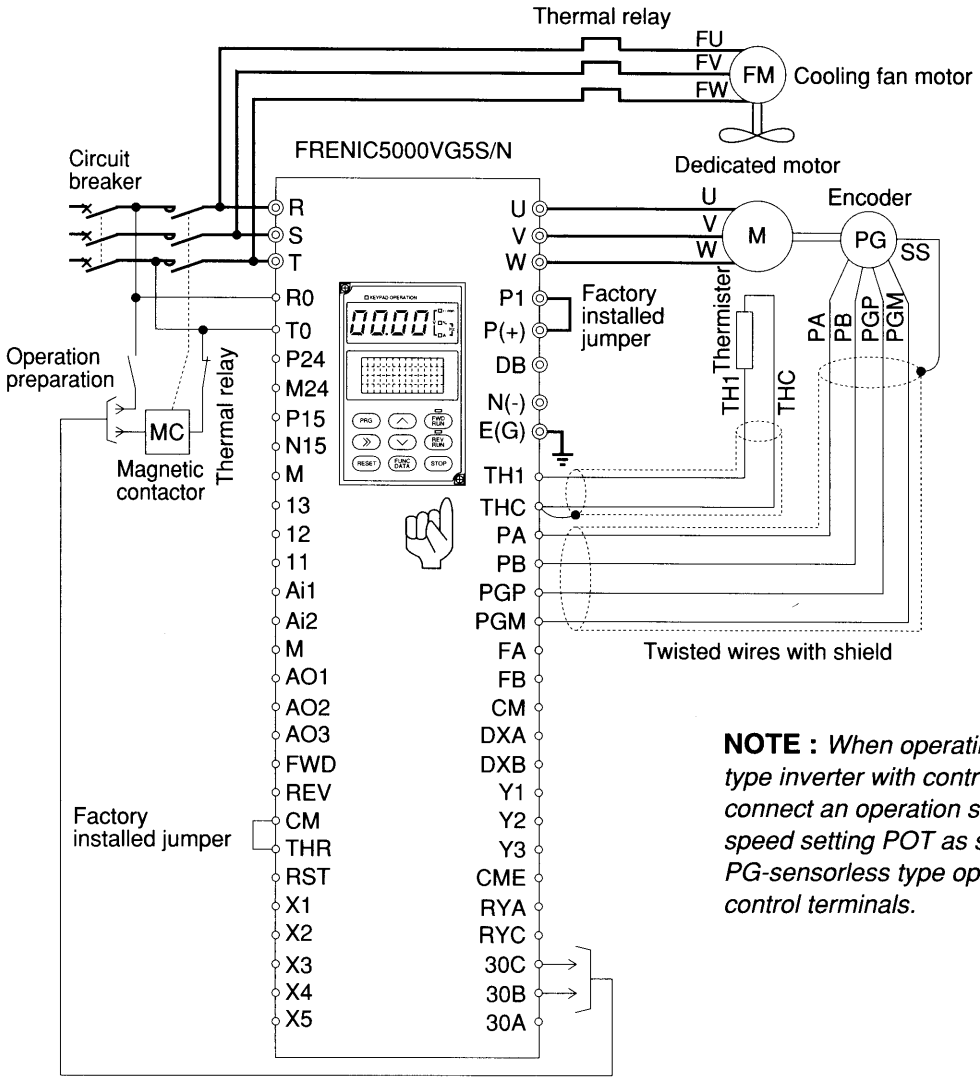


Fig. 6-7-1 Examples of basic connection

3) PG sensor type operation with keypad panel



NOTE : *When operating PG sensor type inverter with control terminals, connect an operation switch and a speed setting POT as same as 2) PG-sensorless type operation with control terminals.*

Fig. 6-7-1 Examples of basic connection (continued)

NOTES

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.

NOTE : *When applying AC power to the inverter, a voltage may be applied to the inverter output terminals U, V and W even if the inverter output is stopping.*

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 mistakes or bad conditions exist.

1) After connection (wiring) has been completed, check the inverter for the following :
— Check for wiring errors.
— Check for leaving connection.
— Check for short-sircuit or grounding of terminals and wires.

2) Attach the front cover.

3) 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.

4) Inverter can be operated after about 2 secounds from supplying AC power to the main circuit 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 fan 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.

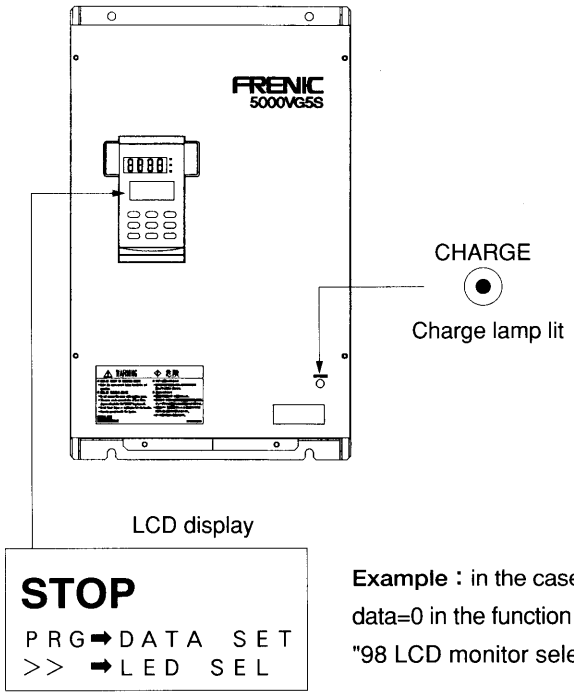


Fig. 7-1 Display AC power is supplied

5) 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. 48 to 119).

NOTE : *In generally, do not perform a meggar test since it was performed at factory shipping. If necessary, for meggar testing method, refer to "11-4 Insulation checks" (p. 125).*

8 Keypad Panel Operation

8-1 Keypad panel function

The function of the keypad panel are as followes:
- — Selection of operation
- — Input of operation command, setting of speed
- — Selection of function and entering and reading out of data (Monitoring)
- — Protection of data
- — Initializing of data
- — Reading out of operation and alarm information
- — Adjustment of analog data of input and output
- — Auto-tuning
- — Input of reset command for preset data and alarm

Keypad operation indicator

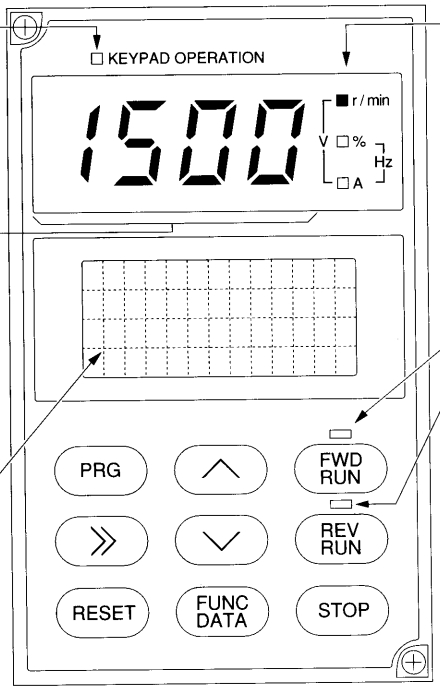
This indicator lights when the run and stop commands can be inputted per the Run and Stop keys.

Digital indicator (LED)

This indicator displays the operation data, preset speed 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 turns ON according to input state of forward and reverse operation commands inputted by the keypad panel and control terminals. When inputting stop command this indicator turns OFF even if during deceleration.

Fig.8-1 Keypad panel

Program key (PRG)

This key selects the operation mode, program mode and alarm mode.

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.

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 (FWD RUN) · (REV RUN), **Stop key** (STOP)

These keys are used to input the run and stop commands. These functions are active when the data of "02 Operation mode" is set at 0.

(FWD RUN) :Forward command

(REV RUN) :Reverse command

Up key (∧), **Down key** (∨)

These keys are used to increase or decrease values on the data setting operation, speed 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

8-2 Keypad panel handing

The inverter is shipped with the keypad panel mounted. When dismounting 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 dismount the keypad panel during operation or applying AC power to the inverter. However, dismounting it while the run command is inputted from the keypad panel will stop the inverter.*

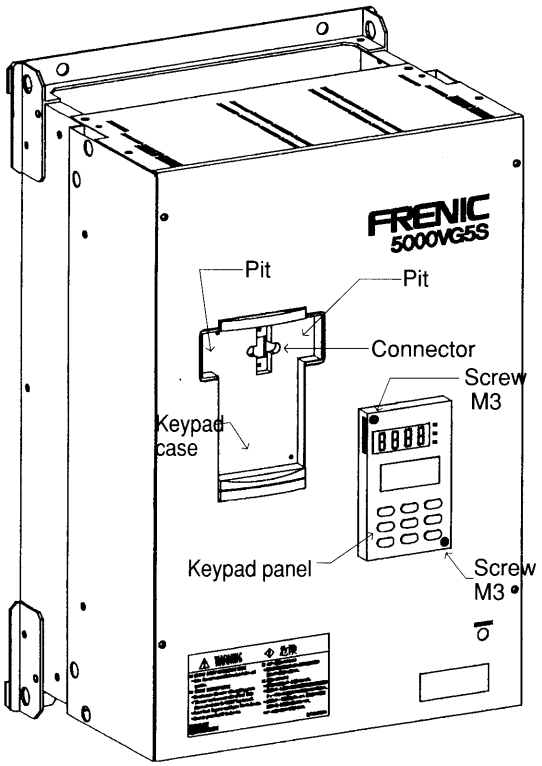


Fig. 8-2-1 keypad panel dismounting

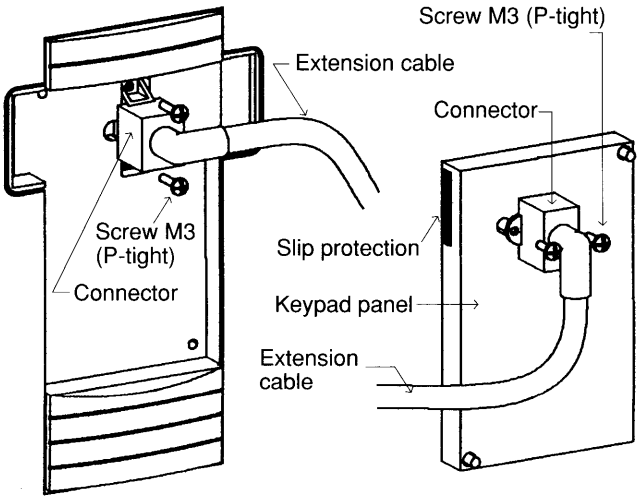


Fig. 8-2-2 Extension cable connection

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 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 extention cable, the core wires of the cable may be torn off or the connector may be damaged.*

c) Removing method of the extension cable
Pull out slowly the extension cable connectors from the keypad panel and the keypad case.

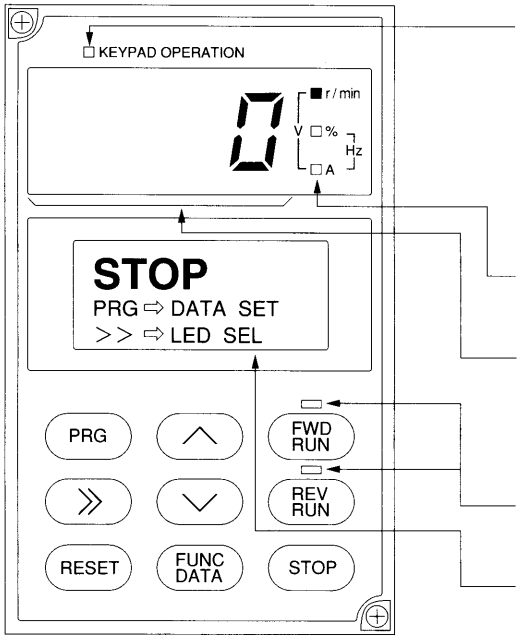
d) Remounting the key pad panel
When the keypad panel is attached on the equipment, loosen the two attached screws (M3), and detach the keypad panel from the equipment.

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.

8-3 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.



This indicator lights when the run and stop commands can be inputted (The data of "02 Operation command" is set at 0).

NOTE: Do not carelessly press RUN or STOP keys when this LED is lighting. If pressing these keys by mistake except in the alarm mode, the inverter starts or stops.

LED is turned on corresponding to the unit of the LED data.

The operation data during stopping is indicated according to the data (written value) of function "95 LED monitor select".
Indication example: Motor speed (data: 00)

These indicators do not light as the inverter is stopping.

The operation mode screen is displayed according to the data (written value) of function "98 LCD monitor select."

Fig. 8-3-1 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.
When the inverter starts operation, the liquid crystal display shown in Fig. 8-3-1 changes as shown in Fig. 8-3-2.

Indication example:
When the data of function "98 LCD monitor select" is 0 and forward command is inputted.

Fig. 8-3-2 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.
Furthermore, auto-tuning of speed regulating system and motor constants system can be conducted.

The relations of the operation mode, liquid crystal display and operation key are as shown in Fig. 8-3-4 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 01 Speed command
"01 N SETTING"
— Unit indicator, keypad operation indicator and operation indicator are expressed as Fig. 8-3-3.

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

Fig. 8-3-3 Expression for indicators

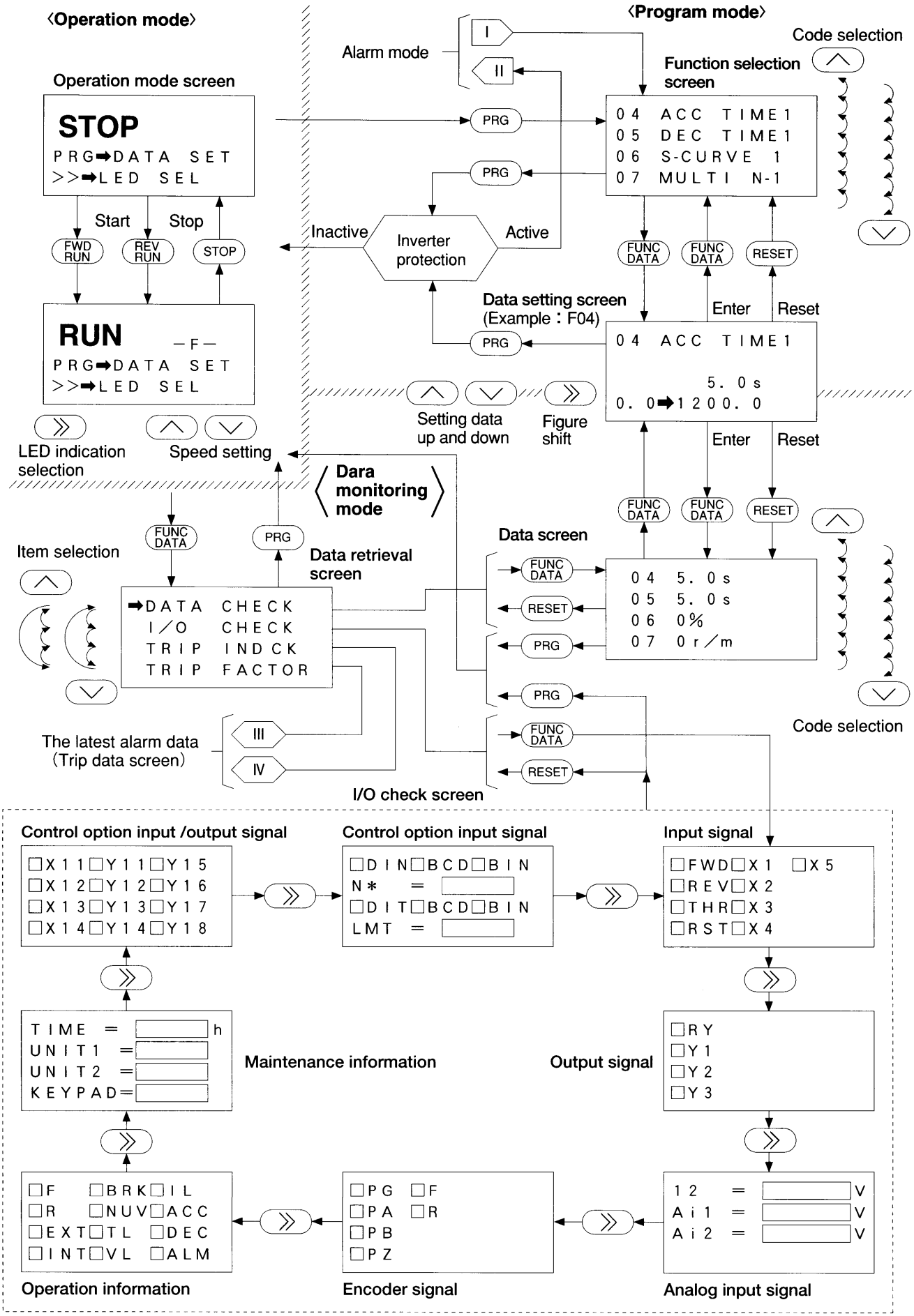


Fig. 8-3-4 keypad panel operation and LCD indication 1

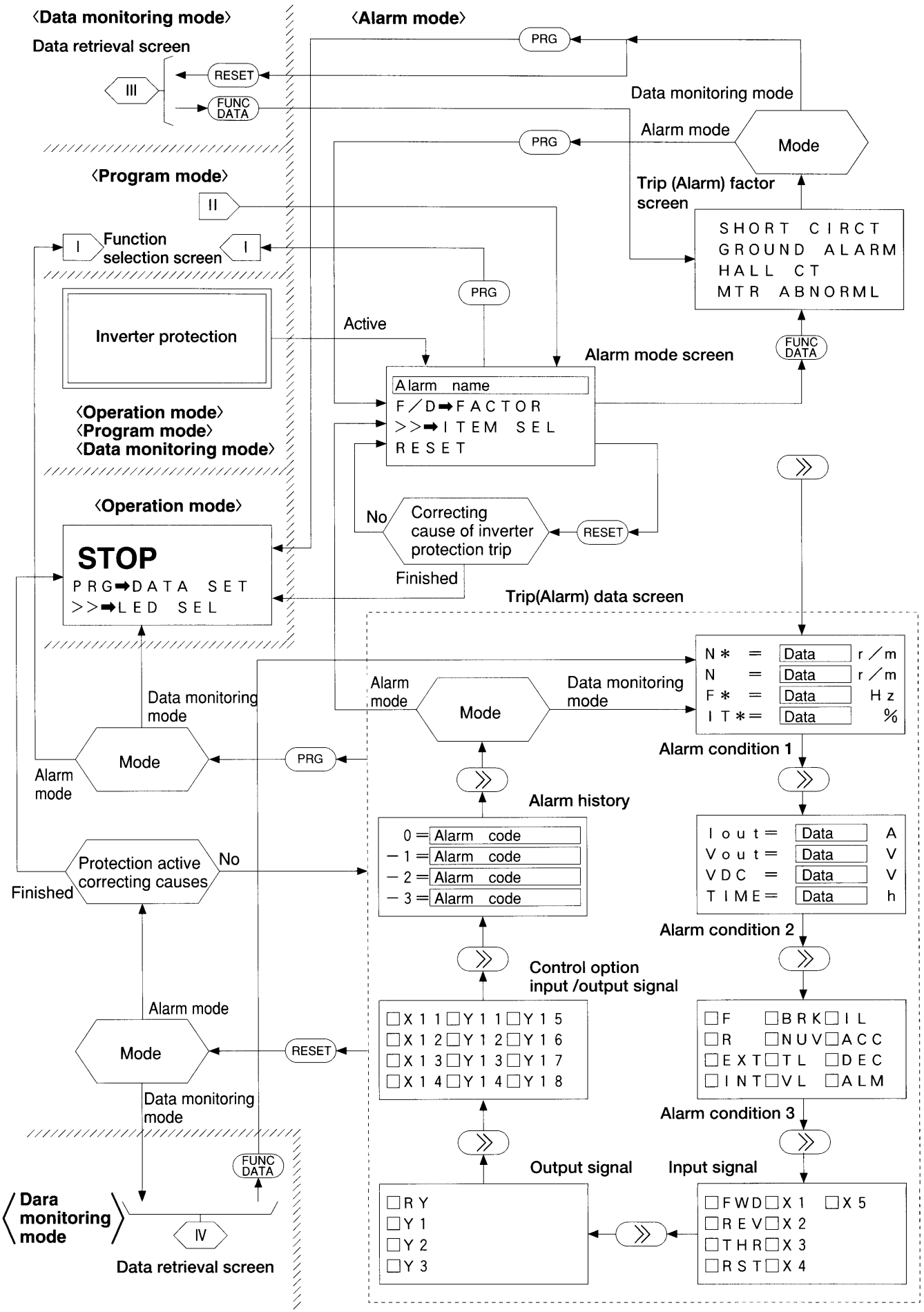


Fig. 8-3-5 keypad panel operation and LCD indication 2

8-4 Program mode

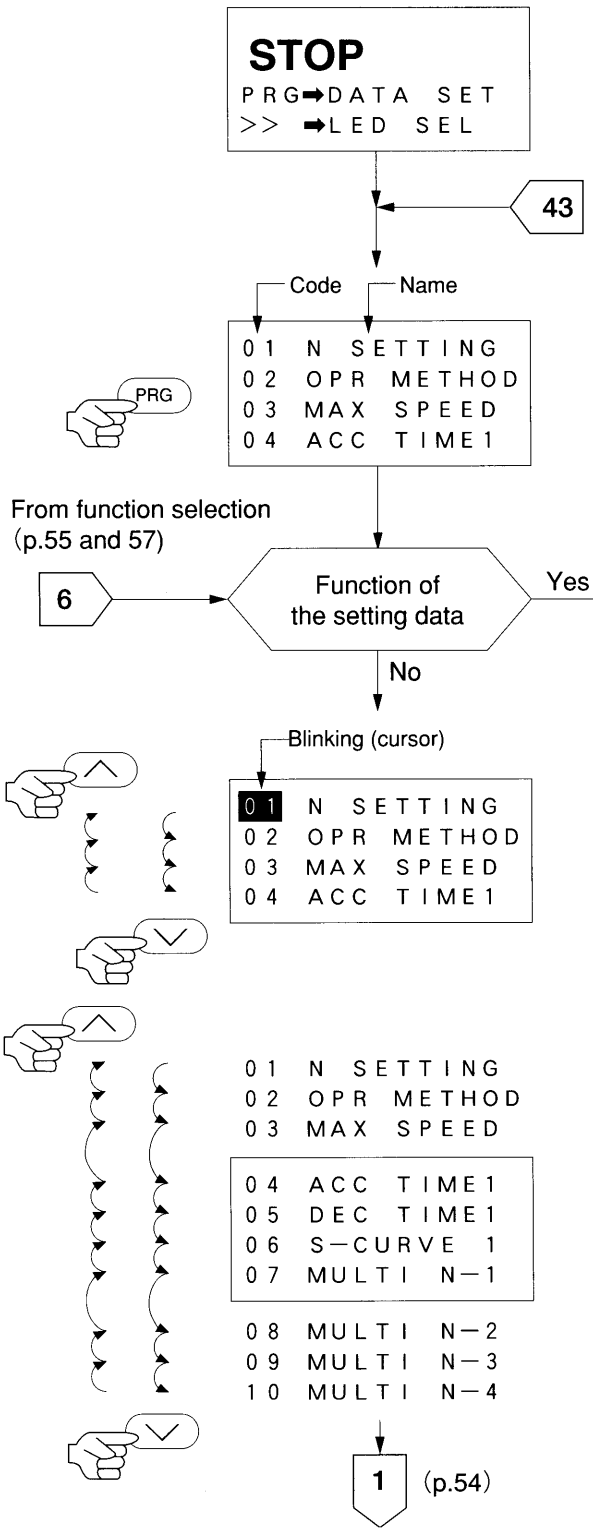
⚠ WARNING

Missetting of the function data may cause dangerous conditions. Therefore, verify the data again before operation.

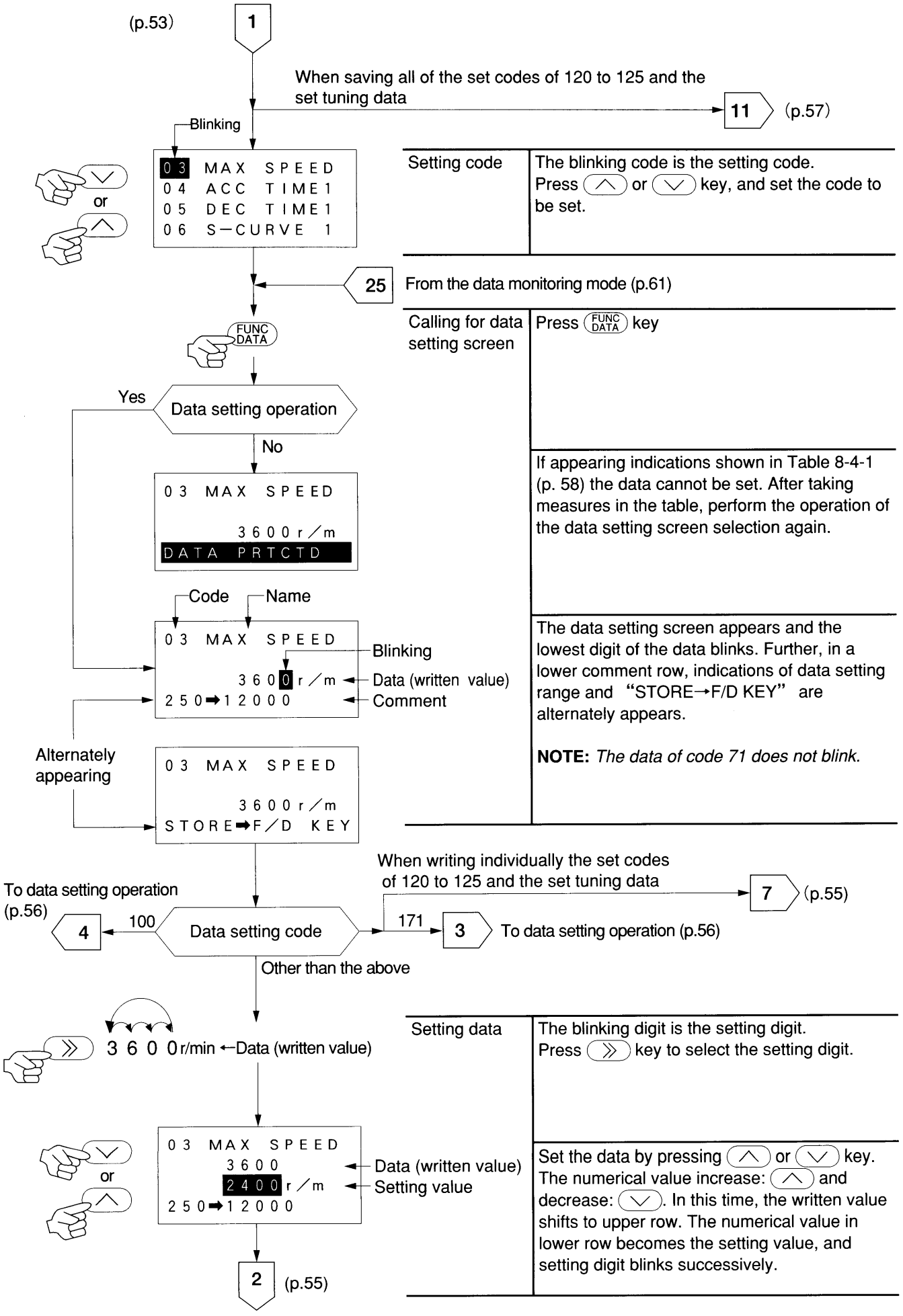
Before starting operation, write the data necessary for the motor and equipment into the functions. The functions and their data are indicated on LCD. LED indicates displays depending on the data of "95 LED MONT S". These displays do not change by the operation in this subsection.

Writing starts from selection of the function.

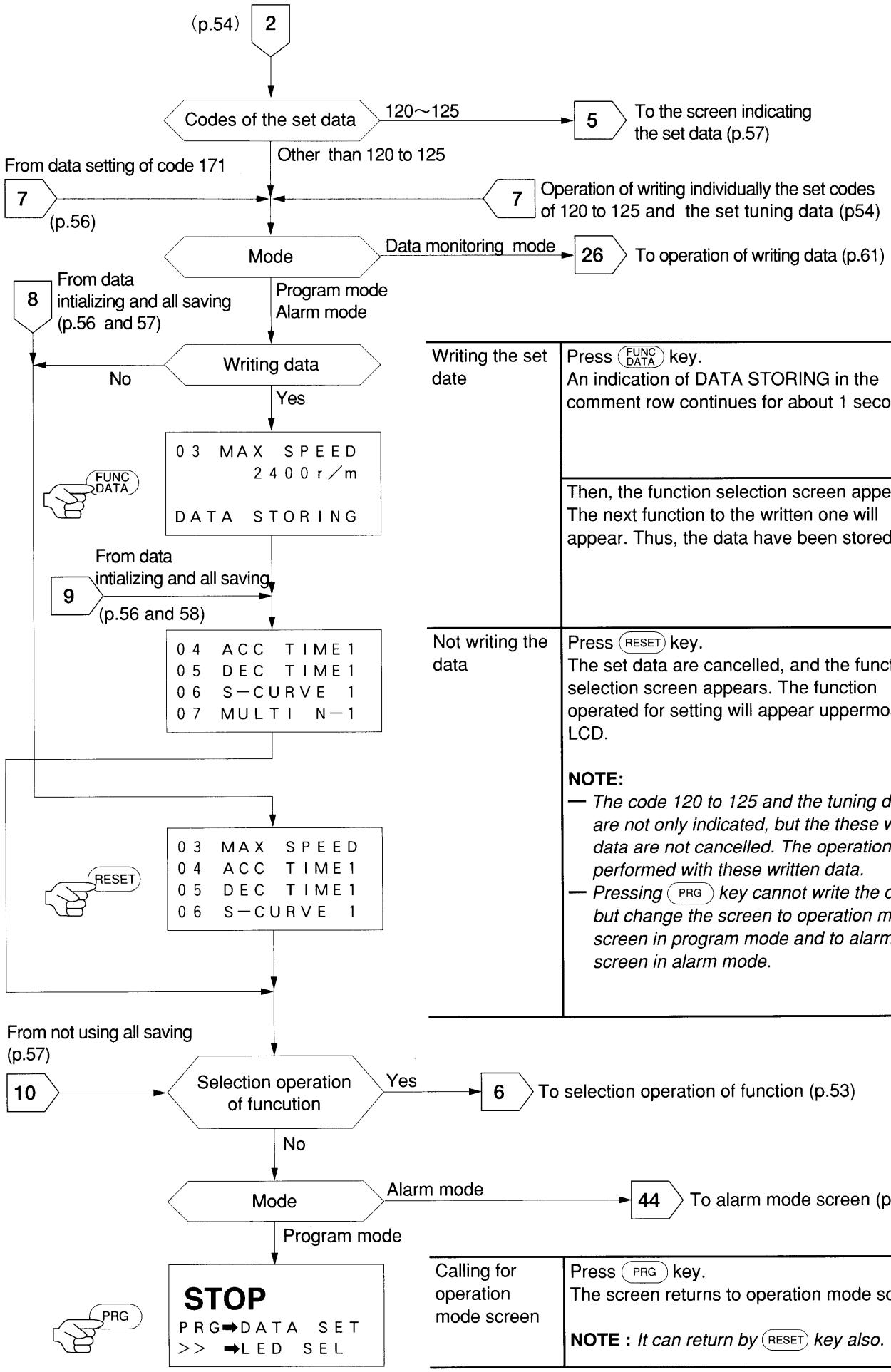
Indication example: When changing the data of "03 MAX SPEED" from 3600 r/min to 2400 r/min.



Calling for function selection	Call for the function selection screen on LCD by pressing (PRG) key. In this screen, four function codes and their names are listed. There appears the screen per the latest selecting operation including the the selecting operation in a data identification screen in data monitoring mode.
Selecting the code	Press (∧) or (∨) key, then, the blinking code moves in turn as shown in the figure.
	When continuing to press the key at the upper or lower end, the screen is scrolled showing new codes and their names. Release the (∧) or (∨) key if the code to be set appears. **NOTE:** *The functions of "31 DROOP (Level)" or more may not appear even if being selected. This is because the data of function block selection is set at 0. Select the code of function block selection for the objected code. And after rewriting its data to 1 by the operation described afterward, select the function again.*

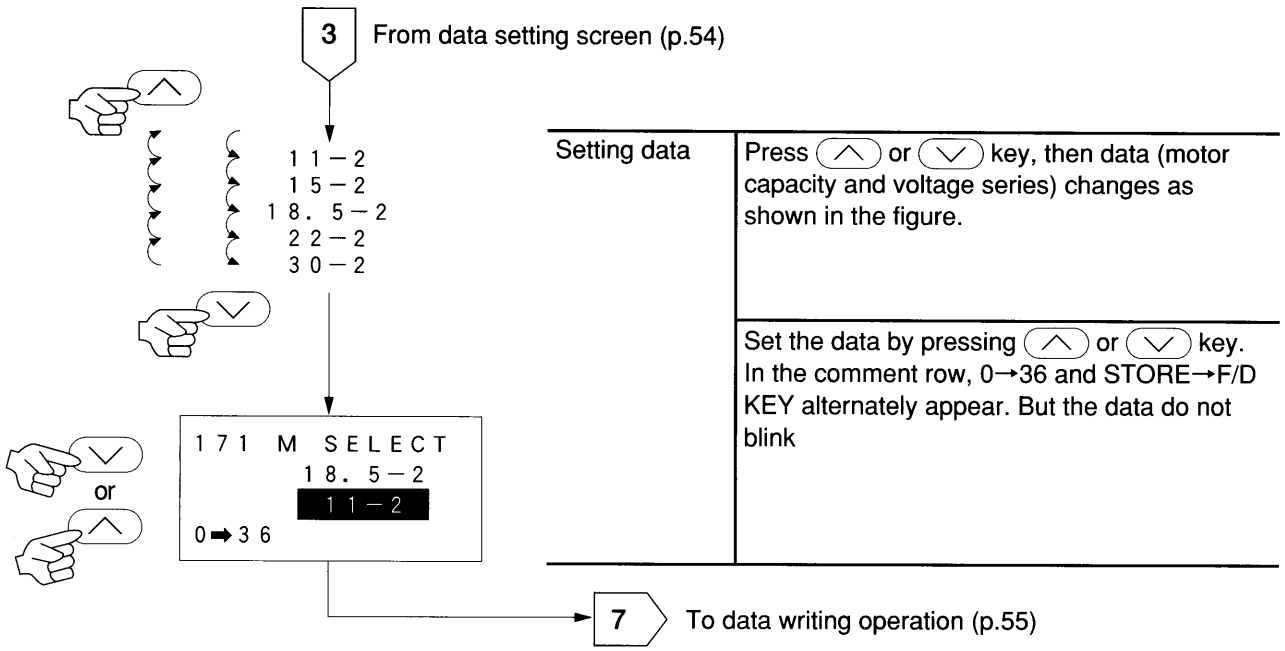


Setting code	The blinking code is the setting code. Press (∧) or (∨) key, and set the code to be set.
Calling for data setting screen	Press (FUNC DATA) key
	If appearing indications shown in Table 8-4-1 (p. 58) the data cannot be set. After taking measures in the table, perform the operation of the data setting screen selection again.
	The data setting screen appears and the lowest digit of the data blinks. Further, in a lower comment row, indications of data setting range and "STORE→F/D KEY" are alternately appears. **NOTE:** *The data of code 71 does not blink.*
Setting data	The blinking digit is the setting digit. Press (≫) key to select the setting digit.
	Set the data by pressing (∧) or (∨) key. The numerical value increase: (∧) and decrease: (∨). In this time, the written value shifts to upper row. The numerical value in lower row becomes the setting value, and setting digit blinks successively.

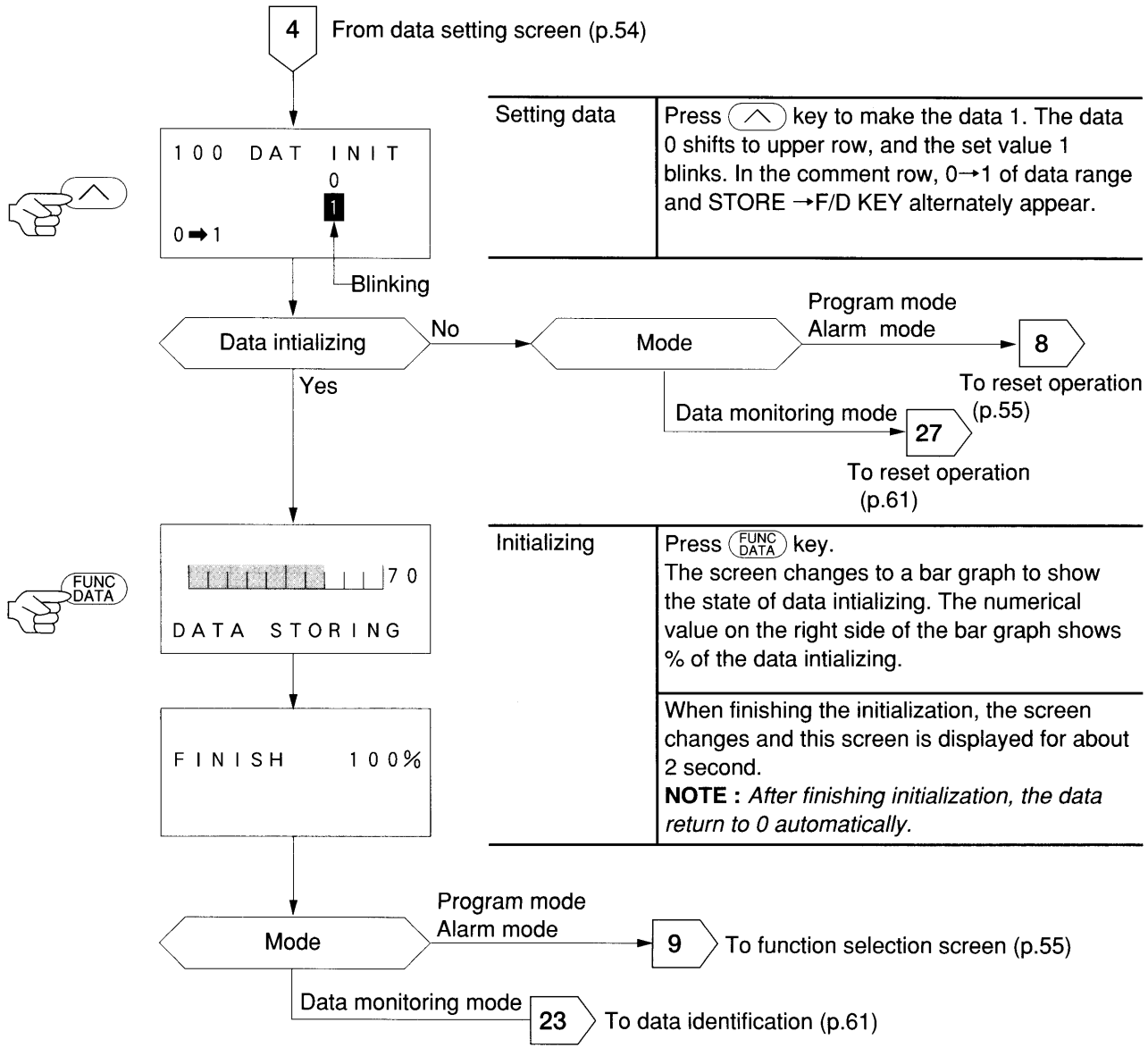


Writing the set date	Press FUNC DATA key. An indication of DATA STORING in the comment row continues for about 1 second.
	Then, the function selection screen appears. The next function to the written one will appear. Thus, the data have been stored.
Not writing the data	Press RESET key. The set data are cancelled, and the function selection screen appears. The function operated for setting will appear uppermost on LCD. **NOTE:** — *The code 120 to 125 and the tuning data are not only indicated, but the these written data are not cancelled. The operation is performed with these written data.* — *Pressing PRG key cannot write the data, but change the screen to operation mode screen in program mode and to alarm mode screen in alarm mode.*

Calling for operation mode screen	Press PRG key. The screen returns to operation mode screen. **NOTE :** *It can return by RESET key also.*

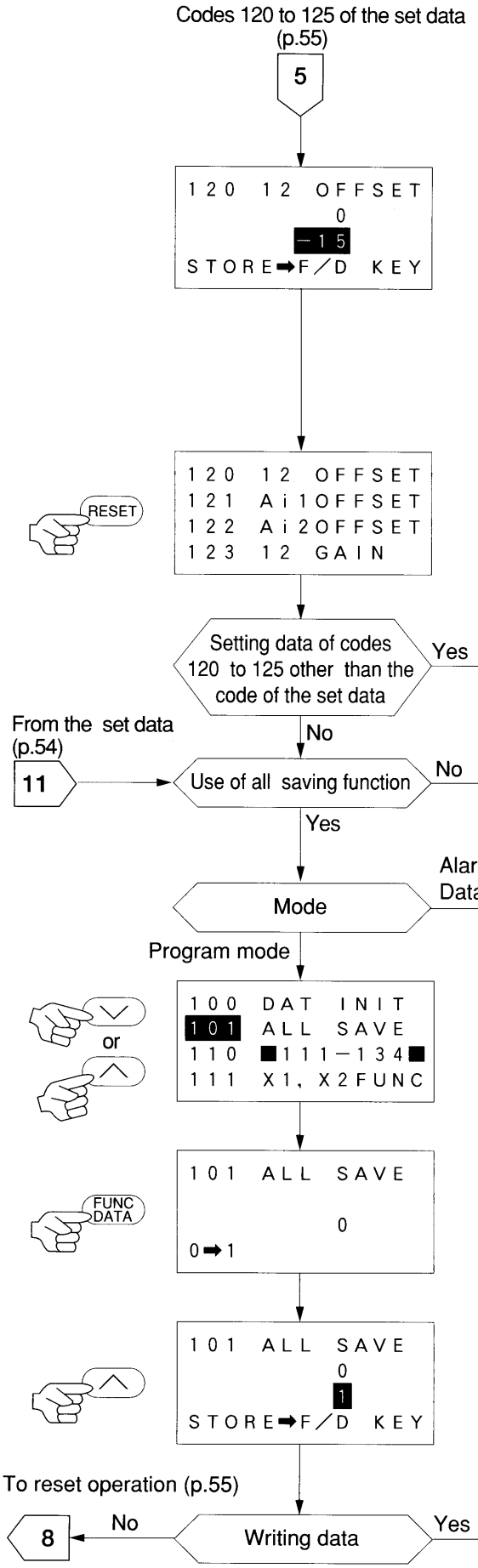


Setting data	Press ⌃ or ⌄ key, then data (motor capacity and voltage series) changes as shown in the figure.
	Set the data by pressing ⌃ or ⌄ key. In the comment row, 0→36 and STORE→F/D KEY alternately appear. But the data do not blink



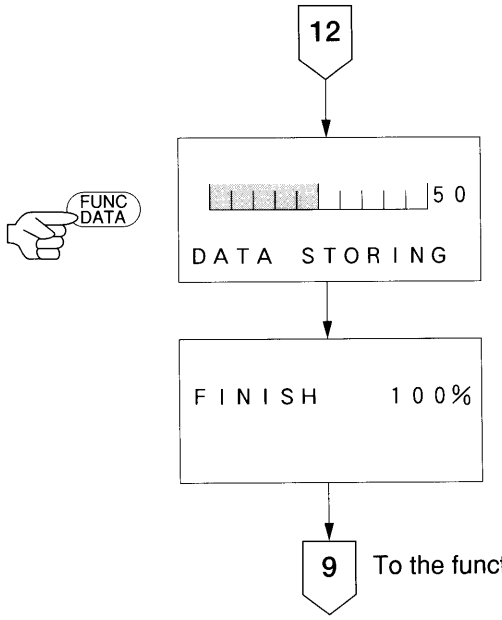
Setting data	Press ⌃ key to make the data 1. The data 0 shifts to upper row, and the set value 1 blinks. In the comment row, 0→1 of data range and STORE →F/D KEY alternately appear.

Initializing	Press FUNC DATA key. The screen changes to a bar graph to show the state of data intializing. The numerical value on the right side of the bar graph shows % of the data intializing.
	When finishing the initialization, the screen changes and this screen is displayed for about 2 second. **NOTE :** *After finishing initialization, the data return to 0 automatically.*



Indicating the set data	These data become the operation data even without writing operation. The set value is indicated with numerics of outline letter on a black background. This indication does not change even if the mode or screen changes. However, when writing the data, the indication changes to black letter. **NOTE:** *To return the set data to the data before setting, press ∧ or ∨ key or make OFF (open) the power supply. Even if pressing RESET key, the data do not return to the data before setting.*
Calling for function selection	Press RESET key. The function selection screen appears, indicating the set function uppermost.
Setting code 101	Select "101 ALL SAVE" by pressing ∧ or ∨ key.
Calling for the data setting screen	Press FUNC DATA key. The data 0 blinks. In the comment row, "0→1" of data setting range and "STORE→F/D KEY" alternately appear.
Preparing rewriting all data of codes 120 to 125	Set the setting data at 1 by pressing ∧ key. The data 0 shifts to upper row, and the set value 1 blinks. In the comment row, alternate indication continues like in the data setting screen.

From preparation of rewriting all data (p.57)



To the function selection screen (p.55)

Rewriting all data in memory	Press (FUNC DATA) key. The screen changes to a bar graph screen to show the state of rewriting with a figure and numerics. On the right side of the bar graph, the numerics of % are shown.
	The screen changes after finishing of rewriting. This screen is shown for about 2 seconds.

NOTE:

- *When calling for the data setting screen. if appearing indications shown in Table 8-4-1, the data cannot be set.*
- *The functions of "31 DROOP (level)" or more may not appear if the data of function block selection is set at 0.*
- *Setting and writing of data beyond the data setting range cannot be performed since the setting data are limited by upper and lower limits of the data setting range.*
- *When passing about 10 min after finishing the operation in program mode, the screen automatically returns to the mode before the operation.*
- *The operation data (operating condition) cannot be established only by the operation of setting data. These are the data only on LCD. The set data become operation data when writing the data into memory. Therefore, after setting data, press (FUNC DATA) key to rewrite the data. However, the inverter can be operated by the speed setting with (∧) or (∨) key on keypad panel, the codes 120 to 125 and the tuning data without pressing (FUNC DATA) key. But, since the data in memory have not been rewritten, the data are cancelled by loss of the control power supply.*

Table 8-4-1 Indications which do not allow data setting or writing

Indication in comment row	Description	Measure
INV RUNNING	Indicates that the function is unchangeable while running and the inverter is running	Stop the inverter.
DATA PTRTCTD	The data of "200 PROTECTED" is 1 (The data is unchangeable.)	Rewrite the data to 0.
DATA STORING	Since the other data are being written, the data setting is impossible.	Wait for finish of writing.
TUNING	Since auto-tuning is being conducted, the data setting is impossible.	Wait for finish of tuning.
FWD/REV ON	Since Run command is inputted to the control terminals FWD or REV, the data of "02 OPR METHOD" are unchangeable	Release the Run command (OFF).

8-5 Data monitoring mode

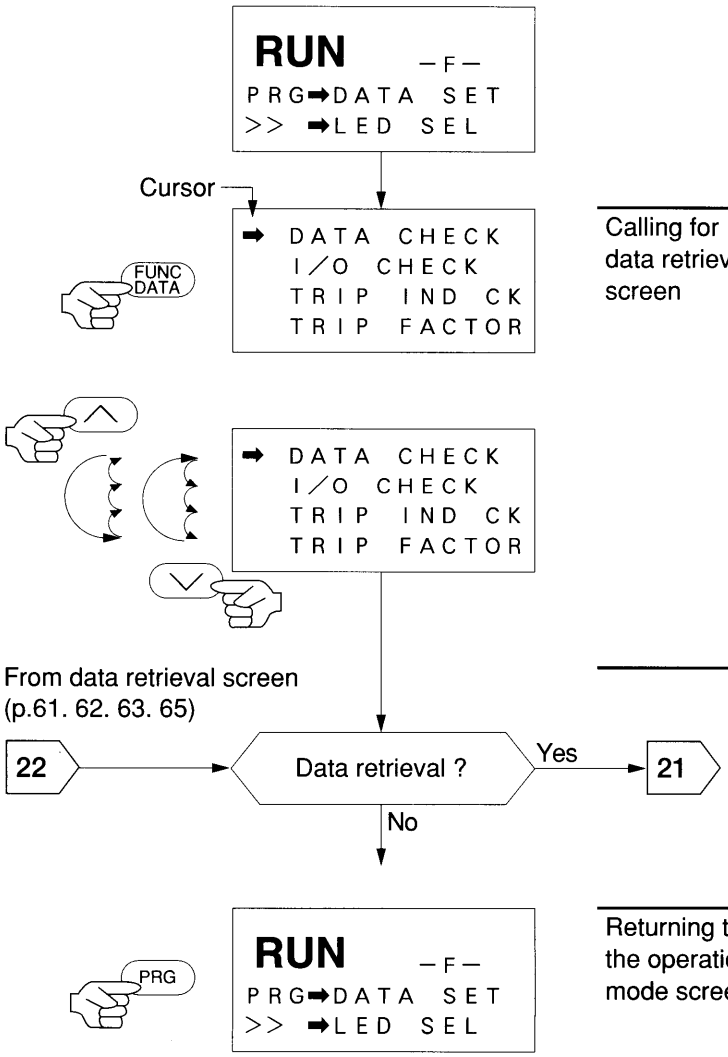
Table 8-5-1 Indicated data

Data retrieval	LCD	LED
Data identification	Code and data (written value)	Indication according to "95 LED MONT S"
I/O CHECK	Input and output signal status, operation information and maintenance information	
TRIP IND CK	Alarm data, input and output signal status and alarm history on the latest protection trip	The latest alarm code
TRIP FACTOR	Presumption items 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 "95 LED MONT S". The LED data does not change during operation on the data retrieval screen.

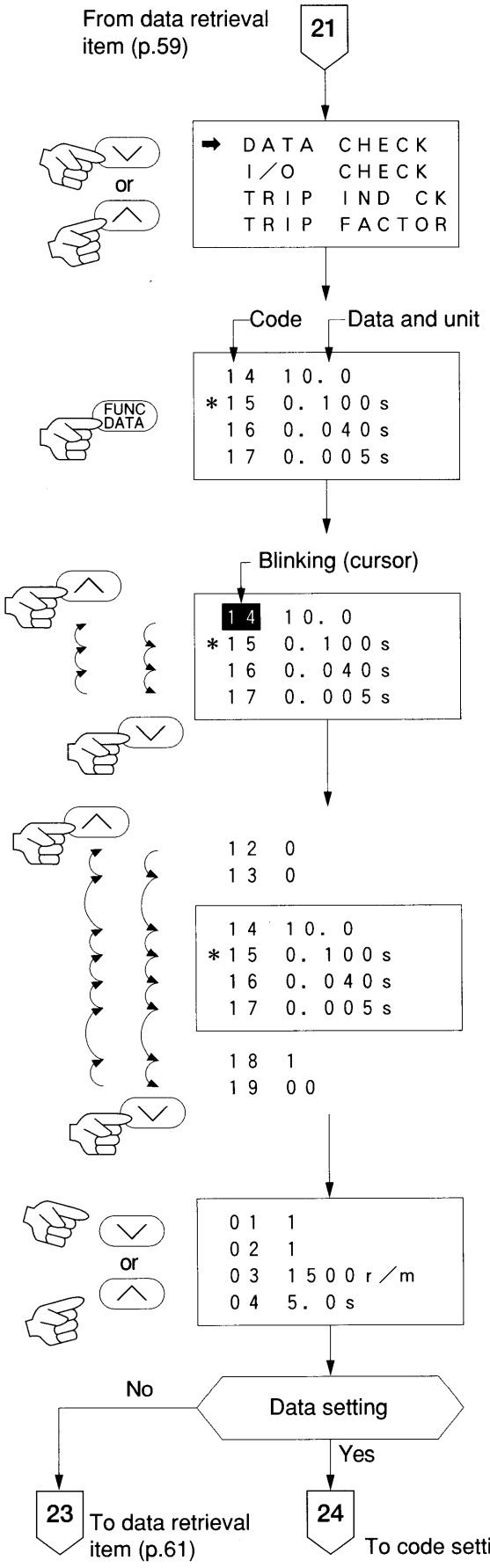


Calling for data retrieval screen	Press (FUNC DATA) key to call the data retrieval screen. A cursor (blinking arrow) indicates the item to select.
	Press (∧) or (∨) key. The cursor position changes per pushing the key. When the cursor comes to the item, release the key. Then the cursor stops. **NOTE :** *You can shift the cursor using (≫) key.*

To function data identification (p. 60)
To input and output data identification (p. 62)
To trip (alarm) data identifying (p. 63)
To trip (alarm) factor identifying (p. 64)

Returning to the operation mode screen	After reading out the data, push (PRG) key. The screen returns to the operation mode screen. **NOTE :** (RESET) *key is also available.*

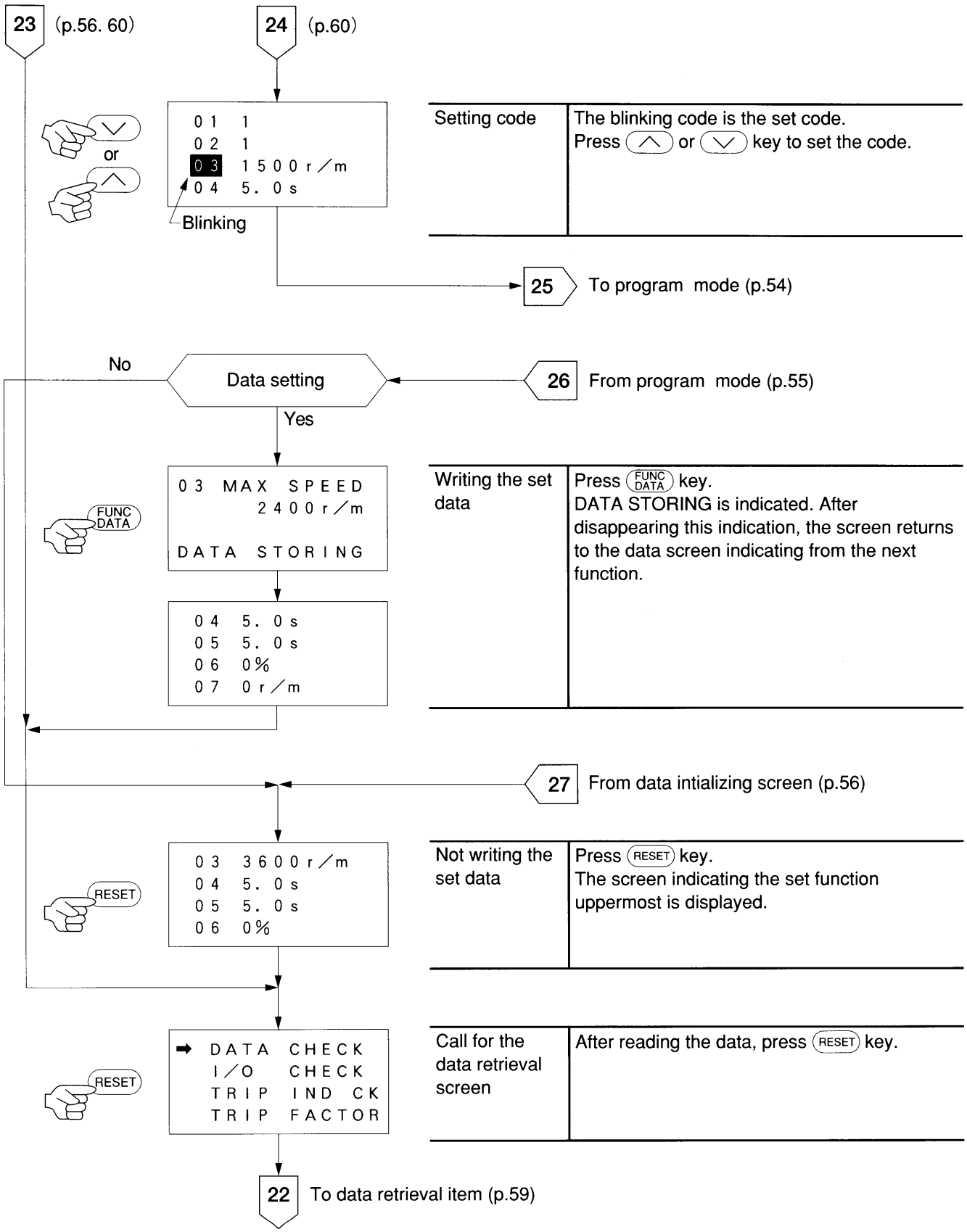
b) Function data (written value) identification



NOTE : *When the data is other than standard data, ∗ mark is indicated on the left side of the code in the data screen.*

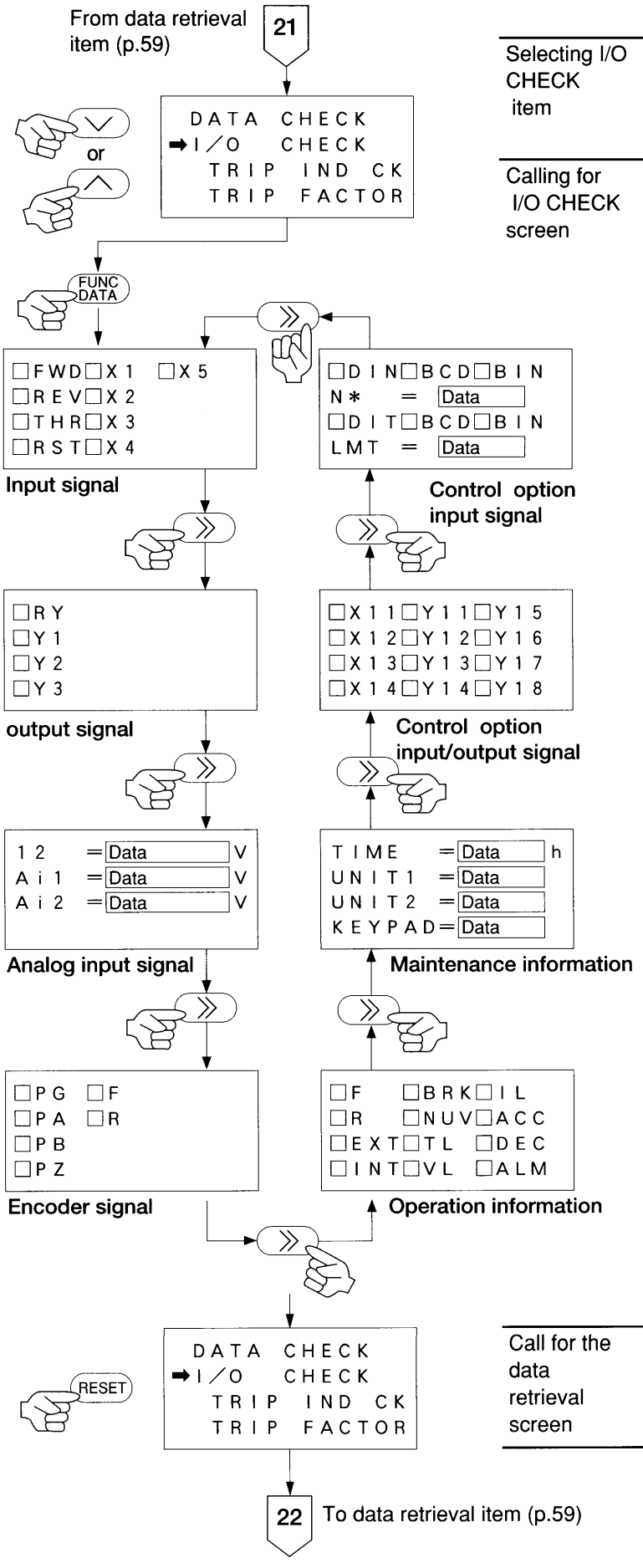
Selecting the data identifying item	Press (∧) or (∨) key to put the cursor on "DATA CHECK" in the data retrieval screen.
Indicating the data screen	Press (FUNC DATA) key. The data screen appears. In this screen, 4 codes and their data (written value) are indicated. The displayed screen becomes the screen of the latest operation including selection operation on the function selection screen in the program mode.
Selecting the code	Press (∧) or (∨) key. The blinking code moves as shown in the figure.
	When continuing the key at the uppermost or lowermost position, the screen scrolls and new code is indicated.
Identifying the data	When the code to be read appears, release the (∧) or (∨) key

When necessary to set the data, conduct the next operation. The screen can be directly transfered from the data screen to the data setting screen in the program mode.


23 (p.56. 60)
24 (p.60)
or
01 1
02 1
03 1500r/m
04 5.0s
Blinking
Setting code
The blinking code is the set code.
Press ^ or v key to set the code.
25 To program mode (p.54)
No
Data setting
26 From program mode (p.55)
Yes
03 MAX SPEED
2400r/m
DATA STORING
FUNC DATA
Writing the set data
Press FUNC DATA key.
DATA STORING is indicated. After disappearing this indication, the screen returns to the data screen indicating from the next function.
04 5.0s
05 5.0s
06 0%
07 0r/m
27 From data intializing screen (p.56)
03 3600r/m
04 5.0s
05 5.0s
06 0%
RESET
Not writing the set data
Press RESET key.
The screen indicating the set function uppermost is displayed.
➡ DATA CHECK
I/O CHECK
TRIP IND CK
TRIP FACTOR
RESET
Call for the data retrieval screen
After reading the data, press RESET key.
22 To data retrieval item (p.59)

c) Input/output data identification

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



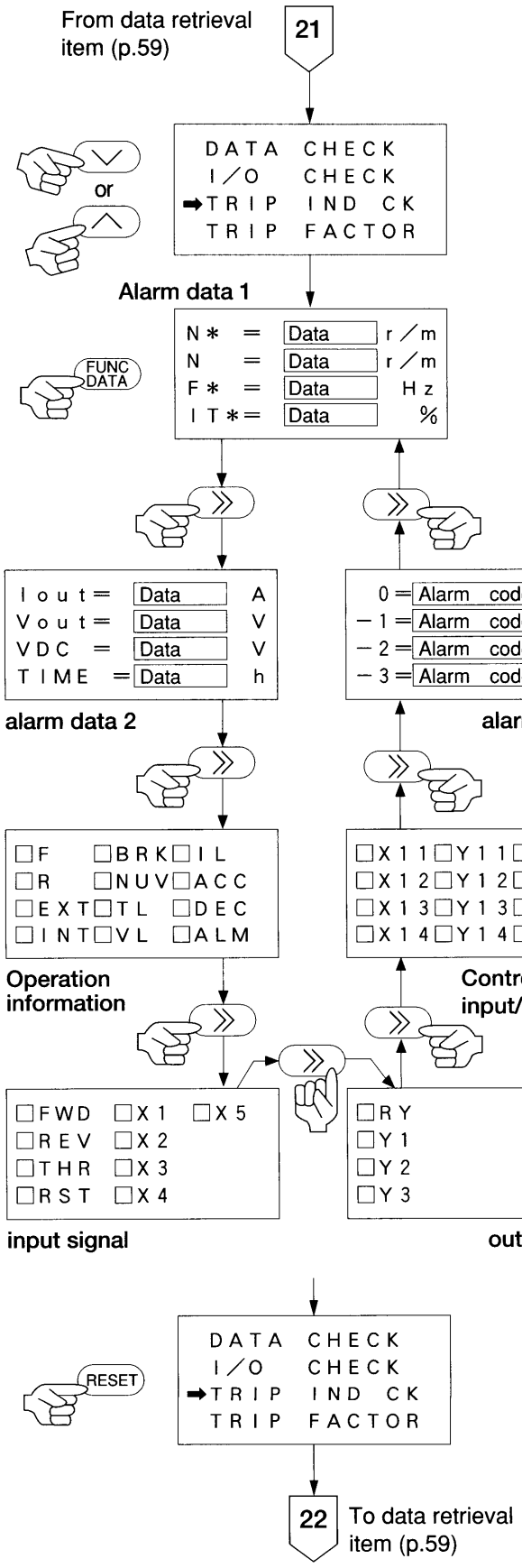
Selecting I/O CHECK item	Press (∧) or (∨) key to put the cursor on "I/O CHECK" on the data retrieval screen.
Calling for I/O CHECK screen	Press (FUNC DATA) key. The input signal screen appears. Press (≫) key. The screen changes in the order shown in the figure per pressing (≫) key. **Input signal screen** Indicating the input state of the control input terminals **Output signal screen** Indicating the output state of the output terminals **Analog input signal screen** Indicating the input voltage values setting from the control terminals such as speed. **Encoder signal screen** PG: Existing or not existing of the signal of an interface card OPCII-VG5-PG. PA, PB and PZ: Lager signals of each phase than the high levels (PZ is for option) F: Forward rotation detection R: Reverse rotation detection **Operation information screen** F: In forward operation, EXT: In pre-excitation R: In reverse operation, INT: Inverter stopping BRK: In resistance braking NUV: Existing of main circuit voltage TL: In torque limiting VL: In voltage limiting IL: In current limiting ACC: In acceleration DEC: In deceleration ALM: In activation of protection **Maintenance information** TIME: Total operation time UNIT1: ROM No. for speed control system UNIT2: ROM No. for current control system KEYPAD: ROM No. for keypad panel **Input and output signal screen for control options** Refer to the Control option Instruction Manuals. **Indication** ■: Signal ON, □: Signal OFF
Call for the data retrieval screen	After finish of the data identification, press (RESET) key. The screen returns to the data retrieval screen from any screen.

d) Trip (alarm) data identifying

For the latest trip (alarm) data, seven 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 : *The data are not lost when the powers supply is turned OFF. After recovery of the power supply, the alarm data is indicated again.*

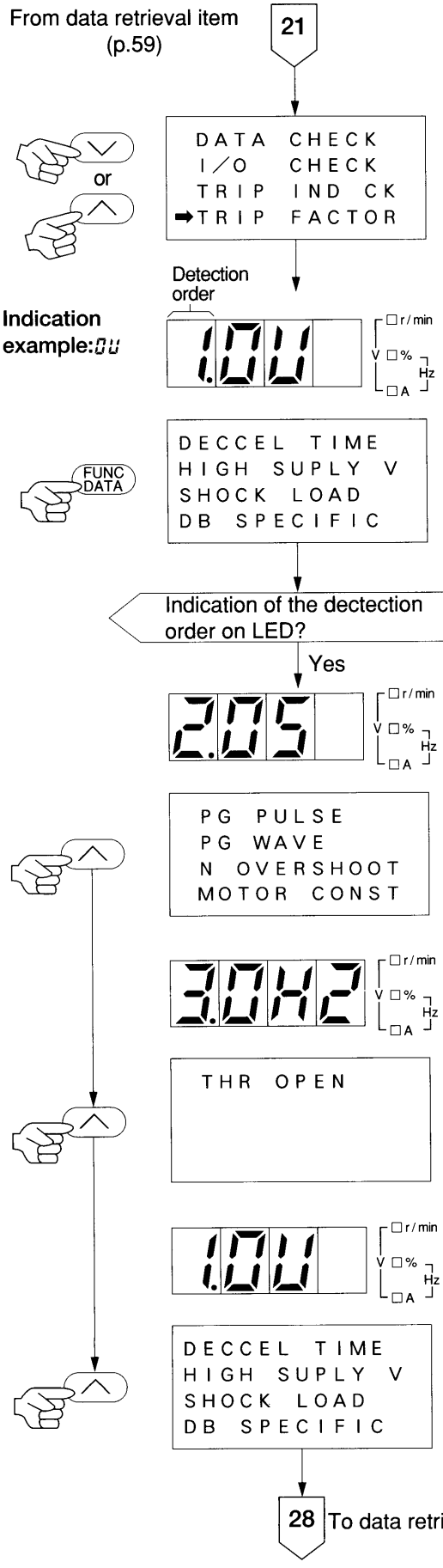


Selecting trip data item	Press (∧) or (∨) key to put the cursor on "TRIP IND CK" on the data retrieval screen.
Calling for the trip data screen	Press (FUNC DATA) key. The alarm data 1 screen appears. Press (≫) key. Then, the screen changes per pressing (≫) key as shown in the figure. **Alarm data 1 screen** N*: Speed written value, N: Speed detection value, F*: Frequency command value, IT*: Torque current command value **Alarm data 2 screen** Iout: Output current, Vout: Output voltage, VDC: DC link voltage, TIME: Total operation time at activation of protection function **Operation information** Indicating the operation data at alarm detection, Indicated items are same as in c) Input/output data identification. **Input signal screen** Indicating input state of the control input terminals **Output signal screen** Indicating output state of the output terminals **Input and output signal screen for control options** Refer to the Control option Instruction Manuals. **Alarm history screen** Indicating the alarm code occurred in the past. Indicating the first detected alarm code when two or more alarms occur at the same time.
Call for the data retrieval screen	After finish of the data identification, press (RESET) key. The screen returns to the data retrieval screen from any screen.

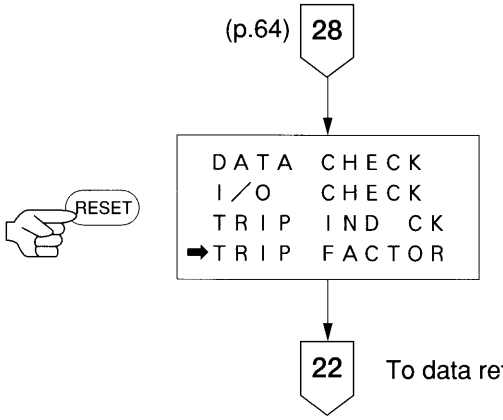
e) Trip (alarm) factor identifying

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

NOTE : *The data are not lost when the powers supply is turned OFF. However, when the alarms are two or more, the second and following alarm codes are erased.*



Selecting the trip factor item	Press (∧) or (∨) key, and set the cursor to "TRIP FACTOR" of the data retrieval screen.
Calling for trip factor screen	Press (FUNC DATA) 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.
Retrieval of alarm contents	When the detection order is indicated, it shows that the protection was activated owing to complex causes. Press (∧) 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 (∧) key, indicating the relevant alarm code and its presumed cause, and return to the detection order 1 if all causes have been sloved. When pressing (∨) key, the detection order will be indicated in reverse order, for instance, 1→3→2→1. **Indication example** Detection oder / Alarm name 1 / Overvoltage 2 / Overspeed 3 / External alarm



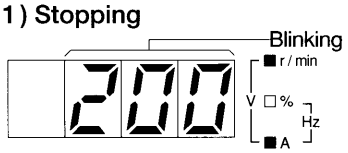
Call for the data retrieval screen	After finish of the data identification, press (RESET) key. The screen returns to the data retrieval screen from any screen.

8-6 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 speed setting and the RUN and STOP commands can be inputted from the key pad panel.

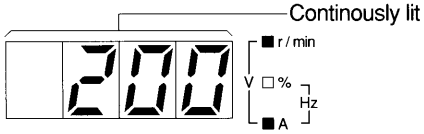
a) Operation mode screen selection
Call for the operation mode screen on LCD referring to Fig. 8-3-4 (p.43).
The screen according to the data of "98 LCD MONT S" is displayed on LCD.
As to LED, refer to " c) LED indication selection". The data on LED in the operation mode blinks while the inverter is in stopping, and continuously light while it is in running.

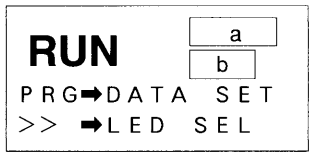
1) Stopping



a. LED indication factor
blank : 1 time
×10 : 10 times

2) Running





b. Motor rotation
—F— : Forward rotation
—R— : Reverse rotation

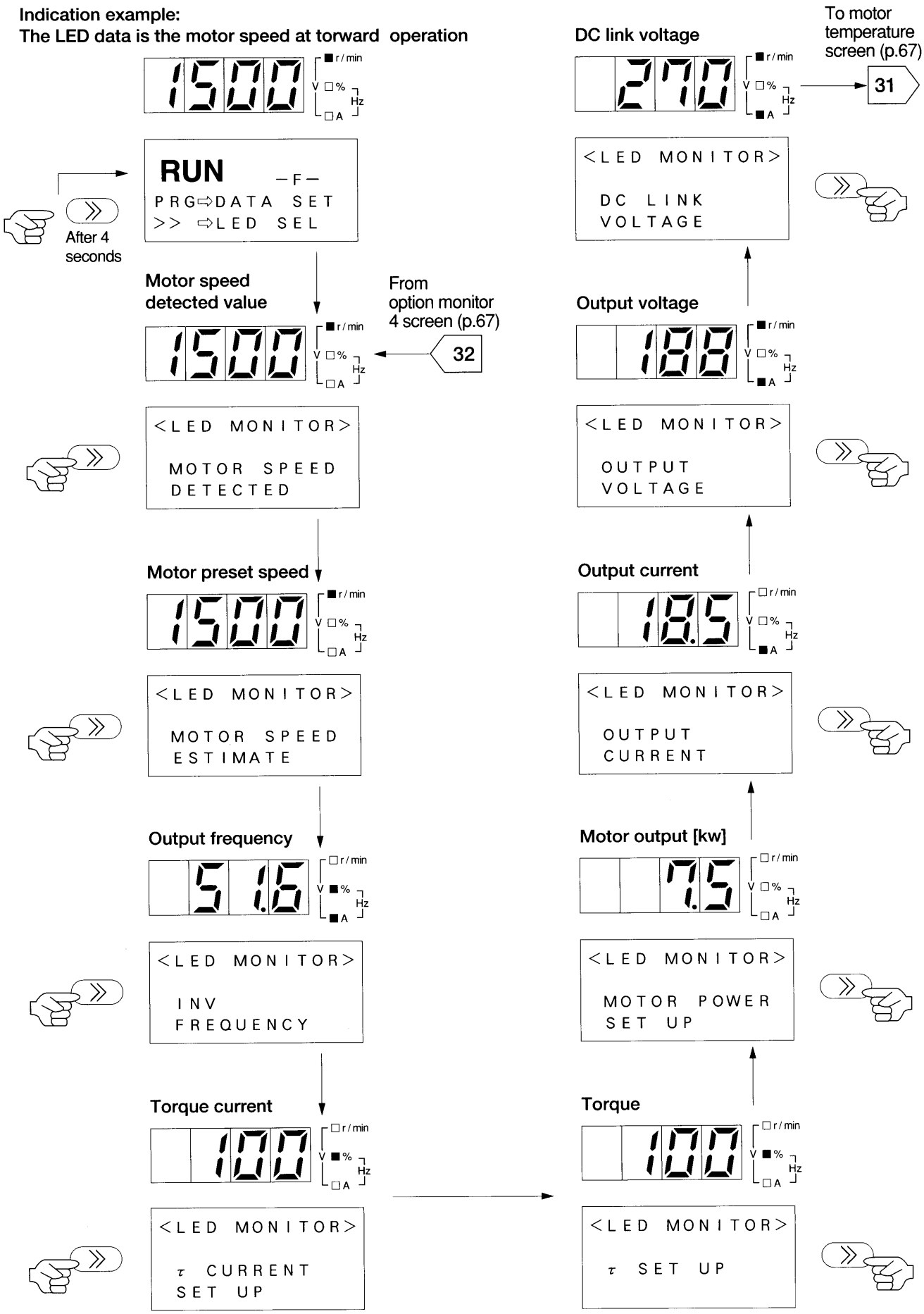
b) Display content selection for operation mode screen
Rewriting the data of "98 LCD-MONT S", you can change the display content of the LCD screen, for instance, to a bar chart.
Refer to "8-4 Program mode" (p.53) for changing the data, and "9 Function" (p.83) for display content.

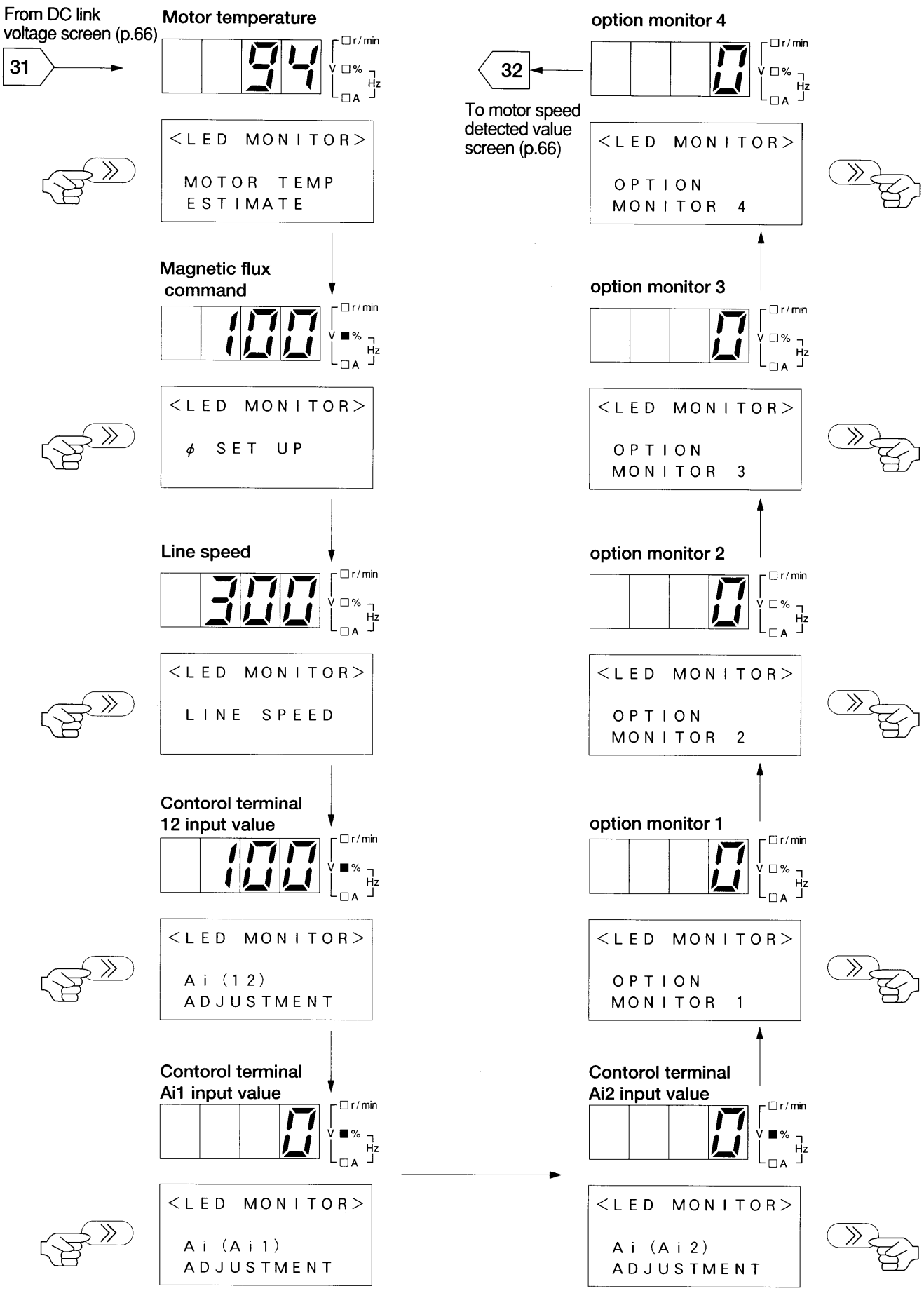
c) LED indication selection
LED indicates the data according to "95 LED MONTS".

Indication example: Motor is running at speed of 1000 r/min in forward rotation
(When the data of code 95 is 00.)

When the data is selected and indicated without rewriting the data of code 95, press (≫) key as follows:
— 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. 56 per each press of SHIFT key.
— Finish selecting the data
The LCD screen returns to the operation mode screen 4 seconds after the (≫) key is released.

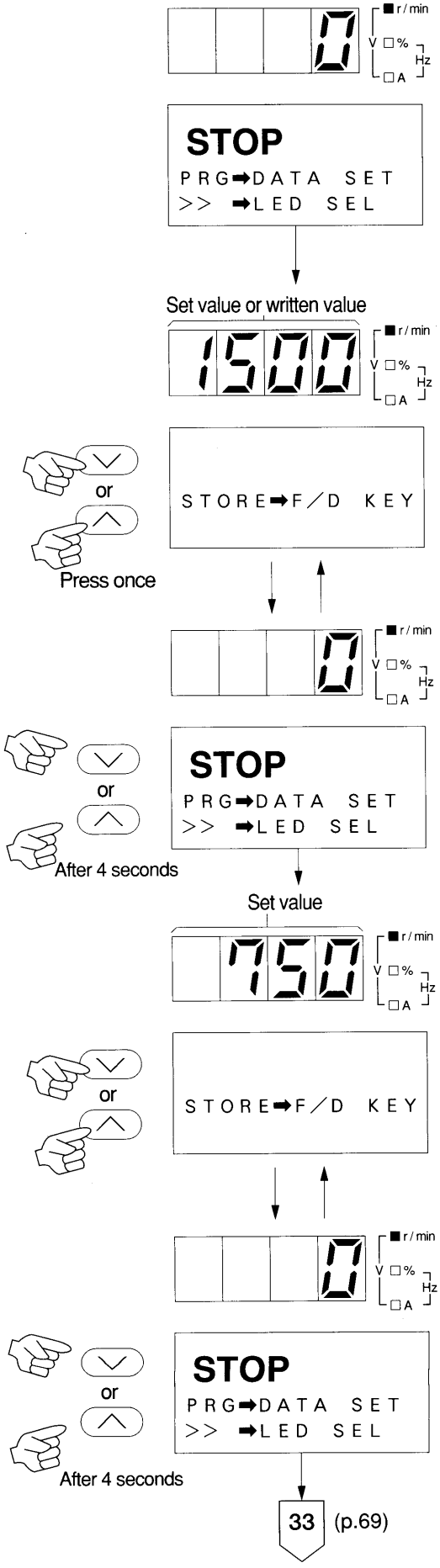
The LED continues to indicate the selected data until the next operation is selected. However, this selection is not stored into memory. When AC power is turned off, the selected data is lost.


Indication example:
The LED data is the motor speed at torward operation
1500
RUN -F-
PRG⇨DATA SET
>> ⇨LED SEL
After 4 seconds
Motor speed detected value
From option monitor 4 screen (p.67)
32
<LED MONITOR>
MOTOR SPEED DETECTED
Motor preset speed
<LED MONITOR>
MOTOR SPEED ESTIMATE
Output frequency
51.6
<LED MONITOR>
INV FREQUENCY
Torque current
100
<LED MONITOR>
τ CURRENT SET UP
DC link voltage
270
To motor temperature screen (p.67)
31
<LED MONITOR>
DC LINK VOLTAGE
Output voltage
188
<LED MONITOR>
OUTPUT VOLTAGE
Output current
18.5
<LED MONITOR>
OUTPUT CURRENT
Motor output [kw]
7.5
<LED MONITOR>
MOTOR POWER SET UP
Torque
100
<LED MONITOR>
τ SET UP


From DC link voltage screen (p.66)
31
Motor temperature
94
<LED MONITOR>
MOTOR TEMP ESTIMATE
Magnetic flux command
100
<LED MONITOR>
φ SET UP
Line speed
300
<LED MONITOR>
LINE SPEED
Contorol terminal 12 input value
100
<LED MONITOR>
Ai (12) ADJUSTMENT
Contorol terminal Ai1 input value
0
<LED MONITOR>
Ai (Ai1) ADJUSTMENT
option monitor 4
32
To motor speed detected value screen (p.66)
0
<LED MONITOR>
OPTION MONITOR 4
option monitor 3
0
<LED MONITOR>
OPTION MONITOR 3
option monitor 2
0
<LED MONITOR>
OPTION MONITOR 2
option monitor 1
0
<LED MONITOR>
OPTION MONITOR 1
Contorol terminal Ai2 input value
0
<LED MONITOR>
Ai (Ai2) ADJUSTMENT
r/min
%
Hz
A

d) SPEED setting

You can set the motor speed with keypad panel,if the data of "01 N SETTING "is 0.

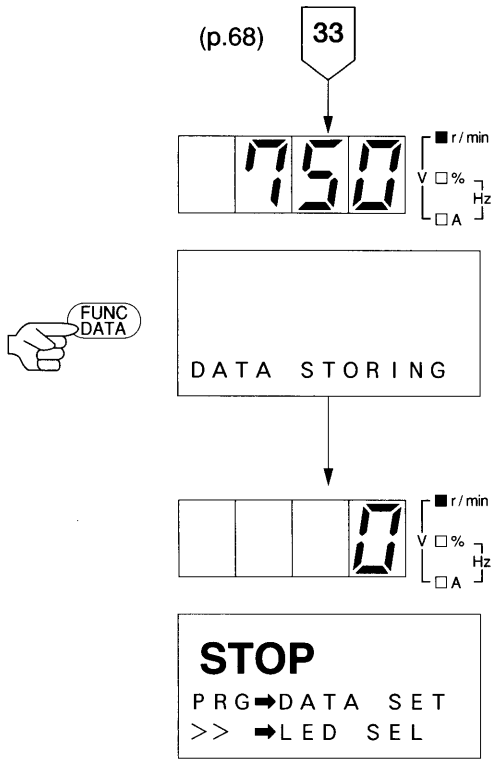


33 (p.69)

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

Indication example:
The set speed is changed from 1500r/min to 750r/min during inverter stopping and the motor speed is selected for the LED indication (Data 00 of "95 LED MONT S").

Identifying the set speed	Press ∧ or ∨ key once. LED indicate the current speed 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 speed	Press ∧ key for increasing speed and speed ∨ key for reducing speed. 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.



Writing the speed setting value into the memory	Press (FUNC DATA) key when the setting value is indicated on LED. If the screen changed to the screen before operation, 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 speed has been completed.

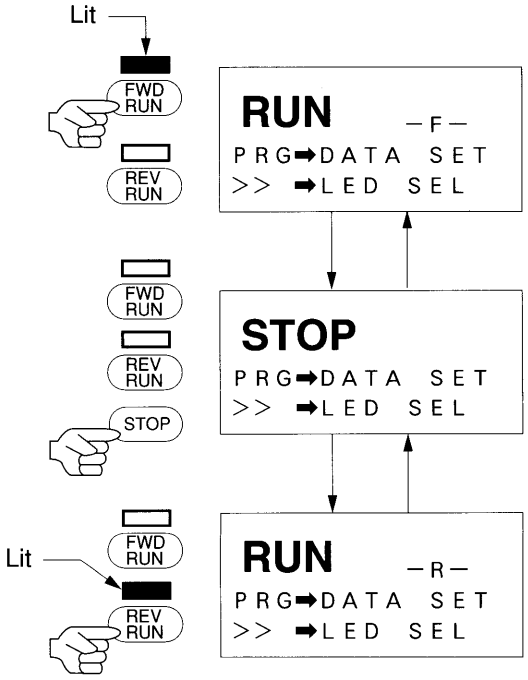
e) Inputting run and stop commands.

⚠ WARNING

Since stop command is inputted according to the data of function "02 Operation command", it may not be inputted from the keypad panel at emergency. Under this condition, turn OFF (open) the power supply circuit breaker.

The RUN and STOP commands can be inputted from (FWD RUN), (REV RUN) and (STOP) keys when the operation indicator turns ON on keypad panel (When the data of "02 OPR METHOD" is 0).

Turned on: Command can be input.
■ **KEYPAD OPERATION**
□ **KEYPAD OPERATION**
Turned off: Command cannot be input.

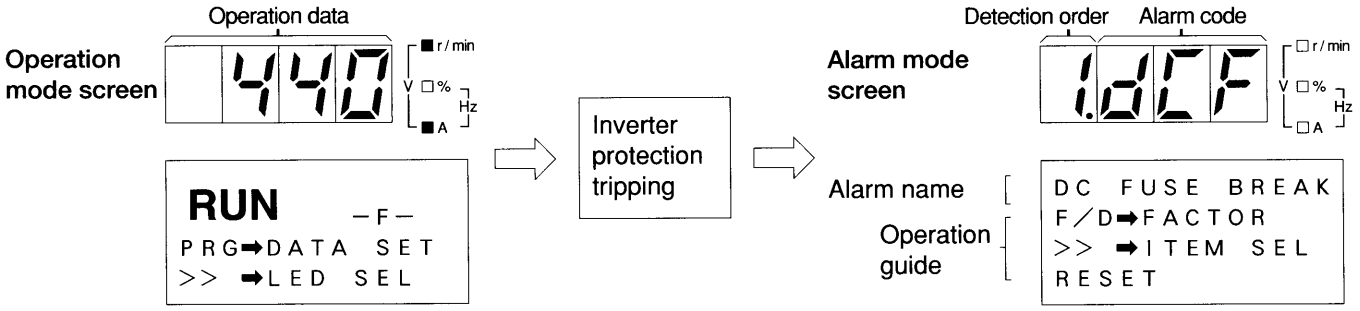


Starting to forward rotation	Press (FWD RUN) key. The motor is accelerated toward forward rotation according to the selected acceleration time. The forward operation indicator turns ON.
Stopping	Press (STOP) key. The motor is decelerated according to the selected deceleration time. At the time point of inputting stop command, the operation indicator turns OFF.
Starting to reverse rotation	Press (REV RUN) key. The motor is accelerated toward reverse rotation according to the selected acceleration time. The reverse operation indicator turns ON.

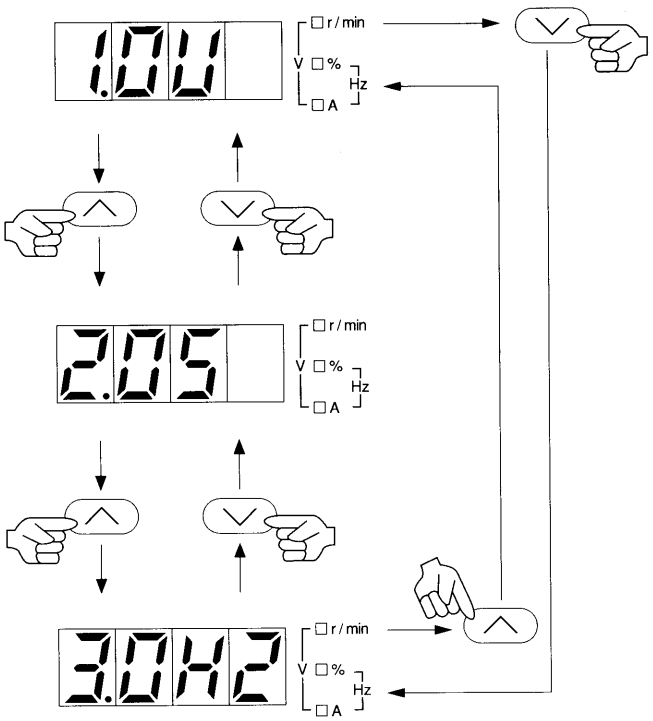
NOTE : *Even if during the program mode and data monitoring mode, when the keypad operation indicator turns ON, the operation commands can be inputted from (FWD RUN), (REV RUN) and (STOP) keys.*

8-7 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.



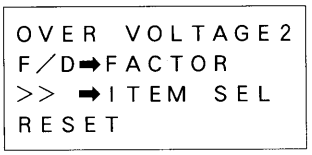
a) Alarm code retrieval on complex tripping causes



Indication example:

Detection order	Alarm name
1	Overvoltage
2	Overspeed
3	External alarm

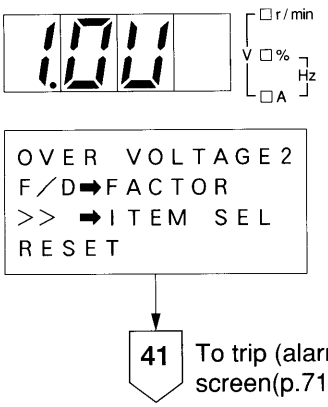
LCD screen during alarm code retrieval



Identify the alarm code that the inverter protection has detected at first and then press (∧) key. The detection order will change from 2 to 3 per pressing (∧) 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 (∨) 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 (∧) or (∨) key. The alarm name of the first detection order is continuously indicated.

b) Trip (alarm) factor identifying

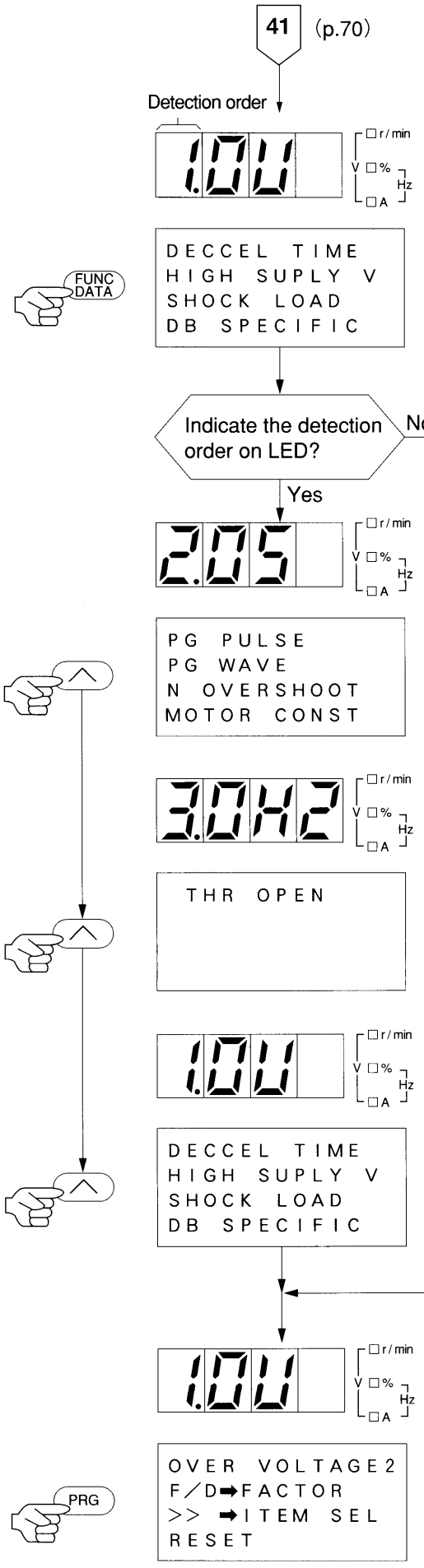
The presumable protection trip factor is indicated onLCD.



41 To trip (alarm) factor screen(p.71)

Indication example:

Detection order	Alarm name
1	Overvoltage
2	Overspeed
3	External alarm

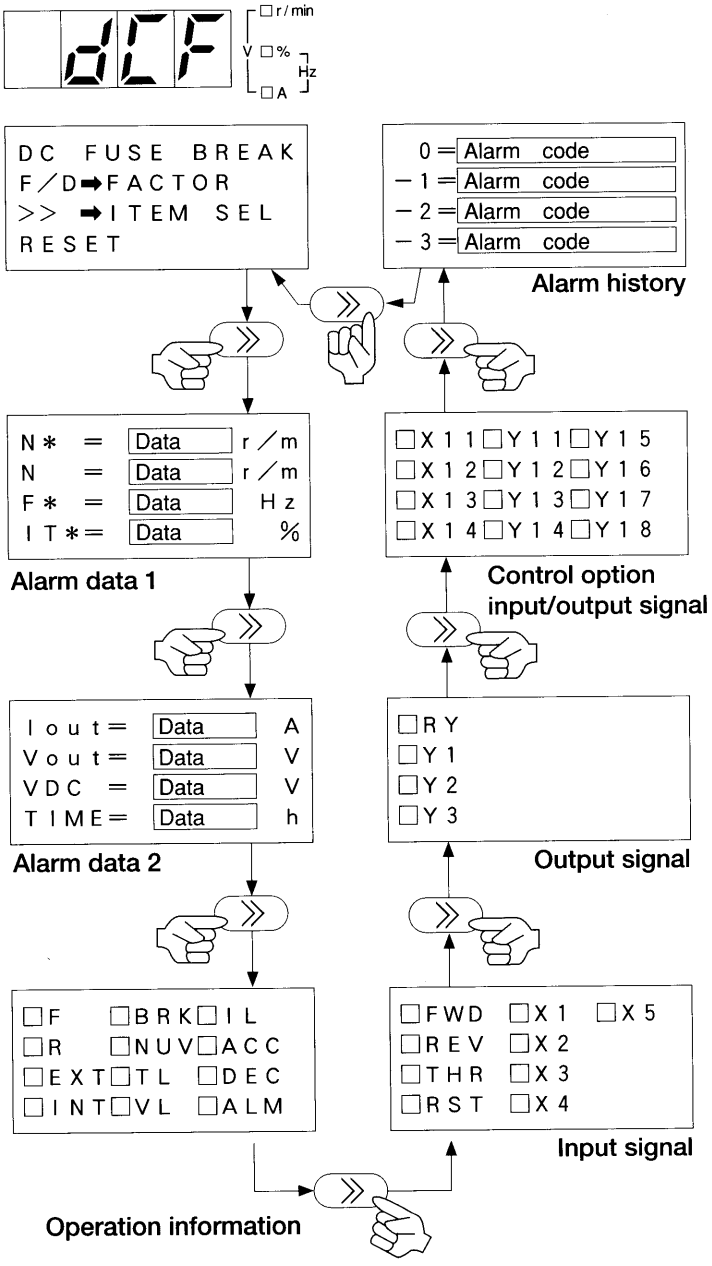


Calling for trip factor screen	Press (FUNC DATA) key following the operation guide on the alarm mode screen. LCD will changes to the trip factor screen. The LED indication does not change.
Retrieval of alarm contents	When the detection order is indicated, it shows that the protection was activated owing to complex causes. Press (∧) key. LED indicates the detection order 2 and the second alarm code. LCD indicates the presumed 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 presumed 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.
Returning to the alarm mode screen.	After identifying the factor, press (PRG) key to return to the alarm mode screen.

c) Trip (alarm) data identifying

Seven screens can be selected and indicated for the trip (alarm) data on LCD.
Press (≫) key following the guide of the alarm mode screen. At first, the alarm data 1 screen is displayed.
Press (≫) key further. The screen will change as shown in the figure per pressing (≫) key. If the displays of 7 screens are completed, the screen returns to the alarm mode screen.
The indication of LED does not change even by pressing (≫) key.

NOTE : *Following selections can be conducted on any screen of the 7 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 (∧) or (∨) 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.*



Alarm data 1 screen
N*: Speed written value,
N: Speed detection value,
F*: Frequency command value,
IT*: Torque current command value

Alarm data 2 screen
Iout: Output current, Vout: Output voltage,
VDC: DC link voltage,
TIME: Total operation time at activation of protection function

Operation information screen
F: In forward operation
R: In reverse operation
BRK: In resistance braking
NUV: Existing of main circuit voltage
TL: In torque limiting VL: In voltage limiting
IL: In current limiting
ACC: In acceleration DEC: In deceleration
ALM: In activation of protection

Input signal screen
Indicating input state of the control input terminals.

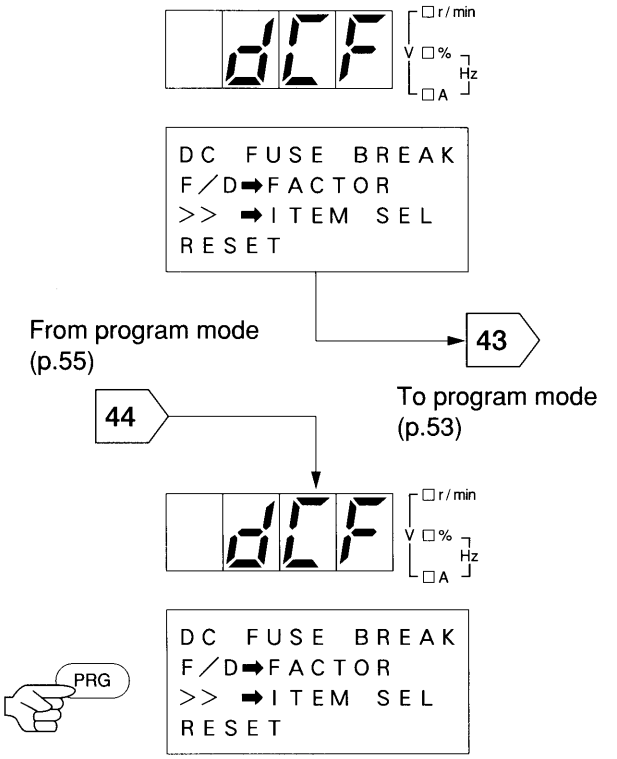
Output signal screen
Indicating output state of the output terminals.

Input and output signal screen for control options
Refer to the Control option Instruction Manuals.

Alarm history screen
Indicating the alarm code occurred in the past.
Indicating the first detected alarm code when two or more alarms occur at the same time.
The first trip for the latest trip and the previous three trips can be indicated by alarm history screen.
0: Latest trip
−1: 1st Previous trip
−2: 2nd Previous trip
−3: 3rd Previous trip

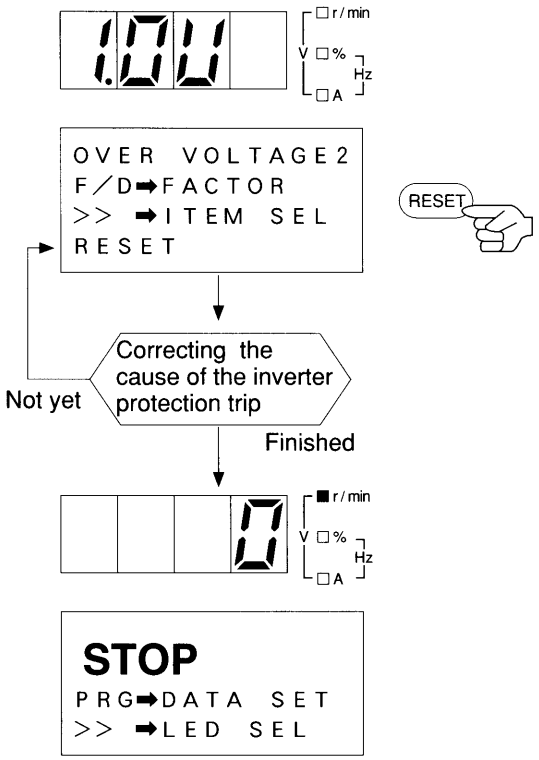
d) Program mode selection

The data setting method is same as that in "Program mode". Refer to p. 53.



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.



8-8 Auto-tuning

⚠ WARNING

The motor and machine or equipment repeat to run and stop when starting auto-tuning. Therefore, conduct the auto-tuning after confirming safety.

Auto-tuning automatically measures the data necessary for FRENIC5000VG5 series by repeating run and stop of the motor, and writes the measured data into the object function. In the auto-tuning function, there are a speed regulator system (ASR) and motor constants system.

a) Auto-tuning for speed control system (ASR)

This measures the following data:
— Selected ASR: P constant and I constant
"14 ASR1-P" and "15 ASR1-I" , or "37 ASR2-P" and "38 ASR2-I"
— Data for observer: Integration time and load inertia
" 54 OBSERVER 2" and "55 OBSERVER 3"

Before starting the tuning, prepare as follows:
— Stop the inverter output.
— Connect the motor with the load.
— Set the data of "200 PROTECTED" at 1 and write it.
— Set the speed command at 50% or more of the data of "03 MAX SPEED" and write it.
— Check that the acceleration torque is 10% or more of the motor rated torque and the of acceleration time is 0.1 second or more.

NOTE : *When measuring at no-load etc., if the acceleration torque is not 10% or more of the motor rated torque, keep the acceleration torque by shortening the acceleration time.*

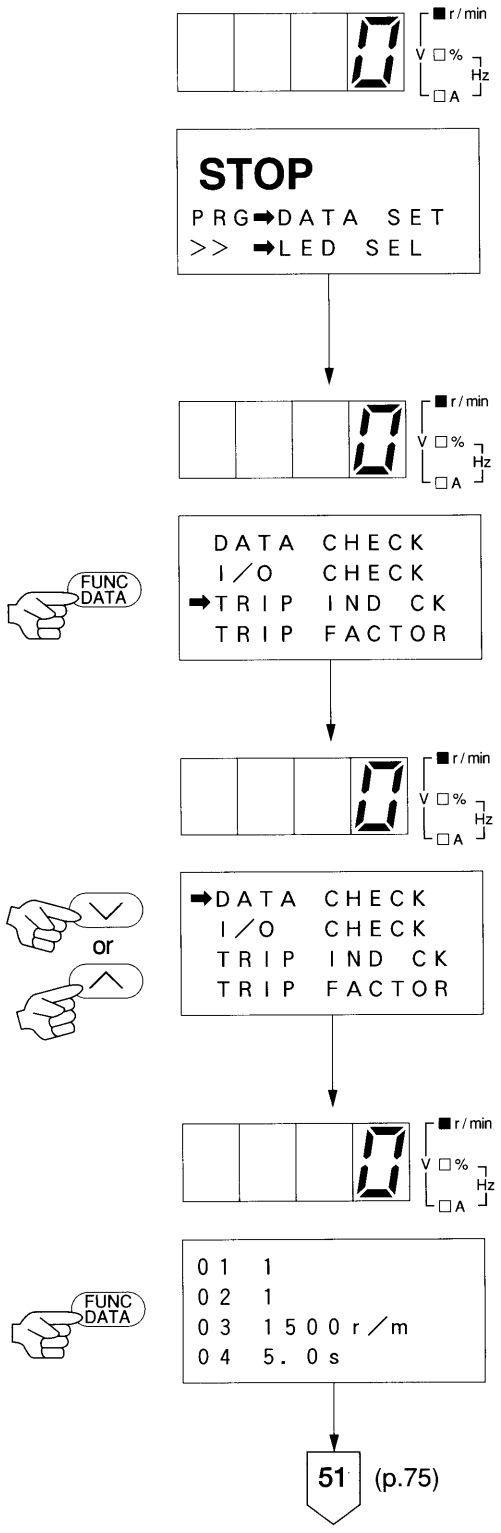
— Set the selected data of S-curve acceleration and deceleration ("06 S-CURVE 1" or "35 S-CURVE 2") at 0 and write it.
— Set the data of "31 DROOP" at 0.0 and write it.
— Set the data of "53 OBSERVER 1" at 1.00 and write it when using observer.

NOTE: *When the acceleration and deceleration time is long, the tuning time also becomes long. To measure the tuning data in a short time, shorten the acceleration and deceleration time up to the allowable value.*

NOTE : *The auto-tuning for speed control system starts by the command from keypad panel or control terminals. This does not start through the data communication (RS485).*

NOTE : *The motor repeats to start and stop in ten odd times during tuning. Too many repeats show impossibility of tuning. Then, press (STOP) key to stop tuning.*

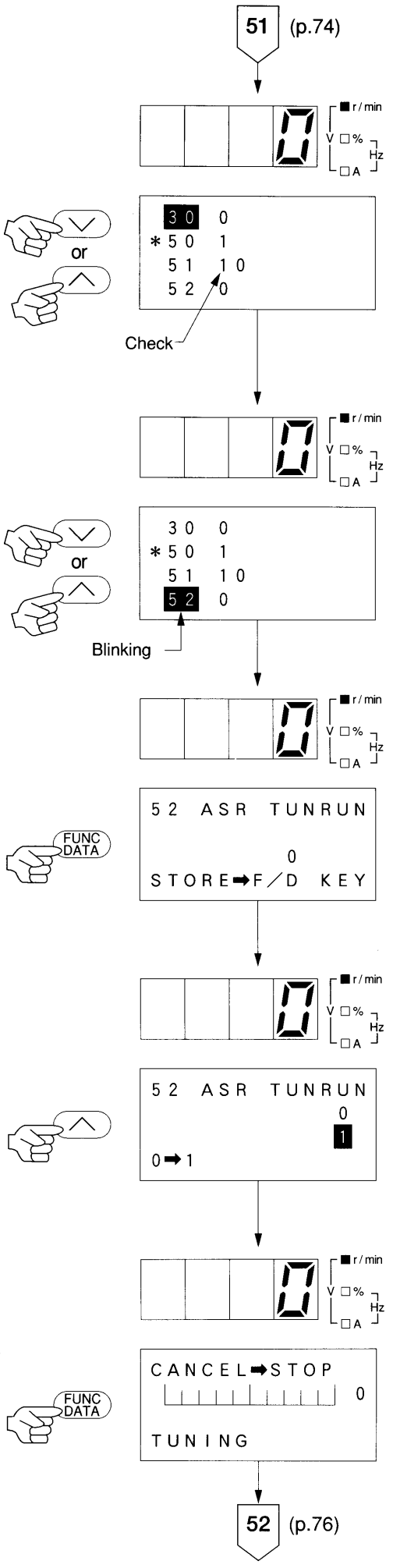
Since the data are necessary to be checked in tuning, a procedure conducting from the data monitoring mode will be shown.



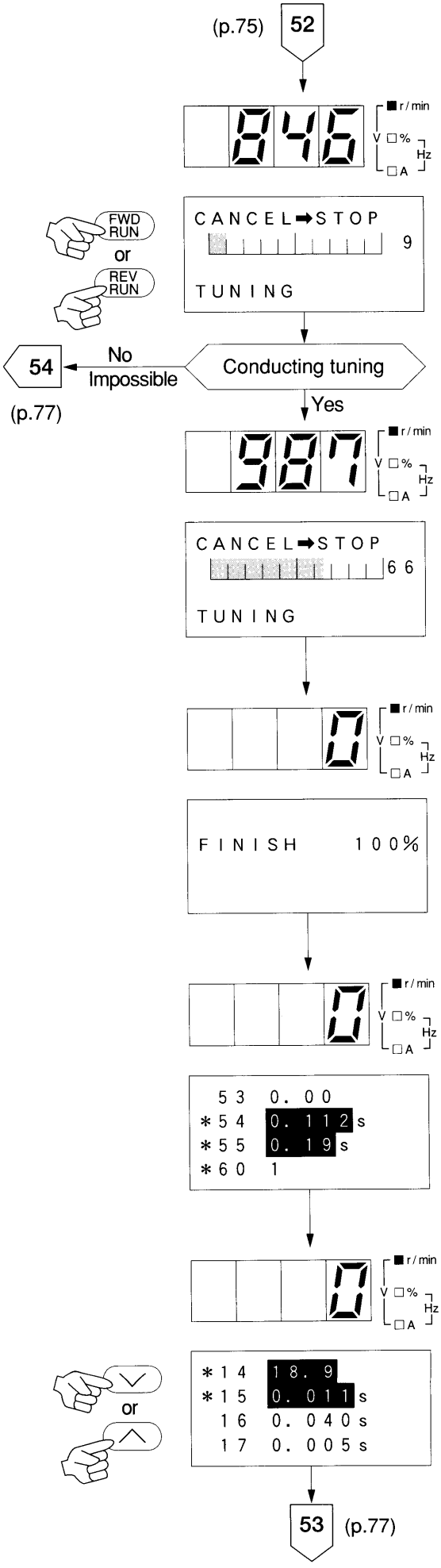
LED indicates the data of selected item in "95 LED MONT S" during tuning.

LED indication example: Motor speed (data 00)

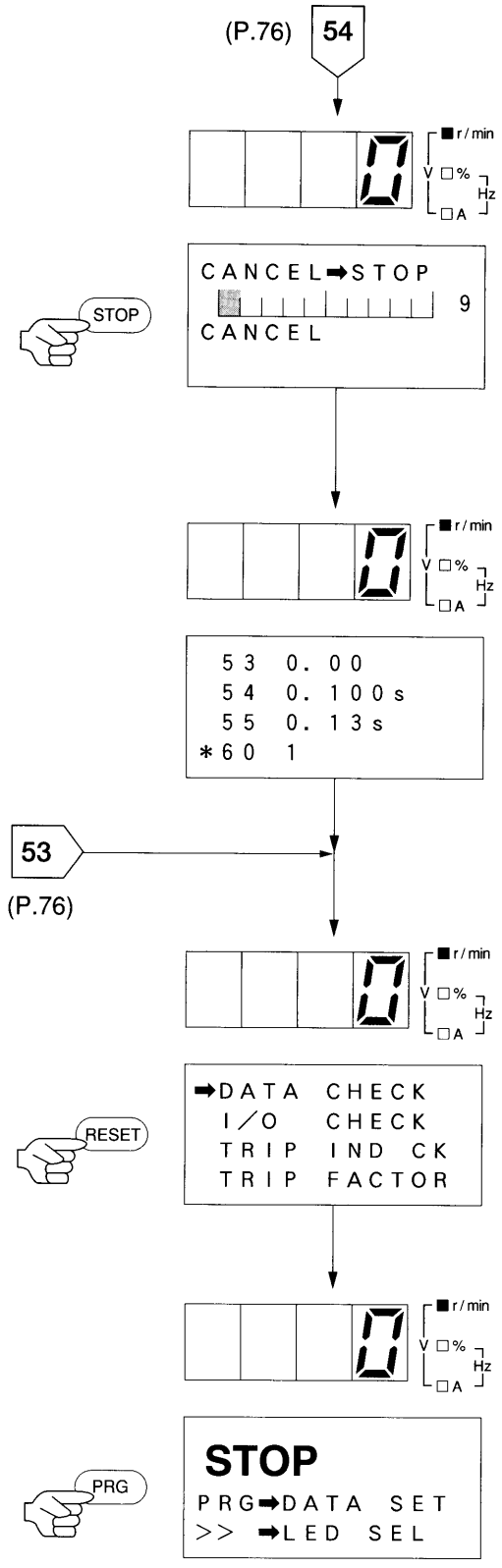
Calling for the data retrieval screen	Press (FUNC DATA) key.
	Press (∧) or (∨) key to put the cursor on DATA CHECK. **NOTE:** *The cursor moves with (≫) key also.*
Calling for the data screen	Press (FUNC DATA) key. The data screen indicating 4 codes and their data appears.



Calling for the screen indicating codes 51 and 52	Press (∧) or (∨) key until appearing codes 51 and 52. Check the second digit of the data of code 52 (ASR response speed) for matching the load. If the data is not suitable, rewrite the data referring to "8-4 program mode" and "8-5 Data monitoring mode". After rewriting the data, check the data.
Selecting code 52	Press (∧) or (∨) key to put the blinking cursor on code 52.
Calling for the data setting screen	Press (FUNC DATA) key. The data setting screen appears and the data of 0 blinks. In the comment row, "0→1" of data setting range and "STORE→F/D KEY" alternately appear. When tuning from program mode, call for this screen referring to "8-4 Program mode"
Setting the data	Press (∧) key to set the data at 1. 0 of the data shifts to the upper row, and the setting value 1 blinks. In the comment row, "0→1" and "STORE →F/D KEY" alternately appear.
Calling for tuning screen	Press (FUNC DATA) key. The tuning screen appears. The tuning does not yet start.



Input starting command of tuning	Input forward or reverse run command. **NOTE:** — *Input forward or reverse run command from the keypad panel or control terminals according to " 02 OPR METHOD" . But, when inputting the command from the control terminals, input stop command after inputting the forward or reverse run command. Then the tuning starts.* — *The motor repeats start and stop during tuning. The rotating direction of the motor follows the forward or reverse run command.* When the tuning starts, a bar graph and numerics (%) on the right side of the bar graph show progressing state. If the tuning is impossible because of unsatisfactory condition etc., the motor repeats start and stop, but the tuning screen does not progress.
Continuing tuning	The bar graph and numerics show the degree of tuning progress. **NOTE:** *During the tuning, since the motor speed etc, change successively, it is difficult to read the data when monitoring the data with LED.*
Finishing tuning	When the tuning finished, the screen changes to FINISH screen. This screen is shown for about 2 seconds.
Returning to the data screen (or function selection screen)	The data screen indicated from code 53 appears. When starting the tuning from the program mode, function selection screen from code 53 appears.
Checking the tuning data	Press ⌃ or ⌄ key to check the tuning data. These data are not written, but serve as the operation data. If the data become definite, write them into memory. All data can be written with "101 ALL SAVE" also.



Stopping the tuning	Press (STOP) key. The indication changes from TUNING to CANCEL, and the progress of the bar graph and numerics stop. This screen is displayed for about 2 seconds.
Returning to the data screen	The data screen indicated from code 53 appears. The data before the tuning are shown.
Calling for the data retrieval screen	Press (RESET) key.
Calling for the operation mode screen	Press (PRG) key. **NOTE:** *The screen returns to the operation mode screen with (RESET) key also.*

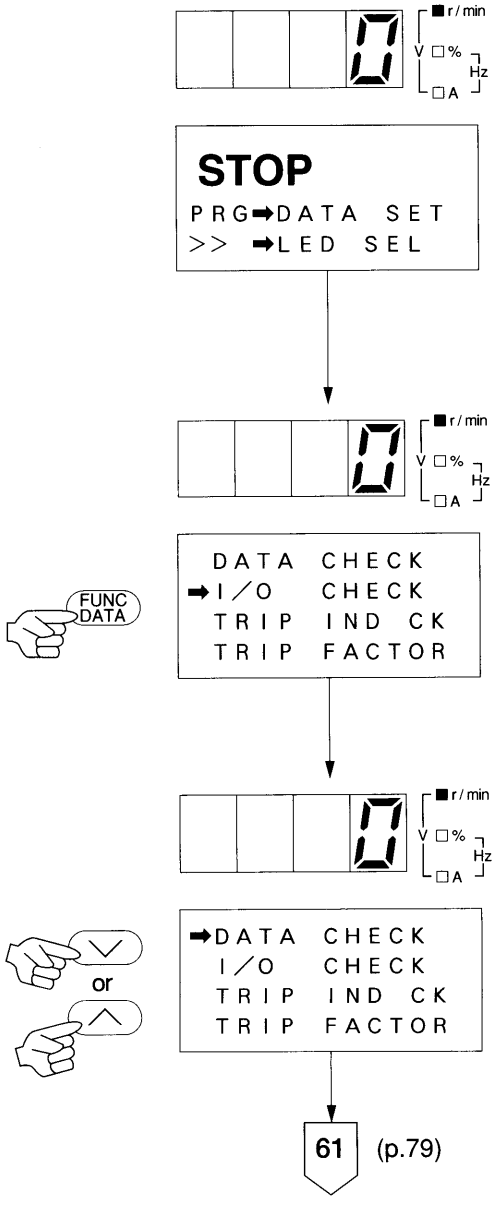
b) Motor constants auto-tuning

Motor constants of code 182 to 197 are measured.
Before starting the tuning, prepare as follows:
— Stop the inverter output.
— Set the data of "200 PROTECTED" at 1 and write it.
— Match the data of code 171 to 179 with the specification of the motor to be tuned.

NOTE : *When selecting OTHERS in the data of "171 M SELECT", write an initial value into "184 RATED Im".*
The initial value of "171 M SELECT"
= The data of "176 RATED A" ×0.5
However, the data written into "184 RATED Im" changes to measured value by the tuning.

NOTE :
— *The tuning is conducted regardless of connection between the motor and load. However, since only forward rotation is allowable during tuning, disconnect the load from the motor if the load has difficulty in forward running.*
— *When the acceleration and deceleration time is long, the tuning time also becomes long. To measure the tuning data in a short time, shorten the acceleration and deceleration up to the allowable value. Or, disconnect the load and shorten the acceleration and deceleration time to the necessary time for the motor.*
— *If starting tuning in the case of abnormality on the motor side, such as output circuit break, the state changes to the alarm mode. Er7 is indicated on LED, and alarm mode screen appears on LCD.*

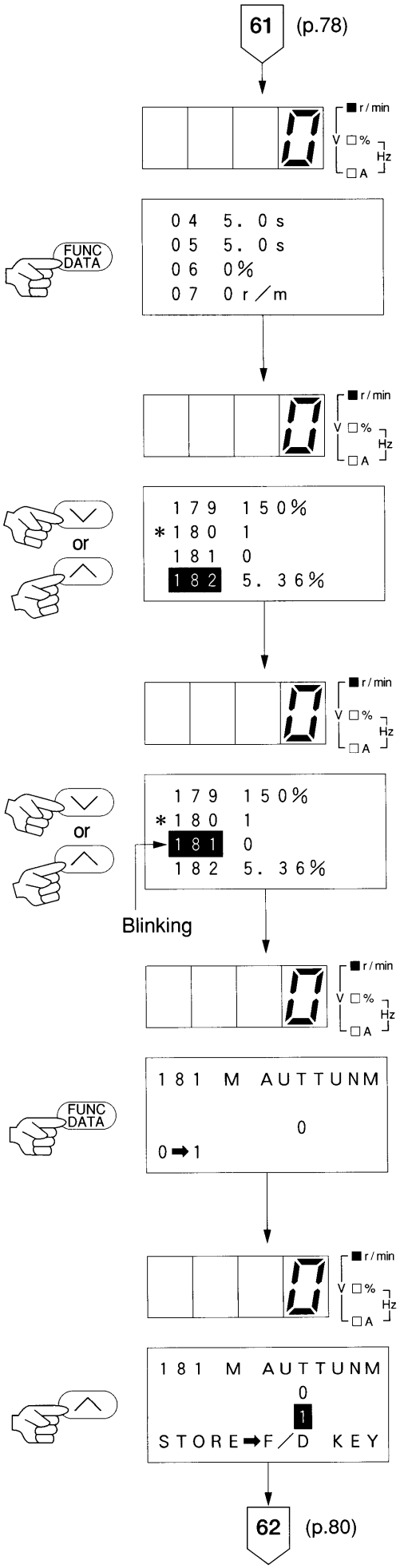
Since the data are necessary to be checked in tuning, a procedure conducting from the data monitoring mode will be shown.



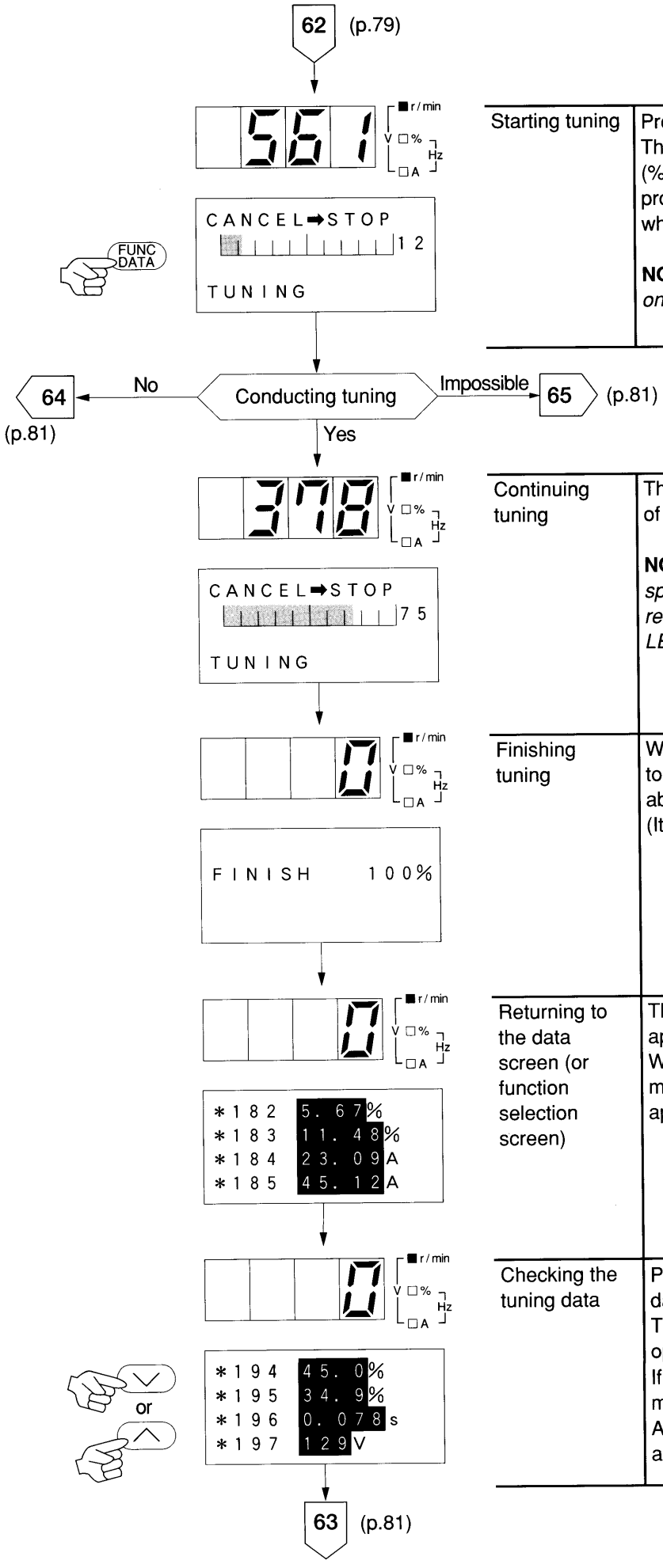
LED indicates the data of selected item in "95 LED MONT S" during tuning.

LED indication example: Motor speed (data 00)

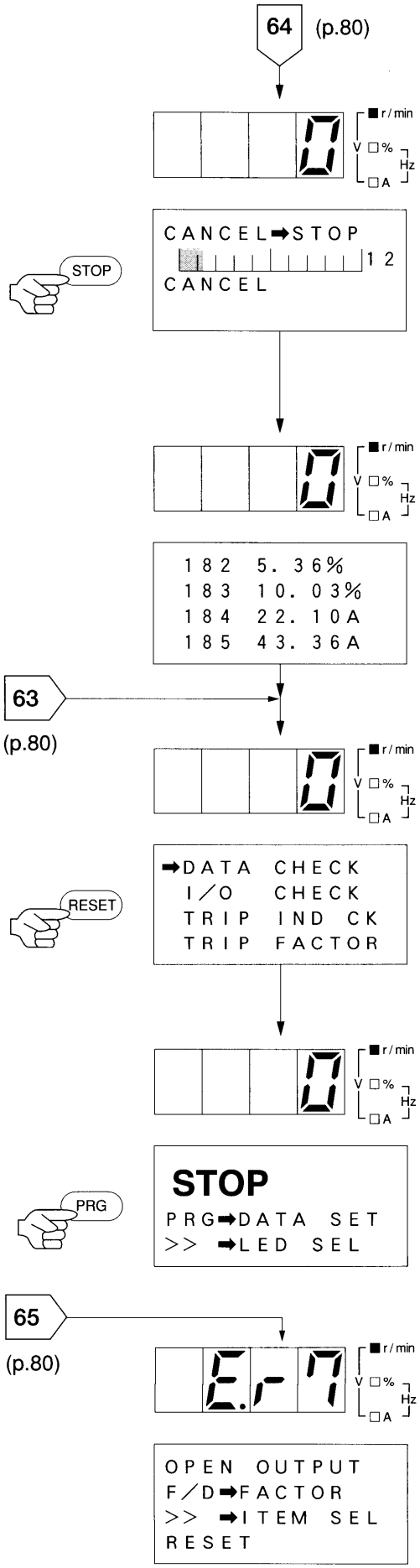
Calling for the data retrieval screen	Press (FUNC DATA) key
	Press (∧) or (∨) key to put the cursor on DATA CHECK. **NOTE:** *The cursor moves with (≫) key also.*



Calling for the data screen	Press (FUNC DATA) key. The data screen indicating 4 codes and their data appears.
Calling for the screen indicating codes 180 and 181	Press (∧) or (∨) key up to appearing codes 180 and 181. Check the data of code 180. — data 0: Tuning forbid — data 1: Tuning possible If the data is 0, rewrite the data referring to "8-4 Program mode" After rewriting the data, check the data.
Selecting code 181	Press (∧) or (∨) key to put the blinking cursor on code 181
Calling for the data setting screen	Press (FUNC DATA) key. The data setting screen appears and the data of 0 blinks. In the comment row, "0→1" of data setting range and "STORE→F/D KEY" alternately appear. If the data of code 180 is 0, the indication in the comment row becomes DATA PRTCTD. In this case, the tuning is impossible. When tuning from program mode, call for this screen referring to "8-4 Program mode".
Setting the data	Press (∧) key to set the data at 1. 0 of the data shifts to the upper row, and the setting value 1 blinks. In the comment row, "0→1" and "STORE →F/D KEY" alternately appear.



Starting tuning	Press (FUNC DATA) key. The tuning starts. A bar graph and numerics (%) on the right side of the bar graph show progressing state. The left figure shows only when the tuning is possible. **NOTE:** *The motor repeats start and stop, but only in forward rotation*
Continuing tuning	The bar graph and numerics show the degree of tuning progress. **NOTE:** *During the tuning, since the motor speed etc, change successively, it is difficult to read the data when monitoring the data with LED.*
Finishing tuning	When the tuning finished, the screen changes to FINISH screen. This screen is shown for about 2 seconds. (It takes about 4.5 min from start to finish.)
Returning to the data screen (or function selection screen)	The data screen indicated from code 182 appears. When starting the tuning from the program mode, function selection screen from code 182 appears.
Checking the tuning data	Press (^) or (v) key to check the tuning data. These data are not written, but serve as the operation data. If the data become definite, write them into memory. All data can be written with "101 ALL SAVE" also.



Stopping the tuning	Press (STOP) key. The indication changes from TUNING to CANCEL, and the progress of the bar graph and numerics stop. This screen is displayed for about 2 seconds.
Returning to the data screen	The data screen indicated from code 182 appears. The data before the tuning are shown.
Calling for the data retrieval screen	Press (RESET) key after finish of the tuning.
Calling for the operation mode screen	Press (PRG) key. **NOTE:** *The screen returns to the operation mode screen with (RESET) key also.*
Being impossible to conduct tuning	If the measurement was impossible because of break or high impedance of the output circuit, the state changes to the alarm mode, and "Er7 " is indicated on LED.

NOTES

9 Function

9-1 Function table

Table 9-1 Function table

	Code	Name	LCD monitor	Setting range	Unit	Increment	Factory writing: With PG	Factory writing: Without P G	Ref. page
Basic functions	01	Speed command	01 N SETTING	0: Keypad panel (UP key, DOWN key 1: Other than keypad panel (Terminal 12, multistep speed, etc.)	—	—	1		95
	02	Operation command	02 OPR METHOD	0: Keypad panel (FWD, REV, STOP key) *1) 1: External signals (FWD, REV)	—	—	1		100
	03	Maximum speed	03 MAX SPEED	250 to 12000 r/min	r/min	1	1500		98
	04 05	Acceleration time 1 Deceleration time 1	04 ACC TIME1 05 DEC TIME1	0.0 to 1200.0 s	s	0.1	5.0		97
	06	S-curve acc/dec 1 (S width)	06 S-CURVE 1	0 to 50%	%	1	0		
	07 08 09 10 11 12 13	Multistep speed 1 Multistep speed 2 Multistep speed 3 Multistep speed 4 Multistep speed 5 Multistep speed 6/Creeping speed 1 Multistep speed 7/Creeping speed 2	07 MULTI N-1 08 MULTI N-2 09 MULTI N-3 10 MULTI N-4 11 MULTI N-5 12 MULTI6/SLOW1 13 MULTI7/SLOW2	-12000 to 12000r/min	r/min	1	0		96
	14	ASR1 (P constant)	14 ASR1-P	0.1 to 999.9	—	0.1	20.0	10.0	
	15	(I constant)	15 ASR1-I	0.000 to 5.000 s, P-control at 0.000 s	s	0.001	0.040	0.200	103
	16	Filter time-constant (Speed setting)	16 N*FILTER	0.000 to 5.000 s	s	0.001	0.040		
	17	(Speed detection)	17 N FILTER				0.005		104
	18	Torque limiter (Mode select)	18 τ LIMIT M	0: 4 quadrants unified 1: Drive, brake individual 2: Upper and lower limits (ASR command) 3: Drive, brake individual always	—	—	0		105
	19	(Level select)	19 τ LIMIT s	000 to 222	—	—	000		106
				##0: Code 21, ##1: Ai. ##2: Di #0#: Code 20, #1#: Ai, #2#: Di 0##: CTAD ON Torque limit 1=DIT card input 1##: CTAD ON Torque limit 2=DIT card input 2##: CTAD ON Torque limit 1=DIT card input CTAD OFF Torque limit 2=DIT card input					
	20	Torque limiter (Level 1)	20 τ LIMIT 1	-250 to 250%	%	1	150		
	21	(Level 2)	21 τ LIMIT 1				10		
	22	Motor electronic thermal overload (Mode select)	22 M OL MODE	0: Inactive 1: Active (Self fan, general-purpose motor) 2: Active (Forced fan, dedicated motor)	—	—	0		108
	23	(Level)	23 M OL LEVEL	0.0 to 999.9 A	A	0.1	by motor		
	24	Restart after momentary power failure (Mode select)	24 RESTART M	0: Inactive (Without restart, LU trip alarm) 1: Active	—	—	0		110
	25	DC brake (Braking time)	25 DC BRK TIM	0.0 to 10.0 s	s	0.1	0.0		
	26	(Braking level)	26 DC BRK LVL	10 to 100%	%	1	10		101
	27	Pre-excitation (Time)	27 PRE-EXCITE	0.0 to 10.0 s	s	0.1	0.0	0.1	
Control functions (ASR related)	30	Function block (31-44)	30■■31 -44■■	0: Function code 31 to 44-Block closed 1: Function code 31 to 44-Block opened	—	—	0		119
	31	Droop (Level)	31 DROOP	0.0 to 25.0%	%	0.1	0.0		103
	32	Filter time constant (ASR output)	32 ASR FILTER	0.000 to 0.200 s	s	0.001	0.000		
	33 34	Acceleration time 2 Deceleration time 2	33 ACC TIME2 34 DEC TIME2	0.0 to 1200.0 s	s	0.1	5.0		97
	35	S-curve acc/dcc 2 (S-width)	35 S-CURVE 2	0 to 50%	%	1	0		
	36	Speed ratio setting (Terminal 12 input)	36 12 RATIO	0.001 to 2.000	—	0.001	1.000		96

NOTE: *The functions in ☐ are changeable in operation. # in data setting range denotes any data.*
1) When inputting FWD and REV (ON), the data cannot change.

Table 9-1 Function table (continued)

	Code	Function Name	LCD monitor	Setting range	Unit	Increment	Factory writing With PG	Factory writing Without PG	Ref. page
Control functions (ASR related)	37	ASR2 (P constant)	37 ASR2-P	0.1 to 999.9	—	0.1	20.0	10.0	103
	38	(I constant)	38 ASR2-I	0.000 to 5.000 s	s	0.001	0.040	0.200	
	39	ASR1, 2 switching ramp	38 ASR SWITCH	0.00 to 2.55 s	s	0.01	1.00		
	40	Torque bias (Level 1)	40 τ BIAS1	-250 to 250%	%	1	150		107
	41	(Level 2)	41 τ BIAS2				10		
	42	Torque control/ Torque current control (Select)	42 τ CONTROL	00 to 11 Torque command Ai 0#: Inactive 1#: Active (using ATS) Torque current command Ai #0: Inactive #1: Active (using ATCS)	—	—	00		
	43	Magnetic flux command (Select)	43 ϕ MODE	0: Ordinary (Internal calculation) 1: Ai (AFLUX)	—	—	0		108
	44	Magnetic flux level under light load	44 ϕ LEVEL	10 to 100%	%	1	25	100	
Control functions (ASR tuning)	50	Function block (51-55)	50■■51 -55■■	0: Function code 51 to 55-Block closed 1: Function code 51 to 55-Block opened	—	—	0		119
	51	ASR tuning (Mode select)	51 ASR TUN M	00 t0 21 ASR response 0#: Low 1#: Medium 2#: High Observer select #0: Inactive #1: Active	—	—	10	00	104
	52	(Operation select)	52 ASR TUNRUN	0: Inactive, 1: Active	—	—	0		—
	53	Data for state observer (Gain for compensation)	53 OBSERVER 1	0.00 to 1.00	—	0.01	0.00		104
	54	(Integration time)	54 OBSERVER 2	0.005 to 1.000 s	s	0.001	0.100		
	55	(Load inertia)	55 OBSERVER 3	0.01 to 30.00 s *3)	s	0.01	*2)		
Control functions (Detection level)	60	Function block (61-74)	60■■61 -74■■.	0: Function code 61 to 74-Block closed 1: Function code 61 to 74-Block opened	—	—	0		119
	61	Motor overheating protection (Temp.)	61 M OH	100 to 200℃ (Valid only with NTC thermistor)	℃	1	150		109
	62	Motor overheat early warning (Temp.)	62 M PRE OH	50 to 200℃ (Valid only with NTC thermistor)	℃	1	75		
	63	Inverter overload early warning (Level)	63 INV PRE OL	25 to 100%	%	1	90		114
	64	Motor overload warning (Level)	64 M PRE OL	25 to 100%	%	1	90		109
	65	Zero speed detection (Level)	65 ZERO N LVL	1 to 1200 r/min	r/min	1	10		100
	66	Speed detection (Level 1)	66 OPT N1	1 to 12000 r/min (Absolute value)	r/min	1	1500		113
	67	(Level 2)	67 OPT N2	-12000 to 12000 r/min (With polarity)	r/min	1	1500		
	68	(Level 3)	68 OPT N3						
	69	Speed detection method	69 N DET MODE	0000 to 1111 #### (Method of code 65 / Method of code 66 / Method of code 67 / Method of code 68) 0: Speed feedback (Estimated value) 1: Speed command	—	—	0000		
	70	Speed arrival (Detection width)	70 N ARRIVAL	1.0 to 20.0%	%	0.1	3.0		114
	71	Speed agreement (Detection width)	71 N AGREMENT	1.0 to 20.0%	%	0.1	3.0		
	72	(Off-delay timer)	72 AGR DELAY	0.000 to 1.000 s	s	0.001	0.300		
	73	Torque detection (Level)	73 τ LEVEL	1.0 to 250.0%	%	0.1	30.0		
	74	Operation continue timer	74 RUN CONTT	0.00 to 5.00 S	s	0.01	0.50	0.00	100

NOTE: *The functions in ▭ are changeable in operation. # in data setting range denotes any data.*

*2) *The data of the dedicated motor with the same capacity of the inverter are written.*

*3) *When the data of code 171 are rewritten, the data of the Fuji Electric's dedicated motor for VG5 series are written. Further, it is possible to individually write.*

Table 9-1 Function table (continued)

	Function		LCD monitor	Setting range	Unit	Increment	Factory writing		Ref. page
	Code	Name					With PG	Without P G	
Control functions (Operating mode selection)	80	Function block (81-101)	80■■81 -101■	0: Function code 81 to 101-Block closed 1: Function code 81 to 101-Block opened	—	—	0		119
	81	Auto-restart (Restart time)	81 AUTO RESET	0 to 7 times	—	1	0		111
	82	(Restart interval)	82 RESET INT	2 to 20 s	s	1	5		
	83	Speed bias setting	83 N BIAS	-12000 to 12000 r/min	r/min	1	0		
	84	Speed limiter (Mode select)	84 N LMT METH	0: FWD/REV individual limit CSRL OFF: FWD (Code 85), REV (Code 86) CSRL ON : FWD (Code 86), REV (Code 85) 1: FWD/REV same limits CSRL OFF: Code 85 CSRL ON : Code 86 2: Upper and lower limits CSRL OFF: 110% limit CSRL ON : Lower limit (Code 86) Upper limit (Code 85)	—	—	0		99
	85	Speed limiter (Level 1)	85 N LMT LVL1	0.0 to 110.0%	%	0.1	100.0		
	86	(Level 2)	86 N LMT LVL2						
	87	Creeping select (Select)	87 U/D JOG S	00 to 11 1: Creeping 1 select 0#: Code 121/#: Ai (AJSS1) 2: Creeping 2 select #0: Code 13/#1: Ai (AJSS2)	—	—	00		98
	88	Rotation direction switching	88 F/R DIR SW	0: Same direction as operation command 1: Reverse direction against operation command	—	—	0		101
	89	Speed feed back (Signal select)	88 N FEDBAC M	0: Ordinary, 1: Ai (ASFB), 2: High selector	—	—	0		102
	90	Excessive voltage suppression	90 SUP FUNC M	0 to 1 Excessive voltage suppression function 0: Inactive, 1: Active	—	—	0		—
	91	Operation method (Response)	91 OPR METH M	00 to 11 0#: High speed response 1#: High accuracy control #0: Operation OFF when OFF between FWD-CM or REV-CM #1: Operation OFF at zero speed or less even if ON between FWD-CM or REV-CM	—	—	00		102
	92	Torque command monitor (Polarity select)	92 τ MONT S	000 to 111 0##: Torque command output (BTR) + at FWD torque 1##: Torque command output (BTR) + at FWD drive #0#: Torque meter (BTM1, keypad panel) + at FWD torque #1#: Torque meter (BTM1, keypad panel) + at FWD drive ##0: Torque ammeter (BTC1, keypad panel) + at FWD torque ##1: Torque ammeter (BTC1, keypad panel) + at FWD drive	—	—	000		116
	93	Language	93 LANGUAGE	0: Japanese 1: English	—	—	0		119
	94	LCD monitor (Brightness)	94 BRIGHTNESS	0 (dark) to 10 (bright)	—	—	5		
	95	LED monitor select	95 LED MONT S	00 to 12 Data | Ordinary indication 00 Motor speed (r/min) *1 01 Motor speed command (ASR input) *1 02 Inverter frequency (Hz) *1 03 Torque current (%) *1 04 Torque (%) *1 05 Motor output *1 06 Output current (A) *1 07 Output voltage (V) *1 08 Link voltage (V) *1 09 Motor temperature (℃) *1 0A Magnetic flux (%) *1 0B Load speed conversion value *2 0C AI adjust (12) *1 0D AI adjust (Ai1) *1 0E AI adjust (Ai2) *1 0F Option monitor 1 *1 10 Option monitor 2 *1 11 Option monitor 3 *1 12 Option monitor 4 *1 At speed setting from keypad pannel. *1: Motor speed command value (ACC/DEC calculator input) is indicated. *2: Load speed command value is indicated.	—	—	00		118

NOTE: *The functions in* ▭ *are changeable in operation. # in data setting range denotes any data.*

Table 9-1 Function table (continued)

	Function		LCD monitor	Setting range	Unit	Increment	Factory writing		Ref. page
	Code	Name					With PG	Without PG	
Control functions (Operating mode selection)	96	Load speed indication (Coefficient 1)	96 LOAD COEF1	1 to 9999 Load speed=Motor speed × Coefficient 1 / Coefficient 2	—	1	1000		118
	97	(Coefficient 2)	97 LOAD COEF2		—	1	1000		
	98	LED monitor select	98 LED MONT S	0: Operation state, Operation guidance 1: N*, N 2: N, τ 3: N, It 4: N, I	—	—	0		
	99	Motor sound	99 M SOUND	0: 2.5 kHz, 1: 5 kHz, 2: 10 kHz (5 kHz) (In VG5S, the carrier is kept at 5 kHz when the data are set at 2.) *2)	—	—	2		—
	100	Data initializing	100 DAT INIT	0: Inactive 1: Active (Codes 0 to 170 are initialized except codes 55 and 120 to 125.)	—	—	0		119
	101	Save all data	101 ALL SAVE	0: Inactive 1: Active	—	—	0		
Interface	110	Function block (111-134)	110■111 -134■	0: Function code 111 to 134-Block closed 1: Function code 111 to 134-Block opened	—	—	0		
	111	X1-X5 function select (X1-X2)	111 X1,X2FUNC	0000 to 2020 (Digits of 1000 and 100): Function of X1 (Digits of 10 and 1) : Function of X2 ※ As for correspondence, refer to setting range of code 113	—	—	0506		112
	112	(X3-X4)	112 X3,X4FUNC	0000 to 2020 (Digits of 1000 and 100): Function of X3 (Digits of 10 and 1) : Function of X4 ※ As for correspondence, refer to setting range of code 113	—	—	070F		
	113	(X5)	113 X5 FUNC	00 to 20	—	—	02		
	114	Multistep speed command agreement timer	114 MLT N TIM	0.000 to 0.100 s	s	0.001	0.000		96

Data	Name	Abbreviation
00	Operation command select	COPC
01	Speed setting value select	CSRM
02	Coast-to-stop command	CMCS
03	Pre-excitation command	CPEX
04	Operation signal hold	CHLD
05	Multistep speed setting select 1	CSR1
06	Multistep speed setting select 2	CSR2
07	Multistep speed setting select 4	CSR4
08	UP/DOWN adjuster up command	CUP
09	UP/DOWN adjuster down command	CDWN
0A	UP/DOWN adjuster clear command	CCLR
0B	Creeping speed select	CJSC
0C	ACC/DEC, UP/DOWN select	CSUC
0D	Speed setting value limit	CSRL
0E	Speed/torque control select	CSTC
0F	Torque limit	CTL
10	ACC/DEC time select	CADT
11	ACC/DEC by-pass	CADB
12	Torque bias command 1	CTB1
13	Torque bias command 2	CTB2
14	Droop ON	CDRP
15	ASR PI select	CPI
16	ASR P/PI select	CPPI
17	Ai1-ACC/DEC zero hold	CAI1Z
18	Ai2-ACC/DEC zero hold	CAI2Z
19	Unused	—
1A	Analog/digital select (Speed)	CSAD
1B	Analog/digital select (Torque)	CTAD
1C	Di card input latch signal (Speed)	CDILS
1D	Di card input latch signal (Torque)	CDILT
1E	T-link enable	CTEN
1F	Di command for transmission	CTDI
20	RS485 enable	CREN

NOTE: *The functions in* ▭ *are changeable in operation.*

*2) *The inverter for the standard applicatoin motor 75kW or more is 2.5kHz of the frequency of the carrier. (The frequency of the carrier is 2.5kHz as 1 or 2 as for the data.)*

Table 9-1 Function table (continued)

	Function		LCD monitor	Setting range	Unit	Increment	Factory writing		Ref. page
	Code	Name					With PG	Without P G	
Interface	115	Y1-Y3, RY function select (Y1-Y2)	115 Y1,Y2FUNC	0000 to 1212 (Digits of 1000 and 100): Function of Y1 (Digits of 10 and 1) : Function of Y2 ※ as for correspondence, refer to data range 116	—	—	0005		112
	116	(Y3-RY)	116 Y3,RYFUNC	0000 to 1212 (Digits of 1000 and 100): Function of Y3 (Digits of 10 and 1) : Function of RY	—	—	0604		
				Data / Name / Abbreviation 00 DC link voltage establishment DVDC 01 In operation DRUN 02 In acceleration DACC 03 In deceleration DDEC 04 Speed exist DNZS 05 Speed arrival DSAR 06 Speed agreement DSAG 07 Speed detection (Level 1: Absolute value) DSD1 08 Speed detection (Level 2: With polarity) DSD2 09 Speed detection (Level 3: With polarity) DSD3 0A In torque limit DTLM 0B Torque detection DTD 0C Inverter overload early warning DOL 0D Motor overheating early warning DMOH 0E Motor overload early warning DMOL 0F Brake release signal DBRS 10 In braking DBRK 11 DO for transmission DTDO 12 Transmission error DTER					
	117	Ai1-Ai2 function select	117 Ai1-2FUNC	0000 to 0D0Ds (Digits of 1000 and 100): Function of Ai1 (Digits of 10 and 1) : Function of Ai2	—	—	0000		117
				Data / Name / Scale / Abbreviation 00 Input signal interrupt — AOFF 01 Speed auxiliary setting 1 ±10V/±Nmax AAS1 02 Speed auxiliary setting 2 ±10V/±Nmax AAS2 03 Torque limit (Level 1) ±10V/±150% ATL1 04 Torque limit (Level 2) ±10V/±150% ATL2 05 Torque bias ±10V/±150% ATBS 06 Torque command (before limit) ±10V/±150% ATS 07 Torque current command ±10V/±150% ATCS 08 Creeping speed 1 ±10V/±Nmax AJSS1 09 Creeping speed 2 ±10V/±Nmax AJSS2 0A Magnetic flux command ±10V/±100% AFLUX 0B Speed feedback ±10V/±Nmax ASFB 0C Motor temperature ±10V/±200℃ AMTMP 0D Speed override warning ±10V/± 50% ASOR					
	118	Up/down limiter (Ai1)	118 Ai1 U-LMT	0.00 to 60.00 s	s	0.01	0.01		
	119	(Ai2)	119 Ai2 U-LMT	0.00 to 60.00 s	s	0.01	0.01		
	120	Offset setting (12)	120 12 OFFSET	-300 to 300	—	1	—		96
	121	(Ai1)	121 Ai1OFFSET	(About -1 to 1%)					117
	122	(Ai2)	122 Ai2OFFSET						
	123	Gain setting (12)	123 12 GAIN	0.000 to 2.000	—	0.001	—		96
	124	(Ai1)	124 Ai1 GAIN						117
	125	(Ai2)	125 Ai2 GAIN						

NOTE: *The functions in* ☐ *are changeable in operation.*

Table 9-1 Function table (continued)

	Function		LCD monitor	Setting range	Unit	Increment	Factory writing		Ref. page
	Code	Name					With PG	Without PG	
Interface	126	AO1-AO3 function selection	126 AO1-3FUNC	000 to FFF2	—	—	1750		116
				(Digit of 1000) AO1 function: 0 to F (Digit of 100) AO2 function : 0 to F (Digit of 10) AO3 function : 0 to F (Digit of 1) AO1 adjust 0: AO ordinary output 1: Output corresponding to 10 V 2: Output corresponding to -10 V				
				Data / Name / Scale / Abbreviation 0 Speed meter (One side deflec.) ±Nmax/+10 V BSM1 1 Speed meter (Both side deflec.) ±Nmax/±10 V BSM2 2 Speed setting 0 ±Nmax/±10 V BSR0 3 Speed setting 1 ±Nmax/±10 V BSR1 4 Speed setting 2 ±Nmax/±10 V BSR2 5 Speed setting ±Nmax/±10 V BSR 6 Speed feedback ±Nmax/±10 V BSFB 7 Torque current (Both side deflec.) ±150%/±10 V BTC1 8 Torque current (One side deflec.) ±150%/+10 V BTC2 9 Torque meter (Both side deflec.) ±150%/±10 V BTM1 A Torque meter (One side deflec.) ±150%/+10 V BTM2 B Torque command output ±150%/±10 V BTR C Motor current detection (r.m.s) Code 176/+5 V BMC D Motor voltage detection (r.m.s). Code 175/+5 V BMV E Motor temperature 200°C/+10 V BMTMP F DC link voltage 800 V/+10 V BVDC				
	127	Bias setting (AO1)	127 AO1 BIAS	-100.0 to 100.0%	%	0.1	0.0		
	128	(AO2)	128 AO2 BIAS						
	129	(AO3)	129 AO3 BIAS						
	130	Gain setting (AO1)	130 AO1 GAIN	-10.00 to 10.00	—	0.01	1.00		
	131	(AO2)	131 AO2 GAIN						
	132	(AO3)	132 AO3 GAIN						
	133	Filter select	133 AO1-3FILT	000 to 222	—	—	111		
				AO1 Filter 0##: Inactive 1##: Active (Filter 10 ms) 2##: Active (Filter 100 ms) AO2 Filter #0#: Inactive #1#: Active (Filter 10 ms) #2#: Active (Filter 100 ms) AO3 Filter ##0: Inactive ##1: Active (Filter 10 ms) ##2: Active (Filter 100 ms)				
	134	Dedicated function for manufacturer	134 DD FUNC 1	—	—	—	—		119

NOTE: *The functions in ▭ are changeable in operation. # in data setting range denotes any data.*

Table 9-1 Function table (continued)

	Function		LCD monitor	Setting range	Unit	Increment	Factory writing		Ref. page
	Code	Name					With PG	Without P G	
Interface	140	Function block (141-169)	140■141 -169■	0: Function code 141 to 169 closed 1: Function code 141 to 169 opened	—	—	0		119
	141	Operation command select	141 OPR COMND	00 to 02 Operation command select #0: Terminal block or keypad pane #1: MICREX #2: RS485	—	—	00		*4)
	142	Control input through transmission	142 LINK DI	0000 to FFFF(h)	—	—			
	143	Speed command through transmission	143 LINK N	8000 to 7FFF(h)	—	—			
	144	T-link operation at error (Mode)	144 TLINK MOD	0 to 3 0: Compulsory stop 1: Stop after continued operation for the operation time (Code 145) 2: Stop when the error continues for longer than the operation time (Code 145) 3: Continue the operation	—	—	0		*5)
	145	(Operation time)	145 TLINK TIM	0.01 to 20.00 s	s	0.01	0.10		
	146	RS485 address built-in as standard	146 485 ADRES	0 to 99	—	—	0		
	147	RS485 operation at error (Mode)	147 485 MODE	0 to 3 0: Compulsory stop 1: Stop after continued operation for the operation time (Code 148) 2: Stop when the error continues for longer through the operation time (Code 148) 3: Continue the operation	—	—	3		*6)
	148	(Operation time)	148 485 TIMER	0.01 to 20.00 s	s	0.01	0.10		
	149	(Detection time of communication break)	149 485 BREAK	0 to 60 s 0: Detection of communication break invalid Other than 0: Detection of communication break valid	—	—	60		
	150	(Answer interval time)	150 485 ANS	0.01 to 1.00 s	s	0.01	0.05		
	151	X11-X14 function select (X11-X12)	151 X11X12FUC	0000 to 2020(h)	—	—	0000		* 7)
	152	(X13-X14)	152 X13X14FUC	0000 to 2020(h)	—	—	0000		
	153	Y11-Y13 function select (Y11-Y12)	153 Y11Y12FUC	0000 to 1212(h)	—	—	0000		
	154	(Y13)	154 Y13 FUNC	00 to 12(h)	—	—	00		
	155	OPCII-VG5-DI function select	155 OP-DI FUC	00 to 11 Select when using for speed setting 0#: Binary 1#: BCD Select when using for torque setting #0: Binary #1: BCD	—	—	00		*8)
	156	BCD input speed setting	156 BCD COMND	99 to 7999	—	1	1000		*9)

NOTE:

- *The functions in ▭ are changeable in operation. # in data setting range denotes any data.*
- *Code 157 to 169 are not used.*
- *Code 142 and 143 can be only read, but cannot be written.*

*4) *As for the details of this function, refer to T-link Interface Option Instruction Manual (INR-HF50746) or Standard Built-in RS485 Instruction Manual (INR-HF50730).*

*5) *As for the details of this function, refer to T-link Interface Option Instruction Manual (INR-HF50746).*

*6) *As for the details of this function, refer to Standard Built-in RS485 Instruction Manual (INR-HF50730).*

*7) *As for the details of this function, refer to Digital Input/Output Option Instruction Manual (INR-HF50752).*

*8) *As for the details of this function, refer to Digital Input Option (for Speed Setting) Instruction Manual (INR-HF50736) or Digital Input Option (for Torque Setting) Instruction Manual (INR-HF50751)*

*9) *As for the details of this function, refer to Digital Input Option (for Speed Setting) Instruction Manual (INR-HF50736).*

Table 9-1 Function table (continued)

	Function		LCD monitor	Setting range	Unit	Increment	Factory writing		Ref. page
	Code	Name					With PG	Without PG	
Motor constants	170	Function block (171 to 197)	170■171 -197■	0: Function code 171 to 197 closed 1: Function code 171 to 197 opened	—	—	0		119
	171	Motor select	171 M SELECT	0.75-2 : 0.75 kW 200 V 3.7-4 : 3.7 kW 400 V 1.5-2 : 1.5 kW 200 V 5.5-4 : 5.5 kW 400 V 2.2-2 : 2.2 kW 200 V 7.5-4 : 7.5 kW 400 V 3.7-2 : 3.7 kW 200 V 11-4 : 11 kW 400 V 5.5-2 : 5.5 kW 200 V 15-4 : 15 kW 400 V 7.5-2 : 7.5 kW 200 V 18.5-4 : 18.5 kW 400 V 11-2 : 11 kW 200 V 22-4 : 22 kW 400 V 15-2 : 15 kW 200 V 30-4 : 30 kW 400 V 18.5-2 : 18.5 kW 200 V 37-4 : 37 kW 400 V 22-2 : 22 kW 200 V 45-4Y : 45 kW 400 V 30-2 : 30 kW 200 V 45-4S : 45 kW 400 V 37-2 : 37 kW 200 V 55-4 : 55 kW 400 V 45-2Y : 45 kW 200 V 75-4 : 75 kW 400 V 45-2S : 45 kW 200 V 90-4 : 90 kW 400 V 55-2 : 55 kW 200 V 110-4 : 110 kW 400 V 75-2 : 75 kW 200 V 132-4 : 132 kW 400 V 90-2 : 90 kW 200 V 160-4 : 160 kW 400 V 200-4 : 200 kW 400 V 220-4 : 220 kW 400 V other : The others	—	—	*2)		—
	172	Number of PG pulses	172 PG PULSE	0: PG unused 1 to 3000: Number of pulses	—	1	1024	0	102
	173	NTC Thermistor select	173 THR SELCT	0: Unused 1: Used	—	—	1	0	109
	174	Motor rating (Capacity)	174 M CAPACIT	0.1 to 300.0 kW *3)	kW	0.1	*2)		—
	175	(Voltage)	175 RATED V	80 to 480 V *3)	V	1	*2)		
	176	(Current)	176 RATED A	0.1 to 999.9 A (RMS) *3)	A	0.1	*2)		
	177	(Base speed)	177 BAS SPEED	125 to 12000 r/min	r/min	1	1500		
	178	(Number of poles)	178 M POLES	2 to 12 poles	—	1	4		
	179	Overload capacity	179 OVERLOAD	0 to 250%	%	1	150		107
	180	Motor characteristics (Protection) auto-tuning	180 M AUTTUNP	0: Code 181 operation forbid 1: Code 181 operation enabled	—	—	0		—
	181	(Operation)	181 M AUTTUNM	0: Inactive 1: Active	—	—	0		
	182	Motor characteristics (%RI)	182 M(%RI)	0.01 to 99.99% *3)	%	0.01	*2)		
	183	(%X)	183 M(%X)						
	184	(Exciting current)	184 RATED Im	0.01 to 300.0 A (Peak) *3)	A	0.01			
	185	(Torque current)	185 RATED It	0.01 to 655.35 A (Peak) *3)	A	0.01			
	186	(Slip at driving)	186 SL(DRV)Hz	0.001 to 20.000 Hz *3)	Hz	0.001			
	187	(Slip at braking)	187 SL(BRK)Hz						
	188	(Iron loss coefficient 1)	188 IRON LOS1	0.00 to 10.00% *3)	%	0.01			
	189	(Iron loss coefficient 2)	189 IRON LOS2						
	190	(Iron loss coefficient 3)	190 IRON LOS3						
	191	(Magnetic saturation factor 1)	191 MGT SAT 1	0.0 to 100% *3)	%	0.1			
	192	(Magnetic saturation factor 2)	192 MGT SAT 2						
	193	(Magnetic saturation factor 3)	193 MGT SAT 3						
	194	(Magnetic saturation factor 4)	194 MGT SAT 4						
	195	(Magnetic saturation factor 5)	195 MGT SAT 5						
	196	(Secondary time-constant)	196 ROTOR TIM	0.001 to 9.999 s *3)	s	0.001			
	197	(Induced voltage coefficient)	197 ROTOR E	0 to 999 V *3)	V	1			
	200	Data protection	200 PROTECTED	0: Data change forbid 1: Data change enabled	—	—	0		119

NOTE: *The functions in ▭ are changeable in operation.*

*2) *The data of the dedicated motor with the same capacity as the inverter are written.*

*3) *When the data of code 171 are rewritten, the data of Fuji Electric's dedicated motor for VG5 series. Further, it is able to individually write.*

9-2 Description of functions

a) Control block diagram

To simplify the figure, the terms in these diagrams are described as follows:

— F is attached before number of function codes.
Example: F12 → Function code 12

— & is attached before data (written values), and □ of data value shows any data.
Example: &□1 → The digit of 10 is any value and the digit of 1 is 1.

— All of function select input/output are described with the abbreviation shown on "Table 9 -1 Function table.
Example: CSR1 → Multistep speed 1

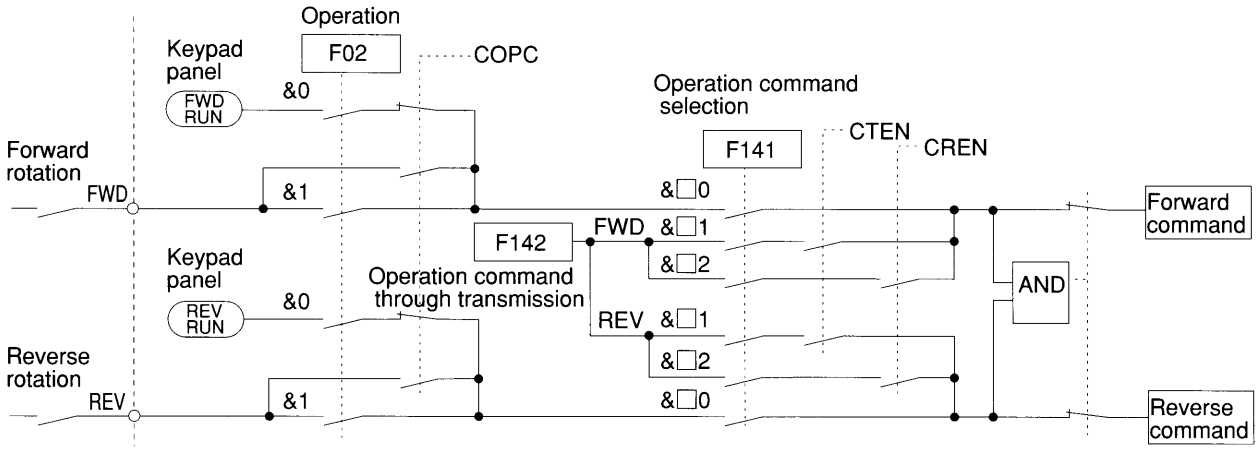


Fig. 9-2-1 Block diagram of operation command selection

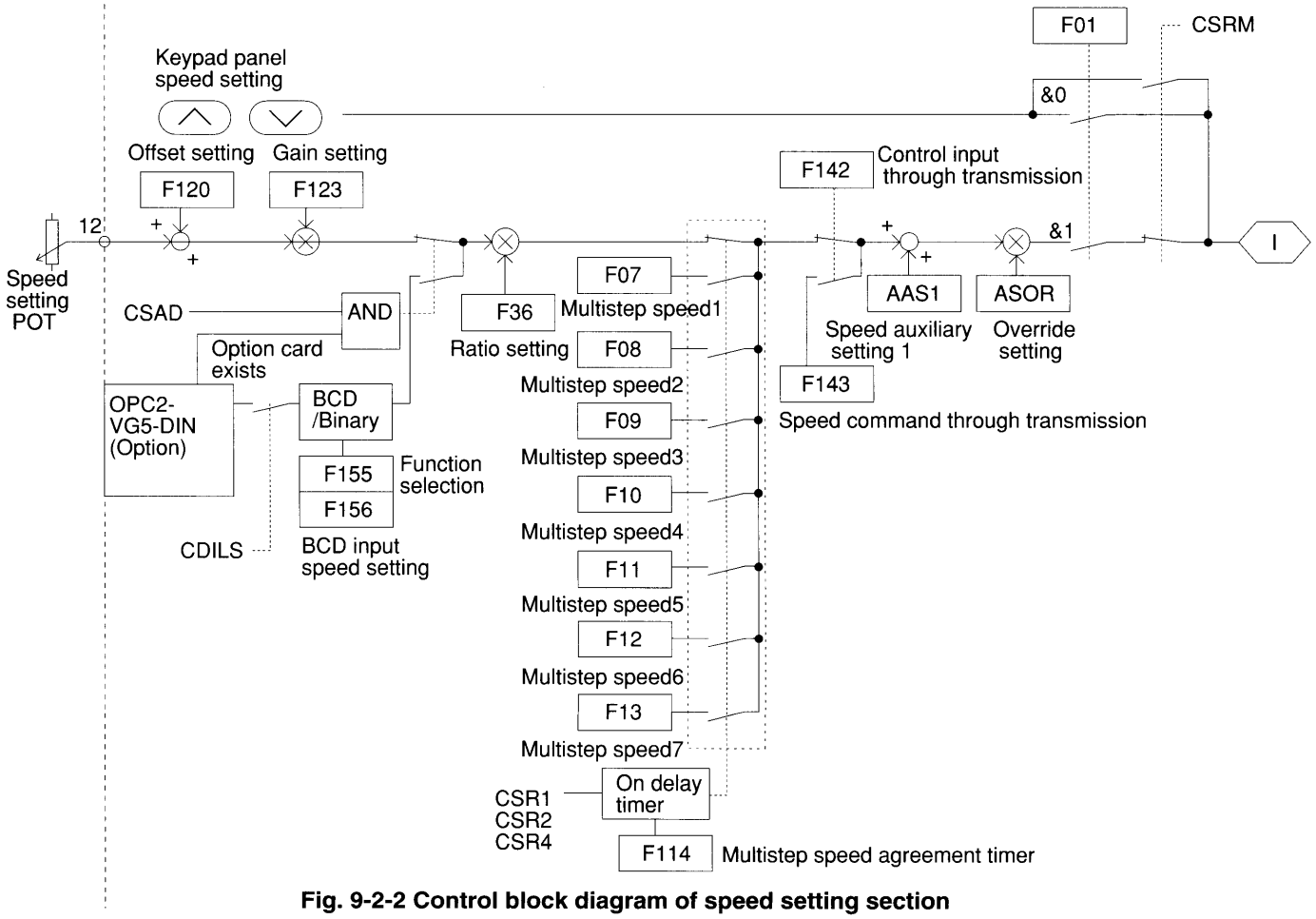


Fig. 9-2-2 Control block diagram of speed setting section

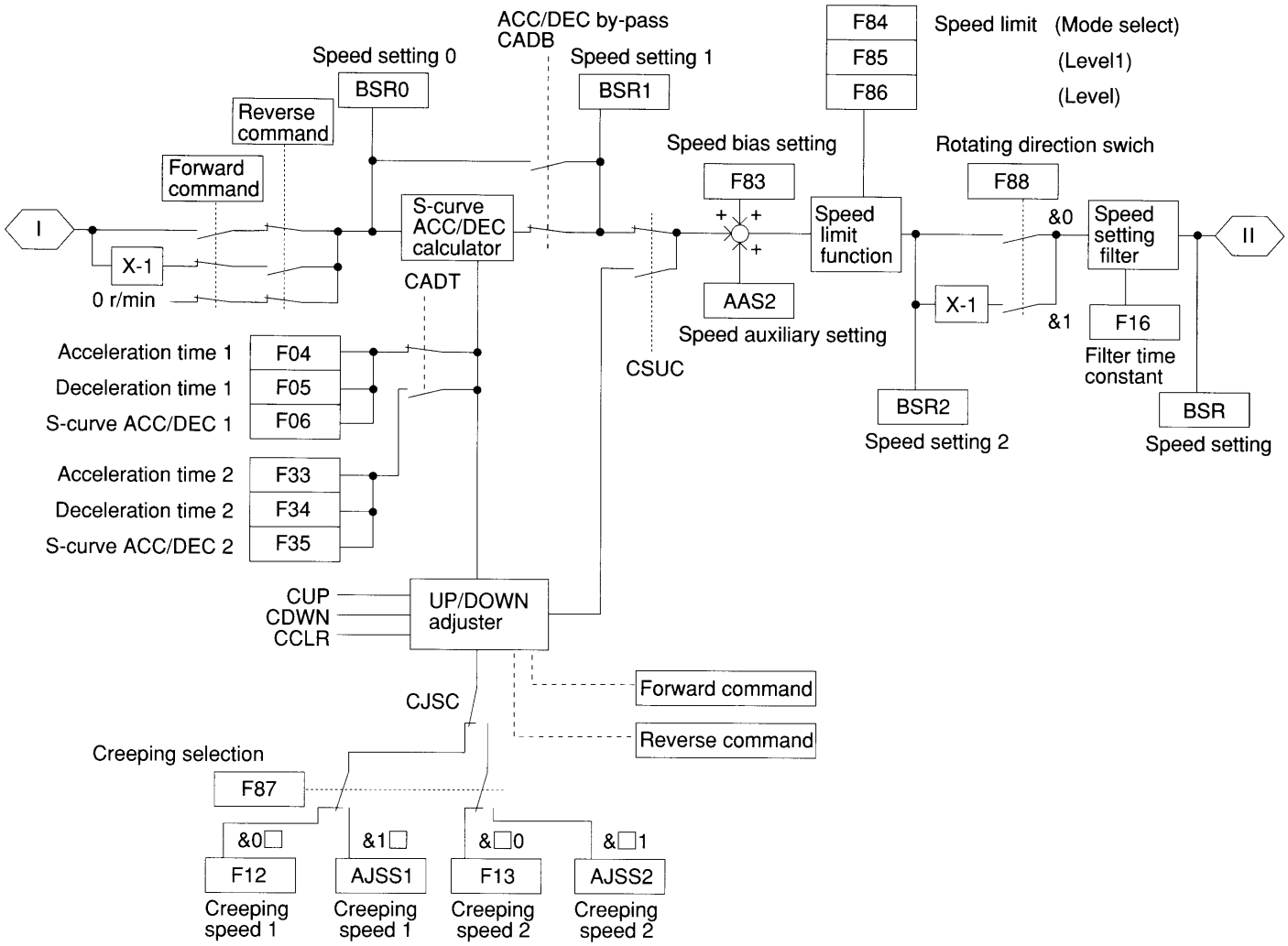


Fig. 9-2-3 Block diagram of ACC/DEC calculator and UP/DOWN adjuster

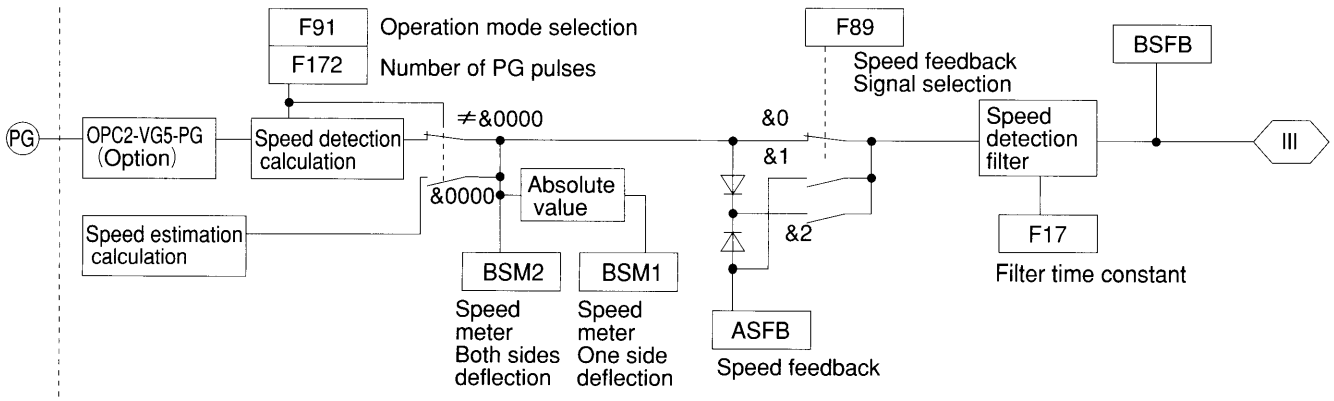


Fig. 9-2-4 Block diagram of speed detection section

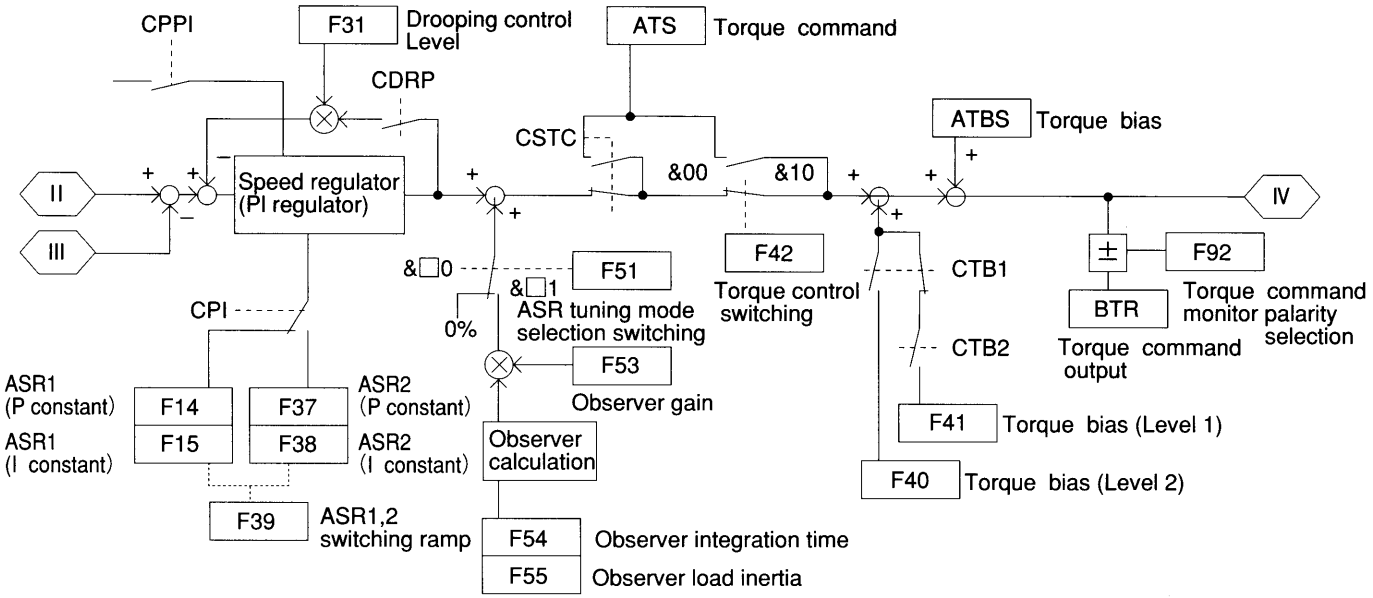


Fig. 9-2-5 Block diagram of speed regulator and torque calculation (1)

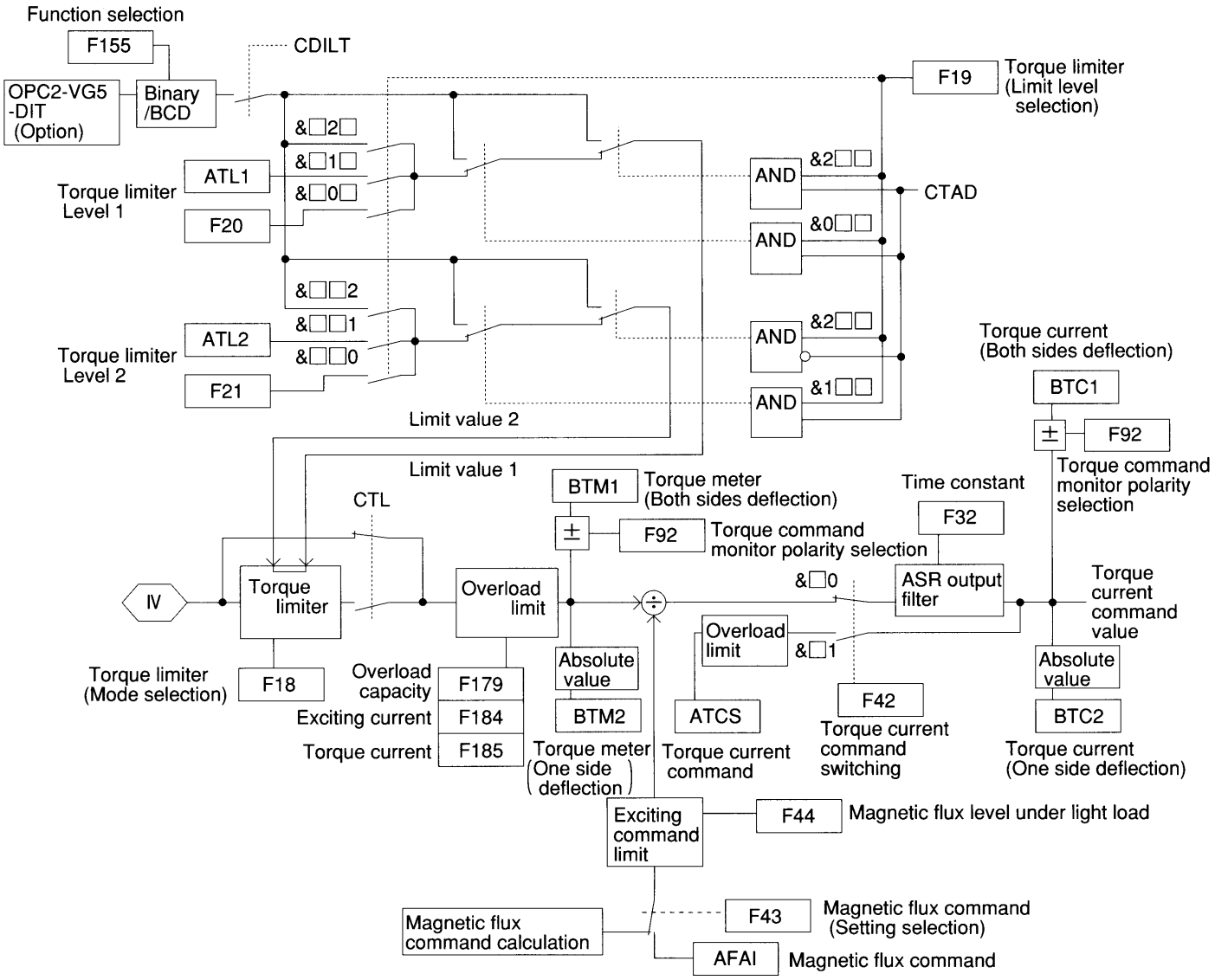


Fig. 9-2-6 Block diagram of torque calculation (2)

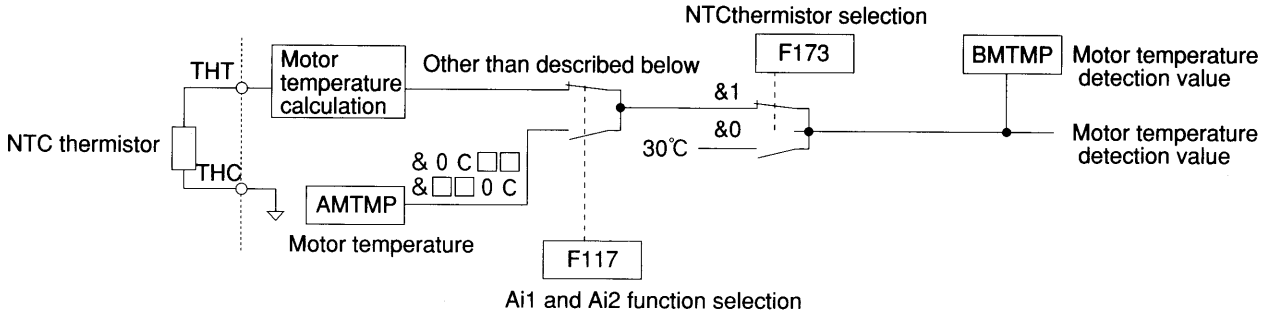


Fig. 9-2-7 Block diagram of motor temperature detection

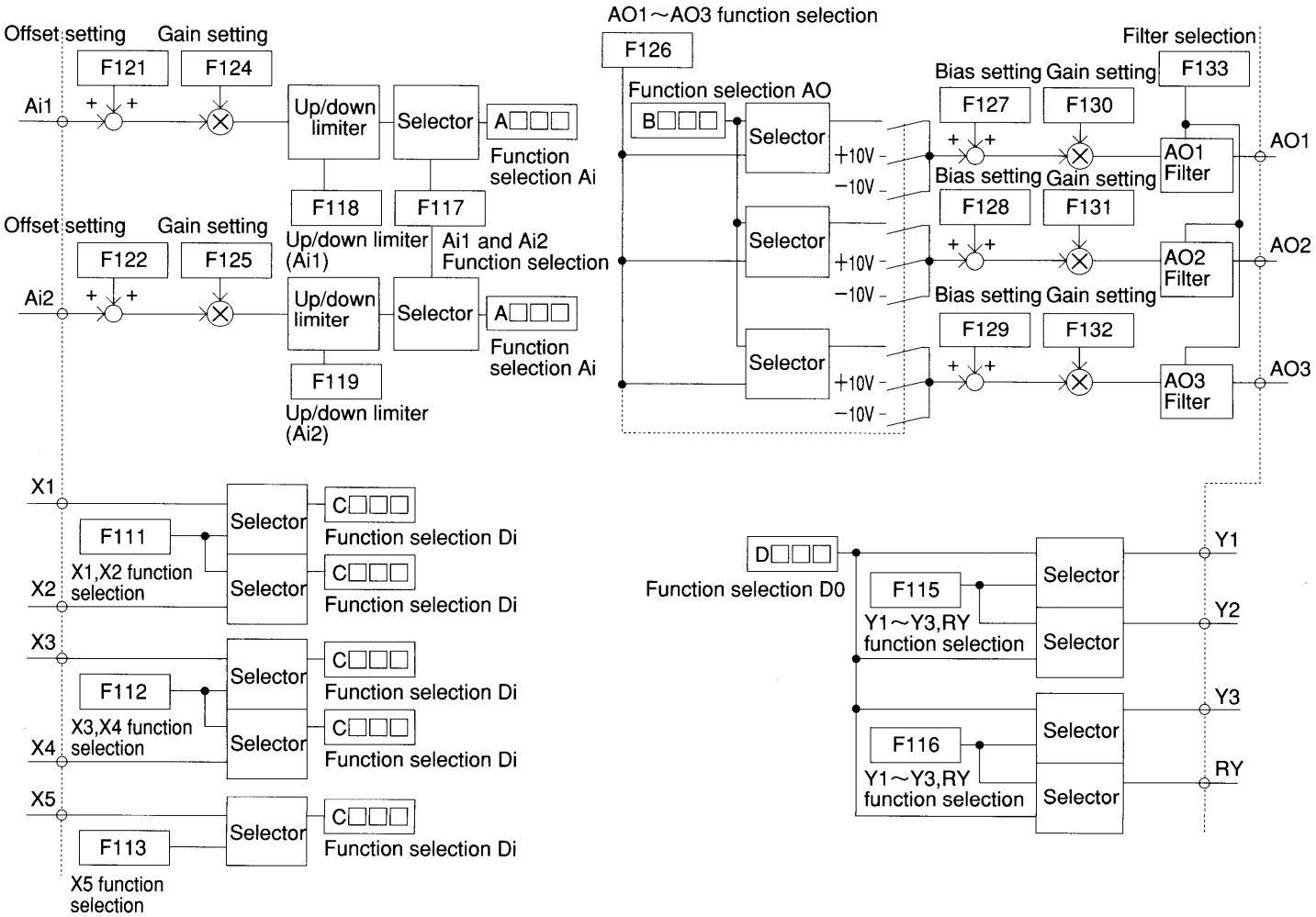


Fig. 9-2-8 Block diagram of function selection input/output selection

b) Speed setting

⚠ WARNING

If mistaking speed setting, the motor may run at speed exceeding withstand-overspeed of the motor, and the equipment may be damaged and cause difficulties by damage. Match the data of function "03 Maximum speed" with the specification of whole equipment to keep a safe speed.

When summing up result of function "83 Speed bias setting" and speed auxiliary setting 2 (Ai1, Ai2 Function select) is higher than function "65 Zero speed detection", the equipment continues running of the speed of the above-mentioned summing up result even if the operation commands (FWD and REV) are made OFF. Take care so as not to cause accident.

There are following methods for speed setting.
— Setting from keypad panel
— Setting from control terminal 12
— Multistep speed setting
— Setting from UP/DOWN adjustor
— Setting through RS485
— 16 bit binary and BCD (Option OPC2-VG5-DIN necessary)
— Setting through T-link (Option OPC2-VG5-TL necessary)

As for RS485, 16 bit binary and BCD, and T-link, refer to each Instruction Manual in detail.
Standard Built-in RS485 Instruction Manual INR-HF50730
Digital Input Option (for Speed Setting) Instruction Manual INR-HF50736
T-link Interface Option Instruction Manual INR-HF50746

These speed setting methods have selection priority order, and may not be applicable in the some related functions. Refer to the control block diagram or the description.

01 Speed command

This command selects speed setting method.

Data	Speed setting method
0	Setting from keypad panel
1	Setting from other than keypad panel,e.g. control terminal 12,multi-step speed setting,etc.

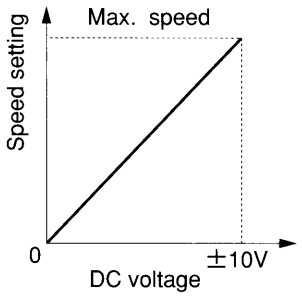
When CSRM of function selection Di is made ON, the setting from keypad panel becomes valid regardless the setting described above.

Setting from keypad panel

The speed can be set by (∧) or (∨) key.
Only when the setting from keypad panel is active, the setting value can be changed.

Setting from control terminal 12

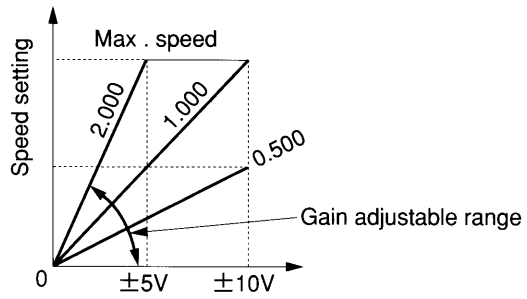
DC voltage of both polarities (0 to ±10 V) can be input. The rotation direction of a motor changes with the combination of these polarities and operation commands (FWD and REV). (Refer to the description of function "88 Rotation direction switching".) By input of 10 V, the speed becomes to the max. speed set with function "03 Maximum speed". The input level (converted to voltage value) can be checked with I/O check screen of keypad panel.



120 Offset setting (12)
123 Gain setting (12)

Function	Setting range
Offset setting (12)	-300 to 300
Gain setting (12)	0.000 to 2.000

Offset setting and gain setting can adjust the speed setting value against DC voltage at control terminal 12. When the DC voltage at control terminal 12 is not rated value, or the voltage drop cannot be neglected because of long wiring, these settings can be used for compensation. For example, when gain are made twice, the maximum speed is gained at 5 V.



DC voltage of control terminal 12

Adjusting method
Select AI adjust (12) on LED monitor of keypad panel (related function "95 LED monitor select"). After setting the voltage of control terminal 12 at minimum voltage (corresponding to 0 V), adjust the data of function "120 Offset setting (12)" so that LED monitor indication becomes 0.0%. Next, after setting the voltage of control terminal 12 at maximum voltage (corresponding to ±10 V), adjust the data of function "123 Gain setting (12)" so that LED monitor indication becomes 100.0% or -100.0%.

Offset voltage adjustable range: about ±180 mV

36 Speed ratio setting

Setting range: 0.001 to 2.000

A ratio of speed against setting from control terminal 12 and setting by 16 bit binary and BCD can be set. Refer to Fig. 9-2-2.

07 Multistep speed 1
08 Multistep speed 2
09 Multistep speed 3
10 Multistep speed 4
11 Multistep speed 5
12 Multistep speed 6
13 Multistep speed 7

Setting range: -12000 to 12000 r/min

Seven kinds of setting speed can be selected by writing the speed in each function. When using these functions, select 05 (CSR1), 06 (CSR2) and 07 (CSR4) in function "111 to 113 X1-X5 function select". Then, select and input a contact signal to each control terminal. When signal is not input to each terminal, the setting value from control terminal 12 or 16 bit binary/BCD (Option) becomes valid.

If the setting values exceed function "03 Maximum speed", the setting value becomes to the maximum speed.

	External setting speed	Multistep 1	Multistep 2	Multistep 3	Multistep 4	Multistep 5	Multistep 6	Multistep 7
CSR1	○	●	○	●	○	●	○	●
CSR2	○	○	●	●	○	○	●	●
CSR4	○	○	○	○	●	●	●	●

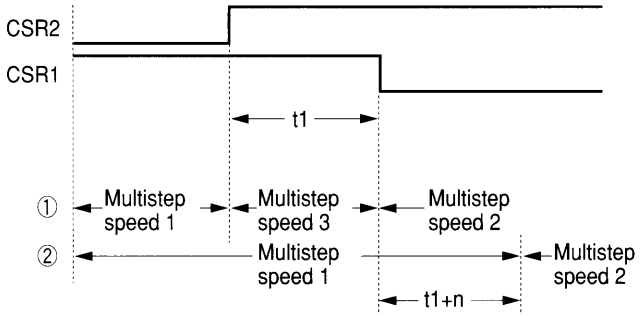
● Contact ON ○ Contact OFF

114 Multistep speed command agreement timer

Setting range: 0.000 to 0.100 s

If the timing of switching between control terminals (X1 to X5) selected in function "111 to 113 X1-X5 function select" is shifted, a speed setting value out of the specification may be selected. Therefore, the speed setting value is switched at the time point when the same state of CSR1, CSR2 and CSR4 is confirmed to continue for the setting time by this function.

Operation example: Switching from multistep speed 1 to multistep speed 2



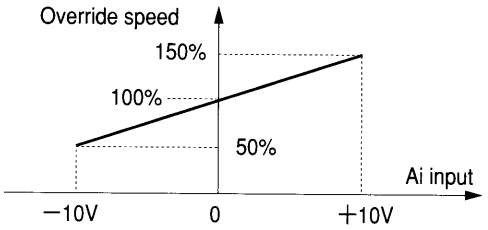
When the switchover timing between CSR1 and CSR2 is delayed for t1 (ms) as the operation example, without the agreement timer, the speed setting is switched from multistep speed 1 to multistep speed 3 and to multistep speed 2, then, a section of multistep speed 3 occurs (①). When the agreement timer is provided, this state is corresponded by setting the agreement timer for t1+n (ms), n ≧1 (②).

Speed auxiliary setting (AAS1)

This becomes valid by selecting 01 (AAS1) in function "117 Ai1, Ai2 function select" . The setting speed is the maximum speed set in function "03 Maximum speed" by 10 V of Ai input. Refer to Fig. 9-2-2.

Speed override (ASOR)

This becomes valid by selecting 0D (ASOR) in function "117 Ai1, Ai2 function select" . The setting speed is overrided to 150% of the setting speed by 10 V of Ai input and to 50% by -10 V.



This makes the signal before input to ACC/DEC calculator variable. Refer to Fig. 9-2-2. The result of the override is limited by the maximum speed.

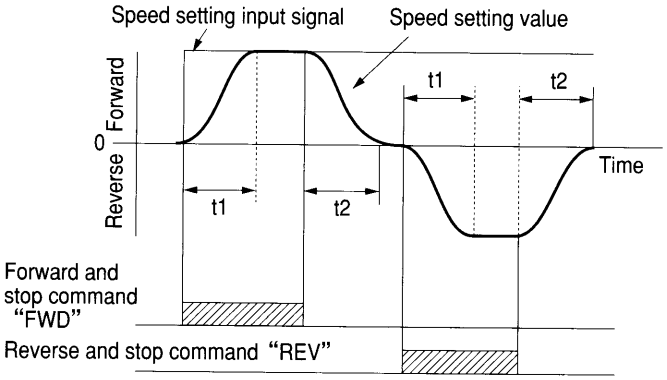
ACC/DEC calculator

Acceleration time from 0 to the maximum speed, deceleration time from the maximum speed to 0 and 2 patterns of S-curve acc/dec application range can be selected.

04 Acceleration time 1
05 Deceleration time 1
06 S-curve acc/dec 1
33 Acceleration time 2
34 Deceleration time 2
35 S-curve acc/dec 2

Function	Setting range
Acc. time and dec. time	0.0 to 1200.0 s
S-curve acc/dec	0 to 50%

The time from 0 r/min to the maximum speed (Code 03) is set with the acceleration time, and the time from the maximum speed to 0 r/min is set with the deceleration time. S-curve acc/dec makes the speed values a curve at starting and arriving the setting speed. Therefore, the acceleration and deceleration movements are smooth and less shocking. When the S-curve acc/dec is 0, the acceleration and deceleration are linear.



Acc/dcc. operation time from 0 to maximum speed (In the case of acc. time 1, dec. time 1 and S-curve acc/dec 1)

$$t1 = \text{Acc. time } 1 \times \left(1 + 2 \times \frac{\text{S-curve acc/dec 1 (\%)}}{100\ (\%)}\right)\ [s]$$

$$t2 = \text{Dec. time } 1 \times \left(1 + 2 \times \frac{\text{S-curve acc/dec 1 (\%)}}{100\ (\%)}\right)\ [s]$$

Two kinds of acceleration time, deceleration time and S-curve acc/dec can be selected. These 2 kinds are changed over by selecting 10 (ACC/DEC time select CATD) in function "111 to 113 X1-X5 function select" and inputting a contact signal to the selected control terminal (X1 to X5).

CATD ON	CATD OFF
04 Acceleration time 1	33 Acceleration time 2
05 Deceleration time 1	34 Deceleration time 2
06 S-curve acc/dec 1	35 S-curve acc/dec 2

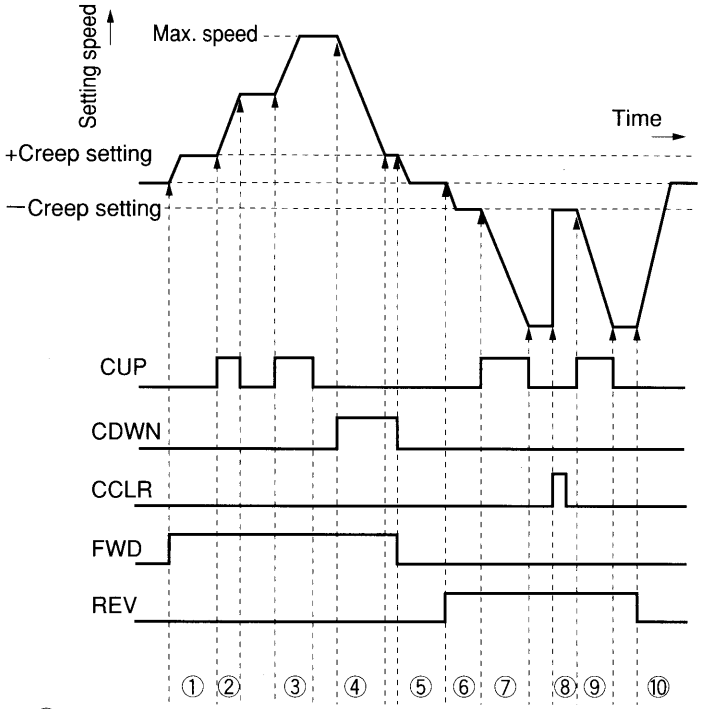
Even if setting S-curve acc/dec, when changing over CATD during acceleration or deceleration, S-curve may be disabled.

The ACC/DEC calculation can be by-passed by selecting 11 (ACC/DEC by-pass CADB) in function "111 to 113 X1-X5 function select" and inputting a contact signal to the selected control terminal (X1 to X5). (The operation becomes the same as setting acc/dec. time at 0.00 s and S-curve acc/dec at 0%.)

UP/DOWN adjuster

The speed setting value can be increased or decreased by ON/OFF of a contact signal. Select 0C (ACC/DEC, UP/DOWN select CSUC) in function "111 to 113 X1-X5 function select" and input a contact signal to the selected control terminal (X1 to X5). ON of CSUC makes the speed setting value from UP/DOWN adjuster valid. When CSUC is ON, the other speed settings are disabled.

Operation example 1: When S-curve acc/dcc is set at 0%

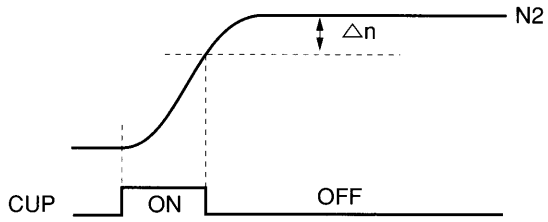


① By making FWD ON, the setting speed is accelerated in forward rotation up to + creep setting.
② By making FWD and CUP ON, the setting speed is accelerated in forward rotation.
③ By making FWD and CUP ON, the setting speed is accelerated in forward rotation. But, upper limit is the maximum speed.
④ By making FWD and CDWN ON, the setting speed is decelerated in forward rotation. But, lower limit is the creep setting.
⑤ By making FWD OFF, the setting speed is decelerated in forward rotation. When the motor speed is zero or reverse, the operation is made OFF.
⑥ By making REV ON, the setting speed is accelerated in reverse rotation up to -creep setting.
⑦ By making REV and CUP ON, the setting speed is accelerated in reverse rotation.
⑧ By making REV and CCLR ON, the setting speed becomes to the -creep setting.
⑨ By making REV and CUP ON, the setting speed is accelerated in reverse rotation.
⑩ By making REV OFF, the setting speed is accelerated in reverse rotation up to the zero command. When motor speed becomes to zero or forward, the operation is made OFF.

The setting speed is changed by CUP, CDWN and CCLR of function selection Di.
When CCLR and CUP, or CCLR and CDWN are made ON in the same time, CCLR has priority. When CUP and CDWN are made ON in the same time, both of CUP and CDWN are treated as invalid (OFF).

The up and down speeds of the setting speed accord with the selected acc. and dec. times, and S-curve acc/dec.

Operation example 2: When using S-curve acc/dcc, the setting speed is increased by S width (Δn in below example) after making CUP (CDWN) OFF.



12 Creeping speed 1
13 Creeping speed 2
87 Creeping select

Function	Setting range
Creeping speed 1 and Creeping speed 2	-12000 to 12000 r/min
Creeping select	00 to 11

When the UP/DOWN adjuster is valid, the code 12 and 13 become creeping speed setting value.

NOTE : *If the setting value exceeds the maximum speed, the value is regarded as the maximum speed.*

The creeping speeds are selected by parameters of code 12 and 13, and by analog input of function selection selected in Ai1 and Ai2 function select (code 117).

Code 87	Selecting creeping speed setting
0#	Creeping speed 1 code 12
1#	Creeping speed 1 function selection analog input AJSS1
#0	Creeping speed 2 code 13
#1	Creeping speed 2 function selection analog input AJSS2

Creeping speed 1 (2nd digit setting of code 87) and creeping speed 2 (1st digit setting of code 87) are changed over by function select Di CJSC.

CJSC OFF: Creeping speed 1 is valid.
CJSC ON : Creeping speed 2 is valid.

03 Maximum speed

Setting range: 250 to 12000r/min

If this value exceeds maximum speed described on the nameplate of the motor, the motor may be broken. Match this with the motor.

83 Speed bias setting

Setting range: -12000 to 12000 r/min

This value is added to the speed setting value outputted from ACC/DEC calculator (refer to Fig. 9-2-3).

⚠ CAUTION

When the added result of this and speed auxiliary setting 2 (selected in Ai1, Ai2 function selection) exceeds the data of function "65 Zero speed detection (Level)", the operation continues at the speed of the above-mentioned added result even if the operation command (FWD or REV) is made OFF.

Speed auxiliary setting 2 (AAS2)

This becomes active when selecting 02 of function "117 Ai1, Ai2 function select". When inputting 10 V, the speed setting is the setting value of function "03 Maximum speed". Refer to Fig. 9-2-3.

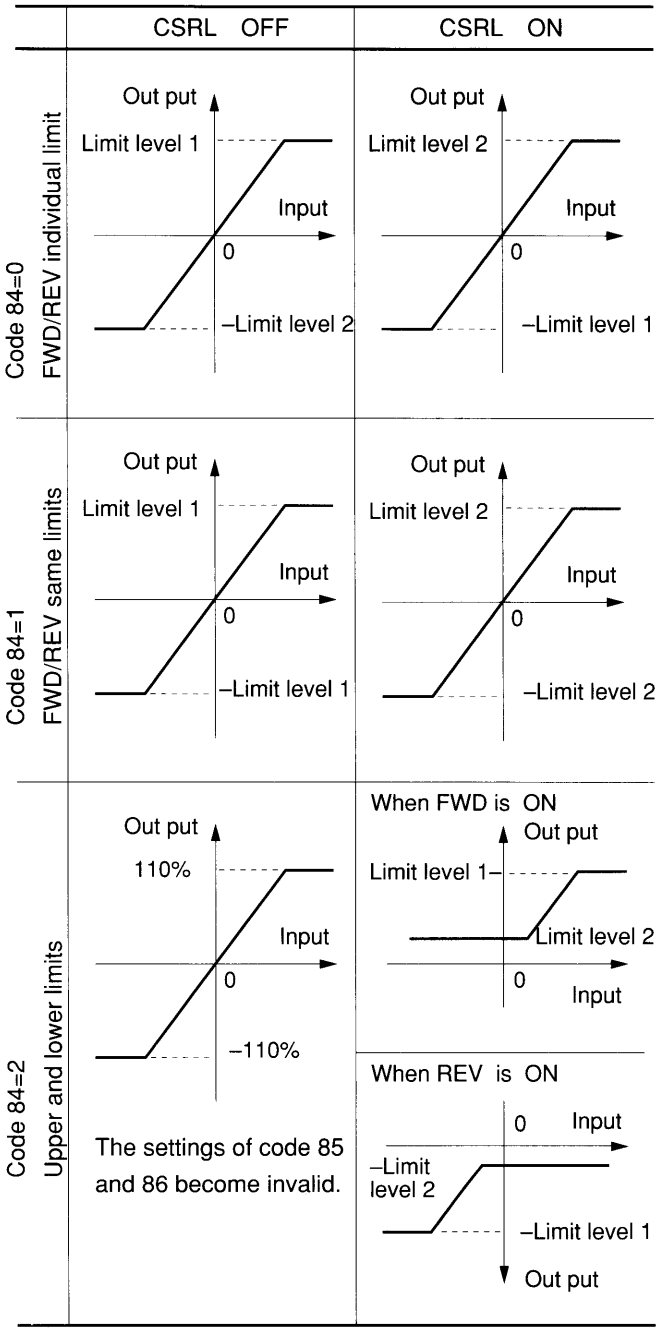
⚠ CAUTION

When the added result of this and the setting value of function "83 Speed bias setting" exceeds the data of function "65 Zero speed detection (Level)", the operation continues at the speed of the above-mentioned added result even if the operation command (FWD or REV) is made OFF.

84 Speed limiter (Mode select)
85 Speed limiter (Level 1)
86 Speed limiter (Level 2)

Function	Setting range
Speed limiter (Mode select)	0 to 2
Speed limiter (Level 1) and (Level 2)	0.0 to 110.0%

These specify upper and lower limits to the speed setting value. Six patterns of limit mode are selected by function "84 Speed limiter (Mode select)" and function selection Di.



FWD/DEV individual limit can be used as a function of reversing prevention when the data are as follows:

Example: Limit level 1=100% and Limit level 2=0%
FWD ON and CSRL ON: Reverse rotation prevention in forward rotation.

REV ON and CSRL ON: Forward rotation prevention in reverse rotation.

NOTE: *When using upper and lower limits (code 84=2) and CSRL is ON, take care that the speed setting value is fixed at limit level 2 if limit level 2 (lower limit) ≧ limit level 1 (upper limit).*

c) Operation command

There are following methods for input of operation and stop commands.
— Inputting from control terminals FWD and REV
— Inputting from FWD/RUN and REV/RUN keys on keypad panel
— Inputting through RS485
— Inputting through T-link

As for input through RS485 and T-link, refer to each Instruction Manual.
Standard built-in RS485 Instruction Manual INR-HF50730
T-link Interface Option Instruction Manual INR-HF50746

02 Operation command

This function selects input method of operation command.

Data	Input method of operation command
0	Input from keypad panel
1	Input from other than keypad panel, e.g. control terminals, RS485 and T-link

When COPC of function selection Di is made ON, the input from keypad panel becomes valid regardless the data described above.

Operation from keypad panel

The motor runs in forward rotation by pressing (FWD RUN) key.
The motor runs in reverse rotation by pressing (REV RUN) key.
The motor in running stops by pressing (STOP) key.

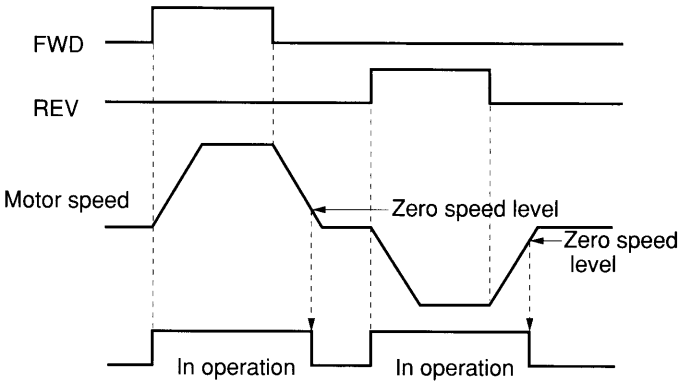
Operation from Control terminals

ON/OFF of control terminals FWD or REV is run and stop command.
Further, the rotation direction can be changed over by signal changeover of control terminals. When FWD and REV are made ON in the same time, both signals are treated as OFF.

65 Zero speed detection (Level)

Setting range: 1 to 1200 r/min

While the motor is decelerating to stop by OFF of running command, the command is made OFF when the motor speed decelerates up to zero speed detection level.

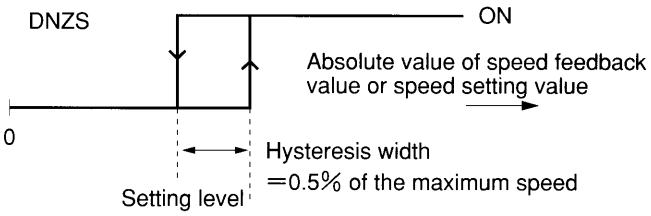


The zero speed can be also detected by the speed setting value according to function "69 Speed detection mode".

When the added result of functions "83 Speed bias setting" and speed auxiliary setting 2 (AAS2) exceeds the zero speed detection Level, the operation continues at the speed of added result even if the operation command is made OFF.

If the data exceeds the maximum speed (code 03), the detection level becomes to the maximum speed.

The zero speed detection signal can be outputted from a control terminal by setting DNZS (Speed exist) of function selection DO.

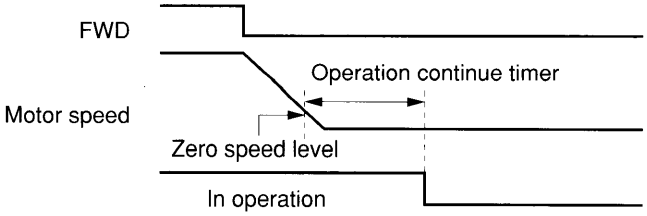


74 Operation continue timer

Setting range: 0.00 to 5.00 s

Time, for which the motor continues operation after motor speed arrived zero speed detection level during the motor is decelerating to stop, is specified. While this operation, the speed setting value becomes to 0 r/min.

This function is invalid for sensorless control.

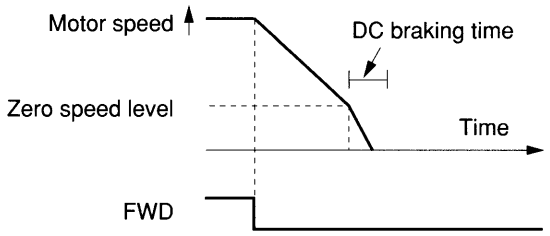


When running command is made ON during operation of the operation continue timer, the inverter returns to running again.

25 DC brake (Braking time)
26 DC brake (Braking level)

Function	Setting range
DC brake (Braking time)	0.0 to 10.0 s
DC brake (Braking level)	10 to 100%

When a running motor is supplied to with a DC voltage (making output frequency 0), the motor generate braking torque to decelerate to stop. This is called DC brake. During deceleration of a motor, after arriving zero speed level, a DC brake operates for a setting time, If the motor does not stop within the setting time, the motor coasts to stop.



88 Rotation direction switching

When the data of this function are made 1, the rotation direction of a motor can be reversed. The rotation direction of the motor is defined by this function, the polarity of the speed setting value and the state of operation command.

Code 88	Speed setting	Operation command	Rotation direction
0	+Data	FWD ON	FWD
		REV ON	REV
	-Data	FWD ON	REV
		REV ON	FWD
1	+Data	FWD ON	REV
		REV ON	FWD
	-Data	FWD ON	FWD
		REV ON	REV

Pre-excitation function

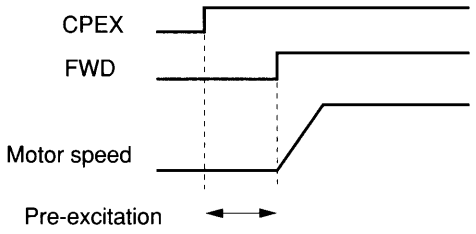
This function to supply an exciting current to a motor for enhancing torque response at motor starting.

⚠ CAUTION

The automatic speed regulator (ASR) does not function during pre-excitation. Therefore, the motor may run by external load disturbance, etc. When using the pre-excitation, use a mechanical brake together with electrical brake.

Pre-excitation command (CPEX)

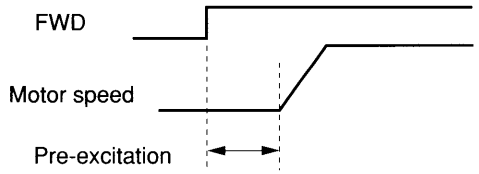
Select "03 Pre-excitation command (CPEX)" in function "111 to 113 X1-X5 function select", and input a contact signal to the selected control terminal (X1 to X5). When CPEX is made ON, the motor enters into pre-excitation state.
When operation command (FWD or REV) is made ON, the motor returns from pre-excitation state to ordinary state.



27 Pre-excitation

Setting range: 0.0 to 10.0 s

When operation command (FWD or REV) is made ON, the motor automatically enter into pre-excitation state for the setting time.



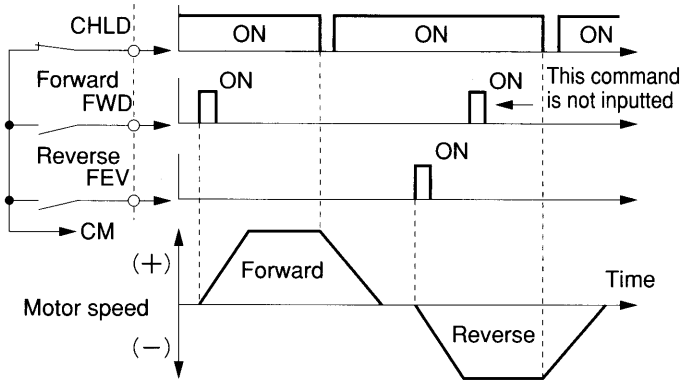
Data of code 27

Coast-to-stop command (CMCS)

Select "02 Coast-to-stop command (CMCS)" in function "111 to 113 X1-X5 function select", and input a contact signal to the selected control terminal (X1 to X5). When CMCS is made ON, the inverter operation is made OFF and the motor coasts to stop.

Operation signal hold (CHLD)

Select "04 Operation signal hold (CHLD)" in function "111 to 113 X1-X5 function select", and input a contact signal to the selected control terminal (X1 to X5). While CHLD is made ON, the operation command (FWD and REV) is held, and change of operation command is not accepted after this. When CHLD is made OFF, the inverter returns to the ordinary operation. By connecting circuit as shown in below figure, the operation command can be continuously inputted with automatic reset type switches.



The coast-to-stop signal is valid even during operation signal holding.

91 Operation method (1st digit) Operation OFF by zero speed setting

This method can be selected by setting the 1st digit of code 91 at 1,
When the input speed setting value of ACC/DEC calculator becomes equal to or less than function "65 Zero speed detection (Level)", operation is made OFF even if operation command (FWD or REV) is ON. This function becomes invalid when using UP/DOWN adjuster.

When using "74 Operation continue timer" or "25 and 26 DC brake", these functions operate respectively after the input speed setting value of ACC/DEC calculator becomes equal to or less than function "65 Zero speed detection (Level)"

d) Speed detection

89 Speed feedback (Signal select)

This selects speed feedback signals

Data	Speed feedback
0	Speed detection value from PG of motor or speed estimated value
1	Function selection analog input (AFSB)
2	High selection of speed detection value from PG of motor or speed estimated value, and function selection analog input (AFSB)

172 Number of PG pulses

Setting range: 0 to 3000 P/R

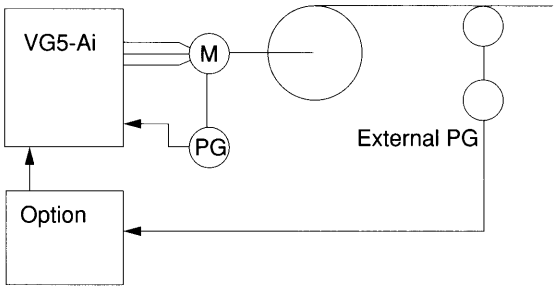
Match this with the number of motor PG pulses.
Further, the control system changes by this data.

Data=0: PG-sensorless type vector control
Data≠0: PG sensor type vector control

Speed feedback (AFSB)

This is used for input of speed detection with external PG.
When using this function, it is recommended to use this in combination with control option (Built-in option card: OPCII-VG3-FV or Separate type option unit MCA-II-VG3-FV).

Example for use



91 Operation method (2nd digit) Response

This selects the calculation periods of speed detection from motor PG.

Data=0: Constant period of 1 ms
Data=1: Constant period of 4 ms

e) ASR (Automatic Speed Regulator)

⚠ CAUTION

If the adequate data of functions related to ASR are not written, for example making suddenly the gain high, the motor causes hunting, and then the motor and equipment may be damaged and cause difficulties by the damage.

Do not suddenly make the data of functions "15 ASR1 (I constant)" and "38 ASR2 (I constant)" large. Further, do not suddenly make the data of functions "14 ASR1 (P constant)" and "37 ASR2 (P constant)" small.

There are following functions related to ASR:
— Writing P constant and I constant (ASR of 2 stages)
— Selection of P control and PI control
— ASR input filter (speed setting and speed detection)
— ASR output filter
— Droop control

14 ASR1 (P constant)
15 ASR1 (I constant)
37 ASR2 (P constant)
38 ASR2 (I constant)

Function	Setting range
P constant	0.1 to 999.9 times
I constant	0.000 to 5.000 s

Speed deviation $\Delta N \rightarrow$ ASR $\rightarrow$ Torque command τ^*

The transfer function of ASR system is shown as following equation:

$$\tau^* = Kp\left(1 + \frac{1}{S\,Ti}\right) \times \Delta N$$

here Kp : P constant
Ti : I constant

Definition of 1.0 times of P constant:
The gain is 1.0 so as to make τ^*=100% (rated torque) when speed deviation ΔN=100% (the max. speed).

ASR PI select (CPI)

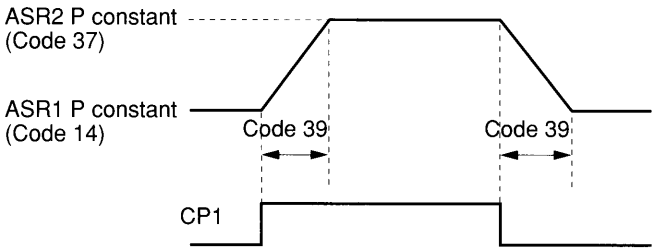
Changeover of ASR 1 and ASR 2 is conducted by selecting "15 ASR PI select (CPI)" in function "111 to 113 X1-X5 function select" and making the selected control terminal (X1 to X5) ON/OFF.

CPI: OFF ASR 1 (code 14 and 15) is active.
CPI: ON ASR 2 (code 37 and 38) is active.

39 ASR1,2 switching ramp

Setting range: 0.00 to 2.55 s

This function softens the changeover shock between functions "14 ASR1-P" and "37 ASR2-P".



ASR P/PI select (CPPI)

Select "16 ASR P/PI select (CPPI)" in function "111 to 113 X1-X5 function select", and make the selected control terminal (X1 to X5) ON/OFF.

CPPI: OFF ASR PI control
CPPI: ON ASR P control

When the data of I constant is 0.000 s, the ASR system becomes P control.

16 Filter time-constant (Speed setting)

Setting range: 0.000 to 5.000 s

A time constant of first-order time lag filter for speed setting value is set with this function. This is used when the response to speed command is made lag or the voltage of analog speed setting is unstable.

17 Filter time-constant (Speed detection)

Setting range: 0.000 to 5.000 s

A time constant of first-order time lag filter for speed detection value is set with this function. This is so used as when ripple of the speed detection signal is large. If the time constant is too large, the control may become unstable. In this case, decrease ASR P gain (code 14 and 37).

32 Filter time-constant (ASR output)

Setting range: 0.000 to 0.200 s

A time constant of first-order time lag filter for ASR output is set with this function. Use this function when a mechanical resonance etc. occur.

31 Droop control (Level)

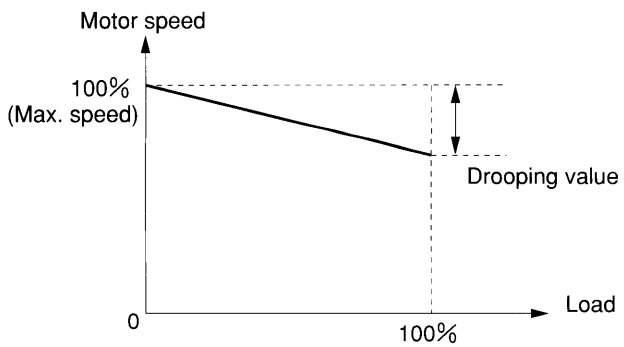
Setting range: 0.0 to 25.0%

Control system to give torque command a drooping characteristic of speed is called droop control. This is applied to balance the loads of two or more motors or to use a motor as a helper to a main motor.

The droop control is active by selecting "14 Droop ON (CDRP)" in function "111 to 113 X1-X5 function select", and making the selected control terminal (X1 to X5) ON.

CRDP: OFF Droop control inactive
CRDP: ON Droop control active

The drooping value at 100% of torque command is set with code 31.



f) Observer

This function enhances the speed control response against external load disturbance by estimating load torque with mechanical model.

51 ASR tuning (Mode select) Observer selection

When the data is made 1, the observer becomes active.

53 Data for state observer (Gain for compensation)

Setting range: 0.00 to 1.00

This is a gain to add an estimated value of load torque found with the observer function to ASR output.

54 Data for state observer (Integration time)

Setting range: 0.005 to 1.000 s

This data defines the response of the observer function. The smaller the data is, the higher the response becomes. Take care that the control may become unstable by making the data too small.

55 Data for state observer (Load inertia)

Setting range: 0.01 to 30.00 s

The coasting time for accelerating to the base speed with rated torque is written with this function. As a standard written value, the acceleration time of only the dedicated motor for VG5 of the same capacity as that of the inverter has been written.

g) Torque control and its related function

⚠ CAUTION

If the data of functions related to torque control are made large by mistake, the motor output an excessive force over necessity, and then, the motor and equipment may be damaged and cause difficulties by the damage. Set the data of function "179 Overload capacity" at the specification of whole equipment to keep safe torque output.

In torque control, there are 3 methods, torque limit, torque bias and torque direct input.

■ **Torque limit has following methods:**
— Parameter
— Function selection analog input (Ai1, Ai 2)
— 16 bit binary and BCD
(OPC2-VG5-DIT Option necessary)

As for the details of setting from 16 bit binary and BCD, refer to Digital Input Option (for Torque Setting) Instruction Manual INR-HF50751.

■ **Torque bias has 2 methods as follows:**
— Parameter
— Function selection analog input (Ai1, Ai 2)

To perform these torque controls, change of the data of two or more functions is necessary. Refer to the control block diagram and the descriptions.

18 Torque control (Mode select)

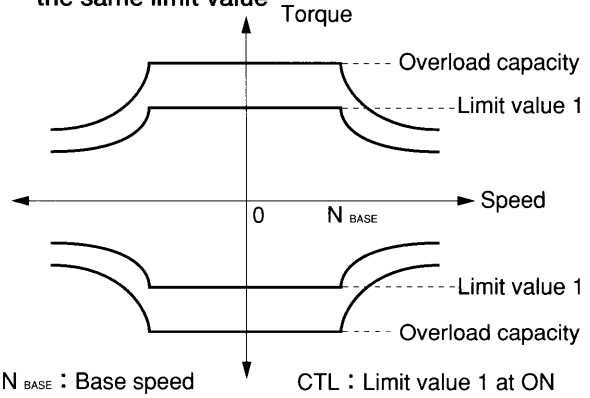
Setting range: 0 to 3

There are following 4 modes for torque limit:
— Limit by unified value (4 quadrants unified)
— Limit individual for driving and braking (drive/brake individual)
— Upper and lower limits to ASR command (Upper/lower limit)
— Always limit individual for driving and braking (drive/brake individual always)

To effectively limit torque, select 0F (Torque limit CTL) in function "111 to 113 X1-X5 function select", and input a control signal to the selected control terminal (X1 to X5). (There is a limit method in which the limit becomes valid without input to CTL.)

Code 18 sets only limit mode, while the limit values are selected with code 19.

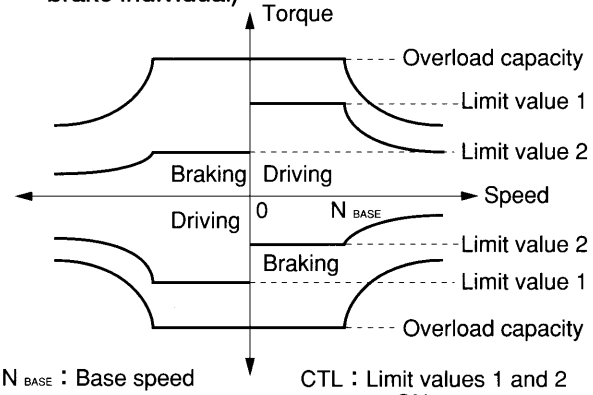
0 : Limit of torque current command value with the same limit value



N_{BASE} : Base speed

CTL : Limit value 1 at ON

1 : Individual limits for driving and braking (Drive/brake individual)

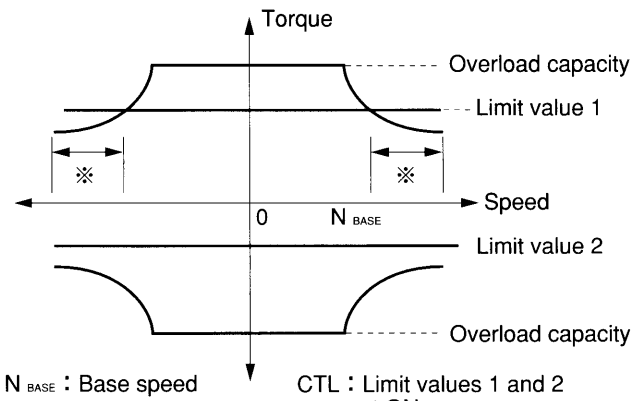


N_{BASE} : Base speed

CTL : Limit values 1 and 2 at ON

Both of limit value 1 and 2 are absolute values.

2 : Upper and lower limits to ASR command value



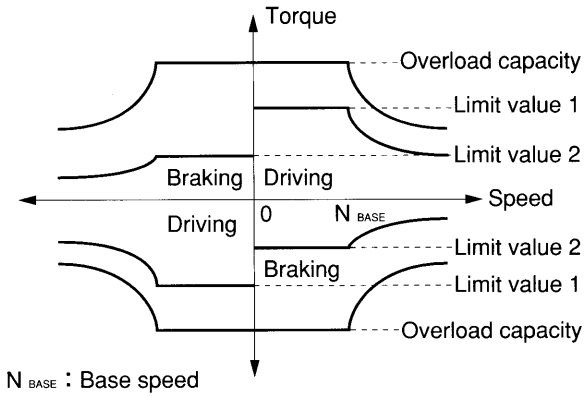
N BASE : Base speed

CTL : Limit values 1 and 2 at ON

Limit value 1 is upper limit and limit value 2 is lower limit, and the torque is limited within a range of——.
Limit values 1 and 2 should be with a sign. By ordinary. the limit value 1 is + (plus) and the limit value 2 is —(minus).
When limit value 1 < limit value 2, the limit value 1 has priority.

Since ※ is a limit by the overload capacity and not by torque limit, DTLM (described afterward) is made OFF.

3 : Individual limits always for driving and braking



N BASE : Base speed

Both of limil value 1 and 2 are absolute values.

The limits by the limit value 1 and 2 are active regardless ON/OF of CTL.

■ Function selection DO in torque limit: DTLM
This is made ON when the torque command value is limited by the torque limit values 1 or 2.

19 Torque limit (Level select)
20 Torque limit (Level 1)
21 Torque limit (Level 2)

Function	Setting range
Level select	000 to 222
Level	-250 to 250%

As for elements for using limit values 1 and 2, there are 3 kinds of the elements as follows:
① Functions
(Code 20 is for limit value 1 and code 21 is for limit value 2.)
② Analog inputs (Ai1 and Ai2)
(ATL 1 corresponds to limit value 1 and ATL 2 corresponds to limit value 2.)
③ 16 bit binary and BCD (OPC2-VG5-DIT Option necessary)
(Since only one value can be inputted, this value corresponds to one of either limit value 1 or 2.)

The elements of ① to ③ described above are allocated by following methods:

■ Selection for limit value 1
① Input limit value 1 with code 20.
Code 19=#0#
Function selection Di Analog/digital select (Torque)
CATD: OFF
(Factory writing is at OFF.)

② Input limit value 1 with analog
Code 19=#1#
Select 03 ATL1 in function "117 Ai1,Ai2 function select"
Torque limit (Level 1): ATL1 ±10 V/±150%

NOTE : *Except Code 18=2, if analog input < 0, the limit value 1 is limited at O%.*

③ 16 bit binary and BCD (OPC2-VG5-DIT Option necessary)
As for details of setting and writing, refer to Digital Input Option (for Torque setting) Instruction Manual INR-HF50752.

■ Selection for limit value 2
① Input limit value 2 with code 21.
Code 19=##0
Function selection Di Analog/digital select (Torque)
CATD: OFF
(Factory writing is at OFF.)

② Input limit value 2 with analog
Code 19=##1
Select 04 ATL2 in function "117 Ai1,Ai2 function select"
Torque limit (Level 2): ATL2 ±10 V/±150%

NOTE : *Except Code 18=2, if analog input < 0, the limit value 2 is limited at O%.*

③ 16 bit binary and BCD (OPC2-VG5-DIT Option necessary)
As for details of setting and writing, refer to Digital Input Option (for Torque setting) Instruction Manual INR-HF50752.

40 Torque bias (Level 1)
41 Torque bias (Level 2)

Setting range: -250 to 250%

These are used for compensation of load mechanical loss, etc.
Two kinds of code 40 and 41 are selected by combination of torque bias command 1 and 2: CTB 1 and CTB 2 in function selection Di.
The position in which the torque bias is added is the pre-stage of torque limit (refer to Fig. 9-2-5)

	Torque bias invalid	Code 40 Level 1		Code 41 Level 2
CTB1	○	●	●	○
CTB2	○	○	●	●

● : Contact ON ○ : Contact OFF

■ Torque bias by analog input (ATBS)
Select 05 in function "117 Ai1,Ai2 function select".
Torque bias: ATBS ±10V/±150%

42 Torque control/ Torque current control select

Setting range: 00 to 11

With this function, torque command value and torque current command value by analog input are selected.

■ Torque command by analog input (ATS)
— Select 06 in function "117 Ai1,Ai2 function select".
Torque command (before limit): ATS ±10V/±150%
In addition to the above condition, write one of below ① or ②.
— ① Code 42=10
— ② Allocate 0E Speed/torque control select CSTC in "111 to 113 X1-X5 function select", and input a contact signal (CSTC: ON).

NOTE : *The torque command (ATS) is limited by the torque limit value, since the torque command is positioned before the torque limit (refer to Figs. 9-2-5 and 9-2-6).*

■ Torque current command by analog input (ATCS)
— Select 06 in function "117 Ai1,Ai2 function select".
Torque current command: ATCS ±10V/±150%
— Code 42=01

NOTE : *The torque current command (ATCS) is limited by function "179 overload capacity" (refer to Fig. 9-2-6).*

179 Overload capacity

Setting range: 0 to 250%

With this function, the torque command is limited (refer to Fig. 9-2-6).
This data should be matched to the specifications of whole system to keep safe torque output.

When the overload capacity defined by maximum permissible current of the inverter is smaller than the data of code 179, the torque is limited with the inverter overload capacity.

■ Overload capacity defined by the maximum permissible current of the inverter

$$\text{Overload capacity} = \frac{\sqrt{I_{MAX}^2 - I_{M100}^2/2}}{I_{T100}/\sqrt{2}} \times 100\%$$

here,
I_{MAX} : The maximum permissible current of the inverter
I_{M100}: Rated exciting current (peak) (Code 184)
I_{T100}: Rated torque current (peak) (code 185)

h) Magnetic flux

43 Magnetic flux command (Select)

With this function, input method of magnetic command value is changed over between internal calculation and analog input.
In sensorless control, do not conduct the analog input of magnetic flux.(The control becomes unstable.)

Data	Magnetic flux command
0	Ordinary (Internal calculation)
1	Analog input (AFLUX)

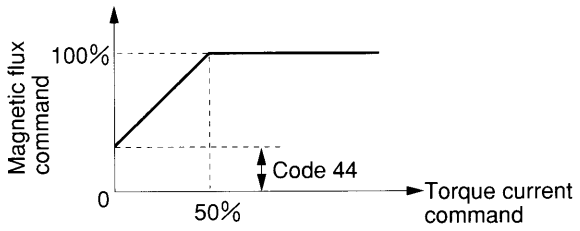
■ **Magnetic flux command by analog input**
Select 0A of function "117 Ai1,Ai2 function select".

Magnetic flux command: AFLUX ;10 V/+100%
100% means "Magnetic flux for output of 100% rated torque" .
(If analog input < 0V, the magnetic flux is limited at 0%.)

44 Magnetic flux level under light load

Setting range: 10 to 100%

When the data is made smaller, electromagnetic noise at light load can be suppressed.
The magnetic flux command value becomes smaller corresponding to the torque current command as shown in below figure, and, as the result, the electromagnetic noise becomes smaller.



NOTE: *In the case of sensorless control, this function is invalid.*

i) Motor protection function

22 Motor electronic thermal overload (Mode select)
23 Motor electronic thermal overload (Level)

With these functions, operation of electronic thermal overload relay and kind of motor are selected, and operation level is written. Match the kind of motor the used driving motor.
When using dedicated motor for VG5, this relay is permissible to be inactive (unused) since a motor protection function by NTC thermistor is active.
The general-purpose motor in the market can be almost protected with this electronic thermal overload relay. However, check the characteristics of the motor since it may be not protected in the following cases:
— Multi-pole motor and non-standard motor
— Motor for special operation such as high-frequent acc/dec operation and intermittent operation

■ **Mode selection**

Data	Operation
0	Inactive (unused)
1	Motor with self-cooling fan and general-purpose motor
2	Motor with forced-cooling fan and Fuji inverter motor

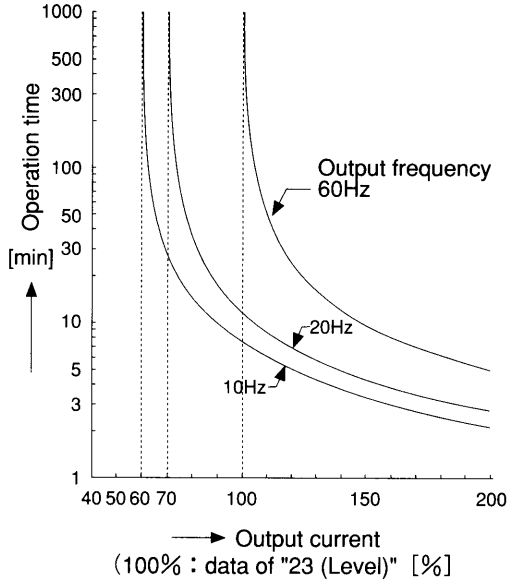
■ **Operation level**
Setting range: 0.1 to 999.9 A
When exceeding the operation level, the inverter stops according to the current-operation time characteristics.

■ **Example of written data**
Inverter:FRN30VG5S-2A (Rated output current 116 A)
Motor: Fuji's standard 3-phase motor MLA6187
(30 kW. 4 poles)
Power supply: 220 V/60 Hz

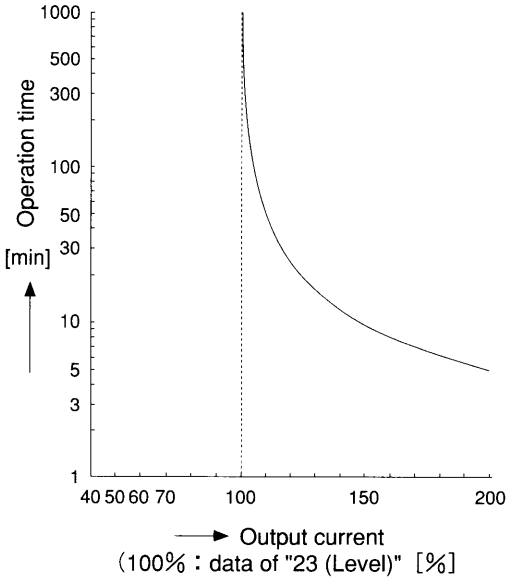
When connecting the motor MLA6187 to the power supply of 220 V, 60 Hz, rated current is 97 A. In general, the rated current of motor = operation level is selected. Then, the data are written as follows:

"22 (Select)" : 1, and "23 (Level)" : 97.0 A

■ **Current-operation time characteristics (Mode select data: 1)**



■ **Current-operation time characteristics (Mode select data: 2)**



64 Motor overload early warning

Setting range: 25 to 100%

With this function, a level of overload early warning signal before activation of motor overload protection is defined. 100% of the data shows the current value written in function "23 Motor electronic thermal overload (Level)". The operation characteristics corresponds to the data of " 22 Motor electronic thermal overload (Mode select)".

The early warning signal can be outputted by DMOL of function selection DO.

This signal can be outputted also when not using the electronic thermal overload relay. The operation characteristics in this case are that of code 22=2.

173 NTC thermistor select

0: NTC thermistor unused
1: NTC thermistor used or motor temperature input from function selection Ai

61 Motor overheating protection

Setting data: 100 to 200℃

An alarm (OH4) activates when detected temperature of motor exceeds the written data. Write the protection level according to the motor kind. When using the dedicated motor for VG5, write 150℃.

This function is valid when using NTC thermistor or inputting the motor temperature from function selection Ai.

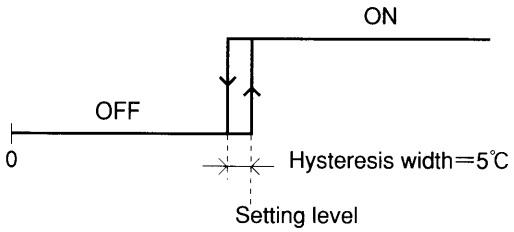
62 Motor overheating early warning

Setting data: 50 to 200 ℃

Motor overheating early warning activates when detected temperature of motor exceeds the written data.

The early warning signal is outputted by DMOH of function selection DO.
However, this is valid only when using NTC thermistor.

<Operation of DMOH>



j) Restart function after momentary power failure

⚠ WARNING

When having selected restart-active after momentary voltage failure, the inverter automatically starts at power recovery, and the motor automatically starts running. Take care not to cause accident.

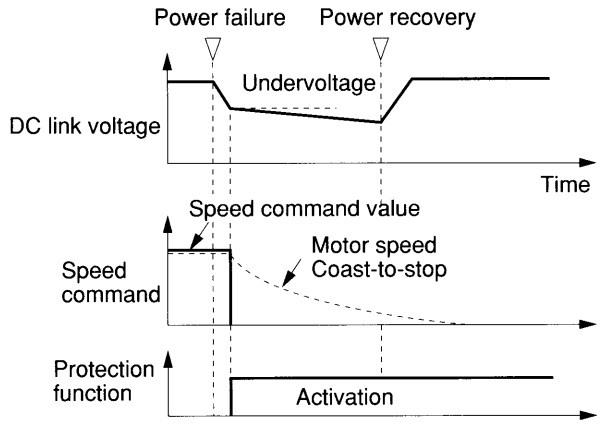
24 Restart after momentary power failure (Mode select)

With this function, activation or not of restart after momentary power failure is selected.

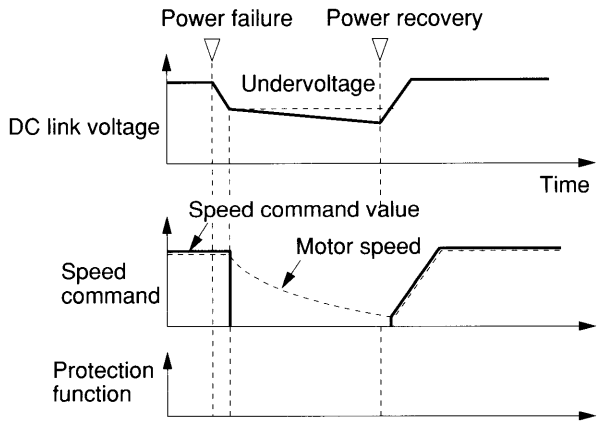
Data	At power failure	At power recovery
0	Alarm LU activate Output stop	Without restart
1	Alarm LU does not activate.	With restart

Remark: Activation of LU denotes undervoltage of inverter protection function, and output stop denotes inverter output stop.

■ **Operation without restart**



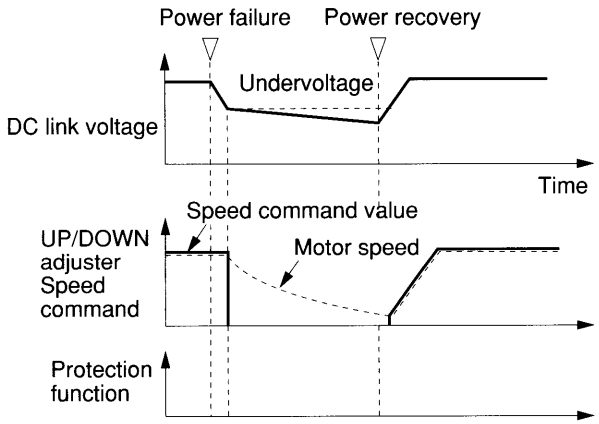
■ **Operation with restart**



In the case of soft start/stop operation
At power failure :
Inverter output stops at undervoltage level of DC link voltage, and the motor coasts to stop.
At power recovery:
When the DC link voltage is established, acceleration is calculated from the motor speed at the time point, and the speed command value is recovered with the acceleration to the speed before power failure.

■ **Operation with restart**
In the case of UP/DOWN adjuster operation
At power failure :
Inverter output stops at undervoltage level of DC link voltage, and the motor coasts to stop.
At power recovery:
When the DC link voltage is established, acceleration is calculated from the motor speed at the time point, and the speed command value is recovered with the acceleration to the speed set by UP/DOWN adjuster before power failure.

During recovering to the speed before power failure, the commands of CUP, CDWN and CCLR are invalid.
When making the operation command (FWD and REV) OFF during power failure, the motor decelerates to stop by deceleration command of the inverter after power recovery.



■ **Operation commands at restart**
— Command from keypad panel
Restart is enable if not inputting OFF during power failure.
— Command from control terminals
Restart is enable if making the switch ON at power recovery.

When using operation signal hold function for automatic reset type switches, restart is enable if not inputting stop command (CHLD of function selection Di OFF) during power failure.

NOTE : *In the case of the operation commands from keypad panel or control terminals with automatic reset type switches, when losing control power source within the inverter because of long time power failure, input of operation command is necessary to start the inverter after power recovery.*

k) Restart function

⚠ CAUTION

If the cause of alarm has not been removed, the inverter cannot operate even if trying to restart. When repeating the restart in this state, the damage of the equipment will is expanded. The data of function "81 Auto-restart (Restart times) should be as small as possible.

With this function, when an alarm is detected, the protection of the inverter is automatically released, and the inverter is started. The times of this automatic release and the interval from activation of protection to the release are written into the functions.

■ Alarms to which the restart function is valid
Overvoltage (OU), Undervoltage (LU), inverter overheating (OH1), printed circuit board overheating (OH3), inverter overload (OLU) and motor overload

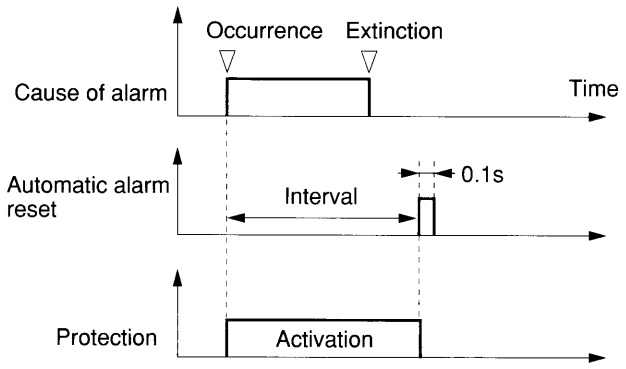
81 Auto-restart (Restart times)
82 Auto-restart (Interval)

Function	Setting range
Restart times	0 to 7 times
Restart interval	2 to 20 s

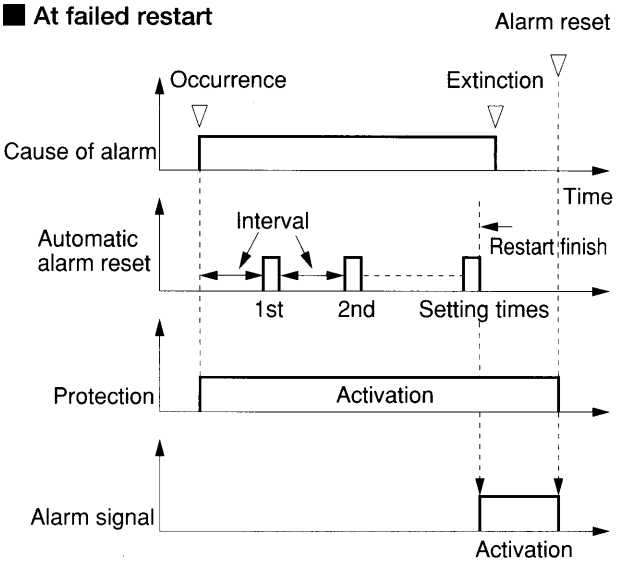
If not using restart function, make the restart time 0. If setting the restart times 1 to 7, the restart operation starts when the alarms described above are activated.

At detection alarm, after setting time in function "82 Auto-restart (interval)" , the protection is released and the inverter is started. If the cause of the alarm has been removed in this time, the inverter continues to operate without transferring to alarm mode. If the cause is remained, the protection activates again. If the cause of the alarm has not been removed by repeating this operation, the mode transfers to alarm mode at the time point of exceeding the data of function "81 Auto-restart (Restart times)" . When the cause of the alarm is removed within the set repeat times, alarm indication and alarm output signal (any alarm) are not outputted and alarm history etc. are not rewritten. When transfering to alarm mode, these indication and rewriting are performed.

■ At successful restart



■ At failed restart



I) Function selection data setting

111 X1-X5 function select (X1,X2)
112 X1-X5 function select (X3,X4)
113 X1-X5 function select (X5)

Data	Function name	Abbre-viation	Details in page
00	Operation command select	COCP	100
01	Speed setting value select	CSRM	95
02	Coast-to-stop command	CMCS	101
03	Pre-excitation command	CPEX	
04	Operation signal hold	CHLD	102
05	Multistep speed setting select 1	CSR1	96
06	Multistep speed setting select 2	CSR2	
07	Multistep speed setting select 4	CSR4	
08	UP/DOWN adjuster up command	CUP	98
09	UP/DOWN adjuster down command	CDWN	
0A	UP/DOWN adjuster clear command	CCLR	
0B	Creeping speed select	CJSC	
0C	ACC/DEC, UP/DOWN select	CSUC	
0D	Speed setting value limit	CSRL	99
0E	Speed/torque control select	CSTC	107
0F	Torque limit	CTL	105
10	ACC/DEC time select	CADT	97
11	ACC/DEC by-pass	CADB	
12	Torque bias command 1	CTB1	107
13	Torque bias command 2	CTB2	
14	Droop ON	CDRP	104
15	ASR PI select	CPI	103
16	ASR P/PI select	CPPI	
17	Ai1-ACC/DEC zero hold	CAI1Z	117
18	Ai2-ACC/DEC zero hold	CAI2Z	
19	Unused	—	—
1A	Analog/digital select (Speed)	CSAD	*1)
1B	Analog/digital select (Torque)	CTAD	*2)
1C	Di card input enable signal (Speed)	CDILS	*1)
1D	Di card input enable signal (Torque)	CDILT	*2)
1E	T-link enable	CTEN	*3)
1F	Di command for transmission	CTDI	*3)
20	RS485 enable	CREN	*4)

*1): Digital Input Option (for Speed Setting) Instruction Manual
INR-HF50736

*2): Digital Input Option (for Torque Setting) Instruction Manual
INR-HF50751

*3): T-link Interface Option Instruction Manual
INR-HF50746

*4): Standard Built-in RS485 Instruction Manual
INR-HF50730

The functions of contact input terminals for control (X1 to X5) can be selected as shown in the above table. When using the functions in the table, input a contact signal to the relevant terminal after writing the data.

If the same function is selected for two or more contact terminals for control, this is treated as OR.

■ **Data example: When allocating standard written value**

Code 111 : 0 5 0 6
X1 — X2

Code 112 : 0 7 0 F
X3 — X4

Code 113 : 0 2
X5

115 Y1-Y3, RY function select (Y1, Y2)
116 Y1-Y3, RY function select (Y3, RY)

The signals for control and indication can be selected to input to open-collector output terminals (Y1 to Y3) and a relay terminal (RY).

■ **Data example: When allocating standard written value**

Code 115 : 0 0 0 5
Y1 — Y2

Code 116: 0 6 0 4
Y3 — RY

Data	Function name	Abbre-viation	Details in page
00	DC Link voltage establishment	DVDC	115
01	In operation	DRUN	
02	In acceleration	DACC	
03	In deceleration	DDEC	
04	Speed exist	DNZS	100
05	Speed arrival	DSAR	114
06	Speed agreement	DSAG	
07	Speed detection	DSD1	113
08	Speed detection	DSD2	
09	Speed detection	DSD3	
0A	In torque limit	DTLM	106
0B	Torque detection	DTD	114
0C	Inverter overload early warning	DOL	
0D	Motor overheating early warning	DMOH	109
0E	Motor overload early warning	DMOL	
0F	Brake release signal	DBRS	115
10	In braking	DBRK	
11	DO for transmission	DTDO	*)
12	Transmission error	DTER	

*): DO for transmission DTDO and transmission error DTER are the signals related to communication through RS485 and T-link. In detail, refer to each Instruction Manual.
Standard Built-in RS485 Instruction Manual
INR-HF50730
T-link Interface Option Instruction Manua
INR-HF50746

66 Speed detection (Level 1)

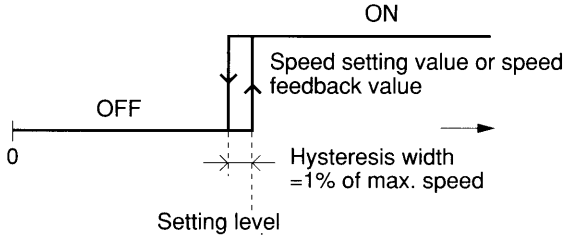
Setting range: 1 to 12000 r/min

A detection signal is outputted when the absolute value of speed detection exceeds the data level.

The detection signal is outputted with DSD1 of function select DO.

If the data is the maximum speed or more, the data level is judged as the maximum speed.

<Operation of DSD1>



67 Speed detection (Level 2)
68 Speed detection (Level 3)

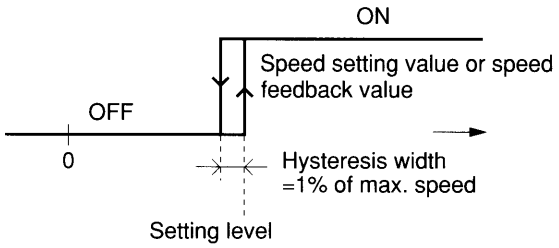
Setting range: -12000 to 12000 r/min

A detection signal is outputted when the speed detection value exceeds the data level. The detection signal is outputted with DSD2 of function select DO for level 2; and with DSD3 for level 3.

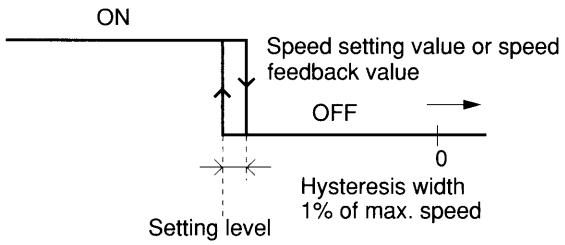
If the data is the maximum speed or more, the data level is judged as the maximum speed.

<Operation of DSD2 and DSD3>

When the detection level is +data (plus)



When the detection level is — data (minus)



69 Speed detection method

Speed detection methods of the speed detection functions in functions "65 to 68 Zero speed detection and Speed detection (Level 1 to 3)" are selected individually.

The speed detection methods are speed command and speed feedback.

Function code	Detection method
0###	Detection method of code 68, Speed feedback
1###	Detection method of code 68, Speed command
#0##	Detection method of code 67, Speed feedback
#1##	Detection method of code 67, Speed command
##0#	Detection method of code 66, Speed feedback
##1#	Detection method of code 66, Speed command
###0	Detection method of code 65, Speed feedback
###1	Detection method of code 65, Speed command

70 Speed arrival (Detection width)

Setting range: 1.0 to 20.0%

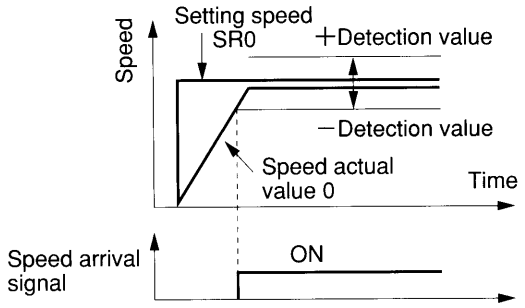
With this function, a judging level (detection width) of arrival of actual speed (BSFB) at the setting speed (input signal of acc/dec calculation SR0) is written in.

When the actual speed value enters within detection width of both + and − signs from the setting speed, the detection signal is outputted.

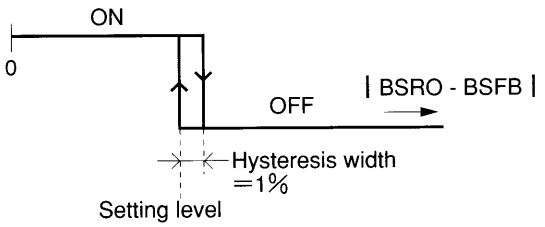
100% of this data is the maximum speed (code 03).

The detection signal is outputted with DSAR of function select DO.

This function cannot normally operate in the speed setting with UP/DOWN adjuster. Further, when using speed auxiliary setting 2 (AAS2) and speed bias setting (code 83), this function cannot normally operate also.



<Operation of DSAR>



71 Speed agreement (Detection width)
72 Speed agreement (Off-delay timer)

Setting range:
Detection width: 1.0 to 20.0%
Off-delay timer: 0.000 to 1.000 s

With these function, an agreement level of speed setting value BSR and speed actual value (BSFB) is written.

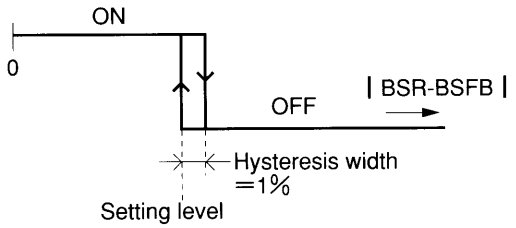
When the actual speed value enters within detection width of both + and - signs from the speed setting value, the detection signal is made ON.

The detection signal is outputted with DSAG of multi-functions DO.

100% of this data is the maximum speed (code 03).

When the speed actual value returns within the detection width from speed setting value during operation of the off-delay timer, the detection signal is not made OFF.

<Operation of DSAG>



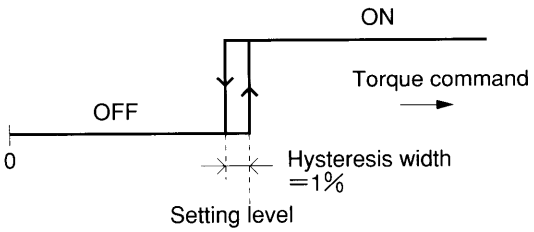
73 Torque detection (Level)

Setting range: 1.0 to 250.0%

With this function, when the torque command value exceed the data, a detection signal is outputted. 100% of this data is the torque command at continuous rating.

The detection signal is outputted with DTD of function selection DO.

<Operation of DTD>



63 Inverter overload early warning (Level)

Setting range: 25 to 100%

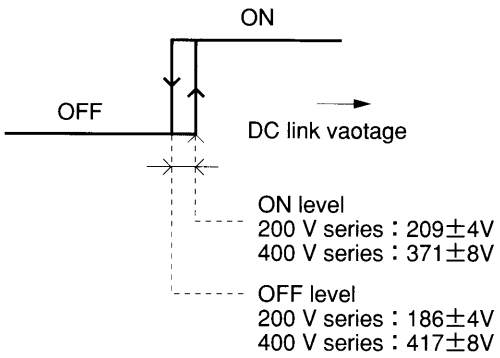
With this function, an overload early warning signal before activation of inverter overload protection (Alarm: OLU) is outputted. At 100% setting, the signal is outputted in the same time as the overload alarm. As for the overload alarm characteristics, refer to Fig. 12-1-2 (p. 125).

This early warning signal is outputted with DOL of function selection DO.

■ DC Link voltage establishment DVDC

When the DC link voltage is established (not under the undervoltage level), DVDC is made ON.

<Operation of DVDC>

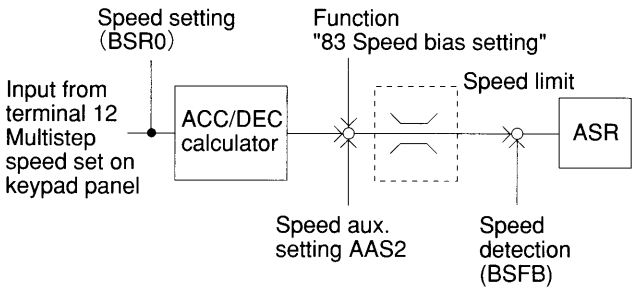


■ In operation DRUN

In inverter operation, DRUN is made ON; and in stopping, is made OFF.

■ In acceleration DACC and in deceleration DDEC

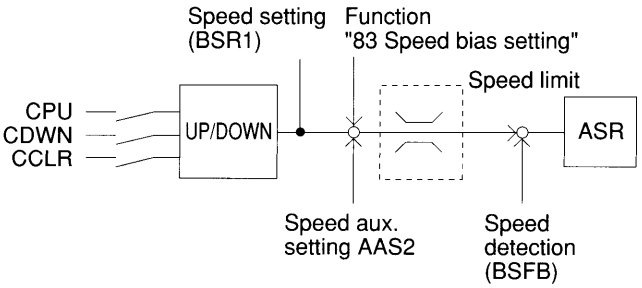
— ACC/DEC calculator type



It is judged by comparing the input of ACC/DEC calculator (BSR0) with the speed detection value (BSFB) that the inverter is either in acceleration or in deceleration. The signals of in acceleration or in deceleration are made OFF at speed arrival based on the level of function "70 Speed arrival (Detection width)".

However, the signals of in acceleration or in deceleration are not outputted when the speed except 0 is set in speed auxiliary setting 2 (AAS2) and function "83 Speed bias setting" or when the speed is limited to 100% or less by the speed limit function.

— UP/DOWN adjuster type



The signals of in acceleration or in deceleration are outputted according to increasing or decreasing of the UP/DOWN adjuster output BSR1.

■ In braking DBRK

DBRK is made ON in braking by judging driving or braking of the motor.

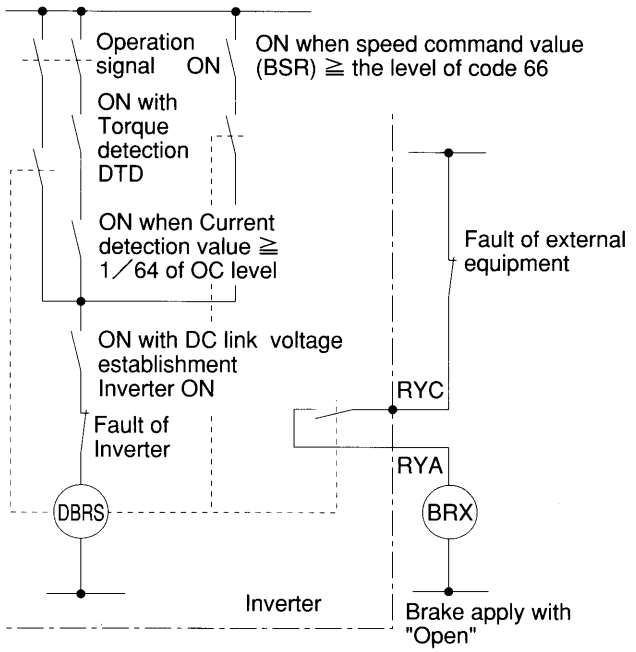
Judgement of driving or braking of the motor

	Speed detection value≧0	Speed detection value<0
Torque command≧0	Driving	Braking
Torque command<0	Braking	Driving

■ Brake release signal DBRS

An example of use of brake release signal is shown in following diagram.

The apply and release of the mechanical brake is controled by the data of functions "73 Torque detection (Level)" and "66 Speed detection (Level 1)".



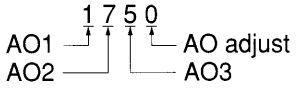
Write the torque level of releasing brake in the function "73 Torque detection (Level)".
Write the speed level of applying brake in the function "66 Speed detection (Level)"

The early warning signal is outputted with DOL of function jselection DMOH.

126 AO1-AO3 function select

Analog signal selection and AO output adjust signal selection are performed with this function.
The data are 4 digits each of which is individual and is allocated as following example:

Data example:



■ **AO adjust**

Data	Function
0	AO ordinary output
1	For gain adjust AO1 to AO3 output the data corresponding to +10 V.
2	For gain adjust AO1 to AO3 output the data corresponding to -10 V.

■ **Signal selection of AO output**
Analog signals shown in following table can be selected to output to analog output terminals AO1 to AO3.

Data	Name	Scale	Abbre-viation	Ref. in Fig.
0	Speed meter (One side deflec.)	±Nmax/+10 V	BSM1	9-2-4
1	Speed meter (Both side deflec.)	±Nmax/±10 V	BSM2	9-2-4
2	Speed setting 0	±Nmax/±10 V	BSR0	9-2-3
3	Speed setting 1	±Nmax/±10 V	BSR1	9-2-3
4	Speed setting 2	±Nmax/±10 V	BSR2	9-2-3
5	Speed setting	±Nmax/±10 V	BSR	9-2-3
6	Speed feedback	±Nmax/±10 V	BSFB	9-2-4
7	Torque current (Both side deflec.)	±150%/±10 V	BTC1	9-2-6
8	Torque current (One side deflec.)	±150%/±10 V	BTC2	9-2-6
9	Torque meter (Both side deflec.)	±150%/±10 V	BTM1	9-2-6
A	Torque meter (One side deflec.)	±150%/±10 V	BTM2	9-2-6
B	Torque command output	±150%/±10 V	BTR	9-2-6
C	Motor current detection (r.m.s)	Code 176/+5 V	BMC	—
D	Motor voltage detection (r.m.s)	Code 175/+5 V	BMV	—
E	Motor temperature	200°C/+10 V	BMTMP	9-2-7
F	DC link voltage	800 V/+10 V	BVDC	—

Remark: Nmax means the data of function "03 Maximum speed"

92 Torque command monitor (Polarity select)

The giving polarity in torque command monitor is selected with this function.

Data 0: Torque of forward rotation is made + and torque of reverse rotation is made -.
Data 1: Driving torque is made + and braking torque is made -.

127 Bias setting monitor (AO1)
128 Bias setting monitor (AO2)
129 Bias setting monitor (AO3)

Setting range: -100.0 to 100.0%

This is used for adjusting offset of AO output.
100% of the data corresponds to substantial 10 V.

130 Gain setting (AO1)
131 Gain setting (AO2)
132 Gain setting (AO3)

Setting range: -10.0 to 10.0

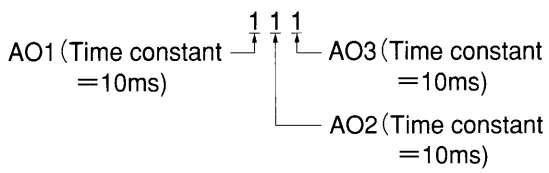
This is used for adjusting gain of AO output.

133 Filter select (AO1, AO2 and AO3)

With this function, active or inactive operations and the time constants of the filter are individually selected.
The data is 3 digits. Write the data for AO1, AO2 and AO3 in turn.

Data	Filter selection
0	Inactive
1	Time constant (10 ms)
2	Time constant

■ **Data example**



117 Ai1, Ai2 function select

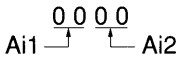
The functions of analog input Ai1 and Ai2 are selected from following table:

Data	Name	Scale	Abbre-viation	Ref. inFig.
00	Input signal interrupt	—	AOFF	—
01	Speed auxiliary setting 1	±10V/±Nmax	AAS1	9-2-2
02	Speed auxiliary setting 2	±10V/±Nmax	AAS2	9-2-3
03	Torque limit (Level 1)	±10V/±150%	ATL1	9-2-6
04	Torque limit (Level 2)	±10V/±150%	ATL2	9-2-6
05	Torque bias	±10V/±150%	ATBS	9-2-7
06	Torque command (before limit)	±10V/±150%	ATS	9-2-5
07	Torque current command	±10V/±150%	ATCS	9-2-6
08	Creeping speed 1	±10V/±Nmax	AJSS1	9-2-3
09	Creeping speed 2	±10V/±Nmax	AJSS2	9-2-3
0A	Magnetic flux command	±10V/±100%	AFLUX	9-2-6
0B	Speed feedback	±10V/±Nmax	ASFB	9-2-4
0C	Motor temperature	±10V/±200℃	AMTMP	9-2-7
0D	Speed override warning	±10V/± 50%	ASOR	9-2-2

When the same function is selected for Ai1 and Ai2, the output of Ai1 has priority.

The data is two of individual 2 digits, and allocated as below example.

■ **Data example**



121 Offset setting (Ai1)
122 Offset setting (Ai2)
124 Gain setting (Ai1)
125 Gain setting (Ai2)

Function	Setting range
Offset setting	-300 to 300
Gain setting	0.000 to 2.000

With the offset and gain settings, input signal value of Ai1 or Ai2 can be adjusted corresponding to DC voltage. If the DC voltage of Ai1 or Ai2 is not the rated value, or if the voltage drop at terminal Ai1 or Ai2 is not negligible because of long wiring, these functions are used for compensation. For example, if the gain setting is made 2.000, 5V of DC voltage can control as a max. scale.

Adjustable range of offset voltage: about ±180 mV

■ **Adjustment method (Ai1)**

Select AI adjust (Ai1) on LED monitor of keypad panel (related function "95 LED monitor select"). Make the voltage at control terminal Ai1 minimum (corresponding to 0 V), and so adjust the data of function "121 Offset setting (Ai1)" as to make the indication of LED monitor 0.0%. Next, make the voltage at control terminal Ai1 maximum (corresponding to ±10 V), and so adjust the data of function "124 Gain setting (Ai1)" as to make the indication of LED monitor 100.0% or -100.0%.

■ **Adjustment method (Ai2)**

Select AI adjust (Ai2) on LED monitor of keypad panel (related function "95 LED monitor select"). Make the voltage at control terminal Ai2 minimum (corresponding to 0 V), and so adjust the data of function "122 Offset setting (Ai2)" as to make the indication of LED monitor 0.0%. Next, make the voltage at control terminal Ai1 maximum (corresponding to ±10 V), and so adjust the data of function "125 Gain setting (Ai2)" as to make the indication of LED monitor 100.0% or -100.0%.

118 Up/down limiter (Ai1)
119 Up/down limiter (Ai2)

Setting range: 0.00 to 60.00 s

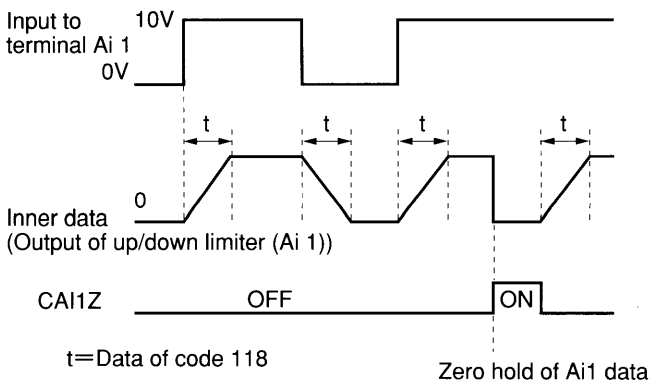
With these functions, when the voltage of 0 → 10 V is inputted to analog input terminal Ai1 and Ai2, the coasting time of changing the inner data of the inverter from 0 V data to 10 V data is adjusted.

■ **Function selection Di CAI1Z, CAI2Z**

When CAI1Z of function selection Di is made ON, input voltage to Ai1 is held at zero. (The data of input voltage from terminal Ai1 is made invalid.)

When CAI2Z of function selection Di is made ON, input voltage to Ai2 is held at zero. (The data of input voltage from terminal Ai2 is made invalid.)

Operation example



95 LED monitor select

An item indicated on LED of keypad panel by ordinary is selected. When setting motor speed (or load speed), LED indication changes for the speed setting value (or load speed setting value).

Data	Indication item	
	Ordinary indication	At speed setting from keypad panel
00	Motor speed [r/min]	Motor speed setting value
01	Motor speed setting value [r/min]	
02	Output frequency command value [Hz]	
03	Torque current [%]	
04	Torque [%]	
05	Motor output	
06	Output current [A]	
07	Output voltage [V]	
08	DC link voltage [V]	
09	Motor temperature [℃]	
0A	Magnetic flux command [%]	
0B	Load speed	Load speed setting value
0C	Input value of control terminal 12 [%]	Motor speed setting value
0D	Input value of control terminal Ai1 [%]	
0E	Input value of control terminal Ai2 [%]	
OF	Option monitor 1	
10	Option monitor 2	
11	Option monitor 3	
12	Option monitor 4	

96 Load speed indication (Coefficient 1)
97 Load speed indication (Coefficient 2)

These are coefficients for speed conversion for LED indication. Load speed is calculated from the coefficient 1 (code 96) and the coefficient 2 (code 97) as the following equation.

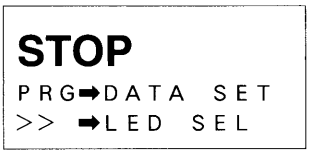
$$\text{Load speed} = \text{Motor speed} \times \frac{\text{Coefficient 1}}{\text{Coefficient 2}}$$

98 LCD monitor select

Indication contents on LCD screen in operation mode are selected with this function.

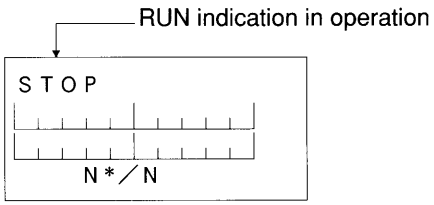
Data	Indicated item
0	Operation state and operation guidance
1	Speed setting value (N*)/motor speed (N)
2	Motor speed (N)/torque command value (τ)
3	Motor speed (N)/torque current command value (It)
4	Motor speed (N)/output current (I)

Data 0 : At stop

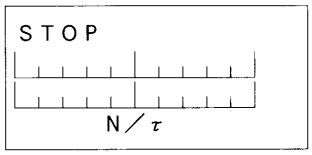


In operation

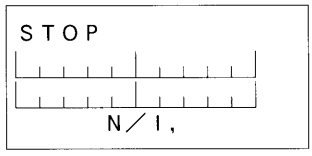
Data : 1



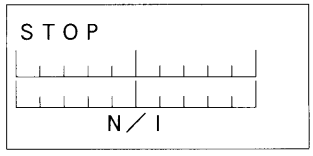
Data : 2



Data : 3



Data : 4



The full scale value of the data is as follows:

Indication content	Full scale value
Motor speed and speed command value	Maximum speed (Code 03)
Torque command value and torque current value	Overload capacity (Code 179)
Output current	Inverter permissible maximum current

NOTE: *The scales cannot be adjusted.*

94 LCD monitor (Brightness)

The brightness of LCD screen is adjusted with this function. When making the screen brighter, make the numeric value larger, and when making it darker, make the numeric value smaller.

Data	0,1,2, · · · · · · · · ·8,9,10
Screen	Dark ◄——► Bright

93 Language

The language of LCD is selected with this function.

Data	Language
0	Japanese
1	English

30 Function block (31-44)
50 Function block (51-55)
60 Function block (61-74)
80 Function block (81-101)
110 Function block (111-134)
140 Function block (141-169)
170 Function block (171-200)

Indication or not-indication of the functions of codes, which are indicated in ( ) within function names in the function block or sandwiched between ■s or ■■s, on the LCD screen is selected with these functions.

Data	Indication
0	Yes
1	No

NOTE: *If the data of each function are not indicated, the written value is the operation data (Operating condition).*

100 Data initializing

This is a function to return the rewritten data by the customer to the standard written data (initialization).

The object functions are all functions except codes 55, 120 to 125, and 171 to 200.

Functions out of object functions for initialization.
Code 55, and 171 to 197: Motor characteristics functions
Code 120 to 125: Functions for adjusting offset and gain for control terminals 12, Ai1 and Ai2
Code 200: Data protection

When pressing FUNC key after making the data 1, the data are initialized.

Data	Operation
0	Inactive
1	Active

101 Save all data

The data of all functions are saved with this function.

Data	Operation
0	Inactive
1	Active

200 Data protection

This function is used for prohibiting against rewriting the data.

Data	Operation
0	Disabled
1	Enabled

134 Dedicated function for manufacturer

This function used by the Company for test etc. before factory shipping. Do not rewrite this by the customer.

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

Missetting of the function data may cause dangerous conditions. Therefore, verify the data again before operation.

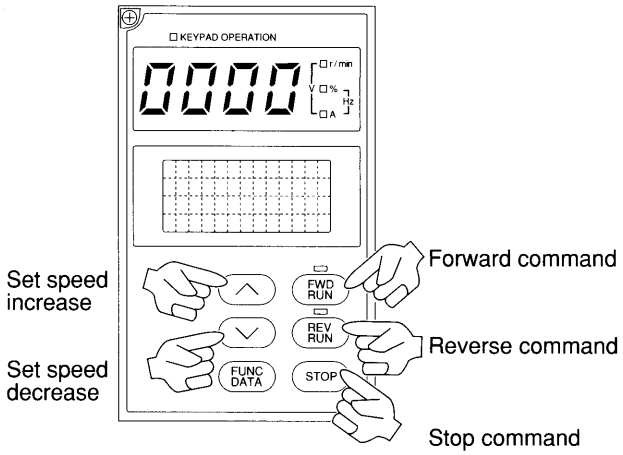
⚠ CAUTION

For RUN and STOP, use the FWD-CM (forward) and REV-CM (reverse) terminals, or the FWD/RUN, REV/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.

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.

1) Operation command per keypad panel



2) Operation command per control circuit terminal

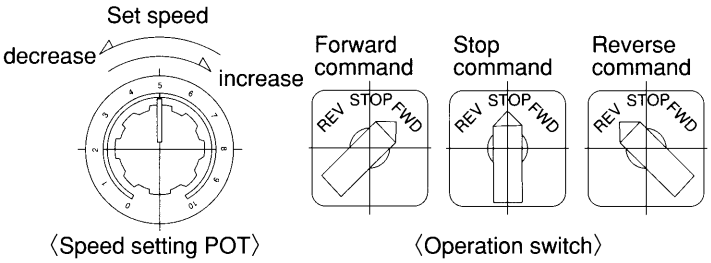


Fig. 10-1 Operation command method

Basic procedures are shown in Table 10-1. Refer to Fig. 6-7-1 Basic connection (PP.44 to 45). 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 "8-6 Operation mode" (p.65) and functions "95 LED monitor select" (p.118) in "9-2 Description of functions".

1) Before operation in conjunction with mechanical equipment, check the inverter and motor individually with trial operation.

2) Set the speed as low as the moter can start

Table 10-1 Operation command method

Operation	Speed setting	Operation command	Function data
Keypad panel	Press (∧) key, then set speed increases. Press (∨) key, then set speed decreases. Press (∧) key during operation, then motor speed increases. Press (∨) key during operation, then motor speed decreases	Press (FWD RUN) key, then the motor starts running forward. Press (STOP) key, then the motor decelerates and stops. Press (REV RUN) key, then the motor starts running in reverse. Press (STOP) key, then the motor decelerates and stops.	"01 Speed setting" : 0 "02 Operation " : 1
Control circuit terminal	Turn speed setting POT knob clockwise, then the set speed increases. Turn the knob counterclockwise, then the set speed decreases. Turn the knob clockwise during operation,then motor speed increases. Turn the knob counterclockwise during operation, then motor speed decreases.	Set the switch to FWD, then the motor starts running forward. Set the switch to STOP, then the motor decelerates and stops. Set the switch to REV, then the motor starts running in reverse. Set the switch to STOP, then the motor decelerates and stops	"01 Speed setting" : 1 "02 Operation " : 1

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

NOTE : *When mis-matching the direction to the commands, change the connection referring to "6 Connection and Wiring" (p.31)*

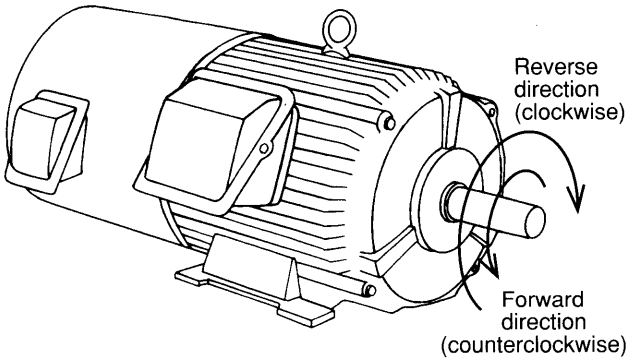


Fig. 10-2 Rotating direction of motor

4) After checking correct direction of rotation, set a low speed to ensure the motor safety opertion. And check for the following :
— Smooth rotation of motor
— Any abnormal vibrations or noise in the motor
— Items prescribed in relevant "Motor instruction manual" .

5) Checking for 4), raise the speed setting gradually up to the maximum speed if no abnormality exists. Verify that the motor speed reaches the data of "03 MAX SPEED" or "85 SPEED LIMIT (Uper limit)"

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

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

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

9) Give a stop command.

Then the test trial operation of the inverter and motor completed.
If there is no problem, couple the motor with the mechanical equipment, and operate them according to the instruction of the mecanical equipment.
When needing change of the data of functions, write the data again.

NOTE :
— *Do not repeat running and stopping the motor by the main cicuit braker or the magnet contactor. It may cause reduction of the service life and fault. If inevitable, it should be about once per a hour.*

— *If operation command from (FWD RUN) key and (REV RUN) key on the keypad panel or the control terminals is a pulse signal, the operation command is automatically made OFF state by the inverter protection operation.*

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.

⚠ 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.

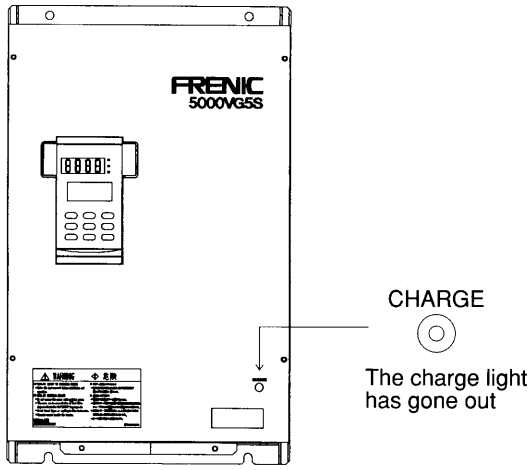


Fig. 11-1-1 Charge lamp

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 abnomal section or cause of abnormality or replace and repair abnormal parts and cause of abnomlity.

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/s2(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 inspections

For periodic inspection, 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 switching OFF 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 the particular application (semi-annually, annually, etc.).*

11-3 Electrical performance measurements

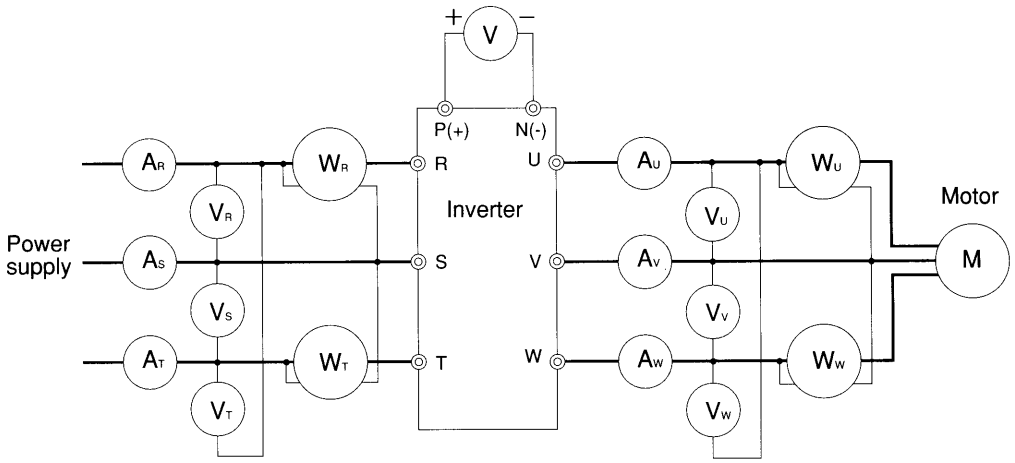
Since the inverter's input/output voltage (power supply side/motor side)and current contain high frequencies, selection of the measuring device could lead to gross difference of indications. When using the measuring device for power frequency use, refer to the recommended measuring device as shown in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

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



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

NOTE : *If the inverter 200V series is tested with the 500VDC 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.

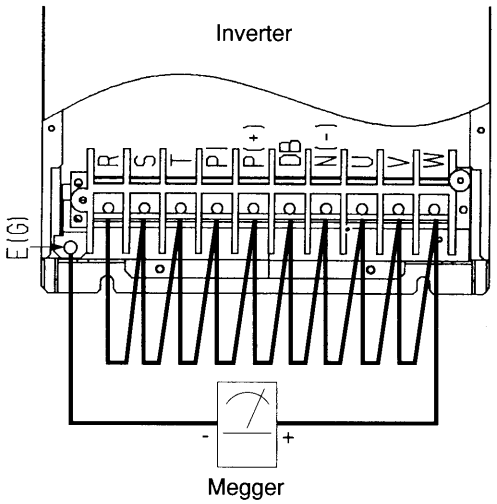


Fig. 11-4-1 Main circuit megger test connections

Disconnect the wires connected to the main circuit terminals R, S, T, P1, P(+), N(-), DB, 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 terminal DB is not attached to some types of unit. For these units, connect all the terminals without DB with a common wire.*

Perform the test applying the megger voltage only between the common wire and the ground terminal E(G).

The megger value 5MΩ 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 1MΩ and more is normal.

⚠ CAUTION

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

The parts of 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℃, 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 parts replacement	Replacement method
Cooling fan	3 years	New
DC link capacitor	7 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 part 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.*

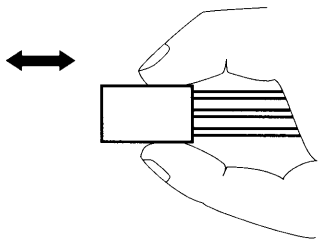


Fig. 11-5-1 Holding method of connector

— *When inserting connector, match the Nos. of the connector to avoid inserting 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 VG5S series replacement parts list

Part name	Part type	Rating	Inverter type / Quantity															
			FRN0.75VG5S-2	FRN1.5VG5S-2	FRN2.2VG5S-2	FRN3.7VG5S-2	FRN5.5VG5S-2	FRN7.5VG5S-2	FRN11VG5S-2	FRN15VG5S-2	FRN18.5VG5S-2	FRN22VG5S-2	FRN30VG5S-2	FRN37VG5S-2	FRN45VG5S-2	FRN55VG5S-2	FRN75VG5S-2	FRN90VG5S-2
IGBT	HF5B0696	600V 30A	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0697	600V 50A	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0699	600V 75A	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—
	HF5B0700	600V 100A	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—
	HF5B0705	600V 150A	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—
	HF5B0706	600V 200A	—	—	—	—	—	—	—	4	1	—	—	—	—	—	—	—
	HF5B0707	600V 300A	—	—	—	—	—	—	—	—	3	—	—	6	—	—	—	—
	HF5B0708	600V 400A	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—	—
	HF5B8491	600V 400A	—	—	—	—	—	—	—	—	—	—	3	—	—	—	—	—
	HF5B8492	600V 400A	—	—	—	—	—	—	—	—	—	—	—	—	6	6	9	12
	HF5B0703	600V 75A	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—
	HF5B0710	600V 300A	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
	HF5B0711	600V 300A	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	HF5B0740	600V 400A	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—
	HF5B1457	600V 400A	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
Control printed circuit board	EP-3611 □ □	——	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Power supply and gate drive printed circuit board	EP-3652 □-C-1	——	1	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—
	EP-3652 □-C-2		—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	EP-3652 □-C-3		—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—
	EP-3652 □-C-4		—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—
	EP-3652 □-C-5		—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	EP-3652 □-C-6		—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	EP-3652 □-C-7		—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
	EP-3652 □-C-9		—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	EP-3653 □-C-1		—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—
	EP-3653 □-C-3		—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—
	EP-3725 □-C-4		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	EP-3725 □-C-5		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Cooling fan	3108NL-05W-B39	DC24V	2	2	2	2	2	1	1	—	—	—	—	—	—	—	—	—
	4715KL-05W-B39		—	—	—	—	—	—	—	1	1	1	1	1	1	1	—	—
	4715PS-22T-B30	AC220V	—	—	—	—	—	1	1	2	2	2	—	—	—	—	1	—
	2750M		—	—	—	—	—	—	—	—	—	—	2	2	2	—	—	—
	6250MG1		—	—	—	—	—	—	—	—	—	—	—	—	—	3	2	6
DC link capacitor	HF5B0418 2200 μF	DC400V 2200 μF	1	1	1	—	2	—	—	—	—	—	—	—	—	—	—	—
	HF5B0418 3300 μF	DC400V 3300 μF	—	—	—	—	—	2	—	—	4	—	—	—	—	—	—	—
	HF5B0418 3900 μF	DC400V 3900 μF	—	—	—	1	—	—	—	3	—	4	—	—	—	—	—	—
	HF5A2892 4700 μF	DC400V 4700 μF	—	—	—	—	—	—	2	—	—	—	4	—	—	—	—	—
	HF5A5037 6800 μF	DC400V 6800 μF	—	—	—	—	—	—	—	—	—	—	—	4	5	—	—	—
	HF5B0414 5600 μF	DC400V 5600 μF	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	—
	HF5A5037 8200 μF	DC400V 8200 μF	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	6

Table 11-5-2 200V VG5S series replacement parts list (continued)

Part name	Part type	Rating	Inverter type / Quantity															
			FRN0.75VG5S-2	FRN1.5VG5S-2	FRN2.2VG5S-2	FRN3.7VG5S-2	FRN5.5VG5S-2	FRN7.5VG5S-2	FRN11VG5S-2	FRN15VG5S-2	FRN18.5VG5S-2	FRN22VG5S-2	FRN30VG5S-2	FRN37VG5S-2	FRN45VG5S-2	FRN55VG5S-2	FRN75VG5S-2	FRN90VG5S-2
DC fuse	CR2LS-20	AC250V 20A	1	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	CR2LS-30	AC250V 30A	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
	CR2LS-50	AC250V 50A	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	CR2LS-75	AC250V 75A	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—
	CR2LS-100	AC250V 100A	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	CR2L-125	AC250V 125A	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—
	CR2L-200	AC250V 200A	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
	CR2L-225	AC250V 225A	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—
	CR2L-300	AC250V 300A	—	—	—	—	—	—	—	—	—	—	—	1	1	1	—	—
	CR2L-400	AC250V 400A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—
	A50P 600-4	AC500V 600A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	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 200V VG5N series replacement parts list

Part name	Part type	Rating	Inverter type / Quantity												
			FRN0.75VG5N-2	FRN1.5VG5N-2	FRN2.2VG5N-2	FRN3.7VG5N-2	FRN5.5VG5N-2	FRN7.5VG5N-2	FRN11VG5N-2	FRN15VG5N-2	FRN18.5VG5N-2	FRN22VG5N-2	FRN30VG5N-2	FRN37VG5N-2	FRN45VG5N-2
IGBT	HF5B0696	600V 30A	1	1	—	—	—	—	—	—	—	—	—	—	—
	HF5B0697	600V 50A	—	—	1	—	—	—	—	—	—	—	—	—	—
	HF5B0699	600V 75A	—	—	—	3	—	—	—	—	—	—	—	—	—
	HF5B0700	600V 100A	—	—	—	—	3	—	—	—	—	—	—	—	—
	HF5B0705	600V 150A	—	—	—	—	—	4	—	—	—	—	—	—	—
	HF5B0706	600V 200A	—	—	—	—	—	—	4	1	—	—	—	—	—
	HF5B0707	600V 300A	—	—	—	—	—	—	—	3	—	—	6	—	—
	HF5B0708	600V 400A	—	—	—	—	—	—	—	—	3	—	—	—	—
	HF5B8491	600V 400A	—	—	—	—	—	—	—	—	—	3	—	—	—
	HF5B8492	600V 400A	—	—	—	—	—	—	—	—	—	—	—	6	6
	HF5B0703	600V 75A	—	—	—	1	1	—	—	—	—	—	—	—	—
	HF5B0710	600V 300A	—	—	—	—	—	—	—	—	1	—	—	—	—
	HF5B0711	600V 300A	—	—	—	—	—	—	—	—	—	1	—	—	—
	HF5B0740	600V 400A	—	—	—	—	—	—	—	—	—	—	1	1	—
	HF5B1457	600V 400A	—	—	—	—	—	—	—	—	—	—	—	—	2

Table 11-5-3 200V VG5N series replacement parts list (continued)

Part name	Part type	Rating	Inverter type / Quantity												
			FRN0.75VG5N-2	FRN1.5VG5N-2	FRN2.2VG5N-2	FRN3.7VG5N-2	FRN5.5VG5N-2	FRN7.5VG5N-2	FRN11VG5N-2	FRN15VG5N-2	FRN18.5VG5N-2	FRN22VG5N-2	FRN30VG5N-2	FRN37VG5N-2	FRN45VG5N-2
Control printed circuit borad	EP-3611 □ □	——	1	1	1	1	1	1	1	1	1	1	1	1	1
Power supply and gate drive printed circuit borad	EP-3652 □-C-1	——	1	1	1	—	—	—	—	—	—	—	—	—	—
	EP-3652 □-C-2		—	—	—	1	—	—	—	—	—	—	—	—	—
	EP-3652 □-C-3		—	—	—	—	1	—	—	—	—	—	—	—	—
	EP-3652 □-C-4		—	—	—	—	—	1	—	—	—	—	—	—	—
	EP-3652 □-C-5		—	—	—	—	—	—	1	—	—	—	—	—	—
	EP-3652 □-C-6		—	—	—	—	—	—	—	1	—	—	—	—	—
	EP-3652 □-C-7		—	—	—	—	—	—	—	—	1	—	—	—	—
	EP-3652 □-C-9		—	—	—	—	—	—	—	—	—	1	—	—	—
	EP-3653 □-C-1		—	—	—	—	—	—	—	—	—	—	1	—	—
	EP-3653 □-C-3		—	—	—	—	—	—	—	—	—	—	—	1	1
Cooling fan	3108NL-05W-B39	DC24V	2	2	2	2	1	1	—	—	—	—	—	—	—
	4715KL-05W-B39		—	—	—	—	—	—	1	1	1	1	1	1	1
	4715PS-22T-B30	AC220V	—	—	—	—	1	1	2	2	2	—	—	—	—
	2750M		—	—	—	—	—	—	—	—	—	2	2	2	—
	6250MG1		—	—	—	—	—	—	—	—	—	—	—	—	3
DC link capacitor	HF5B0418 2200 μF	DC400V 2200 μF	1	1	—	2	—	—	—	—	—	—	—	—	—
	HF5B0418 3300 μF	DC400V 3300 μF	—	—	—	—	2	—	—	4	—	—	—	—	—
	HF5B0418 3900 μF	DC400V 3900 μF	—	—	1	—	—	—	3	—	4	—	—	—	—
	HF5A2892 4700 μF	DC400V 4700 μF	—	—	—	—	—	2	—	—	—	4	—	—	—
	HF5A5037 6800 μF	DC400V 6800 μF	—	—	—	—	—	—	—	—	—	—	4	5	—
	HF5B0414 5600 μF	DC400V 5600 μF	—	—	—	—	—	—	—	—	—	—	—	—	6
DC fuse	CR2LS-20	AC250V 20A	1	1	—	—	—	—	—	—	—	—	—	—	—
	CR2LS-30	AC250V 30A	—	—	1	—	—	—	—	—	—	—	—	—	—
	CR2LS-50	AC250V 50A	—	—	—	1	—	—	—	—	—	—	—	—	—
	CR2LS-75	AC250V 75A	—	—	—	—	1	1	—	—	—	—	—	—	—
	CR2LS-100	AC250V 100A	—	—	—	—	—	—	1	—	—	—	—	—	—
	CR2L-125	AC250V 125A	—	—	—	—	—	—	—	1	—	—	—	—	—
	CR2L-200	AC250V 200A	—	—	—	—	—	—	—	—	1	—	—	—	—
	CR2L-225	AC250V 225A	—	—	—	—	—	—	—	—	—	1	—	—	—
	CR2L-300	AC250V 300A	—	—	—	—	—	—	—	—	—	—	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 11-5-4 400V VG5S series replacement parts list

Part name	Part type	Rating	Inverter type / Quantity																	
			FRN3.7VG5S-4	FRN5.5VG5S-4	FRN7.5VG5S-4	FRN11VG5S-4	FRN15VG5S-4	FRN18.5VG5S-4	FRN22VG5S-4	FRN30VG5S-4	FRN37VG5S-4	FRN45VG5S-4	FRN55VG5S-4	FRN75VG5S-4	FRN90VG5S-4	FRN110VG5S-4	FRN132VG5S-4	FRN160VG5S-4	FRN200VG5S-4	FRN220VG5S-4
IGBT	HF5B0698	1200V 25A	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0701	1200V 50A	—	3	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0702	1200V 75A	—	—	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0709	1200V 100A	—	—	—	3	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	HF5B0419	1200V 100A	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0421	1200V 150A	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—	—	—	—
	HF5A5365	1200V 200A	—	—	—	—	—	—	—	3	3	—	—	6	—	—	—	—	—	—
	HF5A5366	1200V 300A	—	—	—	—	—	—	—	—	—	3	3	—	6	6	9	9	12	12
	HF5B0704	1200V 25A	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0713	1200V 200A	—	—	—	—	—	—	—	1	1	1	1	—	—	—	—	—	—	—
	HF5B1464	1200V 300A	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
Control printed circuit borad	EP-3611 □ □	——	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Power supply and gate drive printed circuit borad	EP-3626 □-C-1	——	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	EP-3626 □-C-2		—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	EP-3626 □-C-3		—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	EP-3626 □-C-4		—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	EP-3626 □-C-5		—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—
	EP-3626 □-C-6		—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—
	EP-3654 □-C-1		—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—
	EP-3654 □-C-2		—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—
	EP-3725 □-C-1		—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—
	EP-3725 □-C-2		—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—
	EP-3725 □-C-3		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Cooling fan	3108NL-05W-B39	DC24V	2	2	2	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	4715KL-05W-B39		—	—	—	1	1	1	1	1	1	1	1	1	—	—	—	—	—	—
	4715PS-22T-B30	AC220V	—	—	—	—	—	2	2	2	2	—	—	—	1	1	—	—	—	—
	2750M		—	—	—	—	—	—	—	—	—	2	—	—	—	—	2	2	—	—
	6250MG1		—	—	—	—	—	—	—	—	—	—	3	3	3	3	3	3	6	6
DC link capacitor	HF5B0418 1500 μF	DC400V 1500 μF	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0418 2200 μF	DC400V 2200 μF	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0418 3300 μF	DC400V 3300 μF	—	—	2	—	—	4	—	—	—	—	—	—	—	—	—	—	—	—
	HF5B0418 3900 μF	DC400V 3900 μF	—	—	—	—	—	—	4	—	—	—	—	—	—	—	—	—	—	—
	HF5A2892 4700 μF	DC400V 4700 μF	—	—	—	2	—	—	—	4	—	—	—	—	—	—	—	—	—	—
	HF5B0414 5600 μF	DC400V 5600 μF	—	—	—	—	2	—	—	—	—	6	6	6	—	—	—	—	—	—
	HF5A5037 6800 μF	DC400V 6800 μF	—	—	—	—	—	—	—	—	4	—	—	—	6	—	8	—	12	—
	HF5A5037 8200 μF	DC400V 8200 μF	—	—	—	—	—	—	—	—	—	—	—	—	—	6	—	8	—	12

Table 11-5-4 400V VG5S series replacement parts list (continued)

Part name	Part type	Rating	Inverter type / Quantity																
			FRN3.7VG5S-4	FRN5.5VG5S-4	FRN7.5VG5S-4	FRN11VG5S-4	FRN15VG5S-4	FRN18.5VG5S-4	FRN22VG5S-4	FRN30VG5S-4	FRN37VG5S-4	FRN45VG5S-4	FRN55VG5S-4	FRN75VG5S-4	FRN90VG5S-4	FRN110VG5S-4	FRN132VG5S-4	FRN160VG5S-4	FRN200VG5S-4	FRN220VG5S-4
DC fuse	CR6L-20	AC600V 20A	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	CR6L-30	AC600V 30A	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	CR6L-50	AC600V 50A	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—
	CR6L-75	AC600V 75A	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—
	CR6L-100	AC600V 100A	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—
	CR6L-150	AC600V 150A	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—
	CR6L-200	AC600V 200A	—	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—
	CR6L-300	AC600V 300A	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—
	A700Q 400-4	AC700V 400A	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—	—	—	—
	A700Q 500-4	AC700V 500A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—
	A700Q 600-4	AC700V 600A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	—
	A700QS 800-4	AC700V 800A	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	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 11-5-5 400V VG5N series replacement parts list

Part name	Part type	Rating	Inverter type / Quantity									
			FRN3.7VG5N-4	FRN5.5VG5N-4	FRN7.5VG5N-4	FRN11VG5N-4	FRN15VG5N-4	FRN18.5VG5N-4	FRN22VG5N-4	FRN30VG5N-4	FRN37VG5N-4	FRN45VG5N-4
IGBT	HF5B0701	1200V 50A	3	—	1	1	—	—	—	—	—	—
	HF5B0702	1200V 75A	—	3	—	—	1	—	—	—	—	—
	HF5B0709	1200V 100A	—	—	3	—	—	1	—	—	—	—
	HF5B0419	1200V 100A	—	—	—	3	—	—	—	—	—	—
	HF5B0421	1200V 150A	—	—	—	—	3	3	—	—	—	—
	HF5A5365	1200V 200A	—	—	—	—	—	—	3	3	—	—
	HF5A5366	1200V 300A	—	—	—	—	—	—	—	—	3	3
	HF5B0704	1200V 25A	1	1	—	—	—	—	—	—	—	—
	HF5B0713	1200V 200A	—	—	—	—	—	—	1	1	1	1
Control printed circuit borad	EP-3611 □ □	——	1	1	1	1	1	1	1	1	1	1

Table 11-5-5 400V VG5N series replacement parts list (continued)

Part name	Part type	Rating	Inverter type / Quantity									
			FRN3.7VG5N-4	FRN5.5VG5N-4	FRN7.5VG5N-4	FRN11VG5N-4	FRN15VG5N-4	FRN18.5VG5N-4	FRN22VG5N-4	FRN30VG5N-4	FRN37VG5N-4	FRN45VG5N-4
Power supply and gate drive printed circuit borad	EP-3626 □-C-2	——	1	—	—	—	—	—	—	—	—	—
	EP-3626 □-C-3		—	1	—	—	—	—	—	—	—	—
	EP-3626 □-C-4		—	—	1	1	—	—	—	—	—	—
	EP-3626 □-C-5		—	—	—	—	1	1	—	—	—	—
	EP-3626 □-C-6		—	—	—	—	—	—	1	1	—	—
	EP-3654 □-C-1		—	—	—	—	—	—	—	—	1	1
Cooling fan	3108NL-05W-B39	DC24V	2	2	1	1	—	—	—	—	—	—
	4715KL-05W-B39		—	—	1	1	1	1	1	1	1	1
	4715PS-22T-B30	AC220V	—	—	—	—	2	2	2	2	—	—
	2750M		—	—	—	—	—	—	—	—	2	—
	6250MG1		—	—	—	—	—	—	—	—	—	3
DC link capacitor	HF5B0418 2200 μF	DC400V 2200 μF	2	—	—	—	—	—	—	—	—	—
	HF5B0418 3300 μF	DC400V 3300 μF	—	2	—	—	4	—	—	—	—	—
	HF5B0418 3900 μF	DC400V 3900 μF	—	—	—	—	—	4	—	—	—	—
	HF5A2892 4700 μF	DC400V 4700 μF	—	—	2	—	—	—	4	—	—	—
	HF5B0414 5600 μF	DC400V 5600 μF	—	—	—	2	—	—	—	—	6	6
	HF5A5037 6800 μF	DC400V 6800 μF	—	—	—	—	—	—	—	4	—	—
DC fuse	CR6L-30	AC600V 30A	1	1	—	—	—	—	—	—	—	—
	CR6L-50	AC600V 50A	—	—	1	1	—	—	—	—	—	—
	CR6L-75	AC600V 75A	—	—	—	—	1	—	—	—	—	—
	CR6L-100	AC600V 100A	—	—	—	—	—	1	—	—	—	—
	CR6L-150	AC600V 150A	—	—	—	—	—	—	1	1	—	—
	CR6L-200	AC600V 200A	—	—	—	—	—	—	—	—	1	—
	CR6L-300	AC600V 300A	—	—	—	—	—	—	—	—	—	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 Trouble Shooting

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

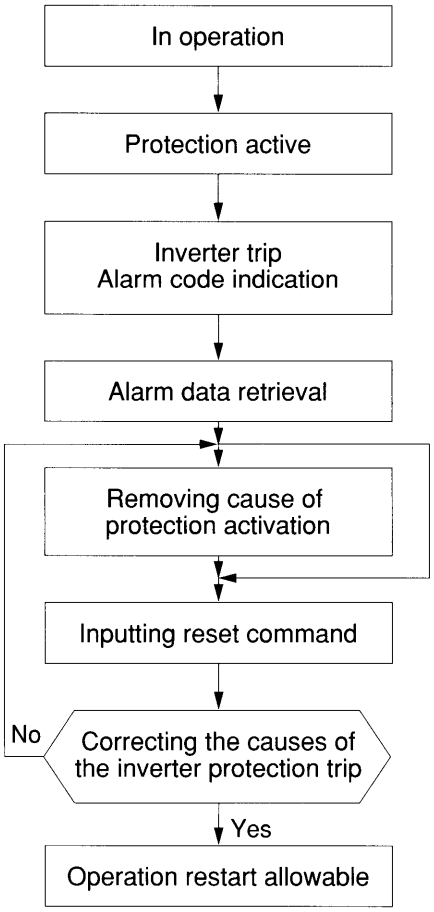
If the inverter protection is activated, the inverter immediately trips (output stop), LCD displays alarm mode screen, and LED indicates alarm code. After tripping, the motor is released from the inverter, and coasts to stop.

The activation of protection (tripped state) continues till inputting reset command. Input the reset command after removing cause of the protection activation or replacing parts.

The activated state is released and the mode changes to operation mode, then, the operation of the inverter can be restarted.

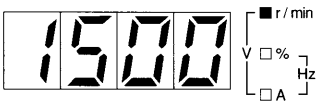
NOTE : *As for the operation method in the alarm mode, refer to "8-7 Alarm mode" (p. 70)*

Indication example:
The overload protection of the inverter is activated when the inverter is operating at speed of 1500 r/min.



1) In operation

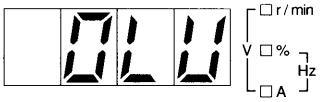
Operation data



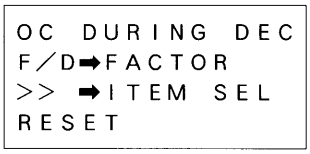
Operation mode screen

2) Inverter trip and alarm indication

Alarm code

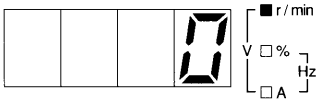


Alarm mode screen



3) Operation restart allowable

Operation data



Operation mode screen

Fig. 12-1-1 Operation and indication at alarm mode

Table 12-1-1 Protection of inverter

Protective function	Keypad panel display		Operation explanation
	LED	LCD	
Overcurrent	OC	OVER CURRENT1	Operates if the instant output current of the inverter exceeds the overcurrent detection level by short-circuit or grounding in the circuit on the output side.
Ground fault	EF	GROUND ALARM	Operates at the ground detection of inverter output circuit. Excessive ground fault current will also operate overcurrent protection. This function is to protect the parts. Provide Earth leakage relay or Earth leakage breaker for preventing burn or fire hazard.
Fuse blow-out	dCF	DC FUSE BREAK	Operates when a fuse blows in DC link circuit due to a short-circuit in IGBT circuit.
Overvoltage	OU	OVER VOLTAGE2	Operates if the DC voltage in DC link circuit exceeds the overvoltage detection level by rise of power supply voltage or regenerative power. However, the protection is not possible if excessive voltage (high voltage) is applied by mistake. Overvoltage detection level: 200 V series: 400 V 400 V series: 800 V
Undervoltage	LU	UNDERVOLTAGE2	Operates if the DC voltage in the DC link circuit becomes less than the undervoltage detection level. If the data 1 of function "24 Restart after momentary power failure" has been selected, this does not operate. Undervoltage detection level: 200 V series: 186 V 400 V series: 371 V
Inverter overheating	OH1	INV OVERHEAT	Operates if the temperature around fins for cooling rectifier diodes and IGBT rises due to stopping of cooling fan etc.
External alarm input	OH2	EXT ALARM	Operates according to the signal of control terminal THR through the alarm contacts of external equipment such as a braking unit, braking resistor if connected.
Inverter overheating	OH3	PCB OVERHEAT	Operates if the temperature around the printed circuit board within the inverter due to insufficient ventilation etc.
Motor overheating	OH4	MTR OVERHEAT	Operates if the detected temperature of NTC thermistor built-in the motor exceeds the data of function "61 Motor overheating protection".
Motor overload	OL	MTR OVERLOAD	Operates if the motor current (inverter output current) exceeds the operation level of function "23 Motor electronic thermal overload" .In detail, refer to "9-2 Function description" i) Motor protection function.
Inverter overload	OLU	INV OVERLOAD	Operates if the output current exceeds the inverse-time overload characteristics shown in Fig. 12-1-2.
Over speed	OS	OVER SPEED	Operates if the motor speed exceeds 120% of the data of the function "03 Maximum speed" .
Encoder circuit open	PG	PG BREAK	Operates if the circuit between encoder terminals PA and PB is broken or the PG interface card is not attached when the data of function "172 Number of PG pulses" is other than 0.
Thermistor circuit open	nrb	THERM BREAK	Operates if the circuit of a thermistor is broken when the data of function "173 NTC Thermistor select" is 1.
Charging circuit abnormal	PbF	CIRCUIT ALARM	Operates if a bypass circuit is not built in the DC link circuit (not closing a magnetic contactor for charging circuit bypass) even if after 2 s from power supply ON.
Memory error	Er1	MEMORY ERROR	Operates if an error such as abnormal writing occurs on the memory.
Communication error of keypad panel	Er2	KEYPD COM ERR	Operates, when Run or Stop command is inputted from keypad panel, if transmission error between the keypad panel and the control part, or a halt in transmission is detected. **NOTE:** *When operating with the control terminals, the inverter continues to operate without alarm indication and alarm output (any fault). Further, The indication is fixed to the monitored state at error detection (not change).*
CPU error	Er3	CPU ERROR	Operates when an error occurs in CPU.

Table 12-1-1 Protection of inverter (continued)

Protective function	Keypad panel display		Operation explanation
	LED	LCD	
RS485 error	Er5	RS485 ALARM	Operates if a communication error or line cut occurs when the data of function "147 RS485 operation at error" are 0 to 2.
Inverter output circuit abnormal	Er7	OUT LINE ERR	Operates if the measured value exceeds the data range of the motor characteristics in motor constants auto-tuning or if the inverter output circuit is broken or not connected.
A/D converter error	Er8	HARD ERROR	Operates when an error occurs in A/D converter circuit.

NOTE:

— *If the control power source voltage so decreased as to disable to keep the operation of the inverter control circuit, all protections are automatically reset.*

— *If the indication on keypad panel is out of this table, refer to the Instruction Manual of used option.*

When the inverter protection 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, only the first detected alarm code is indicated. The alarm histories are successively rewritten per activation of the inverter protection and the fourth or more previous alarm code is lost on the screen.

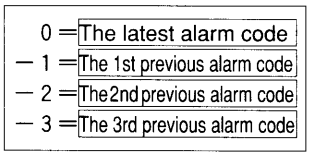


Fig. 12-1-3 Alarm history screen

As for inverter protection other than these, protection against surge voltage penetrated from the power supply is provided with surge suppressors connected to the circuits of main circuit power supply terminals (R, S and T) and control power supply terminals (R0 and T0).

Between line and ground: 7 kV (1.2×50 μs)
Between lines : 5 kV (10×200 μs)

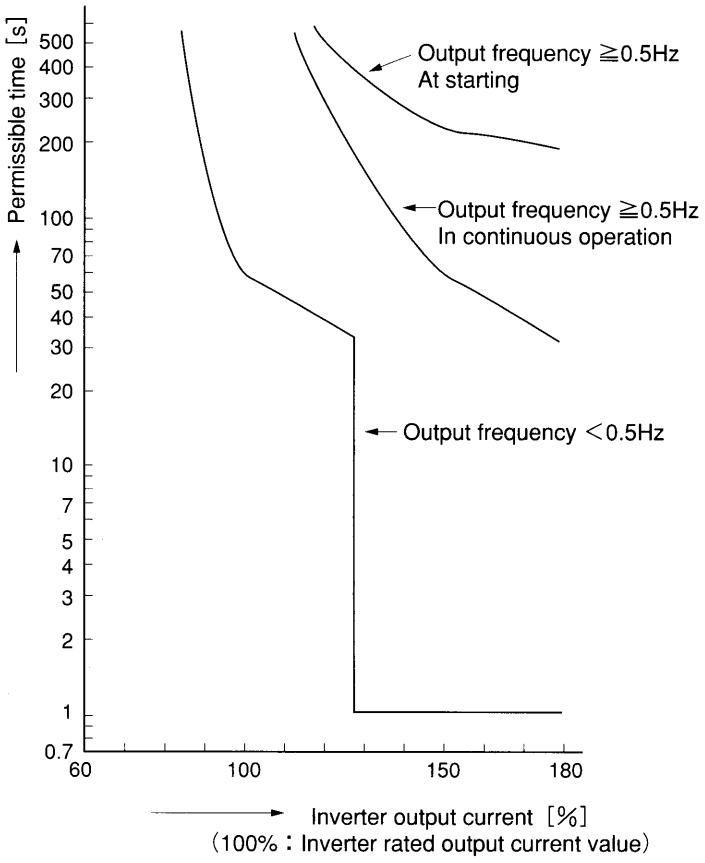
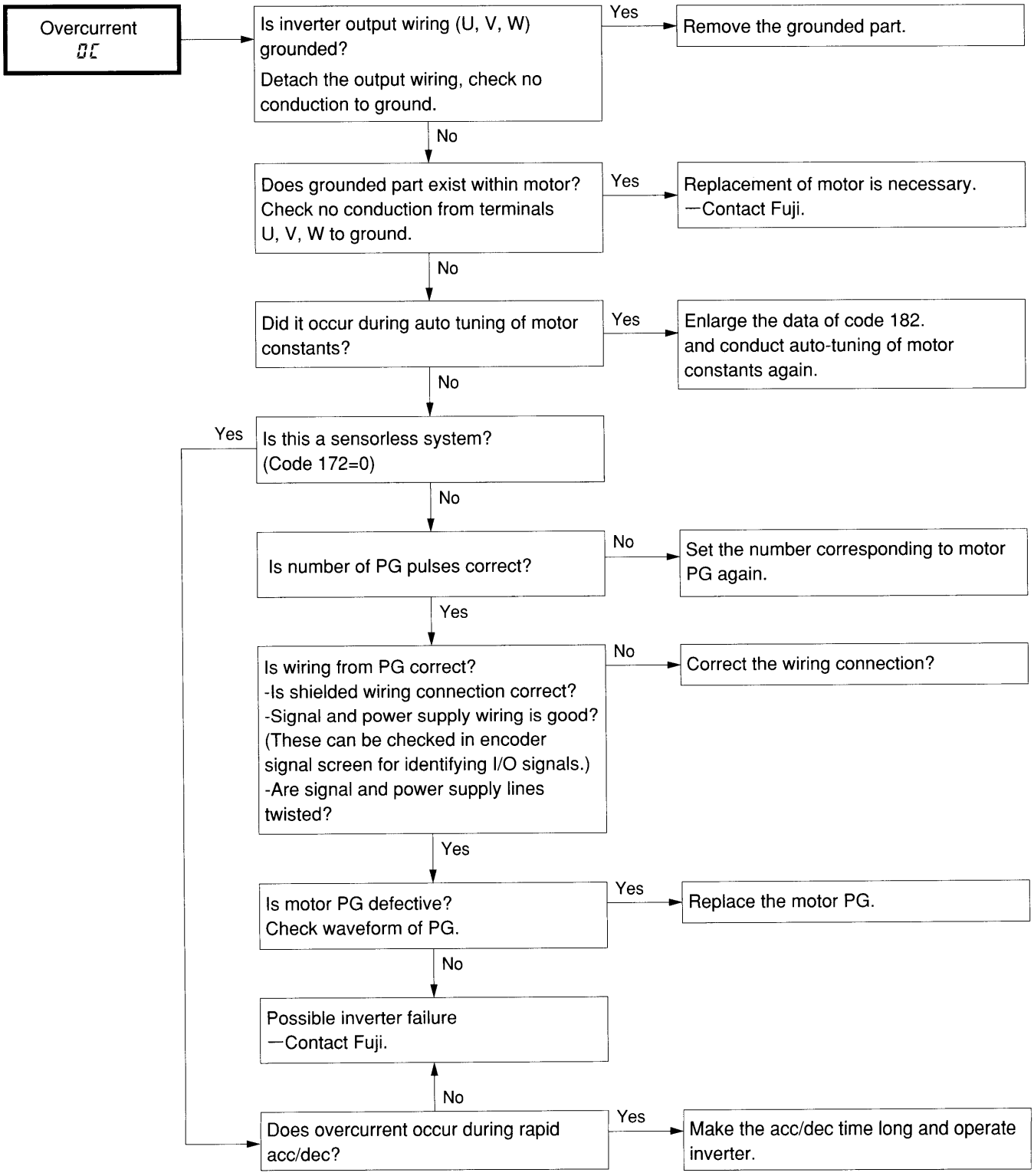


Fig.12-1-2 Inverter overload characteristics

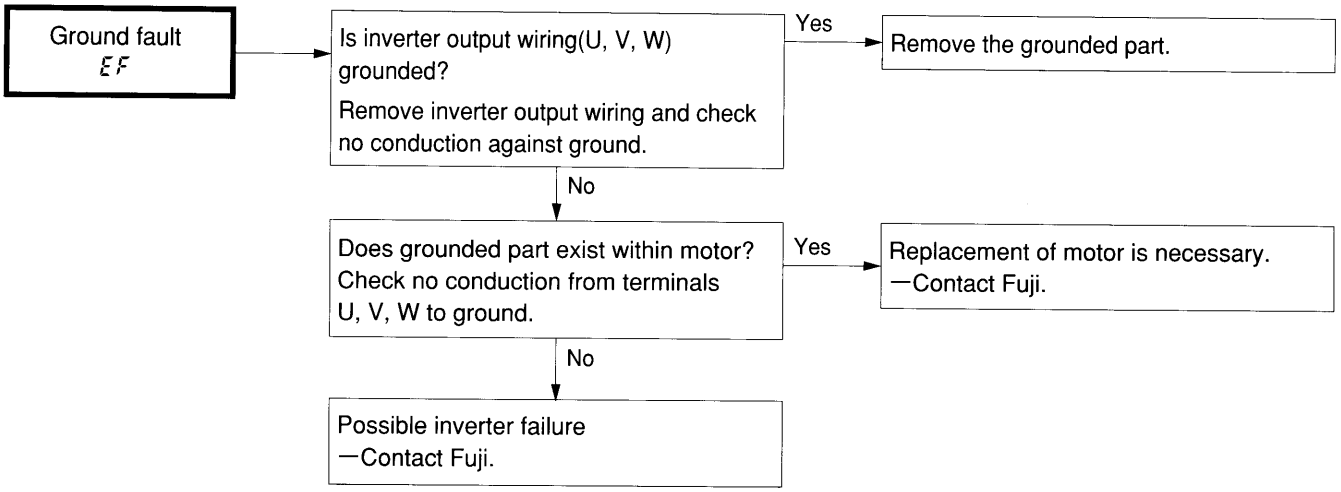
12-2 Diagnosis and remedy in case of protection activation

NOTE : *The terms are abbreviated as follows:*
— Function code is called code.
— Encoder is called PG.

a) Overcurrent

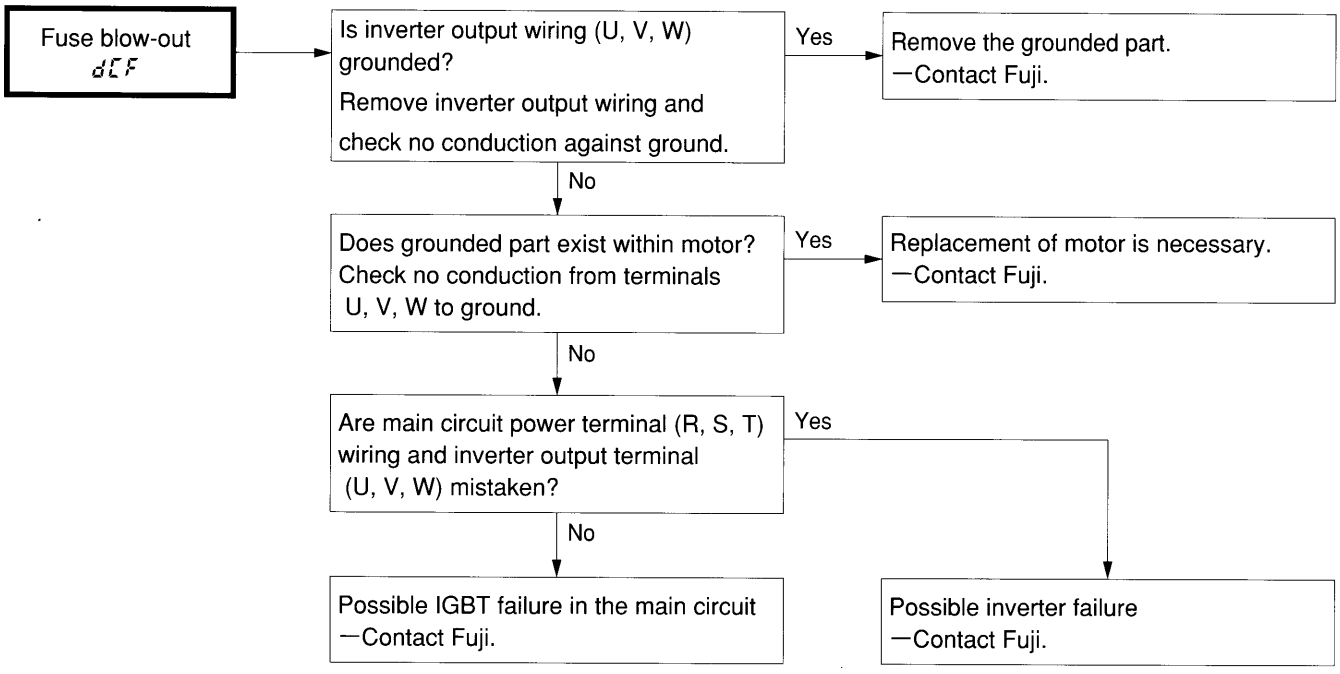


b) Ground fault

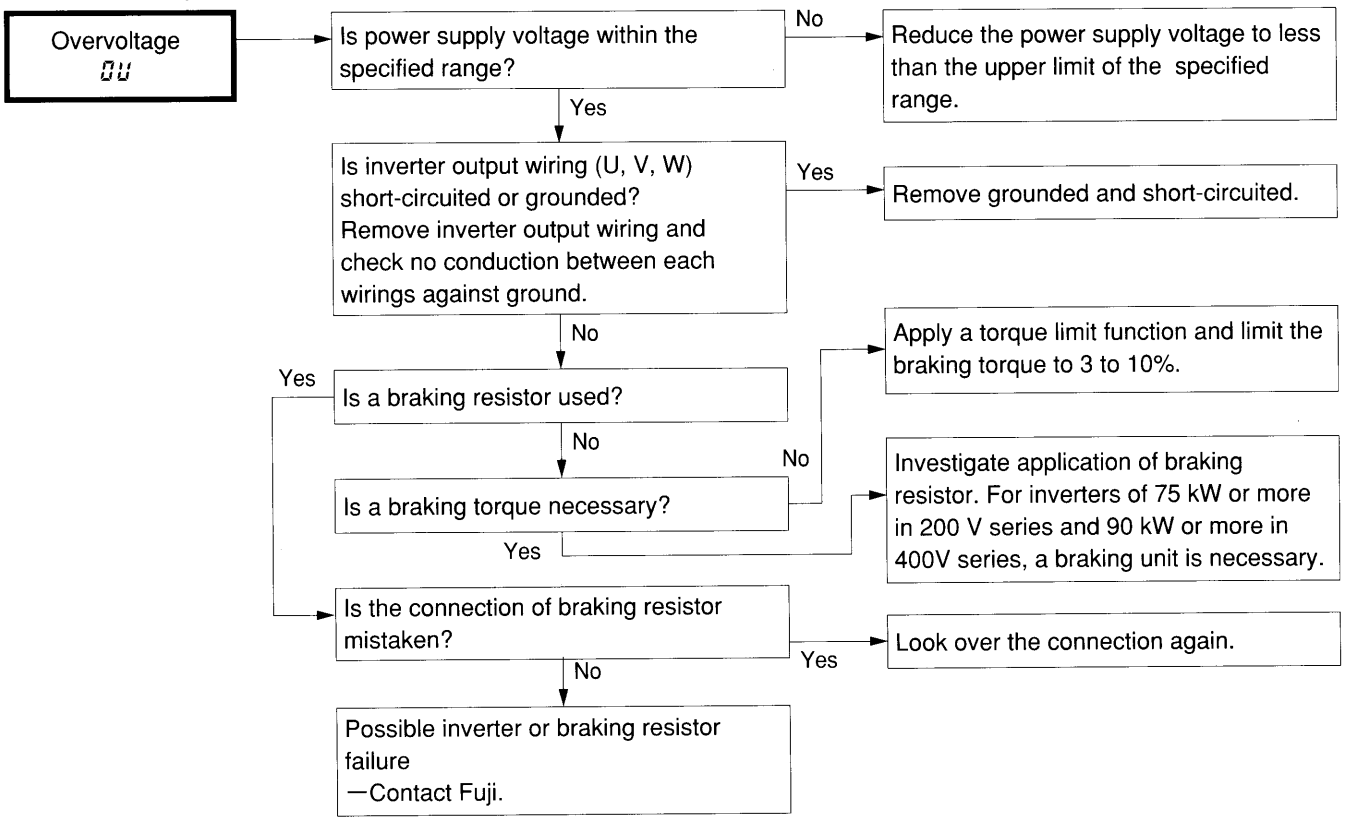


c) Fuse blow-out

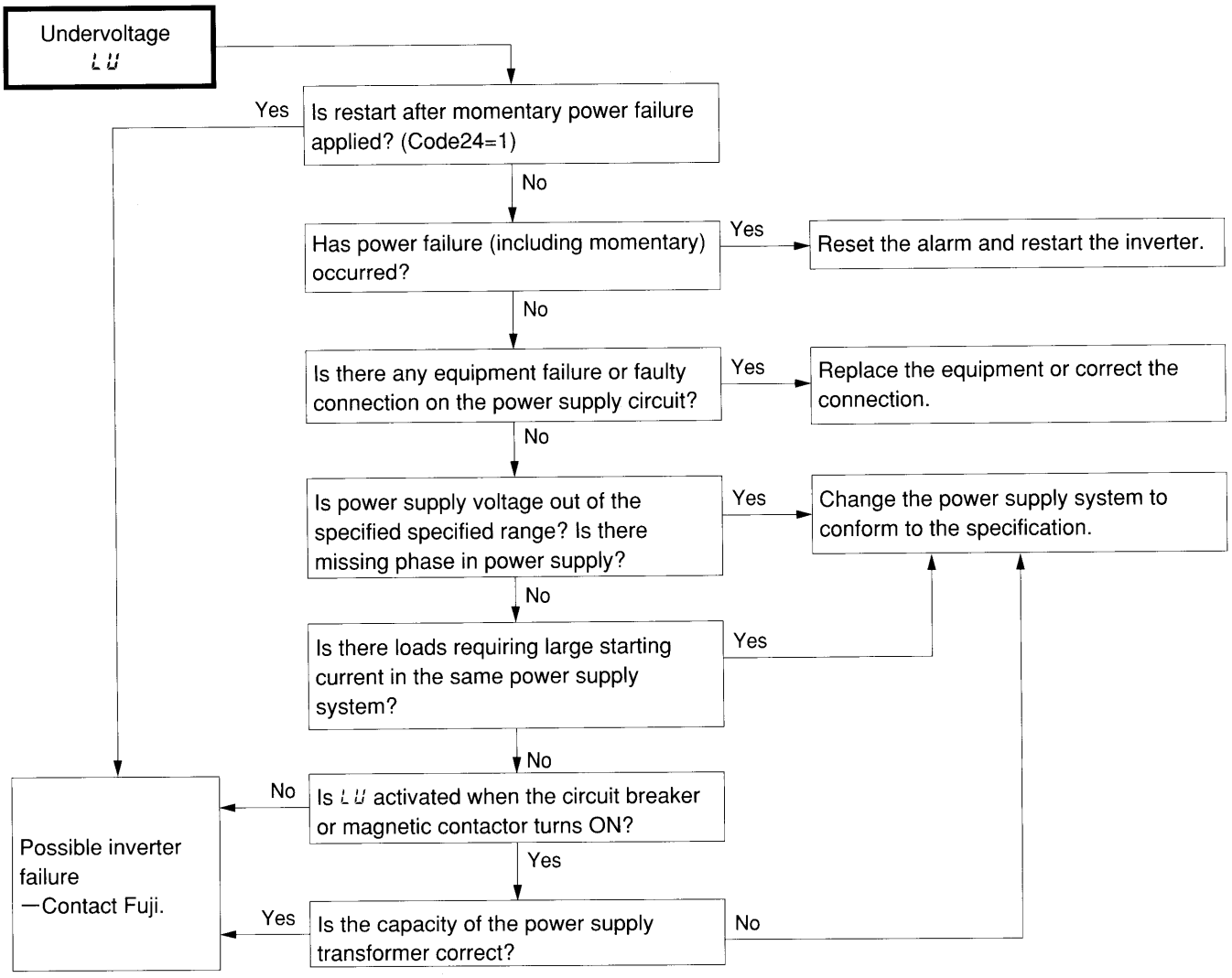
The fuse is provided for preventing secondary disaster such as fire hazard. When this alarm is activated, immediately cut OFF power supply, check the cause according to following procedure, and replace the inverter.
When this alarm occurs, contact Fuji Co. without making power supply ON.



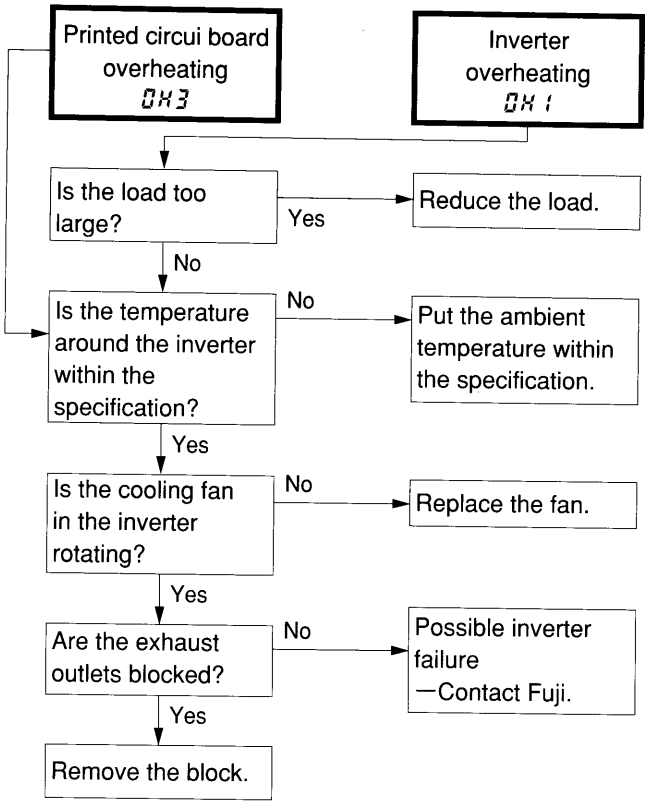
d) Overvoltage



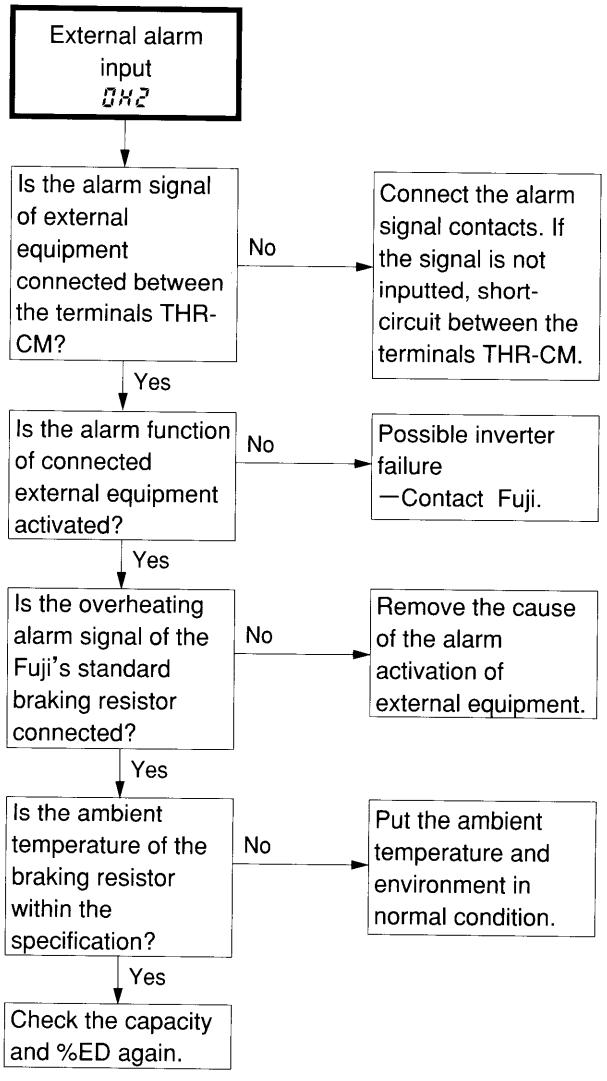
e) Undervoltage



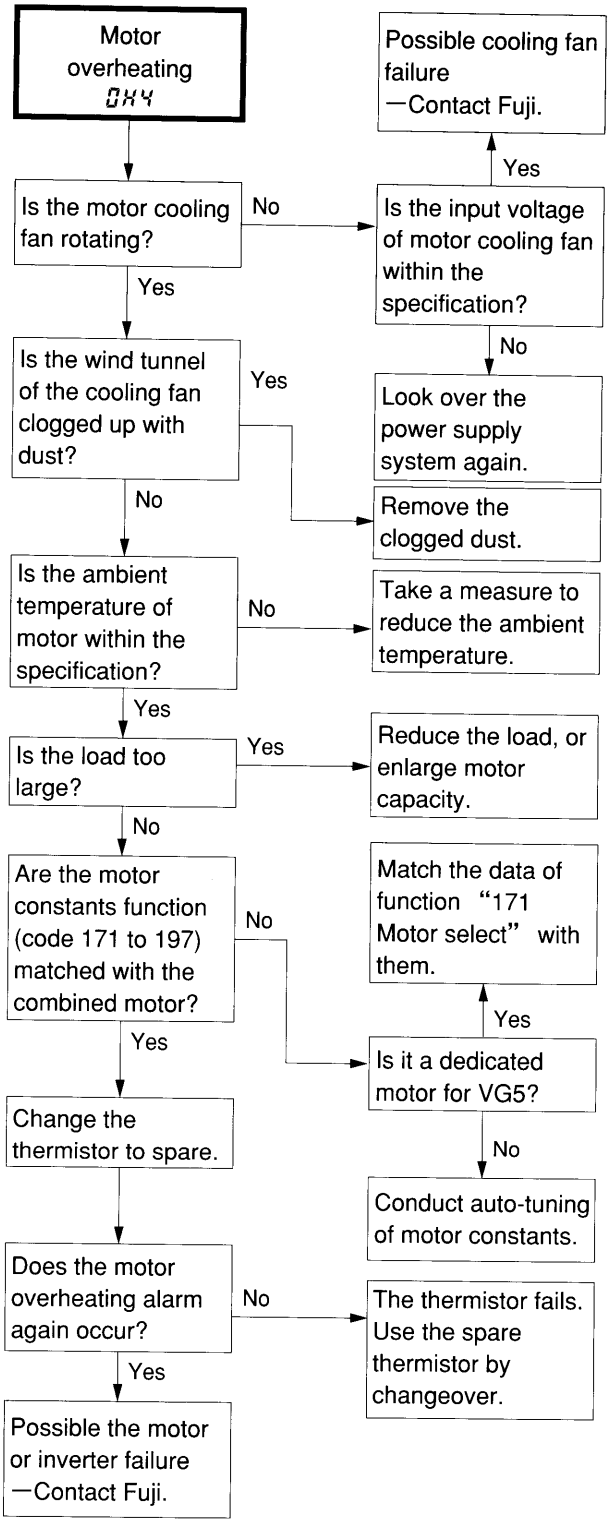
f) Inverter overheating and printed circuit board overheating



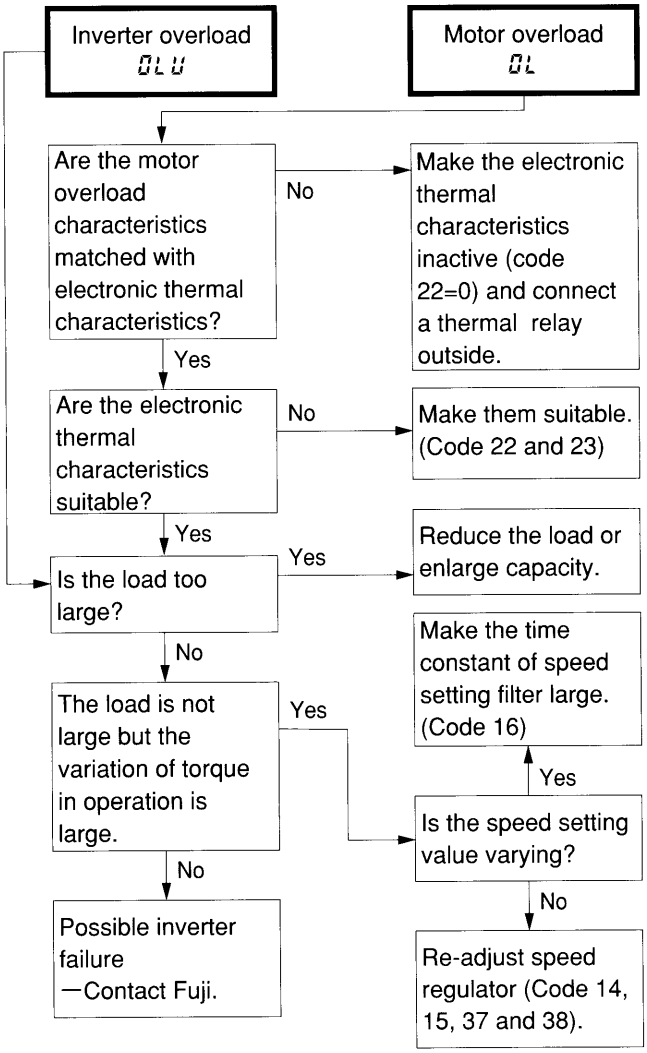
g) External alarm input



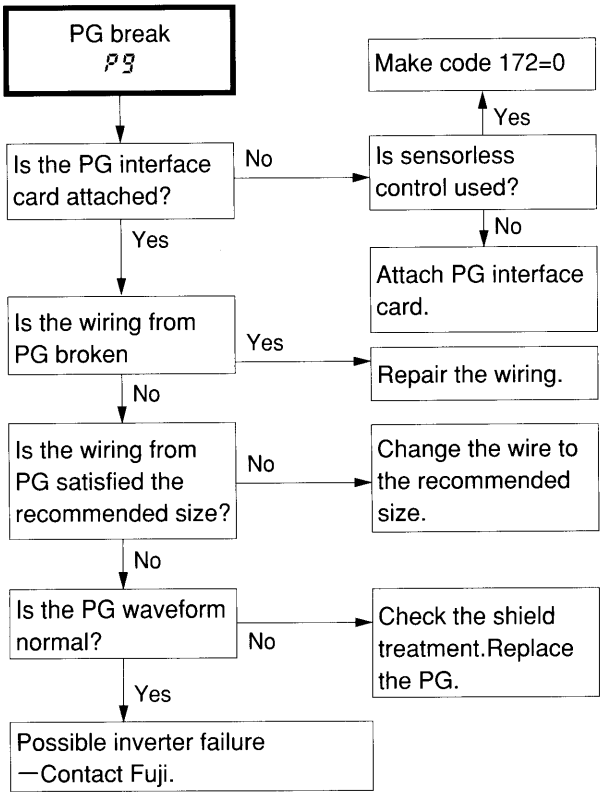
h) Motor overheating



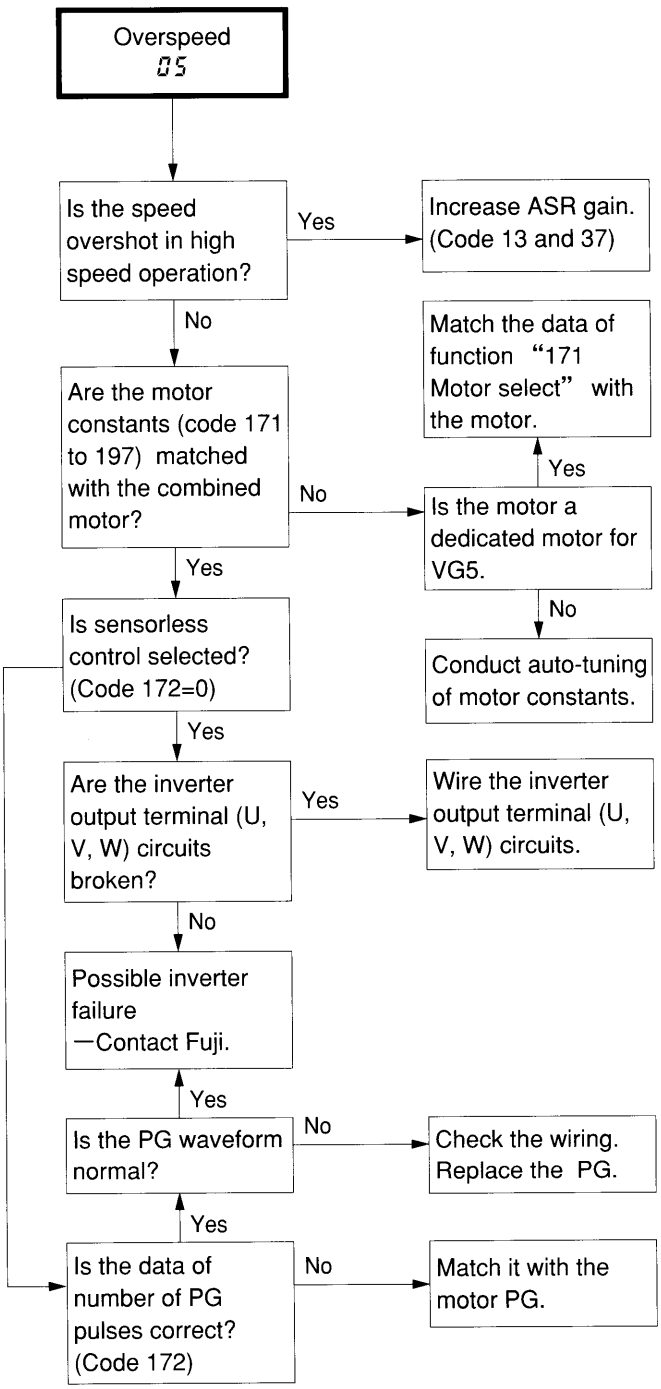
i) Motor overload and inverter overload



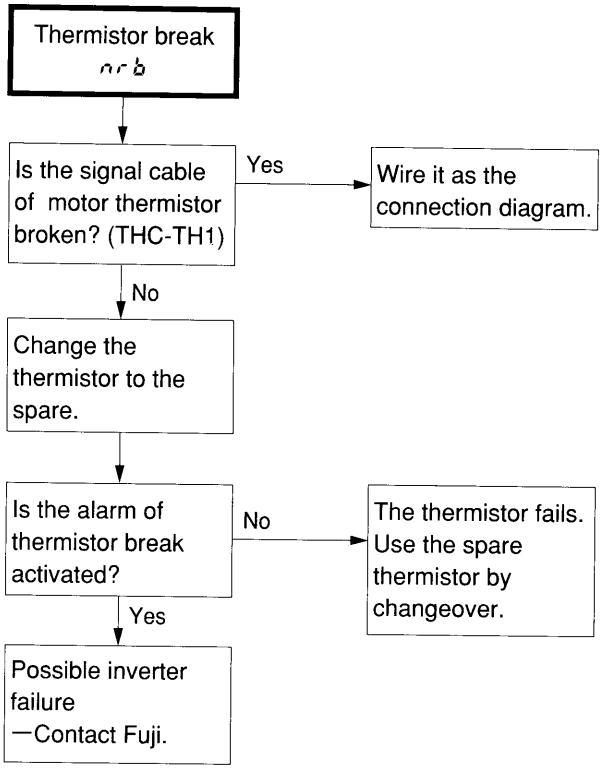
j) PG break



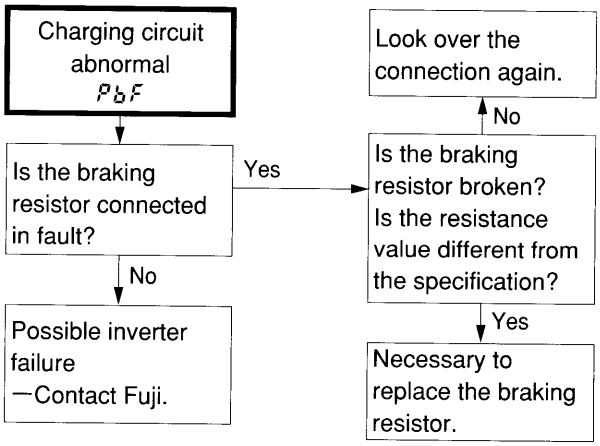
k) Overspeed



l) Thermistor break



m) Charging circuit abnormal

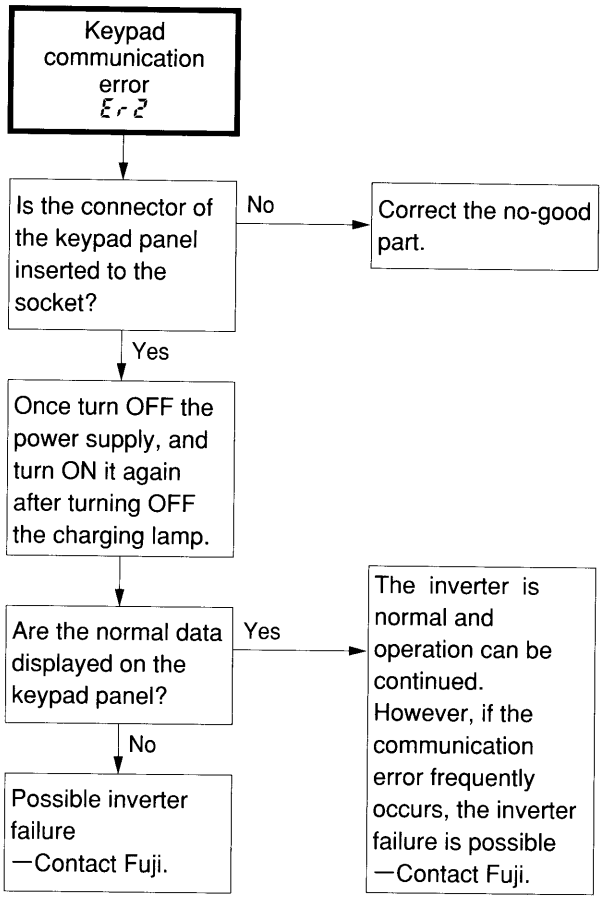


n) Memory error (Er 1)

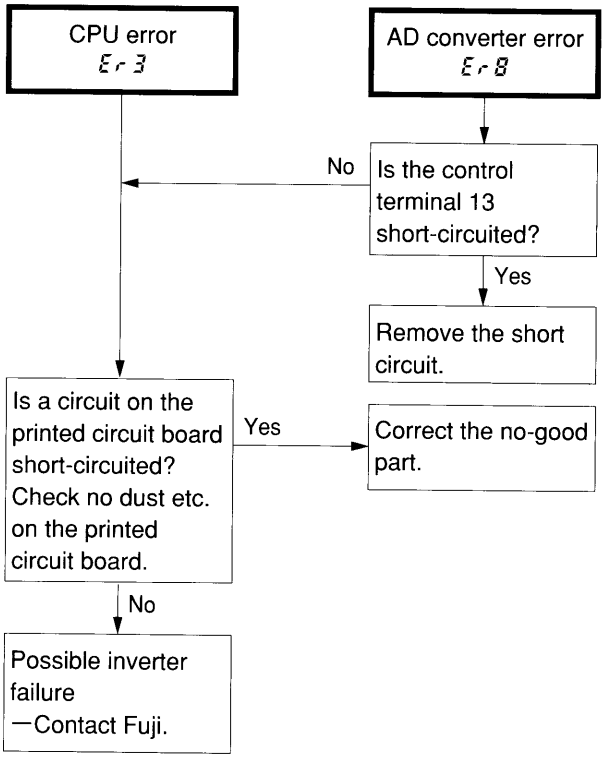
When memory error occurs, check the data of function before turning off the power supply. If the data are correct, only the backup memory is abnormal. Save the data with all save function again, and then, if the memory error does not occur, the inverter can be operated. Inspect visually the printed circuit board, and check that dust etc. are not attached.

If the function data is found to be abnormal or if the memory error frequently occurs, contact Fuji Co. since inverter failure is possible.

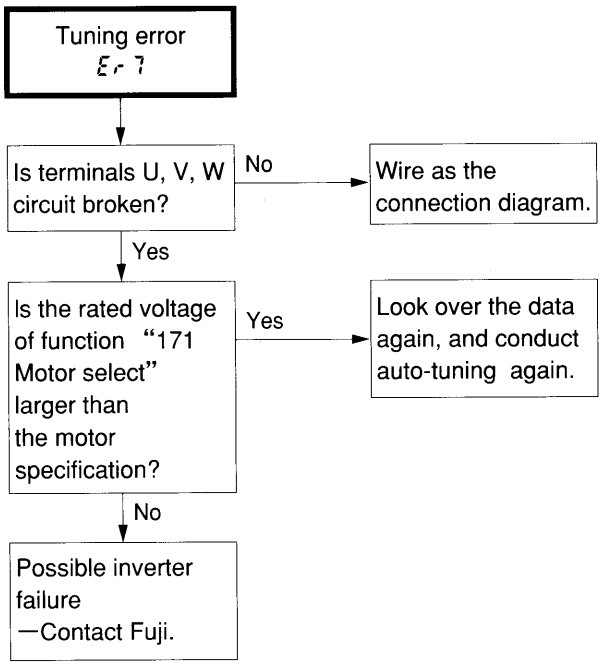
o) Keypad communication error



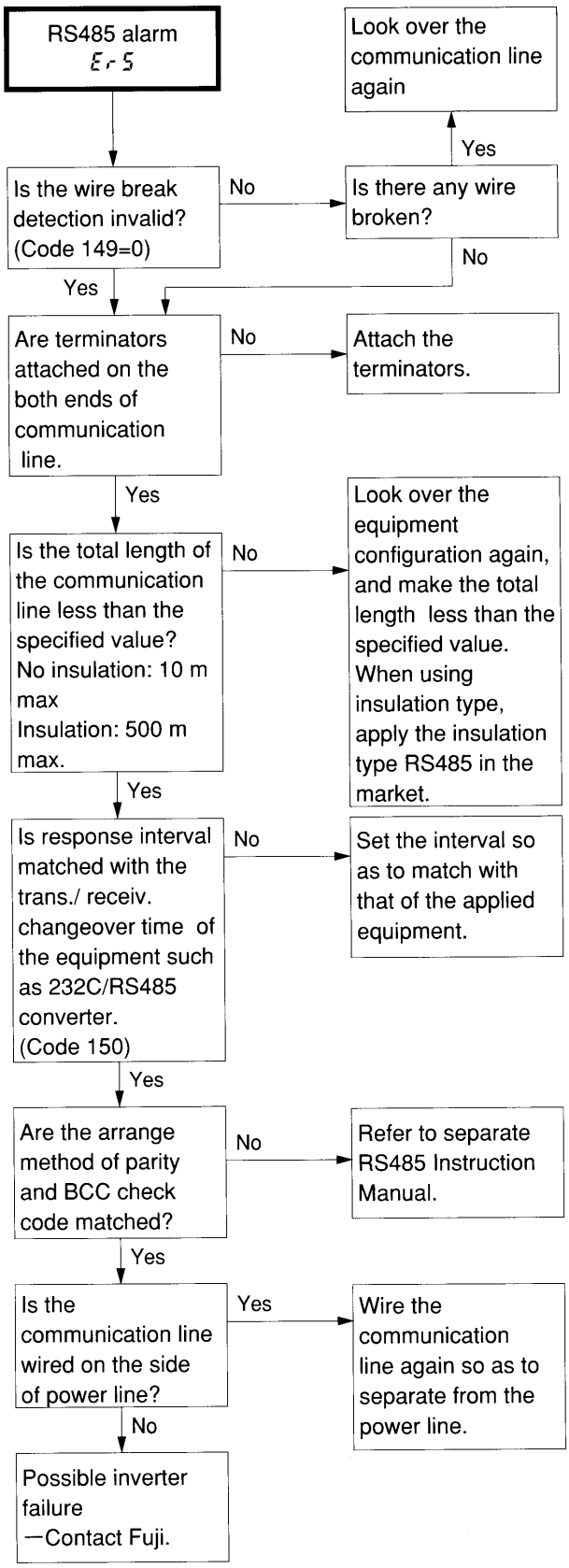
p) CPU error and AD converter error



q) Tuning error

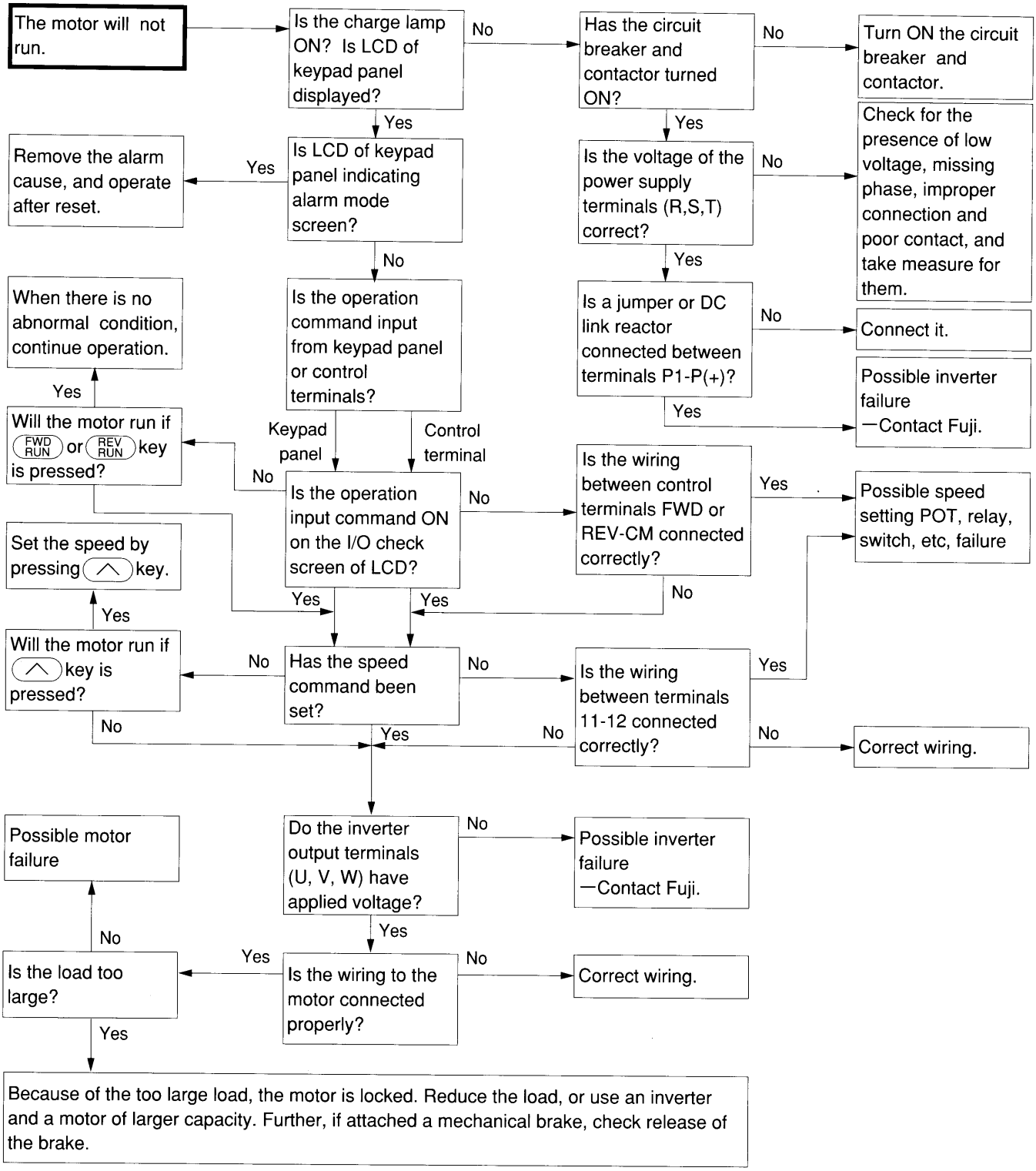


r) RS485 alarm



12-3 Diagnosis and remedy in case of motor abnormal

a) Motor will not run



NOTE: *Monitor the operation command or speed setting value on LED and LCD of keypad panel by selecting each function.*

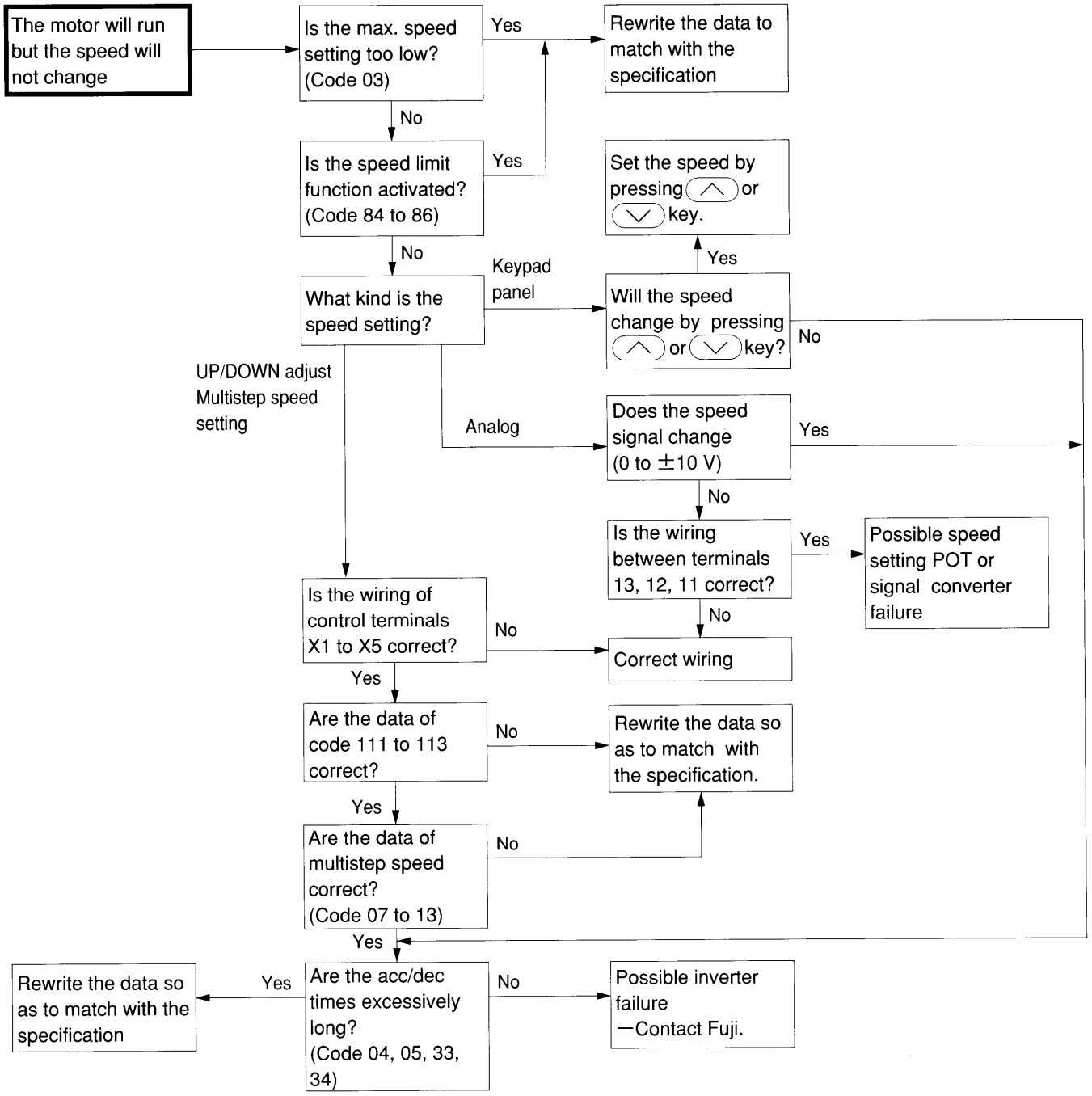
Motor will not start under these conditions:

— In the pre-excitation defined by function "27 Pre-excitation (Time)"

— When selecting coast-to-stop command with digital input of function "111 to 113 X1-X5 Function select" and making the relevant terminal input ON.

— When a limit of speed setting is active by function "84 to 86 Speed limiter"

b) Motor will run but speed will not change



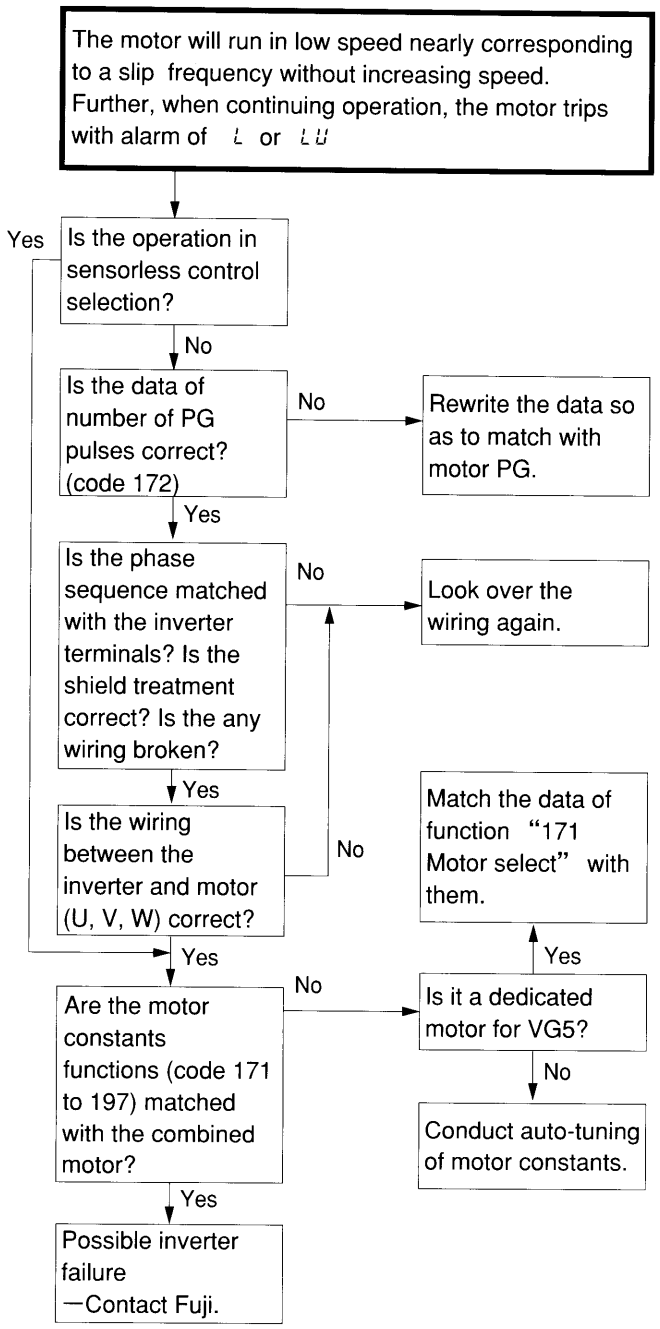
Motor speed change is very slow under these conditions:

— When mistaking the data setting of functions related to control such as function "123 Gain setting (12)".

— When selecting speed auxiliary setting of function selection analog input (terminals Ai1 and Ai2), and not changing the sum value of the signals from the control terminals 12, Ai1 and Ai2.

— When activating torque limit due to too large load.

c) Motor will run only in low speed



NOTE:

— *There is the case that the motor does not stop if the operation command is made OFF when above-mentioned phenomenon occurs.*
In this case,interrupt the power supply or make the coast-to-stop signal ON. Select the coast-to-stop signal with function selection input (function 111 to 113).

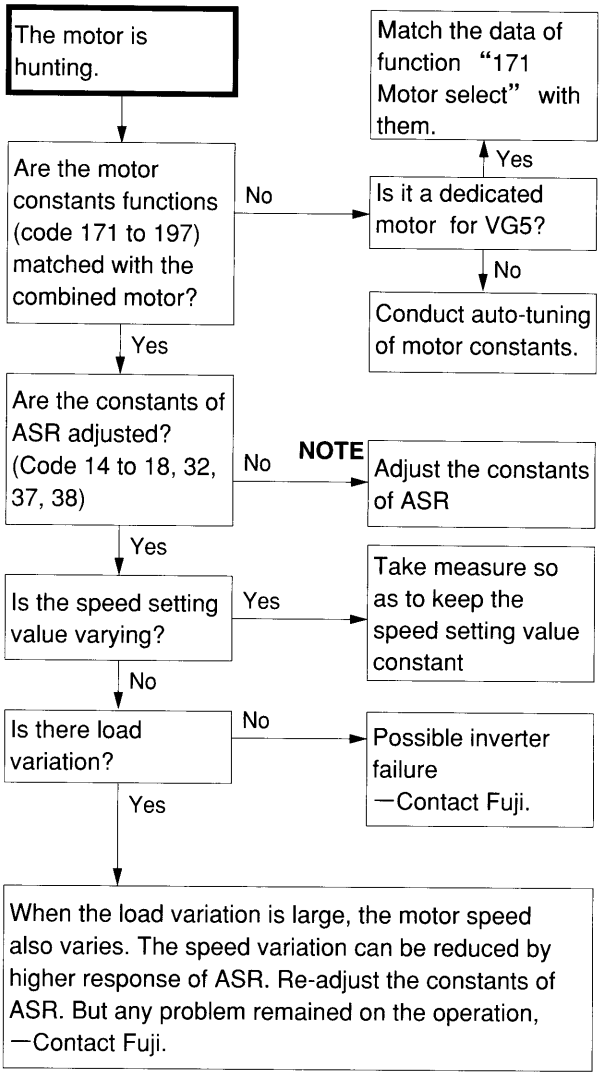
— *Encoder is abbreviated to PG*

d) Motor will run in reverse direction of the command

— When the phase sequence of the main circuit wiring between the inverter and motor (U, V, W) is faulty in the sensorless control.

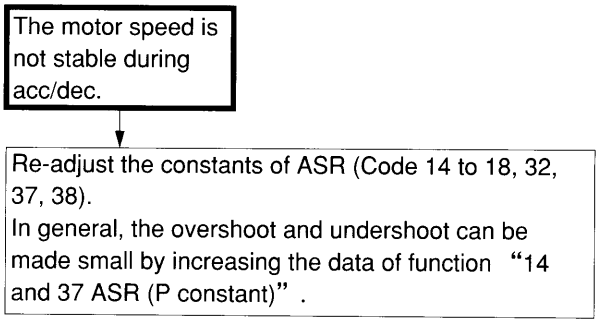
— When the data related to speed command is mistaken.

e) Motor will run with large speed variation (hunting)

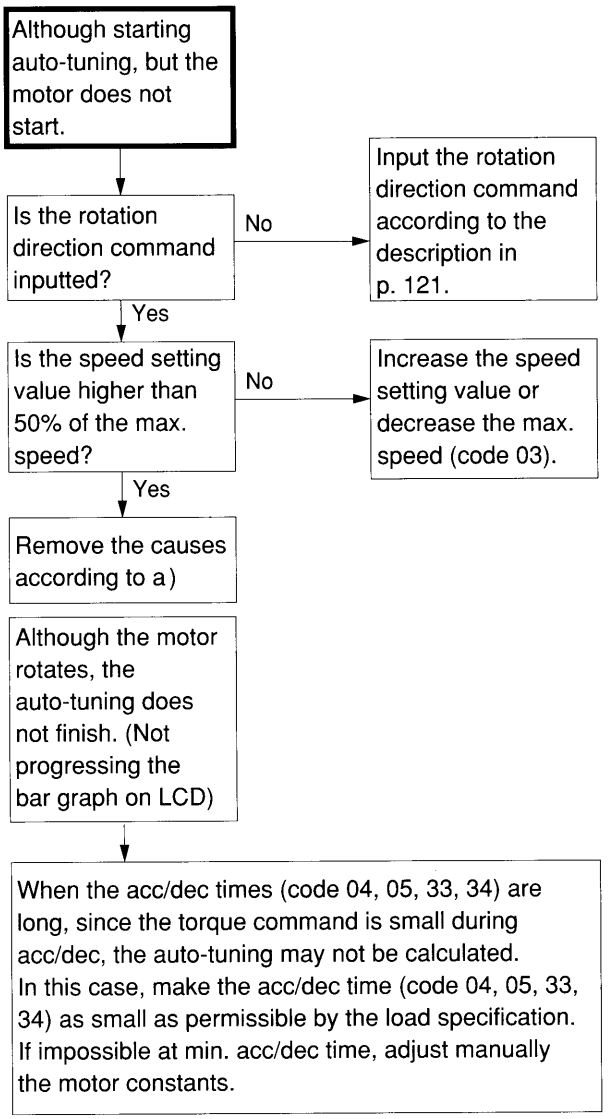


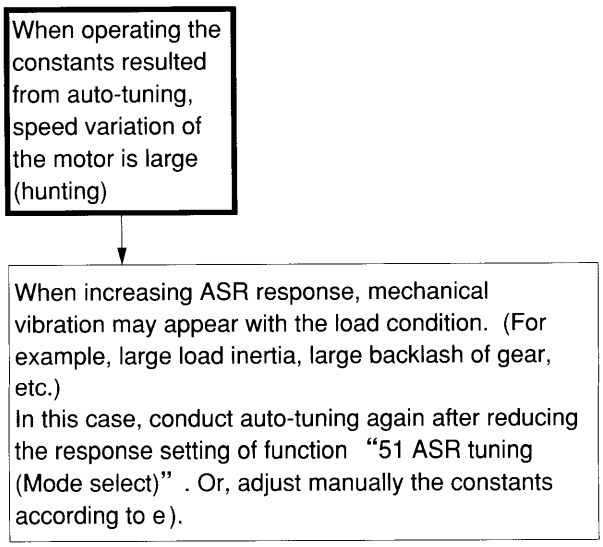
NOTE: *In general, the hunting is made small by reducing the data of function "14 and 37 ASR (P constant)" and increasing the data of function "15 and 38 ASR (I constant)"*

f) Motor speed is not stable during acceleration and deceleration (Overshoot and undershoot are large.)

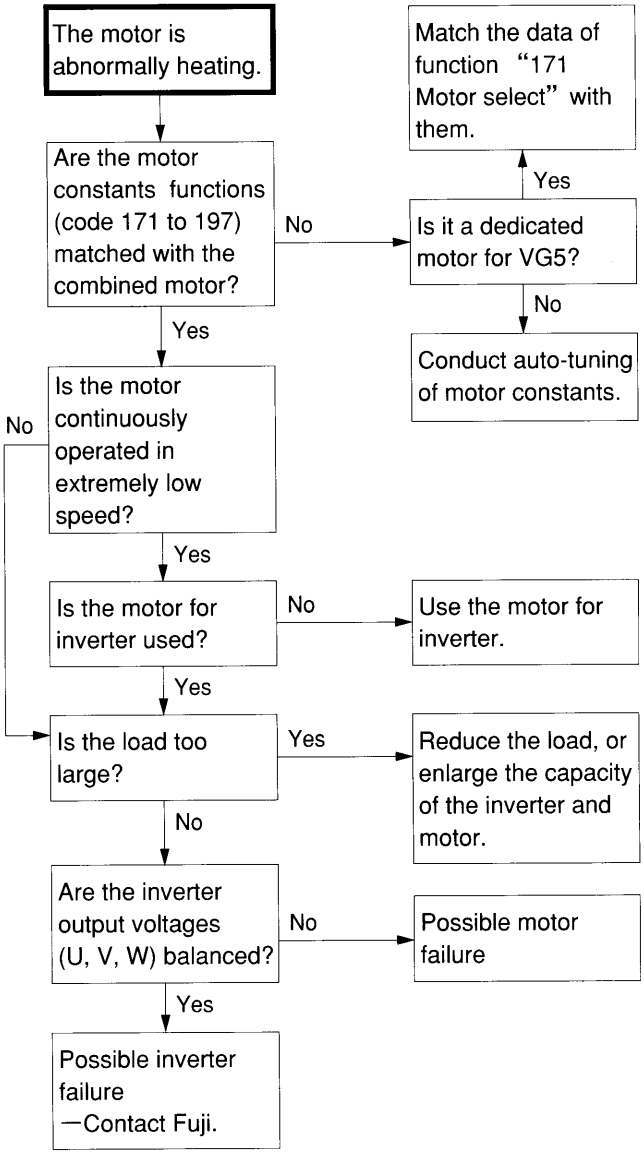


g) ASR (automatic speed regulator) auto-tuning



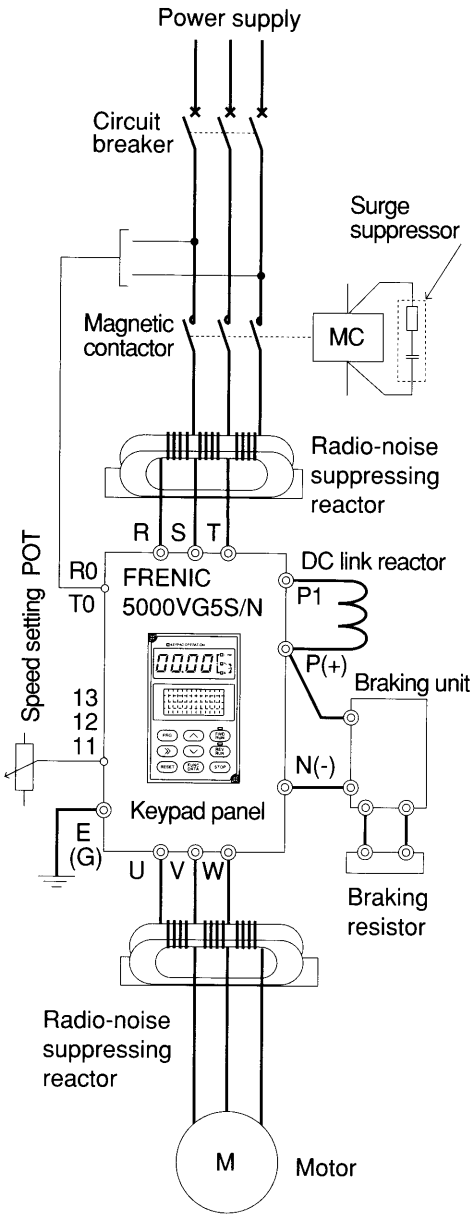


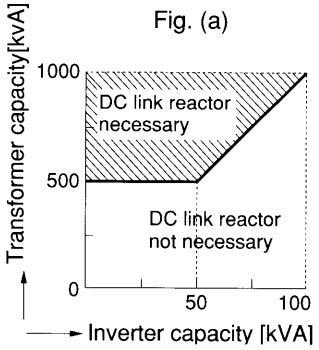
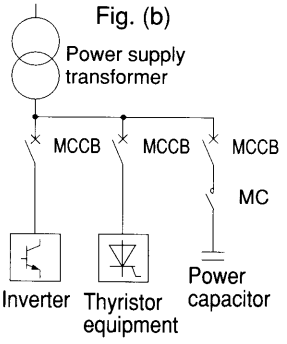
h) Others



13 Option

Fig. 13-1-1 Option



Circuit breaker	Circuit breaker (MCCB) is connected for protecting the main circuit up to the inverter and switching 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 the reactor 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. — 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 in parallel connected to the same power source. — 3-phase power supply voltage is unbalanced by 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. Fig. (a)  Fig. (b)  DC link reactor is included in the purchase of the inverter for standard applicable motors rated 75 kW and above (separate-supply unit).
Braking unit and braking resistor	Connected braking unit and braking resistor when large braking torque is needed.
Speed setting POT	Connect the setting POT for speed setting per control circuit terminal. Power is supplied from the inverter.
Keypad panel and extention cable	Extention cable is used when the keypad panel is used apart from the inverter.
Attachment for external cooling	The attachment is applied for the inverter with plastic cover when the inverter is used as external cooling type.

13-1 Braking unit and braking resistor

Table 13-1-1 Standard specifications of braking units and braking resistors

voltage	Motor rated output [kW]	Inverter type	Braking duty 5% ED						Braking duty 10% ED					
			Braking unit		Braking resistor				Braking unit		Braking resistor			
			Type	Qty.	Type	Qty.	Capacity [kW]	Resistance [Ω]	Type	Qty.	Type	Qty.	Capacity [kW]	Resistance [Ω]
200V series	0.75	FRN0.75VG5S/N-2	Built-in inverter	—	DB2.2V-21B	1	0.6	30	Built-in inverter	—	For the braking unit and the braking resistor in this range, please contact Fuji.			
	1.5	FRN1.5VG5S/N-2												
	2.2	FRN2.2VG5S/N-2												
	3.7	FRN3.7VG5S/N-2			DB3.7V-21B	1	1.2	24			DB3.7V-22B	1	1.8	24
	5.5	FRN5.5VG5S/N-2			DB5.5V-21B	1	1.2	16			DB5.5V-22B	1	2.4	16
	7.5	FRN7.5VG5S/N-2			DB7.5V-21B	1	1.8	12			DB7.5V-22B	1	3.6	12
	11	FRN11VG5S/N-2			DB11V-21B	1	2.4	8			DB11V-22B	1	4.8	8
	15	FRN15VG5S/N-2			DB15V-21B	1	3.6	6			DB15V-22B	1	7.2	6
	18.5	FRN18.5VG5S/N-2			DB18.5V-21B	1	3.6	4.5			DB18.5V-22B	1	7.2	4.5
	22	FRN22VG5S/N-2			DB22V-21B	1	4.8	4			DB22V-22B	1	9.6	4
	30	FRN30VG5S/N-2			DB30V-21B	1	6.0	2.5			For the braking unit and the braking resistor in this range, please contact Fuji.			
	37	FRN37VG5S/N-2			DB37V-21B	1	7.2	2.25						
	45	FRN45VG5S/N-2			DB45V-21B	1	9.6	2						
	55	FRN55VG5S-2			DB37-2B	2	4.8×2	3/2						
	75	FRN75VG5S-2	BU55-2B	2	DB45-2B	2	6×2	2.5/2						
	90	FRN90VG5S-2	BU55-2B	2	DB55-2B	2	7.2×2	2/2						
400V series	3.7	FRN3.7VG5S/N-4	Built-in inverter	—	DB3.7V-41B	1	0.8	96	Built-in inverter	—	DB3.7V-42B	1	1.8	96
	5.5	FRN5.5VG5S/N-4			DB5.5V-41B	1	1.2	64			DB5.5V-42B	1	2.4	64
	7.5	FRN7.5VG5S/N-4			DB7.5V-41B	1	1.8	48			DB7.5V-42B	1	3.6	48
	11	FRN11VG5S/N-4			DB11V-41B	1	2.4	32			DB11V-42B	1	4.8	32
	15	FRN15VG5S/N-4			DB15V-41B	1	3.6	24			DB15V-42B	1	7.2	24
	18.5	FRN18.5VG5S/N-4			DB18.5V-41B	1	3.6	18			DB18.5V-42B	1	7.2	18
	22	FRN22VG5S/N-4			DB22V-41B	1	4.8	16			DB22V-42B	1	9.6	16
	30	FRN30VG5S/N-4			DB30V-41B	1	6.0	10			For the braking unit and the braking resistor in this range, please contact Fuji.			
	37	FRN37VG5S/N-4			DB37V-41B	1	7.2	9						
	45	FRN45VG5S/N-4			DB45V-41B	1	9.6	8						
	55	FRN55VG5S-4			DB37-4B	2	4.8×2	12/2						
	75	FRN75VG5S-4			DB45-4B	2	6×2	10/2						
	90	FRN90VG5S-4	BU110-4B	1	DB55-4B	2	7.2×2	7.5/2						
	110	FRN110VG5S-4	BU132-4B	1	For the braking resistor in this range, please contact Fuji.									
	132	FRN132VG5S-4	BU110-4B	2										
	160	FRN160VG5S-4	BU110-4B	2										
	200	FRN200VG5S-4	BU132-4B	2										
	220	FRN220VG5S-4	BU132-4B	2										

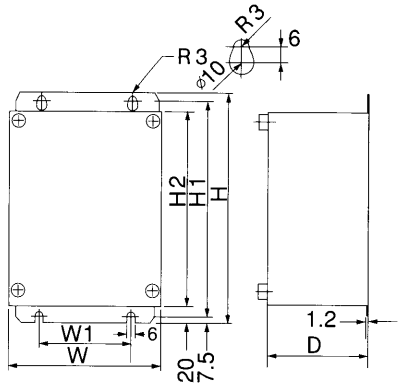
Table 13-1-2 Common specification of braking units and braking registors

Braking torque [%]	150
Braking duty [%ED]	5 (allowable duration : 5 s), 10(allowable duration :10 s)
Protective function	If the braking unit or resistor overheats, braking unit transistors are shut down and the inverter protective function is activated.
Ambient temperature	−10 to +50℃

Table 13-1-3 Braking unit and braking resistor conection

Motor rated output [kW]	Voltage: 200V series			Voltage: 400V series		
	Inverter type	Connection diagram Fig.6-6-1 (p.43)		Inverter type	Connection diagram Fig.6-6-1 (p.43)	
		Braking duty 5% ED	Braking duty 10% ED		Braking duty 5% ED	Braking duty 10% ED
0.75	FRN0.75VG5S/N-2	1)	——	——	——	——
1.5	FRN1.5VG5S/N-2					
2.2	FRN2.2VG5S/N-2					
3.7	FRN3.7VG5S/N-2		1)	FRN3.7VG5S/N-4	1)	1)
5.5	FRN5.5VG5S/N-2			FRN5.5VG5S/N-4		
7.5	FRN7.5VG5S/N-2			FRN7.5VG5S/N-4		
11	FRN11VG5S/N-2			FRN11VG5S/N-4		
15	FRN15VG5S/N-2			FRN15VG5S/N-4		
18.5	FRN18.5VG5S/N-2			FRN18.5VG5S/N-4		
22	FRN22VG5S/N-2			FRN22VG5S/N-4		
30	FRN30VG5S/N-2		——	FRN30VG5S/N-4		——
37	FRN37VG5S/N-2			FRN37VG5S/N-4		
45	FRN45VG5S/N-2			FRN45VG5S/N-4		
55	FRN55VG5S-2	2)		FRN55VG5S-4	2)	
75	FRN75VG5S-2	5)		FRN75VG5S-4		
90	FRN90VG5S-2			FRN90VG5S-4	4)	
110	——	——	——	FRN110VG5S-4	——	
132				FRN132VG5S-4		
160				FRN160VG5S-4		
200				FRN200VG5S-4		
220				FRN220VG5S-4		

Fig. 13-1-1 Braking unit



Terminal arrangement

Fig. A

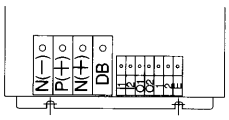
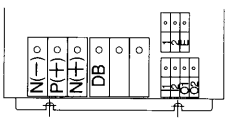
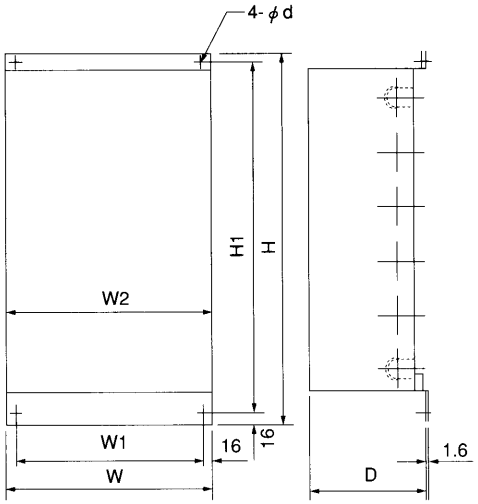


Fig. B



Voltage	Type	Dimensions[mm]						Terminal arrangement and screw size			Mass [kg]
		W	W1	H	H1	H2	D	Figure	P(+), N(−) DB	1,2,E (I1,I2,O1,O2)	
200V series	BU55-2B	230	130	240	225	200	170	A	M6	M4	7
400V series	BU110-4B	250	150	400	385	360	170	A	M6	M4	12
	BU132-4B							B	M8		

Fig. 13-1-2 Braking resistor



Terminal arrangement

Fig. A

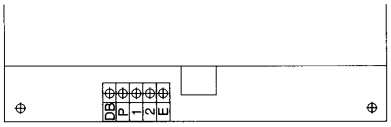
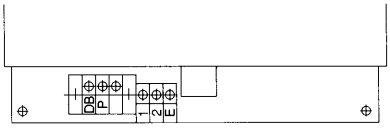


Fig. B



Duty	Type	Dimensions [mm]						Mounting hole dia.	Qty.	Terminal screw size		Mass [kg]
		W	W1	W2	H	H1	D			Main circuit	Control circuit	
200V series 5%ED	DB2.2-21B	330	298	330	242	210	140	φ8	1	M4	M4	4
	DB3.7V-21B	400	368	400	280	248						5
	DB5.5V-21B											
	DB7.5V-21B	400	368	400	480	448	140	φ10				6
	DB11V-21B											7
	DB15V-21B	400	368	400	660	628	140			M5		10
	DB18.5V-21B											
	DB22V-21B	400	368	400	660	628	240					13
	DB30V-21B									M6		18
	DB37V-21B	400	368	405	750	718	240					22
	DB45V-21B	400	368	405	750	718	340					26
	DB37-2B	400	368	400	660	628	240		2	M5		26(13×2)
	DB45-2B									M6		36(18×2)
	DB55-2B	400	368	405	750	718	240					44(22×2)
200V series 10%ED	DB3.7V-22B	400	368	400	480	448	140	φ10	1	M4	M4	7
	DB5.5V-22B											8
	DB7.5V-22B	400	368	400	660	628	140			M5		11
	DB11V-22B	400	368	400	660	628	240					15
	DB15V-22B	400	368	405	750	718	240			M6		25
	DB18.5V-22B											
	DB22V-22B	400	368	405	750	718	340					30
400V series 5%ED	DB3.7V-41B	420	388	420	280	248	140	φ8	1	M4	M4	5
	DB5.5V-41B	420	388	420	480	448	140	φ10				7
	DB7.5V-41B											
	DB11V-41B											8
	DB15V-41B	420	388	420	660	628	140					11
	DB18.5V-41B											
	DB22V-41B	420	388	420	660	628	240					14
	DB30V-41B									M5		19
	DB37V-41B	420	388	425	750	718	240					21
	DB45V-41B	420	388	425	750	718	340					26
	DB37-4B	420	388	420	660	628	240		2	M4		28(14×2)
	DB45-4B									M5		38(19×2)
	DB55-4B	420	388	425	750	718	240					42(21×2)
400V series 10%ED	DB3.7V-42B	420	388	420	480	448	140	φ10	1	M4	M4	8
	DB5.5V-42B	420	388	420	660	628	140					11
	DB7.5V-42B											
	DB11V-42B	420	388	420	660	628	240					15
	DB15V-42B	420	388	425	750	718	240			M5		25
	DB18.5V-42B											
	DB22V-42B	420	388	425	750	718	340					30

13-2 Reactor

a) DC link reactor

Fig. A

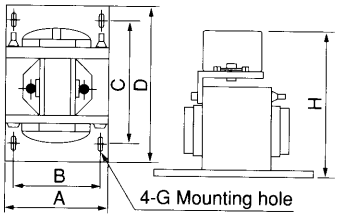


Fig. B

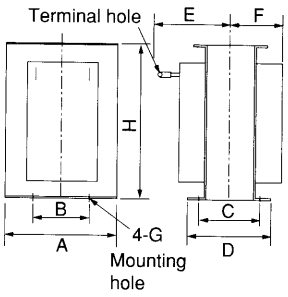


Fig. C

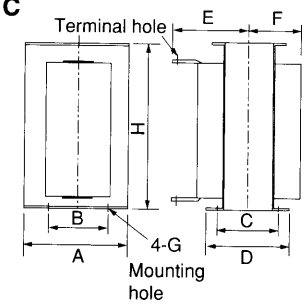


Fig. D

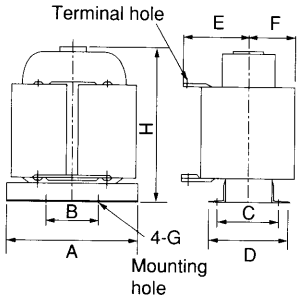
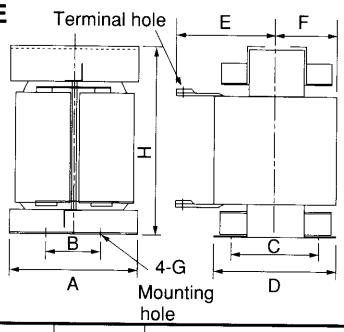


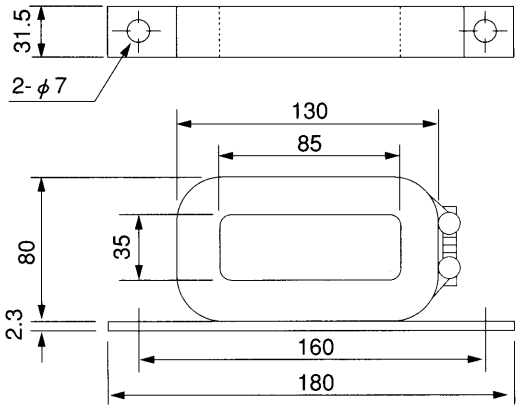
Fig. E

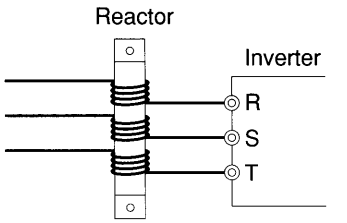


Voltage	Motor rated output [kW]	Inverter type	Reactor type	Figure	Dimensions [mm]									Mass [kg]
					A	B	C	D	E	F	G	H	Mounting hole dia.	
200V series	0.75	FRN0.75VG5S/N-2	DCR2-0.75	A	66	56	72	90	—	—	5.2×8	94	M4	1.4
	1.5	FRN1.5VG5S/N-2	DCR2-1.5	A	66	56	72	90	—	—	5.2×8	94	M4	1.6
	2.2	FRN2.2VG5S/N-2	DCR2-2.2	A	86	71	80	100	—	—	6×9	110	M4	1.8
	3.7	FRN3.7VG5S/N-2	DCR2-3.7	A	86	71	80	100	—	—	6×9	110	M4	2.6
	5.5	FRN5.5VG5S/N-2	DCR2-5.5	A	111	95	80	100	—	—	7×11	130	M5	3.6
	7.5	FRN7.5VG5S/N-2	DCR2-7.5	A	111	95	80	100	—	—	7×11	130	M5	3.8
	11	FRN11VG5S/N-2	DCR2-11	A	111	95	80	100	—	—	7×11	137	M6	4.3
	15	FRN15VG5S/N-2	DCR2-15	A	146	124	96	120	—	—	7×11	171	M6	5.9
	18.5	FRN18.5VG5S/N-2	DCR2-18.5	A	146	124	96	120	—	—	7×11	180	M8	7.4
	22	FRN22VG5S/N-2	DCR2-22	B	155	75	90	116	105	70	9×15	210	10.5	14
	30	FRN30VG5S/N-2	DCR2-30	B	146	75	100	126	130	70	9×15	210	10.5	16
	37	FRN37VG5S/N-2	DCR2-37	C	156	80	100	126	110	70	9×15	260	10	19
	45	FRN45VG5S/N-2	DCR2-45	C	156	80	110	136	130	75	9×15	260	10	23
	55	FRN55VG5S-2	DCR2-55	C	170	85	110	136	130	75	9×15	300	10	28
	75	FRN75VG5S-2	DCR2-75	D	200	80	95	126	180	75	10×16	240	12	19
	90	FRN90VG5S-2	DCR2-90	E	180	100	100	131	150	75	10×15	275	15	22
400V series	3.7	FRN3.7VG5S/N-4	DCR4-3.7	A	86	71	80	100	—	—	6×9	110	M4	2.6
	5.5	FRN5.5VG5S/N-4	DCR4-5.5	A	86	71	80	100	—	—	6×9	110	M4	2.6
	7.5	FRN7.5VG5S/N-4	DCR4-7.5	A	111	95	80	100	—	—	7×11	130	M5	4.2
	11	FRN11VG5S/N-4	DCR4-11	A	111	95	80	100	—	—	7×11	130	M5	4.3
	15	FRN15VG5S/N-4	DCR4-15	A	146	124	96	120	—	—	7×11	171	M5	5.9
	18.5	FRN18.5VG5S/N-4	DCR4-18.5	A	146	124	96	120	—	—	7×11	171	M6	7.2
	22	FRN22VG5S/N-4	DCR4-22	B	155	112	105	126	150	70	7×11	130	6.4	12
	30	FRN30VG5S/N-4	DCR4-30	B	150	75	85	111	155	70	9×15	210	8.4	14
	37	FRN37VG5S/N-4	DCR4-37	B	146	75	100	126	155	70	9×15	210	8.4	17
	45	FRN45VG5S/N-4	DCR4-45	B	146	75	115	141	180	75	9×15	210	10.5	21
	55	FRN55VG5S-4	DCR4-55	B	146	75	130	156	190	85	9×15	210	10.5	25
	75	FRN75VG5S-4	DCR4-75	E	200	70	120	151	160	80	10×16	250	10.5	25
	90	FRN90VG5S-4	DCR4-90	E	220	70	140	171	165	85	10×16	280	13	32
	110	FRN110VG5S-4	DCR4-110	E	220	70	150	181	170	95	10×16	290	13	36
	132	FRN132VG5S-4	DCR4-132	E	190	80	146	177	180	90	11	360	13	40
	160	FRN160VG5S-4	DCR4-160	E	220	90	140	177	200	90	12×20	350	12	45
	200	FRN200VG5S-4	DCR4-200	E	230	100	140	181	180	110	12×20	310	15	50
	220	FRN220VG5S-4	DCR4-220	E	230	100	150	201	180	110	12×20	320	15	50

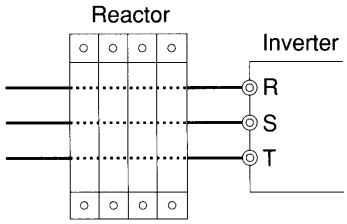
b) Radio-noise suppressing reactor

Type : ACL-10A Mass 1.7kg Unit [mm]





Coil 4 turns or more in the same direction for each phase.

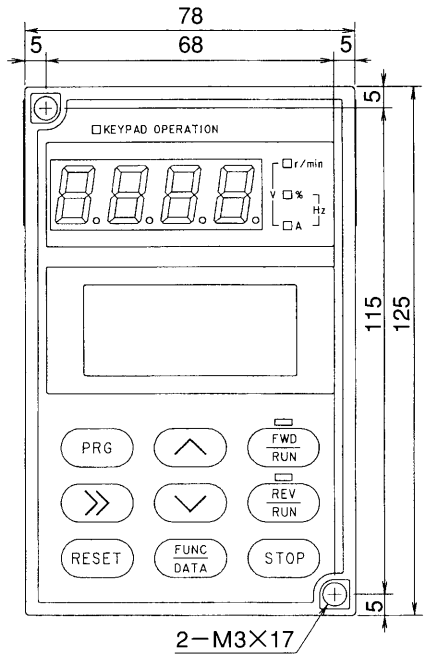


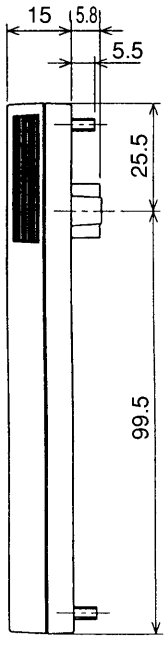
If the wires are too thick to coil, the wires through the 4 reactors stuck

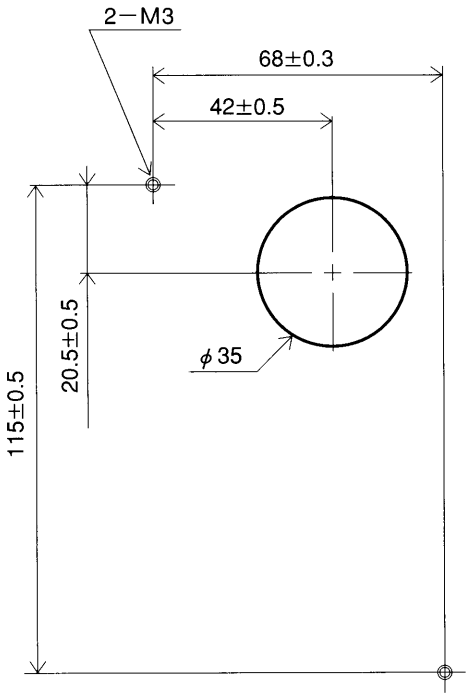
13-3 Auxiliary parts

Fig. 13-3-1 Keypad panel

Type : TP-VG5







〈Panel cutting〉

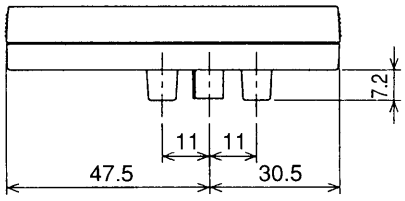
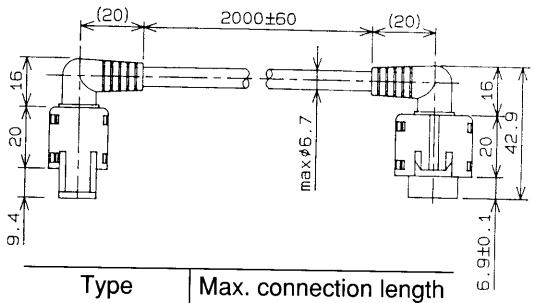
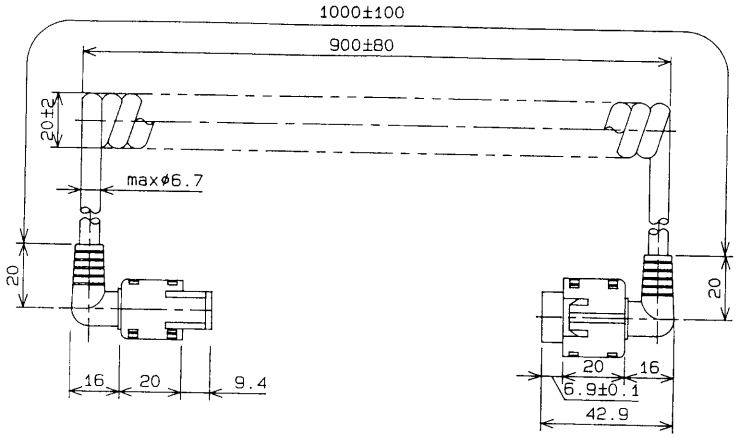


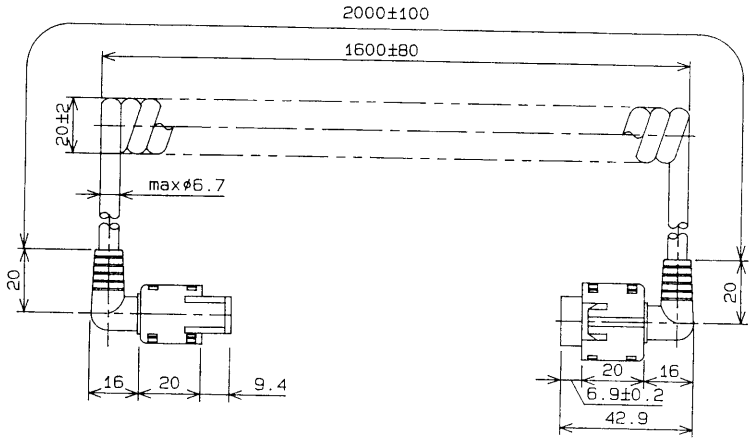
Fig. 13-3-2 Extention cable for keypad panel



Type	Max. connection length
GBIII-10R-2S	2m



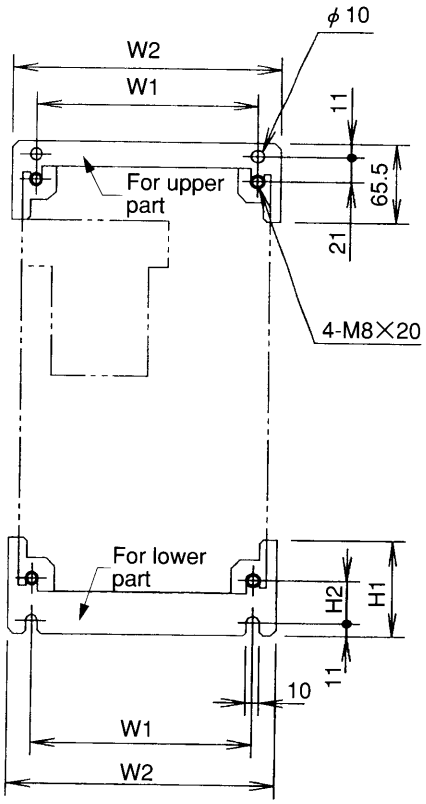
Type	Max. connection length
GBIII-10R-1S	5m



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

Type	Max. connection length
GBIII-10R-2C	10m

Fig. 13-3-3 Attachement for external cooling



○ : Attachment mounting hole
◎ : VG5 mounting hole
⬚ : Inverter exterior view

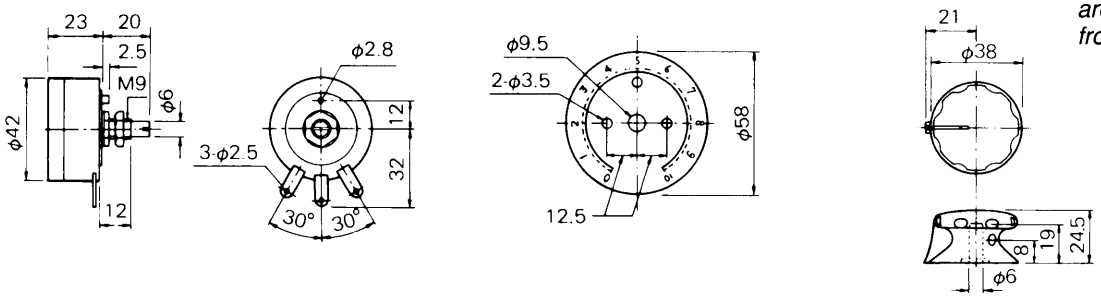
Type	Inverter Type	W1	W2	H1	H2	Thick plate
PBVG5-7.5	FRN0.75～7.5VG5S-2 FRN3.7～7.5VG5S-4 FRN0.75～5.5VG5N-2 FRN3.7～5.5VG5N-4	183	222	79.5	35	2
PBVG5-15	FRN11VG5S-2 FRN11～15VG5S-4 FRN7.5VG5N-2 FRN7.5～11VG5N-4	233	272	79.5	35	2
PBVG5-22	FRN15～22VG5S-2 FRN18.5～22VG5S-4 FRN11～18.5VG5N-2 FRN15～18.5VG5N-4	298	337	65.5	21	2

Fig. 13-3-4 Speed setting POT

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

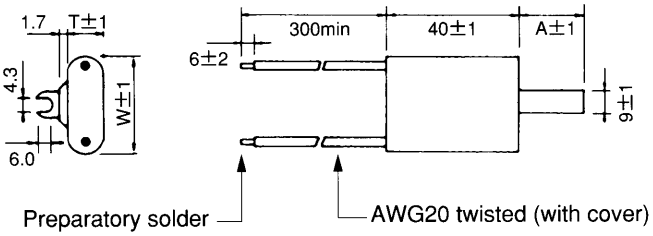
Scale plate Type: 60P

Knob Type : 40N



NOTE : *Scale plate and knob are sold separately from POT itself.*

Fig. 13-3-5 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

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

Voltage	Motor rated output [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			Standard motor rated current	Braking cicuit current
			Input current (Total r.m.s. value)		DC link reactor cicuit current	Input current (Total r.m.s. value)		DC link reactor cicuit current		
			With DCR	Without DCR		With DCR	Without DCR			
200V series	0.75	FRN0.75VG5S/N-2	3.3	5.7	3.9	2.9	5.1	3.5	4.8	3.1
	1.5	FRN1.5VG5S/N-2	6.1	10.7	7.4	5.6	9.8	6.7	7.0	6.2
	2.2	FRN2.2VG5S/N-2	8.7	15.2	10.4	8.0	13.9	9.5	11.0	9.0
	3.7	FRN3.7VG5S/N-2	14.3	24.9	17.1	13.0	22.7	15.6	18.0	15.2
	5.5	FRN5.5VG5S/N-2	20.7	36.1	24.8	18.8	32.8	22.5	27.0	22.6
	7.5	FRN7.5VG5S/N-2	27.9	49.0	34.0	25.3	44.2	30.3	37.0	30.8
	11	FRN11VG5S/N-2	42	73	51	39	68	47	49.3	45.2
	15	FRN15VG5S/N-2	56	98	67	52	90	62	63.5	61.6
	18.5	FRN18.5VG5S/N-2	68	118	81	63	109	75	75	76.0
	22	FRN22VG5S/N-2	82	143	98	74	130	89	90	90.4
	30	FRN30VG5S/N-2	110	191	131	100	174	120	116	123
	37	FRN37VG5S/N-2	134	234	161	122	214	147	143	152
	45	FRN45VG5S/N-2	162	283	194	148	259	178	170	185
	55	FRN55VG5S-2	197	345	237	180	315	216	216	226
	75	FRN75VG5S-2	268	——	321	244	——	293	291	308
	90	FRN90VG5S-2	320	——	384	292	——	349	328	370
400V series	3.7	FRN3.7VG5S/N-4	7.2	12.6	8.6	6.6	11.5	7.9	9.0	7.6
	5.5	FRN5.5VG5S/N-4	10.4	18.2	12.5	9.5	16.5	11.3	13.5	11.3
	7.5	FRN7.5VG5S/N-4	14.0	24.4	16.7	12.7	22.1	15.2	18.5	15.4
	11	FRN11VG5S/N-4	20.8	36.3	24.9	18.9	33.0	22.6	27.0	22.6
	15	FRN15VG5S/N-4	27.8	48.5	33.3	25.2	44.0	30.2	33.0	30.8
	18.5	FRN18.5VG5S/N-4	33.8	59.0	40.5	30.6	53.5	36.7	37.5	38.0
	22	FRN22VG5S/N-4	41	72	49	38	66	45	45.0	45.2
	30	FRN30VG5S/N-4	55	96	66	51	88	61	58.0	61.6
	37	FRN37VG5S/N-4	67	117	81	61	107	74	71.5	76.0
	45	FRN45VG5S/N-4	81	142	97	74	130	89	85	92.5
	55	FRN55VG5S-4	99	173	119	90	158	108	108	113
	75	FRN75VG5S-4	134	——	161	122	——	147	145	154
	90	FRN90VG5S-4	160	——	192	146	——	175	165	185
	110	FRN110VG5S-4	193	——	231	176	——	211	197	——
	132	FRN132VG5S-4	231	——	276	210	——	252	240	——
	160	FRN160VG5S-4	278	——	333	253	——	303	284	——
	200	FRN200VG5S-4	345	——	414	314	——	376	354	——
	220	FRN220VG5S-4	379	——	455	345	——	414	399	——

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) Data are those for dedicated motor.
3) Braking cicuit current corresponds to 150% braking torque.

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

Unit[A]

Wire size [mm²]	Ambient temperature		
	30℃	40℃	50℃
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℃*

— *Single wiring in air is assumed.*

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

Unit[A]

Wire size [mm²]	Ambient temperature		
	30℃	40℃	50℃
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℃*

— *Single wiring in air is assumed.*

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

Voltage	Standard series type	Low noise series type	Maximum wire size [mm²]	Terminal screw dia. [mm]
200V series	FRN0.75VG5S-2 FRN1.5VG5S-2 FRN2.2VG5S-2 FRN3.7VG5S-2 FRN5.5VG5S-2 FRN7.5VG5S-2	FRN0.75VG5N-2 FRN1.5VG5N-2 FRN2.2VG5N-2 FRN3.7VG5N-2 FRN5.5VG5N-2	14	M5
	FRN11VG5S-2	FRN7.5VG5N-2	22	M6
	FRN15VG5S-2 FRN18.5VG5S-2 FRN22VG5S-2 FRN30VG5S-2 FRN37VG5S-2	FRN11VG5N-2 FRN15VG5N-2 FRN18.5VG5N-2 FRN22VG5N-2 FRN30VG5N-2	60	M8
	FRN45VG5S-2 FRN55VG5S-2 FRN75VG5S-2	FRN37VG5N-2 FRN45VG5N-2	100 *	M10
	FRN90VG5S-2		325	M12
400V series	FRN3.7VG5S-4 FRN5.5VG5S-4 FRN7.5VG5S-4	FRN3.7VG5N-4 FRN5.5VG5N-4	14	M5
	FRN11VG5S-4 FRN15VG5S-4	FRN7.5VG5N-4 FRN11VG5N-4	22	M6
	FRN18.5VG5S-4 FRN22VG5S-4 FRN30VG5S-4 FRN37VG5S-4 FRN45VG5S-4 FRN55VG5S-4	FRN15VG5N-4 FRN18.5VG5N-4 FRN22VG5N-4 FRN30VG5N-4 FRN37VG5N-4 FRN45VG5N-4	60	M8
	FRN75VG5S-4 FRN90VG5S-4 FRN110VG5S-4 FRN132VG5S-4		100 *	M10
	FRN160VG5S-4		200	M12
	FRN200VG5S-4 FRN220VG5S-4		325	

NOTE :

— *Maximum wire is based on JIS C 2805 "Crimp-type terminal lugs for copper conductors".*

* *For terminals P1, P(+), N(-), CB150-10 specified by JEM1399 "Crimp type terminal for low voltage switching device" allows use of 150mm² wire.*

NOTES

NOTES

Fuji Electric Co.,Ltd.

ED&C and Drive Systems Group

12-1, Yurakucho 1-chome, Chiyoda-ku, Tokyo 100-8410 Japan
ED&C: Phone 3-3211-1424 Fax 3-3211-7983
Drive Systems: Phone 3-3211-1425 Fax 3-3211-7982
Telex: J22331 FUJIELEA or FUJIELEB

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