FREQROL

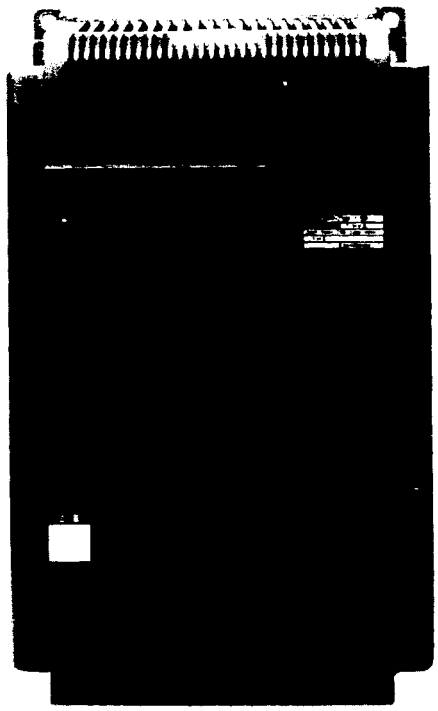
MITSUBISHI
VVVF TRANSISTOR INVERTER

FREQROL-Z300-ER

— INSTRUCTION MANUAL —

MITSUBISHI ELECTRIC

Thank you for choosing the Mitsubishi "FREQROL−Z300" high-function, low acoustic noise inverter.
This manual gives full information on installation, wiring, parameter unit operation procedures, maintenance and inspection.
Please read this manual carefully to use the equipment to its optimum.



CONTENTS

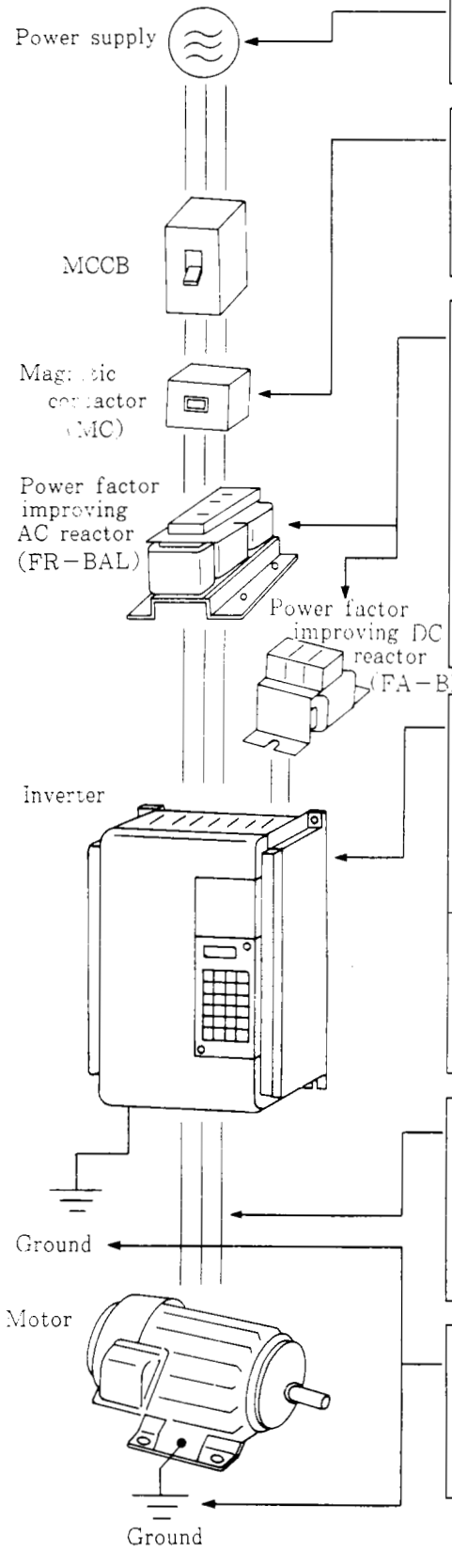
PRECAUTIONS FOR HANDLING THE INVERTER

INVERTER (With the exception of the parameter unit handling)

PARAMETER UNIT

PRECAUTIONS FOR HANDLING THE INVERTER

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



Handling points	Refer To:
Power supply specifications Use the power supply within the allowed power supply specifications of the inverter.	P23
Using the magnetic contactor The magnetic contactor need not be provided. When installed, do not use it to start or stop the inverter. Otherwise the inverter may be damaged.	P 5
Installing the reactors The reactor (option) must be used when the power factor is to be improved or the inverter is installed directly under a large power capacity (1000KVA or more and wiring distance within 4ft) . • Power factor improving ··· FR-Z340-7.5K to 22K DC reactor (FR−BEL) • Power factor improving ··· FR-Z340-2.2K, 4.0K AC reactor (FA−BAL)	P 6
Place of installation The inverter's life span is influenced by ambient temperature. Use the inverter with the ambient temperature as low as possible within the specifications. This must be noted especially when the inverter is installed in a cabinet enclosure.	P 4
Wiring Wrong wiring will lead to inverter damage. The control signal lines must be kept sufficiently away from the main circuit to avoid noise interference.	P4～7
Equipment connected on the output side Do not connect the power capacitor, surge suppressor, and radio noise filter (FR−BIF option) to protect the equipment from damage and the inverter from fault.	
Ground The Z300 series inverters are larger in leakage current than the other series. To prevent accidental electric shock, the motor and inverter must be grounded(earthed).	

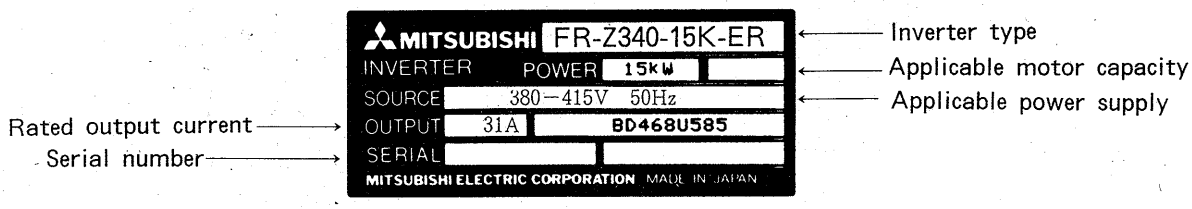
1. ACCEPTANCE INSPECTION

Unpack the unit and check the following :

(1) Check the rating label on the inverter front cover and ensure that the type and output rating conform to your order.

(2) Make sure that the inverter has not been damaged during transportation.

If you have found any discrepancy, damage, etc., please contact your local supplier. Notify the carrier immediately.



Rating Label

Definition of the type code

FR- Z340 - 2.2 K-ER

Symbol	Applicable Motor Capacity
2.2 to 22	Capacity in "KW"

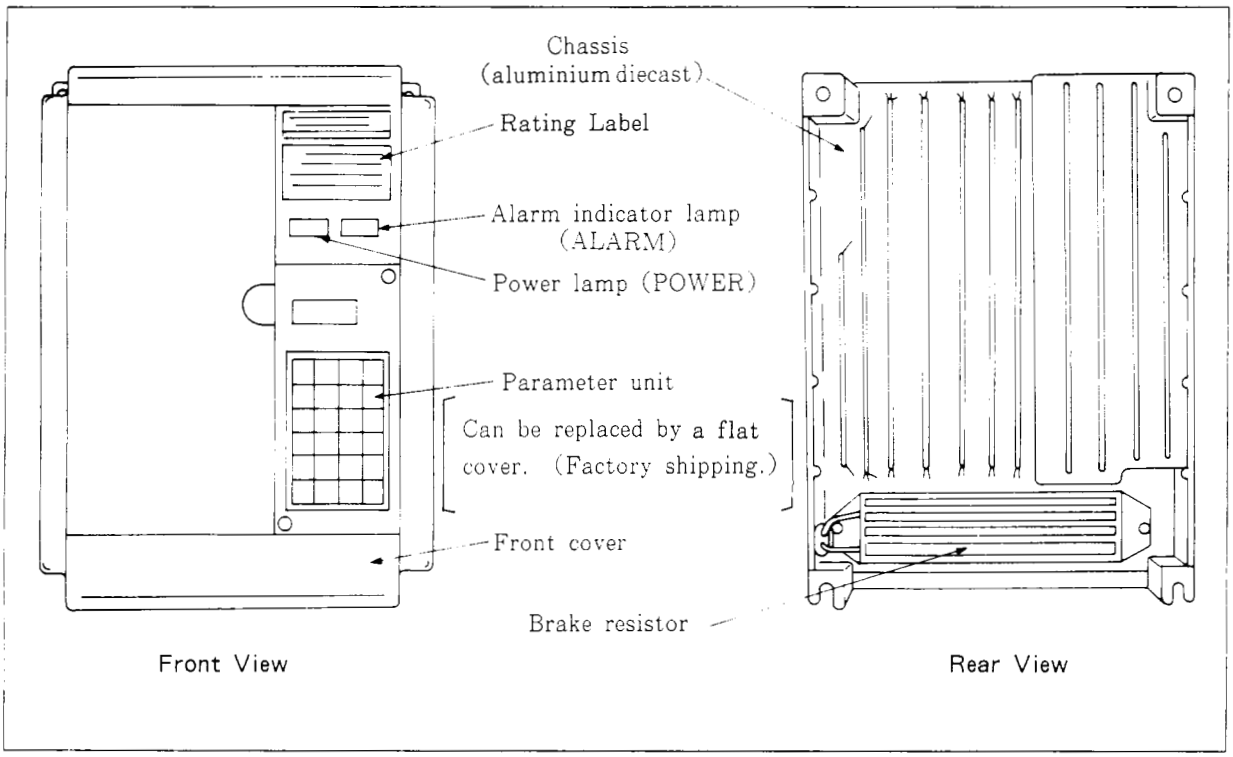
FR- PU 01 E

Parameter Unit	
Marque	
Language	
E	English
	Japanese

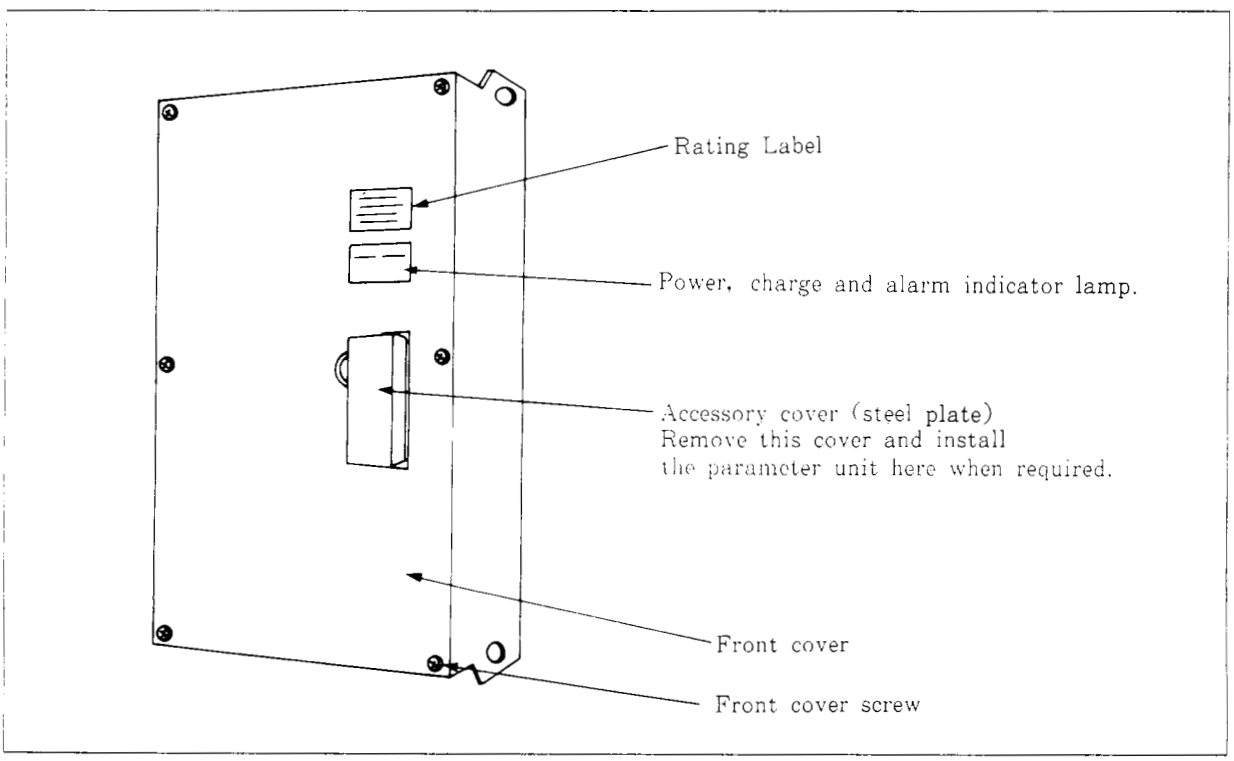
2. STRUCTURE

2.1 Structure and outlook

● FR−Z_{340}−2.2 to 7.5K



● FR−Z_{340}−11K, 15K, 22K



2.2 Removal and Reinstallation of the Front Cover

To remove the front cover, hold down the white button on top of the front cover and pull the cover toward you. (See Fig. 1.)
To reinstall the front cover, insert the catches at the bottom of the cover into the sockets and press the cover against the chassis. (See Fig. 2.)
When the inverter is not equipped with the parameter unit, an accessory cover can be installed on the front cover. To remove the accessory cover, hold down the center of the side face and pull the accessory cover toward you. (See Fig. 3.)

Fig. 1 Removing the Front Cover

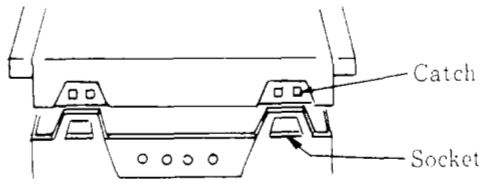


Fig. 2 Reinstalling the Front Cover

Fig. 3 Removing the Accessory Cover

Note : (1) Carefully check that the front cover has been reinstalled securely.
(2) Since the front cover bears the rating plate, the cover removed must be reinstalled to the inverter from which it has been removed. (Check the name plate of the front cover against the one on the right-hand side edge.)
(3) When the parameter unit has been removed, reinstall it in accordance with the procedure in Section 2.3 after reinstalling the front cover.

2.3 Removal and Reinstallation of the Parameter Unit

To remove the parameter unit, loosen the installation screws (2 places) and pull the unit toward you as shown in Fig. 4.
To reinstall the parameter unit, insert the unit so that the connector of the unit fits into that of the inverter as shown in Fig. 4.
After securely fitting the parameter unit onto the inverter, fix the unit with the installation screws.

Note : The parameter unit must not be installed with the front cover removed from the inverter.

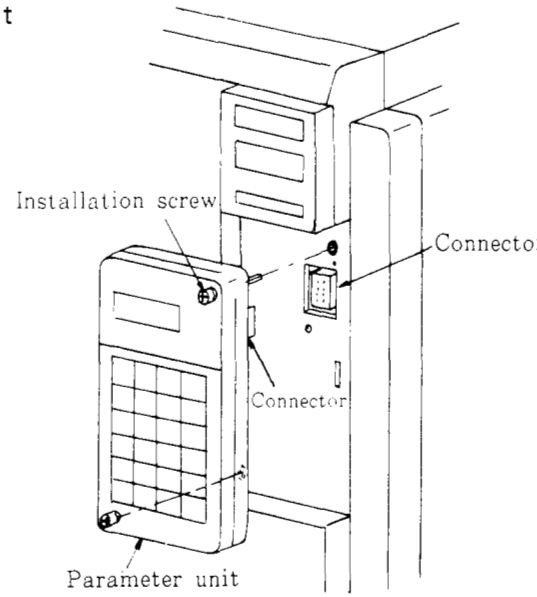


Fig. 4 Installing the parameter unit

3. INSTALLATION

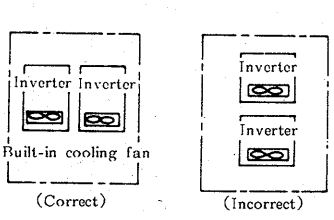
3.1 Transportation

During transportation, carefully handle the inverter to protect it from damage. When holding the inverter, avoid applying force to the front cover only.

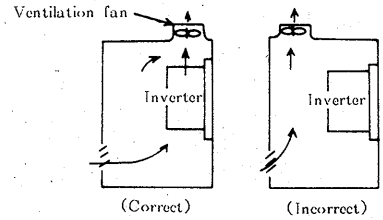
3.2 Place of Installation

(1) Do not install the inverter where it is subjected to direct rays of the sun, high temperature, high humidity, oil mist, flammable gases, fluff, dust, dirt, etc. Install the inverter inside a "totally enclosed" cabinet to prevent any trouble as described above.

Note : When the inverter is installed in the cabinet enclosure, determine the cooling method and cabinet dimensions so that the ambient temperature of the inverter is within the allowable temperature rise (as specified on page 23.)
Extreme care must be taken when two or more inverters are installed and a ventilation fan is mounted in the cabinet. If the inverters and/or ventilation fan is installed in an improper position, the ambient temperature of the inverters will rise and/or the ventilation effect will reduce.



Installation of Two or More Inverters



Position of Ventilation Fan

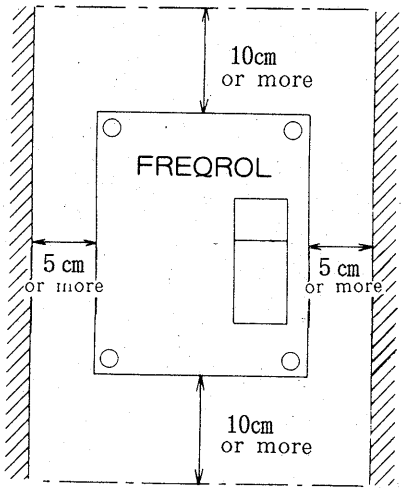
(2) Install the inverter where it is not subjected to vibration.

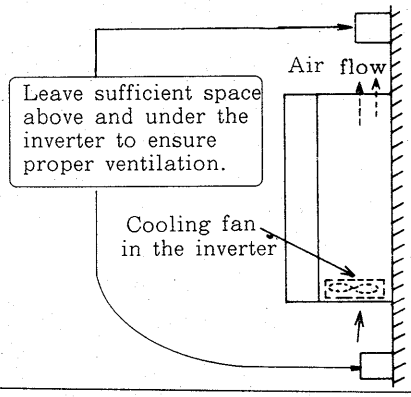
3.3 Direction of Installation

(1) Install the inverter on a flat surface securely with screws or bolts and vertically (so that the letters FREQROL-Z300 are located at the front).

(2) Leave sufficient space around the inverter for ample heat dissipation.

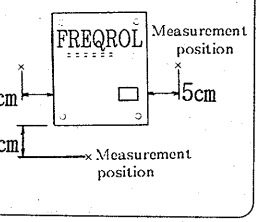
(3) If operation of high duty braking is repeated, for the inverter models of the Z340−7.5K or below, the surface temperature of the brake discharging resistor installed on the rear surface of the inverter may rise (up to about 150℃). To prevent the fire or any hazardous situation, install the inverter on an incombustible surface (such as metal) .





Notes on Ambient Temperature

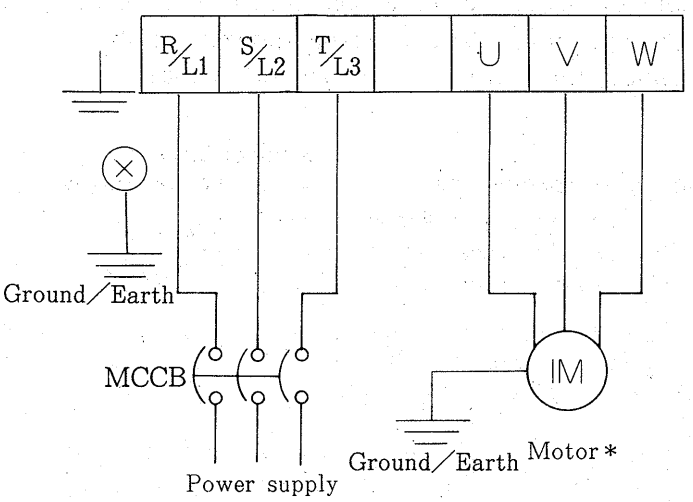
The ambient temperature of the place where the inverter is installed must not exceed the allowable value (120℉, 50℃) because it greatly influences the service life of the inverter.
Check that the ambient temperature is within the allowed value in the positions shown on the right.



4. WIRING

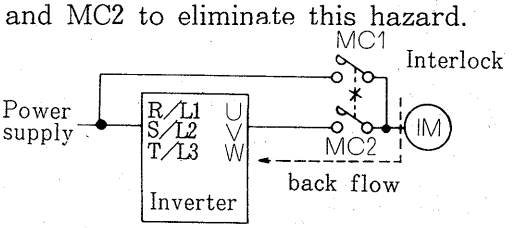
4.1 Main Circuit ····· See page 24 for the terminal block arrangement.

(1) Connection of the power supply and motor



Note :

1. Do not connect the power supply to the output terminals (U, V, W) as this would severely damage the inverter and endanger personnel. This could accidentally occur to an inverter wired as shown below, due to a current backflow if both contactors close simultaneously. Electrically and mechanically interlock contactors MC1 and MC2 to eliminate this hazard.



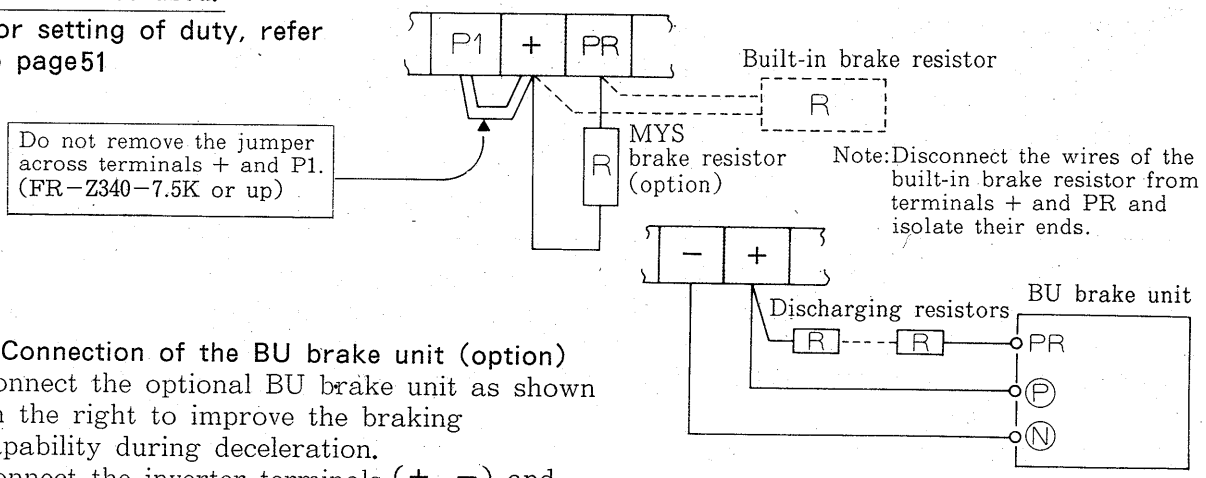
2. Any accident due to the leakage current is not covered by our warranty. Be sure that the wires do not make contact with the casing, etc. The inverter and the motor must be grounded securely using their ground terminals.
3. Without the primary magnetic contactor MC in the inverter, if the start switch is kept on the inverter will automatically restart as soon as the power is switched on after the occurrence of short-time power failure.
   If this automatic restart may cause personal injury or mechanical damage because of the machine movement, use the MC in the power supply so that the power is switched on after safety is ensured.

* In the above connection example, the forward command (terminals STF and SD connected) rotates the motor counterclockwise when seen on the load side.

(2) Connection of the optional brake resistor

The built-in brake resistor connected across terminals + and PR should be disconnected when it cannot thermally endure the high duty operation. In place of that resistor, connect the optional brake resistor. Allowable maximnm brake duty setting of this resistor is 6% or 8% (refer to the brochure for details) . Any other brake resistor must not be used.

For setting of duty, refer to page51



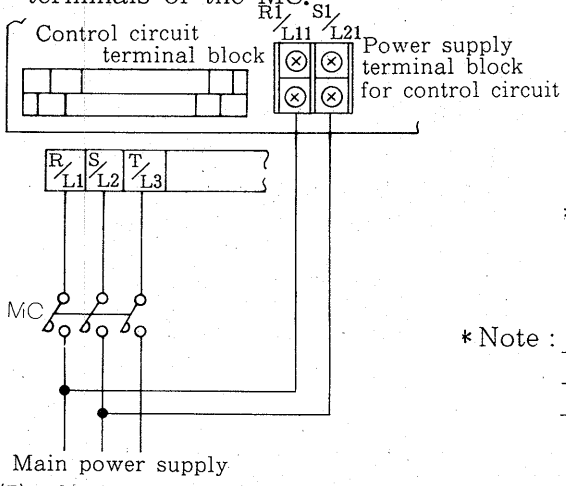
(3) Connection of the BU brake unit (option)

Connect the optional BU brake unit as shown on the right to improve the braking capability during deceleration.
Connect the inverter terminals (+, −) and BU (P, N) brake unit terminals so that their symbols match with each other.
(Incorrect connection my damage the inverter.)

Note : The wiring distance between the inverter, brake unit and discharging resistors should be within 2m (within 5m if wires are twisted).

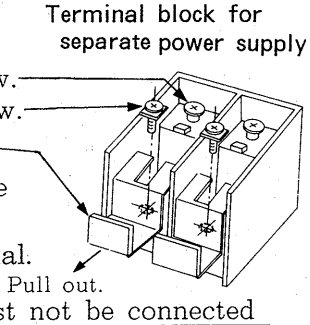
(4) Connecting the control circuit with a power supply different from that of the main circuit

If the magnetic contactor (MC) in the inverter power supply is opened when the protective circuit is operated, the inverter control circuit power is lost and the alarm output signal cannot be output. To keep that signal on, use a different power supply for the control circuit as shown below or connect the control circuit to the primary terminals of the MC.



Connection procedure

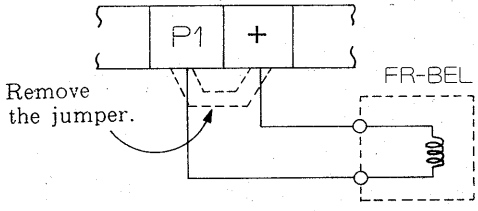
① Loosen the upper screw.
② Remove the lower screw.
③ Pull out the jumper.
*④ Connect the wire of the separate power supply wire to the lower terminal.



*Note : The power supply wire must not be connected to the upper terminal to protect the inverter from damage.

(5) Connecting the power factor improving DC reactor (option)

Connect the FR−BEL power factor improving DC reactor to terminals P1 and +. In this case, the jumper connected across terminals P1 and + must be removed. Otherwise, the reactor cannot provide its functions.



Note : 1. Keep the wiring distance within 5m.
2. The wire size should be equivalent or larger than the power supply wires (R/L1, S/L2, T/L3).

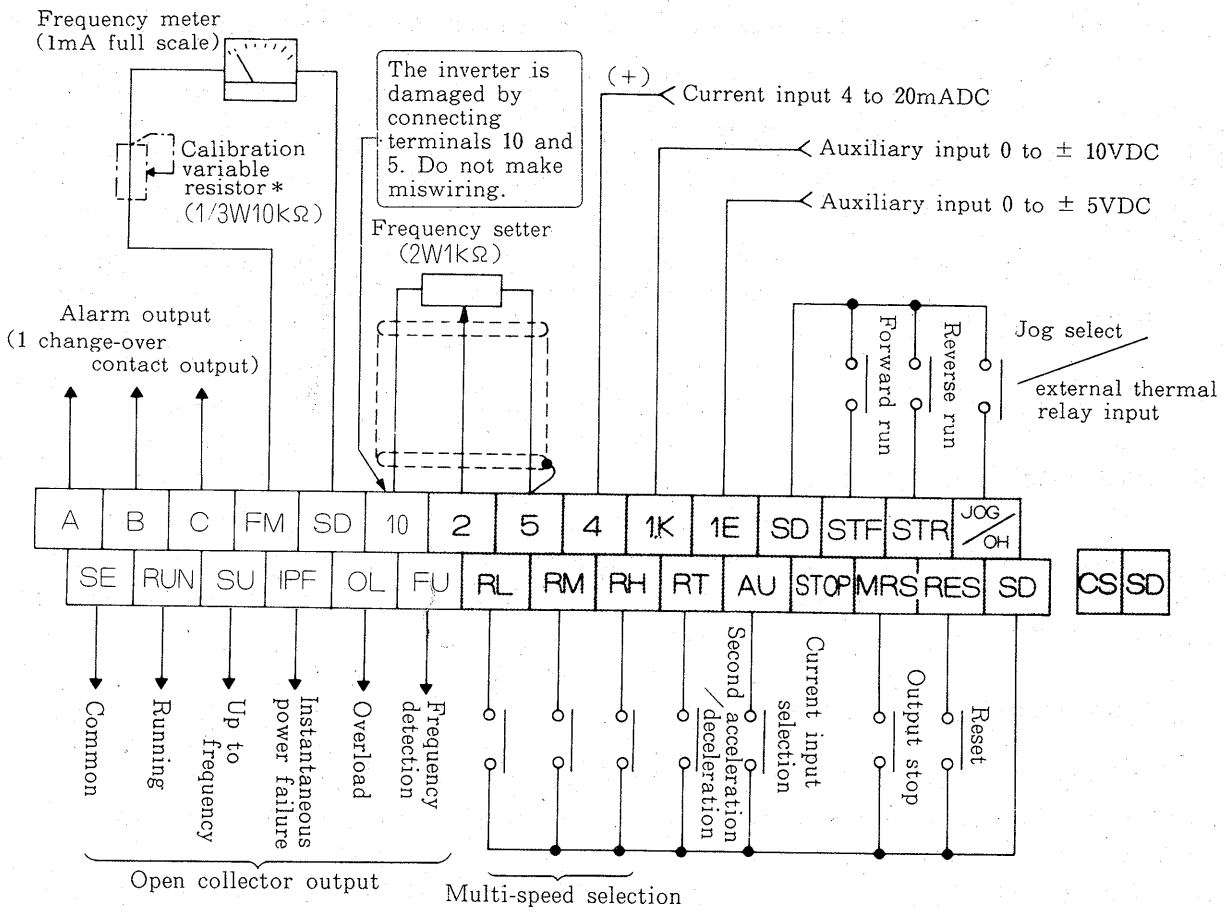
Cautions on Grounding

The leakage current of the Z300 series is larger than that of the other series. To prevent accidental electric shock, the motor and inverter must be earthed (class 3 earthing ··· earthing resistance 100Ω or less).

Notes on Wiring the Peripherals and the power supply

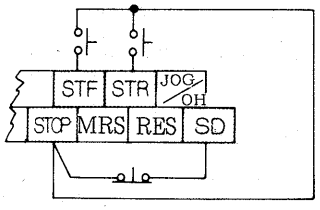
1. When wiring the peripherals installed in the cabinet enclosure where the inverter is installed, cover the slits in the top of the inverter to prevent wire off-cuts, screws, etc. from entering into the inverter. Remove the cover during normal inverter operation.

4.2 Control Circuit ····· See page 27 for the terminal block arrangement.



● Using the STOP terminal

Connect as follows for the threewire control signal (forward, reverse).



● Using the CS terminal

This terminal is only provided for 11K, 15K and 22K models and used to perform either instantaneous power failure automatic restart operation or commercial power supply–inverter switch–over operation.

Example : After-instantaneous power failure automatic restart operation

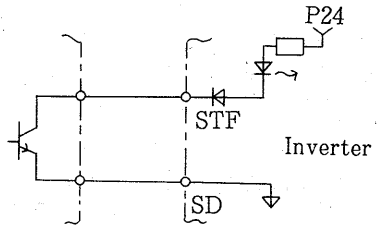
(1) Connect CS and SD.

(2) Set 0 in parameter 67. (See page 54.)

Note : See the technical information for the sequence diagram of commercial power supply-inverter switch-over operation.

● Signal input using

A transistor (open collector output) may be used in place of the dry contact input signal.



Nete : 1.Terminals SD and 5 are common terminals for the I/O signals and are isolated from each other and must not be grounded.

2.Use shielded or twisted wires for the control circuit terminals. These wires must be kept away from the main circuit and power circuit (including the 220V relay sequence circuit).

3.To prevent contact fault, use two low level signal contacts in parallel or a twin contact for the frequency setting signal.

*4.This calibration variable resistor is not required when calibration is made from the parameter unit.

5. OPERATION

5.1 Operation Mode

Select either of the following operation mode in accordance with the application and operating specifications :

Operation Mode	Description	Remarks
Operation using external input signals	The inverter is operated with the start switch, frequency setting variable resistor, etc. connected to the control terminals.	Factory-set so that this operation mode is selected at power on. *
Operation using the parameter unit	The inverter is started, set in frequency, and operated at variable speed from the parameter unit.	Prepare the parameter unit if it is not provided for the inverter used. (See page 34 for the operating procedure.)

* "Parameter unit operation mode" can be selected at power on. (See Page 33.)

5.2 Pre-Operetion Checks.

Before applying power to the inverter, pre-operation checks include, but are not limited to, the items listed below. Please read this entire manual carefully, and have qualified personnel review the installation before start-up.

Installation checks

(1). Visually inspect the inverter, including the fan, heatsinks, enclosure, circuit board, connections, etc. Check for loose connections at the circuit board and terminals. Make sure that all screws and other fasteners are tight.
(2). Check the cabinet for proper cooling provisions, clearances, temperature, presence of metal filings, combustible materials, foreign objects, inlet air filtering (if necessary) . The inverter must be protected from moisture, condensation, dust, gases, oil mist, powdery substances, metal filings, matter, etc.
(3). Ensure that the inverter will not be subjected to significant vibration.
(4). Perform insulation resistance test with a continuity tester (500 V max.) , as described in sec. 6. 2. (3) . Be careful to follow the precautions mentioned in that section.
(5). Ensure that all aspects of the installation conform with applicable electrical codes.
(6). The rear surface can reach high temperatures . Do not install the inverter on or near flammable material such as plastic or wood.

Wiring and Application checks :

(1). Do not open the cover while the CHARGE lamp is on. Perform inspection or parts replacement only after this lamp goes out. An electrical shock hazard exists for several minutes after power is disconnected. Before working on connections, disconnect power and wait until the charge lamp is completely off. Confirm that the DC bus is discharged by measuring voltage across terminals P and N. The voltage should be less than 30VDC.
(2). Check for short circuits, grounds scraped insulation, loose wires, etc.
(3). Do not connect supply power to output terminals U, V, and W.
(4). Do not short-circuit terminals P and N.
(5). Confirm that supply power is within specified limits.
(6). Ensure that no short circuit path exists between terminals 10 and 5.
(7). Confirm that the motor nameplate full load ampere rating is less than or equal to the output ampere rating of the inverter.

(8). Make sure that 220VAC external control power is not applied to any control terminals.

(9). If the supply power has a capacity greater than 1MVA (1000KVA) , and the wire length from the supply transformer is less than 10 meters (33ft.) , it is necessary to add line reactors or a transformer to the inverter input.

(10). Power factor correction capacitors must not be installed in the motor circuit.

(11). If power factor correction capacitors are installed in the supply power circuit, either :

a) the capacitors must not be switched, or

b) line reactors or a transformer must be added to the inverter input, between the inverter and the capacitors.

(12). For applications with frequent starts and stops, do not start and stop the inverter by switching input power on and off. Rather, use the Parameter Unit or control input (STF or STR) for start/stop.

(13). Before operating the motor, ensure that the motor and connected load can safely withstand operation at the intended speed, especially if operation above 60Hz - is planned.

(14). Confirm the settings for parameters no. 1, 4, 9, 18, 20, 39, etc. before starting the motor, so that the motor speed does not exceed expectations. These parameters affect the motor speed.

(15). Do not set parameter No. 30, regenerative brake duty, to a value larger than the factory setting, or a value calculated to be safe after reviewing the application and the instruction manual.

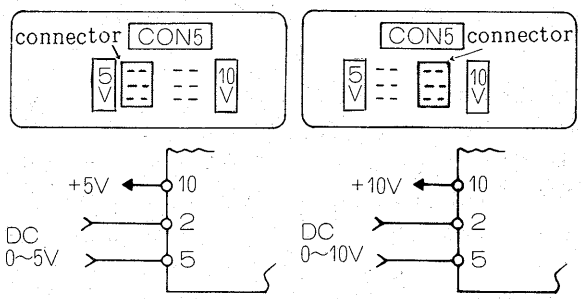
5.3 Pre-Operation Settings

The inverter is not provided with setting switches, variable resistors and the like. Use the parameter unit (FR-PU01) to change or check the set values of various functions (e.g. acceleration/deceleration time, electronic overcurrent protector) in accordance with the load and operational specifications. (See page 47 for the factory-set values of the functions.)

For the set value changing and checking procedures, see the section of the "PARAMETER UNIT" in this manual (from page 30 onward).

The main items to be set before operation are as follows :

Item	Description	Ref. Page
Maximum output frequency	●External input signal operation mode The maximum output frequency is factory-set as indicated below. The setting must be changed when the inverter is run at a higher value. Maximum output frequency value set at the factory ●Voltage signal···5VDC (or 10VDC) for 50Hz ●Current signal···20mADC for 50Hz, 4mADC for 0Hz Changing the maximum output frequency setting Change the value of "frequency at 5V input" (or "frequency at 20mA input") from the parameter unit. ●Parameter unit operation mode The maximum output frequency is up to the maximum frequency (factory-set to 120Hz) .	P. 50 P. 57
Acceleration/deceleration time	Factory-set to 5 seconds for the 7.5K or below and 15 seconds for the 11K or above. Set the required value if the inverter is operated at other than the above value. The set time is the length of time until the "frequency at 5V input" is reached.	P. 49

Item	Description	Ref. Page
Electronic overcurrent protector	The set value is identical to the protective level value of the other series (FR−Z100, Z200). Set the value of full load current of applied motor. When the Mitsubishi inverter driving motor "constant-torque motor" is used, the electronic overcurrent protector can also be set for this motor.	P. 50
Frequency setting input signal setting (for operation with analog signal)	When external analog signal is input to perform operation, set the input signal specifications using the input signal select connector (CON5) on the printed circuit board. The connector setting need not be changed when a variable resistor is connected across terminals 10, 2 and 5 to perform operation. ● Operation at 0 to 5VDC ● Operation at 0 to 10VDC  Note : Operation cannot be performed without the connector inserted. ● Operation at 4 to 20mADC 4 to 20mADC input is only selected when terminals AU and SD are connected. Hence, AU and SD must be connected to perform operation with this signal.	P. 50
Maximum frequency Minimum frequency	To be only used to restrict the upper and lower limits of the output frequency. Since the maximum or minimum frequency may be output at less than the maximum output frequency, proper operation cannot be perfomed if it is changed unreasonably. Note : Setting the minimum frequency causes the inverter to operate at the set minimum frequency by simply switching on the start signal.	P. 50
Frequency meter calibration	Allows the frequency meter to be calibrated from the parameter unit without using a calibration resistor.	P. 38

5.4 Check Points during Test Run

After checking that the inverter start signal is off (in external signal operation mode), switch on the no-fuse breaker (MCCB) and magnetic contactor (MC) at the inverter input side.

Perform test run and check the operating status in the following procedure :

Power on

The power lamp on the inverter display panel is lit (yellow).

External signal operation mode | Parameter unit operation mode

For full information on operation, see the section of the "PARAMETER UNIT" (from page 34 on).

Operation mode	When equipped with the parameter unit, the inverter is automatically set to external signal operation mode, as well as monitoring mode, at power on.	Press the PU OP key to select parameter unit operation mode.
Start ↓ Acceleration ↓ Run	Turn on the forward or reverse start signal (switch) ↓ Slowly turn the frequency setting potentiometer from zero to the fully clockwise position.	• Direct setting Enter the required frequency with numeral keys and press the WRITE key. • Step setting Press the ▲ key until the required frequency is reached and press the WRITE key. ↓ Press the FWD or REV key. (At this time, monitoring mode is selected automatically.)
Deceleration ↓ Stop	Slowly turn the frequency setter knob counterclockwise to the fully counterclockwise (zero) position.	Press the STOP key.

…The motor speed increases in proportion to the rise in frequency meter reading * (frequency value indicated on the parameter unit).

…The motor speed decreases in proportion to the fall in frequency meter reading (frequency value indicated on the parameter unit). When the output frequency reaches the DC injection brake operating frequency, the DC injection brake is applied to bring the motor to a sudden stop. (See the notes given below.)

* Note : If the parameter unit is not in monitoring mode, increase or decrease in frequency cannot be displayed.

Check Points

(1) Check that the direction of motor rotation is correct. (See page 5 for the wiring and rotation direction.)
(2) Check that the motor does not produce any unusual noise or vibration.
(3) Check that the frequency meter deflects smoothly.
(4) Check that the ALARM lamp is not lit (inverter does not trip) during acceleration or deceleration. If the inverter has tripped, check the following :
- Load (magnitude)
- Acceleration/deceleration time (increase)
- Boost value (reduce)

Note

(1) The inverter is not started up if the forward (STF) and reverse (STR) start signals are switched on at the same time. The motor is decelerated to a stop if they are switched on at the same time during operation.
(2) High-frequency sound is generated by the motor for 0.5 seconds during which the DC injection brake is applied during deceleration at less than the DC injection brake operating frequency (less than the starting frequency if the frequency setting signal level is lowered gradually). This sound is not a fault.
(3) When the ALARM lamp is lit and the motor is coasted to a stop, **switch the power off or reset the inverter using the reset terminal after making sure that the motor has stopped.**

6. MAINTENANCE AND INSPECTION

The transistorized inverter mainly consists of semiconductor elements. Daily inspection must be perfomed to prevent any fault from occurring due to the influences of the installation environments, such as temperature, humidity, dust, dirt and vibration, changes in the parts with time, service life, and other factors.

6.1 Precautions for Maintenance and Inspection

(1) The operator must check that the power is on or off by himself so that any person not in charge does not misoperate the inverter.

(2) Soon after the power is switched off, the capacitor remains charged at high voltage. Before performing inspection, ensure that the charge lamp on the printed circuit board is off and then check that the voltage across the main circuit terminals P and N of the inverter is 30VDC or less using a tester, etc.

6.2 Check Items

Have a proper understanding of the definitions of power and alarm indications provided for the transistorized inverter. Also, have a proper understanding of the settings of electronic overcurrent protector, acceleration/deceleration time, etc. from the parameter unit and record the set values.

(1) Daily inspection

Basically, check for the following :

(a) Motor operation fault
(b) Improper installation environment
(c) Cooling system fault
(d) Unusual vibration and noise
(e) Unusual overheat and discoloration

During operation, check the inverter I/O voltages using a tester.

(2) Periodic maintenance and inspection

Check the areas inaccessible during operation and requiring periodic inspection.

(a) Cooling system : Clean the air filter, etc.
(b) Screws and bolts : Check that they are securely tightened and retighten as necessary.
(c) Conductors and insulating materials : Check for corrosion and damage.
(d) Insulation resistance : Measure.
(e) Cooling fan, smoothing capacitor, relay: Check and change if necessary.

Daily and periodic maintenance and inspection items and criteria are given in Table 1.

(3) Insulation resistance test

(a) Before performing the insulation resistance test using a continuity tester on the external circuit, disconnect the wires from all terminals of the inverter so that the test voltage is not applied to the inverter.
(b) Conduct the insulation resistance test on the inverter main circuit only as shown in Fig. 6 and do not perform the test on the control circuit.
(c) For the continuity test of the control circuit, use a tester (high resistance range) and do not use the continuity tester or buzzer.

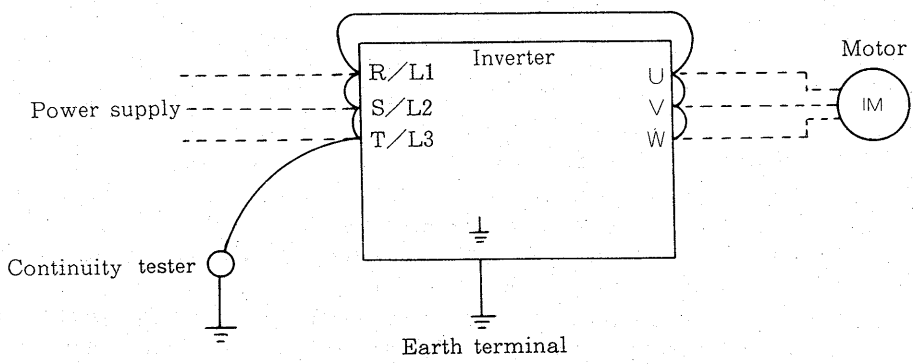


Fig. 6 Insulation Resistance Test

Area of Inspdction	Inspection Item	Descripion	Interval			Method	Criterion	Instrument
				Periodic				
				1-year	2-year			
Overall	surrounding environment	Check ambient temperature, humidity, dust, dirt, etc.	○			See note on p. 4	Ambient temperature:14°F to 122°F (−10°C to +50°C), non-freezing. Ambient humidity:90% or less, non-condensing.	Thermometer, hygrometer, recorder
	All equipment	Check for unusual vibration and noise.	○			Visual and auditory check.	No fault.	
	Line voltage	Check that main circuit voltage is normal. insulation tester	○			Measure voltage across inverter terminals R_{L1}, S_{L2} and T_{L3}	180 to 220V (360 to 440V) 50Hz 180 to 253V (360 to 506V) 60Hz	Tester, digital multimeter
Main circuit	Overall	(1)Check with continuity tester (across main circuit terminals and ground terminal). (2)Check for loose screws and bolts. (3)Check for overheat on each part. (4)Clean.		○ ○	○	(1) Disconnect all wires from inverter and measure across terminals R_{L1}, S_{L2}, T_{L3}, U, V, W and ground terminal with tester. (2) Retighten (3) Visual check.	(1) 5MΩ or more (2), (3) No fault	500V continuity tester
	Conductors, wires	(1) Check conductors for distortion. (2) Check sheaths for breaks		○ ○		(1), (2) Visual check.	(1), (2) No fault.	
	Terminal block	Check for breaks		○		Visual check	No fault	
	Inverter module Converter module	Check resistance across terminals.			○	Disconnect wires from inverter and measure across terminals R_{L1}, S_{L2}, T_{L3} and +, −, and across U, V, W and +, − with tester × 1 range.	(See P. 15.)	Analog tester
	Smoothing capacitor	(1) Check for liquid leakage. (2) Check for safety valve projection and bulges. (3) Measure electrostatic capacity.	○ ○	 ○		(1), (2) Visual check. (3) Measure with capacity meter.	(1), (2) No fault (3) 85% or more of rated capacity.	Capacity meter
	Relay	(1) Check for chatter during operation. (2) Check timer operating time. (3) Check for rough surface on contacts.		○ ○ ○		(1) Auditory check (2) Length of time from power on to relay on. (3) Visual check.	(1) No fault (2) Relay should be switched on in 0.1 to 0.15 seconds. (3) No fault	Universal counter
	Resistor	(1) Check for crack in resistor insulation. (2) Check for open wire.		○ ○		(1) Visual check. Cement resistor, wire-wound resistor. (2) Disconnect wire from one end and measure with tester.	(1) No fault. (2) Error should be within 10% of indicated resistance value.	Tester, digital multimeter
Control circuit Protective circuit	Operation check	(1) Check balance of output voltages across phases with inverter operated independently. (2) Perform sequence protective operation test to make sure of on fault in protective and display circuits.		○ ○		(1) Measure voltage across inverter output terminals U, V, W. (2) Simulatively connect inverter protective circuit output terminals.	(1) Phase-to-phase voltage balance within 8V. (2) Fault must occur because of sequence.	Digital multimeter, rectifier type voltmeter
Cooling system	Cooling fan	(1) Check for unusual vibration and noise. (2) Check for loose connection. (3) Clean air Filter	○ ○	 ○ 		(1) Turn by hand after turning off cooling fan. (2) Retighten.	(1) Smooth rotation. (2) No fault.	
Display	Display	(1) Check for lamp blown. (2) Clean.	○	 ○		(1) Lamps indicator lamp on panel. (2) Clean with rag.	(1) Check that lamps are lit.	
	Meter	Check that reading is normal.	○			(1) Check reading of meters on panel.	(1) Must satisfy specified and managememt values.	Voltmeter, ammeter, etc.
Motor	Overall	(1) Check for unusual vibration and noise. (2) Check for unusual odor.	○ ○			(1) Auditory, sensory, visual checks (2) Check for unusual odor due to overheat, damage, etc.	(1), (2) No fault	
	Insulation resistance	(1) Check with Continuity tester (across terminals and ground terminal)			○	(1) Disconnect wires from U, V, W and include motor wires.	(1) 5MΩ or more.	500V continuity tester

Table1 Daily and periodic maintenance and inspection items.

6.3 Measurement of Main Circuit Voltages, Currents and Power

(1) Measurement of voltages and currents

Since the voltages and currents on the inverter power supply and output sides include high harmonic components, data depends on the instruments used and circuits measured.

To measure the voltages and currents, use instruments with the commercial frequency in Table 2 and in the circuit in Fig. 7.

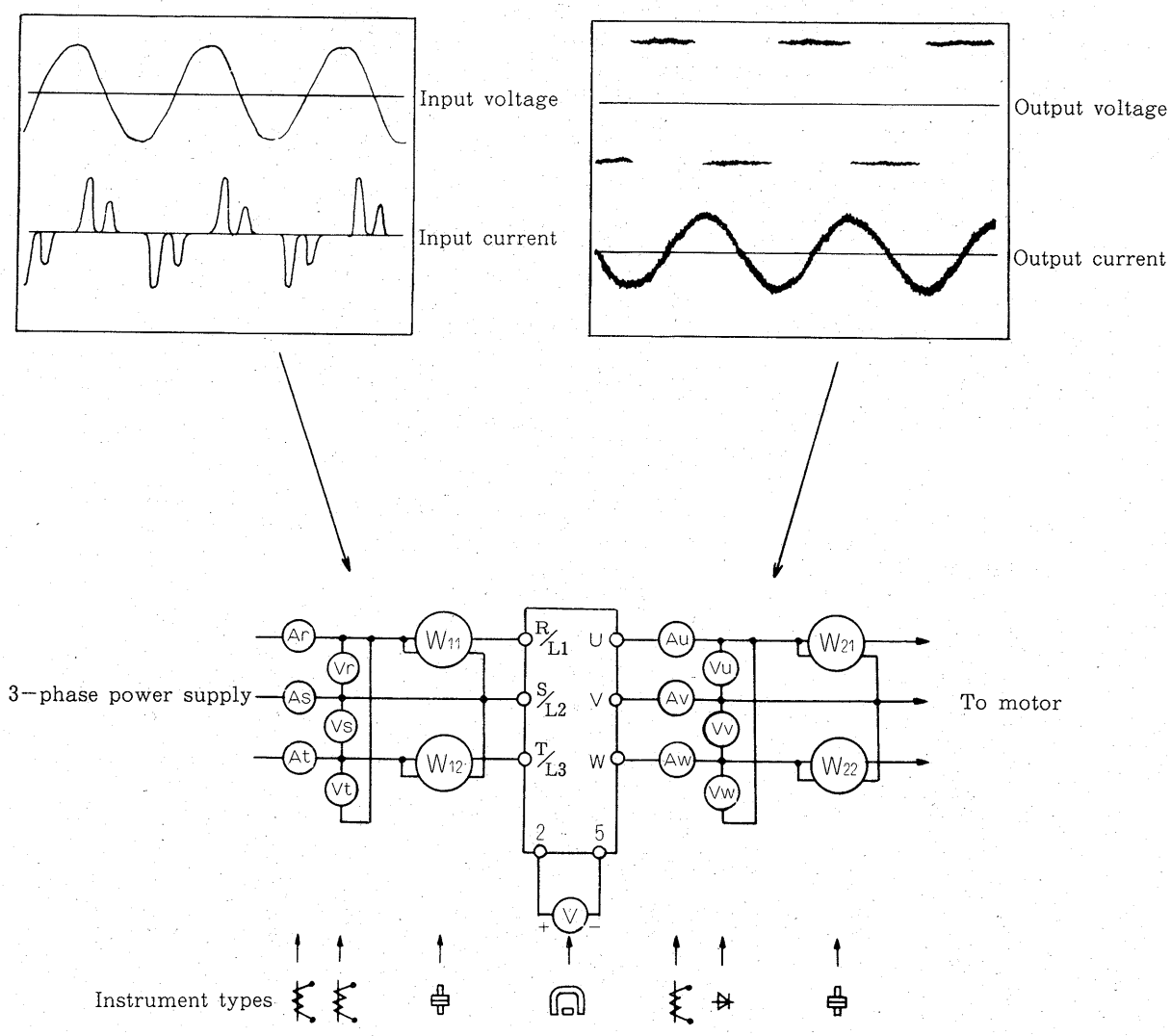


Fig. 7 Typical Measuring Points and Instruments

Table 2 Measuring Points and Instruments

Item	Measuring Point	Measuring Instrument	Remarks (Reference Measured Value) *
Line voltage V_1	Across $R/L1$ and $S/L2$, $S/L2$ and $T/L3$, and $T/L3$ and $R/L1$	Moving-iron type	380W−415V ±10%
Power supply current I_1	$R/L1$, $S/L2$, and $T/L3$ line currents	Moving-iron type	
Power supply power P_1	At $R/L1$, $S/L2$ and $T/L3$, and across $R/L1$ and $S/L2$ and $S/L2$ and $T/L3$	Electrodynamic type	$P_1=W_{11}+W_{12}$
Source power factor Pf_1	Calculate after measuring line voltage, power supply current and power supply power.		
Output voltage V_2	Across U and V, V and W, and W and U	Rectifier type (not moving-iron type)	Difference between phases is within 1% or maximum output voltage.
Output current I_2	U, V and W line currents	Moving-iron type	Current should be equal to or less than inverter rated current. Difference between phases is 10% or lower.
Output power P_2	At U, V and W, and across U and V, and V and W	Electrodynamic type	$P_2=W_{21}+W_{22}$
Output power factor Pf_2	Calculate in similar manner to power supply power factor.		
Converter output	Across + and −	Moving-coil type (such as tester)	POWER lamp is lit. $1.35\times V_1$ Maximum 760V during regenerative operation
Frequency setting signal	Across 2 and 5	Moving-coil type (Tester, etc. may be used) (Internal resistance : 50kΩ or larger)	0 to 5V/0 to 10VDC
	Across 1K and 5		0 to 10VDC
	Across 1E and 5		0 to 5VDC
	Across 4 and 5		4 to 20mADC
Frequency setting power supply	Across 10 and 5	〃	5/10VDC
Frequency meter signal	Across FM and SD	〃	Approx. 3.5VDC at maximum frequency (without frequency meter)
Start signal Select signal	Across STF,STR,RH,RM, RS, JOG/OH, RT,AU and SD	〃	20 to 30VDC when open ON voltage 1VDC or less
Reset	Across RES and SD		
Output stop	Across MRS and SD		
Alarm signal	Across A and C Across B and C	Moving-coil type (such as tester)	<Normal> <Fault> Across A and C : Discontinuity Continuity Across B and C : Continuity Discontinuity

6.4 Checking the Inverter Module and Converter Module

(1) Preparation

- Disconnect the external power supply wires (L1, L2, L3), motor wires (V, U, W).
- Prepare a tester. (1Ω resistance measurement range)

(2) Checking

Change the polarity of the tester alternately at the inverter terminals L1, L2, L3, U, V, W, + and −, and check for continuity.

Note 1 : Before measurement, check that the smoothing capacitor is discharging.

2 : At the time of discontinuity, the measured value indicated is a nearly infinite value. Due to the influence of the smoothing capacitor, continuity may instantaneously be established and infinite not indicated. At the time of continuity, the measured value is several to several tens of ohms depending on the number of modules, number of parallel modules, circuit tester type, etc. If all measured values are almost the same, the modules are without fault.

		Tester Polarity		Measured Value		Tester Polarity		Measured Value
		⊕	⊖			⊖	⊕	
Converter module	D 1	R/L1	+	Discontinuity	D 4	R/L1	−	Continuity
		+	R/L1	Continuity		−	R/L1	Discontinuity
	D 2	S/L2	+	Discontinuity	D 5	S/L2	−	Continuity
		+	S/L2	Continuity		−	S/L2	Discontinuity
	D 3	T/L3	+	Discontinuity	D 6	T/L3	−	Continuity
		+	T/L3	Continuity		−	T/L3	Discontinuity
Inverter module	TR 1	U	+	Discontinuity	TR 4	U	−	Continuity
		+	U	Continuity		−	U	Discontinuity
	TR 3	V	+	Discontinuity	TR 6	V	−	Continuity
		+	V	Continuity		−	V	Discontinuity
	TR 5	W	+	Discontinuity	TR 2	W	−	Continuity
		+	W	Continuity		−	W	Discontinuity

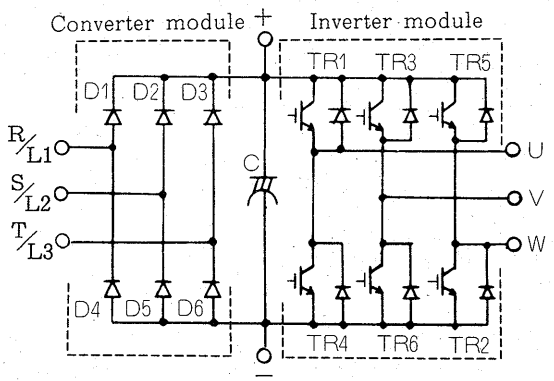


Fig. 8 Module Element Numbers and Terminals to Be Checked

6. 5 Replacement of Parts

The inverter consists of many electronic parts such as semiconductor elements.

The following parts may deteriorate with age because of their structures or physical characteristics. For preventive maintenance, the parts must be changed periodically.

(1) Cooling fan

The cooling fan cools heat-generating parts such as the main circuit semiconductor elements. The service life of the cooling fan bearing is usually 10,000 to 35,000 hours. Hence, the cooling fan must be changed every 2 to 3 years if the inverter is run continuously. When unusual noise and/or vibration is noticed during inspection, the cooling fan must also be changed.

(2) Smoothing capacitor

A large-capacity aluminum electrolytic capacitor is used for smoothing DC-link bus voltage of the main circuit. Its characteristics are adversely affected by ripple current, etc. When the inverter is operated in ordinary, air-conditioned environment, change the capacitor about every 5 years.

When a given period has elapsed, the capacitor deteriorates rapidly. Check the capacitor every year (less than six months if the life will be expired soon). Check the following :

1) Case (sides and bottom for expansion)
2) Sealing plate (for remarkable warp and extreme crack)
3) Explosion-proof valve (for excessive valve expansion and operation)
4) Appearance, external crack, discoloration, leakage.

When the rated capacity of the capacitor has reduced below 85%, change the capacitor. For its capacity measurement, a handy device is available on the market.

(3) Relays

To prevent contact fault, relays must be changed in accordance with the number of accumulative switching times (switching life).

See Table 4 for the inverter parts changing guide. Lamps and other short-lived parts must also be changed during periodic inspection.

Table 4 Replacement Parts of the Inverter

Part Name	Standard Replacement Interval	Description
Cooling fan	2 to 3 years	Change (as required)
Smoothing capacitor	5 years	Change (as required)
Relays	—	Change (as required)

7. TROUBLESHOOTING

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

7. 1 Clearing Up the Cause of Fault

(1) Checking the parameter unit display

If a faulty operation occurs, the display of the parameter unit shows the corresponding alarm to indicate the cause of that fault. The alarm display may be indicated by the corresponding error numbers. (See page 57.) For full information on the display characters, see pages 21 and 22.

Error No.	Parameter Unit Display	Cause of Fault	Check Point	Remedy
1	OC1 : Overcurrent during acceleration	Overcurrent	Acceleration made too fast? Check for output short circuit or ground fault.	Increase acceleration time. Remove short circuit
2	OC2 : Overcurrent during constant-speed operation.		Sudden load change? Check for output short circuit or ground fault.	Keep load stable.
3	OC3 : Overcurrent during deceleration		Deceleration made too fast? Check for output short circuit or ground fault.	Increase deceleration time. Remove short circuit
4	OVT : Regenerative overvoltage (Deceleration time fault)	Overvoltage on DC bus (terminals + and −)	Deceleration made too fast?	Increase deceleration time. (Set deceleration time in accordance with load inertia.)
5	THM : Overload alarm	Thermal relay for motor	Motor used under overload?	Reduce load. Increase motor and inverter capacities.
6	THT : Overload alarm	Thermal relay for inverter		
7	IPF : Instantaneous power failure	Instantaneous power failure	Check the cause of instantaneous power failure occurrence.	
8	UVT : Undervoltage	Line voltage drop	Check power system equipment such as power capacity.	
9	FIN : Fin overheat	Cooling fin overheat	Cooling fan stopped? (2.2K and above) Ambient temperature high?	Change cooling fan. Reduce ambient temperature.
10	BE : Brake transistor alarm	Brake transistor fault	Braking frequency proper?	Reduce load inertia.) Reduce braking frequency.
11	GF : Ground fault overcurrent	Ground fault occurred on output side.	Check motor and wires for ground fault.	Clear ground fault.

Error No.	Parameter Unit Display	Cause of Fault	Check Point	Remedy
12	OHT:External thermal relay operation	External thermal relay operated.	Check motor for overheat	Reduce load and operating frequency.
13	OLT : Stall prevention	Stall prevention or current limiting function activated too long.	Motor used under overload?	Reduce load. Increase motor and inverter capacities.
14	OPT : Inverter-mounted option connection alarm	Option and inverter connected improperly.	Check for loose connector.	Securely connect.
15	PE : Parameter storage element alarm	Storage element (EEPROM) capacity exceeded, faulty	Number of parameter write times too many?	Change inverter.
16 **	PE : Frequency setting power supply short circuit	Frequency setting voltage drop	Short across terminals 10 and 5?	Correct miswiring.
17	OC1:Output short circuit during acceleration	Short circuit on output side	Short circuit across motor wires or motor phases?	Remedy short circuit area.
18	OC2:Output short circuit during constant -speed operation			
19	OC3:Output short circuit during deceleration			

** Not displayed when 10V has been selected for the frequency setting voltage (see page10).

7. 2 Faults and Check Points

Fault	Typical Check Point
Motor does not rotate.	(1) Checking the main circuit • Check that the power is applied (POWER lamp is on). • Check that the motor is connected properly. (2) Checking the input signals • Check that the start signal is entered. • Check that both the forward and reverse start signals are not on together. • Check that the frequency setting signal is not zero. • Check that the signal across terminals AU and SD is on when the frequency setting signal is 4 to 20mA. • Check that the output stop signal (across terminals MRS and SD) or reset signal (across RES and SD) is not on. (3) Checking the function (parameter) set values • Check that the reverse prevention (Pr. 78) is not set. • Check that the operation mode (Pr. 79) setting is proper. • Check that the bias and gain (C-2 to C-5) settings are correct. • Check that the starting frequency (Pr. 13) set value is not greater than the running frequency. • Check that various operational functions (such as three-speed operation), especially the maximum frequency, are not zero. (4) Checking the load • Check that the load is not too heavy and the shaft is not locked. (5) Others • Check that the alarm indicator lamp (ALARM) is not on.
The motor rotates in opposite direction.	• Check that the phase sequence of the output terminals U, V and W is correct. • Check that the start signals (forward, reverse) are connected properly.
Speed greatly differs from the predetermined value.	• Check that the frequency setting signal is proper. (Measure the input signal level.) • Check that the following function (parameter) set values are proper : Maximum frequency (Pr. 1), frequency at 5V input (Pr. 20), frequency at 20mA input (Pr. 21), bias, gain (C-2 to C-5), base frequency voltage (Pr. 19) • Check that the input signal lines are not affected by external noise. (Use of shielded cable)
Acceleration/deceleration is not smooth.	• Check that the acceleration/deceleration time set value is not too short. • Check that the load is not too heavy. • Check that the current limiting function is not operating because of too large torque boost set value.
Speed varies during operation.	• Check that the load is not varying. • Check that the frequency setting signal is not varying.
Motor current is large.	• Check that the load is not too heavy. • Check that the torque boost (manual) set value is not too large.
Speed does not increase.	• Check that the maximum frequency set value is proper, i. e. it is not too small. • Check that the load is not too heavy. • Check that the current limiting function is not operating because of too large torque boost set value.

Note : "Pr." indicates a function number (parameter).

7. 3 Protective Functions

When any of the protective functions have been activated, switch the power off, then on, or reset the inverter with the reset terminal (RES).

Function	Description		Display	Error No.	Alarm Code	Alarm Output
In-acceleration/constant-speed stall prevention current limitation	If 150% or more of the inverter rated current flows in the motor during acceleration the inverter stops the increase in frequency until the load current reduces to prevent the inverter from resulting in overcurrent tripping. If 150% or more of the rated current flows during ordinary (constant-speed) operation, the frequency reduces until the load current reduces to prevent the inverter from resulting in overcurrent tripping. When the load current has reduced below 150%, the frequency increases again and continues acceleration up to the set speed and continues operation.		EOLT (EOLT) (Indicates a stop due to the activation of the function for a long time during constant-speed operation.)	13	D	Not provided Provided by EOLT display.
In-deceleration stall prevention	If the brake operating amount has exceeded the specified value due to excessive regenerative energy during motor deceleration, the decrease in frequency stops to prevent the inverter from resulting in overvoltage tripping. As soon as the regenerative energy has reduced, the frequency reduces and continues deceleration.					
Overcurrent shutoff	When the inverter output current has reached or exceeded 200% of the rated current, the protective circuit is activated to stop the inverter.	During acceleration	EOC1	1	1	Provided
		During constant-speed operation	EOC2	2	2	
		During deceleration	EOC3	3	3	
Regenerative overvoltage shutoff	When a converter output overvoltage is caused by regenerative energy from the motor, the protective circuit is activated to stop and hold the transistor output off.		EOuT (EOVT)	4	4	Provided
Instantaneous power failure protection	If instantaneous power failure has occurred longer than 15 msec (this applies also to inverter input power shutoff), the inverter activates a stop and hold the inverter output off, thereby preventing a fault. At this time, the alarm output contacts are open (across B and C). (If the power failure is within 15msec, the control circuit operates without fault. If the power failure continues for more than about 100msec, the protective circuit is reset.)		EIPF (EIPF)	7	7	Provided
Undervoltage protection	If the inverter line voltage has reduced, the control circuit cannot operate properly, resulting in a decrease in motor torque and/or the increase in heat generation. To prevent this, if the line voltage reduces below about 300V, inverter output is stopped		EUuT (EUVT)	8	8	Provided
Brake transistor alarm detection	If the brake transistor fault has occurred due to extremely large regenerative brake amount, etc., fault detection stops the inverter output.		EbE (EBE)	10	A	Provided

Function	Description	Display	Error No.	Alarm Code	Alarm Output
Overload shutoff (electronic overcurrent protector)	The electronic overcurrent protector in the inverter detects a motor overload during rated operation, or motor overheat during low-speed operation, the protective circuit is activated and stops and holds the inverter output off. When for example, a pole change, or dual speed motor, or if several motors are connected to the inverter output, then the Electronic overcurrent protection cannot discriminate and is ineffective. In these cases, fit an appropriate thermal overload for each winding or each motor, then set Pr9 to 0 amps, to cancel ETH function. Full protection for the inverter is still assured, by a separate trip circuit, which will activate automatically if more than 150% current flows, current trip is inversely proportional to time, i. e. 150% current for 1 minutes or 200% current for 0.5 seconds.	Motor protection E r H n (ETHM)	5	5	Provided
		Inverter protection E r H r (ETHT)	6	6	
Fin overheat protection	Models of 2.2K and above are forced-cooled by the fan. If the fan has stopped and the semiconductor cooling fin has overheated, the sensor is activated to stop and hold the inverter output off.	E F I n (EFIN)	9	9	Provided
Brake resistor overheat protection	If the regenerative brake amount from the motor has exceeded the specified value, brake operation is stopped to protect the brake resistor from overheat. When the brake resistor has cooled, then brake operation is resumed.		—	—	Not provided
Output ground fault overcurrent protection	If a ground fault current has occurred due to a ground fault occurring in the output (load) side of the inverter, inverter output stops. A ground fault occurring at low ground resistance may activate the overcurrent protection (OC1 to OC3).	E G r (EGF)	11	B	Provided
External thermal relay operation	If the external themal relay, for motor overheat protection, or the temperature relay in the motor has been switched on (relay contacts open), stops and holds the inverter output off. This protection is only provided when the "external thermal relay input" function has been selected.	E O H r (EOHT)	12	C	Provided
Inverter-mounted option connection	Stops the inverter output if the option used in the inverter results in a connection (connector) fault during operation.	E O P r (EOPT)	14	E	Provided
Parameter storage element alarm	Stops the output, if the EEPROM, which stores the function set values, element fault has occurred.	E P E (EPE)	15	F	Provided

Note : See page 59 for the alarm codes.

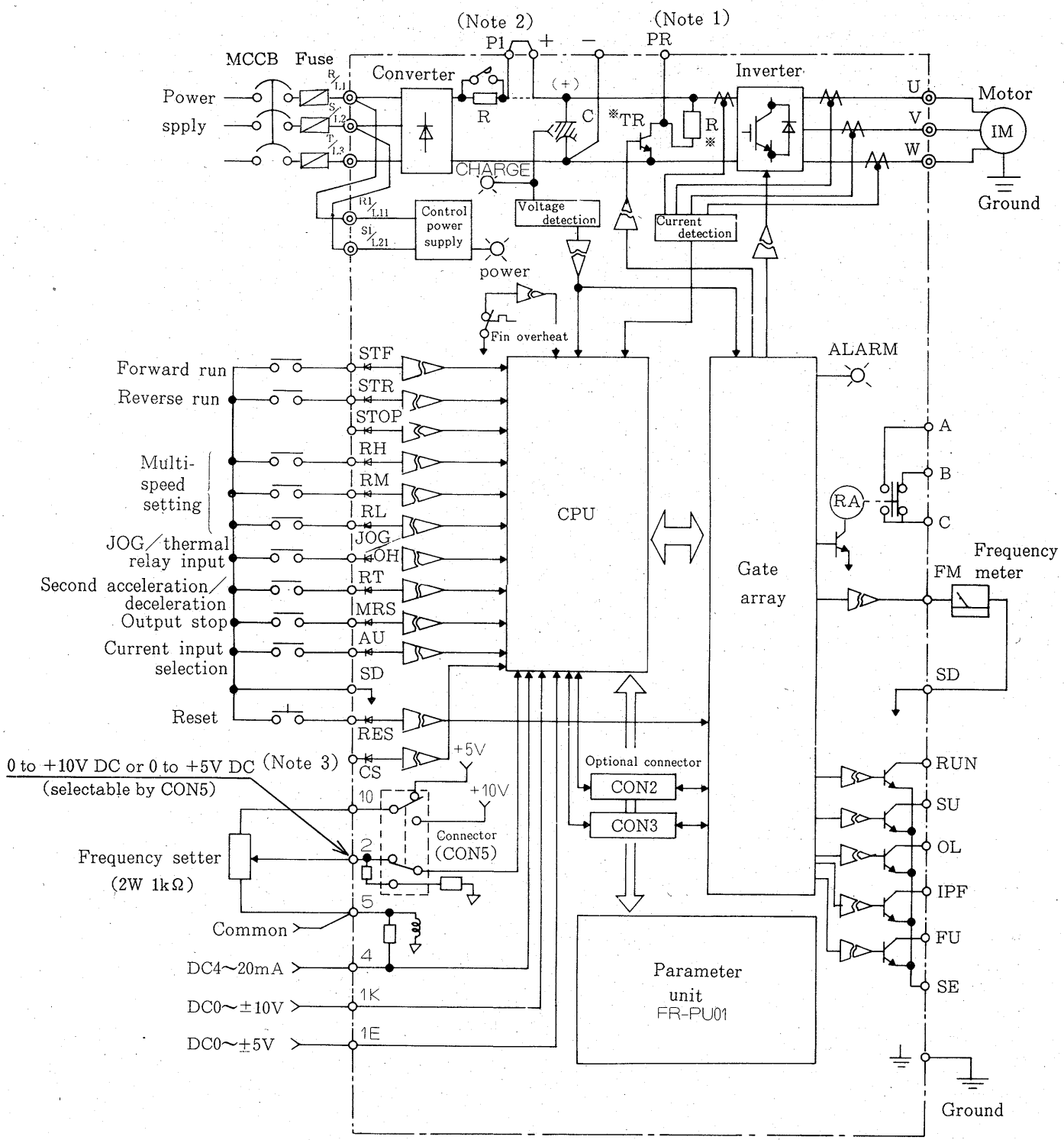
8. SPECIFICATIONS

8. 1 Standard Specifications

Voltage class			400V						
Type FR-Z340-			2.2K	4.0K	5.5K	7.5K	11K	15K	22K
Applicable motor capacity (hp)			3	5.5	7.5	10	15	20	25/30
Output rating	Output capacity (kVA)		4.2	7.2	10.4	13	18.3	23.6	32.8
	Output current (Amps)		6	10	13	17	23	31	43
	Output voltage (*1)		Three phase, 380V−415V						
Input rating	AC voltage, frequency		Three phase, 380V−415V 50Hz						
	Allowable AC voltage fluctuation		380−10% to 415+10%						
	Allowable frequency fluctuation		5%						
	Power capacity (kVA)(*2)		5.5	9	12	17	20	28	34/41
Control specifications	Control system		Sinusoidal PWM control						
	Frequency control range		0.5 to 360Hz (starting frequency 0.5 to 10Hz adjustable)						
	Frequency setting resolution	Digital input	0.01Hz (less than 100Hz), 0.1Hz (100Hz or more)- when parameter unit is used						
		Analog input	1/1000 of maximum set frequency						
	Frequency accuracy	Digital setting	Within 0.01% of set output frequency-when set from parameter unit						
		Analog setting	Within 0.5% of maximum output frequency (at 25℃±10℃)						
	Voltage/frequency characteristics		Crossover frequency 50 to 360Hz adjustable constant torque or torque pattern selectable						
	Torque boost		Manual and automatic torque boost						
	Braking torque	Regenerative	100% or more (short time rated) ····· 2.2K to 7.5K Capacitor charging (about 20% or more *3) ····· 11K to 22K						
		DC injection	Operating frequency (0 to 60Hz), operating time (0 to 10 seconds), voltage (torque) variable						
	Current limiting control		Limiting current 150%, null functioning is selectable						
	Stall prevention activating level		Activating current level is adiustable						
	Overload current rating		150% 1 minute, 200% 0.5 seconds						
Operational specifications	Frequency setting signal		0 to 5VDC, 0 to 10V, 4 to 20mA, auxiliary input 0 to ±5V, 0 to ±10VDC						
	Start command		Forward and reverse command individual, 2-wire or 3-wire control selectable						
	Acceleration/deceleration time		0.1 to 3600 seconds (acceleration and deceleration can be set seperately.)						
	Second acceleration/deceleration time		0.1 to 3600 seconds (acceleration and deceleration set to the same value or independent)						
	Acceleration/deceleration mode		Linear, S-pattern (2 types) selectable Shape A, Shape B						
	Multi-speed setting		Up to 7 speed (0 to 360Hz adjustable at each speed)						
	Maximum, minimum frequency setting		Maximum frequency can be set between 0 and 360Hz, minimum between 0 and 60Hz						
	Jogging operation		With jogging (JOG) mode select terminal (*6)(0 −360Hz)						
	Frequency jump		3 jump frequency points can be defined						
	Reset signal		With external reset input terminal (0.1 sec pulse)						
	Output stop signal		With input terminal						
	Operation status output signal		Running (RUN), up to frequency (SU), overload (OL), instantaneous power failure (IPF), frequency detection (FU)						
	Alarm output		1-C dry contact (230VAC 0.3A, 30VDC 0.3A)						
Protective/alarm functions			Overcurrent shutoff (during acceleration, deceleration, constant speed), regenerative overvoltage shutoff, undervoltage, instantaneous power failure, overload shutoff (electronic thermal relay), brake transistor alarm (*4), ground fault current, output short circuit, fin overheat, brake resistor overheat (*4), stall prevention, overload alarm						
Environment	Ambient temperature		−10℃ to +50℃						
	Ambient humidity		90%RH or less (non-condensing)						
	Storage temperature (*5)		−20℃ to +65℃						
	Ambience		No corrosive gases, oil mist, dust or dirt						
	Altitude, vibration		Below 3,300ft (1,000m) 0.6G or less.						
Inverter-mounted option			Up to two options can be used in the same time.						
Protective structure			IP20				IP00		
Weight (lb)			24		27		56		67

Note : *1. The maximum output voltage can not exceed the line voltage. Below the line voltage, the output voltage can be set as required
*2. The power capacity may depend on the value of the power supply impedance (including the input reactor).
*3. Depends on the motor loss.
*4. Not provided for the FR-Z340-11K to 22K.
*5. Short-time temperature during transportation, etc. Must be vibration free at sub-zero temperature.
*6. Jogging operation can be performed from the parameter unit.

8. 2 Block Diagram



Note : 1. Terminal PR is provided for FR−Z340−2.2K to 7.5K.
2. Terminal PI is provided for FR−Z340−5.5K to 22K.
3. Terminal CS is provided for the models of 11K and up.
*4. The models of 11K and up are not provided with the built-in brake resistor and brake transistor.

8. 3 Terminals

Symbol		Terminal	Description
Main circuit, power circuit	R/L1, S/L2, T/L3	AC power input terminals	Connect the commercial power supply.
	U,V,W	Inverter output terminals	Connect a three-phase squirrel-cage motor.
	+, P1, PR, −	Converter output terminals	Connect the optional BU brake unit (across terminals + and −) and external brake resistor (across terminals + and PR).
	R/L1, S/L2	Control circuit power supply terminals	Connected to the power supply terminals R/L1 and S/L2. To retain the alarm display, remove the jumper from the terminal block and apply **separate external voltage supply. (See p.6.)**
	⏚	Ground (earth) terminal	Inverter chassis (casing) grounding terminal
Control circuit (input signals)	STF	Forward start terminal	Connect STF and SD for forward run and disconnect to stop.
	STR	Reverse start terminal	Connect STR and SD for reverse run and disconnect to stop.
	STOP	Start self-holding (3-wire control) select terminal	Connect STOP and SD to select self-holding (3-wire control) start (See p. 7.)
	RH,RM RL	Multi-speed select terminals	Connect RH/RM/RL and SD as required to select up to 7 speeds. (See p.53)
	JOG /OH	JOG mode select or external thermal relay input terminal	Connect JOG and SD to select jogging operation. Run and stop with the start signal (STF, STR). Can also be used as the thermal relay contact input terminal to stop the inverter by the operation of the external thermal relay. (See p.53)
	RT	Second acceleration/ deceleration time select terminal	Connect RT and SD to select the second acceleration/ deceleration time
	MRS	Inverter output stop signal	Used to shut off the inverter output to bring the motor to a stop by the magnetic brake, etc. Connect MRS and SD to shut off the inverter output.
	RES	Reset terminal	Used to reset inverter tripping. Connect RES and SD for more than 0.1 seconds.
	AU	Current input select terminal	Connect AU and SD to run the inverter with the 4 to 20mA frequency setting signal.
	CS		Connect CS and SD to allow automatic restart control upon power-on after instantaneous power failure. (See p. 54)
	SD	Contact input common terminal	Common to the contact input signals and frequency meter. Isolated from the common circuit of the control circuit (5).
	10	Frequency setting power supply terminal	5V or 10VDC (selected by changing the connector setting). Allowable load current 10mA.
	2	Frequency setting (voltage signal) terminal	Input of 0 to 5VDC (0 to 10VDC) achieves the maximum output frequency at 5V (or 10V) and makes I/O proportionate to each other. Set the connector(CON5)to 5V to define 0 to 5VDC input and to 10V to define 0 to 10VDC input. **Internal resistance : 10kΩ.**
	5	Frequency setting input common terminal	Common to frequency setting signals. Not isolated from the common circuit of the control circuit. Do not ground.
	1 K	Auxiliary frequency setting input terminal	Input of 0 to 10VDC achieves the maximum output frequency at +10V (or −10V*) and makes I/O proportionate to each other. Added to the signal of terminal 2. **Internal resistance : 10k.**
	1 E	Auxiliary frequency setting input terminal	Input of 0 to 5VDC achieves the maximum output frequency at +5V (or −5V*) and makes I/O proportionate to each other. Added to the signal of terminal 2. Internal resistance : 10kΩ.
	4	Frequency setting (current signal) terminal	Input 4 to 20mADC. Internal resistance 250Ω.

Symbol		Terminal	Description
Control circuit (output signals)	A,B,C	Alarm output terminals	1-C dry contact output indicating that the output has been shut off by the protective function of the inverter. Normal : B-C closed (A-C open). Alarm : B-C open (A-C closed). (Contact capacity : 230VAC 0.3A, 30VDC 0.3A)
	RUN	Inverter running terminal	Switched to low at or above the starting frequency. Switched to high during stop or DC dynamic brake operation. (Open collector transistor output)
	SU	Up-to-frequency terminal	Switched to low when the output frequency has reached within the range of 10% of the set frequency (factory setting, adjustable). Switched to high during acceleration, deceleration, or stop. (Open collector transistor output)
	OL	Overload alarm terminal	Switched to low when current limitation or stall prevention activated. Switched to high when current limitation or stall prevention is cancelled. (Open collector transistor output)
	IPF	Instantaneous power failure terminal	Switched to low when instantaneous power failure or undervoltage protection is activated. (Open collector transistor output)
	FU	Frequency detection terminal	Switched to low when the output frequency has reached or exceeded the detection frequency set as appropriate. Switched to high when below the detection frequency. (Open collector transistor output)
	SE	Open collector output common terminal	Common to RUN, SU, OL, IPF and FU. Isolated from the common circuit of the control circuit.
	FM	Frequency meter or digital counter terminal	Factory-set to be approx. 3.5VDC (when FM and SD are disconnected) at 60Hz. Proportional to the output frequency. The output voltage has pulse waveform. Pulse frequency is factory-set to 1440Hz/60Hz.

* When 1 is set in function 64 to perform forward/reverse run with the analog signal, the maximum output frequency is achieved at −5V (or −10V)

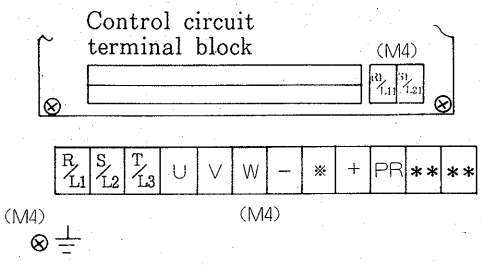
Note : The open collector transistor output is rated at 24VDC, 0.1A.

8. 4 Terminal Block Arrangement

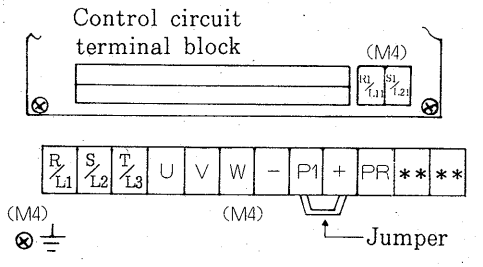
Main Circuit Terminal Blocks

400V class

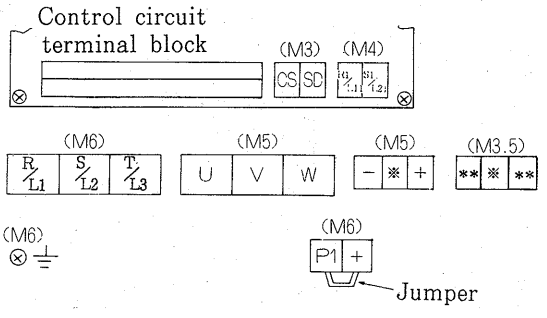
■ FR-Z340-2.2K, 3.7K



■ FR-Z340-7.5K, 5.5K



■ FR-Z340-11K, 15K, 22K



Note : Terminals marked * are not used.
〃 * * are factory use only.

Control Circuit Terminal Block

Common to all models

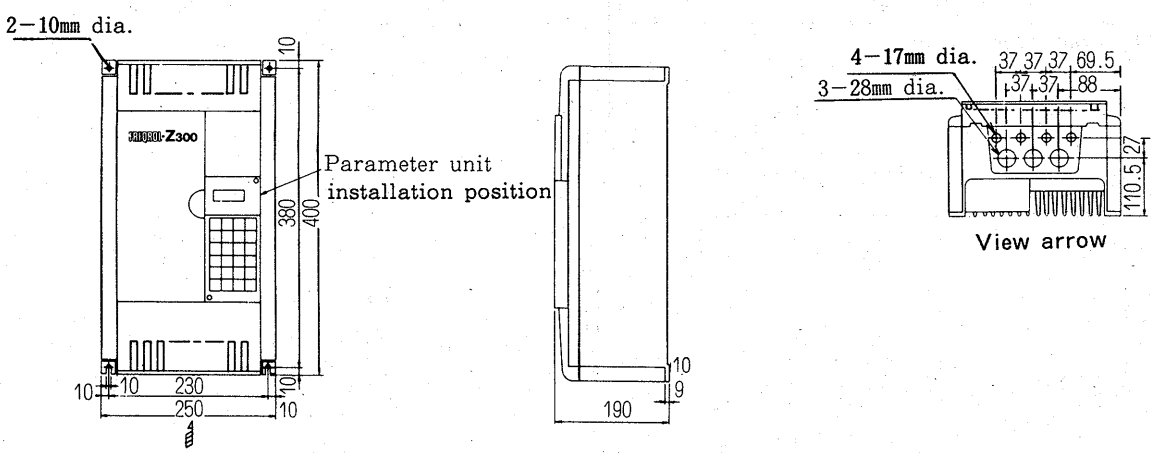
Structure···Two-stage molded terminals

Screw size ··· M3.5

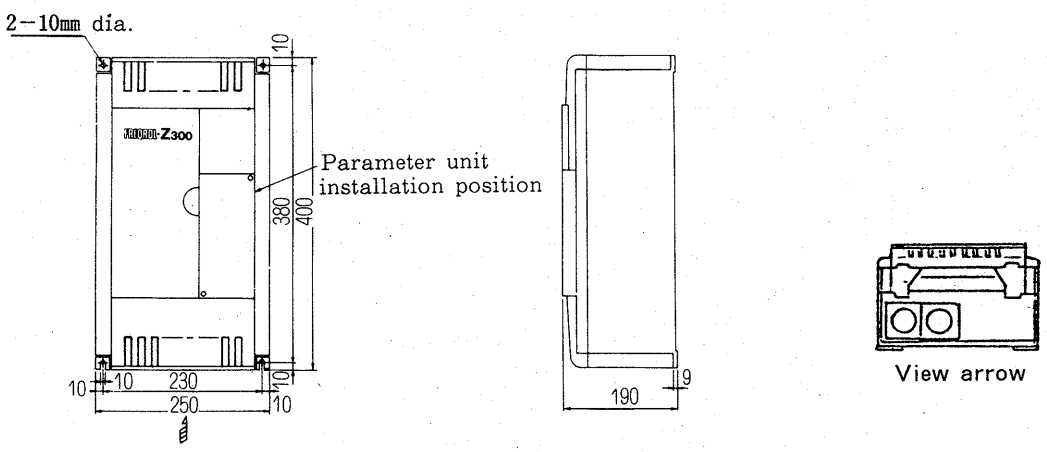
A	B	C	FM	SD	10	2	5	4	1K	1E	SD	STF	STR	JOG/OH		
SE	RUN	SU	IPF	OL	FU	RL	RM	RH	RT	AU	STOP	MRS	RES	SD		

8.6 Structure

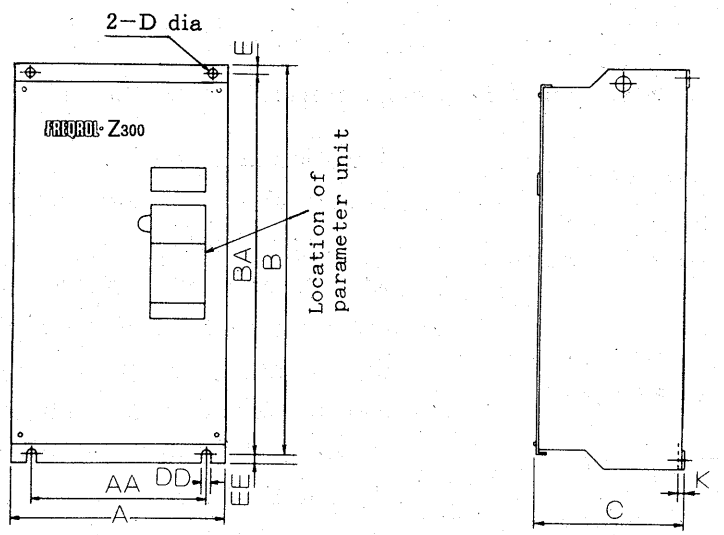
■ FR−Z340−2.2K, 4.0K



■ FR−Z340−5.5K, 7.5K



■ FR−Z340−11K, 15K, 22K



Inverter type	A	AA	B	BA	C	DD	E	EE	K
FR-Z340-11, 15K	340	290	595	570	195	12	15	10	8
FR-Z340-22K	340	290	595	570	195	12	15	10	8

8.7 Selection of Peripherals

Motor capacity (kw)	Applicable Inverter Type	No-Fuse Breaker (MCCB)		Magnetic Contactor (MC)	Wire size (AWG)		Input Fuse (Amps)
		Standard	With power factor improving reactor		L1,L2,L3	U,V,W	
2.2	FR−Z340−2.2K	Type NF30, 15A	Type NF30, 10A	S−K20	14	14	20
3.7	FR−Z340−3.7K	Type NF30, 20A	Type NF30, 15A	S−K20	14	14	30
5.5	FR−Z340−5.5K	Type NF30, 30A	Type NF30, 20A	S−K20	12	14	45
7.5	FR−Z340−7.5K	Type NF30, 30A	Type NF30, 30A	S−K20	12	12	60
11	FR−Z340−11K	Type NF50, 50A	Type NF50, 40A	S−K20	10	10	80
15	FR−Z340−15K	Type NF100, 60A	Type NF50, 50A	S−K25	5	8	100
18.5	FR−Z340−22k	Type NF100, 75A	Type NF100, 60A	S−K35	5	8	150
22	FR−Z340−22k	Type NF100, 90A	Type NF100, 75A	S−K50	4	5	150

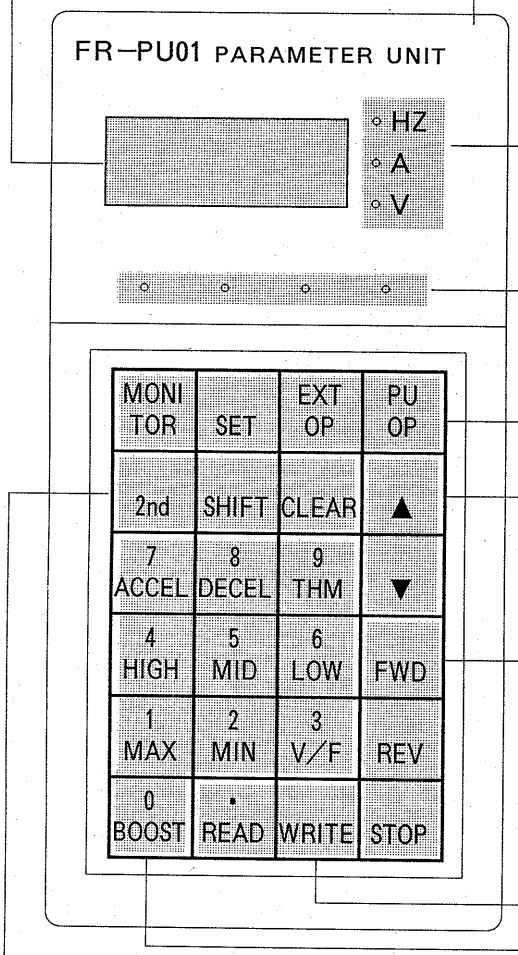
Note: 1. Select the MCCB in accordance with the power capacity.
2. The motor wire sizes assume that the length is 20m.

1. INTRODUCTION TO THE PARAMETER UNIT

The FR−PU01E parameter unit is installed to the FR−Z series inverter or connected to it by a cable (option) and allows operation to be performed, functions to be selected (set values to be read/written), the operating status to be monitored, and alarm function to be displayed.

The FR−PUO1E parameter unit is here after referred to as the "PU."

Display:
7-segment display (4 digits) for indicating the frequeucy, motor current, function set value, alarm definition, etc.



Installation screw:
Loosen the two screws to remove the PU from the inverter.

Monitoring mode indicator lamps:
Indicate the units of data currently being displayed (e.g. frequency, motor current).

Select mode indicator lamps:
When any of the mode select keys are pressed, the corresponding lamps are lit to indicate the mode selected.

Mode select keys:
Used to select operation by PU, operation by external signals, write/read of function set values, or monitoring of frequency, motor current, alarm display.

Frequency change keys:
Used to continuously increase or decrease the running frequency. Only valid while pressed.

Operation command keys:
Give forward, reverse and stop commands.

Write, read keys:
Used to check (read) and change (write) function set values after pressing the [SET] key.

Function and numeral keys:
Used to select any of the first functions and enter the frequency, function number and set value.

Second, third function select (2nd) key:
Used to read and change (write) the set value of any second function after pressing the [SET] key. Used with the [SHIFT] key to select any of the third functions.

Shift key:
Used to select monitoring mode (frequency, motor current, alarm definition) or any of the third functions.

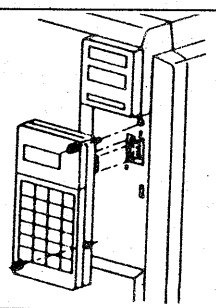
Clear key:
Used to clear a wrong set value and return to the previous value.

2. INSTALLATION OF THE PARAMETER UNIT

The PU may either be installed directly to the inverter or connected to the inverter by an optional cable so that it may be hand-held or installed in a panel. The PU may be installed and removed when the inverter is on or running.

2.1 Direct Installation to the Inverter

The PU is used on the front cover of the inverter (electrically coupled by the connector). For the modes not equipped with the PU. remove the accessory cover from the inverter front cover an install the PU in that position.



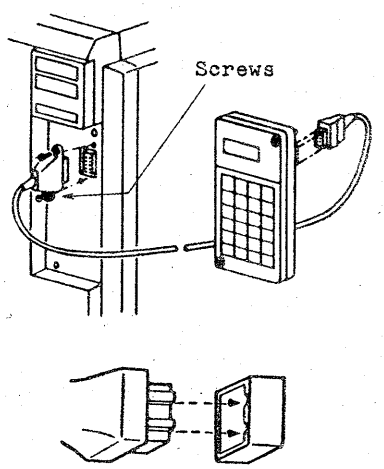
(1) **Connection**
Securely insert the PU connector into the inverter connector as shown on the left.

(2) **Fixture**
Securely fix the PU to the inverter with two PU installation screws.

CAUTION The PU should be installed directly to the inverter with the inverter front cover installed.

2.2 Connection Using the Cable

The PU may be installed not only to the inverter but also to the surface of a panel or may be hand-held for adjustment, maintenance, inspection, etc. In this case, an optional cable is required for connection of the PU to the inverter.



(1) **Connection**
Securely insert one end of the cable into the inverter connector and the other end into the PU as shown on the left.
Insert the cable plugs along the connector guides (as shown on the left).
(The inverter may be damaged if the plug is inserted in the wrong direction.)

(2) **Fixture**
Secure the inverter-side cable plug with installation screws.
Fix the PU-side cable plug so that the cable may not be disconnected by its own weight.

CAUTION The cable (option) for use with the PU must only be used to connect the PU and inverter.

3. FUNCTIONS OF THE PARAMETER UNIT

The PU may be used in a wide variety of applications from motor operation to monitoring as described below:

Selection of operation mode (p. 34)	Allows selection between external operation mode and PU operation mode. External operation·····The inverter is operated from the start switch and frequency setting variable resistor, connected to the inverter terminal block. (EXT OP) PU operation·····The inverter is started/stopped and set to running frequency from the PU keyboard. (PU OP)
Operation of motor (p. 35)	The frequency may either be entered directly from the ten-key pad or by holding down the ▲ (or ▼) keys.
Change of function set value	Allows the required function to be read directly or rewritten··· ·····p. 36 Convenient functions ●All set value clear (initialization) ·····p. 39 ●Write disable ····· p. 52 ●Frequency meter calibration·····p. 38
Monitoring (p. 41)	Allows the operating status (e. g. output frequency, motor current) to be checked and alarm definitions to be monitored.

Operation Mode (EXT OP), (PU OP)

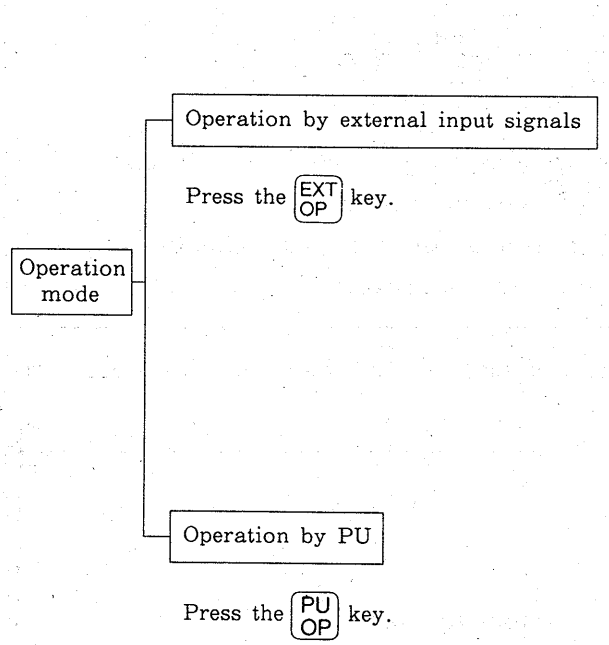
There are two major operation modes for the inverter; "operation by external input signals" and "operation by PU." The operation mode may either be selected (switched) by PU's mode select keys or limited (fixed) as specified.

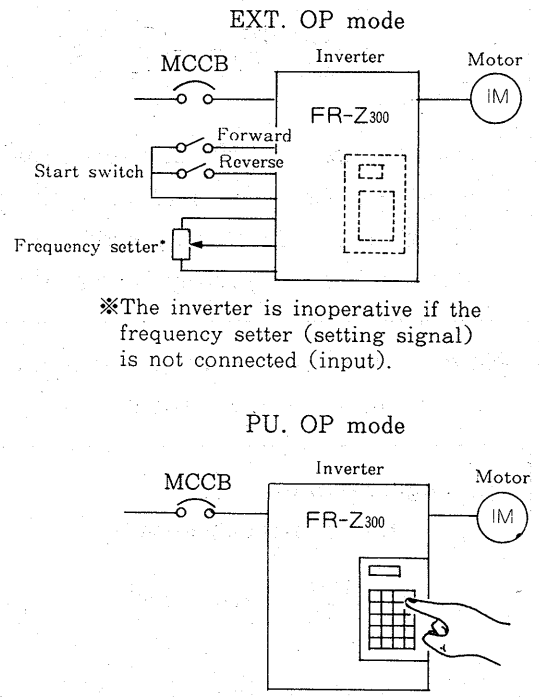
Factory-Set Operation Mode (Default on Inverter Power Up)

The operation mode defaults to "external input signal operation" mode. Hence, the inverter is ready to be operated by powering it up. In this state, switch on the start signal (across STF/STR and SD) to start operation.

Limiting (Fixing) the Operation Mode

The operation mode at power on may be limited, e. g. operation from the PU is enabled at power on without switching the operation mode with the PU's mode select key. For full information on setting the operation mode, see page 52.





Note **Switching from PU operation mode to external input signal operation mode**

This switching cannot be performed if the start signal is on (across terminals STF/STR and SD). The switching operation must be performed (the EXT OP key pressed) after the start signal has been switched off and the motor has stopped.

The motor can be started and stopped from the PU without using the external frequency setter or start switch. The PU also allows jog operation.

Operating Procedure

Key press procedure examples

(1) Directly entering (setting) the required frequency ≪Direct setting≫

Key press sequence

PU/OP → Required frequency (up to 4 digits) → WRITE → FWD (or REV) → STOP

Setting the running frequency ····· Repeating this setting during operation allows the speed to be varied.

(2) Setting the required frequency with gradual speed change with ▲ or ▼ key ≪Step setting≫

Key press sequence

PU/OP → ▲ (or ▼) → WRITE → FWD (or REV) → STOP

Use the ▲ or ▼ key to define the required frequency. The frequency only increases (or decreases) while the ▲ or ▼ key is pressed.
These keys may also be used for microadjustment as the frequency change is slow at first, gradually increasing with time as key is pressed.

Note When the required frequency has been defined, the WRITE key must be pressed to store the set frequetcy.

(3) Jog operation

Key press sequence

PU/OP → SHIFT → FWD (or REV) **(Hold to run)**

Hold down the FWD (or REV) key to operate, release to stop.
The jog operation frequency is the value set in parameter 15.

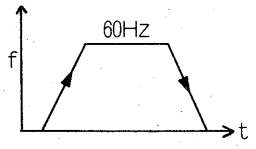
To return to external operation mode, press the STOP key and after the motor has stopped, press the EXT/OP key. (If switching is not achieved, see page 46.)

(4) Changing the speed from the PU during multi-speed operation

See the procedure (1) or (2) on page 36.

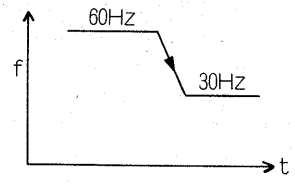
Typical Operation

● 60Hz operation (Stop to 60Hz)



	60Hz Setting		Start	Stop
Key used	PU OP, 6, 0	WRITE	FWD or REV	STOP
indication	60 Hz A V	60.00 ↕ alternately F	60.00 Hz A V	0.00 Hz A V

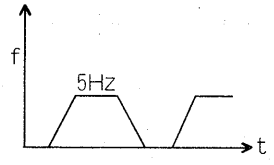
● Speed change during operation (60Hz to 30Hz)



	(60Hz Operation)		30Hz Setting	
Key used	——	PU OP	3, 0	WRITE
indication	60.00 Hz A V	60.00	30	30.00 Displayed ↕ alternately F

Note When the monitoring mode indicator lamp is on, direct frequency setting cannot be performed. In this case, set the frequency again after cancelling monitoring mode by pressing the PU key.

● Jog operation



	Sesecting jog Mode	Operation
Key used	PU OP, SHIFT	FED (or REV)
indication	JOG Hz A V	* 5.00 Hz A V

Note

1. JOG mode cannot be selected during motor operation and must be selected after stopping the motor by the STOP key.
2. Press the PU OP key to cancel JOG mode.
3. The jog operation frequency and acceleration/deceleration time (acceleration time = deceleration time) can be defined by parameters. (See page 53.) Their factory-set values are 5Hz and 0.5 seconds (i.e. acceleration/deceleration takes 0.04 seconds to reach 5Hz.)
4. Check the starting frequency if the motor does not start. Pr 13
   If start frequency Pr 13 is higher than Jog frequency Pr 15, motor will not start.

● Monitoring mode is automatically selected and the current output frequency displayed when the motor is started by pressing the start key (FWD or REV).*

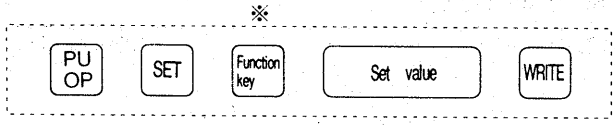
● The mode indicator lamp above the PU OP key flickers to indicate that the inverter is running (motor is rotating). (This also applies to the DC injection brake operation.)

The PU allows the required function to be selected from among many functions of the inverter and their set values can be changed or checked.
The factory-set value need not be changed when they are appropriate.
Function groups 1 to 3 are different in operating procedure as described below.

Operating Procedure

(1) Setting the first function (numbers 0 so 9) ····· Main function

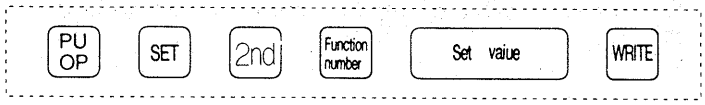
※



Note: The procedure on the left allows speed change to be made during three-speed operation (high, medium, low).

※The function names (abbreviated) are indicated on the keys (0 to 9).

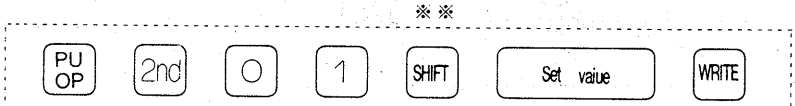
(2) Setting the second function(from function number 10 onward) ····· Used for application operation, etc.



Note: The procedure on the left allows speed change to be made during multi-speed operation (speeds 4 to 7).

(3) Setting the third function ····· Calibration

※※



※※ The required function is called and set in accordance with the number of times the SHIFT key is pressed. For more information, see page 44.

Reading the set value

In any of the above procedures, do not enter the set value and press the key instead of READ.

(Example) SET 2nd Function number READ (Second function)

Terminating or canceling the function setting

Press the PU OP key to switch to monitoring or motor operation from the PU during setting or on completion of write.

Setting Examples

(1) Setting the first function (acceleration time) ····· Change from 5 seconds to 10 seconds.

	Selecting First Function	Setting Acceleration Time	Reading Present Value	Changing to 10 Seconds	Write
key used	SET	→ 7 ACCEL	→ READ	→ 1 0	→ WRITE
Indication	PF ○Hz ○A ○V ○ ● ○ ●	PF 7	5.0	10	10.00 ↕Displayed alternately PF.15

Note: After write is complete, any function number of the first functions may be called by pressing the corresponding function key without pressing SET

(2) Setting the second function (jog operation frequency) ····· Change from 5Hz to 10Hz.

	Selecting Second Functiom	Setting Jog Frequency	Reading Present Value	Changing 10Hz	Write
key used	SET 2nd	→ 1 5	→ READ	→ 1 0	→ WRITE
Indication	PF. ○Hz ○A ○V ○ ● ○ ●	PF.15	5.00 (5Hz)	10 (10Hz)	10 ↕Displayed alternately PF 7

Note: 1. PF is followed by a period to indicate that the function selected is the second function. (PF.)

2. After write is complete, any parameter number of the second functions may be called by pressing 2nd and entering the corresponding Function number without pressing SET

When the required function cannot be changed or read

See page 45 if the setting procedure results in alarm display and the set value cannot be written.

The PU allows calibration (adjustment) of the display meter connected across the frequency meter connection terminals FM and SD of the inverter.
When a digital display meter is used, the PU allows the frequency of the pulse train output signal to be adjusted.

Preparation: (1) Connect a frequency meter across inverter terminals FM and SD. (Note the polarity.)
(2) When a calibration resistor has already been connected, adjust the resistance value to zero or remove the resistor.

Operating Procedure

1. Set the reference output frequency of the FM terminal.
   (it need not be set when operation is performed at the maximum output frequency of 60Hz or less.)

   PU OP → READ → 2nd → 3 → 8 → Set value → WRITE
   Set value: Set max frequency
   Default value is 60Hz

2. Perform operation at the maximum output frequency from the PU. (*)

   PU OP → Set value → WRITE → FWD (or REV)

3. Select the meter calibration mode.

   PU OP → 2nd → 0 → 1

4. Adjust the reading.

   Hold down the ▲ (or ▼) key in accordance with the meter reading.
   Press the WRITE key on completion of adjustment.

※The motor need not be connected.

Typical Operation ····· Operation at the maximum output frequency of 120Hz

	Step	Keying Sequence
1	Set 120(Hz) in function 20 "frequency at 5V input."	PU OP → SET → 2nd → 2 → 0 → 1 → 2 → 0 → WRITE
2	Set 120(Hz) in function 38 "FM terminal reference output frequency."	PU OP → SET → 2nd → 3 → 8 → 1 → 2 → 0 → WRITE
3	Operate at 120Hz from the PU.	PU OP → 1 → 2 → 0 → WRITE → FWD (or REV)
4	Select calibration mode.	PU OP → 2nd → 0 → 1
5	Make calibration.*	Adjust with ▲ or ▼ key and press WRITE key on completion.
6	Check linearity. (Run at 60Hz.)	PU OP → 6 → 0 → WRITE (Check that the reading is 60Hz)
7	Stop operation.	STOP

Note*: Calibration cannot be made if the parameter write disable has been set (set value of function 77 is 1).

Initializing the Set Values

All or most of the function settings can be returned to the factory-set values (initialized). This operation is referred to as "all clear."
Either of the following all clear types may be selected.

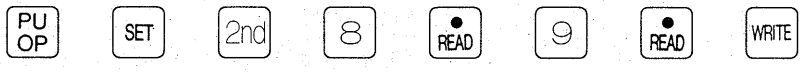
All Clear Types

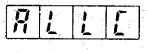
Either type may be selected by function 75:

All Clear Mode	Set Value of Function	Initialization
Initialization with the exception of some functions	0 (Factory setting)	All functions are initialized with the exception of the frequency at 5V input, frequency at 20mA input, parameter write disable selection, frequency setting voltage and current bias/gain (third functions).
Initialization of all functions*	1	All functions are initialized to factory-set values.

*All clear mode (function 75) is also initialized to the factory-set value.

Operating Procedure ····· Initialization in all clear mode selected by function 75



On completion of write,  is displayed and flickers.

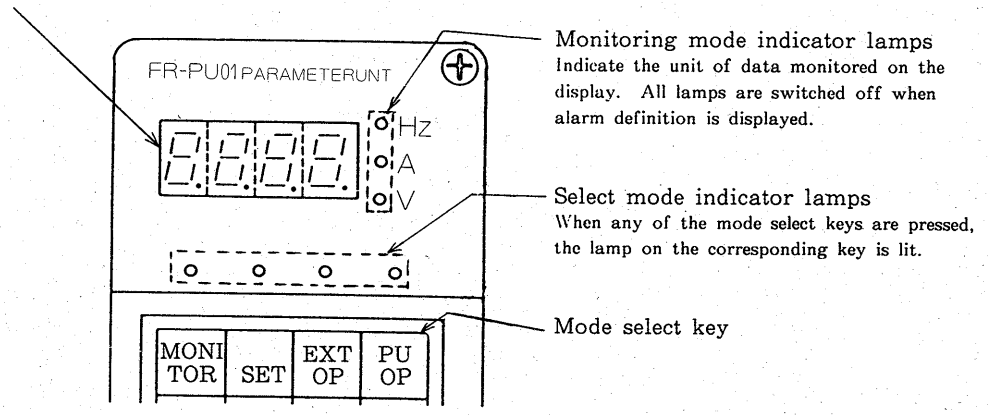
The PU allows monitoring (on the segment display and LEDs) of the inverter output status (e. g. output frequency, output voltage), load state (e. g. motor current) and activated protective function at alarm occurrence.

Types of Monitoring

Monitoring Type		Unit	Display	Remarks
Output frequency		Hz	Display and monitoring mode indicator lamps	In monitoring mode, press SHIFT to switch the data being displayed. (p. 41)
Output voltage		V		
Motor current	Steady-state	A		
	Peak	A		Displayed only when data to be monitored is set in function 76. Switched from output voltage being monitored. (p. 56)
Regenerative brake operation factor		%		
Converter output voltage		V		
Speed		rpm, etc.		Switched from output frequency being monitored when function 37 is set. (p. 56)
Direction of rotation		–	Monitoring mode indicator lamps	Forward ··· on. reverse ··· flicker.
Running		–	Select mode indicator lamps	The lamp above the corresponding mode select key is lit. Flickers during run and lit during stop.
External/PU operation mode		–		
Monitoring mode		–		The lamp above the mode select key is lit to indicate the mode state.
Setting mode		–		
Jog mode		–	Display	"Jog" is displayed when jog operation mode is selected. (p. 34)
Alarm definition*	Protection name	(Symbol)		Indicates the protective function activated. Allows past alarms to be checked. (p. 41)
	Code	(Numeral)		Valid only when function 76 has been set. (p. 56)
Current limiting operation		–	Monitoring mode indicator lamps	All monitoring mode indicator lamps are lit when the limiting function is activated.

* For alarm definitions, see page 44.

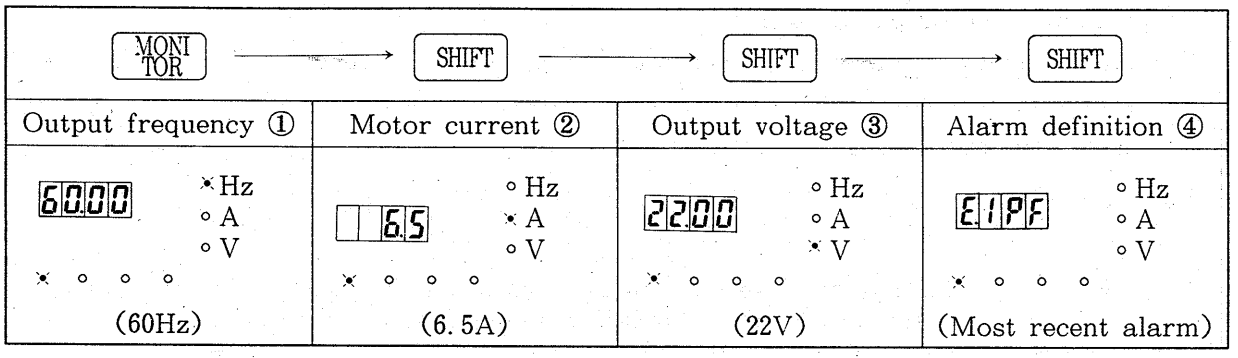
Display (4–digit, 7–segment LED)



Parameter unit

Typical Operation

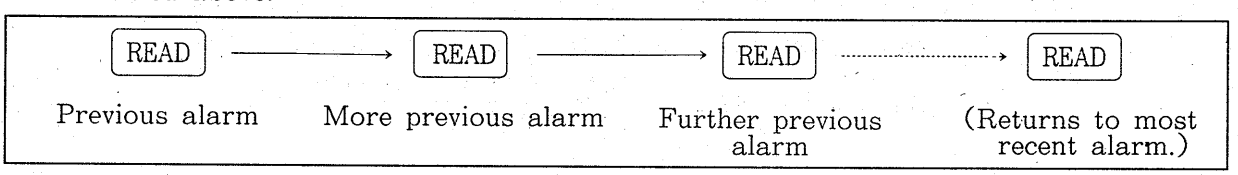
● **Output frequency, motor current (steady-state), output voltage, alarm definition (check)**



Note: When the alarm definition④ is being displayed, press SHIFT one more time to return to the output frequency display.①

● **To read the past alarm definitions**

Up to four alarm definitions can be read, beginning with the most recent alarm.
Perform the following operation when the most recent alarm definition is being displayed as indicated above.



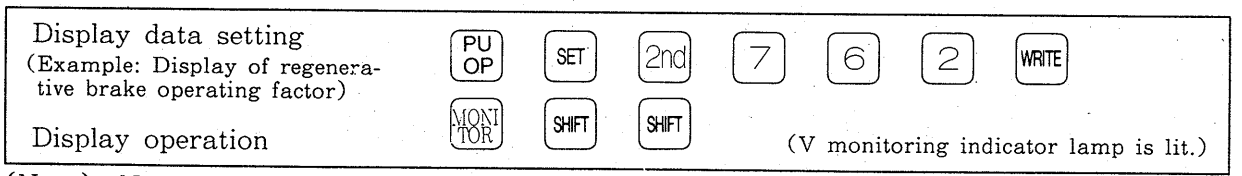
Note **1. To clear the alarm definitions :**
When the alarm definition is being displayed, press the CLEAR key to clear the alarm definition currently being displayed from the memory and display the preceding alarm definition. (Note)

2. To read the operating status immediately before alarm occurrence :
On occurrence of alarm, the display automatically switches to the indication of the protective function activated. At this time, press the SHIFT key (without resetting) to return to the output frequency monitoring. This allows the running frequency immediately before alarm to be read. This also applies to the current and voltage values which, however, do not remain in memory.

3. Repeated alarm errors will cause the inverter, to "drop off" the oldest error in memory.

● **Motor peak current, regenerative brake operating factor, converter output voltage, alarm code**

Any of the above data may be selected by setting the function 76.
The selected data is displayed for the above output voltage monitoring.



(Note) : Never clear the alarm history record, if you are going to call out a Mitsubishi service engineer. The service history alarm will assist in deciding the reason for the inverter tripping. If no alarm history is present, for the service engineer to check, then there was no need to call out an engineer.

● **To read the speed**

Any of the motor and load shaft speeds, line speed, etc. can be displayed in proportion to the output frequency.

The speed display is made valid when other than 0 is set in function 37.

To display the speed of a 4-pole motor :

Function setting: PU OP → SET → 2nd → 3 → 7 → 4 (4 poles) → WRITE

Display: Running the inverter switches the output frequency (Hz) monitoring to the speed display in R.P.M (equivalent to frequency).

Note : 1. For full information on the function set values, see page 56.

2. The displayed speed is not the actual speed. Use the "FR−ZPO feedback control" option to display the actual speed.

3. The display switches to the speed by reading any of the frequency set value, such as the running or set frequency defined by the PU (see page 41).

Example : When the running frequeucy has been set to 30Hz from the PU, reading the speed as indicated above displays 900 (rpm).

$$\text{Displayed speed } N = \frac{120 \times f \text{ (running frequency)}}{p \text{ (number of poles)}}$$

Monitoring Mode Indicator Lamps

In this manual, the monitoring mode indicator lamps are indicated in the following arrangement. ● indicates that any of the monitoring mode and select mode indicator lamps is on and ○ indicates off.

Indication	Function	
○ Hz	Indicates the frequency. (Note 1)	All lamps except for the selected mode flicker if the current limiting or stall prevention function is switched on in monitoring mode. On during forward run and flicker during reverse run.
○ A	Indicates the motor current.	
○ V	Indicates the output voltage. (Note 2)	

Note : 1. The speed is displayed when other than 0 is set in function 37.

2. Other data is displayed when any of 1 to 4 is set in function 76. (See page 56)

Alarm Definitions

If any inverter fault has occurred, the PU display automatically indicates the corresponding following alarm definitions. (For further details, see page 21 and 22)

Indication	Characters	Description	Error No.
E0C 1	EOC1	Inverter output current has exceeded the overcurrent limit during acceleration.	1
E0C2	EOC2	Inverter output current has exceeded the overcurrent limit during constant-speed operation.	2
E0C3	EOC3	Inverter output current has exceeded the overcurrent limit during deceleration.	3
E0uT	EOVT	Regenerative energy from the motor has caused the inverter DC-link voltage to exceed the regenerative overvoltage limit.	4
ETHn	ETHM	Electronic thermal relay in the inverter has been activated (150 % or less of the set current).	5
ETHT	ETHT	Electronic thermal relay in the inverter has been activated (150 % or more of the set current).	6
EIPF	EIPF	Instantaneous power failure protection in the inverter has been activated	7
EUuT	EUVT	Input line voltage has dropped below the specified value.	8
EFIn	EFIN	Transistor cooling fin temperature in the inverter has exceeded the specified value.	9
E bE	E BE	Brake transistor in the inverter is faulty.	10
E GF	E GF	Excessive current detected in the inverter output circuit due to ground fault.	11
EOHT	EOHT	External thermal relay has switched on.	12
EOLT	EOLT	Stall prevention has been activated to stop the motor during constant-speed operation.	13
EOPT	EOPT	Connection fault has occurred in the option unit used in the inverter during operation.	14
E PE	E PE	Data storage device corresponding to the inverter function number (parameter) is faulty.	15
E PE	E PE	Frequency setting power supply short circuit. (Terminals 10 and 5 are short circuited) (See p. 17.)	16
E0C 1	EOC1	Excessive current detected during acceleration due to short circuiting on the output side.	17
E0C2	EOC2	Overcurrent detected during constant-speed operation due to short circuiting on the output side.	18
E0C3	EOC3	Overcurrent detected during deceleration due to short circuiting on the output side.	19

※These error numbers are not displayed for FR-Z320-0.75K and 1.5K.

Display Characters (Alphanumeric characters)

Correspondences between characters and indications are as follows :

Character	Indication
0	0
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9

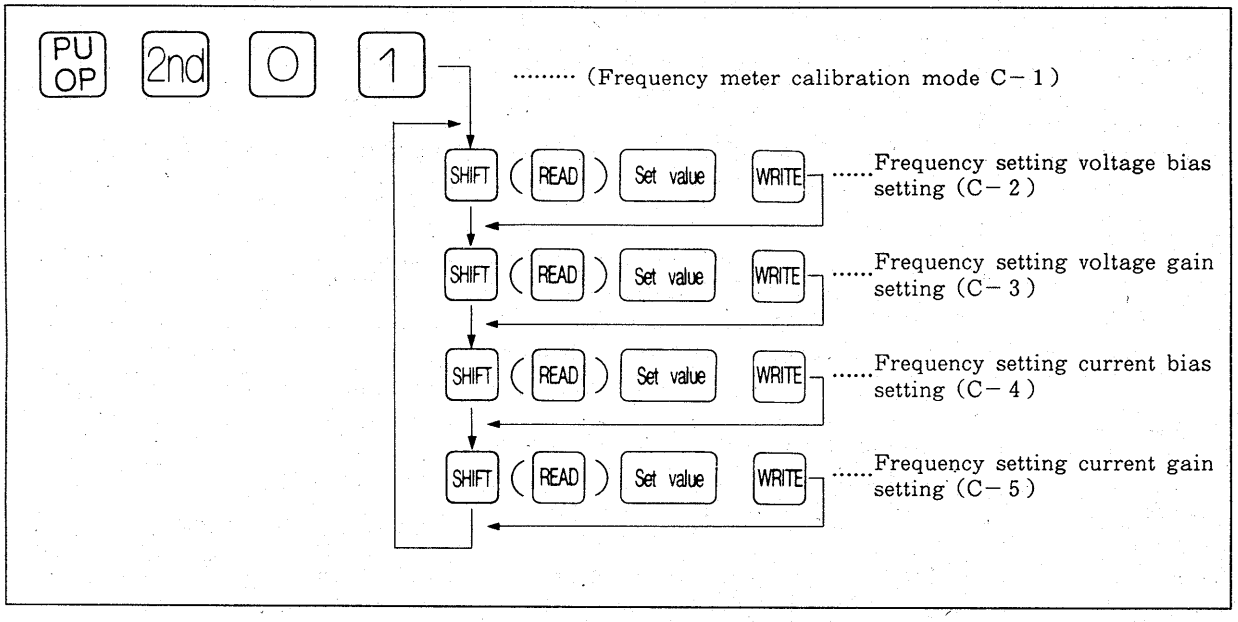
Character	Indication
A	A
B	b
C	C
E	E
F	F
G	G
H	H
I	I
J	J
L	L

Character	Indication
M	M
N	n
O	o
P	P
T	t
U	U
V	v
r	r
–	-

Adjusting "Bias" and "Gain" of the Frequency Setting Sigmal

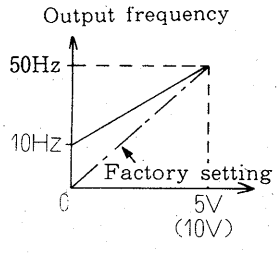
The "bias" and "gain" functions adjust the relationship between the set input signal given from outside the inverter to set the output frequency, e. g. 0 to 5VDC, 0 to 10VDC or 4 to 20mADC, and the output frequency.
These functions are assigned as the third functions and can be defined in the following procedure :

Operating Procedure



Adjustment example

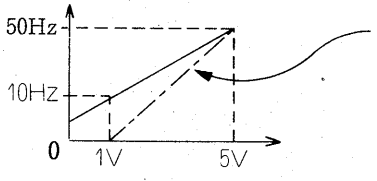
● Frequency setting voltage bias setting ····· To set the output frequency to 10Hz at the set voltage of 0V.



Frequency setting voltage

	Selecting Third Function	Bias	Read	setting to 10Hz	Write
keys pressed	PU OP, 2nd, 0, 1	SHIFT	READ	1, 0	WRITE
Display	C-1, Hz A V	C-2	0 (OHZ)	10 (10HZ)	10 ⇕ Displayed alternately C-2

Note : Make the above adjustment at the frequeucy setting input voltage (across terminals 2 and 5) of 5V (or 10V) or after disconnecting the input wires. (To obtain the characteristic shown on the left)
If the voltage is being applied, the output frequency at that voltage is set, e. g. if 1V is being applied across terminals 2 and 5 when the above setting is made, the output characteristic is as shown by the following continuous line.
The gain and current inputs can be set in the similar manner.



Set the output frequency to 0Hz by the above operation when 0Hz output is required at the input of 1V.

Precautions for PU Operation

Note the following during PU operation so that values may be set and entered properly.

Item	Precaution
Running the motor from the PU	1. Made valid only when the [PU OP] key is pressed. 2. The running frequency cannot be set in monitoring mode (the lamp above the MONITOR key is on). Press the [PU OP] key to cancel monitoring mode before entering the running frequency. 3. When the speed display has been selected (other than 0 set in function 37), enter the running speed in that speed unit. Note : When this display has been selected, do not set the speed using the [▲] and/or [▼] key. Otherwise, correct setting or proper operation may not be performed. 4. When error (Err.) is displayed or value cannot be written. (1) The value entered is greater than the maximum frequency (function 1 set value) or smaller than the minimum frequency (function 2 set value). (2) Parameter write disable has been set (1 set in function 77). (3) In external operation mode (lamp above the [EXT OP] key is on). (4) In monitoring mode (lamp above the MONITOR key is on). (In this case, step setting can be made.) 5. Jog operation (1) Cannot be performed while the motor is running. To be performed after the motor has stopped. (2) When the motor does not rotate, check if the jog operation frequency is smaller than the starting frequency (function 13).
Writing the set value	1. Only valid in PU operation mode and cannot be performed in external operation mode. (Read can be performed in either mode.) 2. Cannot be performed while the motor is running. To be performed after stopping the motor. The set value of the following functions may be written during operation : (1) Multi-speed setting (speed 1 to 7) ····· Function 4 to 6, 24 to 27 (2) PU monitoring display switching ····· Function 76

Item	Precaution
Writing the set value	3. Any set value cannot be written in any of the following cases (error is displayed) : (1) In external operation mode. (2) The motor is running (except for the above paragraph 2). (3) Parameter write disable has been set. (4) The function number selected is not indicated in the function list. (5) The value entered is above the setting range. (6) The value entered is greater than the maximum frequency already set or smaller than the minimum frequency. When the error has been displayed. press the PU/OP key or resume operation from the beginning.
Reading the set value	1. The set values of the first and second functions may be read in either of "PU operation" or "external operation" mode or while the motor is running. 2. The set values of the third functions may only be read in PU operation mode.
Monitoring	1. When the motor is to be run from the PU, press the start key (forward or reverse)after setting the running frequency to automatically switch to monitoring mode.
Common ● Operation mode ● Number of input value digits and decimal point	1. Switching between PU operation and external operation Mode switching cannot be made by pressing the PU/OP (or EXT/OP) key if : (1) The motor is running ; (2) The external operation start signal (across terminals STF or STR and SD) is on ; or (3) The operation mode (function 79) is fixed to PU or external operation. 2. External operation mode is selected when the inverter is powered up after powered down or is reset (across terminals RES and SD). (Factory setting) 3. The maximum number of input digits is 4. If the value entered has more digits, the last significant digit is ignored (e. g. 12345 is entered as 2345). 4. Zero must not be omitted. If .1 is entered in place of 0.1. it is actually entered as 1 with the decimal point ignored.

5. FUNCTIONS

Function List

Function Number (Parameter)		Function Description	Setting Range	Factory Setting	Refer To :	See Also
First function	0	Primary torque boost (manual)	0 to 30% of input volts	See page 49.	page 49	pr 40
	1	Interim maximum frequency	0 to 120Hz	120Hz	page 50	Pr 18
	2	Minimum frequency	0 to 60Hz	0 Hz	page 50	
	3	V/F (base) crossover frequency	50 to 360Hz	50Hz	page 51	Pr 20,21
	※ 4	3-speed setting (high speed)	0 to 360Hz	50Hz	page 53	
	※ 5	3-speed setting (medium speed)	0 to 360Hz	31Hz	page 53	
	※ 6	3-speed setting (low speed)	0 to 360Hz	10Hz	page 53	
	7	Primary acceleration time	0.1 to 3600 seconds	See page 49.	page 49	Pr 44
	8	Primary deceleration time	0.1 to 3600 seconds	See page 49.	page 49	Pr 44,45
	9	Electronic thermal overload	0 to 999.9A	See page 50.	page 50	
Second function	◎ 10	DC injection, Brake operation frequency	0 to 60Hz	3 Hz	page 51	
	11	DC injection, Brake operating time	0 to 10 seconds	0.5 seconds	page 51	
	12	DC injection, Brake voltage	0 to 20% of input volts	See page 51.	page 51	
	13	Start frequency boost	0.5 to 10Hz	0.5Hz	page 51	
	14	Machne load, V/F pattern matching	0, 1, 2, 3, 10, 11, 12, 13	0	page 50	
	15	Jog frequency	0 to 360Hz	5 Hz	page 53	
	16	Jog acceleration/deceleration time	0.1 to 3600 seconds	0.5 seconds	page 53	
	◎ 17	External thermal relay/Jog selector	0, 1	0	page 51	
	18	High-speed maximum frequency	120 to 360Hz	120Hz	page 50	Pr 1
	19	Crossover frequency voltage (Programmable, stabilized output volts)	0 to 500V, 9999	9999	page 51	
	20	Frequency at 5V (10V) input	1 to 360Hz	50Hz	page 50	Pr 3
	◎ 21	Frequency at 20mA input	1 to 360Hz	50Hz	page 50	Pr 3
	22	Stall prevention activation level	0 to 200% (current)	0 %	page 52	
	◎ 23	Deceleration time during current limiting operation	0, 0.1 to 3600 seconds	See page 52.	page 52	
	※ 24	Multi-speed setting (speed 4)	0 to 360Hz, 9999	9999	page 53	
	※ 25	Multi-speed setting (speed 5)	0 to 360Hz, 9999	9999	page 53	
	※ 26	Multi-speed setting (speed 6)	0 to 360Hz, 9999	9999	page 53	
	※ 27	Multi-speed setting (speed 7)	0 to 360Hz, 9999	9999	page 53	
	28	Multi-speed input compensation selection	0, 1, 2	0	page 53	
	29	Acceleration/deceleration pattern selection	0, 1, 2, 3	0	page 49	
	30	Maximum regenerative brake duty	0 to 30% (% ED)	See page 51.	page 51	
	31	Frequency jump 1A	0 to 360Hz, 9999	9999	page 53	
		Hold frequency during backlash acceleration	0 to 360Hz	1 Hz	page 54	
	32	Frequency jump 1B	0 to 360Hz, 9999	9999	page 53	
		Hold time during backlash acceleration	0 to 360 seconds	0.5 seconds	page 54	
	33	Frequency jump 2A	0 to 360Hz, 9999	9999	page 53	
		Hold frequency during backlash deceleration	0 to 360Hz	1 Hz	page 54	
	34	Frequency jump 2B	0 to 360Hz, 9999	9999	page 53	
		Hold time during backlash deceleration	0 to 360 seconds	0.5 seconds	page 54	
	35	Frequency jump 3A	0 to 360Hz, 9999	9999	page 53	
	36	Frequency jump 3B	0 to 360Hz, 9999	9999	page 53	
	37	R.P.M/Engineering units display	See page 57.	0	page 56	
	38	FM terminal output reference frequency (Erequency meter output calibration)	1 to 360Hz	50Hz	page 56	
	39	Setting no load current for automatic torque boost	0 to 215A, 9999	9999	page 49	
		Setting no load current fo slip compensation	0 to 215A	See page 52.	page 52	
	40	Torque boost (automatic)	0 to 200% volts	0	page 49	Pr 0
		Slip compensation speed gain	0 to 1000%	100%	page 52	
	◎ 41	Up-to-frequency sensitivity	1 to 100%, 9999	10%	page 55	
	◎ 42	Output frequency detection	0.5 to 360Hz, 9999	6 Hz	page 55	

Function Number (Parameter)		Function	Setting Range	Factory Setting	Refer To :
Second function	◎ 43	Output frequency detection at reverse run	0.5 to 360Hz, 9999	9999	page 55
		Second output frequency detection	0.5 to 360Hz	6 Hz	page 55
	◎ 44	Second acceleration/deceleration time	0.1 to 3600 seconds	5 seconds	page 49
	◎ 45	Second deceleration time	0.1 to 3600 seconds, 9999	9999	page 49
	◎ 46	Second torque boost (manual)	0 to 30% volts, 9999	9999	page 49
	47	Second V/F (Crossover frequency)	50 to 360Hz, 9999	9999	page 51
	48	Second stall prevention activation level (current)	0 to 200%	150%	page 52
	49	Second stall prevention activation level (frequency)	0 to 360Hz	0 Hz	page 52
	59	Slip compensation selection	0, 1, 2	0	page 52
	63	Alarm code output selection	0, 1, 2	0	page 55
	◎ 64	Polarity reversible operation selection	0, 1	0	page 54
	66	Cushion time for automatic restart after instantaneous power failure/commercial power supply-inverter switch-over	0.1 to 5 seconds	0.5 seconds	page 54
	67	Reset time for automatic restart after instantaneous power failure/commercial power supply-inverter switch-over	0, 0.1 to 5 seconds, 9999	9999	page 54
	75	Parameter all clear mode	0, 1	0	page 39
	※ 76	PU monitoring display switching	0, 1, 2, 3, 4	0	page 54
	77	Parameter write disable selection	0, 1	0	page 35
	78	Reverse run prevention selection	0, 1, 2	0	page 52
	79	Operation mode selection	0, 1, 2	0	page 52
Third function	C－1	Frequency meter calibration	0 to 360Hz	0 Hz	page 38
	C－2	Frequency setting, voltage bias	0 to 120Hz	0 Hz	page 57
	C－3	Frequency setting, voltage gain	1 to 360Hz	50Hz	page 57
	C－4	Frequency setting, current bias	0 to 120Hz	0 Hz	page 57
	C－5	Frequency setting, current gain	1 to 360Hz	50Hz	page 57

Minimum setting increments :

Frequency ····· 0.01Hz, time ····· 0.1 sec., current ····· 0.1A, % ····· 1%

Note : 1. Functions marked ※ can be changed in set values during operation of the inverter.
2. Function marked ◎ are different in function number between the FR－Z300 and FR－Z100/200 series.
3. Second V/F pattern, torque boost, acceleration, deceleration, stall prevention etc, are all independent of their equivalent primary functions.
4. Setting 9999 is an arbitrary number, selected by the factory, to show that any function set at 9999 will be in operative.

Now that you have set all the inverter's parameters to give optimum performance from your inverter, motor and machine, please take the time to cycle through the Parameters 1－79, C1－C5 and make note of them in the table provided at the back of this manual.

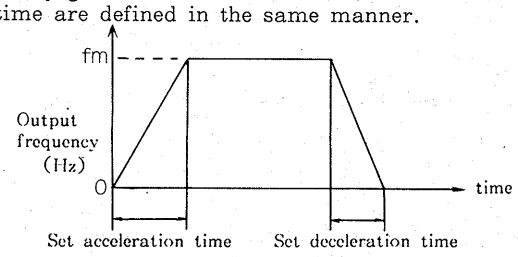
In the event that your machine needs to be serviced or overhauled during its normal inspection period, this written table of parameters will prove invaluable. Select Pr. 0, press READ, note etc. till all readings are recorded.

Remember, a sharp pencil is better than a blunt memory.

Setting the acceleration/deceleration time

Acceleration time [7], deceleration time [8]

Can be set between 0.1 and 3600seconds.
The set time indicates a period of time required to reach the frequency (fm) set to "frequency at 5V input" (page 50).
The jog and second acceleration/deceleration time are defined in the same manner.



Note : The set time of S-pattern acceleration/deceleration A (see below) is a period of time (ramp) required to reach the crossover frequency.

Second acceleration/deceleration time [4][4], second deceleration time [4][5]

Selected by the external contact signals which is given by connecting terminals RT and SD.
Factory setting = 5 seconds (acceleration time = deceleration time)

- To set different values for the acceleration and deceleration times
  Set acceleration time in function [4][4] and then set deceleration time in function [4][5]

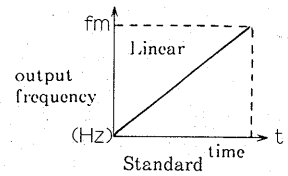
Note : Setting 9999 (factory setting) in function [4][5] defines the acceleration and deceleration times set in function [4][4] to the same value.

Selecting the acceleration/deceleration pattern

Acceleration/deceleration pattern selection [2][9]

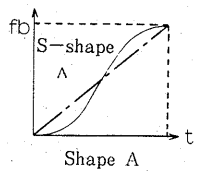
Set value 0	Linear acceleration/deceleration (factory setting)
Set value 1	S-pattern acceleration/deceleration A
Set value 2	S-pattern acceleration/deceleration B
Set value 3	Backlash prevention function (see page 55)

Set value = 0
〔Linear acceleration/deceleration〕



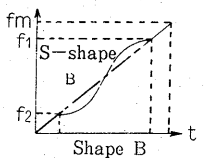
General acceleration/deceleration mode which allows speed to be increased or decreased straight up to the frequency at 5V input (fm).

Set value = 1
〔S-shape acceleration/deceleration A〕



Allows the acceleration/deceleration time to be reduced because the ramp is made steeper where the motor output torque is larger and gentler where the torque is smaller.

Set value = 2
〔S-shape acceleration/deceleration B〕

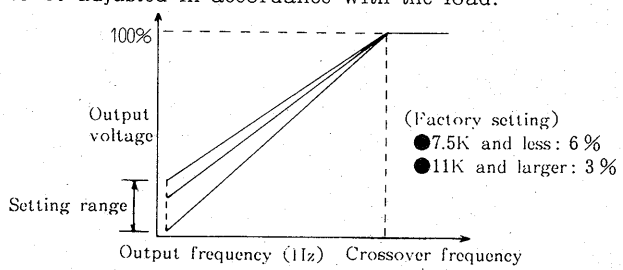


Provides an S-pattern characteristic between running frequencies f1 and f2, and features smooth acceleration/deceleration. The time having elapsed during this period is the same as that of linear acceleration/deceleration.

Adjusting the motor torque (torque boost adjustment)

Torque boost (manual) [0], Second torque boost (manual) [4][6]

Allows the motor torque in the low frequency area to be adjusted in accordance with the load.

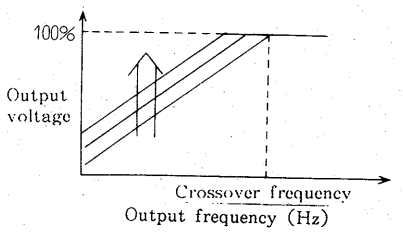


Note : 1. Both the manual and automatic functions can be used at the same time.
2. Current limiting function may be activated if the set value is too large. By using the current monitoring function, these two settings can be adjusted in accordance with the monitored motor current.
3. Second torque boost is made valid by connecting terminals RT and SD.

Motor's exciting current (No load current) setting for torque boost (automatic) [3][9], torque boost (automatic) [4][0]

Automatically controls the inverter output voltage (torque) in accordance with the load current detected.

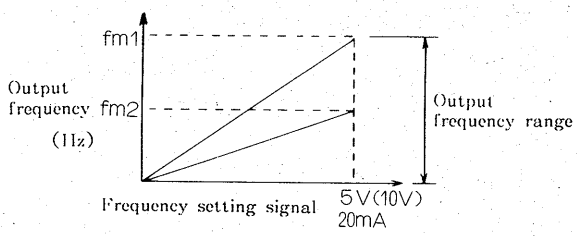
Function	Set Value
39	Sets the motor mo-load current I_o (Amps) 9999 : I_o = inverter rated current x 0.5
40	Sets the boost compensation value (%). 0 : torque boost (automatic) disabled.



Setting the maximum output frequency

Frequency at 5V (10V) input [2][0], frequency at 20mA input [2][1]

Allows the frequency to be set when the external frequency setting signal is 5VDC (or 10VDC) or 20mA. Hence, this frequency is the maximum output frequency when the inverter is operated by external signal.
All acceleration/deceleration times, including those of jog and multi-speeds, are the period of time required to reach this frequency.

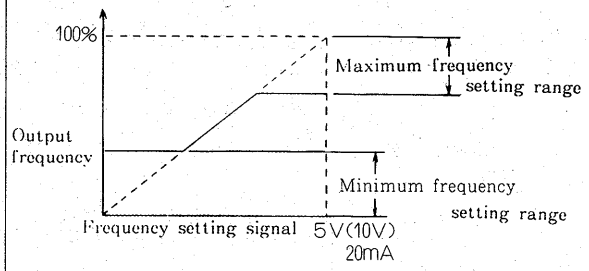


Note: This value is automatically over written by changing the third function (page 57) "frequency setting voltage gain" or "frequency setting current gain." As these functions have the same facilities as the third functions (C−3 and C−5), the most recent function selected has priority.

Setting the output frequency limits

Maximum frequency [1], minimum frequency [2]

Allow the output frequency to be clamped at the upper and lower limits.



Note: The minimum frequency should be greater than the starting frequency (see page 50).
The maximum frequency can not exceed 120Hz. For higher setting, use parameter [1][8]

High-speed maximum frequency [1][8]

To be defined for operations at higher than 120Hz. The maximum frequency [1] is automatically over written to this frequency.
To keep safety, parameter [1] is limited to 120Hz. Take special care with this parameter.

Setting the electronic thermal overload protection

Electronic thermal relay [9]

The set value for motor overheat protection is defined by a current value (Amps).
Setting to 0A disables this protection function.
Factory setting = (rated output current of the inverter)

Electronic thermal overload for constant-torque motor

When Mitsubishi's "constant-torque motor" exclusively used for inverter driving is used, the electronic thermal overload for use with this motor is set either of 10 to 13.
Set any of the following values in function [1][4] in accordance with the load characteristic to use the value set in function [1] [4] as the set value.

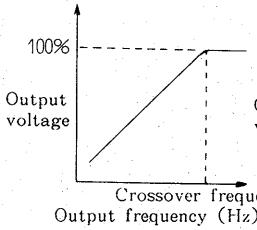
Set value 10	Constant-torque load	
Set value 11	Variable-torque load	
Set value 12	Constant-torque load	Boost 0% at reverse run
Set value 13	for lifting application	Boost 0% at forward run

Selecting the applied load characteristic

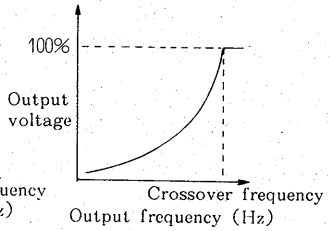
Applied load selection [1][4]

Allows the V/F characteristic to be selected in accordance with the load characteristic of the driven machine.

Set value = 0 (factory setting)
For constant-torque loads (e.g. conveyor, carrier)

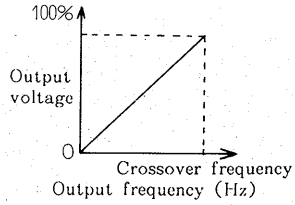


Set value = 1
For variable-torque loads (e.g. fan, pump)



Set appropriate V/F pattern by setting of the torque boost, V/F (base frequency) and crossover frequency voltage. [3], [20], [21].

Set value = 2 ····· Setting of boost to 0% at reverse run
Set value = 3 ····· Setting of boost to 0% at forward run
Constant-torque load for lifting applications



Note: Use set values 10 to 13 when separately blowered motor, which can work down to the low frequency with 100% torque output, is applied to the inveter.

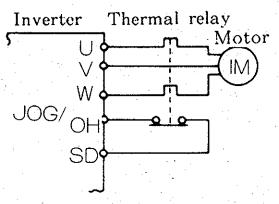
Selecting the external thermal relay input

Jog or External thermal relay input selection [4][6]

Stops the inverter and outputs alarm if the thermal relay outside the inverter is activated. The inverter remains stopped even if the thermal relay contacts are reset. Until inverter itself is reset.
Connect the thermal relay contacts (normally closed) across terminals JOG/OH and SD.

Set value	JOG/OH Terminal Function
0	JOG mode selected (factory setting)
1	External thermal relay input

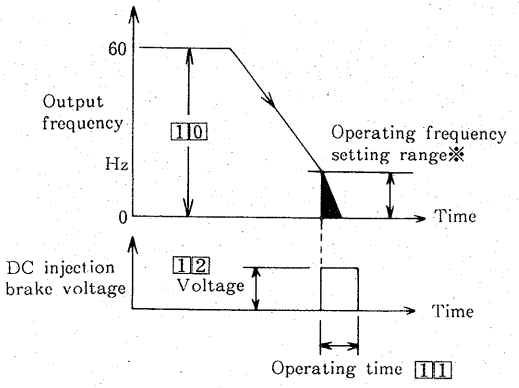
Note: Alarm "OHT" is displayed if 1 is set with terminals JOG/OH and SD opened.



Setting the DC injection brake

DC injection brake operating frequency [1][0], DC injection brake operating time [1][1], DC injection brake voltage [1][2]

Allows the stopping accuracy of positioning operation, etc. to be adjusted in accordance with the load by setting the DC injection brake torque (voltage) at a stop, operation time and operation starting frequency (※).

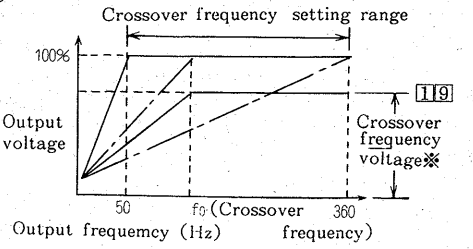


Note: 1. The operating time should be set to 0 when the DC injection brake is not required.
2. The DC injection brake is applied at 0.5Hz when the inverter is decelerated by using the frequency setting signal (or key). (Factory setting)
3. Factory-set value of DC injection brake voltage 7.5K and down ··· 8%, 11K and up ··· 4%
4. Setting 9999 to DC injection brake operating time [1][1] switches to coutinuous operation. Note that long-time operation will cause the motor to overheat.
5. Best results are obtained when [1][0] is set to a small value.

Setting the voltage/frequency output characteristics

V/F (crossover frequency) [3], crossover frequency voltage [1][9], second V/F (crossover frequency) [4][7]

Allows the crossover frequency (reference frequency at the rated torque of the motor) to be set as appropriate between 50 and 360Hz in accordance with the motor rating. Also allows setting of the output voltage at the crossover frequency. If the output voltage is set to less than the line voltage, that value is the maximum output voltage of the inverter.

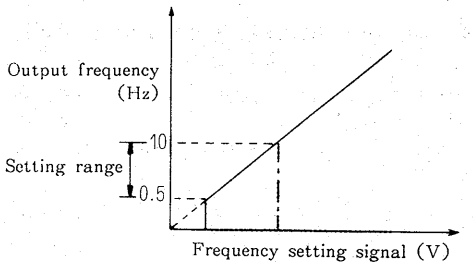


※
1. The maximum output voltage is same as the input line voltage if the crossover frequency voltage is set to 9999 (factory setting).
2. The second V/F is made valid by connecting terminals RT and SD.

Setting the starting frequency

Starting frequency [1][3]

Allows the frequency at start to be defined between 0.5 and 10Hz.



This function can be used to give a higher starting torque, with or without voltage boost.

Setting the regenerative brake operating factor (%ED)

Regenerative brake operating factor [3][0]

Allows the operating factor of the brake resistor to be defined. To increase the operating factor, the appropriate brake resistor capacity must be selected according to the technical information.
Maximum capacity of the discharging registor mounted in the inverter 7.5KW or smaller as stardard is 3% and 6% or 8% for exclusive optional resistors. Setting this value larger than this each resistor's maximum capacity would lead to overheating of the resistor which could become a fire hazard.
Factory setting −2.2K to 7.5K 2%
Note: Setting is invalid for the higher capacity models. (11K−22K)

<Warning> Do not increase the set value of this parameter from the factory setting unless external resistor is installed. Increasing this setting using mount-on resistor would lead to overheating of the resistor which could become a fire hazard.

Setting the current limiting control

Deceleration time during current limiting control 23

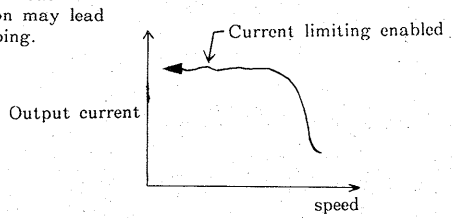
Controls the output current to prevent tripping if the current exceeds the specified value due to sudden deceleration or overload. The motor is decelerated if this control is kept activated.
The length of the deceleration can be set between 0.1 and 3600 seconds.

Set value 0	Current limiting control disable
Set value 0.1 to 3600	Current limiting control enable

Factory setting ····· Enabled
0.75K to 7.5K : 1 second
11K to 22K : 3 seconds

- When the current limiting function is activated, all the select mode indicator lamps blink with the exception of the one selected (see page 30).
- When E.OVT is caused by this function enabled, increase the set value of 23

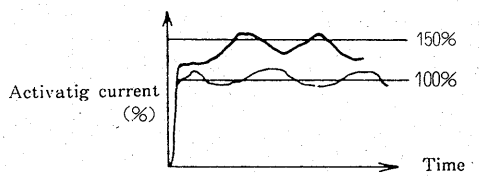
Note:
1. Continued operation may activate overload protection.
2. Excessive load condition may lead to tripping.



Setting the stall prevention activation level

Stall prevention activation level 22

Allows the stall prevention activating current level to be changed so that overload (excessive torque) is prevented when the capacity of the motor driven is small as compared to the inverter capacity.



Note: The activating current (%) indicates its ratio to the rated output current of the inverter.
Stall prevention remains off when 0 is defined. (Factory setting)

Second stall prevention activation level (current) 48, Second stall prevention activation level (frequency) 49

Allows the stall prevention activation level to be changed within the limited range, in addition to the above stall prevention activation level facility.
For example, the second stall prevention activation level can be used to define stall prevention of a smaller level than the above 22 at 10Hz or less.
Note: Not activated during acceleration.

Selecting operation mode and disable (write, reverse run)

Parameter write disable selection 77

Disables parameter write by using the PU.

Set value 0	Parameter write enable (factory setting)
Set value 1	Parameter write disable

Note: Write is allowed for functions (parameters) 77 and 79 even though 77 is set to 1.

Reverse run prevention selection 78

Defined to prevent any damage due to reverse running of the machine.

Set value 0	Reverse run allowed (factory setting)
Set value 1	Reverse run disallowed※※
Set value 2	Forward run disallowed※※

※※: Reverse or forward run is disallowed for both PU and external operation.

Operation mode selection 79

Allows operation to be only limited to PU or external mode.

Set value 0	Operation may be switched between PU and external mode. (factory setting)
Set value 1	Operation only allowed in PU mode.
Set value 2	Operation only allowed in external mode.

Note: This function may be changed in external operation mode.

Setting the slip compensation

Setting of motor's exciting current (No load current) for slip compensation 39
Slip compensation speed gain 40

Allows the motor speed regulation to be suppressed in accordance with the motor current detected, since the speed varies according to the magnitude of the load.

- Setting method
  Set 2 in function 59 to allow slip compensation to be defined.
  (Factory setting = 0)

Setting the motor's exciting current (No load current) 75
Define the no-load current of the motor.
Factory setting ··· Inverter rated current × 0.5(A)75
Setting the speed gain
Increase the gain to increase the compensation value.
Decrease the gain to decrease the compensation value.
Factory setting ··· 100%
Decrease the gain when the target speed has been exceeded and increase when the target has not been reached.

Compensated frequency $\triangle f$:
$\triangle f = K \cdot G \cdot (I_M - I_0)$ (Hz), $K = \dfrac{0.06}{\text{Inverter's rated current}}$

where, G=Gain % (pr.40)
$\triangle f_{max}$ = 0.1×pr.3 (Hz)
I_M=Inverter's output current
I_0=Motor's exciting current

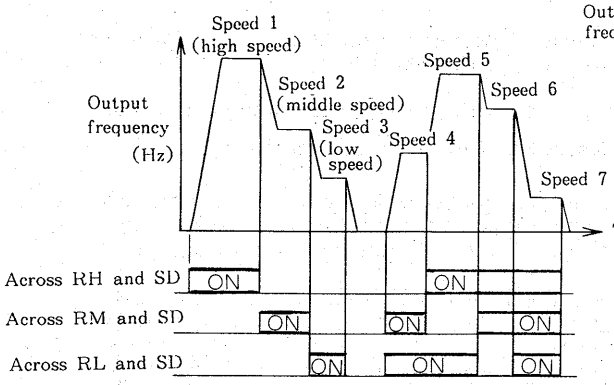
Setting the multi-speed pre-set operation

Speed 1 (high speed)	4	3-speed pre-setting
Speed 2 (middle speed)	5	
Speed 3 (low speed)	6	
Speed 4	2 4	Multi-speed pre-setting
Speed 5	2 5	
Speed 6	2 6	
Speed 7	2 7	

Allows any speed to be selected by closing the external contact signal (across terminals RH/RM/RL and SD). Each speed (frequency) can be pre-set between 0 and 360Hz.

Note: 1. Speed 4 to 7 are not selected if 2 1 4 to 2 1 7 are set to 9999 (factory setting).
2. For 3-speed setting, the frequency is set to the low-speed signal if two or more speeds are selected at the same time.

Example: The frequency is set to 50Hz if the signal across terminals RH and SD and across RL and SD are switched on at the same time after setting the high speed (RH) to 40Hz and the low speed (RL) to 50Hz and 2 1 4 to 2 1 7 are set to 9999.

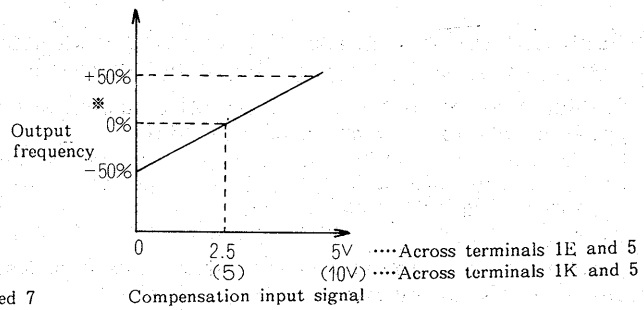


Multi-speed input compensation selection 2 1 8

Allows the speeds (frequencies) of multi-speed pre-set operation to be compensated for by giving external compensation signals.

Set value	Compensation by Input Signal
0	No compensation (factory setting)
1	Compensated
2	Override

Note: 1. Input the compensation signal into compensation input terminal 1K or 1E.
2. The override ratio is −50% for the compensation signal of 0V and +50% for 5V (or 10V), between which the ratio is proportionate to the signal.
Do not enter the master speed setting signal (across terminals 2 and 5).

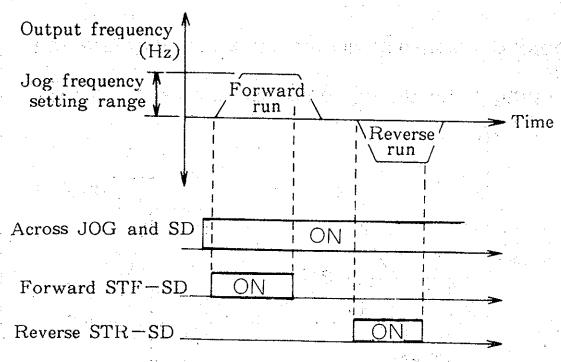


※0% is defined by the speed of RH, RM or RL command.

Setting for jog operation

Jog frequency 1 1 5, jog acceleration/deceleration time 1 1 6

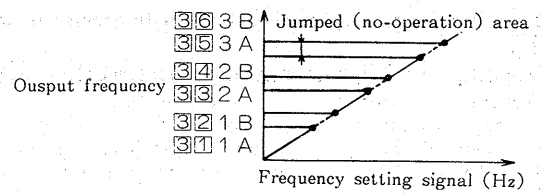
Allows jog operation to be started and stopped by selecting JOG mode (connecting the JOG and SD terminals) and switching on/off the starting signal (terminals STF, STR).
Jog operation may also be performed by using the PU. (See page 34.)



Setting the jump frequency

Frequency jumps 3 1 1 to 3 1 6

Allows any of the three areas to be jumped to avoid resonance attributable to the frequency unique to the mechanical system. The jump frequency may be set to either the top or bottom point of the area jumped. The value set to 1A, 2A or 3A is a jump point and operation is performed at this frequency.



Note: 1. Frequency jump is not made when the set value is 9999 (factory setting).
2. Setting 3 in function 2 1 9 switches 3 1 1 to 3 1 4 for use against backlash (see page 54).

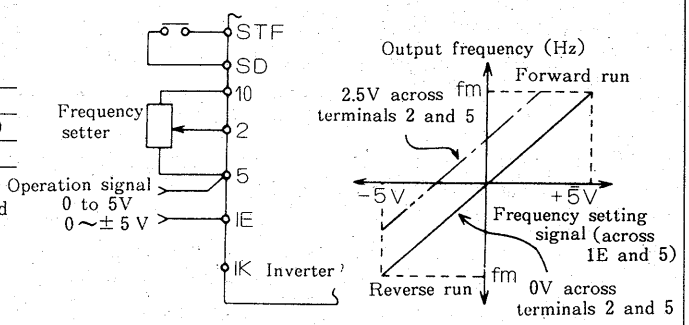
Selecting the reversible operation by frequency setting signal

Polarity reversible operation selection 6|4

Allows the forward (positive polarity) or reverse (negative) operation to be selected by setting the analog signal polarity using the auxiliary input signal terminal (1K or 1E).

Set value	Polarity Reversible Operation
0	Disallowed (Stop if negative polarity is given)
1	Allowed

Use the auxiliary input terminal only to perform forward or reverse operation by the frequency setting signal only independent to start signal STF or STR. The frequency setting signal is added to a command (voltage) if the command has been input across terminals 2 and 5.



Adjustment for automatic restart after instantaneous power failure or commercial power supply to inverter switch-over operation

Cushion time for automatic restart after instantaneous power failure or commercial power supply to inverter switch-over 6|6

Indicates the voltage rise time for automatic restart control. Allows the optimum operation to be performed by setting this time a little longer when the load (inertia etc.) is large.
Factory setting = 0.5 seconds
Note: For models 11K and below, this time may only be set when the FR−ZNS option is used.

Reset time for automatic restart after instantaneous power failure or commercial power supply to inverter switch-over 6|7

FR−Z340−11K, 15K and 22K standard-equipped with the instantaneous power failure automatic restart and commercial power supply to inverter switch-over operation functions. Define as follows to perform either of these functions. The reset time indicates a period of time required to commence control for the optimum restart.

Set Value	Automatic restart after instantaneous power failure or commercial power supply to inverter switch-over operation	
9999 (factory setting)	Disallowed	
0	Allowed ※	Reset time is set to the value indicated on the right.
0.1 to 5		Reset time may be defined between 0.1 and 5 sec. in accordance with the load specifications (inertia, torque).

Reset time
2.2K, 3.7K: 0.4 seconds
5.5K to 22K: 1.0 seconds

Note: 1. For the 7.5K and lower capacity models, the above setting is variable even though the FR−ZNS option is not used in the inverter.
2. For the terminal (CS) used for operation, see the inverter instruction manual. (models 11K to 22K)

※When the FR−ZNS option is not used (7.5K and below), setting 0 or any of 0.1 to 5 enables function 2|3 even though it has been disabled (setting 0), so that free running restart operation can be performed by this current limiting function when the power is restored. At this time, restarting is effected after the above reset time has elapsed. At ordinary power-on, the inverter also starts control after the above reset time has elapsed.

Setting to smooth backlash of reduction gear

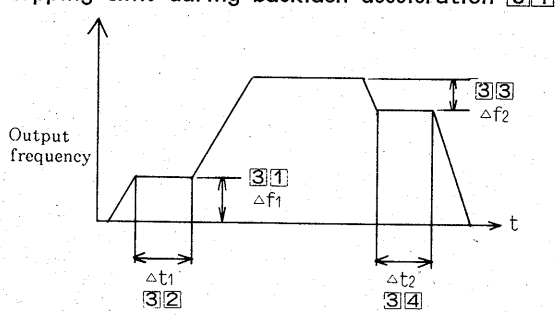
Stopping frequency during backlash acceleration 3|1

Stopping time during backlash acceleration 3|2

Prevents the inverter from tripping due to excessive torque on the motor shaft caused by backlash of the reduction gear during switching from forward run to reverse or vice versa or during deceleration.
Effective for starting a load having excessive inertia, e. g. fan.
Setting 3 in function 2|9 switches the frequency jump function 3|1 to 3|4 to backlash prevention mode.

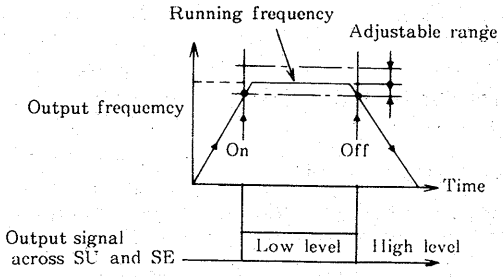
Stopping frequency during backlash deceleration 3|3

Stopping time during backlash deceleration 3|4

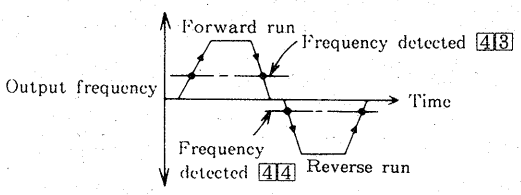


Adjusting and selecting the output signal (open collector transistor output)

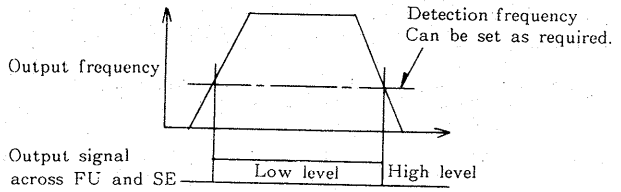
Up-to-frequency sensitivity 41
<Terminal SU>※
Allows the output signal "on" range to be adjusted between 1 and 100% of the running frequency when the output frequency has reached the running frequency.



Output frequency detection at reverse run 43
<Terminal FU Terminal SU>※
Allows the magnetic brake operation timing to be changed for forward run (upward motion) and reverse run (downward motion) during elevating operation, etc. The parameter is set to "9999" before shipment and the output frequency detected (10Hz) is the same at forward run and reverse run.



Output frequency detection 42
<Terminal FU>
Allows the required frequency to be set as appropriate between 0 and 360Hz.
The signal across terminals FU and SD is switched low if the output frequency reaches or exceeds the set value and is switched high if it drops below that value. This facility may be used for mechanical brake operation, open signal, etc.
Setting "9999" allows the FU terminal to be used as an output terminal which indicates "PU operation mode."



※Setting 9999 in function 41 allows the SU terminal to be used as the second output frequency detection terminal.
At this time, the detection frequency is the value set in 43.

Alarm code output selection 63
Allows the alarm code to be output from the open collector output terminal as a 4-bit digital signal at occurrence of an alarm.

Output Termimal	Set Value		
	0 (factory setting)	1	2
SU	Up-to-frequency	Alarm code bit 3	Normal ··· Operating status signal※
OL	Overload alarm	Alarm code bit 2	
IPF	Instantaneous power failure	Alarm code bit 1	Alarm ··· Alarm code signal
FU	Frequency detection	Alarm code bit 0	

Note: For more information on the alarm codes, see page 57.

※Identical to the output signal at the set value of 0.

Setting the speed display in R.P.M. or Engineering Units.

Speed display 3 7

Allows the speed monitored to be indicated as motor speed(RPM), load shaft speed, or line speed (m/min) instead of frequency (Hz).
The motor speed is indicated as a synchronous speed in terms of the output frequency and does not match the actual rotation.

Set value = 0	Output Frequency (Hz) indicated (Factory setting)
Set value = 2 to 10(Number of motor poles entered)	Motor speed (rpm) indicated
Set value = 11 to 9998	Load speed indicated※

Example
1. Speed indication
To drive a 4-pole motor

Set value → 4

Indicated value = 1500 or 50Hz equivalent.

Note: Enter an even number (number of motor poles) between 2 and 10. Any odd number entered results in an error.

1. ※ Enter a speed at 50Hz. The speed indicated may not match the actual speed due to motor slip. When motor speed or load speed indication has been selected, all functions defined in frequency (Hz) must be set in motor speed or load speed (with the exception of the third functions excluding frequency meter calibration). In this case, the fraction part is omitted.
2. Do not use the ▲ , ▼ keys when changing the running speed from the PU. Instead input the speed digitally. eg 1, 4, 2, 0 keys.

2. Line speed indication

55m/min at 50Hz

Set value → 5 5

Then at 50Hz motor speed the indicated value on PU will be 55m/min.

Note: The speed at 50Hz must be entered. The value entered must be within the range 11 to 9998. If 10 is entered, for example, the speed of a 10-pole motor is indicated.

Monitoring display

PU monitoring display switching 7 6

In addition to the normal monitor display function of Volts, Amps, and Hz, by setting Pr.76 to any of the set values in the table, extra information can be displayed opposite the "V" LED on the PU unit during motor/inverter operation as indicated in the "Display" table opposite.

Set Value	Display Data
0	Output voltage (V) (factory setting)
1	DC bus link voltage (V) (DC voltage)
2	Regenerative brake operating duty (%)
3	Peak output current (Amps) (effective value)
4	Error number

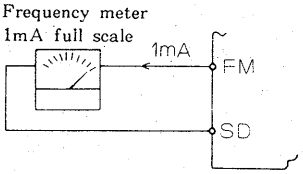
Note: 1. The regenerative brake operating factor and peak output current are indicated in terms of the maximum values during operation.
The peak output current is indicated in terms of maximum value while the start signal (STF or STR) is on.

2. For full information on the error numbers, see page 18.

Calibrating the frequency meter, digital display meter

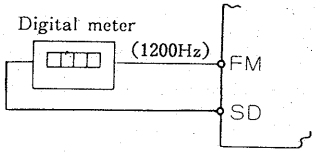
Frequency meter calibration C-1

Allows the frequency meter connected to the inverter to be calibrated by the PU without using a calibration resistor. For the calibration method, see page 44.



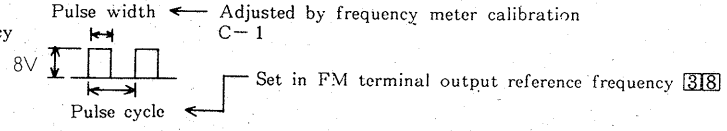
FM terminal reference output frequency 3 8

Allows the pulse train signal from the FM terminal to be displayed on a digital counter. Allows setting of the inverter output frequency at the FM terminal pulse train signal frequency of 1200Hz. For operation at 50Hz or higher, change this parameter in addition to the "frequency at 5V input" (parameter 20).



● Pulse output specifications of the FM terminal

Connection of a digital counter allows the frequency (Hz) or speed (m/min) to be displayed digitally. (The actual speed is not displayed.)



Note: 1. At 50Hz, parameter C-1 is factory-set to 1mA full-scale and parameter 38 to 1200Hz FM output frequency.
2. When the voltage across terminals FM and SD is measured by a tester, the reading is about 3.5V at the maximum output frequency. (When a display meter is not connected.)
3. When connecting a digital, this counter must be calibrated first.

Adjusting the output frequency

Frequency setting voltage bias C-2
Frequency setting voltage gain C-3
Frequency setting current bias C-4
Frequency setting current gain C-5

Allows the output frequency to be defined appropriate in relation to the frequency setting signal (0 to 5V, 0 to 10V or 4 to 20mA DC).

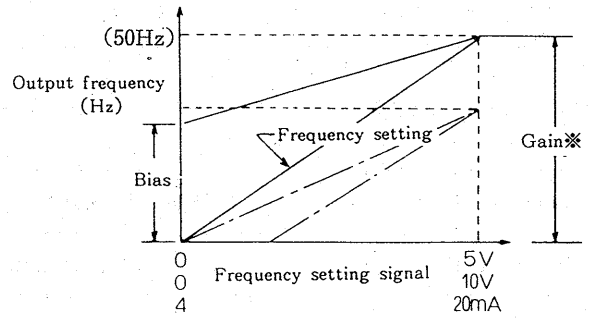
Bias

Modifies the output frequency in reference to the setting signal entered across terminals 2 and 5 (or 4 and 5).

Gain

Modifies the output frequency with respect to the setting signal entered across terminals 2 and 5 (or 4 and 5) when given signal is zero, it is taken by the inverter as 5V (or 10V) or 20mA signal.

See page 44 for the setting method.



※Setting this value automatically changes the "frequency at 5V input" (function 20) or "frequency at 20mA input" (function 21).

Alarm Code Output

Any alarm definition can be output as a 4-bit binary signal. The output signal is output from the open collector transistor output terminals, SU, OL, IPF, FU of the inverters terminal block.

Correspondences between the alarm definitions and alarm codes are as follows. The parameter unit also allows the alarm definition to be identified in more detail by the error numbers. See Pr.76 setting 4.

Alarm Definition (Protective Function)		Display	Output Terminal Signal On/Off※				(Alarm Code)
			SU	OL	IPF	FU	
Normal operation		–	0	0	0	0	0
Overcurrent shutoff	During acceleration	OC 1	0	0	0	1	1
	During constant-speed operation	OC 2	0	0	1	0	2
	Durring deceleration	OC 3	0	0	1	1	3
Regenerative overvoltage shutoff		OVT	0	1	0	0	4
Electronic thermal relay	Motor protection	THM	0	1	0	1	5
	Inverter protection	THT	0	1	1	0	6
Instantaneous power failure		IPF	0	1	1	1	7
Undervoltage		UVT	1	0	0	0	8
Fin overheat		FIN	1	0	0	1	9
Brake transistor alarm		BE	1	0	1	0	A
Output side ground fault overcurrent		GF	1	0	1	1	B
External thermal relay operation		OHT	1	1	0	0	C
Stall prevention activated stop		OLT	1	1	0	1	D
Inverter-mounted option alarm		OPT	1	1	1	0	E
Parameter storage memory alarm		PE	1	1	1	1	F

• 0 : output transistor off, 1 : output transistor on (common terminal : SE)

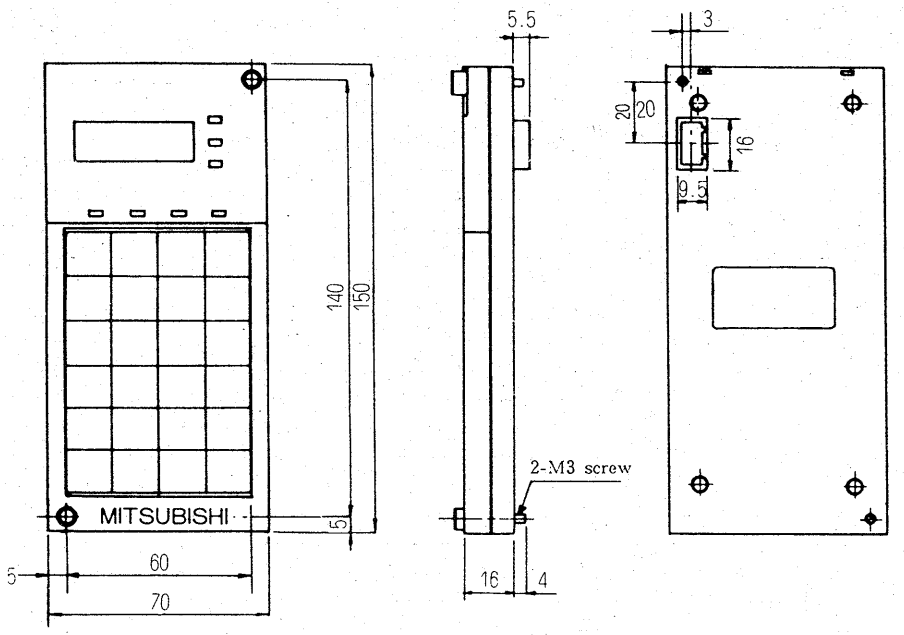
6. SPECIFICATIONS

Standard Specifications

Item	Specifications		
Ambient temperature	Operating	−10℃ to +50℃	
	Storage	−20℃ to +65℃	
Ambient humidity	90%R.H max.		Non-condensing
Operating ambient	No oil mist and corrosive gases. Minimal dust, dirt.		
Cooling method	Self-cooling		
Connection	Inverter mounted or through cable FR−CBL		
Power supply	Power supplied from the inverter		
Display	LED display (4-digit, 7-segment LED and indicator lamps)		
Keyboard	24 keys (covered with polyurethane film)		
Size	150 (H) × 70 (W) × 16 (D)		
Weight	0.1kg		
Number of write times	100,000 times max.		

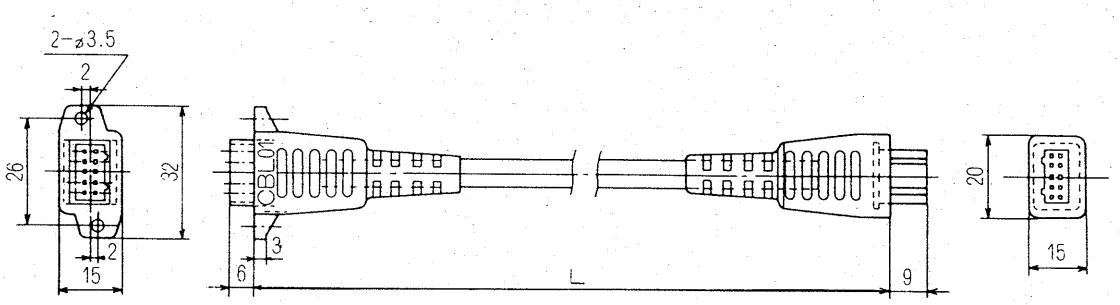
Dimensional Diagrams

● Parameter Unit



(Unit : mm)

● Connection cable (option)



Type	L (m)
FR-CBL 01	1
FR-CBL 03	3
FR-CBL 05	5

MACHINE HISTORY RECORD

Pr. No	Setting Range	Factory Default	New Customer Settings	New Customer Settings	New Customer Settings
0	0 to 30 %	See page 49.			
1	0 to 120 Hz	120 Hz			
2	0 to 60 Hz	0 Hz			
3	50 to 360 Hz	50 Hz			
4	0 to 360 Hz	50 Hz			
5	0 to 360 Hz	31 Hz			
6	0 to 360 Hz	10 Hz			
7	0.1 to 3600 seconds	See page 49.			
8	0.1 to 3600 seconds	See page 49.			
9	0 to 999.9A	See page 49.			
10	0 to 60 Hz	3 Hz			
11	0 to 10 seconds	0.5 seconds			
12	0 to 20%	See page 51.			
13	0.5 to 10 Hz	0.5 Hz			
14	0, 1, 2, 3, 10, 11, 12, 13	0			
15	0 to 360 Hz	5 Hz			
16	0.1 to 3600 seconds	0.5 seconds			
17	0, 1	0			
18	120 to 360 Hz	120 Hz			
19	0 to 500V, 9999	9999			
20	1 to 360 Hz	60 Hz			
21	1 to 360 Hz	60 Hz			
22	0 to 200 %	0 %			
23	0, 0.1 to 3600 seconds	See page 52.			
24	0 to 360 Hz, 9999	9999			
25	0 to 360 Hz, 9999	9999			
26	0 to 360 Hz, 9999	9999			
27	0 to 360 Hz, 9999	9999			
28	0, 1, 2	0			
29	0, 1, 2, 3	0			
30	0 to 30 %	See page 51.			
31	0 to 360 Hz, 9999	9999			
	0 to 360 Hz	1 Hz			
32	0 to 360 Hz, 9999	9999			
	0 to 360 seconds	0.5 seconds			
33	0 to 360 Hz, 9999	9999			
	0 to 360 Hz	1 Hz			
34	0 to 360 Hz, 9999	9999			
	0 to 360 seconds	0.5 seconds			
35	0 to 360 Hz, 9999	9999			
36	0 to 360 Hz, 9999	9999			
37	See page 57.	0			
38	1 to 360 Hz	50 Hz			
39	0 to 215A, 9999	9999			
	0 to 215A	See page 52.			
40	0 to 200 %	0			
	0 to 1000 %	100 %			
41	1 to 100 %, 9999	10 %			
42	0.5 to 360 Hz, 9999	6 Hz			
43	0.5 to 360 Hz, 9999	9999			
	0.5 to 360 Hz	6 Hz			
44	0.1 to 3600 seconds	5 seconds			
45	0.1 to 3600 seconds, 9999	9999			
46	0 to 30%, 9999	9999			
47	50 to 360 Hz, 9999	9999			
48	0 to 200%	150 %			
49	0 to 360 Hz	0 Hz			
50	0, 1, 2	0			

Pr. No	Setting Range	Factory Default	New Customer Settings	New Customer Settings	New Customer Settings
63	0, 1, 2	0			
◎64	0, 1	0			
66	0.1 to 5 seconds	0.5 seconds			
67	0, 0.1 to 5 seconds, 9999	9999			
75	0, 1	0			
※76	0, 1, 2, 3, 4	0			
77	0, 1	0			
78	0, 1, 2	0			
79	0, 1, 2	0			
C−1	0 to 360 Hz	0 Hz			
C−2	0 to 120 Hz	0 Hz			
C−3	0 to 360 Hz	50 Hz			
C−4	0 to 120 Hz	0 Hz			
C−5	0 to 360 Hz	50 Hz			
		Date			
		Signature			
		Machine Ref.			
		Next Service			

DATE INSTALLED _____ , INVERTER SERIAL No. _____

MACHINE TYPE & SERIAL No. _____

MOTOR TYPE & SERIAL No.

TYPE		
SER. No.		
KW		INPUT
SPEED		INPUT
VOLTS		INPUT
AMPS		INPUT

Motor nameplate data.

MACHINE LOAD CLASSIFICATION

CONSTANT TORQUE		
VARIABLE TORQUE		
CONSTANT H. P.		
MOTOR SPEED RANGE	____To ____ rpm	
INPUT CONTROL SIGNAL	0−5V	
	0−10V	
	4−20mA	
	other	
NOTES		

PEASE KEEP THIS MANUAL IN A SAFE PLACE.

In the unlikely event that this motor/machine/inverter combination does not perform as expected, the service history record will help to expedite a speedy solution to your problem.

Please contact your local supplier and have this page handy for your reference.

Thank−you. MITSUBISHI ELECTRIC CORPORATION. JAPAN.

MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE: MITSUBISHI DENKI BLDG. MARUNOUCHI TOKYO 100 TELEX: J24532 CABLE MELCO TOKYO

IB(NA)66274(9103)ROD

Printed in Japan