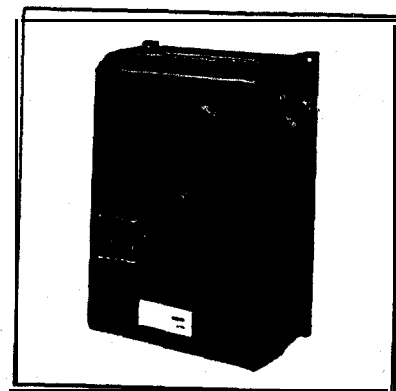


MITSUBISHI

TRANSISTORIZED INVERTER

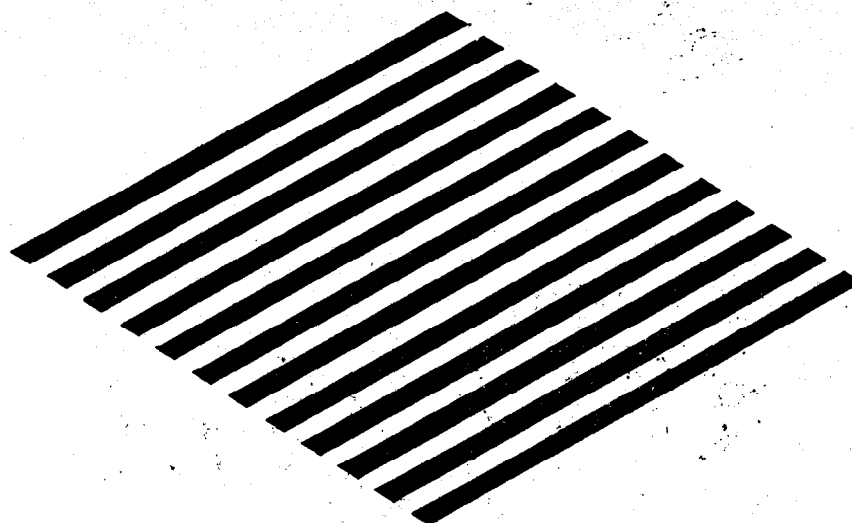
New Standard 20.1.82

FREQROL-K



Instruction Manual

---- Single-Phase input
220/240VAC serie
(0.37, 0.75Kw)



FORWORD

Thank you for your purchase of Mitsubishi Multi-Purpose Inverter FREQROL-K.

This is a variable frequency power supply unit to control the speed of squirrel-cage induction motors. This instruction manual is intended both to explain the unit and to outline operation procedures.

This unit is not difficult to operate, but incorrect operation may lead to some troubles, so read this instruction manual carefully before operation. If you use to unit properly, we are sure it will give you many years of satisfaction.

Please make sure to attach this instruction manual to the unit when the unit is shipped.

CONTENTS

1. UNPACKING	1
2. TRANSPORTING	1
3. INSTALLATION.. ..	1
4. WIRING AND POWER SUPPLY RATING	1
Wiring	1
5. OPERATIONS	4
5-1 Points to check before operations	4
5-2 Preparations before operations	4
5-3 Operations	5
5-4 Operation's precautions	6
6. MAINTENANCE AND INSPECTION.	7
7. CONSTRUCTION AND ARRANGEMENTOF CONTROLLER PARTS	6
8. TROUBLESHOOTING AND COUNTERMEASURE	9
8-1 Troubleshooting chart	9
8-2 Failures indicated by lighting of alarm indication lamps and how to deal with them	13
8-3 Measuring voltage and current	15
9. STANDARD SPECIFICATIONS	17
10. PROTECTIVE FUNCTIONS	16
11. INPUT/OUTPUT TERMINAL	19

1. UNPACKING

After unpacking your FREQROL-K, first check the following points.

- Refer to the name plate to confirm that the model and the output rating is indeed the one you ordered.
(See table 1)
 - Check where there has been any damage or breakage to the FREQROL-K during transportation.
- If you have any doubts about the above, or find any damage to the unit, please contact your local service representative.

Table 1 FR-K Series Configuration

Motor output (kW)	0.37	0.75
Without operation panel	FR-K-S370B	FR-K-S750B
With operation panel	FR-K-S370BM	FR-K-S750BM

Note: The operation panel is provided with a frequency setter, a frequency meter and a FWD/REV starting switch.

2. TRANSPORTING

When transporting the FREQROL-K, handle it gently to prevent damage. There are depressions on both the top and the bottom where the unit can be grasped, and these should be held when it is moved.
Do not apply too much force to the fan at the bottom of the unit. The unit is covered with a plastic case, and care should be taken not to apply force only to this cover during transport,

3. INSTALLATION

- Place the inverter in a clean and well ventilated location. Avoid locations exposed to direct sunlight, or subject to high temperatures, humidity, dust or corrosive gases.
- Install the inverter securely on the wall with bolts or screws, vertically so that the letters "FREQROL-K" appears front.
- Since the inverter does generate some heat during operations, any other equipment or parts should be installed at least 10 cm away from up and the bottom to prevent heat confined.
The brake resistor attached to the rear of the unit also generates heat, so the unit should not be placed on a wall with low heat resistance.
- If your inverter is one equipped with an operation panel, take care to put it in a place where it can be easily operated.

4. WIRING AND POWER SUPPLY RATING

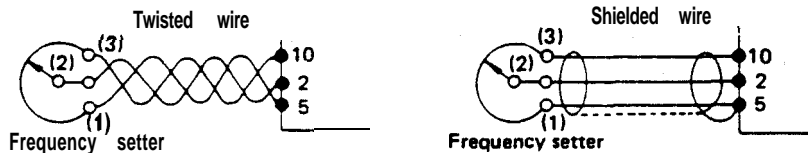
4-1 Wiring

Connect wiring correctly according to following instructions and refer to Fig. 1, Standard Wiring Diagram.

For wiring of the peripheral devices such as MCCB, refer to Table 2, Selection of Peripherals.

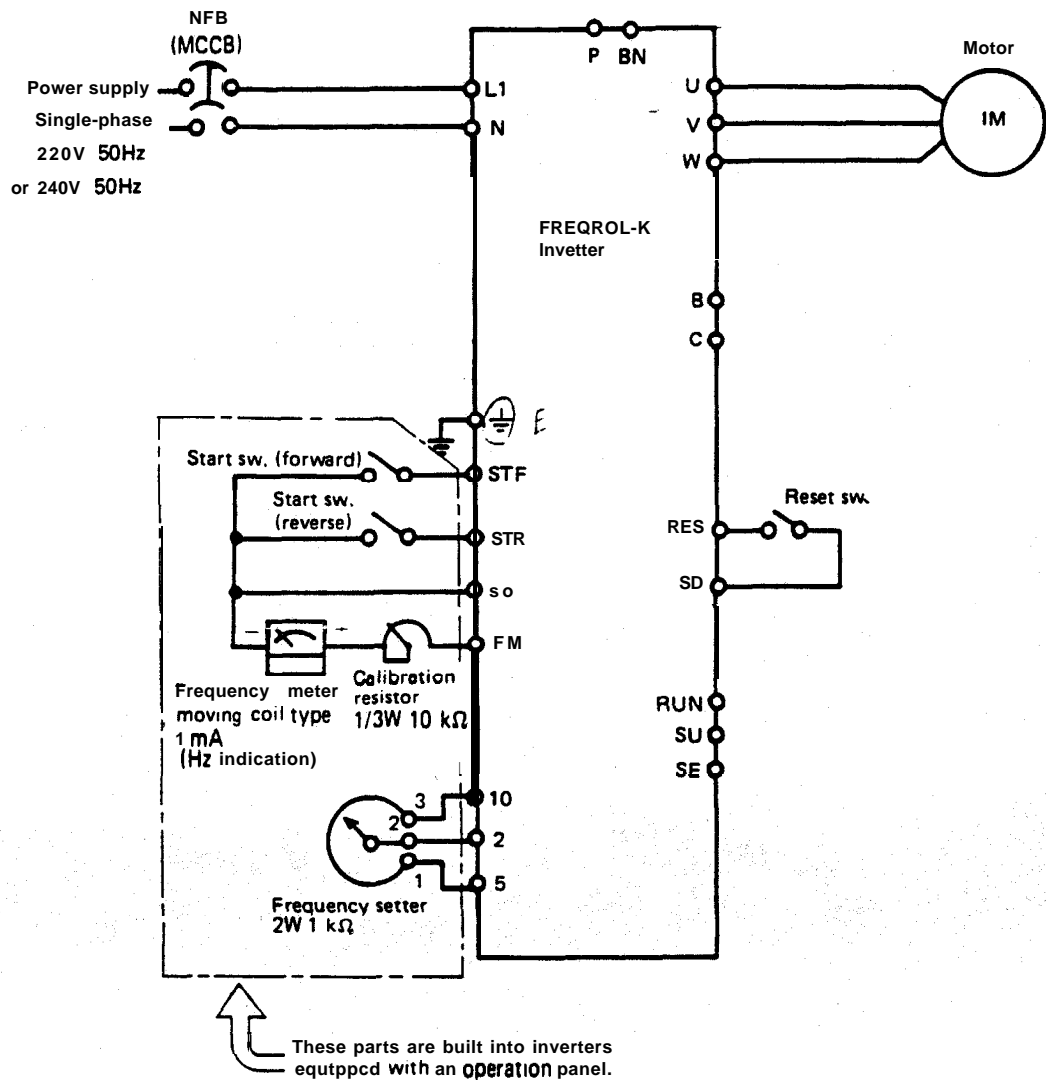
- (1) When the wiring cover located at the bottom of the inverter is pushed inward and then pulled toward the operator, the wiring cover alone is removed thus exposing all terminal blocks. A corrugated gripping surface has been provided for your convenience. Now perform wiring.

- (2) The wirings of the frequency setter, FWD/REV start switches, frequency meter and calibration resistor of meter equipped with an operation panel in Fig. 1 have already connected.
- (3) Do not wire the power cable in such a manner that the line source voltage is directly applied to the **output** terminals U, V and W.
- (4) It is not always necessary to provide wiring to the reset **switch**, since the circuit can be restored by cutting off MCCB or Magnetic Contactor (MS) if the output protective circuit has been activated to stop the controller.
- (5) Since terminals P and N have been provided for brake unit and discharge resistor connections, avoid connecting only discharge resistor, or any other equipment, to these terminals.
- (6) Since the frequency setting signal current is extremely low if it is necessary to **use** contacts in the frequency setting circuit, use two pairs of parallel contacts or twin contacts for extremely low current to prevent poor contact.
- (7) Use shielded wires or twisted wires as the wire cable in connections to the control terminals to prevent the control circuit from being induced by other equipment, and also connect them away from the main circuit and high voltage circuit (Relay sequence circuit of 220V AC or 240V AC.)

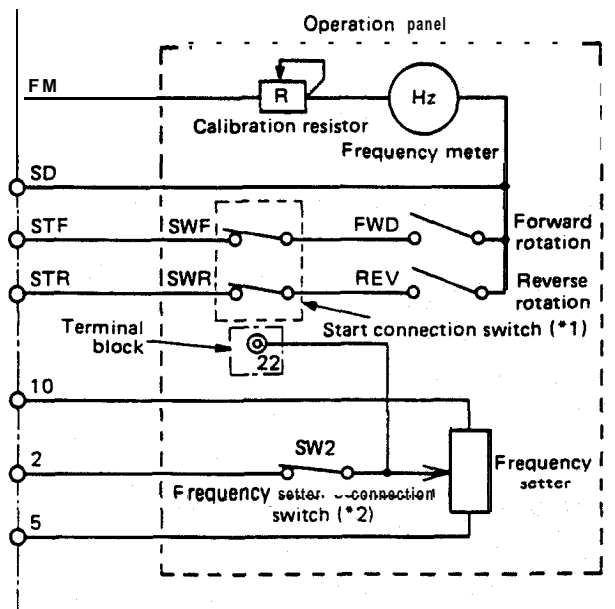


- (8) The output wires from the inverter are protected from short-circuiting (i.e., short-circuiting among terminals U, V and W) by an overcurrent protective circuit. However, there is no **pro**tection against short-circuit caused by accidental leakage such as grounding. Therefore, care should be taken to position the wires so as to prevent them from making contact with the chassis, etc.
- (9) Rotation direction of the motor is counterclockwise as seen from the load side with the normal wiring to the output terminals U, V and W.

Fig. 1 Standard Wiring Diagram



o Model with operation panel



- 1: To input external start signal (across terminals STF, STR and SD), set the switch SWF or SWR to position OFF.
(The switches are set at position ON when shipping.)
- 2: To input external frequency setting signal (across terminals 2 and 5), set the switch SW2 to position OFF.
(The switch is set at position ON when shipping.)

5. OPERATIONS

5-1 Points to check before operations

After installation and wiring of **FREQROL-K** is completed, check the following points before operating.

if insulation is to be checked with a megger, perform only the test between controller and grounding.

Newer perform a megger test between the inverter's terminals.

Also do not perform a megger test on the control circuit terminals.

Refer to section 6 for details on megger insulation tests.

- (1) Check whether wiring conforms to the standard wiring diagram.
- (2) Check for points short-circuited by broken wire, etc.
- (3) Check if any wire is strained,
- (4) Check tightness of screws, of terminals and other fasteners.
- (5) Check motor load conditions.

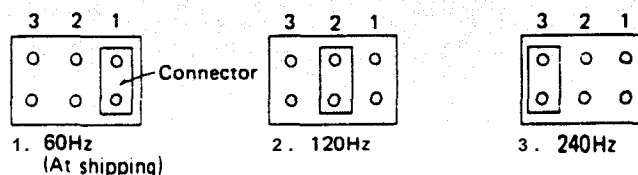
5-2 Preparations before operations

When inspection is completed, open the setting panel flap on the inverter front panel and make the following setting.

5-2-1 Selection of maximum output frequency (set with connector)

By changing the position of the connector on the P.C. board, set the maximum output frequency.

The maximum output frequency is set to **60Hz** at shipping. (Don't change the connector while inverter is operating)



Note: If you are using a general-type motor, do not set the maximum output frequency to **240Hz**.

(This setting is for special-designed motors.)

5-2-2 Selection of frequency setting signal (set with select switch)

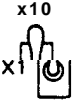


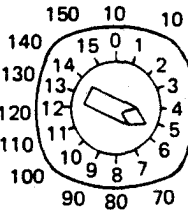
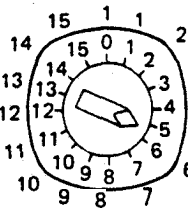
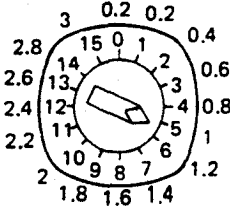
The settings 0-5V and 0-10V are available for frequency signal. The 0-5V position is set at shipping. If another setting is required, select as follows:

- (1) For 0-5V DC signal: set the select switch to the down position. (at shipping)
- (2) For 0-10V DC signal: set the select switch to the up position.

5-2-3 Setting of acceleration/deceleration time (set with ACCEL/DECEL dials and select switches)

Set acceleration and deceleration times by setting the ACCEL and DECEL dials and the acceleration and deceleration time magnifying select switches.

- (1) Acceleration and deceleration times can be set independently.
- (2) Acceleration and deceleration time refers to the time during which output frequency is increasing from 0 to maximum frequency or decreasing from maximum frequency to 0.
- (3) The relationship between the figures on the notches of the ACCEL and DECEL dials and the position of the acceleration and deceleration time magnifying select switch is shown in the figure below. Set them at positions appropriate according to applications and kinds of the motor load.

Select switch	 x10 X0.2	 x10 X0.2	 x10 X0.2
Select dial (sec.)			
Range	10 ~ 150 sec. (10 seconds increment)	1 ~ 15 sec. (1 second increment)	0.2 ~ 3 sec. (0.2 second increment)

(4) Both the acceleration and deceleration times are set at 5 seconds at shipping.

5-3 Operations

When the preparations have been completed, begin inverter operations in the following procedure:

- (1) First close the MCCB, then the magnetic contactor (MS) by pushbutton. The power pilot lamp on the inverter panel should light in yellow. The motor will not yet rotate in this state. Touch the motor with your hand to see that there are no buzzing sounds or vibration.
- (2) If there are no abnormalities, turn the FWD start switch (or REV start switch) on. Gradually turn the knob of frequency setter clockwise. When the knob is turned to "3Hz" position, the motor will start rotating. And turned farther clockwise, the frequency (rotation of the motor) will increase gradually up to its maximum frequency setting (60Hz, 120Hz or 240Hz)
- (3) When the frequency setter has been set at the desired frequency, and the FWD start switch (or REV start switch) has been turned on, motor revolutions will increase to the set value within the time set by the acceleration time setting dial described above, and then continue to operate at the setting frequency. If the motor does not accelerate smoothly and the ALARM lamp blinks during the acceleration or the "ALARM" indication lamp lights up, this is because the acceleration time has been set at too short period in relation to the motor load, and the acceleration time should thus be lengthened.
- (4) When the FWD start switch (or REV start switch) is turned off while the motor is rotating, motor speed is decelerated in the time period set by the DECEL dial. When the frequency falls below 3Hz, the DC dynamic brake will be activated and the motor will stop immediately. If the motor speed does not decelerate smoothly and the ALARM lamp blinks during the deceleration or the "ALARM" indication lamp lights up, this is because the deceleration time is not sufficient for the motor load, and the deceleration time should thus be lengthened.
- (5) If the FWD start switch and the REV start switch are turned on simultaneously, the motor will not rotate. Also, if the FWD start switch and the REV start switch are simultaneously activated while the motor is rotating, the motor will begin decelerating in the same manner as when the FWD (or REV) start switch is turned off.
- (6) If the FWD start switch is turned off and the REV start switch turned on while the motor is rotating forward, the motor speed will decelerate to a frequency of 3Hz, at which point the rotation direction will automatically be reversed, accelerating gradually to the frequency that has been set. The same is also true of movement from reverse to forward rotation.

- (7) If the settings of the acceleration or deceleration times are changed during motor operations, the previous settings will remain in memory and the changes will not take effect. Note that this unit is designed for changes in the setting of acceleration and deceleration time to be made at a inverter frequency below 3Hz.
- (8) If the protective circuits, such as those against overcurrent and regenerative overvoltage are activated, the alarm indication lamp will light up in red and the shut-off state will continue. To reset after a shut-off, perform the following operations:
 - First turn off the power supply with the MCCB or the Magnetic contactor (MS), then turn it on.
 - Short-circuit the terminals between RES (reset) and SD (common) of the control circuit by the reset switch, then (after about 0.1 second), reopen.
- (9) Use the calibration resistor to adjust the frequency meter so that the frequency is indicated as 60, 120 or 240Hz when the commanded voltage (across terminals between 2 and 5) is set to 5V DC or 10V DC by the frequency setting input signal select switch.
Inverters equipped with a frequency meter have already been adjusted at the factory before shipping.
- (10) When the DC dynamic brake activates at below 3Hz during deceleration, it may cause a high-pitched noise. This noise is common, and does not indicate any abnormalities (The DC dynamic brake functions for about 0.5 second.)

5.4 Operation's Precautions

When the confirmations described above have been completed you may begin normal operations, but keep the following points in mind when doing so.

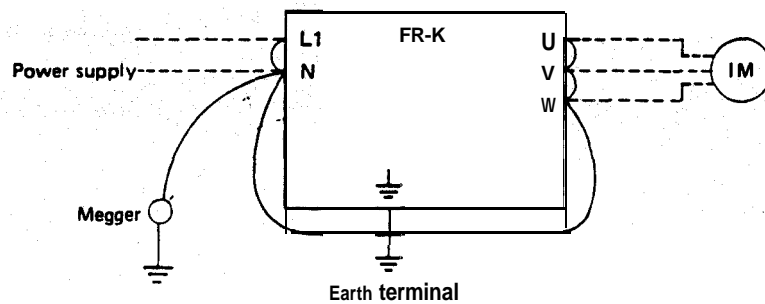
- (1) When a general type motor is being driven by the inverter, the temperature, noise and vibrations will be somewhat higher than they would be with a commercial power supply.
- (2) Since cooling efficiency decreases at low speed operations, it is necessary to reduce the torque from the rated motor torque. (Refer to the catalog for the torque reduction ratio.)
- (3) The FREQROL-K is capable of controlling plural motors at the same time. When the inverter is used to control more than one motor, care should be taken that the total current requirement for the simultaneously operated motors is within the rated output current of the inverter.
- (4) If the FREQROL-K is being used to control multipole motors with 8 or more poles, submersible motors, or other special-purpose motors, carefully examine the rated current and other electrical specification.
- (5) Do not add a capacitor nor surge absorber to the output circuit of the inverter. This may activate the overcurrent protection.
- (6) If you are using a motor with mechanical brakes, the brake exciting circuit should not be connected to the inverter output, and make certain that brake action can be affected after turning off the inverter's power supply.
- (7) If using motors of different capacity or special-purpose motors, or if more than one motor is being used simultaneously, add a thermal overload relay to the inverter output circuit to protect the motor from being burned up. In this case turn the electronic thermal relay setting dial (TH) on the operation panel as far as it will go in the clockwise direction.
- (8) Since the built-in brake resistor will cause temperature increases, mount it on nonflammable materials such as metal or concrete.

6. MAINTENANCE AND INSPECTION

The FREQROL-K is the static type, so almost no daily maintenance is required. The following maintenance practices should, however, be observed.

- (1) Since the capacitor in the inverter remains charged at high voltage for a while after the inverter is turned off, perform inspections only after charge indication lamp "CHARGE" goes out. Also, the cooling fan will continue to run for some time after the power has been turned off, so be careful to keep hands away from this area.
- (2) From time to time, inspect the inverter for dust and dirt accumulated inside, and clean it if there is a buildup.
- (3) Check the tightness of terminal block screws and mounting screws. If they come any loose, tighten them securely. Make certain there are no defects in the wiring parts or components. Replace defective wiring pan if found, or contact your service representative.
- (4) Megger test
 - a) When performing a megger test on the external equipment, remove all inverter terminals so that the test voltage will not be applied to the inverter.
 - b) Perform megger tests only for the main circuit of the inverter as shown in Fig. 2. Do not apply the test voltage to the control circuit.
 - c) To check the FREQROL-K control circuit, use a multimeter (set to high resistance range position). Do not use a megger or buzzer.

Fig. 2 Megger Test

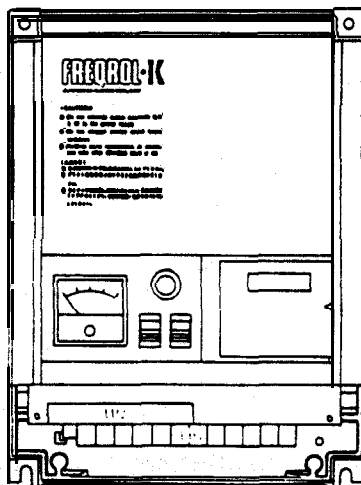


7. CONSTRUCTION AND ARRANGEMENT OF INVERTER PARTS

As noted above, wiring requires only the removal of the wiring cover at the bottom of the inverter. To inspect the inverter's interior, however, proceed as follows:

- (1) When the wiring cover is removed, the plastic cover's two set screws will be exposed. Remove these screws and slide the plastic cover upward.
- (2) The P.C. board of the control circuit has been attached by set screws.

Fig. 3 Type FR-K-S370B, S750B



Control circuit terminal arrangement

TB2

B	C	P12	SU	RUN	SE	10	2	5	STF	STR	SD	RES	SD	FM
---	---	-----	----	-----	----	----	---	---	-----	-----	----	-----	----	----

(M3)

TB1

		L1	N			U	V	W	B	N	P
--	--	----	---	--	--	---	---	---	---	---	---

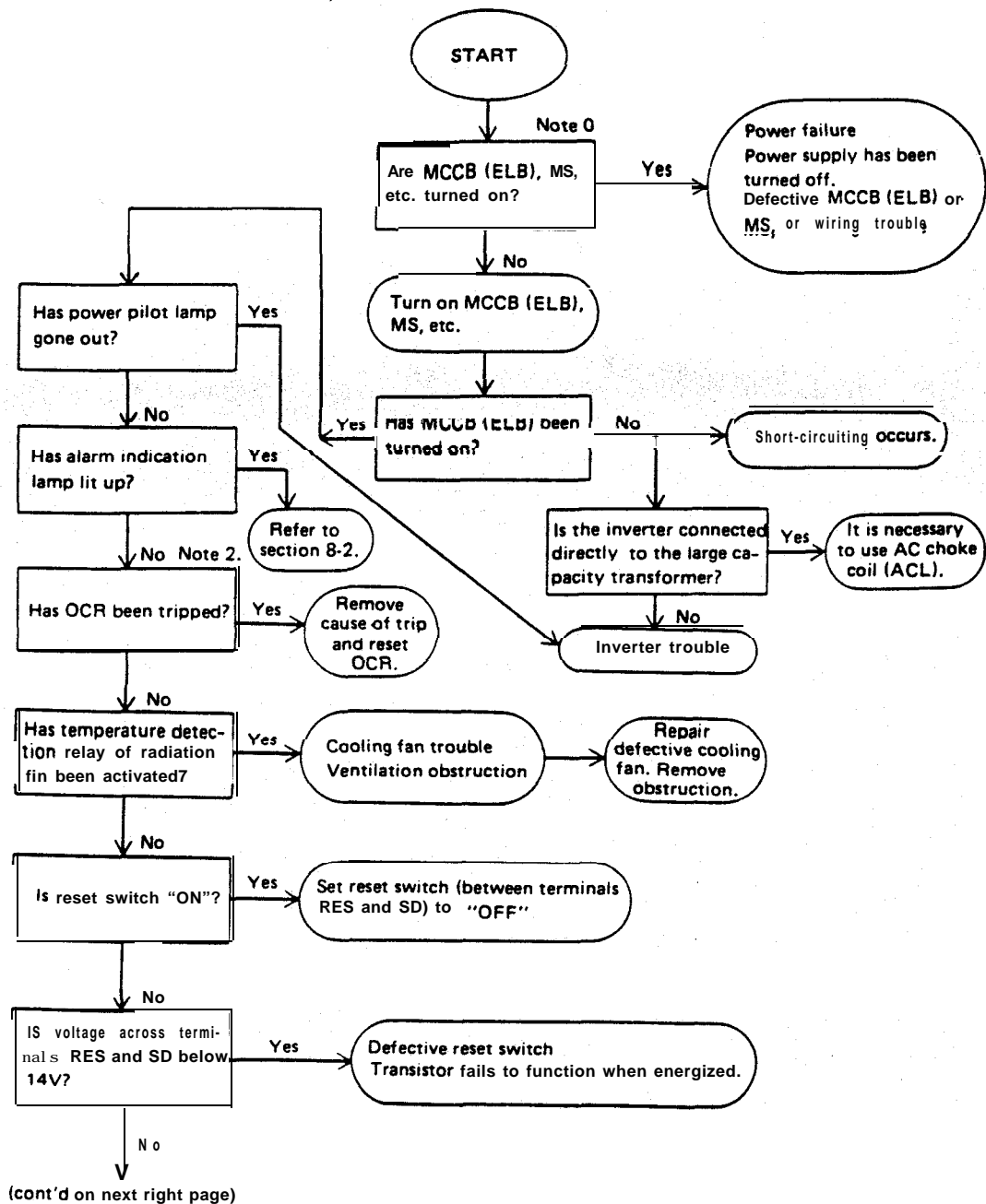
(M4)

8. TROUBLESHOOTING AND COUNTERMEASURE

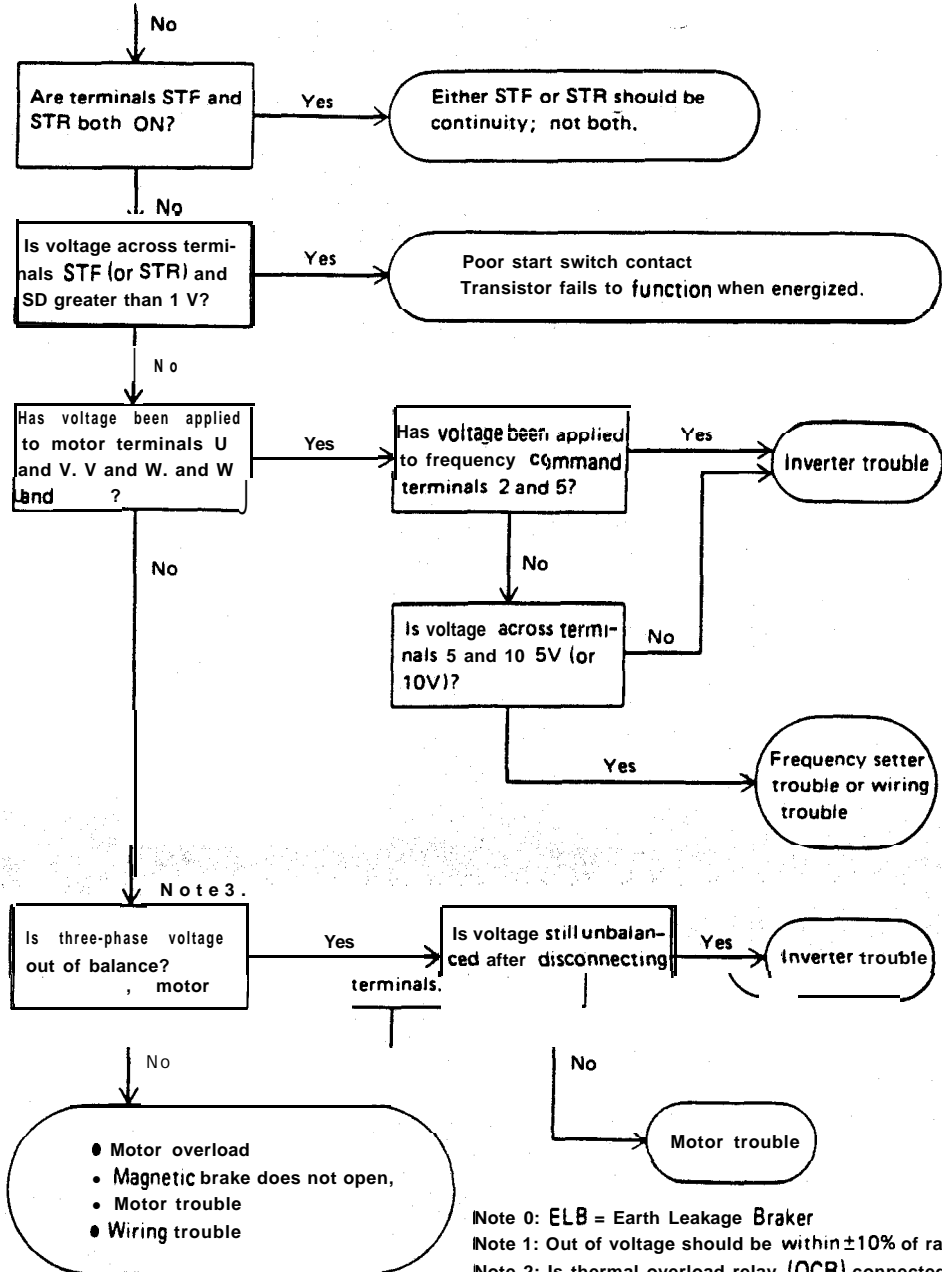
In the unlikely event that there should be problems with the inverter or it should lose any of its functions, use the troubleshooting chart below to identify the cause and apply the appropriate countermeasure. If your problem is not described below, the inverter is out of order, one of the parts has been damaged or if you have any other problem not dealt with here, contact with your local service representation.

8-1 Troubleshooting Chart

(1) Motor does not run.



(cont'd from left page)



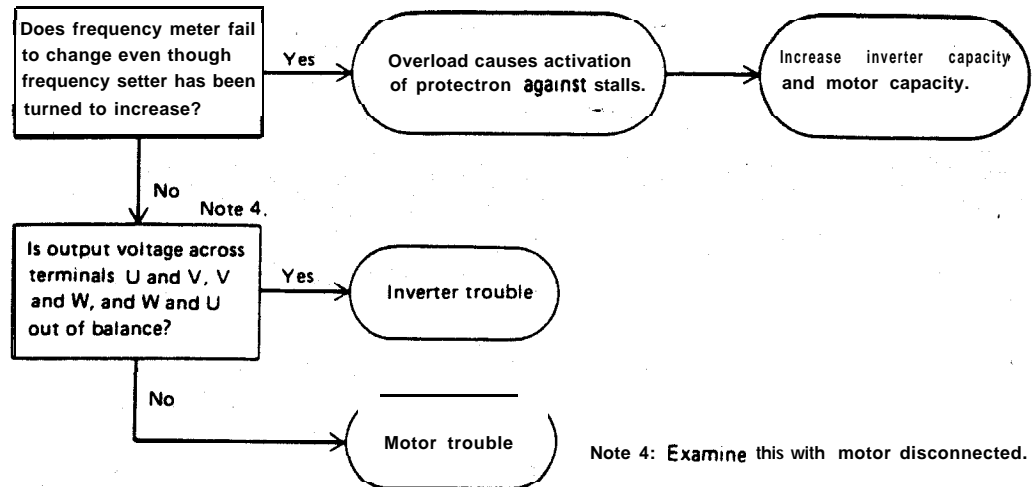
Note 0: ELB = Earth Leakage Braker

Note 1: Out of voltage should be within $\pm 10\%$ of rated voltage.

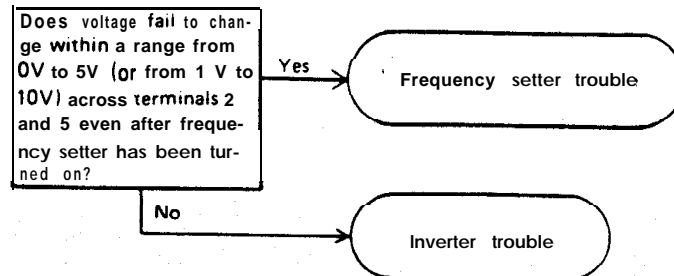
Note 2: Is thermal overload relay (OCR) connected.

Note 3: Imbalanced should be within 1% of maximum output voltage.

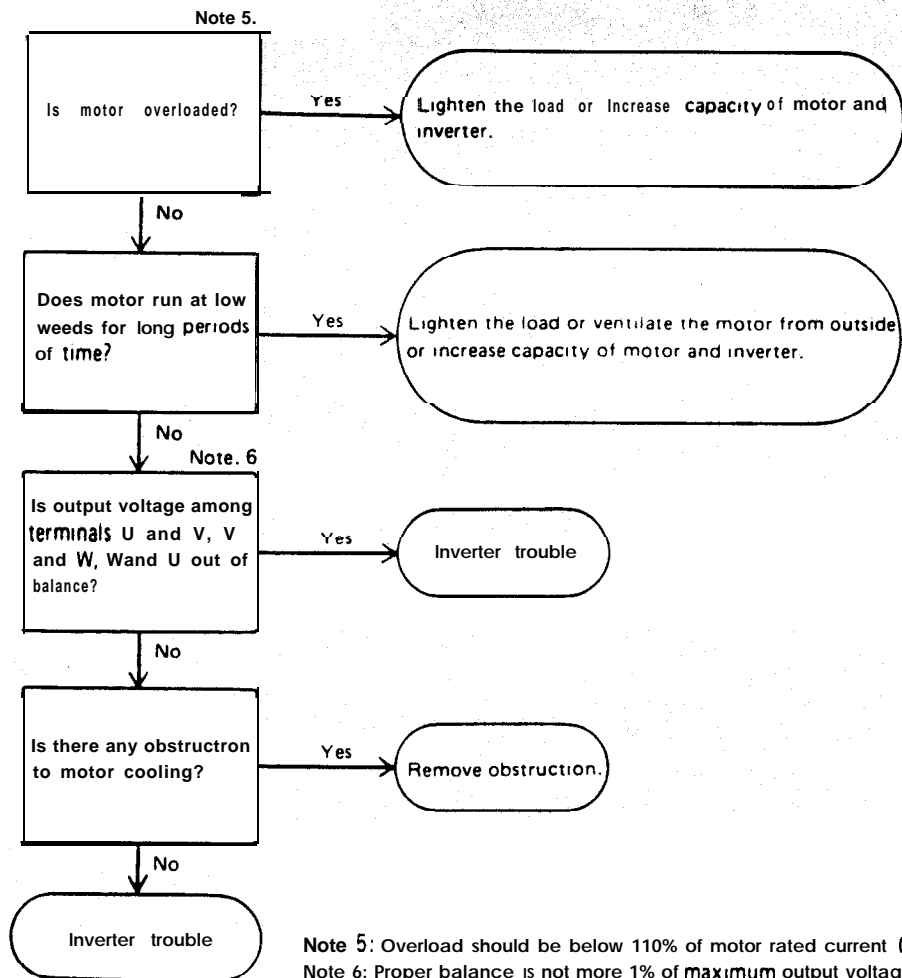
(2) Motor buzzes and does not run.



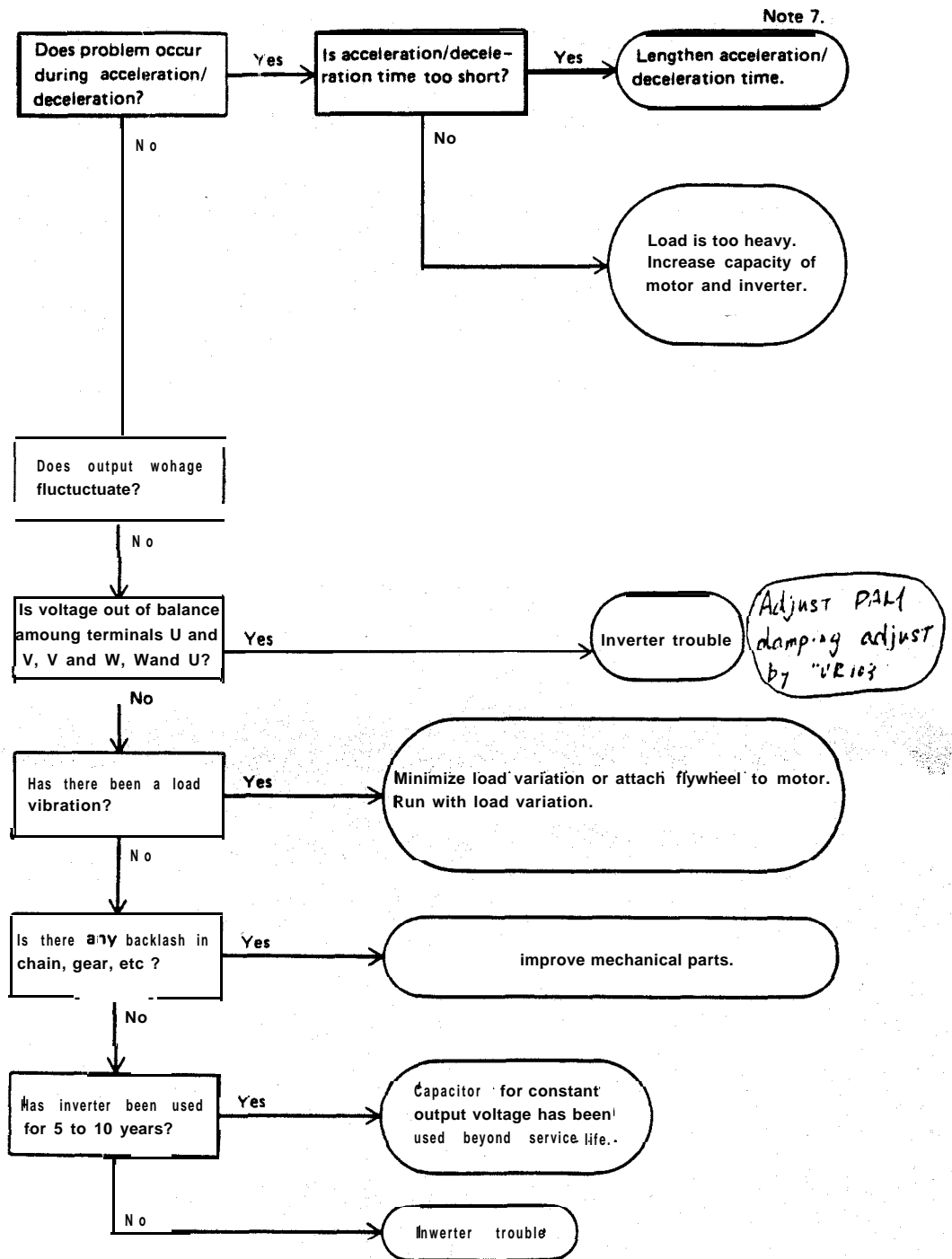
(3) Motor runs at constant speed and cannot be controlled.



(4) Motor overheats.



(5) Motor does not run smoothly



Note 7: Activation of protection function against stalls causes unstable acceleration/deceleration.

8-2 Failures indicated by Lighting of Alarm indication Lamps and How to Deal with Them

The protective functions can be activated by various conditions, as shown below. If an alarm indication lamp lights up, it is important to keep your head and examine the cause of the problem, and then to apply the appropriate countermeasure.

Alarm	Cause	Description	Countermeasure
Alarm indication lamp "ON"	Acceleration time is too short.		Lengthen acceleration/ deceleration time.
	Inverter's output circuit is turned on and off.	Check whether the magnetic contactor has been turned on after the inverter start signal (ST) went ON.	Correct sequence if wrong. If it is necessary to turn on and off of inverter's output circuit, increase the capacity of inverter by five times or more.
	Peak load reached instantaneously.		Adjust machine so that peak load is not reached. Increase capacity of inverter by 1 or 2 class.
	Load is too heavy.	Even after acceleration time has been lengthened, motor hardly runs before the alarm indication lamp lights up. (The electronic thermal relay has been activated due to overload or overheating caused by low speed operations. thus turning alarm indication lamp on.)	Since static friction torque is larger than the torque of motors under 3Hz at start-up, increase capacity of motor and inverter. Lighten the load or change operations pattern.
	Built-in brake is being used too frequently.	Deceleration may be done in several stages. If the maximum number allowable is exceeded, however, this will increase the frequency of use of the brake, and an alarm indication lamp will come on.	Either lengthen the deceleration time or lessen its frequency. Add an external brake unit.
	Either a capacitor for power factor improvement or a capacitor for surge absorber has been inserted at inverter's output circuit.	There is an overcurrent because impedance of capacitor is small against high frequency.	Remove them. If they have been factory-set, care should be taken not to forget to remove them. It is recommended to insert a reactor into the input circuit in order to improve the power factor.
	Short-circuit or ground fault in the output circuit of the inverter.	Ground faults do not always cause an overcurrent trip (OCT) state. If a ground fault occurs, it may lead to inverter trouble.	Locate the short-circuited points and apply the appropriate countermeasure.
	Motor is turned on again during free running (running by inertia force after power has been turned off).	Since inverter starts operation at 3Hz, motor runs by regenerative operation, which generates overcurrent.	Restart the motor only after it has stopped completely. In automatic operation, use a timer to start the motor after it has stopped completely.

Alarm	Cause	Description	Countermeasure
Alarm indication lamp "ON"	Activation of the temperature detection relay of the radiation fin.	When the fin for cooling power modules is overheated, the temperature sensor activates to stop output	Cooling fan trouble or ventilation obstruction in radiation fin has caused a rise in temperature, so remove those troubles.
	External noise.	Consider the possibility of external noise when the alarm indication lamp lights up for causes other than these described above.	Twisted wire or shield wire are used to the frequency setting signal circuit (10, 2, 5). Shield wire should be connected to terminal "5" only and do not connect shield wire with grounding or around terminal of other circuit (i.e., instrumentation circuit).
	Instantaneous power failure.	If there has been an instantaneous power failure for 15 msec or more, and the power supply has been restored before the motor has stopped after a free running, overcurrent may occur.	Reset the inverter and restart it. If you wish to keep the alarm state on display, use an external circuit.

Note: If you cannot identify the trouble even after checking all the points listed above, try disconnecting the motor from the inverter. If the alarm indication lamp still comes on, there has been a breakdown in the inverter.

8-3 Measuring Voltage and Current

Since the primary and secondary voltage and current contain high frequency, data may differ depending upon the instrument used and the circuit to be measured.

If you use a measuring instrument for commercial frequency, select one listed in Table 3 and measure the circuit as shown in Fig. 5

Variation of the indicated value are shown in Fig. 6. However, even measuring instruments of the same accuracy may be inconsistent because of differences in factors such as manufacturer, model type or year made, etc.

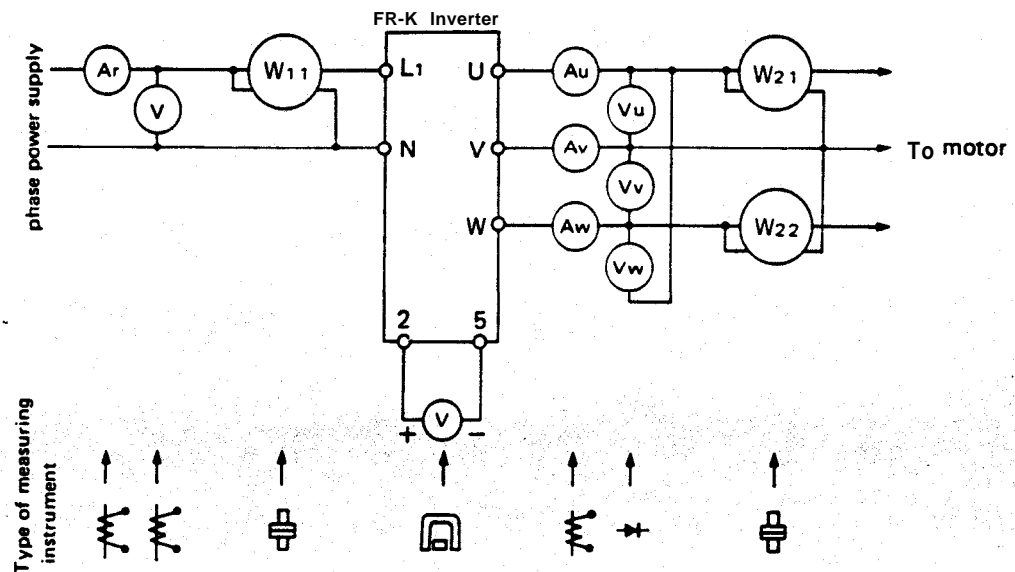
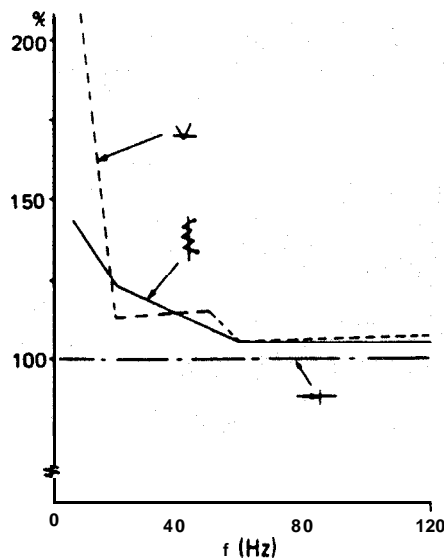


Fig. 6 Points to be Measured and Examples of Measuring Instruments



Example: Output voltage of inverter
Take the indicated value of
rectifier type voltmeter as
100%.










Motor rating: 3.7k
4P FR-K-3700U
inverter

- Rectifier type
- Moving-iron type
- Electrothermic type

↑
deleted

Fig. 6 Variation of Indicated Value Depending on the Type of the Measuring Instrument

Table 3 Terminals to be Measured and Measuring Instrument

Item	Terminals to be measured	Measuring instrument	Remarks (reference value)
Supply voltage: V1	Across terminals L1 and N	 Moving-iron type	Commercial voltage: 198 to 264V AC
Current at power supply: I1	Line current at terminals L1 and N. <i>RS and T</i>	 Moving-iron type	<i>230V</i>
Power at power supply: P1	Terminals L1 and N	 Electro-dynamo-meter type	P = W ₁₁
Power factor at power supply: Pf 1	Measure supply voltage (V1), current at power supply (I1) and power at power supply (P1), and calculate power factor using equation shown below: $Pf1 = \frac{P1}{\sqrt{3} V1 \times I1} \times 100\%$		
Voltage at output: V2	Across terminals U and V, V and W, and W and U.	 Rectifier type (Moving-iron type is not available)	Difference between each phase should be within 10%
Current at output: I2	Line current at terminals U, V and W.	 Moving-iron type	Below rated current of inverter Difference between each phase is $\pm 1\%$ or lower.
Power at output: P2	Terminals U, V and W and across terminals U and V, and V and W.	 Electro-dynamo-meter type	P2 = W ₂₁ + W ₂₂
Power factor at output: Pf2	Calculate in a similar manner as for power supply, using the following equation: $Pf2 = \frac{P2}{\sqrt{3} V2 \times I2} \times 100\%$		
Output of converter	Across terminals P and BN <i>↑</i> <i>N</i>	 Moving-coil type (such as multi-meter)	Charge lamp lights up when voltage is 70V DC or more. <i>1.35 x V1</i> Maximum 380V DC during regeneration.
Frequency setting signal	Across terminals 2 and 5	 Moving-coil type (such as multi-meter) (internal resistance: 50 kΩ or more)	0 to 5V DC (0 to 10V DC)
Power supply for frequency setting	Across terminals 10 and 5	ditto	5V DC
Power supply for frequency	Across terminals FM and SD <i>STD</i>	ditto	About 5 V DC at maximum frequency (when frequency meter is connected.)
Forward operation signal	Across terminals STF and SD	ditto	Open: 13V DC to 19V DC ON voltage: 1V DC or less OFF voltage: 13V DC or more
Reverse operation signal	Across terminals STR and SD		
Reset	Across terminals RES and SD		
Base shut-off (alarm) signal	Across terminals B and C	 Moving-coil type (such as multi-meter)	Measuring continuity Continuity when power supply is shut off or during normal operations.

Terminals "5" is common.

Terminal "SD" is common.

9. STANDARD SPECIFICATIONS

Item		FR-K-S370B	FR-K-S750B
Output rating	Normal output (kW)	0.37	0.75
	Output capacity (kVA)	0.95/1.1	1.5/1.7
	Rated output current (A)	2.5	4.0
	Maximum output voltage	Single-phase 220V or 240V	
Power source requirement (kVA)		1.5	2.5
Weight (kg)		3.5	3.5
Construction		Totally enclosed type IP50	
Power supply	Voltage/frequency	Single-phase AC220V/AC240V 50Hz	
	Allowable voltage regulation	198 to 264V	
	Allowable frequency regulation	50Hz $\pm 5\%$	
Control specifications	Control method	Sinusoidal PWM, Voltage-control	
	Frequency range	1 : 10 (6 \cdot 60Hz) or 1 : 20 (6 \cdot 120Hz) or 1 : 40 (6 \cdot 240Hz) selectable (Operation starts at 3Hz)	
	Frequency resolution (Hz/maximum frequency)	0.25/160, 0.5/1120, 1.0/1240	
	Frequency accuracy	$\pm 0.5\%$ (25°C $\pm 10^\circ\text{C}$)	
	Voltage/frequency ratio	Voltage/Frequency ratio constant until 50Hz, Voltage is constant above 50Hz	
	Overcurrent resistance	309% for one minute	
	Frequency setting signal	0 \cdot 5V DC, 0 \cdot 10V DC changeable	
	Acceleration/deceleration time	0.2 \cdot 3.0 sec. (in 0.2 sec. increments), 1 \cdot 15 sec. (in 1 sec. increments), 10 \cdot 150 sec. (in 10 sec. increments) selectable	
	Regenerative braking torque	Approx. 120% of rated motor torque (short time rating)	
	Protective functions	Protection against stalls caused by overcurrent, protection against stalls caused by regenerative overvoltage, overcurrent protection, regenerative overvoltage protection, instantaneous power failure, thermo detect of the heatsink alarm against overload.	
Environment conditions	Ambient temperature	-10°C to +40°C (To be free from freezing)	
	Ambient humidity	Below 90% (To be free from condensation)	
	Atmosphere	To be free from corrosive gas	
	Altitude	Less than 1,000 m	
	Vibration	Less than 0.5G	

10. PROTECTIVE FUNCTION


The protective functions listed below are built into the FR-K Series inverters.

When the protective circuits are activated, output is stopped by shutting off the base of the transistor so that the modules are protected. This will cause the motor to stop after a brief free run. To start again, it is necessary to either reset by using the reset terminal "RES", or to turn off and on the power.

Protection against stalls caused by overcurrent	If an overcurrent more than 150% of the rated current occurs during acceleration the frequency increase is stopped and frequency is kept until the load current has been reduced, thus preventing the inverter from the stall. If an overcurrent larger than 150% of the rated current occurs during normal operations (at constant speed), the frequency is decreased until the load current has been reduced, thus preventing the inverter from the stall. When the load current has been decreased below 150%, frequency will be increased again and acceleration will be continued to reach the set frequency level.
Protection against stalls caused by regenerative overvoltage	This protective circuit detects any regenerative energy during deceleration, so that the frequency decrease will be stopped until the output voltage of the capacitor has been reduced, thus preventing the inverter from the stall. When the regenerative energy has been reduced, frequency will be decreased again and deceleration continued.
Overcurrent protection	If an overcurrent large than 200% of rated output current is detected through the output current, the overcurrent protection circuit will be activated to cut off the transistor circuit and keep it off. (When an overcurrent protection circuit has been activated, the alarm indication lamp will light up.) (Activation of the overcurrent protection circuit is caused mainly by a power supply decrease, extreme load inertial (GD_2), extremely short preset acceleration time, or a short-circuit in the inverter secondary circuit, so to remove the trouble and restore the circuit examine all possible failure.)
Regenerative overvoltage protection	When an overvoltage is caused by regenerative energy at the converter output, the protection circuit is activated to cut off the transistor circuit and keep it off. (An alarm indication lamp will light up in such cases.) (Activation of the regenerative overvoltage protection circuit is caused mainly by an extremely short preset deceleration time, so lengthen the preset deceleration time or consider using the optional brake unit.)
Instantaneous power failure protection	If a power failure continues for 15 msec or more, the instantaneous power failure protection circuit is activated to cut off the transistor circuit and keep it off. (An alarm indicator will light up in such cases.) If the power failure is within 15 msec, the protection circuit will not work and the control circuit will continue operation.
Overload protection (electronic thermal relay)	Any overload while the motor is running under its rated condition or overheating at low speed running is detected by an electronic thermal relay, which cuts off the transistor circuit and keeps it off. (Alarm indication lamp will light up in such cases.) (Check the cause of the overload and either lighten the load, change the operations pattern or reconsider the capacity of inverter and motor.)
Overload alarm	If the motor becomes overloaded, an alarm indication lamp will go on and off. If overload increases further, the overcurrent protection function will be activated. If the alarm indicator goes on and off during acceleration/deceleration, preset to longer acceleration/deceleration times. If an alarm indication begins blinking during fixed speed operation, lighten the load or reconsider the capacity of inverter and motor.

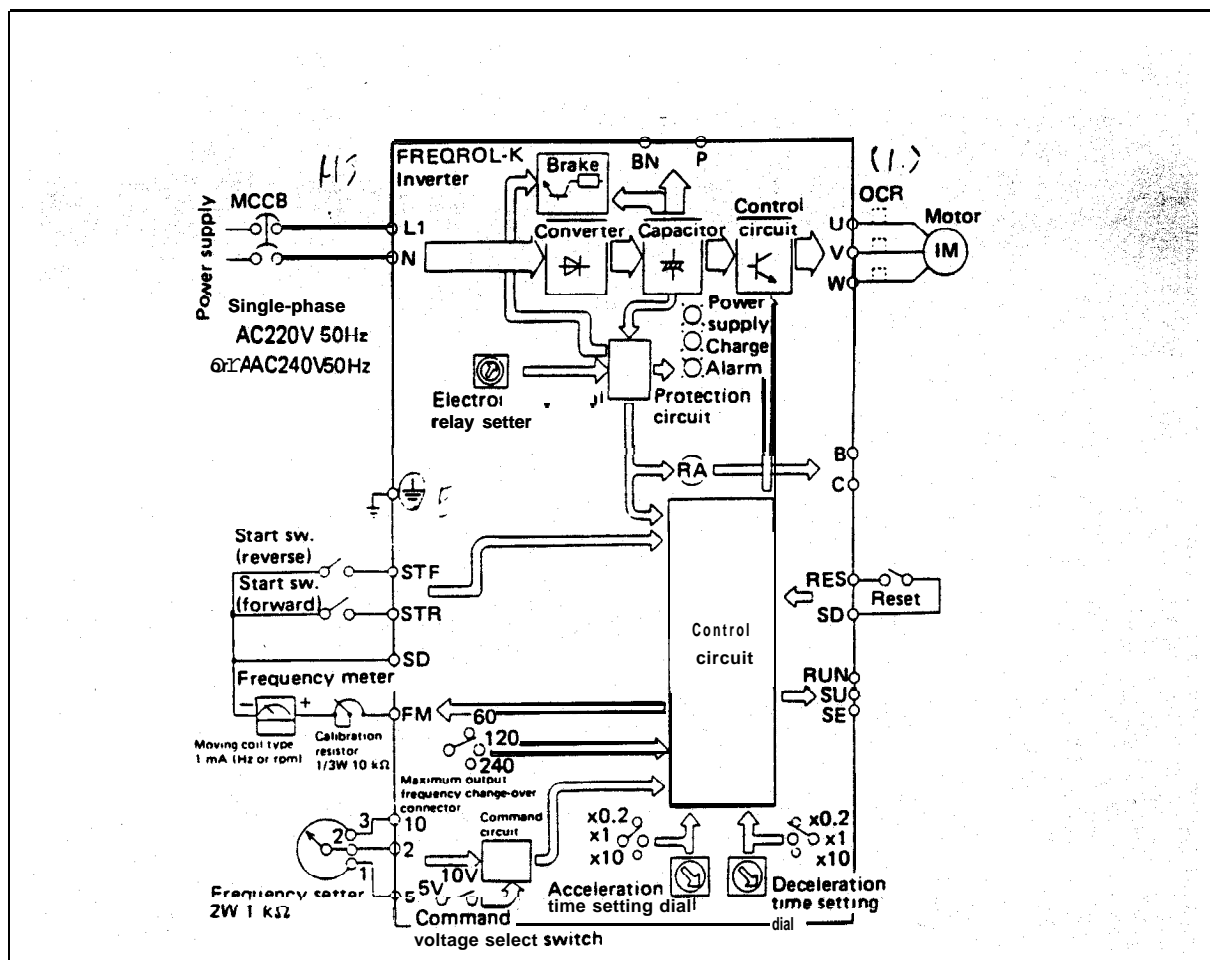
Note: When the overcurrent protection, regenerative overvoltage protection, or instantaneous power failure protection is activated, an alarm indicator lamp lights up and that state will be retained. However, when the magnetic contactor (MS) is opened by an alarm signal, the alarm display will not be retained. If you wish to retain the alarm display, design the circuit so that main circuit and control circuit are configured independently. In order to retain the display of an alarm, disconnect control circuit power terminal R1 and S1, and connect the separate power.

11. INPUT/OUTPUT TERMINAL

Terminal symbol	Terminal name	Rating	Description
L1, N	AC powered supply input terminal	Single-phase 220V 50Hz or 240V 50Hz	
	Earth terminal		Be sure to ground both inverter and the panel box which encloses inverter.
U.V.W.	Output terminals for motor		Connection for three-phase induction motor.
P.BN	Output terminals for converter	-	Terminals for connection of regenerative brake unit. Never connect anything other than brake unit to these terminals.
10-5	Power supply terminal for frequency setting	5V DC \pm 0.01V DC Allowable load current: 6 mA	Use these terminals as power supplies for external setters such as the variable resistor for frequency setting (motor speed setting).
2-5	Terminals for input signal of frequency	Input resistor 11 k Ω \pm 1 k Ω	Maximum frequency (60Hz, 120Hz, or 240Hz) is obtained at 5V (10V).
STF-SD STR-SD	Input terminal for forward start signal Input terminal for reverse start signal	Input resistor 2.5 k Ω Open voltage 14 to 20V DC Optoelectronic isolator Controllable by means of open-collector.	Forward start by closing terminals between STF and SD, stoppage by opening them Reverse start by closing terminals between STR and SD, stoppage by opening them. Closing terminals between STF and SD, and STR and SD simultaneously causes stop command.
FM-SD	Output terminal for frequency meter	Allowable load current: 1 mA Optoelectronic isolator output voltage form is pulse.	Approximately 5V DC is obtained at maximum frequencies (60Hz, 120Hz, or 240Hz) and output voltage is in proportion with the frequencies. Connect moving-coil type ampere meter (DC 1 mA) with terminals FM and SD. Use calibration variable resistor 10K 1/3W by inserting it in series.
RES-SD	Input terminal for signal	Input resistor 4.7 k Ω Open voltage 14 to 20V DC Optoelectronic isolator Controllable by means of open-collector	For resetting emergency stop of the inverter caused by the activation of protection circuit. Resetting initializes each part of the control circuit immediately, and the circuit to inverter and converter is shut off. To give this reset command, it is necessary to short-circuit across terminals RES and SD for 0.1 second or more. Initial reset is automatically performed inside the controller 0.2 to 0.4 seconds later after power up.
B-C	Output terminal for alarm	Contact output 0.3A $\cos\phi = 0.4$ 30V DC 0.3A	Normally closed contact that provides alarm signal when protective circuit is activated. When this signal is provided, power to the converter and inverter are cut off and the motor will stop after free running.

Terminal symbol	Terminal name	Rating	Description
RUN-SE	Output terminal controller operations	Open-collector of transistor Allowable load 23V DC 0.1A	Open-collector: L ... when the commanded frequency is above 3Hz H ... normally Use power supply 24V DC with ripple voltage within 10%.
SU-SE	Output terminal for correspondence of frequencies		Output terminal that indicates whether the actual frequency corresponds to the preset frequency: Open-collector: L ... corresponds H ... does not correspond

Fig. 7 Block Diagram





MITSUBISHI ELECTRIC CORPORATION

HEAD OFFICE MITSUBISHI DENKI BLDG MARUNOUCHI TOKYO 100 TELEX. J24532 CABLE MELCO TOKYO
NAGOYA WORKS 1-14, YADA-MINAMI 5, HIGASHI-KU, NAGOYA, JAPAN