



**TRANSISTORIZED INVERTER  
INSTRUCTION MANUAL**

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**COMBINATION CONTROLLER**

**FR-AL**

Thank you for choosing this Mitsubishi transistorized Inverter option.

This instruction manual gives handling information and precautions for use of this equipment.

Incorrect handling might cause an unexpected fault. Before using the equipment, please read this manual carefully to use the equipment to its optimum.

Please forward this manual to the end user.

### **This section is specifically about safety matters**

Do not attempt to install, operate, maintain or inspect this product until you have read through this instruction manual and appended documents carefully and can use the equipment correctly.

Do not use this product until you have a full knowledge of the equipment, safety information and instructions.

In this instruction manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



Assumes that incorrect handling may cause hazardous conditions, resulting in death or severe injury.



Assumes that incorrect handling may cause hazardous conditions, resulting in medium or slight injury, or may cause physical damage only.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

## **SAFETY INSTRUCTIONS**

### 1. Electric Shock Prevention

#### **WARNING**

- While power is on or when the inverter is running, do not open the front cover. You may get an electric shock.
- Do not run the inverter with the front cover removed. Otherwise, you may access the exposed high-voltage terminals or the charging part of the circuitry and get an electric shock.
- If power is off, do not remove the front cover except for wiring or periodic inspection. You may access the charged inverter circuits and get an electric shock.
- Before starting wiring or inspection, switch power off, wait for more at least 10 minutes and check for the presence of any residual voltage with a meter etc.
- Earth the option unit.
- Any person who is involved in the wiring or inspection of this equipment should be fully competent to do the work.
- Always install the inverter before wiring. Otherwise, you may get an electric shock or be injured.
- Operate the switches with dry hands to prevent an electric shock.
- Do not subject the cables to scratches, excessive stress, heavy loads or pinching. Otherwise, you may get an electric shock.

### 2. Fire Prevention

#### **CAUTION**

- Mount the option unit on an incombustible surface. Installing the inverter or option unit directly on or near a combustible surface could lead to a fire.
- If the inverter has become faulty, switch off the inverter power. A continuous flow of large current could cause a fire.

### 3. Injury Prevention

#### **CAUTION**

- Apply only the voltage specified in the instruction manual to each terminal to prevent damage etc.
- Ensure that the cables are connected to the correct terminals. Otherwise, damage etc. may occur.
- Always make sure that polarity is correct to prevent damage etc.
- While power is on and for some time after power-off, do not touch the option unit as they are hot and you may get burnt.

#### 4. Additional instructions

Also note the following points to prevent an accidental failure, injury, electric shock, etc.:

##### (1) Transportation and installation

### CAUTION

- When carrying products, use correct lifting gear to prevent injury.
- Do not stack the inverter boxes higher than the number recommended.
- Ensure that installation position and material can withstand the weight of the option unit. Install according to the information in the Instruction Manual.
- Do not operate if the option unit is damaged or has parts missing.
- Do not stand or rest heavy objects on the option unit.
- Check the option unit mounting orientation is correct.
- Prevent screws, wire fragments, conductive bodies, oil or other flammable substances from entering the option unit.
- Do not drop the option unit, or subject it to impact.
- Use the inverter under the following environmental conditions:

Environment	Ambient temperature	-10°C to +50°C (non-freezing)
	Ambient humidity	90%RH or less (non-condensing)
	Storage temperature	-20°C to +65°C*
	Ambience	Indoors (free from corrosive gas, flammable gas, oil mist, dust and dirt)
	Altitude, vibration	Maximum 1000m above sea level for standard operation. 5.9 m/s <sup>2</sup> or less (conforming to JIS C0911)

\*Temperatures applicable for a short time, e.g. in transit.

##### (2) Trial run

### CAUTION

- Check all parameters, and ensure that the machine will not be damaged by a sudden start-up.

##### (3) Operation

### WARNING

- Do not modify the equipment.

(4) Emergency stop

 **CAUTION**

- Provide a safety backup such as an emergency brake which will prevent the machine and equipment from hazardous conditions if the inverter or option fails.

(5) Maintenance, inspection and parts replacement

 **CAUTION**

- Do not carry out a megger (insulation resistance) test on the control circuit of the option unit.

(6) Disposing of the inverter

 **CAUTION**

- Treat as industrial waste.

(7) General instructions

Many of the diagrams and drawings in this instruction manual show the inverter without a cover, or partially open. Never run the inverter like this. Always replace the cover and follow this instruction manual when operating the inverter.

## CONTENTS

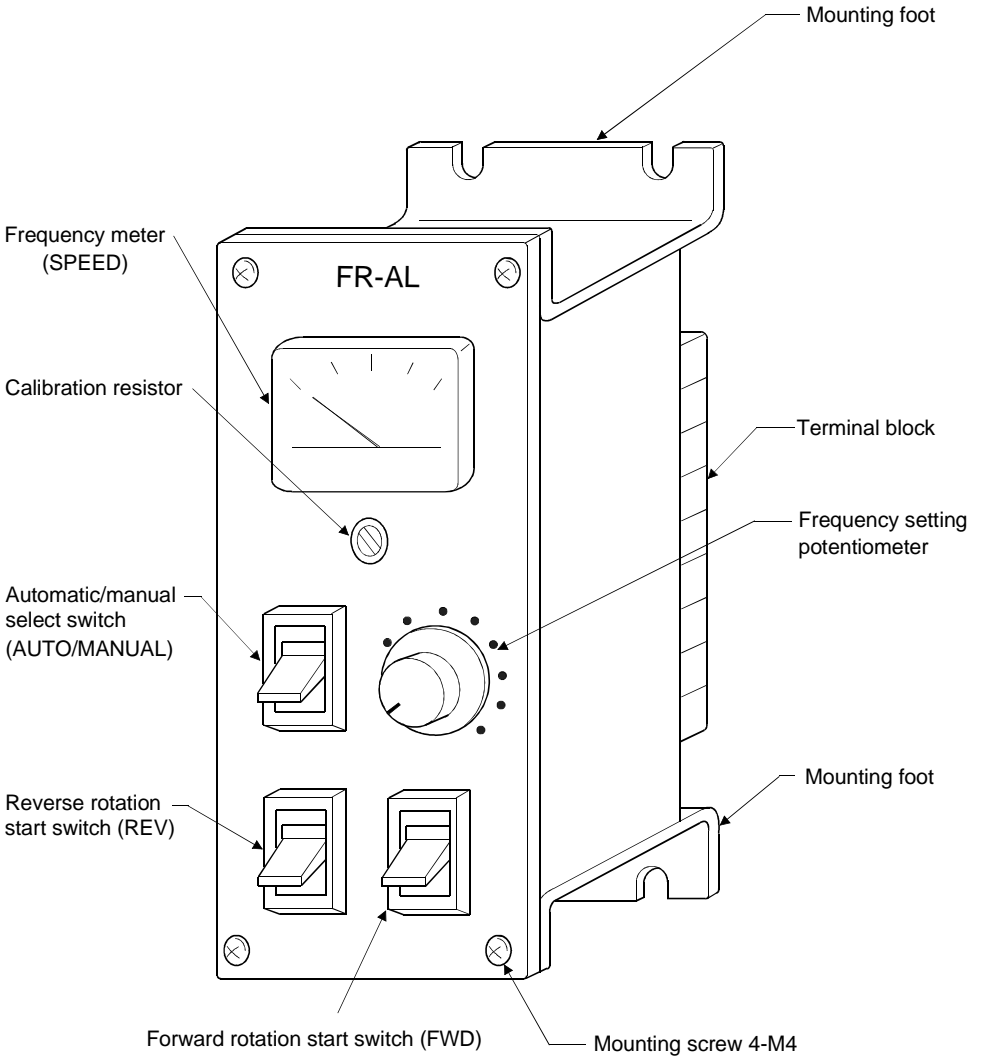
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## FR-AL COMBINATION CONTROLLER

The "FR-AL" combination controller is designed to enable joint operation under the control of the voltage signal (0 to 5VDC, 0 to 10VDC) from other equipment in the "AUTO" position of the select switch (CS1) or independent manual operation with the knob provided on the controller in the "MANUAL" position.

# 1. STRUCTURE

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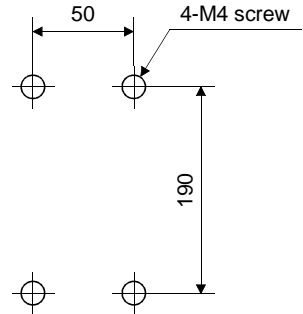
**Fig.1 Structure**

## 2. INSTALLATION

The controller can be installed by fastening the mounting feet with screws (4 screws). The mounting dimensions are shown in Fig. 2.

(Note) Install the unit after wiring the terminal block.

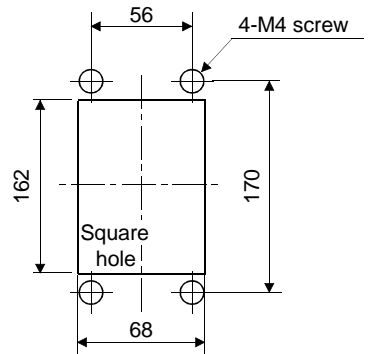
When changing the wiring after installation, removal of the mounting screws (4, M4 screws) in the front panel allows you to remove only the unit, leaving the mounting feet behind.



**Fig. 2 Mounting Dimensions**

### **Embedding the controller in a panel etc.**

- (1) Cut the mounting panel to the mounting hole dimensions in Fig. 3.
- (2) Take off the mounting screws (4 screws) in the controller front panel, and remove the mounting feet.

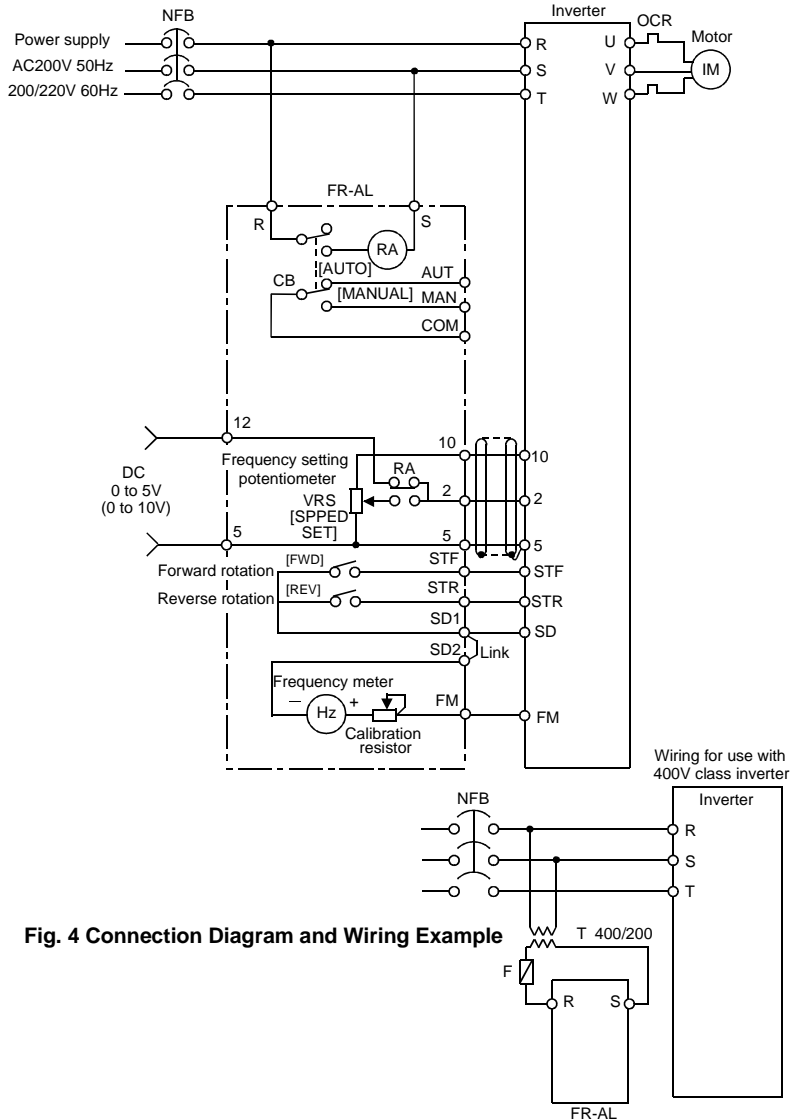


**Fig. 3 Embedding Dimensions**



# 3. WIRING

## 3.1 Circuit Structure and Connection Method



**Fig. 4 Connection Diagram and Wiring Example**

### 3.2 Circuit Explanation

The circuit consists of the automatic (AUTO) and manual (MANUAL) selector circuit, start (forward/reverse rotation) circuit, frequency setting circuit and frequency meter circuit.

#### Selection between automatic (AUTO) and manual (MANUAL)

Moving the "AUTO"- "MANUAL" select switch (CS) to "MANUAL" energizes the relay RA to disconnect the externally input frequency setting signal (across automatic operation signal terminal 12-5), enabling the frequency setting signal to be given to the inverter with the frequency setting potentiometer (VRS) on the panel.

Moving the switch to "AUTO" outputs the externally input frequency setting signal (joint operation signal) to be output (across terminals 2-5) unchanged, disconnecting the output of the frequency setting potentiometer of this unit.

(Note) The above switching cannot be performed when no power (200V series) is input to terminals R-S. Therefore, always make connection. Use a transformer for the 400V series inverters.

### 3.3 Terminal Layout and Wiring Instructions

The terminal layout is shown in Fig. 5.

- (1) Terminals SD1 and SD2 are connected by a link.
- (2) Terminals marked \* cannot be used as they are provided for terminal mounting.

- Wiring instructions -

- (1) The wiring distance between controller and inverter should be 50m maximum and should be made as short as possible.
- (2) Use twisted or shielded cables for wiring the frequency setting potentiometer (terminals 10, 2, 5), and connect the shields to the common (terminal 5), not to the earth. (Refer to Fig. 4.)

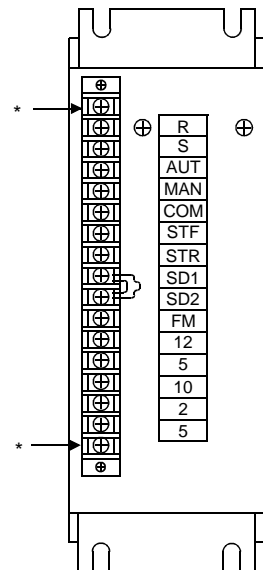


Fig. 5 Terminal Layout Diagram

## 4. ADJUSTMENT

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Adjustment to be made for operation is to calibrate the frequency meter. The meter may not indicate a correct value depending on the wiring distance, the inverter's frequency meter output signal (terminal FM), etc.

Therefore, before starting operation, always refer to the following items and calibrate the frequency meter.

### **Adjustment method**

Start the inverter and turn the frequency setting potentiometer (VRS) to make the voltage across inverter terminals 2-5 maximum (5V or 10V). In this state, make adjustment with the calibration resistor (VRN) on the front panel until the frequency meter deflects to full-scale (maximum frequency).

#### **• Using the parameter unit to make adjustment**

For digital inverters, the parameter unit can be used to make calibration. In this case, make adjustment with the calibration resistor (VRN) in the fully clockwise position. (Refer to the inverter instruction manual for the adjustment method.)

- The frequency meter is factory-adjusted to deflect to full-scale in the fully clockwise position of the frequency setting potentiometer (VRS). However, when the FR-AL is connected to the Z<sub>200</sub> or F<sub>400</sub> series inverters, the meter does not indicate the maximum frequency. (About 70% indication)

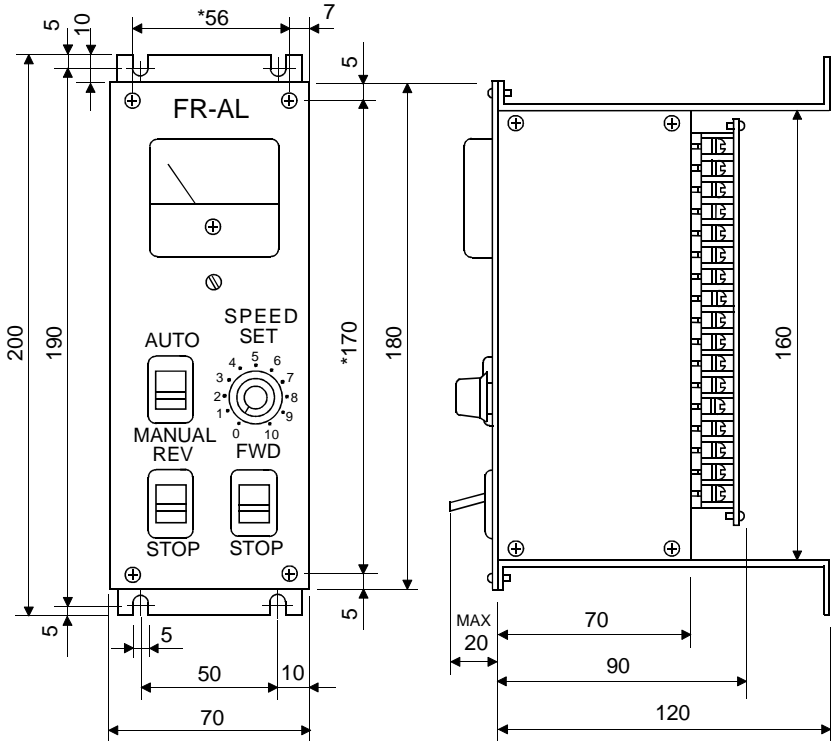
Hence, always make calibration when using the unit with the aforementioned series of inverters.

## 5. SPECIFICATIONS

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Operation power supply voltage [Terminals R, S]	200VAC 50Hz, 200/220VAC 60Hz
Power consumption	1VA
Frequency setting input voltage [Terminal 10]	5V or 10VDC
Frequency setting output signal [Terminal 2]	0 to 5VDC 0 to 10VDC
Frequency setting potentiometer (VRS)	1k $\Omega$ 1W B characteristic
Frequency meter	1mA full-scale DC ammeter
Calibration resistor (VRN)	10k $\Omega$ 1/3W

# 6. OUTLINE DRAWING



\*Mounting dimensions for embedding in a panel etc. (Refer to page 2)

# REVISIONS

\*The manual number is given on the bottom left of the back cover.

Print Date	*Manual Number	Revision
Jul., 2000	IB(NA)-0600041-A	First edition