

mitsubishi

TRANSISTORIZED FREQUENCY INVERTER

PREAMPLIFIER

TYPE FR-FA
Instruction Manual

PREAMPLIFIER type FR-FA

The Preamplifier "FR-FA*" is mainly used to convert and amplify output signal from a speed setter to make the output signal applicable as frequency setting signal to the FREQROL inverter.

In general, the output signal from the speed setter is adjustable within a ratio of 1 to 5, that is, within a range from 2mA to 10mA, or 4mA to 20mA, for example, thus permitting frequency only within the ratio of 1 to 5.

When the Preamplifier is used, the output from the speed setter may be easily changed within a range of 0% to 100%.

The Preamplifier is provided with an input terminal to serve as an OP amplifier (operational amplifier). Also, since the unit has a built-in output clamp circuit, it can also be utilized as an OP amplifier with output clamp.

*Note: A number in * is suffixed for the different power supply. Refer to the Table 2.*

1. OUTLINE DRAWING

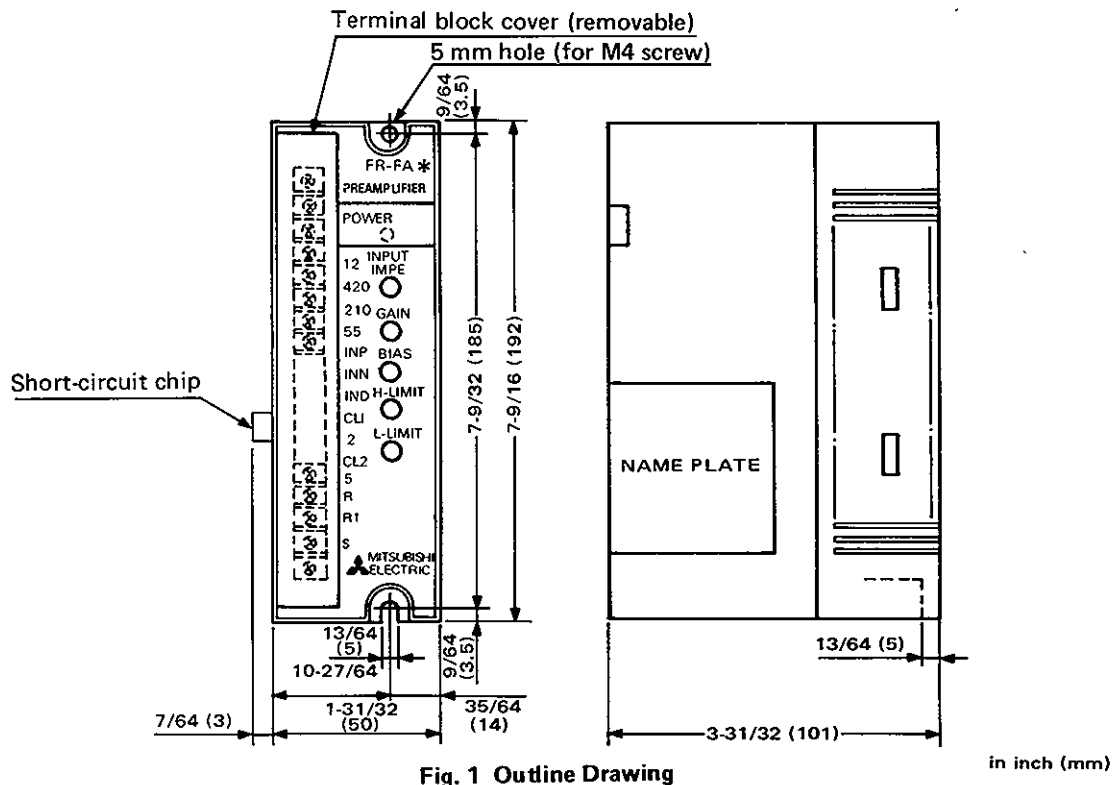


Fig. 1 Outline Drawing

2. INSTALLATION

- (1) Do not install the preamplifier in a place exposed to the direct rays of the sun, and a place where temperature and humidity are high, and a place where there are a lot of dust and corrosive gases. Be sure to install the preamplifier in a clean and dry place. (The unit is not a totally enclosed type.)
- (2) Install the preamplifier in a place which is not liable to be filled with heat. Install the preamplifier so that the wiring distance between the inverter and preamplifier is minimum (e.g., install them inside the same control box).
- (3) Since cables protrude from the left side face of unit, install the preamplifier considering the wiring space of cables.

3. WIRING

- (1) Remove the terminal cover. To remove the terminal cover, pull the recessed portions on the left side toward you as shown in Fig. 2.
- (2) Connect the power supply across R and S. (For the type without suffix number, it is possible to connect the power supply across R1 and S depending on line voltage.) If incorrect wiring is done, the internal transformer may burn. (See the block diagram in Fig. 4.)
- (3) When it is required to provide a relay contact to the signal line, connect two contacts of microcurrent switching relay in parallel (or twin contact) to prevent improper contact.
- (4) Use twisted wire or shielded wire for signal line. Separate the signal line from the power line.

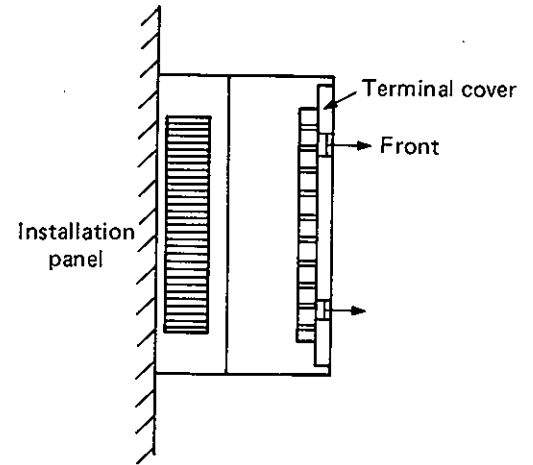


Fig. 2

4. SPECIFICATION

Power supply: Refer to the Table 2

Allowable line voltage fluctuation range: $\pm 10\%$

Power consumption: Approx. 3VA

[Application to speed setter]

Input signal: Terminal "420", 4 to 20mA(*10 to 50mA) Input impedance: 280Ω (Fixed)
Terminal "210", 2 to 10mA(*1 to 5mA) Input impedance 560Ω (Adjustable)

Output signal: Terminal "2", 0 to 5V DC 7.5mA (Capable of connecting 15 inverters. 0 to 10V output is also possible.)

Standard gain: Output $0 \pm 60\text{mV}$ with input 4mA } When terminal "420" is used
Output $5^{+0.05}_0$ V with input 20mA

Gain adjustable range: 1/5 to 3 times of standard gain

Bias adjustable range: $-\frac{9}{6}$ V (at standard gain) under 4mA input

Note: When input signal marked * is used, "GAIN" and "BIAS" must be readjusted.

[Application as OP amplifier]

Input signal: 0 to $\pm 10\text{V}$ DC

Input impedance: Terminal "INP", "INN", "IND" $11 \pm 1\text{k}\Omega$

Output signal: 0 to 12V 7.5mA

Gain adjustable range:	Terminal "INP"	Common input	1/5 to 3
	Terminal "INN"	Differential input	-1/5 to -3
	Terminal "IND"	Differential input200 times larger than gain at "INN"

Bias adjustable range: $\pm 8\text{V}$ (at connector NOR) under 0V input
 $+\frac{12}{0}$ V (at connector REV)

Clamp adjustable range: Refer to Table 1.

Ambient temperature: -10°C to $+50^\circ\text{C}$ (to be free from freezing)

5. PRINCIPLE

Fig. 3 shows the level change when Preamplifier "FR-FA*" is used together with a speed setter.

In the Preamplifier, output current from the speed setter is changed to voltage signal, and amplified by the OP amplifier. The frequency setting signal is made up after the amplified signal voltage is subjected to bias voltage.

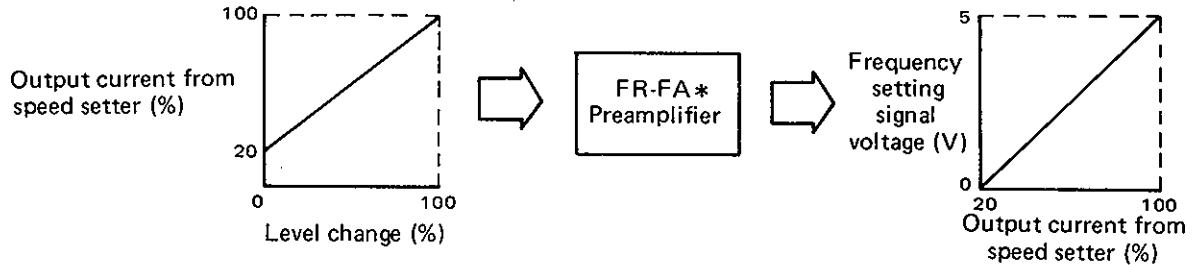


Fig. 3 Level Change by Preamplifier

	Short of terminals CL1-2	Short of terminals CL2-2
High limit clamp		
Low limit clamp	Low limit clamp is not operated.	

Table 1 Clamp Adjusting Range

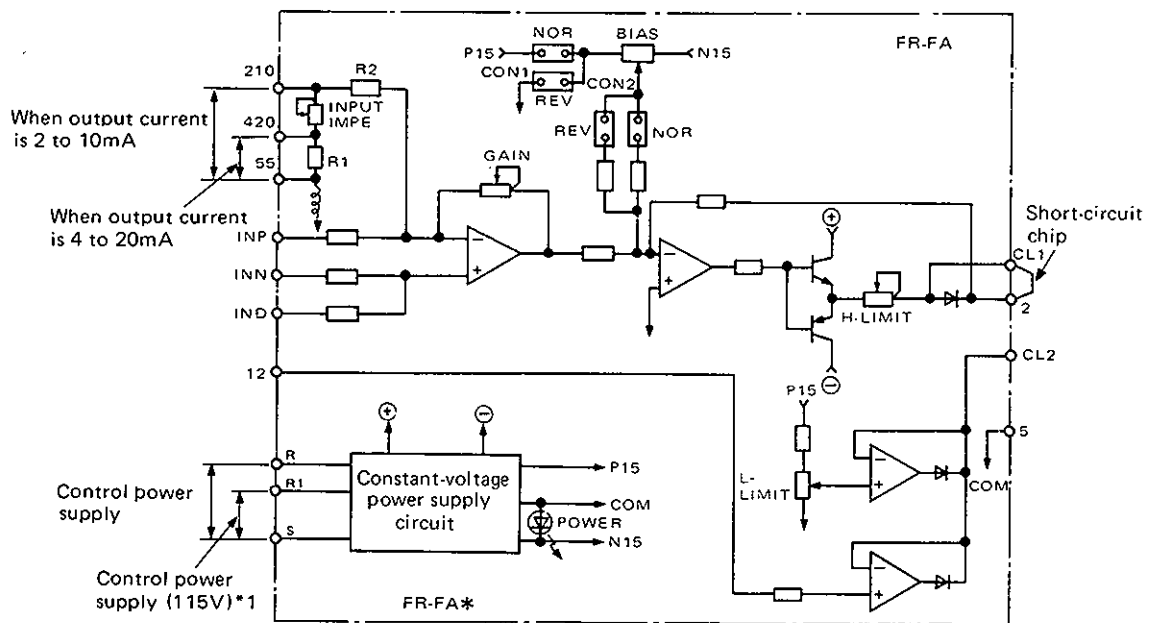
6. CIRCUIT CONSTRUCTION

Fig. 4 shows the internal circuit block diagram of the Preamplifier. When the Preamplifier is used for the output conversion of speed setter and output current varies in the range of 4 to 20mA, connect the output current across terminals "420" and "55" so that "55" is of negative polarity. Then, the output current flows from the speed setter to resistor R1, and a voltage determined by the product of the impedance value and output current from speed setter is applied to the OP amplifier through R2. Likewise, when output current varies in the range of 2 to 10mA, connect the output current across terminals "210" and "55". Then, a voltage determined by the product of R1+"INPUT IMPE" and output current from speed setter is applied to the OP amplifier. The output of OP amplifier is connected to the transistor. By amplifying current by this transistor, the output current of Preamplifier is given allowance.

When the output current from speed setter is not as described above, for example, the output current is 10mA to 50mA, connect it across terminals "420" and "55". When it is 1 to 5mA, connect it across terminals "210" and "55". However, it is required to readjust the gain setter "GAIN" and the bias setter "BIAS" so that the output voltage from the Preamplifier, measured across terminals "2" and "5", reaches 5V when the output current from speed setter is at the maximum level, and 0V when the output current is at the minimum level.

The output impedance of the speed setter should be 280Ω when the output current is connected across terminals "420" and "55", and 560Ω when the output current is connected across terminals "210" and "55". The output impedance is usually below 600Ω when a speed setter with output current ranging from 4mA to 20mA is used. When output current ranging from 2mA to 10mA is used, the input impedance setter "INPUT IMPE" is also required to be readjusted in usual operation.

Common input terminal "INP" and differential input terminal "INN" are provided to permit the Preamplifier to be used as OP amplifier. Also, the Preamplifier has terminal for low-impedance input "IND" that may be used when the preceding device has high impedance output. When terminal "IND" is used, the gain of the OP amplifier is 200 times larger than the case where terminal "INN" is used. Therefore, a suitable impedance should be connected for the use of terminal "IND". The output high limit clamp circuit is biased on division of saturated voltage output from the OP amplifier by clamp voltage adjust variable resistor "H-LIMIT" and output resistance. The output low limit clamp uses diode OR system. When the low limit clamp is required, remove the short-circuit chip from across terminals "CL1" and "2", and connect it across terminals "CL2" and "2".



Note1) 115VAC power supply can be connected only for the type with no suffix No.

Fig. 4 Internal Circuit Diagram of FR-FA Preamplifier

7. ADJUSTMENT

The gain setter "GAIN" and bias setter "BIAS" have been properly adjusted to meet the speed setter of 4 to 20mA as described above. Therefore, no readjustment is required when the speed setter is used with output voltage of 0 to 5V. However, when a speed setter having the output current indicated above is used or output voltage of 0 to 10V is used, proceed as follows.

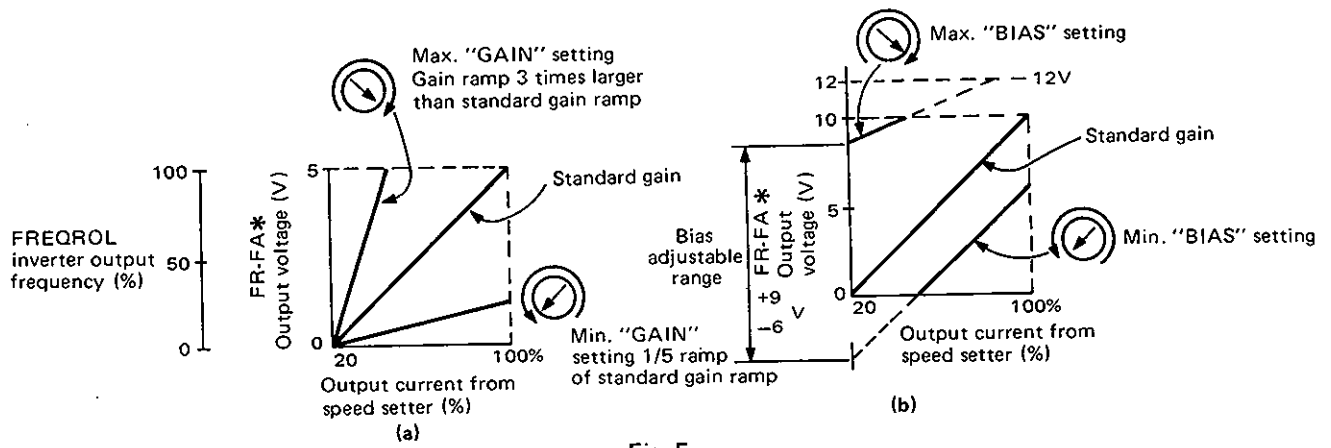


Fig. 5

(1) Gain setter "GAIN". "used to change gain ramp"

Turn and set the bias setter so that output voltage from the Preamplifier is 0V when the output current from the speed setter is minimum (20%). Then increase the output current from the speed setter and adjust the gain setter "GAIN" so that the output is 5V when the output current from the speed setter is maximum (100%). This setting provides the standard gain of the Preamplifier.

By turning "GAIN", the gain can be changed as shown in Fig. 5(a).

(2) Bias setter "BIAS". "used to horizontally shift gain ramp"

When "BIAS" is turned from its standard setting with "GAIN" maintained at standard setting as described in (1), the ramp gain horizontally shifts as shown in Fig. 5(b). This bias adjustment is possible within a range from +9V to -6V. When it is necessary to finely adjust the standard gain, repeat the adjustment on the "GAIN" and "BIAS" two or three times.

(3) Input impedance setter "INPUT IMPE"

As previously explained, the input impedance setter "INPUT IMPE" usually requires no readjustment. When a special input impedance is required, however, the terminal "210" is used and the input impedance may be adjusted by turning "INPUT IMPE" within a range from 280Ω to 780Ω.

(4) Adjustment to be made when the Preamplifier is used as OP amplifier

The adjustment can be made basically in the same manner as explained at the preceding steps (1) and (2); turn "GAIN" to adjust the ratio (gain) of output voltage to input voltage and turn "BIAS" to adjust the output voltage (bias) at 0V of input voltage.

The output high limit clamp should be adjusted by the high limit clamp setter "H-LIMIT" so that the output voltage does not exceed the specified level even when a large input voltage is given to the Preamplifier. "H-LIMIT" is factory-set (to fully clockwise position) so that the clamp is not provided.

(5) Selection of terminal CL1 or CL2

When the short-circuit chip is connected across terminals CL1 and 2, output voltage of ±12V is possible. However, the low limit clamp function and terminal 12 function do not operate.

When the short-circuit chip is connected across terminals CL2 and 2, output voltage is 0 to +12V. However, the low limit clamp (the minimum level is set so that output voltage is not reduced more than required) is possible. Adjust the low limit clamp by use of the low limit clamp setter "L-LIMIT". This setter is factory-set (fully counterclockwise) so that the clamp is not provided. By use of terminal 12 as shown in Fig. 6, the low limit clamp may also be set by the external variable resistor.

When the Preamplifier is used as OP amplifier, it is not required to adjust "INPUT IMPE" because this setter has no connection.

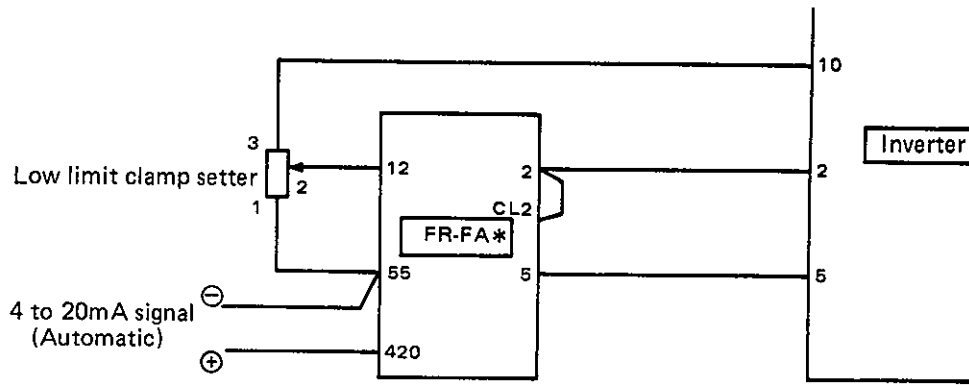


Fig. 6

Note: This circuit is used to set the low limit clamp from the exterior. The circuit may also be used for the following application.

Since the low limit clamp circuit gives priority to larger signals, the frequency of inverter can be manually controlled by the low limit clamp setter during test run or manual operation. However, never input signals of 4 to 20mA.

8. APPLICATION

[Example of pressure control by speed setter]

The Pre-amplifier may be used in a variety of fields to control pressure, temperature, flow rate and other variables when it is associated with sensor or detector, and speed setter or regulator.

Fig. 7 shows an example where the inverter is used to drive the pump motor, output from the pressure transducer is connected to a regulator and the output from the regulator is led into the inverter through the Pre-amplifier. In this example, desired pressure is set on the regulator.

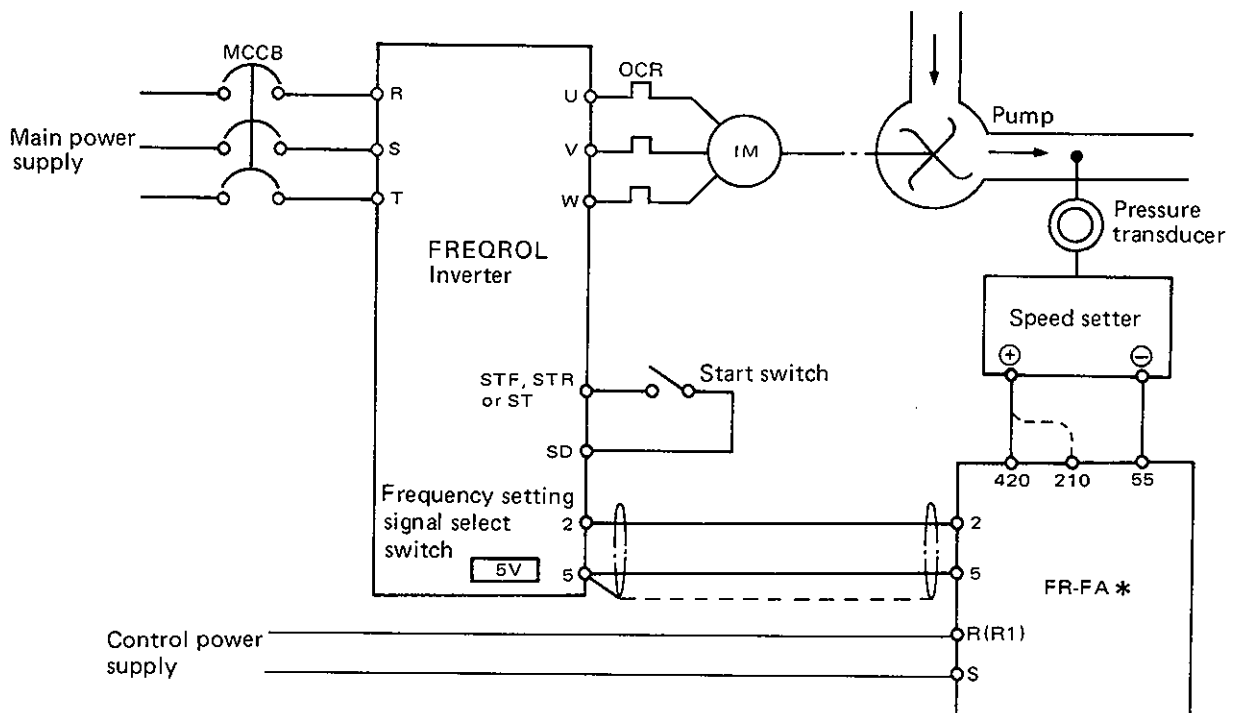


Fig. 7 Pressure Control Example

The connection of DC tach. follower "AS-OL*" between the preamplifier and inverter as shown in Fig. 8 allows manual operation by use of the frequency setter of DC tach. follower. Therefore, the preamplifier can be utilized for machine adjustment, etc.

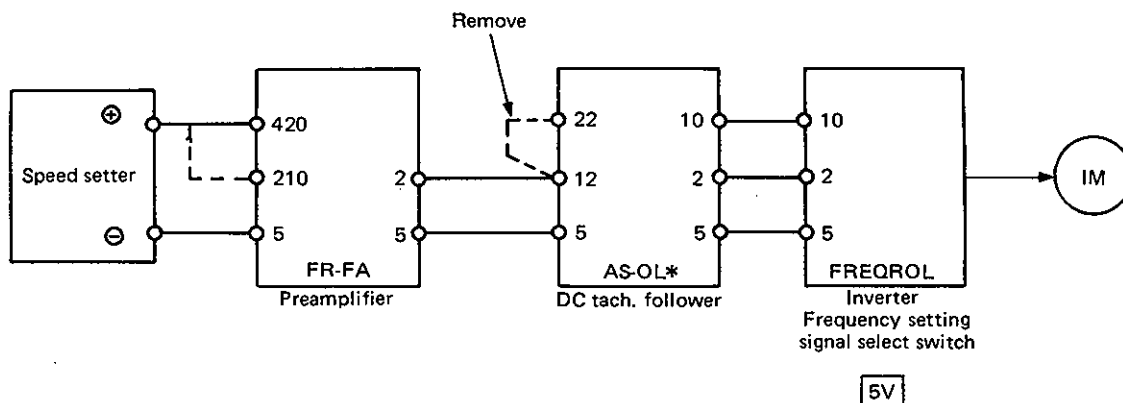
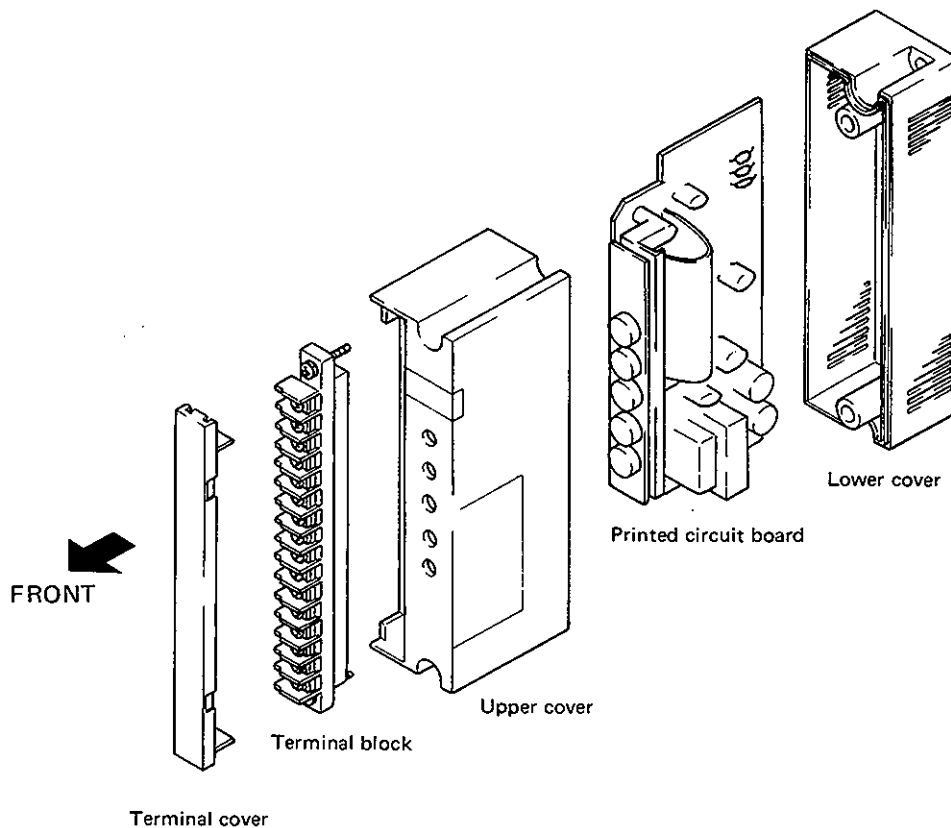


Fig. 8 Automatic Operation by Speed Setter (Manual operation also possible)

9. MAINTENANCE AND INSPECTION

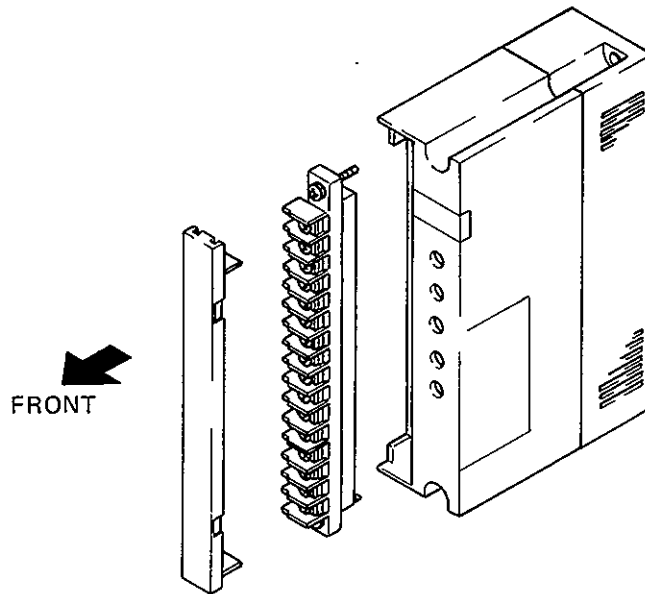
(1) Internal inspection

By removing two screws from the rear surface of unit, the case is divided into two sections and a printed circuit board is exposed. Since the printed circuit board is of a card edge type, it can be pulled out of the case.



(2) Unit replacement

Should the unit be changed due to failure, etc., replacement can be made without disconnecting the cables which have already been wired. Remove the terminal cover and loosen the terminal block fixing screws at both ends of the terminal block. Then, the terminal block is lifted toward front. With the terminal block fixing screws disconnected from the case, pull the terminal block toward front. Then, the terminal block is removed from the case.



Suffix No.	Control power supply	
	FR series FR-FC, FD, FG, FA	ASPAC series AS-OX, OK, FK, OL, OH, OT
None, 1, 2	200/200/220VAC 50/60/60Hz 115VAC 60Hz	200/200/220VAC 50/60/60Hz
4	—	115VAC 60Hz
5	220VAC 50Hz	220VAC 50Hz
6	240VAC 50Hz	240VAC 50Hz

Table 2 Control power supply and suffix No.