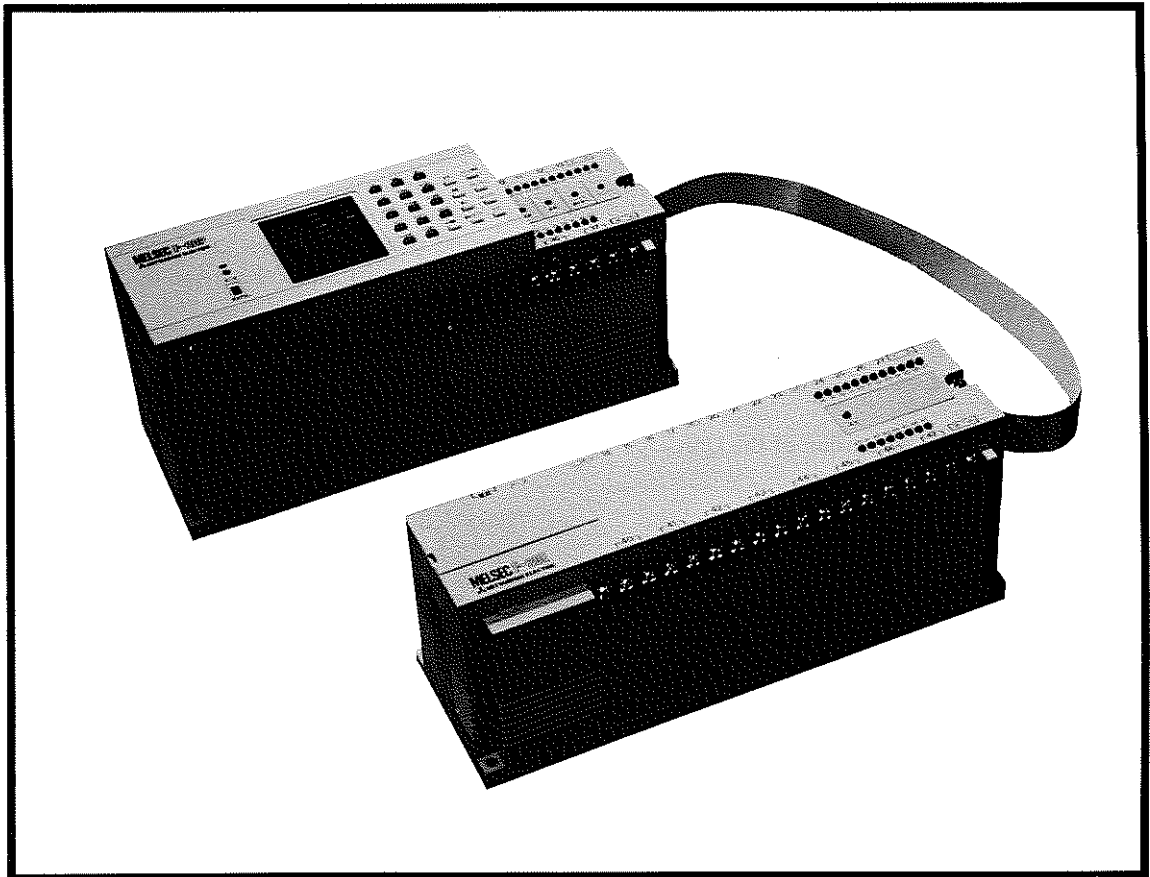


MITSUBISHI

MELSEC F-12R, F-20M Programmable Controller

INSTRUCTION MANUAL



- This manual provides technical information and guidance on the installation and use of the Mitsubishi F-12R and F-20M Programmable Controller and its extension unit.
- Users should ensure that the detail of this manual is studied and understood before attempting to install or use the units.
- Information concerning the programming of the system, using the F-20P-E programmer unit, is covered in a separate manual.

 **MITSUBISHI ELECTRIC CORPORATION**

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THE MITSUBISHI F SERIES PC RANGE

The Mitsubishi F series of programmable controllers and auxiliary equipments are of compact size and light weight, and are ideal for small industrial process control requirements and machines. A separate range, the K series, is available for larger and more complex application requirements.

Essentially there are two ranges (F-20 and F-40) in the F series. They share a common programmer. The ROM writer, program loader and other peripherals are also common to the F-20 and F-40 ranges. The F-12R model is fully compatible with F-20 and its peripherals except the ROM function is not available.

The extension units to expand the number of inputs and outputs can be used with the base unit to give an overall choice of I/O numbers from 12 to 80 by 10 points. In addition to large variations such as supply voltage, output type or sink/source type, the analog timer unit and positioning counter module are available to cover many applications.

Nomenclatures of Base & Extension Unit

Model F - □ □ □ - □ □ □
 Expl. F - 20 M R - E S 1
 ① ② ③ ④ ⑤ ⑥

- ① indicates the number of inputs/outputs
- ② indicates type of the unit
 M: Base Unit (RAM and ROM)
 E: Extension Unit
 N/A: Base Unit (RAM only)
- ③ indicates type of output
 R: Relay, S: SSR, T: Transistor
- ④ specifies power supply voltage ratings
 E: 220/240VAC, U: 110/120VAC, D: 24VDC
- ⑤ indicates type of input/output connections
 S: Source Input and Sink Output
 SS: Source Input and Source Output (Transistor)
 N/A: Sink Input and Sink Output
- ⑥ indicates model version

PERIPHERALS

Programming Panel	F-20P-E
Graphic Programming Panel	GP-80F
ROM Writer	F-20MW
Program Loader	F-20H
ROM Cassette	F-ROM-1
Remote Cable	F-20P-CAB
DIN Rail Attachment	F-20D (for F-10, 12, 20) F-40D (for F-40)

BASIC MODELS OF BASE UNIT & EXTENSION UNIT

Unit \ OUTPUT TYPE	F-10/12		F-20		F-40	
	Base Unit	Extension Unit	Base Unit	Extension Unit	Base Unit	Extension Unit
Relay Output	F-12R	F-10ER	F-20MR	F-20ER	F-40MR	F-40ER
SSR Output	-	-	F-20MS	F-20ES	F-40MS	F-40ES
Transistor Output	-	-	F-20MT	F-20ET	F-40MT	F-40ET

Output Loads

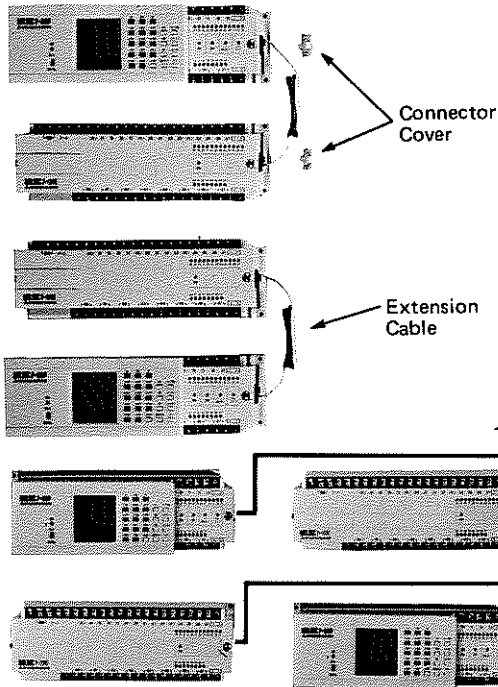
The basic unit and extension unit have the output power ratings indicated in the following table. For loads over the rated maximum limits shown, operation should be performed through an extra relay, capable of handling the load. Loads under the minimum limits shown will need an additional bleed resistor to prevent incorrect operation due to leakage currents flowing in the output circuits (no leakage current flows in the F-10ER unit and transistor unit).

		Relay Output	SSR Output	Transistor Output
Rated Output Current (Resistance load)		2A a Point	1A a Point and 4A per 8 Points Total	1A a Point and 4A per 8 Points Total
MAX. Load	Inductive Load (Ex: Contactor, Solenoid, Solenoid Valve etc.)	Stated in page 8	50VA (110/120VAC) 100VA (220/240VAC)	24W (24VAC)
	Lamp Load	100W	100W	3W (2W Lamp + 6W solenoid)
	Rush Current	10A/Cycle	10A/Cycle	3ADC
MIN. Load	Inductive Load (Ex: Contactor Solenoid, Solenoid Valve etc.)	0.6VA (110/120VAC) 2.3VA (220/240VAC)		=
	Lamp Load	0.4W (110/120VAC) 1.5W (220/240VAC)		-

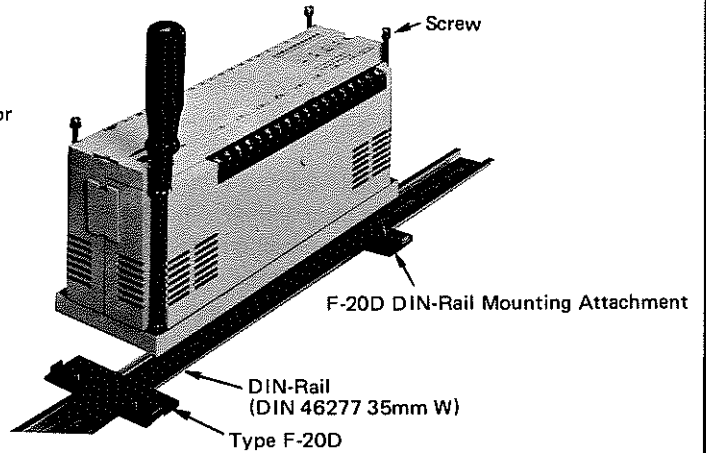
N.B. = Leakage Current of Circuits = 1.1/1.2mA (110/120VAC) Max. 2.2/2.4mA (220/240VAC) Max.

Unit Installation

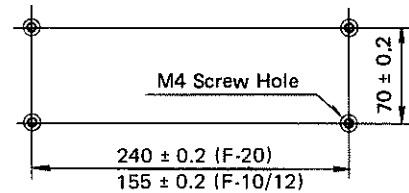
Disposition of Extension Unit



Installation on DIN-Rail



Screw Hole Pitch (Direct Installation) mm



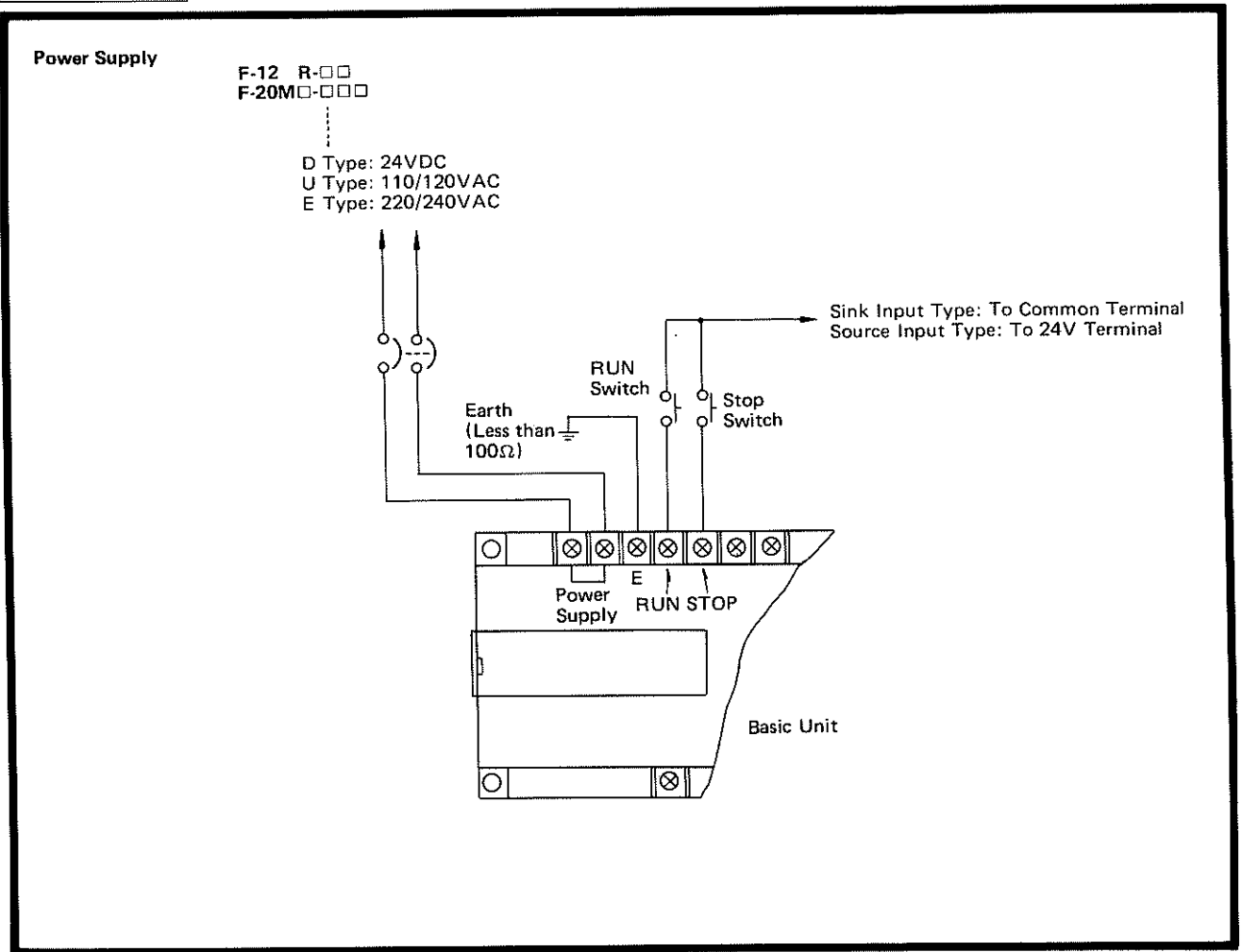
DISCRIPTION

1. The base unit and extension unit can be mounted with suitable screws direct to any flat surface by using the four corner holes provided.
2. Alternatively an optional DIN rail mounting kit is available.
3. Basic and extension units are of the same dimensions and can be connected with the 300mm long extension cable provided with the extension unit. Connectors for the extension cable are located at the side of each unit and protected (when not in use) by a replaceable pliable cover.

CAUTION

1. Whilst the F series PC is suitable for most industrial situations, it should not be used in excessively hostile environments associated with extremes of damp, dust, temperature, corrosive gases, vibration or mechanical impact.
2. A space of some 30mm should be allowed around the unit for heat dissipation.
3. The PC should not be installed near to high voltage supply cables or other such electrical apparatus.

Power Supply



DISCRIPTION

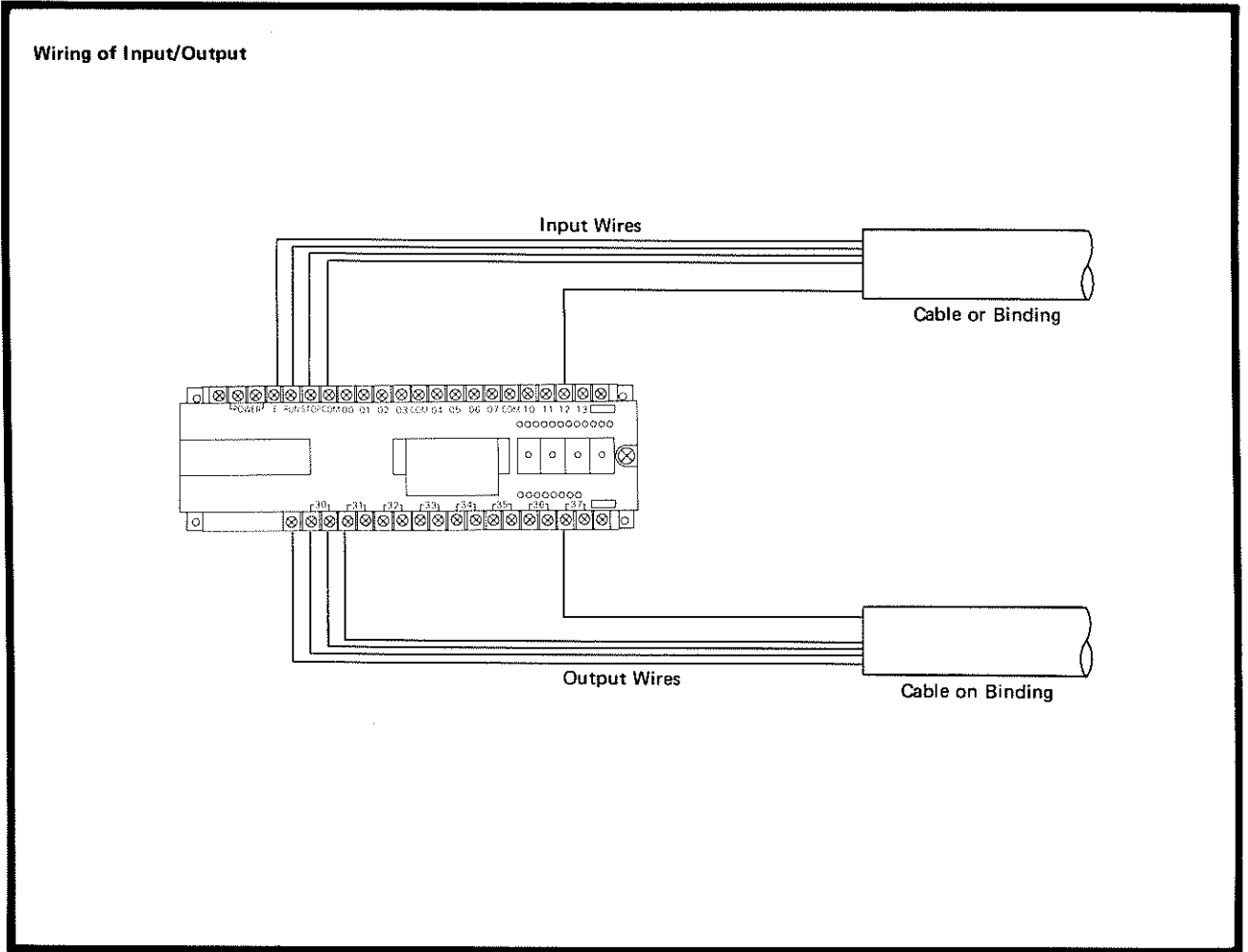
1. Connect a power supply cable of the correct rating to the basic unit and extension unit (if used) as illustrated.
2. The power consumption of the basic unit is less than 11VA and that of the extension unit is less than 6VA. However this does not include the power consumption of any external loads.
3. All units must be earthed as illustrated.
4. 'Stop' or 'Run' function terminals should be connected to key switches or other suitable control devices (push buttons) as illustrated.
5. The 'Run' mode is used when the programmable controller is running a programme (controlling a system).

When the 'Stop' mode is used (or there is a power failure of more than 20 m/sec) all outputs are turned off and timers, plus 48 of the 64 auxiliary relays, are reset. However, all counters and 16 of the auxiliary relays are maintained in the cpu by integral auxiliary battery support.

CAUTION

1. Supply voltages should be as specified, and earthing specific to the programmable controller e.g. not shared with any high power equipment such as a motor system.
2. When the 'Stop' switch is 'on', all outputs will be 'off'. However, it is recommended that external facilities be provided in case of emergencies to support and back this facility.
3. The power must be off when the ROM cassette is loaded on the basic unit or unloaded from the unit.

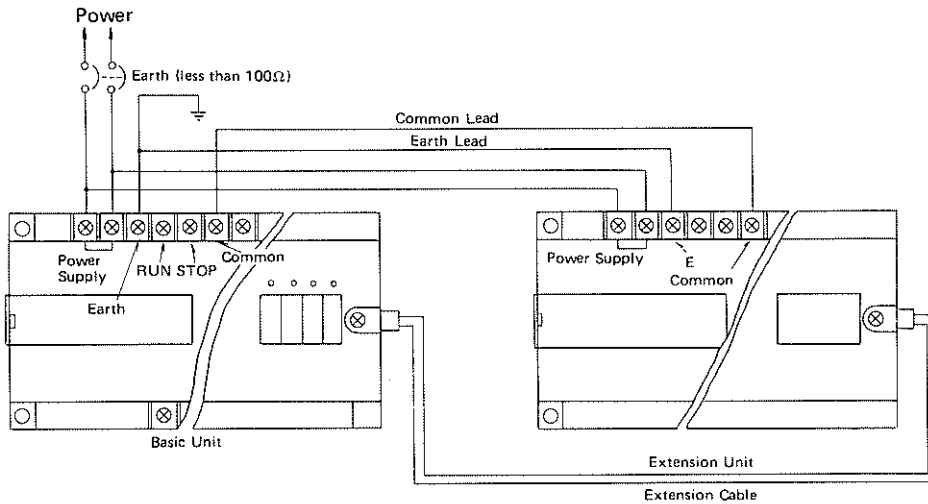
Wiring of Input/Output



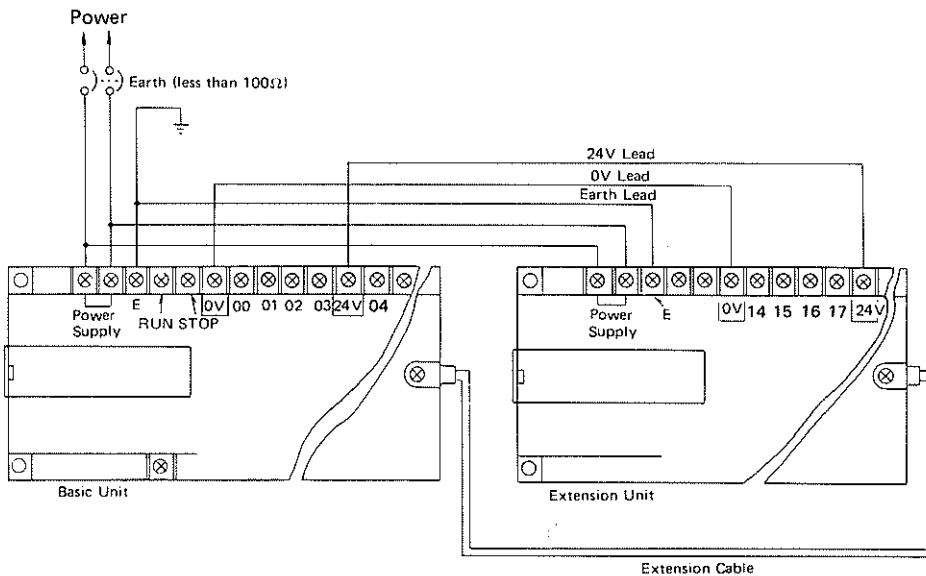
1. Input and output wires must be kept separate and away from any power supply cables or high voltage cables.
2. For the sake of convenience, appearance and to avoid damage or failure, input wires should be bound or cabled together as should output wires.
3. It is recommended that input and output wires are not longer than 20 meters for the general use. However the length depends upon the conditions of the noise environment and voltage drop.

Extension of the unit

1. Sink Input Type (F-20□□-U), (F-12R-U), (F-10ER-U)



2. Source Input Type (F-20□□-ES, ESS), (F-12R-ES), (F-10ER-ES)



DISCRIPTION

- Any type of extension unit (relay, SSR or transistor) can be used with any base unit according to the output configuration required e.g. basic unit with relay outputs, extension unit with SSR outputs.
However, DC power model and AC power model cannot be used in pairs of base unit and extension unit.
- EXTENSION CABLE**
The extension cable used to connect the basic unit and an extension unit should be kept separate from any other cables or wires by a distance of 30mm at least.

3. EARTH TERMINAL

The extension unit must be specifically earthed in the same manner as the basic unit.

4. COMMON TERMINAL (U TYPE UNITS ONLY)

One of the common terminals of the extension unit should be connected to any one of the common terminals of the basic unit.

5. 0 VOLT TERMINALS (ES TYPE UNITS ONLY)

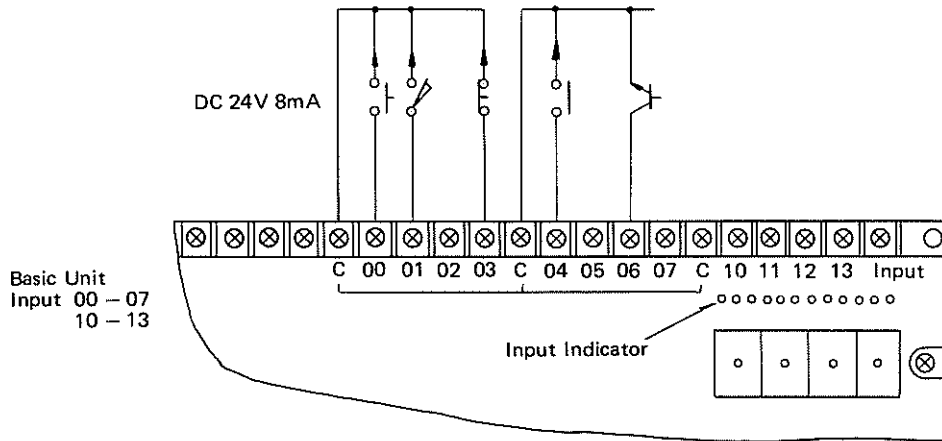
0V terminals of extension and base units shall be connected together on the safety side.

6. 24 V TERMINAL (ES TYPE UNITS ONLY)

One of the 24V terminals of the base and extension units shall be connected together on the safety side.

Input Handling

Sink Input Type (F-20□□-U), (F-12R-U)
(F-20□□-D), (F-10ER-U)



DESCRIPTION

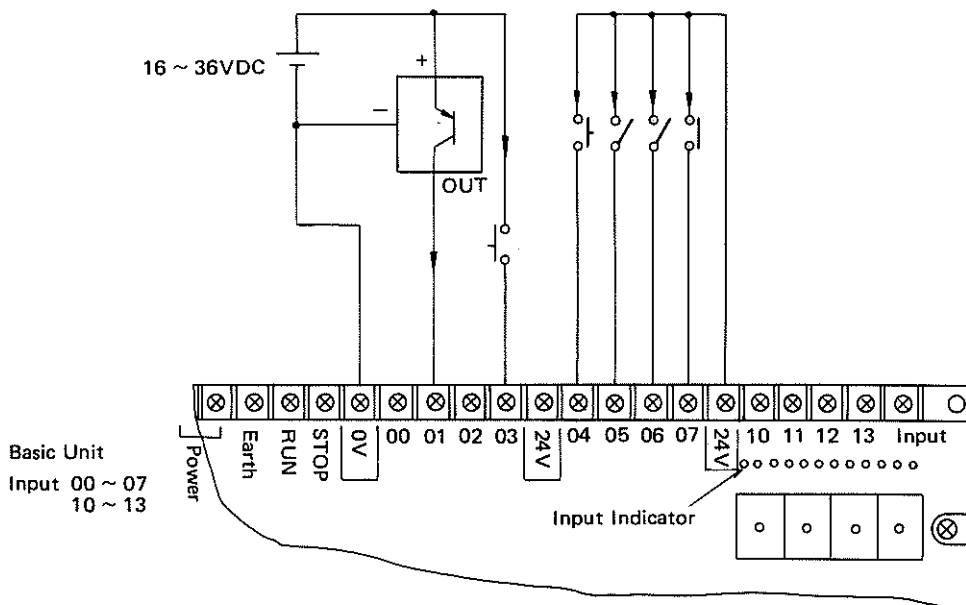
1. Connect control devices, e.g. limit switches, push buttons etc., to the input terminations 00 to 13 of the base unit and 14 to 27 of the extension unit.
2. All common terminals are connected internally and are common. However base and extension unit commons are not linked unless connected together externally as detailed in another section.

CAUTION

1. The input current rating at each input terminal is DC24V 8mA and control devices should be specified accordingly.
2. If transistor circuits such as proximity switches are connected to input terminals then their parallel resistance should be more than 100kΩ and their series resistance less than 1kΩ.
3. A pulse input of less than 50 milliseconds may not be accepted by the controller.

Input Handling

Source Input Type (F-20□□-ES, ESS), (F-12R-ES), (F-10ER-ES)
 F-20□□-DS



DESCRIPTION

1. Connect control devices e.g. limit switches, push buttons etc., to the input terminations 00 to 13 of the base unit and 14 to 27 of the extension unit.
2. The base unit, and extension unit, each have their two 24V terminals commonly connected internally. However, it is necessary to connect one of the base and extension units' 24V terminals together when using an extension unit.

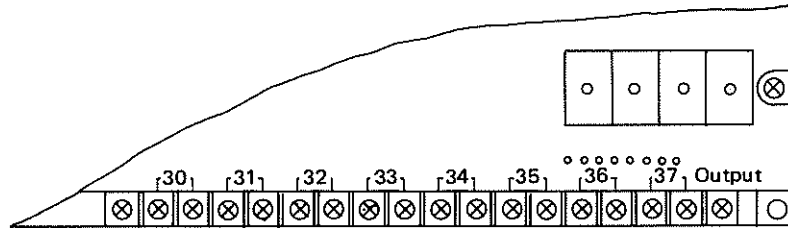
CAUTION

1. The input current at each input terminal is DC24V 6mA and control devices should be specified accordingly.
2. The 24V input terminal points should not be used to power external transistors such as proximity switches. If this requirement exists, use an external power source of 16 to 36VDC.
3. If transistor circuits such as proximity switches are connected to input terminals, then their resistance should be more than 100k Ω , and their series resistance less than 1k Ω .
4. A pulse input of less than 50 milliseconds may not be accepted by the controller.

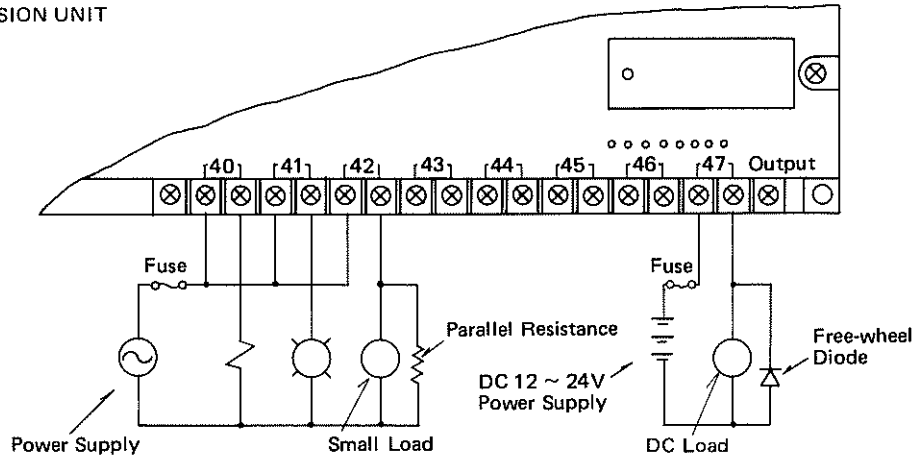
Output Handling

Relay Output Type (F-20□R-□□) , (F-12R-□□) , (F-10ER-□□)

BASE UNIT



EXTENSION UNIT



DESCRIPTION

1. Connect external load devices e.g. contactors, pilot lamps, solenoid (electromagnetic) valves etc., to output terminations.
2. Normal open relay contacts are connected internally to the output terminals on the base and extension units. The ratings of the contacts are 2A at 24VDC, 110/120VAC, 220/240VAC. These ratings apply for resistive loads ($\text{COS } \phi = 1.0$).
3. Applicable loads to the output relays are subject to the frequency of operations. According to our life test data, followings are given for a reference of the relay durability level;

Inductive Load	Frequency of Operation
Less than 35VA	Up to 3,000,000
Less than 80VA	Up to 1,000,000
Less than 120VA	Up to 200,000

Manufacturer's guaranty level: 500,000 operations at 35VA.

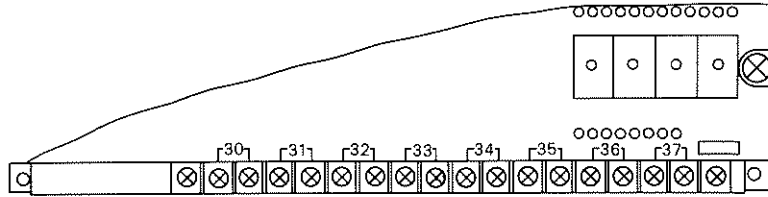
CAUTION

1. Each internal contact is protected by a residual current circuit (except F-10ER model). When the contact is closed, its current leakage will normally be less than 2.2mA at 220VAC or 1.2mA at 120VAC. (No leakage current flows in the F-10ER) However it is possible that this might have some effect on external loads. Where the external current demand is very low it may prove necessary to provide additional parallel resistance because of the influence of leakage (see diagram above).
2. When using the controller in a direct current circuit, it is recommended to connect a free wheel diode in parallel to the inductive load.
3. Overload Protection
Back-up fuses or circuit protectors are recommended on output circuits to prevent damage to the circuit boards of the PC in the event of a short circuit fault in an external output circuit.

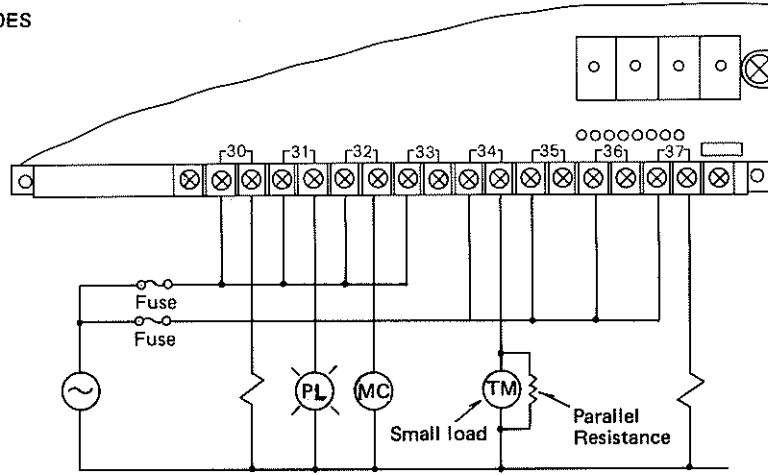
Output Handling

SSR Output Type (F-20□S-□□)

Basic Unit F-20MS
Output 30 ~ 37



Extension Unit F-20ES
Output 40 ~ 47



DESCRIPTION

1. Connect external load devices e.g. contactors, pilot lamps, solenoid (electromagnetic) valves etc., to output terminations 30 to 37 of the base unit and 40 to 47 of the extension unit (where used).
2. The load limitation of the triac (SSR) outputs is 1A for each individual output, but the total collective output load should not exceed 4A across all eight outputs at AC110/120V or AC220/240V.
3. For inductance loads, the rated coil of magnetic contactors should be within 50VA at AC110/120V or 100VA at AC220/240V. If the coil load is over these limits then an external relay will be required.
4. For lamp loads above 100W then an external relay will also be required.

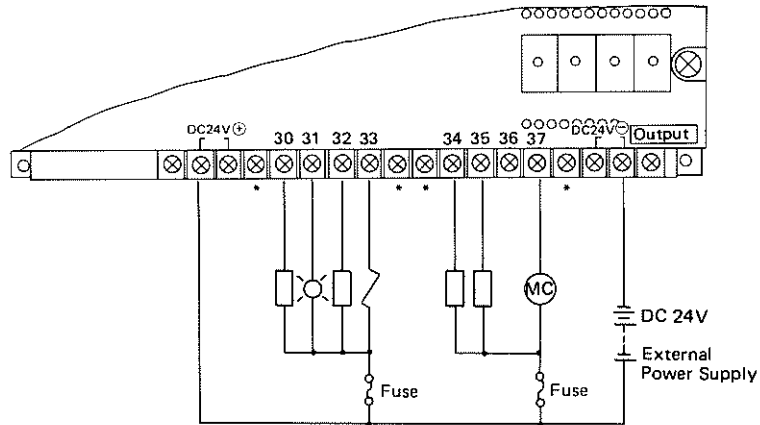
CAUTION

1. Each triac (SSR) inside the unit will withstand moderate surge currents, and is protected by a residual current circuit. With the triac 'off' current leakage is less than 1.2mA at AC120V or 2.2mA at AC220V. However it is possible that this might have some effect on external loads.
2. It is not possible to operate triac output card on DC loads.
3. 2A rated back-up fuses or circuit protectors are recommended per each 4 outputs to prevent damage to the circuit boards of the PC in the event of a short circuit fault in one of the external circuits.
4. Overload Protection
Back-up fuses or circuit protectors are recommended on output circuits to prevent damage to the circuit boards of the PC in the event of a short circuit fault in an external output circuit.

Output Handling

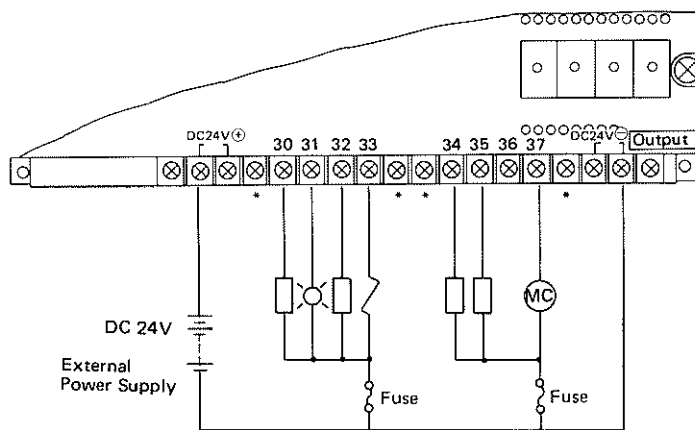
Transistor Output Type (F-20□T-□□)

Sink Output Models
 (F-20MT-U F-20MT-ES)
 (F-20ET-U F-20ET-ES)



* Blank Terminal

Source Output Models
 (F-20MT-ESS)
 (F-20ET-ESS)



* Blank Terminal

DISCUSSION

1. Connect external load devices e.g., contactors, pilot lamps, solenoid (electromagnetic) valves etc., to output terminations 30 to 37 of the base unit and 40 – 47 of the extension unit (where used).
2. The load limitation of the NPN transistor outputs is 1A for each individual output, but the total collective output load should not exceed 4A across all eight outputs at DC24V.
3. Due to surge current limitations lamp loads should be within 3W.
4. When other load are connected to a output termination in addition to lamp load, the total collective output load should be as specified with reference to following table.

Lamp Load	Additional Load
2W	6W
1W	16W
0	24W

CAUTION

1. The external DC power supply should be DC24V +15% –30%.
2. 2A rated back-up fuses or protectors are recommended per each 4 outputs to prevent damage to the circuit boards of the PC in the event of a short circuit fault in one of the external circuits.
3. Overload Protection
 Back-up fuses or circuit protectors are recommended on output circuits to prevent damage to the circuit boards of the PC in the event of a short circuit fault in an external output circuit.

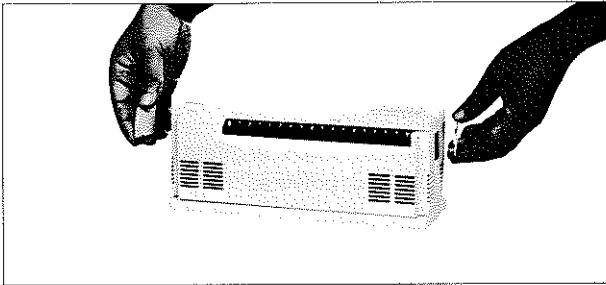
Maintenance and Diagnostics

Battery Maintenance

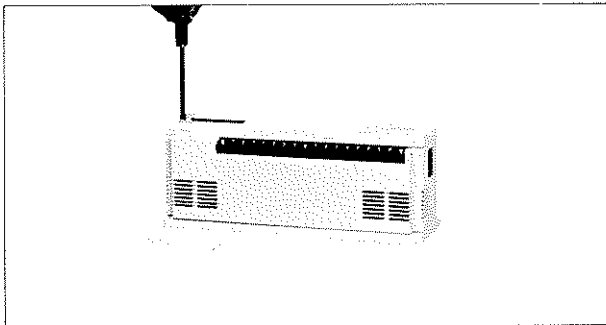
1. The program memory, counters and 16 of the 64 auxilliary relays are backed by a non-chargeable lithium battery (list no: F-20BC).
2. When the battery runs low, LED indicator on the base unit is illuminated. (See next page).
3. However, regardless of its condition, it is recommended that the battery be replaced every five years.

BATTERY RENEWAL: Battery is renewed by the following procedure.

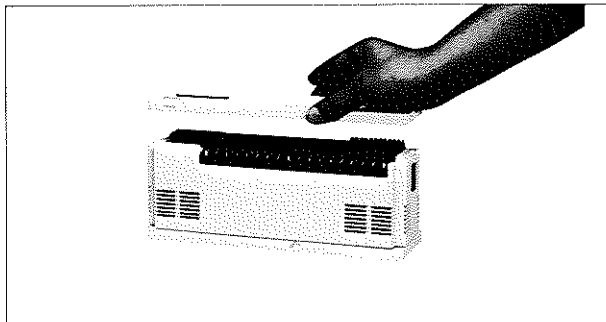
- 1 Remove covers for extension cable, ROM cassette and Programming Panel connector.



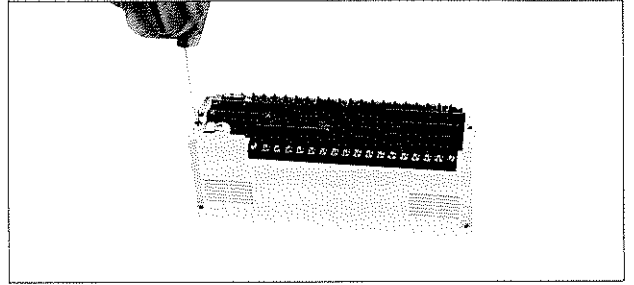
- 2 Remove 2 screws at both ends of upper cover.



- 3 Take off upper cover.



- 4 Remove a retaining screw for battery holder and pull out the battery together with holder, connector and installation screw.



- 5 Renew the battery set together with holder and connecting lead.
Service battery is supplied with battery holder and connecting lead in a set.
- 6 Re-assemble the installation screw and upper cover of the unit in reverse of the procedure.

CAUTION:

1. Disconnection of existing battery and connection of new battery must be completed within 30 seconds, whilst an inside capacitor supports the program memory.
2. Ensure that power is off during battery replacement.

PRELIMINARY CHECKS

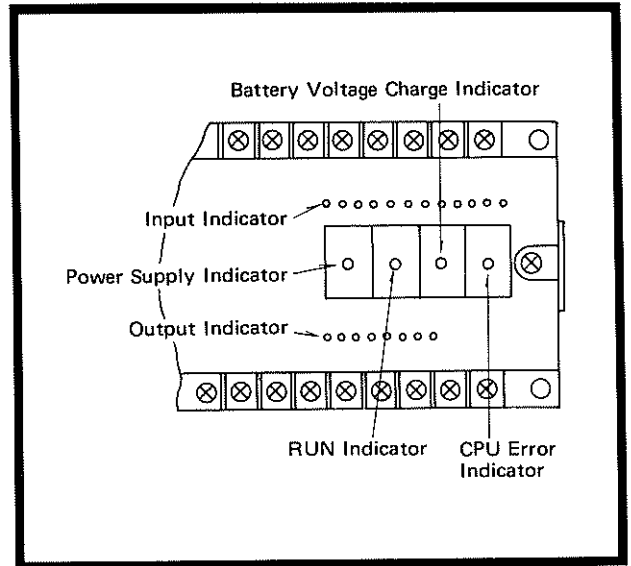
Before operating the unit, it is advisable to carry out the following checks:

- a. That the power and earth leads are properly connected.
- b. That input and output leads are properly connected and not entangled. (It is worthwhile numbering each lead according to its input and output assignment).
- c. That output loads and input contacts are within the specification limits detailed earlier.

DIAGNOSTICS

The base unit's LEDs enable the following conditions to be checked:

1. Power Supply
LED illumination indicates that the power is 'on'. If the LED fails to illuminate when the unit is under apparent power, then the unit may be faulty.
2. Run
If the run LED is not illuminated when the programming panel is turned to 'monitor' and the unit is in 'run' mode then (assuming all wiring connections to be correct), it is likely the unit is faulty.
3. Battery
If the battery LED illuminates then renew the battery.
4. Interference from external apparatus
If the 'cpu error' LED illuminates this may be as a result of electrical noise interference from some external apparatus. Otherwise it indicates a fault in the unit.



5. Input circuit operation
Failure of the input LEDs to illuminate when properly connected and powered may be fault of the unit.
6. Outputs
If outputs fail to function, whether the LEDs are illuminated, it may be a unit fault. However, in the case of those units fitted with relay outputs the life of the relay is stated in the section of Relay Output. If the unit has exceeded this number of operations or the output relays are obviously worn out then a replacement relay board should be fitted as detailed in the next section.

Checking the Programme

Programmes can be checked and monitored by using the facility available on the programming panel for this purpose.

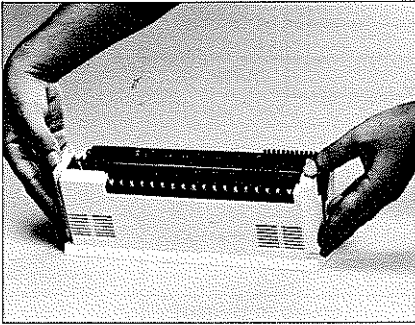
Maintenance

Periodically the unit's installation should be checked to ensure that it has not been contaminated by dust or other contaminants, also that all termination connections are still tight. The unit should not be installed in a situation where the temperature is likely to rise to above 50°C.

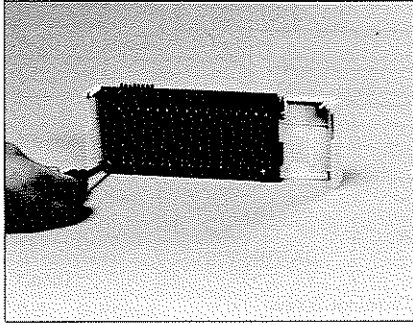
Relay Board Replacement

The relay output board can be changed as follows:

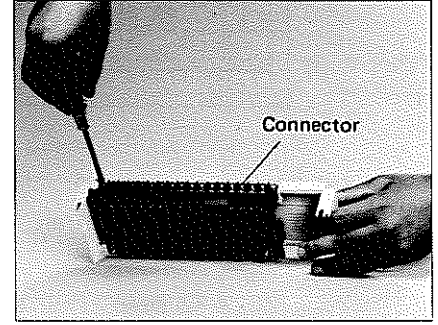
Remove the front cover with same procedure in the section of battery renewal, and renew the relay board as illustrated:



Remove front cover



Remove mounting screws for board



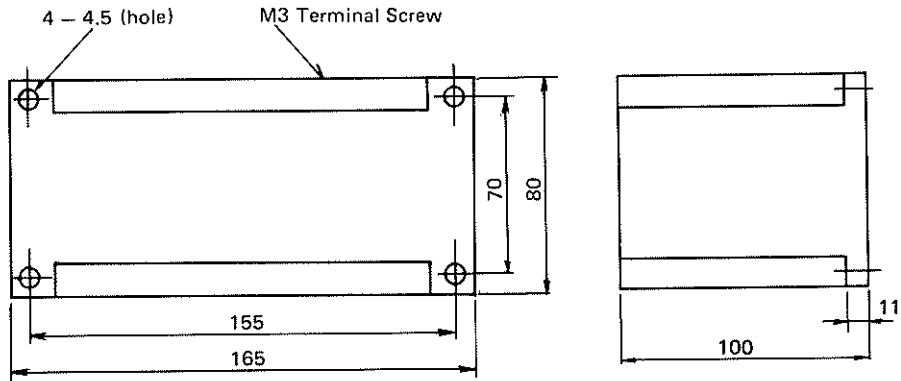
Remove mounting screws for terminal box

Insulation

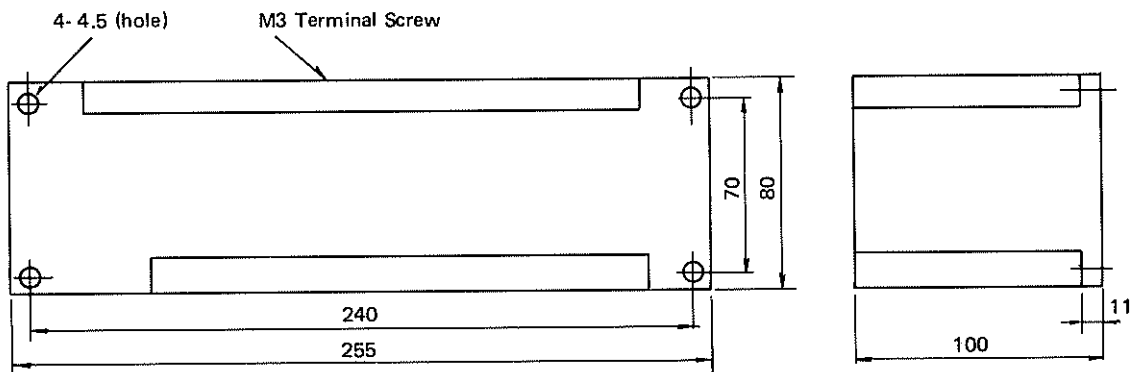
In order to measure the insulation resistance of the programmable controller, first remove all terminal leads and take measurements between the earth and other required terminals.

Outlines (mm)

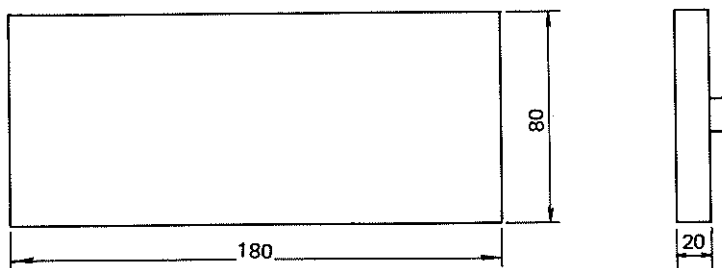
* F-12R Base Unit and F-10ER Extension Unit



* F-20 Base Unit and Extension Unit



* F-20P-E programming unit



SPECIFICATIONS

Main voltage	Voltage	D, DS: 24VDC +—8V U: 90 ~ 132VAC, 50/60Hz ES: 220 ~ 240VAC +10%—15%, 50/60Hz			} with LED indication
	Consumption	BU: Less than 11VA EU: Less than 6VA			
Input	Number of points	F-12R BU: 6 Points F-10ER EU: 4 Points F-20 BU and EU: 12 Points			
	Type and method	No-voltage contact, Photocoupler isolated			
	Current and voltage	ES: 6mA/24VDC U: 8mA/24VDC			
	Indication	LED, all inputs			
Output	Number of points	F-12R BU: 6 Points F-10ER EU: 6 Points F-20 BU and EU: 8 Points			
	Indication	LED, all outputs			
	Output type	R*	S*	T	*Current Leakage 2.2mA/220VAC (Except F-10ER)
	Method	No-voltage contact	Triac (SSR)	Transistor	
	Current and voltage	2A/24VDC, 110/120, 220/240VAC (Resistance Load)	1A/110/ 120VAC 220/240VAC	1A/DC24	
Timer	Number of points	BU: 8 Points			
	Type and method	Digital, set by PP, on-delay timer			
	Range	0.1 ~ 9.9s or 1 ~ 99s			
Counter	Number of points	BU: 8 Points			
	Type and method	Digital, set by PP, down-counter, Power-failure compensated			
	Setting range	1 ~ 99			
Auxiliary relay	Number of points	BU: 64 Points (Included 16 Points of battery back-up)			
Program	Method	Stored program			
	Language	Relay symbols, 14 instructions			
	Memory	C-MOS RAM + EP-ROM (Option)			
	Capacity	320 steps			
	Speed	Average: 0.1ms/step (Version 1:0.05ms)			
	Write in	by key of PP			
Protection	Power-failure compensation	Operation continues if failure duration is less than 20ms			
	Battery	Lithium, capable of 5-year RAM backup			
	Self-diagnostic functions	Battery voltage-drop indication, CPU error indication			
	Insulation resistance	More than 5MΩ, 500VDC between terminals and earth (Except D, DS type)			
	Insulation withstand voltage	1,500VAC, 1min			
	Noise immunity	1,000V, 1μsec Verified using a noise simulator			
	Noise Spike	Withstand NEMA noise spike test (NEMA-ICS2-230)			
Environment	Ambient-temperature	0 ~ 55°C			
	Storage temperature	—15 ~ 65°C			
	Ambient humidity	Less than 95% RH, no condensation			
	Vibration resistance	10 ~ 55Hz, 0.5mm (max.: 2G)			
Dimensions	W x H x D (mm)	See the outlines			
Weight	kg	F-12R/F-10ER: approx. 1.3 kg F-20 BU/EU: approx. 1.5 kg			

PP: Programming panel
BU: Basic Unit
EU: Extension Unit

U: AC 110/120V Type
ES: AC 220/240V Type
D, DS: DC 24V Type

R: Relay Output Type
S: SSR Output Type
T: Transistor Output Type

MEMO

