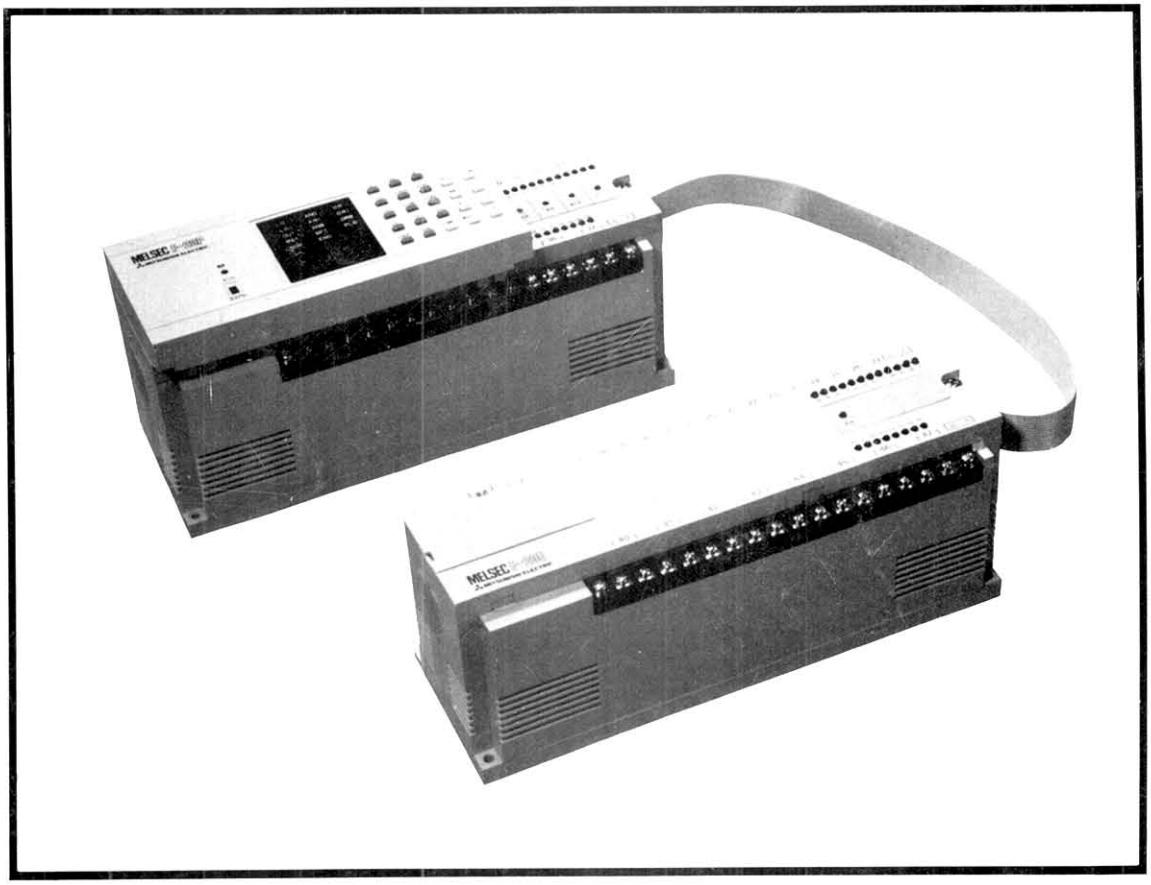
MITSUBISHI

MELSEC F-20M Programmable Controller

INSTRUCTION MANUAL



- This manual provides technical information and guidance on the installation and use of the Mitsubishi F-20M Programmable Controller and its F-20E extension unit.
- Users should ensure that the detail of this manual is studied and understood before attempting to instal 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

Components

Following Units and peripherals are provided to apply the full functions of F-20M.

		Relay Output	SSR Output*	Transistor Output*	Ref.
	Basic Unit	F-20MR ★	F-20MS ★	F-20MT ★	
	Extension Unit	F-20ER ★	F-20ES ★	F-20MT ★	Incl: Extension cable
Peripherals	Programming Panel	F-20P-E			
	ROM Writer	F-20MW (Incl. support ROM)			
	Program Loader	F-20H-DE			
	ROM Cassette	F-ROM-1			
	Remote Cable	F-20P-CAB			
	DIN-Rail Mounting Attachment	F-20D			
	Printer	GT-10*			

* Please confirm whether local stocks are available.
★ A suffix 'U' or 'ES' to the list numbers of the basic and extension units is used to specify voltage ratings and input type viz:
'U' = 110/120VAC, sink input type
'ES' = 220/240VAC, source input type.

Functions (points)

Item \ Unit	Basic Unit	Extension Unit	Total
Input	12	12	24
Output	8	8	16
Timer	8 (0.1 ~ 99s)	–	8
Counter	8 (1 ~ 99)	–	8
Auxiliary Relay	64	–	64
Execution Speed	0.1ms/step (avg.)		–

Memories

When a ROM cassette is loaded into the basic unit it automatically overrides the RAM of the base unit. When the ROM is removed the unit reverts to its RAM only function.

Ensure that power is off during such memory changes.

Programming

The sequence required can be programmed by using of the programming panel, ROM writer or program loader either in the RAM of the basic unit or in the ROM cassette. During the programming in the RAM of the basic unit, ensure that the stop switch has been turned on to stop all control functions. (Details of the programming are given in a separate manual.)

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.

		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.)	35VA	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)		–

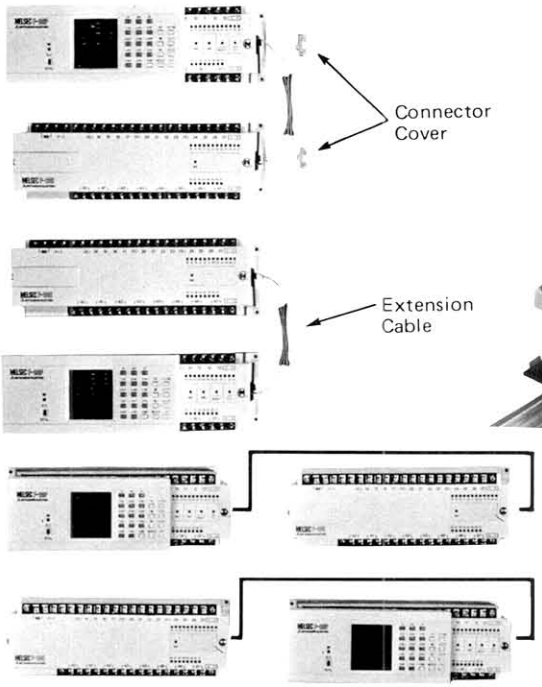
N.B. = Leakage Current of Circuits = 1.1/1.2mA (110/120VAC) Max.
2.2/2.4mA (220/240VAC) Max.

Overload Protection

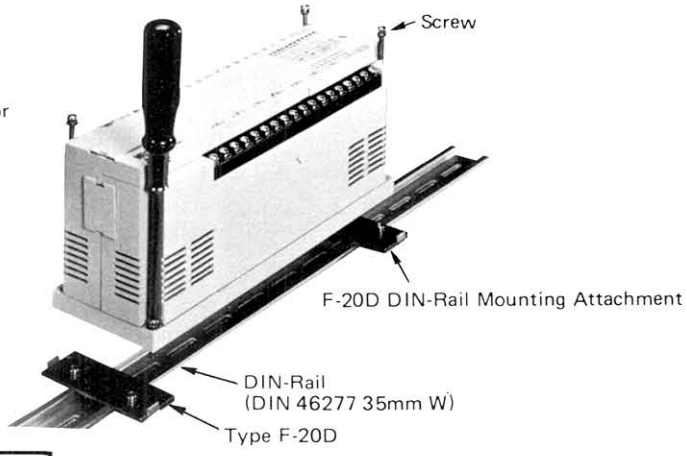
Back-up fuses or circuit breakers are recommended on output circuits to prevent damage to the circuit boards of the PC in the event of a short circuit fault in an external output circuit.

Unit Installation

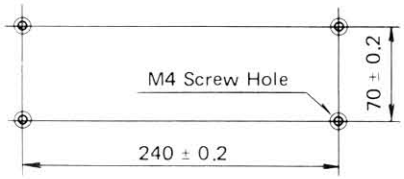
Disposition of Extension Unit



Installation on DIN-Rail



Screw Hole Pitch
(Direct Installation) mm



DISCRIPTION

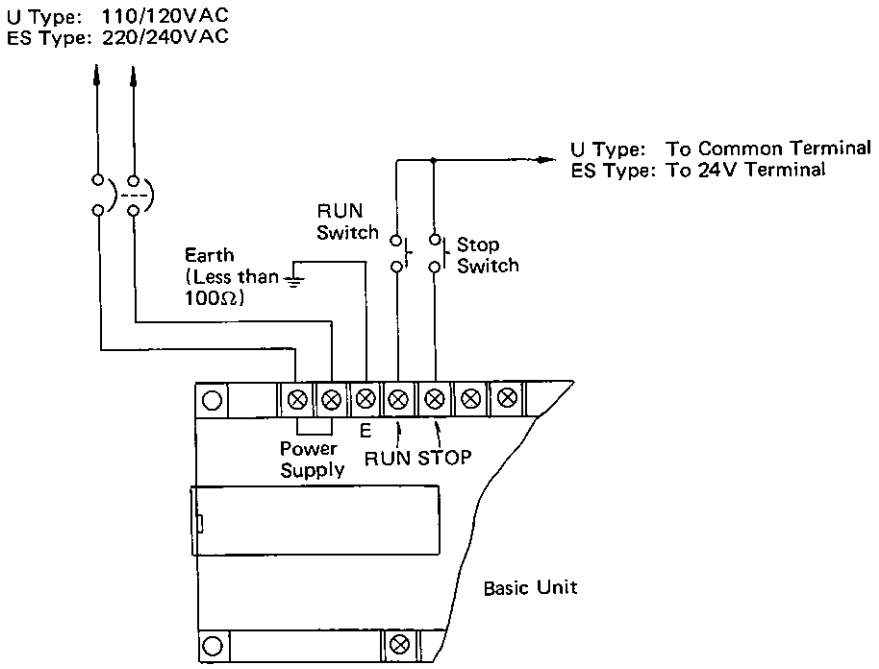
1. The F-20M basic unit and extension unit can be mounted with suitable screws direct to any flat surface by using the four corner holes provided.
2. Alternatively an optional DIN rail mounting kit is available.
3. Basic and extension units are of the same dimensions and can be connected with the 300mm 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-20 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 F-20 should not be installed near to high voltage supply cables or other such electrical apparatus.

Power Supply

Power Supply



DISCRIPTION

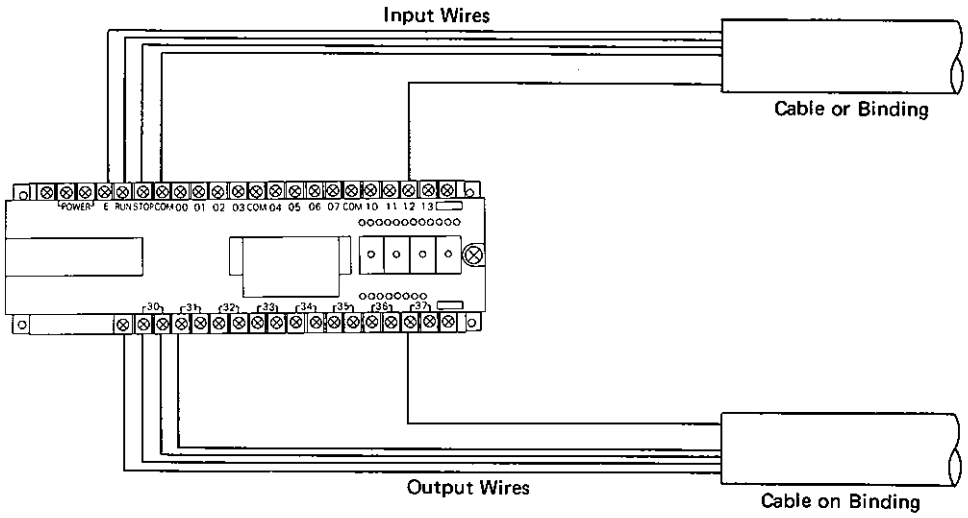
1. Connect a power supply cable of the correct rating to the basic unit and extension unit (if used) as illustrated.
2. The power consumption of the basic unit is less than 11VA and that of the extension unit is less than 6VA. However this does not include the power consumption of any external loads.
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

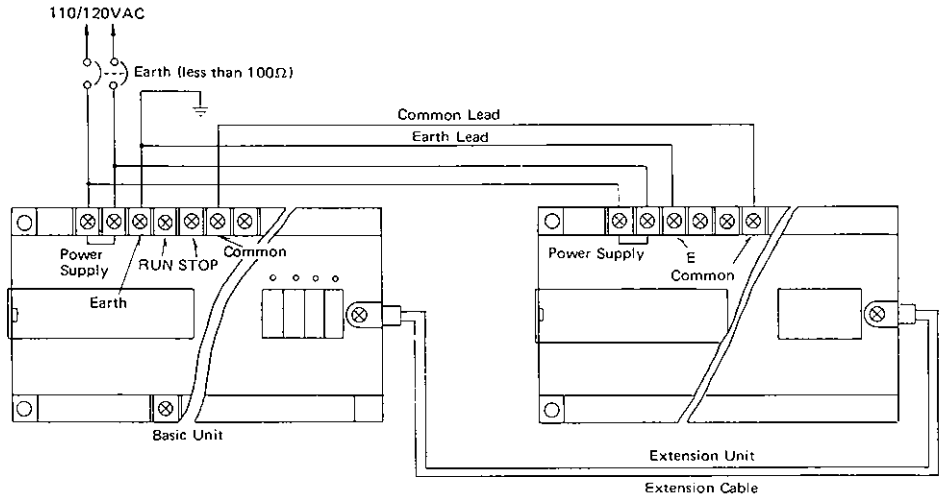
Wiring of Input/Output



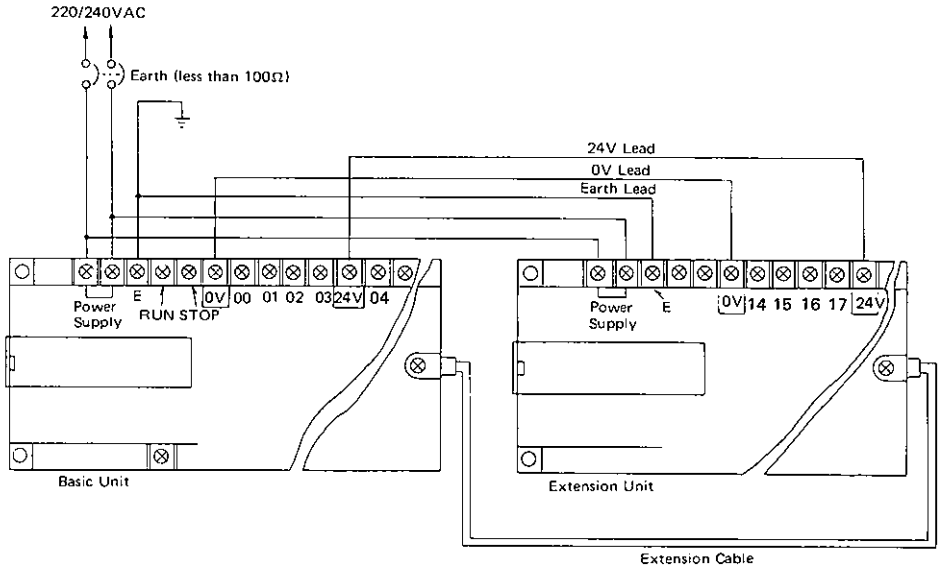
1. Input and output wires must be kept separate and away from any power supply cables or high voltage cables.
2. For the sake of convenience, appearance and to avoid damage or failure, input wires should be bound or cabled together as should output wires.
3. It is recommended that input and output wires 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 U Type Unit (110/120VAC Sink input type)



2 ES Type Unit (220/240VAC Source input type)



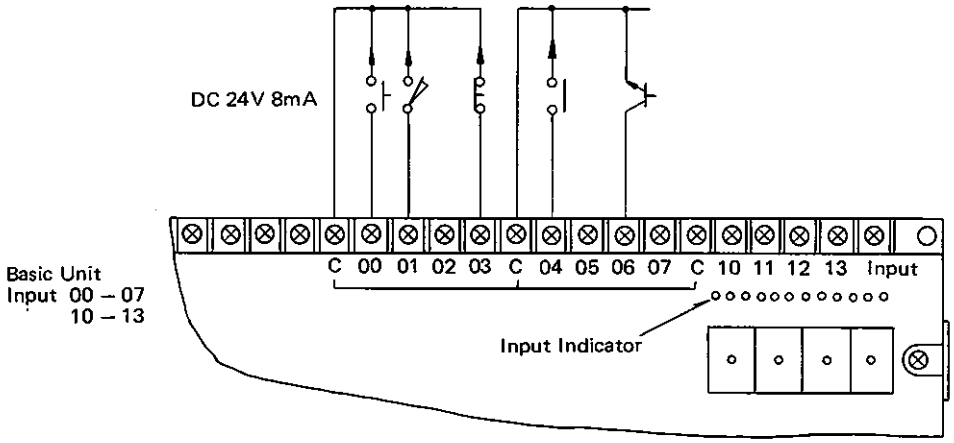
DISCRIPTION

1. 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.
2. **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

U Type (Sink Input Type)

(F-20M□-U
F-20E□-U)



DESCRIPTION

1. Connect control devices, e.g. limit switches, push bottons 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.

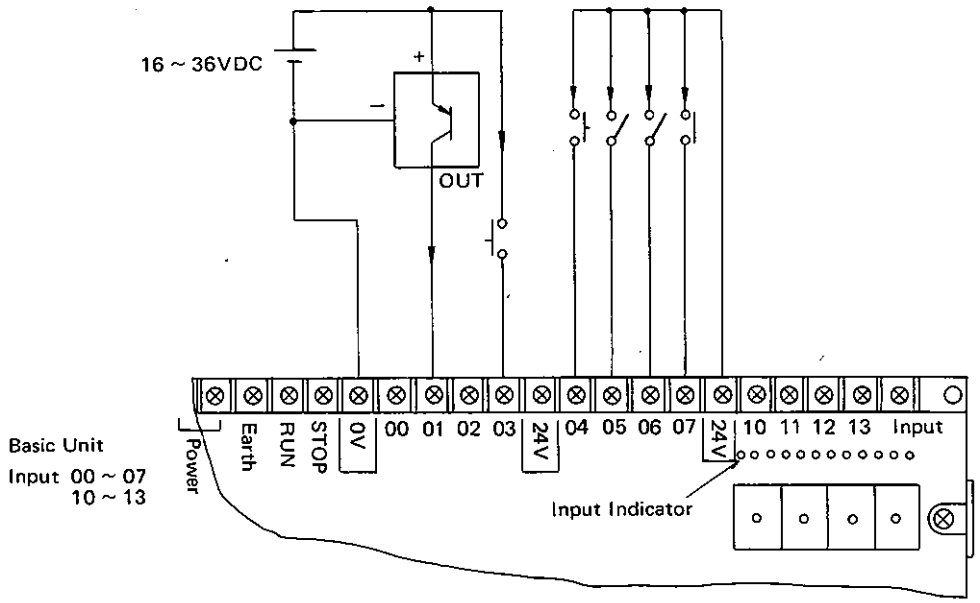
CAUTION

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

ES Type (Source Input Type)

(F-20M□-ES
F-20E□-ES)



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.

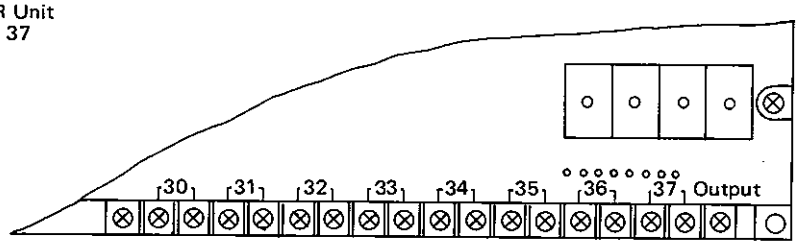
CAUTION

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 100kΩ, and their series resistance less than 1kΩ.
4. A pulse input of less than 50 milliseconds may not be accepted by the controller.

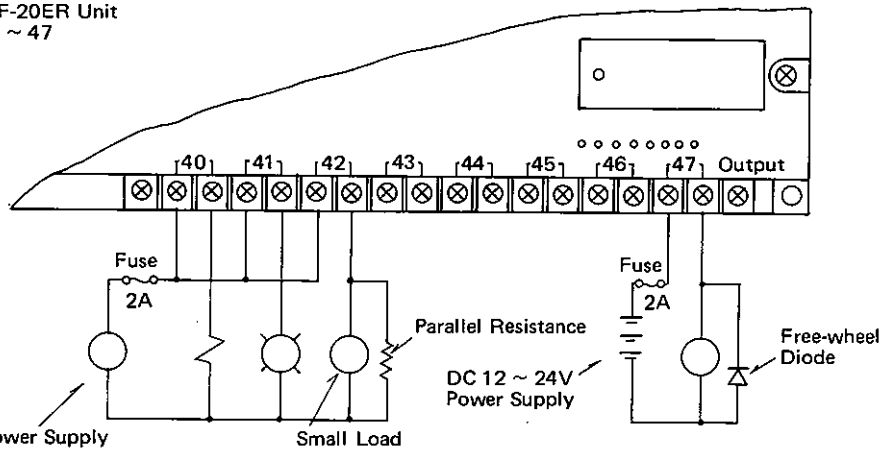
Output Handling

Relay Output Type

Basic F-20MR Unit
Output 30 ~ 37



Extension F-20ER Unit
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 basic unit and 40 to 47 of the extension unit (where used).
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 (COS ϕ = 1.0).
3. In the case of inductive loads, the output load should be limited to less than 35VA. Should the output load be greater than 35VA, then an external relay capable of handling the load should be used.

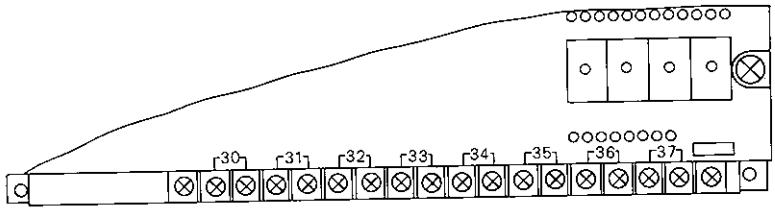
CAUTION

1. Each internal contact is protected by a residual current circuit. When the contact is closed, its current leakage will normally be less than 2.2mA at 220VAC or 1.2mA at 120VAC.
   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.

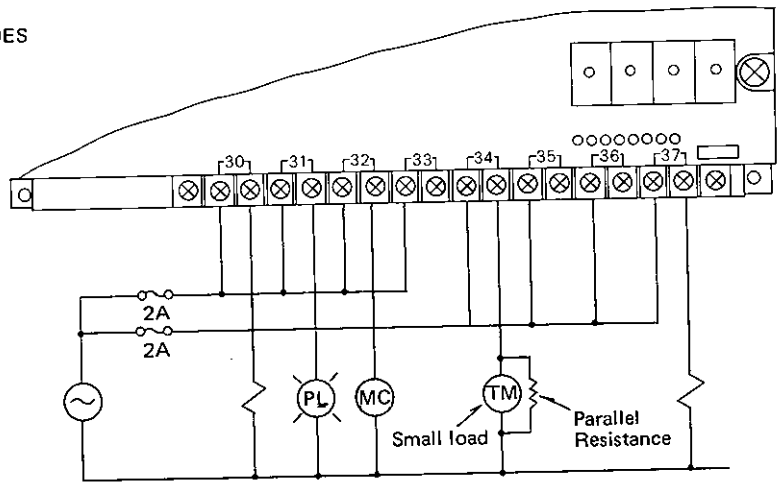
Output Handling

SSR Output Type

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 no exceed 4A across all eight outputs at AC110/120V or AC220/240V.
3. For inductance loads, the rated coil fo 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.

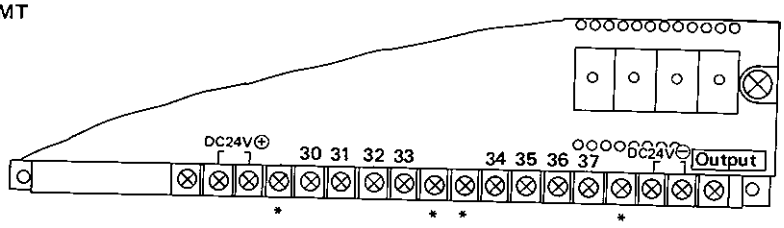
CAUTION

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.

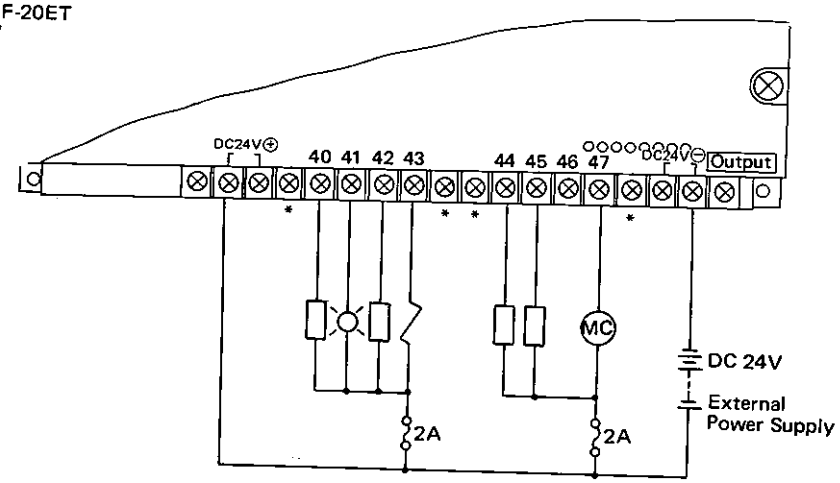
Output Handling

Transistor Output Type

Basic Unit F-20MT
Output 30 ~ 37



Extension Unit F-20ET
Output 40 ~ 47



* Blank Terminal

DISCRIPTION

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

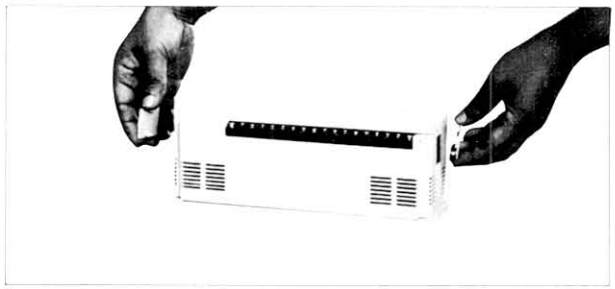
1. The external DC power supply should be DC24V +15% –30%.
2. 2A rated back-up fuses or protectors are recommended per each 4 outputs to prevent damage to the circuit boards of the PC in the event of a short circuit fault in one of the external circuits.

Battery Maintenance

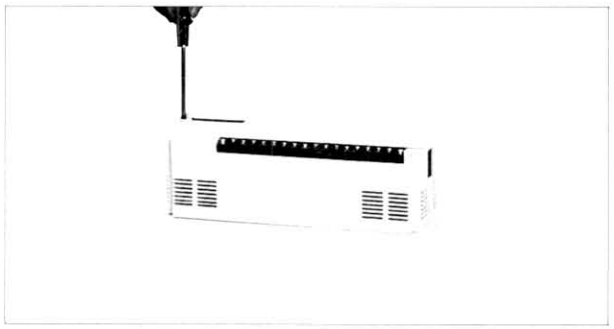
1. The program memory, counters and 16 of the 64 auxilliary relays are backed by a non-chargeable lithium battery (list no: F-20BC).
2. When the battery runs low, LED indicator on the base unit is illuminated. (See next page).
3. However, regardless of its condition, it is recommended that the battery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

BATTERY RENEWAL: Battery is renewed by the following procedure.

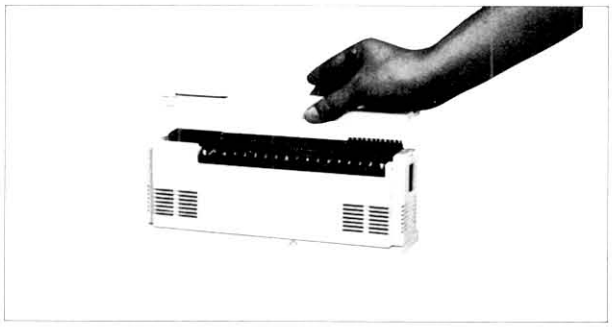
1 Remove covers for extension cable, ROM cassette and Programming Panel connector.



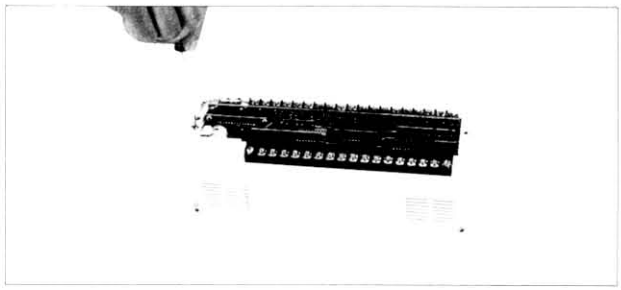
2 Remove 2 screws at both ends of upper cover.



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

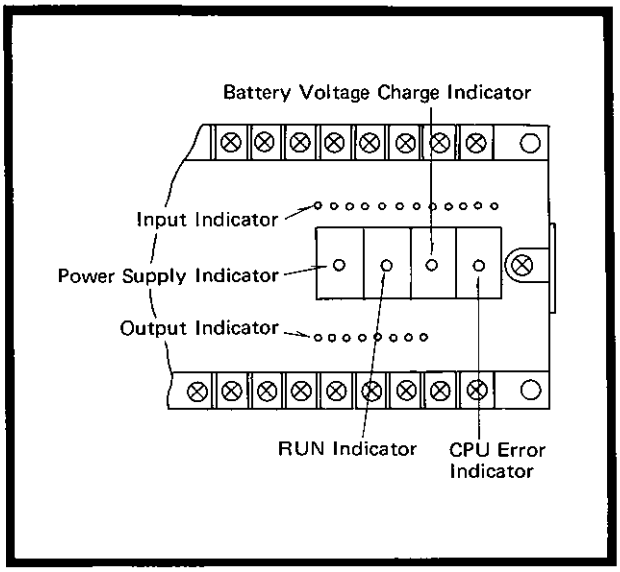
Before operating the unit, it is advisable to carry out the following checks:

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 (F-20MR, F-20ER) the life of the relay is approximately 500,000 operations. 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.

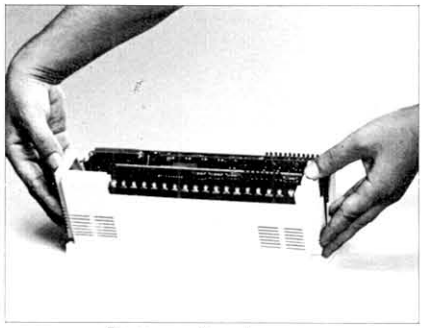
Maintenance

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.

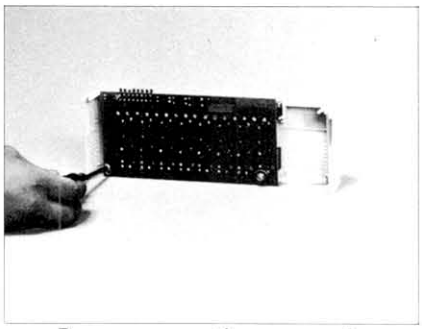
F-20RB (For F-20MR and F-20ER) Relay Board

The relay output board can be changed as follows:

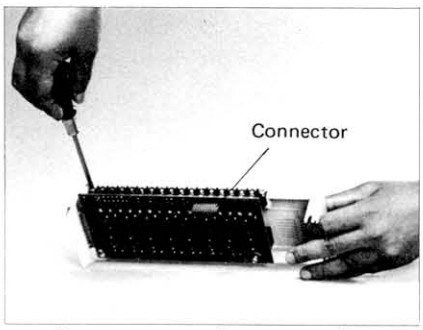
Remove the front cover with same procedure in the section of battery renewal, and renew the relay board as illustrated:



Remove front cover



Remove mounting screws for board



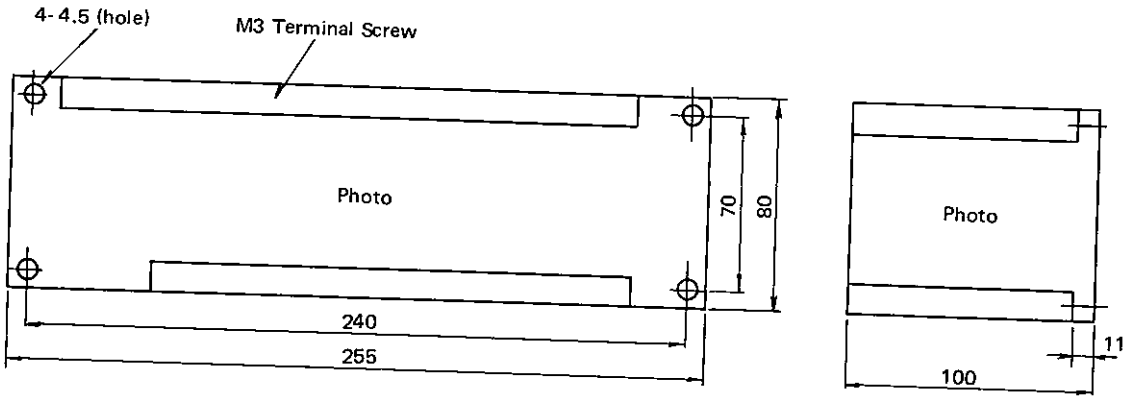
Remove mounting screws for terminal box

Insulation

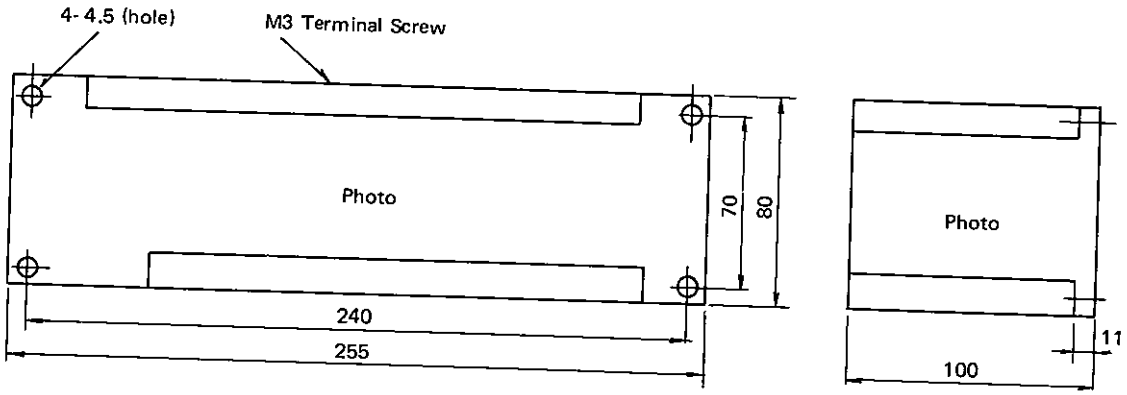
In order to measure the insulation resistance of the programmable controller, first remove all terminal leads and take measurements between the earth and other required terminals.

Outlines

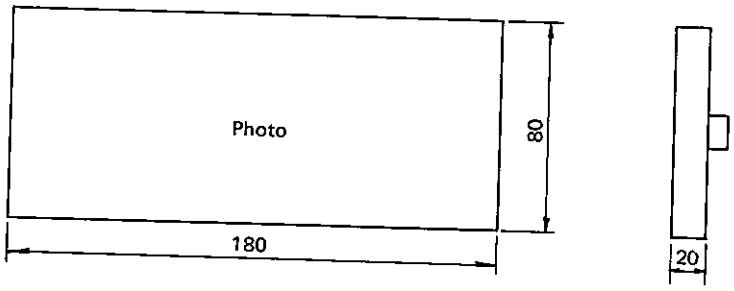
*** F20M basic unit (memory and battery contained)**



*** F20ER Extension unit (Extension cable 0.3m x 1 unit is attached)**



*** F-20P-E programming unit**



*** F-20D base for DIN rail (option) (two units per one)**

SPECIFICATIONS

Main voltage	Voltage	U: 90 ~ 132VAC, 50/60Hz ES: 220 ~ 240VAC +10%–15%, 50/60Hz			Terminal block, front-access maintenance system, power on/off indicator
	Consumption	BU: Less than 11VA EU: Less than 6VA			
Input	Number of points	BU: 12 + 2 (for run/stop) EU: 12			Common-use: 14 points
	Type and method	No-voltage contact			All inputs photocoupler isolated
	Current and voltage	ES: 6mA/24VDC U: 8mA/24VDC			From the built-in power supply
	Indication	BU: 12 points + 1 point for run			LEDs
Output	Number of points	BU: 8 EU: 8			Independent use: 8 points
	Indication	8 points			LEDs
	Output type	R	S	T	
	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	Current Leakage: 2.2mA/220VAC
Timer	Number of points	BU: 8			On-delay type
	Type and method	Digital, set by PP			Display: 2 digits
	Range	0.1 ~ 9.9s or 1 ~ 99s			
Counter	Number of points	BU: 8			
	Type and method	Digital, set by PP			Reset takes precedence
	Setting range	1 ~ 99			Power-failure compensated
Auxiliary relay	Number of points	BU: 64			16 of 64 points are power-failure compensated
Program	Method	Stored programme			Capacity: 320 steps
	Language	Relay symbols			Instructions: 14
	Memory	C-MOS RAM + EP-ROM (Option)			Power-failure compensated
	Speed	Average: 0.1ms/step			
	Write in	Key in by-PP			
Protection	Power-failure compensation	Operation continues if failure duration is less than 20ms			
	Battery	Lithium, capable of 5-year RAM backup service			
	Self-diagnosic functions	Battery voltage-drop indication, CPU error indication			
	Insulation resistance	More than 5MΩ, 500VDC			Between terminals and earth
	Insulation withstand voltage	1,500VAC, 1min			
	Noise immunity	1,000V, 1μsec			Verified using a noise simulator
	Noise Spike	Withstand NEMA noise spike test			NEMA-1CS2-230
Environment	Ambient-temperature	0 ~ 55°C			No condensation
	Storage temperature	–15 ~ 65°C			–
	Ambient humidity	Less than 95% RH			–
	Vibration resistance	10 ~ 55Hz, 0.5mm (max.: 2G)			–
Dimensions	W x H x D (mm)	BU: 255 x 80 x 100			–
		EU: 255 x 80 x 100			
		PP: 180 x 80 x 20			
Weight	kg	BU: Approx. 1.5			
		EU: Approx. 1.5			
		PP: Approx. 0.2			

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

U: AC 110/120V Type
ES: AC 220/240V Type

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

MEMO

MITSUBISHI ELECTRIC CORPORATION
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