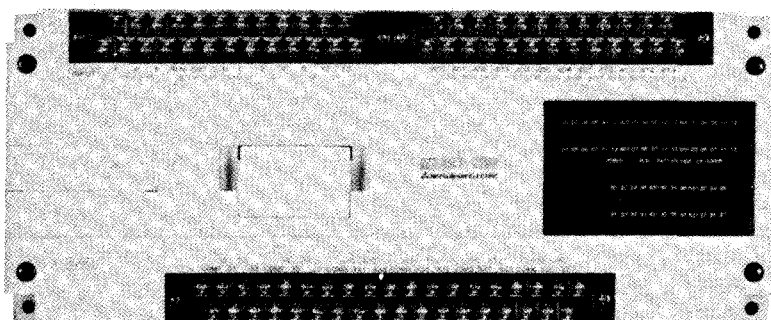




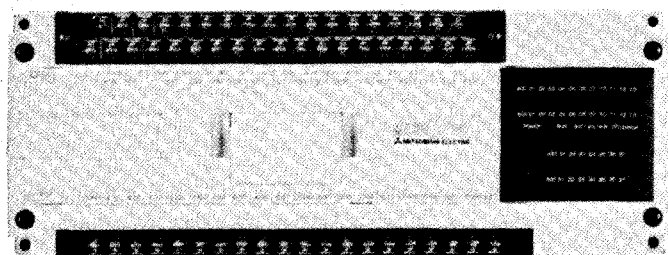
**MITSUBISHI**  
Programmable Controller

# ENHANCED F<sub>2</sub> SERIES

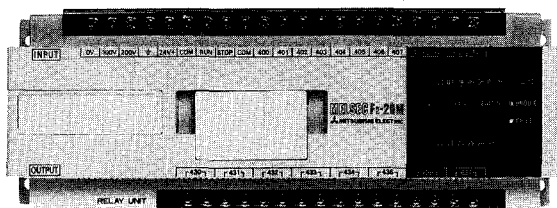
## INSTRUCTION MANUAL



F2-60MR



F2-40MR



F2-20MR

- This manual provides technical information and guidance on the installation and use of the Mitsubishi F2 series 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 a programmer unit, is covered in a separate manual.

**MITSUBISHI ELECTRIC CORPORATION**

These products contain Strategic Products subject to COCOM regulations. They should not be exported without authorization from the appropriate governmental authorities.

**MITSUBISHI ELECTRIC CORP.**

# TABLE OF CONTENTS

<b>1. THE F2 SERIES SYSTEM</b>	
1-1 Description of F2 series PC	1
1-2 Basic models of base unit & extension unit	1
1-3 Extension unit selection	2
1-4 Memory	3
1-5 Basic programming peripherals	4
<b>2. PRELIMINARY WIRINGS</b>	
2-1 Power supply	6
2-2 Grounding	8
2-3 RUN/STOP mode terminals	8
2-4 RUN output terminals	8
2-5 DC24V terminals	9
<b>3. INPUT HANDLING</b>	
3-1 Example of connections	10
3-2 Input terminals	10
3-3 Input circuit specifications	11
3-4 Cautions	11
3-5 AC input handlings	12
<b>4. OUTPUT HANDLING</b>	
4-1 Relay output models	13
4-2 Triac (SSR) output models	14
4-3 Transistor output models (Sink output)	15
4-4 Transistor output models (Source output)	16
4-5 Output circuit specifications	18
<b>5. F2-40AC/F2-40AC2 (HIGH SPEED COUNTER INTERFACE) HANDLING</b>	
5-1 Installation	

# 1

# THE F<sub>2</sub> SERIES SYSTEM

## 1-1 DESCRIPTIONS OF THE ENHANCED F<sub>2</sub> SERIES PC

The Mitsubishi enhanced F<sub>2</sub> series of programmable controllers and auxiliary equipment are higher version models to the F & F<sub>2</sub> series and are ideal for small industrial process control.

The I/O capacity is 120 points max. per unit, but 240 I/Os can be covered by linkage operation. Now the F<sub>2</sub> series is enhanced greatly with additional specialized features and functions.

The outlines are as follows, but accordingly peripherals need to be updated.

However, when it is used within conventional F<sub>2</sub> functions, peripherals need not be updated.

### ENHANCED FUNCTIONS

- ① The program capacity is enhanced up to 2000 steps. (Except F<sub>2</sub>-20M)  
And in addition to EPROM cassette, EEPROM cassette can be read and written.
- ② Points of state for Step-ladder are enhanced from 40 to 168 points.
- ③ 64 points of data register (BCD 3 digit) are added.
- ④ Functional instructions are highly enhanced. (Including arithmetic handling)
- ⑤ Special function units can be handled.

\*Only CPU card in the base unit is enhanced, so dimensions and Input/Output card are the same as before.

- ③ indicates type of output  
R: Relay, S: SSR, T: Transistor
- ④ specifies power supply voltage rating
  - N/A ..... 100/110VAC, 200/220VAC
  - U&UL ..... 110/120VAC, 220/240VAC
  - E ..... 110/120VAC, 220/240VAC
  - D ..... 24VDC
- ⑤ indicates type of input/output connections
  - N/A ..... 24VDC sink input (minus common) and sink output
  - S ..... 24VDC source input (plus common) and sink output
  - A1 ..... 100/120VAC source input (plus common) and sink output
  - A2 ..... 220/240VAC source input (plus common) and sink output
  - SS ..... 24VDC source input (plus common) and source output

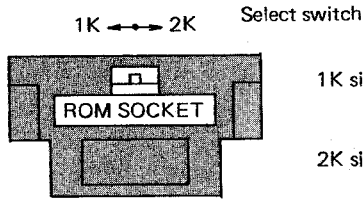
### 1-3 EXTENSION UNIT SELECTION

The F2-20M has one extension port, F2-40M has two extension ports and F2-60M has three extension ports where extension units are connected. According to the requirements of I/O numbers and other additional functions, select the appropriate base and extension unit.

## 1-4 MEMORY

SELECTION  
OF  
MEMORY  
CAPACITY

F2-40M  
60M



1K side; 0 – 999 steps  
RAM 1K,  
F-ROM-1, F-EEPROM-1  
2K side; 0 – 1999 steps  
RAM 2K  
F-ROM-2, F-EEPROM-2

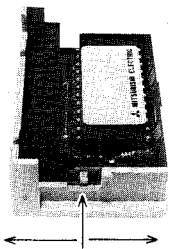
Removing ROM-cassette cover, the select switch is easily accessible.  
Turn the switch rightward or leftward according to the memory capacity required.  
Before changing mode, never fail to turn off the power.

The RAM memory is battery-backed and battery replacement should be as described in the maintenance section 8-3.

### Memory Cassettes (For long term storage)

	Capacity	F2-20M	F2-40/60M	
			1k	2k
F-ROM-1	1k	✓	✓	X
F-ROM-2	2 x 2k	2 x 1k	2 x 1k	✓
F-EEPROM-1	1k	✓	✓	X
F-EEPROM-2	2k	1k	1k	✓

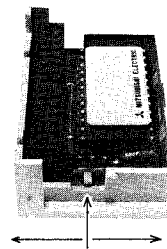
### F-ROM-2 Program Select Switch



PROG No.0      PROG No.1

Each program is of 2K capacity

### F-EEPROM Memory Protect Switch



Programming (OFF)      Memory protect. (ON)

This is a safety measure against accidental erasure of program.  
Normally, it is switched to ON, switch to OFF only for programming.

## 1-5 BASIC PROGRAMMING PERIPHERALS

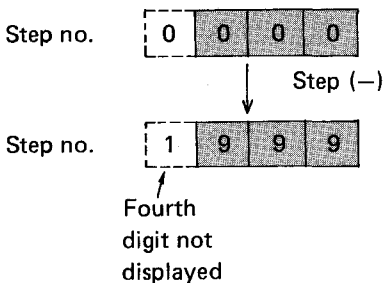
Model	Description	Compatibility
F-20PE	Clip-on programmer	Fully, but 3 digit display only
F1-20PE	" "	" " " " " "
F2-20PE (3d)	3 digit clip-on programmer	As above, 1k tape storage only
F2-20PE (4d)	4 digit clip-on programmer	Fully
<b>GP-20PE</b>	<b>Graphic clip-on programmer</b>	Fully
GP-80F2-B	Graphic programmer	Fully
GP-80ROW	GP80 ROM WRITER	YES require adapter for 2k EPROM
F2-20GF	Interface unit	1k use only
F2-20GF1	Interface unit	Version 2.0 fully Previous version : 1k only
F-20CAB	Remote cable	Fully
F-20MW	ROM writer	1k use only
F2-20H-DE, U	Program loader	See *
A6 GPP	Graphic programmer	Disk SW1 GP-GPPF-EE
A6 HGP	" "	Disk SW1 GP-HGPF-EE
A6 PHP	" "	Disk SW1 GP-GPPF-EE

\*Units with serial nos. 85    - - or higher have enhanced F2 functions & 2k RAM. However, EPROM capability remains at 1k.

With 3 digit programming panels, the following key changes are required to access elements S800 & S900:

STL 800 → ANB 800  
 S 800 → NOP 800  
 R 800 → END 800

Also panel display:



## Other Peripherals

**HIGH SPEED COUNTERS**  
(adaptor port)

2 kHz bidirectional 2 phase counting.  
(Described in this booklet)

**Data Link**  
(adaptor port)

Data transmission between 2 F2-base units.  
(Described in this booklet)

**Analog Input/Output**  
(extension port)

8-bit A/D and D/A converter. 4 inputs and 2 outputs.  
Current or voltage mode.

**Data Input/Output Unit**  
(adaptor port)

48 input, 48 output multiplexed I/O points are handled  
without losing any I/O points of the base or extension  
unit.

**Communication Network Interface**  
(extension port)

Allows F-series controllers to communicate with A-series  
PLC network. 32 base units can be linked.

**Data Access Unit**  
(programmer port)

Displays and sets counter and timer values continuously.

**Programmable CAM. switch**  
(extension port)

Absolute position resolver and 32 multiple position  
switching outputs of accuracy option of  $0.5^\circ$  or  $1^\circ$ .  
Speed or angle data can be sent to PC.

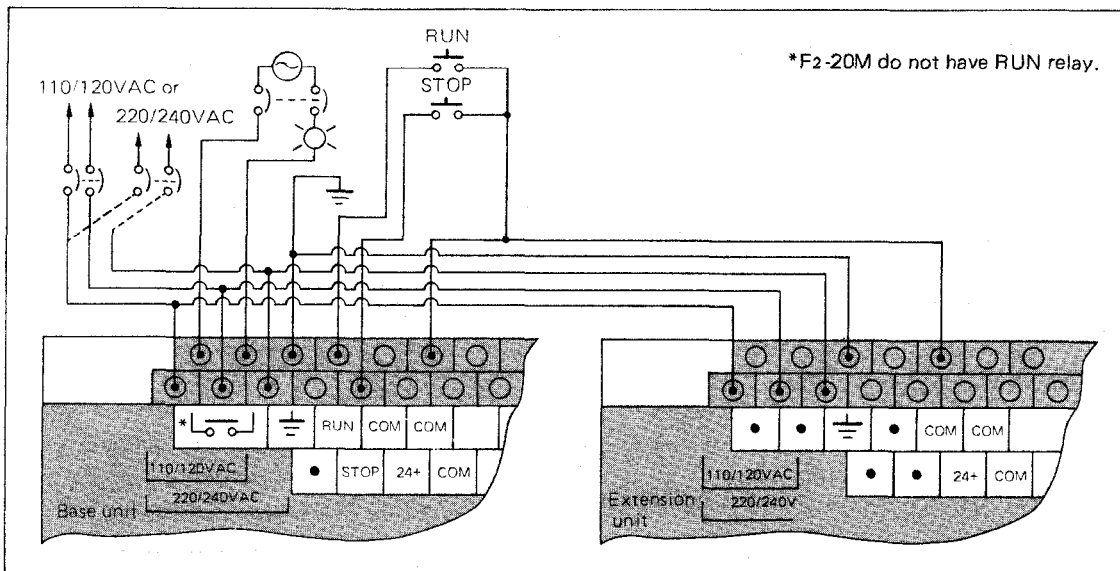
**Pulse Output Unit & Teach Unit**  
(extension port)

Provides pulse signals to servo or stepper motor driver for  
easy positional control. Teach unit allows easy positional  
point programming.

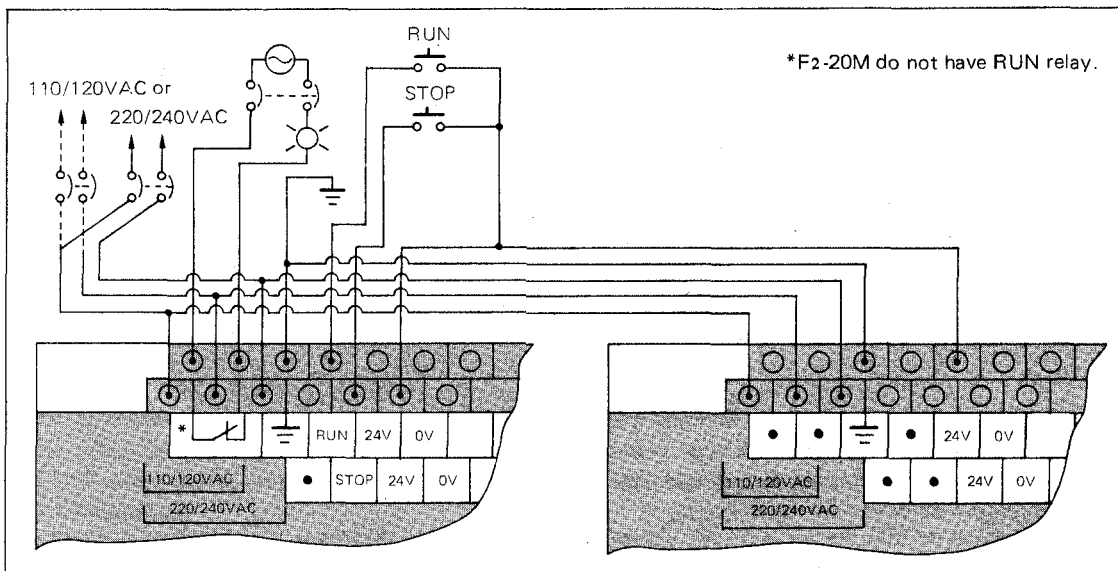


# 2 PRELIMINARY WIRINGS

**Example of sink DC input (minus common) model**  
 (F2-20/40/60□□, F2-20/40/60□□-U, F2-40/60□□-UL)



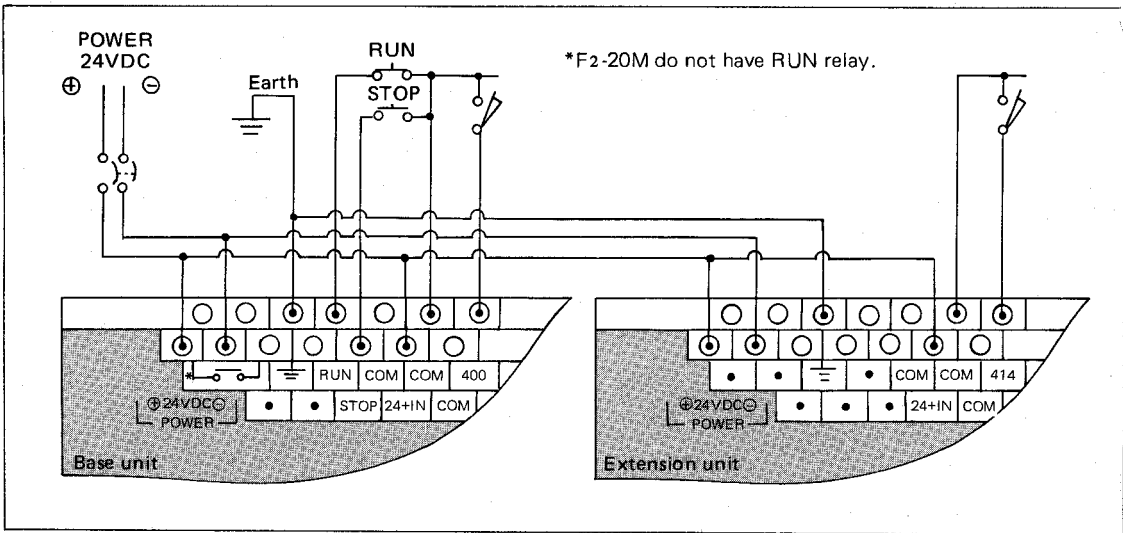
**Example of source DC input (plus common) model (F2-20/40/60□□-ES)**



## 2-1 POWER SUPPLY

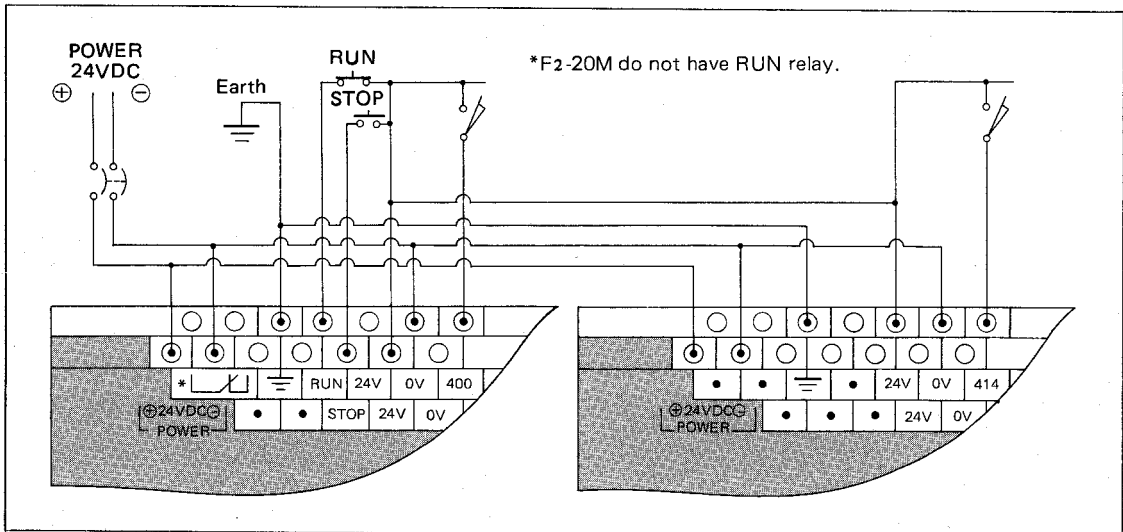
- Power supply voltage ..... AC 110/120V  $\begin{matrix} +10\% \\ -15\% \end{matrix}$  or AC 220/240V  $\begin{matrix} +10\% \\ -15\% \end{matrix}$  50/60Hz (-U, -ES type models)  
 AC110/120V  $\pm 10\%$  or AC 220/240V  $\pm 10\%$  50/60Hz (-UL type model)
- Power consumption ..... less than 20VA (F2-20) 24VA (F2-40), 40VA (F2-60)
- DC 24V output capacity ..... 0.1A (F2-20/40DC input model), 0.2A (F2-60DC input model)  
 (External power source) (Excluding the power to non-voltage contacts)

**Example of sink DC input (minus common) model (F2-20/40/60□□-D)**



☆ Ensure that the input **24 + IN** terminal is connected to the power **+** terminal as illustrated above.

**Example of source DC input (plus common) model (F2-20/40/60□□-DS)**



☆ Ensure that the input **0V** terminal is connected to the power **-** terminal as illustrated above.

**POWER SUPPLY**

Power supply voltage . . . . . 24VDC±8V

### 2-1-1 Power Supply

- (1) Connect a power supply cable of the correct rating to the base unit and extension unit (if used) as illustrated. Supply voltages should be as specified. It is recommended to provide power supply switch which can be used when the ROM cassette is plugged in or off.
- (2) The power consumption of the base unit is less than 20VA to F2-20, 25VA to F2-40 and 40VA to F2-60 however, this does not include the power consumption of any external load.
- (3) The power must be switched off when the ROM cassette is loaded on the base unit or unloaded from the unit.
- (4) The power supply to the extension (if used) shall be connected to same ON/OFF switch for the base unit.

### 2-1-2 Emergency Stop

Although the PC is designed to switch off all its outputs in emergencies, external safety power switching equipment should be incorporated also.

## 2-2 GROUNDING

- (1) The unit must be grounded as illustrated. The extension unit (if used) must also be grounded with same line of base unit.
- (2) Resistance should be less than  $100\Omega$ .
- (3) Grounding must not be shared with any high power equipment such as a motor system.

## 2-3 RUN/STOP MODE TERMINALS

- (1) These terminals should be connected to key switches or other suitable control devices (push button) as illustrated.
- (2) The RUN mode is used when the programmable controller is running a program (controlling a system).
- (3) When the STOP mode is used (or there is a power failure of more than 20msec.), all outputs are turned off and timers, plus the 128 of 192 auxiliary relays are reset. However, all counters and 64 of the auxiliary relays, state relays and some special auxiliary relays are maintained by battery support.
- (4) 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 up this facility.
- (5) In the case of AC input models, see section 3-5.

If RUN terminal is kept ON by permanent wiring, normally, PC will not leave RUN mode. However, if power is removed and a programming panel is connected in program mode, on return of power, PC will enter program mode and allow alterations to be made to the program.

## 2-4 RUN OUTPUT TERMINALS ( or ) (except F2-20M)

- (1) A relay contact is provided between these two terminals inside. The contact is switched on at normal run mode, but is switched off if CPU error might be caused from electrical noise interference, etc. It is switched off in STOP mode.
- (2) This facility is used to make an emergency stop circuit or warning circuit.
- (3) Output load of the relay is less than 35VA. For loads over the rated limit, operation should be performed through an extra relay.

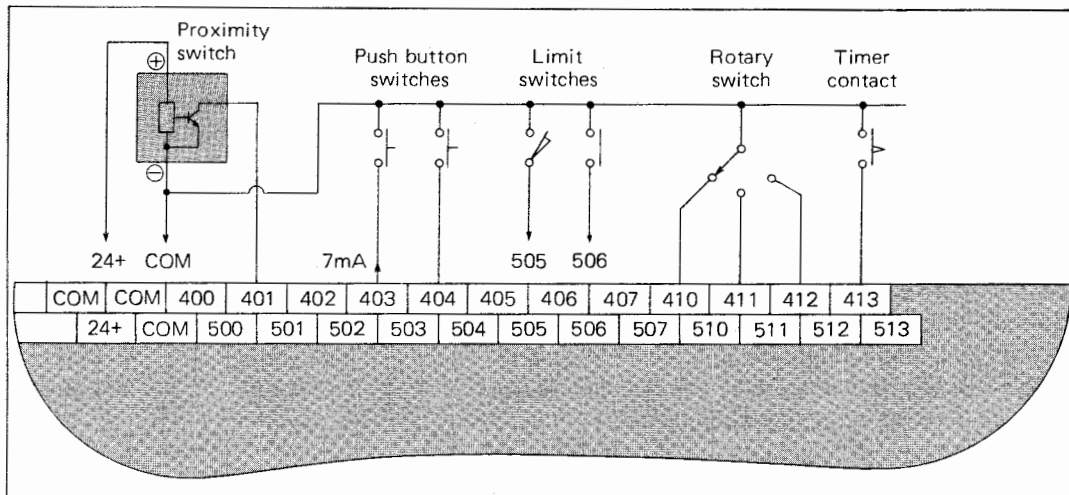
## 2-5 DC24V TERMINALS

- (1) In the case of the sink input (minus common) models, input devices of non-voltage contacts are powered from input terminals and the 24+ terminals provide DC24V power for input sensor devices such as proximity switches or photo sensors.
- (2) In the case of the source input (plus common) models, non-voltage contact devices are powered from the 24V terminals and the 24V terminals have extra power capacity for the input sensor devices as specified.
- (3) If the extension unit is used, connect the DC24V terminals between the base unit and extension unit. The COM terminals are also connected in the same manner.
- (4) Any external power must not be supplied to these terminals.

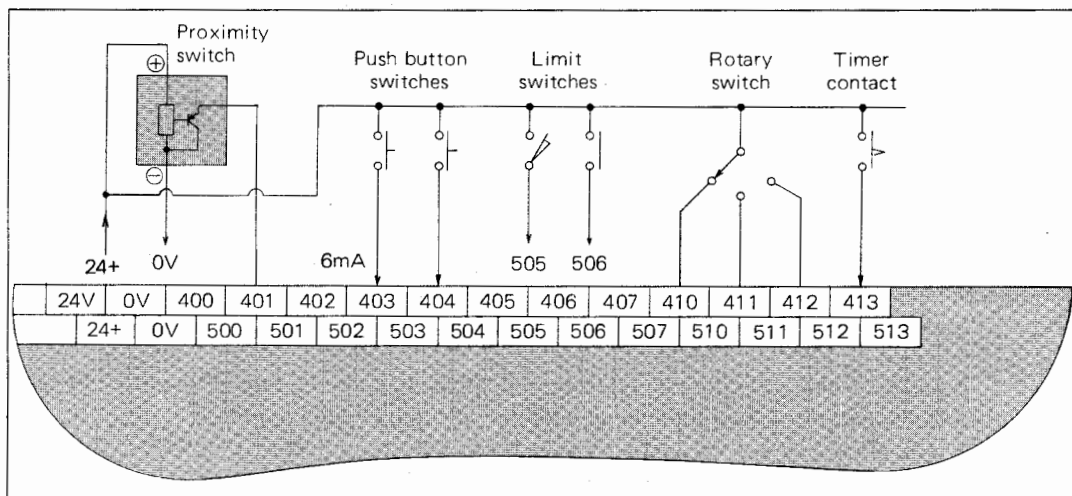
# 3 INPUT HANDLING

## 3-1 EXAMPLE OF CONNECTIONS

### (1) Sink input (minus common) models (F2-20/40/60□□, F2-20/40/60□□-U, F2-40/60□□-UL)



### (2) Source input (plus common) models (F2-20/40/60□□-ES)



## 3-2 INPUT TERMINALS

Model	Numeric assignment of inputs		Number of inputs per unit
	Base unit	Extension unit	
F2-20	400 - 413	414 - 427	12 points
F2-40	400 - 413	414 - 427	24 points
	500 - 513	514 - 527	
F2-60	00 - 13	14 - 27	36 points
	400 - 413	414 - 427	
	500 - 513	514 - 527	

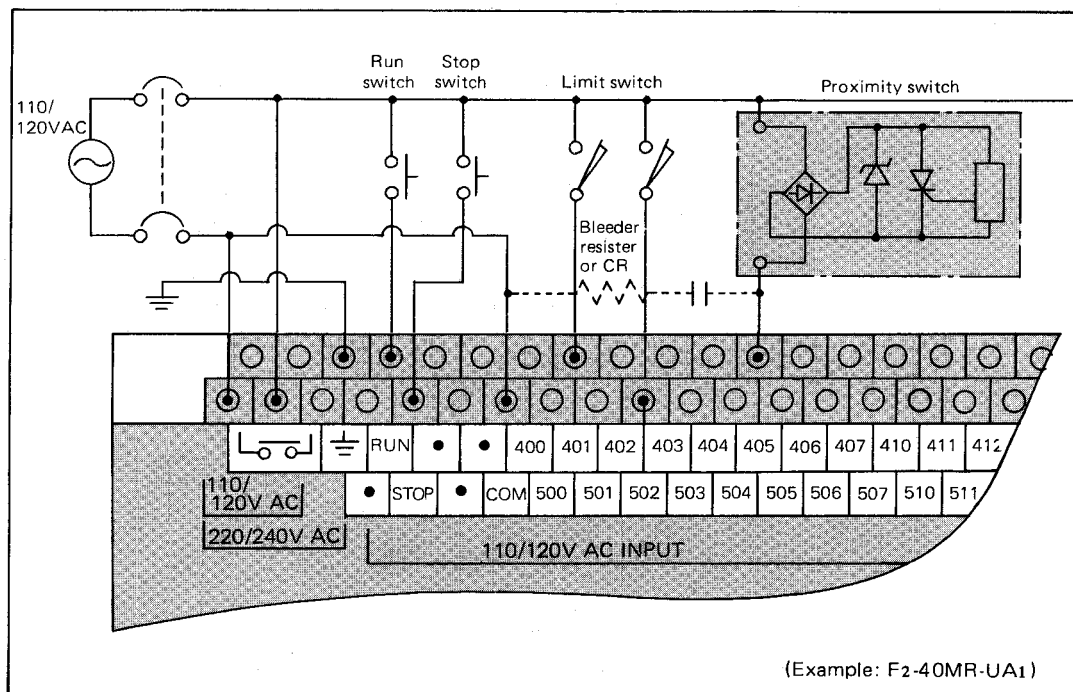
### 3-3 INPUT CIRCUIT SPECIFICATIONS

	DC24V Input (Sink input minus common)	DC24V Input (Source input plus common)	AC100V Input (Source input plus common)	AC200V Input (Source input plus common)
Input circuit				
Rated input voltage	DC24V $\pm$ 4V (Self-supply)	DC24V $\pm$ 4V (Self-supply)	AC100/120V +10% (50/60Hz) -15%	AC200/240V +10% (50/60Hz) -15%
Input impedance	Approx. 3.7k $\Omega$	Approx. 3.7k $\Omega$ (F2-20) Approx. 4k $\Omega$ (F2-40/60)	Approx. 10.6k $\Omega$ /60Hz (12.6k $\Omega$ /50Hz)	Approx. 18.5k $\Omega$ /60Hz (22k $\Omega$ /50Hz)
Operation current	OFF $\rightarrow$ ON	DC4mA Min.	DC4mA Min.	AC7mA Min.
	ON $\rightarrow$ OFF	DC1.5mA Max.	DC1.5mA Max.	AC2mA Max.
Response time	OFF $\rightarrow$ ON	Approx. 10m.sec	Approx. 10m.sec	Approx. 15m sec
	ON $\rightarrow$ OFF	Approx. 5m.sec	Approx. 5m.sec	Approx. 8m sec
Insulation	Photo-coupler insulation			
Indication	LED turns ON when input is activated.			

### 3-4 CAUTIONS

- Connect input control devices, e.g. limit switches, push buttons, to the input terminations as specified.
- In the case of sink input (minus common) models, non-voltage contact devices are powered from the input terminals and the 24V terminal points can be used to power external transistors such as proximity switches.  
The capacity of 24V DC source is rated by 0.1 Amp (F2-20/40) and 0.2 Amp (F2-60) from 24V terminal in addition to each 7mA from all input terminals.
- In the case of source input (plus common) models, non-voltage contact devices are powered from the 24V terminals and the current rating at each input terminal is 24VDC, 6mA. The control devices should be specified accordingly.  
The 24V terminal points can also be used to power external transistors such as proximity switches.  
Total of 0.1 Amp (F2-20/40) and 0.2 Amp (F2-60) current by two 24V terminals can be used for such transistors in addition to each 6mA supply to all input terminals.  
If further more power is requested, use an external power source of 16 to 36V DC.  
The 0V terminals are used for negatives of this DC source.
- If transistor circuits, such as proximity switches, are connected to input terminals, their parallel resistance should be more than 100k $\Omega$  and their series resistance less than 1k $\Omega$ .
- Three common terminals are connected internally and are common. However, the base and extension unit commons are not linked unless connected together externally as detailed in other section 2-5.  
The common terminal is also used for a negative of 24V DC source.
- For the sake of convenience and appearance and to avoid damage or failure, input wires should be bound or cabled together.  
It is recommended that input wires are not longer than 20 meters for the general use. However, the length can be longer but it depends upon the conditions of the noise environment and voltage drop.

### 3-5 AC INPUT HANDLINGS (F2-20/40/60□□-□A1, A2)



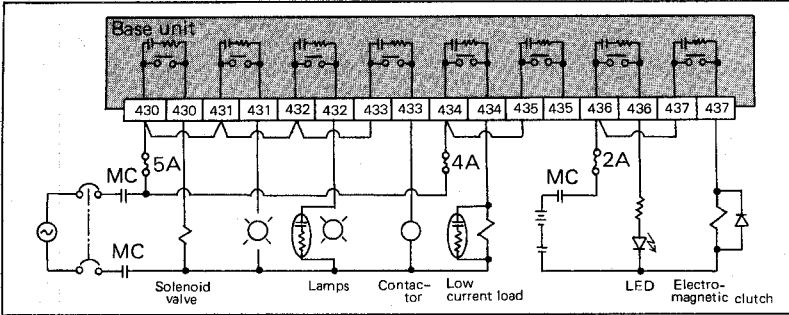
- When input devices such as proximity switches or photo sensors are connected to the input terminals, be aware that the leakage current may activate the input signal incorrectly. Where the leakage current is more than 2mA, it may prove necessary to provide additional bleeder resistor or CR circuit (e.g.  $0.1\mu\text{F} + 100\Omega$ ), otherwise use input devices with low leakage current of less than 2mA.
- The power supply to the PC can use 110/220VAC, however, AC input voltage of 110VAC or 220VAC is different according to the model name.
- When AC input type PC and DC input type PC are mixed, (e.g. base unit and extension unit), common terminals of inputs must **not** be connected together.

# 4

# OUTPUT HANDLING

## 4-1 RELAY OUTPUT MODELS (F2-20/40/60□R, -□□)

**F2-20MR**



**F2-20ER**

r40 <sub>1</sub>	r41 <sub>1</sub>	r42 <sub>1</sub>	r43 <sub>1</sub>	r44 <sub>1</sub>	r45 <sub>1</sub>	r46 <sub>1</sub>	r47 <sub>1</sub>
------------------	------------------	------------------	------------------	------------------	------------------	------------------	------------------

**F2-40MR**

COM <sub>3</sub>	430	431	432	433	COM <sub>4</sub>	434	435	436	437	COM <sub>5</sub>	530	531	532	533	COM <sub>6</sub>	534	535	536	537
------------------	-----	-----	-----	-----	------------------	-----	-----	-----	-----	------------------	-----	-----	-----	-----	------------------	-----	-----	-----	-----

**F2-40ER**

COM <sub>9</sub>	440	441	442	443	COM <sub>10</sub>	444	445	446	447	COM <sub>11</sub>	540	541	542	543	COM <sub>12</sub>	544	545	546	547
4 points common				4 points common				4 points common				4 points common							

**F2-60MR**

	30	32		34	36	430	432	434	436	530	532	534	536				
COM <sub>1</sub>	31	33	COM <sub>2</sub>	35	37	COM <sub>3</sub>	431	433	COM <sub>4</sub>	435	437	COM <sub>5</sub>	531	533	COM <sub>6</sub>	535	537

**F2-60ER**

	40	42		44	46	440	442	444	446	540	542	544	546				
COM <sub>7</sub>	41	43	COM <sub>8</sub>	45	47	COM <sub>9</sub>	441	443	COM <sub>10</sub>	445	447	COM <sub>11</sub>	541	543	COM <sub>12</sub>	545	547
4 points common		4 points common		4 points common		4 points common		4 points common		4 points common		4 points common					

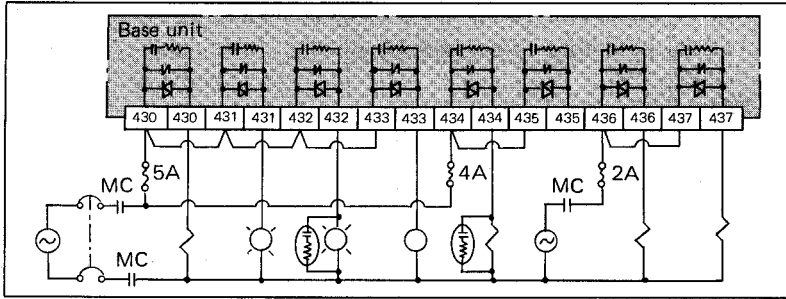
- Connect external load devices e.g. contactors, pilot lamps, solenoid (electromagnetic) valves, etc., to output terminations of the base unit and extension unit (if used).
- As shown in the above figure, four common terminals are provided for the output terminations. As these commons are not linked and cover each four output terminals in their block, different types of power can be used as shown in the above example as far as the output terminals in a block share one type of power.



- 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 24V DC, 110/120V AC, 220/240V AC. These ratings apply for resistive loads ( $\text{COS } \phi = 1.0$ ).  
The durability data of output relays is stated in another section (4-5).
- Each internal contact is protected by a residual current circuit. When the contact is closed, its current leakage will normally be less than 1.1mA at 220V AC or 0.55mA at 110V AC. 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 section 4-5).
- When using the controller in a direct current circuit, it is recommended to connect a free wheel diode in parallel to the inductive load.
- Type-UL Output is 72VA, at 120/240V AC. (2A for resistive load)

#### 4-2 TRIAC (SSR) OUTPUT MODELS (F2-20/40/60□S, -□□)

##### F2-20MS



##### F2-20ES

r401	r411	r421	r431	r441	r451	r461	r471
------	------	------	------	------	------	------	------

##### F2-40MS

COM <sub>3</sub>	430	431	432	433	COM <sub>4</sub>	434	435	436	437	COM <sub>5</sub>	530	531	532	533	COM <sub>6</sub>	534	535	536	537
------------------	-----	-----	-----	-----	------------------	-----	-----	-----	-----	------------------	-----	-----	-----	-----	------------------	-----	-----	-----	-----

##### F2-40ES

COM <sub>9</sub>	440	441	442	443	COM <sub>10</sub>	444	445	446	447	COM <sub>11</sub>	540	541	542	543	COM <sub>12</sub>	544	545	546	547
------------------	-----	-----	-----	-----	-------------------	-----	-----	-----	-----	-------------------	-----	-----	-----	-----	-------------------	-----	-----	-----	-----

4 points  
common

4 points  
common

4 points  
common

4 points  
common

##### F2-60MS

	30	32		34	36	430	432	434	436	530	532	534	536				
COM <sub>1</sub>	31	33	COM <sub>2</sub>	35	37	COM <sub>3</sub>	431	433	COM <sub>4</sub>	435	437	COM <sub>5</sub>	531	533	COM <sub>6</sub>	535	537

##### F2-60ES

	40	42		44	46	440	442	444	446	540	542	544	546				
COM <sub>7</sub>	41	43	COM <sub>8</sub>	45	47	COM <sub>9</sub>	441	443	COM <sub>10</sub>	445	447	COM <sub>11</sub>	541	543	COM <sub>12</sub>	545	547

4 points  
common

4 points  
common

4 points  
common

4 points  
common

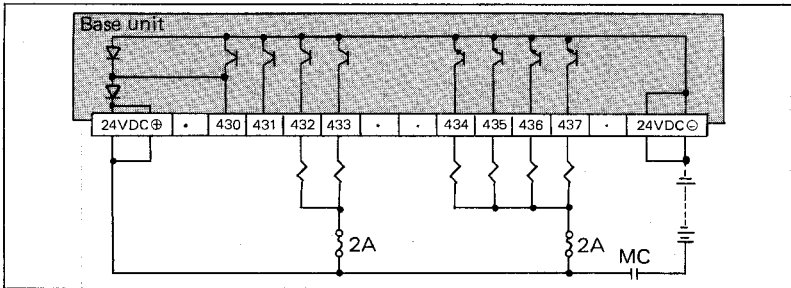
4 points  
common

4 points  
common

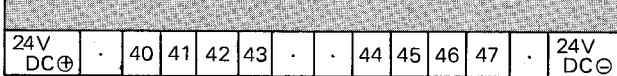
- Connect external load devices e.g. contactors, pilot lamps, solenoid (electromagnetic) valves, etc., to output terminations of the base unit and extension unit (if used).
- As shown in the last figure, common terminals are provided for the output terminations. As these commons are not linked and cover each four output terminals in their block, different types of power can be used as shown in the above example as far as the output terminals are in a block share of one type of power.
- The load limitation of the triac (SSR) outputs is 1A for each individual output, but the total collective output load should not exceed 8A across all 16 outputs at AC 110/120V or AC 220/240V.
- For inductive loads, the rated coil of magnetic contactors should be within 50VA at AC 110/120V or 100VA at AC 220/240V. If the coil load is over these limits, then an external relay will be required. For lamp loads above 100W, an external relay will also be required.
- 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 AC 120V or 2.2mA at AC 220V. However, it is possible that this might have some effect on external loads. It is not possible to operate triac output card on DC loads.

### 4-3 TRANSISTOR OUTPUT MODELS (F2-20/40/60□T, □) SINK OUTPUT TYPE

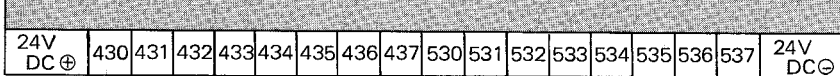
**F2-20MT**



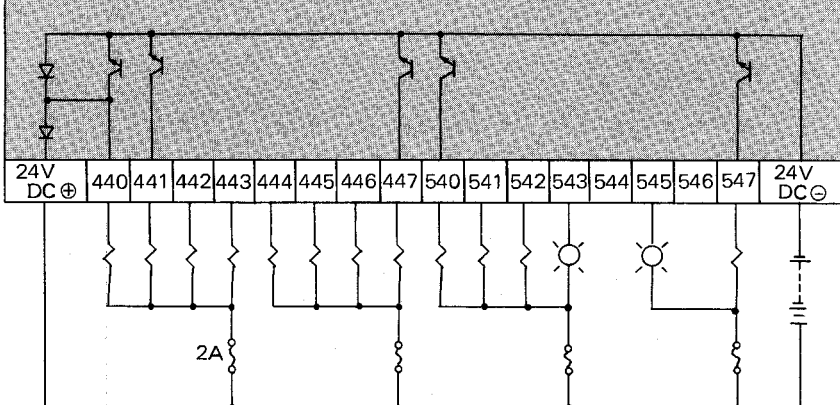
**F2-20ET**



**F2-40MT**



**F2-40ET**



F2-60MT																	
		30	32	34	36		430	432	434	436		530	532	534	536		
24V DC ⊕	31	33	35	37			431	433	435	437		531	533	535	537	24V DC ⊖	

F2-60ET																	
		40	42	44	46		440	442	444	446		540	542	544	546		
24V DC ⊕	41	43	45	47			441	443	445	447		541	543	545	547	24V DC ⊖	

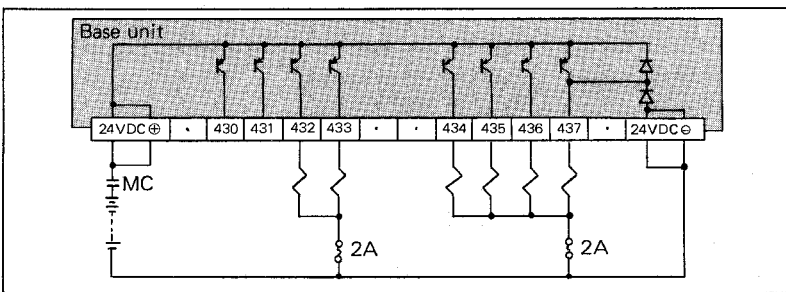
- Connect external load devices e.g. contactors, pilot lamps, solenoid (electromagnetic) valves, etc., to output terminations of the base unit and extension unit.
- The load limitation of the transistor outputs is 1A for each individual output, but the collective output load should not exceed 2A per 4 points at DC 24V.
- Due to surge current limitations lamp loads should be within 3W.
- When other loads are connected to an output termination in addition to lamp load, the total output load to this termination should be as specified with reference to the following table.

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

- The external DC power supply should be DC 24V +15%/-30%.
- 2A rated back-up fuses or protectors are recommended per each four 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.

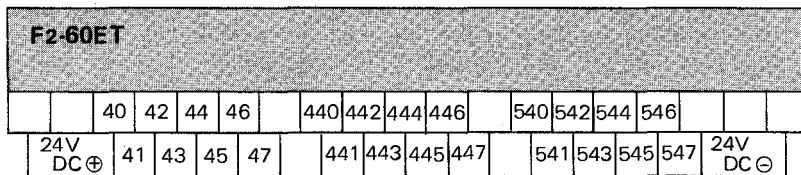
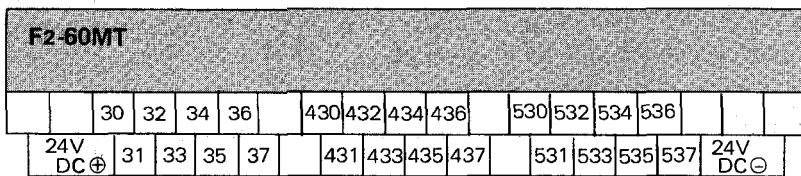
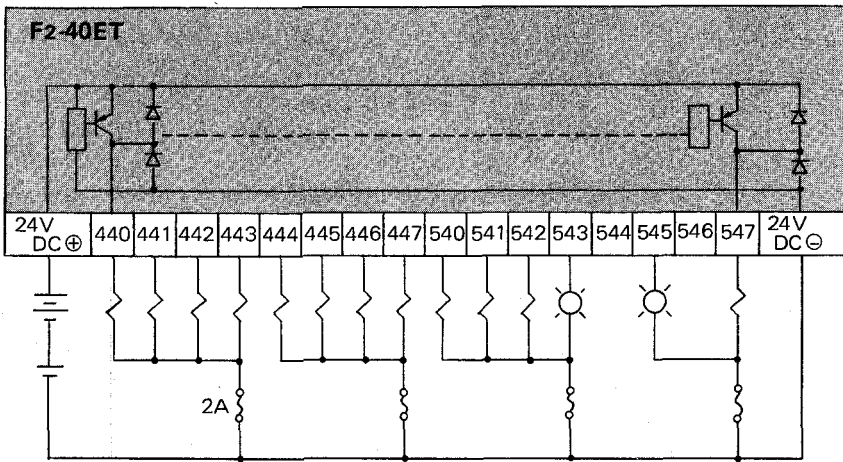
#### 4-4 TRANSISTOR OUTPUT MODELS (F2-20/40/60 □ T-□SS) SOURCE OUTPUT TYPE

F2-20MT



F2-20ET																
24V DC ⊕	·	40	41	42	43	·	·	44	45	46	47	·	·	24V DC ⊖		

F2-40MT																	
24V DC ⊕	430	431	432	433	434	435	436	437	530	531	532	533	534	535	536	537	24V DC ⊖

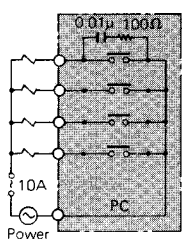
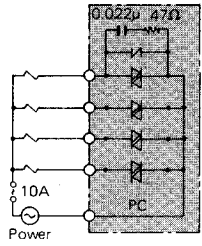
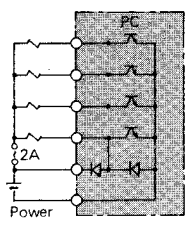
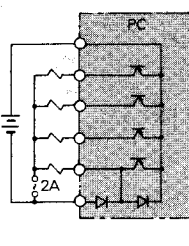


- Connect external load devices e.g. contactors, pilot lamps, solenoid (electromagnetic) valves, etc., to output terminations of the base unit and extension unit (if used).
- The load limitation of the transistor outputs is 1A for each individual output, but the collective output load should not exceed 2A per 4 points at DC 24V.
- Due to surge current limitations lamp loads should be within 3W.
- When other load are connected to a single output termination in addition to lamp load, the total output load to this termination should be as specified with reference to following table.

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

- The external DC power supply should be DC 24V +15%/-30%.
- 2A rated back-up fuses or protectors are recommended per each four 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.

## 4-5 OUTPUT CIRCUIT SPECIFICATIONS

		Relay Output	Triac Output	Transistor Output (Sink output)	Transistor Output (Source output)
Output circuit					
External power source		Less than 250VAC /30VDC	80–240VAC	24VDC +10% -30%	24VDC +10% -30% *
Max. Load	Rated output current (Resistance load)	2A/point	1A/point but 2A per 4 points total	1A/point but 2A per 4 points total	1A/point but 2A per 4 points total
	Inductive load	Detailed below	50VA (110/120VAC) 100VA (220/240VAC)	24W (24VDC)	24W (24VDC)
	Lamp load	100W	100W	3W (Detailed in Section 4-3)	3W (Detailed in Section 4-4)
Rush current		10A/Cycle	10A/Cycle	5A/10ms	5A/10ms
Leakage current		0.55mA/110VAC 1.1mA/220VAC	1.1mA/110VAC 2.2mA/220VAC	—	—
Min. Load (Inductive load)		0.2VA/110AC 0.8VA/220VAC	0.4VA/110VA 1.6VA/220VAC	—	—
Response time	OFF→ON	Approx. 5m.sec	Less than 1m.sec	Less than 1m.sec	Less than 1m.sec
	ON→OFF	Approx 10m.sec	10m.sec Max.	Less than 1m.sec	Less than 1m.sec
Circuit insulation		Relay insulation	Photo-triac	Photo-coupler	Photo-coupler
Indications		LED (When relay coil is activated)	LED (When triac is activated)	LED (When photo-coupler is activated)	LED (When photo-coupler is activated)

\* If lower supply voltage is used: load current = 0.5A/point (12VDC), 2.5mA/point (5VDC) or less

The basic unit and extension unit have the output power ratings indicated in the above 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 surge absorber circuit (approx.  $0.1\mu\text{F} + 100\Omega$ ) to prevent incorrect operation due to leakage currents flowing in the output circuits.

### 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.

### Inductive Load of Relay Output

Applicable loads to the output relays are subject to the no. of operations. According to our life test data, the following gives a reference of the relay durability level;

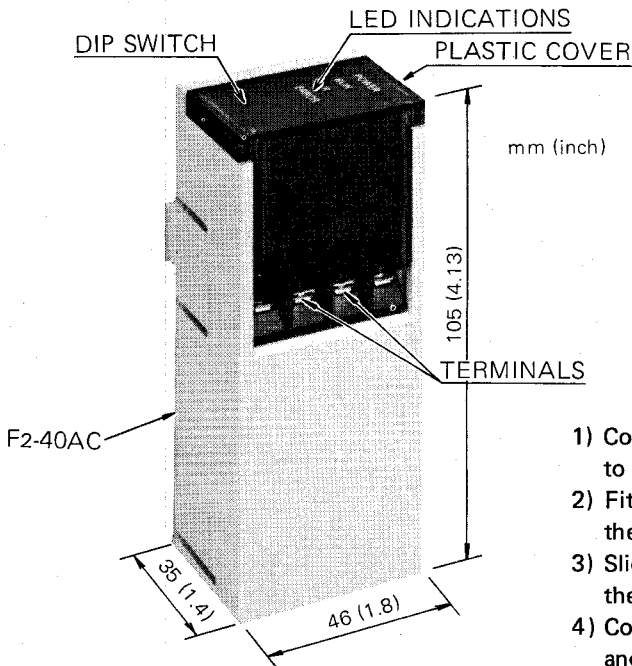
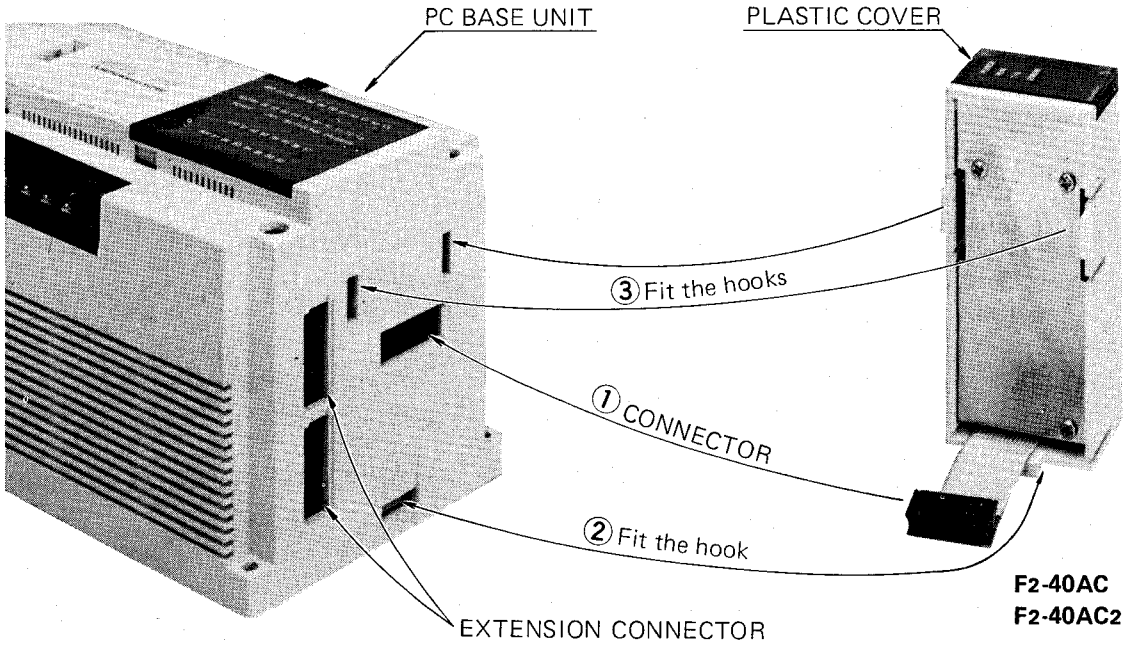
Inductive Load	No. of Operations
Less than 35VA	UP to 3,000,000
Less than 80VA	UP to 1,000,000
Less than 120VA	Up to 200,000

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

# 5

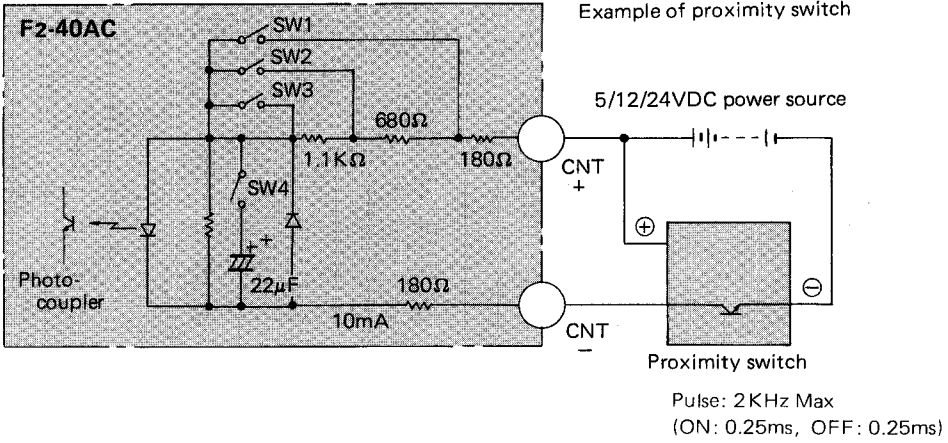
## F<sub>2</sub>-40AC/F<sub>2</sub>-40AC<sub>2</sub>(HIGH SPEED COUNTER INTERFACE) HANDLINGS

### 5-1 INSTALLATION

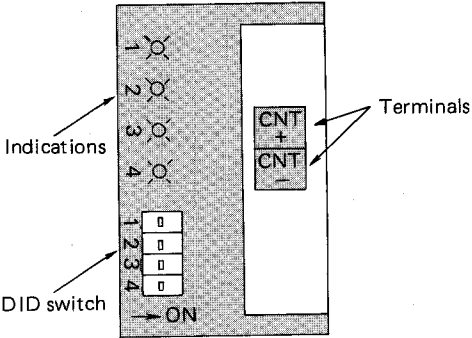


- 1) Connect a connector of the F<sub>2</sub>-40AC/AC<sub>2</sub> to the PC.
- 2) Fit the hooks in the installation holes of the PC.
- 3) Slide the plastic cover upward to remove the cover.
- 4) Connect the input wires to the terminals and adjust the DIP switch.

### 5-2 F2-40AC CONNECTIONS OF INPUT CIRCUIT



### 5-3 INDICATIONS AND DIP-SWITCH SETTINGS



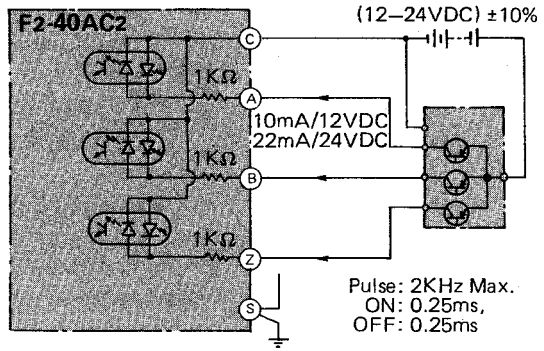
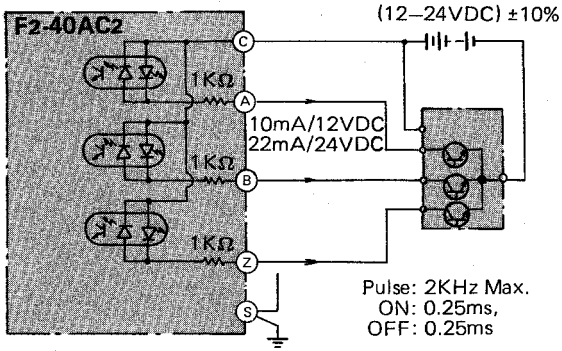
#### LED indications:

- 1 ..... Mode selection (M470)
- 2 ..... Up/down selection (M471)
- 3 ..... Start (M472)
- 4 ..... Input signal

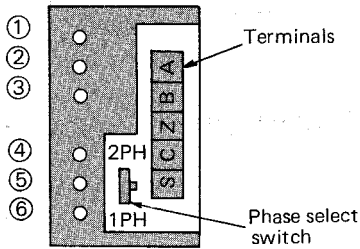
#### DIP switch settings:

- SW1 ..... Switch ON only when 5VDC is used for input device.
- SW2 ..... Switch ON only when 12VDC is used for input device.
- SW3 ..... Switch ON only when 24VDC is used for input device.
- SW4 ..... Switch ON only when input filter is required.

### 5-4 F2-40AC2 CONNECTIONS OF INPUT CIRCUIT

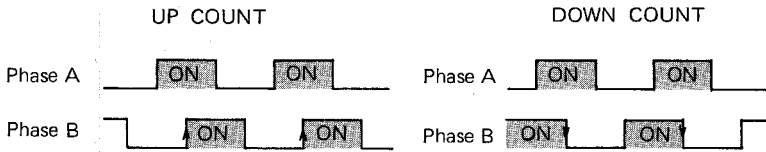


### 5-5 INDICATIONS



#### LED indications:

- ① ..... Mode selection (M470)
  - ② ..... Up/down selection (M471)
  - ③ ..... Start (M472)
  - ④ ..... Phase A
  - ⑤ ..... Phase B
  - ⑥ ..... Phase Z
- Input signals

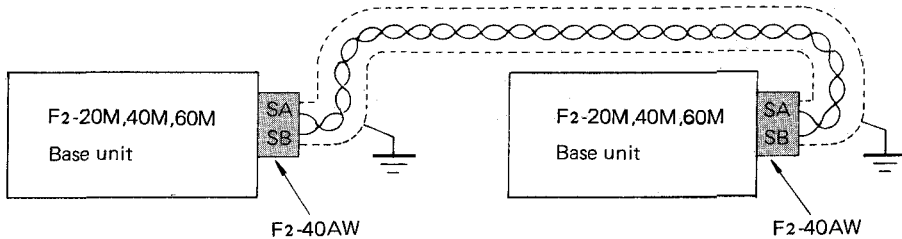




## 6

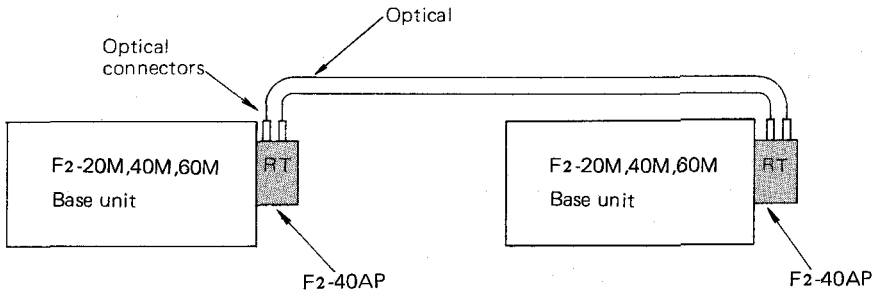
# F<sub>2</sub>-40AW/AP(PC LINK INTERFACE) HANDLINGS

## 6-1 F<sub>2</sub>-40AW (WIRE LINK) INSTALLATION



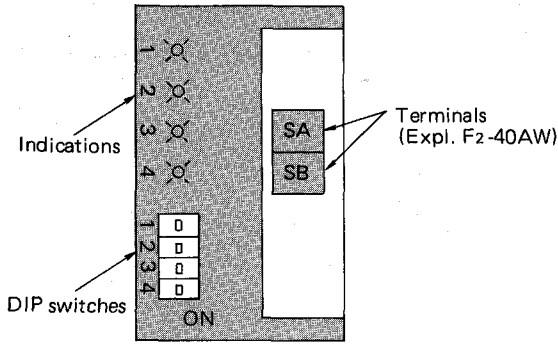
- (1) Attach the unit to the PC in the same manner as the F<sub>2</sub>-40AC (Section 5-1).
- (2) Connect two units with a twist-pair cable as illustrated (SA to SA, SB to SB), and both ends of sealing twist are connected to the earth terminals of the PCs.
- (3) The cable length shall be less than 10 meters (approx. 35 feet) and keep away from high voltage supply cables or other such electrical apparatus to avoid electrical noise interference.

## 6-2 F<sub>2</sub>-40AP (OPTICAL FIBER LINK) INSTALLATION



- (1) Attach the unit to the PC in the same manner as the F<sub>2</sub>-40AC (Section 5-1).
- (2) Connect two units with optical plastic fiber cables as illustrated (R to T, T to R).
- (3) The cable length shall be less than 50 meters (approx. 160 feet).
- (4) The optical fiber cables and optical connectors are not included in the attachment. The material specifications and supply should be inquired to a Mitsubishi agent.

### 6-3 INDICATIONS AND DIP-SWITCH SETTINGS



LED indications:

- 1 ..... Power supply
- 2 ..... Linkage RUN
- 3 ..... Signal transmission
- 4 ..... Transmission error

DIP switch settings:

SW1 ..... Switch OFF at all times.

SW2 ..... Switch ON at all times.

SW3 ..... Since two PC units must be identified for the signal handlings mentioned in the next section 6-4, the SW3 makes identifications of both PCs as follows:

ON ..... Side A PC (Master)

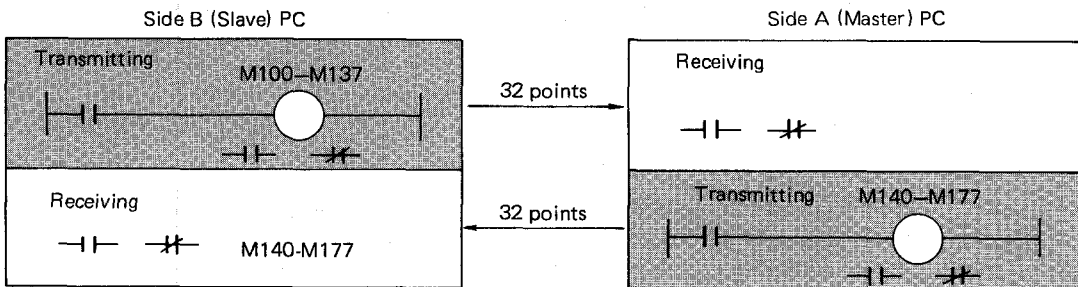
OFF ..... Side B PC (Slave)

SW4 ..... Switch ON to transmit 32 points of signals or switch OFF to transmit 16 points of signals.

### 6-4 SIGNAL TRANSMISSION

For the linkage operations of two PCs, certain auxiliary relays are shared with both PCs and the signal transmissions are as follows:

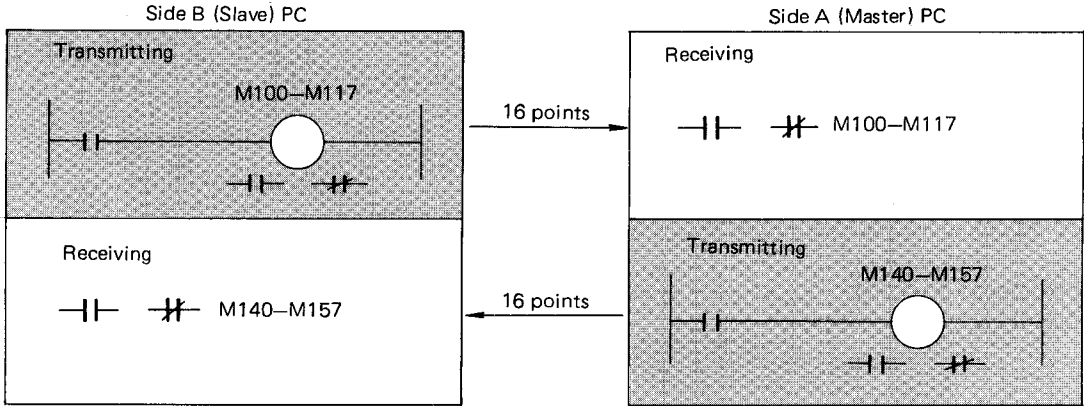
(1) 32 Points Transmission



Side B PC can activate the auxiliary relays M100–M137 subjectively and Side A PC receives the data to share with the contacts in the program. On the other hand auxiliary relays M140–M177 are activated by Side A PC and the data is shared by Side B PC and used in its program.

(Auxiliary relay M100–M137 cannot be activated by Side A PC and M140–177 cannot be activated by Side B PC.)

(2) 16 Points Transmission



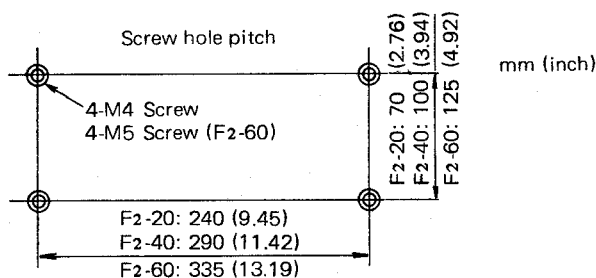
In the same manner as 32 point transmission, auxiliary relays M100–M117 are activated by Side B PC and M140–157 is activated by Side A PC.

- Ref. 1) Linkage operation of 32/16 points is also available. But the auxiliary relays of which data is expected to receive from another PC must not be activated as an output coil.
- 2) It takes approx. 7.2msec for the signal transmission between the PCs. Maximum delay time of signal transmission is 7.2msec plus execution time of the PC.

# 7

# INSTALLATION AND ENVIRONMENT

## 7-1 INSTALLATION



- (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.  
DIN rail mounting kit is available for F2-20 and F2-40 models.
- (2) Do not attempt to install the equipment on the floor surface or ceiling to avoid temperature rise.  
Install the equipment on the wall surface.
- (3) When mounting the unit on the wall surface, beware of conductive trashes falling into the unit through the ventilation opening etc. Conductive trashes may cause damage to the circuit boards of the PC or cause operation failure.

## 7-2 EXTENSION CABLE

- (1) Extension cable of 0.45 meter (1.47 feet) length is attached with the F2-20E, and extension cables of 0.6 meter (1.97 feet) length are attached with the F2-40E and F2-60E unit.
- (2) The extension cables 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 (1.2 inch) at least.
- (3) I/O assignment numbers e.g. 00, 400, 500 are marked to each extension port, and the ports with same number shall be connected between the base unit and extension unit.  
Labels of 00, 400 and 500 are attached to the base unit for the usage of F-4T, F-10ER or F-20E.

## 7-3 ENVIRONMENT

While 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. The unit should not be installed in a situation where the temperature is likely to rise to above 50°C (122°F) and a space of some 50mm (2 inches) should be allowed around the unit for heat dissipation.

## 7-4 ELECTRICAL NOISE INTERFERENCE

To avoid electrical noise interference from some external apparatus, the unit should not be installed near high voltage supply cables or other such electrical apparatus. Input and output wires must be kept separate and away from any power supply cables or high voltage cables.

## **7-5 WIRINGS**

- (1) For the sake of convenience and appearance and to avoid damage or failure, input wires should be bound or cable together as well as output wires.
- (2) It is recommended that input and output wires are not longer than 20 meters (65 feet) for the general use. However the length can be longer but depends upon the conditions of the noise environment and voltage drop.
- (3) DC cable and AC cable should not be bound together.
- (4) External emergency stop circuit or interlocks for dangerous contactor such as forward/reverse should be provided in addition to the PC sequence.
- (5) If internal power fuse should be cut in a event of wrong voltage supply, the fuse replacement may not recover the unit.

## **7-6 PERIPHERAL INSTALLATION**

- (1) The power must be switched off when the ROM cassette is loaded or unloaded.
- (2) When F2-20P-E or F1-20P-E or F-20P-E is plugged on the PC during the PC power is ON. The slide switch of the programme must be MONITOR mode for normal correct operation. (exception in section 2-3)

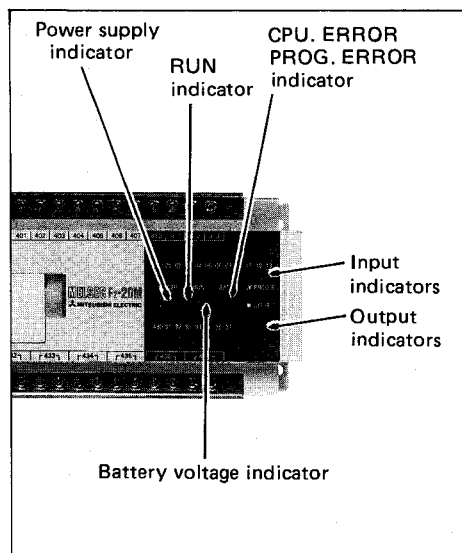
# 8

# DIAGNOSIS AND MAINTENANCE

## 8-1 PRELIMINARY CHECKS

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

- a. That the power and ground leads are properly connected.
- b. That input and output leads are properly connected and not entangled. (It is worthwhile numbering each load according to its input and output assignment.)
- c. That output loads and input contacts are within the specification limits detailed earlier.
- d. That program/monitor mode on the programming panel and RUN/STOP mode on the base unit are properly set.
- e. That the extension cable is properly connected.
- f. Programmes can be checked and monitored by using the facility available on the programming panel for this purpose.



## 8-2 DIAGNOSIS

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

### (1) Power Supply Indication

LED illumination indicates that the power is 'on'. If the LED fails to illuminate when the unit is under apparent power, open the fuse cover and check the fuse. If the PC will not recover, the unit may be faulty.

### (2) Run Indication (CPU mode):

When LED do not turn on when external settings are apparently correct, remove programming panel and check the following:

- a. Check STOP terminal has not been activated. STOP terminal has priority over RUN.
- b. Check the RUN terminal has correct logic voltage.
- c. Check power supply is of the correct level with a voltmeter.
- d. Software error will not allow CPU to enter RUN mode, try a simple program after erasing program memory.

### (3) Battery

If the battery LED illuminates, replace the battery immediately. A special auxiliary relay M76 is turned ON when battery level is low.

### (4) Program Error Indication

CPU ERROR LED flickers when following errors are caused:

#### 1) Programming errors

- a. Timer or counter without constant K
- b. Grammatic error in a program
- c. Circuit error in a program

#### 2) Battery voltage drop

#### 3) Sum-check error, which may be caused by noise interference or conductive debris falling into the unit.

In this case, check the program, battery voltage indication, electrical noise source or possibility of conductive debris, and try to operate again after the power reset.

## (5) CPU Error Indication

CPU ERROR LED is turned ON in following cases:

- 1) CPU execution error is caused by noise interference or conductive trashes fallen into the unit.
- 2) ROM cassette is loaded or unloaded when the PC power is turned ON.
- 3) Watch-dog timer error is caused if program execution time is more than 0.07 second.
  - a. In this case, turn the PC power OFF and switch ON again (power reset). If the PC operation is recovered, check the electrical noise source or possibility of conductive trashes.
  - b. If the CPU ERROR LED flickers after power reset, check the program error in the same manner as former item (Section 8-2(4)).
  - c. If the CPU ERROR LED is still turned ON, check the program execution time.

## (6) Input Indications

When the input LEDs fail to illuminate, check the ON/OFF status in the program with programmer, and check whether input switching device works properly. Beware the following possibilities:

- a. If current rating of input device is too large, contact error may be caused.
- b. When the bleed resistor for external LED indication is provided in parallel to the input device, the PC input may be turned ON incorrectly because of the leakage current.
- c. The PC may not accept the input signal which is shorter than PC execution time.
- d. When output of internal 24V power for sensor is overloaded or short-circuited, protective circuit inside PC will work and automatically the voltage will drop, and accordingly, all inputs will not be accepted.  
In this case, release wirings from 24+ terminal.
- e. With the F2-40/60 type, contact error of input terminal block may occur. So when returning the terminal block remember to fasten it again.

## (7) Output Indication

If outputs fail to function, the following cases might be the cause:

- a. When very low current device is connected to the relay output or triac output PC models, the output device may be activated incorrectly because of the PC leakage current.
- b. The short circuit and large current load may cause the damage of the PC relay contact or damage of triac and transistor devices in the PC, thus, output failure.
- c. With the F2-40/60 type, contact error of output terminal block may occur. So when returning the terminal block remember to fasten it again.

It is possible that the errors are inter-linked, e.g. low power levels can affect many things. Thus consider all the possibilities of the diagnostic list. If the fault is not found even after following the suggested diagnostic checks, please refer to a Mitsubishi Service agent.

## 8-3 MAINTENANCE

### (1) Periodical Check

The PC contain maintenance-free components except for a lithium battery and sometimes output relays. The battery life is approx. 5 years (1 year warrantly) and relay life is subjected to the frequency of operations and current level (see the section of output handling).

The battery is replaced in the manner stated below (2).

The units installation should be checked to ensure that it has not been contaminated by dust or other contaminations, also that all terminal connections are still tight.

The unit should not be installed in a situation where the temperature is likely to rise to above 50°C (122°F).

### (2) Battery Renewal

- a. The program RAM memory and a part of software functions are backed by a non-chargeable lithium battery, of which discharge life is more than five years (1 year warrantly). When the battery voltage runs low, LED indicator on the base unit is illuminated. However, regardless of its condition, it is recommended that the battery be replaced every five years.
- b. To renew the battery, remove a panel cover of the base unit and renew the battery within 30 seconds, while an inside capacitor supports the memories. (In this way program will remain)

## SPECIFICATIONS

### General Specifications

Power supply	:	AC110~120/AC220~240V $\begin{matrix} +10\% \\ -15\% \end{matrix}$ 50/60Hz (-U, -ES Type) AC110~120/AC220~240V $\pm 10\%$ 50/60Hz (-UL Type) DC24V $\pm 8V$ (-D, -DS Type)
Consumption	:	F2-20: 20VA, F2-40: 25VA, F2-60: 40VA
Power-failure compensation	:	20msec.
Ambient temperature	:	0 ~ 55°C (32 ~ 131°F)
Storage temperature	:	-15 ~ 65°C (5 ~ 149°F)
Ambient humidity	:	85% (no condensation)
Vibration resistance	:	10 ~ 55Hz, 0.5mm (Max. 2G)
Insulation resistance	:	5M $\Omega$ (500VDC)
Insulation withstand voltage	:	1500VAC, 1 minute
Noise immunity	:	1000V, 1 $\mu$ sec.
Noise spike	:	NEMA-1CS2-230

### CPU Memory

Method	:	Stored program, Repeated arithmetic
Program language	:	Relay and logic symbols (ladder)
Instructions	:	Sequential instructions : 20 } Total 187 Step-ladder instructions : 2 } Functional instructions : 165 }
Program capacity	:	2000 steps (F2-40, 60M), 1000 steps (F2-20M)
Execution speed	:	Average 7 $\mu$ sec/step
Memory	:	C-MOS RAM standard, EP-ROM, EEP-ROM option
CPU	:	$\mu$ p 8031
Self-diagnostics	:	Program-check, watch-dog timer, battery voltage. power supply voltage, etc.
Battery	:	Lithium battery

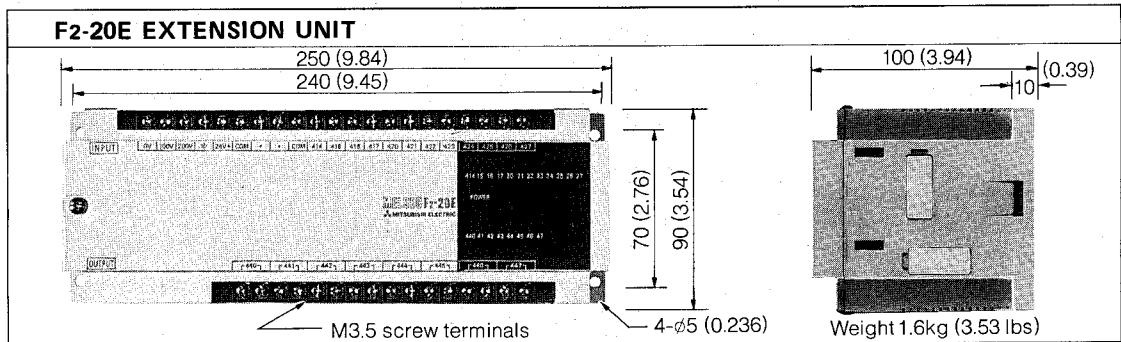
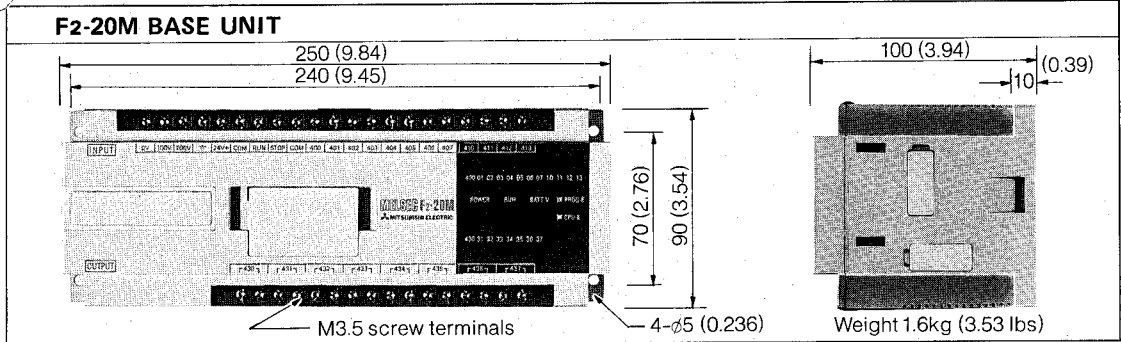


➤ **Functional Spec.**

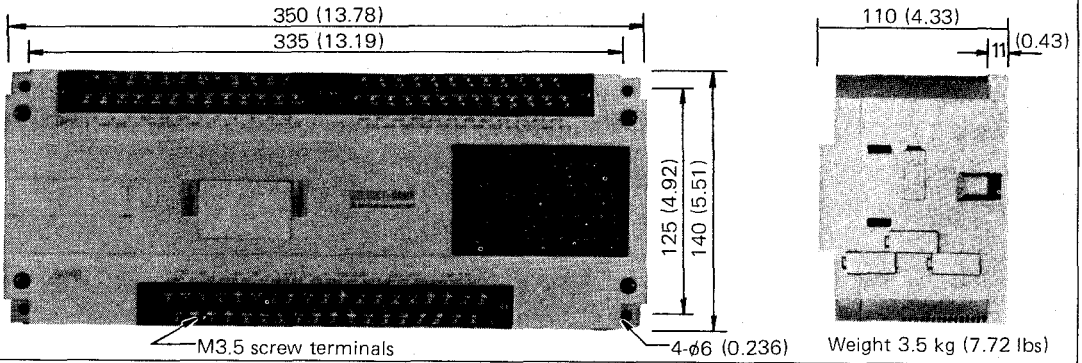
Number of inputs	:	F2-20	12 points (W/RUN, STOP inputs)
		F2-40	24 points (W/RUN, STOP inputs)
		F2-60	36 points (W/RUN, STOP inputs)
Number of output	:	F2-20	8 points
		F2-40	16 points (W/RUN contact)
		F2-60	24 points (W/RUN contact)
Input sensor power	:	F2-20	24VDC 0.18A total (All inputs turned OFF)
		F2-40	24VDC 0.25A total (ditto)
		F2-60	24VDC 0.43A total (ditto)
Timers	:	0.1 ~ 999 sec. timer	24 points (3 digit)
		0.01 ~ 99.9 sec. timer	8 points (3 digit)
Counters (backed by battery)	:	1 ~ 999	32 points up/down available one 6-digit High-Speed Counter
Data register	:	Timer and counter	32 + 32 points (BCD 3 digit)
		General use	64 points (BCD 3 digit)
Auxiliary relays			
No battery back-up	:		128 points (M100 ~ M277)
Backed by battery	:		64 points (M300 ~ M377)
State	:		168 points (S600 ~ S647, S800 ~ S877, S900 ~ S977)
JMP/EJP	:		64 points (700 ~ 777)
Data registers	:		64 points (D700 ~ D777)

**OUTLINE AND DIMENSIONS**

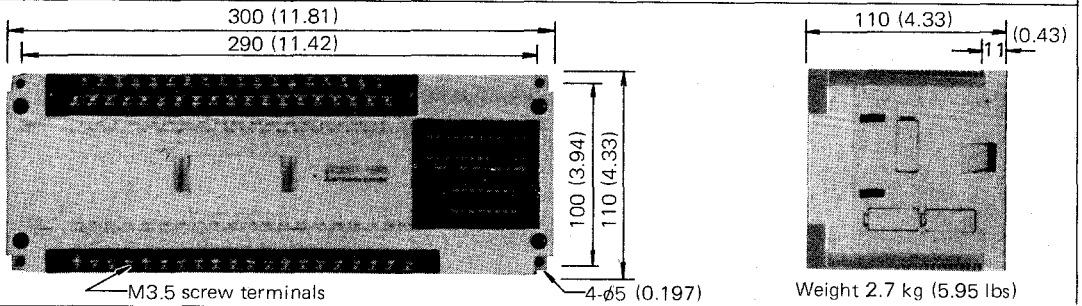
mm (inch)



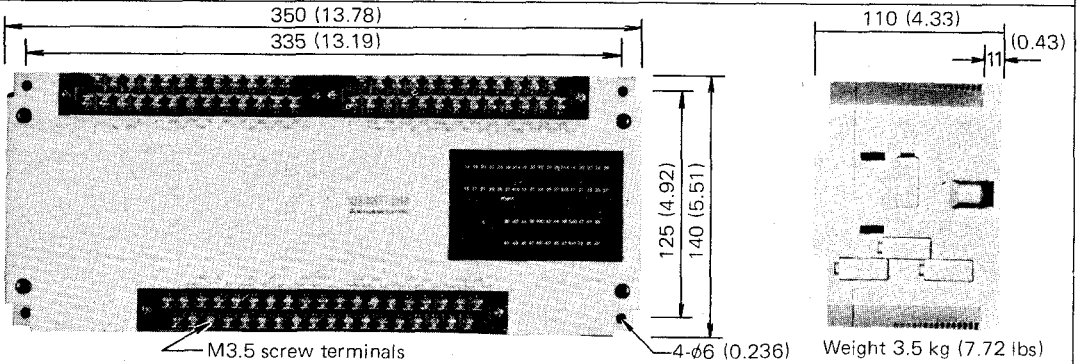
**F2-60M BASE UNIT**



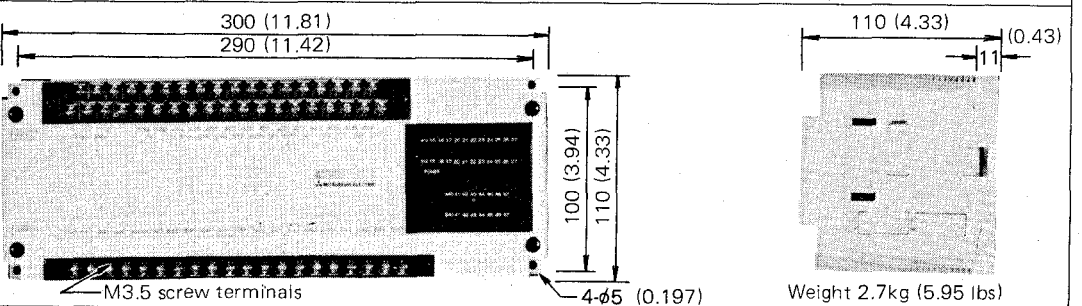
**F2-40M BASE UNIT**



**F2-60E EXTENSION UNIT**



**F2-40E EXTENSION UNIT**



 **MITSUBISHI ELECTRIC CORPORATION**  
HEAD OFFICE: MITSUBISHI DENKI BLDG., MARUNOUCHI, TOKYO 100. TELEX: J24532 CABLE: MELCO TOKYO

---

JY992D02801D (ROD)

The specifications and designs are  
subject to change without notice.