Panasonic®

PROGRAMMABLE CONTROLLER

FP-M
Hardware

FP-M Hardware
ACG-M0045-1 94.12

Matsushita Electric Works, Ltd.

Safety Precautions

Observe the following notices to ensure personal safety or to prevent accidents.
To ensure that you use this product correctly, read this User's Manual thoroughly before use.
Make sure that you fully understand the product and information on safe.
This manual uses two safety flags to indicate different levels of danger.

WARNING

If critical situations that could lead to user's death or serious injury is assumed by mishandling of the product.

-Always take precautions to ensure the overall safety of your system, so that the whole system remains safe in the event of failure of this product or other external factor.
-Do not use this product in areas with inflammable gas. It could lead to an explosion.
-Exposing this product to excessive heat or open flames could cause damage to the lithium battery or other electronic parts.

CAUTION

If critical situations that could lead to user's injury or only property damage is assumed by mishandling of the product.

-To prevent abnormal exothermic heat or smoke generation, use this product at the values less than the maximum of the characteristics and performance that are assure in these specifications.
-Do not dismantle or remodel the product. It could lead to abnormal exothermic heat or smoke generation.
-Do not touch the terminal while turning on electricity. It could lead to an electric shock..
-Use the external devices to function the emergency stop and interlock circuit.
-Connect the wires or connectors securely.
The loose connection might cause abnormal exothermic heat or smoke generation
-Do not allow foreign matters such as liquid, flammable materials, metals to go into the inside of the product. It might cause exothermic heat or smoke generation.
-Do not undertake construction (such as connection and disconnection) while the power supply is on.

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CHAPTER 1

FEATURES

1-1. Features and Functions

1. Features

- **Excellent performance in a compact body**

  Succeeding the advanced functions of the FP1 programmable controller, the FP-M is designed to fulfill machine building requirements. The advantages of compact size, expandability, and time-tested dependability are convincing reasons to consider the FP-M as an alternative to the control systems with which you are familiar.

- **Greatly increased program memory and high execution speed**

  FP-M surpasses the competition with a basic instruction execution speed of 1.6 µs/step and an ample program capacity of 2,720 and 5,000 steps. The board is driven by battery-backed RAM (EEPROM or EPROM program back-up option is also available). Types with an additional RS232C port and clock/calender (C types) are available to boost the range of applications possible.

- **Smart system expandability**

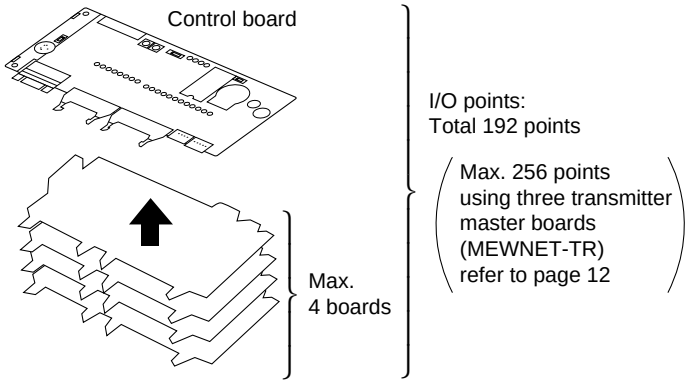
  Up to four expansion boards can be stacked under the control board, but no additional mounting space is needed. This module enables you to add discrete I/O points and intelligent functions such as analog control, high-speed counter control, and link functions easily.
  Available expansion boards are:
  Transistor I/O, Relay I/O, Analog I/O, A/D, D/A, High-speed Counter, I/O Link, and FP-M Transmitter Master Boards.

I/O Expansion Example

Control board	Total I/O points				
	0 expansion	1 expansion	2 expansions	3 expansions	4 expansions
*C20R (Relay output)	20 12 inputs/8 outputs	40 24 inputs/16 outputs	60 36 inputs/24 outputs	80 48 inputs/32 outputs	100 60 inputs/40 outputs
*C20T (Transistor output)	20 12 inputs/8 outputs	60 36 inputs/24 outputs	100 60 inputs/40 outputs	140 84 inputs/56 outputs	180 108 inputs/72 outputs
*C32T (Transistor output)	32 16 inputs/16 outputs	72 40 inputs/32 outputs	112 64 inputs/48 outputs	152 88 inputs/64 outputs	192 112 inputs/80 outputs

For details about expansion refer to page 12.

* In the table above, the twenty I/O point relay type expansion board is used for the C20R and the forty I/O point transistor type is used for the C20T and C32T.



- **Easy programming environment**

  NPST-GR changes your personal computer into a powerful programming support tool. This editing software is fully compatible with FP series programmable controllers.

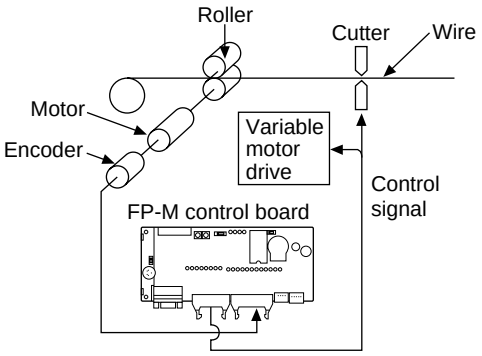
2. Functions

1) Advanced control functions

■ High-speed counter function

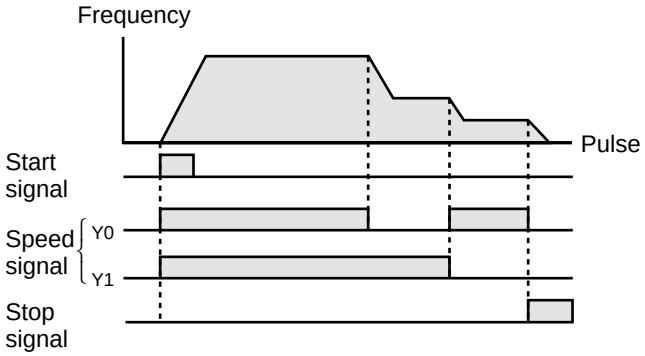
The built-in high-speed counter function supports four modes: two-phase input, UP, DOWN, and UP/DOWN. The FP-M can read the input regardless of the scan time.

Max. counting speed	1-phase: 10 k Hz (when duty cycle ratio 50 %) 2-phase: 10 k Hz
Counting range	–8,388,608 to 8,388,607



Application: Pattern output function

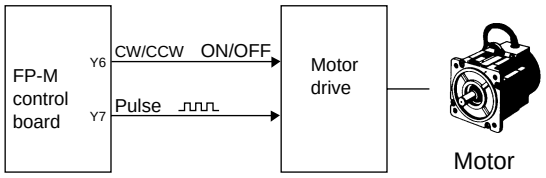
This function of the control board allows the setting of a maximum of eight output patterns with 15 level settings of the high-speed counter. Can also be applied to multi-stage speed control with use of an invertor.



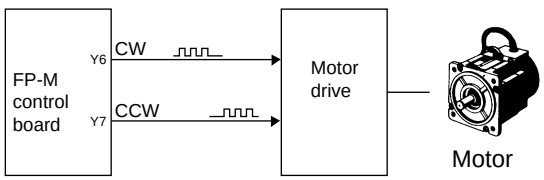
■ Pulse output function (transistor output type)

This function allows the output of a direct pulse (45 Hz to 4.9 k Hz) from the FP-M. In combination with a drive, a motor can be controlled. As direct pulse is possible, an additional positioning controller is not necessary. As the FP-M has two pulse outputs, it also supports motor drives with one input for forward driving and the other input for reverse driving. To prevent incorrect forward/reverse driving, create an interlock circuit outside of the FP-M.
In addition, since the built-in high-speed counter can internally take the pulse output, no external wiring for feedback control is required.

• **Wiring example for a drive with one pulse input and one direction input:**



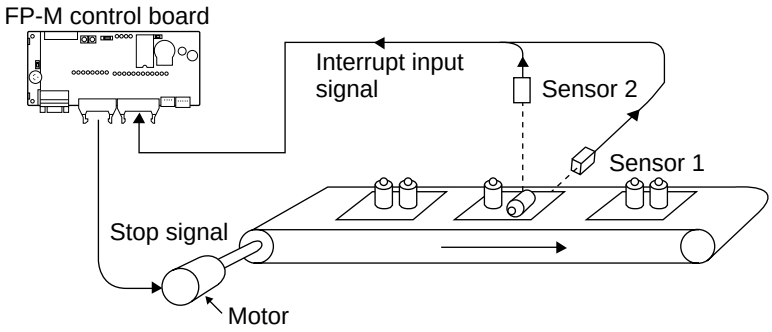
• **Wiring example for a drive with two pulse inputs:**



■ Interrupt input function

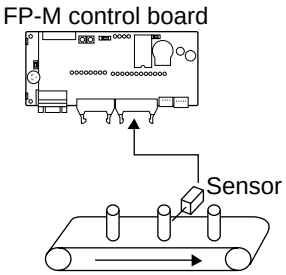
This function executes an interrupt program immediately after an external interrupt input (minimum pulse width of 0.2 ms) occurs, regardless of the input timing. It enables high-speed processing at a fixed timing and is not affected by scan time. Therefore it is useful when performing control which would be disrupted by variations in processing time due to such factors as timing synchronization.

• Timing control on a board inspection line
Immediately executes interrupt program when an edge detection signal comes in by interrupt input from sensor 1. Sensor 2 inspects the part, and if an abnormality is detected, the conveyor stops and the abnormality is reported.



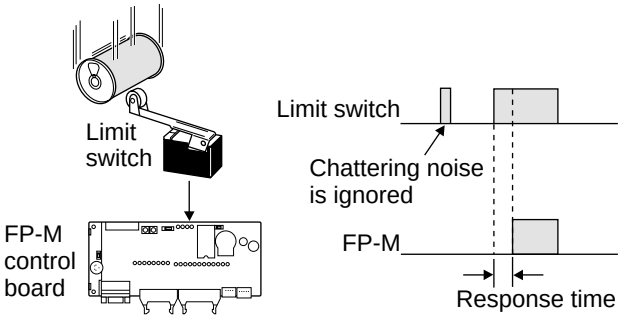
■ Pulse catch input function

This function catches input pulse signals down to a minimum width of 0.5 ms. It is effective for situations such as when the sensor detects the moving target at a high-speed.



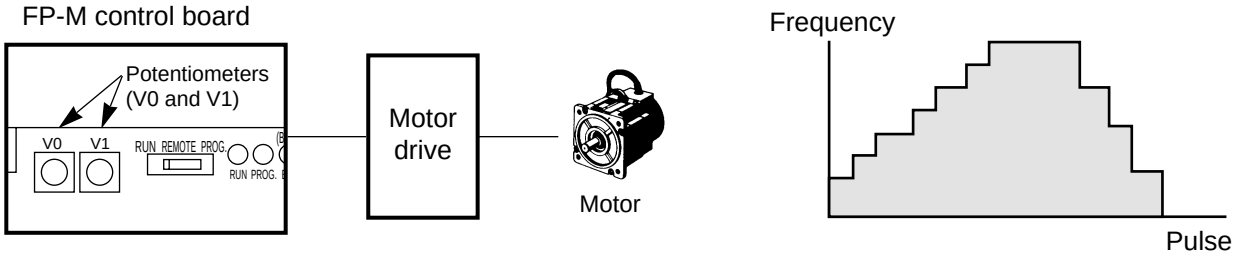
■ Adjustable input time filtering function

This function allows the input response time (input time constant) of the control board to be changed within a range of 1 to 128 ms in accordance with the input device connected. This prevents input errors due to such causes as limit switch chattering noise.



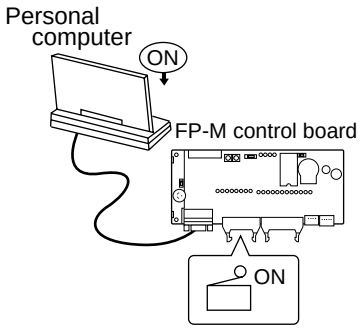
■ Manual dial-set register control function

This function makes it possible to change the values of special data registers DT9040 and DT9041 within a range of 0 to 255 using the potentiometers on the control board. Input settings involving analog-type numerical data such as analog timer and pulse output frequency changes can be performed.



■ Forced ON/OFF control function

This function allows the state of the input and output contacts to be forced ON or OFF with a programming tool (NPST-GR Software, etc.). By forcing the output contact ON or OFF, the connection on the output side can be checked. By forcing the input contact ON or OFF, the program can be checked.



■ Password protection function

This function forbids reading and writing of the program and system registers. It can be used for program protection and when secrecy is required.

■ Constant length scan setting function

The duration of one scan is fixed by setting it to units of 2.5 ms, eliminating variation in the scan time.

■ Clock/Calendar control function (C20RC, C20TC, and C32TC types)

By means of year, month, day, hour, minute, second, and day of the week settings, this function makes it possible to change temporal elements of control. It can be used for temporal control of such items as lighting, air conditioning, and equipment.

2) Network

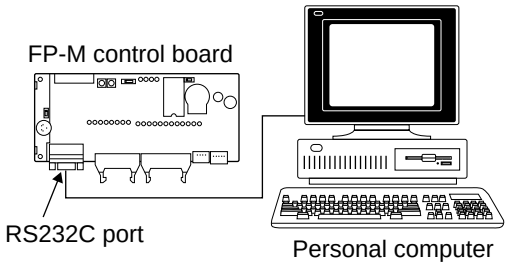
■ Computer link function (MEWTOCOL)

This function allows the reading and writing of FP-M contact information and data register content from a host computer. It can be used for such applications as data collection and the monitoring of operating conditions. The computer program is written in BASIC and C languages.

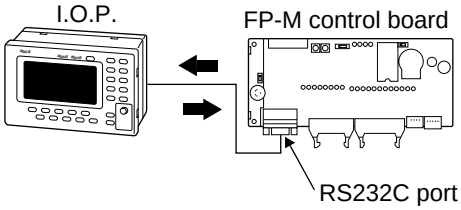
Communication between one computer and one FP-M control board

• Using RS232C port (C20RC, C20TC, and C32TC types)

The RS232C port can be used for direct connection to a personal computer.

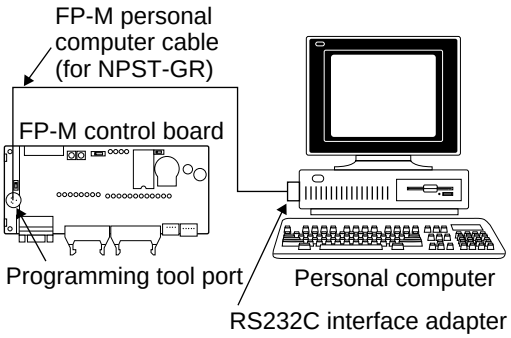


When connected to an I.O.P. using the computer link function, the I.O.P.'s data can be read as the FP-M's internal relay or data register. This can be used for such operations as production control.



• Using programming tool port (all series)

The programming tool port can also be used for direct connection to a personal computer.

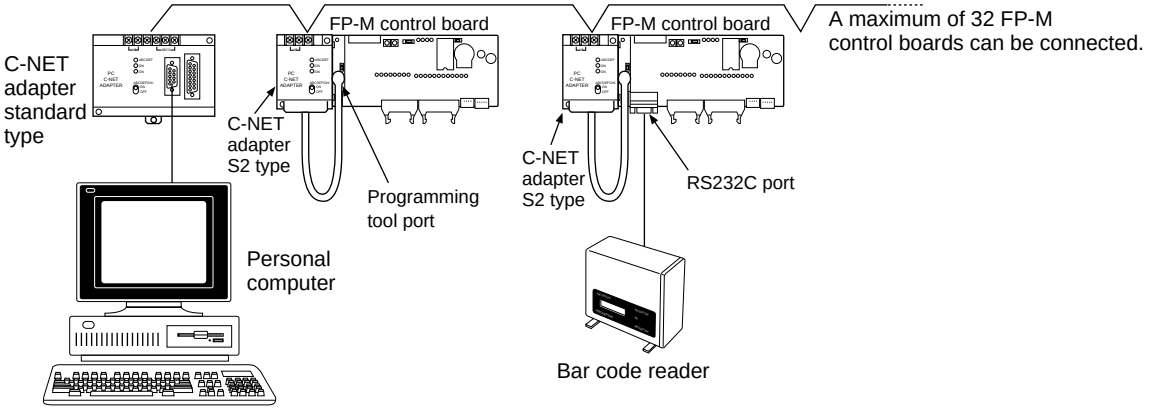


Note:

• When using a control board equipped with an RS232C port (C20RC, C20TC, and C32TC types), various combinations can be created by making a computer link with the programming tool port and connecting another device with the RS232C port.

Communication between one computer and 32 FP-M control boards

Using a C-NET adapter, a maximum of 32 FP-M control boards can be connected with one personal computer. If a bar code reader is connected via the RS232C port, this system can be used for the collection of various production control information.

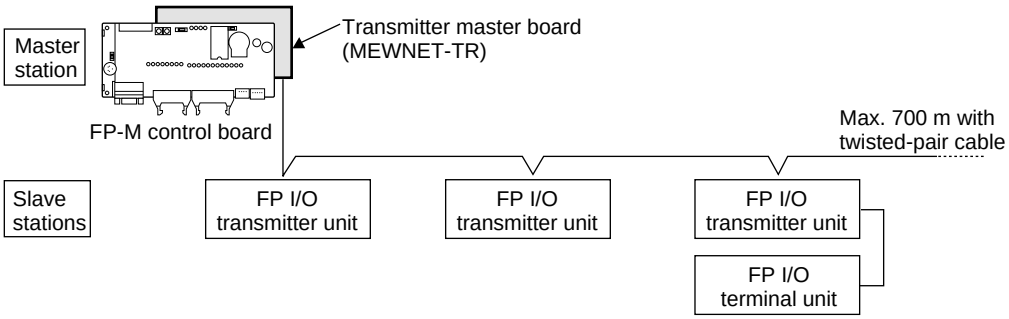


• Refer to C-NET LINK UNIT Technical Manual for details about computer link.

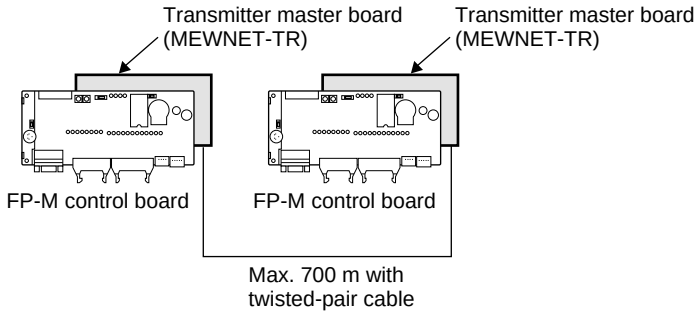
■ MEWNET-TR (distributed I/O) system

I/O information can be exchanged between the master and several slave stations at a remote site. A maximum of 32 inputs and 32 outputs can be controlled per master board.
This system supports a total communication distance of 700 m per port using a twisted-pair cable. Master to master communication is also available.

- **Master-slave communication**

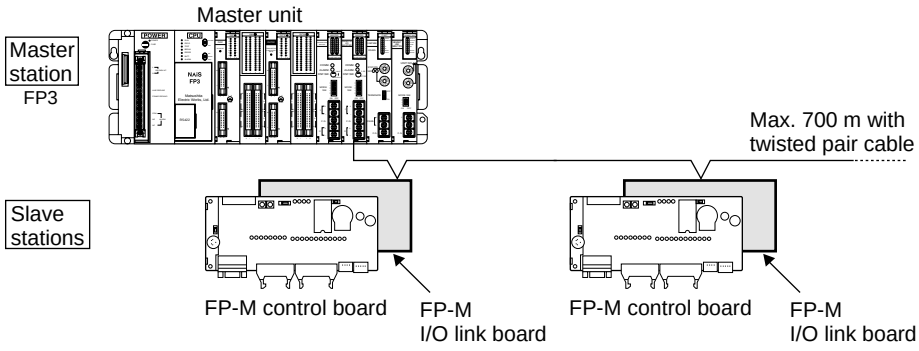


- **Master-master communication**



■ MEWNET-F (distributed I/O) system

Using a FP-M I/O link board, this function allows the exchange of I/O information with the master unit of the FP series programmable controller through a two-conductor cable.

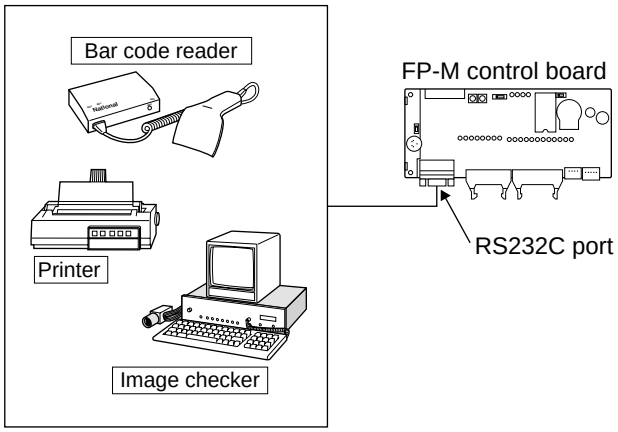


Note:

• Refer to “REMOTE I/O SYSTEM Technical Manual” for details about MEWNET-F (remote I/O) system.

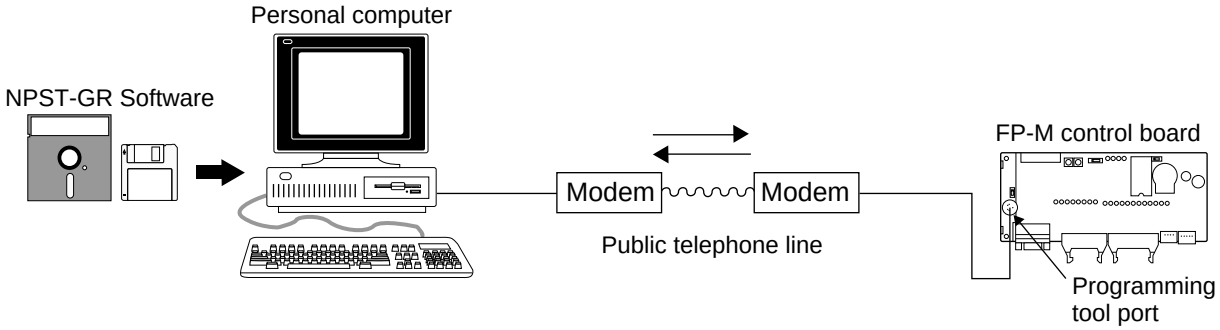
■ General communication using RS232C port (C20RC, C20TC, and C32TC types)

This function allows data input and output when connected to a device having an RS232C port. Data reading from a bar code reader, data output to a printer, and bilateral data exchange with the image checker are all possible.



■ Modem communication

Using a modem, the FP-M can perform long-distance communication with a personal computer to monitor and change data and also to change the program. Using C-NET adapters, you can control up to 32 programmable controllers from a personal computer. Through the RS232C port, the FP-M can initiate a call to a computer via modems for alarm purposes.



1-2. Product Types

1. Control Boards

Series		Description					
		Built-in memory	I/O point	Operating voltage	Input type	Output type	Part number
C20R	Standard type	RAM (2.7 k steps)	20 Input: 12 Output: 8	24 V DC	Sink/source	Relay, 2A 250 V AC	Board: AFC12212
							Case: AFC10212
	C20RC type*	RAM (5 k steps)	20 Input: 12 Output: 8	24 V DC	Sink/source	Relay, 2A 250 V AC	Board: AFC22212C
							Case: AFC20212C
C20T	Standard type	RAM (2.7 k steps)	20 Input: 12 Output: 8	24 V DC	Source	Transistor, 0.8 A (NPN open collector)	Board: AFC12242
							Case: AFC10242
					Sink	Transistor, 0.8 A (PNP open collector)	Board: AFC12252
							Case: AFC10252
	C20TC type*	RAM (5 k steps)	20 Input: 12 Output: 8	24 V DC	Source	Transistor, 0.8 A (NPN open collector)	Board: AFC22242C
							Case: AFC20242C
					Sink	Transistor, 0.8 A (PNP open collector)	Board: AFC22252C
							Case: AFC20252C
C32T	Standard type	RAM (2.7 k steps)	32 Input: 16 Output: 16	24 V DC	Source	Transistor, 0.8 A (NPN open collector)	Board: AFC12342
							Case: AFC10342
					Sink	Transistor, 0.8 A (PNP open collector)	Board: AFC12352
							Case: AFC10352
	C32TC type*	RAM (5 k steps)	32 Input: 16 Output: 16	24 V DC	Source	Transistor, 0.8 A (NPN open collector)	Board: AFC22342C
							Case: AFC20342C
					Sink	Transistor, 0.8 A (PNP open collector)	Board: AFC22352C
							Case: AFC20352C

Notes:

- * CPUs with a RS232C port and clock/calendar function (C20RC, C20TC and C32TC types).
- Board types include AFB88021 (4 spacers, 20 mm), APL9511 (power supply cable), AFB8505 (jumper cable) and 4 screws (20 mm × 2, 8 mm × 2).
- Case types include the control board, case for control board (C20R type for AFC18011, C20T type for AFC18012 and C32T type for AFC18013), AFB88032 (4 spacers, 8 mm), APL9511 (power supply cable), AFB8505 (jumper cable), 4 screws (20 mm × 2, 8 mm × 2), and AFB6804 (mounting plate).
- 12 V DC operating voltage type is also available.

2. Expansion Boards

Series	Description				
	I/O point	Operating voltage	Input type	Output type	Part number
E20R expansion I/O board	20 Input: 12 Output: 8	24 V DC	Sink/source	Relay	AFC13012
M1T-E expansion I/O board	40 Input: 24 Output: 16	24 V DC	Source	Transistor (NPN open collector)	AFB6342
			Sink	Transistor (PNP open collector)	AFB6342P
M1T-EI expansion input board	36 Input: 36	24 V DC	Source	———	AFB6392
M1T-EO expansion output board	32 Output: 32	24 V DC	———	Transistor (NPN open collector)	AFB6340

Note:

• Operating voltage 12 V DC type is also available.

3. Intelligent Boards

Type	Description	Operating voltage	Part number
Analog I/O board	Input: 4 channels/board Output: 1 channel/board Input/output range: 0 to 5 V, 0 to 10 V, 0 to 20 mA Resolution: 1/256 (8 bits)	24 V DC	AFB6480
A/D converter board	Input: 4 channels/board Analog input range: 0 to 5 V, 0 to 10 V, 0 to 20 mA Digital output range: K0 to K999	24 V DC	AFB6400
D/A converter board	Output: 2 channels/board Analog output range: 0 to 5 V, 0 to 10 V, 0 to 20 mA Digital input range: K0 to K999	24 V DC	AFB6410
High-speed counter board	Input: 2 channels Counting range: -8,388,608 to 8,388,607 Max. counting speed: 1-phase mode: 20 k Hz 2-phase mode: 5 k Hz	———	AFB6420

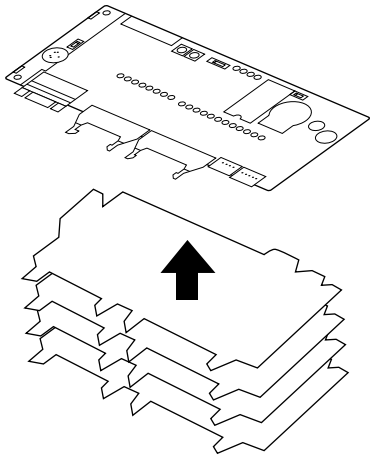
4. Link Boards and Adapters

Type	Description		Operating voltage	Part number
MEWNET-TR FP-M transmitter master board	FP-M transmitter master board enables the FP-M to exchange I/O information with slave stations at remote site using a twisted-pair cable. Connecting with another FP-M transmitter master board or with an FP3 transmitter master unit, you can exchange I/O information with another FP-M at remote site. Communication medium (RS485 port): twisted-pair cable up to 32 inputs and 32 outputs can be controlled per board.		24 V DC	AFC1752
FP I/O transmitter unit	Input type	4 points	24 V DC	AFP87525
		8 points		AFP87521
		16 points		AFP87522
	Output type (Transistor, 0.5 A, NPN open collector)	4 points	24 V DC	AFP87527
		8 points		AFP87523
		16 points		AFP87524
FP I/O terminal unit (with an expansion cable APL2510)	Input type	8 points	24 V DC	AFP87425
		16 points		AFP87426
	Output type (Transistor, 0.5 A, NPN open collector)	8 points	24 V DC	AFP87427
		16 points		AFP87428
MEWNET-F FP-M I/O link board	The FP-M I/O link board is the interface board for exchanging I/O information between an FP3/FP5 and an FP-M. When the FP-M is connected to the MEWNET-F system (FP3/FP5) via the FP-M I/O link board, you can exchange I/O information using a 2-conductor cable.		24 V DC	AFC1732
C-NET adapter standard type	RS485 ↔ RS422/RS232C signal converter Used for communication between the programmable controller and your computer. Communication medium (RS485 port): 2-conductor cable or twisted pair cable		24 V DC	AFP8532
			100 V to 240 V AC	AFP8536
C-NET adapter S2 type (for FP-M control board only)	RS485 ↔ RS232C signal converter for programming tool port of FP-M control board. Used for communication between the C-NET adapter and FP-M control board.		———	AFP15402

1-3. Expansion and Configurations

1. Expansion of FP-Ms

- A total of 4 boards (expansion boards, intelligent boards, and link boards) can be stacked under the control board.
- Total number of I/O points:
  C20R series: Max. 100 points*, C20T series: Max. 180 points, C32T series: Max. 192 points**
  * Expansion board of the relay type is used.
  ** Max. 256 points using 3 transmitter master boards (MEWNET-TR).



	Total number of I/O points		
	C20R series	C20T series	C32T series
	Max. 100 points	Max. 180 points	Max. 192 points
Control board	20 points	20 points	32 points
Max. 4 boards (Expansion boards, intelligent boards, and link boards)	80 points	160 points	160 points

Note:

- There are no restrictions on the order of expansion of boards (relay and transistor output type), intelligent boards, and link boards.

2. Restriction of Expansion

Be sure to check that the boards are added according to the following restrictions:

1) Expansion boards

■ Expansion I/O board (E20R)
- Number of expandable boards: 4 boards
- Total number of I/O points:
  - C20R and C20T series: Max. 100 points
  - C32T series: Max. 112 points

■ Expansion I/O board (M1T-E series)
- Number of expandable boards: 4 boards
- Total number of I/O points:
  - C20R and C20T series: Max. 180 points
  - C32T series: Max. 192 points

■ Expansion Input board (M1T-EI)
- Number of expandable boards: 2 boards
- Total number of I/O points:
  - C20R and C20T series: Max. 92 points
  - C32T series: Max. 104 points

■ Expansion Output board (M1T-EO series)
- Number of expandable boards: 2 boards
- Total number of I/O points:
  - C20R and C20T series: Max. 84 points
  - C32T series: Max. 96 points

2) Intelligent boards

■ Analog I/O board (M1T-A), A/D converter board (M1T-AD), and D/A converter board (M1T-DA)
- Number of expandable boards: 4 boards

■ High-speed counter board (M1T-HSC)
- Number of expandable boards: 1 board

3) Link boards

■ FP-M transmitter master board
- Number of expandable boards: 3 boards

■ FP-M I/O link board
- Number of expandable boards: 1 board

Note:

- Refer to page 13, “3. Combination of Boards” for details about combination of control boards and expansion boards.

3. Combination of Boards

1) Combination of relay output type control and expansion boards

Total number of boards	Requested I/O point			Number of boards	
	Total	Input	Output	Control board C20R series (I: 12, O: 8)	Expansion board E20R series (I: 12, O: 8)
1	20	12	8	1	
2	40	24	16	1	1
3	60	36	24	1	2
4	80	48	32	1	3
5	100	60	40	1	4

2) Combination of transistor output type control and expansion boards

Total number of boards	Requested I/O point			Number of boards				
				Control board		Expansion board		
	Total	Input	Output	C20T series (I: 12, O: 8)	C32T series (I: 16, O: 16)	M1T-E (I: 24, O: 16)	M1T-EI (I: 36)	M1T-EO (O: 32)
1	20	12	8	1				
	32	16	16		1			
2	52	12	40	1				1
	56	48	8	1			1	
	60	36	24	1		1		
	64	16	48		1			1
	68	52	16		1		1	
	72	40	32		1	1		
3	84	12	72	1				2
	88	48	40	1			1	1
	92	36	56	1		1		1
		84	8	1			2	
	96	72	24	1		1	1	
		16	80		1			2
	100	60	40	1		2		
		52	48		1		1	1
	104	40	64		1	1		1
		88	16		1		2	
	108	76	32		1	1	1	
	112	64	48		1	2		
4	120	48	72	1			1	2
	124	84	40	1			2	1
	132	60	72	1		2		1
		52	80		1		1	2
	136	96	40	1		2	1	
		40	96		1	1		2
		88	48		1		2	1
	140	84	56	1		3		
	144	64	80		1	2		1
	148	100	48		1	2	1	
	152	88	64		1	3		
5	156	84	72	1			2	2
	168	96	72	1		2	1	1
		88	80		1		2	2
	180	108	72	1		4		
		100	80		1	2	1	1
	192	112	80		1	4		

Notes:

- You can combine both relay output type and transistor output type control boards and expansion boards.
- Intelligent boards can also be combined with the control board.

1-4. Programming Tools for FP-Ms

1. Programming Tools

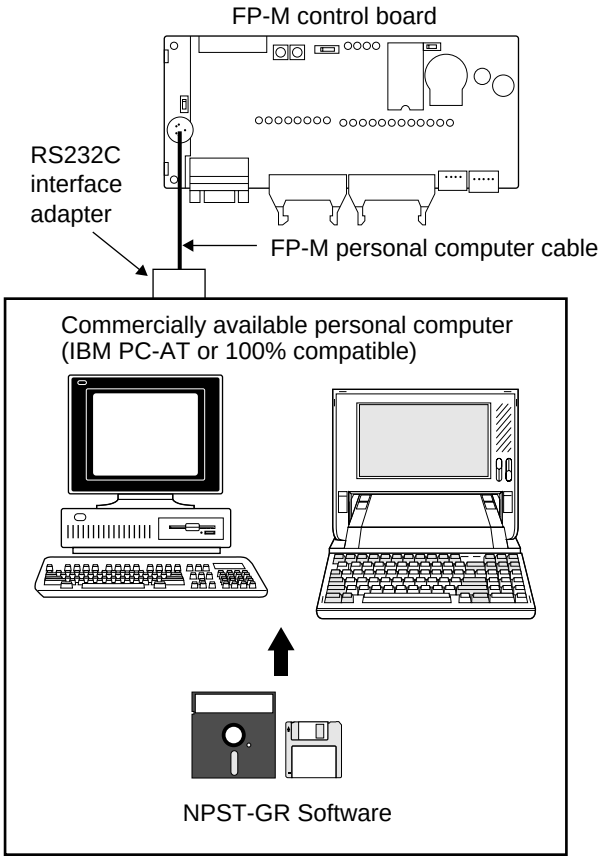
Program editing can be done with a commercially available personal computer and FP Programmer Ⅱ.

1) NPST-GR Software

Using the NPST-GR program editing software, programs can be easily created with any personal computer.

Necessary tools

- Computer: Commercially available personal computer (IBM PC-AT or 100% compatible)
  System required:
  - Main memory: 550 KB or more free
  - EMS: 800 KB or more free
  - Hard disk space: 2 MB or more
  - Operating system MS-DOS Ver. 3.30 or higher
  - Video mode (display mode): EGA or VGA
- NPST-GR Software Ver. 3: AFP266538
- FP-M personal computer cable:
  3 m/9.843 ft.: AFC8513



Notes:

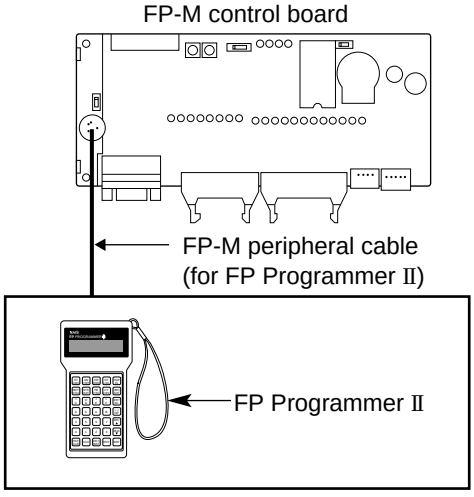
- The .EXE files in NPST-GR Software are compressed in the system disks. When installing NPST-GR, you will have to expand them.
- When using NPST-GR Software Ver. 2, refer to page 220, “1. Differences Between NPST-GR Ver. 2.4 and Ver. 3.1.”
- Refer to page 106, “5-7. How to Program ROM” and “NPST-GR Manual”, for details about writing programs using NPST-GR Software.
- Refer to page 239, “8-14. Product Types”, for details about FP-M personal computer cable and RS232C interface adapter.

2) FP Programmer Ⅱ

With the hand-held FP Programmer Ⅱ, such operations as writing, reading, and retrieval of programs can be performed.

Necessary tools

- FP Programmer Ⅱ: AFP1114
- FP-M peripheral cable (for FP Programmer Ⅱ)
  1 m/3.281 ft.: AFC8521
  3 m/9.843 ft.: AFC8523



Notes:

- Refer to page 106, “5-7. How to Program ROM” and “FP PROGRAMMER Ⅱ Operation Manual”, for details about writing programs using the FP Programmer Ⅱ.
- Refer to page 239, “8-14. Product Types”, for details about FP-M peripheral cable (for FP Programmer Ⅱ).

2. Tools for Making a Programmed ROM

- Using an FP ROM writer or a commercially available ROM programmer, the contents of the FP-M control board's internal RAM can be written to ROM (memory).
- The following types of ROM (memory) are available:
  - Memory (EPROM): AFP5202
    Memory for storing programs. Writing is done with an FP ROM writer or a commercially available ROM programmer.
  - Master memory (EEPROM): AFP5207
    Memory for copying programs. Writing is done with attaching a master memory on the user memory socket.

1) Writing a program to memory (EPROM) with an FP ROM writer

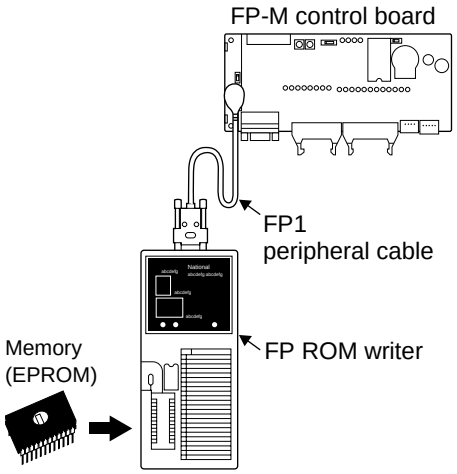
- The content of the FP-M control board's internal RAM is written directly to the memory (EPROM).

Necessary tools

- FP ROM writer: AFP5651
- Memory (EPROM): AFP5202
- FP1 peripheral cable
  0.5 m/1.640 ft.: AFP15205
  3 m/9.843 ft.: AFP1523

Note:

> • Refer to page 106, "5-7. How to Program ROM" and "FP ROM WRITER Technical Manual", for details about programming ROM.



2) Writing a program to memory (EPROM) with NPST-GR Software and a commercially available ROM programmer

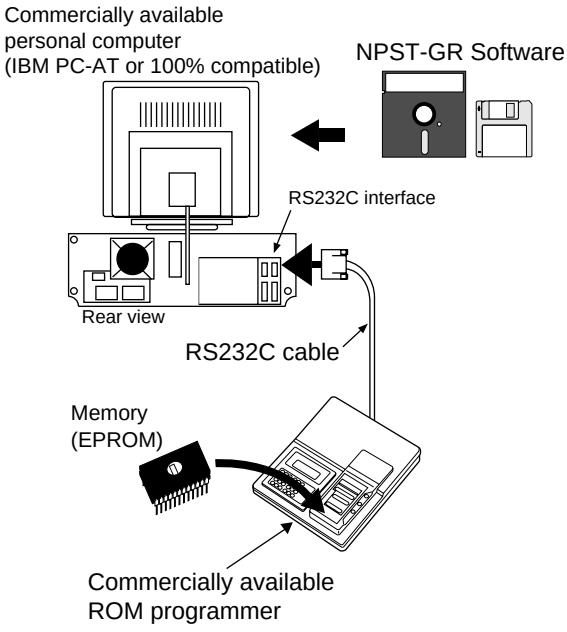
[Program with NPST-GR Software → Commercially available ROM programmer's internal memory → Memory (EPROM)]

Necessary tools

- Computer: Commercially available personal computer (IBM PC-AT or 100 % compatible machine)
  System required:
  - Main memory: 550 KB or more free
  - EMS: 800 KB or more free
  - Hard disk space: 2 MB or more
  - Operating system: MS-DOS Ver. 3.30 or higher
  - Video mode (display mode): EGA or VGA
- NPST-GR Software Ver. 3: AFP266538
- RS232C cable: Needs to be made to match the specifications of the commercially available ROM programmer.
- Commercially available ROM programmer:
  We recommend Aval Data Corporation's PECKER 11.
- Memory (EPROM): AFP5202

Note:

> • The .EXE files of NPST-GR Software are compressed in the system disks. When installing NPST-GR, you will have to expand them.

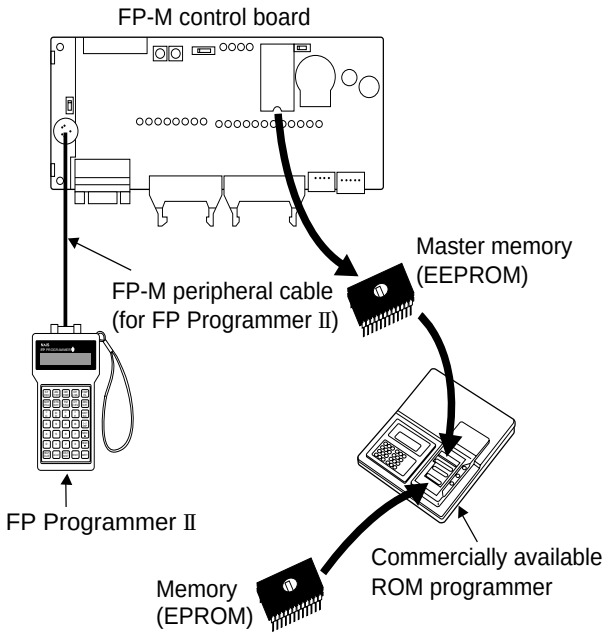


3) Writing a program to the memory (EPROM) via the master memory (EEPROM) with a commercially available ROM programmer

[Program in FP-M control board's internal RAM → Master memory (EEPROM) → Commercially available ROM programmer's internal memory → Memory (EPROM)]

Necessary tools

- FP Programmer Ⅱ: AFP1114
- FP-M peripheral cable (for FP Programmer Ⅱ)
  1 m/3.281 ft.: AFC8521
  3 m/9.843 ft.: AFC8523
- Commercially available ROM programmer:
  We recommend Aval Data Corporation's PECKER 11.
- Master memory (EEPROM): AFP5207
- Memory (EPROM): AFP5202



Note:

• Refer to page 106, "5-7. How to Program ROM" and "FP PROGRAMMER Ⅱ Operation Manual", for details about programming ROM.

CHAPTER 2

SPECIFICATIONS AND PARTS TERMINOLOGY

2-1. Specifications of Control Board and Expansion Board

1. General

Item	Description
Ambient temperature	0˚C to +55˚C (32˚F to +131˚F)
Ambient humidity	30 % to 85 % RH (non-condensing)
Storage temperature	–20˚C to +70˚C (–4˚F to +158˚F)
Storage humidity	30 % to 85 % RH (non-condensing)
Breakdown voltage (See note.)	Transistor output type: 500 V rms for 1 min Between DC terminal and frame ground terminal Relay output type: 1,500 V rms for 1 min Between output terminal and frame ground terminal
Insulation resistance (See note.)	Min. 100 MΩ (measured with a 500 V DC megger) Between DC terminal and frame ground terminal
Vibration resistance	10 Hz to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm (0.030 in.), 10 min on 3 axes
Shock resistance	Shock of 98 m/s^2 or more, 4 times on 3 axes
Noise immunity	1,000 Vp-p with pulse widths 50 ns and 1 μs (based on in-house measurements)
Operating environment	Must be free from corrosive gases and excessive dust.
Rated operating voltage	24 V DC
Operating voltage range	Controller power supply: 21.6 to 26.4 V DC Input/output power supply: 20.4 to 26.4 V DC (C20T, C32T series) 22.8 to 26.4 V DC (C20R series)
Current consumption	Controller power supply: 0.2 A or less Input/output power supply: Approx. 5 mA per an input point Approx. 3 mA per an output point (except load current)

2. Performance

Item		Description
Programming method		Relay symbol
Control method		Cyclic operation
Program memory		Built in RAM (lithium battery backup) EEPROM (master memory)/EPROM (memory) [optional items]
Program capacity		2.7 k type: 2,720 steps 5 k type: 5,000 steps
Operation speed		1.6 μs/step, basic instruction
Kinds of instruction	Basic	81
	High-level	111
External input (X)		208 points (See note.)
External output (Y)		208 points (See note.)

Notes:

- No capacitor connected between DC terminal and frame ground terminal when the breakdown voltage and insulation resistance test is performed.
- The actual number of points that can be used is the total number of I/O points of the control board and the expansion board.

Item		Description
Internal relay (R)		1,008 points
Special internal relay (R)		64 points
Timer/counter (T/C)		144 points
Auxiliary timer		Unlimited number of points (0.01 s to 327.67 s)
Data register (DT)		2.7 k type: 1,660 words 5 k type: 6,144 words
Special data register (DT)		112 words (For control board: 70 words, for intelligent boards: 42 words)
Index register (IX, IY)		2 words
MCR points		32 points
Number of labels (JMP,LOOP)		64 points
Differential points (DF or DF/)		Unlimited number of points
Number of step ladders		128 stages
Number of subroutines		16 subroutines
Number of interrupt programs		9 programs
Advanced control functions	High-speed counter (1 channel)	Input: Count input (X0, X1)/reset input (X2) Counting input mode: up mode, down mode, up/down mode, 2-phase mode Counting range: –8,388,608 to 8,388,607 Max. counting speed: up/down mode 10 k Hz, 2-phase mode 10 k Hz Min. input pulse width: 1 phase 50 μs • 2 phases 50 μs
	Manual dial-set register	2 potentiometers
	Pulse catch input	Total 8 points (X0 to X7)
	Interrupt input	
	Periodical interrupt	10 ms to 30 s interval
	RS232C port (See note.)	Communication speed: 300/600/1,200/2,400/4,800/9,600/19,200 bps Communication distance per port: 15 m/49.213 ft. Connector: D-SUB 9 pins connector
	Clock/calendar (See note.)	Clock/calendar function available
	I/O link	64 I/O points (32 inputs and 32 outputs) or 32 I/O points (16 inputs and 16 outputs)
	Pulse output (See note.)	2 points (Y6 and Y7) Pulse output frequency range: 360 to 5,000 Hz/180 to 5,000 Hz/90 to 5,000 Hz/45 to 5,000 Hz
	Constant scan	2.5 ms × set value (160 ms or less)
Adjustable input time filtering		1 to 128 ms
Self-diagnosis function		Watchdog timer, battery detection, program check, and others
Memory backup (at 25˚C)		Approx. 27,000 h (C types: C20RC, C20TC and C32TC) Approx. 53,000 h (except C types: C20R, C20T and C32T)

Notes:

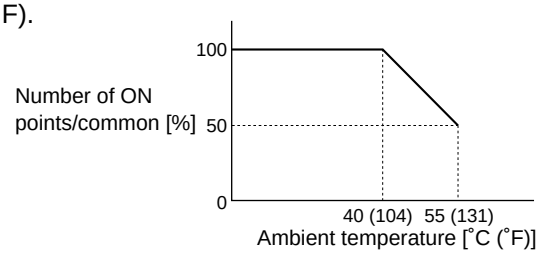
- The RS232C port and clock/calendar functions are available for the C types (C20RC, C20TC and C32TC).
- The pulse output function is available for the transistor output type.
- The two pulse outputs, Y6 and Y7 cannot be used at the same time.

3. Input

Item	Description
Rated input voltage	24 V DC
Operating voltage range	20.4 V to 26.4 V DC
ON voltage/current	19.2 V or less/3 mA or less (19.2 V or less/3.6 mA: C32T series only)
OFF voltage/current	2.4 V or more/1 mA or more
Input impedance	Control board: Approx. 4.8 kΩ Expansion board: Approx. 4.4 kΩ
Response time ON ↔ OFF	2 ms or less (at normal input) (See note.) 50 μs or less (in setting high-speed counter) 200 μs or less (in setting interrupt input) 500 μs or less (in setting pulse catch)
Operating mode indicator	LED
Insulation method	Optical coupler

Notes:

- Input response time can be changed using the input time filtering function to 1, 2, 4, 8, 16, 32, 64, or 128 ms in unit of 8 inputs. However, for expansion boards, the input response time is fixed at 2 ms (or less).
- The number of ON points must be decreased when the ambient temperature is high (between 40 ˚C/104 ˚F and 55 ˚C/131 ˚F).



4. Output

1) Relay output type

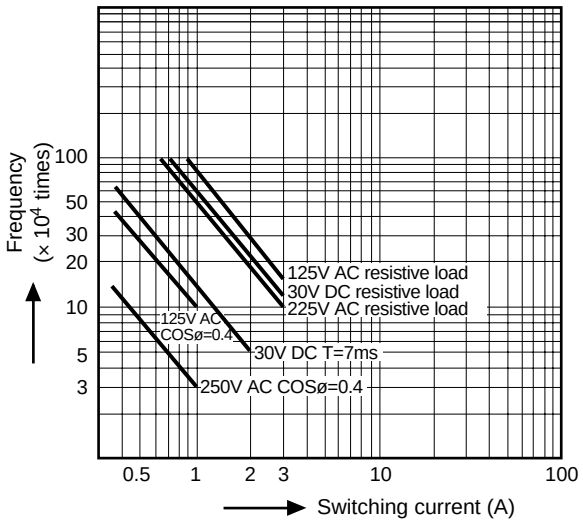
Item	Description
Rated operating voltage	24 V DC
Operating voltage range	22.8 V to 26.4 V DC
Output type	Normally open (1 Form A), 2 points/common
Rated control capacity	2 A 250 V AC, 2 A 30 V DC (resistive) (See note 1.)
Response time OFF → ON	8 ms or less
ON → OFF	10 ms or less
Mechanical life time	2×10^7 operations or more
Electrical life time	10^5 operations or more
Surge absorber	None
Operating mode indicator	LED

2) Transistor output type (PNP and NPN open collector)

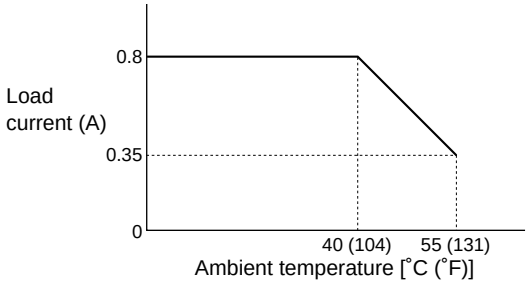
Item	Description
Insulation method	Optical coupler
Rated load voltage	24 V DC
Operating load voltage range	20.4 V to 26.4 V DC
Max. load current	0.8 A/point (at 24 V DC) (See note 2.)
OFF state leakage current	100 μA or less
ON state voltage drop	1.5 V or less
Response time OFF → ON	1 ms or less
ON → OFF	1 ms or less (100 μs or less: Y6 and Y7)
Surge absorber	Zener diode
Operating mode indicator	LED

Notes:

1. Life characteristics of built-in relay (PA relay)



2. The maximum load current is kept within the following ranges when the ambient temperature is high.



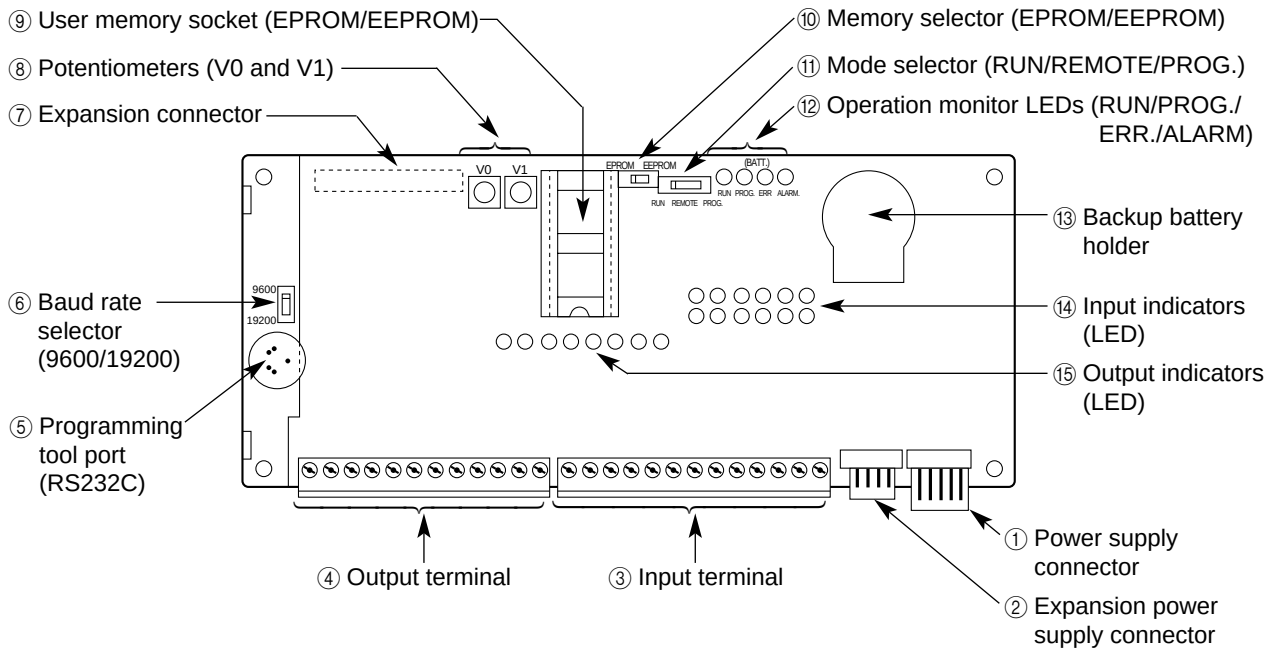
3. Make the current for one common no more than the following values.
   8 points/common circuit: 3 A/common
   16 points/common circuit: 5 A/common

2-2. Parts Terminology

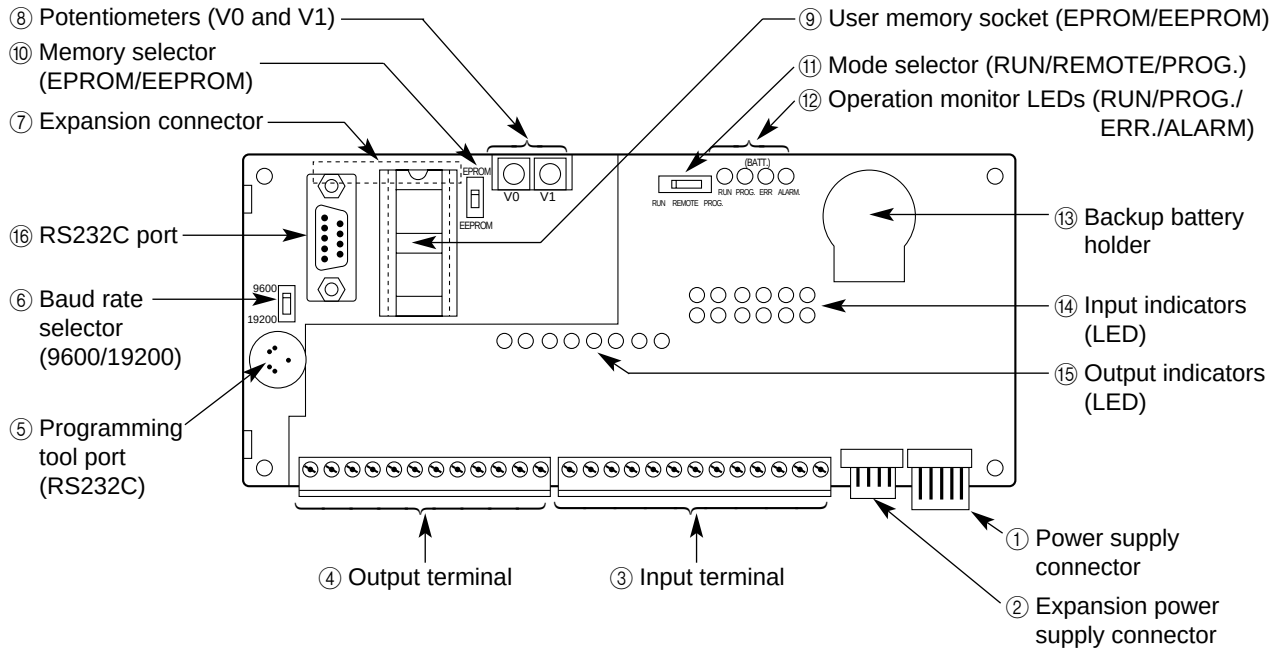
1. Control Boards

1) C20R and C20RC types

■ C20R type



■ C20RC type



① **Power supply connector:** Power supply connector for 24 V DC

② **Expansion power supply connector:** Supplies the power (24 V DC) to the expansion board using expansion power supply cable.

③ **Input terminal:** Connect the input field devices (e.g., limit switch).
C20R and C20RC types: 12 input points
Use a solderless terminal for wiring.

④ **Output terminal:** Connect the output field devices (e.g., solenoid).
C20R and C20RC types: 8 output points
Use a solderless terminal for wiring.

⑤ **Programming tool port (RS232C):** Use this port for the programming tools (e.g., FP Programmer Ⅱ or personal computer).

⑥ **Baud rate selector (9600/19200):** Selects the baud rate for communication with a programming tool.
Set the selector according to the connected programming tools.
- FP Programmer (AFP1112): 19,200 bps
- FP Programmer (AFP1112A): 19,200 bps or 9,600 bps
- FP Programmer Ⅱ (AFP1114): 19,200 bps or 9,600 bps
- Personal computer: 9,600 bps

⑦ **Expansion connector:** Connects the expansion boards.

⑧ **Potentiometers (V0 and V1):** Set with a screwdriver, the potentiometers allow manually adjusting the controller. This feature makes input an analog value ranging from K0 to K255. Each set value is stored respectively in manual dial-set registers (V0: DT9040 and V1: DT9041).

⑨ **User memory socket (EPROM/EEPROM):** Use this socket to install the memory (EPROM) and master memory (EEPROM).

⑩ **Memory selector (EPROM/EEPROM):** Select the used memory type.
EPROM: memory
EEPROM: master memory

⑪ **Mode selector (RUN/REMOTE/PROG.):**

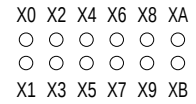
RUN mode:	The control board executes programs.
REMOTE mode:	The RUN or PROG. mode can be changed using programming tools.
PROG. mode:	Used for editing program.

⑫ **Operation monitor LEDs (RUN/PROG./ERR./ALARM):**

RUN LED ON:	Turns on when program is executed.
Flashes:	Turns on when forced ON/OFF operation is executed in RUN mode.
PROG. LED ON:	Turns on when the control board halts program execution.
ERR. LED ON:	Turns on when a self-diagnostic error occurs.
ALARM LED ON:	Turns on when an abnormality is detected or watchdog timer error occurs.

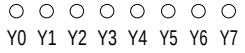
⑬ **Backup battery holder:** Holder for the backup battery. Refer to page 125, “6-4. Maintenance”, for details about backup battery replacment.

⑭ **Input indicators (LED):** Indicates the input ON/OFF states.



[X0, X4, and X8 LEDs: green
Other LEDs: red]

⑮ **Output indicators (LED):** Indicates the output ON/OFF states.

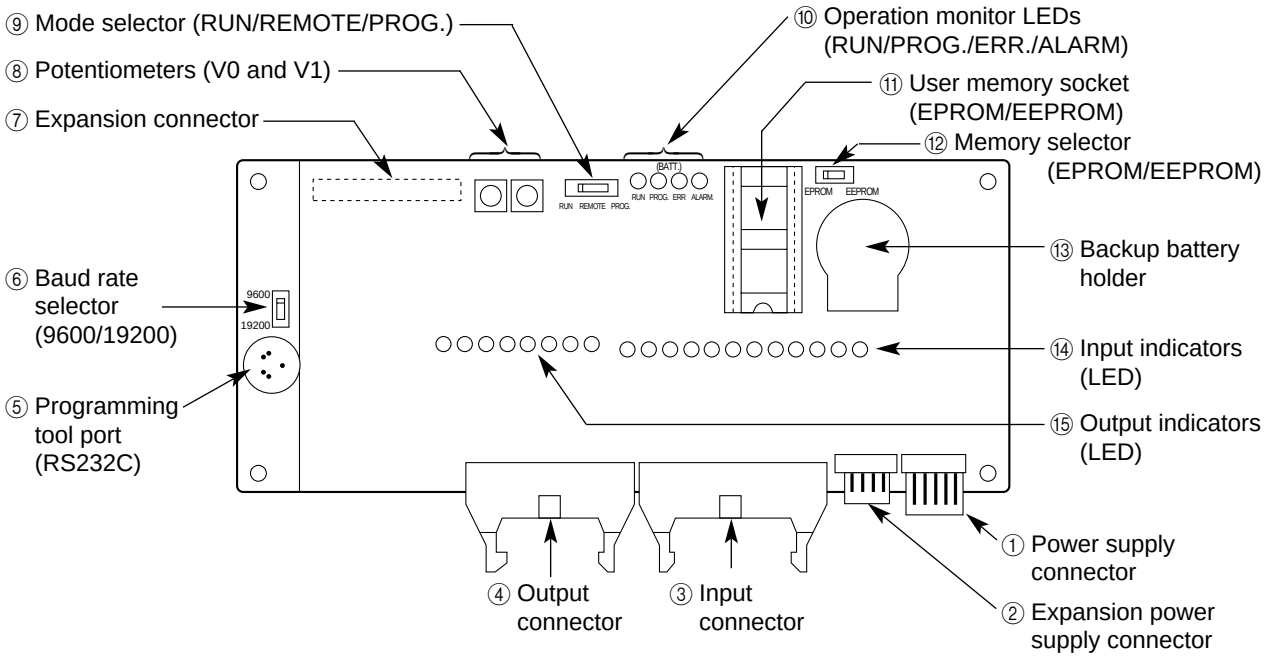


[Y0 and Y4 LEDs: green
Other LEDs: red]

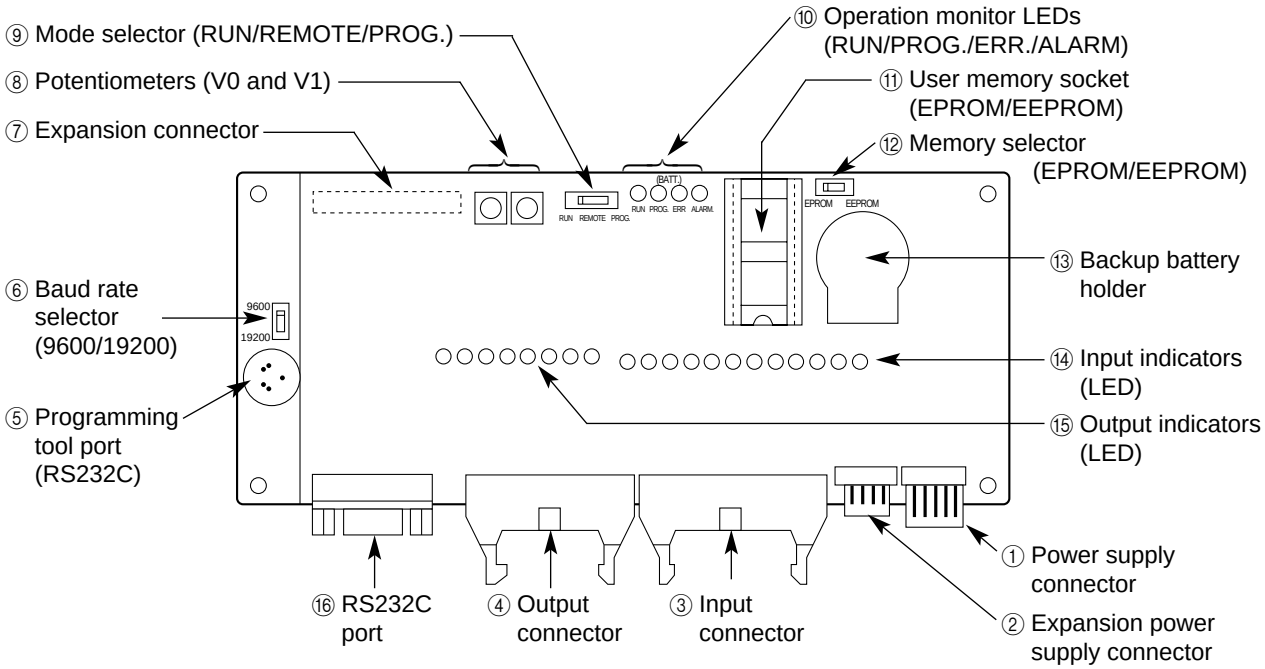
⑯ **RS232C port (C20RC type only):** Use this port to connect peripheral devices with RS232C port (e.g., I.O.P. and bar-code reader).

2) C20T and C20TC types

■ C20T type



■ C20TC type



① **Power supply connector:** Power supply connector for 24 V DC

② **Expansion power supply connector:** Supplies the power (24 V DC) to the expansion board using expansion power supply cable.

③ **Input connector (20-pin):** Connects the input field devices (e.g., limit switch).
MIL connector is used. Use a terminal, wire-press socket and flat cable connector for wiring.
C20T and C20TC types: 12 input points

④ **Output connector (16-pin):** Connects the output field devices (e.g., solenoid).
MIL connector is used. Use a terminal, wire-press socket and flat cable connector for wiring.
C20T and C20TC types: 8 output points

⑤ **Programming tool port (RS232C):** Use this port for the programming tools (e.g., FP Programmer Ⅱ or personal computer).

⑥ **Baud rate selector (9600/19200):** Selects the baud rate for communication with a programming tool.
Set the selector according to the connected programming tools.
- FP Programmer (AFP1112): 19,200 bps
- FP Programmer (AFP1112A): 19,200 bps or 9,600 bps
- FP Programmer Ⅱ (AFP1114): 19,200 bps or 9,600 bps
- Personal computer: 9,600 bps

⑦ **Expansion connector:** Connects the expansion boards.

⑧ **Potentiometers (V0 and V1):** Set with a screwdriver, the potentiometers allow manually adjusting the controller. This feature makes input an analog value ranging from K0 to K255. Each set value is stored respectively in manual dial-set registers (V0: DT9040 and V1: DT9041).

⑨ **Mode selector (RUN/REMOTE/PROG.):**
RUN mode: The control board executes programs.
REMOTE mode: The RUN or PROG. mode can be changed using programming tools.
PROG. mode: Used for editing program.

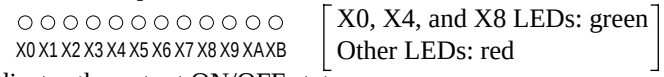
⑩ **Operation monitor LEDs (RUN/PROG./ERR./ALARM):**
RUN LED ON: Turns on when program is executed.
Flashes: Turns on when forced ON/OFF operation is executed in RUN mode.
PROG. LED ON: Turns on when the control board halts program execution.
ERR. LED ON: Turns on when a self-diagnostic error occurs.
ALARM LED ON: Turns on when an abnormality is detected or watchdog timer error occurs.

⑪ **User memory socket (EPROM/EEPROM):** Use this socket to install the memory (EPROM) and master memory (EEPROM).

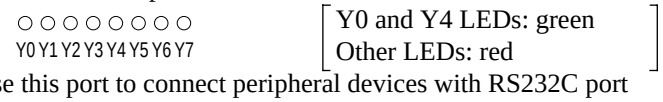
⑫ **Memory selector (EPROM/EEPROM):** Select the used memory type.
EPROM: memory
EEPROM: master memory

⑬ **Backup battery holder:** Holder for the backup battery. Refer to page 125, “6-4. Maintenance”, for details about backup battery replacement.

⑭ **Input indicators (LED):** Indicates the input ON/OFF states.



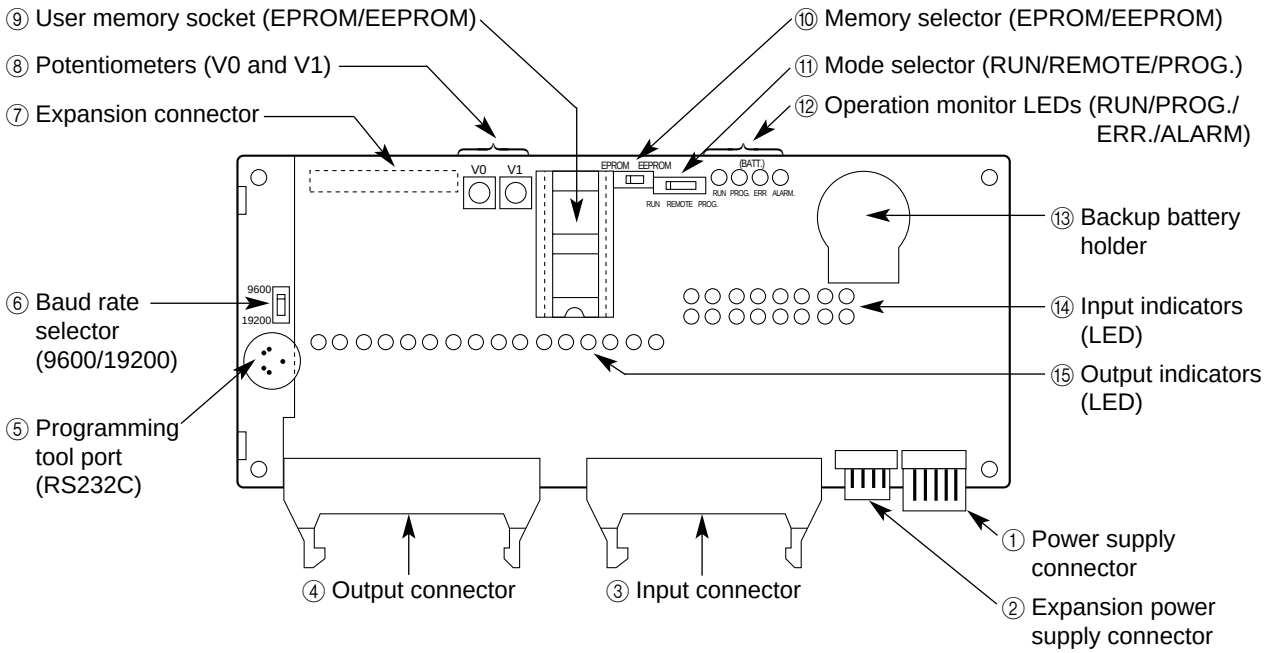
⑮ **Output indicators (LED):** Indicates the output ON/OFF states.



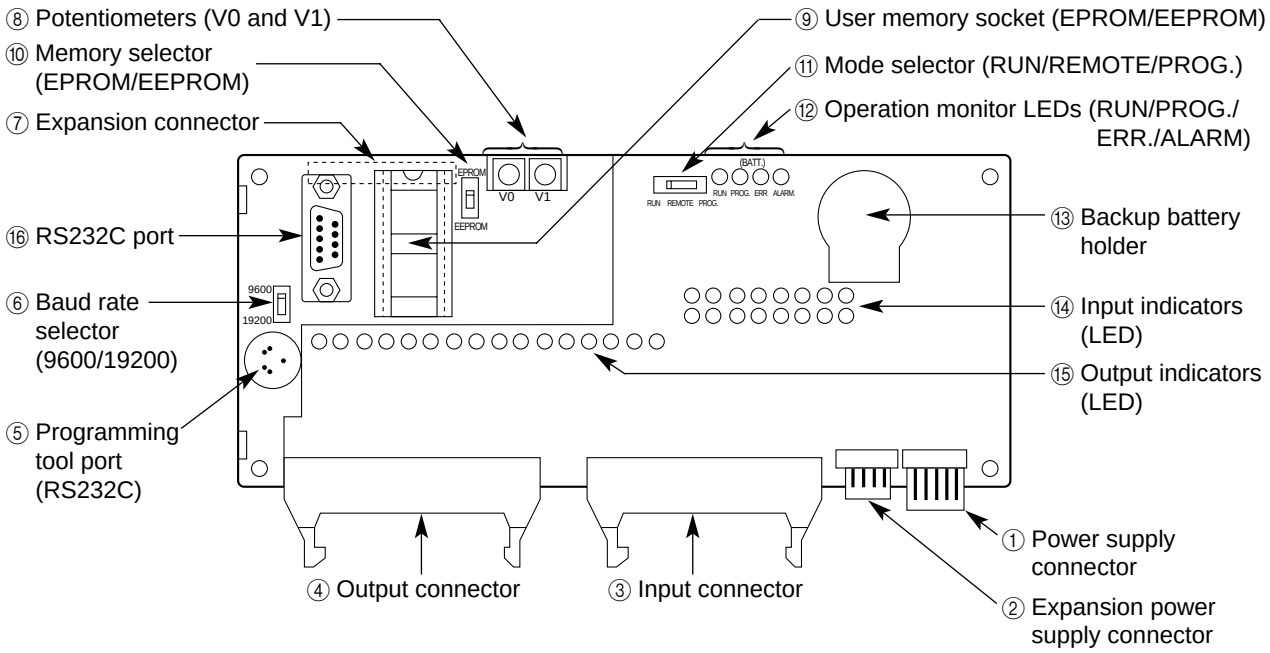
⑯ **RS232C port (C20TC type only):** Use this port to connect peripheral devices with RS232C port (e.g., I.O.P. and bar-code reader).

3) C32T and C32TC types

■ C32T type



■ C32TC type



① **Power supply connector:** Power supply connector for 24 V DC

② **Expansion power supply connector:** Supplies the power (24 V DC) to the expansion board using expansion power supply cable.

③ **Input connector (30-pin):** Connects the input field devices (e.g., limit switch).
MIL connector is used. Use a wire-press socket and flat cable connector for wiring.
C32T and C32TC types: 16 input points

④ **Output connector (34-pin):** Connects the output field devices (e.g., solenoid).
MIL connector is used. Use a wire-press socket and flat cable connector for wiring.
C32T and C32TC types: 16 output points

⑤ **Programming tool port (RS232C):** Use this port for the programming tools (e.g., FP Programmer Ⅱ or personal computer).
This interface is for RS232C transmission.

⑥ **Baud rate selector (9600/19200):** Selects the baud rate for communication with a programming tool.
Set the selector according to the connected programming tools.
- FP Programmer (AFP1112): 19,200 bps
- FP Programmer (AFP1112A): 19,200 bps or 9,600 bps
- FP Programmer Ⅱ (AFP1114): 19,200 bps or 9,600 bps
- Personal computer: 9,600 bps

⑦ **Expansion connector:** Connects the expansion boards.

⑧ **Potentiometers (V0 and V1):** Set with a screwdriver, the potentiometers allow manually adjusting the controller. This feature makes input an analog value ranging from K0 to K255. Each set value is stored respectively in manual dial-set registers (V0: DT9040 and V1: DT9041).

⑨ **User memory socket (EPROM/EEPROM):** Use this socket to install the memory (EPROM) and master memory (EEPROM).

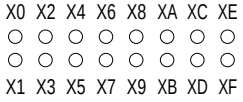
⑩ **Memory selector (EPROM/EEPROM):** Select the used memory type.
EPROM: memory
EEPROM: master memory

⑪ **Mode selector (RUN/REMOTE/PROG.):**
RUN mode: The control board executes programs.
REMOTE mode: The RUN or PROG. mode can be changed using programming tools.
PROG. mode: Used for editing program.

⑫ **Operation monitor LEDs (RUN/PROG./ERR./ALARM):**
RUN LED ON: Turns on when program is executed.
Flashes: Turns on when forced ON/OFF operation is executed in RUN mode.
PROG. LED ON: Turns on when the control board halts program execution.
ERR. LED ON: Turns on when a self-diagnostic error occurs.
ALARM LED ON: Turns on when an abnormality is detected or watchdog timer error occurs.

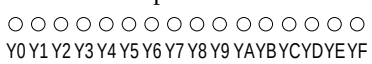
⑬ **Backup battery holder:** Holder for the backup battery. Refer to page 125, “6-4. Maintenance”, for details about backup battery replacement.

⑭ **Input indicators (LED):** Indicates the input ON/OFF states.



[X0, X4, X8, and XC LEDs: green
Other LEDs: red]

⑮ **Output indicators (LED):** Indicates the output ON/OFF states.

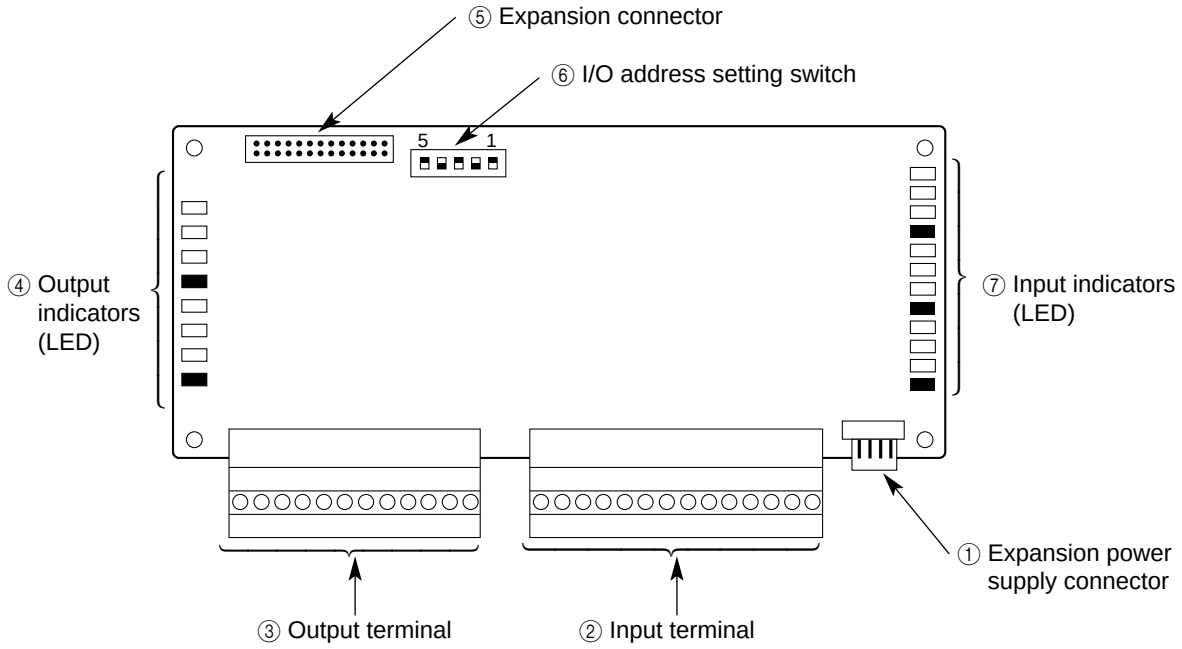


[Y0, Y4, Y8, and YC LEDs: green
Other LEDs: red]

⑯ **RS232C port (C32TC type only):** Use this port to connect peripheral devices with RS232C port (e.g., I.O.P. and bar-code reader).

2. Expansion Boards

1) E20R type



① **Expansion power supply connector:** Connected to the control board, the power is supplied to the expansion board through this.

② **Input terminal (15-pin):** Connects the input field devices (e.g., limit switch). This terminal block is removable.

③ **Output terminal (12-pin):** Connects the output field devices (e.g., solenoid). This terminal block is removable.

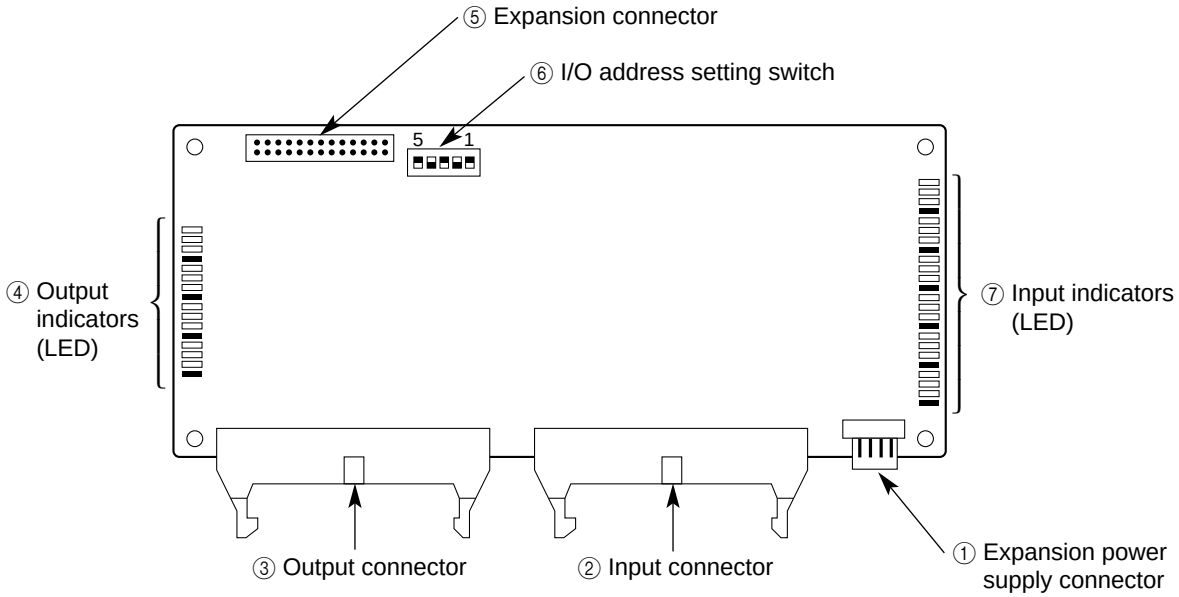
④ **Output indicators (LED):** Indicates the output ON/OFF states.

⑤ **Expansion connector:** Connects the control board with internal circuit.

⑥ **I/O address setting switch:** The I/O addresses for the expansion boards are set using this switch. Refer to page 39, “3-2. I/O Allocation of Expansion Boards”, for details.

⑦ **Input indicators (LED):** Indicates the input ON/OFF states.

2) M1T-E type



① **Expansion power supply connector:** Connected to the control board, the power is supplied to the expansion board through this.

② **Input connector (40-pin):** Connects the input field devices (e.g., limit switch).
MIL connector is used. Use a wire-press socket and flat cable connector for wiring.

③ **Output connector (34-pin):** Connects the output field devices (e.g., solenoid).
MIL connector is used. Use a wire-press socket and flat cable connector for wiring.

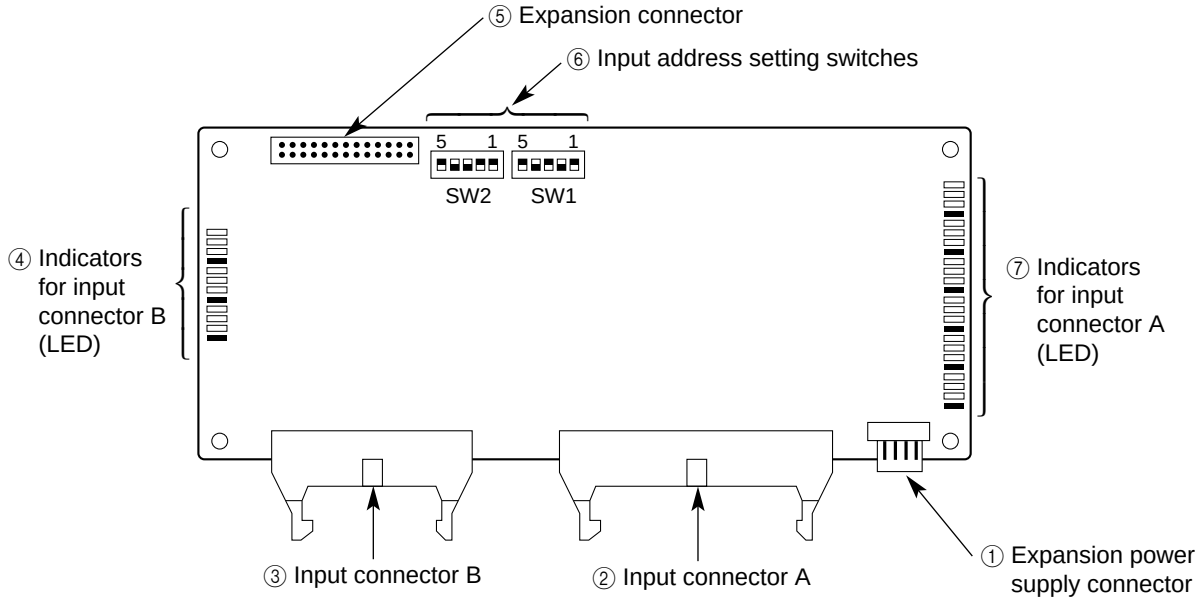
④ **Output indicators (LED):** Indicates the output ON/OFF states.

⑤ **Expansion connector:** Connects the control board with the internal circuit.

⑥ **I/O address setting switches:** The I/O addresses for the expansion boards are set using this switch. Refer to page 39, “3-2. I/O Allocation of Expansion Boards”, for details.

⑦ **Input indicators (LED):** Indicates the input ON/OFF states.

3) M1T-EI type



① **Expansion power supply connector:** Connected to the control board, the power is supplied to the expansion board through this.

②③ **Input connector A (40-pin) and B (20-pin):** Connects the input field devices (e.g., limit switch). MIL connector is used. Use a wire-press socket and flat cable connector for wiring.

④ **Indicators for input connector B (LED):** Indicates the input ON/OFF states.

⑤ **Expansion connector:** Connects the control board with the internal circuit.

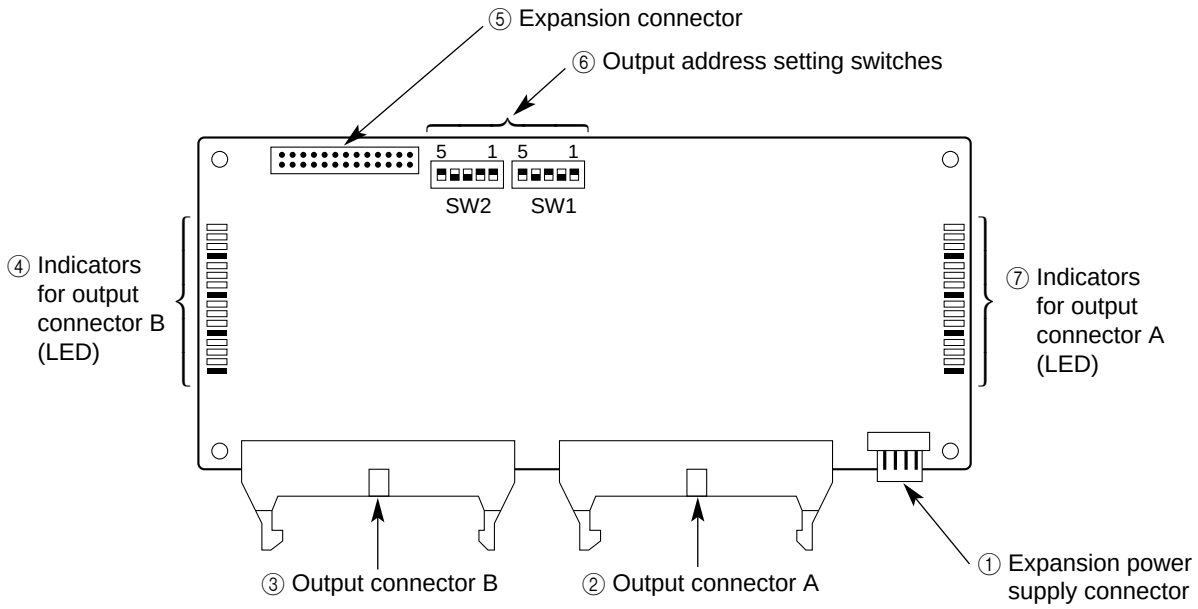
⑥ **Input address setting switches:** The input addresses for the expansion boards are set using these switches.

SW1: Input address setting switch for input connector A
SW2: Input address setting switch for input connector B

Refer to page 39, “3-2. I/O Allocation of Expansion Boards”, for details.

⑦ **Indicators for input connector A (LED):** Indicates the input ON/OFF states.

4) M1T-EO type



① **Expansion power supply connector:** Connected to the control board, the power is supplied to the expansion board through this.

②③ **Output connector A (34-pin) and B (34-pin):** Connects the output field devices (e.g., solenoid). MIL connector is used. Use a wire-press socket and flat cable connector for wiring.

④ **Indicators for output connector B (LED):** Indicates the output ON/OFF states.

⑤ **Expansion connector:** Connects the control board with the internal circuit.

⑥ **Output address setting switches:** The output addresses for the expansion boards are set using these switches.

SW1: Output address setting switch for output connector A

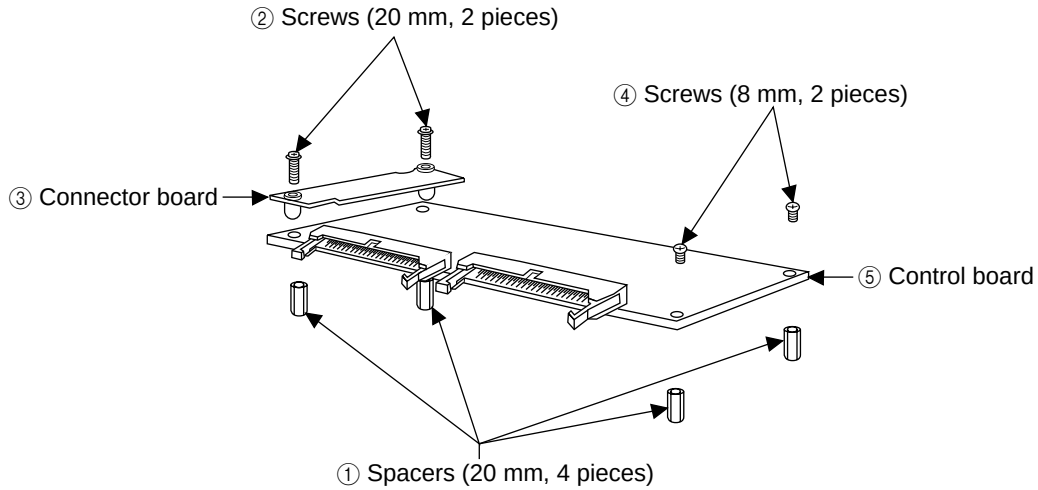
SW2: Output address setting switch for output connector B

Refer to page 39, “3-2. I/O Allocation of Expansion Boards”, for details.

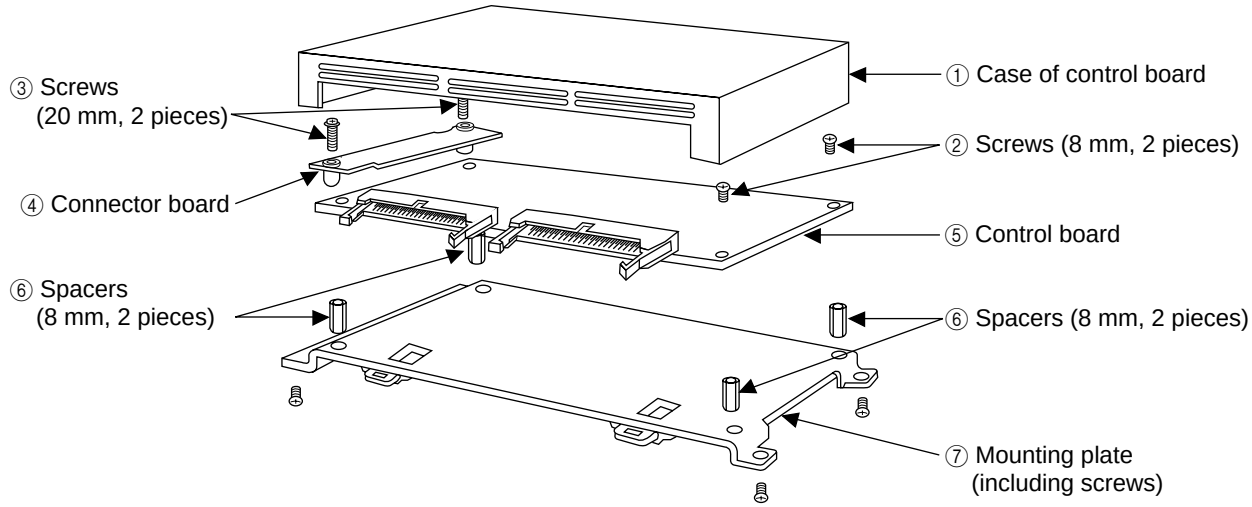
⑦ **Indicators for output connector A (LED):** Indicates the output ON/OFF states.

3. Board and Case Structure

1) Board type



2) Case type



Note:

• The connector board is already connected on C20RC, C20TC and C32TC types when shipped.

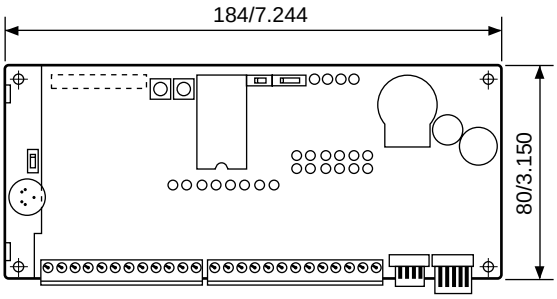
2-3. Dimensions

1. Board Type

1) Control boards

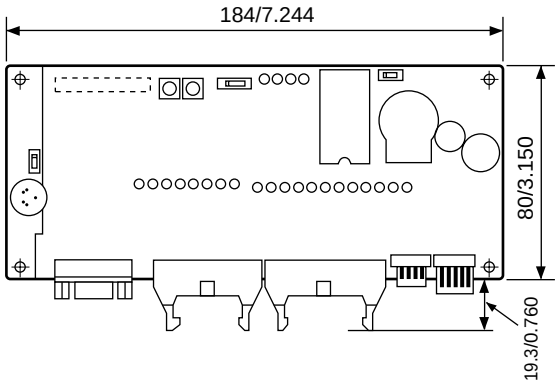
■ C20R and C20RC types

e.g.) C20R type



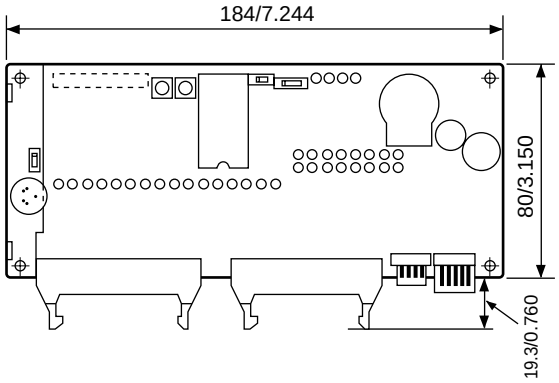
■ C20T and C20TC types

e.g.) C20TC type



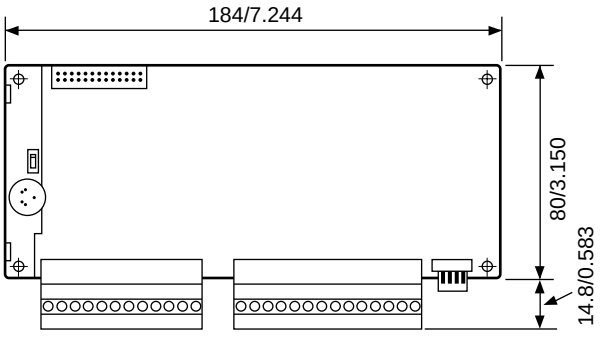
■ C32T and C32TC types

e.g.) C32T type



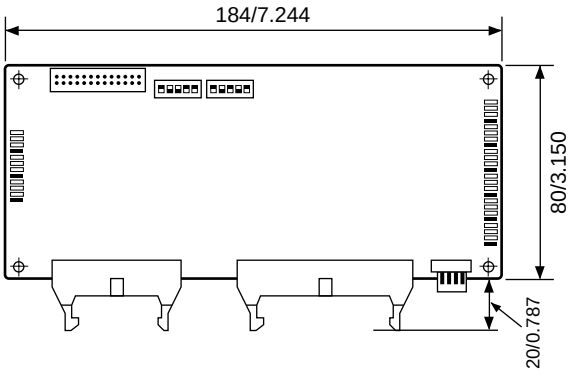
2) Expansion boards

■ M1T-E20R type



■ M1T-E, M1T-EI, and M1T-EO types

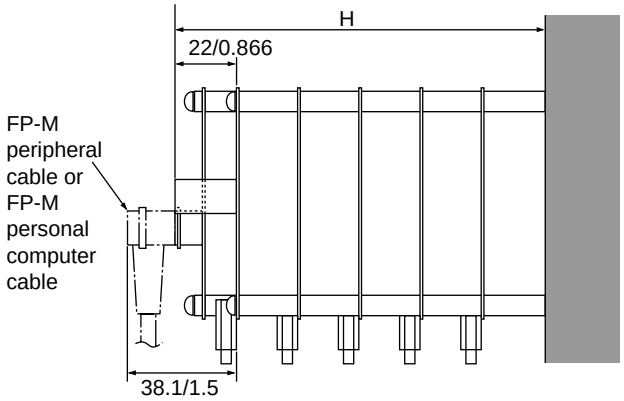
e.g.) M1T-EI type



(unit: mm/in.)

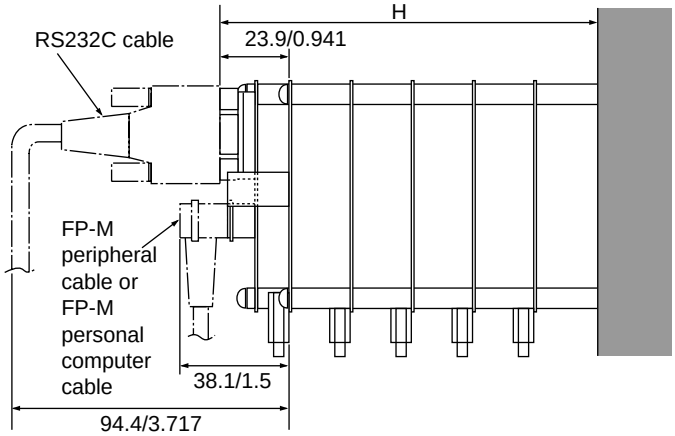
3) Building dimensions

Control board C20R, C20T, C20TC, and C32T types



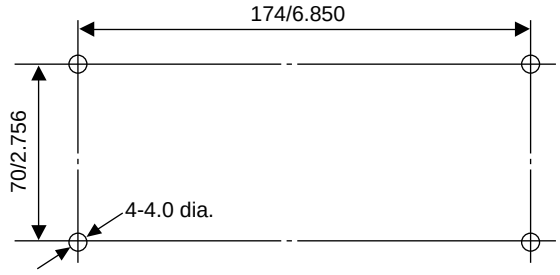
Board	H (mm/in.)
1 control board	43.6/1.717
1 control board and 1 expansion board	65.2/2.567
1 control board and 2 expansion boards	86.8/3.417
1 control board and 3 expansion boards	108.4/4.268
1 control board and 4 expansion boards	130.0/5.118

Control board C20RC and C32TC types



Board	H (mm/in.)
1 control board	45.5/1.791
1 control board and 1 expansion board	67.1/2.642
1 control board and 2 expansion boards	88.7/3.492
1 control board and 3 expansion boards	110.3/4.343
1 control board and 4 expansion boards	131.9/5.193

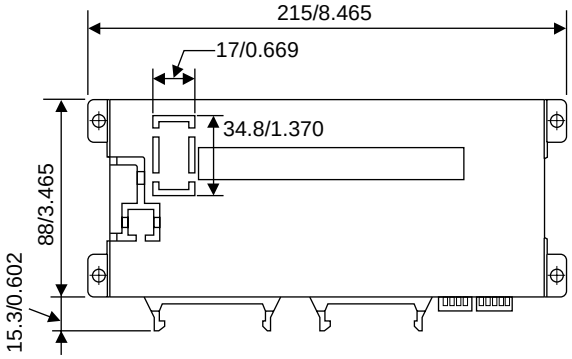
4) Mounting hole dimensions



(unit: mm/in.)

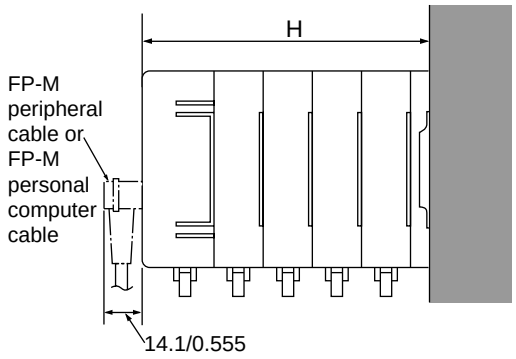
2. Case Type

1) Case dimensions for control, expansion, intelligent and link boards



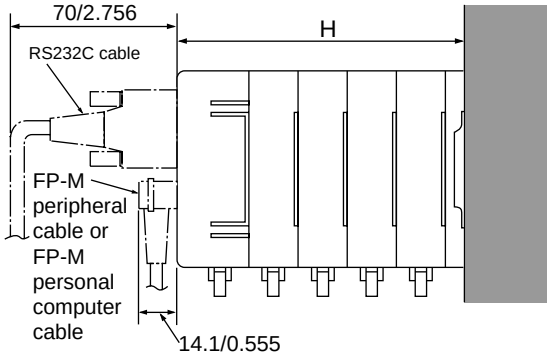
2) Building dimensions

Control board C20R, C20T, and C32T types



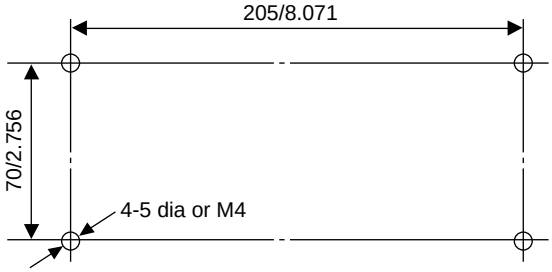
Board	H (mm/in.)
1 control board	44.2/1.740
1 control board and 1 expansion board	63.8/2.512
1 control board and 2 expansion boards	85.4/3.362
1 control board and 3 expansion boards	107.0/4.213
1 control board and 4 expansion boards	128.6/5.063

Control board C20RC, C20TC, and C32TC types



Board	H (mm/in.)
1 control board	44.2/1.740
1 control board and 1 expansion board	63.8/2.512
1 control board and 2 expansion boards	85.4/3.362
1 control board and 3 expansion boards	107.0/4.213
1 control board and 4 expansion boards	128.6/5.063

3) Mounting hole dimensions



Tolerance±1.0/±0.39 (unit: mm/in.)

CHAPTER 3

I/O ALLOCATION

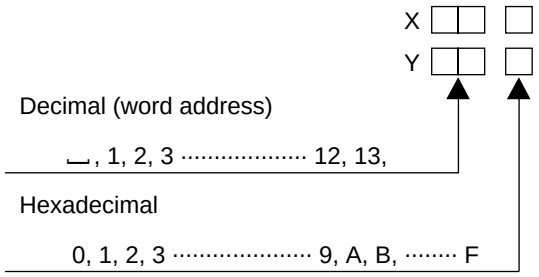
3-1. I/O Allocation of Control Boards

• The I/O addresses for the control boards are fixed as follows.

Board type	I/O point	I/O allocation
C20R and C20RC	12 inputs	X0 to XB
	8 outputs	Y0 to Y7
C20T and C20TC	12 inputs	X0 to XB
	8 outputs	Y0 to Y7
C32T and C32TC	16 inputs	X0 to XF
	16 outputs	Y0 to YF

Note:

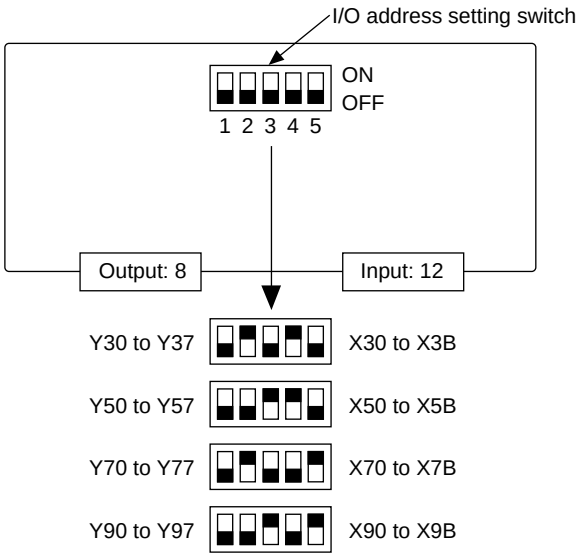
• The lowest digit for these relay addresses is expressed in hexadecimals and the second and higher digits are expressed in decimals as shown below.



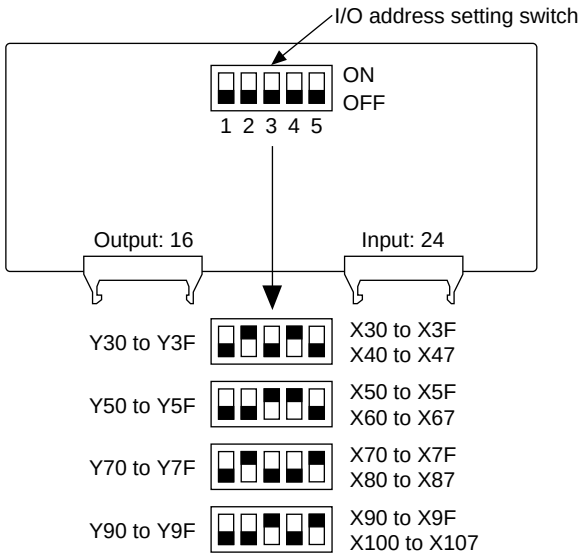
3-2. I/O Allocation of Expansion Boards

• The I/O addresses for the expansion boards are set by the I/O address setting switches. Be sure to allocate I/O addresses of the expansion boards before installation, referring to following.

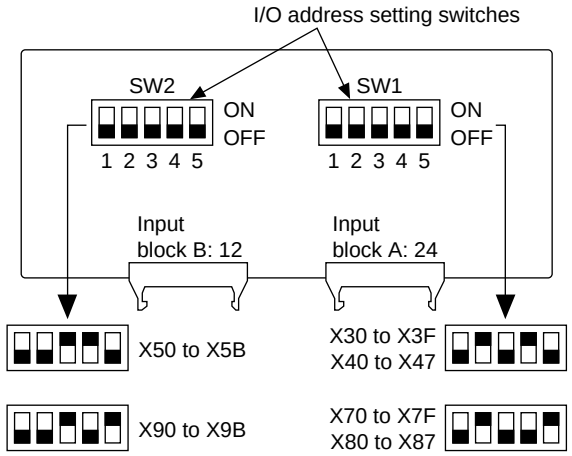
■ E20R type



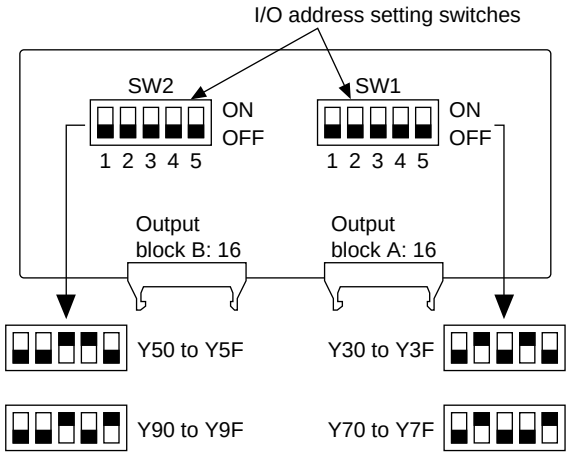
■ M1T-E type



■ M1T-EI type



■ M1T-EO type

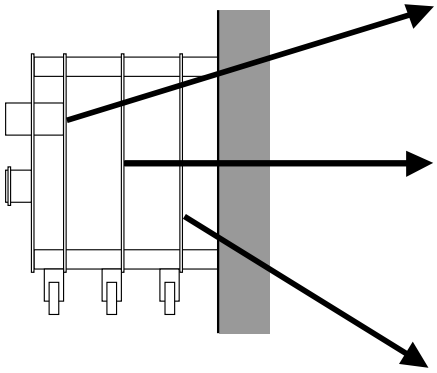


Notes:

- When connecting expansion boards to the control board, be sure not to overlap I/O addresses.
- When connecting an input or output board to a control board, I/O address settings for blocks A and B should be performed separately using SW1 and SW2. Be sure to configure I/O address setting switches SW1 and SW2 with different settings in order to prevent I/O address overlap.

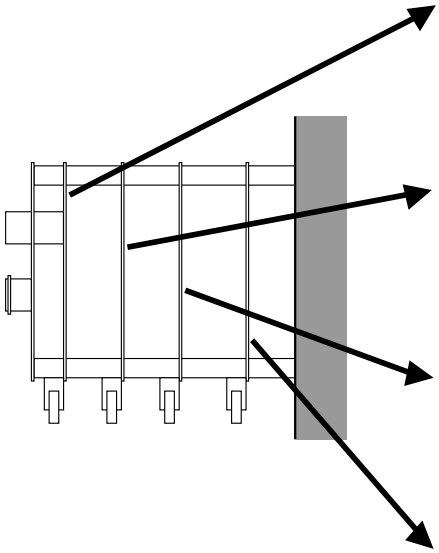
3-3. I/O Allocation Examples

• Example 1



Board	I/O address setting switch	I/O allocation
Control board C20T type Output: 8 Input: 12	———	X0 to XB Y0 to Y7
Expansion I/O board M1T-E type I/O address setting switch Output: 16 Input: 24	ON OFF 1 2 3 4 5	X30 to X3F X40 to X47 Y30 to Y3F
Expansion I/O board E20R type I/O address setting switch Output: 8 Input: 12	ON OFF 1 2 3 4 5	X50 to X5B Y50 to Y57

• Example 2



Board	I/O address setting switch	I/O allocation
Control board C32T type Output: 16 Input: 16	———	X0 to XF Y0 to YF
Expansion I/O board M1T-E type I/O address setting switch Output: 16 Input: 24	ON OFF 1 2 3 4 5	X30 to X3F X40 to X47 Y30 to Y3F
Expansion I/O board M1T-E type I/O address setting switch Output: 16 Input: 24	ON OFF 1 2 3 4 5	X50 to X5F X60 to X67 Y50 to Y5F
Expansion output board M1T-EO type I/O address setting switches SW2 SW1 Output block B: 16 Output block A: 16	SW1 for block A ON OFF 1 2 3 4 5	Y70 to Y7F
	SW2 for block B ON OFF 1 2 3 4 5	Y90 to Y9F

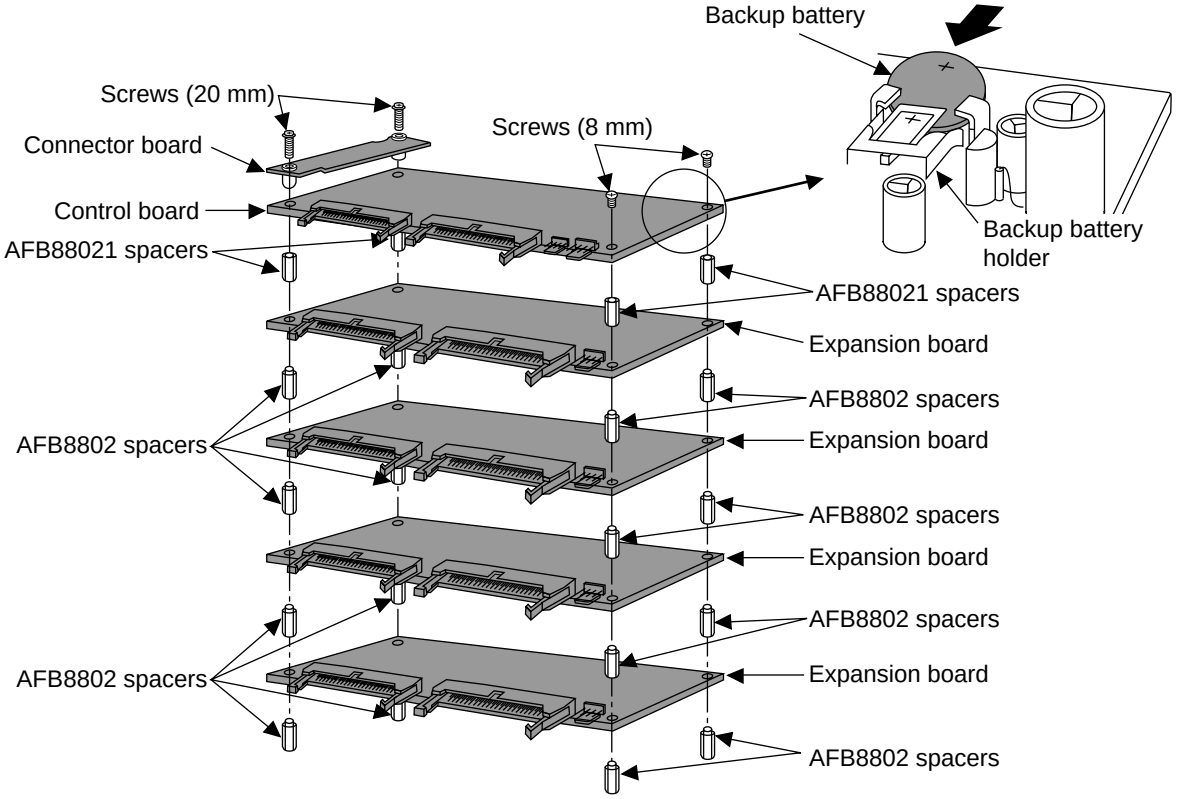
CHAPTER 4

INSTALLATION AND WIRING

4-1. Stacking the Boards

1. Board Type

• The procedure for assembling boards is as follows.
Example: 1 control board and 4 expansion boards



Spacers

Shape	Length	Description	Part number
	20 mm	4 spacers attached to a control board	AFB88021
	20 mm	4 spacers attached to an expansion board	AFB8802

■ Procedure

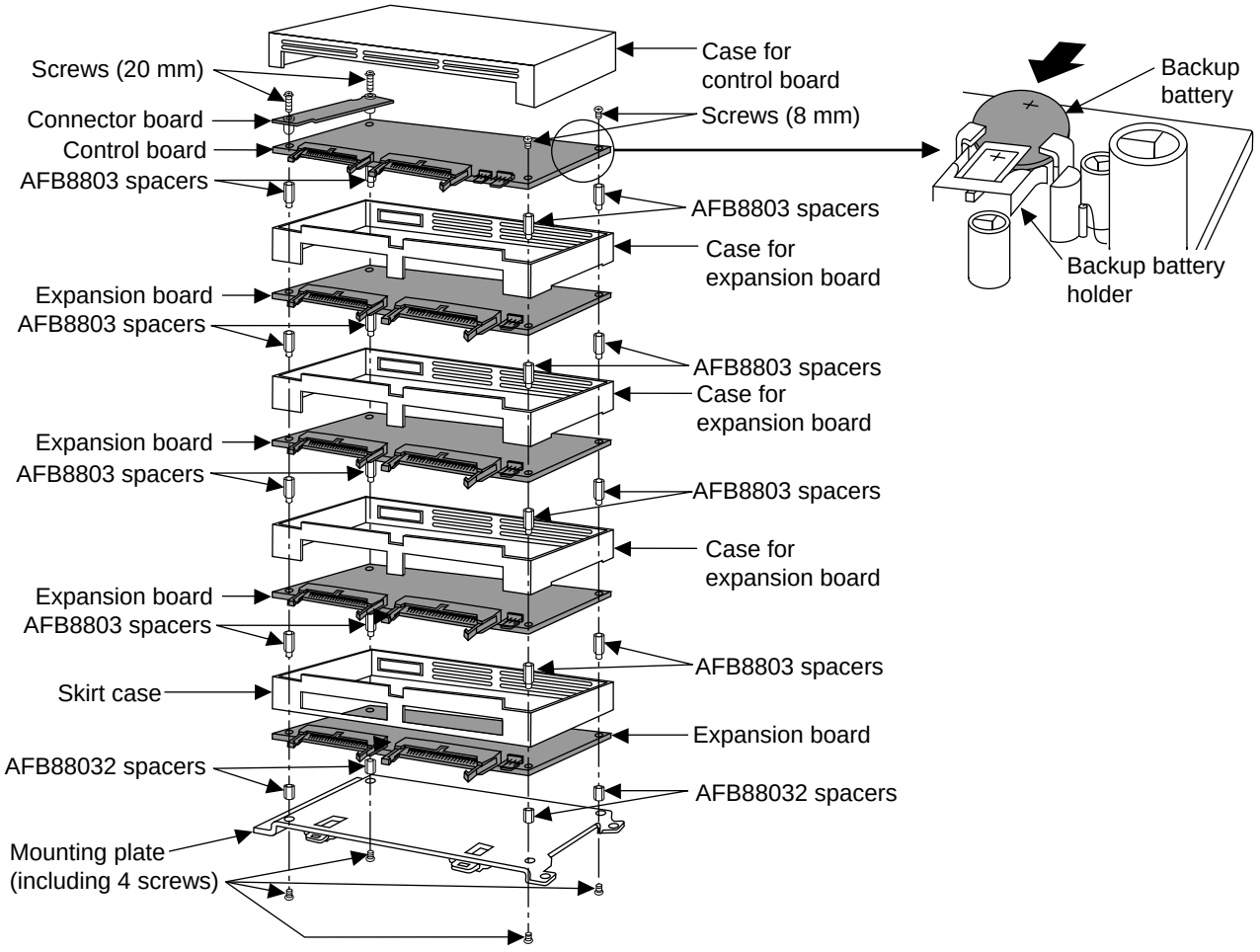
1. Assemble each expansion board using the AFB8802 spacers.
2. When adding a control board to the expansion board, mount using the AFB88021 spacers and 8 mm screws. After attaching the connector board to the control board, tighten with the 20 mm screws. Note that the C type control board is shipped with the connector board already attached.
3. Insert the backup battery in the backup battery holder as shown in the drawing.

Notes:

- The lengths of the spacers for the board type and the case type are different, so be sure not to get them confused.
- Do not touch the boards directly with your hands when handling. When it is necessary to touch the board, first touch a grounded metal object to discharge any static electricity. Do not touch any electronic parts or connectors directly.

2. Case Type

• The procedure for assembling cases is as follows.
Example: 1 control board and 4 expansion boards



Spacers

Shape	Length	Description	Part number
	18 mm	4 spacers attached to an expansion and control boards	AFB8803
	8 mm	4 spacers attached to a mounting plate	AFB88032

■ Procedure

1. Using the four screws of the mounting plate, attach the mounting plate with AFB88032 spacers.
2. Assemble the expansion board using the skirt case and AFB8803 spacers.
3. Assemble the remaining expansion boards using the case for expansion board and AFB8803 spacers.
4. After connecting the connector board to the control board, attach the control board using the 20 mm and 8 mm screws. Note that the C type control board is shipped with the connector board already attached.
5. Insert the backup battery in the backup battery holder as shown in the drawing.
6. Finally, mount the case for control board.

Notes:

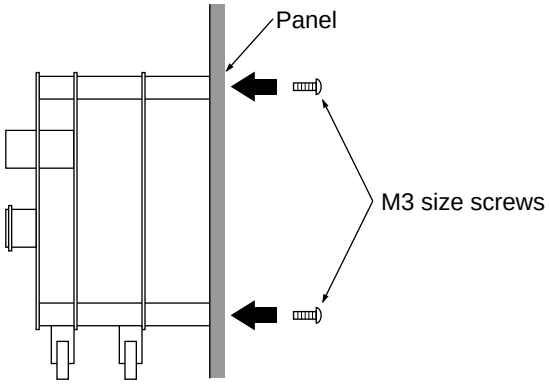
- The lengths of the spacers for the board type and the case type are different, so be sure not to get them confused.
- Do not touch the boards directly with your hands when handling. When it is necessary to touch the board, first touch a grounded metal object to discharge any static electricity. Do not touch any electronic parts or connectors directly.

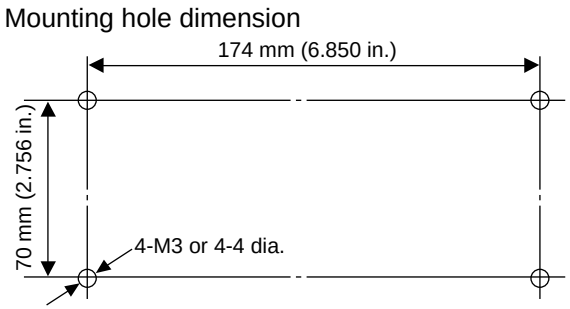
4-2. Installation

1. Panel Mount

1) Board type mounting method (without mounting plate)

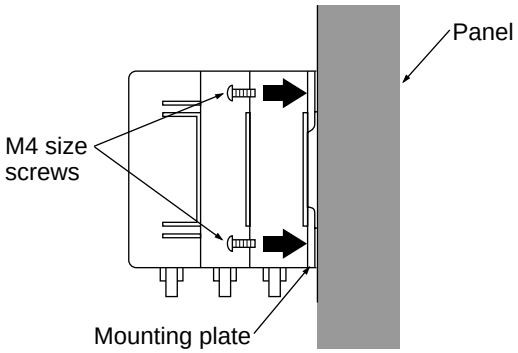
• Mount the stacked boards on the panel with four M3 size screws as follows.

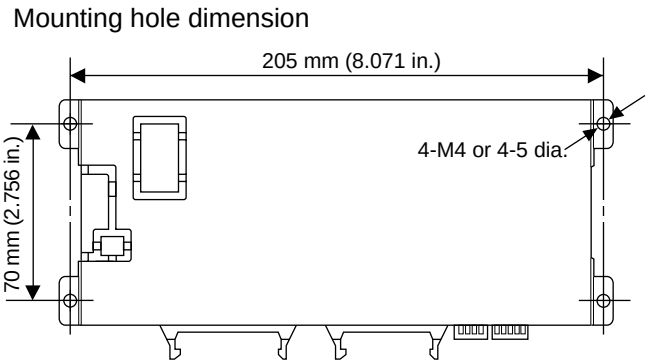




2) Case type mounting method (using mounting plate)

• Mount the mounting plate on the panel with four M4 size screws as follows.

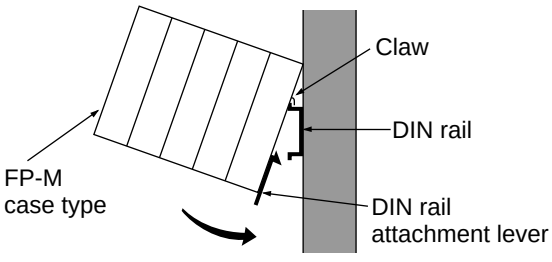




2. DIN Rail Mount

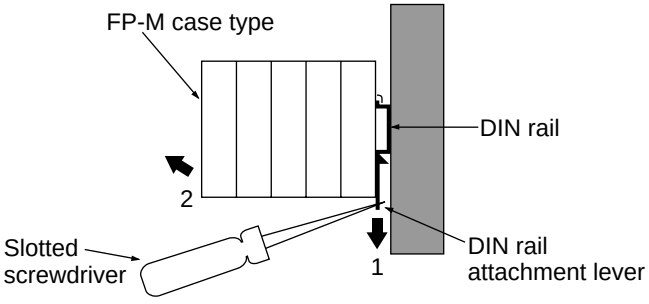
■ Attachment

• Put the claw of the FP-M mounting plate on the DIN rail and attach the FP-M on the rail.



■ Detachment

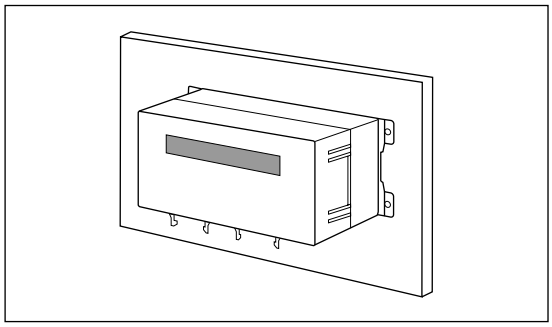
• To detach the FP-M from the DIN rail, pull the lever down with a slotted screwdriver.



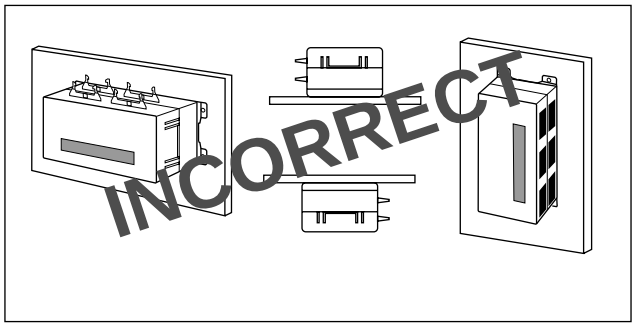
3. Cautions

- Install and remove the boards when all power is turned OFF.
- Do not drop pieces of wire or other objects on the board when wiring.
- Do not use the board where it will be exposed to the following:
  - Ambient temperatures of 0˚C to 55˚C (32˚F to 131˚F).
  - Ambient humidity of 35 % to 85 % RH.
  - Sudden temperature changes that cause condensation.
  - Inflammable or corrosive gas.
  - Excessive airborne dust or metal particles.
  - Benzine, paint thinner, alcohol or other organic solvents or strong alkaline solutions such as ammonia or caustic soda.
  - Excessive vibration or shock.
  - Influence from power transmission lines, high voltage equipment, power cables, power equipment, radio transmitters, or any other equipment that can generate high switching surges.
  - Water in any form including spray or mist.
  - Direct sunlight.
- Do not install the board above devices which generate heat such as heaters, transformers or large scale resistors.

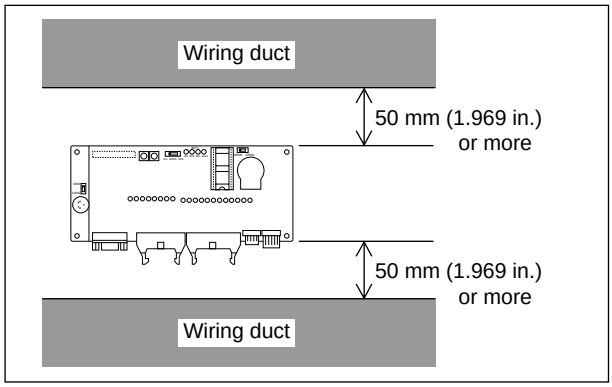
- Install as shown below, for heat radiating boards.



- Do not install the board as shown below.



- When mounting a wiring duct, maintain a clearance between the board and duct as shown below. (Illustration: FP-M control board)



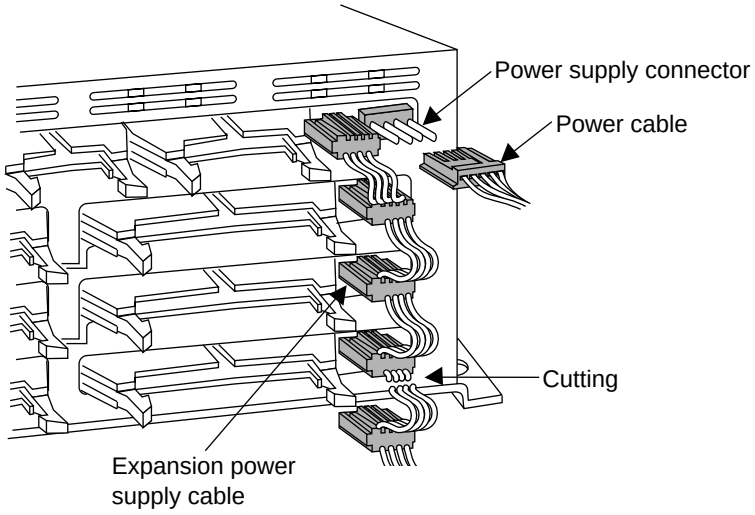
- Keep 100 mm (3.937 in.) or more clearance between the FP-M and other equipment in order to avoid heat radiation.

4-3. Wiring

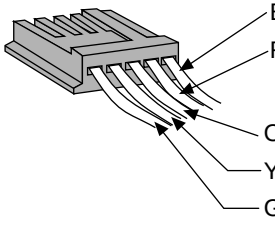
1. Power Supply Wiring

1) Wiring for power supply

- Power is supplied to the control board via the power cable [AWG#28 (UL1007)].
- Power is supplied to the expansion board via the expansion connector. For input/output field devices, power is supplied to the expansion board via the expansion power supply connector.



■ Power cable



Controller power supply:
- Power supply for the controller's internal circuit.
- Supply 24 V DC the brown (+) and red (–) wires.

Input/Output power supply:
- Power supply for connected input and output field devices (I/O circuits).
- Supply 24 V DC the green (+) and yellow (–) wires.
- The orange wire is for a spare I/O power supply (5 V to 24 V DC).

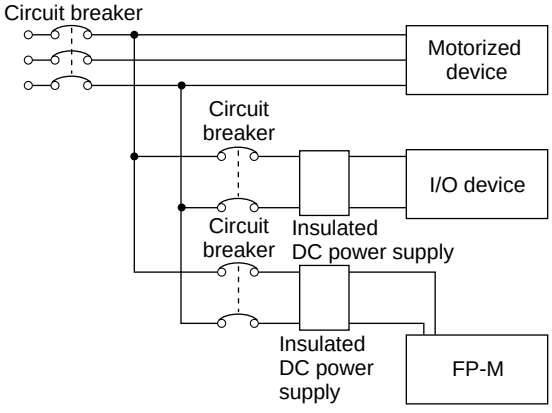
Notes:

- Twist the brown and red, and yellow and green power cables to stop incoming noise.
- Depending on the expansion boards, cut any excess expansion power supply cable.
- Ground is common with the yellow wire (0 V).

2) Power supply lines

- The power supply lines for the FP-M, I/O devices and motorized devices should be isolated as shown on the right.
- Excessive noise and line voltage fluctuations can result in FP-M misoperation or system shutdown. To prevent accidents caused by noise and line voltage fluctuations, be sure to employ countermeasures (such as use of an insulated DC power supply, isolation of controller and I/O power supply, etc.) when wiring the power supply lines.

Example:



■ Operating voltage range

Item	Operating voltage range
Controller's power supply	21.6 to 26.4 V DC (all control boards)
I/O power supply	20.4 to 26.4 V DC (C20T, C20TC, C32T and C32TC) 22.8 to 26.4 V DC (C20R and C20RC)

3) Grounding

- The FP-M has sufficient noise resistance under low noise level conditions. However, ground the FP-M for safety.
- When grounding, an earth-ground resistance of 100 Ω or less is recommended to limit the effect of noise due to electromagnetic interference.
- Ground each board by grounding the mounting plate or spacers.
- Do not use a grounding wire with 2 mm^2 or larger conducts, that is shared with other devices.

Correct **Incorrect**

4) Momentary power drop

- The FP-M is not influenced by momentary power drops (less than 10 ms).

5) Safety

- In certain applications, malfunction may occur for the following reasons.
  An operation time lag when a momentary power drop occurs.
  Abnormality in the FP-M, power supply circuit, or other devices.
- In order to prevent malfunction from resulting in system shutdown, the following special attention is required.

Start up sequence:

The FP-M should be operated after all of the outside devices are energized. To keep this sequence, the following measures are recommended.
Set the mode selector from PROG. to RUN after power is supplied to all of the outside devices.
Program the FP-M so that it disregards the inputs and outputs until the outside devices are energized.

Emergency stop circuit:

Add an emergency stop circuit to controlled devices in order to prevent a system shutdown or an irreparable accident when malfunction occurs.

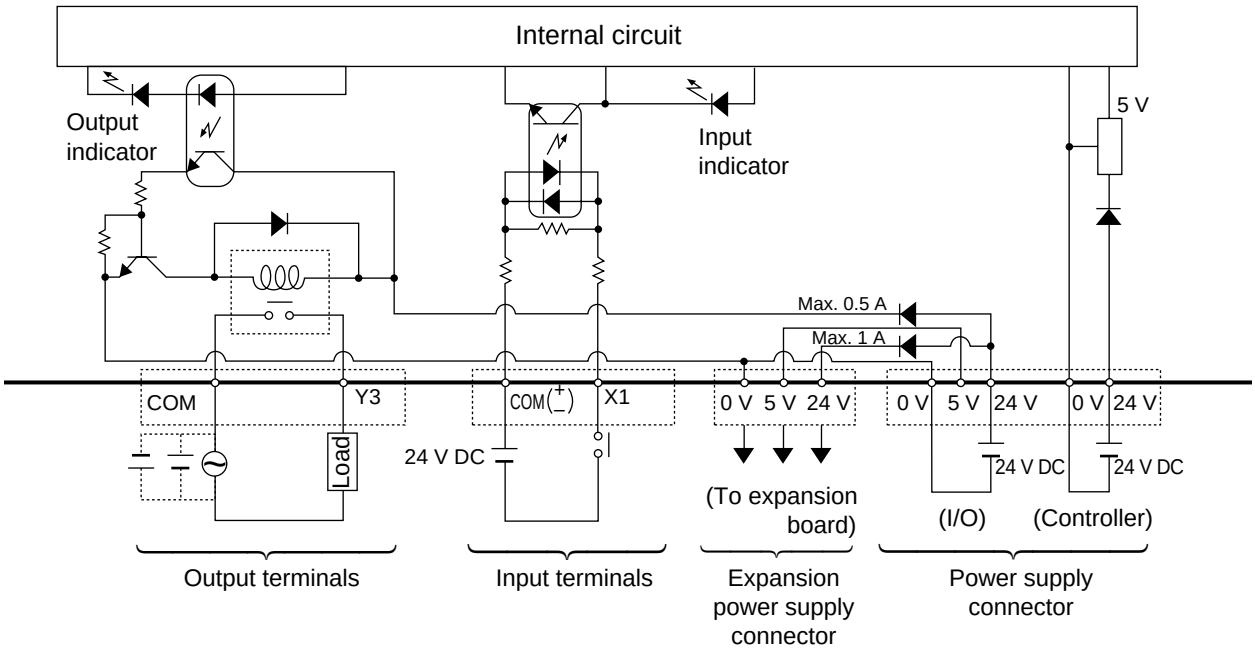
Interlock circuit:

When two motions that are opposed to each other are controlled, add an interlock circuit between the programmable controller's outputs and the control device.
e.g.:
When a motor clockwise/counter-clockwise operation is controlled, provide an interlock circuit that prevents clockwise and counter-clockwise signals from inputting into the motor at the same time.

2. Input and Output Wiring (Control and Expansion Boards)

1) Wiring for I/O power supply (C20R control board and E20R expansion board)

e.g.) C20R wiring diagram



• **I/O power supply**

Input side:

- Use for driving the internal circuit.
- An input power supply is not required for the E20R expansion board if COM (±) is connected to 24 V or 0 V, because it is supplied by the internal circuit. Also, when COM (±) and the 24 V terminal are connected, they become a source input. When COM (±) terminal and 0 V terminal are connected, they become a sink input.

Output side:

- Use for driving output field devices.

• **Current capacity range of I/O power supply**

Ic + Ie ≦ 1 A

Ic: Current capacity for output of control board

Internal drive current 7.5 mA × number of ON points

Ie: Current capacity for expansion board

Notes:

• I/O current capacity for E20R expansion board:

Ia: Current capacity for input of expansion board

Internal drive current 5 mA × number of ON points + current for field devices (e.g., photoelectric sensor)

Ib: Current capacity for output of expansion board

Internal drive current 7.5 mA × number of ON points

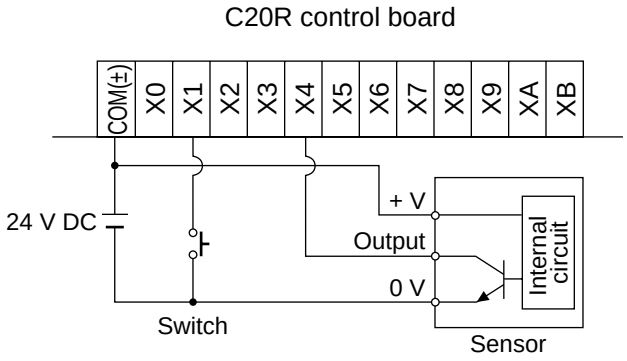
• Consumption current of the intelligent/link board is as follows:

- Analog I/O board: Max. 250 mA
- FP-M transmitter master board: Max. 70 mA
- FP-M I/O link board: Max. 50 mA

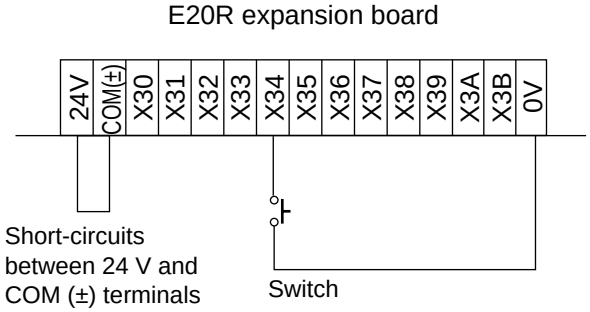
2) Wiring description for I/O power supply (C20R control board and E20R expansion board)

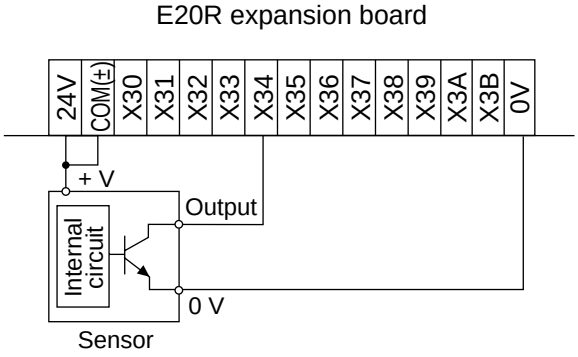
■ Input side

• Supply a 24 V DC external power supply to the input circuit.



• Since the E20R is supplied input power through the internal circuit, the input voltage is not needed.



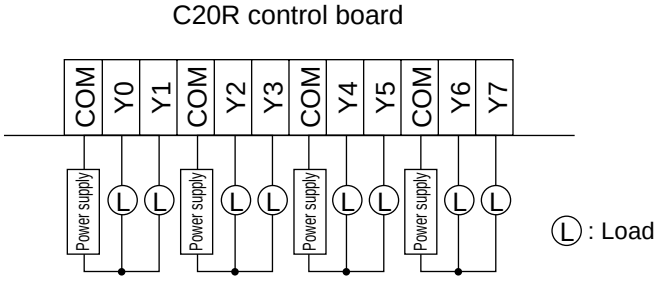


Note:

• Supply the I/O current within the limitation.

■ Output side

• The load power supply is supplied to each common terminal.

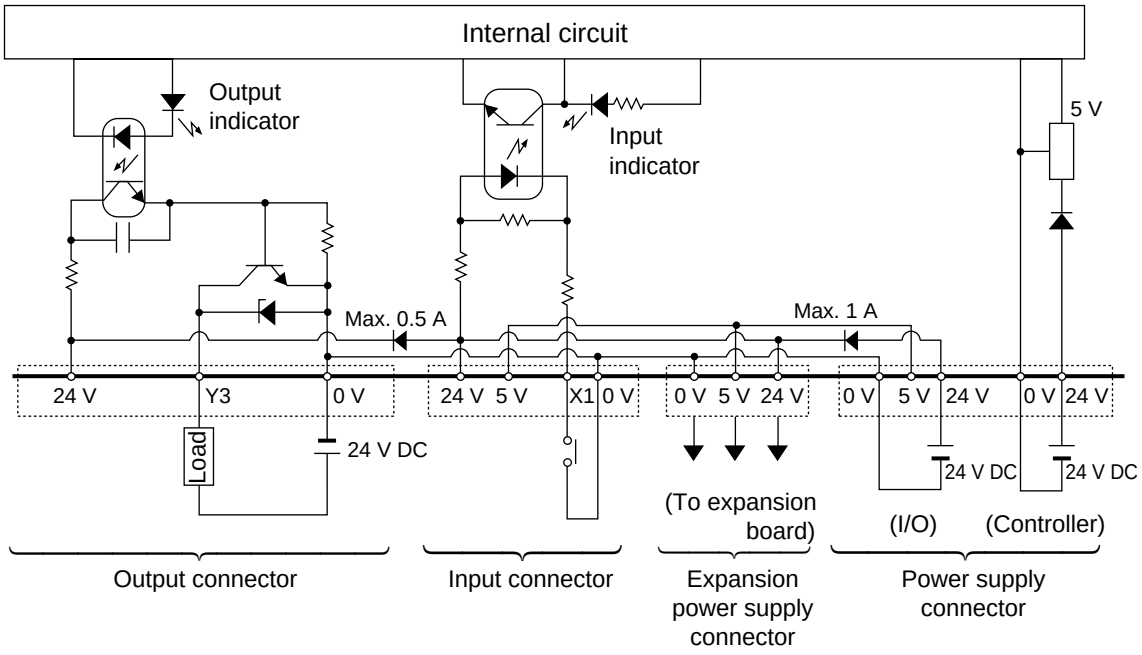


• Load current

Board type	Current capacity (resistive load)
C20R, E20R	2 A 250 V AC/point, 2 A 30 V DC/point, 2 A/common

3) Wiring for I/O power supply (C20T, C32T, M1T-E, M1T-EI, and M1T-EO series)

e.g.) C20T wiring diagram



• **I/O power supply**

Input side:
- Use for driving the internal circuit.
- An external power supply is not required for the input connector.
- The 24 V DC terminal of the input connector can be used as the power supply for input field devices (e.g., photoelectric sensors).
- The 5 V terminal on the input connector can supply 5 to 24 V DC.

Output side:
- Use for driving output field devices.
- When the load current is small (e.g., LED, etc.), drive by using the 24 V DC terminal of the output connector.

Note:

• The 24 V DC terminal or 0 V terminal of the I/O connector are connected internally.

• **Current capacity range of I/O power supply**

Id + Ic + Ie ≦ 1 A

Ic ≦ 0.5 A

If ≦ 0.5 A

Id: Current capacity for input of control board
Internal drive current 5 mA × number of ON points + current for field devices (e.g., photoelectric sensor)

Ic: Current capacity for output of control board
Internal drive current 3 mA × number of ON points + current for field devices

Ie: Current capacity for expansion board

If: Current capacity for output of expansion I/O board

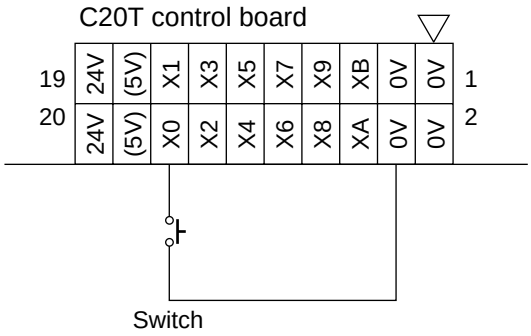
Note:

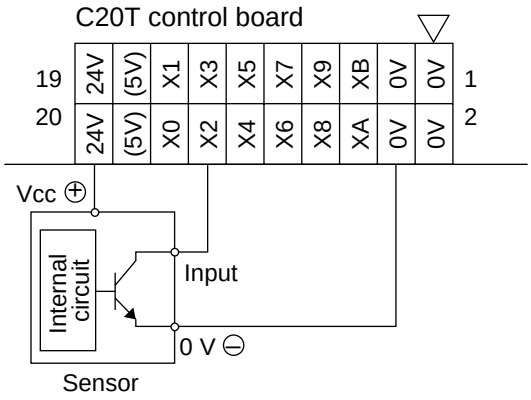
• Consumption current of the intelligent/link board is as follows:
- Analog I/O board: Max. 250 mA
- FP-M transmitter master board: Max. 70 mA
- FP-M I/O link board: Max. 50 mA

4) Wiring description for I/O power supply (C20T, C32T, M1T-E, M1T-EI, and M1T-EO series)

■ Input side

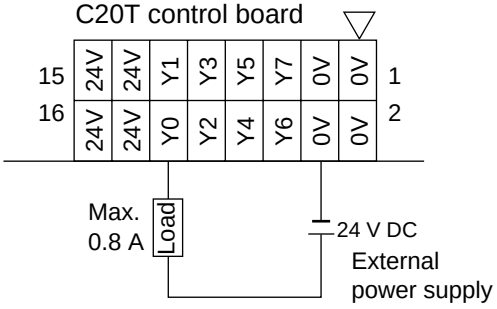
- Since C20T is supplied input power through the internal circuit, the input voltage is not needed.
- Do not exceed the I/O current capacity given on the previous page.

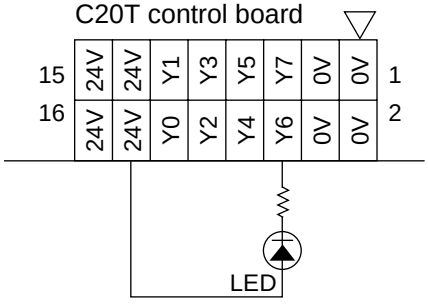




■ Output side

- If the load current is 0.8 A or more, supply external power.
- If the load is 0.8 A or less, such as for LEDs, you can use the built-in DC power supply (24 V).
- Do not exceed the I/O current capacity given on the previous page.





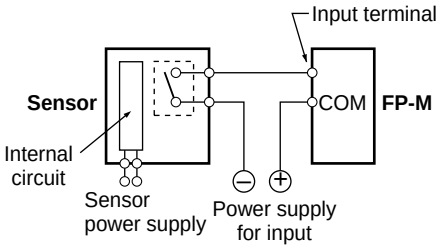
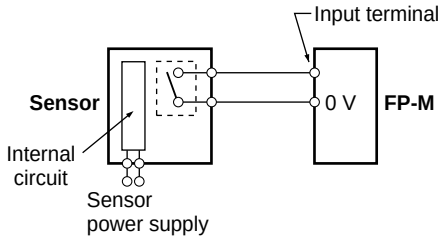
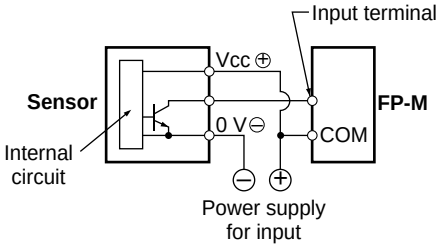
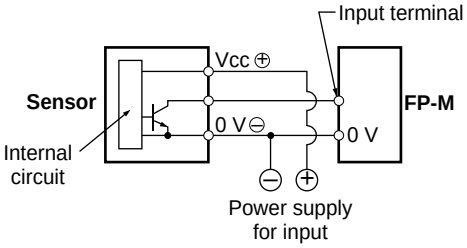
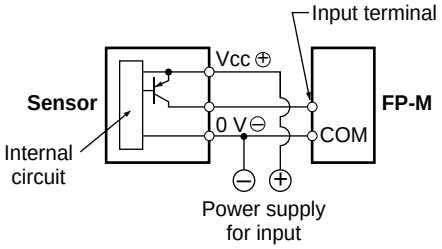
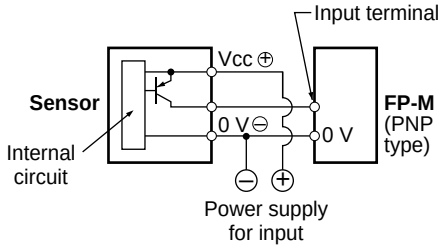
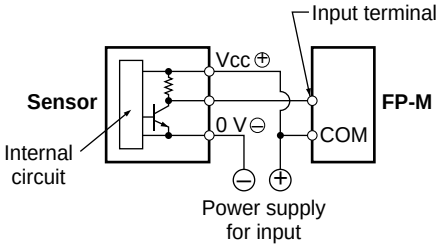
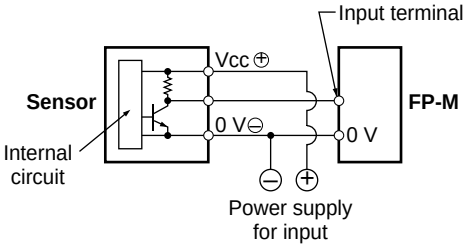
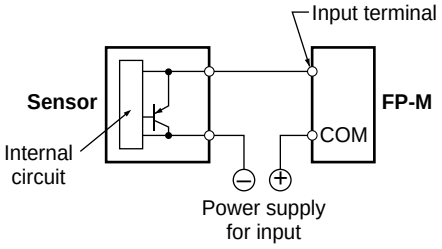
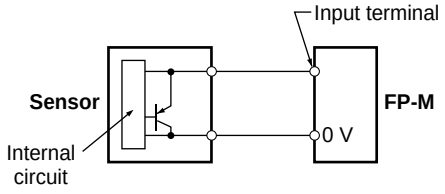
- Load current

Board type	Current capacity
C20T, C32T, M1T-E, M1T-EO	0.8 A/point, 5 A/common

■ Input wiring examples

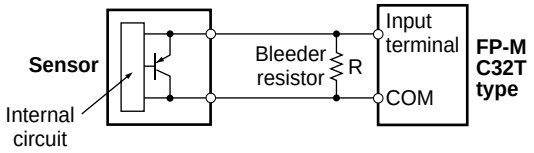
WIRING THE PHOTOELECTRIC SENSORS

• Due to the differences in photoelectric sensor output schemes, connect as shown below:

Photoelectric sensor	FP-M C20R, C20RC, and FP-M E20R	FP-M C20T, C20TC, C32T, C32TC, M1T-E, and M1T-EI
Relay output type		
NPN open collector output type		
PNP open collector output type		
Universal output type		
Two-wire type		

■ Wiring a two-wire type sensor

• If the input of the FP-M is not turned OFF because of leakage current from the sensor, the use of a bleeder resistor is recommended, as shown below.



R: Bleeder resistor (kΩ)
I: Sensor's leakage current (mA)

The OFF voltage of the FP-M input is 2.4 V, therefore, select an R value so that the voltage between the COM terminal and the input terminal will be less than 2.4 V.

• Control board (input impedance is 4.8 kΩ)

The bleeder resistor R is: $R \leqq \frac{11.52}{4.8I-2.4}$

• Expansion board (input impedance is 4.4 kΩ)

The bleeder resistor R is: $R \leqq \frac{10.56}{4.4I-2.4}$

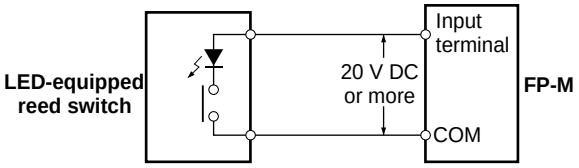
• The wattage W of the resistor is:

$$W = \frac{(\text{Power supply voltage})^2}{R}$$

In the actual selection, use a value that is 3 to 5 times the value of W.

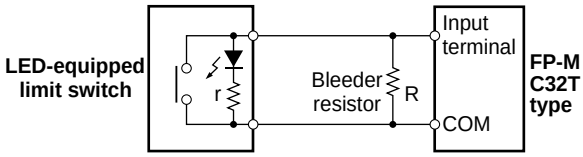
■ Wiring a LED-equipped reed switch

• When a LED is connected serially to an input contact such as the LED-equipped reed switch, make the voltage applied to the FP-M input circuit greater than 20 V. In particular, take care when connecting a number of switches in serial.



■ Wiring a LED-equipped limit switch

• If the input of the FP-M is not turned OFF or if the LED of the limit switch is kept ON because of the leakage current, the use of a bleeder resistor is recommended, as shown below.



r: Internal resistor of limit switch (kΩ)
R: Bleeder resistor (kΩ)

The OFF voltage of the FP-M input is 2.4 V, therefore when the power supply voltage is 24 V, select R so that the current will be greater than $I = \frac{24 - 2.4}{r}$

• Control board (input impedance is 4.8 kΩ)

The bleeder resistor R is: $R \leqq \frac{11.52}{4.8I-2.4}$

• Expansion board (input impedance is 4.4 kΩ)

The bleeder resistor R is: $R \leqq \frac{10.56}{4.4I-2.4}$

• The wattage W of the resistor is:

$$W = \frac{(\text{Power supply voltage})^2}{R}$$

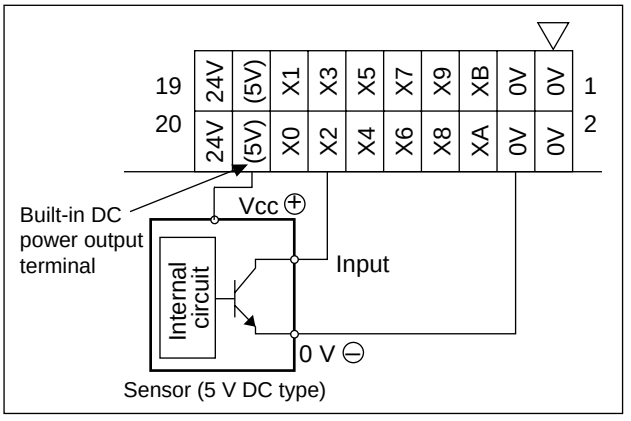
Select a value that is 3 to 5 times the value of W.

■ Connecting an input device with a different voltage (ex.: a 5 V sensor, etc.)

• When connecting a device with a power supply voltage different from the FP-M input voltage, such as a 5 V sensor, connect in common to the built-in DC power output terminal as shown below.

Note:

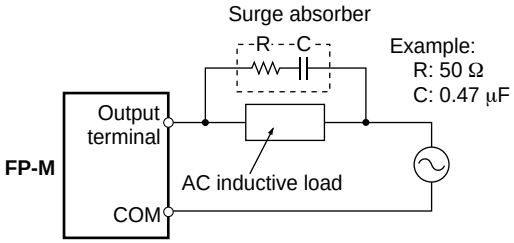
• Some sensors do not allow for this type of use, therefore check the specifications of the sensor before wiring.

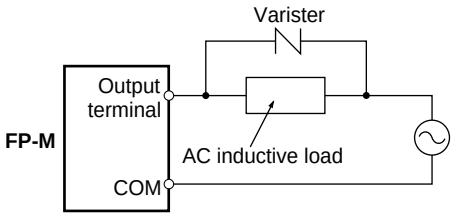


■ Output wiring examples

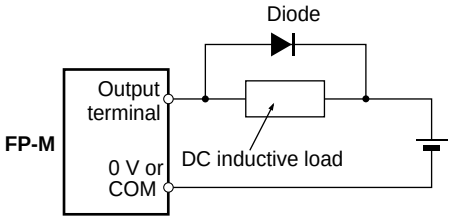
• Connect a protective circuit such as the one shown below when switching inductive loads.
When switching DC type inductive loads with a relay output type, be sure to connect a diode across the ends of the load.

When using an AC inductive load

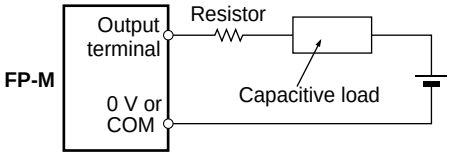


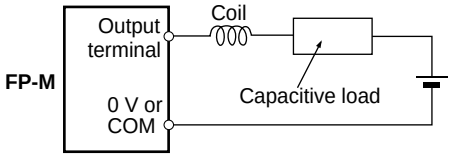


When using a DC inductive load



When using a capacitive load





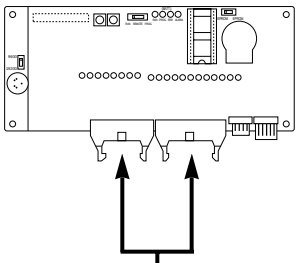
• **Mounting the protective device**
In the actual circuit, it is necessary to locate the protective device (diode, resistor, capacitor, varister, etc.) in the immediate vicinity of the load or contact. If located too far away, the effectiveness of the protective device may diminish. As a guide, the distance should be within 50 cm (19.685 in.).

• **Type of load and inrush current**
The type of load and its inrush current characteristics, together with the switching frequency are important factors which cause contact welding. Particularly for loads with inrush currents, measure the steady state current and inrush current and use a relay or magnet switch which provides an ample margin of safety. The table on the right shows the relationship between typical loads and their inrush currents.

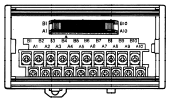
Type of load	Inrush current
Resistive load	Steady state current
Solenoid load	10 to 20 times the steady state current
Motor load	5 to 10 times the steady state current
Incandescent lamp load	10 to 15 times the steady state current
Mercury lamp load	Approx. 3 times the steady state current
Sodium vapor lamp load	1 to 3 times the steady state current
Capacitive load	20 to 40 times the steady state current
Transformer load	5 to 15 times the steady state current

5) Wiring for I/O connectors (MIL connector)

• There are the following 4 methods for wiring to the I/O connectors (MIL connectors) on each board.



CT-2 connector terminal

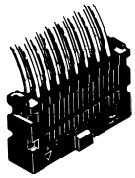


• The I/O connector on the board and the connector on the CT-2 connector terminal can be connected using a cable. Input wiring and transistor output wiring is easy.

RT-2 relay terminal

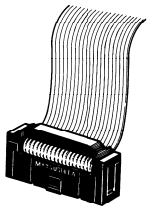
• The terminals are connected using a cable. This eliminates the work required for wiring.
• Control of up to 2 A is possible using this terminal, and maintenance and inspection such as relay replacements are easy.

Wire-press socket



• A twisted wire (0.2 to 0.3 mm-squared) can be connected directly.
• The wiring can be done easily using wires with the covers on, and a pressure welder.
• Wiring mistakes can also be corrected easily.

Flat cable connector



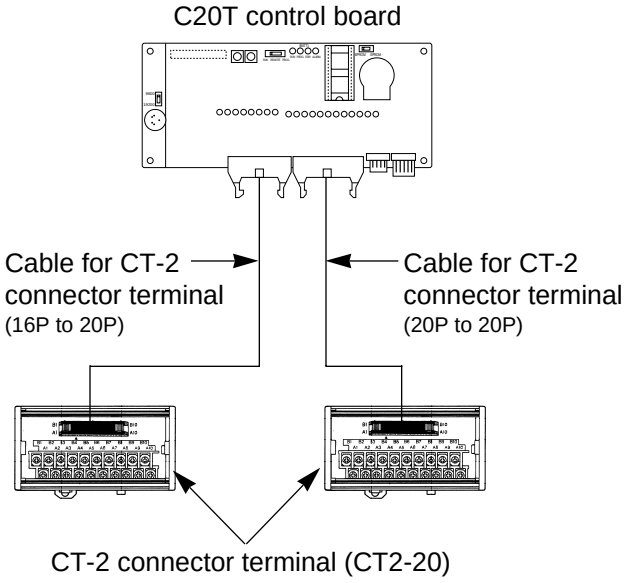
• Wiring can be done easily using a flat cable with a connector on only one end.

■ CT-2 connector terminal

- Select a CT-2 connector terminal and a cable for the CT-2 connector terminal with the correct number of pins for the connector on each board.
- Use a terminal block for M3 size screws for the connector on the CT-2 connector terminal.

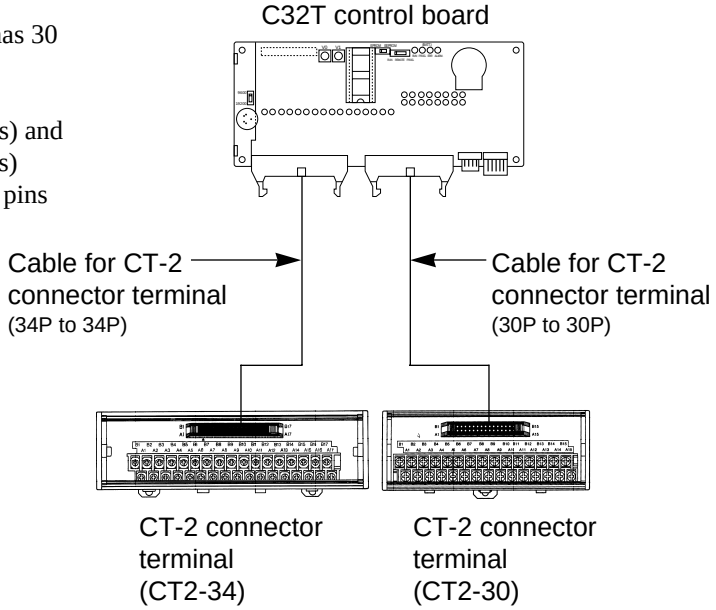
Connector example 1: C20T control board

- The I/O connector for the C20T control board has 20 input pins and 16 output pins.
  Use:
  - CT-2 connector terminals: CT2-20 (for 16 pins and 20 pins)
  - Cable for CT-2 connector terminal: 16 and 20 pins



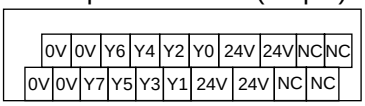
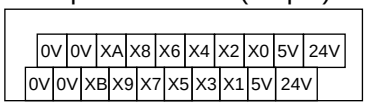
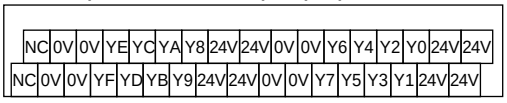
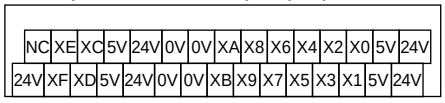
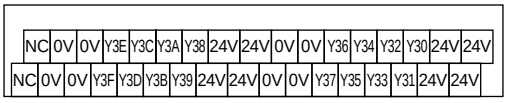
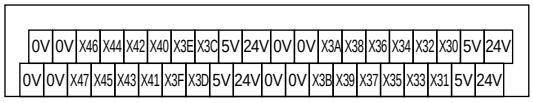
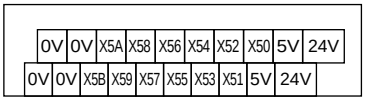
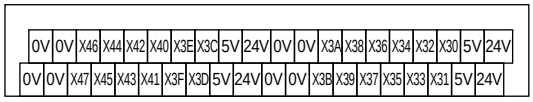
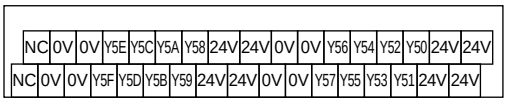
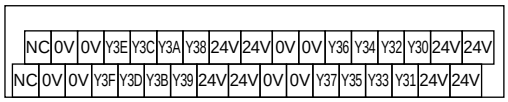
Connector example 2: C32T control board

- The I/O connector for the C32T control board has 30 input pins and 34 output pins.
  Use:
  - CT-2 connector terminals: CT2-30 (for 30 pins) and CT2-34 (for 34 pins)
  - Cable for CT-2 connector terminal: 30 and 34 pins



Pin layouts of the CT-2 connector terminal

• When connecting the CT-2 connector terminal to each board, the terminal marked "▼" on the I/O connector for each board is connected to the A1 terminal on the CT-2 connector terminal.

Board type	Pin layout of CT-2 connector terminal
C20T, C20TC control board	For output connector (20-pin)  For input connector (20-pin) 
C32T, C32TC control board	For output connector (34-pin)  For input connector (30-pin) 
M1T-E expansion I/O board	For output connector (34-pin)  For input connector (40-pin) 
M1T-EI expansion input board	For input connector B (20-pin)  For input connector A (40-pin) 
M1T-EO expansion output board	For output connector B (34-pin)  For output connector A (34-pin) 

Product types

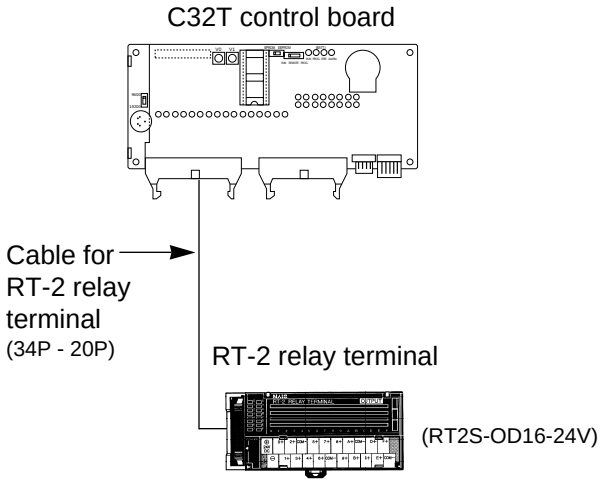
Board type	Number of pins	CT-2 connector terminal	Cable for CT-2 connector terminal
C20T, C20TC control board	Output: 16	CT2-20	AYT51163 (1 m), AYT51165 (2 m)
	Input : 20		AYT51203 (1 m), AYT51205 (2 m)
C32T, C32TC control board	Output: 34	CT2-34	AYT51343 (1 m), AYT51345 (2 m)
	Input : 30	CT2-30	AYT51303 (1 m), AYT51305 (2 m)
M1T-E expansion I/O board	Output: 34	CT2-34	AYT51343 (1 m), AYT51345 (2 m)
	Input : 40	CT2-40	AYT51403 (1 m), AYT51405 (2 m)
M1T-EI expansion input board	Connector B: 20	CT2-20	AYT51203 (1 m), AYT51205 (2 m)
	Connector A: 40	CT2-40	AYT51403 (1 m), AYT51405 (2 m)
M1T-EO expansion output board	Connector B: 34	CT2-34	AYT51343 (1 m), AYT51345 (2 m)
	Connector A: 34		AYT51343 (1 m), AYT51345 (2 m)

■ RT-2 relay terminal

- Number of connectable RT-2 relay terminal output type
  - C20T, C20TC, C32T and C32TC control board: 1 terminal
  - M1T-E expansion board: 1 terminal
  - M1T-EO expansion board: 2 terminals
- Use a terminal block for M3 size screws for the RT-2 relay terminal connector.
- Apply a 24 V DC power supply to the 24 V DC (+) and (-) terminals to drive the relays on the RT-2 relay terminal. Use the same power supply for the board I/O and for the RT-2 relay terminal.
- The terminals on the RT-2 relay terminal and the board I/O allocation are given in the table below:

Terminal No.	I/O allocation
0+	Y0
1+	Y1
2+	Y2
3+	Y3
COM-	Common for Y0 to Y3
4+	Y4
5+	Y5
6+	Y6
7+	Y7
COM-	Common for Y4 to Y7
8+	Y8
9+	Y9
A+	YA
B+	YB
COM-	Common for Y8 to YB
C+	YC
D+	YD
E+	YE
F+	YF
COM-	Common for YC to YF

Connector example:



Product types

Board type	Number of pins	RT-2 relay terminal	Cable for RT-2 relay terminal
C20T, C20TC control board	Output: 16	• RT2S-OD16-24V (DIN rail mounting type) • RT2S-M-OD16-24V (Direct mounting type)	AY15723 (1 m), AY15725 (2 m)
C32T, C32TC control board	Output: 34		AY25523 (1 m), AY25525 (2 m)
M1T-E expansion I/O board	Output: 34		
M1T-EO expansion output board	Connector B: 34 Connector A: 34		

Notes:

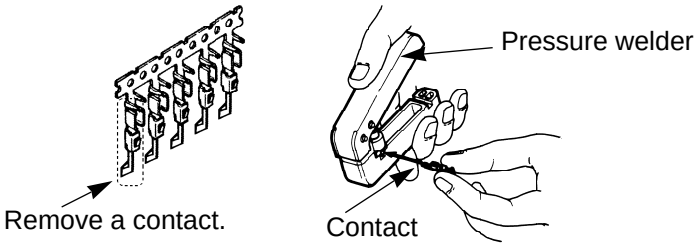
- The I/O connector for the C20T control board has 8 output pins. Use 8 pins (0+ to 7+ terminals) for the RT-2 relay terminal.
- The PC relay terminal of the 8 output pins (part No. RT1S-OD08-24V-S) can also be used.

■ Wiring using wire-press socket for loose wires

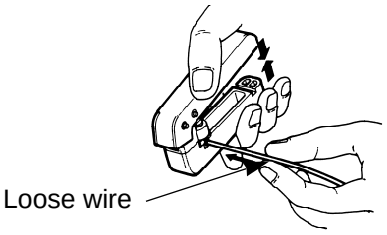
• The following describes how to assemble the wire-press socket for loose wires.

Procedure

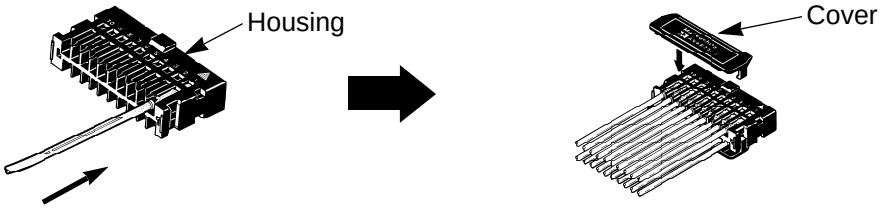
1. Insert the removed contact into a pressure welder.



2. Firmly insert the covered loose wire to the end and lightly squeeze the welder.

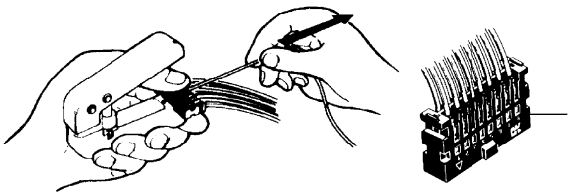


3. Insert the wires with the pressure-connected contacts into the housing. After inserting all the wires, mount the cover and finish the socket.



Note:

• If there is a wiring mistake or the cable is incorrectly pressure-connected, the contact puller pin on the welder can be used to remove the contact.



Applicable cables

Number	Cross section area	External figure	Rated current
AWG #22	0.3 mm²	1.1 to 1.5 dia.	3 A
AWG #24	0.2 mm²		

Note:

• AWG #22: 12 wires per 0.18 should be used.

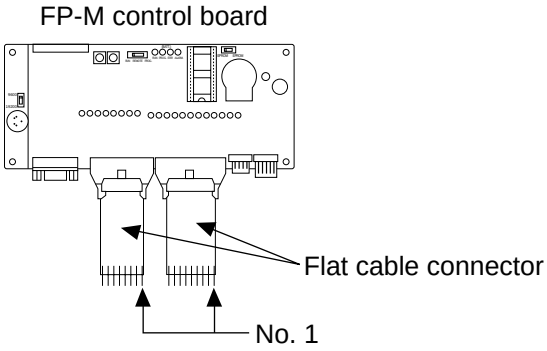
Product types

Board type	Number of pins	Housing	Cover	Contact (5 in line)
C20T, C20TC control board	Output: 16	AXW1164A	AXW61601A	AXW7221 for AWG #22, 24
	Input: 20	AXW1204A	AXW62001A	
C32T, C32TC control board	Output: 34	AXW1344A	AXW63401A	
	Input: 30	AXW1304A	AXW63001A	
M1T-E expansion I/O board	Output: 34	AXW1344A	AXW63401A	
	Input: 40	AXW1404A	AXW64001A	
M1T-EI expansion input board	Connector B: 20	AXW1204A	AXW62001A	
	Connector A: 40	AXW1404A	AXW64001A	
M1T-EO expansion output board	Connector B: 34	AXW1344A	AXW63401A	
	Connector A: 34			

Stapler type pressure welder for loose wires: AXY52000

■ Wiring using flat cable connector

• The following shows the wiring for a flat cable connector.



• Connect “No. 1” on the flat cable to the terminal marked “▼” on the I/O connector for each board.

Applicable flat cable

Number	Pitch	Rated current
AWG #28 stranded wire (7 leads of 0.127 dia.)	1.27 mm	1 A

Product types

Board type	Number of pins	Flat cable connector	Connector
C20T, C20TC control board	Output: 16	APL9531 (1 m), APL9532 (2 m)	AXM116415
	Input: 20	APL9541 (1 m), APL9542 (2 m)	AXM120415
C32T, C32TC control board	Output: 34	AFB8531 (1 m), AFB8532 (2 m)	AXM134415
	Input: 30	AFB8521 (1 m), AFB8522 (2 m)	AXM130415
M1T-E expansion I/O board	Output: 34	AFB8531 (1 m), AFB8532 (2 m)	AXM134415
	Input: 40	AFB8541 (1 m), AFB8542 (2 m)	AXM140415
M1T-EI expansion input board	Connector B: 20	APL9541 (1 m), APL9542 (2 m)	AXM120415
	Connector A: 40	AFB8541 (1 m), AFB8542 (2 m)	AXM140415
M1T-EO expansion output board	Connector B: 34	AFB8531 (1 m), AFB8532 (2 m)	AXM134415
	Connector A: 34		

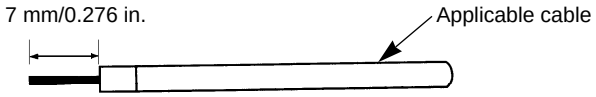
6) Wiring for I/O terminals

• The following shows how to wire the I/O terminals for each board.

■ Wiring not using solderless terminals

Procedure:

• Remove 7 mm of the cover from the applicable cable and insert it directly into the I/O terminal. Mount with a screwdriver.



Applicable cables: AWG #26 to #18 (0.128 mm^2 to 1.81 mm^2)

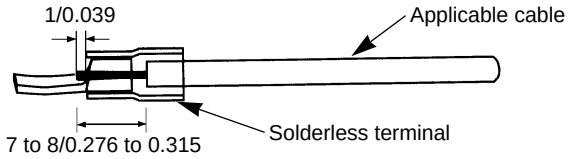
Note:

• The wiring may become disconnected due to vibration, so do not use soldered cables.

■ Wiring using solderless terminals

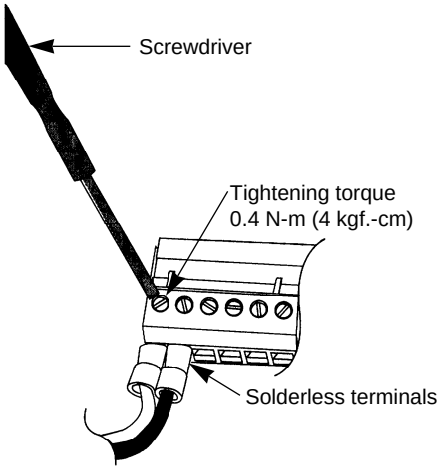
Procedure:

1. Remove 7 to 8 mm of the cover from the applicable cable and insert into the solderless terminal.

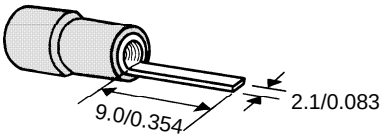


(unit: mm/in.)

2. Insert the cable with the solderless terminal into the I/O terminal and tighten using a screwdriver. The torque should be less than 0.4 N-m (4 kgf-cm).



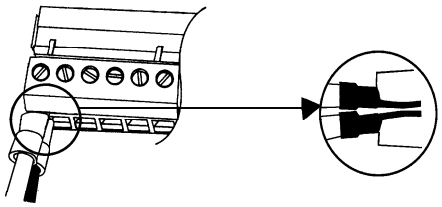
Applicable cables: AWG #28 to #16 (0.08 mm^2 to 2.5 mm^2)
Product type
Solderless terminals (100 pcs): AFC8805



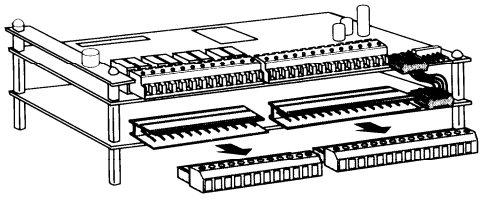
(unit: mm/in.)

Notes:

• When connecting 2 wires to a single terminal, insert as shown in the drawing to the right.

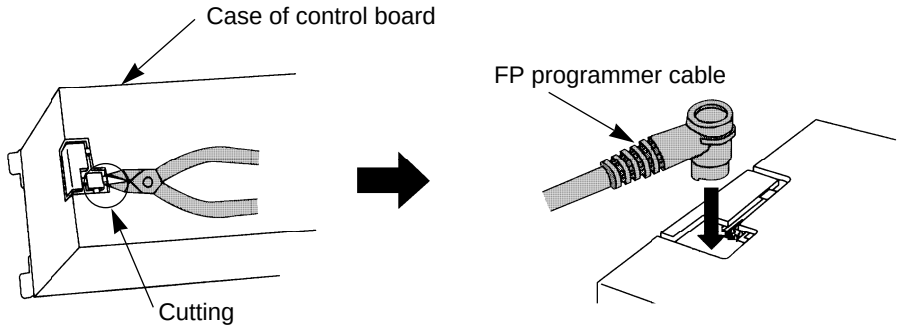


• It is possible to remove the I/O terminals from the expansion boards and intelligent boards to wire.



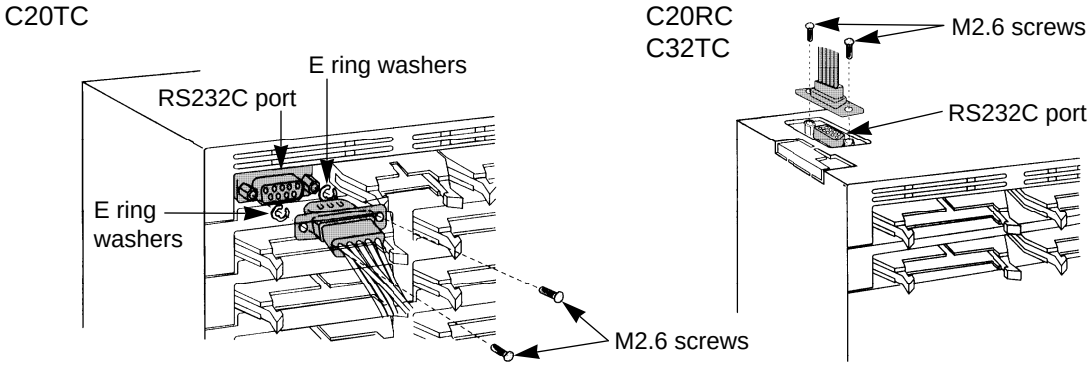
7) Wiring for programming tool port

• For the case type, when connecting the FP programmer cable with the control board through the case, cut the case in 3 places as shown below.



8) Wiring for RS232C port

• Connect an RS232C cable to the RS232C port on the C20RC, C20TC, and C32TC control boards.



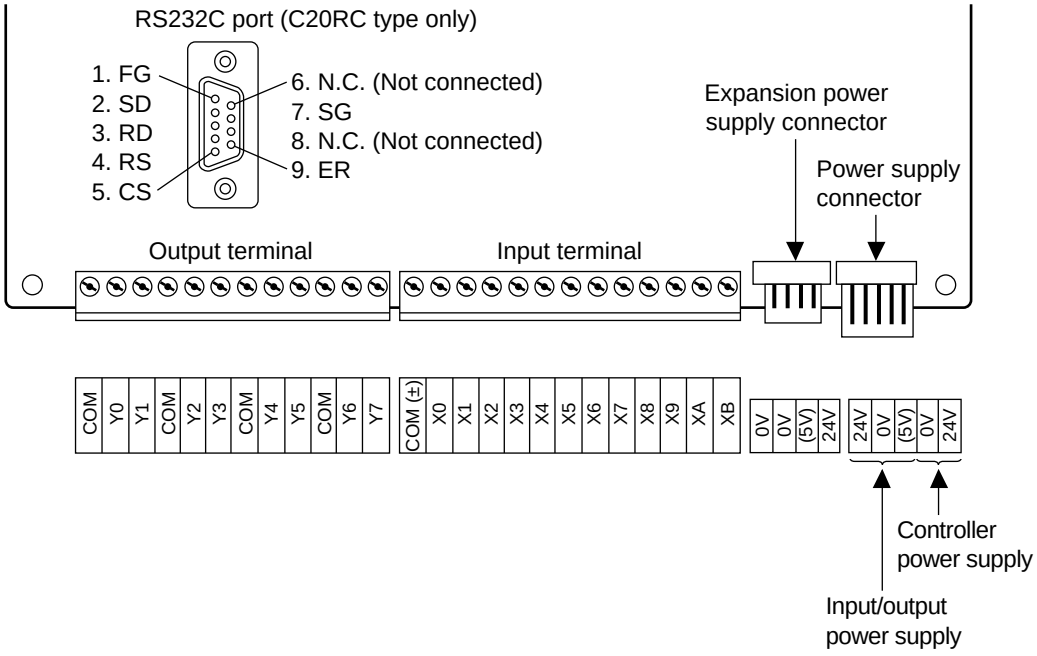
3. Wiring Diagram and Pin Layouts

1) Control boards

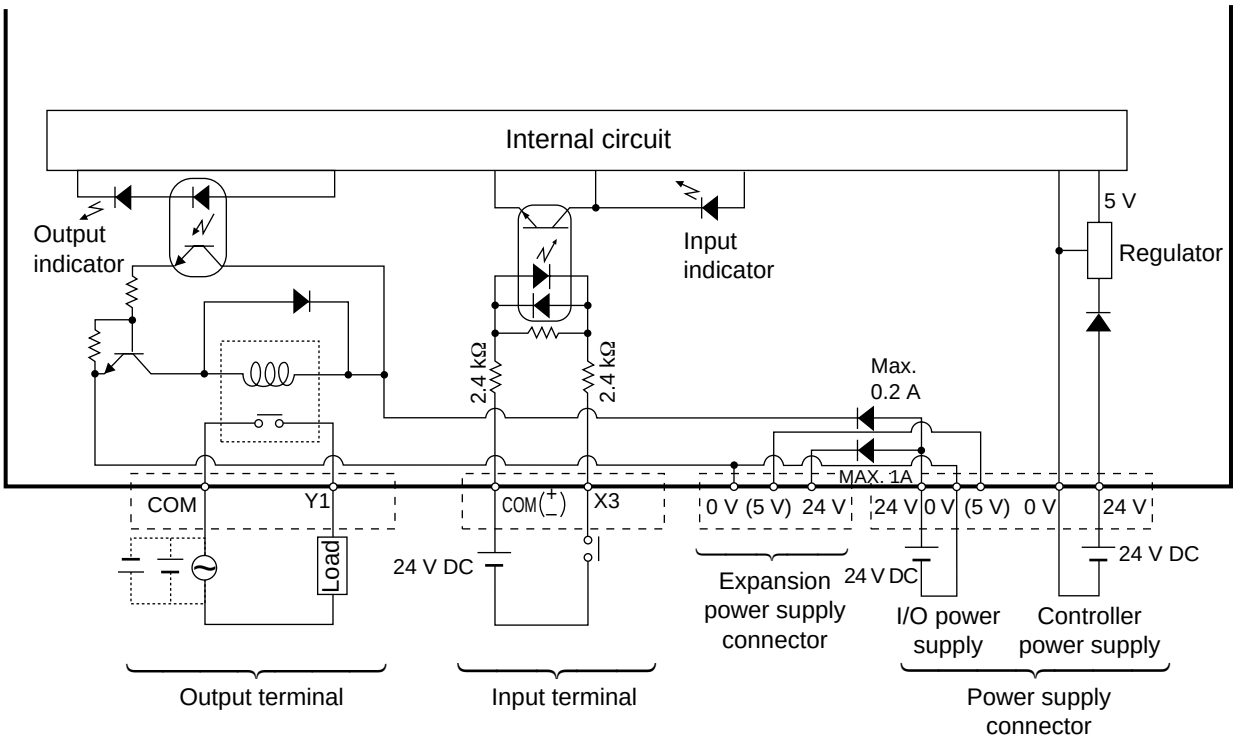
C20R and C20RC types

■ Pin layout

• The I/O addresses for the C20R and C20RC control boards are fixed as follows.



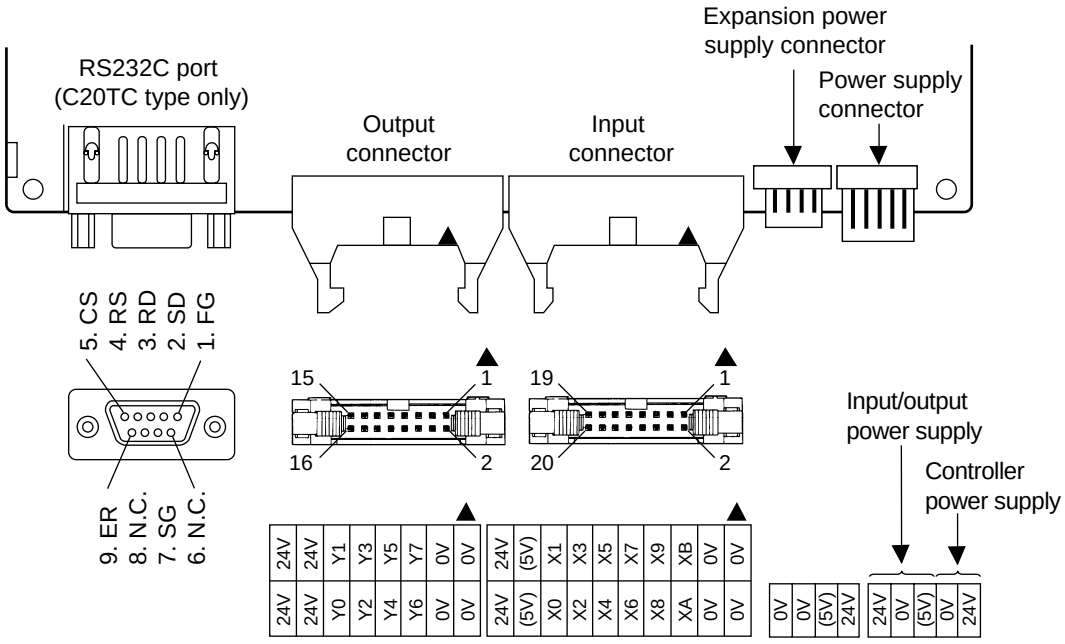
■ Internal circuit and wiring example



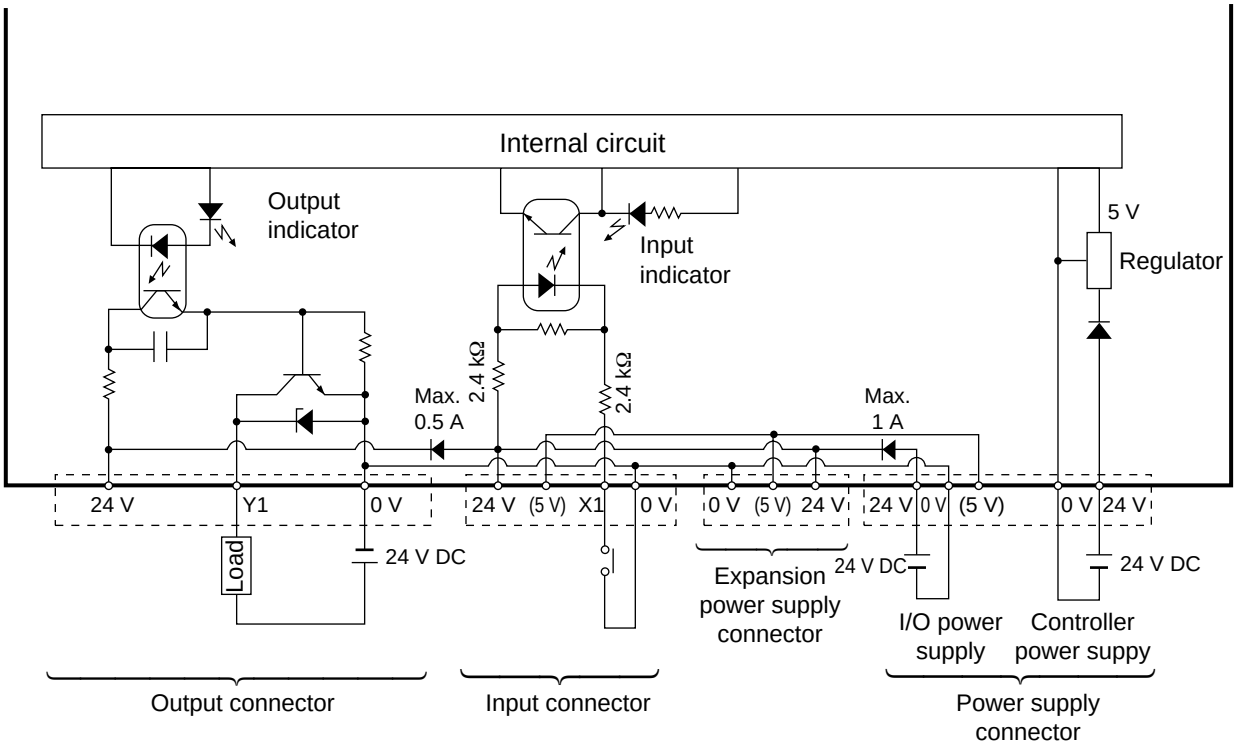
C20T and C20TC types

■ Pin layout (transistor output type)

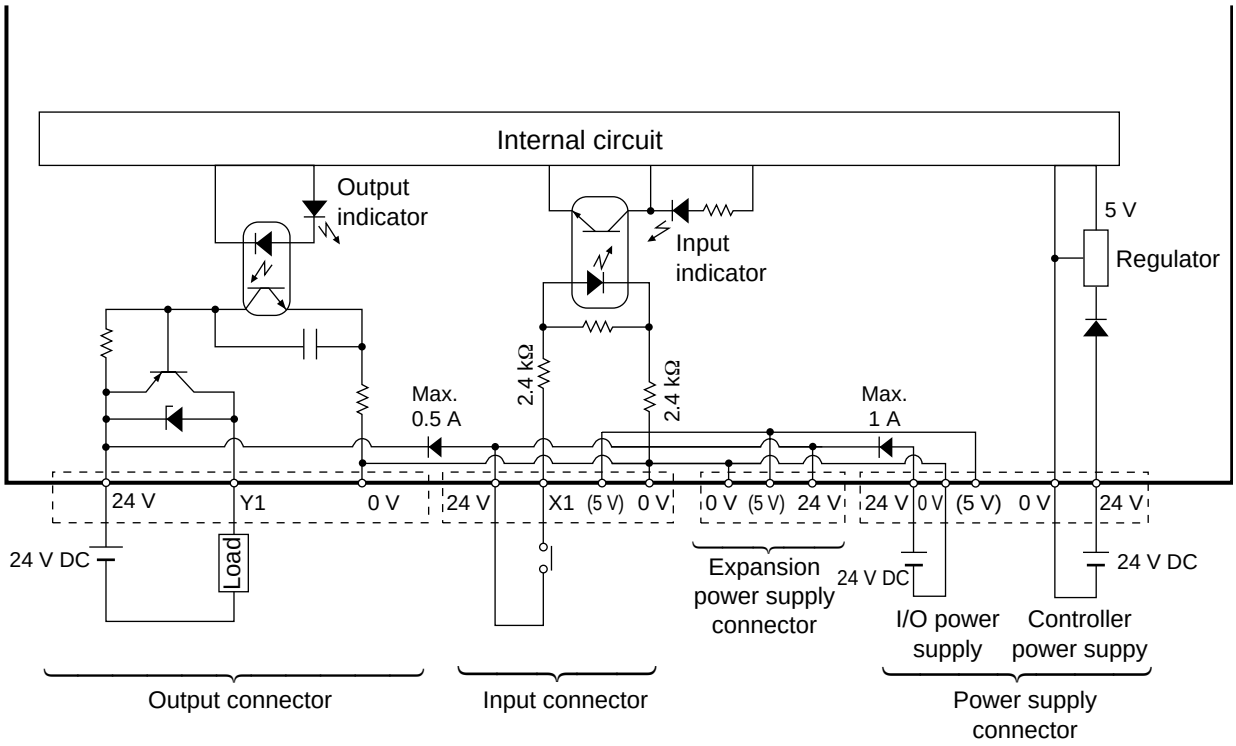
• The I/O addresses for the C20T and C20TC control boards are fixed as follows.



■ Internal circuit and wiring example (NPN open collector output type)



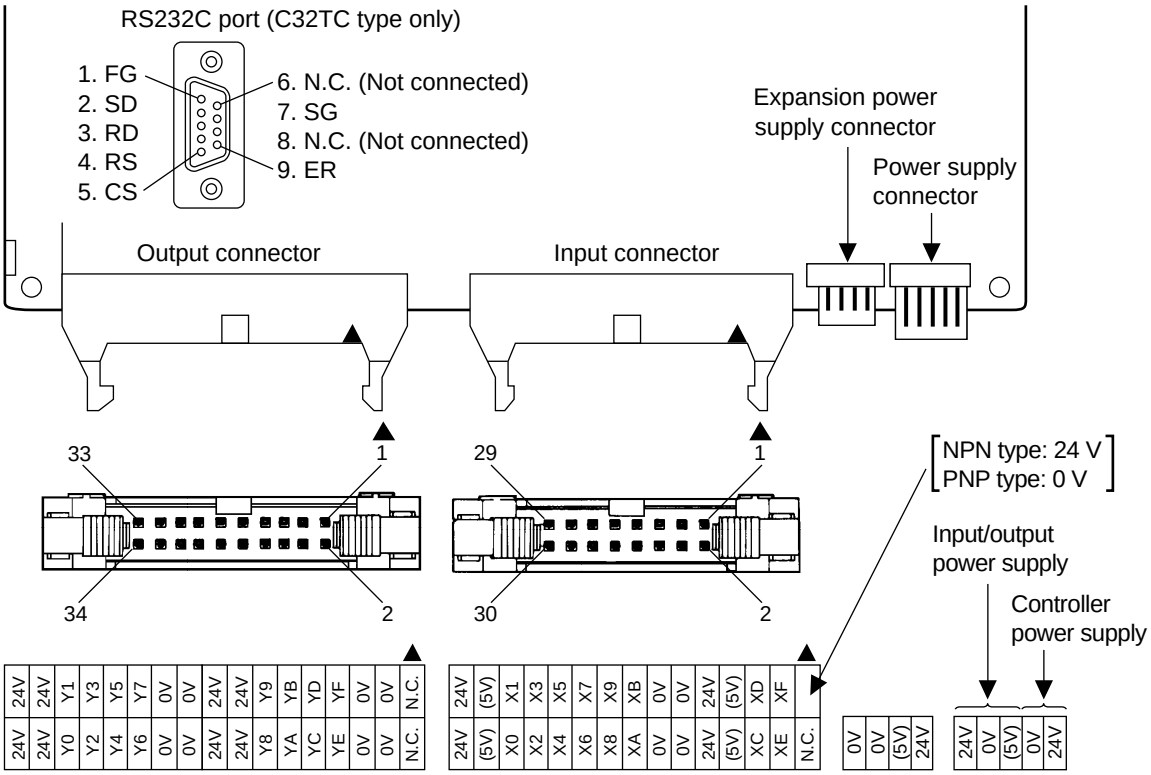
■ Internal circuit and wiring example (PNP open collector output type)



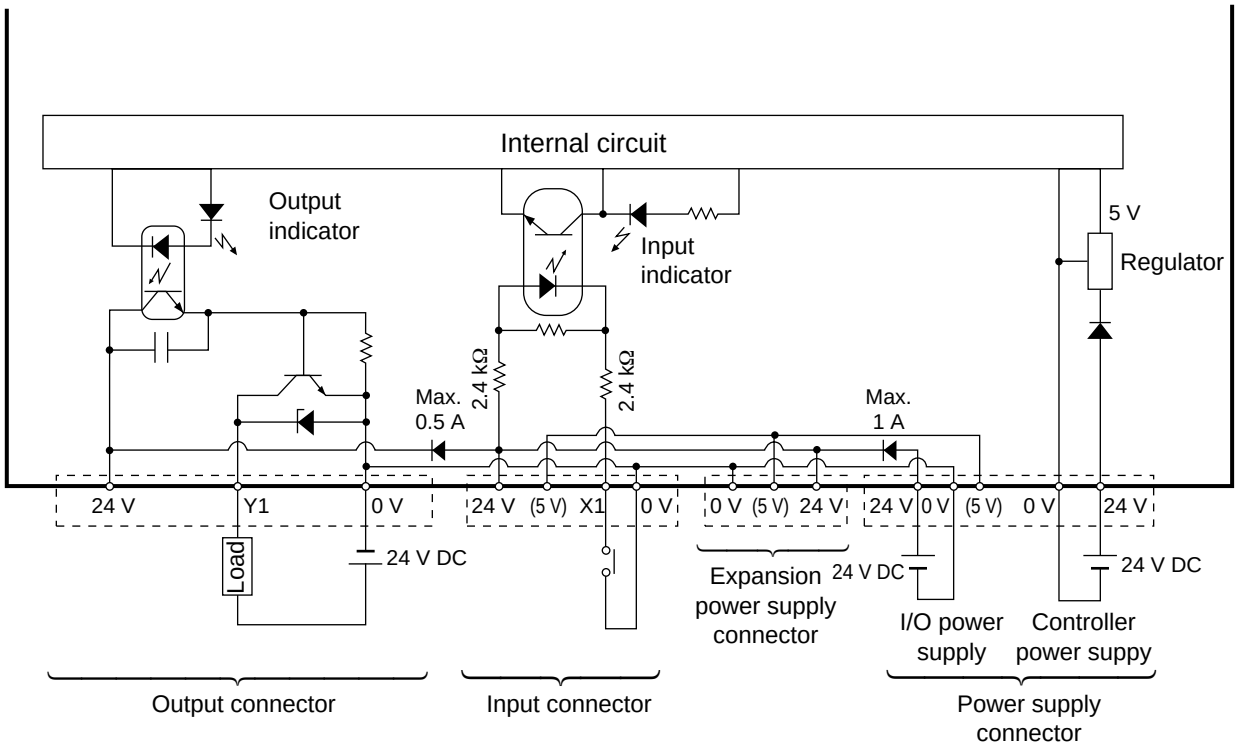
C32T and C32TC types

■ Pin layout (transistor output type)

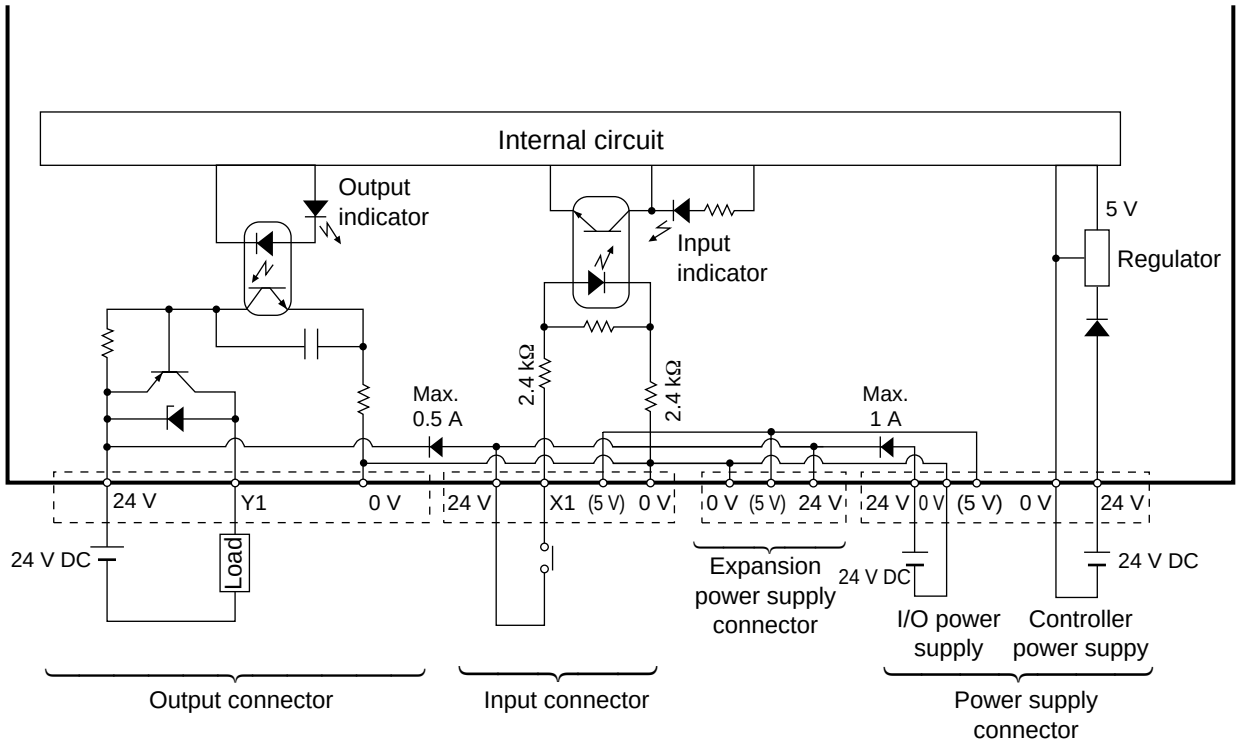
• The I/O addresses for the C32T and C32TC control boards are fixed as follows.



■ Internal circuit and wiring example (NPN open collector output type)



■ Internal circuit and wiring example (PNP open collector output type)

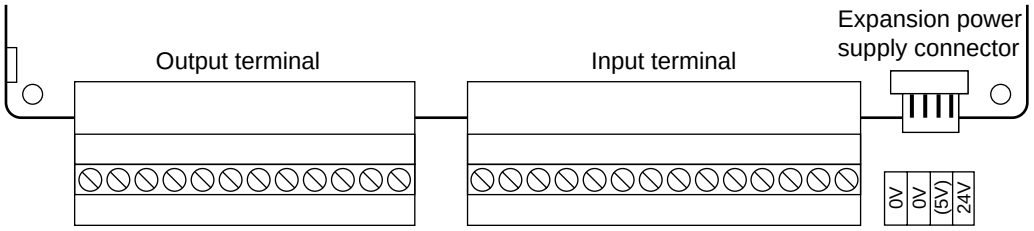


2) Expansion boards

E20R type

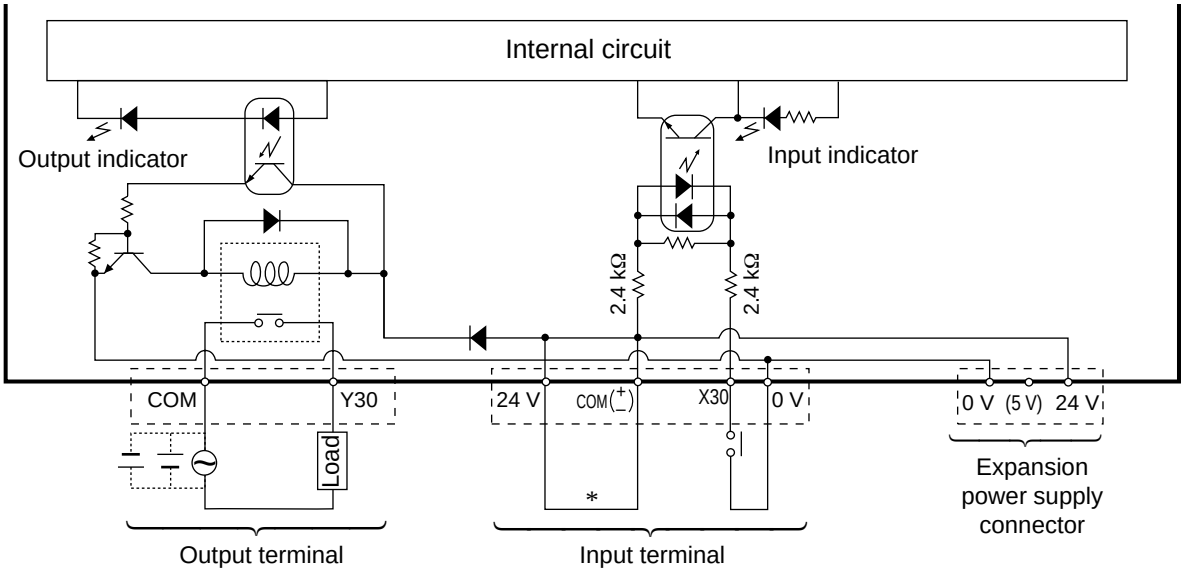
■ Pin layout

• The I/O addresses for the E20R type expansion board are set by the I/O address setting switch.



Switch position	I/O address of input and output terminal	
	Output terminal	Input terminal
ON OFF 1 2 3 4 5	COM Y30 Y31 COM Y32 Y33 COM Y34 Y35 COM Y36 Y37 Y30 to Y37	24V COM (±) X30 X31 X32 X33 X34 X35 X36 X37 X38 X39 X3A X3B 0V X30 to X3B
ON OFF 1 2 3 4 5	COM Y50 Y51 COM Y52 Y53 COM Y54 Y55 COM Y56 Y57 Y50 to Y57	24V COM (±) X50 X51 X52 X53 X54 X55 X56 X57 X58 X59 X5A X5B 0V X50 to X5B
ON OFF 1 2 3 4 5	COM Y70 Y71 COM Y72 Y73 COM Y74 Y75 COM Y76 Y77 Y70 to Y77	24V COM (±) X70 X71 X72 X73 X74 X75 X76 X77 X78 X79 X7A X7B 0V X70 to X7B
ON OFF 1 2 3 4 5	COM Y90 Y91 COM Y92 Y93 COM Y94 Y95 COM Y96 Y97 Y90 to Y97	24V COM (±) X90 X91 X92 X93 X94 X95 X96 X97 X98 X99 X9A X9B 0V X90 to X9B

■ Internal circuit and wiring example

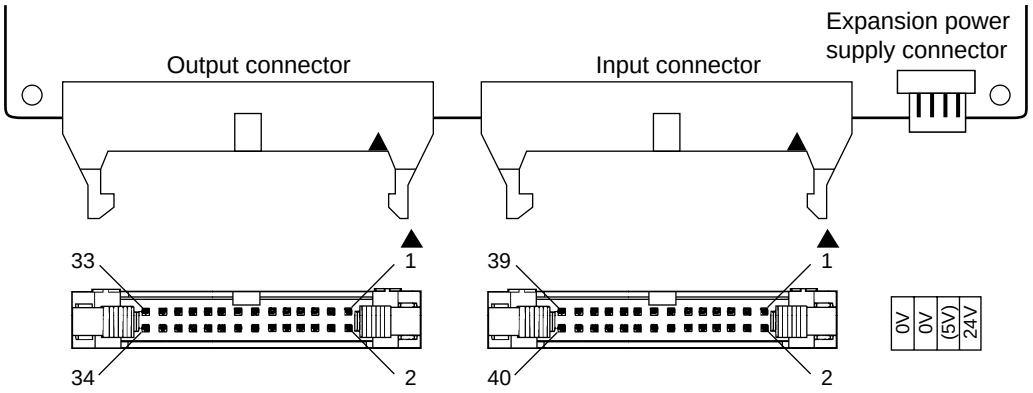


* Short-circuit between
- COM (±) and 24 V: Source input mode
- COM (±) and 0 V: Sink input mode

M1T-E type

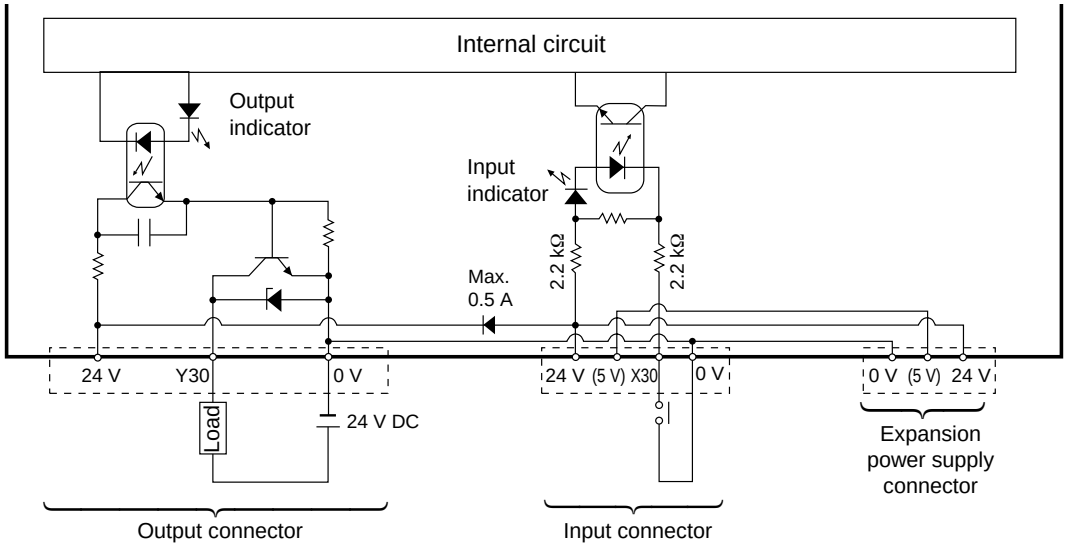
■ Pin layout (transistor output type)

• The I/O addresses for the M1T-E type expansion board are set by the I/O address setting switch.

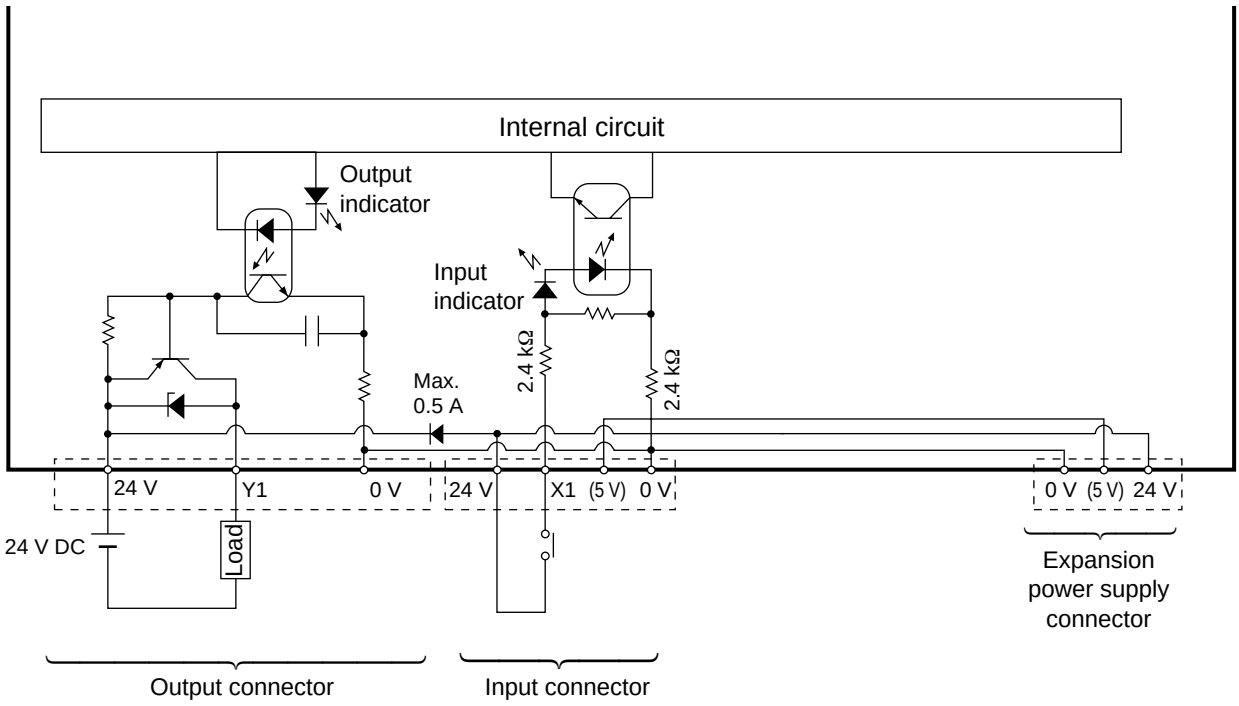


Switch position	I/O address of input and output connector	
	Output connector	Input connector
ON OFF 1 2 3 4 5	24V 24V Y31 Y33 Y35 Y37 0V 0V 24V 24V Y39 Y3B Y3D Y3F 0V 0V N.C. 24V 24V Y30 Y32 Y34 Y36 0V 0V 24V 24V Y38 Y3A Y3C Y3E 0V 0V N.C. Y30 to Y3F	24V (5V) X31 X33 X35 X37 X39 X3B 0V 0V 24V (5V) X3D X3F X41 X43 X45 X47 0V 0V 24V (5V) X30 X32 X34 X36 X38 X3A 0V 0V 24V (5V) X3C X3E X40 X42 X44 X46 0V 0V X30 to X3F, X40 to X47
ON OFF 1 2 3 4 5	24V 24V Y51 Y53 Y55 Y57 0V 0V 24V 24V Y59 Y5B Y5D Y5F 0V 0V N.C. 24V 24V Y50 Y52 Y54 Y56 0V 0V 24V 24V Y58 Y5A Y5C Y5E 0V 0V N.C. Y50 to Y5F	24V (5V) X51 X53 X55 X57 X59 X5B 0V 0V 24V (5V) X5D X5F X61 X63 X65 X67 0V 0V 24V (5V) X50 X52 X54 X56 X58 X5A 0V 0V 24V (5V) X5C X5E X60 X62 X64 X66 0V 0V X50 to X5F, X60 to X67
ON OFF 1 2 3 4 5	24V 24V Y71 Y73 Y75 Y77 0V 0V 24V 24V Y79 Y7B Y7D Y7F 0V 0V N.C. 24V 24V Y70 Y72 Y74 Y76 0V 0V 24V 24V Y78 Y7A Y7C Y7E 0V 0V N.C. Y70 to Y7F	24V (5V) X71 X73 X75 X77 X79 X7B 0V 0V 24V (5V) X7D X7F X81 X83 X85 X87 0V 0V 24V (5V) X70 X72 X74 X76 X78 X7A 0V 0V 24V (5V) X7C X7E X80 X82 X84 X86 0V 0V X70 to X7F, X80 to X87
ON OFF 1 2 3 4 5	24V 24V Y91 Y93 Y95 Y97 0V 0V 24V 24V Y99 Y9B Y9D Y9F 0V 0V N.C. 24V 24V Y90 Y92 Y94 Y96 0V 0V 24V 24V Y98 Y9A Y9C Y9E 0V 0V N.C. Y90 to Y9F	24V (5V) X91 X93 X95 X97 X99 X9B 0V 0V 24V (5V) X9D X9F X101 X103 X105 X107 0V 0V 24V (5V) X90 X92 X94 X96 X98 X9A 0V 0V 24V (5V) X9C X9E X100 X102 X104 X106 0V 0V X90 to X9F, X100 to X107

■ Internal circuit and wiring example (NPN open collector output type)



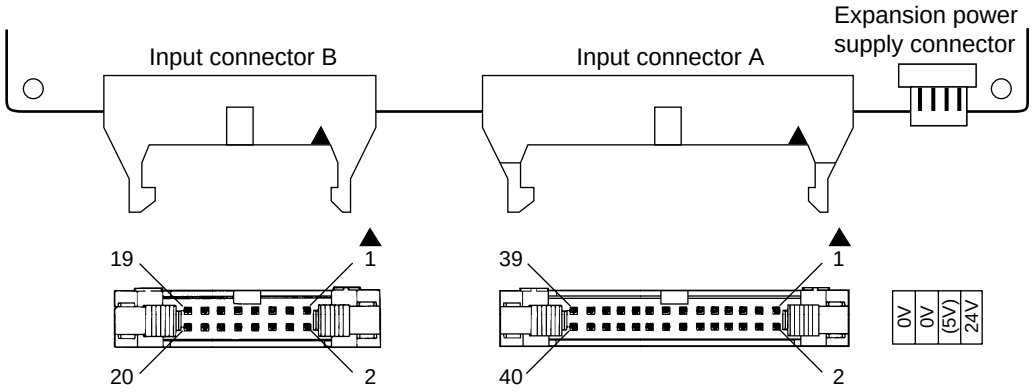
■ Internal circuit and wiring example (PNP open collector output type)

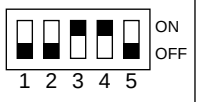
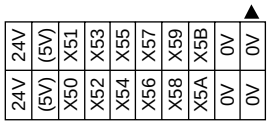
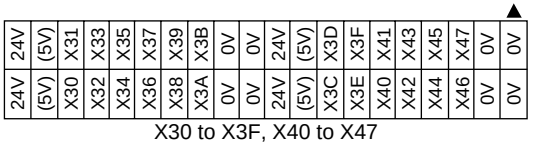
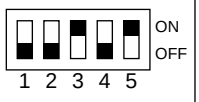
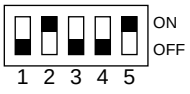
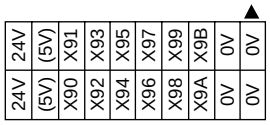
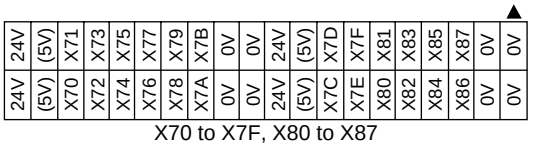


M1T-EI type

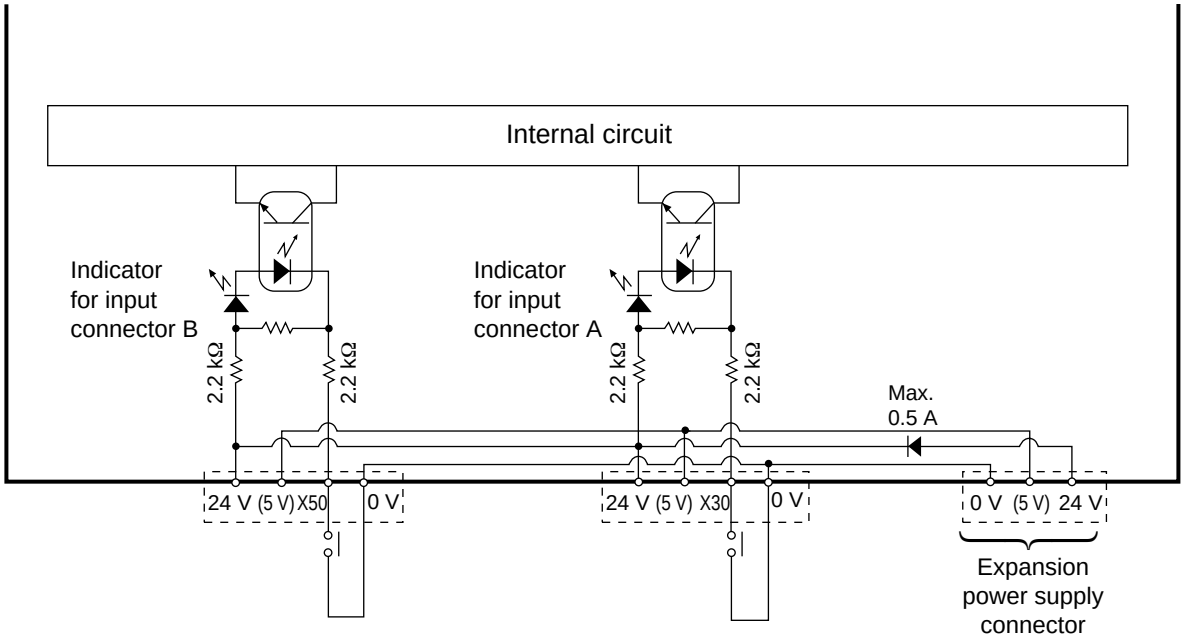
■ Pin layout

• The input addresses for the M1T-EI type expansion board are set by the I/O address setting switches.



Switch position		Input address of input connector	
Block B (SW2)	**Block A (SW1)**	**Input connector B**	**Input connector A**
		 X50 to X5B	 X30 to X3F, X40 to X47
		 X90 to X9B	 X70 to X7F, X80 to X87

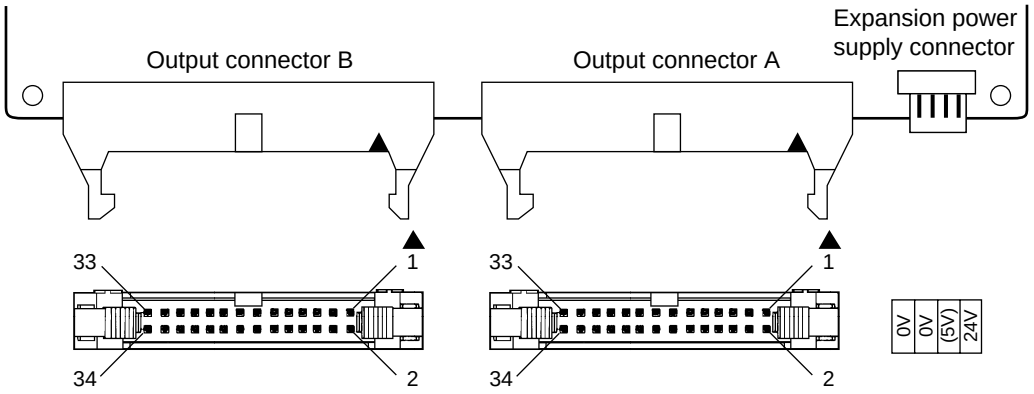
■ Internal circuit and wiring example



M1T-EO type

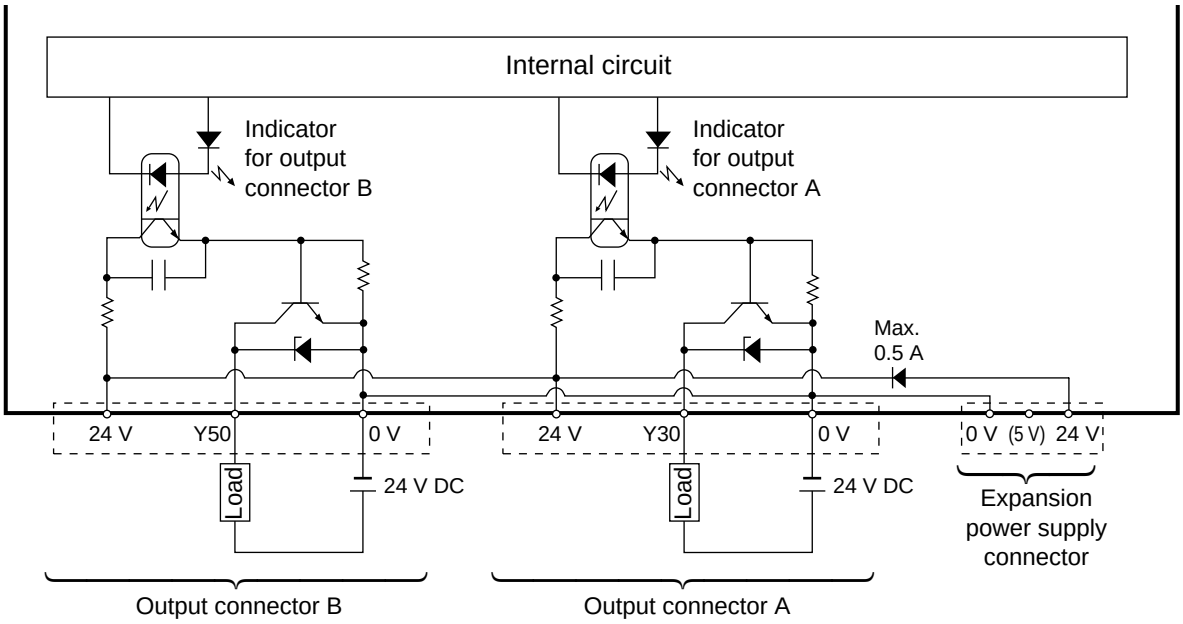
■ Pin layout (transistor output type)

• The output addresses for the M1T-EO type expansion board are set by the I/O address setting switches.



Switch position		Output address of output connector	
Block B (SW2)	Block A (SW1)	Output connector B	Output connector A
ON OFF 1 2 3 4 5	ON OFF 1 2 3 4 5	24V 24V Y51 Y53 Y55 Y57 0V 0V 24V 24V Y59 Y5B Y5D Y5F 0V 0V N.C. 24V 24V Y50 Y52 Y54 Y56 0V 0V 24V 24V Y58 Y5A Y5C Y5E 0V 0V N.C. Y50 to Y5F	24V 24V Y31 Y33 Y35 Y37 0V 0V 24V 24V Y39 Y3B Y3D Y3F 0V 0V N.C. 24V 24V Y30 Y32 Y34 Y36 0V 0V 24V 24V Y38 Y3A Y3C Y3E 0V 0V N.C. Y30 to Y3F
ON OFF 1 2 3 4 5	ON OFF 1 2 3 4 5	24V 24V Y91 Y93 Y95 Y97 0V 0V 24V 24V Y99 Y9B Y9D Y9F 0V 0V N.C. 24V 24V Y90 Y92 Y94 Y96 0V 0V 24V 24V Y98 Y9A Y9C Y9E 0V 0V N.C. Y90 to Y9F	24V 24V Y71 Y73 Y75 Y77 0V 0V 24V 24V Y79 Y7B Y7D Y7F 0V 0V N.C. 24V 24V Y70 Y72 Y74 Y76 0V 0V 24V 24V Y78 Y7A Y7C Y7E 0V 0V N.C. Y70 to Y7F

■ Internal circuit and wiring example (NPN open collector output type)



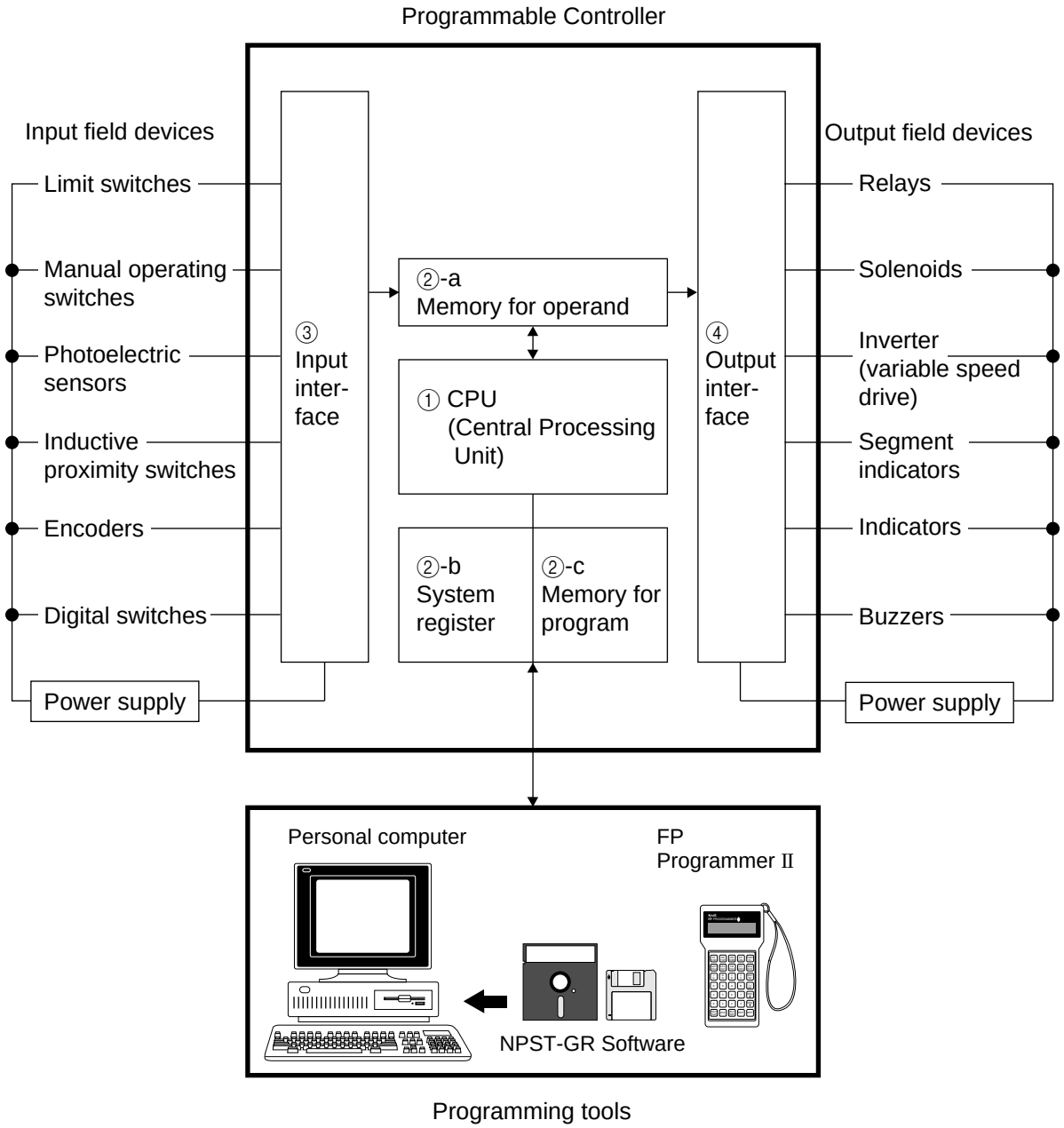
CHAPTER 5

BEFORE PROGRAMMING

5-1. Operating Principles of the Programmable Controller

1. Basic Configuration

A programmable controller is composed of four basic sections: ① CPU, ② memory, ③ input interface, and ④ output interface. An inside look at these sections will help you understand their functions and operation of the programmable controller.



■ Functions of the four sections

① CPU (Central Processing Unit)

Controls the operation of the programmable controller including the I/Os according to the program.

② Memory

Memory areas where the program and information needed for operation of the programmable controller are stored.

Types of Memory

② -a: Memory for operands

The memory area for storing operand data (external input relays, timer/counter set value, and data registers, etc.).

② -b: System register

The memory area for storing the system settings of programmable controllers. Information in this area decides the operand characteristics, advanced control function availabilities, and so on. The system registers can be set using an FP Programmer Ⅱ or personal computer using NPST-GR Software.

② -c: Memory for program

The memory area to store the program for execution. Programs are written using an FP Programmer Ⅱ or personal computer using NPST-GR Software.

③ Input interface

Interface that receives data from the field devices and transfers it to the memory for operands.

④ Output interface

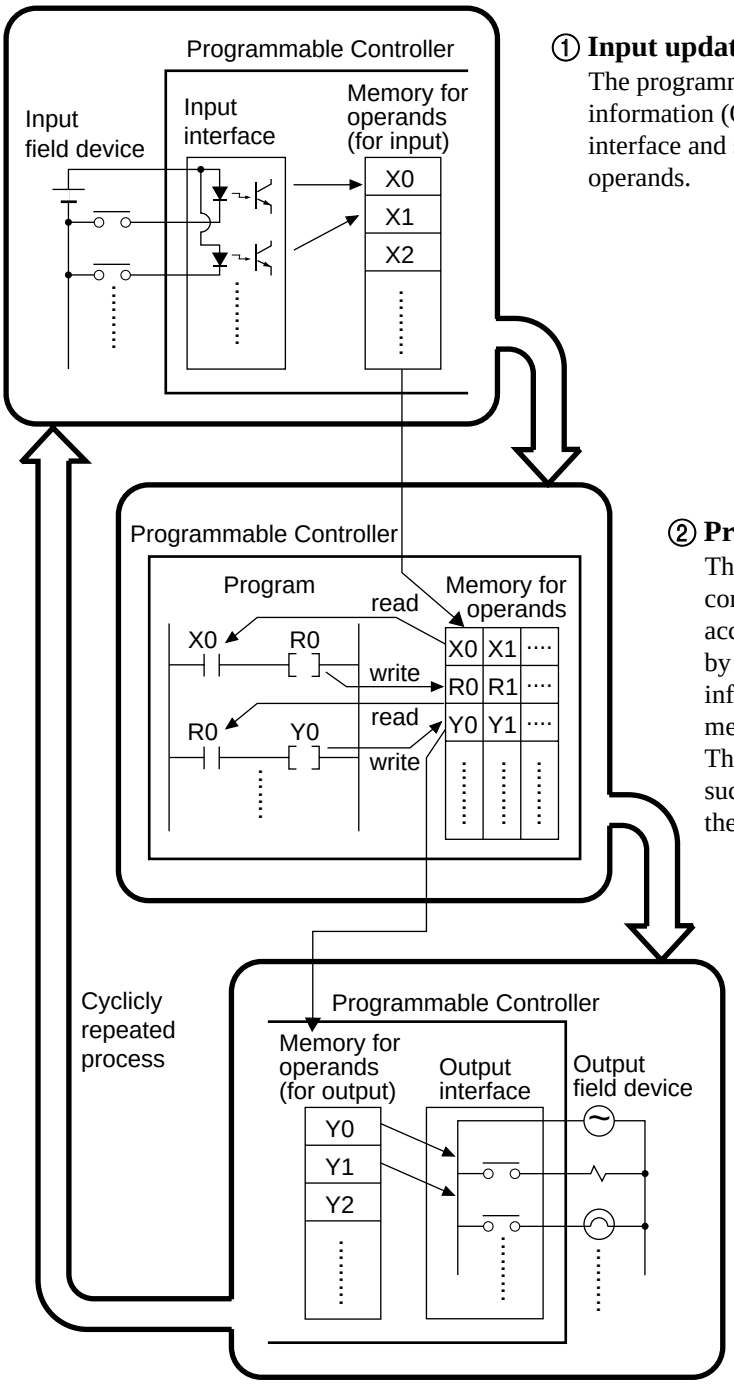
Interface that outputs data from the memory for operands to the field devices.

2. Basic Operation

The basic operation of the programmable controller is:

- To read data from all the input field devices
- To execute the program according to the logic programmed
- To turn the output field devices ON or OFF

The process of reading inputs, executing the program, and updating the outputs is cyclicly repeated in the same manner.



① Input update stage

The programmable controller reads information (ON or OFF) at the input interface and stores it in the memory for operands.

② Program execution stage

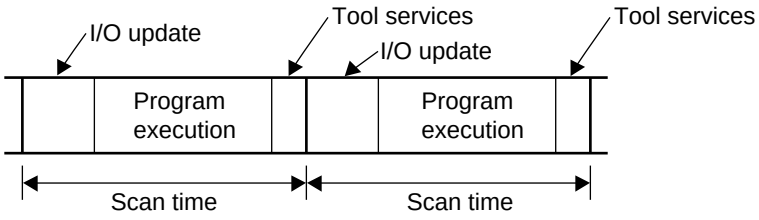
The CPU of the programmable controller executes the program according to the logic programmed by reading and writing the information to and from the memory for operands.
The memory for operands is successively updated according to the execution of the program.

③ Output update stage

After program execution, the information (ON or OFF) in the memory for operands is written to the output interface and turns the output field devices ON or OFF.

■ Scan time of the programmable controller

- The process of input update, program execution, and output update is referred to as a **scan** and the process repeated over and over in the same manner is referred to as the **cyclic execution method.**
- In the cyclic execution method, since the process of input update is performed immediately after the output update, the process of input update and output update is sometimes called **I/O update** for the purpose of simplification.
- In addition to program execution and I/O update, the programmable controller also performs a variety of error checking (self-diagnostic function) and also communicates with the programming tools. These operations are referred to, as a whole, as **tool services** and are performed after program execution.
- Since the **scan time** is defined as the time required for one scan, the cyclic operation of a scan (I/O update, program execution, and tool service) can be shown below.



5-2. Before Turning the Power ON

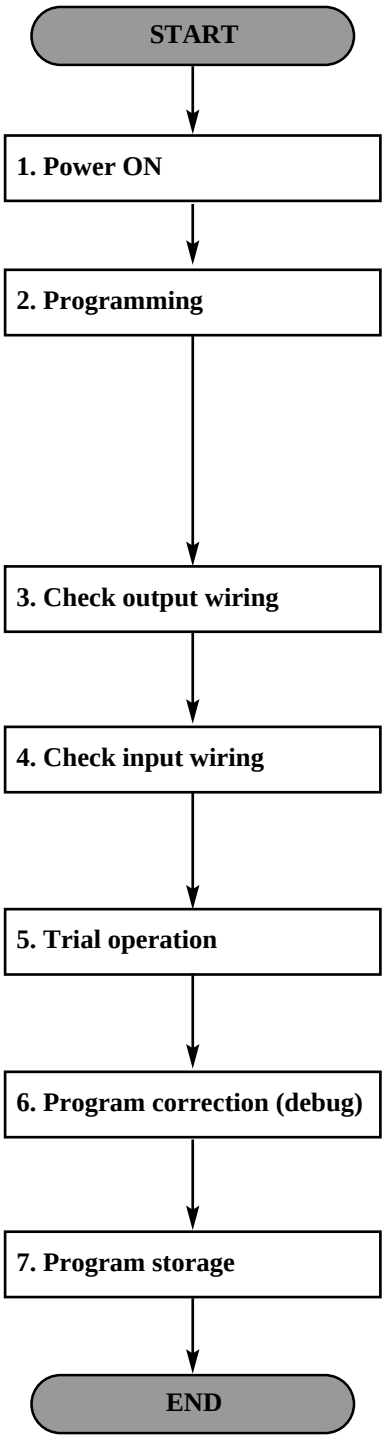
1. Things to Check Before Turning the Power ON

• After wiring, be sure to check these items before turning the power ON.

Check item	Description	Page to see
Board	• Does the board type match the design list ? • Are the mounting screws properly tightened ? • Do the spacer types match the boards ?	page 42 and 43
Power Supply	• Is operating voltage supplied correctly ? • Is the wire size correct ?	page 46 and 47
Wiring	• Does the wiring of connector and terminal match ? • Is the operating voltage of I/O correct ? • Are the expansion power supply cables properly connected ? • Is the wire size correct ?	page 48 to 62
Setting of control board	• Is the mode selector set to the PROG. mode ? • Is the backup battery properly inserted in the holder ? • Is the baud rate selector set correctly ?	page 22 to 27, 84, 100 and 125
Setting of expansion board	• Is the I/O address setting switch on the expansion board set correctly ? • Aren't the I/O addresses overlapping ?	
Memory (EPROM and EEPROM)	• Is the memory (EEPROM or EPROM) properly attached ? • Does the memory type match the position of memory selector ?	page 106 and 107

2. Operation Procedure

• After installation and wiring, perform a trial operation according to the following procedure.



• Before turning the power ON, check the items on the previous page.
• After the power is ON, does the PROG. LED turn ON correctly?

• A program can be written using NPST-GR Software or FP Programmer II.
• Check the program using the self-diagnostic function of the programming tool.

Note:

• Using the FP Programmer Ⅱ, be sure to make the program clear before input.

• Check the output wiring by using the forced output function.

• Check the input wiring by watching the ON/OFF status of the input indicators.

• When the mode selector is switched from PROG. to RUN, does the operating LED turn ON ?
• Check the operation of the program.

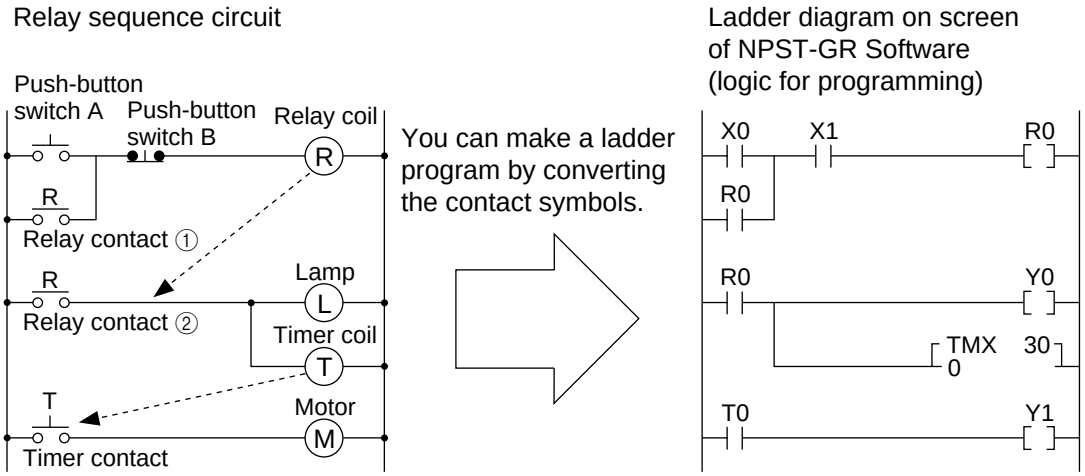
• If there is a problem in the operation, check the program using the monitoring function of the programming tool.
• Rewrite the program.

• We recommend that the created program be saved onto a floppy disk or EPROM/EEPROM.

5-3. How to Program the Programmable Controller

1. Making a Ladder Diagram

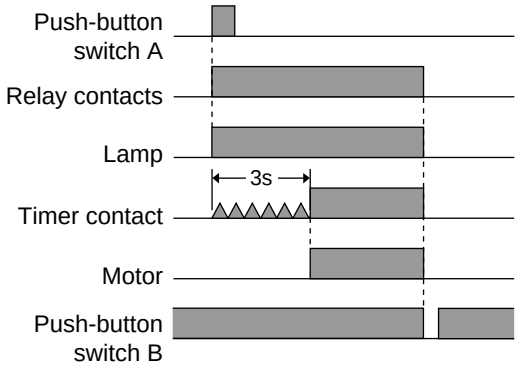
Originally, programmable controllers were designed as a replacement for relay-controlled systems. Therefore, programs can be easily created with a relay sequence circuit as shown below.



■ Explanation of movement

1) When push-button switch A is pressed, the coil of relay R0 is energized and its contacts turn ON.
2) Since contact ① of relay R0 supplies power to the coil of relay R0, the coil stays energized even if switch A is turned OFF (self-hold circuit).
3) Contact ② of relay R0 supplies power to lamp Y0 and timer T0. The lamp turns ON and the timer starts timing operation.
4) After the preset time (e.g., 3 s), timer contact T0 turns ON and motor Y1 starts operation.
5) When push-button switch B is pressed, the coil of relay R0 is de-energized and all the power turns OFF.

■ Time chart



■ I/O allocation

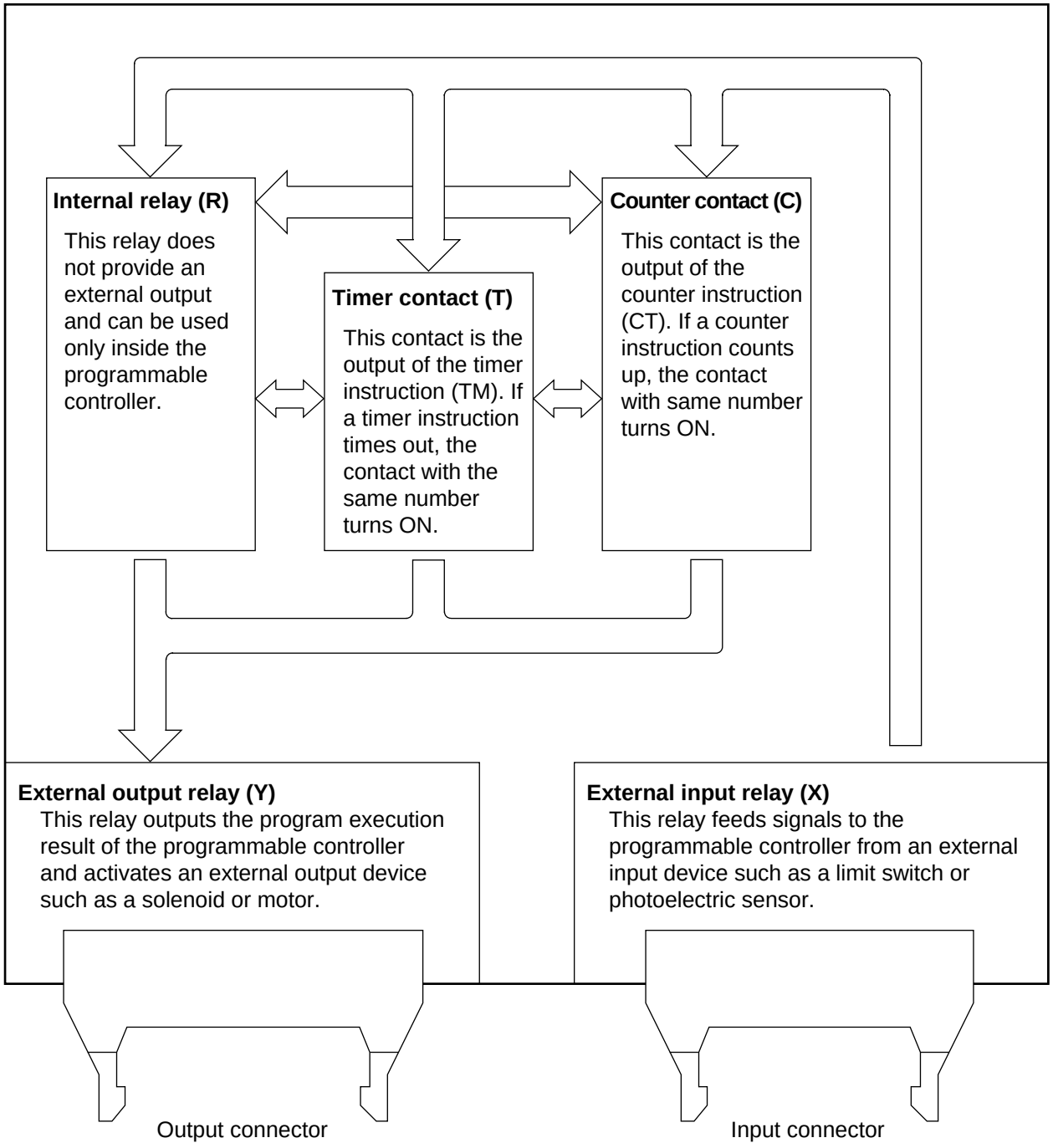
The input and output addresses of the programmable controller are allocated according to the condition in the sequence diagram.

Item	Name of device	I/O assignment
External input	Push-button switch A	X0
	Push-button switch B	X1
External output	Lamp	Y0
	Motor	Y1
Internal relay	Supplemental relay	R0
Timer	Timer	T0

• All relays and timers used in the sequence circuit are replaced with internal relays and timers in the programmable controller.

2. Relays and Timer/Counter Contacts in the FP-M

The FP-M programmable controller contains many relays and timer/counter contacts, as follows.

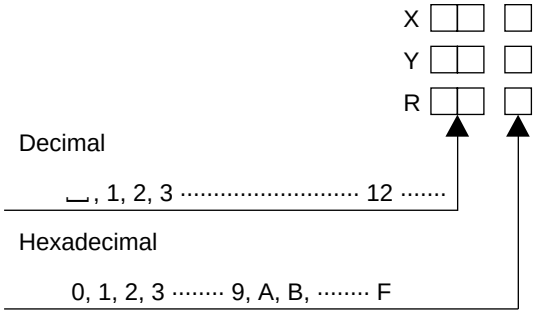


■ Memory area

Item		Symbol	Numbering	
			2.7 k type	5 k type
Relay	**External input relay**	X (bit)	208 points (X0 to X12F)	
		WX (word)	13 words (WX0 to WX12)	
	External output relay	Y (bit)	208 points (Y0 to Y12F)	
		WY (word)	13 words (WY0 to WY12)	
	Internal relay	R (bit)	1,008 points (R0 to R62F)	
		WR (word)	63 words (WR0 to WR62)	
	Special internal relay	R (bit)	64 points (R9000 to R903F)	
		WR (word)	4 words (WR900 to WR903)	
Timer/ Counter contact	**Timer contact**	T (bit)	100 points (T0 to T99)	
	Counter contact	C (bit)	44 points (C100 to C143)	

■ External input relay (X), external output relay (Y), internal relay (R)

• The lowest digit for these relay's X, Y, and R numbers is expressed in hexadecimal and the second and higher digits are expressed in decimal to enable both bit and word processing.



Example:

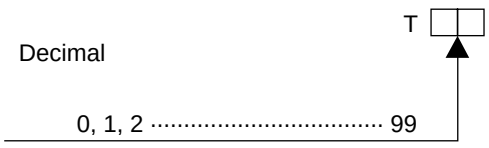
Relay number

X0, X1, X2, X3, X4, X5, X6, X7, X8, X9, XA, XB, XC, XD, XE, XF
X10, ····· X1F
X20, ····· X2F
X90, ····· X9F
X100, ····· X10F
X110, ····· X11F
X120, ····· X12F

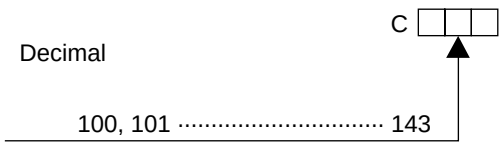
■ Timer contact (T), counter contact (C)

• The timer contact (T) and counter contact (C) numbers are expressed in decimal.

Timer contact (T)



Counter contact (C)



3. I/O Allocation in the FP-M

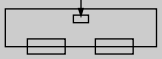
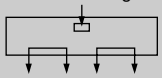
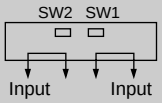
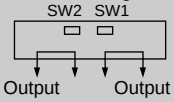
1) Control boards

• The I/O addresses for the control boards are fixed as follows.

Board type	I/O point	I/O allocation
C20R and C20RC	12 inputs	X0 to XB
	8 outputs	Y0 to Y7
C20T and C20TC	12 inputs	X0 to XB
	8 outputs	Y0 to Y7
C32T and C32TC	16 inputs	X0 to XF
	16 outputs	Y0 to YF

2) Expansion boards

• The I/O addresses for the expansion boards are set by the I/O address setting switches as follows.

Board type	I/O point	I/O address setting switches and I/O allocation			
		ON OFF 1 2 3 4 5	ON OFF 1 2 3 4 5	ON OFF 1 2 3 4 5	ON OFF 1 2 3 4 5
E20R type I/O address setting switch  Output: 8 Input: 12	12 inputs	X30 to X3B	X50 to X5B	X70 to X7B	X90 to X9B
	8 outputs	Y30 to Y37	Y50 to Y57	Y70 to Y77	Y90 to Y97
M1T-E type I/O address setting switch  Output: 16 Input: 24	24 inputs	X30 to X3F X40 to X47	X50 to X5F X60 to X67	X70 to X7F X80 to X87	X90 to X9F X100 to X107
	16 outputs	Y30 to Y3F	Y50 to Y5F	Y70 to Y7F	Y90 to Y9F
M1T-EI type I/O address setting switches  	Input block A: 24 inputs (using SW1)	X30 to X3F X40 to X47	X50 to X5F X60 to X67	X70 to X7F X80 to X87	X90 to X9F X100 to X107
	Input block B: 12 inputs (using SW2)	X30 to X3B	X50 to X5B	X70 to X7B	X90 to X9B
M1T-EO type I/O address setting switches  	Output block A: 16 outputs (using SW1)	Y30 to Y3F	Y50 to Y5F	Y70 to Y7F	Y90 to Y9F
	Output block B: 16 outputs (using SW2)	Y30 to Y3F	Y50 to Y5F	Y70 to Y7F	Y90 to Y9F

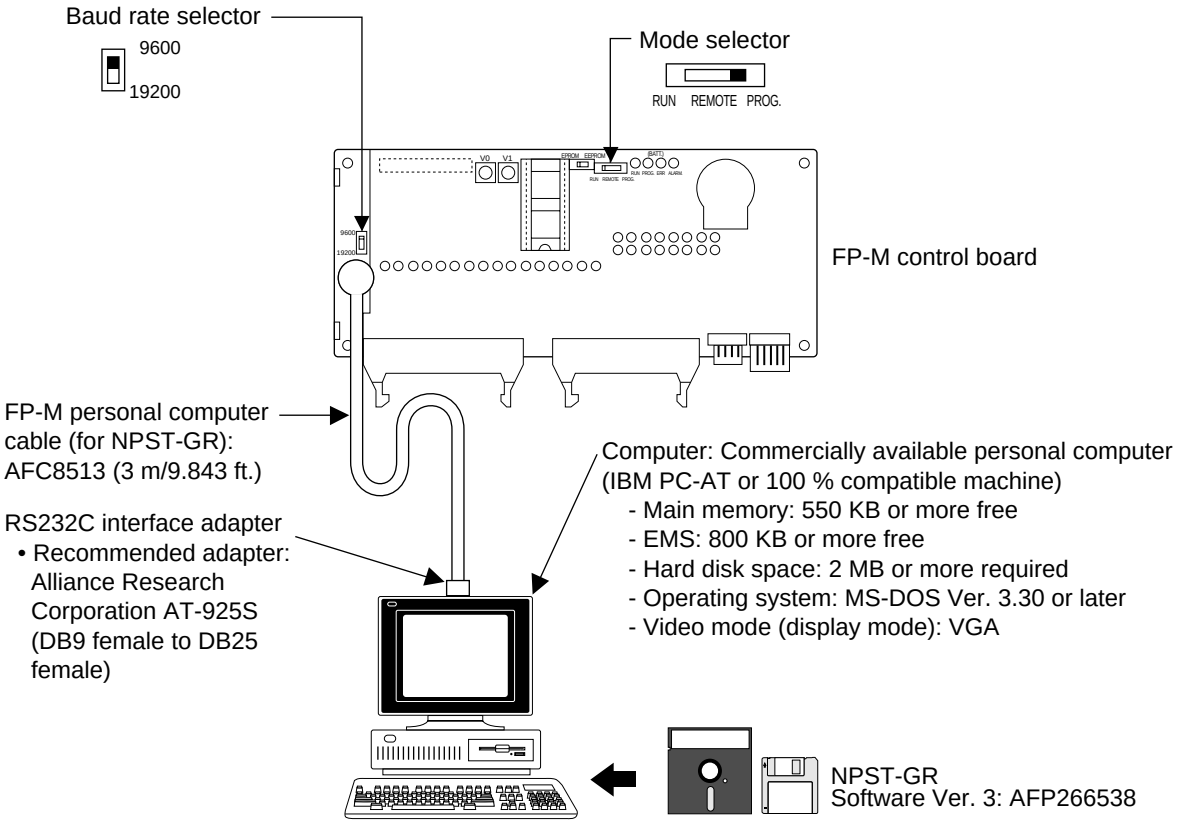
Notes:

• Set the I/O address setting switches collectly.
• Do not overlap the I/O address on dual switches.

5-4. Programming with NPST-GR Software

NPST-GR Software Ver. 3 offers program entry, editing, and monitoring of FP series programmable controllers. With this software, you can concentrate on the control pattern rather than wasting time learning how to enter the program.

1. System Configuration



■ Connection between a control board and a computer

- An FP-M personal computer cable (for NPST-GR) and a RS232C interface adapter are required to connect a personal computer to the FP-M control board.

■ Setting of FP-M control board

- Set the baud rate selector of the FP-M control board to 19200 or 9600.

Note:

- If the microprocessor of your computer works at 8 MHz or 16 MHz, set the baud rate selector of the FP-M to 9600 bps.

■ Personal computer setting

- Set your personal computer's RS232C parameter to asynchronous. Refer to the manuals that came with your computer.

2. Features of NPST-GR Software Ver. 3

NPST-GR Software is a programming support tool for the FP-M. The things you can do with the NPST-GR are briefly introduced in the following:

• Programming

NPST-GR provides three programming modes.

- Programming by entering ladder symbols: the program will be displayed in ladder diagrams (Ladder symbol mode)
- Programming by entering Boolean: the program will be displayed in ladder diagrams (Boolean ladder mode)
- Programming by entering Boolean: the program will be displayed in Boolean (Boolean non-ladder mode)

You can create a program using any of these methods and you can change the method any time. The display will change automatically according to the method you select. With any method, you can create a program by selecting instructions from the function keys.
NPST-GR Software also provides various features which enable effective programming such as the ability to customize it to make program creation easier.
While creating a program, you can copy, delete, move, and search for a part of the program.

• Comment function

You can enter comments for relays and output instructions.
These comments show you which device the relay corresponds to, or for what application the relay is used.

• Program check

With the program checking function, you can check the created program for grammatical errors.

• Monitoring

To support programming capability, NPST-GR Software can monitor the program you created and perform a test run for verifications. You can check the status of relays and registers, and the programmable controller operating status. This makes it easy to perform debugging and field adjustments.

• System register setting

You can set the system registers using NPST-GR Software. Using the screen messages makes option selection and value entry much easier.

• Documentation

You can print-out all the settings you made, such as program and system register settings.

• Data transfer

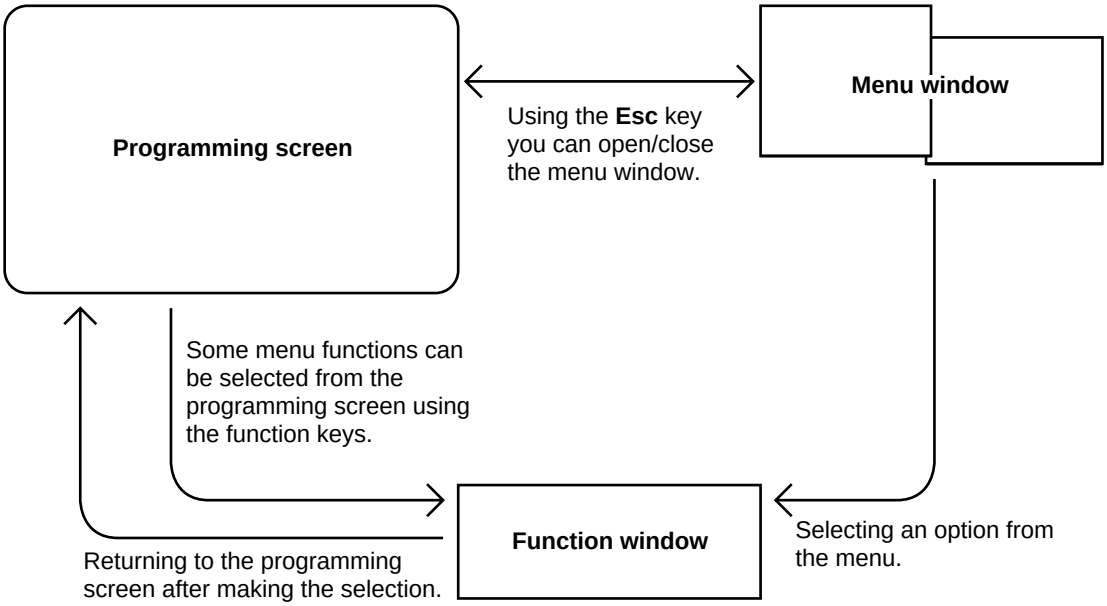
You can transfer the program created with NPST-GR Software to the programmable controller easily by key operation. You can also transfer the data to ROM.

• Data management

You can save the data to a disk, which is useful for back-ups and temporary storage before transferring the data to the programmable controller.

3. NPST-GR Configuration

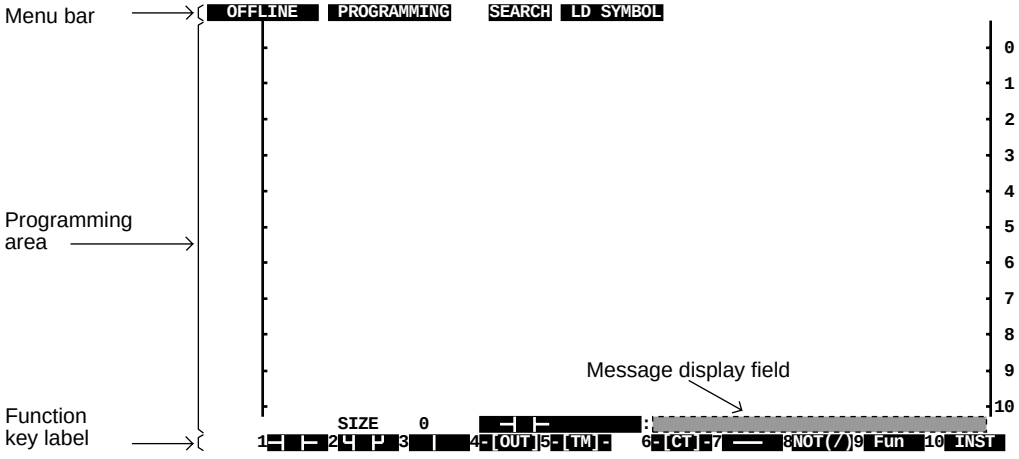
The NPST-GR Software is configured as follows.



- **Programming screen**
  The screen where a program is created or edited. At the very first moment when, the software is activated, the programming screen is displayed in the ladder symbol mode. Next, the menu window appears over it.
- **Menu window**
  The window to select an option. The various functions of the NPST-GR Software can be selected from this window. Functions selected from the menu window are called menu functions.
  When you start the software, the menu screen automatically overlaps the programming screen.
- **Function window**
  When you select a menu function from the menu window, the corresponding window will be displayed.

1) Overview of the programming screen

The programming screen consists of a menu bar, a programming area and function key labels, as shown below. The display varies depending on the programming mode you are in.
The following figure shows the programming screen when you are in the ladder symbol mode.



- **Menu bar**
  The uppermost line on the screen is called the “menu bar”.
  The menu bar indicates which mode, what function and which programming mode you are currently in.

When you are in the ONLINE mode, it indicates whether you are monitoring the program or not, and which mode the programmable controller is currently in.

When you are in the OFFLINE mode

① Indicates which mode you are in: the OFFLINE mode or the ONLINE mode.
In the OFFLINE Mode, the software cannot communicate with the programmable controller, and in the ONLINE mode, it can communicate with the programmable controller. Depending on the function you use or how you use the function, you must be in either OFFLINE mode or ONLINE mode. For example, you should be in the OFFLINE mode when you enter comments, and in the ONLINE mode when you monitor the program. When creating a program, if you are in the ONLINE mode, the program will be transferred to the programmable controller simultaneously with entry of the program.

Note:

- When you use NPST-GR in the ONLINE mode, you must connect the computer on which NPST-GR is activated with the programmable controller.

② Indicates what function you are currently using.
For example, when you are creating a program, “PROGRAMMING” will be displayed.

③ Displayed when you are in the ladder symbol mode to indicate whether you are in the SEARCH mode or the ENTRY mode.

④ Indicates which programming style you are currently in.
The software provides three programming styles: Ladder symbol mode, Boolean ladder mode and Boolean non-ladder mode.

Ladder symbol mode

The ladder symbol mode allows you to create a program by entering ladder symbols. Ladder symbols are graphic symbols which show logical elements, such as ⊣ ⊢. The program will be displayed as a logic diagram on the screen. This diagram is called a “ladder diagram”.
When you are in the ladder symbol mode, you will be in either the SEARCH mode or the ENTRY mode.

Boolean ladder mode

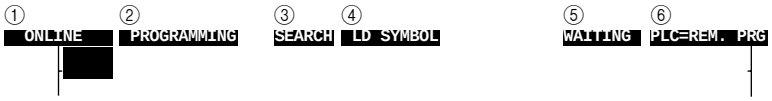
In the Boolean ladder mode, you can create a program by entering Boolean, but the program will be displayed as a ladder diagram.

Boolean non-ladder mode

The Boolean non-ladder mode allows you to create programs by entering Boolean. The program will be displayed as you entered it, in order of the addresses.

When you are in the ladder symbol mode, “LD SYMBOL” is displayed.
In the Boolean ladder mode or Boolean non-ladder mode, “BOOLEAN” is displayed.
The difference can be recognized by the display in the programming area.

When you are in the ONLINE mode



When you are in ladder symbol mode <default display>

① to ④ are the same as when you are in the OFFLINE mode.

⑤ Indicates whether NPST-GR is monitoring a program or not.
While monitoring a program, "MONITOR" will be displayed here.
When not monitoring, "WAITING" will be displayed here.

⑥ Indicates the status, such as the current mode, of the programmable controller connected to the computer.

• Programming area

Depending on the programming mode (Ladder symbol mode, Boolean ladder mode, and Boolean non-ladder mode) you select, the display will vary.

• Function key labels

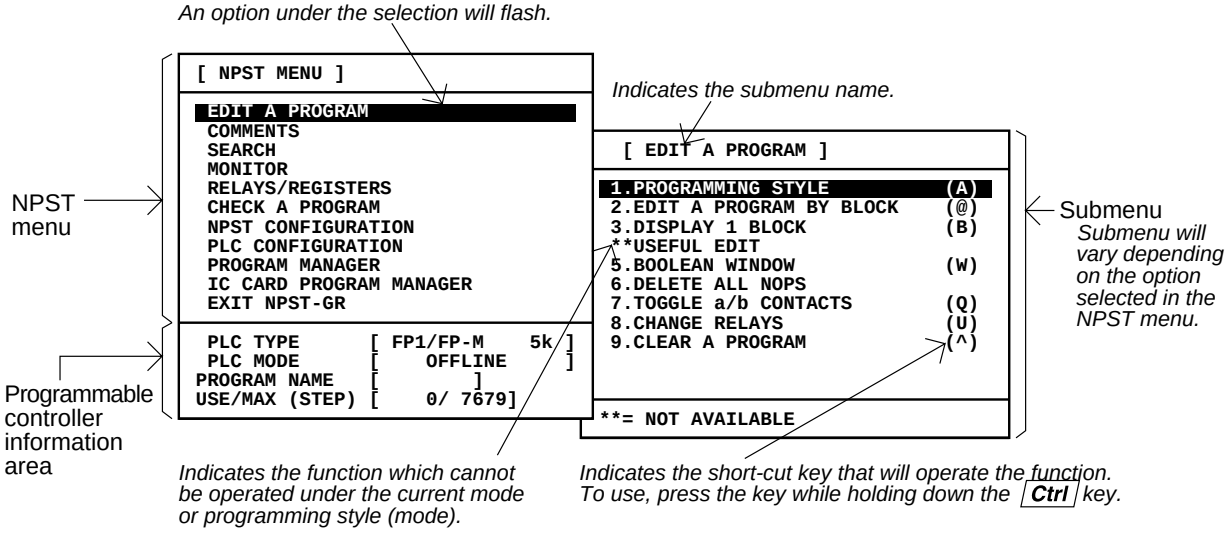
Corresponds to the function keys on the keyboard.
You may also use a function key in combination with **Shift** or **Ctrl**.

• Message display field

Any message from the software, such as error messages, will be displayed on the lower right of the screen.

2) Overview of the menu window

Immediately after starting NPST-GR, the menu window will overlap the programming screen.
On the menu bar, you will see "NPST MENU" while the menu window is being displayed.



• NPST menu

In the NPST menu, the submenu names are listed.
From the NPST menu, select a submenu that the menu function you want to use belongs to.

• Submenu

In the submenu, the menu functions are listed.

• Programmable controller information area

PLC TYPE

Indicates the type of programmable controller currently specified.

PLC TYPE:	FP1	0.9 k
	FP1/FP-M	2.7 k
	FP1/FP-M	5 k
	FP3	10 k
	FP3/FP-C	16 k
	FP5	16 k
	FP10/FP10S	30 k
	FP10	60 k

PLC MODE

Indicates the operation mode of the programmable controller.
When you are in the OFFLINE mode, "OFFLINE" will be displayed here.
In the ONLINE mode, the display will vary according to the setting on the programmable controller.

PROGRAM NAME

The name of program is displayed on the screen. When you create a new program, nothing will be displayed. When you load the program from a disk or the programmable controller, the filename you registered for the program will be displayed.

USE/MAX (STEP)

Indicates the number of steps (program size). The number of steps you have already used for the program during editing or creation, and the maximum of number of steps you can use for the program is indicated.

4. NPST-GR Installation and Configuration

1) Preparing for installation

This section describes how to install the device driver ANSI.SYS. Install the software using the installation program. The installation program is included in the NPST-GR system disk. The installation program cannot start if the device driver ANSI.SYS provided with the MS-DOS system disk has been installed in the disk on which you want to install NPST-GR. If ANSI.SYS has not been installed, install ANSI.SYS first and then install NPST-GR.

Procedure

1. If the ANSI.SYS file does not exist on the disk on which you want to install NPST-GR, copy the ANSI.SYS file from the MS-DOS system disk to the hard disk. For example, to copy the ANSI.SYS file to the root directory of the hard disk, insert the MS-DOS system disk into drive A and type the following after the DOS prompt:

   `COPY A:\ANSI.SYS C:`(**Enter**)
2. If the DEVICE command for ANSI.SYS is not included in the CONFIG.SYS file, modify the CONFIG.SYS file. For example, to add the DEVICE command to the CONFIG.SYS file, type the following at the DOS prompt (C:\):

   `COPY CONFIG.SYS+CON CONFIG.SYS`(**Enter**)
   `DEVICE=ANSI.SYS`(**Enter**)

   Then, press **Ctrl** + **Z** and press **Enter**.
   The CONFIG.SYS file will now contain the new line.

Notes:

- After modifying the CONFIG.SYS file, reset the personal computer so that your changes take effect.
- Note that the directory in which the ANSI.SYS exists must match the pathname used for the DEVICE command.

2) NPST-GR installation

This section describes how to install NPST-GR. Make a backup disk of the software and use it for installation.

Procedure

1. If the current drive is other than drive A, change to drive A by typing “A:” at the DOS prompt.
2. Insert the backup disk of the NPST-GR system disk into drive A.
3. Type the following at the DOS prompt (A:) to start the installation program:
   INSI (Enter)

   The installation program will start. The following screen will appear.

```
NPST-GR Installation Program                                    Ver.3.1


              To install the NPST-GR, type INSI and specify the source drive
              and the target drive.  The "source drive" is the drive where you
              place the NPST-GR System Disk.  The "target drive" is the drive
              on which you want to install the NPST-GR.

              [Format]

              INST [source drive]: [target drive]:

              [Example]

              When the NPST-GR System Disk is now in the drive A and you want
              to install the NPST-GR on the drive C, type:

              INSI A: C:(Enter)

A:\>
```

4. Type the following at the DOS prompt:
   INSI A: C: (Enter)

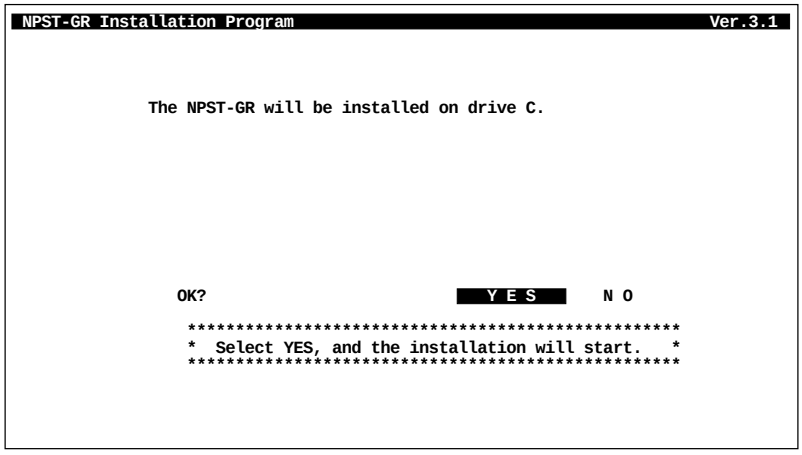
   This shows that the backup disk of the NPST-GR system disk is in drive A and that you are going to install NPST-GR onto drive C. The following screen will appear.

```
NPST-GR Installation Program                                    Ver.3.1


            The source drive    a:
            The target drive    c:




              OK?                          Y E S     N O
```

5. Make sure that the source drive and the target drive are specified correctly. The "**source drive**" shows the drive which the NPST-GR system disk is in. The "**target drive**" shows the drive onto which you want to install NPST-GR.

   When the source drive and the target drive are specified correctly, select "**YES**" and press **Enter**.
   If not, select "**NO**" and press **Enter**. You will return to the previous screen.

   When you select "**YES,**" the following screen will appear:



6. Check the message. To install, select "**YES**" and press **Enter**. The installation will start.
   If you do not want to install, select "**NO**" and press **Enter**. You will return to the previous screen.

   When the installation is complete, "**C:\NPST3**" will appear.

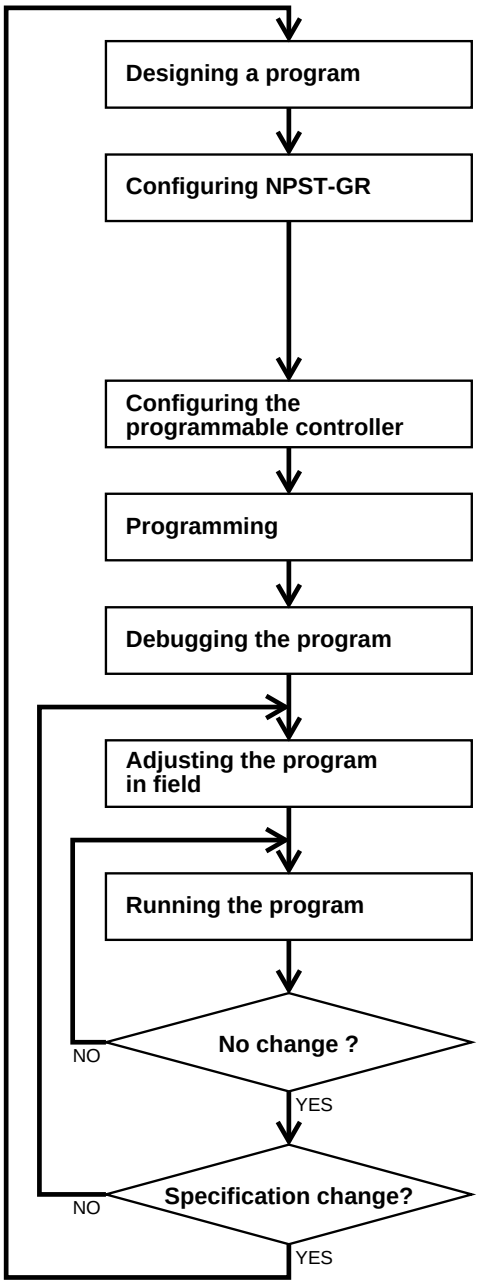
Note:

- When NPST-GR is installed successfully, the following files are stored in the NPST3 directory:

NPST.EXE	Contains a program which starts NPST-GR.
NPSTE.EXE	Contains the system program for NPST-GR.
NPST.HLP	Contains help messages.
NPSTP000.CIG	Contains information for printer control.

3) How to use NPST-GR effectively

The flowchart shown below is an example of how you can use NPST-GR before you run a program in the field. Except for the settings for NPST-GR and programmable controller configuration, you can freely change the order of the flowchart.



Design a program according to your system.
What type of programmable controller do you use?
What relays and registers do you use for the program, etc?

Customize NPST-GR. Set the communication conditions for communicating with peripheral devices. Select the type of programmable controller for the program you created or system registers you set. Specify the maximum number of comments you will add to a program.

Note:

* Once you save data together with NPST-GR on a disk, NPST-GR will start with that data.

Set system registers 0 to 418.

Create or edit a program according to your design.
There are various functions useful for creating or editing a program.
Overview the NPST functions provided by the software, and create or edit the program.

With the program check, monitor, search, and test run functions, etc., you can debug the program you created or edited.
You can preset the register values.

4) NPST-GR startup

To start NPST-GR, follow the procedure below.

Procedure

1. If the personal computer is OFF, turn it ON.
   You will see the DOS prompt C:\.
2. Change to the NPST3 directory by typing the following at the DOS prompt:
   `CD NPST3`(**Enter**)
3. Type the following to start the NPST-GR Software:
   `NPST`(**Enter**)
   NPST-GR will start.

5) Configuring NPST-GR

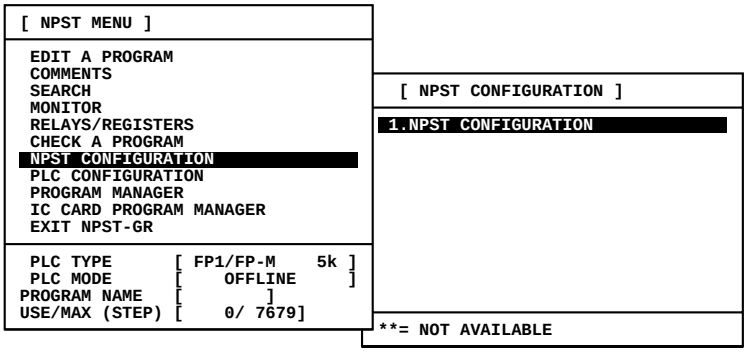
■ Selecting [NPST CONFIGURATION] from the menu window

Before you create a program, you must first configure the settings and change the default settings if necessary.

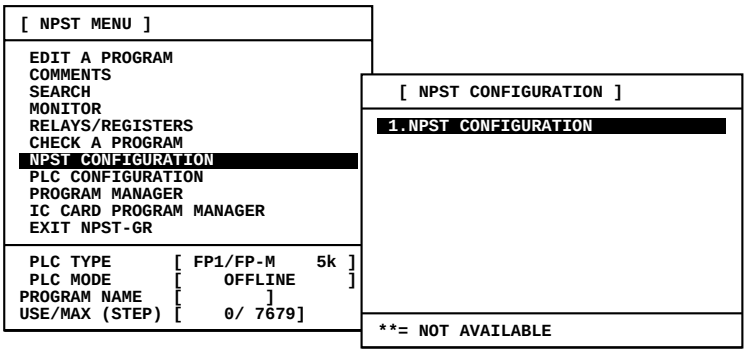
If the programming screen is displayed, press **Esc** to display the "NPST MENU" window.

Procedure

1. Move the cursor to an option on the NPST menu with the **up** and **down arrow** keys.
   The submenu which belongs to the option you select will be displayed.

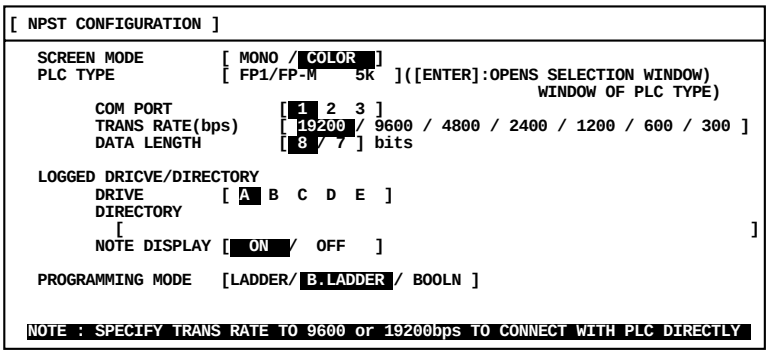


2. Press **Enter** or the **Right arrow** key.
   The cursor will move to the submenu. The option currently selected with the cursor will blink.



3. Press **Enter**.

4. Move the cursor to the item you want to select with the **up** and **down arrow** keys.
   Select an option with the **right** and **left arrow** keys.



<SCREEN 1> window

• SCREEN MODE

You can select the NPST-GR screen mode between color and black/white.

MONO: Displays the screen in black and white.
COLOR: Displays the screen in color.
(Black/Cyan/Red/Magenta/Green/Bright Blue/Yellow or Brown/White)

• PLC TYPE

Before setting the configuration of the programmable controller and creating a program, you must specify the type of programmable controller for which you create a program.

You can select from;

FP1	0.9 k: FP1 C14/C16 series
FP1/FP-M	2.7 k: FP1 C24/C40 series and FP-M (2.7 k) C20R/C20T/C32T
FP1/FP-M	5 k: FP1 C56/C72 series and FP-M (5 k) C20RC/C20TC/C32TC
FP3	10 k: FP3 (10 k)
FP3/FP-C	16 k: FP3 (16 k) and the FP-C (16 k)
FP5	16 k: FP5 (16 k)
FP10/FP10S	30 k: FP10 (30 k) and FP10S (30 k)
FP10	60 k: FP10 (60 k)

COM PORT

Specify the serial port which is connected to the programmable controller.

1: Use COM PORT 1
2: Use COM PORT 2
3: Use COM PORT 3

TRANS RATE (bps)

Specify the transmission rate for communication with the programmable controller or modem.
Select between 19200, 9600, 4800, 2400, 1200, 600 or 300.
For communication with the programmable controller, specify either 19200 or 9600.
If the clock frequency is a multiple of five, you must select 19200. If you do not select 19200, NPST-GR will not communicate with the programmable controller.

DATA LENGTH

Specify the data length for communication with the programmable controller.
Select either 8-bit or 7-bit.

• LOGGED DRIVE/DIRECTORY

Specify the logged drive when you manage files.

DRIVE/DIRECTORY

Specify the logged directory when you manage files. Include a \ at the beginning and at the end of the directory, eg., \npst\program\.
If you omit this, the root directory will be specified.

NOTE DISPLAY

Specify whether file notes, which are the notes entered for a file (such as filename and date), are to be displayed when the disk file list is displayed.

ON: Displays the file notes.
OFF: Omits displaying the file notes.

• PROGRAMMING MODE

Select the programming mode for creating or editing a program.

Select from;

LADDER: The ladder symbol mode
B.LADDER: The Boolean ladder mode
BOOLN: The Boolean non-ladder mode

■ Logging or saving the parameters

After you set the parameters in [**1.NPST CONFIGURATION**], you must log the settings so that NPST-GR will be reconfigured according to the parameters you set. If you go to the programming screen or use other functions without logging the parameters you set, they will be aborted.
If you try to exit [**1.NPST CONFIGURATION**] without logging the parameters by pressing **Esc**, the confirmation message "**EXIT OK ? (Y/N)**" will appear on the right bottom of the screen. Type **N** to return to the previous operation. Type **Y** if you want to abort the settings you made. The setting will be aborted and you will go to the programming screen. In each parameter window, you will see the SAVE label on the function key labels. If you set parameters on more than one window, you can save the parameters at one time after completing the settings. When you log the settings, you can also save the settings to the disk if necessary.

Procedure

1. Press the **F1** key on the screen where one of the windows for setting parameters is displayed.
   The <SAVE> window will be displayed at the lower left of the screen.
2. Select "YES" or "NO" for the message "**SAVE DISK ? [YES / N O]**"
   Select "YES" to save the parameters in the disk.
3. Type **Y** or **N** for the message "**LOG PARAMETERS ? (Y/N)**".
   Type **Y** to execute the operation. After execution, the window will close.
   If you selected "YES" for "**SAVE DISK ? [YES / N O]**", the message, "**SAVING TO THE DISK COMPLETED.**" will be displayed at the bottom of screen when the parameter has been successfully saved to the disk.

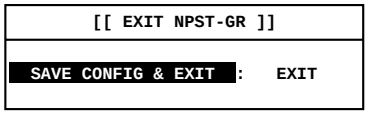
To quit the operation, type **N**. The window will close.

5. Exiting NPST-GR

The [**1.EXIT NPST-GR**] option allows you to exit NPST-GR and to return to the MS-DOS screen.

Procedure

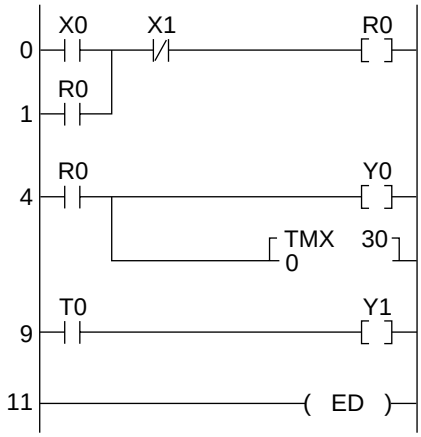
1. Select the [**EXIT NPST-GR**] option from the NPST menu.
2. Select the [**1.EXIT NPST-GR**] option from the [**EXIT NPST-GR**] menu.
   The [**EXIT NPST-GR**] window will open.



3. Select "**SAVE CONFIG & EXIT**" to save the parameters set with the [**NPST CONFIGURATION**] menu and exit NPST-GR. Select "**EXIT**" to exit NPST-GR without saving them.
4. Press **Enter**. You will exit NPST-GR and the DOS prompt will appear on the screen. When you turn OFF the computer, make sure that the DOS prompt is displayed on the screen.

6. Basic Key Operation for Programs

Input the following program using the ladder symbol mode.



Boolean Non-ladder		Key operation
Address	Instruction	
0	ST X 0	F1 F1 0 Enter
1	OR R 0	F2 F3 0 Enter
2	AN/ X 1	F3 F8 F1 1 Enter
3	OT R 0	F4 F3 0 Enter
4	ST R 0	F1 F3 0 Enter
5	OT Y 0	F4 F2 0 Enter
6	TM X 0	F5 F1 0 ⇤⇥
	K 30	F1 3 0 Enter
9	ST T 0	F1 F4 0 Enter
10	OT Y 1	F4 F2 1 Enter
11	ED	F10 Ctrl + F3 Enter

When you first start NPST-GR, you will be in the ladder symbol mode.
The **[1.PROGRAMMING STYLE]** option changes the programming style to the Boolean non-ladder mode.
Procedure

1. Select the **[EDIT A PROGRAM]** option from the NPST menu.
2. Select the **[1.PROGRAMMING STYLE]** option from the **[EDIT A PROGRAM]** menu.
3. Select "BOOLEAN NONLADDER" from the **[PROGRAMMING STYLE]** window.
4. Press **Enter**.

■ Program input

Input the program using the function keys. The command language input will be displayed in the input field at the bottom of the screen. It will be interpreted and displayed as an element on the ladder diagram when you press the **Enter** key.
[Input Deletions]
When deleting from the input field.....Press **BS**.
When deleting from the ladder diagram display area.....Move the cursor to the location containing the mistake and press **Del**.
Refer to the "NPST-GR Software" manual for details.

7. Downloading a Program to the Programmable Controller

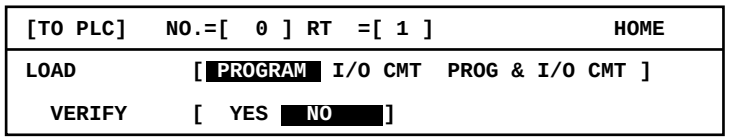
The [**4.LOAD A PROGRAM TO PLC**] option downloads the program and/or the I/O comments which are on the screen of the programmable controller. After you complete the program, you must download the program so that the programmable controller executes it.

Notes:

- The downloaded program will be executed when you set the mode of programmable controller to RUN.
- Before you start operation, make sure that NPST-GR is in the ONLINE mode.

Procedure

1. Select the [**PROGRAM MANAGER**] option from the NPST menu.
2. Select the [**4.LOAD A PROGRAM TO PLC**] option from the [**PROGRAM MANAGER**] menu.
   The [**LOAD TO PLC**] window will appear on the screen.



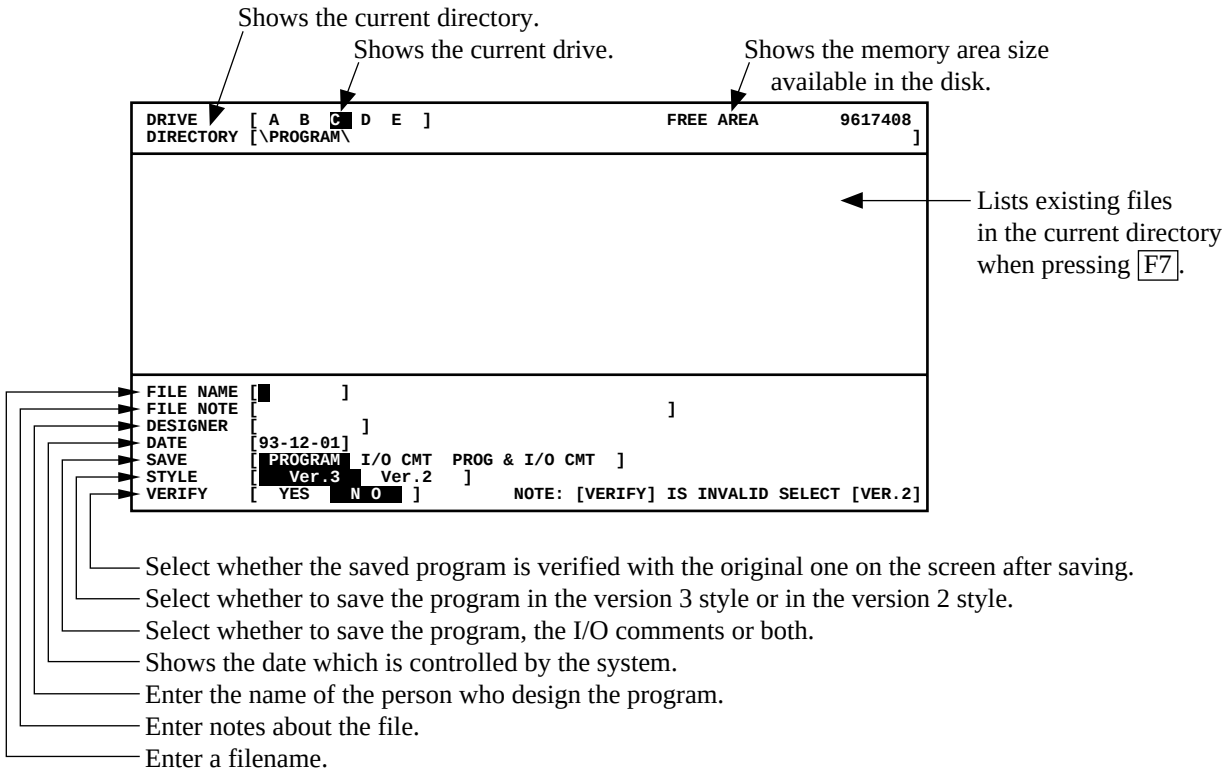
3. If you want to change the communicating station, press **Ctrl** + **F7**.
4. If the programmable controller is in the RUN mode, change to the PROG. mode.
   When the programmable controller is in the REMOTE mode, you can change it by pressing **Ctrl** + **F6**.
5. Specify what you want to load to the programmable controller at "**LOAD.**"
   Select "**PROGRAM**" to download only the program.
   Select "**I/O CMT**" to download only the I/O comments.
   Select "**PROG & I/O CMT**" to download both the program and the I/O comments.
6. Specify whether or not to verify the programs.
   Select "**YES**" at "**VERIFY**" with the **arrow** keys when you want to verify the transferred program with the one displayed on the screen after downloading. Select "**NO**" if you do not want to verify the program.
7. Press **Enter** to start downloading.
   During the download, "**LOADING PROGRAM...**" will appear on the screen.
   If you select "**YES**" at "**VERIFY,**" the message "**VERIFYING PROGRAM...**" will appear.
   When completed successfully, "**VERIFY OK**" will appear on the bottom of the screen. The number of steps used for the program will be displayed at the bottom of the screen.

8. Saving a Program to Disk

The [**2.SAVE A PROGRAM TO DISK**] option saves the program and/or the I/O comments which exist on the screen to the disk of your personal computer.

Procedure

1. Select the [**PROGRAM MANAGER**] option from the NPST menu.
2. Select the [**2.SAVE A PROGRAM TO DISK**] option from the [**PROGRAM MANAGER**] menu.
   A window for saving the program and/or I/O comments will open on the screen. You will see "**SAVE PROGRAM**" on the menu bar.



3. If you want to change the drive, press **F6**.
4. If you want to change the directory, press **F8**.
5. Enter a filename in the "**FILE NAME**" area.
6. If necessary, enter the information for "**FILE NOTE**", "**DESIGNER**" and "**DATE**". These items are optional and can be skipped. Press the **down arrow** key to go to the next item.
7. Specify what you want to save to the disk at "**SAVE.**"
   Select "**PROGRAM**" to save only the program.
   Select "**I/O CMT**" to save only the I/O comments.
   Select "**PROG & I/O CMT**" to save both the program and the I/O comments.
8. Determine which version style you want to save in.
   Select "**Ver.3**" to save in the version 3 style.
   Select "**Ver.2**" to save in the version 2 style.
9. When you select "**Ver.3**", select whether you want to verify the programs.
   Select "**YES**" at "**VERIFY**" with the **arrow** keys, to verify the saved program with the program on the screen after saving. Select "**NO**" if you do not want to verify the program.
10. Press **Enter**.
    When you select "**Ver.3**," saving will start.

9. Printing

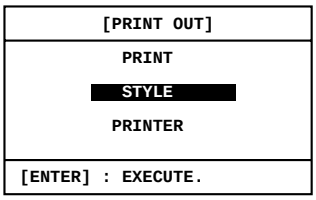
The **[A.PRINT OUT]** option prints out:

- the program displayed on the screen, as a ladder diagram or in Boolean.
- the list of the relays, registers or control instructions used in the program.
- the parameters set with the [**NPST CONFIGURATION**] menu
- the parameters set for system registers 0 to 418, the I/O map, and the remote I/O map

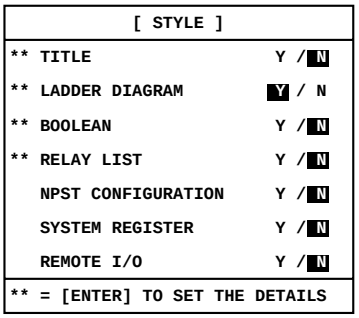
When you select the **[A.PRINT OUT]** option, the **[PRINT OUT]** window will open. First, select what you want to print out by selecting the "**STYLE**" option, and start printing by selecting the "**PRINT**" option. With the default settings, only the program will be printed in the ladder diagram style.

Procedure

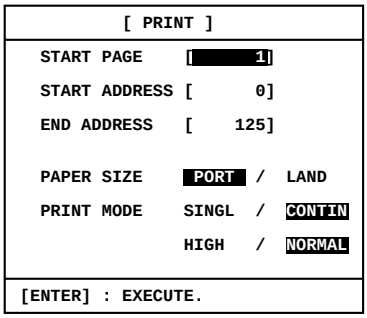
1. Select the **[PROGRAM MANAGER]** option from the NPST menu.
2. Select the **[A.PRINT OUT]** option from the **[PROGRAM MANAGER]** menu.
   The **[PRINT OUT]** window will open.



3. Select "**STYLE**" in the **[PRINT OUT]** window.
   The **[STYLE]** window will open.



4. Specify what you want to print out in the **[STYLE]** window.
   Select "Y" for the item which you want to print. Select "N" not to print it.
5. Press **F1** to log the settings in each window and to return to the previous window.
   You must press **F1** on every window on which you made any change. When pressing **F1**, you will be asked "**SURE?**" Type **Y** to log the changes you made. To cancel them, type **N**.
6. Select "**PRINT**" from the **[PRINT OUT]** window.
7. Press **Enter**. The **[PRINT]** windows shown right will open.

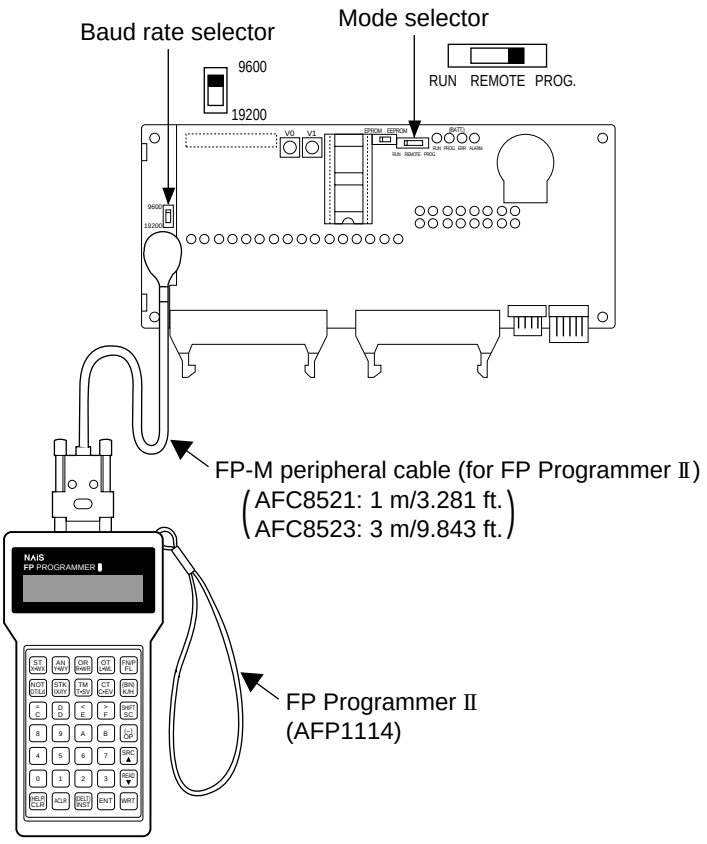


8. When you want to change the settings in the windows, select the desired options. To select an option, use the **right** or **left arrow** key. To go to the next item, press the **down arrow** key.
9. Press **Enter** to start printing.

5-5. Programming with FP Programmer Ⅱ

The FP Programmer Ⅱ performs program entry, editing, and monitoring of FP series programmable controllers.

1. System Configuration



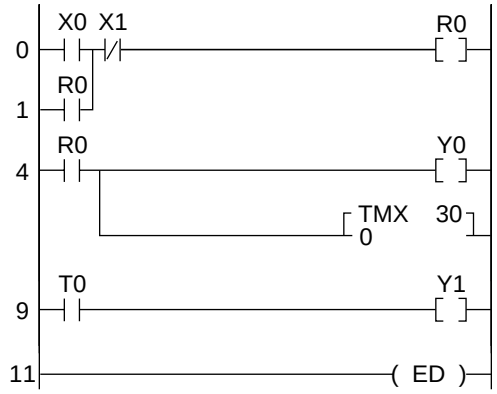
■ Connection between an FP-M control board and an FP Programmer Ⅱ

- An FP-M peripheral cable (for FP Programmer Ⅱ) is required to connect an FP-M control board to an FP Programmer Ⅱ.

■ Setting of FP-M control board

- Set the baud rate selector of the FP-M control board to 19200.

2. Downloading a Program to the Programmable Controller



Boolean Non-ladder				FP Programmer Ⅱ key operations
Address	Instruction			
0	ST	X	0	ST X-WX, ST X-WX, 0, WRT
1	OR	R	0	OR R-WR, OR R-WR, 0, WRT
2	AN/	X	1	AN Y-WY, NOT DT/Ld, ST X-WX, 1, WRT
3	OT	R	0	OT L-WL, OR R-WR, 0, WRT
4	ST	R	0	ST X-WX, OR R-WR, 0, WRT
5	OT	Y	0	OT L-WL, AN Y-WY, 0, WRT
6	TM	X	0	TM T-SV, ST X-WX, 0, ENT
		K	30	(BIN) K/H, 3, 0, WRT
9	ST	T	0	ST X-WX, TM T-SV, 0, WRT
10	OT	Y	1	OT L-WL, AN Y-WY, 1, WRT
11	ED			SHIFT SC, 1, 0, SHIFT SC, WRT

Procedure

1. Connect FP Programmer Ⅱ and the FP-M control board using the FP-M peripheral cable (for FP Programmer Ⅱ).
2. Set the mode selector of the FP-M control board to PROG.
3. Press the keys on the FP Programmer Ⅱ, as shown on the right, to clear all the data stored in the FP-M control board.

   ACLR, (–) OP, 0, ENT, SHIFT SC, (DELT) INST
4. Enter the address from where you want to enter instructions. Use the alphanumeric keys to enter the address. In the example, instructions are entered from address 0, therefore, press 0 to read its contents then press READ ▼.

   ACLR, 0, READ ▼
5. Download the program (addresses and instructions) to the programmable controller.

Notes:

- An alarm will sound if you try to download a program while in RUN mode or if you press the wrong keys. If an alarm sounds, press the ACLR key and redo the download operation from the beginning.
- The first time you input a program, be sure to execute the program clear procedure (step 3 above) before starting input.

■ Key operations for correcting input errors

• Correcting the contents of the program

Procedure example

1. Read the contents of address 3. ACLR, 3, READ ▼
2. Clear the display for address 3. (HELP) CLR
3. Rewrite with the correct instructions. OT L-WL, OR R-WR, 0, WRT

• Adding/inserting instructions

Procedure example

1. Read the contents of address 3. ACLR, 3, READ ▼
2. Insert the new instruction. OT L-WL, OR R-WR, 0, (DELT) INST

• Deleting instructions

Procedure example

1. Read the contents of address 3. ACLR, 3, READ ▼
2. Delete. SHIFT SC, (DELT) INST

■ Inputting instructions that are not on the key display

There are two ways to input instructions such as the **ED** (END) instruction and the **DF** (Leading edge differential) instruction, which are not on the key display.

• Using the HELP function

Procedure example

1. Press the keys shown on the right. 

2. Next, press 

to look for the desired instruction.
3. Input the number for the instruction.
   Example:
   The **ED** instruction. 

• Direct input of the instruction code

Example:
The **ED** instruction. 

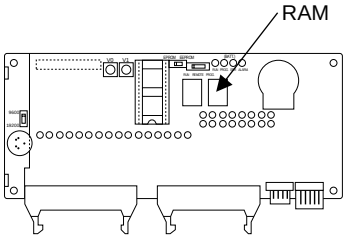
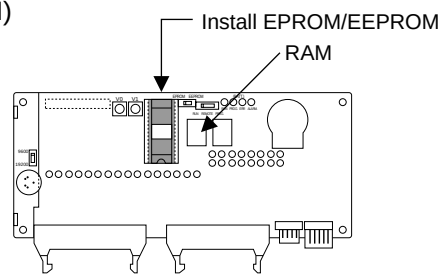
5-6. RAM and ROM Operations

1. RAM and ROM Operations

- The program may be downloaded and saved to RAM on the FP-M control board or to memory (EPROM) or master memory (EEPROM).
- Use of the RAM and EPROM/EEPROM memory makes it easy to reproduce and transfer programs.

■ Operations

RAM operation: Operation with installed RAM
ROM operation: Operation with memory (EPROM) or master memory (EEPROM)

Item	RAM operation	ROM operation
Memory	RAM on the control board 	Memory (EPROM) or master memory (EEPROM) 
Execution of program	The built-in program is executed.	When the mode is changed from PROG. to RUN or the power is turned ON in the RUN mode, the contents of ROM are loaded into the RAM on the FP-M control board and the program is executed. Necessary tools • Memory (EPROM): AFP5202 • Master memory (EEPROM): AFP5207 • Commercially available ROM programmer: We recommend Aval Data Corporation's "PECKER 11"
Backup	The contents of RAM are saved using the backup battery. Note: Replace the backup battery when voltage of the battery is low. (See page 125.) • Battery life (FP-M C20R, C20T, and C32T: Approx. 53,000 hrs. FP-M C20RC, C20TC, and C32TC: Approx. 27,000 hrs.)	Since the contents of the program and system registers are written to ROM, backup is not necessary. The hold area contents written to RAM are backed up by the backup battery.

2. Operation Without Backup Battery Enabled

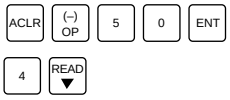
- When the voltage of the backup battery is low or the backup battery is disconnected, system register 4 specifies the operation of FP-M.
- This battery error disregarding function is available for NPST-GR Software Ver. 3 or later.

Procedure

• Using NPST-GR Software Ver. 3.1

1. In the ONLINE mode, press Esc to display the [NPST MENU] window.
2. Select the **PLC CONFIGURATION** option from the NPST menu.
3. Select the **1. SYSTEM REGISTER** option from the [PLC CONFIGURATION] menu.
4. Press the F8 key on the [SYSTEM REGISTER] screen.
   The **ACT ON ERROR** window will open.
5. Select system register **4. BATTERY ERROR INDICATION** in the **ACT ON ERROR** window.
6. Select "YES" or "NO" for system register **4. BATTERY ERROR INDICATION**.
   YES: The conditions (voltage of backup battery low or backup battery disconnected) are regarded as errors.
   NO: The conditions (voltage of backup battery low or backup battery disconnected) are not regarded as errors.
7. Press F1 to save the setting contents and press Esc to return to the previous window.

• Using FP Programmer Ⅱ



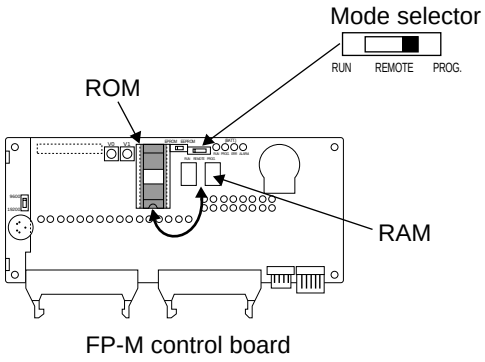
1. Press the keys shown on the right.
2. To read the contents of system register 4, press the keys shown on the right.
3. Press the "**K, 0**" or "**K, 1**" keys for system register 4 (operation without backup battery).
   K0: The conditions (voltage of backup battery low or backup battery disconnected) are regarded as errors.
   K1: The conditions (voltage of backup battery low or backup battery disconnected) are not regarded as errors.
4. Press the "**ACLR**" key to end OP50 operation.
   The FP Programmer Ⅱ will return to its initial state.

3. Notes on Operation with Memory (ROM Operation)

• When the FP-M is operated with the installed memory (ROM), the mode selector causes the following operational changes to occur.

■ When the power is turned ON in PROG. mode

• In the PROG. mode, even if the memory (ROM) is installed, the programming tools (NPST-GR Software or FP Programmer Ⅱ) read the contents of the RAM on the FP-M control board.
• Accordingly, to verify the contents of memory (ROM) while in the PROG. mode, you can transmit the contents to RAM using the following procedure.



Procedure

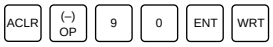
• Using NPST-GR Software Ver. 3.1

1. In the ONLINE mode, press **Esc** key to display the [NPST MENU] window.
2. Select the **PROGRAM MANAGER** option from the NPST menu.
3. Select the **7. COPY PROGRAM BETWEEN ROM & RAM** option from the [PROGRAM MANAGER] menu.
4. Press **F1**.
   When the **COPY ROM TO RAM** window opens, the contents of ROM will be loaded from ROM to RAM.

```
[COPY ROM TO RAM]   NO.=[  0 ] RT  =[ 1 ]        HOME
PROGRAM & SYSTEM REGISTER WILL BE TRANSFERRED
FROM ROM TO RAM.
 F1  :  EXECUTE.
```

• Using FP Programmer Ⅱ

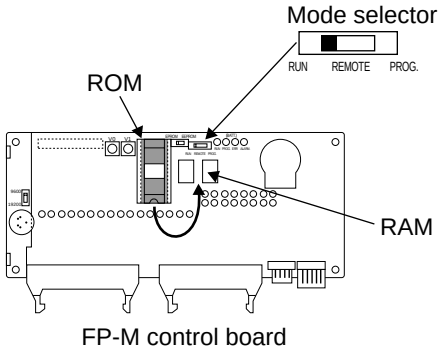
1. Press the keys in the sequence shown on the right.



2. The contents of memory (ROM) will automatically be loaded into the RAM on the FP-M control board.

■ When the power is turned ON in RUN mode

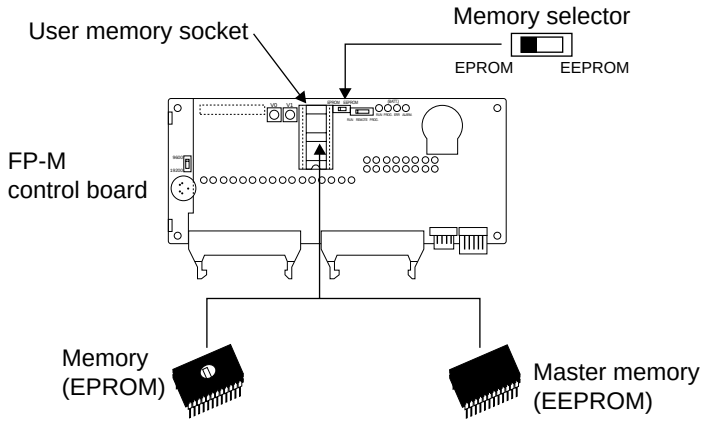
• The contents of memory (ROM) are automatically loaded (overwritten) into the RAM on the FP-M control board when the power is turned ON. Note that the previous contents of the RAM will be erased.



5-7. How to Program ROM

1. Memory (ROM) Type

- FP-M program writing and operation can be done using only the internal RAM. However, program writing, operation and saving, etc., are also possible using optional ROM.
- The contents of the program and system registers are written to the memory or master memory. When the ROM is driven [contents of the memory (ROM) are transferred to RAM], the existing contents of memory and system registers will be overwritten.
- The contents of memory for operand, such as internal relays and data registers, are not overwritten.

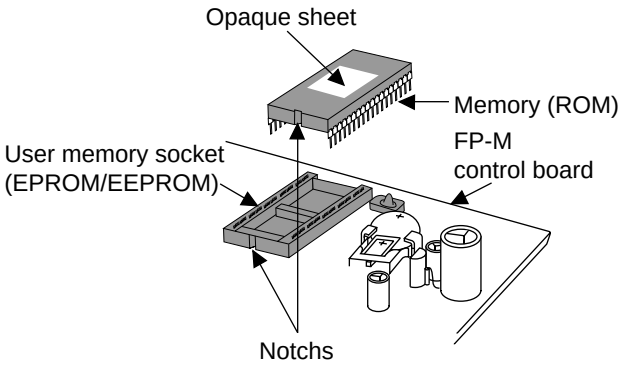


■ Memory type

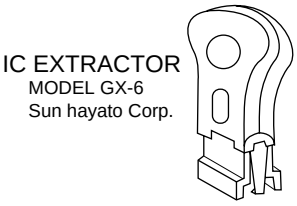
Type	Part number	Writing method	Description
Memory (EPROM) 2 pieces in a set	AFP5202	Commercially available ROM programmer	27C256 or equivalent Suitable for program storage or ROM operation when installed on the FP-M control board.
Master memory (EEPROM) 1 piece in a set	AFP5207	FP-M control board (A ROM programmer is not required.)	28C256 or equivalent You can write data without using a ROM programmer. Suitable for copying and transmitting the program.

2. Install the Memory (ROM)

- Set the same mode between memory (ROM) type and memory selector.
- Turn OFF the power of the FP-M control board before installing or removing the memory (EPROM) and master memory (EEPROM).
- Put the memory on the user memory socket, align the pins of the memory with the user memory socket holes and insert correctly.
- Attach an opaque sheet onto the window on the memory (EPROM) before use. If the opaque sheet is not attached, light may cause problems.



- When removing the memory (EPROM) and master memory (EEPROM) from the user memory socket, use of an IC EXTRACTOR is recomended. Note that the surface of the FP-M control board might be damaged by using a screwdriver.



3. How to Program ROM

- Using a commercially available ROM programmer, the contents of RAM on the FP-M control board can be written to the memory (ROM).
- The following types of memory (ROM) are available:
  - Memory (EPROM): AFP5202 [27C256 type or equivalent]
    Memory for storing programs. Writing is done with a commercially available ROM programmer.
  - Master memory (EEPROM): AFP5207 [28C256 type or equivalent]
    Memory for copying programs. Writing is done with a master memory attached to the FP-M control board.

1) Writing a program to the memory (EPROM) via master memory (EEPROM) with a commercially available ROM programmer

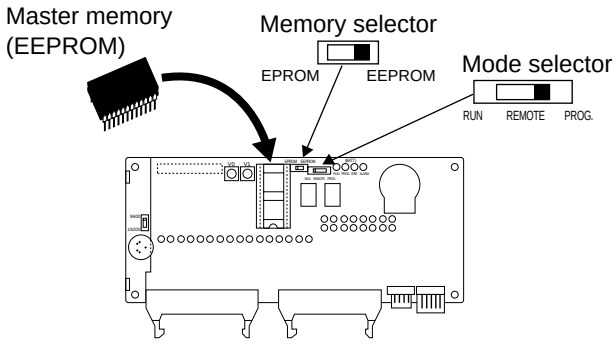
Necessary tools

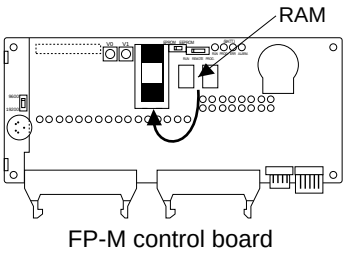
- Memory (EPROM): AFP5202 [27C256 type or equivalent]
- Master memory (EEPROM): AFP5207 [28C256 type or equivalent]
- Commercially available ROM programmer: We recommend Aval Data Corporation's PECKER 11
- Programming tools
  - FP-M personal computer cable (for NPST-GR): AFC8513 (3 m/9.843 ft.)
  - RS232C interface adapter: See page 84.
  - Commercial computer: IBM PC-AT or 100 % compatible machine
    Main memory: 550 KB or more free
    EMS: 800 KB or more free
    Hard disk space: 2 MB or more required
    Operating system: MS-DOS Ver. 3.30 or later
    Video mode (display mode): VGA
  - NPST-GR Software Ver. 3: AFP266538
  - FP-M peripheral cable: AFC8521 (1 m/3.281 ft.), AFC8523 (3 m/9,843 ft.)
  - FP Programmer Ⅱ: AFP1114

Procedure

[FP-M RAM → master memory (EEPROM) → ROM programmer memory → memory (EPROM)]

1. Turn OFF the power of the FP-M control board.
2. Attach the master memory (EEPROM) to the FP-M control board. Set the memory selector to EEPROM mode.
3. Set the mode selector of the FP-M control board to PROG. mode and then turn ON the power of the FP-M control board.
4. Transfer the contents of RAM to the master memory (EEPROM) using programming tools (NPST-GR Software or FP Programmer Ⅱ) as shown below.

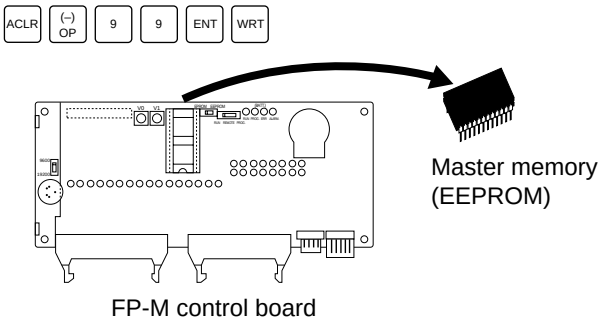




- Using NPST-GR Software Ver. 3.1
  - ① In the ONLINE mode, press the **Esc** key to display the [NPST MENU] window.
  - ② Select the **PROGRAM MANAGER** option from the NPST menu.
  - ③ Select the **7. COPY PROGRAM BETWEEN ROM & RAM** option from the [PROGRAM MANAGER] menu.
  - ④ Press **F1**.
    When the [COPY RAM TO ROM] window opens, the contents of RAM will be loaded from RAM to ROM.

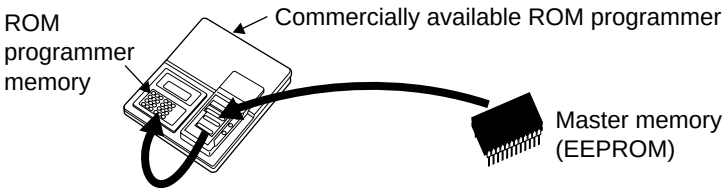
[COPY RAM TO ROM] NO.=[0] RT =[1] HOME
PROGRAM & SYSTEM REGISTER WILL BE TRANSFERRED FROM RAM TO ROM.
F1 : EXECUTE.

- Using FP Programmer Ⅱ
  - ① Press the keys in the sequence shown right.
  - ② The contents of RAM will be loaded into the attached ROM.

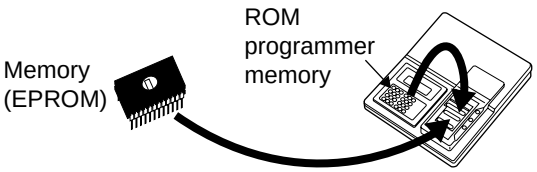


5. Turn OFF the power of FP-M control board. Detach the programmed master memory (EEPROM) from the FP-M control board.

6. Attach the master memory (EEPROM) to the ROM programmer. Transfer the contents of master memory (EEPROM) to ROM programmer memory.



7. Replace the master memory (EEPROM) on the ROM programmer with the memory (EPROM). Write the contents of the ROM programmer memory to the memory (EPROM).



Notes:

- If you want to write the contents of RAM on the FP-M control board to a master memory (EEPROM), be sure to set the mode selector to PROG. before turning ON the power.
- When using a commercially available ROM programmer to write to the master memory (EEPROM) or the memory (EPROM), refer to the manual that comes with it for operation procedure and settings.

2) Writing a program to the memory (EPROM) with NPST-GR Software and a commercially available ROM programmer

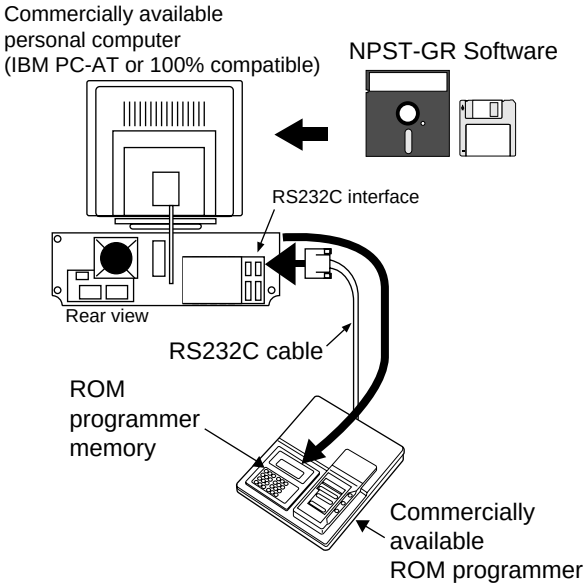
Necessary tools

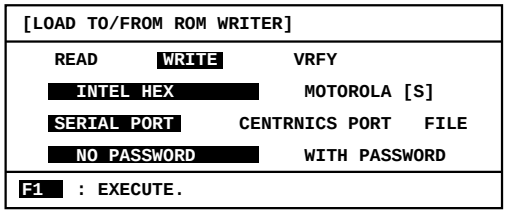
- Memory (EPROM): AFP5202 [27C256 type or equivalent]
- Commercially available ROM programmer: We recommend Aval Data Corporation's PECKER 11
- Programming tools
  - RS232C cable: Needs to be customized to match the specifications of the commercial ROM programmer.
  - Commercial computer: IBM PC-AT or 100 % compatible machine
    Main memory: 550 KB or more free
    EMS: 800 KB or more free
    Hard disk space: 2 MB or more required
    Operating system: MS-DOS Ver. 3.30 or later
    Video mode (display mode): VGA
- NPST-GR Software Ver. 3: AFP266538

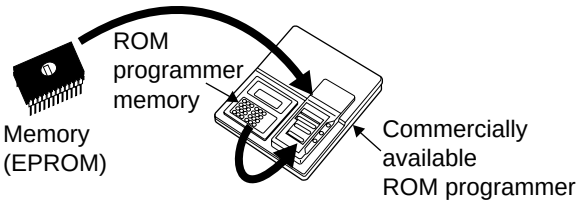
Procedure

[Program with NPST-GR Software → ROM programmer memory → memory (EPROM)]

1. Transfer the program from the computer to the ROM programmer memory using NPST-GR Software as shown below.
   - Using NPST-GR Software Ver. 3.1
     ① In the ONLINE mode, press **Esc** key to display the [NPST MENU] window.
     ② Select the **NPST CONFIGURATION** option from the NPST menu.
     ③ Select the **1. NPST CONFIGURATION** option from the **NPST CONFIGURATION** menu.
     ④ Press **SHIFT** + **F6 (ROM)** keys. The <ROM CONFIG> window will open.
     ⑤ Select the parameter for each setting item according to the ROM programmer. Then press the **F1** key.
     <ROM CONFIG> window setting items
     TRANS RATE (bps): 9600, 4800, 2400, 1200, 600, 300
     DATA LENGTH: 8, 7
     PARITY CHECK: NO, EV, OD
     STOP BIT: 1, 2
     ⑥ Select the **8. LOAD TO/FROM ROM WRITER** option from the **PROGRAM MANAGER** menu.
     ⑦ Select "WRITE" in the window and specify the format according to the ROM programmer.
     ⑧ Press the **F1 (EXEC)** key to load the program.
2. Attach the memory (EPROM) to the ROM programmer.
3. Write the contents of the ROM programmer memory to the memory (EPROM).







Note:

- When using a commercially available ROM programmer to write to the master memory (EEPROM) or the memory (EPROM), refer to the manual that comes with it for operation procedure and settings.

CHAPTER 6

TROUBLESHOOTING AND MAINTENANCE

6-1. Self-diagnostic Function

FP-M programmable controllers use the self-diagnostic function when something goes wrong with them. The abnormalities detected by the self-diagnostic function are divided into three categories:

• Self-diagnostic error

This type of error is detected when the following occurs:
- Hardware problem in CPU or ROM, and backup battery problem (ROM, system, interrupt, or battery abnormality).
- An instruction is incorrectly executed in RUN mode (operation error).

• Total-check error

This type of error is detected by a total-check operation when the following occurs. The total-check operation is performed when the mode selector is changed from PROG. to RUN.
- Program abnormalities such as syntax errors, duplicated use of output, and instruction combination errors. (syntax error, duplicated output error, mismatch error, program area error, operand error)

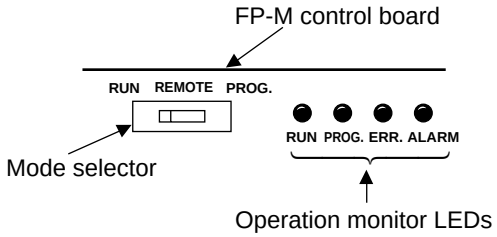
The total-check operation can also be performed by using the FP Programmer Ⅱ (OP9 function) or the NPST-GR Software [“1.TOTALLY CHECK A PROGRAM” (menu 1) or “V.TOTALLY CHECK” (menu 2)].

• System watchdog timer error

This type of error is detected when the following occurs:
- program scan time is extraordinarily long
- hardware abnormality is detected

1. Operation Monitor LEDs When an Error Occurs

• The status of the operation monitor LEDs on the FP-M control board vary, as shown in the table below.



Content	Position of the mode selector	LED status			
		RUN	PROG.	ERR.	ALARM
Normal operation	RUN	ON	OFF	OFF	OFF
	PROG.	OFF	ON	OFF	OFF
Forced ON/OFF	RUN	Flash	OFF	Varies	OFF
	PROG.	OFF	ON	Varies	OFF
When a self-diagnostic error occurred	RUN	Varies	Varies	ON	OFF
	PROG.	OFF	ON	ON	OFF
When a total-check error occurred	RUN	OFF	ON	ON	OFF
	PROG.	OFF	ON	OFF	OFF
When a system watchdog timer error occurred	RUN	Varies	Varies	Varies	ON
	PROG.	Varies	Varies	Varies	ON

2. Operation Status When an Error Occurs

When an error occurs, the FP-M usually stops operating. However, regarding duplicated output errors, a backup battery abnormality, and operation errors, you can continue operation by changing the system register settings.

1) Duplicated output error (total-check error)

• If the duplicated use of output is detected, the FP-M stops operating and the ERR. LED turns ON.
When you change system register 20 settings using the FP Programmer Ⅱ or NPST-GR Software, duplicated output is not regarded as an error and the FP-M continues to operate. In this case, the ERR. LED does not turn ON.

Duplicated output error: system register 20 (K1 or ENAB)
[FP Programmer Ⅱ: K0 (stops operation), K1 (continues operation)]
[NPST-GR Ver. 3.1: DISA (stops operation), ENAB (continues operation)]

2) Battery error (self-diagnostic error)

• If the voltage of the backup battery lowers or if the backup battery disconnects, the ERR. LED turns ON.

Battery error: system register 4 (K1 or NO)
[FP Programmer Ⅱ: K0 (stops operation), K1 (continues operation)]
[NPST-GR Ver. 3.1: YES (stops operation), NO (continues operation)]

3) Operation error (self-diagnostic error)

• An operation error is one of the errors in the programmable controllers. These errors occur when an instruction [one of high-level/some basic (e.g., **ST =**) instructions] is executed abnormally.
• When an operation error occurs, operation of the programmable controller stops. At the same time, operation error flags R9007 and R9008 turn ON, the error address is stored in DT9017 and DT9018, the error code [K45 (H2D)] is set at DT9000, and the ERR. LED lights.
However, when you change system register 26 settings using the FP Programmer Ⅱ or NPST-GR Software (Ver. 3.1 or later), the FP-M continues to operate. In this case, even if the FP-M continues to operate, this is regarded as an error and the ERR. LED stays ON.

Operation error: system register 26
[FP Programmer Ⅱ: K0 (stops operation), K1 (continues operation)]
[NPST-GR Ver. 3.1: STOP (stops operation), STRT (continues operation)]

6-2. Troubleshooting

1. Points to be Checked When an Error Occurs

When an abnormality is detected, check the following points.

- If the ERR. LED is ON,
  refer to page 115, ■ **When an ERR. LED is ON.**
- If the ALARM LED is ON,
  refer to page 117, ■ **When an ALARM LED is ON.**
- If the all LEDs are OFF,
  refer to page 117, ■ **When all LEDs are OFF.**
- If the output does not work,
  refer to page 118, ■ **Diagnosing output malfunction.**
- If the communication error is detected by the NPST-GR Software,
  refer to page 121, ■ **When "PLC = COMM. ERR" is displayed on the NPST-GR screen.**
- If the PROTECT ERROR is detected by the programming tool,
  refer to page 122, ■ **When "PROTECT ERROR" is displayed.**

Note:

- Check the entire system including peripheral devices, referring the followings:
  - Observe what is happening.
  - Check for error repetition.
  - Check the status of indicators.
  - Check that power is properly supplied to the programmable controller.
  - Check whether the trouble detected is in the programmable controller or in other devices.
  - Check whether the trouble detected is in the I/O section or other parts.
  - Check whether there is problem with the program or not.

■ When an ERR. LED is ON

<Condition: an error is detected by the self-diagnostic function>

Set the mode selector of the FP-M control board from RUN to PROG.

Is ERR. LED on the FP-M control board turned OFF?

NO (ERR. LED ON) **Go to page 116**

YES (ERR. LED OFF)

Probably a total-check error. Check the program using the programming tool.

• Using NPST-GR Software Ver. 3.1

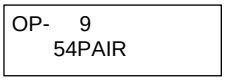
<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing **Esc**, and then select "CHECK A PROGRAM" to skip to the [CHECK A PROGRAM] subwindow. In the [CHECK A PROGRAM] subwindow, select "1. TOTALLY CHECK A PROGRAM".

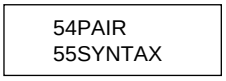
<If you are using MENU 2 screen type>
Open [ONLINE MONITOR FUNCTION MENU] by pressing **Esc**, and then select "V. TOTALLY CHECK".

In the [TOTALLY CHK] window, press **F1** to execute the program check. You can get the address and program where a total-check error occurs. The type of errors can also be displayed.

• Using FP Programmer II

Press the keys on the FP Programmer II as shown on the right.
When a total-check error occurs, the screen shown on the right is displayed. You can find the address and program where a total-check error occurs by pressing the READ ▼ key.





Correct the program referring to page 123, 1. Table of Total-check Error Codes.

Set the mode selector of the FP-M control board from PROG. to RUN.

From page 115

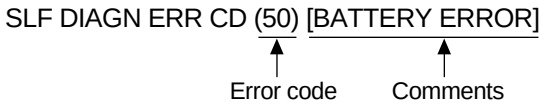
Probably a self-diagnostic error.
Check the program using the programming tool.

• Using NPST-GR Software Ver. 3.1

<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing **Esc**, and then select "MONITOR" to skip to the [MONITOR] subwindow. In the [MONITOR] subwindow, select "7. STATUS DISPLAY".

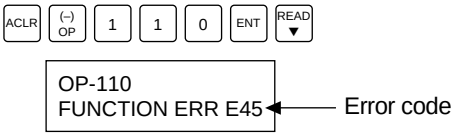
<If you are using MENU 2 screen type>
Open [ONLINE MONITOR FUNCTION MENU] by pressing **Ctrl** and **F10** together, and then select "P. STATUS DISPLAY".

At the bottom of the [STATUS DISPLAY] window, you can find the error code in "( )", represented in decimal, and comments in "[ ]", as shown on the right.



• Using FP Programmer II

Press the keys on the FP Programmer II as shown on the right.
When self-diagnostic error occurs, the screen shown on the right is displayed.



Check the FP-M referring to page 124, 2. Table of Self-diagnostic Error Codes.

Cancel error status and start operation again.

• You can cancel the error status in the following ways:
- Turn the power OFF and then ON.
- Cancel the error status using the NPST-GR Software Ver. 3.1 or the FP Programmer II.
  To perform this function, use "OP 112" of the FP Programmer II or [STATUS DISPLAY] of NPST-GR Software Ver. 3.1. (This function is not available with a conventional FP Programmer or with NPST-GR Software Ver. 3.0 or earlier.)
- Cancel the error status using the **F148 (ERR)** instruction.

■ When an ALARM LED is ON

<Condition: a system watchdog timer error occurs>

Set the mode selector of the FP-M control board from RUN to PROG. and turn the power OFF and then ON.

- If the ALARM LED is turned ON again, there is probably an abnormality in the FP-M control board. Please contact your dealer.
- If the ERR. LED is turned ON, go to page 115, ■ When an ERR. LED is ON.

Set the mode selector of the FP-M control board from PROG. to RUN.

- If the ALARM LED is ON, the program execution time is too long. Check the program, referring the following:
  - Check if instructions such as **JP** or **LOOP** are programmed in such a way that a scan can never finish.
  - Check that interrupt instructions are executed in succession.

■ When all LEDs are OFF

Check the power supply wiring.

Check if the power supplied to the programmable controller is in the range of the rating.

- Be sure to check the fluctuation in the power supply.

Make sure the direction is correct when installing ROM memory on the FP-M control board.

- Installation in the wrong direction may cause the power supply to short.

Disconnect the power supply wiring to the other devices if the power supplied to the FP-M control board is shared with them.

- If the LEDs on the FP-M control board turn ON at this moment, the capacity of the power supply is not enough to control other devices as well.
- Prepare another power supply for other devices or increase the capacity of the power supply.

■ Diagnosing output malfunction

<First check the output condition and then the input condition>

① Output condition: the output indicators are ON

Check the wiring of the output devices.

↓

Check if the power is properly supplied to the output devices.

- If the power is properly supplied to the load, there is probably an abnormality in the load. Check the load again.
- If the power is not supplied to the load, there is probably an abnormality in the FP-M's output.
  Please contact your dealer.

② Output condition: the output indicators are OFF

Monitor the output condition using a programming tool.

How to monitor the outputs:

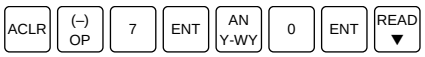
• Using the NPST-GR Software Ver. 3.1

<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing **Esc**, then select "MONITOR" to skip to the [MONITOR] subwindow.
In the [MONITOR] subwindow, select "3. MONITOR LISTED RELAYS".

<If you are using MENU 2 screen type>
Open [ONLINE MONITOR FUNCTION MENU] by pressing **Ctrl** and **F10** together, then select "I. LISTED RELAYS".

• Using the FP Programmer II

Press the keys on the FP Programmer II as shown on the right.



If the output monitored is turned ON, there is probably a duplicated output error or I/O allocation error.
Check the program and the I/O allocation.

↓

(Next page)

Forcing ON the output using a programming tool.

- **Using NPST-GR Software Ver. 3.1**

<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing **Esc**, then select "RELAYS/REGISTERS" to skip to the [RELAYS/REGISTERS] subwindow.
In the [RELAYS/REGISTERS] subwindow, select "1. FORCE I/O".

<If you are using MENU 2 screen type>
Open [ONLINE MONITOR FUNCTION MENU] by pressing **Ctrl** and **F10** together, then select "D. FORCE I/O".

- **Using FP Programmer Ⅱ**

Press the keys on the FP Programmer Ⅱ as shown on the right.

Check if the output indicator is ON.

- If the output indicator is turned ON, go to input condition check.
- If the output indicator remains OFF, there is probably an abnormality in the FP-M control board's output circuit.
  Please contact your dealer.

③ Input condition: the input indicators are ON

Monitor the input condition using a programming tool.

How to monitor the inputs:

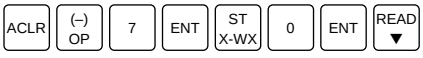
- **Using NPST-GR Software Ver. 3.1**

<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing **Esc**, then select "MONITOR" to skip to the [MONITOR] subwindow.
In the [MONITOR] subwindow, select "3. MONITOR LISTED RELAYS".

<If you are using MENU 2 screen type>
Open the [ONLINE MONITOR FUNCTION MENU] by pressing **Ctrl** and **F10** together, then select "I. LISTED RELAYS".

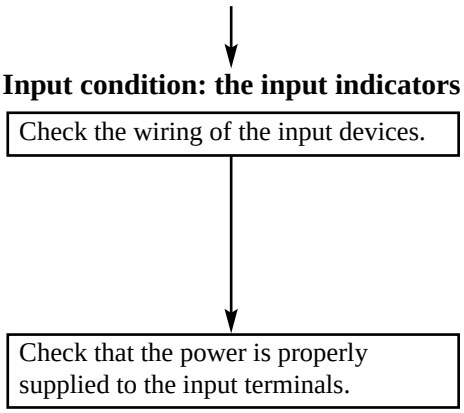
- **Using the FP Programmer Ⅱ**

Press the keys on the FP Programmer Ⅱ as shown on the right.



If the input monitored is OFF, there is probably an I/O allocation error or an abnormality with the FP-M's input.
Please contact your dealer.
If the input monitored is ON, check the program again.
Also check for current leaks at the input devices (e.g., two-wired photoelectric sensors).
Check for the duplicated use of output or the program flow when a control instruction such as **MC** or **JP** is used.
Check the settings of the I/O allocation and I/O address setting switch.

(Next page)



- If the power is properly supplied to the input terminal, there is probably an abnormality in the FP-M's internal circuit.
  Please contact your dealer.
- If the power is not properly supplied to the input terminal, there is probably an abnormality in the input device or input power supply.
  Check the wiring again.

■ When "PLC = COMM. ERR" is displayed on the NPST-GR screen

Check if the baud rate settings of the FP-M and NPST-GR are the same.

• NPST-GR baud rate setting

<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing the **Esc** key, then select "NPST CONFIGURATION" to skip to the [NPST CONFIGURATION] subwindow. In the [NPST CONFIGURATION] subwindow, select "1. NPST CONFIGURATION".

<If you are using MENU 2 screen type>
Open [NPST FUNCTION MENU] by pressing the **Esc** key, then select "Z. NPST CONFIGURATION".

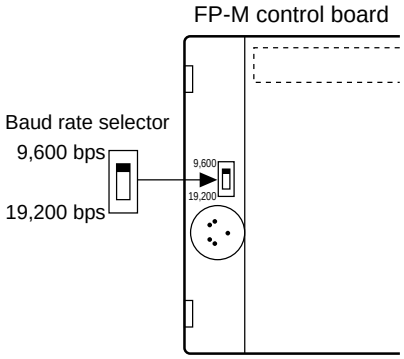
In this window, you can find the baud rate as shown below:

TRNS RATE (bps) [19200 / 9600 / 4800 / 2400 / 1200 / 600 / 300]

Select a baud rate (19,200 or 9,600), press the **F1** key and select "SAVE DISK ? YES" to register this change onto the disk.

• FP-M baud rate setting

Set the baud rate using the baud rate selector of the FP-M control board.



Note:

• Even when both the NPST-GR and FP-M are set to 19,200 bps, sometimes a computer cannot communicate with the FP-M properly at 19,200 bps. If this happens, change both of their settings to 9,600 bps and try again.

Check the cable and RS232C interface adapter.

RS232C interface adapter: Needs to be customized to match your computer.

• Confirm the cable specifications, referring to the following examples:

RS232C interface adapter & IBM PC-AT (9 Pins)

Connected to RS232C interface adapter (25 pins male)		Connected to IBM PC-AT (9 pins female)	
Pin No.	Abbreviation	Pin No.	Abbreviation
1	FG	1	CD (DCD)
2	SD (TXD)	2	RD (RXD)
3	RD (RXD)	3	SD (TXD)
4	RS (RTS)	4	ER (DTR)
5	CS (CTS)	5	SG
6	DR (DSR)	6	DR (DSR)
7	SG	7	RS (RTS)
8	CD (DCD)	8	CS (CTS)
20	ER (DTR)	9	RI (CI)

RS232C interface adapter & personal computer (25 Pins)

Connected to RS232C interface adapter (25 pins male)		Connected to personal computer (25 pins male)	
Pin No.	Abbreviation	Pin No.	Abbreviation
1	FG	1	FG
2	SD (TXD)	2	SD (TXD)
3	RD (RXD)	3	RD (RXD)
4	RS (RTS)	4	RS (RTS)
5	CS (CTS)	5	CS (CTS)
6	DR (DSR)	6	DR (DSR)
7	SG	7	SG
8	CD (DCD)	8	CD (DCD)
20	ER (DTR)	20	ER (DTR)

Confirm the setting of the personal computer referring to the manual for your computer.

■ When "PROTECT ERROR" is displayed

① When memory (EPROM) or master memory (EEPROM) is installed in the FP-M control board

If memory (EPROM) or master memory (EEPROM) is installed on the FP-M control board, the program cannot be modified.
Proceed with program modification as follows:

First, turn OFF the power of the FP-M control board.
Then, remove the memory (EPROM) or master memory (EEPROM) from the FP-M control board.

↓

Modify the program using a programming tool.

↓

Save the modified program to the memory (EPROM) or master memory (EEPROM) and start operation again. (Refer to page 103, "5-6. RAM and ROM Operations", for details about ROM operation.)

② When a password is set for the programmable controller

Change the setting of the password using a programming tool.

- **Using NPST-GR Software Ver. 3.1**

<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing the **Esc** key, and then select "PLC CONFIGURATION" to skip to the [PLC CONFIGURATION] subwindow.
In the [PLC CONFIGURATION] subwindow, select "5. SET PLC PASSWORD".

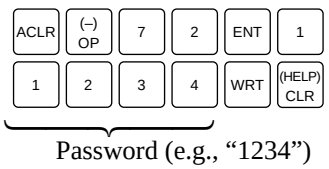
<If you are using MENU 2 screen type>
Open [NPST FUNCTION MENU] by pressing the **Esc** key in the ONLINE mode, and then select "SET PLC PASSWORD".

↓

In the [SET PLC PASSWORD] window, select ENAB and press the **Enter** key to set the mode of the password setting to enable saving and loading of the program.

- **Using FP Programmer Ⅱ**

Press the keys on the FP Programmer Ⅱ as shown on the right.



6-3. Error Codes

- When the ERR. LED turns ON, a total-check error or self-diagnostic error has occurred. The causes of the error can be known by checking the error code in "1. Table of Total-check Error Codes" or "2. Table of Self-diagnostic Error Codes" in this section.
- For details about the error checking procedure, refer to page 115, "■ When an ERR. LED in ON".

1. Table of Total-check Error Codes

Error code	Name of error	Description	Step to take
E1	Syntax error (SYNTAX)	Instruction is incorrectly programmed.	Set the mode of FP-M to PROG. and input the instruction correctly, referring to the description for the instruction.
E2	Duplicated output error (DUP USE)	Two or more **OT** and **KP** instructions are programmed using same relay.	Set the mode of FP-M to PROG. and correct the program so that one relay is not used for two or more **OT** and **KP** instructions. This error can be disregarded by changing the system register 20 setting to K1 (ENAB).
E3	Not paired error (PAIR)	One of the instructions, which must be paired, is missing (e.g., **JP** and **LBL**). The paired instruction sets may have been programmed in the incorrect order (e.g., **MC** and **MCE**).	Set the mode of FP-M to PROG. and program the missing instruction. Program the instruction sets in the proper order, referring to the description of the instruction.
E4	System register parameter error (MISMATCH)	The operand for the instruction is out of the range set in the system register.	Set the mode of FP-M to PROG. and check the system register parameter using a FP Programmer II (OP50) or NPST-GR Software (1. SYSTEM REGISTER in the PLC CONFIGURATION).
E5	Program area error (PRG AREA)	The instruction has been programmed in the incorrect position (e.g., **INT** and **IRET** instructions are programmed at the address before the **ED** instruction).	Set the mode of FP-M to PROG. and program the instruction in the proper position, referring to the description of the instruction.
E8	Operand error (OPR COMBI)	Incorrect operand has been entered for the instruction.	Set the mode of FP-M to PROG. and program the instruction using the correct operand, referring to the description of the instruction.

2. Table of Self-diagnostic Error Codes

Error code	Name of error	Program execution when an error occurs	Description	Step to take
E26	ROM error	Stops	Probably an abnormality in the memory (EPROM) or master memory (EEPROM).	Program the memory (EPROM) or master memory (EEPROM) again and try to operate. If the same error is detected, try to operate with another memory (EPROM) or master memory (EEPROM).
E28	System register error	Stops	Probably an abnormality in the system register.	Set the mode of FP-M to PROG., initialize the system register and set it again.
E31	Interrupt error	Stops	Probably a hardware abnormality or an abnormality caused by noise.	Turn OFF the power of the FP-M and check the surrounding noise level.
E32	Interrupt error	Stops	Probably a hardware abnormality or an abnormality caused by noise.	Turn OFF the power of the FP-M and check the surrounding noise level.
			Probably an interrupt program corresponding to the trigger is missing.	Set the mode of FP-M to PROG. and create a program which corresponds to the interruption.
E45	Operation error	Selectable (by system register 26) (See note 1.)	Probably an abnormality was detected when a high-level or basic instruction was executed.	Check the program, referring to the error address which is stored in special data registers DT9018 and DT9017.
E50	Battery error	Continues	The voltage of the backup battery lowers or the connector of the backup battery is disconnected.	Replace the backup battery. The operation without backup battery can be specified by system register 4. (See note 2.)
E100 to E199	Self-diagnostic error warning by **F148 (ERR)** instruction	Stops	• The self-diagnostic error code specified by the **F148 (ERR)** instruction is transferred to DT9000. • The contents of the self-diagnostic error code can be confirmed using the programming tools. - NPST-GR Software: “7. STATUS DISPLAY” in ONLINE mode - FP Programmer Ⅱ: “OP-110”	
E200 to E299		Continues		

Notes:

1. System register 26 specifies the program execution state when an operation error occurs.
   Settings:
   K0: FP-M stops operation if an operation error occurs.
   K1: FP-M continues operation even if an operation error occurs.
2. System register 4 specifies the operation of the FP-M when the voltage of the backup battery lowers or when the backup battery disconnects.
   Settings:
   K0: The conditions above are regarded as errors.
   K1: The conditions above are not regarded as errors.

6-4. Maintenance

Although programmable controllers have been designed in such a way to minimize maintenance and offer trouble-free operation, several maintenance aspects should be taken into consideration. If preventive maintenance is performed periodically, you will minimize the possibility of system malfunctions.

1. Replacement of Backup Battery

1) Battery life

Control board	Battery life (at 25 ˚C/77 ˚F ambient temperature)
C20R, C20T, and C32T types	Approx. 53,000 hours (approx. 6 years)
C20RC, C20TC, and C32TC types	Approx. 27,000 hours (approx. 3 years)

• When the voltage of the backup battery lowers, special internal relays R9005 and R9006 turn ON and the ERR. LED turns ON. Replace the backup battery within a month after this battery error is detected.

2) Using backup battery type

Item	Part number	Description
Backup battery	AFB8801	Lithium battery, BR2032/CR2032 type or equivalent For all FP-M control boards

Caution:

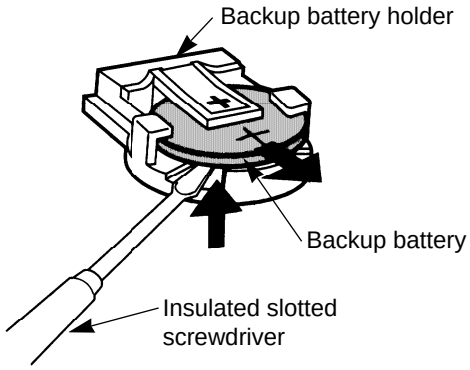
• Never throw batteries into a fire. Do not dispose of them in trash that will be incinerated.

3) How to replace backup battery

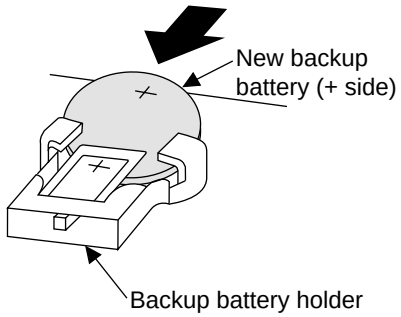
• Replace the battery within 3 minutes, after applying the power to the FP-M control board more than 1 minute.

Procedure

① Turn OFF the power of FP-M control board.
② Lift the backup battery on the FP-M control board using insulated slotted screwdriver as shown on the right.
③ Remove the backup battery from the backup battery holder as shown on the right.



④ With the + side facing up, insert the new backup battery into the backup battery holder by sliding it in sideways as shown on the right.
⑤ Turn ON the power of the FP-M control board.



Note:

• Before inserting the new battery, check that nothing is attached to the + and – surfaces.

2. Check Items

• Perform a daily or periodic check to maintain proper operation of the FP-M programmable controller.

Item	Check point	Criteria for judgement
Power supply voltage	Check the power supply condition by measuring it at power supply terminals of the FP-M.	21.6 to 26.4 V DC
I/O power supply voltage	Check the I/O power supply condition by measuring it at I/O power supply terminals of the FP-M.	20.4 to 26.4 V DC: C20T and C32T types 22.8 to 26.4 V DC: C20R type
Environment	Ambient temperature (e.g., temperature in the control box)	0 ˚C to 55 ˚C/32 ˚F to 131 ˚F
	Ambient humidity (e.g., humidity in the control box)	30 to 85 % RH (non-condensing)
	Is dirt and dust present?	Free from corrosive gases and excessive dust
LEDs on control boards	RUN LED	Turns ON when program is executed.
	ERR. LED	Turns ON when a self-diagnostic error occurs.
	ALARM LED	Turns ON when an abnormality is detected or watchdog timer error occurs.
Indicators (LED) on control and expansion boards	Input indicators (LED)	Turns ON when input devices are ON. Turns OFF when input devices are OFF.
	Output indicators (LED)	Turns ON when output devices are ON. Turns OFF when output devices are OFF.
Mounting and connecting condition	• Are all of the boards firmly fixed on a panel? • Are all the terminal screws securely tightened? • Is the wiring being properly kept?	———
Backup battery	Is the backup battery being periodically replaced?	Refer to the preceding page.

CHAPTER 7

INTELLIGENT AND LINK BOARDS

7-1. Analog I/O Board

Input and output of analog data (voltage and current) is possible by expanding the FP-M control board with an analog I/O board.

1. Specifications

1) General

Item	Description
Ambient temperature	0 ˚C to +50 ˚C (32 ˚F to +122 ˚F) (See note.)
Ambient humidity	30 % to 80 % RH (non-condensing)
Storage temperature	–20 ˚C to +70 ˚C (– 4 ˚F to +158 ˚F)
Vibration resistance	10 Hz to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm (0.030 in.), 10 min on 3 axes
Shock resistance	Shock of 98 m/s^2 or more, 4 times on 3 axes
Noise immunity	800 Vp-p (based on in-house measurements)

Note:

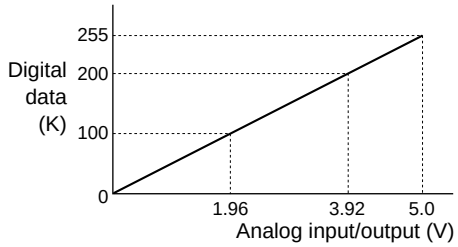
- When using in ambient temperature of 45 ˚C to 50 ˚C, be sure to make the number of ON points on the upper expansion board 50 % or less.

2) Performance

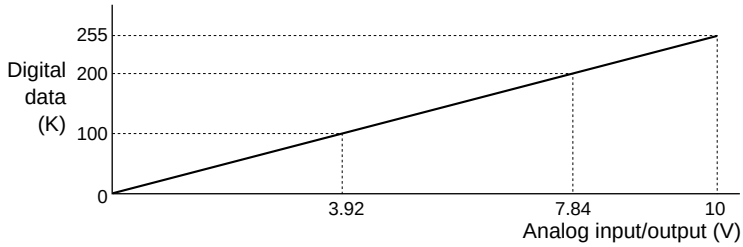
Item		Description
Analog input specifications	Number of input channels	4 channels
	Input range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
	Resolution	1/256
	Overall accuracy	±3LSB (at 25 ˚C/77 ˚F), ±5LSB (at 0 ˚C to 50 ˚C/32 ˚F to 122 ˚F)
	Response time	2.5 ms/channel
	Input impedance	1 MΩ or more (for 0 to 5 V and 0 to 10 V range) 250 Ω (for 0 to 20 mA range)
	Absolute input range	+15 V (at 0 to 5 V and 0 to 10 V range) +30 mA (at 0 to 20 mA range)
	Digital converted data	K0 to K255
Analog output specifications	Number of output channels	1 channel
	Output range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
	Resolution	1/256
	Overall accuracy	±1.0 % of full scale (at 25 ˚C/77 ˚F), ±2.0 % of full scale (at 0 ˚C to 50 ˚C /32 ˚F to 122 ˚F)
	Response time	2.5 ms/channel
	Output impedance	0.5 Ω or less (for 0 to 5 V and 0 to 10 V output range)
	Max. output current	20 mA (for 0 to 5 V and 0 to 10 V output range)
	Allowable load resistance	0 to 500 Ω (for 0 to 20 mA range)
	Digital data	K0 to K255
Insulation method		Optical coupler (not insulated between channels)

■ Analog data conversion characteristics

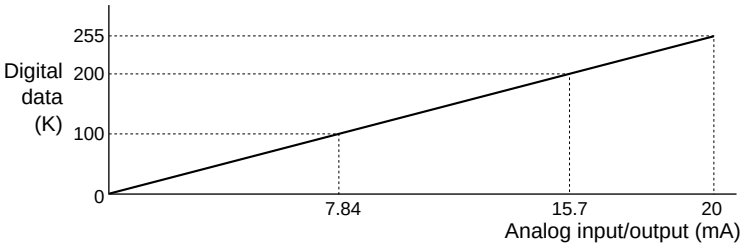
• 0 to 5 V range



• 0 to 10 V range

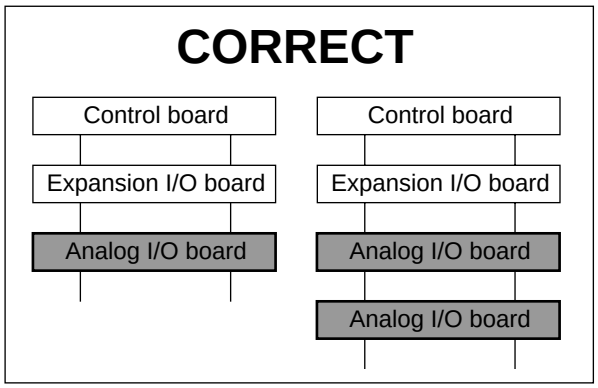


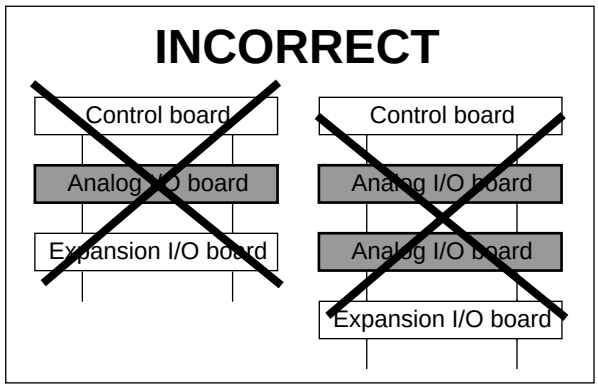
• 0 to 20 mA range



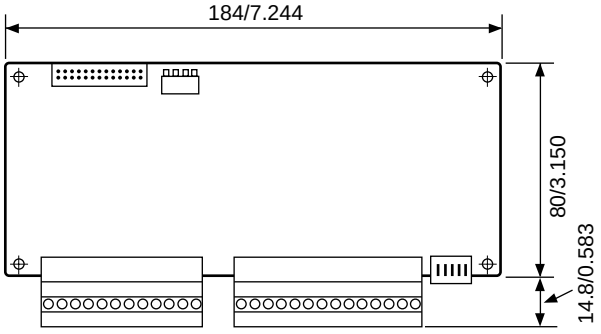
3) Restriction of expansion

- A total of four analog I/O boards can be attached to the control board.
- When expanding analog I/O boards, install them beneath the expansion I/O board as shown below.



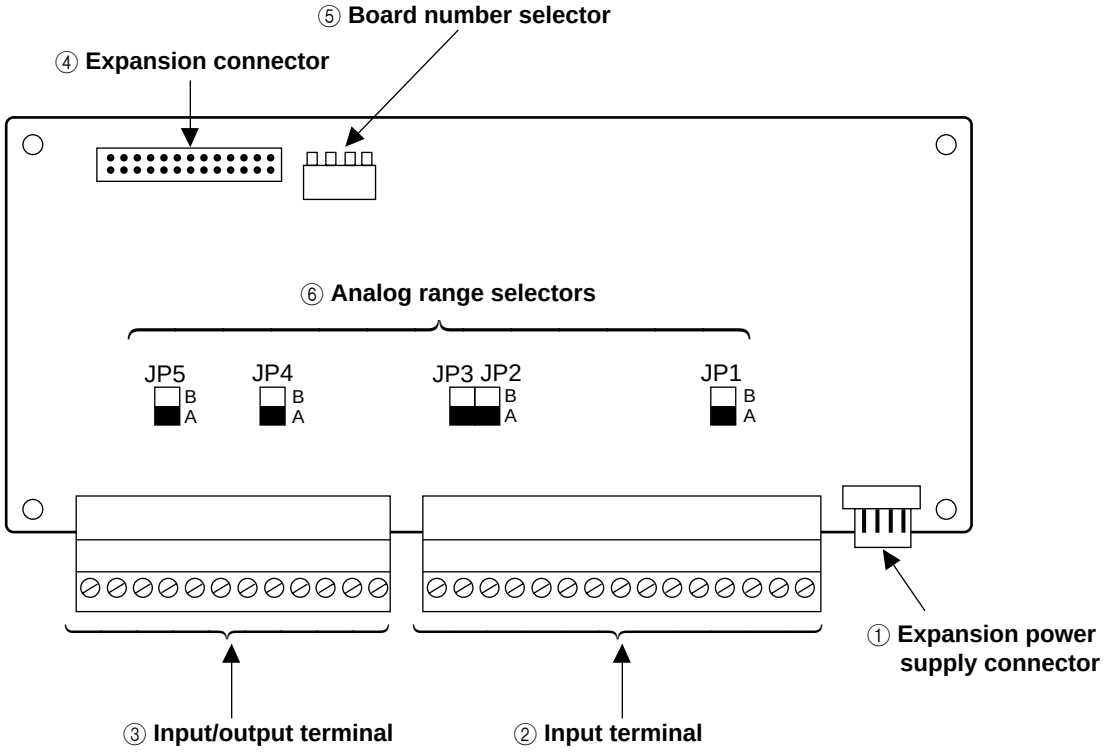


2. Dimensions



(unit: mm/in.)

3. Parts Terminology



① **Expansion power supply connector:**	Supplies power (24 V DC) to the analog board using the expansion power supply cable.
② **Input terminal (15-pin):**	Connect the input field devices (e.g., limit switch). This terminal block is removable.
③ **Input/output terminal (12-pin):**	Connect the input/output field devices (e.g., limit switch, solenoid). This terminal block is removable.
④ **Expansion connector:**	Connects the control board with internal circuit.
⑤ **Board number selector:** (See following page.)	Sets the special data register for storing analog input and output data by selecting the board number.
⑥ **Analog range selectors:** (See following page.)	The analog I/O ranges are selectable with jumper pins on the board.

■ Analog range setting

Jumper pin	Pin position	Selectable range		
JP1	A	Analog input	Channel 0	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V
JP2	A	Analog input	Channel 1	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V
JP3	A	Analog input	Channel 2	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V
JP4	A	Analog input	Channel 3	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V
JP5	A	Analog output	Channel 0	Voltage output: 0 to 5 V (Current output: 0 to 20 mA)
	B			Voltage output: 0 to 10 V

Note:

• The jumper pins (JP1 to JP5) are set to position “A” when shipped.

■ Board number setting

• Analog input and output data for analog I/O boards are stored in special data registers (DT9080 to DT9102) using the board number selector as follows.

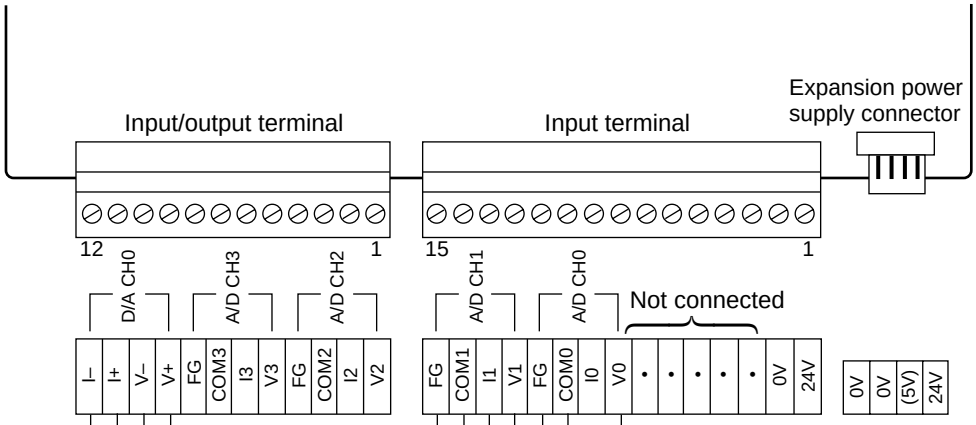
Board number	Selector position	Input/output	Channel number	Special data register
No. 0		Converted digital value of analog input from analog I/O board No. 0	0	DT9080
			1	DT9081
			2	DT9082
			3	DT9083
		Digital value for specifying analog output from analog I/O board No. 0	0	DT9096 DT9097
No. 1		Converted digital value of analog input from analog I/O board No. 1	0	DT9084
			1	DT9085
			2	DT9086
			3	DT9087
		Digital value for specifying analog output from analog I/O board No. 1	0	DT9098 DT9099
No. 2		Converted digital value of analog input from analog I/O board No. 2	0	DT9088
			1	DT9089
			2	DT9090
			3	DT9091
		Digital value for specifying analog output from analog I/O board No. 2	0	DT9100 DT9101
No. 3		Converted digital value of analog input from analog I/O board No. 3	0	DT9092
			1	DT9093
			2	DT9094
			3	DT9095
		Digital value for specifying analog output from analog I/O board No. 3	0	DT9102 DT9103

Notes:

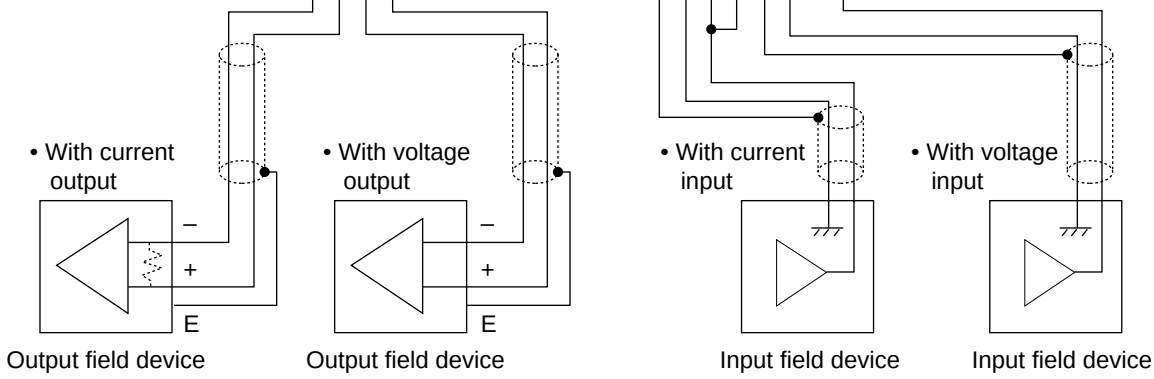
• Refer to page 201, “8-7. Special Data Registers”, for details about special data registers.
• When two or more analog I/O boards are installed, be sure to configure the board number selector in order to prevent special data register overlap. The board number selectors are set to board number 0 (all “OFF” position) when shipped.
• Board number selector upper state is “OFF (▀)” and the lower state is “ON (▄)”.

4. Wiring

■ Pin layout



■ Wiring example



Notes:

- When using current input, connect between current input terminal (e.g., I0, I1, I2, I3) and voltage input terminal (e.g., V0, V1, V2, V3).
- The voltage and current range cannot be used on the same channel at one time. The terminals of the unused range should be left open.
- Use the 24 V terminal of the input terminal or the expansion power supply connector for the analog I/O board power supply.
- Refer to page 61, “6) Wiring for I/O terminals”, for the wiring.
- To prevent electric and magnetic interference, use shielded twisted-cable (two-core type) for I/O signals.
- Keep the main circuit wiring away from high voltage lines. Do not bundle signal cables and high voltage lines together.
- The shielded cable should be grounded at:
  Output signal: Output field device side
  Input signal: FG (frame ground) terminal of analog I/O board

7-2. A/D Converter Board

Input of analog data (voltage and current) is possible by expanding the FP-M control board with an intelligent board for analog data input.

1. Specifications

1) General

Item	Description
Ambient temperature	0 ˚C to +50 ˚C (32 ˚F to +122 ˚F) (See note.)
Ambient humidity	30 % to 80 % RH (non-condensing)
Storage temperature	–20 ˚C to +70 ˚C (– 4 ˚F to +158 ˚F)
Vibration resistance	10 Hz to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm (0.030 in.), 10 min on 3 axes
Shock resistance	Shock of 98 m/s^2 or more, 4 times on 3 axes
Noise immunity	800 Vp-p (based on in-house measurements)

Note:

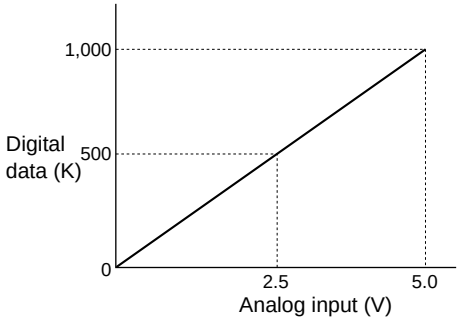
- When using in ambient temperature of 45 ˚C to 50 ˚C, be sure to make the number of ON points on the upper expansion board 50 % or less.

2) Performance

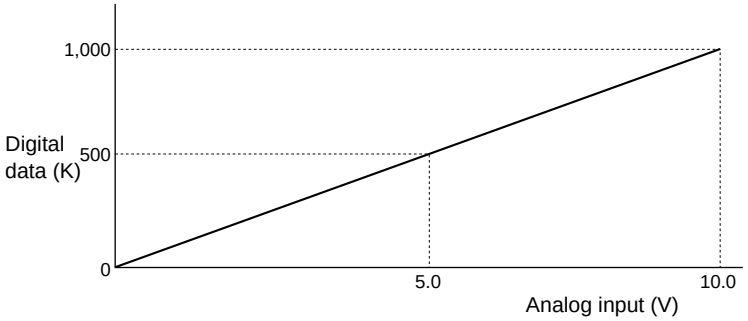
Item	Description
Number of input channels	4 channels
Input range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
Resolution	1/1000
Overall accuracy	±1.0 % of full scale (at 25 ˚C/77 ˚F), ±2.0 % of full scale (at 0 ˚C to 50 ˚C/32 ˚F to 122 ˚F)
Response time	2.5 ms/channel
Input impedance	1 MΩ or more (for 0 to 5 V and 0 to 10 V range) 250 Ω (for 0 to 20 mA range)
Absolute input range	+15 V (at 0 to 5 V and 0 to 10 V range) +30 mA (at 0 to 20 mA range)
Digital converted data	K0 to K1000
Insulation method	Optical coupler (not insulated between channels)

■ Analog data conversion characteristics

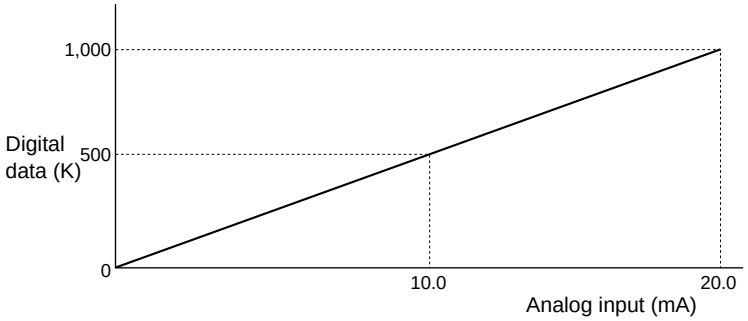
• 0 to 5 V range



• 0 to 10 V range

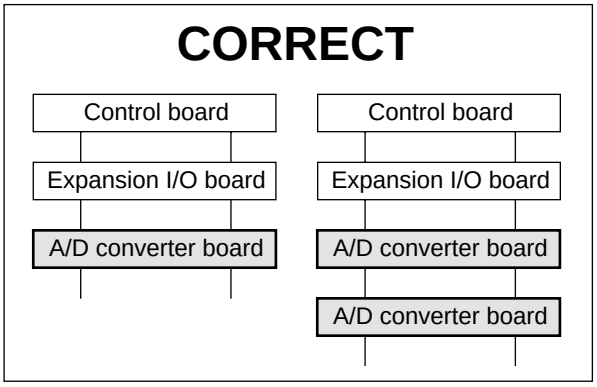


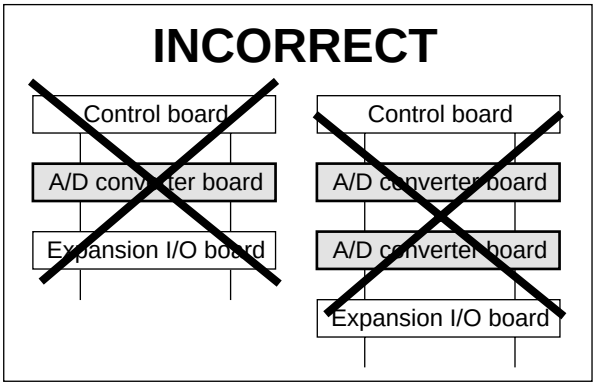
• 0 to 20 mA range



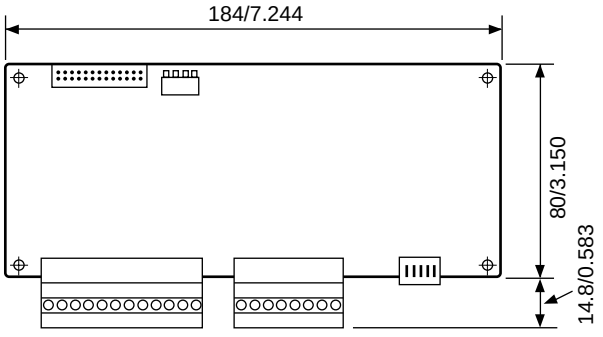
3) Restriction of expansion

- A total of four A/D converter boards can be attached to the control board.
- When expanding A/D converter boards, install them beneath the expansion I/O boards as shown below.



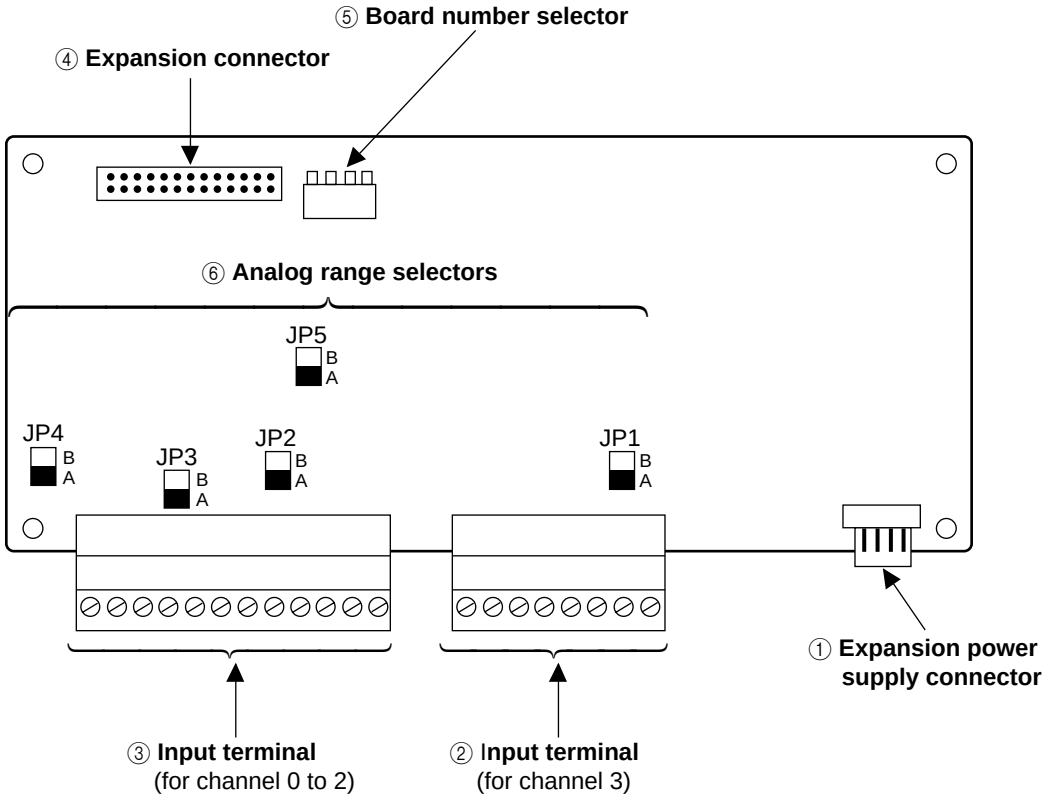


2. Dimensions



(unit: mm/in.)

3. Parts Terminology



① **Expansion power supply connector:** Supplies power to the A/D converter board using the expansion power supply cable.

② **Input terminal (8-pin):** Connect the input field devices (e.g., limit switch) for channel 3.

③ **Input terminal (12-pin):** Connect the input field devices (e.g., limit switch) for channels 0, 1 and 2.

④ **Expansion connector:** Connects the control board with the internal circuit.

⑤ **Board number selector:** Sets the special data register for storing analog input data by selecting the board number.
(See following page.)

⑥ **Analog range selectors:** The analog input ranges are selectable with jumper pins on the board.
(See following page.)

■ Analog range setting

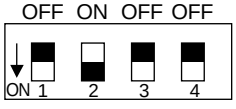
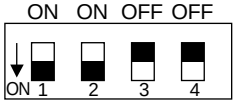
Jumper pin	Pin position	Selectable range		
JP1	A	Analog input	Channel 3	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V
JP2	A	Analog input	Channel 2	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V
JP3	A	Analog input	Channel 1	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V
JP4	A	Analog input	Channel 0	Voltage input: 0 to 5 V (Current input: 0 to 20 mA)
	B			Voltage input: 0 to 10 V

Note:

• The jumper pins (JP1 to JP4) are set to position “A” when shipped.

■ Board number setting

• Analog input data for A/D converter boards are stored in special data registers (DT9080 to DT9095) using the board number selector as follows.

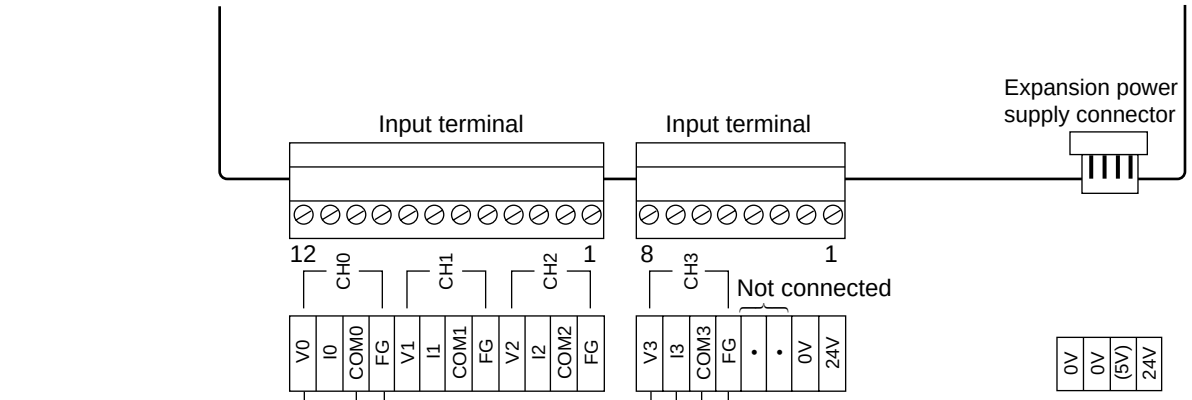
Board number	Selector position	Input/output	Channel number	Special data register
No. 0		Converted digital value of analog input from A/D converter board No. 0	0	DT9080
			1	DT9081
			2	DT9082
			3	DT9083
No. 1		Converted digital value of analog input from A/D converter board No. 1	0	DT9084
			1	DT9085
			2	DT9086
			3	DT9087
No. 2		Converted digital value of analog input from A/D converter board No. 2	0	DT9088
			1	DT9089
			2	DT9090
			3	DT9091
No. 3		Converted digital value of analog input from A/D converter board No. 3	0	DT9092
			1	DT9093
			2	DT9094
			3	DT9095

Notes:

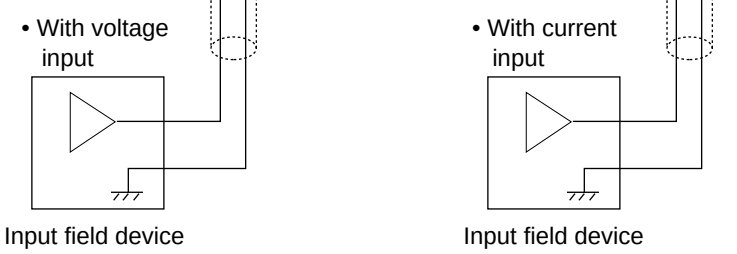
• Refer to page 201, “8-7. Special Data Registers”, for details about special data registers.
• When two or more A/D converter boards are installed, be sure to configure the board number selector in order to prevent special data register overlap. The board number selectors are set to board number 0 (all “OFF” position) when shipped.
• Board number selector upper state is “OFF ( )” and the lower state is “ON ( )”.

4. Wiring

■ Pin layout



■ Wiring example



Notes:

- When using current input, connect between current input terminal (e.g., I0, I1, I2, I3) and voltage input terminal (e.g., V0, V1, V2, V3).
- The voltage and current range cannot be used on the same channel at one time. The terminals of the unused range should be left open.
- Use the 24 V terminal of the input terminal or the expansion power supply connector for the A/D converter board power supply.
- Refer to page 61, “6) Wiring for I/O terminals”, for the wiring.
- To prevent electric and magnetic interference, use shielded twisted-cable (two-core type) for input terminals.
- Keep the main circuit wiring away from high voltage lines. Do not bundle signal cables and high voltage lines together.
- The shielded cable should be grounded to the FG (frame ground) terminal of A/D converter board. Depending on the noise conditions, if might be better to ground the cable at the input field device side.

7-3. D/A Converter Board

Output of analog data (voltage and current) is possible by expanding the FP-M control board with an intelligent board for analog data output.

1. Specifications

1) General

Item	Description
Ambient temperature	0 ˚C to +50 ˚C (32 ˚F to +122 ˚F) (See note.)
Ambient humidity	30 % to 80 % RH (non-condensing)
Storage temperature	–20 ˚C to +70 ˚C (– 4 ˚F to +158 ˚F)
Vibration resistance	10 Hz to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm (0.030 in.), 10 min on 3 axes
Shock resistance	Shock of 98 m/s^2 or more, 4 times on 3 axes
Noise immunity	800 Vp-p (based on in-house measurements)

Note:

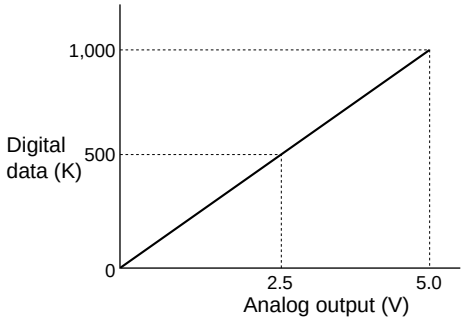
• When using in ambient temperature of 45 ˚C to 50 ˚C, be sure to make the number of ON points on the upper expansion board 50 % or less.

2) Performance

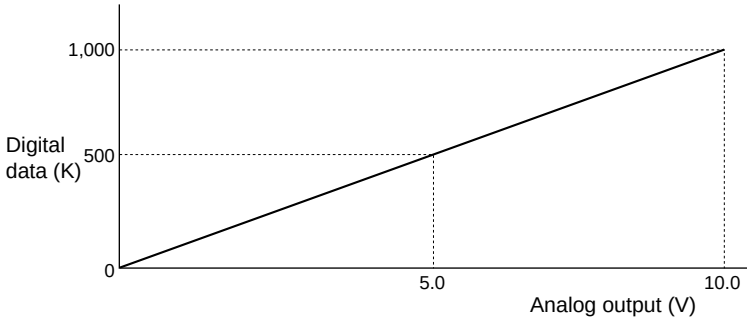
Item	Description
Number of output channels	2 channels
Output range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
Resolution	1/1000
Overall accuracy	±1.0 % of full scale (at 25 ˚C/77 ˚F), ±2.0 % of full scale (at 0 ˚C to 50 ˚C/32 ˚F to 122 ˚F)
Response time	2.5 ms/channel
Output impedance	0.5 Ω or less (for 0 to 5 V and 0 to 10 V range)
Max. output current	20 mA (for 0 to 5 V and 0 to 10 V range)
Allowable load resistance	0 to 500 Ω (for 0 to 20 mA range)
Digital data	K0 to K1000
Insulation method	Optical coupler (not insulated between channels)

■ Analog data conversion characteristics

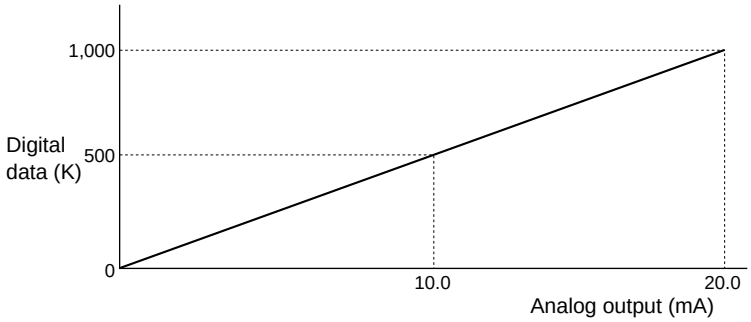
• 0 to 5 V range



• 0 to 10 V range

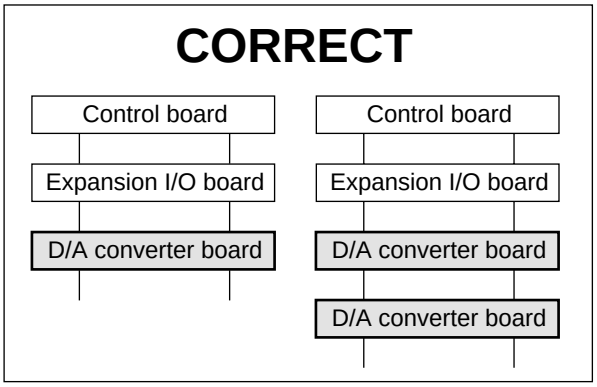


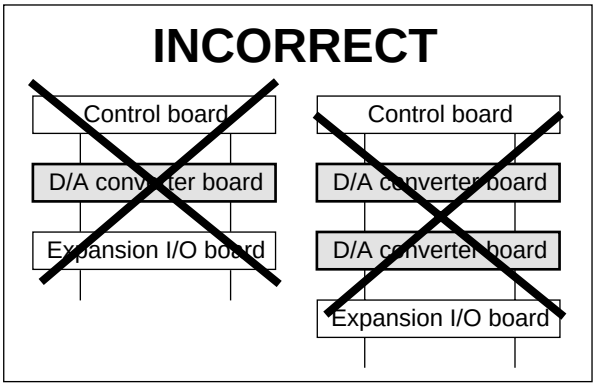
• 0 to 20 mA range



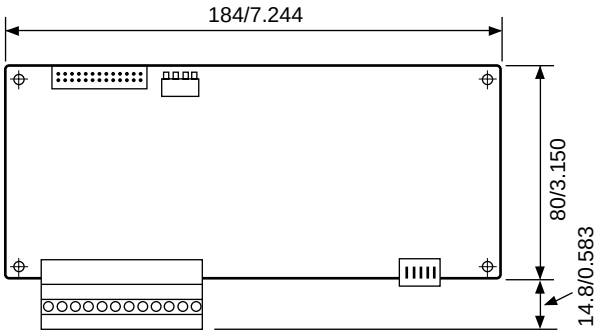
3) Restriction of expansion

- A total of four D/A converter boards can be attached to the control board.
- When expanding D/A converter boards, install them beneath the expansion I/O boards as shown below.



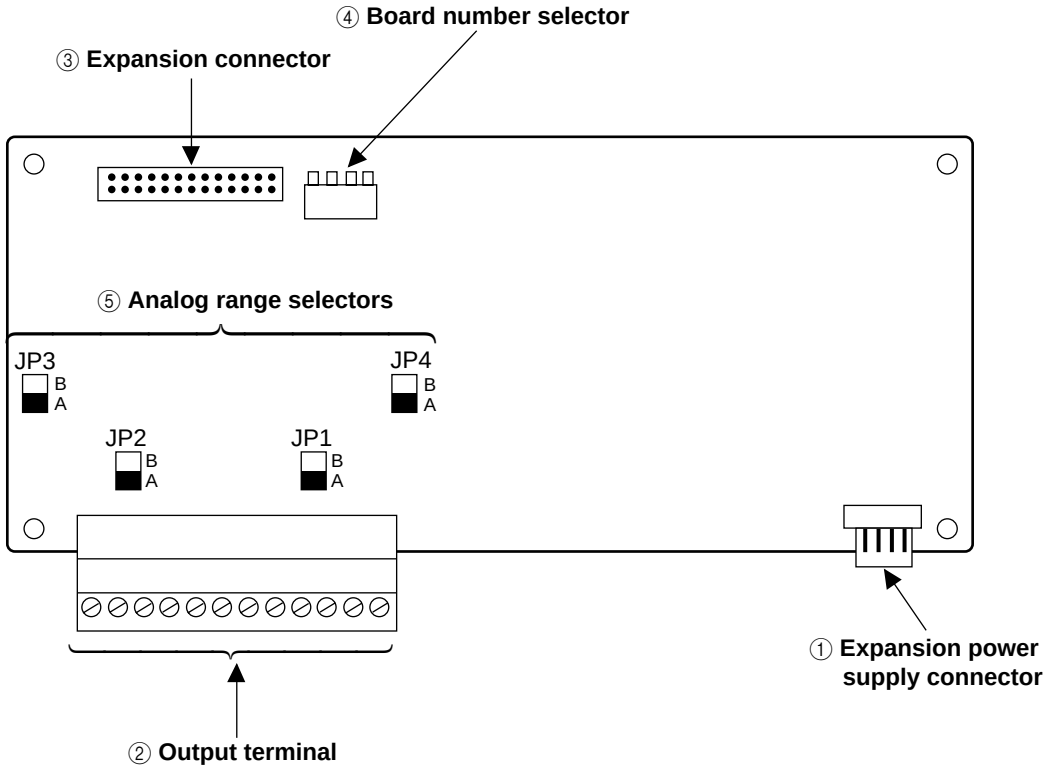


2. Dimensions



(unit: mm/in.)

3. Parts Terminology



① **Expansion power supply connector:** Supplies power (24 V DC) to the D/A converter board using the expansion power supply cable.

② **Output terminal (12-pin):** Connect the external output devices (e.g., solenoid) for channels 0 and 1.

③ **Expansion connector:** Connects the control board with the internal circuit.

④ **Board number selector:** (See following page.) Sets the special data register for storing analog output data by selecting the board number.

⑤ **Analog range selectors:** (See following page.) The analog output ranges are selectable with jumper pins on the board.

■ Analog range setting

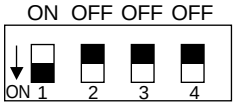
Jumper pin	Pin position	Selectable range		
JP1	A	Analog output	Channel 0	Voltage output: 0 to 5 V (Current output: 0 to 20 mA)
	B			Voltage output: 0 to 10 V
JP2	A	Analog output	Channel 1	Voltage output: 0 to 5 V (Current output: 0 to 20 mA)
	B			Voltage output: 0 to 10 V

Note:

• The jumper pins (JP1 and JP2) are set to position “A” when shipped.

■ Board number setting

• Analog output data for D/A converter boards are stored in special data registers (DT9096 to DT9103) using the board number selector as follows.

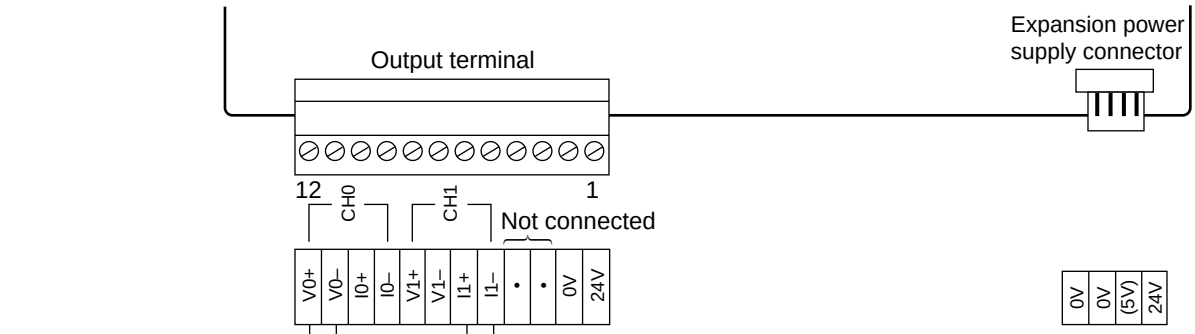
Board number	Selector position	Input/output	Channel number	Special data register
No. 0		Digital value for specifying analog output from D/A converter board No. 0	0	DT9096
			1	DT9097
No. 1		Digital value for specifying analog output from D/A converter board No. 1	0	DT9098
			1	DT9099
No. 2		Digital value for specifying analog output from D/A converter board No. 2	0	DT9100
			1	DT9101
No. 3		Digital value for specifying analog output from D/A converter board No. 3	0	DT9102
			1	DT9103

Notes:

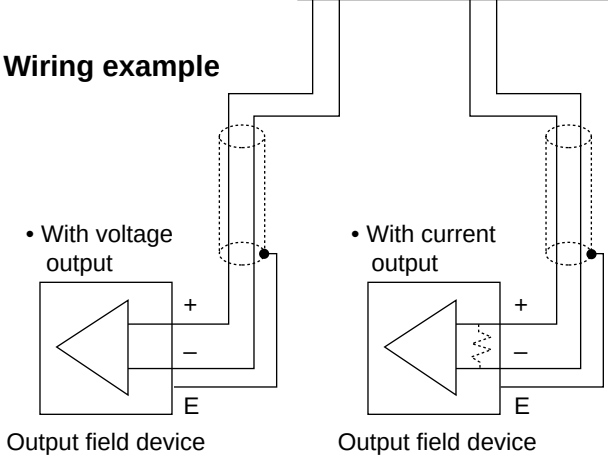
• Refer to page 201, “8-7. Special Data Registers”, for details about special data registers.
• When two or more D/A converter boards are installed, be sure to configure the board number selector in order to prevent special data register overlap. The board number selectors of the D/A converter board are set to board number 0 (all “OFF” position) when shipped.
• Board number selector upper state is “OFF (▀)” and the lower state is “ON (▄)”.

4. Wiring

■ Pin layout



■ Wiring example



Notes:

- The voltage and current range cannot be used on the same channel at one time. The terminals of the unused range should be left open.
- Use the 24 V terminal of the output terminal or the expansion power supply connector for the D/A converter board power supply.
- Refer to page 61, “6) Wiring for I/O terminals”, for the wiring.
- To prevent electric and magnetic interference, use shielded twisted-cable (two-core type) for output terminal.
- Keep the main circuit wiring away from high voltage lines. Do not bundle signal cables and high voltage lines together.
- The shielded cable should be grounded to the output field device. Depending on the noise conditions, if might be better not to ground the cable or to connect the cable to the output signal common side.

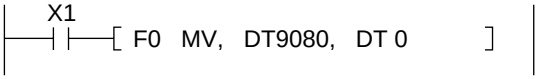
7-4. Programming for Analog I/O, A/D Converter, and D/A Converter Boards

1. Digital Values of Analog Input

- The converted digital values are stored in the special data registers (DT9080 to DT9095) by the board number selector of each board.

- Be sure to use the **F0 (MV)** instruction to transfer the converted digital value in the special data registers (DT9080 to DT9095) into other data registers.

Example: Transfer the converted digital value of DT9080 to the data register DT0 when X1 turns ON.



- The contents of special data registers DT9080 to DT9095 can be monitored using NPST-GR Software or FP Programmer Ⅱ.

Note:

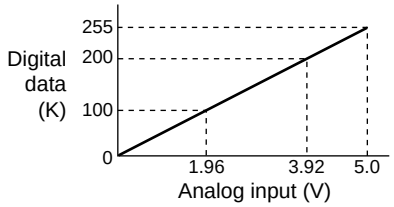
- The converted digital values of analog input are transmitted to special data registers DT9080 to DT9095 at the time of programmable controller I/O updating during each scan. Transmission will not occur if the mode selector of the FP-M control board is set to PROG.

■ Analog input data conversion characteristics

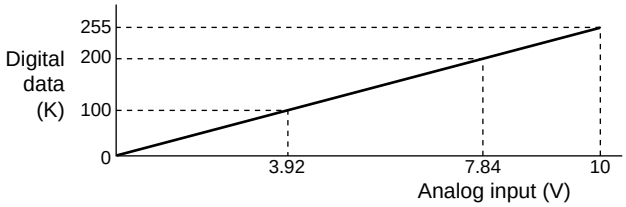
- The ranges of the converted digital values of analog input are shown below:
  - When analog I/O board is installed
    K0 to K255 (0 to 5 V, 0 to 10 V and 0 to 20 mA)
    The range of converted digital values
    (8 bits resolution of special data registers DT9080 to DT9095)

<Analog I/O Board>

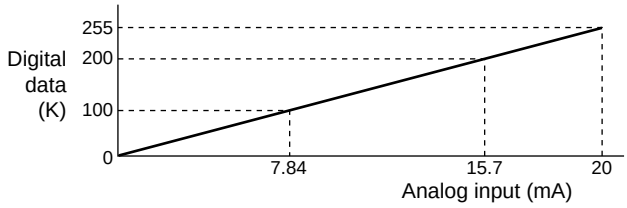
• 0 to 5 V range



• 0 to 10 V range



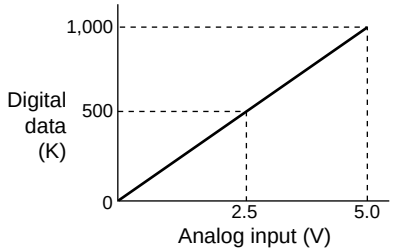
• 0 to 20 mA range



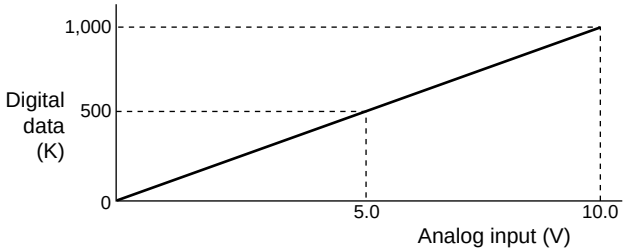
- When the A/D converter board is installed
  K0 to K999 (0 to 5 V, 0 to 10 V and 0 to 20 mA)
  The range of converted digital values
  (10 bits resolution of special data registers DT9080 to DT9095)

<A/D Converter Board>

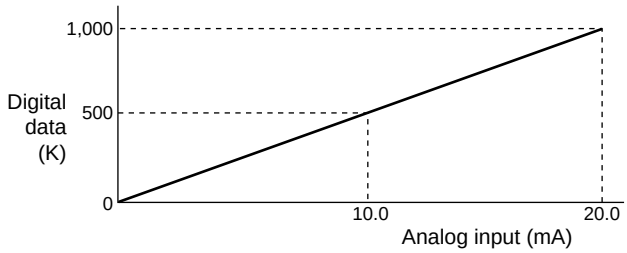
• 0 to 5 V range



• 0 to 10 V range



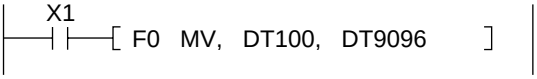
• 0 to 20 mA range



2. Digital Values of Analog Output

- The digital values are stored in the special data registers (DT9096 to DT9103) by the board number selector of each board.
- Be sure to use the **F0 (MV)** instruction to transfer the digital values into special data registers DT9096 to DT9103.
- The data is transferred from the special data registers at the time of I/O update in each scan.

Example: Transfer the digital value of data register DT100 to special data register DT9096 when X1 turns ON.



- The digital data can be transferred into special data registers DT9096 to DT9103 using NPST-GR Software or FP Programmer Ⅱ.

Note:

- When the FP-M control board mode selector is set to the PROG. mode or an error occurs, the analog output data becomes 0.

■ Analog output data conversion characteristics

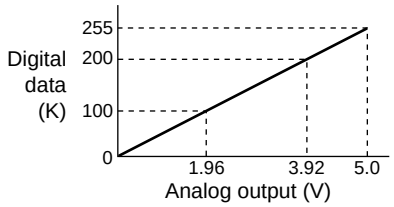
• The ranges of digital values to specify analog output are shown below:

- When analog I/O board is installed

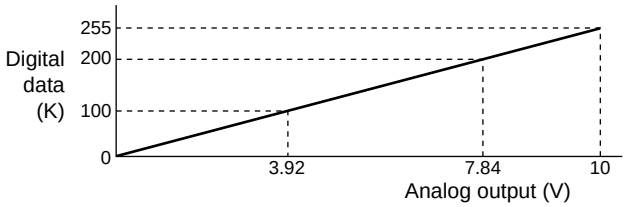
K0 to K255 (0 to 5 V, 0 to 10 V, and 0 to 20 mA)
The range of digital values for specifying analog output
(8 bits resolution of special data registers DT9096 to DT9103)

<Analog I/O Board>

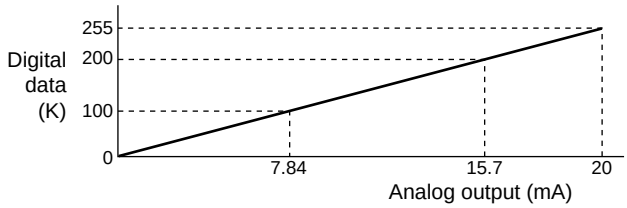
• 0 to 5 V range



• 0 to 10 V range



• 0 to 20 mA range

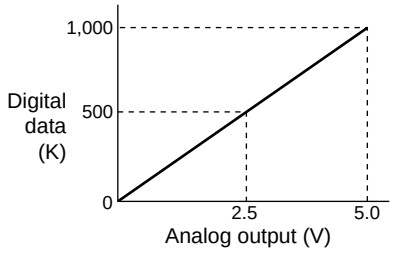


- When D/A converter board is installed

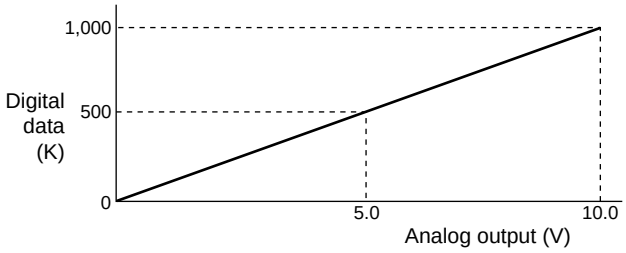
K0 to K999 (0 to 5 V, 0 to 10 V, and 0 to 20 mA)
The range of digital values for specifying analog output
(10 bits resolution of special data registers DT9096 to DT9103)

<D/A Converter Board>

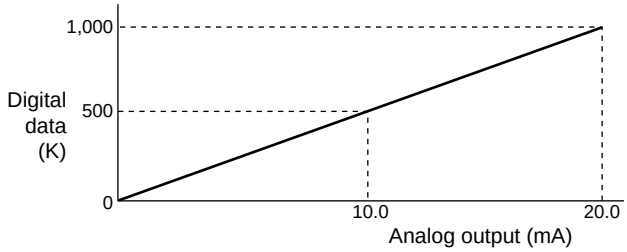
• 0 to 5 V range



• 0 to 10 V range



• 0 to 20 mA range



3. Specification of Analog I/O Data

• When the analog I/O board is installed, be sure to specify the data within the range of K0 to K255 (using 8 bits) as follows:

Data in the special data register

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Binary data				

K0 to K255

The analog input data (A/D) in bit positions 8 to 15 becomes 0.
The analog output data (D/A) in bit positions 8 to 15 is ignored.

Example:

If K-1 is set to special data register DT9096, analog data, being regarded as K255, is output.

Data configuration when K-1 is set:

DT9096	Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
	Binary data	1 1 1 1	1 1 1 1	1 1 1 1	1 1 1 1

K255

Data in bit positions 8 to 15 is ignored.

Note:

• If data outside K0 to K255 is specified, the analog value is output ignoring data in bit positions 8 to 15.

• When the A/D converter board or D/A converter board is installed, be sure to specify the data within the range of K0 to K999 (using 10 bits) as follows:

Data in the special data register

Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
Binary data				

K0 to K999

The analog input data (A/D) in bit positions 10 to 15 becomes 0.
The analog output data (D/A) in bit positions 10 to 15 is ignored.

Example:

If K1,024 is set to special data register DT9096, analog data, being regarded as 0, is output.

Data configuration when K1,024 is set:

DT9096	Bit position	15 • • 12	11 • • 8	7 • • 4	3 • • 0
	Binary data	0 0 0 0	0 1 0 0	0 0 0 0	0 0 0 0

K0

Data in bit positions 10 to 15 is ignored.

Notes:

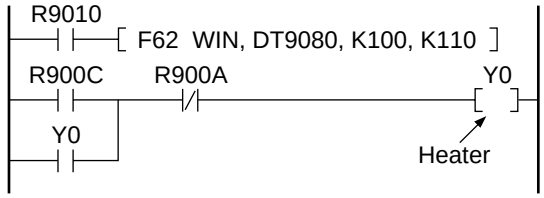
• If data outside K0 to K1,023 is specified, the data is handled ignoring data in bit positions 10 to 15.
• If data K1,000 to K1,023 is specified, analog data that is slightly more than the maximum rated value (5 V, 10 V, and 20 mA) is output.

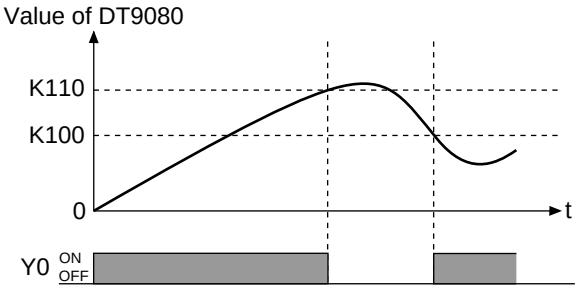
4. Applications

■ Example 1: A/D program example of simple temperature control

• Compares the analog data from channel 0 of analog control board No. 0 (DT9080) with preset values (K100 and K110). The compared result is stored in special internal relays R900A and R900C.
- When the contents of DT9080 < K100, external output relay Y0 (heater) goes ON.
- When the contents of DT9080 > K110, external output relay Y0 (heater) goes OFF.

Program





Special internal relays
- R9010: Always ON relay
- R900A: > flag
- R900C: < flag

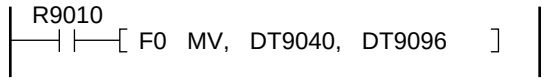
High-level instruction
- **F62 (WIN)**: 16-bit data band compare

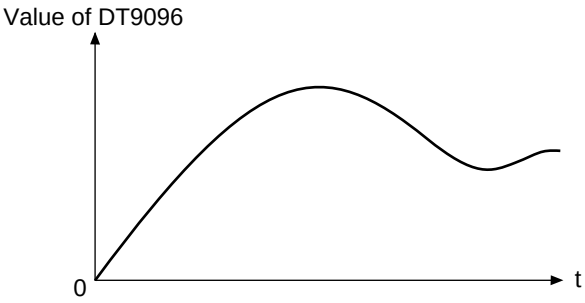
Special data register
- DT9080: Channel 0 of converted digital value from analog control board No. 0

■ Example 2: D/A program example of variable speed control

• Transfer the value of potentiometer V0 on the FP-M control board to channel 0 of analog control board No. 0 (DT9096).

Program





Special internal relay
- R9010: Always ON relay

High-level instruction
- **F0 (MV)**: 16-bit data, move

Special data registers
- DT9040: Manual dial-set register for potentiometer V0 on FP-M control board
- DT9096: Channel 0 of digital value for specifying analog data output from analog control board No. 0

7-5. High-speed Counter Board

This is a 2 channel high-speed counter board. One high-speed counter board can be used to expand the FP-M control board.

1. Specifications

1) General

Item	Description
Ambient temperature	0 ˚C to +50˚C (32 ˚F to 122 ˚F)
Ambient humidity	30 % to 80 % RH (non-condensing)
Storage temperature	– 20 ˚C to +70 ˚C (– 4 ˚F to +158 ˚F)
Storage humidity	30 % to 80 % RH (non-condensing)
Vibration resistance	10 Hz to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm (0.030 in.), 10 min on 3 axes
Shock resistance	98 m/s^2 (10 G) or more, 4 times on 3 axes
Noise immunity	800 V or more (based on in-house measurements)

2) Performance

Item		Description
Counter Specifications	Counter channels	2 channels (CH 0, CH 1)
	Max. counting speed	1-phase mode: 20 kHz 2-phase/4-time multiplication mode: 5 kHz
	Counting range	–8,388,608 to +8,388,607
	Number of target value settings	2 points/channel
Input Specifications	Input mode	3 modes (2-phase/4-time multiplication mode, individual input mode, directional input mode) * The mode is set using the input mode selector.
	Number of input points	3 points (INA, INB, RESET) × 2 channels 2 points (RST.E, O.INH) × 2 channels
	Rated input voltage	24 V DC
	Input voltage range	21.6 to 26.4 V DC
	Insulation method	Optical coupler
	ON voltage	19.2 V DC or less
	OFF voltage	4.8 V DC or more
	Min. input pulse width	50 μs at INA and INB inputs 2.5 ms at RESET input
	Input delay time	1 ms or less at RST.E and O.INH inputs
	Input current	Approx. 7.5 mA at INA, INB, and RESET inputs Approx. 5 mA at RST.E and O.INH inputs
	Input type	Source

Item		Description
Output Specifications	Number of output points	2 points (OUT 0 and OUT 1) /channel
	Rated load voltage	24 V DC
	Load voltage range	21.6 to 26.4 V DC
	Insulation method	Optical coupler
	Output type	Transistor NPN open collector
	Max. load current	200 mA
	Residual voltage	1.5 V or less
	Leakage current	100 μA or more
	Response time ON → OFF	1 ms or less
	OFF → ON	1 ms or less

3) Differences in specifications between high-speed counter function with FP-M control board and high-speed counter board

Item	Description	
	High-speed counter function of FP-M control board	**High-speed counter board**
Counter channels	1 channel	2 channels (CH 0, CH 1)
Max. counting speed	1-phase mode: 10 kHz 2-phase mode: 10 kHz	1-phase mode: 20 kHz 2-phase/4-time multiplication mode: 5 kHz
Number of target value settings	Optionally set	2 points/channel
Input mode	4 modes (up, down, up/down, and 2-phase mode)	3 modes (2-phase/4-time multiplication, individual input, and directional input mode)
Number of input points	3 points • Count pulse inputs (X0 and X1) • External reset input (X2) × 1 channel	6 points [Count A/B phase pulse inputs (INA and INB), External reset input (RST)] × 2 channels 4 points [Input to enable external reset (RST.E), Input to inhibit accord output (O.INH)] × 2 channels
Min. input pulse width	1-phase: 50 µs 2-phase: 50 µs	INA and INB inputs: 50 µs RESET input: 2.5 ms
Number of output points	Optionally set	2 points (OUT0 and OUT1)/channel
Functions	• Output set operation (output goes ON) using **F162 (HC0S)** instruction • Output reset operation (output goes OFF) using **F163 (HC0R)** instruction • Reading and changing elapsed value using **F1 (DMV)** instruction • Interrupt function using the elapsed value of **F162 (HC0S)**, **F163 (HC0R)**, **F164 (SPD0)**, and **F165 (CAM0)** instruction • Pulse output control or pattern output control using **F164 (SPD0)** instruction • Cam output control using **F165 (CAM0)** instruction	• Output condition control (output goes OFF → ON or ON → OFF) when the target value agrees with the elapsed value • Reading and changing elapsed value • Reading capture value

Item	Description	
	High-speed counter function of FP-M control board	High-speed counter board
Special data registers related to high-speed counter	• DT9044 and DT9045: Elapsed value area • DT9046 and DT9047: Target value area • DT9052: Control area	• High-speed counter board channel 0 area: - DT9104 and DT9105: Target value area 0 - DT9106 and DT9107: Target value area 1 - DT9108 and DT9109: Elapsed value area - DT9110 and DT9111: Capture value area • High-speed counter board channel 1 area: - DT9112 and DT9113: Target value area 0 - DT9114 and DT9115: Target value area 1 - DT9116 and DT9117: Elapsed value area - DT9118 and DT9119: Capture value area • DT9120: Control area • DT9121: Status monitor area

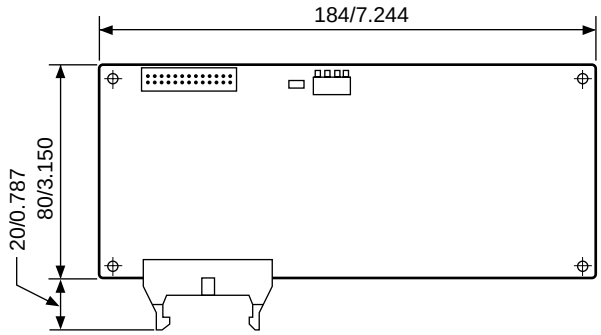
Note:

• Refer to FP-M/FP1 Programming Manual “4-4. How to Use the High-speed Counter”, for details about instructions **F1 (DMV)**, **F162 (HC0S)**, **F163 (HC0R)**, **F164 (SPD0)**, and **F165 (CAM0)** that are related to the high-speed counter function.

4) Restriction of expansion

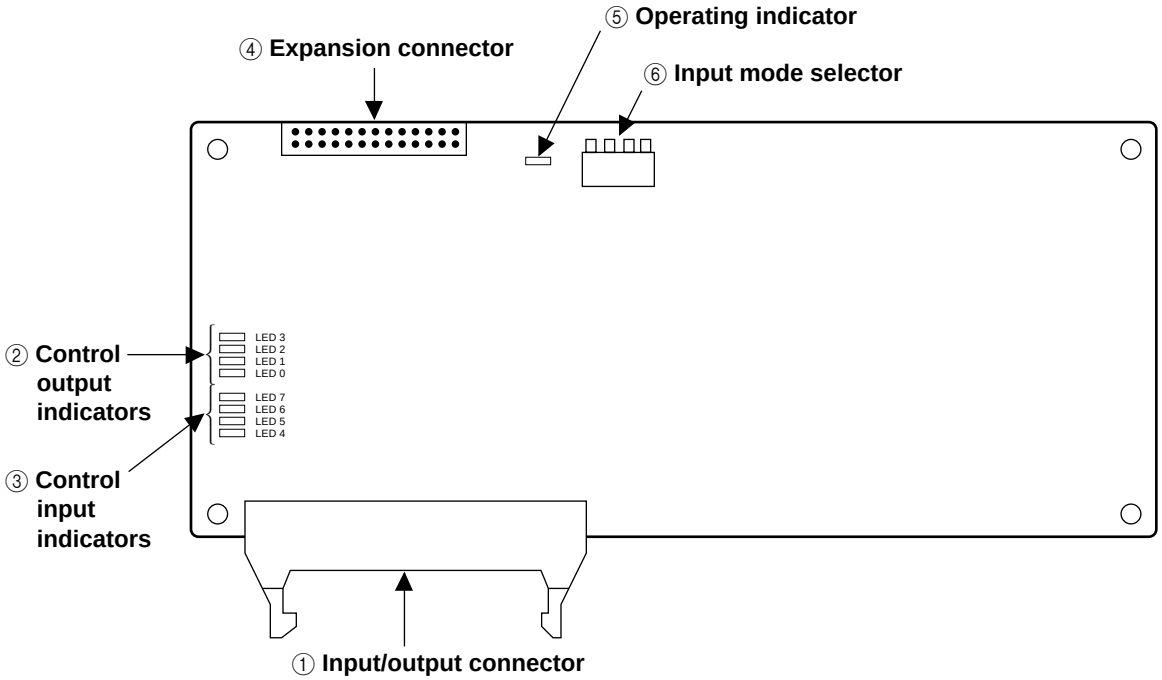
• One high-speed counter board can be attached to the control board.

2. Dimensions



(unit: mm/in.)

3. Parts Terminology



① **Input/output connector (26-pin):**
(See page 156.)

Connects the input and output field devices (e.g., encorder, motor driver) of the high-speed counter board.
MIL connector is used.

② **Control output indicators:**

LED 0: ON when OUT 00 terminal is in the ON state
LED 1: ON when OUT 01 terminal is in the ON state
LED 2: ON when OUT 10 terminal is in the ON state
LED 3: ON when OUT 11 terminal is in the ON state

③ **Control input indicators:**

LED 4: ON when RST.E0 terminal is in the ON state
LED 5: ON when O.INH0 terminal is in the ON state
LED 6: ON when RST.E1 terminal is in the ON state
LED 7: ON when O.INH1 terminal is in the ON state

④ **Expansion connector:**

Connects the internal circuit of the control board.

⑤ **Operating indicator:**

The LED is normally ON when the high-speed counter board is properly connected and operating.

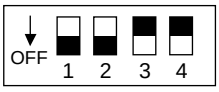
⑥ **Input mode selector:**
(See following page.)

Selects the input mode for the high-speed counter board.

■ Input mode setting

• 2-phase/4-time multiplication mode

Switch position

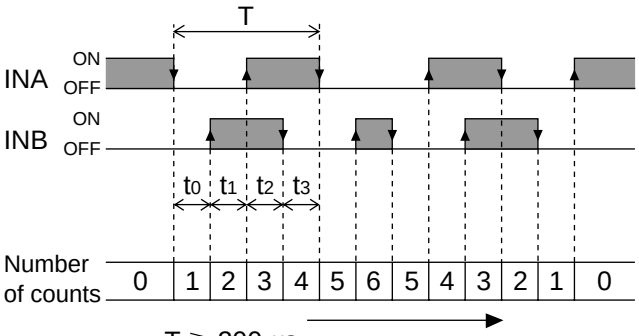


Operation conditions

INA	INB	Counting mode
ON / OFF	ON	Down
	OFF	Up
ON / OFF	ON	Up
	OFF	Down

INB	INA	Counting mode
ON / OFF	ON	Up
	OFF	Down
ON / OFF	ON	Down
	OFF	Up

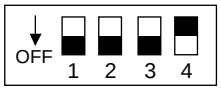
Time chart



$T \geqq 200\ \mu s$
$t_0, t_1, t_2, t_3 \geqq T/8$
Max. counting speed: 5 kHz

• Individual input mode

Switch position

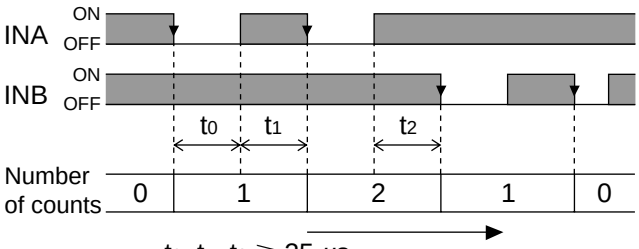


Operation conditions

INA	INB	Counting mode
ON / OFF	—	Up

INB	INA	Counting mode
ON / OFF	—	Down

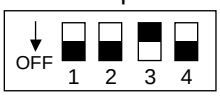
Time chart



$t_0, t_1, t_2 \geqq 25\ \mu s$
Max. counting speed: 20 kHz

• Directional input mode

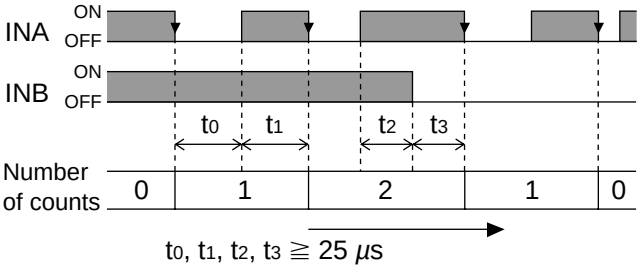
Switch position



Operation conditions

INA	INB	Counting mode
ON / OFF	ON	Up
	OFF	Down

Time chart



$t_0, t_1, t_2, t_3 \geqq 25\ \mu s$
Max. counting speed: 20 kHz

Note:

• INA: A-phase pulse input, INB: B-phase pulse input

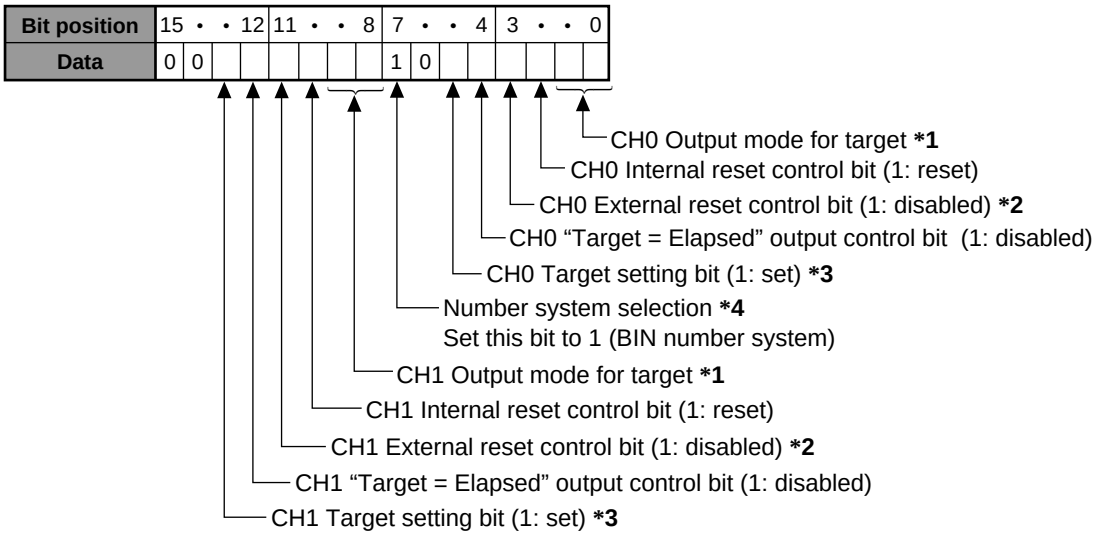
4. I/O Allocation

• The data of the high-speed counter board are stored in the special data registers.

Channel number	Data type	Special data register	Description
Channel 0	Target value 0	DT9104, DT9105	• These registers are for storing data of the high-speed counter board. • The target value areas, elapsed value, and capture value are processed in binary in the range of K-8,388,608 to K8,388,607. If the data outside the range is input, the data is handled while disregarding bit positions 24 to 31 in each register (bit positions 8 to 15 in higher 16-bit area of 32-bit data). **Note:** • Be sure to use the **F1 (DMV)** instruction to transfer data in these special data registers to other registers, or data in other registers to these special data registers.
	Target value 1	DT9106, DT9107	
	Elapsed value	DT9108, DT9109	
	Capture value	DT9110, DT9111	
Channel 1	Target value 0	DT9112, DT9113	
	Target value 1	DT9114, DT9115	
	Elapsed value	DT9116, DT9117	
	Capture value	DT9118, DT9119	
Channels 0 and 1	Control area	DT9120	• The control modes for the high-speed counter board are specified by DT9120. The control modes, output mode, internal and external reset enable/disable, "target = elapsed" output control, and target setting can be set. For details about construction of DT9120, refer to the following page.
	Status monitor register area	DT9121	• The status of the high-speed counter board can be monitored by DT9121. The status of reset enable input, output disable input, flag condition when target value = elapsed value, and error code can be monitored. For details about construction of DT9121, refer to the following page.

■ Construction of DT9120

This area specifies the control modes for the high-speed counter board.



***1. Output mode:**

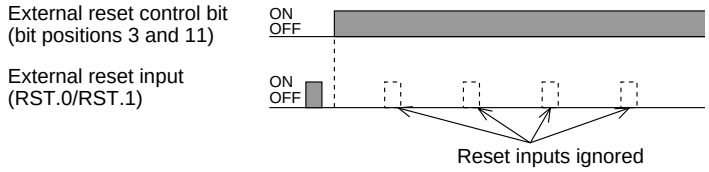
The output goes ON or OFF when the elapsed value becomes equal to the target. These bits specify the mode for output transition when the elapsed value becomes equal to the target value. If the output mode is changed, set the target value again.

Bit position	Channel	Corresponding target value	Corresponding output
0	0	Target 0	OUT00
1		Target 1	OUT01
8	1	Target 0	OUT10
9		Target 1	OUT11

Bit data 0: OFF → ON
1: ON → OFF

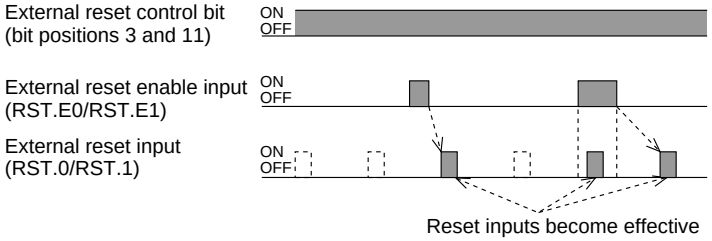
***2. External reset control bit:**

These bits (bit positions 3 and 11) are in the ON state, the external reset inputs (RST.0/RST.1) are ignored as:



By turning ON the external reset enable inputs (RST.E0/RST.E1), you can enable the external reset inputs (RST.0/RST.1). The external reset inputs (RST.0/RST.1) effective are:

- external reset inputs while the external reset enable input is in the ON states.
- the first external reset inputs after the external reset enable input turns OFF.



***3. Target setting:**

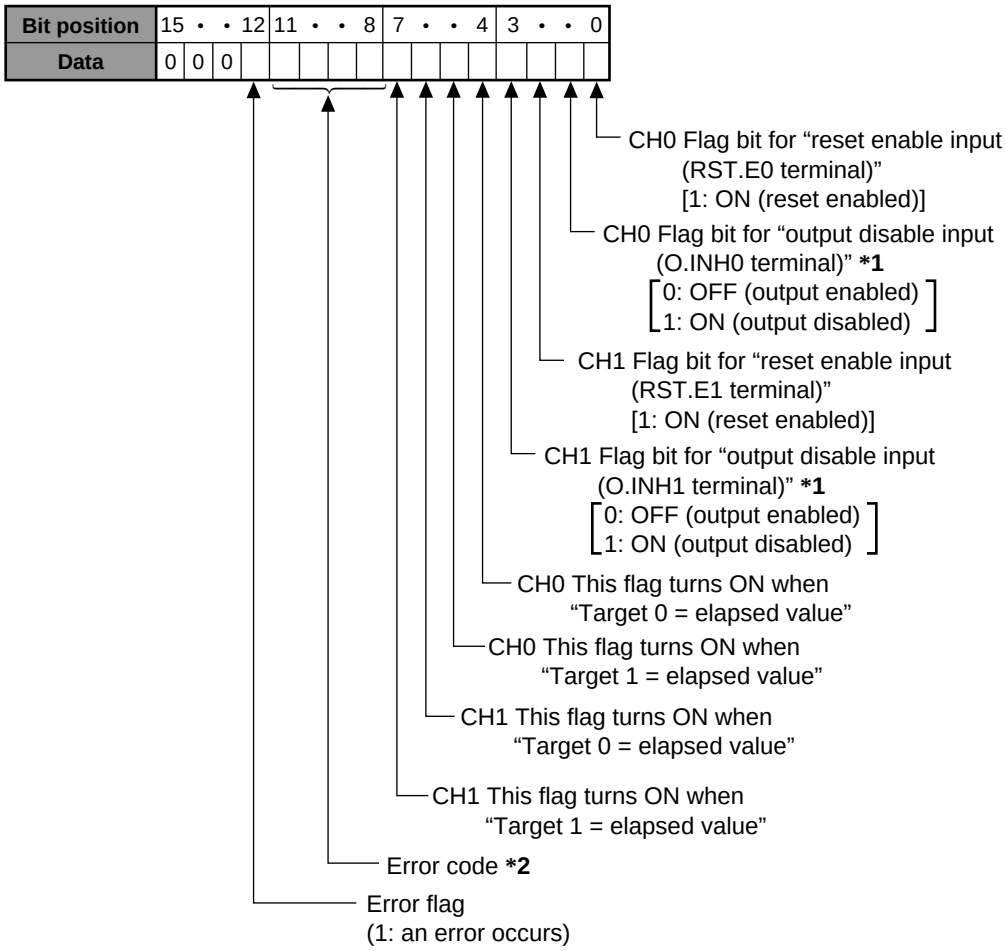
To preset the target values for the high-speed counter board, first, transfer the set values to the special data registers for the target values. Then, turn the target setting bit from 0 to 1. A set value is revised at the moment the leading edge of this bit is detected. Therefore, if the bit is already set to 1, change the bit from 1 to 0 and then change it back to 1.

***4. Number system selection:**

This bit is prepared to select the number system used for the high-speed counter board. If you set this bit to 0, the data counts the number in the BCD code. However, the FP-M usually handles numbers in binary, so use of the binary number system is recommended.

■ Construction of DT9121

The status of the high-speed counter board can be monitored in this area.



***1. Output disable input:**

This input disables external output even if the high-speed counter is set to the output enable mode by DT9120. While this input is turned ON, the output of the high-speed counter board is not changed even if the elapsed value becomes equal to the target.

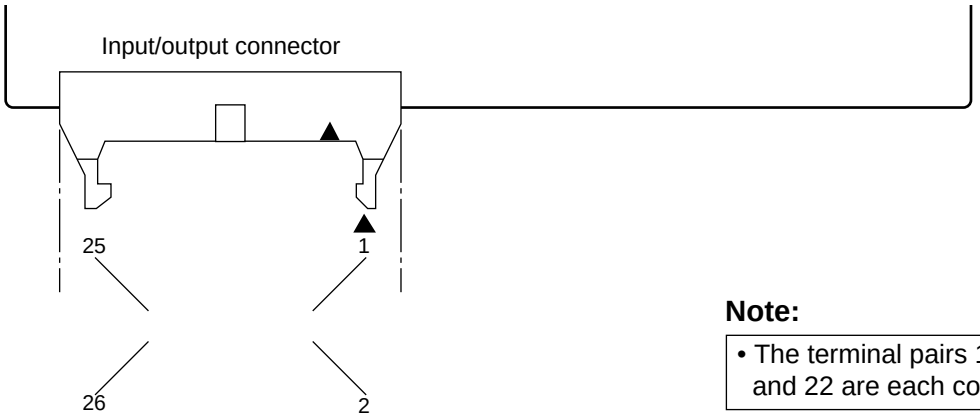
***2. Error codes**

A BCD error is detected only when data for the high-speed counter board is set to BCD operation using **F0 (MV)** and bit position 7 of DT9120.

Bit position				Description
11	10	9	8	
0	0	0	1	BCD error
0	0	1	0	CH0 overflow/underflow
0	1	0	0	CH1 overflow/underflow
1	0	0	0	Watchdog timer error

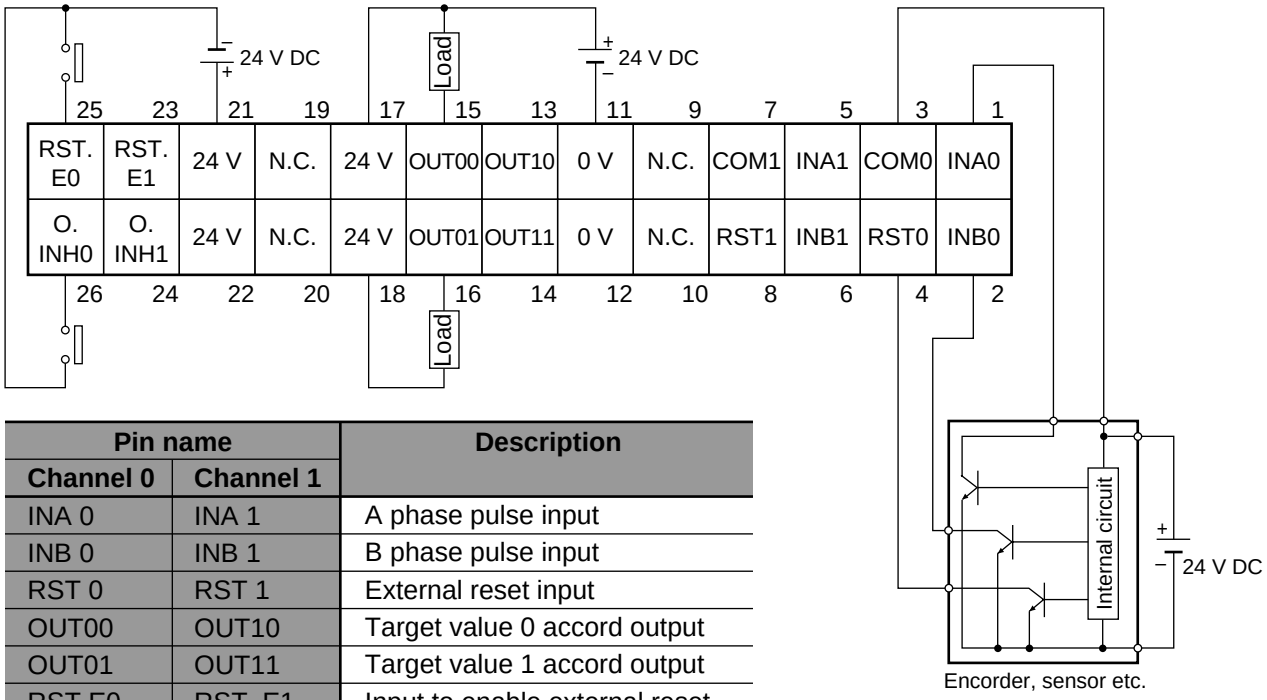
5. Wiring

■ Pin layout and wiring example



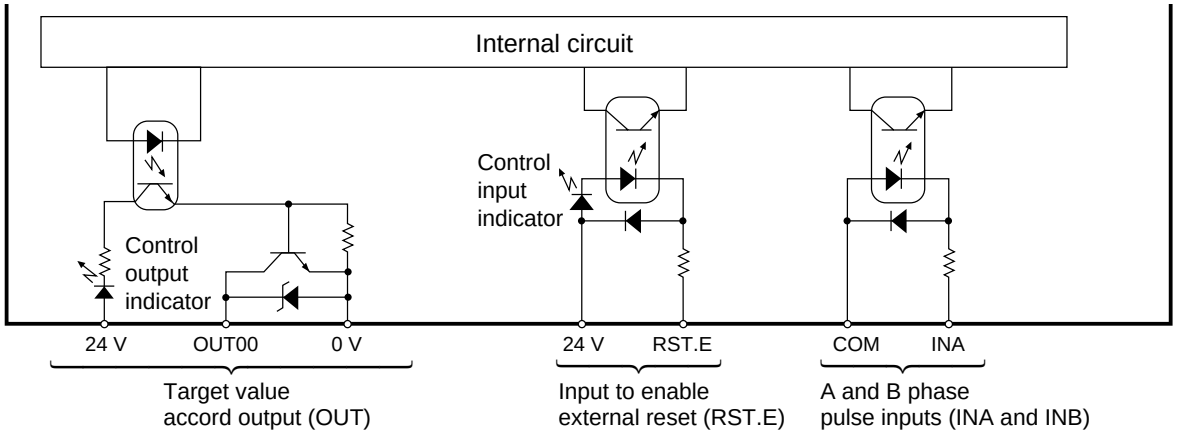
Note:

- The terminal pairs 11 and 12, 17 and 18, 21 and 22 are each connected internally.



Pin name		Description
Channel 0	Channel 1	
INA 0	INA 1	A phase pulse input
INB 0	INB 1	B phase pulse input
RST 0	RST 1	External reset input
OUT00	OUT10	Target value 0 accord output
OUT01	OUT11	Target value 1 accord output
RST.E0	RST. E1	Input to enable external reset
O.INH0	O.INH1	Input to inhibit accord output

■ Internal circuit of high-speed counter board



6. Programming for High-speed Counter Board

1) High-speed counter board related instructions F0 (MV), F1 (DMV)

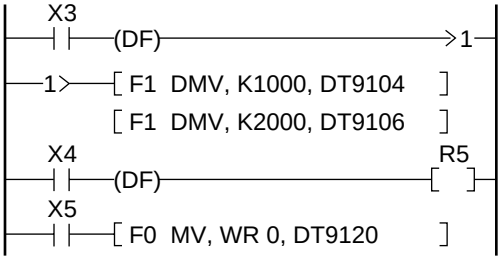
- Be sure to use only the **F1 (DMV)** instruction when changing the target value and reading and changing the elapsed value of the high-speed counter board stored in special data registers DT9104 through DT9119.
- Be sure to use the **F0 (MV)** instruction, when changing the setting and reading the status of the high-speed counter board.

■ Changing the target value

- Only the **F1 (DMV)** instruction changes the target value of the high-speed counter board stored in special data registers DT9104 through DT9107 and DT9112 through DT9115.

Program example:

- Changing the target value of the high-speed counter board
  When trigger X3 turns ON:
  - Transfer the target value 0 “K1000” of board channel 0 to special data registers DT9104 and DT9105.
  - Transfer the target value 1 “K2000” of board channel 0 to special data registers DT9106 and DT9107.



Note:

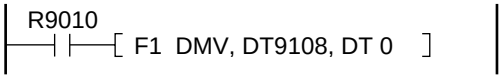
- The target value is processed when 1 is set to bit position 5 (target setting bit for channel 0) of DT9120.

■ Changing and reading the elapsed value

- Only the **F1 (DMV)** instruction changes and reads the elapsed value of the high-speed counter board stored in the special data registers DT9108, DT9109, DT9116, and DT9117.

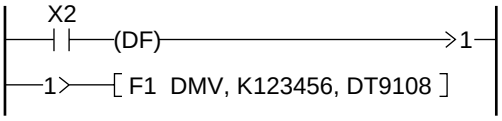
Program example:

- Reading the elapsed value of the high-speed counter board
  The elapsed value of board channel 0 stored in DT9108 is copied to data register DT0.



R9010: Always ON relay
DT9108: Elapsed value area of high-speed counter board channel 0

- Changing the elapsed value of the high-speed counter board
  The elapsed value of board channel 0 is changed to K123,456 when trigger X2 turns ON.



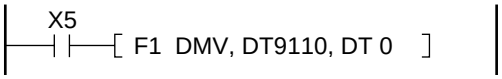
DT9108: Elapsed value area of high-speed counter board channel 0

■ Reading the capture value

• Only the **F1 (DMV)** instruction reads the capture value of the high-speed counter board stored in special data registers DT9110, DT9111, DT9118, and DT9119.

Program example:

• Reading the capture value of the high-speed counter board
The capture value of board channel 0 stored in DT9110 is copied to data register DT0 when trigger X5 turns ON.



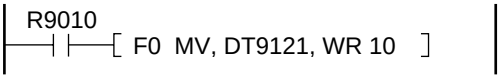
DT9110: Capture value area of the high-speed counter board channel 0

■ Monitoring the status of the high-speed counter board

• The **F0 (MV)** instruction reads the control status of the high-speed counter board stored in special data register DT9121.

Program example:

• Monitoring the status of the high-speed counter board
The control status of the high-speed counter board stored in DT9121 is copied to word internal relay WR10.



DT9121: High-speed counter board status monitor area

2) Notes on programming the high-speed counter

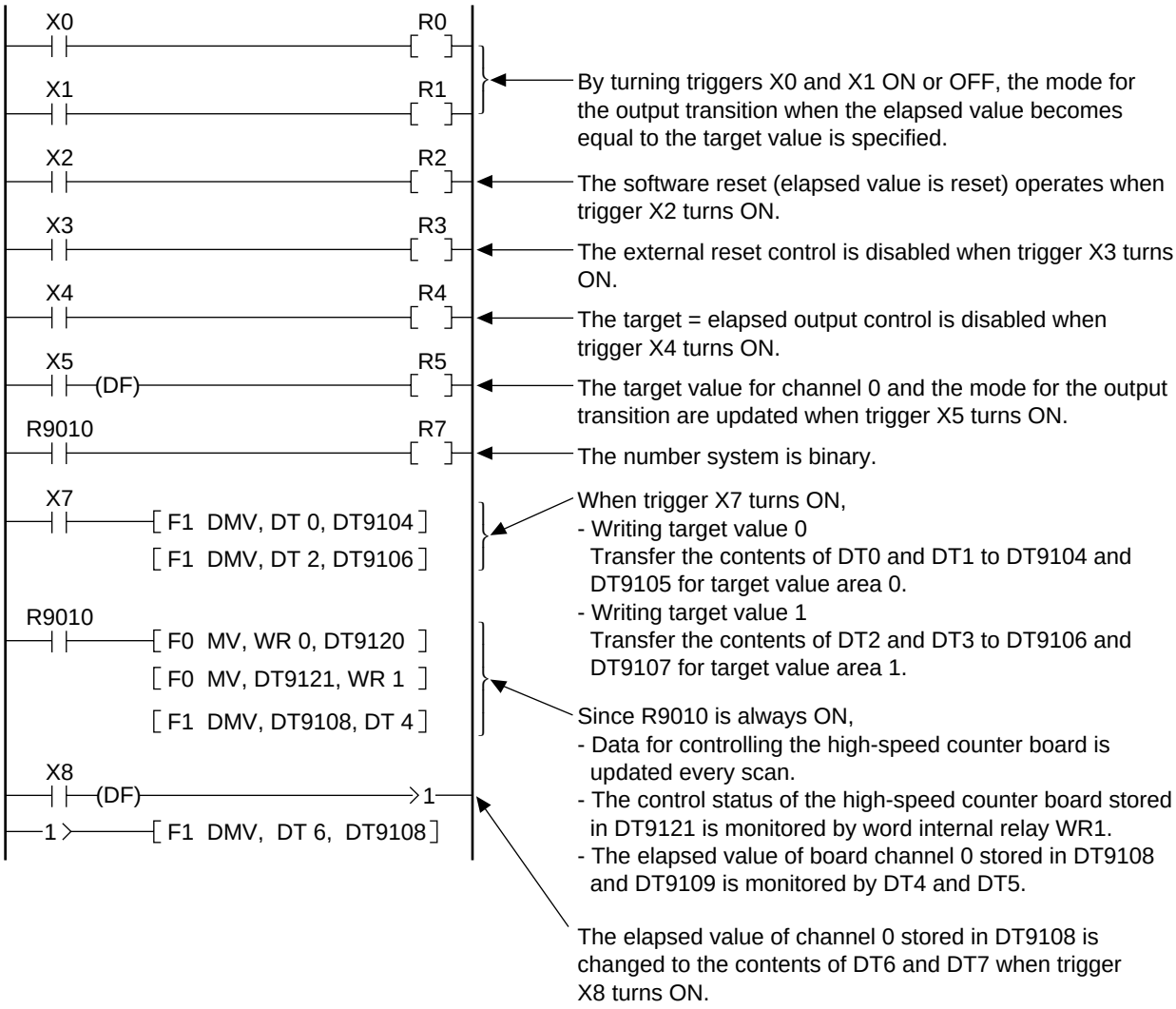
• Operation errors will occur in the following circumstances:
- The high-speed counter board is disconnected from the FP-M control board when instructions **F0 (MV)** and **F1 (DMV)** are executed.
- The setting of the input mode selector on the high-speed counter board is incorrect when instructions **F0 (MV)** and **F1 (DMV)** are executed.
- When the target value is consecutively set to the same channel and executed.
- When the changing/reading of the elapsed and capture value are executed consecutively.
If executing consecutively, execute leaving one or more scan times open.

• When changing/reading the contents of special data registers DT9104 through DT9119, be sure to use the **F1 (DMV)** instruction.
• Once the operation mode is specified, the high-speed counter operates in the mode until a new setting is made.
• An error will occur if an elapsed value is read simultaneously in a normal program and interrupt program.

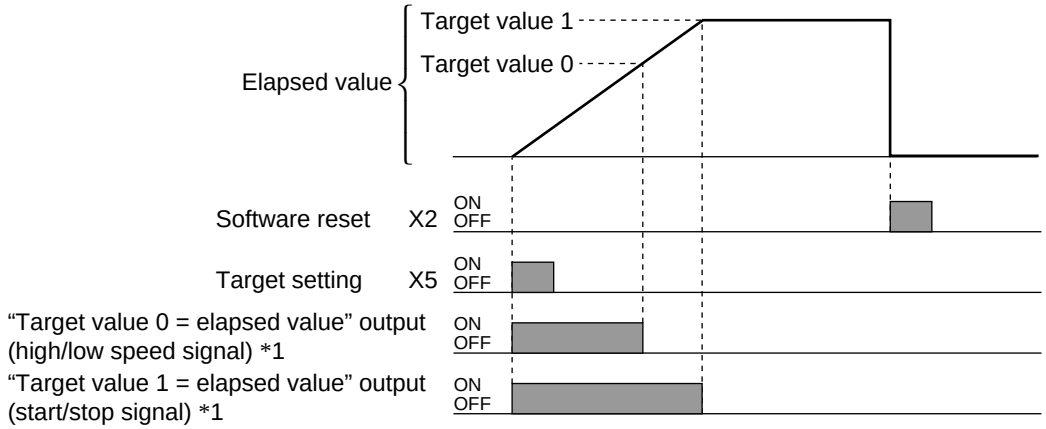
3) Applications

■ Example 1: Position control

Program example



Time chart:

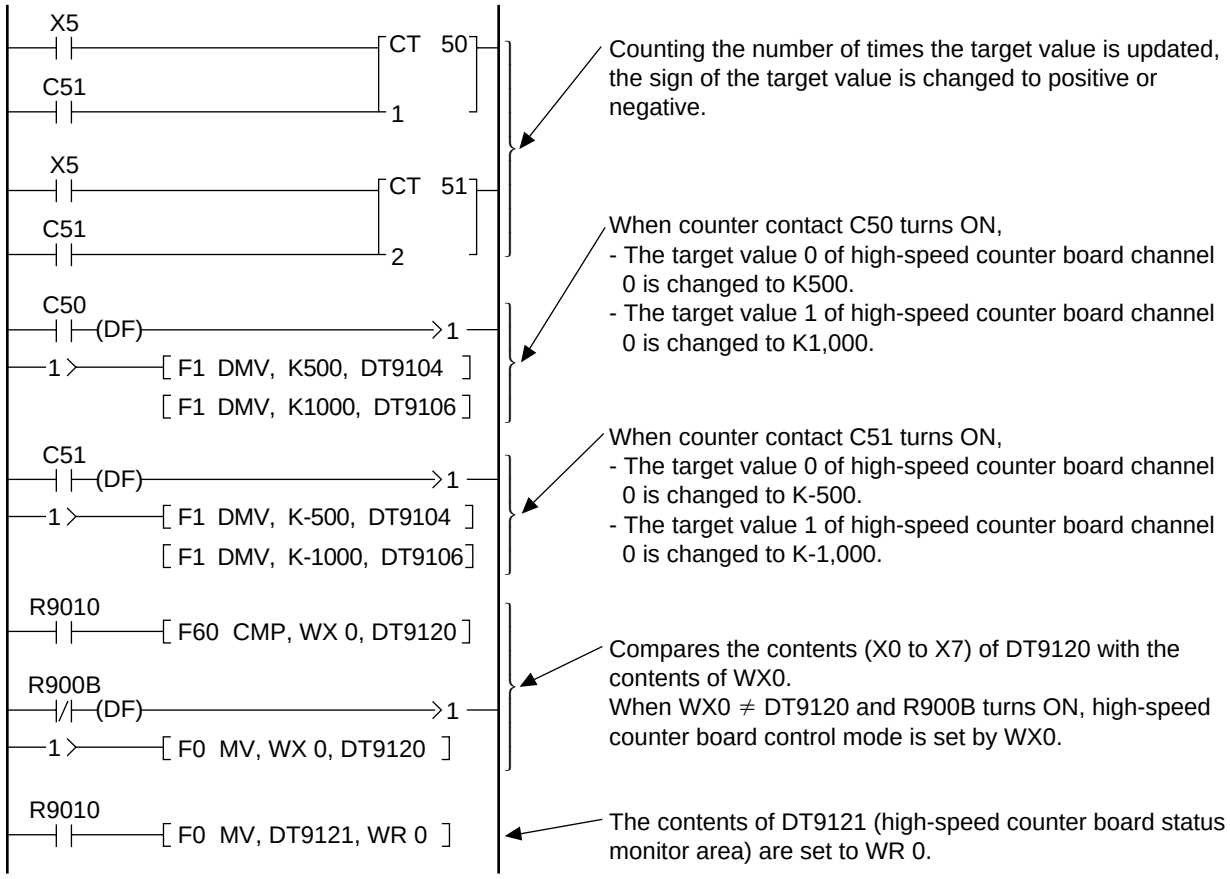


*1 ····· The mode for the output transition is specified as ON → OFF.

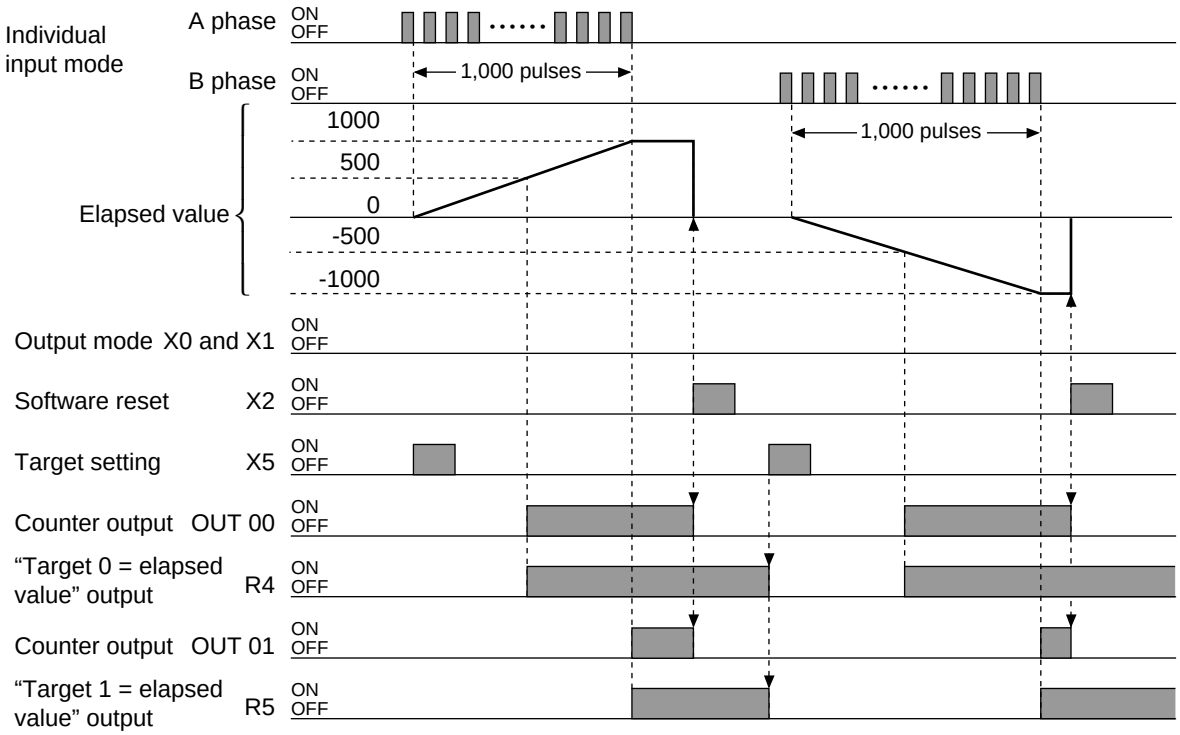
■ Example 2: Elapsed value comparison control

High-speed counter board setting conditions: Individual input mode (A phase: 1,000 pulse, B phase: 1,000 pulse)

Program example



Time chart:



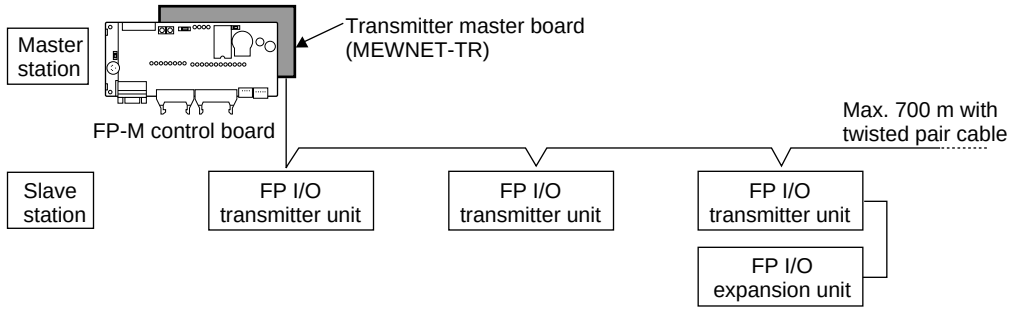
7-6. FP-M Transmitter Master Board (MEWNET-TR)

Refer to “FP-M/FP1 MEWNET-TR (Remote I/O) system Technical Manual” for details about the FP-M transmitter master board.

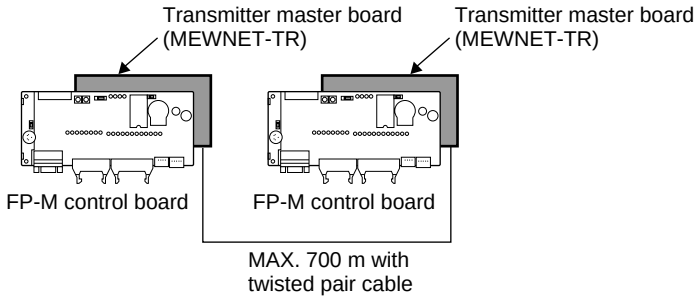
I/O information can be exchanged between the master and several slave stations at a remote site. A maximum of 32 inputs and 32 outputs can be controlled per master board. This system supports a total transmission distance of 700 m per port using a twisted pair cable.

■ MEWNET-TR (distributed I/O) system

• Master-slave communication



• Master-master communication



MEWNET-TR System Specifications

Item	Description
Communication method	Two-lines, half-duplex
Syncronization method	Asyncronous system
Communication path	2-conductor cable or twisted pair cable
Transmission distance	Max. 400 m (1,312.34 ft.) with 2-conductor cable Max. 700 m (2,296.59 ft.) with twisted pair cable
Communication speed	500 kbps
Controllable I/O points (See note.)	Max. 48 inputs and 32 outputs/FP-M transmitter master board (MEWNET-TR) Max. 128 inputs and 96 outputs/control board
Controllable slave stations (See note.)	Combination of FP I/O transmitter units (16, 8, 4 point input and output types)
Interface	RS485

Notes:

• The controllable I/O points are set by the operation mode selector.
• Controllable slave stations are determined by the number of unit I/O points used by system.

1. Specifications

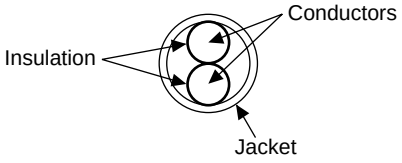
1) General

Item	Description
Ambient temperature	0 ˚C to +50 ˚C (32 ˚F to 122 ˚F)
Ambient humidity	30 % to 80 % RH (non-condensing)
Storage temperature	–20 ˚C to +70 ˚C (– 4 ˚F to +158 ˚F)
Storage humidity	30 % to 80 % RH (non-condensing)
Vibration resistance	10 Hz to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm (0.030 in.), 10 min on 3 axes
Shock resistance	98 m/s^2 (10 G) or more, 4 times on 3 axes
Operating environment	Must be free from corrosive gases and excessive dust.

2) Performance

Item	Description
Rated operating voltage	24 V DC
Operating voltage range	20.4 to 26.4 V DC
Current consumption	70 mA or less (at 24 V DC)

■ Recommended cable

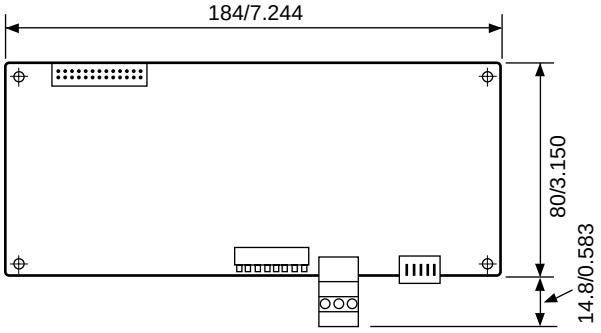


Conductor:
Size: Min. 1.25 mm^2 (AWG16 or larger)
Resistance: Max. 16.8 Ω/km (at 20 ˚C/68 ˚F)
Cable:
Insulation material: Polyethylene
Insulation thickness: Max. 0.5 mm/0.020 in.
Jacket diameter: Approx. 8.5 mm/0.335 in.

3) Restriction of expansion

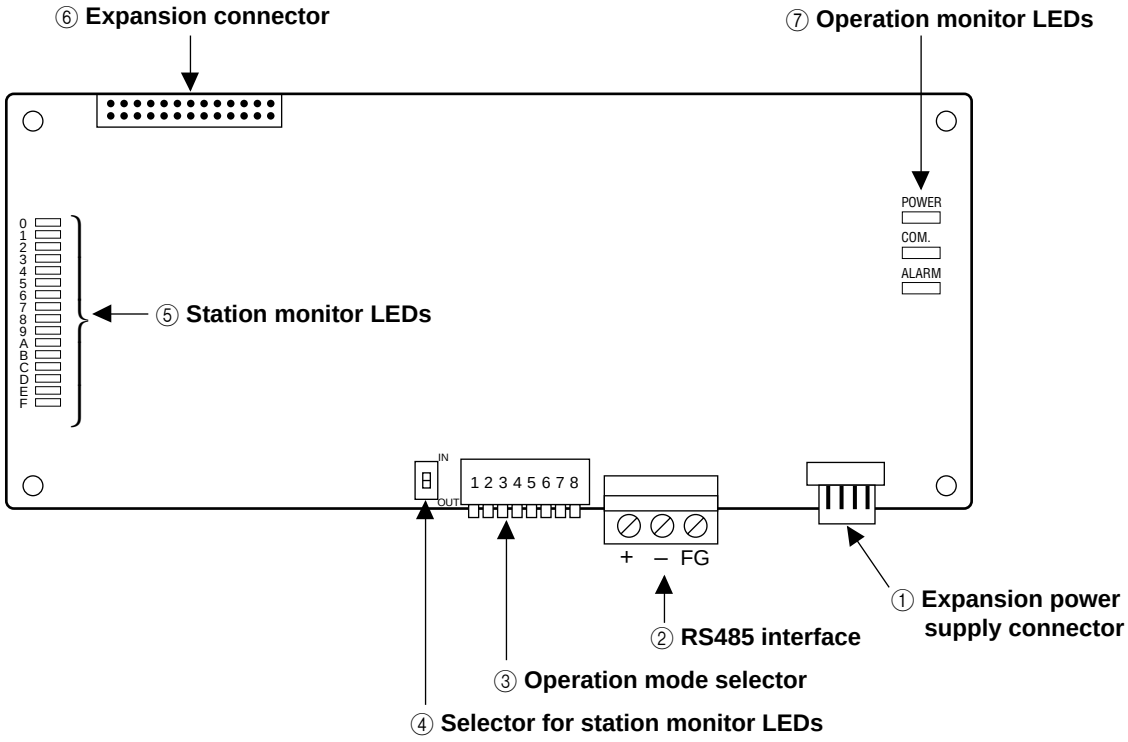
• A total of three FP-M transmitter master boards (MEWNET-TR) can be attached to the control board.

2. Dimensions



(unit: mm/in.)

3. Parts Terminology



① **Expansion power supply connector:** Supplies power to the FP-M transmitter master board (MEWNET-TR) through the expansion power supply cable.

② **RS485 interface:** Interface for MEWNET-TR communications.

③ **Operation mode selector:** (See following page.) Selects the MEWNET-TR communication conditions and sets the I/O addresses.

④ **Selector for station monitor LEDs:** Selects condition of station monitor LEDs (input or output).
- INPUT position: Status of slave station (FP I/O transmitter units) input type is indicated by LEDs.
- OUTPUT position: Status of slave station (FP I/O transmitter units) output type is indicated by LEDs.

⑤ **Station monitor LEDs:** LEDs that monitor the slave stations connected to the FP-M transmitter master board (MEWNET-TR).

⑥ **Expansion connector:** Connected to the control board.

⑦ **Operation monitor LEDs:** (See following page.) Indicate the operation and communication status of the MEWNET-TR system.

■ Operation monitor LEDs

LED	Description	
POWER	ON:	Power is supplied.
	OFF:	Power is not supplied.
COM.	Flashing:	Normal communication status (Flashes in approx. 0.2 s intervals)
	ON:	Not communicating
	Flashing slowly:	A communication error occurred at the slave station. The normal slave station continues I/O control operation. (Flashes in approx. 1 s intervals)
	OFF:	Abnormal condition
ALARM	Flashing:	Station number setting error
	ON:	FP-M transmitter master board (MEWNET-TR) error
	OFF:	Normal

■ Operation mode selector setting

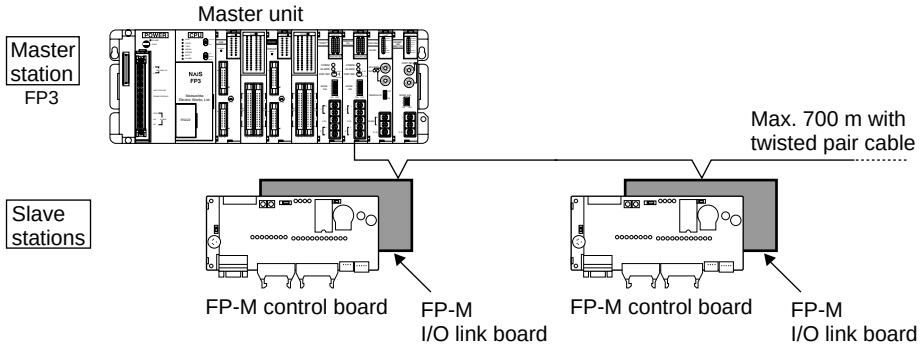
Selector number	Function	Description	Selector position							
			1	2	3	4	5	6	7	8
1	System configuration selection	I/O link system: (FP-M – FP-M) (FP-M – FP3/FP10S)	ON							
		I/O link system: [FP-M (master) – FP I/O transmitter unit (slave)]	OFF							
2	Output operation condition during a communication error	Stop		ON						
		Start (continues I/O control operation)		OFF						
3	Terminal station setting	Not a terminal station			ON					
		Terminal station			OFF					
4	Error flag (R9036) setting	ON when an I/O link error occurs				ON				
		Not setting				OFF				
5	Not used	———————————					—			
6, 7, and 8	I/O allocation setting (use I/O address for expansion board)	32 inputs: X110 to X12F 32 outputs: Y110 to Y12F						OFF	—	—
		48 inputs: X70 to X87, X90 to X107 32 outputs: Y70 to Y7F, Y90 to Y9F						ON	ON	ON
		24 inputs: X70 to X87 16 outputs: Y70 to Y7F						ON	ON	OFF
		48 inputs: X30 to X47, X50 to X67 32 outputs: Y30 to Y3F, Y50 to Y5F						ON	OFF	ON
		24 inputs: X30 to X47 16 outputs: Y30 to Y3F						ON	OFF	OFF

7-7. FP-M I/O Link Board (MEWNET-F)

Refer to “REMOTE I/O SYSTEM Technical Manual” for details about MEWNET-F (Remote I/O) system.

Using a FP-M I/O link board, this function allows the exchange of I/O information with the master unit of the FP series programmable controller through a 2-conductor cable.

■ MEWNET-F (distributed I/O) system



MEWNET-F (Remote I/O) System Specifications

Item	Description
Communication method	Two-lines, half-duplex
Syncronization method	Asyncronous system
Communication path	2-conductor cable or twisted pair cable
Transmission distance	Max. 400 m (1,312.34 ft.) with 2-conductor cable Max. 700 m (2,296.59 ft.) with twisted pair cable
Communication speed	500 kbps
Controllable I/O points	Max. 1,024 points per master unit
Controllable slave stations	Max. 32 stations per master unit
Interface	RS485

1. Specifications

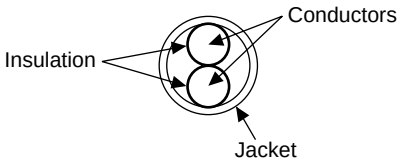
1) General

Item	Description
Ambient temperature	0 ˚C to +50 ˚C (32 ˚F to 122 ˚F)
Ambient humidity	30 % to 85 % RH (non-condensing)
Storage temperature	–20 ˚C to +70 ˚C (– 4 ˚F to +158 ˚F)
Storage humidity	30 % to 85 % RH (non-condensing)
Breakdown voltage	Across external terminal and frame ground terminal: 500 V AC, 1 min
Insulation resistance	100 MΩ or more, between external terminal and frame ground terminal (measured with a 500 V DC megger)
Vibration resistance	10 Hz to 55 Hz, 1 cycle/min: double amplitude of 0.75 mm (0.030 in.), 10 min on 3 axes
Shock resistance	98 m/s^2 (10 G) or more, 4 times on 3 axes
Noise immunity	1,000 Vp-p with pulse width, 50 ns or 1 μs (based on in-house measurements)
Operating environment	Must be free from corrosive gases and excessive dust.

2) Performance

Item	Description
Rated operating voltage	24 V DC
Operating voltage range	21.6 to 26.4 V DC
Current consumption	50 mA or less (at 24 V DC)

■ **Recommended cable**

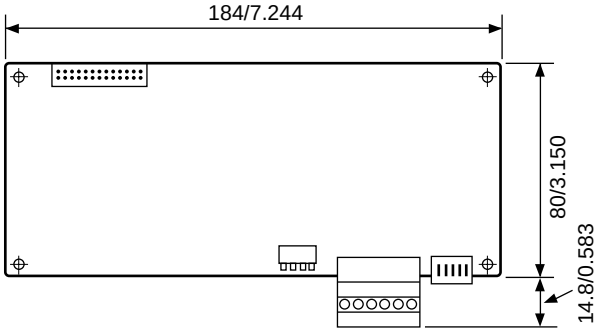


Conductor:
Size: Min. 1.25 mm^2 (AWG16 or larger)
Resistance: Max. 16.8 Ω/km (at 20 ˚C/68 ˚F)
Cable:
Insulation material: Polyethylene
Insulation thickness: Max. 0.5 mm/0.020 in.
Jacket diameter: Approx. 8.5 mm/0.335 in.

3) Restriction of expansion

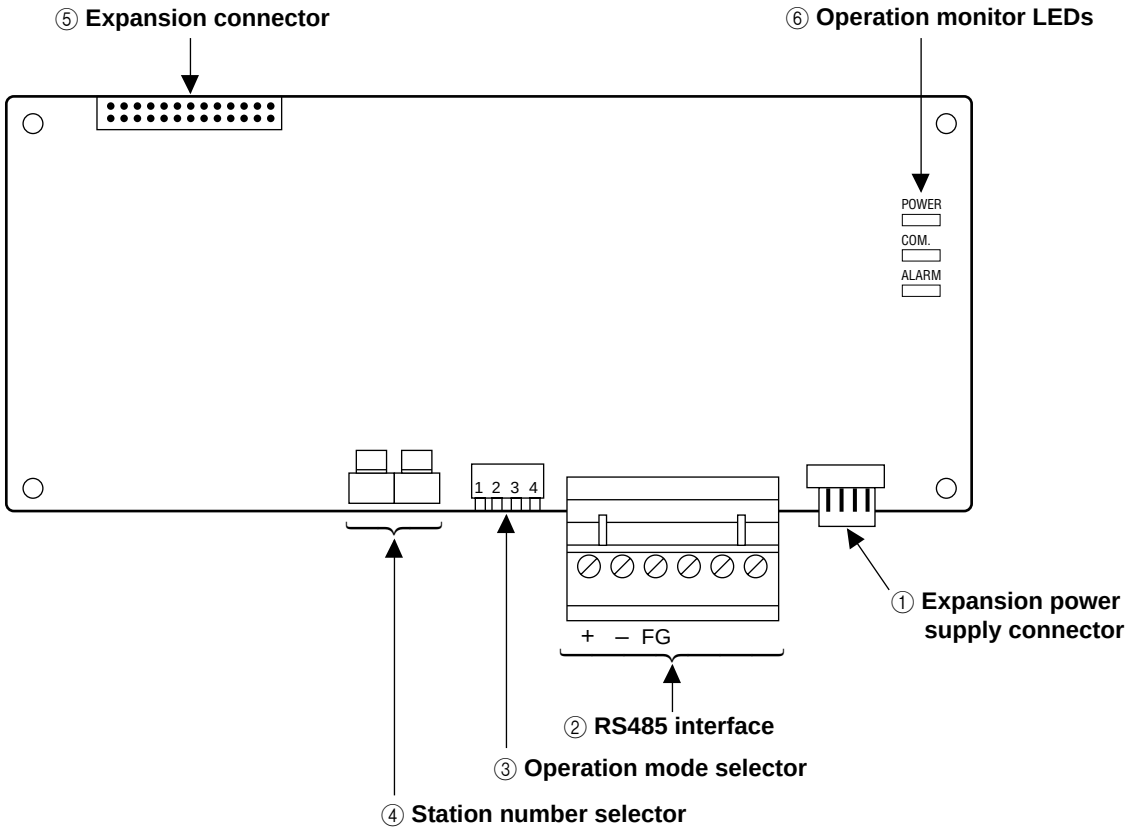
• One FP-M I/O link board (MEWNET-F) can be attached to the control board.

2. Dimensions



(unit: mm/in.)

3. Parts Terminology

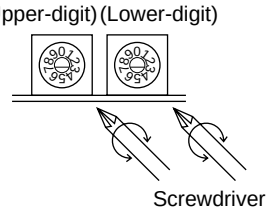


① Expansion power supply connector: Supplies power to the FP-M I/O link board (MEWNET-F) through the expansion power supply cable.

② RS485 interface: Connects a communication cable for the MEWNET-F system.

③ Operation mode selector: (See following page.)
Selects the MEWNET-F communication conditions and controllable I/O points.

④ Station number selector:
Sets the station number with a Phillips screwdriver for the MEWNET-F system.



⑤ Expansion connector: Connects the control board to transfer data.

⑥ Operation monitor LEDs: (See following page.)
Indicates the operation and communication status of the MEWNET-F system.

■ Operation monitor LEDs

LED	Description	
POWER	ON:	Power is supplied.
	OFF:	Power is not supplied.
COM.	Flashing:	Normal communication status (Flashes in approx. 0.2 s intervals)
	ON:	Not communicating
	Flashing slowly:	A communication error occurred at the slave station. The normal slave station continues I/O control operation. (Flashes in approx. 1 s intervals)
	OFF:	Abnormal condition
ALARM	Flashing:	Station number setting error
	ON:	FP-M I/O link board (MEWNET-F) error
	OFF:	Normal

■ Operation mode selector setting

Selector number	Function	Description	Selector position 1	2	3	4
1 and 2	Terminal station setting	Not terminal station	OFF	OFF		
		Terminal station	ON	ON		
3	Output operation condition during a communication error	Stop			OFF	
		ON state (maintain its output condition)			ON	
4	I/O points setting	64 points 32 input points: X110 to X12F 32 output points: Y110 to Y12F				OFF
		32 points 16 input points: X110 to X11F 16 output points: Y110 to Y11F				ON

CHAPTER 8

APPENDIX

8-1. Performance Specifications

1. Control and Expansion Board Specifications

Item		Description
Programming method		Relay symbol
Control method		Cyclic operation
Program memory		Built-in RAM (lithium battery backup) EEPROM (master memory)/EPROM (memory) [optional items]
Program capacity		2.7 k type: 2,720 steps 5 k type: 5,000 steps
Operation speed		1.6 μs/step: basic instruction
Kinds of instruction	Basic	81
	High-level	111
External input (X)		208 points (See note.)
External output (Y)		208 points (See note.)
Internal relay (R)		1,008 points
Special internal relay (R)		64 points
Timer/counter (T/C)		144 points
Auxiliary timer		Unlimited number of points (0.01 s to 327.67 s)
Data register (DT)		2.7 k type: 1,660 words 5 k type: 6,144 words
Special data register (DT)		112 words (For control board: 70 words, for intelligent boards: 42 words)
Index register (IX, IY)		2 words
MCR points		32 points
Number of labels (JMP,LOOP)		64 points
Differential points (DF or DF*I*)		Unlimited number of points
Number of step ladders		128 stages
Number of subroutines		16 subroutines
Number of interrupt programs		9 programs
Advanced control functions	High-speed counter (1 channel)	Input: Count input (X0, X1)/reset input (X2) Counting input mode: up mode, down mode, up/down mode, 2-phase mode Counting range: –8,388,608 to 8,388,607 Max. counting speed: up/down mode 10 k Hz, 2-phase mode 10 k Hz Min. input pulse width: 1-phase 50 μs • 2-phase 50 μs
	Manual dial-set register	2 potentiometers
	Pulse catch input Interrupt input	Total 8 points (X0 to X7)
	Periodical interrupt	10 ms to 30 s (10 ms interval)

Note:

- The actual number of points that can be used is the total number of I/O points of the control board and the expansion board.

Item		Description
Advanced control functions	RS232C port (See note.)	Communication speed: 300/600/1,200/2,400/4,800/9,600/19,200 bps Communication distance per port: 15 m/49.213 ft. Connector: D-SUB 9 pin connector
	Clock/calendar (See note.)	Clock/calendar function available
	I/O link	64 I/O points (32 inputs and 32 outputs) or 32 I/O points (16 inputs and 16 outputs)
	Pulse output (See note.)	2 points (Y6 and Y7) Pulse output frequency range: 360 to 5,000 Hz/180 to 5,000 Hz/90 to 5,000 Hz/45 to 5,000 Hz
	Constant scan	2.5 ms × set value (160 ms or less)
Adjustable input time filtering		1 to 128 ms
Self-diagnosis function		Watchdog timer, battery detection, program check, etc.
Memory backup (at 25˚C)		Approx. 27,000 h (C types: C20RC, C20TC and C32TC) Approx. 53,000 h (except C types: C20R, C20T and C32T)

Notes:

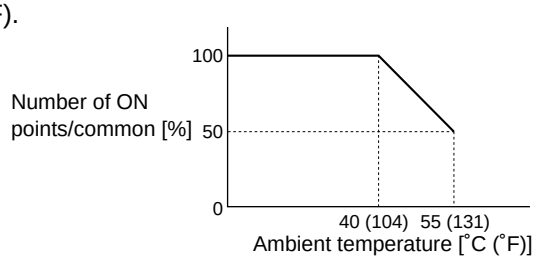
- The RS232C port and clock/calendar functions are available for the C types (C20RC, C20TC and C32TC).
- The pulse output function is available for the transistor output type.
- The two pulse outputs, Y6 and Y7 cannot be used at the same time.

■ Input specifications

Item	Description
Rated input voltage	24 V DC
Operating voltage range	20.4 V to 26.4 V DC
ON voltage/current	19.2 V or less/3 mA or less (19.2 V or less/3.6 mA: C32T series only)
OFF voltage/current	2.4 V or more/1 mA or more
Input impedance	Control board: Approx. 4.8 kΩ Expansion board: Approx. 4.4 kΩ
Response time ON ↔ OFF	2 ms or less (at normal input) (See note.) 50 μs or less (in setting high-speed counter) 200 μs or less (in setting interrupt input) 500 μs or less (in setting pulse catch)
Operating mode indicator	LED
Insulation method	Optical coupler

Notes:

- Input response time can be changed using the input time filtering function to 1, 2, 4, 8, 16, 32, 64, or 128 ms in unit of 8 inputs. However, for expansion boards, the input response time is fixed at 2 ms (or less).
- The number of ON points must be decreased when the ambient temperature is high (between 40 ˚C/104 ˚F and 55 ˚C/131 ˚F).



■ Output specifications

Relay output type

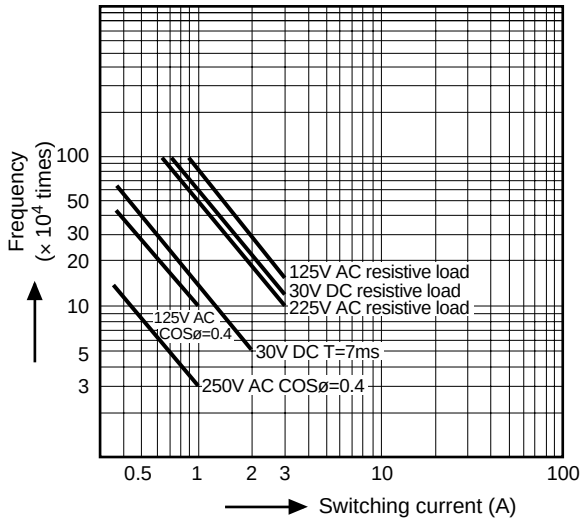
Item	Description
Rated operating voltage	24 V DC
Operating voltage range	22.8 V to 26.4 V DC
Output type	Normally open (1 Form A), 2 points/common
Rated control capacity	2 A 250 V AC, 2 A 30 V DC (resistive load)(See note 1.)
Response time OFF → ON	8 ms or less
ON → OFF	10 ms or less
Mechanical life time	2×10^7 operations or more
Electrical life time	10^5 operations or more
Operating mode indicator	LED

Transistor output type (PNP or NPN open collector)

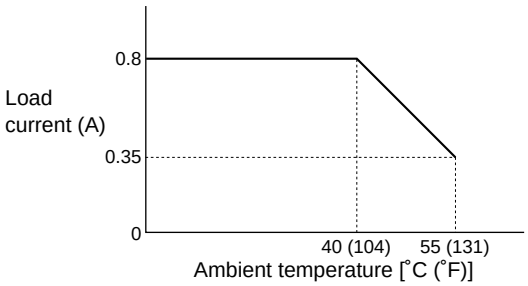
Item	Description
Insulation method	Optical coupler
Rated load voltage	24 V DC
Operating load voltage range	20.4 V to 26.4 V DC
Max. load current	0.8 A/point (at 24 V DC) (See note 2.)
OFF state leakage current	100 μA or less
ON state voltage drop	1.5 V or less
Response time OFF → ON	1 ms or less
ON → OFF	1 ms or less (100 μs or less: Y6 and Y7)
Surge absorber	Zener diode
Operating mode indicator	LED

Notes:

1. Life characteristics of built-in relay (PA relay)



2. The maximum load current is kept within the following ranges when the ambient temperature is high.



3. Make the current for one common no more than the following values.
   8 points/common circuit: 3 A/common
   16 points/common circuit: 5 A/common

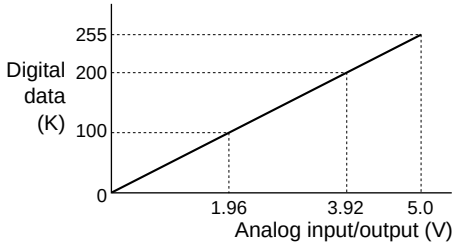
2. Intelligent Boards Specifications

1) Analog I/O board specifications

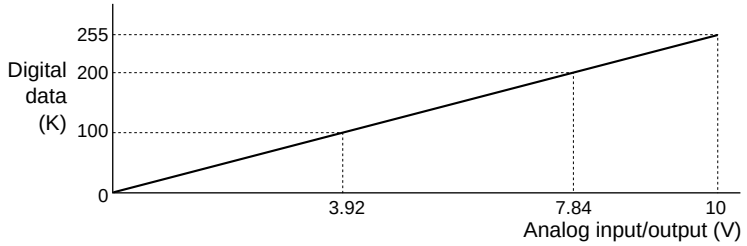
Item		Description
Analog input specifications	Number of input channels	4 channels
	Input range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
	Resolution	1/256
	Overall accuracy	±3LSB (at 25 ˚C/77 ˚F), ±5LSB (at 0 ˚C to 50 ˚C/32 ˚F to 122 ˚F)
	Response time	2.5 ms/channel
	Input impedance	1 MΩ or more (for 0 to 5 V and 0 to 10 V range) 250 Ω (for 0 to 20 mA range)
	Absolute input range	+15 V (at 0 to 5 V and 0 to 10 V range) +30 mA (at 0 to 20 mA range)
	Digital converted data	K0 to K255
Analog output specifications	Number of output channels	1 channel
	Output range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
	Resolution	1/256
	Overall accuracy	±1.0 % of full scale (at 25 ˚C/77 ˚F), ±2.0 % of full scale (at 0 ˚C to 50 ˚C/32 ˚F to 122 ˚F)
	Response time	2.5 ms/channel
	Output impedance	0.5 Ω or less (for 0 to 5 V and 0 to 10 V output range)
	Max. output current	20 mA (for 0 to 5 V and 0 to 10 V output range)
	Allowable load resistance	0 to 500 Ω (for 0 to 20 mA range)
	Digital data	K0 to K255
Insulation method		Optical coupler (not insulated between channels)

■ Analog data conversion characteristics

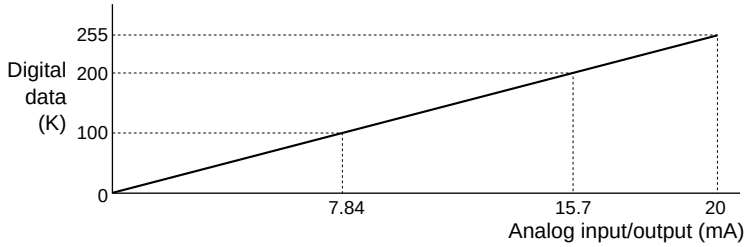
• 0 to 5 V range



• 0 to 10 V range



• 0 to 20 mA range



2) A/D converter and D/A converter board specifications

■ A/D converter board specifications

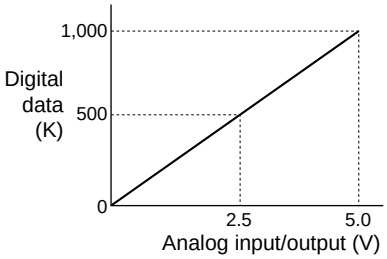
Item	Description
Number of input channels	4 channels
Input range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
Resolution	1/1000
Overall accuracy	±1.0 % of full scale (at 25˚C/77 ˚F), ±2.0 % of full scale (at 0 ˚C to 50 ˚C/32 ˚F to 122 ˚F)
Response time	2.5 ms/channel
Input impedance	1 MΩ or more (for 0 to 5 V and 0 to 10 V range) 250 Ω (for 0 to 20 mA range)
Absolute input range	+15 V (at 0 to 5 V and 0 to 10 V range) +30 mA (at 0 to 20 mA range)
Digital converted data	K0 to K1000
Insulation method	Optical coupler (not insulated between channels)

■ D/A converter board specifications

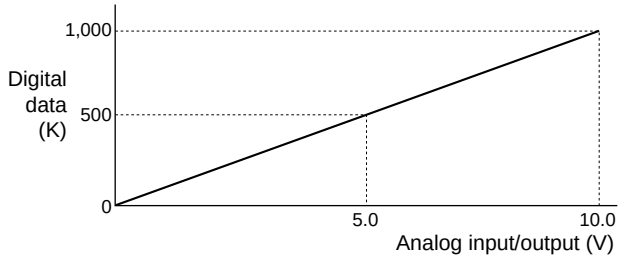
Item	Description
Number of output channels	2 channels
Output range	0 to 5 V, 0 to 10 V, and 0 to 20 mA
Resolution	1/1000
Overall accuracy	±1.0 % of full scale (at 25 ˚C/77 ˚F), ±2.0 % of full scale (at 0 ˚C to 50 ˚C/32 ˚F to 122 ˚F)
Response time	2.5 ms/channel
Output impedance	0.5 Ω or less (for 0 to 5 V and 0 to 10 V range)
Max. output current	20 mA (for 0 to 5 V and 0 to 10 V range)
Allowable load resistance	0 to 500 Ω (for 0 to 20 mA range)
Digital data	K0 to K1000
Insulation method	Optical coupler (not insulated between channels)

■ Analog data conversion characteristics

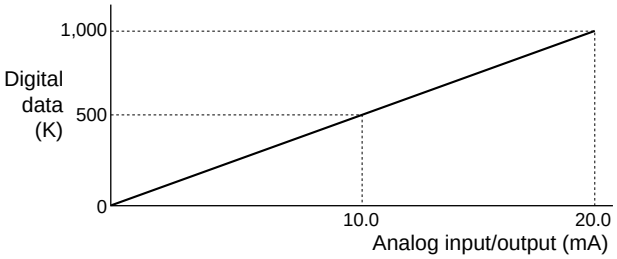
• 0 to 5 V range



• 0 to 10 V range



• 0 to 20 mA range



3) High-speed counter board specifications

Item		Description
Counter specifications	Counter channels	2 channels (CH 0, CH 1)
	Max. counting speed	1-phase mode: 20 kHz 2-phase mode: 5 kHz
	Counting range	–8,388,608 to +8,388,607
	Number of target value settings	2 points/channel
Input specifications	Input mode	3 modes (2-phase/4-time multiplication mode, individual input mode, directional input mode) * The mode is set using the input mode selector.
	Number of input points	3 points (INA, INB, RESET) × 2 channels 2 points (RST.E, O.INH) × 2 channels
	Rated input voltage	24 V DC
	Input voltage range	21.6 to 26.4 V DC
	Insulation method	Optical coupler
	ON voltage	19.2 V DC or less
	OFF voltage	4.8 V DC or more
	Min. input pulse width	50 μs at INA and INB inputs 2.5 ms at RESET input
	Input delay time	1 ms or less at RST.E and O.INH inputs
	Input current	Approx. 7.5 mA at INA, INB, and RESET inputs Approx. 5 mA at RST.E and O.INH inputs
	Input type	Source
Output specifications	Number of output points	2 points (OUT 0 and OUT 1)
	Rated load voltage	24 V DC
	Load voltage range	21.6 to 26.4 V DC
	Insulation method	Optical coupler
	Output type	Transistor PNP or NPN open collector
	Max. load current	200 mA
	Residual voltage	1.5 V or less
	Leakage current	100 μA or more
	Response time ON → OFF OFF → ON	1 ms or less 1 ms or less

4) FP-M transmitter master board (MEWNET-TR) specifications

■ Performance specifications

Item	Description
Rated operating voltage	24 V DC
Operating voltage range	20.4 to 26.4 V DC
Current consumption	70 mA or less (at 24 V DC)

■ MEWNET-TR system specifications

Item	Description
Communication method	Two-lines, half-duplex
Syncronization method	Asyncronous system
Communication path	2-conductor cable (VCTF: 0.75 mm × 2 conductors)
Transmission distance	Max. 400 m (1,312.34 ft.) with 2-conductor cable Max. 700 m (2,296.59 ft.) with twisted pair cable
Communication speed	500 kbps
Controllable I/O points (See note.)	Max. 48 inputs and 32 outputs/FP-M transmitter master board (MEWNET-TR) Max. 128 inputs and 96 outputs/control board
Controllable slave stations (See note.)	Combination of FP I/O transmitter units (16, 8, 4 point input and output types)
Interface	RS485

5) FP-M I/O link board (MEWNET-F) specifications

■ Performance specifications

Item	Description
Rated operating voltage	24 V DC
Operating voltage range	21.6 to 26.4 V DC
Current consumption	50 mA or less (at 24 V DC)

■ MEWNET-F system specifications

Item	Description
Communication method	Two-lines, half-duplex
Syncronization method	Asyncronous system
Communication path	2-conductor cable (VCTF: 0.75 mm × 2 conductors)
Transmission distance	Max. 400 m (1,312.34 ft.) with 2-conductor cable Max. 700 m (2,296.59 ft.) with twisted-pair cable
Communication speed	500 kbps
Controllable I/O points (See note.)	Max. 1,024 points per master unit
Controllable slave stations (See note.)	Max. 32 stations per master unit
Interface	RS485

Notes:

- The controllable I/O points are set by the operation mode selector.
- Controllable slave stations are determined by the number of unit I/O points used by system.

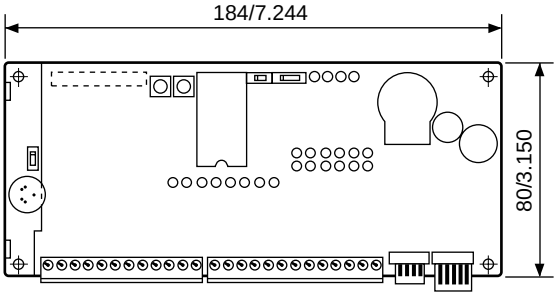
8-2. Dimensions

1. Board Type

1) Control boards

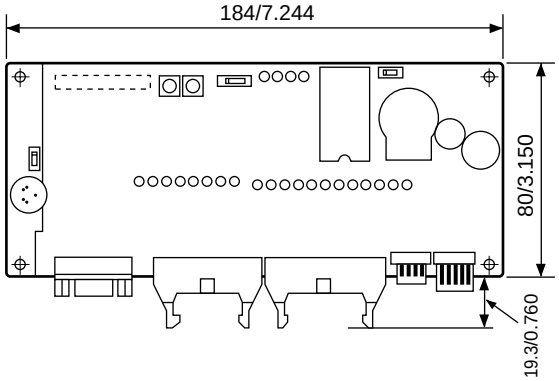
■ C20R and C20RC types

e.g.) C20R type



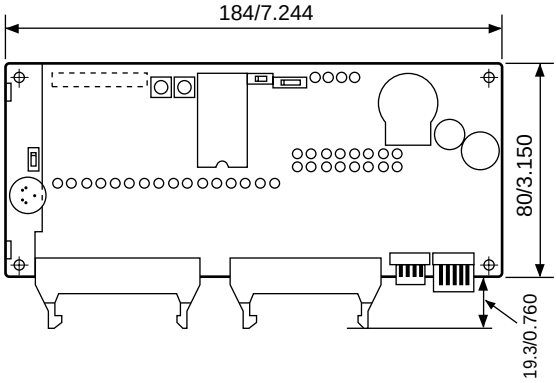
■ C20T and C20TC types

e.g.) C20TC type



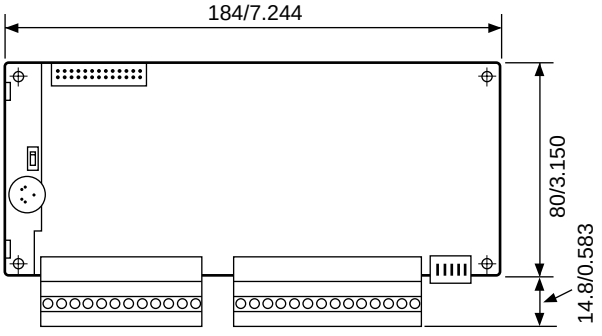
■ C32T and C32TC types

e.g.) C32T type



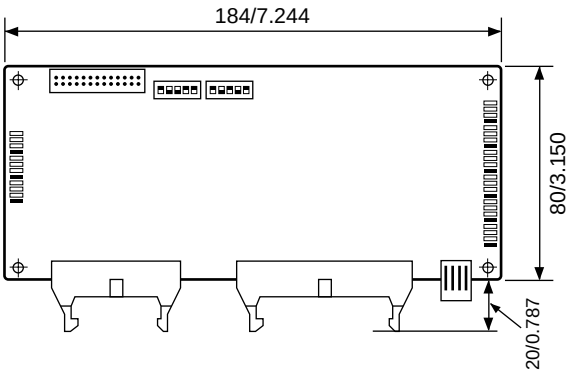
2) Expansion boards

■ M1T-E20R type



■ M1T-E, M1T-EI, and M1T-EO types

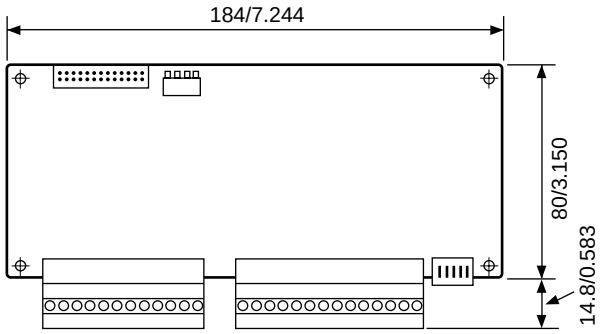
e.g.) M1T-EI type



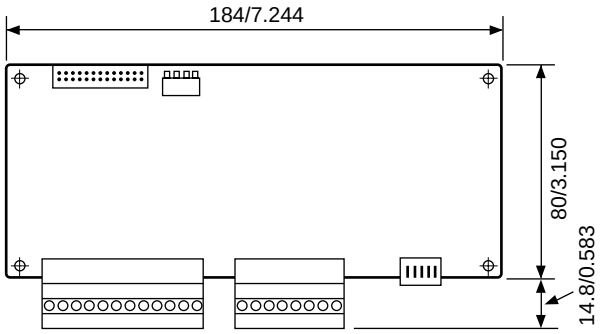
Tolerance ±1.0/±0.39 (unit: mm/in.)

3) Intelligent and link boards

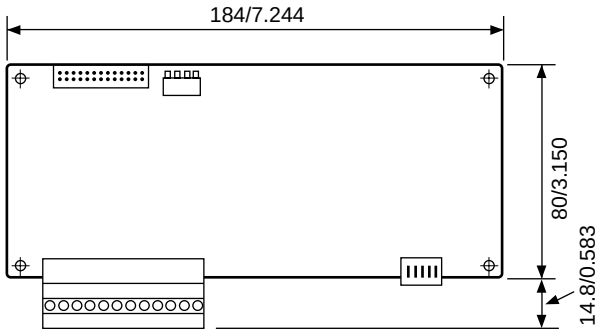
■ **Analog I/O board**



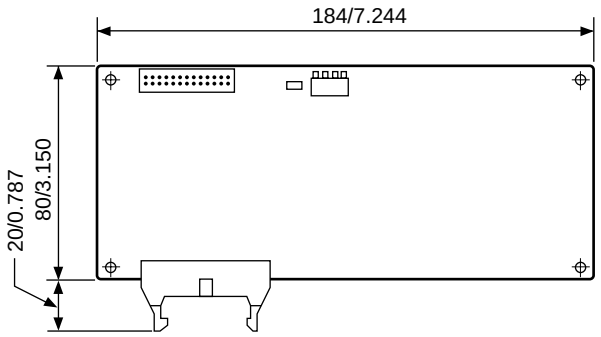
■ **A/D converter board**



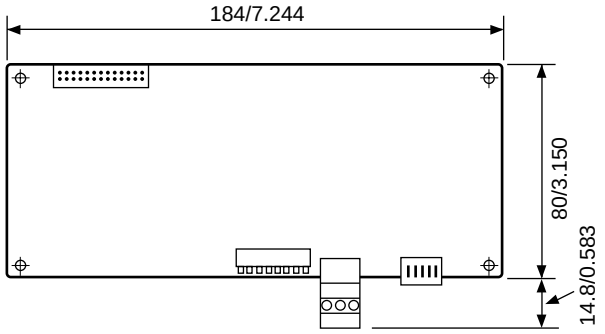
■ **D/A converter board**



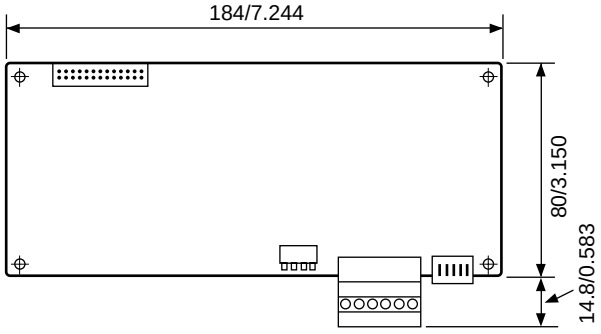
■ **High-speed counter board**



■ **FP-M transmitter master board**



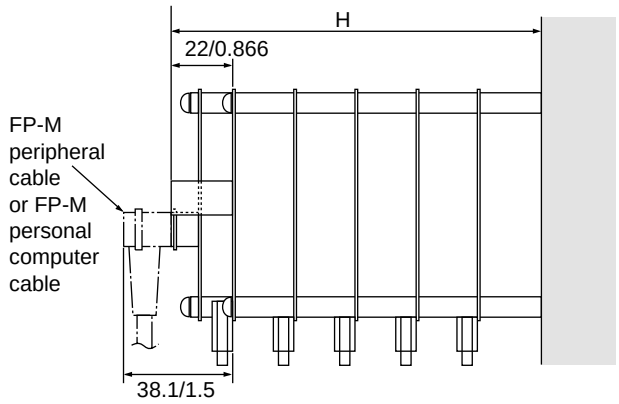
■ **FP-M I/O link board**



Tolerance ±1.0/±0.39 (unit: mm/in.)

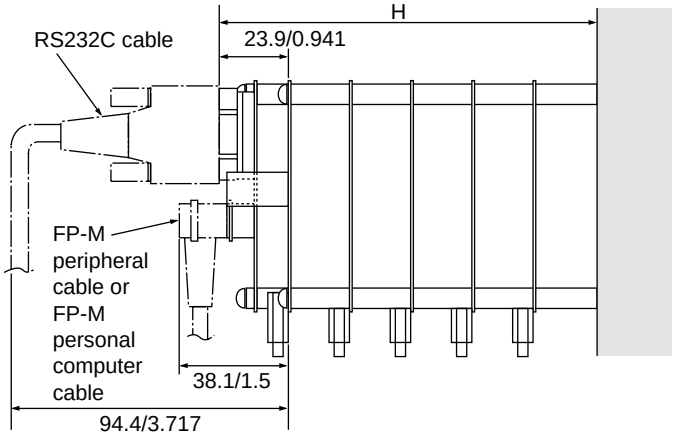
4) Building dimensions

Control board C20R, C20T, C20TC, and C32T types



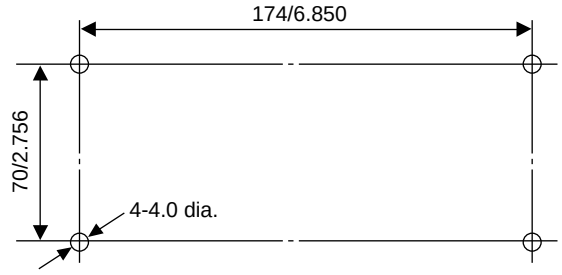
Board	H (mm/in.)
1 control board	43.6/1.717
1 control board and 1 expansion board	65.2/2.567
1 control board and 2 expansion boards	86.8/3.417
1 control board and 3 expansion boards	108.4/4.268
1 control board and 4 expansion boards	130.0/5.118

Control board C20RC and C32TC types



Board	H (mm/in.)
1 control board	45.5/1.791
1 control board and 1 expansion board	67.1/2.642
1 control board and 2 expansion boards	88.7/3.492
1 control board and 3 expansion boards	110.3/4.343
1 control board and 4 expansion boards	131.9/5.193

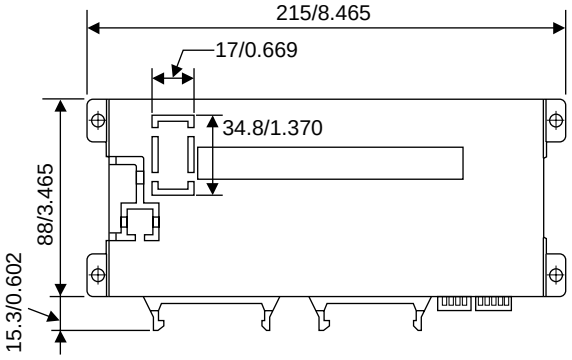
5) Mounting hole dimensions



Tolerance ±1.0/±0.39 (unit: mm/in.)

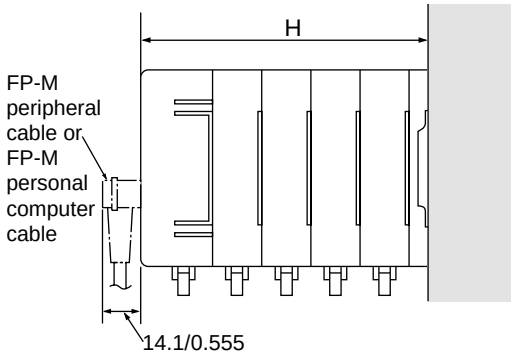
2. Case Type

1) Case dimensions for control, expansion, intelligent and link boards



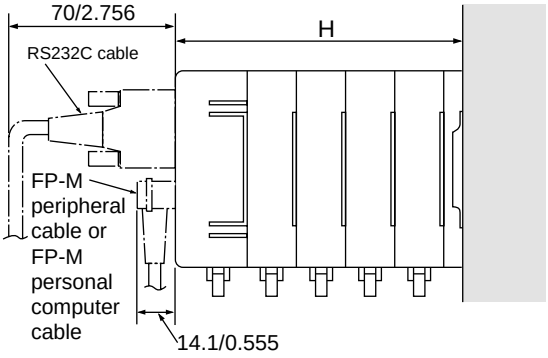
2) Building dimensions

Control board C20R, C20T, and C32T types



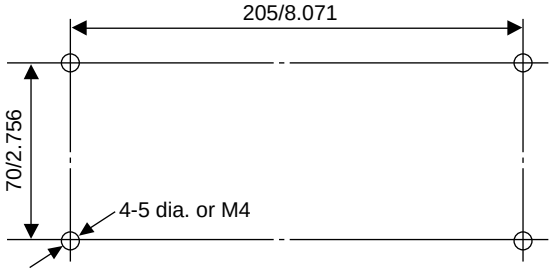
Board	H (mm/in.)
1 control board	44.2/1.740
1 control board and 1 expansion board	63.8/2.512
1 control board and 2 expansion boards	85.4/3.362
1 control board and 3 expansion boards	107.0/4.213
1 control board and 4 expansion boards	128.6/5.063

Control board C20RC, C20TC, and C32TC types



Board	H (mm/in.)
1 control board	44.2/1.740
1 control board and 1 expansion board	63.8/2.512
1 control board and 2 expansion boards	85.4/3.362
1 control board and 3 expansion boards	107.0/4.213
1 control board and 4 expansion boards	128.6/5.063

3) Mounting hole dimensions



Tolerance ±1.0/±0.39 (unit: mm/in.)

8-3. I/O Allocation Table

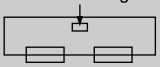
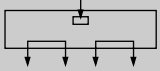
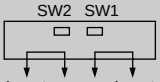
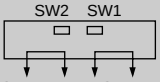
1. I/O Allocation of Control Boards

• The I/O addresses for the control boards are fixed as follows.

Board type	I/O point	I/O allocation
C20R and C20RC	12 inputs	X0 to XB
	8 outputs	Y0 to Y7
C20T and C20TC	12 inputs	X0 to XB
	8 outputs	Y0 to Y7
C32T and C32TC	16 inputs	X0 to XF
	16 outputs	Y0 to YF

2. I/O Allocation of Expansion Boards

• The I/O addresses for the expansion boards are set by the I/O address setting switches as follows.

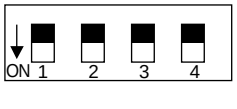
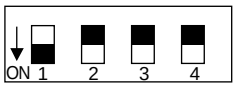
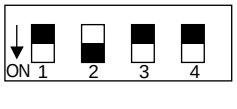
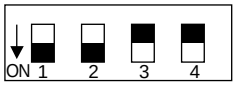
Board type	I/O point	I/O address setting switches and I/O allocation			
					
E20R type I/O address setting switch  Output: 8 Input: 12	12 inputs	X30 to X3B	X50 to X5B	X70 to X7B	X90 to X9B
	8 outputs	Y30 to Y37	Y50 to Y57	Y70 to Y77	Y90 to Y97
M1T-E type I/O address setting switch  Output: 16 Input: 24	24 inputs	X30 to X3F X40 to X47	X50 to X5F X60 to X67	X70 to X7F X80 to X87	X90 to X9F X100 to X107
	16 outputs	Y30 to Y3F	Y50 to Y5F	Y70 to Y7F	Y90 to Y9F
M1T-EI type I/O address setting switches SW2 SW1  Input block B: 12 Input block A: 24	Input block A: 24 inputs (using SW1)	X30 to X3F X40 to X47	X50 to X5F X60 to X67	X70 to X7F X80 to X87	X90 to X9F X100 to X107
	Input block B: 12 inputs (using SW2)	X30 to X3B	X50 to X5B	X70 to X7B	X90 to X9B
M1T-EO type I/O address setting switches SW2 SW1  Output block B: 16 Output block A: 16	Output block A: 16 outputs (using SW1)	Y30 to Y3F	Y50 to Y5F	Y70 to Y7F	Y90 to Y9F
	Output block B: 16 outputs (using SW2)	Y30 to Y3F	Y50 to Y5F	Y70 to Y7F	Y90 to Y9F

Notes:

- When connecting the expansion boards to the control board, be sure not to overlap I/O addresses.
- When connecting the M1T-EI and M1T-EO type expansion boards, I/O address settings for block A and B should be performed separately using the I/O address setting switches SW1 and SW2. Be sure to configure SW1 and SW2 with different settings in order to prevent I/O address overlap.

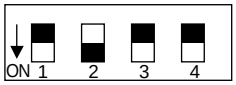
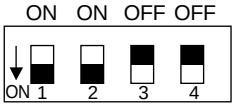
3. Allocation of Analog I/O, A/D Converter, and D/A Converter Boards

- The data for the analog I/O, A/D converter, and D/A converter boards are stored in specially selected data registers (DT9080 to DT9103) using the board number selector.
- The data for these boards are stored in special data registers as follows.

Board type	Board number	Board number selector position	Input/output	Channel number	Special data register
Analog I/O board	No. 0		Analog input	0	DT9080
				1	DT9081
				2	DT9082
				3	DT9083
			Analog output	0	DT9096 and DT9097
	No. 1		Analog input	0	DT9084
				1	DT9085
				2	DT9086
				3	DT9087
			Analog output	0	DT9098 and DT9099
	No. 2		Analog input	0	DT9088
				1	DT9089
				2	DT9090
				3	DT9091
			Analog output	0	DT9100 and DT9101
	No. 3		Analog input	0	DT9092
				1	DT9093
				2	DT9094
				3	DT9095
			Analog output	0	DT9102 and DT9103
A/D converter board	No. 0		Analog input	0	DT9080
				1	DT9081
				2	DT9082
				3	DT9083
	No. 1		Analog input	0	DT9084
				1	DT9085
				2	DT9086
				3	DT9087
	No. 2		Analog input	0	DT9088
				1	DT9089
				2	DT9090
				3	DT9091
	No. 3		Analog input	0	DT9092
				1	DT9093
				2	DT9094
				3	DT9095

Note:

- Board number selector upper state is “OFF (■)” and the lower state is “ON (■)”.

Board type	Board number	Board number selector position	Input/output	Channel number	Special data register
D/A converter board	No. 0		Analog output	0	DT9096
				1	DT9097
	No. 1		Analog output	0	DT9098
				1	DT9099
	No. 2		Analog output	0	DT9100
				1	DT9101
	No. 3		Analog output	0	DT9102
				1	DT9103

Notes:

- Refer to page 201, “8-7. Special Data Registers”, for details about special data registers.
- When two or more of these boards are installed, be sure to configure the board number selector in order to prevent special data register overlap. The board number selectors are set to board number 0 (all “OFF” position) when shipped.
- Board number selector upper state is “OFF (■)” and the lower state is “ON (■)”.

4. Allocation of High-speed Counter Board

- The data for the high-speed counter board are stored in specially selected data registers (DT9104 to DT9121).
- The data for these boards are stored in special data registers as follows.

Board type	Channel number	Data type	Special data register
High-speed counter board	Channel 0	Target value 0	DT9104 and DT9105
		Target value 1	DT9106 and DT9107
		Elapsed value	DT9108 and DT9109
		Capture value	DT9110 and DT9111
	Channel 1	Target value 0	DT9112 and DT9113
		Target value 1	DT9114 and DT9115
		Elapsed value	DT9116 and DT9117
		Capture value	DT9118 and DT9119
	Channels 0 and 1	Control area	DT9120
		Status monitor register area	DT9121

5. I/O Allocation of FP-M Transmitter Master Board

• The I/O addresses for the transmitter master board are set according to the operation mode selector as follows.

Board type	Operation mode selector position			I/O point	I/O allocation
	6	7	8		
FP-M transmitter master board	OFF	—	—	32 inputs 32 outputs	X110 to X12F Y110 to Y12F
	ON	ON	ON	48 inputs 32 outputs	X70 to X87, X90 to X107 Y70 to Y7F, Y90 to Y9F
	ON	ON	OFF	24 inputs 16 outputs	X70 to X87 Y70 to Y7F
	ON	OFF	ON	48 inputs 32 outputs	X30 to X47, X50 to X67 Y30 to Y3F, Y50 to Y5F
	ON	OFF	OFF	24 inputs 16 outputs	X30 to X47 Y30 to Y3F

Notes:

• When connecting the FP-M transmitter master board, be sure not to overlap I/O addresses.
• Switch positions 1 to 5 of the operation mode selector are not ignored.

6. I/O Allocation of FP-M I/O Link Board

• The I/O addresses for the FP-M I/O link board are set according to the operation mode selector as follows.

Board type	Operation mode selector position	I/O point	I/O allocation
	4		
FP-M I/O link board	OFF	64 points 32 inputs 32 outputs	 X110 to X12F Y110 to Y12F
	ON	32 points 16 inputs 16 outputs	 X110 to X11F Y110 to Y11F

Notes:

• When connecting the FP-M I/O link board, be sure not to overlap I/O addresses.
• Switch positions 1 to 3 of the operation mode selector are not ignored.

8-4. Table of Memory Areas

Item	Name and function	Symbol	Numbering	
			2.7 k type	5 k type
External I/O relays	**External input relay** This relay feeds signals to the programmable controllers from an external device such as a limit switch or photoelectric sensor.	X (bit)	208 points (X0 to X12F)	
		WX (word)	13 words (WX0 to WX12)	
	External output relay This relay outputs the program execution result of the programmable controllers and activates an external device such as a solenoid or motor.	Y (bit)	208 points (Y0 to Y12F)	
		WY (word)	13 words (WY0 to WY12)	
Internal relays	**Internal relay** This relay does not provide an external output and can be used only within the programmable controllers.	R (bit)	1,008 points (R0 to R62F)	
		WR (word)	63 words (WR0 to WR62)	
	Special internal relay This relay is a special internal relay which has specific applications. This relay cannot be used for output. Use it only as a contact. Refer to page 198, “8-6. Special Internal Relays”.	R (bit)	64 points (R9000 to R903F)	
		WR (word)	4 words (WR900 to WR903)	
Timer/ counter	**Timer contact** This contact is the output of a **TM** (timer) instruction. If a **TM** instruction has timed out, the contact with the same number turns ON.	T (bit)	100 points (T0 to T99)	
	Counter contact This contact is the output of a **CT** (counter) instruction. If a **CT** instruction has counted up, the contact with the same number turns ON.	C (bit)	44 points (C100 to C143)	
	Timer/counter set value The timer/counter set value area is a memory area where the set value of the **TM/CT** (timer/counter) instructions is stored. Each timer/counter set value area consists of 1 word (1 word = 16 bits). The address of this memory area corresponds to the **TM/CT** instruction number.	SV (word)	144 words (SV0 to SV143)	
	Timer/counter elapsed value The timer/counter elapsed value area is a memory area where the elapsed value of the **TM/CT** (timer/counter) instruction is stored. Each timer/counter elapsed value area consists of 1 word (1 word = 16 bits). The address of this memory area corresponds to the **TM/CT** instruction number.	EV (word)	144 words (EV0 to EV143)	

Notes:

- Timer/counter contacts are represented in decimal.
- Word addresses are represented in decimal.
- The addresses for relay bits (X, Y, and R) are represented by a combination of word addresses (decimal) and hexadecimals. The least significant digit is hexadecimal and the rest of the digits are decimal.

Item	Name and function	Symbol	Numbering	
			2.7 k type	5 k type
Data area	**Data register** The data register is a memory area for data processed within the programmable controllers and each data register consists of 1 word (1 word = 16 bits).	DT (word)	1,660 words (DT0 to DT1659)	6,144 words (DT0 to DT6143)
	Special data register The special data register is a memory area that has special applications. Refer to page 201, “8-7. Special Data Registers” for details about the special data register.	DT (word)	112 words (DT9000 to DT9069 and DT9080 to DT9121)	
Index modifier	**Index register** The index register can be used as an address and constants modifier.	IX (word) IY (word)	One word each (No numbering system)	
Constant	**Decimal constants**	K	16-bit constant (word): K-32,768 to K32,767	
			32-bit constant (double word): K-2,147,483,648 to K2,147,483,647	
	Hexadecimal constants	H	16-bit constant (word): H0 to HFFFF	
			32-bit constant (double word): H0 to HFFFFFFFF	

8-5. System Registers

1. What Are System Registers

- The FP series programmable controller is configured by setting certain parameters. The parameters, which configure the system and special functions, are called system registers.
- Like other registers in the FP series programmable controller, each system register consists of 16 bits. System register addresses are also assigned to each of the system registers.

■ Summarizing the functions of system registers

By function, system registers of the FP series programmable controller are classified into 8 types, as follows:

① **System register 0:**	**Size prepared for program capacity (fixed).** The value in this system register cannot be changed when you use an FP-M. You can use it only for monitoring the program capacity of the FP-M.
② **System registers 5, 6, 7, 8, and 14:**	**Characteristics settings of the area for timer/counter instructions and operands.** Performs assignments for numbers of timers/counters and the hold/non-hold area.
③ **System registers 4, 20, and 26:**	**Operation settings when abnormality is detected.** Sets whether the duplicated use of output and a low battery are to be regarded as errors, or whether the programmable controller should execute a program when an operation error occurs.
④ **System registers 31 and 34:**	**Processing time settings.** Sets the scan time of the programmable controller and the waiting time of computer link communication.
⑤ **System registers 400, 402, and 403:**	**Input mode settings.** Performs settings of the inputs, such as high-speed counter input, pulse catch inputs, and interrupt inputs.
⑥ **System registers 404 through 407:**	**Input time filtering settings.** Sets the input time constants in 8-input units.
⑦ **System registers 410 and 411:**	**Communication settings of port for programming tools (RS422).** Sets the station number, the character length, and the modem compatibility for the programming port.
⑧ **System registers 412 through 418:**	**Communication settings of RS232C serial port.** Sets the communication specifications of the RS232C serial port, such as communication mode, data format, and modem compatibility.

■ How to set the system registers

The system registers can be set by a programming tool.

• Using NPST-GR Software Ver. 3.1

① Set the mode of the programmable controller to PROG.

② Open the [SYSTEM REGISTER] window using the following procedure:

<If you are using MENU 1 screen type>

Open [NPST MENU] by pressing **Esc**, and then select "PLC CONFIGURATION" to skip to the [PLC CONFIGURATION] subwindow.
Select "1. SYSTEM REGISTER" in the [PLC CONFIGURATION] subwindow.

<If you are using MENU 2 screen type>

Open [NPST FUNCTION MENU] by pressing **Esc**, and then select "R. SYSTEM REGISTER".

Set the mode of the NPST-GR Software to ONLINE by pressing **Ctrl** + **Esc** together.

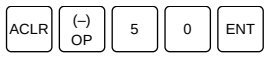
Open the window you want to set by pressing one of **F6** through **F10** or **Shift** + **F6** through **F10**, and change the value in the system register.

③ After setting, press **F1** and type " **Y** " to save the revised settings to the programmable controller.

• Using the FP Programmer Ⅱ

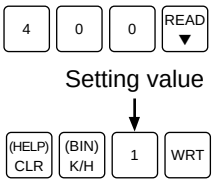
① Set the mode of the programmable controller to PROG.

② Press the keys on the FP Programmer Ⅱ, as shown on the right.



③ Input the system register address referring to the example and read the current settings.

EXAMPLE:
When reading system register 400, press the keys as shown on the right.



④ Input new settings referring to the example.

EXAMPLE:
To input K1, press the keys as shown on the right.

You can also input new settings in hexadecimal by pressing (BIN) K/H before inputting the setting value.

Note:

- The revised settings of the system register become effective soon after the revision. However, in case of changing the modem compatibility, the revised setting become effective after the power is turned from OFF to ON.

2. Table of the System Registers

Address	Name of system register	Default value	Description
0	Program capacity	K3 or K5	The program capacity is automatically specified according to the type of the programmable controllers. FP-M 2.7 k type (2,720 steps): K3 FP-M 5 k type (5,000 steps): K5 The value in this system register is fixed.
4	Operation without backup battery	K0	This register specifies the operation of the FP-M when the voltage of the backup battery lowers or when the backup battery disconnects. K0: the conditions above are regarded as errors K1: the conditions above are not regarded as errors
5	Counter instruction starting address	K100	Starting number for counter instructions is specified. • Setting range K0 to K144 • Setting the same value as system register 6 is recommended. • If the maximum value of the setting range is input, all of the areas are used as timers. EXAMPLE: If system register 5 is set to K120: - Timers: T0 to T119 (120 timers) - Counters: C120 to C143 (24 counters)
6	Hold area starting address settings for timer/counter area	K100	Hold area starting address for timer/counter is specified. • Setting range K0 to K144 • Setting the same value as system register 5 is recommended. • If the maximum value of the setting range is input, all of the areas are used as non-hold areas. EXAMPLE: If system register 6 is set to K120: - Non-hold area: 0 to 119 - Hold area: 120 to 143

Address	Name of system register	Default value	Description
7	Hold area starting address settings for internal relays	K10	Hold area starting address for internal relays is specified in word-units. • Setting range K0 to K63 • If the maximum value of the setting range is input, all of the areas are used as non-hold areas. EXAMPLE: If system register 7 is set to K30: - Non-hold area: R0 to R29F - Hold area: R300 to R63F
8	Hold area starting address settings for data registers	K0	Hold area starting address for data registers is specified. • Setting range FP-M 2.7 k type: K0 to K1660 FP-M 5 k type: K0 to K6144 • If the maximum value of the setting range is input, all of the areas are used as non-hold areas. EXAMPLE: If system register 8 of FP-M 2.7 k type is set to K10: - Non-hold area: DT0 to DT9 - Hold area: DT10 to DT165
14	Hold/non-hold settings for step ladder	K1	Hold/non-hold settings for step ladder operation are specified. K0: Hold K1: Non-hold
20	Operation settings for duplicated use of output	K0	This register specifies the operation of the FP-M when a duplicated use of output is programmed. K0: a duplicated use of output is regarded as a total-check error. K1: a duplicated use of output is not regarded as an error.
26	Operation settings when an operation error occurs	K0	This register specifies the operation of the FP-M when an operation error is detected. K0: FP-M stops operation if an operation error occurs. K1: FP-M continues operation even if an operation error occurs.
31	Waiting time settings for multi-frame communication	K2600 (6500 ms)	This register specifies the maximum waiting time between delimiters when multi-frame communication is performed with the computer link. • Setting range (set value: K4 to K32760) × 2.5 ms [10 ms to 81900 ms] **Note:** • When you set this register using NPST-GR Software, set a time that can be divided by 2.5.

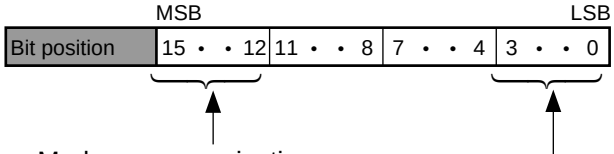
<table>
<tr><th>Address</th><th>Name of system register</th><th>Default value</th><th>Description</th></tr>
<tr><td>34</td><td>Constant value settings for scan time</td><td>K0</td><td>This register specifies the constant scan time.
• Setting range
K0: the constant scan function is not used (normal)
K1 to K64:
(set value: K1 to K64) × 2.5 ms [2.5 ms to 160 ms]
Note:
• When you set this register using NPST-GR Software, set a time that can be divided by 2.5.</td></tr>
<tr><td>400*</td><td>High-speed counter mode settings</td><td>H0</td><td>H0 □ 0 □
Setting
<table>
<tr><th rowspan="2">Set value</th><th colspan="3">Input contact of FP-Ms</th></tr>
<tr><th>X0</th><th>X1</th><th>X2</th></tr>
<tr><td>H0</td><td colspan="3">High-speed counter function not used.</td></tr>
<tr><td>H1</td><td colspan="2">2-phase input</td><td>————</td></tr>
<tr><td>H2</td><td colspan="2">2-phase input</td><td>Reset input</td></tr>
<tr><td>H3</td><td>Up input</td><td colspan="2">————</td></tr>
<tr><td>H4</td><td>Up input</td><td>————</td><td>Reset input</td></tr>
<tr><td>H5</td><td>————</td><td>Down input</td><td>————</td></tr>
<tr><td>H6</td><td>————</td><td>Down input</td><td>Reset input</td></tr>
<tr><td>H7</td><td colspan="2">Up/Down input
(X0: Up input, X1: Down input)</td><td>————</td></tr>
<tr><td>H8</td><td colspan="2">Up/Down input
(X0: Up input, X1: Down input)</td><td>Reset input</td></tr>
</table>
Setting for pulse output connection
H0: Internally not connected
H1: Internally connected
• Output pulse internal connection setting:
Available for transistor output type FP-Ms (C20T, C20TC, C32T, and C32TC).
• If you are using is the transistor output type FP-Ms, the pulses from Y6 and Y7 can be directly input to X0 and X1 without external wiring. However, if X0 and X1 are used as inputs for pulses from Y6 and Y7, they cannot be used as other input terminals.
<table>
<tr><th>Set value</th><th>Operation mode</th></tr>
<tr><td>H107</td><td>Pulse output Y7 → Up input X0
Pulse output Y6 → Down input X1
X2 is not used for high-speed counter</td></tr>
<tr><td>H108</td><td>Pulse output Y7 → Up input X0
Pulse output Y6 → Down input X1
X2 is used as reset input</td></tr>
</table>
</td></tr>
</table>

Note:

• * When system registers 400, 402, 403, 404, and 405 are set at the same time, their priorities are:
-1st 400 (high-speed counter mode settings)
-2nd 402 (pulse catch input function settings)
-3rd 403 (interrupt trigger settings)
-4th 404 (input time filtering settings)
-last 405 (input time filtering settings)

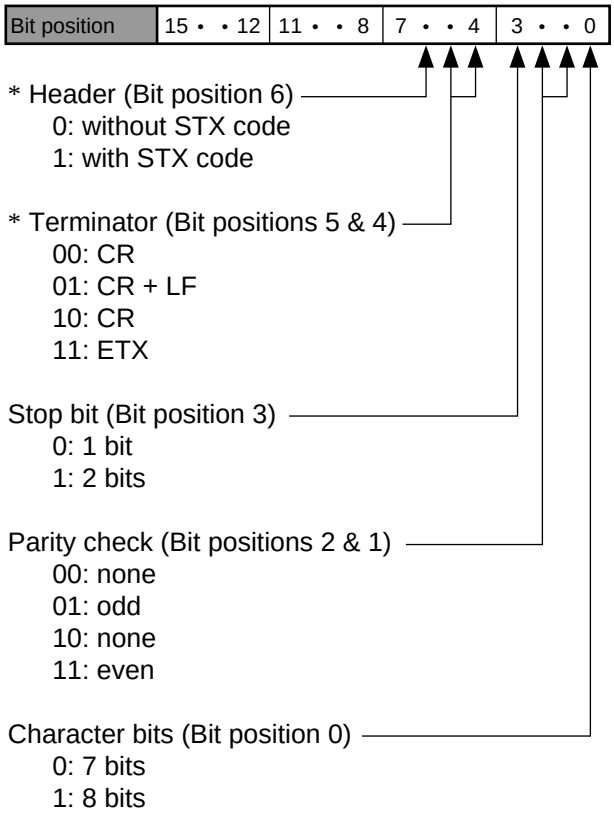
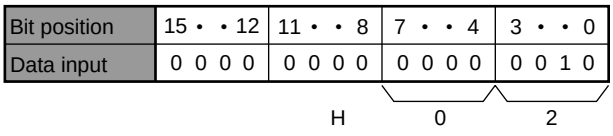
<table>
<tr><th>Address</th><th>Name of system register</th><th>Default value</th><th>Description</th></tr>
<tr><td>402</td><td>Pulse catch input function settings
(pulse of 500 μs or more duration)</td><td>H0</td><td>This register specifies the pulse catch inputting function availabilities for X0 to X7.
• Settings
0: standard input mode
1: pulse catch input mode
Input the specific value in an order so that the bit corresponding to each input becomes “1” when you use the pulse catch function.
System register 402
<table><tr><td>Bit position</td><td>15 • • 12</td><td>11 • • 8</td><td>7 • • 4</td><td>3 • • 0</td></tr><tr><td>Corresponding input</td><td>———</td><td>———</td><td>X7 X6 X5 X4</td><td>X3 X2 X1 X0</td></tr></table>
• Setting range
All FP-Ms (8 inputs X0 to X7): H0 to HFF
EXAMPLE:
If the pulse catch function is used for inputs X3, X4, and X5, input H38 as follows:
System register 402
<table><tr><td>Bit position</td><td>15 • • 12</td><td>11 • • 8</td><td>7 • • 4</td><td>3 • • 0</td></tr><tr><td>Corresponding input</td><td>———</td><td>———</td><td>X7 X6 X5 X4</td><td>X3 X2 X1 X0</td></tr><tr><td>Data input</td><td>0 0 0 0</td><td>0 0 0 0</td><td>0 0 1 1</td><td>1 0 0 0</td></tr></table>H 3 8</td></tr>
<tr><td>403</td><td>Interrupt trigger settings</td><td>H0</td><td>This register specifies inputs of the FP-M as interrupt triggers.
• Settings
0: standard input mode
1: interrupt input mode
Input the specific value in an order so that the bit corresponding to each input becomes “1” when you use interrupt programs.
System register 403
<table><tr><td>Bit position</td><td>15 • • 12</td><td>11 • • 8</td><td>7 • • 4</td><td>3 • • 0</td></tr><tr><td>Corresponding input</td><td>———</td><td>———</td><td>X7 X6 X5 X4</td><td>X3 X2 X1 X0</td></tr></table>
• Setting range
All FP-Ms (8 inputs X0 to X7): H0 to HFF
EXAMPLE:
If the interrupt input function is used for inputs X1 and X2, input H6 as follows:
System register 403
<table><tr><td>Bit position</td><td>15 • • 12</td><td>11 • • 8</td><td>7 • • 4</td><td>3 • • 0</td></tr><tr><td>Corresponding input</td><td>———</td><td>———</td><td>X7 X6 X5 X4</td><td>X3 X2 X1 X0</td></tr><tr><td>Data input</td><td>0 0 0 0</td><td>0 0 0 0</td><td>0 0 0 0</td><td>0 1 1 0</td></tr></table>H 6</td></tr>
</table>

<table>
<tr><th>Address</th><th>Name of system register</th><th>Default value</th><th>Description</th></tr>
<tr><td>404</td><td>Input time filtering setting (X0 to X1F)</td><td>H1111 (all 2 ms)</td><td rowspan="2">Sets the input time filtering in 8-input units.
• Settings
<table><tr><th>Set value</th><th>Input time filtering</th></tr><tr><td>H0</td><td>1 ms</td></tr><tr><td>H1</td><td>2 ms</td></tr><tr><td>H2</td><td>4 ms</td></tr><tr><td>H3</td><td>8 ms</td></tr><tr><td>H4</td><td>16 ms</td></tr><tr><td>H5</td><td>32 ms</td></tr><tr><td>H6</td><td>64 ms</td></tr><tr><td>H7</td><td>128 ms</td></tr></table></td></tr>
<tr><td>405</td><td>Input time filtering setting (X20 to X27)</td><td>H1111 (all 2 ms)</td></tr>
<tr><td colspan="4">• Set system registers 404 and 405, referring to the following:
No. 404 = H□□□□
X0 to X7
X8 to XF
X10 to X17
X18 to X1F
No. 405 = H 1 1 1 □
X20 to X27
Fixed
Fixed
Fixed
EXAMPLE:
If you specify the input time filtering for X0 to X7 as 4 ms, for X8 to XF as 1 ms, for X10 to X17 as 1 ms, and for X18 to X1F as 1 ms, input H1112 to system register 404.
System register 404
<table><tr><td>Bit position</td><td>15 • • 12</td><td>11 • • 8</td><td>7 • • 4</td><td>3 • • 0</td></tr><tr><td>Data input</td><td>0 0 0 1</td><td>0 0 0 1</td><td>0 0 0 1</td><td>0 0 1 0</td></tr></table><table><tr><td>H</td><td>1
X18 to X1F (2 ms)</td><td>1
X10 to X17 (2 ms)</td><td>1
X8 to XF (2 ms)</td><td>2
X0 to X7 (4 ms)</td></tr></table></td></tr>
</table>

<table>
<tr><th>Address</th><th>Name of system register</th><th>Default value</th><th>Description</th></tr>
<tr><td>410</td><td>Station number (UNIT NO.) setting for programming tool port</td><td>K1</td><td>This register specifies the station number (UNIT NO.) when the computer link communication is performed through the programming tool port.
• Setting ranges
K1 to K32 (UNIT NO. 1 to 32)</td></tr>
<tr><td>411</td><td>Communication format and modem settings for programming tool port</td><td>H0</td><td>Communication format settings and the settings for modem communication compatibility are performed when the programming tool port is used.
• Setting
 

Modem communication
H0: Disabled
H8: Enabled

Communication format (character bits)
H0: 8 bits
H1: 7 bits
<table>
<tr><th rowspan="2">Set value</th><th colspan="2">Settings</th></tr>
<tr><th>Modem</th><th>Character bits</th></tr>
<tr><td>H0</td><td rowspan="2">Disabled</td><td>8 bits</td></tr>
<tr><td>H1</td><td>7 bits</td></tr>
<tr><td>H8000</td><td rowspan="2">Enabled</td><td>8 bits</td></tr>
<tr><td>H8001</td><td>7 bits</td></tr>
</table></td></tr>
<tr><td>412</td><td>Communication mode settings for RS232C serial port</td><td>K0</td><td>Selects the functions for the RS232C serial port.
• Settings
K0: when the RS232C serial port is not used.
K1: when the RS232C serial port is used for computer link communication.
K2: when the RS232C serial port is used for general purpose communication.</td></tr>
</table>

Address	Name of system register	Default value	Description
413	Communication format setting for RS232C serial port	H3	This register specifies the communication settings for the RS232C serial port. • Settings  EXAMPLE: If you want to set the RS232C serial port as follows, input H2 to system register 413. - Header: without STX code - Terminator: CR - Stop bit: 1 bit - Parity: odd - Character bits: 7 bits System register 413 

Note:

• * The settings for the header and the terminator in system register 413 become effective when system register 412 is set to K2 (GENERAL). If you select K1 (COMPTR LNK) or K0 (UNUSED), the settings for the header and the terminator are discarded.

<table>
<tr><th>Address</th><th>Name of system register</th><th>Default value</th><th>Description</th></tr>
<tr><td>414</td><td>Baud rate settings for RS232C serial port</td><td>K1</td><td>This register specifies the baud rate of the RS232C serial port.
• Settings
<table><tr><th>Set value</th><th>Baud rate</th></tr><tr><td>K0</td><td>19,200 bps</td></tr><tr><td>K1</td><td>9,600 bps</td></tr><tr><td>K2</td><td>4,800 bps</td></tr><tr><td>K3</td><td>2,400 bps</td></tr><tr><td>K4</td><td>1,200 bps</td></tr><tr><td>K5</td><td>600 bps</td></tr><tr><td>K6</td><td>300 bps</td></tr></table></td></tr>
<tr><td>415</td><td>Station number (UNIT NO.) settings for RS232C serial port</td><td>K1</td><td>This register specifies the station number (UNIT NO.) when the RS232C serial port is used for computer link communication. (Refer to system registers 412 and 413, for details about the computer link communication settings.)
• Setting range
K1 to K32 (UNIT NO. 1 to 32)</td></tr>
<tr><td>416</td><td>Modem communication settings for RS232C serial port*</td><td>H0</td><td>The setting for modem communication compatibility is performed when the RS232C serial port is used.
• Settings
H0: modem communication disabled
H8000: modem communication enabled
When modem communication is enabled, set system registers 412, 413, 415. Refer to page 224, “8-12. Modem Communication”.</td></tr>
<tr><td>417</td><td>Starting address setting for data received from RS232C serial port</td><td>K0</td><td>This register specifies the starting address of data registers used as the buffer for data received from the RS232C serial port when general-purpose communication is performed. (Refer to system registers 412 and 413, for details about general-purpose communication settings.)
• Setting range
FP-M 2.7 k type: K0 to K1660
FP-M 5 k type: K0 to K6144
EXAMPLE:
If K0 is input to system register 417, the number of bytes received from the RS232C serial port is stored in DT0 and the data received are stored starting from DT1.</td></tr>
</table>

Note:

• * The system register 416 setting is available only for:
- FP-M C types (C20RC/C20TC/C32TC).
- NPST-GR Software version 3.1 or later.

Address	Name of system register	Default value	Description
418	Buffer capacity setting for data received from RS232C serial port	K1660	This register specifies the number of words to be used as a buffer. (Refer to system register 417 for details about the starting address settings.) • Setting range FP-M 2.7 k type: K0 to K1660 FP-M 5 k type: K0 to K6144 EXAMPLE: If K0 is input to system register 417 and K100 to system register 418, the number of data received is stored to DT0 and the data received are stored starting from DT1 to DT99.

8-6. Special Internal Relays

The special internal relays are used for special purposes in the FP-M programmable controller.
These special internal relays cannot output. Use special internal relays only as contacts.

Address	Name	Description
R9000	Self-diagnostic error flag	Turns ON when a self-diagnostic error occurs. The self-diagnostic error code is stored in DT9000.
R9005	Battery error flag (Non-hold)	Turns ON for an instant when a battery error occurs.
R9006	Battery error flag (Hold)	Turns ON and keeps the ON state when a battery error occurs.
R9007	Operation error flag (Hold)	Turns ON and keeps the ON state when an operation error occurs. The error address is set in DT9017.
R9008	Operation error flag (Non-hold)	Turns ON for an instant when an operation error occurs. The error address is set in DT9018.
R9009	Carry flag	Turns ON for an instant, - when an overflow or an underflow occurs. - when “1” is set by one of the shift instructions. This is also used as flag for the **F60 (CMP)** instruction.
R900A	> flag	Turns ON for an instant when the compared results are larger.
R900B	= flag	Turns ON for an instant, - when the calculated results become 0 in the high-level instructions. - when the compared results are equal in the high-level instructions.
R900C	< flag	Turns ON for an instant when the compared results are smaller.
R900D	Auxiliary timer instruction (**F137**)	Turns ON when the set value is decreased and reaches 0.
R900E	Programming tool port error flag	Turns ON when a programming tool port error occurs.
R900F	Constant scan error flag	Turns ON when a constant scan error occurs.
R9010	Always ON relay	Always ON.
R9011	Always OFF relay	Always OFF.

Address	Name	Description
R9012	Scan pulse relay	Turns ON and OFF alternately at each scan.
R9013	Initial ON relay	Turns ON only at the first scan in the operation. Turns OFF from the second scan and maintains the OFF state.
R9014	Initial OFF relay	Turns OFF only at the first scan in the operation. Turns ON from the second scan and maintains the ON state.
R9015	Step ladder initial ON relay	Turns ON only in the first scan of the process the moment step ladder process is started.
R9018	0.01 s clock pulse relay	Repeats ON/OFF operations in 0.01 s cycles. (ON : OFF = 0.005 s : 0.005 s)
R9019	0.02 s clock pulse relay	Repeats ON/OFF operations in 0.02 s cycles. (ON : OFF = 0.01 s : 0.01 s)
R901A	0.1 s clock pulse relay	Repeats ON/OFF operations in 0.1 s cycles. (ON : OFF = 0.05 s : 0.05 s)
R901B	0.2 s clock pulse relay	Repeats ON/OFF operations in 0.2 s cycles. (ON : OFF = 0.1 s : 0.1 s)
R901C	1 s clock pulse relay	Repeats ON/OFF operations in 1 s cycles. (ON : OFF = 0.5 s : 0.5 s)
R901D	2 s clock pulse relay	Repeats ON/OFF operations in 2 s cycles. (ON : OFF = 1 s : 1 s)
R901E	1 min clock pulse relay	Repeats ON/OFF operations in 1 min cycles. (ON : OFF = 30 s : 30 s)
R9020	RUN mode flag	ON while mode of the programmable controller is set to RUN. OFF while mode of the programmable controller is set to PROG.
R9026	Message flag	ON while the **F149 (MSG)** instruction is executed.
R9027	Remote mode flag	ON while mode selector of the FP-M control board is set to REMOTE.
R9029	Forced flag	ON during the forced ON/OFF operation.
R902A	Interrupt flag	ON while external interrupts are enabled. Refer to the **ICTL** instruction in the FP-M/FP1 Programming Manual.
R902B	Interrupt error flag	Turns ON when an interrupt error occurs.
R9032	RS232C port selection flag	ON while the RS232C port is set to GENERAL (K2) in the system register 412. C types (C20RC/C20TC/C32TC) only.

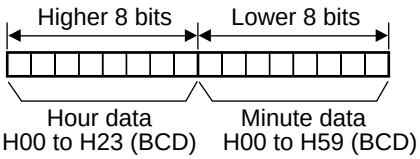
Address	Name	Description
R9033	Print-out flag	ON while a **F147 (PR)** instruction is executed. Refer to the **F147 (PR)** instruction in the FP-M/FP1 Programming Manual.
R9036	I/O link error flag	Turns ON when an I/O link error occurs.
R9037	RS232C error flag	Turns ON when an RS232C error occurs. C types (C20RC/C20TC/C32TC) only
R9038	RS232C receive flag (**F144**)	Turns ON when a terminator is received by the programmable controller using the **F144 (TRNS)** instruction. Refer to the **F144 (TRNS)** instruction in the FP-M/FP1 Programming Manual. C types (C20RC/C20TC/C32TC) only
R9039	RS232C send flag (**F144**)	OFF while data is not been sent by the **F144 (TRNS)** instruction. ON after the data is sent by the **F144 (TRNS)** instruction. Refer to the **F144 (TRNS)** instruction in the FP-M/FP1 Programming Manual. C types (C20RC/C20TC/C32TC) only
R903A	High-speed counter control flag	ON while a high-speed counter is controlled using the **F162 (HC0S), F163 (HC0R), F164(SPD0), and F165 (CAM0)** instructions. Refer to the **F162 (HC0S), F163 (HC0R), F164(SPD0), and F165 (CAM0)** instructions in the FP-M/FP1 Programming Manual.
R903B	Cam control flag	ON while a **F165 (CAM0)** instruction is executed. Refer to the **F165 (CAM0)** instruction in the FP-M/FP1 Programming Manual.

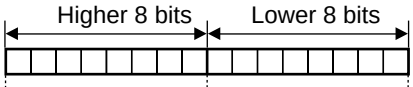
8-7. Special Data Registers

• Special data registers are used as a memory area and each data is composed of 16 bits.

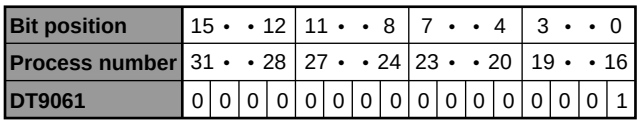
Address	Name	Description
DT9000	Self-diagnostic error code register	• The self-diagnostic error code is stored in DT9000 when a self-diagnostic error occurs.
DT9014	Auxiliary register for **F105** and **F106** instructions	• One shift-out hexadecimal digit is stored in hexadecimal digit position 0 (bit positions 0 to 3) when an **F105 (BSR)** or **F106 (BSL)** instruction is executed. • Refer to the **F105 (BSR)** and **F106 (BSL)** instructions in the FP-M/FP1 Programming Manual.
DT9015	Auxiliary register for **F32, F33, F52,** and **F53** instructions	• Divided remainder is stored in DT9015 when an **F32 (%)** or **F52 (B%)** instruction is executed. • Lower 16-bit of divided remainder are stored in DT9015 when an **F33 (D%)** or **F53 (DB%)** instruction is executed. • Refer to the **F32 (%), F52 (B%), F33 (D%),** and **F53 (DB%)** instructions in the FP-M/FP1 Programming Manual.
DT9016	Auxiliary register for **F33** and **F53** instructions	• Higher 16-bit of divided remainder is stored in DT9016 when an **F33 (D%)** or **F53 (DB%)** instruction is executed. • Refer to the **F33 (D%)** and **F53 (DB%)** instructions in the FP-M/FP1 Programming Manual.
DT9017	Operation error address register (hold)	• An operation error address is stored in DT9017 and held when an operation error is detected.
DT9018	Operation error address register (non-hold)	• The address of the latest operation error is stored in DT9018 when an operation error is detected.
DT9019	2.5 ms ring counter register	• The stored data in DT9019 is increased by one every 2.5 ms. This can be used to determine the elapsed time of some procedures by calculating the time differences.
DT9022	Scan time register (current value)	• Current scan time is stored in DT9022. Scan time is calculated using the formula: Scan time (ms) = data × 0.1 (ms)
DT9023	Scan time register (minimum value)	• Minimum scan time is stored in DT9023. Scan time is calculated using the formula: Scan time (ms) = data × 0.1 (ms)
DT9024	Scan time register (maximum value)	• Maximum scan time is stored in DT9024. Scan time is calculated using the formula: Scan time (ms) = data × 0.1 (ms)

<table>
<tr><th>Address</th><th>Name</th><th>Description</th></tr>
<tr><td>DT9025</td><td>Mask condition monitoring register for input -initiated interrupts (Interrupt program: INT0 to INT7)</td><td>• The mask conditions of input-initiated interrupts can be monitored.
<table><tr><td>Bit position</td><td colspan="4">15 • • 12</td><td colspan="4">11 • • 8</td><td colspan="4">7 • • 4</td><td colspan="4">3 • • 0</td></tr><tr><td>INT program</td><td colspan="4">————</td><td colspan="4">————</td><td colspan="4">7 • • 4</td><td colspan="4">3 • • 0</td></tr><tr><td>DT9025</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>• The mask conditions are judged by the status of each bit:
Interrupt disabled (masked): 0 Interrupt enabled (unmasked): 1
• Each bit position of DT9025 (bit positions 0 to 7) falls on an interrupt instruction number.
• Refer to the ICTL instruction in the FP-M/FP1 Programming Manual.</td></tr>
<tr><td>DT9027</td><td>Time-initiated interrupt interval monitoring register</td><td>• This register is available for monitoring the time-initiated interrupt interval. The interval is calculated using the formula:
- K1 to K3000: interval (ms) = data × 10 (ms)
- K0: time-initiated interrupt is not used.
• Refer to the ICTL instruction in the FP-M/FP1 Programming Manual.</td></tr>
<tr><td>DT9030</td><td>Message 0 register</td><td rowspan="6">• The contents of the specified message are stored in DT9030, DT9031, DT9032, DT9033, DT9034, and DT9035 when an F149 (MSG) instruction is executed.
• Refer to the F149 (MSG) instruction in the FP-M/FP1 Programming Manual.</td></tr>
<tr><td>DT9031</td><td>Message 1 register</td></tr>
<tr><td>DT9032</td><td>Message 2 register</td></tr>
<tr><td>DT9033</td><td>Message 3 register</td></tr>
<tr><td>DT9034</td><td>Message 4 register</td></tr>
<tr><td>DT9035</td><td>Message 5 register</td></tr>
<tr><td>DT9037</td><td>Work register 1 for F96 instruction</td><td>• The number of found data is stored in DT9037 when an F96 (SRC) instruction is executed.
• Refer to the F96 (SRC) instruction in the FP-M/FP1 Programming Manual.</td></tr>
<tr><td>DT9038</td><td>Work register 2 for F96 instruction</td><td>• The data position found in the first place counting from the first 16-bit area is stored in DT9038 when an F96 (SRC) instruction is executed.
• The address stored is counted from the starting address of the register specified by starting 16-bit area.
• Refer to the F96 (SRC) instruction in the FP-M/FP1 Programming Manual.</td></tr>
<tr><td>DT9040</td><td>Manual dial-set register (V0)</td><td rowspan="2">Values of the potentiometers (V0 and V1) are stored as:
V0 → DT9040
V1 → DT9041</td></tr>
<tr><td>DT9041</td><td>Manual dial-set register (V1)</td></tr>
</table>

<table>
<tr><th>Address</th><th>Name</th><th>Description</th></tr>
<tr><td>DT9044</td><td>High-speed counter elapsed value area (lower 16-bit)</td><td>• Lower 16-bit of high-speed counter elapsed value is stored in DT9044.</td></tr>
<tr><td>DT9045</td><td>High-speed counter elapsed value area (higher 16-bit)</td><td>• Higher 16-bit of high-speed counter elapsed value is stored in DT9045.</td></tr>
<tr><td>DT9046</td><td>High-speed counter target value area (lower 16-bit)</td><td>• Lower 16-bit of high-speed counter target value is stored in DT9046.</td></tr>
<tr><td>DT9047</td><td>High-speed counter target value area (higher 16-bit)</td><td>• Higher 16-bit of high-speed counter target value is stored in DT9047.</td></tr>
<tr><td>DT9052</td><td>High-speed counter control register</td><td>• A register dedicated to control high-speed counter operation.
• Refer to the F0 (MV) (high-speed counter control) instruction in the FP-M/FP1 Programming Manual.</td></tr>
<tr><td>DT9053</td><td>Clock/calendar monitor register</td><td>• Hour and minute data of the clock/calendar are stored in DT9053. This register is available only for monitoring the data.
• The hour and minute data is stored in BCD as:
 

• C types (C20RC/C20TC/C32TC) only</td></tr>
<tr><td>DT9054</td><td>Clock/calendar monitor and setting register (minute/second)</td><td rowspan="4">• Data of the clock/calendar are stored in DT9054, DT9055, DT9056, and DT9057. These registers are available both for settings and for monitoring the clock/calendar.
• When setting the clock/calendar by using the F0 (MV) instruction, the revised setting becomes effective from the time when the most significant bit of DT9058 becomes “1”.
• The data is stored in BCD as:
 

<table>
<tr><td>DT9054</td><td>Minute
H00 to H59 (BCD)</td><td>Second
H00 to H59 (BCD)</td></tr>
<tr><td>DT9055</td><td>Day
H01 to H31 (BCD)</td><td>Hour
H00 to H23 (BCD)</td></tr>
<tr><td>DT9056</td><td>Year
H00 to H99 (BCD)</td><td>Month
H01 to H12 (BCD)</td></tr>
<tr><td>DT9057</td><td>——</td><td>Day of week
H00 to H06 (BCD)</td></tr>
</table>
• C types (C20RC/C20TC/C32TC) only</td></tr>
<tr><td>DT9055</td><td>Clock/calendar monitor and setting register (day/hour)</td></tr>
<tr><td>DT9056</td><td>Clock/calendar monitor and setting register (year/month)</td></tr>
<tr><td>DT9057</td><td>Clock/calendar monitor and setting register (day of week)</td></tr>
</table>

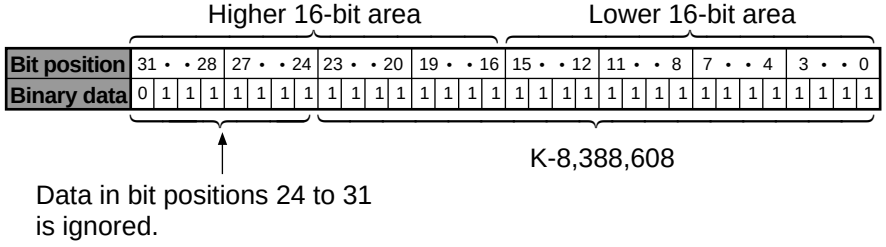
<table>
<tr><th>Address</th><th colspan="2">Name</th><th>Description</th></tr>
<tr><td>DT9058</td><td colspan="2">Clock/calendar adjustment register</td><td>• The clock/calendar is adjusted as follows when the least significant bit of DT9058 is set to “1”.
- When second data is H00 to H29 (BCD), the second data is cut off to H00 (BCD).
- When second data is H30 to H59 (BCD), the second data is cut off to H00 (BCD) and one is added to the minute data.
• The revised clock/calendar settings, which are performed using the F0 (MV) instructions, become effective when the most significant bit of DT9058 is set to “1”.
• C types (C20RC/C20TC/C32TC) only</td></tr>
<tr><td>DT9059</td><td colspan="2">Communication error code register</td><td>• A RS232C port communication error code is stored in the higher 8-bit area of DT9059.
• A programming tools port communication error code is stored in the lower 8-bit area of DT9059.
• C types (C20RC/C20TC/C32TC) only</td></tr>
<tr><td>DT9060</td><td rowspan="8">Step ladder process monitor registers</td><td>Process numbers: 0 to 15</td><td rowspan="8">• These registers monitor the condition of step ladder programs.
Execution of the step ladder program is monitored by the bit data as follows:
- Executing: 1
- Not executing: 0
Each bit in the registers corresponds to a step ladder process as shown in the following example:
<EXAMPLE>
Since bit position 0 of DT9061 is “1”, step ladder process 16 is executing.
 
<table><tr><td>Bit position</td><td colspan="4">15 • • 12</td><td colspan="4">11 • • 8</td><td colspan="4">7 • • 4</td><td colspan="4">3 • • 0</td></tr><tr><td>Process number</td><td colspan="4">31 • • 28</td><td colspan="4">27 • • 24</td><td colspan="4">23 • • 20</td><td colspan="4">19 • • 16</td></tr><tr><td>DT9061</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td></tr></table></td></tr>
<tr><td>DT9061</td><td>Process numbers: 16 to 31</td></tr>
<tr><td>DT9062</td><td>Process numbers: 32 to 47</td></tr>
<tr><td>DT9063</td><td>Process numbers: 48 to 63</td></tr>
<tr><td>DT9064</td><td>Process numbers: 64 to 79</td></tr>
<tr><td>DT9065</td><td>Process numbers: 80 to 95</td></tr>
<tr><td>DT9066</td><td>Process numbers: 96 to 111</td></tr>
<tr><td>DT9067</td><td>Process numbers: 112 to 127</td></tr>
</table>

Address	Name		Description
DT9080	Digital converted value from analog control board No. 0	Channel 0	• These registers are used to store the digital converted value of analog inputs from analog control boards of the A/D converter board or analog I/O board. • The range of digital converted value depends on the type of analog control boards as follows: <When A/D converter board is installed> K0 to K999 (0 to 20 mA/0 to 5 V/0 to 10 V) Range of digital converted value (10 bits resolution) **Note:** • If analog data over the maximum analog value (20 mA/5 V/10 V) is input, digital data up to K1,023 is available. However, be sure to input analog voltage or analog current within the rated range in order to prevent system damages. <When Analog I/O board is installed> K0 to K255 (0 to 20 mA/0 to 5 V/0 to 10 V) Range of digital converted value (8 bits resolution) **Note:** • Even if analog data outside the specified range is input, digital converted value outside K0 to K255 is not available. Be sure to input analog voltage or analog current within the rated range in order to prevent system damages. • Be sure to use the **F0 (MV)** instruction to transfer data in these special data registers into other data registers.
DT9081		Channel 1	
DT9082		Channel 2	
DT9083		Channel 3	
DT9084	Digital converted value from analog control board No. 1	Channel 0	
DT9085		Channel 1	
DT9086		Channel 2	
DT9087		Channel 3	
DT9088	Digital converted value from analog control board No. 2	Channel 0	
DT9089		Channel 1	
DT9090		Channel 2	
DT9091		Channel 3	
DT9092	Digital converted value from analog control board No. 3	Channel 0	
DT9093		Channel 1	
DT9094		Channel 2	
DT9095		Channel 3	

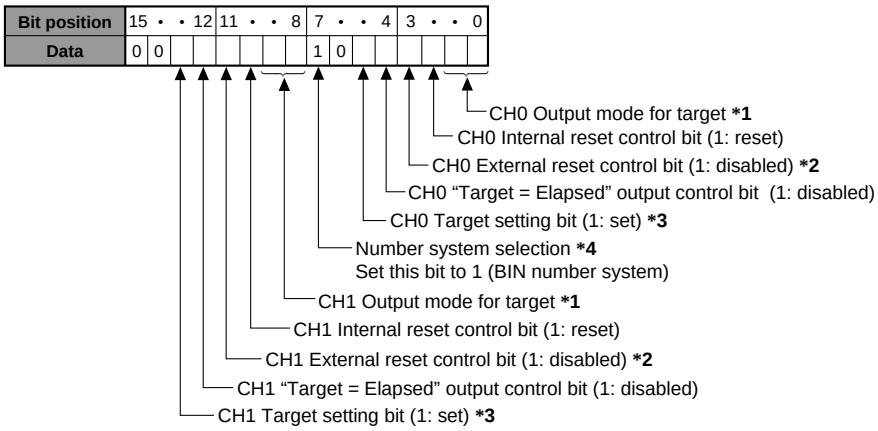
<table>
<tr><th>Address</th><th>Name</th><th>Description</th></tr>
<tr><td>DT9096
DT9097</td><td>Digital value for specifying analog data output from analog control board No. 0</td><td rowspan="3">• These registers are used to specify data for analog output from the analog control boards of the D/A converter boards or analog I/O boards.
• The range of digital value to specify analog output depends on the type of analog control boards as follows:
<When D/A converter boards is installed>
Range of digital data for specifying analog output (10 bits): K0 to K999 (0 to 20 mA/0 to 5 V/0 to 10 V)
Note:
• Be sure to specify data within the range of K0 to K999.
- If data K1000 to K1023 is specified, analog data a little bit more than the maximum rated value (20 mA/5 V/10 V) is output.
- If data outside K0 to K1023 is specified, data is handled disregarding data in bit positions 10 to 15.

<EXAMPLE>
If K-24 is input, analog data is output regarding it as K999.
Data configuration when K-24 is input:
<table><tr><td>Bit position</td><td colspan="4">15 • • 12</td><td colspan="4">11 • • 8</td><td colspan="4">7 • • 4</td><td colspan="4">3 • • 0</td></tr><tr><td>Binary data</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td></tr></table>K999
Data in bit positions 10 to 15 is ignored.</td></tr>
<tr><td>DT9098
DT9099</td><td>Digital value for specifying analog data output from analog control board No. 1</td></tr>
<tr><td>DT9100
DT9101</td><td>Digital value for specifying analog data output from analog control board No. 2</td></tr>
<tr><td>DT9102
DT9103</td><td>Digital value for specifying analog data output from analog control board No. 3</td><td>
<When Analog I/O board is installed>
Range of digital data for specifying analog output (8 bits): K0 to K255 (0 to 20 mA/0 to 5 V/0 to 10 V)
Note:
• Be sure to specifying data within the range of K0 to K255. If data outside K0 to K255 is specified, data is handled disregarding data in bit positions 8 to 15.

<EXAMPLE>
If K-1 is input, analog data is output regarding it as K255.
Data configuration when K-1 is input:
<table><tr><td>Bit position</td><td colspan="4">15 • • 12</td><td colspan="4">11 • • 8</td><td colspan="4">7 • • 4</td><td colspan="4">3 • • 0</td></tr><tr><td>Binary data</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table>K255
Data in bit positions 8 to 15 is ignored.
• Be sure to use the F0 (MV) instruction to transfer data into these special data registers.</td></tr>
</table>

Address	Name		Description
DT9104 DT9105	High-speed counter board channel 0 area	Target value area 0	• These registers are performed for storing data of the high-speed counter board. • The target values 0 and 1, elapsed value, and capture value are processed in binary in the range of K-8,388,608 to 8,388,607. **Notes:** • Be sure to use the **F1 (DMV)** instruction to transfer data in these special data registers to other registers or data in other registers to these special data registers. • When changing data in these special data registers, be sure to specify data in the range of K-8,388,608 to K8,388,607. If data outside the range is input, data is handled disregarding bit positions 24 to 31 (bit positions 8 to 15 in the higher 16-bit area of 32-bit data). <EXAMPLE> If K2,147,483,647 is specified, high-speed counter acts regarding it as K-8,388,608. Data configuration when K2,147,483,647 is input: 
DT9106 DT9107		Target value area 1	
DT9108 DT9109		Elapsed value area	
DT9110 DT9111		Capture value area	
DT9112 DT9113	High-speed counter board channel 1 area	Target value area 0	
DT9114 DT9115		Target value area 1	
DT9116 DT9117		Elapsed value area	
DT9118 DT9119		Capture value area	

Address	Name	Description
DT9120	High-speed counter board control area	■ **Construction of DT9120** This area specifies the control modes for the high-speed counter board.



***1. Output mode:**

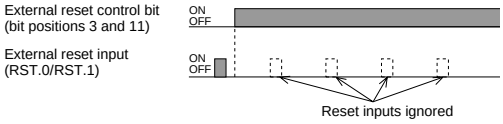
The output goes ON or OFF when the elapsed value becomes equal to the target. These bits specify the mode for output transition when the elapsed value becomes equal to the target value. If the output mode is changed, set the target value again.

Bit position	Channel	Corresponding target value	Corresponding output
0	0	Target 0	OUT00
1		Target 1	OUT01
8	1	Target 0	OUT10
9		Target 1	OUT11

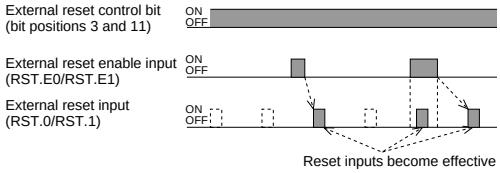
Bit data 0: OFF → ON
1: ON → OFF

***2. External reset control bit:**

These bits (bit positions 3 and 11) are in the ON state, the external reset inputs (RST.0/RST.1) are ignored as:



By turning ON the external reset enable inputs (RST.E0/RST.E1), you can enable the external reset inputs (RST.0/RST.1). The external reset inputs (RST.0/RST.1) effective are:
- external reset inputs while the external reset enable input is in the ON states.
- the first external reset inputs after the external reset enable input turns OFF.



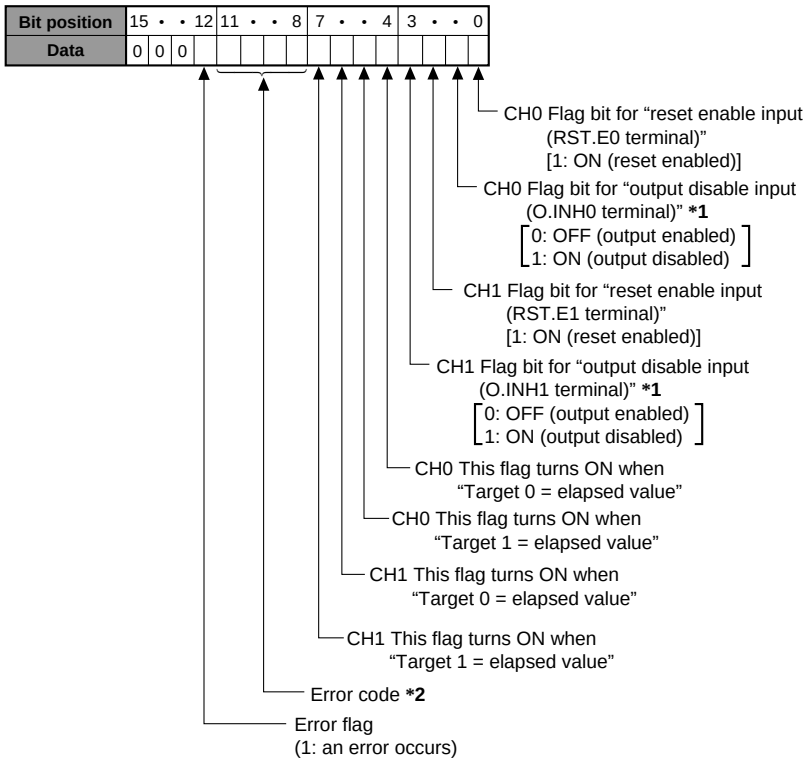
***3. Target setting:**

To preset the target values for the high-speed counter board, first, transfer the set values to the special data registers for the target values. Then, turn the target setting bit from 0 to 1. A set value is revised at the moment the leading edge of this bit is detected. Therefore, if the bit is already set to 1, change the bit from 1 to 0 and then change it back to 1.

***4. Number system selection:**

This bit is prepared to select the number system used for the high-speed counter board. If you set this bit to 0, the data counts the number in the BCD code. However, the FP-M usually handles numbers in binary, so use of the binary number system is recommended.

Address	Name	Description
DT9121	High-speed counter board status monitor area	■ **Construction of DT9121** The status of the high-speed counter board can be monitored in this area.



***1. Output disable input:**

This input disables external output even if the high-speed counter is set to the output enable mode by DT9120. While this input is turned ON, the output of the high-speed counter board is not changed even if the elapsed value becomes equal to the target.

***2. Error codes**

A BCD error is detected only when data for the high-speed counter board is set to BCD operation using **F0 (MV)** and bit position 7 of DT9120.

Bit position				Description
11	10	9	8	
0	0	0	1	BCD error
0	0	1	0	CH0 overflow/underflow
0	1	0	0	CH1 overflow/underflow
1	0	0	0	Watchdog timer error

8-8. Table of the Error Codes

• For details about the error checking procedure, refer to page 115, "■ When an ERR. LED is ON".

1. Table of Total-check Error Codes

Error code	Name of error	Program execution when an error occurs	Description	Steps to take
E1	Syntax error (SYNTAX)	Stops	Instruction is incorrectly programmed.	Set the mode of FP-M to PROG. and input the instruction correctly, referring to the description for the instruction.
E2	Duplicated output error (DUP USE)	Stops	Two or more **OT** and **KP** instructions are programmed using same relay.	Set the mode of FP-M to PROG. and correct the program so that one relay is not used for two or more **OT** and **KP** instructions. This error can be disregarded by changing the system register 20 setting to K1 (ENAB).
E3	Not paired error (PAIR)	Stops	One of the instructions, which must be paired, is missing (e.g., **JP** and **LBL**). The paired instruction sets may have been programmed in the incorrect order (e.g., **MC** and **MCE**).	Set the mode of FP-M to PROG. and program the missing instruction sets in the proper order, referring to the description of the instruction.
E4	System register parameter error (MISMATCH)	Stops	The operand for the instruction is out of the range set in the system register.	Set the mode of FP-M to PROG. and check the system register parameter using a FP Programmer II (OP50) or NPST-GR Software (1. SYSTEM REGISTER in the PLC CONFIGURATION).
E5	Program area error (PRG AREA)	Stops	The instruction has been programmed in the incorrect position (e.g., **INT** and **IRET** instructions are programmed at the address before the **ED** instruction).	Set the mode of FP-M to PROG. and program the instruction in the proper position, referring to the description of the instruction.
E8	Operand error (OPR COMBI)	Stops	Incorrect operand has been entered for the instruction.	Set the mode of FP-M to PROG. and program the instruction with the proper operand, referring to the description of the instruction.

2. Table of Self-diagnostic Error Codes

Error code	Name of error	Program execution when an error occurs	Description	Steps to take
E26	ROM error	Stops	Probably an abnormality in the memory (EPROM) or master memory (EEPROM).	Program the memory (EPROM) or master memory (EEPROM) again and try to operate. If the same error is detected, try to operate with another memory (EPROM) or master memory (EEPROM) .
E28	System register error	Stops	Probably an abnormality in the system register.	Set the mode of FP-M to PROG. and initialize the system register.
E31	Interrupt error	Stops	Probably a hardware abnormality or an abnormality caused by noise.	Turn OFF the power of the FP-M and check the surrounding noise level.
E32	Interrupt error	Stops	Probably a hardware abnormality or an abnormality caused by noise.	Turn OFF the power of the FP-M and check the surrounding noise level.
			Probably an **INT** (interrupt) program corresponding to the trigger is missing.	Set the mode of FP-M to PROG. and make an **INT** program which corresponds to the interruption.
E45	Operation error	Selectable by system register 26 (default: stops) (System register 26 settings K0: FP-M stops operation if an operation error occurs. K1: FP-M continues operation even if an operation error occurs.)	Probably an abnormality was detected when a high-level or basic instruction was executed.	Check the contents of special data registers (DT9017 and DT9018) to find the program address where the operation error occurred. Then correct the program referring to the description of the instruction.
E50	Battery error	Continues	The voltage of the backup battery dropped or the backup battery has been pulled out from the holder.	Replace the backup battery. The operation without backup battery can be specified by system register 4. (System register 4 settings K0: The conditions are regarded as errors. K1: The conditions are not regarded as errors.)
E100 to E199	Self-diagnostic error set by **F148 (ERR)** instruction	Stops	• The self-diagnostic error code specified by the **F148 (ERR)** instruction is transferred to DT9000. • The contents of the self-diagnostic error code can be confirmed using the following programming tools. - NPST-GR Software: “7. STATUS DISPLAY” in ONLINE mode - FP Programmer Ⅱ: “OP-110”	
E200 to E299		Continues		

8-9. Table of Instructions

1. Basic Instructions

Name	Boolean	Description	Step
Start	**ST**	Begins a logic operation with a Form A (normally open) contact.	1
Start Not	**ST/**	Begins a logic operation with a Form B (normally closed) contact.	1
Out	**OT**	Outputs the operated result to the specified output.	1
Not	**/**	Inverts the operated result up to this instruction.	1
AND	**AN**	Connects a Form A (normally open) contact serially.	1
AND Not	**AN/**	Connects a Form B (normally closed) contact serially.	1
OR	**OR**	Connects a Form A (normally open) contact in parallel.	1
OR Not	**OR/**	Connects a Form B (normally closed) contact in parallel.	1
AND stack	**ANS**	Performs an AND operation on multiple instruction blocks.	1
OR stack	**ORS**	Performs an OR operation on multiple instruction blocks.	1
Push stack	**PSHS**	Stores the operated result up to this instruction.	1
Read stack	**RDS**	Reads the operated result stored by the **PSHS** instruction.	1
Pop stack	**POPS**	Reads and clears the operated result stored by the **PSHS** instruction.	1
Leading edge differential	**DF**	Turns ON the contact for only one scan when the leading edge of the trigger is detected.	1
Trailing edge differential	**DF/**	Turns ON the contact for only one scan when the trailing edge of the trigger is detected.	1
Set	**SET**	Holds the contact (in bit) ON.	3
Reset	**RST**	Holds the contact (in bit) OFF.	3
Keep	**KP**	Turns ON the output and maintains its condition.	1
No operation	**NOP**	No operation.	1
0.01 s units timer	**TMR**	Sets the ON-delay timer for 0.01 s units (0 to 327.67 s).	3
0.1 s units timer	**TMX**	Sets the ON-delay timer for 0.1 s units (0 to 3276.7 s).	3
1 s units timer	**TMY**	Sets the ON-delay timer for 1 s units (0 to 32767 s).	4
Auxiliary timer	**F137 (STMR)**	Sets the ON-delay timer for 0.01 s units (0.01 to 327.67 s).	5
Counter	**CT**	Subtracts the preset counter.	3
UP/DOWN counter	**F118 (UDC)**	Sets the UP/DOWN counter.	5
Shift register	**SR**	Shifts one bit of 16-bit [word internal relay (WR)] data to the left.	1
Left/right shift register	**F119 (LRSR)**	Shifts one bit of the 16-bit data range to the left or to the right.	5
Master control relay	**MC**	Executes the instructions from **MC** to **MCE** when the predetermined trigger (I/O) turns ON.	2
Master control relay end	**MCE**		2
Jump	**JP**	Skips to the **LBL** instruction that has the same number as the **JP** instruction when the predetermined trigger turns ON.	2
Label	**LBL**	Label used for execution of **JP** and **LOOP** instructions.	1
Loop	**LOOP**	Skips to the **LBL** instruction that has the same number as the **LOOP** instruction and executes what follows it repeatedly until the data of a specified operand becomes “0”.	4

• For more about the instructions above, refer to “FP-M /FP1 Programming Manual”.

Name	Boolean	Description	Step
End	**ED**	Indicates the end of a main program.	1
Conditional end	**CNDE**	Ends one scan when the predetermined trigger turns ON.	1
Start step	**SSTP**	Indicates the start of the step ladder process.	3
Next step (pulse execution type)	**NSTP**	Opens the process of the step ladder and resets the process including the instruction itself. **NSTP** is executed when the leading edge of its trigger is detected.	3
Next step (scan execution type)	**NSTL**	Opens the process of the step ladder and resets the process including the instruction itself. **NSTL** is executed every scan if its trigger is ON.	3
Clear step	**CSTP**	Resets the specified process.	3
Step end	**STPE**	Closes the step ladder operations and returns to normal ladder operation.	1
Subroutine call	**CALL**	Executes the specified subroutine.	2
Subroutine entry	**SUB**	Indicates the start of the subroutine program.	1
Subroutine return	**RET**	Ends the subroutine program and returns to the main program.	1
Interrupt control	**ICTL**	Specifies the condition of the interrupt.	5
Interrupt	**INT**	Starts an interrupt program.	1
Interrupt return	**IRET**	Ends the interrupt program and returns instruction control to the main program.	1

Name	Boolean	Operand	Description	Step
Word compare: Start equal	**ST =**	S1, S2	Performs Start, AND or OR operation by comparing two word data in the following conditions.	5
Word compare: AND equal	**AN =**	S1, S2	ON: when S1 = S2	5
Word compare: OR equal	**OR =**	S1, S2	OFF: when S1 ≠ S2	5
Word compare: Start equal not	**ST <>**	S1, S2	Performs Start, AND or OR operation by comparing two word data in the following conditions.	5
Word compare: AND equal not	**AN <>**	S1, S2	ON: when S1 ≠ S2	5
Word compare: OR equal not	**OR <>**	S1, S2	OFF: when S1 = S2	5
Word compare: Start larger	**ST >**	S1, S2	Performs Start, AND or OR operation by comparing two word data in the following conditions.	5
Word compare: AND larger	**AN >**	S1, S2	ON: when S1 > S2	5
Word compare: OR larger	**OR >**	S1, S2	OFF: when S1 ≦ S2	5
Word compare: Start equal or larger	**ST >=**	S1, S2	Performs Start, AND or OR operation by comparing two word data in the following conditions.	5
Word compare: AND equal or larger	**AN >=**	S1, S2	ON: when S1 ≧ S2	5
Word compare: OR equal or larger	**OR >=**	S1, S2	OFF: when S1 < S2	5

• For more about the instructions above, refer to “FP-M /FP1 Programming Manual”.

Name	Boolean	Operand	Description	Step
Word compare: Start smaller	**ST <**	S1, S2	Performs Start, AND or OR operation by comparing two word data in the following conditions. ON: when S1 < S2 OFF: when S1 ≧ S2	5
Word compare: AND smaller	**AN <**	S1, S2		5
Word compare: OR smaller	**OR <**	S1, S2		5
Word compare: Start equal or smaller	**ST <=**	S1, S2	Performs Start, AND or OR operation by comparing two word data in the following conditions. ON: when S1 ≦ S2 OFF: when S1 > S2	5
Word compare: AND equal or smaller	**AN <=**	S1, S2		5
Word compare: OR equal or smaller	**OR <=**	S1, S2		5
Double word compare: Start equal	**STD =**	S1, S2	Performs Start, AND or OR operation by comparing two double word data in the following conditions. ON: when (S1+1, S1) = (S2+1, S2) OFF: when (S1+1, S1) ≠ (S2+1, S2)	9
Double word compare: AND equal	**AND =**	S1, S2		9
Double word compare: OR equal	**ORD =**	S1, S2		9
Double word compare: Start equal not	**STD <>**	S1, S2	Performs Start, AND or OR operation by comparing two double word data in the following conditions. ON: when (S1+1, S1) ≠ (S2+1, S2) OFF: when (S1+1, S1) = (S2+1, S2)	9
Double word compare: AND equal not	**AND <>**	S1, S2		9
Double word compare: OR equal not	**ORD <>**	S1, S2		9
Double word compare: Start larger	**STD >**	S1, S2	Performs Start, AND or OR operation by comparing two double word data in the following conditions. ON: when (S1+1, S1) > (S2+1, S2) OFF: when (S1+1, S1) ≦ (S2+1, S2)	9
Double word compare: AND larger	**AND >**	S1, S2		9
Double word compare: OR larger	**ORD >**	S1, S2		9
Double word compare: Start equal or larger	**STD >=**	S1, S2	Performs Start, AND or OR operation by comparing two double word data in the following conditions. ON: when (S1+1, S1) ≧ (S2+1, S2) OFF: when (S1+1, S1) < (S2+1, S2)	9
Double word compare: AND equal or larger	**AND >=**	S1, S2		9
Double word compare: OR equal or larger	**ORD >=**	S1, S2		9
Double word compare: Start smaller	**STD <**	S1, S2	Performs Start, AND or OR operation by comparing two double word data in the following conditions. ON: when (S1+1, S1) < (S2+1, S2) OFF: when (S1+1, S1) ≧ (S2+1, S2)	9
Double word compare: AND smaller	**AND <**	S1, S2		9
Double word compare: OR smaller	**ORD <**	S1, S2		9
Double word compare: Start equal or smaller	**STD <=**	S1, S2	Performs Start, AND or OR operation by comparing two double word data in the following conditions. ON: when (S1+1, S1) ≦ (S2+1, S2) OFF: when (S1+1, S1) > (S2+1, S2)	9
Double word compare: AND equal or smaller	**AND <=**	S1, S2		9
Double word compare: OR equal or smaller	**ORD <=**	S1, S2		9

• For more about the instructions above, refer to “FP-M /FP1 Programming Manual”.

2. High-level Instructions

Number	Boolean	Operand	Description	Flag operation					Step
				> R900A	= R900B	< R900C	CY R9009	ER R9007 R9008	
F0	MV	S, D	16-bit data move					↕	5
F1	DMV	S, D	32-bit data move					↕	7
F2	MV/	S, D	16-bit data invert and move					↕	5
F3	DMV/	S, D	32-bit data invert and move					↕	7
F5	BTM	S, n, D	Bit data move					↕	7
F6	DGT	S, n, D	Hexadecimal digit move					↕	7
F10	BKMV	S1, S2, D	Block move					↕	7
F11	COPY	S, D1, D2	Block copy					↕	7
F15	XCH	D1, D2	16-bit data exchange					↕	5
F16	DXCH	D1, D2	32-bit data exchange					↕	5
F17	SWAP	D	Higher/lower byte in 16-bit data exchange					↕	3
F20	+	S, D	16-bit data [D + S → D]		↕		↕	↕	5
F21	D+	S, D	32-bit data [(D + 1, D) + (S + 1, S) → (D + 1, D)]		↕		↕	↕	7
F22	+	S1, S2, D	16-bit data [S1 + S2 → D]		↕		↕	↕	7
F23	D+	S1, S2, D	32-bit data [(S1 + 1, S1) + (S2 + 1, S2) → (D + 1, D)]		↕		↕	↕	11
F25	–	S, D	16-bit data [D – S → D]		↕		↕	↕	5
F26	D–	S, D	32-bit data [(D + 1, D) – (S + 1, S) → (D + 1, D)]		↕		↕	↕	7
F27	–	S1, S2, D	16-bit data [S1 – S2 → D]		↕		↕	↕	7
F28	D–	S1, S2, D	32-bit data [(S1 + 1, S1) – (S2 + 1, S2) → (D + 1, D)]		↕		↕	↕	11
F30	*	S1, S2, D	16-bit data [S1 × S2 → (D + 1, D)]		↕			↕	7
F31	D*	S1, S2, D	32-bit data [(S1 + 1, S1) × (S2 + 1, S2) → (D + 3, D + 2, D + 1, D)]		↕			↕	11
F32	%	S1, S2, D	16-bit data [S1/S2 → D...(DT9015)]		↕		↕	↕	7
F33	D%	S1, S2, D	32-bit data [(S1 + 1, S1)/(S2 + 1, S2) → (D + 1, D)...(DT9016, DT9015)]		↕		↕	↕	11
F35	+1	D	16-bit data increment [D + 1 → D]		↕		↕	↕	3
F36	D+1	D	32-bit data increment [(D + 1, D) + 1 → (D + 1, D)]		↕		↕	↕	3
F37	–1	D	16-bit data decrement [D – 1 → D]		↕		↕	↕	3
F38	D–1	D	32-bit data decrement [(D + 1, D) –1 → (D + 1, D)]		↕		↕	↕	3
F40	B+	S, D	4-digit BCD data [D + S → D]		↕		↕	↕	5
F41	DB+	S, D	8-digit BCD data [(D + 1, D) + (S + 1, S) → (D + 1, D)]		↕		↕	↕	7
F42	B+	S1, S2, D	4-digit BCD data [S1 + S2 → D]		↕		↕	↕	7
F43	DB+	S1, S2, D	8-digit BCD data [(S1 + 1, S1) + (S2 + 1, S2) → (D + 1, D)]		↕		↕	↕	11
F45	B–	S, D	4-digit BCD data [D – S → D]		↕		↕	↕	5

- Specification of flag operation in the above table:
  [↕]: The flag (special relay) available for the instruction (turns ON/OFF according to the condition).
  [ ](blank): The flag (special relay) not available for the instruction (keeps the state regardless of the instruction).
- For more about the instructions above, refer to “FP-M /FP1 Programming Manual”.

Number	Boolean	Operand	Description	Flag operation					Step
				> R900A	= R900B	< R900C	CY R9009	ER R9007 R9008	
F46	DB–	S, D	8-digit BCD data [(D + 1, D) – (S + 1, S) → (D + 1, D)]		↕		↕	↕	7
F47	B–	S1, S2, D	4-digit BCD data [S1 – S2 → D]		↕		↕	↕	7
F48	DB–	S1, S2, D	8-digit BCD data [(S1 + 1, S1) – (S2 + 1, S2) → (D + 1, D)]		↕		↕	↕	11
F50	B*	S1, S2, D	4-digit BCD data [S1 × S2 → (D + 1, D)]		↕			↕	7
F51	DB*	S1, S2, D	8-digit BCD data [(S1 + 1, S1) × (S2 + 1, S2) → (D + 3, D + 2, D + 1, D)]		↕			↕	11
F52	B%	S1, S2, D	4-digit BCD data [S1/S2 → D...(DT9015)]		↕			↕	7
F53	DB%	S1, S2, D	8-digit BCD data [(S1 + 1, S1)/(S2 + 1, S2) → (D + 1, D)...(DT9016, DT9015)]		↕			↕	11
F55	B+1	D	4-digit BCD data increment [D + 1 → D]		↕		↕	↕	3
F56	DB+1	D	8-digit BCD data increment [(D + 1, D) + 1 → (D + 1, D)]		↕		↕	↕	3
F57	B–1	D	4-digit BCD data decrement [D – 1 → D]		↕		↕	↕	3
F58	DB–1	D	8-digit BCD data decrement [(D + 1, D) – 1 → (D + 1, D)]		↕		↕	↕	3
F60	CMP	S1, S2	16-bit data compare	↕	↕	↕	↕	↕	5
F61	DCMP	S1, S2	32-bit data compare	↕	↕	↕	↕	↕	9
F62	WIN	S1, S2, S3	16-bit data band compare	↕	↕	↕		↕	7
F63	DWIN	S1, S2, S3	32-bit data band compare	↕	↕	↕		↕	13
F64	BCMP	S1, S2, S3	Block data compare		↕			↕	7
F65	WAN	S1, S2, D	16-bit data AND		↕			↕	7
F66	WOR	S1, S2, D	16-bit data OR		↕			↕	7
F67	XOR	S1, S2, D	16-bit data exclusive OR		↕			↕	7
F68	XNR	S1, S2, D	16-bit data exclusive NOR		↕			↕	7
F70	BCC	S1, S2, S3, D	Block check code calculation					↕	9
F71	HEXA	S1, S2, D	Hexadecimal data → ASCII code					↕	7
F72	AHEX	S1, S2, D	ASCII code → Hexadecimal data					↕	7
F73	BCDA	S1, S2, D	BCD data → ASCII code					↕	7
F74	ABCD	S1, S2, D	ASCII code → BCD data					↕	9
F75	BINA	S1, S2, D	16-bit data → ASCII code					↕	7
F76	ABIN	S1, S2, D	ASCII code → 16-bit data					↕	7
F77	DBIA	S1, S2, D	32-bit data → ASCII code					↕	11
F78	DABI	S1, S2, D	ASCII code → 32-bit data					↕	11
F80	BCD	S, D	16-bit data → 4-digit BCD data					↕	5
F81	BIN	S, D	4-digit BCD data → 16-bit data					↕	5
F82	DBCD	S, D	32-bit data → 8-digit BCD data					↕	7
F83	DBIN	S, D	8-digit BCD data → 32-bit data					↕	7
F84	INV	D	16-bit data invert					↕	3

• Specification of flag operation in the above table:
[↕]: The flag (special relay) available for the instruction (turns ON/OFF according to the condition).
[ ](blank): The flag (special relay) not available for the instruction (keeps the state regardless of the instruction).
• For more about the instructions above, refer to “FP-M /FP1 Programming Manual”.

Number	Boolean	Operand	Description	Flag operation					Step
				> R900A	= R900B	< R900C	CY R9009	ER R9007 R9008	
F85	NEG	D	16-bit data two's complement					↕	3
F86	DNEG	D	32-bit data two's complement					↕	3
F87	ABS	D	16-bit data absolute				↕	↕	3
F88	DABS	D	32-bit data absolute				↕	↕	3
F89	EXT	D	16-bit data sign extension					↕	3
F90	DECO	S, n, D	Decode					↕	7
F91	SEGT	S, D	16-bit data 7-segment decode					↕	5
F92	ENCO	S, n, D	Encode					↕	7
F93	UNIT	S, n, D	16-bit data combine					↕	7
F94	DIST	S, n, D	16-bit data distribute					↕	7
F95	ASC	S, D	Character → ASCII code					↕	15
F96	SRC	S1, S2, S3	Table data search					↕	7
F100	SHR	D, n	Right shift of 16-bit data in bit units				↕	↕	5
F101	SHL	D, n	Left shift of 16-bit data in bit units				↕	↕	5
F105	BSR	D	Right shift of one hexadecimal digit (4 bits) of 16-bit data					↕	3
F106	BSL	D	Left shift of one hexadecimal digit (4 bits) of 16-bit data					↕	3
F110	WSHR	D1, D2	Right shift of one word (16 bits) of 16-bit data range					↕	5
F111	WSHL	D1, D2	Left shift of one word (16 bits) of 16-bit data range					↕	5
F112	WBSR	D1, D2	Right shift of one hexadecimal digit (4 bits) of 16-bit data range					↕	5
F113	WBSL	D1, D2	Left shift of one hexadecimal digit (4 bits) of 16-bit data range					↕	5
F118	UDC	S, D	UP/DOWN counter		↕		↕		5
F119	LRSR	D1, D2	Left/right shift register				↕	↕	5
F120	ROR	D, n	16-bit data right rotate				↕	↕	5
F121	ROL	D, n	16-bit data left rotate				↕	↕	5
F122	RCR	D, n	16-bit data right rotate with carry flag data				↕	↕	5
F123	RCL	D, n	16-bit data left rotate with carry flag data				↕	↕	5
F130	BTS	D, n	16-bit data bit set					↕	5
F131	BTR	D, n	16-bit data bit reset					↕	5
F132	BTI	D, n	16-bit data bit invert					↕	5
F133	BTT	D, n	16-bit data test		↕			↕	5
F135	BCU	S, D	Number of ON bits in 16-bit data					↕	5
F136	DBCU	S, D	Number of ON bits in 32-bit data					↕	7
F137	STMR	S, D	Auxiliary timer						5
F138	HMSS	S, D	Hours, minutes, and seconds data to seconds data					↕	5
F139	SHMS	S, D	Seconds data to hours, minutes, and seconds data					↕	5
F140	STC	————	Carry flag (R9009) set				↕		1
F141	CLC	————	Carry flag (R9009) reset				↕		1

• Specification of flag operation in the above table:
[↕]: The flag (special relay) available for the instruction (turns ON/OFF according to the condition).
[ ](blank): The flag (special relay) not available for the instruction (keeps the state regardless of the instruction).
• For more about the instructions above, refer to "FP-M /FP1 Programming Manual".

Number	Boolean	Operand	Description	Flag operation					Step
				> R900A	= R900B	< R900C	CY R9009	ER R9007 R9008	
F143	IORF	D1, D2	Partial I/O update					↕	5
F144	TRNS	S, n	Serial communication FP-M C types (C20RC/C20TC/C32TC) only					↕	5
F147	PR	S, D	Parallel printout FP-M transistor output type only					↕	5
F148	ERR	n	Self-diagnostic error set					↕	3
F149	MSG	S	Message display						13
F157	CADD	S1, S2, D	Time addition [(S1+2, S1+1, S1) + (S2+1, S2) → (D+2, D+1, D)]					↕	9
F158	CSUB	S1, S2, D	Time subtraction [(S1+2, S1+1, S1) – (S2+1, S2) → (D+2, D+1, D)]					↕	9
F0	MV	S, DT9052	High-speed counter control					↕	5
F1	DMV	S, DT9044 or DT9044, D	Change and read of the elapsed value of high-speed counter					↕	7
F162	HC0S	S, Yn	High-speed counter output set					↕	7
F163	HC0R	S, Yn	High-speed counter output reset					↕	7
F164	SPD0	S	Pulse output control FP-M transistor output type only Pattern output control					↕	3
F165	CAM0	S	Cam control					↕	3

• Specification of flag operation in the above table:
[↕]: The flag (special relay) available for the instruction (turns ON/OFF according to the condition).
[ ](blank): The flag (special relay) not available for the instruction (keeps the state regardless of the instruction).
• For more about the instructions above, refer to “FP-M /FP1 Programming Manual”.

8-10. Table of Binary/BCD Expressions

Decimal number	Binary data (hexadecimal expression)	BCD data (BCD H code)
0	0000 0000 0000 0000 (H 0 0 0 0)	0000 0000 0000 0000 (H 0 0 0 0)
1	0000 0000 0000 0001 (H 0 0 0 1)	0000 0000 0000 0001 (H 0 0 0 1)
2	0000 0000 0000 0010 (H 0 0 0 2)	0000 0000 0000 0010 (H 0 0 0 2)
3	0000 0000 0000 0011 (H 0 0 0 3)	0000 0000 0000 0011 (H 0 0 0 3)
4	0000 0000 0000 0100 (H 0 0 0 4)	0000 0000 0000 0100 (H 0 0 0 4)
5	0000 0000 0000 0101 (H 0 0 0 5)	0000 0000 0000 0101 (H 0 0 0 5)
6	0000 0000 0000 0110 (H 0 0 0 6)	0000 0000 0000 0110 (H 0 0 0 6)
7	0000 0000 0000 0111 (H 0 0 0 7)	0000 0000 0000 0111 (H 0 0 0 7)
8	0000 0000 0000 1000 (H 0 0 0 8)	0000 0000 0000 1000 (H 0 0 0 8)
9	0000 0000 0000 1001 (H 0 0 0 9)	0000 0000 0000 1001 (H 0 0 0 9)
10	0000 0000 0000 1010 (H 0 0 0 A)	0000 0000 0001 0000 (H 0 0 1 0)
11	0000 0000 0000 1011 (H 0 0 0 B)	0000 0000 0001 0001 (H 0 0 1 1)
12	0000 0000 0000 1100 (H 0 0 0 C)	0000 0000 0001 0010 (H 0 0 1 2)
13	0000 0000 0000 1101 (H 0 0 0 D)	0000 0000 0001 0011 (H 0 0 1 3)
14	0000 0000 0000 1110 (H 0 0 0 E)	0000 0000 0001 0100 (H 0 0 1 4)
15	0000 0000 0000 1111 (H 0 0 0 F)	0000 0000 0001 0101 (H 0 0 1 5)
16	0000 0000 0001 0000 (H 0 0 1 0)	0000 0000 0001 0110 (H 0 0 1 6)
17	0000 0000 0001 0001 (H 0 0 1 1)	0000 0000 0001 0111 (H 0 0 1 7)
18	0000 0000 0001 0010 (H 0 0 1 2)	0000 0000 0001 1000 (H 0 0 1 8)
19	0000 0000 0001 0011 (H 0 0 1 3)	0000 0000 0001 1001 (H 0 0 1 9)
20	0000 0000 0001 0100 (H 0 0 1 4)	0000 0000 0010 0000 (H 0 0 2 0)
⋮	⋮	⋮
63	0000 0000 0011 1111 (H 0 0 3 F)	0000 0000 0110 0011 (H 0 0 6 3)
⋮	⋮	⋮
255	0000 0000 1111 1111 (H 0 0 F F)	0000 0010 0101 0101 (H 0 2 5 5)
⋮	⋮	⋮
9999	0010 0111 0000 1111 (H 2 7 0 F)	1001 1001 1001 1001 (H 9 9 9 9)

8-11. Versions of Programming Tools

1. Differences Between NPST-GR Ver. 2.4 and 3.1

NPST-GR Software Ver. 3.1 is designed to support all the functions of the FP series programmable controllers described in this manual. However, compared with previous NPST-GR Software, version 3.1 requires an additional system. For this reason, NPST-GR Ver. 2.4 has been introduced for computers without the system required for Ver. 3.1.
The differences in functions and requirements between NPST-GR Ver. 2.4 and 3.1 are explained in the table below.

■ System requirements

Item	NPST-GR Ver. 2.4 (AFP266528)	NPST-GR Ver. 3.1 (AFP266538)
Type of computer	IBM PC-AT or 100% compatible	
CPU	i80286, i80386, or i80486	i80386 or i80486 recommended
Hard Disk Space	2 MB or more if installed in your hard disk drive. [If your computer has two floppy disk drives (including RAM drive), no hard disk drive is required.]	Approx. 2 MB or more
Floppy Disk Drive	One disk drive for 3.5-inch 2HD floppies formatted at 1.44 MB or one for 5.25-inch 2HD floppies formatted at 1.2 MB.	
Main Memory	500 KB or more free	550 KB or more free
EMS	Not required	800 KB or more free
Video Mode	EGA or VGA (CGA type can also be used if the time chart monitoring function is not used.)	
RS232C port	COM 1 or COM 2	
Operating System	PC-DOS or MS-DOS version 3.3 or later ANSI. SYS required	PC-DOS or MS-DOS version 3.3 or later (version 5.0 is recommended) ANSI. SYS required for installation EMS driver based on LIM V4.0

■ **Functions**

Item		NPST-GR Ver. 2.4 (AFP266528)	NPST-GR Ver. 3.1 (AFP266538)
Programmable controllers supported		FP1: 0.9 k FP1/FP-M: 2.7 k FP1/FP-M: 5 k FP3: 10 k FP3/FP-C: 16 k FP5: 16 k	FP1: 0.9 k FP1/FP-M: 2.7 k FP1/FP-M: 5 k FP3: 10 k FP3/FP-C: 16 k FP5: 16 k FP10/FP10S: 30 k FP10: 60 k
Instructions	36 comparison instructions	36 comparison instructions (**ST=**, **AN <**, etc.) not available	All the instructions of an FP-M can be programmed.
Modem communication settings		Not available. Modem communication parameters cannot be set. (System register 416 for the RS232C port and 411 for the RS422 port cannot be set using NPST-GR Ver. 2.4.)	Available. Modem communication parameters can be set. (System register 416 for the RS232C port and 411 for the programming tool port)
Error clear function		Not available.	Available.
Battery error disregarding function		Operation without backup battery cannot be selected. (System register 4 cannot be set using NPST-GR Ver. 2.4.)	Operation without backup battery can be selected. (System register 4 can be modified.)

2. Differences Between the FP Programmer and FP Programmer Ⅱ

The FP Programmer Ⅱ is designed to support all the functions of the FP series programmable controllers described in this manual. Differences in functions between the FP Programmer and the FP Programmer Ⅱ are explained in the table.

■ FP Programmer (AFP1112 and AFP1112A) and FP Programmer Ⅱ (AFP1114)

Item	FP Programmer (AFP1112)	FP Programmer (AFP1112A)	FP Programmer Ⅱ (AFP1114)
Programmable controllers supported	FP1, FP3, FP5	FP1, FP3, FP5	FP-M, FP-C, FP1, FP3, FP5, FP10S, FP10
Communication parameters	Fixed as: Baud rate: 19,200 bps Character bits: 8 bits Parity: ODD Stop bit: 1 bit	The parameters are automatically adjusted when connected to the programmable controller. Baud rate: 19,200 bps or 9,600 bps Character bits: 8 bits or 7 bits Parity: ODD Stop bit: 1 bit	The parameters are automatically adjusted when connected to the programmable controller. Baud rate: 19,200 bps or 9,600 bps Character bits: 8 bits or 7 bits Parity: ODD Stop bit: 1 bit
36 comparison instructions (**ST =** etc.)	Not available	Not available	Available
NSTL instruction	Not available	Available	Available
F12 (ICRD)/P12 (PICRD), F13 (ICWT)/P13 (PICWT), F14 (PGRD)/P14 (PPGRD) instructions	Not available	Not available	Available
F64 (BCMP)/P64 (PBCMP), F98 (CMPR)/ P98 (PCMPR), F99 (CMPW)/P99 (PCMPW), F157 (CADD)/P157 (PCADD), F158 (CSUB)/ P158 (PCSUB) instructions	Not available. These instructions cannot be programmed. However, you can monitor the instructions with it.	Available	Available

Item	FP Programmer (AFP1112)	FP Programmer (AFP1112A)	FP Programmer Ⅱ (AFP1114)
OP 21 (route number settings)	Available Only routes 1 to 3 can be selected.	Available Routes 1 to 6 can be selected.	Available Routes 1 to 6 can be selected.
OP 72 (password enabled/disabled settings)	Not available	Available	Available
OP 73 (password registration function)	Not available	Not available	Available
OP 74 (password forcing clear function)*	Not available	Not available	Available
OP 91 (program/system register read/write function)	Not available	Not available	Available
OP 92 (system register read/write function)	Not available	Not available	Available
OP 99 (EEPROM write function)	Available. However, “BCC ERR” is displayed on the LCD if a program with more than 11 k steps is written to EEPROM.	Available	Available
OP 112 (Error cancellation function)	Not available	Not available	Available

Note:

- *If the OP 74 function is executed, the program stored in the programmable controller will be deleted.

8-12. Modem Communication

FP-M programmable controllers have modem communication functions.
This allows data transfer and long-distance communication between a personal computer and an FP-M.
This function is available not only for the computer link function but also when NPST-GR Software is used.
Using C-NET adapters, you can control up to 32 programmable controllers with one computer.

1. Using the Programming Tool Port (FP-M control board all types)

When modem communication is performed using the programming tool port of an FP-M, not only computer link but also programming with NPST-GR Software can be performed.
To perform modem communication using the programming tool port, set system registers 410 and 411 as follows:

- System register 410.....Station number setting
  Setting: K1 through K32 (See notes.)
- System register 411.....Communication format and modem setting
  Setting: H8000 or H8001

H8000 means		H8001 means	
Modem communication:	enabled	Modem communication:	enabled
Character bit:	8 bits	Character bit:	7 bits

Notes:

- With NPST-GR Software version 3.0 or higher, you cannot set system register 411 to the modem enable mode.
- The baud rate is fixed at 2,400 bps and the setting in system register 414 is ignored.
- The same station number (UNIT NO.) cannot be assigned to FP-Ms in the same network.
- Since initialization of the modem is performed only by a FP-M whose UNIT NO. (system register 410) is set to K1, pay attention to the following when station numbers (UNIT NO.s) are assigned to FP-Ms:
  - when one computer communicates with one FP-M, system register 410 should be set to K1.
  - when one computer communicates with two or more FP-Ms, no two FP-Ms can have the same station number (UNIT NO.) and one of the FP-Ms in the network must be assigned as station number 1 (UNIT NO. 1).
- Modem initialization is performed only when the mode of the programmable controller is set from PROG. to RUN or when the power turns ON in the RUN mode by an FP-M whose UNIT NO. (system register 410) is set to K1. Therefore, be sure to apply power to the modem, before the FP-M is turned ON.
- Once the modem is initialized successfully, it will not re-initialize if the mode of the programmable controller is set to RUN from PROG. again.
- When one computer communicates with two or more programmable controllers, set the modem to the mode without character echo.
- Be sure to set the computer and C-NET adapters to the same communication format.

■ How to set system registers 410 and 411

• Using NPST-GR Software version 3.1

<If you are using MENU 1 screen type>
Open the [NPST MENU] by pressing **Esc**, and then select “PLC CONFIGURATION” to skip to the [PLC CONFIGURATION] subwindow.
In the [PLC CONFIGURATION] subwindow, select “1. SYSTEM REGISTER”.

<If you are using MENU 2 screen type>
Open [NPST FUNCTION MENU] by pressing **Esc**, and then select “R. SYSTEM REGISTER”.

Open the [SYSTEM REGISTER]-[SET RS422 PORT] window by pressing **Sift** + **F9** together.
The following is displayed:

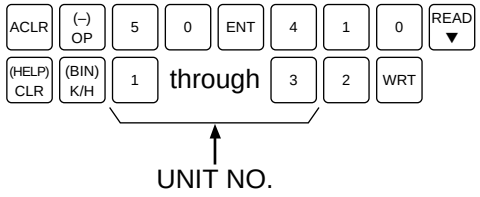
410	UNIT NO.	[1] (1- 32).....Set K1.
411	RS422 FORMAT DATA LENGTH	[8BIT/ 7BIT].....Select 8-bit or 7-bit.
	RS422 MODEM CONNECTION	[ENAB / DISA].....Select ENAB.

After setting, save the status of system registers by pressing **F1**.

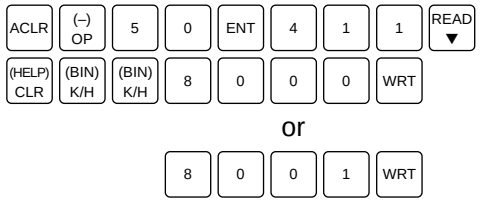
• Using FP Programmer Ⅱ

Press the keys on the FP Programmer Ⅱ as follows.

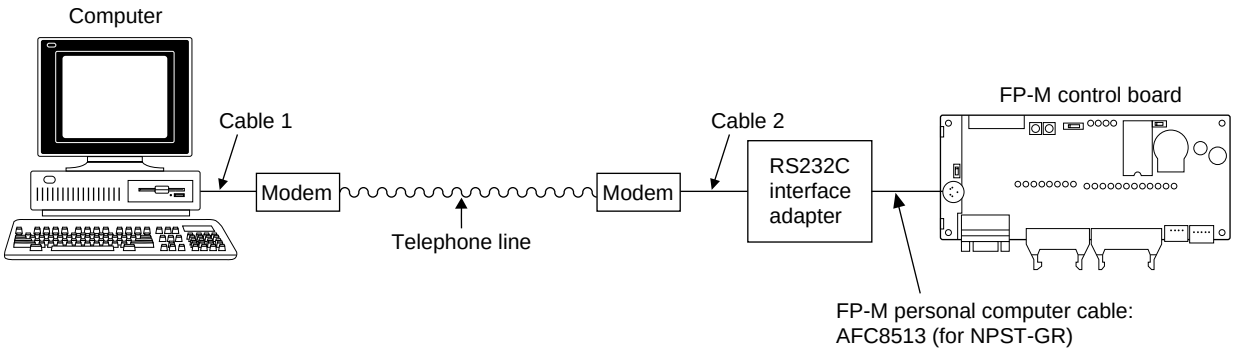
• System register 410



• System register 411



■ System configuration: One computer and one FP-M control board



The following diagrams show the pin layout of the cables for modem communication.

Cable pin layout

Cable 1:

• Between IBM PC-AT (9 pins) and a modem (25 pins)

IBM PC-AT (9 pins)		Modem (25 pins)	
Pin No.	Abbreviation	Pin No.	Abbreviation
1	CD (DCD)	8	CD (DCD)
2	RD (RXD)	3	RD (RXD)
3	SD (TXD)	2	SD (TXD)
4	ER (DTR)	20	ER (DTR)
5	SG	7	SG
6	DR (DSR)	6	DR (DSR)
7	RS (RTS)	4	RS (RTS)
8	CS (CTS)	5	CS (CTS)
9	RI (CI)	22	RI (CI)

• Between a personal computer (25 pins) and a modem (25 pins)

Personal computer (25 pins)		Modem (25 pins)	
Pin No.	Abbreviation	Pin No.	Abbreviation
1	FG	1	FG
2	SD (TXD)	2	SD (TXD)
3	RD (RXD)	3	RD (RXD)
4	RS (RTS)	4	RS (RTS)
5	CS (CTS)	5	CS (CTS)
6	DR (DSR)	6	DR (DSR)
7	SG	7	SG
8	CD (DCD)	8	CD (DCD)
20	ER (DTR)	20	ER (DTR)

Cable 2: Between a modem and RS232C interface adapter

Modem (25 pins)		RS232C interface adapter (25 pins)	
Pin No.	Abbreviation	Pin No.	Abbreviation
1	FG	1	FG
2	SD (TXD)	2	SD (TXD)
3	RD (RXD)	3	RD (RXD)
4	RS (RTS)	4	RS (RTS)
5	CS (CTS)	5	CS (CTS)
6	DR (DSR)	6	DR (DSR)
7	SG	7	SG
8	CD (DCD)	8	CD (DCD)
20	ER (DTR)	20	ER (DTR)

2. Using the RS232C Port [FP-M C type control boards (C20RC/C20TC/C32TC)]

When modem communication is performed using the RS232C port, the computer link function can be performed.
To perform modem communication using the RS232C port, set system registers 412, 413, 415, and 416 as follows:

- System register 412.....K1 (select computer link)
- System register 413..... Data format

  Start bit: 1 (fixed, no need to set this)
  Character bits: 7 bits or 8 bits
  Parity bit: None or 1 bit (ODD or EVEN)
  Stop bit: 1 bit or 2 bits
  Set the character bits, parity bit, and stop bit so that the total number of bits used to send a character adds up to 10 bits.

  Control code

  Header: NO STX or STX
  Terminator: CR, CR + LF, or ETX
  These settings are ignored when the computer link is selected.

- System register 415.....K1 though K32 (See notes below.)
- System register 416.....H8000 (RS232C MODEM CONNECTION ENABLED)

Notes:

- With NPST-GR Software version 3.0 or higher, you cannot set system register 416 to the modem enable mode.
- The baud rate is fixed at 2,400 bps and the setting of system register 414 is ignored.
- The same station number (UNIT NO.) cannot be assigned to FP-Ms in the same network.
- Since initialization of the modem is performed only by an FP-M whose UNIT NO. (system register 415) is set to K1, pay attention to the following when station numbers (UNIT NO.s) are assigned to FP-Ms:
  - when one computer communicates with one FP-M, system register 415 should be set to K1.
  - when one computer communicates with two or more FP-Ms, no two FP-Ms can have same station number (UNIT NO.) and one of the FP-Ms in the network must be assigned as station number 1 (UNIT NO. 1).
- Modem initialization is performed only when the mode of the programmable controller set to RUN from PROG., or when the power is turned ON in the RUN mode by an FP-M whose UNIT NO (system register 415) is set to K1. Therefore, be sure to apply power to the modem, before the FP-M is turned ON.
- Once the modem is initialized successfully, it will not re-initialize if the mode of the programmable controller is set to RUN from PROG. again.
- When one computer communicates with two or more programmable controllers, set the modem to the mode without character echo.
- Be sure to set the computer and C-NET adapters to the same communication format.

■ How to set system registers 412, 413, 416, and 415

• Using NPST-GR Software version 3.1

<If you are using MENU 1 screen type>
Open [NPST MENU] by pressing **Esc**, and then select "PLC CONFIGURATION" to skip to the [PLC CONFIGURATION] subwindow.
In the [PLC CONFIGURATION] subwindow, select "1. SYSTEM REGISTER".

<If you are using MENU 2 screen type>
Open [NPST FUNCTION MENU] by pressing **Esc**, and then select "R. SYSTEM REGISTER".

Open the [SYSTEM REGISTER]-[SET RS232C] window by pressing **Shift** + **F8** together.
The following is displayed:

412	RS232C PORT SELECTION		[UNUSED / COMPUTER LNK / GENERAL]
			.....Select COMPUTER LNK.
413	RS232C SEND FORM		
		DATA LENG*	[7BIT / 8BIT].....Select 7-bit or 8-bit.
		PARITY CHK	[NONE / WITH] ....Select with or without parity check
			[ODD / EVEN] .....Select ODD or EVEN when the parity, above, is selected.
		STOP BIT	[1BIT / 2BIT].....Select 1-bit or 2-bit.
		TERMINATOR	[CR / CR+LF / CR / ETX]
		HEADER	[NO STX / STX]
			Terminator and header settings are ignored in the computer link mode.
414	RS232C BAUDRATE		[1].....This setting is ignored when the modem connection is selected.
416	RS232C MODEM CONNECTION		[ENAB / DISA].....Select "ENAB".

Open the [SYSTEM REGISTER]-[COMPUTER LNK] window by pressing **Shift** + **F7** together and the following is displayed:

415	UNIT NO.	[1].....Select K1 though K32.

After setting, save the status of the system registers by pressing **F1**.

Note:

• * Set the character length, parity check, and stop bit so that the total number of bits used to send a character add up to 10 bits.

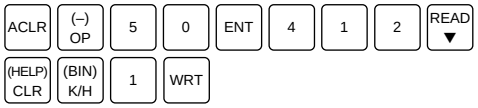
EXAMPLES

Start bit		Character bits		Parity bit		Stop bits		Total
1	+	7	+	1	+	1	=	10 bits
1	+	7	+	0	+	2	=	10 bits
1	+	8	+	0	+	1	=	10 bits

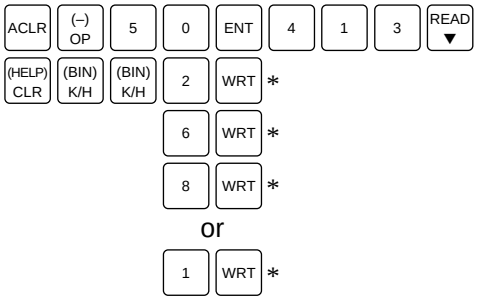
• Using FP Programmer Ⅱ

Press the keys on the FP Programmer Ⅱ as follows.

• System register 412



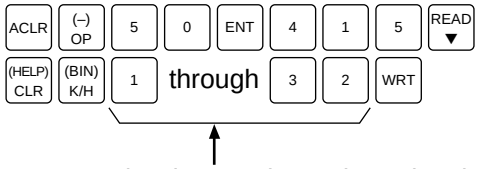
• System register 413



* The specifications for communication will be:

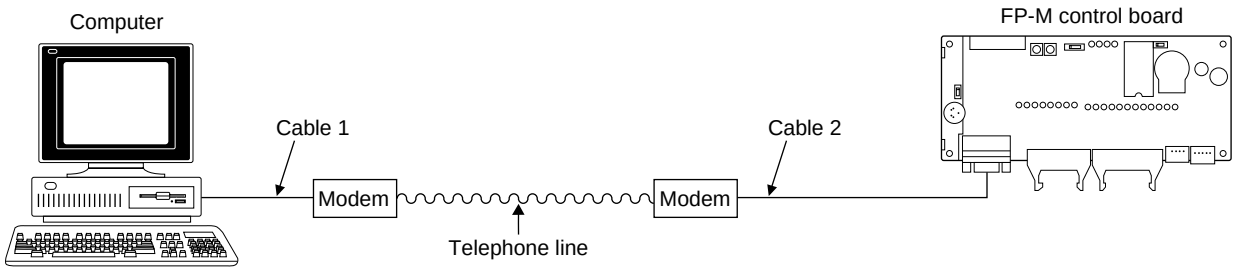
	Character bits	Parity	Stop bits
- when 2 (H) is input,	7-bit	Odd parity	1-bit
- when 6 (H) is input,	7-bit	Even parity	1-bit
- when 8 (H) is input,	7-bit	None	2-bit
- when 1 (H) is input,	8-bit	None	1-bit

• System register 415



• System register 416

■ System configuration: One computer and one FP-M control board



The following diagrams show the pin layout of the cables for modem communication.

Cable pin layout
Cable 1:

• Between IBM PC-AT (9 pins) and a modem (25 pins)

IBM PC-AT (9 pins)

Pin No.	Abbreviation
1	CD (DCD)
2	RD (RXD)
3	SD (TXD)
4	ER (DTR)
5	SG
6	DR (DSR)
7	RS (RTS)
8	CS (CTS)
9	RI (CI)

Modem (25 pins)

Pin No.	Abbreviation
8	CD (DCD)
3	RD (RXD)
2	SD (TXD)
20	ER (DTR)
7	SG
6	DR (DSR)
4	RS (RTS)
5	CS (CTS)
22	RI (CI)

• Between a personal computer (25 pins) and a modem (25 pins)

Personal computer (25 pins)

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
6	DR (DSR)
7	SG
8	CD (DCD)
20	ER (DTR)

Modem (25 pins)

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
6	DR (DSR)
7	SG
8	CD (DCD)
20	ER (DTR)

Cable 2: Between a modem and RS232C port of FP-M control board

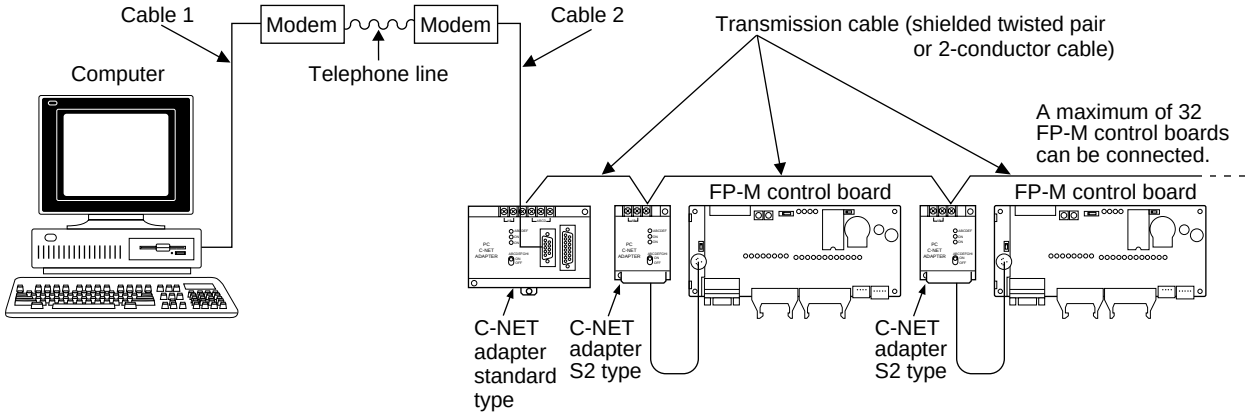
Modem (25 pins)

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
7	SG
8	CD (DCD)
20	ER (DTR)
22	RI (CI)

RS232C port (25 pins) of FP-M control board

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
7	SG
8	———
9	ER (DTR)
6	———

■ System configuration: One computer and two or more FP-M control board



The following diagrams show the pin layout of the cables for modem communication.

Cable pin layout

Cable 1:

• Between IBM PC-AT (9 pins) and a modem (25 pins)

IBM PC-AT (9 pins)

Pin No.	Abbreviation
1	CD (DCD)
2	RD (RXD)
3	SD (TXD)
4	ER (DTR)
5	SG
6	DR (DSR)
7	RS (RTS)
8	CS (CTS)
9	RI (CI)

Modem (25 pins)

Pin No.	Abbreviation
8	CD (DCD)
3	RD (RXD)
2	SD (TXD)
20	ER (DTR)
7	SG
6	DR (DSR)
4	RS (RTS)
5	CS (CTS)
22	RI (CI)

• Between a personal computer (25 pins) and a modem (25 pins)

Personal computer (25 pins)

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
6	DR (DSR)
7	SG
8	CD (DCD)
20	ER (DTR)

Modem (25 pins)

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
6	DR (DSR)
7	SG
8	CD (DCD)
20	ER (DTR)

Cable 2: Between a modem and RS232C port of FP-M control board

Modem (25 pins)

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
7	SG
8	CD (DCD)
20	ER (DTR)
22	RI (CI)

RS232C port (25 pins) of C-NET adapter

Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
7	SG
8	———
9	ER (DTR)
6	———

8-13. Terminology

address: An alphanumeric value that identifies where data is stored.

ambient temperature: The temperature of the air surrounding a system.

American Wire Gauge (AWG): A standard system used for designating the size of electrical conductors. Larger gauge numbers have smaller diameter.

AND: A Boolean operation that produces a logic "1" output if all inputs are "1", and a logic "0" if any input is "0".

ASCII: American Standard Code for Information Interchange. ASCII is normally used when alphanumeric (letters and decimal numbers) and control codes are sent as information to printers, etc. ASCII can be represented using 7 or 8 bits and is often expressed in a 2-digit hexadecimal form converted from specific binary expressions. ASCII expressed in 2-digit hexadecimals is called "ASCII HEX code". For details about actual ASCII codes, refer to the table for ASCII.
[EXAMPLE] When a letter "M" is expressed in ASCII code:
7-bit ASCII : 1001101 (binary)
ASCII HEX code: 4D (hexadecimal)

asynchronous: Not synchronous. Repeated operations that take place in patterns unrelated over time.

AWG: See American Wire Gauge (AWG).

backplane: A printed circuit board located in the back of a chassis, that contains a data bus, power bus, and mating connectors for units. For FP3, FP5, FP10S and FP10 programmable controllers, two types of backplanes are available:
Master Backplane
Expansion Backplane

backup: A device that is kept available to replace something that may fail during operation.

battery backup: A battery or set of batteries that will provide power to the processor memory only when system power is lost. All FP-Ms and FP1 C24, C40, C56, and C72 series programmable controllers have a battery backup system.

battery low: A condition that exists when the backup battery voltage drops low enough to require battery replacement. For all FP-Ms and FP1 C24, C40, C56, and C72 series, the ERR. LED turns ON.

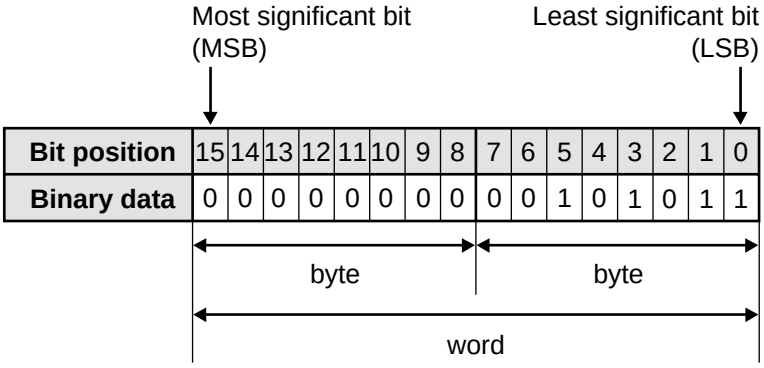
baud: Formally defined as the shortest pulse width in data communication. However, usually used to refer to the number of binary bits transmitted per second (bps) during serial data communication.

BCC: See Block Check Code.

BCD: See Binary Coded Decimal.

binary:

In general, programmable controllers work with binary numbers in one form or another to represent various codes or quantities. The binary number system uses the number 2 as the base and the only allowable symbols are “0” and “1”. There are no 2s, 3s, etc. Each digit of binary is called as “bit”. “Bit” means “binary digit”. A group of 8 bits is called a “byte” and a group of 16 bits (two bytes) is called a “word”.

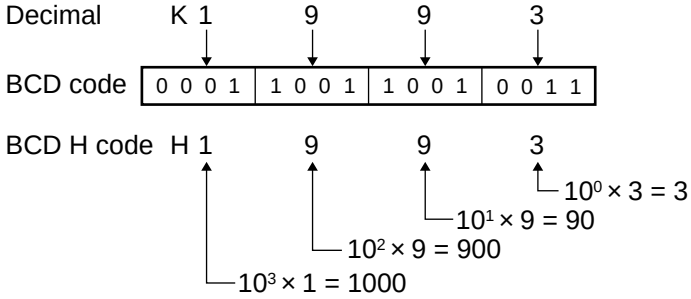


The binary number “0000000000101011” is expressed in decimal as follows:
$1 \times 2^0 + 1 \times 2^1 + 0 \times 2^2 + 1 \times 2^3 + 0 \times 2^4 + 1 \times 2^5 + \cdots\cdots + 0 \times 2^{15}$
$= 1 + 2 + 0 + 8 + 0 + 32 + \cdots\cdots + 0$
$= 43$

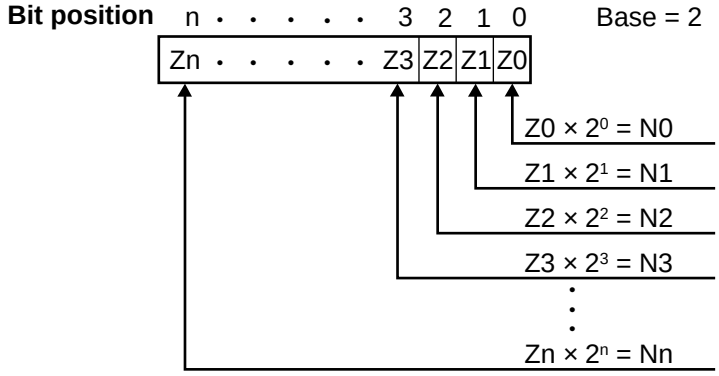
Binary Coded Decimal (BCD):

One of the codes expressed in binary. BCD is a binary code in which each decimal digit from 0 to 9 is represented by four binary digits (bits). The four positions have a weighted value of 1, 2, 4, and 8, respectively, starting with the least significant bit. A thumbwheel switch is specified as a BCD device, and when connected to a programmable controller, each decimal digit requires four inputs.
BCD is usually expressed grouping four bits as one digit in the same way as the hexadecimal constant H. **When BCD is grouped in four bit units, the BCD is expressed by adding the prefix H to the data. Since the weight of each BCD H code is same as that of decimals, be sure to pay attention not to be confused with hexadecimal numbers when BCD H code is handled.**

Example: When K1993 (decimal) is expressed in BCD.



binary number system: A number system that uses two symbols, “0” and “1”. Each digit position has a weighted value of 1, 2, 4, 8, 16, 32, 64, and so on begining with the least significant (right-most) digit.



The sum of N0 through Nn is the decimal equivalent of the number in base “2”.

Block Check Code (BCC): This code is used to detect errors in message transmissions. It is created by Exclusive ORing all of the codes from the header though the last text character, then translating the result (8-bit) data into two ASCII characters.

buffer: A group of registers used for temporary data storage. This is used for data transmission and works effectively when there are transmission rate differences between sending and receiving devices.

bug: Software errors which will cause unexpected actions.

bus: Power distribution conductors.

Central Processing Unit: The Central Processing Unit is usually referred to as the CPU. The CPU controls system activities of the programmable controller.

character: A symbol such as a letter of the alphabet or decimal number. An ASCII character is most commonly used to express characters using binary.

complement: A logical operation that inverts a signal or bit. The complement of “1” is “0”, and the complement of “0” is “1”.

computer link: One of the communication methods between a computer and programmable controllers. In a computer link, the computer is the host, and it can control programmable controllers using a protocol. For FP series programmable controllers, communication between a computer and programmable controllers is performed using the MEWTOCOL-COM, a half-duplex communication protocol. From the computer, you can read, write, or monitor data stored in the memory of a programmable controller.

CPU: See Central Processing Unit.

CRT: Abbreviation for cathode-ray tube.

debug: Removing errors from a program.

decimal number system: The decimal number system uses the number 10 as the base and the allowable symbols are “0”, “1”, “2”, “3”, “4”, “5”, “6”, “7”, “8”, and “9”. Each digit position has a weighted value of 1, 10, 100, 1000, and so on, begining with the least significant (right-most) digit.

duplex: See full-duplex.

EEPROM: Electrically Erasable Programmable Read Only Memory. EEPROM can be programmed and erased by electrical pulses.

EPROM: Erasable Programmable Read Only Memory. EPROM can be reprogrammed after being entirely erased with the use of an ultra-violet light source.

FIFO: See First-In-First-Out.

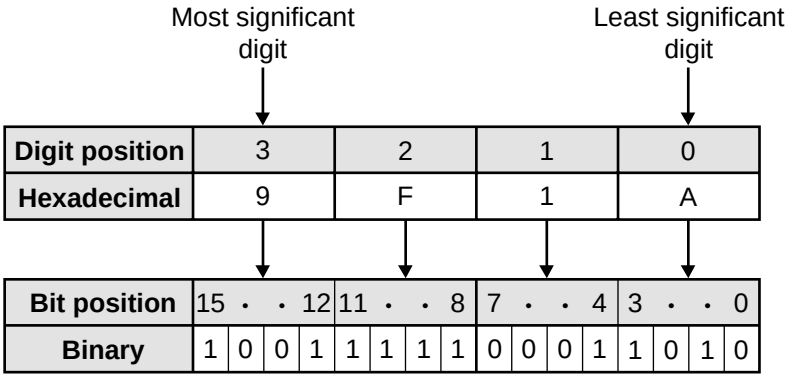
First-In-First-Out: The order that data is written in, and read from registers.

flag: A relay used to detect and remember certain events in the programmable controller. In FP series programmable controllers, some of the special internal relays are used as flags.

full-duplex: A communication link in which data can be transmitted and received at the same time.

half-duplex: A communication link in which transmission is limited to one direction at a time.

hexadecimal: The hexadecimal number system uses 16 as the base. The allowable symbols are numbers 0 through 9 and letters A through F. The letters are substituted for numbers 10 to 15, respectively, to represent all 16 numbers in one digit. The binary number system can easily be represented in hexadecimal with 4 bit groups. In this manner, a very large binary number can be represented by a hexadecimal number with significantly fewer digits.



hold: The memory area whose contents will not be lost or modified if operating power is lost or if the mode of the programmable controller is changed from RUN to PROG.

interrupt: The act of performing a more urgent task by putting off the presently executing task. FP series programmable controllers have three types of interrupts, as follows:
- input initiated interrupt
- high-speed counter initiated interrupt
- time initiated interrupt

I/O: Abbreviation of Input/Output.

I/O update: Taking the input data at the input interface into the memory for program execution and outputting the result of program execution to the output interface.

ladder diagram: A standard for representing relay-logic systems.

LCD: Abbreviation for Liquid Crystal Display.

leading edge differential: A programming technique to operate a bit only for one scan at the moment its input condition turns ON from the OFF state.

Least Significant Bit (LSB): The bit which represents the smallest value in a byte, word, or double-word.

Least Significant Digit (LSD): The digit which represents the smallest value in a number.

LED: Abbreviation for Light-Emitting Diode.

malfunction: Incorrect function.

Master Control Relay: A relay which controls any series of programs with its operation. If the master control relay is de-energized, all of the contacts and devices controlled by the master control relay are de-energized.

MEWTOCOL-COM: A half-duplex communication protocol for FP series programmable controllers that performs communication between a computer and programmable controllers.

modem: Abbreviation for MOdulator/DEModulator. The modem modulates digital signals and transmits them through a telephone line.

Most Significant Bit (MSB): The bit which represents the greatest value in a byte, word, or double-word.

Most Significant Digit (MSD): The digit which represents the greatest value in a number.

multidrop link: A communication link in which one host can communicate with two or more stations.

noise: Random, unexpected electrical signals, that are caused by radio waves or by electrical or magnetic fields.

non-hold: The memory area whose contents will be lost or modified if operating power is lost or if the mode of the programmable controller is changed from RUN to PROG.

normally-closed contact: A contact which is closed when the coil of the relay is not activated.

normally-open contact: A contact which is open when the coil of the relay is not activated.

offline: Not being in continuous communication with another processor.

online: Being in continuous communication with another processor.

overflow: The act of exceeding the maximum limit in a registers capacity.

parity check: A check method for the number of 1s in a character when data communication is performed. The parity check is performed by calculating the number of ones in a character.

peripheral device: Devices that are connected to the programmable controller.

PLC: Abbreviation for Programmable Logic Controller. See programmable controller.

potentiometer: A simple transducer which works based on resistance change. The FP-M manual-set registers work according to the potentiometers named “V0”, “V1”, “V2”, or “V3”.

programmable controller: A control device which can be programmed to control process or machine operations. A programmable controller is often referred to as a PLC when abbreviated.

RAM: Random Access Memory. RAM provides an excellent means for easily creating and altering a program. Many of the FP series programmable controllers use RAM with battery backup for the application memory.

register: A unit of memory for various types of data. A register is usually 16 bits wide.

ROM: Read Only Memory. See EEPROM and EPROM.

RS232C: An EIA communication standard for data transmission media that is less than 15 m. Most common serial communication standard.

RS422: An EIA communication standard for data transmission media.

rung: Term for a ladder program. A rung refers to the programmed instructions that drive one output.

scan: Time required to read all inputs, execute the program, and update local and remote information.

self-diagnostic function: A function within the programmable controller which monitors operation and indicates any fault that is detected.

serial communication: A communication style in which data is transmitted bit by bit serially.

stop bit: The last bit when a character is transmitted.

system errors: Errors resulting from the device or the environment.

system register: The registers used only for system settings of the programmable controller.

trailing edge differential: A programming technique to operate a bit only for one scan at the moment its input condition turns OFF from the ON state.

two’s complement: A number system used to express positive and negative numbers in binary. In this system, the number becomes negative if the most significant bit of the data is “1”. In FP series programmable controllers, numbers are expressed using the two’s complement.

underflow: The act of going below the minimum limit in a register’s capacity.

watchdog timer: A timer that monitors processing time of the programmable controller. If the program does not time out, the processor is assumed to be faulty.

word: A unit of bits which is usually executed at the same time. A word is composed of 16 bits.

8-14. Product Types

1. Case Type

■ **Refer to the part numbers below when using a case type control board.**

Type	Combination of control board and case	Memory (program capacity)	Description				Part number
			Operating voltage	I/O point	Input	Output	
C20R	Control Board: AFC12212 Case: AFC18011	RAM (2.7 k steps)	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC	Relay 2 A	AFC10212
C20RC	Control Board: AFC22212C Case: AFC18011	RAM (5 k steps)	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC	Relay 2 A	AFC20212C
C20T	Control Board: AFC12242 Case: AFC18012	RAM (2.7 k steps)	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC	Transistor 0.8 A NPN type	AFC10242
	Control Board: AFC12252 Case: AFC18012			Total: 20 Input: 12 Output: 8	24 V DC	Transistor 0.8 A PNP type	AFC10252
C20TC	Control Board: AFC22242C Case: AFC18012	RAM (5 k steps)	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC	Transistor 0.8 A NPN type	AFC20242C
	Control Board: AFC22252C Case: AFC18012			Total: 20 Input: 12 Output: 8	24 V DC	Transistor 0.8 A PNP type	AFC20252C
C32T	Control Board: AFC12342 Case: AFC18013	RAM (2.7 k steps)	24 V DC	Total: 32 Input: 16 Output: 16	24 V DC	Transistor 0.8 A NPN type	AFC10342
	Control Board: AFC12352 Case: AFC18013			Total: 32 Input: 16 Output: 16	24 V DC	Transistor 0.8 A PNP type	AFC10352
C32TC	Control Board: AFC22342C Case: AFC18013	RAM (5 k steps)	24 V DC	Total: 32 Input: 16 Output: 16	24 V DC	Transistor 0.8 A NPN type	AFC20342C
	Control Board: AFC22352C Case: AFC18013			Total: 32 Input: 16 Output: 16	24 V DC	Transistor 0.8 A PNP type	AFC20352C

■ **Use the appropriate case below when expanding a case type board (expansion, intelligent and link board).**

Type	Description	Part number
Case for expansion board	Install the case between stacked boards Spacers supplied (18 mm, AFB8803): 4 pieces	AFC1802
Skirt case	Install the case on the bottom of the boards Spacers supplied (18 mm, AFB8803): 4 pieces	AFC1803

Notes:

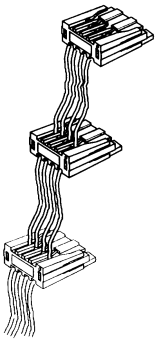
- Since the lengths of the attached spacers for case and board types are different, use the spacers attached to the case.
  Spacers: case type 8 mm, board type 20 mm
- The case type consists of the control board, case, mounting plate (AFB6804) with 4 screws and the following packing parts.

Packing parts:

Screws
for control board
(8 mm): 2 screws;
for connector board
(20 mm): 2 screws

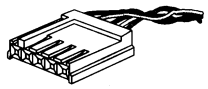
Backup battery
(AFB8801): 1 piece

Jumper cable
(AFB8505): 1 piece

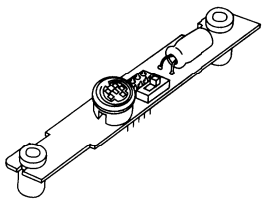


Spacers
(8 mm, AFB88032): 4 pieces

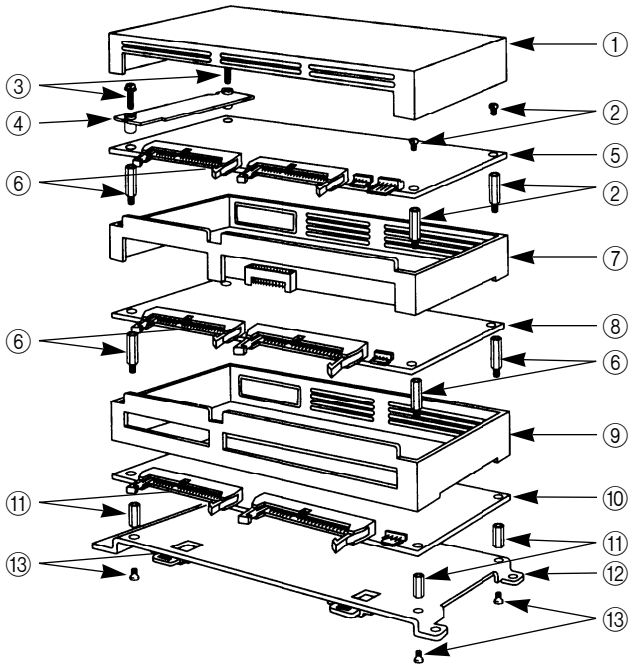
Power supply cable
(APL9511): 1 piece



Connector board
(This board is already connected in C20RC and C32TC types when shipped.)



■ Structure of case type



① Case for the control board
② Screws (8 mm)
③ Screws (20 mm)
④ Connector P.C.B.
⑤ Control board
⑥ Spacers (18 mm)
⑦ Case for expansion board
⑧ Expansion board
⑨ Skirt case
⑩ Expansion board
⑪ Spacers (8 mm)
⑫ Mounting plate
⑬ Screws

2. Board Type

■ Control boards

Type	Memory (program capacity)	Description				Part number
		Operating voltage	I/O point	Input	Output	
C20R	RAM (2.7 k steps)	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC Sink/source	Relay 2 A	AFC12212
C20RC	RAM (5 k steps)	24 V DC				AFC22212C
C20T	RAM (2.7 k steps)	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC Source	Transistor 0.8 A NPN type	AFC12242
				24 V DC Sink	Transistor 0.8 A PNP type	AFC12252
C20TC	RAM (5 k steps)	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC Source	Transistor 0.8 A NPN type	AFC22242C
				24 V DC Sink	Transistor 0.8 A PNP type	AFC22252C
C32T	RAM (2.7 k steps)	24 V DC	Total: 32 Input: 16 Output: 16	24 V DC Source	Transistor 0.8 A NPN type	AFC12342
				24 V DC Sink	Transistor 0.8 A PNP type	AFC12352
C32TC	RAM (5 k steps)	24 V DC	Total: 32 Input: 16 Output: 16	24 V DC Source	Transistor 0.8 A NPN type	AFC22342C
				24 V DC Sink	Transistor 0.8 A PNP type	AFC22352C

Notes:

- The board type consists of the control board and packing parts.
  Packing parts:
  - Screws for control board (8 mm): 2 screws; for connector board (20 mm): 2 screws
  - Spacers (20 mm, AFB88021): 4 pieces
  - Backup battery (AFB8801): 1 piece
  - Power supply cable (APL9511): 1 piece
  - Jumper cable (AFB8505): 1 piece
  - Connector board (This board is already connected in C20RC and C32TC types when shipped.)
- Since the lengths of the attached spacers for case and board types are different, use the spacers attached to the board.
  Spacers: board type 20 mm, case type 8 mm
- 12 V DC type operating voltage is also available. Please contact your dealer.

■ Expansion I/O boards

Type	Description				Part number
	Operating voltage	I/O point	Input type	Output type	
Expansion I/O Board E20R	24 V DC	Total: 20 Input: 12 Output: 8	24 V DC Sink/source	Relay 2 A	AFC13012
Expansion I/O Board M1T-E	24 V DC	Total: 40 Input: 24 Output: 16	24 V DC Source	Transistor 0.8 A NPN type	AFB6342
			24 V DC Sink	Transistor 0.8 A PNP type	AFB6342P
Expansion Input Board M1T-EI	24 V DC	Total: 36 Input: 36	24 V DC Source	———	AFB6392
Expansion Output Board M1T-EO	24 V DC	Total: 32 Output: 32	———	Transistor 0.8 A NPN type	AFB6340

■ Intelligent boards

Type	Description	Part number
Analog I/O Board	Operating voltage: 24 V DC Number of I/O channels: - Input: 4 channels, Output: 1 channel I/O range: 0 to 5 V, 0 to 10 V, and 0 to 20 mA Resolution: 1/256 (8 bits)	AFB6480
A/D Converter Board	Operating voltage: 24 V DC Number of input channels: 4 channels Input range: 0 to 5 V, 0 to 10 V, and 0 to 20 mA Resolution: 1/1000 (10 bits)	AFB6400
D/A Converter Board	Operating voltage: 24 V DC Number of output channels: 2 channels Output range: 0 to 5 V, 0 to 10 V, and 0 to 20 mA Resolution: 1/1000 (10 bits)	AFB6410
High-speed Counter Board	Counter points: 2 points (channel 0 and 1) Max. counting speed: - 1-phase mode: 20 k Hz, 2-phase mode: 5 k Hz	AFB6420

Note:

- The expansion I/O and intelligent boards consist of the preceding board and spacers (20 mm, AFB8802): 4 pieces.

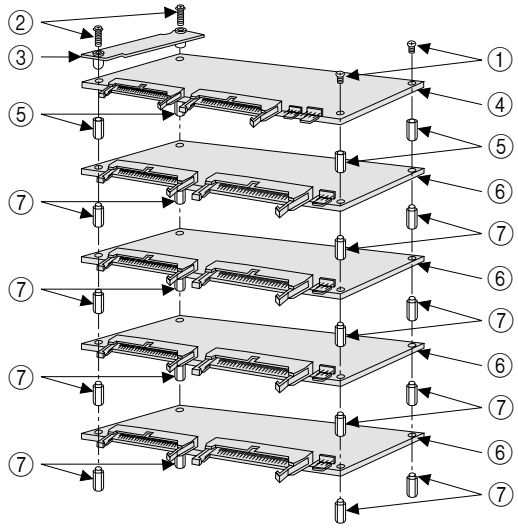
■ Link boards

Type	Description		Part number
FP-M Transmitter Master Board (MEWNET-TR)	FP-M transmitter master board enables the FP-M to exchange I/O information with slave stations at remote site using a twisted pair cable. Connecting with another FP-M transmitter master board or with an FP3 transmitter master unit, you can exchange I/O information with another FP-M at remote site. Communication medium (RS485 port): twisted pair cable up to 32 inputs and 32 outputs can be controlled per board.		AFC1752
FP I/O Transmitter Unit	Operating voltage: 24 V DC Input type	4 points	AFP87525
		8 points	AFP87521
		16 points	AFP87522
	Operating voltage: 24 V DC Output type (transistor NPN type, 0.5 A)	4 points	AFP87527
		8 points	AFP87523
		16 points	AFP87524
FP I/O Terminal Unit (with an expansion cable APL 2510)	Operating voltage: 24 V DC Input type	8 points	AFP87425
		16 points	AFP87426
	Operating voltage: 24 V DC Output type (transistor NPN type, 0.5 A)	8 points	AFP87427
		16 points	AFP87428
FP-M I/O Link Board	This board is an interface board for exchanging I/O information between an FP3/FP5 and an FP-M. When an FP-M control board is connected to the FP3/FP5 remote I/O system via this board, you can exchange I/O information using 2-conductor cable. Controllable I/O points: Max. total 64 points (Input: 32 points, Output: 32 points) Operating voltage: 24 V DC		AFC1732
C-NET Adapter standard type	Operating voltage: 24 V DC/100 to 240 V AC RS485 ↔ RS422/RS232C signal converter Used for communication between an FP-M and your computer using a shielded twisted pair or 2-conductor cable.		AFP8532 (24 V DC) AFP8536 (100 to 240 V AC)
C-NET Adapter S2 type	RS485 ↔ RS232C signal converter for FP-M only Used for communication between the C-NET adapter standard type and an FP-M control board.		AFP15402

Notes:

- When setting the I/O allocation of an FP-M transmitter master board and an FP-M I/O link board using the operation mode selector, be sure not to overlap I/O addresses.
- The FP-M transmitter master board and FP-M I/O link board (board type) consist of the board and four spacers (20 mm, AFB8802).

■ Structure of board type



① Screws (8 mm)
② Screws (20 mm)
③ Connector P.C.B.
④ Control board
⑤ Spacers (20 mm, AFB88021)
⑥ Expansion board
⑦ Spacers (20 mm, AFB8802)

3. Programming Tools

■ FP Programmer Ⅱ

Type	Description	Part number
FP Programmer Ⅱ	Hand held programming tool for FP programmable controller.	AFP1114
FP-M Peripheral Cable (for FP Programmer Ⅱ) (See note.)	Cable needed for connection, - between the programming tool port of FP-M control board and FP Programmer Ⅱ communication port (RS232C interface). - between the FP-M control board and FP data access unit.	AFC8521 (1 m/3.3 ft.) AFC8523 (3 m/9.8 ft.)

■ NPST-GR Software

Type	Description	Part number
NPST-GR Software Ver.3	Program editing software used System required: IBM PC-AT or 100 % compatible with 2 MB or more hard disk drive, MS-DOS Ver. 3.30 or higher, and EGA or VGA display mode	AFP266538
FP-M Personal Computer Cable (for NPST-GR) (See note.)	Cable needed for connection between the programming tool port of FP-M control board and D-SUB 25 connector of RS232C interface adapter.	AFC8513 (3 m/9.8 ft.)
RS232C Interface Adapter	Adapter needed for connection between the programming tool port of FP-M personal computer cable (for NPST-GR) and RS232C interface (9 or 25 pins) of personal computer. Refer to example of adapter specifications on page 245.	Needs to be made to match your computer
RS232C Cable (See note.)	Cable needed for connections between the RS232C port of C type control boards (C20RC/C20TC/C32TC) and RS232C interface (9 or 25 pins) of your personal computer.	Needs to be made to match your computer

Note:

• The specifications for each cable used for communications are shown on page 246 to 248.

■ Memory

Type	Description	Part number
Memory (EPROM)	Memory for storing the programs. Writing is done with a commercial ROM programmer. EPROM (27C256 type or equivalent) We recommend Aval Data Corporation's ROM programmer, "PECKER 11".	AFP5202 (2 pieces in a set)
Master memory (EEPROM)	Memory for copying and transmitting the programs. Writing is done with a master memory attached to an FP-M control board. EEPROM (28C256 type or equivalent)	AFP5207 (1 piece in a set)

■ Peripheral devices

Type	Description	Part number
FP Panel Mounting Cord	A cord that can be mounted on the panel to extend the programming tool connector of the FP-M control board. Refer to specifications for cord on page 249.	AFC8531 (1 m/3.3 ft.) AFC8532 (2 m/6.6 ft.)
FP Data Access Unit	A unit for monitoring and changing values of timer/counter/data registers after the programmable controller has been installed to the machine.	AFP1682

■ Pin layout diagram of RS232C interface adapter

The following diagrams show pin layout examples for the RS232C interface adapter.

Example 1:

FP-M personal computer cable (for NPST-GR) to IBM PC-AT (9 pins)

RS232C interface adapter

FP-M personal computer cable RS232C interface 25 pins, male		IBM PC-AT RS232C interface 9 pins, female	
Pin No.	Abbreviation	Pin No.	Abbreviation
1	FG	1	CD (DCD)
2	SD (TXD)	2	RD (RXD)
3	RD (RXD)	3	SD (TXD)
4	RS (RTS)	4	ER (DTR)
5	CS (CTS)	5	SG
6	DR (DSR)	6	DR (DSR)
7	SG	7	RS (RTS)
8	CD (DCD)	8	CS (CTS)
20	ER (DTR)	9	RI (CI)

Example 2:

FP-M personal computer cable (for NPST-GR) to personal computer (25 pins)

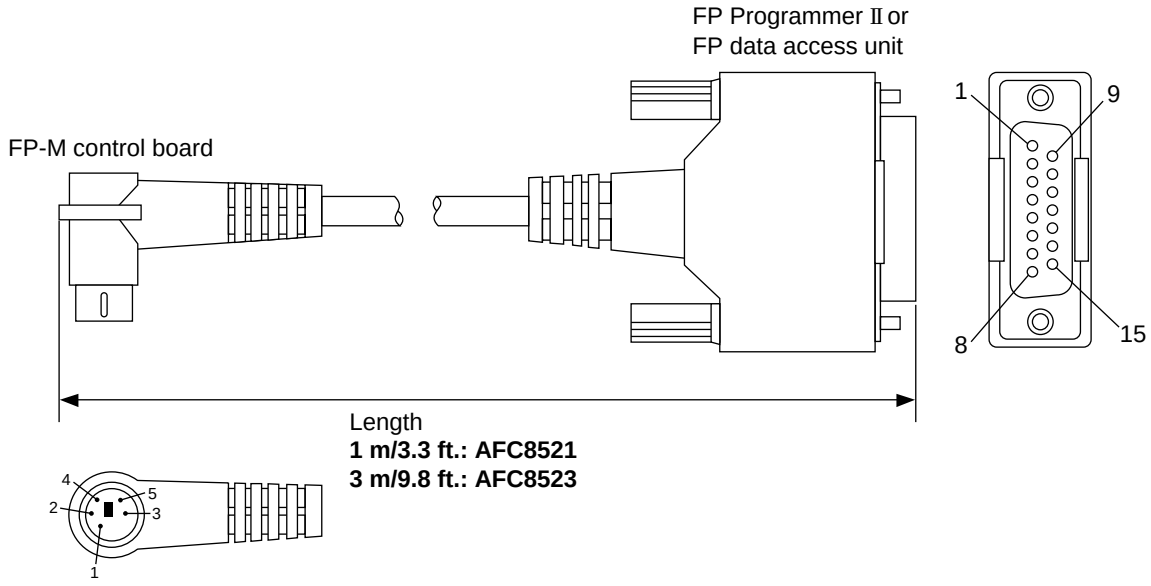
RS232C interface adapter

FP-M personal computer cable RS232C interface 25 pins, male		Personal computer RS232C interface 25 pins, female	
Pin No.	Abbreviation	Pin No.	Abbreviation
1	FG	1	FG
2	SD (TXD)	2	SD (TXD)
3	RD (RXD)	3	RD (RXD)
4	RS (RTS)	4	RS (RTS)
5	CS (CTS)	5	CS (CTS)
6	DR (DSR)	6	DR (DSR)
7	SG	7	SG
8	CD (DCD)	8	CD (DCD)
20	ER (DTR)	20	ER (DTR)

■ Specifications for cable and cord

• FP-M peripheral cable (for FP Programmer Ⅱ)

- Programming tool port of FP-M control board to connector (RS232C interface) of FP Programmer Ⅱ
- Programming tool port of FP-M control board to connector of FP data access unit



Pin No.	Abbreviation
—	FG
1	SG
2	SD
3	RD
4	—
5	+5 V

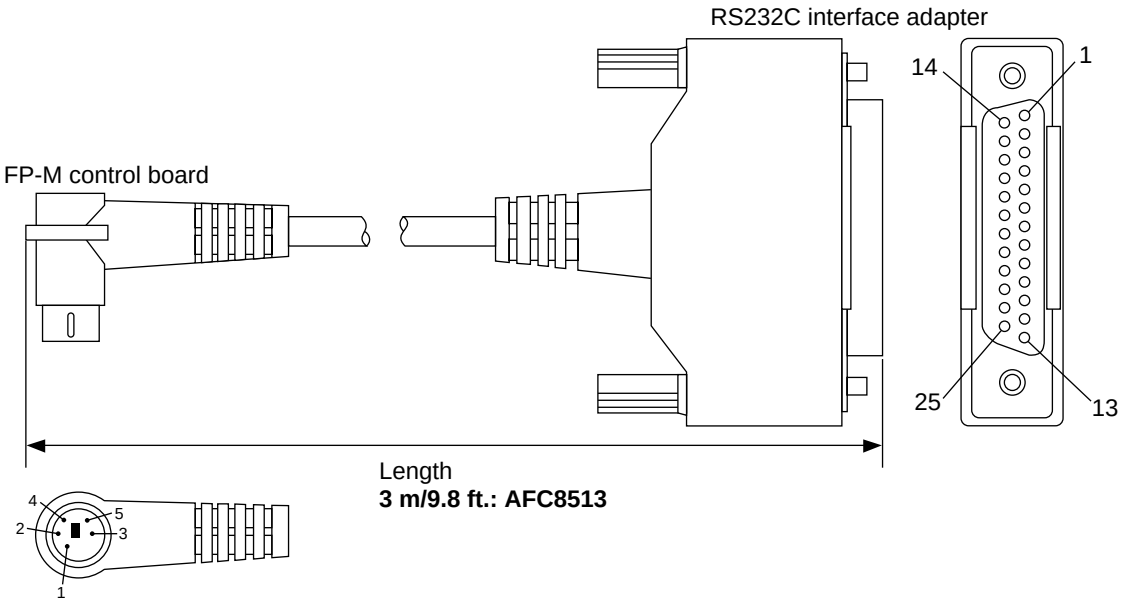
FP-M control board

Pin No.	Abbreviation
—	FG
2	SG
3	RD
11	SD
4	—
1	+5 V
5	—
6	—
7	—
8	—
9	—
10	SG
12	—
13	—
14	—
15	—

FP Programmer Ⅱ or
FP data access unit

• FP-M personal computer cable (for NPST-GR)

Connects the programming tool port of the FP-M control board to the D-SUB 25 connector of the RS232C interface adapter



Pin No.	Abbreviation
—	FG
1	SG
2	SD
3	RD
4	—
5	+5 V

FP-M control board

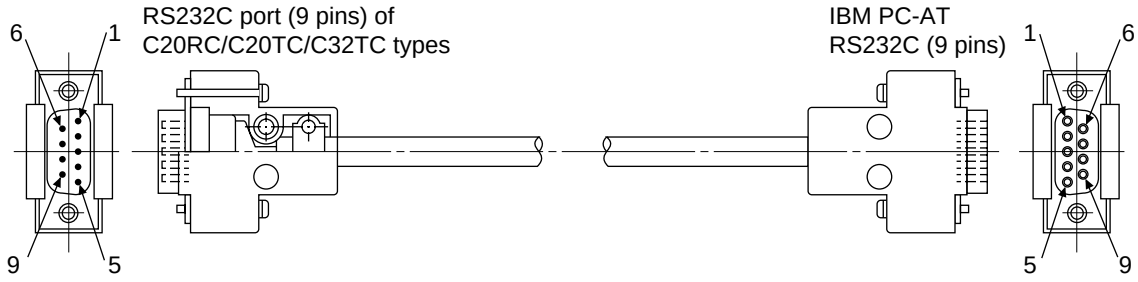
Pin No.	Abbreviation
—	FG
7	SG
3	RD
2	SD
1	—
4	RS
5	CS
6	DR
8	CD
20	ER
9	—
10	—
11	—
12	—
13	—
14	—
15	—
16	—
17	—
18	—
19	—
21	—
22	—
23	—
24	—
25	—

RS232C interface adapter

- **RS232C cable**

  Connects the RS232C port of a C type control board (C20RC/C20TC/C32TC) to the RS232C interface (9 or 25 pins) of a personal computer

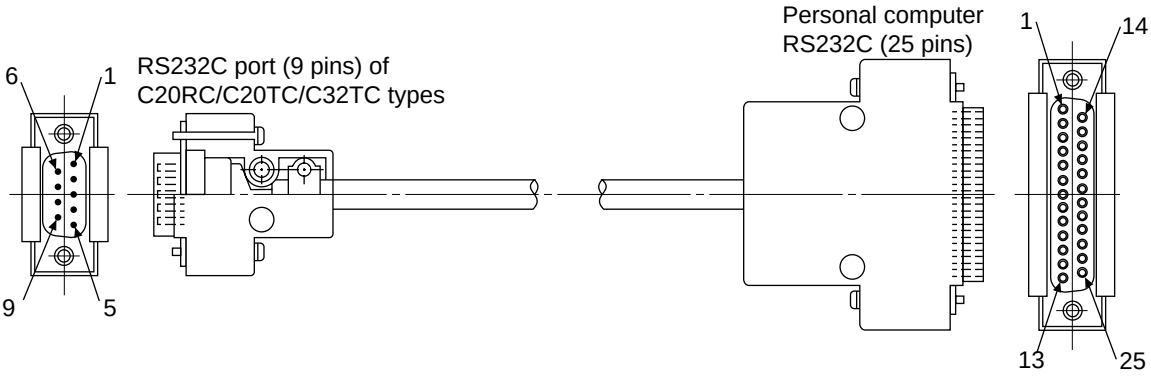
RS232C port of C20RC/C20TC/C32TC types to RS232C interface (9 pins) of personal computer



Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
6	RI (CI)
7	SG
8	CD (DCD)
9	ER (DTR)

Pin No.	Abbreviation
1	CD (DCD)
2	RD (RXD)
3	SD (TXD)
4	ER (DTR)
5	SG
6	DR (DSR)
7	RS (RTS)
8	CS (CTS)
9	RI (CI)

RS232C port of C20RC/C20TC/C32TC types to RS232C interface (25 pins) of personal computer

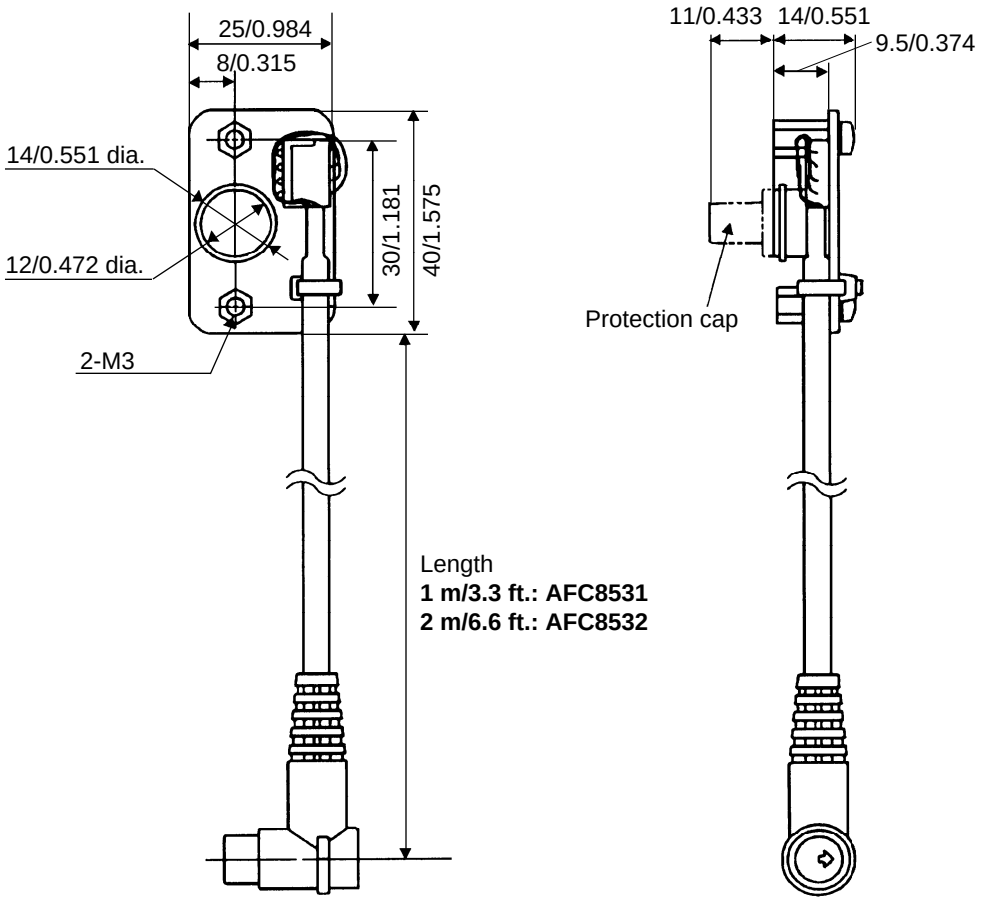


Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
6	RI (CI)
7	SG
8	CD (DCD)
9	ER (DTR)

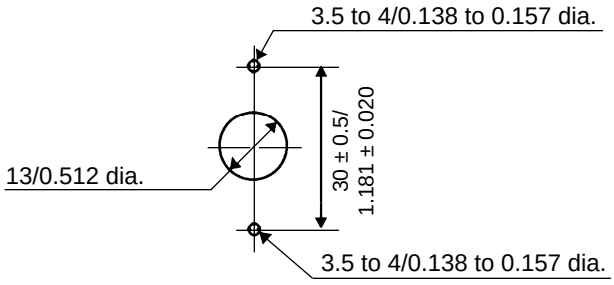
Pin No.	Abbreviation
1	FG
2	SD (TXD)
3	RD (RXD)
4	RS (RTS)
5	CS (CTS)
6	DR (DSR)
7	SG
8	CD (DCD)
20	ER (DTR)

• FP panel mounting cord

Dimensions



Mounting hole dimensions

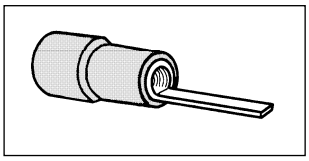


(unit: mm/in.)

4. Wiring Parts for I/O Terminal

• **Applicable boards:**
- Control boards: C20R and C20RC types
- Expansion board: E20R type
- Intelligent boards: Analog I/O, A/D converter, and D/A converter boards

■ Solderless terminal



Type	Description	Part number
Solderless terminal	Applicable wire: AWG28 to AWG16 (0.08 mm^2 to 2.5 mm^2)	AFC8805 (100 pieces in a set)

5. Wiring Parts for I/O Connectors (MIL connectors)

• **Applicable boards:**
- Control boards: C20T, C20TC, C32T, and C32TC types
- Expansion boards: M1T-E, M1T-EI, and M1T-EO types
- Intelligent board: High-speed counter board

■ CT-2 connector terminal (DIN rail mounting type)

Board type	Connector	CT-2 connector terminal
		Part number
C20T/C20TC	Output connector (16-pin)	CT2-20
	Input connector (20-pin)	
C32T/C32TC	Output connector (34-pin)	CT2-34
	Input connector (30-pin)	CT2-30
M1T-E	Output connector (34-pin)	CT2-34
	Input connector (40-pin)	CT2-40
M1T-EI	Input connector B (20-pin)	CT2-20
	Input connector A (40-pin)	CT2-40
M1T-EO	Output connector B (34-pin)	CT2-34
	Output connector A (34-pin)	

Cable for CT-2 connector terminal

Product name	Applicable I/O connector (number of pins)	Part number	
		1 m/3.3 ft.	2 m/6.6 ft.
Cable with connector	Output connector (16-pin) for C20T and C20TC types	AYT51163	AYT51165
	Input connector (20-pin) for C20T and C20TC types	AYT51203	AYT51205
	Input connector B (20-pin) for M1T-EI type		
	Input connector (30-pin) for C32T and C32TC types	AYT51303	AYT51305
	Output connector (34-pin) for C32T, C32TC, and M1T-E types	AYT51343	AYT51345
	Output connector A and B (34-pin) for M1T-EO type		
	Input connector (40-pin) for M1T-E type	AYT51403	AYT51405
	Input connector A (40-pin) for M1T-EI type		

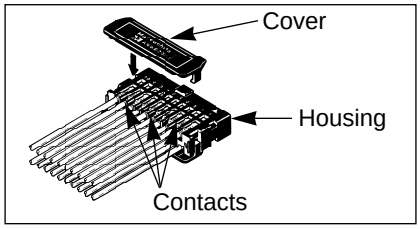
■ RT-2 relay terminal

Board type	Connector	RT-2 relay terminal
		Part number
C20T/C20TC	Output connector (16-pin)	DIN rail mounting type: RT1S-OD08-24V-S
C32T/C32TC	Output connector (34-pin)	DIN rail mounting type: RT2S-OD16-24V
M1T-E	Output connector (34-pin)	Direct mounting type: RT2S-M-OD16-24V
M1T-EO	Output connector B (34-pin)	
	Output connector A (34-pin)	

Cable for RT-2 relay terminal

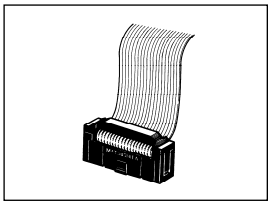
Applicable I/O connector (number of pins)	Part number	
	1 m/3.3 ft.	2 m/6.6 ft.
Output connector (16-pin) for C20T and C20TC types	AY15723	AY15725
Output connector (34-pin) for C32T, C32TC, and M1T-E types	AY25523	AY25525
Output connector A and B (34-pin) for M1T-EO type		

■ Wire-press socket



Board type	Connector	Part number		
		Housing	Cover	Contact
C20T/C20TC	Output connector (16-pin)	AXW1164A	AXW61601A	AXW7221
	Input connector (20-pin)	AXW1204A	AXW62001A	
C32T/C32TC	Output connector (34-pin)	AXW1344A	AXW63401A	
	Input connector (30-pin)	AXW1304A	AXW63001A	
M1T-E	Output connector (34-pin)	AXW1344A	AXW63401A	
	Input connector (40-pin)	AXW1404A	AXW64001A	
M1T-EI	Input connector B (20-pin)	AXW1204A	AXW62001A	
	Input connector A (40-pin)	AXW1404A	AXW64001A	
M1T-EO	Output connector B (34-pin)	AXW1344A	AXW63401A	
	Output connector A (34-pin)			

■ Flat cable connector (flat cable with one side connector)



Board type	Connector	Part number	
		1 m/3.3 ft.	2 m/6.6 ft.
C20T/C20TC	Output connector (16-pin)	APL9531	APL9532
	Input connector (20-pin)	APL9541	APL9542
C32T/C32TC	Output connector (34-pin)	AFB8531	AFB8532
	Input connector (30-pin)	AFB8521	AFB8522
M1T-E	Output connector (34-pin)	AFB8531	AFB8532
	Input connector (40-pin)	AFB8541	AFB8542
M1T-EI	Input connector B (20-pin)	APL9541	APL9542
	Input connector A (40-pin)	AFB8541	AFB8542
M1T-EO	Output connector B (34-pin)	AFB8531	AFB8532
	Output connector A (34-pin)		

Connector

Applicable I/O connector (number of pins)	Part number
Output connector (16-pin) for C20T and C20TC types	AXM116415
Input connector (20-pin) for C20T and C20TC types Input connector B (20-pin) for M1T-EI type	AXM120415
Input connector (30-pin) for C32T and C32TC types	AXM130415
Output connector (34-pin) for C32T, C32TC, and M1T-E types Output connector A and B (34-pin) for M1T-EO type	AXM134415
Input connector (40-pin) for M1T-E type Input connector A (40-pin) for M1T-EI type	AXM140415

6. Accessories

Type	Description	Part number
Case for control board	Put the case on top of the control board. Spacers supplied (8 mm, AFB88032): 4 pieces	C20R type: AFC18011
		C20T type: AFC18012
		C32T type: AFC18013
Case for expansion board	Install the case between stacked boards. Spacers supplied (18 mm, AFB8803): 4 pieces	AFC1802
Skirt case with spacers	Install the case on the bottom of boards. Spacers supplied (18 mm, AFB8803): 4 pieces	AFC1803
I/O number label for expansion I/O board	To indicate I/O location of expansion board. The seal is on the side of case.	E20R type: AFC18062
		M1T-E type: AFC18061
		M1T-EI type: AFC18063
		M1T-EO type: AFC1806
Mounting plate with screws	This metal plate attaches the boards. Attached 4 screws Refer to page 35, “2-2. Dimensions, 2. Case Type” for mounting hole dimensions.	AFB6804
DIN rail	DIN standard rail (width 35 mm/length 1 m)	AT8-DLA1
Fastening plate	To fix FP-M on the DIN rail	ATA4806

7. Maintenance Parts

Type	Description		Part number
Spare battery for FP-M	Replacement for backup battery BR2032/CR2032 or equivalent		AFB8801
Power supply cable	Available with control board		APL9511
Jumper cable	Available with control board		AFB8505
Spacers	For case type	Shape: □ , Length: 8 mm	AFB88032
		Shape: ⊏□, Length: 18 mm	AFB8803
	For board type	Shape: □, Length: 20 mm	AFB88021
		Shape: ⊏□, Length: 20 mm	AFB8802

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RECORD OF CHANGES

ACG No.	Date	Description of Changes
ACG-M0045-1	DEC. 1994	First edition

These materials are printed on ECF pulp.
These materials are printed with earth-friendly vegetable-based (soybean oil) ink.

Please contact .....

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Specifications are subject to change without notice.

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