# Operation manual of FB-PLC【Hardware】

Chapter 1 FB-PLC Introduction

The FB-PLC has two main unit models FBE and FBN, the FBE is the standard main unit, and the FBN is a high speed NC positioning main unit, the instruction sets of both units are fully compatible. With respect to their function, the I/O frequency of NC positioning pulse of FBE may reach 20KHz, the circuit structure is single end method, while the I/O frequency of NC positioning pulse of FBN may reach up to 512KHz. In order to reach this high speed I/O, its I/O circuit employs dual line differential method.

1.1   Name and Appearance

Layout plan inside cover plate (main unit)
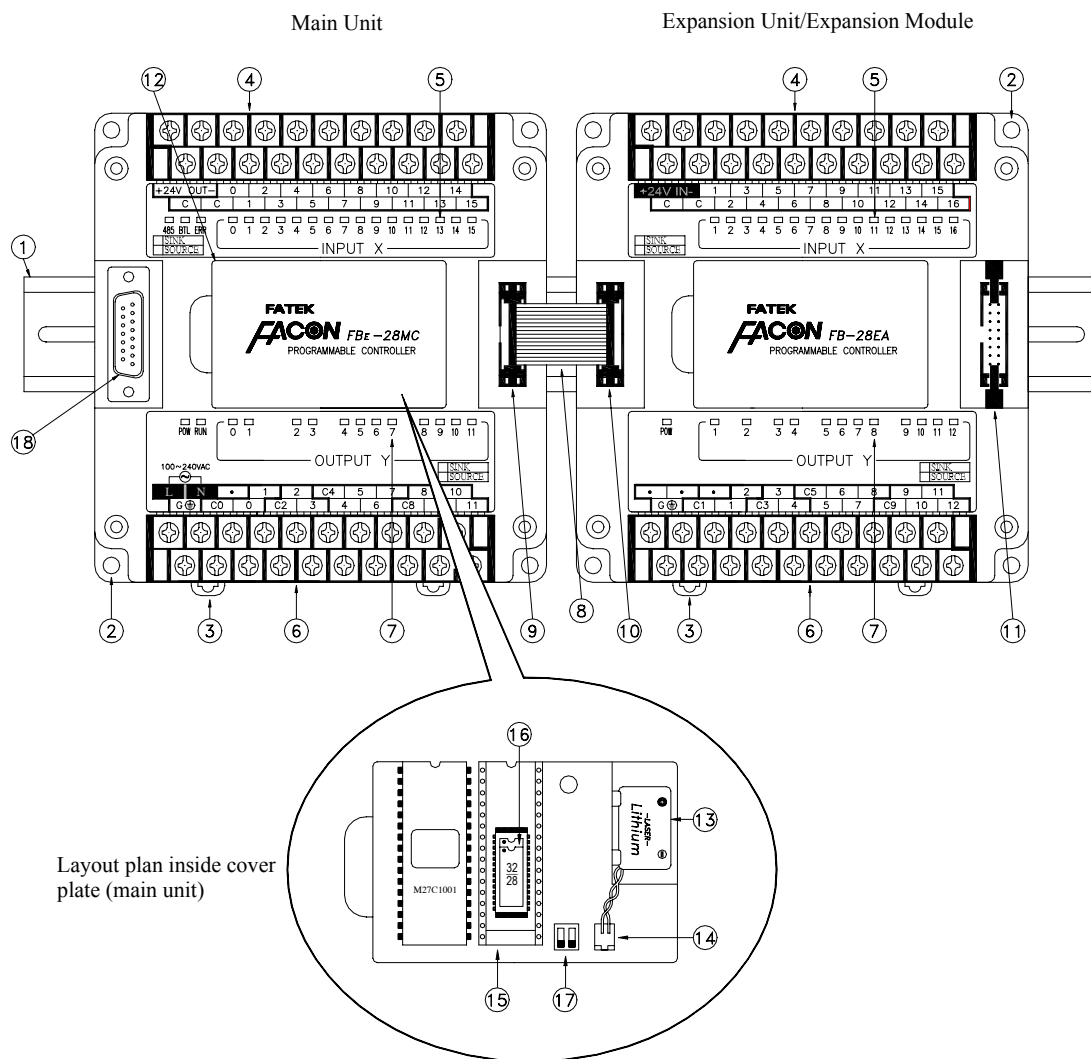
① 35mm wide DIN Rail
② Screw hole ($\phi 4.5 \times 4$)
③ Tab for removing off DIN Rail
④ Input terminal blocks

⑤ Input LED indication
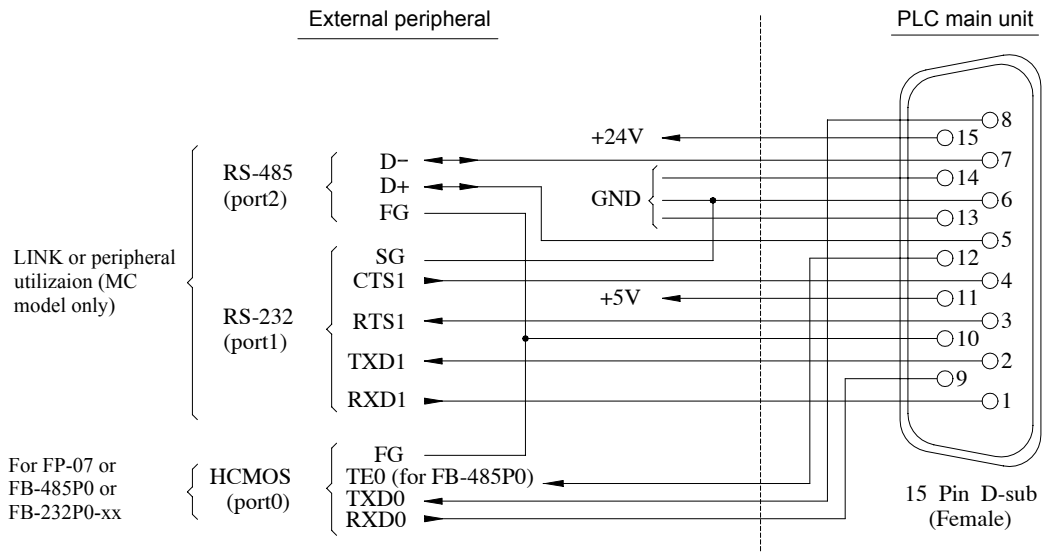⑥ Output terminal blocks
⑦ Output LED indication
⑧ Expansion cable

⑨ The output connector (connected to the input connector of expansion unit/expansion module) of main unit

⑩ The input connector of expansion unit/expansion module (connected to main unit or front expansion unit/module)

⑪ The output connector of expansion unit/expansion module (connected to next expansion unit/module)

⑫ Cover plate of the module

⑬ Lithium battery for program/data backup

⑭ Connector for lithium battery

⑮ Socket for User's program (EPROM/FLASH ROM/EEPROM)

● This socket is for insertion of EPROM/FLASH ROM/EEPROM which storing the user's ladder program and may with the data of registers. The main unit is built-in SRAM with battery backup to store the user's ladder program and data of registers, if the socket is empty, it still works no problem. For the considerations of mass production of machine copy or for long term maintenance, the user may copy the program and data of registers storing in SRAM to the EPROM/FLASH ROM/EEPROM via FP-07B handheld programmer (The main unit also can copy the program and data of registers into FLASH ROM directly). Insert the copy of EPROM/FLASH ROM/EEPROM into the spare socket, the main unit will overwrite the SRAM with the copy of EPROM/FLASH ROM/EEPROM （the existing program in the SRAM will be replaced by the program of EPROM/FLASH ROM/EEPROM）every power on, and the PLC will be in "RUN" mode automatically regardless its "RUN" or "STOP" mode before.

● The socket is a 32Pin DIP type. The packs which can be inserted into this socket are with 256K or 512K bits (Both are 28Pin DIP packing) or 1M bits （32Pin DIP packing） memory capacity. (Of the memory type, please refer to paragraph 2.1.3 of "Basic manual")

⑯ 32 Pin /28 Pin memory pack insertion direction and pin indication sticker

● Since the 256K or 512K bits memory packs are 28Pin DIP packing, but the socket of the PLC is 32Pin, there will be 4 empty pins left. Please observe the instruction on this sticker on how to install the memory pack and where to plug it into the IC socket (i.e. there are 4 empty Pins on top of the socket). And whether it is a 32Pin or 28Pin memory pack, the directional notch should be on the same side as the sticker.

⚠ Caution

1. The selection of memory pack follows the description of paragraph 2.1.3 of Basic manual, insertion of invalid memory pack （such as 28C256） may result in scrambled PLC data or loss of program or data, and produce unexpected action of the PLC and may endanger the unit, the equipment, or human safety.

2. Even though the selection of memory pack is correct, if the insertion of the memory pack into the spare socket failed to observe the direction/pin indicated on the sticker, it may result in scrambled PLC data or loss of program or data, and produce unexpected action of PLC and may endanger the unit, the equipment, or human safety.

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⑰ Com. port setting switch, refer to Advanced manual for setting.

⑱ 15Pin D-Sub main unit communication connector, with 1 or 3 com. port respectively and described as follows:
  ● MA model：HCMOS com. port ×1 (port0); only 1 com. port
  ● MC model：HCMOS com. port ×1 (port0), RS-232 com. port ×1 (port1)
    RS-485 com. port ×1 (port2); total 3 com. Ports

● The figure below tells the detailed pin definition of the 15Pin D-sub of the main unit：

External peripheral   PLC main unit

```
                                                          +24V  ←          ○8
                                                                 ○15
RS-485      D−  ←                                                      ○7
(port2)     D+  ←                                                 ○14
            FG                                   GND              ○6
                                                                 ○13
LINK or peripheral                                                    ○5
utilizaion (MC     SG                                            ○12
model only)        CTS1  ►                        +5V  ←         ○4
                                                                 ○11
RS-232      RTS1  ►                                              ○3
(port1)                                                          ○10
            TXD1  ►                                                   ○2
                                                                 ○9
            RXD1  ►                                                   ○1

For FP-07 or          FG
FB-485P0 or  HCMOS   TE0 (for FB-485P0)  ←                           15  Pin  D-sub
FB-232P0-xx  (port0) TXD0  ←                                             (Female)
                     RXD0  ►
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● FB-DTBR can be used to lead out 3 com. ports signals from the 15Pin D-sub connector of the main unit, it may transfer the port2 signals (RS-485) to 3-pin terminal block, and transfer port1 (RS-232) to standard 9Pin D-sub connector. Besides, converts port0 (HCMOS) signal into RS-232 signal first, and then transfer it to another standard 9Pin D-sub connector. To remain compatible with the peripherals of FB series at the same time, the signals (except D+ and D−) of the 15Pin D-sub of the main unit are transfered to the 15 pin D-sub's of FB-DTBR transparently. Following is the illustration of FB-DTBR:

FB-DTBR or   PLC main unit
FB-DTBR-E
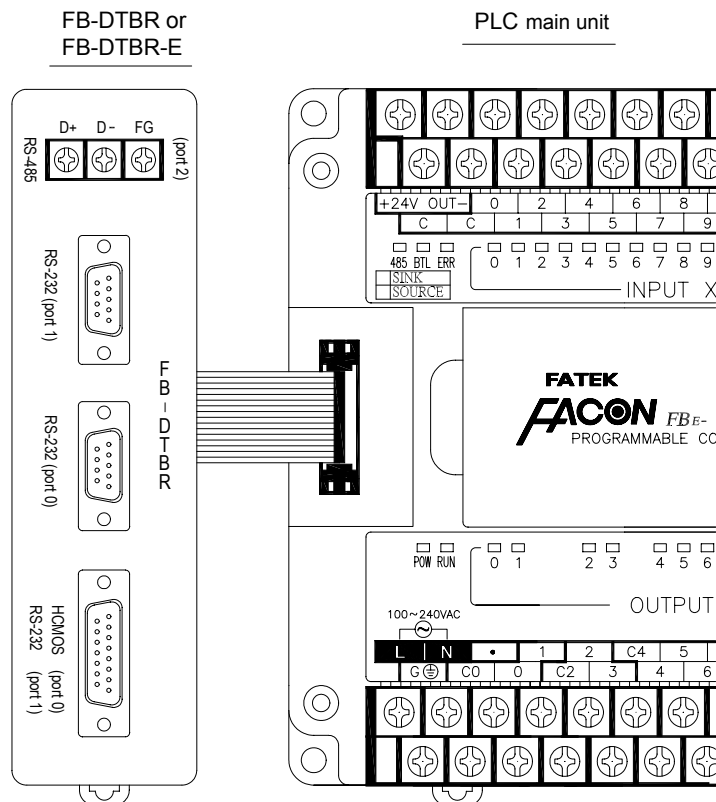
Note 1 ：port0 signal is present on the lowest 15Pin D-sub connector of FB-DTBR by HCMOS signal, and also is present on the 9Pin D-sub above the 15Pin D-sub connector as an RS-232 signal via a signal conversion. Whenever the FP-07 or FB-485P0 is plugged into the 15Pin D-sub thus the HCMOS port 0 will be connected to, the FB-DTBR will disable the converter automatically and make the 9Pin D-sub RS-232 of port0 floating. The 9Pin D-sub RS-232 (port0) will be operational only after removing the connection to the HCMOS port.

Note 2 ：In addition of being converted to RS-232 signal in a 9Pin D-sub female connector via FB-DTBR, the HCMOS signal of port0 may be converted to RS-232 signal of 9Pin/25Pin D-sub female connector by using FB-232P0-9F/FB-232P0-25F communication cable with signal converter, or may also be converted into RS-485 signal of 3-pin terminal block by using FB-485P0.

● FB-DTBR-E can be used to lead out 3 com. ports signals from the 15Pin D-sub connector of the main unit, it may transfer the port2 signals (RS-485) to 3-pin terminal block, and transparently transfer the 15Pin D-sub signals (except D+ and D−) of the main unit to the 15Pin D-sub's of FB-DTBR-E. Besides, converts port0 (HCMOS) signal into RS-232 signal first, and then transfer it to the standard 9Pin D-sub connector above the 15Pin D-sub. There is also a 9Pin D-sub connector to connect to 10 Base-T Ethernet, it is the interface of FB-PLC to enter the Ethernet environment.　Following is the illustration of FB-DTBR-E:

1.2　External Dimensions

Outlook I：

　　Main unit　　　　　　　　：FBE-40M△，FBN-36MCT

　　Expansion unit/module：FBE-40EA(P)，FB-4AJ(K)△

140.00
130.00

unit：mm

← 4-Φ5.0
Mounting hole

175

185

85.00
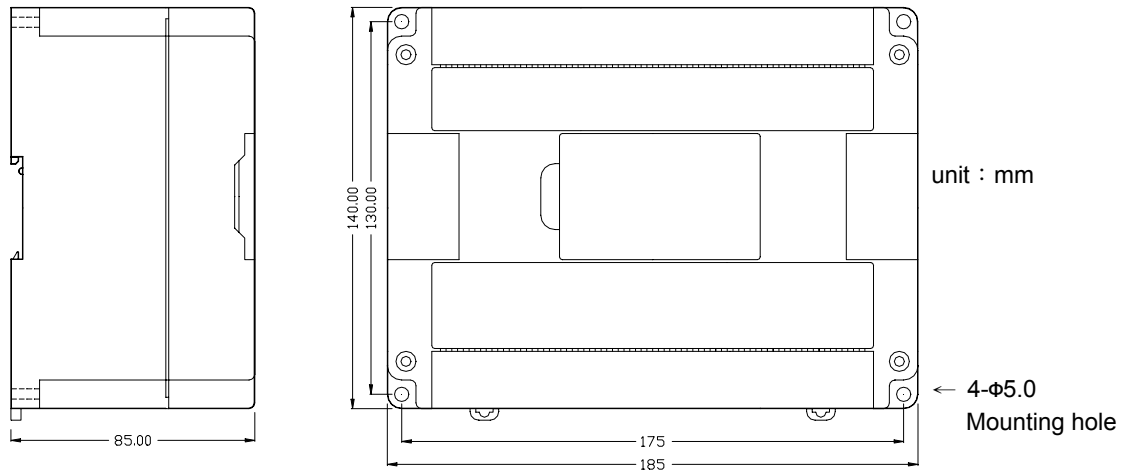
Outlook II：

　　Main unit　　　　　　　　　：FBE-20M△，FBE-28M△，FBN-19MCT，FBN-26MCT`

　　Expansion unit/module　：FBE-28EA(P)，FB-48EAT，FB-48EX，FB-48EYT，FB-8AD，FB-2DA，FB-7SG△

140.00
130.00

unit：mm

← 4-Φ5.0
Mounting hole

125

135

85.00
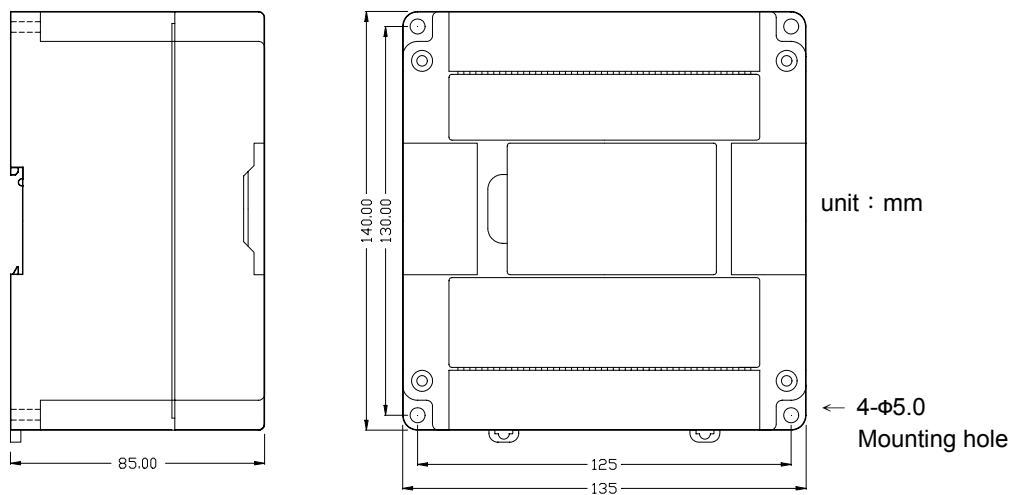
Outlook III：

Expansion module：FB-8EA, FB-8EX, FB-8EY, FB-EPOW, FB-6AD, FB-2DA, FB-2AJ(K)4, FB-2AH(T)4

140.00
130.00

unit：mm

← 2-Φ5.0
Mounting hole

85.00

39
49
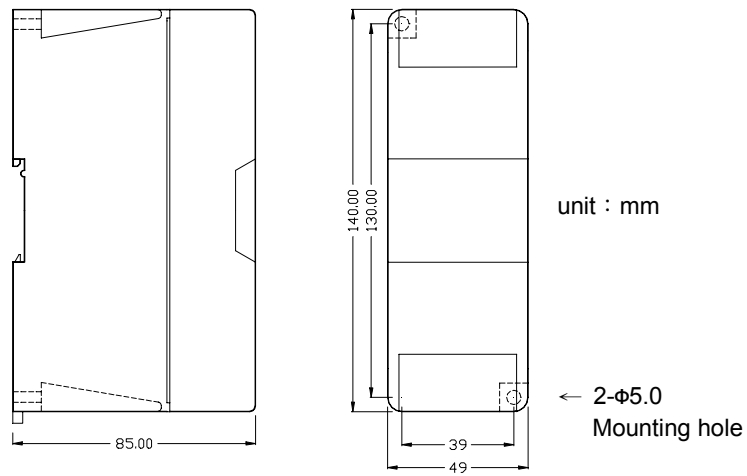
Outlook IV：

Communication distributor：FB-DTBR, FB-DTBR-E

72.70

140.00
130.00

unit：mm

← 2-Φ5.0
Mounting hole

66.00

39
49
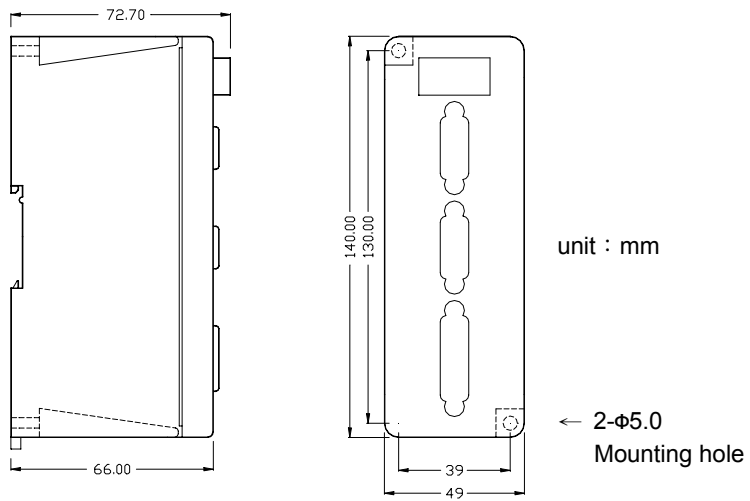
Outlook V：

Programming panel：FP-07A/B

unit：mm
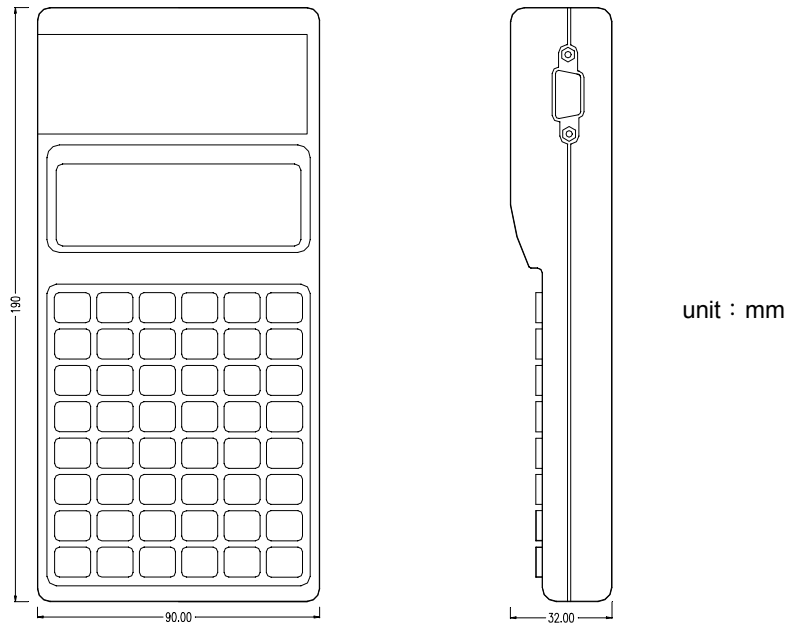
Outlook VI：

Data access panel：FB-DAP-A(R), FB-DAP-B(R)

unit：mm
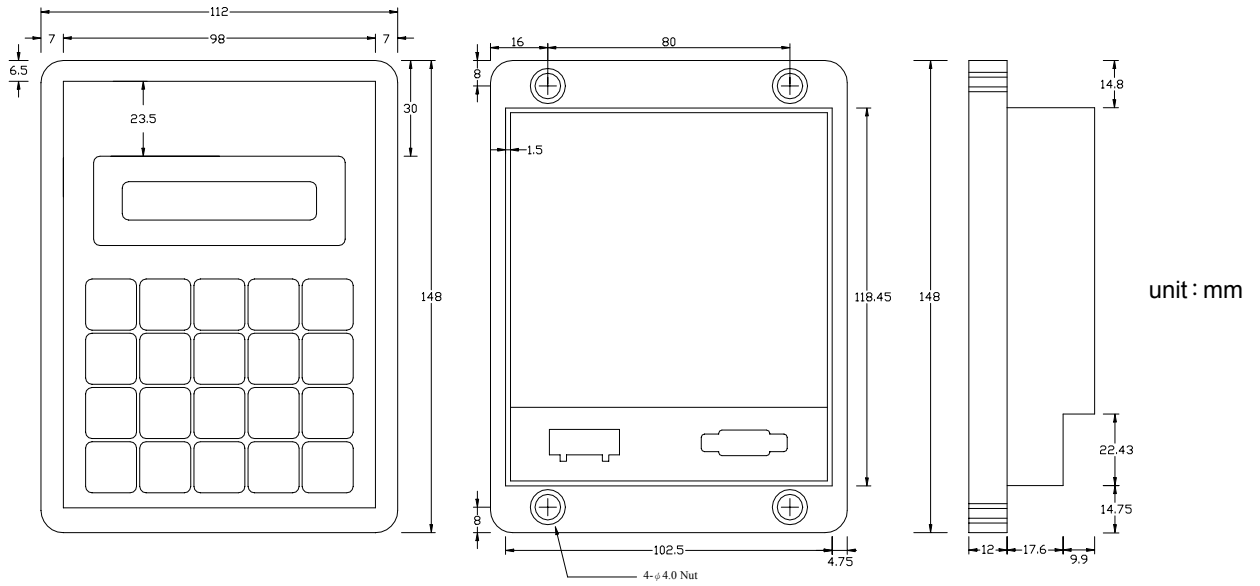
1.3 List of Products

Item	Model	Specifications
Main Unit of standard type	FBE-20MA□◇△-◎	12 DC24V inputs (support 2 SHSC, total 8KHz), 8 outputs, Comm. port ×1 (HCMOS)
	FBE-28MA□◇△-◎	16 DC24V inputs (support 2 SHSC, total 8KHz), 12 outputs, Comm. port ×1 (HCMOS)
	FBE-40MA□◇△-◎	24 DC24V inputs (support 2 SHSC, total 8KHz), 16 outputs, Comm. port ×1 (HCMOS)
Main Unit of advanced type	FBE-20MC□◇△-◎	12 DC24V inputs (support 3 HHSC, 20KHz ; 4 SHSC, total 8KHz), 8 outputs (support pulse output ×1, 20KHz), Comm. port × 3 (HCMOS, RS-232, RS-485)
	FBE-28MC□◇△-◎	16 DC24V inputs (support 4 HHSC, 20KHz ; 4 SHSC, total 8KHz), 12 outputs (support pulse output ×2, 20KHz), Comm. port × 3 (HCMOS, RS-232, RS-485)
	FBE-40MC□◇△-◎	24 DC24V inputs (support 4 HHSC, 20KHz ; 4 SHSC, total 8KHz), 16 outputs (support pulse output ×4, 20KHz), Comm. port × 3 (HCMOS, RS-232, RS-485)
Main Unit of advanced type with NC position control	FBN-19MCT◇△-◎	3 diff. inputs (support 1 HHSC, 512KHz), 8 DC24V inputs (support 2 HHSC, 20KHz ; 4 SHSC), 2 diff. outputs (support pulse output ×1, 512KHz), 6 outputs, 3 comm. ports (HCMOS, RS-232, RS-485)
	FBN-26MCT◇△-◎	6 diff. inputs (support 2 HHSC, 512KHz), 8 DC24V inputs (support 2 HHSC, 20KHz ; 4 SHSC), 4 diff. outputs (support pulse output ×2, 512KHz), 8 outputs, 3 comm. ports (HCMOS, RS-232, RS-485)
	FBN-36MCT◇△-◎	12 differential inputs (support 4 HHSC, 512KHz), 8 DC24V inputs, 8 differential outputs (support pulse output ×4, 512KHz), 8 outputs, 3 comm. ports (HCMOS, RS-232, RS-485)
Digital Unit	FBE-28EAP□◇-◎	Terminal block, 16 DC24V inputs, 12 outputs, power supply built-in
	FBE-40EAP□◇-◎	Terminal block, 24 DC24V inputs, 16 outputs, power supply built-in
Expansion Modules of Digital I/O	FB-28EA□◇	Terminal block, 16 DC24V inputs, 12 outputs
	FB-40EA□◇	Terminal block, 24 DC24V inputs, 16 outputs
	FB-32EX◇	Terminal block, 32 DC24V inputs
	FB-8EA□◇	Thin type, terminal block, 4 DC24V inputs, 4 outputs
	FB-8EX◇	Thin type, terminal block, 8 DC24V inputs
	FB-8EY□◇	Thin type, terminal block, 8 outputs
	FB-48EAT	Header connector, 24 DC24V inputs, 24 transistor outputs (current less than 0.1A), without LED indicator
	FB-48EX	Header connector, 48 DC24V inputs, without LED indicator
	FB-48EYT	Header connector, 48 transistor outputs (current less than 0.1A), without LED indicator
Display Modules	FB-7SG1	Thin type, Header connector, 7 segment display module, drives 1 set (8 digits) 7-Segment LEDs.
	FB-7SG2	Thin type, Header connector, 7 segment display module, drives 2 sets (16 digits) 7-Segment LEDs.
Analog Input + Temperature Modules	FB-2AH4	Thin type, terminal block, 2 points of general purpose analog input, 4 points of PT-100 RTD input
	FB-2AT4	Thin type, terminal block, 2 points of general purpose analog input, 4 points of PT-1000 RTD input
	FB-2AJ4	Thin type, terminal block, 2 points of general purpose analog input, 4 points of J-type thermocouple input
	FB-2AK4	Thin type, terminal block, 2 points of general purpose analog input, 4 points of K-type thermocouple input
	FB-4AJ(K)12	Terminal block, 4 points of 12 bits general purpose analog input, 12 points of J(K) thermocouple input
	FB-4AJ(K)18	Terminal block, 4 points of 12 bits general purpose analog input, 18 points of J(K) thermocouple input
	FB-4AJ(K)24	Terminal block, 4 points of 12 bits general purpose analog input, 24 points of J(K) thermocouple input
Analog Modules	FB-6AD	Thin type, terminal block, 6 analog inputs, 12 bits resolution, selectable input signal: -10V/-5V~0V~+10V/+5V，-20mA/-10mA~0mA~+20mA/+10mA
	FB-2DA	Thin type, terminal block, 2 analog outputs, 12 bits resolution, selectable output signal: -10V/-5V~0V~+10V/+5V, -6V/-3V~+2V/+1V~+10V/+5V, -20mA/-10mA~0mA~+20mA/+10mA, -12mA/-6mA~+4mA/+2mA~+20mA/+10mA, 16 types in total
	FB-EPOW-◎	Thin type, power supply for expansion module, two sets 24VDC/400mA power output

• SHSC: Software High Speed counter   • HHSC: Hardware High Speed counter   • diff: Differential

Item	Model	Specifications
Programming device	FP-07A	Hand-held programming panel
	FP-07B	Hand-held programming panel with EPROM/EEPROM/FLASHROM writer and RS-232 communication interface
	PROLADDER-DOS	DOS version PROLADDER programming software
	PROLADDER-WIN	WINDOWS version PROLADDER programming software
Communication Converter / Cable	FB-DTBR	Communication distributor which provides the independent connection of these 3 communication ports deriving from the main unit
	FB-DTBR-E	Communication distributor with Ethernet interface, which provides the independent connection of the communication ports deriving from the main unit
	FB-485	The communication converter which converts RS-232 to RS-485 signal
	FB-485P0	Converts the comm. port 0 (HCMOS) to RS-485 signal and leads to communication connector of 3-pin terminal block
	FB-485P2	Transparently transfer comm. port 2 (RS-485) to communication connector of 3-pin terminal block
	FB-232P0-9F-150	Converts the FB main unit port0(HCMOS) to RS-232 signal and connects to a communication line of 9Pin D-sub female connector with a 150cm cable
	FB-232P0-25F-150	Converts the FB main unit port0(HCMOS) to RS-232 signal and connects to a communication line of 25Pin D-sub female connector with a 150 cm cable
	FB-MOSP0-MD-150	Connects the FB main unit port0(HCMOS) to communication line(for FP-07) on Mini-DIN connector with a 150 cm cable
	FB-232P1-9M-30	Connects the FB main unit port1(RS-232) to communication line of 9Pin D-sub male connector with a 30cm cable
	FB-232P1-9F-150	Connects the FB main unit port1(RS-232) to communication line of 9Pin D-sub female connector with a 150cm cable
	FB-232P1-25F-150	Connects the FB main unit port1(RS-232) to communication line of 25Pin D-sub female connector, with a 150cm cable
	FB-MOSP0-9M-150	Connects the FB main unit port0(HCMOS) to communication line of 9Pin D-sub male connector with a 150 cm cable (for FB-DAP-A/AR)
	FB-3EXT-15	Transparently transfer the signals of the main unit 15Pin D-sub to 3 independent 15Pin D-sub's
I/O cable	HD30-22AWG-200	30 Pin/22 AWG header I/O cable, in 200cm length(for FB-48EA/EX/EY)
Convenient MMI	FB-DAP-A(R)	16 × 2 LCD display, 20 keypads, HCMOS communication interface (with wireless card reader)
	FB-DAP-B(R)	16 × 2 LCD display, 20 keypads, need 24V power supply, RS-485 communication interface (with wireless card reader)
Wireless card	CARD-1	Read only wireless card (for FB-DAP-AR/BR)
	CARD-2	Read/Witre wireless card (for FB-DAP-AR/BR)
Training box	FB-TBOX	Dimension of the box: 50cm × 36cm × 18cm, which with FBE-28MCTR main unit, FP-07 handhled programmer, 16 simulation switch inputs, 12 isolated relay outputs, stepping motor, encoder, 7-segment LED, I/O terminal, thumbwheel switch, keyboard with16 key
Input simulation switch	FB-28SW	Input simulation switch for 20/28 points main unit.
	FB-40SW	Input simulation switch for 40 points main unit.
7 segment LED and display board	DB.56 (DB.56LED)	.56' x 8 7 segment LED display board (with 7 segment LED)
	DB.8 (DB.8LED)	.8' x 8 7 segment LED display board (with 7 segment LED)
	DB2.3 (DB2.3LED)	2.3' x 8 7 segment LED display board (with 7 segment LED)
	DB4.0 (DB.56LED)	4.0' x 8 7 segment LED display board (with 7 segment LED)
ROM PACK	EPROM-1M	1M bits EPROM PACK (for storing ladder program and data)
	FLASHROM-1M	1M bits FLASHROM PACK (for storing ladder program and data)
ROM EXTRACTOR	ROM-EXTRACTOR	ROM PACK extractor

- 1. □：Blank-Relay output, T-Transistor output, S-SSR output   ex: FBE-20MCT
- 2. ◇：Blank-Sink (NPN), J-Source (PNP)   ex: FBE-20MCTJ
- 3. △：R (real time clock), for option   ex: FBE-20MCTJR
- 4. ◎：Blank-100~240VAC Power, D-DC24V Power   ex: FBE-20MCTJR-D
- 5. The specifications are subject to change without prior notice

1.4 Function Specifications of Main Units

■ CPU specifications

"*" is default, user configurable

Item				Specification	Note
Execution speed				0.33uS/Sequential instruction	
Program capacity				13K Words	
Program memory				EPROM、FLASHROM or RAM+ Lithium battery Back-up	
Sequential instruction				34 instructions	
Function instructions		MA Model		275 instructions (103 Kinds)	Include derivative instruction
		MC Model		300 instructions (109 Kinds)	
Flow chart command (SFC)				4	
Digital《Bit status》	X	Input contact (DI)		X0～X255 (256)	External digital input
	Y	Output relay (DO)		Y0～Y255 (256)	External digital output
	TR	Temporary relay		TR0～TR39 (40)	
	M	Internal relay	Non-retentive	M0～M799 (800)*	
				M1400～M1911 (512)	
			Retentive	M800～M1399 (600)*	
		Special relay		M1912～M2001 (90)	
	S	Step relay	Non-retentive	S0～S499 (500)	
			Retentive	S500～S999 (500)	
	T	Timer "Time up" status contact		T0～T255 (256)	
	C	Counter "Count up" status contact		C0～C255 (256)	
Register《Word data》	TMR	Timer current value register	0.01S time base	T0～T49 (50)*	
			0.1S time base	T50～T199 (150)*	
			1S time base	T200～T255 (56)*	
	CTR	Counter current value register	16 Bits Non-retentive	C0～C139 (140)*	
			16 Bits Retentive	C140～C199 (60)*	
			32 Bits Non-retentive	C200～C239 (40)*	
			32 Bits Retentive	C240～C255 (16)*	
	HR DR	Data register	Retentive	R0～R2999 (3000)* D0～D3071 (3072)*	
			Non-retentive	R3000～R3839 (840)*	
	HR ROR		Retentive	R5000～R8071 (3072)*	
			Read only register	R5000～R8071 can be set to ROR(0)*	ROR will be saved into program area
	IR	Analog input register (AI)		R3840～R3903 (64)	Correspond to external analog input
	OR	Analog output register (AO)		R3904～R3967 (64)	Correspond to external analog output
	SR (Special register)	System register		R3968～R4095，R4136～R4167 (157)	Except for R4152~R4154
		0.1mS high-speed timer register		R4152～R4154 (3)	
		High-speed counter register	Hardware (4 sets)	DR4096～DR4110 (4×4)	
			Software (4 sets)	DR4112～DR4126 (4×4)	
		Calendar register	Minute Second	R4129 R4128	Option

Calendar register	Minute	Second	Year	Month	R4133	R4132	Option
	R4129	R4128	Year	Month	R4133	R4132	
	Date	Hour	Hour Minute	Week	R4135	R4134	

	XR	Index register		V、Z (2)		
Interrupt control		External input interrupt		32 interrupts (16 points input positive/negative edge)		
		Internal timing interrupt		8 modes(1、2、3、4、5、10、50、100mS)		
0.1mS High speed timer (HST)				1(16 bits)、4(32 bits, share with HHSC)		

Item			Specification	Note
High-speed counter	Hardware high-speed counter (HHSC) /32bits	Quantity	3(19MC/20MC)、4(26MC/28MC/36MC/40MC)	• Total of HHSC and SHSC is 8 sets
		Counting mode	8 modes(U/D、U/D×2、K/R、K/R×2、A/B、A/B×2、A/B×3、A/B×4)	• HHSC can be converted into 32bits/0.1mS time base high speed timer
		Counting frequency	Maximum is 20KHz(Single end input) or 512KHz(FB$_N$ differential input)	
	Software high-speed counter (SHSC) /32bits	Quantity	2(MA model),4(MC model)	
		Counting mode	3 modes(U/D、K/R、A/B)	
		Counting frequency	Maximum 8KHz	
Communication interface	HCMOS (port0)		Communication speed 9.6Kbps～38.4Kbps，LRC error check	Default is 9.6Kbps
	RS-232 (port1)		Communication speed 600bps～38.4Kbps，LRC error check	
	RS-485 (port2)		Communication speed 4800bps～614.4Kbps，LRC or CRC-16 error check	
	Maximum link stations		1～255(255)	
NC position pulse output (HSPSO)	Number of axis		1 axis(19MC/20MC)、2 axes(26MC/28MC)、4axes(36MC/40MC)	Only available for MC
	Maximum output frequency		20KHz(Single ended output)、512KHz(FB$_N$ differential output)	
	Pulse output mode		3 modes(U/D、K/R、A/B)	
	Position language		Dedicated FACON position language	

1.5 Environmental Specifications

Item			Specification	Remark
Operating ambient air temperature	Enclosed equipment	min.	5°C	Permanent installation
		max.	40°C	
	Open equipment	min.	5°C	
		max.	55°C	
Storage temperature			-25°C～+70°C	
Relative humidity			5%～95%	
Pollution degree			Degree II	
Corrosion immunity			According to IEC-68	
Altitude			≦2000m	
Vibration immunity	Mount DIN RAIL		0.5G，3 axis direction， 2hrs for each direction	
	Mount by screw		2G，3 axis direction，2hrs for each direction	
Shock immunity			10G，3 axis direction，3 times for each direction	
Noise immunity			1500Vp-p，width 1us	
Withstand			1500VAC，1 minute	L，N to any other terminal

⚠ Warning

The above stated are the normal application environment condition of the FB-PLC, please confirm with Fatek for any application condition exceeding the above stated limits.

⚠ Caution

Under industrial environment, the mains may cause non-periodical transient high current or high voltage pulses due to the opening or closing of the mains of other large power equipments, The user should take appropriate action (such as using power transformer or MOV suppressing elements) to protect the PLC and its peripheral system.

1.6   I/O Wiring Diagram of Various Models

The I/O wiring diagram for various models are shown below. They are based on 4 different models divided into FBE main unit, FBN main unit, expansion unit, and expansion module totally in four.

1.6.1   FBE main units   （9.52mm detachable terminal block）

- Main unit with 20 points of Digital I/O.
  （12 inputs / 8 outputs）

  DC power source

+24V OUT-	X0	X2	X4	X6	X8	X10	•	•
C	C	X1	X3	X5	X7	X9	X11	•	•

SINK
SOURCE

FBE-20MA-D/FBE-20MC-D

24VDC

SINK
SOURCE

+	−		•	Y1	Y2	C4	Y5	Y7	•	•
G⏚	C0	Y0	C2	Y3	Y4	Y6	•	•	•

AC power source

+24V OUT-	X0	X2	X4	X6	X8	X10	•	•
C	C	X1	X3	X5	X7	X9	X11	•	•

SINK
SOURCE

FBE-20MA /FBE-20MC

100V~240VAC

SINK
SOURCE

L	N		•	Y1	Y2	C4	Y5	Y7	•	•
G⏚	C0	Y0	C2	Y3	Y4	Y6	•	•	•

- Main unit with 28 points of Digital I/O.
  （16 inputs / 12 outputs）

  DC power source

+24V OUT-	X0	X2	X4	X6	X8	X10	X12	X14
C	C	X1	X3	X5	X7	X9	X11	X13	X15

SINK
SOURCE

FBE-28MA-D/FBE-28MC-D

24VDC

SINK
SOURCE

+	−		•	Y1	Y2	C4	Y5	Y7	Y8	Y10
G⏚	C0	Y0	C2	Y3	Y4	Y6	C8	Y9	Y11

● Main unit with 28 points of Digital I/O.
（16 inputs / 12 outputs）

+24V OUT-	X0	X2	X4	X6	X8	X10	X12	X14
C	C	X1	X3	X5	X7	X9	X11	X13	X15

SINK
SOURCE

FBE-28MA /FBE-28MC

AC power source

100V~240VAC

SINK
SOURCE

L	N	•	Y1	Y2	C4	Y5	Y7	Y8	Y10
G⊕	C0	Y0	C2	Y3	Y4	Y6	C8	Y9	Y11

● Main unit with 40 points of Digital I/O.
（24 inputs / 16 outputs）

+24V OUT-	X0	X2	X4	X6	C	X9	X11	X13	X15	X16	X18	X20	X22
C	C	X1	X3	X5	X7	X8	X10	X12	X14	C	X17	X19	X21	X23

SINK
SOURCE

FBE-40MA-D/FBE-40MC-D

DC power

24VDC

SINK
SOURCE

+	−	•	Y1	•	Y2	•	Y4	Y6	•	Y8	Y10	•	Y12	Y14
G⊕	C0	Y0	•	C2	Y3	C4	Y5	Y7	C8	Y9	Y11	C12	Y13	Y15

+24V OUT-	X0	X2	X4	X6	C	X9	X11	X13	X15	X16	X18	X20	X22
C	C	X1	X3	X5	X7	X8	X10	X12	X14	C	X17	X19	X21	X23

SINK
SOURCE

FBE-40MA/FBE-40MC

AC power

100V~240VAC

SINK
SOURCE

L	N	•	Y1	•	Y2	•	Y4	Y6	•	Y8	Y10	•	Y12	Y14
G⊕	C0	Y0	•	C2	Y3	C4	Y5	Y7	C8	Y9	Y11	C12	Y13	Y15

1.6.2 FBN Main Units （7.62mm detachable terminal block）

● Main unit with 19 points of digital I/O
（11 inputs / 8 outputs）

DC power source

+24V OUT-	1 -	2 -	3 -	•	•	•	4	6	8	10
FG	1+	2+	3+	•	•	•	C	5	7	9	11

SINK / SOURCE

FBN-19MC-D

SINK / SOURCE

24VDC

+	−	•	0 -	1 -	•	•	•	2	4	6	•
G⊕	SG	0+	1+	•	•	•	C2	3	5	7	•

AC power source

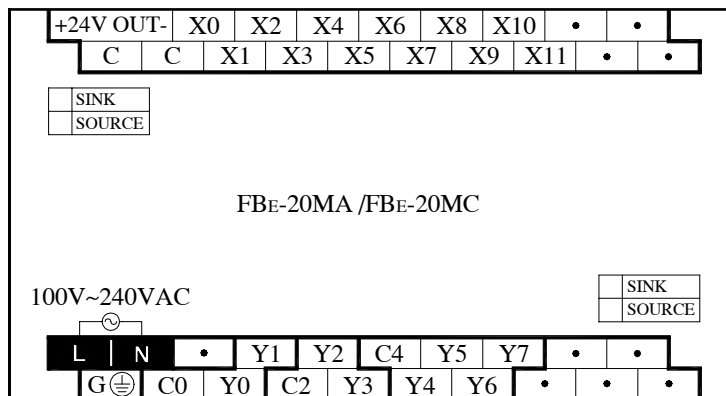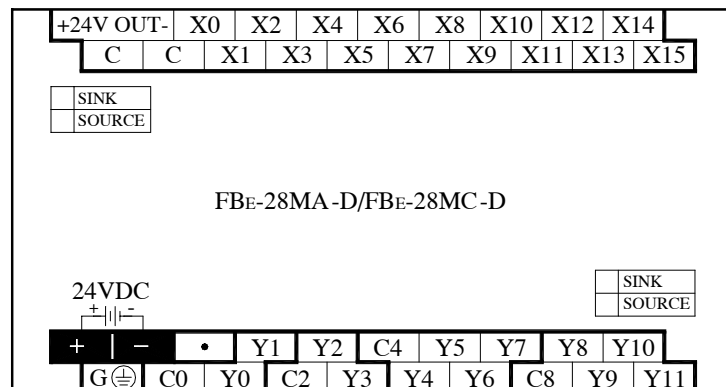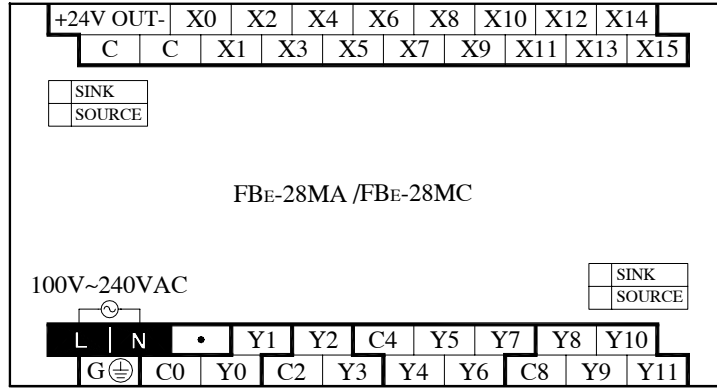	+24V OUT-	1 -	2 -	3 -	•	•	•	4	6	8	10
FG	1+	2+	3+	•	•	•	C	5	7	9	11

SINK / SOURCE

FBN-19MC

SINK / SOURCE

100V~240VAC

L	N	•	0 -	1 -	•	•	•	2	4	6	•
G⊕	SG	0+	1+	•	•	•	C2	3	5	7	•
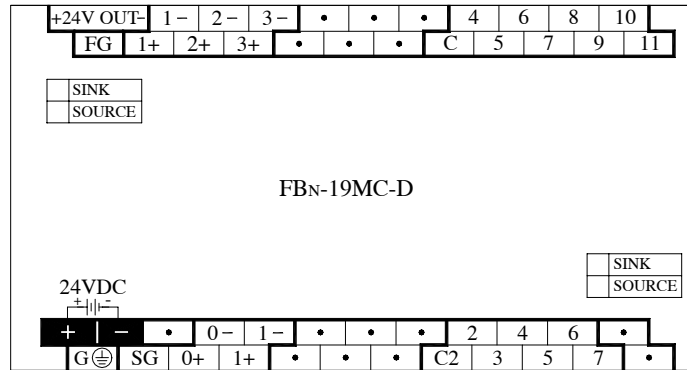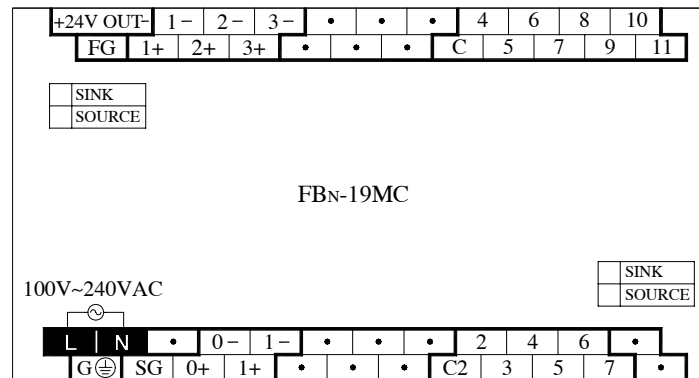
● Main unit with 26 points of digital I/O.
（14 inputs / 12 outputs）

DC power source

+24V OUT-	0 -	1 -	3 -	4 -	5 -	7 -	8	10	12	14
FG	0+	1+	3+	4+	5+	7+	C	9	11	13	15

SINK / SOURCE

FBN-26MC-D

SINK / SOURCE

24VDC

+	−	•	0 -	1 -	2 -	3 -	•	4	6	8	10
G⊕	SG	0+	1+	2+	3+	•	C4	5	7	9	11

AC power source

+24V OUT-	0 -	1 -	3 -	4 -	5 -	7 -	8	10	12	14
FG	0+	1+	3+	4+	5+	7+	C	9	11	13	15

SINK / SOURCE

FBN-26MC

SINK / SOURCE

100V~240VAC

L	N	•	0 -	1 -	2 -	3 -	•	4	6	8	10
G⊕	SG	0+	1+	2+	3+	•	C4	5	7	9	11
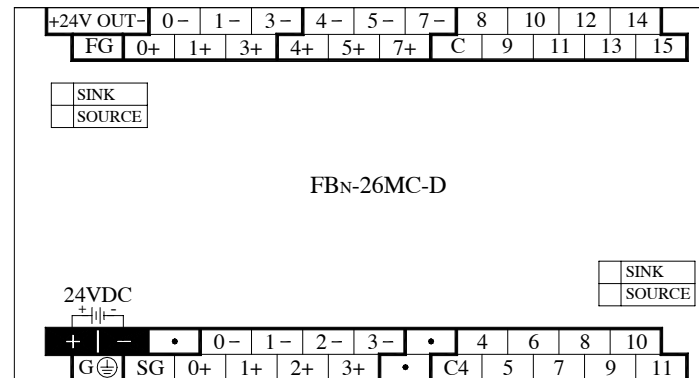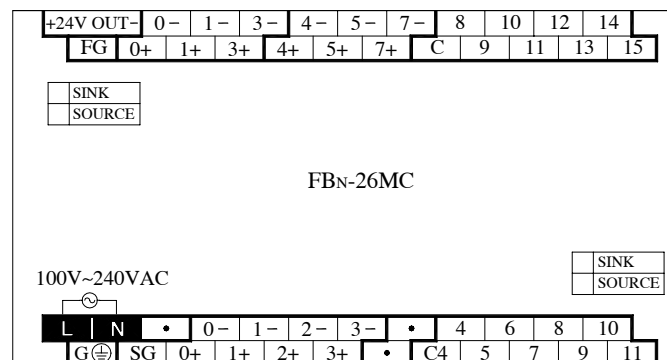
- Main unit with 36 points of digital I/O.
  （20 inputs / 16 outputs）

+24V OUT-	0−	1−	3−	4−	5−	7−	8−	9−	11−	12−	13−	15−	16	18	20	22
FG	0+	1+	3+	4+	5+	7+	8+	9+	11+	12+	13+	15+	C	17	19	21	23

SINK
SOURCE

FBN-36MC-D

DC power source

SINK
SOURCE

24VDC

+	−	•	0−	1−	2−	3−	0+	1+	2+	3+	•	8	9	11	•	12	14
G⏚	SG0	0+	1+	2+	3+	SG4	4−	5−	6−	7−	•	C8	10	•	C12	13	15

+24V OUT-	0−	1−	3−	4−	5−	7−	8−	9−	11−	12−	13−	15−	16	18	20	22
FG	0+	1+	3+	4+	5+	7+	8+	9+	11+	12+	13+	15+	C	17	19	21	23

SINK
SOURCE

AC power source

FBN-36MC

SINK
SOURCE

100V~240VAC

L	N	•	0−	1−	2−	3−	0+	1+	2+	3+	•	8	9	11	•	12	14
G⏚	SG0	0+	1+	2+	3+	SG4	4−	5−	6−	7−	•	C8	10	•	C12	13	15

1.6.3　Digital I/O Expansion Units　（9.52mm terminal block）

- Expansion unit with 28 points of digital I/O.
  （16 inputs / 12 outputs）

+24V OUT-	X1	X3	X5	X7	X9	X11	X13	X15
C	C	X2	X4	X6	X8	X10	X12	X14	X16

SINK
SOURCE

FB-28EAP-D

DC power

SINK
SOURCE

24VDC

+	−	•	Y2	Y3	C5	Y6	Y8	Y9	Y11
G⏚	C1	Y1	C3	Y4	Y5	Y7	C9	Y10	Y12

+24V OUT-	X1	X3	X5	X7	X9	X11	X13	X15
C	C	X2	X4	X6	X8	X10	X12	X14	X16

SINK
SOURCE

AC power

FB-28EAP

SINK
SOURCE

100V~240VAC

L	N	•	Y2	Y3	C5	Y6	Y8	Y9	Y11
G⏚	C1	Y1	C3	Y4	Y5	Y7	C9	Y10	Y12
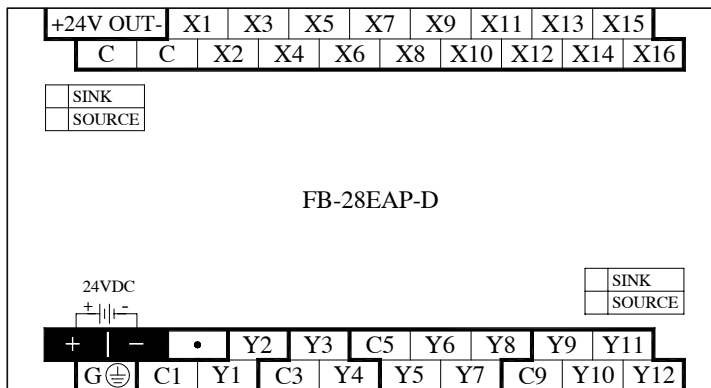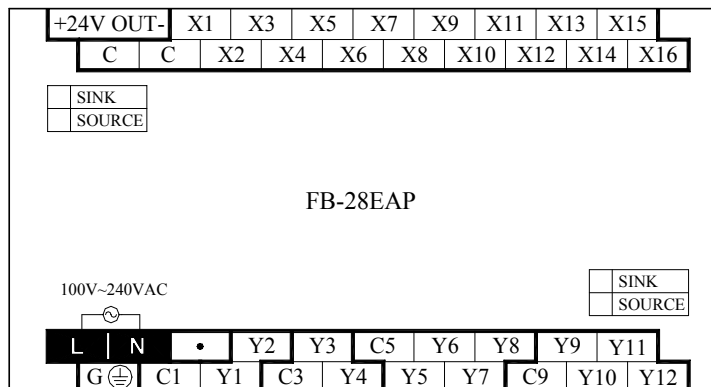
- **Expansion unit with 40 points of digital I/O.**
  （24 inputs / 16 outputs）

DC power

FB-40EAP-D

| +24V OUT- | X1 | X3 | X5 | X7 | C | X10 | X12 | X14 | X16 | X17 | X19 | X21 | X23 |
| C | C | X2 | X4 | X6 | X8 | X9 | X11 | X13 | X15 | C | X18 | X20 | X22 | X24 |

SINK / SOURCE

24VDC
±‖‡

SINK / SOURCE

| + | — | • | Y2 | • | Y3 | • | Y5 | Y7 | • | Y9 | Y11 | • | Y13 | Y15 |
| G⏚ | C1 | Y1 | • | C3 | Y4 | C5 | Y6 | Y8 | C9 | Y10 | Y12 | C13 | Y14 | Y16 |

AC power

FB-40EAP

| +24V OUT- | X1 | X3 | X5 | X7 | C | X10 | X12 | X14 | X16 | X17 | X19 | X21 | X23 |
| C | C | X2 | X4 | X6 | X8 | X9 | X11 | X13 | X15 | C | X18 | X20 | X22 | X24 |

SINK / SOURCE

100V~240VAC

SINK / SOURCE

| L | N | • | Y2 | • | Y3 | • | Y5 | Y7 | • | Y9 | Y11 | • | Y13 | Y15 |
| G⏚ | C1 | Y1 | • | C3 | Y4 | C5 | Y6 | Y8 | C9 | Y10 | Y12 | C13 | Y14 | Y16 |

1.6.4 Digital I/O Expansion Modules

- **Expansion module with 28 points of digital I/O.**
  （16 inputs / 12 outputs）

  ⎡ 9.52mm
  ⎣ Terminal block ⎤
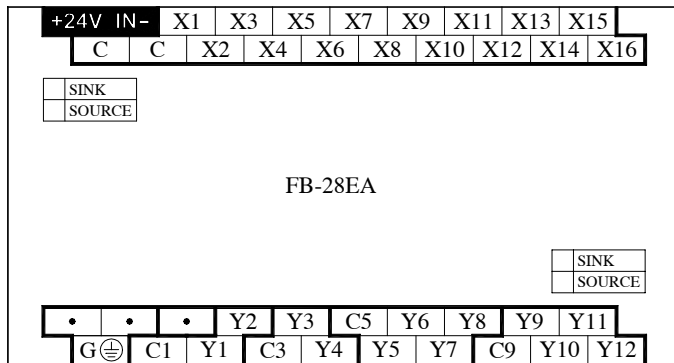
FB-28EA

| +24V IN- | X1 | X3 | X5 | X7 | X9 | X11 | X13 | X15 |
| C | C | X2 | X4 | X6 | X8 | X10 | X12 | X14 | X16 |

SINK / SOURCE

SINK / SOURCE

| • | • | • | Y2 | Y3 | C5 | Y6 | Y8 | Y9 | Y11 |
| G⏚ | C1 | Y1 | C3 | Y4 | Y5 | Y7 | C9 | Y10 | Y12 |

- **Expansion module with 40 points of digital I/O.**
  （24 inputs / 16 outputs）

  ⎡ 9.52mm
  ⎣ Terminal block ⎤

FB-40EA

| +24V IN- | X1 | X3 | X5 | X7 | C | X10 | X12 | X14 | X16 | X17 | X19 | X21 | X23 |
| C | C | X2 | X4 | X6 | X8 | X9 | X11 | X13 | X15 | C | X18 | X20 | X22 | X24 |

SINK / SOURCE

SINK / SOURCE

| • | • | • | Y2 | • | Y3 | • | Y5 | Y7 | • | Y9 | Y11 | • | Y13 | Y15 |
| G⏚ | C1 | Y1 | • | C3 | Y4 | C5 | Y6 | Y8 | C9 | Y10 | Y12 | C13 | Y14 | Y16 |
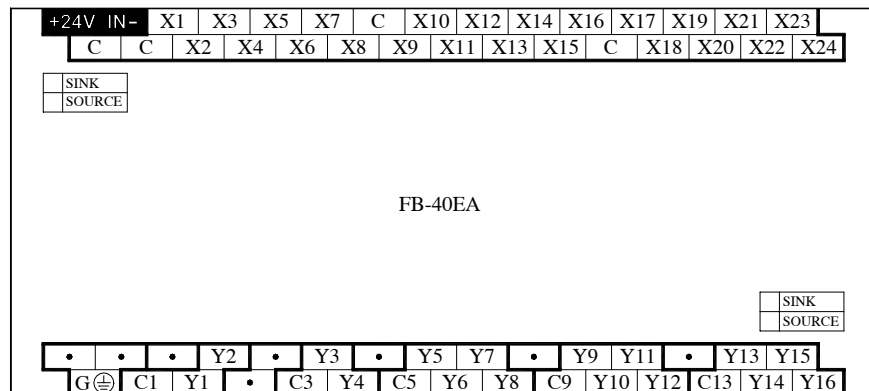
● Expansion module with 32 points of digital input

(9.52mm Terminal block)

| +24V IN− | X1 | X3 | X5 | X7 | X9 | X11 | X13 | X15 |
| C | C | X2 | X4 | X6 | X8 | X10 | X12 | X14 | X16 |

SINK
SOURCE

FB-32EX

SINK
SOURCE

| • | • | X17 | X19 | X21 | X23 | X25 | X27 | X29 | X31 |
| G⏚ | C | X18 | X20 | X22 | X24 | X26 | X28 | X30 | X32 |
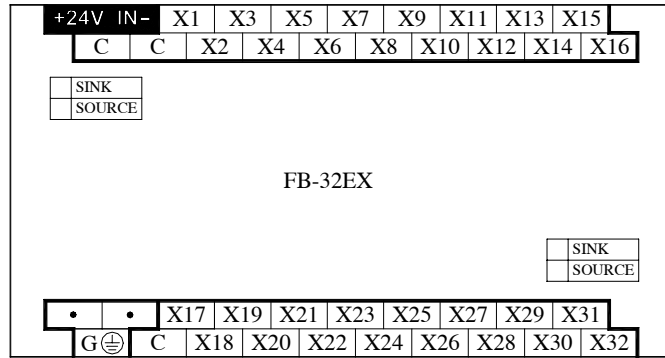
● Expansion module with 8 points of digital I/O
（4 inputs / 4 outputs）

(7.62mm Terminal block)
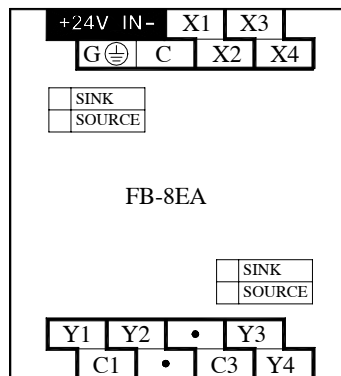
| +24V IN− | X1 | X3 |
| G⏚ | C | X2 | X4 |

SINK
SOURCE

FB-8EA

SINK
SOURCE

| Y1 | Y2 | • | Y3 |
| C1 | • | C3 | Y4 |

● Expansion module with 8 points of digital input

(9.52mm Terminal block)

| +24V IN− | X3 |
| X1 | X2 | X4 |

SINK
SOURCE

FB-8EX

SINK
SOURCE

| G⏚ | X5 | X7 |
| C | X6 | X8 |

● Expansion module with 8 points of digital output

(9.52mm Terminal block)

| G⏚ | Y1 | Y3 |
| C1 | Y2 | Y4 |

SINK
SOURCE

FB-8EY

SINK
SOURCE

| • | Y5 | Y7 |
| C5 | Y6 | Y8 |

● High density expansion module with 48
　points of digital I/O.
　（24 inputs / 24 outputs, Sink type only）

　　　　30 Pins / 2.54mm
　　　　Header connector

SINK

```
  2 • • • • • • • • • • • • • • •  30
▶ 1 • • • • • • • • • • • • • • •  29
```
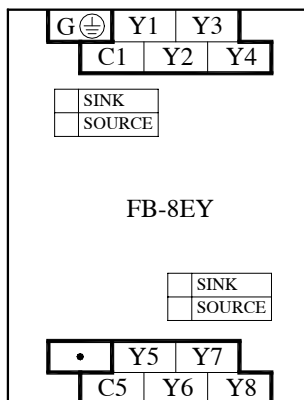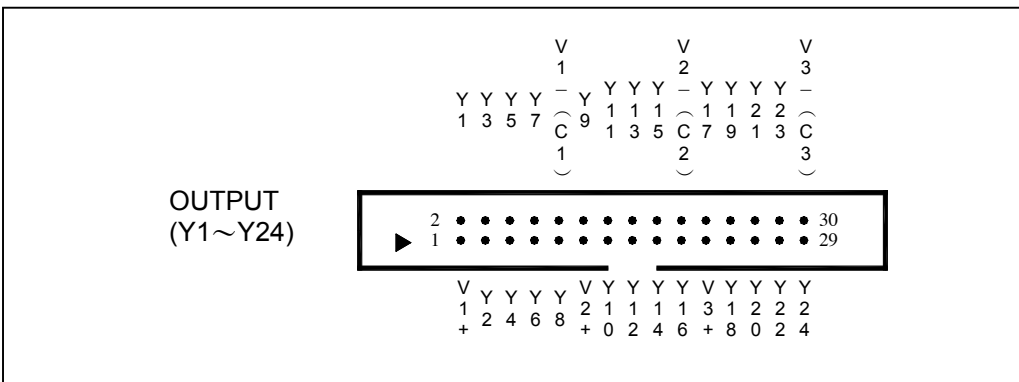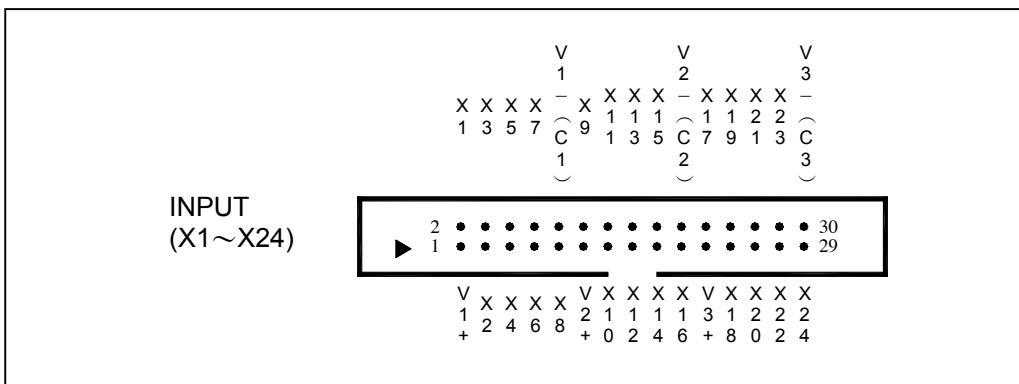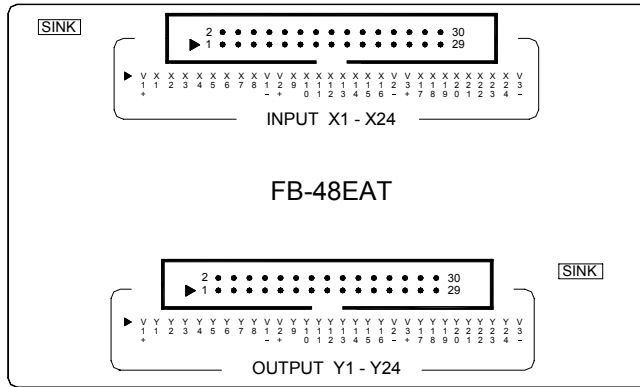
V X X X X X X X X V V X X X X X X X X X X X X X X X X X X X V
1 1 2 3 4 5 6 7 8 1 2 9 1 1 1 1 1 1 2 3 1 1 2 2 2 2 3
+   0 1 2 3 4 5 6 - + 7 8 9 0 1 2 3 4 -

INPUT X1 - X24

FB-48EAT

```
  2 • • • • • • • • • • • • • • •  30
▶ 1 • • • • • • • • • • • • • • •  29
```

SINK

V Y Y Y Y Y Y Y Y V V Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y Y V
1 1 2 3 4 5 6 7 8 1 2 9 1 1 1 1 1 1 2 3 1 1 2 2 2 2 3
+   0 1 2 3 4 5 6 - + 7 8 9 0 1 2 3 4 -

OUTPUT Y1 - Y24

INPUT
(X1～X24)

```
            V             V             V
            1             2             3
X X X X  –  X  X X X  –  X X X X  –
1 3 5 7  C  9  1 1 1  C  1 1 2 2  C
         1     1 3 5  2  7 9 1 3  3

  2 • • • • • • • • • • • • • • •  30
▶ 1 • • • • • • • • • • • • • • •  29

V  X X X X  V X X X X  V X X X X
1  2 4 6 8  2 1 1 1 1  3 1 2 2 2
+           + 0 2 4 6  + 8 0 2 4
```

OUTPUT
(Y1～Y24)

```
            V             V             V
            1             2             3
Y Y Y Y  –  Y  Y Y Y  –  Y Y Y Y  –
1 3 5 7  C  9  1 1 1  C  1 1 2 2  C
         1     1 3 5  2  7 9 1 3  3

  2 • • • • • • • • • • • • • • •  30
▶ 1 • • • • • • • • • • • • • • •  29

V  Y Y Y Y  V Y Y Y Y  V Y Y Y Y
1  2 4 6 8  2 1 1 1 1  3 1 2 2 2
+           + 0 2 4 6  + 8 0 2 4
```
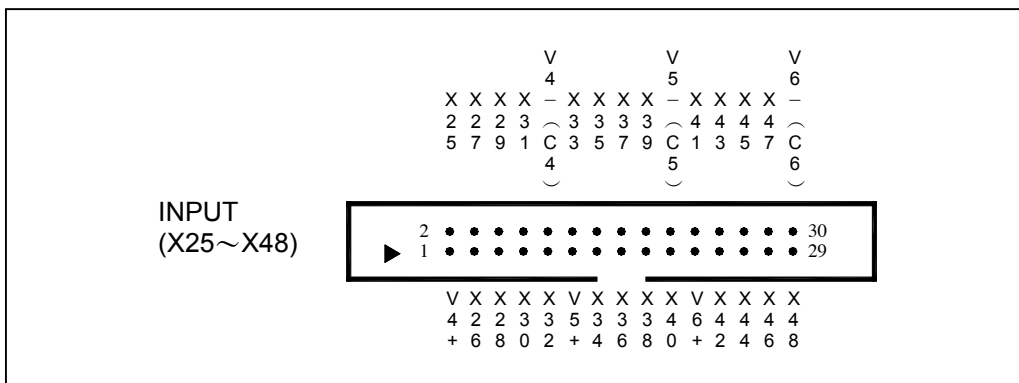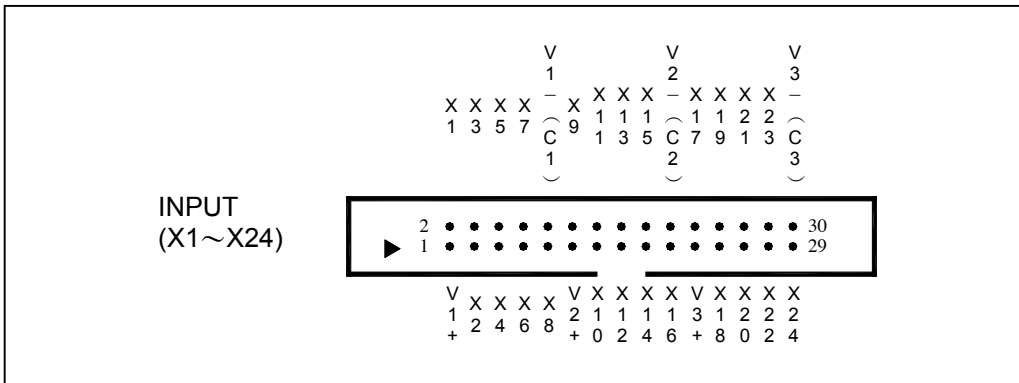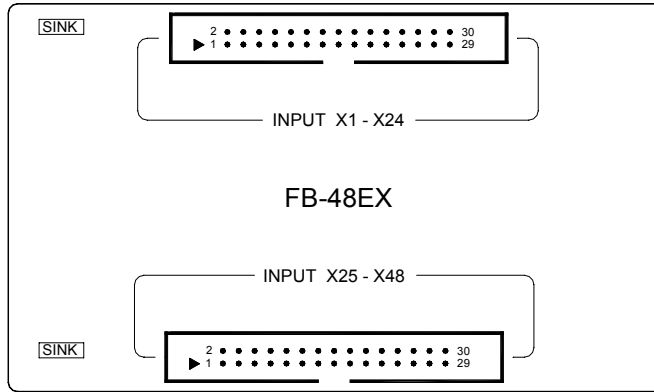
● High density expansion module with 48
  points of digital input.
  (Sink type only)

┌ 30 Pins / 2.54mm ┐
│ Header connector │
└   ┘

[SINK]

INPUT X1 - X24

FB-48EX

INPUT X25 - X48

[SINK]

INPUT
(X1～X24)

```
              V               V               V
              1               2               3
X X X X   ─   X X X X   ─   X X X X   ─
1 3 5 7   C   9 1 1 1   C   1 1 2 2   C
          1     1 3 5   2   7 9 1 3   3
          ⌣             ⌣             ⌣
```
```
  2  ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●  30
▶ 1  ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●  29
```
```
V             V               V
1 X X X X     2 X X X X X     3 X X X X
1 2 4 6 8     + 1 1 1 1 1     + 1 2 2 2 2
+                 0 2 4 6           8 0 2 4
```

INPUT
(X25～X48)

```
              V               V               V
              4               5               6
X X X X   ─   X X X X   ─   X X X X   ─
2 2 2 3   C   3 3 3 3   C   4 4 4 4   C
5 7 9 1   4   3 5 7 9   5   1 3 5 7   6
          ⌣             ⌣             ⌣
```
```
  2  ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●  30
▶ 1  ● ● ● ● ● ● ● ● ● ● ● ● ● ● ●  29
```
```
V X X X X V X X X X X V X X X X
4 2 2 3 3 5 3 3 3 3 4 6 4 4 4 4
+ 6 8 0 2 + 4 6 8 0 + 2 4 6 8
```

1-19

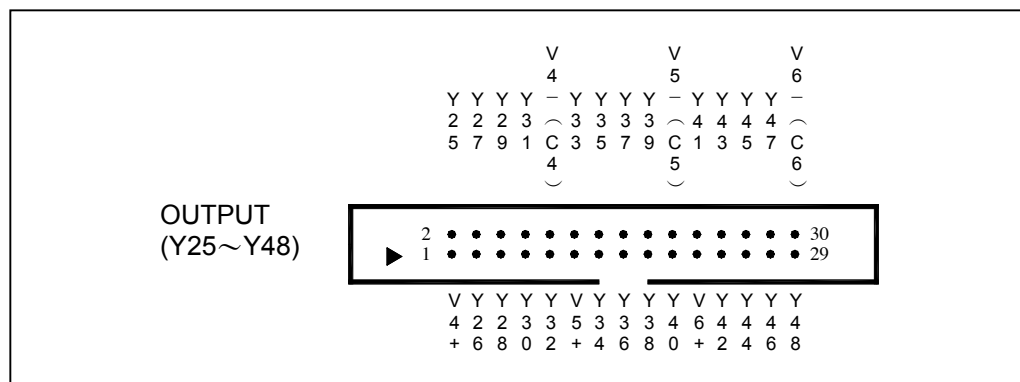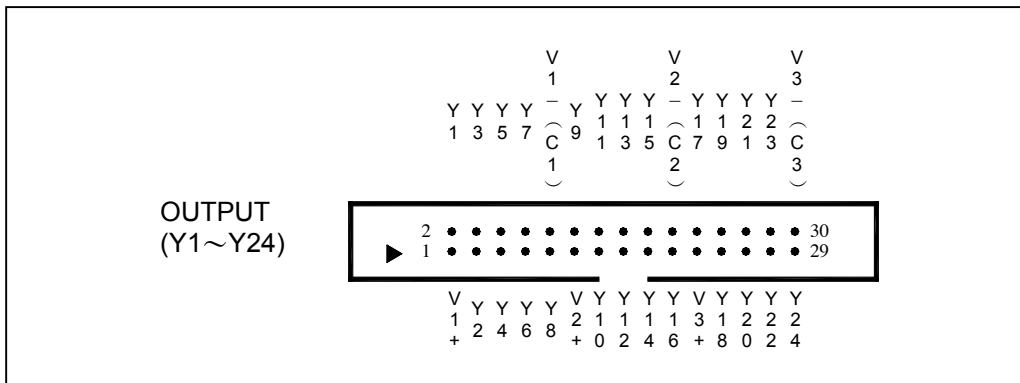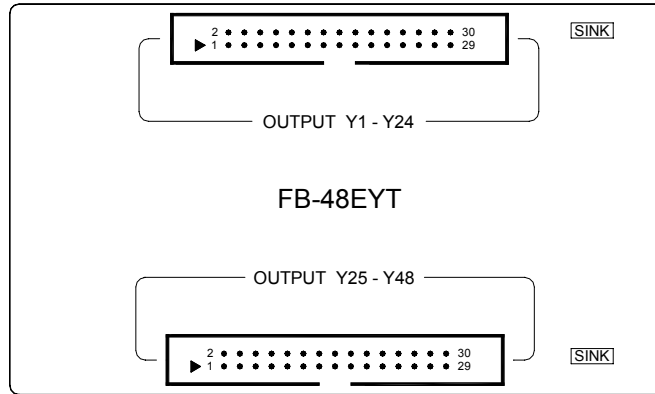- High density expansion module with 48 points of digital output. (Sink type only)

[30 Pins / 2.54mm Header connector]

SINK

OUTPUT Y1 - Y24

FB-48EYT

OUTPUT Y25 - Y48

SINK

OUTPUT (Y1～Y24)

Top row labels:
Y1 Y3 Y5 Y7 (~C1~) Y9 Y11 Y13 Y15 V1− (~C2~) Y17 Y19 Y21 Y23 V2− (~C3~) V3−

```
2 • • • • • • • • • • • • • • 30
▶1 • • • • • • • • • • • • • • 29
```

Bottom row labels:
V1+ Y2 Y4 Y6 Y8 V1+ Y10 Y12 Y14 Y16 V2+ Y18 Y20 Y22 Y24

OUTPUT (Y25～Y48)

Top row labels:
Y25 Y27 Y29 Y31 (~C4~) Y33 Y35 Y37 Y39 V4− (~C5~) Y41 Y43 Y45 Y47 V5− (~C6~) V6−

```
2 • • • • • • • • • • • • • • 30
▶1 • • • • • • • • • • • • • • 29
```

Bottom row labels:
V4+ Y26 Y28 Y30 Y32 V4+ Y34 Y36 Y38 Y40 V5+ Y42 Y44 Y46 Y48

1.6.5 Special Expansion Modules

- 7-segment LED
  display module

  ⎛ 16 Pins / 2.54mm ⎞
  ⎝ Header connector ⎠

+	−	F
+24V	IN	G

DISPLAY 1

FB-7SG 1/2

DISPLAY 2
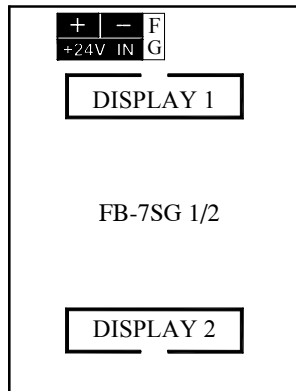
- Analog input
  module with 6
  points of input

  ⎛ 7.62mm ⎞
  ⎝ Terminal block ⎠

+24V	IN−	I0+	I1+
G⏚	FG	I0-	I1-

FB-6AD

I2+	I3+	I4+	I5+
I2-	I3-	I4-	I5-
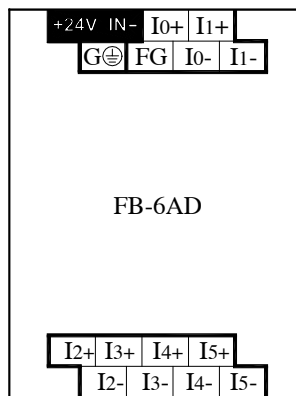
- Analog output
  module with 2
  points of output

  ⎛ 9.52mm ⎞
  ⎝ Terminal block ⎠

+24V	IN−	•
G⏚	•	•

FB-2DA

FG	O0-	O1+
O0+	FG	O1-
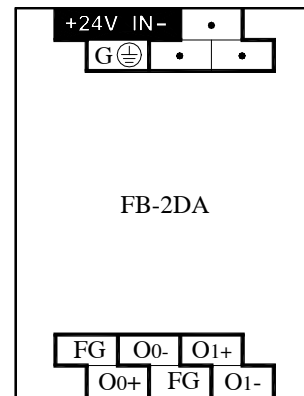
- Temperature module with 2
  points of general purpose
  analog input and 4 points of
  PT100(PT-1000) RTD input

  ⎛ 7.62mm ⎞
  ⎝ Terminal block ⎠

+24V	IN−	I0+	I1+
G⏚	RC	I0-	I1-

RTD
COMM.

FB-2AH(T)4

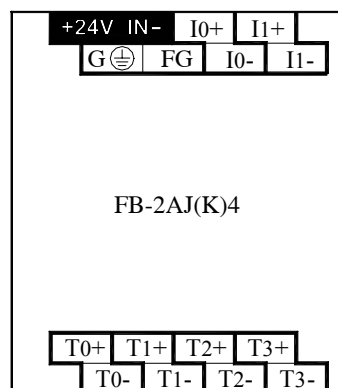| P0	P1	P2	P3
P0	P1	P2	P3
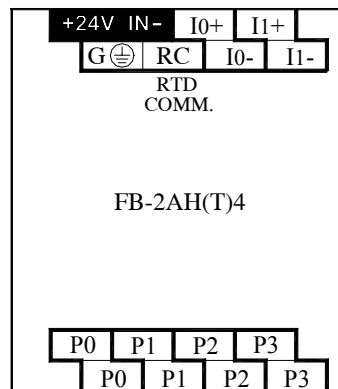
- Temperature module with 2
  points of general purpose
  analog input and 4 points of
  J(K) thermocouple input

  ⎛ 7.62mm ⎞
  ⎝ Terminal block ⎠

+24V	IN−	I0+	I1+
G⏚	FG	I0-	I1-

FB-2AJ(K)4

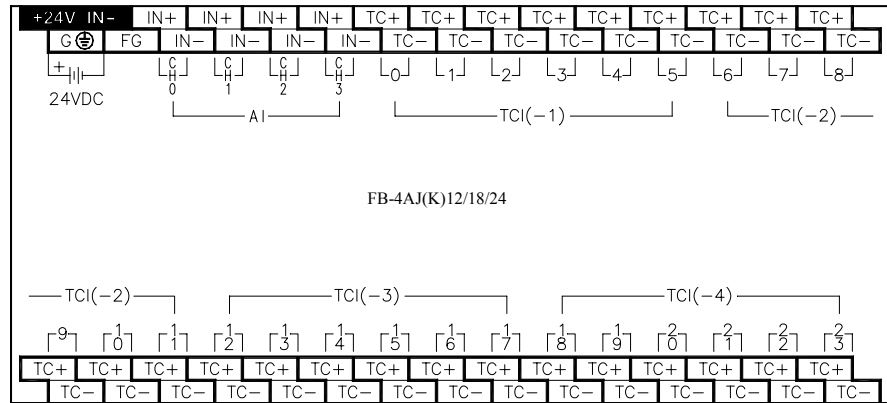| T0+	T1+	T2+	T3+
T0-	T1-	T2-	T3-

- Temperature module with 4 points of general purpose analog input and 12/18/24 points of J(K) thermocouple input

[9.52mm Terminal block]

+24V	IN−	IN+	IN+	IN+	IN+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+
G⏚	FG	IN−	IN−	IN−	IN−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−

24VDC

CH0 CH1 CH2 CH3 | 0 1 2 3 4 5 6 7 8

└── AI ──┘   └──── TCI(−1) ────┘   └── TCI(−2) ──┘

FB-4AJ(K)12/18/24

└── TCI(−2) ──┘   └──── TCI(−3) ────┘   └──── TCI(−4) ────┘

9 10 11 12 13 14 15 16 17 18 19 20 21 22 23

TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+	TC+
TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−	TC−

1.6.6 Power Supply for Expansion Modules （9.52mm terminal block）

- Power supply for expansion module

DC power

+24V OUT−

FB-EPOW-D

24VDC

+ | −

G⏚
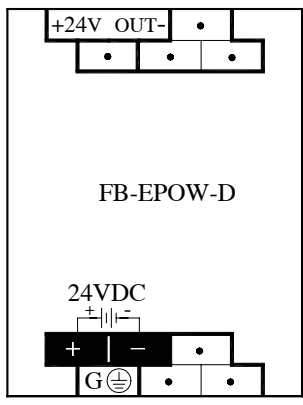
- Power supply for expansion module

AC power

+24V OUT−

FB-EPOW

100V~240VAC

L | N

G⏚