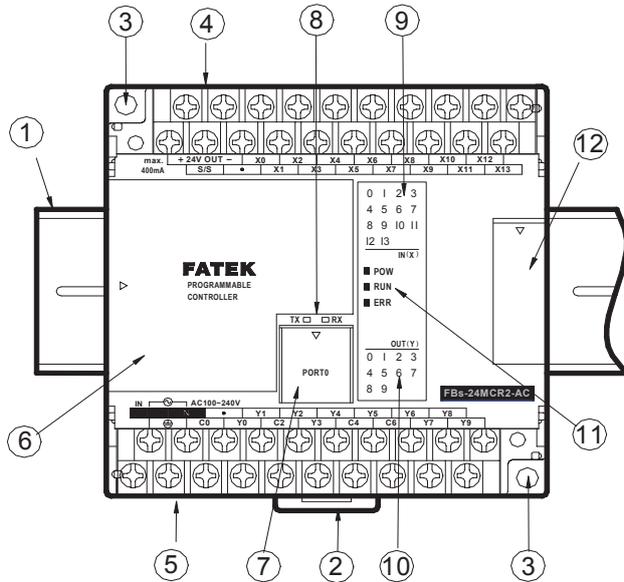


Chapter 1 Introduction of FATEK FBS Series PLC

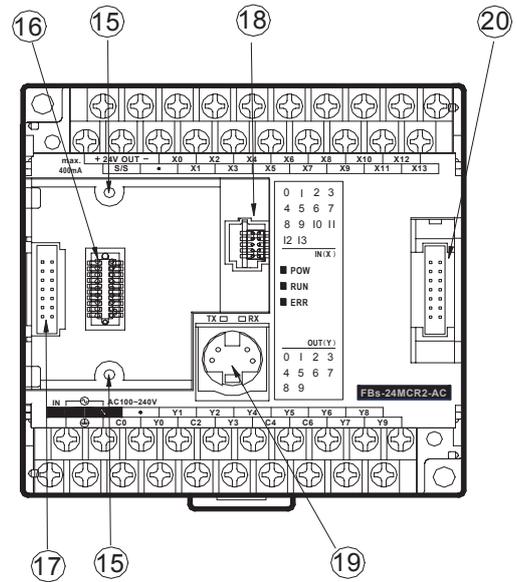
The FATEK FBS Series PLC is a new generation of micro PLC equipped with excellent functions comparable to medium or large PLC, with up to five communication ports. The maximum I/O numbers are 256 points for Digital Input (DI) and Digital Output (DO), 64 words for Numeric Input (NI) and Numeric Output (NO). The Main Units of FBs are available in three types: MA (Economy Type), MC (High-Performance Type), and MN (High-Speed NC Type). With the combination of I/O point ranges from 10 to 60, a total of 17 models are available. Fifteen DI/DO and 19 NI/NO models are available for Expansion Units/Modules. With interface options in RS232, RS485, USB, Ethernet, CANopen, Zigbee and GSM, the communication peripherals are available with 15 boards and modules.

1.1 Appearance of Main Unit

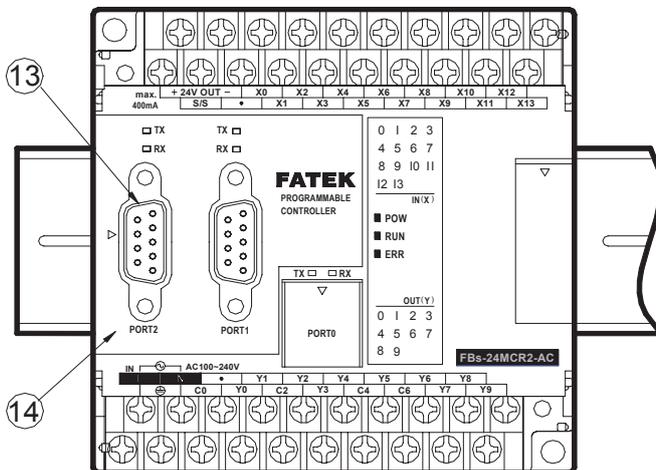
All the Main Units of FBs-PLC have the same physical structure. The only difference is the case width. There are four different case sizes, which are 60mm, 90mm, 130mm, and 175mm. The figure below will use the Main Unit case of the FBs-24MC as an example for illustration:



(Front view without Communication Board)



(Front view with cover plate removed)



(Front view with CB-22 Board installed)

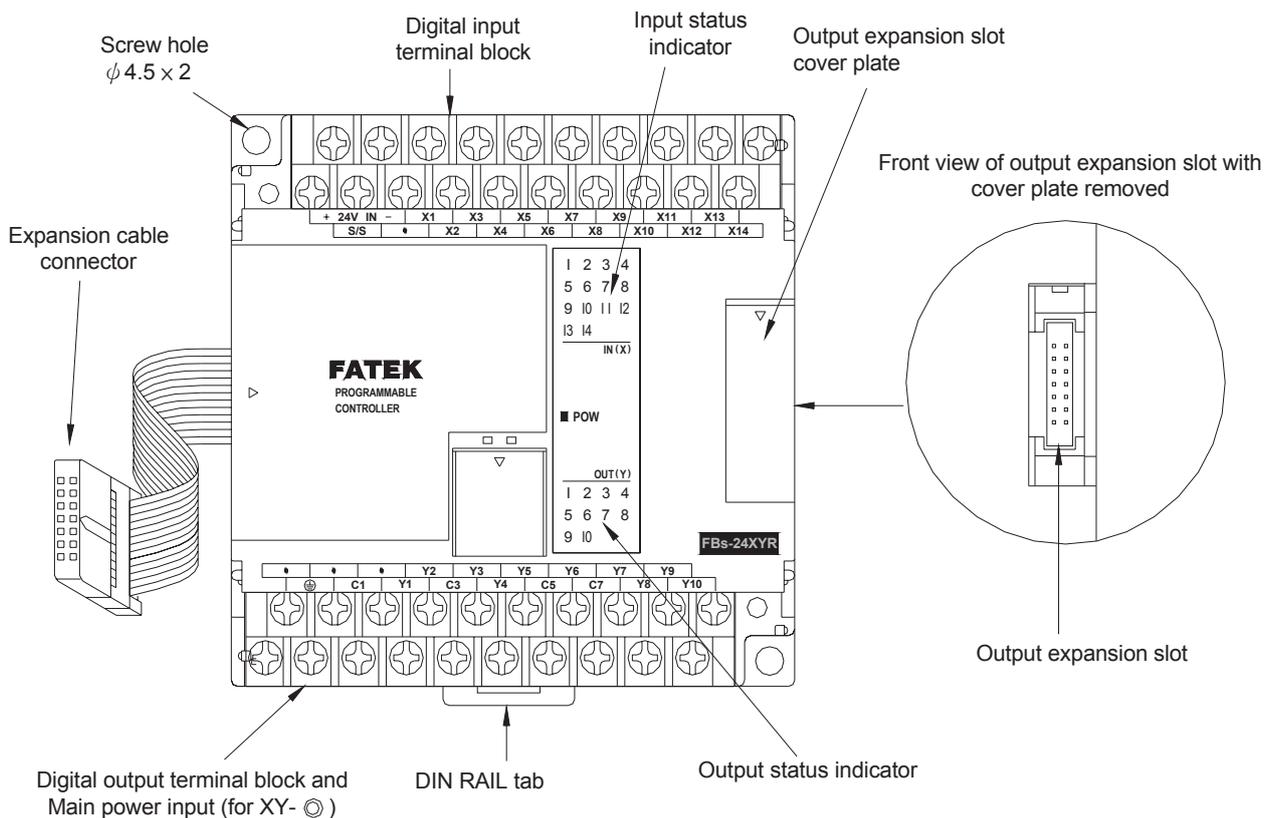
- ① 35mm-width DIN RAIL
- ② DIN RAIL tab
- ③ Hole for screw fixation ($\phi 4.5 \times 2$)
- ④ Terminals of 24VDC power input and digital input (Pitch 7.62mm)
- ⑤ Terminals of main power input and digital output (Pitch 7.62mm)
- ⑥ Standard cover plate (without communication board)
- ⑦ Cover plate of built-in communication port (Port 0)

- ⑧ Indicators for transmit (TX) and receive (RX) status of built-in communication port (Port0).
- ⑨ Indicator for Digital Input (Xn).
- ⑩ Indicator for Digital Output (Yn).
- ⑪ Indicator for system status (POW, RUN, ERR).
- ⑫ I/O output expansion header cover [units of 20 points or beyond only], with esthetic purpose and capable of securing expansion cable.
- ⑬ FBS-CB22 Communication Board (CB).
- ⑭ FBS-CB22 CB cover plate (each CB has its own specific cover plate)
- ⑮ Screw holes of communication board.
- ⑯ Connector for communication board (for 7 types CB of CB2, CB22, CB5, CB55, CB25, CBE, CBCAN , 3 types AIO of B2DA, B2AD, B4AD, and 2 types DAP of BDAP and BPEP)
- ⑰ Left side (communication) expansion header (only available in MC/MN model, for CM22, CM25, CM55, CM25E, CM55E, and CMGSM connection).
- ⑱ Connector for Memory Pack.
- ⑲ Connector for built-in communication port (Port 0) (With USB and RS232 optional, shown in the figure is for RS232)
- ⑳ Right side (I/O) output expansion header (only available in units with 20 points or beyond), for connecting with cables from expansion units/modules.

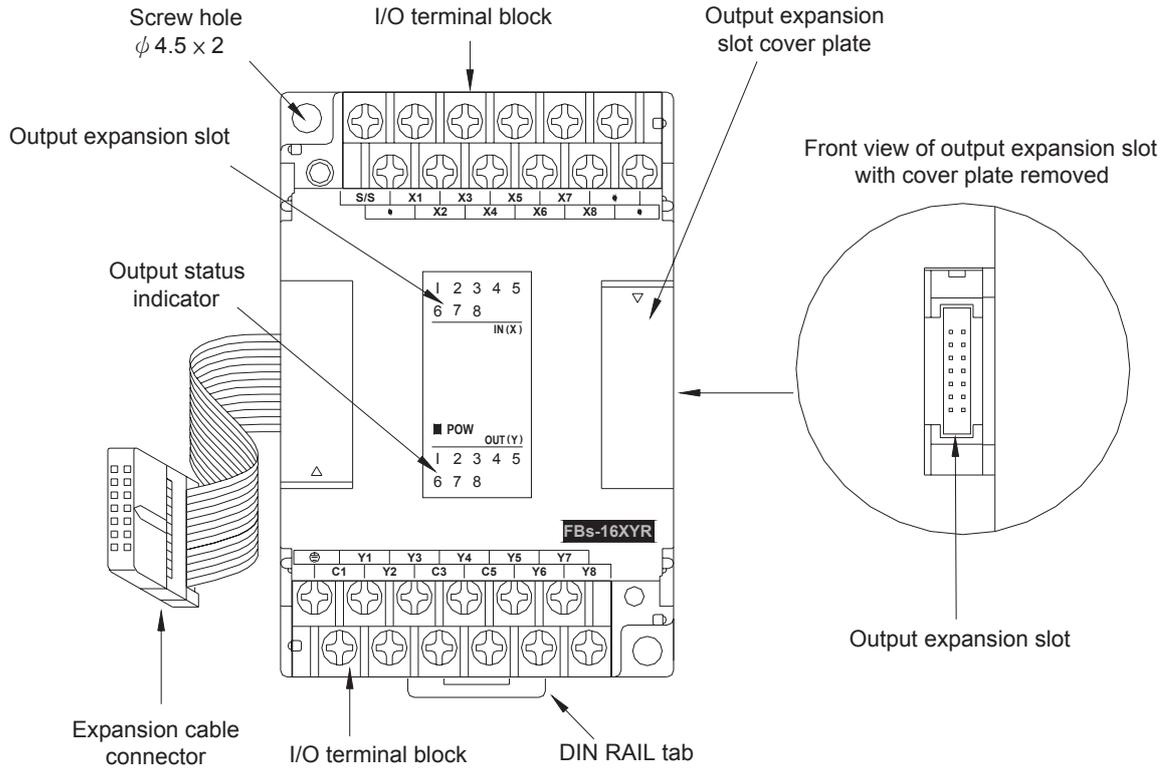
1.2 Appearance of Expansion Unit/Module

There are three types of cases for expansion units/modules. One type uses the same case as main unit that of the 90mm, 130mm, and 175mm, while the other two have thinner 40mm and 60mm cases, which are for expansion modules. All expansion cables (left) of expansion units/modules are flat ribbon cables (5cm long), which were soldered directly on the PCB, and the expansion header (right) is a 14Pin Header, with this to connect the right adjacent expansion units/modules. In the following, each of the three types of expansion units/modules is described as an example:

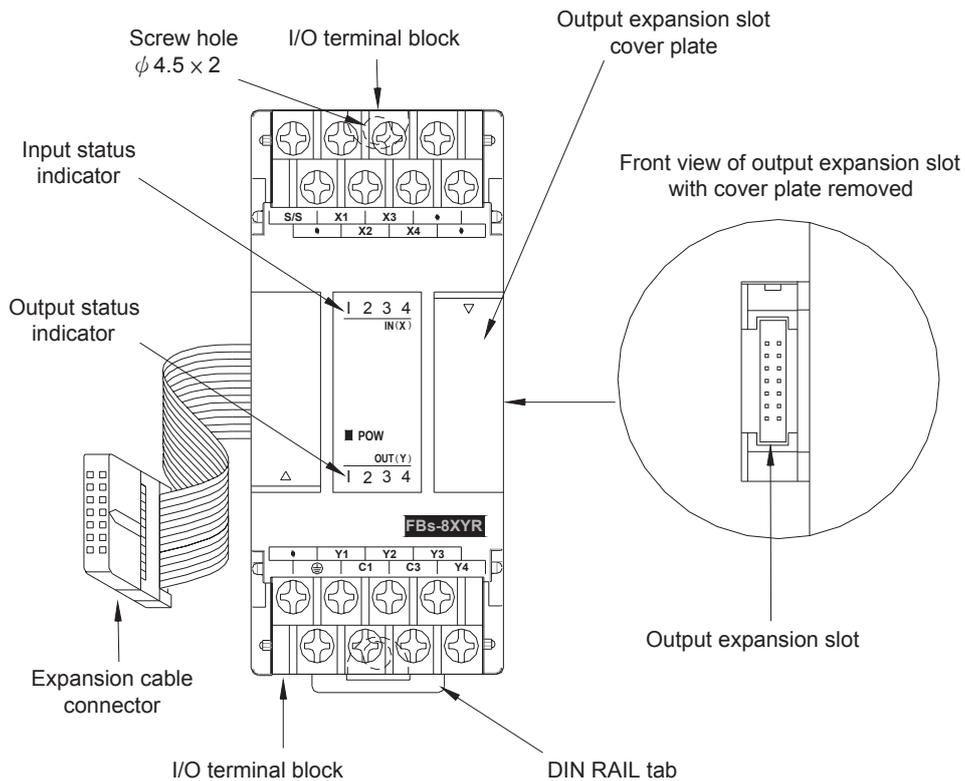
- Expansion unit/module with 90mm, 130mm, or 175mm width case: [-24XY◇-◎, -40XY◇-◎, -60XY◇-◎, -16TC, -16RTD]



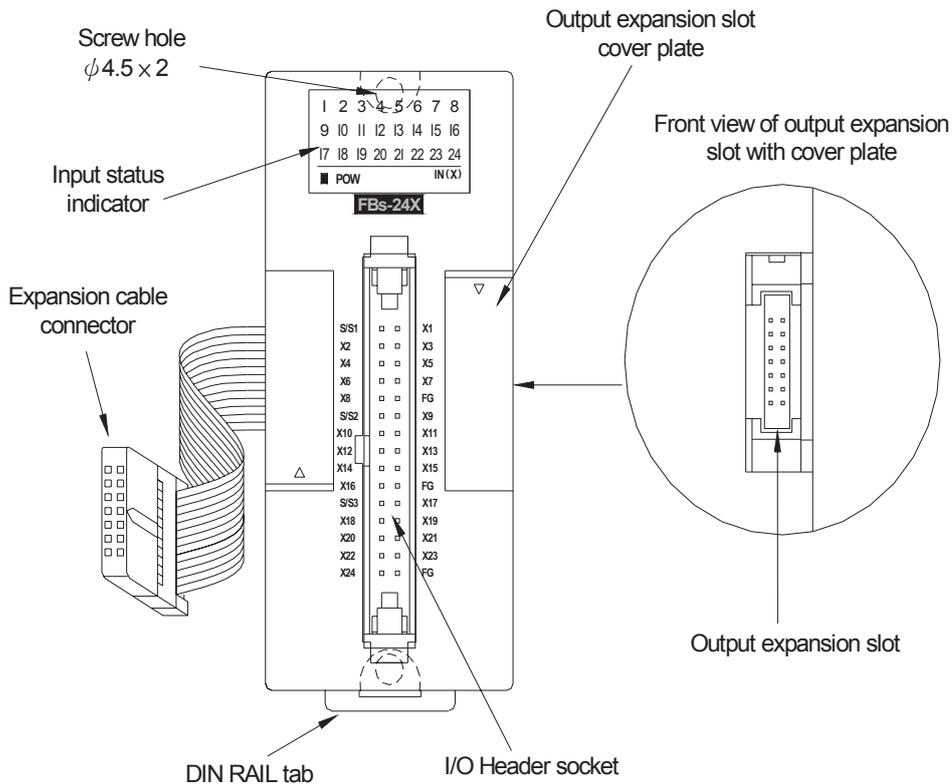
- Expansion unit/module with 60mm width case: [-16XY◇, -16Y◇, -20X]



- Expansion module with 40mm width case: [-8XY◇, -8Y◇, -8X, -6AD, -2DA, -4DA, -4A2D, -2A4TC, -2A4RTD, -7SG1, -7SG2, -2TC, -6TC, -6RTD, -CM5H, -6NTC, -4PT, -1LC, -1HLC, -VOM]

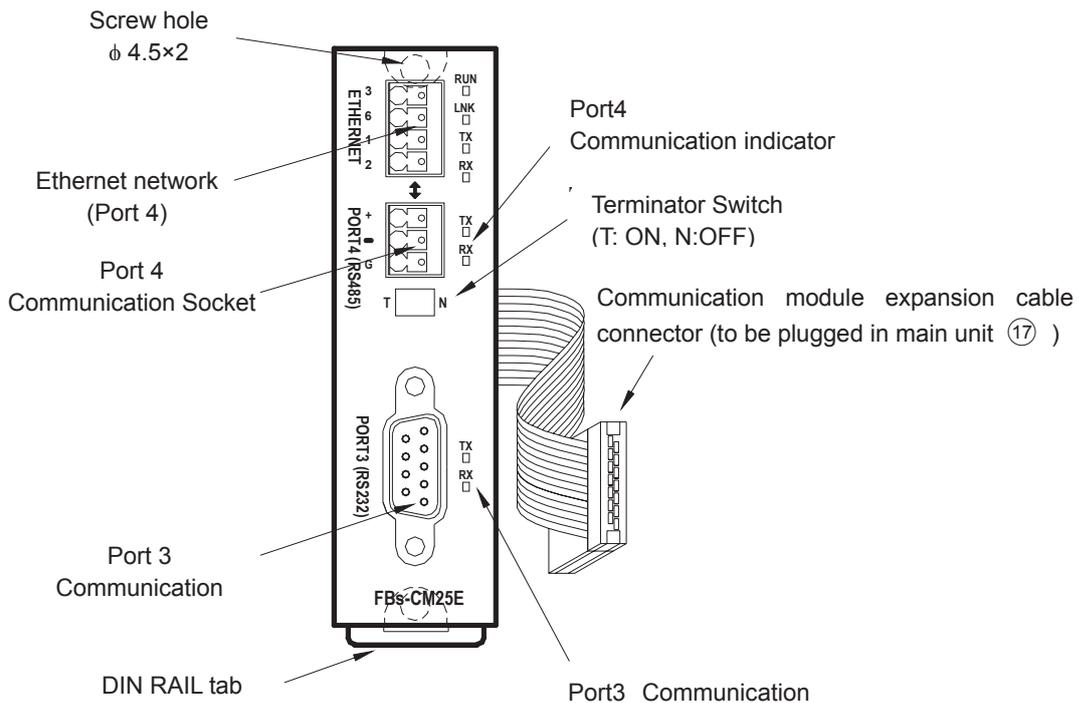


- Expansion module with 40mm width case: [-24X, -24YT, -24YJ, -32DGI]



1.3 Appearance of Communication Expansion Module

The Communication Module (CM) of FBs-PLC has a 25mm-width case, which can be used in the following seven modules: -CM22, -CM25, -CM55, -CM25E, -CM55E, -CM25C, -CM5R.



1.4 List of FBs-PLC Models

Module Name		Specifications		
Main Units	Basic Main Units	FBs-10MA◇△-◎-C	6 points 24VDC digital input (2 points high speed 100KHz, 2 points medium speed 20KHz, 2 points medium speed total 5KHz); 4 points relay or transistor output (2 points high speed 100KHz, 2 points medium speed 20KHz); 1 RS232 or USB port(expandable up to 3); I/O is not expandable	
		FBs-14MA◇△-◎-C	8 points 24VDC digital input (2 points high speed 100KHz, 2 points medium speed 20KHz, 4 points medium speed total 5KHz); 6 points relay or transistor output (2 point high speed 100KHz, 4 points medium speed 20KHz); 1 RS232 or USB port(expandable up to 3); I/O is not expandable	
		FBs-20MA◇△-◎-C	12 points 24VDC digital input (2 points high speed 100KHz, 4 points medium speed 20KHz, 6 points medium speed total 5KHz); 8 points relay or transistor output (2 points high speed 100KHz, 6 points medium speed 20KHz); 1 RS232 or USB port(expandable up to 3)	
		FBs-24MA◇△-◎-C	14 points 24VDC digital input (2 points high speed 100KHz, 6 points medium speed 20KHz, 6 points medium speed total 5KHz); 10 points relay or transistor output (2 points high speed 100KHz, 6 points medium speed 20KHz); 1 RS232 or USB port(expandable up to 3)	
		FBs-32MA◇△-◎-C FBs-32MB◇△-◎-C	20 points 24VDC digital input (2 points high speed 100KHz, 6 points medium speed 20KHz, 8 points medium speed total 5KHz); 12 points relay or transistor output (2 points high speed 100KHz, 6 points medium speed 20KHz); 1 RS232 or USB port(expandable up to 3); (MB is detachable terminal block)	
		FBs-40MA◇△-◎-C FBs-40MB◇△-◎-C	24 points 24VDC digital input (2 points high speed 100KHz, 6 points medium speed 20KHz, 8 points medium speed total 5KHz); 16 points relay or transistor output (2 points high speed 100KHz, 6 points medium speed 20KHz); 1 RS232 or USB port(expandable up to 3); (MB is detachable terminal block)	
		FBs-60MA◇△-◎-C FBs-60MB◇△-◎-C	36 points 24VDC digital input (2 points high speed 100KHz, 6 points medium speed 20KHz, 8 points medium speed total 5KHz); 24 points relay or transistor output (2 points high speed 100KHz, 6 points medium speed 20KHz); 1 RS232 or USB port(expandable up to 3); (MB is detachable terminal block)	
	Advanced Main Units	FBs-10MC◇△-◎	6 points 24VDC digital input (2 points high speed 200KHz, 2 points medium speed 20KHz, 2 points medium speed total 5KHz); 4 points relay or transistor output (2 points high speed 200KHz, 2 points medium speed 20KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; I/O is not expandable	
		FBs-14MC◇△-◎	8 points 24VDC digital input (2 points high speed 200KHz, 2 points medium speed 20KHz, 4 points medium speed total 5KHz); 6 points relay or transistor output (2 points high speed 200KHz, 4 points medium speed 20KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; I/O is not expandable	
		FBs-20MC◇△-◎	12 points 24VDC digital input (4 points high speed 200KHz, 2 points medium speed 20KHz, 6 points medium speed total 5KHz); 8 points relay or transistor output (4 points high speed 200KHz, 4 points medium speed 20KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
		FBs-24MC◇△-◎	14 points 24VDC digital input (4 points high speed 200KHz, 4 points medium speed 20KHz, 6 points medium speed total 5KHz); 10 points relay or transistor output (4 points high speed 200KHz, 4 points medium speed 20KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
		FBs-32MC◇△-◎	20 points 24VDC digital input (6 points high speed 200KHz, 2 points medium speed 20KHz, 8 points medium speed total 5KHz); 12 points relay or transistor output (6 points high speed 200KHz, 2 points medium speed 20KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
		FBs-40MC◇△-◎	24 points 24VDC digital input (6 points high speed 200KHz, 2 points medium speed 20KHz, 8 points medium speed total 5KHz); 16 points relay or transistor output (6 points high speed 200KHz, 2 points medium speed 20KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
		FBs-60MC◇△-◎	36 points 24VDC digital input (8 points high speed 200KHz, 8 points medium speed total 5KHz); 24 points relay or transistor output (8 points high speed 200KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
	NC Positioning Main Units	FBs-20MN◇△-◎	2 sets (1 axis) 920KHz 5VDC digital differential input, 10 points 24VDC digital input (4 points high speed 200KHz, 6 points medium speed total 5KHz); 2 sets (1 axis) 920KHz 5VDC digital differential output, 6 points relay or transistor output (average high speed 200KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
		FBs-32MN◇△-◎	4 sets (2 axes) 920KHz 5VDC digital differential input, 16 points 24VDC digital input (4 points high speed 200KHz, 8 points medium speed total 5KHz); 4 sets (2 axes) 920KHz 5VDC digital differential output, 8 points relay or transistor output (4 points high speed 200KHz); 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
		FBs-44MN◇△-◎	8 sets (4 axes) 920KHz 5VDC digital differential input, 20 points 24VDC digital input (8 points medium speed total 5KHz); 8 sets (4 axes) 920KHz 5VDC digital differential output, 8 points relay or low speed transistor output; 1 RS232 or USB port (expandable up to 5); built-in RTC; detachable terminal block	
	Right Side Expansion Modules	Expansion Power Supply	FBs-EPW-AC/D24	Power supply of 100~240VAC or 24VDC input for expansion module; 3 sets output power with 5VDC, 24VDC, and 24VDC, 14W capacity
		DIO Expansion Units	FBs-24XY◇-◎	14 points 24VDC digital input, 10 points relay or transistor output, built-in power supply
			FBs-40XY◇-◎	24 points 24VDC digital input, 16 points relay or transistor output, built-in power supply
			FBs-60XY◇-◎	36 points 24VDC digital input, 24 points relay or transistor output, built-in power supply
		DIO Expansion Modules	FBs-8X	8 points 24 VDC digital input
			FBs-8Y◇	8 points relay or transistor output
			FBs-8XY◇	4 points 24VDC digital input, 4 points relay or transistor output
			FBs-16Y◇	16 points relay or transistor output
			FBs-16XY◇	8 points 24VDC digital input, 8 points relay or transistor output
			FBs-20X	20 points 24VDC digital input
			FBs-24XY◇	14 points 24VDC digital input, 10 points relay or transistor output
FBs-40XY◇			24 points 24VDC digital input, 16 points relay or transistor output	
FBs-60XY◇			36 points 24VDD digital input, 24 points relay or transistor output	
FBs-24X	24 points high-density 24VDC digital input, 30 pins header with latch			
FBs-24YT/J	24 points high-density transistor SINK(T) or SOURCE(J) output (0.1A max.) · 30 pins header with latch			

Module Name		Specifications
Thumbwheel switch module	FBs-32DGI	8 sets 4 digits (total 32 digits) thumbwheel switch (or 128 points independent switch) multiplex input module, 30 pins header connector
16/7 Segment LED display modules	FBs-7SG1	1 set 8 digits 7-segment/4 digits 16-segment LED display (or 64 points independent LED) output display module, 16 pins header connector
	FBs-7SG2	2 sets 8 digits 7-segment/4 digits 16-segment LED display (or 128 points independent LED) output display module, 16 pins header connector
AIO modules	FBs-2DA	2 channels, 14-bit analog output module (-10~10V, 0~10V or -20~20mA, 0~20mA)
	FBs-4DA	4 channels, 14-bit analog output module (-10~10V, 0~10V or -20~20mA, 0~20mA)
	FBs-4A2D	4 channels, 14-bit analog input (same specification as 6AD)+2 channels, 14-bit analog output (same specification as 2DA) combo module
	FBs-6AD	6 channels, 14-bit analog input module (-10~10V, 0~10V or -20~20mA, 0~20mA)
Temperature measurement modules	FBs-2TC	2 channels, thermocouple temperature input module with 0.1°C resolution.
	FBs-6TC	6 channels, thermocouple temperature input module with 0.1°C resolution.
	FBs-16TC	16 channels, thermocouple temperature input module with 0.1°C resolution.
	FBs-6RTD	6 channels, RTD temperature input module with 0.1°C resolution.
	FBs-16RTD	16 channels, RTD temperature input module with 0.1°C resolution.
	FBs-6NTC	6 channels, NTC temperature input module with 0.1°C resolution.
AI + Temperature Measurement combo modules	FBs-2A4TC	2 channels, 14-bit analog input (same specifications as 6AD)+ 4 channels thermocouple temperature input (same specifications as 6TC) combo module
	FBs-2A4RTD	2 channels, 14-bit analog input (same specifications as 6AD) + 4 channels RTD temperature input (same specifications as 6RTD) combo module
Voice modules	FBs-VOM	Built-in 1MB memory (play continuously up to 2 minutes), extendable 4GB SD card(play continuously up to 8,000 minutes) voice module, 245 messages, output 2W
Load Cell Module	FBs-1LC	1 channel, load cell measurement module with 16-bit resolution (including sign bit)
Potential Meter Module	FBs-4PT	4 channels, 14-bit potential meter input module (Impedance range: 1~10K Ω)
Communication modules	FBs-CM22	2 ports RS232 (Port3 +Port 4) communication module
	FBs-CM55	2 ports RS485 (Port3 +Port 4) communication module
	FBs-CM25	1 port RS232 (Port3) + 1 port RS485 (port 4) communication module
	FBs-CM25E	1 port RS232 (Port3) + 1 port RS485 (port 4) + Ethernet network interface communication module
	FBs-CM55E	1 port RS485 (Port3) + 1 port RS485 (port 4) + Ethernet network interface communication module
	FBs-CMZB	ZigBee communication module
	FBs-CMZBR	ZigBee communication repeater
	FBs-CMGSM	GSM wireless communication module
	FBs-CM25C	General purpose RS232 to RS485/RS422 communication interface converter with photocouple isolation
	FBs-CM5R	General purpose RS485 repeater with photocouple isolation
	FBs-CM5H	General purpose 4 ports RS485 HUB with photocouple isolation, RS485 can be connected as star connection
	Communication boards	FBs-CB2
FBs-CB22		2 ports RS232 (Port 1+ Port 2) communication board
FBs-CB5		1 port RS485 (Port 2) communication board
FBs-CB55		2 ports RS485 (Port 1+ Port 2) communication board
FBs-CB25		1 port RS232 (Port 1) + 1 port RS485 (Port 2) communication board
FBs-CBE		1 port 10 Base T Ethernet communication board
FBs-CBEH		1 port 100 Base T Ethernet communication board
AIO boards	FBs-B2DA	2 channels, 12-bit analog output board (0~10V or 0~20mA)
	FBs-B2A1D	2 channels, 12-bit analog input + 1 channel, 12-bit analog output combo analog board (0~10V or 0~20mA)
	FBs-B4AD	4 channels, 12-bit analog input board (0~10V or 0~20mA)
Precision Load Cell Module	FBs-1HLC	1 channel, high precision weighing control module with 24-bit resolution
3-Axis Motion Control Module	FBs-30GM	3-Axis with linear and circular interpolation advanced motional control module, 3 sets of 200KHz high speed pulse input, 3 sets of 500KHz high speed pulse output, 14 points main unit, 16M Bytes program capacity, 20K Words retentive file register, built-in RS485 and Ethernet, 7.62mm detachable terminal block
Simple HMI	FBs-BDAP	Board type Data Access Panel
	FBs-BPEP	Board type Parameter Entry Panel
	FBs-PEP/PEPR	Multi characters with graphics-based Parameter Entry Panel, built-in RFID Read/Write module with PEPR
	FBs-DAP-B/BR	16 X 2 LCD character display, 20 keys keyboard, 24VDC power supply, RS485 communication interface, built-in RFID Read/Write module with BR
	FBs-DAP-C/CR	16 X 2 LCD character display, 20 keys keyboard, 5VDC power supply, RS232 communication interface, built-in RFID Read/Write module with CR

Module Name		Specifications	
Peripheral and Accessory	RFID Card	CARD-H Read / Write wireless card (for FBs-DAP-BR/CR and FBs-PEPR)	
	Programming Devices	FP-08	FBs- Series PLC handheld programmer
		Winproladder	FATEK-PLC Winproladder Programming software
	Memory Pack	FBs-PACK	FBs-PLC program memory pack with 20K Words program, 20K Words register, write protection switch
	PWMDA module	PWMDA	10-bit single channel pulse width modulation(PWM) 0~10V analog output (AO) module
	USB- RS232 Converter Cable	FBs-U2C-MD-180	Communication converter cable with standard USB AM connector to RS232 MD4M connector (used in standard PC USB to FBs main unit Port 0 RS232), length 180cm
	Communication cables	FBs-232P0-9F-150	MD4M to DB9F communication cable (FBs main unit Port 0 RS232 connect to standard DB9M), length 150cm
		FBs-232P0-9M-400	MD4M to DB9M communication cable (FBs main unit Port 0 RS232 connect to DB9F), length 400cm
		FBs-232P0-MD-200	MD4M to MD4M communication cable (FBs main unit Port 0 RS232 connect to FBs-PEP/PEPR), length 200cm
		FBs-232P0-MDR-200	MD4M to 90 MD4M communication cable (FBs main unit Port 0 RS232 connect to FBs-PEP/PEPR), length 200cm
	High density DIO cable	HD30-22AWG-200	High density modules(FBs-24X, FBs-24YT/J, FBs-32DGI) connector · 30pin Socket, 22AWG I/O cable, length 200cm
	16/7-Segment LED display	DBAN.8-nR	0.8" 4-digit 16-segment LED display, n means R(Red) 16-segment LED characters display installed, can be 1~4
		DBAN.2.3-nR	2.3" 4-digit 16-segment LED display, n means R(Red) 16-segment LED characters display installed, can be 1~4
		DB.56-nR	0.56" 8-digit 7-segment display, n means R(Red) 7-segment LED characters display installed, can be 1~8
		DB.8-nR	0.8" 8-digit 7-segment display, n means R(Red) 7-segment LED characters display installed, can be 1~8
DB2.3-nR		2.3" 8-digit 7-segment display, n means R(Red) 7-segment LED characters display installed, can be 1~8	
Training Box	DB4.0-nR	4.0" 4-digit 7-segment display, n means R(Red) 7-segment LED characters display installed, can be 1~4	
	FBs-TBOX	46cm x 32 cm x 16cm suitcase, containing FBs-24MCT main unit. FBs-CM25E communication module (RS232 + RS485 + Ethernet network), 14 simulated input switches, 10 external relay output, Doctor terminal outlet I/O, peripherals such as stepping motor, encoder, 7-segment display, 10 of 10mm LED indicator, thumbwheel switch, and 16 key keyboard.	

- ◇ : R — Relay output ; T — Transistor SINK(NPN) output ; J — Transistor SOURCE (PNP) output
- △ : 2 — built-in RS232 port ; U — built-in USB port (non-standard)
- ◎ : AC — 100~240VAC power supply ; D12 — 12VDC power supply ; D24 — 24VDC power supply
- C : Blank — Standard ; —C — add in RTC
- The unmarked frequencies of Digital Input (DI) or Digital Output (DO) are low speed.

1.5 Specifications of Main Unit

Item		Specification				Note	
Execution Speed		0.33uS/per Sequence Command					
Space of Control Program		20K Words					
Program Memory		FLASH ROM or SRAM + Lithium battery for Back-up					
Sequence Command		36					
Application Command		326 (126 types)				Include Derived Commands	
Flow Chart (SFC) Command		4					
Single Point 《BIT Status》	X	Output Contact(DI)		X0~X255 (256)		Corresponding to External Digital Input Point	
	Y	Output Relay(DO)		Y0~Y255 (256)		Corresponding to External Digital Output Point	
	TR	Temporary Relay		TR0~TR39 (40)			
	M	Internal Relay	Non-retentive	M0~M799 (800)*		Can be configured as retentive type	
			Retentive	M1400~M1911 (512)			
		Special Relay	M1912~M2001 (90)		Can be configured as non-retentive type		
	S	Step Relay	Non-retentive	S0~S499 (500)*		S20~S499 can be configured as retentive type	
			Retentive	S500~S999 (500)*		Can be configured as non-retentive type	
T	Timer "Time Up" Status Contact		T0~T255 (256)				
C	Counter "Count Up" Status Contact		C0~C255 (256)				
Register 《WORD Data》	TMR	Current Time Value Register	0.01S Time base	T0~T49 (50)*		T0 ~ T255 Numbers for each time base can be flexibly adjusted.	
			0.1S Time base	T50~T199 (150)*			
		1S Time base	T200~T255 (56)*				
	CTR	Current Counter Value Register	16-Bit	Retentive	C0~C139 (140)*		Can be configured as non-retentive type
				Non-retentive	C140~C199 (60)*		Can be configured as retentive type
		32-Bit	Retentive	C200~C239 (40)*		Can be configured as non-retentive type	
			Non-retentive	C240~C255 (16)*		Can be configured as retentive type	
	HR DR	Data Register	Retentive	R0~R2999 (3000)*		Can be configured as non-retentive type	
				D0~D3999 (4000)			
	Non-retentive		R3000~R3839 (840)*		Can be configured as retentive type		
			R5000~R8071 (3072)*		When not configured as ROR, it can serve as normal register (for read/Write)		
	HR ROR	Read-only Register	R5000~R8071 can be configured as ROR, default setting is (0)*		ROR is stored in special ROR area and not consume program space		
			File Register		Must save/retrieved via special commands		
			F0~F8191 (8192)*				
	IR	Input register		R3840~R3903 (64)		Corresponding to external numeric input	
	OR	Output Register		R3904~R3967 (64)		Corresponding to external numeric output	
SR	Special System Register		R3968~R4167 (197) R4000~R4095 (96)				
《Special Register》	0.1mSHigh Speed Timer register		R4152~R4154 (3)				
	High Speed Counter Register	Hardware(4 sets)	DR4096~DR4110 (4× 4)				
		Software (4 sets)	DR4112~DR4126 (4× 4)				
	Real Time Calendar Register (Not available in MA model)		R4128 (sec)	R4128 (min)	R4130 (hour)	R4131 (day)	
			R4132 (month)	R4133 (year)	R4134 (week)	Optional for MA module	
XR	Index Register		V・Z (2), P0~P9 (10)				
Interrupt Control	External Interrupt Control		32 (16 point input positive/negative edges)				
	Internal Interrupt Control		8 (1, 2 3, 4, 5, 10, 50, 100mS)				
0.1mS High Speed Timer (HST)		1 (16bits), 4 (32bits, derived from HHSC)					

High Speed Counter	Hardware High Speed Counter (HHSC) /32 bits	Channels	Up to 4	<ul style="list-style-type: none"> Total number of HHSC and SHSC is 8. HHSC can change into High Speed Timer with 32 bits/0.1mS Time base.
		Counting mode	8 (U/D, U/D× 2, K/R K/R× 2, A/B, A/B× 2, A/B× 3 A/B× 4)	
		Counting frequency	Up to 200KHz (single-end input) or 920KHz (differential input)	
	Software High Speed Counter (SHSC) /32 bits	Channels	Up to 4	
		Counting mode	3 (U/D · K/R · A/B)	
		Counting frequency	Maximum sum up to 5KHz	
Communication Interface	Port0 (RS232 or USB)		Communication Speed 4.8Kbps~921.6Kbps (9.6Kbps)*	Port1~4 talk FATEK or Modbus RTU Master/Slave Communication Protocol
	Port1~Port4 (RS232, RS485 or Ethernet)		Communication Speed 4.8Kbps~921.6Kbps (9.6Kbps)*	
	Maximum Connections		254	
NC Positioning Output (PSO)	Number of Axes		Up to 4	
	Output Frequency		200KHz single output (single) 100KHz (A/B way) 920KHz(single way) and 460KHz(A/B way) differential output.	
	Output Pulse Mode		3 (U/D · K/R · A/B)	
	Positioning Language		Special Positioning Programming Language	
HSPWM Output	Number of Points		Up to 4	
	Output Frequency		72Hz~18.432KHz (with 0.1% resolution) 720Hz~184.32KHz (with 1% resolution)	
Captured input	Points	Max.36 points (all of main units have the feature) > 10 μ S(super high speed/high speed input)		
	Captured pulse width	> 47 μ S(medium speed input) > 470 μ S(mid/low speed input)		
Setting of Digital Filter	X0~X15	Frequency 14KHz ~ 1.8MHz Tine constant 0 ~ 1.5mS/0 ~ 15mS,adjustable by step of 0.1mS/1mS		Chosen by frequency at high frequencies Chosen by time constant at low frequencies
	X16~X35	Time constant 1mS~15mS,adjustable by step of 1mS		
Maximum expandable module		32		

1.6 Environmental Specifications

Item		Specification	Note	
Operating Ambient Temperature	Enclosure equipment	Minimum	5°C	Permanent Installation
		Maximum	40°C	
	Open equipment	Minimum	5°C	
		Maximum	55°C	
Storage Temperature		-25°C~+70°C		
Relative Humidity (non-condensing, RH-2)		5%~95%		
Pollution Level		Degree II		
Corrosion Resistance		By IEC-68 Standard		
Altitude		≤2000m		
Vibration	Fixed by DIN RAIL	0.5G, for 2 hours each along the 3 axes		
	Secured by screws	2G, for 2 hours each along the 3 axes		
Shock		10G, 3 times each along the 3 axes		
Noise Suppression		1500Vp-p, width 1us		
Withstand Voltage		1500VAC, 1 minute		L, N to any terminal

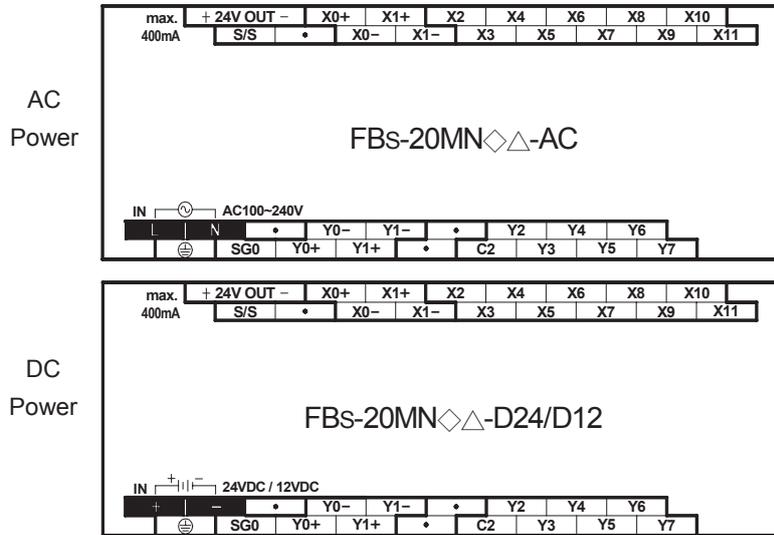
Warning

The listed environmental specifications are for FBs-PLC under normal operation. Any operation in environment not conform to above conditions should be consulted with FATEK.

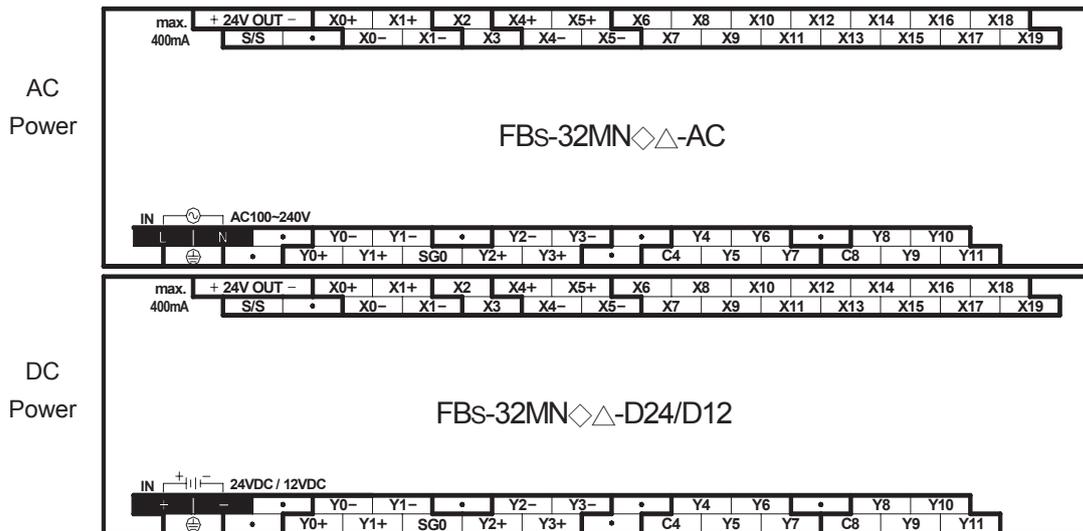
1.7 Connection Diagrams of Various Models

1.7.1 NC Control Main Unit [7.62mm Detachable Terminal Block]

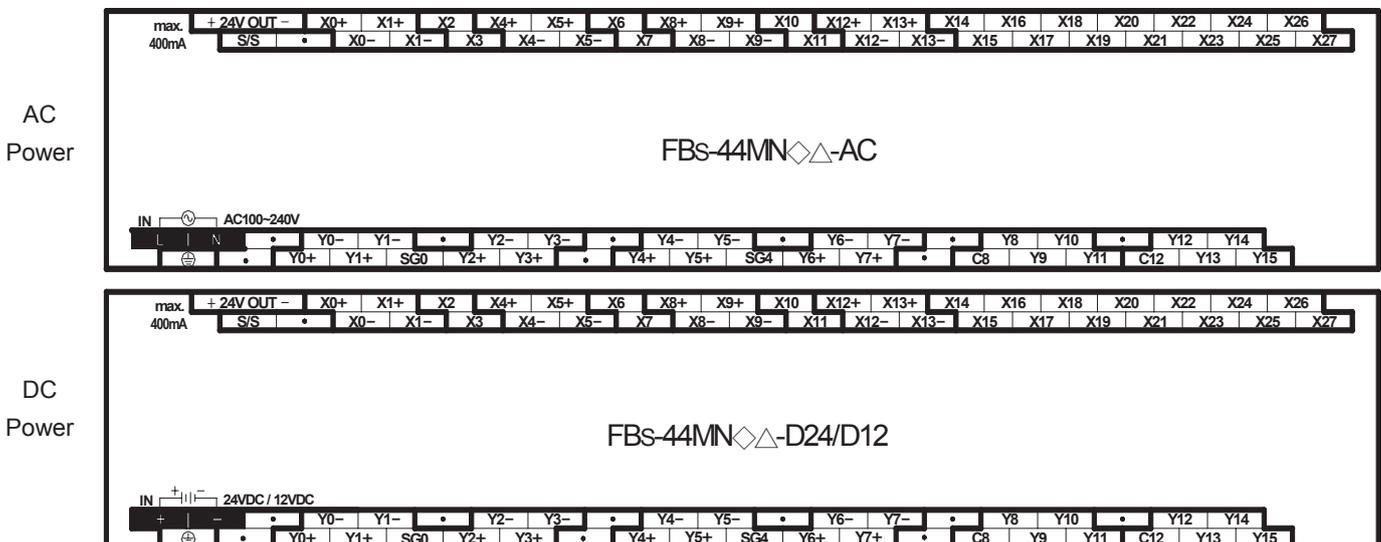
- 20 point digital I/O main unit (12 points IN, 8 points OUT)



- 32 point digital I/O main unit (20 points IN, 12 points OUT)



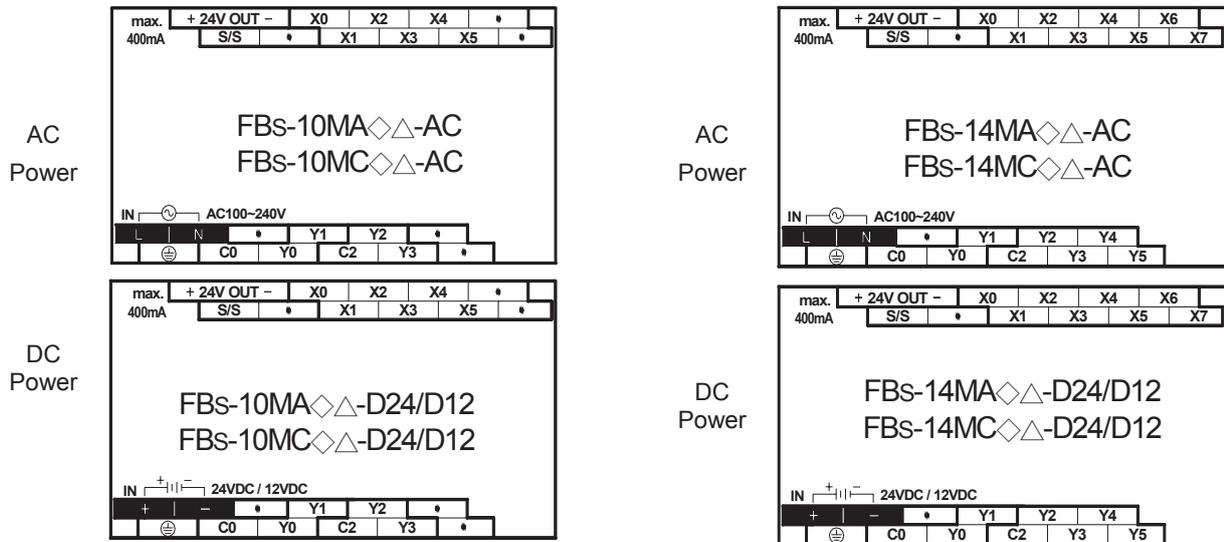
- 44 point digital I/O main unit (28 points IN, 16 points OUT)



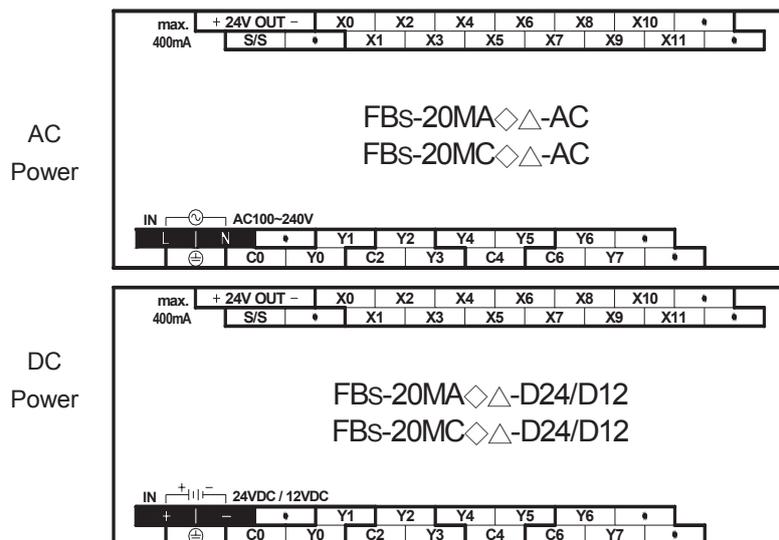
1.7.2 Basic/Advanced Main Unit

[7.62mm Terminal Block, fixed in model MA, detachable in models MB/MC]

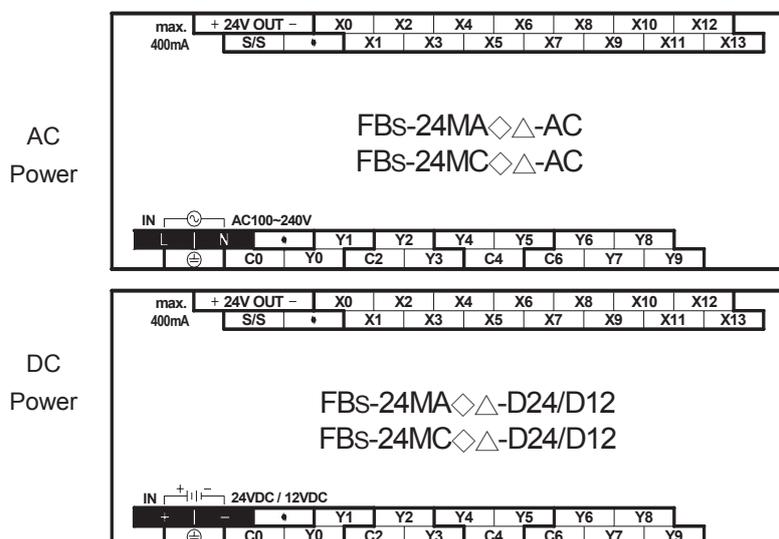
- 10 point digital I/O main unit (6 points IN, 4 points OUT)
- 14 point digital I/O main unit (8 points IN, 6 points OUT)



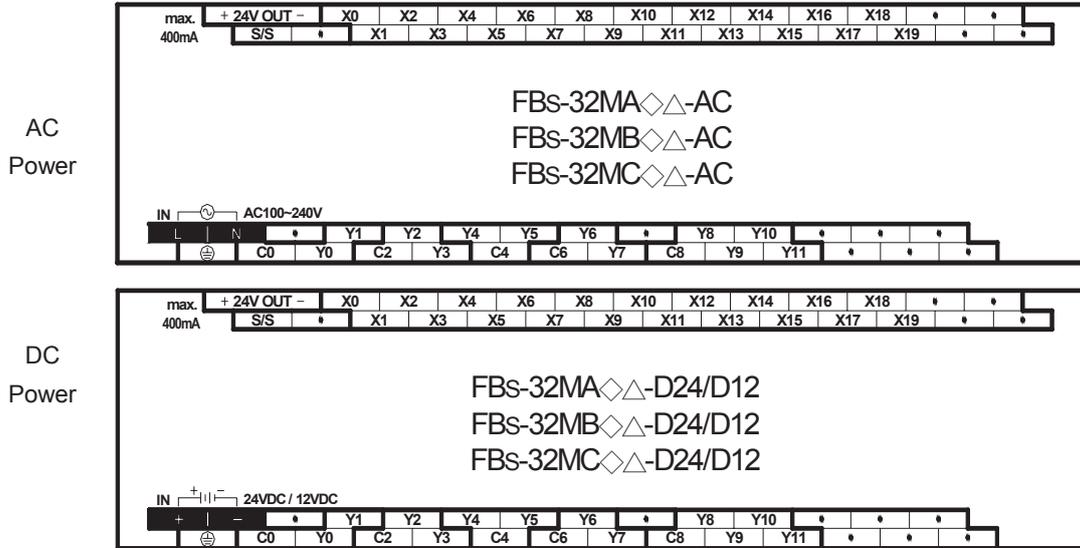
- 20 point digital I/O main unit (12 points IN, 8 points OUT)



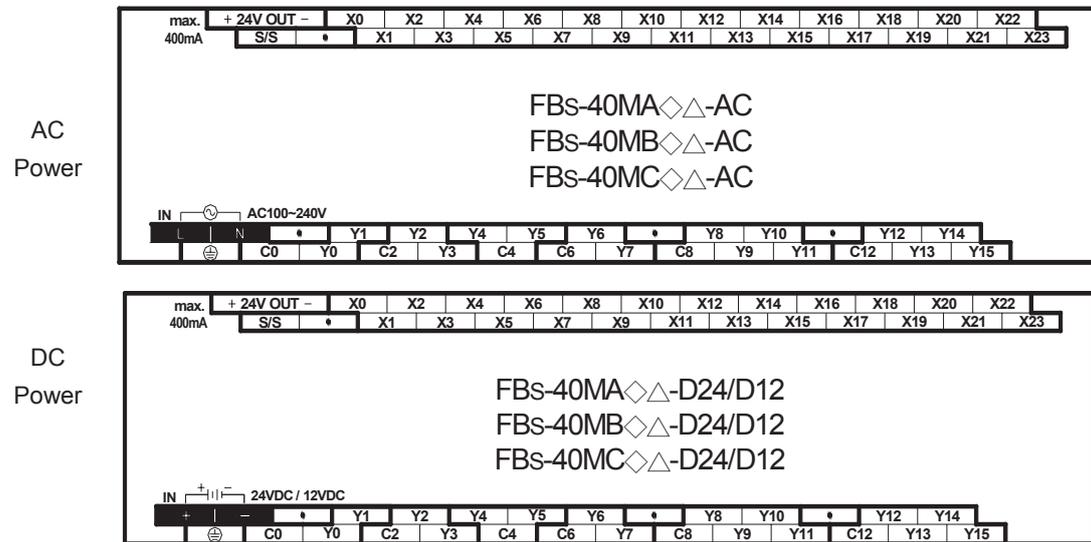
- 24 point digital I/O main unit (14 points IN, 10 points OUT)



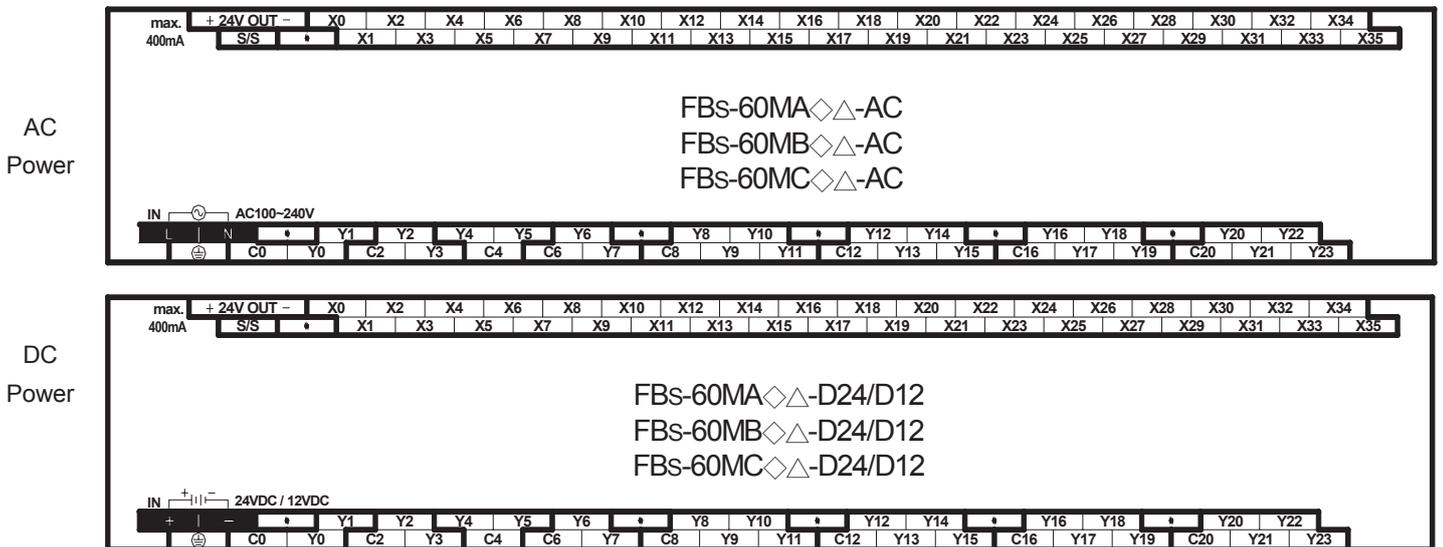
- 32 point digital I/O main unit (20 points IN, 12 points OUT)



- 40 point digital I/O main unit (24 points IN, 16 points OUT)



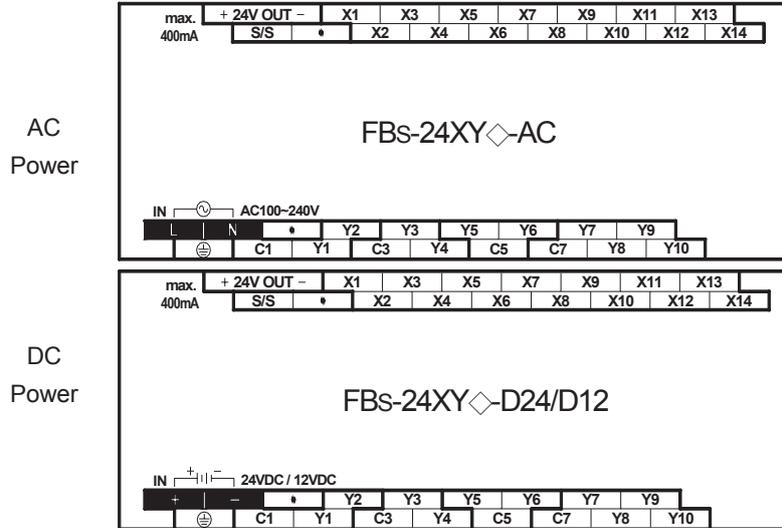
- 60 point digital I/O main unit (36 points IN, 24 points OUT)



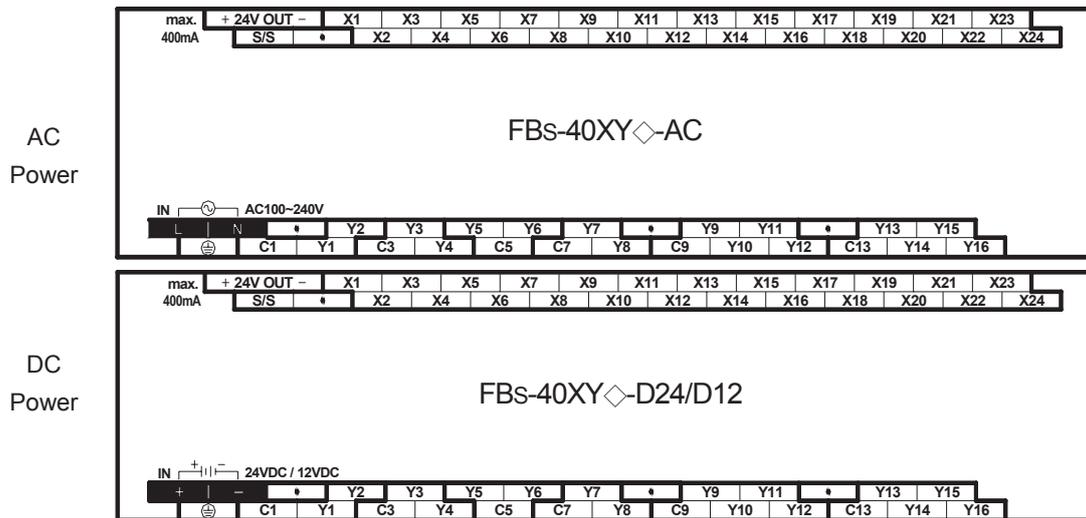
1.7.3 Digital I/O Expansion Unit

[7.62mm fixed terminal block]

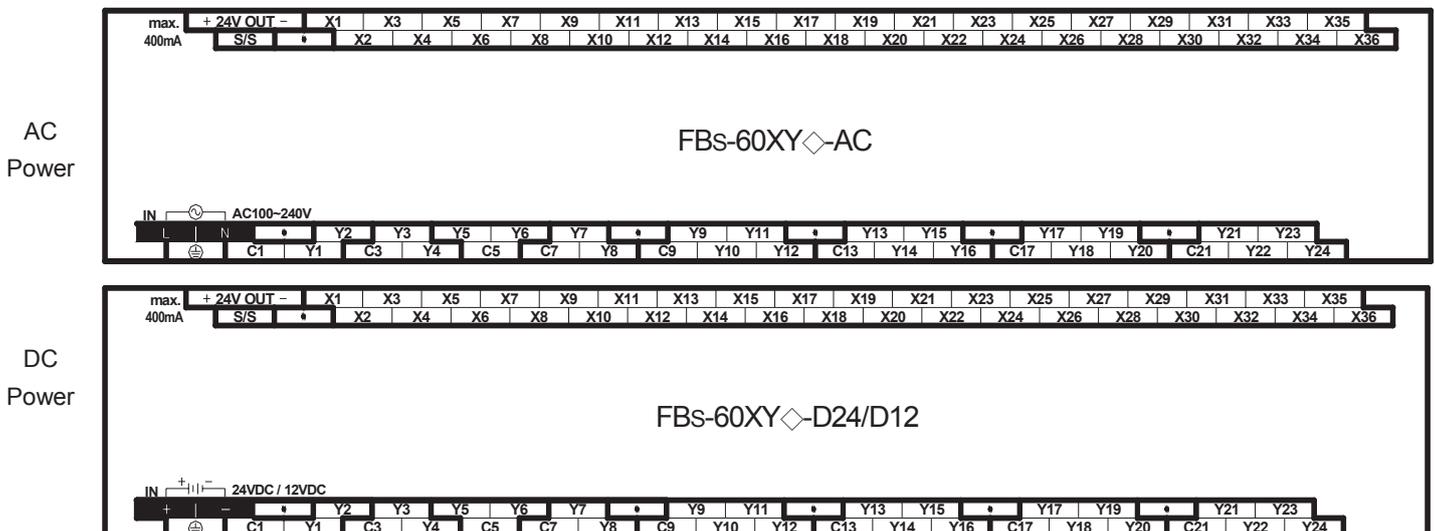
- 24 point I/O expansion unit (14 points IN, 10 points OUT)



- 40 point I/O expansion unit (24 points IN, 16 points OUT)



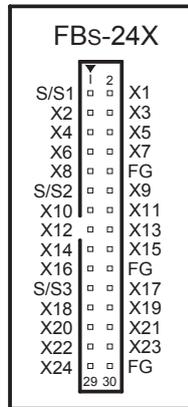
- 60 point I/O expansion unit (36 points IN, 24 points OUT)



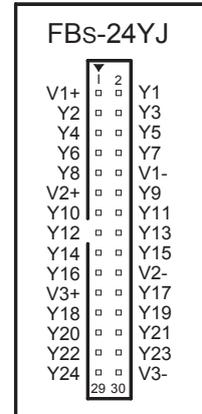
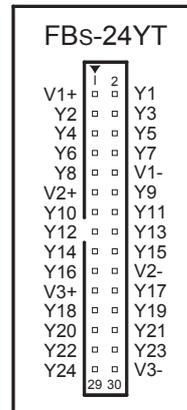
1.7.5 High-Density Digital I/O Expansion Module

[30Pin/2.54mm Header connector]

- 24 point high-density input module (24 points IN)



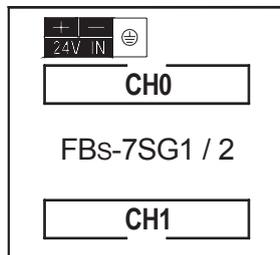
- 24 point high-density transistor output module (24 points OUT)



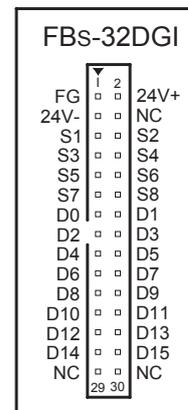
1.7.6 Numeric I/O Expansion Module

[2.54mm Header connector]

- 7 segment LED display module (8 digits/-7SG1, 16 digits/-7SG2) [16 pin/2.54mm Header connector]



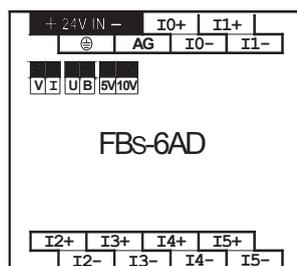
- Thumbwheel switch multiplex input module (4 digitsx8) [30Pin/2.54mm Header connector]



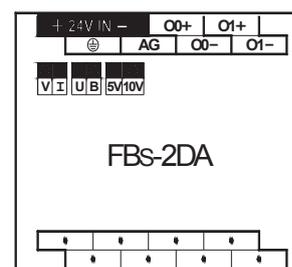
1.7.7 Analog I/O Expansion Module

[7.62mm fixed terminal block]

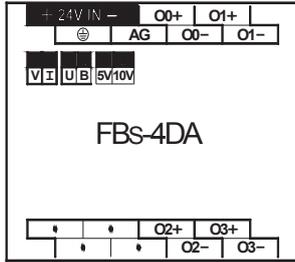
- 6 channel A/D analog input module



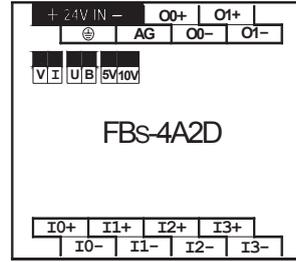
- 2 channel D/A output module



- 4 channel D/A output module



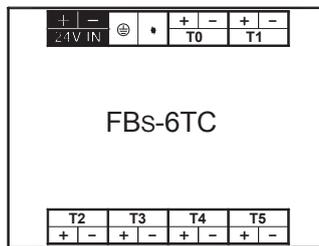
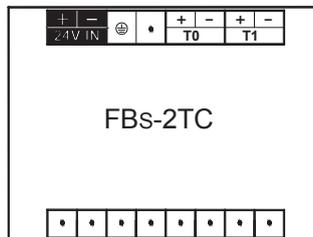
- 4 channel A/D input, 2 channel D/A output module



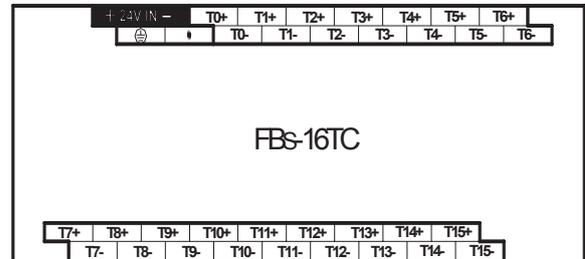
1.7.8 Temperature Input Module

[7.62mm fixed terminal block]

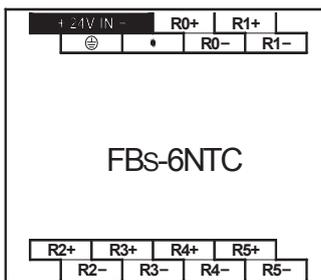
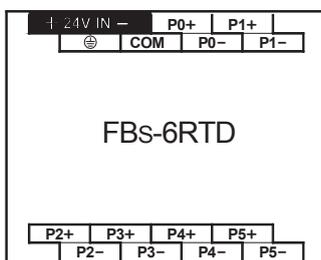
- 2/6 channel thermocouple input module



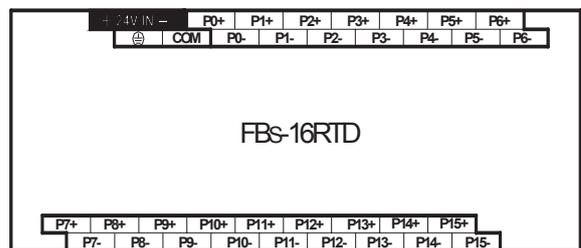
- 16 channel thermocouple input module



- 6 channel RTD input module



- 16 channel RTD input module



Digital Input (DI) Circuit

The FB s-PLC provides the ultra high speed differential double end 5VDC inputs (i.e., single input with two terminals without common) and the single-end 24VDC inputs which use the common terminal to save terminals. The response speeds of single-end common input circuits are available in high, medium and low. Because the double end input circuit has two independent terminals, it can be connected either in SINK or SOURCE (we will use the term SRCE) for input or in differential input wiring for line driver source. The single-end input circuit can be set to SINK or SRCE type by varying the wiring of the common terminals S/S inside PLC and external common wire of input circuits (see Sec. 6.3 for details).

6.1 Specifications of Digital Input (DI) Circuit

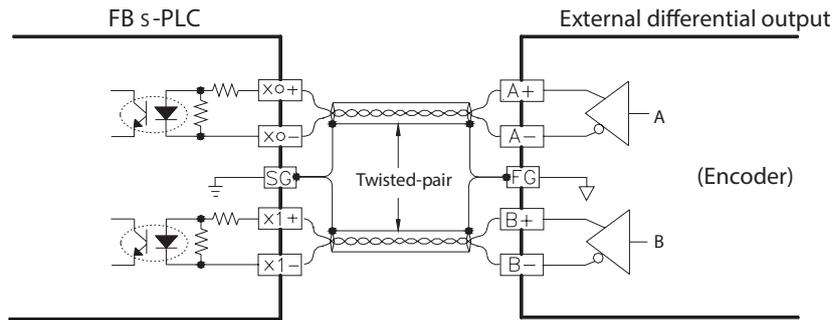
Item		5VDC Differential Input	24VDC Single-end Input				Note
		Ultra High Speed(HSC) 920KHz	High Speed(HSC) 100KHz	Medium Speed(HSC) 20KHz* ¹	Mid/Low Speed 470 μS* ²	Low Speed (200Hz)	
Input Signal Voltage		5VDC ±10%	24VDC ±10%				
Input Current Threshold	ON Current	> 6 mA	> 4mA		> 2.3mA		
	OFF Current	< 2 mA	< 1.5mA		< 0.9mA		
Maximum Input current		20mA	7mA		4.2 mA		
Input Status Indication		Displayed by LED: Lit when "ON", dark when "OFF"					
Isolation Type		Photo coupler signal isolation					
SINK/SRCE Wiring		Independent Wiring		Via variation of internal common terminal S/S and external common wiring			
List of Input Response Speed for Various Models	FB s-20MN	X0,1		X2~11			* ¹ : Limit of input speed in MA model is 10KHz
	FB s-32MN	X0,1,4,5		X2,X3,X6~15	X16~19		
	FB s-44MN	X0,1,4,5,8,9,12,13		X2,3,6,7,10,11,14,15	X16~27		
	FB s-10MC		X0,1	X2~5			
	FB s-14MC		X0,1	X2~7			
	FB s-20MC		X0,1	X2~11			
	FB s-24MC		X0,1	X2~13			
	FB s-32MC		X0,1	X2~15	X16~19		
	FB s-40MC		X0,1	X2~15	X16~23		
	FB s-60MC		X0,1	X2~15	X16~35		
	FB s-10MA			X0~3	X4~5		
	FB s-14MA			X0~3	X4~7		
	FB s-20MA			X0~3	X4~11		
	FB s-24MA			X0~3	X4~13		
	FB s-32MA			X0~3	X4~19		
	FB s-40MA			X0~3	X4~23		
	FB s-60MA			X0~3	X4~35		
Expansion Unit/Module						All Input Points	
Noise Filtering Time Constant* ³		DHF(0ns ~ 15ms) + AHF(470ns)		DHF(0 ~ 15ms) + AHF(470 μs)		AHF(4.7ms)	DHF : Digital Hardware Filter AHF : Analog Hardware Filter

* : The standard product of MC-type High-Speed input is 2 points, it can extend to 3~8points (Option). Every increment one High-speed input point, and decrement one Middle-speed input point relatively. Only X4~X5,X8~X9 and X12~X13 input can be extended, and the priority is low serial-number to High serial-number.

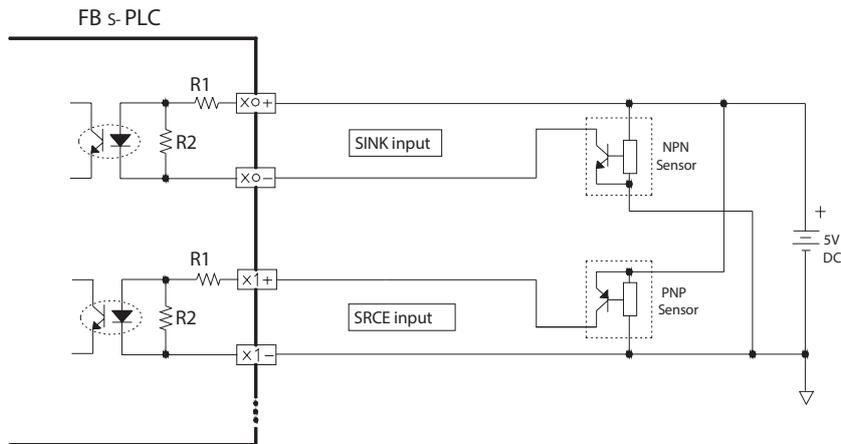
6.2 Structure and Wiring of 5VDC Ultra High Speed Differential Input Circuit

Only the MN main unit of FBs provides the 5VDC ultra high speed differential input circuit, which is mainly used for the input of hardware high speed counter (HHSC) with a maximum working frequency up to 920 KHz. In practice, to ensure the high speed and high noise immunity, please use Line-Driver for differential line driving. In environments with small noise and medium working frequency (< 100KHz), however, it can be changed to the 5VDC single-end SINK or SRCE input or to the 24VDC single-end SINK or SRCE input by connecting a 3K Ω /0.5W resistor in series, as shown in the figure below.

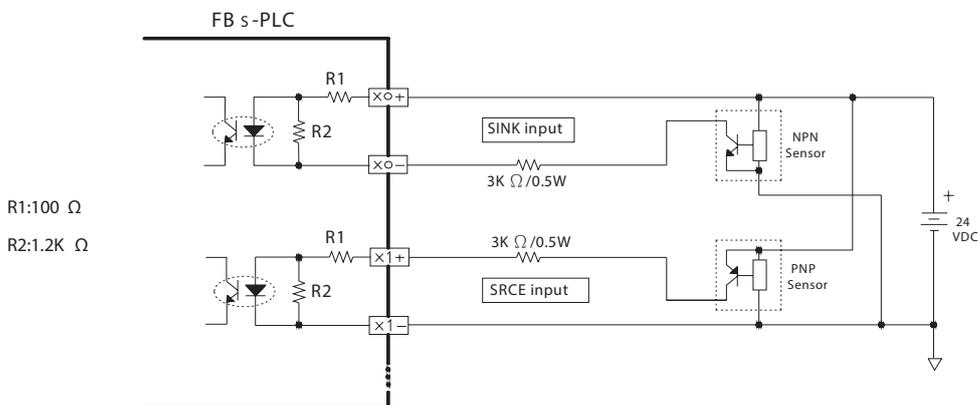
- (A) Wiring of 5VDC differential input for Line-Driver driving (with frequency up to 920KHz for high speed and environments with large noise)



- (B) Wiring of 5VDC differential input to 5VDC single SINK or SRCE input (100KHz)



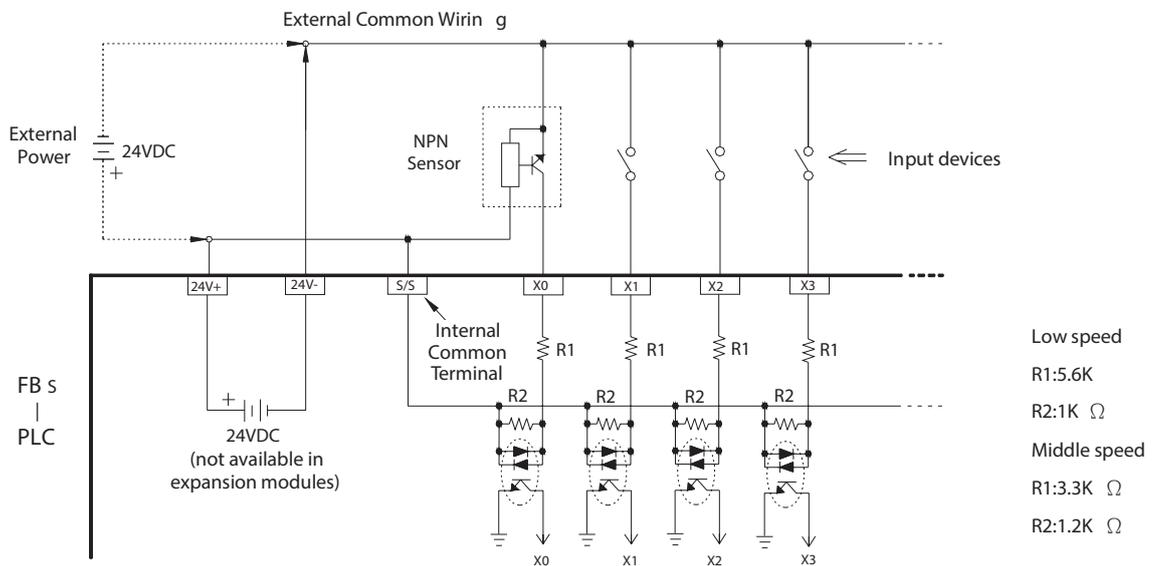
- (C) Method of converting 5VDC differential input to 24VDC single-end SRCE input (frequency < 100KHz)



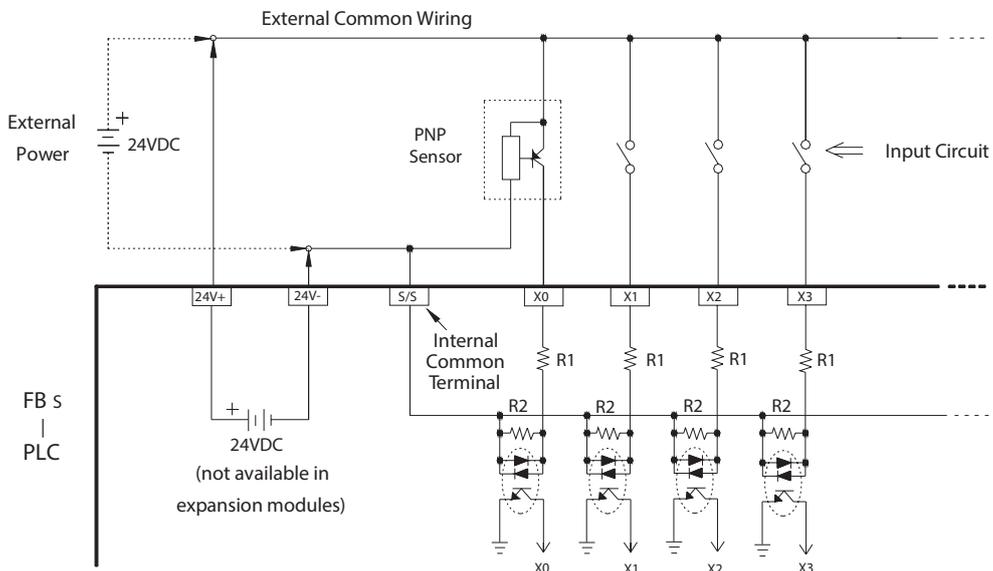
6.3 24VDC Single-End Input Circuit and Wiring for SINK/SRCE input

The 24VDC single-end digital input circuits of FB S-PLC are available for high, medium and low speed. They all have the similar circuit structures but with different response speeds. To save input terminals, the circuit of single-end input is implemented by connecting one end of all input points (photo coupler) inside the PLC to the same internal common point labeled as S/S. The other end of each input circuit is connected to corresponding terminals such as X0, X1, X2, etc. The S/S common terminal and N single-end inputs comprise of N digital inputs (i.e., only N+1 terminals are used for N terminals). Therefore, we call this type of input structure the single-end input. The user also needs to do the same thing when making the connection of external digital input devices. Namely, the one end of all input devices (e.g., buttons, switches) are connected together and called the external common wire, while the other ends of input circuits are connected to the input terminals X0, X1, X2, etc., of PLC. Then finish it by connecting the external common wiring and internal common terminal S/S to the positive/negative terminals of the 24VDC power. When connect the internal common terminal S/S to 24V+ (positive) and the external common wire to 24V- (negative), then the circuit serve as SINK input. On the contrary, while exchange the wiring of the above internal and external common will serve as a SRCE input. The above wiring schemes can illustrated below:

- Wiring of single-end common SINK input (internal common terminal S/S to 24V+, external common wiring to 24V-)



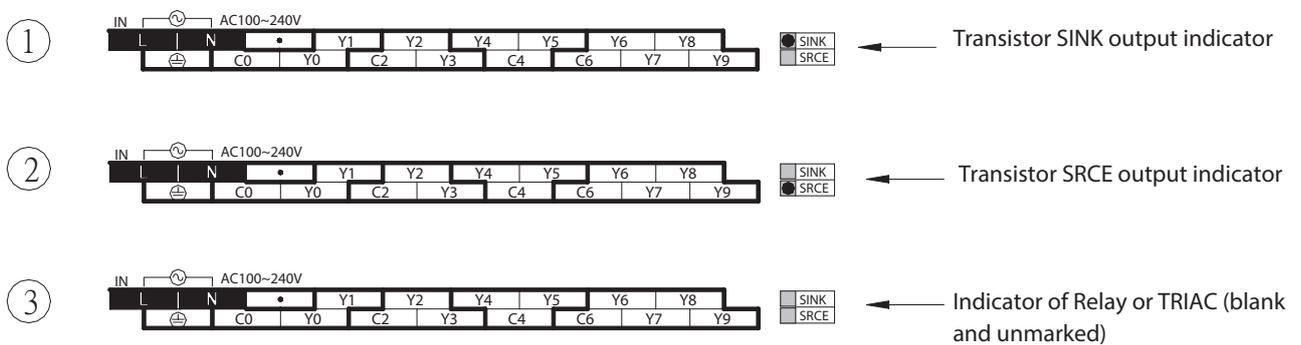
- Wiring of single-end common SRCE input (internal common terminal S/S to 24V-, external common wiring to 24V+)



Digital Output (DO) Circuit

The digital outputs of FB s-PLC are available in the following two structures: the 5VDC ultra high speed Line-driver type differential output (i.e., one output occupying two terminals) , and the single-end output circuit for saving terminals. There are three kinds of output device for the single-end output, which are relays, TRIAC and transistors. Since the relay and TRIAC are bilateral, even when used in single-end output, they can serve as SINK or SRCE output. The transistor, however, because of its polarities, after being used as single-end common output, its SINK and SRCE polarities are exactly the opposite (common point Cn of SINK output must connect to negative end of DC power). Therefore, the product model of transistor output of FB s-PLC for SINK and SRCE is distinct. At the right side of terminal block of FB s-PLC, there is a place for making SINK or SRCE label. The following are labeling examples of:

- ① SINK output models in FB s-PLC
- ② Transistor SRCE output model
- ③ Relay of TRIAC models with no SINK /SRCES polarity :



Warning

No over current protection is available in the FB s series PLC. Except for the 5V differential output circuit, all other output circuits have to be added with over current or short circuit protections externally, such as fuses, in applications with safety concern.

Terminals labeled by "●" on the terminal block are empty contacts, which cannot be connected with any wire to maintain the required safety clearance and to avoid damage to the unit.

In situations where simultaneous operations of outputs (such as reverse/forward action of motor) pose safety concerns, besides the interlock in PLC programs, additional interlock circuits are needed outside PLC, as shown below :

The diagram shows two parallel output circuits. The top circuit consists of a 'PLC Forward output' (represented by a switch symbol), a 'Forward limit switch', and an 'Interlock contact (NC)' in series. The bottom circuit consists of a 'PLC Reverse output' (represented by a switch symbol), a 'Reverse Limit switch', and an 'Interlock contact (NC)' in series. The two 'Interlock contact (NC)' components are connected in a cross-interlocking configuration: the NC contact of the forward circuit is connected to the line of the reverse circuit, and the NC contact of the reverse circuit is connected to the line of the forward circuit. Both interlocking lines terminate at 'Magnetic switch or Relay A' and 'Magnetic switch or Relay B' respectively.

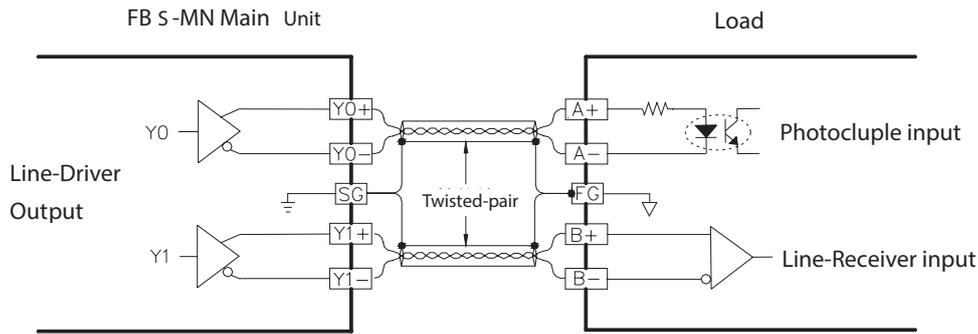
Specifications of Digital Output Circuit

Item Specification		Differential Output	Single-End Transistor Output			Single-End Relay Output	Single-End TRIAC Output	
		Ultra High Speed	High Speed	Medium Speed	Low Speed			
Maximum switching (working) Frequency		920KHz(1-phase) 460KHz(2-phase)	120KHz	20KHz	200HZ	For ON/OFF, not for frequent exchange		
Working Voltage		5VDC ±10%	5 ~ 30VDC			<250VAC,30VDC	100 ~ 240VAC	
Maximum Load Current	Resistive	50mA	0.5A	0.1A	0.5A	2A/single, 4A/common	1A	
	Inductive					80VA	15VA/100VAC 30VA/200VAC	
Maximum Voltage Drop (@ maximum load)		—	0.6V	2.2V	1.2V	0.06V(initial)	1.2Vrms	
Minimum Load		—	—			2mA/DC power	25mA	
Leakage Current		—	< 0.1 mA/30VDC			—	2mA	
Maximum Output Delay Time	ON → OFF	200nS	200nS	15 μS	1mS	10mS	1mS	
	OFF → ON			30 μS			1/2AC period	
Output Status Indication		LED is bit when `ON`, dark when `OFF`						
Over Current Protection		N/A						
Isolation Type		Photo Coupler Isolation				Electromagnetic Isolation	Photo Coupler Isolation	
SINK/SRCE Output Type		Independent Dual Terminals for arbitrary connection	Choose SINK/SRCE by models and non-exchangeable			Bilateral device, can be arbitrarily set to SINK/SRCE output		
List of Input Response Speed for Various Models	FB s-20MN(T,S)	Y0~1		Y2~7		Y2~7	Y2~7	
	FB s-32MN(T,S)	Y0~3		Y4~7	Y8~11	Y4~11	Y4~11	
	FB s-44MN(T,S)	Y0~7			Y8~15	Y8~15	Y8~15	
	FB s-10MC(T,S)		Y0,2	Y1,3		All output points	All output points	
	FB s-14MC(T,S)		Y0,2	Y1,3~5				
	FB s-20MC(T,S)		Y0,2	Y1,3~7				
	FB s-24MC(T,S)		Y0,2	Y1,3~7	Y8~9			
	FB s-32MC(T,S)		Y0,2	Y1,3~7	Y8~11			
	FB s-40MC(T,S)		Y0,2	Y1,3~7	Y8~15			
	FB s-60MC(T,S)		Y0,2	Y1,3~7	Y8~23			
	FB s-10MA(T,S)			Y0~3				
	FB s-14MA(T,S)			Y0~3	Y4~5			
	FB s-20MA(T,S)			Y0~3	Y4~7			
	FB s-24MA(T,S)			Y0~3	Y4~9			
	FB s-32MA(T,S)			Y0~3	Y4~11			
	FB s-40MA(T,S)			Y0~3	Y4~15			
	FB s-60MA(T,S)			Y0~3	Y4~23			
	Expansion Units/Modules(T,S)				All output points			

* : The standard product of MC-type High-Speed output is 2 points, it can extend to 3~8points (Option). Every increment one High-speed output point, and decrement one Middle-speed output point relatively. Only X4~X5,X8~X9 and X12~X13 output can be extended, and the priority is low serial-number to High serial-number.

5VDC Ultra High Speed Line-Driver Differential Output Circuit and its Wiring

The 5VDC ultra high speed Line-Driver differential output circuit of FB S-PLC is only available for the main unit of the MN model. Its output can connect to general photo coupler circuit or Line-Receiver input circuit, with the connection shown in the figure below. To improve noise immunity and maintain signal quality, please use twisted pair with shield (or aluminum foils) for connection and connect the shield with SG of PLC and FG of the driver. Please also operate in 2-phase driving mode (because 2-phase driving can automatically cancel interferences from noise pulses).



(With frequency up to 750KHz, for use in high speed and large noise environments)

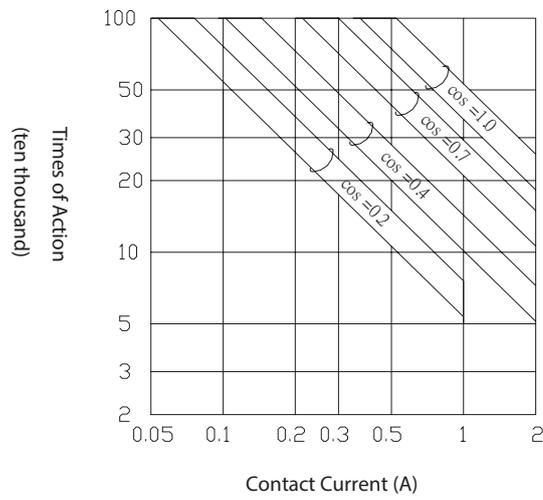
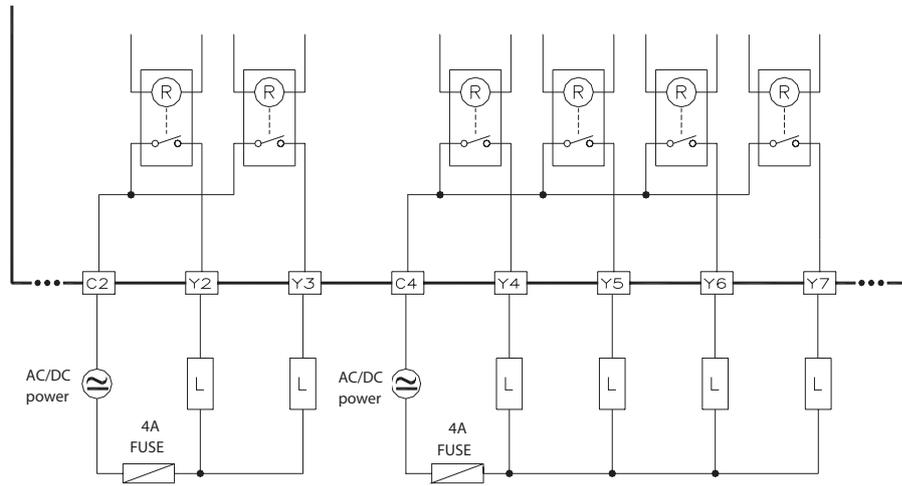
Single-End Output Circuit

Except that the 5VDC ultra high speed output circuit has independent dual terminal outputs, all other output circuits such as relays, transistors or TRIAC are single-end output structure. A single-end output in each digital output (DO) takes up only one terminal. But since any output device has two ends, the one end of several output devices have to be connected together to one common point (called output common) for single-end output. Then each output point can output via this common point. The more output device share a same common points, the more terminals are saved, while relatively increasing the current running through the common point. Combination of any output common with its individual single-end outputs are called a Common Output Block, which is available in 2, 4 and 8PTs (high-density module) in FB S-PLC. Each Common Output Block is separated from one another. The common terminal has a label initiated with letter "C", while its numbering is determined by the minimum Yn number which comprise the output block. In the example of the figure below, the number of common terminal of output block Y2 and Y3 is C2, while the number of common terminal of output Block Y4, Y5, Y6 and Y7 is C4. The various single-end common output circuits are described below :

Structure and Wiring of Single-End Relay Output Circuit

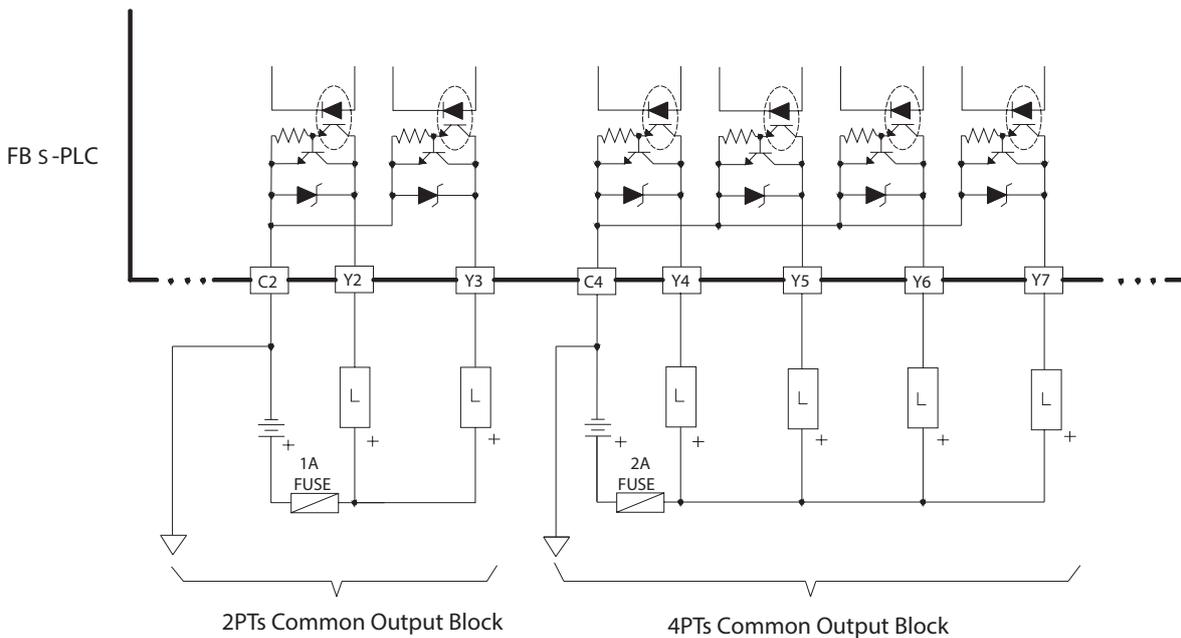
Because relay contacts have no polarity, it can be applied for AC or DC load power. Each relay can provide current up to 2A. The maximum rated current in all output commons of FB S-PLC is 4A. Its mechanical lifetime can reach up to 2 million times, while the contacts have a shorter lifetime. The lifetime also varies depending on working voltage, load type (power factor $\cos \phi$) and contact current. The relation between them is plotted in the figure below. In the case of pure resistive load ($\cos \phi = 1.0$) at 120VAC and 2A, the lifetime of contacts is about 250 thousand times. While for high inductive or capacitive load with $\cos \phi$ up to 0.2 and current within 1A, the lifetime decreases rapidly to about 50 thousand times (AC200V) or 80 thousand times (AC120V).

FB s -PLC

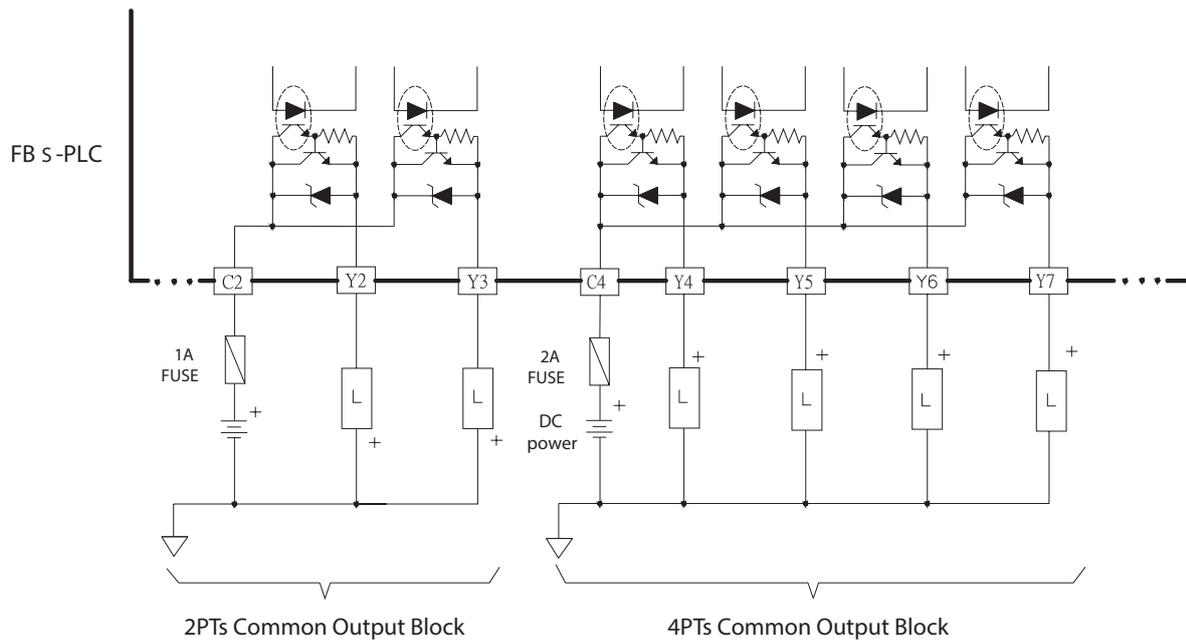


Structure and Wiring of Single-End Transistor SINK and SRCE Output Circuit

A. Transistor Single-End SINK Output

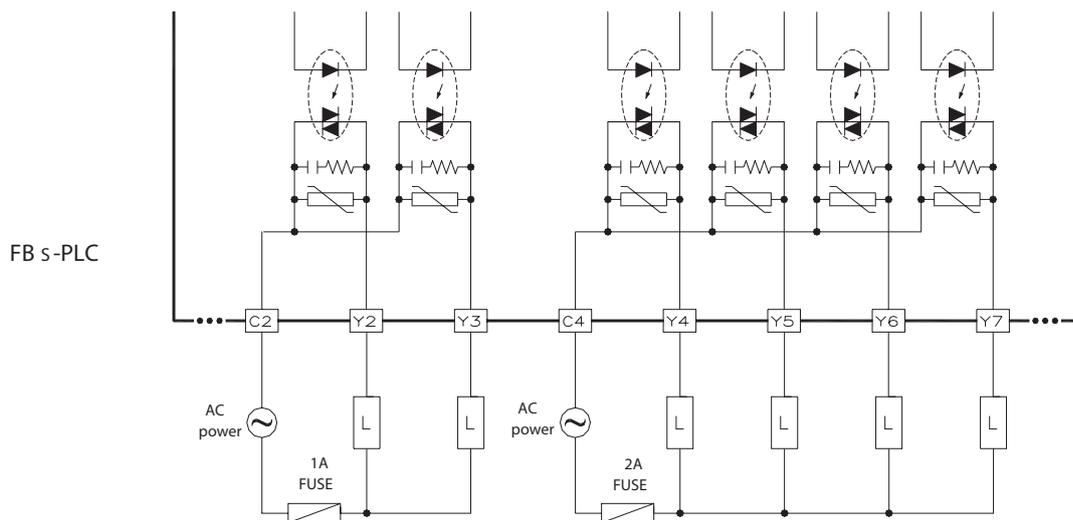


B. Transistor Single-End SRCE Output



The figure above uses output blocks of 2PTs common and 4PTs common as an example to explain the differences in structural and wiring for SINK and SRCE output circuits, respectively. (8PTs common has the same block structure and wiring, except with different point number) The single-end SINK output and SRCE transistor output in FB s-PLC are different models. The user must check whether it is SINK output model or SRCE output model when purchasing.

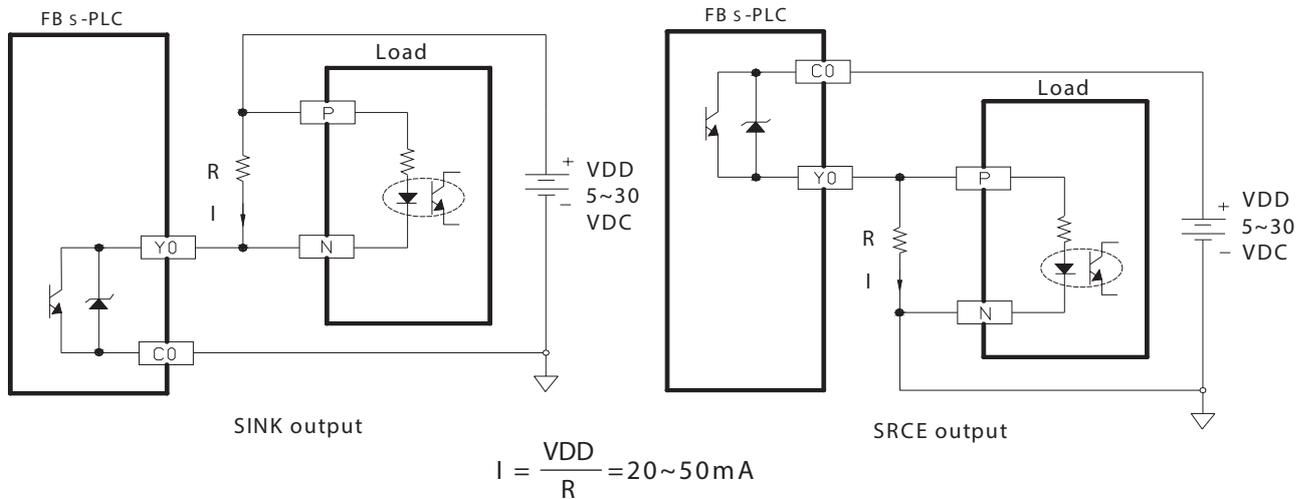
Structure and Wiring of Single-End TRIAC Output Circuit



- TRIAC output can only be used for AC load. Furthermore, a load current larger than the holding current (25mA) is required to keep TRIAC conducting. Therefore, when the load current is less than 25mA, a Dummy load must be connected parallel with load to make the load current larger than the TRIAC holding current. Besides, note that even when TRIAC output is open (OFF), there still exists a leakage current of 1mA (AC100V) or 2mA (AC200V), which may trigger actions in loads that can be activated by small currents. Connection of Dummy load in parallel with the load described above can solve this problem.

Speed up the Single-End Transistor Output Circuit (only applicable to high- and medium-speed)

Either with the SINK or SRCE structure in single-end output transistor circuit, when the transistor switches from ON to OFF, the junction capacitor between transistor CE electrodes should be charged to near the load voltage VDD before it can stop the current running through the photocoupler inside the load, which increases the OFF time and decreases the response speed. This problem can be solved by adding a Dummy load to accelerate charging rate and speed up the working frequency of transistor output. For the transistor output in FB s-PLC, Dummy load that are added to the high- and medium-speed transistor output and generate a load current of 20~50mA is adequate. For low speed transistor where its driving capability (0.5A) but speed is concerned, adding a Dummy load only decreases its driving capability without any significant improvement and hence is not recommended. The following diagram shows how to add a Dummy load to SINK and SRCE transistor output.



Output Device Protection and Noise Suppression in DO Circuit

Since the digital output circuits are mainly used for the ON/OFF switching operation, the output components such as relays, transistors and TRIAC can be deemed as kinds of switch components. Normally, surge currents or counter-electromotive force voltages are generated during the ON/OFF operation of these switch components. The effect of surge currents or counter-electromotive force voltages is particularly serious when heavy capacitive or inductive loads are incorporated, which may cause damage to the output components or generate noises in other electronic circuits and equipment. Among those three FB s-PLC output components, where TRIAC require no special treatment because of their features of smaller rated current, zero cross in ON/OFF, and built-in protection circuits, special consideration should be given to relays and transistors when they are used in high power applications or connected with capacitive or inductive loads and are described in the following:

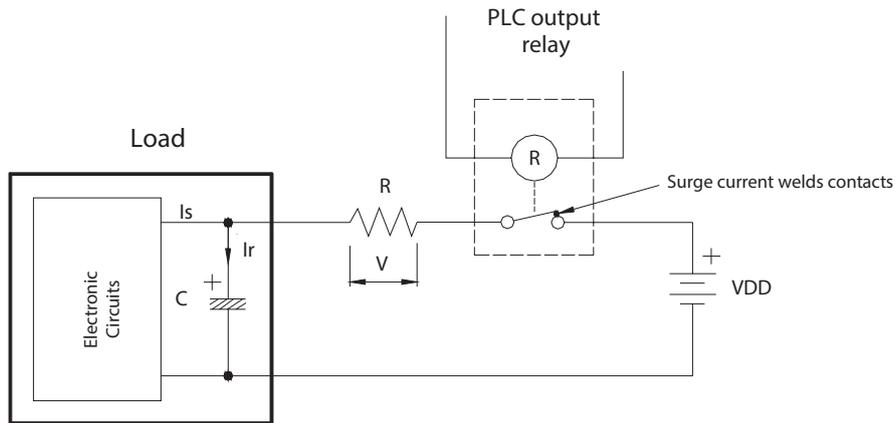
Protection of Relay Contacts and Noise Suppression

Because the relay contacts are used to contact switch components having extremely low resistance, the surge current IR generated instantly upon turning on the relay is normally pretty strong (even if the steady load current is very small). Under such strong surge, the contact tends to melt and stick due to extreme temperature in such a way that the relay cannot trip when it is disconnected. In addition, when the relay connections are OFF, large di/dt is generated because of the instantaneous change from low resistance to open circuit (∞) soon after following the tripping of contact. As a result, an extremely strong counter-electromotive force voltage is induced, which creates sparks between the electrodes of two relay contacts and results in poor contact due to carbon deposits. Among those three output components, either in ON or OFF state, very serious interference can be caused by the surge current or the counter-electromotive of the relay. The solutions to this problem are listed as follows:

Structure and Wiring of Single-Ended Transistor NM and SRCE Output Circuit

A. Suppression of Surge Current

⇒ Connect a small resistor R in series to lower the surge current, but note that too large R will affect the driving capability or cause too much voltage drop.



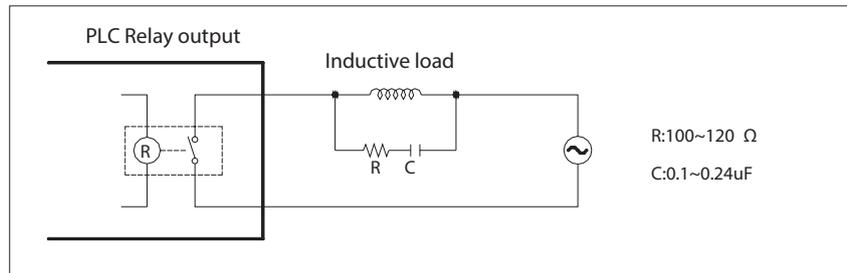
$$R \geq \frac{VDD}{I_r \text{ max}}$$

(note power dissipation $P = I_s^2 R$ and voltage drop $V = I_s R$)

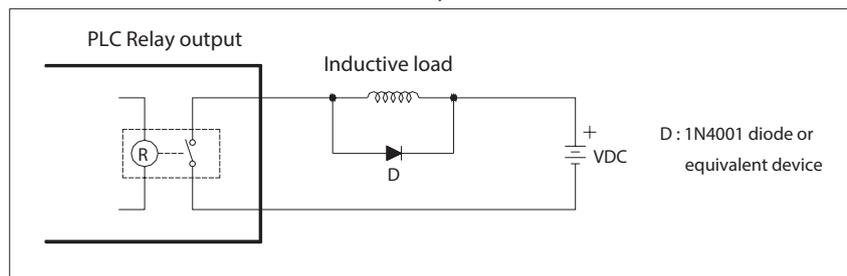
$I_r \text{ max of relay in FBS-PLC} = 5A$

B. Suppression of Counter-Electromotive Force

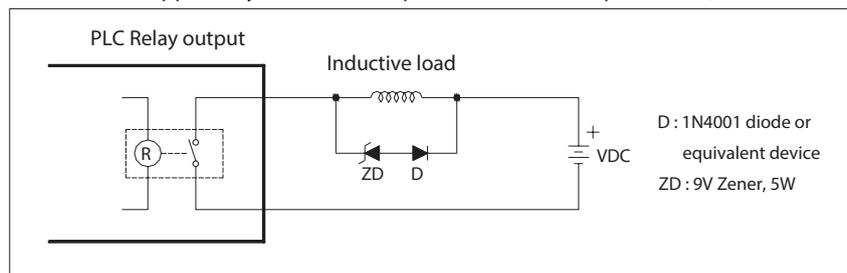
For the inductive load, whether in AC or DC power, suppression devices must be connected in parallel to both its ends to protect the relay contacts and lower noise interference. The schematic diagrams for AC and DC powers are shown below, respectively:



Scheme of AC power load



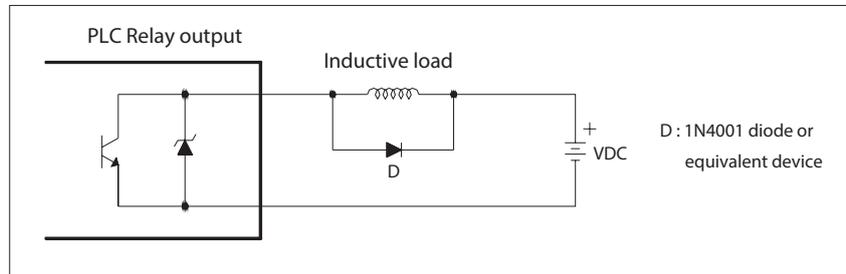
Suppress by a diode in DC power load (for low power)



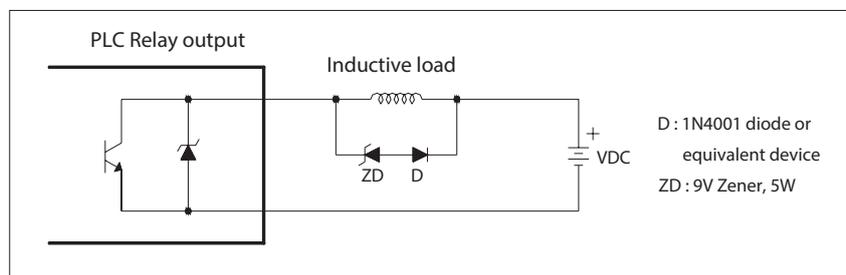
Suppress by a diode + Zener in DC power load (for high power and frequent ON/OFF)

Protection of Transistor Output and Noise Suppression

The transistor output in FB S-PLC already includes Zener diode for counter-EMF, which is sufficient for low power inductive load and medium frequency of ON/OFF application. In conditions of high power or frequent ON/OFF, please construct another suppression circuit to lower noise interference and prevent voltage from exceeding the limit or overheating that may damage the transistor output circuit.



Suppress by a diode (for low power)



Suppress by a diode + Zener (high power and frequent ON/OFF)