General Specification

GS 34M6H62-02E

FA-M3
F3CU04-0S, F3CU04-1S
Temperature Control and PID Module

FA-M3

■ General

F3CU04-□S is a temperature control and PID module for the FA-M3.

■ Features

- High Speed and Performance
  The input sampling period is 200 ms for 4 loops.
  The input conversion accuracy is 0.1% of full scale, and the input resolution is 0.1°C.
- Universal Input
  Each channel may be configured for either thermocouple, RTD or DC voltage input connection.
- Dynamic Auto-tuning
  Simply setting a minimum number of parameters (e.g., input ranges and set points) is sufficient to start operation, without need for manual tuning of PID parameters.
  If a set point or other major condition is changed during operation, PID parameters are automatically recalculated.

● Specifications

General

- The F3CU04-0S, occupying a single slot, controls up to four loops.
- The F3CU04-1S, occupying two slots, controls up to four loops.
- PID constants, set points and some other control parameters are stored in the module, eliminating the need to set up parameters before each operation. A specific SP backup procedure needs to be executed to store set points to the EEPROM. Otherwise, set points are not stored to the EEPROM when updated.

Input

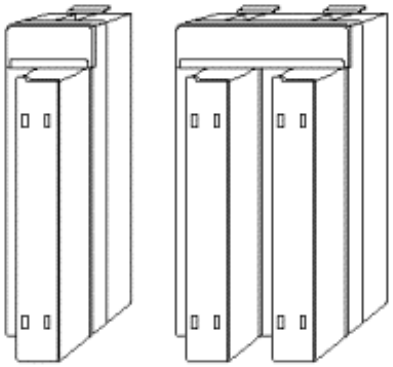
- Individual input channels are isolated from each other, as well as from the internal circuit.

Control

- Auto-tuning and the “super” feature that makes use of fuzzy logic to suppress output overshooting are provided as standard functions to achieve optimal control.
- Heating and cooling control are also supported. Using a cooling output, however, may require reduced number of output loops, or use of another output module.
  (The F3CU04-1S allows both a heating output and cooling output without reduction in the number of output loops.)
- The module offers cascade control and other compound loop controls.

Output

- The control output type is time-proportional PID. Depending on the wiring, the module can be connected to a relay or an SSR.
- The F3CU04-1S also provides continuous PID output (4-20 mA).



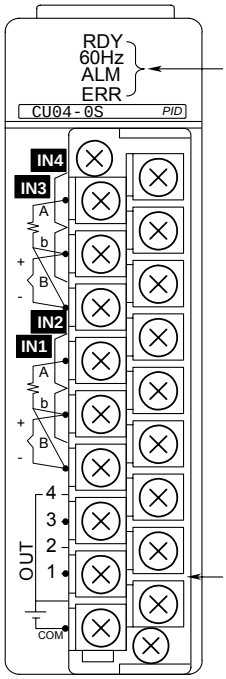
■ Model and Suffix Codes

Model	Suffix Code	Style Code	Option Code	Description
F3CU04	-0S	—	—	4 loops of universal input Time-proportional PID output (open collector) Single-slot size
	-1S	—	—	4 loops of universal input and output (open collector, continuous 4-20 mA output) Double-slot size

■ Components and Functions

Front view

● F3CU04-0S (Single-slot type)



Status Indicators

RDY (green)

Lit when the internal circuit is functioning normally. Turns off when an error occurs in the module.

60 Hz (green)

Indicates the frequency of the commercial power supply,
Off: 50Hz;
On: 60 Hz.

ALM (orange)

Lit when an alarm occurs in any loop.

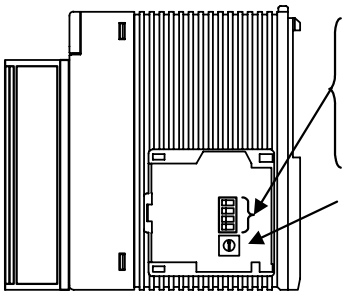
ERR (red)

Lit or flashes when a hardware failure is detected or an error is detected in stored data.
Lit when an error is detected in RAM, ROM, system data, calibration values, ADC, RJC or EEPROM.
Flashes when a parameter error or burnout is detected.

I/O terminal block

18-point detachable terminal block with M3.5 screws.

Right side view



SW1-1: Temperature unit selector switch
SW1-2: Power frequency selector switch
SW1-3: Input type selector switch
SW1-4: Input type selector switch

SW5: Input type selector switch
(Input type is determined by the combined values of SW1-3, SW1-4, and SW5.)

Note: This is the right side view of the module with its cover removed.

● F3CU04-1S (Double-slot type)

Status Indicators

RDY (green)

Lit when the internal circuit is functioning normally. Turns off when an error occurs in the module.

60 Hz (green)

Indicates the frequency of the commercial power supply,
Off: 50Hz; On: 60 Hz.

ALM (orange)

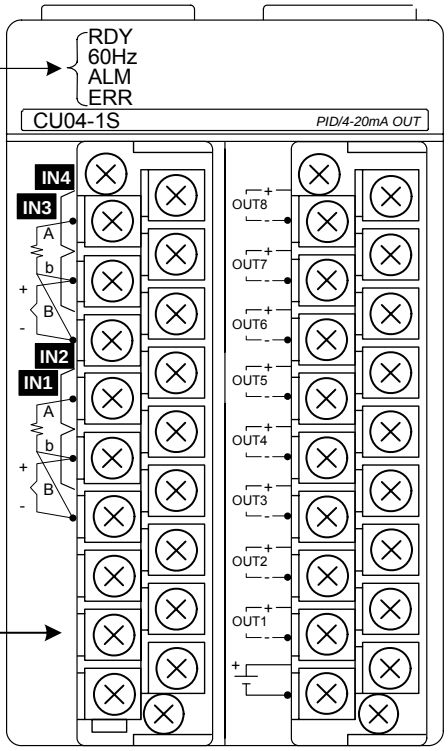
Lit when an alarm occurs in any loop.

ERR (red)

Lit or flashes when a hardware failure is detected or an error is detected in stored data.
Lit when an error is detected in system data, calibration values, ADC, RJC or EERPROM.
Flashes when a parameter error or burnout is detected.

I/O terminal block

18-point detachable terminal block with M3.5 screws.



■ Specifications

General Specifications

Item		Specification	
		F3CU04-0S	F3CU04-1S
Number of loops		4	
Isolation	Between input terminals and internal circuit	Isolated by photocouplers and transformers (tested for 1500 V AC voltage withstanding for one minute)	
	Between internal terminals		
	Between output terminals and internal circuit		
Alarm types		12 types of alarm: measured value upper limit, measured value lower limit, deviation upper limit, deviation lower limit, deviation upper/lower limit, and within deviation upper/lower limit, all with or without waiting	
Number of alarm outputs (input relays)		4 alarm outputs per loop (2 input relays for alarms 1 and 2 for each loop)	
Alarm ON-delay function		Yes	
Warm-up time		30 minutes min.	
Max. allowable ambient temperature change rate*1		10°C/h max.	
Mounting position		Horizontal or inverted orientation not allowed. Air vents in the enclosure above and below the module must be kept open.	
External connection		One 18-point terminal block with M3.5 screws	Two 18-point terminal blocks with M3.5 screws
External dimensions*2		28.9 (W) × 100 (H) × 106.1 (D) mm	58 (W) × 100 (H) ×106.1 (D) mm
Current consumption		460 mA (5 VDC)	470 mA (5 VDC)
Weight		200 g	350 g

*1: The stated accuracy for the reference junction for thermocouple input is not guaranteed if this ambient temperature change rate is exceeded.

*2: Outside dimensions excluding protrusions (for details, see the Extension Dimensions diagram).

Input specifications

Item			Specification	
			F3CU04-0S	F3CU04-1S
Input sampling period			200 ms for four loops or 100 ms for two loops	
Input types and ranges*1			Universal input (individual inputs separately configurable by software or collectively by hardware) Thermocouple input :15 ranges RTD input : 9 ranges DC mV input : 2 ranges DC V input : 4 ranges	
Input accuracy			±0.1% of F.S.*1	
Burnout detection			Thermocouples or RTDs are checked for burnout. Selectable as Upscale, Downscale or None.	
	Detection current	Thermocouple	100 nA max.	
		RTD	100 nA max.	
Reference junction compensation	Thermocouple*2		±2.0°C (0 to 55°C)	
Measuring current	RTD		Approx. 270 µA	
Allowable input wiring resistance	RTD		10 Ω max. per wire (three wires must have the same resistance)	
Allowable signal source resistance	Thermocouple or DC mV input		250 Ω max.	
	DC V input		2 kΩ max.	
Allowable input voltage range			-20 to 20 VDC	
Noise reduction*3		Common mode	120 dB (50/60 Hz)	
		Normal mode	40 dB (50/60 Hz)	
Effect of ambient temperature			Input stability: ±0.01%/°C or ±1 µV/°C, whichever is greater	

*1: See Table 1, “Instrument Range and Accuracy (for high resolution operation) 1/4 or 3/4”.

*2: This value assumes that all input and output terminals are correctly wired (that is, solderless termination, wiring, and connection are correct).

*3: This value assumes that the power supply frequency is correctly selected.

Table 1 Instrument Range and Accuracy (for high resolution operation with SW1-1 set to OFF) 1/4

Input Category	Input Type[*1]	Instrument Range[*2]	Input Type Selector witch[*3] SW1-3	SW1-4	SW5	Software Setting	Accuracy[*4]	Resolution[*2]
Software setting (factory setting)			OFF	OFF	0	Instrument ranges may be specified by software using one of the following codes.		
Thermocouple	K[*5]	-200.0 to 1370.0°C	OFF	OFF	1	1 ($01)	± 0.5°C[*5]	0.1°C[*5]
		-200.0 to 1000.0°C			2	2 ($02)	± 0.5°C[*5]	0.1°C[*5]
		-200.0 to 500.0°C			3	3 ($03)	± 0.5°C[*6]	0.1°C[*6]
	J	-200.0 to 1200.0°C			4	4 ($04)	± 0.5°C[*7]	0.1°C[*7]
		-200.0 to 500.0°C			5	5 ($05)	± 0.5°C[*8]	0.1°C[*8]
	T	-270.0 to 400.0°C			6	6 ($06)	± 0.5°C[*9]	0.1°C[*9]
	B[*10]	0.0 to 1600.0°C			7	7 ($07)	± 1.0°C[*10]	0.1°C[*10]
	S[*11]	0.0 to 1600.0°C			8	8 ($08)	± 1.0°C[*11]	0.1°C[*11]
	R[*11]	0.0 to 1600.0°C			9	9 ($09)	± 1.0°C[*11]	0.1°C[*11]
	N	-200.0 to 1300.0°C			A	10 ($0A)	± 0.6°C[*12]	0.1°C[*12]
	E	-270.0 to 1000.0°C			B	11 ($0B)	± 0.5°C[*13]	0.1°C[*13]
	L	-200.0 to 900.0°C			C	12 ($0C)	± 0.6°C	0.1°C
	U	-200.0 to 400.0°C			D	13 ($0D)	± 0.6°C	0.1°C
	W[*14]	0.0 to 1600.0°C			E	14 ($0E)	± 0.8°C[*14]	0.1°C[*14]
	Platinel 2	0.0 to 1390.0°C			F	15 ($0F)	± 0.6°C	0.1°C
RTD	JPt100	-200.0 to 500.0°C	OFF	ON	0	16 ($10)	± 0.4°C	0.1°C
		-200.0 to 200.0°C			1	17 ($11)	± 0.4°C	0.1°C
		0.0 to 300.0°C			2	18 ($12)	± 0.3°C	0.1°C
		0.00 to 150.00°C			3	19 ($13)	± 0.20°C	0.02°C
	Pt100	-200.0 to 850.0°C			4	20 ($14)	± 0.4°C	0.1°C
		-200.0 to 500.0°C			5	21 ($15)	± 0.4°C	0.1°C
		-200.0 to 200.0°C			6	22 ($16)	± 0.4°C	0.1°C
		0.0 to 300.0°C			7	23 ($17)	± 0.3°C	0.1°C
		0.00 to 150.00°C			8	24 ($18)	± 0.20°C	0.02°C
DC voltage	DC mV input[*15]	0 to 10.00 mV DC	— [*16]	ON	9	25 ($19)	± 0.1% of instrument range ± 1 digit[*15]	
		0 to 100.0 mV DC			A	26 ($1A)		
	DC V input[*15]	0.000 to 1.000 V DC			B	27 ($1B)		
		0.000 to 5.000 V DC			D	29 ($1D)		
		1.000 to 5.000 V DC			E	30 ($1E)		
		0.00 to 10.00 V DC			F	31 ($1F)		

*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.
*2: For thermocouples K, B, S, R, and W, input ranges may be set wider than their instrument ranges (see the notes below). However, if the input range width exceeds 1600°C, the resolution becomes twice of the indicated value. Furthermore, the actual range for an acceptable input is the input range ±5%.
*3: If you change the hardware switch settings, data stored in the EEPROM is initialized to follow the switch settings after power on.
*4: This accuracy applies if the ambient temperature is 25 ± 5°C and the input value is within the instrument range. If the input type is thermocouple and reference junction compensation is used, you should also take into consideration the accuracy of the reference junction compensation.
*5: For K-type thermocouples, the input range may be set from -270.0 to 1370.0°C. The accuracy and resolution depend on measured temperatures as follows:
-270.0 to -200.0°C : Neither accuracy or resolution is guaranteed.
-200.0 to 0.0°C : ±1.0°C accuracy, 0.2°C resolution
*6: For K-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to -180.0°C : ±0.9°C accuracy, 0.2°C resolution
-180.0 to -100.0°C : ±0.6°C accuracy, 0.1°C resolution
*7: For J-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to -100.0°C : ±1.0°C accuracy, 0.2°C resolution
*8: For J-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to -150.0°C : ±0.6°C accuracy, 0.1°C resolution
*9: For T-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-270.0 to -200.0°C : ±3.5°C accuracy, 0.5°C resolution
-200.0 to -100.0°C : ±1.0°C accuracy, 0.1°C resolution
*10: For B-type thermocouples, the input range may be set from 0.0 to 1800.0°C. The accuracy and resolution depend on measured temperatures as follows:
0.0 to 300.0°C : Neither accuracy nor resolution is guaranteed.
300.0 to 900.0°C : ±2.5°C accuracy, 0.3°C resolution
*11: For S-type and R-type thermocouples, the input range may be set from 0.0 to 1700.0°C. The accuracy and resolution depend on measured temperatures as follows:
0.0 to 200.0°C : ±1.5°C accuracy, 0.2°C resolution
*12: For N-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200.0 to 0.0°C : ±1.3°C accuracy, 0.3°C resolution
*13: For E-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-270.0 to -200.0°C : ±6.5°C accuracy, 2.0°C resolution
-200.0 to -100.0°C : ±1.0°C accuracy, 0.2°C resolution
*14: For W-type thermocouples, the input range may be set from 0.0 to 2300.0°C. The accuracy and resolution depend on measured temperatures as follows:
0.0 to 100.0°C : ±1.0°C accuracy, 0.2°C resolution
*15: Resolution is determined by the upper and lower limits for the input range, as well as the upper and lower scaling limits. It is represented by one digit.
*16: "–" means that the value is ignored.

Table 1 Instrument Range and Accuracy (for low resolution operation with SW1-1 set to OFF) 2/4

Input Category	Input Type[*1]	Instrument Range[*2]	Input Type Selector Switch[*3]			Software Setting	Accuracy[*4]	Resolution[*2]
			SW1-3	SW1-4	SW5			
Software setting			ON	OFF	0	Instrument ranges may be specified by software using one of the following codes.		
Thermocouple	K[*5]	-200 to1370°C	ON	OFF	1	33 ($21)	± 2°C[*5]	1°C[*5]
		-200 to1000°C			2	34 ($22)	± 2°C[*5]	1°C[*5]
		-200 to500°C			3	35 ($23)	± 2°C	1°C
	J	-200 to 1200°C			4	36 ($24)	± 2°C	1°C
		-200 to 500°C			5	37 ($25)	± 2°C	1°C
	T[*6]	-270 to 400°C			6	38 ($26)	± 2°C[*6]	1°C
	B[*7]	0 to 1600°C			7	39 ($27)	± 2°C[*7]	1°C[*7]
	S[*8]	0 to 1600°C			8	40 ($28)	± 2°C[*8]	1°C
	R[*8]	0 to 1600°C			9	41 ($29)	± 2°C[*8]	1°C
	N[*9]	-200 to 1300°C			A	42 ($2A)	± 2°C[*9]	1°C
	E[*10]	-270 to 1000°C			B	43 ($2B)	± 2°C[*10]	1°C[*10]
	L	-200 to 900°C			C	44 ($2C)	± 2°C	1°C
	U	-200 to 400°C			D	45 ($2D)	± 2°C	1°C
	W[*11]	0 to 1600°C			E	46 ($2E)	± 2°C	1°C
	Platinel 2	0 to 1390°C			F	47 ($2F)	± 2°C	1°C
RTD	JPt100	-200 to 500°C	ON	ON	0	48 ($30)	± 2°C	1°C
		-200 to 200°C			1	49 ($31)	± 2°C	1°C
		0 to 300°C			2	50 ($32)	± 2°C	1°C
		0.0 to 150.0°C			3	51 ($33)	± 0.3°C	0.1°C
	Pt100	-200 to 850°C			4	52 ($34)	± 2°C	1°C
		-200 to 500°C			5	53 ($35)	± 2°C	1°C
		-200 to 200°C			6	54 ($36)	± 2°C	1°C
		0 to 300°C			7	55 ($37)	± 2°C	1°C
		0.0 to 150.0°C			8	56 ($38)	± 0.3°C	0.1°C

*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.
*2: For thermocouples K, B, S, R, and W, input ranges may be set wider than their instrument ranges (see the notes below). However, if the input range width exceeds 1600°C, the resolution becomes twice of the indicated value. Furthermore, the actual range for an acceptable input is the input range ±5%.
*3: If you change the hardware switch settings, data stored in the EEPROM is initialized to follow the switch settings after power on.
*4: This accuracy applies if the ambient temperature is 25 ± 5°C and the input value is within the instrument range. If the input type is thermocouple and reference junction compensation is used, you should also take into consideration the accuracy of the reference junction compensation.
*5: For K-type thermocouples, the upper and lower input range limits may be set from -270 to 1370°C. The accuracy and resolution depend on measured temperatures as follows:
-270 to -200°C : Neither accuracy nor resolution is guaranteed.
*6: For T-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-270 to -200°C : ±4°C accuracy, 1°C resolution
*7: For B-type thermocouples, the upper and lower input range limits may be set from 0 to 1800°C. The accuracy and resolution depend on measured temperatures as follows:
0 to 300°C : Neither accuracy nor resolution is guaranteed.
300 to 900°C : ±3°C accuracy, 1°C resolution
*8: For S-type and R-type thermocouples, the upper and lower input range limits may be set from 0 to 1700°C.
*9: For N-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-200 to 0°C : ±3°C accuracy, 1°C resolution
*10: For E-type thermocouples, the detailed accuracy and resolution are as follows:
-270 to -200°C : ±8°C accuracy, 2°C resolution
-200 to 1000°C : ±2°C accuracy, 1°C resolution
*11: For W-type thermocouples, the upper and lower input range limits may be set from 0 to 2300°C.

Table 1 Instrument Range and Accuracy (for high resolution operation with SW1-1 set to ON) 3/4

Input Category	Input Type[*1]	Instrument Range[*2]	Input Type Selector Switch[*3] SW1-3	SW1-4	SW5	Software Setting	Accuracy[*4]	Resolution[*2]
Software setting (factory setting)			OFF	OFF	0	Instrument ranges may be specified by software using one of the following codes.		
Thermocouple	K[*5]	-328.0 to 2498.0°F	OFF	OFF	1	1 ($01)	± 1.0°F[*5]	0.2°F[*5]
		-328.0 to 1832.0°F			2	2 ($02)	± 1.0°F[*5]	0.2°F[*5]
		-328.0 to 932.0°F			3	3 ($03)	± 1.0°F[*6]	0.2°F[*6]
	J	-328.0 to 2192.0°F			4	4 ($04)	± 1.0°F[*7]	0.2°F[*7]
		-328.0 to 932.0°F			5	5 ($05)	± 1.0°F[*8]	0.2°F
	T	-454.0 to 752.0°F			6	6 ($06)	± 1.0°F[*9]	0.2°F[*9]
	B[*10]	32 to 2912°F			7	7 ($07)	± 2°F[*10]	1°F[*10]
	S[*11]	32 to 2912°F			8	8 ($08)	± 2°F[*11]	1°F
	R[*11]	32 to 2912°F			9	9 ($09)	± 2°F[*11]	1°F
	N	-328.0 to 2372.0°F			A	10 ($0A)	± 1.2°F[*12]	0.2°F[*12]
	E	-454.0 to 1832.0°F			B	11 ($0B)	± 1.0°F[*13]	0.2°F[*13]
	L	-328.0 to 1652.0°F			C	12 ($0C)	± 1.2°F	0.2°F
	U	-328.0 to 752.0°F			D	13 ($0D)	± 1.2°F	0.2°F
	W[*14]	32 to 2912°F			E	14 ($0E)	± 2°F	1°F
	Platinel 2	32.0 to 2534.0°F			F	15 ($0F)	± 1.2°F	0.2°F
RTD	JPt100	-328.0 to 932.0°F	OFF	ON	0	16 ($10)	± 0.8°F	0.2°F
		-328.0 to 392.0°F			1	17 ($11)	± 0.8°F	0.2°F
		32.0 to 572.0°F			2	18 ($12)	± 0.6°F	0.2°F
		32.0 to 302.0°F			3	19 ($13)	± 0.4°F	0.2°F
	Pt100	-328.0 to 1562.0°F			4	20 ($14)	± 0.8°F	0.2°F
		-328.0 to 932.0°F			5	21 ($15)	± 0.8°F	0.2°F
		-328.0 to 392.0°F			6	22 ($16)	± 0.8°F	0.2°F
		32.0 to 572.0°F			7	23 ($17)	± 0.6°F	0.2°F
		32.0 to 302.0°F			8	24 ($18)	± 0.4°F	0.2°F
DC voltage	DC mV input[*15]	0 to 10.00 mV DC	— [*16]	ON	9	25 ($19)	± 0.1% of instrument range ± 1 digit[*15]	
		0 to 100.0 mV DC			A	26 ($1A)		
	DC V input[*15]	0.000 to 1.000 V DC			B	27 ($1B)		
		0.000 to 5.000 V DC			D	29 ($1D)		
		1.000 to 5.000 V DC			E	30 ($1E)		
		0.00 to 10.00 V DC			F	31 ($1F)		

*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.
*2: For thermocouples K, B, S, R, and W, input ranges may be set wider than their instrument ranges (see the notes below). However, if the input range width exceeds 2880°F, the resolution becomes twice of the indicated value. Furthermore, the actual range for an acceptable input is the input range ±5%.
*3: If you change the hardware switch settings, data stored in the EEPROM is initialized to follow the switch settings after power on.
*4: This accuracy applies if the ambient temperature is 77°F±9°F and the input value is within the instrument range. If the input type is thermocouple and reference junction compensation is used, you should also take into consideration the accuracy of the reference junction compensation.
*5: For K-type thermocouples, the input range may be set from -454.0 to 2498.0°F. The accuracy and resolution depend on measured temperatures as follows:
-454.0 to -328.0°F : Neither accuracy or resolution is guaranteed.
-328.0 to 32.0°F : ±2.0°F accuracy, 0.4°F resolution
*6: For K-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-328.0 to -292.0°F : ±2.0°F accuracy, 0.4°F resolution
-292.0 to -148.0°F : ±1.2°F accuracy, 0.2°F resolution
*7: For J-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-328.0 to -148.0°F : ±2.0°F accuracy, 0.4°F resolution
*8: For J-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-328.0 to -238.0°F : ±1.2°F accuracy, 0.2°F resolution
*9: For T-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-454.0 to -328.0°F : ±6.5°F accuracy, 1.0°F resolution
-328.0 to -148.0°F : ±2.0°F accuracy, 0.2°F resolution
*10: For B-type thermocouples, the input range may be set from 32 to 3272°F. The accuracy and resolution depend on measured temperatures as follows:
32 to 572°F : Neither accuracy nor resolution is guaranteed.
572 to 1652°F : ±5°F accuracy, 1°F resolution
*11: For S-type and R-type thermocouples, the input range may be set from 32 to 3092°F. The accuracy and resolution depend on measured temperatures as follows:
32 to 392°F : ±3°F accuracy, 1°F resolution
*12: For N-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-328.0 to 32.0°F : ±2.5°F accuracy, 0.6°F resolution
*13: For E-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-454.0 to -328.0°F : ±12.0°F accuracy, 4.0°F resolution
-328.0 to -148.0°F : ±2.0°F accuracy, 0.4°F resolution
*14: For W-type thermocouples, the input range may be set from 32 to 4172°F.
*15: Resolution is determined by the upper and lower limits for the input range, as well as the upper and lower scaling limits. It is represented by one digit.
*16: "–" means that the value is ignored.

Table 1 Instrument Range and Accuracy (for low resolution operation with SW1-1 set to ON) 4/4

Input Category	Input Type[*1]	Instrument Range[*2]	Input Type Selector Switch[*3]			Software Setting	Accuracy[*4]	Resolution[*2]
			SW1-3	SW1-4	SW5			
Software setting			ON	OFF	0	Instrument ranges may be specified by software using one of the following codes.		
Thermocouple	K[*5]	-328 to 2498°F	ON	OFF	1	33 ($21)	± 2°F[*5]	1°F[*5]
		-328 to 1832°F			2	34 ($22)	± 2°F[*5]	1°F[*5]
		-328 to 932°F			3	35 ($23)	± 2°F	1°F
	J	-328 to 2192°F			4	36 ($24)	± 2°F	1°F
		-328 to 932°F			5	37 ($25)	± 2°F	1°F
	T[*6]	-454 to 752°F			6	38 ($26)	± 2°F[*6]	1°F
	B[*7]	32 to 2912°F			7	39 ($27)	± 2°F[*7]	1°F[*7]
	S[*8]	32 to 2912 °F			8	40 ($28)	± 2°F[*8]	1°F
	R[*8]	32 to 2912°F			9	41 ($29)	± 2°F[*8]	1°F
	N[*9]	-328 to 2372°F			A	42 ($2A)	± 2°F[*9]	1°F
	E[*10]	-454 to 1832°F			B	43 ($2B)	± 2°F[*10]	1°F[*10]
	L	-328 to 1652°F			C	44 ($2C)	± 2°F	1°F
	U	-328 to 752°F			D	45 ($2D)	± 2°F	1°F
	W[*11]	32 to 2912°F			E	46 ($2E)	± 2°F	1°F
	Platinel 2	32 to 2534°F			F	47 ($2F)	± 2°F	1°F
RTD	JPt100	-328 to 932°F	ON	ON	0	48 ($30)	± 2°F	1°F
		-328 to 392°F			1	49 ($31)	± 2°F	1°F
		32 to 572°F			2	50 ($32)	± 2°F	1°F
		32 to 302°F			3	51 ($33)	± 2°F	1°F
	Pt100	-328 to 1562°F			4	52 ($34)	± 2°F	1°F
		-328 to 932°F			5	53 ($35)	± 2°F	1°F
		-328 to 392°F			6	54 ($36)	± 2°F	1°F
		32 to 572°F			7	55 ($37)	± 2°F	1°F
		32 to 302°F			8	56 ($38)	± 2°F	1°F

*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.

*2: For thermocouples K, B, S, R, and W, input ranges may be set wider than their instrument ranges (see the notes below). However, if the input range width exceeds 2880°F, the resolution becomes twice of the indicated value. Furthermore, the actual range for an acceptable input is the input range ±5%.

*3: If you change the hardware switch settings, data stored in the EEPROM is initialized to follow the switch settings after power on.

*4: This accuracy applies if the ambient temperature is 77°F±9°F and the input value is within the instrument range. If the input type is thermocouple and reference junction compensation is used, you should also take into consideration the accuracy of the reference junction compensation.

*5: For K-type thermocouples, the upper and lower input range limits may be set from -454 to 2498°F. The accuracy and resolution depend on measured temperatures as follows:
-454 to 328°F : Neither accuracy nor resolution is guaranteed.

*6: For T-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-454 to -328°F : ±7°F accuracy, 1°F resolution

*7: For B-type thermocouples, the upper and lower input range limits may be set from 32 to 3272°F. The accuracy and resolution depend on measured temperatures as follows:
32 to 572°F : Neither accuracy nor resolution is guaranteed.
572 to 1652°F : ±5°F accuracy, 1°F resolution

*8: For S-type and R-type thermocouples, the upper and lower input range limits may be set from 32 to 3092°F. The accuracy and resolution depend on measured temperatures as follows:
32 to 392°F : ±3°F accuracy, 1°F resolution

*9: For N-type thermocouples, the accuracy and resolution depend on measured temperatures as follows:
-328 to 32°F : ±4°F accuracy, 1°F resolution

*10: For E-type thermocouples, the detailed accuracy and resolution are as follows:
-454 to 328°F : ±12°F accuracy, 4°F resolution
-328 to 148°F : ±3°F accuracy, 1°F resolution

*11: For W-type thermocouples, the upper and lower input range limits may be set from 32 to 4172°F.

Table 3 Power Supply Frequency

Power Supply Frequency	Input Type Selector Switch*			Remarks
	SW1-2	SW1-4	SW5	
Software setting	Any	OFF	0	Power supply frequency may be specified by software. (Factory setting)
50Hz	OFF	Other than the above.		Removes 50 Hz power supply frequency noise overlapping input signals.
60Hz	ON			Removes 60 Hz power supply frequency noise overlapping input signals.

*: When you turn on the power after changing the hardware switch settings, data stored in the EEPROM is initialized to follow the switch settings.

Control Specifications (can be set for individual loops)

Item		Specification	
		F3CU04-0S	F3CU04-1S
Control mode *1		Normal, cascade, two-input changeover, and setting output	
Output mode selection		ON/OFF control, PID control, and heating/cooling control *2	
Number of setting groups		4 groups: set point, proportional band, integration time, derivative time, manual reset value, and forward/reverse operation	
	Changeover method	Zone changeover using set point number or input temperature	
Auto-tuning		Calculates PID parameters using limit cycle method (when specified)	
"Dynamic auto-tuning" *3		PID parameters are automatically recalculated at control start, set point change, or hunching.	
"Super" *4		Suppresses overshooting using fuzzy logic theory	
Operation mode		RUN/STOP, automatic output/manual output, local/remote, set point number, and cascade output/automatic output/manual output (when cascade is used)	
Set point gradient setting		Both acceleration and deceleration can be set	
Output limit		Both upper and lower limits can be set	
Control period		Equivalent to input sampling period	
Output update period	Time-proportional PID output	Determined by cycle time (0.5 to 240 s)	
	Continuous PID output (4-20 mA)	N.A.	Equivalent to input sampling period

*1: Cascade or two-input changeover mode uses two loops of input and output terminals.
*2: Cooling output in the heating/cooling control mode requires another output module, or uses two loops of output terminals (for F3CU04-0S only).
*3: Not available in the heating/cooling or zone PID control mode.
*4: Not available in the ON/OFF control mode.

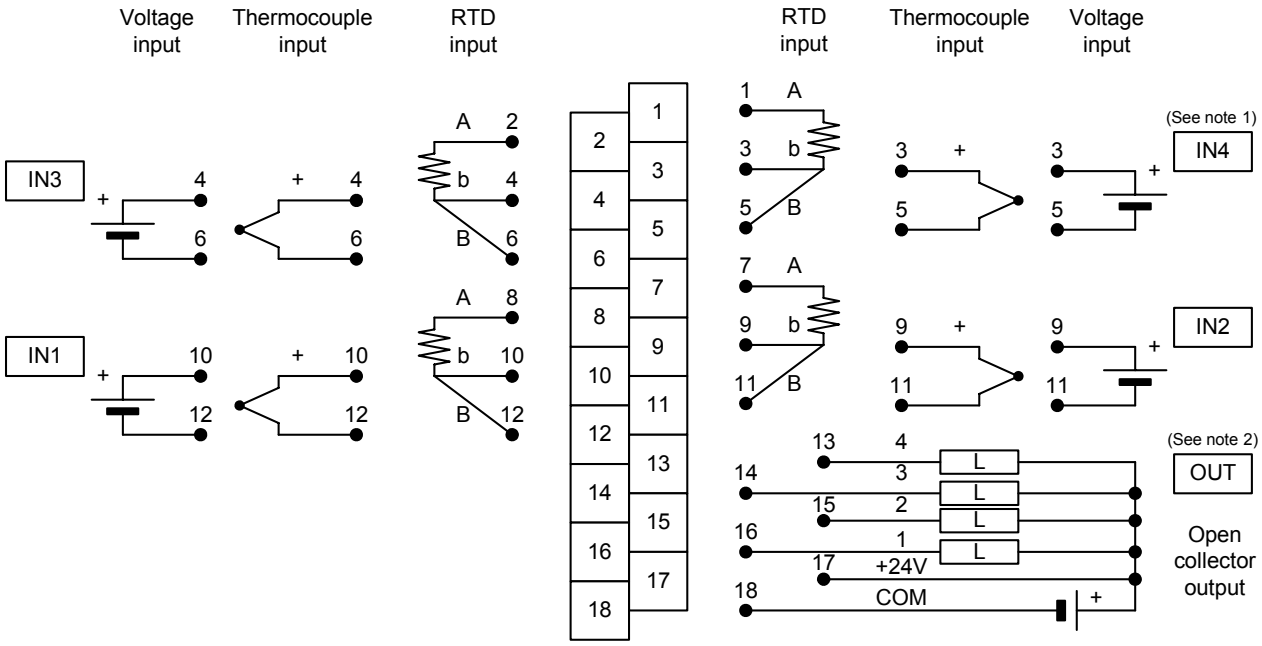
Output Specifications

Item		Specification	
		F3CU04-0S	F3CU04-1S
Number of outputs		4	8
External power supply*		24 VDC ±10%, 50 mA	24 VDC ±10%, 400 mA
Time-proportional PID output (Open collector)	Rated load voltage	24 VDC	
	Maximum load current	0.1 A per point	0.1 A per point and 0.4 A for 8 points
	ON residual voltage	0.5 VDC max.	
	OFF leakage current	0.1 mA max.	
	Response time	OFF→ON: 1 ms max., ON→OFF: 1 ms max.	
	Cycle time	0.5 to 240 s	
	Time-proportional resolution	10 ms or 0.05% of F.S., whichever is greater	
Continuous PID output (4-20mA)	Output range	N.A.	4-20 mA (3.2-20.8 mA)
	Allowable load resistance		600 Ω max.
	Output accuracy		±1.0% of F.S.
	Output resolution		0.05% of F.S.

*: External power supply is not required if no output terminal is used (that is, if only input terminals are used).

■ External Connection Diagram

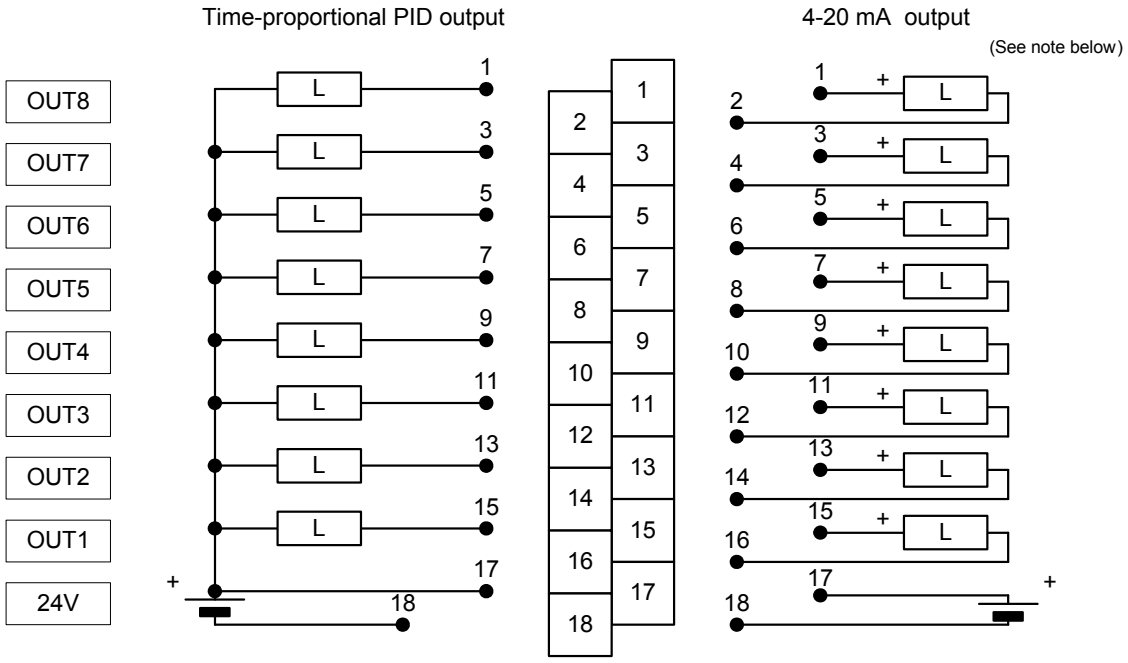
● F3CU04-0S terminal block (front) and F3CU04-1S terminal block (front left)



Note 1: The module supports mixed input types. Each channel may be wired for RTD, thermocouple, or voltage input independently.

Note 2: The F3CU04-1S has no output functions and requires no external power supply. Use the output terminals of the right terminal block.

● F3CU04-1S terminal block (front right)



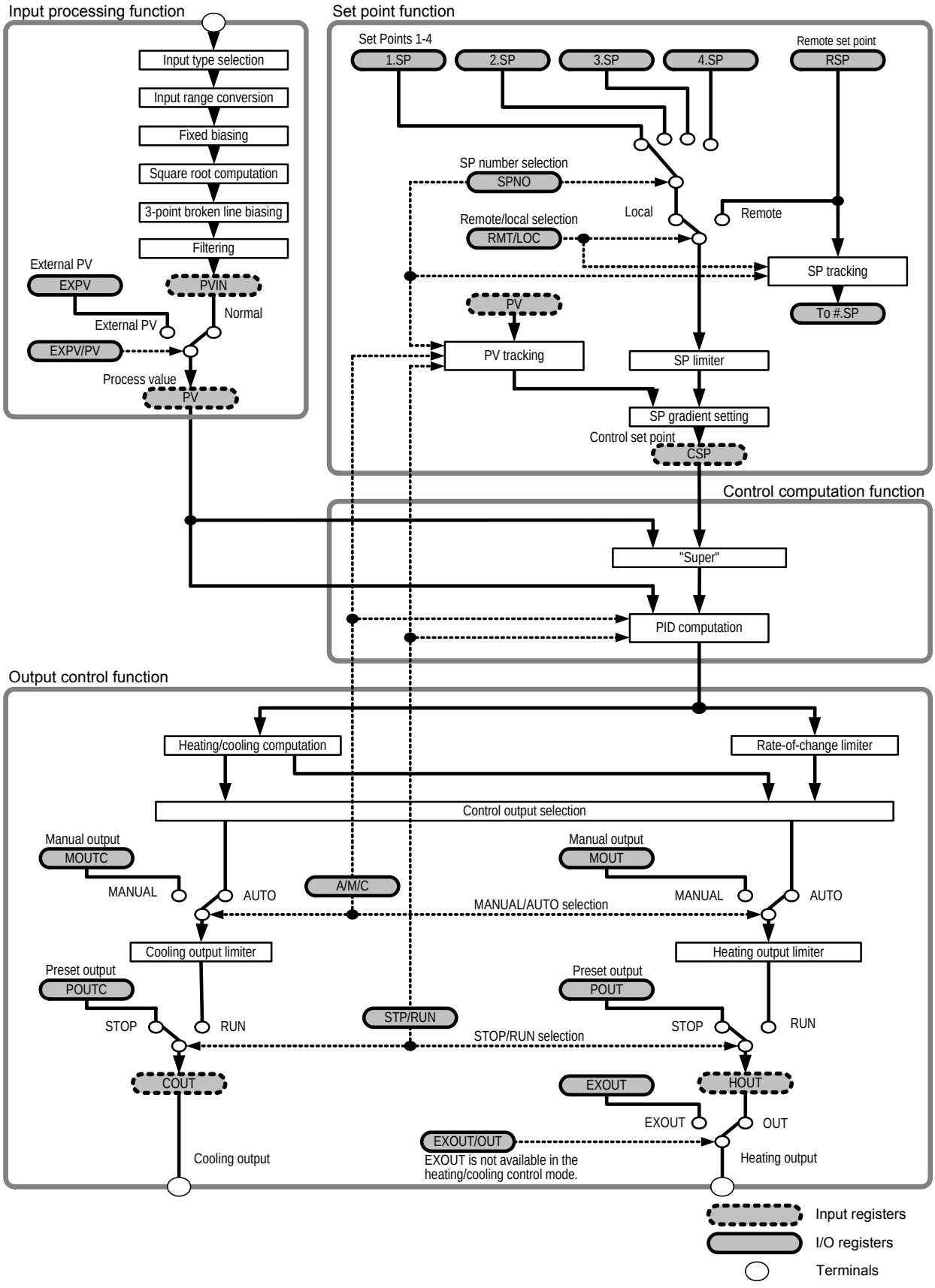
Note: The module allows mixed outputs. Each channel may be wired for time-proportional PID or 4-20 mA output independently.

■ Functions List

Function			Description
Controller	Input sampling period		Sets the input sampling period (This affects the number of available loops).
	Controller mode selection		Specifies controller mode for a pair of 2 loops.
	Controller mode	Single input mode	Basic controller mode with one control and computation function where two loops operate independently.
		Cascade	Two control and computation functions perform cascade control (using 2 loops of input and output).
		Two-input changeover	Switches between two measured inputs (using a register or measured value range) and handles them as one measured input (using 2 loops of input and output).
		Disabled	Loops specified as 'disabled' are not used.
Output processing	Control type selection		Selects from on/off, PID, and heating/cooling control modes.
	Control types	On/off	Performs control by turning on (100% output) or turning off the output (0% output). *1
		PID	Controls output according to PID computation results.
		Heating/cooling	Controls both heating and cooling outputs according to PID computation results.
	Output limiter	Output limiter	Sets the upper and lower limits for control output.
		Rate-of-change limiter	Sets the maximum allowable rate-of-change of control output.
	Output type selection *2		Selects between time-proportional output (open collector) and continuous output (4-20 mA).
	Analog output *2		Specifies a fixed value output for any output terminal not used for process control.
Input processing	Input type selection		Sets input type using switches (for all loops) or software (for individual loops).
	Power supply frequency specification		Specifies the power supply frequency. An appropriate setting value will reduce the effect of common mode noise.
	Input range setting		Sets input ranges.
	PV range setting		Sets the range of the control loop for two-input changeover mode.
	Burnout selection		Selectable from Up-scale, Down-scale, or OFF (no burnout detection) for thermocouple or RTD input open-circuit detection. *3
	Reference junction compensation selection		Sets thermocouple reference junction compensation to either on or fixed value.
	Input computation	Broken-line biasing	Specifies any temperature and its bias value. A compensation value based on the linear interpolation of the specified bias values is automatically added to a measured input. This function is particularly useful for a deteriorated sensor, for which input compensation is desirable.
		Fixed biasing	Specifies a fixed bias value to be automatically added to measured input values. This function is useful when a measured input suffers a fixed deviation due to a known physical problem with a sensor, or when fine adjustment of measured input is desirable for better consistency with values indicated by other equipment, even though data deviation is within tolerance.
		Input filtering	Filtering can be used to remove high frequency noise from measured inputs such as flow rate and pressure. Filtering is a first order delay numerical operation.
		Square root extraction	Performs square root extraction on measured inputs. This function is useful for converting differential pressure signals (of orifice, nozzle, or other types of restriction flowmeter) to flow rate signals.
	Two-input changeover		Sets the two-input changeover mode to perform changeover based on temperature range, preset temperature value, or register value.
	External PV input		An external value, such as a processed value from a CPU module, may be used as an input to the module.
Controlling	Set point	Set points	Four preset values are assigned to each loop. The set point can be selected using the control set up number selection parameter.
		SP limiter	Limits the set point value. Set points are restricted within the specified range in remote or cascade operation.
		SP gradient	Acceleration (UPR) and deceleration (DNR) may be set independently to vary the set point at a fixed rate or to prevent sudden changes in the set point.
		Remote setting	Allows the set point to be changed continuously and remotely by a CPU module.
	Auto-tuning	Dynamic auto-tuning	Automatically recalculates PID constants when control begins or when the control becomes unstable to achieve continuous stable control.
		Auto-tuning	When given a start tuning instruction, measures the characteristics of a control object by switching on and then switching off the output, and then automatically determines and sets an optimum PID constant.
	Control/ computation	Forward/reverse	Defines the direction of output increase or decrease corresponding to a positive or negative deviation.
		PID control mode	Selectable between constant-value and follow-up control modes. Automatically selects an optimum PID control mode (differentiation-precedent PID control or deviation-differentiation PID control) according to operation characteristics. PID control mode is selectable in cascade or remote operation.
		Super	Suppresses overshooting using fuzzy logic theories.
		Anti-reset windup	Prevents excessive integration and hence overshooting by suspending PID computation. The deviation width for resuming PID computation can be set using parameters.
	PID selection function		Each loop may select one of the four PID setting groups assigned to it.
	PID selection	Set point number selection	Switches between PID parameters according to the set point number selection.
		Zone PID function	Automatically switches between PID setting groups based on process values. May also switch between PID setting groups when the deviation is too large.
	Operation		Switches between run/stop, automatic/manual/cascade, remote/local, and other operation modes.
Alarm	Alarm	Alarm setup	Sets four alarms for each loop. Alarms may be triggered by measurement value upper or lower limit or differential upper or lower limit.
		Waiting	Suppresses alarm during the startup period after powering on until the operation stabilizes.
		Delay timer	Reports an alarm only if an alarm condition persists for a minimum duration.
Backup function (Storing of preset values)			Stores parameters to the EEPROM, which is writable up to 100,000 times.

*1: Numbers within parentheses (100% and 0%) applies when the output is configured as a continuous output (for F3CU04-1S only).
*2: Available for F3CU04-1S only.
*3: When burnout selection is set to OFF, the measured input value at the time of burnout (open circuit) is unpredictable and may approach either the upper limit or the lower limit. Furthermore, the burnout relay is not set. However +OVER or -OVER is detected.

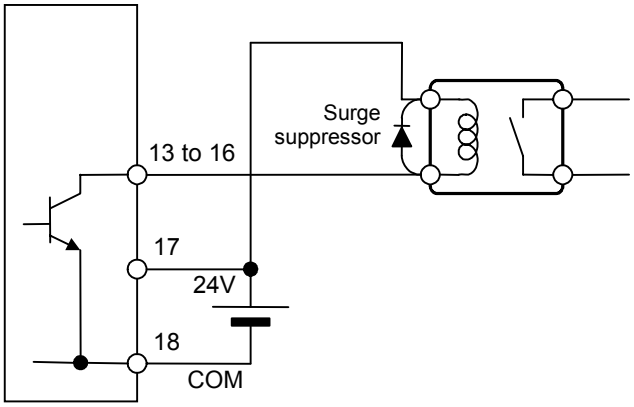
● Function block diagram for F3CU04 (single-loop operation)



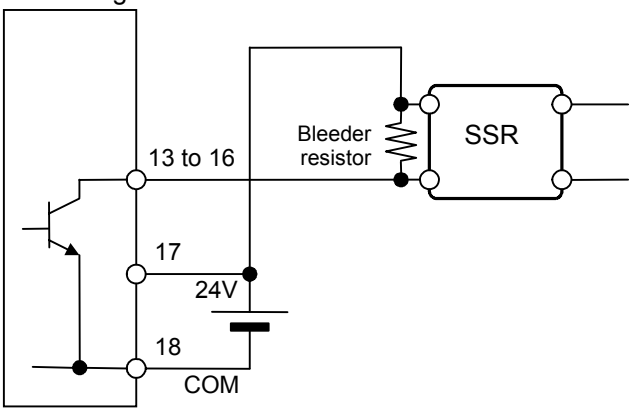
● Wiring to the F3CU04-0S output terminals

The output of the F3CU04-0S module is open collector output.

Controlling a relay



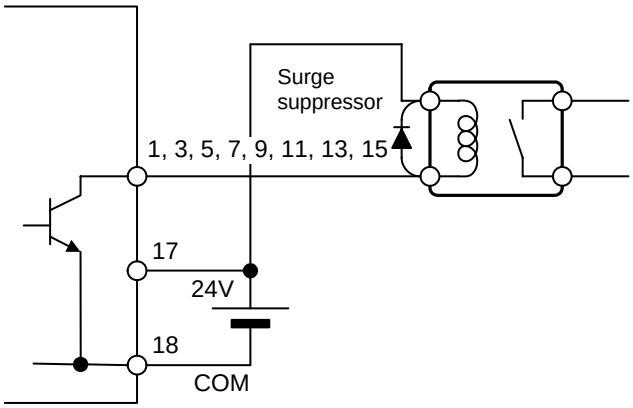
Controlling an SSR



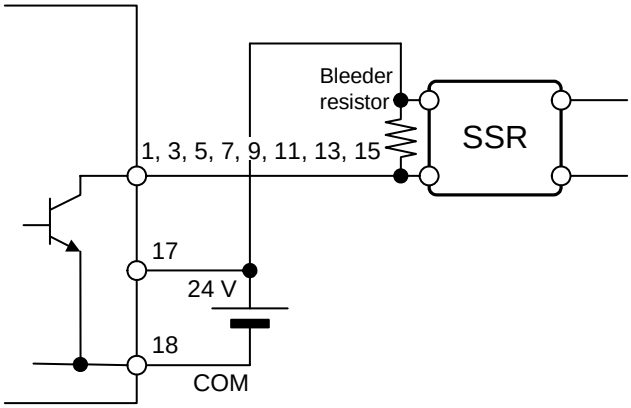
● Wiring to the F3CU04-1S output terminals

The output of the F3CU04-1S module may be configured either as open collector or 4-20 mA continuous output.

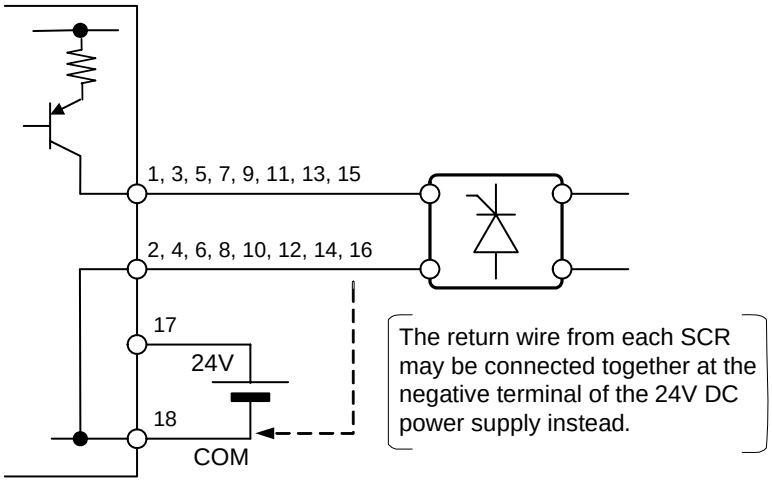
Controlling a relay



Controlling an SSR



4-20mA continuous output



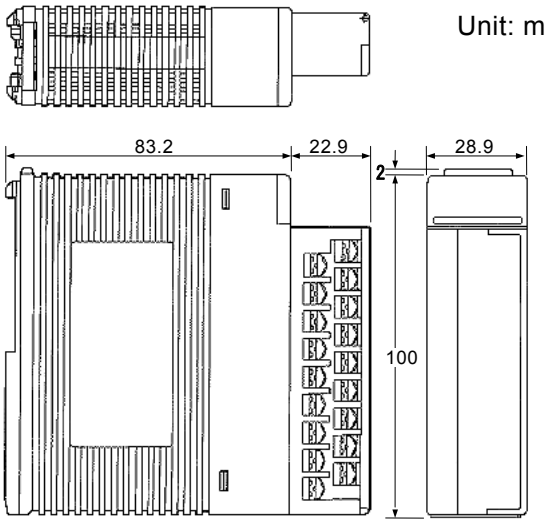
■ Operating Environment

There is no restriction on the type of CPU modules that can be used with this module.

■ External Dimensions

F3CU04-0S

Unit: mm



F3CU04-1S

Unit: mm