

# General Specification

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

FA-M3

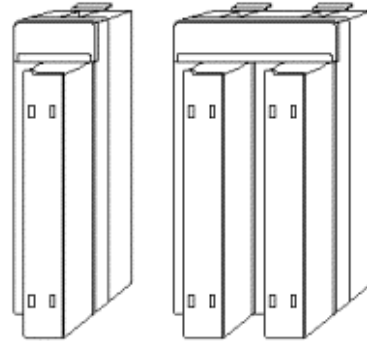
GS 34M6H62-01E

## ■ General

F3CU04-□N 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 control set points) is sufficient to start operation, without need for manual tuning of PID parameters.  
If a control set point or other major condition is changed during operation, PID parameters are automatically recalculated.



## ● Specifications

### General

- The F3CU04-0N, occupying a single slot, controls up to four loops.
- The F3CU04-1N, occupying two slots, controls up to four loops.
- PID constants, preset values and other control parameters are stored in the module, eliminating the need to setup parameters before each operation.

### 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.
- It also supports heating and cooling control. Using a cooling output, however, may require reduced number of output loops, or use of another output module. The F3CU04-1N allows both a heating output and cooling output without reducing 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 F3CU04-1N also provides continuous PID output (4-20 mA).

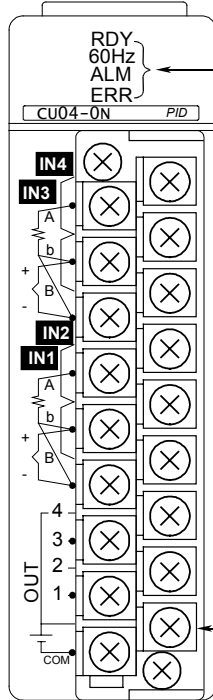
## ■ Model and Suffix Codes

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

## ■ Components and Functions

### Front view

#### ● F3CU04-0N (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 channel.

##### 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 EEPROM.

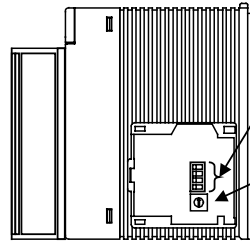
Flashes when a monitor, input or operation parameter error or burnout is detected.

#### Input terminal block

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

### Right side view

#### ● F3CU04-1N (Double-slot type)



- 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.

#### ● F3CU04-1N (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 channel.

##### ERR (red)

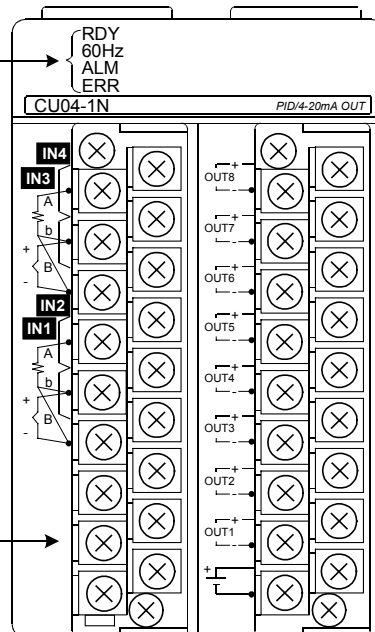
Lit or flashes when a hardware failure is detected or an error is detected in stored data.

Lit when an error is detected in system data, calibration values, ADC, RJC or EEPROM.

Flashes when a monitor, input or parameter error or burnout is detected.

#### I/O terminal block

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



## ■ Specifications

### General Specifications

Item	Specification	
	F3CU04-0N	F3CU04-1N
Number of loops	4	
Isolation	Between input terminals and internal circuit	Isolated by photocouplers and transformers (tested for 1500 V AC voltage withstanding)
	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 (internal 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 <sup>1</sup>	10°C/h max.	
Mounting position	Horizontal or inverted orientation not allowed	
External connection	One 18-point terminal block with M3.5 screws	Two 18-point terminal blocks with M3.5 screws
External dimensions <sup>2</sup>	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	
	F3CU04-0N	F3CU04-1N
Input sampling period	200 ms for four loops or 100 ms for two loops	
Input types and ranges <sup>1</sup>	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. <sup>1</sup>	
Burnout detection	Thermocouples or RTDs are checked for burnout. Selectable as Upscale, Downscale or None.	
	Detection current	Thermocouple RTD
Reference junction compensation	Thermocouple <sup>2</sup>	±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 <sup>3</sup>	Common mode	120 dB (50/60 Hz)
	Normal mode	40 dB (50/60 Hz)
Effect of ambient temperature	Input stability: ±0.01%/°C or ±1µV/°C, whichever is greater	

\*1: See Table 1, "Instrument Range and Accuracy (for high resolution operation) 1/2".

\*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 <sup>*1</sup>	Instrument Default Range <sup>*2</sup>	Input Type Selector switch <sup>*3</sup>			Software Setting	Accuracy <sup>*4</sup>	Resolution <sup>*2</sup>
			SW1-3	SW1-4	SW5			
Software setting (factory setting)			OFF	OFF	0	Instrument default ranges may be specified by software using one of the following codes.		
Thermocouple	K <sup>*5</sup>	-200.0 to 1370.0°C	OFF	OFF	1	1 (\$01)	± 0.5°C <sup>*5</sup>	0.1°C <sup>*5</sup>
		-200.0 to 1000.0°C			2	2 (\$02)	± 0.5°C <sup>*5</sup>	0.1°C <sup>*5</sup>
		-200.0 to 500.0°C			3	3 (\$03)	± 0.5°C <sup>*6</sup>	0.1°C <sup>*6</sup>
	J	-200.0 to 1200.0°C			4	4 (\$04)	± 0.5°C <sup>*7</sup>	0.1°C <sup>*7</sup>
		-200.0 to 500.0°C			5	5 (\$05)	± 0.5°C <sup>*8</sup>	0.1°C <sup>*8</sup>
	T	-270.0 to 400.0°C			6	6 (\$06)	± 0.5°C <sup>*9</sup>	0.1°C <sup>*9</sup>
	B <sup>*10</sup>	0.0 to 1600.0°C			7	7 (\$07)	± 1.0°C <sup>*10</sup>	0.1°C <sup>*10</sup>
		0.0 to 1600.0°C			8	8 (\$08)	± 1.0°C <sup>*11</sup>	0.1°C <sup>*11</sup>
	S <sup>*11</sup>	0.0 to 1600.0°C			9	9 (\$09)	± 1.0°C <sup>*11</sup>	0.1°C <sup>*11</sup>
		0.0 to 1600.0°C			A	10 (\$0A)	± 0.6°C <sup>*12</sup>	0.1°C <sup>*12</sup>
	R <sup>*11</sup>	-200.0 to 1300.0°C			B	11 (\$0B)	± 0.5°C <sup>*13</sup>	0.1°C <sup>*13</sup>
		-270.0 to 1000.0°C			C	12 (\$0C)	± 0.6°C	0.1°C
	E	-200.0 to 900.0°C			D	13 (\$0D)	± 0.6°C	0.1°C
		-200.0 to 400.0°C			E	14 (\$0E)	± 0.8°C <sup>*14</sup>	0.1°C <sup>*14</sup>
	W <sup>*14</sup>	0.0 to 1600.0°C			F	15 (\$0F)	± 0.6°C	0.1°C
0.0 to 1390.0°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
					9	25 (\$19)		
DC voltage	DC mV input <sup>*15</sup>	0 to 10.00 mV DC	— <sup>*16</sup>	ON	A	26 (\$1A)	± 0.1% of instrument range ± 1 digit <sup>*15</sup>	
		0 to 100.0 mV DC			B	27 (\$1B)		
	DC V input <sup>*15</sup>	0.000 to 1.000 V DC			D	29 (\$1D)		
		0.000 to 5.000 V DC			E	30 (\$1E)		
		1.000 to 5.000 V DC			F	31 (\$1F)		
		0.00 to 10.00 V DC						

\*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.  
 \*2: For thermocouples K, B, S, R, and W, instrument default ranges may be changed to wider ranges (see the notes below). However, if the instrument range exceeds 1600°C, the resolution becomes twice of the indicated value. Furthermore, the actual range for acceptable input is instrument range±5%.  
 \*3: Data stored in the EEPROM is initialized to follow the hardware switch when power is turned 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 instrument 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 instrument 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 instrument 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 instrument 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 instrument 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 <sup>1</sup>	Instrument Default Range	Input Type Selector Switch <sup>3</sup>			Software Setting	Accuracy <sup>4</sup>	Resolution <sup>2</sup>
			SW1-3	SW1-4	SW5			
Software setting			ON	OFF	0	Instrument default ranges may be specified by software using one of the following codes.		
Thermocouple	K <sup>5</sup>	-200 to 1370°C	ON	OFF	1	33 (\$21)	± 2°C <sup>5</sup>	1°C <sup>5</sup>
		-200 to 1000°C			2	34 (\$22)	± 2°C <sup>5</sup>	1°C <sup>5</sup>
		-200 to 500°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	-270 to 400°C			6	38 (\$26)	± 2°C <sup>6</sup>	1°C
	B <sup>7</sup>	0 to 1600°C			7	39 (\$27)	± 2°C <sup>7</sup>	1°C <sup>7</sup>
	S <sup>8</sup>	0 to 1600°C			8	40 (\$28)	± 2°C	1°C
	R <sup>9</sup>	0 to 1600°C			9	41 (\$29)	± 2°C	1°C
	N	-200 to 1300°C			A	42 (\$2A)	± 2°C <sup>9</sup>	1°C
	E	-270 to 1000°C			B	43 (\$2B)	± 2°C <sup>10</sup>	1°C <sup>10</sup>
	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 <sup>11</sup>	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, instrument default ranges may be changed to wider ranges (see the notes below). Furthermore, the actual range for acceptable input is instrument range±5%.
- \*3: Data stored in the EEPROM is initialized to follow the hardware switch when power is turned 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 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 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 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 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 <sup>1</sup>	Instrument Default Range <sup>2</sup>	Input Type Selector Switch <sup>3</sup>			Software Setting	Accuracy <sup>4</sup>	Resolution <sup>2</sup>
			SW1-3	SW1-4	SW5			
Software setting (factory setting)			OFF	OFF	0	Instrument default ranges may be specified by software using one of the following codes.		
Thermocouple	K <sup>5</sup>	-328.0 to 2498.0°F	OFF	OFF	1	1 (\$01)	± 1.0°F <sup>5</sup>	0.2°F <sup>5</sup>
		-328.0 to 1832.0°F			2	2 (\$02)	± 1.0°F <sup>5</sup>	0.2°F <sup>5</sup>
		-328.0 to 932.0°F			3	3 (\$03)	± 1.0°F <sup>6</sup>	0.2°F <sup>6</sup>
	J	-328.0 to 2192.0°F			4	4 (\$04)	± 1.0°F <sup>7</sup>	0.2°F <sup>7</sup>
		-328.0 to 932.0°F			5	5 (\$05)	± 1.0°F <sup>8</sup>	0.2°F
	T	-454.0 to 752.0°F			6	6 (\$06)	± 1.0°F <sup>9</sup>	0.2°F <sup>9</sup>
	B <sup>10</sup>	32 to 2912°F			7	7 (\$07)	± 2°F <sup>10</sup>	1°F <sup>10</sup>
	S <sup>11</sup>	32 to 2912°F			8	8 (\$08)	± 2°F <sup>11</sup>	1°F
	R <sup>11</sup>	32 to 2912°F			9	9 (\$09)	± 2°F <sup>11</sup>	1°F
	N	-328.0 to 2372.0°F			A	10 (\$0A)	± 1.2°F <sup>12</sup>	0.2°F <sup>12</sup>
	E	-454.0 to 1832.0°F			B	11 (\$0B)	± 1.0°F <sup>13</sup>	0.2°F <sup>13</sup>
	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 <sup>14</sup>	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
					9	25 (\$19)		
DC voltage	DC mV input <sup>15</sup>	0 to 10.00 mV DC	— <sup>16</sup>	ON	A	26 (\$1A)	± 0.1% of instrument range ± 1 digit <sup>15</sup>	
		0 to 100.0 mV DC			B	27 (\$1B)		
	DC V input <sup>15</sup>	0.000 to 1.000 V DC			D	29 (\$1D)		
		0.000 to 5.000 V DC			E	30 (\$1E)		
		1.000 to 5.000 V DC			F	31 (\$1F)		
		0.00 to 10.00 V DC						

\*1: Applicable standard is JIS/IEC/DIN (ITS-90) for thermocouples and RTD.  
 \*2: For thermocouples K, B, S, R, and W, instrument default ranges may be changed to wider ranges (see the notes below). Furthermore, the actual range for acceptable input is instrument range±5%.  
 \*3: Data stored in the EEPROM is initialized to follow the hardware switch when power is turned 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 instrument 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 instrument 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 instrument range may be set from 32 to 3092°F. The accuracy and resolution depend on measured temperatures as follows:  
 32 to 3092°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 instrument range may be set from 32 to 4172°F.  
 \*15: Resolution is determined by the upper and lower limits for the instrument 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 <sup>*1</sup>	Instrument Default Range	Input Type Selector Switch <sup>3</sup>			Software Setting	Accuracy <sup>*4</sup>	Resolution <sup>*2</sup>
			SW1-3	SW1-4	SW5			
Software setting			ON	OFF	0	Instrument default ranges may be specified by software using one of the following codes.		
Thermocouple	K <sup>*5</sup>	-328 to 2498°F	ON	OFF	1	33 (\$21)	± 2°F <sup>*5</sup>	1°F <sup>*5</sup>
		-328 to 1832°F			2	34 (\$22)	± 2°F <sup>*5</sup>	1°F <sup>*5</sup>
		-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	-454 to 752°F			6	38 (\$26)	± 2°F <sup>*6</sup>	1°F
	B <sup>*7</sup>	32 to 2912°F			7	39 (\$27)	± 2°F <sup>*7</sup>	1°F <sup>*7</sup>
	S <sup>*8</sup>	32 to 2912°F			8	40 (\$28)	± 2°F	1°F
	R <sup>*9</sup>	32 to 2912°F			9	41 (\$29)	± 2°F	1°F
	N	-328 to 2372°F			A	42 (\$2A)	± 2°F <sup>*9</sup>	1°F
	E	-454 to 1832°F			B	43 (\$2B)	± 2°F <sup>*10</sup>	1°F <sup>*10</sup>
	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 <sup>*11</sup>	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
-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, instrument default ranges may be changed to wider ranges (see the notes below). Furthermore, the actual range for acceptable input is instrument range±5%.
- \*3: Data stored in the EEPROM is initialized to follow the hardware switch when power is turned 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 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 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 range limits may be set from 32 to 3092°F. The accuracy and resolution depend on measured temperatures as follows:  
32 to 3092°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 range limits may be set from 32 to 4172°F.

**Table 3 Power Supply Frequency**

Power Supply Frequency	Input Type Selector Switch <sup>1</sup>			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.

\*: Data stored in the EEPROM is initialized to follow the hardware switch when power is turned on.

**Control Specifications (can be set for individual loops)**

Item	Specification		
	F3CU04-0N	F3CU04-1N	
Control mode * <sup>1</sup>	Normal, cascade, two-input changeover, setting output, and monitoring		
Output mode selection	ON/OFF control, PID control, and heating/cooling control * <sup>2</sup>		
Number of setting groups	4 groups: control set point, proportional band, integration time, differentiation time, manual reset value, and forward/reverse operation		
Changeover method	Zone changeover using control set point number or input temperature		
Auto-tuning	Calculates PID parameters using limit cycle method (when specified)		
“Dynamic auto-tuning” * <sup>3</sup>	PID parameters are automatically recalculated at control start, control set point change, or hunching.		
“Super” * <sup>4</sup>	Suppresses overshooting using fuzzy logic theory		
Operation mode	RUN/STOP, automatic output/manual output, local/remote, control set point number, and cascade output/automatic output/manual output (when cascade is used)		
Control 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, and uses two loops of input and output terminals (for F3CU04-0N only).
- \*3: Not available in the heating/cooling control mode.
- \*4: Not available in the ON/OFF or heating/cooling control mode.

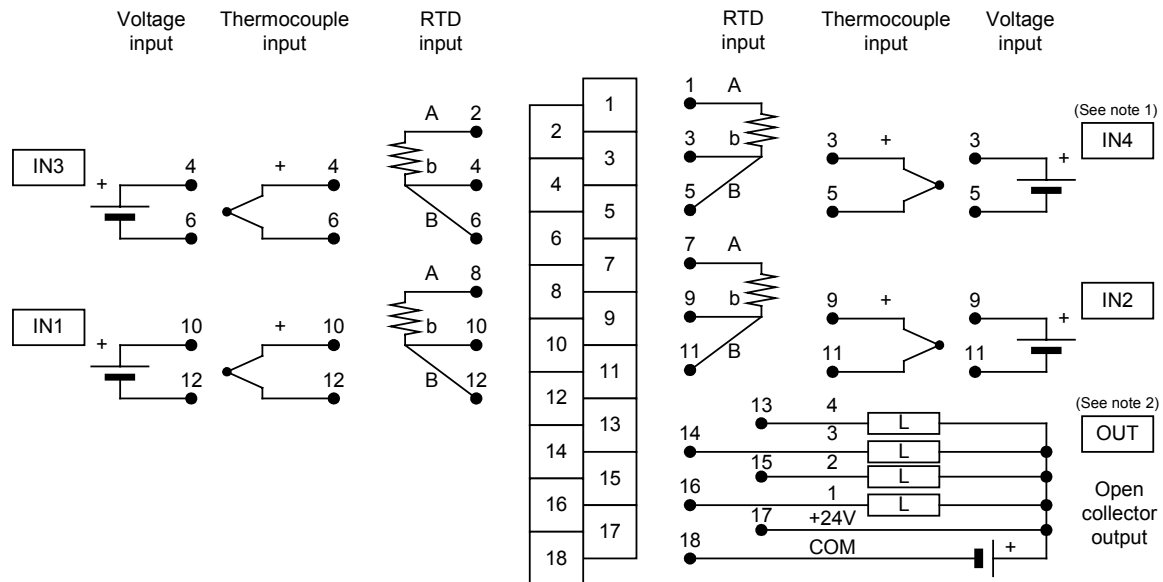
**Output Specifications**

Item	Specification		
	F3CU04-0N	F3CU04-1N	
Number of outputs	4	8	
External power supply <sup>*</sup>	24 VDC ±10%, 50 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).

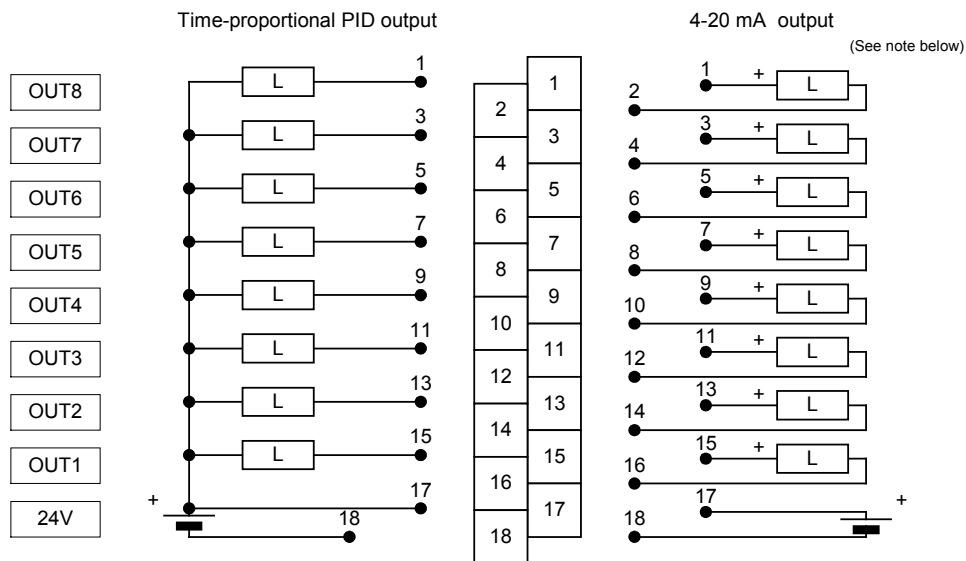
## External Connection Diagram

### F3CU04-0N terminal block (front) and F3CU04-1N 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 F3CU04-1N has no output functions and requires no external power supply. Use the output terminals of the right terminal block.

### F3CU04-1N terminal block (front right)



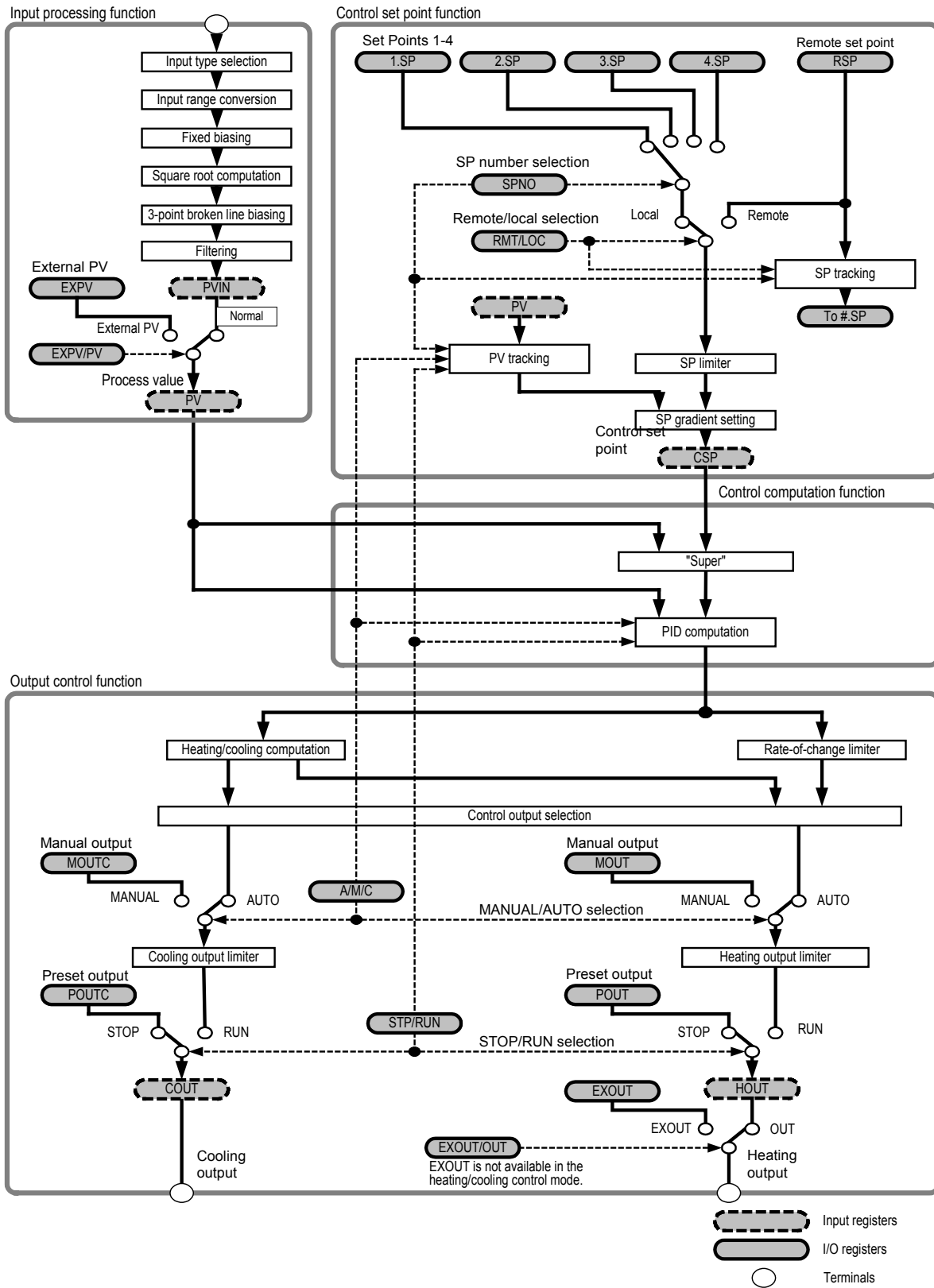
- Note: The module allows mixed outputs. Each channel may be wired for time-proportional PID or 4-20 mA output independently.

■ Functions List

Function		Description	
Monitoring	Input sampling period	Sets the input sampling period (This affects the number of available channels).	
	Monitoring mode selection	Specifies monitoring mode for a pair of 2 channels.	
	Monitoring mode	Single input mode	Basic control mode with one control and computation system where two channels operate independently.
		Cascade	Two control and computation systems perform cascade control (using 2 channels 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 channels of input and output).	
	Disabled	Channels specified as 'disabled' are not used.	
Output processing	Output mode selection	Selects from on/off, PID, and heating/cooling control modes.	
	Control output modes	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.
	Control output functions	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 channels) or software (for individual channels).	
	Power supply frequency specification	Specifies the power supply frequency. An appropriate setting value will reduce common mode noise.	
	Input range setting	Sets input ranges.	
	PV range setting	Sets PV range 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	Sets thermocouple reference junction compensation to either on or fixed value.	
	Input operation functions	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 process input	An external value, such as a processed value from a CPU module, may be used as an input to the module.		
Controlling	Control set point	Control set points	Four preset values are assigned to each channel. The control set point can be selected using the control set up number selection parameter.
		SP limiter	Limits the control set point value. Control 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 control set point at a fixed rate or to prevent sudden changes in the control set point.
		Remote setting	Allows the control 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-precendent 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 channel may select one of the four PID setting groups assigned to it.	
	PID selection	Control set point number selection	Switches between PID parameters according to the control 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 two alarms for each channel. 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 1,000,000 times.	

\*1: Numbers within parentheses (100% and 0%) applies when the output is configured as a continuous output (for F3CU04-1N only).  
 \*2: Available for F3CU04-1N 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.

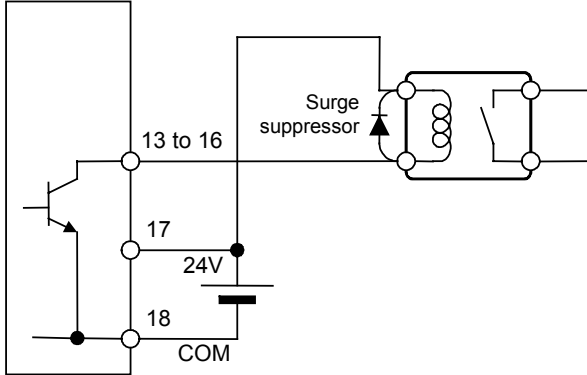
● Function block diagram for F3CU04 (single-loop operation)



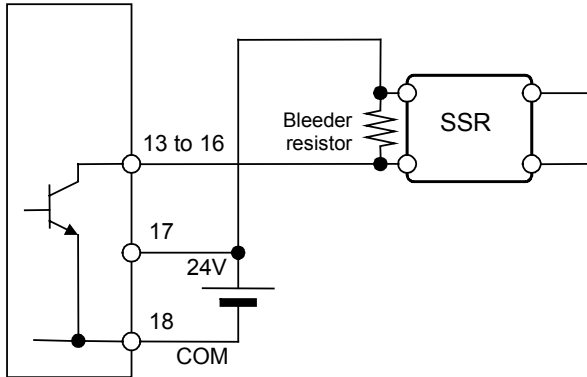
## ● Wiring to the F3CU04-0N output terminals

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

Controlling a relay



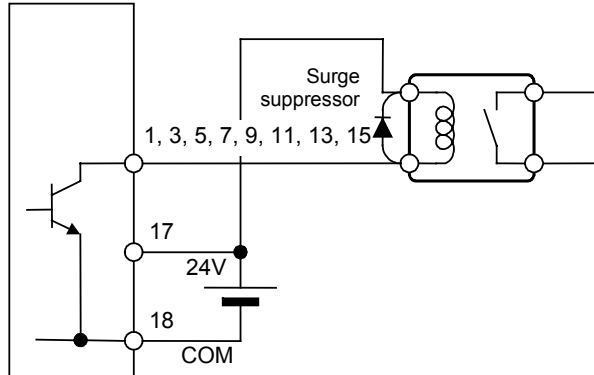
Controlling an SSR



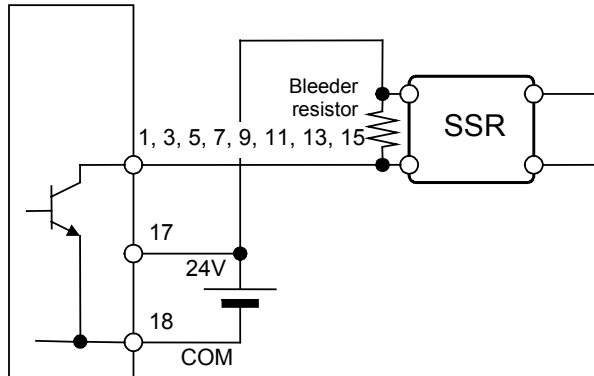
## ● Wiring to the F3CU04-1N output terminals

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

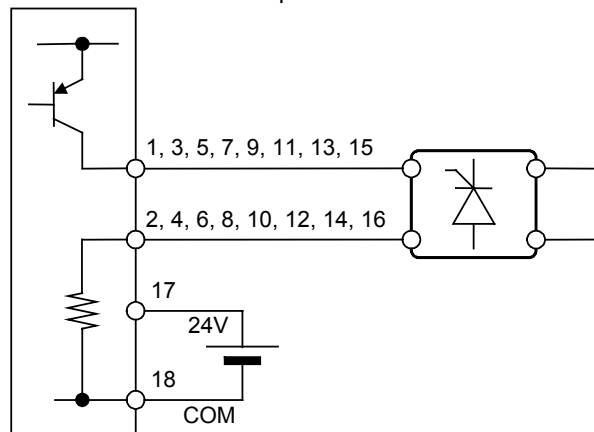
Controlling a relay



Controlling an SSR



4-20 mA continuous output

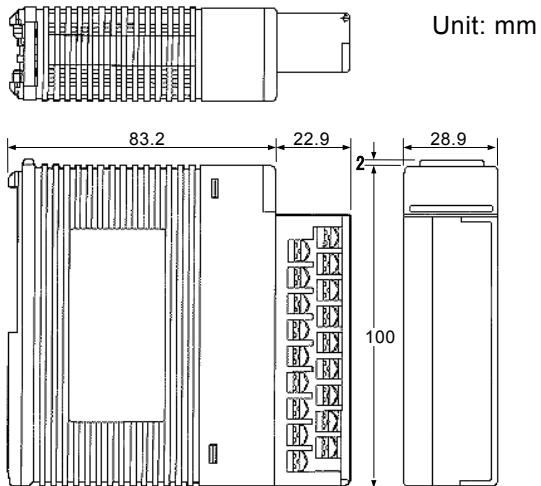


## ■ Operating Environment

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

## ■ External Dimensions

F3CU04-0N



F3CU04-1N

