CJ Series Temperature Control Unit

CJ1W-TC

CSM_CJ1W-TC_DS_E_2_1

A Single Unit Performing All the Functions of 4 Temperature Controllers

- A Special I/O Unit with direct input of thermocouple or resistance thermometer, PID control with 2 degrees of freedom, and open collector output

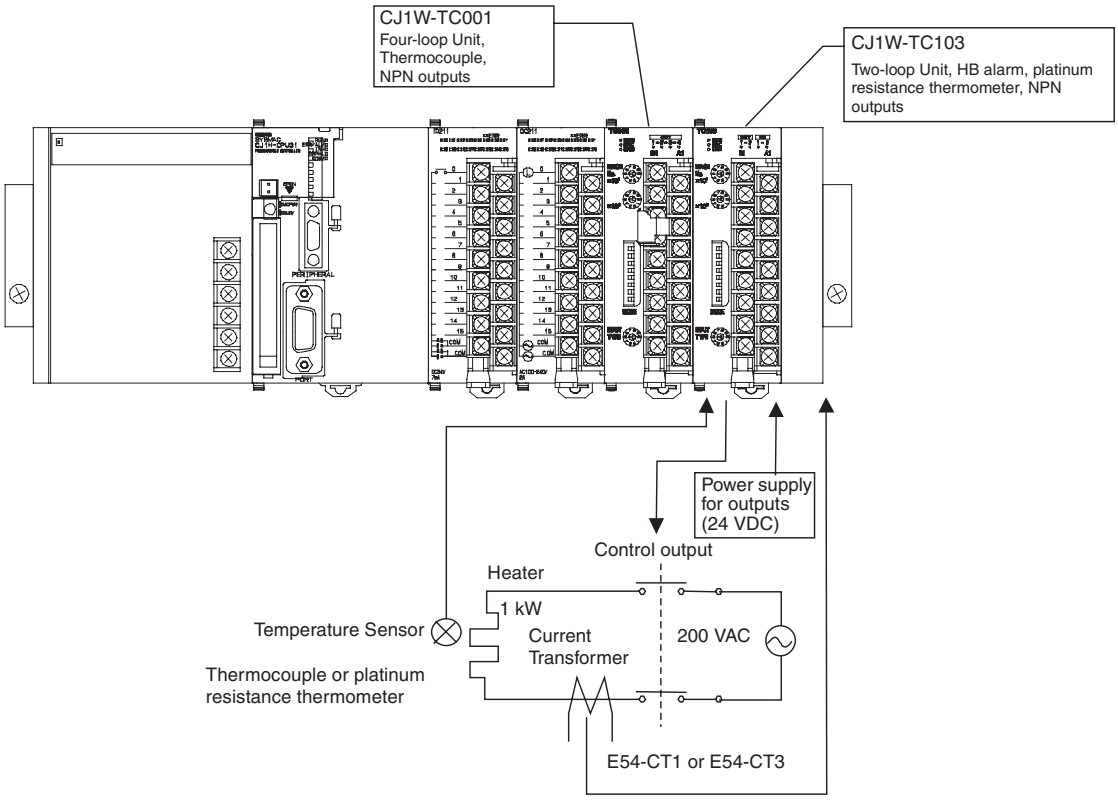
CJ1W-TC001

Features

- Built-in PID control with 2 or 4 control loops or ON/OFF control
- Direct input of 7 types of thermocouple or resistance thermometer
- 500 ms sampling cycle
- RUN/STOP control from CPU Unit
- Unrestricted CPU Unit cycle time
- Heater burnout detection
- Auto-tuning (AT) function

System Configuration

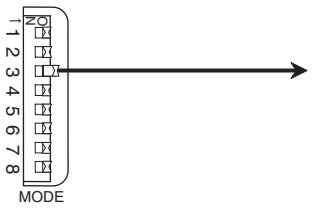
The following diagram shows a basic system with a CJ1W-TC001 Temperature Control Unit (4 control loops, thermocouple inputs, and NPN outputs) and a CJ1W-TC103 Temperature Control Unit (2 control loops with heater burnout detection, platinum resistance thermometer inputs, and NPN outputs).
Note that this system configuration is given strictly as an example. When constructing an actual system, check the specifications, performance, and safety of each component by referring to the respective manuals.



Note: 1. An OMRON E54-CT1 or E54-CT3 Current Transformer must be used as the Current Transformer (CT). Do not use any other Current Transformer.

2. Turn ON the Stop Bit for the loop to stop temperature control. If PID control is being used and the heater is turned OFF using an operation switch input to the heater, PID control performance will be adversely affected.

3. To connect this Unit to the NJ series, set pin 3 "Data storage/display format" of the DIP switch to ON.
(The factory setting is OFF)



SW3

Data storage/display format	Settings
Settings are not allowed.	OFF
16-bit binary	ON

This change becomes effective when the Controller is reset, or when the Unit is restarted.

Ordering Information

International Standards

- The standards are abbreviated as follows: U: UL, U1: UL (Class I Division 2 Products for Hazardous Locations), C: CSA, UC: cULus, UC1: cULus (Class I Division 2 Products for Hazardous Locations), CU: cUL, N: NK, L: Lloyd, and CE: EC Directives.
- Contact your OMRON representative for further details and applicable conditions for these standards.

Unit classification	Product name	Specifications			No. of unit numbers allocated	Current consumption (A)		Model	Standards
		No. of loops	Temperature sensor inputs	Control outputs		5 V	24 V		
CJ1 Special I/O Units	Temperature Control Units	4 loops	Thermocouple input (R, S, K, J, T, B, L)	Open collector NPN outputs (pulses)	2	0.25	–	**CJ1W-TC001 ***	UC1, N, L, CE
		4 loops		Open collector PNP outputs (pulses)		0.25	–	**CJ1W-TC002 ***	
		2 loops, heater burnout detection function		Open collector NPN outputs (pulses)		0.25	–	**CJ1W-TC003**	
		2 loops, heater burnout detection function		Open collector PNP outputs (pulses)		0.25	–	**CJ1W-TC004**	
		4 loops	Platinum resistance thermometer input (JPt100, Pt100)	Open collector NPN outputs (pulses)		0.25	–	**CJ1W-TC101 ***	
		4 loops		Open collector PNP outputs (pulses)		0.25	–	**CJ1W-TC102 ***	
		2 loops, heater burnout detection function		Open collector NPN outputs (pulses)		0.25	–	**CJ1W-TC103**	
		2 loops, heater burnout detection function		Open collector PNP outputs (pulses)		0.25	–	**CJ1W-TC104**	

* This unit cannot be used, with the Machine Automation Controller NJ-series.

Mountable Racks

Model	NJ system		CJ system (CJ1, CJ2)	
	CPU Rack	Expansion Rack	CPU Rack	Expansion Backplane
CJ1W-TC001 CJ1W-TC002 CJ1W-TC101 CJ1W-TC102	Not supported		10 Units	10 Units (per Expansion Backplane)
CJ1W-TC003 CJ1W-TC004 CJ1W-TC103 CJ1W-TC104	10 Units	10 Units (per Expansion Backplane)		

Specifications

General Specifications

Item	Specification			
Unit classification	CJ-series Special I/O Unit			
Compatible Racks	CJ-series CPU Rack or CJ-series Expansion Rack			
Max. number of Units	10 Units/Rack max. (CPU Rack or Expansion Rack)			
CPU Unit data areas for data storage/exchange	Special I/O Unit Area (960 words) CIO 2000 to CIO 2959	20 words/Unit for constant data exchange (6 output words and 14 input words)	CPU Unit to Temperature Control Unit	• Set point (SP) • Operating commands • RUN/STOP control • Start/Stop AT • Write commands • Heater burnout set value
			Temperature Control Unit to CPU Unit	• Process value (PV) • Set point (SP) • Status • Heater current monitor
	DM words allocated to Special I/O Units (9,600 words) D20000 to D29599	10 words/Unit transferred when power is turned ON or Unit is restarted	CPU Unit to Temperature Control Unit	• Alarm mode • Alarm hysteresis
		90 words/Unit for regular data exchange	Two-way transfer between CPU Unit and Temperature Control Unit	• Alarm value • Input compensation value • Control period • Hysteresis • Proportional band • Integral time • Derivative time • Output monitor
Insulation resistance	20 MΩ min. (at 500 VDC) between the following points: • All output and NC terminals and external AC terminals (Power Supply Unit) • All input terminals and external AC terminals (Power Supply Unit) • All input terminals and all output terminals • All external DC terminals (inputs, outputs, and NC) and the FG plate • Between input terminals (sensor and CT inputs) • I/O terminals and NC terminals			
Dielectric strength	2,000 VAC 50/60 Hz for 1 min., detected current: 1 mA • The output terminals/NC terminals and external AC terminals (Power Supply Unit) 1,000 VAC 50/60 Hz for 1 min., detected current: 1 mA • Input terminals and external AC terminals (Power Supply Unit) • Input terminals and output terminals • External DC terminals (inputs, outputs, and NC) and the FG plate 500 VAC 50/60 Hz for 1 min., detected current: 1 mA • Between input terminals (sensor and CT inputs) • I/O terminals and NC terminals			
Internal current consumption	250 mA max., 5 VDC			
Other	Other general specifications conform to the CJ-series general specifications.			
Dimensions	31 × 90 × 65 mm (W × H × D)			
Weight	150 g max.			

Characteristics

Item	Specification	
Model number	CJ1W-TC00□	CJ1W-TC10□
Temperature sensor	Thermocouple: R, S, K, J, T, L, B	Platinum resistance thermometer: Pt100, JPt100
Number of loops	4 loops or 2 loops with heater burnout detection *1	
Control output and heater burnout alarm output	NPN or PNP outputs, both with short-circuit protection *1 External power supply voltage: 24 VDC $^{+10\%}_{-15\%}$ Max. switching capacity: 100 mA (per output) Leakage current: 0.3 mA max. Residual voltage: 3 V max.	
Temperature control method	ON/OFF control or PID control with two degrees of freedom (Set with pin 6 on the Unit's DIP switch.)	
Control operation	Forward or reverse operation (Set with pins 4 and 5 on the Unit's DIP switch.)	
RUN/STOP control	Supported (Controlled from the CPU Unit through bits allocated in the Special I/O Unit area.)	
Operation with CPU Unit in PROGRAM mode	The Temperature Control Unit can be set to continue operating or stop operating when the CPU Unit is in PROGRAM mode. (Set with pin 1 on the Unit's DIP switch.)	
Auto/Manual switch for operational output	None	
Autotuning (AT) of PID constant	Supported (Controlled from the CPU Unit through bits allocated in the Special I/O Unit area.)	
Indication accuracy	Celsius: ±0.3% of PV or ±1°C (whichever is larger) ± 1 digit max. Fahrenheit: ±0.3% of PV or ±2°F (whichever is larger) ± 1 digit max. • L and −100°C or less for K and T are ±2°C ± 1 digit max. • 200°C or less for R and S is ±3°C ± 1 digit max. • No accuracy is specified for 400°C or less for B *2	Celsius: ±0.3% of PV or ±0.8°C (whichever is larger) ± 1 digit max. Fahrenheit: ±0.3% of PV or ±1.6°F (whichever is larger) ± 1 digit max.
Hysteresis (when using ON/OFF control)	0.0 to 999.9 °C or °F (0.1 °C or °F units)	
Proportional band	0.1 to 999.9 °C or °F (0.1 °C or °F units)	
Integral (reset) time	0 to 9,999 s (one-second units)	
Derivative (rate) time	0 to 9,999 s (one-second units)	
Control period	1 to 99 s (one-second units)	
Sampling period	500 ms (4 loops)	
Output refresh period	500 ms (4 loops)	
Display refresh period	500 ms (4 loops)	
Input compensation value	−99.9 to 999.9 °C or °F (0.1 °C or °F units)	
Alarm output setting range	−999 to 9,999 °C or °F (1 °C or °F units) The setting range will be −99.9 to 999.9 °C or °F (0.1 °C or °F units) for K or J with decimal point mode, or platinum resistance thermometer.	
External terminal connections	Removable terminal block with 18 points (M3 screws)	
Effect on the CPU Unit's cycle time	0.4ms	

*1. The last three digits of the model number indicate the Unit's features:

CJ1W-TC □ 0 □

- Output type
  - 1: NPN outputs, four-loop control outputs
  - 2: PNP outputs, four-loop control outputs
  - 3: NPN outputs, two-loop control outputs and heater burnout alarm outputs
  - 4: PNP outputs, two-loop control outputs and heater burnout alarm outputs
- Always 0.
- Input type
  - 0: Thermocouple input
  - 1: Platinum resistance thermometer input

*2. Indication accuracy of thermocouples

- Accuracy ratings are given for the Temperature Control Unit used in a set with a cold-junction compensator (on the terminal block). Always use the Unit and terminal block in a set. There are labels with serial numbers attached to the terminal blocks and Units to help keep track of the sets.
- When returning a thermocouple-type Temperature Control Unit for repair, always return the Unit and the terminal block (with the cold-junction compensator) as a set.

Heater Burnout (HB) Alarm

Item	Specification
Maximum heater current	Single-phase AC, 50 A
Indication accuracy of input current	±5% of full scale ± 1 digit max.
Heater burnout alarm setting range	0.1 to 49.9 A (0.1 A units) The heater burnout detection function will not operate if the set value is set to 0.0 A or 50.0 A. (When the SV is 0.0 A, the heather burnout alarm will be OFF. When the SV is 50.0 A, the heater burnout alarm will be ON.)
Min. detectable ON time *	200 ms

* If the control output is ON for less than 200 ms, the heater burnout detection function will not operate and heater current measurement will not be performed.

Current Transformer (CT) Ratings

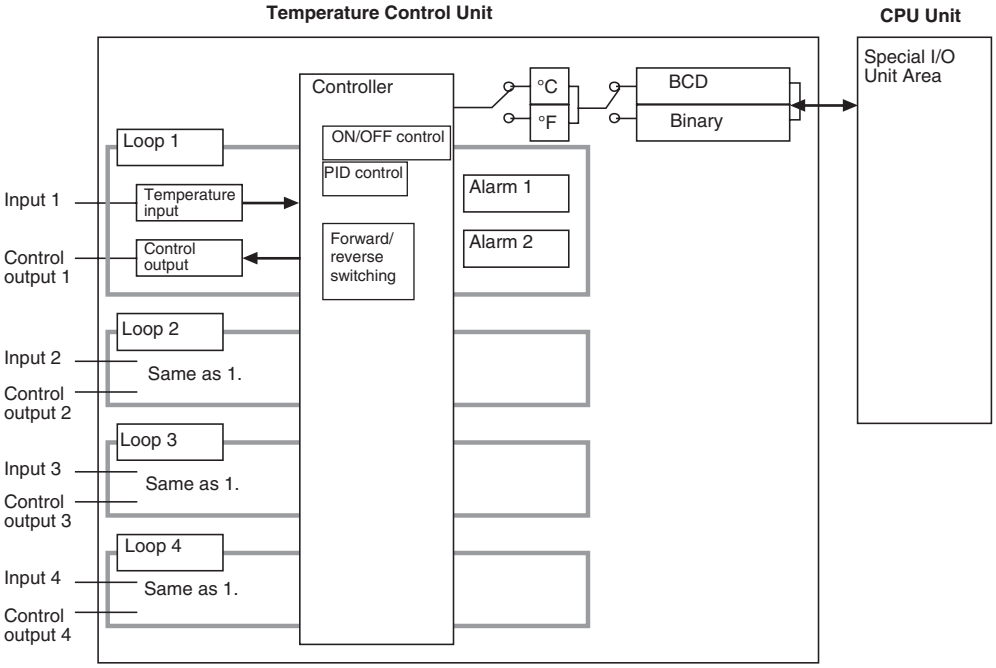
Item	E54-CT1	E54-CT3
Max. continuous heater current	50A	120 A *
Dielectric strength	1,000 VAC (1 min.)	
Vibration resistance	50 Hz, 98 m/s^2	
Weight	Approx. 11.5 g	Approx. 50 g
Accessories	None	Contacts (2) Plugs (2)

Note: Do not use any Current Transformer (CT) other than the OMRON E54-CT1 or E54-CT3 Current Transformer.

* The maximum continuous heater current that can be detected at a CJ1W-TC□□□ Temperature Control Unit is 50 A.

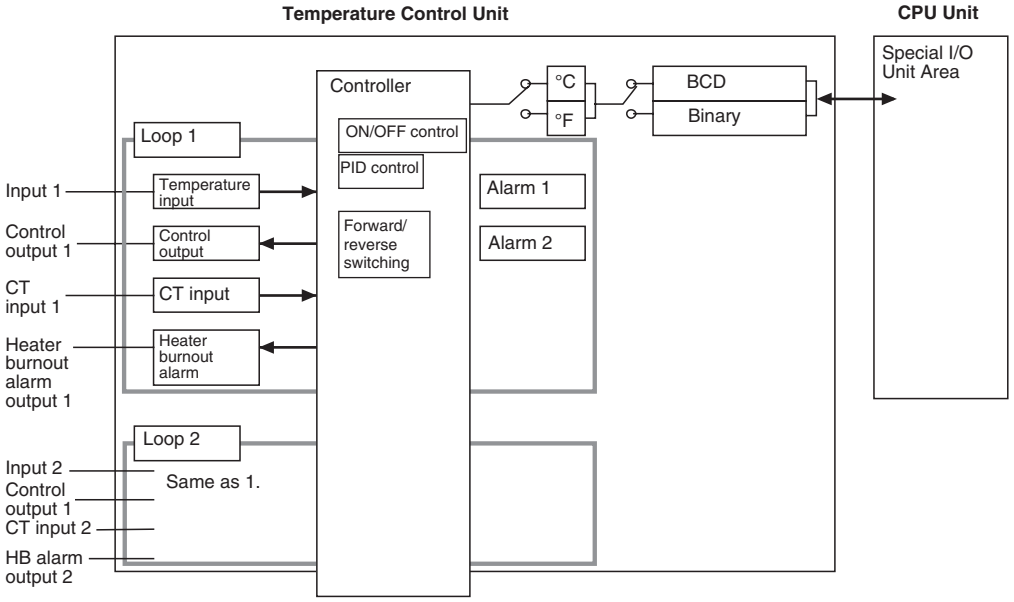
Input Function Block Diagrams

Four-loop Units

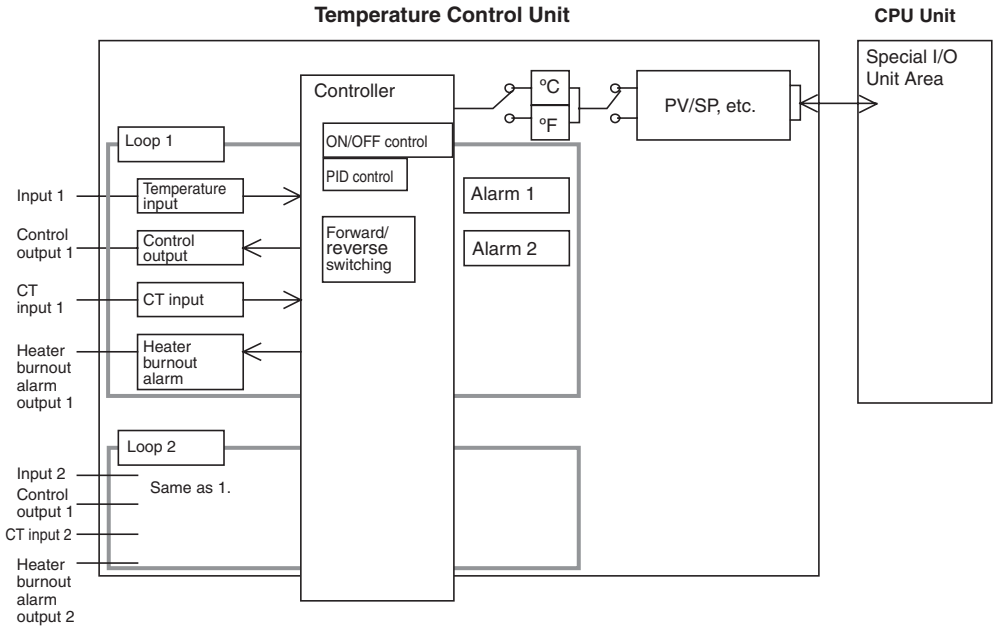


Two-loop Units with Heater Burnout Alarm

When the Unit is used with CJ-series CPU unit



When the Unit is used with NJ-series CPU unit



Input Specifications

When the Unit is used with CJ-series CPU unit

A switch on the front of the Unit (pin 3 of the DIP switch) selects whether the Temperature Control Unit's data is stored and indicated as 4-digit BCD or binary (i.e., 4-digit hexadecimal). Pin 2 of the DIP switch selects whether the temperature is indicated in °C or °F.
The indicated range will be within ±20°C or ±20°F of the setting ranges shown in the following table. *1

Thermocouple Input Setting Ranges

No.	Input type	°C		°F	
		16-bit binary	BCD	16-bit binary	BCD
0	K: –200 to 1,300°C (–300 to 2,300°F)	FF38 to FFFF to 0514 (–200 to –1 to 1,300)	F200 to 1300 (–200 to 1,300)	FED4 to FFFF to 08FC (–300 to –1 to 2,300)	F300 to 2300 (–300 to 2,300)
1	K: 0.0 to 500°C (0.0 to 900.0°F)	0000 to 1388 (0.0 to 500.0)	0000 to 5000 (0.0 to 500.0)	0000 to 2328 (0.0 to 900.0)	0000 to 9000 (0.0 to 900.0)
2	J: –100 to 850°C (–100 to 1,500°F)	FF9C to FFFF to 0352 (–100 to –1 to 850)	F100 to 0850 (–100 to 850)	FF9C to FFFF to 05DC (–100 to –1 to 1,500)	F100 to 1500 (–100 to 1,500)
3	J: 0.0 to 400°C (0.0 to 750.0°F)	0000 to 0FA0 (0.0 to 400.0)	0000 to 4000 (0.0 to 400.0)	0000 to 1D4C (0.0 to 750.0)	0000 to 7500 (0.0 to 750.0)
4	T: –200.0 to 400.0°C (–300.0 to 700.0°F)	F830 to FFFF to 0FA0 (–200.0 to –0.1 to 400.0)	F999 to 4000 (–99.9 to 400.0) *3	F448 to FFFF to 1B58 (–300.0 to –0.1 to 700.0)	F999 to 7000 (–99.9 to 700.0) *3
5	L: –100 to 850°C (–100 to 1,500°F)	FF9C to FFFF to 0352 (–100 to –1 to 850)	F100 to 0850 (–100 to 850)	FF9C to FFFF to 05DC (–100 to –1 to 1,500)	F100 to 1500 (–100 to 1,500)
6	L: 0.0 to 40 °C (0.0 to 750.0°F)	0000 to 0FA0 (0.0 to 400.0)	0000 to 4000 (0.0 to 400.0)	0000 to 1D4C (0.0 to 750.0)	0000 to 7500 (0.0 to 750.0)
7	R: 0 to 1,700°C (0 to 3,000 °F)	0000 to 06A4 (0 to 1,700)	0000 to 1700 (0.0 to 1,700)	0000 to 0BB8 (0 to 3,000)	0000 to 3000 (0.0 to 3,000)
8	S: 0 to 1,700°C (0 to 3,000 °F)	0000 to 06A4 (0 to 1,700)	0000 to 1700 (0.0 to 1,700)	0000 to 0BB8 (0 to 3,000)	0000 to 3000 (0.0 to 3,000)
9	B: 100 to 1,800°C (300 to 3,200 °F) *2	0064 to 0708 (100 to 1,800)	0100 to 1800 (100 to 1,800)	012C to 0C80 (300 to 3,200)	0300 to 3200 (300 to 3,200)

Platinum Resistance Thermometer Input Setting Ranges

No	Input type	°C		°F	
		16-bit binary	BCD	16-bit binary	BCD
0	Pt100: –200.0 to 650.0 °C (–300.0 to 1,200.0 °F)	F830 to FFFF to 1964 (–200.0 to –0.1 to 650.0)	F999 to 6500 (–99.9 to 650.0) *3	F448 to FFFF to 2EE0 (–300.0 to –0.1 to 1,200.0)	F999 to 9999 (–99.9 to 999.9) *3
1	JPt100: –200.0 to 650.0 °C (–300.0 to 1,200.0 °F)	F830 to FFFF to 1964 (–200.0 to –0.1 to 650.0)	F999 to 6500 (–99.9 to 650.0) *3	F448 to FFFF to 2EE0 (–300.0 to –0.1 to 1,200.0)	F999 to 9999 (–99.9 to 999.9) *3
2 to 9	–	Settings 2 through 9 are not allowed.		Settings 2 through 9 are not allowed.	

Note: When the input type setting switch has been changed, the SV and input compensation values will change as follows:
- If the SV exceeds the setting range, it will be fixed at the lower limit or upper limit of the setting range.
- The position of the decimal point will change if necessary.

For example, when the temperature range is changed by changing the input type setting switch from 0 (K-type thermocouple with a temperature range of –200 to 1,300°C) to 1 (K-type thermocouple with a temperature range of 0.0 to 500.0°C), an SV of 200°C would be changed to 20.0°C.

*1. If the allowed indication range is exceeded, a sensor error will occur, the corresponding Sensor Error Flag will be turned ON, and the PV will contain the data "CCCC." When a sensor error occurs, that control loop's control output will be turned OFF. The alarm function will operate because the PV indicates an abnormally high temperature.
*2. The lower limit for B thermocouple is 0°C or 0°F.
*3. The indicator range for BCD display will be clamped at the lower or upper limit in the region between the lower or upper limit of the setting range and the point where a sensor error occurs.
When the display units are 0.1°C or 0.1°F, the display's lower limit value is –99.9 and the upper limit value is 999.9.

When the Unit is used with NJ-series CPU unit

Pin 2 of the DIP switch selects whether the temperature is indicated in °C or °F.
The indicated range will be within ±20°C or ±20°F of the setting ranges shown in the following table.
If the allowed indication range is exceeded, a sensor error will occur. The corresponding sensor error bit will be turned ON and the PV (process value) will contain the data "-13108".
When a sensor error occurs, that control loop's control output will be turned OFF. The alarm function will operate because the PV indicates an abnormally high temperature.

Thermocouple Input Setting Ranges

Sensor	Set value	Input type	Temperature range
Thermocouple	0	K	-200 to 1300°C/-300 to 2300°F
	1		0.0 to 500.0°C/0.0 to 900.0°F
	2	J	-100 to 850°C/-100 to 1500°F
	3		0.0 to 400.0°C/0.0 to 750.0°F
	4	T	-200.0 to 400.0°C/-300.0 to 700.0°F
	5	L	-100 to 850°C/-100 to 1500°F
	6		0.0 to 400.0°C/0.0 to 750.0°F
	7	R	0 to 1700°C/0 to 3000°F
	8	S	0 to 1700°C/0 to 3000°F
	9	B *	100 to 1800°C/300 to 3200°F

Note: When the Input Type Switch has been changed, the SV and input compensation values will change as follows:

- If the SV exceeds the setting range, it will be fixed at the lower limit or upper limit of the setting range.
- The position of the decimal point will change if necessary.

* The lower-limit indication for B-type thermocouples is 0°C or 0°F.

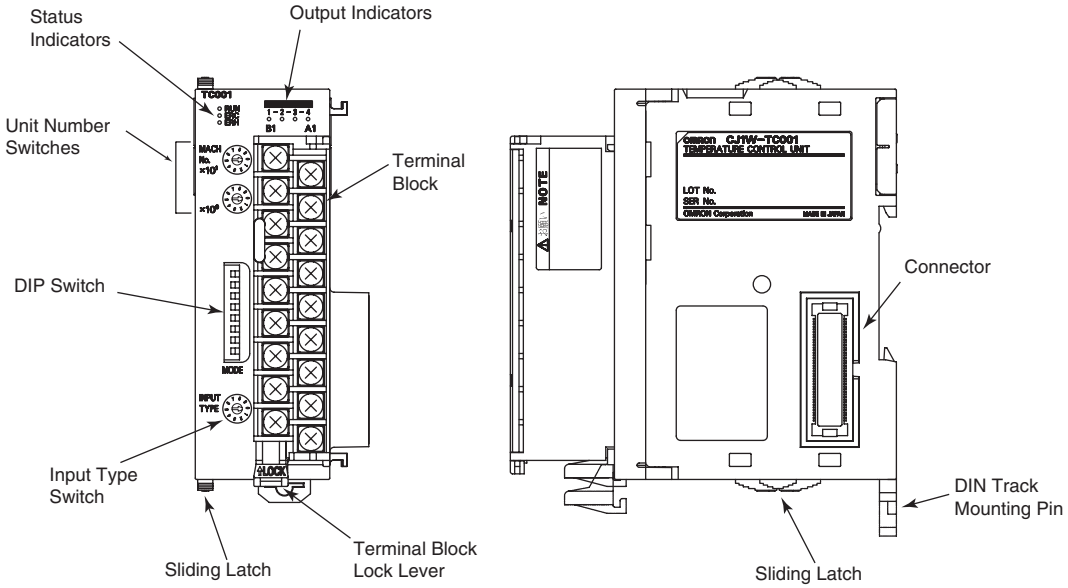
For example, when the temperature range is changed by changing the Input Type Switch from 0 (K-type thermocouple with a temperature range of −200 to 1,300°C) to 1 (K-type thermocouple with a temperature range of 0.0 to 500.0°C), an SV of 200°C will be changed to 20.0°C.

Platinum Resistance Thermometer Input Setting Ranges

Sensor	Set value	Input type	Temperature range
Platinum Resistance Thermometer	0	Pt100	-200.0 to 650.0°C/-300.0 to 1200.0°F
	1	JPt100	-200.0 to 650.0°C/-300.0 to 1200.0°F
	2 to 9		Do not set 2 through 9.

Part Names and Functions

Part Names



Indicators

Status Indicators

The Status Indicators indicate the operating status of the Temperature Control Unit, as explained in the following table.

Indicator	Name	Color	Status	Meaning
RUN	RUN Indicator	Green	Lit	Normal operating status
			Not lit	Temperature control is stopped.
ERC	Temperature Control Unit Error	Red	Lit	An error occurred in the Temperature Control Unit itself, such as a Sensor Error or Initialization Error.
			Not lit	Normal operating status
ERH	CPU Unit Error	Red	Lit	An error occurred in the CPU Unit.
			Not lit	Normal operating status

Output Indicators

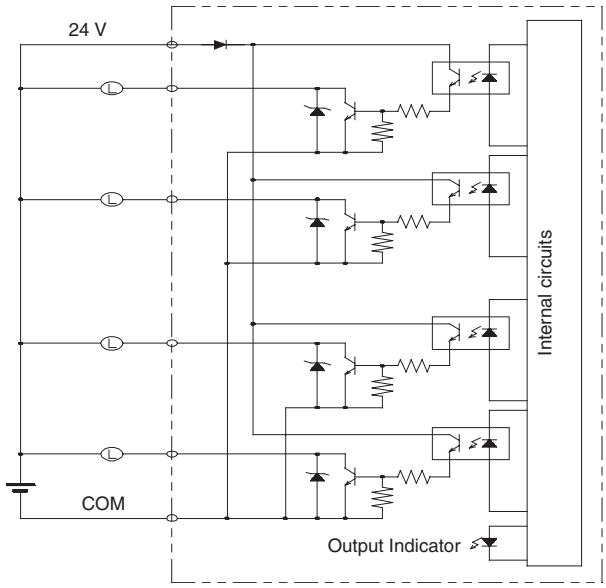
The Output Indicators light to indicate when the corresponding Temperature Control Unit output is ON.

Output Circuits

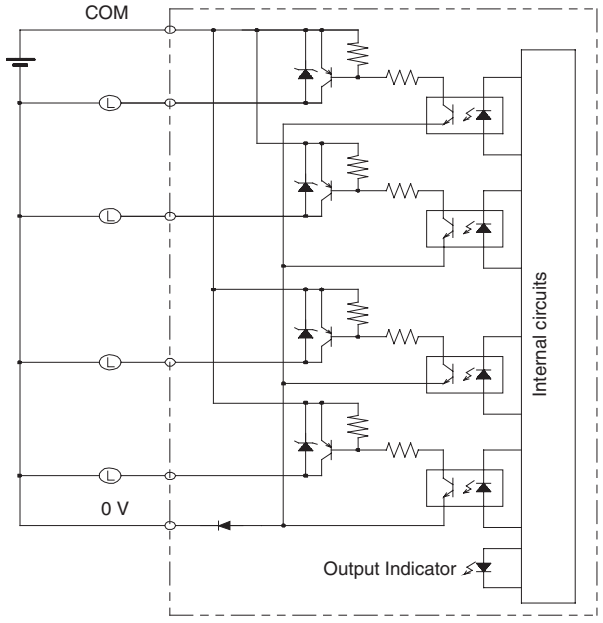
The following diagrams show the internal output circuits.

Output Circuits

NPN Outputs
(CJ1W-TC□01 and CJ1W-TC□03)



PNP Outputs
(CJ1W-TC□02 and CJ1W-TC□04)



Wiring

Terminal Wiring Examples

Thermocouple Temperature Control Units

CJ1W-TC001
(4 loops, NPN outputs)

Input 2 –	B1	A1	Input 1 –
Input 2 +	B2	A2	Input 1 +
Cold-junction comp.	B3	A3	N.C.
Cold-junction comp.	B4	A4	N.C.
Input 4 –	B5	A5	Input 3 –
Input 4 +	B6	A6	Input 3 +
Output 2	B7	A7	Output 1
Output 4	B8	A8	Output 3
0 V COM (–)	B9	A9	24 V

CJ1W-TC002
(4 loops, PNP outputs)

Input 2 –	B1	A1	Input 1 –
Input 2 +	B2	A2	Input 1 +
Cold-junction comp.	B3	A3	N.C.
Cold-junction comp.	B4	A4	N.C.
Input 4 –	B5	A5	Input 3 –
Input 4 +	B6	A6	Input 3 +
Output 2	B7	A7	Output 1
Output 4	B8	A8	Output 3
0 V	B9	A9	24 V COM (+)

CJ1W-TC003
(2 loops, NPN outputs, HB alarm)

Input 2 –	B1	A1	Input 1 –
Input 2 +	B2	A2	Input 1 +
Cold-junction comp.	B3	A3	N.C.
Cold-junction comp.	B4	A4	N.C.
CT input 2	B5	A5	CT input 1
CT input 2	B6	A6	CT input 1
Output 2	B7	A7	Output 1
HB output 2	B8	A8	HB output 1
0 V COM (–)	B9	A9	24 V

CJ1W-TC004
(2 loops, PNP outputs, HB alarm)

Input 2 –	B1	A1	Input 1 –
Input 2 +	B2	A2	Input 1 +
Cold-junction comp.	B3	A3	N.C.
Cold-junction comp.	B4	A4	N.C.
CT input 2	B5	A5	CT input 1
CT input 2	B6	A6	CT input 1
Output 2	B7	A7	Output 1
HB output 2	B8	A8	HB output 1
0 V	B9	A9	24 V COM (+)

Note: Do not connect any wiring to the N.C. terminals.

Platinum Resistance Thermometer Temperature Control Units

CJ1W-TC101
(4 loops, NPN outputs)

Input 2 B'	B1	A1	Input 1 B'
Input 2 B	B2	A2	Input 1 B
Input 2 A	B3	A3	Input 1 A
Input 4 B'	B4	A4	Input 3 B'
Input 4 B	B5	A5	Input 3 B
Input 4 A	B6	A6	Input 3 A
Output 2	B7	A7	Output 1
Output 4	B8	A8	Output 3
0 V COM (–)	B9	A9	24 V

CJ1W-TC102
(4 loops, PNP outputs)

Input 2 B'	B1	A1	Input 1 B'
Input 2 B	B2	A2	Input 1 B
Input 2 A	B3	A3	Input 1 A
Input 4 B'	B4	A4	Input 3 B'
Input 4 B	B5	A5	Input 3 B
Input 4 A	B6	A6	Input 3 A
Output 2	B7	A7	Output 1
Output 4	B8	A8	Output 3
0 V	B9	A9	24 V COM (+)

CJ1W-TC103
(2 loops, NPN outputs, HB alarm)

Input 2 B'	B1	A1	Input 1 B'
Input 2 B	B2	A2	Input 1 B
Input 2 A	B3	A3	Input 1 A
N.C.	B4	A4	N.C.
CT input 2	B5	A5	CT input 1
CT input 2	B6	A6	CT input 1
Output 2	B7	A7	Output 1
HB output 2	B8	A8	HB output 1
0 V COM (–)	B9	A9	24 V

CJ1W-TC104
(2 loops, PNP outputs, HB alarm)

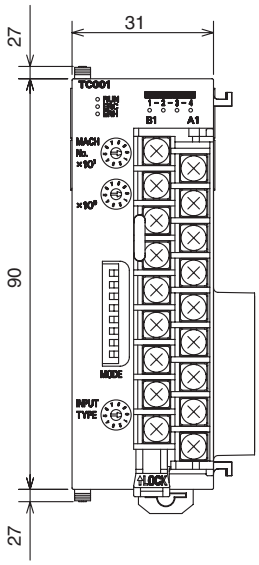
Input 2 B'	B1	A1	Input 1 B'
Input 2 B	B2	A2	Input 1 B
Input 2 A	B3	A3	Input 1 A
N.C.	B4	A4	N.C.
CT input 2	B5	A5	CT input 1
CT input 2	B6	A6	CT input 1
Output 2	B7	A7	Output 1
HB output 2	B8	A8	HB output 1
0 V	B9	A9	24 V COM (+)

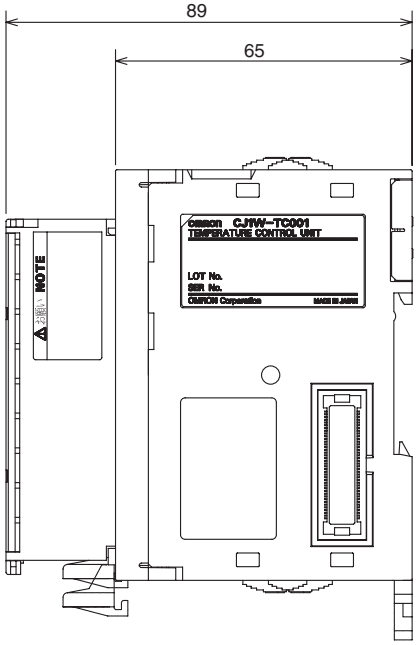
Note: Do not connect any wiring to the N.C. terminals.

Dimensions

(Unit: mm)

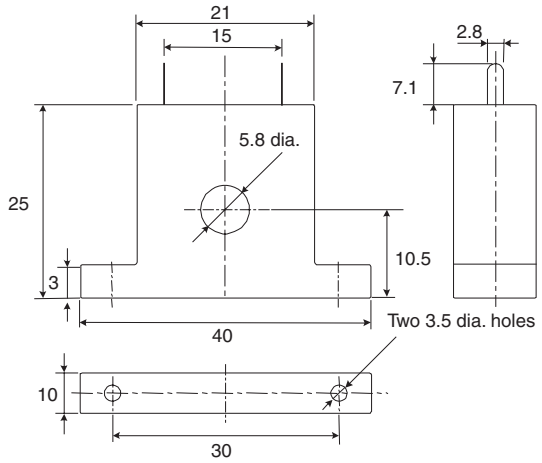
CJ1W-TC□□□



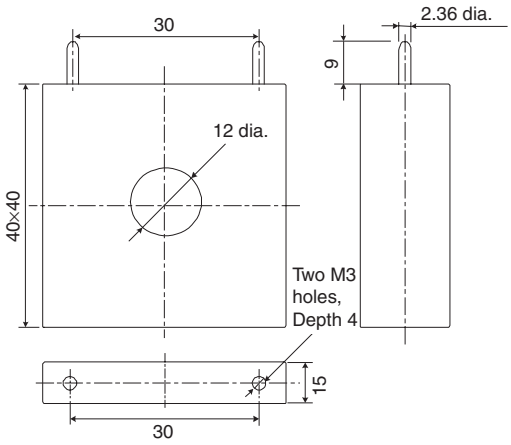


Current Transformer (Sold Separately)

E54-CT1



E54-CT3



Related Manuals

Manual name	Cat. No.	Model numbers	Application	Description
CJ-series Temperature Control Units Operation Manual for NJ-series CPU Unit	W491	CJ1W-TC003/ -TC004/-TC103/ -TC104	Leaning the functions and application methods of the CJ-series Temperature Control Units used in an NJ-series configuration.	Describes the application methods of the CJ-series Temperature Control Units used in an NJ-series configuration.
CJ Series Temperature Control Units Operation Manual	W396	CJ1W-TC□□□	Leaning the functions and application methods of the CJ-series Temperature Control Units.	Describes the application methods of the CJ-series Temperature Control Units.

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2011.12

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