OPERATING MANUAL

TEMPERATURE CONTROLLER
(Modbus, 4 digit, LED display type, size 48 × 48mm)

MODEL **TC10CM**

CONTENTS

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BEFORE USE ....

Thank you for choosing us. Before use, please check contents of the package you received as outlined below.
If you have any problems or questions with the product, please contact our sales office or representatives.

■ PACKAGE INCLUDES:

Temperature controller
(controller + CJC sensor, 1 pcs + terminating resistor, 1 pcs) ...(1)
Mounting frame .....(1)
Watertight packing .....(1)
Engineering unit label sheet .....(1)

■ MODEL NO.

Confirm Model No. marking on the product to be exactly what you ordered.

■ INSTRUCTION MANUAL

This manual describes necessary points of caution when you use this product, including installation, connection and basic maintenance procedures.
This controller is programmable by using the PC Configurator Software. For detailed information on the PC configuration, refer to the TC10CFG users manual. The TC10CFG PC Configurator Software is downloadable at our web site.

■ SYMBOLS USED ON THE PRODUCT AND IN THIS MANUAL

⚠ The symbol indicated on the equipment means that the user must refer to the related parts in the manual for safe operation of the equipment. It is essential to read the instructions wherever the symbol appears in the manual.

⚠ **WARNING**: is reserved for conditions and actions that can cause serious or fatal injury.
⚠ **CAUTION**: is reserved for conditions and actions that can cause injury or instrument damage.

⚠ CAUTION

■ REGARDING SAFETY

- If the equipment is used in a manner not specified by us, the protection provided by the equipment may be impaired.

■ CONFORMITY WITH EU DIRECTIVES

- This equipment is suitable for Pollution Degree 2 and Installation Category II (transient voltage 2500V). Reinforced insulation (signal input or output or Modbus to power input: 300V) and basic insulation (signal input to output to Modbus: 300V) are maintained. Prior to installation, check that the insulation class of this unit satisfies the system requirements.
- Altitude up to 2000 meters.
- The equipment must be installed such that appropriate clearance and creepage distances are maintained to conform to CE requirements. Failure to observe these requirements may invalidate the CE conformance.
- The actual installation environments such as panel configurations, connected devices, connected wires, may affect the protection level of this unit when it is integrated in a panel system. The user may have to review the CE requirements in regard to the whole system and employ additional protective measures* to ensure the CE conformity.
  * For example, installation of noise filters and clamp filters for the power source, input and output connected to the unit, etc.
- In order to enable the operator to turn off the power input immediately, install a switch or a circuit breaker according to the relevant requirements in IEC 60947-2 and properly indicate it.

POINTS OF CAUTION

■ POWER INPUT RATING & OPERATIONAL RANGE

- Locate the power input rating marked on the product and confirm its operational range as indicated below:
  100 – 240V AC rating: 85 – 264V, 47 – 66 Hz, approx. 4.5 – 6.5 VA

■ ENVIRONMENT

- Indoor use.
- When heavy dust or metal particles are present in the air, install the unit inside proper housing with sufficient ventilation.
- Do not install the unit where it is subjected to continuous vibration. Do not subject the unit to physical impact.
- Environmental temperature must be within -10 to +55°C (14 to 131°F) with relative humidity within 5 to 90% RH in order to ensure adequate life span and operation.

■ REQUIREMENTS TO ENSURE IP66

- Observe the designated panel cutout size (45 × 45 mm).
- The watertight packing included in the product package must be placed behind the panel.
- Confirm visually that the sealing is not contorted or excessively run off the edge after installation.

■ WIRING

- Do not install cables close to noise sources (relay drive cable, high frequency line, etc.).
- Do not bind these cables together with those in which noises are present. Do not install them in the same duct.

■ AND ....

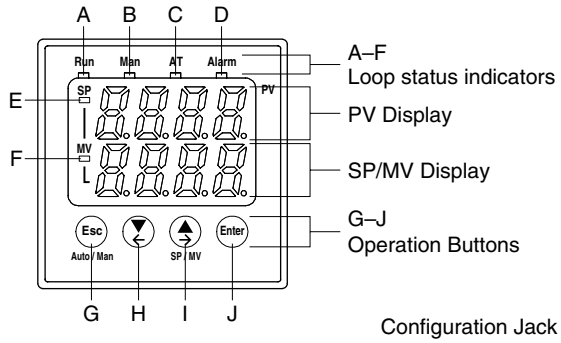
- The unit is designed to function as soon as power is supplied, however, a warm up for 10 minutes is required for satisfying complete performance described in the data sheet.
- With voltage output, do not leave the output terminals shortcircuited for a long time. The unit is designed to endure it without breakdown, however, it may shorten appropriate life duration.

LIGHTNING SURGE PROTECTION

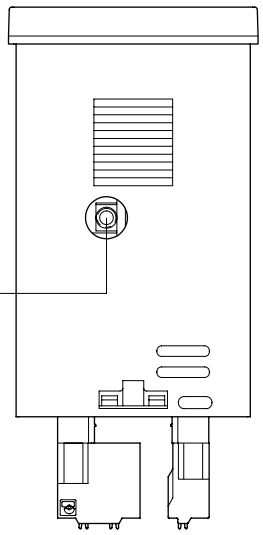
We offer a series of lightning surge protector for protection against induced lightning surges. Please contact us to choose appropriate models.

COMPONENT IDENTIFICATION

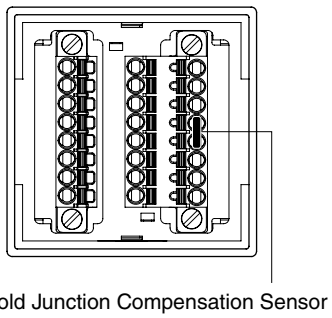
■ FRONT VIEW



■ BOTTOM VIEW



■ REAR VIEW



■ LOOP STATUS INDICATOR

No.	ITEM	FUNCTION
A	Run	Green LED turns on while loop is in operation.
B	Man	Green LED turns on during manual mode.
C	AT	Green LED turns on during auto-tuning.
D	Alarm	Red LED turns on while alarm is occurring.
E	SP	Red LED turns on while displaying SP value.
F	MV	Red LED turns on while displaying MV value.

■ OPERATION BUTTON

No.	ITEM		FUNCTION
G	Esc	Auto/Man	Long-press during setting to return to the normal state. Press in the normal state to switch between auto and manual.
H	▼←		Press and release quickly to move down through numbers or settings. Long-press to move to the lower digit.
I	▲→	SP/MV	Press and release quickly to move up through numbers or settings. Long-press to move to the upper digit. Press in the normal state to switch between SP value and MV value.
J	Enter		Determine the setting value, and at the same time write the setting value to non-volatile memory.

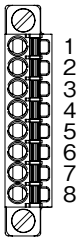
■ PV display

PV value is displayed in the normal state, and setting item is displayed during setting.

■ SP/MV display

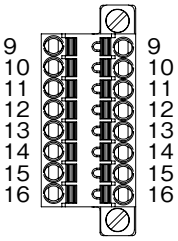
SP value and MV value are switched in the normal state, and setting item is displayed during setting.

■ **Connector for power input, CT input 1, control output 3, 4**



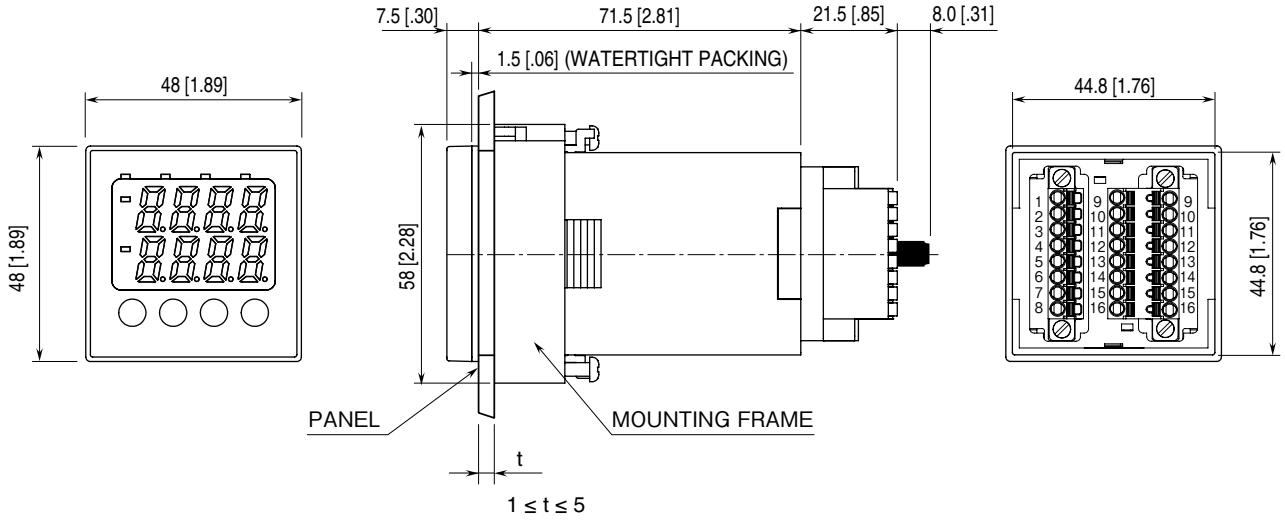
No.	ID	FUNCTION
1	Do1	Control output 3
2	Do2	Control output 4
3	COM	Control output 3, 4 COM
4	k	Clamp-on current sensor
5	I	Clamp-on current sensor
6	NC	Unused
7	U	Power input
8	V	Power input

■ **Connector for universal input 1, control output 1, 2, Modbus**



No.	ID	FUNCTION
9	Mv1	Control output 1
10	Mv2	Control output 2
11	COM	Control output 1, 2 COM
12	Pv1	Universal input 1
13	Pv2	Universal input 1
14	Pv3	Universal input 1
15	DA	Modbus
16	DB	Modbus

EXTERNAL DIMENSIONS unit: mm [inch]

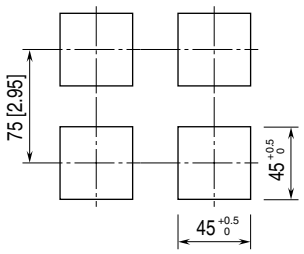


INSTALLATION

■ PANEL CUTOUT unit: mm [inch]

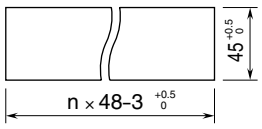
■ Single Mounting

(Conform to degree of protection IP66)



■ Clustered Mounting

(Not conform to degree of protection IP66)

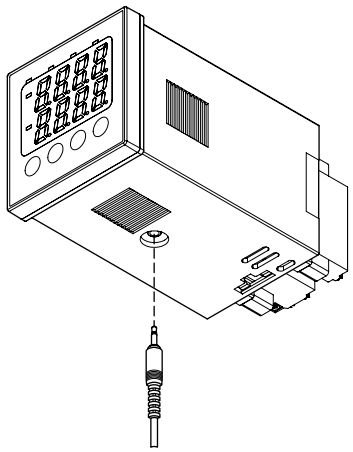


(n：number of the units)

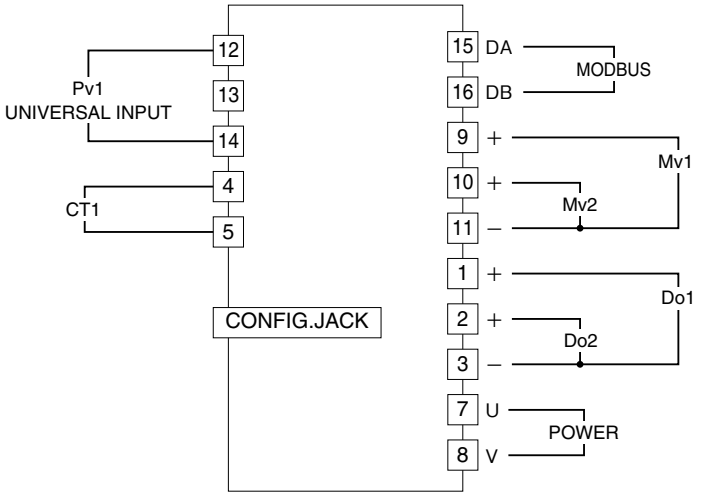
Panel thickness: 1 to 8 [0.04 to 0.31]

■ HOW TO CONNECT CONFIGURATOR CABLE

• The configuration jack is on the bottom of the unit.
When configurating after mounting the panel, keep enough space under the unit.

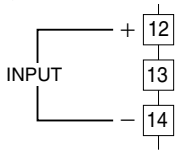


TERMINALS CONNECTIONS

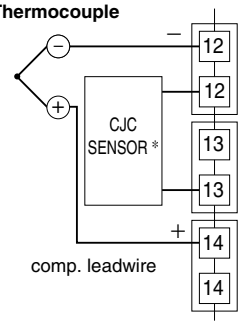


■ UNIVERSAL INPUT CONNECTION (Pv1) e.g.

• DC Current (0 – 20mA DC)
• DC Voltage (-1000 – +1000mV DC)
• DC Voltage (-10 – +10V DC)

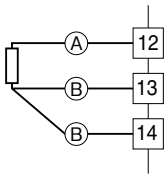


• Thermocouple

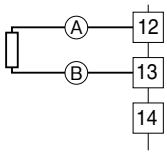


* The CJC sensor does not have polarity. Install compensation leadwire inside the t-branch connector, and CJC sensor on the outside.

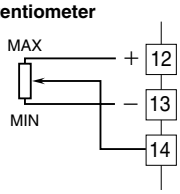
• RTD/Resistor (3-wire)



• RTD/Resistor (2-wire)

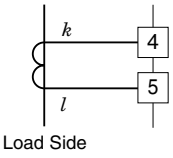


• Potentiometer

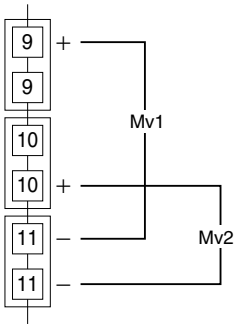


■ CT1 CONNECTION e.g.

• Clamp-on Current Sensor (model : CLSE)

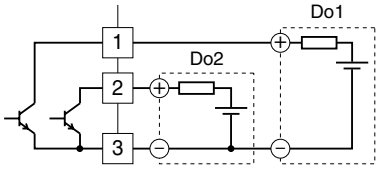


■ CONTROL OUTPUT Mv1, Mv2 CONNECTION e.g.

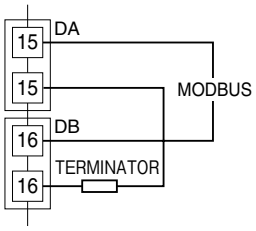


■ CONTROL OUTPUT Do1, Do2 CONNECTION e.g.

• Open Collector

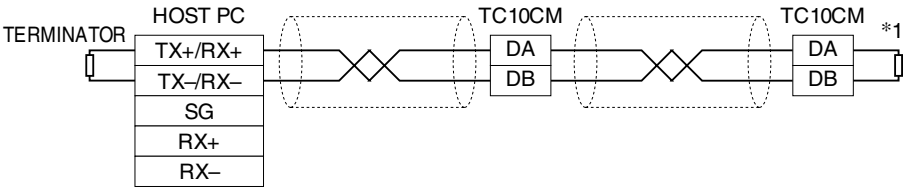


■ MODBUS CONNECTION e.g.



CONNECTION DIAGRAMS

■ **MASTER CONNECTION**



NO.	ID	FUNCTION
15	DA	DA
16	DB	DB

*1. For using attached terminator, mount it between terminals 15 and 16.

■ **SEPARABLE TENSION CLAMP TERMINAL**

Unit side connector: MC 1,5 / 8 - GF - 3,5
TFMC 1,5 / 8 - STF - 3,5 (Phoenix Contact)
Cable side connector: FMC 1,5 / 8 - STF - 3,5 (Phoenix Contact)
Applicable wire size: 0.2 – 1.5 mm²
Stripped length: 10 mm
Recommended solderless terminal
- AI0,25 - 10YE 0.25 mm² (Phoenix Contact)
- AI0,34 - 10TQ 0.34 mm² (Phoenix Contact)
- AI0,5 - 10WH 0.5 mm² (Phoenix Contact)
- AI0,75 - 10GY 0.75 mm² (Phoenix Contact)
- A1 - 10 1.0 mm² (Phoenix Contact)
- A1,5 - 10 1.5 mm² (Phoenix Contact)

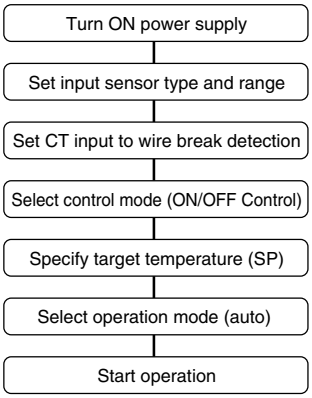
SYSTEM CONFIGURATIONS & CONTROL EXAMPLES

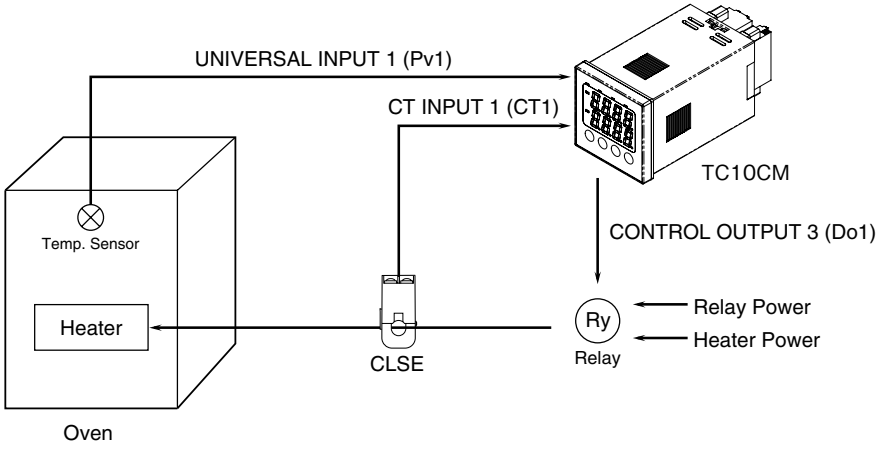
■ **Heating ON/OFF control and heater wire break detection**

1. Installation example:

- Temperature Controller (model: TC10CM)
- Clamp-on Current Sensor (model: CLSE)
- Oven
- Heater
- Relay
- Temperature sensor

2. Proccess until start operating:



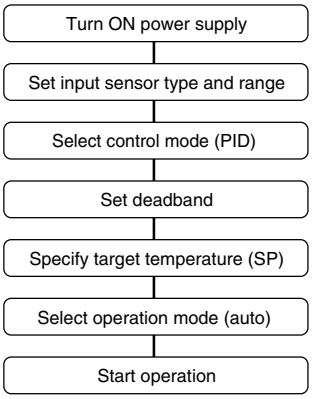


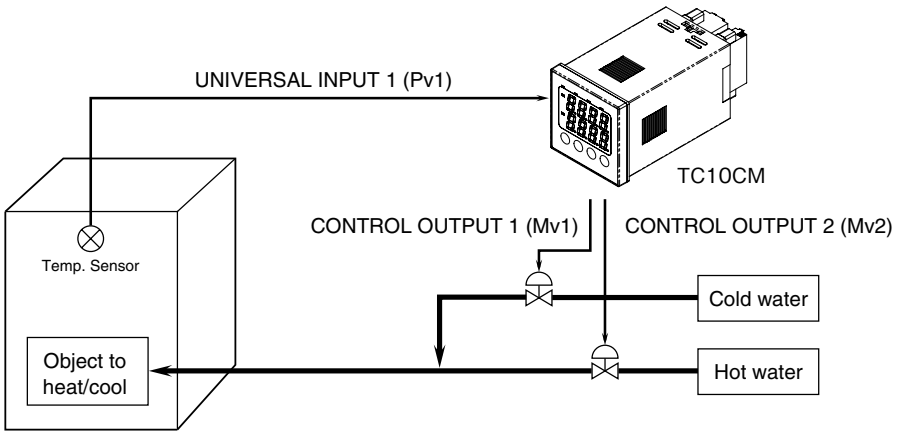
■ **Heating and cooling control (PID)**

1. Installation example:

- Temperature Controller (model: TC10CM)
- Object to heat/cool
- Temperature sensor

2. Proccess until start operating:





MODBUS COMMUNICATION

This device conforms with Modbus-RTU protocol (MODBUS APPLICATION PROTOCOL V1.1a / Modbus over Serial Line Specification & Implementation Guide V1.0).
The following communication parameters are selectable.

COMM. PROPERTY	SELECTION
Node address	1 to 247
Baud rate	4800 bps 9600 bps 19200 bps 38400 bps (*) 57600 bps
Parity bit	None Odd (*) Even
Stop bit	1 bit (*) 2 bits

(*) Factory setting

When appropriately set, the host PC connected via RS-485 can read measurands from and write configurations (setting) to the device.
All registers are assigned to Holding Registers, can be read out using Read Holding Registers command. If reading an address with no assigned register is attempted, '0' is given.
Write Multiple Registers command is used to write registers. If writing an address with no assigned register is attempted, 'Exception' is given.

FUNCTION CODE	COMMAND	RECOMMENDED TIME OUT VALUE
03	Read Holding Registers	0.5 seconds
04	Read Input Registers	0.5 seconds
06	Preset Single Register	2 seconds
16	Write Multiple Registers	2 seconds

These commands enable reading measurands and writing configurations.
Registers are represented in 16-bit integers. All registers are in the form of integer unless specifically given in the explanations.

CAUTION : DO NOT apply new setting via Modbus and the front control buttons at once.

It is recommended to wait for a time period indicated under 'recommended time out value' in the above table to receive a response for a command. If no response is received for these time periods, take appropriate error processing such as retrying.

■ READING EXAMPLE

To read the MV value in the table below.

ADDRESS	PARAMETER	UNIT
5	Loop 1, Heating MV (control output)	0.01%

If 7510 is read, the register value is converted into actual engineering unit value by the following equation:
7510 × 0.01 = 75.10%

■ WRITING EXAMPLE

To write 40.0 at the SP value in the table below.

ADDRESS	PARAMETER	RANGE	DEFAULT
1153	Loop 1, SP (setpoint)	-199.9 to +999.9 (decimal by input 1 decimal setting)	25.0

With the decimal setting '1', write in '400' for '400.'
With the decimal setting '2,' write in '4000' for '40.00.'

■ **READING**

The following parameters can be read out and write in.

ADDRESS	PARAMETER	WRITE IN	UNIT
1	Loop 1, Status 1 (See the table below)	---	---
2	Loop 1, Status 2 (See the table below)	---	---
3	Loop 1, PV (present value)	---	Input 1 decimal setting
4	Loop 1, Internal SP (setpoint value)	---	Input 1 decimal setting
5	Loop 1, Heating MV (control output)	✓ (at MANUAL)	0.01%
6	Loop 1, Cooling MV (control output)	✓ (at MANUAL)	0.01%
7	Loop 1, Local SP (setpoint value)	✓	Input 1 decimal setting
67	CT input 1, Current value	---	0.1 A
68	CT input 1, Current value at the control output ON *1	---	0.1 A
69	CT input 1, Current value at the control output OFF *1	---	0.1 A

*1. '-1' (-0.1 A) is set when the Controller is unable to measure if the relevant control output does not remain ON or OFF for the defined time duration in a control cycle. No CT alarm is judged in this case.

Status 1 is assigned with the following status indicators.

	BIT		STATUS	PARAMETER	DATA 0	DATA 1
STATUS 1	LSB	0	RUN	Loop operating condition	STOP	RUN
		1	AUTO	Loop control mode	MANUAL	AUTO
		2	---	---	---	---
		3	SP_LAMP	SP lamp operation	Not operating	Operating
		4	AT	Auto-tuning	Not running	Running
		5	---	---	---	---
		6	---	---	---	---
		7	INP_ERR	Input error	Normal	Error
		8	---	---	---	---
		9	ALM_HB	Heater wire break alarm	Normal	Alarm
		10	ALM_SB	SSR shortcircuit failure alarm	Normal	Alarm
		11	ALM_OC	Overload alarm	Normal	Alarm
		12	---	---	---	---
		13	ALM_PV1	PV 1 alarm	Normal	Alarm
		14	ALM_PV2	PV 2 alarm	Normal	Alarm
	MSB	15	ALM_PV3	PV 3 alarm	Normal	Alarm
STATUS 2	LSB	16	---	---	---	---
		17	---	---	---	---
		18	BANK0	Bank bit 0	OFF	ON
		19	BANK1	Bank bit 1	OFF	ON
		20	POUT_1 *2	Control output 1	OFF	ON
		21	POUT_2 *2	Control output 2	OFF	ON
		22	POUT_3 *2	Control output 3	OFF	ON
		23	POUT_4 *2	Control output 4	OFF	ON

*2. Control output status is read. This bit is always at '1' (ON) with DC output.

■ SETPOINT VALUE SETTING

SP for each loop can be changed via Modbus.

ADDRESS	PARAMETER	RANGE	DEFAULT
7	Loop 1, Local SP (setpoint value)	-199.9 to +999.9 (decimal by input 1 decimal setting)	---

These registers are overwritten by the SP in bank setting when the power supply is turned off or when the bank is switched. Write the SP in the bank setting if the values should be maintained.

■ COMMAND EXECUTION

Predefined commands for each loop can be issued via Modbus by writing in the following addresses.

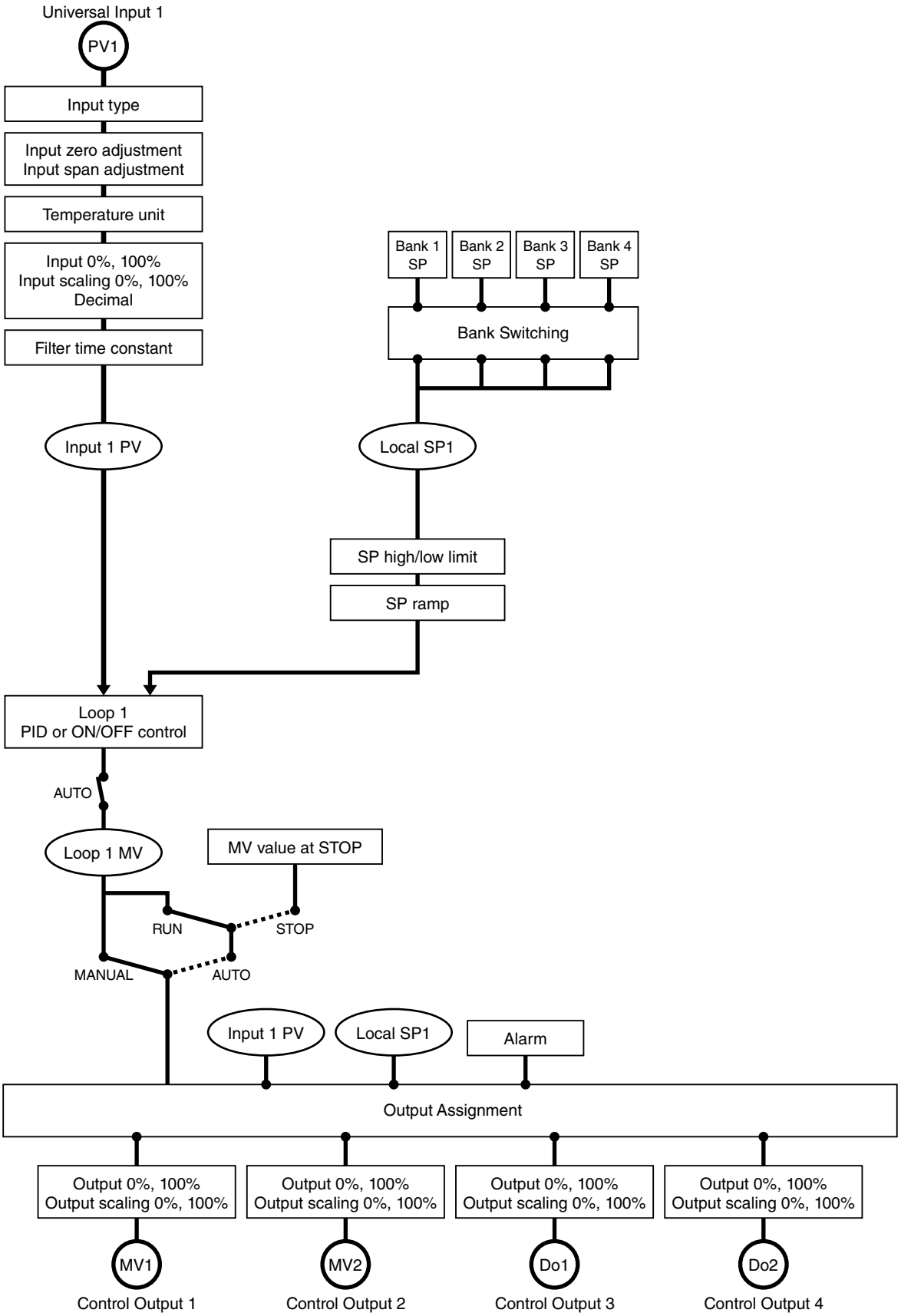
ADDRESS	PARAMETER	RANGE	DEFAULT
65	Loop 1, Command	See the table below.	---

Available commands are as in the table below:

COMMAND	PARAMETER
1	Set loop operation to RUN
2	Set loop operation to STOP
3	Set control mode to AUTO
4	Set control mode to MANUAL
8	Reset all latched alarms in the loop
9	Reset all latched PV alarms
10	Reset all latched CT alarms
16	Switch to Bank 1
17	Switch to Bank 2
18	Switch to Bank 3
19	Switch to Bank 4
24	Run auto-tuning in the conditions specified by Bank 1
25	Run auto-tuning in the conditions specified by Bank 2
26	Run auto-tuning in the conditions specified by Bank 3
27	Run auto-tuning in the conditions specified by Bank 4

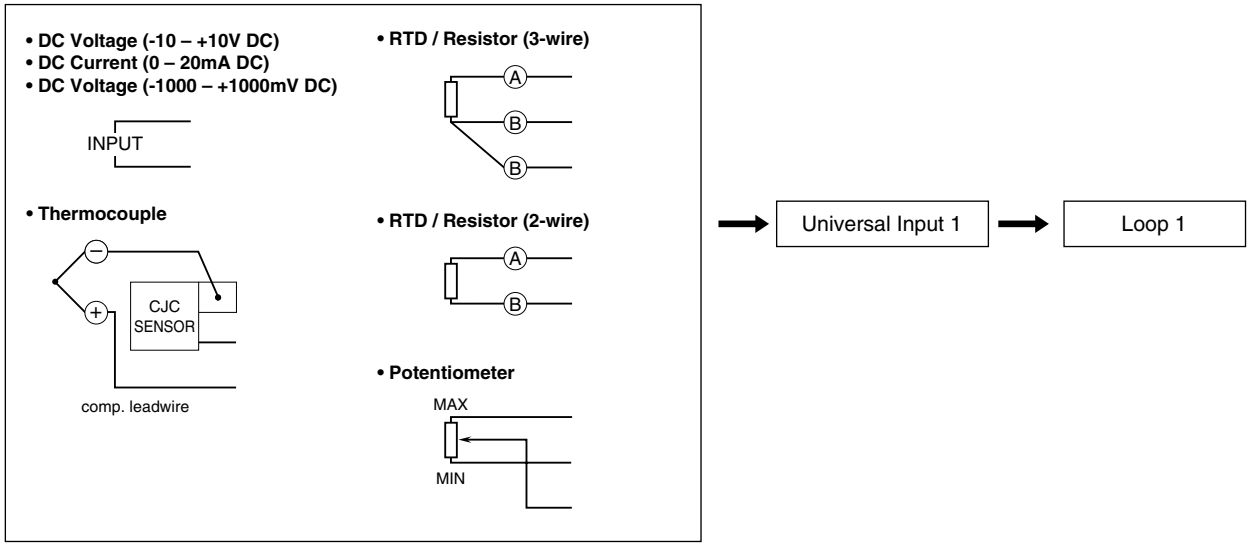
FUNCTION BLOCK DIAGRAM

The figure below is a simplified function block diagram showing relations between the I / O signal and the setting.



UNIVERSAL INPUT

The Controller has one universal input (universal input 1) which can be assigned for temperature inputs. In addition to RTD and thermocouples, resistor, DC and potentiometer inputs are also usable. The resistor, DC and potentiometer input is scaled into a temperature range.
Universal input 1 is assigned as PV input signal for loop 1.



■ INPUT TYPE

ADDRESS	PARAMETER	RANGE	DEFAULT
129	Universal input 1, Input type	See the table below.	10

SET VALUE	PARAMETER
0	DC 0 – 20 mA
1	DC -1000 – +1000 mV
2	DC -10 – +10 V
3	POT 0 – 4000 Ω
4	POT 0 – 2500 Ω
5	POT 0 – 1200 Ω
6	POT 0 – 600 Ω
7	POT 0 – 300 Ω
8	POT 0 – 150 Ω
9	Resistor 0 – 4000 Ω
10	RTD Pt 100
14	RTD Pt 500
15	RTD Pt 1000
16	RTD Pt 50 Ω
17	RTD JPt 100

SET VALUE	PARAMETER
20	RTD Ni 508.4 Ω
22	RTD Cu 10
24	TC (PR)
25	TC K
26	TC E
27	TC J
28	TC T
29	TC B
30	TC R
31	TC S
32	TC C
33	TC N
34	TC U
35	TC L
36	TC P

For potentiometer, set the input type in the range that [Total resistance + leadwire resistance] falls in.
When the leadwire resistance is high, exclude the effect of leadwire resistance with the setting 'input 0%/100%'.

■ WIRING

Choose either 2 wires or 3 wires when the input type is set to RTD or resistor.

ADDRESS	PARAMETER	RANGE	DEFAULT
130	Universal input 1, Wiring	2 wires 3 wires	3 wires

■ BURNOUT

Choose burnout function when the input type is set to thermocouple, RTD, resistor or potentiometer.

ADDRESS	PARAMETER	RANGE	DEFAULT
131	Universal input 1, Burnout	Disable Enable	Enable

■ COLD JUNCTION COMPENSATION

Choose cold junction compensation by the cold junction temperature sensor included in the product package for thermocouple input.
When the setting is disabled, the terminal temperature is assumed to show 0°C so that the measured emf is directly converted into temperature.

ADDRESS	PARAMETER	RANGE	DEFAULT
132	Universal input 1, Cold junction compensation	Disable Enable	Enable

■ TEMPERATURE UNIT

Choose temperature unit used for thermocouple or RTD input.
The setting is applied only to the unit, but not to the temperature values such as SP. If you have changed the unit setting, be sure to check and change all other temperature values.

ADDRESS	PARAMETER	RANGE	DEFAULT
133	Universal input 1, Temperature unit	degC degF	degC

■ INPUT ZERO ADJUSTMENT / INPUT SPAN ADJUSTMENT

Input signals can be finely adjusted.
The following equation is applied to the engineering unit value data.

[Adjusted value] = [input] × [input span adjustment] + [input zero adjustment]

ADDRESS	PARAMETER	RANGE	DEFAULT
134	Universal input 1, Input zero adjustment	-19.99 to +19.99 (unit as in the table below)	0.00
135	Universal input 1, Input span adjustment	0.8500 to 1.1500 (When setting the main unit, 3 decimal places)	1.0000

INPUT TYPE	UNIT
0 – 20 mA DC	mA
-1000 – +1000 mV DC	mV
-10 – +10 V DC	V
Thermocouple	mV
RTD, Resistor	Ω
Potentiometer	%

■ INPUT 0% / INPUT 100% / INPUT SCALING 0% / INPUT SCALING 100%

DC, resistor and potentiometer input signals can be converted into a temperature range.
Specify the original input range from INPUT 0% to INPUT 100%, and the converted range from INPUT SCALING 0% to INPUT SCALING 100%.

ADDRESS	PARAMETER	RANGE	DEFAULT
136	Universal input 1, Input 0%	-1000.0 to +4000.0 *3 (unit as in the table below)	4.0
137	Universal input 1, Input 100%		20.0
138	Universal input 1, Input scaling 0%	-199.9 to +999.9 (decimal by input 1 decimal setting)	0.0
139	Universal input 1, Input scaling 100%		100.0

*3. Signed words have the maximum range up to +32767. +32768 to +40000 is internally converted into -32768 to -25536 so that the entire range up to 40000 can be within the normal range limits.

Setting unit and range in input 0% / input 100%

INPUT TYPE	UNIT	RANGE
0 – 20 mA DC	mA	0.0 to 20.0
-1000 – +1000 mV DC	mV	-1000 to 1000
-10 – +10 V DC	V	-10.0 to 10.0
Potentiometer	%	0.0 to 100.0
Resistor	Ω	0 to 4000
RTD, Thermocouple	---	0.0 to 0.0

■ FILTER TIME CONSTANT

First order lag filter can be applied to the input signal. Time constant setting is available from 0.5 to 60.0 seconds. Setting 0.0 disables the filter function.
The filter operates just like a typical CR filter. With a step input, the filter output takes the preset time constant time to reach 63% value.

ADDRESS	PARAMETER	RANGE	DEFAULT
140	Universal input 1, Filter time constant	0.0, 0.5 to 60.0 seconds	0.0

■ DECIMAL

Choose the number of decimal places for PV (input) signal.
The setting affects the input and relevant loop, and the output setting assigned to its loop's control output.
Those parameters affected by the setting are indicated with 'decimal by input 1 decimal setting.

ADDRESS	PARAMETER	RANGE	DEFAULT
141	Universal input 1, Decimal	0, 1, 2 (digits)	1

PV and relevant ranges may be limited as shown in the table below depending upon the decimal setting.

DECIMAL	RANGE
0	-32000 – +32000
1	-3200.0 – +3200.0
2	-320.00 – +320.00

Related ranges are not automatically scaled when the setting is changed. Be sure to check and change all other values.

CONTROL OUTPUT

The Controller has four control outputs (control output 1 through 4) which are assigned to control output, alarm output and other outputs.
Basic output channel configuration is determined by the model number suffix codes as shown below.

Control output 1, Control output 2	TC10CM-A-x	0 – 20 mA DC output
	TC10CM-V-x	0 – 10 V DC output
	TC10CM-P-x	12V pulse output
Control output 3, Control output 4	Open collector output	

Each output channel can be assigned with alarm output (ON / OFF) or with control output (continuous value) as explained in the table below.

OUTPUT	ON / OFF	CONTINUOUS VALUE
0 – 20 mA DC	ON at 100% scaled current; OFF at 0% scaled current	Scaled output range is converted into a proportional current range
0 – 10 V DC	ON at 100% scaled voltage; OFF at 0% scaled voltage	Scaled output range is converted into a proportional voltage range
12V pulse	ON at 12V; OFF at 0V	Scaled output range is converted into a proportional duty ratio output
Open collector	ON at closed state; OFF at open state	Scaled output range is converted into a proportional duty ratio output

■ OUTPUT ASSIGNMENT

ADDRESS	PARAMETER	RANGE	DEFAULT
1281	Control output 1, Output assignment	See the table below.	16
1441	Control output 2, Output assignment		0
1601	Control output 3, Output assignment		0
1761	Control output 4, Output assignment		0

SET VALUE	PARAMETER	TYPE	OUTPUT SCALING DECIMAL
0	Not assigned	---	----
1	Device error	ON / OFF	----
2	Alarm OR	ON / OFF	----
3	Alarm AND	ON / OFF	----
16	Loop 1, Heating control output	Continuous value	----
17	Loop 1, Cooling control output	Continuous value	----
18	Loop 1, PV	Continuous value	By input 1 decimal setting
19	Loop 1, Internal SP	Continuous value	By input 1 decimal setting
20	Loop 1, Local SP	Continuous value	By input 1 decimal setting
22	Loop 1, Input error	ON / OFF	----

■ CONTROL CYCLE

Specify duty cycle for duty ratio output. Disregarded with DC signal output setting.

ADDRESS	PARAMETER	RANGE	DEFAULT
1282	Control output 1, Control cycle	1.0 to 99.9 seconds	2.0
1442	Control output 2, Control cycle		
1602	Control output 3, Control cycle		
1762	Control output 4, Control cycle		

■ MINIMUM ON / OFF WIDTH

Specify the minimum pulse width for ON and OFF with duty ratio output.
For example, with 1% setting, the output below 1% is output as 0%, while the output above 99% is output as 100%.

ADDRESS	PARAMETER	RANGE	DEFAULT
1283	Control output 1, Minimum ON / OFF width	0.0 to 50.0%	0.0
1443	Control output 2, Minimum ON / OFF width		
1603	Control output 3, Minimum ON / OFF width		
1763	Control output 4, Minimum ON / OFF width		

■ OUTPUT SCALING 0% / OUTPUT SCALING 100%

Scales and outputs the assigned output value.

ADDRESS	PARAMETER	RANGE	DEFAULT
1284	Control output 1, Output scaling 0% *4	-199.9 to +999.9 (Input 1 decimal digits unit) *5	0.0
1285	Control output 1, Output scaling 100% *4		100.0
1444	Control output 2, Output scaling 0% *4		0.0
1445	Control output 2, Output scaling 100% *4		100.0
1604	Control output 3, Output scaling 0% *4		0.0
1605	Control output 3, Output scaling 100% *4		100.0
1764	Control output 4, Output scaling 0% *4		0.0
1765	Control output 4, Output scaling 100% *4		100.0

*4. Output scaling 0 to 100% is valid only when control output is assigned to PV, Internal SP or Local SP on setting "OUTPUT ASSIGNMENT". Disregarded if it is assigned to others.
Output scaling 0% of control output 1 is PV (input value) or SP (target value) at which the control output 1 output becomes 0%.
Output scaling 100% of control output 1 is PV (input value) or SP (target value) at which the control output 1 output becomes 100%.
The same applies to control output 2, control output 3, control output 4.
e.g. If the "OUTPUT ASSIGNMENT" setting is "Loop 1 PV", as it follows.
If output scaling 0% of control output 1 become 20,
at that time PV of Loop 1 is 20, control output 1 outputs 0%.
If output scaling 100% of control output 1 become 80,
at that time PV of Loop 1 is 80, control output 1 outputs 100%.
*5. Refer to the "DECIMAL" about digits setting

■ OUTPUT 0% / OUTPUT 100%

When output control is 0%, output 0% is setting the value of output from the terminal block of unit.
When output control is 100%, output 100% is setting the value of output from the terminal block of unit.

ADDRESS	PARAMETER	RANGE	DEFAULT
1286	Control output 1, Output 0%	0.0 to 100.0	*6
1287	Control output 1, Output 100%		
1446	Control output 2, Output 0%		
1447	Control output 2, Output 100%		
1606	Control output 3, Output 0%	0.0 to 100.0%	0.0
1607	Control output 3, Output 100%		100.0
1766	Control output 4, Output 0%		0.0
1767	Control output 4, Output 100%		100.0

*6. Default value and engineering unit depends upon the model number suffix code as in the table below.

MODEL	DEFAULT(OUTPUT 0%)	DEFAULT(OUTPUT 100%)	UNIT
TC10CM-A-x	4.0	20.0	mA
TC10CM-V-x	0.0	10.0	V
TC10CM-P-x	0.0	100.0	%

■ OUTPUT INVERSION

12V pulse signal level and open collector output, relay output and auxiliary relay output ON / OFF logic can be inverted.

ADDRESS	PARAMETER	RANGE	DEFAULT
1288	Control output 1, Output inversion	0 : Normal 1 : Inverted	0
1448	Control output 2, Output inversion		
1608	Control output 3, Output inversion		
1768	Control output 4, Output inversion		

LOOP

The Controller has one control loop (loop 1) which can be assigned with PID and ON / OFF control operations.
Loop receives the universal input to feedback and perform temperature control.

■ OPERATION AT STARTUP

Specify whether the Controller automatically starts operating (RUN) or not (STOP). With STOP setting, it outputs the predefined 'MV output at STOP status.'

ADDRESS	PARAMETER	RANGE	DEFAULT
193	Loop 1, Operation at startup	0 : STOP 1 : RUN	0

At startup means the timing when the power up.

■ CONTROL MODE AT STARTUP

Specify the control mode at the startup. In MANUAL mode, the control output can be manually manipulated. In AUTO mode, the Controller starts automatic control operations.

ADDRESS	PARAMETER	RANGE	DEFAULT
194	Loop 1, Control mode at startup	0 : MANUAL 1 : AUTO	0

At startup means the timing when the power up.

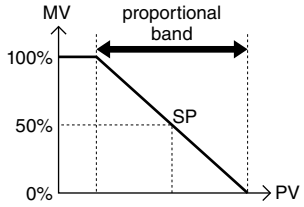
■ CONTROL TYPE

Specify the control strategy for each loop.

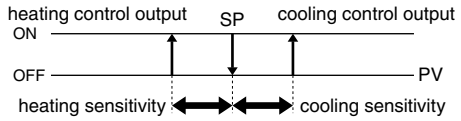
ADDRESS	PARAMETER	RANGE	DEFAULT
195	Loop 1, Control type	0 : Standard PID control 1 : Heating-cooling PID control 2 : Heating-cooling ON / OFF control	0

• Standard PID Control
Typical PID control operation is performed by PID1 P (proportional band), PID1 I (integral time) and PID1 D (derivative time) set in the selected bank. The Controller automatically adjusts the heating control output (MV) to match the setpoint value (SP) with the universal input value (PV).

• Heating-Cooling PID Control
PID control is applied to both heating and cooling using PID parameters in PID1 (for heating) and PID2 (for cooling) parameters.

PARAMETER	DESCRIPTIONS	SMALLER SET VALUE	LARGER SET VALUE
P (proportional band)	P output is proportional to the deviation between the input (PV) and the setpoint (SP).  	• Takes shorter time to reach the target temperature • Overshooting or cycling may occur more frequently.	• Takes longer time to reach the target temperature • Overshooting is unlikely to occur.
I (integral time)	I output is proportional to the integrated deviation between PV and SP. It is used to automatically adjust offset by P output.	• Takes shorter time to reach the target temperature • Overshooting, undershooting, or cycling may occur to a greater degree.	• Takes longer time to reach the target temperature • Overshooting, undershooting, or cycling may be diminished.
D (derivative time)	D output is proportional to the derivative of deviation between PV and SP. It is used as a corrective action against changes in PV and SP.	• Overshooting or undershooting may occur to a greater degree.	• Overshooting or undershooting may be diminished. • Small hunting may occur.

• Heating-Cooling ON / OFF Control
The control output is turned on until the universal input (PV) matches the setpoint value (SP) and then turned off. Heating control is applied when the SP is greater than the PV, while cooling control is applied when the SP is smaller than the PV. The output is turned on again if the PV is deviated from the SP again, but the sensitivity to react to a deviation can be set for heating and cooling respectively.



■ DIRECT / REVERSE ACTION

Direct or reverse action can be specified for the standard PID control.
Choose 'reverse' action when the MV should be decreased with an increasing PV (typical heating control), and 'direct' action when the MV should be increased (typical cooling control).
Disregarded if the selected control strategy is other than the standard PID control.

ADDRESS	PARAMETER	RANGE	DEFAULT
196	Loop 1, Direct / reverse action	0 : Reverse 1 : Direct	0

■ SP LOW LIMIT / SP HIGH LIMIT

Specify the lower and the upper limits for the SP.
For example, if the SP range is set to 0.0 – 100.0, setting 100.0 is used for setting 200.0 automatically.

ADDRESS	PARAMETER	RANGE	DEFAULT
199	Loop 1, SP low limit	-199.9 to +999.9 (decimal by input 1 decimal setting)	-199.9
200	Loop 1, SP high limit		999.9

■ MV AT STARTUP / MV AT STOP / MV AT ERROR

Specific MV values can be set for respective loop status.

ADDRESS	PARAMETER	RANGE	DEFAULT
201	Loop 1, MV at startup	-105.00 to +105.00% (When setting the main unit, 1 decimal places)	0.00
202	Loop 1, MV at STOP		
203	Loop 1, MV at error		

At startup means the timing when the power up.
At error means the input errors such as burnout.
With standard PID control, -5.00 is used for any value below -5.00.
With heating-cooling PID control, positive value is applied for heating control, and negative value is applied for cooling control.
With ON / OFF control, cooling control is turned on at -100.00, both cooling and heating is off at 0.00, and heating is on at 100.00.
With MANUAL control mode, the MV at startup is applied at the startup, however, once the Controller transits from AUTO to MANUAL, the MV value at the moment of the transition is carried on.
The Controller's action is determined in the following priority order: MANUAL > STOP > Error.

■ MV LOW LIMIT / MV HIGH LIMIT

Specify the lower and the upper limits for the MV.
For example, if the MV range is set to 0.00 – 50.00, setting 50.00 is used for setting 70.00 automatically.

ADDRESS	PARAMETER	RANGE	DEFAULT
204	Loop 1, MV low limit	-100.00 to +100.00% (When setting the main unit, 1 decimal places)	-100.00
205	Loop 1, MV high limit		100.00

With heating-cooling control, when the MV value is positive, it means heating control, and when the MV value is negative, it means cooling control.
This setting will be ignored in manual mode.

■ ERROR ACTION

Specify the Controller's action in case of an input error (burnout).

ADDRESS	PARAMETER	RANGE	DEFAULT
206	Loop 1, Error action	0 : Operation continued 1 : 'MV at error' output 2 : STOP	1

With 'Operation continued' setting, the Controller continues operating.
With 'MV at error' output setting, it outputs the specified output value until the error is cancelled.
With STOP setting, the Controller stops operating. It does not restart automatically even when the error is cancelled.

■ CT ALARM ACTION

Specify the Controller's action in case of an alarm by CT input (heater wire break, SSR shortcircuit failure or overload).

ADDRESS	PARAMETER	RANGE	DEFAULT
207	Loop 1, CT alarm action	0 : Operation continued 1 : 'MV at error' output 2 : STOP	1

With 'Operation continued' setting, the Controller continues operating.
With 'MV at error' output setting, it outputs the specified output value until the error is cancelled.
With STOP setting, the Controller stops operating. It does not restart automatically even when the error is cancelled.

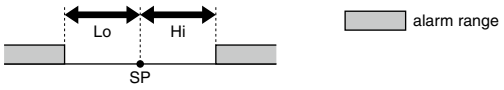
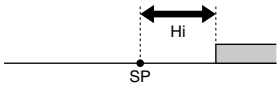
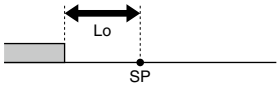
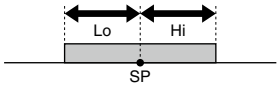
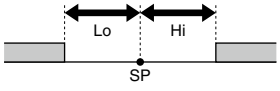
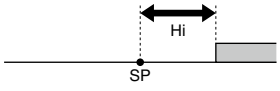
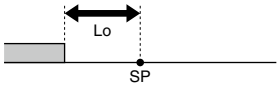
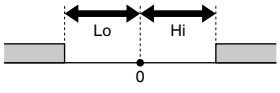
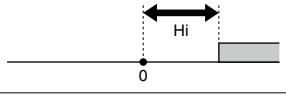
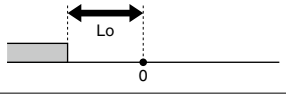
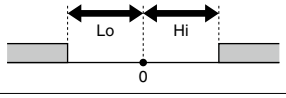
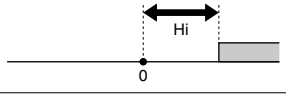
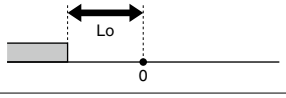
■ PV ALARM 1, PV ALARM 2, PV ALARM 3

The Controller monitors PV signal to trigger alarms in predefined conditions.
Three alarm conditions (PV ALARM 1 through 3) can be specified.
High / low setpoint values can be specified by banks, together with other settings such as SP.

• ALARM TYPE

Specify conditions to be monitored for alarm trip.

ADDRESS	PARAMETER	RANGE	DEFAULT
321	Loop 1, Alarm 1 type	See the table below.	0
329	Loop 1, Alarm 2 type		
337	Loop 1, Alarm 3 type		

SET VALUE	ALARM TYPE	
0	Alarm OFF	
1	Deviation Hi/Lo limit	
2	Deviation Hi limit	
3	Deviation Lo limit	
4	Deviation range	
5	Deviation Hi/Lo limit with standby sequence	
6	Deviation Hi limit with standby sequence	
7	Deviation Lo limit with standby sequence	
8	Absolute value Hi/Lo limit	
9	Absolute value Hi limit	
10	Absolute value Lo limit	
11	Absolute value Hi/Lo limit with standby sequence	
12	Absolute value Hi limit with standby sequence	
13	Absolute value Lo limit with standby sequence	

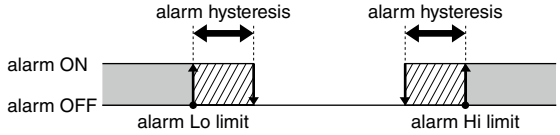
Standby sequence is a function to prevent unwanted alarm triggered at the startup or at an SP change. When PV is in alarm range from the startup or at an SP change, no alarm is triggered.
Once it is out and then in the range, alarm is triggered.

• ALARM HIGH SETPOINT / ALARM LOW SETPOINT

Multiple setpoint values can be specified by using banks. Refer to 'BANK' section for assigned addresses.
For the deviation alarm, specify offset values from the SP (positive value for a temperature value greater than the SP, negative value for one smaller).
For the absolute value alarm, specify absolute temperature values.

• ALARM HYSTERESIS

Hysteresis, a deadband between ON point and OFF point, is used to prevent frequent ON / OFF operations (generally called 'chattering') of an alarm output device when the PV fluctuates around the setpoint.



ADDRESS	PARAMETER	RANGE	DEFAULT
322	Loop 1, Alarm 1 hysteresis	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
330	Loop 1, Alarm 2 hysteresis		
338	Loop 1, Alarm 3 hysteresis		

• ALARM LATCHING

Once an alarm is tripped, it is held even when the alarm condition is cancelled.
Latched alarm is reset by turning the device's power supply off or by Modbus command.

ADDRESS	PARAMETER	RANGE	DEFAULT
323	Loop 1, Alarm 1 latching	0 : Disable 1 : Enable	0
331	Loop 1, Alarm 2 latching		
339	Loop 1, Alarm 3 latching		

• ALARM ON DELAY / ALARM OFF DELAY

Alarm ON delay time is applied to the time during which an alarm condition should remain true, before the alarm trips.
Alarm OFF delay time is applied to the time during which an alarm conditions should remain false, before the tripped alarm is reset.
Setting 0 means no delay in the alarm operations.

ADDRESS	PARAMETER	RANGE	DEFAULT
324	Loop 1, Alarm 1 ON delay	0 to 999 seconds	0
332	Loop 1, Alarm 2 ON delay		
340	Loop 1, Alarm 3 ON delay		
325	Loop 1, Alarm 1 OFF delay		
333	Loop 1, Alarm 2 OFF delay		
341	Loop 1, Alarm 3 OFF delay		

• ALARM SP TYPE

When the SP is changed, actual target temperature gradually changes in a ramp setting until it reaches the final setpoint. Choose either the setpoint in the ramp transition or the final setpoint should be used for reference of alarm judgment.

ADDRESS	PARAMETER	RANGE	DEFAULT
326	Loop 1, Alarm 1 SP type	0 : Ramp SP 1 : SP	0
334	Loop 1, Alarm 2 SP type		
342	Loop 1, Alarm 3 SP type		

• ALARM OUTPUT

Specify the output device for alarms.
When one of the control outputs is specified, be sure also to specify 'Alarm OR' or 'Alarm AND' with its output assignment.
With 'Alarm OR' setting, the output is provided if one or more alarms assigned to it are in true conditions. With 'Alarm AND' setting it is provided only if all alarms assigned to it are in true conditions.

ADDRESS	PARAMETER	RANGE	DEFAULT
327	Loop 1, Alarm 1 output	0 : Network only 1 : Control output 1 2 : Control output 2 3 : Control output 3 4 : Control output 4	0
335	Loop 1, Alarm 2 output		
343	Loop 1, Alarm 3 output		

BANK

The Controller has four sets of banks. Temperature setpoint and PID and other parameters can be stored and switched easily during operation via Modbus communication.
Bank 1 is used when there is no bank switching.

■ SP (SETPOINT VALUE)

Specify local SP.

CAUTION	Local SP bank is saved in the nonvolatile memory of the device. If the SP bank is changed frequently during operation, the memory may reach its limit of writing, approx. 106 cycles in a short time. Use the 'Setpoint Value Setting' for frequent changes.

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1153	Loop 1, SP (setpoint value)	-199.9 to +999.9 (decimal by input 1 decimal setting)	25.0

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1313	Loop 1, SP (setpoint value)	-199.9 to +999.9 (decimal by input 1 decimal setting)	25.0

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1473	Loop 1, SP (setpoint value)	-199.9 to +999.9 (decimal by input 1 decimal setting)	25.0

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1633	Loop 1, SP (setpoint value)	-199.9 to +999.9 (decimal by input 1 decimal setting)	25.0

■ SP RAMP FALL RATE / SP RAMP RISE RATE

SP can be changed gradually in specified ramp rates when a new SP value is applied. SP ramp fall rate is applied with a decreasing SP, while SP rise rate is with an increasing SP. Unit is "setting temperature / sec."
The SP is instantly switched to a new value when '0.0' is set.
The setting is valid for all SP value changes except at STOP status and in error status.

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1154	Loop 1, SP ramp fall rate	0.0 to 999.9 per second (decimal by input 1 decimal setting)	0.0
1155	Loop 1, SP ramp rise rate		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1314	Loop 1, SP ramp fall rate	0.0 to 999.9 per second (decimal by input 1 decimal setting)	0.0
1315	Loop 1, SP ramp rise rate		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1474	Loop 1, SP ramp fall rate	0.0 to 999.9 per second (decimal by input 1 decimal setting)	0.0
1475	Loop 1, SP ramp rise rate		

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1634	Loop 1, SP ramp fall rate	0.0 to 999.9 per second (decimal by input 1 decimal setting)	0.0
1635	Loop 1, SP ramp rise rate		

■ P (proportional band) / I (integral time) / D (derivative time)

PID parameters are used in standard and heating-cooling PID control.
Only PID1 is used for the standard PID. With the heating-cooling PID, PID1 is used for heating, while PID2 is for cooling.

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1156	Loop 1, PID1 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1157	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
1158	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1159	Loop 1, PID2 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1160	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
1161	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1316	Loop 1, PID1 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1317	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
1318	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1319	Loop 1, PID2 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1320	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
1321	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1476	Loop 1, PID1 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1477	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
1478	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1479	Loop 1, PID2 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1480	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
1481	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1636	Loop 1, PID1 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1637	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
1638	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1639	Loop 1, PID2 P (proportional band)	0.1 to 999.9 (decimal by input 1 decimal setting) (unit is temperature)	8.0
1640	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
1641	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0

■ HEATING SENSITIVITY / COOLING SENSITIVITY

Sensitivity, a deadband between ON point and OFF point for heating / cooling control output, is used to prevent frequent ON/OFF operations (generally called 'chattering') of a control output device when the PV fluctuates around the setpoint.

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1168	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
1169	Loop 1, Cooling sensitivity		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1328	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
1329	Loop 1, Cooling sensitivity		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1488	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
1489	Loop 1, Cooling sensitivity		

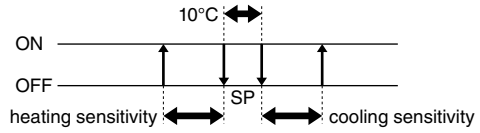
[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1648	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
1649	Loop 1, Cooling sensitivity		

■ DEADBAND

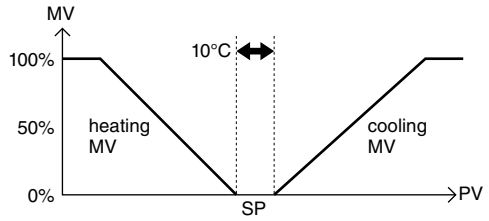
Deadband is a zone in which neither heating nor cooling control is performed.
Negative value setting means both heating and cooling control is performed in the zone.

The figure below shows an example of ON / OFF control with the deadband set to 10°C.

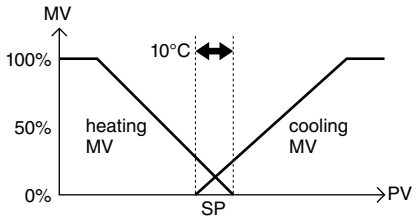


At PID control, deadband is enabled for P control. At P control (I = 0 and D = 0.0), with continuous value control, a zone in which both heating MV and cooling MV equal 0 is formed at ±5°C of the SP when the deadband is set to 10°C. With the setting to -10°C, the zone is with both heating MV and cooling MV.

• Deadband set to 10°C (at I=0, D=0.0)



• Deadband set to -10°C (at I=0, D=0.0)



Note: In order to be intelligible, the graphs show MV at P control. However, in case that I and / or D are set, the graphs may be different from the above, since switching of heating MV / cooling MV does not match SP.

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1170	Loop 1, Deadband	-199.9 to +199.9 (decimal by input 1 decimal setting)	0.0

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1330	Loop 1, Deadband	-199.9 to +199.9 (decimal by input 1 decimal setting)	0.0

[Bank 3]

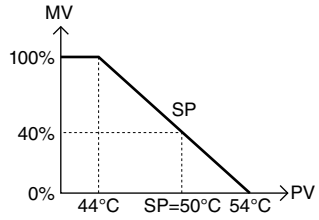
ADDRESS	PARAMETER	RANGE	DEFAULT
1490	Loop 1, Deadband	-199.9 to +199.9 (decimal by input 1 decimal setting)	0.0

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1650	Loop 1, Deadband	-199.9 to +199.9 (decimal by input 1 decimal setting)	0.0

■ MANUAL RESET

Manual reset is used to eliminate errors by offset generated by P control (I = 0, D = 0.0) or PD control (I = 0).
MV (control output) changes from 100% to 0% proportionally to the temperature range set with P value. The MV is converted so that the MV set with the manual reset value is equal to the SP.
The figure below shows an example of MV value transition against PV when SP is set to 50.0°C, the manual reset value to 40.00%, with P (proportional-only) control (P = 10.0, I = 0, D = 0.0).



[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1171	Loop 1, Manual reset	0.00 to 100.00% (When setting the main unit, 1 decimal places)	50.00

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1331	Loop 1, Manual reset	0.00 to 100.00% (When setting the main unit, 1 decimal places)	50.00

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1491	Loop 1, Manual reset	0.00 to 100.00% (When setting the main unit, 1 decimal places)	50.00

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1651	Loop 1, Manual reset	0.00 to 100.00% (When setting the main unit, 1 decimal places)	50.00

■ ALARM LOW SETPOINT / HIGH SETPOINT FOR PV ALARM 1...3

High and low alarm setpoint values for PV Alarm 1 through 3 are set in the banks.
Alarm setpoints can be easily switched between banks depending upon different conditions such as setpoint changes.

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1162	Loop 1, Alarm 1 low setpoint	-199.9 to +999.9 (decimal by input 1 decimal setting)	0.0
1163	Loop 1, Alarm 1 high setpoint		
1164	Loop 1, Alarm 2 low setpoint		
1165	Loop 1, Alarm 2 high setpoint		
1166	Loop 1, Alarm 3 low setpoint		
1167	Loop 1, Alarm 3 high setpoint		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1322	Loop 1, Alarm 1 low setpoint	-199.9 to +999.9 (decimal by input 1 decimal setting)	0.0
1323	Loop 1, Alarm 1 high setpoint		
1324	Loop 1, Alarm 2 low setpoint		
1325	Loop 1, Alarm 2 high setpoint		
1326	Loop 1, Alarm 3 low setpoint		
1327	Loop 1, Alarm 3 high setpoint		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1482	Loop 1, Alarm 1 low setpoint	-199.9 to +999.9 (decimal by input 1 decimal setting)	0.0
1483	Loop 1, Alarm 1 high setpoint		
1484	Loop 1, Alarm 2 low setpoint		
1485	Loop 1, Alarm 2 high setpoint		
1486	Loop 1, Alarm 3 low setpoint		
1487	Loop 1, Alarm 3 high setpoint		

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1642	Loop 1, Alarm 1 low setpoint	-199.9 to +999.9 (decimal by input 1 decimal setting)	0.0
1643	Loop 1, Alarm 1 high setpoint		
1644	Loop 1, Alarm 2 low setpoint		
1645	Loop 1, Alarm 2 high setpoint		
1646	Loop 1, Alarm 3 low setpoint		
1647	Loop 1, Alarm 3 high setpoint		

CT INPUT

The Controller has one CT input (CT input 1) which is used to monitor the control outputs with clamp-on current sensors, for alarm purposes.

CAUTION	The Controller can monitor the control outputs only in case of 12V pulse or open collector. These outputs must be set for PID or heating-cooling PID control assigned with heating output or cooling output.

■ CT SENSOR TYPE

ADDRESS	PARAMETER	RANGE	DEFAULT
1217	CT input 1, CT sensor type	See the table below.	0

SET VALUE	SENSOR MODEL	INPUT RANGE
0	CLSE-R5	0.0 – 5.0 A
1	CLSE-05	0.0 – 50.0 A
2	CLSE-10	0.0 – 100.0 A
3	CLSE-20	0.0 – 200.0 A
4	CLSE-40	0.0 – 400.0 A
5	CLSE-60	0.0 – 600.0 A

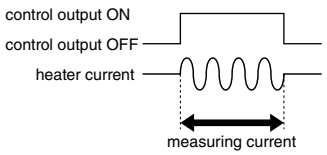
■ OUTPUT ASSIGNMENT

ADDRESS	PARAMETER	RANGE	DEFAULT
1218	CT input 1, Output assignment	See the table below.	0

SET VALUE	OUTPUT
0	Control output 1
1	Control output 2
2	Control output 3
3	Control output 4

■ HEATER WIRE BREAK ALARM / SSR SHORTCIRCUIT FAILURE ALARM / OVERLOAD ALARM

The following three types of alarm are available using the CT inputs.
These alarms could be used independently or in combination.
For example, with a heater driven by an SSR, the heater wire break, the SSR shortcircuit failure and the overload can be all detected and alerted.

Heater wire break alarm	Current flows through the load normally when the control output is on. Current stops when the heater's wire breaks. The Controller measures the current with a clamp-on current sensor and triggers an alarm when it is below the setpoint.	
SSR shortcircuit failure alarm	Current stop normally when the control output is off. Current flows through the load when the SSR fails in the shortcircuit mode. The Controller measures the current with a clamp-on current sensor and triggers an alarm when it is above the setpoint.	
Overload alarm	Regardless of the control status, the Controller continuously measures the current with a clamp-on current sensor and triggers an alarm when it is above the setpoint.	

CAUTION	Control output must be turned on for at the minimum of 110 milliseconds to detect a heater wire break; must be turned off for at the minimum of 200 milliseconds to detect an SSR shortcircuit failure. If there is no ON and / or OFF status longer than the minimum duration for one control cycle, the Controller cannot measure current. Current display shows -0.1A (invalid measurement) and all related alarms are reset except for those latched.

• ALARM SETTING

Choose alarm functions.

ADDRESS	PARAMETER	RANGE	DEFAULT
257	CT input 1, Heater wire break alarm	0 : Disable 1 : Enable	0
263	CT input 1, SSR shortcircuit failure alarm		
269	CT input 1, Overload alarm		

• ALARM SETPOINT

Specify a threshold for each alarm.

ADDRESS	PARAMETER	RANGE	DEFAULT
258	CT input 1, Heater wire break alarm setpoint	0.0 to 600.0 A	0.0
264	CT input 1, SSR shortcircuit failure alarm setpoint		
270	CT input 1, Overload alarm setpoint		

• ALARM HYSTERESIS (DEADBAND)

Hysteresis, a deadband between ON point and OFF point, is used to prevent frequent ON / OFF operations (generally called 'chattering') of an alarm output device when the current fluctuates around the setpoint.

ADDRESS	PARAMETER	RANGE	DEFAULT
259	CT input 1, Heater wire break alarm hysteresis	0.0 to 99.9 A	0.0
265	CT input 1, SSR shortcircuit failure alarm hysteresis		
271	CT input 1, Overload alarm hysteresis		

• ALARM LATCHING

Once an alarm is tripped, it is held when the alarm condition is cancelled.
Latched alarm is reset by turning the device's power supply off or by a Modbus command.

ADDRESS	PARAMETER	RANGE	DEFAULT
260	CT input 1, Heater wire break alarm latching	0 : Disable 1 : Enable	0
266	CT input 1, SSR shortcircuit failure alarm latching		
272	CT input 1, Overload alarm latching		

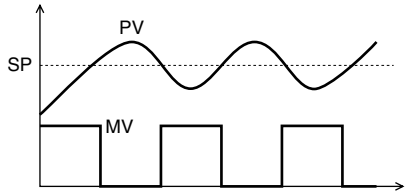
• ALARM OUTPUT

Specify the output device for alarms.
When one of the control outputs is specified, be sure also to specify 'Alarm OR' or 'Alarm AND' with its output assignment.
With 'Alarm OR' setting, the output is provided if one or more alarms assigned to it are in true conditions. With 'Alarm AND' setting it is provided only if all alarms assigned to it are in true conditions.

ADDRESS	PARAMETER	RANGE	DEFAULT
261	CT input 1, Heater wire break alarm output	0 : Network only 1 : Control output 1 2 : Control output 2 3 : Control output 3 4 : Control output 4	0
267	CT input 1, SSR shortcircuit failure alarm output		
273	CT input 1, Overload alarm output		

AUTO-TUNING

Limit cycle method auto-tuning is available for standard PID and heating-cooling PID control to automatically determine appropriate PID parameters by providing MV signal in steps as shown below and observing PV signal behavior.
Auto-tuning conditions should be set in advance. The Controller starts auto-tuning by a command.



CAUTION	In order to stop a running auto-tuning process, turn the power supply off or STOP the loop operation. Once STOP is applied, switch to RUN again to resume normal control, cancelling the auto-tuning.

■ AUTO-TUNING CONTROL TYPE

ADDRESS	PARAMETER	RANGE	DEFAULT
208	Loop 1, Auto-tuning control type	See the table below.	0

SET VALUE	AUTO-TUNING CONTROL TYPE
0	Follow-up PID control
1	Follow-up PI control
2	PID control with fixed setpoint
3	PI control with fixed setpoint

Follow-up control is suitable for a loop in which the setpoint changes according to the process status.

■ AUTO-TUNING HYSTERESIS (DEADBAND)

Specify hysteresis values to be applied when monitoring PV variation in the auto-tuning process.
If the PV fluctuates, set a larger value. Too large a value may result in tuning to inappropriate PID parameters.

ADDRESS	PARAMETER	RANGE	DEFAULT
209	Loop 1, Auto-tuning hysteresis	0.0 to 999.9 (decimal by input 1 decimal setting)	0.8

■ AUTO-TUNING MV HIGH LIMIT / AUTO-TUNING MV LOW LIMIT

Specify the maximum range of MV applied in steps for auto-tuning.
With standard PID control, 0.00 is used for a negative range.
With heating-cooling PID control, a negative value is used for the cooling control.

ADDRESS	PARAMETER	RANGE	DEFAULT
210	Loop 1, Auto-tuning MV high limit	-100.00 to +100.00% (When setting the main unit, 1 decimal places)	100.00
211	Loop 1, Auto-tuning MV low limit		-100.00

DISPLAY SETTING

Display setting of the unit can be configured.

■ BRIGHTNESS

The brightness of the display can be adjusted with 0 to 3, 4 levels. “3” is brightest.

ADDRESS	PARAMETER	RANGE	DEFAULT
769	Brightness	0 – 3	3

MODBUS COMMUNICATION CONFIGURATION

Modbus communication configuration can be set. Be sure that the communication condition set here is updated immediately.

■ NODE ADDRESS

ADDRESS	PARAMETER	RANGE	DEFAULT
2049	Node address	1 – 247	1

■ BAUD RATE

ADDRESS	PARAMETER	RANGE	DEFAULT
2050	Baud rate	0 : 57600 bps 1 : 38400 bps 2 : 19200 bps 3 : 9600 bps 4 : 4800 bps	1

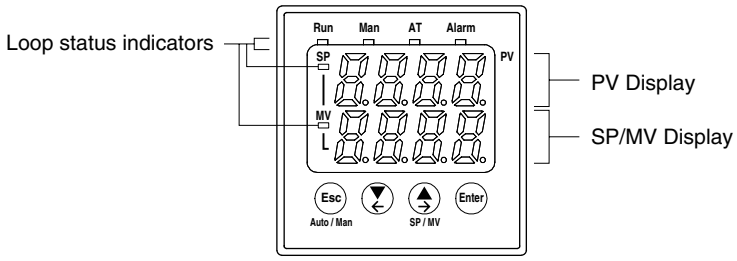
■ PARITY

ADDRESS	PARAMETER	RANGE	DEFAULT
2051	Parity	0 : None 1 : Odd 2 : Even	1

■ STOP BIT

ADDRESS	PARAMETER	RANGE	DEFAULT
2052	Stop bit	0 : 1 bit 1 : 2 bits	0

DISPLAY



■ PV DISPLAY

In monitor mode, PV of displayed loop is displayed. In setting mode, abbreviation for setting item is displayed.

■ SP / MV DISPLAY

In monitor mode, SV or MV of displayed loop is displayed. In setting mode, setting value of setting item is displayed.
With heating-cooling control, when the MV value is positive, it means heating control, and when the MV value is negative, it means cooling control.

■ LOOP STATUS INDICATOR

ID	FUNCTION
Run	Green LED turns on while displayed loop is in operation. Off when it is stopped.
Man	Green LED turns on when MV of displayed loop is manual mode. Off when it is auto.
AT	Green LED turns on during auto-tuning of displayed loop.
Alarm	Red LED turns on for the status of alarm 1 to 3. (It turns on if any of them is in alarm status.)

CHARACTER SET

0	1	2	3	4	5	6	7	8	9	-	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
0	1	2	3	4	5	6	7	8	9	-	A	b	C	d	E	F	G	H	ı	J	K	L	n	n	o	P	q	r	S	t	U	v	W	X	y	Z

BUTTONS

The unit has 4 buttons, each button have 1 or more functions. The characters printed below the buttons such as “Auto / Man”, “SP / MV”, “Enter” are button functions in monitor mode. The characters printed on the buttons such as “Esc”, “↓”, “↑”, “↵” represent button functions in setting mode.
In following explanation of button operations, “Press & hold” means pressing the button for 1 second or more.

■ BASIC BUTTON OPERATIONS IN SETTING MODE

BUTTON		FUNCTION
Enter	Press	Apply / Go down one level / Save setting value
	Press & hold	Return to monitor mode with saving setting value
Esc	Press	Cancel / Go back one level up
	Press & hold	Return to monitor mode without saving setting value
↑ / ↓	Press	Choose setting menu, setting item / Change parameter
← / →	Press & hold	Shift through display digits to change parameter (Press & hold for 0.6 sec.)

■ RESTARTING THE DEVICES

Pressing & holding the [Esc] button for 5 seconds or more enables the devices restart.

■ SWITCHING OPERATING MODE

Operation mode can be switched with buttons.

• SWITCHING AUTO / MANUAL

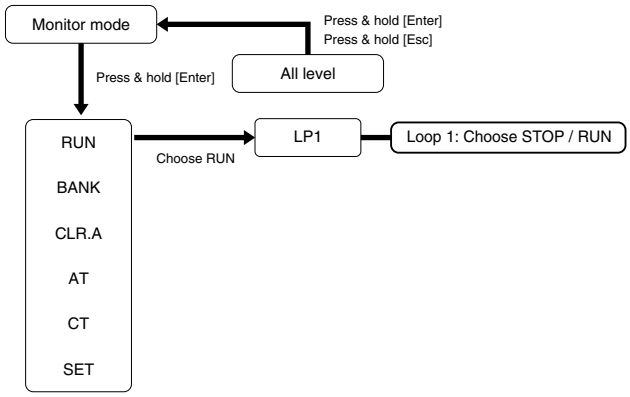
Auto / Manual of displayed loop are switched with [Auto / Man] button in monitor mode.

• SWITCHING SP DISPLAY / MV DISPLAY

SP Display / MV Display of displayed loop are switched with [SP / MV] button in monitor mode.

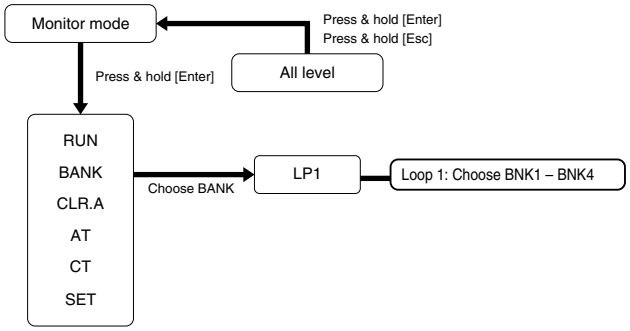
• SWITCHING RUN / STOP

Press & hold the [Enter] button in the monitor mode. Choose “RUN” and press [Enter]. Choose the loop 1, then apply RUN or STOP. Pressing & holding the [Esc] button or [Enter] button enables to go back to the monitor mode.



• SWITCHING BANKS

Press & hold the [Enter] button in the monitor mode. Choose "BANK" and press [Enter]. Choose the loop 1, then apply among BANK1 to 4. Pressing & holding the [Esc] button or [Enter] button enables to go back to the monitor mode.



• SETTING SP

In the case that SP is displayed in the monitor mode, pressing [Enter] button enables setting of SP. Setting of SP updates value of operation while setting is changed. Pressing [Enter] button applies the value and the value is saved into the non-volatile memory. Pressing [Esc] button cancels the value and it returns to the value before the change.

• SETTING MV

In the case that MV is displayed in the monitor mode and when the mode is MANUAL, pressing [Enter] button enables setting of MV. Setting of MV updates value of operation while setting is changed. Pressing [Enter] button apply the value and return to monitor mode. Pressing [Esc] button cancels the value and it returns to the value before the change.

■ ADVANCED SETTING MODE

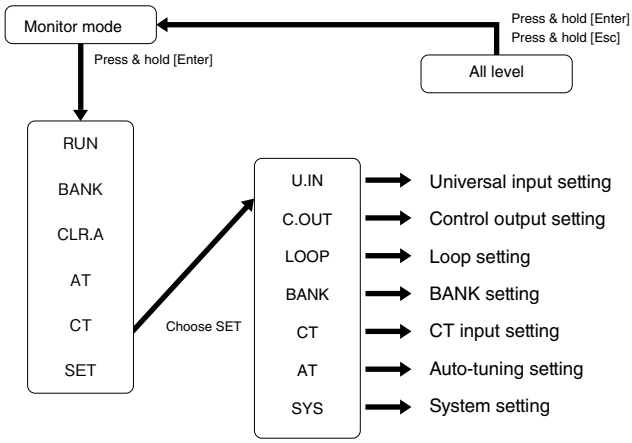
In advanced setting mode, all setting is available.

• STARTING ADVANCED SETTING MODE

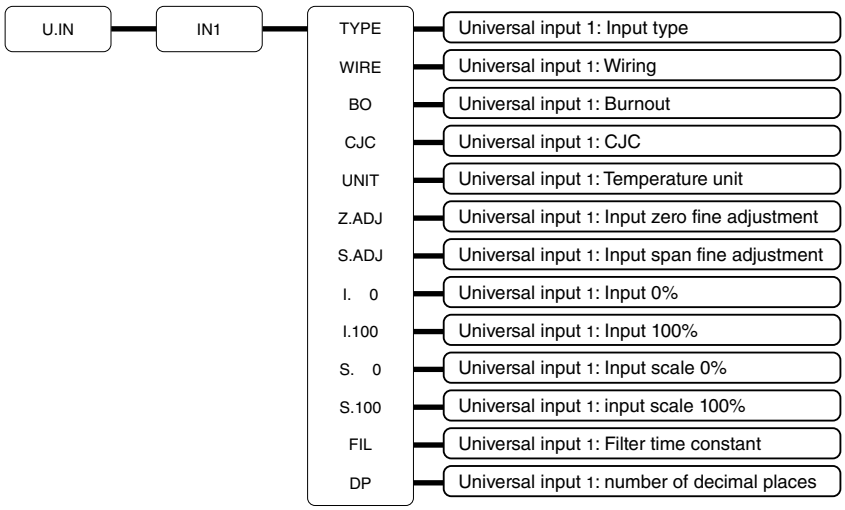
Press & hold the [Enter] button in the monitor mode. Choose “SET” and press the [Enter]. Pressing & holding the [Esc] or [Enter] button in anywhere in the menu enables to return to the monitor mode. In the case of pressing & holding the [Enter] button, setting items are saved.

• PARAMETER CHANGE IN BASIC SETTING MODE

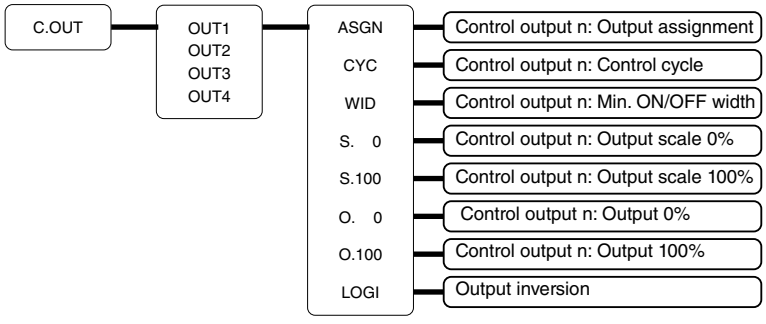
Setting menu or selected item is displayed in the PV Display, setting value is displayed in the SP Display. Choose the item to change and press the [Enter] button. The first digit of setting value starts blinking and can be changed. For detailed description and setting range, refer to the page for each setting item.



• UNIVERSAL INPUT SETTING

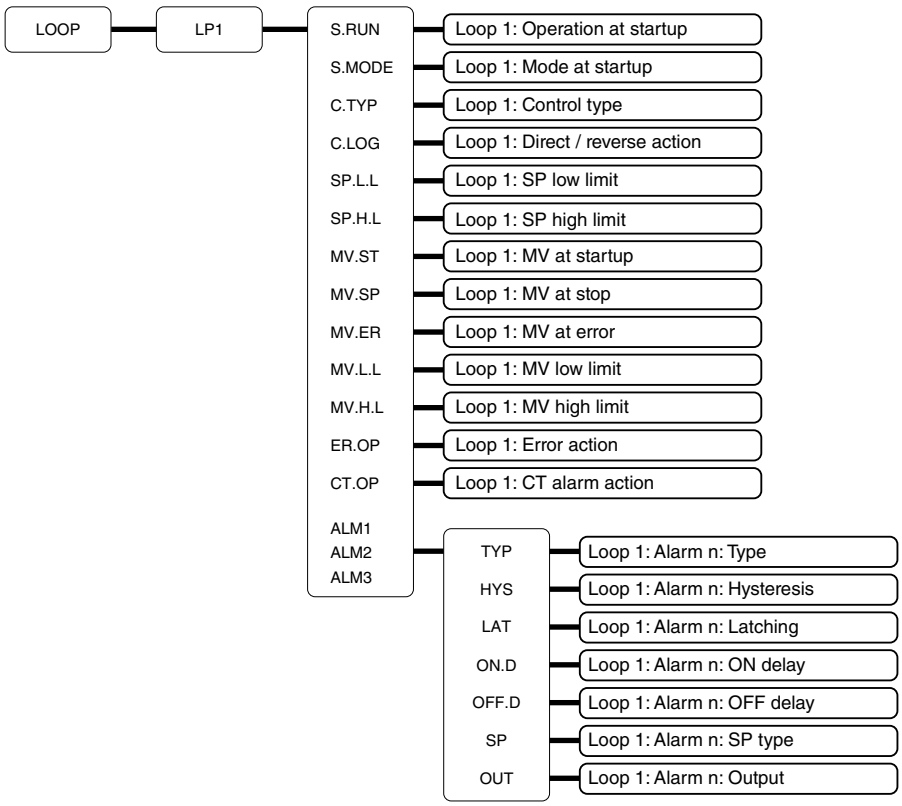


• CONTROL OUTPUT SETTING



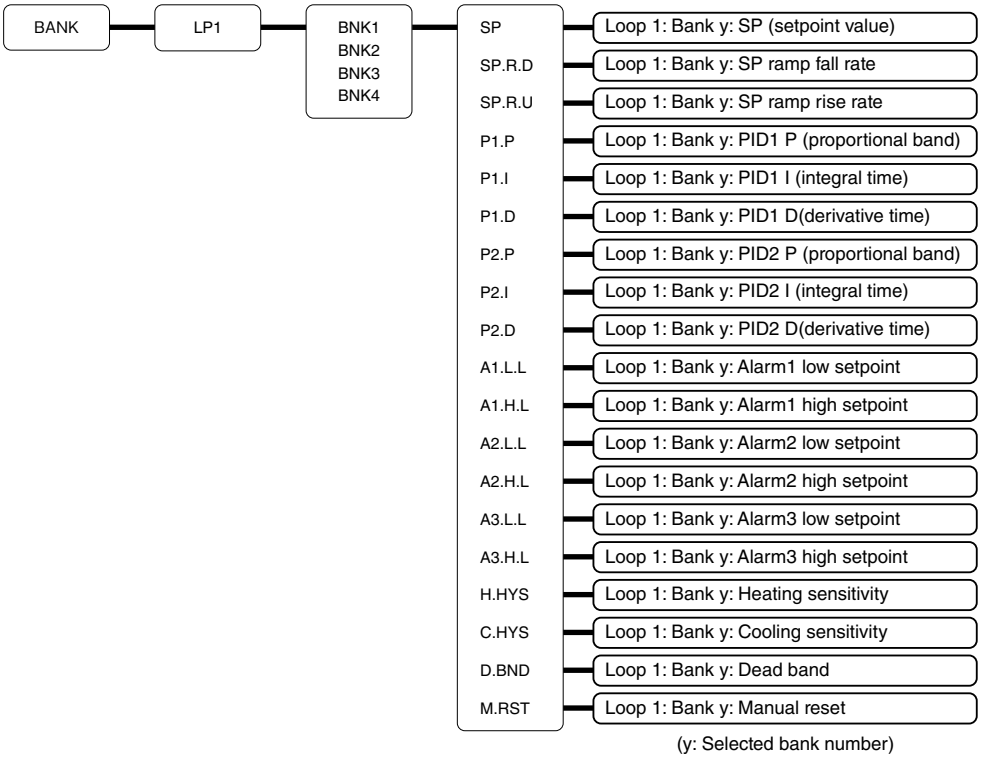
(n: Control output ch)

• LOOP SETTING



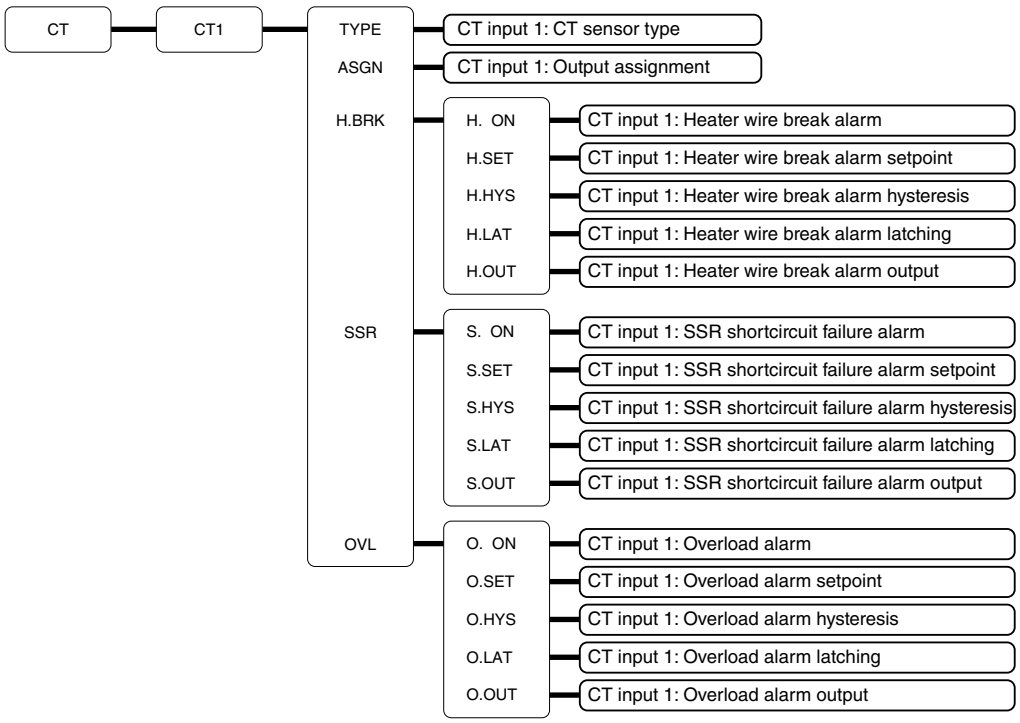
(n: Alarm number)

• BANK SETTING

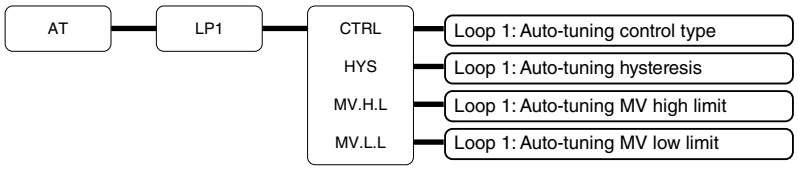


(y: Selected bank number)

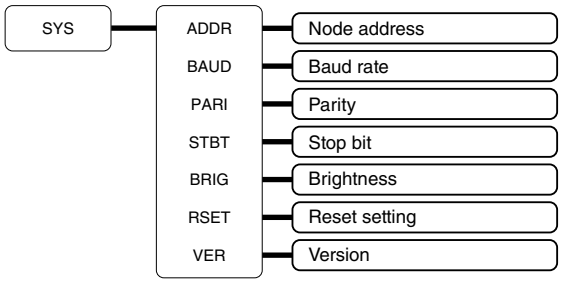
• CT INPUT SETTING



• AUTO-TUNING SETTING



• SYSTEM SETTING

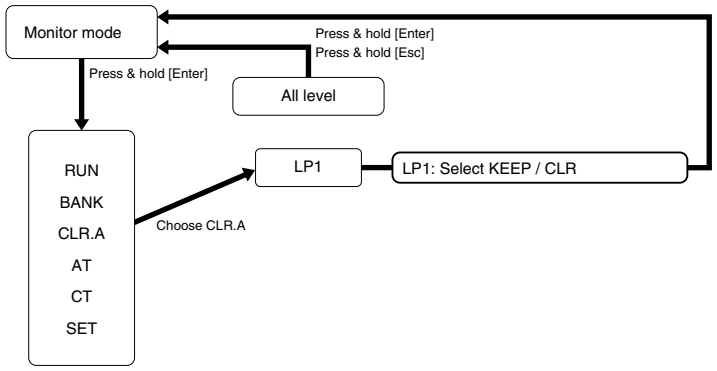


Note: For “Reset setting”, reset is available with unit operation. Reset command is not available with Modbus communication.
By setting this value to “1” and applying, all settings return to initial setting. After reset is completed, this value returns to “0”.

■ RESET LATCHED ALARM

Press & hold the [Enter] button in the monitor mode. Choose “CLR.A” and press the [Enter]. Choose the loop 1, by applying “CLR” enables to reset all latched alarms in the loop.

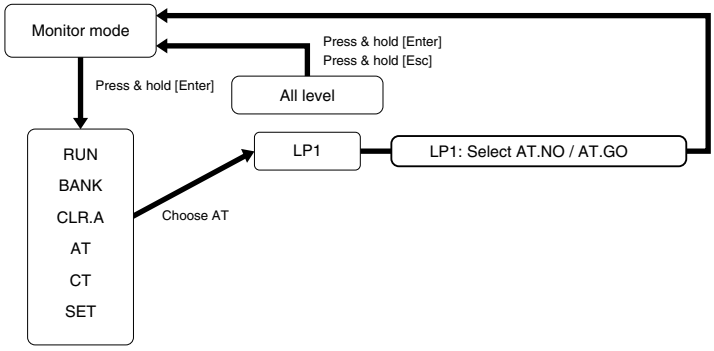
• HOW TO RESET ALARMS



■ RUNNING AUTO-TUNING

Press & hold the [Enter] button in the monitor mode. Choose “AT” and press the [Enter]. Choose the loop 1, by applying “AT.GO” auto-tuning is started and the display returns to monitor view. While running auto-tuning, “AT” LED is on, when auto-tuning is completed LED is off. Appropriate SP should be set before running auto-tuning, since auto-tuning with button operation tunes based on the SP setting of bank which is used in the loop. The loop should be set to run condition in advance in order to run auto-tuning. When it is stop condition, auto-tuning cannot be run.

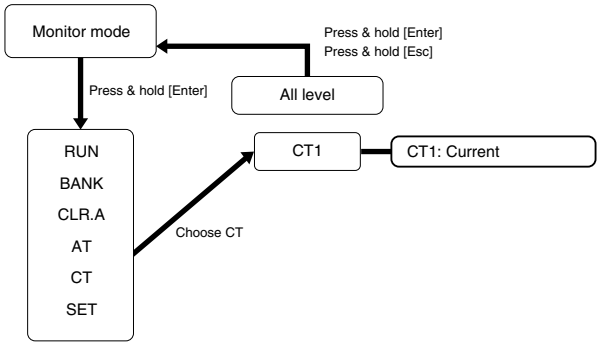
• HOW TO RUN AUTO-TUNING



■ MONITOR OF CT INPUT

Press & hold the [Enter] button in the monitor mode. Choose “CT” and press the [Enter]. By choosing CT1, present current value in [A] is displayed in SP display.

• HOW TO MONITOR CT INPUT



ERROR MESSAGES

PV DISPLAY	DESCRIPTION	WHAT TO DO
IN1.E	Burnout at universal input 1	Check the connection of universal input 1.
CT1.E	CT input 1 error(Heater wire break alarm / SSR shortcircuit failure alarm / Overload alarm)	Check the connection of CT input 1.
AD1.E	Universal input 1 error	Cycle the power. If the unit does not restore, repair is required.
CT.E	CT input error	
EEP.E	Non-volatile memory error	
BOOT	Firmware update mode	Cycle the power.