INSTRUCTION MANUAL

TEMPERATURE CONTROLLER
(5 digit, LED display type)

MODEL **TC10EM**

Contents

BEFORE USE ....

Thank you for choosing M-System. 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 M-System's Sales Office or representatives.

■ PACKAGE INCLUDES:

Temperature controller (controller + CJC sensor, 2 pcs).....(1)
Mounting bracket.....(1) pair
Watertight sealing.....(1)
Ferrite core (TDK ZCAT 3035-1330).....(1)

■ MODEL NO.

Confirm that the model number described on the product is exactly what you ordered.

■ INSTRUCTION MANUAL

This manual describes necessary points of caution when you use this product, including installation and connection. 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 M-System's web site: http://www.m-system.co.jp

POINTS OF CAUTION

■ CONFORMITY WITH EC DIRECTIVES

- This equipment is suitable for Pollution Degree 2 and Installation Category II. Reinforced insulation (signal input to output to power input: 300V) and basic insulation (signal input or output or power input to Modbus: 300V) are maintained. Prior to installation, check that the insulation class of this unit satisfies the system requirements.
- The equipment must be mounted inside a suitable fire enclosure.
- 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.
- 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 60947-1 and IEC 60947-3 and properly indicate it.

■ ENVIRONMENT

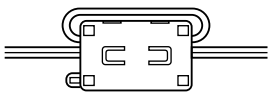
- Indoor use
- When heavy dust or metal particles are present in the air, install the unit inside proper housing with sufficient ventilation.
- Do not install the unit where it is subjected to continuous vibration. Do not subject the unit to physical impact.
- Environmental temperature must be within -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 IP 65

- Observe the designated panel cutout size (W92 × H92 mm).
- The watertight sealing included in the product package must be placed behind the front cover.
- Tighten screws of the brackets until the unit is fixed to the panel. (torque 0.5 N·m)
- Confirm visually that the sealing is not contorted or excessively run off the edge after installation.

■ WIRING

- Do not install cables (power supply, input, output and communication) 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.
- Twist the power cables 1 turn around the ferrite core at near the unit as shown below.



■ UNUSED INPUT CHANNELS

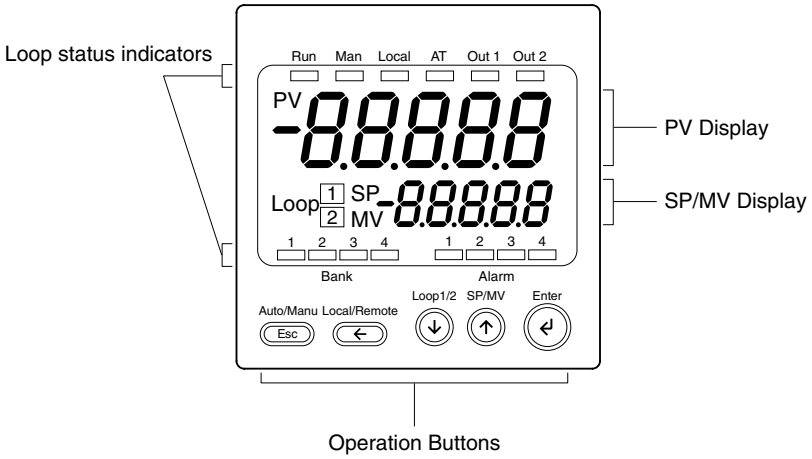
- Unused channels can be specified and set to voltage input on the PC Configurator Software (model: TC10CFG) to prevent the error which is possibly caused by open of the field terminals.

■ AND....

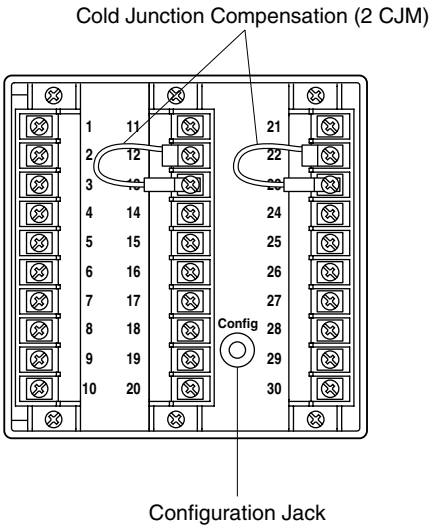
- The unit is designed to function as soon as power is supplied, however, a warm up for 10 minutes is required for satisfying complete performance described in the data sheet.

COMPONENT IDENTIFICATION

■ **FRONT VIEW**



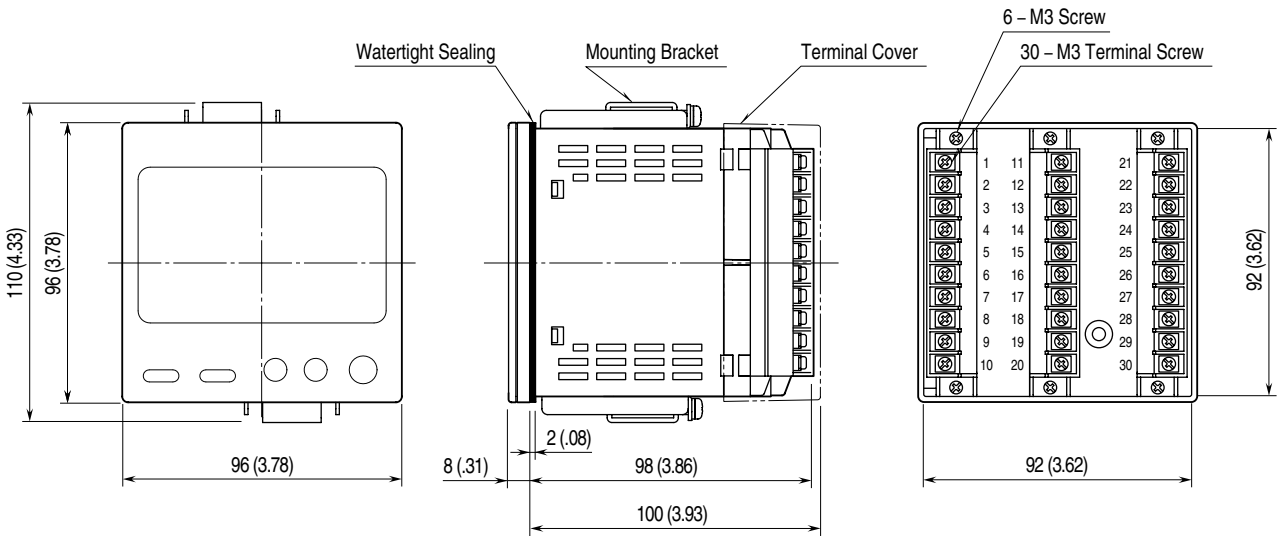
■ **REAR VIEW**



■ **LOOP STATUS INDICATOR**

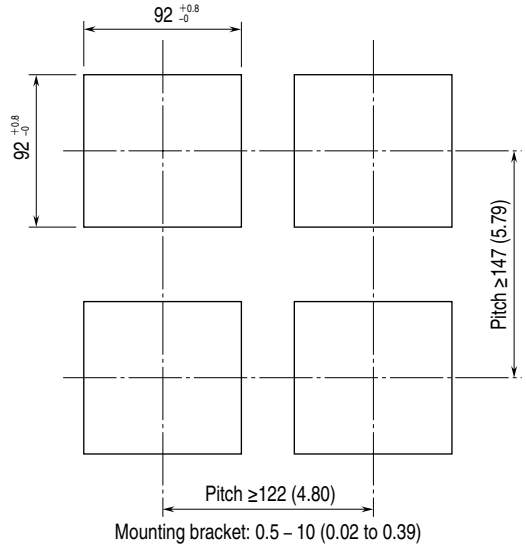
Run : Green LED turns on while loop is in operation.
Man : Green LED turns on during manual mode.
Local : Green LED turns on when local SP is selected.
AT : Green LED turns on during auto-tuning.
Out1 : Green LED turns on during heating control output.
Out2 : Green LED turns on during cooling control output.
Loop1 : Amber LED turns on when loop 1 is chosen.
Loop2 : Amber LED turns on when loop 2 is chosen.
Bank1 : Green LED turns on when bank 1 is chosen.
Bank2 : Green LED turns on when bank 2 is chosen.
Bank3 : Green LED turns on when bank 3 is chosen.
Bank4 : Green LED turns on when bank 4 is chosen.
Alarm1: Red LED turns on at alarm 1.
Alarm2: Red LED turns on at alarm 2.
Alarm3: Red LED turns on at alarm 3.
Alarm4: Red LED turns on while setting is saving to the non-volatile memory.

EXTERNAL DIMENSIONS unit: mm (inch)



INSTALLATION

■ **PANEL CUTOUT unit: mm (inch)**

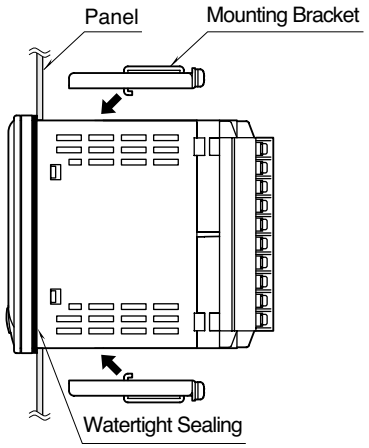


■ **CAUTION**

- Degree of protection, IP65 is applicable to the front panel of the unit with single mounting according to the specified panel cutout. Not applicable in case of re-mounting. After installation ensure waterproof of the mounting.
- Install the unit to vertical panel so that its function buttons are at the bottom side. Installing by other direction will cause degradation of life span or performance due to rise of the internal temperature.
- Ensure that there is sufficient space for ventilation inside a panel. Do not install above the devices that generate high heat such as heaters, transformers or resistors. Observe at the minimum of 55 mm (2.2") in vertical direction, minimum of 30 mm (1.2") in horizontal direction for maintenance purpose.

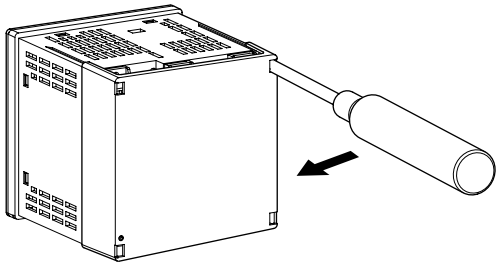
■ **HOW TO MOUNT THE UNIT ON A PANEL**

1) Remove the mounting brackets.
2) Remove the terminal cover and insert it into the panel cutout prior to insertion of the unit.
3) Insert the unit into the panel cutout. The watertight packing must be in place to conform degree of protection, IP65. Do not remove it.
4) Hang the hooks of the mounting brackets at the square holes on the upper and bottom side of the unit. Tighten screws of the brackets until the unit is fixed to the panel. (torque 0.5 N·m)



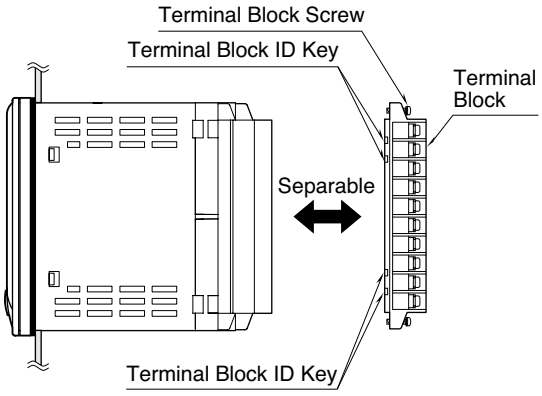
■ **HOW TO REMOVE THE TERMINAL COVER**

Insert the minus tip of a screwdriver into each hole at the four corners of the cover and pull it to the direction as indicated below to separate the terminal cover.

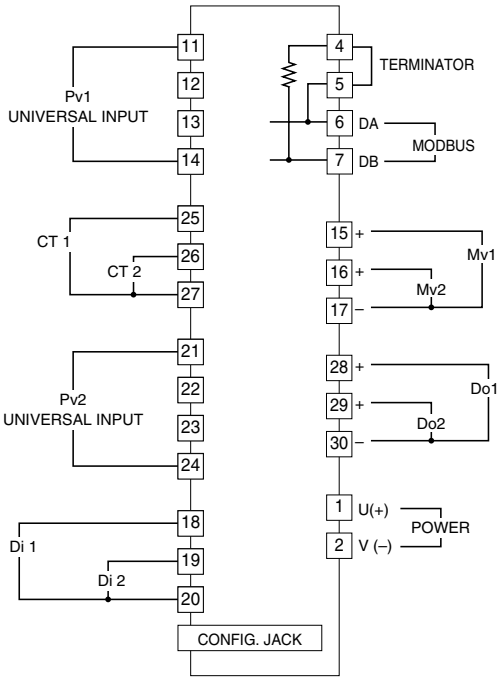


■ **HOW TO REMOVE THE TERMINAL BLOCK**

- The terminal block is separable in two pieces. Loosen two screws on top and bottom of the terminal block to separate.
- Be sure to turn off the power supply, input/output signal and communication signal before separating the terminal block.
- Each terminal block has ID keys so that it can be inserted to applicable terminal socket only.

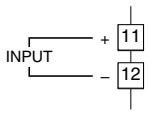


TERMINALS CONNECTIONS

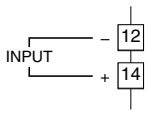


■ **UNIVERSAL INPUT CONNECTION (Pv1) e.g.**

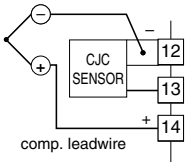
•DC Voltage (-10 – +10V DC)
•DC Current (0 – 20mA DC)



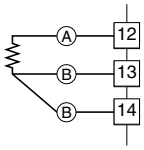
•DC Voltage (-1000 – +1000mV DC)



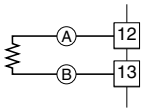
•Thermocouple



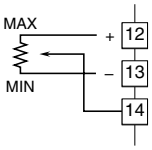
•RTD/Resistor (3-wire)



•RTD/Resistor (2-wire)

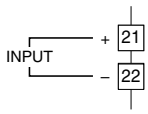


•Potentiometer

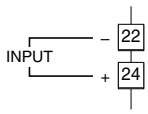


■ **UNIVERSAL INPUT CONNECTION (Pv2) e.g.**

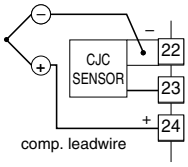
•DC Voltage (-10 – +10V DC)
•DC Current (0 – 20mA DC)



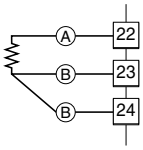
•DC Voltage (-1000 – +1000mV DC)



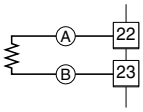
•Thermocouple



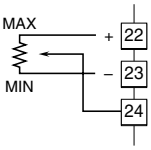
•RTD/Resistor (3-wire)



•RTD/Resistor (2-wire)

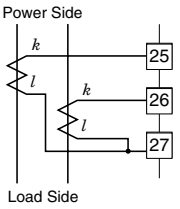


•Potentiometer

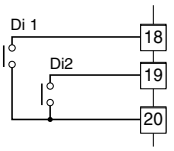


■ **CT 1 / CT 2 CONNECTION e.g.**

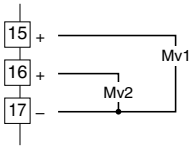
•Clamp-on current Sensor



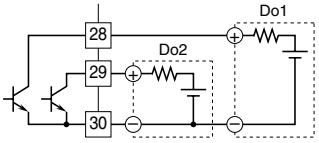
■ **DISCRETE INPUT CONNECTION e.g.**



■ **CONTROL OUTPUT 1 & 2 CONNECTION e.g.**



■ **CONTROL OUTPUT 3 & 4 CONNECTION e.g.**



FUNCTION DESCRIPTIONS

■ UNIVERSAL INPUT

- Input types
  (1) DC: 0 – 20mA / -1000 – +1000mV / -10 – +10V
  (2) Potentiometer: Max. total resistance 4000Ω
  (3) Resistor: Max. 4000Ω
  (4) RTD: Pt 100 / Pt 500 / Pt 1000 / Pt 50Ω / JPt 100 / Ni 508.4Ω / Cu 10
  (5) Thermocouple: (PR) / K / E / J / T / B / R / S / C / N / U / L / P
- Two input points can be assigned respectively with one of the selections (1) through (5).
- Sampling cycle: 100 milliseconds
- Burnout detection available for potentiometer, resistor, RTD and thermocouple inputs
- Cold junction compensation sensors for thermocouple input included in the product package
- Fine input adjustment available
- DC, potentiometer and resistor inputs can be scaled into temperature ranges.
- First order lag filter for input signals

■ CONTROL OUTPUT

- Output types
  (1) 12V DC pulse / 0 – 20mA DC / 0 – 10V DC
  selected by model number suffix code when ordering
  (2) Open collector
- Two output points by the selection (1) plus two output points with the selection (2)
- Control cycle 0.1 to 99.9 seconds
- Output resolution 1 millisecond
- PV, SP and MV signals can be scaled and provided as duty ratio output; Alarm contact output (ON/OFF) also available
- Minimum ON/OFF pulse width can be specified for relay life protection

■ CONTROL LOOP

- Control strategies
  (1) Standard PID control
  (2) Heating-cooling PID control
  (independent PID operation for heating and cooling)
  (3) Heating-cooling ON/OFF control
  (heating-only or cooling-only output is possible.)
- Two control loops can be assigned respectively to one of the selections (1) through (3).
- Limit cycle method auto-tuning
- Direct/reverse action selectable for standard PID control
- Input 2 can be cascaded to loop 1 as its SP (remote SP)
- MV tracking function: MV in manual mode is carried on into auto mode.
- High/low limits selectable for SP and MV values
- Specific MV values applicable at STOP/abnormality.
- Three PV alarm modes selectable for each loop
- Four bank settings available for each loop; Banks can be switched during operation.
- Bank setting
  SP / SP rise ramp / SP fall ramp / P / I / D / Cooling P / Cooling I / Cooling D / Heating sensitivity / Cooling sensitivity / Deadband / PV alarm high/low limits

■ EVENT INPUT

- Two discrete input points can be assigned to a specific event.
- Event types
  Switching banks / Switching operation / Switching manual/auto mode / Switching local/remote SP

■ CT INPUT

- Input type
  M-System clamp-on current sensor (model: CLSE)
- Two input points can be assigned respectively to monitor specific control output status.
- One signal can watch heater wire break, SSR shortcircuit failure and overload at once.
- 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.

■ COMMUNICATION

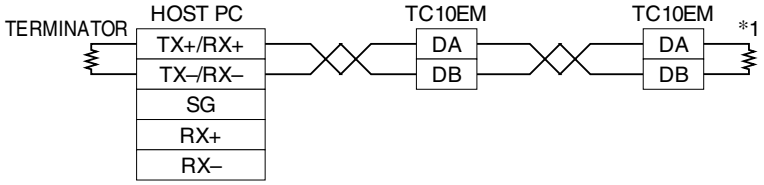
- Monitoring and setting can be performed easily with PC Configurator Software (model: TC10CFG).
- Various values can be read and written via Modbus communication.

■ BUTTON OPERATION

- Monitoring and setting can be performed with button operation.

CONNECTION DIAGRAMS

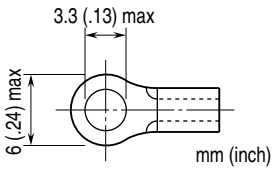
■ MASTER CONNECTION



NO.	ID	FUNCTION
6	DA	DA
7	DB	DB

*1. For using internal terminator, short-accross terminals 4 and 5.

Solderless terminal: Refer to the drawing on the right.
Recommended manufacturer: Japan Solderless Terminal MFG.Co.Ltd, Nichifu Co.,ltd
Applicable wire size: 0.25 to 1.65 mm² (AWG 22 to 16)



SYSTEM CONFIGURATIONS & CONTROL EXAMPLES

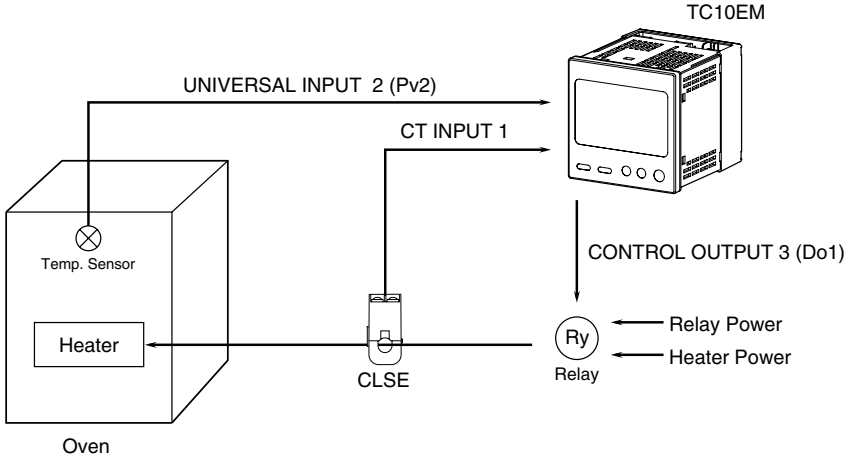
■ 1 loop heating ON/OFF control and heater wire break detection

1. Installation example:

- Temperature Controller (model: TC10EM)
- Clamp-on Current Sensor (model: CLSE)
- Oven
- Heater
- Relay
- Temperature sensor

2. Proccess until start operating:

Turn ON power supply
↓
Set input sensor type and range
↓
Set CT input to wire break detection
↓
Select control mode (ON/OFF Control)
↓
Specify target temperature (SP)
↓
Select operation mode (auto)
↓
Start operation



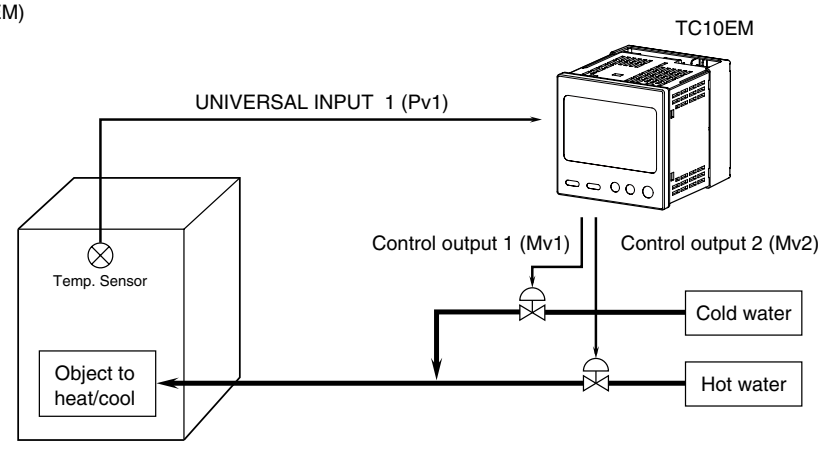
■ 1 loop heating and cooling control (PID)

1. Installation example:

- Temperature Controller (model: TC10EM)
- Object to heat/cool
- Temperature sensor

2. Proccess until start operating:

Turn ON power supply
↓
Set input sensor type and range
↓
Select control mode (PID)
↓
Set deadband
↓
Specify target temperature (SP)
↓
Select operation mode (auto)
↓
Start operation



Note: The examples above are for single loop, however, dual loop control is also availabe using only one TC10EM.

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:
$7510 \times 0.01 = 75.10\%$

■ WRITING EXAMPLE

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

ADDRESS	PARAMETER	RANGE	DEFAULT
1153	Loop 1, SP (setpoint)	-3200.0 to +3200.0 (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.'
With the setting '3,' '40000' cannot be written as the maximum range is limited up to 32000.

■ **READING**

The following parameters can be read out.

ADDRESS	PARAMETER	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)	0.01%
6	Loop 1, Cooling MV (control output)	0.01%
7	Loop 1, Local SP (setpoint value)	Input 1 decimal setting
8	Loop 1, Remote SP (setpoint value)	Input 1 decimal setting
9	Loop 2, Status 1 (See the table below)	---
10	Loop 2, Status 2 (See the table below)	---
11	Loop 2, PV (present value)	Input 2 decimal setting
12	Loop 2, Internal SP (setpoint value)	Input 2 decimal setting
13	Loop 2, Heating MV (control output)	0.01%
14	Loop 2, Cooling MV (control output)	0.01%
15	Loop 2, Local SP (setpoint value)	Input 2 decimal setting
67	CT input 1, Current value	0.1A
68	CT input 1, Current value at the control output ON *1	0.1A
69	CT input 1, Current value at the control output OFF *1	0.1A
70	CT input 2, Current value	0.1A
71	CT input 2, Current value at the control output ON *1	0.1A
72	CT input 2, Current value at the control output OFF *1	0.1A

*1. '-1' (-0.1A) 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 and Status 2 are 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	RSP	Local / Remote SP selection	Local SP	Remote SP
		3	SP_LAMP	SP lamp operation	Not operating	Operating
		4	AT	Auto-tuning	Not running	Running
		5	POUT_12 *2	Loop 1 status: Control output 1 Loop 2 status: Control output 2	OFF	ON
		6	POUT_34 *2	Loop 1 status: Control output 3 Loop 2 status: Control output 4	OFF	ON
		7	INP_ERR	Input error	Normal	Error
		8	INP_R_ERR	Remote SP input error	Normal	Error
		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	0	EV1	Event input 1	OFF	ON
		1	EV2	Event input 2	OFF	ON
		2	BANK0	Bank bit 0	OFF	ON
		3	BANK1	Bank bit 1	OFF	ON

*2. Control outputs 1 and 3 are read out at Loop 1 status, Control output 2 and 4 are read at Loop 2 status regardless of the output assignment setting. These bits 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)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	---
15	Loop 2, Local SP (setpoint value)		

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.	---
66	Loop 2, Command		

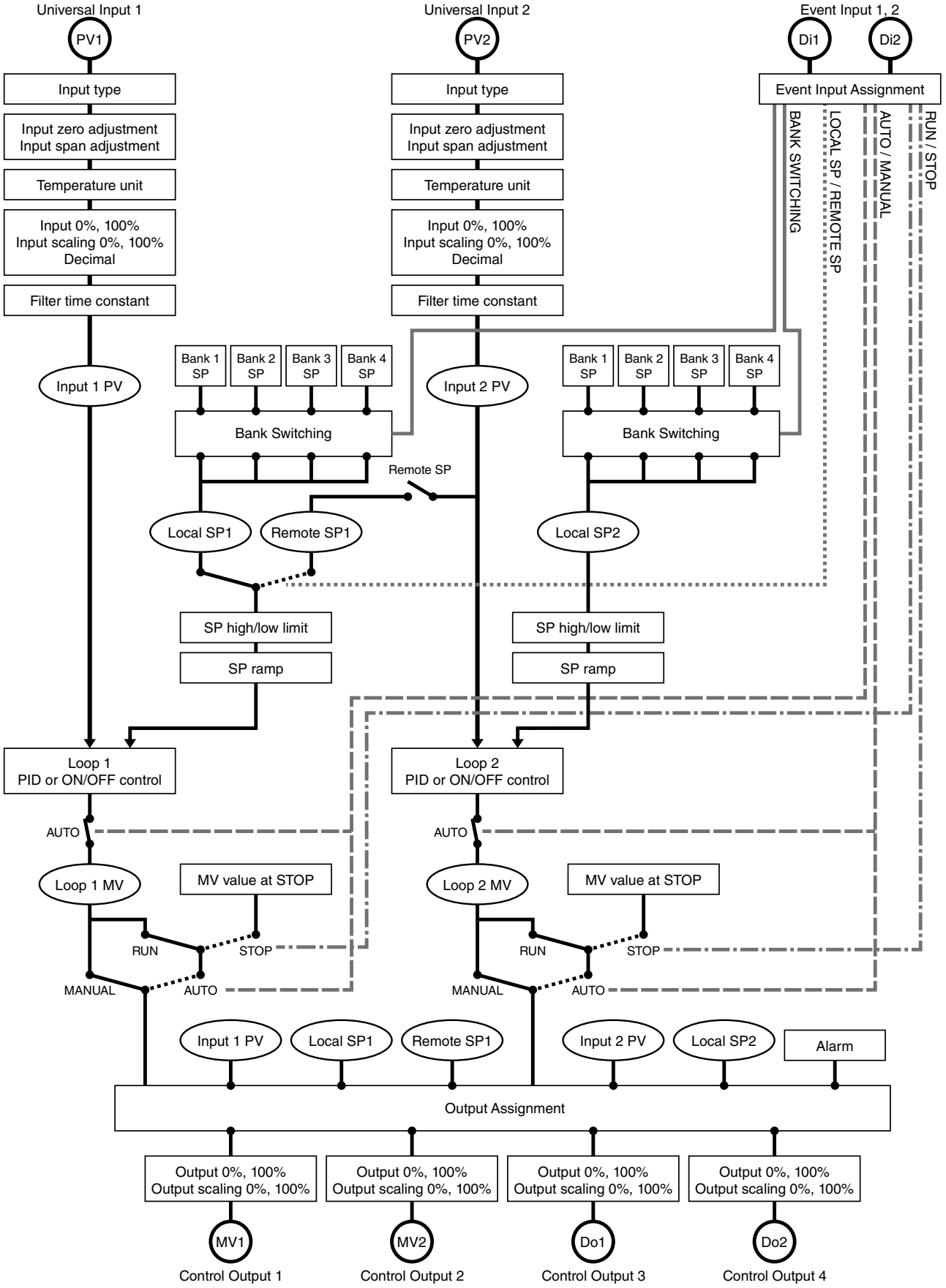
Available commands are as in the table below:

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 0
17	Switch to Bank 1
18	Switch to Bank 2
19	Switch to Bank 3
24	Run auto-tuning in the conditions specified by Bank 0
25	Run auto-tuning in the conditions specified by Bank 1
26	Run auto-tuning in the conditions specified by Bank 2
27	Run auto-tuning in the conditions specified by Bank 3

Loop operation, control mode and bank switching operation can be executed by an event input, however, using both commands and event inputs may cause an unexpected result. We recommend that a function assigned to an event input be not controlled by a command.

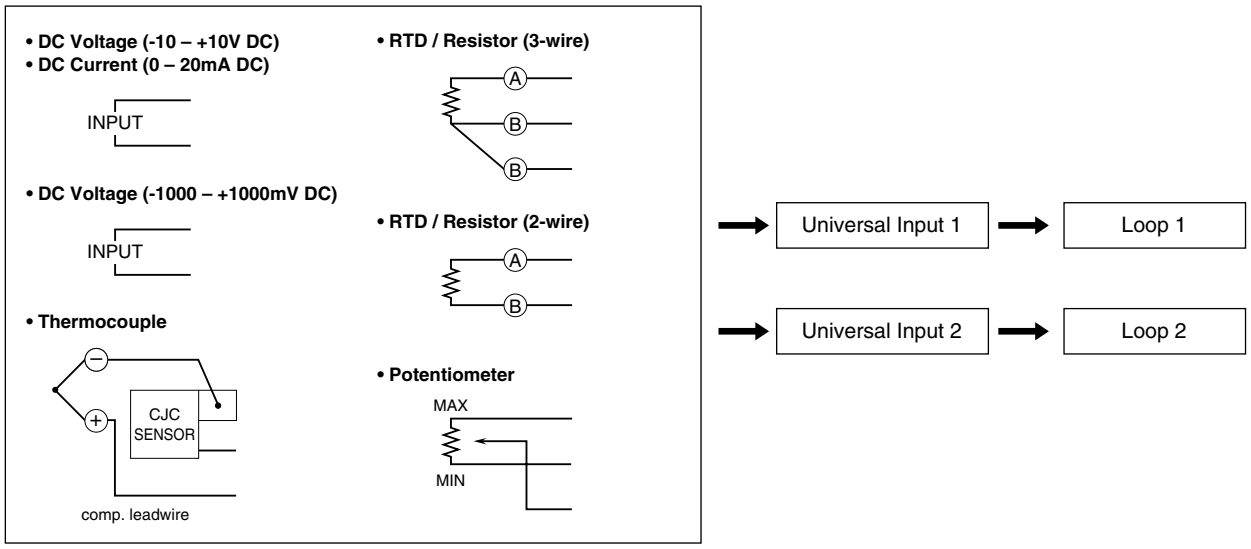
FUNCTION BLOCK DIAGRAM

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



UNIVERSAL INPUT

The Controller has two universal inputs (universal input 1, universal input 2) which can be assigned independently 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 usually assigned as PV input signal for loop 1, while universal input 2 is for loop 2. Universal input 2 signal can be cascaded into the loop 1 SP.



■ INPUT TYPE

ADDRESS	PARAMETER	RANGE	DEFAULT
129	Universal input 1, Input type	See the table below.	10
385	Universal input 2, Input type		

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

SET VALUE	PARAMETER
20	RTD Ni 508.4Ω
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

■ 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	0 : 2 wires 1 : 3 wires	1
386	Universal input 2, Wiring		

■ BURNOUT

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

ADDRESS	PARAMETER	RANGE	DEFAULT
131	Universal input 1, Burnout	0 : Disable 1 : Enable	1
387	Universal input 2, Burnout		

■ 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	0 : Disable 1 : Enable	1
388	Universal input 2, Cold junction compensation		

■ 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	0 : degC 1 : degF	0
389	Universal input 2, Temperature unit		

■ 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	-300.00 to +300.00 (unit as in the table below)	0.00
390	Universal input 2, Input zero adjustment		
135	Universal input 1, Input span adjustment	0.8500 to 1.1500	1.0000
391	Universal input 2, Input span adjustment		

INPUT TYPE	UNIT
0 – 20mA DC	mA
-1000 – +1000mV DC	mV
-10 – +10V 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%	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	0.0
139	Universal input 1, Input scaling 100%		100.0
392	Universal input 2, Input 0%	-1000.0 to +4000.0 *3 (unit as in the table below)	4.0
393	Universal input 2, Input 100%		20.0
394	Universal input 2, Input scaling 0%	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
395	Universal input 2, 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.

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

■ 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
396	Universal input 2, Filter time constant		

■ 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' or 'decimal by input 2 decimal setting.'

ADDRESS	PARAMETER	RANGE	DEFAULT
141	Universal input 1, Decimal	0, 1, 2, 3 (digits)	1
397	Universal input 2, Decimal		

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
3	-32.000 – +32.000

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	TC10EMPx	12V DC pulse output
	TC10EMAx	0 – 20mA DC output
	TC10EMVx	0 – 10V DC 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
12V DC pulse	ON at 12V; OFF at 0V	Scaled output range is converted into a proportional duty ratio output
0 – 20mA DC	ON at 100% scaled current; OFF at 0% scaled current	Scaled output range is converted into a proportional current range
0 – 10V DC	ON at 100% scaled voltage; OFF at 0% scaled voltage	Scaled output range is converted into a proportional voltage range
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		32
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	----
4	Input error, OR for all loops	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
21	Loop 1, Remote SP	Continuous value	By input 1 decimal setting
22	Loop 1, Input error	ON/OFF	----
23	Loop 1, Remote SP input error	ON/OFF	----
32	Loop 2, Heating control output	Continuous value	----
33	Loop 2, Cooling control output	Continuous value	----
34	Loop 2, PV	Continuous value	By input 2 decimal setting
35	Loop 2, Internal SP	Continuous value	By input 2 decimal setting
36	Loop 2, Local SP	Continuous value	By input 2 decimal setting
38	Loop 2, 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% / OUTPUT 0% / OUTPUT 100%

Specify the internal temperature output range from OUTPUT SCALING 0% to OUTPUT SCALING 100%, and the converted output range from OUTPUT 0% to OUTPUT 100%.

ADDRESS	PARAMETER	RANGE	DEFAULT
1284	Control output 1, Output scaling 0%	-3200.0 to + 3200.0 (temperature unit)*4	0.0
1285	Control output 1, Output scaling 100%		100.0
1444	Control output 2, Output scaling 0%		0.0
1445	Control output 2, Output scaling 100%		100.0
1604	Control output 3, Output scaling 0%		0.0
1605	Control output 3, Output scaling 100%		100.0
1764	Control output 4, Output scaling 0%		0.0
1765	Control output 4, Output scaling 100%		100.0
1286	Control output 1, Output 0%	0.0 to 100.0	*5
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

*4. Output scaling 0 to 100 % is valid only when control output is assigned to PV, Internal SP, Local SP or Remote SP. Disregarded if it is assigned to others.
*5. Default value and engineering unit depends upon the model number suffix code as in the table below.

MODEL	OUTPUT 0%	OUTPUT 100%	UNIT
TC10EMPx	0.0	100.0	%
TC10EMAx	4.0	20.0	mA
TC10EMVx	0.0	10.0	V

■ OUTPUT INVERSION

Voltage pulse signal level and open collector 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 two control loops (loop 1, loop 2) which can be assigned independently with PID and ON/OFF control operations.
Each loop receives the relevant 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
449	Loop 2, Operation at startup		

■ 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
450	Loop 2, Control mode at startup		

■ CONTROL TYPE

Specify the control strategy for each loop.

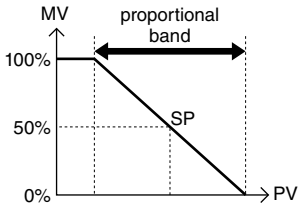
ADDRESS	PARAMETER	RANGE	DEFAULT
195	Loop 1, Control type	0 : Standard PID control 1 : Heating-cooling PID control 2 : Heating-cooling ON/OFF control	0
451	Loop 2, Control type		

• 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).

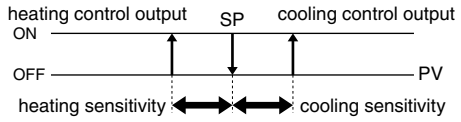
• Heating-Cooling PID Control

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.

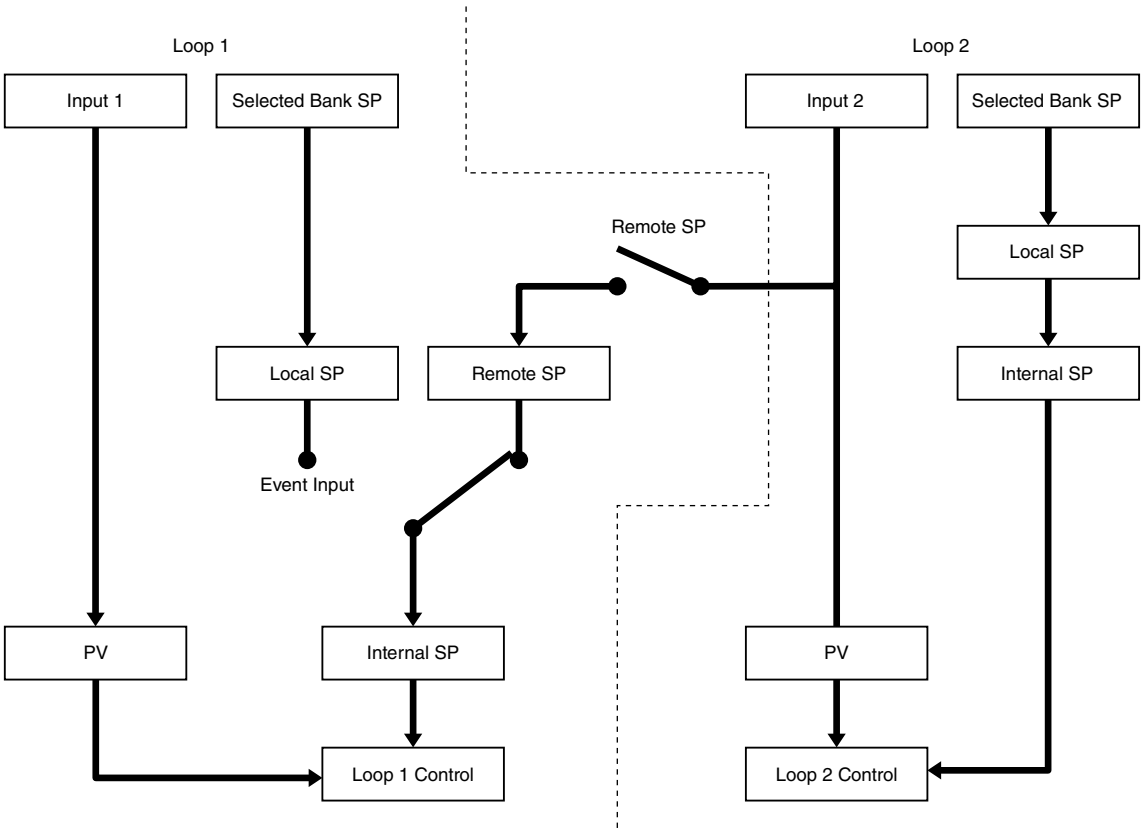
ADDRESS	PARAMETER	RANGE	DEFAULT
196	Loop 1, Direct/reverse action	0 : Reverse 1 : Direct	0
452	Loop 2, Direct/reverse action		

■ REMOTE SP

Input 2 signal can be cascaded into Input 1 setpoint value as Remote SP.

ADDRESS	PARAMETER	RANGE	DEFAULT
197	Loop 1, Remote SP	0 : Disable 1 : Enable	0

Remote SP operates as in the function diagram below.
Local and remote SP are switched by an event input. If no event input is assigned, only the remote SP is used.



■ SP TRACKING

Specify whether the remote SP should be carried on when it is switched to the local SP mode.

ADDRESS	PARAMETER	RANGE	DEFAULT
198	Loop 1, SP tracking	0 : Disable 1 : Enable	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	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	-3200.0
200	Loop 1, SP high limit		3200.0
455	Loop 2, SP low limit	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	-3200.0
456	Loop 2, SP high limit		3200.0

■ 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 %	0.00
202	Loop 1, MV at STOP		
203	Loop 1, MV at error		
457	Loop 2, MV at startup		
458	Loop 2, MV at STOP		
459	Loop 2, MV at error		

With standard PID control, -5.00 is used for any value below -5.00.
With heating-cooling PID control, 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 %	-100.00
205	Loop 1, MV high limit		100.00
460	Loop 2, MV low limit		-100.00
461	Loop 2, MV high limit		100.00

■ ERROR ACTION

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

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

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
463	Loop 2, CT alarm action		

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.

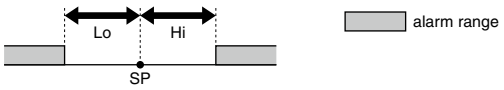
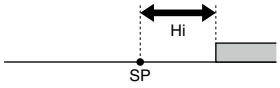
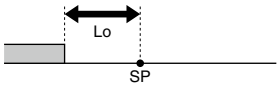
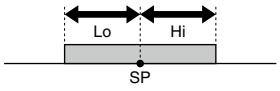
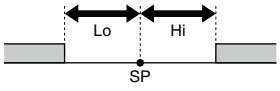
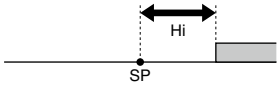
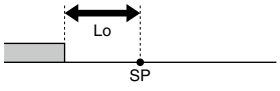
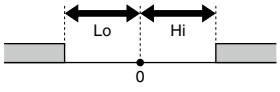
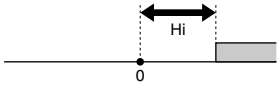
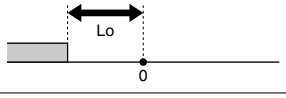
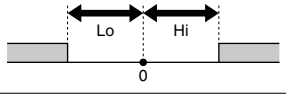
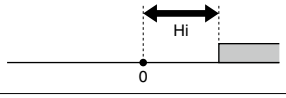
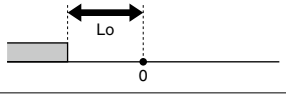
■ PV ALARM 1, PV ALARM 2, PV ALARM 3

The Controller monitors PV signal to trigger alarms in predefined conditions.
Three alarm conditions (PV ALARM 1 through 3) per loop 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		
577	Loop 2, Alarm 1 type		
585	Loop 2, Alarm 2 type		
593	Loop 2, 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	

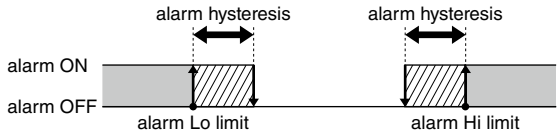
Standby sequence is a function to prevent unwanted alarm triggered at the startup or at an SP change. If the PV is in alarm range at the startup or at an SP change, no alarm is triggered until the PV is out of the range. Once it is out and then in the range again, normal alarm function starts functioning.

• 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		
578	Loop 2, Alarm 1 hysteresis	0.0 to 999.9 (decimal by input 2 decimal setting)	
586	Loop 2, Alarm 2 hysteresis		
594	Loop 2, 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		
579	Loop 2, Alarm 1 latching		
587	Loop 2, Alarm 2 latching		
595	Loop 2, 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		
580	Loop 2, Alarm 1 ON delay		
588	Loop 2, Alarm 2 ON delay		
596	Loop 2, 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		
581	Loop 2, Alarm 1 OFF delay		
589	Loop 2, Alarm 2 OFF delay		
597	Loop 2, 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		
582	Loop 2, Alarm 1 SP type		
590	Loop 2, Alarm 2 SP type		
598	Loop 2, 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		
583	Loop 2, Alarm 1 output		
591	Loop 2, Alarm 2 output		
599	Loop 2, Alarm 3 output		

BANK

The Controller has four sets of banks per loop. Temperature setpoint and PID and other parameters can be stored and switched easily during operation by an external event input (Di) or 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. 10^6 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)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
1793	Loop 2, SP (setpoint value)		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1313	Loop 1, SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
1857	Loop 2, SP (setpoint value)		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1473	Loop 1, SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
1921	Loop 2, SP (setpoint value)		

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1633	Loop 1, SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
1985	Loop 2, SP (setpoint value)		

■ 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 3200.0 per second (decimal by input 1 decimal setting)	0.0
1155	Loop 1, SP ramp rise rate		
1794	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
1795	Loop 2, SP ramp rise rate		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1314	Loop 1, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 1 decimal setting)	0.0
1315	Loop 1, SP ramp rise rate		
1858	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
1859	Loop 2, SP ramp rise rate		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1474	Loop 1, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 1 decimal setting)	0.0
1475	Loop 1, SP ramp rise rate		
1922	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
1923	Loop 2, SP ramp rise rate		

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1634	Loop 1, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 1 decimal setting)	0.0
1635	Loop 1, SP ramp rise rate		
1986	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
1987	Loop 2, 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 3200.0 (decimal by input 1 decimal setting)	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 3200.0 (decimal by input 1 decimal setting)	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
1796	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1797	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
1798	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1799	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1800	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
1801	Loop 2, 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 3200.0 (decimal by input 1 decimal setting)	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 3200.0 (decimal by input 1 decimal setting)	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
1860	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1861	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
1862	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1863	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1864	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
1865	Loop 2, 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 3200.0 (decimal by input 1 decimal setting)	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 3200.0 (decimal by input 1 decimal setting)	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
1924	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1925	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
1926	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1927	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1928	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
1929	Loop 2, 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 3200.0 (decimal by input 1 decimal setting)	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 3200.0 (decimal by input 1 decimal setting)	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
1988	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1989	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
1990	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
1991	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting)	8.0
1992	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
1993	Loop 2, 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		
1808	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
1809	Loop 2, 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		
1872	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
1873	Loop 2, 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		
1936	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
1937	Loop 2, Cooling sensitivity		

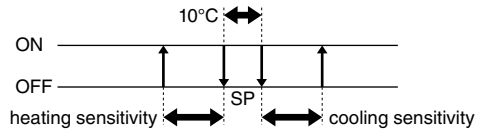
[Bank 4]

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		
2000	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
2001	Loop 2, Cooling sensitivity		

■ DEADBAND

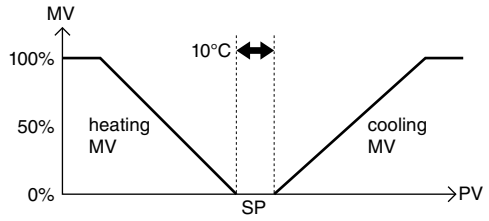
Deadband is a zone in which neither heating nor cooling control is performed.
Negative value setting means both heating and cooling control is performed in the zone.

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

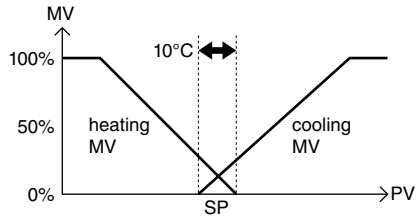


At PID control, deadband is enabled for P control. At P control (I = 0 and D = 0.0), with continuous value control, a zone in which both heating MV and cooling MV equal 0 is formed at ±5°C of the SP when the deadband is set to 10°C. With the setting to -10°C, the zone is with both heating MV and cooling 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 avobe, since switching of heating MV / cooling MV does not match SP.

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
1170	Loop 1, Deadband	-999.9 to +999.9	0.0
1810	Loop 2, Deadband	(decimal by input 1/2 decimal setting)	

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1330	Loop 1, Deadband	-999.9 to +999.9	0.0
1874	Loop 2, Deadband	(decimal by input 1/2 decimal setting)	

[Bank 3]

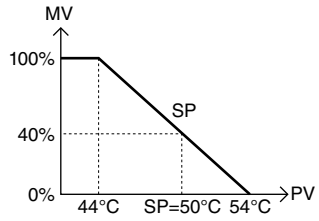
ADDRESS	PARAMETER	RANGE	DEFAULT
1490	Loop 1, Deadband	-999.9 to +999.9	0.0
1938	Loop 2, Deadband	(decimal by input 1/2 decimal setting)	

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1650	Loop 1, Deadband	-999.9 to +999.9	0.0
2002	Loop 2, Deadband	(decimal by input 1/2 decimal setting)	

■ 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 %	50.00
1811	Loop 2, Manual reset		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1331	Loop 1, Manual reset	0.00 to 100.00 %	50.00
1875	Loop 2, Manual reset		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1491	Loop 1, Manual reset	0.00 to 100.00 %	50.00
1939	Loop 2, Manual reset		

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1651	Loop 1, Manual reset	0.00 to 100.00 %	50.00
2003	Loop 2, Manual reset		

■ 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. Other PV alarm related parameters are set with PV Alarm 1 through 3.
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	-3200.0 to +3200.0 (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		
1802	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
1803	Loop 2, Alarm 1 high setpoint		
1804	Loop 2, Alarm 2 low setpoint		
1805	Loop 2, Alarm 2 high setpoint		
1806	Loop 2, Alarm 3 low setpoint		
1807	Loop 2, Alarm 3 high setpoint		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
1322	Loop 1, Alarm 1 low setpoint	-3200.0 to +3200.0 (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		
1866	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
1867	Loop 2, Alarm 1 high setpoint		
1868	Loop 2, Alarm 2 low setpoint		
1869	Loop 2, Alarm 2 high setpoint		
1870	Loop 2, Alarm 3 low setpoint		
1871	Loop 2, Alarm 3 high setpoint		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
1482	Loop 1, Alarm 1 low setpoint	-3200.0 to +3200.0 (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		
1930	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
1931	Loop 2, Alarm 1 high setpoint		
1932	Loop 2, Alarm 2 low setpoint		
1933	Loop 2, Alarm 2 high setpoint		
1934	Loop 2, Alarm 3 low setpoint		
1935	Loop 2, Alarm 3 high setpoint		

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
1642	Loop 1, Alarm 1 low setpoint	-3200.0 to +3200.0 (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		
1994	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
1995	Loop 2, Alarm 1 high setpoint		
1996	Loop 2, Alarm 2 low setpoint		
1997	Loop 2, Alarm 2 high setpoint		
1998	Loop 2, Alarm 3 low setpoint		
1999	Loop 2, Alarm 3 high setpoint		

EVENT INPUT

The Controller has two discrete inputs for event control (event input 1, event input 2) which can be assigned for various purposes such as mode switching, bank switching.
In the following explanations, an open contact is described OFF, while a closed contact is ON.

■ EVENT INPUT 1 FUNCTION ASSIGNMENT / EVENT INPUT 2 FUNCTION ASSIGNMENT

ADDRESS	PARAMETER	RANGE	DEFAULT
1249	Event input 1 function assignment	See the table below.	0
1409	Event input 2 function assignment		

SET VALUE	FUNCTION
0	Disable
1	All loops, Bank bit 0
2	All loops, Bank bit 1
3	All loops, Control operation: OFF = STOP / ON = RUN
4	All loops, Control operation: OFF = RUN / ON = STOP
5	All loops, Control mode: OFF = MANUAL / ON = AUTO
6	All loops, Control mode: OFF = AUTO / ON = MANUAL
17	Loop 1, Bank bit 0
18	Loop 1, Bank bit 1
19	Loop 1, Control operation: OFF = STOP / ON = RUN
20	Loop 1, Control operation: OFF = RUN / ON = STOP
21	Loop 1, Control mode: OFF = MANUAL / ON = AUTO
22	Loop 1, Control mode: OFF = AUTO / ON = MANUAL
23	Loop 1, SP: OFF = Local SP / ON = Remote SP
24	Loop 1, SP: OFF = Remote SP / ON = Local SP
33	Loop 2, Bank bit 0
34	Loop 2, Bank bit 1
35	Loop 2, Control operation: OFF = STOP / ON = RUN
36	Loop 2, Control operation: OFF = RUN / ON = STOP
37	Loop 2, Control mode: OFF = MANUAL / ON = AUTO
38	Loop 2, Control mode: OFF = AUTO / ON = MANUAL

Combination of bank bit 0 and 1 determines which bank should be used.

BANK BIT 0	BANK BIT 1	SELECTED BANK
OFF	OFF	Bank 1
ON	OFF	Bank 2
OFF	ON	Bank 3
ON	ON	Bank 4

If only one of the bank bits is assigned for event, the other (non-assigned) bit status is assumed to be OFF when selecting a bank.

CT INPUT

The Controller has two CT inputs (CT input 1, CT input 2) which are 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 DC 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
1377	CT input 2, CT sensor type		

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

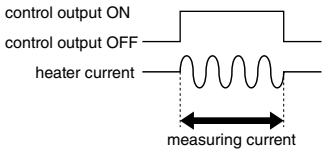
■ OUTPUT ASSIGNMENT

ADDRESS	PARAMETER	RANGE	DEFAULT
1218	CT input 1, Output assignment	See the table below.	0
1378	CT input 2, Output assignment		

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.

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		
513	CT input 2, Heater wire break alarm		
519	CT input 2, SSR shortcircuit failure alarm		
525	CT input 2, 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		
514	CT input 2, Heater wire break alarm setpoint		
520	CT input 2, SSR shortcircuit failure alarm setpoint		
526	CT input 2, 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		
515	CT input 2, Heater wire break alarm hysteresis		
521	CT input 2, SSR shortcircuit failure alarm hysteresis		
527	CT input 2, 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		
516	CT input 2, Heater wire break alarm latching		
522	CT input 2, SSR shortcircuit failure alarm latching		
528	CT input 2, Overload alarm latching		

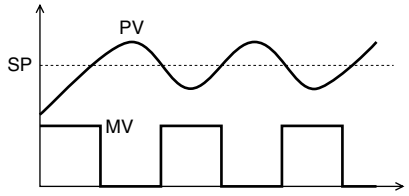
• ALARM OUTPUT

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		
517	CT input 2, Heater wire break alarm output		
523	CT input 2, SSR shortcircuit failure alarm output		
529	CT input 2, 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
464	Loop 2, Auto-tuning control type		

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 1/2 decimal setting)	0.8
465	Loop 1, Auto-tuning hysteresis		

■ 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 %	100.00
211	Loop 1, Auto-tuning MV low limit		-100.00
466	Loop 2, Auto-tuning MV high limit		100.00
467	Loop 2, 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

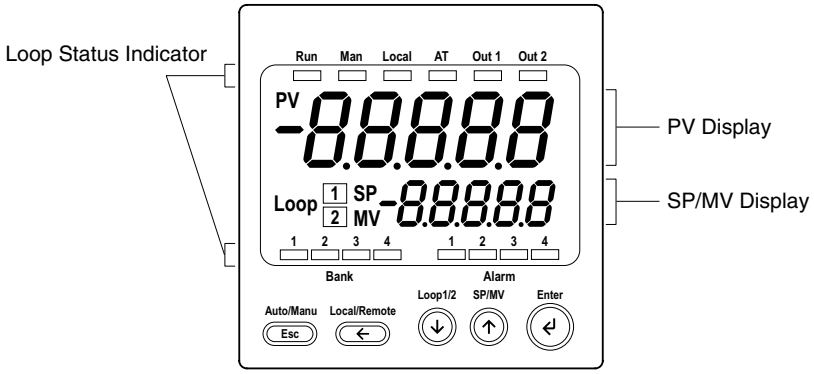
■ PARITY

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.

■ LOOP STATUS INDICATOR

ID	FUNCTION	REMARK
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.	
Local	Green LED turns on when SP of displayed loop is local SP. Off when it is remote SP.	
AT	Green LED turns on during auto-tuning of displayed loop.	
Out1	ON/OFF status for heating control output of loop1. Green LED turns on when duty output or ON/OFF output is on. Green LED turns on when analog output is other than 0 %.	In the case one of control output 1 to 4 is assigned to heating control output.
Out2	ON/OFF status for cooling control output of loop1. Green LED turns on when duty output or ON/OFF output is on. Green LED turns on when analog output is other than 0 %.	In the case one of control output 1 to 4 is assigned to cooling control output.
Loop1/2	Amber LED turns on for displayed loop.	
SP/MV	Amber LED turns on for whether SP or MV is displayed.	
Bank1 – 4	Green LED turns on for displayed loop in use.	
Alarm1 – 3	Red LED turns on for the status of alarm 1 to 3.	
Alarm4	Red LED turns on while setting is saving to the non-volatile memory.	

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	I	J	K	L	M	n	o	P	q	r	S	t	U	v	W	X	Y	Z

BUTTONS

The unit has 5 buttons, each button have 2 functions. The characters printed above the buttons such as “Auto/Manu”, “Local/Remote”, “Loop1/2”, “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. When setting numbers, holding down ↑ / ↓ key increase or decrease the value automatically.

■ 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
↑ / ↓		Choose setting menu, setting item / Change parameter
←		Shift through display digits to change parameter

■ SWITCHING OPERATING MODE

Operation mode can be switched with buttons.

● SWITCHING LOOP1 / LOOP2

Displayed loop is switched with [Loop1/2] button in monitor mode. The status in the loop is displayed with PV, SP, MV and all status indicators.

● SWITCHING AUTO / MANUAL

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

● SWITCHING LOCAL SP / REMOTE SP

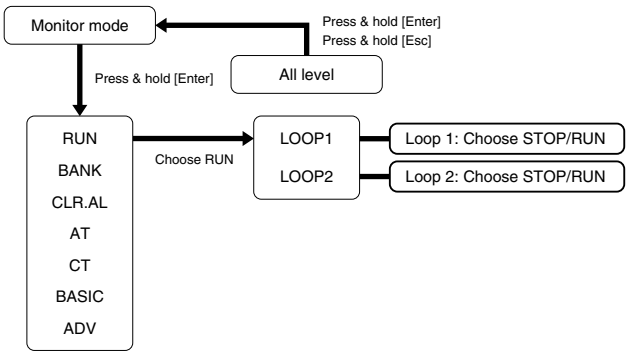
Local SP / Remote SP of displayed loop are switched with [Local/Remote] button in monitor mode. Only in the case Remote SP is valid with loop 1. When Remote SP is invalid or loop2, this setting remains in Local SP even button is pressed.

● SWITCHING SP DISPLAY / MV DISPLAY

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

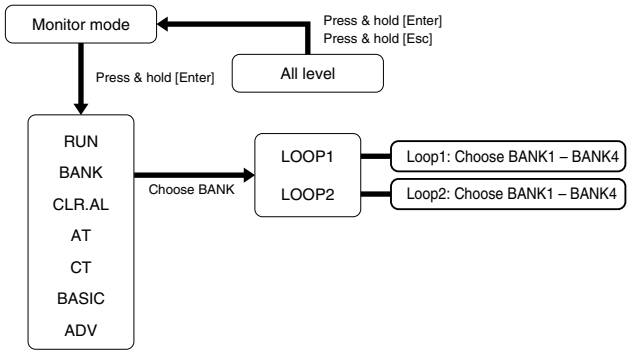
● SWITCHING RUN / STOP

Press & hold the [Enter] button in the monitor mode. Choose “RUN” and press [Enter]. Choose the loop which needs to run or stop, 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 which needs to change bank, 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 and when the mode is Local SP, 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.

■ BASIC SETTING MODE

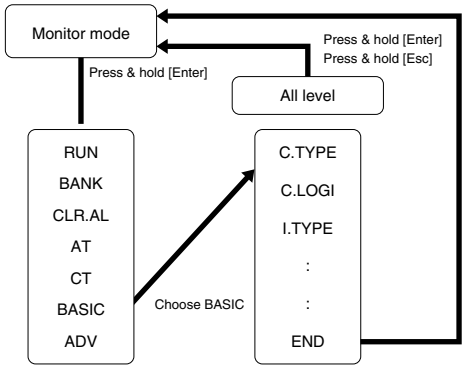
Control type, Universal input and Control output are available in basic setting mode, which is for quick start of operation. Since PID parameter setting is not included, perform auto tuning after basic setting or set PID parameters in advanced setting. The settings in basic setting mode are included in advanced setting.

● STARTING BASIC SETTING MODE

Press & hold the [Enter] button in the monitor mode. Choose "BASIC" and press the [Enter]. Pressing the [Enter] at "END" in the item menu or pressing & holding the [Esc] 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

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.



● **SETTING ITEMS IN BASIC SETTING MODE**

LOOP	SETTING ITEM DISPLAY	DESCRIPTION	CONDITION
Loop 1(Loop 1 LED ON)	C.TYPE	Loop 1 Control type	–
	C.LOGI	Loop 1 direct/ reverse action	Control type = standard PID control
	I.TYPE	Universal input 1, input type	–
	I.WIRE	Universal input 1, wiring	Input type = RTD, Resistor
	I. CJC	Universal input 1, CJC	Input type = T/C
	I. 0	Universal input 1, input 0 %	Input type = DC, Potentiometer, Resistor
	I. 100	Universal input 1, input 100 %	
	I.S. 0	Universal input 1, input scale 0 %	
	I.S. 100	Universal input 1, input scale 100 %	
	I. DP	Universal input 1, decimal point position	–
Loop 2(Loop 2 LED ON)	C.TYPE	Loop 2 Control type	–
	C.LOGI	Loop 2 direct/ reverse action	Control type = standard PID control
	I.TYPE	Universal input 2, input type	–
	I.WIRE	Universal input 2, wiring	Input type = RTD, Resistor
	I. CJC	Universal input 2, CJC	Input type = T/C
	I. 0	Universal input 2, input 0 %	Input type = DC, Potentiometer, Resistor
	I. 100	Universal input 2, input 100 %	
	I.S. 0	Universal input 2, input scale 0 %	
	I.S. 100	Universal input 2, input scale 100 %	
	I. DP	Universal input 2, decimal point position	–
Loop1, 2 common(Loop1, 2 LED ON)	01.ASN	Control output 1, output assignment	–
	01.CYC	Control output 1, control cycle	Control output 1 is assigned and being pulse output.
	01. 0	Control output 1, output 0 %	Control output 1 is assigned.
	01. 100	Control output 1, output 100 %	
	02.ASN	Control output 2, output assignment	–
	02.CYC	Control output 2, control cycle	Control output 2 is assigned and being pulse output.
	02. 0	Control output 2, output 0 %	Control output 2 is assigned.
	02. 100	Control output 2, output 100 %	
	03.ASN	Control output 3, output assignment	–
	03.CYC	Control output 3, control cycle	Control output 3 is assigned.
	03. 0	Control output 3, output 0 %	
	03. 100	Control output 3, output 100 %	
	04.ASN	Control output 4, output assignment	–
	04.CYC	Control output 4, control cycle	Control output 4 is assigned.
	04. 0	Control output 4, output 0 %	
	04. 100	Control output 4, output 100 %	
–	END	End of setting	

■ ADVANCED SETTING MODE

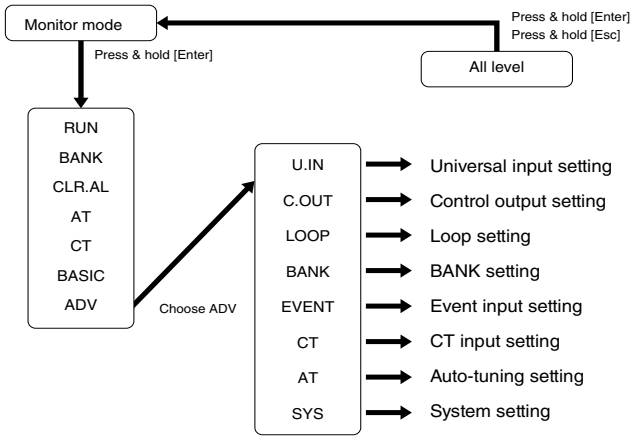
In advanced setting mode, all setting is available.

● STARTING ADVANCED SETTING MODE

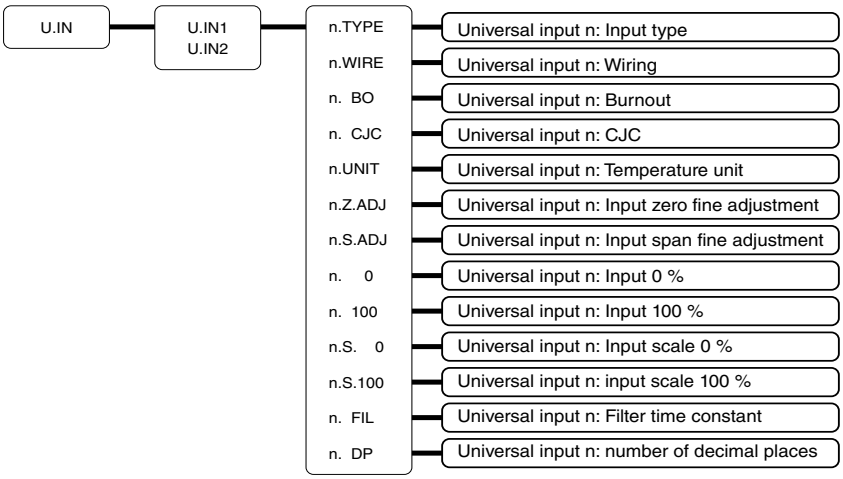
Press & hold the [Enter] button in the monitor mode. Choose “ADV” and press the [Enter]. Pressing & holding the [Esc] or [Enter] button in anywhere in the menu enables to return to the monitor mode. In the case of pressing & holding the [Enter] button, setting items are saved.

● 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.

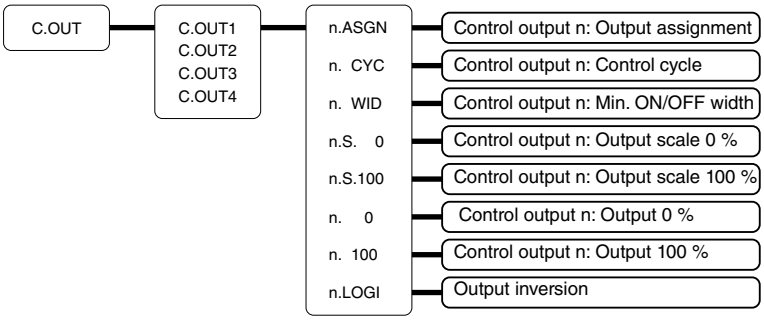


● UNIVERSAL INPUT SETTING



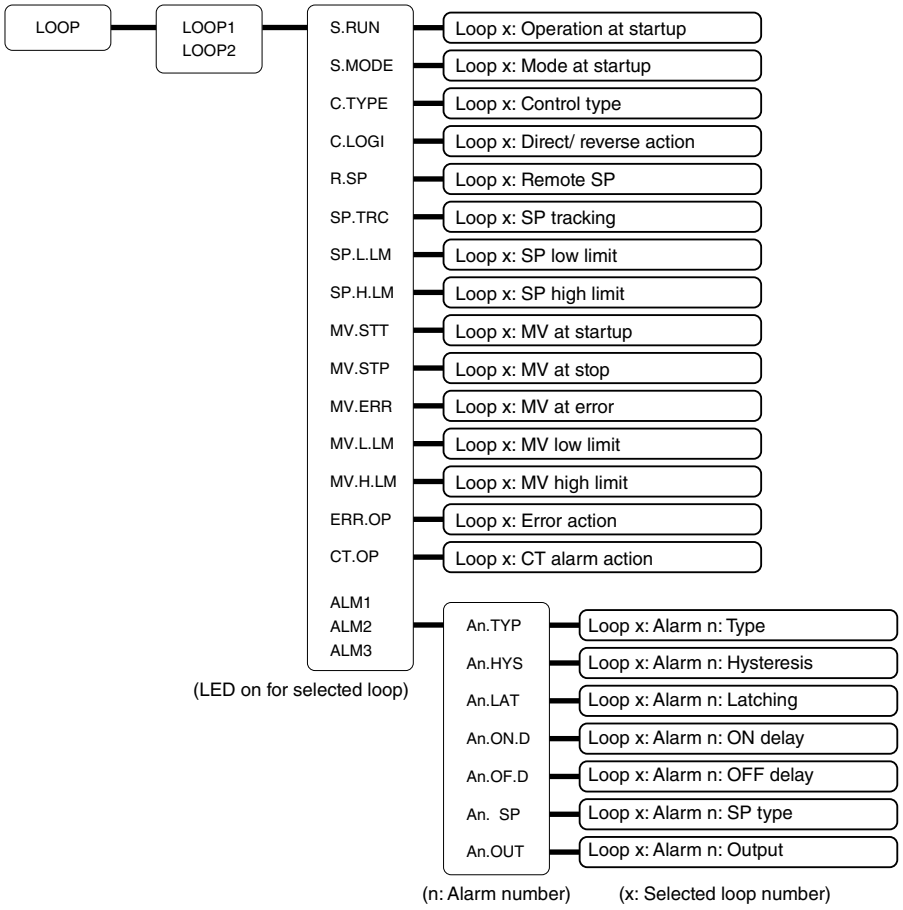
(n: Universal input ch)

● CONTROL OUTPUT SETTING

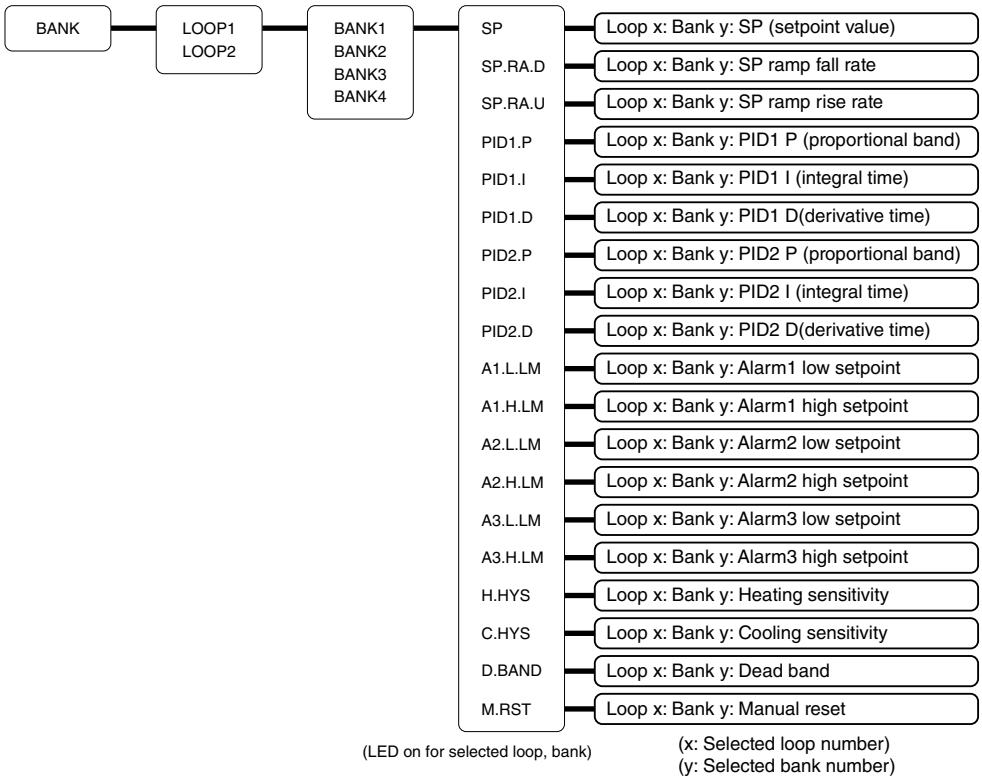


(n: Control output ch)

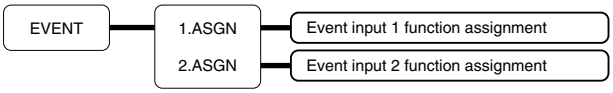
● LOOP SETTING



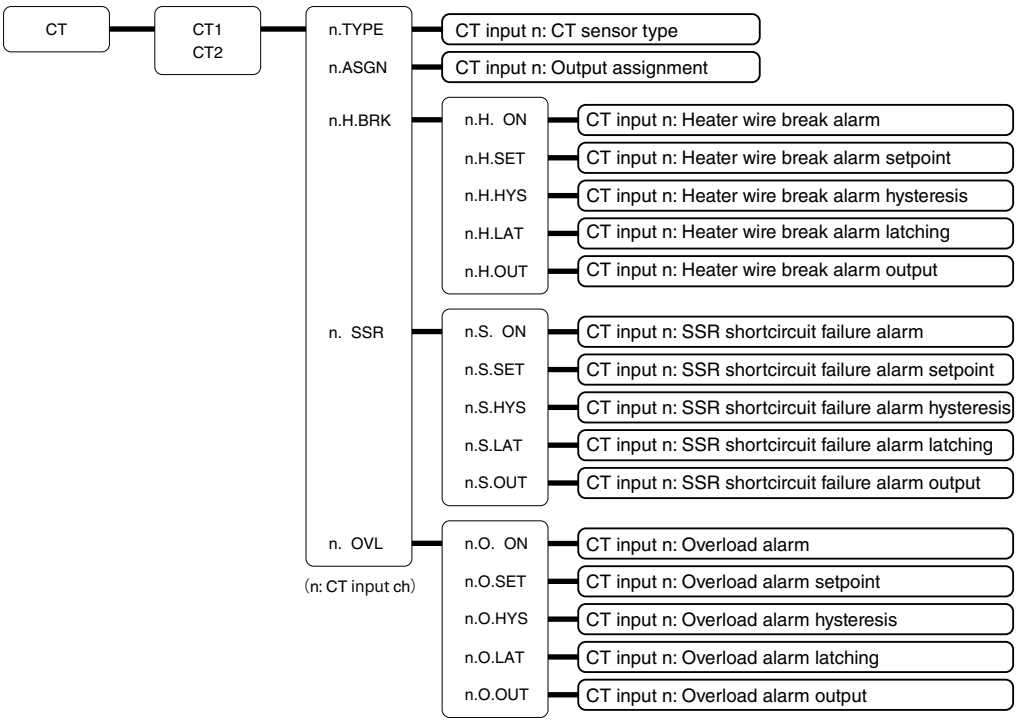
● BANK SETTING



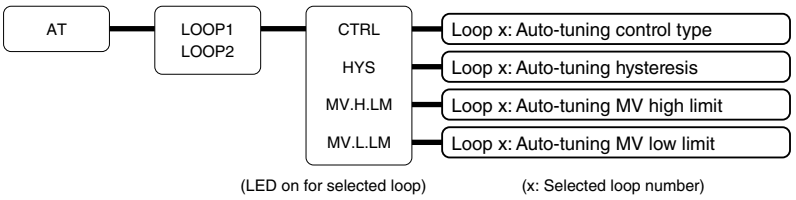
● EVENT INPUT SETTING



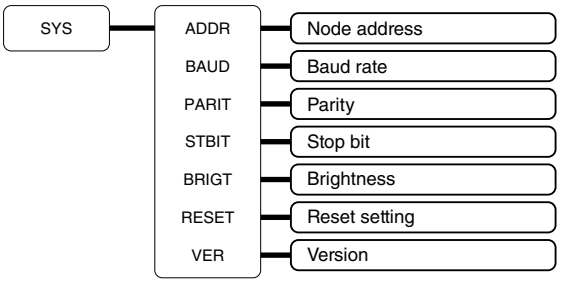
● CT INPUT SETTING



● AUTO-TUNING SETTING



● SYSTEM SETTING

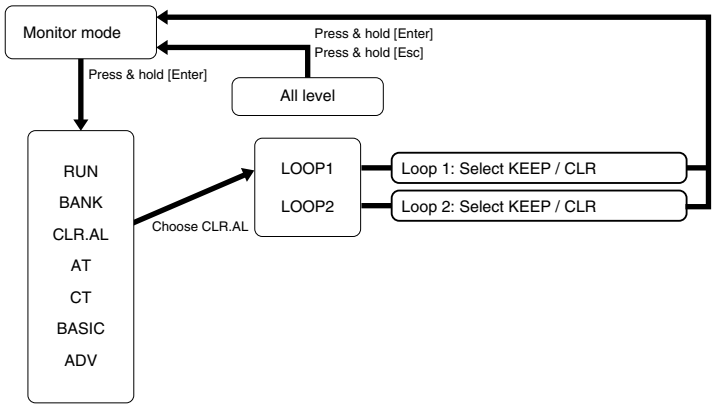


Note) For “Reset setting”, reset is available with unit operation. Reset command is not available with Modbus communication.
By setting this value to “1” and applying, all settings return to initial setting. After reset is completed, this value returns to “0”.

■ RESET LATCHED ALARM

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

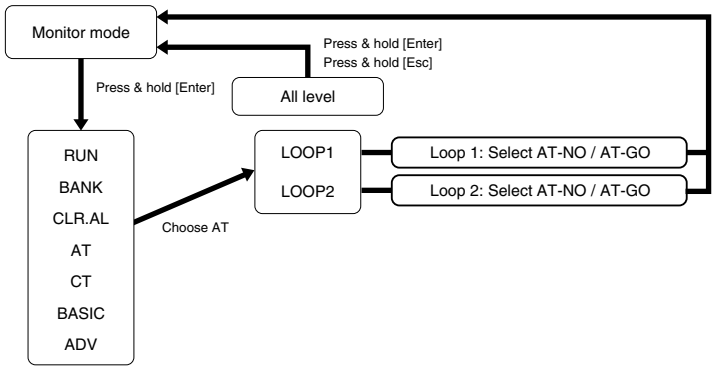
● HOW TO RESET ALARMS



■ RUNNING AUTO-TUNING

Press & hold the [Enter] button in the monitor mode. Choose “AT” and press the [Enter]. Choose the loop for which need to run auto-tuning, 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.

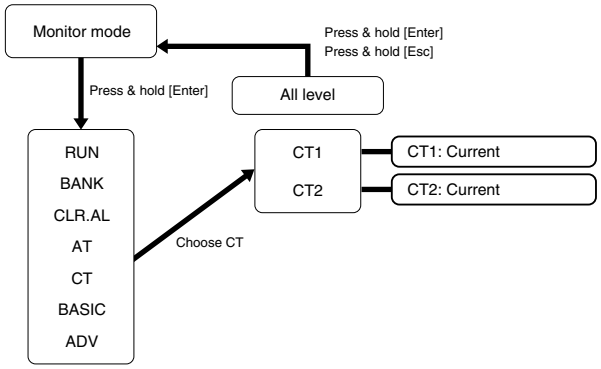
● HOW TO RUN AUTO-TUNING



■ MONITOR OF CT INPUT

Press & hold the [Enter] button in the monitor mode. Choose “CT” and press the [Enter]. By choosing CT1/CT2, 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.
RSP.E	Burnout at remote SP	Check the connection of universal input 2.
IN2.E	Burnout at universal input 2	
CT1.E	CT input 1 error(Heater wire break alarm/ SSR shortcircuit failure alarm/ Overload alarm)	Check the connection of CT input 1.
CT2.E	CT input 2 error(Heater wire break alarm/ SSR shortcircuit failure alarm/ Overload alarm)	Check the connection of CT input 2.
AD1.E	Universal input 1 error	Cycle the power. If the unit does not restore, repair is required.
AD2.E	Universal input 2 error	
CT.E	CT input error	
EEP.E	Non-volatile memory error	

LIGHTNING SURGE PROTECTION

M-System offers a series of lightning surge protector for protection against induced lightning surges. Please contact M-System to choose appropriate models.