INSTRUCTION MANUAL

TEMPERATURE CONTROL MODULE

MODEL **R3-TC2**

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 control module
(control module + CJC sensor, 2 pcs.).....(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.

POINTS OF CAUTION

■ HOT SWAPPABLE MODULES

- Replacing the module does not affect other modules on the same base. Thus, the module can be replaced while the power is ON. However, replacing multiple modules at once may greatly change live voltage levels. We highly recommend to replace them one by one.

■ 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 30 to 90% RH in order to ensure adequate life span and operation.

■ 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.

■ UNUSED INPUT CHANNELS

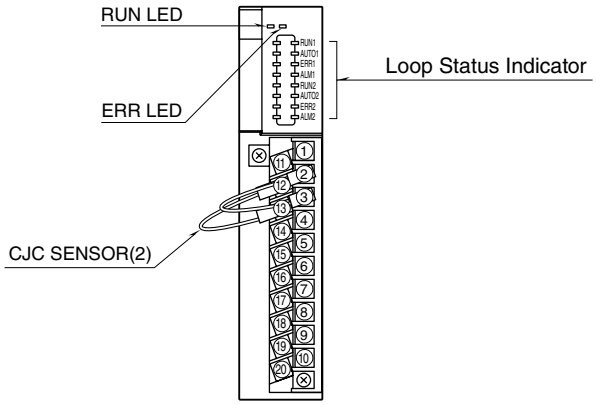
- Unused channels can be specified and set so on the PC Configurator Software (model: R3CON) without needing to short at the field terminals.

■ 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



■ STATUS INDICATOR LED

RUN indicator: Bi-color (red/green) LED;
Red when the internal bus operates normally.
ERR indicator: Bi-color (red/green) LED;
Red at device error;
Green in normal operating conditions.
Loop status indicators: Red LED

RUN1:	Turns on while loop 1 is in operation.
AUTO1:	Turns on during auto mode, turns off during manual mode with loop 1
ERR1:	Turns on at error with loop 1
ALM1:	Turns on at alarm with loop 1
RUN2:	Turns on while loop 2 is in operation.
AUTO2:	Turns on during auto mode, turns off during manual mode with loop 2
ERR2:	Turns on at error with loop 2
ALM2:	Turns on at alarm with loop 2

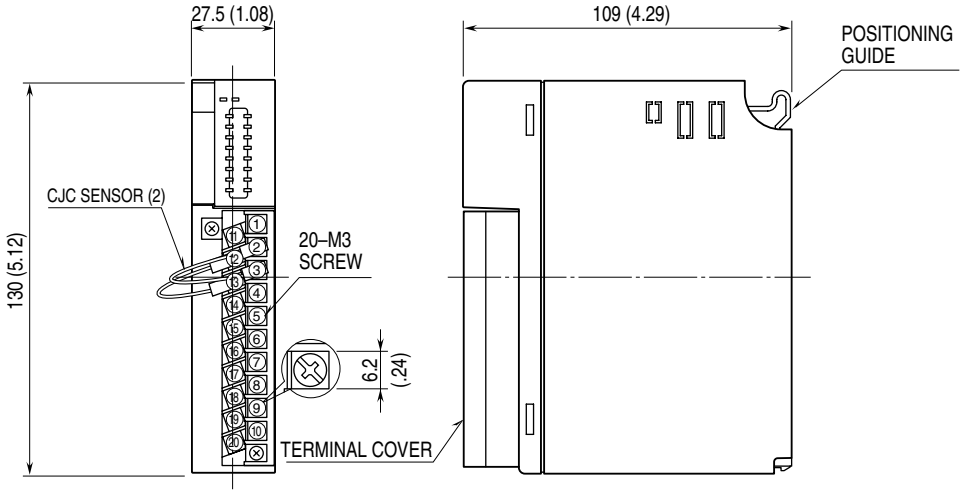
INSTALLATION

Use the Installation Base (model: R3-BSx).

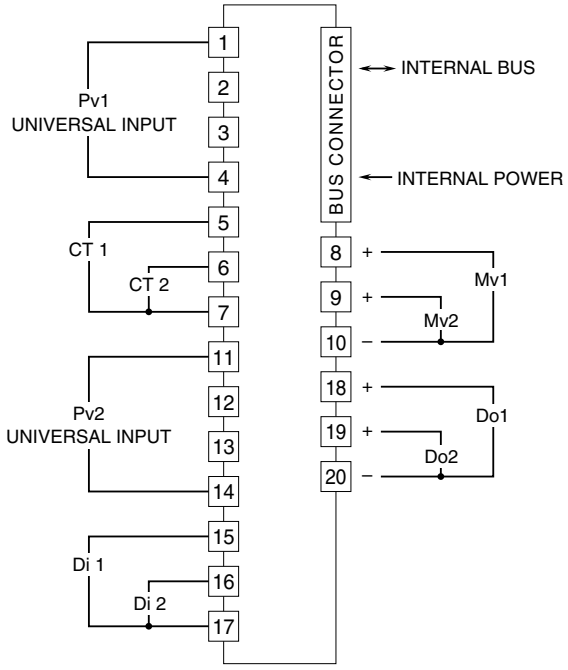
TERMINAL CONNECTIONS

Connect the unit as in the diagram below.

■ **EXTERNAL DIMENSIONS unit: mm (inch)**

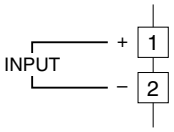


■ **CONNECTION DIAGRAM**

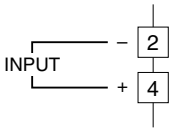


■ **UNIVERSAL INPUT CONNECTION (Pv1) e.g.**

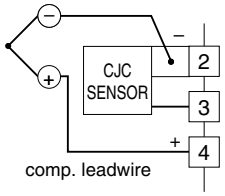
•DC Voltage (-10 – +10V DC)
•DC Current (0 – 20mA DC)



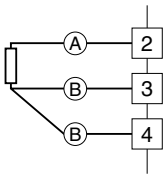
•DC Voltage (-1000 – +1000mV DC)



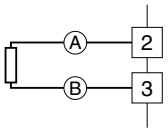
•Thermocouple



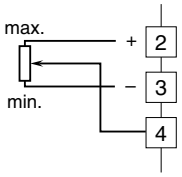
•RTD/Resistor (3-wire)



•RTD/Resistor (2-wire)

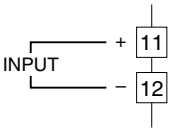


•Potentiometer

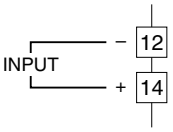


■ **UNIVERSAL INPUT CONNECTION (Pv2) e.g.**

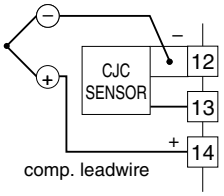
•DC Voltage (-10 – +10V DC)
•DC Current (0 – 20mA DC)



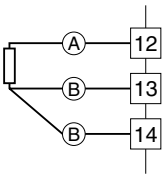
•DC Voltage (-1000 – +1000mV DC)



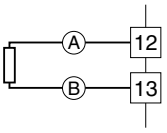
•Thermocouple



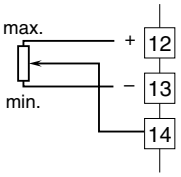
•RTD/Resistor (3-wire)



•RTD/Resistor (2-wire)

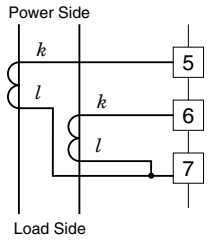


•Potentiometer

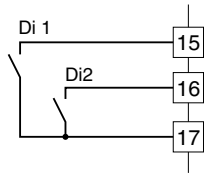


■ **CT 1 / CT 2 CONNECTION e.g.**

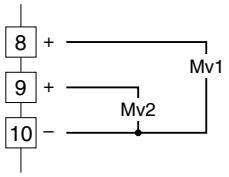
•Clamp-on current Sensor



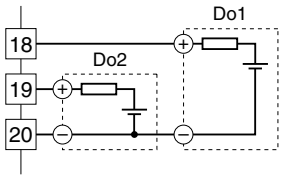
■ **DISCRETE INPUT CONNECTION e.g.**



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



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



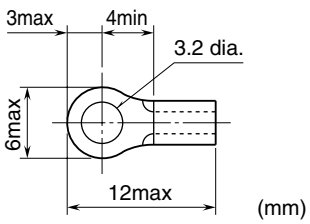
WIRING INSTRUCTIONS

■ SCREW TERMINAL

Torque: 0.5 N·m

■ SOLDERLESS TERMINAL

Refer to the drawing below for recommended ring tongue terminal size. Spade tongue type is also applicable. Solderless terminals with insulation sleeve do not fit.
Applicable wire size: 0.3 – 0.75 mm²
Recommended manufacturer: Japan Solderless Terminal MFG. Co., Ltd., Nichifu Co., Ltd.



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 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
  (100 msec. fixed for control output 0 – 20 mA and 0 – 10 V DC)
- 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
  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: R3CON).
- Various values can be read out via network communication (data allocation mode: 8)
- Modbus interface module (model: R3-NM3) available with the R3 extension area communication realizes a large capacity data reading/writing.

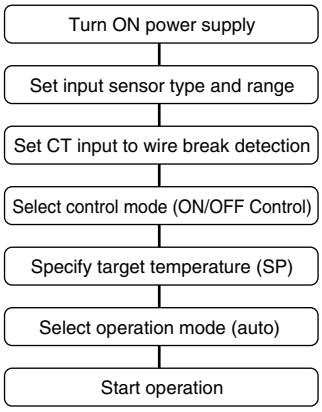
SYSTEM CONFIGURATIONS & CONTROL EXAMPLES

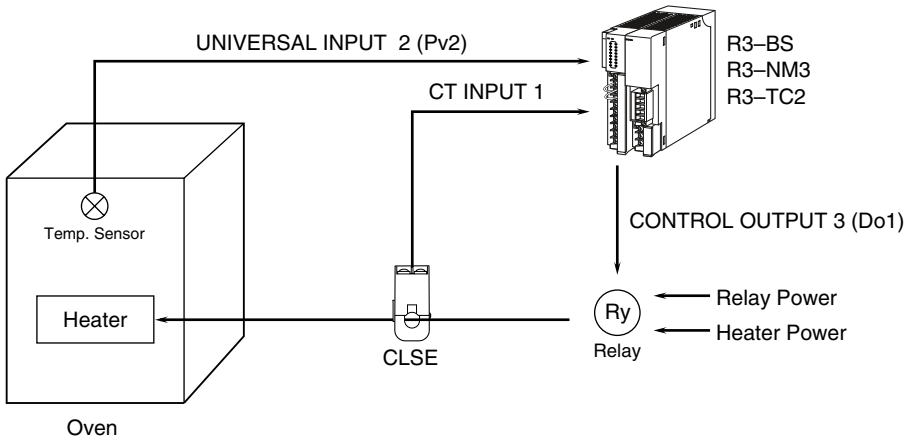
■ 1 loop heating ON/OFF control and heater wire break detection

1. Installation example:

- Base (model: R3–BS)
- Interface Module (model: R3–NM3)
- Temperature Control Module (model: R3–TC2)
- Clamp-on Current Sensor (model: CLSE)
- Oven
- Heater
- Relay
- Temperature sensor

2. Proccess until start operating:



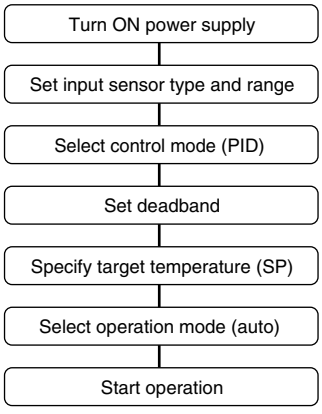


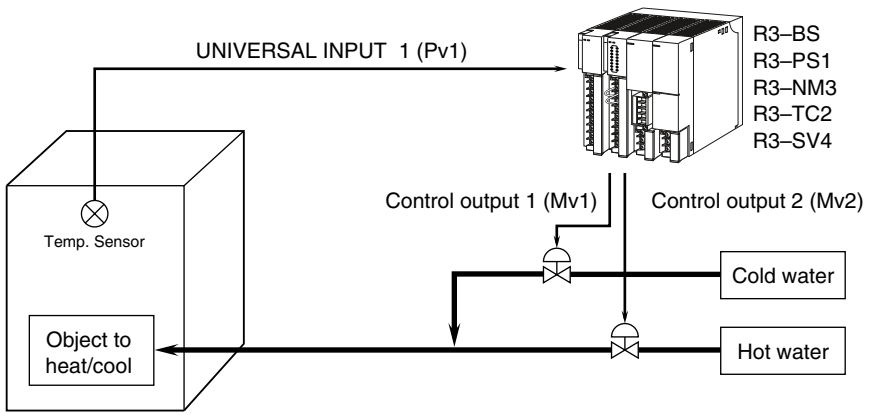
■ 1 loop heating and cooling control (PID)

1. Installation example:

- Base (model: R3–BS)
- Power Supply Module (R3–PS1)
- Interface Module (model: R3–NM3)
- Temperature Control Module (model: R3–TC2)
- DC Voltage Input Module (model: R3–SV4)
  (Other R3 modules also available)
- Object to heat/cool
- Temperature sensor

2. Proccess until start operating:





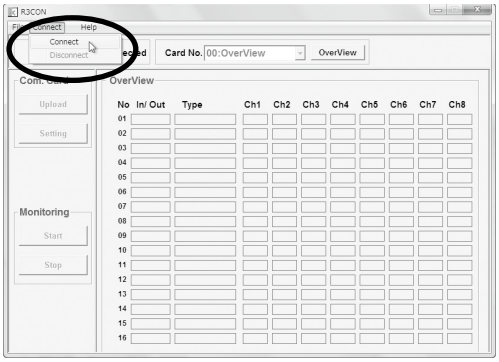
Note: The examples above are for single loop, however, dual loop control is also availabe using only one R3-TC2.

OPERATION

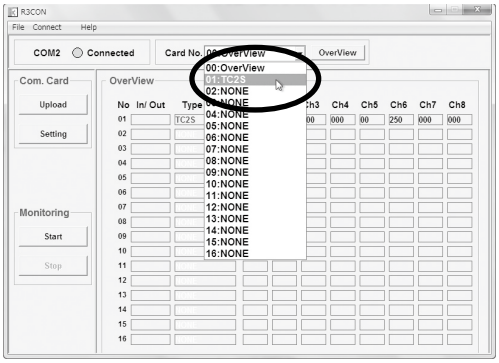
■ GETTING READY WITH PC CONFIGURATOR SOFTWARE (model: R3CON)

The PC Configurator Software is used to set up various parameters for the Temperature Controller Module and to perform auto-tuning.

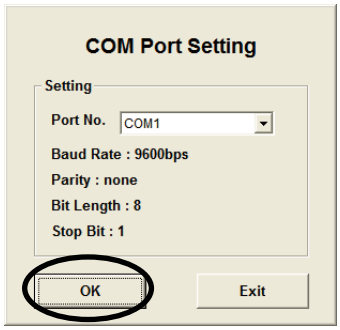
Connect the CONFIG port to the PC and start up the R3CON. The flowchart below shows how to move to the Controller's setting window. In this example, the R3-TC2 is supposed to be installed in the slot 1.



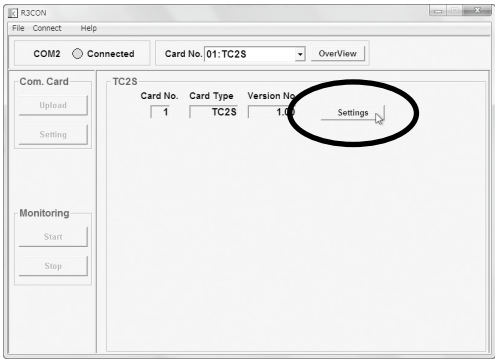
Click [Connect] under [Connect] menu



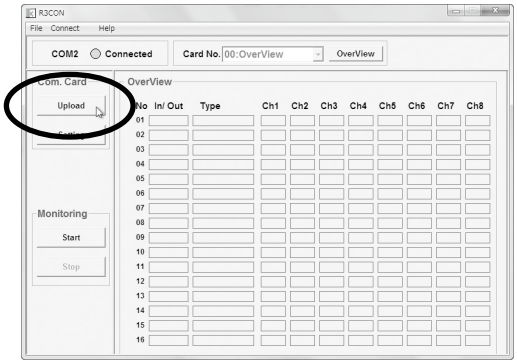
Choose 'TC2S' from the list



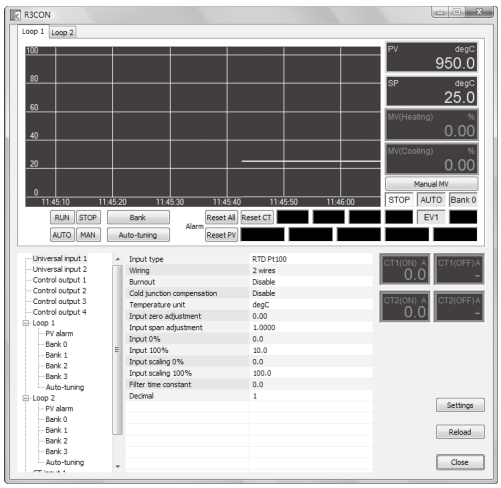
Choose a COM port and click OK



Click [Settings] button

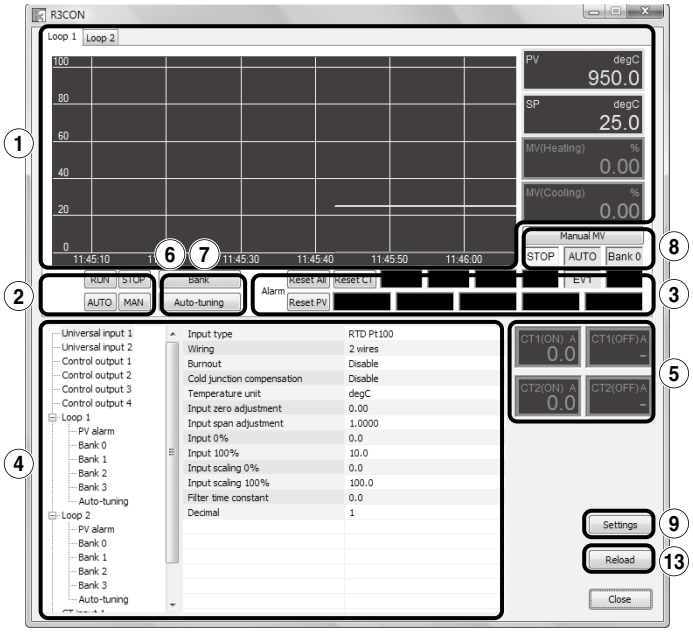


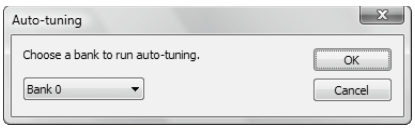
Click [Upload] button

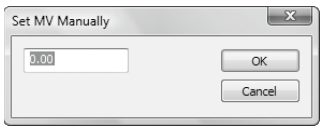


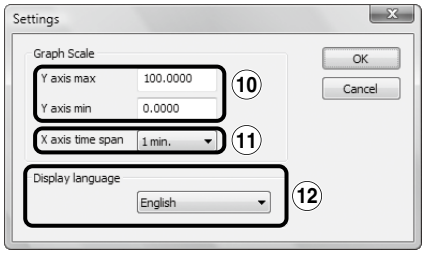
■ R3CON CONFIGURATION WINDOW

The Controller's setting window is as shown below.
The trend graph shows real time PV and MV status, and parameters and operation status can be monitored.









(1) MONITOR WINDOW
Trend graph shows PV, SP and MV for loop 1 and 2.
Choose Loop 1 or Loop 2 tub at the top.
Trend data for both loops is continuously stored even though only one loop is chosen at a moment.

(2) SWITCHING OPERATION / MODE
Control operation and mode is set with the buttons.

(3) ALARM INDICATORS / RESET BUTTONS
Alarm status of the selected loop is indicated.
Various alarm status can be reset by clicking [Reset PV], [Reset CT] and [Reset All].

(4) SETTING ITEMS TREE & LIST
Setting parameters are grouped in the menu tree.
Choose a specific group to show a parameter list to choose from. Modified selections / values are written in the device immediately.
For setting details, refer to the R3-TC2 instruction manual.

(5) CT INPUT INDICATORS
CTx(ON) display shows current value when the relevant control output is ON; while CTx(OFF) shows current when it is OFF.
' - ' shows that the control output has not been switched on or off during the last control cycle.

(6) BANK
[Switch Bank] dialog box appears when [Bank] button is clicked.
Choose a bank and click OK to apply the change.

(7) AUTO-TUNING
[Auto-tuning] dialog box appears when [Auto-tuning] is clicked.
Choose a bank and click OK to start auto-tuning for the specified bank.

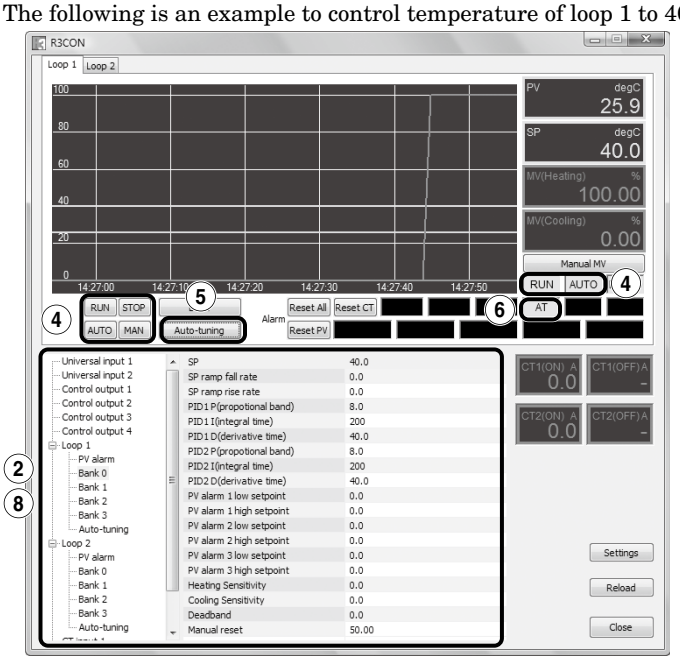
(8) MANUAL MV
[Set MV Manually] dialog box appears when [Manual MV] button is clicked.
Enter a MV value and click OK to apply the change (only in MAN mode).

(9) SETTINGS
Graph scales in the trend graph and display language can be changed.
[Settings] dialog box appears when the button is clicked.
(10) Y axis max / Y axis min
Specify a full-scale temperature range for Y axis.
Selectable from -9999.9999 to +9999.9999.
Minimum span is of 0.2.
(11) X axis time span
Specify a full-scale time span for X axis.
Selectable among:
10 sec. 30 sec. 1 min. 3 min. 5 min.
10 min. 15 min. 30 min. 1 hour 2 hours
(12) Display Language
English and Japanese can be switched.

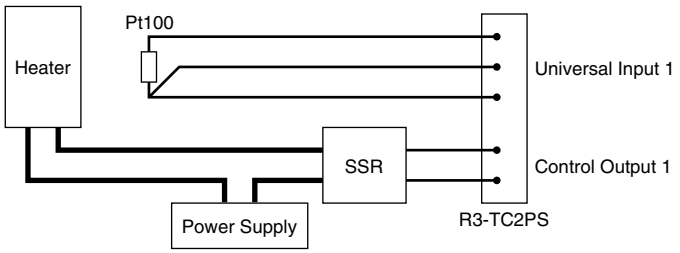
(13) RELOAD
Used to upload the setting from the device.
Alternatively press F5 button on the keyboard to reload.

■ SETTING EXAMPLE 1: TEMPERATURE CONTROL WITH STANDARD PID

The following is an example to control temperature of loop 1 to 40.0°C by standard PID control.



(1) Connect Pt100 to the universal input terminal 1 to measure temperature. Connect also an SSR and a heater to the control output 1.



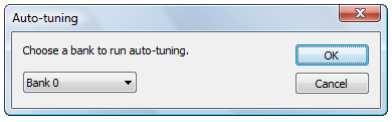
(2) Go to the setting items tree and change the following parameters.

SETTING ITEMS TREE	PARAMETER	SELECTION
Universal input 1	Input type	RTD Pt 100
Universal input 1	Wiring	3 wires
Control output 1	Output assignment	Loop 1, Heating control
Loop 1, Bank 0	SP (setpoint value)	40.0

(3) Confirm that Pt100 is correctly connected to the universal input 1 and the controlled object (heater, etc) for heating control to the control output 1.

(4) Click RUN button and AUTO button located below the trend graph to start control operations. Indicators STOP and MAN are switched respectively to RUN and AUTO.

(5) Click Auto-tuning button located below the trend graph to show the Auto-tuning dialog box. Choose Bank 0 and click OK.



(6) The Controller starts auto-tuning. Indicator AT starts blinking. Click STOP button to stop the auto-tuning.

(7) Indicator AT stops blinking to start control operation when the auto-tuning is complete.

(8) Go to the setting items tree and change the following parameters so that the control operation automatically starts at the start up of the device.

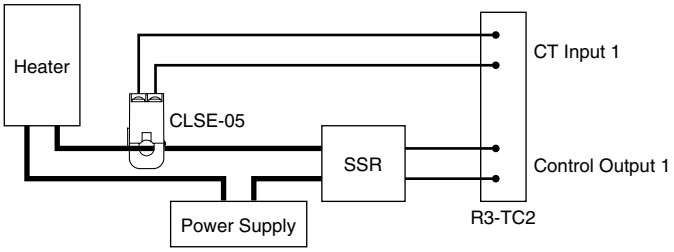
SETTING ITEMS TREE	PARAMETER	SELECTION
Loop 1	Operation at startup	RUN
Loop 1	Control mode at startup	AUTO

Now the setting is complete.

■ SETTING EXAMPLE 2: HEATER WIRE BREAK

In addition to the setting example 1 configuration, the heater's wire break can be detected using a CT input. Suppose that the heater has 100V / 1kW rating, driven by an SSR.

(1) Current flowing through the heater is calculated in the equation: 1kW / 100V = 10A. Choose the current sensor model CLSE-05, for the maximum of 50A rating. Connect the sensor to CT input 1 as in the figure below.



(2) Go to the setting items tree and change the following parameters.

SETTING ITEMS TREE	PARAMETER	SELECTION
CT input 1	CT sensor type	CLSE-05
CT input 1	Output assignment	Control output 1

(3) Once the above setting is complete, the Controller measures current values of the control output 1 at ON and OFF states. The CT1(ON) display shows (approx.) 10A and the CT1(OFF) display shows (approx.) 0.0A.

(4) Set a threshold for the heater wire break.

Set to 5.0A, a value half the rating (approx. 10.0A).

SETTING ITEMS TREE	PARAMETER	SELECTION
CT input 1	Heater wire break alarm	Enable
CT input 1	Heater wire break alarm setpoint	5.0

(5) Set also the following items if the wire break should be alerted at the control output 3 (open collector).

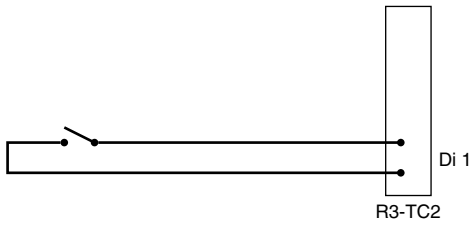
SETTING ITEMS TREE	PARAMETER	SELECTION
CT input 1	Heater wire break alarm output	Control output 3
Control output 3	Output assignment	Alarm OR

Now the heater wire break alarm setting is complete.

■ SETTING EXAMPLE 3: SWITCHING SETPOINT VALUE BY EVENT INPUT

The Controller has two discrete inputs for event control input.
At the maximum of four sets of temperature setpoints and PID parameters can be predefined and stored in the 'banks.' The external event input can be used to switch among these banks.
In this example, the Controller is set according to the example 1 for the setpoint 40.0°C. By using banks, an additional setting to switch the setpoint to 50.0°C by an event input is created.

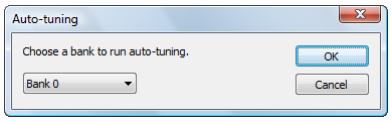
(1) Connect a switch to the discrete input 1 as shown below.



(2) Go to the setting items tree and change the following parameters.

SETTING ITEMS TREE	PARAMETER	SELECTION
Loop 1, Bank 1	SP (setpoint value)	50.0
Event input	Event input 1 function assignment	Loop 1, Bank bit 0

(3) Click Auto-tuning button located below the trend graph to show the Auto-tuning dialog box. Choose Bank 1 and click OK. The Controller go through auto-tuning and then starts control operations.



Now the setting is complete to switch the temperature setpoint to 50.0°C with the switch closed (ON) and to 40.0°C with the same opened (OFF).

MODBUS COMMUNICATION

■ R3 I/O DATA

The Controller functions as an analog input module in the R3 remote I/O system. The following 8 words of analog input data can be read out at Input Register area.

+0		Loop 1 PV (number of decimal places as specified with the 'input 1 decimal')
+1		Loop 1 SP (number of decimal places as specified with the 'input 1 decimal')
+2		Loop 1 Heating MV (0.01% increments)
+3		Loop 1 Cooling MV (0.01% increments)
+4		Loop 2 PV (number of decimal places as specified with the 'input 2 decimal')
+5		Loop 2 SP (number of decimal places as specified with the 'input 2 decimal')
+6		Loop 2 Heating MV (0.01% increments)
+7		Loop 2 Cooling MV (0.01% increments)

■ R3 EXTENSION AREA COMMUNICATION

The Controller is compatible with the R3 extension area communication.
By using the model R3-NM3 Modbus Extension Network Module, a large volume of its data can be read out and written in from the Modbus host device via Holding Register area.

■ EXTENSION AREA ADDRESS ASSIGNMENTS

A Holding Register area of 3000 words is assigned per I/O module as shown in the table below.

SLOT	ADDRESS
1	2001 through 5000
2	5001 through 8000
3	8001 through 11000
4	11001 through 14000
:	:
15	44001 through 47000
16	47001 through 50000

■ READING EXAMPLE

In order to read the MV value in the table below from the R3-TC2 in the slot position 2, read 1 word at the address 5005, slot 2 top address 5001 added with 4.

ADDRESS	PARAMETER	UNIT
+4	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

In order to write 40.0 at the SP value in the table below of the R3-TC2 in the slot position 3, write 400 (when the input 1 decimal is set to '1,' disregard the decimal point) at the address 9153, slot 3 top address 8001 added with 1152.

ADDRESS	PARAMETER	RANGE	DEFAULT
+1152	Loop 1, SP (setpoint)	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	25.0

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 column shows offsets from the top address of the R3 Extension Area Communication.

ADDRESS	PARAMETER	UNIT
+0	Loop 1, Status 1 (See the table below)	---
+1	Loop 1, Status 2 (See the table below)	---
+2	Loop 1, PV (present value)	Input 1 decimal setting
+3	Loop 1, Internal SP (setpoint value)	Input 1 decimal setting
+4	Loop 1, Heating MV (control output)	0.01%
+5	Loop 1, Cooling MV (control output)	0.01%
+6	Loop 1, Local SP (setpoint value)	Input 1 decimal setting
+7	Loop 1, Remote SP (setpoint value)	Input 1 decimal setting
+8	Loop 2, Status 1 (See the table below)	---
+9	Loop 2, Status 2 (See the table below)	---
+10	Loop 2, PV (present value)	Input 2 decimal setting
+11	Loop 2, Internal SP (setpoint value)	Input 2 decimal setting
+12	Loop 2, Heating MV (control output)	0.01%
+13	Loop 2, Cooling MV (control output)	0.01%
+14	Loop 2, Local SP (setpoint value)	Input 2 decimal setting
+66	CT input 1, Current value	0.1A
+67	CT input 1, Current value at the control output ON *1	0.1A
+68	CT input 1, Current value at the control output OFF *1	0.1A
+69	CT input 2, Current value	0.1A
+70	CT input 2, Current value at the control output ON *1	0.1A
+71	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 alarm 1	Normal	Alarm
		14	ALM_PV2	PV alarm 2	Normal	Alarm
	MSB	15	ALM_PV3	PV alarm 3	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
+6	Loop 1, Local SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	---
+14	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
+64	Loop 1, Command	See the table below.	---
+65	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.

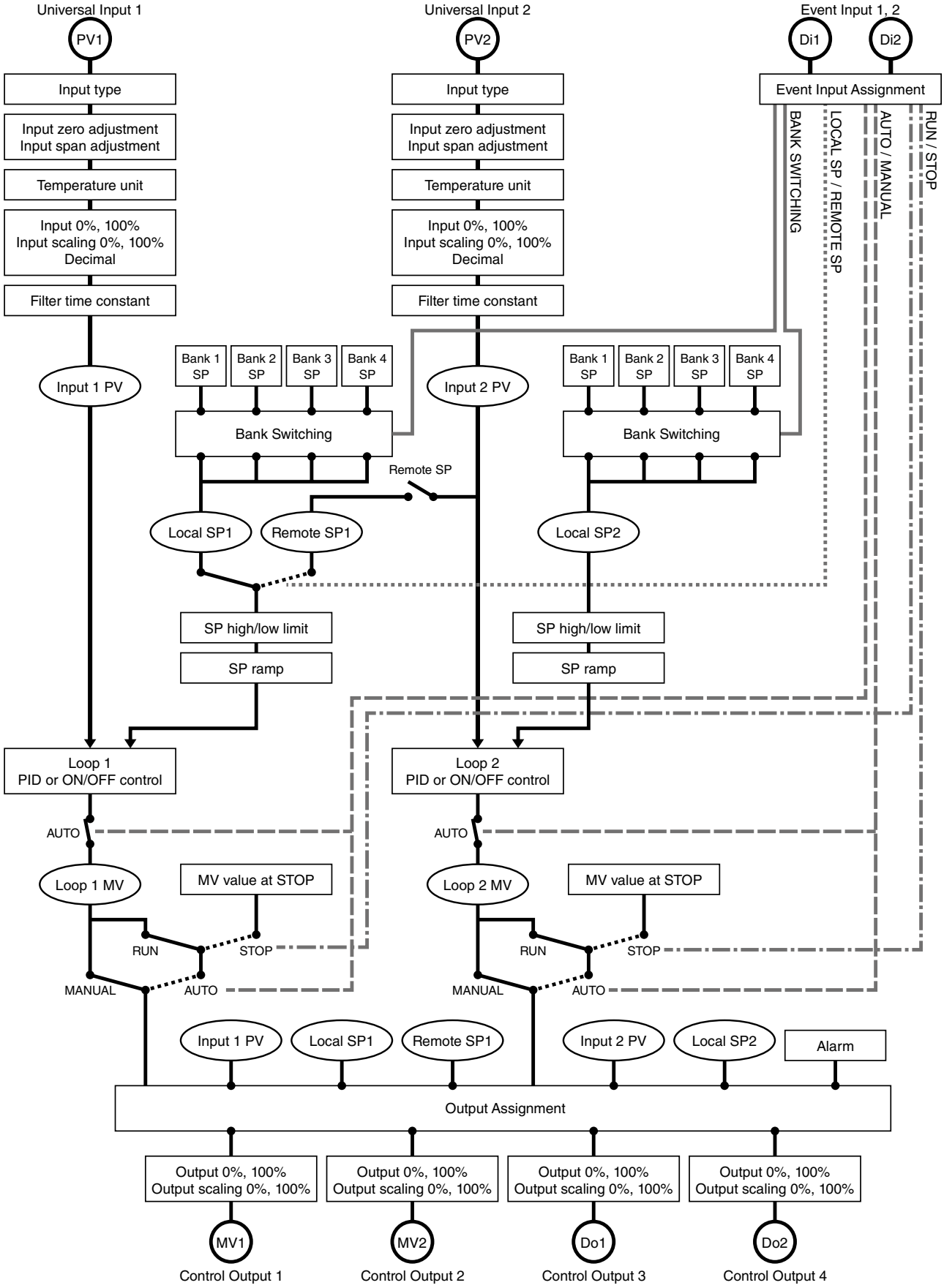
SETTING

■ SETTING CHANGE VIA MODBUS

Reading and writing via Modbus from the host is possible by the Network Module (model: R3-NM3).
Parameters are listed with Modbus address and data size in this manual. Access Holding Registers at these addresses to read and write to refer and change settings.
Refer to “COMMUNICATION” section for the procedure.

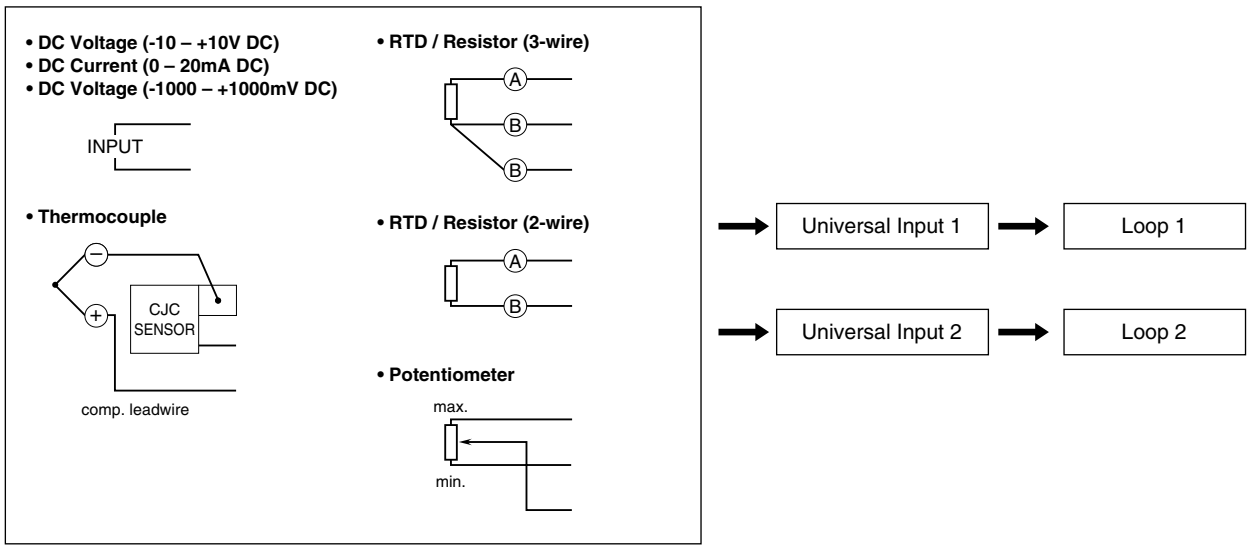
■ FUNCTION BLOCK DIAGRAM

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
+128	Universal input 1, Input type	See the table below.	10
+384	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
+129	Universal input 1, Wiring	0 : 2 wires 1 : 3 wires	1
+385	Universal input 2, Wiring		

■ BURNOUT

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

ADDRESS	PARAMETER	RANGE	DEFAULT
+130	Universal input 1, Burnout	0 : Disable 1 : Enable	1
+386	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
+131	Universal input 1, Cold junction compensation	0 : Disable 1 : Enable	1
+387	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
+132	Universal input 1, Temperature unit	0 : degC 1 : degF	0
+388	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
+133	Universal input 1, Input zero adjustment	-300.00 to +300.00 (unit as in the table below)	0.00
+389	Universal input 2, Input zero adjustment		
+134	Universal input 1, Input span adjustment	0.8500 to 1.1500	1.0000
+390	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
+135	Universal input 1, Input 0%	-1000.0 to +4000.0 *3 (unit as in the table below)	4.0
+136	Universal input 1, Input 100%		20.0
+137	Universal input 1, Input scaling 0%	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	0.0
+138	Universal input 1, Input scaling 100%		100.0
+391	Universal input 2, Input 0%	-1000.0 to +4000.0 *3 (unit as in the table below)	4.0
+392	Universal input 2, Input 100%		20.0
+393	Universal input 2, Input scaling 0%	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
+394	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
+139	Universal input 1, Filter time constant	0.0, 0.5 to 60.0 seconds	0.0
+395	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
+140	Universal input 1, Decimal	0, 1, 2, 3 (digits)	1
+396	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	R3-TC2Ax	0 – 20mA DC output
	R3-TC2Vx	0 – 10V DC output
	R3-TC2Px	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 – 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
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
+1280	Control output 1, Output assignment	See the table below.	16
+1440	Control output 2, Output assignment		32
+1600	Control output 3, Output assignment		16
+1760	Control output 4, Output assignment		32

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	2
17	Loop 1, Cooling control output	Continuous value	2
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	2
33	Loop 2, Cooling control output	Continuous value	2
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
+1281	Control output 1, Control cycle	1.0 to 99.9 seconds	2.0
+1441	Control output 2, Control cycle		
+1601	Control output 3, Control cycle		
+1761	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
+1282	Control output 1, Minimum ON/OFF width	0.0 to 50.0 %	0.0
+1442	Control output 2, Minimum ON/OFF width		
+1602	Control output 3, Minimum ON/OFF width		
+1762	Control output 4, Minimum ON/OFF width		

■ OUTPUT SCALING 0% / OUTPUT SCALING 100%

Scales and outputs the assigned output value.

ADDRESS	PARAMETER	RANGE	DEFAULT
+1283	Control output 1, Output scaling 0% *4	-3200.0 to +3200.0 (Input 1 decimal digits unit or Input 2 decimal digits unit) *5	0.0
+1284	Control output 1, Output scaling 100% *4		100.0
+1443	Control output 2, Output scaling 0% *4		0.0
+1444	Control output 2, Output scaling 100% *4		100.0
+1603	Control output 3, Output scaling 0% *4		0.0
+1604	Control output 3, Output scaling 100% *4		100.0
+1763	Control output 4, Output scaling 0% *4		0.0
+1764	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, Local SP or Remote 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
+1285	Control output 1, Output 0%	0.0 to 100.0	*6
+1286	Control output 1, Output 100%		
+1445	Control output 2, Output 0%		
+1446	Control output 2, Output 100%		
+1605	Control output 3, Output 0%	0.0 to 100.0%	0.0
+1606	Control output 3, Output 100%		100.0
+1765	Control output 4, Output 0%		0.0
+1766	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
R3-TC2Ax	4.0	20.0	mA
R3-TC2Vx	0.0	10.0	V
R3-TC2Px	0.0	100.0	%

■ OUTPUT INVERSION

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

ADDRESS	PARAMETER	RANGE	DEFAULT
+1287	Control output 1, Output inversion	0 : Normal 1 : Inverted	0
+1447	Control output 2, Output inversion		
+1607	Control output 3, Output inversion		
+1767	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
+192	Loop 1, Operation at startup	0 : STOP 1 : RUN	0
+448	Loop 2, Operation at startup		

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
+193	Loop 1, Control mode at startup	0 : MANUAL 1 : AUTO	0
+449	Loop 2, Control mode at startup		

At startup means the timing when the power up.

■ CONTROL TYPE

Specify the control strategy for each loop.

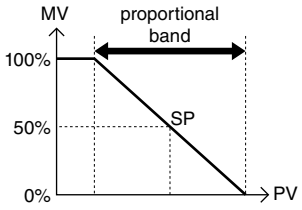
ADDRESS	PARAMETER	RANGE	DEFAULT
+194	Loop 1, Control type	0 : Standard PID control 1 : Heating-cooling PID control 2 : Heating-cooling ON/OFF control	0
+450	Loop 2, Control type		

• 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).

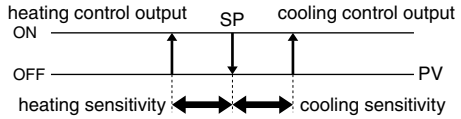
• Heating-Cooling PID Control

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.

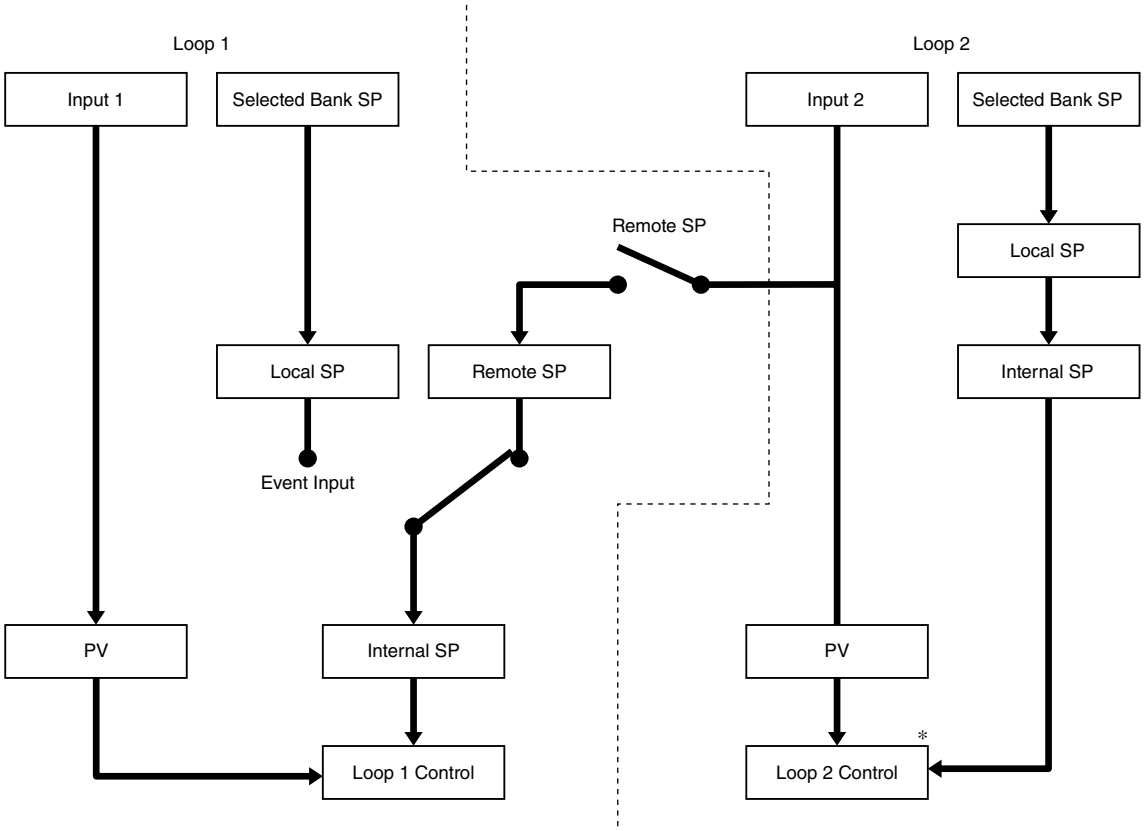
ADDRESS	PARAMETER	RANGE	DEFAULT
+195	Loop 1, Direct/reverse action	0 : Reverse 1 : Direct	0
+451	Loop 2, Direct/reverse action		

■ REMOTE SP

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

ADDRESS	PARAMETER	RANGE	DEFAULT
+196	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.



* Loop 2 control is not available while loop 1 remote SP is enabled.

■ SP TRACKING

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

ADDRESS	PARAMETER	RANGE	DEFAULT
+197	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
+198	Loop 1, SP low limit	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	-3200.0
+199	Loop 1, SP high limit		3200.0
+454	Loop 2, SP low limit	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	-3200.0
+455	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
+200	Loop 1, MV at startup	-105.00 to +105.00 %	0.00
+201	Loop 1, MV at STOP		
+202	Loop 1, MV at error		
+456	Loop 2, MV at startup		
+457	Loop 2, MV at STOP		
+458	Loop 2, 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, 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
+203	Loop 1, MV low limit	-105.00 to +105.00 %	-100.00
+204	Loop 1, MV high limit		100.00
+459	Loop 2, MV low limit		-100.00
+460	Loop 2, 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) or an error in the remote SP input.

ADDRESS	PARAMETER	RANGE	DEFAULT
+205	Loop 1, Error action	0 : Operation continued 1 : 'MV at error' output 2 : STOP	1
+461	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
+206	Loop 1, CT alarm action	0 : Operation continued 1 : 'MV at error' output 2 : STOP	1
+462	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.

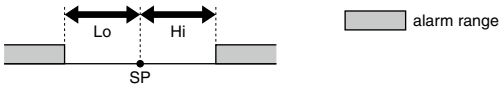
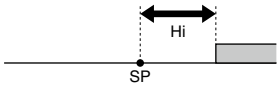
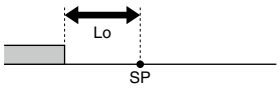
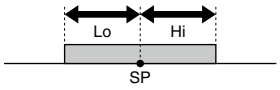
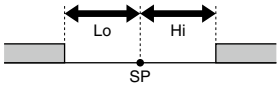
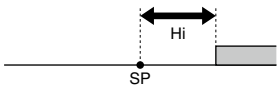
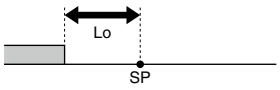
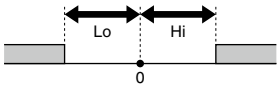
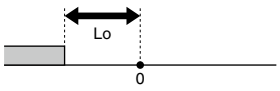
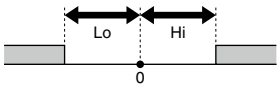
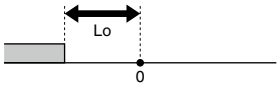
■ PV ALARM 1, PV ALARM 2, PV ALARM 3

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
+320	Loop 1, Alarm 1 type	See the table below.	0
+328	Loop 1, Alarm 2 type		
+336	Loop 1, Alarm 3 type		
+576	Loop 2, Alarm 1 type		
+584	Loop 2, Alarm 2 type		
+592	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	

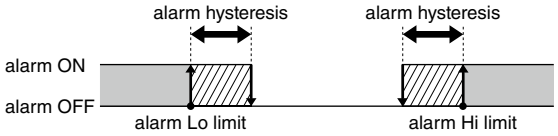
Standby sequence is a function to prevent unwanted alarm triggered at the startup or at an SP change. If the PV is in alarm range at the startup or at an SP change, no alarm is triggered until the PV is out of the range. Once it is out and then in the range again, normal alarm function starts functioning.

• 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
+321	Loop 1, Alarm 1 hysteresis	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
+329	Loop 1, Alarm 2 hysteresis		
+337	Loop 1, Alarm 3 hysteresis		
+577	Loop 2, Alarm 1 hysteresis	0.0 to 999.9 (decimal by input 2 decimal setting)	
+585	Loop 2, Alarm 2 hysteresis		
+593	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
+322	Loop 1, Alarm 1 latching	0 : Disable 1 : Enable	0
+330	Loop 1, Alarm 2 latching		
+338	Loop 1, Alarm 3 latching		
+578	Loop 2, Alarm 1 latching		
+586	Loop 2, Alarm 2 latching		
+594	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
+323	Loop 1, Alarm 1 ON delay	0 to 999 seconds	0
+331	Loop 1, Alarm 2 ON delay		
+339	Loop 1, Alarm 3 ON delay		
+579	Loop 2, Alarm 1 ON delay		
+587	Loop 2, Alarm 2 ON delay		
+595	Loop 2, Alarm 3 ON delay		
+324	Loop 1, Alarm 1 OFF delay		
+332	Loop 1, Alarm 2 OFF delay		
+340	Loop 1, Alarm 3 OFF delay		
+580	Loop 2, Alarm 1 OFF delay		
+588	Loop 2, Alarm 2 OFF delay		
+596	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
+325	Loop 1, Alarm 1 SP type	0 : Ramp SP 1 : SP	0
+333	Loop 1, Alarm 2 SP type		
+341	Loop 1, Alarm 3 SP type		
+581	Loop 2, Alarm 1 SP type		
+589	Loop 2, Alarm 2 SP type		
+597	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
+326	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
+334	Loop 1, Alarm 2 output		
+342	Loop 1, Alarm 3 output		
+582	Loop 2, Alarm 1 output		
+590	Loop 2, Alarm 2 output		
+598	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 0 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 0]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1152	Loop 1, SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
+1792	Loop 2, SP (setpoint value)		

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1312	Loop 1, SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
+1856	Loop 2, SP (setpoint value)		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1472	Loop 1, SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
+1920	Loop 2, SP (setpoint value)		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1632	Loop 1, SP (setpoint value)	-3200.0 to +3200.0 (decimal by input 1/2 decimal setting)	25.0
+1984	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.
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 0]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1153	Loop 1, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 1 decimal setting)	0.0
+1154	Loop 1, SP ramp rise rate		
+1793	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
+1794	Loop 2, SP ramp rise rate		

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1313	Loop 1, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 1 decimal setting)	0.0
+1314	Loop 1, SP ramp rise rate		
+1857	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
+1858	Loop 2, SP ramp rise rate		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1473	Loop 1, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 1 decimal setting)	0.0
+1474	Loop 1, SP ramp rise rate		
+1921	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
+1922	Loop 2, SP ramp rise rate		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1633	Loop 1, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 1 decimal setting)	0.0
+1634	Loop 1, SP ramp rise rate		
+1985	Loop 2, SP ramp fall rate	0.0 to 3200.0 per second (decimal by input 2 decimal setting)	0.0
+1986	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 0]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1155	Loop 1, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1156	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
+1157	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1158	Loop 1, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1159	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
+1160	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0
+1795	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1796	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
+1797	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1798	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1799	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
+1800	Loop 2, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1315	Loop 1, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1316	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
+1317	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1318	Loop 1, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1319	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
+1320	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0
+1859	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1860	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
+1861	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1862	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1863	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
+1864	Loop 2, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1475	Loop 1, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1476	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
+1477	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1478	Loop 1, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1479	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
+1480	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0
+1923	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1924	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
+1925	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1926	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1927	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
+1928	Loop 2, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1635	Loop 1, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1636	Loop 1, PID1 I (integral time)	0 to 3999 seconds	200
+1637	Loop 1, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1638	Loop 1, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 1 decimal setting) (unit is temperature)	8.0
+1639	Loop 1, PID2 I (integral time)	0 to 3999 seconds	200
+1640	Loop 1, PID2 D (derivative time)	0.0 to 999.9 seconds	40.0
+1987	Loop 2, PID1 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1988	Loop 2, PID1 I (integral time)	0 to 3999 seconds	200
+1989	Loop 2, PID1 D (derivative time)	0.0 to 999.9 seconds	40.0
+1990	Loop 2, PID2 P (proportional band)	0.1 to 3200.0 (decimal by input 2 decimal setting) (unit is temperature)	8.0
+1991	Loop 2, PID2 I (integral time)	0 to 3999 seconds	200
+1992	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 0]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1167	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
+1168	Loop 1, Cooling sensitivity		
+1807	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
+1808	Loop 2, Cooling sensitivity		

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1327	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
+1328	Loop 1, Cooling sensitivity		
+1871	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
+1872	Loop 2, Cooling sensitivity		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1487	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
+1488	Loop 1, Cooling sensitivity		
+1935	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
+1936	Loop 2, Cooling sensitivity		

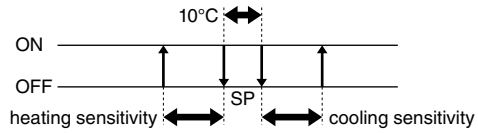
[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1647	Loop 1, Heating sensitivity	0.0 to 999.9 (decimal by input 1 decimal setting)	0.0
+1648	Loop 1, Cooling sensitivity		
+1999	Loop 2, Heating sensitivity	0.0 to 999.9 (decimal by input 2 decimal setting)	0.0
+2000	Loop 2, Cooling sensitivity		

■ DEADBAND

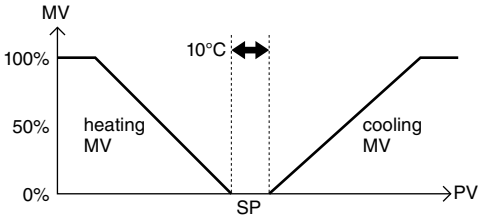
Deadband is a zone in which neither heating nor cooling control is performed.
Negative value setting means both heating and cooling control is performed in the zone.

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

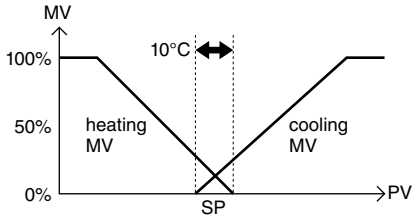


At PID control, deadband is enabled for P control. At P control (I = 0 and D = 0.0), with continuous value control, a zone in which both heating MV and cooling MV equal 0 is formed at ±5°C of the SP when the deadband is set to 10°C. With the setting to -10°C, the zone is with both heating MV and cooling 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
+1169	Loop 1, Deadband	-999.9 to +999.9 (decimal by input 1/2 decimal setting)	0.0
+1809	Loop 2, Deadband		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1329	Loop 1, Deadband	-999.9 to +999.9 (decimal by input 1/2 decimal setting)	0.0
+1873	Loop 2, Deadband		

[Bank 3]

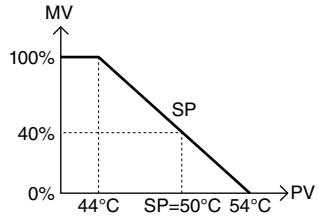
ADDRESS	PARAMETER	RANGE	DEFAULT
+1489	Loop 1, Deadband	-999.9 to +999.9 (decimal by input 1/2 decimal setting)	0.0
+1937	Loop 2, Deadband		

[Bank 4]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1649	Loop 1, Deadband	-999.9 to +999.9 (decimal by input 1/2 decimal setting)	0.0
+2001	Loop 2, Deadband		

■ 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 0]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1170	Loop 1, Manual reset	0.00 to 100.00 %	50.00
+1810	Loop 2, Manual reset		

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1330	Loop 1, Manual reset	0.00 to 100.00 %	50.00
+1874	Loop 2, Manual reset		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1490	Loop 1, Manual reset	0.00 to 100.00 %	50.00
+1938	Loop 2, Manual reset		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1650	Loop 1, Manual reset	0.00 to 100.00 %	50.00
+2002	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 0]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1161	Loop 1, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	0.0
+1162	Loop 1, Alarm 1 high setpoint		
+1163	Loop 1, Alarm 2 low setpoint		
+1164	Loop 1, Alarm 2 high setpoint		
+1165	Loop 1, Alarm 3 low setpoint		
+1166	Loop 1, Alarm 3 high setpoint		
+1801	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
+1802	Loop 2, Alarm 1 high setpoint		
+1803	Loop 2, Alarm 2 low setpoint		
+1804	Loop 2, Alarm 2 high setpoint		
+1805	Loop 2, Alarm 3 low setpoint		
+1806	Loop 2, Alarm 3 high setpoint		

[Bank 1]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1321	Loop 1, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	0.0
+1322	Loop 1, Alarm 1 high setpoint		
+1323	Loop 1, Alarm 2 low setpoint		
+1324	Loop 1, Alarm 2 high setpoint		
+1325	Loop 1, Alarm 3 low setpoint		
+1326	Loop 1, Alarm 3 high setpoint		
+1865	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
+1866	Loop 2, Alarm 1 high setpoint		
+1867	Loop 2, Alarm 2 low setpoint		
+1868	Loop 2, Alarm 2 high setpoint		
+1869	Loop 2, Alarm 3 low setpoint		
+1870	Loop 2, Alarm 3 high setpoint		

[Bank 2]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1481	Loop 1, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	0.0
+1482	Loop 1, Alarm 1 high setpoint		
+1483	Loop 1, Alarm 2 low setpoint		
+1484	Loop 1, Alarm 2 high setpoint		
+1485	Loop 1, Alarm 3 low setpoint		
+1486	Loop 1, Alarm 3 high setpoint		
+1929	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
+1930	Loop 2, Alarm 1 high setpoint		
+1931	Loop 2, Alarm 2 low setpoint		
+1932	Loop 2, Alarm 2 high setpoint		
+1933	Loop 2, Alarm 3 low setpoint		
+1934	Loop 2, Alarm 3 high setpoint		

[Bank 3]

ADDRESS	PARAMETER	RANGE	DEFAULT
+1641	Loop 1, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 1 decimal setting)	0.0
+1642	Loop 1, Alarm 1 high setpoint		
+1643	Loop 1, Alarm 2 low setpoint		
+1644	Loop 1, Alarm 2 high setpoint		
+1645	Loop 1, Alarm 3 low setpoint		
+1646	Loop 1, Alarm 3 high setpoint		
+1993	Loop 2, Alarm 1 low setpoint	-3200.0 to +3200.0 (decimal by input 2 decimal setting)	0.0
+1994	Loop 2, Alarm 1 high setpoint		
+1995	Loop 2, Alarm 2 low setpoint		
+1996	Loop 2, Alarm 2 high setpoint		
+1997	Loop 2, Alarm 3 low setpoint		
+1998	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
+1248	Event input 1 function assignment	See the table below.	0
+1408	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 0
ON	OFF	Bank 1
OFF	ON	Bank 2
ON	ON	Bank 3

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 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
+1216	CT input 1, CT sensor type	See the table below.	0
+1376	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

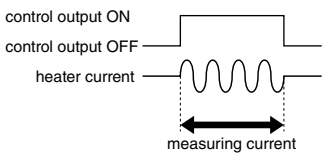
■ OUTPUT ASSIGNMENT

ADDRESS	PARAMETER	RANGE	DEFAULT
+1217	CT input 1, Output assignment	See the table below.	0
+1377	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.

• ALARM SETTING

Choose alarm functions.

ADDRESS	PARAMETER	RANGE	DEFAULT
+256	CT input 1, Heater wire break alarm	0 : Disable 1 : Enable	0
+262	CT input 1, SSR shortcircuit failure alarm		
+268	CT input 1, Overload alarm		
+512	CT input 2, Heater wire break alarm		
+518	CT input 2, SSR shortcircuit failure alarm		
+524	CT input 2, Overload alarm		

• ALARM SETPOINT

Specify a threshold for each alarm.

ADDRESS	PARAMETER	RANGE	DEFAULT
+257	CT input 1, Heater wire break alarm setpoint	0.0 to 600.0 A	0.0
+263	CT input 1, SSR shortcircuit failure alarm setpoint		
+269	CT input 1, Overload alarm setpoint		
+513	CT input 2, Heater wire break alarm setpoint		
+519	CT input 2, SSR shortcircuit failure alarm setpoint		
+525	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
+258	CT input 1, Heater wire break alarm hysteresis	0.0 to 99.9 A	0.0
+264	CT input 1, SSR shortcircuit failure alarm hysteresis		
+270	CT input 1, Overload alarm hysteresis		
+514	CT input 2, Heater wire break alarm hysteresis		
+520	CT input 2, SSR shortcircuit failure alarm hysteresis		
+526	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
+259	CT input 1, Heater wire break alarm latching	0 : Disable 1 : Enable	0
+265	CT input 1, SSR shortcircuit failure alarm latching		
+271	CT input 1, Overload alarm latching		
+515	CT input 2, Heater wire break alarm latching		
+521	CT input 2, SSR shortcircuit failure alarm latching		
+527	CT input 2, Overload alarm latching		

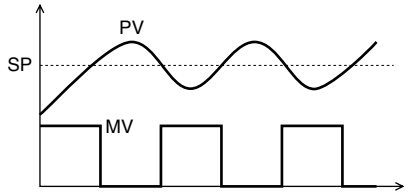
• ALARM OUTPUT

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
+260	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
+266	CT input 1, SSR shortcircuit failure alarm output		
+272	CT input 1, Overload alarm output		
+516	CT input 2, Heater wire break alarm output		
+522	CT input 2, SSR shortcircuit failure alarm output		
+528	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
+207	Loop 1, Auto-tuning control type	See the table below.	0
+463	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
+208	Loop 1, Auto-tuning hysteresis	0.0 to 999.9 (decimal by input 1/2 decimal setting)	0.1
+464	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
+209	Loop 1, Auto-tuning MV high limit	-105.00 to +105.00 %	100.00
+210	Loop 1, Auto-tuning MV low limit		-100.00
+465	Loop 2, Auto-tuning MV high limit		100.00
+466	Loop 2, Auto-tuning MV low limit		-100.00