SA1, SA3,SA4 Series Digital Controller

Instruction Manual

Please do not begin operating this product until you have read this instruction manual thoroughly and you understand its contents.

Safety Rules

For matters regarding safety, potential damage to equipment and/or facilities, additional instructions and notes are indicated by the following headings.

⚠ WARNING

This heading indicates hazardous conditions that could cause injury or death of personnel unless extreme caution is exercised.

⚠ CAUTION

This heading indicates hazardous conditions that could cause damage to equipment and/or facilities unless extreme caution is exercised.

NOTE

This heading indicates additional instructions and/or notes.

⚠ WARNING

The SA1, SA3,SA4 series digital controller is designed for controlling temperature/humidity and other physical quantities of general industrial equipment.
Avoid using it for control of devices upon which human life is dependant. When used, adequate and effective safety measures must be taken.
No warranty is valid in the case of an accident arising from the use of this product without having taken such safety measures.

⚠ CAUTION

- To avoid damage to connected equipment, facilities or the SA1, 3 ,4 itself due to a fault of the product, safety measures must be taken before usage, such as the installation of a fuse, an overheating protection device and the like.
- As a means to turn the power off, a switch or a breaker should be installed in the extemal power circuit to be connected to the power terminal of the instrument.
- Since the instrument does not have a built-in fuse, do not forget to install a fuse in the power circuit to be connected to the power terminal.
  Fuse rating/characteristics: 250V AC 0.5A/medium lagged or lagged type.

⚠ CAUTION

- Do not use this instrument other than specified.
- Using the instrument other than specified may result in trouble with the instrument or may cause a fire.
- Voltage/current of a load to be connected to the output terminal should be within a rated range.
- Do not block the draft hole or allow dust and the like to stick to the case of the instrument for heat discharge.
  A rise in temperature or insulation failure may result in a reduction of the life of the product and/or problems with it or may cause a fire.
- Do not operate keys on the front panel with a hard or sharply pointed object. Operate the keys only by softly touching them by your finger tips.
- When cleaning the instrument, wipe it gently with a dry cloth. Never use solvent such as thinner.

1. Introduction

1-1. Check before Use and Confirmation of Model Codes

This product has been fully inspected for quality assurance prior to shipment. However, you are requested to make sure that there is no error, damage or shortage of delivered items by checking the model codes and the external view of the product.

Confirmation of Model Codes

Check the model codes affixed to the case of the product to ascertain if the respective codes designate what was specified when you ordered it, referring to the following code table.

Item	Model	Instructions
1.Model	SA3－	W96×H96（mm）
	SA4－	W48×H96（mm）
	SA1－	W48×H48（mm）
2.Inputtype	8	Thermocouple:B,R,S,K,E,JN,PLII,WRe5-26,U,L R.T.D PT100
	6	Voltage,Current
3. Controlout put	Y－	Contact:2a 240VAC
	I－	Current:4～20mA DC(max.load resistance 600Ω)
	P－	SSR drive voltage:12V± 1.5VDC
	V－	Voltage:0～10VDC(max.load current2mA)
4. Eventout put	1	2 point:EV1 EV2
	2	3 point:EV1 EV2 EV3
5. Remarks	C	None
	M	Sensor power:24V DC 25mA

※ Ev3 and 24v sensor power sources cannot be selected at the same time.

2. About Installation

2-1.Installation Conditions (environmental conditions)

Note:

This instrument should not be used in any of the places mentioned below. Selection of any of the places may result in trouble with the instrument, damage to it or even a fire.

① Where flammable gas, corrosive gas, oil mist and particles that can deteriorate electrical insulation are generated or abundant.

② Where the temperature is below -10°C or above 50°C.

③ Where the relative humidity is above 90% RH or below the dew point.

④ Where highly intense vibration or impact is generated or transferred.

⑤ Where the instrument is exposed to dew drops or direct sunlight.

⑥ Where the instrument is directly exposed to the air of the heater or the air conditioner.

⑦ Where the height is above 2000m.

2-2.Wiring note

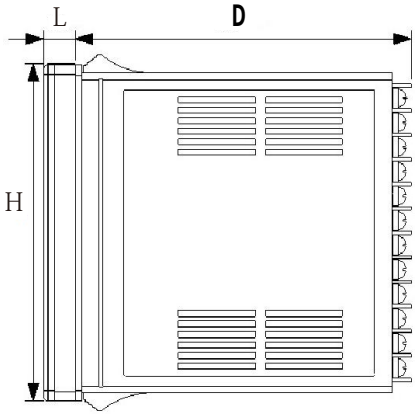
⚠ CAUTION

- Besure to turn off power before wiring.Failure to do so could result inelectric shock.
- After wiring,do not touch terminal elements or other charged parts while conducting electricity.Failure to do so could result in electric shock.

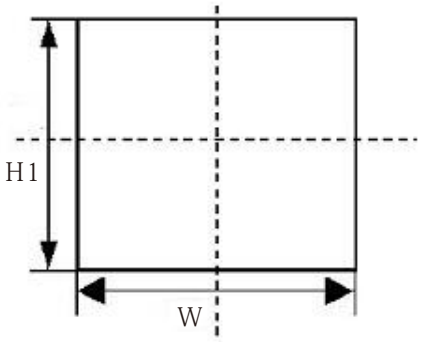
① Wire in accordance with the terminal layout on the controller.Afterwiring,check and make sure the wiring is correct.
② For thermo couple input,use a compensating conductor that matches the type of thermocouple.
③ For R.T.D.input,resistance for lead wires should be a maximun of 5Ω .per wire.All 3 wires should have the same resistance.
④ Input signal wires must not be accommodated with a strong electric circuit in the same conduit or duct.
⑤ Using shielded wiring is effective for static induction noise.
⑥ For power supply,use wiring or cable with sectional area of at least 1mm that offers the same performances as 600V vinyl insulated wiring.

2-3.External Dimensions and Panel Cutout

External dimensions



Panel cutout

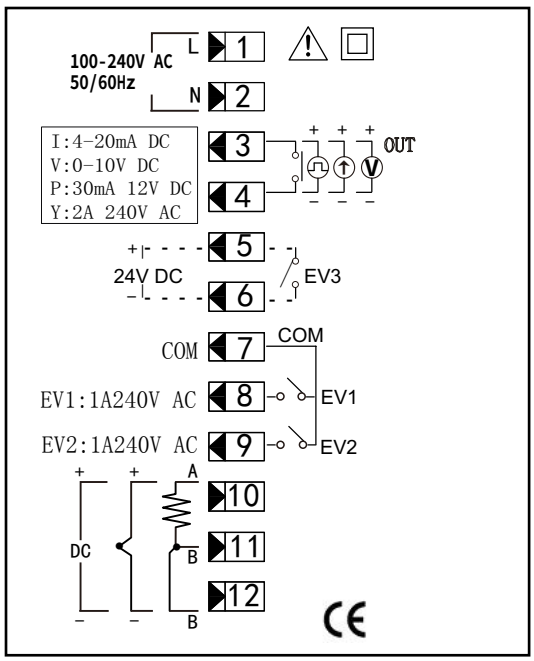


Unit: mm

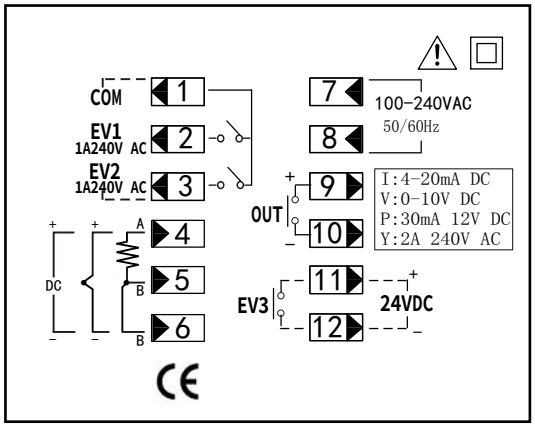
Model	External dimensions				Panel cutout	
	L	H	wide	D	H1	W
SA3	9	96	96	96	92+0.8	92+0.8
SA4	9	96	48	96	92+0.8	45+0.6
SA1	9	48	48	96	45+0.6	45+0.6

2-4.Terminal Layout

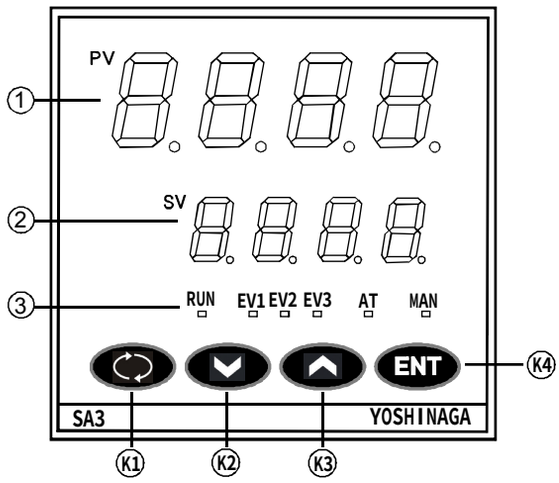
SA3/SA4



SA1



3.Names and Functions of Parts on Front Panel



Operation part

Num.	Name	Function
K1	Parameter key	Select screen groups and Switch parameters screen
K2	Down key	Decrements setting values. The longer the key is pressed, the set value change faster.
K3	Up key	Increments setting values. The longer the key is pressed, the set value change faster.
K4	Enter key	Enters setting values.

Display part

Num.	Name	Function
①	Measured valued(PV)/ Parameter names display	1.Displays current PV value. 2.Displays the name of parameters. 3.Displays type of abnormal measured input.
②	Target set value(SV)/ Set parameters display	1.Displays target set values. 2.Displays setting values on each respective parameter setting screen.
③	Action display	1.Displays status of controller.

Action display

OUT:Control output LED(green) MAN:Manual control LED(green)

EV1,EV2,EV3:Event output LED(orange) AT:Auto turning LED(green)

4.Basic setting

4-1. Input type setting

※ During sensor input, the lower limit and the higher limit of measuring range is displayed and no change is possible.

※ During linear input(mA,V), The higher/lower limit value of scaling can be set.

※ A set code is unable to changed in running mode.
Note: A change of a measuring range code will initialized all datas related to the measuring range.

4-2. Proportional cycling time

Initial value

P output:3 seconds.

Y output:30 seconds.

※ Short cycle regulation changes fast,suitable for small inertia system, large inertia of the cycle canbe setlonger.

4-3. Control out put limiter setting

Output value is setting independently for higher limit and lower limit.The lower limit(0.0~99.9%) is less than the higher limit(0.1~100.0%).Example:for 0~10V output range,OUT limit value is set to 20%,OUT limit value is set to 80%,then the output range is 2~8V.

5.AUTO TURNING(AT)

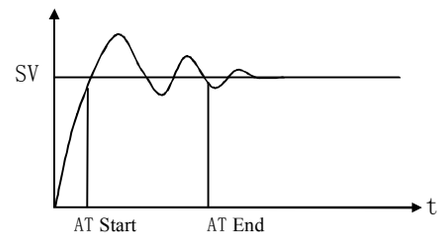
5-1. Function

This is the Function to automatically calculate and set P. I. D values, i.e., parameters of PID control.the time required for calculation depends on the details of control.

5-2 AT execution

Press the UP key on the "0-2 AT execution setting screen"changes OFF shown on the target set value(SV) display to ON and the decimal point on the rightmost digit blinks. Upon pressing the ENT key, the decimal point stops blinking and AT action begins. The AT lamp flashes when auto turning being executed.

While AT is in execution, ON/OFF action of output is repeated several times in accordance with rise and fall of the measured value from the target value as the border and the PID values are saved in an internal memory.Immediately when they are stored, control using these PID values begins and AT action ends. Then, the target set value display shows OFF and the AT lamp stops flashing.



Auto turning schemes

5-3. Cancellation of AT

To cancel AT before it finishes, press the down key on the " 0-2 AT execution setting screen" and select " OFF" .When then enter key is pressed, AT is cancelled.The AT lamp then stop flashing.
NOTE:If AT is cancelled before completion, PID values are not changed.

5-4. AT cannot be executed

AT cannot be executed under any of the following conditions.

1.Control output is in manual mode.
2.The proportional band(P) of control output is oFF.
3.Do not perform when PV measurement exceeds range
4.0-2 window lock 2.3 modes are not executed

6.Setting of Event(EV1.EV2)Action Type

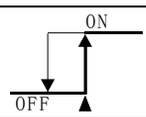
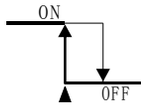
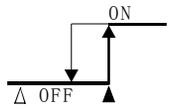
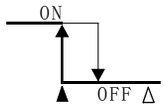
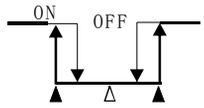
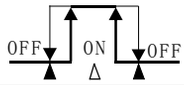
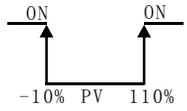
6-1. Select and register a code for either mode 1 (1-11, 1-13, 1-14, 1-16) "Alarm code" or "Alarm standby code".

6-2. Event selection alarm action diagrams.

The following are alarm action diagrams for selecting event.

△:Target set SV value

▲:Alarm action point

Eventtype	Diagrams	Explanation
non	non	No event alarm
HA		Higher limit absolute value
LA		Lower limit absolute value
Hd		Higher limit deviation
Ld		Lower limit deviation
od		Outside higher/lower limit deviations
Id		Within higher/lower limit deviations
So		Scaleover

7. Event Action

7-1. Deviation Alarm

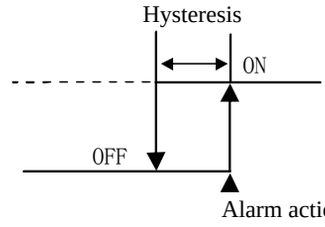
The alarm action point will change along with the target set value (SV). For example, when the target set value is 20°C, +10 should be set for higher limit deviation alarm in order to put an alarm in action at 30°C and higher. To put an alarm action at 30°C and lower when the target set value is 100°C, –70°C should be set for higher limit deviation alarm.

7-2. Absolute Value Alarm

An alarm action point is set by an absolute value. For example, when the measured value exceeds 100°C, 100°C should be set for higher limit absolute alarm in order to put an alarm in action at 100°C and higher. To put an alarm in action at 70°C and lower 70°C should be set for lower limit absolute alarm.
In case of absolute value alarm, the alarm only works for the measured value (PV) with no relation to the target set value (SV).

7-3. Hysteresis

Set alarm hysteresis to avoid alarm false operation and frequent alarms. Alarm hysteresis is set independently for EV1 and EV2, the initial value is 5 units.As shown below:



7-4. Standby action

- The measured value may be within an event action area when applying power.To avoid this situation can use standby action.
- In case on is set for event standby ,there is no event output upon applying power even when measured value is within an event action area. Even is output when it reaches the event action area again after it gets out of the event action area.

※ . Standby action code table

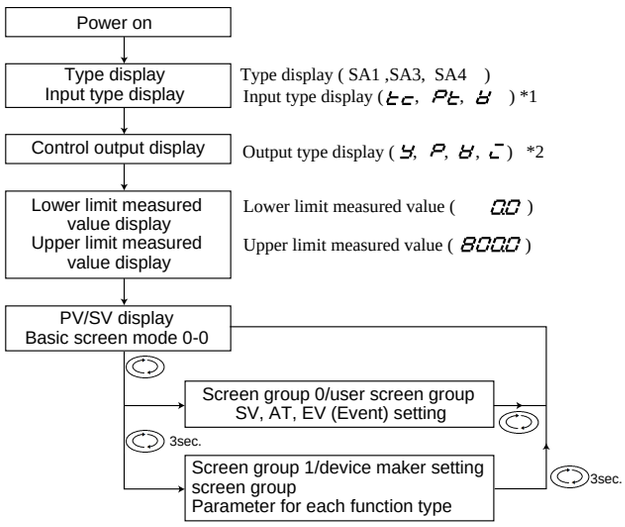
1: No standby action
2: Standby action only when power is applied
3: Standby action when power is applied or when changed to SV
4:Alarm state suppression when overrun

8. Outline of Specifications

Display	
Display accuracy	±(0.3% FS+1digit)
Display accuracy maintaining range	23±5°C
Measured value display range	Input range or –10~110% of measuring range
Setting	
Setting method	By operating 4 keys on the front panel
Setting limiter	Within the measuring range, individual setting for higher and lower limits (Lower limit<Higher limit)
Input	
Input type	Multi input (TC, Pt100, Jpt100) V (In case of mA input, Current input handled by external receiving impedance 250Ω
PV bias	–1999~2000 Unit
PV filter	0~100 seconds
Control	
Control mode	Auto tuning PID control, manual control
Type of control output	Relay contact, SSR drive voltage, voltage, current
Output control characteristics	RA/DA switching
Output limiter	Lower limit: 0.0~99.9% Upper limit: lower limit +0.1~100.0%
Event	
Output points	3 points EV1, EV2,EV3
Contact rating	240V AC 1A (resistive load)
Event type	Absolute values, deviations (higher, lower, higher/lower, within, outside)
Event action	On-Off action
Standby action	Selectable from the 3-type standby mode
General specifications	
Ambient temperature for operational condition	–10°C~+50°C
Supply voltage	100~240V AC±10% 50/60Hz
Power consumption	Approximately 10VA(max)

9.Explanation of Screens and Setting

9-1.How to change screens



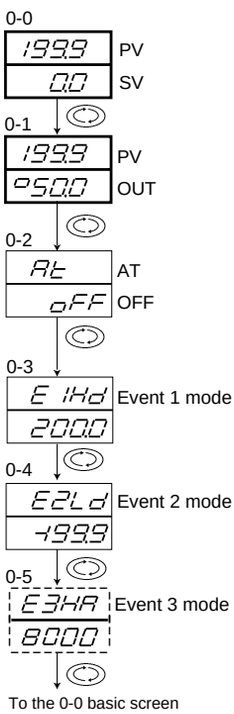
Pressing the ◌ key continuously for 3seconds calls the 1-0 initial screen of screen group 1.

*1: Input type display
tc: Thermocouple, Pt: R.T.D, V: Voltage (V)

*2: Output type display
Y: Contact, P: SSR drive voltage, V: Voltage, C: Current

When the ∧ and ∨ keys are pressed on the setting screen, the decimal point of the rightmost digit flashes and the numerical value can be changed. The set numerical value will be registered and the digit will go off when the ENT key is pressed.

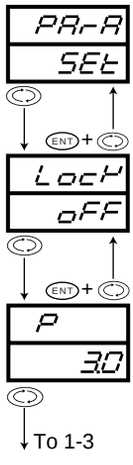
9-2.Mode 0 screen group



Mode No. Screen title	Function
0-0	Basic screen
0-1 manual mode	(1)Manual control of control output (manual mode) To Switch Automatic→Manual, Manual → Automatic, press the ENT key for 3 seconds continuously on the 0-1 screen. Upon turning to manual, the MAN lamp flashes and the output value can be selected by the use of ∧ and ∨ keys. To cancel, press the ENT key again for 3 seconds continuously and automatic output will return.
0-2 Auto tuning	AT is a function of automatically processing and setting P.I.D.control. ※ Refer to **5** AUTO TURNING(AT)
0-3 Event 1 action points	Event 1 action point setting (Initial value: refer table 3)
0-4 Event 2 action points	Event 2 action point setting (Initial value: refer table 3)
0-5 Event 3 action points	Event 3 action point setting (Initial value: refer table 3) ※ **EV3 is not selected. This window is not displayed**

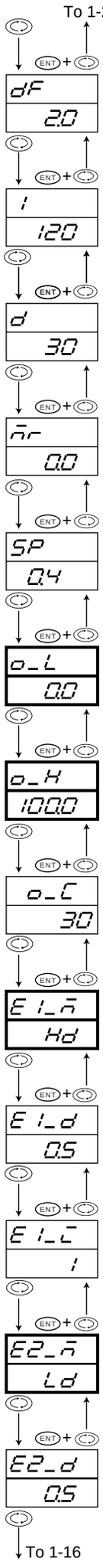
9-3.Mode 1 (Device maker setting screen group)

Pressing the ◌ key continuously for 3 seconds on the basic screen will proceed to the mode 1 screen group.



Mode No. Screen title	Setting range ( ) = initial value	Function
1-0 Initial screen		Initial screen
1-1 Key lock setting	OFF 1~3 (OFF)	OFF: Key control possible for all screens 1: Key control not possible for screens except user setting screen group 2: Key control not possible for other than SV setting 3: All key control not possible
1-2 Proportional band setting	OFF, 0.1~999.9% (3.0) Control output: During contact P=OFF (factory setting)	The width of proportional band will be set during the time of control. The smaller the proportional band, the larger the output difference for the deviation (gap between PV and SV).

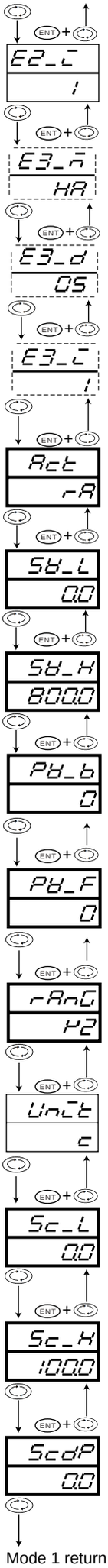
*When the ◌ key is pressed while the ENT key is being pressed, the preceding setting screen is called back.



Mode No. Screen title	Setting range ( ) = initial value	Function
1-3 Hysteresis setting	1~999 Unit (20)	The width of hysteresis during ON-OFF control P=OFF Displays while setting.
1-4 Integral time setting	OFF, 1~6000 sec. (120) P or P+D control when OFF setting	Time setting to cancel the offset (deviation) which occurs during proportional control Integral action cannot take action when I=OFF. No display when P=OFF.
1-5 Derivative time setting	OFF, 1~3600 sec. (30) P or P+I control when OFF setting	Estimates the fluctuation of the outcome of control and will conduct correction. Integral action cannot take action when d=OFF. No display when P=OFF.
1-6 Manual reset setting When I:OFF is set	–50.0~50.0% (0.0)	Will correct the offset which occurred at proportional control manually. No display when P=OFF.
1-7 Target value function setting	OFF, 0.01~1.00 (0.4)	A function which controls the overshoot and undershoot when the target value is reached. The effect is large when 1.00 and small when 0.00. No display when P=OFF.
1-8 lower limit output limiter setting	0.0~99.9% (0.0)	Will set the control output of lower limit value.
1-9 higher limit output limiter setting	0–L+0.1~100.0% (100.0)	Will set the control output of higher limit value.
1-10 Proportional cycle time setting When Y, P is output	1~120 sec (Y: 30, P: 3) No display when I, V is output	The output of the proportional cycle will be set when contact and SSR drive voltage are outputted. No display if the type of the control output is current or voltage.
1-11 EV1 type Code setting	OFF, Hd~So (HD)	OFF: None Hd: Higher limit deviation Ld: Lower limit deviation od: Outside higher/lower limit deviations Id: Within higher/lower limit deviations HA: Higher limit absolute value LA: Lower limit absolute value So: Scale over
1-12 EV 1 Hysteresis setting	1~999 Unit (5) Alarm code No display when So (So: scale over, see 6-2)	The width of hysteresis when alarm relay is ON and OFF.
1-13 EV 1 Standby action setting	1~4 (1) Alarm code No display when So	1: No standby action 2: Standby action only when power is applied 3: Standby action when power is applied or when changed to SV 4: Control mode (no standby)
1-14 EV 2 type Code setting	OFF, Hd~So (LD)	Same as EV1
1-15 EV 2 Hysteresis setting	1~999 Unit (5) Alarm code No display when So	Same as EV1

*When the ◌ key is pressed while the ENT key is being pressed, the preceding setting screen is called back.

To 1-15



Mode No. Screen title	Setting range ( ) = initial value	Function
1-16 EV 2 Standby action setting	1~4 (1) Alarm code No display when So	Same as EV1
1-17 EV 3 type Code setting	OFF, Hd~So (HA)	Same as EV1
1-18 EV 3 Hysteresis setting	1~999 Unit (5) Alarm code No display when So	Same as EV1
1-19 EV 3 Standby action setting	1~4 (1) Alarm code No display when So	Same as EV1
1-20 Control output characteristics setting	rA/dA (rA)	Switching the characteristics of control action rA : heating/humidify (reverse action) dA: cooling/dehumidify (direct action)
1-21 SV lower limiter setting	Lower limit value of measuring range (0.0) within measuring range SV_L<SV_H	In case a narrower setting range of target value than a measuring range is used, a lower limit value is set.
1-22 SV higher limiter setting	Higher limit value of measuring range (800.0)	In case a narrower setting range of target value than a measuring range is used, a higher limit value is set. (It can prevent erroneous setting in a risky range and has some other advantageous effect.)
1-23 PV bias value Setting Screen	–1999~2000 Unit (0/0.0)	This value is used to correct an input error from a sensor or the like. The displayed value will change based on the set number. When a bias is given, control is also carried out with a corrected value.
1-24 PV Filter time setting screen	0~100 sec (0)	Incase input changes conspicuously or noise continues, PV filter is used to mitigate such undesirable effect. When 0 second is set, filter does not function.
1-25 Measuring range code setting screen	Default value:K2	Each code represents a combination of an input type and a measuring range. (Refer to 11. Table 1.Table of Measuring Range Codes)
1-26 Input unit setting screen	C/F (˚C)	Select the temperature unit for sensor input and register by ENT key. This screen is not displayed when linear input (V or mA) is set.
1-27 Input scaling Lower limit value setting	–1999~9999 unit (0.0)	A lower limit value of scaling of linear input is set and registered by ENT key. (For sensor input, the screen is for monitoring only and setting is not possible.)
1-28 Input scaling Higher limit value setting	SCL+10~SCL+5000 (100.0)	A higher limit value of scaling of linear input is set and registered by ENT key. (For sensor input, the screen is for monitoring only and setting is not possible.)
1-29 Input scaling Decimal point setting	None~0.001digit on the right of decimal point (0.0)	The position of decimal point during linear input scaling is set and is registered by ENT key. (For sensor input, the screen is for monitoring only and setting is not possible.)

Mode 1 return to the initial screen

10. Cause of Trouble and Troubleshooting

Screen display	Problem	Cause	Remedy
HHHH	Higher limit scaleover	1.Break in thermocouple input wiring 2.Input measured value exceeded higher limit of measuring range by 10%	1.Check thermocouple input wiring for possible break.If there is nothing wrong with wiring, replace thermocouple. 2.For voltage or current input,check the measurement signal transmission unit. Check if set measuring range code is correct for input signal.
LLLL	Lower limit scaleover	Input measured value fell bellow lower limit of measuring range by 10%	Check for measurement input wiring reverse polarity or possible break
b---	Break in R.T.D wiring	Break in R.T.D wiring	Check R.T.D. input wiring for possible break. If there is nothing wrong with wiring,replace R.T.D.
CJuu	Higher limit scaleover of cold junction of thermocouple input	Ambien temperature has exceeded 80℃	1.Reduce ambient temperature to the level provided in the environment conditions. 2.If ambient temperature has not exceeded 80℃, examine the controller.
CJnn	Lower limit scaleover of cold junction of thermocouple input	Ambien temperature has fallen below -20℃	1.Raise ambient temperature to the level provided in the environment conditions. 2.If ambient temperature has not fallen below -20℃, examine the controller.

11.Schedules

Table 1.Table of Measuring Range Codes

	Input type	Display Code	Measuring range
Thermocouple	K	K1	-199.9～+400.0℃
	K	K2	0.0～800.0℃
	K	K3	0～1200℃
	R	r	0～1700℃
	J	J	0～600℃
	E	E	0～700℃
	S	S	0～1700℃
	T	t	-199.9～+200.0℃
	N	n	0～1300℃
	B	b	0～1800℃
	PLII	PL2	0～1300℃
	WRe5-26	WrE5	0～2300℃
	U	u	-199.9～+200.0℃
	L	L	0～+600℃
R.T.D.	Pt100	Pt1	-200～+600℃
	Pt100	Pt2	-100.0～+100.0℃
	Pt100	Pt3	-50.0～+50.0℃
	Pt100	Pt4	0.0～200.0℃
Voltage	-1～1V	-1_1	Scaling possible. Setting range: -1999~ 9999 unit Span:10~10000 unit
	0～1V	0_1	
	0～2V	0_2	
	0～5V	0_5	
	1～5V	1_5	
	0～10V	0_10	

Table 2.EventType

Code	Type of event	Comment
non	None	
Ha	Higher limit absolute value	For the initial value and setting range,see the "Table 3:Event initial value and setting range"
La	Lower limit absolute value	
Hd	Higher limit deviation	
Ld	Lower limit deviation	
Id	Within higher/lower limit deviations	
Od	Outside higher/lower limit deviations	
So	Scaleover	

Table 3.Event Initial Value And Setting Range

Input Type	Display Code	Initial Value	Setting Range
Multi input	Ha	Measuring range higher limit value	Within measuring range
	La	Measuring range lower limit value	Within measuring range
	Hd	2000 unit	-1999~2000 unit
	Ld	-1999 unit	-1999~2000 unit
	Id/Od	2000 unit	0~2000 unit
Voltage/ Current inpurt	Ha	1000 unit	0~1000 unit
	La	0 unit	0~1000 unit
	Hd	2000 unit	-1999~2000 unit
	Ld	-1999 unit	-1999~2000 unit
	Id/Od	2000 unit	0~2000 unit

NOTE:
1.Thermocouple B:Accuracy guarantee not applicable to 400℃ or below.
2.Pt3:Accuracy of this whose reading is ± 0.25%FS.
3.Thermocouple K,T,U:Accuracy of those whose readings are below -100℃ is ± 0.7%FS.
4.Current input handled by external receiving impedance 250Ω
5.The input type can be changed during reset mode.
6.If the setting is modified,all data related to measuring range will beinitialized.
7.Unless otherwise specified, the measuring rang will be set as follows when shipped from the factory.

Input	Display code	Measuring range
Multi input(M)	K2	0.0～800.0℃
Voltage(V)	0_10	0.0～100.0

The contents of this manual are subject to change without notice.

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