

# SMA93/73/33 Series Digital Controller Instruction Manual

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

## 1. Safty rules

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

- ⚠ WARNING:** Matters that could result in injury or death if instructions are not followed.
- ⚡ CAUTION:** Matters that could result in equipment damage if instructions are not followed.

### ⚠ WARNING

The SMA series digital controllers are designed to control temperature and other physical quantities of general industrial equipment. You should either take appropriate safety measures or avoid using for control that could have a serious effect on human life. The manufacturer shall not be liable for an accident that results if used without taking appropriate safety measures.

- Safety caution**
- You should be shocked if you touch charged parts.
- The controller does not have a built-in fuse. Be sure to mount a fuse on the power circuit connected to the power terminal. Fuse rating: 250V AC 0.5A
- Always consider the application conditions and use the output relays within their rated load and electrical life expectancy.
- Do not allow pieces of metal, wire clippings, or fine metallic shaving or filings from installation to enter the product.
- Do not use the product where subject to flammable or explosive gas. Otherwise, minor injury from explosion may occasionally occur.
- Never disassemble, modify or repair the product.
- Do not apply voltage/current other than rated input to the input terminal. Doing so could shorten product life and lead to equipment failure.
- A malfunction in the temperature controller may occasionally make control operations impossible or prevent alarm outputs, resulting in property damage. To maintain safety in the event of malfunction of the controller, take appropriate safety measures, such as installing a monitoring device on a separate line.

### ⚡ CAUTION

- Be sure to wire properly with correct polarity of terminals. Do not wire the terminals which are not used.
- To avoid inductive noise, keep the wiring for the controller's terminal block away from power cables carry high voltages or large currents. Using shielded cables and using separate conduits or ducts is recommended.
- Design system (control panel, etc) considering the 2 seconds of delay that the controller's output to be set after power on.
- To allow heat to escape, do not block the area around the product. Do not block the ventilation holes on the product.
- Do not use paint thinner or similar chemical to clean with. Use standard grade alcohol.
- Always turn off the power supply before pulling out the interior of the product, and never touch nor apply shock to the terminals or electronic components. When inserting the interior of the product, do not allow the electronic components to touch the case.
- Use this product within the rated load and power supply.
- Do not use this product in the following places
  - \*Places subject to dust or corrosive gas.
  - \*Places subject to icing and condensation.
  - \*Places subject to direct sunlight.
  - \*Places subject to vibration and large shocks.
  - \*Places subject to splashing liquid or oil atmosphere.
  - \*Places directly subject to heat radiated from heating equipment.
  - \*Places subject to intense temperature change.

## 2. Specifications

Supply voltage	: 100-240V AC ±10% 50/60Hz
Power consumption	: 6VA MAX
Display accuracy	: ±0.2% FS+1 digit
Sampling cycle	: 0.2 seconds
Control characteristics	: Positive action (DA, cooling control) Reaction (RA, heating control)
Control output accuracy	: 0.0125% (1/8000)
Output updating cycle	: 0.2 seconds
Data storage	: Non-volatile memory (EEPROM)
Use of environmental conditions	
Temperature	: -10 ~ 50
Humidity	: Max. 90%RH (no dew condensation)
Elevation	: Max. 2000 m above sea level
Category	:
Pollution	: 2
Storage temperature	: -20 ~ 65
Input/noise removal ratio	: Normal mode minimum 50dB
Insulation resistance	: Between input/output terminals and power terminal Min. 500V DC, 20M
Dielectric strength	
Between input/output terminals and power terminal	: 2300 V AC, 1 minute
Between input and Y output	: 2300 V AC, 1 minute
Between input and P, I, V output	: 2300 V AC, 1 minute
Material of case	: ABS+PC
External dimensions	
SMA33	: 48 × 48mm
SMA73	: 48 × 96mm
SMA93	: 96 × 96mm
Weight	
SMA33	: Approx. 100g
SMA73	: Approx. 160g
SMA93	: Approx. 220g
Applicable standards	
Safety	: IEC61010-1 and EN61010-1
EMC	: EN61326-1 : 2006

## 3. Model code and accessories check

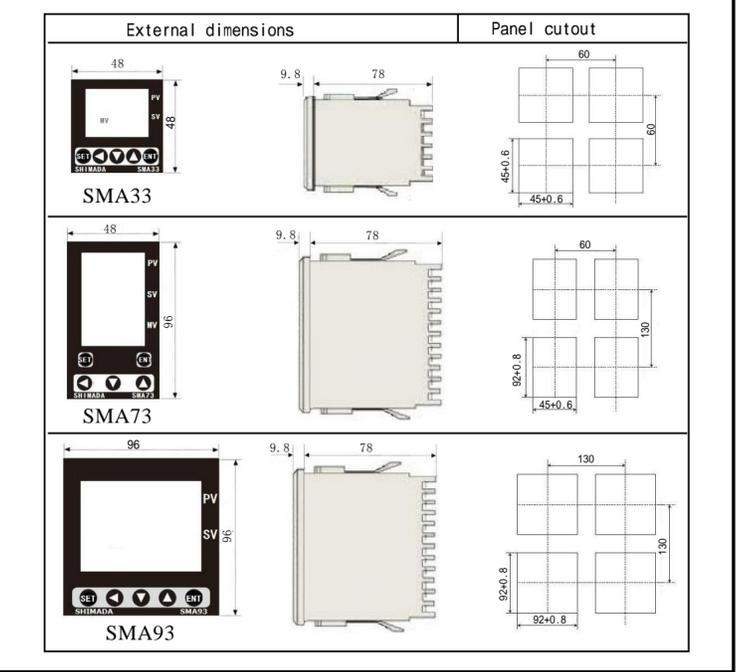
You should check the specification code and make sure you have all the accessories to make sure nothing is missing. Compare the specification code on the case with "3. Model Selection table" to make sure it is the product you ordered. Please verify the following attachments is complete:

- Digital Controller 1
- Instruction Manual 1
- Fixed buckle 2

## 4. Model Selection table

Item	Model	Standard configuration: Control output 1
1. Model	SMA93-	W 96 × H 96 (mm)
	SMA73-	W 48 × H 96 (mm)
	SMA33-	W 48 × H 48 (mm)
2. Input type	8	Thermocouple: B, R, S, K, E, JN, PLII, WRe5-26; U, L (DIN43710); R.T.D: PT100
	6	Voltage: -1~1, 0~1, 0~5, 0~10, 1~5V DC Current: (4~20mA, 0~20mA) Handled by external receiving impedance 250Ω
3. Control output 1	Y	Contact: 1a 240V AC 3A (inductive load)
	I	Current: 4~20mA DC (max. load resistance 600Ω)
	P	SSR drive voltage: 12V ±1.5V DC (max. load current 30mA)
	V	Voltage: 0~10V DC (max. load current 2mA)
4. Control output 2	N	None
	Y	Contact: 1a 240V AC 3A (inductive load)
	I	Current: 4~20mA DC (max. load resistance 600Ω)
	P	SSR drive voltage: 12V ±1.5V DC (max. load current 30mA)
5. Power supply	A	100 ~ 240VAC ±10% 50/60Hz
	D	24VAC/DC ±10% 50/60Hz
6. Procedure	N	None
	P	Program control (40 steps)
7. Event output	2	2point: EV1, EV2
	1	1point: EV1
8. Analog output (SMA33 No choice)	0	None
	4	Current (4~20mA), max. load resistance 300Ω
	6	Voltage (0~10V), max. load current 2mA
9. Communication function	0	None
	5	RS-485
10. External input (DI) (SMA33 No choice)	0	None
	1	1 point (RUN/SV2)
11. Status output (DO) (SMA33 No choice)	0	None
	1	2 points: DO1, DO2
12. Special notes	0	None
	1-9	Have

## 5. External dimensions and panel cutout



## 6. Wiring note

### ⚡ CAUTION

- Be sure to turn off power before wiring. Failure to do so could result in electric shock.
- After wiring, do not touch terminal elements or other charged parts while conducting electricity. Failure to do so could result in electric shock.
- Wire in accordance with the terminal layout on the controller. After wiring, check and make sure the wiring is correct.
- For thermocouple input, use a compensating conductor that matches the type of thermocouple.
- For R.T.D. input, resistance for lead wires should be a maximum of 0.5Ω per wire. All 3 wires should have the same resistance.
- Input signal wires must not be accommodated with a strong electric circuit in the same conduit or duct.
- Using shielded wiring is effective for static induction noise.
- For power supply, use wiring or cable with sectional area of at least 1mm<sup>2</sup> that offers the same performances as 600V vinyl insulated wiring.

## 7. Names and functions of parts on front panel



Symbol	Name	Function	
SET	Parameter key	Select screen groups and Switch parameters screen	
Up key	Up key	Increments setting values.	
Down key	Down key	Decrements setting values.	
Shift key	Shift key	Mobile data bit. When modifying parameters, this key first	
ENT	Enter key	Decrements setting values	
PV	Measured value (PV)/Parameter names display	1. Displays current PV value 2. Displays the name of parameters. 3. Displays type of abnormal measured input.	
	SV	Target set value (SV)/Set parameters display	1. Displays target set values. 2. Displays setting values on each respective parameter setting screen.
	MV	Control output value	1. Control output 1 output percentage 2. For two outputs, press the SET + ENT key, the OUT2 light flashes, and MV is the output percentage of control output 2.
Action display	SV rise	SV rise	
	Curve status display	SV flat SV drop	
	AL1	Event output 1 LED	
AL2	Event output 2 LED		
OUT1	Control output 1 LED		
OUT2	Control output 2 LED		
MAN	Manual control LED		
AT	Auto turning LED		
RUN	Action display LED		
COM	Communication mode		

## 8. Basic setting

- Modify parameter setting method**  
When making parameter change in each window, press Key activation, press key again or press the key to change the data, and finally press the ENT key to confirm.
- 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 be changed in running mode.  
Note: A change of a measuring range code will initialize all data related to the measuring range.
- Control output characteristics**  
Control output characteristics can be set independently for output.  
For heating, set to RA (reverse action) and for cooling set to DA (direct action).
- Proportional cycling time**  
Initial value: P output: 2 seconds, Y output: 30 seconds.  
Short cycle regulation changes fast, suitable for small inertia system, large inertia of the cycle can be set longer.  
\* When 4-20mA / 0-10V is output, this window is not displayed.
- Control output ON-OFF control**  
When P = OFF, the integral I and differential D parameters are automatically canceled, and the position sensitivity adjustment parameter dF [1-3] window appears for adjusting the position motion width.  
For example: during the reaction, the set value is 500, the dF sensitivity is 10, the "Y" relay contact is turned off at 505, and is pulled in at 495 or below.
- Control output limiter setting**  
According to the needs of the site, you can set the upper and lower limit output values in the [1-6] [1-7] window.  
Example: for 0~10V output range, OUT1 limit value is set to 20%, OUT2 limit value is set to 80%, then the output range is 2~8V.
- Slope control**  
From stop to running state, the regulator starts from the current measured value PV and runs according to the set slope parameter. When the target set value SV changes or the slope value changes, the slope control is restarted.  
\* Only valid when setting control, (with the program table screen blocked), set the window (4-18) "ramp", set the unit: degrees/minute
- Timing function**  
When the measured value PV is equal to the set value SV, the timer will start, and the controller will stop when the heat preservation platform ends.  
During the timing of the insulation platform, if the target set value changes, the time is re-timed.  
When the platform is active, the platform signal light is ON. (This window is masked when the regulator has a program function). Setting window (4-19). unit: hour/minute.
- Manual setting of control output**  
On the main screen, press the SET+ENT key for 3 seconds to switch between automatic/manual status.  
When manually outputting, the MAN light is on, press the / key to set the control output percentage.  
When equipped with control output 2, click the SET+ENT key to switch the manual control between Out1 and Out 2, and the corresponding selected control output signal light is on.  
\* In the standby state or at automatic turning (AT) state, the manual output is invalid
- Run and stop**  
After setting the parameters, the user must set it to (RUN) in the (0-1) window to run. The "RUN" light is on during the running state.  
Run / Stop Shortcut  
Press the and keys simultaneously on the basic screen for 3 seconds, the RUN light is on, and the meter enters the running state, otherwise it stops.  
If the user selects the DI function and selects "RUN" in the (4-20) window, the external control input will take precedence.
- Return function**  
In any screen except user layer, if there is no operation for 1 minute, the screen will automatically return to 0-0 basic screen  
In any setting window, press the SET key for 2 seconds, the screen will return to the 0-0 basic screen

## 9. Program control function

- Program operation and constant value control switching**  
Set the "F-SV" setting control/P-SV program control in the [2-1] SV-M window.
- Use program to control preparameter settings**  
1) Set up in window group 2 (program parameter layer): number of curves, number of times of execution, time unit, ensure platform wait and power off protection, etc.  
2) Set in window group 3 (program setup layer): start SV value, end step number, PV start and curve step target value and time.
- PV start function**  
1) If the PV value fits between the start SV value (SSV) and target step 1 SV value (SV1), the PV start function operates and time is shortened.  
 1: SSV ≧ PV ≧ SV1  
 2: SSV ≧ PV ≧ SV1  
 T1: Shortened time PV start. T2: Execution time  
 2) If the PV value exists in a place that exceeds the step 1 SV value (SV1), the PV start function operates and step 1 is omitted.  
 1: SSV < SV1 < PV  
 2: SSV > SV1 > PV  
 4. **Guarantee soak zone**  
If PV is not in the specified guarantee soak zone when switching from an inclination step to a level step, it does not shift to the next control step. It is only effective when shifting from an inclination step to a level step.  
 (1) Guarantee soak zone OFF: After step 1 time elapses, it shifts to step 2 even if PV has not yet reached SV1. (Follow picture 1)  
 (2) If guarantee soak zone is set:  
 After step 1 time elapses, it shifts to step 2 if it has reached the Guarantee soak zone (Follow picture 2)  
 If the Guarantee zone has not yet been reached even though step 1 time has elapsed, guarantee soak is executed until it reaches the Guarantee zone. (Follow picture 3)  
 Picture 1, Picture 2, Picture 3  
 5. **Power failure compensation**  
If the power failure when the program being executed, when the power is applied again, the program starts up in a state preceding the power failure.  
 6. **Program execution forced jump:**  
In the (0-2) "STEP" window, press the button for 3 seconds, the program control ends the current execution step, the forcibly jumps to the next.  
 7. **Program execution pause:**  
In the (0-2) "STEP" window, after the button is pressed for 3 seconds, the program pauses, and then press the button for 3 seconds to release the pause and the program continues to run.

## 10. Auto turning (AT)

- 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.
- AT execution**  
Press the UP key on the "0-7 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 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.  
 3) AT cannot be executed AT cannot be executed under any of the following conditions.  
 1. Control output is in manual mode.  
 2. Reset mode.  
 3. The proportional band (P) of control output is OFF.  
 4. Do not perform when PV measurement exceeds range.
- Cancellation of AT**  
To cancel AT before it finishes, press the down key on the "0-7 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.

## 11. Option function

- Analogue output (AO)**  
The analogue output is after the current measured value (PV), the preset target value (SV) or output value (OUT) is converted to voltage or current outputs. For recorders, cascade control, etc.  

Analogue output type	Analogue output scaling lower limit value	Analogue output scaling higher limit value
PV	Lower limit value of measuring range	Higher limit value of measuring range
SV	Lower limit value of measuring range	Higher limit value of measuring range
OUT	0.0%	100%
- External control input DI**  
An external voltage-free contact input -- (simplifies the complexity of the button operation).  

Settings window	Code	External control input allocation type	Note
[4-20]	non	No selection	Initial value: non
	RUN	Run/stby	Level
	SV2	SV2 Set value	Level SV2 Settings window [4-21]

 \* SV2: double set SV value, (for daylight control in greenhouse, pre-heating or heat preservation of heating system)
- Communication function**  
With the SMA series, RS-485 communications Using MODBUS RTU protocol and SHIMADA's standard protocol.  
\* For details see SMA Series Digital Controller Communications Interface Instruction Manual.  

Name	Code	Setting range	Initial value	Settings window
Communication address	Addr	1-255	1	[4-27]
Communication data format	dATA	E81 E82 N81 N82	E81	[4-28]
Communication speed	bps	2400 4800 9600 19200 38400	9600	[4-29]
Communication memory mode	MEM	RAM, EP, EEP	EEP	[4-30]
Communication protocol	Adm	rtu: MODBUS rtu protocol SMA: Shimada agreement	RTU	[4-32]

12. Other explanation of functions

- 1) .PV bias and filter time
  - **PV bias:** Used for compensating input error of sensors, etc. The PV bias can be set on "4-7 pv bias". When bias is applied, control is also executed according to the compensated value
  - **PV filter time:** Used to alleviate the effect if input varies radically or noise is superimposed. The larger the set value, the stronger the filtering effect, but affect the measurement speed the specific settings be adjusted according to the situation.
- 2) .Output Manual Resel setting Screen (Mr)
  - In PID action, an offset is corrected automatically by I, i.e., integration. When OFF is set for I, output should be increased or decreased manually. This method is called manual resel
  - Mr setting window [1-5], setting range: -50 to 50%.
- 3) .Output target value function setting screen(sp)
  - A function which controls the overshoot and undershoot when the target value is reached.
  - The effect is large when 1.0 and small when 0.0.
  - Setting range: 0.0~1.0, Initial value:0.4
- 4) . Key lock function
  - At the completion of parameter adjustment, in order to prevent misoperation change parameter setting, the keystrokes can be locked, locking rear can only view the set parameters.
  - Setting window [4-1]
  - Setting range: 0: not locked, 1: set the screen lock except the user layer, 2: Screen lock except user layer run/stop

13. Alarm

The SMA93 / 73/33 standard configuration provides 2 relay alarm outputs. Set the alarm type in the [4-9] [4-12] window, and set the actual alarm value of the alarm relay in [0-5] [0-6] or Deviation.

13.1. Event selection alarm action diagrams

△:SV value ▲:Set value of alarm action point

Event type	Diagrams	Explanation
non	OFF	No event alarm
HA		Higher limit absolute alarm
LA		Lower limit absolute alarm
Hd		Higher limit deviation alarm
Ld		Lower limit deviation alarm
Od		Outside higher/lower limit deviation alarm
Id		Inside higher/lower limit deviation alarm
So		Scaleover
RUN		The program control/fixed value control triggers the alarm when it is running; when it stops, it cancels the alarm.
MAN		When manual control is, an alarm is triggered; other states, the alarm is canceled.
AT		The alarm is triggered during auto-tuning; the auto-tuning ends and the alarm is canceled.
RST		An alarm is triggered when the program ends. When the fixed value control, the alarm will be issued when the insulation platform timing ends.
STEP		An alarm is triggered at the end of the set program run.

13.2. Alarm Hysteresis

Set alarm hysteresis to avoid alarm false operation and frequent alarms. Alarm hysteresis is set independently for AL1,AL2, the initial value is 5 units. As shown below:

Alarm lag settings window: [4-10] [4-13]

Alarm action point setting value

13.3. Alarm power-on suppression

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.

Alarm suppression setting window: [4-11] [4-14], initial value: OFF

13.4. Positive and negative action of alarm relay:

Settings window:[4-15], Initial value:n\_0(Normally open)

14.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 below 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.
CJHH	Higher limit scaleover of cold junction of thermocouple input	Ambient temperature has exceeded 80°C	1. Reduce ambient temperature to the level provided in the environment conditions. 2. If ambient temperature has not exceeded 80°C, examine the controller.
CJLL	Lower limit scaleover of cold junction of thermocouple input	Ambient temperature has fallen below -20°C	1. Raise ambient temperature to the level provided in the environment conditions. 2. If ambient temperature has not fallen below -20°C, examine the controller.

15.Schedules

Table 1. Measuring Range Codes

Input type	Display Code	Measuring range	
Thermocouple	K	-199.9~+400.0°C	
	K2	0.0~800.0°C	
	K3	0~1200°C	
	R	0~1700°C	
	J	0~600°C	
	E	0~700°C	
	S	0~1300°C	
	T	-199.9~+200.0°C	
	N	0~1300°C	
	B	0~1800°C	
R.T.D.	PL11	0~1300°C	
	WR5-26	0~2300°C	
	U	-199.9~+200.0°C	
	L	0~600°C	
	Pt100	-200~+600°C	
	Pt100	-100.0~+100.0°C	
	Pt100	-50.0~+50.0°C	
	Pt100	0.0~+200.0°C	
	Pt100	-100.0~+350.0°C	
	-1~1V	-1.1	
Voltage	0~1V	0.1	
	0~2V	0.2	
	0~5V	0.5	
	1~5V	1.5	
	0~10V	0.10	
	0~20mA	0.20	
	4~20mA	4.20	
	Current	0~1000 unit	0~1000 unit
		0~1000 unit	0~1000 unit
		0~1000 unit	0~1000 unit
0~1000 unit		0~1000 unit	
0~1000 unit		0~1000 unit	
0~1000 unit		0~1000 unit	
0~1000 unit		0~1000 unit	
0~1000 unit		0~1000 unit	
0~1000 unit		0~1000 unit	
0~1000 unit		0~1000 unit	

Table 2. Event type codes

code	Type of event	Remarks
non	none	
Ha	Higher limit absolute alarm	For the initial value and setting range, see "Table 3:Event initial value and setting range".
La	Lower limit absolute alarm	
Hd	Higher limit deviation alarm	
Ld	Lower limit deviation alarm	
Id	Outside higher/lower limit deviation alarm	
Od	Inside higher/lower limit deviation alarm	
So	Scaleover	
Run	Run	
Man	Manual control	
AT	AT	

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
Voltage/Current input	Id/Od	2000 unit	0~2000 unit
	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	

Table 4. Enter Type Factory Initial and Set Range

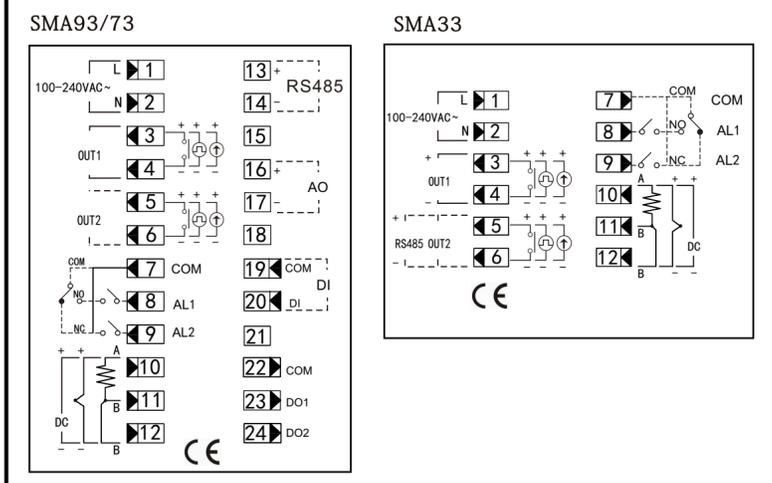
Input	Display Code	Measuring range
Multi input(M)	K2	0.0~800.0°C
Voltage(V)	0.10	0.0~100.0°C
Current(mA)	4.20	0.0~100.0°C

NOTE:  
 1. Thermocouple B: Accuracy guarantee not applicable to 400°C 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°C is ±0.7%FS.  
 4. Current input handled by external receiving impedance 250 Ω  
 5. The input type can be changed during reset mode.  
 6. If the setting is modified, all data related to measuring range will be initialized.  
 7. Unless otherwise specified, the measuring range will be set as follows when shipped from the factory.

16.Status output(DO) type list Option

code	Event type	Note
non	none	
So	Scaleover	
Run	Run	
Man	Manual control	
AT	AT	
HA	Higher limit absolute	
LA	Lower limit absolute	
Prun	Program run	For program control only
Step	Step signal	For program control only
Hold	Hold signal	For program control only
Guaz	Wait zone	For program control only
Pin	Pattern signal	For program control only
PEnd	Program end signal	For program control only

17.Terminal Layout



Manufacturer: Shimada Electronics (Changzhou) Co., Ltd. SHIMADA CO., LTD. No. 18 Changwu Middle Road, Wujin District, Changzhou, Jiangsu, China. E-MAIL: shimadavip@163.com URL: http://www.shimada.vip

18.Operation flow chart and function description

