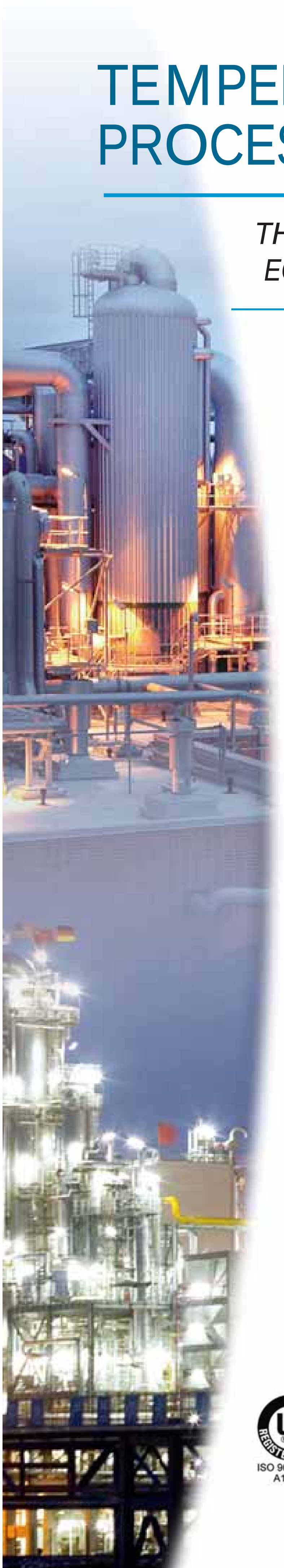
TEMPERATURE AND PROCESS CONTROLLERS

TP 720
TP 731
TP 750



THEY PROVIDE SIMPLE, RELAIABLE AND ECONOMIC CONTROL OF INDUSTRIAL PROCESS

Quick and exact operation as result of PID action improved with FUZZY logic.

Process parameters calculation optimized by Autotuning function.

It avoids errors and makes easier the handling of process control.

Industries and applications

- Chemical Industries
- Plastics treatment industries
- Paper processing industries
- Welding equipment
- Oven manufacturing
- Other types of industries and applications...

Processes

- Control of temperature, pressure, flow, level, volume processes, etc…
- Industrial equipment control
- Valve positioners control
- Servo operation and speed variators control
- Process limit values control
- Other types of processes…

ISO 9001:2000
A15026

FANOX
PROTECTIÓN AND CONTROL

Warning

- **Before wiring, please make sure the power is shut down.**
- **After turning on the power, please don't touch the terminal pins which are very dangerous.**
- **Please don't misconnect the terminal pins for communication, linear output & pulse output with AC power.**
- **Please don't try to dismiss, repair or modify the products and components.**
- **If the TP 7 has been damaged during transportation, please don't connect to the power.**
- **Don't install or operate the TP 7 in which the environment contains explosive materials and gas.**
- **Please operate the TP 7 under specified voltage.**

General Information:

1. Make check if the TP 7 is what you order model after opening it.
2. Please read the user manual before using it.
3. Try to avoid any direct impact and vibration.
4. Please fasten the screw properly.
5. Please use alcohol to clean the TP 7; don't use varnish or organic detergent to clean.

Note for installation:

1. Don't install the TP 7 in the environment containing many dust and corrosive gas, especially H_2SO_4 and Ammonia place.
2. Don't install the TP 7 in the environment with spraying water & paint.
3. Don't install the TP 7 in the environment where the temperature is unstable.
4. Don't install the product near the heating source.
5. Please mount the TP 7 horizontal.
6. Please don't install the TP 7 nearby the equipments that can generate high frequency interference or surge, such as high frequency solder machine & cutting machine.

Note for Wiring:

1. There should have a safety distance between High voltage / current and input/output.
2. Please don’t connect the TP 7 with devices, such as motor, converter, battery and electrical elements etc.
3. If any bigger power supplies or electrical power line around the temperature controller, please add a receiver or noise filter on the input power side to avoid outside signal affecting our system.
4. The surrounding temperature for the TP 7 must be lower than 55°C.
5. Don’t put any heavy stuff or pressure on the TP 7.

Content

Firstly, thank you for reading Fanox TP 7 user manual. Your full support is the motive for us to improve our products.

1. Introduction

According to the dimension of the TP 7 series, there are several models available for selection:
TP 710(48*24mm) W*H, TP 720(48*48mm) W*H, TP 730(96*48mm) W*H,
TP 731(48*96mm) W*H, TP 740(72*72mm) W*H, TP 750(96*96mm) W*H; all of them are satisfying all your need.

TP 7 series is using ADC which is a 24 bit analog-digital high resolution converter for signal measurement to enhance the accuracy of measuring signal continuously by sampling it every 256 ms. The TP 7 series use PID auto calculation for more accurate P.I.D value to avoid any troubles for adjusting the value manually.

Using PID+Fuzzy control enables the system to proceed fast and stable in supporting different output signal control and different alarm model setting to satisfy all your needs completely.
It also integrated with analogue signal into readable data which is very convenient.
Using popular communication interface of RS-485 to compatible with ModBus (RTU, ASCII) communication help users to complete the system integrate no matter connecting to PC or PLC without any problem.

2. Features:

- PID with Auto-Tune Algorithm。
- Auto-Tune with shifting setting value.
- ON/OFF, PID+ Fuzzy Temperature control regulator
- Heating, Cooling, Heating/Cooling control system.
- Digital Filter
- Variable Input signals: K, J, R, S, B, E, N, T, PT100, JPT100, DCV, DCI…。
- Variable control output：Relay Voltage Pulse, Linear Voltage, Linear Current.
- Variable Alarm Output。
- Support on linear Voltage/current for transmitter output function.
- Support on MODBUS Communication Function
- CE Certificate
- Detecting wrong message while the wiring for sensor is broken.
- Heater Break Alarm
- Memory Storage。
- Remote Setting Point。
- Manual Control Output。
- Compensation for temperature deviation。

3. Specification

- Power Supply：85～265 VAC / 18～36 VDC。
- Cold Junction Compensated Deviation at 23°C ±1°C。
- Accuracy：±0.3% F.S. 。
- Temperature Unit: Celsius/Fahrenheit
- Sampling Time：256mS。
- Display：Upper/Bottom row 4 digits, 7 segments & LED Indicator
- Communication Interface：RS-485。
- Relay Control Output：5A at 250VAC / 3A at 250VAC。
- Pulse Voltage Output：12VDC 20mA。
- Relay Alarm Output：3A at 250VAC。
- Linear Analog Output：0～10V, 4～20mA… 0.5% F.S. 。
- CT Input：AC 2～30A。
- Flash EEPROM Memory。

4. **Standard Measuring Range**

Type	Input signal	Range	Accuracy
Thermocouple	K Type	-200°C ~ 1370°C	0.3% ± 1 Digit
	J Type	-210°C ~ 1200°C	0.3% ± 1 Digit
	R Type	-50°C ~ 1760°C	0.3% ± 1 Digit
	S Type	-5°C ~ 1760°C	0.3% ± 1 Digit
	B Type	-250°C ~ 1820°C	±0.8°C ± 1 Digit
	E Type	-200°C ~ 1000°C	0.3% ± 1 Digit
	N Type	-200°C ~ 1300°C	0.3% ± 1 Digit
	T Type	-200°C ~ 400°C	±2°C ± 1 Digit
Heating Resistance	PT-100	-200°C ~ 850°C	0.3% ± 1 Digit
	JPT-100	-200°C ~ 850°C	0.3% ± 1 Digit
Voltage	mV	0 ~ 350mV	0.3% ± 1 Digit
Current	mA	0 ~ 20mA	0.3% ± 1 Digit
Other	Linear Input	Custom-Made	

5. Ordering Information

TP 7 Model List

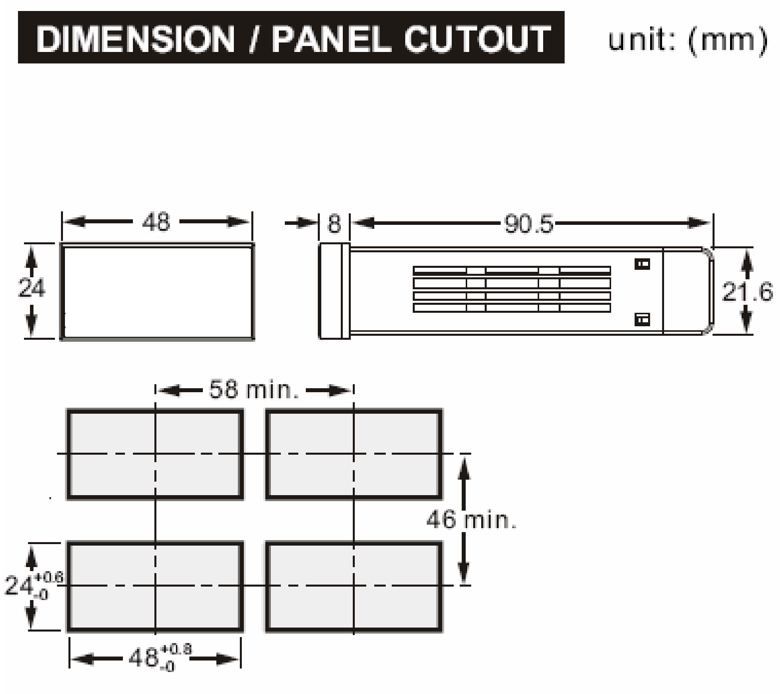
TP 7 □ □~□ □ □ □~□

Dimensions	20 ➡ 48 x 48 mm 31 ➡ 48 x 96 mm	50 ➡ 96 x 96 mm
Control Output 1	1 ➡ Output relay 2 ➡ Output 4~20 mA	3 ➡ Output 0~10 Vdc 4 ➡ Voltage pulse (12 Vdc)
Control Output 2	0 ➡ None 1 ➡ Output relay	2 ➡ Output 4~20 mA 3 ➡ Output 0~10 Vdc 4 ➡ Voltage pulse (12 Vdc)
Alarm Output	1 ➡ 1 set	2 ➡ 2 sets
Retransmission	0 ➡ None	1 ➡ 4~20 mA DC
Communications	0 ➡ None 1 ➡ RS485	2 ➡ Heater break detection (only TP 720)

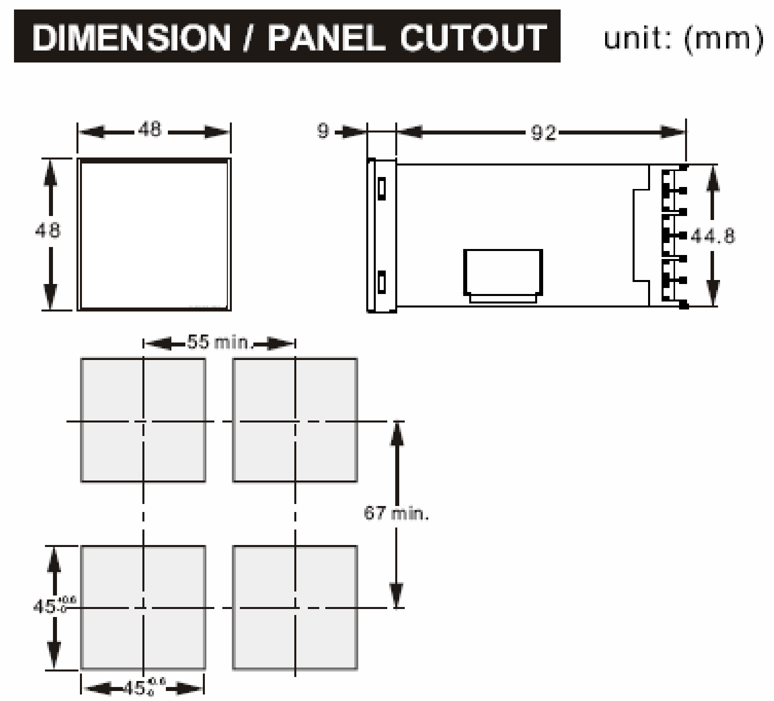
Other options, configurations or sizes, please consult

6. Dimension/Panel Cut Out

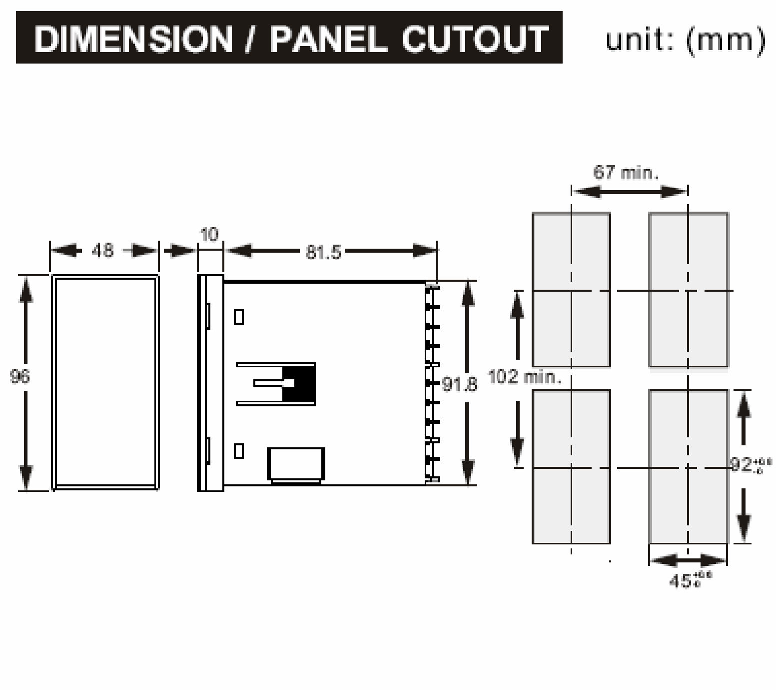
6.1, TP 710-Series



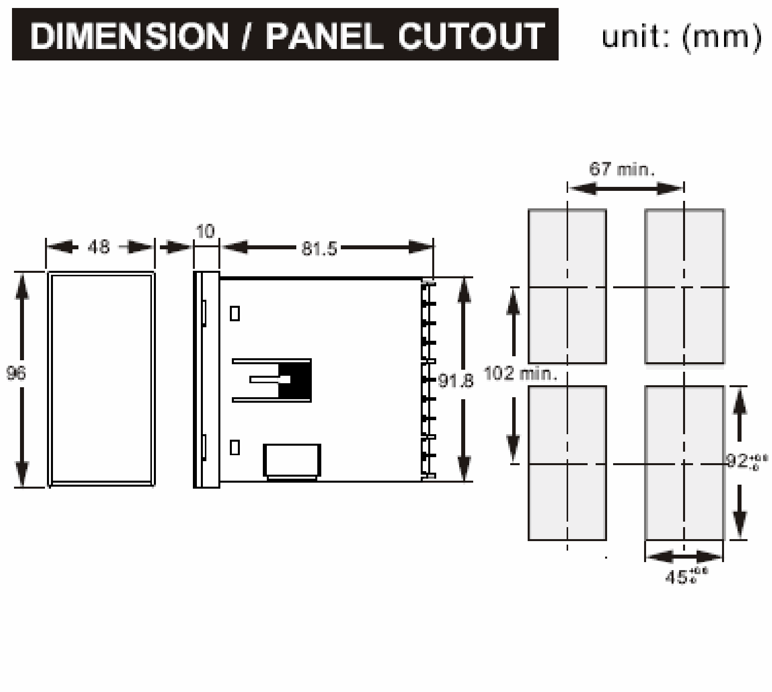
6.2, TP 720-Series



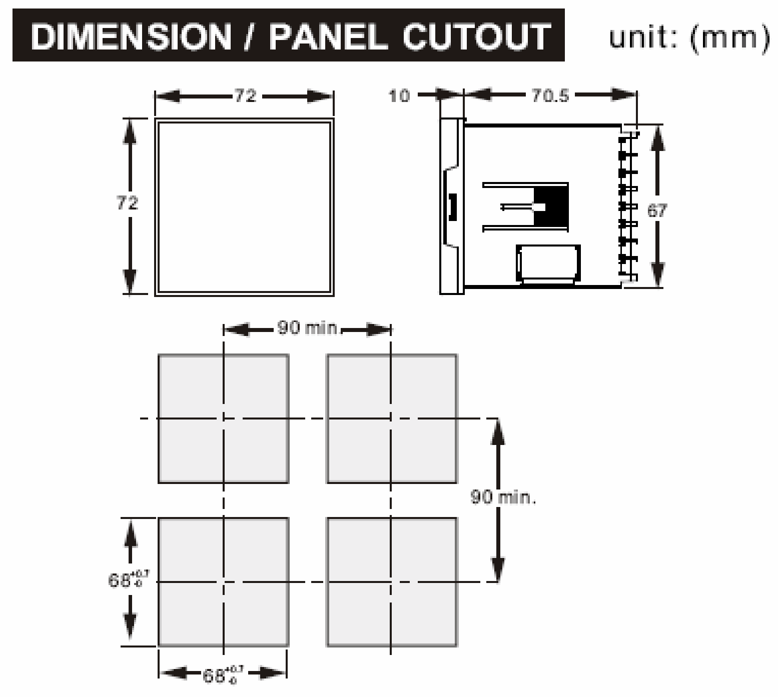
6.3, TP 730-Series



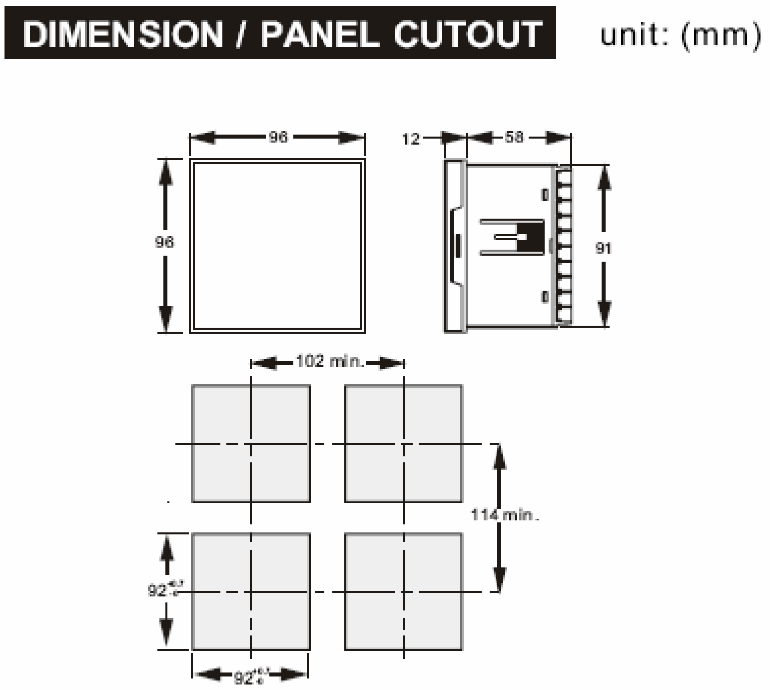
6.4, TP 731-Series



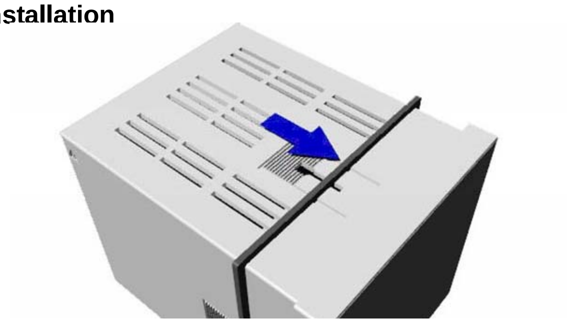
6.5, TP 740-Series



6.6, TP 750-Series



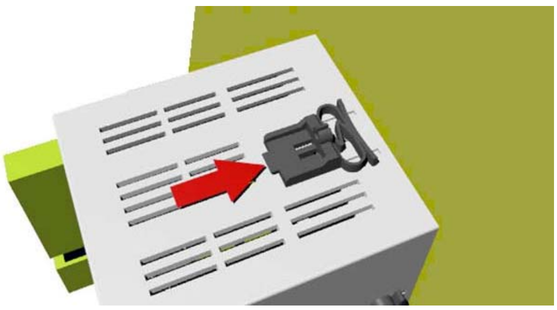
7. Installation



Please put the water proof seal to the correct position.

Install the TP 7 into the hole of the machine.

Fasten the clip onto the top of the TP 7.



Push the clip to fasten it .

8. Operation

8.1 Character Table

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

8.2 Keypad Function

The TP 7 series have three buttons which are Enter, Shift, Up for operating all functions.

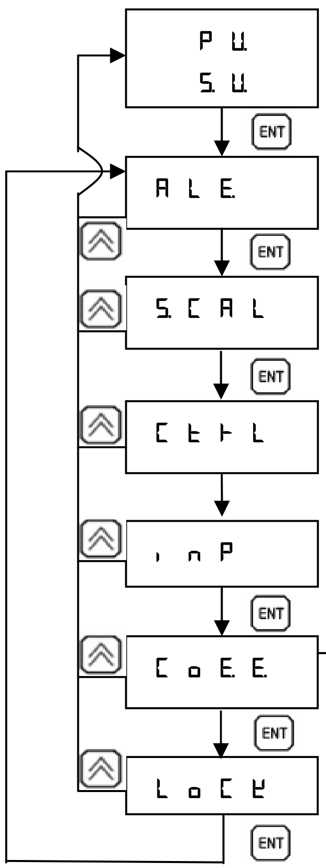
Before pressing any buttons, the temperature controller is in the mode of displaying the present value (PV) on the upper row of 7 segment and the setting value (SV) on the buttom row. Pressing ENT button to get into the operating mode.

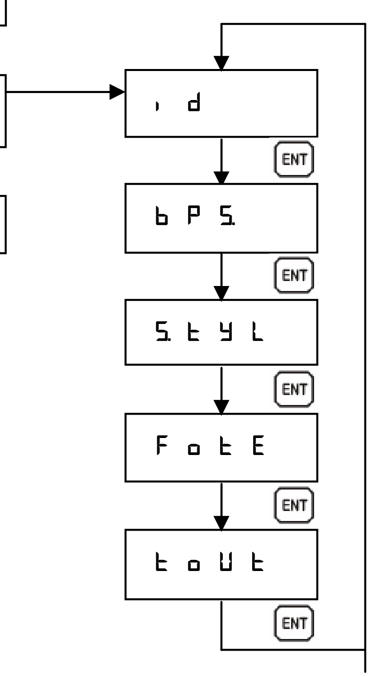
Operating Mode consists of menu mode and setting mode in which the three buttons functions differently.

	Selection	Settings
UP	Escape	Addition
SHIFT	Enter	Position Shift
ENTER	Switch	Confirmation

8.3 Switching Menu

Menu Mode





In the display status, press ENT button to get into menu mode.
Shows main menu A L E.
Press ENT again to get into main menu S. C A L
Press ENT again to get into main menu S. C A L
Press ENT again to get into main menu S. C A L
Press ENT again to get into main menu S. C A L
Press ENT again to get into main menu S. C A L
Then press ENT again to get into main menu S. C

Finding the desired parameter under the main menu then press to get in and press ENT to switch desired sub-menu for preceding it as same as for main menu.

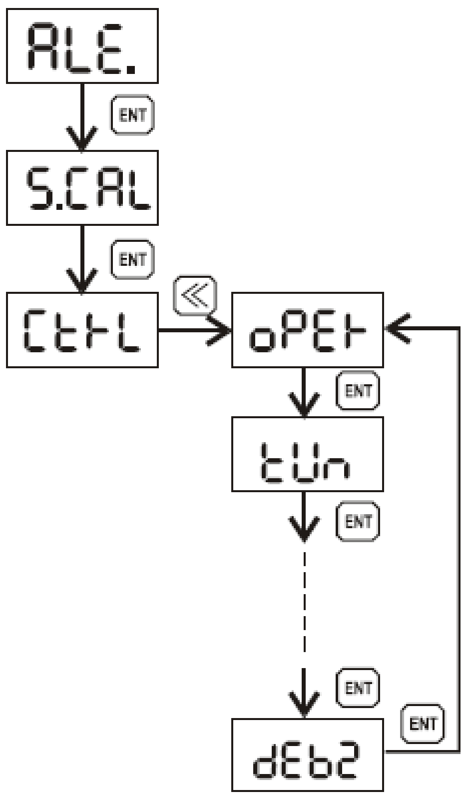
While finding the desired sub-menu, press to enter setting mode where you can press shift button and increased button for setting desired value and confirming it by pressing to save.

While you are in sub-menu, you can press ENT get back to main menu and press again enable you to get back to menu mode.

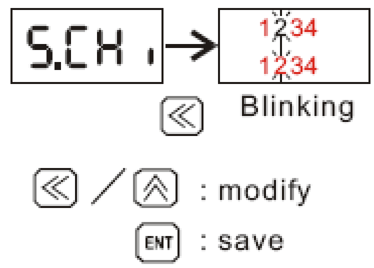
8.4 Example of Keypad button Function

ENT ENTER Button

1) Main menu switch or sub-menu switch.



2) Confirmation to save settings
Example: Confirmation of change of SCHi value



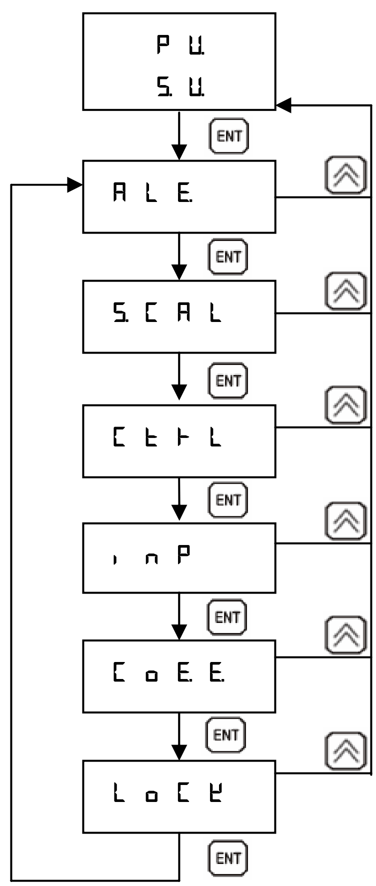
9. Menu Function Description

9.1 Parameters for Main Menu

Parameters for main menu	Name of Parameters for main menu	Description of Parameters
P u S u	PV Value SV Value	Present Value Setting Value
A L E	ALM	Selection for Alarm Setting
S C A L	SCAL	Scale Setting
C t r L	CTRL	Control Setting
i n P	INP	Input signal Setting
C o E E	COMM	Communication Setting
L o C k	LOCK	Look Function

In display mode, press ENT Button for circulating to other selection on menu.

Parameter Flowchart on Main Manu



10. ALE. List of Parameters for Alarm Menu

Parameter	Name of Parameters	Description of Parameters	Setting Range	Preset Value
PoS.1	Position 1	Alarm Relay Position 1	-1999～9999	0
HyS.1	Hysteresis 1	Alarm Relay Hysteresis 1	0000～9999	0
dy1	Delay 1	Alarm Relay Delay time 1	00～99	00
dir1	Direction 1	Alarm Relay Direction 1	Hi/Lo	Hi
S.ty1	Style 1	Alarm Relay Style 1	St1～St10	St1
PoS.2	Position 2	Alarm Relay Position 2	-1999～9999	0
HyS.2	Hysteresis 2	Alarm Relay Hysteresis 2	0000～9999	0
dy2	Delay 2	Alarm Relay Delay time 2	00～99	00
dir2	Direction 2	Alarm Relay Direction 2	Hi/Lo	Hi
S.ty2	Style 2	Alarm Relay Style 2	St1～St10	St1

ALE. Parameter function is to set preferable alarm style according to the working place requirement to select a suitable style for alarm and output which ensure your system is settled in a safe environment. When the control output is used for other application, such as 4~20mA output, you can set the alarm output as the use of control output which is no need to buy other item for saving money.

In the operating mode, press ENT Button once to enter into alarm menu for setting.

- PoS.1 : Setting of 1st alarm relay position
- HyS.1 : Setting of 1st alarm relay hysteresis.
- dy1 : Setting of 1st alarm relay delay time (s) for activating alarm output.
- dir1 : Setting of 1st alarm output direction；Relay Output: Hi NO、Lo NC.
- S.ty1 : Selection of 1st alarm style (referring to following S.tyL alarm styles.
- PoS.2 : Setting of 2nd alarm relay position
- HyS.2 : Setting of 2nd alarm relay hysteresis.
- dy2 : Setting of 2nd alarm relay delay time (s) for activating alarm output.
- dir2 : Setting of 2nd alarm output direction；Relay Output: Hi NO、Lo NC.
- S.ty2 : Selection of 2nd alarm style (referring to following S.tyL alarm styles).

StYL Alarm Styles

10.1 St 1 Deviation High Alarm

Star Alarm Output
When PV>=SV+POS1 is established, DY1 starts counting till completely the alarm relay output.

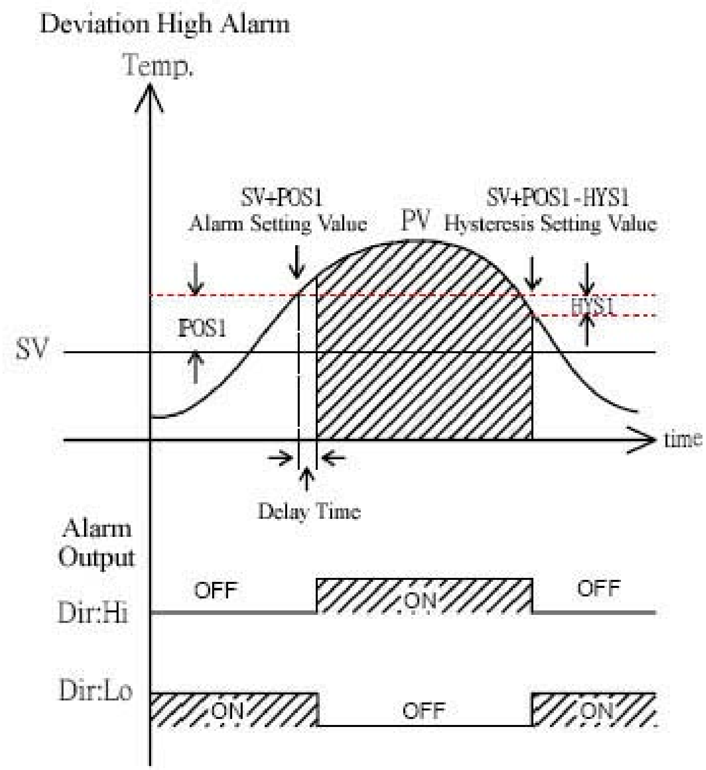
Switch off Alarm Output
When the condition of PV<SV+POS1-HYS1 is established, the alarm relay stop.

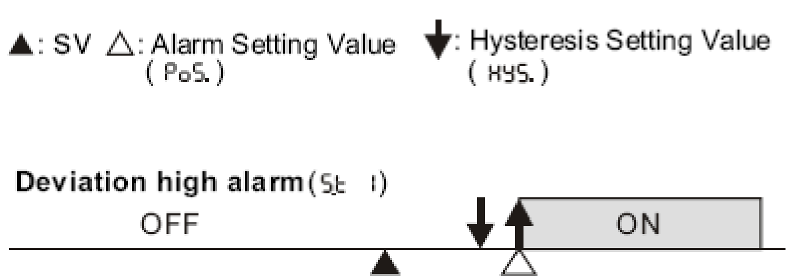
Example：
PV= Present Value Output
SV= Setting Value.
POS1= Alarm Relay Position 1
DY1= Delay Time.

SV=60； POS1=10；

HYS1=5； DY1=5;

When PV>=70, DY1 starts counting till completely the counting, then alarm relay outputs. When PV<65 alarm relay stops for output.





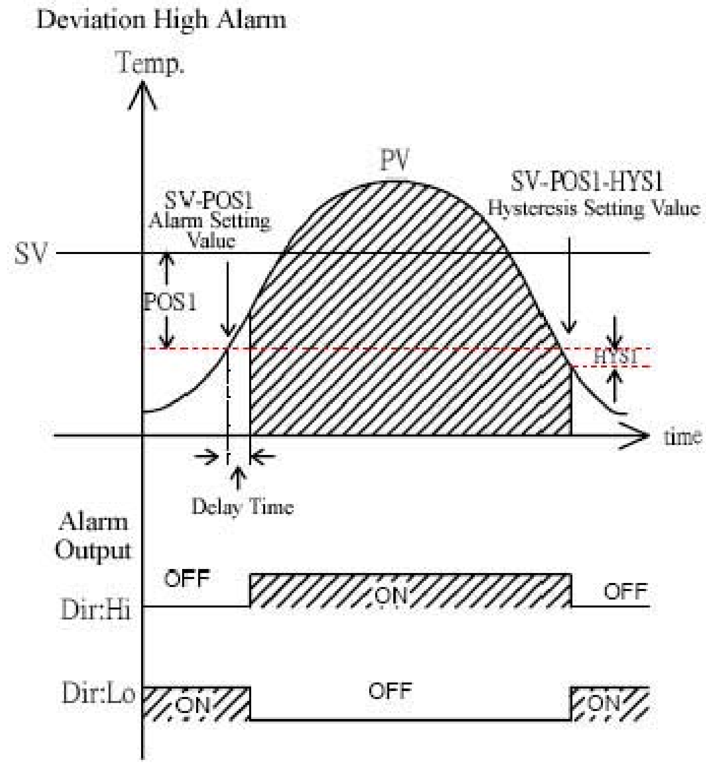
10.2 St 2 Deviation High Alarm

Star Alarm Output
When PV>=SV-POS1 is established
DY1 starts counting till completely the counting, then alarm relay outputs.

Switch off Alarm Output
When the condition of PV<=SV-POS1-HYS1
Is established, the alarm relay stop.

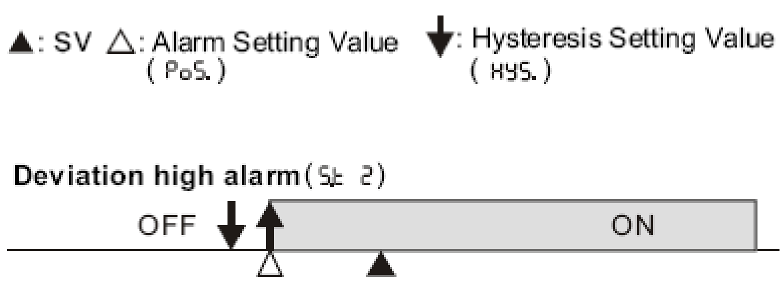
Example：
PV= Present Value Output
SV= Setting Value.
POS1= Alarm Relay Position 1
DY1= Delay Time.

SV=60； POS1=10；
HYS1=5； DY1=5;



When PV>=50, DY1 starts counting till completely the counting then alarm relay outputs.

When PV<45 alarm relay stops output.



10.3 St 3 Deviation Low Alarm

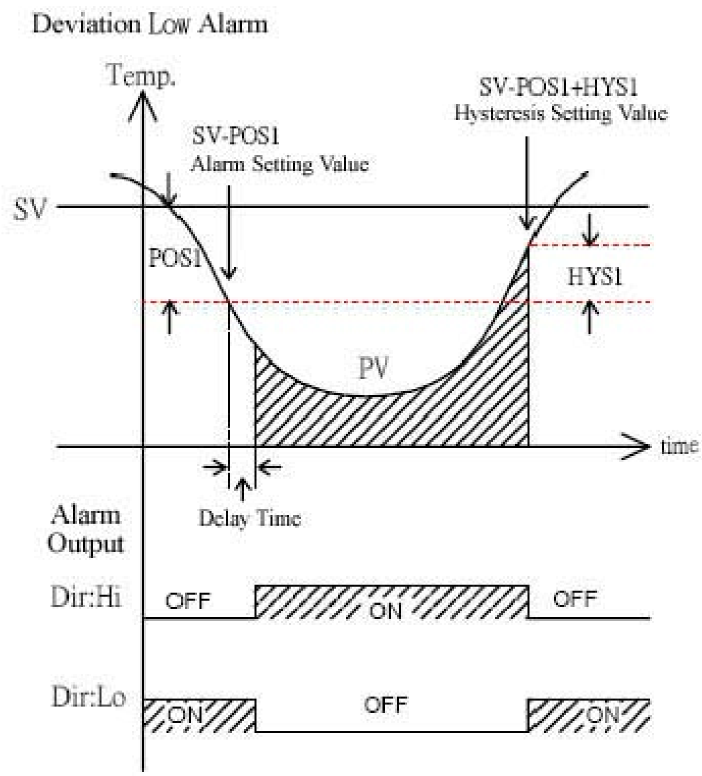
Star Alarm Output
When PV<=SV-POS1 is established.
DY1 starts counting till completely the counting, then alarm relay output

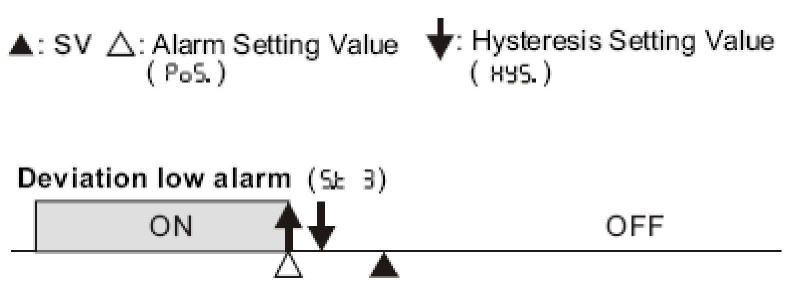
Switch off Alarm Output
When the condition of PV>=SV-POS1+HYS1 Is established, the alarm relay stop.

Example：
PV= Present Value Output
SV= Setting Value.
POS1=Alarm Relay Position 1
DY1= Delay Time.

SV=60； POS1=10；
HYS1=5； DY1=5;
When PV<=50 DY1 start counting till completely the counting then alarm relay outputs.

When PV>=55 alarm relay stops output





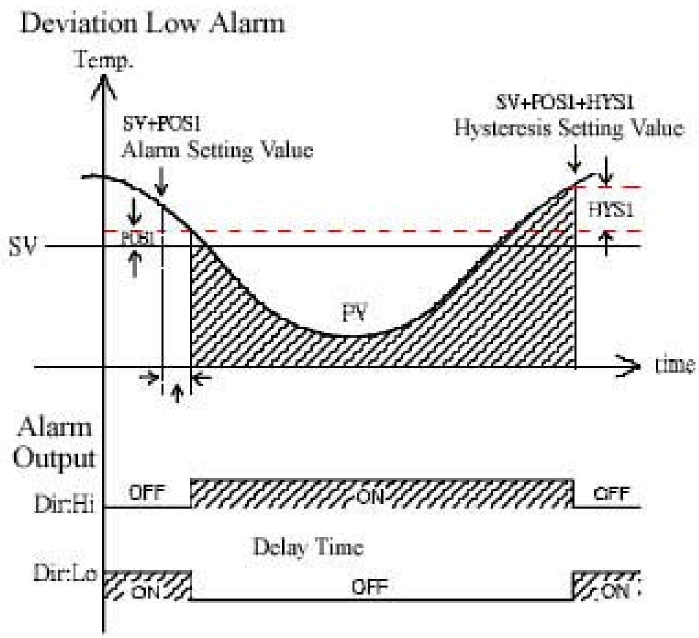
10.4 St 4 Deviation Low Alarm

Star Alarm Output

When PV<=SV+POS1 is established

DY1 starts counting till completely the

counting, then alarm relay output.



Switch off Alarm Output

When the condition of PV>=SV+POS1+HYS1

the alarm relay stop.

Example：

PV= Present Value Output

SV= Setting Value.

POS1= Alarm Relay Position 1

DY1= Delay Time.

SV=60； POS1=10；

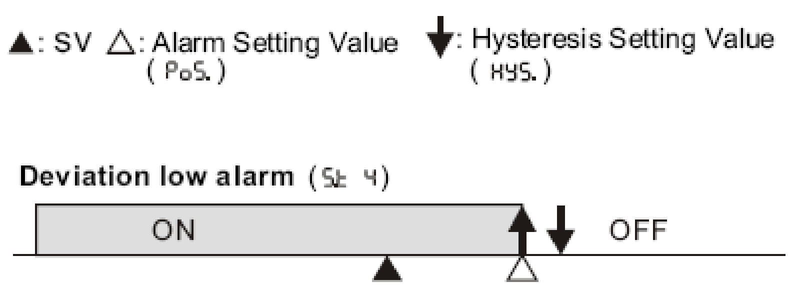
HYS1=5； DY1=5;

When PV<=70 DY1 start counting till

completely the counting then alarm relay

output.

When PV>=75 alarm relay stops for output

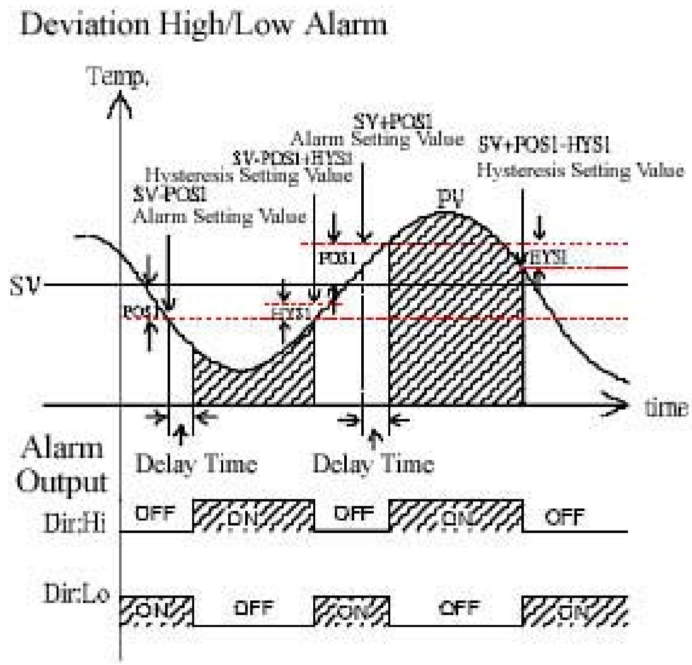


10.5 StS Deviation High/Low Alarm

Star Alarm Output
When PV<=SV-POS1 or PV>=SV+POS1
is established.　DY1 starts counting
till completely the counting, then alarm
relay output

Switch off Alarm Output
When the condition of PV>=SV-POS1+HYS1 or
the alarm relay stop.

Example：
PV= Present Value Output
SV= Setting Value.
POS1= Alarm Relay Position 1
DY1= Delay Time.



SV=60；　POS1=10；
HYS1=5；　DY1=5;
When PV<=50 or PV>=70, DY1 starts
counting till completely the counting then alarm relay output.

When PV>=55 or PV<=65 alarm relay stops for output.

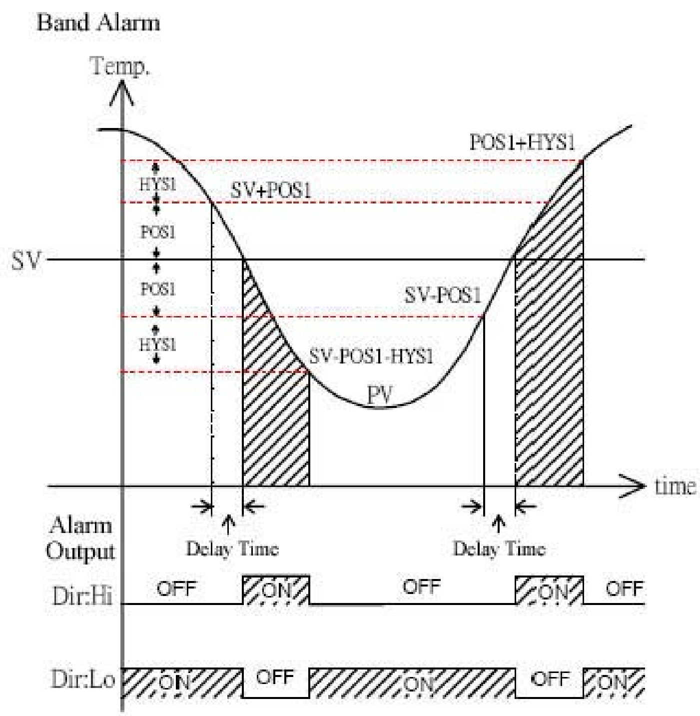
▲: SV △: Alarm Setting Value (PoS.)　↓: Hysteresis Setting Value (HYS.)

Deviation high/low alarm (StS)

10.6 5t6 Band Alarm

Star Alarm Output

When PV>=SV-POS1 or PV<=SV+POS1 is established,　DY1 starts counting till completely the counting, then alarm relay output.



Switch off Alarm Output

When the condition of PV<=SV-POS1-HYS1 or PV>=SV+POS1+HYS1 The alarm relay stop.

Example：

PV= Present Value Output

SV= Setting Value.

POS1= Alarm Relay Position 1

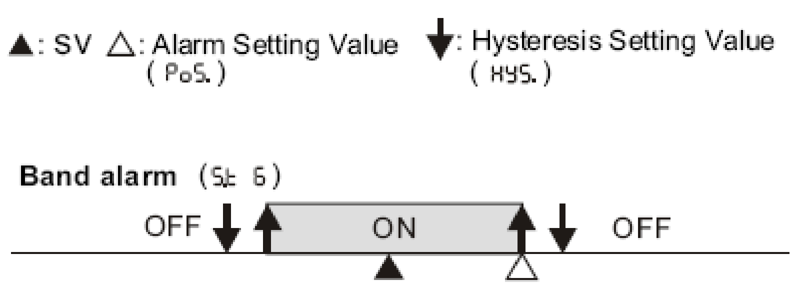
DY1= Delay Time.

SV=60；　POS1=10；

HYS1=5；　DY1=5;

When PV>=50 or PV<=70　DY1 start counting till completely the counting then alarm relay output.

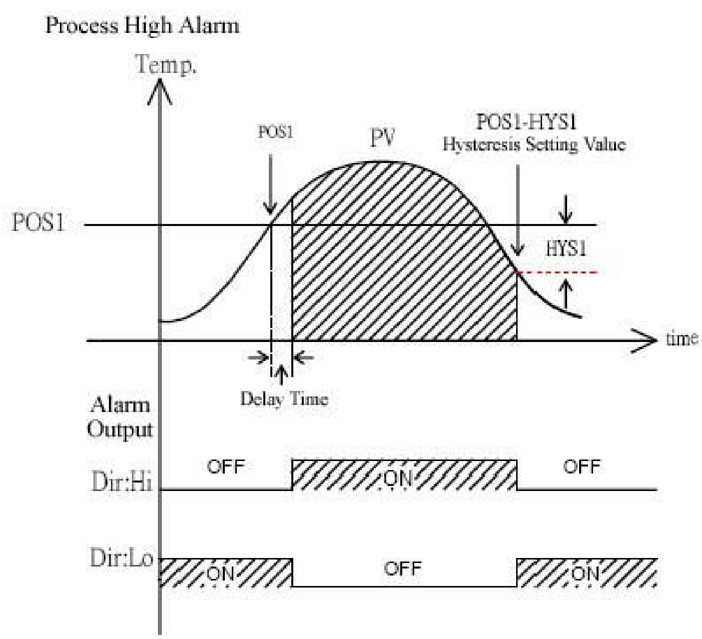
When PV<=45 or PV>=75 alarm relay stops for output.



10.7 St 1 Process High Alarm 1

Star Alarm Output
When PV>=POS1 is established,
DY1 starts counting till completely
then counting, then alarm relay output

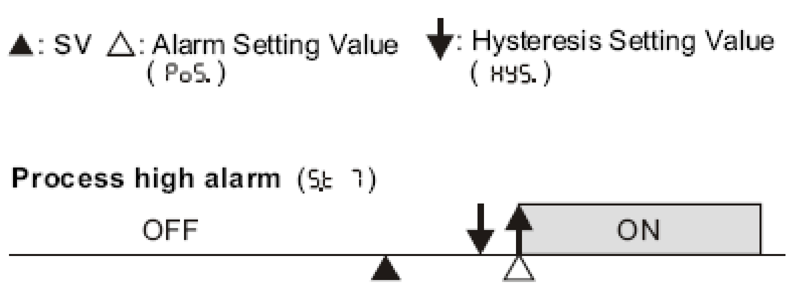
Switch off Alarm Output,
When the condition of
PV<=POS1-HYS1
The alarm relay stop.



Example：
PV= Present Value Output
SV= Setting Value.
POS1= Alarm Relay Position 1
DY1= Delay Time.

SV=60； POS1=10；
HYS1=5； DY1=5;
When PV>=60 DY1 starts
counting till completely it then
alarm relay output.

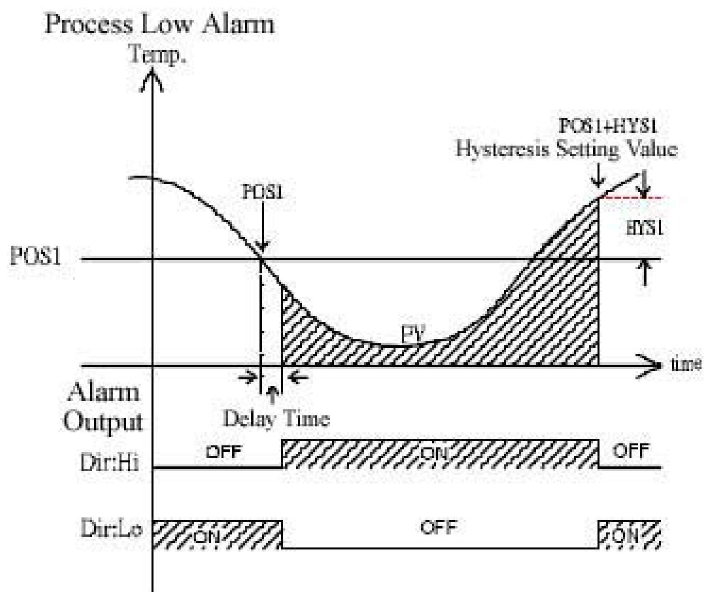
When PV<=55 alarm relay stops for output.



10.8 St 8 Process Low Alarm

Star Alarm Output,
When PV<=POS1 is established
DY1start counting till completely
then counting, then alarm relay output

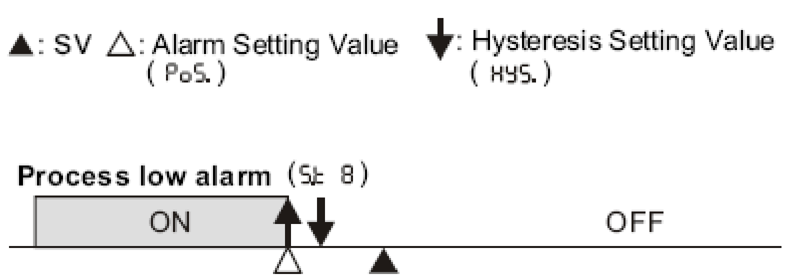
Switch off Alarm Output,
When the condition of
PV>=POS1+HYS1,
the alarm relay stop.



Example：
PV= Present Value Output
SV= Setting Value.
POS1= Alarm Relay Position 1
DY1= Delay Time.

SV=60； POS1=10；
HYS1=5； DY1=5;
When PV<=60 DY1 start counting
till completely the counting then alarm relay output.

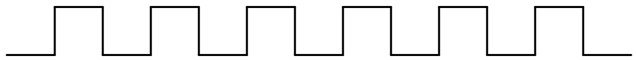
When PV>=55 alarm relay stops for output.



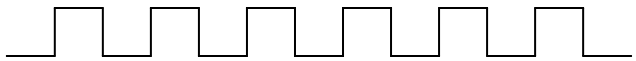
10.9 5.t 9 Control Output 1

Alarm relay follows control output 1 for an action

OUT1
Control Output



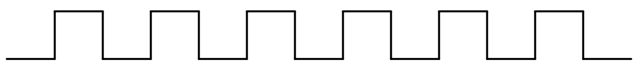
ALM1
Alarm Output



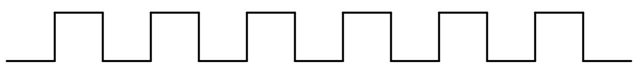
10.10 5.t 10 Control Output 2

Alarm relay follows Control Output 2 for an action

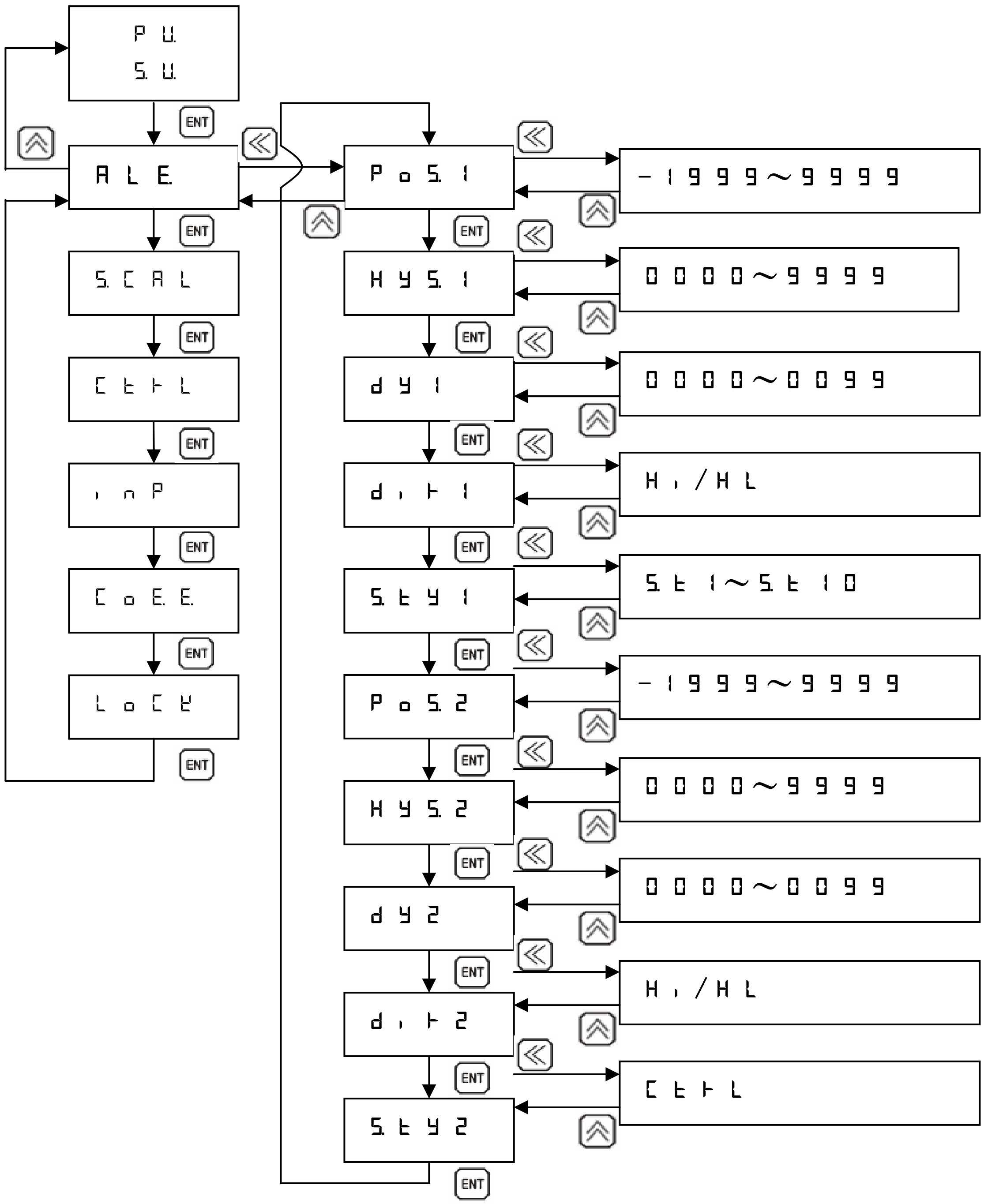
OUT2
Control Output



ALM2
Alarm Output



10.11 ALE Parameter Flow chart



11. S. C A L List of Parameters for Scale Setting

Display of Parameter	Name of Parameter	Description of Parameters	Setting Range	Preset Value
S. V.	Set Value SV	Setting Value	-1999～9999	0
d o t	Dot	Decimal Point Setting	0～3	1
S. C H	Scal Hi	Scale High Limitation	-1999～9999	9999
S. C L	Scal Lo	Scale Low Limitation	-1999～9999	0
L i E. H	Limit Hi	Max Setting Range of SV	-1998～9999	9999
L i E. L	Limit Lo	Min. Setting Range of SV	-1999～9999	0
U n i t	Unit	Temperature Unit	°C/°F	°C
P E t C	Percentage	Percentage Display	On/Off	Off
S. C H i	Scal Hi Input	Linearity of Scale High	-1999～19999	100
S. C L i	Scal Lo Output	Linearity of Scale Low	-1999～19999	0

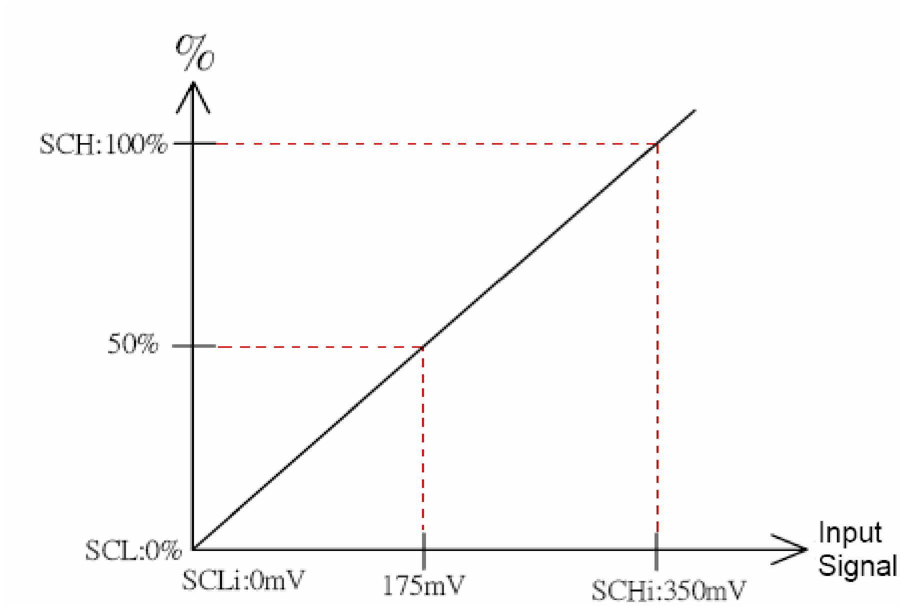
S. C A L The function of the parameters is enable end-users to set the display unit to either °C or °F according to their requirement. For safety purpose, It also can set different proportion and add the function of setting limitation to prevent any loss due to ignorance of the workers.
To press ENT Button twice gets into SCAL main menu where its sub-menu is showing as follow:

- S. V. ：Setting Value；Setting value should be between L i E. H & L i E. L
- d o t ：Decimal Point Setting.
- S. C H ：Scale High Limitation
- S. C L ：Scale Low Limitation
- L i E. H ：Maximum Temp Setting Range.
- L i E. L ：Minimum Temp Setting Range.
- U n i t ：Temperature Unit Setting.
- P E t C ：Percentage Display Setting.
- S. C H i ：Linearity of Scale High.
- S. C L i ：Linearity of Scale Low.

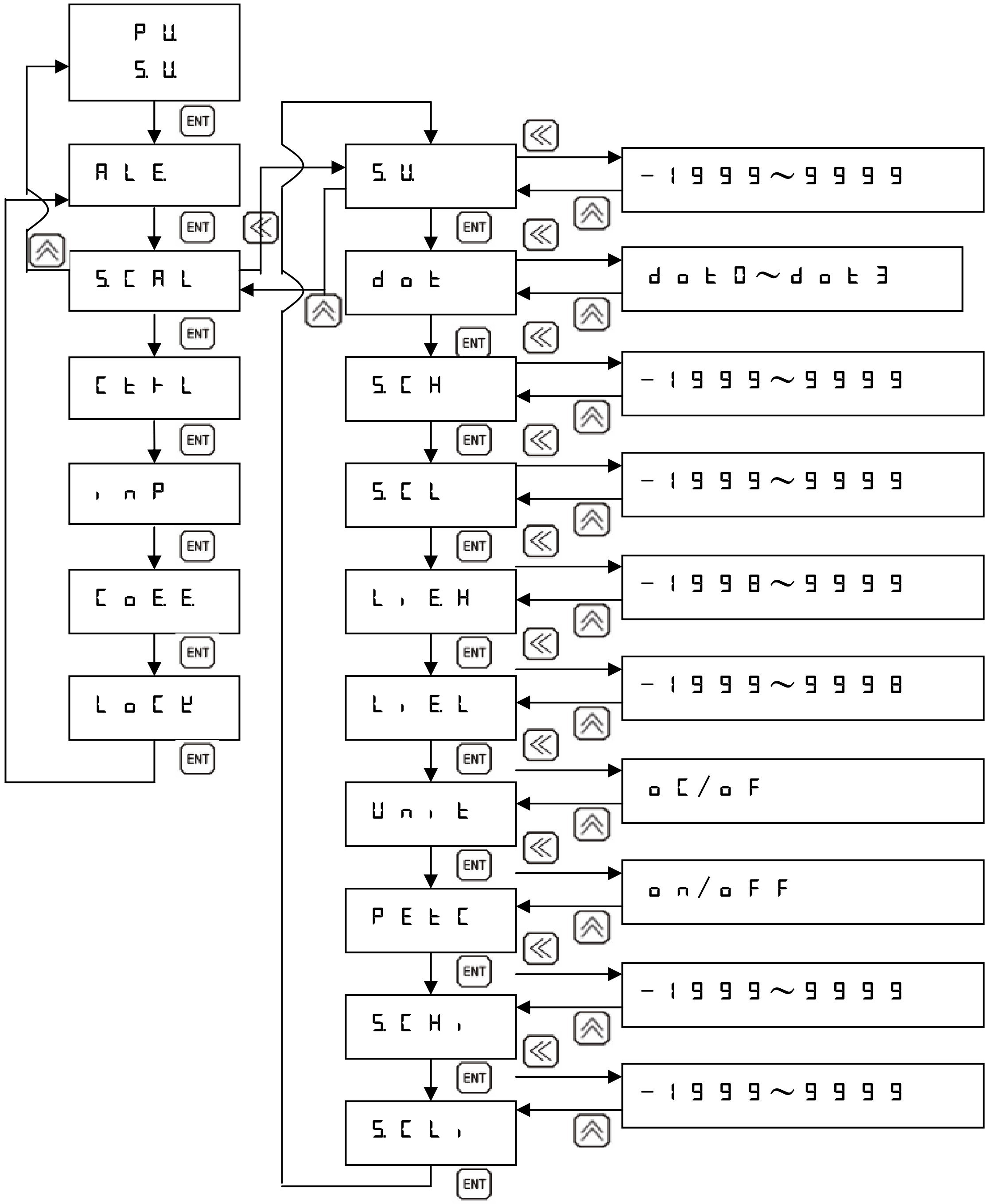
Example：

When the input signal is 0~350mV, desired display range is 0~100% and the setting value (SV) can not be higher than Limit Hi 80% ,and lower than Limit Lo 20%, the setting method is to be same as below：

- S.U ： Setting manually, but can't be higher than 80 or lower than 20
- dot ：dot1 Setting decimal at first digit.
- S.CH ：100.0 Maximum setting display range at 100.0.
- S.CL ：0000 Minimum setting display range at 000.0
- LiEH ：100.0 Limitation of max input range at 100.0.
- LiEL ：000.0 Setting scale low at 000.0
- Unit ：oC/oF Setting temperature display unit.
- PEtC ：on Setting percentage display
- S.CHi ：350.0 Max input signal sets at 350mV
- S.CLi ：000.0 Minimum input signal sets at 0mV



11.1 S.CAL FlowChart for Scale Parameters



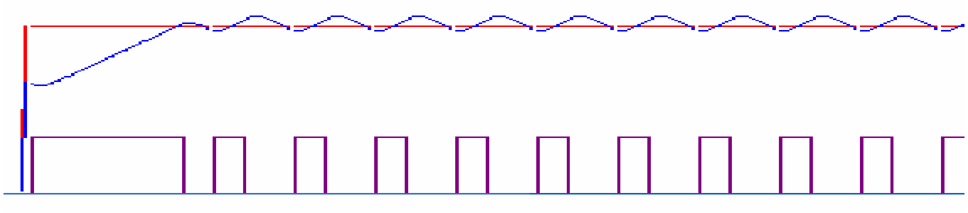
12. CtrL Parameters for Operation Setting

Display of Parameter	Name of Parameters	Description of Parameters	Setting Range	Preset Value
oPEr	Operation	Selection of operation mode	PID/ONOFF	ONOFF
tUn	Tun	Auto Tuning	TUN/OFF	OFF
biAS	Bias	PV Compensation	-1999～9999	0
oFSt	Offset	SV deviation setting for auto turning	-1999～9999	0
P	Proportional	Proportional Parameter	0000～9999	3
i	Integral	Integral Parameter	0000～9999	200
d	Derivative	Derivative Parameter	0000～9999	20
MArE	MARE	Manual Reset	00.00～99.99	0
FiLt	Filter	Software Filter	1～100	1
ModE	Mode	Selection of Control	H-C/Cool	H-C
oUt1	Out1	Control Output 1	Heat/Cool	Heat
oUt2	Out2	Control Output 2	Heat/Cool	Cool
dir1	Direction 1	Relay output direction 1	Hi/Lo	Hi
dir2	Direction 2	Relay output direction 2	Hi/Lo	Hi
CYC1	Cycle time 1	Control output cycle time 1	0000～999.9	5.0
CYC2	Cycle time 2	Control output cycle time 2	0000～999.9	5.0
HYS1	Hysteresis 1	Control output hystersesis 1	0000～9999	0
HYS2	Hysteresis 2	Control output hysteresis 2	0000～9999	0
dbon	Dead band	Dead band control	ON/OFF	OFF
dEb1	Deadband 1	Dead band of heater	-1999～9999	0
dEb2	Deadband 2	Dead band of cooler	-1999～9999	0

CtrL These parameters function at setting control mode according to end-users' requirements to select ON/OFF control or PID control for the most suitable mode. PID control is applied with auto-turning calculation for a more accurate value to save trouble and with the build in Fuzzy algorithm is to assure the stabilization of your system.

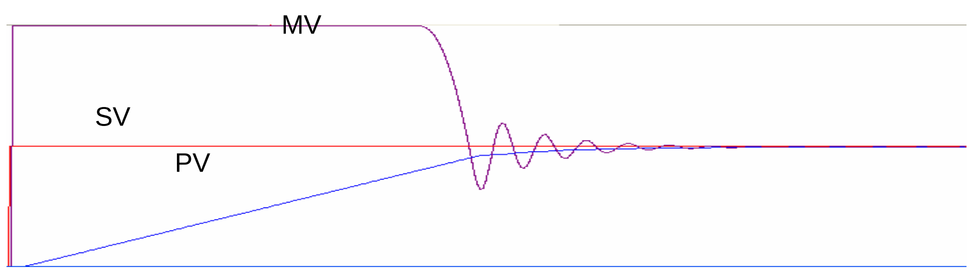
- oPEt ：Selection of operation modes onoF ：ON-OFF Mode Pid ：PID Mode
-

OnOff Mode/onoF



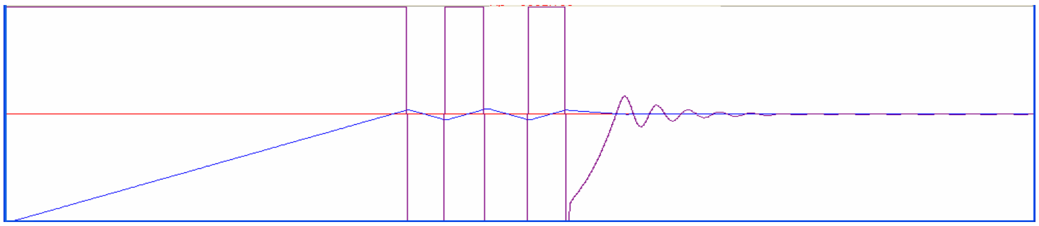
OnOff mode control is a very common and simple control mode. When the control output is programmed as the heating output and the temperature lower than setting value, control output start to activate; if the temperature is higher than setting value, control output deactivate in order to control the temperature. It also can adjust hysteresis band to reduce the overshooting on the system to achieve the best control and stability.

PID Mode/Pid



PID control is corresponding to three constants which are proportional 、Integral 、derivative. P is to handle the immediate error. I is to learn from the past and D is to handle the future. When control output is the heating output, the PT-series will apply PID+Fuzzy algorithm to calculate a MV value (manipulate value) to be used in determining whether the control output should be strong or week in order to control the PV value (Present Value) to be closer to SV value (Set Value) and also to constantly calculating the deviation of stability and prediction. The built-in Fuzzy control is to enhance the system in stability for achieving the best control and efficient.

➢ tUn：If process auto tune algorithm； tUn：Turn on oFF：Turn off



After turning on the auto tuning, the system is programmed for a full speed heating and cooling to oscillate two cycles and then calculate a set of parameters of P、I、D which are used in PID Algorithm control output to achieve the temperature in a certain value .

Adding the oFSt setting is to prevent the status of overheating due to auto tune algorithm resulting in overshooting in system.

➢ biAS：Input Deviation Compensated. While the present value is different from predict value in a constant value, using this parameter can adjust the value.

➢ oFSt：Auto tune calculation for the SV deviation setting.

After setting the parameter, the SV+oFSt value is programmed for auto tuning. Eg. When SV is set at 200°C , and OFST is set at -10°C, the formula of SV+OFST=200+(-10)=190°C is applied for auto tuning in order to prevent overheating and damage occurred during the algorithm operating.

➢ P： Proportional Parameter. It is created by auto-tune calculating

Automatically or set manually. P is only valid in the proportional to the deviation of the system. Once the deviation is appeared, the proportional regulator is started to adjust the value to reduce the deviation.

➢ i：Integral Parameter. It is created by auto-tune calculating

automatically or set manually. I is to learn from the past and erase the stable.

deviation on the system. While the deviation is created, the integral regulator is programmed to adjust the value till erasing all the deviation.

➢ d：Derivative. It is calculated automatically with auto-tune or set manually. D is

to handle the future by a reaction according to the change ratio of deviation on the system foresees the trend of deviation to erase the deviation by the derivative regulator before it is created.

➢ E.AtE：Manual Reset.

While the I Parameter = 0 and the PV>SV, then Output MV value＝AtE setting value.

➢ FiLt：Filter；To reduce the noise of input signal is to set the range from 1～100.

➢ E.odE：Selection for control output.

Select H-C for heating/cooling system.

Select Co for cooling system.

➢ oUt1：Control Output 1 Setting.

HEAt：Connect output contact to heater for a heating logical control.

CooL：Connect output contact to cooler for a cooling logical control.

➢ oUt2：Control Output 2 Setting.

HEAt：Output contact to be connected to heater for a heating logical control.

CooL：Output contact to be connected to cooler for a cooling logical control.

➢ dir1：Control Output Direction 1

Relay Output：Hi N.O、Lo N.C。

Pulse Output：Hi No control output, output=0V.

Lo No control output, output= 12V.

Analog Output：Hi No control output, output= zero signal.

Lo No control output, output=full signal.

➢ dir2：Control Output Direction 2

Relay Output：Hi N.O、Lo N.C。

Pulse Output：Hi No control output, output=0V.

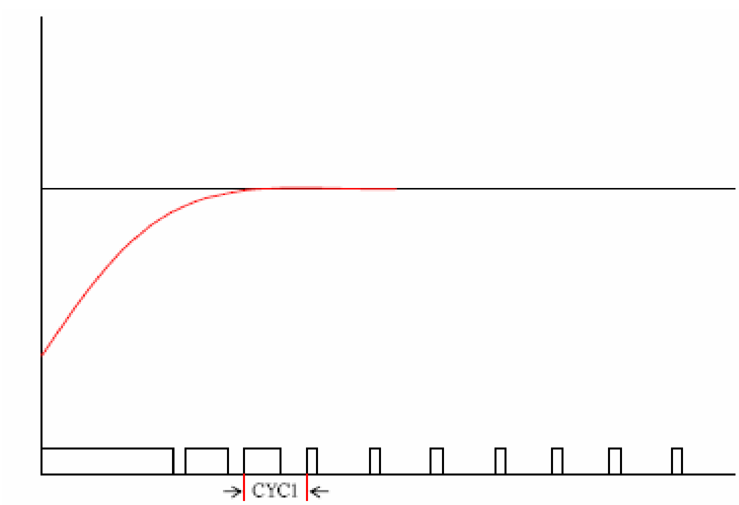
Lo No control output, output= 12V.

Analog Output：Hi No control output, output= zero signal.

Lo No control output, output=full signal.

➢ CYC1：Control Cycle Time at PID mode for control output 1.

➢ CYC2：Control Cycle Time at PID mode for control output 2.



- HYS1：Control Output Hysteresis 1
- HYS2：Control Output Hysteresis 2.

For example of ONOFF control, when PV>SV, the control output should shut down immediately. When PV<SV, the control output should turn on immediately. During the fast reaction where the control output is shutting down and turning on constantly, setting HYS can mitigate the over reaction for ONOFF. HYS is set at PV>SV+HYS, control output is deactivated, while HYS is set at PV<SV-HYS, control output is activated.

- dbon：Deadband Control.
- dEb1：Deadband Parameter of Heater
- dEb2：Deadband Parameter of Cooler

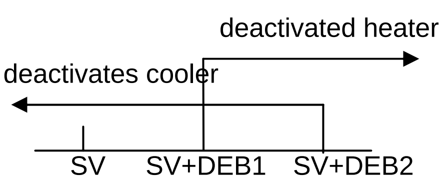
When the control output is in heating mode；If PV>SV+DEB1, then deactivate heater.

When the control output is in cooling mode；If PV>SV+DEB2, then deactivate cooler.

DEB1>0；DEB2>0

Over SV+DEB1 deactivates heater

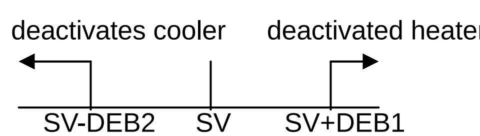
Under SV+DEB2 deactivates cooler



DEB1>0；DEB2<0

Over SV+DEB1 deactivates heater

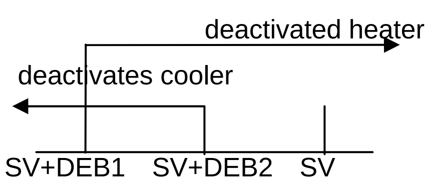
Under SV-DEB2 deactivates cooler



DEB1<0；DEB2<0

Over SV-DEB1 deactivates heater

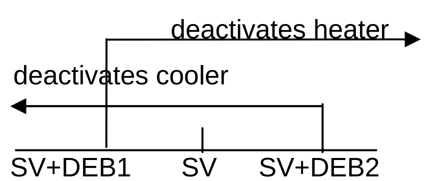
Under SV-DEB2deactivates cooler



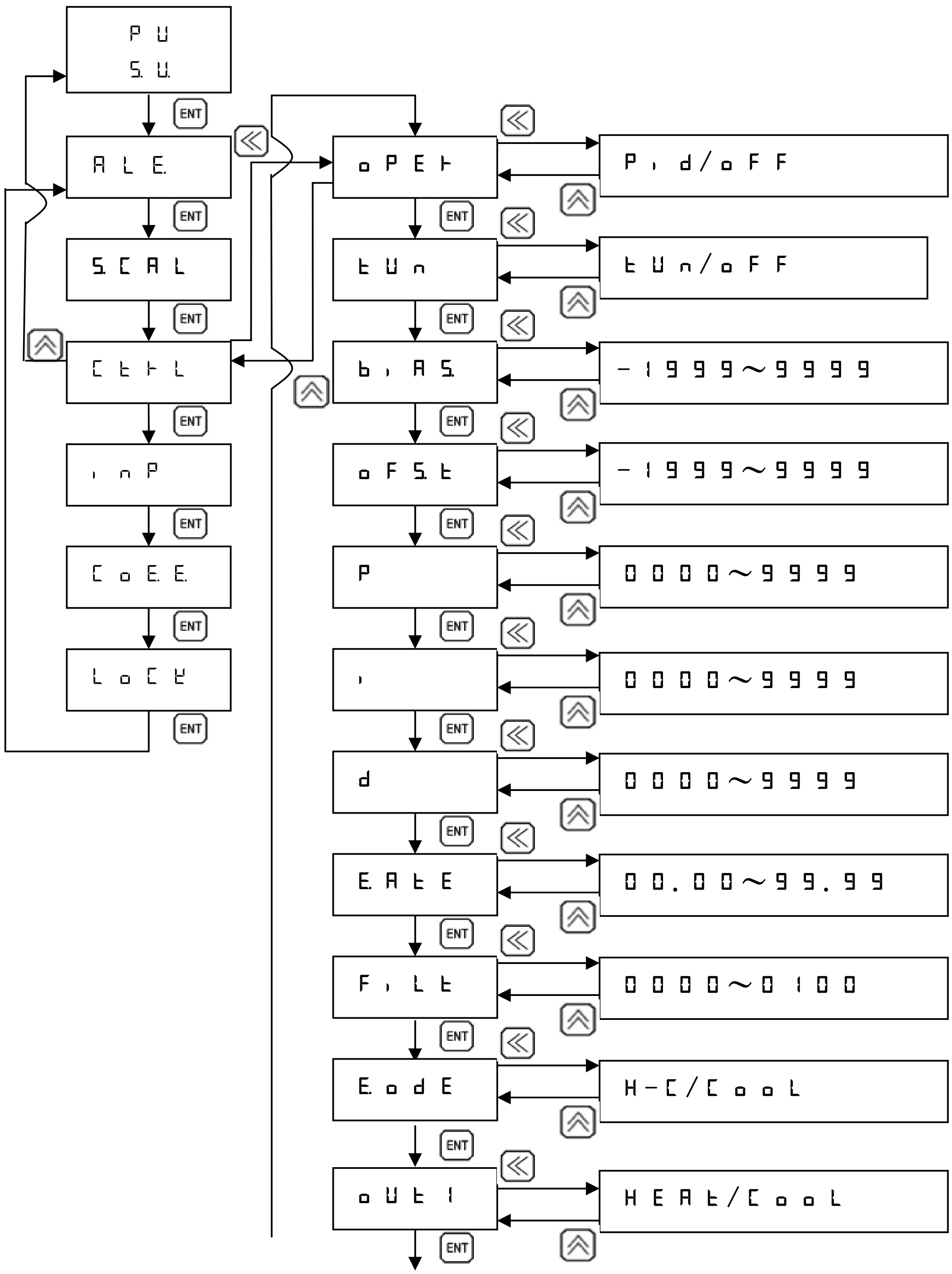
DEB1<0；DEB2>0

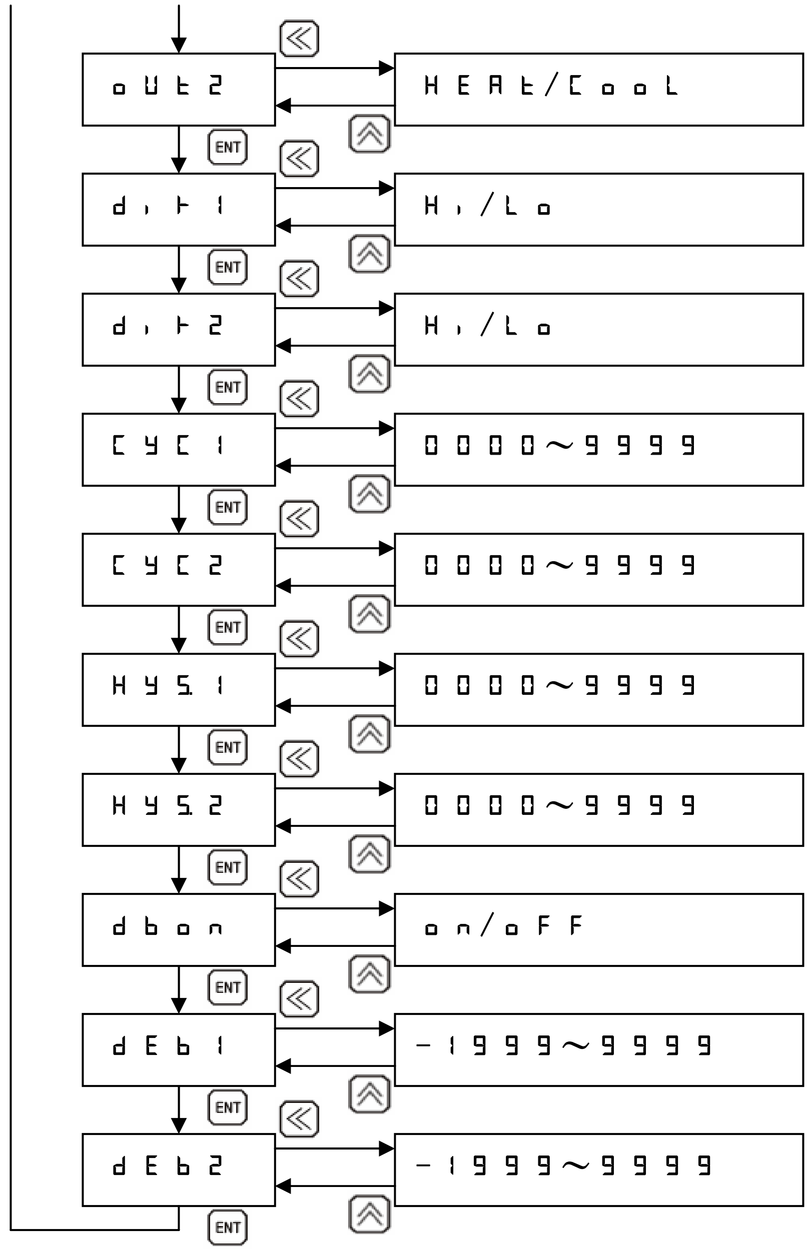
Over SV-DEB1 deactivates heater

Under SV+DEB2 deactivates cooler



12.1 CtrL Parameters Flow Chart





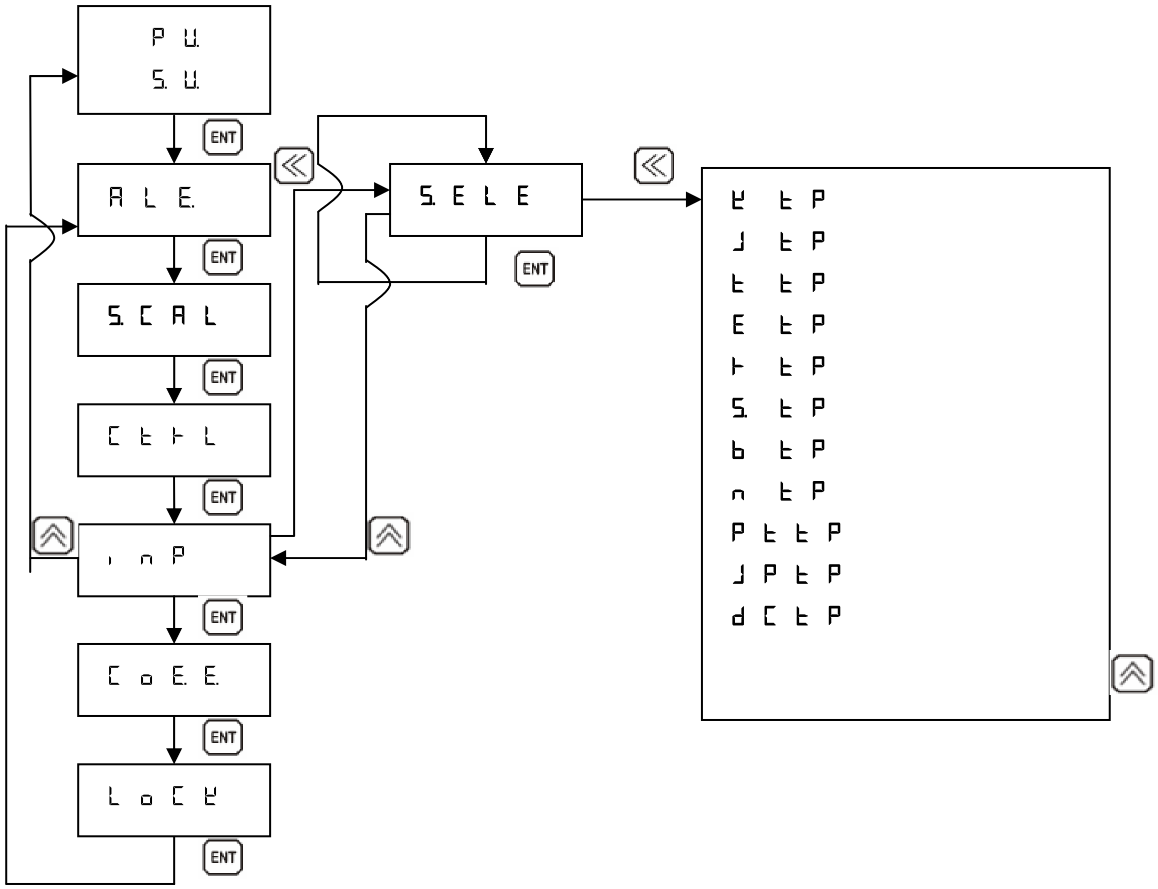
oUt2
HEAt/CooL
dit1
Hi/Lo
dit2
Hi/Lo
CYC1
0000~9999
CYC2
0000~9999
HYS.1
0000~9999
HYS.2
0000~9999
dbon
on/oFF
dEb1
-1999~9999
dEb2
-1999~9999
ENT

13. i n P Parameters table

Parameter	Name of Parameter	Description of Parameter	Setting Range	Preset Value
S. E L E	Select	Selection for input signal of sensors	K Type J Type T Type E Type R Type S Type B Type N Type PT Type JPT Type DC Type	K Type

- K t P： K Type Thermocouple Input。
  Input Range：-200～1370°C 0.3%±1Digit。
- J t P： J Type Thermocouple Input
  Input Range：-210～1200°C 0.3%±1Digit。
- t t P： T Type thermocouple Input
  Input Range：-200～400°C ±2°C±1Digit。
- E t P： E TypeThermocouple Input。
  Input Range：-200～1000°C 0.3%±1Digit。
- r t P： R TypeThermocouple Input。
  Input Range：-50～1760°C 0.3%±1Digit。
- S. t P： S TypeThermocouple Input。
  Input Range：-50～1760°C 0.3%±1Digit。
- b t P： B TypeThermocouple Input。
  Input Range：250～1820°C ±8°C±1Digit。
- n t P： N TypeThermocouple Input。
  Input Range：-200～1300°C 0.3%±1Digit。
- P t t P：PT TypeThermocouple Resistance。
  Input Range：-200～850°C 0.3%±1Digit。
- J P t P：JPT TypeThermocouple Resistance。
  Input Range：-200～850°C 0.3%±1Digit。
- d C t P：DC Type Voltage Input。
  Input Range：0～350mV 0.3%±1Digit。

13.1 CtrL Parameter Flow Chart



14. C o E. E. List of Parameter

Paramter	Name of Parameter	Description of Parameter	Setting Range	Preset Value
i d	ID	Identification	1～255	1
b P S.	BPS.	Baudrate	Describe below	9600
S. t y L	Styl	Transmitting Style	Describe Below	8n1
F o r E.	Formate	Transmitting Format	Hex/Ascii	Hex
t o U t	Time Out	Setting for Time limit	100～9999	100

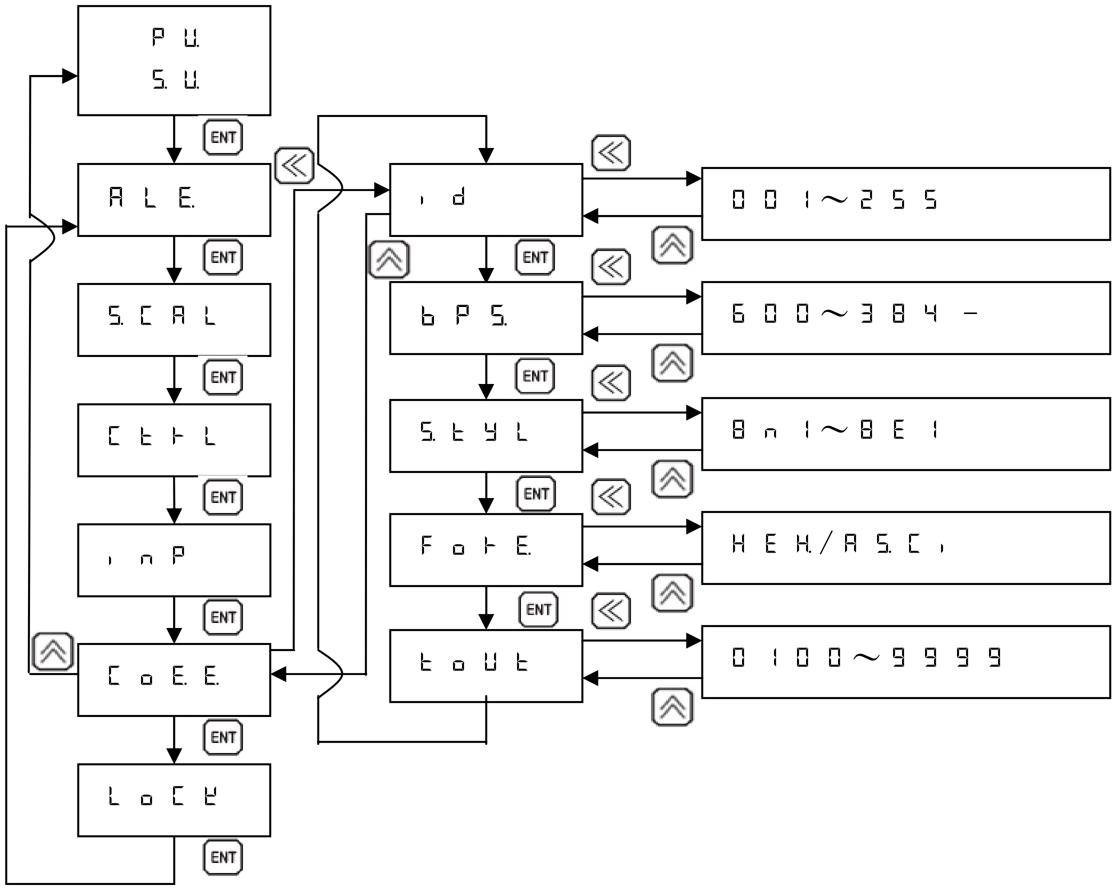
- b P S. ：Selection for Baud Rate Communication。
  - 6 0 0 ：Baud Rate600。
  - 1 2 0 0 ：Baud Rate1200。
  - 2 4 0 0 ：Baud Rate2400。
  - 4 8 0 0 ：Baud Rate4800。
  - 9 6 0 0 ：Baud Rate9600。
  - 1 9 2 -：Baud Rate19200。
  - 3 8 4 -：Baud Rate38400。

- S. t y L ：Selection for Communication Style。
  - 8 n 1 ：None Parity Check，Stops one bit
  - 8 n 2 ：None Parity Check，Stops two bits
  - 8 o 1 ：Odd Check，Stops one bit.
  - 8 E 1 ：Even Check，Stops one bit.

- F o r E. ：Selection for Communication Format。
  - H E H. ：Hex Mode。
  - A S. C i ：ASCII Mode。

- t o U t ：Setting for Time Limit

14.1 CoEE Parameter Flow Chart



15、oCk List of Parameter

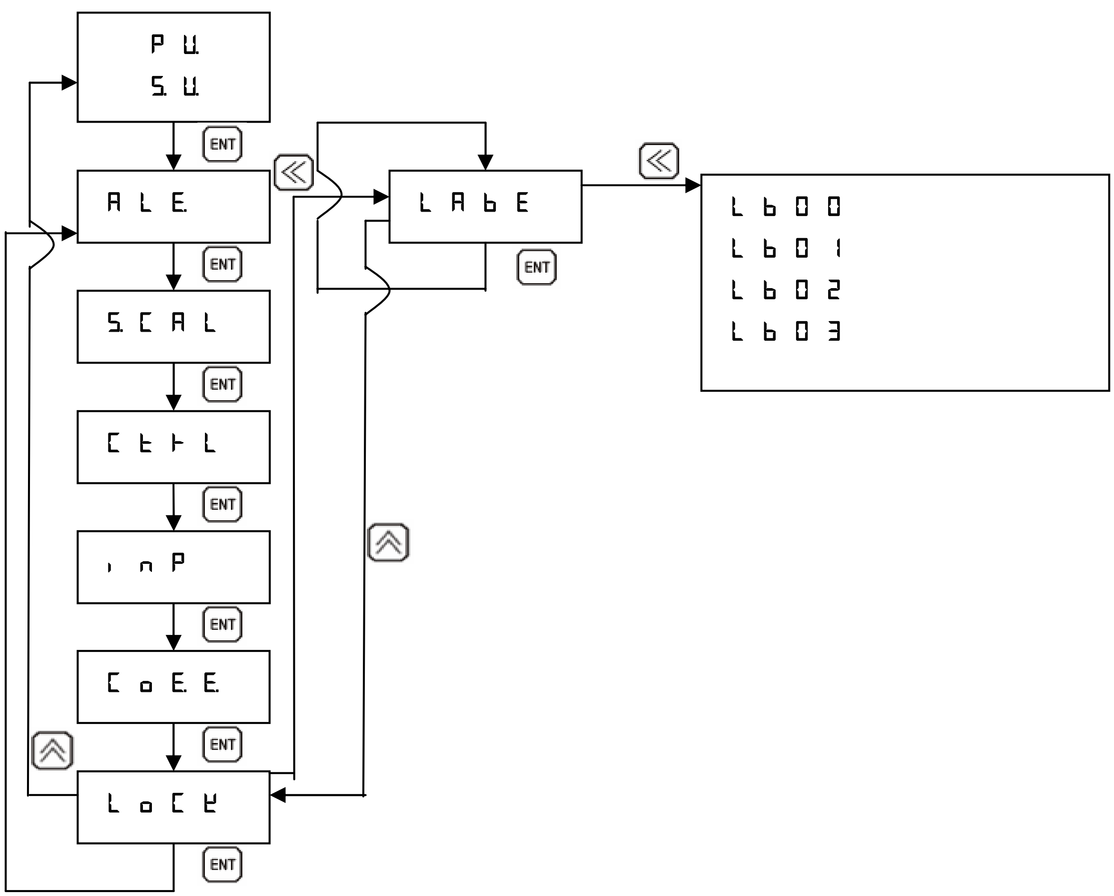
Parameter	Name of Parameter	Description	Setting Range	Preset Value
LAbE	LABEL	Lock	Lb00～Lb03	Lb00

LOCK	Lb03	Lb02	Lb01	Lb00
ALE.				
PoS.1			○	○
HYS.1				○
dY1				○
dIr1				○
StY1				○
PoS.2			○	○
HYS.2				○
dY2				○
dIr2				○
StY2				○
SCAL				
S.U.		○	○	○
dot				○
S.CH				○
S.CL				○
LIE.H				○
LIE.L				○
UnIt				○
PErt				○
S.CHI				○
S.CLI				○
CtrL				
oPEr			○	○
tUn			○	○
bIAS.			○	○
oFSt			○	○
P			○	○
I			○	○
d			○	○
CArE			○	○
FILt			○	○
CodE			○	○
oUt1			○	○
oUt2			○	○
dIr1			○	○
dIr2			○	○

LOCK	Lb03	Lb02	Lb01	Lb00
CYC1			○	○
CYC2			○	○
HYS.1			○	○
HYS.2			○	○
dbon			○	○
dEb1			○	○
dEb2			○	○
S.EGE.				
EnAb				
LooP			○	○
StAt			○	○
ALE.			○	○
ALEt			○	○
S.S.U.1			○	○
S.S.U.2			○	○
S.S.U.3			○	○
S.S.U.4			○	○
S.S.U.5			○	○
S.S.U.6			○	○
S.S.U.7			○	○
S.S.U.8			○	○
S.t 1			○	○
S.t 2			○	○
S.t 3			○	○
S.t 4			○	○
S.t 5			○	○
S.t 6			○	○
S.t 7			○	○
S.t 8			○	○
inP				
K tP				○
J tP				○
t tP				○
E tP				○
r tP				○
S.tP				○
b tP				○
n tP				○

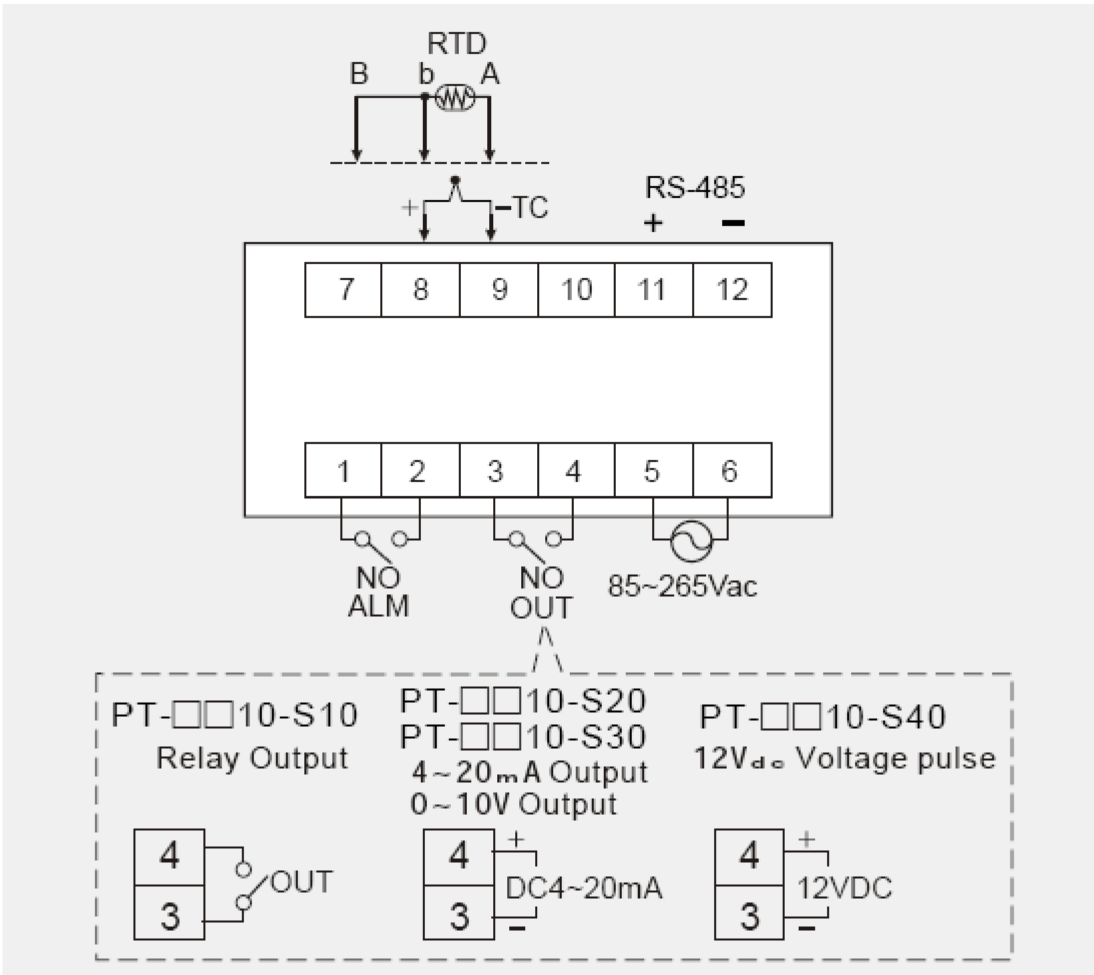
LOCK	Lb03	Lb02	Lb01	Lb00
PtEP				○
uPtP				○
dCtP				○
CoE.E.				
id				○
bPS.				○
StYL				○
ForE.				○
toUt				○
LoCK				
LAbE	○	○	○	○

15.1 LoCK Parameter Flowchart

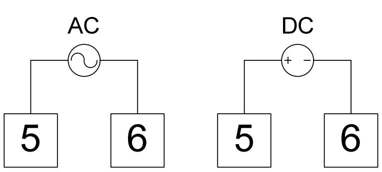


16、Explanation for Terminal Wiring

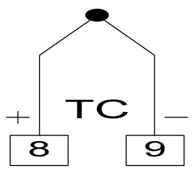
16.1 PT-7310 Explanation for Terminal Wiring

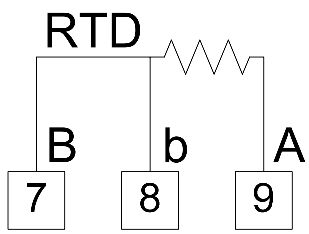


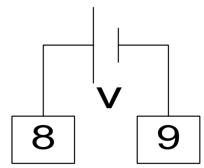
Power Supply Connection

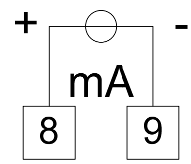


Sensor Connection

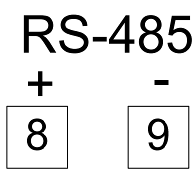




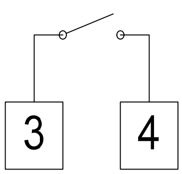


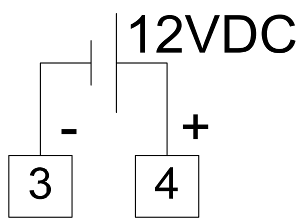


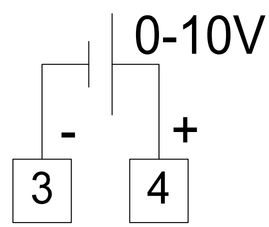
Communication Connection

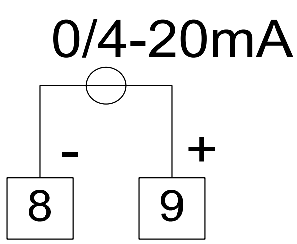


1st Control Output Connection

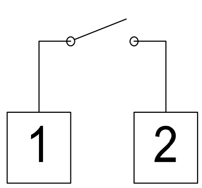




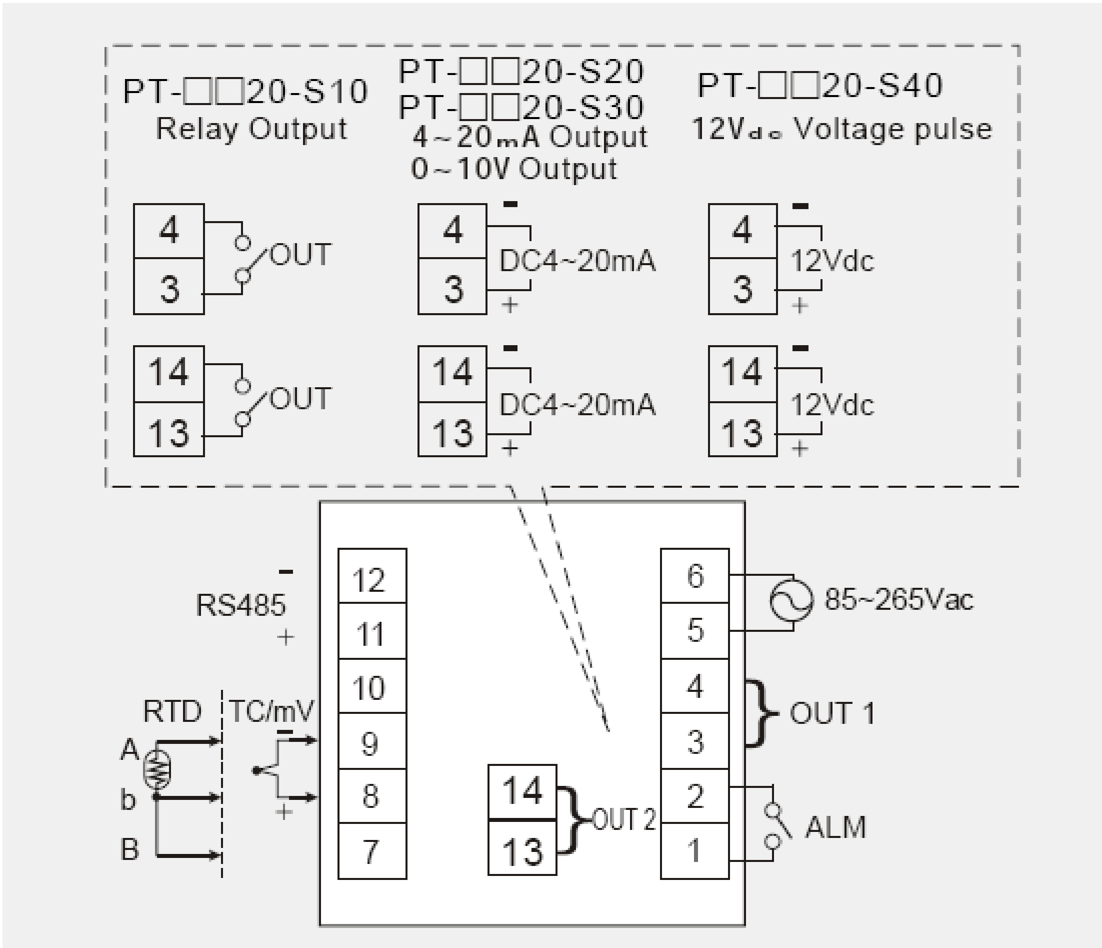




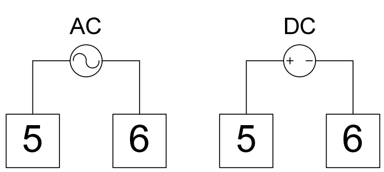
1st alarm Output Connection



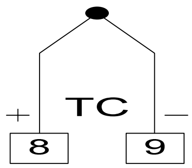
16.2 PT-7320 Explanation of Terminal wiring

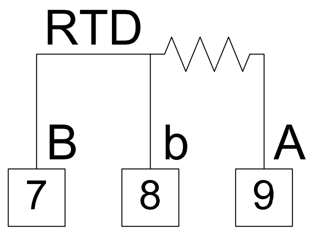


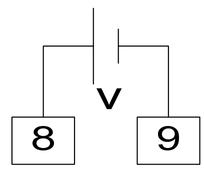
Power Supply Connection

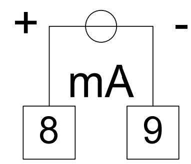


Sensor Connection

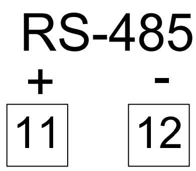




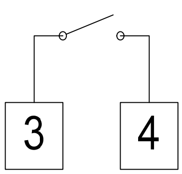


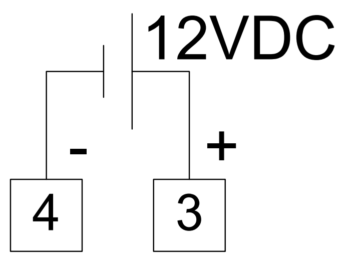


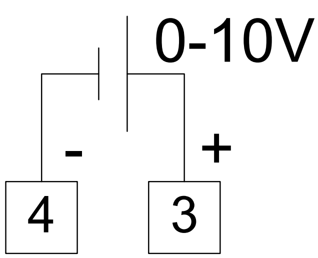
Communication Connection

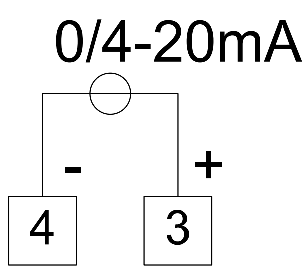


1st Control Output connection

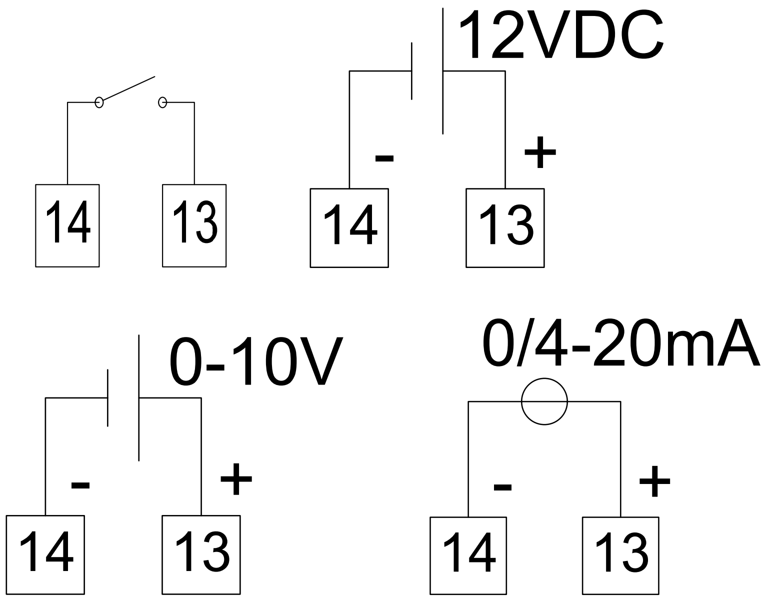




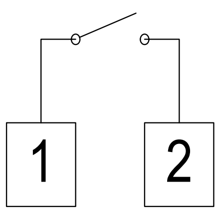




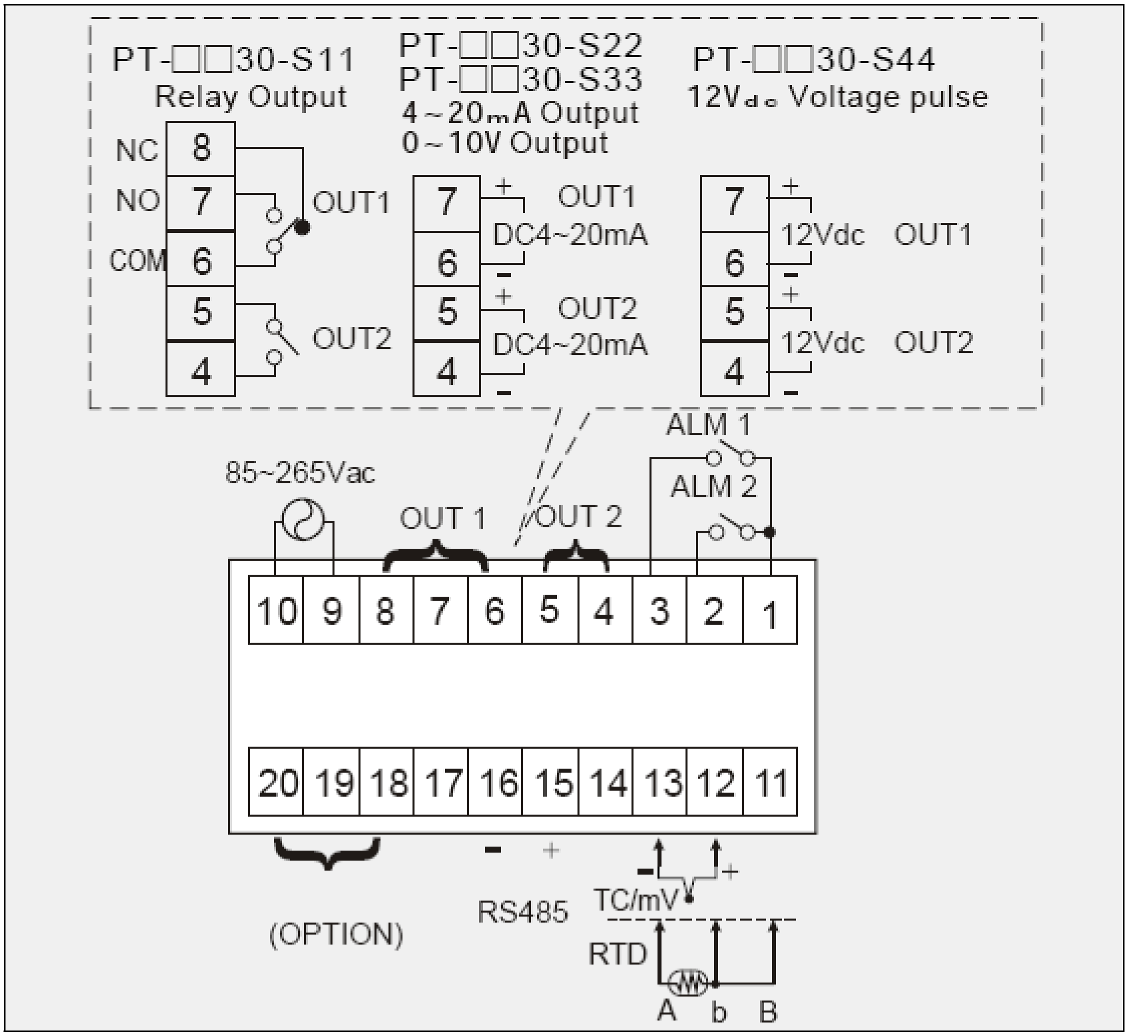
2nd Control Output Connection



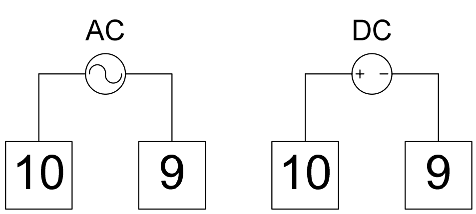
1st Alarm Output Connection



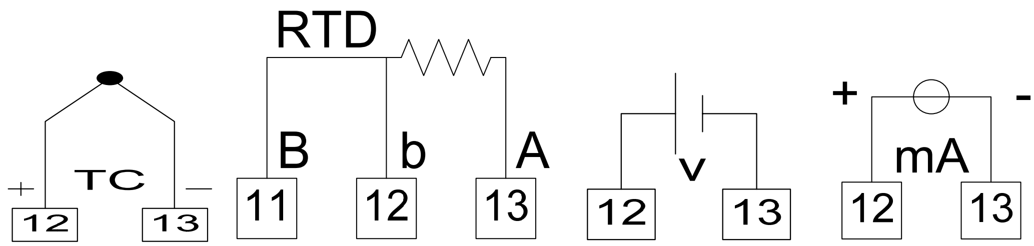
16.3 PT-7330 Explanation for Terminal Wiring



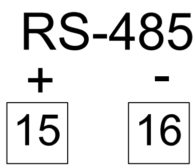
Power Supply Connection



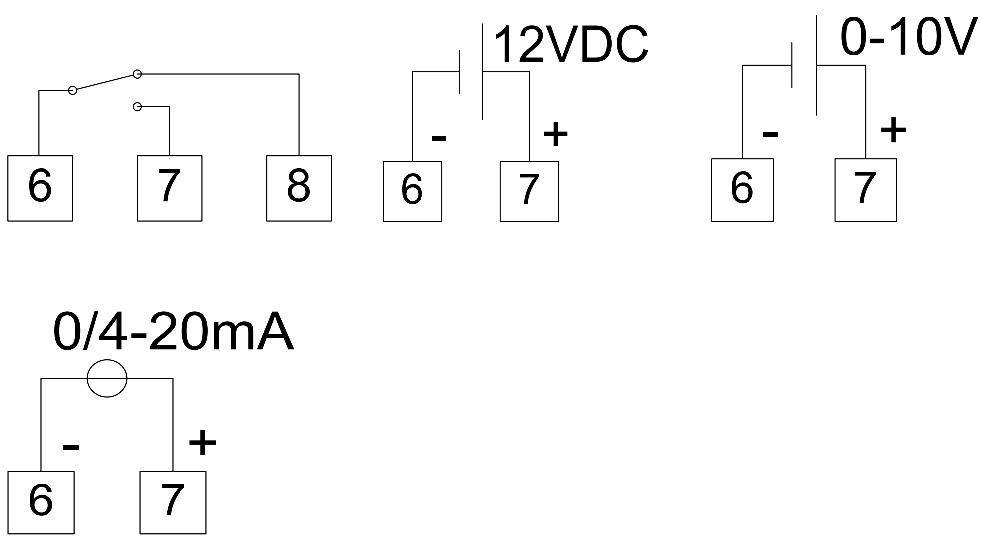
Sensor Connection



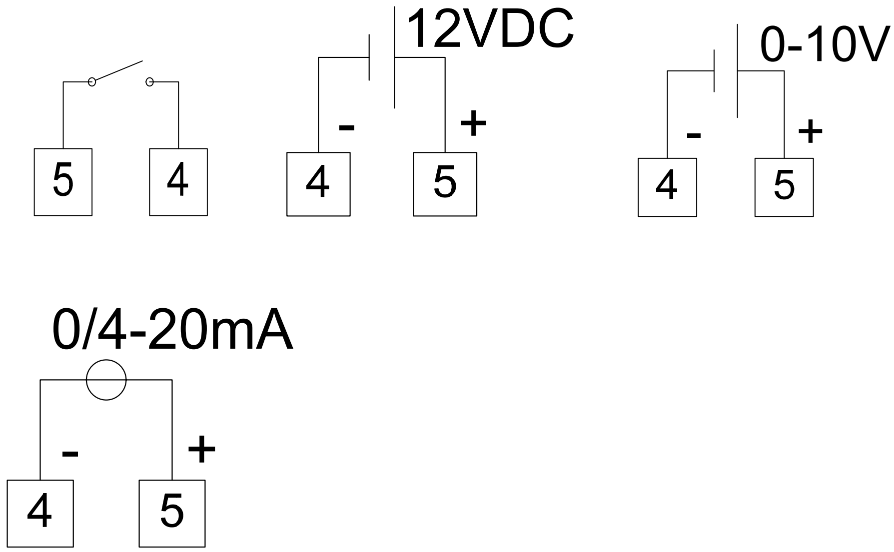
Communication connection



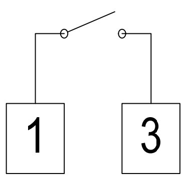
1st Control Output Connection



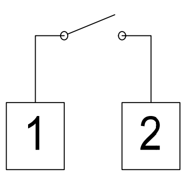
2nd Control Output Connection



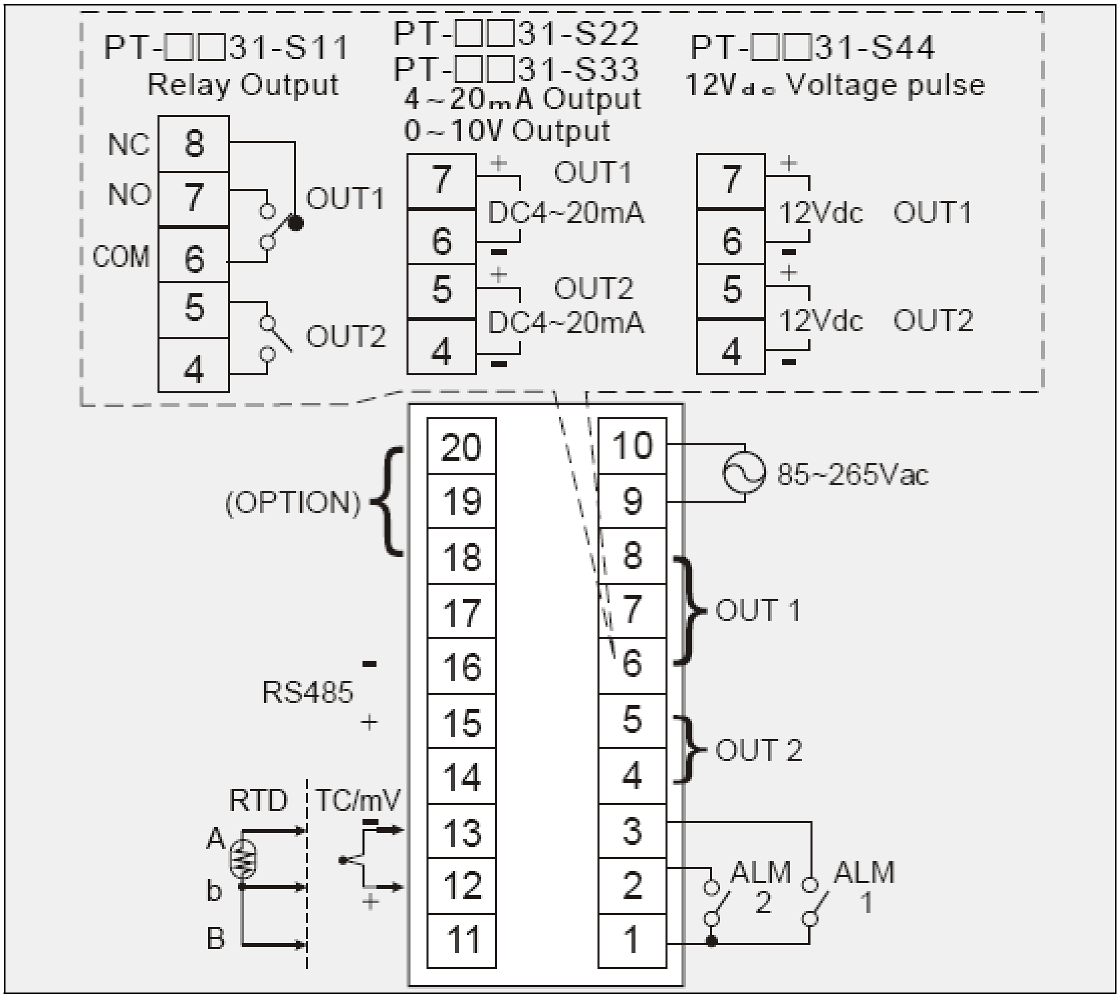
1st Alarm Output connection



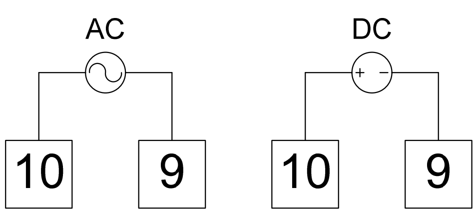
2nd Alarm Output connection



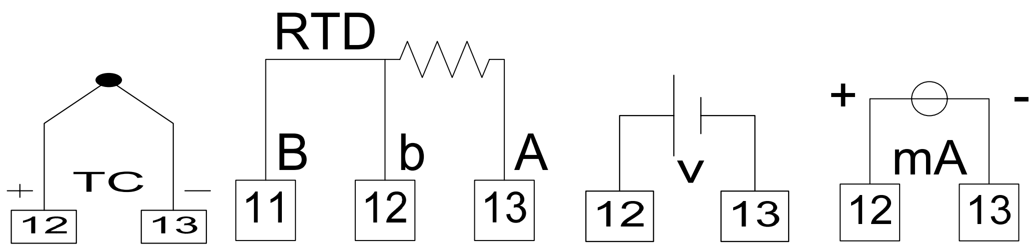
16.4 PT-7331 Explanation for Terminal Wiring



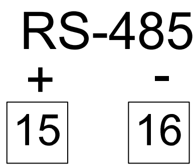
Power Supply Connection



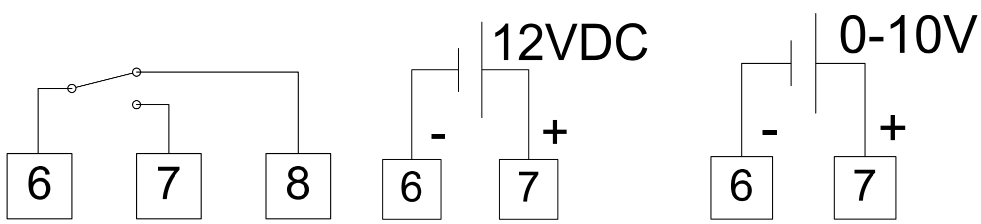
Sensor Connection

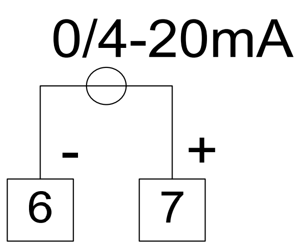


Communication Connection

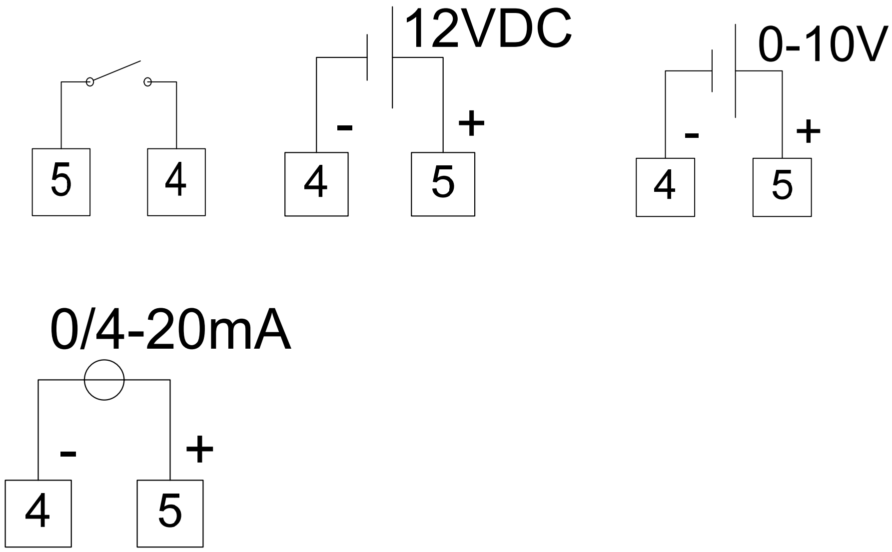


1st Control Output Connection

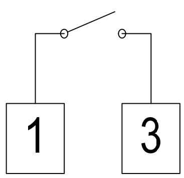




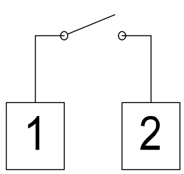
2nd Control Output Connection



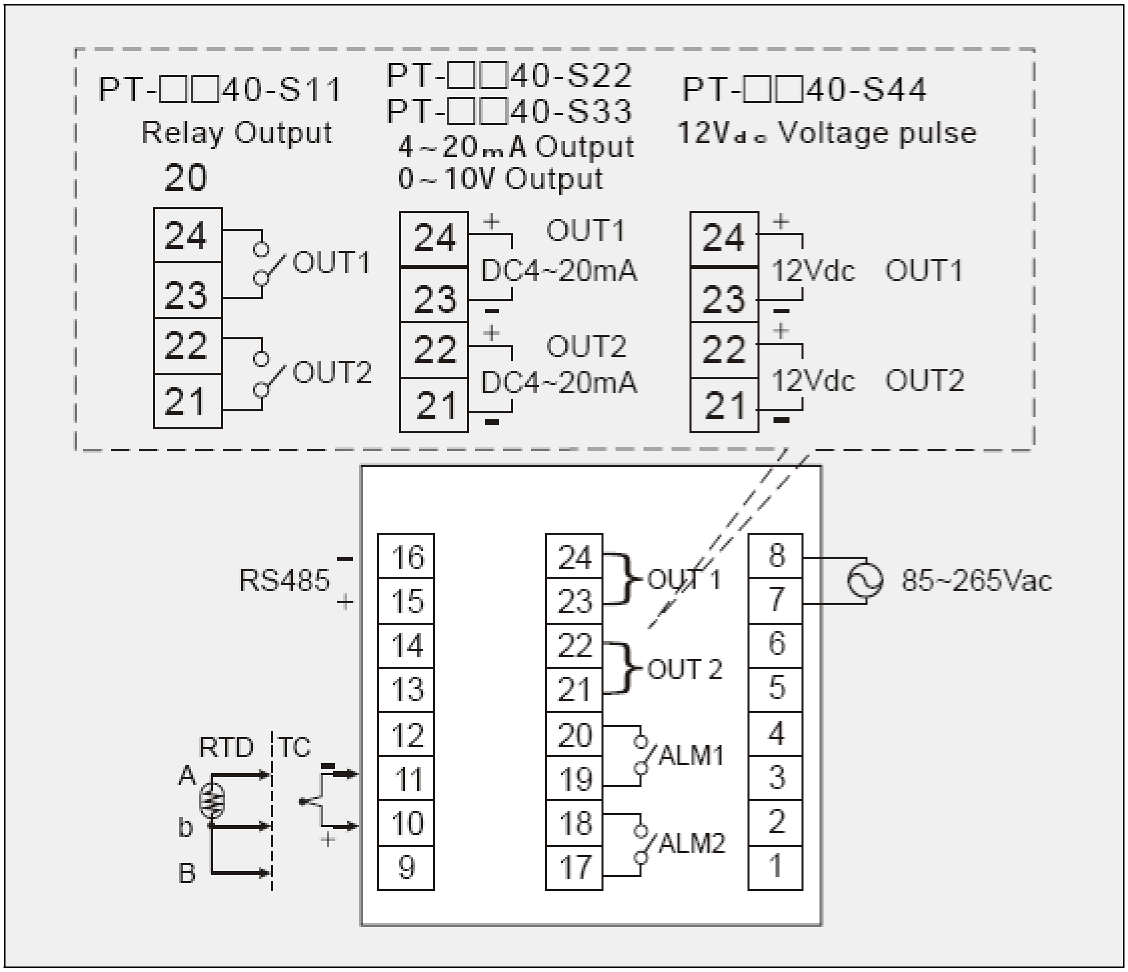
1st Alarm Output Connection



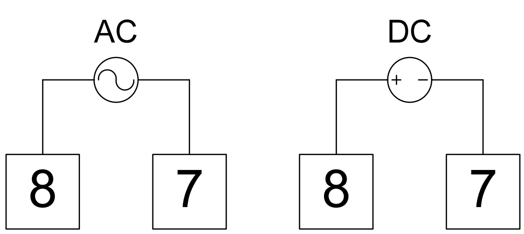
2nd Alarm Output Connection



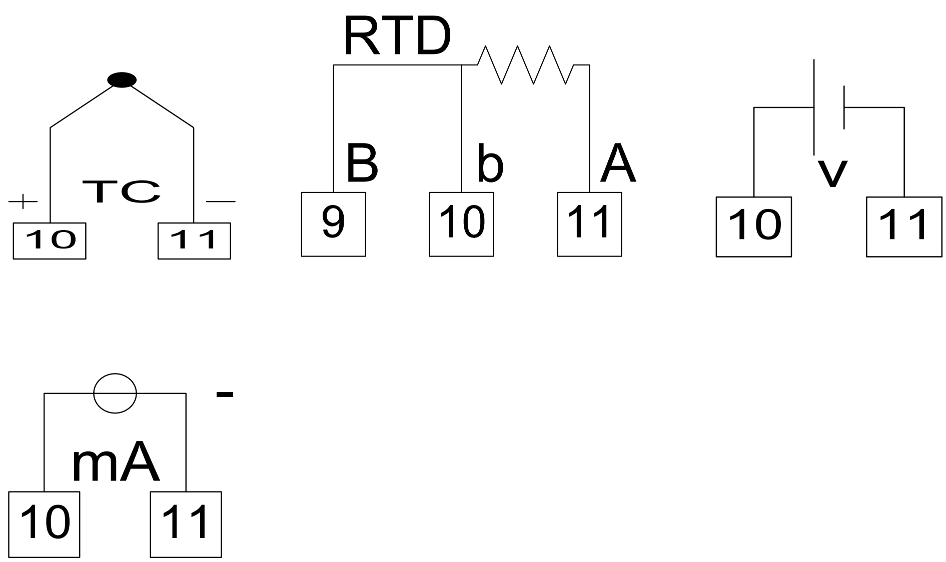
16.5 PT-7340 Explanation for Terminal Wiring



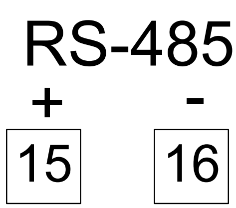
Power supply Connection



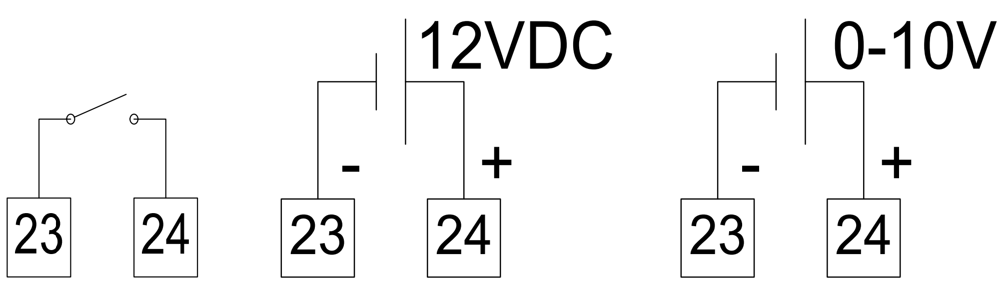
Sensor Connection

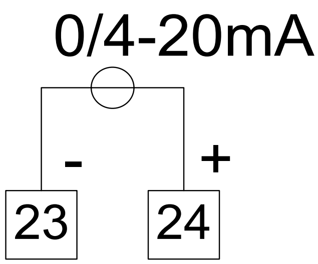


Communication Connection

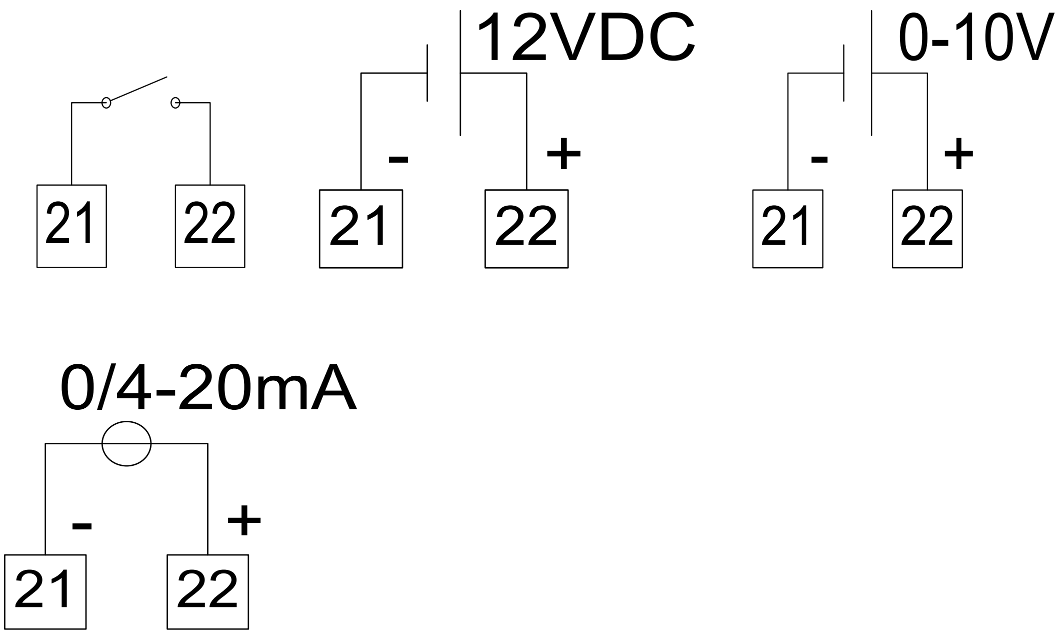


1st Control Output Connection

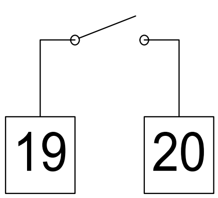




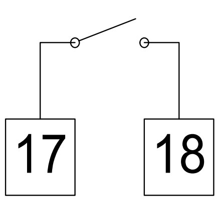
2nd Control Output Connection



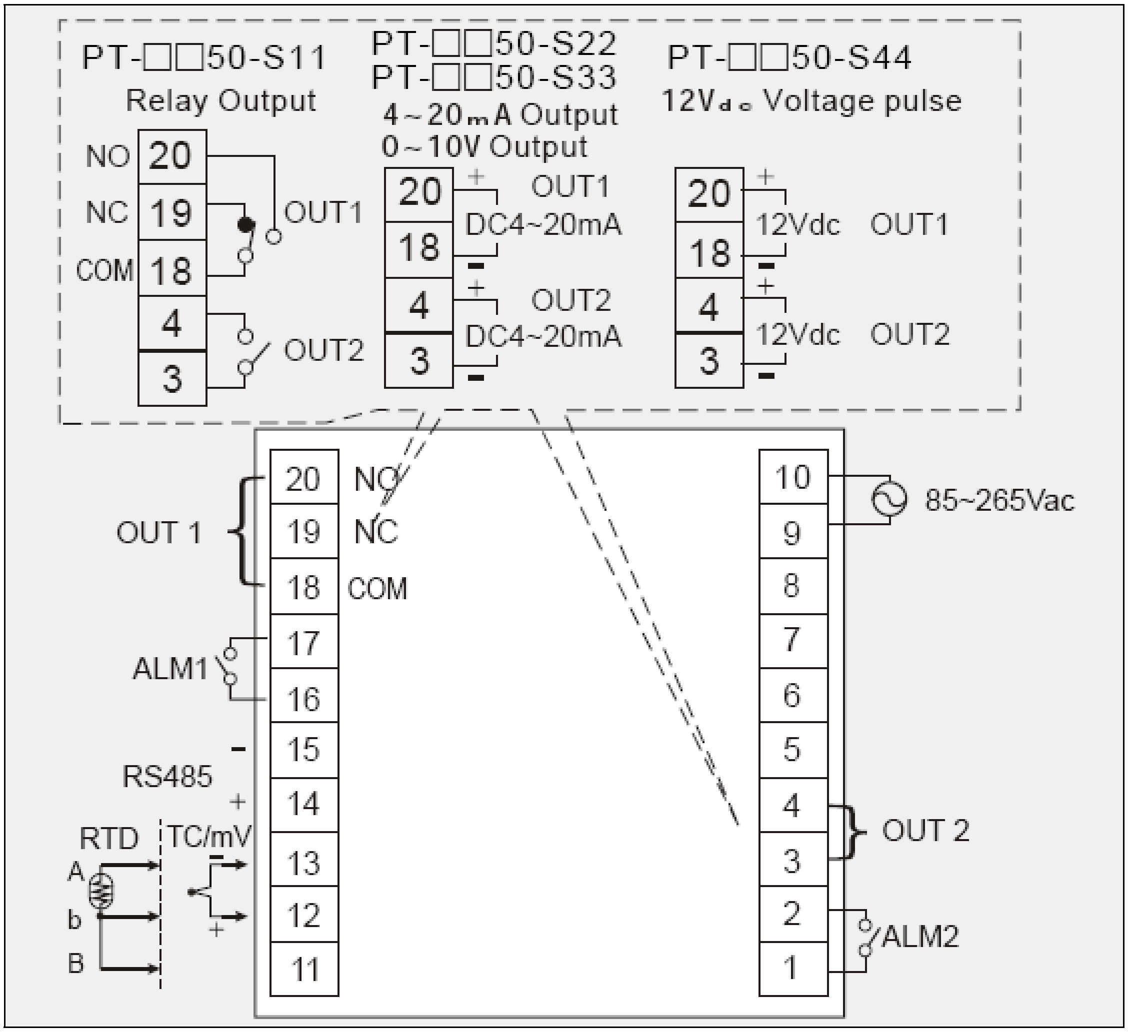
1st Alarm Output Connection



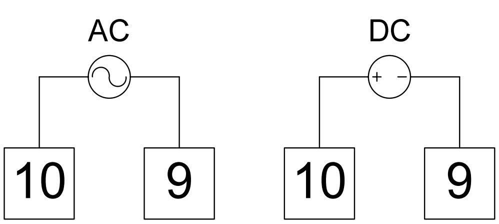
2nd Alarm Output Connection



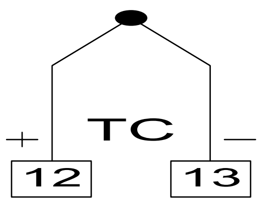
16.6 PT-7350 Explanation for Terminal Wiring

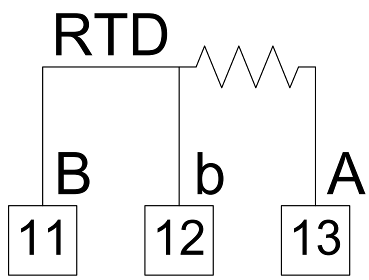


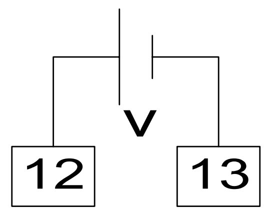
Power Supply Connection

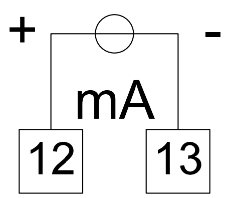


Sensor Connection

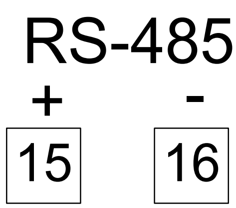




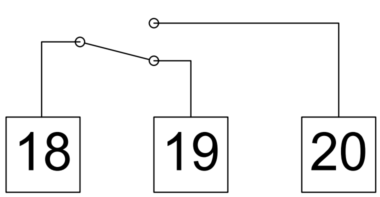


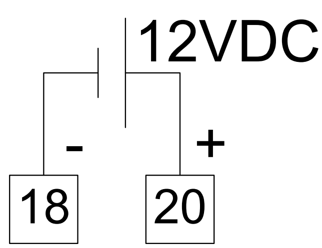


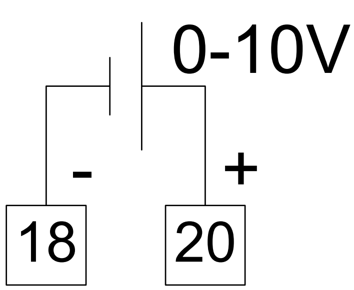
Communication Connection

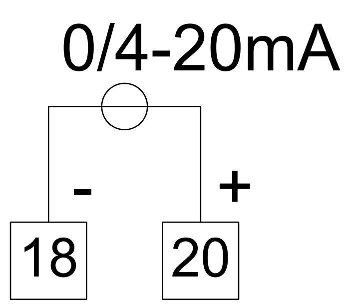


1st Control Output Connection

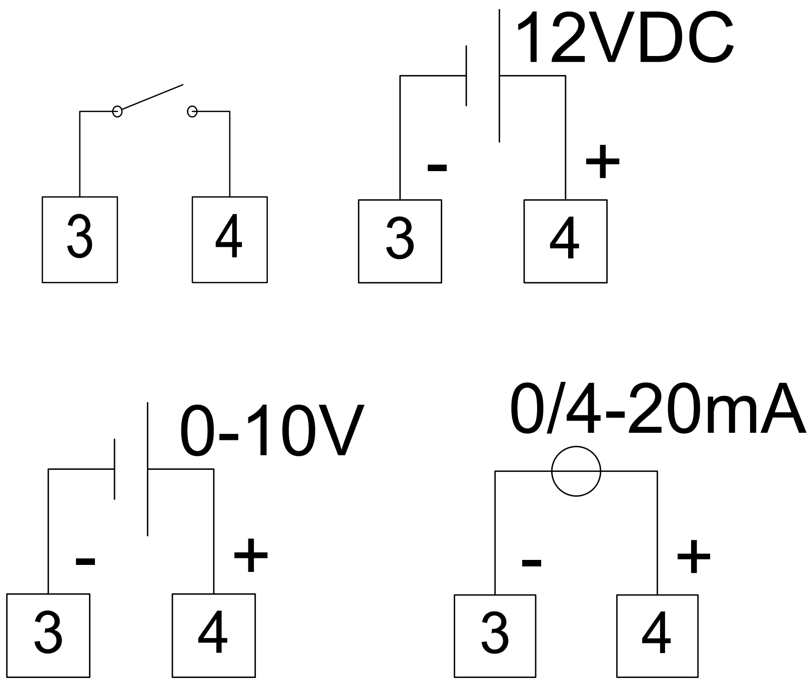




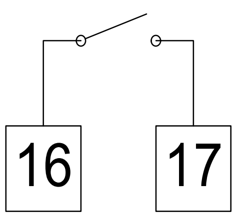




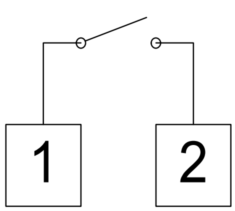
2nd Control Output Connection



1st Alarm Output Connection



2nd Alarm Output Connection



17. Explanation of Communication Protocol

17.1 Mode of Communication

QUERY			
	Example	ASCII	RTU
Field Name	(Hex)	Characters	8-Bit Field
Header		: (colon)	None
Slave Address	06	0 6	0000 0110
Function	03	0 3	0000 0011
Starting Address Hi	00	0 0	0000 0000
Starting Address Lo	6B	6 B	0110 1011
No. of Registers Hi	00	0 0	0000 0000
No. of Registers Lo	03	0 3	0000 0011
Error Check		LRC (2 chars.)	CRC (16 bits)
Trailer		CR LF	None
	Total Bytes:	17	8

Master Query with ASCII/RTU Framing

RESPONSE			
	Example	ASCII	RTU
Field Name	(Hex)	Characters	8-Bit Field
Header		: (colon)	None
Slave Address	06	0 6	0000 0110
Function	03	0 3	0000 0011
Byte Count	06	0 6	0000 0110
Data Hi	02	0 2	0000 0010
Data Lo	2B	2 B	0010 1011
Data Hi	00	0 0	0000 0000
Data Lo	00	0 0	0000 0000
Data Hi	00	0 0	0000 0000
Data Lo	63	6 3	0110 0011
Error Check		LRC (2 chars.)	CRC (16 bits)
Trailer		CR LF	None
	Total Bytes:	23	11

Slave Response with ASCII/RTU Framing

17.2 Address List

Temperature Meter ModBus Command List				
Address No.	Command Name	DataRange	Attribute	Remark
0	COM_VerCode		R	
1	COM_AlmPos1	-1999~9999	R/W	
2	COM_AlmHys1	0000~9999	R/W	
3	COM_AlmDyTime1	00~99	R/W	
4	COM_AlmDir1	0~1	R/W	
5	COM_AlmStyle1	0~9	R/W	0~7:St1-St8 8:St9 9:St10
6	COM_ScalSv1	-1999~9999		R/W
7	COM_ScalDot	0~3	R/W	0~3:Dot0~Dot3
8	COM_ScalSch	-1999~9999	R/W	
9	COM_ScalScl	-1999~9999	R/W	
10	COM_ScalLimtH	-1999~9999	R/W	
11	COM_ScalLimtL	-1999~9999	R/W	
12	COM_ScalUnit	0~1	R/W	0:°C 1:°F
13	COM_ScalPercentage	0~1	R/W	0: OFF 1: ON
14	COM_ScalSchl	-1999~9999	R/W	
15	COM_ScalScll	-1999~9999	R/W	
16	COM_CtlSelOper	0~1	R/W	0: ON/FF 1: PID+Fuzzy
17	COM_CtlHys1	0000~9999		
18		0~1	R/W	0: OFF 1: ON
19	COM_CtlTun		R	
20	COM_CtlP1	0000~9999	R/W	
21	COM_CtlI1	0000~9999	R/W	
22	COM_CtlD1	0000~9999	R/W	
23	COM_CtlDir1	0~1	R/W	0:Lo 1:Hi
24	COM_CtlCycleTime1	0000~9999	R/W	
25	COM_CtlBias	-1999~9999	R/W	
26	COM_CtlManualReset	0000~9999	R/W	
27	COM_CtlFilter	1~100	R/W	
28	COM_InpSel	0~10	R/W	0:K 1:J 2:T 3:E 4:R 5:S 6:B 7:N 8:Pttp 9:JPtP 10:dCtP
29	COM_TemperatureValue		R/W	

Temperature Meter ModBus Command List				
Address No.	Command Name	Data Range	Attribute	Remark
40	COM_SegmEnable	0~1	R/W	0: OFF 1: ON
41	COM_SegmLoop	0~1	R/W	0: OFF 1: ON
42	COM_SegmStart	0~7	R/W	0~7: Str1~Str8
43	COM_SegmAlmNo	0~8	R/W	0: OFF 1~8:Alml~Am18
44	COM_SegmAlmT	0000~9999	R/W	
45	COM_SegmSv1	-1999~9999	R/W	
46	COM_SegmSv2	-1999~9999	R/W	
47	COM_SegmSv3	-1999~9999	R/W	
48	COM_SegmSv4	-1999~9999	R/W	
49	COM_SegmSv5	-1999~9999	R/W	
50	COM_SegmSv6	-1999~9999	R/W	
51	COM_SegmSv7	-1999~9999	R/W	
52	COM_SegmSv8	-1999~9999	R/W	
53	COM_SegmT1	0000~9999	R/W	
54	COM_SegmT2	0000~9999	R/W	
55	COM_SegmT3	0000~9999	R/W	
56	COM_SegmT4	0000~9999	R/W	
57	COM_SegmT5	0000~9999	R/W	
58	COM_SegmT6	0000~9999	R/W	
59	COM_SegmT7	0000~9999	R/W	
60	COM_SegmT8	0000~9999	R/W	

Temperature Meter ModBus Command List				
Address No.	Command Name	Data Range	Attribute	Remark
100	COM_AlmPos2	-1999~9999	R/W	
101	COM_AlmHys2	0000~9999	R/W	
102	COM_AlmDyTime2	00~99	R/W	
103	COM_AlmDir2	0~1	R/W	0:Lo 1:Hi
104	COM_AlmStyle2	0~9	R/W	0~7:St1-St8 8:St9 9:St10
105	None			
106	COM_CtlHys2	0000~9999	R/W	
107	None			
108	None			
109	None			
110	COM_CtlDir2	0~1	R/W	0:Lo 1:Hi
111	COM_CtlDeadband	-1999~9999	R/W	
112	COM_CtlDeadband2	-1999~9999	R/W	
113	COM_CtlCycleTime2	0000~9999	R/W	

17.3 Introduction for MODBUS Communication

17.3.1 Explanation for RTU(HEX) MODE

1. Basic structure of commands (16 Hexadecimal)

START	ADDRESS	FUNCTION	DATA	CRC	END
T1~4	8Bit	8Bit	N x 8Bit	8Bit	T1~4

START ：at least 4 data bits without transmitting data.

ADDRESS ：read or control the address of meter.

(address range: 1~255).

FUNCTION ：03H: read the data of Meter.

H: write out the data into Meter.

DATA ：Include address of the register and the number of words for read.

CRC CHECK ：16bit CRC，the details of calculation showing in folwoing

END ：at least 4 data bits without transmitting data.

2.Bit Per Byte

4 Modes：

Start Bit	Data Bit	Parity	Stop
1	8	None	2
1	8	Even	1
1	8	Odd	1
1	8	None	1

3.CRC algorithm

Two ways of CRC algorithm: **logical algorithm** and **check list** .

CRC column is a 2 hex bytes, calculating from **address** to **data end**. If the CRC value from PC calculation is different from received value, then the data is an error.

Addres s	Functio n	Data Count	Data	Data	Data	Data	CRC Lo	CRC Hi

4.Logical algorithm:

Procedures:

(1) Install a one -16 Hexadecimal bytes into FFFF (Hex), defining as CRC register.

(2) Let the low byte of CRC and the 1st byte of Message to be excluded or Exclusive OR，then the result saves to CRC register.

(3) Right Shift 1 byte of the CRC register, then set zero as the high byte of CRC register, comparing to the removed byte and defining as SLSB.

(4) If SLSB=0, repeat procedure 3. If SLSB=1，let CRC register and parameter A001 (Hex) to be excluded, then save to CRC register.

(5) Repeat procedure 3 & 4, until complete the 8 bytes.

(6) Repeat procedure 2-5, until all Bytes to be completed.

(7) The calculated value required to be exchanged by the high/low byte.

Example of Logical Algorithm (For C)

```
unsigned int addCRC( unsigned CRC,unsigned char b )
{
unsigned char i,bh,bl;
bh=CRC/256;
bl=CRC%256;
bl^=b;
CRC=bh*256+bl;
for(i=0;i<8;i++)
if(CRC&0x0001) CRC=(CRC/2)^0xA001;
else CRC=CRC/2;
return CRC;
}
unsigned char Check_CRC(void)
{ unsigned int i,CRC;
CRC=addCRC(0xFFFF,ID);
for(i=1;i<(TXD_CNT-2);i++) CRC=addCRC(CRC,TXDB[i]) ;
return CRC;
}
```

6. Checksum

```
static const unsigned int CRCtbl[ 256 ] = {
0x0000,0xC0C1,0xC181,0x0140,0xC301,0x03C0,0x0280,0xC241,0xC601,0x06C0,0x0780,0xC
741,0x0500,0xC5C1,0xC481,0x0440,0xCC01,0x0CC0,
0x0D80,0xCD41,0x0F00,0xCFC1,0xCE81,0x0E40,0x0A00,0xCAC1,0xCB81,0x0B40,0xC901,0
x09C0,0x0880,0xC841,0xD801,0x18C0,0x1980,0xD941,0x1B00,0xDBC1,0xDA81,0x1A40,0x1
E00,0xDEC1,0xDF81,0x1F40,0xDD01,0x1DC0,0x1C80,0xDC41,0x1400,0xD4C1,0xD581,0x15
40,0xD701,0x17C0,0x1680,0xD641,0xD201,0x12C0,0x1380,0xD341,0x1100,0xD1C1,0xD081,
0x1040,0xF001,0x30C0,0x3180,0xF141,0x3300,0xF3C1,0xF281,0x3240,0x3600,0xF6C1,0xF7
81,0x3740,0xF501,0x35C0,0x3480,0xF441,0x3C00,0xFCC1,0xFD81,0x3D40,0xFF01,0x3FC0,
0x3E80,0xFE41,0xFA01,0x3AC0,0x3B80,0xFB41,0x3900,0xF9C1,0xF881,0x3840,0x2800,0xE
8C1,0xE981,0x2940,0xEB01,0x2BC0,0x2A80,0xEA41,0xEE01,0x2EC0,0x2F80,0xEF41,0x2D0
0,0xEDC1,0xEC81,0x2C40,0xE401,0x24C0,0x2580,0xE541,0x2700,0xE7C1,0xE681,0x2640,0
x2200,0xE2C1,0xE381,0x2340,0xE101,0x21C0,0x2080,0xE041,0xA001,0x60C0,0x6180,0xA1
41,0x6300,0xA3C1,0xA281,
0x6240,0x6600,0xA6C1,0xA781,0x6740,0xA501,0x65C0,0x6480,0xA441,
0x6C00,0xACC1,0xAD81,0x6D40,0xAF01,0x6FC0,0x6E80,0xAE41,0xAA01,
0x6AC0,0x6B80,0xAB41,0x6900,0xA9C1,0xA881,0x6840,0x7800,0xB8C1,0xB981,0x7940,0x
BB01,0x7BC0,0x7A80,0xBA41,0xBE01,0x7EC0,0x7F80,0xBF41,0x7D00,0xBDC1,0xBC81,0x
7C40,0xB401,0x74C0,0x7580,0xB541,0x7700,0xB7C1,0xB681,0x7640,0x7200,0xB2C1,0xB38
1,0x7340,0xB101,0x71C0,0x7080,0xB041,0x5000,0x90C1,0x9181,0x5140,0x9301,0x53C0,0x5
280,0x9241,0x9601,0x56C0,0x5780,0x9741,0x5500,0x95C1,0x9481,
0x5440,0x9C01,0x5CC0,0x5D80,0x9D41,0x5F00,0x9FC1,0x9E81,0x5E40,
0x5A00,0x9AC1,0x9B81,0x5B40,0x9901,0x59C0,0x5880,0x9841,0x8801,
0x48C0,0x4980,0x8941,0x4B00,0x8BC1,0x8A81,0x4A40,0x4E00,0x8EC1,0x8F81,0x4F40,0x8
D01,0x4DC0,0x4C80,0x8C41,0x4400,0x84C1,0x8581,0x4540,0x8701,0x47C0,0x4680,0x8641,
0x8201,0x42C0,0x4380,0x8341, 0x4100,0x81C1,0x8081,0x4040 };
```

```
unsigned addCRC( unsigned CRC,char b )
{
return ( CRC >> 8 ) ^ CRCtbl[ ( CRC & 0xFF ) ^ b ];
}
```

4.Read the Register of Meter (Function Code＝03 Hex)

Request：

Slave Address	1 Byte	1~255
Function code	1 Byte	03
Start Address	2 Byte	0x0000~0xFFFF
Quantity of Register	1 Byte	1~10
CRC Check	2 Byte	

Response：

Slave Address	1 Byte	1~255
Function code	1 Byte	03
Byte Count	1 Byte	2 x N
Register Value	N x 2 Byte	
CRC Check	2 Byte	

5. Write out Meter Register (Function Code＝06 Hex)

Request：

Slave Address	1 Byte	1~255
Function code	1 Byte	06
Register Address	2 Byte	0x0000~0xFFFF
Register Value	2 Byte	0x0000~0xFFFF
CRC Check	2 Byte	

Response：

Slave Address	1 Byte	1~255
Function code	1 Byte	06
Register Address	2 Byte	0x0000~0xFFFF
Register Value	2 Byte	0x0000~0xFFFF
CRC Check	2 Byte	

17.3.2 ASCII MODE

1、 Basic Structure of Command (16 Hexadecimal)

START	ADDRESS	FUNCTION	DATA	LRC CHECK	END
1CHAR	2CHAR	2CHAR	nCHAR	2CHAR	2CHAR CR LF

(1).START ：Fixed as":"(3AH)。

(2).ADDRESS ：Read or control the address of Meter (Address rang:1~255)。

(3).FUNCTION："03":Read the data of Meter。

"06":Write out the data into Meter。

(4).DATA ：Include the address of the register and the number of word for read。

(5).LRC CHECK：8bit LRC，the detail of calculation is shown in following chapter。

(6).END ：CR(0DH), LF(0AH)。

2、Bit Per Byte

9 Types:

Start Bit	Data Bit	Parity	Stop
1	8	None	1
1	7	None	2
1	7	Odd	1
1	7	Even	1
1	8	None	2
1	8	Odd	1
1	8	Even	1
1	7	Odd	2
1	7	Even	2

3、 LRC algorithm

The common LRC algorithm is Logical algorithm in which LRC column is a one-16 Hexadecimal, calculating from address to data end. If the LRC value from PC calculation is different from received value, then the data is an error. Procedures：

(1). Install a one-8 bytes register into 00(Hex), defining as LRC register.

(2).The high bytes value of the Message to be transmitted from ASCII to Binary, then moving 4 bits to left hand side and adding low byte value from ASCII to Binary.

(3). Repeat procedure 2, until 3 bits are completed.

(4). The calculated LRC value requires of having complement 2 for transforming and installing into Message.

START	ADDRESS	FUNCTION	DATA	LRC CHECK	END
1CHAR	2CHAR	2CHAR	nCHAR	2CHAR	2CHAR CR LF
0	1,2	3,4	5,6,7,8	9,10	11,12

```
unsigned char CharToBinary(char Code)
{   Unsigned char b=0xff;
if(Code>='0' && Code<='9') b=Code-'0';     // 0-9
else
if(Code>='A' && Code<='F') b=Code-'A'+10; // A-F
return b;
}
unsigned char Check_LRC(void)
{
unsigned char i, LRC=0;
for(i=1;i<=7;i+=2)
LRC+=(CharToBinary(RXDB[i])<<4 + CharToBinary (RXDB[i+1]) );
LRC =0x00-LRC;
return LRC;
}
```

4、Read the Register of Meter. (Function Code＝"03" ASCII)

Request：

Start	1 Byte	":"
Slave Address	2 Byte	"01"~"FF"
Function code	2 Byte	"03"
Start Address	4 Byte	"0000"~"FFFF"
Quantity of Register	4 Byte	"0001"~"0040"
LRC Check	2 Byte	"XX"
End	2 Byte	CR(0x0D),LF(0xOA)

Response：

Start	1 Byte	":"
Slave Address	2 Byte	"01"~"FF"
Function code	2 Byte	"03"
Byte Count	2 Byte	"02"~"80"
Register Value	N x 4 Byte	"0000"~"FFFF"
LRC Check	2 Byte	"XX"
End	2 Byte	CR(0x0D),LF(0xOA)