**PT444-T**

**Operating Manual**

sub-Zero Precision Control, always


## Introduction

A proportional–integral–derivative controller (PID controller or three term controller) is a control loop feedback mechanism widely used in industrial control systems and a variety of other applications requiring continuously modulated control. A PID controller continuously calculates an error value as the difference between a desired setpoint (SV) and a measured process variable (PV) and applies a correction based on proportional, integral, and derivative terms (denoted P, I, and D respectively) which give the controller its name.

PT444-T is a two set point PID controller. It is available in touch version. Customized iconic display interprets status easily.

## Caution for your safety

**WIRING:** The probe and its corresponding wires should never be installed in a conduit next to control or power supply lines. The electrical wiring should be done as shown in the diagram. The power supply circuit should be connected to a protection switch. The terminals admit wires of upto 2.5sq mm.

**WARNING:** Improper wiring may cause irreparable damage and personal injury. Kindly ensure that wiring is done by qualified personnel only.

**Maintenance:** Cleaning: Clean the surface of the controller with a soft moist cloth. Do not use abrasive detergents, petrol, alcohol or solvents.

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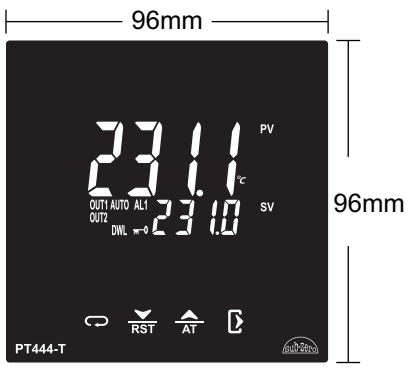
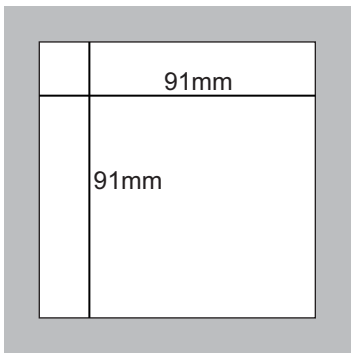
**Controller** :Controller should be installed in a place protected by vibration, water and corrosive gasses and where ambient temperature does not exceed the values specified in the technical data.

**Probe :**To give a correct reading, the probe must be installed in a place protected from thermal influences, which may affect the temperature to be controlled.

## Dimensions



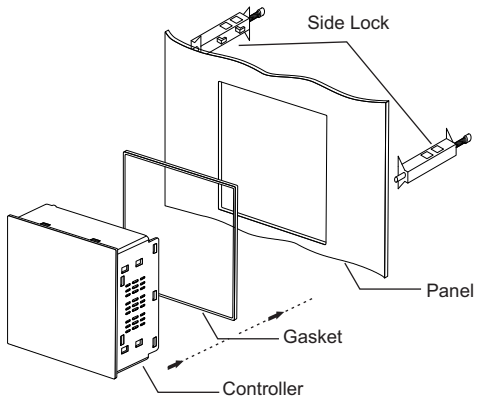

## Panel Cutout



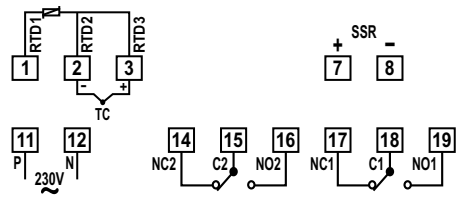

## Product Mounting

**Installation :**

1. Prepare the panel cutout with proper dimension.
2. Fix the side locks to place controller in proper position.




## Connection Diagram

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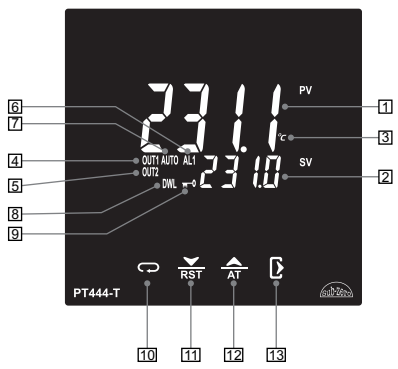
## User Interface




| Sr. No. | | Description |
|---|---|---|
| 1 | | **Process Value (PV)**<br>RUN mode : Displays current measured value.<br>SETTING mode : Displays parameter. |
| 2 | | **Set value (SV)**<br>RUN mode : Displays set value.<br>Displays countdown time when Dwell timer is running.<br>SETTING mode : Displays set value of parameter. |
| 3 | °C | Displays the Temperature unit. |
| 4 | OUT1 | Turns ON while control output1 is ON. |
| 5 | OUT2 | Turns ON while control output2 is ON. |
| 6 | AL1 | Turns ON when the corresponding alarm out turns ON. |
| 7 | AUTO | Turns ON when auto tuning is in progress. |
| 8 | DWL | Flashes during Dwell timer is in progress.<br>Continuous ON : Dwell time elapsed. |
| 9 | | Turns ON when keypad is locked. |
| 10 | | **Next key :**<br>Used to enters parameters level, moves to next parameters.<br>Press & hold this key atleast 2 seconds to enter in Set Mode.<br>Press & hold this key atleast 4 seconds to enter in Level1 Parameter.<br>Press & hold this key atleast 6 seconds to enter in Level2 Parameter. |
| 11 | RST | **Down / Reset Key :**<br>Used in Program mode to decrement parameter value.<br>Used to reset the Dwell timer. |
| 12 | AT | **Up / AT Key :**<br>Used in Program mode to increment parameter value.<br>Press this key for 2 seconds to start or stop auto-tuning. |
| 13 | | **Exit Key :**<br>Press this key to save the setting value and to exit the programing mode. |

## Input types & Input range

| Input Type | | Decimal Point | Display | Input Range (°C) |
|---|---|---|---|---|
| Thermocouple | J | 1 | J | -50 to 750°C |
| | K | 1 | K | -50 to 1200°C |
| RTD | Pt 100 | 1 | rtd | -99 to 400°C |
| | | 0.1 | rtd.1 | -99.9 to 400.0°C |

## Technical Specification

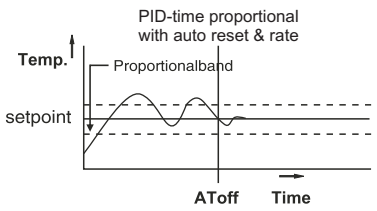
**Housing** : Black ABS Plastic
**Front Cover** : Polycarbonate Plastic
**Dimensions** : Frontal : 96 X 96mm, Depth : 61mm
**Panel Cutout** : 91 X 91mm
**Mounting** : Flush panel mounting with two side-locks
**Protection** : IP65 Front
**Connections** : Terminal connectors.
≤ 2.5sq mm terminal only.
**Display** : 4 X 20mm 7 segment White display,
4 X 9.5mm 7 segment Green display
7 Iconic LEDs for Indication
**Data storage** : Non-volatile flash memory
**Operating temp.** : 0°C to 60°C (non-condensing)
**Operating humidity** : 20% to 85% (non-condensing)
**Storage temp** : -25°C to 60°C (non-condensing)
**Power input** : 230 Vac ±15 % , 50/60Hz Standard.
85 to 265Vac, 12/24Vdc on request.
**Control output** : **Relay :** 5A, 230V AC (Resistive) or
SSR (field selectable) : 10V DC, 30mA
**Auxiliary output** : **Relay :** 5A, 230V AC (Resistive)
**Input Type** : RTD : Pt100
Thermocouple : J, K
**Resolution** : 0.1°C / 1°C for RTD (Pt100) input
1°C for Thermocouple (J, K) input
**Display Accuracy:** RTD : 0.1% of F.S +/- 1°C
Thermocouple : 0.3% of F.S
(20 min of settling time for TC)
**Sampling Period :** 1 second

## Working

**1. Auto tuning**

The Auto-tuning function automatically computes and sets the proportional band (P), Integral time (I), Derivative time (D) as per process characteristics.

While Auto-tune is in progress **"AUTO"** led will turn ON.
After Auto-tuning is complete the **"AUTO"** led will turn OFF.



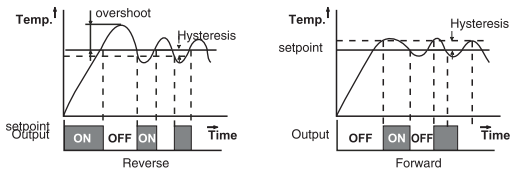

If auto -tuning is not complete after 3-4 cycles, it is suspected to fail. In this case, check the wiring & parameters such as the control action, input type etc.
Carry out the auto-tuning again, if there is a change in setpoint or process parameters.

**Note : In Auto Tuning running time, user can not change the parameter value.**

**2. ON/OFF control action (For reverse mode)**

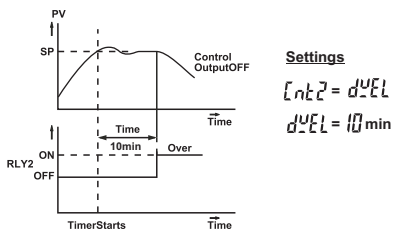
The relay is 'ON' up to the set temperature and cuts"OFF" above the set temperature . As the temperature of the system drops ,the relay is switched 'ON' at a temperature lower than the set point .

**HYSTERESIS:**
The difference between the temperature at which relay switches 'OFF' is the hysteresis or dead band.




**3. Dwell Timer :**

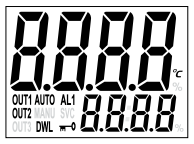
A dwell timer is used to control a process at a fixed temperature for a defined period. Once the process reaches the setpoint, dwell timer starts to count until time out . After the time competes, control output goes OFF and auxiliary output energies as an alarm.




**Note:**
1) DWL icon LED blinking indicates that dwell timer is in progress. It switches to continuous 'ON' when dwell timer is over.
2) When DWL TIMER is running, count-down time will be displayed on lower display. Once total time elapsed lower display will show "donE".
3) If Dwell time programmed as OFF, it will disable the dwell timer.
4) When soak in progress & dwell time is modified, new dwell time is applicable .
5) The dwell period can be reduced or increased when the timer is running. if it is reduced to meet the time elapsed. the timer will change to the end state.
6) Once the timer output was energized it can be reset with the RST Reset key.

## Initial Display when Power is ON

When power is On, entire display part will flash for 3 sec, software revision will flash for 3 sec and then enters in to RUN mode.




**1. Entire display Part**


**2. Run Mode**

## Parameter Setting Mode

### SET MODE

**1 SEt 1 Parameter** — Function: To set control1 set point.

Press & hold RST key for 2 second.

Display will show SEt 1. User can change SEt 1 value using UP/ DOWN keys. Holding the key, will change the value at a faster rate. Press RST key to store the desired value & move to the next parameter.( For 2 relays SEt2 / Dwell). Set value also can be stored by pressing Key

| Min | Max | Fac. |
|---|---|---|
| LSu | HSu | 0°C |

**2 SEt2 Parameter** — Function: To set control2 set point. **(For 2 Relays)**

This parameter is prompted only if Relay 2 is configured in Cnt2,
1. As absolute auxiliary control or as an alarm (High/Low) mode.
2. As deviation auxiliary control or as a deviation alarm mode.

Note: If Cnt2 set to OFF, SEt2 will not be shown in the SP setting.

| Min | Max | Fac. |
|---|---|---|
| LSu | HSu | 0°C |

**3 dyEL Parameter** — Function: Sets the dwell time.

This parameter is prompted only if Relay 2 is configured in Cnt2 as "dyEL".

**For dwell timer operation please refer Working section.**

| Min | Max | Fac. |
|---|---|---|
| oFF | 9999 min | oFF |

### LEVEL1 Parameter

Press & hold RST key for 4 seconds to enter into Level1 parameter setting( LEuL1 will flash).
When release the key, inPt will flash.
Press **UP/DOWN** keys to modify the set value and to go to the next parameter by pressing RST key.
Press the Exit key to save the set value and to come out of parameter setting after changing the set value.

**4 inPt Parameter** — Function: Sets the type of input sensor .

While changing the sensor type SEt 1, SEt2, inb, LSu , HSu parameters of level1 will reset accordingly.

For type of input sensor & range please refer **"Input types & Input range"** table.

**For J type sensor**

| Min | Max | Fac. |
|---|---|---|
| K | rtd.1 | J |

**5 inb Parameter** — Function: Sets input correction.

In time it may be possible that the display may be offset by a degree or so.
To compensate for this error, user may need to add or minus the degrees required to achieve the correct temperature.

**Example :** The temperature on the display is 28°C, whereas the actual temperature is 30°C. User will have to set the " inb" parameter to 2°C, which means that once out of the programming mode, the temperature on display will be 30°C (28°C+ 2°C).

| Min | Max | Fac. |
|---|---|---|
| -20°C | 20°C | 0°C |

**6 LSu Parameter** — Function: Sets the lower limit of PV input.

Sets the minimum limit for set point adjustment. It can be set from minimum specified range of selected sensor to HSV-1 value.

Once set at a particular value, this will not allow the set point to go below this value.

When changing the setting value and SV < LSV, SV will reset as LSV.

**For J type sensor**

| Min | Max | Fac. |
|---|---|---|
| -50°C | HSu - 1 | -50°C |

**7 HSu Parameter** — Function: Sets the upper limit of PV input.

Sets the maximum limit for set point adjustment. It can be set from LSV+1 value to maximum specified range of selected sensor.

Once set at a particular value, this will not allow the set point to go above this value.

When changing the setting value and SV > HSV, SV will reset as HSV.

**For J type sensor**

| Min | Max | Fac. |
|---|---|---|
| LSu +1 | 750°C | 750°C |

**8 Cnt2 Parameter** — Function: Sets control action for relay2.

This parameter used to set required control action for relay 2 as,

oFF = No action
rE = Reverse
Fd = Forward
dyEL = Dwell time

| Min | Max | Fac. |
|---|---|---|
| oFF | dyEL | rE |

**9 HYS2 Parameter** — Function: Sets the hysteresis for ON-OFF action in Control2.

This parameter will be prompted only if selected control action is rE (reverse) or Fd (forward) in Cnt2 setting.
It sets the deadband between ON & OFF switching of the output.

**Example (For Fd control) :** If the set point is set at 100°C and hysteresis is set at 2°C, then when the system reaches 100°C, the heater relay will go OFF. Since the hysteresis is 2°C, the heater relay will get ON (restart) at 102°C (100°C +2°C).

| Min | Max | Fac. |
|---|---|---|
| 1°C | 100°C | 2°C |

**10 ōod2 Parameter** — Function: Sets the alarm type.

It's applicable when Cnt2 action is rE (reverse) or Fd (forward).

Ab5 : Absolute

dEu : Deviation

**For alarm types setting , please refer Alarm Type description.**

| Min | Max | Fac. |
|---|---|---|
| Ab5 | dEu | Ab5 |

**11 ALrn Parameter** — Function: Sets AL1 icon as alarm relay ON/OFF indicator for alarm indication.

Set "YES" to enable AL1 icon.
AL1 icon turns ON when the corresponding alarm output turns ON.
Type of alarm can selected by using ōod2 parameter.

| Min | Max | Fac. |
|---|---|---|
| no | YES | no |

**12 rSt Parameter** — Function : To restore default settings of the controller.

When Set to YES all parameter are programmed to factory values.
Useful to debug setting related problems.

| Min | Max | Fac. |
|---|---|---|
| no | YES | no |

## LEVEL2 Parameter

Press & hold ⏎ key for 6 seconds to enter into Level2 parameter setting(LEuL2 will flash). When release the key, Cnt1 will flash.
Press **UP/DOWN** keys to modify the set value and to go to the next parameter by pressing ⏎ key.
Press the ⏎ key to save the set value and to come out of parameter setting after changing the set value.

**13 Cnt1 Parameter** — Function: Sets control action for relay1/SSR.

This parameter is used to set required control action for relay 1/SSR as,

rE = Reverse

Fd = Forward

Pid = PID

| Min | Max | Fac. |
|---|---|---|
| rE | Pid | Pid |

**14 AT Parameter** — Function: Runs auto tunning.

This parameter is used to set YES/NO to start and stop Auto-tuning.
When Setting as YES , the unit starts auto-tuning. After Completing no is automatically Set.
During auto-tuning, the AUTO icon is continuously ON.

This parameter will be prompted only if selected control action is PID in Cnt1.

| Min | Max | Fac. |
|---|---|---|
| no | YES | no |

**15 CYCt Parameter** — Function: Sets cycle time for PID action.

Cycle time also known as duty cycle, the total length of time for the controller to complete one ON/OFF cycle.

**Example :** With a 20 second cycle time, an on time of 10 seconds and an OFF time of 10 seconds represents a 50 percent power output. The controller will cycle ON and OFF while within the proportional band.

| Min | Max | Fac. |
|---|---|---|
| 1 sec | 60 sec | 3 sec |

**16 P Parameter** — Function: Sets proportional band.

Sets the proportional band of PID parameter.

Term P is proportional to the current value of the SV-PV error .

**Example :** If the (SV-PV) error is large and positive, the control output will be proportionately large and positive and vice versa if error is negative.

| Min | Max | Fac. |
|---|---|---|
| 0.1°C | 100.0°C | 10.0°C |

**17 I Parameter** — Function: Sets integration time.

Sets the integration time of PID parameter.

Term I accounts for past values of the SV-PV error and integrates them over time to produce the I term.

**Example :** If there is a residual SV-PV error after the application of proportional control, the integral term seeks to eliminate the residual error by adding a control effect due to the historic cumulative value of the error.

Setting "0" will turn OFF integration.

| Min | Max | Fac. |
|---|---|---|
| 0 sec | 2000 sec | 120 sec |

**18 d Parameter** — Function: Sets differential time.

Sets the differential time of PID parameter.

Term D is a best estimate of the future trend of the SV-PV error, based on its current rate of change. It is sometimes called "anticipatory control", as it is effectively seeking to reduce the effect of the SV-PV error by exerting a control influence generated by the rate of error change. The more rapid the change, the greater the controlling or dampening effect.

Setting "0" will turn OFF differential.

| Min | Max | Fac. |
|---|---|---|
| 0 sec | 1000 sec | 30 sec |

**19 HYS1 Parameter** — Function: Sets the hysteresis width for ON-OFF action in Control1.

This parameter will be prompted only if selected control action is rE (reverse) or Fd (forward) in Cnt1 setting.
It sets the deadband between ON & OFF switching of the output.

**Example (For Fd control) :** If the set point is set at 100°C and hysteresis is set at 2°C, then when the system reaches 100°C, the heater relay will go OFF. Since the hysteresis is 2°C, the heater relay will get ON (restart) at 102°C (100°C +2°C).

| Min | Max | Fac. |
|---|---|---|
| 1°C | 100°C | 2°C |

**20 out Parameter** — Function: Sets Control1 output.

This parameter is used to configure Cnt1 out as,
SSr = SSR
rLY = Relay

User has to set this parameter in accordance with the output used.

| Min | Max | Fac. |
|---|---|---|
| SSr | rLY | rLY |

**21 LoC Parameter** — Function: To lock keypad.

This parameter is used to lock the parameter so that tampering is not possible by by-standers.

no = unlocked parameter

YES = Locked parameter

When locked all parameters can only be viewed ,but can not be modified.

Keypad Locked

| Min | Max | Fac. |
|---|---|---|
| no | YES | no |

## LED Indication

| LED | Status | Description |
|---|---|---|
| OUT1 | ON | Relay1 / SSR ON. |
| | OFF | Relay1 / SSR OFF. |
| OUT2 | ON | Relay2 ON. |
| | OFF | Relay2 OFF. |
| AUTO | ON | Tuning is in progress. |
| | OFF | Tuning Stop. |
| DWL | FLASHING | Dwell timer is in progress.. |
| | ON | Dwell time elapsed. |
| | OFF | Dwell timer disabled. |
| AL1 | ON | Alarm relay ON. |
| | OFF | Alarm Relay OFF. |
| 🔑 | ON | Parameters are Locked. |
| | OFF | Parameters are Unlocked. |

## Error Messages

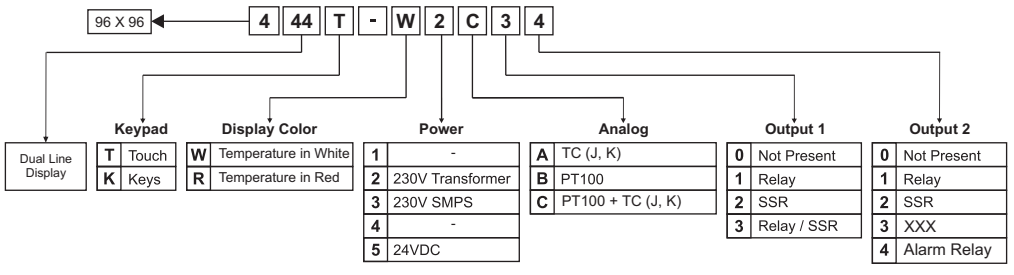
| Message | Description |
|---|---|
| oPEn | Displays when input sensor is disconnected or sensor is not connected. |
| HHHH | Flashes when measured value is higher than input range. |
| LLLL | Flashes when measured value is lower than input range. |

## Alarm Types

| Setting | Alarm Type | Description |
|---|---|---|
| Cnt2 = Fd<br>ALrn = YES<br>ōod2 = Ab5 | Absolute value high limit alarm | SV = SEt2<br>Alarm ON when PV > SV + HYS2<br>Alarm OFF when PV = SV |
| Cnt2 = rE<br>ALrn = YES<br>ōod2 = Ab5 | Absolute value low limit alarm | SV = SEt2<br>Alarm ON when PV < SV - HYS2<br>Alarm OFF when PV = SV |
| Cnt2 = Fd<br>ALrn = YES<br>ōod2 = dEu | Deviation high limit alarm | SV = SEt1 + SEt2<br>FD Alarm ON when PV > SV + HYS2<br>Alarm OFF when PV = SV |
| Cnt2 = rE<br>ALrn = YES<br>ōod2 = dEu | Deviation low limit alarm | SV = SEt1 + SEt2<br>FD Alarm ON when PV < SV - HYS2<br>Alarm OFF when PV = SV |

*HYS2 : Alarm output hysteresis

## Ordering Information




## Pro-Key ( On Request )

To use Pro-key user must insert it prior to power ON. Insert the pro-key and power ON controller. When the display flashes for 5 seconds, touch the ⏎ key for 1 second. Controller will enter into Pro-key mode and will display " ProK ". Then touch either of the below given keys to use the Pro-key.
Functions of Pro-key and the keys to be used for are as given below:

| Function | Keys to be Used |
|---|---|
| To upload the parameters from the controller | touch "AT" key |
| To download the parameters to the controller | touch "RST" key |
| To set and exit | touch "⏎" key |

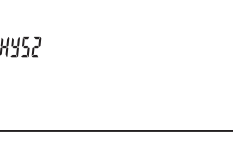
If user tries to enter Pro-key mode without inserting the pro key or with wrong connection, no further function will be activated after displaying "AT or RST". Controller will display "ProE". Then switch off controller and insert the pro key properly and try to enter Pro key mode.
User has to first Upload the parameters in the Subzero Validated Blank Pro-Key and then subsequently use it for downloading.

**● Uploading mode**

Press AT key to upload the parameters to Pro Key.
Lower display will show "u-oK" once uploading is done. Press ⏎ to exit display will show "----" and return to normal display.

**● Downloading mode**

Similarly connect Pro key to the controller .
Press RST key to download all parameters from Pro key to the controller.
Lower display will show "d-oK" once download is done.
Once done press ⏎ key to exit and display will flash and return to normal mode.





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## Calibration Certificate

| | |
|---|---|
| **DATE** | |
| **MODEL NO.** | |
| **CONTROLLER SR. NO.** | |

**Claimed Accuracy :**
For TC inputs : 0.3% of FS
For RTD inputs : 0.1% of FS +/-1°C
(20 min of settling time for TC inputs)

**Calibration Instrument & Sr. No :** _____

**Calibrated ON** : _____
**Valid Upto** : _____

The calibration of this unit has been verified at the following values :

| SENSOR TYPE | VALUE TESTED (°C) | VALUE Observed (°C) |
|---|---|---|
| RTD | 0°C | All values within specified limit of accuracy |
| | 100°C | |
| | 350°C | |
| J,K | 50°C | |
| | 400°C | |
| | 650°C | |

Instrument is confirmed accepted as accuracy is within the specified limit. This certificate is valid upto one year from the date of issue.

**Checked By :**

_____

(Specification are subject to change, since development is a continuos process.)

**PVR Controls, India**