DELTA

PPI
The Perfection Experts

2-in-1 Self Tune
PID Temperature Controller

(RTD & Thermocouples)

User Manual

CONTENTS

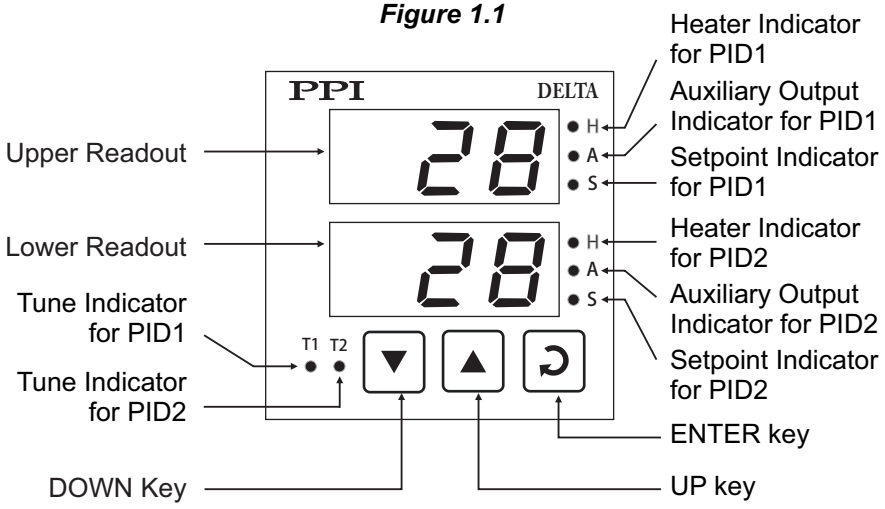
For RTD

For Thermocouples

Section 1
FRONT PANEL LAYOUT

The controller front panel comprises of digital readouts, LED indicators and membrane keys as shown in Figure 1.1 below.

Figure 1.1



READOUTS

The Upper Readout is a 3 digit, 7-segment bright red LED display and usually displays the Temperature Value for PID1. In Operator Mode, the Upper Readout shows and permits editing of Control Setpoint and/or Auxiliary Setpoint for PID1. In set-up mode, the Upper Readout displays parameter values.

The Lower Readout is a 3 digit, 7-segment bright red LED display and usually displays the Temperature Value for PID2. In Operator Mode, the Lower Readout shows and permits editing of Control Setpoint and/or Auxiliary Setpoint for PID2. In set-up mode, the Lower Readout displays the prompts for the parameters.

INDICATORS

There are eight front panel LED indicators to show various statuses for each PID. The Table 1.1 and Table 1.2 below list each LED indicator (identified by the front panel legend), the position on the front panel and the associated status it indicates for PID1 and PID2, respectively.

Table 1.1

PID1 Indicator	Position on the Front Panel	Functions
H	To the right of Upper Readout	• Indicates the On/Off status of Heater Output for PID1
A	To the right of Upper Readout	• Flashes while the Upper Readout shows the Auxiliary Setpoint value for PID 1 in Operator Mode • Indicates the On/Off status of Auxiliary Output for PID1
S	To the right of Upper Readout	• Flashes while the Upper Readout shows the Control Setpoint value for PID 1 in Operator Mode
T1	To the left of DOWN key	• Flashes while the PID1 Tuning is in progress

Table 1.2

PID2 Indicator	Position on the Front Panel	Functions
H	To the right of Lower Readout	• Indicates the On/Off status of Heater Output for PID2
A	To the right of Lower Readout	• Flashes while the Lower Readout shows the Auxiliary Setpoint value for PID 2 in Operator Mode • Indicates the On/Off status of Auxiliary Output for PID2
S	To the right of Lower Readout	• Flashes while the Lower Readout shows the Control Setpoint value for PID 2 in Operator Mode
T2	To the left of DOWN key	• Flashes while the PID2 Tuning is in progress

KEYS

There are three tactile keys provided on the front panel for configuring the controller, setting-up the parameter values and selecting operation modes. The Table 1.3 below details the key functions.

Table 1.3

Symbol	Key	Function
▼	DOWN	Press to decrease the parameter value. Pressing once decreases the value by one count; keeping pressed speeds up the change.
▲	UP	Press to increase the parameter value. Pressing once increases the value by one count; keeping pressed speeds up the change.
↵	ENTER	Press to store the set parameter value and to scroll to the next parameter on the PAGE.

Notes:

1. While in MAIN display mode, pressing DOWN and UP keys simultaneously followed by pressing ENTER key, allows entering in Set-up mode (Refer *Section 3: Pages & Parameters*).
2. While in MAIN display mode, upon pressing ENTER key once, the Upper Readout flashes Control Setpoint and pressing twice, the Upper Readout flashes Auxiliary Setpoint (if selected) for PID1. Upon the subsequent pressing of ENTER key once, the Lower Readout flashes Control Setpoint and pressing twice, the Lower Readout flashes Auxiliary Setpoint (if selected) for PID2. (Refer *Section 2: Basic Operations*).

Section 2
BASIC OPERATIONS

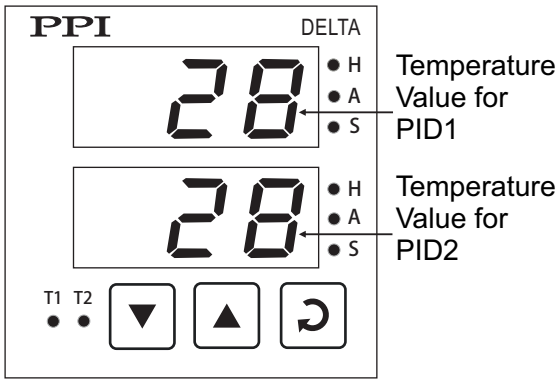
POWER-UP

Upon switching on the power to the controller, all displays and indicators are lit on for approximately 3 seconds during which time the controller runs through a self-test sequence. This is followed by the indication of the controller model name dEL on the Upper Readout and the firmware version 2.2 on the Lower Readout, for approximately 1 second.

MAIN DISPLAY MODE

After the power-up display sequence, the Upper Readout and Lower Readout start showing the measured Temperature value for PID1 and PID2, respectively. This is called the MAIN display mode and this is the one that shall be used most often. The MAIN display mode is depicted in Figure 2.1.

Figure 2.1



FIRST-TIME / NEW INSTALLATION

For a first-time installation of a new controller or if the controller is removed from one application and installed on a different application, it is recommended to observe the following sequence of parameter settings that are required for controller's intended operation. (Refer Section 3 : Pages & Parameters for details on parameter settings).

1. Set the Installation parameters for PID1 and PID2 in PAGE-10.
2. Set the Configuration parameters on PAGE-11.
3. Set the PID Control Parameters for PID1 and PID2 on PAGE-12.
4. Set Auxiliary Function parameters (if Auxiliary Output is to be used for Alarm, Control or Blower operation) for PID1 and PID2 in PAGE-13 and PAGE-14, respectively.
5. Return to MAIN display mode. Set the Control Setpoint and Auxiliary Setpoint (if selected) to the desired values as described below in the Sub-section : Operator Mode.

The controller then detects this as a "New Installation" and immediately starts self-tuning for PID1 and/or PID2 if the configured control action is PID. The front panel indicators T1 (for PID1) and T2 (for PID2) flash while tuning is in progress and turn off upon completion of the tuning for the respective PID.

OPERATOR MODE

Adjusting the Control and Auxiliary Setpoint for PID1 and PID2

The Control Setpoint and Auxiliary Setpoint for PID1and PID2 can be directly adjusted on the Upper and Lower readout, respectively, while the controller is in the MAIN display mode. The Control and Auxiliary Setpoint adjustment for PID1and PID2 is permitted only if they are not locked via the parameter 'Setpoint Locking' in PAGE-11. If not locked, step through the

following sequence to adjust the Setpoint values.

1. Press and release ENTER key.

   The Upper Readout starts flashing Control Setpoint value for PID1. The front panel indicator S to the right of Upper Readout flashes to indicate that the value shown on the Upper Readout is Control Setpoint for PID1. The Lower Readout continues to show the measured Temperature value for PID2.

   Press UP/DOWN keys to adjust the Control Setpoint value. Pressing UP or DOWN key once changes the value by one count; holding the key pressed speeds up the rate of change. The Upper Readout stops flashing as long as the UP or DOWN key is pressed for adjustment to avoid any obstructions in viewing.

2. Press and release ENTER key.

   The new value for the Control Setpoint for PID1 is stored in the controller memory. The controller now enters either into step 3 or step 5 depending upon the selection for the Auxiliary Function for PID1. If the Auxiliary Function for PID1 is selected as 'None', the controller directly enters into step 5 else it enters into step 3.

3. The Upper Readout starts flashing Auxiliary Setpoint (Alarm, Blower or Auxiliary Control) value for PID1. The front panel indicator A to the right of Upper Readout flashes to indicate that the value shown on the Upper Readout is Auxiliary Setpoint for PID1. The Lower Readout continues to show the measured Temperature value for PID2.

   Press UP/DOWN keys to adjust the Auxiliary Setpoint value for PID1.

4. Press and release ENTER key. The new value for the Auxiliary Setpoint for PID1 is stored in the controller memory.

5. The Lower Readout starts flashing Control Setpoint value for PID2. The front panel indicator S to the right of Lower Readout flashes to indicate that the value shown on the Lower Readout is Control Setpoint for PID2. The Upper Readout now shows the measured Temperature value for PID1.

   Press UP/DOWN keys to adjust the Control Setpoint value for PID2.

6. Press and release ENTER key.

   The new value for the Control Setpoint for PID2 is stored in the controller memory. The controller now enters either into next step (step 7) or returns to MAIN display mode depending upon the selection for the Auxiliary Function for PID2. If the Auxiliary Function for PID2 is selected as 'None', the controller returns to MAIN display mode else it enters the next step.

7. The Lower Readout starts flashing Auxiliary Setpoint (Alarm, Blower or Auxiliary Control) value for PID2. The front panel indicator A to the right of Lower Readout flashes to indicate that the value shown on the Lower Readout is Auxiliary Setpoint for PID2. The Upper Readout continues to show the measured Temperature value for PID1.

8. Press and release ENTER key. The new value for the Auxiliary Setpoint for PID2 is stored in the controller memory and the controller returns to the MAIN display mode.

Repeat steps 1 through 8 each time to alter/view the Setpoint values for PID1 and PID2.

Notes:

1. It is a must to press the ENTER key after adjusting the Control/Auxiliary Setpoint else, the new value will not be registered / stored. The controller waits (approx. for 30 seconds) by flashing new Control/Auxiliary Setpoint Value. If the ENTER key is not pressed within wait time, the altered value will not store in the controller memory and the previous set value will be retained. Also, if the power failure occurs prior to pressing ENTER key, upon resumption of power, the controller will not store the altered value and retain the previous set value.
2. Upon adjusting the new Control Setpoint, the controller automatically enters into the Self-Tuning Mode (the Tune Indication, T1 and T2 for PID1 and PID2, respectively starts flashing if the “New Installation” condition is detected). Also, if the ‘Tune at Setpoint Change’ function is enabled in PAGE-11 parameter list, the controller automatically enters into the Self-Tunning Mode upon adjusting the Control Setpoint in the following conditions:

i) The “Tune at Setpoint Change” condition is detected.

ii) The Self-Tunning Mode is manually aborted while the Tunning is in progress.

3. The Auxiliary Setpoint value is available only if the Auxiliary Function is selected to other than non (None).
4. The Control and Auxiliary setpoint adjustments are permitted only if these are not locked via the parameter 'LOCK' in PAGE-11. The setpoint values, however, are always available for viewing regardless of the lock.
5. While in Operator Mode, the heater and auxiliary output statuses for both PID1 and PID2 are forced off to clearly indicate what the Upper or the Lower Readout is indicating.
6. The Control Setpoint is adjustable to any value between Min. Range(-199ºC) and the value set for the parameter ‘Temperature Range' for the respective PID.
7. The Auxiliary Setpoint value can be adjusted as an absolute value or relative to Control Setpoint value depending upon the function type selected for the Auxiliary Output. (Refer *Section 7: Auxiliary Function Parameters*).

Issuing Tune / Abort Command

The controller's 'X-PERT' algorithm is powered with the ability to self detect the events such as new installation, substantial change in Control Setpoint, etc. for tuning itself to the process under control for both the PIDs. However, the user can issue separate Tune Command to each PID to force itself and make an attempt to improve the already computed values of the constants used by the PID control algorithm. Only under the following instances, the user should issue the Tune Command:

1. If for some reason the control accuracy / performance is not satisfactory.
2. If it is required to re-initiate the tuning procedure once the self-initiated tuning procedure was aborted by the user by issuing Abort Command.
3. There are substantial changes in the operating conditions such as change in load, heater size, etc., after the initial installation.
4. By the machine / equipment manufacturer at the time of dispatch to the end user. This is to ensure that the controller re-tunes for the new conditions such as running the machine with full load condition.

There are separate Tune / Abort commands for PID1 and PID2. Upon issuing Tune / Abort command, the respective PID enters / exits the re-tuning procedure. Follow the steps below to issue Tune or Abort Command:

1. While the controller is in the MAIN display mode, keep UP and DOWN keys simultaneously pressed (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout is blanked.
2. Release UP and DOWN keys and then press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0.
3. Press ENTER key. The Lower Readout now shows either tn.1 (if PID1 is not already tuning) or Ab.1 (if the tuning for PID1 is in progress) and the Upper Readout shows no (No).
4. Press UP key to select YES (Yes) on the Upper Readout to issue Tune / Abort command for PID1. Press ENTER key to register the YES command. Upon pressing ENTER key, PID1 enters / exits tuning operation depending upon the command issued. If Tune command is issued, the front panel indicator T1 starts flashing to indicate that PID1 has begun tuning operation. If, however, Abort command is issued, the flashing indicator T1 turns off to indicate that PID1 tuning operation is aborted.

   The Lower Readout now shows either tn.2 (if PID2 is not already tuning) or Ab.2 (if the tuning for PID2 is in progress) and the Upper Readout shows no (No).
5. Repeat step 4 for issuance of Tune / Abort command for PID2. The controller automatically returns to MAIN display mode upon pressing ENTER key.

Notes:

1. The Tune and Abort Commands are mutually exclusive. That is, the Tune Command is available only when tuning is not already initiated whereas Abort Command is available only while tuning is in progress.
2. While the tuning operation is in progress, the user is advised not to disturb the process or any parameter values of the controller under tuning. Upon completion of the tuning operation, the respective indicator (T1 for PID1 and T2 for PID2) turns off to indicate that the tuning operation is over.

The following tips can help user to decide when to issue Tune command.

1. In most applications, the controller is subject to dry run (without actual load conditions) by the machine manufacturer after its first installation on the machine. This is usually done to conduct tests / trails of the machine. It may then be desired that the controller automatically enter into re-tuning procedure while it is first run with full load conditions at the end user site. For this, it is best to issue the Tune command and switch off the controller prior to dispatch (thus, leaving the tuning procedure incomplete). The controller then automatically resumes the tuning when it is powered next time.
2. If it is found that the control results are not satisfactory (may be due to dynamic changes in the load conditions), it is best to issue this command while the process is being controlled near the Control Setpoint. This will cause small disturbances in the Temperature value while the controller is performing tuning procedure but shall eventually result in a stable control once the tuning procedure is complete.

TEMPERATURE VALUE ERROR INDICATIONS

In case, the measured Temperature value falls below the Minimum Range (-199ºC) or rises above the Maximum Range (600ºC) specified for the RTD Pt100 input or in case of RTD Pt100 open / broken; the controller flashes the error messages as listed in Table 2.1 below. Note that the messages for PID1 are flashed on Upper Readout while those for PID2 are flashed on the Lower Readout. The Figure 2.2 illustrates the RTD Pt100 Open condition and Under-range condition for PID1 and PID2, respectively

Figure 2.2

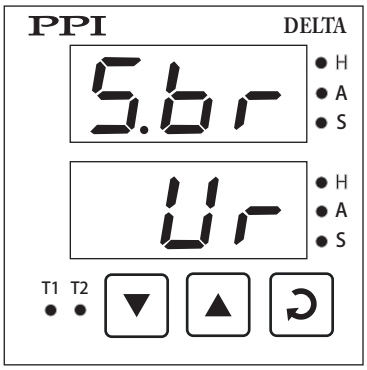


Table 2.1

Message	Error Type
Or	Over-range (Temp. above Max. Range)
Ur	Under-range (Temp. below Min. Range)
5.br	Sensor Break (Thermocouple is open or broken)

Notes:

1. In case of Over-range and Under-range condition, the Control Output and Auxiliary Output (if selected as Blower or Control) of the respective PID is held at the minimum level, that is, OFF.
2. In case of Sensor break (open) condition; the control signal (% output power) will depend upon the Sensor Break Strategy selected in PAGE-11 parameter list that is commonly applicable for PID1 and PID2.
3. For 3-wire RTD sensor input, If the compensating lead (connected at rear panel terminal number 3) is not connected or gets open, the controller does not indicate PV error but the measured value is not compensated for the lead resistance.
4. In case Tunning operation is in progress, the controller automatically aborts the Tunning operation upon detecting the PV error condition.
5. If the Auxiliary Function is selected as Alarm for PID1 and/or PID2, the respective alarm gets activated in error conditions. Refer below, *Sub-section: Alarm Status Under Temperature Error Conditions.*

ALARM STATUS UNDER TEMPERATURE VALUE ERROR CONDITIONS

The Table 2.2 below summarizes the alarm status under various Temperature error conditions. The alarm ON status means the alarm is activated and OFF means the alarm is not activated. The corresponding Auxiliary output is energized / de-energized in accordance with the alarm status and control logic (Normal / Reverse).

Table 2.2

ERROR TYPE	ALARM TYPE	ALARM STATUS
Under-range	Process Low	ON
	Process High	OFF
	Negative Deviation	ON
	Positive Deviation	OFF
	Band	ON
Over-range or Open	Process Low	OFF
	Process High	ON
	Negative Deviation	OFF
	Positive Deviation	ON
	Band	ON

SENSOR BREAK PROTECTION

The controller facilitates the Sensor Break Protection for RTD Pt100 as described below:

- The broken or open sensor is indicated by flashing S.br (Sensor Break) as Sensor Break Indication on the controller Upper and/or Lower Readout and the alarm is activated if set as 'Process High' for PID1 and/or PID2.
- While detecting Sensor Break, the Temperature value rises rapidly before Sensor break indication occurs. The Sensor Open/Break is detected by an Overrange input signal exceeding the maximum of linearisation table.
- Upon detecting the Sensor Break Condition, the controller enters into Open Loop mode and depending upon the 'Sensor Break Strategy' selected, the controller maintains either the Output Power that it was outputting prior to Sensor Break Condition or 0% Output Power until the Sensor Break Condition is removed.

(For more details on 'Sensor Break Strategy', refer Section 5 : Configuration Parameters.)

Section 3
PAGES & PARAMETERS

ORGANIZATION

The controller requires various user settings that determine how the controller will function or operate. These settings are called parameters.

The parameters are always presented in a fixed format: The Lower Readout displays the parameter prompt (identification tag) and the Upper Readout displays the set value. The parameters appear in the same sequence as listed in their respective sections.

For convenience and ease of memorizing, the various parameters have been arranged in different groups depending upon the functions the parameters represent. Each group is assigned a unique PAGE NUMBER for its access and the parameters within each group are presented for settings depending upon the function(s) selected.

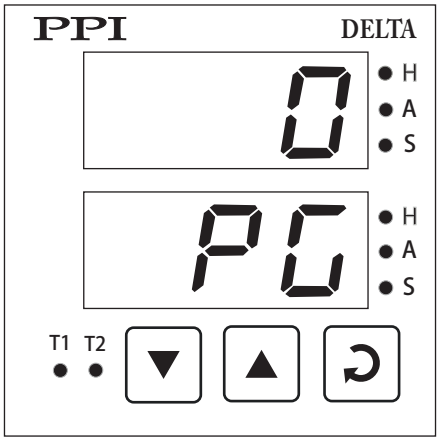
SET-UP MODE

The set-up mode allows the user to view or modify the parameter values. The entry from the MAIN display mode to Set-up mode requires appropriate setting of the PAGE NUMBER.

Follow the steps below to open a desired PAGE for setting the parameter values.

1. While the controller is in MAIN display mode, keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
2. Press ENTER key. The Lower Readout shows PG (PAGE) and the Upper Readout shows 0. See Figure 3.1.

Figure 3.1



3. Adjust the Upper Readout to the desired PAGE NUMBER using the UP/DOWN keys. Pressing the UP or DOWN key once, changes the value by one count. Holding the key pressed speeds up the rate of change.
4. Press and release ENTER key. The Lower Readout shows the prompt for the first parameter listed in the PAGE and the Upper Readout shows its current value.

Note:

If the entered PAGE NUMBER is invalid (contains no parameter list or any associated function), the controller returns to the MAIN display mode.

ADJUSTING PARAMETER VALUES

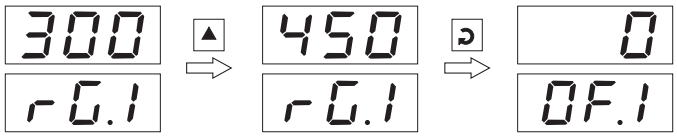
Once a desired PAGE is accessed, step through the following sequence to adjust the values of the desired parameters:

1. Press and release the ENTER key until the prompt for the required parameter appears in the Lower Readout. The last parameter in the list rolls back to the entered PAGE NUMBER.
2. Use UP and DOWN keys to adjust the parameter value.

   Note that some parameters (examples; Alarm Setpoint, Blower Setpoint, etc.) have Numeric Values while others (examples; Control Action, Setpoint Locking, etc.) have a series of Options. If adjusting a Numeric Value; depressing the UP/DOWN key once, increases/decreases the parameter value by one digit. For parameters having a series of options, depressing the UP/DOWN key once takes you to the next/previous option. In each case, keeping the UP/DOWN key pressed speeds up the rate. If the value reaches the maximum / minimum settable value/option, the Upper Readout flashes and the UP (if maximum value is reached) or DOWN (if minimum value is reached) key has no effect.
3. Once the parameter value is adjusted, press and release ENTER key. The new value gets stored in the controller's non-volatile memory and the next parameter in the list is displayed.

The Figure 3.2 illustrates the example of altering the value for the parameter 'Temperature Range' for PID1.

Figure 3.2



4. Upon pressing ENTER key at the last parameter in the list, the PAGE NUMBER setting is presented again with Lower Readout showing PG and the Upper Readout showing the most recent PAGE NUMBER accessed. The user is thus allowed to either re-enter the same PAGE NUMBER by simply pressing ENTER key or to enter any other desired PAGE by adjusting the PAGE NUMBER using UP/DOWN keys and then pressing the ENTER key.
5. To exit the Set-up mode, enter any invalid PAGE NUMBER in PAGE set-up display mode and press ENTER key. The controller reverts to the MAIN display mode.

Note:

1. It is a must to press the ENTER key after altering the value of a parameter else the new value will not be registered / stored. That is, a return to the MAIN display (by time out) without pressing the ENTER key will not store the altered value in the controller memory and the previous set value will be retained. Also, if the power failure occurs prior to pressing ENTER key, upon resumption of power, the controller reverts to MAIN display without storing the altered value and retains the previous set value.
2. If the controller is left in Program mode for more than 30 seconds without any key operation, the controller automatically exits the Program mode and returns to the MAIN display mode. This is called Time-out exit from the Program mode.

CONDITIONAL PARAMETERS

As discussed above the various parameters (user set values) are grouped and listed in separate PAGES. For convenience, each PAGE contains a list of parameters that relate to some specific functions or operations.

Note, however, that not all parameters are always presented to the user. Some parameters are presented only if the corresponding function or Operation Mode is selected. Such parameters are called the Conditional parameters, as their availability is dependent on the options selected for some other parameters (in the same or other PAGE). For example, consider the parameter 'PID Control Parameters' contained in PAGE-12 parameter list. These parameters are presented only if the controller is set operate in PID control by setting the 'Control Action' parameter to 'PID' contained in PAGE-10 parameter list.

Suppressing the conditional parameters (if the conditions are not met) avoids ambiguity and makes the parameter list more comprehensive. Refer the definitions below each parameter table (listed in the following 4 sections) for the conditional parameters. Also note that the parameters appear in the same sequence as shown in the table for each PAGE

PARAMETER LOCKING

Though access to any PAGE is always permitted, the adjustments of the parameter values, however, can be locked at the supervisory level.

If the lock is enabled, the parameter values in each PAGE can only be viewed but cannot be adjusted. That is, the UP/DOWN keys are inhibited. This feature facilitates the supervisory level to protect the parameter values from unauthorized tampering or accidental alterations by the operator.

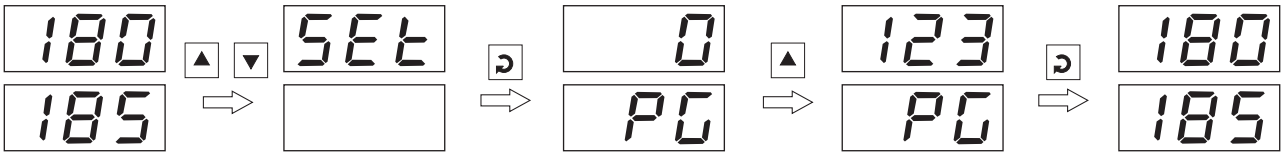
The controller is shipped from the factory in Unlocked (Lock disabled) condition. The user can enable the lock once the initial configuration and installation is done.

For enabling/disabling the lock, step through the following sequence:

1. While the controller is in the MAIN display mode, keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
2. Press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0. Adjust the Upper Readout to PAGE NUMBER 123.
3. Press and release ENTER key. The controller returns to the MAIN display with the LOCK enabled.

The Figure 3.3 below illustrates locking procedure:

Figure 3.3



Unlocking

1. While the controller is in the MAIN display mode, keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
2. Press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0. Adjust the Upper Readout to PAGE NUMBER 123.
3. Press and release ENTER key. The controller returns to the MAIN display mode.
4. Repeat steps 1 through 3. This time, the controller returns to the MAIN display with the LOCK disabled (open).

Notes:

1. Since there is no front panel indication for the 'Lock Enabled' condition, ensure that the lock is enabled by trying to adjust the parameters in any valid PAGE.
2. If the Control and Auxiliary setpoint adjustment is not locked in PAGE-11 parameter list, these Setpoint values can be adjusted from MAIN display even under parameter lock condition. These Setpoints adjustment is allowed or disallowed by Locking or Unlocking the Operator Mode in PAGE-11 parameter list prior to Lock enabled.
3. The facility for 'setting Default Values' by accessing PAGE-99 is also inhibited (locked) when the parameter LOCK is enabled. Accessing PAGE-99 shall be treated as an invalid PAGE NUMBER.
4. Note that it requires entering PAGE NUMBER 123 once for LOCKING but twice for UNLOCKING. Also, for UNLOCKING, the PAGE NUMBER 123 must be entered twice during the same duration for which the controller is powered. That is, entering the PAGE NUMBER 123 once prior to power loss and once after resumption of power shall not UNLOCK.

5. Do not forget to enable the LOCK again if it was UNLOCKED for some parameter value alteration.

SETTING DEFAULT VALUES

The controller is shipped from the factory with all the parameters set to their default factory set values. Thus, for the first time installation there is no need for re-setting the parameters to their default values. However, in case the controller is removed from a particular installation and fitted on a different machine, it is recommended to reset all the parameters to their default values before configuring the controller for the new installation.

Follow the steps below for re-setting the parameters to default values:

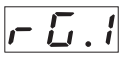
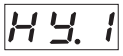
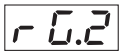
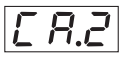
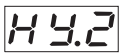
1. Ensure that the controller is in MAIN display mode and unlocked for parameter adjustments.
2. Keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
3. Press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0.
4. Adjust the Upper Readout to PAGE NUMBER 99 using UP / DOWN keys.
5. Press ENTER key. The controller resets and restarts from Power-up display sequence with all the parameters set to their factory set default values.

Section 4
INSTALLATION PARAMETERS

The Installation parameters are contained in PAGE-10 and are required to be set only at the time of a new installation.

The Installation parameters are listed below in Table 4.1, followed by their definitions.

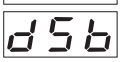
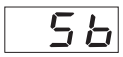
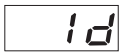
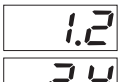
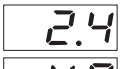
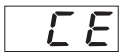
Table 4.1

Parameter Description	Settings (Default Value)
TEMPERATURE RANGE FOR PID1  This parameter value must be set in accordance with the Maximum Temperature Range for which the equipment /machine is designed.	-199 to 600ºC (Default : 300)
ZERO OFFSET FOR PID1  This value is algebraically added to the measured PV to derive the final PV that is displayed and compared for alarm/control. Final PV = Measured PV + Offset	-99 to +99ºC (Default : 0)
CONTROL ACTION FOR PID1  Select appropriate Control Algorithm suited for process requirement.	 PID  On-Off (Default : PID)
HYSTERISIS FOR PID1  ***(Available for On-Off Control only)*** Sets differential (dead) band between ON-OFF switching for PID1.	1 to 999ºC (Default : 2)
TEMPERATURE RANGE FOR PID1  This parameter value must be set in accordance with the Maximum Temperature Range for which the equipment /machine is designed.	-199 to 600ºC (Default : 300)
ZERO OFFSET FOR PID2  This value is algebraically added to the measured PV to derive the final PV that is displayed and compared for alarm/control. Final PV = Measured PV + Offset	-99 to +99ºC (Default : 0)
CONTROL ACTION FOR PID2  Select appropriate Control Algorithm suited for process requirement.	 PID  On-Off (Default : PID)
HYSTERISIS FOR PID2  ***(Available for On-Off Control only)*** Sets differential (dead) band between ON-OFF switching for PID2.	1 to 999ºC (Default : 2)

Section 5
CONFIGURATION PARAMETERS

The Configuration parameters are grouped in PAGE-11. These parameters allow the user to configure the controller for Auto detection of Tuning at Setpoint Change, Sensor Break Strategy, Setpoint Locking and Digital (serial) communication with a Master Device like PC (if hardware module fitted). The Configuration parameters are listed below in Table 5.1, followed by their definitions.

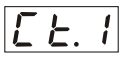
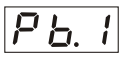
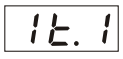
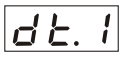
Table 5.1

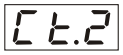
Parameter Description	Settings (Default Value)
SELF-TUNE ON SETPOINT CHANGE  Re-tune the controller if there is a substantial (large) change in the SP value. The P, I, D values are optimized.	 Enable  Disable (Default : Enable)
SENSOR BREAK STRATEGY  Selects Output Power Strategy that the Controller will follow while Thermocouple / RTD is broken or disconnected. Auto : Before Sensor Break if measured Temperature value was with in ±4ºC of the control setpoint last measured % output power is maintained else 0% output power is maintained. Manual : Controller maintains output power at 0% during sensor break condition.	 Auto  Manual (Default : Auto)
SETPOINT LOCKING  Selected setpoint editing is Prohibited to operator for any accidental changes or unauthorized tempering.	 None  Control Setpoint  Auxiliary Setpoint  Both Control & Auxiliary Setpoint (Default : None)
CONTROLLER ID NUMBER  Unique numeric code assigned to the controller for identification by the host. Set the value as required by the host.	1 to 127 (Default : 1)
BAUD RATE  Communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	 1200bps  2400bps  4800bps  9600bps (Default : 9.6 bps)
COMMUNICATION WRITE ENABLE  *Yes* The Read/Write parameters can be accessed for both reading and writing. *No* The Read/Write parameters can only be accessed for reading. That is, the parameter values cannot be altered through serial communication.	 Yes  No (Default : Yes)

Section 6
PID CONTROL PARAMETERS

As described in *Section 4: Installation Parameters*, the Control Action can be set as ON-OFF or PID. If the selected Control Action is PID, the controller allows adjustments of various control related parameters that are grouped in PAGE-12. Note that these parameters are not presented to the user if the set Control Action is ON-OFF.

Table 6.1

Parameter Description	Settings (Default Value)
VIEW OUTPUT POWER FOR PID1  This is a view only parameter (can not be adjusted by the user) that facilitates the indication of % output power computed by the PID algorithm. The computed value lies between Min. power (0%) and Max. power (100%).	Not Applicable (for View Only) (Default : Not Applicable)
CYCLE TIME FOR PID1  This parameter (expressed in seconds) is used by the PID control algorithm for implementing the time proportion output associated with the drive for external Relay or SSR as the control output. For the time proportion output, the PID implements the output power by adjusting the ON time of Relay/SSR drive as a % of the Cycle Time. The relay/SSR remains OFF for the rest of the Cycle Time. For example, if the Cycle Time is set to 20.0 seconds and if the output power demand is 10%, the ON and OFF time duration for relay/SSR are computed.	0.5 to 99.5 Seconds (in steps of 0.5 Sec.) (Default : 1.0)
PROPORTIONAL BAND FOR PID1  This parameter value defines the band within which the control output signal varies proportionally between the maximum (100%) to the minimum (0%) level depending upon the error (difference between the Control Setpoint and Temperature Value). The Proportional Band is expressed in °C. Though this parameter value is automatically set by the self-tune utility, the user can alter the value manually.	1 to 999°C (Default : 10)
INTEGRAL TIME (RESET) FOR PID1  This parameter value, expressed in seconds, is a measure of the time response of the process and defines the time that PID takes to remove the steady state offset errors within the proportional band. Though this parameter value is automatically set by the self-tune utility, the user can alter the value manually. Setting this parameter value to 0 cuts-off the integral action.	0 to 999 Seconds (Default : 100)
DERIVATIVE TIME (RATE) FOR PID1  This parameter value, expressed in seconds, defines how strong the control output level will change in response to the rate of change of measured Temperature value. This, in effect, produces larger proportional and Integral actions should the Temperature value change at a faster rate. Though this parameter value is automatically set by the self-tune utility, the user can alter the value manually. Setting this parameter value to 0 cuts-off the derivative action.	0 to 250 Seconds (Default : 25)

Parameter Description	Settings (Default Value)
VIEW OUTPUT POWER FOR PID2  Same as View Output Power for PID1	Not Applicable (for View Only) (Default : Not Applicable)
CYCLE TIME FOR PID2  Same as Cycle Time for PID1	0.5 to 99.5 Seconds (in steps of 0.5 Sec.) (Default : 20.0 Sec. for Relay 1.0 Sec. for SSR)
PROPORTIONAL BAND FOR PID2  Same as Proporation Band for PID1	1 to 999°C (Default : 10)
INTEGRAL TIME (RESET) FOR PID2  Same as Intergral Time (reset) PID1	0 to 999 Seconds (Default : 100)
DERIVATIVE TIME (RATE) FOR PID2  Same as Derivative Time (rate) for PID1	0 to 250 Seconds (Default : 25)

Section 7
AUXILIARY FUNCTION PARAMETERS

As a standard hardware configuration, the controller is always supplied with drive for external Relay/SSR that can be configured as output for Auxiliary function such as Alarm, Auxiliary Control or Blower operation. The parameters presented to the user depend upon the Auxiliary Function selected. The Auxiliary Function parameters for PID1 and PID2 are grouped on PAGE-13 and PAGE-14, respectively, and are listed below in Table 7.1 followed by their definitions.

Table 7.1

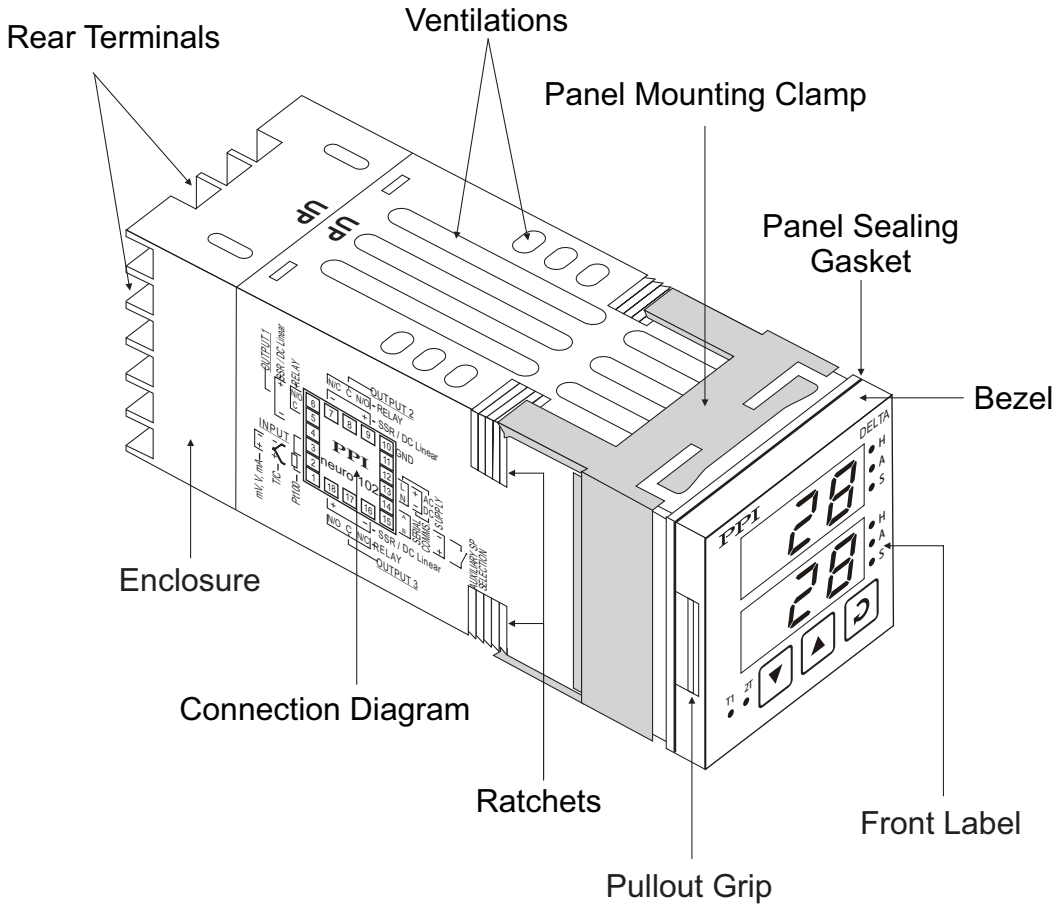
Parameter Description	Settings (Default Value)
AUXILIARY FUNCTION FOR PID1 AF.1 Select the function / feature for which the Auxiliary output 1 is to be used.	non None ALA Alarm Con Control bLr Blower (Default : None)
Alarm Function Parameters for PID1	
ALARM TYPE tYP Select the Alarm activation type.	P.Lo Process Low P.H, Process High dEu Deviation Band bnd Window Band (Default : Process Low)
ALARM SETPOINT SP *(Available for Process High or Process Low Alarm Type)* Sets Alarm limit independent of control setpoint.	-199 to 600 (Default : 0)
ALARM DEVIATION BAND bnd *(Available for Deviation Band Alarm Type)* Sets positive or negative deviation (offset) limit from control setpoint for High or Low Alarm activation, respectively.	-99 to 999 (Default : 0)
ALARM WINDOW BAND bnd *(Available for Window Band Alarm Type)* Sets symmetrical positive and negative deviation (offset) limits from control setpoint for both High and Low Alarm activation.	3 to 999 (Default : 3)
ALARM LOGIC LOG Select 'Normal' if Alarm is to activate an Audio / Visual alarm. Select 'Reverse' if Alarm is to Trip the system.	nor Normal rEu Reverse (Default : Normal)
ALARM INHIBIT Inh Set to Yes to suppress Alarm activation upon power-up or process start-up.	YES Yes no No (Default : Yes)

Parameter Description	Settings (Default Value)
Alarm Control Function Parameters for PID1	
AUXILIARY SETPOINT SP Positive (+) or Negative (-) offset to Control Setpoint for defining Auxiliary Setpoint.	(Min. Range - SP) to (Max. Range - SP) for selected Input (Default : 0)
CONTROL HYSTERESIS HYS *(Available for On-Off Control)* Sets a differential (dead) band between the ON and OFF states. Keep it large enough to avoid frequent switching of the load without losing the desired control accuracy.	1 to 999 (Default : 2)
CONTROL LOGIC LOG *Normal* The Output remains ON for PV *below* Setpoint and OFF otherwise. *Reverse* The Output remains ON for PV *above* Setpoint and OFF otherwise.	nor Normal rEv Reverse (Default : Normal)
Blower Function Parameters for PID1	
Blower Setpoint SP Positive (+) offset to Control Setpoint (SP) for defining Blower Setpoint.	0 to 250 (Default : 0)
Blower Hysteresis HYS Sets a differential (dead) band between the blower ON and OFF states.	1 to 250 (Default : 2)

Section 8
HARDWARE ASSEMBLY & CONFIGURATIONS

OUTER CASE

Figure 8.1



The Figure 8.1 above shows the controller outer-case when viewed with controller front label upright. The controller outer case is a rigid plastic Enclosure into which the electronics assembly fits. The Enclosure in turn fits into the standard DIN size panel cutout, as described in *Section 9 : MECHANICAL INSTALLATION*.

Notice the nomenclatures used to identify the various parts as the same are used throughout the sections describing installation, configuration and electrical connections.

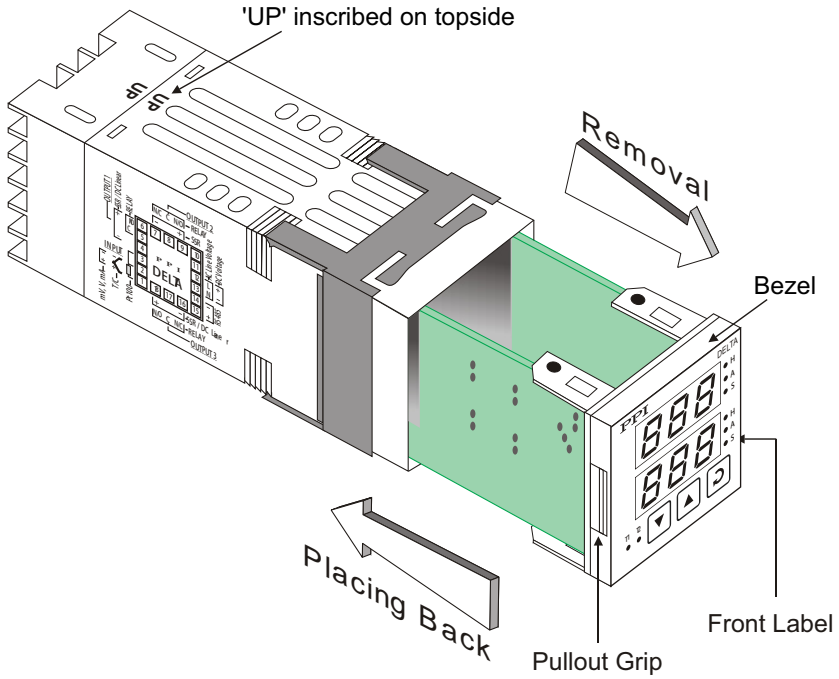
ELECTRONICS ASSEMBLY

The electronics assembly can be removed from the plastic Enclosure and placed back as described below:

Removal

1. Hold the controller with its front label upright.
2. Hold the Bezel with the fingers on the pullout grips provided on the left and right sides of the bezel. Pull the bezel outward. The assembly comes out with the bezel.

Figure 8.2

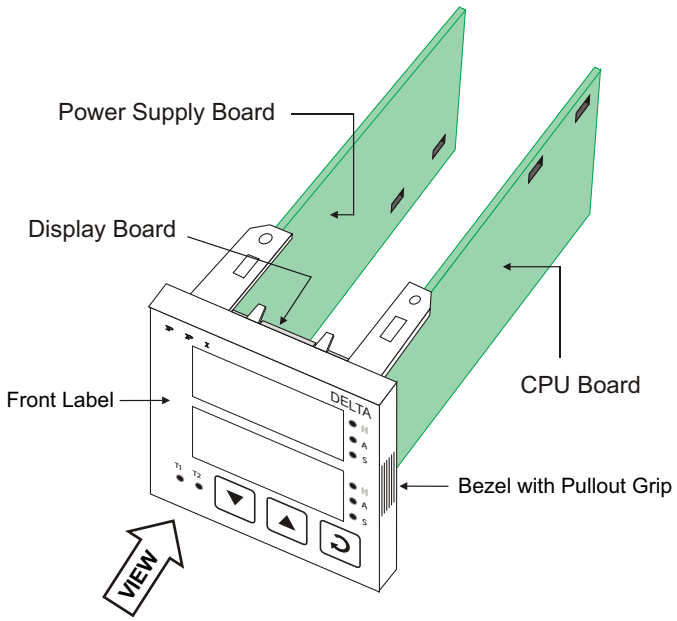


Placing Back

1. Hold the bezel with the front label upright.
2. Hold the Enclosure such that the UP inscribed on the Enclosure is on the topside.
3. Insert the bezel gently with the boards on either side sliding into the guides provided inside of the Enclosure.
4. Ensure that the bezel fits in tight on the Enclosure-front to secure the panel-sealing gasket.

The Figure 8.3 below shows the basic electronics assembly of the controller (without any plug-in modules). The basic electronics assembly of the controller comprises of 3 Printed Circuit Boards. As shown in the figure, when viewed from the front, the CPU board is to the right, Power-supply board is to the left and the Display board is behind the bezel.

Figure 8.3

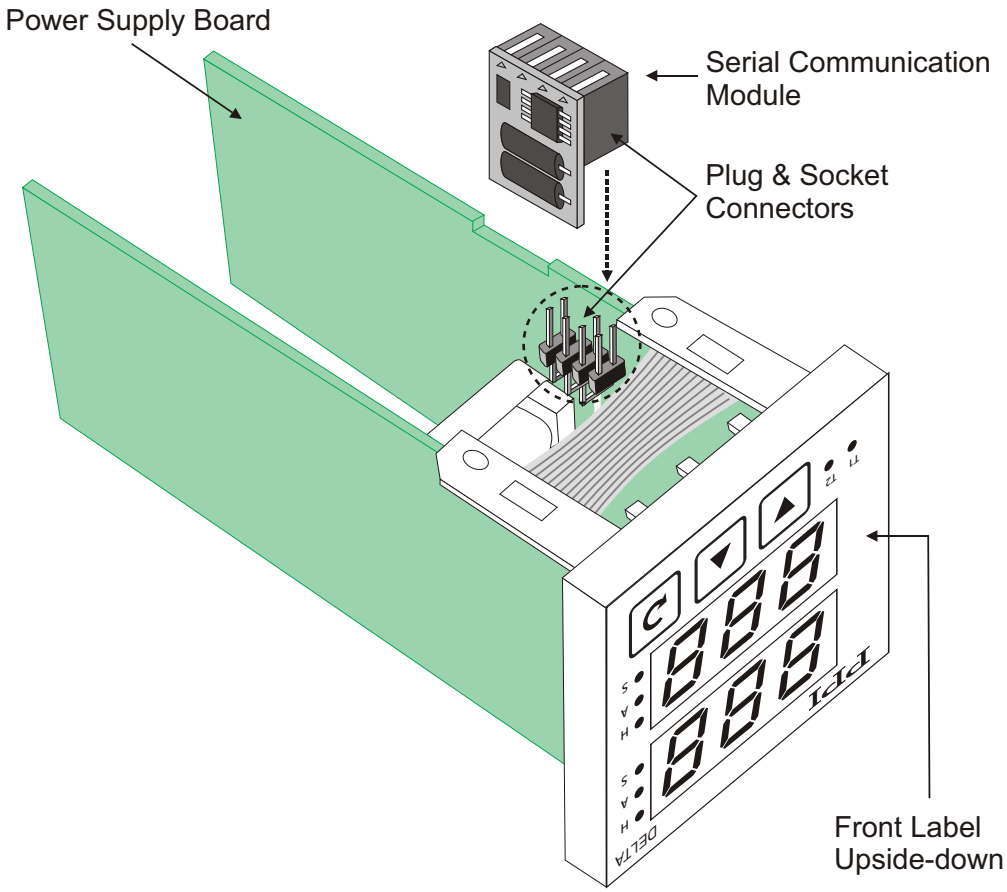


Serial Communication Module

The plug for the serial communication module is located on the Power supply board. The Figure 8.4 below illustrates how to plug-in the serial communication module. To plug (or unplug) the module simply insert (or remove) the socket into (or from) the plug.

Figure 8.4

Mounting Serial Communication Module



Section 9
MECHANICAL INSTALLATION

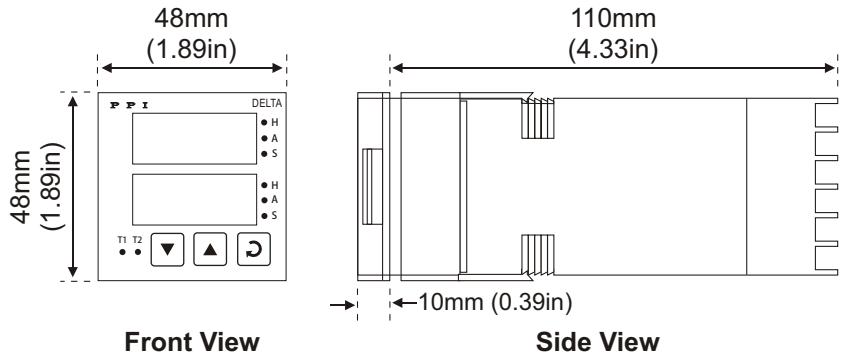
The following precautions should be strictly observed while installing the controller:

1. The place of installation should be free of corrosive/combustible gases and electrically conductive pollution.
2. Ensure that the place of installation is not subject to rapid ambient changes that can cause condensation. Also, the Ambient Temperature (0 to 55°C) and Relative Humidity (5 to 90%) surrounding the controller should not exceed the maximum specified for the proper operation of the controller.
3. The place of installation should be adequately protected against excessive electrostatic or electromagnetic interference.
4. The controller should not be subject to direct vibration or shock.
5. The controller should not be exposed to dust, salt air, direct sunlight or radiant heat.

OUTER DIMENSIONS

The Figure 9.1 shows the outer dimensions of the controller.

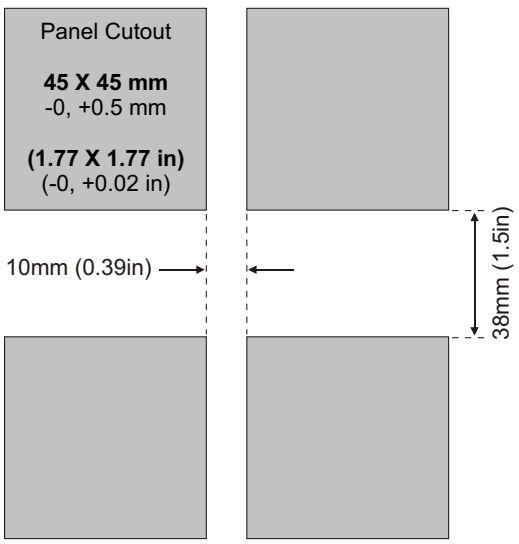
Figure 9.1



PANEL CUTOUT AND RECOMMENDED MINIMUM SPACING

The Figure 9.2 shows the panel cutout requirements for a single controller and also the minimum spacing recommended if several controllers are required to be mounted on a single panel.

Figure 9.2

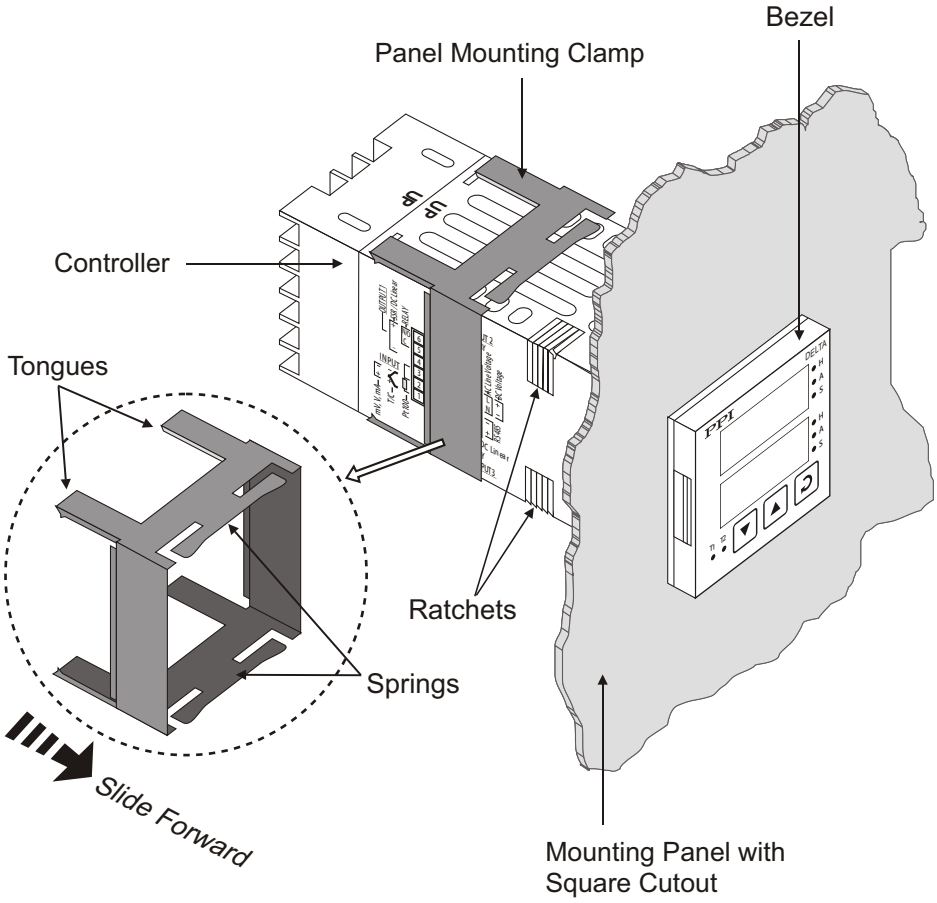


PANEL MOUNTING

Follow the steps below for mounting the controller on panel:

1. Prepare a square cutout to the size shown in Figure 9.2.
2. Remove the Panel Mounting Clamp from the controller Enclosure.
3. Insert the rear of the controller housing through the panel cutout from the front of the mounting panel.
4. Hold the controller gently against the mounting panel such that it positions squarely against the panel wall, see Figure 9.3. Apply pressure only on the bezel and not on the front label.
5. Slide the mounting clamp forward until it is firmly in contact with the rear face of the mounting panel and the tongues of the clamp engage in the ratchets on the controller enclosure. Ensure that the springs of the clamp push firmly against the rear face of the mounting panel for secured mounting.

Figure 9.3



Section 10
ELECTRICAL CONNECTIONS

WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

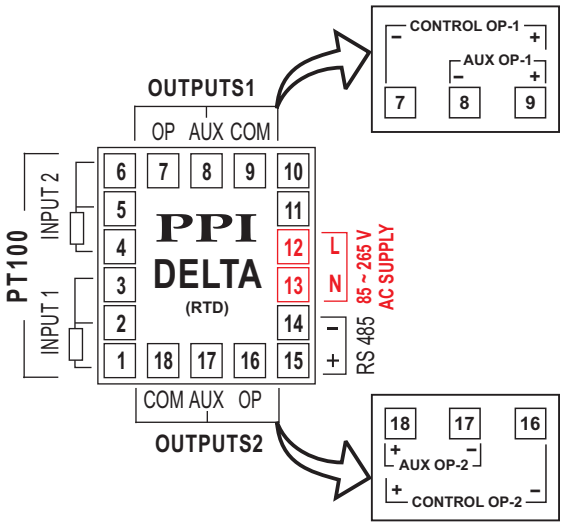
1. The user must rigidly observe the Local Electrical Regulations.
2. Do not make any connections to the unused terminals for making a tie-point for other wires (or for any other reasons) as they may have some internal connections. Failing to observe this may result in permanent damage to the controller.
3. Run power supply cables separated from the RTD sensor cables. If the cables are run through conduits, use separate conduits for power supply cable and RTD cables.
4. Use appropriate fuses and switches, wherever necessary, for driving the high voltage loads to protect the controller from any possible damage due to high voltage surges of extended duration or short-circuits on loads.
5. Take care not to over-tighten the terminal screws while making connections.
6. Make sure that the controller supply is switched-off while making / removing any connections or removing the controller from its enclosure.

CONNECTION DIAGRAM

The Electrical Connection Diagram is shown on the left side of the controller enclosure. The diagram shows the terminals viewed from the REAR SIDE with the controller label upright. Note that the RS-485 connections are applicable only if the respective plug-in module is fitted. Also the DC SUPPLY is applicable only if the controller is supplied with 20 to 50 VDC supply voltage option.

The rear panel electrical wiring connection diagram is shown in Figure 10.1 below.

Figure 10.1



DESCRIPTIONS

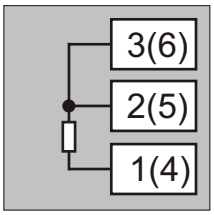
The back panel connections are described as under:

INPUT (Terminals 1, 2 and 3 for PID1, Terminals 4, 5 and 6 for PID2)

The controller accepts RTD Pt100, 3-wire as input.

RTD Pt100, 3-wire

Figure 10.2



Connect single leaded end of RTD bulb of PID1 to terminal 1 and the double leaded ends to terminal 2 and 3 (interchangeable). Similarly, connect single leaded end of RTD bulb of PID2 to terminal 4 and the double leaded ends to terminal 5 and 6 (interchangeable) as shown in Figure 10.2. Use copper conductor leads of very low resistance for RTD connections. Ensure that all 3 leads are of the same gauge and length. Use single run cables avoiding any intermediate joints.

Note:
The numbers in brackets indicate the terminal numbers for PID 2

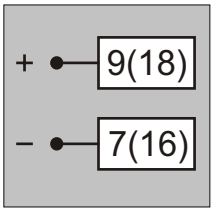
CONTROL OUTPUT (Terminals 7 and 9 for PID1, Terminals 16 and 18 for PID 2)

The Control Output is always provided with fixed built-in DC voltage pulses (for driving external Relay or SSR module) as Control Output signals. Note that, there is no provision for built-in Relay for either Control Output or Auxiliary output due to size constraints.

The Terminals for DC voltage control output drive signals for driving external Relay/SSR output for both PID1 and PID2 are shown in the Figure 10.3.

Figure 10.3

Drive for external Relay/SSR



DC Voltage level is generated for switching the external Relay / SSR (Solid State Relay) which in turn switches the load. Connect (-) and (+) terminals of PID1 Relay / SSR to terminals 7 (OP) and 9 (COM), respectively. Similarly, connect (-) and (+) terminals of PID2 Relay / SSR to terminals 16 (OP) and 18 (COM), respectively.

Note:
The numbers in brackets indicate the terminal numbers for PID2

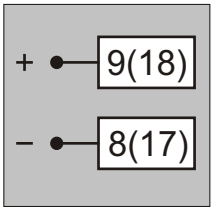
AUXILIARY OUTPUT (Terminals 8 and 9 for PID1, Terminals 17 and 18 for PID2)

Similar to the Control Output, the Auxiliary Output is always provided with fixed built-in DC voltage pulses (for driving external Relay or SSR module) as Auxiliary Output signals.

The Terminals for DC voltage auxiliary output drive signals for driving external Relay/SSR output for both PID1 and PID2 are shown in the Figures 10.4.

Figure 10.4

Drive for external Relay/SSR



DC Voltage level is generated for switching the external Relay / SSR (Solid State Relay) which in turn switches the load. Connect (-) and (+) terminals of PID1 Relay / SSR to terminals 8 (AUX) and 9 (COM), respectively. Similarly, connect (-) and (+) terminals of PID2 Relay / SSR to terminals 17 (AUX) and 18 (COM), respectively.

Note:
The numbers in brackets indicate the terminal numbers for PID 2

Relay Ratings

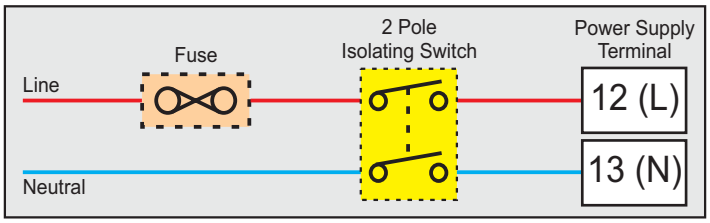
DC Voltage level is generated for switching the external Relay with Potential-free changeover contacts, N/O (Normally Open), C (Common) and N/C (Normally Close); rated 2A/240 VAC, 2A/30 VDC (resistive load) can be used as relay output.

SSR Ratings

DC Voltage level is generated for switching the external SSR (Solid State Relay) which in turn switches the load. Use Zero-Crossover, 3 to 30 VDC operated SSR, rated approximately 1.5 times the actual load rating. Use appropriate Heat Sink for mounting the SSR for load rating exceeding 10A.

POWER SUPPLY (Terminals 12 and 13)

Figure 10.5



As standard, the controller is supplied with power connections suited for 85 to 264 VAC line supply. Use well-insulated copper conductor wire of the size not smaller than 0.5 mm² for power supply connections. Connect Line (phase) supply line to terminal 12 and the Neutral (Return) supply line to terminal 13. The controller is not provided with fuse and power switch. If necessary, mount them separately. Use a time lag fuse rated 1A @ 240 VAC as shown in Figure 10.5 above.

For DC Supply connect Signal & Common to controller terminals 12 & 13, respectively

Caution

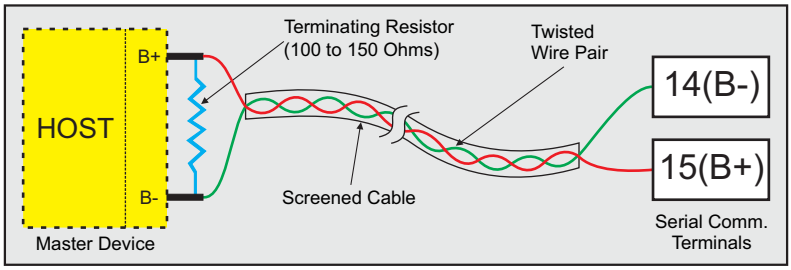
The controller is designed for installation in an enclosure which provides adequate protection against electric shock. Local regulations regarding electrical installation should be rigidly observed. Consideration should be given to prevention of access to the Power supply terminals by unauthorized personal. If the Relay contacts are to carry mains (line) voltage, it is recommended that the Relay contacts mains (line) supply should be switched and fused in a similar manner but should be separate from the controller mains (line) supply.

RS 485 SERIAL COMMUNICATION (Terminals 14 and 15)

If optional plug-in communication board is fitted, connect terminal 15 and 14 of the controller to (+) and negative (-) terminals of the master device.

To ensure reliable operation of the RS485 Serial Communication Link (without data corruption due to line noise or reflections), use a pair of twisted wires inside screened cable with the terminating resistor (100 to 150 Ohms) at one end, as shown in Figure 10.6 below.

Figure 10.6



Notes :

1. The communication cable should be a pair of twisted wires inside screened cable as shown in figure 10.6 above. It should have less than 100 ohms / km nominal DC resistance (Typically 24 AWG or thicker). Connect the terminating resistor (Typically 100 to 150 ohm) at one end to improve noise immunity.
2. Run the communication cable separated from cables (like power supply, Relay/Contactor cable etc.). If the cable are run through conduit use a separate conduit for communication cables.
3. Communication cables may run through low level signal cable (like RTD inputs, DC Voltage Pulse outputs) if these cables are not exposed to an interference source.
4. Do not use redundant wires in communication cables for other signals.
5. Ensure that the cable is “daisy chained” between controllers for multi-dropped wiring. That is, run from one controller to the next to the final controller in the chain.

WIRING FOR EXTERNAL RELAY BOARD

As already mentioned that the controller has no provision for built-in Relay for either Control or Auxiliary outputs due to size constraints. The user has to use external Relay /SSR for driving the load of the Control / Auxiliary outputs for both PID1 and PID2.

PPI offers optional Relay Board (Part No. 04247-2SHRLY-RV1) that can be driven using the OP (for PID1) and OP (for PID2) outputs.

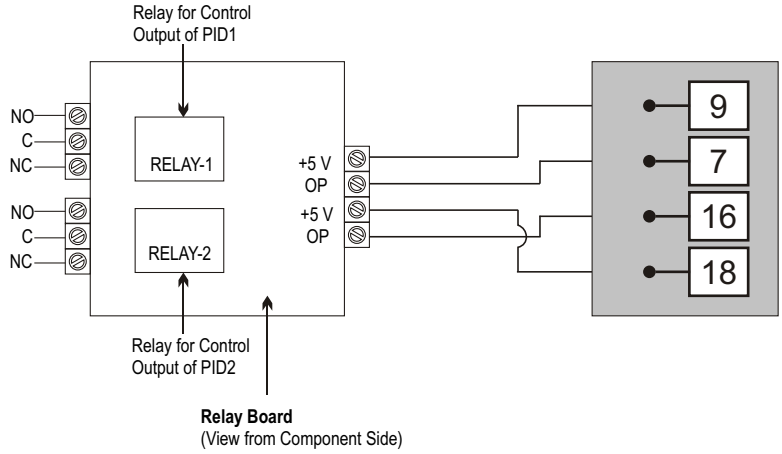
For Control Outputs, the load (like heaters) for PID1 and/or PID2 are to be driven through potential-free contacts of Relay Board.

Similarly, for Auxiliary Output the load (like Hooter, Buzzer, Heater, Blower etc.) for PID1 and/or PID2 are to be driven through potential-free contacts of Relay Board.

The Figure 10.7 and Figure 10.8 below shows the wiring connection diagram for Relay Board for Control Output and Auxiliary Output, respectively.

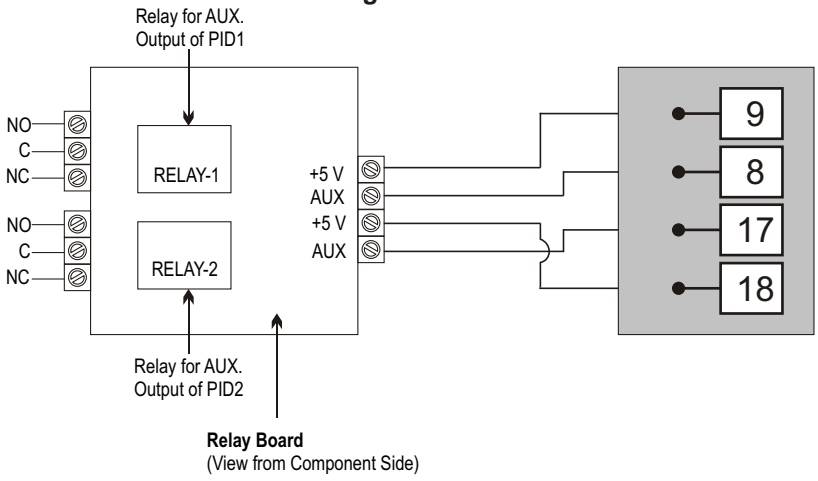
WIRING CONNECTION FOR CONTROL OUTPUT

Figure 10.7



WIRING CONNECTION FOR AUXILIARY OUTPUT

Figure 10.8

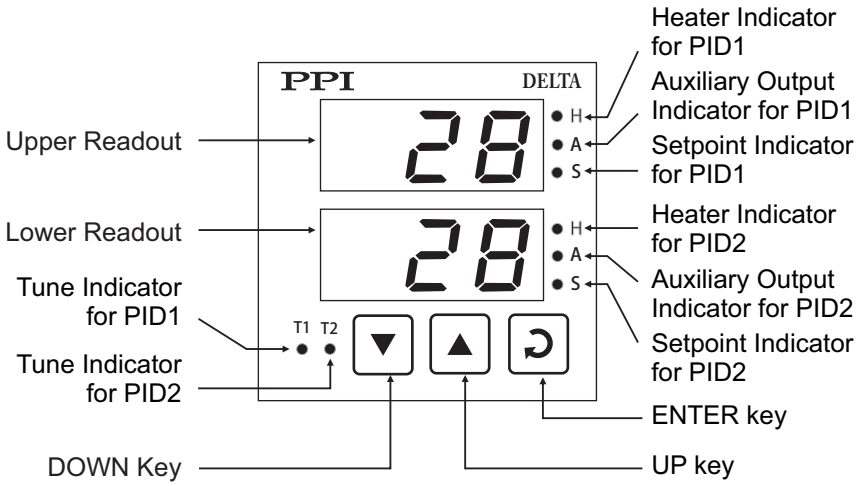


Delta Thermocouples

Section 1
FRONT PANEL LAYOUT

The controller front panel comprises of digital readouts, LED indicators and membrane keys as shown in Figure 1.1 below.

Figure 1.1



READOUTS

The Upper Readout is a 3 digit, 7-segment bright red LED display and usually displays the Temperature Value for PID1. In Operator Mode, the Upper Readout shows and permits editing of Control Setpoint and/or Auxiliary Setpoint for PID1. In parameter set-up mode, the Upper Readout displays parameter values.

The Lower Readout is a 3 digit, 7-segment bright red LED display and usually displays the Temperature Value for PID2. In Operator Mode, the Upper Readout shows and permits editing of Control Setpoint and/or Auxiliary Setpoint for PID2. In parameter set-up mode, the Lower Readout displays the prompts for the parameters.

INDICATORS

There are eight front panel LED indicators to show various statuses for each PID. The Table 1.1 and Table 1.2 below list each LED indicator (identified by the front panel legend), the position on the front panel and the associated status it indicates for PID1 and PID2, respectively.

Table 1.1

PID1 Indicator	Position on the Front Panel	Functions
H	To the right of Upper Readout	• Indicates the On/Off status of Heater Output for PID1
A	To the right of Upper Readout	• Flashes while the Upper Readout shows the Auxiliary Setpoint value for PID 1 in Operator Mode • Indicates the On/Off status of Auxiliary Output for PID1
S	To the right of Upper Readout	• Flashes while the Upper Readout shows the Control Setpoint value for PID 1 in Operator Mode
T1	To the left of DOWN key	• Flashes while the PID1 Tuning is in progress

Table 1.2

PID2 Indicator	Position on the Front Panel	Functions
H	To the right of Lower Readout	• Indicates the On/Off status of Heater Output for PID2
A	To the right of Lower Readout	• Flashes while the Lower Readout shows the Auxiliary Setpoint value for PID 2 in Operator Mode • Indicates the On/Off status of Auxiliary Output for PID2
S	To the right of Lower Readout	• Flashes while the Lower Readout shows the Control Setpoint value for PID 2 in Operator Mode
T1	To the left of DOWN key	• Flashes while the PID2 Tuning is in progress

KEYS

There are three tactile keys provided on the front panel for configuring the controller, setting-up the parameter values and selecting operation modes. The Table 1.3 below details the key functions.

Table 1.3

Symbol	Key	Function
▼	DOWN	Press to decrease the parameter value. Pressing once decreases the value by one count; keeping pressed speeds up the change.
▲	UP	Press to increase the parameter value. Pressing once increases the value by one count; keeping pressed speeds up the change.
↵	ENTER	Press to store the set parameter value and to scroll to the next parameter on the PAGE.

Notes:

1. While in MAIN display mode, pressing DOWN and UP keys simultaneously followed by pressing ENTER key, allows entering in Set-up mode (Refer *Section 3: Pages & Parameters*).
2. While in MAIN display mode, upon pressing ENTER key once, the Upper Readout flashes Control Setpoint and pressing twice, the Upper Readout flashes Auxiliary Setpoint (if selected) for PID1. Upon the subsequent pressing of ENTER key once, the Lower Readout flashes Control Setpoint and pressing twice, the Lower Readout flashes Auxiliary Setpoint (if selected) for PID2. (Refer *Section 2: Basic Operations*).

Section 2
BASIC OPERATIONS

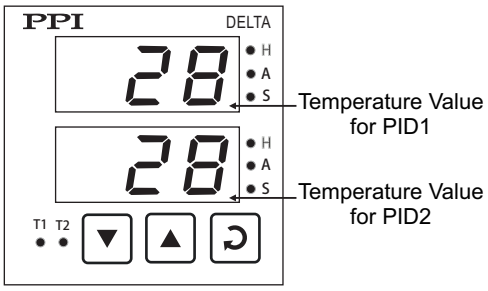
POWER-UP

Upon switching on the power to the controller, all displays and indicators are lit on for approximately 3 seconds during which time the controller runs through a self-test sequence. This is followed by the indication of the controller model name dEL on the Upper Readout and the firmware version on the Lower Readout, for approximately 1 second.

MAIN DISPLAY MODE

After the power-up display sequence, the Upper Readout and the Lower Readout start showing the measured Temperature value for PID1 and PID2, respectively. This is called the MAIN display mode and this is the one that shall be used most often. The MAIN display mode is depicted in Figure 2.1.

Figure 2.1



FIRST-TIME / NEW INSTALLATION

It is recommended to observe the following sequence of operations for a first-time installation for a new controller or if the controller is removed from one machine and installed on a different machine.

1. Set the Installation parameters (Input Type, Output Type and Temperature Range) for PID1 and PID2 in PAGE-10 parameter list. *(*Refer *Section 3: Pages and Parameters* for parameter settings.)
2. Set the Configuration parameters as applicable for PID1 and PID2 in PAGE-11.
3. Set Auxiliary Function parameters (if Auxiliary Output is to be used for Alarm, Control or Blower operation) for PID1 and PID2 in PAGE-13 and PAGE-14, respectively.
4. Return to MAIN display mode. Set the Control Setpoint and Auxiliary Setpoint (if selected) to the desired values as described later in this section.

The controller then detects this as a “New Installation” and immediately starts self-tuning for PID1 and/or PID2 if the configured control action is PID. The front panel indicators T1 (for PID1) and T2 (for PID2) flash while tuning is in progress and turn off upon completion of the tuning for the respective PID.

OPERATOR MODE

Adjusting the Control and Auxiliary Setpoint for PID1 and PID2

The Control Setpoint and Auxiliary Setpoint for PID1and PID2 can be directly adjusted on the Upper and Lower readout, respectively, while the controller is in the MAIN display mode. The Control and Auxiliary Setpoint adjustment for PID1and PID2 is permitted only if they are not locked via the parameter 'Setpoint Locking' in PAGE-11. If not locked, step through the following sequence to adjust the Setpoint values.

1. Press and release ENTER key.

   The Upper Readout starts flashing Control Setpoint value for PID1. The front panel indicator S to the right of Upper Readout flashes to indicate that the value shown on the Upper Readout is Control Setpoint for PID1. The Lower Readout continues to show the measured Temperature value for PID2.

Press UP/DOWN keys to adjust the Control Setpoint value. Pressing UP or DOWN key once changes the value by one count; holding the key pressed speeds up the rate of change. The Upper Readout stops flashing as long as the UP or DOWN key is pressed for adjustment to avoid any obstructions in viewing.

2. Press and release ENTER key.

   The new value for the Control Setpoint for PID1 is stored in the controller memory. The controller now enters either into step 3 or step 5 depending upon the selection for the Auxiliary Function for PID1. If the Auxiliary Function for PID1 is selected as 'None', the controller directly enters into step 5 else it enters into step 3.

3. The Upper Readout starts flashing Auxiliary Setpoint (Alarm, Blower or Auxiliary Control) value for PID1. The front panel indicator A to the right of Upper Readout flashes to indicate that the value shown on the Upper Readout is Auxiliary Setpoint for PID1. The Lower Readout continues to show the measured Temperature value for PID2.

   Press UP/DOWN keys to adjust the Auxiliary Setpoint value for PID1.

4. Press and release ENTER key. The new value for the Auxiliary Setpoint for PID1 is stored in the controller memory.

5. The Lower Readout starts flashing Control Setpoint value for PID2. The front panel indicator S to the right of Lower Readout flashes to indicate that the value shown on the Lower Readout is Control Setpoint for PID2. The Upper Readout now shows the measured Temperature value for PID1.

   Press UP/DOWN keys to adjust the Control Setpoint value for PID2.

6. Press and release ENTER key.

   The new value for the Control Setpoint for PID2 is stored in the controller memory. The controller now enters either into next step (step 7) or returns to MAIN display mode depending upon the selection for the Auxiliary Function for PID2. If the Auxiliary Function for PID2 is selected as 'None', the controller returns to MAIN display mode else it enters the next step.

7. The Lower Readout starts flashing Auxiliary Setpoint (Alarm, Blower or Auxiliary Control) value for PID2. The front panel indicator A to the right of Lower Readout flashes to indicate that the value shown on the Lower Readout is Auxiliary Setpoint for PID2. The Upper Readout continues to show the measured Temperature value for PID1.

8. Press and release ENTER key. The new value for the Auxiliary Setpoint for PID2 is stored in the controller memory and the controller returns to the MAIN display mode.

   Repeat steps 1 through 8 each time to alter/view the Setpoint values for PID1 and PID2.

Notes:

1. The Auxiliary Setpoint value is available only if the Auxiliary Function is selected to other than non (None).
2. The Control and Auxiliary setpoint adjustments are permitted only if these are not locked via the parameter 'LOCK' in PAGE-11. The setpoint values, however, are always available for viewing regardless of the lock.
3. While in Operator Mode, the heater and auxiliary output statuses for both PID1 and PID2 are forced off to clearly indicate what the Upper or the Lower Readout is indicating.
4. The Control Setpoint is adjustable to any value between 0 and the value set for the parameter 'Temperature Range' for the respective PID.
5. The Auxiliary Setpoint value can be adjusted as an absolute value or relative to Control Setpoint value depending upon the function type selected for the Auxiliary Output. (Refer *Section 7: Auxiliary Function Parameters*).

Issuing Tune / Abort Command

The controller's 'X-PERT' algorithm is powered with the ability to self detect the events such as new installation, substantial change in Control Setpoint, etc. for tuning itself to the process under control for both the PIDs. However, the user can issue separate Tune Command to each PID to force itself and make an attempt to improve the already computed values of the constants used by the PID control algorithm. Only under the following instances, the user should issue the Tune Command:

1. If for some reason the control accuracy / performance is not satisfactory.
2. If it is required to re-initiate the tuning procedure once the self-initiated tuning procedure was aborted by the user by issuing Abort Command.
3. There are substantial changes in the operating conditions such as change in load, heater size, etc., after the initial installation.
4. By the machine / equipment manufacturer at the time of dispatch to the end user. This is to ensure that the controller re-tunes for the new conditions such as running the machine with full load condition.

There are separate Tune / Abort commands for PID1 and PID2. Upon issuing Tune / Abort command, the respective PID enters / exits the re-tuning procedure. Follow the steps below to issue Tune or Abort Command:

1. While the controller is in the MAIN display mode, keep UP and DOWN keys simultaneously pressed (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout is blanked.
2. Release UP and DOWN keys and then press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0.
3. Press ENTER key. The Lower Readout now shows either tn.1 (if PID1 is not already tuning) or Ab.1 (if the tuning for PID1 is in progress) and the Upper Readout shows no (No).
4. Press UP key to select YES (Yes) on the Upper Readout to issue Tune / Abort command for PID1. Press ENTER key to register the YES command. Upon pressing ENTER key, PID1 enters / exits tuning operation depending upon the command issued. If Tune command is issued, the front panel indicator T1 starts flashing to indicate that PID1 has begun tuning operation. If, however, Abort command is issued, the flashing indicator T1 turns off to indicate that PID1 tuning operation is aborted.

   The Lower Readout now shows either tn.2 (if PID2 is not already tuning) or Ab.2 (if the tuning for PID2 is in progress) and the Upper Readout shows no (No).
5. Repeat step 4 for issuance of Tune / Abort command for PID2. The controller automatically returns to MAIN display mode upon pressing ENTER key.

Notes:

1. The Tune and Abort Commands are mutually exclusive. That is, the Tune Command is available only when tuning is not already initiated whereas Abort Command is available only while tuning is in progress.
2. While the tuning operation is in progress, the user is advised not to disturb the process or any parameter values of the controller under tuning. Upon completion of the tuning operation, the respective indicator (T1 for PID1 and T2 for PID2) turns off to indicate that the tuning operation is over.

The following tips can help user to decide when to issue Tune command.

1. In most applications, the controller is subject to dry run (without actual load conditions) by the machine manufacturer after its first installation on the machine. This is usually done to conduct tests / trails of the machine. It may then be desired that the controller automatically enter into re-tuning procedure while it is first run with full load conditions at the end user site. For this, it is best to issue the Tune command and switch off the controller prior to dispatch (thus, leaving the tuning procedure incomplete). The controller then automatically resumes the tuning when it is powered next time.
2. If it is found that the control results are not satisfactory (may be due to dynamic changes in the load conditions), it is best to issue this command while the process is being controlled near the Control Setpoint. This will cause small disturbances in the Temperature value while the controller is performing tuning procedure but shall eventually result in a stable control once the tuning procedure is complete.

TEMPERATURE VALUE ERROR INDICATIONS

In case, the measured Temperature value falls below the Minimum Range or rises above the Maximum Range specified for the selected input Thermocouple type or in case of Thermocouple open / broken; the controller flashes the error messages as listed in Table 2.1 below. Note that the messages for PID1 are flashed on Upper Readout while those for PID2 are flashed on the Lower Readout. The Figure 2.2 illustrates the Thermocouple Open condition and Under-range condition for PID1 and PID2, respectively

Figure 2.2

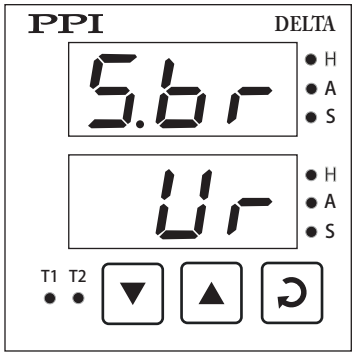


Table 2.1

Message	Error Type
Or	Over-range (Temp. above Max. Range)
Ur	Under-range (Temp. below Min. Range)
5.br	Sensor Break (Thermocouple is open or broken)

Notes:

1. In case of Over-range and Under-range condition, the Control Output and Auxiliary Output (if selected as Blower or Control) of the respective PID is held at the minimum level, that is, OFF.
2. In case of Sensor break (open) condition; the control signal (% output power) will depend upon the Sensor Break Strategy selected in PAGE-11 parameter list that is commonly applicable for PID1 and PID2.
3. If the Auxiliary Function is selected as Alarm for PID1 and/or PID2, the respective alarm gets activated in error conditions. Refer below, *Sub-section: Alarm Status Under Temperature Error Conditions.*

ALARM STATUS UNDER TEMPERATURE VALUE ERROR CONDITIONS

The Table 2.2 below summarizes the alarm status under various Temperature error conditions. The alarm ON status means the alarm is activated and OFF means the alarm is not activated. The corresponding Auxiliary output is energized / de-energized in accordance with the alarm status and control logic (Normal / Reverse).

Table 2.2

ERROR TYPE	ALARM TYPE	ALARM STATUS
Under-range	Process Low	ON
	Process High	OFF
	Negative Deviation	ON
	Positive Deviation	OFF
	Band	ON
Over-range or Open	Process Low	OFF
	Process High	ON
	Negative Deviation	OFF
	Positive Deviation	ON
	Band	ON

Section 3
PAGES & PARAMETERS

ORGANIZATION

The controller requires various user settings that determine how the controller will function or operate. These settings are called parameters.

The parameters are always presented in a fixed format: The Lower Readout displays the parameter prompt (identification tag) and the Upper Readout displays the set value. The parameters appear in the same sequence as listed in their respective sections.

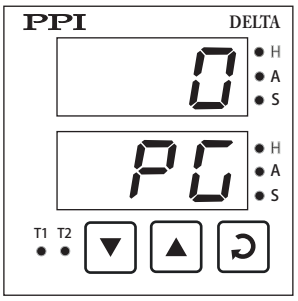
For convenience and ease of memorizing, the various parameters have been arranged in different groups depending upon the functions the parameters represent. Each group is assigned a unique PAGE NUMBER for its access and the parameters within each group are presented for settings depending upon the function(s) selected.

PARAMETER SET-UP MODE

The parameter set-up mode allows the user to view or modify the parameter values. The entry from the MAIN display mode to parameter Set-up mode requires appropriate setting of the PAGE NUMBER.

Follow the steps below to open a desired PAGE for setting the parameter values.

Figure 3.1



1. While the controller is in MAIN display mode, keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
2. Press ENTER key. The Lower Readout shows PG (PAGE) and the Upper Readout shows 0. See Figure 3.1.
3. Adjust the Upper Readout to the desired PAGE NUMBER using the UP/DOWN keys. Pressing the UP or DOWN key once, changes the value by one count. Holding the key pressed speeds up the rate of change.
4. Press and release ENTER key. The Lower Readout shows the prompt for the first parameter listed in the PAGE and the Upper Readout shows its current value.

Note:
If the entered PAGE NUMBER is invalid (contains no parameter list or any associated function), the controller returns to the MAIN display mode.

ADJUSTING PARAMETER VALUES

Once a desired PAGE is accessed, step through the following sequence to adjust the values of the desired parameters:

1. Press and release the ENTER key until the prompt for the required parameter appears in the Lower Readout.
2. Use UP and DOWN keys to adjust the parameter value.

   Note that some parameters (examples; Alarm Setpoint, Blower Setpoint, etc.) have Numeric Values while others (examples; Control Action, Setpoint Locking, etc.) have a series of Options. If adjusting a Numeric Value; depressing the UP/DOWN key once, increases/decreases the parameter value by one digit. For parameters having a series of options, depressing the UP/DOWN key once takes you to the next/previous option. In each case, keeping the UP/DOWN key pressed speeds up the rate. If the value reaches the maximum / minimum settable value/option, the Upper Readout flashes and the UP (if maximum value is reached) or DOWN (if minimum value is reached) key has no effect.
3. Once the parameter value is adjusted, press and release ENTER key. The new value gets stored in the controller's non-volatile memory and the next parameter in the list is displayed.

The Figure 3.2 illustrates the example of altering the value for the parameter ' Output Type' for PID1.

Figure 3.2

4. Upon pressing ENTER key at the last parameter in the list, the PAGE NUMBER setting is presented again with Lower Readout showing PG and the Upper Readout showing the most recent PAGE NUMBER accessed. The user is thus allowed to either re-enter the same PAGE NUMBER by simply pressing ENTER key or to enter any other desired PAGE by adjusting the PAGE NUMBER using UP/DOWN keys and then pressing the ENTER key.
5. To exit the Set-up mode, enter any invalid PAGE NUMBER in PAGE set-up display mode and press ENTER key. The controller reverts to the MAIN display mode.

Also, if the controller is left in set-up mode without any key operation for more than 30 seconds, the controller automatically exits the set-up mode and returns to the MAIN display mode. This is called Time-out exit from the Set-up mode.

Note:

It is a must to press the ENTER key after altering the value of a parameter else the new value will not be registered / stored. That is, a return to the MAIN display (by time out) without pressing the ENTER key will not store the altered value in the controller memory and the previous set value will be retained. Also, if the power failure occurs prior to pressing ENTER key, upon resumption of power, the controller reverts to MAIN display without storing the altered value and retains the previous set value.

PARAMETER LOCKING

Though access to any PAGE is always permitted, the adjustments of the parameter values, however, can be locked at the supervisory level.

If the lock is enabled, the parameter values in each PAGE can only be viewed but cannot be adjusted. That is, the UP/DOWN keys are inhibited. This feature facilitates the supervisory level to protect the parameter values from unauthorized tampering or accidental alterations by the operator.

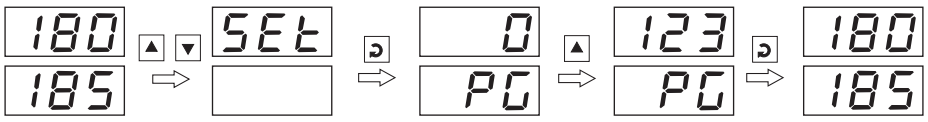
The controller is shipped from the factory in Unlocked (Lock disabled) condition. The user can enable the lock once the initial configuration and installation is done.

For enabling/disabling the lock, step through the following sequence:

1. While the controller is in the MAIN display mode, keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
2. Press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0. Adjust the Upper Readout to PAGE NUMBER 123.
3. Press and release ENTER key. The controller returns to the MAIN display with the LOCK enabled.

The Figure 3.3 below illustrates locking procedure:

Figure 3.3



Note:

Since there is no front panel indication for the 'Lock Enabled' condition, ensure that the lock is enabled by trying to adjust the parameters in any valid PAGE.

Unlocking

1. While the controller is in the MAIN display mode, keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
2. Press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0. Adjust the Upper Readout to PAGE NUMBER 123.
3. Press and release ENTER key. The controller returns to the MAIN display mode.
4. Repeat steps 1 through 3. This time, the controller returns to the MAIN display with the LOCK disabled (open).

Notes:

1. If the Control and Auxiliary setpoint adjustment is not locked in PAGE-11 parameter list, these Setpoint values can be adjusted from MAIN display even under parameter lock condition.
2. The facility for 'setting Default Values' by accessing PAGE-99 is also inhibited (locked) when the parameter LOCK is enabled. Accessing PAGE-99 shall be treated as an invalid PAGE NUMBER.
3. Note that it requires entering PAGE NUMBER 123 once for LOCKING but twice for UNLOCKING. Also, for UNLOCKING, the PAGE NUMBER 123 must be entered twice during the same duration for which the controller is powered. That is, entering the PAGE NUMBER 123 once prior to power loss and once after resumption of power shall not UNLOCK.
4. Do not forget to enable the LOCK again if it was UNLOCKED for some parameter value alteration.

SETTING DEFAULT VALUES

The controller is shipped from the factory with all the parameters set to their default factory set values. Thus, for the first time installation there is no need for re-setting the parameters to their default values. However, in case the controller is removed from a particular installation and fitted on a different machine, it is recommended to reset all the parameters to their default values before configuring the controller for the new installation.

Follow the steps below for re-setting the parameters to default values:

1. Ensure that the controller is in MAIN display mode and unlocked for parameter adjustments.
2. Keep UP and DOWN keys pressed simultaneously (for approximately 3 seconds) until the Upper Readout flashes SEt and the Lower Readout blanks.
3. Press ENTER key. The Lower Readout shows PG and the Upper Readout shows 0.
4. Adjust the Upper Readout to PAGE NUMBER 99 using UP/DOWN keys.
5. Press ENTER key. The controller resets and restarts from Power-up display sequence with all the parameters set to their factory set default values.

Section 4

INSTALLATION PARAMETERS

The Installation parameters are contained in PAGE-10 and are required to be set only at the time of a new installation.

The Installation parameters are listed below in Table 4.1, followed by their definitions.

Table 4.1

Parameter Description	Settings (Default Value)
INPUT TYPE FOR PID1 tC.1 Select Input type in accordance with the type of Thermocouple connected to the input terminals for process value measurement. Ensure proper hardware jumper settings, if required.	Refer Table 4.2 (Default : Type J)
OUTPUT TYPE FOR PID1 OP.1 Select the output type in accordance with the hardware configuration for PID-1. Potential free Relay Change over Contacts are Provided at AUX OP1. Note: This parameter is available for selection only if the Auxiliary Function is selected as “non” (None).	rLy Relay SSr SSR (Default : SSR)
TEMPERATURE RANGE FOR PID1 rG.1 This parameter value must be set in accordance with the Maximum Temperature Range for which the equipment /machine is designed.	0 to Max. Range Specified for the selected Input type (Default : 300)
OFFSET FOR PID1 OF.1 This value is algebraically added to the measured PV to derive the final PV that is displayed and compared for alarm/control. Final PV = Measured PV + Offset	-99 to 99 (Default : 0)
CONTROL ACTION FOR PID1 CA.1 Select appropriate Control Algorithm suited for process requirement.	PId PID On.F On-Off (Default : PID)
INPUT TYPE FOR PID2 tC.2 Select Input type in accordance with the type of Thermocouple connected to the input terminals for process value measurement. Ensure proper hardware jumper settings, if required.	Refer Table (Default : Type J)
OUTPUT TYPE FOR PID2 OP.2 Select the output type in accordance with the hardware configuration for PID-2. Potential free Relay Change over Contacts are Provided at AUX OP2. Note: This parameter is available for selection only if the Auxiliary Function is selected as “non” (None).	rLy Relay SSr SSR (Default : SSR)

Parameter Description	Settings (Default Value)
TEMPERATURE RANGE FOR PID2 r G.2 This parameter value must be set in accordance with the Maximum Temperature Range for which the equipment /machine is designed.	0 to Max. Range Specified for the selected Input type (Default : 300)
OFFSET FOR PID2 OP.2 This value is algebraically added to the measured PV to derive the final PV that is displayed and compared for alarm/control. Final PV = Measured PV + Offset	-99 to 99 (Default : 0)
CONTROL ACTION FOR PID2 CA.2 Select appropriate Control Algorithm suited for process requirement.	PID PID On-Off On.F (Default : PID)

Table 4.2

Option	What it means	Range (Min. to Max.)	Resolution
J	Type J Thermocouple	0 to 760°C	Fixed 1°C
K	Type K Thermocouple	0 to 999°C	

Table 4.3

Option	What it means
rLY	Electromechanical Relay contacts
SSr	DC voltage pulses for driving external Solid State Relay (SSR)

Section 5

CONFIGURATION PARAMETERS

The Configuration parameters are grouped in PAGE-11. These parameters allow the user to set-up the controller for Auto detection of Tuning at Setpoint Change, Sensor Break Strategy, Setpoint Locking and Digital (serial) communication with a Master Device like PC (if hardware module fitted). The Configuration parameters are listed below in Table 5.1, followed by their definitions.

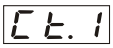
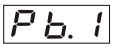
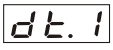
Table 5.1

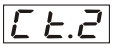
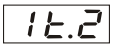
Parameter Description	Settings (Default Value)
SELF-TUNE ON SETPOINT CHANGE [St] Re-tune the controller if there is a substantial (large) change in the SP value. The P, I, D values are optimized.	[Enb] Enable [dSb] Disable (Default : Enable)
SENSOR BREAK STRATEGY [Sb] Selects Output Power Strategy that the Controller will follow while Thermocouple / RTD is broken or disconnected. Auto : Before Sensor Break if measured Temperature value was with in ±4ºC of the control setpoint last measured % output power is maintained else 0% output power is maintained. Manual : Controller maintains output power at 0% during sensor break condition.	[AUt] Auto [MAn] Manual (Default : Auto)
SETPOINT LOCKING [LY] Selected setpoint editing is Prohibited to operator for any accidental changes or unauthorized tempering.	[non] None [SP] Control Setpoint [ASP] Auxiliary Setpoint [ALL] Both Control & Auxiliary Setpoint (Default : None)
CONTROLLER ID NUMBER [Id] Unique numeric code assigned to the controller for identification by the host. Set the value as required by the host.	1 to 127 (Default : 1)
BAUD RATE [br] Communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	[1.2] 1200bps [2.4] 2400bps [4.8] 4800bps [9.6] 9600bps (Default : 9.6 bps)
COMMUNICATION WRITE ENABLE [CE] *Yes* The Read/Write parameters can be accessed for both reading and writing. *No* The Read/Write parameters can only be accessed for reading. That is, the parameter values cannot be altered through serial communication.	[YES] Yes [no] No (Default : Yes)

Section 6
PID CONTROL PARAMETERS

As described in *Section 4: Installation Parameters*, the Control Action can be set as ON-OFF or PID. If the selected Control Action is PID, the controller allows adjustments of various control related parameters that are grouped in PAGE-12. Note that these parameters are not presented to the user if the set Control Action is ON-OFF.

Table 6.1

Parameter Description	Settings (Default Value)
VIEW OUTPUT POWER FOR PID1  This is a view only parameter (can not be adjusted by the user) that facilitates the indication of % output power computed by the PID algorithm. The computed value lies between Min. power (0%) and Max. power (100%).	Not Applicable (for View Only) (Default : Not Applicable)
CYCLE TIME FOR PID1  This parameter (expressed in seconds) is used by the PID control algorithm for implementing the time proportion output associated with relay or SSR as the control output. For the time proportion output, the PID implements the output power by adjusting the ON time of relay/SSR as a % of the Cycle Time. The relay/SSR remains OFF for the rest of the Cycle Time. For example, if the Cycle Time is set to 20.0 seconds and if the output power demand is 10%, the ON and OFF time duration for relay/SSR are computed.	0.5 to 99.5 Seconds (in steps of 0.5 Sec.) (Default : 20.0 Sec. for Relay 1.0 Sec. for SSR)
PROPORTIONAL BAND FOR PID1  This parameter value defines the band within which the control output signal varies proportionally between the maximum (100%) to the minimum (0%) level depending upon the error (difference between the Control Setpoint and Temperature Value). The Proportional Band is expressed in °C. Though this parameter value is automatically set by the self-tune utility, the user can alter the value manually.	1 to 999°C (Default : 10)
INTEGRAL TIME (RESET) FOR PID1  This parameter value, expressed in seconds, is a measure of the time response of the process and defines the time that PID takes to remove the steady state offset errors within the proportional band. Though this parameter value is automatically set by the self-tune utility, the user can alter the value manually. Setting this parameter value to 0 cuts-off the integral action.	0 to 999 Seconds (Default : 100)
DERIVATIVE TIME (RATE) FOR PID1  This parameter value, expressed in seconds, defines how strong the control output level will change in response to the rate of change of measured Temperature value. This, in effect, produces larger proportional and Integral actions should the Temperature value change at a faster rate. Though this parameter value is automatically set by the self-tune utility, the user can alter the value manually. Setting this parameter value to 0 cuts-off the derivative action.	0 to 250 Seconds (Default : 25)

Parameter Description	Settings (Default Value)
VIEW OUTPUT POWER FOR PID2  Same as View Output Power for PID1	Not Applicable (for View Only) (Default : Not Applicable)
CYCLE TIME FOR PID2  Same as Cycle Time for PID1	0.5 to 99.5 Seconds (in steps of 0.5 Sec.) (Default : 20.0 Sec. for Relay 1.0 Sec. for SSR)
PROPORTIONAL BAND FOR PID2  Same as Proporation Band for PID1	1 to 999°C (Default : 10)
INTEGRAL TIME (RESET) FOR PID2  Same as Intergral Time (reset) PID1	0 to 999 Seconds (Default : 100)
DERIVATIVE TIME (RATE) FOR PID2  Same as Derivative Time (rate) for PID1	0 to 250 Seconds (Default : 25)

Section 7
AUXILIARY FUNCTION PARAMETERS

As a standard hardware configuration, the controller is always supplied with additional plug-in modules fitted (Relay/SSR drive) that can be configured as output for Auxiliary function such as Alarm, Auxiliary Control or Blower operation. The parameters presented to the user depend upon the Auxiliary Function selected. The Auxiliary Function parameters for PID1 and PID2 are grouped in PAGE-13 and PAGE-14, respectively, and are listed below in Table 7.1 and Table 7.2, followed by their definitions.

Table 7.1

Parameter Description	Settings (Default Value)
AUXILIARY FUNCTION FOR PID1 AF.1 Select the function / feature for which the Auxiliary output 1 is to be used.	non None ALA Alarm Con Control bLr Blower (Default : None)
ALARM TYPE tYP Select the Alarm activation type.	P.Lo Process Low P.Hi Process High dEv Deviation Band bnd Window Band (Default : Process Low)
ALARM SETPOINT SP *(Available for Process High or Process Low Alarm Type)* Sets Alarm limit independent of control setpoint.	Min. to Max. Range specified for the selected Input Type (Default : 0)
ALARM DEVIATION BAND bnd *(Available for Deviation Band Alarm Type)* Sets positive or negative deviation (offset) limit from control setpoint for High or Low Alarm activation, respectively.	-99 to 999 (Default : 0)
ALARM WINDOW BAND bnd *(Available for Window Band Alarm Type)* Sets symmetrical positive and negative deviation (offset) limits from control setpoint for both High and Low Alarm activation.	3 to 999 (Default : 3)
ALARM LOGIC LOG Select 'Normal' if Alarm is to activate an Audio / Visual alarm. Select 'Reverse' if Alarm is to Trip the system.	nor Normal rEv Reverse (Default : Normal)
ALARM INHIBIT Inh Set to Yes to suppress Alarm activation upon power-up or process start-up.	YES Yes no No (Default : Yes)
AUXILIARY SETPOINT SP Positive (+) or Negative (-) offset to Control Setpoint for defining Auxiliary Setpoint.	(Min. Range - SP) to (Max. Range - SP) for selected Input (Default : 0)

Parameter Description	Settings (Default Value)
CONTROL HYSTERESIS HYS *(Available for On-Off Control)* Sets a differential (dead) band between the ON and OFF states. Keep it large enough to avoid frequent switching of the load without losing the desired control accuracy.	1 to 999 (Default : 2)
CONTROL LOGIC LOG *Normal* The Output remains ON for PV *below* Setpoint and OFF otherwise. *Reverse* The Output remains ON for PV *above* Setpoint and OFF otherwise.	nor Normal rEv Reverse (Default : Normal)
BLOWER SETPOINT SP Positive (+) offset to Control Setpoint (SP) for defining Blower Setpoint.	0 to 250 (Default : 0)
BLOWER HYSTERESIS HYS Sets a differential (dead) band between the blower ON and OFF states.	1 to 250 (Default : 2)

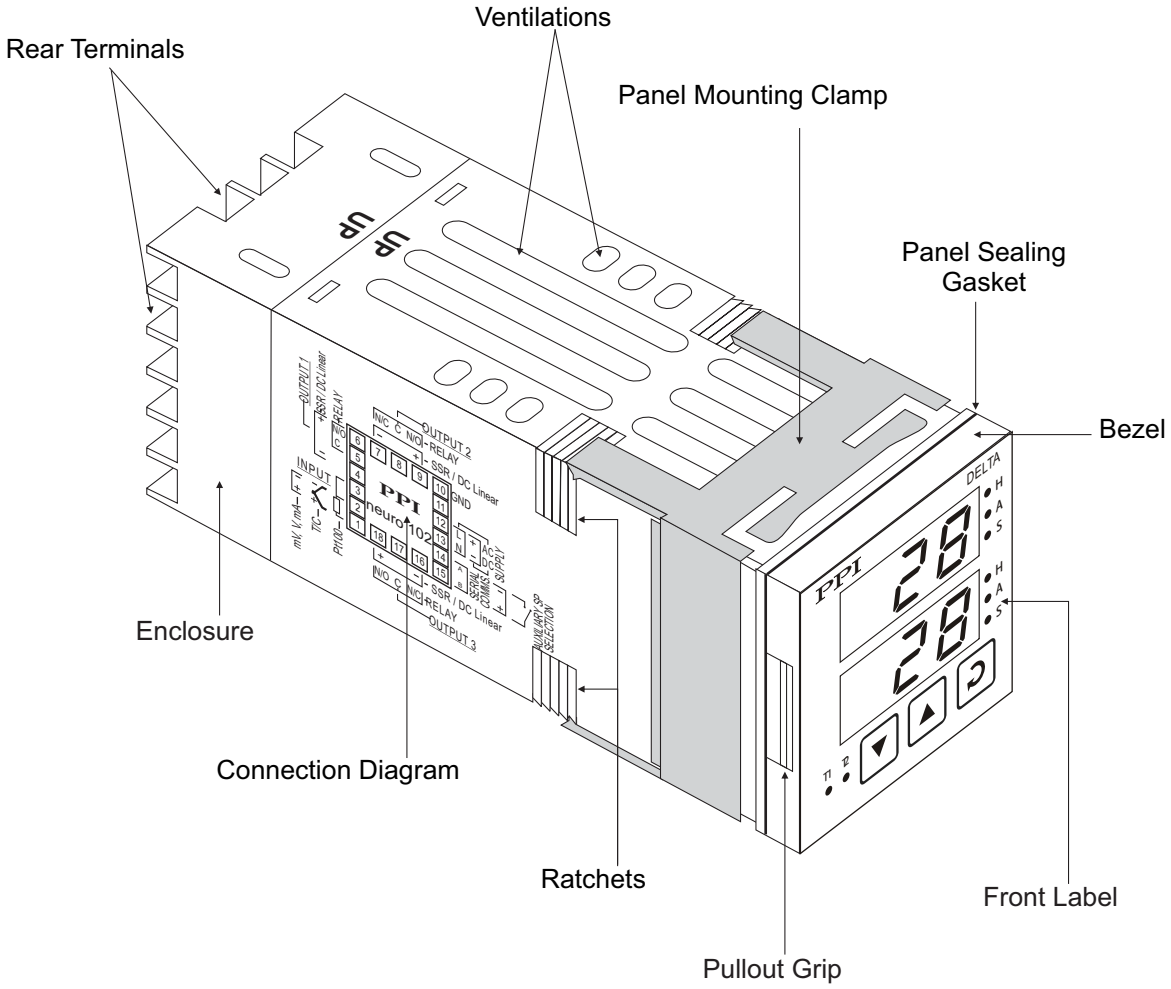
Note :

The Definitions / Descriptions of Auxiliary function parameters for PID2 are same as that described for PID1 but are applied to PID2.

Section 8
HARDWARE ASSEMBLY & CONFIGURATIONS

OUTER CASE

Figure 8.1



The Figure 8.1 above shows the controller outer-case when viewed with controller front label upright. The controller outer case is a rigid plastic Enclosure into which the electronics assembly fits. The Enclosure in turn fits into the standard DIN size panel cutout, as described in *Section 9 : MECHANICAL INSTALLATION*.

Notice the nomenclatures used to identify the various parts as the same are used throughout the sections describing installation, configuration and electrical connections.

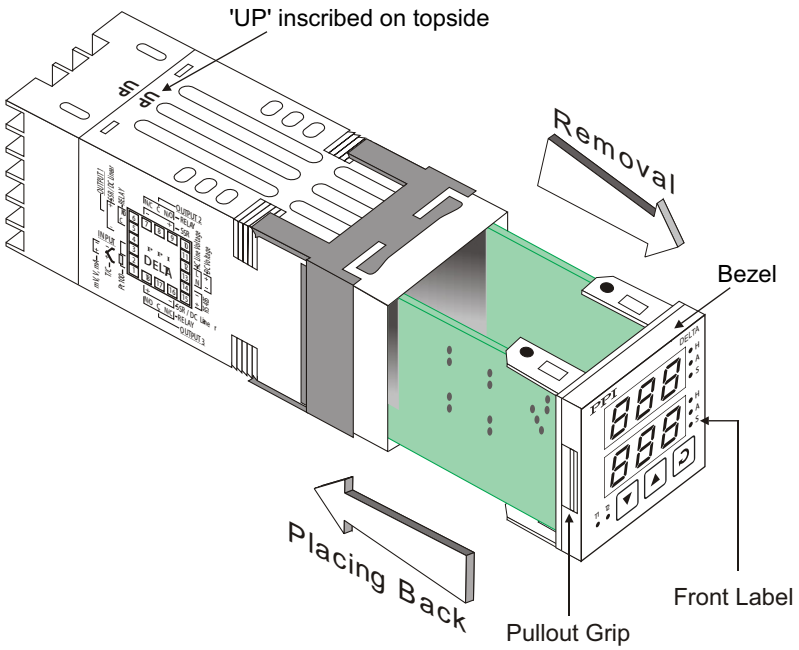
ELECTRONICS ASSEMBLY

The electronics assembly can be removed from the plastic Enclosure and placed back as described below:

Removal

1. Hold the controller with its front label upright.
2. Hold the Bezel with the fingers on the pullout grips provided on the left and right sides of the bezel. Pull the bezel outward. The assembly comes out with the bezel.

Figure 8.2

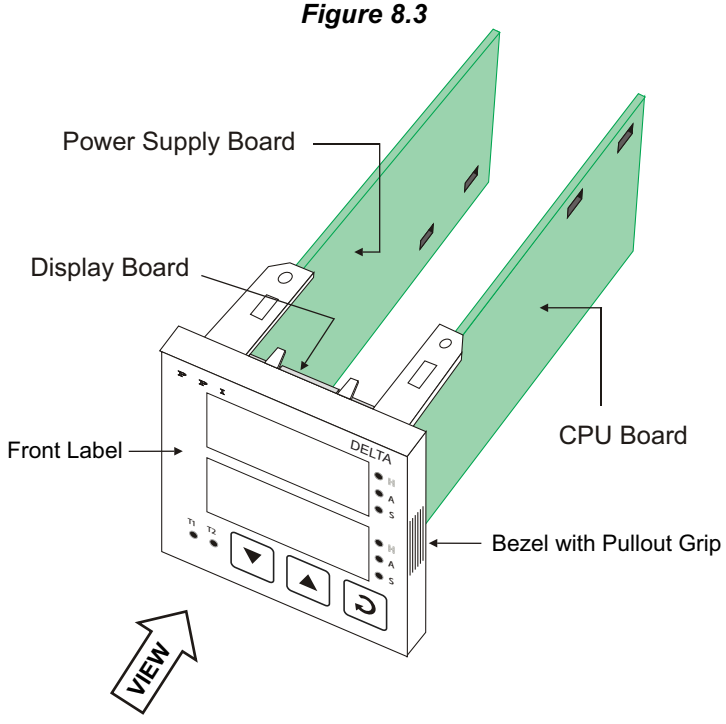


Placing Back

1. Hold the bezel with the front label upright.
2. Hold the Enclosure such that the UP inscribed on the Enclosure is on the topside. Insert the bezel gently with the boards on either side sliding into the guides provided inside of the Enclosure.
3. Ensure that the bezel fits in tight on the Enclosure-front to secure the panel-sealing gasket.

The Figure 8.3 below shows the basic electronics assembly of the controller (without any plug-in modules). The basic electronics assembly of the controller comprises of 3 Printed Circuit Boards. As shown in the figure, when viewed from the front, the CPU board is to the right, Power-supply board is to the left and the Display board is behind the bezel.

Figure 8.3



MOUNTING PLUG-IN MODULES

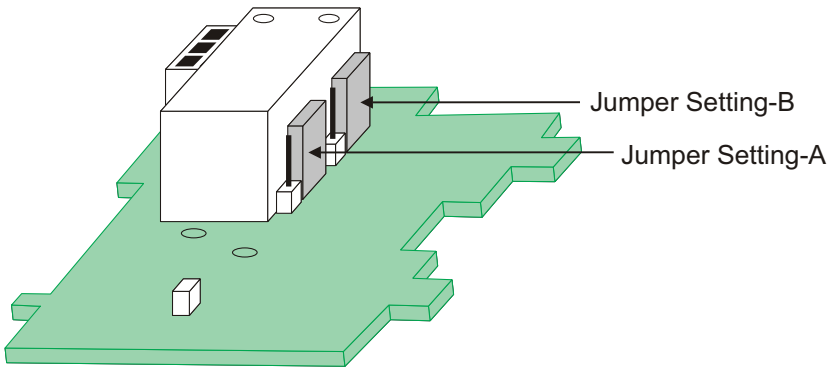
The controller supports up to 3 plug-in modules, viz. Auxiliary Output (Relay/SSR) module for PID1, Auxiliary Output (Relay/SSR) module for PID2 and the Serial Communication module. The Auxiliary Output modules are pre-fitted while the controller is shipped from the factory. The Serial communication module, however, is optional and fitted only if ordered.

All 3 modules have female connector (socket) mounted on them, which fit into the respective male connector (plug) provided on the either CPU board or Power-supply board. The plugs for mounting Auxiliary Output module for PID1 and Serial communication modules are located on the Power-supply board whereas that for Auxiliary Output module for PID2 is located on the CPU board.

Auxiliary Output Modules

The Auxiliary Output modules for PID1 and PID2 are identical and, thus, can be fitted interchangeably in PID1 or PID2 positions. Further, these modules provide jumper settings for the selection of Relay or SSR voltage pulses. The Figure 8.4 below shows the Auxiliary Output module and the jumper arrangement.

Figure 8.4



As shown in Figure 8.4, there are 2 jumper arrangements marked A and B. The selection between Relay and SSR requires both these jumpers A and B to be set appropriately as shown in Table 8.1 below. The double headed arrows show the adjoining Pins that require shorting using the Link.

Table 8.1

Output Type	Jumper Setting - A	Jumper Setting - B
Relay (Arrangement shown in Figure 8.4)		
SSR Voltage Pulses		

Figure 8.5
Mounting Auxiliary Output Module for PID1

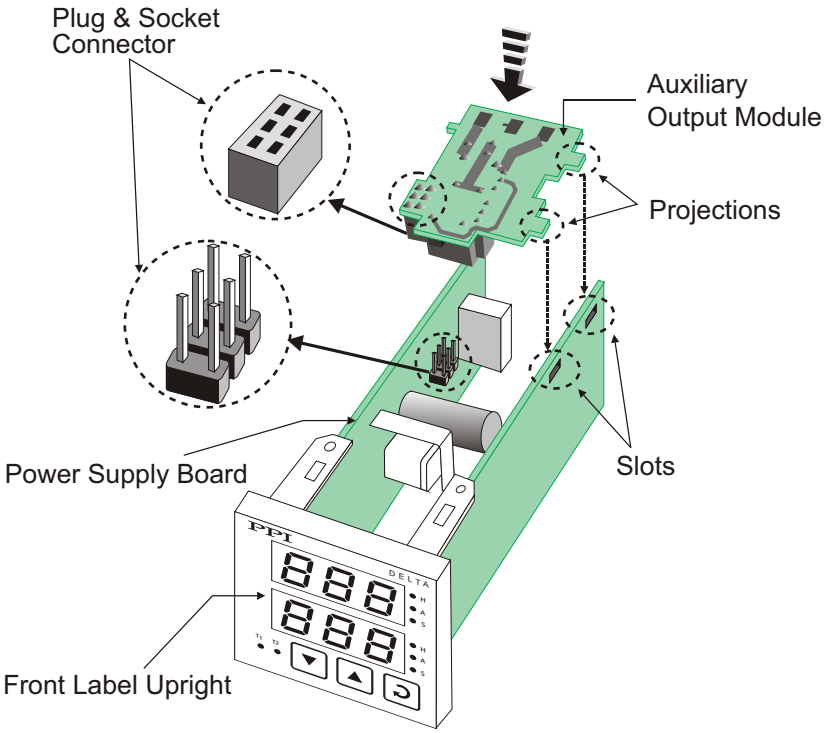
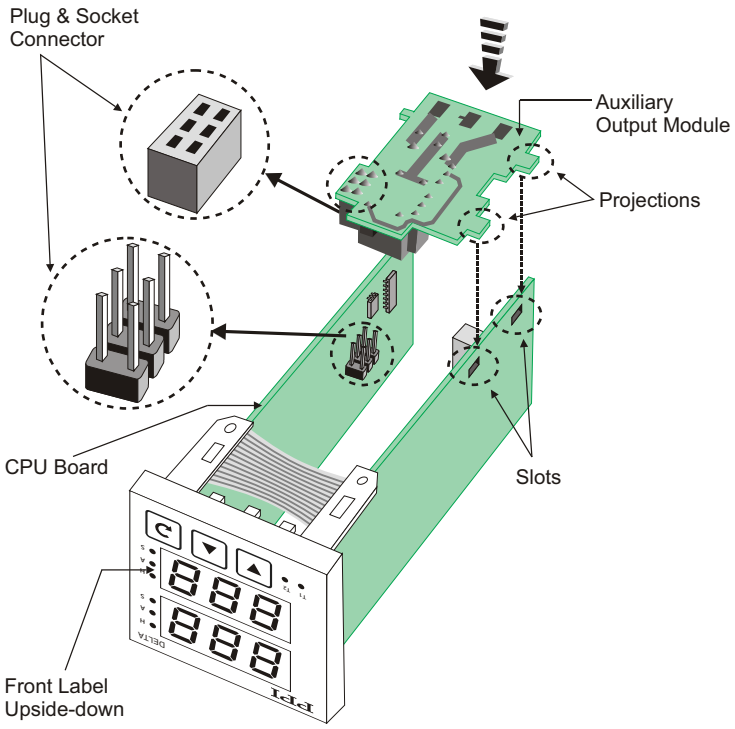


Figure 8.6
Mounting Auxiliary Output Module for PID2



The Figures 8.5 & 8.6 above illustrate how to mount the plug-in Auxiliary Output for PID1 & PID2 module, respectively. Notice the orientation of the controller and a few identifying components shown in figures to help locate the plugs for the modules. Ensure that the socket snap-fits into the plug and the 2 Projections of the module board fit into the 2 Slots provided on the CPU/Power-supply board for proper electrical contacts and secured fitting.

Note :
Notice that the controller is held with front label upside down for mounting the Auxiliary Output for PID2 module.

For plugging out the module(s), follow the steps below:

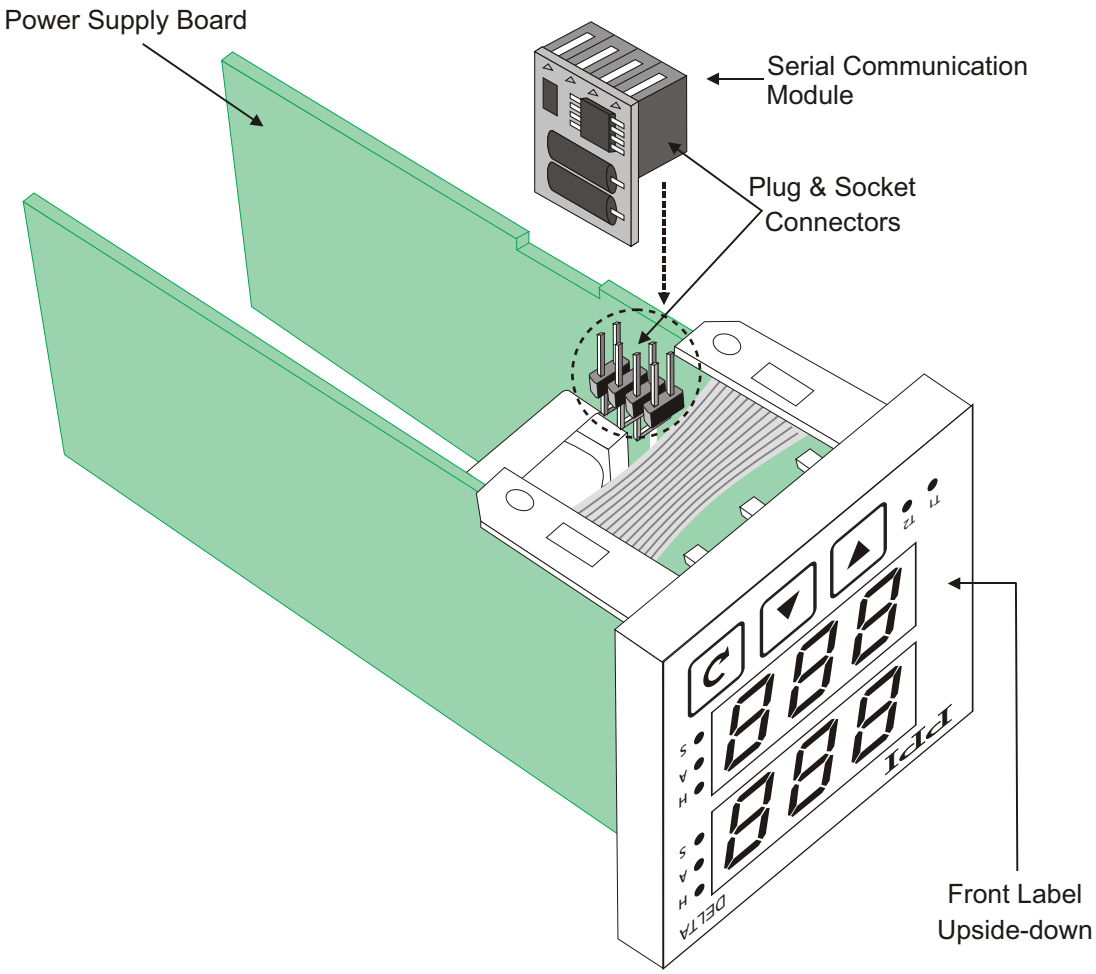
1. Gently pull apart the CPU board and the Power-supply board until the projections of the module board come out of the slots.
2. Pull the module outward to unlock the socket from the plug.

Serial Communication Module

The plug for the serial communication module is located on the Power supply board. The Figure 8.7 below illustrates how to plug-in the serial communication module. To plug (or unplug) the module simply insert (or remove) the socket into (or from) the plug.

Figure 8.7

Mounting Serial Communication Module



Section 9

MECHANICAL INSTALLATION

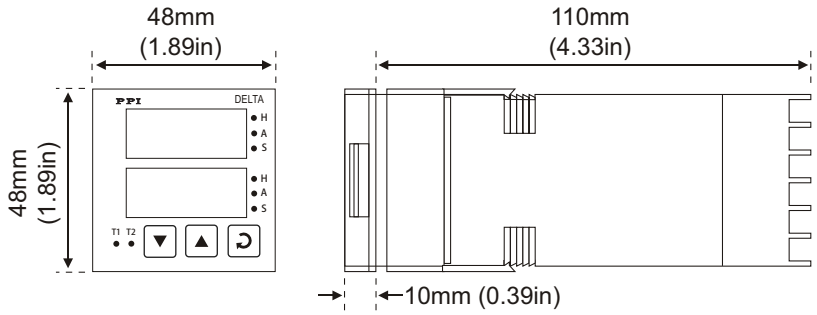
The following precautions should be strictly observed while installing the controller:

1. The place of installation should be free of corrosive / combustible gases and electrically conductive pollution.
2. Ensure that the place of installation is not subject to rapid ambient changes that can cause condensation. Also, the Ambient Temperature (0 to 55°C) and Relative Humidity (5 to 90%) surrounding the controller should not exceed the maximum specified for the proper operation of the controller.
3. The place of installation should be adequately protected against excessive electrostatic or electromagnetic interference.
4. The controller should not be subject to direct vibration or shock.
5. The controller should not be exposed to dust, salt air, direct sunlight or radiant heat.

OUTER DIMENSIONS

The Figure 9.1 shows the outer dimensions of the controller.

Figure 9.1



PANEL CUTOUT AND RECOMMENDED MINIMUM SPACING

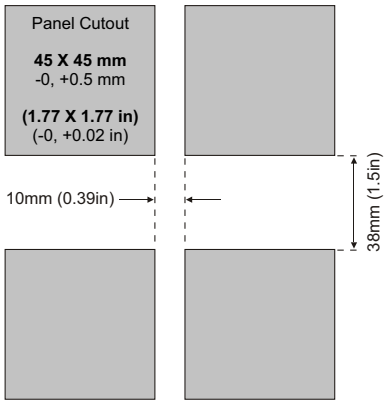
The Figure 9.2 shows the panel cutout requirements for a single controller and also the minimum spacing recommended if several controllers are required to be mounted on a single panel.

PANEL MOUNTING

Follow the steps below for mounting the controller on panel:

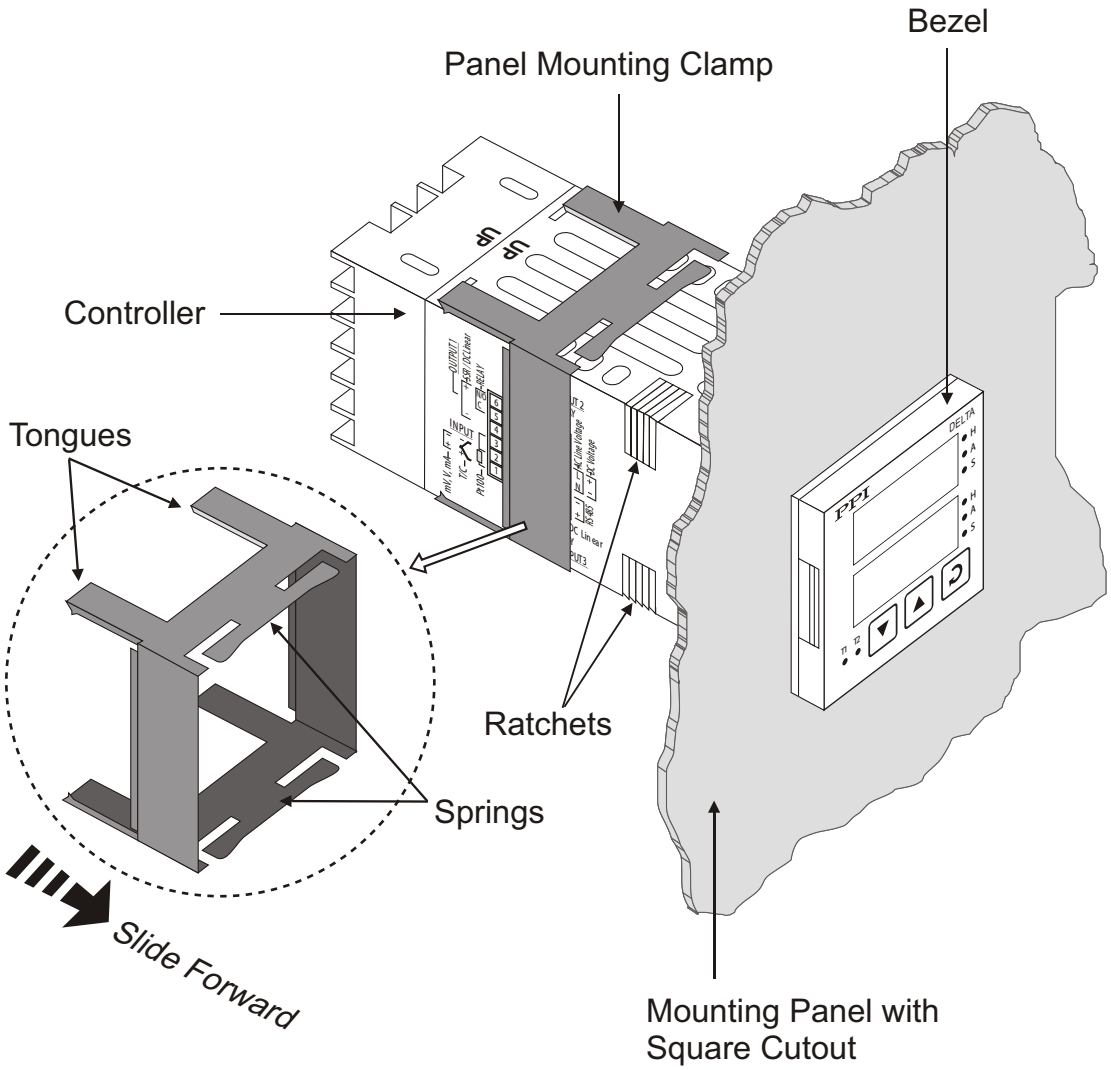
1. Prepare a square cutout to the size shown in Figure 9.2.
2. Remove the Panel Mounting Clamp from the controller Enclosure.

Figure 9.2



3. Insert the rear of the controller housing through the panel cutout from the front of the mounting panel.
4. Hold the controller gently against the mounting panel such that it positions squarely against the panel wall, see Figure 9.3. Apply pressure only on the bezel and not on the front label.
5. Slide the mounting clamp forward until it is firmly in contact with the rear face of the mounting panel and the tongues of the clamp engage in the ratchets on the controller enclosure. Ensure that the springs of the clamp push firmly against the rear face of the mounting panel for secured mounting.

Figure 9.3



Section 10

ELECTRICAL CONNECTIONS

WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

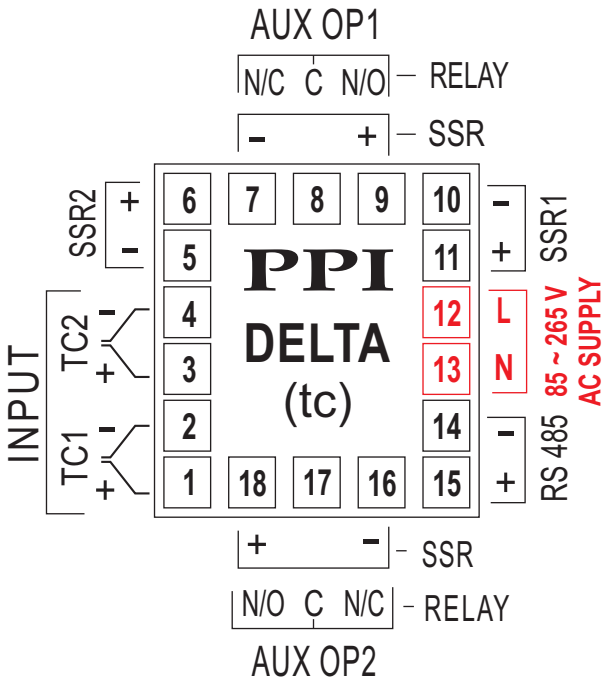
1. The user must rigidly observe the Local Electrical Regulations.
2. Do not make any connections to the unused terminals for making a tie-point for other wires (or for any other reasons) as they may have some internal connections. Failing to observe this may result in permanent damage to the controller.
3. Run power supply cables separated from the Thermocouple cables. If the cables are run through conduits, use separate conduits for power supply cable and Thermocouple cables.
4. Use appropriate fuses and switches, wherever necessary, for driving the high voltage loads to protect the controller from any possible damage due to high voltage surges of extended duration or short-circuits on loads.
5. Take care not to over-tighten the terminal screws while making connections.
6. Make sure that the controller supply is switched-off while making / removing any connections or removing the controller from its enclosure.

CONNECTION DIAGRAM

The Electrical Connection Diagram is shown on the left side of the controller enclosure. The diagram shows the terminals viewed from the REAR SIDE with the controller label upright. Note that the RS-485 connections are applicable only if the respective plug-in module is fitted. Also the DC SUPPLY is applicable only if the controller is supplied with 20 to 50 VDC supply voltage option.

The rear panel electrical wiring connection diagram is shown in Figure 10.1 below.

Figure 10.1



DESCRIPTIONS

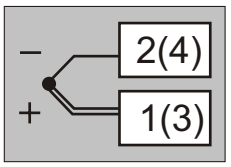
The back panel connections are described as under:

INPUT (Terminals 1 and 2 for PID1, Terminals 3 and 4 for PID2)

The controller accepts thermocouples (J or K) as input. The types and ranges are described in *Section 4 : Installation Parameters.*

Connect the PID1 Thermocouple positive (+) to terminal 1 and Negative (-) to terminal 2. Similarly, connect PID2 Thermocouple positive (+) to terminal 3 and Negative (-) to terminal 4, as shown in Figure 10.2. The correct type of Thermocouple extension lead wires or compensating cable must be used for the entire distance between the controller and the Thermocouples, ensuring that the correct polarity is maintained throughout. Joints in the cable should be avoided.

Figure 10.2



Note:
The numbers in brackets indicate the terminal numbers for PID 2

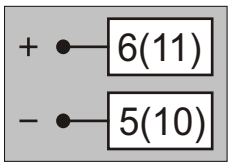
CONTROL OUTPUT (Terminals 5 and 6 for PID1, Terminals 10 and 11 for PID 2)

The Control Output is always provided with fixed built-in DC voltage pulses (for driving either external Relay or SSR module) as Control Output signals. Note that, there is no provision for built-in Relay for Control Output due to size constraints. However, if the Auxiliary Function is set to non (None), the Relay of Auxiliary Output module can be used for Control Output. The required output type has to be selected via front panel keys. The Terminals for SSR voltage output are shown in the Figures 10.3.

Drive for SSR

Figure 10.3

DC Voltage level is generated for switching the external SSR (Solid State Relay) which in turn switches the load. Connect (-) and (+) terminals of PID1 SSR to terminals 5 and 6, respectively. Similarly, connect (-) and (+) terminals of PID 2 SSR to terminals 10 and 11, respectively. Use Zero-Crossover, 3 to 30 VDC operated SSR, rated approximately 1.5 times the actual load rating. Use appropriate Heat Sink for mounting the SSR for load rating exceeding 10A.



Note:
The numbers in brackets indicate the terminal numbers for PID2

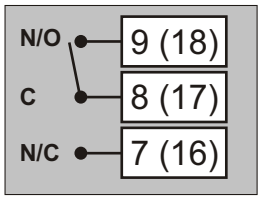
AUXILIARY OUTPUT (Terminals 7, 8 and 9 for PID1, Terminals 16, 17, 18 for PID2)

The Auxiliary Output can be configured as either Relay or DC Voltage pulses for driving SSR. The configuration is through hardware jumper setting on the module as described in *Section 8: Hardware Assembly and Configurations*. The terminals for Relay or SSR voltage output are shown in Figure 10. 4 (a), 10.4 (b), respectively.

Relay

Figure 10.4 (a)

Potential-free relay changeover contacts, N/O (Normally Open), C (Common) and N/C (Normally Close); rated 2A/240 VAC, 2A/30 VDC (resistive load) are provided as relay output. As already mentioned, these relay changeover contacts can also be used for Control Output by selecting through front panel keys if the Auxiliary Function is selected to non (None).



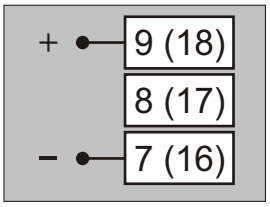
Relay Connections

Drive for SSR

DC Voltage level is generated for switching the external SSR (Solid State Relay) which in turn switches the load. Connect (+) and (-) terminals of SSR to controller terminals marked (+) and (-), respectively.

Note:
The numbers in brackets indicate the terminal numbers for PID 2

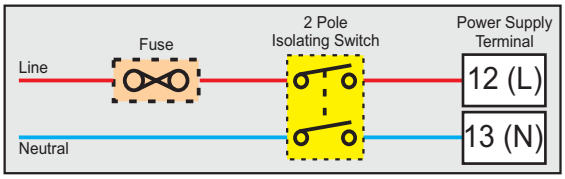
Figure 10.4 (b)



SSR Connections

POWER SUPPLY (Terminals 12 and 13)

Figure 10.5



As standard, the controller is supplied with power connections suited for 85 to 264 VAC line supply. Use well-insulated copper conductor wire of the size not smaller than 0.5 mm² for power supply connections. Connect Line (phase) supply line to terminal 12 and the Neutral (Return) supply line to terminal 13. The controller is not provided with fuse and power switch. If necessary, mount them separately. Use a time lag fuse rated 1A @ 240 VAC as shown in Figure 10.5 above.

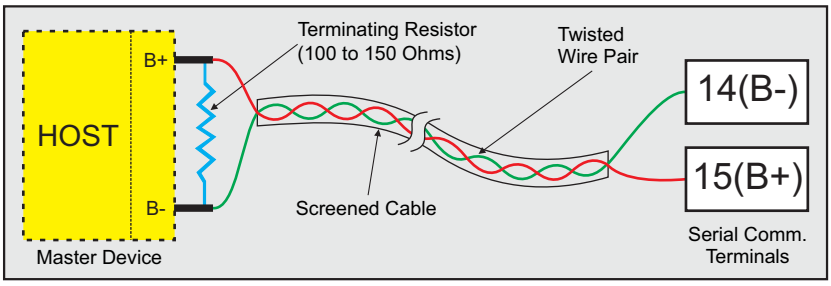
For DC Supply connect Signal & Common to controller terminals 12 & 13, respectively

RS 485 SERIAL COMMUNICATION (Terminals 14 and 15)

If optional plug-in communication board is fitted, connect terminal 15 and 14 of the controller to (+) and negative (-) terminals of the master device.

To ensure reliable operation of the RS485 Serial Communication Link (without data corruption due to line noise or reflections), use a pair of twisted wires inside screened cable with the terminating resistor (100 to 150 Ohms) at one end, as shown in Figure 10.6 below.

Figure 10.6

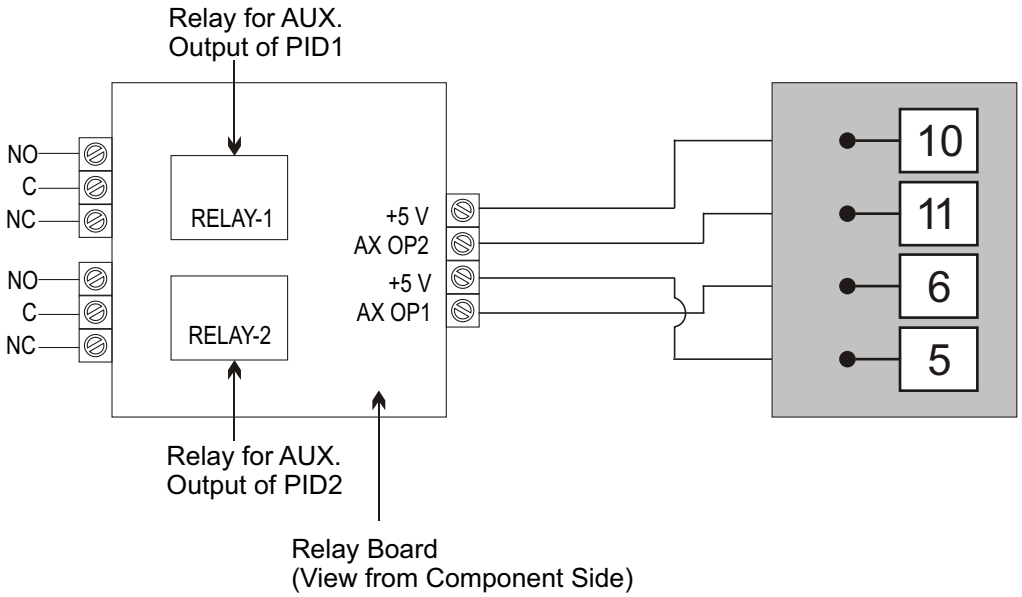


WIRING CONNECTION FOR RELAY BOARD

In case, the Auxiliary Outputs for PID1 and/or PID2 are used for Auxiliary Function (Alarm, Auxiliary Control or Blower) and also the heaters for PID1 and/or PID2 are to be driven through potential-free contacts of relay, PPI offers optional Relay Board (Part No. 04247- 2SHRLY-RV1) that can be driven using the SSR1 (for PID1) and SSR2 (for PID2) outputs.

The figure 10.7 below shows the wiring connection diagram for Relay Board.

Figure 10.7



As mentioned earlier, if the Auxiliary Function is selected for one of the Alarm, Auxiliary Control or Blower operation for PID1 and/or PID2, the parameter 'Output Type' of the respective PID is PAGE 10 is not available for setting and the PID control signal is then available on SSR output terminals only.

PPI
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