HumiTherm-c

PPI
The Perfection Experts

Composite 'Temperature + Humidity' Self Tune PID Controller

Version : Dry-Bulb RTD Pt100, 3-wire
Wet-Bulb RTD Pt100, 3-wire

Version : RTD Pt100, 3-wire for Temperature
DC Linear (Voltage) for Humidity

(PID)

User Manual

CONTENTS

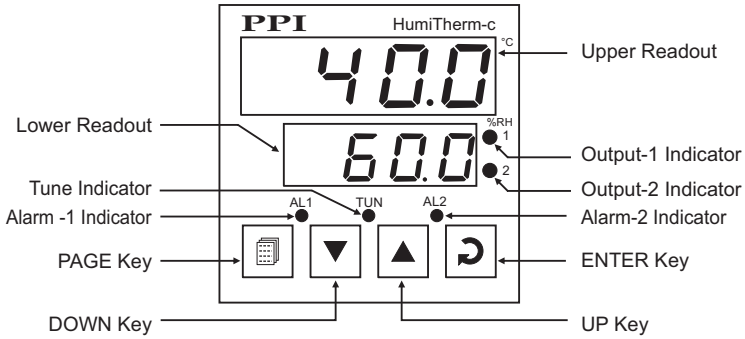
For Dry-Wet

For Temp+RH

Section 1
FRONT PANEL LAYOUT

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

Figure 1.1



READOUTS

The Upper Readout is a 4 digit, 7-segment bright red LED display and usually displays the Dry Bulb Temperature Value in °C. In Program Mode, the Upper Readout displays parameter values.

The Lower Readout is a 4 digit, 7-segment bright green LED display and usually displays Relative Humidity (RH) Value in %. Upon keeping the UP or DOWN key pressed, the Lower Readout displays Wet Bulb Temperature Value in °C. In Program Mode, the Lower Readout displays prompts for the parameters.

The indications on the Upper and Lower Readouts, in general, depend on the mode of operation and parameters configuration. Refer respective sections for more details.

INDICATORS

There are 5 front panel red LED indicators that show various status. The Table 1.1 below lists each LED indicator (identified by the front panel legend) and the associated status it indicates.

Table 1.1

Indicator	Function
1	Indicates Output-1 (Temperature) control ON/OFF status. • Glows if the Heater Output is ON. • Remains OFF if the Heater Output is OFF.
2	Indicates Output-2 (RH) control ON/OFF status. • Glows if the Humidification Output is ON. • Remains OFF if the Humidification Output is OFF.
AL1	Indicates Alarm-1 (Alarm for Temperature Loop) status. • Flashes while the Alarm for Temperature Loop is active. • Remains OFF while the Alarm for Temperature Loop is inactive.
AL2	Indicates Alarm-2 (Alarm for RH Loop) status. • Flashes while the Alarm for RH Loop is active. • Remains OFF while the Alarm for RH Loop is inactive.
TUN	Indicates Tuning or Compressor ON/OFF status. • Flashes while the controller is executing the Tuning operation. • Glows continuously while the Compressor is ON. • Remains OFF, if not executing the Tuning operation or Compressor is OFF.

KEYS

There are four tactile keys provided on the front panel for configuring the controller and setting-up the parameter values. The Table 1.2 below lists each key (identified by the front panel symbol) and the associated function.

Table 1.2

Symbol	Key	Function
	PAGE	Press to enter or exit set-up mode.
	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.

Section 2
BASIC OPERATIONS

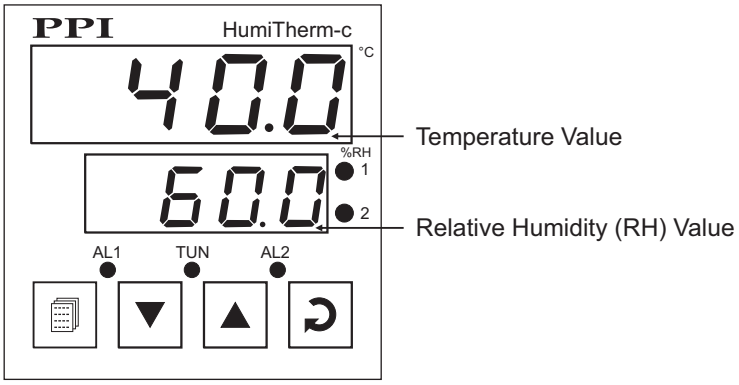
POWER-UP

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 HUmc on the Upper Readout and the firmware version u.01.2 on the Lower Readout, for approximately 1 second.

MAIN DISPLAY MODE

After the Power-up display sequence, the Upper and Lower Readouts start showing the measured Temperature Value in °C and the Relative Humidity in %RH, respectively. (The Lower Readout indication may not indicate %RH value if the controller is configured to operate in 'Temperature Only' mode.) This is 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 below.

Figure 2.1



Upon keeping the UP or DOWN key pressed, the Lower Readout shows the Wet Bulb Temperature in °C.

SETPOINT ADJUSTMENTS

(Refer "Section 3 : Pages & Parameters" for details on Set-up Mode)

For ease of operation, the Temperature and Relative Humidity (% RH) Setpoints (SP) are provided on PAGE-0. The Setpoints can be adjusted if permitted at supervisory level (PAGE-12). Step through the following sequence to adjust the SP value:

1. Press PAGE key while the controller is in MAIN Display Mode. The Lower Readout shows PAGE (PAGE) and the Upper Readout shows 0.
2. Press ENTER key. The Lower Readout shows the prompt for the Temperature Setpoint, °C.SP (°C.SP), and the Upper Readout shows the current setpoint value.
3. Use UP/DOWN keys to adjust the Temperature SP value.
4. Press and release ENTER key. The set value for Temperature Setpoint is registered and stored in the controller's non-volatile memory. The Lower Readout shows the prompt for the %RH Setpoint, rh.SP (rh.SP), and the Upper Readout shows the current setpoint value.
5. Use UP/DOWN keys to adjust the %RH SP value.
6. Press and release ENTER key. The set value for RH Setpoint is registered and stored in the controller's non-volatile memory.
7. Press PAGE key to revert to MAIN Display Mode.

TEMPERATURE-ONLY MODE

The controller can be configured to operate in Temperature-only mode by setting the %RH SP value to 0. In this mode, the controller controls only the Dry Bulb Temperature at the set value through Heater Control Output-1. The %RH Control Output-2 is kept off. The Lower Readout in this case can be selected to either display the %RH value (If Wt Bulb RTD sensor is connected) or the Temperature Unit °C. The parameter L.ind (Lower Readout Indication) can be set to rH (% R H indication) or Unit (°C Indication). This selection is available only if %RH SP value is set to 0.

TUNE INDICATION

Upon issuing TUNE command, the controller starts tuning itself to the process under control. While the controller is executing Tuning operation, the front panel indicator TUN flashes. The user is advised not to disturb the process or alter any parameter values while the tuning is in progress. The TUN indicator automatically turns OFF upon completion of Tuning Procedure. The controller reverts to the MAIN Display Mode and starts maintaining the Temperature and RH values (PV) at their respective Setpoints.

PV ERROR INDICATIONS

The controller indicates the PV error messages for both Temperature and RH Values on Upper and Lower Readout, respectively, in the following conditions.

Error Indication for Dry Bulb Temperature (Upper Readout)

Figure 2.2

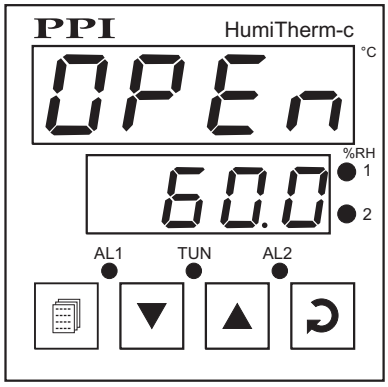


Table 2.1

Message	PV Error Type
Or	Over-range (Dry-Bulb Temp. above Max. Range)
Ur	Under-range (Dry-Bulb Temp. below Min. Range)
OPEn	Open (Sensor open / broken)

Error Indication for Relative Humidity (RH) (Lower Readout)

Figure 2.3

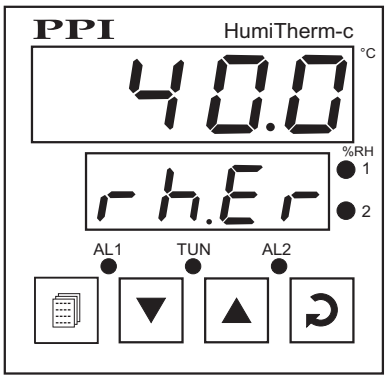


Table 2.2

Message	PV Error Type
Or	Over-range (Wet-Bulb Temp. above Max. Range)
Ur	Under-range (Wet-Bulb Temp. below Min. Range)
OPEn	Open (Sensor open / broken)
rh.Er	Either Dry Bulb Temp. is below -20.0°C or above 162.0°C. The error may also occur if Wet Bulb depression is more then 60.0°C.

Section 3
PAGES AND PARAMETERS

ORGANIZATION

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

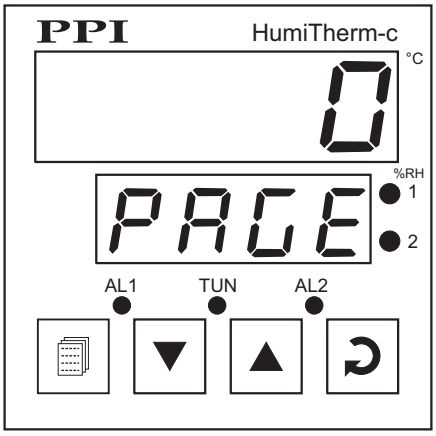
The parameters are always presented in a fixed format: The Lower Readout displays the parameter prompt (Identification Tag) and the Upper Readout displays the set value. The parameters appear in the same sequence as listed in their respective sections.

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.

PROGRAM MODE

The Program Mode allows the user to view or modify the parameter values. The entry from MAIN Display Mode to Program 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. Press and release PAGE key. The Lower Readout shows PAGE and the Upper Readout shows 0. See Figure 3.1.
2. Adjust the Upper Readout to the desired PAGE NUMBER using the UP/DOWN keys.
3. 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 reverts to the MAIN Display Mode.

Adjusting Parameter Values

Once a 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 desired parameter appears on the Lower Readout. The last parameter in the list rolls back to the first parameter.
2. Use UP / DOWN keys to adjust the parameter value.

   Note that some parameters (examples; ‘Alarm Band’, ‘Proportional Band’, ‘Zero Offset for PV’ etc.) have numeric values while others (examples; ‘Output-3 Function Selection’, ‘Compressor Control Strategy’, 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. Press and release the 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 'OP3 Function Selection'.

Figure 3.2

To exit the Program Mode and return to the MAIN Display Mode, press and release PAGE key.

Notes:
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.

PARAMETER LOCKING

Though access to any PAGE is always permitted, the adjustment of the parameter values, however, can be Locked at the supervisory level. If the Lock is enabled, the parameter values on each PAGE can only be viewed but can not be adjusted. This feature facilitates protecting the parameter values from unauthorized tampering or accidental alterations by the operator.

The controller is shipped from the factory in Unlocked condition. The Lock can be enabled once the initial configuration / installation is done.

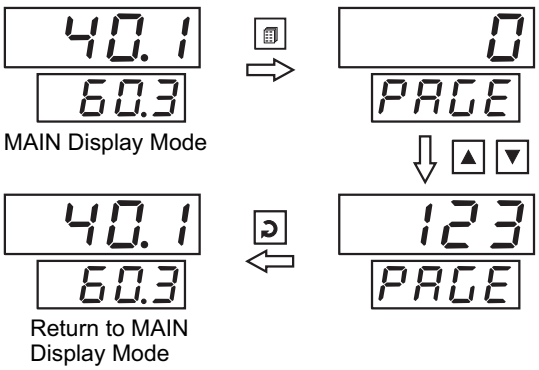
For enabling / disabling the Lock, step through the following sequence:

Locking

1. Press and release PAGE key while the controller is in the MAIN Display Mode. The Lower Readout shows PAGE and the Upper Readout shows 0.
2. Adjust the Upper Readout to the value 123 using UP/DOWN keys.
3. Press and release ENTER key. The controller returns to the MAIN Display Mode with the Lock enabled.

The Figure 3.3 below illustrates the Locking procedure.

Figure 3.3



Unlocking

1. Press and release PAGE key while the controller is in the MAIN Display Mode. The Lower Readout shows PAGE and the Upper Readout shows 0.
2. Adjust the Upper Readout to the value 123 using UP/DOWN keys.
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 Mode with the Lock disabled (Unlocked).

SETTING DEFAULT VALUES

The controller is shipped from the factory with all the parameters set to their default factory set values. If desired, all the parameters can be reset to default values by following the steps below.

1. Ensure that the controller is Unlocked for parameter adjustments.
2. Press and release PAGE key while the controller is in the MAIN Display Mode. The Lower Readout shows PAGE and the Upper Readout shows 0.
3. Adjust the Upper Readout to the numeric value 99 using UP/DOWN keys.
4. Press and release 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
TEMPERATURE PARAMETERS

The PAGE-10 lists Alarm and Control related parameters for Dry-Bulb Temperature. The Table 4.1 below describes each parameter.

Table 4.1

Parameter Description	Settings (Default Value)
ALARM-1 BAND  Sets symmetrical positive and negative deviation (offset) limits from Temperature control setpoint for both High and Low Alarm-1 activation. Example: If Band = 0.5°C, then High Alarm Limit = Setpoint + 0.5°C Low Alarm Limit = Setpoint - 0.5°C	0.3 to 25.0°C (Default : 0.5)
ALARM-1 HYSTERESIS  Sets differential (dead) band between ON and OFF states of Alarm-1.	0.2 to 10.0°C (Default : 0.2)
PROPORTIONAL BAND  Sets proportional gain (% power per unit error) for temperature control loop. Defined in same units and resolution as that for PV.	0.1 to 999.9°C (Default : 5.0)
INTEGRAL TIME  Sets integral time constant in seconds for temperature control loop. Setting the value to 0, cuts-off the integral action.	0 to 1000 Seconds (Default : 100)
DERIVATIVE TIME  Sets derivative time constant in seconds for temperature control loop. Setting the value to 0, cuts-off the derivative action.	0 to 250 Seconds (Default : 25)
CYCLE TIME  Sets the total 'On + Off' time in seconds for time proportional power output for temperature control loop through Output-1.	0.5 to 25.0 Seconds (in steps of 0.5 secs.) (Default : 1.0)

Section 5
RELATIVE HUMIDITY (% RH) PARAMETERS

The PAGE-11 lists Alarm and Control related parameters for %RH (Wet-Bulb). The Table 5.1 below describes each parameter.

Table 5.1

Parameter Description	Settings (Default Value)
ALARM-2 BAND rhAb Sets symmetrical positive and negative deviation (offset) limits from %RH control setpoint for both High and Low Alarm-2 activation. Example: If Band = 2.0 % RH, then High Alarm Limit = SP + 2.0 % RH Low Alarm Limit = SP - 2.0 % RH	0.3 to 25.0% (Default : 2.0)
ALARM-2 HYSTERESIS rhAH Sets differential (dead) band between ON and OFF states of Alarm-1.	0.2 to 10.0% (Default : 2.0)
PROPORTIONAL BAND rhPb Sets proportional gain (% power per unit error) for %RH control loop. Defined in same units and resolution as that for PV.	0.1 to 999.9% (Default : 10.0)
INTEGRAL TIME rh.It Sets integral time constant in seconds for %RH control loop. Setting the value to 0, cuts-off the integral action.	0 to 1000 Seconds (Default : 100)
DERIVATIVE TIME rhdt Sets derivative time constant in seconds for %RH control loop. Setting the value to 0, cuts-off the derivative action.	0 to 250 Seconds (Default : 25)
CYCLE TIME rhCt Sets the total 'On + Off' time in seconds for time proportional power output for %RH control loop through Output-2.	0.5 to 25.0 Seconds (in steps of 0.5 secs.) (Default : 1.0)

Section 6
SUPERVISORY PARAMETERS

The Supervisory Parameters provided on PAGE-12 facilitate supervisory control over the operator level. The Table 6.1 below describes each parameter.

Table 6.1

Parameter Description	Settings (Default Value)
SP ADJUSTMENT ON PAGE-0 SP Supervisory permission for Temperature and %RH setpoint editing on Operator Page (PAGE-0). Set to Enable for permission.	EnbL Enable dSbL Disable (Default : Enable)
SELF-TUNE COMMAND tUnE Set to 'Yes' to initiate a new tuning cycle or set to 'No' to abort a tuning operation in progress.	no No YES Yes (Default : No)
BAUD RATE bAUd Communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	1200 2400 4800 9600 (Default : 4800)
ID FOR TEMPERATURE LOOP db.Id Communication ID used by host for temperature value.	1 to 8 (Default : 1)
ID FOR %RH LOOP rh.Id Communication ID used by host for %RH value.	1 to 8 (Default : 2)

Section 7
OP3 FUNCTION PARAMETERS

The OP3 Function Parameters presented on PAGE-13 allow the user to configure the Output-3 (OP3) Function as Alarm or Compressor Control. The Table 7.1 below describes each parameter.

Table 7.1

Parameter Description	Settings (Default Value)
OUTPUT-3 FUNCTION SELECTION OP3.F Select the function / feature to which the OP3 module is to be logically attached for activation.	AL Alarm CP Compressor (Default : Alarm)
COMPRESSOR SETPOINT CP.SP *(Available only if OP3 function is selected as Compressor)* The setpoint value with which either the Dry Bulb (temperature) SP or PV is compared for the purpose of switching the compressor On / Off. Refer ***section-8*** for details.	0.0 to 50.0°C ***or*** 0.0 to 25.0°C (Default : 45.0 ***or*** 0.2)
COMPRESSOR HYSTERESIS CP.HY *(Available only if 'Compressor Control Strategy' is set to 'Dry Bulb PV'.)* Sets differential (dead) band between Compressor switching ON and OFF states. Refer ***section-8*** for details.	0.1 to 25.0°C (Default : 0.2)
COMPRESSOR TIME DELAY t.dLY *(Available if OP3 function is Compressor)* The Time Delay that must elapse before the compressor is switched ON from OFF state Setting to 0 cuts-off the time delay function.	0.00 to 10.00 Min. Sec (in steps of 5 Seconds) (Default : 00.00)

Section 8
UTILITY PARAMETERS

The Utility Parameters are grouped on PAGE-33 and allow the user to set the Compressor Control Strategy and the Zero-Offset values for Temperature and the Relative Humidity (RH) values. The Table 8.1 below describes each parameter.

Table 8.1

Parameter Description	Settings (Default Value)
COMPRESSOR CONTROL STRATEGY CP.St Refer detailed description below.	db.SP Dry Bulb SP db.Pu Dry Bulb PV (Default : Dry Bulb SP)
ZERO OFFSET FOR DRY-BULB TEMPERATURE VALUE db.oF This value is algebraically added to the measured Dry-Bulb Temperature value to derive the final PV that is displayed and compared for alarm / control.	-25.0 to +25.0°C (Default : 0.0)
ZERO OFFSET FOR WET BULB TEMPERATURE VALUE ub.oF This value is algebraically added to the measured Wet-Bulb Temperature value to derive the final PV that is used to compute the % RH Value.	-25.0 to +25.0°C (Default : 0.0)
ZERO OFFSET FOR RH VALUE rh.OF This value is algebraically added to the measured %RH value to derive the final PV that is displayed and compared for alarm / control.	-25.0 to +25.0% (Default : 0.0)

Compressor Control Strategy

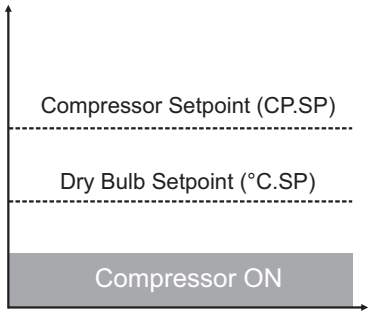
The controller offers two different control algorithms for switching the compressor through Output 3 (OP3) Relay / SSR module using the parameter 'Compressor Control Strategy'. The two strategies are explained below. Note that either strategy operates (switches ON/OFF) the OP3 only if the parameter 'OP3 Function' on PAGE-13 is set to 'Compressor' and the 'Compressor Operation Mode (CP.OP)' parameter on PAGE-1 is set to 'Auto'.

1. Dry Bulb SP Strategy

In this strategy, the controller provides two user settable parameters, viz. *Compressor Setpoint* (CP.SP) & *Time Delay* (t.dLY) in PAGE 13 parameter list.

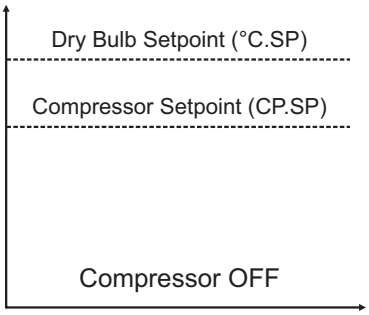
The Compressor ON or OFF state is determined based on the relative position of the Dry Bulb SP (Temperature Setpoint) with respect to the *Compressor Setpoint.* If the Dry Bulb SP is below the Compressor Setpoint, the compressor remains ON and if the Dry Bulb SP is equal or above the Compressor Setpoint, the compressor remains OFF. The following Figures 8.1 and 8.2 illustrate the compressor ON and compressor OFF operation respectively.

Figure 8.1



Dry Bulb SP < Compressor SP
➡ Compressor ON

Figure 8.2



Dry Bulb SP ≥ Compressor SP
➡ Compressor OFF

This strategy eliminates the dependency on the user for switching off the compressor (for saving valuable electrical energy) when not required. The Compressor Setpoint for this parameter value is usually set to the maximum expected Ambient Temperature. It is usually not required to switch-on compressor if the desired Temperature is significantly above the Ambient Temperature and thus a considerable energy saving can be achieved by keeping the compressor OFF.

2. *Dry Bulb PV Strategy*

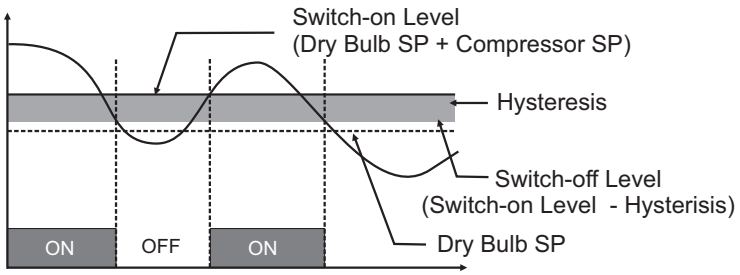
In this strategy, the controller provides three user settable parameters, viz. Compressor Setpoint (CP.SP), Hysteresis (CP.HY) & Time Delay (t.dLY) in PAGE 13 parameter list. The Compressor ON or OFF state is determined by comparing the Dry Bulb PV with the Compressor Switch-on Level and the Compressor Switch-off Level. The Compressor Switch-on and Switch-off levels are determined using Dry Bulb SP (db.SP), Compressor Setpoint (CP.SP) and Hysteresis (CP.HY), as below.

Switch-on Level = Dry Bulb SP (db.SP) + Compressor SP (CP.SP)

Switch-off Level = Switch-on Level - Hysteresis (CP.HY)

The Hysteresis introduces a dead-band between the Compressor Switch-on Level and Switch-off Level. The following Figure 8.3 illustrates the compressor ON-OFF operation.

Figure 8.3



Examples

1) For Dry Bulb SP = 20.0°C, Compressor SP = 1.0°C & Hysteresis = 1.2°C;
Switch-on Level = Dry Bulb SP + Compressor SP = 20.0 + 1.0 = 21.0°C
Switch-off Level = Switch-on Level - Hysteresis = 21.0 - 1.2 = 19.8°C.

2) For Dry Bulb SP = 20.0°C, Compressor SP = 1.0°C & Hysteresis = 0.8°C;
Switch-on Level = Dry Bulb SP + Compressor SP = 20.0 + 1.0 = 21.0°C
Switch-off Level = Switch-on Level - Hysteresis = 21.0 - 0.8 = 20.2°C.

Section 9
COMPRESSOR OPERATION & POWER INDICATION

The PAGE-1 allows the operator to select the compressor switching as 'Automatic' or 'Manual', through a parameter 'Compressor Operation'. This parameter is available and applicable only if the 'Compressor Control' is selected for 'Output-3 (OP3) Function' in PAGE-13 parameter list. The page also facilitates viewing the PID output powers for both Temperature and %RH control loops and also Wet-Bulb Setpoint. Refer Table 9.1 below.

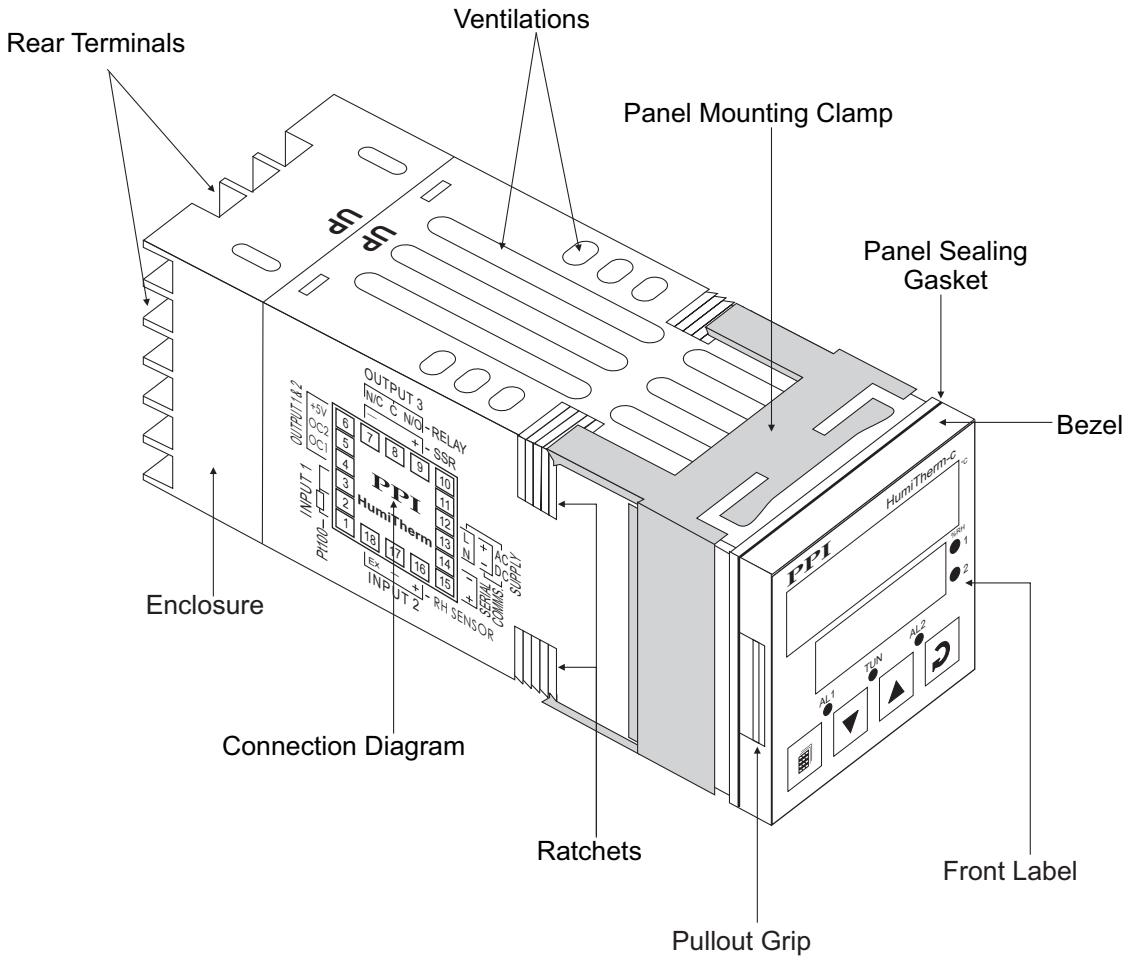
Table 9.1

Parameter Description	Settings (Default Value)
COMPRESSOR OPERATION MODE CP.OP If selected as 'Auto', the compressor switching is determined by the controller based on the setting for the parameter 'Compressor Control Strategy' on PAGE-33. The 'Off' or 'On' selection allows the operator to manually switch the compressor OFF or ON regardless of the 'Compressor Control Strategy'.	AUTO Automatic OFF Off On On (Default : Auto)
WET-BULB TEMPERATURE SETPOINT wb.SP This value is derived using Dry-Bulb SP & %RH SP.	Within Specified Temperature Range (View Only - Non editable)
OUTPUT POWER FOR TEMPERATURE LOOP OUt.1	0 to 100.0% (View Only - Non editable)
OUTPUT POWER FOR %RH LOOP OUt.2	0 to 100.0% (View Only - Non editable)

Section 10
HARDWARE ASSEMBLY & CONFIGURATIONS

OUTER CASE

Figure 10.1



The Figure 10.1 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 11 : 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.

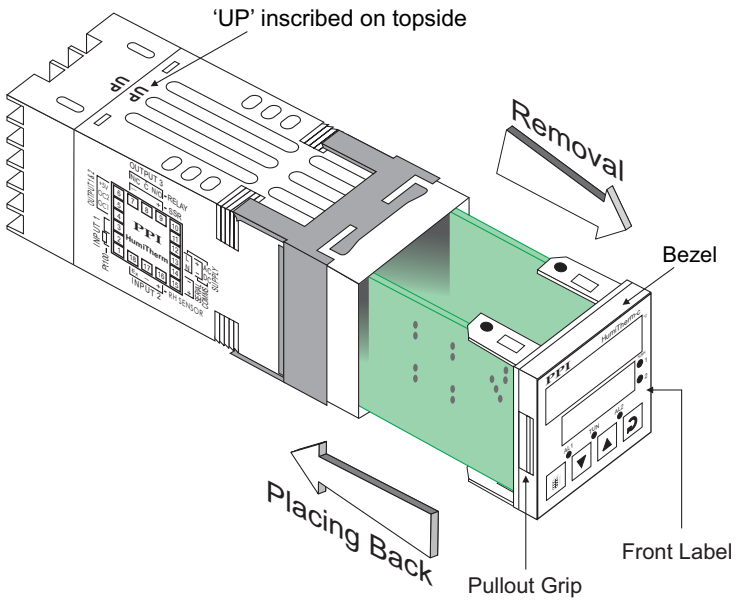
ELECTRONIC ASSEMBLY

The electronic assembly can be removed from the plastic Enclosure and placed back as described below and illustrated in Figure 10.2

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 10.2.

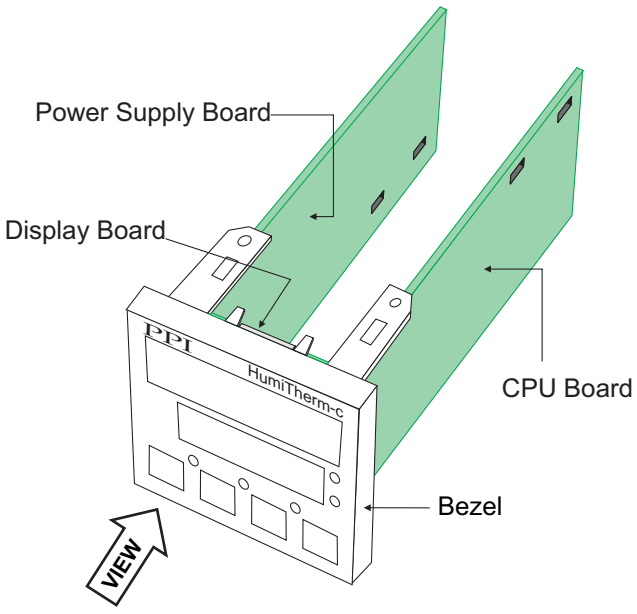


Placing Back

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 10.3 below shows the basic electronics assembly of the controller (without plug-in modules). The basic electronics assembly 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 10.3



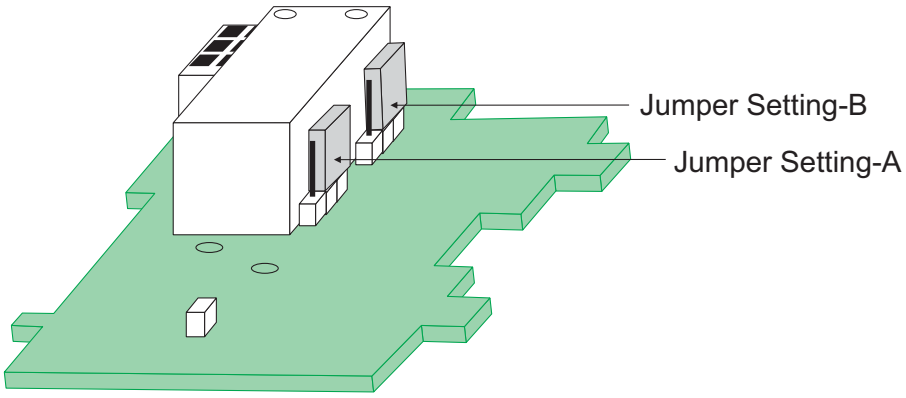
MOUNTING PLUG-IN MODULES

The controller supports Input-2 (DC Linear Voltage) module which is mandatary for measuring Relative Humidity (%RH) Value and two optional plug-in modules, viz. Output-3 (Relay/SSR) module and Serial Communication module. These modules are either pre-fitted while the controller is shipped from the factory (if ordered with the basic configuration) or can be fitted by the user if ordered separately. Both the optional modules have female connector (socket) mounted on them, which fit into the respective male connector (plug) provided on Power-supply board

Output-3 Module

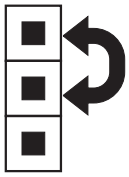
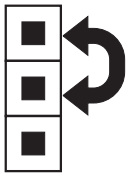
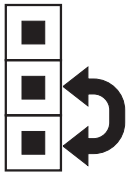
The Output-3 module provides jumper selectable Relay contacts or SSR drive as output. The Figure 10.4 below shows the output module and the jumper arrangement.

Figure 10.4



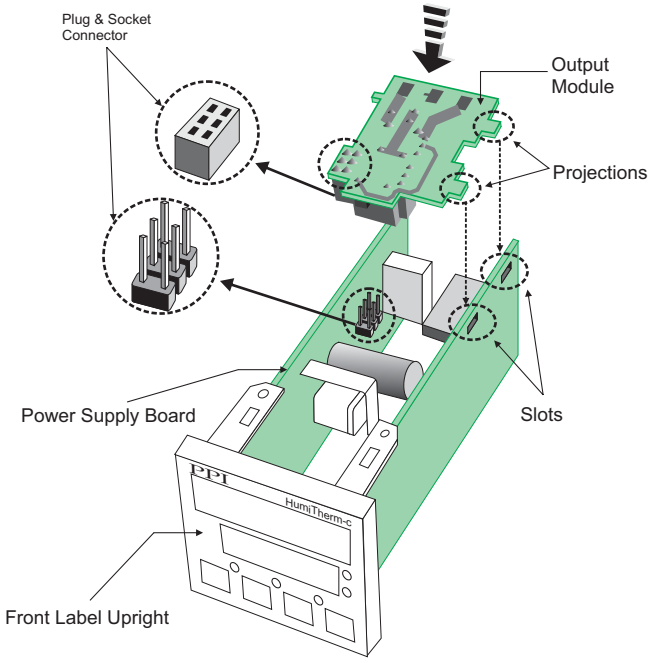
As shown in above Figure, there are 2 jumper arrangements marked A and B. The selection between Relay and SSR requires both these jumpers A and B to be set appropriately as shown in Table 10.1 below. The double headed arrows show the adjoining Pins that require shorting using the Link.

Table 10.1

Output Type	Jumper Setting - A	Jumper Setting - B
Relay (Arrangement shown in Figure 10.4)		
SSR Voltage Pulses		

The Figure 10.5 below illustrates how to mount the plug-in Output-3 module. Notice the orientation of the controller and a few identifying components shown in figure to help locate the plug for the module. 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 Power-supply board for proper electrical contacts and secured fitting.

Figure 10.5
Mounting Output-3 Module



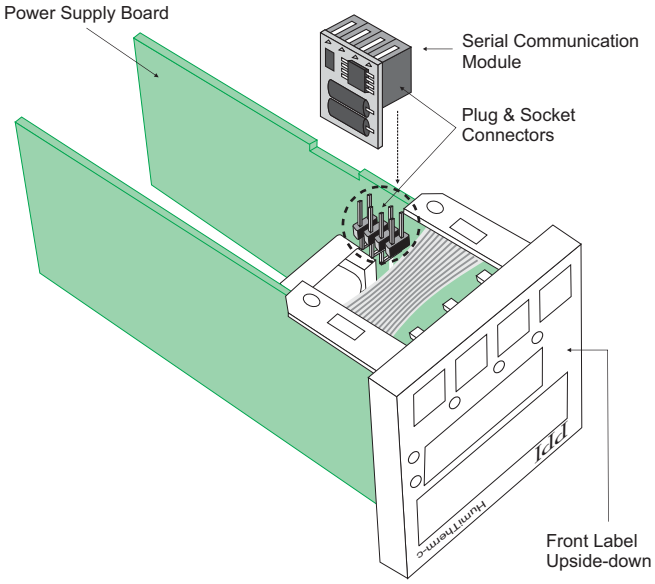
For plugging out the module(s), follow the steps below:

1. Gently pull apart the Power-supply board and the CPU 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 10.6 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.

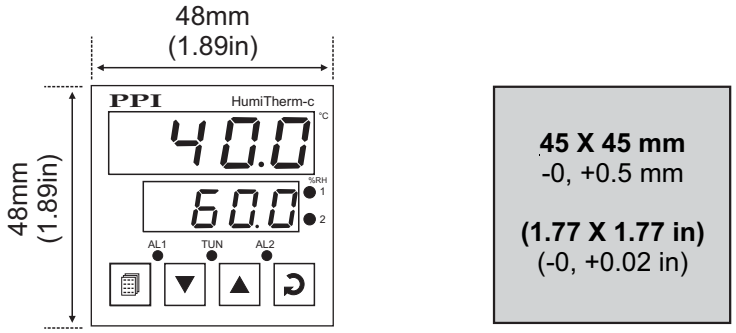
Figure 10.6
Mounting Serial Communication Module



Section 11
MECHANICAL INSTALLATION

OUTER DIMENSIONS AND PANEL CUTOUT

Figure 11.1



Front View **Panel Cutout**

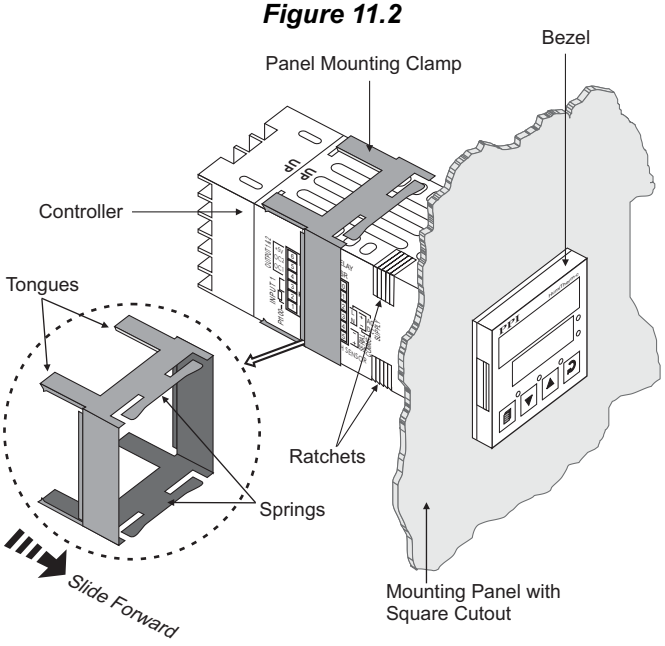
The Figure 11.1 shows the controller front outer dimensions and the panel cutout requirements. for a single controller and also the minimum spacing recommended if several controllers are required to be mounted on a single panel.

PANEL MOUNTING

Follow the steps below for mounting the controller on panel:

1. Prepare a square cutout to the size shown in Figure 11.1.
2. Remove the Panel Mounting Clamp from the controller Enclosure and insert the rear of the controller housing through the panel cutout from the front of the mounting panel.
3. Hold the controller gently against the mounting panel such that it positions squarely against the panel wall, see Figure 11.2. Apply pressure only on the bezel and not on the front label.
4. 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, as shown in Figure 11.2. Ensure that the springs of the clamp push firmly against the rear face of the mounting panel for secured mounting.

Figure 11.2



Section 12
ELECTRICAL CONNECTIONS

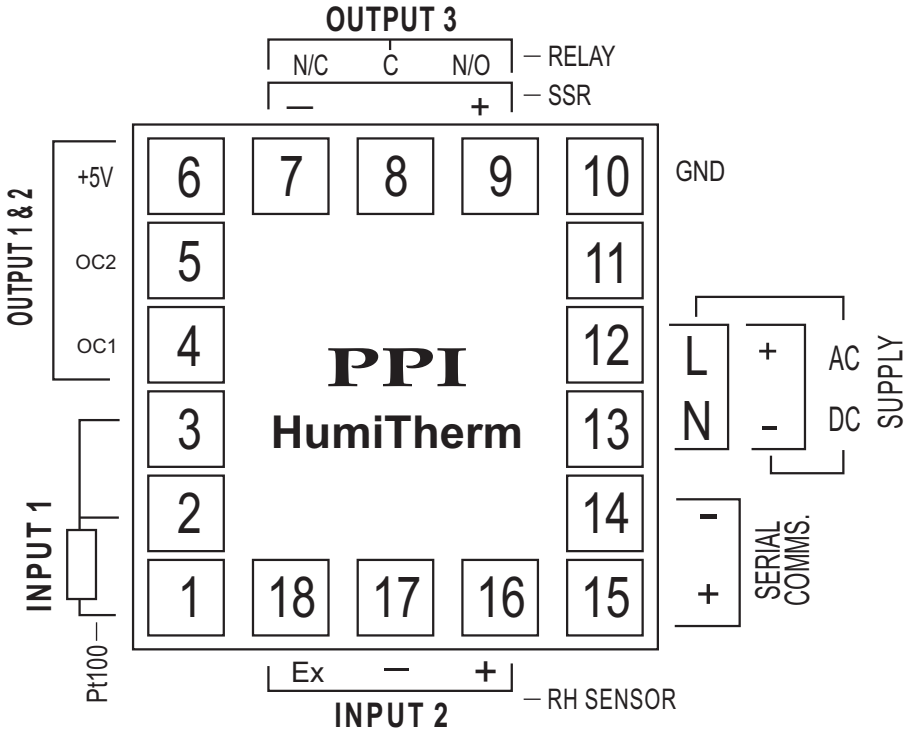
WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

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 low-level signal cables (like RTD, DC Linear (Voltage) signals, etc.). If the cables are run through conduits, use separate conduits for power supply cable and low-level signal 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 enclosure. The diagram shows the terminals viewed from the REAR SIDE with the controller label upright. Refer the label provided on the Rear Side for terminal numbers. Note that the OUTPUT-3 and the Serial Comm. connections are applicable only if the respective plug-in modules are fitted. The rear panel electrical wiring connection diagram is shown in Figure12.1.

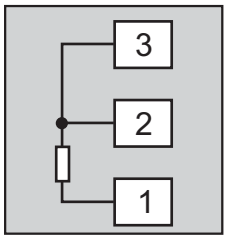
Figure 12.1



DESCRIPTIONS

INPUT-1 : Dry-Bulb RTD Pt100, 3-Wire (Terminals 1, 2 and 3)

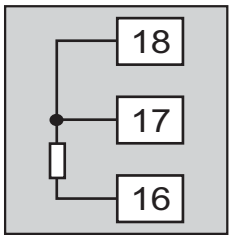
Figure 12.2 (a)



Connect single leaded end of RTD bulb to terminal 1 and the double leaded ends to terminal 2 and 3 (interchangeable) as shown in Figure 12.2 (a). 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.

INPUT-2 : Wet-Bulb RTD Pt100, 3-Wire (Terminals 16, 17 and 18)

Figure 12.2 (b)

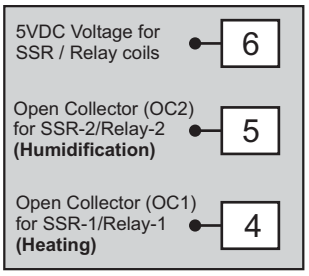


Connect single leaded end of RTD bulb to terminal 16 and the double leaded ends to terminal 17 and 18 (interchangeable) as shown in Figure 12.2 (b). Use copper conductor leads of very low resistance for RTD connections. Ensure that all 3 leads are of the same gauge and length. Use single run cables avoiding any intermediate joints.

OUTPUT-1 (HEATING) & OUTPUT-2 (HUMIDIFICATION)

The Output-1 and Output-2 are configured for DC Voltage capable of switching the external SSR (Solid State Relay) or Relay. Use Zero-Crossover, 3 to 30 VDC operated SSR, rated approximately 1.5 times the actual load rating. In case of relay, use Relay with coil rated for 5VDC. The terminals for output-1 & output-2 are as shown in Figure 12.3.

Figure 12.3



HEATING (Terminals 4 & 6)

Connect terminals 6 & 4 to SSR (+) & (-) respectively OR to the relay coil.

HUMIDIFICATION (Terminals 5 & 6)

Connect terminals 6 & 5 to SSR (+) & (-) respectively OR to the relay coil.

OUTPUT- 3 (Terminals 7,8 and 9)

The Output-3 module (if fitted) can be configured as either Relay or SSR Drive for Alarm or Compressor Control output. The configuration is through hardware jumper settings on the module as described in *Section 8: Hardware Assembly And Configurations.*

The terminals for Relay, DC Voltage pulses output for SSR output are shown in Figure 12.4 (a) & 12.4 (b), respectively.

Figure 12.4 (a)

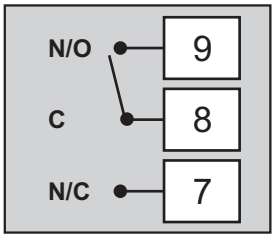
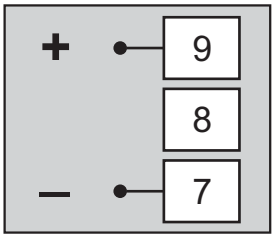


Figure 12.4 (b)



Relay

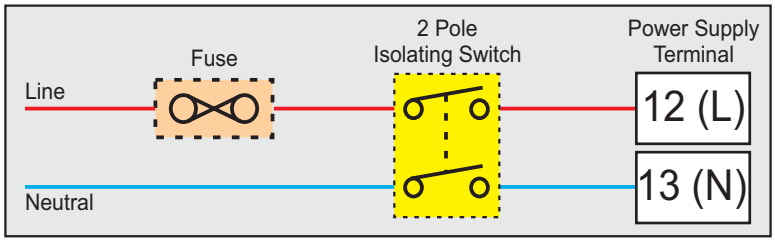
Potential-free Relay changeover contacts N/O (Normally Open), C (Common) and N/C (Normally Close); rated 2A/240 VAC (resistive load) are provided as Relay output. Use external auxiliary device like contactor with appropriate contact rating for driving the actual load.

Drive for SSR

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

POWER SUPPLY (Terminals 12 and 13)

Figure 12.5



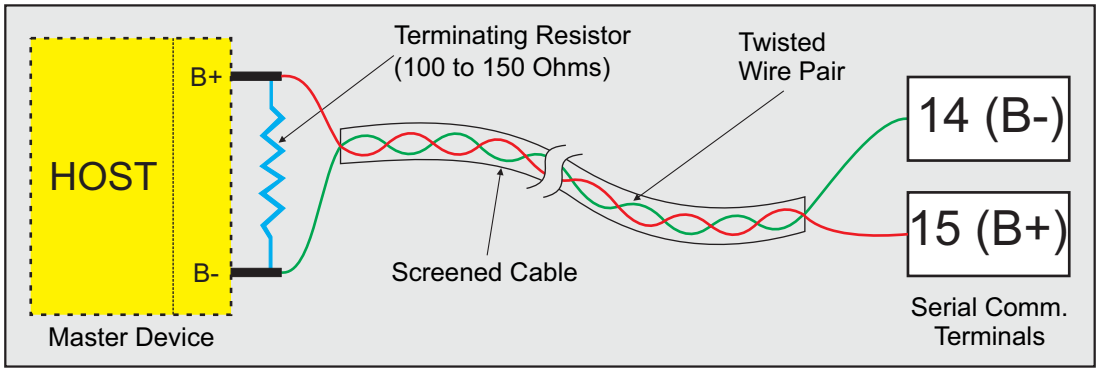
The controller is supplied with power connections suited for 85 to 264 VAC line supply. Use well-insulated copper conductor wire of the size not smaller than 0.5mm^2 for power supply connections. Connect Line (Phase) supply line to terminal 12 and the Neutral (Return) supply line to terminal 13 as shown in Figure 12.5 above. The controller is not provided with fuse and power switch. If necessary, mount them separately. Use a time lag fuse rated 1A @ 240 VAC.

SERIAL COMMUNICATION PORT (Terminals 14 and 15)

If the optional plug-in communication board is fitted, connect terminal 15 and 14 of the controller to (+) and (-) terminals of the Master device for RS485 port. In case of RS232 port connect terminal 15 to TXD (Transmit), Terminal 14 to RXD (Receive) and Terminal 10 to GND (Ground).

To ensure reliable operation of the 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 12.6 below.

Figure 12.6

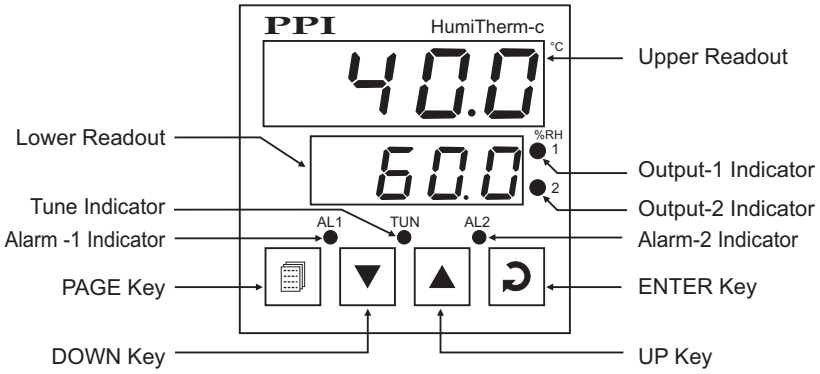


HumiTherm-c Temp+RH

Section 1
FRONT PANEL LAYOUT

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

Figure 1.1



READOUTS

The Upper Readout is a 4 digit, 7-segment bright red LED display and usually displays the Temperature Value in °C. In Program Mode, the Upper Readout displays parameter values.

The Lower Readout is a 4 digit, 7-segment bright green LED display and usually displays Relative Humidity (RH) Value in %. In Program Mode, the Lower Readout displays prompts for the parameters.

The indications on the Upper and Lower Readouts, in general, depend on the mode of operation and parameters configuration. Refer respective sections for more details.

INDICATORS

There are 5 front panel red LED indicators. These indicator show various statuses. The Table 1.1 below lists each LED indicator (identified by the front panel legend) and the associated status it indicates.

Table 1.1

Indicator	Function
1	Indicates Output-1 (Temperature) control ON/OFF status. • Glows if the Temperature control Output is ON. • Remains OFF if the Temperature control Output is OFF.
2	Indicates Output-2 (RH) control ON/OFF status. • Glows if the RH control Output is ON. • Remains OFF if the RH control Output is OFF.
AL1	Indicates Alarm-1 (Alarm for Temperature Loop) status. • Flashes while the Alarm for Temperature Loop is active. • Remains OFF while the Alarm for Temperature Loop is inactive.
AL2	Indicates Alarm-2 (Alarm for RH Loop) status. • Flashes while the Alarm for RH Loop is active. • Remains OFF while the Alarm for RH Loop is inactive.

Indicator	Function
TUN	Indicates Tuning or Compressor ON/OFF status. • Flashes while the controller is executing the Tuning operation. • Glows continuously while the Compressor is ON. • Remains OFF, if not executing the Tuning operation or Compressor is OFF.

KEYS

There are four tactile keys provided on the front panel for configuring the controller and setting-up the parameter values. The Table 1.2 below lists each key (identified by the front panel symbol) and the associated function.

Table 1.2

Symbol	Key	Function
	PAGE	Press to enter or exit set-up mode.
	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.

Section 2
BASIC OPERATIONS

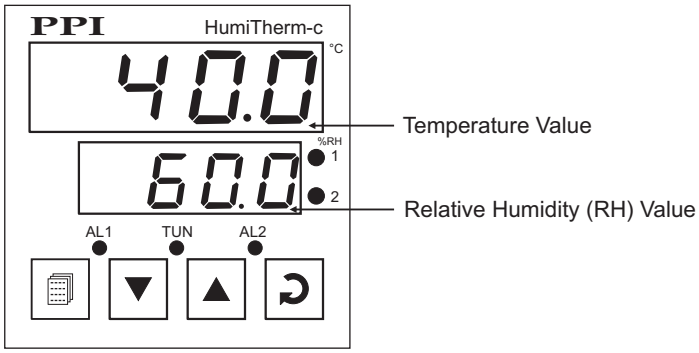
POWER-UP

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 HUmc on the Upper Readout and the firmware version 1.01.0 on the Lower Readout, for approximately 1 second.

MAIN DISPLAY MODE

After the Power-up display sequence, the Upper and Lower Readouts start showing the measured Temperature Value in °C and the Relative Humidity in %RH, 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 2.1below.

Figure 2.1



SETPOINT ADJUSTMENTS

(Refer "Section 3 : Pages & Parameters" for details on Set-up Mode)

For ease of operation, the Temperature and Relative Humidity (% RH) Setpoints (SP) are provided on PAGE-0. The Setpoints can be adjusted if permitted at supervisory level (PAGE-12). Step through the following sequence to adjust the SP value:

1. Press PAGE key while the controller is in MAIN Display Mode. The Lower Readout shows PAGE (PAGE) and the Upper Readout shows 0.
2. Press ENTER key. The Lower Readout shows the prompt for the Temperature Setpoint, °C.SP (°C.SP), and the Upper Readout shows the current setpoint value.
3. Use UP/DOWN keys to adjust the Temperature SP value.
4. Press and release ENTER key. The set value for Temperature Setpoint is registered and stored in the controller's non-volatile memory. The Lower Readout shows the prompt for the %RH Setpoint, rh.SP (rh.SP), and the Upper Readout shows the current setpoint value.
5. Use UP/DOWN keys to adjust the %RH SP value.
6. Press and release ENTER key. The set value for RH Setpoint is registered and stored in the controller's non-volatile memory.
7. Press PAGE key to revert to MAIN Display Mode.

TUNE INDICATION

Upon issuing TUNE command, The controller starts tuning itself to the process under control. While the controller is executing

Tuning operation, the front panel indicator TUN flashes. The user is advised not to disturb the process or alter any parameter values while the tuning is in progress. The TUN indicator automatically turns OFF upon completion of Tuning Procedure. The controller reverts to the MAIN Display Mode and starts maintaining the Temperature and RH values (PV) at their respective Setpoints.

PV ERROR INDICATIONS

The controller indicates the PV error messages for both Temperature and RH Values on Upper and Lower Readout, respectively, in the conditions depicted in figure 2.2 & table 2.1.

Figure 2.2

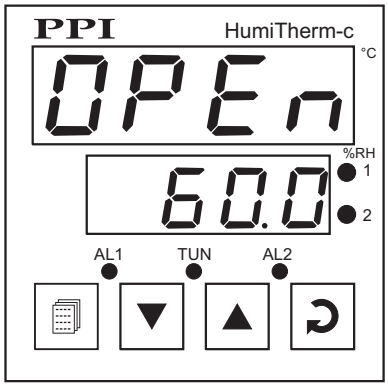


Table 2.1

Message	PV Error Type
Or	Over-range (Dry-Bulb Temp. above Max. Range)
Ur	Under-range (Dry-Bulb Temp. below Min. Range)
OPEn	Open (Sensor open / broken)

Notes :

1. In case of Temperature Value Error condition, both the control signals (Output-1 & Output-2) are held at the minimum level (OFF).
2. 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.
3. The tuning operation, if in progress, is automatically aborted upon detecting PV Error condition.

Section 3
PAGES AND PARAMETERS

ORGANIZATION

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

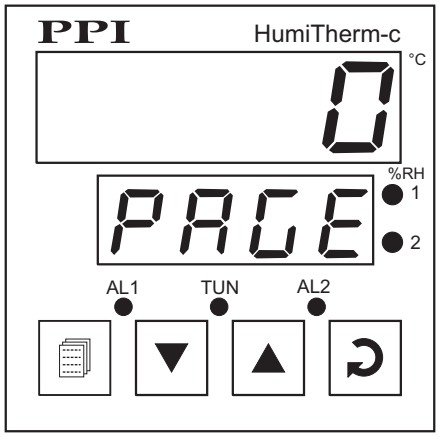
The parameters are always presented in a fixed format: The Lower Readout displays the parameter prompt (Identification Tag) and the Upper Readout displays the set value. The parameters appear in the same sequence as listed in their respective sections.

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.

PROGRAM MODE

The Program Mode allows the user to view or modify the parameter values. The entry from MAIN Display Mode to Program 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. Press and release PAGE key. The Lower Readout shows PAGE and the Upper Readout shows 0. See Figure 3.1.
2. Adjust the Upper Readout to the desired PAGE NUMBER using the UP/DOWN keys.
3. 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 reverts to the MAIN Display Mode.

Adjusting Parameter Values

Once a 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 desired parameter appears on the Lower Readout. The last parameter in the list rolls back to the first parameter.
2. Use UP / DOWN keys to adjust the parameter value.

   Note that some parameters (examples; ‘Alarm Band’, ‘Proportional Band’, ‘Zero Offset for PV’ etc.) have numeric values while others (examples; ‘Output-3 Function Selection’, ‘Compressor Control Strategy’, 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. Press and release the 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 'OP3 Function Selection'.

Figure 3.2

To exit the Program Mode and return to the MAIN Display Mode, press and release PAGE key.

Notes:
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.

PARAMETER LOCKING

Though access to any PAGE is always permitted, the adjustment of the parameter values, however, can be Locked at the supervisory level. If the Lock is enabled, the parameter values on each PAGE can only be viewed but can not be adjusted. This feature facilitates protecting the parameter values from unauthorized tampering or accidental alterations by the operator.

The controller is shipped from the factory in Unlocked condition. The Lock can be enabled once the initial configuration / installation is done.

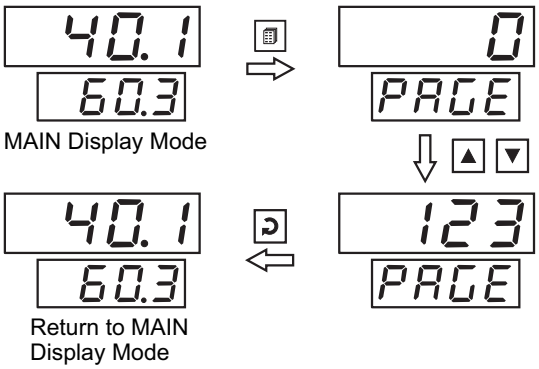
For enabling / disabling the Lock, step through the following sequence:

Locking

1. Press and release PAGE key while the controller is in the MAIN Display Mode. The Lower Readout shows PAGE and the Upper Readout shows 0.
2. Adjust the Upper Readout to the value 123 using UP/DOWN keys.
3. Press and release ENTER key. The controller returns to the MAIN Display Mode with the Lock enabled.

The Figure 3.3 below illustrates the Locking procedure.

Figure 3.3



Unlocking

1. Press and release PAGE key while the controller is in the MAIN Display Mode. The Lower Readout shows PAGE and the Upper Readout shows 0.
2. Adjust the Upper Readout to the value 123 using UP/DOWN keys.
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 Mode with the Lock disabled (Unlocked).

SETTING DEFAULT VALUES

The controller is shipped from the factory with all the parameters set to their default factory set values. If desired, all the parameters can be reset to default values by following the steps below.

1. Ensure that the controller is Unlocked for parameter adjustments.
2. Press and release PAGE key while the controller is in the MAIN Display Mode. The Lower Readout shows PAGE and the Upper Readout shows 0.
3. Adjust the Upper Readout to the numeric value 99 using UP/DOWN keys.
4. Press and release 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
TEMPERATURE PARAMETERS

The PAGE-10 lists Alarm and Control related parameters for Temperature. The Table 4.1 below describes each parameter.

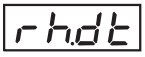
Table 4.1

Parameter Description	Settings (Default Value)
ALARM-1 BAND  Sets symmetrical positive and negative deviation (offset) limits from Temperature control setpoint for both High and Low Alarm-1 activation. Example: If Band = 0.5°C, then High Alarm Limit = Setpoint + 0.5°C Low Alarm Limit = Setpoint - 0.5°C	0.3 to 25.0°C (Default : 0.5)
ALARM-1 HYSTERESIS  Sets differential (dead) band between ON and OFF states of Alarm-1.	0.2 to 10.0°C (Default : 0.2)
PROPORTIONAL BAND  Sets proportional gain (% power per unit error) for temperature control loop. Defined in same units and resolution as that for PV.	0.1 to 999.9°C (Default : 5.0)
INTEGRAL TIME  Sets integral time constant in seconds for temperature control loop. Setting the value to 0, cuts-off the integral action.	0 to 1000 Seconds (Default : 100)
DERIVATIVE TIME  Sets derivative time constant in seconds for temperature control loop. Setting the value to 0, cuts-off the derivative action.	0 to 250 Seconds (Default : 25)
CYCLE TIME  Sets the total 'On + Off' time in seconds for time proportional power output for temperature control loop through Output-1.	0.5 to 25.0 Seconds (in steps of 0.5 secs.) (Default : 1.0)

Section 5
RELATIVE HUMIDITY (%RH) PARAMETERS

The PAGE-11 lists Alarm and Control related parameters for %RH. The Table 5.1 below describes each parameter.

Table 5.1

Parameter Description	Settings (Default Value)
ALARM-2 BAND  Sets symmetrical positive and negative deviation (offset) limits from %RH control setpoint for both High and Low Alarm-2 activation. Example: If Band = 2.0 % RH, then High Alarm Limit = SP + 2.0 % RH Low Alarm Limit = SP - 2.0 % RH	0.3 to 25.0% (Default : 2.0)
ALARM-2 HYSTERESIS  Sets differential (dead) band between ON and OFF states of Alarm-1.	0.2 to 10.0% (Default : 2.0)
PROPORTIONAL BAND  Sets proportional gain (% power per unit error) for %RH control loop. Defined in same units and resolution as that for PV.	0.1 to 999.9% (Default : 10.0)
INTEGRAL TIME  Sets integral time constant in seconds for %RH control loop. Setting the value to 0, cuts-off the integral action.	0 to 1000 Seconds (Default : 100)
DERIVATIVE TIME  Sets derivative time constant in seconds for %RH control loop. Setting the value to 0, cuts-off the derivative action.	0 to 250 Seconds (Default : 25)
CYCLE TIME  Sets the total 'On + Off' time in seconds for time proportional power output for %RH control loop through Output-1.	0.5 to 25.0 Seconds (in steps of 0.5 secs.) (Default : 1.0)

Section 6
SUPERVISORY PARAMETERS

The Supervisory Parameters provided on PAGE-12 facilitate supervisory control over the operator level. The Table 6.1 below describes each parameter.

Table 6.1

Parameter Description	Settings (Default Value)
SP ADJUSTMENT ON PAGE-0 SP Supervisory permission for temperature and %RH setpoint editing on Operator Page (PAGE-0). Set to Enable' for permission.	EnbL Enable dSbL Disable (Default : Enable)
SELF-TUNE COMMAND tUnE Set to 'Yes' to initiate a new tuning cycle or set to 'No' to abort a tuning operation in progress.	no No YES Yes (Default : No)
BAUD RATE bAUd Communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	1200 2400 4800 9600 (Default : 4800)
ID FOR TEMPERATURE LOOP °C.Id Communication ID used by host for temperature value.	1 to 8 (Default : 1)
ID FOR %RH LOOP rh.Id Communication ID used by host for %RH value.	1 to 8 (Default : 2)

Section 7
OP3 FUNCTION PARAMETERS

The OP3 Function Parameters presented on PAGE-13 allow the user to configure the Output-3 (OP3) Function as Alarm or Compressor Control. The Table 7.1 below describes each parameter.

Table 7.1

Parameter Description	Settings (Default Value)
OUTPUT-3 FUNCTION SELECTION OP3.F Select the function / feature to which the OP3 module is to be logically attached for activation.	AL Alarm CP Compressor (Default : Alarm)
COMPRESSOR SETPOINT CP.SP *(Available only if OP3 function is selected as Compressor)* The setpoint value with which either the Dry Bulb (temperature) SP or PV is compared for the purpose of switching the compressor On / Off. Refer *section-8* for details.	0.0 to 50.0°C ***or*** 0.0 to 25.0°C (Default : 45.0 ***or*** 0.2)
COMPRESSOR HYSTERESIS CP.HY *(Available only if 'Compressor Control Strategy' is set to 'Dry Bulb PV'.)* Sets differential (dead) band between Compressor switching ON and OFF states. Refer *section-8* for details.	0.1 to 25.0°C (Default : 0.2)
COMPRESSOR TIME DELAY t.dLY *(Available if OP3 function is Compressor)* The Time Delay that must elapse before the compressor is switched ON from OFF state Setting to 0 cuts-off the time delay function.	0.00 to 10.00 Min. Sec (in steps of 5 Seconds) (Default : 00.00)

Section 8
UTILITY PARAMETERS

The Utility Parameters are grouped on PAGE-33 and allow the user to set the Compressor Control Strategy and the Zero-Offset values for Temperature and the Relative Humidity (RH) values. The Table 8.1 below describes each parameter.

Table 8.1

Parameter Description	Settings (Default Value)
COMPRESSOR CONTROL STRATEGY CP.St Refer detailed description below.	db.SP Dry Bulb SP db.Pu Dry Bulb PV (Default : Dry Bulb SP)
ZERO OFFSET FOR TEMPERATURE VALUE oC.OF This value is algebraically added to the measured Temperature value to derive the final PV that is displayed and compared for alarm / control. Final PV = Measured PV + Offset	-25.0 to +25.0°C (Default : 0.0)
ZERO OFFSET FOR RH VALUE rh.OF This value is algebraically added to the measured %RH value to derive the final PV that is displayed and compared for alarm / control. Final PV = Measured PV + Offset	-25.0 to +25.0% (Default : 0.0)
%RH LOW rhLo % RH Value corresponding to **0 VDC** signal input form RH Transmitter. Refer ***Note*** on page-2.	-199.9 to 999.9 (Default : 0)
%RH HIGH rhHi % RH Value corresponding to **5 VDC** signal input form RH Transmitter. Refer ***Note*** on page-2.	-199.9 to 999.9 (Default : 151.5)

COMPRESSOR CONTROL STRATEGY

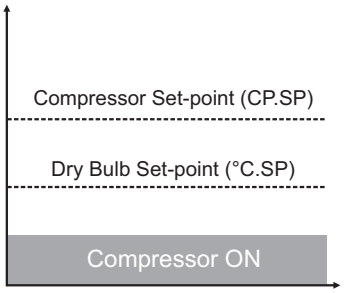
The controller offers two different control algorithms for switching the compressor through Output 3 (OP3) Relay / SSR module using the parameter 'Compressor Control Strategy'. The two strategies are explained below. Note that either strategy operates (switches ON/OFF) the OP3 only if the parameter 'OP3 Function' on PAGE-13 is set to 'Compressor' and the 'Compressor Operation Mode (CP.OP)' parameter on PAGE-1 is set to 'Auto'.

1. Dry Bulb SP Strategy

In this strategy, the controller provides two user settable parameters, viz. *Compressor Set-point* (CP.SP) & *Time Delay* (t.dLY) in PAGE 13 parameter list.

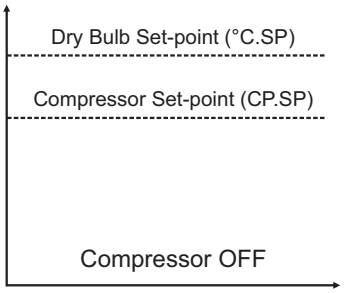
The Compressor ON or OFF state is determined based on the relative position of the Dry Bulb SP (Temperature Set-point) with respect to the *Compressor Set-point.* If the Dry Bulb SP is below the Compressor Set-point, the compressor remains ON and if the Dry Bulb SP is equal or above the Compressor Set-point, the compressor remains OFF. The following Figures 8.1 and 8.2 illustrate the compressor ON and compressor OFF operation respectively.

Figure 8.1



Dry Bulb SP < Compressor SP
➡ Compressor ON

Figure 8.2



Dry Bulb SP ≥ Compressor SP
➡ Compressor OFF

This strategy eliminates the dependency on the user for switching off the compressor (for saving valuable electrical energy) when not required. The Compressor Set-point for this parameter value is usually set to the maximum expected Ambient Temperature. It is usually not required to switch-on compressor if the desired Temperature is significantly above the Ambient Temperature and thus a considerable energy saving can be achieved by keeping the compressor OFF.

2. *Dry Bulb PV Strategy*

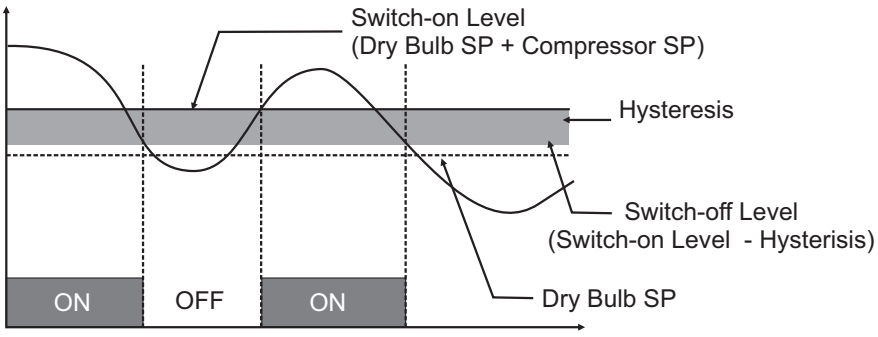
In this strategy, the controller provides three user settable parameters, viz. Compressor Set-point (CP.SP), Hysteresis (CP.HY) & Time Delay (t.dLY) in PAGE 13 parameter list. The Compressor ON or OFF state is determined by comparing the Dry Bulb PV with the Compressor Switch-on Level and the Compressor Switch-off Level. The Compressor Switch-on and Switch-off levels are determined using Dry Bulb SP (db.SP), Compressor Set-point (CP.SP) and Hysteresis (CP.HY), as below.

Switch-on Level = Dry Bulb SP (db.SP) + Compressor SP (CP.SP)

Switch-off Level = Switch-on Level - Hysteresis (CP.HY)

The Hysteresis introduces a dead-band between the Compressor Switch-on Level and Switch-off Level. The following Figure 8.3 illustrates the compressor ON-OFF operation.

Figure 8.3



Examples

1) For Dry Bulb SP = 20.0°C, Compressor SP = 1.0°C & Hysteresis = 1.2°C;
Switch-on Level = Dry Bulb SP + Compressor SP = 20.0 + 1.0 = 21.0°C
Switch-off Level = Switch-on Level - Hysteresis = 21.0 - 1.2 = 19.8°C.

2) For Dry Bulb SP = 20.0°C, Compressor SP = 1.0°C & Hysteresis = 0.8°C;
Switch-on Level = Dry Bulb SP + Compressor SP = 20.0 + 1.0 = 21.0°C
Switch-off Level = Switch-on Level - Hysteresis = 21.0 - 0.8 = 20.2°C.

%RH LOW AND %RH HIGH

The controller is calibrated for 0 to 5 VDC input for % RH. The transmitter output signal, however, may be any voltage between 0 to 5 VDC (for e.g. 0 to 1 VDC, 1 to 3.6 VDC, 0 to 3.3 VDC etc.). The value for 'Range Low' and 'Range High' parameters must be corresponding to 0 and 5 VDC only. For this, use the following formulae for computing the 'Range Low' and 'Range High' values.

$$\text{Range Low} = \frac{100.0}{\text{Span}} \times (0 - \text{Signal Low})$$

$$\text{Range High} = \frac{100.0}{\text{Span}} \times (5 - \text{Signal Low})$$

(where; Span = Signal High - Signal Low)

Example 1
Signal Low = 0 VDC, Signal High = 1.0 VDC

Here, Span = 1.0 - 0 = 1.0 VDC

$$\text{Range Low} = \frac{100.0}{1.0} \times (0 - 0) = \mathbf{0.0}$$

$$\text{Range High} = \frac{100.0}{1.0} \times (5 - 0) = \mathbf{500.0}$$

Example 2
Signal Low = 0 VDC, Signal High = 3.3 VDC

Here, Span = 3.3 - 0 = 3.3 VDC

$$\text{Range Low} = \frac{100.0}{3.3} \times (0 - 0) = \mathbf{0.0}$$

$$\text{Range High} = \frac{100.0}{3.3} \times (5 - 0) = \mathbf{151.5}$$

Example 3
Signal Low = 1.0 VDC, Signal High = 3.6 VDC

Here, Span = 3.6 - 1.0 = 2.6 VDC

$$\text{Range Low} = \frac{100.0}{2.6} \times (0 - 1.0) = \mathbf{-38.5}$$

$$\text{Range High} = \frac{100.0}{2.6} \times (5 - 1.0) = \mathbf{153.8}$$

Section 9

COMPRESSOR OPERATION & POWER INDICATION

The PAGE-1 allows the operator to select the compressor switching as 'Automatic' or 'Manual', through a parameter 'Compressor Operation'. This parameter is available and applicable only if the 'Compressor Control' is selected for 'Output-3 (OP3) Function' in PAGE-13 parameter list. The page also facilitates viewing the PID output powers for both Temperature and %RH control loops and also Wet-Bulb Setpoint. Refer Table 9.1 below.

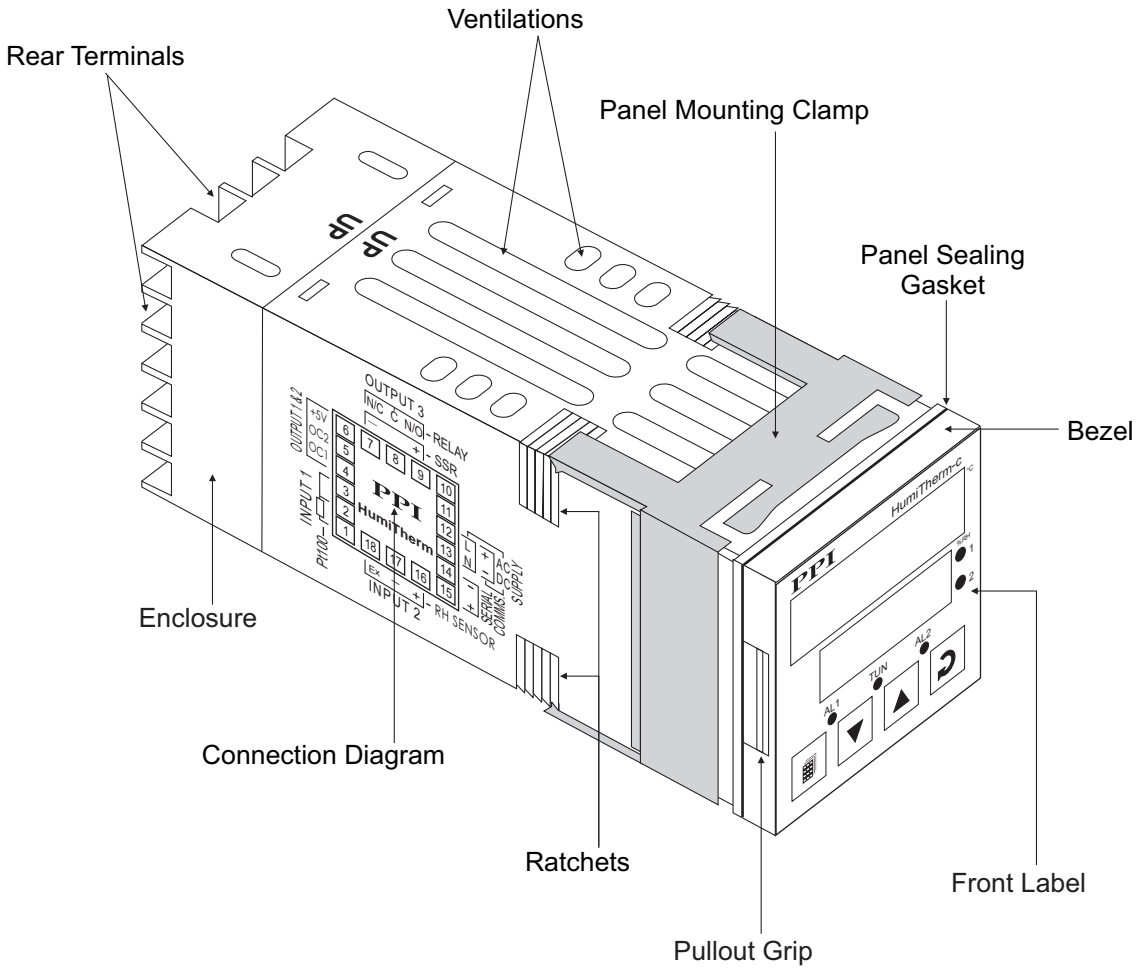
Table 9.1

Parameter Description	Settings (Default Value)
COMPRESSOR OPERATION MODE CP.OP If selected as 'Auto', the compressor switching is determined by the controller based on the setting for the parameter 'Compressor Control Strategy' on PAGE-33. The 'Off' or 'On' selection allows the operator to manually switch the compressor OFF or ON regardless of the 'Compressor Control Strategy'.	AUtO Automatic OFF Off On On (Default : Auto)
OUTPUT POWER FOR TEMPERATURE LOOP OUt.1	0 to 100.0% (View Only - Non editable)
OUTPUT POWER FOR %RH LOOP OUt.2	0 to 100.0% (View Only - Non editable)

Section 10
HARDWARE ASSEMBLY & CONFIGURATIONS

OUTER CASE

Figure 10.1



The Figure 10.1 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 11 : 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.

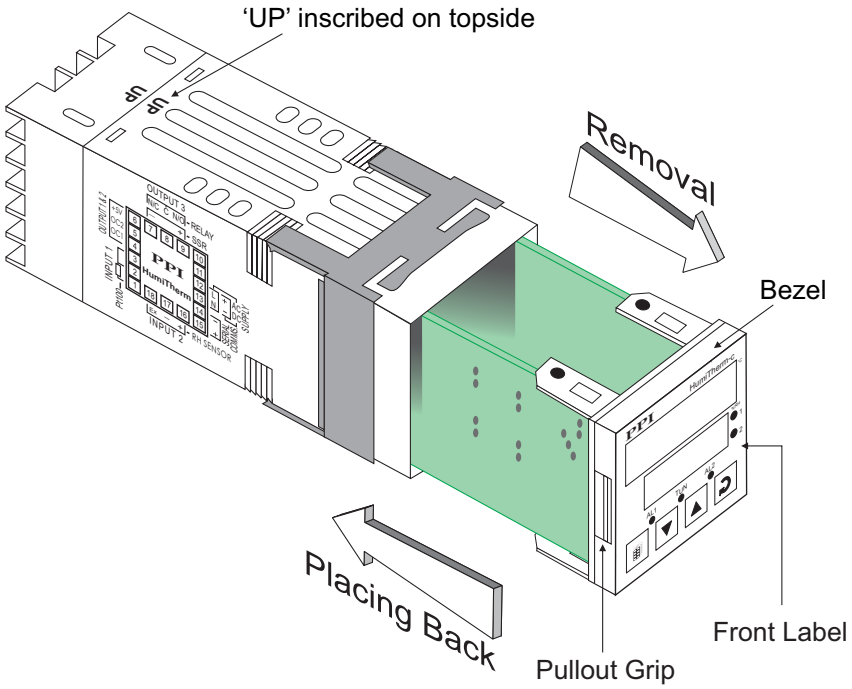
ELECTRONIC ASSEMBLY

The electronic assembly can be removed from the plastic Enclosure and placed back as described below and illustrated in Figure 10.2

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 10.2.

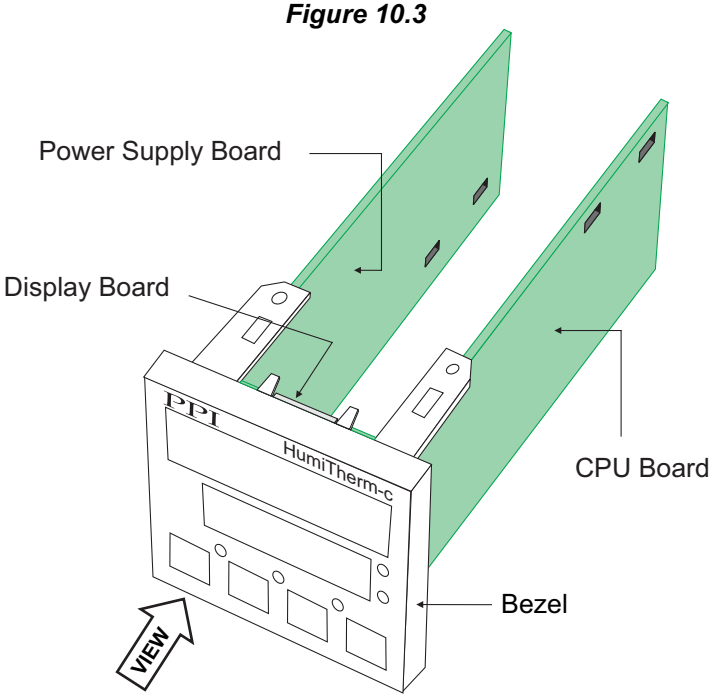


Placing Back

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 10.3 below shows the basic electronics assembly of the controller (without plug-in modules). The basic electronics assembly 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 10.3



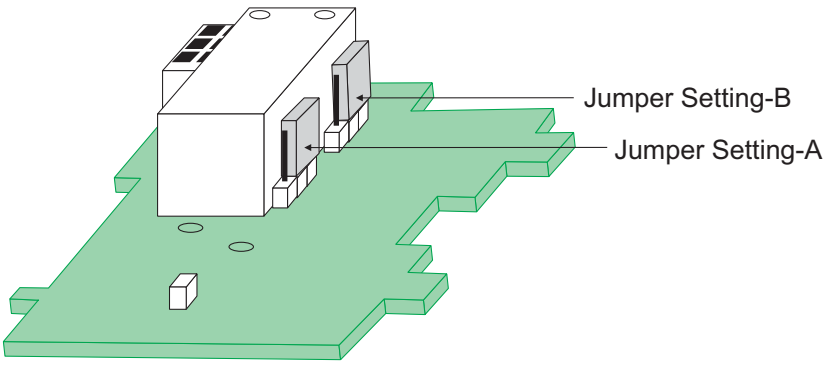
MOUNTING PLUG-IN MODULES

The controller supports Input-2 (DC Linear Voltage) module which is mandatary for measuring Relative Humidity (%RH) Value and two optional plug-in modules, viz. Output-3 (Relay/SSR) module and Serial Communication module. These modules are either pre-fitted while the controller is shipped from the factory (if ordered with the basic configuration) or can be fitted by the user if ordered separately. Both the optional modules have female connector (socket) mounted on them, which fit into the respective male connector (plug) provided on Power-supply board

Output-3 Module

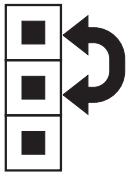
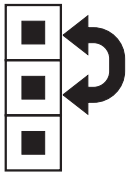
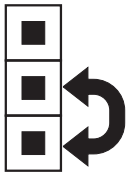
The Output-3 module provides jumper selectable Relay contacts or SSR drive as output. The Figure 10.4 below shows the output module and the jumper arrangement.

Figure 10.4



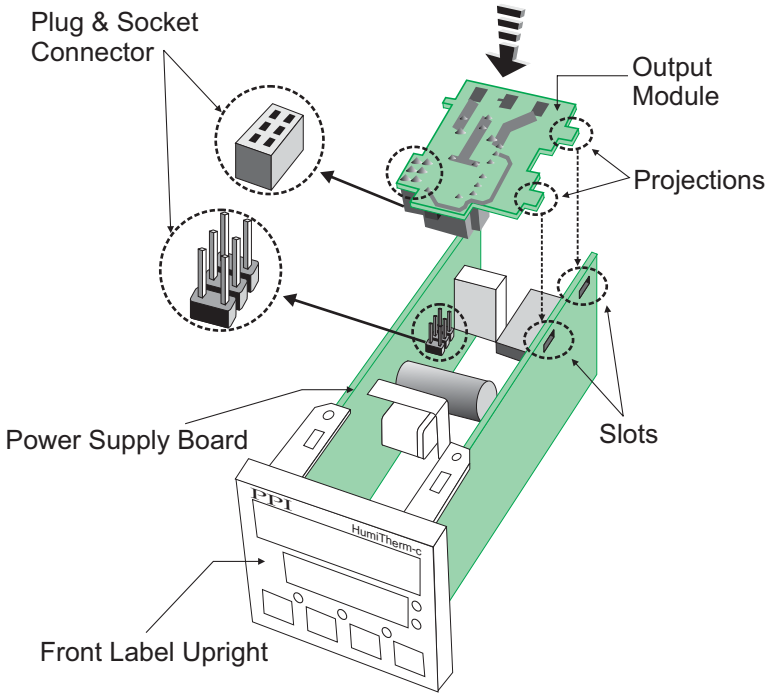
As shown in above Figure, there are 2 jumper arrangements marked A and B. The selection between Relay and SSR requires both these jumpers A and B to be set appropriately as shown in Table 10.1 below. The double headed arrows show the adjoining Pins that require shorting using the Link.

Table 10.1

Output Type	Jumper Setting - A	Jumper Setting - B
Relay (Arrangement shown in Figure 10.4)		
SSR Voltage Pulses		

The Figure 10.5 below illustrates how to mount the plug-in Output-3 module. Notice the orientation of the controller and a few identifying components shown in figure to help locate the plug for the module. 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 Power-supply board for proper electrical contacts and secured fitting.

Figure 10.5
Mounting Output-3 Module



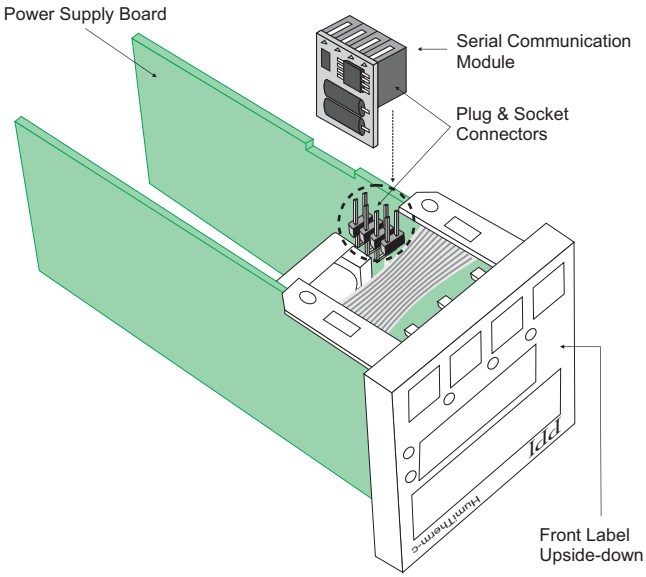
For plugging out the module(s), follow the steps below:

1. Gently pull apart the Power-supply board and the CPU 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 10.6 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.

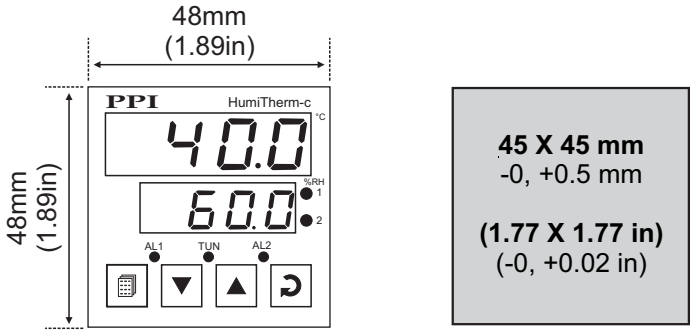
Figure 10.6
Mounting Serial Communication Module



Section 11
MECHANICAL INSTALLATION

OUTER DIMENSIONS AND PANEL CUTOUT

Figure 11.1



Front View **Panel Cutout**

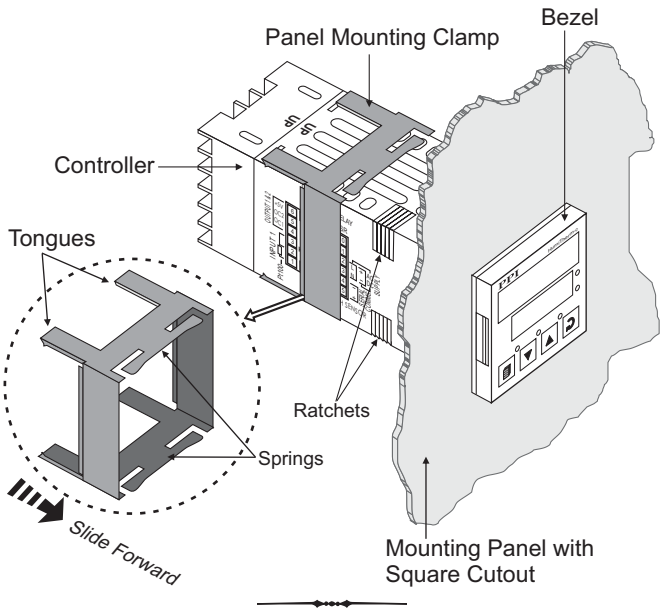
The Figure 11.1 shows the controller front outer dimensions and the panel cutout requirements. for a single controller and also the minimum spacing recommended if several controllers are required to be mounted on a single panel.

PANEL MOUNTING

Follow the steps below for mounting the controller on panel:

1. Prepare a square cutout to the size shown in Figure 11.1.
2. Remove the Panel Mounting Clamp from the controller Enclosure and insert the rear of the controller housing through the panel cutout from the front of the mounting panel.
3. Hold the controller gently against the mounting panel such that it positions squarely against the panel wall, see Figure 11.2. Apply pressure only on the bezel and not on the front label.
4. 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, as shown in Figure 11.2. Ensure that the springs of the clamp push firmly against the rear face of the mounting panel for secured mounting.

Figure 11.2



Section 12
ELECTRICAL CONNECTIONS

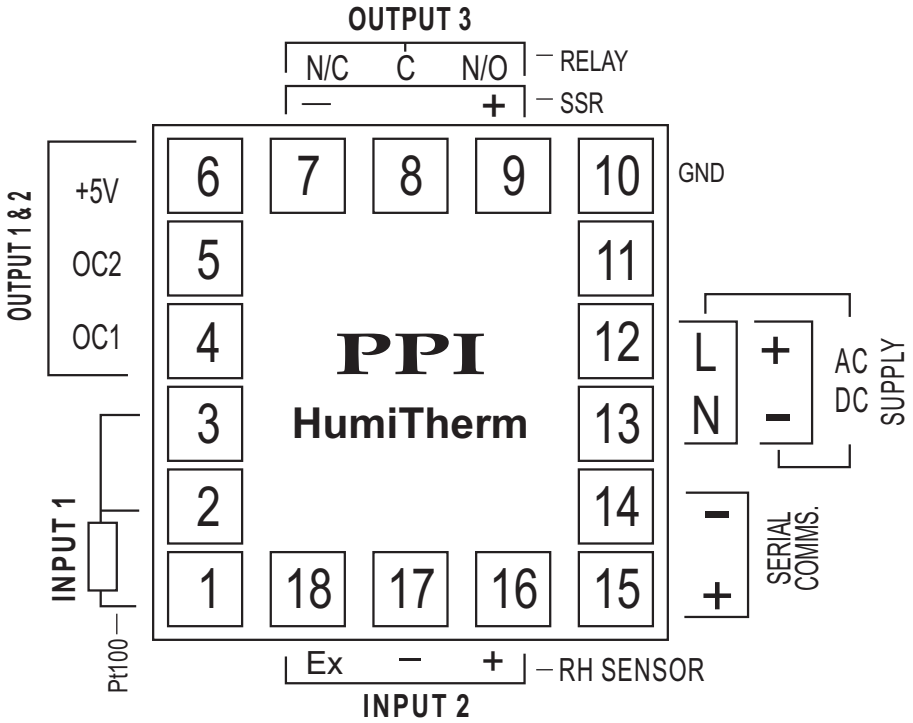
WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

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 low-level signal cables (like RTD, DC Linear (Voltage) signals, etc.). If the cables are run through conduits, use separate conduits for power supply cable and low-level signal 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 enclosure. The diagram shows the terminals viewed from the REAR SIDE with the controller label upright. Refer the label provided on the Rear Side for terminal numbers. Note that the OUTPUT-3 and the Serial Comm. connections are applicable only if the respective plug-in modules are fitted. The rear panel electrical wiring connection diagram is shown in Figure12.1.

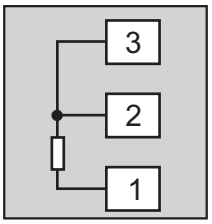
Figure 12.1



DESCRIPTIONS

INPUT-1 : RTD Pt100, 3-Wire (Terminals 1, 2 and 3)

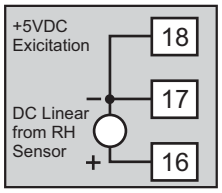
Figure 12.2 (a)



The controller accepts 3-wire RTD Pt100 as input for measuring Dry Bulb Temperature Value. Connect single leaded end of RTD bulb to terminal 1 and the double leaded ends to terminal 2 and 3 (interchangeable) as shown in Figure 12.2 (a). 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.

INPUT-2 : DC Linear Voltage (Terminals 16,17 & 18)

Figure 12.2 (b)

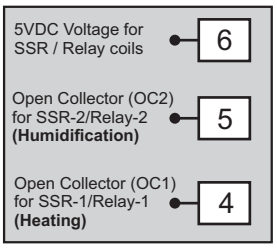


Connect Positive (+) of DC Linear from RH Sensor to terminal 16 and Negative (-) to terminals 17 as shown in the Figure 12.2 (b). Terminal 18 provides +5VDC @ 20mA excitation supply for the transmitter. Use copper conductor leads of very low resistance for connections. Use single run cables avoiding any intermediate joints.

OUTPUT-1 (HEATING) & OUTPUT-2 (HUMIDIFICATION)

The Output-1 and Output-2 are configured for DC Voltage capable of switching the external SSR (Solid State Relay) or Relay. Use Zero-Crossover, 3 to 30 VDC operated SSR, rated approximately 1.5 times the actual load rating. In case of relay, use Relay with coil rated for 5VDC. The terminals for output-1 & output-2 are as shown in Figure 12.3.

Figure 12.3



HEATING (Terminals 4 & 6)

Connect terminals 6 & 4 to SSR (+) & (-) respectively OR to the relay coil.

HUMIDIFICATION (Terminals 5 & 6)

Connect terminals 6 & 5 to SSR (+) & (-) respectively OR to the relay coil.

OUTPUT- 3 (Terminals 7,8 and 9)

The Output-3 module (if fitted) can be configured as either Relay or SSR Drive for Alarm or Compressor Control output. The configuration is through hardware jumper settings on the module as described in *Section 8: Hardware Assembly And Configurations*.

The terminals for Relay, DC Voltage pulses output for SSR output are shown in Figure 12.4 (a) & 12.4 (b), respectively.

Figure 12.4 (a)

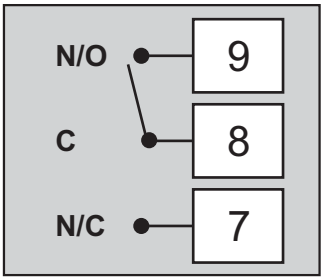
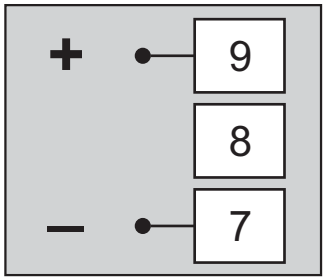


Figure 12.4 (b)



Relay

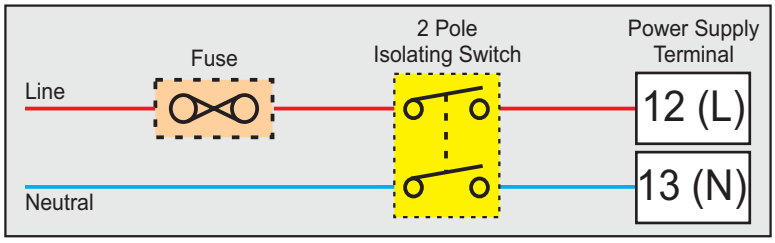
Potential-free Relay changeover contacts N/O (Normally Open), C (Common) and N/C (Normally Close); rated 2A/240 VAC (resistive load) are provided as Relay output. Use external auxiliary device like contactor with appropriate contact rating for driving the actual load.

Drive for SSR

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

POWER SUPPLY (Terminals 12 and 13)

Figure 12.5



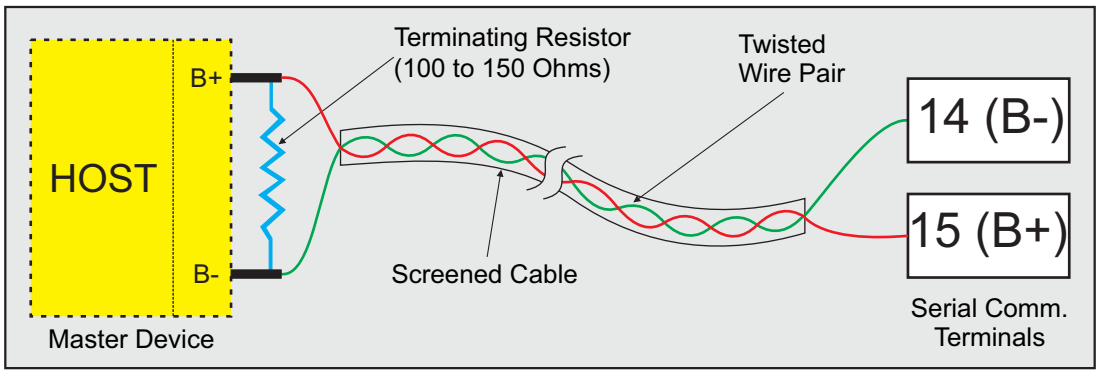
The controller is supplied with power connections suited for 85 to 264 VAC line supply. Use well-insulated copper conductor wire of the size not smaller than 0.5mm^2 for power supply connections. Connect Line (Phase) supply line to terminal 12 and the Neutral (Return) supply line to terminal 13 as shown in Figure 12.5 above. The controller is not provided with fuse and power switch. If necessary, mount them separately. Use a time lag fuse rated 1A @ 240 VAC.

SERIAL COMMUNICATION PORT (Terminals 14 and 15)

If the optional plug-in communication board is fitted, connect terminal 15 and 14 of the controller to (+) and (-) terminals of the Master device for RS485 port. In case of RS232 port connect terminal 15 to TXD (Transmit), Terminal 14 to RXD (Receive) and Terminal 10 to GND (Ground).

To ensure reliable operation of the 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 12.6 below.

Figure 12.6



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