

Smart Temperature & Humidity Control for Air Handling Units (AHUs)



HumiTherm-AH Pro

Universal Inputs (RTD/mAV)
Programmable Economic & Comfort Zones
Heat, Humidifier & 'Cool + De-humidifier' Outputs
¼ DIN (96x96) Compact Enclosure

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User Manual



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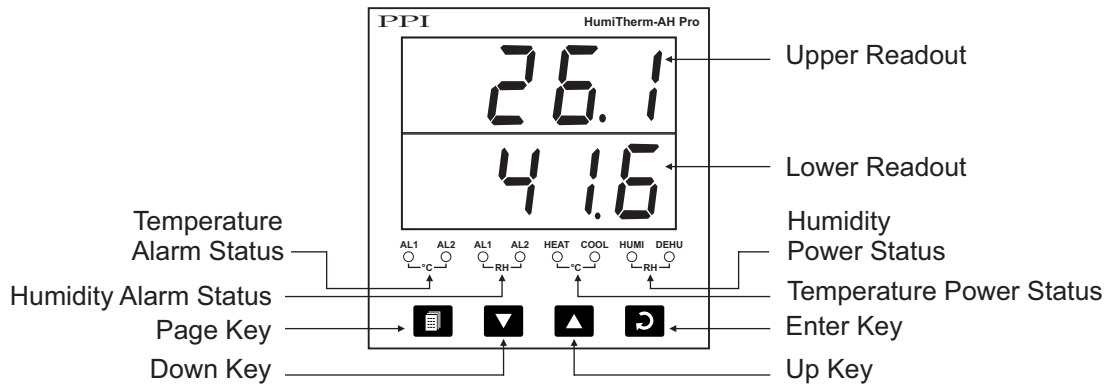
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Section 1

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

Upper Readout

This is a 4 digit, 7-segment bright green LED display and usually displays the Temperature Value in °C.

In Program Mode, the Upper Readout displays parameter values.

Lower Readout

This 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.

INDICATORS

There are 8 front panel red LED indicators. These indicators 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
AL1 AL2 ┌ °C ─┘	Temperature Alarm (Alarm-1 & Alarm-2) Status <ul style="list-style-type: none"> Flashes while the Alarm is active Remains OFF while the Alarm is inactive
AL1 AL2 ┌ RH ─┘	%RH Alarm (Alarm-1 & Alarm-2) Status <ul style="list-style-type: none"> Flashes while the Alarm is active Remains OFF while the Alarm is inactive
HEAT COOL ┌ °C ─┘	Temperature (Heat & Cool) Output Power Status <ul style="list-style-type: none"> Flashes while the HEAT/ COOL Power is above Minimum OFF while the Heat / Cool Power is at Minimum
HUMI DEHU ┌ RH ─┘	Humidity (Humidification & Dehumidification) Output Power Status <ul style="list-style-type: none"> Flashes while the HUMI / DEHU Power is above Minimum OFF while the HUMI / DEHU Power is at Minimum

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.



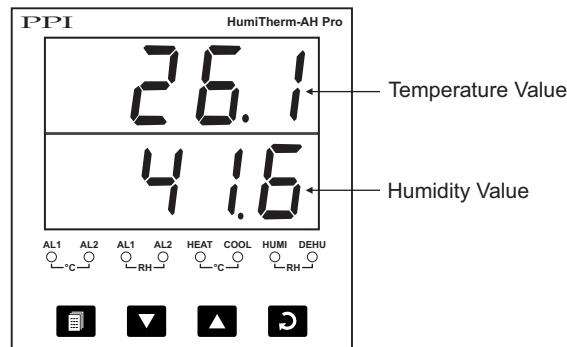
Section 2 BASIC OPERATIONS

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

MAIN DISPLAY MODE

Figure 2.1






After the Power-up display sequence the controller enters into MAIN Display Mode. This is the default mode wherein the Upper Readout displays the measured Temperature in °C and the Lower Readout displays the measured Relative Humidity in %. The MAIN Display Mode is depicted in Figure 2.1 above.

PV ERROR INDICATIONS

The controller flashes the PV error messages for Temperature and RH Values on Upper and Lower Readout, respectively. The Error Messages are listed in Table 2.1 below.

Table 2.1

Message	Error Type	Cause
	Over-range	Temperature/Humidity above Max. Range
	Under-range	Temperature/Humidity below Min. Range
	Sensor Open	Sensor (RTD) Broken / Open

ALARM STATUS UNDER PV ERROR CONDITIONS

For Alarm activation, the *Under-range* condition is treated as minimum PV, whereas the *Over-range* and *Open* conditions are treated as maximum PV. Thus, Process High Alarm is activated upon *Over-range/Open* error. Similarly, Process Low Alarm is activated upon *Under-range* error. An *RH Error* condition activates Alarm associated with RH measurement.

OPERATOR PAGE AND PARAMETERS

The parameters that may require frequent settings or viewing are organized on a separate page, called the Operator Page. The editing of the operator parameters is however selectively controlled at supervisory level and the parameter settings cannot be locked by the Master Lock.

Accessing Operator Page & Adjusting Parameters

Step through the following sequence to open the Operator Page and to adjust the operator parameter values.

1. Press and release PAGE key. The Lower Readout shows PAGE and Upper Readout shows 0.
2. Press ENTER key. The Lower Readout shows prompt (Parameter name) for the first available operator parameter and the Upper Readout shows its value.
3. Use UP / DOWN keys to adjust the value and then press ENTER key to store the set value and scroll to the next parameter.

Use PAGE key to return to MAIN Display Mode.

The operator parameters are described in Table 2.3.

Table 2.3

Parameter Description	Settings (Default Value)
SELECT CHANNEL SEL Select the Temperature or RH channel for setting Control and/or Alarm setpoints through the subsequent parameters.	00 Temp rh Humidity (Default : Temp)
ECONOMIC LOW SETPOINT ECL0 Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.	0.0 to Comfort Low Setpoint (Default : For Heater : 19.0 For Humidifier : 20.0)
COMFORT LOW SETPOINT CFL0 Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.	Economic Low Setpoint to Comfort High Setpoint (Default : For Heater : 21.0 For Humidifier : 40.0)
COMFORT HIGH SETPOINT CFHI Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.	Comfort Low Setpoint to Economic High Setpoint (Default : For Heater : 24.0 For Humidifier : 60.0)
ECONOMIC HIGH SETPOINT ECH1 Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.	Comfort High Setpoint to 100.0 (Default : For Heater : 28.0 For Humidifier : 80.0)
ALARM-1 SETPOINT A1SP ALARM-2 SETPOINT A2SP Depending on the selected channel, this parameter sets the limit for either temperature or Humidity Alarm-1 / Alarm-2. This parameter is presented only if Alarm type is selected as Process High or Process Low.	Setpoint Low Limit to Setpoint High Limit (Default : 0.0)

VIEW CONTROL OUTPUT POWERS

The controller facilitates viewing the Temperature (Heat), Humidity (Humidifier), and 'Cool + De-humidifier' powers on a separate page, called the Control Info Page. The values are non-editable.

Accessing Control Info Page & Viewing Power Values

Step through the following sequence to open the Control Info Page to view power values.

1. Press and release PAGE key. The Lower Readout shows PAGE and Upper Readout shows 0.
2. Use Up/Down Keys to adjust the Upper Readout Value to 1.
3. Press ENTER key. The Lower Readout shows the identifier for the output power type and the Upper Readout shows its value.
4. Keep pressing Enter Key to scroll through all the power values.

Use PAGE key to return to MAIN Display Mode.

The Output Power Types are listed in the Table below.

Parameter Description	Settings (Default Value)
TEMPERATURE POWER Heating output power in %. <div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">0CPr</div>	Read Only
HUMIDITY POWER Humidifier output power in %. <div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">rhPr</div>	Read Only
COOL POWER Cooling output power in %. <div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">CP04</div>	Read Only
DE-HUMIDIFIER POWER De-Humidifier output power in %. <div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">dP04</div>	Read Only
NET COOL POWER % Net Power i.e. cool + de-Humidifier power as per selected "Cool Output Power Strategy". <div style="text-align: center; border: 1px solid black; padding: 2px; width: fit-content; margin: 5px auto;">nEtP</div>	Read Only



Section 3

SET-UP MODE : ACCESS AND OPERATION

The various parameters are arranged in different groups depending upon the functions they represent. Each such group is called a PAGE and is assigned a unique numeric value, called PAGE NUMBER, for its access.

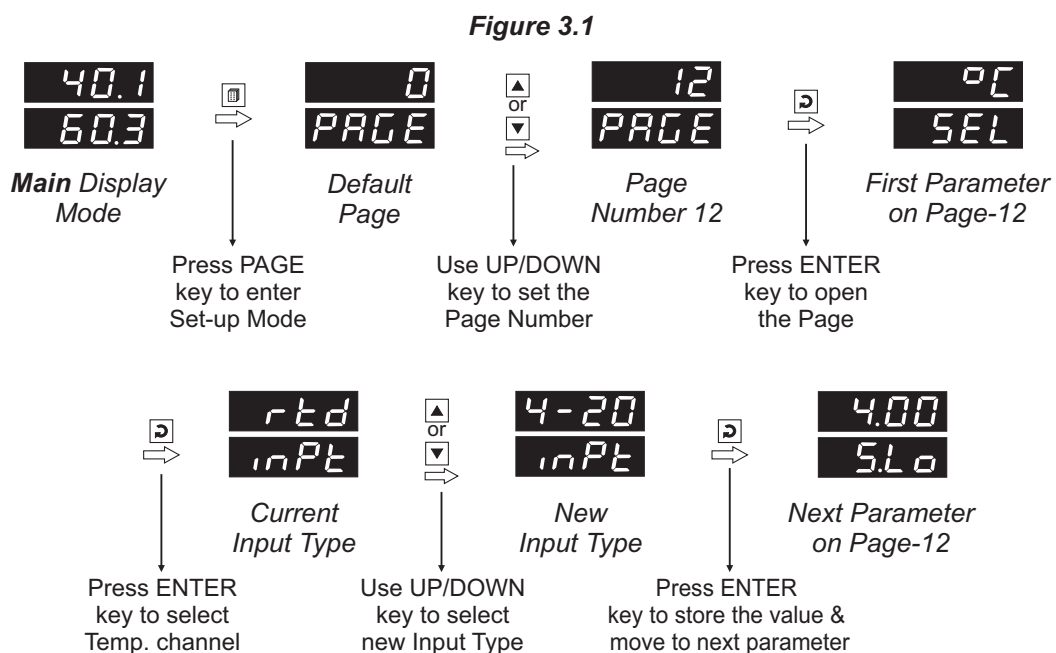
The parameters are always presented in a fixed format: The Lower Readout displays the parameter prompt (Identification Name) and the Upper Readout displays the set value. The parameters appear in the same sequence as listed in their respective sections.

SET-UP MODE

The Set-up Mode allows the user to view and modify the parameter values. Follow the steps below for setting the parameter values:

1. Press and release PAGE key. The Lower Readout shows (PAGE) and the Upper Readout shows page number (0). Refer Figure 3.1.
2. Use UP / DOWN keys to set the desired PAGE NUMBER.
3. Press and release ENTER key. The Lower Readout shows the prompt for the first parameter listed in the set PAGE and the Upper Readout shows its current value. If the entered PAGE NUMBER is invalid (contains no parameter list or any associated function), the controller reverts to the MAIN Display Mode.
4. Press and release the ENTER key until the prompt for the required parameter appears on the Lower Readout. (The last parameter in the list rolls back to the first parameter).
5. Use UP / DOWN keys to adjust the parameter value. (The display flashes if UP key is pressed after reaching the maximum value or DOWN key is pressed after reaching the minimum value).
6. 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 3.1 illustrates the example of altering the value for the parameter 'Input Type for Temperature Channel'.



Notes

1. Each page contains a fixed list of parameters that are presented in a pre-determined sequence. Note however that availability of a few parameters, called Conditional Parameters, depend upon the settings for some other parameters. For example, the parameters 'Range Low' & 'Range High' are not available if the selected Input Type is RTD.
2. To exit the set-up mode and return to the MAIN Display Mode, press and release PAGE key.
3. If no key is pressed for approximately 30 seconds, the set-up mode times out and reverts to the MAIN Display Mode.

MASTER LOCKING

The controller facilitates locking all the PAGES by applying Master Lock Code. Under Locking, the parameters are available for *view only* and cannot be adjusted. The Alarm set-points and standby mode parameters are not locked by the Master Lock if the adjustments are permitted at supervisory level (page 13).

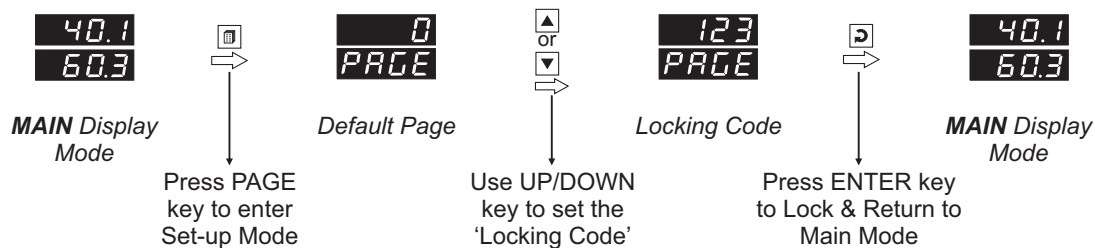
For enabling / disabling the Lock, step through the following sequence:

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. Use UP / DOWN keys to set the Page Number to 123 on the Upper Readout.
3. Press and release ENTER key. The controller returns to the MAIN Display Mode with the Lock enabled.

The Figure 3.2 below illustrates the Locking procedure.

Figure 3.2



UnLocking

Repeat the Locking procedure twice for unlocking.



Section 4

PAGE 8 : AHU PARAMETERS

Refer Appendix-C : *AHU Temperature and Humidity Control Strategy* & Appendix-D : *Dew Point & Cooling in AHU Systems* for more detail.

Table 4.1

Parameter Description	Settings (Default Value)
<p>'COOL + DE-HUMIDIFIER' OUTPUT TYPE CdOP</p> <p>Select type for 'Cool + De-Humidifier' output in accordance with the hardware module fitted and / or the jumper settings.</p> <p>Refer <i>Appendix-D : Dew Point & Cooling in AHU Systems</i> for more detail.</p>	<div style="display: flex; flex-direction: column; gap: 5px;"> <div>rLY Relay</div> <div>SSr SSR</div> <div>0-20 0 - 20 mA</div> <div>4-20 4 - 20 mA</div> <div>0-5 0 - 5 V</div> <div>0-10 0 - 10 V</div> </div> <p>(Default : 0 - 10 V)</p>
<p>COOL OUTPUT POWER STRATEGY COOL</p> <p>Refer <i>Appendix-D : Dew Point & Cooling in AHU Systems</i> for more detail.</p>	<div style="display: flex; flex-direction: column; gap: 5px;"> <div>SUM 'Sum' of Cooling & De-humidifier power</div> <div>G.O.F.2 'Greater' of Cooling & De-humidifier power</div> </div> <p>(Default : SUM)</p>
<p>COOL POWER LOW CPL</p> <p>Sets the minimum % output power limit for 'Cool + De-Humidifier' output.</p>	<p>0 to Cool Power High (Default : 0)</p>
<p>COOL POWER HIGH CPH</p> <p>Sets the maximum % output power limit for 'Cool + De-Humidifier' output.</p>	<p>Cool Power Low to 100 (Default : 100)</p>
<p>COOL CYCLE TIME CCT</p> <p>Sets the 'On + Off' cycle time in seconds for time proportional power output through 'Cool + De-Humidifier' output Relay / SSR.</p>	<p>0.5 to 100.0 (Default : 10.0)</p>
<p>SELECT CHANNEL SEL</p> <p>Select the Temperature (°C) or Humidity (RH) channel for viewing and/or editing the Control settings through the subsequent parameters.</p>	<div style="display: flex; flex-direction: column; gap: 5px;"> <div>°C Temp</div> <div>rh Humidity</div> </div> <p>(Default : Temp)</p>

Parameter Description	Settings (Default Value)
<p>HEAT/HUMIDIFIER OUTPUT TYPE OPE</p> <p><u>Heat Control</u></p> <p>Select type for Heat output in accordance with the hardware module fitted and / or the jumper settings.</p> <p><u>Humidifier Control</u></p> <p>(This parameter is available only if 'Humidifier Output Enable' parameter is set to "Yes")</p> <p>Select type for Humidifier output in accordance with the hardware module fitted and / or the jumper settings.</p> <p>(Note : For Humidifier only two options are available : Relay or SSR)</p>	<div style="display: flex; flex-direction: column; align-items: flex-start;"> <div style="margin-bottom: 5px;">rly Relay</div> <div style="margin-bottom: 5px;">SSr SSR</div> <div style="margin-bottom: 5px;">0-20 0 - 20 mA</div> <div style="margin-bottom: 5px;">4-20 4 - 20 mA</div> <div style="margin-bottom: 5px;">0-5 0 - 5 V</div> <div style="margin-bottom: 5px;">0-10 0 - 10 V</div> <p>(Default : For Heater : 0 to 10V For Humidifier : SSR)</p> </div>
<p>ECONOMIC LOW SETPOINT ECLD</p> <p>Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.</p>	<p>0.0 to Comfort Low Setpoint (Default : For Heater : 19.0 For Humidifier : 20.0)</p>
<p>COMFORT LOW SETPOINT CFLO</p> <p>Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.</p>	<p>Economic Low Setpoint to Comfort High Setpoint (Default : For Heater : 21.0 For Humidifier : 40.0)</p>
<p>COMFORT HIGH SETPOINT CFHI</p> <p>Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.</p>	<p>Comfort Low Setpoint to Economic High Setpoint (Default : For Heater : 24.0 For Humidifier : 60.0)</p>
<p>ECONOMIC HIGH SETPOINT ECHI</p> <p>Refer Appendix-C : AHU Temperature & Humidity Control Strategy for details.</p>	<p>Comfort High Setpoint to 100.0 (Default : For Heater : 28.0 For Humidifier : 80.0)</p>
<p>HEAT/HUMIDIFIER POWER LOW PL</p> <p>Sets the minimum % output power limit for Heat or Humidifier.</p>	<p>0 to Heat/Humidifier Power High (Default : 0)</p>
<p>HEAT/HUMIDIFIER POWER HIGH PH</p> <p>Sets the maximum % output power limit for Heat or Humidifier.</p>	<p>Heat/Humidifier Power Low to 100 (Default : 100)</p>

Parameter Description	Settings (Default Value)
<p>HEAT/HUMIDIFIER CYCLE TIME 10</p> <p>Sets the total 'On + Off' time in seconds for time proportional power output through Heat or Humidifier Relay / SSR.</p>	<p>0.5 to 100.0 (Default : 10.0)</p>



Section 5

PAGE-10 : ALARM PARAMETERS

The Alarm Parameters for both *Temperature* and *Humidity* are similar and grouped under their respective channel. To select and edit any parameters for *Temperature* (°C) or *Humidity* (RH), first select the appropriate channel using the parameter 'SEL' (Select). Refer Table 5.1 for parameter description and settings.

Table 5.1

Parameter Description	Settings (Default Value)
<p>SELECT CHANNEL SEL</p> <p>Select the Temperature (°C) or Humidity (RH) channel for viewing and/or editing the Alarm settings through the subsequent parameters.</p>	<p>0C Temp</p> <p>rh Humidity</p> <p>(Default : Temp)</p>
<p>ALARM 1 TYPE AL_1</p> <p><i>None</i> The Alarm function is disabled.</p> <p><i>Process Low</i> The Alarm is activated upon the Temperature/Humidity value equaling or falling below the 'Alarm Set-point' value.</p> <p><i>Process High</i> The Alarm is activated upon the Temperature/Humidity value equaling or rising above the 'Alarm Set-point' value.</p>	<p>none None</p> <p>P_Lo Process Low</p> <p>P_Hi Process High</p> <p>(Default : None)</p>
<p>ALARM-1 HYSTERESIS A1HY</p> <p><i>(Not Available if Alarm Type is None)</i></p> <p>This parameter sets a differential (dead) band between the ON and OFF Alarm status change. Keep it large enough to avoid frequent switching of the Alarm relay.</p>	<p>0.2 to 99.9</p> <p>(Default : 2.0)</p>
<p>ALARM-1 INHIBIT A1h</p> <p><i>(Not Available if Alarm Type is None)</i></p> <p><i>Yes</i> The Alarm activation is suppressed until the Temperature / Humidity value is within Alarm limits from the time the controller is switched ON. This allows suppressing the Alarm during the start-up Alarm conditions.</p> <p><i>No</i> The Alarm is not suppressed during the start-up Alarm conditions.</p>	<p>no No</p> <p>YES Yes</p> <p>(Default : Yes)</p>
<p>ALARM 2 TYPE AL_2</p> <p>ALARM-2 HYSTERESIS A2HY</p> <p>ALARM-2 INHIBIT A2h</p> <p><i>The parameter descriptions and settings are the same as that for Alarm-1.</i></p>	

Section 6

PAGE 12 : INPUT CONFIGURATION PARAMETERS

The Controller supports interface for both RTD Pt100 Sensors and DC Current / Voltage outputs from Temperature/Humidity Transmitters. The Parameters on this PAGE allows appropriate configuration for available input types for each channel (Temperature & Humidity). The parameters for both *Temperature* and *Humidity* input types are similar and grouped under their respective channel. To select and edit any parameters for *Temperature* (°C) or *Humidity* (RH), first select the appropriate channel using the parameter 'SEL' (Select).

Refer Table 6.1 for parameter description and settings.

Table 6.1

Parameter Description	Settings (Default Value)																					
SELECT CHANNEL SEL Select the Temperature (°C) or Humidity (RH) channel for Input Sensor configurations.	0C Temp RH Humidity (Default : Temp)																					
INPUT TYPE I nPt Select Input type in accordance with the type of Temperature or Humidity sensor/transmitter connected for measurement.	Refer Table 6.2 (Default : For Temp. : RTD & For Humidity : 0 to 5.0)																					
SIGNAL LOW S.Lo <i>(Available for DC linear mV/V/mA Inputs only)</i> The transmitter output signal value corresponding to Range Low process value. Refer <i>Appendix-B : DC Linear Signal Interface</i> for details.	<table border="1"> <thead> <tr> <th>Input Type</th> <th>Settings</th> <th>Default</th> </tr> </thead> <tbody> <tr> <td>0 to 20 mA</td> <td>0.00 to Signal High</td> <td>0.00</td> </tr> <tr> <td>4 to 20 mA</td> <td>4.00 to Signal High</td> <td>4.00</td> </tr> <tr> <td>0 to 1.25 V</td> <td>0.000 to Signal High</td> <td>0.000</td> </tr> <tr> <td>0 to 5 V</td> <td>0.000 to Signal High</td> <td>0.000</td> </tr> <tr> <td>0 to 10 V</td> <td>0.00 to Signal High</td> <td>0.00</td> </tr> <tr> <td>1 to 5 V</td> <td>1.000 to Signal High</td> <td>1.000</td> </tr> </tbody> </table>	Input Type	Settings	Default	0 to 20 mA	0.00 to Signal High	0.00	4 to 20 mA	4.00 to Signal High	4.00	0 to 1.25 V	0.000 to Signal High	0.000	0 to 5 V	0.000 to Signal High	0.000	0 to 10 V	0.00 to Signal High	0.00	1 to 5 V	1.000 to Signal High	1.000
Input Type	Settings	Default																				
0 to 20 mA	0.00 to Signal High	0.00																				
4 to 20 mA	4.00 to Signal High	4.00																				
0 to 1.25 V	0.000 to Signal High	0.000																				
0 to 5 V	0.000 to Signal High	0.000																				
0 to 10 V	0.00 to Signal High	0.00																				
1 to 5 V	1.000 to Signal High	1.000																				
SIGNAL HIGH S.Hi <i>(Available for DC linear mV/V/mA Inputs only)</i> The transmitter output signal value corresponding to Range High process value. Refer <i>Appendix-B : DC Linear Signal Interface</i> for details.	<table border="1"> <thead> <tr> <th>Input Type</th> <th>Settings</th> <th>Default</th> </tr> </thead> <tbody> <tr> <td>0 to 20 mA</td> <td>Signal Low to 20.00</td> <td>20.00</td> </tr> <tr> <td>4 to 20 mA</td> <td>Signal Low to 20.00</td> <td>20.00</td> </tr> <tr> <td>0 to 1.25 V</td> <td>Signal Low to 1.250</td> <td>1.250</td> </tr> <tr> <td>0 to 5 V</td> <td>Signal Low to 5.000</td> <td>5.000</td> </tr> <tr> <td>0 to 10 V</td> <td>Signal Low to 10.00</td> <td>10.00</td> </tr> <tr> <td>1 to 5 V</td> <td>Signal Low to 5.000</td> <td>5.000</td> </tr> </tbody> </table>	Input Type	Settings	Default	0 to 20 mA	Signal Low to 20.00	20.00	4 to 20 mA	Signal Low to 20.00	20.00	0 to 1.25 V	Signal Low to 1.250	1.250	0 to 5 V	Signal Low to 5.000	5.000	0 to 10 V	Signal Low to 10.00	10.00	1 to 5 V	Signal Low to 5.000	5.000
Input Type	Settings	Default																				
0 to 20 mA	Signal Low to 20.00	20.00																				
4 to 20 mA	Signal Low to 20.00	20.00																				
0 to 1.25 V	Signal Low to 1.250	1.250																				
0 to 5 V	Signal Low to 5.000	5.000																				
0 to 10 V	Signal Low to 10.00	10.00																				
1 to 5 V	Signal Low to 5.000	5.000																				
RANGE LOW r.Lo <i>(Available for DC linear mV/V/mA Inputs only)</i> The process value corresponding to the Signal Low value from the transmitter. Refer <i>Appendix-B : DC Linear Signal Interface</i> for details.	-199.9 to 999.9 (Default : 0.0)																					

Parameter Description	Settings (Default Value)
<p>RANGE HIGH r.h.i</p> <p><i>(Available for DC linear mV/V/mA Inputs only)</i></p> <p>The process value corresponding to the Signal High value from the transmitter. Refer <i>Appendix-B : DC Linear Signal Interface</i> for details.</p>	-199.9 to 999.9 (Default : 100.0)
<p>OFFSET OFSE</p> <p>This value is algebraically added to the measured Temperature / Humidity Value to derive the final Value that is displayed and compared for alarm / control. Use this value to nullify any known constant error.</p> <p>Final Value = Measured Value + Offset</p>	-50.0 to 50.0 (Default : 0.0)
<p>FILTER F.LT</p> <p>Sets the time constant, in seconds, for the low-pass digital filter applied to the measured PV. The filter helps smoothing / averaging the signal input and removing the undesired noise. The higher the filter value the lower the indication response to the PV changes and vice-a-versa.</p>	0.5 to 60.0 Seconds (in steps of 0.5 Seconds) (Default : 2.0 sec.)

Table 6.2

Option	What it means	Range (Min. to Max.)	Resolution
rtd	3-wire, RTD Pt100 (Available for Temperature Input Only)	-199.9 to +600.0°C	0.1 °C
0-20	0 to 20mA DC current	-199.9 to 999.9 units	0.1 units
4-20	4 to 20mA DC current		
RES.1	Reserved (Do not select)		
RES.2			
1.25	0 to 1.25V DC voltage		
5.0	0 to 5.0V DC voltage		
10.0	0 to 10.0V DC voltage		
1-5	1 to 5.0V DC voltage		

Section 7

PAGE 13 : SUPERVISORY PARAMETERS

The supervisory level responsibilities include exercising control over operator, making process related decisions and controlling the availability of process data for remote use.

The Table 7.1 below list supervisory parameters.

Table 7.1

Parameter Description	Settings (Default Value)
CONTROL/ALARM SET-POINT ADJUSTMENT PERMISSION SP.OP Supervisory permission for Control & Alarm set-point adjustments for Temperature & Humidity channels. Set to 'Enable' for permission.	d5bL Disable EnbL Enable (Default : Disable)
DEVICE SLAVE ID 1d (Applicable for Serial Communication) 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 baud (Applicable for Serial Communication) This parameter sets communication speed in 'Bits per Second'. Set the value to match with the host baud rate.	4.8 4800 9.6 9600 19.2 19200 (Default : 9600)
PARITY PARi (Applicable for Serial Communication) One of the communication error trapping features. Select the data packet parity as implemented by the host protocol.	nonE None EuEn Even Odd Odd (Default : Even)
SERIAL WRITE PERMISSION CoñE (Applicable for Serial Communication) Setting to 'No' disallows the host to set / modify any parameter values. The host, however, can read the values.	no No YES Yes (Default : Yes)



Section 8

PAGE 15 : UNOCCUPANCY MODE PARAMETERS

Refer Appendix-E : Occupancy-Based Control Using Setback Offset for more detailed.

Table 8.1

Parameter Description	Settings (Default Value)
<p>UNOCCUPANCY MODE ENABLE UOEn</p> <p>Enables or disables occupancy-based zone shifting. When enabled, configured setback offsets are applied during Unoccupied Mode.</p>	<p>no No yes Yes (Default : No)</p>
<p>UNOCCUPANCY 'TEMPERATURE OFFSET' UeOF</p> <p>Signed temperature offset applied to Comfort and Economic temperature limits during Unoccupied Mode.</p>	<p>-10.0 to 10.0 (Default : 2.0)</p>
<p>UNOCCUPANCY 'HUMIDITY OFFSET' UHOF</p> <p>Positive humidity widening value applied to Comfort and Economic humidity limits during Unoccupied Mode.</p>	<p>0.0 to 20.0 (Default : 10.0)</p>
<p>HUMIDIFICATION IN UNOCCUPANCY MODE UOHU</p> <p>Enables or disables humidification output during Unoccupied Mode. Dehumidification remains active.</p>	<p>d5bL Disable EnbL Enable (Default : Disable)</p>
<p>UNOCCUPANCY MODE SELECT SOURCE UOSr</p> <p>Selects the control source for activating Unoccupied Mode (Digital Input or MODBUS command).</p>	<p>dI DI (Digital Input) rtU RTU (MODBUS) (Default : DI)</p>



Section 9

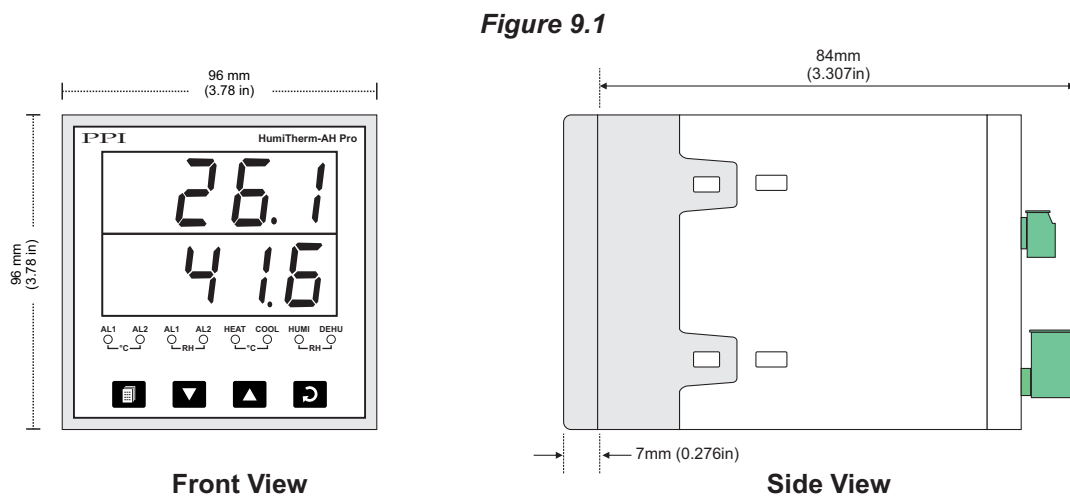
MECHANICAL INSTALLATION

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 and Relative Humidity 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.

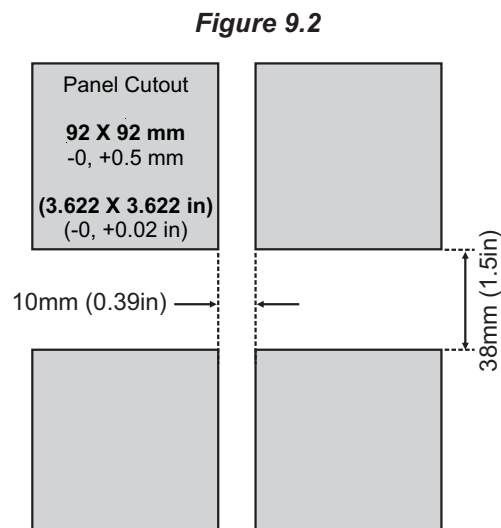
OUTER DIMENSIONS

The Figure 9.1 shows the outer dimensions of the controller.



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.

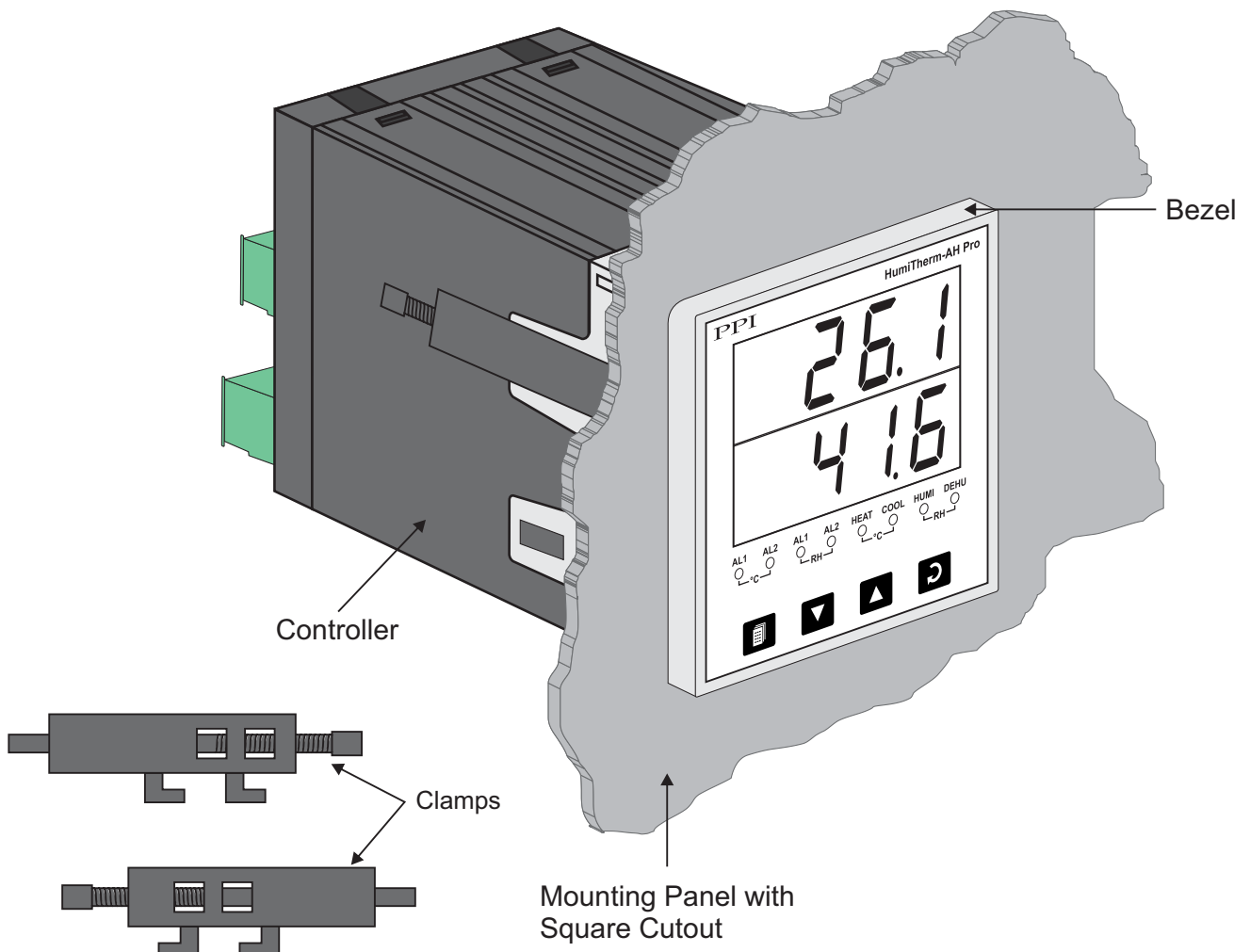


PANEL MOUNTING

Follow the steps below for mounting the controller on panel:

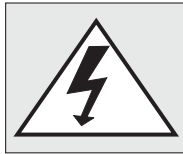
1. Prepare a square cutout to the size shown in Figure 9.2.
2. Remove the Mounting Clamps from the controller Enclosure.
3. Insert the rear of the controller housing through the panel cutout from the front of the mounting panel.
4. Hold the controller gently against the mounting panel such that it positions squarely against the panel wall, see Figure 9.3. Apply pressure only on the bezel and not on the front label.
5. Fix the Mounting Clamps (one after the other) such that the metallic projection fits in the square hole provided on the top and bottom sides of the enclosure. Tighten the clamp screw until the clamps firmly secure against the panel wall.

Figure 9.3



Section 10

ELECTRICAL CONNECTIONS



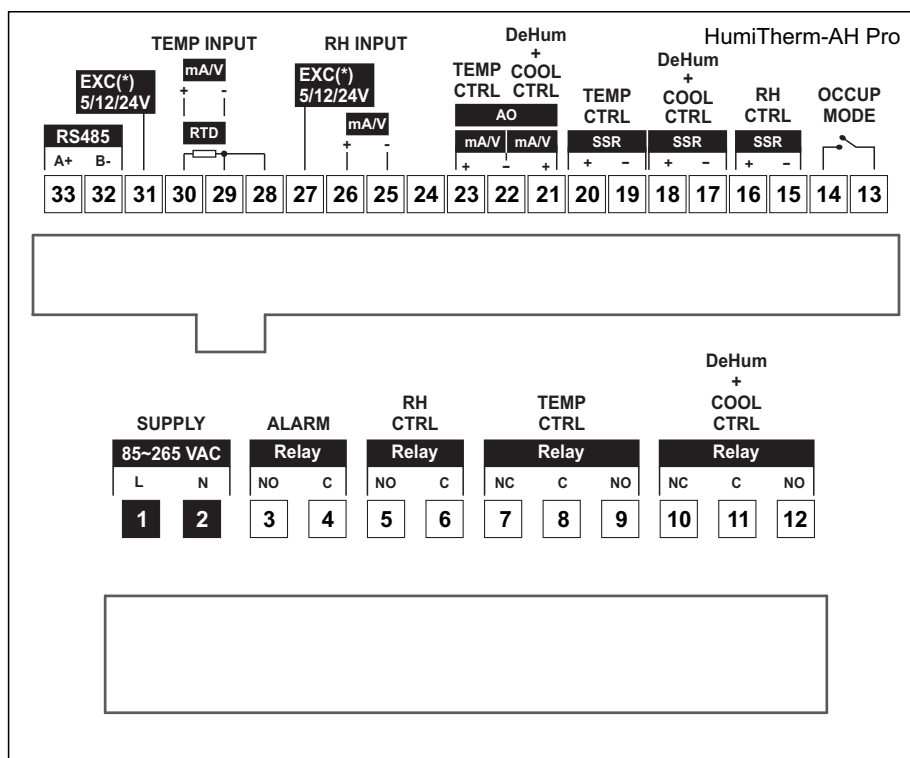
WARNING
MISHANDLING / NEGLIGENCE CAN RESULT IN PERSONAL DEATH OR SERIOUS INJURY.

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 low-level signal cables (like **RTD**, **DC** Linear Current/Voltage, 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 controller enclosure. The diagram shows the terminals viewed from the **REAR SIDE** with the controller label upright. The Connection Diagram is a generic one; the connections shown for optional modules are applicable only if the modules are fitted.

Figure 10.1

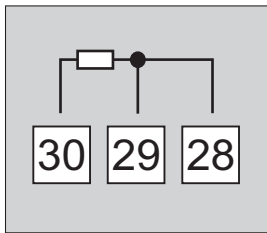


DESCRIPTIONS

TEMP INPUT : RTD Pt100, 3-Wire / mA / V (Terminals 30, 29, 28)

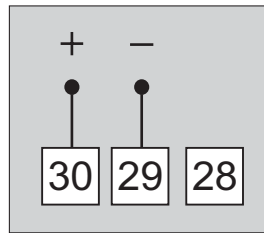
RH INPUT : mA / V (Terminals 26, 25)

Figure 10.2 (a) : RTD Input

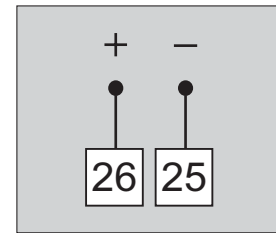


Temperature Input

Figure 10.2 (b) : mA / V Input



Temperature Input



Humidity Input

** Refer "EXC 5/12/24VDC : Excitation Voltage for Transmitters (Terminal : 31, 27)"*

RTD Pt100, 3-wire

Connect single lead end of RTD bulb to terminal 30 and the double lead ends to terminal 29 and 28, interchangeable, as shown in Figure 10.2 (a). Use copper conductor leads of very low resistance ensuring that all 3 leads are of the same gauge and length. Avoid joints in the cable.

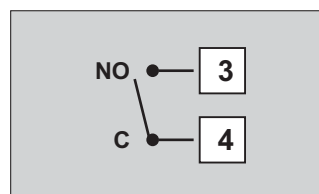
DC Linear Signal (mA/V)

Use a shielded twisted pair with the shield grounded at the signal source for connecting Voltage source. Connect common (-) to terminal 29 (25) and the signal (+) to terminal 30 (26), as shown in Figure 10.2 (b). The DC Current source (mA) is also connected in the similar way.

ALARM : Temperature / Humidity Alarm Relay Output (Terminals 3, 4)

(This output is common to all alarms. Refer front panel LED indicators for specific alarm activations.)

Figure 10.3



Temp. / Humidity Alarm Relay

TEMP. CTRL : Temperature (Heat) Control Relay Output (Terminals 7, 8, 9)

TEMP. CTRL : Temperature (Heat) Control SSR Output (Terminals 20, 19)

TEMP. CTRL : Temperature (Heat) Control mA/V Output (Terminals 23, 22)

DeHum + COOL CTRL : 'De-Humidifier + Cool' Control Relay Output (Terminals 10, 11, 12)

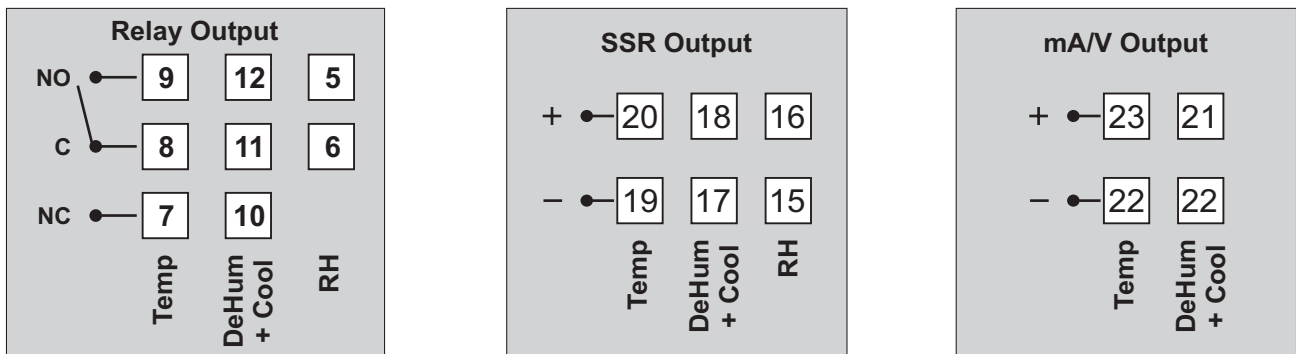
DeHum + COOL CTRL : 'De-Humidifier + Cool' Control SSR Output (Terminals 18, 17)

DeHum + COOL CTRL : 'De-Humidifier + Cool' Control mA/V Output (Terminals 21, 22)

RH CTRL : Humidifier Control Relay Output (Terminals 5, 6)

RH CTRL : Humidifier Control SSR Output (Terminals 16, 15)

Figure 10.4



Relay Output

Potential-free Relay changeover contacts NO (Normally Open), NC (Normally Close), and C (Common) rated 10A/240 VAC (resistive load).

SSR Output

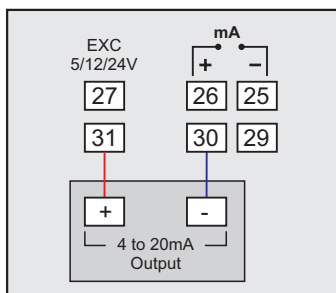
Connect (+) and (-) terminals of SSR to (+) and (-) terminals of controller, respectively. Use Zero-Crossover, 3 to 30 VDC operated SSR.

mA/V Output

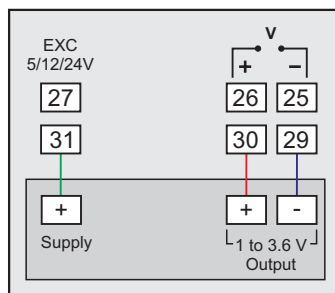
The terminal marked '+' & '-' are the Current/Voltage source output and return, respectively.

EXC 5/12/24VDC : Excitation Voltage for Transmitters (Terminal : 31, 27)

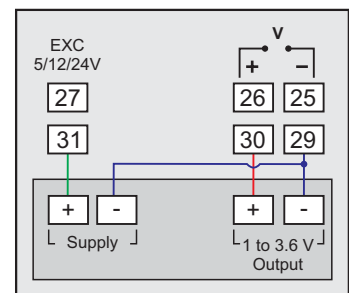
The Controller is supplied with either 5 or 12 or 24VDC @ 30 mA power source. This is primarily meant for exciting 2-wire or 4-wire Current / Voltage output transmitters. Please note that only the Source terminal (positive) is provided on the back panel termination. The Sensor negative terminal is used as Return terminal (ground) for excitation output.



2-wire Current Transmitter (5/12/24VDC Supply)



3-wire Voltage Transmitter (5/12/24VDC Supply)



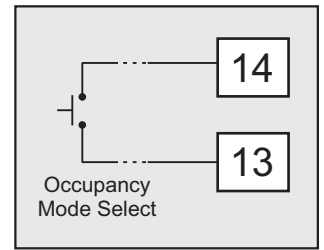
4-wire Voltage Transmitter (5/12/24VDC Supply)

OCCUP MODE (Terminals 14, 13)

The potential-free contact closure digital input for switching between Occupancy (Day) and Unoccupancy (Night).

OPEN = Occupancy Mode
CLOSE = Unoccupancy Mode.

Figure 10.5

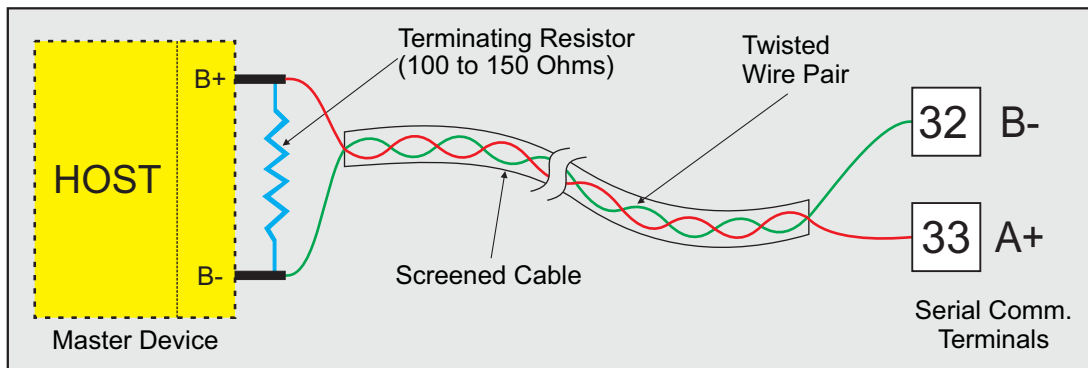


RS485 : Serial Communication Port (Terminals 33, 32)

Connect terminal 33 and 32 of the controller to (+) and (-) RS485 terminals of the Master device.

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 10.6 below.

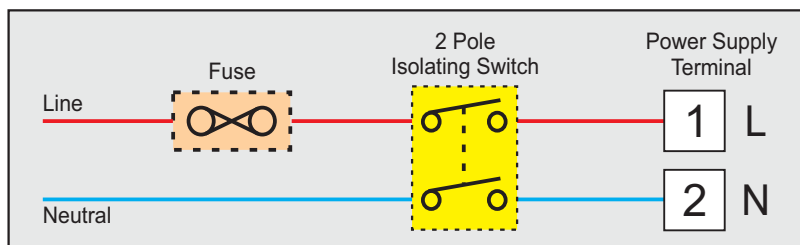
Figure 10.6



85~264 VAC : Power Supply (Terminals 1, 2)

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 0.5mm² for power supply connections. Connect Line (Phase) supply line to terminal 1 and the Neutral (Return) supply line to terminal 2 as shown in Figure 10.7 below. The controller is not provided with fuse and power switch. If necessary, mount them separately. Use a time lag fuse rated 1A @ 240 VAC.

Figure 10.7



Section 11 MODBUS MAPPING

Table 1 : Read Only Parameters

Parameter	Data Type	Address	Remark								
Parameter Modified through Front Panel Keys	16 bit signed integer	1	<table border="1"> <thead> <tr> <th>Value</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>One or more parameters are modified using front panel keys since last MODBUS read.</td> </tr> <tr> <td>0</td> <td>No parameter is modified since last MODBUS read.</td> </tr> </tbody> </table>	Value	Meaning	1	One or more parameters are modified using front panel keys since last MODBUS read.	0	No parameter is modified since last MODBUS read.		
			Value	Meaning							
			1	One or more parameters are modified using front panel keys since last MODBUS read.							
0	No parameter is modified since last MODBUS read.										
Measured Temperature Value	16 bit signed integer	2	<i>Resolution Based Parameter : Refer Appendix-A</i> The following constant counts indicate PV Errors.								
Measured Humidity Value	16 bit signed integer	3									
			<table border="1"> <thead> <tr> <th>Value</th> <th>PV Error Type</th> </tr> </thead> <tbody> <tr> <td>-32768</td> <td>Under Range</td> </tr> <tr> <td>+32752</td> <td>Over Range</td> </tr> <tr> <td>+32767</td> <td>Sensor Open</td> </tr> </tbody> </table>	Value	PV Error Type	-32768	Under Range	+32752	Over Range	+32767	Sensor Open
Value	PV Error Type										
-32768	Under Range										
+32752	Over Range										
+32767	Sensor Open										
Alarm 1 Status for Temperature	16 bit signed integer	5	<table border="1"> <thead> <tr> <th>Value</th> <th>Status</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Alarm OFF</td> </tr> <tr> <td>1</td> <td>Alarm ON</td> </tr> </tbody> </table>	Value	Status	0	Alarm OFF	1	Alarm ON		
Value	Status										
0	Alarm OFF										
1	Alarm ON										
Alarm 2 Status for Temperature	16 bit signed integer	7									
Alarm 1 Status for Humidity	16 bit signed integer	6									
Alarm 2 Status for Humidity	16 bit signed integer	8									
Occupancy Mode Change Digital Input Status	16 bit signed integer	9	<table border="1"> <thead> <tr> <th>Value</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Occupancy</td> </tr> <tr> <td>1</td> <td>Unoccupancy</td> </tr> </tbody> </table>	Value	Mode	0	Occupancy	1	Unoccupancy		
Value	Mode										
0	Occupancy										
1	Unoccupancy										
Heat Output Power	16 bit signed integer	15	<i>Resolution Based Parameter : Refer Appendix-A</i>								
Humidification Output Power	16 bit signed integer	16									
Cool Output Power	16 bit signed integer	17									
Dehumidification Output Power	16 bit signed integer	18									
Net Cool Output Power (Sum or Larger of Cool & Dehumidification Power)	16 bit signed integer	19									

Table 2 : Read / Write Parameters

Parameter	Data Type	Address	Remark																				
Input Type for Temperature	16 bit signed integer	44	<table border="1"> <thead> <tr> <th>Value</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>RTD Pt100, 3-wire</td> </tr> <tr> <td>1</td> <td>0 to 20 mA</td> </tr> <tr> <td>2</td> <td>4 to 20 mA</td> </tr> <tr> <td>3</td> <td>Reserved 1</td> </tr> <tr> <td>4</td> <td>Reserved 2</td> </tr> <tr> <td>5</td> <td>0 to 1.25 V</td> </tr> <tr> <td>6</td> <td>0 to 5 V</td> </tr> <tr> <td>7</td> <td>0 to 10 V</td> </tr> <tr> <td>8</td> <td>1 to 5 V</td> </tr> </tbody> </table>	Value	Type	0	RTD Pt100, 3-wire	1	0 to 20 mA	2	4 to 20 mA	3	Reserved 1	4	Reserved 2	5	0 to 1.25 V	6	0 to 5 V	7	0 to 10 V	8	1 to 5 V
			Value	Type																			
			0	RTD Pt100, 3-wire																			
			1	0 to 20 mA																			
			2	4 to 20 mA																			
			3	Reserved 1																			
			4	Reserved 2																			
			5	0 to 1.25 V																			
			6	0 to 5 V																			
			7	0 to 10 V																			
8	1 to 5 V																						
Input Type for Humidity	16 bit signed integer	45	<table border="1"> <thead> <tr> <th>Value</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0 to 20 mA</td> </tr> <tr> <td>2</td> <td>4 to 20 mA</td> </tr> <tr> <td>3</td> <td>Reserved 1</td> </tr> <tr> <td>4</td> <td>Reserved 2</td> </tr> <tr> <td>5</td> <td>0 to 1.25 V</td> </tr> <tr> <td>6</td> <td>0 to 5 V</td> </tr> <tr> <td>7</td> <td>0 to 10 V</td> </tr> <tr> <td>8</td> <td>1 to 5 V</td> </tr> </tbody> </table>	Value	Type	1	0 to 20 mA	2	4 to 20 mA	3	Reserved 1	4	Reserved 2	5	0 to 1.25 V	6	0 to 5 V	7	0 to 10 V	8	1 to 5 V		
			Value	Type																			
			1	0 to 20 mA																			
			2	4 to 20 mA																			
			3	Reserved 1																			
			4	Reserved 2																			
			5	0 to 1.25 V																			
			6	0 to 5 V																			
			7	0 to 10 V																			
			8	1 to 5 V																			
Signal Low for Temperature	16 bit signed integer	46	<i>Resolution Based Parameter : Refer Appendix-A</i>																				
Signal High for Temperature	16 bit signed integer	48																					
Range Low for Temperature	16 bit signed integer	50																					
Range High for Temperature	16 bit signed integer	52																					
Zero-Offset for Temperature	16 bit signed integer	54																					
Signal Low for Humidity	16 bit signed integer	47																					
Signal High for Humidity	16 bit signed integer	49																					
Range Low for Humidity	16 bit signed integer	51																					
Range High for Humidity	16 bit signed integer	53																					
Zero-Offset for Humidity	16 bit signed integer	55																					

Parameter	Data Type	Address	Remark								
Digital Filter for Temperature	16 bit signed integer	90	<i>Resolution Based Parameter : Refer Appendix-A</i> Settable in multiples of 0.5 Seconds. Non-multiples of 0.5 are automatically converted to the nearest multiple of 5.								
Digital Filter for humidity	16 bit signed integer	91									
Alarm-1 Type for Temperature	16 bit signed integer	56	<table border="1"> <thead> <tr> <th>Value</th> <th>Type</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>None</td> </tr> <tr> <td>1</td> <td>Process Low</td> </tr> <tr> <td>2</td> <td>Process High</td> </tr> </tbody> </table>	Value	Type	0	None	1	Process Low	2	Process High
Value	Type										
0	None										
1	Process Low										
2	Process High										
Alarm-2 Type for Temperature	16 bit signed integer	62									
Alarm-1 Type for Humidity	16 bit signed integer	57									
Alarm-2 Type for Humidity	16 bit signed integer	63									
Alarm-1 SP for Temperature	16 bit signed integer	40	<i>Resolution Based Parameter : Refer Appendix-A</i>								
Alarm-1 Hysteresis for Temperature	16 bit signed integer	58									
Alarm-2 SP for Temperature	16 bit signed integer	42									
Alarm-2 Hysteresis for Temperature	16 bit signed integer	64									
Alarm-1 SP for Humidity	16 bit signed integer	41									
Alarm-1 Hysteresis for Humidity	16 bit signed integer	59									
Alarm-2 SP for Humidity	16 bit signed integer	43									
Alarm-2 Hysteresis for Humidity	16 bit signed integer	65									
Alarm-1 Inhibit for Temperature	16 bit signed integer	60	<table border="1"> <thead> <tr> <th>Value</th> <th>Inhibit</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Disable</td> </tr> <tr> <td>1</td> <td>Enable</td> </tr> </tbody> </table>	Value	Inhibit	0	Disable	1	Enable		
Value	Inhibit										
0	Disable										
1	Enable										
Alarm-2 Inhibit for Temperature	16 bit signed integer	66									
Alarm-1 Inhibit for Humidity	16 bit signed integer	61									
Alarm-2 Inhibit for Humidity	16 bit signed integer	67									

Parameter	Data Type	Address	Remark														
Heat Output Type	16 bit signed integer	69	<table border="1"> <thead> <tr> <th>Value</th> <th>Output Type</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Relay</td> </tr> <tr> <td>1</td> <td>SSR</td> </tr> <tr> <td>2</td> <td>0 to 20 mA</td> </tr> <tr> <td>3</td> <td>4 to 20 mA</td> </tr> <tr> <td>4</td> <td>0 to 5 V</td> </tr> <tr> <td>5</td> <td>0 to 10 V</td> </tr> </tbody> </table>	Value	Output Type	0	Relay	1	SSR	2	0 to 20 mA	3	4 to 20 mA	4	0 to 5 V	5	0 to 10 V
			Value	Output Type													
			0	Relay													
			1	SSR													
			2	0 to 20 mA													
			3	4 to 20 mA													
4	0 to 5 V																
5	0 to 10 V																
Humidification Output Type	16 bit signed integer	70	<table border="1"> <thead> <tr> <th>Value</th> <th>Output Type</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Relay</td> </tr> <tr> <td>1</td> <td>SSR</td> </tr> </tbody> </table>	Value	Output Type	0	Relay	1	SSR								
			Value	Output Type													
0	Relay																
1	SSR																
Economic Low Setpoint for Heat Control	16 bit signed integer	71	<i>Resolution Based Parameter : Refer Appendix-A</i>														
Economic High Setpoint for Heat Control	16 bit signed integer	77															
Economic Low Setpoint for Humidification Control	16 bit signed integer	72															
Economic High Setpoint for Humidification Control	16 bit signed integer	78															
Comfort Low Setpoint for Heat Control	16 bit signed integer	73															
Comfort High Setpoint for Heat Control	16 bit signed integer	75															
Comfort Low Setpoint for Humidification Control	16 bit signed integer	74															
Comfort High Setpoint for Humidification Control	16 bit signed integer	76															
Heat Power Low Limit	16 bit signed integer	79															
Heat Power High Limit	16 bit signed integer	81															
Humidification Power Low Limit	16 bit signed integer	80															
Humidification Power High Limit	16 bit signed integer	82															
Cycle Time for Heat Output Power (Relay / SSR)	16 bit signed integer	83		<i>Resolution Based Parameter : Refer Appendix-A</i> Settable in multiples of 0.5 Seconds. Non-multiples of 0.5 are automatically converted to the nearest multiple of 5.													
Cycle Time for Humidification Output Power	16 bit signed integer	84															

Parameter	Data Type	Address	Remark														
Cool + Dehumidification Output Type	16 bit signed integer	85	<table border="1"> <thead> <tr> <th>Value</th> <th>Output Type</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Relay</td> </tr> <tr> <td>1</td> <td>SSR</td> </tr> <tr> <td>2</td> <td>0 to 20 mA</td> </tr> <tr> <td>3</td> <td>4 to 20 mA</td> </tr> <tr> <td>4</td> <td>0 to 5 V</td> </tr> <tr> <td>5</td> <td>0 to 10 V</td> </tr> </tbody> </table>	Value	Output Type	0	Relay	1	SSR	2	0 to 20 mA	3	4 to 20 mA	4	0 to 5 V	5	0 to 10 V
Value	Output Type																
0	Relay																
1	SSR																
2	0 to 20 mA																
3	4 to 20 mA																
4	0 to 5 V																
5	0 to 10 V																
Cool Output Power Strategy	16 bit signed integer	86	<table border="1"> <thead> <tr> <th>Value</th> <th>Strategy</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>'Sum' of Cooling & Dehumidification Power</td> </tr> <tr> <td>1</td> <td>'Greater' of Cooling & Dehumidification Power</td> </tr> </tbody> </table>	Value	Strategy	0	'Sum' of Cooling & Dehumidification Power	1	'Greater' of Cooling & Dehumidification Power								
Value	Strategy																
0	'Sum' of Cooling & Dehumidification Power																
1	'Greater' of Cooling & Dehumidification Power																
Cool Power Low Limit	16 bit signed integer	87	<i>Resolution Based Parameter : Refer Appendix-A</i> Settable in multiples of 0.5 Seconds. Non-multiples of 0.5 are automatically converted to the nearest multiple of 5.														
Cool Power High Limit	16 bit signed integer	88															
Cool Cycle Time (Relay / SSR)	16 bit signed integer	89															
Operator Page Setpoint Edit Permission	16 bit signed integer	94	<table border="1"> <thead> <tr> <th>Value</th> <th>Permission</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Disable</td> </tr> <tr> <td>1</td> <td>Enable</td> </tr> </tbody> </table>	Value	Permission	0	Disable	1	Enable								
Value	Permission																
0	Disable																
1	Enable																
Occupancy / Unoccupancy Mode Switching Enable / Disable	16 bit signed integer	95	<table border="1"> <thead> <tr> <th>Value</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Disable</td> </tr> <tr> <td>1</td> <td>Enable</td> </tr> </tbody> </table>	Value	Mode	0	Disable	1	Enable								
Value	Mode																
0	Disable																
1	Enable																
Unoccupancy Temperature Offset	16 bit signed integer	96	<i>Resolution Based Parameter : Refer Appendix-A</i>														
Unoccupancy Humidity Offset	16 bit signed integer	97															
Humidity Control Enable / Disable in Unoccupancy Mode	16 bit signed integer	98	<table border="1"> <thead> <tr> <th>Value</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Disable</td> </tr> <tr> <td>1</td> <td>Enable</td> </tr> </tbody> </table>	Value	Mode	0	Disable	1	Enable								
Value	Mode																
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Occupancy / Unoccupancy Mode Select Command Source	16 bit signed integer	99	<table border="1"> <thead> <tr> <th>Value</th> <th>Command Source</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Digital Input</td> </tr> <tr> <td>1</td> <td>MODBUS Register</td> </tr> </tbody> </table>	Value	Command Source	0	Digital Input	1	MODBUS Register								
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Occupancy / Unoccupancy Mode Select MODBUS Command (If Selected)	16 bit signed integer	100	<table border="1"> <thead> <tr> <th>Value</th> <th>Mode</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Occupancy</td> </tr> <tr> <td>1</td> <td>Unoccupancy</td> </tr> </tbody> </table>	Value	Mode	0	Occupancy	1	Unoccupancy								
Value	Mode																
0	Occupancy																
1	Unoccupancy																



APPENDIX - A

HANDLING DECIMAL VALUES IN MODBUS REGISTERS

Overview

MODBUS protocol utilizes 16-bit signed integer registers (Input and Holding Registers) to store data. These registers accommodate values within the range -32,767 to 32,768. However, many process parameters require values with decimal precision. Since MODBUS registers inherently do not support floating-point values, decimal handling is achieved through scaling techniques.

This section describes how **Fixed** and **Programmable** decimal point parameters are stored and retrieved using MODBUS registers.

Handling Fixed Decimal Point Values

For parameters with a fixed decimal resolution, the integer values written to the MODBUS register are automatically converted by the device. However, when reading values, users must convert the retrieved integer values back to their corresponding decimal representations by dividing them by the appropriate power of 10.

Example: Fixed Decimal Resolution of 0.01

- Parameter Range: -12.34 to 20.00
- Scaling Factor: 100 (since $0.01 = 10^{(-2)}$)
- Writing a Value: To set a parameter to 34.82, write $34.82 \times 100 = 3482$ into the register.
- Reading a Value: If the register contains 3482, the actual value is $3482 \div 100 = 34.82$.

This method ensures consistency in handling values with fixed decimal precision across MODBUS communication.

Handling Programmable Decimal Point Values

For parameters with a programmable decimal resolution, the number of decimal places is stored in a separate parameter named Resolution (or PV Resolution). The resolution value determines the scaling factor applied when storing and retrieving values in MODBUS registers.

Resolution Parameter Definition

The resolution parameter is stored as an integer value corresponding to the decimal precision:

Resolution Value	Decimal Precision	Scaling Factor
0	1 (No Decimals)	$10^0=1$
1	0.1	$10^1=10$
2	0.01	$10^2=100$
3	0.001	$10^3=1000$

Example: Programmable Decimal Resolution

- Resolution Parameter Value: 3 (corresponding to 0.001 resolution)
- Writing a Value: To set the parameter to 27.651, use Scaling Factor 1000 (corresponding to Resolution value 3) to convert the decimal value to integer value : $27.651 \times 1000 = 27651$ and write to the MODBUS register.
- Reading a Value: If the register contains 27651, divide by 1000 (10^3) to get 27.651.

Using this method, MODBUS allows flexible handling of parameters where decimal precision may need to be adjusted dynamically.



APPENDIX - B

DC LINEAR SIGNAL INTERFACE

Overview

Various transmitters generate different signal types, such as mV, V, or mA, with distinct signal ranges. To ensure compatibility with a wide range of transmitters, PPI products offer configurable Signal Type and Range settings.

Common industry-standard signal ranges include:

- 0 to 80 mV, 0 to 160 mV
- 0 to 5 V, 1 to 5 V, 0 to 10 V
- 0 to 20 mA, 4 to 20 mA

Additionally, since transmitters output different signal ranges corresponding to specific process values (e.g., a 1 to 4.5 V signal may represent 5% to 95% RH), PPI products allow users to configure the process value range and resolution.

Required Parameters for Linear Transmitter Interface

For interfacing linear transmitters, the following six parameters must be configured:

Parameter	Definition	Example
Input Type	Defines the standard DC signal type in which the transmitter signal range falls.	4 to 20 mA
Signal Low	The minimum signal value corresponding to the lowest process value.	4.00 mA
Signal High	The maximum signal value corresponding to the highest process value.	20.00 mA
PV Resolution	Defines the smallest measurable unit for the process value.	0.01 psi
Range Low	The process value corresponding to Signal Low.	0.00 psi
Range High	The process value corresponding to Signal High.	5.00 psi

Mathematical Representation

The relationship between transmitter signal values and the corresponding process values follows a straight-line equation:

$$Y = mX + C$$

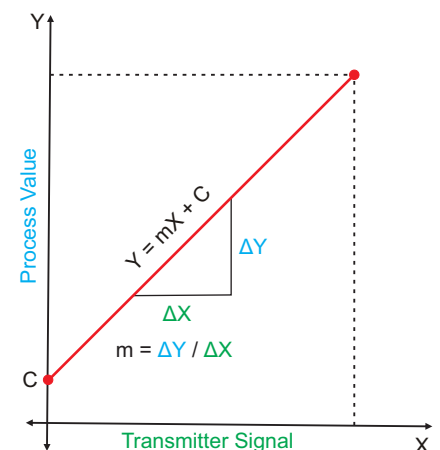
Where;

X : Signal Value from Transmitter

Y : Process Value Corresponding to X

C : Process Value Corresponding to X = 0 (Y-intercept)

m : Slope (Change in Process Value per unit Change in Signal Value)

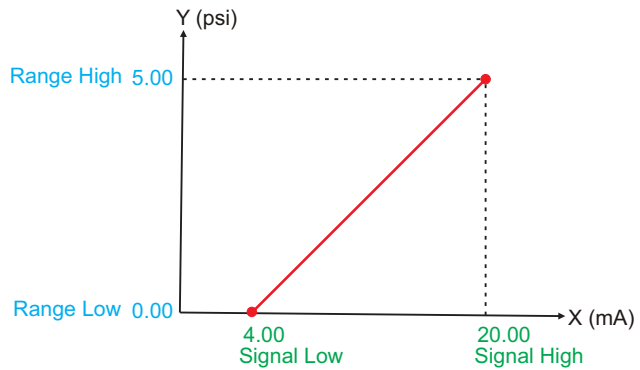


Examples of Transmitter Configurations

Example 1:

Pressure Transmitter (4 to 20 mA corresponding to 0 to 5 psi)

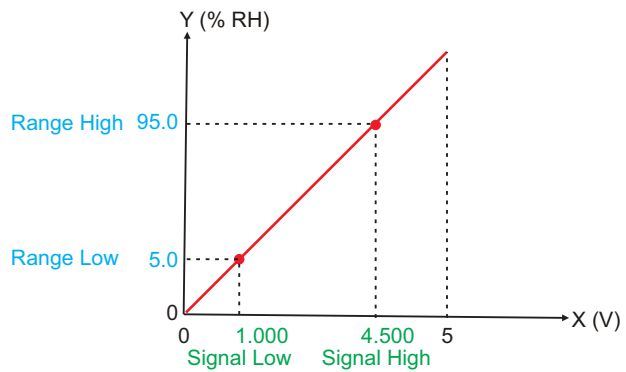
Input Type : 4-20 mA
 Signal Low : 4.00 mA
 Signal High : 20.00 mA
 PV Resolution : 0.01
 Range Low : 0.00
 Range High : 5.00



Example 2

Humidity Transmitter (1 to 4.5 V corresponding to 5 to 95 %RH)

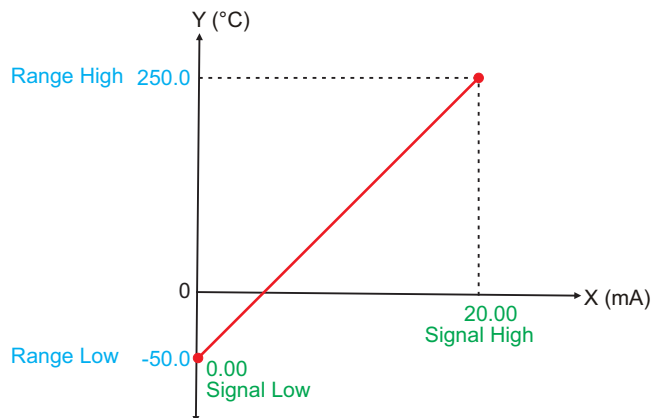
Input Type : 0-5 V
 Signal Low : 1.000 V
 Signal High : 4.500 V
 PV Resolution : 0.1
 Range Low : 5.0
 Range High : 95.0



Example 3

Temperature Transmitter (0 to 20 mA corresponding to -50 to 250 °C)

Input Type : 0-20 mA
 Signal Low : 0.00 mA
 Signal High : 20.00 mA
 PV Resolution : 0.1
 Range Low : -50.0
 Range High : 250.0



APPENDIX - C

AHU TEMPERATURE AND HUMIDITY CONTROL STRATEGY

Overview

HumiTherm-AH Pro is designed specifically for Air Handling Unit (AHU) applications and follows a **zone-based control philosophy** aligned with standard HVAC industry practices.

The controller regulates:

- Air Temperature
- Relative Humidity (%RH)

By coordinating:

- Heating
- Cooling
- Humidification
- Dehumidification (via cooling below dew point)

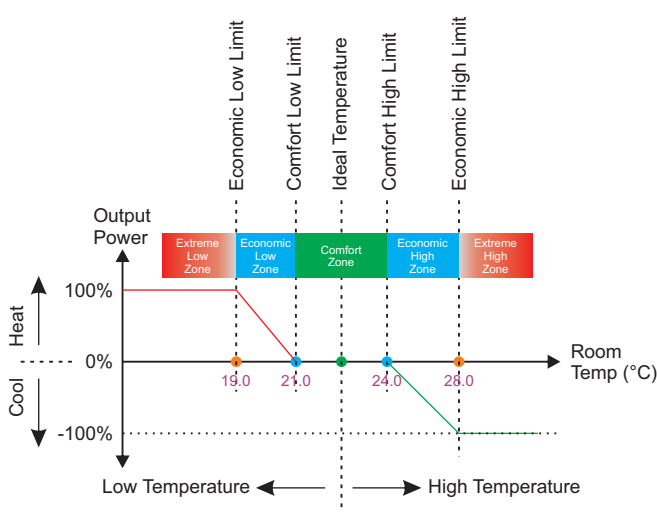
The control strategy ensures:

- Stable comfort conditions
- Energy-efficient operation
- Reduced actuator wear
- Simplified field commissioning

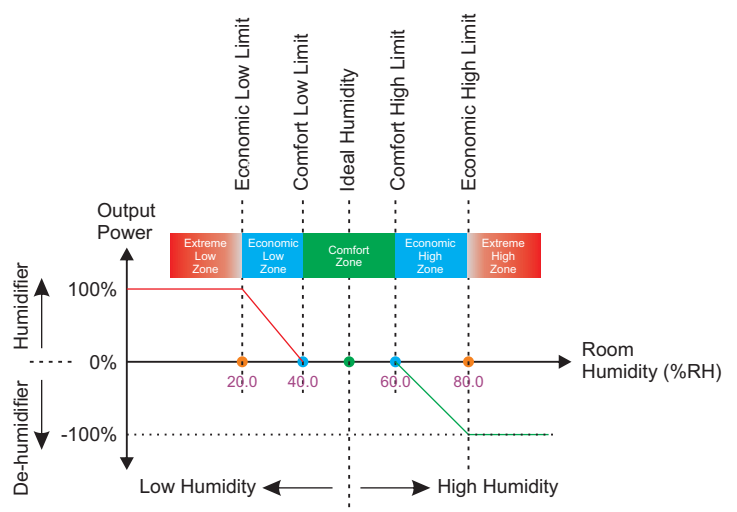
Zone-Based Control Concept

Instead of aggressive PID-only regulation around a single setpoint, HumiTherm-AH Pro uses **Comfort and Economic Zones**.

Temperature Control Algorithm



Humidity Control Algorithm



Note : The zone-limits are user settable. The values shown in the figure are for illustration purpose only.

Comfort Zone

Within the defined comfort band:

- No heating
- No cooling
- No humidification
- No dehumidification

This prevents unnecessary cycling and maximizes energy efficiency.

Economic Zones

Outside the comfort band but within acceptable limits:

- Outputs increase proportionally
- Smooth control action is applied
- Equipment stress is minimized

This ensures gradual correction without oscillation.

Extreme Zones

Beyond economic limits:

- Full control output is applied
- Rapid recovery is achieved

This protects conditioned spaces during abnormal conditions.

Temperature Control Strategy

Temperature control is implemented using progressive heating and cooling outputs.

Heating

- Activated when temperature falls below economic low limit.
- Output increases proportionally as temperature decreases.

Cooling

- Activated when temperature rises above economic high limit.
- Output increases proportionally as temperature increases.

The comfort deadband prevents frequent switching between heating and cooling.

Humidity Control Strategy

Humidity control is treated as an independent but coordinated loop.

Humidification

- Activated when %RH falls below economic low limit.
- Output increases progressively as humidity decreases.

Dehumidification

- Achieved by controlled cooling below dew point.
- Cooling coil removes excess moisture through condensation.
- Dehumidification output increases as humidity rises above economic high limit.

Wide comfort bands prevent excessive energy usage.

Sensible vs Latent Cooling

HumiTherm-AH Pro inherently distinguishes between:

Sensible Cooling

- Cooling applied above dew point for temperature control only.

Latent Cooling (Dehumidification)

- Cooling applied below dew point to remove moisture from air.

Both actions (Sensible Cooling & Latent Cooling) are coordinated through the cooling output.

Cooling and Dehumidification Coordination

In AHU systems, the cooling coil performs both:

- Temperature reduction
- Moisture removal

HumiTherm-AH Pro intelligently combines temperature and humidity demands using a configurable strategy:

- Maximum demand method
- Summation method

This ensures proper control without unnecessary overcooling.

Reheat Consideration

During dehumidification:

- Air may become excessively cold.
- Heating may be applied to restore comfort temperature.

The zone-based logic minimizes unwanted cool–reheat cycles to improve overall system efficiency.

Benefits of This Control Philosophy

- Industry-aligned AHU control methodology
- Stable and predictable operation
- Reduced commissioning complexity
- Lower risk of hunting and oscillation
- Energy-efficient moisture management

Summary

HumiTherm-AH Pro implements a practical, field-proven AHU control philosophy that balances:

- Comfort
- Energy efficiency
- Equipment protection
- Ease of use

The controller is designed to behave the way AHUs are intended to operate in real-world HVAC systems.



APPENDIX - D

DEW POINT & COOLING IN AHU SYSTEMS

What is Dew Point?

Dew Point Temperature is the temperature at which air becomes fully saturated (100% RH) and water vapour begins to condense into liquid.

In practical AHU terms:

- If air is cooled **above dew point** → only temperature reduces
- If air is cooled **below dew point** → moisture condenses and humidity reduces

Dew point therefore determines whether cooling will remove moisture or not.

Sensible Cooling (Cooling Above Dew Point)

Definition

Cooling the air while remaining above its dew point temperature.

What Happens Physically

- Air temperature decreases
- Relative humidity increases (because cooler air holds less moisture)
- No moisture is removed

Where It Is Used

- When only temperature reduction is required
- Comfort cooling in moderate humidity conditions

AHU Implementation

- Cooling coil valve opens proportionally
- Air temperature reduces
- No condensate forms on coil

This is purely **temperature control**.

Latent Cooling (Cooling Below Dew Point)

Definition

Cooling the air below its dew point temperature to remove moisture.

What Happens Physically

- Air temperature drops to dew point
- Moisture condenses on cooling coil
- Condensed water drains away
- Humidity reduces

This process removes **latent heat** from the air.

AHU Implementation

- Cooling valve opens sufficiently
- Coil surface temperature falls below dew point
- Condensation occurs
- Drain pan collects moisture

This is the mechanism used for **dehumidification**.

Dew Point in Real AHU Operation

In real systems:

- Return air mixes with fresh air
- Mixed air has a specific dry-bulb temperature and humidity
- Dew point is determined by the moisture content
- Cooling coil temperature determines whether:
 1. Only sensible cooling occurs
 2. Or both sensible + latent cooling occur

If coil temperature > dew point → no dehumidification

If coil temperature < dew point → moisture removal occurs

How HumiTherm-AH Pro Uses This Principle

The controller does not directly measure dew point.

Instead, it uses temperature and %RH inputs to determine when dehumidification demand exists.

When %RH exceeds the comfort high limit (enters economic zone):

- Cooling output increases
- Coil temperature effectively drops
- Air is cooled below dew point
- Moisture condenses
- %RH reduces

Thus, dehumidification is achieved indirectly through controlled cooling.

Cooling + Reheat Phenomenon

During dehumidification:

- Air is cooled below dew point
- Temperature may drop below comfort range
- Heating output may activate to restore temperature

This is known as:

Cool and Reheat Control

HumiTherm-AH Pro minimizes unnecessary cool-reheat cycling through:

- Wide comfort bands
- Progressive zone-based control
- Coordinated output logic

This improves energy efficiency.

Why Dew Point Matters in AHU Control

Understanding dew point helps explain:

- Why cooling alone sometimes increases %RH
- Why dehumidification always requires cooling
- Why reheating may be necessary
- Why simultaneous heating and cooling can occur in some conditions

It also clarifies why humidity cannot be reduced without dropping coil temperature below dew point.

Practical Example

Assume:

- Air Temperature = 28°C
- Relative Humidity = 70%
- Dew Point ≈ 22°C

If cooling coil cools air to:

- 24°C → No condensation → No dehumidification
- 20°C → Condensation occurs → Moisture removed

After dehumidification:

- Air may be reheated to 24°C
- Final condition: Lower humidity at comfortable temperature

Summary

Cooling Type	Coil Temperature	Moisture Removed	Purpose
Sensible Cooling	Above Dew Point	No	Reduce Temperature
Latent Cooling	Below Dew Point	Yes	Reduce Humidity

HumiTherm-AH Pro intelligently utilizes these physical principles to maintain stable comfort conditions in AHU applications.



APPENDIX - E

OCCUPANCY-BASED CONTROL USING SETBACK OFFSET

Introduction

In HVAC systems, operating conditions typically vary between:

Occupied Mode (Day Mode)

During occupied periods, temperature and humidity are maintained within tighter comfort limits to ensure occupant comfort.

Unoccupied Mode (Night / Standby Mode)

During unoccupied periods, control requirements are relaxed to reduce energy consumption and equipment wear.

HumiTherm-AH Pro supports occupancy-based control using a configurable **Setback Offset** strategy, activated through:

- External Digital Input (DI)
- MODBUS command (RS485 - MODBUS RTU)

This approach allows automatic zone shifting without duplicating complete parameter sets.

Control Philosophy

Instead of storing separate day and night parameter sets, the controller applies configurable offsets to the existing zone limits when Unoccupied Mode is active.

This ensures:

- Stable control dynamics
- Minimal parameter duplication
- Easy commissioning
- Reduced configuration errors

Temperature Setback (ΔT : Signed Offset)

Concept

When Unoccupied Mode is activated:

All temperature zone limits are shifted by a signed offset value (ΔT).

Mathematical Implementation

Let (Occupied Mode) :

- Comfort Low Limit = TCL
- Comfort High Limit = TCH
- Economic Low Limit = TEL
- Economic High Limit = TEH

Then in Unoccupied Mode:

- Comfort Low Limit = TCL + ΔT
- Comfort High Limit = TCH + ΔT
- Economic Low Limit = TEL + ΔT
- Economic High Limit = TEH + ΔT

Where ΔT may be positive or negative.

Example – Cooling Dominant Climate

Occupied Settings:

- TCL = 21°C
- TCH = 24°C
- TEL = 19°C
- TEH = 28°C
- $\Delta T = +3^\circ\text{C}$

Unoccupied Limits Become:

- TCL = 21°C + 3°C = 24°C
- TCH = 24°C + 3°C = 27°C
- TEL = 19°C + 3°C = 22°C
- TEH = 28°C + 3°C = 31°C

Effect:

- Cooling demand reduces at night
- Temperature allowed to float higher
- Energy consumption decreases

Example – Heating Dominant Climate

If $\Delta T = -2^\circ\text{C}$, Unoccupied limits become :

- TCL = 21°C - 2°C = 19°C
- TCH = 24°C - 2°C = 22°C
- TEL = 19°C - 2°C = 17°C
- TEH = 28°C - 2°C = 26°C

Effect:

- Lower heating setpoint at night
- Reduced energy consumption in cold climates

Humidity Setback (ΔRH : Band Widening)

Concept

During Unoccupied Mode, humidity control is relaxed by widening the allowable humidity band.

This reduces humidification and dehumidification energy consumption while maintaining safe environmental limits.

Mathematical Implementation

Let (Occupied Mode) :

- Comfort Low Limit = HCL
- Comfort High Limit = HCH
- Economic Low Limit = HEL
- Economic High Limit = HEH

With humidity widening value ΔRH :

- Comfort Low Limit = HCL - ΔRH
- Comfort High Limit = HCH + ΔRH
- Economic Low Limit = HEL - ΔRH
- Economic High Limit = HEH + ΔRH

ΔRH is always positive.

Example

Occupied Settings:

- Comfort Band: 40% – 60%
- Economic Band: 30% – 80%
- $\Delta RH = 10\%$

Unoccupied Limits Become:

- Comfort Band: 30% – 70%
- Economic Band: 20% – 90%

Effect:

- Humidification demand reduces
- Dehumidification triggers later
- Energy savings achieved

Humidity Control Behavior in Unoccupied Mode

During Unoccupied Mode, humidity control operates using the widened humidity bands (ΔRH applied to both Comfort and Economic limits).

A dedicated parameter allows selective control of **humidification** during Unoccupied Mode, while dehumidification remains active at all times.

Band Widening in Unoccupied Mode

When Unoccupied Mode is activated:

- Comfort and Economic humidity limits are widened by the configured ΔRH value.
- This relaxes humidity control thresholds.
- Energy consumption associated with moisture control is reduced.

Humidification in Unoccupied Mode (Configurable)

A dedicated parameter:

“Humidification in Unoccupied Mode”

provides the following options:

- Enabled – Humidification operates within the widened lower humidity limits.
- Disabled – Humidification output is turned OFF during Unoccupied Mode.

Disabling humidification during unoccupied periods:

- Reduces energy consumption.
- Avoids unnecessary steam or electric heater operation.
- Is suitable for typical comfort HVAC applications.

Dehumidification (Always Active)

Dehumidification remains active in both Occupied and Unoccupied Modes.

- When humidity exceeds the widened high limit, cooling below dew point is applied.
- This prevents excessive moisture buildup overnight.
- It reduces condensation and mold risk.
- It ensures smoother recovery when returning to Occupied Mode.

Practical Recommendation

In most comfort AHU installations:

- Humidification may be disabled during Unoccupied Mode.
- Dehumidification should remain active to maintain safe indoor moisture levels.

This strategy balances:

- Energy efficiency
- Environmental protection
- System stability

Activation Methods

Digital Input (DI)

When configured for Occupancy Mode:

- DI = OPEN → Occupied Mode
- DI = CLOSE → Unoccupied Mode

This allows connection to:

- External time switch
- BMS output
- Building automation panel

MODBUS Command

Unoccupied Mode may also be activated via MODBUS register.

This allows:

- Remote scheduling
- Integration with supervisory control systems
- Centralized building management

Advantages of Offset-Based Strategy

Compared to dual-parameter memory systems, this approach:

- Preserves control band width
- Maintains stable control slopes
- Avoids inconsistent parameter duplication
- Simplifies commissioning
- Reduces configuration errors

The control behavior remains predictable across both modes.

Practical Recommendations

For most comfort AHU installations:

- $\Delta T = +2^{\circ}\text{C}$ to $+4^{\circ}\text{C}$ (cooling dominant climates)
- $\Delta RH = 5\%$ to 15%

For heating dominant climates:

- ΔT may be negative

Values should be selected based on:

- Building type
- Climate conditions
- Energy-saving objectives

Summary





The Occupancy-Based Setback feature in HumiTherm-AH Pro provides:

- Energy-efficient unoccupied operation
- Stable zone translation without re-tuning
- Flexible integration via DI or MODBUS
- Simplified configuration compared to dual memory systems

This feature enables optimized AHU operation across day and night conditions while maintaining system stability.



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