

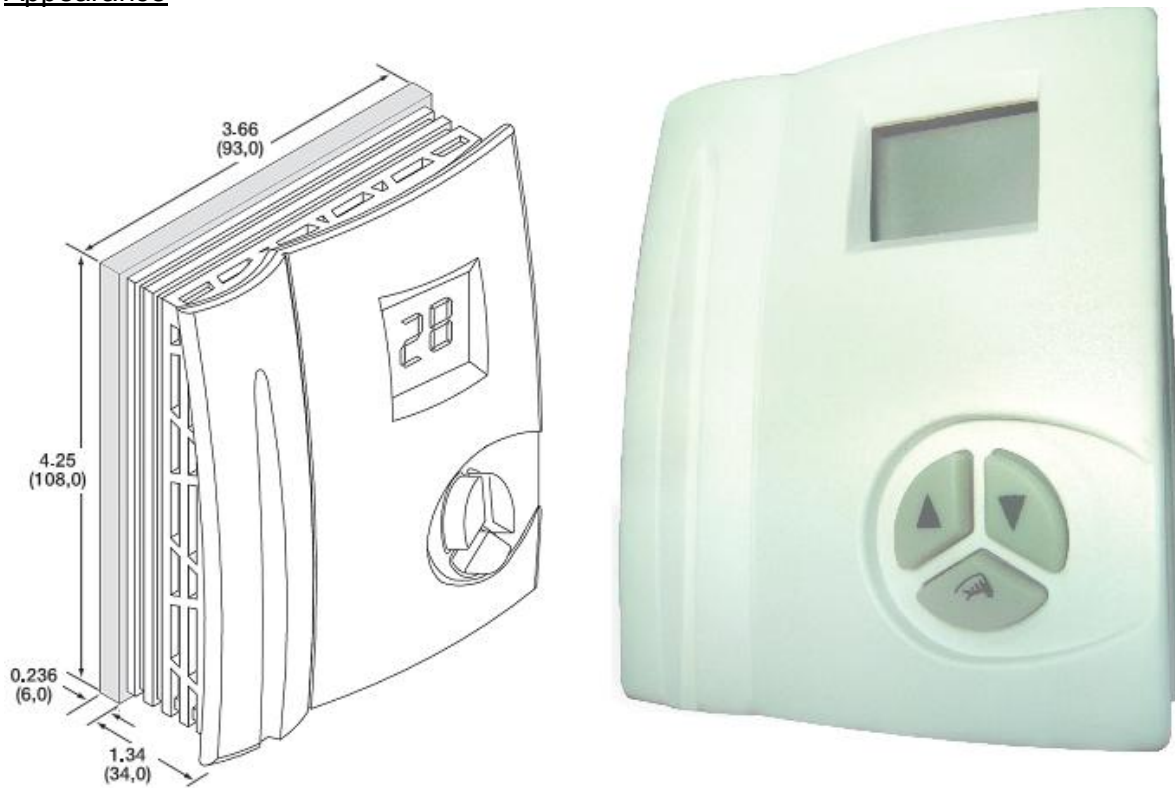
TE150H thermostat Application Bulletin

Revision 1.12


Feature List

- Power Supply:
 - 24 Vac \pm 20%, 50Hz/60Hz
- Measurable temperature range:
 - 20.0°-60.0°C(0.5 °C resolution) / -4-140 °F (1°F resolution)
- Controllable temperature range:
 - 10.0-55.0°C (0.5°C resolution) /50-130 °F (1°F resolution)
- LCD display:
 - Ambient temperature
 - Set point
 - Heat and Cool Mode icon
 - Backlight
- 3 Button keys
- Suitable for Heating or Cooling operation
- Suitable for controlling Modulating type actuators
- Internal or External sensor selection
- US/EU output version
- 0-10V proportional output /2-10V proportional output
- EEPROM memory
- Economy override mode
- Limited temperature range
- Support Two Stage output
- One Heat and One Cool system

Appearance

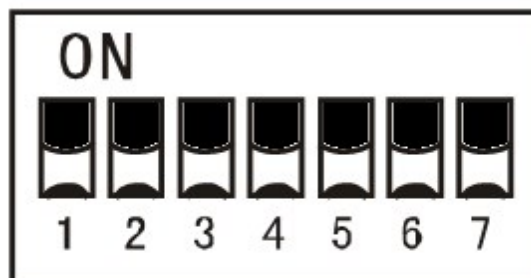


User Interface

Rubber key	Day mode	Night mode	Economy override mode
Up ▲	Increase set point	Economy override	Increase set point
Down ▼	Decrease set point	Economy override	Decrease set point
Hand 	Backlight	Economy override	Exit override mode

Dip switch Selections

Pole	ON	OFF (default setting)
1	° F	° C
2	US for DA actuator	EU for RA actuator
3	Duct application	Room application
4	2-10V	0-10V
5	Normal temperature range	Limited temperature range
6	Two stage output	One stage output
7	One heat and one cool system	Connect one system only

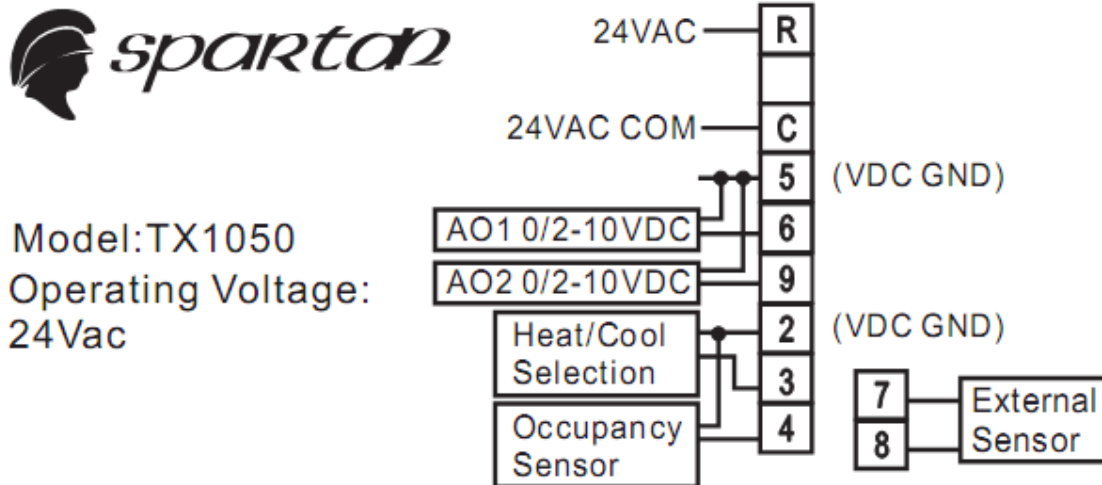


*Please reset power after changing the dip switch selection

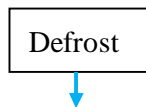
Input and Output Terminal:

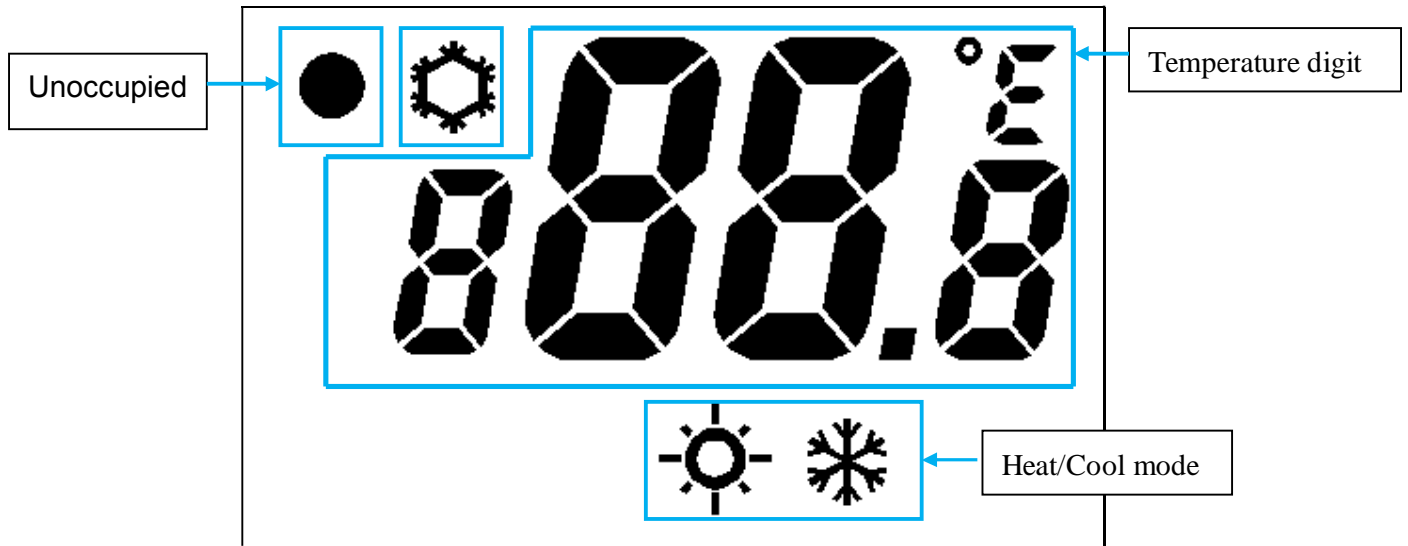
Terminals	Description	Terminal
Power Supply	24 Vac	R
	24 Vac common	C
Input / Output	24 Vac common	2,5
	Heat Cool selection(Open: Heat, Close: Cool)	3
	Occupancy sensor	4
	0-10Vdc analog output (AO1)	6
	0-10Vdc analog output2 (AO2)	9
	External Sensor	7
	External Sensor	8

For modulating type actuators:

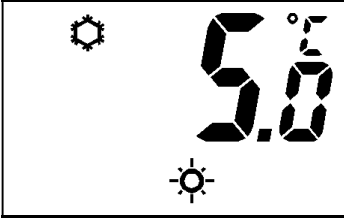




LCD display





Example:

Defrost Occupancy sensor open In ^C	Occupancy sensor open Heat mode In ^C	Occupancy sensor close Cool mode In ^F
		

Operation

Normal mode and Economy mode

Occupancy sensor open represents occupied, thermostat will run normal mode.

Occupancy sensor close represents unoccupied, thermostat will run economy mode.

When the thermostat is running in economy mode, LCD will display “●” at top left corner

User can not adjust the set point in economy mode

Adjusting the Set point(Dip switch 5)

Pressing ▲/▼ button to adjust the set point. The default set point is 20.0°C / 68°F. Set point is flashing when key released and resume displaying ambient temperature after 10 seconds without key input.

Normal temperature range:

Temperature unit	Economy (Unoccupied) and Heat	Normal (Occupied)	Economy (Unoccupied) and cool
°F (1°F resolution)	42-122°F	50-130°F	58-138°F
°C(0.5°C resolution)	6.0-51.0 °C	10.0 – 55.0 °C	14.0 – 59.0 °C


Limited set point range

Temperature unit	Economy (Unoccupied) and Heat	Normal (Occupied)	Economy (Unoccupied) and cool
°F (1°F resolution)	56-68°F	64-76°F	72-84°F
°C(0.5°C resolution)	14.0-20.0 °C	18.0-24.0 °C	22.0 – 28.0 °C


EEPROM memory

Set point will be saved in the EEPROM. The set point will be loaded back when the thermostat is reset.

Backlight:


Backlight will be provided after pressing ▲ or ▼ or . It will be off after key released 10 seconds.

Economy override:

- Holding ▲ or ▼ or  key 2 seconds to enable economy override, LCD will display ● and flash
- This function only operates in economy mode; it will go to normal mode for 2 hours. After 2 hours, it will go back to economy mode and ● will stop flashing.
- If normal mode is enabled (occupancy open) during the 2 hour count down, this function will be cancelled and run to normal mode immediately, ● will turn off.

During the 2 hour count down, user can hold ▲ or ▼ to change set point

If user changes the set point in the economy override, the night mode set point will be updated accordingly (economy override mode +/- 4°C/8°F).

User can hold  key to cancel the economy override.

US/EU output selection(Dip switch 4):


For 0-10V output version(default setting):


Output percentage	EU version	US version
0%	0V	10V
100%	10V	0V

For 2-10V output version:

Output percentage	EU version	US version
0%	2V	10V
100%	10V	2V

Heat /Cool Selection

Heat mode is selected when Terminal 2 and 3 is disconnected.  will be displayed on LCD (default setting)

Cool mode is selected when Terminal 2 and 3 is connected.  will be displayed on LCD

Heat/Cool selection will be disabled when dip7th is ON

System Selection1(Dip switch 6)

Select one or two stage operation.

Dip switch 6	Output
OFF	One stage
ON	Two stage

If Dip switch 6 set at OFF, one stage operation is selected. AO1 will be the output for Heating/Cooling system.

If Dip switch 6 set at ON, two-stage operation is selected. AO1 will be the 1st stage output and AO2 will be the 2nd stage output for Heating/Cooling system.

System Selection2 (Dip switch 7)

Dip switch 7	
OFF	connected one system only
ON	Connected one heat and one cool system

Dip switch 7th pole set at "OFF":

Model selection is controlled by Heat/Cool selection (terminal 2 and terminal 3)

AO1 will be the 1st stage output for heating or cooling

AO2 will be the 2nd stage output for heating or cooling.

Dip switch 7th pole set at "ON":

Output connection is specified as follow:

Heat output is AO1 and Cool output AO2.

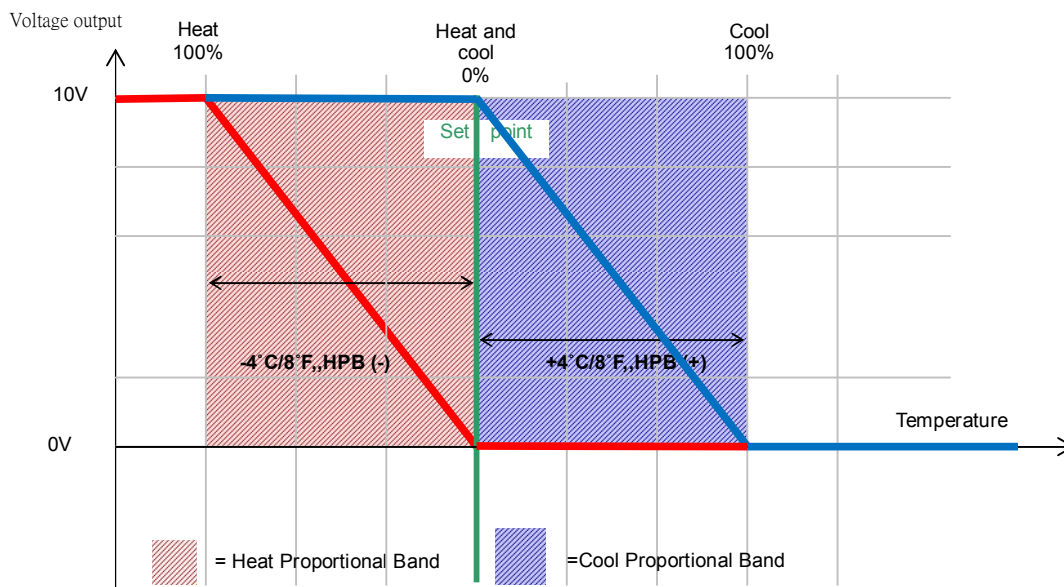
Terminals	Description	Terminal
	0-10Vdc analog output (AO1) (Heat)	6
	0-10Vdc analog output2 (AO2) (Cool)	9

AO1 and AO2 output are out of phase,

EU (dip 2nd Off) :

AO1 act as EU mode, output increases from 0V (0%) to 10V (100%)

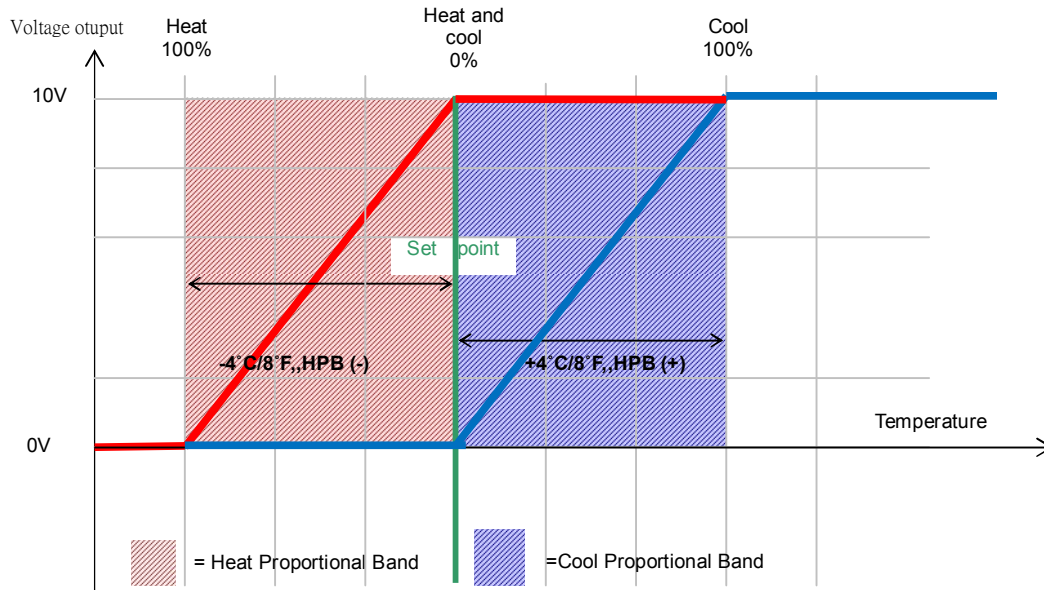
AO2 act as US mode, output goes from 10V(0%) to 0V(100%)



US (dip 2nd ON) :

AO1 act as US mode, output goes from 10V(0%) to 0V(100%)

AO2 act as EU mode, output increases from 0V (0%) to 10V (100%)



When operation mode changeover, it will has 3 minutes delay time, both output will keep at 0%.

Temperature Control

Measurable temperature range:

0.0 – 60.0 °C (0.5°C resolution) / 32 – 140 °F (1°F resolution)

“HI” will be displayed if measured temperature is higher than 60.0°C /140 °F

“LO” will be displayed if measured temperature is lower than 0.0°C /32 °F

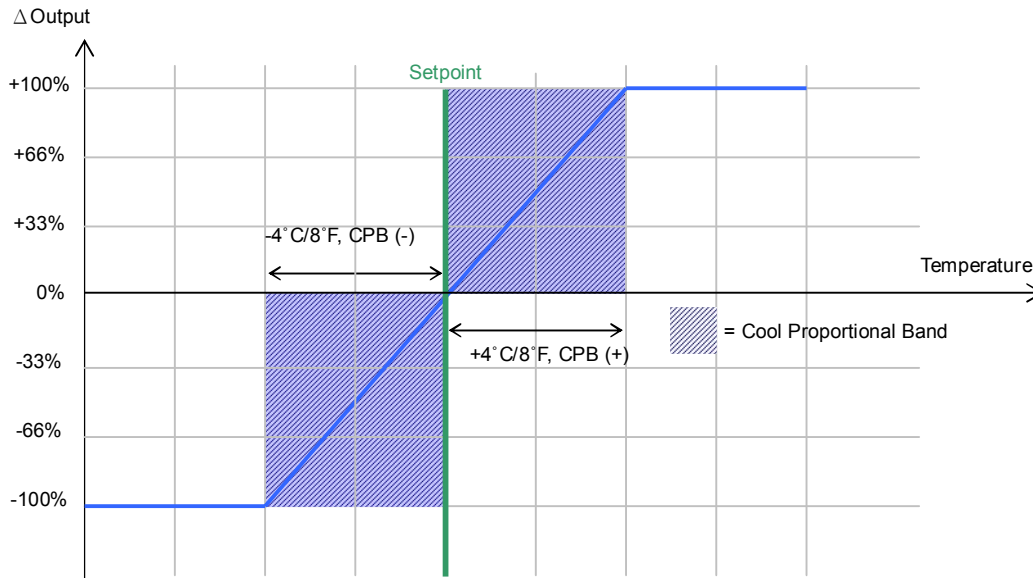


will be displayed if measured temperature is equal or lower 5°C /41 °F

One stage cooling:

Output: AO1

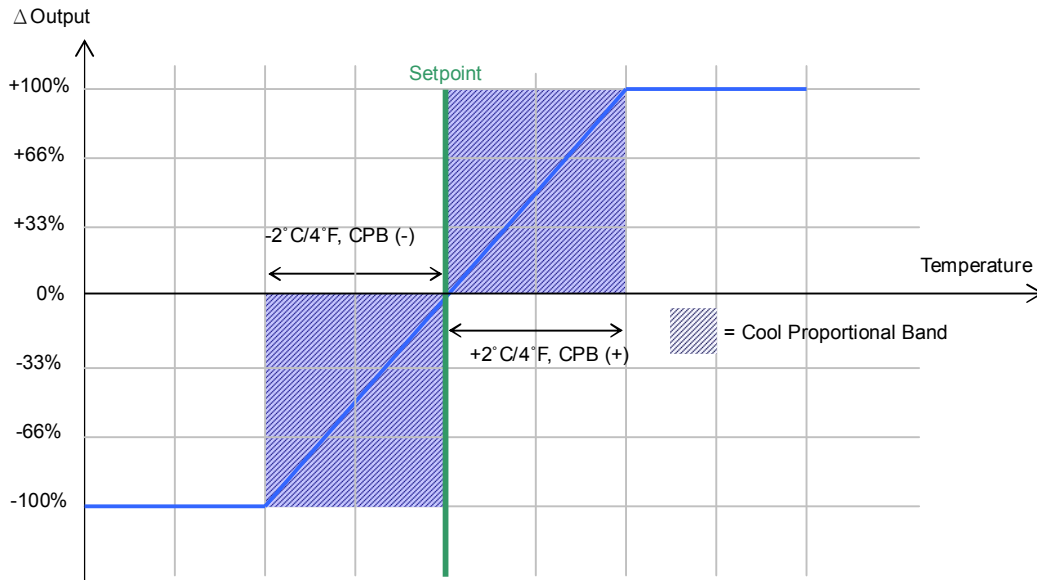
CPB: $\pm 4^{\circ}\text{C}/8^{\circ}\text{F}$



Percentage	0-10V selection	2-10V selection
0%	0V	2V
25%	2.5V	4V
50%	5.0V	6V
75%	7.5V	8V
100%	10V	10V

When the ambient temperature between CPB. The percentage output is calculated by a PI algorithm. The percentage output is updated every 30 seconds.

Two stage Cooling:
 1st stage output: AO1
 2nd stage output: AO2
 CPB: $\pm 4^{\circ}\text{C}/8^{\circ}\text{F}$



When percentage within 0-50%, AO1 opens proportionally, it fully opens when percentage over 50%.

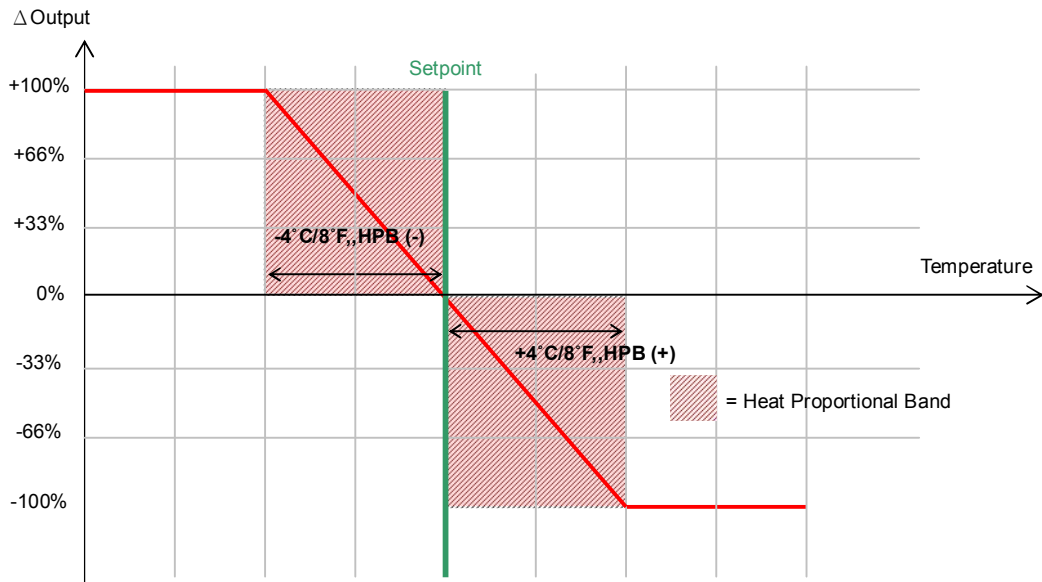
Percentage	0-10V selection	2-10V selection
0%	0V	2V
15%	3V	4.4
35%	7V	7.6
50%	10V	10V
>50%	10V	10V

When percentage is between 51%-100%, AO2 opens proportionally, it is off when percentage $\leq 50\%$.

Percentage	0-10V selection	2-10V selection
0%	0V	2V
15%	0V	2V
35%	0V	2V
50%	0V	2V
55%	1V	2.8v
75%	5V	6V
85%	7V	7.6
100%	10V	10V

When the ambient temperature between CPB. The percentage output is calculated by a PI algorithm. The percentage output is updated every 30 seconds.

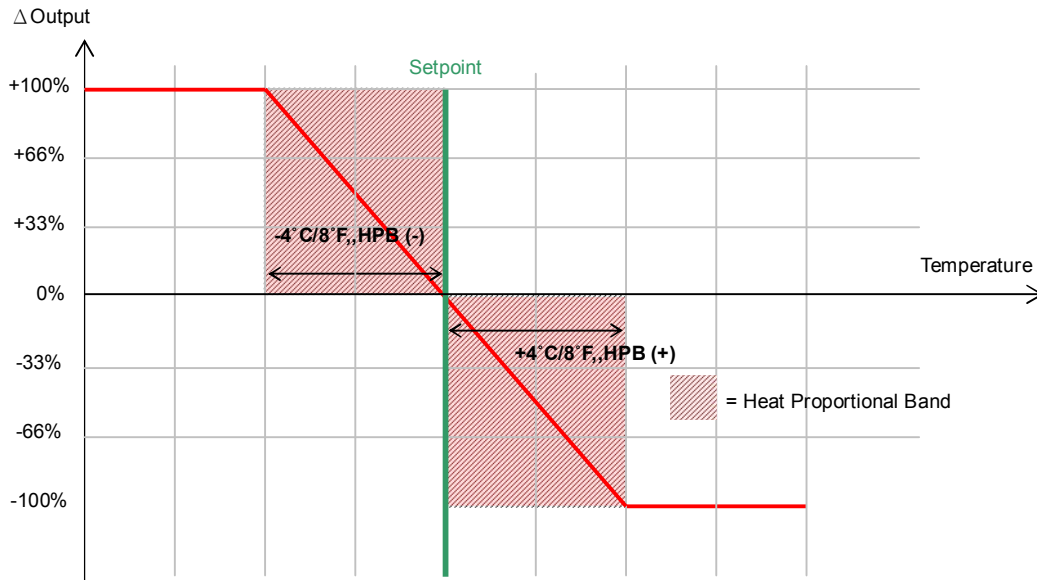
Heat mode:
 One stage heating:
 Output: AO1
 HPB: $\pm 4^{\circ}\text{C}/8^{\circ}\text{F}$



Percentage	0-10V selection	2-10V selection
0%	0V	2V
25%	2.5V	4V
50%	5.0V	6V
75%	7.5V	8V
100%	10V	10V

When the ambient temperature between HPB. The percentage output is calculated by a PI algorithm. The percentage output is updated every 30 seconds.

Two stage heating
 1st stage Output: AO1
 2nd stage output: AO2
 HPB: $\pm 4^{\circ}\text{C}/8^{\circ}\text{F}$



When percentage within 0-50%, AO1 opens proportionally, it fully opens when percentage over 50%.

Percentage	0-10V selection	2-10V selection
0%	0V	2V
15%	3V	4.4
35%	7V	7.6
50%	10V	10V
>50%	10V	10V

When percentage is between 51%-100%, AO2 opens proportionally, it is off when percentage $\leq 50\%$.

Percentage	0-10V selection	2-10V selection
0%	0V	2V
15%	0V	2V
35%	0V	2V
50%	0V	2V
55%	1V	2.8V
75%	5V	6V
85%	7V	7.6
100%	10V	10V

When the ambient temperature between HPB, the percentage output is calculated by a PI algorithm. The percentage output is updated every 30 seconds.

If the ambient temperature is within $\pm 0.4^{\circ}\text{C}/0.8^{\circ}\text{F}$ of set point, the percentage output will keep constant.

Output calculation

$$\text{New output (\%)} = \text{Old output (\%)} + \Delta\text{output (\%)}$$

Δ output (%) = Normal step or Big step

1. Normal step:

Normally delta output will be calculated by present ΔT and previous ΔT integral.

$$\Delta T = (\text{Room temperature} - \text{Set point})$$

2. Big step(first step):

a. Big step = $\Delta T / \text{proportional band} * 40\%$

e.g. $\Delta T = 1^\circ\text{C}/2^\circ\text{F}$, Big step = 10%; $\Delta T = 1.5^\circ\text{C}/3^\circ\text{F}$, Big step = 15%;
 $\Delta T = 2^\circ\text{C}/4^\circ\text{F}$, Big step = 20%; $\Delta T = 4^\circ\text{C}/8^\circ\text{F}$, Big step = 40%;
 $\Delta T = -3^\circ\text{C}/-6^\circ\text{F}$, Big step = - 30%

b. Big step will be added **one time** in following conditions

1. Initial power up, $\Delta T \geq 1^\circ\text{C}/2^\circ\text{F}$.
2. Set point is changed and $\Delta T \geq 1^\circ\text{C}/2^\circ\text{F}$.
3. Room temperature suddenly change and $\Delta T \geq 1^\circ\text{C}/2^\circ\text{F}$.

If $\Delta T \geq 1^\circ\text{C}/2^\circ\text{F}$ in next output update,

Big step will not be added and locked, Δ output (%) = Normal step

The lock will be cancelled when

- i. The other two conditions happened,
- ii. $\Delta T \leq 0.4^\circ\text{C} / 0.8^\circ\text{F}$, the output unchanged

Duct application:

Temperature and output update every 3 seconds (without comparison)

Room application:

Temperature update every 10 seconds (with comparison) and output update every 30 seconds