

## Application 2323 Unit Conditioner with Six Stages of Electric Heat

### Overview

In Application 2323, the controller energizes a maximum of six stages of electric heat in the unit conditioner to control the room temperature. Refer to Figures 2323-1 and 2323-2.

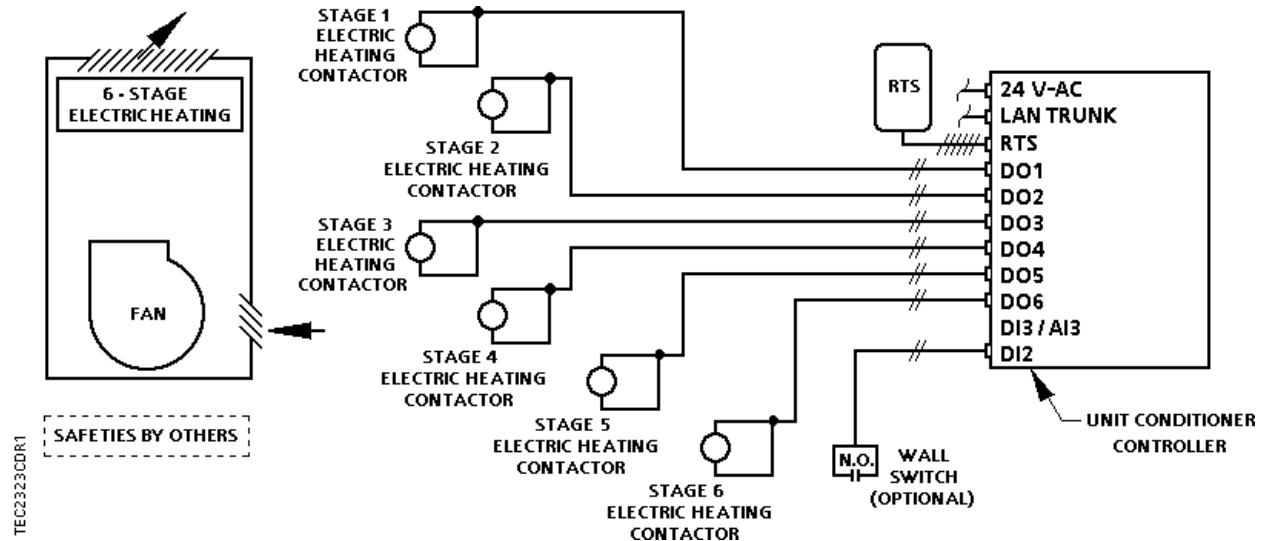
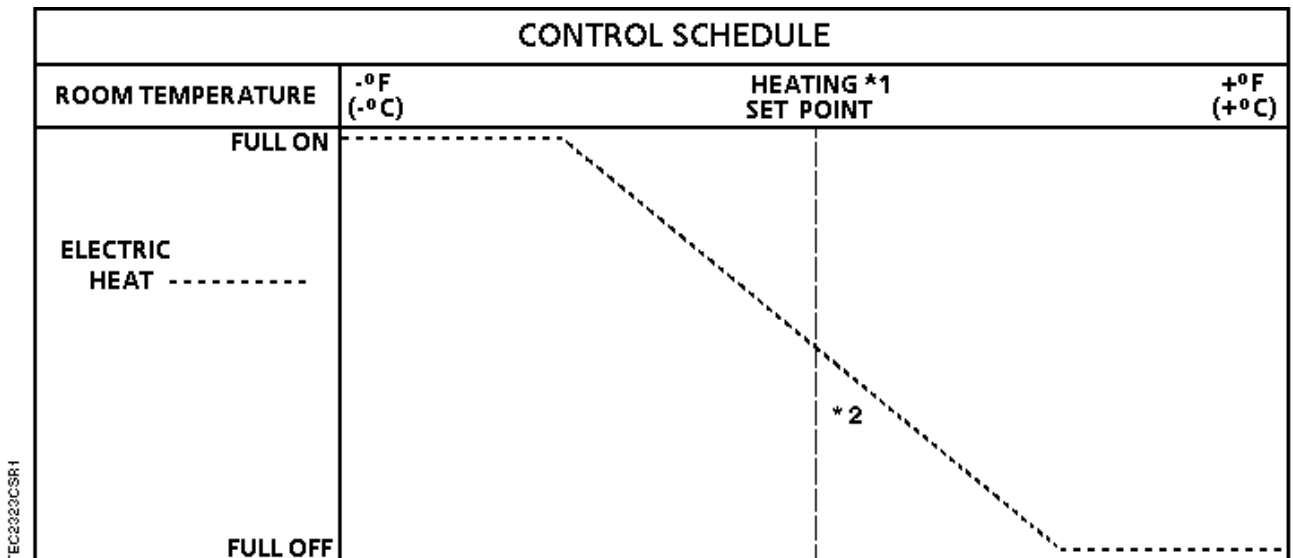


Figure 2323-1. Application 2323 Control Drawing.



### NOTES:

1. Refer to Sequence of Operation, "Control Temperature Set Points".
2. The electric heat is time modulated. This allows it to be controlled proportionally rather than with deadbands.

Figure 2323-2. Application 2323 Control Schedule.

*Hardware inputs*

**analog**

- room temperature sensor
- room temperature set point dial (optional)

**digital**

- night mode override (optional)
- wall switch (optional)

*Hardware outputs*

**analog**

- none

**digital**

- stage 1 electric heat
- stage 2 electric heat
- stage 3 electric heat
- stage 4 electric heat
- stage 5 electric heat
- stage 6 electric heat

*Ordering notes*

Unit Conditioner Controller with Six Stages – Electronic Output 540-795

Refer to *System 600 Configuration and Sizing Guidelines* (125-1830) for product numbers.

Terminal Equipment Controller Room Temperature Sensor

*Point database*

Table 2323-1 presents the point database information for Application 2323.

## Sequence of Operation

### *Control temperature set points*

The following paragraphs present the sequence of operation for Application 2323, "Unit Conditioner with Six Stages of Electric Heat".

Depending on the controller's current operational mode (day or night), the control temperature set point, CTL STPT (number 92) holds the value of one of the following set points:

**Day Mode** – In day mode, CTL STPT holds the value of the point DAY HTG STPT (number 7). If the room temperature sensor has a set point dial and the point STPT DIAL (number 14) is set to YES, then CTL STPT holds the value of the point RM STPT DIAL (number 13).

If the set point dial is used and the value of RM STPT DIAL is less than the value of the point RM STPT MIN (number 11), then CTL STPT holds the value of RM STPT MIN. If the value of RM STPT DIAL is greater than the value of the point RM STPT MAX (number 12), then CTL STPT holds the value of RM STPT MAX.

**Night Mode** – In night mode, CTL STPT holds the value of the point NGT HTG STPT (number 9).

**NOTE:** The value of the point CTL TEMP (number 78) is the same as the value of the point ROOM TEMP (number 4), unless CTL TEMP is overridden.

### *Day and night modes*

The day/night status of the space is determined by the status of the point DAY.NGT (number 29). The control of this point differs depending on whether the controller is monitoring the status of a wall switch or if the controller is connected to a field panel.

When a wall switch is physically connected to the termination strip on the controller at DI 2 (Figures 2323-1 and 2323-3), and the point WALL SWITCH (number 18) equals YES, the controller monitors the status of DI 2. When the status of the point DI 2 (number 24) is ON (the switch is closed), then DAY.NGT will be set to DAY indicating that the controller is in day mode. When the status of DI 2 is OFF (the switch is open), then DAY.NGT will be set to NIGHT indicating that the controller is in night mode.

When WALL SWITCH equals NO, the controller does not monitor the status of the wall switch, even if one is connected to it. In this case, if the controller is operating stand-alone, then the controller stays in day mode all the time. If the controller is operating with centralized control (that is, it is connected to a field panel), then the field panel can send an operator or PPCL command to override the status of the point DAY.NGT. Refer to *Powers Process Control Language (PPCL) User's Manual* (125-1896) and *Field Panel User's Manual* (125-1895) for more information.

### *Night mode override switch*

If an override switch is present on the room temperature sensor and a value (in hours) other than zero has been entered into the point OVRD TIME (number 20), then by pressing the override switch a room occupant can reset the controller to day operational mode for the amount of time that is set in OVRD TIME. The status of the point NGT OVRD (number 21) changes to DAY. After the override time elapses, the controller returns to night mode and the status of NGT OVRD changes back to NIGHT.

It is only when the controller is in night mode that the override switch on the room temperature sensor will have any effect on the controller.

Control loops

The unit conditioner is controlled by one Proportional, Integral, and Derivative (PID) temperature loop.

**Temperature Loop** – The temperature loop is a heating loop. The temperature loop maintains room temperature at the value in the point CTL STPT (number 92). Refer to “Control Temperature Set Points”.

The controller uses the points CTL STPT (number 92) and CTL TEMP (number 78) as the inputs to the heating loop. The output of the heating loop is the point HTG LOOPOUT (number 80) which modulates the electric reheat in order to warm-up the space.

Electric reheat



**CAUTION:**  
Verify that the equipment is supplied with safeties by others to ensure that there is air flow across the heating coils when they are to be energized.

The heating loop controls up to six stages of electric reheat to warm-up the room. The electric reheat is time modulated using a duty cycle as shown in the following example.

*Example:* If the duty cycle is 10 minutes (point HTG STG TIME (number 89) is set to 10 minutes) and the heating loop is calling for 60% of heating (point HTG LOOPOUT (number 80) is set to 60%), then for every 10 minute period, the stages of electric auxiliary heat cycle as follows:

	Stage 1: minutes		Stage 2: minutes		Stage 3: minutes	
	ON	OFF	ON	OFF	ON	OFF
With 1 stage of electric heat:	6	4	--	--	--	--
With 2 stages of electric heat:	10	0	2	8	--	--
With 3 stages of electric heat:	10	0	8	2	0	10

Up to six stages are controlled in the same way.

Fail-safe operation

If the room temperature sensor fails, then the controller operates using the last known temperature value.

Application notes

1. If the temperature swings in the room are excessive, or if there is trouble in maintaining the set point, then the heating loop needs to be tuned. Refer to *System 600 Maintenance and Troubleshooting Manual* (125-1855) for more information.
2. The Unit Conditioner Controller with Six Stages – Electronic Output, as shipped from the factory, keeps all associated equipment OFF. Refer to the TEC Custom Solutions Start-up Documentation for this controller.

3. Spare DOs can be used as auxiliary points that are controlled by the field panel after being defined in the field panel's database. All DOs can be used to control the stages of electric heat. If less than six stages are being controlled by the application, then the DOs that are not used will be spare. Refer to the TEC Custom Solutions Start-up Documentation for this controller.

### Wiring diagrams

The point wiring for Application 2323 is shown in Figure 2323-3.



**CAUTION:** The Controller's Digital Outputs (DOs) control 24 Vac loads only. The maximum rating is 12 VA for each DO. For higher VA requirements, 110 or 220 Vac requirements, separate transformers used to power the load, or DC power requirements, use an interposing 220 V 4-relay module (P/N 540-147).

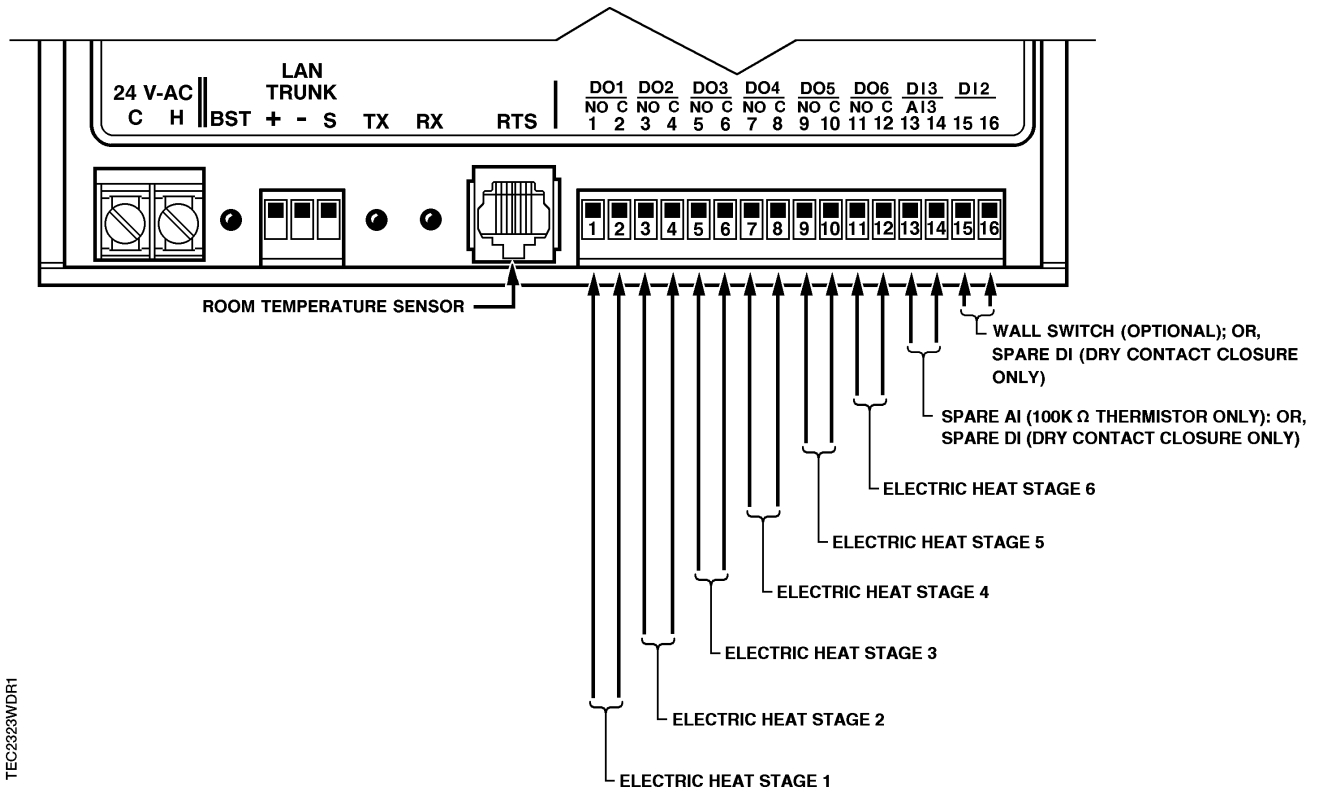


Figure 2323-3. Application 2323 Wiring Diagram.

**Table 2323-1. Point Database for Application 2323.**

Point Number	Descriptor	Factory Default (SI Units)	Engr. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
01	CTLR ADDRESS	99	--	1	0	--	--
02	APPLICATION	2090	--	1	0	--	--
{04}	ROOM TEMP	74.00 (23.44888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--
07	DAY HTG STPT	70.00 (21.20888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--
09	NGT HTG STPT	65.00 (18.40888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--
11	RM STPT MIN	55.00 (12.80888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--
12	RM STPT MAX	90.00 (32.40888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--
{13}	RM STPT DIAL	74.00 (23.44888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--
14	STPT DIAL	NO	--	--	--	YES	NO
{15}	AUX TEMP	74.0 (23.495556)	DEG F (DEG C)	0.5 (0.280000)	37.5 (3.055556)	--	--
18	WALL SWITCH	NO	--	--	--	YES	NO
{19}	DI OVRD SW	OFF	--	--	--	ON	OFF
20	OVRD TIME	0	HRS	1	0	--	--
{21}	NGT OVRD	NIGHT	--	--	--	NIGHT	DAY
{24}	DI 2	OFF	--	--	--	ON	OFF
{25}	DI 3	OFF	--	--	--	ON	OFF
{29}	DAY.NGT	DAY	--	--	--	NIGHT	DAY
{41}	HTG STG 1	OFF	--	--	--	ON	OFF
{42}	HTG STG 2	OFF	--	--	--	ON	OFF
{43}	HTG STG 3	OFF	--	--	--	ON	OFF
{44}	HTG STG 4	OFF	--	--	--	ON	OFF
{45}	HTG STG 5	OFF	--	--	--	ON	OFF
{46}	HTG STG 6	OFF	--	--	--	ON	OFF
59	DO DIR. REV	0	--	1	0	--	--
67	HTG P GAIN	10.00 (18.00)	--	0.25 (0.45)	0.00 (0.00)	--	--
68	HTG I GAIN	0.010 (0.0180)	--	0.001 (0.0018)	0.000 (0.0000)	--	--
69	HTG D GAIN	0 (0.0)	--	2 (3.6)	0 (0.0)	--	--
70	HTG BIAS	0.0	PCT	0.4	0.0	--	--
{78}	CTL TEMP	74.00 (23.44888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--
{80}	HTG LOOPOUT	0.0	PCT	0.4	0.0	--	--
{81}	AVG HEAT OUT	0.0	PCT	0.4	0.0	--	--
82	HTG STG MAX	90.0	PCT	0.4	0.0	--	--
83	HTG STG MIN	10.0	PCT	0.4	0.0	--	--
88	HTG STG CNT	1	--	1	0	--	--
89	HTG STG TIME	10	MIN	1	0	--	--
{92}	CTL STPT	74.00 (23.44888)	DEG F (DEG C)	0.25 (0.14000)	48.00 (8.88888)	--	--

**NOTES:**

1. Points not listed are not used in this application.
2. A single value in a column means that the value is the same in English units and in SI units.
3. Point numbers that appear in brackets {} may be unbundled at the field panel.

**Table 2323-1. Point Database for Application 2323.**

Point Number	Descriptor	Factory Default (SI Units)	Engr. Units (SI Units)	Slope (SI Units)	Intercept (SI Units)	On Text	Off Text
98	LOOP TIME	5	SEC	1	0	--	--
{99}	ERROR STATUS	0	--	1	0	--	--

**NOTES:**

1. Points not listed are not used in this application.
2. A single value in a column means that the value is the same in English units and in SI units.
3. Point numbers that appear in brackets {} may be unbundled at the field panel.