JOHNSON CONTROLS

T500 Series Programmable Thermostats

T500 Series Thermostats provide an economical control solution for single-stage, multi-stage, or heat pump systems. Up to four event setpoints can be selected, as well as heat, cool, automatic changeover, and off modes.

Thermostats are available in the following types: T500HCP-1 (1 heat/1 cool), T500HPP-1 (heat pump, 3 heat/2 cool), T500HPP-2 (heat pump, 1 heat/1 cool), T500MSP-1 (2 heat/2 cool). Each thermostat is packaged with the necessary mounting hardware, and installation is simple and fast for reduced cost.

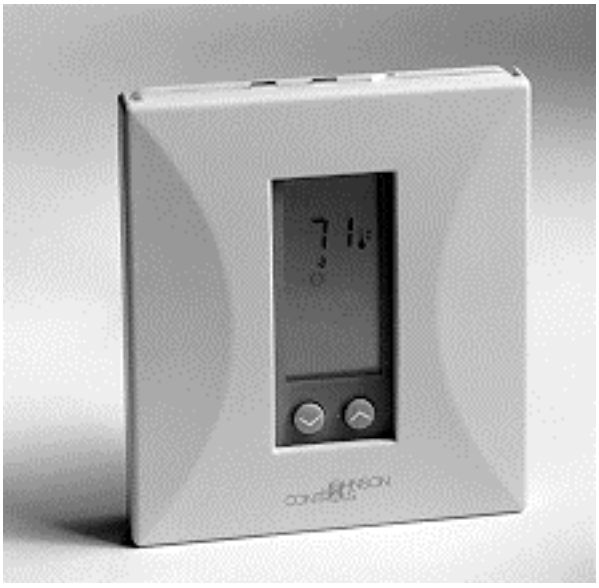

Figure 1: T500 Series Programmable Thermostats

Features and Benefits

❑ **Low-Profile Design**	Complements any decor
❑ **No Batteries Required**	Retains scheduled events and temperatures upon loss of power
❑ **Lockable Access Cover and Keypad Lockout**	Prevents unauthorized changes
❑ **Full Function Liquid Crystal Display (LCD)**	Makes controls easy to read, easy to use
❑ **Remote Sensor Terminals**	Allows the T500 thermostat to be mounted up to 300 m (1,000 ft) away from the controlled space using a SEN-500-1 (sold separately)
❑ **Auxiliary Output**	Energizes for auxiliary equipment operation
❑ **Fuzzy Logic Control**	Optimizes control performance
❑ **Smart Fan Option**	Provides continous fan operation in the occupied mode and intermittent operation at night

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Introduction

The T500 thermostats use an adaptive control routine, based on fuzzy logic, to determine the heating or cooling load of the controlled space. The routine calculates load by evaluating recent room conditions and room reactions to heating and cooling. This load is used to determine the cycle rate of the equipment, giving optimal control of the space.

Supplies Needed

- drill
- 4.7 mm (3/16 in.) drill bit
- 3 mm (1/8 in.) flat-blade screwdriver
- hammer
- marking pencil
- wire stripper

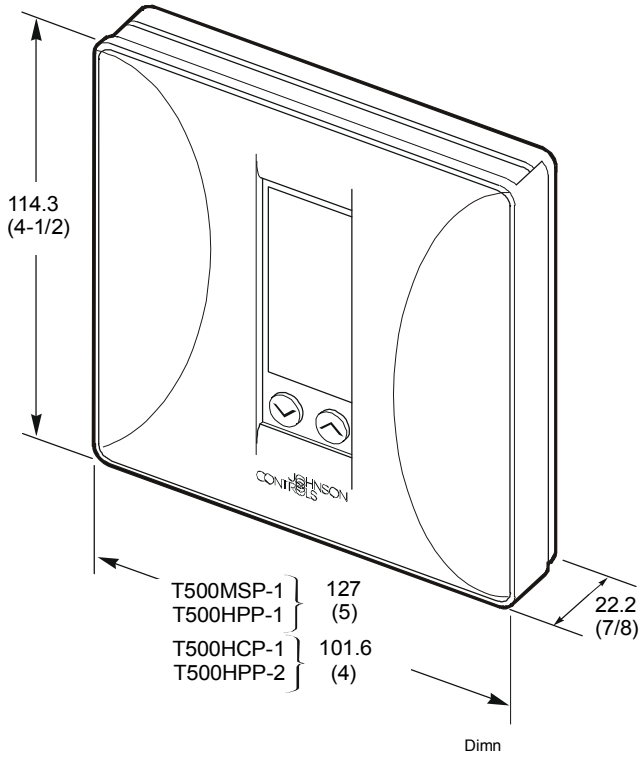

Figure 2: **T500 Dimensions, mm (in.)**

Location Considerations

Locate T500 thermostat as follows:

- on a partitioning interior wall, and approximately 1.5 m (5 ft) above the floor in a location of average temperature
- away from direct sunlight or radiant heat, outside walls or behind doors, air discharge grills, stairwells, or outside doors
- away from steam or water pipes, warm air stacks, unheated/uncooled areas, or sources of electrical interference

CAUTION: **Shock Hazard.**
Disconnect power supply before wiring connections are made to prevent electrical shock or possible damage to the equipment.

Installation and Wiring

Note: When replacing an existing thermostat, remove and use wire tags to identify terminal designations.

To install and wire the thermostat:

1. Lift the thermostat cover and insert a small coin into the slot located in the bottom center of the thermostat case and twist 1/4 turn. (See Figure 3.) Grasp the base from the bottom two corners and separate from the thermostat.
2. Swing the thermostat out from the bottom, and lift up and out of the base. Place the rectangular opening in the base over the equipment control wires protruding from the wall and, using the base as a template, mark the location of the two mounting holes. No leveling is required.
3. Use the supplied anchors and screws for mounting on drywall or plaster. Drill two 4.7 mm (3/16 in.) holes at the marked locations, tap nylon anchors flush to wall surface, and fasten. (See Figure 4.)
4. Connect the wires from the existing system to the thermostat terminals according to wiring designations in Table 2, Table 3, Table 4, or Table 5. Push extra wire back into the wall. Wires must be flush to the plastic base. Plug hole with a fireproof material to prevent drafts from affecting ambient temperature readings.

CAUTION: **Equipment Damage Hazard.** Before applying power, make all wiring connections and check the connections. Short-circuited or improperly connected wires may result in permanent damage to the unit.

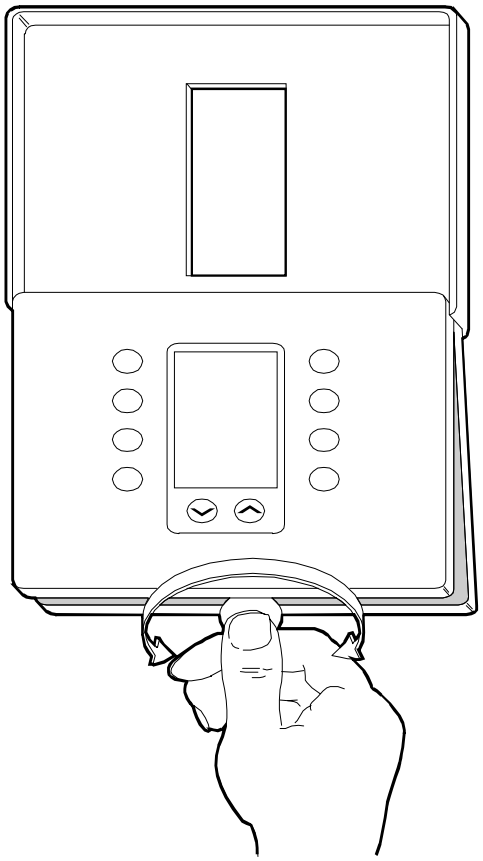

Figure 3: Separating the T500 from the Base

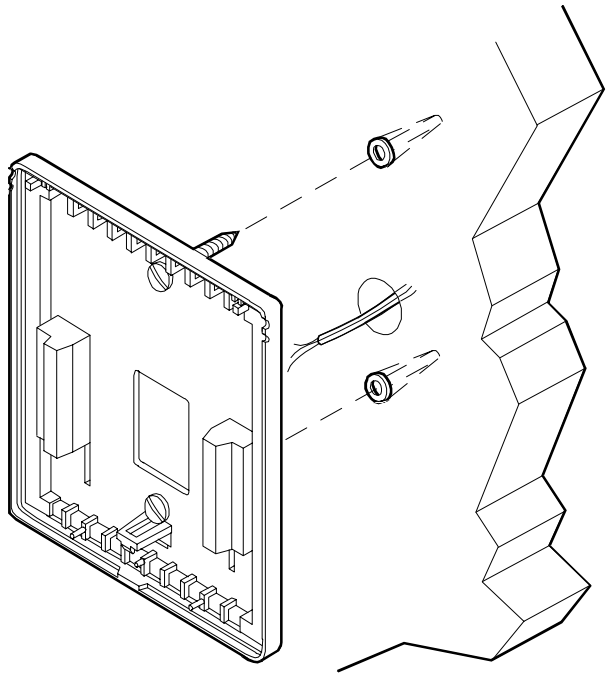

Figure 4: Mounting the Base

Installing the Thermostat Cover Lock

If desired, insert the plastic lock piece into the bottom of the mounted base. The ends of the lock piece should fit snugly under the lock pins extending from the bottom of the mounted base. The tab in the middle of the lock piece should extend downward from the mounted base. (See Figure 5.)

To release the locking mechanism, press the lock piece up and into the base while gently prying open the thermostat at the same time. Use caution to avoid cracking the thermostat base or cover.

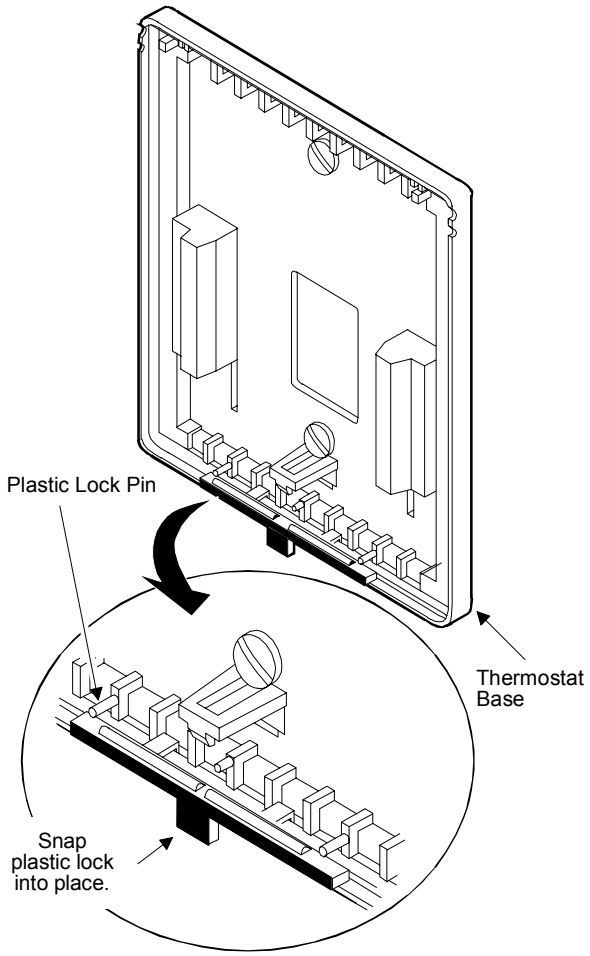

Figure 5: Installing the Thermostat Lock

Reattaching the Thermostat and Cover to the Installed Base

1. Position the thermostat inside the cover, and attach on the hinged tabs located at the top of the base.
2. Swing the thermostat and cover down, and press on the bottom center edge until they snap in place. (See Figure 6.)

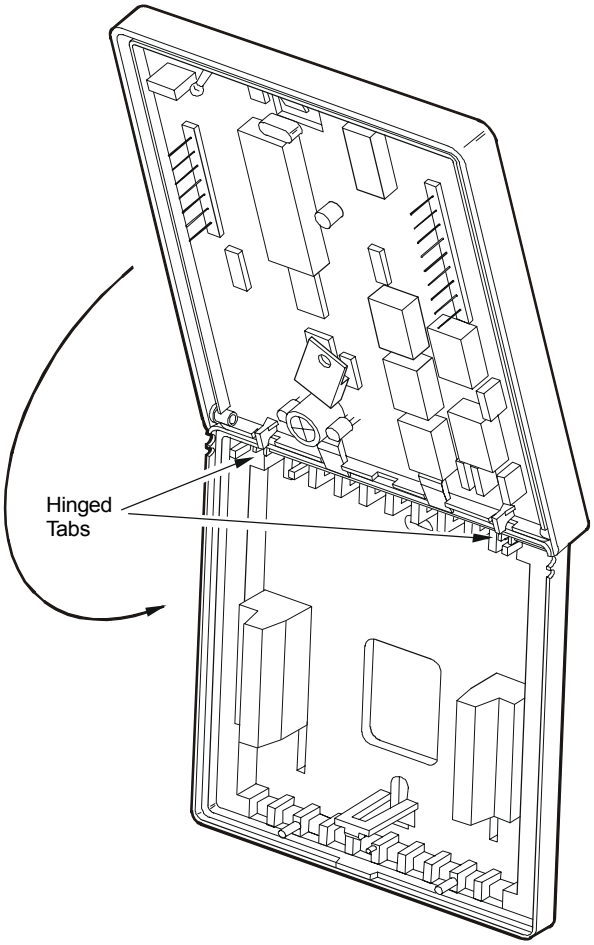

Figure 6: Installing the T500 Thermostat

DIP Switch Selections

CAUTION: **Equipment Damage Hazard.** Before selecting a minimum on/off time, ensure the equipment can tolerate the following maximum hourly cycle rates: 7.5 cycles per hour when using 4-minute on/off, or 15 cycles per hour when using 2-minute on/off.

Table 1: DIP Switch Selections

DIP Switch	Switch Selection	Description
1	On	Allows 2-event (day, night) programming.
	Off	Allows 4-event (morning, day, evening, night) programming.
2 (Smart Fan)	On	During the *morning, day, and evening* events, the fan automatically cycles with the equipment or runs continuously if the **Fan** button is pressed. To run continuously, the **Fan** button need only be pressed once during the morning, day, or evening event after programming the thermostat. Smart Fan remembers that the fan should run continuously during these events after that. During the *night* event, the fan automatically cycles with the equipment by default. Pressing the **Fan** button during the night event overrides and causes the fan to run continuously for that night only. At the end of the *night* event, Smart Fan remembers the fan selection (automatic cycling or continuous fan) for the *morning, day, and evening* events and reverts back.
	Off	Allows the fan to cycle with equipment or run continuously if the **Fan** button is pressed, regardless of the event. Changing between events does not affect the fan.
3	On	Allows 2-minute minimum on/off time for heating and cooling equipment.
	Off	Allows 4-minute minimum on/off time for heating and cooling equipment.
4	On	Locks the keyboard, disabling buttons to prevent tampering. (Only the **Outdoor** and ∨ and ∧ buttons will function. See *Programming the Thermostat, Making Programming Changes While the Keyboard is Locked,* and *Temporary [1 Hour] [Keyboard Locked]* in this bulletin.)
	Off	Unlocks the keyboard.
5	On	**T500HCP-1, T500HPP-2, T500MSP-1 only:** Allows the fan to delay with the plenum switch.
		T500HPP-1 only: Compressor/Auxiliary Interlocked: Turns off the compressor when the auxiliary heat is on. The compressor will remain off for 2 minutes after the auxiliary heat is turned off to ensure that the heat pump coil has cooled.
	Off	**T500HCP-1, T500HPP-2, T500MSP-1 only:** Allows fan to operate immediately with a call for heat.
		T500HPP-1 only: Compressor/Auxiliary Normal: Allows the compressor and auxiliary heat to be on simultaneously.

Continued on next page . . .

DIP Switch (Cont.)	Switch Selection	Description
6	On	**T500HPP-1, T500MSP-1 only:** Allows multi-stage heating or cooling.
	Off	**T500HPP-1, T500MSP-1 only:** Allows single-stage heating or cooling.
7	LED 1 icon off/on (See Table 5.)	**T500HPP-1, T500MSP-1 only:** Optional selection: LCD icon comes on with LED 1.
8	LED 2 icon off/on (See Table 5.)	**T500HPP-1, T500MSP-1 only:** Optional selection: LCD icon comes on with LED 2.

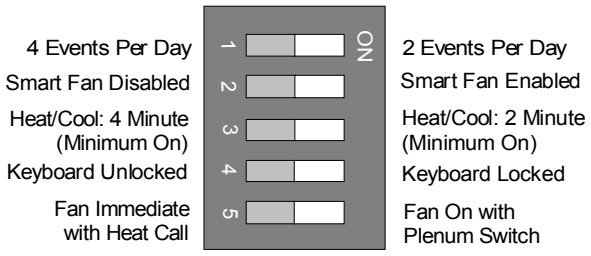

Figure 7: T500HCP-1 Factory-Set DIP Switch Settings (All Off)

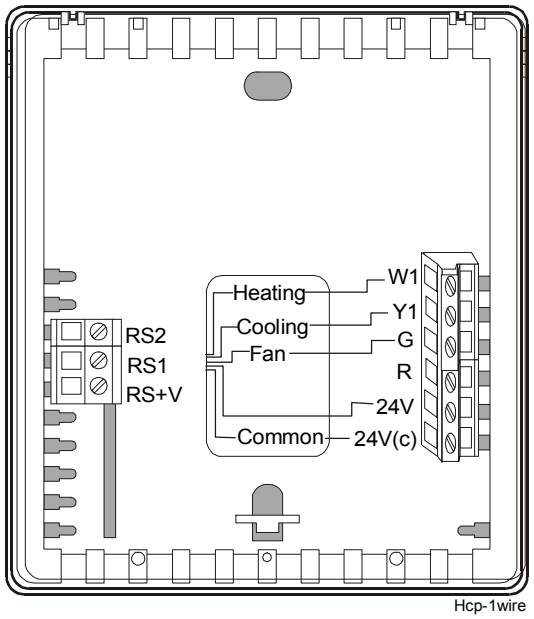

Figure 8: T500HCP-1 Wiring Terminals

Table 2: T500HCP-1 Output Terminal Designations

Terminal	Function
W1	Energizes on call for heating
Y1	Energizes on call for cooling
G	Energizes fan on call for heating or cooling or by pressing **Fan** button
R	Independent switching voltage
24V	24 VAC from equipment transformer
24V(c)	24 VAC (common) from equipment transformer
RS2 **RS1** **RS+V**	Connections for outdoor air temperature or indoor remote sensors; refer to instructions included with sensors.

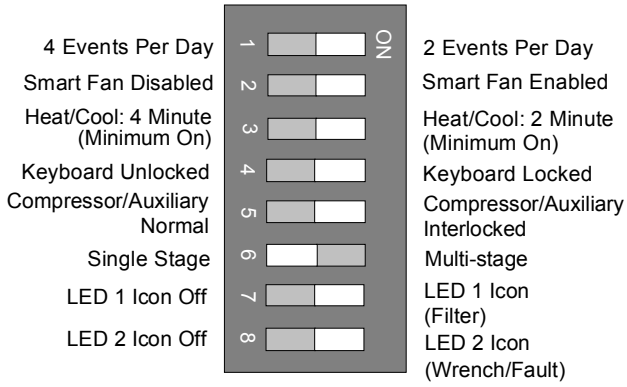

Figure 9: T500HPP-1 DIP Factory-Set DIP Switch Settings

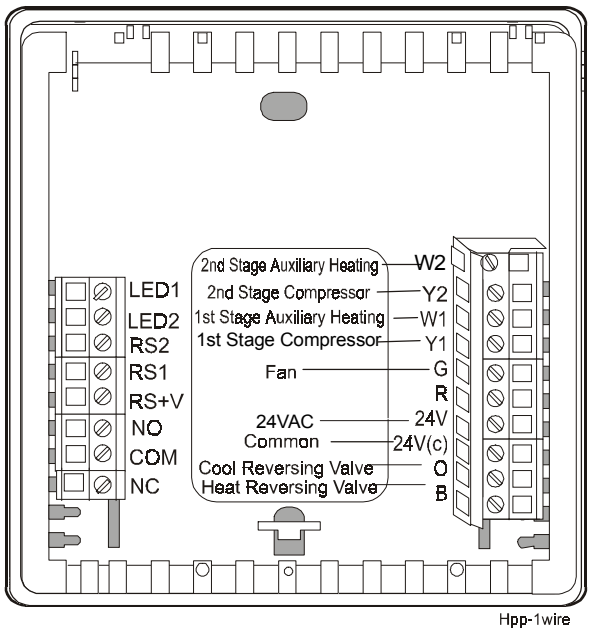

Figure 10: T500HPP-1 Wiring Terminals

Table 3: T500HPP-1 Output Terminal Designations

Terminal	Function
W2	Energizes auxiliary heat as second-stage heating in emergency heat mode
Y2	Energizes compressor No. 2 on call for second-stage heating or cooling
W1	Energizes auxiliary heat as last-stage heating or first-stage in emergency heat
Y1	Energizes compressor No. 1 on call for heating or cooling
G	Energizes fan on call for heating or cooling or by pressing **Fan** button
R	Independent switching voltage
24V	24 VAC from equipment transformer
24V(c)	24 VAC (common) from equipment transformer
O	Energizes reversing valve in the cooling mode
B	Energizes reversing valve in the heating mode
LED 1 **LED 2**	Input connection that energizes LED 1 or LED 2 from remote status device (See Figure 9 and Table 6.)
RS2 **RS1** **RS+V**	Connections for outdoor air temperature or indoor remote sensors; refer to instructions included with sensors.
NO **COM** **NC**	The relay coil is de-energized in the night event. In all other events, the relay coil is energized. (See Figure 16.)

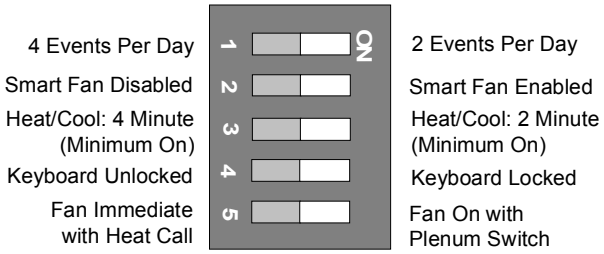

Figure 11: T500HPP-2 Factory-Set DIP Switch Settings (All Off)

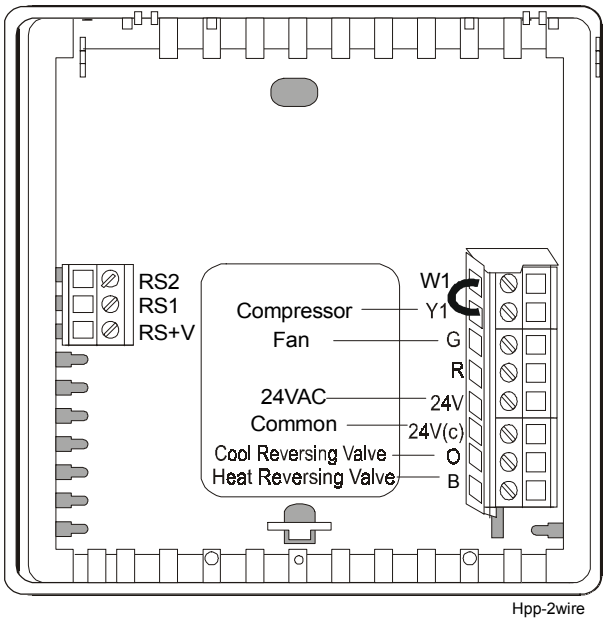

Figure 12: T500HPP-2 Wiring Terminals

Table 4: T500HPP-2 Output Terminal Designations

Terminal	Function	
	Single-Stage Heat Pump Thermostat	**Conventional Single-Stage Heat/Cool Thermostat**
W1*	Jumpered to Y1 (See Note.)	Energizes on call for heating (See Note.)
Y1	Energizes compressor contactor (See Note.)	Energizes on call for cooling (See Note.)
G	Energizes fan on call for heating or cooling or by pressing **Fan** button	
R	Independent switching voltage (See Note.)	
24V	24 VAC from equipment transformer	
24V(c)	24 VAC (common) from equipment transformer	
RS2 RS1 RS+V	Connections for outdoor air temperature or indoor remote sensors; refer to instructions included with sensors	
O	Energizes reversing valve in the cooling mode	Not used
B	Energizes reversing valve in the heating mode	Not used

Note: **Single-Stage Heat Pump:**
Leave the factory-installed jumper connected between W1 and Y1 and wire O or B as shown in Figure 12.

Conventional Single-Stage Heat/Cool:
Remove the factory-installed jumper between W1 and Y1 and wire as shown in Figure 12. Note that the O and B terminals are not used in this application.

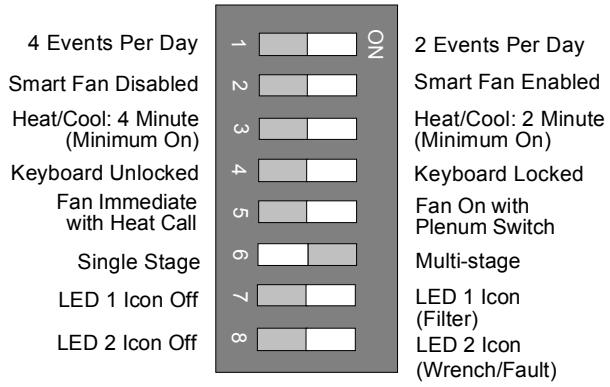

Figure 13: T500MSP-1 Factory Set DIP Switch Settings

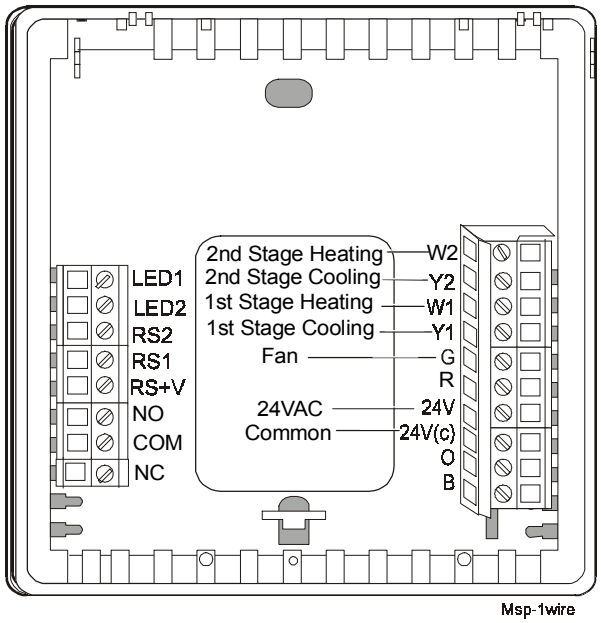

Figure 14: T500MSP-1 Wiring Terminals

Table 5: T500MSP-1 Output Terminal Designations

Terminal	Function
W2	Energizes on a call for second-stage heat
Y2	Energizes on a call for second-stage cooling
W1	Energizes on a call for first-stage heat
Y1	Energizes on a call for first stage cooling
G	Energizes fan on call for heating or cooling or by pressing the **Fan** button
R	Independent switching voltage
24V	24 VAC from equipment transformer
24V(c)	24 VAC (common) from equipment transformer
O	Energizes in the cooling mode
B	Energizes in the heating mode
LED 1 **LED 2**	Input connection that energizes LED 1 or LED 2 from remote status device (See Figure 13 and Table 6.)
RS2 **RS1** **RS+V**	Connections for outdoor air temperature or indoor remote sensors; refer to instructions included with sensors
NO **COM** **NC**	The relay coil is de-energized in the night event. In all other events, the relay coil is energized. (See Figure 18.)

Wiring Diagrams

If the transformer (T2) is to power all of the loads, R and 24 must be connected by inserting jumper JP1 located above the relays. If a separate 24V transformer (T1) is to be used, remove JP1 to disconnect R and 24V(c).

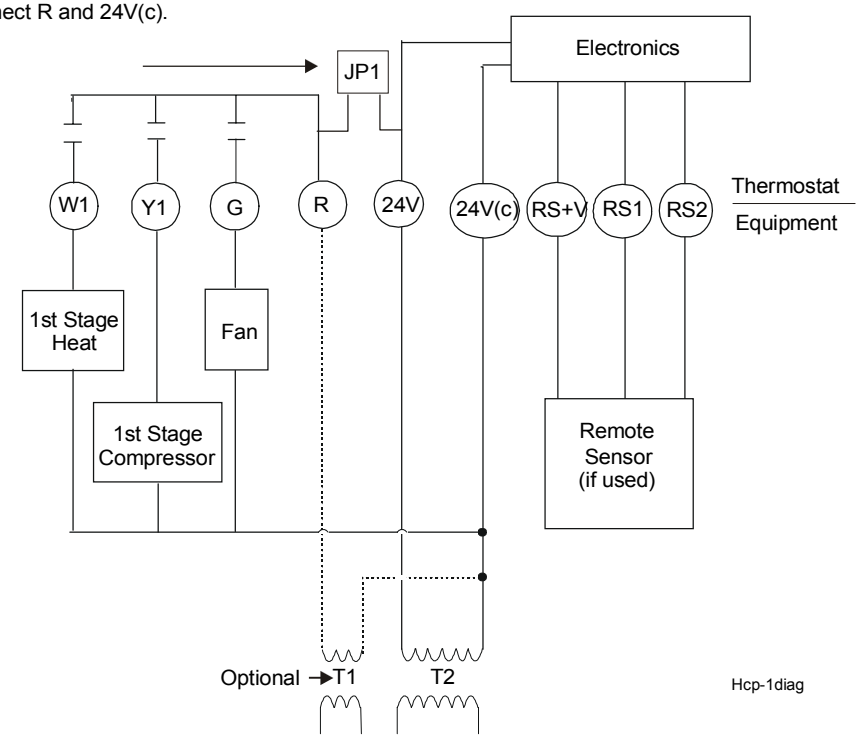

Figure 15: T500HCP-1 Wiring Schematic

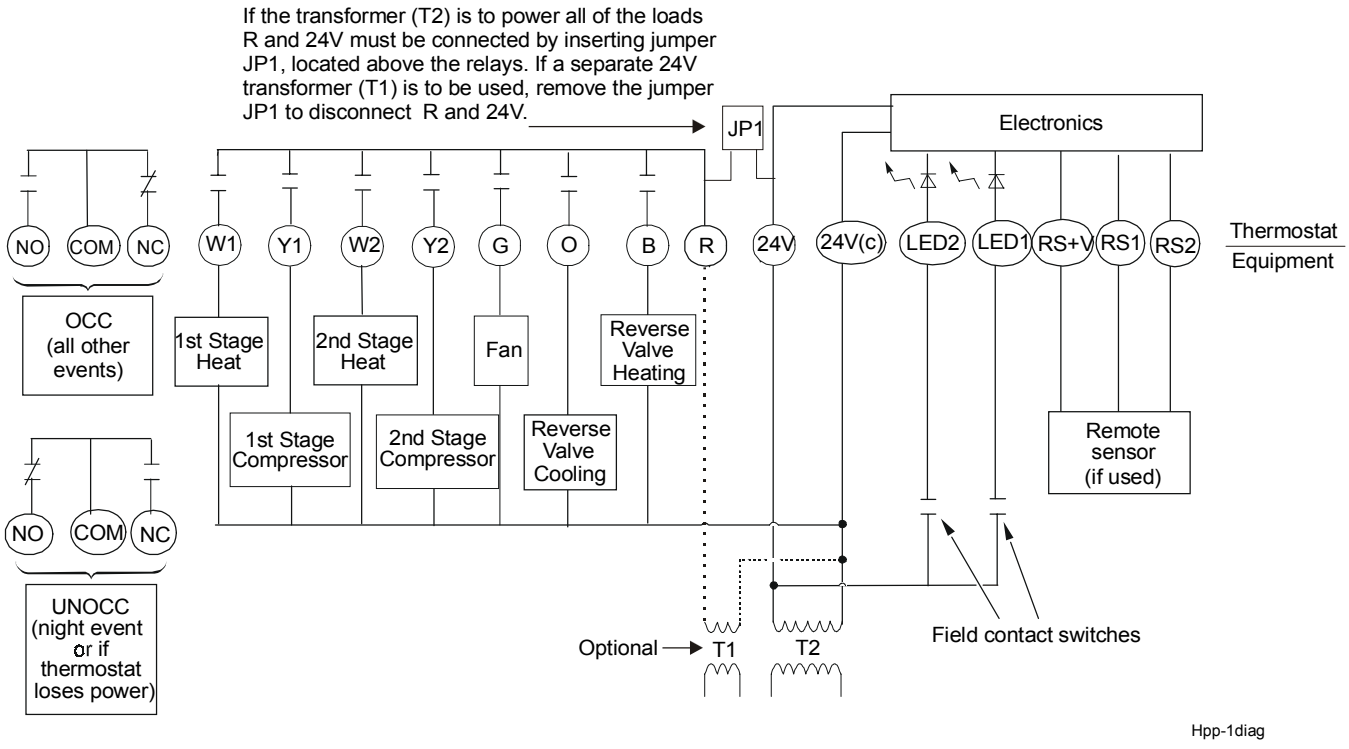

Figure 16: T500HPP-1 Wiring Schematic

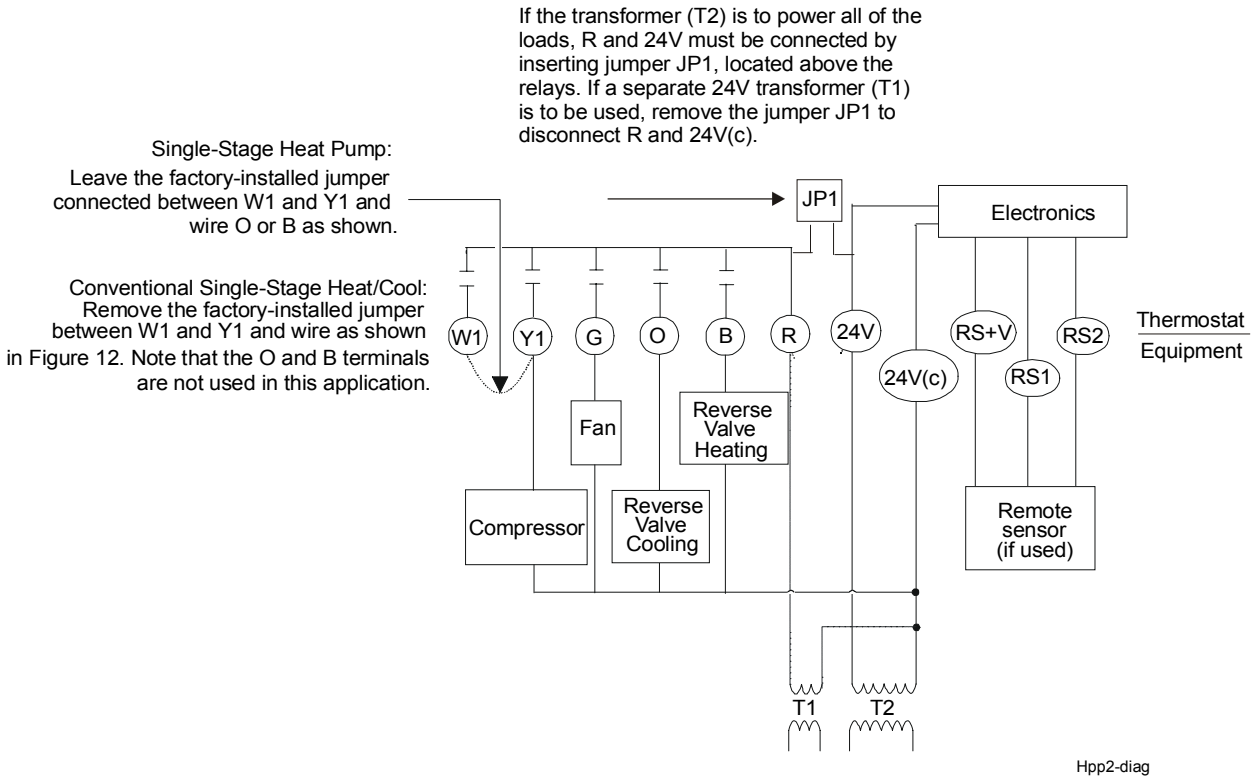

Figure 17: T500HPP-2 Wiring Schematic

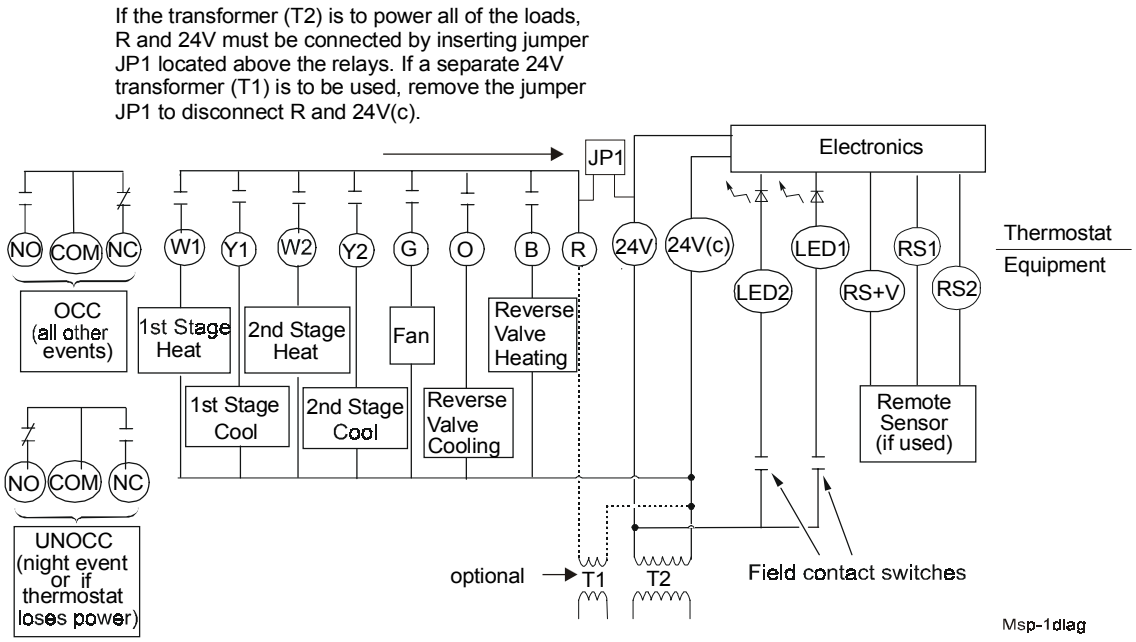

Figure 18: T500MSP-1 Wiring Schematic

Commissioning

The thermostat normally displays room temperature and mode of operation (whether cooling ❄ or heating 🔥 is currently on).

Table 6: LED Indicators (T500MSP-1, T500HPP-1 only)

LED Position	Function
Left	An external switch on the LED 1 Display enables the filter symbol; see Table 1
Center	(T500HPP-1 only) Indicates when highest stage heat is activated; internally controlled
Right	An external switch on the LED 1 Display enables the wrench symbol; see Table 1

Thermostat Operation Overview

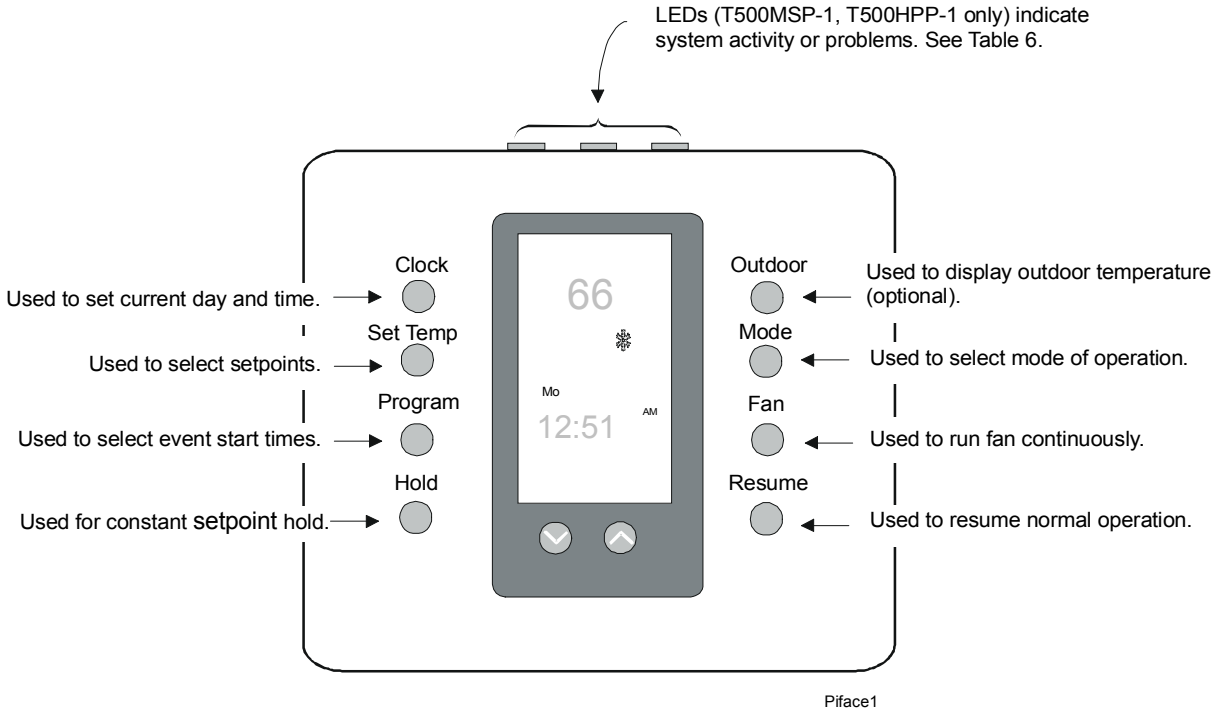

Figure 19: T500 Pushbuttons

Mode

Repeated pressing of the **Mode** button allows selection from four modes of operation (five for the T500HPP-1/Heat Pump model):

- When the **Snowflake** ❄ and the word **COOL** are displayed, the thermostat is in the cooling mode. When the thermostat is calling for cooling, the snowflake will flash.
- When the **Flame** and the word **HEAT** are displayed, the thermostat is in the heating mode. When the thermostat is calling for heating, the flame will flash.
- When the **Flame** and **E Ht** (emergency heat) are displayed, the thermostat will control using the emergency heat with the compressor locked out. (T500HPP-1/Heat Pump only.)
- When the **Snowflake** ❄ and the **Flame** symbols and word **AUTO** are displayed, the thermostat will automatically change over between heating and cooling.

Note: The thermostat never allows less than a 1°C (2°F) difference between the heating and cooling setpoints.

- When **OFF** is displayed, the equipment will not operate.

Note: Use caution when using the **OFF** mode in extremely cold weather.

Celsius/Fahrenheit

Press the ∨ and ∧ buttons simultaneously to alternate between Celsius and Fahrenheit display.

Fuzzy Logic Control

Over time, the T500 learns how long it takes the system to meet the load. If the system can change the room temperature quickly, the T500 allows the thermostat to drift further from setpoint before starting the equipment. If the system takes a longer period of time to change the room temperature, it will not allow the temperature to drift as far from setpoint. The T500 also takes into account the minimum On/Off times. The 2-minute On/Off time allows the equipment to cycle more frequently at smaller differentials than the 4-minute On/Off time. For multi-stage applications, the T500 does not bring on the next stage of cooling or heating if it knows that the system can change the temperature by 6 degrees in 1 hour, or 1 degree in 10 minutes. To verify thermostat operation, force the next stage on by changing the setpoint more than 2 degrees.

Fan

If continuous fan is not selected, the fan will operate automatically and the fan symbol will be off. To select continuous fan operation, press the Fan button. The fan symbol will be displayed. (See Figure 20.) See Smart Fan DIP switch in Table 1.

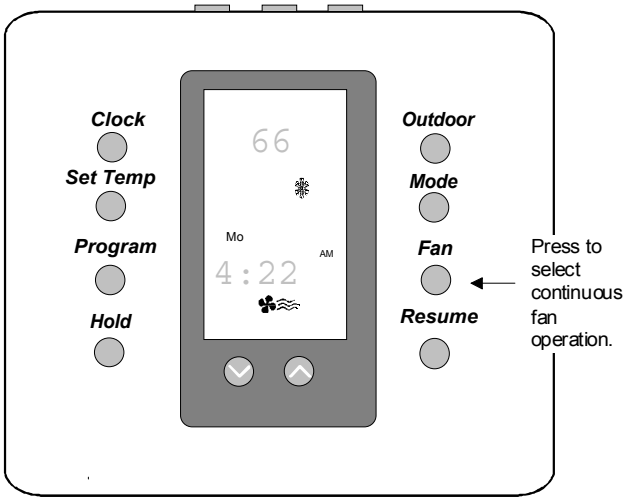

Figure 20: Selecting Continuous Fan Operation

Outdoor Button

When an outdoor temperature sensor (order separately) is connected to the T500 thermostat, you can display the current outdoor temperature by pressing the **Outdoor** button. If the sensor option is not connected, the thermostat will display "— —".

See the *Ordering Information* section.

Programming Overview

Thermostat programming is a 3-part process: setting current time, choosing event setpoints, and setting event times. Throughout the programming procedure, the following terms will be used:

Event = morning, day, evening, night

Event time = the time the event starts

Event setpoint = the temperature setpoint of the event; each event can have only one setpoint for heating or cooling.

Program flexibility is achieved by varying the program start times. When consecutive events are programmed with the same event time, the thermostat will control the temperature according to the setpoint of the latest event.

Table 7 is an example of event times and setpoints for a given week using a 4-event program. See the owner's manual for a blank table.

Note: A 2-event program will only include day and night events.

Table 7: Sample 4-Event Program Settings

Event	Morning		Day		Evening		Night	
Event Setpoint	Heat 68°F	Cool 80°F	Heat 72°F	Cool 76°F	Heat 66°F	Cool 78°F	Heat 60°F	Cool 85°F
	(Time)		(Time)		(Time)		(Time)	
Monday	6 a.m.		8 a.m.		5 p.m.		11 p.m.	
Tuesday	6 a.m.		8 a.m.		5 p.m.		11 p.m.	
Wednesday	6 a.m.		8 a.m.		5 p.m.		11 p.m.	
Thursday	6 a.m.		8 a.m.		5 p.m.		11 p.m.	
Friday	6 a.m.		8 a.m.		5 p.m.		11 p.m.	
Saturday	6 a.m.*		6 a.m.		12 p.m.		12 p.m.	
Sunday	12 p.m.		12 p.m.		12 p.m.		12 p.m.**	

* Thermostat controls to the day setpoint until noon.

** Thermostat controls to the night setpoint until 6 a.m. Monday morning.

Programming the Thermostat

Setting the Current Day and Time

To set the current day and time:

1. Press and release the **Clock** button. The display will flash a day of the week.
2. Press the ∨ or ∧ buttons until the current day shows.
3. Press **Clock** again. The display will flash the hour.
4. Press the ∨ or ∧ buttons until the current hour shows. Be sure AM or PM corresponds to the proper time.
5. Press **Clock** again. The display will flash minutes (:00). (See Figure 21.)
6. Press the ∨ or ∧ buttons until the current minutes show.
7. Press **Clock** to complete the procedure or wait 15 seconds to return to normal display.

Setting the Event Setpoints

Setpoints are programmed for both heating and cooling ❄ modes, and either two (day and night) or four (morning, day, evening, and night) events per day. (See Table 1.) To program a setpoint:

1. Press the **Mode** button until heat is displayed.
2. Press the **Set Temp** button. The mode (heat or cool ❄), event (morning, day, evening, or night) symbols, and the present setpoint will be displayed.
3. Press the ∨ or ∧ buttons to adjust setpoints for the displayed event and mode.
4. Press **Set Temp** to move to the next event. Press the ∨ or ∧ buttons to adjust the setpoint. Repeat this step until all event setpoints are programmed.
5. Press **Mode** until cooling ❄ is displayed, and repeat Steps 2 through 4.
6. Select the desired mode of operation: heat, cool, auto.
7. When programming is complete, press the **Resume** button to return to the normal display.

! CAUTION:	**Equipment Damage Hazard.** Operating a cooling system without proper limit controls in very low outdoor air temperatures can permanently damage the cooling equipment.

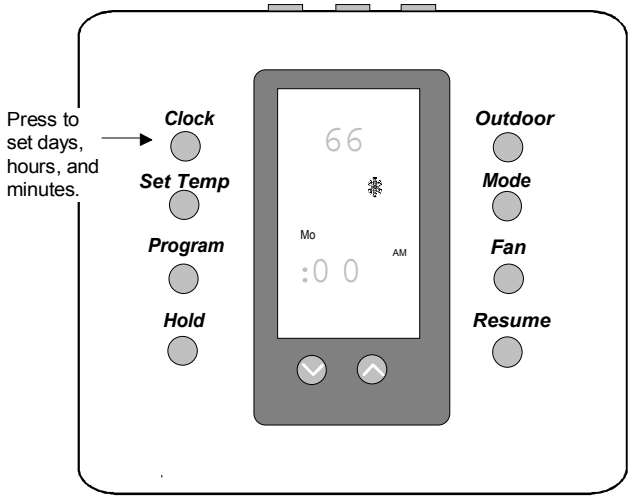

Figure 21: Setting the Current Day and Time

Push Button Auto Repeat

Holding the **Program** button down will advance you through the programming menu in sequence to the desired option.

Setting the Event Times

To program event times:

1. Press and release the **Program** button. The morning event symbol and the current day appear.
2. Press the ∨ or ∧ buttons to select the first single day or the first day of a block of days to be programmed.
3. Press and release **Program**. Press the ∨ or ∧ buttons to set the start time hour for the first event.
4. Press and release **Program**. Press the ∨ or ∧ buttons to set the minutes in 10-minute intervals (i.e., 8:10, 8:20, etc.).
5. Press **Program** to advance to the next event.
6. Repeat Steps 3 through 5 for all remaining events. After programming the last event, press **Program**. **Copy** will be displayed.
7. If you do not want to copy the program, press **Program** and proceed to Step 9. To copy the program, press the ∨ or ∧ buttons to select individual days to copy the program to. The **Copy** function will only allow program times to be copied to sequential days (i.e., Tuesday, Wednesday, Thursday).
8. Press **Program** to copy program settings to the selected days of the week.
9. Repeat the procedures for *Setting the Event Times* for any remaining unprogrammed days of the week.
10. When finished, verify that all events are programmed correctly by repeatedly pressing the **Program** button. When **Copy** appears, press **Program** to skip to the next day.
11. When programming is complete, press **Resume** to return to normal display.

Note: See Table 7 for an example of programming for a given week.

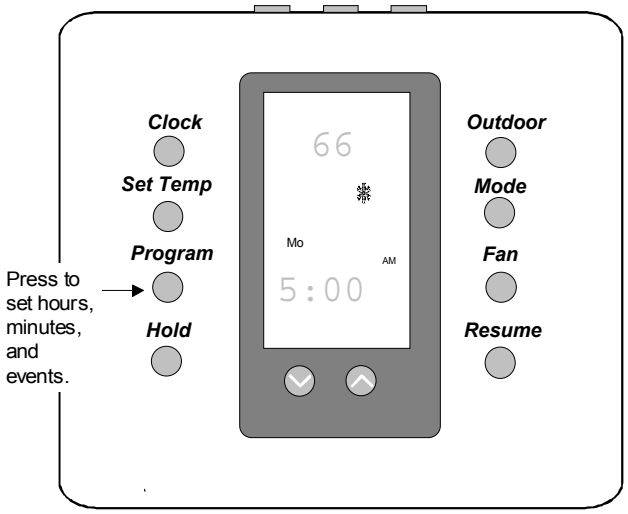

Figure 22: Setting the Event Times

Scheduling 1-, 2-, 3- and 4-Event Days in the Same Week

If the DIP switch is set for 4-event days, a 2-event day can be programmed by setting the same event time for consecutive events. See the example shown in Table 7.

Making Programming Changes While the Keyboard is Locked

To make programming changes while the DIP switch is set to lock the keyboard:

1. Open the thermostat and switch the DIP switch to unlock the keyboard. (See *Table 1: DIP Switch Selections.*) Close the thermostat.
2. Make necessary program changes.
3. Open the thermostat and switch the DIP switch to lock the keyboard again. Close the thermostat.

Override

Constant Hold

To maintain a constant temperature setting:

1. Press the **Mode** button until the desired mode is displayed (heating, cooling, auto).
2. Press the ∨ or ∧ buttons to set the desired setpoint(s).

Note: If the Auto mode is used, press **Mode** twice, and press the ∨ or ∧ buttons to select a cooling setpoint. Press **Mode** again, and the ∨ or ∧ buttons to select a heating setpoint. Press **Mode** again to set the mode back to Auto.

3. Press the **Hold** button. Setpoint(s) will be maintained continuously.
4. Pressing and releasing the **Resume** button will cancel the **Hold** and return to programmed setpoints.

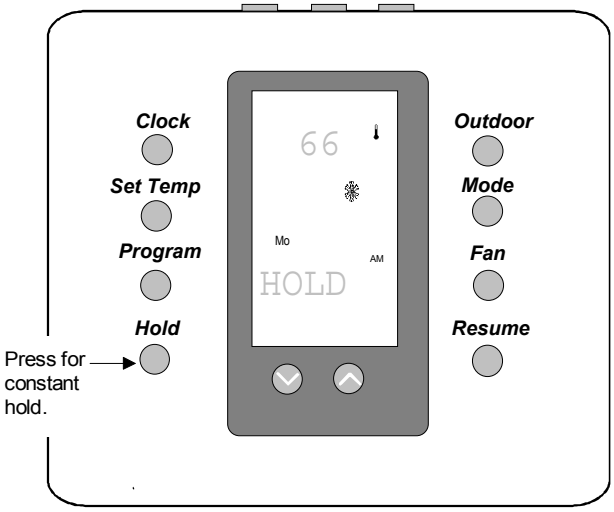

Figure 23: Constant Override (Hold)

Progressive Recovery

During the night mode the thermostat is designed to anticipate a programmed setpoint change. With Progressive Recovery, the desired temperature will be attained at the programmed time instead of beginning the temperature cycle change. Recovery option is selected by pressing the **Program** and **Fan** buttons simultaneously.

Temporary (3 Hour) ⌛ (Keyboard Unlocked)

To implement a temporary change from the current event setpoint for a 3-hour period:

1. Press the ∨ or ∧ buttons to change the scheduled setpoint ± 3°C or ± 6°F. The current mode of operation will appear on the display and an hourglass symbol ⌛ will appear. The temporary setpoint will be maintained for 3 hours.

Note: If the Auto mode is used, press **Mode**, and press the ∨ or ∧ buttons to select a heating setpoint. Press **Mode** again, and the ∨ or ∧ buttons to select a cooling setpoint.

2. Pressing and releasing the **Resume** button will cancel the override and return to the programmed setpoint at any time during the 3 hours.

Note: If the setpoint is altered while in the night mode, the thermostat will change to the day mode setting.

Temporary (1 Hour) ⌛ (Keyboard Locked)

To implement a temporary change from the current event setpoint for a 1-hour period:

1. Press the ∨ or ∧ buttons to change the scheduled setpoint. The current mode of operation will appear on the display and an hourglass symbol ⌛ will appear. The temporary setpoint will be maintained for 1 hour.

Note: If the Auto mode is used, press **Mode**, and press the ∨ or ∧ buttons to select a heating setpoint. Press **Mode** again, and the ∨ or ∧ buttons to select a cooling setpoint.

2. Pressing and releasing the **Resume** button will cancel the override and return to the programmed setpoint at any time during the 1 hour.

Setting Electronic Outdoor High and Low Temperature Balance Points (T500HPP-1 only)

The optional outdoor temperature sensor (order separately) can be installed to allow the selection of outdoor balance points that will lock out auxiliary heat or cooling, depending on the outdoor temperature. The factory-set HibP (auxiliary heat) and LobP (compressors) setpoints are 48°C (118.4°F), and -48°C (-54.4°F) respectively. The HibP and/or LobP will be shown on lower LCD.

The HibP is the temperature above which the auxiliary heat is locked out. The LobP is the temperature below which the compressors are locked out.

To set the balance points:

1. Press and hold the **Outdoor** button while pressing the **Mode** button. **HibP** will appear on the display.
2. Raise or lower the HibP (high balance point) by pressing the ∨ or ∧ buttons.
3. Set the LobP (low balance point) by pressing and holding the **Outdoor button. LobP** will appear on the display.
4. Raise or lower the LobP by pressing the ∨ or ∧ buttons to set the auxiliary heat setpoint.
5. Press **Resume** to return to the normal display.

Options

Remote Sensor

The indoor remote sensor allows the T500 to be mounted away from the controlled space, and allows use of multiple sensors for temperature averaging. Order separately. See *Table 10: Optional Accessories.*

Outdoor Sensor

Order separately. See *Table 10: Optional Accessories.*

Power Failures

If power fails, AC will be displayed for 2 hours. After 2 hours, the display will go blank.

If power is restored in the first 2 hours, the internal clock will be current and the thermostat will resume normal operation. If power is restored after 2 hours, 12:00 AM will flash and the thermostat will control to the night event setpoint until the clock is reset.

Note: If the power fails when the thermostat is in the continuous HOLD mode, the thermostat will continue controlling to the HOLD temperature when power is restored. When the user presses the **Resume** button, the clock will flash 12:00 AM and will remain in the night event setpoint until the clock is reset.

Verification

To verify proper functioning of the thermostat:

1. Press the **Mode** button to select the heat or cool mode. (See Figure 24.)
2. Press the ∨ or ∧ buttons to raise the setpoint above or below the current ambient temperature. The thermostat should call for either heating or cooling.

If the equipment does not come on, proceed to the *Troubleshooting* section.

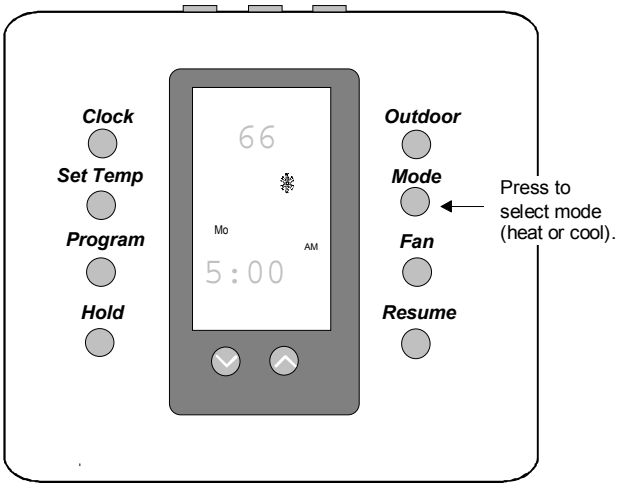

Figure 24: Verifying Proper Operation

Sensor Calibration (Fan/10 Seconds)

The internal and remote sensors can be calibrated to eliminate wire resistance errors or to match another reference.

1. Press and hold the **Fan** button for 10 seconds.
2. Adjust the temperature with the ∨ or ∧ buttons. The temperature is shown on the lower display to the hundredths place. For example, 72°F on the large display is shown as 72 13.

Troubleshooting

Table 8: Troubleshooting

Symptom	Possible Cause	Corrective Action
No display/faint display ...	Supply voltage incorrect	Use a voltmeter to check the voltage between the 24V and 24V(c) terminals. Voltage should be between 20-30 VAC. If voltage is less than 20 VAC, disconnect the thermostat and check the voltage between 24V and the other system wires; see possible causes below. If voltage is greater than 30 VAC, troubleshoot the power source and replace the thermostat.
	System transformer weak or overloaded	Check and/or replace with a suitable 24V transformer.
	Thermostat damaged because system voltage was greater than 30 VAC	Replace with new thermostat and ensure new thermostat is isolated from the system using suitable relays and a transformer of the proper rating.
Keyboard inoperative ...	Keyboard locked	Switch the keyboard DIP switch to the unlocked position.
Thermostat will not call for heat ...	Compressor delay still in progress	Wait - equipment short cycle protection in progress.
	Thermostat setpoint is satisfied	Raise the heating setpoint using the ∧ button.
Thermostat will not call for cooling ...	Compressor delay still in progress	Wait - equipment short cycle protection in progress.
	Thermostat setpoint is satisfied	Lower the cooling setpoint using the ∨ button.
Fan does not turn on ...	Fan failure	Place a jumper between terminals R and G. Fan should come on. If it does not, troubleshoot the fan system. If fan does come on, replace the thermostat.
AC appears on the LCD ...	20-30 VAC is absent from 24V and 24V(c)	Using a voltmeter, measure voltage between the 24V and 24V(c) terminals. If the reading is less than 20 VAC, check system transformer. If the voltage is between 20-30 VAC, replace the thermostat.
LCD shows missing or extra segments ...	LCD failure	Replace the unit.

Ordering information

Table 9: Ordering Information

Item	Product Code Number
Programmable Thermostat, Single-stage, 1 Heat, 1 Cool	T500HCP-1
Programmable Thermostat, Multi-stage, 2 Heat, 2 Cool	T500MSP-1
Programmable Thermostat, Heat Pump, 3 Heat, 2 Cool	T500HPP-1
Programmable Thermostat, Heat Pump, 1 Heat, 1 Cool	T500HPP-2

Accessories

Table 10: Optional Accessories (includes mounting hardware)

Item	Product Code Number
Remote Indoor Temperature Sensor	SEN-500-1
Outdoor Air Temperature Communication Module with Outdoor Air Sensor	SEN-500-2
Outdoor Air Temperature Communication Module with Duct Mount Sensor	SEN-500-3
Conversion Module	ACC-500-1
Thermostat Wall Plate	ACC-500-2

Replacement and Repair Parts

The SEN-500 series of products allows for easy replacement of the sensor. For a replacement sensor, contact the nearest Johnson Controls branch office or wholesale distributor and order using the information from *Table 10: Optional Accessories, Table 11: Replacement Parts,* and *Table 12: Repair Parts*.

Table 11: Replacement Parts

Item	Product Code Number
Replacement Outdoor Air Temperature Communication Module	SEN-500-603
Replacement Outdoor Air Temperature Sensor (including mounting hardware)	SEN-500-604
Replacement Duct Mount Temperature Sensor (including mounting hardware)	SEN-500-605

Table 12: Repair Parts

Item	Product Code Number
3 in. Sensor Probe (use with outdoor air sensor)	SEN-500-601
8 in. Sensor Probe (use with duct mount sensor)	SEN-500-602

Specifications

Product	T500HCP-1, T500MSP-1, T500HPP-1, T500HPP-2	
Power Requirements	20-30 VAC, 50/60 Hz, 24 VAC nominal	
Relay Contact Rating	Maximum Inductive: Maximum Resistive: Minimum:	1 ampere with surges to 3 amperes, 24 VAC Class 2 1 ampere, 24 VDC (2000 VA Maximum for all outputs) 10 uA for 24 VAC circuit; 10 mA for 24 VDC circuit
Recommended Wire Size	18 gauge	
Occupied/Unoccupied Relay Contacts (T500HPP-1 and T500MSP-1 only)	Single-Pole/Double-Throw; The normally open contact is closed in the night event or if the thermostat loses power. The normally closed contact is closed in all other events.	
Thermostat Measurement Range	0 to 48°C (28 to 124°F)	
Outdoor Air Temperature Indication Range	-48 to 48°C (-50 to 124°F)	
Control Range	Heating: 5 to 30°C in 1° steps; 38 to 88°F in 1° steps Cooling: 16 to 40°C in 1° steps; 60 to 108°F in 1° steps	
Display Resolution	1C or 1F	
Minimum Deadband	(Between heating and cooling) 1°C or 2°F	
°C/°F Conversion	20°C = 68°F, each Celsius degree above or below 20°C = 2°F	
Ambient Operating Conditions	0 to 55°C (32 to 131°F); 5 to 90% RH non-condensing	

Continued on next page . . .

Specifications (Cont.)

Ambient Storage Temperatures	-34 to 55°C (-30 to 131°F)
Dimensions (H x W x D)	114.3 x 101.6 x 22.2 mm (4 1/2 x 4 x 7/8 in.) (T500HCP-1, T500HPP-2) 114.3 x 127 x 22.2 mm (4 1/2 x 5 x 7/8 in.) (T500HPP-1, T500MSP-1)
Shipping Weight	0.171 kg (0.37 lb) (T500HCP-1, T500HPP-2) 0.204 kg (0.45 lb) (T500HPP-1, T500MSP-1)
FCC Compliance	This equipment has been tested and found to comply with the limits for a Class A digital device and verified to Class B pursuant to Part 15 of FCC Rules. These limits are designed to provide reasonable protection against harmful interference when this equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his/her own expense.

The performance specifications are nominal and conform to acceptable industry standards. For application at conditions beyond these specifications, consult the local Johnson Controls office. Johnson Controls, Inc. shall not be liable for damages resulting from misapplication or misuse of its products.

This device complies with Class A Part 15 of the FCC rules. It was also verified to Class B. Operation is subject to the following two conditions:
(1) This device may not cause harmful interference.
(2) This device must accept any interference received, including interference that may cause undesired operation.
This Class A digital apparatus meets all of the requirements of the Canadian Interference-Causing Equipment Regulations. Cet appareil numerique de la Classe A respecte toutes les exigences du Reglement sur le materiel brouilleur du Canada.

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