



turn to the experts

# Carrier Sensors Installation Guide





# Table of Contents

<b>Introduction to Carrier sensors</b> .....	<b>1</b>
<b>SPT sensors</b> .....	<b>3</b>
SPT sensor specifications.....	4
Rnet Configuration .....	5
To address an SPT Standard sensor.....	5
Rnet wiring specifications .....	5
Mounting location.....	6
To wire and mount the SPT sensor .....	6
Using an SPT sensor.....	8
To change sensor properties.....	9
To communicate through the sensor's Local Access port.....	10
Troubleshooting SPT sensors.....	10
<b>Alternate space temperature sensor</b> .....	<b>12</b>
Sensor specifications .....	13
Wiring specifications.....	14
Mounting location.....	14
To wire and mount the sensor .....	14
To change a T59 sensor's options.....	15
<b>Supply Air Temperature sensor</b> .....	<b>18</b>
SAT sensor specifications.....	18
Wiring specifications.....	19
Mounting location.....	20
To wire and mount the SAT sensor .....	20
<b>Duct Air Temperature sensor</b> .....	<b>21</b>
DAT sensor specifications .....	21
Wiring specifications.....	22
Mounting location.....	22
To wire and mount the DAT sensor.....	23
<b>Outdoor Air Temperature sensor</b> .....	<b>24</b>
OAT sensor specifications .....	24
Wiring specifications.....	25
Mounting location.....	25
To wire and mount the OAT sensor.....	26
<b>Primary Air Temperature sensor</b> .....	<b>27</b>
PAT sensor specifications.....	27
Wiring specifications.....	28
Mounting location.....	28
To wire and mount the PAT sensor .....	29
<b>CO2 sensor</b> .....	<b>30</b>
CO2 sensor specifications .....	31
Wiring specifications.....	31
Mounting location.....	32
To wire and wall-mount the CO2 sensor .....	32
To wire and duct-mount the sensor .....	33
<b>CO2/Temperature sensor</b> .....	<b>35</b>
CO2/Temperature sensor specifications .....	36
Wiring specifications.....	37
Mounting location.....	37
To wire and mount the CO2/Temperature sensor .....	37

<b>Relative Humidity sensors .....</b>	<b>39</b>
<b>Sensor specifications .....</b>	<b>40</b>
<b>Wiring specifications.....</b>	<b>41</b>
<b>Mounting location.....</b>	<b>41</b>
<b>To wire and mount the Space RH sensors.....</b>	<b>42</b>
Typical power wiring diagrams for Space RH sensors .....	44
<b>To wire and mount the Duct RH sensor .....</b>	<b>45</b>
<b>To wire and mount the Outdoor RH sensor .....</b>	<b>46</b>
Typical power wiring diagrams for Duct RH and Outdoor RH sensors .....	47
<b>Calibrating and troubleshooting relative humidity sensors .....</b>	<b>48</b>
Troubleshooting the RH sensor .....	48
Using SW2 DIP switches to calibrate and troubleshoot.....	48
RH conversion formulas.....	49
<b>Enthalpy switch/receiver and Enthalpy sensor .....</b>	<b>50</b>
<b>Enthalpy switch/sensor specifications.....</b>	<b>51</b>
<b>Wiring specifications.....</b>	<b>51</b>
<b>Mounting location.....</b>	<b>51</b>
<b>To wire and mount the switch/sensor.....</b>	<b>52</b>
<b>Appendix: I-Vu Open Control System Wiring Specifications and Recommended Vendors.....</b>	<b>54</b>
<b>Index .....</b>	<b>55</b>

## Introduction to Carrier sensors

The following Carrier sensors can be used with the specified Open controllers.

Sensor	Part number	Controller								
		WT Zone	WT Bypass	RTU Open	WSHP Open	UC Open	UC Open XP	AppController	VAV Zone	UPC Open
Space temperature sensor (page 3)	SPS SPPL SPP SPPF	• • • •		• • • •	• • • •	• • • •	• • • •	• • • •	• • • •	• • • •
Alternate space temperature sensor (page 12)	33ZCT55SPT 33ZCT56SPT 33ZCT59SPT	•		• • •		• • •	• • •	• • •	• • •	
Supply Air Temperature sensor (page 18)	33ZCSENSAT	•	•	•	•	•	•	•	•	
Duct Air Temperature sensor (page 21)	33ZCSENDAT	•	•	•	•	•	•	•		
Outdoor Air Temperature sensor (page 24)	33ZCSENSOAT			•	•	•	•	•		
Primary Air Temperature sensor (page 27)	33ZCSENSPAT					•	•		•	
CO <sub>2</sub> sensor (page 30)	33ZCSPTCO2-01, 33ZCSPTCO2LCD-01	•		•	•	•	•	•	•	
CO <sub>2</sub> /Temperature sensor (page 35) *	33ZCT55C02 33ZCT56C02	•		• •	• •	• •	• •	• •	• •	
Wall Relative Humidity sensor (page 39)	OPSENSRH-01 33ZCSENSRH-01	•		• •	• •	• •	• •	• •	• •	
Duct Relative Humidity sensor (page 39)	33ZCSENDERH-01			•		•	•	•		
Outdoor Relative Humidity sensor (page 39)	33ZCSENORH-01			•		•	•	•		
Enthalpy switch/receiver (page 50) Enthalpy sensor (page 50)	33CSENTHSW 3CSENSEN			• •		• •	• •	• •		

\* This sensor can be used only for CO<sub>2</sub> sensing with a WSHP Open.

 **Warning!**

Disconnect electrical power to the controller or sensor before wiring it. Failure to follow this warning could cause electrical shock, personal injury, or damage to the device.

 **Caution!**

- Do not run sensor or relay wires in the same conduit or raceway with Class 1 AC or DC service wiring.
- Do not abrade, cut, or nick the outer jacket of the cable.
- Do not pull or draw cable with a force that may harm the physical or electrical properties.
- Avoid splices in any control wiring.

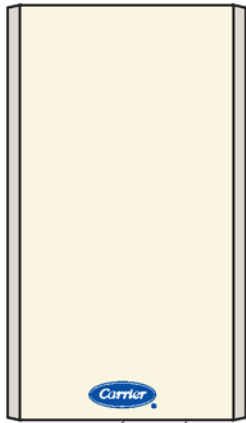
## SPT sensors

Part #SPS, SPPL, SPP, SPPF

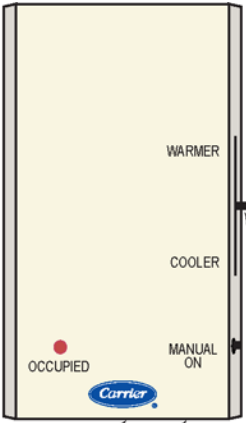
An SPT sensor is a thermistor-based, wall-mounted temperature sensor that monitors zone temperature. An SPT sensor is wired to a controller's **Rnet** port.

Carrier offers the following SPT sensors:

Sensor	Features
<p><b>SPT Standard</b> Part #SPS</p>	<ul style="list-style-type: none"> <li>• Local access port</li> <li>• No operator control</li> </ul>
<p><b>SPT Plus</b> Part #SPPL</p>	<ul style="list-style-type: none"> <li>• Slide potentiometer to adjust setpoint</li> <li>• MANUAL ON button to override schedule</li> <li>• LED to show occupied status</li> <li>• Local access port</li> </ul>



Setscrew  
Local access port



Setscrew  
Local access port

Slide potentiometer

Sensor	Features
<p><b>SPT Pro</b> Part #SPP</p>	<ul style="list-style-type: none"> <li>• LCD display</li> <li>• MANUAL ON button to override schedule</li> <li>• WARMER and COOLER buttons to adjust setpoint</li> <li>• INFO button to cycle through zone and outside air temperatures, setpoints, and local override time</li> <li>• Local access port</li> </ul>
<p><b>SPT Pro Plus</b> Part #SPPF</p>	<ul style="list-style-type: none"> <li>• LCD display</li> <li>• MANUAL ON button to override schedule</li> <li>• WARMER and COOLER buttons to adjust setpoint</li> <li>• INFO button to cycle through zone and outside air temperatures, setpoints, and local override time</li> <li>• MODE button to cycle through custom programmed modes</li> <li>• FAN SPEED button to adjust fan speed</li> <li>• Local access port</li> </ul>



Setscrew  
Local access port



Setscrew  
Local access port

## SPT sensor specifications

Sensor tolerance	Precision Thermistor. Standard accuracy $\pm 0.45^{\circ}\text{F}$ ( $0.25^{\circ}\text{C}$ ). Less than $\pm 0.18^{\circ}\text{F}$ ( $0.1^{\circ}\text{C}$ ) drift over a 10 year period.
Sensor range	50 °F to 95 °F (10 °C to 35 °C)
Power	Supplied by the 4-conductor cable (+12 Vdc @ 250 mA) from the controller.
Communication	115 kbps
Local access port	For local access to start up and troubleshoot system
Environmental operating range	32–122 °F (0–50 °C), 10–90% relative humidity, non-condensing



Mounting	Standard 4x2-in. electrical box using provided 6-32 by 1/2 in. mounting screws.	
Overall dimensions:	Width:	2-3/4 in. (6.9 cm)
	Height:	4-3/4 in. (12.1 cm)
	Depth:	5/8 in. (1.6 cm)

## Rnet Configuration

You wire SPT sensors to a controller's **Rnet** port. An Rnet can consist of any of the following combinations of devices wired in a daisy-chain or hybrid configuration:

- 1 SPT Plus, SPT Pro, or SPT Pro Plus
- 1-4 SPT Standards
- 1-4 SPT Standards, and 1 SPT Plus SPT Pro, or SPT Pro Plus
- Any of the above combinations, plus up to 2 BACview<sup>6</sup>'s but no more than 6 devices total

**NOTE** You must set addresses only on the following Rnet devices:

- SPT Standard sensors if you have more than one on the Rnet. See *To address an SPT Standard sensor* (page 5).
- BACview<sup>6</sup>'s if you have two on the Rnet. See the *BACview Installation and User Guide*.

## To address an SPT Standard sensor

If the Rnet has multiple SPT Standard sensors, the first sensor retains its default address of 1. You must give each additional SPT Standard a unique address on the Rnet. To set the address:

- 1 Pull the back plate off the sensor, pulling from the bottom first.
- 2 Remove the two hexagonal screws that attach the circuit board to the cover plate.
- 3 Remove the cover plate.
- 4 On the circuit board, set the address jumper to 2, 3, or 4.
- 5 Attach the circuit board to the cover plate with the hexagonal screws.

## Rnet wiring specifications

**NOTE** Use the specified type of wire and cable for maximum signal integrity.

Description	4 conductor, unshielded, CMP, plenum rated cable
Conductor	18 AWG
Maximum length	500 feet (152 meters)

Recommended coloring	Jacket: White Wiring: Black, white, green, red
UL temperature rating	32–167°F (0–75°C)
Voltage	300 Vac, power limited
Listing	UL: NEC CL2P, or better

## Mounting location

Mount the sensor:

- In an area representing the average temperature in the space
- On an interior wall
- Approximately 5 feet (1.5 meters) from the floor, or as required by local code
- At least 4 feet (1.2 meters) from any corner
- At least 2 feet (.6 meter) from an open doorway

Do not mount the sensor:

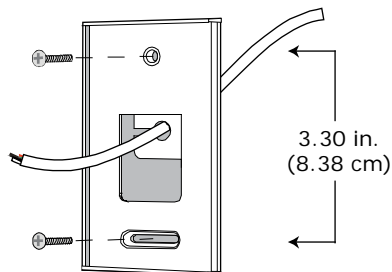
- In drafty locations such as near air conditioning or heating ducts, or near open windows
- Over heat sources such as baseboard heaters, radiators, directly above wall-mounted lighting dimmers, or in direct sunlight

**NOTE** The sensor mounting plate accommodates the NEMA standard 4x2-in. electrical box. However, the sensor can be mounted directly on the wall surface if local codes permit.

## To wire and mount the SPT sensor

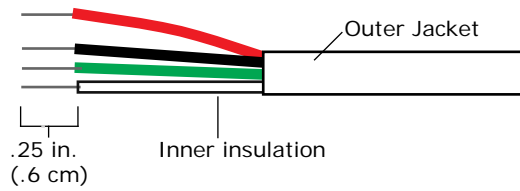
**NOTE** The sensor mounting plate accommodates the NEMA standard 4x2-in. electrical box. However, the sensor can be mounted directly on the wall surface if local codes permit.

- 1 Remove the mounting plate from the SPT sensor. You may need to turn the setscrew in the bottom of the sensor clockwise until you can remove the mounting plate.
- 2 Pull the Rnet communication cable through the wire guide in the mounting plate.

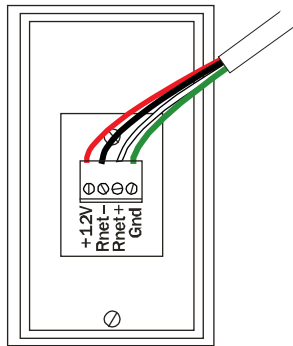


- 3 Use the 2 mounting screws provided to attach the mounting plate to the wall or electrical box.

- Partially cut, then bend and pull off the outer jacket of the Rnet cable(s). Do not nick the inner insulation. Strip about .25 inch (.6 cm) of the inner insulation from each wire.



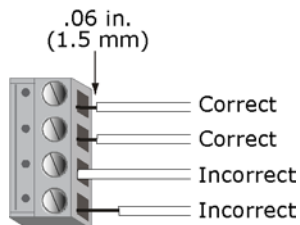
- Insert the other 4 wires into the sensor's screw terminal connector. If wiring 2 cables, insert like-colored wires into each terminal.



Carrier recommends that you use the following Rnet wiring scheme:

Connect this wire...	To this terminal...
Red	+12V
Black	Rnet-
White	Rnet+
Green	Gnd

**CAUTION** Allow no more than .06 inch (1.5 mm) bare communication wire to protrude. If bare communication wire contacts a metal surface other than the terminal block, the sensor may not communicate correctly.



- Attach the sensor's cover and circuit board to the mounting plate, inserting the top first.
- Turn the setscrew one full turn counterclockwise to secure the cover to the mounting plate.
- Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.

## Using an SPT sensor

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### All SPT sensors

Feature	Usage
<b>Local Access port</b>	See <i>To communicate through the Local Access port</i> (page 10).

### SPT Plus

Feature	Usage
<b>Slide potentiometer</b>	Move the potentiometer to raise or lower the zone's setpoint. The maximum you can adjust the setpoint is defined in the <b>Max Adjust</b> field*.
<b>MANUAL ON button</b>	<p>Press this button one time to override the schedule and set the zone to occupied for the amount of time defined in the <b>Each pulse</b> field*. Press the button again to incrementally increase the time. For example, if the <b>Each pulse</b> field is set at five minutes, press the button once for an occupancy of five minutes, twice for ten minutes, and so on. The maximum length of time you can override the schedule is defined in the <b>Max Accum</b> field*.</p> <p>To cancel the override, hold down the <b>MANUAL ON</b> button until the <b>OCCUPIED</b> LED turns off.</p>
<b>OCCUPIED LED</b>	The LED lights when the zone is occupied from a regular schedule or a manual override.

### SPT Pro

Feature	Usage
<b>Display</b>	<p>The display shows occupancy, zone temperature, and an alarm bell icon. Celsius values are to the nearest 0.5 degree; Fahrenheit values are to the nearest full degree.</p> <p>The display shows <b>Occupied</b> when the zone is occupied from a regular schedule or from a manual override.</p>
<b>MANUAL ON button</b>	<p>Press one time to override the schedule and set the zone to occupied for the amount of time defined in the <b>Each pulse</b> field*. Press button again to incrementally increase the time. For example, if the <b>Each pulse</b> field is set at five minutes, press the button once for an occupancy of five minutes, twice for ten minutes, and so on. The maximum length of time you can override the schedule is defined in the <b>Max Accum</b> field*.</p> <p>The display shows the duration of the override in minutes. If the override time exceeds 199 minutes, the display shows the time in hours.</p> <p>To cancel the override, hold the button down until <b>0</b> displays. Wait five seconds for the display to show the current zone temperature again.</p>

Feature	Usage
<b>WARMER and COOLER buttons</b>	<p>To raise or lower the zone's setpoint:</p> <ol style="list-style-type: none"> <li>1 Press either button to display the current average setpoint (the average between the heating and cooling setpoints).</li> <li>2 Press either button again to raise or lower the setpoint. You can adjust the setpoint by no more than the amount defined in the <b>Max Adjust</b> field*.</li> </ol> <p><b>NOTE</b> Pressing either button overrides an unoccupied schedule and sets the zone to occupied for the amount of time defined in the <b>Each pulse</b> field*.</p>
<b>INFO button</b>	<p>Press to cycle through the:</p> <ul style="list-style-type: none"> <li>• zone temperature</li> <li>• outside air temperature, if enabled in the control program</li> <li>• override time, in minutes</li> <li>• heating setpoint</li> <li>• cooling setpoint</li> </ul>

## SPT Pro Plus

The SPT Pro Plus has all the features of the SPT Pro plus the additional functionality described below.

Feature	Usage
<b>MANUAL ON button</b>	The <b>Timed Local Override</b> section of the microblock dialog box determines if pressing the <b>MANUAL ON</b> button sets the zone to occupied for a set amount of time in the same manner as the SPT Pro or sets the zone to continuously occupied.
<b>INFO button</b>	This button cycles through the same information as the SPT Pro.
<b>MODE button</b>	The <b>MODE</b> button lets you cycle through up to 4 operational modes defined with custom programming.
<b>FAN button</b>	Press <b>FAN</b> to select the controlled equipment's fan speed. A fan icon on the left side of the display indicates when the fan is on.

## To change sensor properties

You can use i-Vu Open or Field Assistant, if included with your system, to change sensor properties such as the override time or maximum setpoint adjustment. Go to **Properties** page > **I/O Points** tab > and click on your applicable sensor point, i.e. **Space Temp, SPT Temp Sensor, Zone Temp Sensor** > **Details** tab of microblock popup.

Field Assistant runs on a laptop that you connect to an SPT sensor's Local Access port.

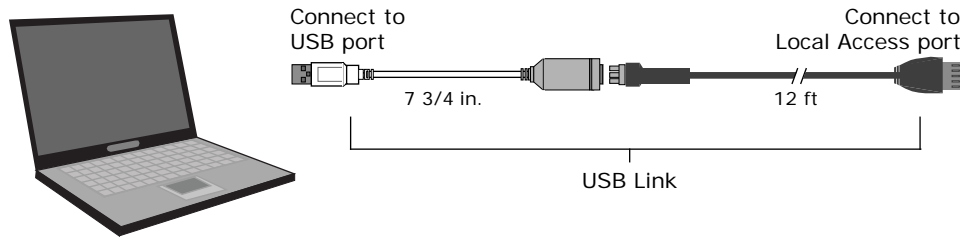
## To communicate through the sensor's Local Access port

You can connect laptop to an SPT sensor's **Local Access** port to make changes to any device on the network.

### PREREQUISITES

- Laptop with a USB port
- USB Link (Part #USB-L)

- 1 If using the USB Link with your laptop for the first time, install the USB Link's driver before connecting the cable to the laptop.
  - a) Put the USB Link Driver CD into your laptop.
  - b) Run the .exe to install the driver. Accept all of the wizard's default settings.
- 2 Connect the laptop to the sensor's **Local Access** port using the USB Link cable(s).



- 3 Launch your software (i-Vu Open, HyperTerminal, Field Assistant, Virtual BACview, Test and Balance).
- 4 Configure the port.
- 5 Verify that the baud rate is set to 115,200.

## Troubleshooting SPT sensors

Use the following tables to troubleshoot an SPT sensor.

### SPT Standard or SPT Plus

If LED on back of circuit board...	Then sensor...
Is not lit	Has no power
Blinks 1 time per second	Has power, but is not communicating
Blinks 2.5 times per second	Is correctly wired and communicating

### SPT Pro or SPT Pro Plus

<b>If display shows...</b>	<b>Then sensor...</b>
Nothing	Has no power
All display elements	Has power, but is not communicating
Only the temperature and current status	Is correctly wired and communicating

**NOTE** If **OF** is displayed, cycle the power on the controller.

## Alternate space temperature sensor

Part #33ZCT55SPT, 33ZCT56SPT, 33ZCT59SPT

The following wall-mounted space temperature sensors can be used instead of an SPT sensor to monitor zone temperature.

Sensor	Features
<p><b>T-55</b> Part #33ZCT55SPT</p>	<ul style="list-style-type: none"> <li>• Timed override button</li> </ul>
<p><b>T-56</b> Part #33ZCT56SPT</p>	<ul style="list-style-type: none"> <li>• Timed override button</li> <li>• Setpoint adjustment</li> </ul>
<p><b>T-59</b> Part #33ZCT59SPT</p>	<ul style="list-style-type: none"> <li>• Timed override button</li> <li>• Setpoint adjustment</li> <li>• LCD display</li> </ul>

**NOTE** The T-59 sensor requires a dedicated 24 Vac, 3 Va transformer to power the sensor.



## Sensor specifications

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Operating range	T55 and T56: 32° to 120°F (0° to 49°C) with a nominal resistance of 10,000 ohms at 77°F (25°C). See table below.  T59: 40° to 104°F (5° to 40°C) with a nominal resistance of 10,000 ohms at 77°F (25°C). See table below.
Sensor tolerance	T55 and T56: ±0.2°C from 0 to 70°C  T59: ±1°F from 40 to 104°C (±1°C from 4 to 40°C)
Humidity	0 to 95%, non-condensing
Power	24 Vac, 3 Va
Dimensions:	Width: 2 3/4 in. (6.98 cm) Height: 4 1/2 in. (11.46 cm) Depth: 1 1/5 in. (2.92 cm)

### Thermistor Resistance vs. Temperature Values for Space Temperature Sensor

#### 10K Type II (CP/MCI)

Temp (F)	Temp (C)	Resistance (Ohms)
-40	-40	335,651
-31	-35	242,195
-22	-30	176,683
-13	-25	130,243
-4	-20	96,974
5	-15	72,895
14	-10	55,298
23	-5	42,315
32	0	32,651
41	5	25,395
50	10	19,903
59	15	15,714
68	20	12,494
77	25	10,000
86	30	8,056
95	35	6,530
104	40	5,325
113	45	4,367
122	50	3,601
131	55	2,985
140	60	2,487
149	65	2,082
158	70	1,752

## Wiring specifications

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Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

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## Mounting location

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Mount the sensor:

- In an area representing the average temperature in the space
- On an interior wall
- Approximately 5 feet (1.5 meters) from the floor, or as required by local code
- At least 4 feet (1.2 meters) from any corner
- At least 2 feet (.6 meter) from an open doorway

Do not mount the sensor:

- In drafty locations such as near air conditioning or heating ducts, or near open windows
- Over heat sources such as baseboard heaters, radiators, directly above wall-mounted lighting dimmers, or in direct sunlight

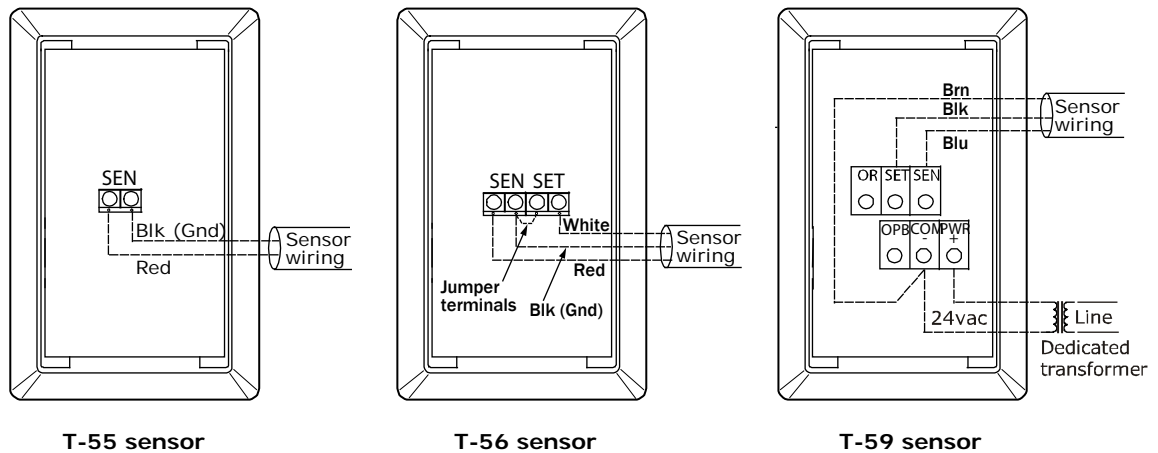
**NOTE** The sensor mounting plate accommodates the NEMA standard 4x2-in. electrical box. However, the sensor can be mounted directly on the wall surface if local codes permit.

## To wire and mount the sensor

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- 1 Turn the 2 setscrews at the bottom of the sensor clockwise to release the sensor's cover from the mounting plate.
- 2 Lift the cover from the bottom, and then release it from the top fasteners.
- 3 Feed the wires from the electrical box through the opening in the center of the sensor mounting plate.
- 4 Use the 2 mounting screws provided to attach the mounting plate to the electrical box.
- 5 Strip the outer jacket from the cable for at least 3 inches (7.62 cm). Strip .25 inch (.6 cm) of insulation from each wire. Cut the shield and drain wire from the cable.
- 6 Use the appropriate diagram below to connect the wiring to the sensor's terminals.
- 7 Reattach the sensor's cover to the mounting plate, inserting the top first.
- 8 Turn the two Allen screws counterclockwise to secure the cover to the mounting plate.
- 9 Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.

**NOTE** Clean sensor with damp cloth only. Do not use solvents.



## To change a T59 sensor's options

You can change user options and field service options in the T59's display. The options are displayed on pages referenced by page number. See tables below.

**NOTE** Because the T-59 is not a communicating device, the T-59's setpoint and offset values must be set to match the same values in the associated controller.

### To display an option page

- 1 In the User Options and Field Service Options tables below, find the option you want to change and its page number.
- 2 With the sensor displaying the current temperature, simultaneously press and hold the ▼ and ▲ keys. After 30 seconds, the sensor's display shows option page 100.
- 3 Release the keys.
- 4 Press ▲ repeatedly until the display shows the page number you want.

**NOTE** To display a field service option page (126 to 132), press the ▲ key until you see 1-, then simultaneously press and hold ▼ and ▲. After approximately 2 seconds, the display shows 126. Press ▲ until you see the page you want.

**NOTE** If you do not press a key for 30 seconds, the sensor automatically returns to normal operation.

### To edit a value

- 1 When the option page you want is displayed, press ▼ to enter edit mode.
- 2 Press ▲ repeatedly to cycle through the numbers 00 to 12. Stop at the number that represents the value you want. See tables below.
- 3 Press ▼ to save the selected value and return to option page.

**NOTE** If you do not press a key for 10 seconds, the sensor automatically returns to option page.

### To return sensor to normal operation

From an option page, press ▲ until the display shows 1-. Then press ▼.

## User Options

Option page	Description
100	Firmware version
101	Temperature scale 00 = °F 01 = °C
102	Temperature Offset (Sensor Trim) °F 00 = -5 01 = -4 02 = -3 03 = -2 04 = -1 05 = 0 (typical) 06 = 1 07 = 2 08 = 3 09 = 4 10 = 5
103	Normal Setpoint Display 00 to 09 = Do Not Use  Offset Setpoint Display 10 = -02 to 02 °F (-02 to 02 °C) 11 = -03 to 03 °F (-03 to 03 °C) 12 = -05 to 05 °F (-05 to 05 °C)
104	Keep at 00
105	Setpoint Lockout 00 = Disable Lockout 01 = Enable Lockout
106	Keep at 00
107	Keep at 00
108	Display Mode 00 = Normal 01 = Setpoint Only
109	Keep at 00

## Field Service Options

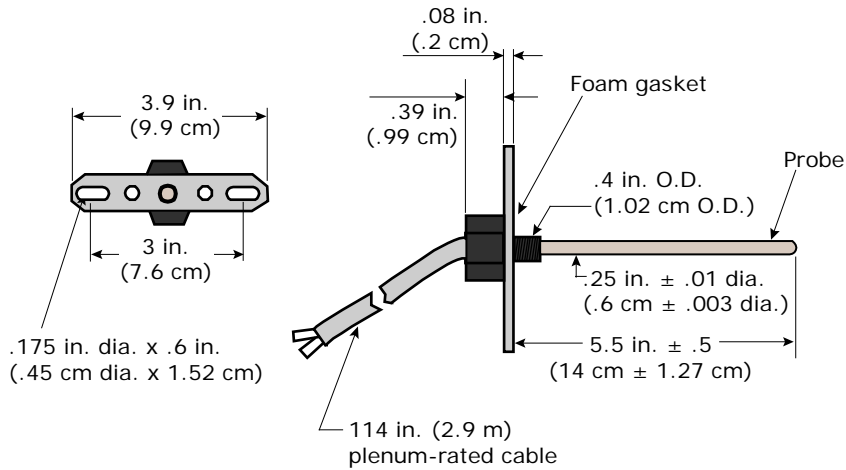
Page	Description
126	Setpoint mode 00 = Use option page 103 setting 01 = Display single offset setpoint 02 = Display Heat/Cool setpoints 03 = Display Heat/Cool setpoints w/Occupied (Occupied icon is shown in setpoint display mode.)

<b>Page</b>	<b>Description</b>
127	Setpoint feedback 00 = Disable feedback 01 = Enable Occupied/unoccupied feedback 02 = Enable Heat/Cool feedback
128	Maximum offset adjustment for setpoint * Note: When using the -00° to +00° selection, option page 105 must be set to value 01.  * 00 = -00° to +00° (F or C) 01 = -01° to +01° (F or C) 02 = -02° to +02° (F or C) (Default) 03 = -03° to +03° (F or C) 04 = -04° to +04° (F or C) 05 = -05° to +05° (F or C) 06 = -06° to +06° (F or C) 07 = -07° to +07° (F or C) 08 = -08° to +08° (F or C) 09 = -09° to +09° (F or C) 10 = -10° to +10° (F or C)
129	Occupied heat setpoint 60 = Default (Range is 10 to 89)
130	Occupied cool setpoint 65 = Default (Range is 10 to 89)
131	Unoccupied heat setpoint 55 = Default (Range is 00 to 99)
132	Unoccupied cool setpoint 90 = Default (Range is 00 to 99)

## Supply Air Temperature sensor

Part #33ZCSENSAT

The Supply Air Temperature (SAT) sensor is required for reheat applications.



**NOTE** If state or local code requires the use of conduit, use a *Primary Air Temperature* (page 27) (Part #33ZCSENPAT) sensor instead of an SAT sensor.

### SAT sensor specifications

Operating range	-40° to 245°F (-40° to 118°C) with a nominal resistance of 10,000 ohms at 77°F (25°C). See table below.
Sensor tolerance	Accuracy of ±0.36°F (0.2°C) from 0° to 70°C
Physical	Has a thermistor encased with a 6-inch (15.2-cm) stainless steel probe. Includes a 114-inch plenum-rated cable and 2 mounting screws.

**Thermistor Resistance vs. Temperature Values for Supply-air-  
Temperature Sensor  
10K Type II (CP/MCI)**

<b>Temp (F)</b>	<b>Temp (C)</b>	<b>Resistance (Ohms)</b>
-40	-40	335,651
-31	-35	242,195
-22	-30	176,683
-13	-25	130,243
-4	-20	96,974
5	-15	72,895
14	-10	55,298
23	-5	42,315
32	0	32,651
41	5	25,395
50	10	19,903
59	15	15,714
68	20	12,494
77	25	10,000
86	30	8,056
95	35	6,530
104	40	5,325
113	45	4,367
122	50	3,601
131	55	2,985
140	60	2,487
149	65	2,082
158	70	1,752

## **Wiring specifications**

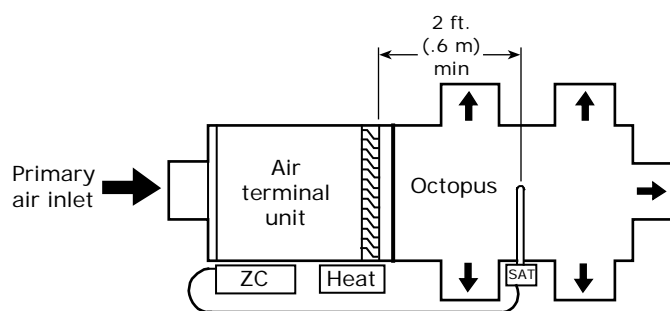
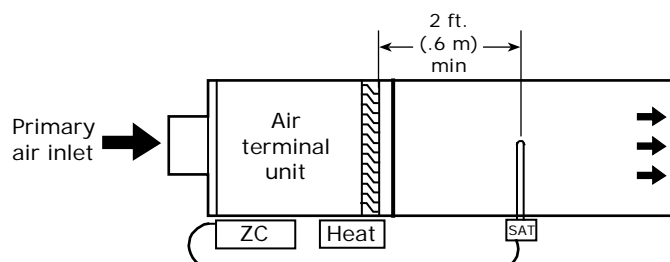
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The sensor includes a 114-inch, plenum-rated cable. To extend the length, use the cable specified below.

Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

## Mounting location

Mount the SAT in the duct downstream from the air terminal. If the zone has electric reheat, mount the sensor at least 2 feet (.6 m) downstream of the electric heater. If the zone has an octopus connected directly at the discharge, mount the sensor in the octopus.



## To wire and mount the SAT sensor

- 1 Drill or punch a .5 inch (1.3 cm) hole in the duct.
- 2 Insert the sensor's probe into the hole.
- 3 Secure the sensor to the duct using the 2 mounting screws provided.

**CAUTION** The tip of the sensor's 6-inch (15.2-cm) probe must not touch the inside of the duct. Use field-supplied bushings as spacers when installing the sensor probe in a duct 6 inches (15.2 cm) or less in diameter.

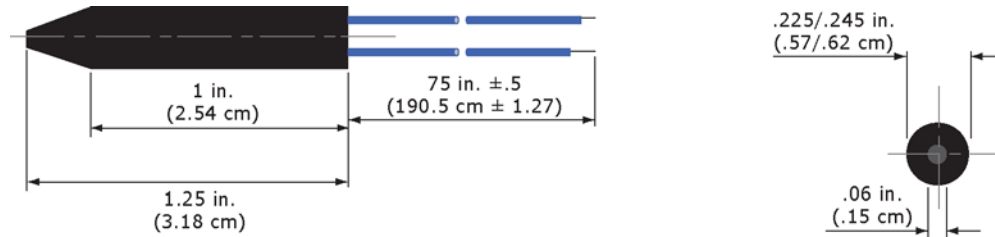
- 4 Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.



## Duct Air Temperature sensor

Part #33ZCSENDAT

The Duct Air Temperature (DAT) sensor monitors supply air and is required for cooling and heating air source applications on non-Carrier dampers and for stand-alone operation.



### DAT sensor specifications

Operating range	-40° to 245°F (-40° to 118°C) with a nominal resistance of 10,000 ohms at 77°F (25°C). See table below.
Sensor tolerance	Accuracy of ±0.36°F (0.2°C) from 0° to 70°C
Physical	Small, epoxy sensor, 1.25 inch (3.2 cm) long. Includes a mounting grommet and 75-inch cable.

**Thermistor Resistance vs. Temperature Values for Duct Temperature Sensor**

**10K Type II (CP/MCI)**

Temp (F)	Temp (C)	Resistance (Ohms)
-40	-40	335,651
-31	-35	242,195
-22	-30	176,683
-13	-25	130,243
-4	-20	96,974
5	-15	72,895
14	-10	55,298
23	-5	42,315
32	0	32,651
41	5	25,395
50	10	19,903
59	15	15,714
68	20	12,494
77	25	10,000
86	30	8,056
95	35	6,530
104	40	5,325
113	45	4,367
122	50	3,601
131	55	2,985
140	60	2,487
149	65	2,082
158	70	1,752

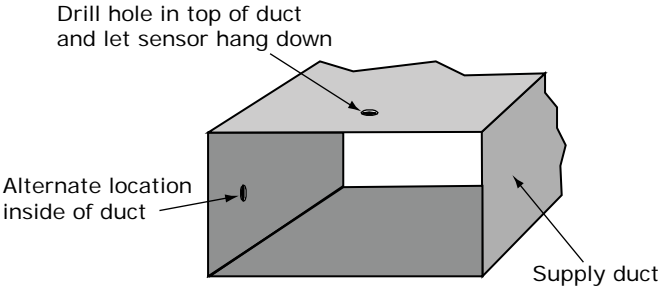
**Wiring specifications**

The sensor includes a 75-inch cable. To extend the length, use the cable specified below.

Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

**Mounting location**

Mount the sensor in the top or side of the supply duct.



## To wire and mount the DAT sensor

---

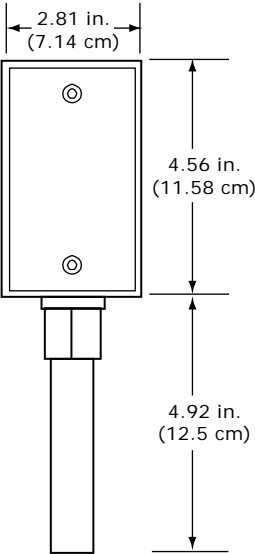
- 1 Drill or punch a .25 inch (.6 cm) hole in the top or side of the supply duct.
- 2 Insert the sensor's probe into the hole. The probe can touch side of duct.
- 3 Snap the grommet into the hole until it is secure.
- 4 Pull on the sensor's wiring until the sensor is snug against the grommet.
- 5 Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.

# Outdoor Air Temperature sensor

Part #33ZCSENOAT

The outdoor air temperature (OAT) sensor monitors the temperature of the outside air before it enters the equipment.

**NOTE** If the sensor is to be installed in the outdoor air duct instead of an outdoor location, use a *Primary Air Temperature* (page 27) (Part #33ZCSENPAT) sensor instead of an OAT sensor.



## OAT sensor specifications

Operating range	-40° to 245° F (-40° to 118° C) with a nominal resistance of 10,000 ohms at 77° F (25° C). See table below.
Sensor tolerance	Accuracy of ±0.36° F (0.2° C) from 0° to 70° C
Physical	Has a thermistor encased in a plastic resin probe that is enclosed in a PVC housing

**Thermistor Resistance vs. Temperature Values for Outdoor Air  
Temperature Sensor  
10K Type II (CP/MCI)**

Temp (F)	Temp (C)	Resistance (Ohms)
-40	-40	335,651
-31	-35	242,195
-22	-30	176,683
-13	-25	130,243
-4	-20	96,974
5	-15	72,895
14	-10	55,298
23	-5	42,315
32	0	32,651
41	5	25,395
50	10	19,903
59	15	15,714
68	20	12,494
77	25	10,000
86	30	8,056
95	35	6,530
104	40	5,325
113	45	4,367
122	50	3,601
131	55	2,985
140	60	2,487
149	65	2,082
158	70	1,752

## Wiring specifications

---

Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

## Mounting location

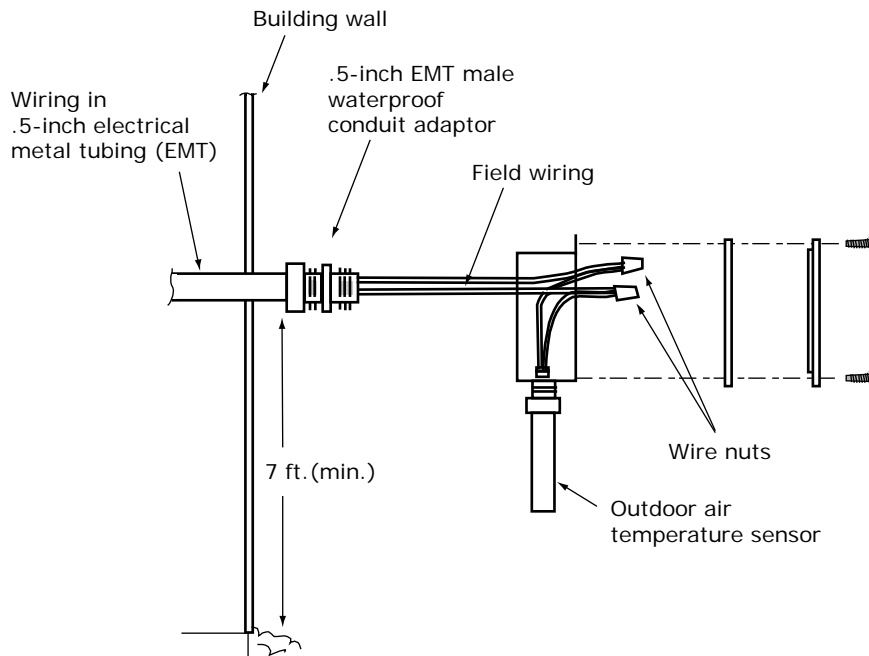
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For applications with an economizer, mount the sensor immediately upstream from the outdoor air damper where it will accurately sense the temperature of the outdoor air entering the mixing box.

For applications without an economizer, mount the sensor in the outdoor air duct near the outdoor air intake or on the northern exterior of the building.

Do not mount the sensor:

- In direct sunlight
- Near the exhaust from air-handling units or compressors
- Near leakage drafts of indoor air
- Near shrubbery or trees
- Under direct water runoff



## To wire and mount the OAT sensor

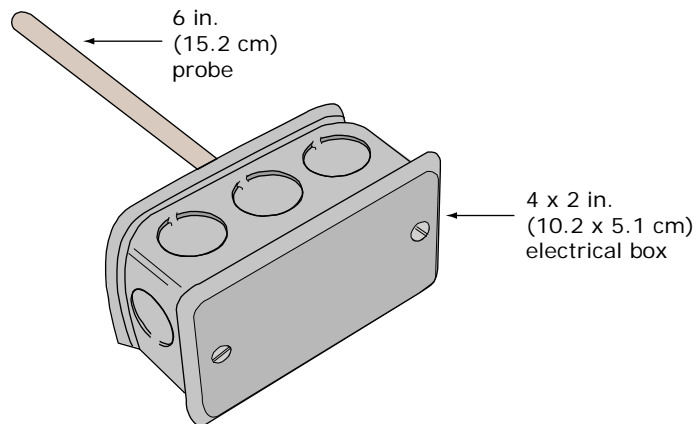
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- 1 Drill a 7/8" hole in a vertical wall.
- 2 Insert a .5-inch piece of electrical metal tubing (EMT).
- 3 Attach a .5-inch male waterproof conduit adaptor to the end of the EMT.
- 4 Remove the knockout in the back of the OAT sensor.
- 5 Attach the sensor box to the conduit adaptor using the adaptor locking nut.
- 6 Replace sensor gasket and cover using the 2 screws provided.
- 7 Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.

## Primary Air Temperature sensor

Part #33ZCSENPAT

The Primary Air Temperature (PAT) sensor monitors the supply air temperature. Use a PAT sensor if state or local code requires the use of conduit. If conduit is not required, you can use an SAT sensor.



### PAT sensor specifications

Operating range	-40° to 245°F (-40° to 118°C) with a nominal resistance of 10,000 ohms at 77°F (25°C). See table below.
Sensor tolerance	Accuracy of $\pm 0.36^\circ\text{F}$ ( $0.2^\circ\text{C}$ ) from 0° to 70°C
Physical	Has a thermistor encased with a 6-inch (15.2-cm) stainless steel probe. Has a 4x2-inch electrical box. Includes 2 mounting screws.

**Thermistor Resistance vs. Temperature Values for Primary Air Temperature Sensor  
10K Type II (CP/MCI)**

Temp (F)	Temp (C)	Resistance (Ohms)
-40	-40	335,651
-31	-35	242,195
-22	-30	176,683
-13	-25	130,243
-4	-20	96,974
5	-15	72,895
14	-10	55,298
23	-5	42,315
32	0	32,651
41	5	25,395
50	10	19,903
59	15	15,714
68	20	12,494
77	25	10,000
86	30	8,056
95	35	6,530
104	40	5,325
113	45	4,367
122	50	3,601
131	55	2,985
140	60	2,487
149	65	2,082
158	70	1,752

**Wiring specifications**

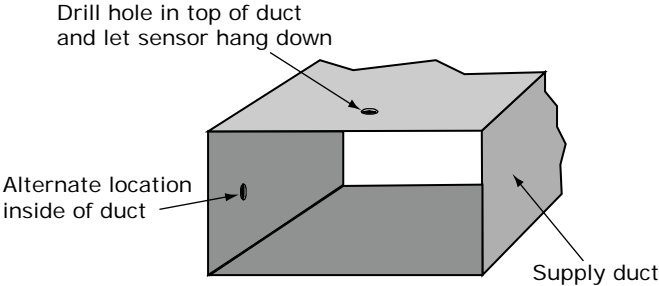
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Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

**Mounting location**

---

Mount the sensor in the top or side of the supply duct.





## To wire and mount the PAT sensor

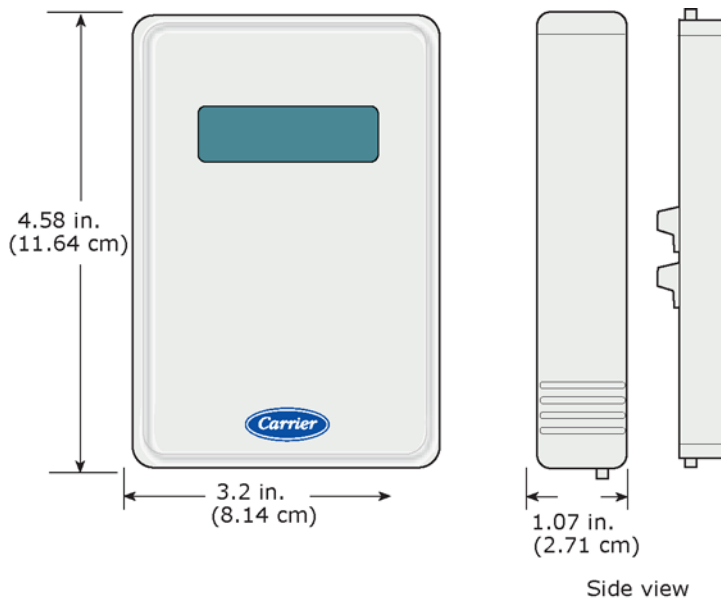
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- 1 Drill or punch a .5 inch (1.3 cm) hole in the duct.
- 2 Connect a .5 inch (1.3 cm) nominal field-supplied conduit between the zone controller enclosure and the junction box.
- 3 Pass the sensor wires through the conduit.
- 4 Insert the sensor's probe into the hole.
- 5 Secure the sensor to the duct using the 2 mounting screws provided.  
**CAUTION** The tip of the sensor's 6-inch (15.2-cm) probe must not touch the inside of the duct.
- 6 Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.

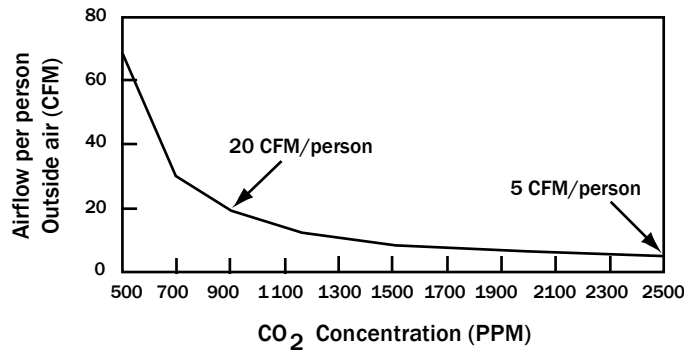
## CO2 sensor

Part #33ZCSPTCO2LCD-01 (Display model)  
 Part #33ZCSPTCO2-01 (No display)  
 Wall-mount or duct-mount  
 Duct installation requires an Aspirator Box (Part #33ZCASPCO2) to house the CO<sub>2</sub> sensor.

A CO<sub>2</sub> sensor monitors carbon dioxide levels. As CO<sub>2</sub> levels increase, the controller adjusts the outside air dampers to increase ventilation and improve indoor air quality. These sensors monitor temperature using a 10K thermister, but are not capable of occupancy override.



The figure below shows ventilation rates for various CO<sub>2</sub> setpoints when outside air with a typical CO<sub>2</sub> level of 350 ppm is used.



**NOTES**

- The sensor has a 4–20 mA output that is converted to 0–5 Vdc by a 250 Ohm, 1/4 watt, 2% tolerance resistor connected across the zone controller's CO<sub>2</sub> input terminals.
- Do not use a relative humidity sensor and CO<sub>2</sub> sensor on the same zone controller.

## CO2 sensor specifications

---

Method	Dual Beam Absorption Infrared™  Patented TEMA (time extended measurement algorithm) self-calibration software  Optional thermistor temperature measurement  Sample Method: Diffusion or flow-thru (50 to 100 ml/min)
Measurement range	Analog Output: 0–2000 ppm factory default adjustable to 10,000 ppm  Digital display: 0–10,000 ppm Sensitivity: ± 10 ppm Resolution: ± 1 ppm
Sensor tolerance	Accuracy: Typical Conditions: °60° to 90°F (15° to 32°C) 0–2000 ppm: ± 50 ppm or ± 3% of reading, whichever is greater 2000–10,000 ppm: ± 5% of reading  Extended Conditions : 32° to 122° (0° to 50°C) 0–2000 ppm: ± 100 ppm or ± 5%, whichever is greater 2000–10,000 ppm: ± 7% of reading, whichever is greater  Pressure Dependence: Add 0.13% of reading per mm Hg decrease from 760 (On board correction, user set)
Annual drift	± 10 ppm (negligible) with TEMA on ± 20 ppm typical with TEMA off  Response Time: 0–90% FS < 2 minutes  Warm-Up Time: 25 C < 2 minutes  Operating Conditions: 32° to 122°F (0° to 50°C) 0–95% RH (relative humidity), non-condensing  Storage Conditions: –40° to 158°F (–40° to 70°C)
Power	Requires a dedicated 24 Vac, 3 Va transformer
Certification	FCC Part 15 Class B  Calibration Interval: Five years/zero ppm gas offset adjust

## Wiring specifications

---

Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

## Mounting location

---

A CO<sub>2</sub> sensor can be wall-mounted or mounted in a return air duct. (Duct installation requires an Aspirator Box Accessory - Part #33ZCASPCO2.)

### Wall mounting

Mount the sensor:

- Near the return air grill to sense the concentration of CO<sub>2</sub> leaving the space
- At least 3 feet (.9 m) from any corner

Do not mount the sensor:

- Where it can have direct breath contact
- In drafty areas such as near supply ducts, open windows, or fans
- Over heat sources
- Where it can be influenced by the supply air. The sensor gives inaccurate readings if the supply air blows directly onto the sensor or the supply air does not have a chance to mix with the room air before it is drawn into the return air stream.

**NOTE** The sensor mounting plate accommodates the NEMA standard 4x2-in. electrical box. However, the sensor can be mounted directly on the wall surface if local codes permit.

### Duct mounting

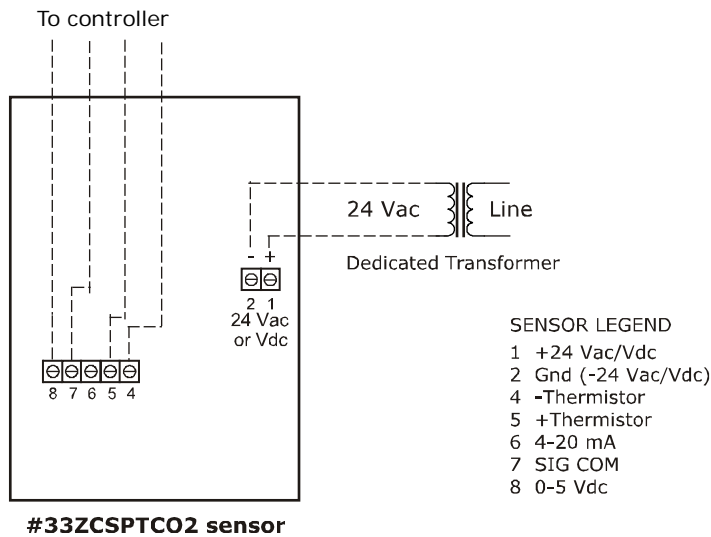
Mount the sensor:

- In a duct that has a diameter or depth of at least 9 inches (22.9 cm)
- At least 6 inches (15.2 cm) upstream or 15 inches (38.1 cm) downstream of a 90-degree turn in the return air duct. The downstream location is preferred.
- In the center of the duct
- Where at least 1 foot (.3 m) of space in front of the sensor is free of obstruction

## To wire and wall-mount the CO2 sensor

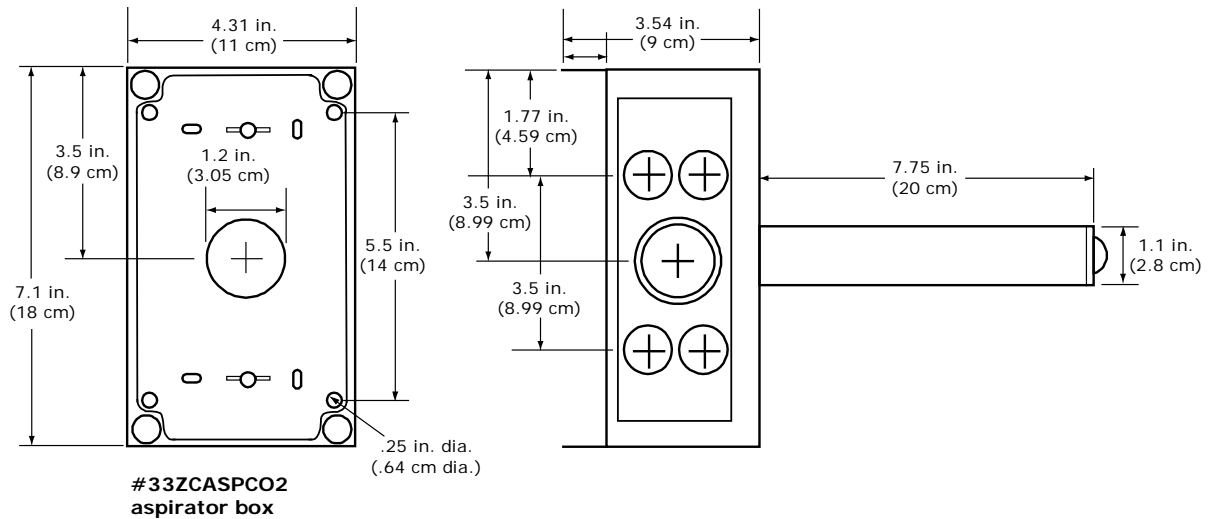
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- 1 Turn the setscrew at the bottom of the sensor clockwise to release the sensor's cover from the mounting plate.
- 2 Lift the cover from the bottom, and then release it from the top fasteners.
- 3 Feed the wires from the electrical box through the opening in the center of the sensor mounting plate.
- 4 Use the 2 mounting screws provided to attach the mounting plate to the electrical box.
- 5 Wire the 24 Vac transformer to the sensor. See diagram below.
- 6 Turn the two Allen screws at the bottom of the unit counterclockwise to secure the cover to the mounting plate.
- 7 Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.



## To wire and duct-mount the sensor

Duct installation requires the Aspirator Box Accessory (Part #33ZCASPCO2) to house the CO<sub>2</sub> sensor.



To mount the aspirator box and sensor:

- 1 Drill a 1.25 inch (3.18 cm) hole in the return duct.
- 2 Remove the aspirator box cover.
- 3 Insert the aspirator box sampling tube into the hole.
- 4 Secure the box to the duct using 2 field-supplied #8 x 1" sheet metal screws.
- 5 Remove .5 inch (1.3 cm) conduit knockout, then install the conduit fittings.
- 6 Mount the CO<sub>2</sub> sensor in the aspirator box using 2 field-supplied #8 x 32 machine screws.

- 7** To wire the CO<sub>2</sub> sensor, see the instructions above in *To wire and wall-mount the CO<sub>2</sub> sensor* (page 32).
- 8** Install the aspirator box cover.

## C02/Temperature sensor

Part #33ZCT55C02  
Part #33ZCT56C02

A CO<sub>2</sub>/space temperature sensor houses two sensors in a single unit. This sensor uses Single Beam Absorption Infrared™ diffusion technology to monitor carbon dioxide (CO<sub>2</sub>) levels and has a 10K thermistor to measure space temperature. The controller uses this information to adjust the outside air dampers to provide proper ventilation and control space temperature.

Sensor	Features
33ZCT55C02	<ul style="list-style-type: none"><li>• CO<sub>2</sub> sensor</li><li>• Space temperature sensor</li><li>• Push-button override</li></ul>
33ZCT56C02	<ul style="list-style-type: none"><li>• CO<sub>2</sub> sensor</li><li>• Space temperature sensor</li><li>• Push-button override</li><li>• Set point adjustment</li></ul>

### NOTES

- The sensor has a 4–20 mA or 0–10 V output.
- Push button override
- Do not use a relative humidity sensor and CO<sub>2</sub> sensor on the same zone controller.

## CO2/Temperature sensor specifications

---

Method	Dual Beam Absorption Infrared™  Patented TEMA (time extended measurement algorithm) self-calibration software  10K Temperature sensor Sample Method: Diffusion	
Measurement range	Analog Output: 0–2000 ppm factory default adjustable to 10,000 ppm	
Sensor tolerance	Accuracy: Typical Conditions: °60° to 90° F (15° to 32° C) 0–2000 ppm: ± 110 ppm	
Annual drift	± 10 ppm (negligible) with TEMA on ± 20 ppm typical with TEMA off  Response Time: 0–90% FS < 2 minutes Warm-Up Time: 25 C < 2 minutes  Operating Conditions: 32° to 122° F (0° to 50° C) 0–95% RH (relative humidity), non-condensing  Storage Conditions: –4° to 158° F (–20° to 70° C)	
Power	18-30 Vac RMS, 50/60 Hz - half wave rectified (dedicated)  18-42 Vdc polarity protected (dedicated)  1.75 Va maximum average power 2.75 Va peak power	
Analog CO2 Output	4-20 mA (RLmax=500 Ohms) and 0–10 V (Source 100 mA, Sink 10 mA)	
Temperature Sensor	10 kOhm Thermistor, 10 kOhm ± 2.5% at 77° F (25° C)	
Temperature Control (#33ZCT56CO2 only)	<b>Slide potentiometer position</b>	<b>Resistance</b>
	Left stop	0 kOhms (+5 kOhms)
	Right stop	100 kOhms (± 10 kOhms)
Certification	FCC Part 15 Class B  Calibration Interval: Five years/zero ppm gas offset adjust	
Mounting	5 1/4 in. (13.3 cm) x 3 in. (7.6 cm) molded plastic. Includes 6x32 machine screws.	



## Wiring specifications

---

Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

## Mounting location

---

This sensor must be placed in an area that is representative of the conditional space or zone.

### Wall mounting

Mount the sensor:

- On an internal wall near a return air grille or duct
- At least 3 feet (.9 m) from any corner, 2 feet from an open doorway and 4 to 6 feet from the floor
- Proximal to the wiring egress on the wall
- Where the temperature operating limits are 32° to 122°F

Do not mount the sensor:

- Close to a window, on an outside wall, or next to a door leading to the outside
- Close to or in direct airflow of areas such as open windows, drafts or over heat sources
- In areas with poor circulation
- Where it may be exposed to direct occupant breathing such as near water coolers or coffee machines

**NOTE** The sensor mounting plate accommodates the NEMA standard 4x2-in. electrical box. However, the sensor can be mounted directly on the wall surface if local codes permit.

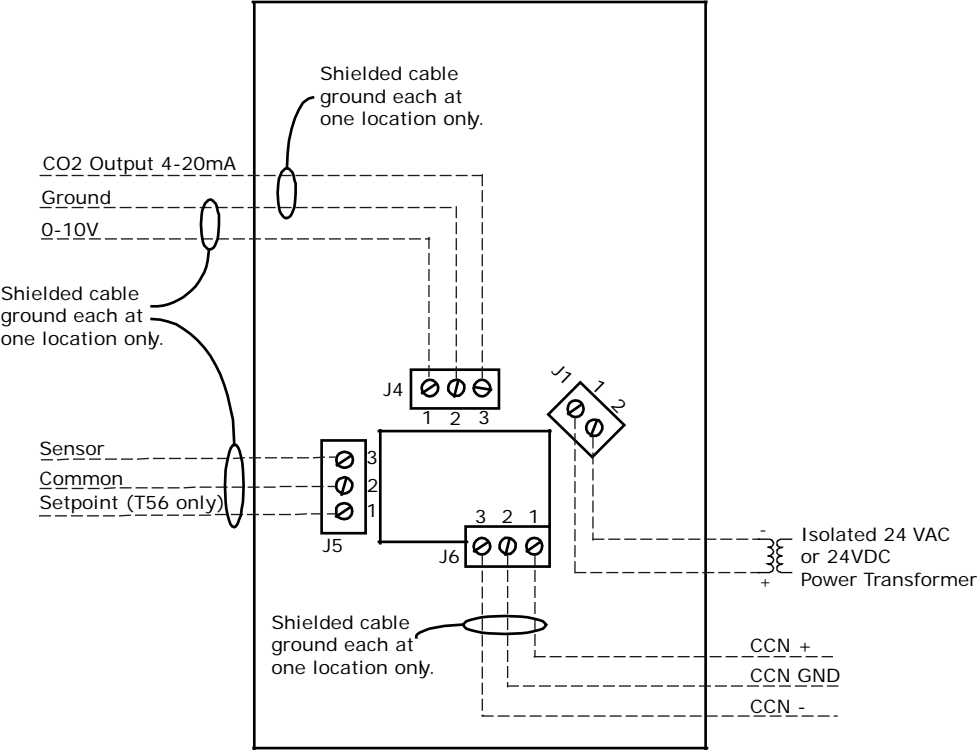
## To wire and mount the CO<sub>2</sub>/Temperature sensor

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- 1 Disassemble the sensor into these three parts: sensor cover, sensor base and mounting plate.
- 2 Feed the wires from the electrical box through the opening in the center of the sensor mounting plate.
- 3 Use the 2 mounting screws provided to attach the mounting plate to the electrical box.
- 4 Run the wiring through the wire hole in the sensor base. See diagram below.
- 5 Reattach the sensor's base to the mounting plate, inserting the top first.
- 6 Separate the wires into two bundles: one bundle for the CO<sub>2</sub> sensor wires (J4 and J1), the other bundle for the temperature sensor and CCN wires (J5 and J6).
- 7 Use the diagram below to connect the wiring to the sensor's J1, J4, J5 and J6 terminals.

**NOTE** On a large number of sensors, J6 was labeled incorrectly with CCN+ and CCN-. Ignore the labels on the circuit board and use the wiring diagram in this book.

- 8 Push excess wire back through the hole.
- 9 Reattach the sensor's cover to the base and mounting plate.
- 10 Turn the two Allen screws counterclockwise to secure the cover to the mounting plate.
- 11 Wire the sensor to the Open controller. See the controller's *Installation and Startup Guide* for details.



#33ZCT55C02 / #33ZCT56C02

# Relative Humidity sensors

Carrier offers 4 Relative Humidity sensors:

Sensor	Usage
<p><b>Space Relative Humidity sensor</b> Part #OPNSENSRH-01</p>	<p>Controls zone humidity (dehumidification) if the rooftop unit has a dehumidification device. If not, the sensor only monitors humidity.</p> <p>#OPNSENSRH-01 can output 0–5 Vdc, 0–10 Vdc, or 4–20 mA.</p> <p>#33ZCSENSRH-01 can output 0–10 Vdc or 4–20 mA.</p>
<p><b>Space Relative Humidity sensor</b> Part #33ZCSENSRH-01</p>	
<p><b>Duct Relative Humidity sensor</b> Part #33ZCSENDRH-01</p>	<p>Measures humidity in duct.</p>

Sensor	Usage
<b>Outdoor Relative Humidity sensor</b> Part #33ZCSENORH-01	Measures outdoor humidity.

The diagram shows a cylindrical sensor with a circular top face and a narrower base. The top face has a 'Carrier' logo. Dimension lines indicate: a depth of 2.25 in. (5.72 cm) from the top face to the base; a width of 3.95 in. (10.03 cm) across the base; and a total height of 4.68 in. (11.89 cm) from the top face to the bottom of the base.

**CAUTION** Do not use a relative humidity sensor and CO<sub>2</sub> sensor on the same zone controller.

## Sensor specifications

Operating temperature	40° to 130°F (-4° to 54°C)	
Humidity	0 to 99%, non-condensing	
Sensor tolerance	Accuracy at 25°C:	±2% RH from 10–80% ±3% RH from 80–99%
Power	18-36 Vdc 24 Vac half-wave rectified	
Output	#OPNSENDRH-01:	4-20 mA, 0-5 Vdc, and 0-10 Vdc
	#33ZCSENSRH-01, #33ZCSENRH-01, and #33ZCSENORH-01:	4-20 mA and 0-10 Vdc
Physical	Includes a 499 Ohm 1 Watt resistor for conversions of the 4-20 mA signal to a +2-10 Vdc output signal	

## Wiring specifications

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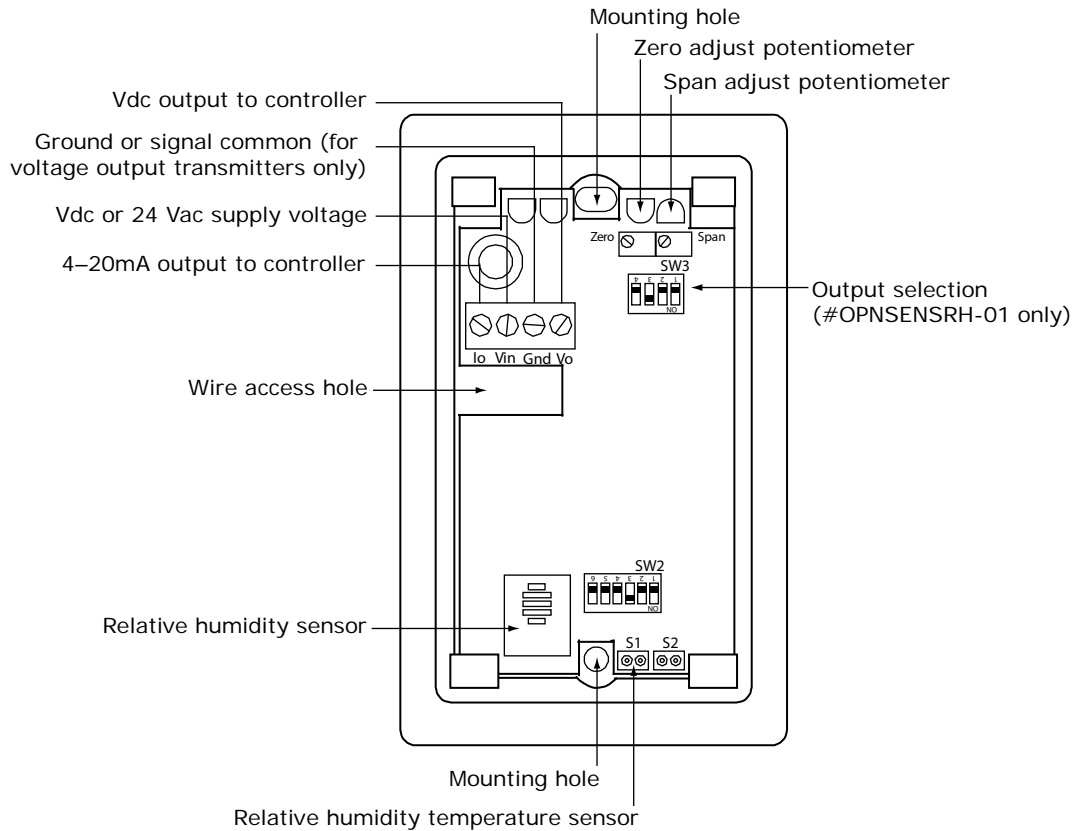
Cable from sensor to controller:	If <100 ft (30.5 meters)	22 AWG, unshielded
	If >100 ft (30.5 meters)	22 AWG, shielded
Maximum length:	500 feet (152 meters)	

## Mounting location

---

Mount this sensor...	In this location
Space RH sensor	<ul style="list-style-type: none"> <li>On an interior wall</li> <li>Approximately 5 feet (1.5 meters) from the floor, beside the space temperature sensor</li> <li>At least 4 feet (1.2 meters) from any corner. Reduced airflow in corners results in erratic sensor readings.</li> <li>Vertically so that the Carrier logo is correctly oriented</li> </ul> <p>Do not mount the sensor:</p> <ul style="list-style-type: none"> <li>In drafty areas such as near heating or air-conditioning ducts, open windows, or fans</li> <li>Over heat sources such as baseboard heaters, radiators, or wall-mounted light dimmers</li> <li>In areas of excessive moisture, corrosive fumes, or vibration</li> </ul> <p>Sensors mounted in these areas will produce inaccurate readings.</p> <p><b>NOTE</b> The sensor mounting plate accommodates the NEMA standard 4x2-in. electrical box. However, the sensor can be mounted directly on the wall surface if local codes permit.</p>
Duct RH sensor	The zone's return air duct
Outdoor RH sensor	Where the sensor is protected from the elements and direct sunlight, such as under an eave

## To wire and mount the Space RH sensors



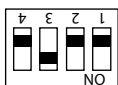
- 1 Remove the sensor's cover from the mounting plate.
- 2 Feed the wires from the electrical box through the wire access hole in the center of the sensor mounting plate.
- 3 Use the 2 screws provided to attach the mounting plate to the electrical box.
- 4 Strip the outer jacket from the cable for at least 4 inches (10.2 cm). Strip .25 inch (.6 cm) of insulation from each wire.
- 5 Wire the unit for power. See *Typical power wiring diagrams for Space RH sensors* (page 44).
- 6 Wire the sensor to the Open controller. See diagrams below and the controller's *Installation and Startup Guide* for details.

Input	Output	Wiring diagram
15–36 Vdc	4–20 mA	<p>4–20 mA Output 15–36 Vdc supply voltage</p>

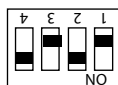
Input	Output	Wiring diagram
21.6–26.4 Vac (#OPNSENSRH-01 only)	4–20 mA	
15–36 Vdc or 21.6–26.4 Vac (#OPNSENSRH-01 only)	0–5 Vdc	
18–36 Vdc or 21.6–26.4 Vac	0–10 Vdc	

- 7 #OPNSENSRH-01 only—Make sure the power is off, then set DIP switches **SW3** to the desired output.

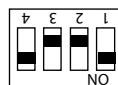
4-20 mA



0-5 Vdc



0-10 Vdc

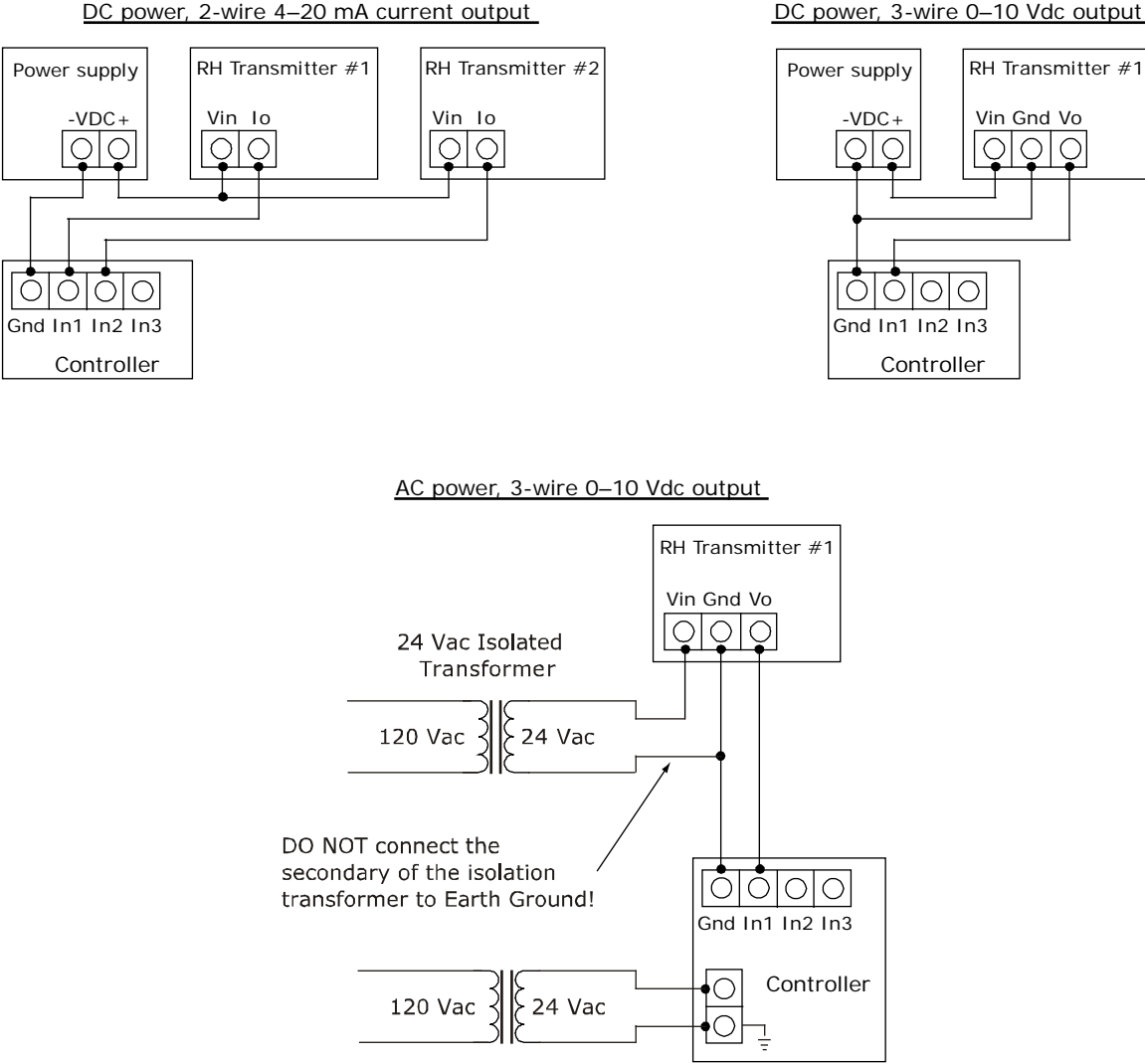


- 8 Reattach the cover to the mounting plate.
- 9 Turn the two Allen screws at the bottom of the unit counterclockwise to secure the cover to the mounting plate.

#### NOTES

- All wiring should be in accordance with all Local and National Electrical Code guidelines.
- If using shielded cable, connect only one end of the shield to ground at the controller. Connecting both ends to ground may cause a ground loop.

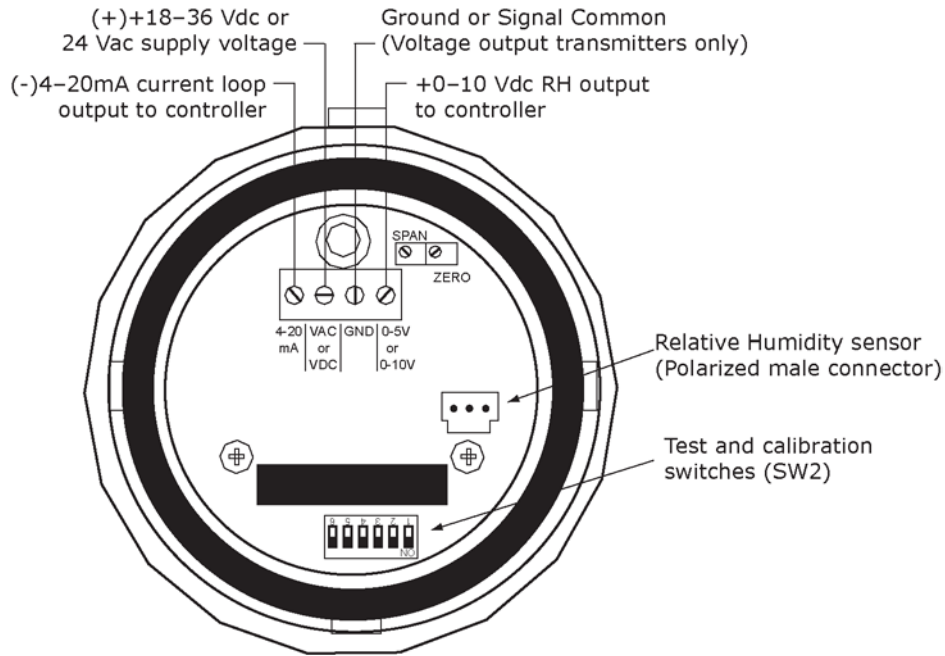
### Typical power wiring diagrams for Space RH sensors



**CAUTION** If using a 24 Vac transformer, use an isolated transformer. If sharing the transformer with your controller or another device, be sure to connect all of the devices with the proper polarity, since most controllers are earth grounded. Failure to do so could cause a ground loop that could damage the devices.



## To wire and mount the Duct RH sensor



- 1 Drill a .75 inch (1.9 cm) diameter hole in the duct where the sensor is to be mounted.
- 2 Insert the stainless steel probe into the hole until the foam contacts the duct, then attach the RH sensor using the 2 self-tapping screws provided.
- 3 Remove the cover.
- 4 On the probe unit, remove the knockout's inner ring.
- 5 If you are not using a .5 inch (1.3 cm) NPT conduit fitting, remove the knockout's outer ring. Tap the ring in 1 or 2 locations with a screwdriver, then remove the ring.
- 6 Install your conduit connectors or watertight fittings.
- 7 Wire the unit for power. See *Typical power wiring diagrams for Duct RH and Outdoor RH sensors* (page 47).
- 8 Wire the sensor to the Open controller. See diagrams below and the controller's *Installation and Startup Guide* for details.

Input	Output	Wiring diagram
15-36 Vdc	4-20 mA	

Input	Output	Wiring diagram
18–36 Vdc or 21.6–26.4 Vac	0–10 Vdc	

- 9 Place the sensor's cover onto the probe unit and gently turn until it is tight.
  - 10 Verify that you are getting a humidity reading.
- NOTE** Allow up to 20 minutes after powering up for the sensor reading to stabilize.

## To wire and mount the Outdoor RH sensor

See sensor diagram in *To wire and mount the Duct RH sensor* (page 45).

- 1 Use the 2 mounting screws provided to secure the sensor.
- 2 Remove the cover and install conduit connectors, watertight fittings, and/or 1/2" vent plug.
 

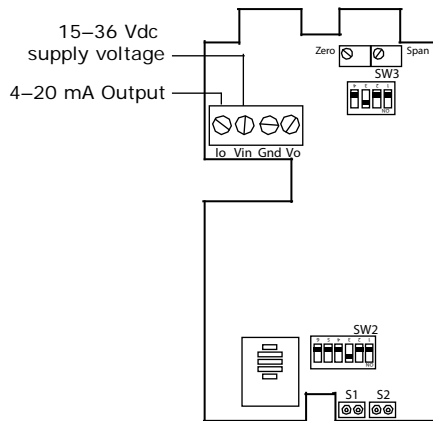
**NOTE** The inner ring will knock out first. Then tap the outer ring in 1 or 2 locations with a screwdriver to peel it out. The cover will be connected to the housing by the sensor leads.
- 3 At the sensor end of the cable, strip back the jacket from the cable for at least 3 inches. Strip 1/4 inch of insulation from each conductor. If using shielded cable, cut the shield and drain wire from the cable.
- 4 Wire the unit for power. See *Typical power wiring diagrams for Duct RH and Outdoor RH sensors* (page 47).
- 5 Wire the sensor to the Open controller. See diagrams below and the controller's *Installation and Startup Guide* for details.

Input	Output	Wiring diagram
15–36 Vdc	4–20 mA	
18–36 Vdc or 21.6–26.4 Vac	0–10 Vdc	

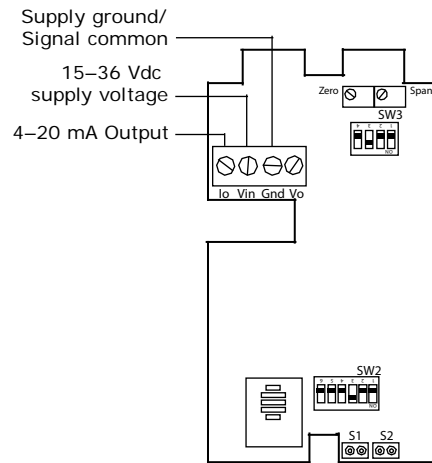
- 6 Place the cover onto the unit and gently turn until it is tight.
  - 7 Verify that you are getting a humidity reading.
- NOTE** Allow up to 20 minutes after powering up for the sensor reading to stabilize.

## Typical power wiring diagrams for Duct RH and Outdoor RH sensors

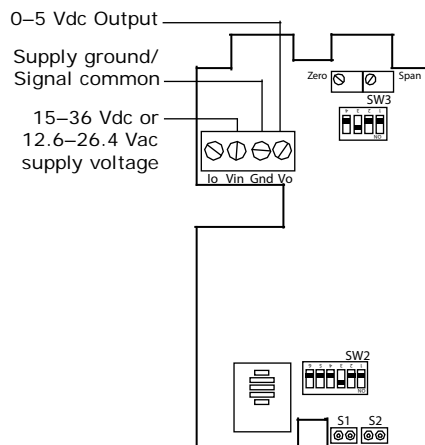
Input: 15–36 Vdc  
Output: 4–20 mA



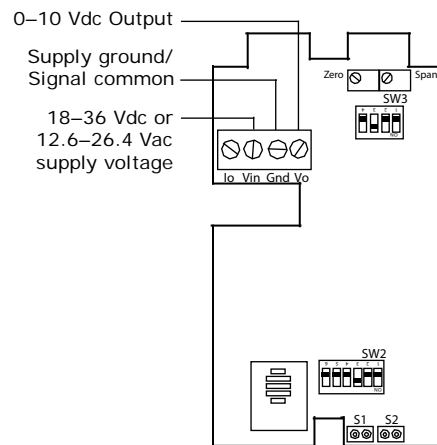
Input: 21.6–26.4 Vac  
Output: 4–20 mA



#OPSENSRH-01 only  
Input: 15–36 Vdc or 21.6–26.4 Vac  
Output: 0–5 Vdc



Input: 18–36 Vdc or 21.6–26.4 Vac  
Output: 0–10 Vdc



**CAUTION** If using a 24 Vac transformer, use an isolated transformer. If sharing the transformer with your controller or another device, be sure to connect all of the devices with the proper polarity, since most controllers are earth grounded. Failure to do so could cause a ground loop that could damage the devices.

## Calibrating and troubleshooting relative humidity sensors

### Troubleshooting the RH sensor

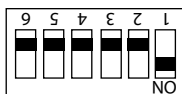
<b>No reading</b>	<p>Verify that:</p> <ul style="list-style-type: none"> <li>You have the correct supply voltage at the power terminal blocks.</li> <li>The wiring configuration and DIP switch settings are correct.</li> <li>All terminal screw connections are tight and that all wires are firmly in place.</li> </ul>
<b>Erratic readings</b>	<p>Verify that:</p> <ul style="list-style-type: none"> <li>All wires are terminated properly.</li> <li>The board does not have condensation on it.</li> <li>The input power is clean. In areas of high RF interference or noise, shielded cable may be needed to stabilize the signal.</li> </ul>
<b>Inaccurate readings</b>	<p>If you suspect the transmitter is not reading within the specified tolerance, contact the factory for assistance.</p>

### Using SW2 DIP switches to calibrate and troubleshoot

Adjust the SW2 DIP switches only if troubleshooting or recalibrating the sensor.

<b>Normal Operating Condition</b>		#3 must always be On for RH signal to respond to the sensor's actual relative humidity measurement.
<b>0% RH Output</b>		Transmitter outputs a 4 mA or 0 Vdc signal regardless of sensor reading. (For troubleshooting only.)
<b>50% RH Output</b>		Transmitter outputs a 12 mA, 2.5 Vdc, or 5 Vdc signal regardless of sensor reading. (For troubleshooting only.)
<b>100% RH Output</b>		Transmitter outputs a 20 mA, 5 Vdc, or 10 Vdc signal regardless of sensor reading. (For troubleshooting only.)
<b>Increment RH Output</b>		<p>Allows calibration of the sensor through imbedded calibration software. Toggle the #2 switch from Off to On to Off again for an increase of 0.5% RH.</p> <p><b>EXAMPLE</b> To correct a 1% drift, perform the above toggle sequence twice.</p> <p><b>NOTE</b> This is a single point calibration and is not recommended for critical applications. Contact the factory before doing any field calibration.</p>

### Decrement RH Output

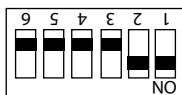


Allows calibration of the sensor through imbedded calibration software. Toggle the #1 switch from Off to On to Off again for a decrease of 0.5% RH.

**EXAMPLE** To correct a 1% drift, perform the above toggle sequence twice.

**NOTE** This is a single point calibration and is not recommended for critical applications. Contact the factory before doing any field calibration.

### Reset to Original Calibration



Resets the transmitter to its original factory calibration. Turn switch #1 and #2 On for a minimum of 5 seconds and then off again.

## RH conversion formulas

Use the following table to convert transmitter output signal to %RH.

Output	EXAMPLE: If signal output is...	Calculation is...
<b>4-20 mA</b> 4 mA = 0% RH 20 mA = 100% RH	12 mA	$(12\text{mA}-4\text{mA})/0.16 = 50\% \text{ RH}$
<b>0-10 Vdc</b> 0 Vdc = 0% RH 10 Vdc = 100% RH	8 Vdc	$8 \text{ Vdc}/0.10 = 80\% \text{ RH}$
<b>0-5 Vdc</b> (#OPNSRHRH-01 only) 0 Vdc = 0% RH 5 Vdc = 100% RH	2 Vdc	$2 \text{ Vdc}/0.05 = 40\% \text{ RH}$

## Enthalpy switch/receiver and Enthalpy sensor

Enthalpy switch/receiver - Part #33CSENTHSW  
 Enthalpy sensor - Part #33CSENTSEN

### Outdoor enthalpy control

Requires a field-installed enthalpy switch/receiver. The enthalpy switch/receiver, mounted in the outdoor air intake, senses temperature and humidity of the surrounding air and calculates the enthalpy.

The enthalpy switch/receiver:

- Energizes the relay output when the outdoor enthalpy is above 28 BTU/lb OR dry bulb temperature is above 75° F
- De-energizes the relay output when the outdoor enthalpy is below 27 BTU/lb AND dry bulb temperature is below 74.5° F.

The relay output is wired to the unit economizer which opens or closes based on the output of the switch.

### Differential enthalpy control

Requires an enthalpy switch/receiver and an enthalpy sensor. The enthalpy switch/receiver, mounted in the outdoor air intake, calculates outdoor air enthalpy. The enthalpy sensor, mounted in the return airstream, calculates the indoor air enthalpy.

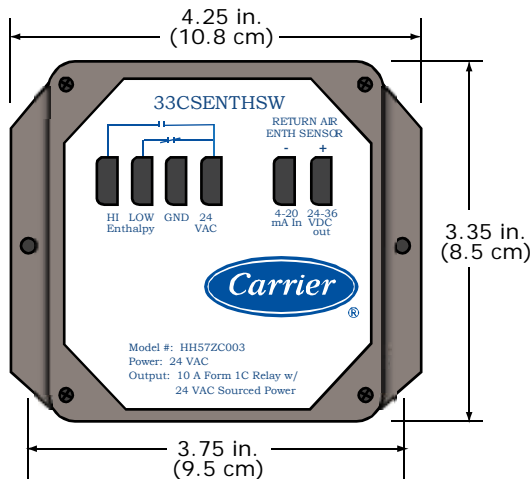
The enthalpy switch/receiver energizes:

- The HI Enthalpy relay output when the outdoor enthalpy is greater than the indoor enthalpy
- The LOW Enthalpy terminal when the outdoor enthalpy is lower than the indoor enthalpy

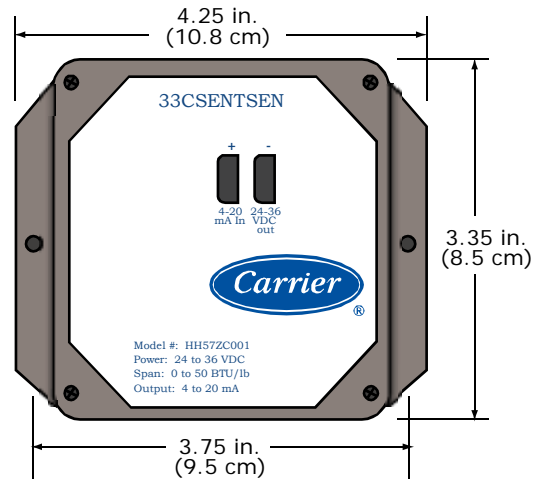
The relay output is wired to the unit economizer which opens or closes based on the output of the switch.

**NOTE** The enthalpy is calculated using an average altitude of 1000 ft above sea level.

### Enthalpy switch/receiver



### Enthalpy sensor



## Enthalpy switch/sensor specifications

---

The following specifications are the same for the switch/receiver and sensor unless noted.

Supply voltage	Switch/Receiver: 24 Vac $\pm$ 15% Sensor: 24 to 36 Vdc
Operating range	-40° to 140° F (-40° to 60° C)
Operating relative humidity	0 to 100%, non-condensing
Output	Switch/Receiver: Sourced 24 Vac through 10 Amp Form 1C relay Sensor: 2-wire, 4–20 mA loop powered
Enthalpy range	Sensor only 0–50 Btu/lb
Enthalpy accuracy	$\pm$ 1 Btu/lb at 77° F (25° C)
Temperature accuracy	$\pm$ 0.36° F (0.2° C) from 32 to 158° F (0 to 70° C)
Relative humidity accuracy	$\pm$ 35 at 77° F (25° C)
Sensitivity	0.1% RH
Repeatability	0.5% RH
Hysteresis	< 0.4% RH
Stability	< 2% drift over 5 years

## Wiring specifications

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Cable from sensor to controller:	If <100 ft (30.5 meters) 22 AWG, unshielded If >100 ft (30.5 meters) 22 AWG, shielded
Maximum length:	500 feet (152 meters)

## Mounting location

---

Mount the enthalpy switch/receiver in the outdoor air intake.

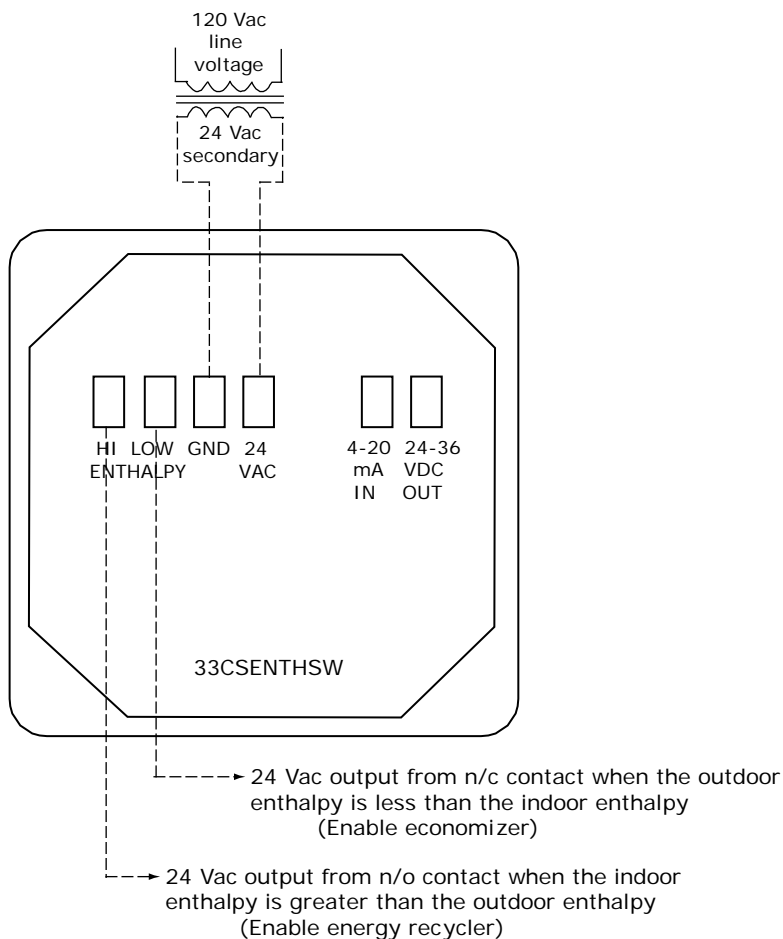
Mount the enthalpy sensor in the return air duct.

Do not mount the enthalpy switch/receivers and sensors where they could be exposed to outdoor elements such as rain or snow. These units are not NEMA 4 enclosures.

## To wire and mount the switch/sensor

### For Outdoor Enthalpy Control

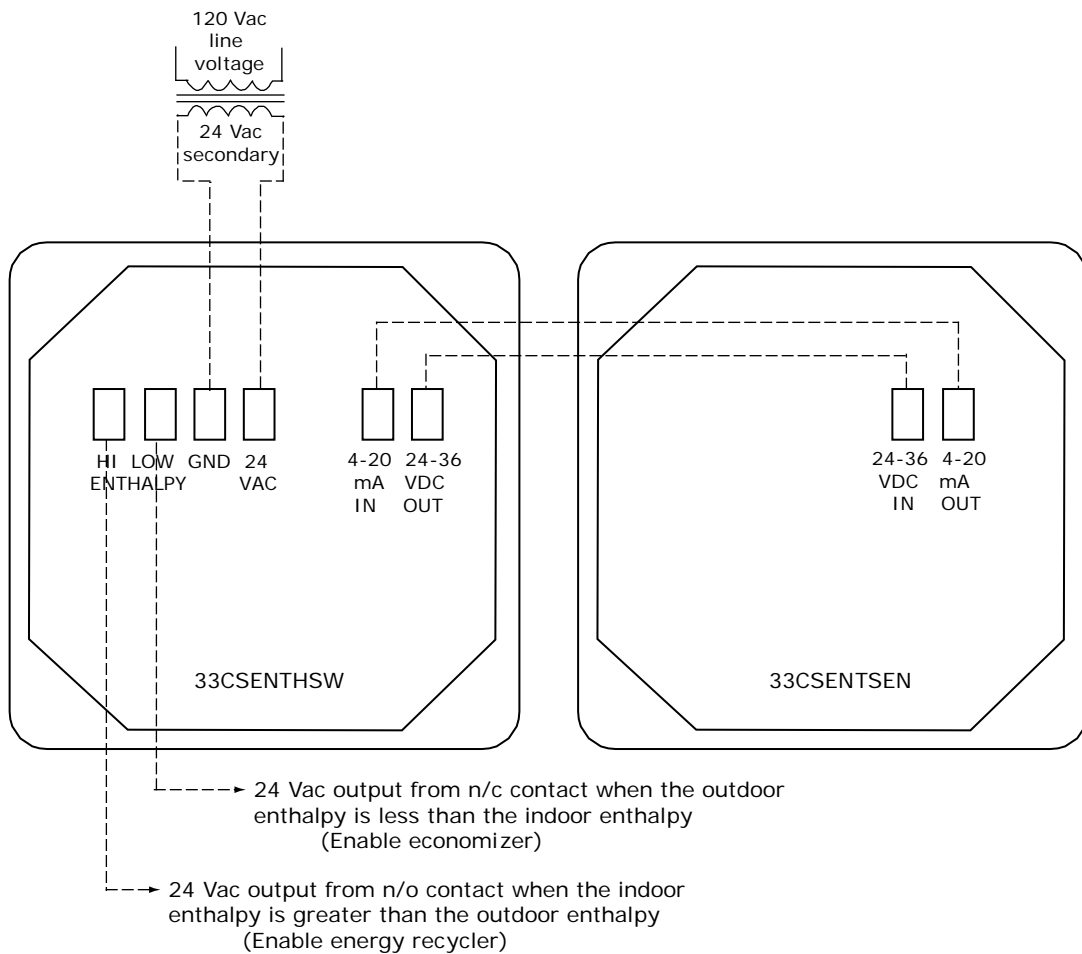
- 1 To mount the enthalpy switch/receiver, insert 2 field-supplied 8 x 3/4-in. TEK screws through its side holes.
- 2 Remove the 4 screws holding the cover on, then remove cover.
- 3 Set the **M1** to **M3** jumper to **M2**. Leave the other jumper on **Off**.
- 4 Replace the cover and the 4 screws.
- 5 Connect the **GND** and **24 Vac** terminals on the enthalpy switch/receiver to the controller's power terminals.
- 6 Connect the **HI** or **LOW** terminals on the enthalpy switch/receiver to the controller's J2-6 input.





## For Differential Enthalpy Control

- 1 To mount the enthalpy sensor, insert 2 field-supplied 8 x 3/4-in. TEK screws through its side holes.
- 2 Repeat step 1 to mount the enthalpy switch/receiver.
- 3 On the switch/receiver, remove the 4 screws holding the cover on, then remove cover.
- 4 Set the **M1** to **M3** jumper to **M2**. Leave the other jumper on **Off**.  
**NOTE** The enthalpy sensor's jumpers should be left at their factory settings of **M3** and **Off**.
- 5 Replace the switch/receiver's cover and the 4 screws.
- 6 Wire the sensor to the switch/receiver. See figure below.
- 7 Connect the **GND** and **24 Vac** terminals on the enthalpy switch/receiver to the controller's power terminals.
- 8 Connect the **HI** or **LOW** terminals on the enthalpy switch/receiver to the controller's J2-6 input.



## Appendix: i-Vu Open Control System Wiring Specifications and Recommended Vendors

Wiring specifications		Recommended vendors & part numbers			
Wire type	Description	Connect Air International	Belden	Ramcorp	Contractors Wire & Cable
MS/TP network (RS-485)	22 AWG, single twisted shielded pair, low capacitance, CL2P, TC foam FEP, plenum rated. See MS/TP Installation Guide for specifications.	W221P-2227	--	25160PV	CLP0520LC
MS/TP network (RS-485)	24 AWG, single twisted shielded pair, low capacitance, CL2P, TC foam FEP, plenum rated. See MS/TP Installation Guide for specifications.	W241P-2000FB	82841	25120-OR	--
Rnet	4 conductor, unshielded, CMP, 18 AWG, plenum rated.	W184C-2099BLB	6302UE	21450	CLP0442
Power - 24 Vac	2 conductor, CM, 18 AWG, unshielded.	W181P-2051	5300UE	21251	CLP0440
Analog & discrete sensor wiring < 100 ft	Single twisted pair, unshielded, CM, 22AWG, plenum rated.	W221P-2005	6500UE	21281	CLP0410
Analog & discrete sensor wiring 100–500 ft	Single twisted shielded pair, CM, 22AWG, plenum rated.	W221P-2044	6500FE	21280	CLP0520

## Index

### #

#33CSENTHSW • 1, 50  
 #33ZCASPCO2 • 30  
 #33ZCSENDAT • 1, 21  
 #33ZCSENDRH-01 • 1  
 #33ZCSENOAT • 1, 24  
 #33ZCSENNORH-01 • 3  
 #33ZCSENIPAT • 1, 18, 24, 27  
 #33ZCSENSAT • 1, 18, 27  
 #33ZCSENSRH-01 • 1, 37  
 #33ZCT55CO2 • 1, 35  
 #33ZCT55SPT • 1, 12  
 #33ZCT56CO2 • 1, 35  
 #33ZCT56SPT • 1, 12  
 #33ZCT59SPT • 1, 12  
 #3CSENSEN • 1, 50  
 #OPNSENSRH-01 • 1  
 #SPP • 1, 3  
 #SPPF • 1, 3  
 #SPPL • 1, 3  
 #SPS • 1, 3

### A

Alternate space temperature sensor • 12  
 aspirator box • 30, 33

### C

CO2 sensor • 1, 30  
 CO2/Temperature sensor • 1, 35

### D

Duct Air Temperature sensor • 1, 21  
 Duct Relative Humidity sensor • 1  
 Duct sensors  
   Duct Air Temperature sensor • 1, 21  
   Duct Relative Humidity sensor • 1  
 Enthalpy sensor • 1, 50  
 Enthalpy switch/receiver • 1, 50  
 Outdoor Air Temperature sensor • 1, 24  
 Primary Air Temperature sensor • 1, 18, 24, 27  
 Supply Air Temperature sensor • 1, 18, 27

### E

Enthalpy sensor • 1, 50  
 Enthalpy switch/receiver • 1, 50

### O

Outdoor Air Temperature sensor • 1, 24  
 Outdoor Relative Humidity sensor • 1  
 outdoor sensors  
   Outdoor Air Temperature sensor • 1, 24  
   Outdoor Relative Humidity sensor • 1

### P

Primary Air Temperature sensor • 1, 18, 24, 27

### R

Relative humidity sensor • 1  
   duct • 1  
   outdoor • 1  
   wall • 1  
 Rnet • 3, 5  
 Rnet wiring specifications • 5  
 RTU Open Controller • 1

### S

space temperature sensors • 1, 3, 12  
 SPT Plus • 3, 5, 8, 10  
 SPT Pro • 3, 5, 8, 10  
 SPT Pro Plus • 3, 5, 8, 10  
 SPT sensors • 1, 3  
 SPT Standard • 3, 5, 10  
 Supply Air Temperature sensor • 1, 18, 27

### T

T55 / T56 • 12, 35  
 temperature sensors  
   Alternate space temperature sensor • 12  
   CO2/Temperature sensor • 1, 35  
   Duct Air Temperature sensor • 1, 21  
   Outdoor Air Temperature sensor • 1, 24  
   Primary Air Temperature sensor • 1, 18, 24, 27  
   SPT sensors • 1, 3  
   Supply Air Temperature sensor • 1, 18, 27

### U

UC Open Controller • 1  
 UC Open XP Controller • 1

### V

VVT Bypass Controller • 1  
 VVT Zone Controller • 1

### W

wall-mounted sensors  
   CO2 sensor • 1, 30  
   CO2/Temperature sensor • 1, 35  
 Wiring specifications  
   Rnet • 5  
 WSHP Open Controller • 1







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