ZS Sensors
Installation Guide

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Important changes are listed in **Document revision history** at the end of this document.

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What are ZS sensors?

The ZS line of thermistor-based temperature sensors consist of:

- Zone sensors that may optionally sense humidity, CO_2, VOC, or motion
- Duct sensors for sensing temperature, temperature/humidity, or averaging temperature
- A pipe temperature sensor
- An immersion sensor
- Outdoor air sensors for sensing temperature or temperature/humidity
- Remote sensors that can be connected to any 10k Type 2 thermistor

ZS Sensors are wired to the Rnet port on Open controllers.

Zone Sensors	**Features**	**Available configurations**	**Part number **** (* = CAR or BNK)
ZS Standard	• Local access port • No user control	Temperature only Temp and humidity Temp and VOC Temp and CO2 Temp, humidity, and VOC Temp, humidity, and CO2	ZS2-* ZS2-H-* ZS2-V-BNK ZS2-C-* ZS2-HV-BNK ZS2-HC-*
ZS Plus	• Slider to make zone warmer or cooler • ⏻ button to override schedule and put zone in an occupied state, or force zone to an unoccupied state • Green LED to indicate occupied state • Local access port	Temperature only Temp and humidity Temp and VOC Temp and CO2 Temp, humidity, and VOC Temp, humidity, and CO2	ZS2PL-* ZS2PL-H-* ZS2PL-V-BNK ZS2PL-C-* ZS2PL-HV-BNK ZS2PL-HC-*

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Zone Sensors	Features	Available configurations	Part number ** (* = CAR or BNK)
ZS Pro 	• LCD display • ⏻ button to override schedule and put zone in an occupied state, or force zone to an unoccupied state • ▲ and ▼ buttons to change any editable property, such as setpoint • *i* button to cycle through information defined in control program • Green LED to indicate occupied state • Local access port • Optional motion sensor 	Temperature only Temp and humidity Temp and CO2 Temp, humidity, and CO2 Temp and motion Temp, humidity, and motion Temp, CO2, and motion Temp, humidity, CO2, and motion	ZS2P-* ZS2P-H-* ZS2P-C-* ZS2P-HC-* ZS2P-M-* ZS2P-HM-* ZS2P-CM-* ZS2P-HCM-*
ZS Pro-F 	All of the ZS Pro's features plus: • ❄/🔥 button to turn on heating, cooling, or fan only, or set to auto control. • button to adjust fan speed • **F/C** button to set temperatures to Fahrenheit or Celsius	Temperature only Temp and humidity Temp and CO2 Temp, humidity, and CO2	ZS2PF-* ZS2PF-H-* ZS2PF-C-* ZS2PF-HC-*

** Replace * in part number with **CAR** or **BNK**.
CAR = sensor with the Carrier logo.
BNK = sensor with no logo. Sensors with VOC are only available without a logo.

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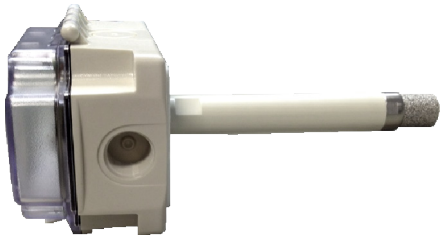
Duct Sensors	Available configurations ***	Part number
Temperature Sensor 	4 in. (10.16 cm) back probe 4 in. (10.16 cm) bottom probe 8 in. (20.32 cm) back probe 8 in. (20.32 cm) bottom probe	ZSD-B-4-6-B ZSD-S-4-6-B ZSD-B-8-6-B ZSD-S-8-6-B
Temperature/Humidity Sensor 	5.3 in. (13.5 cm) back probe 5.3 in. (13.5 cm) bottom probe	ZSD-BH-6-6-B ZSD-SH-6-6-B
Averaging Temperature Sensor 	8 ft (2.44 m) flexible back probe 8 ft (2.44 m) flexible bottom probe 12 ft (3.66 m) flexible back probe 12 ft (3.66 m) flexible bottom probe 24 ft (7.32 m) flexible back probe 24 ft (7.32 m) flexible bottom probe	ZSA-B-8-6-B ZSA-S-8-6-B ZSA-B-12-6-B ZSA-S-12-6-B ZSA-B-24-6-B ZSA-S-24-6-B
Pipe Sensor		
Clamp-on Temperature Sensor 		ZSS-B-2-6-B

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Immersion Sensor		
Temperature Sensor 	2 in. (5.08 cm) back probe 2 in. (5.08 cm) bottom probe 4 in. (10.16 cm) back probe 4 in. (10.16 cm) bottom probe	ZSI-B-2-6-B ZSI-S-2-6-B ZSI-B-4-6-B ZSI-S-4-6-B
Outdoor Air Sensor		
Temperature Sensor 	Bottom probe	ZSO-S-2-6-B
Temperature/Humidity Sensor 	Bottom probe	ZSO-SH-3-6-B

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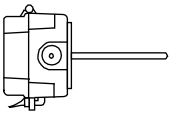
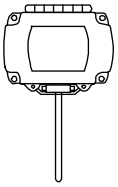
ZS Remote Sensors		
ZS Remote 	Any 10K Type 2 thermistor configuration can be wired to this sensor	ZS-RMT-BNK

*** Back probe:



Bottom probe:



To configure the control program for the desired user interaction with the sensor, see the *ZS Sensor Application Guide*.

For basic user instructions for zone sensors, see the *ZS Zone Sensor User Guide*.

Rnet configuration

You can use the wireless sensors, ZS sensors, and an Equipment Touch or TruVu™ ET Display on the same Rnet.

The number of sensors you can use on a controller's Rnet depends on how many control programs it can have (up to 5 sensors per control program). If a controller has:

- Only one control program, the Rnet can consist of up to 5 wireless and/or ZS sensors
- Multiple control programs, the Rnet can consist of up to 15 wireless and/or ZS sensors

WARNING

Using Rnet tags 5, 6, or 7 in a control program that has a ZS Pro or Pro-F version 3.4.02 or earlier in a Sensor Binder microblock will disable the display on the ZS sensor. You must do one of the following to prevent this occurrence:

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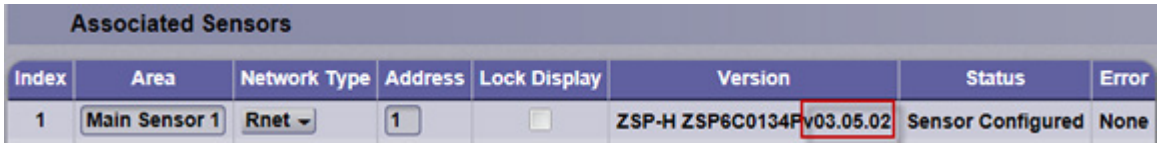
- Replace the ZS Pro or Pro-F with a newer one (v03.05.02 or later).
- If the controller supports multiple control programs, create a separate control program for the ZS Pro without tags 5, 6, or 7.

To determine the ZS Pro or Pro-F version, in the i-Vu® **Installer** tree, expand the controller with the ZS Sensor, and then select the Sensor Binder microblock. The version is shown in the **Associated Sensors** table.



CAUTIONS

- You cannot have SPT Sensors on the same Rnet with any of the above devices.
- An Rnet can have more than one wireless Pro-F sensor, however, changing the setpoint on one Pro-F will not be reflected on the display of another Pro or Pro-F, possibly causing confusion for the user.

Rnet wiring specifications

The Rnet communicates at a rate of 115 kbps and should be wired in a daisy-chain or hybrid configuration.

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

Description	4 conductor, shielded or unshielded, CMP, plenum rated cable
Conductor	22 AWG (7x0096) bare copper
Maximum length	500 feet (152 meters)
Insulation	Low-smoke PVC (or equivalent)
Color Code	Black, white, green, red
Shielding	If shielded, Aluminum/Mylar shield (100% coverage) with TC drain wire
UL temperature rating	32–167°F (0–75°C)
Voltage	300 Vac, power limited
Listing	UL: NEC CL2P, or better

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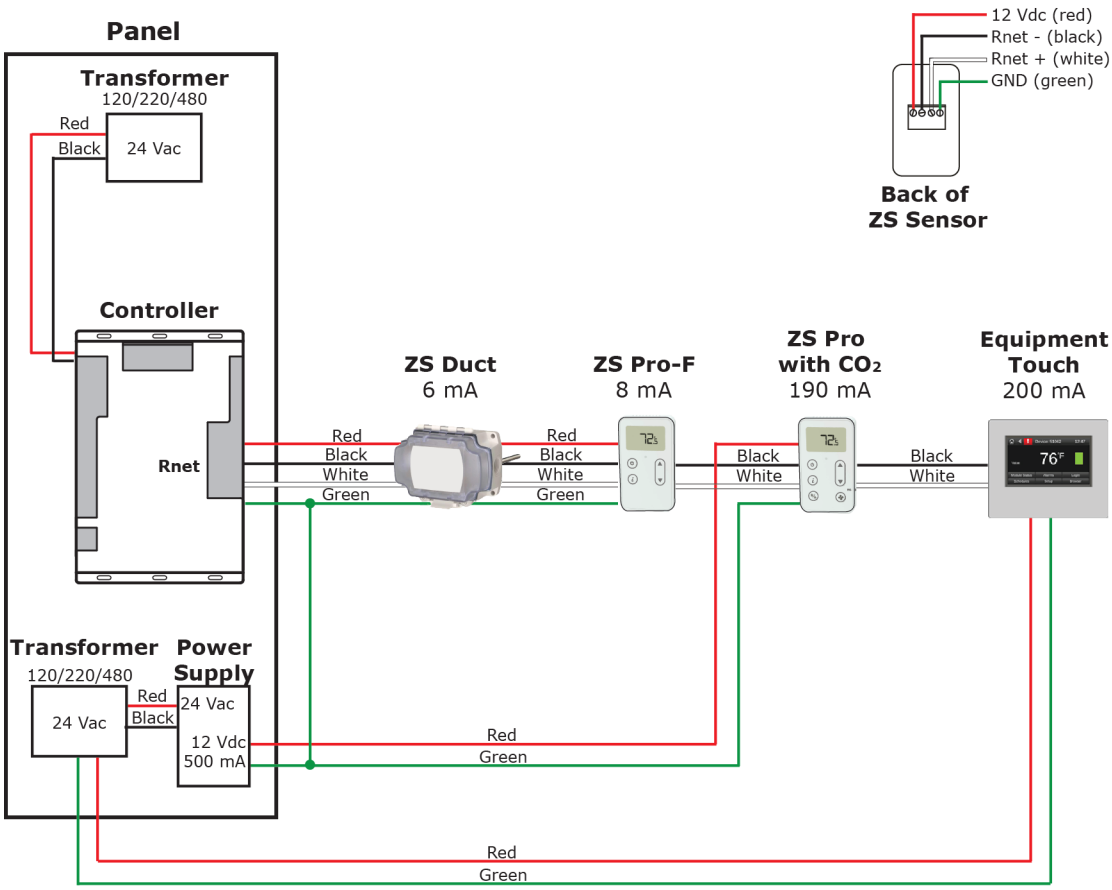
Power requirements

See the sensor specifications for power requirements and power supply information.

Sample wiring diagram with external power supply:



CAUTIONS

- If the power required by the sensors on the Rnet exceeds the power supplied by the controller's Rnet port, you will need to provide an external power supply. See:
  - The specifications for each sensor on the Rnet to determine the power required.
  - The specifications in the controller's Installation and Start-up Guide to determine the power supplied. The power supplied varies by controller model.

  NOTE A Wireless Adapter, Equipment Touch, or TruVu™ ET Display must be powered by an external power source. See each device's Installation and Start-up Guide for more information.

- Do not share power between controller's power and external 12 Vdc unless both devices are half wave.

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ZS zone sensors

ZS Standard	ZS Plus	ZS Pro	ZS Pro with motion sensor	ZS Pro-F

Specifications for ZS zone sensors

Sensing element accuracy		
Temperature	Temperature only: 32° to 122°F (0° to 50°C): ±0.36°F (0.2°C)	Temperature if humidity is included: 50° to 104°F (10° to 40°C): ±0.54°F (0.3°C)
Humidity	20% to 80%: ±2% typical. Less than 0.5% drift per year.	
CO_2	400 to 1250 PPM: ±30 PPM or 3% of reading, whichever is greater 1250 to 2000 PPM: ±5% of reading plus 30 PPM See *CO_2 sensor installation* (page 10).	
VOC	0 to 2,000 CO2 PPM Equivalent: ±100PPM See *Appendix: VOCs detected* (page 44).	
CO_2 sensor type	Non-Dispersive Infrared (NDIR)	
Motion sensor type	Passive infrared (PIR)	

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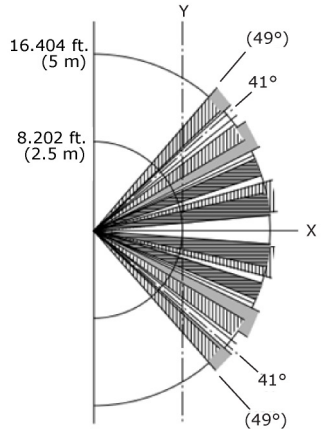
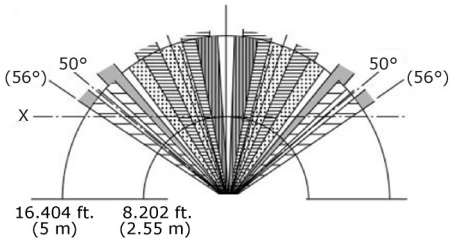
Motion sensor specifications	Detector distance: Detection range (HxV): Movement speed: Detection object:	16.4 ft. (5 m) 100° x 82° 2.62 to 3.94 ft/s (0.8 to 1.2 m/s) 27.56 x 9.84 in. (700 x 250 mm)

Side View



Top View



Power requirements *	Temperature only ZS Standard or ZS Plus: ZS Pro or Pro-F:	 12 Vdc @ 6 mA 12 Vdc @ 7 mA
	Temperature with humidity ZS Standard or ZS Plus: ZS Pro or Pro-F:	 12 Vdc @ 7 mA 12 Vdc @ 8 mA
	Temperature and VOC ZS Standard or ZS Plus	 12 Vdc @ 60 mA
	Temperature, humidity, and VOC ZS Standard or ZS Plus	 12 Vdc @ 60 mA
	Temperature, humidity, and CO_2 All models	12 Vdc @ 15 mA (idle) to 190 mA (CO_2 measurement cycle)
	Temperature and CO_2 All models	12 Vdc @ 15 mA (idle) to 190 mA (CO_2 measurement cycle)
	* A ZS Pro with motion sensor has the same power requirements as a ZS Pro without a motion sensor.	
Power supply	The 4-conductor Rnet cable from a controller supplies power to the Rnet, but the amount of power varies by controller. If the total power required by the sensors on the Rnet exceeds the power supplied by the Rnet port, you will need to use an external power supply. Use the above power requirements to calculate the power required and the size of the external power supply. **NOTE** The controller and the external power supply must share a common ground.	
Communication	115 kbps	
Local access port	For local access to start up and troubleshoot the system	
Environmental operating range	32 to 122°F (0 to 50°C), 10 to 90% relative humidity, non-condensing	
Mounting	Standard 4 x 2 in. electrical box using the 6-32 x 1/2 in. mounting screws provided	

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Overall dimensions	Width: Height: Depth:	2.75 in. (6.98 cm) 4.75 in. (12.06 cm) .86 in. (2.18 cm)
Listed by	FCC Part 15-Subpart B-Class B, CE	

CO2 sensor installation

IMPORTANT Do not install ZS CO_2 sensors in continuous occupancy applications. For a ZS CO_2 sensor to maintain accuracy, it must be installed only in a zone that is unoccupied for at least 4 hours a day with enough air movement during the unoccupied period to return CO_2 to background levels.

A ZS sensor with CO_2 uses Automatic Background Calibration which waits for the lowest value in a 24-hour period that deviates no more than 40PPM for at least 15 minutes, and assigns that value to the 400PPM baseline. This daily Automatic Background Calibration may take up to 21 days to fully calibrate the sensor.

After installation, a ZS sensor with CO_2 must be powered up for one hour before it attains accurate readings.

NOTE Dropping a sensor can upset the calibration, and it may require 21 days to return to our stated accuracy.

Motion sensor installation

The motion sensor on a ZS Pro needs to have a direct line of sight to the occupants in the room.

If the size of the room exceeds the maximum detector range, use multiple sensors to adequately monitor the area.

Avoid placing the sensor:

- In a location that has a direct line of sight through an open door to a hallway where the sensor could detect movement of people in the hallway.
- Near air ducts. Rapidly changing air currents from the air ducts could lead to false sensor readings.

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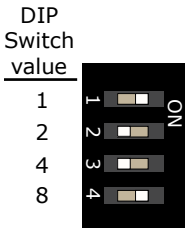
To address a ZS zone sensor

Each ZS Sensor on an Rnet must have a unique address, but addresses do not have to be sequential.

Use the DIP switches on the back of the ZS zone sensor to set an address from 0 to 14. (1 is factory default.) Each DIP switch has the value shown in the figure below. Turn on as many DIP switches as you need so that their total value equals the address.



EXAMPLE DIP switches 1 and 4 above are on. Their values (1 + 8) total 9, so the sensor's address is 9.

To wire and mount a ZS zone sensor

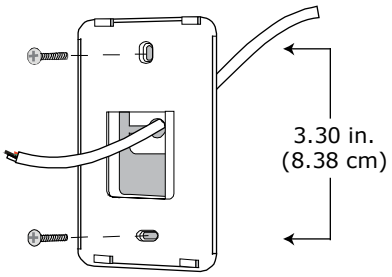
The Rnet communicates at a rate of 115 kbps and should be wired in a daisy-chain or hybrid configuration.

1 Turn off the controller's power.

2 Using a hex screwdriver, turn the setscrew clockwise until it stops turning.

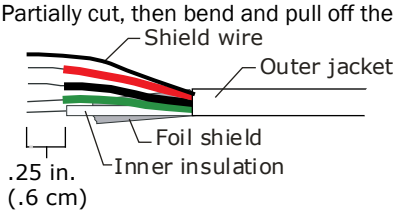
3 Pull out the bottom of the backplate, and then pull off the backplate.

4 Pull the Rnet communication cable through the wire guide in the backplate.



5 Use 2 screws to mount the backplate to the wall or outlet box.

Partially cut, then bend and pull off the outer jacket of the Rnet cable(s). Do not nick the inner insulation.



6 Strip about 0.25 inch (0.6 cm) of the inner insulation from each wire.

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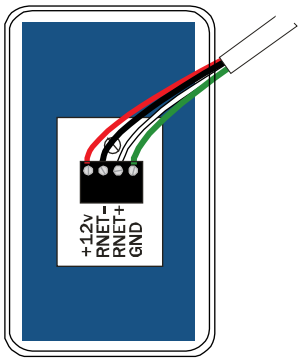
7 If wiring 1 cable to the ZS Sensor, cut the shield wire off at the outer jacket, then wrap the cable with tape at the outer jacket to cover the end of the shield wire.

If wiring 2 cables in a daisy-chain configuration, twist together the shield wires, then wrap the shield wires with tape.

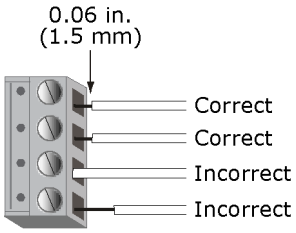
8 Insert the 4 wires into the ZS Sensor's screw terminal connector. If wiring 2 cables, insert like-colored wires into each terminal.



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 0.06 inch (1.5 mm) bare communication wire to protrude. If bare communication wire contacts the cable's foil shield, shield wire, or a metal surface other than the terminal block, the device may not communicate correctly.



9 Attach the sensor's cover and circuit board to the mounted backplate, inserting the top first.

10 Turn the setscrew counterclockwise until the cover cannot be removed.

11 Connect the other end of the Rnet wiring to the controller's **Rnet** port or to a zone sensor.

NOTES

- Insert the shield wire with the ground wire into the controller's **GND** terminal.
- Use the same polarity throughout the Rnet.

12 Turn on the controller's power.

NOTE Use the same polarity throughout the Rnet.

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To communicate through the local access port

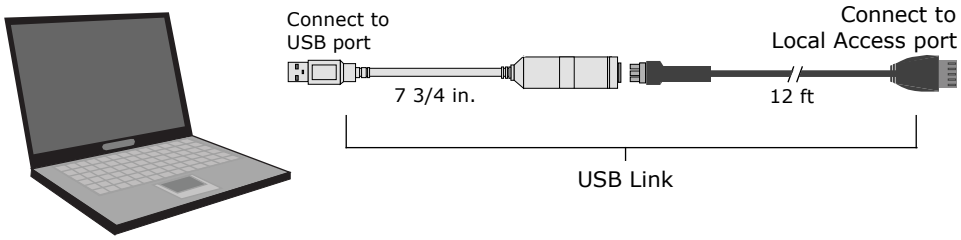
You can connect to the Local Access port of a ZS zone sensor to perform test and balance or to make changes to any device on the network.

PREREQUISITES

- A computer with a USB port
- A USB Link (Part #USB-L)

CAUTION If multiple controllers share power but polarity was not maintained when they were wired, the difference between the controller's ground and the computer's AC power ground could damage the USB Link and the controller. If you are not sure of the wiring polarity, use a USB isolator between the computer and the USB Link. Purchase a USB isolator online from a third-party manufacturer.

Connect the USB Link to the computer and to the ZS Sensor's local access port.



NOTE If using a USB isolator, plug the isolator into your computer's USB port, and then plug the USB Link cable into the isolator.

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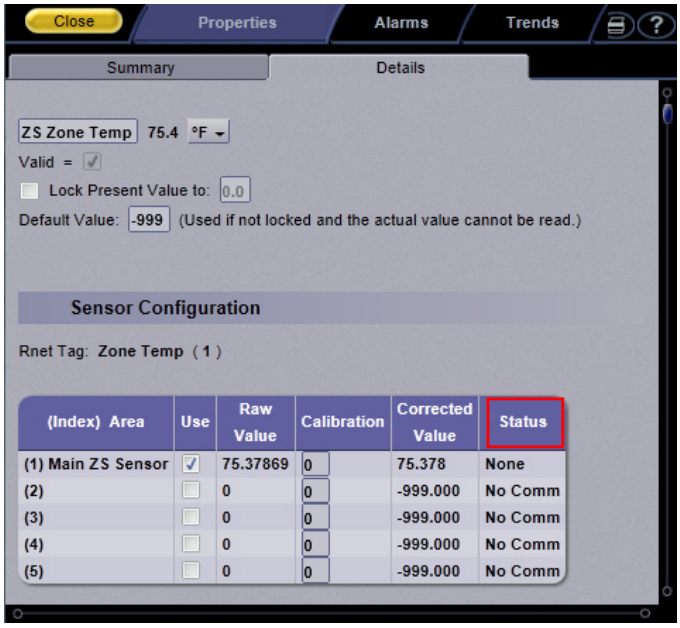
Troubleshooting a ZS Pro or ZS Pro-F

If display shows...	Then...
Incorrect or missing values	Check for errors in the i-Vu® application and Snap. On the control program's **Properties** page, select the **Rnet Points** tab. Verify that values coming in from the sensors and those going out to the sensors are expected values. In the i-Vu® application, double-click the Sensor Binder and ASVI microblocks to check for problems in the **Status** and/or **Error** columns.  If the **Error** column shows **Resource Allocation**, try formatting the sensor. If the error is not corrected by formatting, the control program engineer should reduce the number of items that the sensor is trying to display.
Nothing	The sensor has no power.
 	The sensor is not communicating with the network. Check: • Software/addressing setup • Wiring connections • Controller operating status
Characters that seem out of place	The sensor may have a memory problem. Try formatting the sensor.

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Effective setpoints fields	These fields display the effective setpoint values. They can display a maximum value of 99 or 99.5 if the **Edit Increment** is set to 0.5. If the effective setpoint exceeds this maximum value or if the **Edit Increment** is set to 0.1, the value will flash. **TIP** If you need an Edit Increment of 0.1, put the effective setpoints on the Information screen in the Primary Value field. Hide the effective setpoints on the Home screen by selecting **Sensor Setpoint Adjust Option 4** on the **BACnet Setpoint** microblock's **Rnet** tab.

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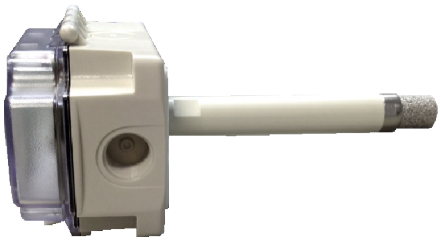
ZS duct sensors

Duct Temperature Sensor

Available with:
- 4 in. (10.16 cm) probe
- 8 in. (20.32 cm) probe
- Back or bottom probe *

Duct Temperature/Humidity Sensor



Available with:
- 5.3 in. (13.5 cm) probe
- Back or bottom probe *

Duct Temperature Averaging Sensor

Available with:
- 8 ft (2.44 m) flexible probe
- 12 ft (3.66 m) flexible probe
- 24 ft (7.32 m) flexible probe
- Back or bottom probe *

* Sensors with back probes (as shown) are to be mounted on the outside of ductwork. Sensors with bottom probes are to be mounted on the inside of ductwork.

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Specifications for ZS duct sensors

Sensing element		
Temperature	Range: Accuracy:	20° to 120°F (-5° to 50°C) ±0.36°F (0.2°C)
Humidity	Range: Accuracy:	10% to 90% ±2.0% typical at less than 0.5% drift per year. Calibrated at 73.4°F (23°C).
Sensor		
Temperature	Range: Accuracy:	20° to 120°F (-5° to 50°C) ±0.9°F (0.5°C)
Humidity	Range: Accuracy:	10% to 90% ±2.0% typical at less than 0.5% drift per year. Calibrated at 73.4°F (23°C).
Enclosure material	Polycarbonate, UL94V-0	
Enclosure rating	NEMA 4, IP66, UV rated	
Enclosure dimensions	Width: Height: Depth:	5 in. (12.7 cm) 4.15 in. (10.54 cm) 2.5 in. (6.35 cm)
Probe	• Temperature sensor probe: 304 SS 0.25 in. (0.64 cm) diameter Length (4 or 8 in.) specified at time of order • Temperature/humidity sensor probe: ABS with SS filter 1.0 in. (2.5 cm) diameter 5.3 in. (13.5 cm) length • Averaging temperature sensor probe: Bendable aluminum 3/16 in. diameter Length of 8, 12, or 24 ft. specified at time of order	
Power requirements	12 Vdc @ 6 mA	
Power supply	The 4-conductor Rnet cable from a controller supplies power to the Rnet, but the amount of power varies by controller. If the total power required by the sensors on the Rnet exceeds the power supplied by the Rnet port, you will need to use an external power supply. Use the above power requirements to calculate the power required and the size of the external power supply. **NOTE** The controller and the external power supply must share a common ground.	
Communication	115 kbps	
Mounting	Duct mount with #8 sheet metal screws	
Listed by	FCC Part 15-Subpart B-Class B, CE	

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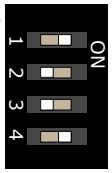
To address a ZS duct sensor

Each ZS Sensor on an Rnet must have a unique address, but addresses do not have to be sequential.

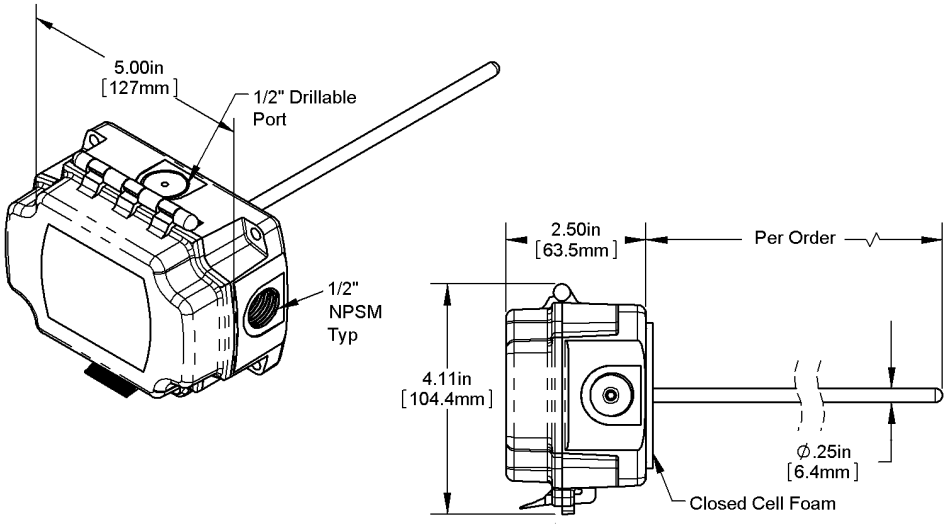
Open the hinged cover on the sensor enclosure, and then use the DIP switches to set an address from 0 to 14. (1 is factory default.) Each DIP switch has the value shown in the figure below. Turn on as many DIP switches as you need so that their total value equals the address.

DIP Switch value	
1	
2	
4	
8	

EXAMPLE DIP switches 1 and 4 above are on. Their values (1 + 8) total 9, so the sensor's address is 9.

To mount a ZS duct temperature or temperature/humidity sensor

Temperature sensor



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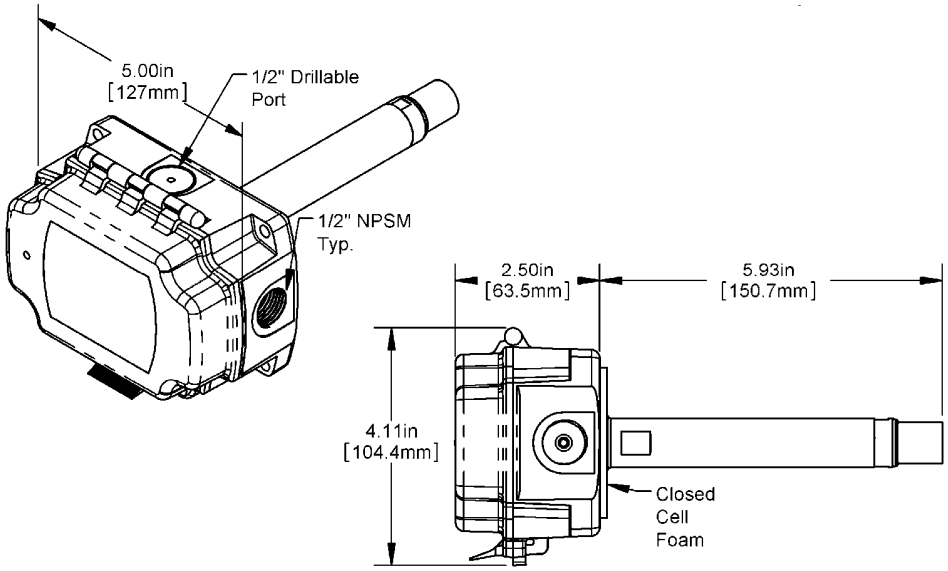
Temperature/Humidity sensor



1. Determine the best location on the duct for the sensor. Mount the sensor:
   - In the middle of the duct away from temperature stratified air, coils, or humidifiers
   - At least 3 duct diameters away from humidifiers.
2. Unlatch and open the hinged door on the sensor's enclosure.
3. Remove the sensor's knockout that is appropriate for your application. When you wire the sensor, you will pull the Rnet communication cable through this hole. See *To wire a ZS duct sensor* (page 22).
4. Close the enclosure door until it latches.
5. If mounting the sensor to the outside of the duct, drill a hole in the duct for the probe, and then insert the probe into the hole.
   - Temperature probe - Drill a .38 in. (.96 cm) hole
   - Temperature/humidity probe - Drill a 1 in. (2.54 cm) hole
6. Push the sensor enclosure against the duct and mark the location of each screw hole in the 4 corners of the enclosure.
7. Remove the sensor, and a drill 1/8 inch pilot screw hole where you made each mark in the previous step.

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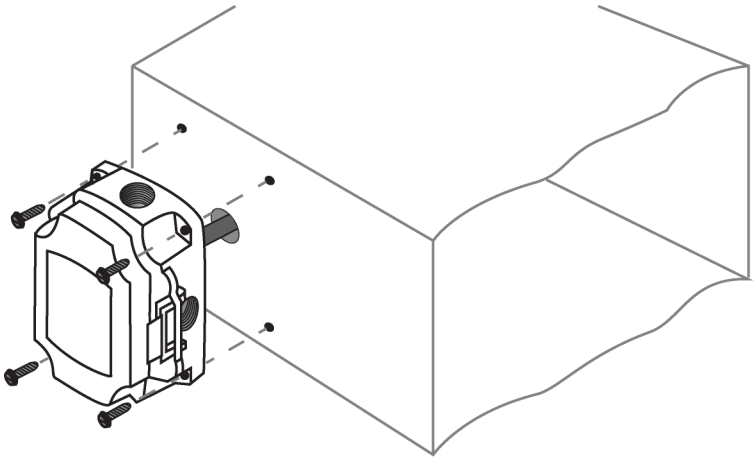
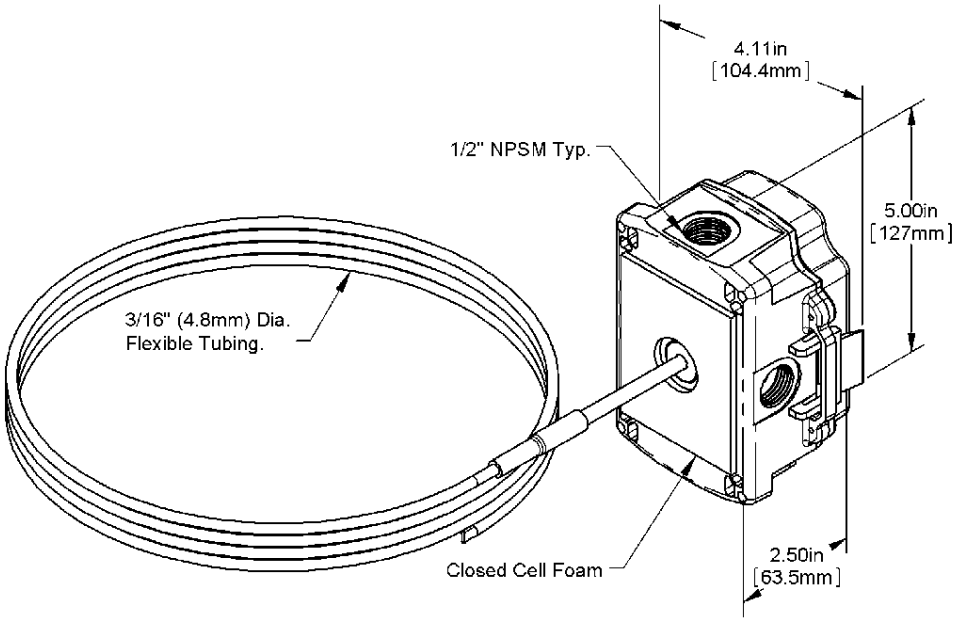
8 Use #8 sheet metal screws to attach the enclosure to the duct.

NOTE You must use a minimum of 2 mounting screws in opposite corners of the enclosure.



9 Tighten the screws so that the foam backing on the enclosure is depressed to prevent air leakage, but do not overtighten or strip the screw threads.

To mount a ZS duct averaging temperature sensor



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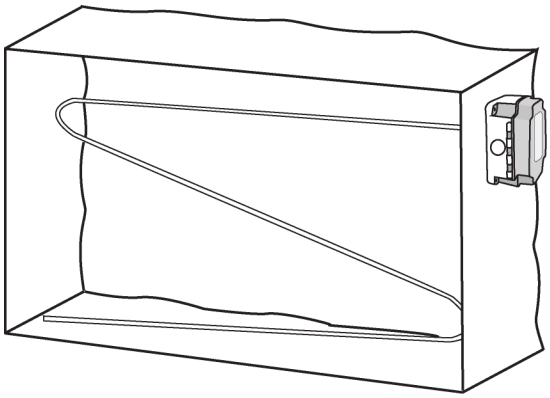
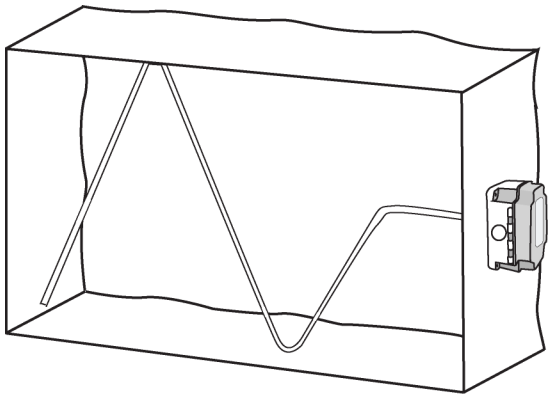
1. Determine the best location on the duct for the sensor. Mount the sensor in the middle or top of the duct as shown below so that the flexible probe can enter the duct in a convenient place.
2. Unlatch and open the hinged door on the sensor's enclosure.
3. Remove the sensor's knockout that is appropriate for your application. The knockouts for indoor versus outdoor applications are noted inside the enclosure. When you wire the sensor, you will pull the Rnet communication cable through this hole. See *To wire a ZS duct sensor* (page 22).
4. Close the enclosure door until it latches.
5. If mounting the sensor to the outside of the duct, drill a .38 in. (.96 cm) hole in the duct for the sensor probe. Insert the sensor probe into the hole by unrolling it into the duct carefully to avoid kinking it.
6. Push the sensor enclosure against the duct and mark the location of each screw hole in the 4 corners of the enclosure.
7. Pull the enclosure away from the duct, and a drill 1/8 inch pilot screw hole where you made each mark in the previous step.
8. Push the enclosure against the duct, and then use #8 sheet metal screws to attach the enclosure to the duct.

   NOTE You must use a minimum of 2 mounting screws in opposite corners of the enclosure.
9. Tighten the screws so that the foam backing on the enclosure is depressed to prevent air leakage, but do not overtighten or strip the screw threads.
10. Serpentine the duct with the sensor probe at least twice across the stratified air in the duct to achieve the best average temperature reading. At the turns, use the provided cable ties to attach the sensor probe to the duct.



Best for vertical stratification



Best for horizontal stratification

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To wire a ZS duct sensor

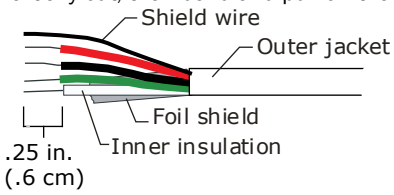
NOTES

- Do not drill into the sensor's watertight enclosure which will violate the NEMA and/or IP rating.
- Use caulk or Teflon tape for your conduit entries to maintain the appropriate NEMA or IP rating for your application.
- For outdoor or wet applications, conduit entry should be from the bottom of the enclosure.

PREREQUISITE The Rnet cable is wired to the controller. The shield wire and the ground wire should be inserted into the controller's GND terminal.

1 Turn off the controller's power.

2 Partially cut, then bend and pull off the outer jacket of the Rnet cable(s). Do not nick the inner insulation.



3 Strip about 0.25 inch (0.6 cm) of the inner insulation from each wire.

4 Unlatch and open the hinged door on the sensor's enclosure.

5 Pull the Rnet communication cable through the knockout hole.

6 If wiring 1 cable to the sensor, cut the shield wire off at the outer jacket, then wrap the cable with tape at the outer jacket to cover the end of the shield wire.

If wiring 2 cables in a daisy-chain configuration, twist together the shield wires, then wrap the shield wires with tape.

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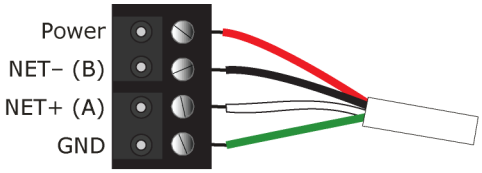
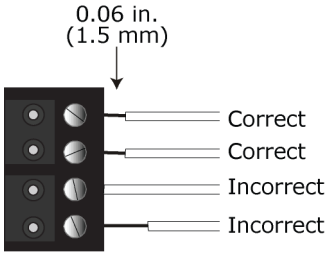
7 Insert the other 4 wires into the sensor's screw terminal connector. If wiring 2 cables, insert like-colored wires into each terminal.



Carrier recommends that you use the following Rnet wiring scheme:

Connect this wire...	**To this terminal...**
Red	Power
Black	NET-
White	NET+
Green	GND

CAUTION Allow no more than 0.06 inch (1.5 mm) bare communication wire to protrude. If bare communication wire contacts the cable's foil shield, shield wire, or a metal surface other than the terminal block, the device may not communicate correctly.



8 Close and latch the sensor's door.

9 Turn on the controller's power.

NOTE Use the same polarity throughout the Rnet.

Humidity filter maintenance

The temperature/humidity sensor has a sintered filter that protects the humidity sensor from various airborne particles. The filter can become dirty and may need periodic cleaning. Symptoms of a dirty filter are that the humidity sensor is slow to respond or consistently reports incorrect values.

To clean the filter:

1 Gently unscrew the filter from the probe.

2 Rinse the filter in warm soapy water, and then rinse in clean water. You can use a nylon brush if needed.

3 Gently screw the clean filter all the way into the probe. Hand tighten only.

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ZS pipe clamp-on temperature sensor

This sensor is primarily used to determine the fluid temperature in a pipe by reading the temperature of the pipe.

Pipe Clamp-on Temperature Sensor

Specifications for ZS pipe temperature sensor

Sensing element	Range: Accuracy:	-40° to 212°F (-40° to 100°C) ±1.3°F (0.72°C)
Sensor	Range: Accuracy:	20° to 120°F (-5° to 50°C) ±0.9°F (0.5°C)
Enclosure material	Polycarbonate, UL94V-0	
Enclosure rating	NEMA 4, IP66, UV rated	
Enclosure dimensions	Width: Height: Depth:	5 in. (12.7 cm) 4.15 in. (10.54 cm) 2.5 in. (6.35 cm)
Sensor pad	1.25" (3.18 cm) diameter copper	
Power requirements	12 Vdc @ 6 mA	
Power supply	The 4-conductor Rnet cable from a controller supplies power to the Rnet, but the amount of power varies by controller. If the total power required by the sensors on the Rnet exceeds the power supplied by the Rnet port, you will need to use an external power supply. Use the above power requirements to calculate the power required and the size of the external power supply. **NOTE** The controller and the external power supply must share a common ground.	
Communication	115 kbps	
Mounting	.5 in. (1.27 cm) stainless steel worm gear hose clamp	
Listed by	FCC Part 15-Subpart B-Class B, CE	

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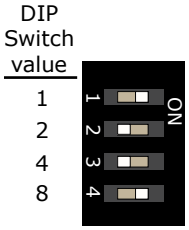
To address a ZS pipe temperature sensor

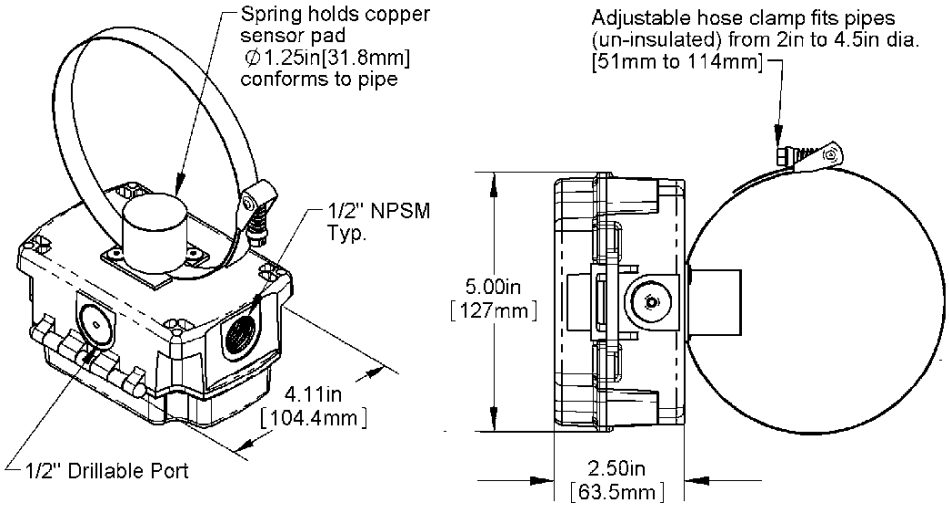
Each ZS Sensor on an Rnet must have a unique address, but addresses do not have to be sequential.

Open the hinged cover on the sensor enclosure, and then use the DIP switches to set an address from 0 to 14. (1 is factory default.) Each DIP switch has the value shown in the figure below. Turn on as many DIP switches as you need so that their total value equals the address.



EXAMPLE DIP switches 1 and 4 above are on. Their values (1 + 8) total 9, so the sensor's address is 9.

To mount a ZS pipe temperature sensor



1. Unlatch and open the hinged door on the sensor's enclosure.
2. Remove the sensor's knockout that is appropriate for your application. The knockouts for indoor versus outdoor applications are noted inside the enclosure. When you wire the sensor, you will pull the Rnet communication cable through this hole. See *To wire a ZS pipe temperature sensor* (page 26).
3. Close the enclosure door until it latches.
4. If the pipe has insulation, remove a 2 in. (5.08 cm) strip around the circumference of the pipe where the sensor will be located. The copper sensor plate and stainless steel strap must directly contact the metal or plastic pipe. Nothing should be between the copper plate and the bare pipe.

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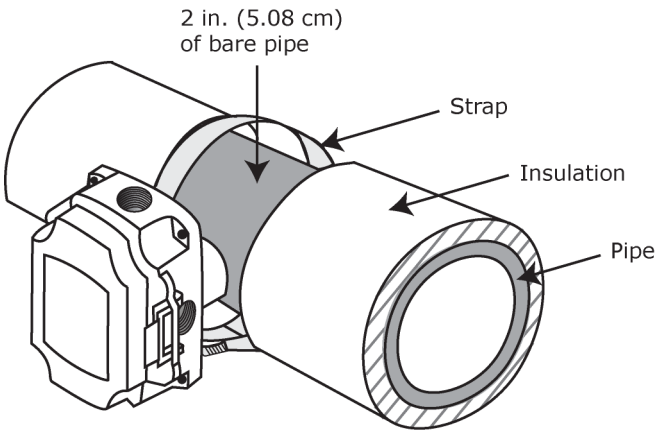
5 Lift up on the clamp screw to release the stainless steel strap from the clamp.

6 Wrap the sensor's strap around the pipe, and then insert the strap into the clamp.

7 Push the clamp screw down against the strap, and then turn the screw to tighten the strap enough so that the sensor does not rotate around the pipe, but only enough so that the foam is compressed no more than 50%.

8 If the pipe does not have insulation, add pipe insulation on either side of the sensor to prevent airflow from affecting the temperature readings. The insulation should:

- Be at least 1 in. thick, but only cover the sensor enclosure to the door hinge.
- Extend a minimum of 4 pipe diameters away from the sensor. For example, a 2 in. (5.08 cm) pipe should have 8 in. (20.32 cm) of insulation on each side of the sensor.



To wire a ZS pipe temperature sensor

NOTES

- Do not drill into the sensor's watertight enclosure which will violate the NEMA and/or IP rating.
- Use caulk or Teflon tape for your conduit entries to maintain the appropriate NEMA or IP rating for your application.
- For outdoor or wet applications, conduit entry should be from the bottom of the enclosure.

PREREQUISITE The Rnet cable is wired to the controller. The shield wire and the ground wire should be inserted into the controller's GND terminal.

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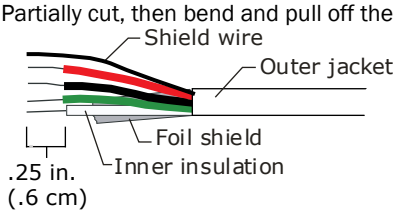
1 Turn off the controller's power.

2 Partially cut, then bend and pull off the outer jacket of the Rnet cable(s). Do not nick the inner insulation.



3 Strip about 0.25 inch (0.6 cm) of the inner insulation from each wire.

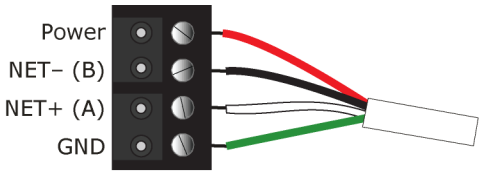
4 Unlatch and open the hinged door on the sensor's enclosure.

5 Pull the Rnet communication cable through the knockout hole.

6 If wiring 1 cable to the sensor, cut the shield wire off at the outer jacket, then wrap the cable with tape at the outer jacket to cover the end of the shield wire.

If wiring 2 cables in a daisy-chain configuration, twist together the shield wires, then wrap the shield wires with tape.

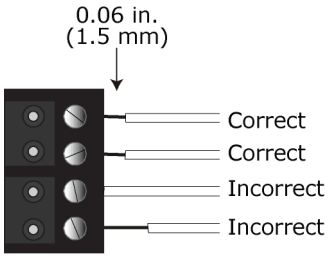
7 Insert the other 4 wires into the sensor's screw terminal connector. If wiring 2 cables, insert like-colored wires into each terminal.



Carrier recommends that you use the following Rnet wiring scheme:

Connect this wire...	**To this terminal...**
Red	Power
Black	NET-
White	NET+
Green	GND

CAUTION Allow no more than 0.06 inch (1.5 mm) bare communication wire to protrude. If bare communication wire contacts the cable's foil shield, shield wire, or a metal surface other than the terminal block, the device may not communicate correctly.



8 Close and latch the sensor's door.

9 Turn on the controller's power.

NOTE Use the same polarity throughout the Rnet.

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ZS immersion temperature sensor

This sensor is primarily used to measure temperature in water pipes, water tanks, or cooling tower sump applications. An immersion sensor is mounted in a thermowell (purchased separately from Carrier).

Immersion Temperature Sensor

Available with:
- 2 in. (5.08 cm) probe
- 4 in. (10.16 cm) probe
- Back or bottom probe

Specifications for ZS immersion temperature sensor

Sensing element	Range: Accuracy:	-40° to 212°F (-40° to 100°C) ±1.3°F (0.72°C)
Sensor	Range: Accuracy:	20° to 120°F (-5° to 50°C) ±0.9°F (0.5°C)
Enclosure material	Polycarbonate, UL94V-0	
Enclosure rating	NEMA 4, IP66, UV rated	
Enclosure dimensions	Width: Height: Depth:	5 in. (12.7 cm) 4.15 in. (10.54 cm) 2.5 in. (6.35 cm)
Probe	304 SS 0.25" (0.64 cm) diameter 2 or 4 in. (5.08 or 10.16 cm) length specified at time of order	
Power requirements	12 Vdc @ 6 mA	
Power supply	The 4-conductor Rnet cable from a controller supplies power to the Rnet, but the amount of power varies by controller. If the total power required by the sensors on the Rnet exceeds the power supplied by the Rnet port, you will need to use an external power supply. Use the above power requirements to calculate the power required and the size of the external power supply. **NOTE** The controller and the external power supply must share a common ground.	

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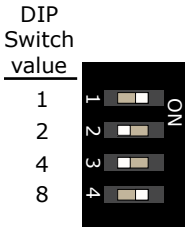
Communication	115 kbps
Mounting	Sensor's 1/2 in. NPSM plastic threads are screwed into a thermowell
Listed by	FCC Part 15-Subpart B-Class B, CE

To address a ZS immersion temperature sensor

Each ZS Sensor on an Rnet must have a unique address, but addresses do not have to be sequential.

Open the hinged cover on the sensor enclosure, and then use the DIP switches to set an address from 0 to 14. (1 is factory default.) Each DIP switch has the value shown in the figure below. Turn on as many DIP switches as you need so that their total value equals the address.



EXAMPLE DIP switches 1 and 4 above are on. Their values (1 + 8) total 9, so the sensor's address is 9.

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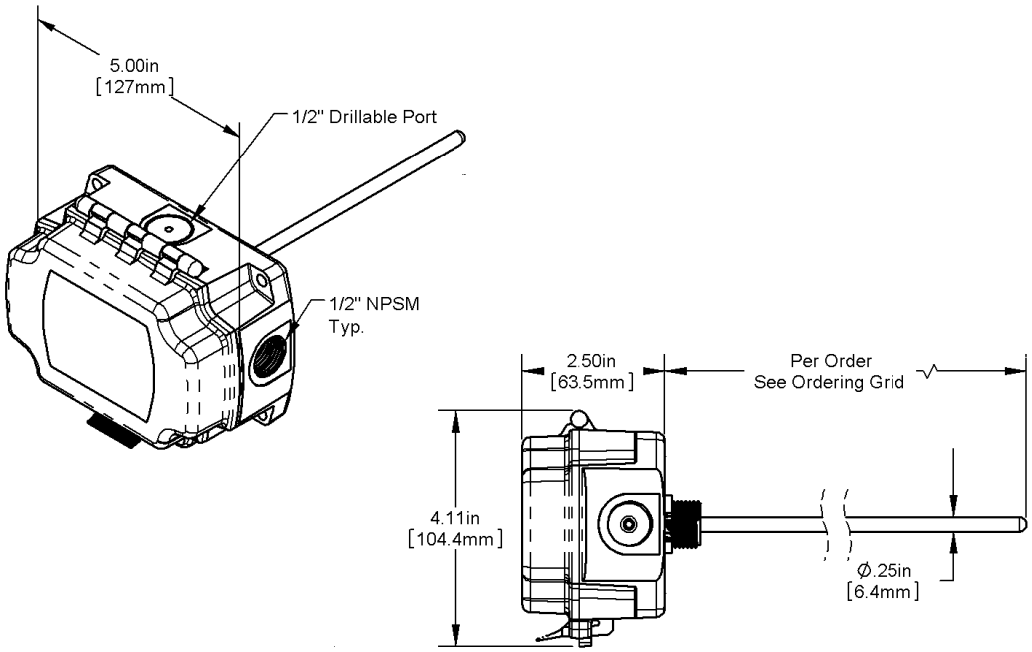
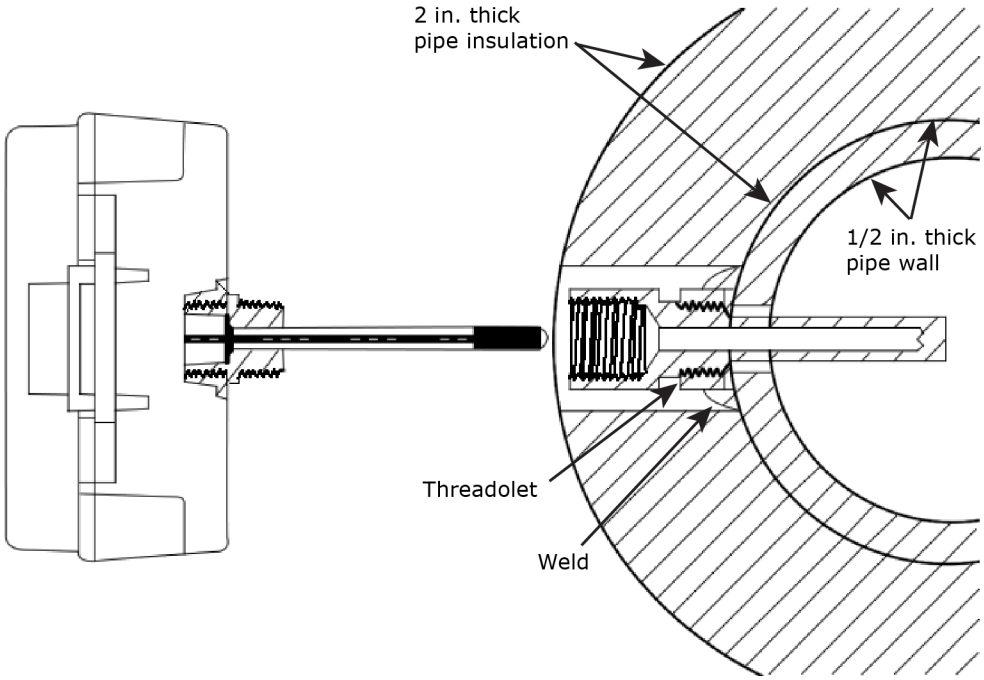
To mount a ZS immersion temperature sensor



An immersion sensor is mounted in a thermowell (purchased separately from Carrier), a hollow tube closed off on one end and threaded at the other end. A thermowell is permanently installed in pipes, tanks or sumps so that an immersion sensor can be inserted into the thermowell to measure the content's temperature. The temperature is transferred through the wall to the thermowell to the sensor. The thermowell prevents the contents of the pipe from escaping and holds in the pressure of pressurized pipes.



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To install the thermowell (typically performed by a pipe fitter)

1 Drill a 3/4 in. hole in the pipe where the thermowell is needed.

2 Weld a Threadolet or Weldolet fitting (not provided) over the hole.

3 Thread sealant such as Teflon tape or pipe dope to the 1/2 in. NPT threads of the thermowell.

4 Insert the thermowell into the threadolet and tighten.

To install the immersion sensor

1 Insert the immersion sensor probe into the thermowell.

2 Screw the sensor's enclosure into the thermowell; hand-tighten until snug.

3 Unlatch and open the hinged door on the sensor's enclosure.

4 Push on the probe until it stops so that the probe is touching the bottom of the thermowell.

5 Close the enclosure door until it latches.

To wire a ZS immersion temperature sensor

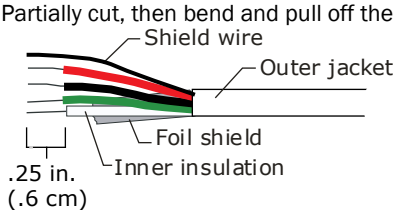
NOTES

- Do not drill into the sensor's watertight enclosure which will violate the NEMA and/or IP rating.
- Use caulk or Teflon tape for your conduit entries to maintain the appropriate NEMA or IP rating for your application.
- For outdoor or wet applications, conduit entry should be from the bottom of the enclosure.

PREREQUISITE The Rnet cable is wired to the controller. The shield wire and the ground wire should be inserted into the controller's GND terminal.

1 Turn off the controller's power.

2 Partially cut, then bend and pull off the outer jacket of the Rnet cable(s). Do not nick the inner insulation.



3 Strip about 0.25 inch (0.6 cm) of the inner insulation from each wire.

4 Unlatch and open the hinged door on the sensor's enclosure.

5 Pull the Rnet communication cable through the knockout hole.

6 If wiring 1 cable to the sensor, cut the shield wire off at the outer jacket, then wrap the cable with tape at the outer jacket to cover the end of the shield wire.

If wiring 2 cables in a daisy-chain configuration, twist together the shield wires, then wrap the shield wires with tape.

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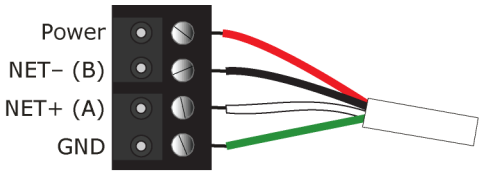
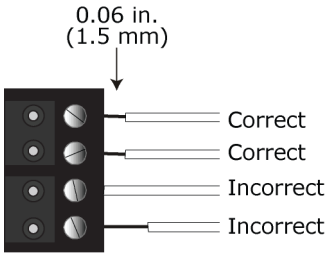
7 Insert the other 4 wires into the sensor's screw terminal connector. If wiring 2 cables, insert like-colored wires into each terminal.



Carrier recommends that you use the following Rnet wiring scheme:

Connect this wire...	**To this terminal...**
Red	Power
Black	NET-
White	NET+
Green	GND

CAUTION Allow no more than 0.06 inch (1.5 mm) bare communication wire to protrude. If bare communication wire contacts the cable's foil shield, shield wire, or a metal surface other than the terminal block, the device may not communicate correctly.



8 Close and latch the sensor's door.

9 Turn on the controller's power.

NOTE Use the same polarity throughout the Rnet.

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ZS outdoor air temperature sensors

ZS outdoor sensors measure temperature or temperature/humidity.

Outdoor Temperature Sensor

Bottom probe only

Outdoor Temperature/Humidity Sensor

Specifications for ZS outdoor air sensors

Sensing element		
Temperature	Range: Accuracy:	-40° to 158°F (-40° to 70°C) ±1.3°F (0.72°C)
Humidity	Range: Accuracy:	10% to 90% ±2.0% typical at less than 0.5% drift per year. Calibrated at 73.4°F (23°C).
Sensor		
Temperature	Range: Accuracy:	20° to 120°F (-5° to 50°C) ±0.9°F (0.5°C)
Humidity	Range: Accuracy:	10% to 90% ±2.0% typical at less than 0.5% drift per year. Calibrated at 73.4°F (23°C).
Enclosure material	Polycarbonate, UL94V-0	
Enclosure rating	NEMA 4, IP66, UV rated	

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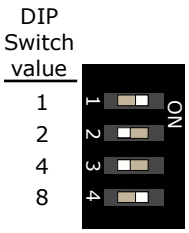
Probe	• Temperature sensor probe: Vented polycarbonate shield, .5 in. (1.27 cm) OD 1.2 in. (3.05 cm) • Temperature/humidity sensor probe: ABS with SS filter 1.0 in. (2.5 cm) diameter 2.4 in. (6.1 cm) length
Enclosure dimensions	Width: 5 in. (12.7 cm) Height: 4.15 in. (10.54 cm) Depth: 2.5 in. (6.35 cm)
Sensing element shield	Vented polycarbonate shield 0.5 in. (1.27 cm) outside diameter 1.2 in. (3.05 cm) long with 1/2 in. NPT threads
Power requirements	12 Vdc @ 6 mA
Power supply	The 4-conductor Rnet cable from a controller supplies power to the Rnet, but the amount of power varies by controller. If the total power required by the sensors on the Rnet exceeds the power supplied by the Rnet port, you will need to use an external power supply. Use the above power requirements to calculate the power required and the size of the external power supply. **NOTE** The controller and the external power supply must share a common ground.
Communication	115 kbps
Mounting	3/16 in. holes
Listed by	FCC Part 15-Subpart B-Class B, CE

To address a ZS immersion temperature sensor

Each ZS Sensor on an Rnet must have a unique address, but addresses do not have to be sequential.

Open the hinged cover on the sensor enclosure, and then use the DIP switches to set an address from 0 to 14. (1 is factory default.) Each DIP switch has the value shown in the figure below. Turn on as many DIP switches as you need so that their total value equals the address.



EXAMPLE DIP switches 1 and 4 above are on. Their values (1 + 8) total 9, so the sensor's address is 9.

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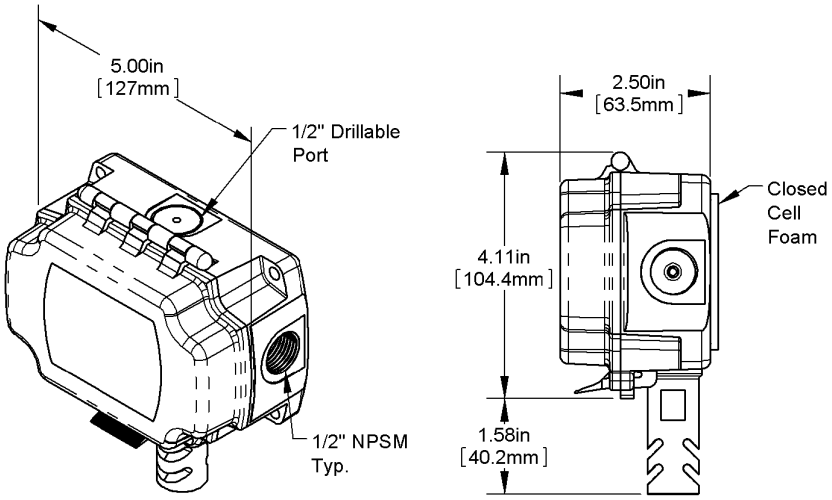
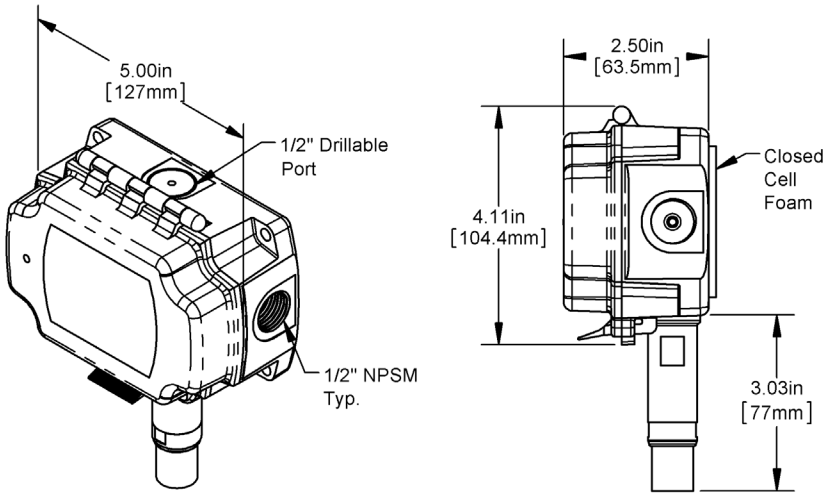
To mount a ZS outdoor air temperature sensor

Outside Air Temperature sensor



Outside Air Temperature/Humidity sensor



1 Determine the best location for the sensor. Mount the sensor:
   - In the shade, never in the sunlight or you will have higher than expected temperature readings by as much as +30%.
   - Away from building windows, doors, or vents.
   - At least one foot below the eave to prevent measurement of trapped heat under the eave.
   - At least four feet about ground level.

2 Drill the mounting holes and mount as shown below with the probe pointing down. Tighten the mounting screws enough to ensure that the foam backing compresses to about 50% of its thickness to create a seal against the wall surface.

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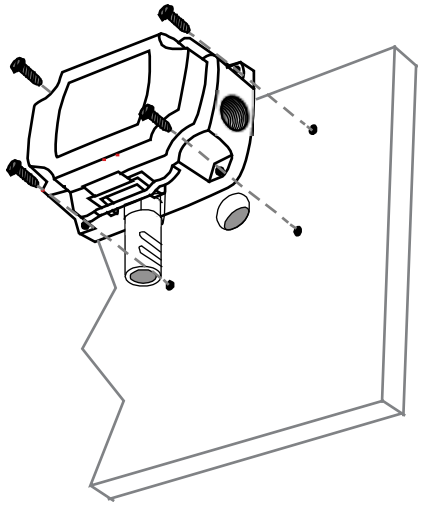


3 Unlatch and open the hinged door on the sensor's enclosure.

4 Route the Rnet cable into the back of the enclosure, and then connect the wiring as described in *To wire a ZS outside air sensor* (page 36).

5 After wiring the sensor, caulk the wiring hole.

6 Close the enclosure door until it latches. Secure with provided cover screws.

To wire a ZS outdoor air sensor

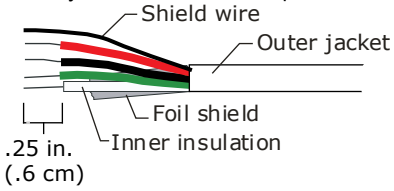
NOTES

- Do not drill into the sensor's watertight enclosure which will violate the NEMA and/or IP rating.
- Use caulk or Teflon tape for your conduit entries to maintain the appropriate NEMA or IP rating for your application.

PREREQUISITE The Rnet cable is wired to the controller. The shield wire and the ground wire should be inserted into the controller's GND terminal.

1 Turn off the controller's power.

2 Partially cut, then bend and pull off the outer jacket of the Rnet cable(s). Do not nick the inner insulation.



3 Strip about 0.25 inch (0.6 cm) of the inner insulation from each wire.

4 Unlatch and open the hinged door on the sensor's enclosure.

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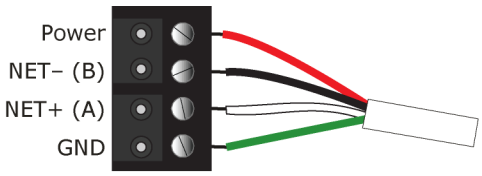
5 Pull the Rnet communication cable through the knockout hole.

6 If wiring 1 cable to the sensor, cut the shield wire off at the outer jacket, then wrap the cable with tape at the outer jacket to cover the end of the shield wire.

If wiring 2 cables in a daisy-chain configuration, twist together the shield wires, then wrap the shield wires with tape.

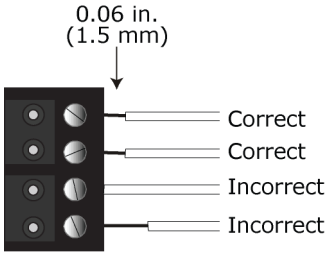
7 Insert the other 4 wires into the sensor's screw terminal connector. If wiring 2 cables, insert like-colored wires into each terminal.



Carrier recommends that you use the following Rnet wiring scheme:

Connect this wire...	**To this terminal...**
Red	Power
Black	NET-
White	NET+
Green	GND

CAUTION Allow no more than 0.06 inch (1.5 mm) bare communication wire to protrude. If bare communication wire contacts the cable's foil shield, shield wire, or a metal surface other than the terminal block, the device may not communicate correctly.



8 Close and latch the sensor's door.

9 Turn on the controller's power.

NOTE Use the same polarity throughout the Rnet.

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Humidity filter maintenance

The temperature/humidity sensor has a sintered filter that protects the humidity sensor from various airborne particles. The filter can become dirty and may need periodic cleaning. Symptoms of a dirty filter are that the humidity sensor is slow to respond or consistently reports incorrect values.

To clean the filter:

1. Gently unscrew the filter from the probe.
2. Rinse the filter in warm soapy water, and then rinse in clean water. You can use a nylon brush if needed.
3. Gently screw the clean filter all the way into the probe. Hand tighten only.

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ZS Remote sensors

ZS Remote sensor

Specifications for ZS Remote sensors

Enclosure material	Polycarbonate, UL94V-0
Enclosure rating	NEMA 4, IP66, UV rated
Enclosure dimensions	Width: 5 in. (12.7 cm) Height: 4.15 in. (10.54 cm) Depth: 2.5 in. (6.35 cm)
Power requirements	12 Vdc @ 6 mA
Power supply	The 4-conductor Rnet cable from a controller supplies power to the Rnet, but the amount of power varies by controller. If the total power required by the sensors on the Rnet exceeds the power supplied by the Rnet port, you will need to use an external power supply. Use the above power requirements to calculate the power required and the size of the external power supply. **NOTE** The controller and the external power supply must share a common ground.
Communication	115 kbps
Listed by	FCC Part 15-Subpart B-Class B, CE

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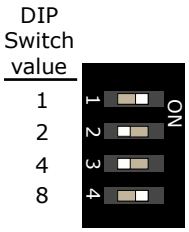
To address a ZS Remote sensor

Each ZS Sensor on an Rnet must have a unique address, but addresses do not have to be sequential.

Open the hinged cover on the sensor enclosure, and then use the DIP switches to set an address from 0 to 14. (0 is factory default.) Each DIP switch has the value shown in the figure below. Turn on as many DIP switches as you need so that their total value equals the address.



EXAMPLE DIP switches 1 and 4 above are on. Their values (1 + 8) total 9, so the sensor's address is 9.

To mount a ZS Remote sensor

1. Determine the best location for the sensor.
2. Unlatch and open the hinged door on the sensor's enclosure.
3. Connect a thermistor to the sensor. See *To connect a thermistor to a ZS Remote sensor* (page 42).
4. Close the enclosure door until it latches.
5. Push the sensor enclosure against the mounting surface and mark the location of each screw hole in the 4 corners of the enclosure.
6. Pull the enclosure away from the mounting surface , and a drill 1/8 inch pilot screw hole where you made each mark in the previous step.
7. Push the enclosure against the mounting surface, and then use #8 sheet metal screws to attach the enclosure to the surface.

   NOTE You must use a minimum of 2 mounting screws in opposite corners of the enclosure.

To wire a ZS Remote sensor

NOTES

- Do not drill into the sensor's watertight enclosure which will violate the NEMA and/or IP rating.
- Use caulk or Teflon tape for your conduit entries to maintain the appropriate NEMA or IP rating for your application.
- For outdoor or wet applications, conduit entry should be from the bottom of the enclosure.

PREREQUISITE The Rnet cable is wired to the controller. The shield wire and the ground wire should be inserted into the controller's GND terminal.

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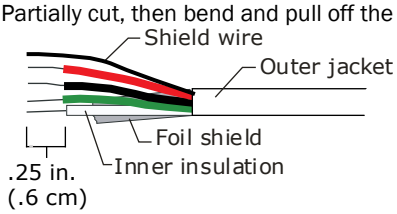
1 Turn off the controller's power.

2 Partially cut, then bend and pull off the outer jacket of the Rnet cable(s). Do not nick the inner insulation.



3 Strip about 0.25 inch (0.6 cm) of the inner insulation from each wire.

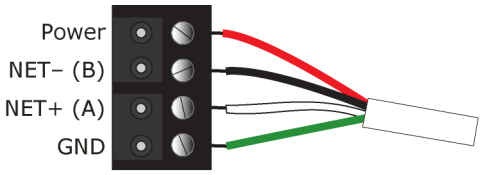
4 Unlatch and open the hinged door on the sensor's enclosure.

5 Pull the Rnet communication cable through the knockout hole.

6 If wiring 1 cable to the sensor, cut the shield wire off at the outer jacket, then wrap the cable with tape at the outer jacket to cover the end of the shield wire.

If wiring 2 cables in a daisy-chain configuration, twist together the shield wires, then wrap the shield wires with tape.

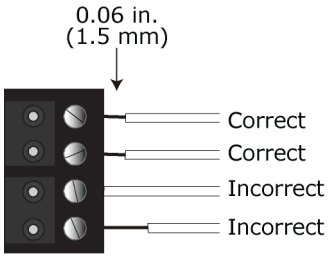
7 Insert the other 4 wires into the sensor's screw terminal connector. If wiring 2 cables, insert like-colored wires into each terminal.



Carrier recommends that you use the following Rnet wiring scheme:

Connect this wire...	**To this terminal...**
Red	Power
Black	NET-
White	NET+
Green	GND

CAUTION Allow no more than 0.06 inch (1.5 mm) bare communication wire to protrude. If bare communication wire contacts the cable's foil shield, shield wire, or a metal surface other than the terminal block, the device may not communicate correctly.



8 Close and latch the sensor's door.

9 Turn on the controller's power.

NOTE Use the same polarity throughout the Rnet.

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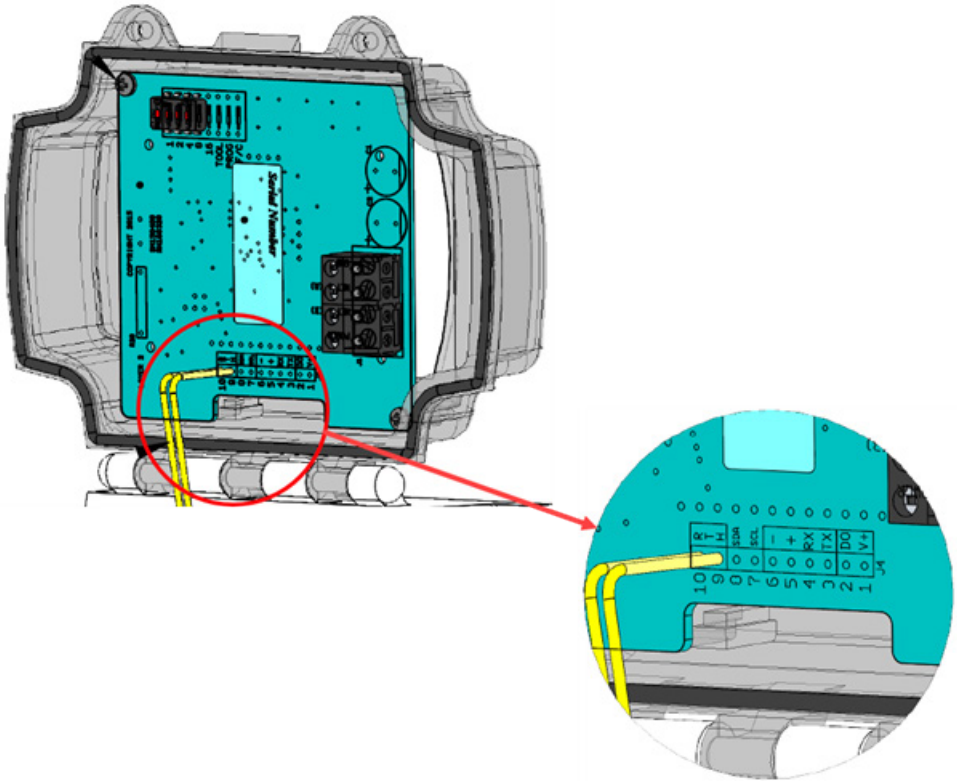
To connect a thermistor to a ZS Remote sensor

You can attach any 10k Type 2 thermistor configuration (non-communicating) to the ZS Remote.

1 Attach the thermistor wires to the sensor wires using the connectors provided with the ZS Remote.



2 Clip the ferrite core provided with the ZS Remote around the wires coming from the sensor.

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To format a ZS Sensor

Formatting a sensor clears its flash memory. Do either of the following to format a sensor:

- Download the controller that the sensor is connected to.
- Do the following:
  a) Remove the wiring connector from the sensor.
  b) Note the current position of the DIP switches.
  c) Set all DIP switches to the ON position.
  d) Reattach the wiring connector to format.
  e) After approximately 3 seconds, remove the wiring connector.
  f) Set the DIP switches back to their original position.
  g) Reattach the wiring connector.

NOTE If you move a sensor from one controller to another controller that has a different control program, format the sensor.

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Appendix: VOCs detected

VOC families that can be detected by our sensors are:

- CO, CH4, LPG
- Alcohols
- Ketones (solvents). Examples are Acetone and Methyl Ethyl Ketone (MEK).
- Organic Acids. Examples are Lactic acid, Acetic acid, Formic acid, Citric acid, and Oxalic acid.
- Amines. Amines are derivatives of ammonia. See http://en.wikipedia.org/wiki/Category:Amines.
- Aliphatic hydrocarbons. These are flammable with little or no odor. Examples are hexane, paraffin, methane, and acetylene.
- Aromatic Hydrocarbons. These are flammable with a discernable odor. Examples are benzene, furan, pyridine, toluene, asphaltene, and picric acid.

Over 10,000 specific chemicals are listed as VOCs, but some of the more common chemicals are:

- Dipropylene glycol
- Ethanol
- Ethyl Alcohol
- Eucalyptol
- Formaldehyde
- Heptane
- Hydrocarbons
- Isobutane
- Isobutene
- Isoprene
- Limonene
- Methane
- Methoxyethanol
- Methoxyethoxyethanol
- Methylcyclohexane
- Methylethylketone
- Methyl methacrylate
- Naphthalene
- Nonanal
- Organic Chloramines
- Pentane
- Phenol
- Pinene
- Propane
- Siloxanes
- Tetrachloroethene
- Tetrachloroethylene
- Toluene
- Trichloromethane
- r (1-methylethyl)cyclopropane
- Xylene

Many things contain these chemicals. For example, cigarette smoke contains benzene and carbon monoxide. Propane (R290/LPG) is commonly used in contemporary refrigerant blends. Most of the above chemicals can be found in cleaners, disinfectants, perfumes, polishes, plastics, glues and lubricants.

Below 1000 ppm = Safe
1000-1500 ppm = Warning
Over 1500 ppm = Poor air quality

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Document revision history

Important changes to this document are listed below. Minor changes such as typographical or formatting errors are not listed.

Date	Topic	Change description	Code*
6/15/20	What are ZS sensors	Added ZS Remote	X-PM-IM-E-IM
	ZS Remote sensors	New topic	
3/3/20	Cover	Updated logo	C-D
3/1/19	Specifications for ZS zone sensors	Motion sensor specification - Detector distance: Changed 16.4 in. to 16.4 ft.	X-O-MW-E
8/24/18	Rnet configuration	Added TruVu™ ET Display and revised wording of first half of topic.	X-D
	Power requirements	Added TruVu™ ET Display	
7/9/18	Power requirements	On the drawing, removed the power of the controller's Rnet port. Added first bullet under CAUTIONS.	X-O-RS-E
	ZS zone sensors - Specifications	Changed description of Power supply spec.	
	CO2 sensor installation	Added paragraph regarding one hour after installation to attain accurate readings.	
3/6/18	Specifications for ZS zone sensors	Changed Sensing element accuracy for Humidity from 10% to 90%: ±1.8% typical to 20% to 80%: ±2% typical.	X-O-AR-O
	Appendix: VOCs detected	New topic	X-O-RS-E
1/9/18	What are ZS sensors? Power requirements ZS zone sensors Specifications for ZS zone sensors To wire and mount a ZS zone sensor	Topics changed to show new zone sensor design	X-D
7/26/17	Rnet configuration	Changed version 3.3.11 to 3.4.02 and changed v03.05.03 to 03.05.02.	X-TS-AP-F
5/31/17	Specifications for: ZS pipe clamp-on sensor ZS immersion sensor ZS outdoor air sensors	Corrected specification for Sensing element. Removed Environmental operating range specification.	X-O-AR-E
5/10/17	Troubleshooting a ZS Pro or ZS Pro-F	Added Effective Setpoints Fields descriptions	X-TS-EE-BR
1/30/17	Specifications for ZS zone sensors	Added CO_2 sensor type	X-TS-JM-F
1/19/17	Entire document	Major revisions to add a motion sensor to a ZS Pro, duct sensors, pipe sensor, immersion sensor, and outdoor air sensors.	X-D
3/10/16	Specifications	Added drift statement to Humidity specification.	X-TS-EE-F
5/26/15	CO_2 sensor installation	New topic	X-TS-RB-BR
11/24/14	Power requirements	Made corrections to wiring diagram	X-TS-JM-O
8/6/14	To address a ZS Sensor	Changed Default address from 0 to 1.	C-D

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