INSTALLATION INSTRUCTIONS

TotalSense™ Series

Indoor Air Quality Sensor

BACnet/Modbus/Analog

CE

IMPORTANT WARNINGS

- Only qualified trade installers should install this product
- This product is not intended for life-safety applications
- Do not install in hazardous or classified locations
- The installer is responsible for all applicable codes
- De-energize power supply prior to installation or service

PRODUCT APPLICATION LIMITATION:

Senva products are not designed for life or safety applications. Senva products are not intended for use in critical applications such as nuclear facilities, human implantable device or life support. Senva is not liable, in whole or in part, for any claims or damages arising from such uses.

FEATURES

The TotalSense series design allows customization for a sensor that meets project requirements for monitoring temperature, carbon dioxide (CO_2), total volatile organic compounds (TVOC), particulate matter (PM), relative humidity (RH), Carbon Dioxide (CO), passive-infrared occupancy sensor (PIR), and ambient light. The product can be ordered as a stand-alone CO_2, RH, Temp, TVOC, CO,PM, or PIR sensor as well as almost any combination of sensors. Resistive-set-point sliders and pushbuttons are also available to meet the requirements for any job. All models come standard with programmable set-point relay (except on PM models) and barometric pressure compensation for CO_2.

Choose the analog version to receive up to three selectable and programmable analog outputs or utilize the communications version to access a myriad of data through Modbus RTU or BACnet MS/TP. Communications version comes standard with ambient light sensing.

To verify the features see the 'Product Identification' section of the installation manual or use the configuration tool at senvainc.com or scan the QR code on the right.

TotalSense Configurator

AQ2 [ ] - [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]

Package
W = Surface

Output Type
A = Analog
B = BACnet/Modbus
D = Dual Analog + BACnet/Modbus

CO2
A = None
C = CO2
D = Dual Channel CO2

Relative Humidity
A = None
2 = 2% RH

VOC
A = None
V = VOC

Advanced Sensors*
A = None
P = Particulate Matter (PM)
O = Ozone
*C = CO*****
*R = PM + CO*****
Q = PM + Ozone

Temperature Output**
A = None
B = Transmitter
C = 100Pt RTD
D = 1000Pt RTD
E = 10K Type 2
F = 10K Type 3
G = 10k w/11k
H = 3k
I = 2k2
J = 1k8
K = 20k

Display
X = None
D = OLED Display
S = OLED display with solid cover
R = Air Quality Ring

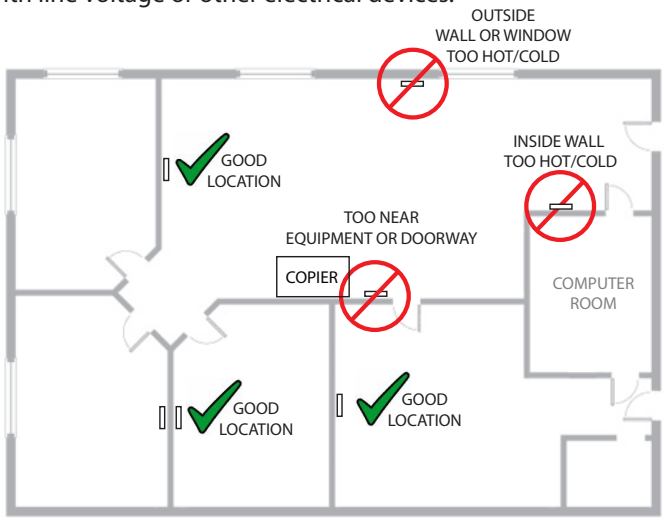
Accessories***
Blank = No Accessories
C = 1k Ω SP Slider
F = 10k Ω SP Slider
E = 910 Ω off set resistor
S= Slider override PB
O = Thermistor Override PB
B = Override PB over comms
U = User PB
T = 200-900Ω SP Slider

PIR Sensor
P = PIR Sensing

*PM Available on AQ2W-B versions only.
**Choose transmitter option for temperature display or BACnet/Modbus temp readings. Thermistor versions will be equipped with an isolated resistive thermistor circuit, so cannot be read on the display or over BACnet/Modbus.
***Slider and pushbutton options not available with PM sensor. Call for additional slider, off set, and override options.
****CO sensor only available with display option for calibration purposes.

INSTALLATION

1. IMPORTANT! Locate the device in an area away from ventilation sources and heat generating equipment and appliances. One sensor per 5000-7500 square feet is normally required. The device should be mounted at light switch height in a vertical orientation. Use insulating material behind the device to ensure reading accuracy.
NOTE: Do not install the device in multi-gang electrical boxes with line voltage or other electrical devices.



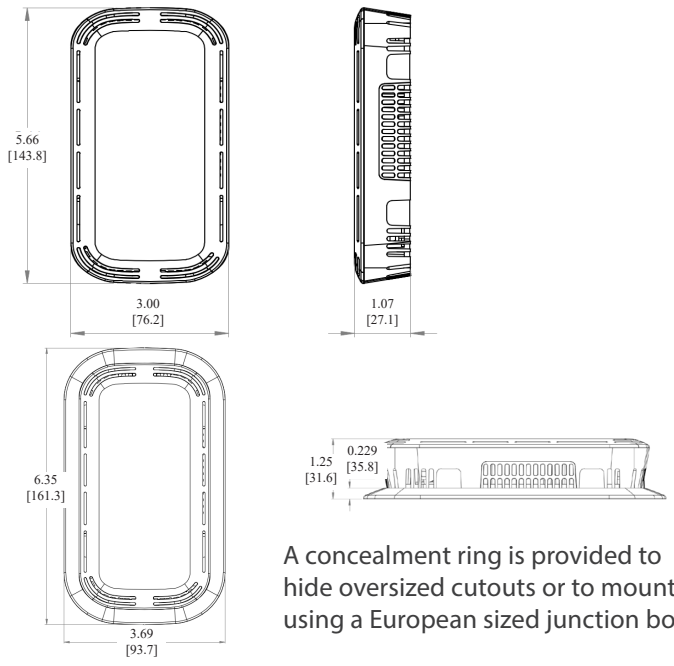
2. Wire according to application. See "Setup- Wiring" section for details.

3. Install backplate to wall or junction-box using screws provided. If using optional trim ring, click the TotalSense into it and secure using 1 screw. Then, mount it to wall or junction box.

4. Apply power.

5. To configure communications or analog voltage scaling, configure DIP switches according to "Setup - Analog" or "setup - Communications" sections.
To configure the device using the color OLED screen, reference the "Setup - Display" section.

DIMENSIONS

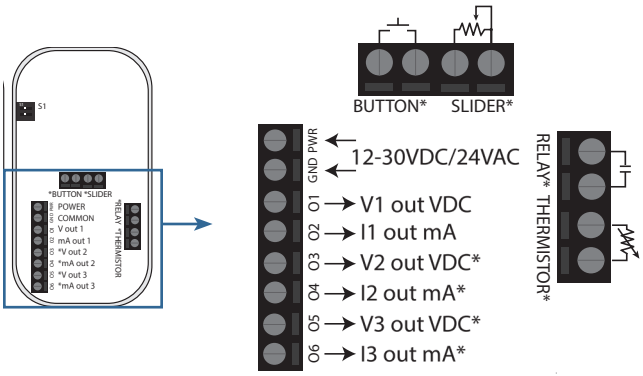


A concealment ring is provided to hide oversized cutouts or to mount using a European sized junction box.

SETUP - WIRING

The following diagrams show terminal locations for each version of the TotalSense. The number of options selected will determine which of the terminals are included on each device.

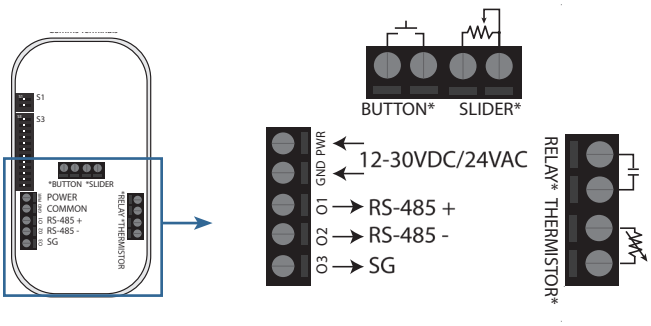
Analog Wiring



*These terminals may not be populated depending on which model is ordered.

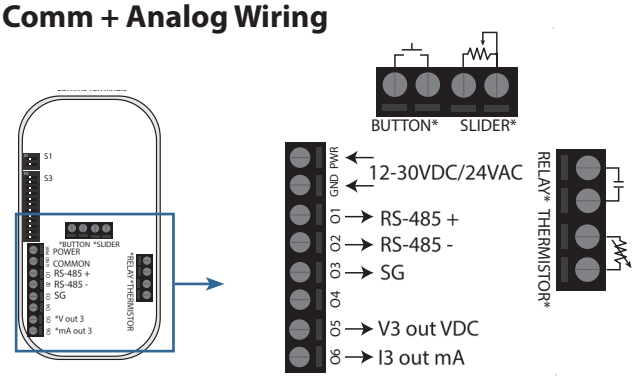
Outputs 1(V1,I1), 2(V2,I2) and 3(V3,I3), will be auto populated in order of the AQ2W ordering matrix:
CO2, RH, Temp, VOC, PM, Slider, CO, O3

Communications Wiring



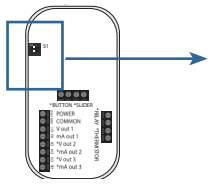
NOTE: A 120 Ω termination resistance may be added in parallel with the RS-485 +/- by moving the very top DIP switch (DIP 1) to the left position. See "DIP Configuration" section for more information.

Comm + Analog Wiring



SETUP - ANALOG

Switch 1 with two DIP switches will be provided with every device and Switch 2 with an additional 12 DIP switches will be provided with communications devices. The following diagram shows how each setting can be configured using the provided switches.

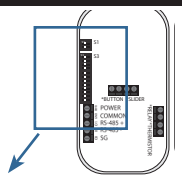


Analog DIP Settings

DIP	Left	Right
1	0-5V	0-10V
2	N/A	N/A

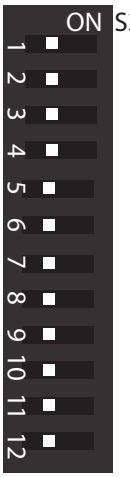
For analog voltage output, select either 0-5V (left) or 0-10V (right) outputs. These analog ranges can be adjusted using the color OLED display. **Adjustments made using the OLED display will override this DIP switch setting.**

SETUP - COMMUNICATIONS



Comms DIP Settings

DIP	Left	Right
1	N/A	Termination Resistor
2	Modbus	BACnet



DIP	Function	Left	Right
1	MAC6	0 (off)	1 (on)
2	MAC5	0	1
3	MAC4	0	1
4	MAC3	0	1
5	MAC2	0	1
6	MAC1	0	1
7	MAC0	0	1
8	BAUD2	0	1
9	BAUD1	0	1
10	BAUD0	0	1
11	D/P/S1	0	1
12	D/P/S0	0	1

DIP	Function
1-7	**MAC Address/ Modbus Address** 0-127 (binary)
8-10	**Baud Rate** 0(000)=9600 1(001)=19200 2(010)=38400 3(011)=57600 4(100)=76800 5(101)=115200
11-12	**Data/Parity/Stp** 0(00)=8N1 1(01)=8N2 2(10)=8O1 3(11)=8E1

DIP switches 1-7 can be arranged to set the MAC address (BACnet) or the Modbus address. Similarly, the baud rate can be set by DIP switches 8-10 and the data/parity/stop bit can be set by DIP switches 11 and 12.

Example:

1	MAC6	0	
2	MAC5	0	
3	MAC4		1
4	MAC3		1
5	MAC2	0	
6	MAC1		1
7	MAC0		1

DIP	Binary	MAC
1-7	0 0 1 1 0 1 1	27

Binary reads right to left, "MAC0" refers to the first bit in the binary string, from there the dip switches are set following the description ordering using the binary string for the desired setting.

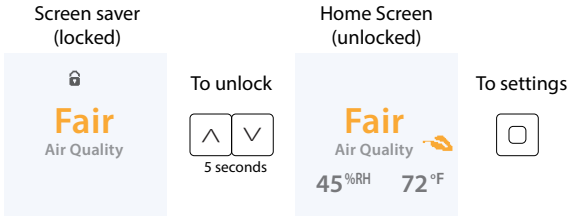
SETUP - DISPLAY

Example screen:

TotalSense devices ordered with color OLED display can be configured from the display or over communications (if applicable). The default screen layout will vary depending on which model is ordered. Each of the 5 sections can be customized. See "Display Navigation Guide" for more information.

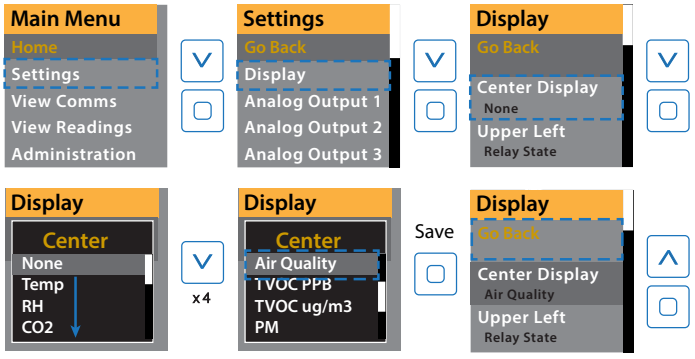
Screen Lock:

If the screen is locked, a lock icon will show when any button is pressed. To unlock, hold the UP and DOWN arrows for 5 seconds. To disable the lock feature, see "Display Navigation Guide".



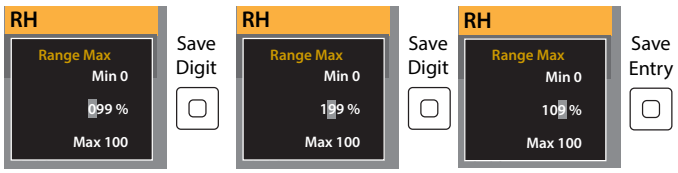
Changing Settings:

To change any setting, press ENTER to see the setup menu and navigate to the desired parameter type and press ENTER again to choose. The example below shows how to adjust the center reading on the display. The dashed blue line shows the desired selections and the blue buttons show how to navigate.



Changing a value:

To adjust a numerical setting, set each digit individually and press ENTER to move the cursor from left to right. When all digits are set, the value will be saved when ENTER is pressed again.



FEATURE - AIR QUALITY

If Air Quality is selected to be displayed or if the Air quality Ring option is selected, the device will monitor each sensor present and will display accordingly.

The average air quality is calculated as follows:

1.Each sensor's current reading is rated according to the below thresholds and given an air quality index (AQI). For each sensor, a good rating is given an AQI of 90, fair is given an AQI of 60 and poor is given an AQI of 0.

2.The average air quality is calculated and a total air quality rating is assigned based on the following thresholds. These thresholds can be adjusted using communications or in the "Air Quality Settings" menu from the display.

a. Good ≥ 75

b. 55 < Fair < 75

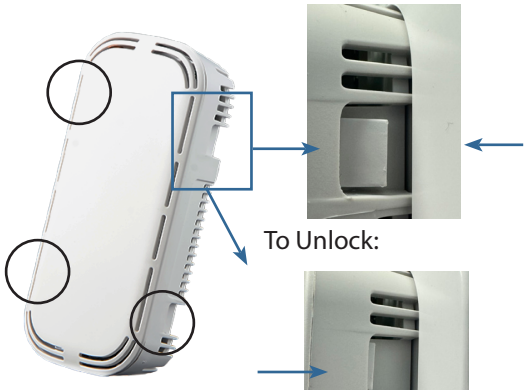
c. Poor ≤ 55

	GOOD (AQI 90)	FAIR (AQI 60)	POOR (AQI 0)
PM2.5	<35 ug/m^3	35-55 ug/m^3	>55ug/m^3
TVOC	<1000 ug/m^3	1000-3000 ug/m^3	>3000 ug/m^3
CO2	<1200 PPM	1200-2000 PPM	>2000 PPM
Temp	64-79°F	<64°F, >79°F	
RH	30-60%	<30%, >60%	<10%, >90%
CO	<25PPM	25-100PPM	>100PPM

FEATURE - LID LOCKS

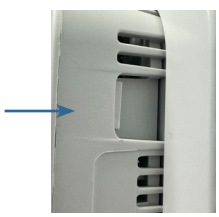
All TotalSense models come standard with locks to keep the lid from being removed, to stop unwanted tampering. There is a Lock located at all 4 lid snaps.

To Lock:



Once lid had been installed, while applying pressure to keep lid in place, push in tabs on the back of the device. Locks will *Click* into place.

To Unlock:



Place a small screwdriver in designated vent, push in to release the lock.

FEATURE - AIR QUALITY RING

An Air Quality (AQ) Ring may be selected in place of a display. The AQ ring will glow green, yellow, or red according to the detected levels. See "Feature - Air Quality" section for thresholds.

The AQ Ring may be disabled or brightness may be adjusted if the communications model is selected. Additionally, it may be set to only display yellow or red when air quality has degraded to fair or poor levels. See TotalSense "BACnet/Modbus User Guide" for more information.

AQ Ring will turn on and off at a 5 second interval if a sensing error occurs. See "Troubleshooting" section for information.

FEATURE - SETPOINT RELAY

All TotalSense models come standard with a setpoint relay except those ordered with a PM sensor.

The relay source determines which reading or status will activate the relay. This can be set or adjusted using the display or communications. See 'Display Navigation Guide' or the applicable protocol guide for details.

Each source selection has a range listed below. To set turn-on and turn-off thresholds, a percentage of this range can be entered into each corresponding parameter. On display versions, the calculated value will show as the percentage is adjusted.

Each time a new source is selected, a default relay threshold will be set based on which technology is chosen. These auto-set values are listed in the table below.

Source Selection	Range	Default Turn-on Threshold	Calculated Turn-on value	Default Turn-off Threshold	Calculated Turn-off value
CO2	0-10,000 PPM	8.0%	800 PPM	7.0%	700 PPM
RH	0-100% RH	60%	60% RH	55%	55% RH
Temp*	-40 - 122 °F	74%	80°F	73%	78°F
TVOC	0-10000 µg/m^3	4%	400 µg/m^3	3.5%	350 µg/m^3
CO	0-200 PPM	50%	100 PPM	40%	80 PPM
Ozone	0-500 PPB	20%	100 PPB		80 PPB

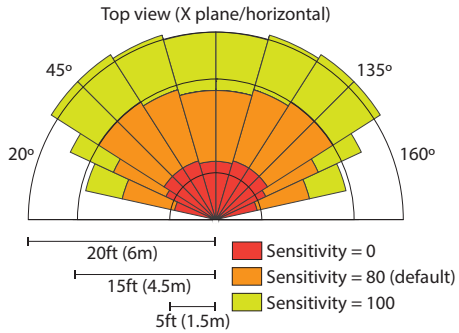
*To calculate threshold % for a given temperature, use the following equation:

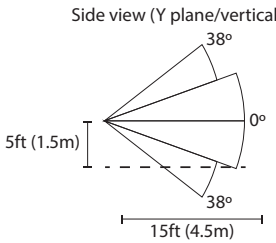
% Threshold = (T+40)/162*100

FEATURE - PIR OCCUPANCY

If PIR option is selected, the PIR (Passive Infrared) sensor will trigger anytime it detects motion. If used to activate the relay or as a communications data point, an off-delay can be programmed using the display or through communications.

The below shows the distance at which the sensor will trigger a motion event based on its adjustable sensitivity rating. A motion event, for the purpose of this graph, is considered the movement of a person or large object.





PIR can be used to automaticly wake the screen when motion is detected in the room.

Feature - Capacitive Touch

Capacitive Touch systems work by sensing the difference of electrical properties. This is different from other touch features that use pressure to detect button presses.
If you are experiencing Cap-touch issues ensure that your system is properly grounded. If the power supply has a floating ground it can cause the device to experience false button presses.

Feature - Override PB over Comms

The override Push button over Comms does not operate using COV.
By defult the Override point will be set high (value of 1) for 10 seconds when the button is pressed. This can be read on point AI35 for BACnet and register 37 for Modbus.

Feature - PID Controls

PID Controls or Proportional-Integral-Derivative Controllers is a Feedback biased modular control system. A PID system will constantly calculate the error value based on current readings and desired set-point.

P (Proportional): The Proportional Gain will change the system sensitivity, it will change the analog output depending on the difference between the feedback value and Set-point. If this gain is set too high, the system becomes unstable and PID will create a frequency output oscillation.

I (Integral): The Integral Gain will increase the analog output-with respect to time. The longer it takes to bring the error to zero the more the Integral gain will increase to account for that. If Integral and Proportional Gain values are set too high, the system can overshoot the set point and create an oscillation (unstable control)

D (Derivative): The Derivative Gain is different that the Proportional and Integral Gains because it does not take in account for the error. Meaning this can not bring the error to zero. The purpose of the Derivative is to smooth the rate that the error goes to zero to try and reduce overshoot. Most HVAC applications will not require the Derivative Gain to be used.

Where T is the temperature in °F

TVOC OPERATION

Training Mode
The TVOC sensor has artificial intelligence (AI) that allows it to sense and understand different environments. This AI will take 48 hours to acclimate to an environment once installed. The 48 hours will happen after every device reboot.

During this time, the sensor will go into "training mode" and will continue to display and output a TVOC value. the staus of the TVOC can be found in the device settings menu.

Manual Calibration
No manual field calibration is necessary. To maintain accuracy, the TVOC sensor will be required to be exposed to fresh air at least once every 2 days. This can be accomplished by increasing airflow in an area or by opening a window.

Scaling:
Senva's TVOC sensor uses an Ethanol reading to determine a raw TVOC value. Additionally, conversion from µg/m^3 uses the molecular weight of Ethanol. To scale based on a different gas baseline, user may enter a scaling factor in TVOC Settings on the display or using communications.

SENVA TECHNICAL SUPPORT

Need further assistance? Call our toll-free number for live technical support: (866) 660-8864 or feel free to email us at support@senvainc.com

ADVANCED SETUP

Display Navigation Guide

BACnet Protocol Guide

Modbus Protocol Guide

TROUBLESHOOTING

Symptom	Solution
Alarm Icon on home screen or blinking AQ Ring	The device has experienced an error with one of the sensors. Navigate to "Advanced Settings" > "Diagnostics" screen to view more information. All zeros will be displayed if no error is present. See "Display Navigation Guide", or the applicable communications guide or consult factory for troubleshooting help or replacement element.
No output	Check wiring. Ensure power supply meets requirements.
Reading error	Verify control panel software is configured for correct output scaling.
	Verify accuracy of test instrument. Observe installation and calibration guidelines.
	Verify unit is located away from sources of hot/cold.
	Verify sensing element is inserted properly.
	Perform calibration only if necessary.

CO_2 CALIBRATION

Automatic Calibration feature:
The CO_2 sensor will automatically baseline CO_2 levels and gradually make adjustments to compensate for sensor drift due to long-term aging of the IR light source. In applications where CO_2 levels are continuously elevated, or spaces are occupied day and night, it is recommended to use our dual channel CO_2 sensor with automatic calibration disabled.

No field calibration is necessary or recommended. However, to facilitate compliance with job requirements and commissioning procedures, provisions for field calibration are provided:

1. Locate calibration instrument and sensor in close proximity to each other in a controlled environment free of drafts, people, and equipment to reduce influence on CO_2 and temperature.
2. Compare output of sensor to calibration instrument, and note difference. (In 0-10V mode/2000ppm range, 1V =200ppm)
3. Refer to the "Setup-Display" section to adjust offset value for CO_2 as needed. Factory calibration may be restored by setting offset back to 0.

In extreme cases where the sensor module has been damaged, a new module may be installed in the field. Consult factory for replacement module and instructions.

SPECIFICATIONS

Power Supply	Without Display	16-30VDC/24VAC(1), 3.5W nominal, 4W max.
	With LED Ring or Display	16-30 VDC/24VAC(1), 4.3W nominal, 5W max
Interface	Color OLED (optional)	1.5" Organic LED Display, 128x128 PX, color
	Air Quality Ring	Color changing (red/yellow/green) LED ring
Analog Outputs (Analog version only)	Quantity	Up to 3 outputs
	Source	CO_2, RH%, Temp, Temp slider, TVOC (selectable)
	Scale	0-5V, 0-10V, 4-20mA (switch selectable, programmable per output)
Protocol Output (Communications version only)	Protocol	BACnet MS/TP or Modbus RTU
	Connection	3-wire RS-485, with isolated ground
	Data Rate	9600, 19200, 38400, 57600, 76800, 115200 (switch selectable)
	Address Range	0-127
Relay Set-point (standard except for PM models)	Type	Solid-state output, 1A @ 30VAC/DC, N.O.
	Source	CO_2 setpoint, RH setpoint, Temp setpoint, TVOC setpoint, PIR motion, air quality, off (selectable)
	Polarity	NO/NC (selectable)

SPECIFICATIONS Cont.

CO_2 (optional)	Type	Non-dispersive Infrared (NDIR)
	Accuracy	±(30ppm + 3% of reading) (400-2000ppm), -10-50°C, 0-85%RH ±(50ppm+ 5% of reading) (2000-5000ppm), -10-50°C, 0-85%RH >5000ppm consult factory
	Resolution	1 ppm
	Range	0-2000 PPM (Default) (Programmable up to 10,000 PPM)
	Response time	90 seconds to 90% reading
	Sample rate	1s
	Temp and Pressure	Compensated. Barometric pressure also readable over communications
Relative Humidity (optional)	Type	Digital CMOS
	Accuracy[2]	±2% over 0 to 80%RH range
	Resolution	0.05%RH
	Response time [3]	30s
	Sample rate	3s
	Operating range	0 to 100%RH (non-condensing)
	Operating conditions [4]	-4 to 140°F (-20 to 60° C) @ RH>90%; -4 to 176°F @ RH=50%
Temperature Transmitter (optional)	Type	Silicon Band-gap
	Nominal Accuracy	±0.3° C (operating range)
	Maximum Accuracy [2]	±0.5° C (at 25° C), ±1.0° C
	Resolution	0.01° C
	Response time	30s
	Sample rate	3s
TVOC (optional)	Type	MOS
	Gas	Total VOC
	Range	0-32,000 µg/m³
	Response Time	<10s
	Output	0-2000 µg/m³ (default) Programmable up to 32,000 µg/m³
PMx (optional) CLASS 1 LASER PRODUCT	Type	Optical
	Size Range	PM1.0, PM2.5, PM4.0, PM10.0
	Scale	0-1000 µg/m³
	Lower detection limit	0.3 µm
	Precision	±10 µg/m³ (0-100µg/m³); ±10% (100-1000 µg/m³)
Carbon Monoxide (optional)	Type	Electrochemical
	Detection Range	0-200 PPM
	Accuracy	±5% FullScale @20° C
	Resolution	1 PPM
	Response Time	<30 seconds to 90%
	Sensor Life	5 years
	Certifications	UL2034 Recognized Component
PIR (optional)	Type	Passive Infrared
	Axis X field of view	140°, 15 ft (4.5m)
	Axis Y field of view	76°, 15 ft (4.5m)
Ambient Light	Type	Phototransistor
	Scale	0-100 fc (lm/ft²), readable over communications
Operating Environment	Temperature	-4 to 122° F (-20 to 50° C). Devices including PM or CO sensors rated (-10 to 50° C) CO sensors can intermittently operate down to –20°C.
	Humidity	0-95% non-condensing
Enclosure	Material	ABS Plastic
	Dimensions	5.67"h x 3.00"w x 1.07"d
Compliance	Agency	CE, RoHS
	Accreditations	RESET Air Accredited Monitor
	Standards	Facilitates compliance with ASHRAE 62.1 standard for air quality Contributes toward satisfying Feature A08 and T06 under WELL Building Standard®

(1) One side of transformer, secondary is connected to signal common. Dedicated transformer is recommended.

(2) Models with PM sensor included achieve ±5% accuracy over 0 to 80%RH range and an additional temperature shift of up +0.5° C

(3) Time for reaching 63% of reading at 25° C and 1 m/s airflow

(4) Long term exposures to conditions outside normal range at high humidity may temporarily offset the RH reading (+3%RH after 60 hours.)

(5) Wiring with silicone or other high VOC insulation will affect TVOC readings

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