INSTALLATION INSTRUCTIONS

TotalSense™ Series

Duct and Outdoor 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). The product can be ordered as a stand-alone CO_2, RH, Temp, TVOC, PM sensor as well as almost any combination of sensors. All models come standard with programmable set-point relay 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.

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
D = Duct
O = Outdoor

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

*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.
**CO sensor only available with display option for calibration purposes.

INSTALLATION

AQD (Duct) Installation

1. Drill a 3/4" hole in duct. Install sensor using gasket and screws provided. The pickup tube will ensure adequate air flow regardless of air flow direction.

2. Mount unit to duct with supplied screws. Continue to step 3 under general installation.

AQO (Outdoor) Installation

1. Select an outdoor location under an eave on north side of building away from direct sunlight and rain exposure.

2. Mount product to building with supplied screws. Continue to step 3 under general installation.

General (both) Installation

3. If installing with a conduit adapter, remove and replace the factory-installed cable gland.

4. Wire analog (or RS485 for BACnet version) outputs as needed.

5. Apply power to sensor.

6. Tighten cable gland firmly around wires. If installing with a conduit adapter, seal wire entry to prevent conduit air from affecting sensor readings or operation.

7. Close lid and tighten screw. Cover must be securely installed to prevent moisture from entering enclosure.

ADVANCED SETUP

Display Navigation Guide

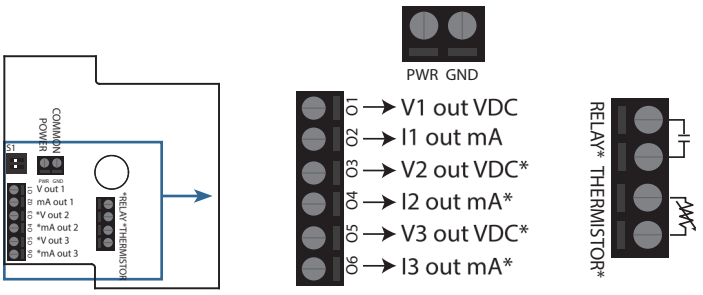
BACnet Protocol Guide

Modbus Protocol Guide

SETUP - WIRING

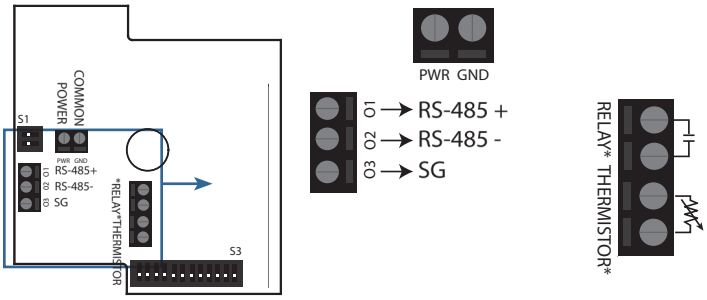
The following diagrams show terminal locations for each version of the TotalSense. The number of options selected will determine which of the terminals are included on each device. For example, if only one sensor is chosen, only 1 pair of analog terminals will be present. Each device will have 4-8 terminals on the left side, 0-4 on the top, and 0-4 on the right side.

Analog Wiring



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

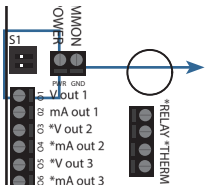
Communications Wiring



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.

SETUP - ANALOG

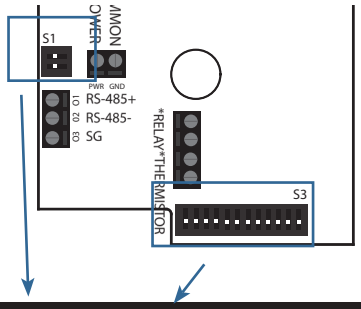
Switch 1 with two DIP switches will be provided with every device and Switch 2 with an additional 12 DIP switches will be provided with communications devices. The following diagram shows how each setting can be configured using the provided switches.



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

S1

S3

DIP	Left	Right
1	No Termination	Termination Resistor
2	Modbus	BACnet

DIP	Function	DOWN	UP
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 in 127 binary configurations 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:

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

3	**MAC4**		**1**
4	**MAC3**		**1**
5	**MAC2**	**0**	
6	**MAC1**		**1**
7	**MAC0**		**1**

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. In this example the full binary string for 27 is 0011011, switch "MAC5" and "MAC6" would be turned off.

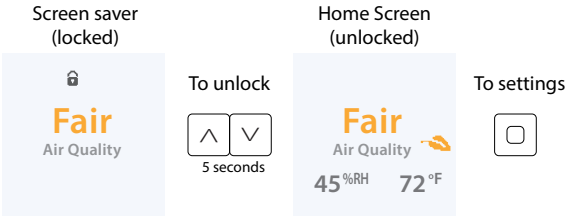
SETUP - DISPLAY

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.

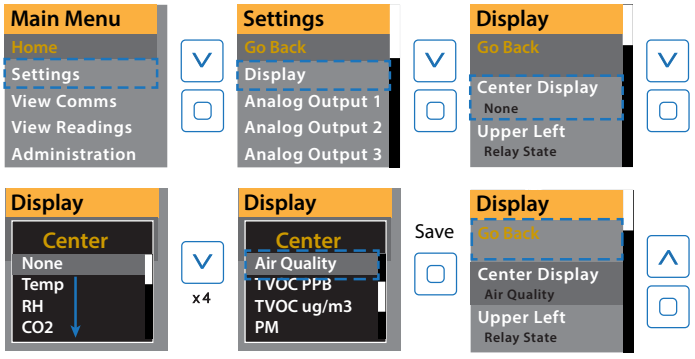
Screen Lock:

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".



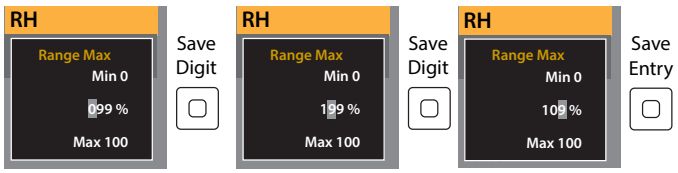
Changing Settings:

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 the device will monitor each CO_2, VOC, PM, RH, and Temp 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 100, 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 100)	POOR (AQI 0)
PM2.5	35 ug/m^3	55ug/m^3
TVOC	1000 ug/m^3	3000 ug/m^3
CO2	800 PPM	2000 PPM
Temp	64-79°F	
RH	30-60%	<10%, >90%

*The table above shows the defaults for the GOOD-POOR threshold, these defaults can be changed to better customize our device for your solution.

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.

Senva CO_2 sensors are factory calibrated to controlled test gases. 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.

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 ppb to µg/m^3 uses the molecular weight of Ethanol. To make conversion based on a different gas baseline, user may enter a scaling factor in TVOC Settings on the display or using communications.

FEATURE - SETPOINT RELAY

All TotalSense Duct and Outdoor models come standard with a setpoint relay.

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	0-1000 µg/m^3	3.5%	35 µg/m^3	3%	30 µg/m^3
PM	0-32000 µg/m^3	1.25%	400 µg/m^3	1.09%	348.8 µg/m^3

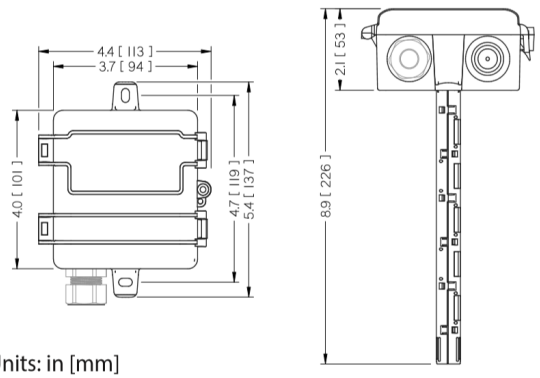
*To calculate threshold % for a given temperature, use the following equation:

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

Where T is the temperature in °F

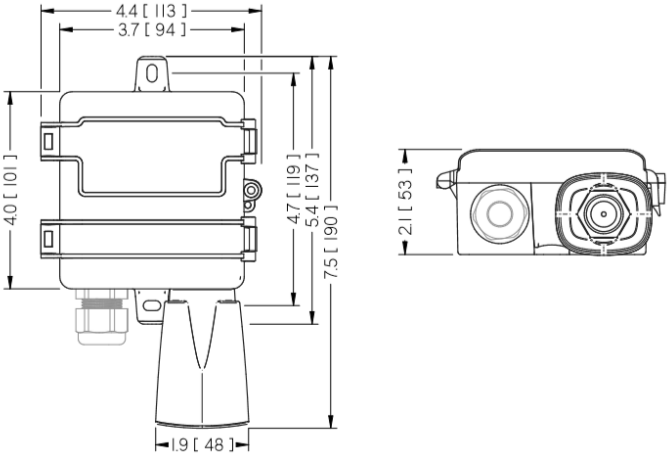
DIMENSIONS

AQ2D Dimensions



Units: in [mm]

AQ2O Dimensions



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

TROUBLESHOOTING

Symptom	Solution
Alarm Icon on home screen	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.

SPECIFICATIONS

Power Supply	All Models	16-30VDC/24VAC(1), 3.5W nominal, 4W max.
Analog Outputs (Analog version only)	Quantity	Up to 3 outputs
	Source	CO_2, RH%, Temp, PM, 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	Type	Solid-state output, 1A @ 30VAC/DC, N.O.
	Source	CO_2 setpoint, RH setpoint, Temp setpoint, TVOC setpoint, air quality, off (selectable)
	Polarity	NO/NC (selectable)

SPECIFICATIONS

CO_2 (optional)	Type	Non-dispersive Infrared (NDIR)
	Accuracy (Standard)	±(30ppm + 3% of reading) (400-2000ppm), -10-50ºC, 0-85%RH ±(50ppm+ 5% of reading) (2000-5000ppm), -10-50ºC, 0-85%RH >5000ppm consult factory
	Accuracy (Dual)	±(30ppm+3% of reading) (0-2000ppm), @ 0-50C ±(50ppm+3% of reading) (2000-5000ppm), @ -10-50C ±(100ppm+10% of reading) (5000-10000ppm), @ 0-50C
	Drift with ABC disabled (Standard)	35ppm/month
	Drift with ABC disabled (Dual Channel)	5ppm/month
	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]	41 to 140° F (5 to 60° C) @ 20% to 80% RH
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	0-10,000 µg/m^3
	Response Time	<10s
	Output	0-2000 µg/m^3 (default) Programmable up to 10,000 µg/m^3
PMx (optional) CLASS 1 LASER PRODUCT	Type	Optical
	Size Range	PM1.0, PM2.5, PM4.0, PM10.0
	Scale	0-1000 µg/m^3
	Lower detection limit	0.3 µm
	Precision	±10 µg/m^3 (0-100µg/m^3); ±10% (100-1000 µg/m^3)
Carbon Monoxide (optional)	Type	Electrochemical
	Detection Range	0-200 PPM
	Accuracy	±5% FullScale @20° C
	Resolution	1 PPM
	Responce Time	<30 seconds to 90%
	Sensor Life	5 years
	Certications	UL2034 Recognized Component
Ozone (optional)	Type	PMOS
	Ozone Detection Range	20-500 ppb
	Accuracy	±15% of fs @ 20° C
Operating Environment	Temperature	-4 to 122ºF (-20 to 50ºC)
	Humidity	0-95% non-condensing
Enclosure	Material	ABS Plastic
	Dimensions	4.0"h x 4.4"w x 2.1"d (AQD: +6.8" probe) (AQO: +2.8" solar shield)
Compliance	Agency	CE, RoHS

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

(2) Models with PM sensor included achieve ±3% 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.)

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