

**Identification and Overview**

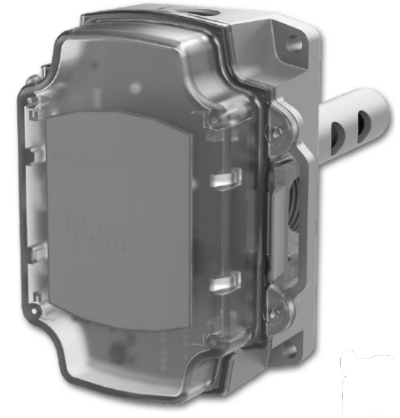
**Particulate Sensor, Duct – Air Quality**

- Field Selectable Particulate Size of PM1.0, PM2.5 and PM10
- Field Selectable Outputs of 0 to 5V, 0 to 10V and 4 to 20mA
- Laser-based, light scattering particle sensing with 10 year expected lifetime.

The BBox Duct Particulate Sensor is an accurate and reliable way of continuously monitoring the concentration of particles in a duct. The duct unit samples duct air using an aspiration tube.

Laser-based sensors provide the highest accuracy for commercial applications and will measure particle concentrations from 0 to 1,000 µg/m<sup>3</sup>.

**Part #: N1-PM-D-BB-A**



**Specifications**

**Power: (Half-wave rectified)**

- 7 to 40 VDC (4 to 20mA Output)
- 7 to 40 VDC or 12 to 28 VAC (0 to 5 VDC Output)
- 15 to 40 VDC or 15 to 28 VAC (0 to 10 VDC Output)
- 75 mA Max @ 24 VDC • 3 VA Max @ 24 VAC

**Load Resistance:** VDC Output 4K Ohms Min

**Sensing Element:** Laser-based, Light Scattering Sensor Element Life: 10 Years Typical

**Concentration Range:** 0 to 1,000 µg/m<sup>3</sup>

**Accuracy at 77°F ±9°F (25°C ±5°C):**

	0 to 100 µg/m <sup>3</sup>	100 to 1,000 µg/m <sup>3</sup>
PM1.0	±25 µg/m <sup>3</sup>	±25% of reading
PM2.5	±15 µg/m <sup>3</sup>	±15% of reading
PM10	±25 µg/m <sup>3</sup>	±25% of reading

**Response Time:** <6 Seconds

**Wiring:** 3 Wires, 16 to 22 AWG

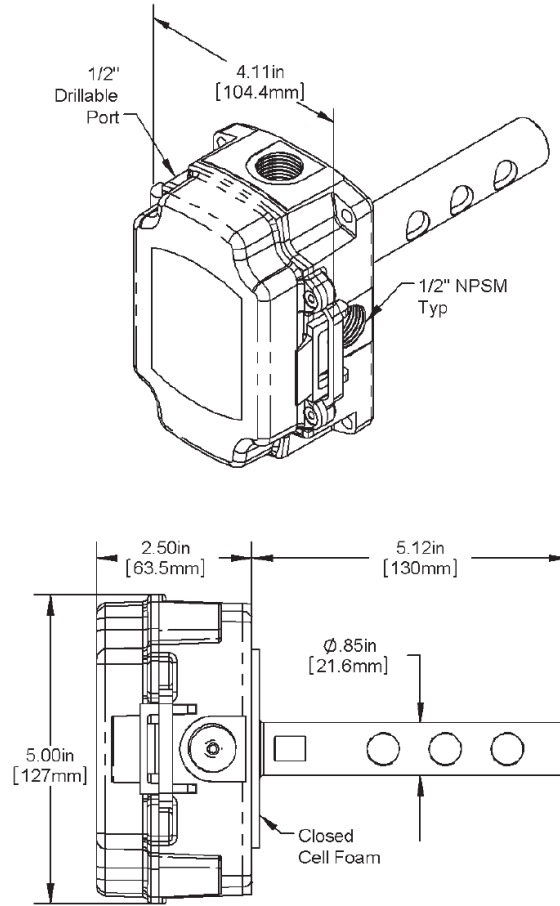
**Environmental Operating Range:**

- 4 to 158°F (-20 to 70°C)
- 0 to 95%RH Non-condensing

**Enclosure Material:**

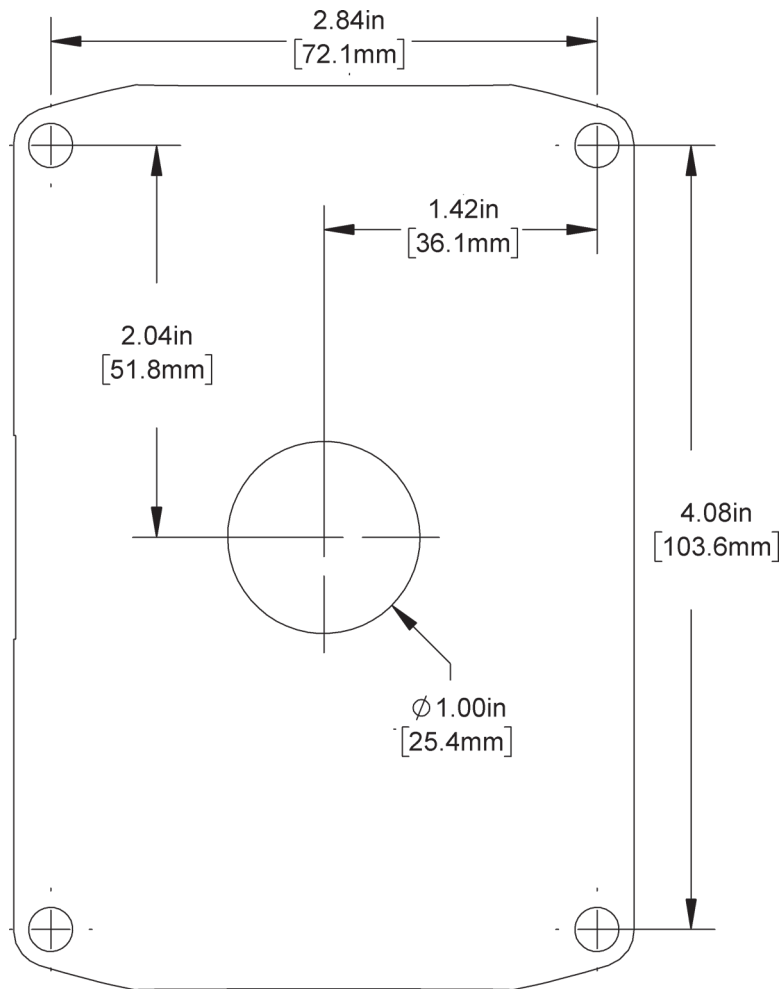
- UV-resistant Polycarbonate, UL94 V-0
- Agency: CE EN 61326-1:2013 EMC, UL94 V-0, RoHS

**Dimensional Drawing**



## Mounting

### Mounting Template – Actual Size



## Mounting

1. We recommend placing the sensor in the middle of the duct wall, away from stratified air, to achieve the best reading. The unit should also be a minimum of 3 duct diameters from an elbow, damper or other duct restriction.
2. Drill a 1" hole for the aspiration probe. Position the box so that airflow is directly into the holes on one side of the aspiration probe. There are no upstream or downstream holes, the air direction is not important.
3. Mount the enclosure to the duct using #10 screws (provided) through a minimum of two of the mounting feet on opposite corners. A 1/8" pilot screw hole in the duct makes mounting easier. Use the enclosure mounting feet to mark the pilot-hole locations.
4. Snug up the screws so that the foam backing is depressed to prevent air leakage but do not over-tighten or strip the threads.

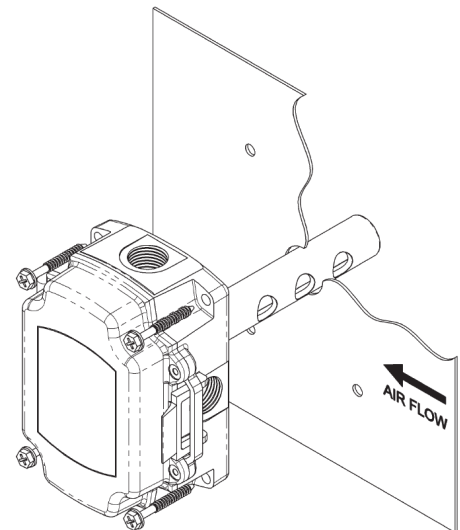



Figure 1: Duct unit mounting


#48171 – 9/7/23


5. Use the provided #6 screws to secure the cover for IP66 rating.
6. We recommend sealing the conduit opening with fiberglass insulation.

	<b>Tip</b>	Air needs to be moving towards holes in aspiration tube for optimal results.
---	------------	--

**Horizontal Mounting:** Vertical mounting orientation shown here. For horizontal mounting, the aspiration tube can be twisted one-quarter turn counterclockwise from its snug position so that the air flow is into the holes in the aspiration tube. Do not twist farther than one-quarter turn.

**Termination**

	<b>Caution</b>	<ul style="list-style-type: none"><li>• Wire the product with power disconnected. Proper supply voltage, polarity, and wiring connections are important to a successful installation. Not observing these recommendations may damage the product and will void the warranty.</li><li>• All wiring must comply with the National Electric Code (NEC) and local codes.</li><li>• Do NOT run this device’s wiring in the same conduit as AC power wiring of NEC class 1, NEC class 2, NEC class 3 or with wiring used to supply highly inductive loads such as motors, contactors and relays. Tests show that fluctuating and inaccurate signal levels are possible when AC power wiring is present in the same conduit as the signal lines. If you are experiencing any of these difficulties, please contact your representative.</li></ul>
---	----------------	--

	<b>Tip</b>	We recommend using twisted pair of at least 22AWG for all wire connections. Larger gauge wire may be required for long runs.
---	------------	--

Terminal	Function
<b>V+</b>	From power supply, see Specifications for requirements.
<b>GND</b>	To controller Ground [GND or Common]
<b>OUT</b>	Voltage and mA Outputs, Particulate Signal, Referenced to GND

Note: Terminal block is pluggable

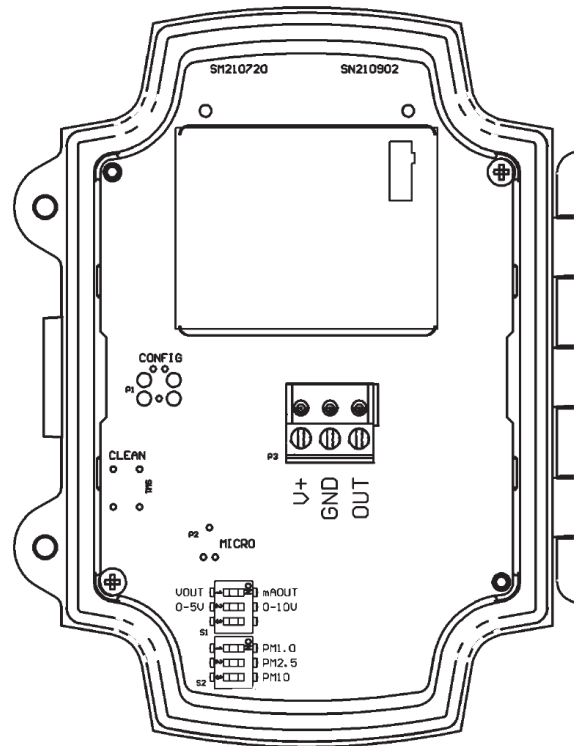


Figure 2: Circuit Board

**Switch S1 & S2 Setup: Outputs & Ranges**

DIP Switch S1:	DIP Switch S2:	
<ol style="list-style-type: none"> <li>Select the Output VOUT = Voltage mAOUT = 3-Wire Transmitter</li> <li>Select the voltage range for VOUT. 0-5V = 0 to 5V Output 0-10V = 0 to 10V Output If "mAOUT" is selected in Step 1, this setting does not matter.</li> <li>Switch #3 is not used.</li> </ol>	<p>Select the particulate size by moving the switch to "ON".</p> <p>PM1.0 = <math>\leq 1.0 \mu\text{m}</math> diameter PM2.5 = <math>\leq 2.5 \mu\text{m}</math> diameter PM10 = <math>\leq 10 \mu\text{m}</math> diameter</p> <p>Only 1 of the 3 switches may be set to "ON". If none of the switches or more than 1 switch is set to "ON", the sensor's output will alternate between 50% and 100% of the output setting to indicate the error.</p>	

Figure 3: DIP Switches S1 and S2

**Output Validation**

1. A simple bump test is performed to validate that the sensor responds to elevated particulate levels.
2. “Smoke in a can” type products, which are often used to test smoke detectors, are a good option for testing all 3 particulate sizes. Cigarette smoke and incense smoke also work, but the particulate size may be too large to be measured on the PM1.0 setting.
3. Open the enclosure cover and spray the smoke in a can at the sensor for 1 to 2 seconds to flood it with smoke. After several seconds, the sensor’s output will increase. It may take several minutes for the sensor’s output to decrease to normal levels as the smoke dissipates.

**Diagnostics**

For the sensor to work correctly, the wiring entrance must remain air tight. If the Particulate Duct Sensor is mounted to a hollow wall and wired through its back, or wired with conduit, it is possible that a draft of clean air may fill the enclosure through the wiring opening. This draft may prevent the unit from measuring particulates. We recommend either a liquid-tight fitting or plugging the conduit at the enclosure.

**Liquid-Tight Fitting** – Liquid-Tight Fitting (BA/LTF) allows wire cables of 0.1 to 0.3 inch outside diameter to enter the box. Tightening the collar onto the wire cable keeps the wiring entrance air tight.

**Conduit** – Included with the Particulate Duct Sensor, is a foam plug to seal the ½ inch EMT. Place the wires into the plug as shown and then insert the plug into the conduit sealing the conduit.

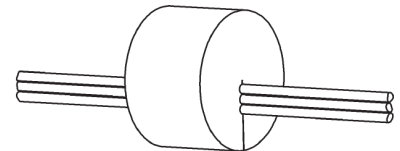





Figure 4: Wires Through Foam Plug

**Diagnostics**

Possible Problems:	Possible Solutions:
General troubleshooting	<ul style="list-style-type: none"> <li>• Determine that the input is set up correctly in the controller and BAS software.</li> <li>• Check wiring at the sensor and controller for proper connections.</li> <li>• Check for corrosion at either the controller or the sensor. Clean off the corrosion, re-strip the interconnecting wire and reapply the connection. In extreme cases, replace the controller, interconnecting wire and/or sensor.</li> <li>• Check the wiring between the sensor and controller. Label the terminals at the sensor end and the controller end. Disconnect the interconnecting wires from the controller and the sensor. With the wires disconnected, measure the resistance from wire-to-wire with a multimeter. The meter should read greater than 10 Meg-ohms, open or OL depending on the meter. Short the interconnecting wires together at one end. Go to the other end and measure the resistance from wire-to-wire with a multimeter. The meter should read less than 10 ohms with 22 gauge or larger wire a distance of 250 feet (76m) or less. If either test fails, replace the wire.</li> <li>• Check power supply/controller voltage supply</li> <li>• Disconnect sensor and check power wires for proper voltage.</li> </ul>
Incorrect particulate output	Check all BAS controller software parameters.
Output alternates between	Check DIP switch S2. Only one of the three S2 switches can be set to “ON”. 50% and 100% of setting.

**Appendix – Symbols Key**

 <b>Warning</b>	Potential for death, serious injury, or permanent damage to a system.
 <b>Caution</b>	Potential for injury, damage to a system, or system failure.
 <b>Tip</b>	Useful information not related to injury or system damage.