LS3 VOC Room Sensor

Installation and Operation Instructions

Product Identification

Humans exhale Volatile Organic Compounds (VOCs) as well as CO_2. The BAPI sensor is able to measure these VOCs, therefore it is as good an indicator of space occupancy as a CO_2 sensor.

The BAPI Sensor is different from other VOC sensors because it has been optimized for Demand Controlled Ventilation (DCV). Using a calibration algorithm, the sensor value is converted to an output with a high correlation to a CO_2 level. This lets you use ASHRAE's occupancy-based VRP schedule to ventilate. (More information on this correlated output is available on our website at www.bapihvac.com)

The sensor also picks up VOCs from other sources such as building materials, perfumes, colognes and furniture off-gassing. Using this sensor to ventilate is a way of achieving true indoor air quality and not just CO_2 dilution.

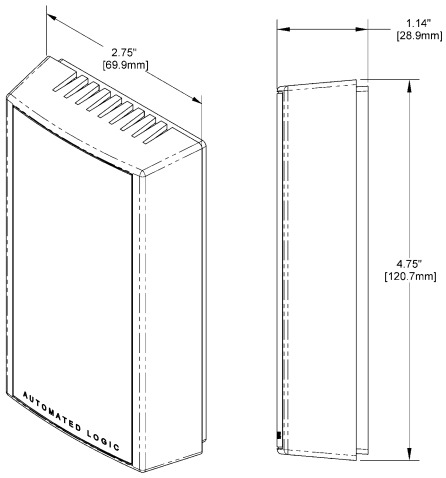

Figure 1: LS3 Room VOC Sensor

Specifications

Power:

19-32 VAC @ 1.9 VA Max, All Outputs
9-35 VDC @ 50 mA Max (9-15VDC recommended) for 0–5 VDC Outputs
15-35 VDC @ 50mA Max (15VDC recommended) for 0-10 VDC Outputs

Sensing Elements: Micro-machined Metal Oxide

Mounting: 2" x 4" J-Box or drywall mount - screws provided

VOC Detection Range: 0 - 2,000ppm CO_2 Equivalent, Analog Output

Response Time: Less Than 60 Seconds (after start-up)

Start-up Time: 15 minutes

Operating Environment:

32 - 122°F (0 - 50°C)
5 - 95%RH non-condensing

Analog Outputs: 0-5, or 0-10VDC >10KΩ impedance

Dimension: 4.75"H x 2.75"W x 1.14"D (120 x 69.9 x 28.9 mm)

Material: ABS Plastic, Material Rated UL94V-0

Certifications: RoHS

Warranty Period: Two years from manufacture date

Mounting

Mounting hardware is provided for both junction box and drywall installation (junction box installation shown).

Junction Box

1. Pull the wire through the wall and out of the junction box, leaving about six inches free.
2. Pull the wire through the hole in the base plate.
3. Secure the plate to the box using the #6-32 x 5/8 inch mounting screws provided.
4. Terminate the unit according to the guidelines in the **Termination** section. (page 3)
5. Mold the foam on the unit's base to the wire bundle to prevent drafts. (see note below)
6. Attach cover by latching it to the top of the base, rotating the cover down and snapping it into place.
7. Secure the cover by backing out the lock-down screw using a 1/16" Allen wrench until it is flush with the bottom of the cover.

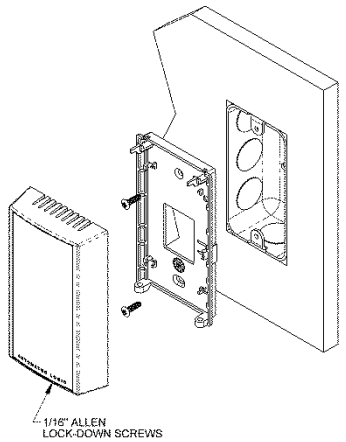

Fig 2: Mounting to a Junction Box

Specifications subject to change without notice.

Mounting Continued

Drywall Mounting

1. Place the base plate against the wall where you want to mount the sensor.
2. Mark out the two mounting holes and the area where the wires will come through the wall.
3. Drill two 3/16" holes in the center of each marked mounting hole, DO NOT punch the holes or the drywall anchors will not hold. Insert a drywall anchor into each hole.
4. Drill one 1/2" hole in the middle of the marked wiring area.
5. Pull the wire through the wall and out of the 1/2" hole, leaving about six inches free.
6. Pull the wire through the hole in the base plate.
7. Secure the base to the drywall anchors using the #6 x 1 inch mounting screws provided.
8. Terminate the unit according to the guidelines in the **Termination** section. (page 3)
9. Mold the foam on the unit's base to the wire bundle to prevent drafts. (see note below)
10. Attach cover by latching it to the top of the base, rotating the cover down and snapping it into place.
11. Secure the cover by backing out the lock-down screw using a 1/16" Allen wrench until it is flush with the bottom of the cover.

NOTE: *In any wall-mount application, the quality of the air within the wall cavity can cause erroneous readings. The mixing of room air and air from within the wall cavity can lead to condensation, erroneous readings and sensor failure. To prevent these conditions, BAPI recommends sealing the conduit leading to the junction box, filling the junction box with fiberglass insulation or sealing the wall cavity.*

Termination

BAPI recommends using twisted pair of at least 22AWG and sealant filled connectors for all wire connections. Larger gauge wire may be required for long runs. All wiring must comply with the National Electric Code (NEC) and local codes.

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. BAPI's 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 BAPI representative.

STOP BAPI recommends against wiring the sensor with power applied as accidental arcing may damage the product and void the warranty.

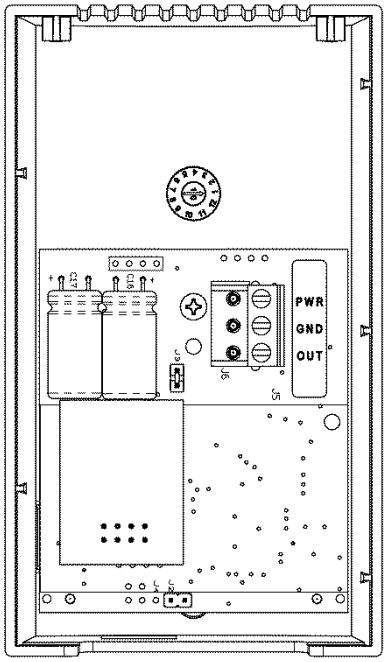

Figure 3: Circuit Board

Terminal	Function
PWR	Power, referenced to GND 19-32 VAC @ 1.5 VA Max For all outputs 9 - 35 VDC @ 50 mA Max (9 – 24VDC recommended) for 0 – 5 VDC Outputs 15 - 35 VDC @ 50mA Max (15 - 24VDC recommended) for 0 - 10 VDC Outputs
GND	To controller Ground [GND or Common]
OUT	Voltage Output, VOC Signal (0 to 2,000 ppm), referenced to GND

The VOC outputs may be field configured for 0 to 5 VDC or 0 to 10 VDC outputs at any time. Set the jumpers on J3 as shown in figures 4 and 5.

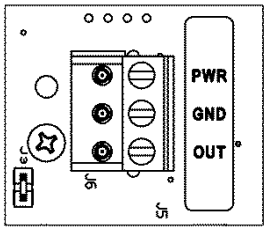

Figure 4: J3 set for 0 to 10 VDC output

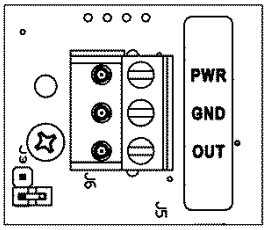

Figure 5: J3 set for 0 to 5 VDC output

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Sensor Start-up

At each power up, the sensor enters the start-up period for 15 minutes. The VOC output will follow the timing shown in figure 6.

During the start-up period an optional verification/commissioning test, described below, may be performed. This test is not mandatory, it is necessary only if building commissioning requires sensor verification or if verification of VOC output is required for later troubleshooting.

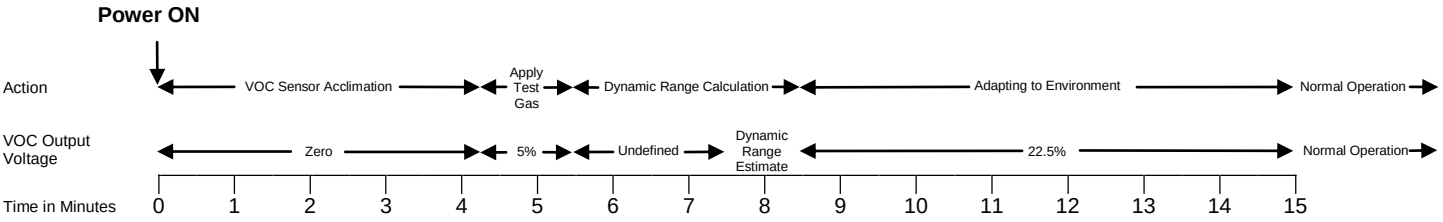

Figure 6: Sensor Start-up Timeline

Optional Sensor Performance Verification and Commissioning

BAPI's VOC sensor contains an adaptive, self adjusting, Volatile Organic Compound (VOC) sensor element that provides a CO_2 equivalent control signal output. When incorporated into a control strategy based on ASHRAE's Demand Control Ventilation algorithm, ventilation using this sensor will achieve true indoor air quality and not just CO_2 dilution.

The fundamental performance criterion of the VOC sensor element is its dynamic sensing range. The VOC sensor element requires a minimum dynamic range of 30% for proper operation. During BAPI's verification/commissioning test, the dynamic range is tested.

BAPI recommends installing the sensor and powering it for at least 48 hours before the first verification test is performed. BAPI further recommends ventilating the space such that the sensor reads 750 ppm or less CO_2 equivalent before any verification test is performed. Wait at least one hour before repeating the test.

1. **Start Automatic Verification/Commissioning Test**
   - A. Remove sensor power for at least one minute and reapply. The VOC sensor will set the VOC output to zero volts. (Power ON in figure 6)
   - B. Wait four minutes fifteen seconds.
   - C. The VOC sensor will set the VOC output voltage to 5% of full scale (0.25 VDC for 0 to 5 VDC, 0.5 VDC or 0 to 10 VDC outputs).
   - D. The 5% output voltage confirms that the VOC sensor is in its verification/commissioning test. (Apply Test Gas in figure 6)
2. **Apply Verification Stimulus**
   - A. Apply the stimulus gas during the first minute after the output voltage is set to 5% (*See Stimulus Preparation and Application)*.
   - B. Read and record the VOC output voltage approximately 2 to 4 minutes following the stimulus gas application to determine the dynamic range measurement. (Dynamic Range Estimate period in figure 6)
   - C. Use the graph in figure 8 to determine dynamic range.
3. **Termination of Verification Mode**
   - A. For the last 7 minutes of the start-up period the sensor adapts to its ambient environment. The VOC sensor will maintain its output voltage at 450 ppm CO_2 equivalent.
   - B. At 15 minutes the VOC sensor will terminate the start-up period and begin normal operation.
   - C. The VOC output will now report the VOCs present as CO_2 equivalents.
4. **Result Analysis and Recommendations**

   The VOC algorithm requires a minimum of 3.0 dynamic range for proper operation. Sensors reporting 30% or less dynamic range should be considered for replacement. (See Figure 8)

Stimulus Preparation and Application

Customer supplied – 70% minimum Isopropyl Alcohol.

Place 50ml of the Isopropyl Alcohol into a 200ml bottle (2oz in an 8oz bottle) with stopper and allow to reach room temperature (65° to 80°F, 18° to 27°C), a minimum of 15 minutes.

1. Using a medical grade syringe, remove the stopper from the alcohol bottle, place the tip of the syringe at least half-way into the bottle and withdraw a 60 ml sample of the **ALCOHOL VAPOR**. (**NO LIQUID**)
2. Replace the stopper on the alcohol bottle.
3. Place the end of the syringe under, or into the bottom ventilation slot of the VOC monitor's housing.
4. Empty the syringe into the sensor using one continuous motion.

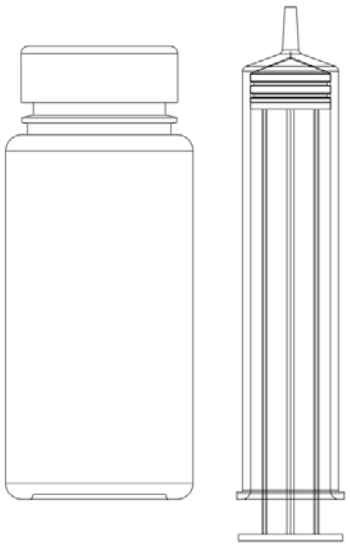

Figure 7: Alcohol Bottle and Syringe BA/VOC-KIT

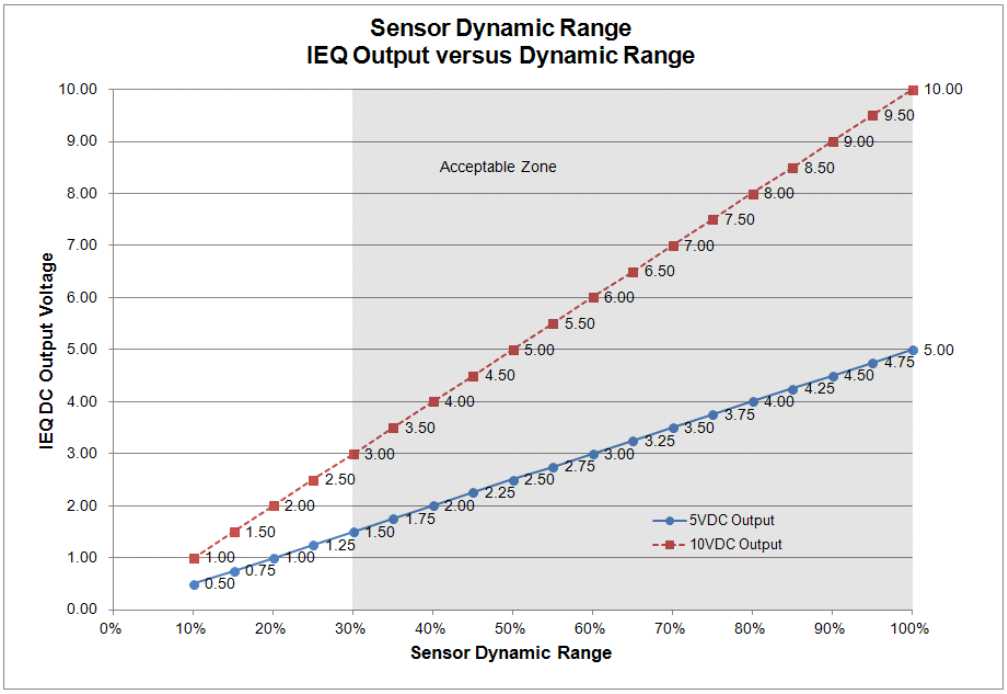

Figure 8: Acceptable Dynamic Range Output

Diagnostics

Possible Problems:	Possible Solutions:
General troubleshooting	- Determine that the input is set up correctly in the controller's and building automation software. - Check wiring at the sensor and controller for proper connections. - 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. - Label the terminals that the interconnecting wires are connected to at the sensor end and the controller end. Disconnect the interconnecting wires from the controller and the sensor. With the interconnecting wires separated at both ends 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 you have. 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 (22 gauge or larger, 250 feet or less). If either test fails, replace the wire. - Check power supply/controller voltage supply - Disconnect sensor and check power wires for proper voltage (see specifications below)
Incorrect VOC	- Wait 15 minutes after a power interruption. - Check all software parameters - Determine if the sensor is exposed to an external environment different from the room (conduit draft)

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