Product Identification

The Indoor Environment Quality output of the BAPI IEQ sensor is 0 to 100% VOC contamination. The VOC contamination can be turned into a CO_2 ppm equivalent by multiplying by 2,000. So 22.5% VOC contamination is 450 ppm CO_2 equivalent, 50% VOC contamination is 1,000 ppm CO_2 equivalent and 100% VOC contamination is 2,000 ppm CO_2 equivalent. Using the CO_2 equivalent number, ventilate the space according to ASHRAE's Demand Controlled Ventilation algorithm at that CO_2 concentration.
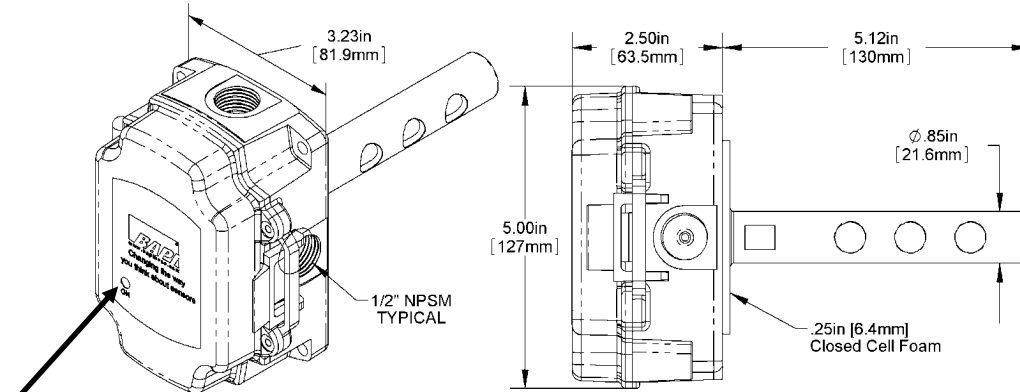

Red & Green LEDs visible here

Figure 1: Duct IEQ Sensor

Specifications

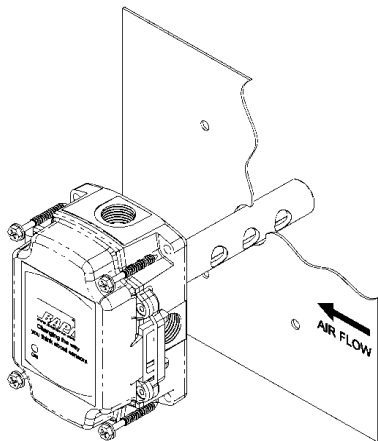| Power:	Analog Output (0-5VDC or 0-10VDC, >10KΩ impedance)
9 - 35 VDC @ 50mA Max (9 – 24VDC recommended) for 0 – 5 VDC Outputs	IEQ Contaminants 0 - 100%
15 - 35 VDC @ 50mA Max (15 - 24VDC recommended) for 0 - 10 VDC Outputs	
No AC Power	**Material:** ABS Plastic, Material Rated UL94V-0
Sensing Elements: Micro-machined Metal Oxide	**Logo Option:**, BAPI Logo or your custom logo, contact BAPI for details
VOC Detection Range: 0 – 100% (0 to 2,000 ppm CO_2 Equivalent)	**Certifications:** RoHs
Response Time: Less Than 60 Seconds (after start-up)	**Warranty period:** Two years from manufacture date
Start-up Time: 15 minutes	**Enclosure Material Rating:** UL94 V-0
Operating Environment: 32 - 122°F (0 - 50°C) 0 – 95%RH non-condensing	**Enclosure Rating:** NEMA4, IP66 (securing screws required)

Mounting

Fig 2: Mounting to a duct

1. BAPI recommends placing the sensor in the middle of the duct wall, away from stratified air, to achieve the best reading. Additionally the unit should be a minimum of 3 duct diameters from an elbow, damper or other duct restriction.

2. Drill a 1" hole for the aspiration probe.

3. 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.

4. Mount the enclosure to the duct using BAPI recommended #10 screws through a minimum of two of the mounting feet on opposite corners. A 1/8 inch pilot screw hole in the duct makes mounting easier. Use the enclosure mounting feet to mark the pilot-hole locations.

5. Snug up the screws so that the foam backing is depressed to prevent air leakage but do not over-tighten or strip the screw threads.

6. Use the provided #6 screws to secure the cover for IP66 rating.

7. BAPI recommends sealing the conduit opening with fiberglass insulation.

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Building Automation Products Inc., 750 North Royal Avenue, Gays Mills WI 54631 USA
Tel. +1-608-735-4800 ● Fax +1-608-735-4804 ● E-mail:sales@bapihvac.com ● Web:www.bapihvac.com

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Terminations

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 not wiring the sensor with power applied as accidental arcing may damage the product and will void the warranty.

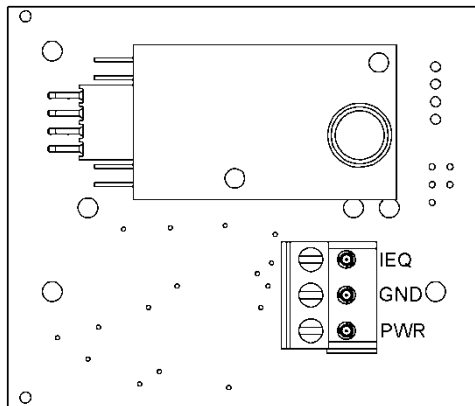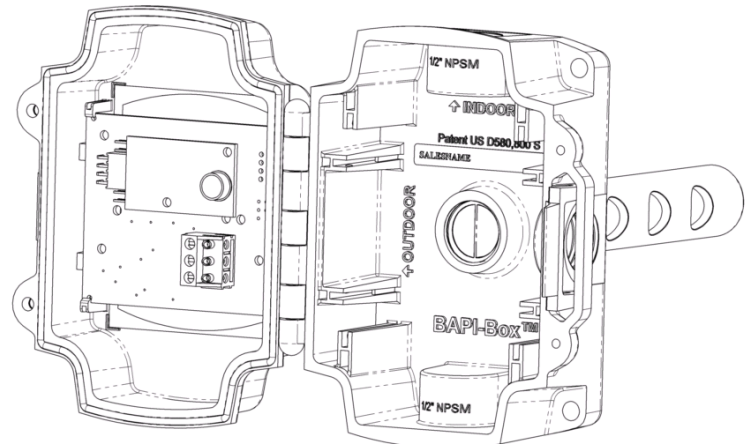| Terminal	Function
IEQ	Voltage output IEQ Signal (0 to 100%) referenced to GND
GND	To controller Ground [GND or Common]
PWR	Power, see specifications section for details, referenced to GND

Figure 3: Circuit Board

Fig 4: Unit Open Showing Circuit Board

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 IEQ	- 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)
IEQ output 0 VDC	- Check to see that VOC sensor is properly plugged onto its pins

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Sensor Start-up

At each power up, the sensor enters the start-up period for 15-minutes. The IEQ output will follow the timing shown in figure 5.

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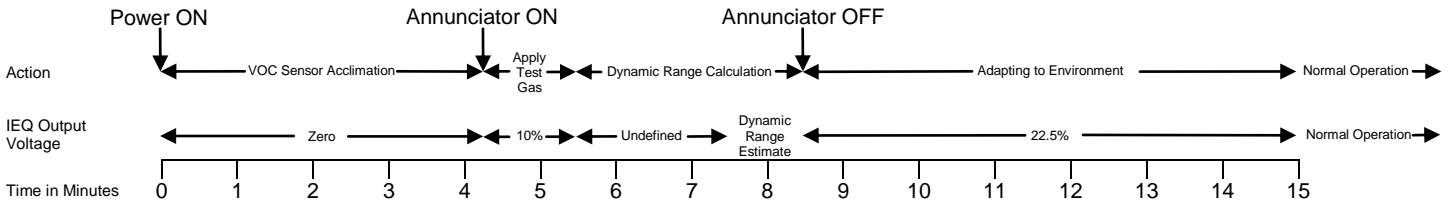

Figure 5: Sensor Start-up Timeline

Optional Sensor Performance Verification and Commissioning

The Indoor Environmental Quality [IEQ] monitor contains an adaptive, self adjusting, Volatile Organic Compound (VOC) sensor that provides a CO_2 equivalent control signal output. When incorporated into a control strategy based on ASHRAE's Demand Control Ventilation algorithm, the IEQ sensor can provide improved indoor environment quality.

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

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 37.5% contaminant or less (750 ppm 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 IEQ sensor will set the IEQ output to zero volts and display units will show zero percent contaminants. (Power ON in figure 5)
    B. Wait four minutes fifteen seconds.
    C. The IEQ sensor will illuminate an annunciator (**ON** icon for display units and a red LED for duct mounted units) as well as set the IEQ output voltage to 10% of full scale (0.5 VDC for 0 to 5 VDC, 1.0 VDC for 0 to 10 VDC or 2.8 VDC for 2 to 10 VDC outputs).
    D. The visual indication and the 10% output voltage confirms that the IEQ sensor is in its verification/commissioning test. (Apply Test Gas period in figure 5)
2. **Apply Verification Stimulus**
    A. Apply the stimulus gas during the first minute after the sensor illuminates the annunciator (*See Stimulus Preparation and Application)*.
    B. Read and record the IEQ output voltage or LCD display approximately 2 to 4 minutes following the stimulus gas application to determine the dynamic range measurement. (Dynamic Range Estimate period in figure 5)
    C. When the dynamic range estimate period is complete the annunciator illuminated in step 1C will be extinguished.
3. **Termination of Verification Mode**
    A. For the last 7 minutes of the start-up period the sensor adapts to its ambient environment, the IEQ sensor will maintain its output at 22.5% (450 ppm CO_2 equivalent).
    B. At 15 minutes the IEQ sensor will terminate the start-up period and begin normal operation.
    C. The IEQ output will now report the VOCs present as CO_2 equivalents.
4. **Result Analysis and Recommendations**
    A. The interpretation of the output in step 2B is a linear representation of the actual measured dynamic range of the sensor. An output value of 30% FS represents 30% dynamic range. An output of 70%, 80%, or 90% FS equates to a sensor dynamic range of equivalent values.
    B. The IEQ algorithm requires a 30% dynamic range for proper operation. Sensors reporting 30% or less dynamic range should be considered for replacement. (see Figure 7)
    C. The VOC sensor board is field replaceable, contact your BAPI representative for details.

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Stimulus Preparation and Application

Customer supplied – 70% minimum Isopropyl Alcohol.

Place 50ml of the Isopropyl Alcohol into a 200ml glass bottle (2oz in an 8oz glass 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 gas vapor. (no liquid)
2. Replace the stopper on the alcohol bottle.
3. Place the end of the syringe -
   A. Over, or into the top ventilation slot of the IEQ monitor's housing for room versions.
   B. Into a knockout opening or directly into the aspiration probe's top hole for duct mount versions.
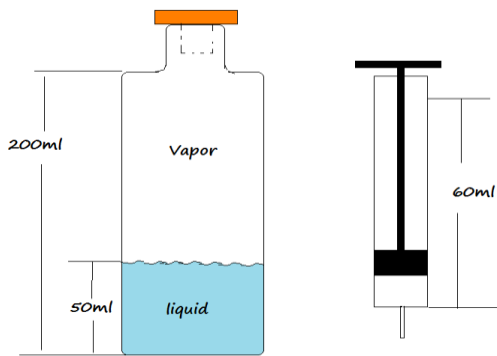4. Empty the syringe into the sensor using one continuous motion.
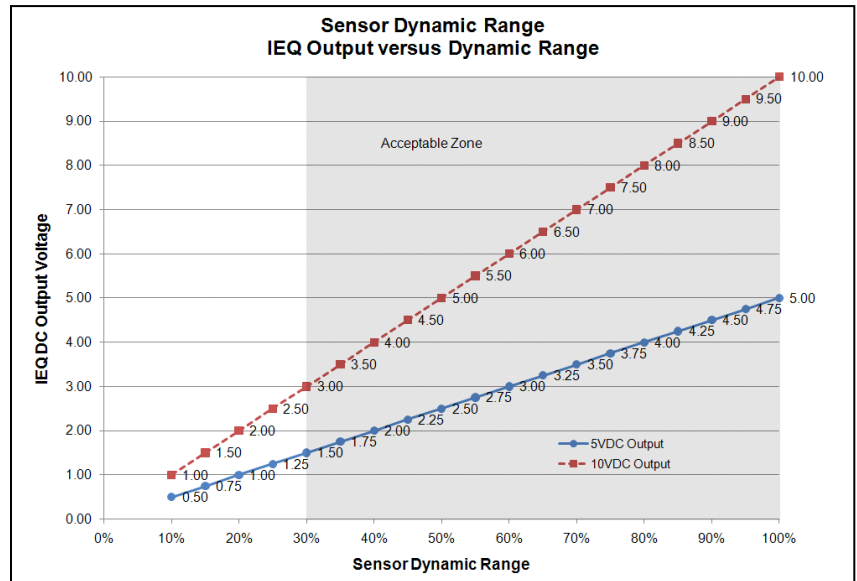
Figure 6: Alcohol Bottle and Syringe

Figure 7: Acceptable Dynamic Range Output

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