CO_2 Room Sensor in the BAPI-Stat 3 Enclosure with Common Ground Configuration

Installation and Operating Instructions

26141_ins_room_CO2 rev. 05/16/12

Identification and Overview

The BAPI CO_2 Sensor is an accurate and reliable way of incorporating demand controlled ventilation into a building's HVAC strategy. It measures the CO_2 in a range of 0 to 2,000 ppm with a field selectable output of 0-5 or 0-10 VDC.

The non-dispersive infrared (NDIR) technology has been optimized to reduce drift. The sensor is also altitude compensated for long-term accuracy and stability. Changing air pressure, due to altitude or weather patterns, can change the output of most CO_2 sensors by as much as 17%. The BAPI unit has a built-in barometric sensor that continuously compensates the output for accurate readings despite inclement weather or the altitude of the installation.

The unit can be ordered as CO_2 alone, or with optional temperature sensing, temperature setpoint, occupant override and humidity sensing. The large format display is easy to read and alternates between the measured values (CO_2, Temperature or Humidity). The display is also field adjustable between °F or °C and all the displayed values may be turned on or off by an HVAC technician.

Optional indication of the CO_2 level as "Good, Fair or Poor" is available as a three-color LED on the unit or as an arrow on the display.

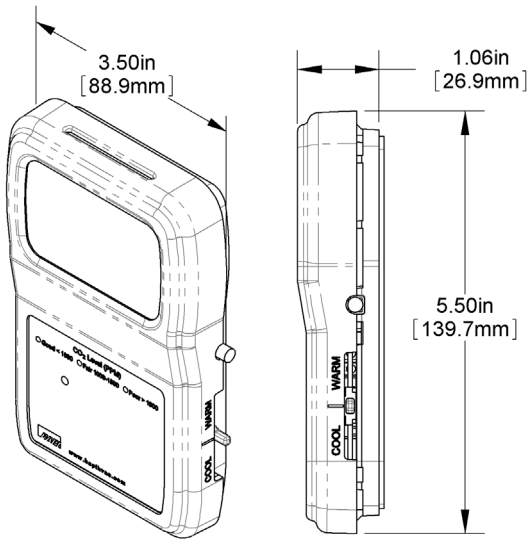

Fig 1: BAPI-Stat 3 Room CO_2 Sensor

Specifications

Power for 0-5 VDC Outputs:
9-35 VDC @ 150mA max (9-24 VDC recommended)

Power for 0-10 VDC Outputs:
15-35 VDC @ 150mA max (15-24 VDC recommended)

Sensing Elements:
CO_2 – Single Beam Non-Dispersive Infrared (NDIR) or Dual Channel NDIR for "24/7" Model

Humidity – Capacitive Polymer ±2% RH Accuracy

Temperature Sensor:
Thermistor, RTD or Semiconductor

Operating Environment:
32-122°F (0-50°C)
0-95%, RH non-condensing

Material ABS Plastic, Material Rated UL94V-O

CO_2 Detection Range: 0 – 2000 ppm

Start-Up Time: 10 Minutes

Response Time: Less Than 2 Minutes (after Start-Up Time)

Mounting: 2"x4" J-Box or drywall – screws provided

Override Output:
Contact .. SPST, 24V AC/DC, 0.5A max
Sensor ... Shorts Out direct temperature sensor
Setpoint . Contact in parallel, resistive setpoint only

LCD Display:
Main Display: 0.76" 4-digit Numeric (Numeric Values)
Minor Display: 0.34" 3-digit Alpha-Numeric (PPM, %RH, °F, °C)

Occ/Un-occ BAPI Man Icon: (Blk=Occupied)

Measurement Offsets: (Field Adjustable)
±5° (F or C) in 0.1° increments
±5% RH in 0.1% RH increments

CO_2 Accuracy: (Automatic Background Calibration model)
400 to 1,250 ppm: ±30ppm or 3% of reading, whichever is greater

1,250 to 2,000 ppm: ±5% of reading + 30ppm

CO_2 Accuracy: (24/7 model)
±75ppm

LED CO_2 Level Indicator:
Good, Green < 1,000 PPM
Fair, Orange = 1,000 to 1,500 PPM
Poor, Red > 1,500 PPM

Certifications: RoHS

Warranty Period: 2 Years from manufacture date

Specifications subject to change without notice.

Building Automation Products, Inc., 750 North Royal Avenue, Gays Mills, WI 54631 USA
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Mounting

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

Note: Screw the 1/26” Allen lock-down screw into the base to open the case, less chance of losing it this way. Back out the lock-down screw to secure the cover.

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.

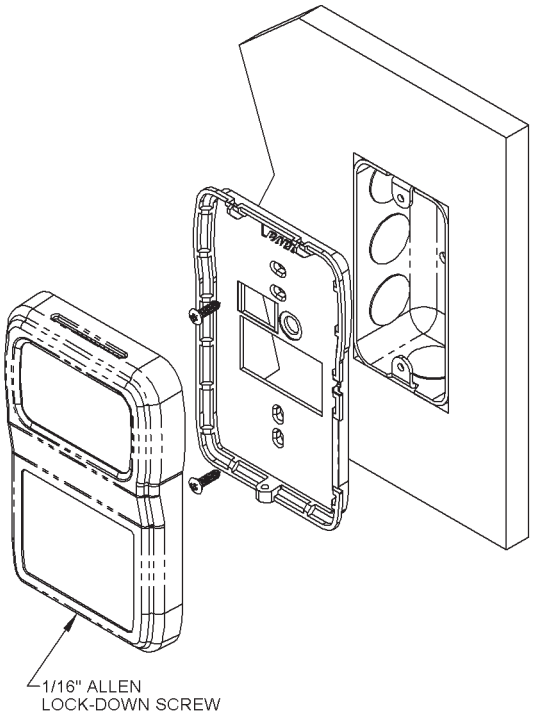

Fig 2: Mounting to a Junction Box

Drywall Mounting

1. Place the base plate against the wall where you want to mount the sensor.
2. Using a pencil, 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 wall temperature and the temperature 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.

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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.

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

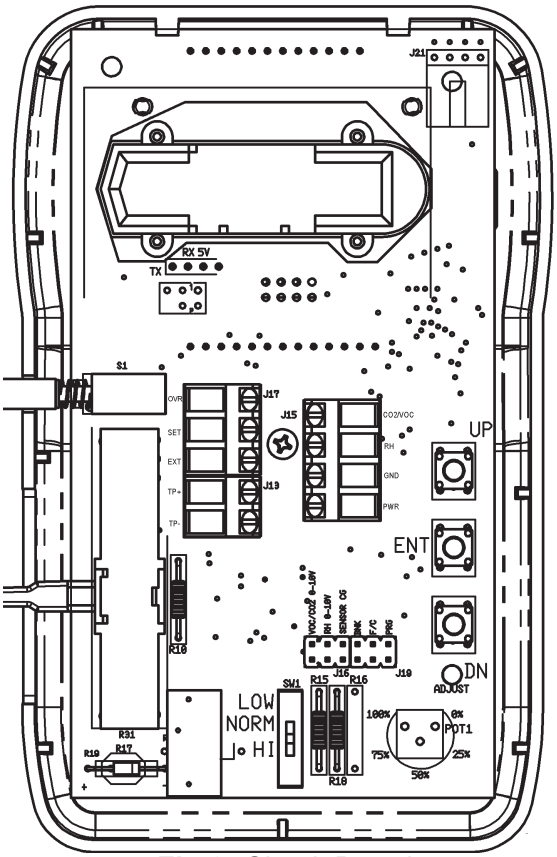

Fig 3: Circuit Board

Terminal	Function
OVR	Override Output (Dry Contact Switch). When Override switch is pushed this terminal is connected to the GND terminal.
SET	Setpoint output. Referenced to GND terminal.
EXT	External occupied LCD indicator is activated by logic LOW or ground at this terminal, referenced to the GND terminal.
TP+ & TP-	Temperature Sensor Output (Resistive Output). When a jumper is on J16, TP- is connected to the GND terminal. When the jumper is off of J16, the temperature sensor is floating. (Semiconductor TP+ = +, TP- = -)
CO_2 / VOC	Voltage output CO2 Signal (0 to 2,000 ppm) referenced to the GND terminal.
RH	Voltage output Humidity Signal referenced to the GND terminal.
GND	To controller Ground [GND or Common]
PWR	Power, referenced to GND 9 to 35 VDC @ 150 mA Max (9 to 24VDC recommended) for 0 to 5 VDC Outputs 15 to 35 VDC @ 150mA Max (15 to 24VDC recommended) for 0 to 10 VDC Outputs

Note: Unit is not ready for operation until the ten-minute start-up time has elapsed.

Optional Test and Balance Switch

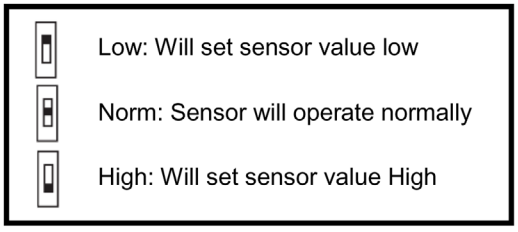

Fig 4: Test and Balance Switch Operation

Sensor Type	Low Temp	High Temp
1000 Ω RTD	1.02K Ω (41.2°F)	1.15K Ω (101.5°F)
3000 Ω Thermistor	7.87K Ω (39.8°F)	1.50K Ω (106.8°F)
10K-2 Thermistor	30.1K Ω (34.9°F)	4.75K Ω (109.1°F)
10K-3 Thermistor	26.7K Ω (35.9°F)	5.11K Ω (108.4°F)
10K-3(11K) Thermistor	7.32K Ω (43.7°F)	3.65K Ω (105.2°F)

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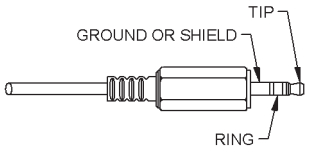
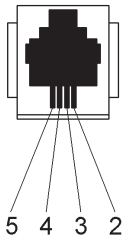
Optional Communications Jack Wiring



C35 Communication Jack
(Male jack shown for clarity)

Table 1: C35 Wiring	
	Wire Color
Ground	Black
Tip	White
Ring	Red



C11 Communication Jack

Table 2: C11 Wiring	
Comm Jack Pin	**Wire Color**
1	Not Connected
2	Black
3	Red
4	Yellow
5	Green
6	Not Connected

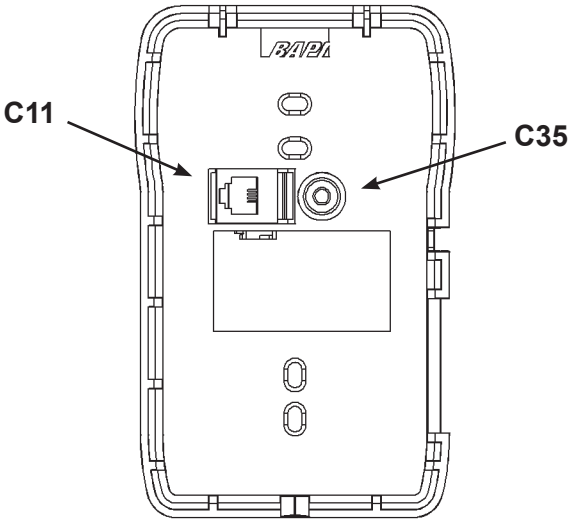


Fig 5: Communication Jacks

User Operation

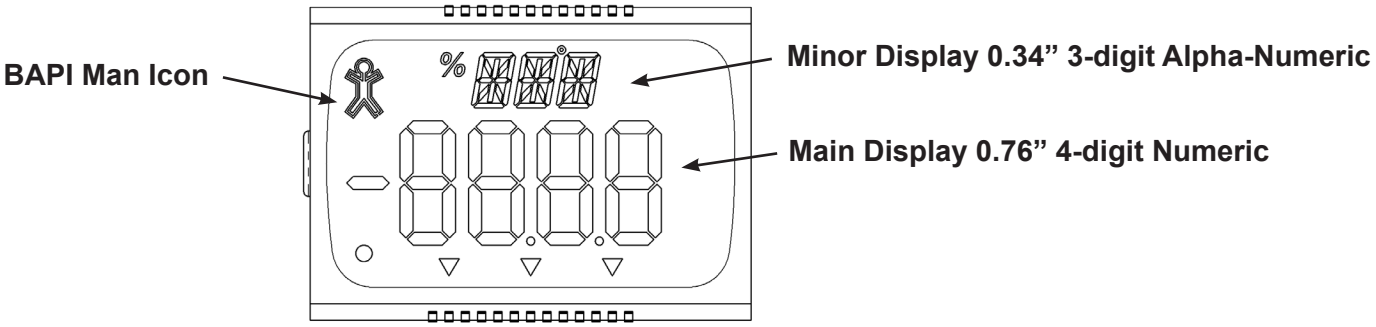


Fig 6: Optional Display

The display indicates CO_2 in PPM, air temperature in degrees Fahrenheit or Celsius, relative humidity in %RH, temperature setpoint in degrees Fahrenheit or Celsius and override using the BAPI Man icon. The three triangle icons are used with the –ARW option to show CO_2 levels and their meaning.

The main display indicates the numeric value of the quantity being displayed. The minor display indicates the engineering units of the value, such as PPM, °F, °C or %RH.

CO_2 Concentration Indicator: A three color LED will light green, yellow or red to indicate CO_2 concentrations.

Table 3: CO_2 Level Indication		
LED Color	**CO_2 ppm**	**Air Quality**
Green	<1,000	Good
Yellow	1,000 to 1,500	Fair
Red	>1,500	Poor

Temperature Setpoint Slide-Pot: Moving the slide pot enough to change the setpoint by one degree will display the setpoint on the main LCD display if equipped with display. The setpoint display will hold for five seconds after moving the slide pot.

Override Button: When the override button is pressed on display units, the BAPI Man icon will display. A dry resistance of less than 1 ohm appears from the override output (OVR) to the Ground terminal (GND). Latching the Icon to show that the system is in override requires that a dry contact on your controller be used to connect terminal EXT to ground.

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Optional Technician Adjustments

BAPI's CO_2 room sensor comes calibrated and ready to operate. In some installations the sensor may not match local instrumentation. The technician adjustment procedure allows °F or °C display units, temperature or humidity offsets or display information to be changed at any time.

Removing Ground from Temperature Sensor

Some installations may experience erratic temperature readings. A possible remedy may be to float the temperature sensor as shown in figures 7 and 8. Run wires directly from TP+ and TP- to the controller's analog input. The VOC/CO_2 and RH jumpers are omitted for clarity.

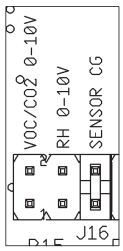

Fig 7: Temp. Sensor Grounded

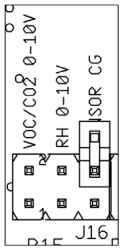

Fig 8: Temp. Sensor Floating

°F or °C Display Units

Figure 9 and figure 10 show the jumper positions for displayed values of Celsius or Fahrenheit degrees. The jumpers on pins PRG and BNK are omitted for clarity.

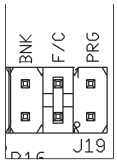

Fig 9: °F

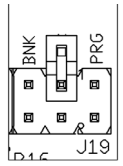

Fig 10: °C

Parameter Offsets & Display Information

Figure 11 and figure 12 show how to place the unit into field setup mode. Take the jumper from the BNK terminals and place it on the PRG terminals. The F/C jumper is omitted for clarity.

The major display should read P1 and the minor display should read DSP.

Use the UP/DN buttons (See Figure 13) to select the desired page.

Press and release the ENT button to select the desired page.

Use the UP/DN buttons to adjust the desired value

Press and release the ENT button to save the change and return to the page display.

Adjust another page or place the jumper into normal operation.

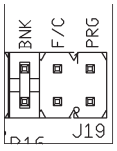

Fig 11: Normal Operation

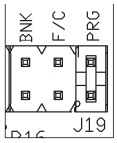

Fig 12: Programming Setup

Table 4: Parameter Offsets & Display Information

Parameter	Display		Adjustment	
	Main	Minor		
Display Options	P1	DSP	**Item**	**Display Action**
			1	Temperature Only
			2	% RH Only
			3	CO_2 Only
			4	Temperature and %RH (10 second rotation)
			5	Temperature and CO_2 (10 second rotation)
			6	%RH and CO_2 (10 second rotation)
			7	Temperature, %RH and CO_2 (10 second rotation)
			8	Setpoint Display Only
Temperature Offset	P2	TMP	±5° in 0.1° increments	
%RH Offset	P3	%RH	±5% RH in 0.1% RH increments	
CO_2 Offset	P4	CO2	±100 ppm in 1 ppm increments	
Altitude	P5	ALT	Effective Pressure Altitude (display only, no adjustment)	

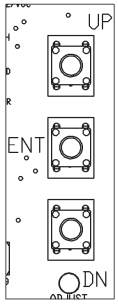

Fig 13: Calibration Buttons

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Output Selection

The CO_2 outputs may be field configured for 0 to 5 VDC or 0 to 10 VDC outputs at any time. Set the jumpers on J16 as shown in figures 14 and 15. The humidity outputs may be field configured for 0 to 5 VDC or 0 to 10 VDC outputs at any time. Set the jumpers on J16 as shown in figures 16 and 17. Note: The sensor may be ordered with optional humidity outputs of 1 to 5 VDC or 2 to 10 VDC, figures 16 and 17 describe those options. **Note:** The jumpers on pins not being described are omitted for clarity on the figures at right.

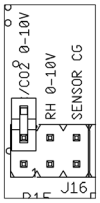

Fig 14: CO_2 Output 0 to 5 VDC

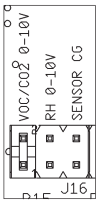

Fig 15: CO_2 Output 0 to 10 VDC

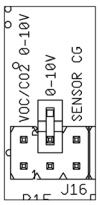

Fig 16: RH Output 0 to 5 or 1 to 5 VDC

Fig 17: RH Output 0 to 10 or 2 to 10 VDC

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 CO_2	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)
Incorrect Humidity	Check all software parameters
	If available, check the sensor against a calibrated instrument such as a hygrometer
	Determine if the sensor is exposed to an external environment different from the room (conduit draft)
Incorrect Temperature	Determine that the temperature sensor's wires are connected to the correct controller input terminals and are not loose.
	Check the wires at the sensor and controller for proper connections.
	Measure the physical temperature at the temperature sensor's location using an accurate temperature standard.
	Output to Controller
	Disconnect the temperature sensor's wire (Terminals TP+ & TP-) and measure the temperature sensor's resistance across the sensor output pins with an ohmmeter. Put the ohmmeters black lead on Terminal TP- and the red lead on Terminal TP+. Compare the temperature sensor's resistance to the appropriate temperature sensor table on the BAPI web site (See below). If the measured resistance is different from the temperature table by more than 5% call BAPI technical support. Don't forget to reconnect the wires.
	How to Find Temperature Sensor Resistance
	Find BAPI's web site at www.bapihvac.com; click on the link labeled SENSOR SPECS on the lower left of the screen and then click on the sensor type you have.
	Make sure that the sensor leads are not touching one another.
	Determine if the sensor is exposed to an external environment different from the room (conduit or wall cavity draft)

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