

Product Identification and Overview

BAPI's Carbon Monoxide Sensor offers enhanced, long life electrochemical sensing with outstanding accuracy at low concentrations. The sensor has field selectable ranges of 0 to 100 ppm, 0 to 200 ppm, 0 to 300 ppm and 0 to 500 ppm. The sensor provides linear outputs of 0 to 5 VDC, 1 to 5VDC, 0 to 10VDC, 2 to 10 VDC or 3-wire 4 to 20 mA. A backlit LCD display shows the CO measurement in ppm. The backlight is turned on for 10 seconds after any button touch. The factory calibrated sensor module is field replaceable.

Two independent SPDT alarm contacts switch at field selectable CO concentrations of 25ppm, 35ppm, 50ppm, 100ppm, and 200 ppm. The status LED is green when the measured CO is below the lowest relay setpoint, red whenever an alarm relay is on or the sensor module is removed, and yellow when the transmitter is performing a self-test or the sensor module needs replacement.

An alarm timer holds the output relays on for a fixed time after the CO level has fallen below 80% of setpoint. This allows additional fan run time to be sure that the CO has been purged. Field selectable times of zero, one, five and ten minutes are provided.

The sensor element is tested daily for proper operation. When the sensor element reaches its end of life, both relays turn on, the output is set to maximum and the status LED flashes yellow.



Fig. 1:
Carbon Monoxide Transmitter in a
Ventilated BAPI-Box

Mounting

Mount the BAPI Carbon Monoxide sensor/transmitter on a solid, non-vibrating surface or structure 3 to 5 feet above floor level. Mount in a horizontal orientation with the enclosure hinge at the top as shown in Figures 3 and 4. Failure to do so may degrade the life of the sensor element.

Do not mount near supply or return diffusers. Refer to local codes for further sensor/transmitter installation information. See BAPI's application note for further mounting recommendations. Go to www.bapihvac.com, select RESOURCE LIBRARY from the banner, Click on Application Notes, Look down the page for the heading Air Quality Related, and chose the link titled Coverage Area and Mounting Recommendations for BAPI Indoor Air Quality Sensors.

1. BAPI recommends #10 (M5) screws of a type and length suitable for the mounting surface. Four mounting screws keeps the box from twisting, twisting may prevent the latch from operating properly. A pilot-hole makes mounting easier. Use the enclosure mounting feet to mark the pilot-hole locations.
2. Snug up the screws so that the foam backing is depressed but do not over-tighten or strip the screw threads.
3. Place the provided #6 screws into the holes on each site of the lid latch to make the cover tamper resistant.

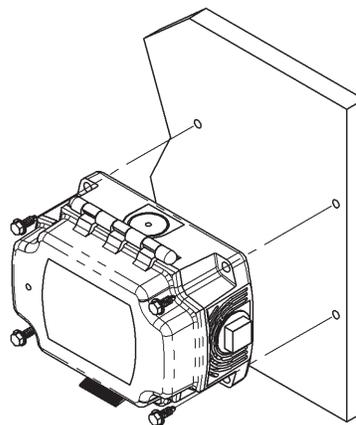


Fig. 3: Screw the unit in place

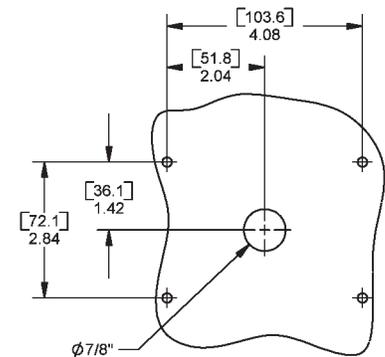


Fig. 2: Drill Template, center 7/8"
hole for rear conduit entry

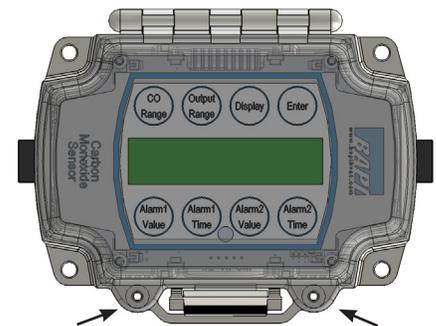


Fig. 4: Holes for tamper
resistant screws

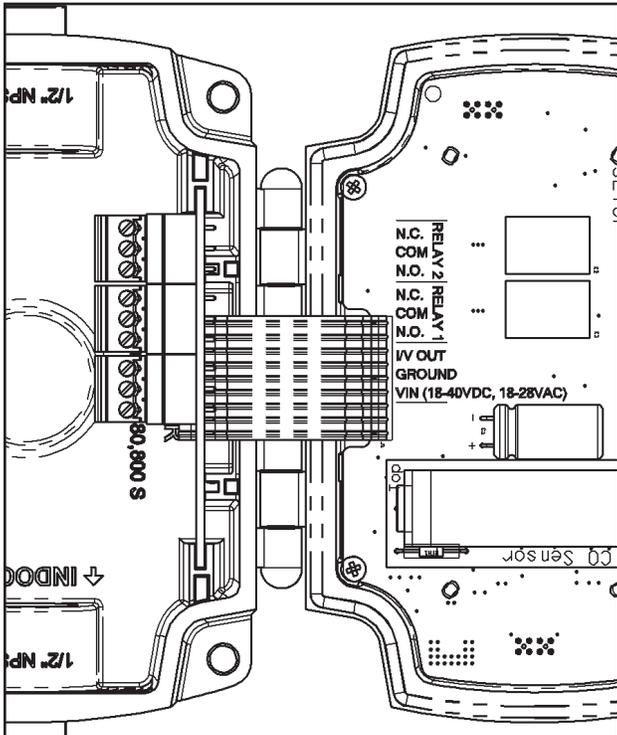
Specifications subject to change without notice.

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. Remove the plug from the conduit opening you wish to use. The field wiring terminals are on a board in the base of the unit. A legend, describing the function of each terminal, is printed on the circuit card in the lid. (See Fig. 5)



BAPI recommends wiring 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 void the warranty.



WIRING TERMINALS

VIN – Input Power

18 to 28 VAC, 7.2 VA Max
18 to 40 VDC, 180 mA Max.

GROUND:

Power and Analog Output Ground

I/V OUT

Three wire voltage or current signal

RELAYS

Relay contacts are galvanically isolated. They are not connected to each other, or to circuit power or ground in the carbon monoxide transmitter.

N.O. – Normally Open Contact

COM – Common Contact

N.C. – Normally Closed Contact

Fig. 5: Field Wiring Terminals

NOTE: The connectors that plug into the jacks on the board use a rising block screw terminal to hold the wires. If the block is in a partially up position, the wire may be inserted under the block and the wire will not be held when the screw is tightened. To avoid improper wiring, turn the male connector screws counterclockwise until the block is below the wire opening before inserting the wire. Lightly tug on each wire after tightening to verify proper termination.

Keeping the Enclosure Air Tight After Termination

For the sensor to work correctly, the wiring entrance must remain air tight. If the CO transmitter 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 ambient Carbon Monoxide. BAPI recommends either a liquid-tight fitting or plugging the conduit at the enclosure.

• **Liquid-Tight Fitting** – BAPI's 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 Carbon Monoxide transmitter is a foam plug to seal the ½ inch EMT. Place the wires into the plug as shown in Fig. 6 and then insert the plug into the conduit sealing the conduit.

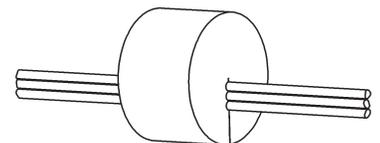


Fig. 6: Wires Through Foam Plug

Specifications subject to change without notice.

Relay Load Termination

The Alarm Relays may be used to switch a load on or off. Fig. 7 shows a circuit that may be used to switch on a load under alarm conditions. Fig. 8 shows a circuit that may be used to switch off a load under alarm conditions. For clarity only Alarm Relay 1 is shown, Alarm Relay 2 may be used in the same way.

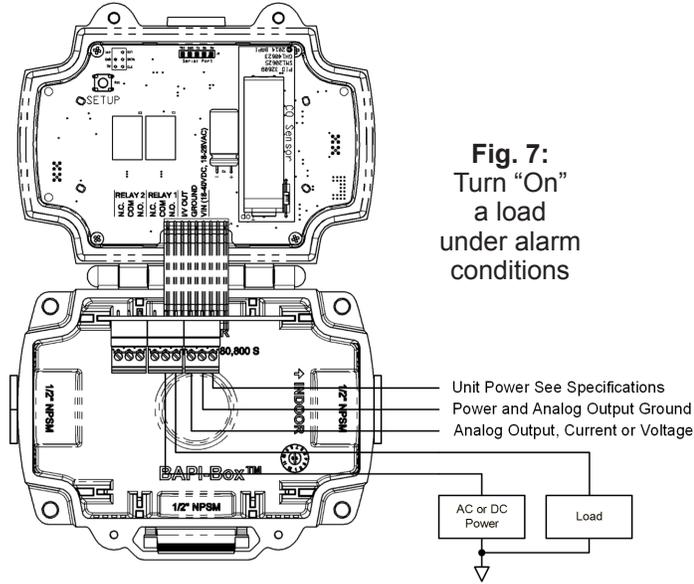


Fig. 7:
Turn "On"
a load
under alarm
conditions

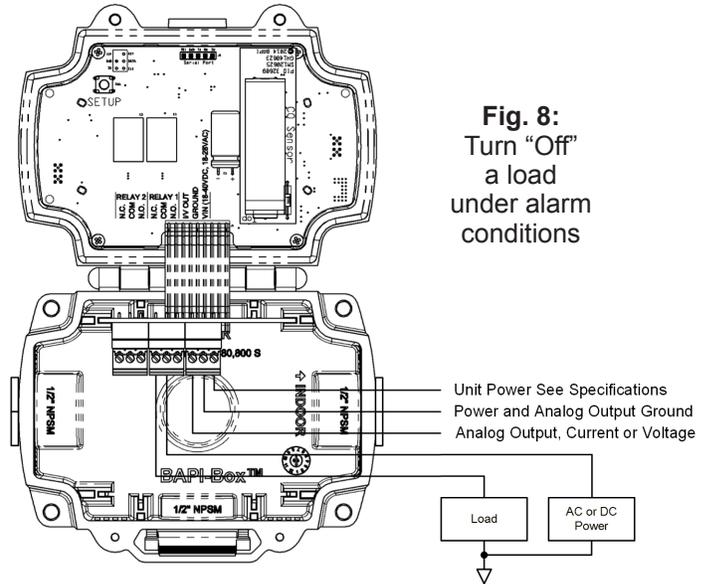


Fig. 8:
Turn "Off"
a load
under alarm
conditions

Fig. 9 shows how two or more Carbon Monoxide Transmitters may be interconnected to switch a load. This example shows how to turn on a load under alarm conditions. Similar circuitry may be used to turn off a load under alarm conditions. Fig. 9 connects together the Normally Open terminals of Alarm Relay #1 in both units and connects them to the load. Fig. 9 also connects together the Common terminals of Alarm Relay #1 in both units and then connects them to the load's power. This wiring circuit will drive the load whenever any one of the Carbon Monoxide Transmitters is in an alarm condition. *Note: Be sure to only connect similar terminals from each unit (Normally Open terminal to Normally Open terminal, etc.). Cross connecting any of the terminals (Normally Closed to Common, etc.) may damage the units and may void the warranty.*

For clarity only Alarm Relay 1 is shown in the example below. Alarm Relay 2 may be used in the same way.

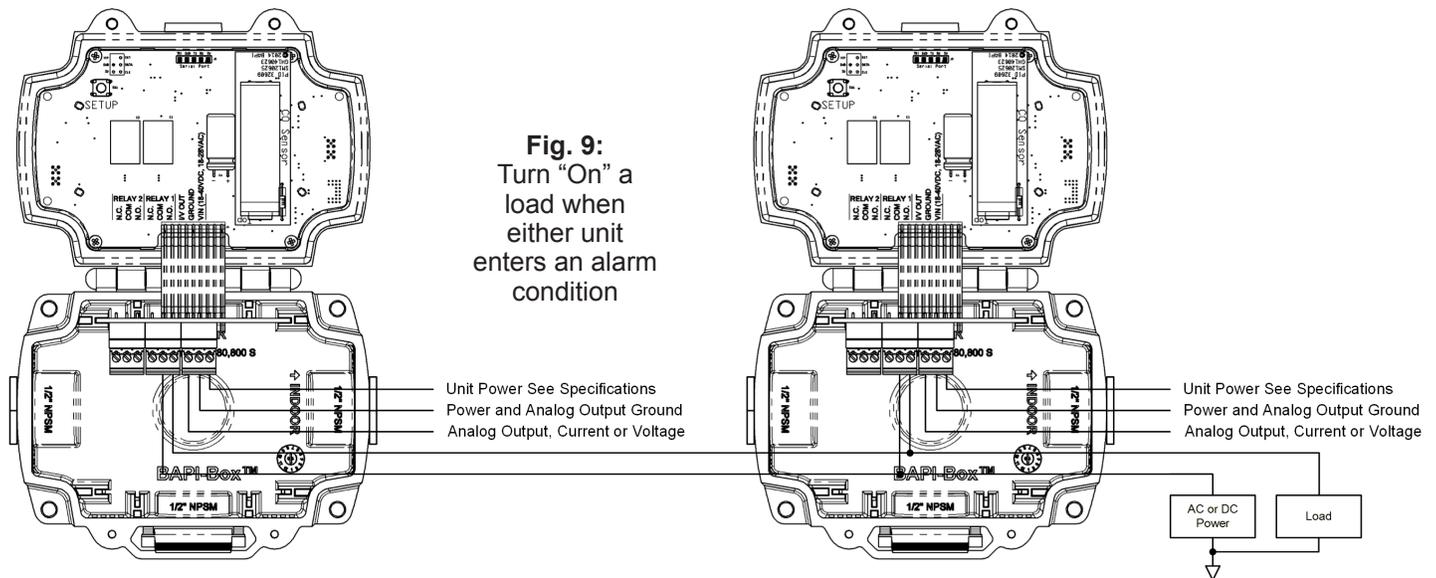


Fig. 9:
Turn "On" a
load when
either unit
enters an alarm
condition

Specifications subject to change without notice.

Relay Load Termination continued...

Some circuits require a switched ground to operate, such as audible alarms, visual alarms, or large AC motor controllers. Fig. 10 shows how to apply ground under an alarm condition. Fig. 11 shows how to remove ground under an alarm condition. For clarity only Alarm Relay 1 is shown. Alarm Relay 2 may be used in the same way.

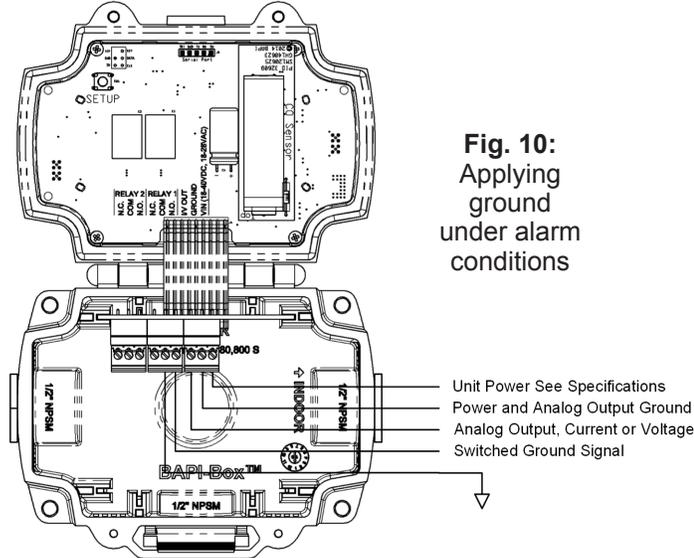


Fig. 10:
Applying ground under alarm conditions

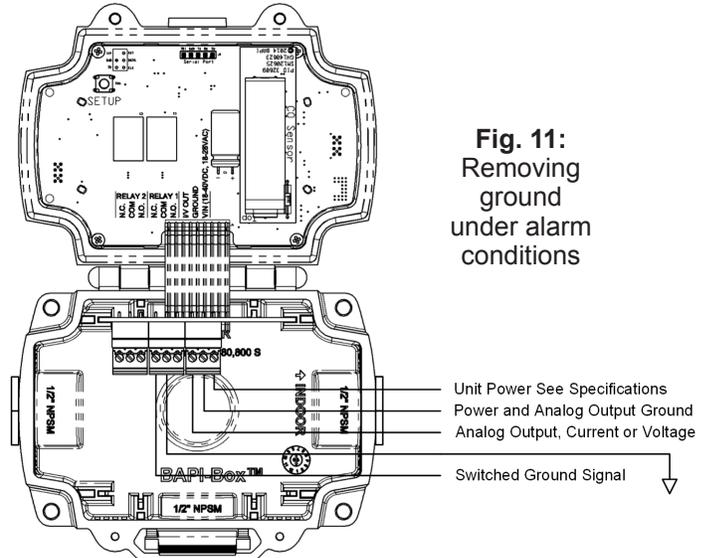


Fig. 11:
Removing ground under alarm conditions

Power Up

During the first 60 seconds after applying power, the Carbon Monoxide Transmitter performs the following functions:

- Front panel capacitive button test;
- Displays the transmitter's software version number;
- Displays the transmitter's serial number;
- Displays the transmitter's run time;
- Displays the CO Module's software version number;
- Displays the CO Module's serial number;
- Displays the CO Module's run time;
- Performs a CO Module self-test;

When the CO Module self-test is complete, the transmitter is operational.

Operation

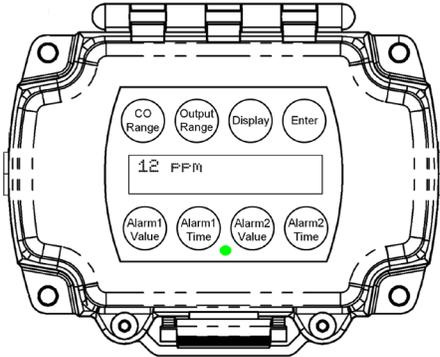
The eight buttons on the face of the unit sense the user's fingertip when pressed against the plastic cover. The buttons allow the user to review or select unit configuration parameters. The top line of the display continues to show the CO measurement when reviewing or selecting parameters.

Parameter Button	Function
	Review or select Carbon Monoxide measurement range used for analog output
	Review or select analog output range
	Review or select display on or display off
	View hidden values, verify edit mode, save edited configuration parameters, or end configuration parameter edit
	Review or select CO concentration to enable Alarm 1 relay
	Review or select number of minutes that Alarm 1 relay stays on after CO dissipates
	Review or select CO concentration to enable Alarm 2 relay
	Review or select number of minutes that Alarm 2 relay stays on after CO dissipates

Operation continued...

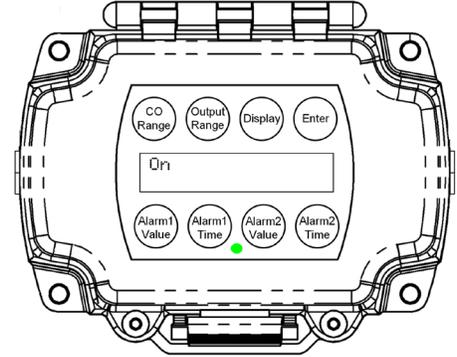
Display On and Display Off Modes

The top line of the display shows the CO measurement when the Display Mode is set to "On". If the Display Mode is set to "Off," the top line of the display shows the word "On" rather than the CO measurement. If the CO measurement is below Alarm 1 or Alarm 2 levels, the LED will be green.



Display "On" Mode

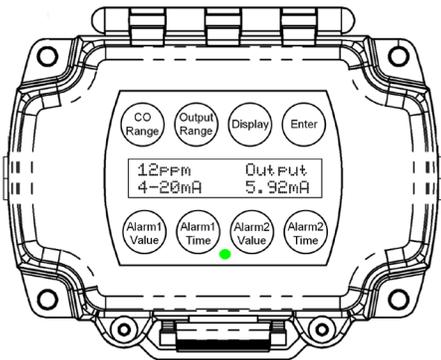
Fig. 12:
Display During Normal Operation
(Reading is below CO alarm value)



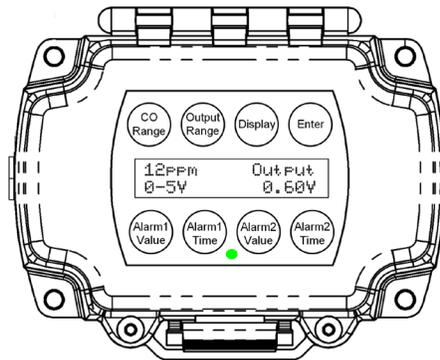
Display "Off" Mode

Displaying the CO Measurement, Analog Output Range and Analog Output Value

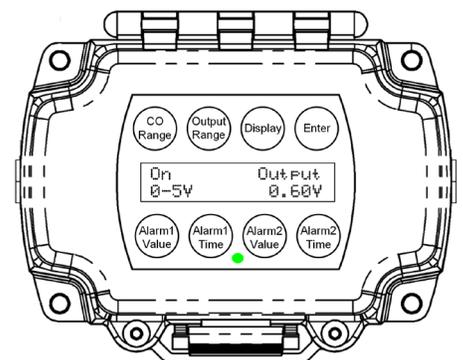
Touching the Enter button displays the Current Reading, the Analog Output Range and Analog Output Value for 10 seconds. The current reading is replaced by the word "On" if the display is set to "Off".



4 to 20 mA Output Mode
(Display set to "On")



0 to 5 Volt Output Mode
(Display set to "On")



0 to 5 Volt Output Mode
(Display set to "Off")

Fig. 13: Display showing the Current Reading, the Analog Output Range and Analog Output Value

CO Sensor Failure Display

The CO sensor element is tested for proper operation daily. If the sensor fails:

- The top line of the display displays "Replace Sensor,"
- The analog output is set to 100% of range
- Both relays turn on,
- The LED flashes yellow.

Note: The sensor failure display is the same whether the display is set to "On" or "Off".

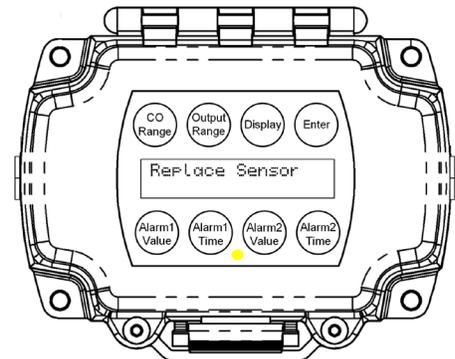


Fig. 14: CO Sensor Failure

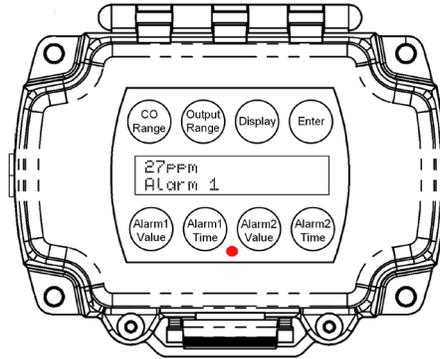
Specifications subject to change without notice.

Operation continued...

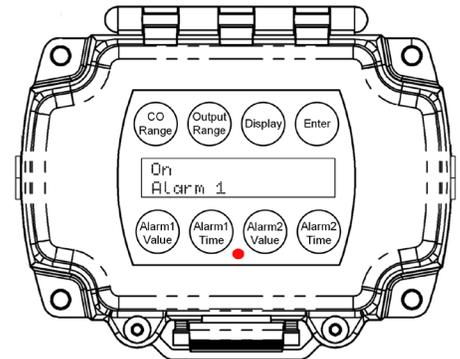
Alarm Condition 1 Display

If the CO measurement exceeds the Alarm 1 setpoint:

- The CO measurement or the word "On" is displayed on the first line
- The alarm condition is displayed on the second line
- The LED will be red
- The backlight flashes



Alarm Condition 1
(Display set to "On")



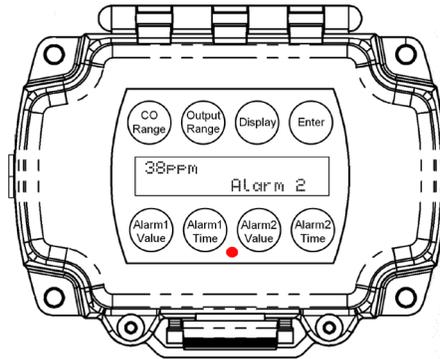
Alarm Condition 1
(Display set to "Off")

Fig. 15: Display when the measurement exceeds Alarm Condition 1 Setpoint

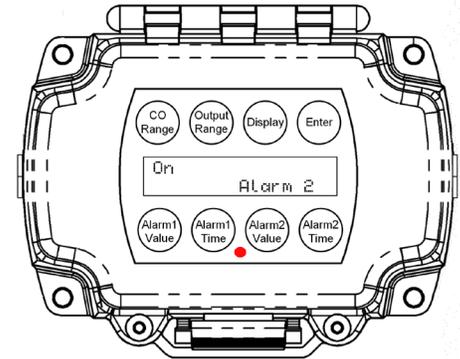
Alarm Condition 2 Display

If the CO measurement exceeds the Alarm 2 setpoint;

- The CO measurement or the word "On" is displayed on the first line
- The alarm condition is displayed on the second line
- The LED will be red
- The back light flashes



Alarm Condition 2
(Display set to "On")



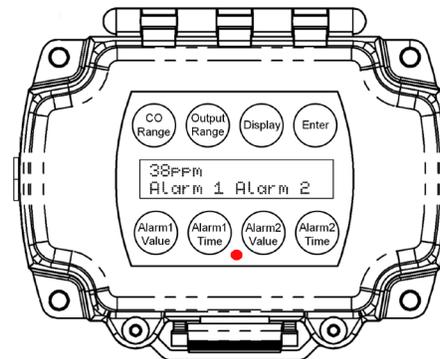
Alarm Condition 2
(Display set to "Off")

Fig. 16: Display when the measurement exceeds Alarm Condition 2 Setpoint

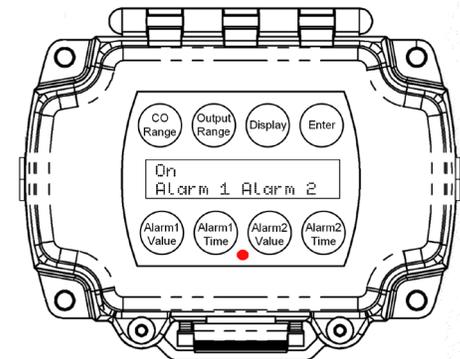
Alarm Condition 1 & 2 Display

If the CO measurement exceeds the Alarm 1 & 2 setpoint;

- The CO measurement or the word "On" is displayed on the first line
- The alarm condition 1 and 2 is displayed on the second line
- The LED will be red
- The back light flashes



Alarm Condition 1 & 2
(Display set to "On")



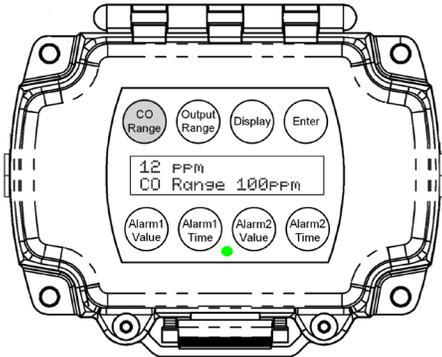
Alarm Condition 1 & 2
(Display set to "Off")

Fig. 17: Display when the measurement exceeds Alarm Condition 1 & 2 Setpoint

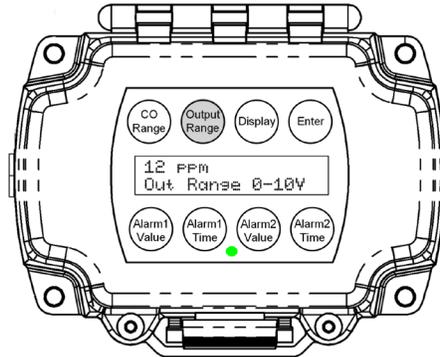
Specifications subject to change without notice.

Reviewing Parameter Settings

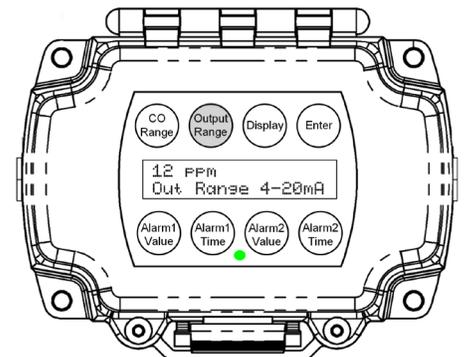
You can review the parameter settings at any time during normal operation by touching any of the eight buttons on the face of the unit. The following figures show a typical display when a button is touched. The values will display for 10 seconds and then the display will revert to normal.



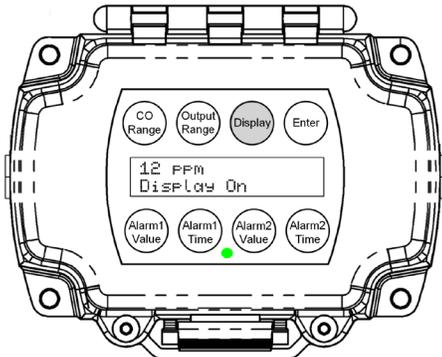
CO Range



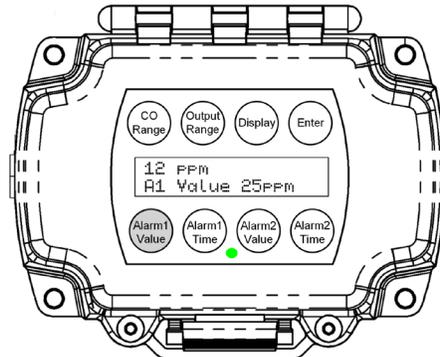
Output Range (0 to 10 Volts)



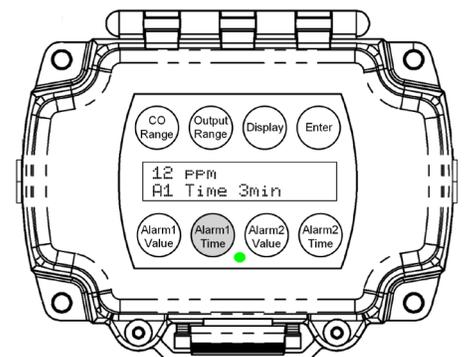
Output Range (4 to 20mA)



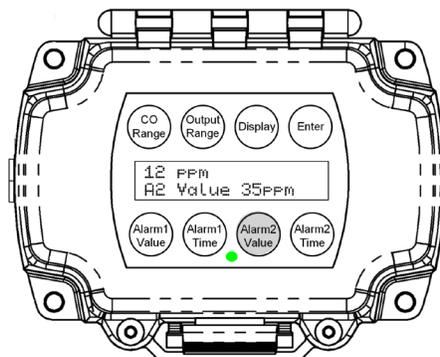
Display Mode



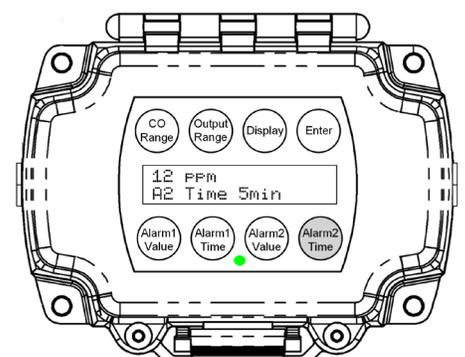
Alarm 1 Value



Alarm 1 Time



Alarm 2 Value



Alarm 2 Time

Specifications subject to change without notice.

Parameter Setup

If field personnel wish to change any parameter settings, they must remove the tamper resistant screws, open the cover, and press the switch on the board labeled "Setup." Follow Fig. 18 below to change parameters.

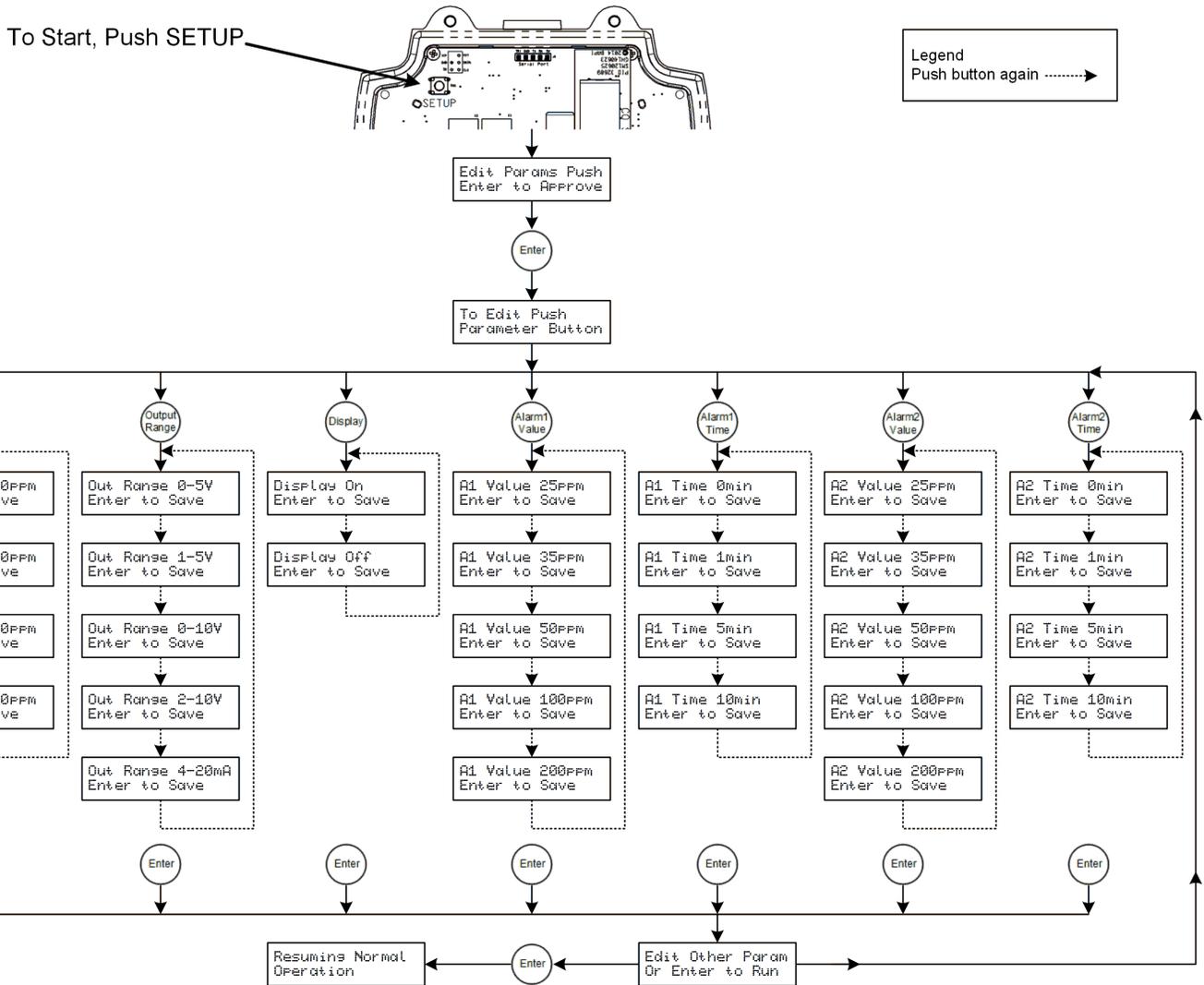


Fig. 18:
Parameter Setup Flow Chart

Specifications subject to change without notice.

Calibration

Every BAPI Carbon Monoxide Transmitter is factory calibrated. Each unit is ready for operation after installation and the 60 second start-up time.

BAPI's factory calibrated CO Module is inexpensive enough to replace, rather than calibrate with expensive and inconvenient gas tanks, regulators, and laptop computer. BAPI recommends replacing the sensor whenever the Replace Sensor alarm is active, every 7 years, or at the recalibration intervals required by the local jurisdiction.

To replace the CO Module (Fig. 19), follow these steps;

- Remove the taper resistant screws and open the lid
- Unplug the power connector
- For the next two steps, hold the sensor by the body, not the endcaps.
- Remove the CO Module by pulling it straight off the transmitter
- Plug in the new sensor by pushing the sensor board straight into the transmitter
- Plug in the power connector
- Close the lid until it clicks, remember to replace the tamper resistant screws

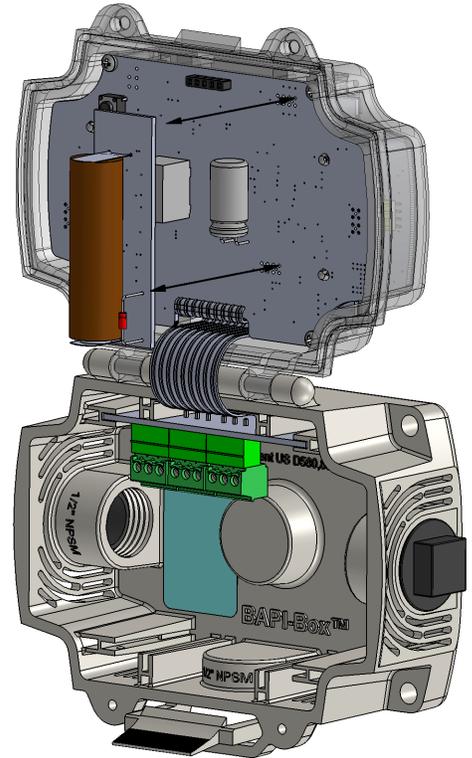


Fig. 19:
Inserting or Removing the
Sensor Module

Maintenance

The BA/CO sensor/transmitter unit should be vacuumed clean once a year or more, depending on the rate of accumulation of any dust or dirt. To avoid sensor damage, the unit **MUST NOT** be submerged in any liquids. Hosing or splashing of the unit with any liquids must also be avoided and may void the warranty.

The sensor in the Carbon Monoxide Transmitter typically has a life of over 7 years. When the sensor reaches the end of its useful life, the transmitter will alarm when a replacement is required. Factory calibrated replacement sensors are available from BAPI.

Specifications**Power**

18 to 28 VAC, 7.2 VA Max
18 to 40 VDC, 180 mA Max

Field Selectable Ranges

0 to 100 ppm
0 to 200 ppm
0 to 300 ppm
0 to 500 ppm

Accuracy

<200ppm, $\pm 3\%$ FS, 32 to 122°F (0 to 50°C)
201 to 500 ppm, 5% FS, 50 to 122°F (10 to 50°C)

Alarm Relays

2 Independent, Dry SPDT (Form C)
2 Amps at 24 VAC/DC, Resistive
140 VA Inrush, 48 VA Holding at 24 VAC

Field Wiring Terminals

Pluggable Screw Terminals, 14 to 24 AWG

Alarm Relay Setpoints

25ppm, 35ppm, 50ppm, 100ppm or 200ppm

Alarm Timer

0, 1, 5 & 10 minutes

Field Selectable Analog Outputs

3-wire 4 to 20 mA
0 to 5 VDC, 1 to 5 VDC
0 to 10 VDC, 2 to 10 VDC

Environmental Operation Range

14 to 122°F (-10 to 50°C)
5 to 95% RH Noncondensing

Lifetime:

7 Years Typical

Specifications subject to change without notice.



Carbon Monoxide Transmitter in a Ventilated BAPI-Box

Installation & Operating Instructions

34612_ins_CO_V_BB

rev. 07/17/15

Diagnostics

POSSIBLE PROBLEMS:

General troubleshooting

POSSIBLE SOLUTIONS:

- Determine that the input is set up correctly in the controller's and building automation software.
- Check wiring for proper termination
- 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.

Unit does not operate

- Cycle power.
- Check power for proper polarity.
- Disconnect the power wires at the controller and measure the voltage coming from the power source. If the voltage is outside the limits specified on page 1, troubleshoot the power source. Reconnect power wires to controller when finished
- Disconnect the power wires at the sensor and measure the wires for the same voltage as at the controller. If the voltage is different from that measured at the source, troubleshoot the wire. Reconnect power wires to sensor when finished.
- Measure the power at the sensor with the power wires connected to the power source. If the voltage is outside the limits specified on page 9, call your BAPI representative.

ADDITIONAL DISPLAY MESSAGES AND INDICATION

Display Message	LED	Indication
Module not found retrying	Solid Red	Sensor Module is loose or missing. Securely plug in a sensor module
mA Output Fault	Flashing Red	Unit is configured for mA output, but the loop resistance is incorrect. Troubleshoot connection.
V Output Fault	Flashing Red	Unit is configured for voltage output, but the output voltage is incorrect. Troubleshoot connection
Replace Sensor	Flashing Yellow	Sensor Module failed self-test, replace the sensor module
Self-Test	Solid Yellow	Sensor Module is performing a self-test

Note: If you are experiencing any other problems besides those described above, contact your BAPI representative.

Specifications subject to change without notice.