

Overview

The Carbon Monoxide (CO) Sensor offers enhanced electrochemical sensing with outstanding accuracy at low concentrations. The Duct unit samples duct air using an aspiration tube. This rough service unit features a ventilated enclosure and is ideal for parking ramps, equipment rooms and warehouses.

The sensor has field selectable CO ranges of 0 to 100, 0 to 200, 0 to 300, and 0 to 500 ppm. It also has field selectable outputs of 0 to 5, 1 to 5, 0 to 10, 2 to 10 VDC and 3-wire 4 to 20 mA output. The large LCD is backlit for 10 seconds after any button push.

Two independent SPDT alarm contacts switch at field selectable CO concentrations of 25, 35, 50, 100, and 200 ppm. An alarm timer can hold the output relays on for one to ten minutes 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. The field replaceable CO sensor module lasts approximately 7 years and is self-tested daily.

NOTE A small heart symbol in the top right corner of the display blinks every $\frac{1}{2}$ second. This heartbeat indicates that the unit is operating correctly.



Figure 1: Rough Service Carbon Monoxide Sensor (top)
Part# NSB-CO-V-BB

Duct Carbon Monoxide Sensor (bottom)
Part# NSB-CO-D-BB

Specifications

Power

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

Field Selectable Ranges

0 to 100, 0 to 200, 0 to 300, and 0 to 500 ppm

CO Sensor Module Life

7 years typical

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

Response Time

<80 seconds from 10% to 90% of range

Alarm Relay Setpoints

25, 35, 50, 100 or 200 ppm

Alarm Timer

0, 1, 5, and 10 minutes

Field Selectable Outputs

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

Accuracy

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

Environmental Operation Range

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

Specifications subject to change without notice.

Mounting

Rough Service Ventilated Unit

1. Mount the unit on a solid, non-vibrating surface 3 to 5 feet above floor level. Mount in a horizontal orientation with the enclosure hinge at the top as shown in Figure 3. Failure to do so may degrade the life of the CO sensor module. Do not mount near supply or return diffusers.
2. Use #10 (M5) screws on the four mounting tabs of the enclosure. A pilot-hole makes mounting easier. Use the enclosure mounting tabs to mark the pilot-hole locations.
3. Snug up the screws so that the foam backing is depressed but do not over-tighten or strip the screw threads.
4. Place the provided #6 screws into the holes on each side of the lid latch to make the cover tamper resistant.

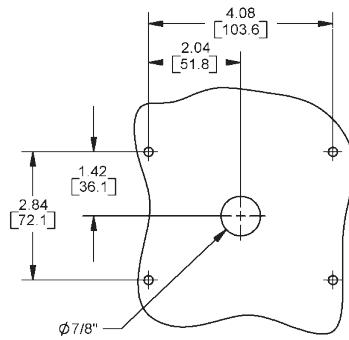


Figure 2: Screw hole template. Drill center 7/8" hole for rear conduit entry on rough service unit.

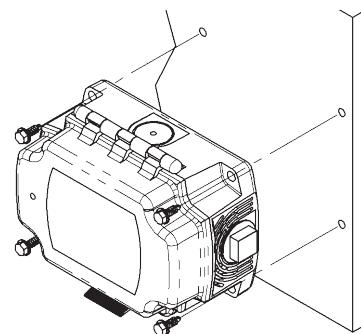


Figure 3: Rough service unit mounting

Duct Aspiration Tube Unit

1. Carrier recommends 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. The air direction is not important.
3. Mount the enclosure to the duct using #10 screws through a minimum of two mounting feet on opposite corners. A 1/8" pilot hole makes mounting easier. Use the mounting feet to mark the pilot-hole locations.
4. Snug the screws until the foam backing is compressed about 50% to prevent air leakage but do not over-tighten.
5. Use the provided #6 screws to secure the cover for IP66 rating.
6. Carrier recommends sealing the conduit opening with fiberglass insulation.

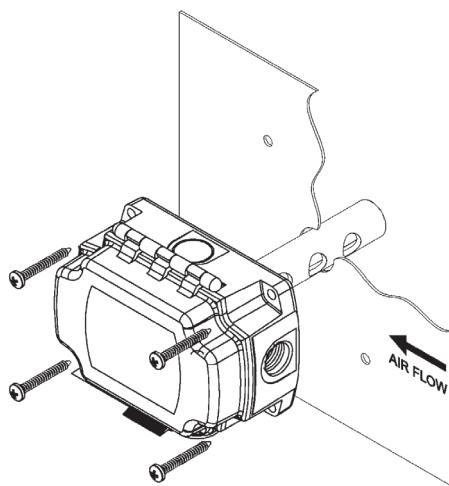


Figure 4: Duct unit mounting

Termination

Carrier recommends using twisted pair of at least 22 AWG 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. Tests show that fluctuating and inaccurate signal levels are possible when AC power wiring is present in the same conduit as the signal lines.



Carrier 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.

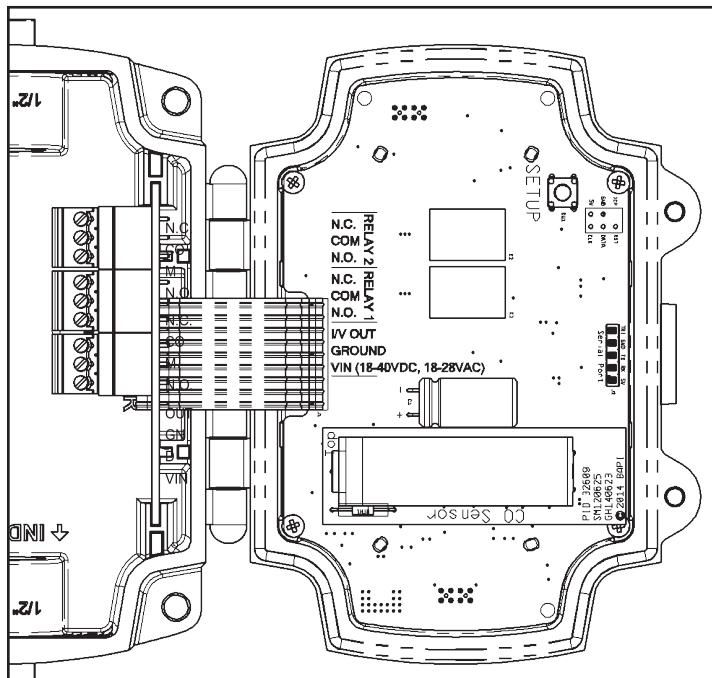


Figure 5: Field Wiring Terminals

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 Airtight After Termination

For the sensor to work correctly, the wiring entrance must remain airtight. If the 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 ambient Carbon Monoxide. Carrier recommends plugging the conduit at the enclosure. Included with the sensor is a foam plug to seal the 1/2 inch EMT. Place the wires into the plug as shown in Figure 6 and then insert the plug into the conduit sealing the conduit.

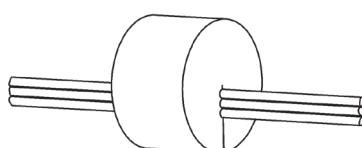


Figure 6:
Wires through foam plug

Specifications subject to change without notice.

Relay Load Termination

The Alarm Relays may be used to switch a load on or off. Figure 7 shows a circuit that may be used to switch on a load under alarm conditions. Figure 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.

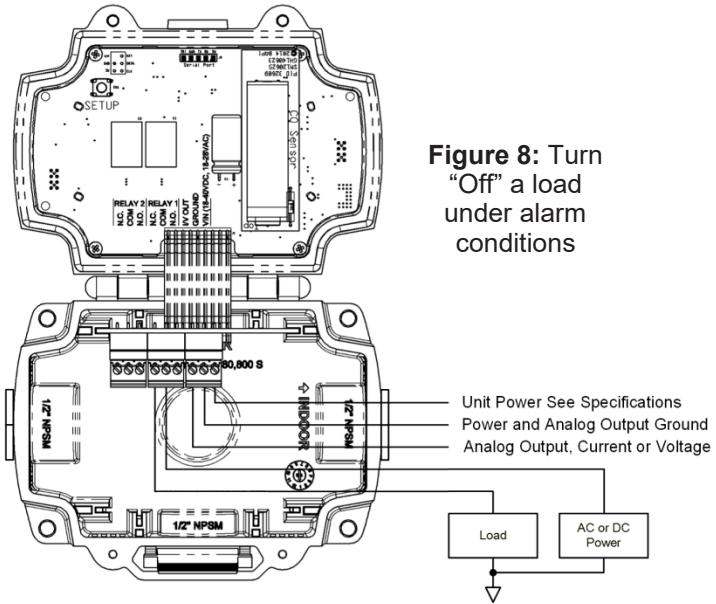
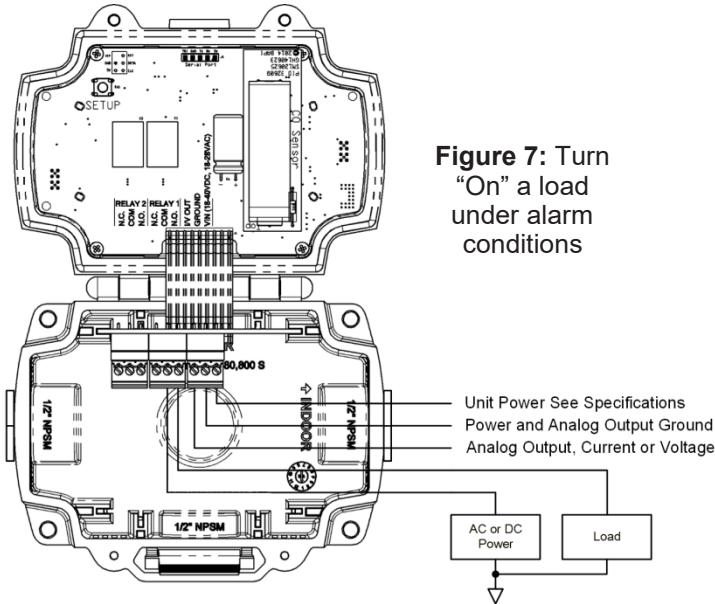
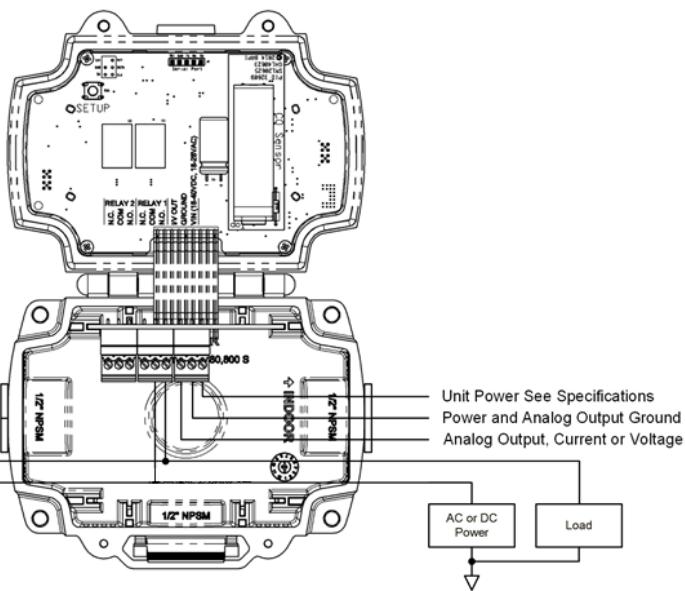
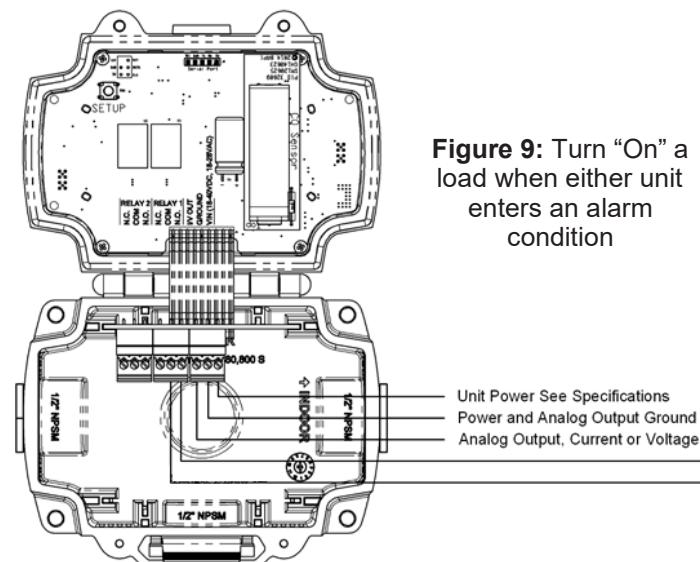


Figure 9 shows how two or more Carbon Monoxide Sensors may be interconnected to switch a load. This example shows how to turn on a load under alarm conditions. Similar circuitry may be used to turn off a load under alarm conditions. Figure 9 connects together the Normally Open terminals of Alarm Relay #1 in both units and connects them to the load. Figure 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 Sensors 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.



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. Figure 10 shows how to apply ground under an alarm condition. Figure 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.

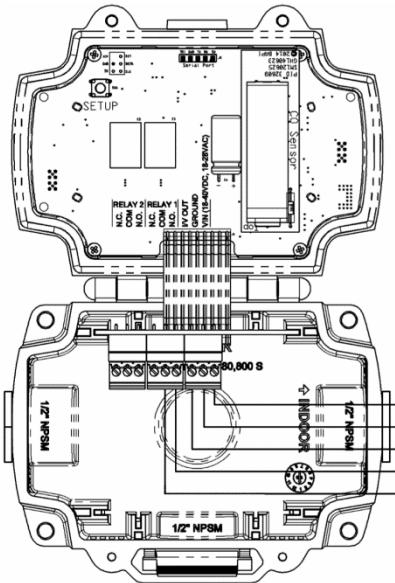


Figure 10:
Applying ground
under alarm
conditions

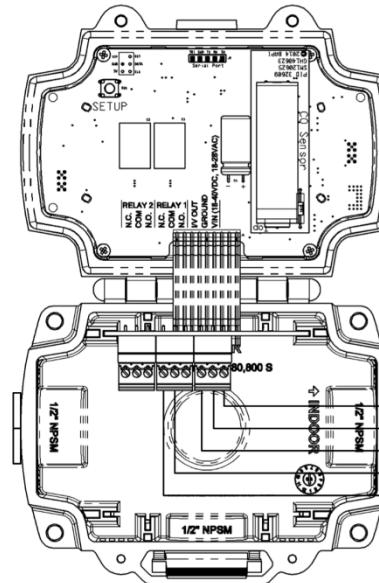


Figure 11:
Removing ground
under alarm
conditions

Power Up

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

- Front panel capacitive button test,
- Displays the sensor's software version number,
- Displays the sensor's serial number,
- Displays the sensor's run time,
- Displays the CO sensor module's software version number,
- Displays the CO sensor module's serial number,
- Displays the CO sensor module's run time,
- Performs a CO sensor module self-test.

When the CO sensor module self-test is complete, the sensor is operational.

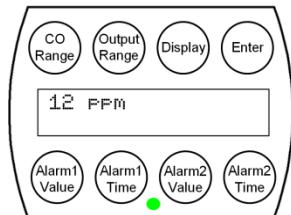
Operation

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.

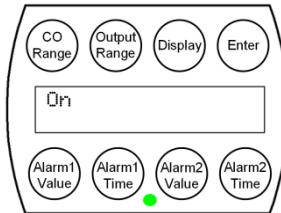
| Parameter Button | Function |
|------------------|---|
| | Review or select Carbon Monoxide measurement range used for analog output |
| | Review or select analog output range |
| | Review or select display on or display off |
| | View hidden values, verify edit mode, save edited configuration parameters, 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.



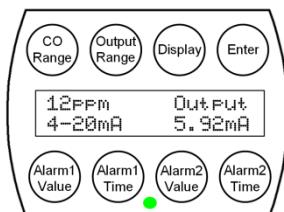
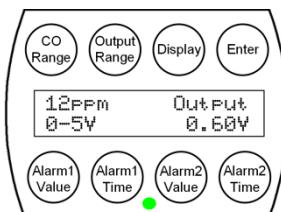
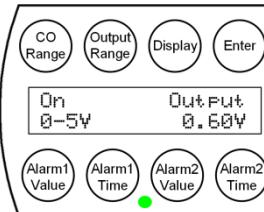
Display "On" Mode

Figure 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

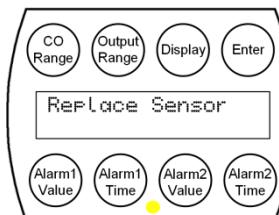
Touching the Enter button displays the Current Reading, the Analog Output Range and Analog Output Value for 10 seconds. The current reading is replaced by the word "On" if the display is set to "Off".

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")**Figure 13:** Display showing the Current Reading, the Analog Output Range and Analog Output Value**CO Sensor Module Failure Display**

The CO sensor module 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.

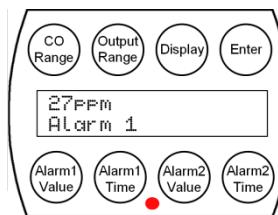
NOTE The sensor failure display is the same whether the display is set to "On" or "Off".

**Figure 14:** CO Sensor Module Failure

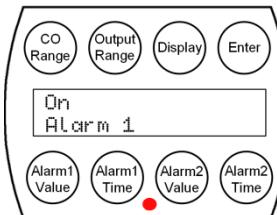
Operation continued...**Alarm Condition 1 Display**

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 display on the second line
- The LED will be red
- The backlight flashes



Alarm Condition 1
(Display set to “On”)



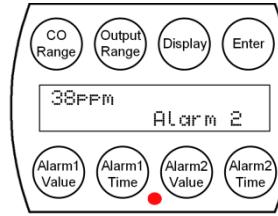
Alarm Condition 1
(Display set to “Off”)

Figure 15: Display when the measurement exceeds Alarm Condition 1 Setpoint

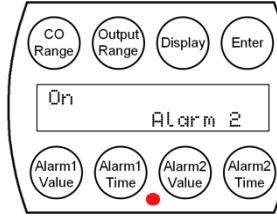
Alarm Condition 2 Display

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”)

Figure 16: Display when the measurement exceeds Alarm Condition 2 Setpoint

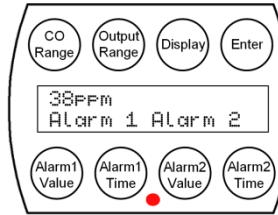
NOTE The Alarm 2 Setpoint may be equal to, greater than, or less than the Alarm 1 Setpoint.

Alarm Condition 1 and 2 Display

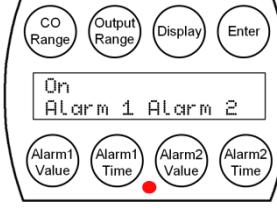
If the CO measurement exceeds the Alarm 1 and 2 setpoint:

- 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

NOTE The Alarm 2 Setpoint may be equal to, greater than, or less than the Alarm 1 Setpoint.



Alarm Condition 1 and 2
(Display set to “On”)



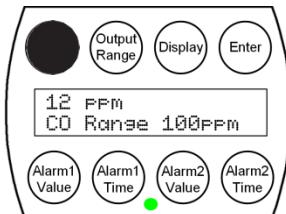
Alarm Condition 1 and 2
(Display set to “Off”)

Figure 17: Display when the measurement exceeds Alarm Condition 1 and 2 Setpoint

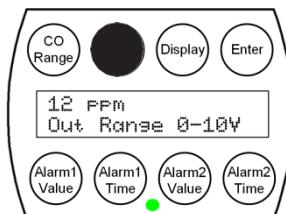
Specifications subject to change without notice.

Reviewing Parameter Settings

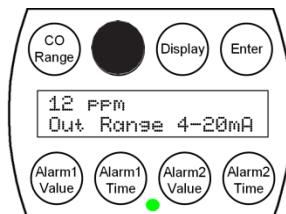
You can review the parameter settings at any time during normal operation by touching any of the eight buttons on the face of the unit. The following figures show a typical display when a button is touched. The values will display for 10 seconds and then the display will revert to normal.



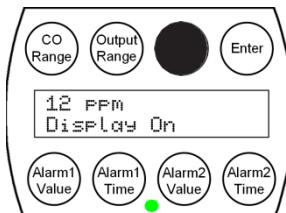
CO Range



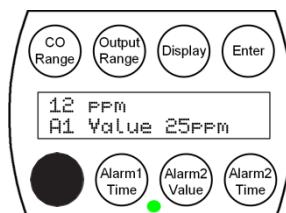
Output Range (0 to 10 Volts)



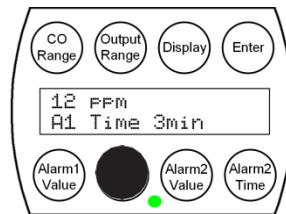
Output Range (4 to 20mA)



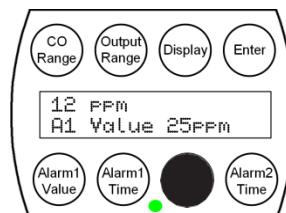
Display Mode



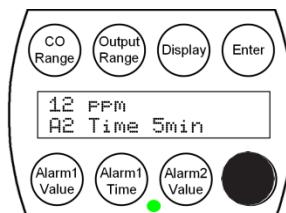
Alarm 1 Value



Alarm 1 Time



Alarm 2 Value



Alarm 2 Time

Figure 18: Parameter Settings

Specifications subject to change without notice.

Parameter Setup and Default Settings

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 Figure 19 below to change parameters.

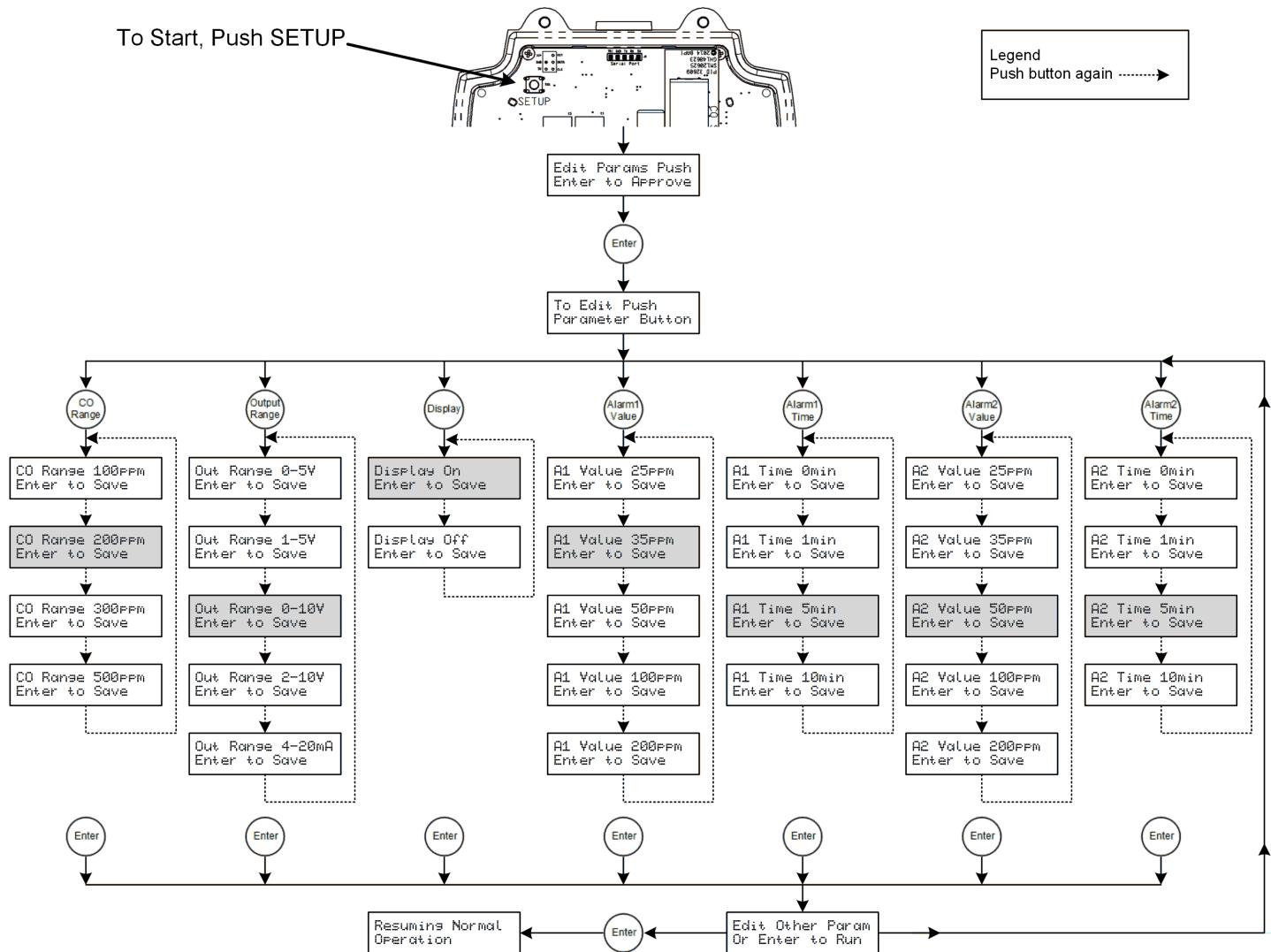


Figure 19: Parameter Setup Flow Chart
(Default settings are shown with gray shading)

Specifications subject to change without notice.

Calibration

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

The factory-calibrated CO sensor module is inexpensive to replace, negating the need for recalibration with expensive and inconvenient gas tanks, regulators, and laptop computer. See *Maintenance* below for instructions on replacing the CO sensor module.

Maintenance

The Carbon Monoxide Sensor 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.

Carrier recommends replacing the CO sensor module whenever the Replace Sensor alarm is active, every 7 years, or at the recalibration intervals required by the local jurisdiction. Factory calibrated replacement CO sensor modules are available from Carrier (Part #NSB-COS).

To replace the CO sensor module (Figure 20):

1. Remove the tamper resistant screws and open the lid.
2. Unplug the power connector.
3. For the next two steps, hold the CO sensor module by the body, not the endcaps.
4. Remove the CO sensor module by pulling it straight off the Sensor.
5. Plug in the new CO sensor module by pushing the sensor board straight into the Sensor.
6. Plug in the power connector.
7. Close the lid until it clicks, and replace the tamper resistant screws.

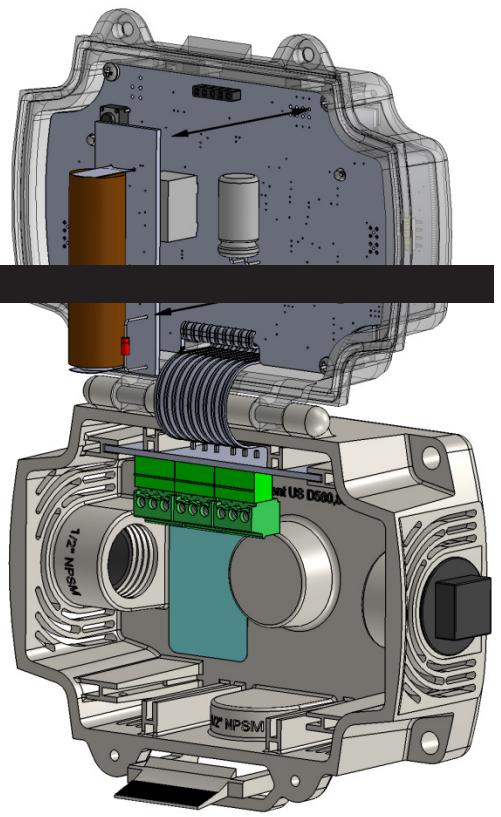


Figure 20: Inserting or Removing the CO Sensor Module

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.

- 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.

Unit does not operate

Additional Display Messages and Indication

| Display Message | LED | Indication |
|------------------------------|-----------------|---|
| Module not found retrying | Solid Red | CO 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 | CO sensor module failed self-test, replace the sensor module |
| Self-Test | Solid Yellow | CO sensor module is performing a self-test |