

#38960 – 1/10/19

Overview

The Nitrogen Dioxide (NO₂) Rough Service Sensor (Part #NSB-NO2-V-BB) offers enhanced electrochemical sensing with outstanding accuracy at low concentrations. The Duct unit (Part #NSB-NO2-D-BB) samples duct air using an aspiration tube. The Rough Service unit features a ventilated BB box and is ideal for parking ramps, equipment rooms and warehouses.

The sensor has field selectable NO₂ ranges and outputs, plus two independent SPDT alarm contacts that switch at field selectable NO₂ concentrations. An alarm timer holds the output relays on for a fixed time after the NO₂ level has fallen below 80% of setpoint. This allows additional fan run time to be sure that the NO₂ has been purged.

The LCD is backlit for 10 seconds after a button push. A status LED is green when the NO₂ is below the lowest relay setpoint. The LED turns red when an alarm relay is on.

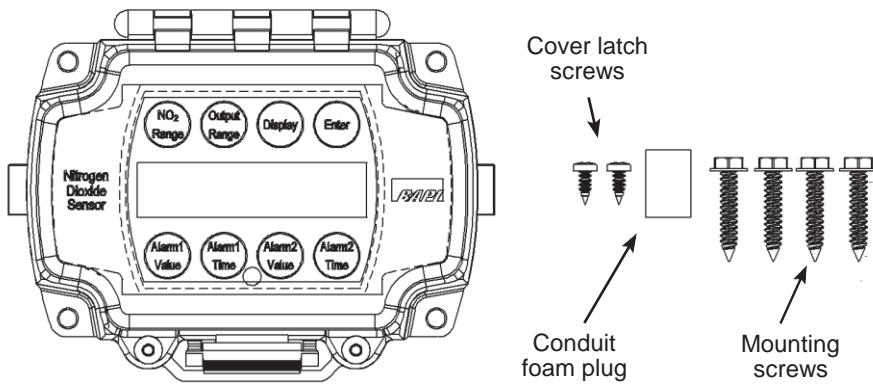


Figure 1: NO₂ Rough Service Sensor and parts

Specifications

Power

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

Field Selectable Ranges

0 to 2.5 ppm • 0 to 5.0 ppm
0 to 7.5 ppm • 0 to 10.0 ppm

Accuracy

±5% of full scale

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

1.0, 2.5, 5.0, 7.5, or 10 ppm

Alarm Timer

0, 1, 5, and 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 non-condensing

Sensor Module Life

7 years typical

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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 2. Failure to do so may degrade the life of the sensor module. Do not mount near supply or return diffusers.
2. Use #10 (M5) screws on the four mounting feet of the enclosure. A pilot-hole makes mounting easier. Use the enclosure mounting feet 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.

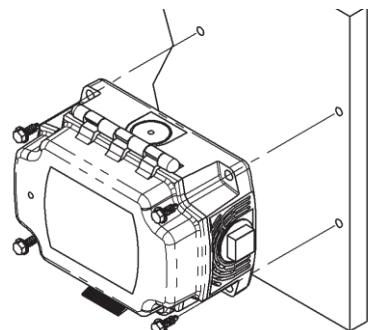


Figure 2: Rough Service Unit mounting

Duct Aspiration Tube Unit

1. Automatd Logic 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.
4. 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.
5. Snug the screws until the foam backing is compressed about 50% to prevent air leakage but do not over-tighten.
6. Use the provided #6 screws to secure the cover for IP66 rating.
7. **Error! Bookmark not defined.**recommends sealing the conduit opening with fiberglass insulation.

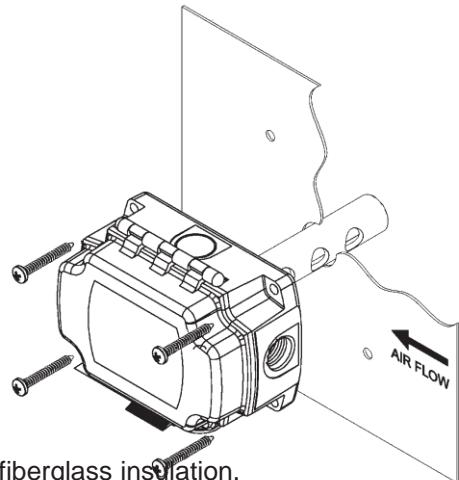
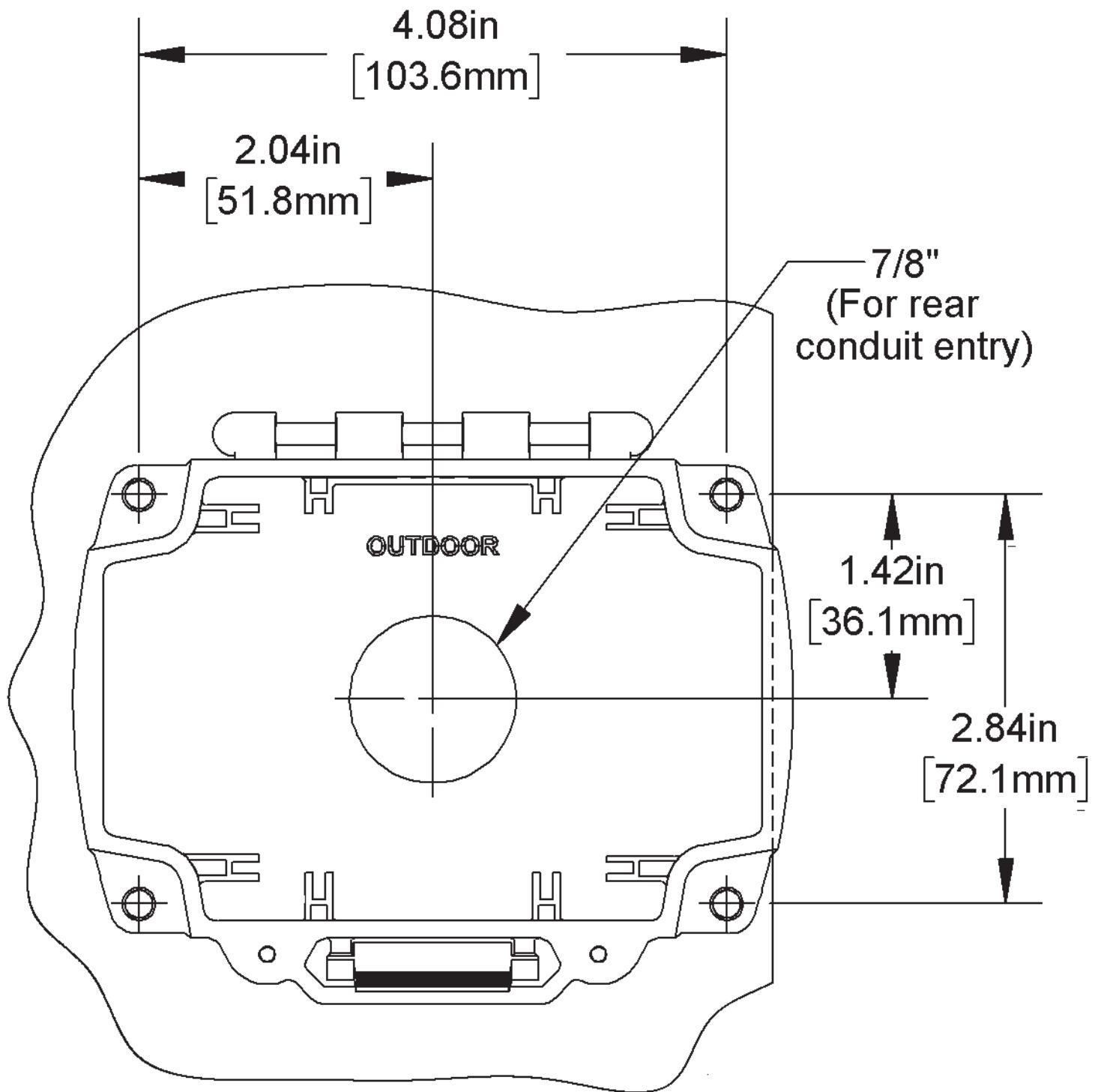


Figure 3: Duct Unit mounting

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Mounting Holes Template**Figure 4:** Screw Hole Template. Shown actual size.

Specifications subject to change without notice.

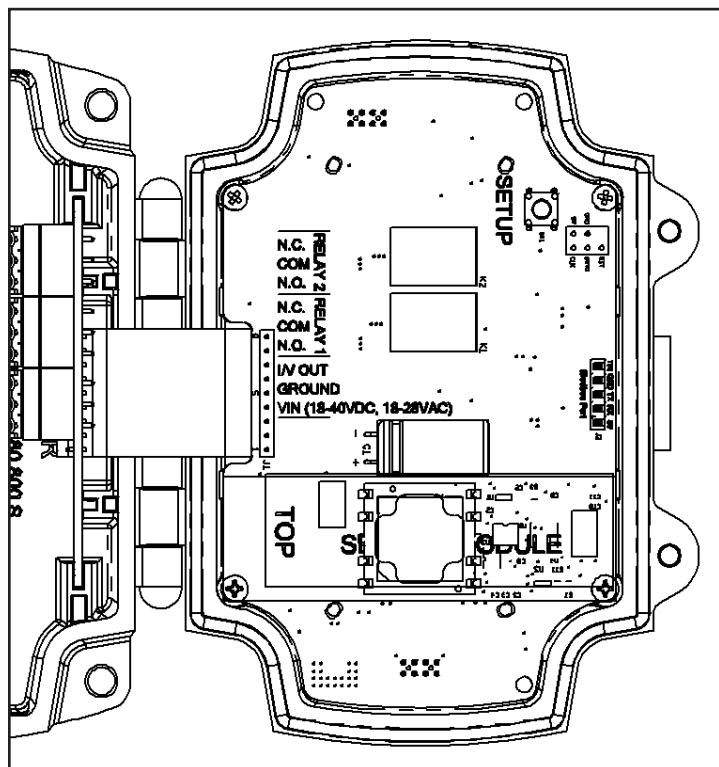
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Termination

Carrier® recommends using twisted pair of at least 22 AWG 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 Figure 5)



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.



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

IV 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

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 Air Tight After Termination

For the sensor to work correctly, the wiring entrance must remain air tight. 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 Nitrogen Dioxide.

Carrier recommends plugging the conduit at the enclosure. Included with the Nitrogen Dioxide transmitter is a foam plug to seal the ½ inch EMT. Place the wires into the plug as shown in Figure 6 and then insert the plug into the conduit sealing the conduit.

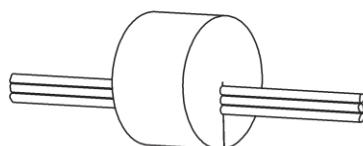


Figure 6:
Wires Through Foam Plug

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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.

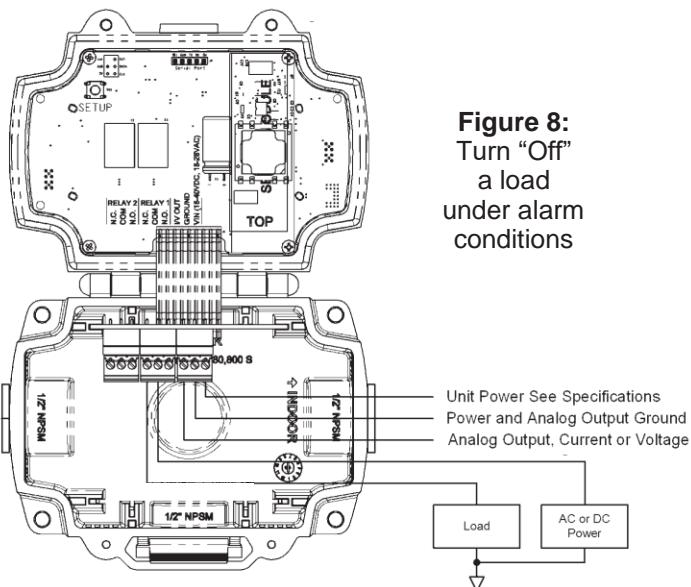
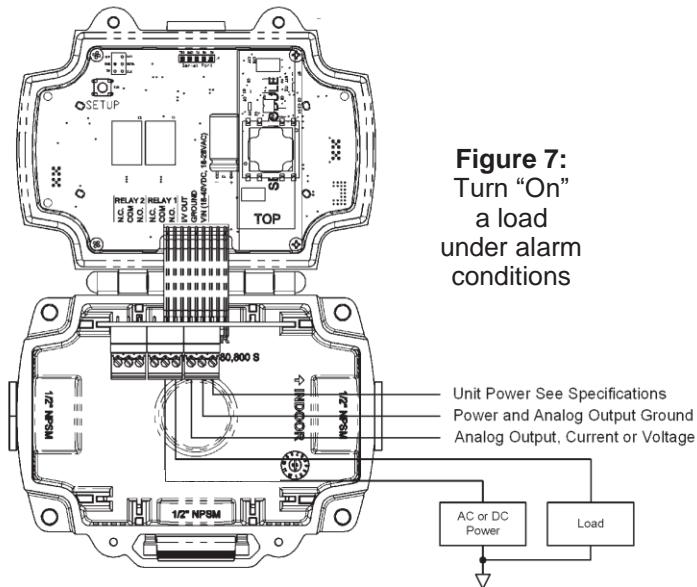
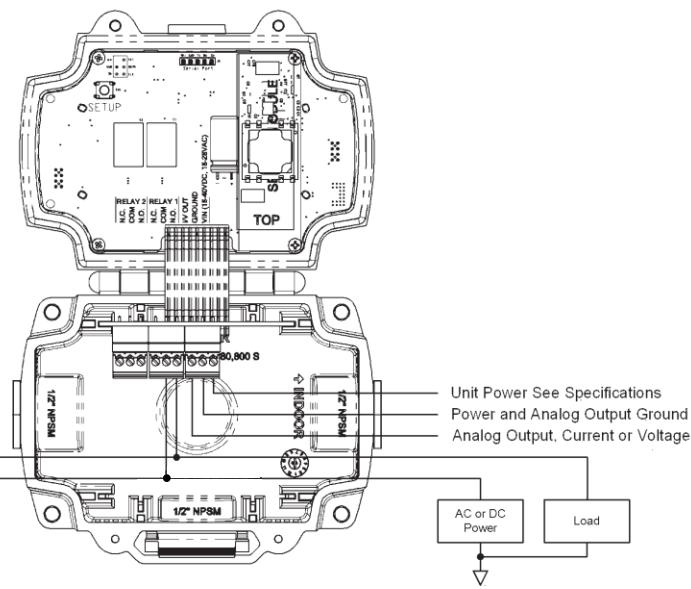
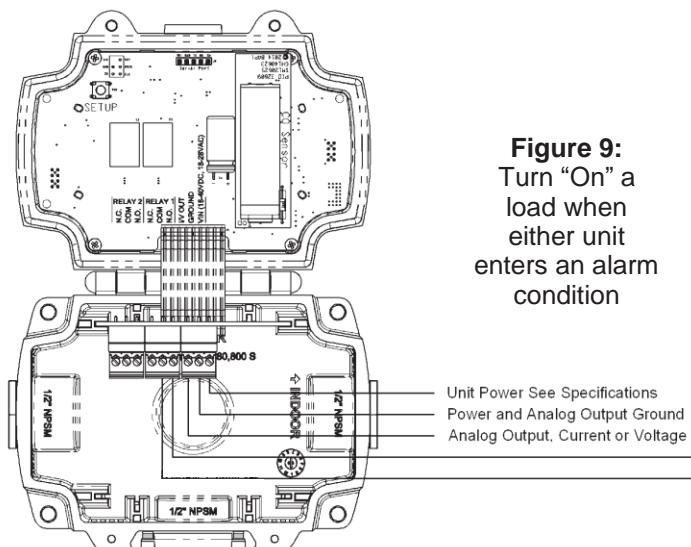


Figure 9 shows how two or more Nitrogen Dioxide or Carbon Monoxide Sensors may be interconnected to switch a load. This example shows how to turn on a load under alarm conditions. Similar circuitry may be used to turn off a load under alarm conditions. Figure 9 connects together the Normally Open terminals 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 Nitrogen Dioxide 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.



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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.

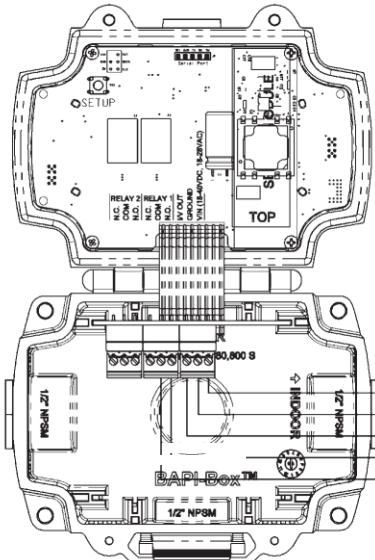


Figure 10:
Applying
ground
under
alarm
conditions

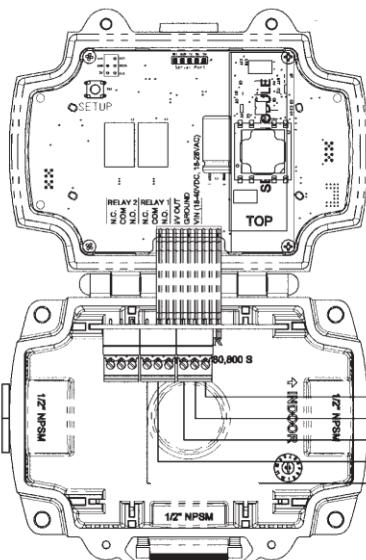


Figure 11:
Removing
ground
under
alarm
conditions

Power Up

During the first 10 minutes after applying power, the Nitrogen Dioxide 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 NO₂ sensor module's software version number;
- Displays the NO₂ sensor module's serial number;
- Displays the NO₂ sensor module's run time;
- Performs a NO₂ sensor module self-test;

When the NO₂ sensor module self-test is complete, the transmitter is operational.

Operation

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

Parameter Button	Function
 tip when	Review or select Nitrogen Dioxide measurement range used for analog output
 the user	Review or select analog output range
 parameters. The top	Review or select PPM display on or off
 NO2 measurement	View hidden values, verify edit mode, save edited configuration parameters, or end configuration parameter edit
	Review or select NO ₂ concentration to enable Alarm 1 relay
	Review or select number of minutes that Alarm 1 relay stays on after NO ₂ dissipates
	Review or select NO ₂ concentration to enable Alarm 2 relay
	Review or select number of minutes that Alarm 2 relay stays on after NO ₂ dissipates

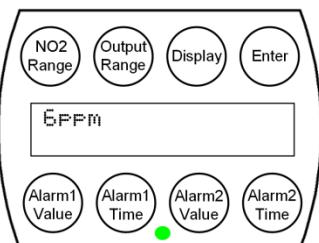
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Operation continued...

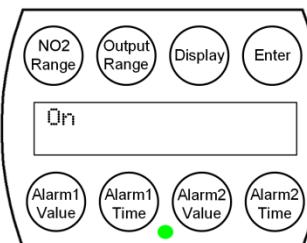
Display On and Display Off Modes

The top line of the display shows the NO₂ 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 NO₂ measurement. If the NO₂ measurement is below Alarm 1 or Alarm 2 levels, the LED will be green.



PPM Display "On" Mode

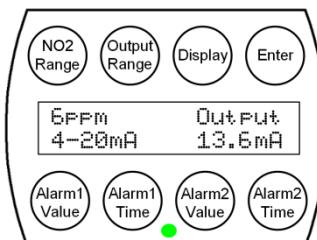
Figure 12:
Display During
Normal Operation
(Reading is below
NO₂ alarm value)



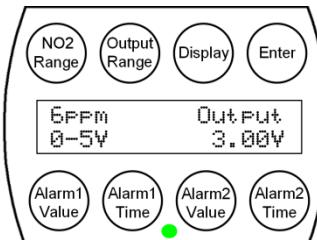
PPM Display "Off" Mode

Displaying the NO₂ Measurement, Analog Output Range and Analog Output Value

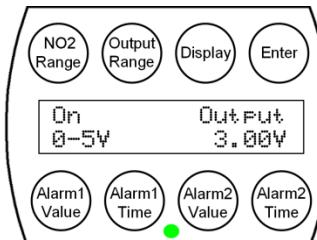
Touching the Enter button displays the Current Reading, the Analog Output Range and Analog Output Value for 10 seconds. The current reading is replaced by the word "On" if the display is set to "Off".



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



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



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

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

NO₂ Sensor Failure Display

The NO₂ 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

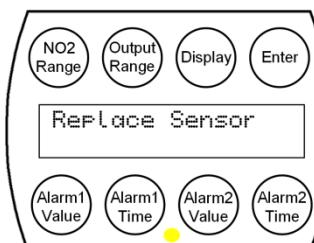


Figure 14: NO₂ Sensor Failure

Specifications subject to change without notice.

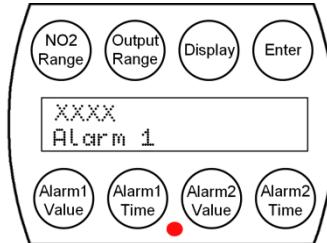
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Operation continued...

Alarm Condition 1 Display

If the NO₂ measurement exceeds the Alarm 1 setpoint:

- The NO₂ 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



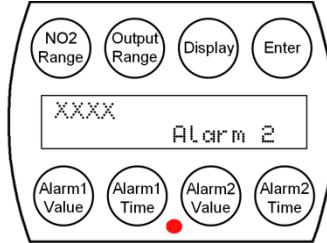
Alarm Condition 1

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

Alarm Condition 2 Display

If the NO₂ measurement exceeds the Alarm 2 setpoint:

- The NO₂ 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

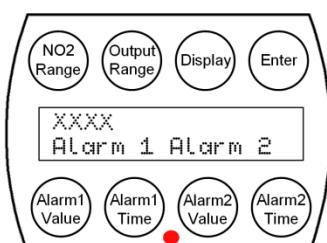
Figure 16: Display when the measurement exceeds Alarm Condition 2 Setpoint

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

Alarm Condition 1 & 2 Display

If the NO₂ measurement exceeds the Alarm 1 & 2 setpoint:

- The NO₂ 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



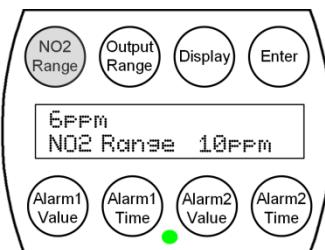
Alarm Condition 1 & 2

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

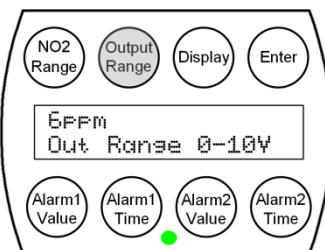
NOTE The Alarm 2 Setpoint may be equal to, greater than or less than the Alarm 1 Setpoint.

Reviewing Parameter Settings

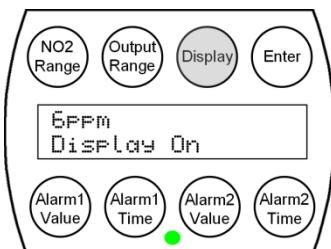
You can review the parameter settings at any time during normal operation by touching any of the eight buttons on the face of the unit. The following figures show a typical display when a button is touched. The values will display for 10 seconds and then the display will revert to normal.



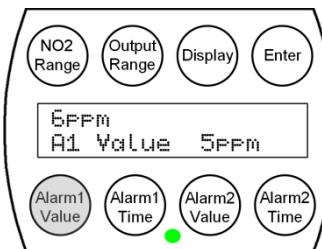
NO₂ Range



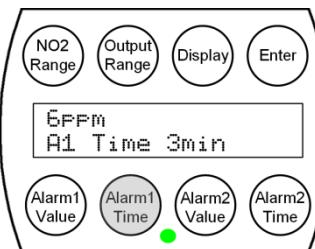
Output Range (0 to 10 Volts)



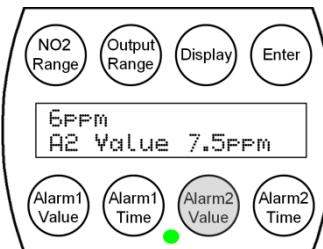
Display Mode



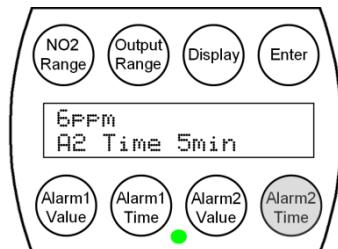
Alarm 1 Value



Alarm 1 Time



Alarm 2 Value



Alarm 2 Time

Figure 18: Parameter Settings

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.

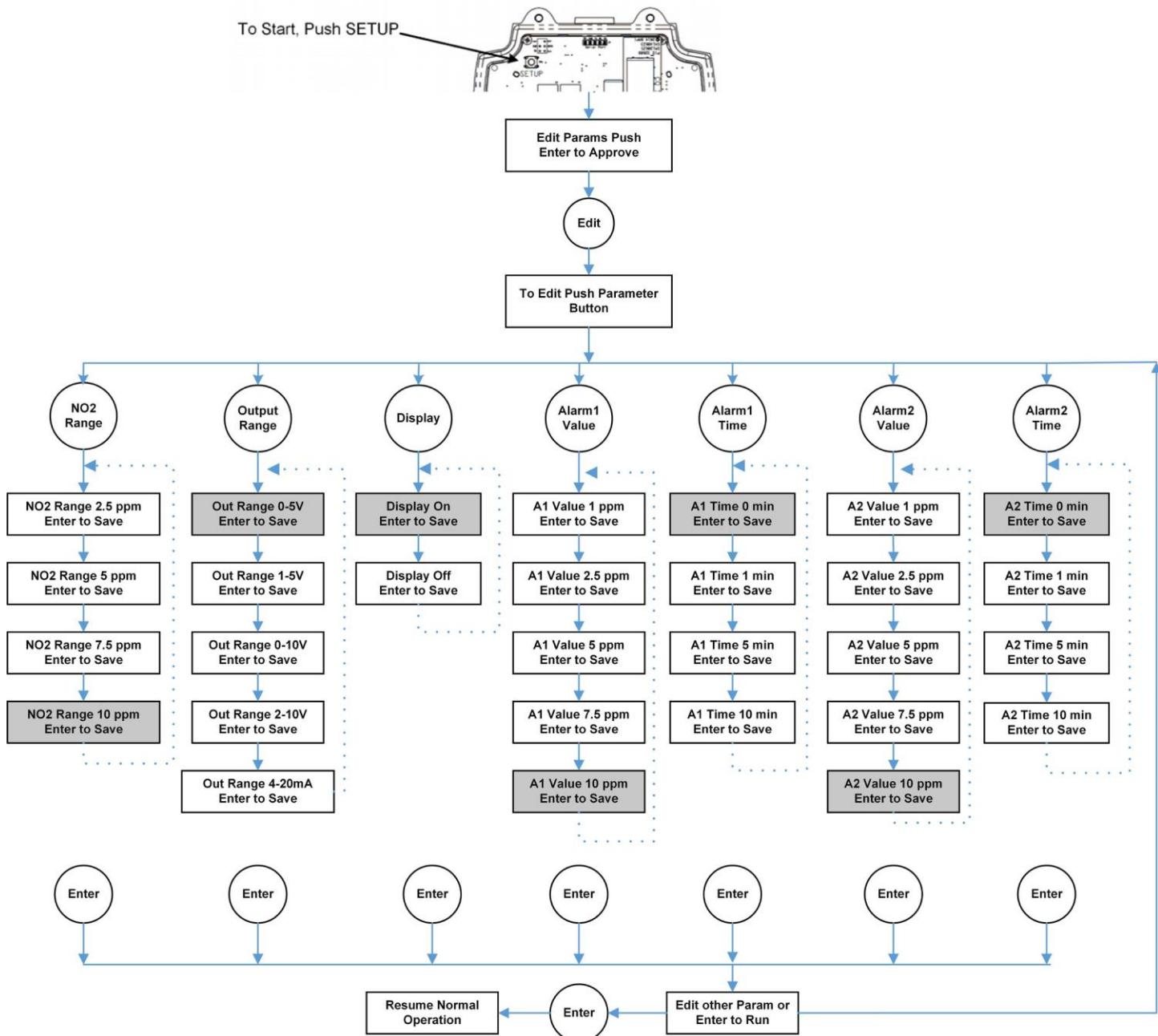


Figure 19:
Parameter Setup Flow Chart
(Default settings are shown with gray shading)

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Calibration

Every Nitrogen Dioxide Sensor is factory calibrated. Each unit is ready for operation after installation and the 10 minute start-up time.

The factory-calibrated NO₂ sensor module is designed for replacement, not field calibration.

Maintenance

The NO₂ 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 sensor module whenever the Replace Sensor alarm is active, every 7 years, or at the recalibration intervals required by the local jurisdiction. Replacement NO₂ sensor modules (Part #NSB-NO2S) are available from Carrier.

To replace the NO₂ 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 sensor module by the edges of the PCB.
4. Remove the two retention screws.
5. Plug in the new sensor module by pushing the sensor board straight into the Sensor.
6. Replace the two retention screws.
7. Plug in the power connector.
8. Close the lid until it clicks, and replace the tamper-resistant screws

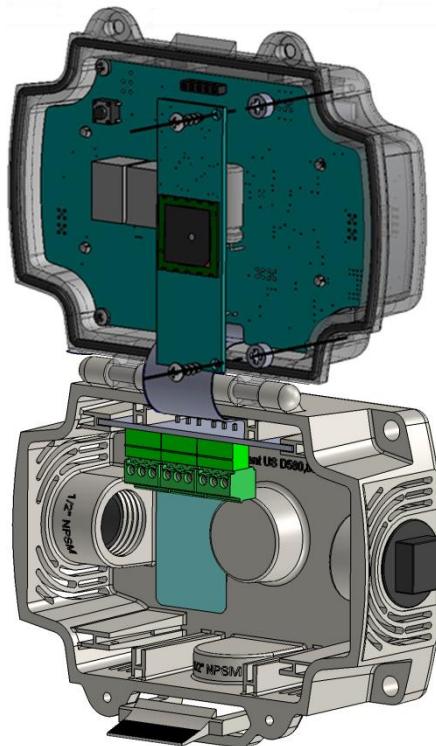


Figure 20: Inserting or
Removing the Sensor Module



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.
- Check the wiring between the unit and the controller. Label wires and terminals 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 10, 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 sensor and the power source.

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.