CO_2 Gas Sensor

(Order Code NavCO2)

The Forston Labs CO_2 Gas Sensor measures gaseous carbon dioxide levels by monitoring the amount of infrared radiation absorbed by carbon dioxide molecules. **Very important:** Do not place the sensor tube directly into any liquid. The sensor is intended only for measuring gaseous, not aqueous, CO_2 concentration.

It has two settings: low range (0–10,000 ppm) and high range (0–100,000 ppm). You can use the CO_2 Gas Sensor to measure the change in carbon dioxide levels for a variety of systems.

This sensor is equipped with circuitry that supports auto-ID.

Inventory of Items Included with the CO_2 Gas Sensor

Check to be sure that each of these items is included with your CO_2 Gas Sensor:

- CO_2 Gas Sensor
- 250 mL gas sampling bottle (Nalgene bottle with lid)
- CO_2 Gas Sensor booklet

Here is the general procedure to follow when using the CO_2 Gas Sensor:

1. Connect the CO_2 Gas Sensor to the interface.
2. The software will identify the CO_2 Gas Sensor and load a default data-collection setup. You are now ready to collect data.

Important Additional Information

- Allow the CO_2 Gas Sensor to warm up for about 90 seconds[1] before collecting data.
- The CO_2 Gas Sensor refreshes its reading every second, but the changes in its measurements are so gradual that the recommended sampling rate is 4 seconds per sample or slower. Gas must diffuse through the holes in the sensor tube before the sensor detects any changes in concentration. Because diffusion of gases is a slow process, there can be delays in the readings.
- The sensor cannot take readings at a CO_2 concentration higher than 10,000 ppm on the low setting and 100,000 ppm on the high setting. If the sensor is reading at or near these maximum values, the CO_2 concentration may be exceeding the maximum value for the setting.
- To collect data in a controlled environment, we recommend that you use the 250 mL Nalgene collection bottle that is included with your sensor.
- Because the sensor operates on the basis of reading IR radiation, you should avoid using the sensor in direct sunlight as much as possible. Even though the IR detector is shielded, it is best to avoid the possibility of reflected light affecting the readings by keeping the sensor in the shade when used outdoors.
- **Very important:** Do not place the sensor tube directly into any liquid. The sensor is intended only for measuring gaseous, not aqueous, CO_2 concentration.

[1] While the CO_2 Gas Sensor is warming up, you will see the readings start near 0 ppm and then slowly increase to the CO_2 level to which the sensor is exposed.

Specifications

Measurement range of CO_2 Gas Sensor:

Low range:	0 to 10,000 ppm CO_2
High range:	0 to 100,000 ppm CO_2

Typical Accuracy (at standard pressure, 1 atm):

Low range:	±100 ppm
High range:	±100 ppm

Typical Resolution:

0 to 10,000 ppm CO_2:	3 ppm
0 to 100,000 ppm CO_2:	30 ppm

Response time:	95% of full-scale reading in 120 seconds
Warm-up time:	90 seconds
Pressure effect:	0.19% of reading/mm of Hg from standard pressure
Output signal range:	0–4.0 V
Input potential:	5 V (±0.25 V)
Gas sampling mode:	diffusion
Normal operating temperature range:	25°C (±5°C)
Operating humidity range:	5–95% (non-condensing)
Storage temperature range:	-40 to 65°C

Stored Calibration: linear (y = bx + a)

Low Range	High Range
a = 0	a = 0
b = 2,500	b = 25,000

How the CO_2 Gas Sensor Works

The Forston Labs CO_2 Gas Sensor measures gaseous carbon dioxide levels in the range of 0 to 10,000 ppm (low range setting) or 0 to 100,000 ppm (high range setting) by monitoring the amount of infrared radiation absorbed by carbon dioxide molecules. The sensor uses an LED as the source to generate infrared radiation (IR). The IR source is located at one end of the sensor's shaft. At the other end of the shaft is an infrared sensor that measures how much radiation gets through the sample without being absorbed by the carbon dioxide molecules. The detector measures infrared radiation in the narrow band centered at 4260 nm. The greater the concentration of the absorbing gas in the sampling tube, the less radiation will make it from the source through the sensor tube to the IR detector. The temperature increase in the infrared sensor produces a voltage that is amplified and read by a Forston Labs interface. Carbon dioxide gas moves in and out of the sensor tube by diffusion through the twenty vent holes in the sensor tube.

The CO_2 Gas Sensor measures gaseous carbon dioxide concentration in units of parts per million, or ppm. In gaseous mixtures, 1 part per million refers to 1 part by volume in 1 million volume units of the whole. A concentration of 600 ppm for CO_2 would simply mean that there are 600 L of CO_2 gas for every 1,000,000 L of air (or 0.6 mL of CO_2 per 1 L of air). As a comparison, the level of carbon dioxide in the Earth's troposphere has gradually increased from 317 ppm in 1960 to current levels of nearly 380 ppm. Exhaled human breath has a carbon dioxide concentration of about 50,000 ppm.

Do I Need to Calibrate the CO_2 Gas Sensor? "No"

You should not have to perform a new calibration when using the CO_2 Gas Sensor. We have set the sensor to match our stored calibration before shipping it.

If you do find that you need to reset your CO_2 Gas Sensor, it can be reset using one known CO_2 level. **Note:** This calibration method is different from the usual two-point calibration performed with other Forston Labs sensors. To reset the CO_2 Gas Sensor in units of parts per million (ppm):

- The calibration will be based on a sample of outside air having a carbon dioxide concentration of about

380 ppm.[2] If you cannot actually perform the calibration outside, obtain outside air in the 250 mL collection bottle (included with your sensor). Either place it in the air outside your building long enough to ensure that its contents are replaced with fresh air, or fill it to the brim with water, take it outside and dump the water to ensure it is filled with fresh air. While still outdoors, insert the sensor into the gas sampling bottle containing fresh outside air. You can now take the bottle and sensor to the location where the calibration is to be done (either outside or back in the lab).

- Connect the CO_2 Gas Sensor to the LabNavigator. Start the data-collection program. Let the sensor warm up for at least 90 seconds.
- When the CO_2 Gas Sensor has warmed up (readings should have stabilized), use a paper clip to press down the calibration button. Release the button as soon as the red light starts to blink. After about 30 seconds, the reading should stabilize at a value of approximately 380 ppm (±40 ppm). If the reading is significantly lower or higher than 380 ppm, simply press the button again to repeat the process.

Temperature Considerations

The CO_2 Gas Sensor is somewhat sensitive to temperature changes. In most cases, variations in CO_2 readings due to temperature changes are small (<100 ppm on Low Range, <1000 ppm on High Range). With good experimental design, the variation in CO_2 readings due to a temperature change will be negligible compared to the overall change in CO_2 concentration. If an entire analysis is to be conducted at a constant temperature, you could improve the accuracy of the readings by calibrating the sensor at that temperature. The sensor is designed to operate between 20°C and 30°C. It can be used outside of this temperature range; however, the readings will be less accurate, even if you calibrate the sensor at the lower or higher temperature. This does not prohibit taking readings using incubation temperatures or outdoor readings at temperatures warmer or colder than the 20 to 30°C range. Allow enough time for your CO_2 Gas Sensor to stabilize at the desired operating temperatures.

Warranty

Forston Labs warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. This warranty does not cover damage to the product caused by abuse or improper use.

FORSTON LABS

Measure.Analyze.Record
Forston Labs
4098 Trouble Trail • Fort Collins, CO 80524
Toll Free (8˜00) 301-1259 • (970) 237-4395 • FAX (970) 237-3347
info@forstonlabs.com • www.forstonlabs.com

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[2]The carbon dioxide concentration in the Earth's atmosphere has steadily increased to an average level of 380 ppm in 2006 according to the Earth Institute at Columbia University. Levels in your area may be slightly higher due to localized influences such as automobile or industrial emissions of carbon dioxide.