

# Go Direct<sup>®</sup> CO<sub>2</sub> Gas (Order Code GDX-CO2)



Go Direct CO<sub>2</sub> Gas measures carbon dioxide concentration, temperature, and relative humidity. This sensor includes built-in temperature compensation and humidity protection. A 250 mL Nalgene bottle is included for running controlled experiments with small plants and animals.

Go Direct CO<sub>2</sub> Gas is ideal for the following experiments:

- Measure the change in CO<sub>2</sub> gas concentration during cellular respiration.
- Measure the change in CO<sub>2</sub> gas concentration during photosynthesis.
- Study the effect of temperature on cell respiration or metabolism of organisms.
- Study how yeast metabolize different sugars.
- Investigate artificial selection by comparing respiration rates of different yeast strains.

**Note:** Vernier products are designed for educational use. Our products are not designed nor are they recommended for any industrial, medical, or commercial process such as life support, patient diagnosis, control of a manufacturing process, or industrial testing of any kind.

## What's Included

- Go Direct CO<sub>2</sub> Gas
- Micro USB Cable
- 250 mL Nalgene Bottle w/Lid

## Compatible Software

See [www.vernier.com/manuals/gdx-co2](http://www.vernier.com/manuals/gdx-co2) for a list of software compatible with Go Direct CO<sub>2</sub> Gas.

## Getting Started

Please see the following link for platform-specific connection information:

[www.vernier.com/start/gdx-co2](http://www.vernier.com/start/gdx-co2)

### Bluetooth Connection

1. Install Graphical Analysis 4 on your computer, Chromebook™, or mobile device. See [www.vernier.com/ga4](http://www.vernier.com/ga4) for software availability.
2. Charge your sensor for at least 2 hours before first use.
3. Turn on your sensor by pressing the power button once. The

### USB Connection

1. If using a computer or Chromebook, install Graphical Analysis 4. If using LabQuest 2, make sure LabQuest App is up to date. See [www.vernier.com/ga4](http://www.vernier.com/ga4) for Graphical Analysis 4 availability or [www.vernier.com/downloads](http://www.vernier.com/downloads) to update LabQuest App.
2. Connect the sensor to the USB port.

3. Launch Graphical Analysis 4 or turn on LabQuest 2. You are now ready to collect data.
4. This is a multi-channel sensor. To change the default channel selections, see [www.vernier.com/start/gdx-co2](http://www.vernier.com/start/gdx-co2)
- Bluetooth<sup>®</sup> LED will blink red.
4. Launch Graphical Analysis 4.
5. Click or tap Sensor Data Collection.
6. Click or tap your Go Direct sensor from the list of Discovered Wireless Devices. Your sensor's ID is located near the barcode on the sensor. The Bluetooth LED will blink green when it is successfully connected.
7. This is a multi-channel sensor. The active channel is listed in the Connected Devices Sensor Channels list. To change channels, select the check box next to the Sensor Channel(s) you would like to activate.
8. Click or tap Done to enter data-collection mode.

## Charging the Sensor

Connect Go Direct CO<sub>2</sub> Gas to the included Micro USB Cable and any USB device for two hours.

You can also charge up to eight Go Direct CO<sub>2</sub> Gas Sensors using our Go Direct Charge Station, sold separately (order code: GDX-CRG). An LED on each Go Direct CO<sub>2</sub> Gas indicates charging status.

Charging	Blue LED on steady while sensor is connected to the Micro USB Cable or Charge Station.
Fully charged	Blue LED is off when charging is complete.

## Powering the Sensor

Turning on the sensor	Press button once. Red LED indicator flashes when unit is on.
Putting the sensor in sleep mode	Press and hold button for more than three seconds to put into sleep mode. Red LED indicator stops flashing when sleeping.

## Connecting the Sensor

See the following link for up-to-date connection information:

[www.vernier.com/start/gdx-co2](http://www.vernier.com/start/gdx-co2)

Connected and charging	Blue and Green LED solid when sensor is connected to Graphical Analysis via USB and unit is charging. (Green LED is obscured by the blue one.)
Connected, fully charged	Green LED solid when sensor is connected to Graphical Analysis via USB and the unit is fully charged.
Charging via USB, connected via Bluetooth	Blue LED is solid and green LED is flashing, but the green flashing LED looks white because it is overwhelmed by the blue.

### Identifying the Sensor

When two or more sensors are connected, the sensors can be identified by tapping or clicking Identify in Sensor Information.

### Using the Product

Connect the sensor following the steps in the Getting Started section of this user manual.

#### Channels

Go Direct CO<sub>2</sub> Gas has three measurement channels:

- CO<sub>2</sub> Gas
- Temperature
- Relative Humidity

#### CO<sub>2</sub> Gas

This channel measures the carbon dioxide concentration in the air. Units can be changed from parts per million (ppm) to parts per thousand (ppt), percent (%), or mg/m<sup>3</sup>. See [www.vernier.com/tit/3845](http://www.vernier.com/tit/3845) for more information. The readings are temperature compensated regardless of whether the temperature channel is activated. This is the default channel that is active when the sensor is connected.

#### Temperature

This channel measures air temperature inside the sensor. Units can be changed from °C to °F or K. This channel is not active by default when the sensor is connected.

#### Relative Humidity

This channel measures the relative humidity of the air. It is not used to compensate CO<sub>2</sub> gas readings. This channel is not active by default when the sensor is connected.

## Calibrating the Sensor

### CO<sub>2</sub> Gas

The CO<sub>2</sub> Gas sensor is factory calibrated. For many experiments, it will not be necessary to calibrate this sensor when using this channel. However, for best accuracy, the sensor can be calibrated using a one-point calibration based on a sample of outside air. Atmospheric air typically has a carbon dioxide concentration of around 400 ppm. Actual levels in your area may be slightly higher due to localized influences such as automobile or industrial emissions of carbon dioxide. To calibrate Go Direct CO<sub>2</sub> Gas

1. Fill the 250 mL Nalgene bottle to the brim with water, take it outside, and dump the water to ensure it is then filled with fresh air. While still outdoors, insert the sensor into the gas sampling bottle that now contains fresh outside air. Take the bottle and sensor to where the calibration will be done.
2. Start the software and identify your sensor, if necessary. Let the sensor warm up for at least 180 seconds before continuing.
3. When the sensor has warmed up (readings should have stabilized), calibrate the sensor using a one-point calibration. Enter a value of 400 ppm for the sample of air collected. Once finished, the sensor should read very close to 400 ppm.

### Temperature

The temperature sensor is factory calibrated and cannot be calibrated by the user.

### Humidity

The relative humidity sensor is factory calibrated and cannot be calibrated by the user.

## Specifications

CO <sub>2</sub> Sensor	
Type	NDIR
Range	0–100,000 ppm
Accuracy	0 to 1,000 ppm ±100 ppm 1,000 to 10,000 ppm ±5% of reading +100 ppm 10,000 to 50,000 ppm ±10% of reading 50,000 to 100,000 ppm ±15% of reading
Resolution	1 ppm CO <sub>2</sub>
Warm-up time	180 seconds
Gas sampling mode	diffusion
Temperature Sensor	
Type	IC

Accuracy	±0.5°C
Resolution	0.1°C
Relative Humidity Sensor	
Type	IC
Range	0 to 100% (non-condensing)
Accuracy	±5% or better
Resolution	0.1%
USB specification	2.0
Wireless specification	Bluetooth 4.2
Maximum wireless range	30 m unobstructed
Battery	650 mA Li-Poly
Battery life (single full charge)	~8 hours
Battery life (long term)	~500 full charge cycles (several years depending on usage)
Normal operating temperature range	20 to 40°C
Operating humidity range	5 to 95% (non-condensing)
Dimensions	Sensor tube: 38 mm length, 28 mm OD; total length: 155 mm

## Care and Maintenance

### Battery Information

Go Direct CO<sub>2</sub> Gas contains a small lithium-ion battery. The system is designed to consume very little power and not put heavy demands on the battery. Although the battery is warranted for one year, the expected battery life should be several years. Replacement batteries are available from Vernier (order code: GDX-BAT-650).

### Storage and Maintenance

To store Go Direct CO<sub>2</sub> Gas for extended periods of time, put the device in sleep mode by holding the button down for at least three seconds. The red LED will stop flashing to show that the unit is in sleep mode. Over several months, the battery will discharge but will not be damaged. After such storage, charge the device for a few hours, and the unit will be ready to use.

Exposing the sensor to temperatures below -15°C or over 45°C will damage the sensor. Additionally, temperatures over 35°C (95°F) will reduce the battery's

lifespan. If possible, store the device in an area that is not exposed to temperature extremes.

**Note:** It is recommended that you wash the Nalgene bottle by hand. Most dishwashers will melt plastic bottles.

### Water Resistance

**Important:** Go Direct CO<sub>2</sub> Gas is neither waterproof, nor is it water resistant, and should never be immersed in water.

If any liquid gets into the device, immediately power the unit down (press and hold the power button for more than three seconds). Disconnect the sensor and charging cable, and remove the battery. Allow the device to dry thoroughly before attempting to use the device again. Do not attempt to dry using an external heat source.

**Note:** Damage due to liquid is not covered under warranty.

## How the Sensor Works

Go Direct CO<sub>2</sub> Gas measures gaseous carbon dioxide levels in the range of 0 to 100,000 ppm by monitoring the amount of infrared radiation absorbed by carbon dioxide molecules. Carbon dioxide gas moves in and out of the sensor tube by diffusion through the vent holes in the sensor tube. The sensor uses a small light 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 CO<sub>2</sub> gas in the sampling tube, the less radiation will make it from the source through the sensor tube to the IR detector.

The sensor also measures air temperature in the sensor shaft using a thermistor in an integrated circuit. When the temperature increases, the resistance of the thermistor decreases. The circuit measures the resistance value at a particular temperature and converts this to a digital signal.

Relative humidity is measured in the sensor shaft using an integrated circuit that uses a capacitive polymer to sense humidity. The circuit produces a signal which varies with relative humidity.

## Troubleshooting

- **Very important:** Do not place the sensor into any liquid. The sensor is intended only for measuring gaseous, not aqueous, CO<sub>2</sub> concentration.
- Allow the sensor to warm up for at least 180 seconds before use. The warm-up process begins when the sensor is charging, connected to a USB port, or connected to software via Bluetooth wireless technology.
- The sensor is sensitive to high humidity. Do not use in a condensing environment.

- The sensor has built-in temperature compensation but the sensor can still be sensitive to rapid and/or large changes in temperature. The sensor is designed to operate best between 20 and 40°C. This does not prohibit the sensor from being used in temperatures outside this range. Just allow enough time for the sensor to stabilize at the desired air temperature. For more accurate results, the sensor can be calibrated at the temperature used.
- The recommended sampling rate is 0.5 samples per second or slower for this sensor. This allows the sensor to average a set of measurements before reporting a value. 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 a delay in response time.
- To collect data in a controlled environment, it is recommended that you use the 250 mL Nalgene bottle that is included with this sensor.
- To collect data simultaneously with Go Direct CO<sub>2</sub> Gas and Go Direct O<sub>2</sub> Gas, it is recommended that you purchase either the BioChamber 250 (250 mL capacity) or the BioChamber 2000 (2 L capacity). Each BioChamber has a second opening with a grommet so that you can insert two probes at once.
- 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.
- If the reported CO<sub>2</sub> gas concentration appears to be incorrect (after the 180 second warm up), calibrate the sensor as described in the Calibration section. Keep in mind that indoor CO<sub>2</sub> gas concentration can vary a great deal and that there can be unit to unit variability of up to 200 ppm CO<sub>2</sub> between sensors.
- If the sensor is reading at or near the maximum range of the sensor, the CO<sub>2</sub> concentration may be exceeding the maximum range of the sensor. Place the sensor in outside air or in ambient room air and wait for the readings to decrease.
- If there is no change in CO<sub>2</sub> gas concentration during an experiment, it may be the experiment and not the sensor. Test the sensor by removing it from the reaction chamber and gently blowing on the shaft to see if it responds to exhaled air.

For more troubleshooting and FAQs, see [www.vernier.com/til/4128](http://www.vernier.com/til/4128)

## Repair Information

If you have followed the troubleshooting steps and are still having trouble with your Go Direct CO<sub>2</sub> Gas, contact Vernier Technical Support at [support@vernier.com](mailto:support@vernier.com) or call 888-837-6437. Support specialists will work with you to determine if the unit needs to be sent in for repair. At that time, a Return Merchandise Authorization (RMA) number will be issued and instructions will be communicated on how to return the unit for repair.

## Accessories/Replacements

Item	Order Code
BioChamber 250	BC-250
BioChamber 2000	BC-2000
250 mL Nalgene Bottle w/Lid	CO2-BTL
Micro USB Cable	CB-USB-MICRO
USB-C to Micro USB Cable	CB-USB-C-MICRO
Go Direct 650 mAh Replacement Battery	GDX-BAT-650

## Warranty

Vernier warrants this sensor to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer (bottle and lid are excluded). This warranty does not cover damage to the product caused by abuse or improper use. This warranty covers educational institutions only.

## Disposal

When disposing of this electronic product, do not treat it as household waste. Its disposal is subject to regulations that vary by country and region. This item should be given to an applicable collection point for the recycling of electrical and electronic equipment. By ensuring that this product is disposed of correctly, you help prevent potential negative consequences on human health or on the environment. The recycling of materials will help to conserve natural resources. For more detailed information about recycling this product, contact your local city office or your disposal service.

Battery recycling information is available at [www.call2recycle.org](http://www.call2recycle.org)

Do not puncture or expose the battery to excessive heat or flame.



The symbol, shown here, indicates that this product must not be disposed of in a standard waste container.

## Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

### FCC Caution

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) this device may not cause harmful interference and
  - (2) this device must accept any interference received, including interference that may cause undesired operation
- RF Exposure Warning

The equipment complies with RF exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. You are cautioned that changes or modifications not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

## IC Statement

This device complies with Industry Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:

(1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

**Industry Canada - Class B** This digital apparatus does not exceed the Class B limits for radio noise emissions from digital apparatus as set out in the interference-causing equipment standard entitled "Digital Apparatus," ICES-003 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause interference, and

(2) this device must accept any interference, including interference that may cause undesired operation of the device.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

**RF exposure warning:** The equipment complies with RF exposure limits set forth for an uncontrolled environment. The antenna(s) used for this transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) l'appareil ne doit pas produire de brouillage, et

(2) l'appareil doit accepter toute interférence radioélectrique, même si cela résulte à un brouillage susceptible d'en compromettre le fonctionnement.

Cet appareil numérique respecte les limites de bruits radioélectriques applicables aux appareils numériques de Classe B prescrites dans la norme sur le matériel interférant-brouilleur: "Appareils Numériques," NMB-003 édictée par Industrie Canada. L'utilisation est soumise aux deux conditions suivantes:

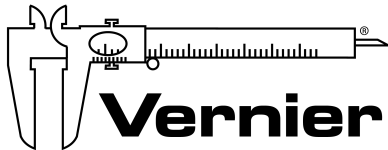
(1) cet appareil ne peut causer d'interférences, et

(2) cet appareil doit accepter toutes interférences, y comprises celles susceptibles de provoquer un dysfonctionnement du dispositif.

Afin de réduire les interférences radio potentielles pour les autres utilisateurs, le type d'antenne et son gain doivent être choisis de telle façon que l'équivalent de puissance isotrope émise (e.i.r.p) n'est pas plus grand que celui permis pour une communication établie.

**Avertissement d'exposition RF:** L'équipement est conforme aux limites d'exposition aux RF établies pour un environnement non supervisé. L'antenne (s) utilisée pour ce transmetteur ne doit pas être jumelée ou fonctionner en conjonction avec toute autre antenne ou transmetteur.

**Note:** This product is a sensitive measurement device. For best results, use the cables that were provided. Keep the device away from electromagnetic noise sources, such as microwaves, monitors, electric motors, and appliances.



**MEASURE. ANALYZE. LEARN.™**

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