Go Direct®
O_2 Gas
(Order Code GDX-O2)

Go Direct O_2 Gas measures gaseous oxygen concentration and air temperature. This sensor has a wide measurement range, which is ideal for studying human and cellular respiration. A 250 mL Nalgene bottle is included for running controlled experiments with small plants and animals.

Go Direct O_2 Gas can be used in a variety of experiments:

- Test catalase activity under various conditions.
- Measure oxygen consumption at rest and after exercise.
- Measure the change in O_2 gas produced during photosynthesis.
- Compare the rates of cell respiration in germinating and non-germinating peas.

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 O_2 Gas
- Micro USB Cable
- 250 mL Nalgene Bottle w/Lid

Compatible Software

See **www.vernier.com/manuals/gdx-o2** for a list of software compatible with Go Direct O_2 Gas.

Quick Start: Vernier Graphical Analysis® and Bluetooth®

1. Charge your sensor for at least 2 hours before first use.
2. Turn on your sensor. The LED will blink red.
3. Launch Graphical Analysis, then click **Sensor Data Collection**.
4. Select your sensor from the list. The sensor ID is located on the sensor label near the bar code. **Note**: If you don't see a list of available sensors, click **WIRELESS**. After selecting your sensor, click **Pair**.
5. This is a multi-channel sensor. Click **SENSOR CHANNELS** and select the channel(s) you want to use.
6. Click **DONE**. You are now ready to collect data.

Using other Vernier data-collection apps or want to connect via USB?

Visit **www.vernier.com/start-go-direct**

Note: This sensor also works with LabQuest 2 and LabQuest 3; it does not work with the original LabQuest.

Charging the Sensor

Connect Go Direct O_2 Gas to the included Micro USB Cable and any USB device for two hours.

You can also charge up to eight Go Direct O_2 Gas Sensors using our Go Direct Charge Station, sold separately (order code: GDX-CRG). An LED on each Go Direct O_2 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-o2

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 Quick Start section of the user manual.

Note: For best results, keep the sensor upright as much as possible during use. Reading may drift if used in a horizontal position.

Channels

Go Direct O_2 Gas has three measurement channels:

- O_2 Gas
- O_2 Gas - rTC
- Temperature

O_2 Gas

This channel measures the oxygen concentration in the air. Units can be changed from percent (%) to parts per thousand (ppt), parts per million (ppm), or or mg/m^3. See **www.vernier.com/til/3846** for more information. There is built-in temperature compensation on this channel that is most effective for slow temperature changes. For rapid temperature changes, consider using the O_2 Gas - rTC channel. O_2 Gas is the default channel that is active when the sensor is connected.

O_2 Gas - rTC

This channel measures oxygen gas concentration, but in addition to the built-in temperature compensation, it uses the on-board thermistor to apply a rapid temperature correction to the oxygen gas reading. This channel should only be used in experiments where starting conditions will be at room temperature and where rapid changes in temperature are likely to occur. Units can be changed from percent (%) to parts per thousand (ppt), parts per million (ppm), or mg/m^3. See **www.vernier.com/til/3846** for more information. This channel is not active by default when then the sensor is connected.

Temperature

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

Videos

View videos related to this product at **www.vernier.com/gdx-o2**

Calibrating the Sensor

O_2 Gas

The sensor is factory calibrated. For many experiments, it will not be necessary to calibrate. However, for best accuracy, the sensor can be calibrated using a one-point calibration using a known concentration of atmospheric oxygen. Enter a value of 20.9% oxygen or a corrected value from the table in the Effect of Humidity section of this user manual. Once finished, the sensor should read 20.9% (or the value entered in the table).

O_2 Gas - rTC

The channel is factory calibrated. For many experiments, it will not be necessary to calibrate the sensor when using this channel. However, for more accurate measurements, the channel can be calibrated using the instructions in the O_2 Gas section of this user manual.

Temperature

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

Effect of Humidity

Because the oxygen concentration varies with the amount of water vapor in the atmosphere, you may want to adjust your atmospheric oxygen calibration value to improve accuracy when using the sensor. The accepted value of 20.9% for atmospheric oxygen levels is calculated in dry air (0% relative humidity). If you know the relative humidity of the location at which you are calibrating, you can substitute one of the values in the table below in place of 20.9%. You can also use the formula below to calculate the corrected oxygen level for calibration. Oxygen concentration decreases linearly as humidity increases. The formula that describes this relationship is

$y = –0.008x + 20.9$, where y = corrected oxygen concentration and x = measured relative humidity.

Relative humidity (%)	0	25	50	75	100
Oxygen (%)	20.9	20.7	20.5	20.3	20.1

Specifications

Oxygen Sensor	
Type	Electrochemical cell
Range	0–100% (0–1000 ppt) O_2
Accuracy (at standard pressure 760 mm Hg)	±1% O_2
Resolution	0.01% O_2
Response time	~12 seconds to 90% of final value
Warm-up time	Less than 5 seconds to 90% of final value
Pressure effect	Directly proportional Pressure range: 0.5 atm to 1.5 atm
Gas sampling mode	Diffusion
Temperature Sensor	
Type	Thermistor
Accuracy	±1°C
Resolution	0.1°C
Wireless specification	Bluetooth 4.2
USB specification	2.0
Maximum wireless range	30 m unobstructed
Battery	650 mA
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 (above 35°C will shorten battery life)
Operating humidity range	0 to 95% RH
Dimensions	Sensor tube: 38 mm length, 28 mm OD; total length: 155 mm

Care and Maintenance

Battery Information

Go Direct O_2 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

Important: Go Direct O_2 Gas must be stored upright when not in use. Failure to store upright will shorten the life of the sensor and void the warranty.

To store Go Direct O_2 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 for 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 O_2 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 liquids is not covered under warranty.

How the Sensor Works

Go Direct O_2 Gas measures the oxygen concentration in the range of 0 to 100% using an electrochemical cell. The cell contains a lead anode and a gold cathode immersed in an electrolyte. Oxygen molecules entering the cell are electrochemically reduced at the gold cathode. This electrochemical reaction generates a current that is proportional to the oxygen concentration between the electrodes. A thermistor inside the electrochemical cells adjusts the output current to control for slow changes in cell temperature. An amplifier converts the current to a digital signal.

The sensor also measures air temperature using a thermistor located in the base of the sensor shaft. When the temperature increases, the resistance of the thermistor decreases. A circuit in the sensor measures the resistance value at a particular

temperature and converts the resistance using the Steinhart-Hart equation. Our programs perform this conversion to provide readings in °C (or other units). This thermistor is also used to adjust the output of the O_2 Gas - rTC channel, providing rapid temperature compensated measurements of oxygen gas concentration.

Troubleshooting

- **Very important:** Do not place the sensor into any liquid. The sensor is intended only for measuring gaseous, not aqueous, O_2 concentration.
- **Important:** Go Direct O_2 Gas must be stored upright when not in use. Failure to store upright will shorten the life of the sensor and void the warranty.
- The sensor is sensitive to high humidity. Do not use in a condensing environment.
- The temperature sensor is very sensitive. Holding the sensor in your hand can cause an increase in temperature readings and change the O_2 gas value on the O_2 - rTC channel. For best results, hold the sensor by its base, close to the charging port.
- 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 1 sample 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, we recommend that you use the 250 mL Nalgene collection bottle that is included with your sensor. Place the tip of the sensor into the opening of the bottle and push the sensor into the bottle.
- To collect data in a controlled environment and also use our one of our CO_2 gas sensors, we recommend purchasing either the BioChamber 250 (250 mL capacity) or the BioChamber 2000 (2 L capacity). Each BioChamber has a second, grommetted opening so that you can insert two probes at once.

For troubleshooting and FAQs, see **www.vernier.com/til/4127**

Repair Information

If you have followed the troubleshooting steps and are still having trouble with your Go Direct O_2 Gas, contact Vernier Technical Support at 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
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
BioChamber 250	BC-250
BioChamber 2000	BC-2000
250 mL Nalgene Bottle w/Lid	CO2-BTL

Warranty

Warranty information for this product can be found on the Support tab at **www.vernier.com/gdx-o2**

General warranty information can be found at **www.vernier.com/warranty**

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**

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 tout 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 disfonctionnement du dispositif.

Afin de réduire les interférences radio potentielles pour les autres utilisateurs, le type d’antenne et son gain doivent être choisie de telle façon que l’équivalent de puissance isotrope émis (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 jumelés 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.

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