Go Direct™ Conductivity Probe

(Order Code GDX-CON)

The Go Direct Conductivity Probe can be used to measure either solution conductivity or total ion concentration of aqueous samples being investigated in the field or in the laboratory. Conductivity is one of the most common environmental tests of aquatic samples. Even though it does not tell you specific ions that are present, it quickly determines the total concentration of ions in a sample.

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 Conductivity Probe
- Micro USB Cable

Compatible Software

See **www.vernier.com/manuals/gdx-con** for a list of software compatible with the Go Direct Conductivity Probe.

Getting Started

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

www.vernier.com/start/gdx-con

Bluetooth Connection

1. Install Graphical Analysis 4 on your computer or Chromebook™. See 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 Bluetooth® 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. 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.

USB Connection

1. Install Graphical Analysis 4 on your computer or Chromebook. See www.vernier.com/ga4 for software availability.
2. Connect the sensor to the USB port.
3. Launch Graphical Analysis 4.
4. Click or tap Device Manager, .
5. 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.
6. Click or tap Done to enter data-collection mode.

Charging the Sensor

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

You can also charge up to eight Go Direct Conductivity Probes using our Go Wireless Charging Station, sold separately (order code: GW-CRG).

Charging	Blue LED is on steady while sensor is connected to the Charging Cable or Charging 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-con

Connected and charging	Blue and Green LED are 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 is 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
1. Thoroughly rinse the lower section of the probe using distilled or deionized water.
2. Connect the sensor following the steps in the Getting Started section of this user manual.
3. When you are finished making measurements, rinse the electrode with distilled water. Store dry.

Note: The Go Direct Conductivity Probe has three sensor channels. By default, the probe measures temperature compensated conductivity. The other two channels are temperature and non-temperature compensated conductivity.

Channels
The Go Direct Conductivity Probe has three measurement channels:

- Conductivity
- Conductivity zero percent (non-temperature compensated conductivity)
- Temperature

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

Calibrating the Sensor
For many experiments, calibrating the Go Direct Conductivity is not required. A calibration equation is stored on each Conductivity Probe before they are shipped, which is used as a default by Vernier software.

For the most accurate measurements with this sensor, we recommend calibration. It is a simple process that takes only a few minutes. For additional calibration information, see **www.vernier.com/til/4011**

To calibrate the sensor in Graphical Analysis, complete the following steps.

1. Click or tap the sensor meter to view sensor options.
2. Select Calibrate and follow the applicable prompts on the Calibrate Sensor screen.

In order to calibrate a Conductivity Probe, or to confirm that a saved calibration is accurate, you should have a supply of conductivity standard solutions that cover the range of the conductivity values you will be measuring. For more information about conductivity standard solutions, including recipes for preparation, see **www.vernier.com/til/760**

Once you have calibrated a Go Direct sensor, the calibration is automatically stored to the sensor and will be used each time you connect to your device. You can always choose to restore factory defaults if you feel the custom calibration is invalid.

To restore factory defaults in Graphical Analysis, complete the following steps.

1. Click or tap the live readouts meter and choose Calibrate.
2. Click or tap Reset Calibration.
3. A window will appear warning you that you are about to reset the calibration. Choose Reset Calibration.

Specifications

Range	0 to 20,000 µS/cm (0 to 10,000 mg/L TDS)
Type	ABS body, parallel graphite electrodes
Response time	98% of final reading in 5 seconds
Temperature compensation	Available as automatic from 5 to 35°C
Temperature range	0 to 80°C
Accuracy using factory calibration	2% while under 10,000 uS/cm (5,000 mg/L TDS)
Resolution	0.01 pH
USB specification	2.0
Wireless specification	Bluetooth 4.2
Maximum wireless range	30 m
Dimensions	19.5 cm total height; 12 cm shaft height
Battery	300 mA Li-Poly
Battery life (single full charge)	~24 hours
Battery life (long term)	~500 full charge cycles (several years depending on usage)

Care and Maintenance
When you have finished using the Conductivity Probe, simply rinse it off with distilled water and blot it dry using a paper towel or lab wipe. The probe can then be stored dry.

If the probe cell surface is contaminated, soak it in water with a mild detergent for 15 minutes. Then soak it in a dilute acid solution (0.1 M hydrochloric acid or 0.5 M acetic acid works well) for another 15 minutes. Then rinse it well with distilled water. **Important:** Avoid scratching the inside electrode surfaces of the elongated cell.

Important: Do not place the electrode in viscous, organic liquids, such as heavy oils, glycerin (glycerol), or ethylene glycol. Do not place the probe in acetone or other organic solvents, such as pentane or hexane.

Battery Information
Go Direct Conductivity Probe contains a small lithium-ion battery in the handle. 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-300)

Storage and Maintenance

To store Go Direct Conductivity Probe 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 go.

Exposing the battery to temperatures over 35°C (95°F) will reduce its lifespan. If possible, store the device in an area that is not exposed to temperature extremes.

Water Resistance

Go Direct Conductivity Probe is not water resistant and should never be immersed in water.

If water 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.

How the Sensor Works

The Go Direct Conductivity Probe measures the ability of a solution to conduct an electric current between two electrodes. In solution, the current flows by ion transport. Therefore, an increasing concentration of ions in the solution will result in higher conductivity values.

The Conductivity Probe is actually measuring *conductance*, defined as the reciprocal of resistance. When resistance is measured in ohms, conductance is measured using the SI unit, *siemens* (formerly known as a *mho*). Aqueous samples are commonly measured in microsiemens, µS.

Even though the Conductivity Probe is measuring conductance, we are often interested in finding conductivity of a solution. Conductivity, *C*, is found using the following formula:

$$C = G \times k_c$$

where *G* is the conductance, and k_c is the cell constant. The cell constant is determined for a probe using the following formula:

$$k_c = d / A$$

where *d* is the distance between the two electrodes, and *A* is the area of the electrode surface.

For example, the cell in Figure 1 has a cell constant:

$$k_c = d / A = 1.0 \text{ cm} / 1.0 \text{ cm}^2 = 1.0 \text{ cm}^{-1}$$

The conductivity value is found by multiplying conductance and the cell constant. Since the Conductivity Probe also has a cell constant of 1.0 cm^{-1}, its conductivity

and conductance have the same numerical value. For a solution with a conductance value of 1000 µS, the conductivity, *C*, would be:

$$C = G \bullet k_c = (1000 \text{ µS}) \times (1.0 \text{ cm}^{-1}) = 1000 \text{ µS/cm}$$

A potential difference is applied to the two probe electrodes in the Conductivity Probe. The resulting current is proportional to the conductivity of the solution. This current is converted into a voltage. Alternating current is supplied to prevent the complete ion migration to the two electrodes. Each cycle of the alternating current, the polarity of the electrodes is reversed, which in turn reverses the direction of ion flow. This very important feature of the Conductivity Probe prevents most electrolysis and polarization from occurring at the electrodes. Thus, the solutions that are being measured for conductivity are not fouled. It also greatly reduces redox products from forming on the relatively inert graphite electrodes.

The Conductivity Probe is automatically temperature compensated between temperatures of 5 and 35°C. Note that the temperature of a solution is being read by a thermistor that extends into the space between the graphite electrodes. Readings are automatically referenced to a conductivity value at 25°C; therefore, the Conductivity Probe will give the same conductivity reading in a solution that is at 15°C as it would if the same solution were warmed to 25°C. This means you can calibrate your probe in the lab, and then use these stored calibrations to take readings in colder (or warmer) water in a lake or stream. If the probe was not temperature compensated, you would notice a change in the conductivity reading as temperature changed, even though the actual ion concentration did not change.

Troubleshooting

When testing a Conductivity Probe, it is best to measure a standard solution because it is easier to determine if the sensor is reading correctly. If your Conductivity Probe is reading differently from the standard solution, you may simply need to calibrate the sensor. See the Calibrating the Sensor section for more information. Here are some other tips to ensure best data collection practices:

- Blot the inside and outside of the electrode cell dry to avoid water droplets diluting or contaminating the sample to be tested.
- Be sure the electrode surfaces in the elongated cell are completely submerged in the liquid and that there are no bubbles around the electrode surface.
- Gently swirl the probe, or stir the solution with a stirring bar and stir plate, during data collection.
- Do not completely submerge the sensor. The handle is not waterproof.
- If you are taking readings at temperatures below 15°C or above 30°C, allow more time for the temperature compensation to adjust and provide a stable conductivity reading.
- When you have finished using the Conductivity Probe, simply rinse it off with distilled water and blot it dry using a paper towel or lab wipe. The probe can then be stored dry.
- If the probe cell surface is contaminated, soak it in water with a mild detergent for 15 minutes. Then soak it in a dilute acid solution (0.1 M hydrochloric acid

or 0.5 M acetic acid works well) for another 15 minutes. Then rinse it well with distilled water and blot dry. **Important:** Avoid scratching the inside electrode surfaces of the elongated cell.

For additional troubleshooting and FAQs, see **www.vernier.com/til/3854**

Sampling in Streams and Lakes

It is best to sample away from shore and below the water surface, if possible. In free-flowing streams, there will usually be good mixing of the water, so that samples taken near the current will be quite representative of the stream as a whole. If you are sampling an impounded stream or a lake, there will be very little mixing; therefore, it is important to sample away from shore and at different depths, if possible. Do not drop the Conductivity Probe so that the entire electrode is submerged. The electrode is not constructed to withstand higher pressures, so seepage into electronic components of the electrode will result. Although it is better to take readings at the collection site, readings of total dissolved solids or conductivity should not change significantly if you collect samples and take readings at a later time. However, be sure that samples are capped to prevent evaporation.

If sample bottles are filled brim full, then a gas such as carbon dioxide, which is capable of forming ionic species in solution, is prevented from dissolving in the water sample. Since the probe has built-in temperature compensation, you can do your calibration in the lab. This means that even though you will be sampling in water that has a different temperature than your calibration temperature, the probe will take correct readings at the new sampling temperature.

Sampling in Ocean Water or Tidal Estuaries: Salinity

Salinity is the total of all non-carbonate salts dissolved in water, usually expressed in parts per thousand (1 ppt = 1000 mg/L). Unlike chloride (Cl^-) concentration, you can think of salinity as a measure of the total salt concentration, comprised mostly of Na^+ and Cl^- ions. Even though there are smaller quantities of other ions in seawater (e.g., K^+, Mg^{2+}, or SO_4^{2-}), sodium and chloride ions represent about 91 percent of all seawater ions. Salinity is an important measurement in seawater or in estuaries where freshwater from rivers and streams mixes with salty ocean water. The salinity level in seawater is fairly constant, at about 35 ppt (35,000 mg/L), while brackish estuaries may have salinity levels between 1 and 10 ppt. 5 The salinity range of the Conductivity Probe is 0 to 10 ppt. Seawater has a salinity of 35 ppt, so any seawater samples will need to be diluted before making measurements with this sensor. We recommend that you dilute seawater samples (or other samples that initially give readings above 10 ppt) to 1/4 of their original concentration, then multiply their measured salinity reading by 4 to obtain a final salinity value, in ppt. Brackish water in coastal estuaries is often in the range of 0 to 10 ppt, well within the high range of the probe.

Since there is no stored salinity calibration for a Conductivity Probe, perform a two-point calibration using 5 ppt and 10 ppt salinity standards. Make sure your sensor switch is on the high conductivity setting. You will need to prepare two standard solutions to calibrate for salinity:

- A low standard (5 ppt salinity), add 4.60 g of NaCl to enough distilled water to prepare 1 liter of solution.
- A high standard (10 ppt salinity), add 9.20 g of NaCl to enough distilled water to prepare 1 liter of solution.

Determining the Concentration: Total Dissolved Solids

Because there is a nearly linear relationship between conductivity and concentration of a specific ion or salt, the Conductivity Probe can be used to determine the concentration of an ion. A curve can be obtained if you prepare or purchase standard solutions. Note in this figure the 2:1 ratio between conductivity in µS/cm and TDS concentration in mg/L. Even though total dissolved solids is often defined in terms of this 2:1 ratio, it should be understood that a TDS reading of 500 mg/L can have a different meaning in a sample that is mostly NaCl than in another sample that is composed primarily of hard water ions such as Ca^{2+} and HCO_3^-. The relationship between conductivity and sodium chloride concentration is approximately a 2:1 ratio and is very nearly a direct relationship.

Repair Information

If you have watched the related product video(s), followed the troubleshooting steps, and are still having trouble with your Go Direct Conductivity Probe, 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
Conductivity Standard Solution (Low, 150 µS/cm), 500 mL	CON-LST
Conductivity Standard Solution (Middle, 1413 µS/cm), 500 mL	CON-MST
Conductivity Standard Solution (High, 12880 µS/cm), 500 mL	CON-HST
Micro USB Cable	CB-USB-MICRO
Go Direct™ 300 mAh Replacement Battery	GDX-BAT-300
USB-C to Micro USB Cable	CB-USB-C-MICRO

Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of five years from the date of shipment to the customer. 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**

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.

Vernier

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Rev. 6/8/17