Magnetic Field Sensor

(Order Code MG-BTA)

The Vernier Magnetic Field Sensor measures a vector component of the magnetic field near the sensor tip. The tip can be adjusted, allowing the user to measure fields that are parallel or perpendicular to the long axis of the sensor. The Magnetic Field Sensor can be used for a variety of interesting experiments involving magnetic fields.

- Measure and study the Earth's magnetic field.
- Determine the direction of magnetic north.
- Study the magnetic field near a permanent magnet.
- Measure the field near a current-carrying wire.
- Measure the field at the opening of a solenoid.

The Magnetic Field Sensor is designed for use with the following interfaces:

- Vernier LabPro® (for use with computers, TI graphing calculators, or Palm Powered™ handhelds)
- Go!®Link
- Vernier EasyLink™
- Texas Instruments CBL 2™ or original CBL™ System
- Universal Lab Interface (ULI)
- Serial Box Interface

NOTE: This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.

Using the Magnetic Field Sensor with a Computer

This sensor can be used with a LabPro, Go! Link, ULI, or Serial Box Interface. Here is the general procedure to follow when using the Magnetic Field Sensor with a computer:

1. Connect the Magnetic Field Sensor to any of the analog ports on LabPro (in most cases, Channel 1 is used) or to Go! Link, a ULI or SBI.
2. Set the range switch to the desired setting.
3. Start the Logger *Pro*® or Logger Lite® software on a computer.
4. You are now ready to collect data. Logger *Pro* or Logger Lite will identify the Magnetic Field Sensor and load a calibration. Click ▶ Collect and begin collecting data.
5. If you are using Logger *Pro* software, an alternative to Step 3 is to open an experiment file in the Logger *Pro* Probes & Sensors folder.

Using the Magnetic Field Sensor with TI Graphing Calculators

This sensor can be used with a TI graphing calculator and with the LabPro or CBL 2™ interfaces or with EasyLink.

Here is the general procedure to follow when using the Magnetic Field Sensor with a graphing calculator and a LabPro or CBL 2:

1. Make sure that the DataMate or EasyData app is installed on your calculator.
2. Use the calculator-to-calculator link cable to connect the interface to the TI graphing calculator using the I/O ports located on each unit. Be sure to push both plugs in firmly.
3. Set the switch on the Magnetic Field Sensor to the desired setting.
4. Connect the Magnetic Field Sensor to any of the analog ports on the interface. In most cases, CH 1 is used.
5. Start the DataMate or EasyData app. It will automatically recognize the sensor and load a calibration. You are ready to collect data.

Here is the general procedure to follow when using the Magnetic Field Sensor with a TI-84 graphing calculator and an EasyLink:

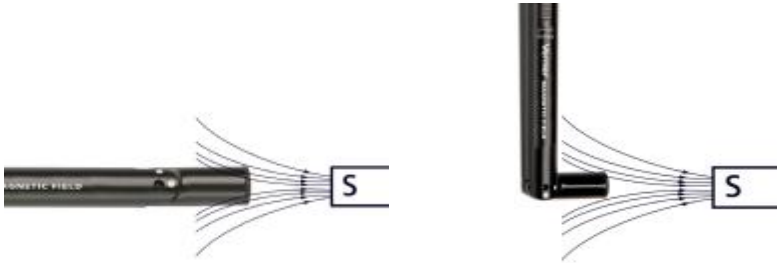
1. Make sure the EasyData app is installed on your calculator.
2. Connect the EasyLink to the USB port on the calculator.
3. Set the switch on the Magnetic Field Sensor to the desired setting.
4. Connect the Magnetic Field Sensor to the EasyLink.
5. The EasyData app should automatically start. If it does not, start the EasyData app. It will automatically recognize the sensor and load a calibration. You are ready to collect data.

Using the Magnetic Field Sensor with Palm Powered Handhelds

1. This sensor can be used with a Palm Powered handheld and the LabPro.
2. Set the range switch on the Magnetic Field Sensor to the desired setting.
3. Connect the Palm Powered handheld, LabPro, and the Magnetic Field Sensor.
4. Start Data Pro.
5. Tap New, or choose New from the Data Pro menu. Tap New again. The Magnetic Field Sensor will be identified automatically.
6. You are now ready to collect data.

How the Magnetic Field Sensor Works

The sensor uses a Hall-effect transducer. It produces a voltage that is linear with magnetic field. The sensor measures the component of the magnetic field that is perpendicular to the white dot on the end of the sensor tip. The reading is positive when the white dot on the sensor points toward a magnetic south pole.



The switch on the sensor shaft is used to select the range. The 6.4 mT range (marked low amplification in an earlier version of this sensor) is used to measure relatively strong magnetic fields around permanent magnets and electromagnets. Each volt represents 32 gauss (3.2×10^{-3} tesla). The range of the sensor is ±64 gauss or $\pm 6.4 \times 10^{-3}$ tesla.

The 0.3 mT range (marked high amplification in an earlier version of this sensor) is used mainly to measure the magnetic field of the Earth and very weak fields. It can be used for other magnets, but the sensor must remain in one position so that the reading is not affected by the background field of the Earth. Each volt represents 1.6 gauss (1.6×10^{-4} tesla). The range of the sensor is ±3.2 gauss or $\pm 3.2 \times 10^{-4}$ tesla.

If the sensor tube is held vertically with the tip horizontal, and rotated until the maximum voltage is found, the tip with the white dot will point to magnetic north. The magnetic inclination in your area can be found by holding the tube so that the white dot is facing north, and rotating the sensor end of the tube down until the voltage reaches a maximum. The angle of the tip from vertical is the magnetic inclination. Note that the north pole of a freely suspended magnet points north, since the magnetic pole of the Earth in the northern hemisphere is a south magnetic pole.

This sensor is equipped with circuitry that supports auto-ID. When used with LabPro, Go! Link, EasyLink, or CBL 2, the data-collection software identifies the sensor and uses pre-defined parameters to configure an experiment appropriate to the recognized sensor. This greatly simplifies the setup procedures for many experiments. Auto-ID is required for the Quick Setup feature of LabPro and CBL 2 when the unit operates remotely from the computer or calculator.

The Magnetic Field Sensor Does Not Require Calibration

You should not have to perform a new calibration when using the Magnetic Field Sensor. We have set the sensor to match our stored calibration before shipping it. You can simply use the appropriate calibration file that is stored in your data-collection software from Vernier.

Stored Calibration Values for the Magnetic Field Sensor

0.3 mT position in gauss
slope = 32.25 gauss/V intercept = –80.625 gauss

6.4 mT position in gauss
slope = 1.6 gauss/V intercept = –3.2 gauss

0.3 mT position in millitesla
slope = 3.225 mT/V intercept = –8.063 mT

6.4 mT position in millitesla
slope = 0.160 mT/V intercept = –0.320 mT

It is not practical to calibrate the Magnetic Field Sensor without reference to a known source of magnetic field. It is useful, however, to zero the Magnetic Field Sensor. Position the sensor, and zero it using your data-collection software. Now, move the magnetic field source, and not the sensor, to explore the spatial variations of the field.

Moving the sensor will upset the zero since the background magnetic field in your lab probably varies with position. For experiments measuring the spatial variation of a magnetic field, it is better to zero the sensor and then move the source to various positions.

How the Magnetic Field Sensor has changed

The swiveling version of the Vernier Magnetic Field sensor began shipping in January 2006. Earlier sensors can be distinguished by having a clear plastic shaft and a switch box on the cable. The older sensor has HI and LO ranges, corresponding to the 0.3 and 6.4 mT ranges of the new sensor. The old sensor also has a fixed tip, with the white dot at the *side* of the shaft. The new sensor has the white dot at the *end* of the tip. In both cases, a positive reading corresponds to the white dot facing a south magnetic pole.

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.

Vernier
Measure. Analyze. Learn.™
Vernier Software & Technology
13979 S.W. Millikan Way • Beaverton, OR 97005-2886
Toll Free (888) 837-6437 • (503) 277-2299 • FAX (503) 277-2440
info@vernier.com • www.vernier.com

Rev. 4/17/06