

# 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.

## Collecting Data with the Magnetic Field Sensor

This sensor can be used with the following interfaces to collect data.

- Vernier LabQuest<sup>®</sup> 2 or original LabQuest<sup>®</sup> as a standalone device or with a computer
- Vernier LabQuest<sup>®</sup> Mini with a computer
- Vernier LabPro<sup>®</sup> with a computer or TI graphing calculator
- Vernier Go!<sup>®</sup>Link
- Vernier EasyLink<sup>®</sup>
- Vernier SensorDAQ<sup>®</sup>
- CBL 2<sup>™</sup>
- TI-Nspire<sup>™</sup> Lab Cradle

Here is the general procedure to follow when using the Magnetic Field Sensor:

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

## Data-Collection Software

- **Logger Pro 3** This computer program is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go!Link.
- **Logger Lite** This computer program is used with LabQuest 2, LabQuest, LabQuest Mini, LabPro, or Go!Link.
- **LabQuest App** This program is used when LabQuest 2 or LabQuest is used as a standalone device.
- **EasyData App** This calculator application for the TI-83 Plus and TI-84 Plus can be used with CBL 2, LabPro, and Vernier EasyLink. We recommend version 2.0 or newer, which can be downloaded from the Vernier web site, [www.vernier.com/easy/easydata.html](http://www.vernier.com/easy/easydata.html), and then transferred to the calculator. See

the Vernier web site, [www.vernier.com/calc/software/index.html](http://www.vernier.com/calc/software/index.html) for more information on the App and Program Transfer Guidebook.

- **DataMate program** Use DataMate with LabPro or CBL 2 and TI-73, TI-83, TI-84, TI-86, TI-89, and Voyage 200 calculators. See the LabPro and CBL 2 Guidebooks for instructions on transferring DataMate to the calculator.
- **DataQuest<sup>™</sup> Software for TI-Nspire** This calculator application for the TI-Nspire can be used with the EasyLink or TI-Nspire Lab Cradle.
- **LabVIEW** National Instruments LabVIEW<sup>™</sup> software is a graphical programming language sold by National Instruments. It is used with SensorDAQ and can be used with a number of other Vernier interfaces. See [www.vernier.com/labview](http://www.vernier.com/labview) for more information.

**NOTE:** Vernier products are designed for educational use. Our products are not designed nor 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.

## Specification

|  |  |               |
|--|--|---------------|
| Resolution (HI $\pm$ 0.32 mT range)  |  |               |
| 13-bit (SensorDAQ)   |  | 0.0001 mT     |
| 12-bit (LabQuest 2, LabQuest, LabQuest Mini, LabPro, TI-Nspire Lab Cradle, Go! Link) |  | 0.0002 mT     |
| 10-bit (CBL 2)   |  | 0.0008 mT     |
| Resolution (LO $\pm$ 6.4 mT range)   |  |               |
| 13-bit (SensorDAQ)   |  | 0.002 mT      |
| 12-bit (LabQuest 2, LabQuest, LabQuest Mini, LabPro, TI-Nspire Lab Cradle, Go! Link) |  | 0.004 mT      |
| 10-bit (CBL 2)   |  | 0.016 mT      |
| Stored Calibration Values  |  |               |
| 6.4 mT position in gauss   |  |               |
| slope  |  | 32.25 gauss/V |
| intercept  |  | -80.625 gauss |
| 0.3 mT position in gauss   |  |               |
| slope  |  | 1.6 gauss/V   |
| intercept  |  | -3.2 gauss    |
| 6.4 mT position in millitesla  |  |               |
| slope  |  | 3.225 mT/V    |
| intercept  |  | -8.063 mT     |
| 0.3 mT position in millitesla  |  |               |
| slope  |  | 0.160 mT/V    |
| intercept  |  | -0.320 mT     |

## 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 ( $3.2 \times 10^{-3}$  tesla). The range of the sensor is  $\pm 64$  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 ( $1.6 \times 10^{-4}$  tesla). The range of the sensor is  $\pm 3.2$  gauss or  $\pm 3.2 \times 10^{-4}$  tesla.



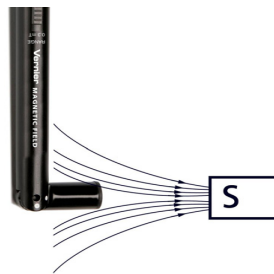
If the sensor tube is held vertically with the tip horizontal, and rotated until the maximum voltage is found, the tip with the white dot will point to magnetic north. The magnetic inclination in your area can be found by holding the tube so that the white dot is facing north, and rotating the sensor 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 LabQuest 2, LabQuest, LabQuest Mini, LabPro, Go! Link, SensorDAQ, TI-Nspire Lab Cradle, 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.

## Optional Calibration Procedure

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.

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.

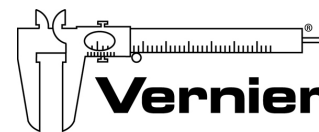
Moving the sensor will upset the zero since the background magnetic field in your lab probably varies with position. For experiments measuring the spatial variation of a magnetic field, it is better to zero the sensor and then move the source to various positions

## 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.



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