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# Vernier Photogate

(Order Code VPG-BTD or VPG-DG)

This general-purpose photogate can be used for a wide variety of experiments in physics and physical science classes. Examples include

- measuring the acceleration due to gravity.
- studying the swing of a pendulum.
- measuring the speed of a rolling object.
- timing the period of a rotating object.
- measuring the speed of objects undergoing collisions.

This document describes the use of both the VPG-BTD and VPG-DG photogates. The only difference between these two photogates is the plug on the end of the cable. The VPG-BTD has a white rectangular British Telecom (BT) plug while the VPG-DG has a quarter-inch stereo plug. The VPG-BTD works directly with our LabPro interface and the TI CBL 2™. The VPG-DG will plug directly into our ULI II and can be adapted to work with the original ULI and CBL.

<p><b>NOTE:</b> This product is to be used for educational purposes only. It is not appropriate for industrial, medical, research, or commercial applications.</p>
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## Using the Vernier Photogate with a Computer

This sensor can be used with a Macintosh® or PC computer and either a Vernier LabPro™ or a Universal Lab Interface. Here is the general procedure to follow when using the photogate with a computer:

1. Connect the photogate or photogates to the appropriate port or ports on the interface.
  - LabPro - Plug the VPG-BTD photogate into DIG 1 on the interface. A second VPG-BTD photogate can be plugged into DIG 2.
  - ULI - Plug the VPG-DG photogate into PORT 1 on the ULI II. A second VPG-DG photogate can be plugged into PORT 2. The VPG-DG can also be used with the original ULI with the proper adapter (order code ADP, \$5).
2. Start the data-collection software on the computer. If you are using a Power Macintosh or Windows® computer, run the Logger *Pro*™ software. If you are using an older Macintosh computer, run the ULI Timer program.
3. Open an experiment file in the Logger *Pro* or ULI Timer folder, and you are ready to collect data.

An optional Super Pulley Accessory (order code SPA, \$18) can be added to allow this photogate to function as a Smart Pulley™.

## Using the Vernier Photogate with TI Graphing Calculators

This sensor can be used with a TI Graphing Calculator and any of the following lab interfaces: LabPro, CBL 2, or CBL™. Here is the general procedure to follow when using the photogate with a graphing calculator:

1. Load a data-collection program onto your calculator:
  - LabPro or CBL 2 - Use the DataGate program. This program is available free on our web site at [www.vernier.com](http://www.vernier.com). Our programs can also be obtained on

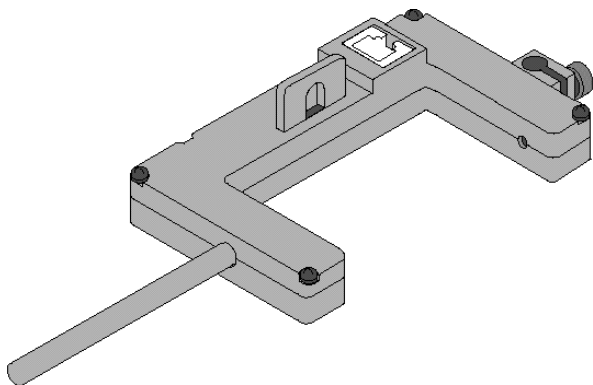
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disk. (Contact us for more information.) Load the program into a calculator using TI-GRAPH LINK™.

- Original CBL - Use the PHYSICS program. This program is available free on our web site at [www.vernier.com](http://www.vernier.com). Our programs can also be obtained on disk. (Contact us for more information.) Load the program into a calculator using TI-GRAPH LINK™.
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. Connect the photogate or photogates to the appropriate port or ports on the interface.
    - LabPro or CBL 2 - Plug the VPG-BTD photogate into DIG 1 on the interface. If you are using LabPro, a second VPG-BTD photogate can be plugged into DIG 2.
    - CBL - One or two VPG-DG photogates will work with the original CBL and the proper adapter. The CBL-P adapter (order code CBL-P, \$5) converts the quarter-inch stereo plug on the end of the VPG-DG into a white British Telecom connector. Plug the quarter-inch stereo plug of the photogate into the adapter and the white end of the adapter into Channel 1 on the CBL. If you want to use two photogates on a CBL, plug each photogate into the Dual-Photogate Adapter (order code CBL-2P, \$18) and plug the adapter into Channel 1 on the CBL.
  4. Start the data-collection program, and you are ready to collect data.

### Mounting the Photogate

The rod included with the photogate can be threaded into the hole in the photogate end to provide a convenient way of mounting the photogate. The rod can be mounted to a ring stand using standard laboratory clamps.



Clamp the photogate to a support rod or mounting bracket. Position the photogate so the object to be timed will pass through the photogate, blocking the beam. Plug the RJ12 phone plug from the cable assembly into the modular phone jack on the photogate housing. Plug the other end of the cable assembly into the lab interface or

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adapter cable. Test the operation of the photogate by watching the LED when the beam is blocked. The LED should go on when the photogate is blocked.

### Photogate Specifications

Detector rise time: <500 ns

Detector fall time: <50 ns

Parallax error: For an object passing within 1 cm of the detector, with a velocity less than 10 m/s, the difference between the true and effective length is less than 1 mm.

Power requirements: 5 VDC at 45 mA.

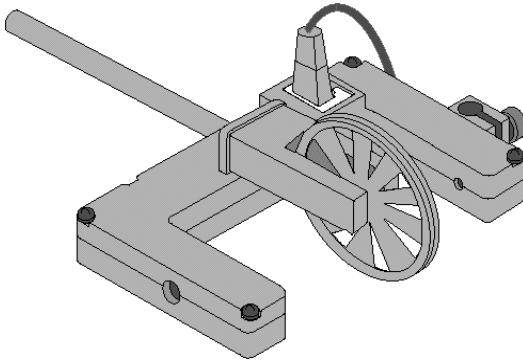
Infrared source: Peak at 880 nm

### How the Photogate Works

The Photogate has a narrow, infrared beam and fast response time, which provide very accurate signals for timing. When the infrared beam between the source and detector is blocked, the output of the photogate is low, and the light-emitting diode (LED) on the photogate goes ON. When the beam is not blocked, the output is high, and the LED is OFF.

### Converting the Photogate to a Smart Pulley

The Super Pulley Accessory (order code SPA, \$18) connects to the photogate by using the metal rod that comes with the photogate. Place the rod through the hole in the photogate and move the pulley into position so that the rod can be threaded into it. Tighten up the rod so that the pulley is held firmly against the photogate. When properly positioned, the spokes of the pulley will block the infrared beam of the photogate each time the spokes pass by.



### Vernier Photogate and Early TI Publications

The Vernier Photogate should not be used as a replacement for the simple photogates (using the TI light sensor) described in the *CBL Experiment Workbook* (which comes with the CBL) or in *Exploring Physics and Math with the CBL System*. The programs used with these books will not work with this type of photogate.

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## Limited Warranty

Vernier warrants this product to be free from defects in materials and workmanship for a period of one year from the date of shipment to the customer. Vernier will repair or replace, at its option, any part of the product that is deemed to be defective in material or workmanship. This warranty does not cover damage to the product caused by abuse or improper use.



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