PHOTOGATE BT63i

WITH PULLEY ATTACHMENT

USER'S GUIDE

CENTRE FOR MICROCOMPUTER APPLICATIONS

http://www.cma-science.nl

Short description

The Photogate BT63i is a traditional photogate, which consists of a light gate allowing detecting objects passing between the photogate arms. In this light gate, a narrow infrared beam is directed to a fast infrared detector, which produces 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 green LED on the photogate goes on. When the beam is not blocked, the output is high and the LED is off. The use of infrared light makes the sensor relatively insensitive to room lighting. The Photogate BT63i can additionally work in the external laser gate mode, a fast visible light detector located at one of the photogate arms responds to the presence of a low-power laser beam. This allows detecting objects passing outside the photogate arms. The external light gate requires a visible pen laser e.g. a typical Class IIIa type laser pointer, with a power of less than 5 mW (not supplied).
The Photogate includes a pulley attachment and a steel support rod for mounting it to a stand. The Photogate can be connected directly to the analog BT inputs of the CMA interfaces, or, in a daisy-chain configuration, up to five photogates can be chained to a single interface input. The sensor cable BT - IEEE1394 needed to connect the sensor to an interface (CMA Article BTsc_1) and IEEE1394 cables needed for daisy-chain connection (CMA Article 07662) are not supplied with the photogate and have to be ordered separately.
The CMA Drop counter accessory 0662drop can be attached to the photogate for titration experiments. This accessory is also not supplied with the photogate and has to be purchased separately (CMA art. nr. 0662drop).

Sensor recognition

The Photogate B63i has a memory chip (EEPROM) with information about the sensor: its name, measured quantity, unit and calibration. Through a simple protocol this information is read by the CMA interfaces and the sensor is automatically recognized when it is connected to these interfaces. If your Photogate is not automatically detected by an interface you have to manually set up your sensor by selecting it from the Coach Sensor Library.

Calibration

The CMA Photogate BT63i is supplied calibrated. The default calibration is a counter calibration 0 to 1000 counts. The Coach software allows selecting the calibration supplied by the sensor memory (EEPROM) or the calibration stored in the Coach Sensor Library. The following photogate ranges are provided in the Coach software:

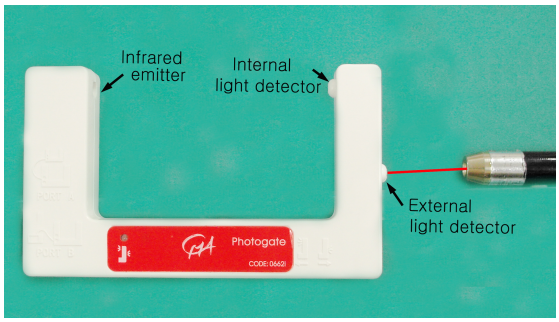
- 0 .. 1000 - to count events (events means change from high to low value),
- 0 .. 5 V – to measure the analog signal value of the detector,
- 0 .. 2m - to measure the distance when a pulley is attached (it is assumed the distance covered by one spoke is 0.0205 m),
- 0 .. 25 mL - to measure the volume when a drop counter is attached (it is assumed that the drop value is 0.04 mL).

Collecting data

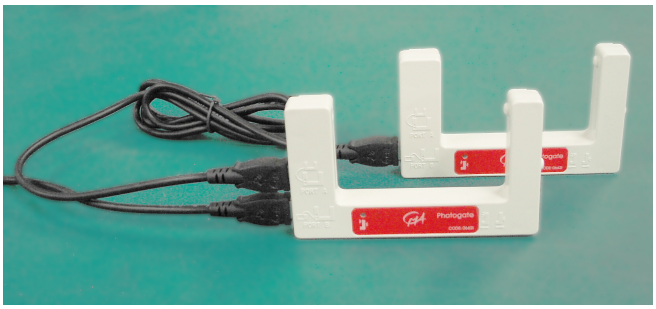
- For internal gate mode, position the photogate so the object to be timed will pass through

the photogate, blocking the beam. When the beam is blocked, the output of the photogate is low, and the green LED goes on. When the beam is not blocked, the output is high and the LED is off. The use of infrared light makes the sensor relatively insensitive to room lighting.

- For external laser gate mode, align a laser such that its beam illuminates the port and the LED turns off. Blocking the laser beam at any point in its path will then turn the LED back on. It is easier to roughly align the laser, and then position the photogate so the LED goes out.
  Warning: Do not align the external laser gate by eye-sight. Follow all safety precautions indicated by the laser manufacturer.



Daisy-Chain Mode



Up to five photogates can be connected in a daisy-chain mode to a single channel of the interface. Connect port B to the interface and port A of the first photogate to port B of the next Photogate, etc. For connection between photogates the separately available IEEE1394 cable should be used. In the daisy-chain mode the software is not able to determine which gate has been blocked. The best setup for this configuration is to use photogate timing and to know the order in which the gates are blocked from the geometry of the experiment.

The Pulley attachment

The pulley is a low-friction pulley with 10 spokes, which connects to the photogate via the slider. When properly positioned, the spokes of the pulley will block the infrared beam of the photogate each time the spokes pass by. It cannot determine the direction or a change in direction and therefore is only useful for movements in one direction. By connecting a belt between the pulley and a rotating object, rotations can also be investigated.
The pulley has a V-shaped groove. The circumference of the wheel measured in the groove is 0.20 m. On the edge of the groove the circumference is 0.21 m. Thus, the movement of a cord from the revolving pulley depends to some extent on the cord thickness. Calibration can be done by measuring the circumference with the used cord and dividing the length by 10, the number of spokes (the step size). Each time a new gap in the pulley is reached it corresponds to a displacement of this distance since the start of the last gap. In the same way, an event-based measurement can be used to measure e.g. rotation. In this case, a suitable step size is $2\pi/10$ radians (0.628 rad). When the pulley is used for the measurement of rotating objects, the step size of the original angle can be determined according

$$Q = \frac{2\pi}{10} * \frac{R_{pulley}}{R_{object}}$$

to the formula on the right.

Suggested experiments

The CMA Photogate BT63i can be used for a wide variety of experiments:

- Counting events
- Measuring the speed of a moving (rolling) object (with the pulley attachment)
- Measuring volume in titration experiments (with the drop counter attachment)
- Studying the time period of a pendulum
- Measuring the acceleration due to gravity (e.g. by using a picket fence).

Technical Specifications

Sensor kind	Analog
Output	Low: 0.17 V (LED on) - blocked gate High: 4.90 V (LED off) - unblocked gate
Infrared source	Peak at 880 nm
Detector rise time	2 μs
Detector fall time	0.5 μs
Spectrum external gate	500 – 1050 nm
Power requirements	5 V DC (± 5%) at 26mA
Pulley diameter *Circumference of pulley* *Spoke number* *Step size*	In groove = 0.064m On edge = 0.067m In groove = 0.20m On edge = 0.21m 10 Angle = 0.6283 rad = 36° Distance = 0.020m to 0.021m (depending on the thread) 10 pulses (steps) per revolution
Steel rod	Length = 0.13 m
Connection	IEEE1394 connector for BT-IEEE1394 sensor cable. Sensor cable not delivered with the sensor.

Warranty:

The Photogate BT63i is warranted to be free from defects in materials and workmanship for a period of 24 months from the date of purchase provided that it has been used under normal laboratory conditions. This warranty does not apply if the sensor has been damaged by accident or misuse.

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

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