LG0 Light Gate Sensor

Description

The LG0 Light Gate sensor is a simple to use, high-speed sensor used to detect when an object is passing through a sensing area. It is paired with an IR emitter to create a sensing area. The LG0 was designed for simplicity and can be connected directly to an Arduino. It is also very fast and sensitive, capable of measuring fast projectiles such as high-powered rifle rounds. It is also useful for measuring paintball or airsoft speeds, or even as a sensor for water drop photography.

Specifications

Parameter	**Min**	**Typ**	**Max**	**Unit**
Input Voltage	2.0		5.5	V
Input Current		20		mA
Response Time		100		ns
Photodiode Angle of View, 90% sensitivity		12		degrees
Photodiode Angle of View, 75% sensitivity		22		degrees
Max Sensitivity Wavelength		900		nm
Photodiode Reverse-Bias Voltage		28		V

Operation Theory

Photodiodes are incredibly fast and sensitive when operated in photoconductive mode. The photodiode's cathode is connected 'backwards' (anode to ground, cathode to positive) and a current-limiting resistor is placed between the cathode and the reverse-bias voltage source.

As light strikes the photodiode, the cathode's voltage drops. When an LED is shining constantly at the photodiode, the cathode's voltage is stable, but when an object passes between the LED and the photodiode, the cathode's voltage rises.

The LG0 uses a four-channel comparator to continually check the cathode's voltage against a reference (threshold) voltage. The threshold voltage is generated by a potentiometer connected to the

photodiode's cathode. The threshold voltage is then stabilized by a low-pass filter. The result is an adjustable, slow-reacting threshold voltage that is based on the cathode's steady-state voltage.

Since the comparator is an open-collector, all of the outputs can be connected. This way, a signal will be sent if at least one cathode voltage rises above its threshold voltage.

The photodiode's reverse-bias voltage is generated by a simple SMPS boost converter. Because the photodiodes and comparator consume very little current, the SMPS is very small and uses little power.

Use

Connecting to the LG0 Light Gate sensor is simple. Connect a power supply to the GND and V+ pins, then connect the SIG pin to your microcontroller.

- Please note the LG0's rated input voltage – it is not recommended to connect to an Arduino's unregulated VIN pin. Use the regulated 5V pin instead.

The LTR-323DB photodiodes must be paired with one or more IR LED's to function. The Vishay TSHF5410 is a suitable LED rated for 100 mA but capable of higher currents when needed.

- If a small sensing area is required then a single LED will suffice.
- For larger sensing areas, an array of LED's can be used. See https://td0g.ca/2020/04/19/ballistic-chronograph-mk2-diy/ for an example.
- The LED power supply must be stable, otherwise the flicker will cause false triggering to occur. Batteries or good regulators are your friend.

The sensitivity of each photodiode is based on the threshold voltage. The threshold voltage can be adjusted by turning the relevant potentiometer.

- The potentiometers are positioned adjacent to the photodiode that they affect.
- Turning the potentiometer clockwise reduces sensitivity.
- It is recommended to start by turning all potentiometer fully clockwise, then slowly adjusting them counter-clockwise until false triggering begins to occur and returning them slightly clockwise.
- The threshold voltage offset can be measured using a multimeter. The circular pad is the photodiode's signal voltage and the square pad is the threshold voltage. A typical voltage difference between the two pads is 70 – 100 mV.

The LM339 comparator is an open collector output, which means that the output is normally floating but is brought to ground when an object is detected. The LG0 has a built-in pullup resistor on the

Signal output to make the normally floating signal high (V+) and the active signal low (GND). To disable the pullup sensor, cut the JP1 jumper.

The outputs of the comparator can be enabled by the headers on the top of the board. Each photodiode is labelled 1 – 4 and the corresponding jumper can be connected or disconnected to enable or disable the photodiode output.

Repository

https://github.com/td0g/ballistic_chronograph_mk2/

Example Usage

https://td0g.ca/2020/04/19/ballistic-chronograph-mk2-diy/

Known Issues

1. The GND and SIG pins on the bottom of the PCB are labelled incorrectly in the silkscreen.

Changelog

2020-04-24	Initial commit	VTG
2020-04-28	Added Known Issue	VTG