

# QRD Sensor

(QRD 1114)

## Overview

The QRD is a combination of an infrared light emitter (LED) and an infrared sensor encased side by side. The emitter produces an IR light beam that reflects off a surface and is detected by the sensor. This can be used to detect color, primarily the difference between light and dark colors (light surfaces will reflect light more than dark surfaces). This sensor must be in close proximity to the object to reflect enough light to operate properly (at full brightness the range is approximately 0.5”).

## Basic Operation

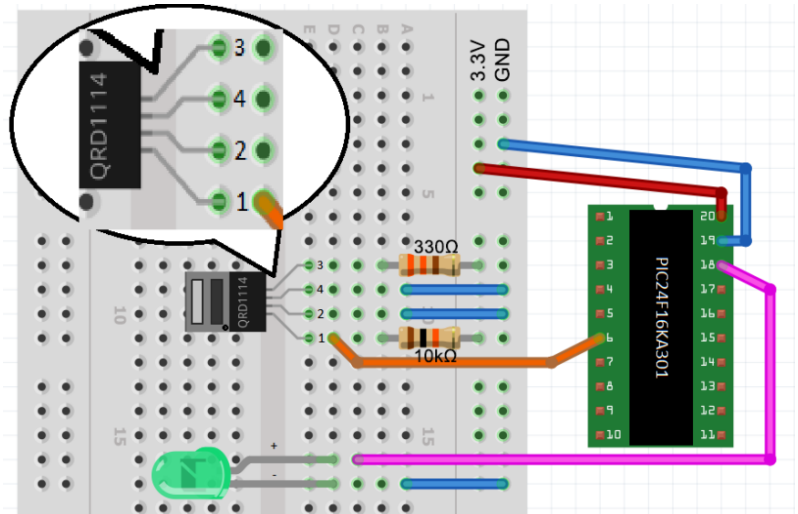
Pins 1 and 2 are the sensor part of the QRD. The circuit is normally at a high resistance, but as IR radiation is detected, the circuit decreases in resistance. On the other side of the unit, Pin 3 is the positive terminal and pin 4 the negative terminal used to power the IR emitter. Supply your choice of DC voltage to power the IR emitter along with an appropriate resistor to limit current to  $\leq 20\text{mA}$  or less. The closer to  $20\text{mA}$  the brighter the IR LED will be, which will give you greater sensing distance.

Resistor sizing example: (with  $V_s$  (supply) of  $3.3\text{V}$ , and  $V_f$  (LED forward voltage) of  $1.7\text{V}$ )

$$V_s - V_f = I * R \quad \rightarrow \quad 3.3\text{V} - 1.7\text{V} = 0.015 * R \quad \rightarrow \quad R = 100 \text{ (minimum)}$$

## Example Wiring Circuit

The resistors used here are  $330\Omega$  and  $10\text{k}\Omega$ . At  $3.3\text{V}$  the  $330\Omega$  resistor limits the current through the Emitter to  $\sim 5\text{mA}$ . The  $10\text{k}\Omega$  resistor acts as a “pull-up” resistor to pull the sensor output “high” when it sees no IR light (dark surface). A large reflection of IR light (light surface) will reduce the internal resistance of the sensor and “short” pin 1 to ground and pull the output “low”. Hence the more reflected IR radiation, the lower the voltage. If used to detect color, in this configuration a light surface will produce a lower voltage whereas a dark surface will produce a higher voltage.



## Troubleshooting

If you think your QRD has stopped working, connect the circuit as shown above and try the following:

- Check if the IR light is working with your phone camera. If you see a violet light, your IR emitter is working. Note: some main cameras have an IR filter, so try using the selfie camera instead.
- Use a multimeter to verify there is power to each side of the QRD. There should be  $\sim 1.7\text{V}$  between pins 3 and 4 on the Emitter and  $\sim 3\text{V}$  (or whatever you supplied) between pins 1 and 2 on the Sensor.
- Test across the sensor (pins 1 and 2) with an oscilloscope or multimeter. You should see a drop in the signal when a light-colored object is moved in front of the QRD. Voltage should drop from around  $3\text{V}$  (or whatever you supplied) to around  $0.2\text{V}$ . Remember, lighter colors (like white) reflect more IR light than darker colors.

