

# LIGHT SENSORS AND CONTROLLING LIGHT LEVELS

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There are two light sensors that are readily available and can easily be used. These are:

- The LDR - light dependent resistor.
- The photodiode.

In this investigation, you will compare these two devices. This should help you to select the best one for you to use. The features to compare are:

- Characteristics - are they linear or not?
- Ease of use - this includes external circuit required.
- Speed of response - this is difficult to investigate; you can look it up in the catalogue.

## THE LDR

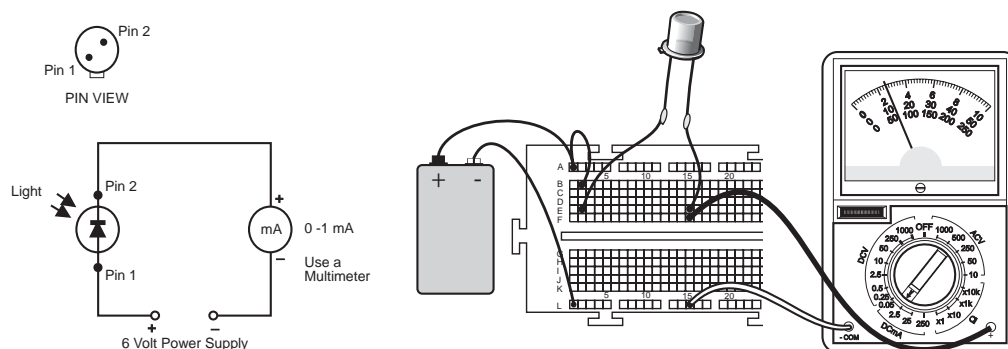
This changes its resistance as the light level changes. The resistance can be measured with a multimeter without connecting the LDR into a circuit.

You need to plot a graph of resistance against light level.

## THE PHOTODIODE

This needs to be connected into a circuit. The current through the photodiode changes with the light level.

This is the circuit you need.



You need to plot a graph of current against light level.

CHANGING THE LIGHT LEVEL

You will need a light source:

This could be a 12 V lamp in a holder.

You can change the light level by moving further away from the lamp.

If you have a light meter, you can measure and record the light level.

If you do not have a light meter, use the following information:

Start 100 mm from the centre of the lamp. Call this light level 1.

If you now move twice as far away, that is 200 mm, the light level will be 1/4.

Use the distances in this table to give the light levels indicated:

Distance from the centre of the lamp	Light level (no units)
100 mm	1
115 mm	0.75 (3/4)
141 mm	0.5 (1/2)
200 mm	0.25 (1/4)
283 mm	0.125 (1/8)

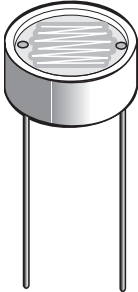
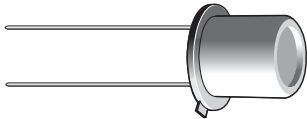
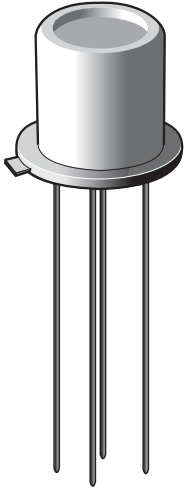
- You will need to do this in a darkened room. Why is this?

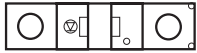
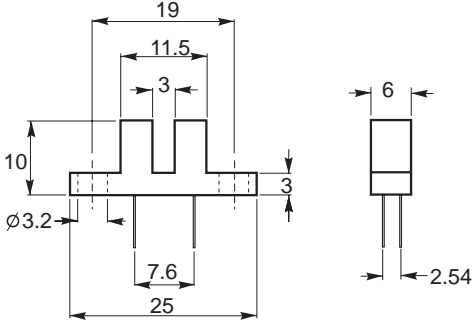
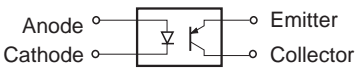
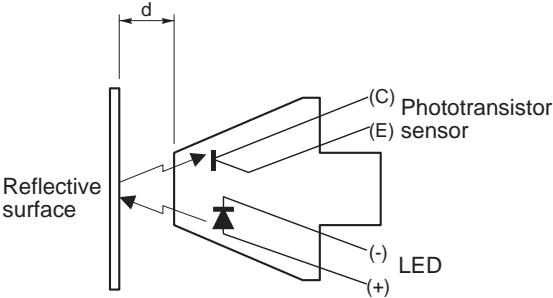
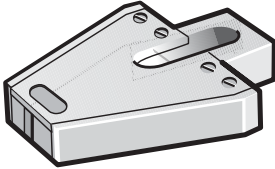
SELECTING A LIGHT SENSOR

Optical sensors are designed to make them more useful.

Some of these use infra red (IR) rather than visible light. This does not affect the way they work.

Here is a summary of these devices:

Device	Typical specification <i>(See catalogues for more information)</i>		Notes
<p><b>LDR (ORP 12)</b></p> 	<p><b>Light intensity (lux)</b></p> <p>10 100 1000</p>	<p><b>Resistance (<math>\Omega</math>)</b></p> <p>3 M 1.3 k 270</p>	<p>Needs to be put into a 'sensing' circuit, e.g. as part of potential divider with an op-amp and transistor. (See TEP Electronics module.) Needs a light source.</p>
<p><b>Photodiode</b></p> 	<p>Dark current 1.4 mA Max. current 100 mA</p>		<p>Needs a separate light source Needs circuit, e.g. reverse biased and connected to op-amp. Fast response.</p>
<p><b>Light activated switch</b></p> 			<p>This contains a photodiode and the associated circuit on one chip. An external resistor and capacitor are needed to set the light level required. When the light level exceeds this, it switches from logic 0 to logic 1. It operates on IR including sunlight. It can be used to drive logic circuits or a reed switch. Needs a light source.</p>

Device	Typical specification <i>(See catalogues for more information)</i>	Notes
<p><b>Slotted opto</b></p>   	<p>This contains an IR emitter and sensor switch in a plastic body. Contains all required circuits on chip. Needs to be connected to logic circuit. Typical current 2 mA.</p>	
<p><b>Reflective opto</b></p>  <p>White dot indicates LED d, optimum distance 4.6mm</p> 	<p>As above but arranged to receive reflected switch-beam.</p>	

<b>Sensor</b>	
<b>Characteristics</b>	
<b>Ease of use</b>	
<b>Speed of response</b>	
<b>Other useful features</b>	

## CONTROLLING LIGHT LEVELS

To control light levels, you need to think about all of the stages in a system. This means the input, process and output.

### **Input**

Selecting a sensor

The sensor you select depends on the situation.

Things to think about:

- Do you need a linear relationship? In other words, do you need the output to change uniformly with light levels?
- Do you need a fast response?
- What is the reliability like?
- What is the cost?
- Do you need a light source as well as a sensor?

When you have selected your sensor, make sure you know what else you need. For example, the LDR needs to be connected as part of a potential divider.

### **Output**

The output will be a light bulb or lamp.

- What power do you need?
- What voltage should it be?

### **Process**

- Do you need to control the light level continuously or switch the lamp ON and OFF?
- Do you need to be able to set the light level?