

LIGHT SENSORS

Basic types of light sensors

Light sensors indicate light intensity by measuring radiant energy of photons in a range of frequencies.

There are 2 main categories of light sensors, each with its own operating principle(s)

- 1) *Generates electricity when illuminated*
 - a. *Photo-emissive*
 - b. *Photo-voltaic*
- 2) *Changes electrical properties when illuminated*
 - a. *Photo-conductive*

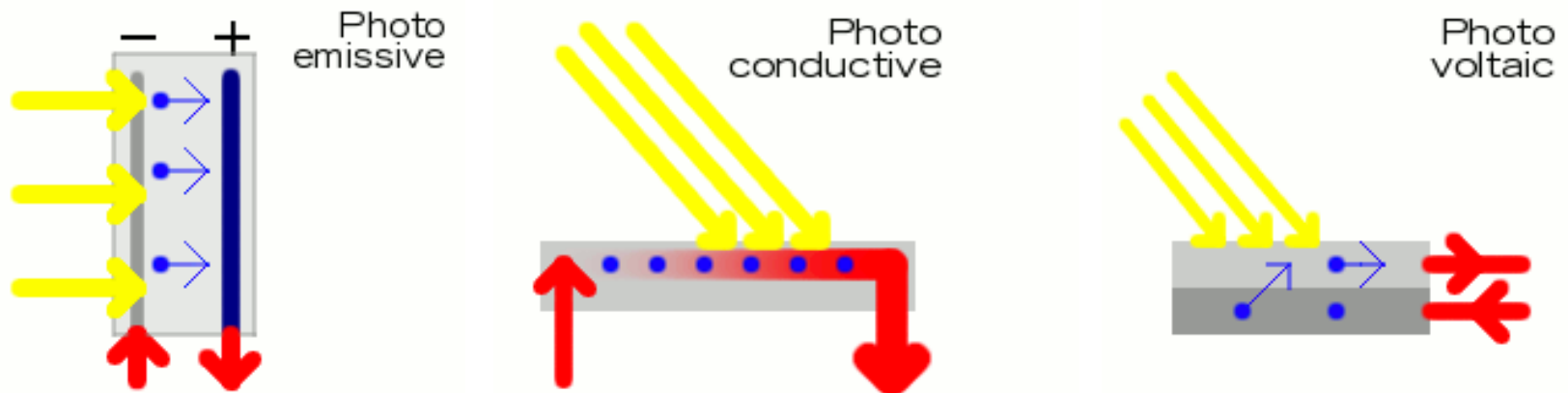


Figure 1: Summary of light sensor operating principles

Photo-emissive sensors

Operation:

- 1. Photons hit a light-sensitive material, releasing free electrons*
- 2. Electrons are collected in anode, forming a current*
- 3. The current is measured, and is dependent on photon intensity and frequency*

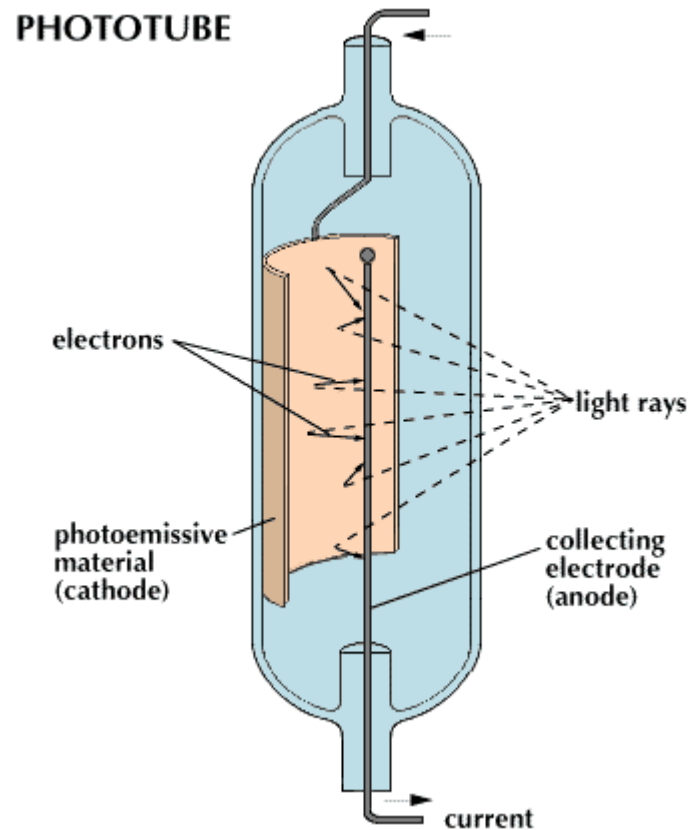


Figure 2: Photo-emissive (phototube) operation

Photo-voltaic sensors

Operation:

1. Photons hit a light-sensitive semiconductor, producing electron-hole pairs
2. Electrons move across the semiconductor's p-n junction, producing a voltage across it
3. The current produced by this voltage is measured

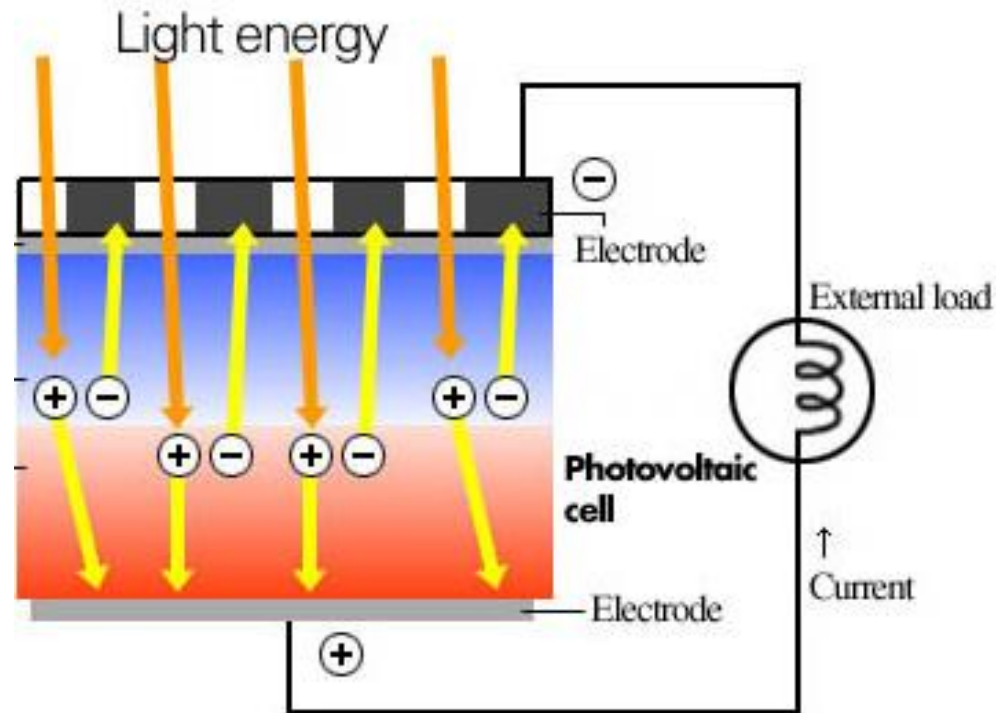


Figure 3: Photo-voltaic cell operation

Photo-conductive sensors

Operation:

1. Photons hit a light-sensitive semiconductor, producing electron-hole pairs
2. Instead of accumulating a voltage (as in the photo-voltaic process), this semiconductor reduces its resistance
3. This increases the amount of current flowing through the semiconductor, which is then measured

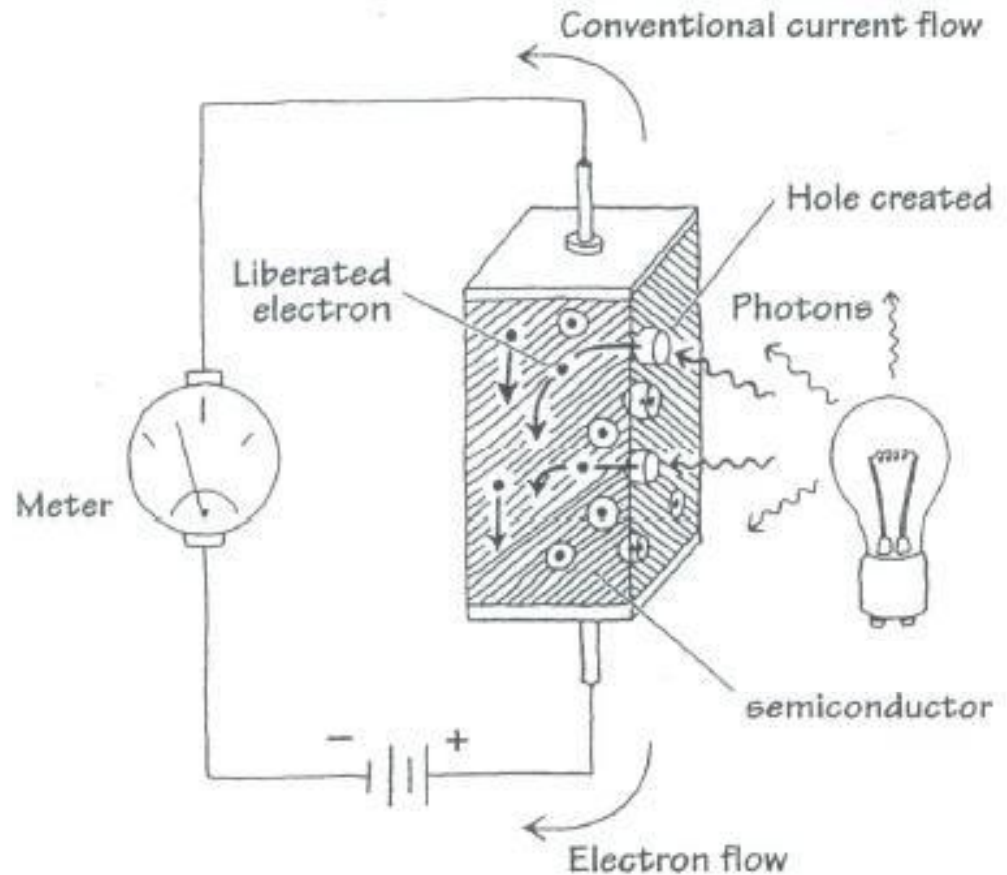


Figure 4: Photo-conductive operation

Light sensor characteristics: responses to light

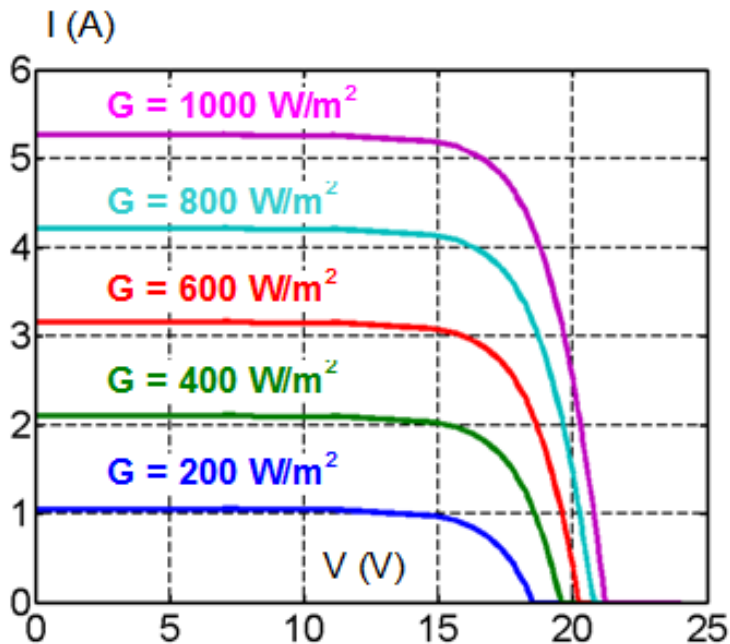


Figure 5: Photo-voltaic cell (G = solar irradiance)

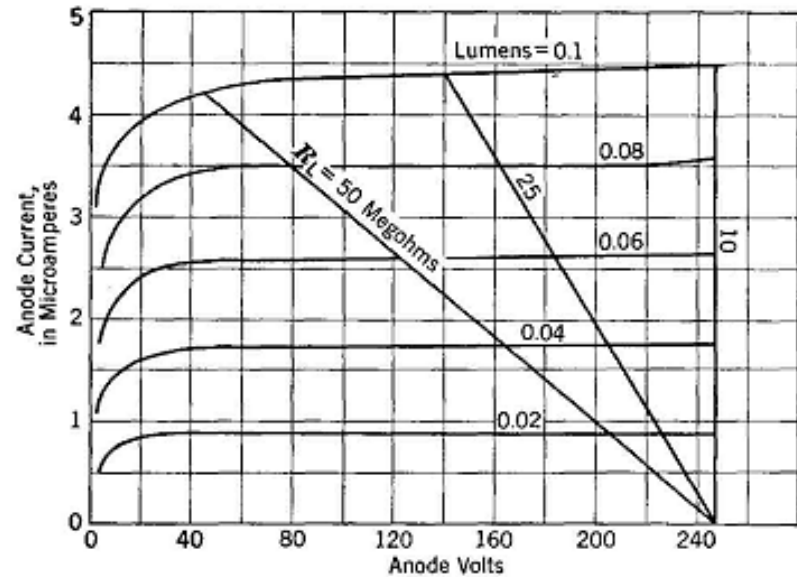


Figure 6: Photo-emissive (vacuum) phototube

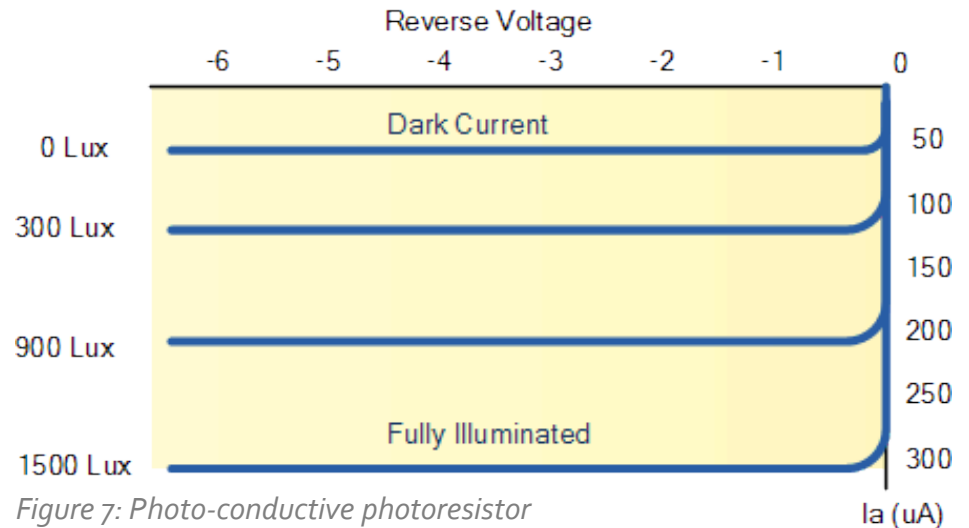


Figure 7: Photo-conductive photoresistor

Interface electronic circuits

- Needs usually an amplifier
- The output depends on the load resistor
- Change in wavelength changes the sensitivity response
- Input voltage is needed so the sensor is not passive
- Low pass filter is required parallel with the load resistor to decrease the noise
- Typically white light is used

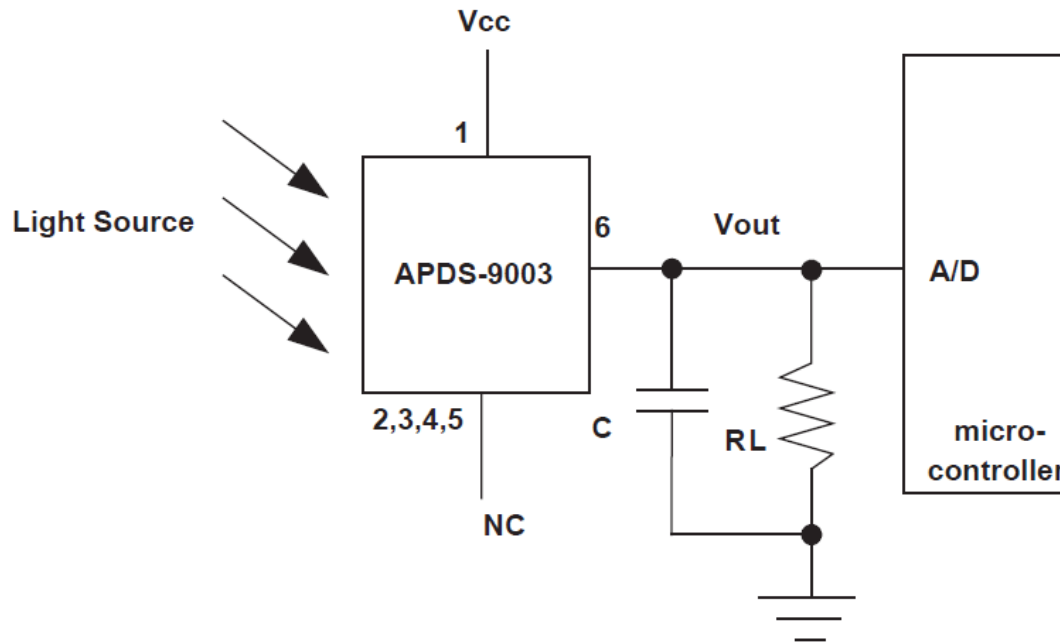


Figure 8: Sample electronic configuration for an ambient light photo sensor

Applications

- *Burglar alarm where the light is sent from one to another sensor, if the light is interrupted, the alarm will go on*
- *Barcode scanner where the scanner illuminates the barcode and collects information*
- *Remote control with infrared light sensor*
- *Telecommunication use light emitting diode to send information with the optical fiber*
- *Mobile phones have many different light sensors*

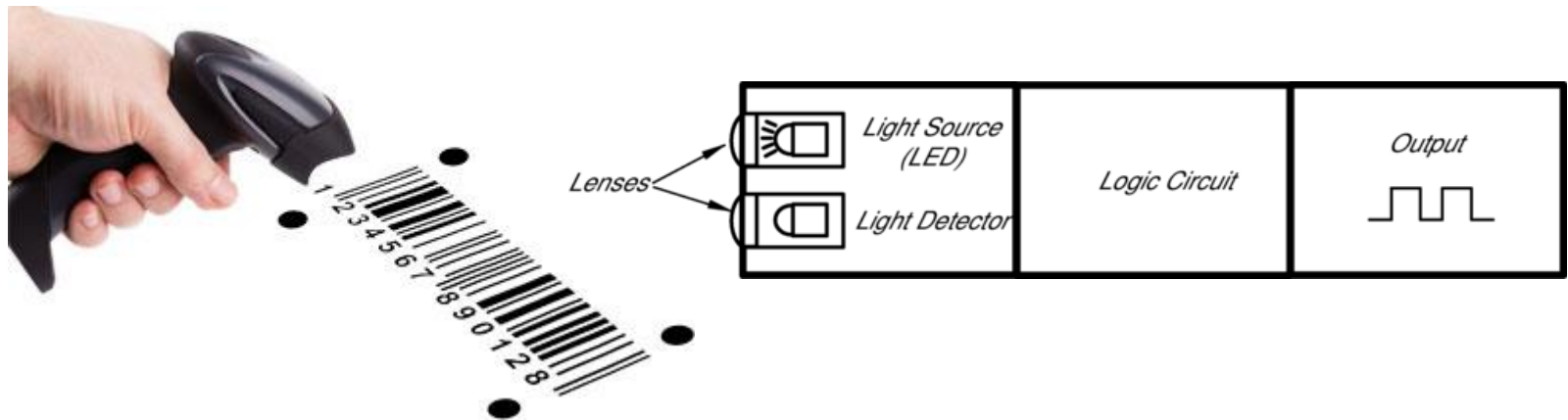


Figure 9: Barcode scanner and typical photoelectric sensor components