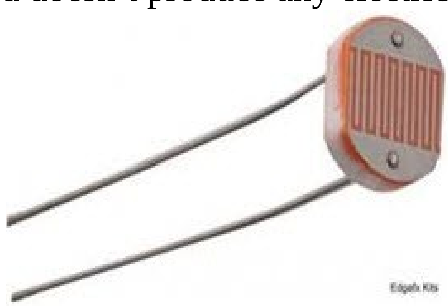
LIGHT SENSOR:

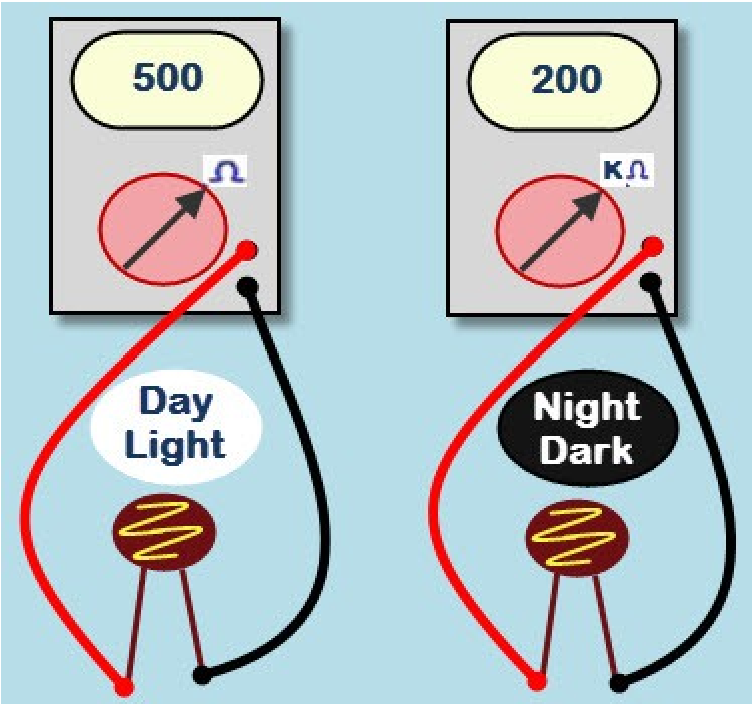
Light sensor circuit is a simple electrical circuit, which can be used to control the (switch on and off) electrical load appliances like lights, fans, coolers, air conditioners, street lights, etc., automatically. By using this light sensor circuit, we can eliminate manual switching as the loads can be controlled automatically based on the daylight intensity. Hence, we can describe it as an automatic light sensor.

There are different types of light sensors available such as photoresistors, photodiodes, photovoltaic cells, phototubes, photomultiplier tubes, phototransistors, charge coupled devices, and so on. But, LDR (Light Dependent Resistor or photoresistor) is used as a light sensor in this light sensor circuit. These LDR sensors are passive and doesn't produce any electrical energy.



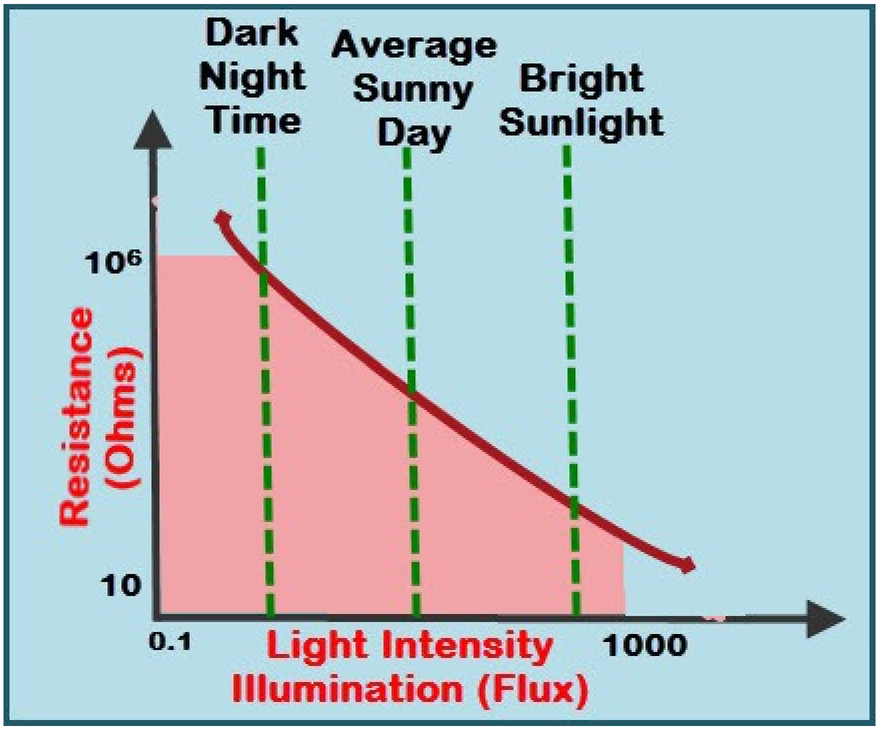
LDR Light Sensor

But, the resistance of the LDR changes with the change in the (light illuminated on the LDR) daylight intensity. LDR sensor is rugged in nature, hence can be used even in dirty and rough external environments. Hence, LDR is preferable compared to other light sensors as it can be used even in the outdoor lighting of homes and in automatic street lights as well.



LDR Resistance Variation with Variation in Light Intensity

Light Dependent Resistor is a variable resistor that is controlled by light intensity. LDRs are made of high resistance semiconductor material, Cadmium Sulphide that exhibits photoconductivity.



Light Intensity vs LDR Resistance

During night time (when the light illuminated on LDR decreases), the LDR exhibits a very high resistance of around a few MΩ (Mega Ohms). During daytime, (when the light is illuminated on LDR), resistance of LDR decreases to around a few 100Ω (hundred Ohms). Hence, the resistance of LDR is inversely proportional to the light illuminated on LDR.

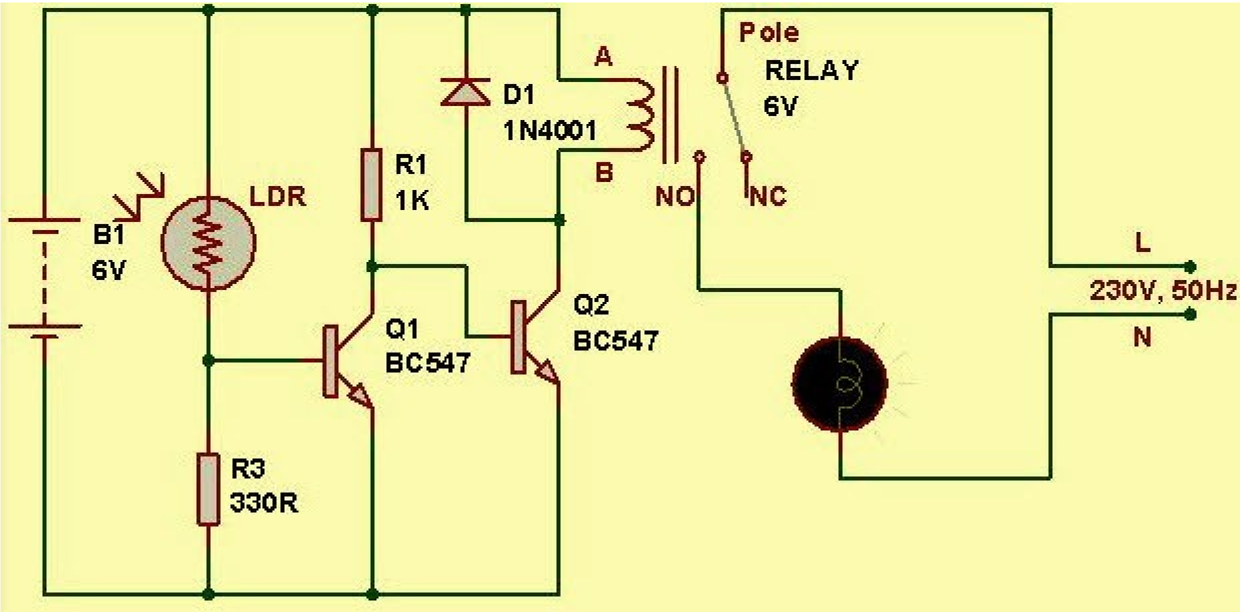
As shown in the above figure, the LDR consists of two terminals similar to a general resistor and a wave-shaped design on its top surface. The graph shown above represents the inverse proportionality of the LDR with the light intensity.

The major drawback of the LDR is that, it is sensitive to light illuminated on it irrespective of the nature of light (natural daylight or even artificial light).

Light Sensor Circuit Working Operation:

The light sensor circuit is an electronic circuit designed using (light sensor) LDR, Darlington pair, relay, diode, and resistors which are connected as shown in the light sensor circuit diagram. A 230v AC supply is provided to the load (in this case, the load is represented with a lamp).

The DC voltage required by the light sensor circuit is supplied from a battery or by using a bridge rectifier circuit. This bridge rectifier circuit converts the 230v AC supply into a 6v DC. The bridge rectifier circuit utilizes a step-down transformer to step-down the 230v into 12v. The diodes connected in the form of a bridge are used to convert the 12v AC into 12v DC. The IC7806 DC voltage regulator is used to convert the 12v DC into 6v DC, and then, this 6V DC is supplied to the circuit. A 230v AC supply for both the load and the bridge rectifier is to be maintained continuously for uninterrupted operation of the light sensor circuit.



Light Sensor Circuit Diagram

During the daytime, the light sensor LDR has very-low resistance of around a few 100Ω. Thus, the supply passes through the LDR and ground through the resistor and variable resistor as shown in the light sensor circuit. This is due to the fact that the resistance offered by the LDR during daytime or when the light is illuminated on LDR is less compared to the resistance of the remaining part of the circuit (that is through relay and Darlington pair). We are aware of the principle of current, that the current always flow in the low resistance path.

Thus, the relay coil does not get enough supply to get energized. Hence, the load is switched off during the daylight. Similarly, during the night time (when the light illuminated on LDR is very less), the LDR resistance increases to a very high value of around a few Mega ohms (approximately 20MΩ). Thus, due to very high resistance of LDR the current flow is very less or almost zero like an open circuit condition. Now, the current flows through the low-resistance path such that it increases base voltage of Darlington pair to reach more than 1.4v. As the Darlington pair is activated, the relay coil gets enough supply to get energized, and hence, the load is switched on during night time or when no light is illuminated on LDR.

Applications for Light Sensors:
Devices that include light sensors have several uses in scientific applications and in everyday consumer products. A light sensor may be part of a safety or security device like a garage door opener or a burglary alarm. These devices often work by shining a beam of light from one sensor to another. If this light is interrupted, the garage door won't close or the alarm will sound. Several modern electronics, including TV’s, computers and wireless phones use ambient light sensors in order to automatically control the brightness of a screen in situations where light intensity is high or low. These light sensors can detect the amount of light in a room and raise or lower the brightness to a more comfortable level. Light sensors can also be used in order to automatically turn on lights outside or inside a business or a home at night. Also, barcode scanners work using light sensor technology.

POTENTIOMETER:

A potentiometer is a manually adjustable electrical resistor that uses three terminals. In many electrical devices, potentiometers are what establish the levels of output. For example, in a loudspeaker, a potentiometer is used to adjust the volume. In a television set, computer monitor or light dimmer, it can be used to control the brightness of the screen or light bulb.

How It Works:
Potentiometers, sometimes called pots, are relatively simple devices. One terminal of the potentiometer is connected to a power source, and another is hooked up to a ground — a point with no voltage or resistance and which serves as a neutral reference point. The third terminal slides across a strip of resistive material. This resistive strip generally has a low resistance at one end, and its resistance gradually increases to a maximum resistance at the other end. The third terminal serves as the connection between the power source and ground, and it usually is operated by the user through the use of a knob or lever.

The user can adjust the position of the third terminal along the resistive strip to manually increase or decrease resistance. The amount of resistance determines how much current flows through a circuit. When used to regulate current, the potentiometer is limited by the maximum resistivity of the strip.

Controlling Voltage:

Potentiometers also can be used to control the potential difference, or voltage, across circuits. The setup involved in utilizing a potentiometer for this purpose is a little more complicated. It involves two circuits, with the first circuit consisting of a cell and a resistor. At one end, the cell is connected in series to the second circuit, and at the other end, it is connected to a potentiometer in parallel with the second circuit.

The potentiometer in this arrangement drops the voltage by an amount equal to the ratio between the resistance allowed by the position of the third terminal and the highest possible resistivity of the strip. In other words, if the knob controlling the resistance is positioned at the exact halfway point on the resistive strip, then the output voltage will drop by exactly 50 percent, no matter what the input voltage is. Unlike with electrical current regulation, voltage regulation is not limited by the maximum resistivity of the strip.