

RESISTORS

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RESISTORS

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AN INTRODUCTION TO RESISTORS

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Resistors determine the flow of current in an electrical circuit. Where there is high resistance in a circuit the flow of current is small, where the resistance is low the flow of current is large. Resistance, voltage and current are connected in an electrical circuit by Ohm's Law.

When a resistor is introduced to a circuit the flow of current is reduced. The higher the value of the resistor the smaller/lower the flow of current.

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RESISTOR IN CIRCUIT - SMALLER FLOW OF CURRENT

FORMULA - OHMS LAW

$$R=V/I \text{ or } I=V/R \text{ or } V=R*I$$

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SUMMARY - FIXED RESISTORS

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Resistors regulate the flow of current in an electrical circuit. Resistors are found in almost every electronic circuit. They are used to protect sensitive components, such as transistors and LEDs (see diagram below).

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The most common type of resistor consists of a small ceramic (clay) tube covered partially by a conducting carbon film.



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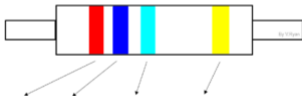


AN INTRODUCTION TO RESISTORS

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Resistors are too small to have numbers printed on them and so they are marked with a number of coloured bands. Each colour stands for a number. Three colour bands shows the resistors value in ohms and the fourth shows tolerance. Resistors can never be made to a precise value and the tolerance band (the fourth band) tells us, using a percentage, how close the resistor is to its coded value. The resistor below, is 4700 ohms.

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YELLOW 4	VIOLET 7	RED 00	RED +/- 2%	4K7 +/- 2%
GREEN 5	BLUE 6	BLACK NONE	GOLD +/- 5%	56R +/- 5%
BROWN 1	GREY 8	GREEN 00000	SILVER +/- 10%	1M8 +/- 10%
ORANGE 3	ORANGE 3	ORANGE 000	NONE +/- 20%	33K +/- 20%

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WRITING THE VALUE OF A RESISTOR

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The value of a resistor can be written in a variety of ways. Some examples are given below:

47R means 47 ohms

5R6 means 5.6 ohms

6k8 means 6800 ohms

1M2 means 1 200 000 ohms

A common value is 'K' which means one thousand ohms. So if a resistor has a value of 7000 ohms it can also be said to have a value of 7K.

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BASIC QUESTIONS ON RESISTOR VALUES AND OHMS LAW

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and answer sheet (pdf file)



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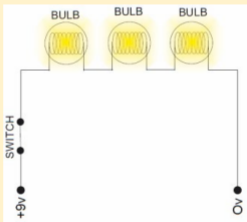


WHAT IS A SERIES CIRCUIT?

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The circuit below, shows three bulbs placed in series. This is called a series circuit. Current flows through each of the bulbs in sequence. Current flows through bulb A, then bulb B and finally bulb C. The more bulbs that are added, the less bright they shine. It is possible to add so many bulbs, that they do not light at all. This is due to the resistance in each bulb.

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RESISTORS IN SERIES

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Resistors shown below are connected in
SERIES.

When resistors are connected in series, their
values are added together:

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$$R \text{ (TOTAL)} = R1 + R2 + R3$$



For example:

$$1K + 1K + 3K9 = 5K9 \text{ (total value)}$$

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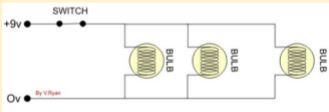


WHAT IS A PARALLEL CIRCUIT?

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The circuit below, shows three bulbs placed in parallel. This is a parallel circuit. Current can flow through each of the bulbs without first having to flow through any others. If any of the bulbs fail the others will still work as current can still flow through the rest of the circuit.

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RESISTORS IN PARALLEL

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The resistors shown below are connected in parallel

When resistors are connected in parallel, their total resistance is given as:

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$$1/R_{\text{total}} = 1/R_1 + 1/R_2$$



For example: $1/R_{\text{total}} = 1/1K + 1/1K = 0.5K$ or 500 ohms

$$\text{OR} = \frac{R_1 \times R_2}{R_1 + R_2}$$

$$= \frac{1 \times 1}{1 + 1} = \frac{1}{2} = 0.5k$$

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MORE – RESISTORS IN PARALLEL QUESTIONS

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on resistors in parallel.



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POTENTIAL DIVIDERS

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Potential Dividers can be used to split the voltage of a circuit. They are widely used in electronic circuits for setting and adjusting voltages - e.g. in radios, games and toys.

You may find that you need a supply of 6 volts and you have a 9 volt battery, your only option may be to make a potential divider.

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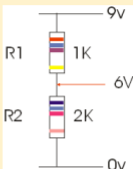


POTENTIAL DIVIDERS

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/ an exercise

If the resistor values are changed to 2K and 1K the voltage will be 6v. The voltage at the centre is determined by the ratio of the two resistor values and is given by the formula:



$$V = \text{supply voltage} \times R2/R1+R2$$

$$V = 9v \times 2000$$

$$1000+2000$$

$$v = 9v \times (2000/3000 \text{ ohms})$$

$$V = 9v \times 0.6666666 \text{ ohms}$$

$$V = 6v$$

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MORE QUESTIONS ON POTENTIAL DIVIDERS

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LIGHT DEPENDENT RESISTORS

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LDRs or Light Dependent Resistors, are very useful especially in light/dark sensor circuits.

Normally the resistance of an LDR is very high, sometimes as high as 1000 000 ohms, but when they are illuminated with light resistance drops dramatically.

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LIGHT DEPENDENT RESISTORS

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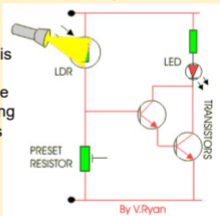
LDRs take several milliseconds to respond to a change in light level. This may sound very fast but in terms of electronics it is slow.

Many different types are available but the most common type used in school projects is an ORP 12

An example of a sensor circuit is shown below.

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When the torch is turned on, the resistance of the LDR falls, allowing current to pass through it.



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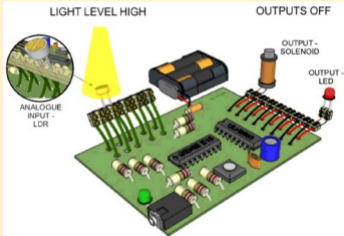
LDRs AS INPUTS

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An LDR is an analogue device, that can be used as an input to a microcontroller circuit . A LDR's resistance varies, determined by light level.

As the LDR is illuminated its resistance drops. The microcontroller is programmed to detect the drop in resistance.

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LDR EXAMINATION QUESTIONS

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Tap the Link Buttons LDR Examination Questions



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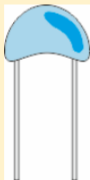


THE THERMISTOR

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Thermistors are made up of a mixture of sulphides or oxides or sometimes metals such as copper, iron or cobalt. They tend to be formed into a disc or a bead sealed with plastic or glass.

They have great resistance at low temperatures, but when they warm up, their resistance decreases rapidly. Current can then flow through them. This makes them ideal as one of the components for a temperature sensor.



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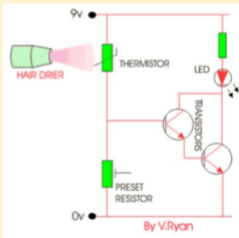
THE THERMISTOR

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Circuit explanation in detail:

When the thermistor is warmed up by the hair drier, its resistance drops. This will take a few seconds. As its resistance drops, current begins to flow from positive 9 volts to negative 0 volts. Current flows into the base of the transistors allowing the LED to light.

The preset resistor can be turned up or down to increase or decrease resistance, in this way it can make the circuit more or less sensitive.



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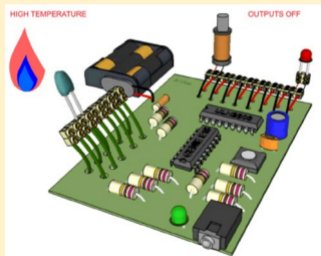


THERMISTORS AS INPUTS

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A thermistor is an analogue device, that can be used as an input to a microcontroller circuit . A thermistor's resistance varies, determined by temperature.

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THE PRESET RESISTOR

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Preset resistors are used in circuits when it is necessary to alter the resistance. Dark/light and temperature sensors usually have these components as the preset resistor allows the circuit to be made more or less sensitive (they can be turned up or down - reducing or increasing resistance)

A small screwdriver can be used to turn the centre part of the preset resistor, altering the value of the resistance. The range of resistance varies, for example:
0 to 100 ohms
0 to 1M ohms

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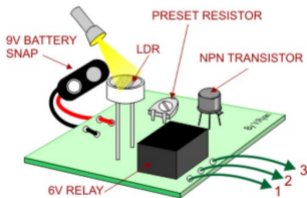


THE PRESET RESISTOR AND SENSOR CIRCUITS

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Below is a simple light/ dark sensor. This can be connected as an input or switch to another circuit. The sensor has three green wires (1, 2 and 3). Wire 2 should always be connected to one of the inputs. If wire 1 is also connected then the sensor acts as a dark sensor. If wires 2 and 3 are connected to the inputs then the sensor operates as a light sensor. *The preset resistor allows the person using the circuit to alter its sensitivity to light/dark.*

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POTENTIOMETER/VARIABLE RESISTOR

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Potentiometers are used in circuits, when it is necessary to alter the resistance. Dark/light and temperature sensors usually have these components, as the potentiometer / variable resistor allows the circuit to be made more or less sensitive (they can be turned up or down - reducing or increasing resistance). The long handle on the potentiometer / variable resistor can be turned clockwise or anticlockwise, altering the value of the resistance.

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