## Page 13.1

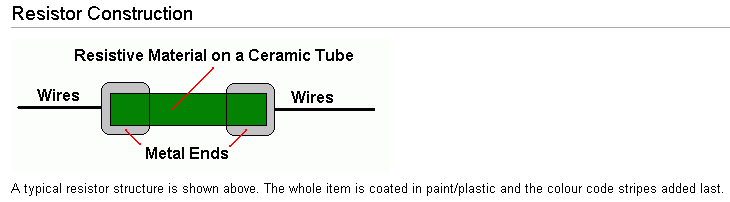
# RESISTORS

* Resistors limit the current flowing to a smaller safe level.
* Two or more resistors can be used as a voltage divider.
* Voltage dividers can use fixed resistors.
* Voltage dividers can use thermistors or LDRs to make temperature or light sensors.
* Voltage dividers can use potentiometers to make angle sensors.
* Voltage dividers can use potentiometers to make volume controls.
* A timing resistor is used in conjunction with a capacitor to make a timing circuit.
* A pull-up resistor increases the voltage, usually close to the positive power supply voltage.
* A pull-down resistor drops the voltage close to zero or perhaps to the negative power supply voltage.

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| Resistor Types.jpg | Resistor-pull-up-down.gif |

Working from the top down in the image above.

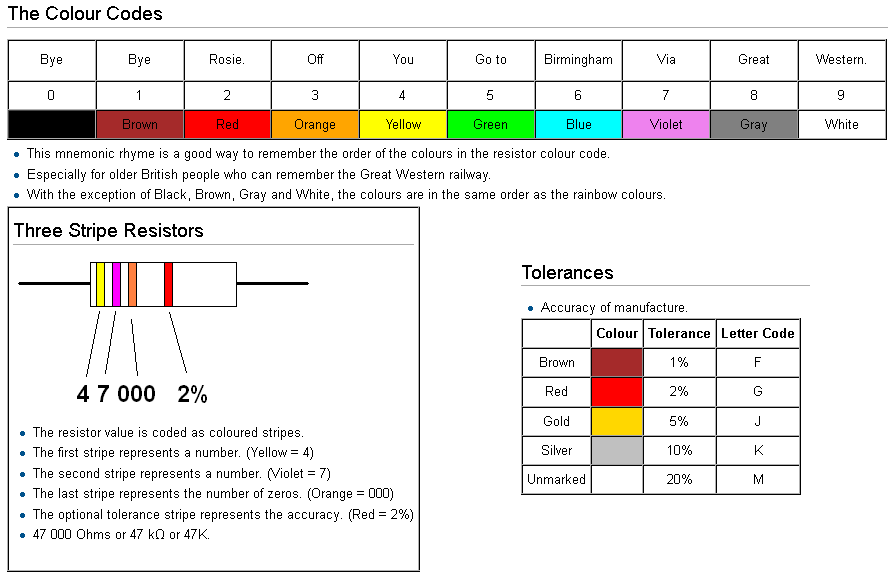
* Wire Wound: Designed to dissipate a lot of heat. Used in very high power situations. 100 Watt resistor.
* Wire Wound: Designed to dissipate heat. Used in high power situations. 10 Watt resistor.
* Wire Wound: Designed to dissipate less heat. Used in lower power situations. 5 Watt resistor.
* Wire Wound: Designed to dissipate less heat. Used in lower power situations. 5 Watt resistor.
* Carbon film: Cheap, not very stable over time, might generate circuit noise. Half Watt resistor.
* Metal Oxide: Slightly more expensive than carbon film, more stable over time, less circuit noise, Quarter Watt Resistor.



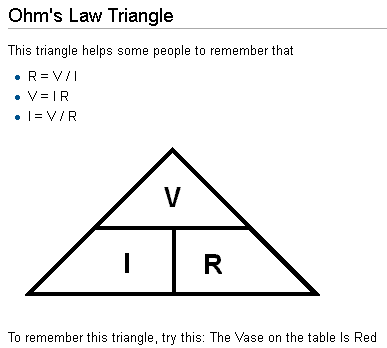
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|  | Resistance …  * opposes the free flow of current. * is like a thin water pipe or a narrow road or a narrow doorway opposing the free flow of people. * is measured in Ohms. * is related to the current and voltage by Ohm's law below. * if a wire is replaced with a resistor, the current drops.  Definition of the Ohm  * If the resistance is one Ohm, a potential difference of one Volt will cause a current of one Amp to flow.  Ohm's Law  * At a given temperature, the potential difference or Voltage drop (V) across a resistor (R) is proportional to the current (I) flowing through it. |

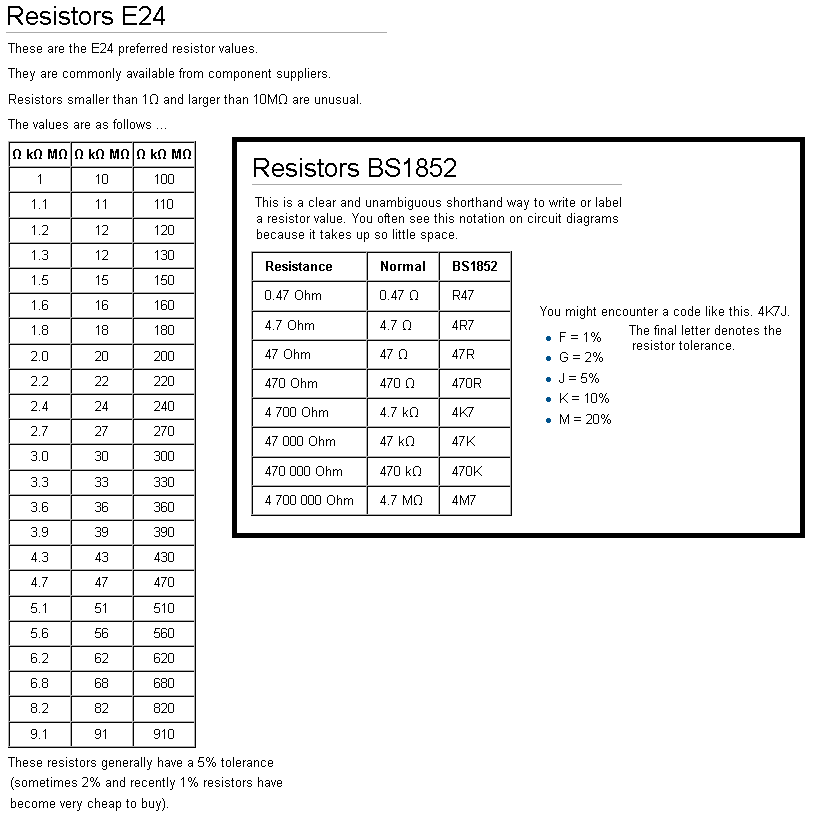
## Zero Ohm Resistors

Zero ohm resistors exist. These are used instead of wires because robotic circuit board assembly machines are already able to work with standard resistor shapes. A whole new robot would be needed to work with wires so zero ohm resistors were invented.



## Calculations





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| LDR As the light gets brighter, the LDR resistance drops.  LDR.jpg  LDR-cct.GIF | Thermistor As the temperature rises, the resistance drops.  Thermistor.GIF |