Resistors

A resistor is one of the most basic components in electronics. It has many roles, comes in many shapes and sizes and depending on how the resistor is used in the circuit, this will determine what it's role is.

Resistor Basics

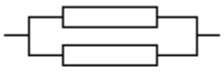
When used, the voltage develops across the resistor and the current flows through the circuit. Resistors are rated in watts, and it is important to use the right wattage otherwise the resistor just overheats and burns out. This can start a fire and burn down your garage!

When connected in series, the two resistors work as a voltage divider circuit. When connected in parallel the voltage is the same across the circuit, but the current is divided between the two resistor legs.

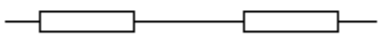
When calculating a resistance value, you may need 25K6 ohms for example however manufacturers produce set values which have a tolerance of 1%, 5% and 20%. Therefore, you select a resistor which is 'closest' to the value you require. For general purpose the caramel ones with a 20% tolerance will work. If you are doing high performance electronics i.e. analogue signal and measurement etc., then the 1% variants will be necessary.

General Purpose Usage

This includes biasing transistors, simple amplifier resistor networks and so on, below are two example circuits.



1) Parrallel Resistance



2) Series Resistance

The maths ☹

Calculating a resistor value is simple R = V/I.

Applying the above as a case:

A LED requires 15mA to illuminate and has a 1.8 Vdc drop. Calculate the resistance required if 5Vdc is supplied to the circuit.

To calculate V:

Vsupply (5Vdc) – Vled (1.8Vdc) = 3.2Vdc

R = V (3.2) / I(0.015)

R = 213, 33 Ohm or 270 Ohm (i.e. 20% resistor, closest match)

Voltage Divider Circuits

The above was an example of a voltage divider circuit; the voltage was divided across two components, the resistor limiting the current and the LED converting the electrical energy into Light.

Voltage divider circuits can become quite complex. They also have interesting uses, for example the LDR switch which will be considered in a subsequent article.

This example however uses a POT (Potentiometer), this is simply a resistor with a value which changes mechanically.

Potentiometers are very useful for adjusting a set value, a reference value and are used in analogue electronics in a number of ways.

One example is where a potentiometer is used to monitor position, i.e. the voltage is converted to an analogue value which can be converted to the angular position of the shaft.

The above are examples of the voltage divider circuit where two or more resistors are used to develop different voltage drops within a circuit.

1 Pager Series

Measuring Ohm Value

Resistors are manufactured in set values, which means that we may not always be able to purchase a resistor value in exactly the value we need. To work around this, you can do any of the following:

- Select the value closest to the one that you need
- Connect more than 1 value in series
- Connect values in parallel
- Use a potentiometer

Note: Connect more than one resistor value in series, add the values together

Connect them in parallel, the resistance is less than half of the lowest value of the paralleled legs.

Resistors are one of a few components that use colour coded bands on the outer housing to denote value.

Some more Maths ☹ ☹

Working with this equation can be a bit tricky but once you get the hang of it, it is quite easy

One thing to remember for parallel calculations is that you are working with the whole or composite resistance.

RP = 1 / (1/RA) + (1/RB) + (1/RC)

Or, assuming there are three equal resistor values in parallel

RP = 1/(1/10) + (1/10) + (1/10)

RP = 1/ (3/10)

RP = 10/3

RP = 3.333

When to use a resistor in Microcontroller design projects

The above question often gets raised on forums and on Q & A sites.

Normally, a PIC input does not need a resistor provided that the input does not exceed the supply voltage of the device, or is high current.

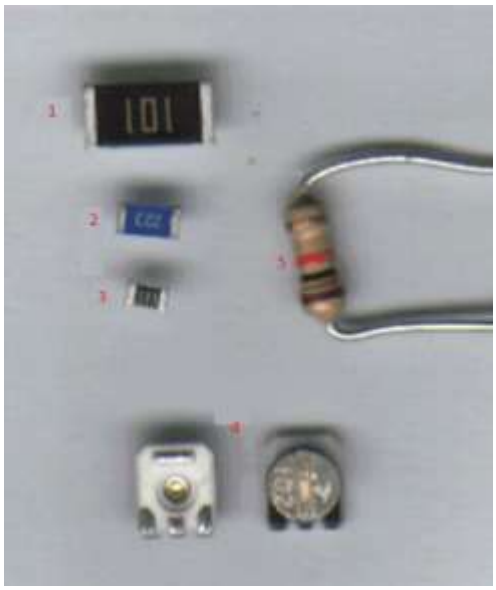
Note: To prevent a floating voltage at the input of a PIC at times a pull-down resistor can be useful.

In other words, a 5 Vdc device can with stand a 5Vdc input.

Supplying current to a device from the microcontroller which is sometimes referred to as direct drive, does require a resistor. A microcontroller can only supply a maximum of 20mA per pin, which can burn out a microcontroller if exceeded.

Resistors come in all shapes and sizes from surface mount types to much larger variants which have heat sinks built in. Since resistance generates heat, which can lead to the resistor overheating the designer must select the right wattage of resistor.

Some Examples of what a resistor looks like are as follows.



1, 2 and three are examples of surface mount devices. 4 are typical examples of potentiometers. 5 is the typical example of a carbon film type resistor which the general hobbyist would use for a home / prototyping project.

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