STEMKRAF – TUTORIAL – PARTS – RESISTOR
https://github.com/teaksoon/stemkraf

Resistor is also a type of Electric Conductor. This type of Electric Conductor is used for its specific **"Resistance Values"**, often added to an electrical circuit to control the amount of Electric Current going into a device. The come in various size and shapes.

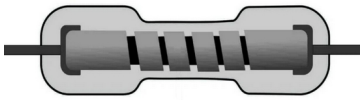
Some Resistor have fixed resistance value, some with variable resistance values.

In this example, we will just look at the fixed value resistor that is commonly used in Arduino based projects, the 0.25w film Resistor

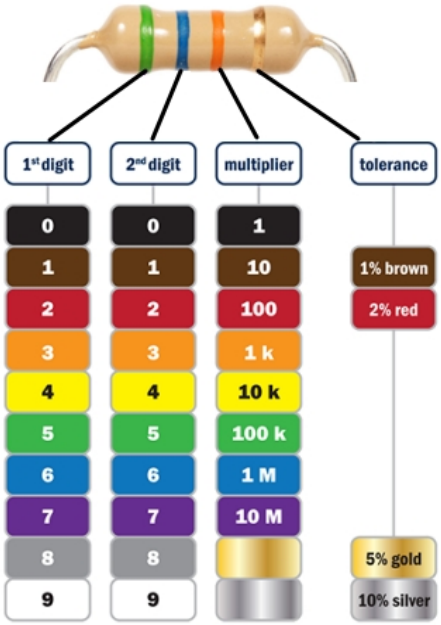
0.25w is the maximum amount of Power (Voltage x Current) that it can handle

0.25w Carbon Film Resistor has carbon film inside, cheaper but less accurate

0.25w Metal Film Resistor Has metal film inside, more expensive but more accurate



0.25w Resistor are color coded for their Resistance Value.



Example: 3 Color Band Resistor

Green = 5
Blue = 6
Orange = 1000(multiplier)
56 x 1000 = 56,000

56kilo-ohm

5% tolerance (deviations)

Sometimes colors are hard to see and we are to buzy to decode the color codes. **The best option** is to use **multimeter** to find out the resistance value of a Resistor. A multimeter can also help to detect faulty resistors (we cannot do that with color codes)

There are many types of multimeters with different functions with a huge price range. Fortunately, all the multimeters can read resistor values.

For low voltage Arduino learning stage where accuracy is not big concern, you can use any of them. Cheapest one will do for beginners. Soon, you will reach a stage when you know exactly what kind of multimeter you need, then buy an expensive unit.

RESISTOR VALUE FOR a regular 5mm LED used with Arduino Uno

220 Ohm Resistor is often used together a regular 5mm "bulb" LED in a 5V electrical circuit (example, the Arduino Uno board). This is important because a regular 5mm "bulb" LED will be damaged if used without a Resistor in this setup.

Why 220 Ohm Resistor ?

We have following information from our circuit and devices:
1.Total Supply Voltage = 5V (Arduino Uno board)

2.Regular 5mm "bulb" LED (information from manufacturer, datasheet)
2.1.LED Voltage Drop = 1.8V
2.2.Electric Current Limit = 20mA (or 0.02A)

These two (3. and 4.), we need to find out on our own
3.Resistor Voltage Drop (RVD) = ?
4.Resistor Value (RV) to get 20mA = ?

3.Resistor Voltage Drop (RVD) = ?

Kirchhoff's Voltage Law,
Total Supply Voltage = Total Voltage Drop

5V(Arduino Uno) = 1.8V(LED) + RVD(Resistor)

RVD = 5V-1.8V = 3.2V (Voltage at our Resistor)

4.Resistor Value (RV)to get 20mA(0.02A) = ?

20mA is not available yet, we want to achieve the 20mA at the LED with our Resistor because we know that is the limit (data provided by the manufacturer of LED). Now we want to find out what Resistor can help to achieve that.

Ohms Law,
Resistance(RV) = Voltage / Current

RV = 3.2V (from our **RVD**) / 0.02A
RV = 160 Ohm

The ideal Resistor to be used with the regular 5mm LED (based on our specs above) on a 5V circuit will be the **160 Ohm Resistor** because it allows the exact 20mA Electric Current into the LED.

Anything smaller than 160 Ohm Resistor will let more than 20mA Electric current flowing into the LED, we risk damaging the LED.

Of cos we need to allow some safety buffer.

So, we just **use the next available higher fixed value resistor, the 220ohm Resistor.**

This Resistor Calculation example is for an LED. This same calculation can apply for other devices which also risk damage if current exceeds the device limit.

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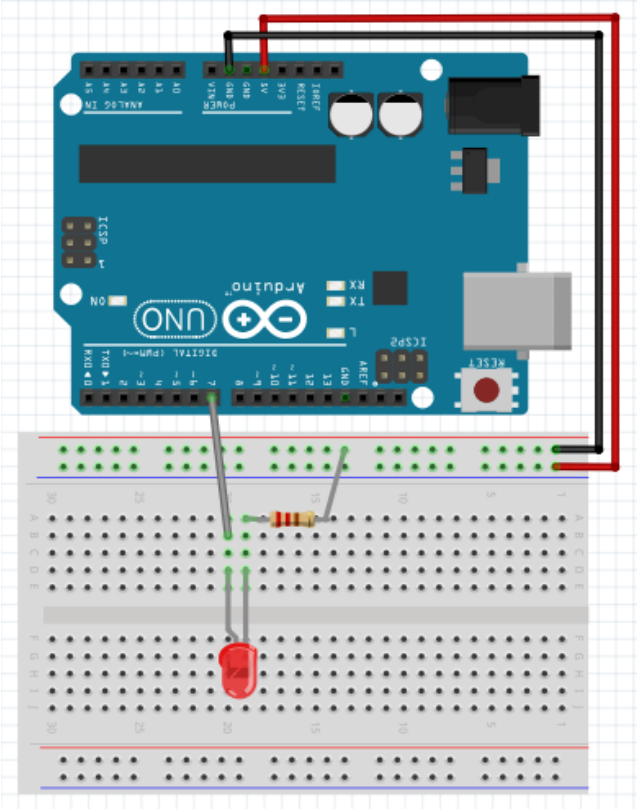
```
Program: tp02A_led_digital_pin
  (1/1): LED digital pin
       :
       : by TeakSoon Ding for STEMKRAF (OCT-2021)
```



Hardware:
1x Arduino Uno
1x Solderless Breadboard

Jumper wires

1x 5mm LED
1x Resistor 220ohm

LED +ve to Digtal Pin 7
LED -ve to Resistor to GND

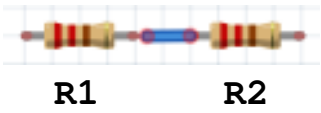
```
// Program: tp02A_led_digital_pin
//        : LED test
//        :
//        : by TeakSoon Ding for STEMKRAF ( OCT-2021 )
// ------------------------------------------------
#define LED_PIN  7
void setup() {
  pinMode(LED_PIN, OUTPUT);
  digitalWrite(LED_PIN, HIGH);
}

void loop() { }
```

- Upload this program with the Arduino IDE Software
- Watch the LED

The LED will stay lighted up as long as this program is not changed.

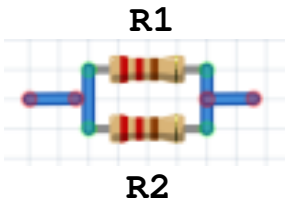
Try change the Resistor to a bigger value ones and watch the LED brightness

When multiple Resistors are used together, the resistance value will changed based on how they are connected together.



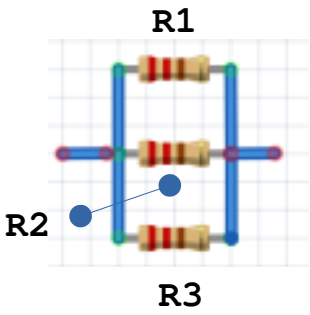
Two or More Resistors in Series:

Total= R1 + R2



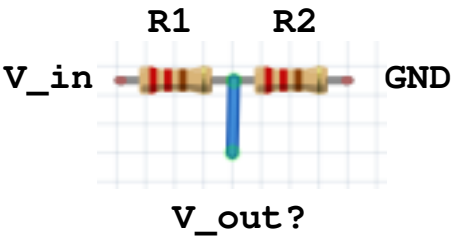
Two Resistors in Parallel:

Total = (R1 x R2) / (R1 + R2)



Three or more Resistors in Parallel:

1/Total = (1/R1)+(1/R2)+(1/R3)



Voltage Divider:

V_out = V_in x (R2 / R1+R2)