

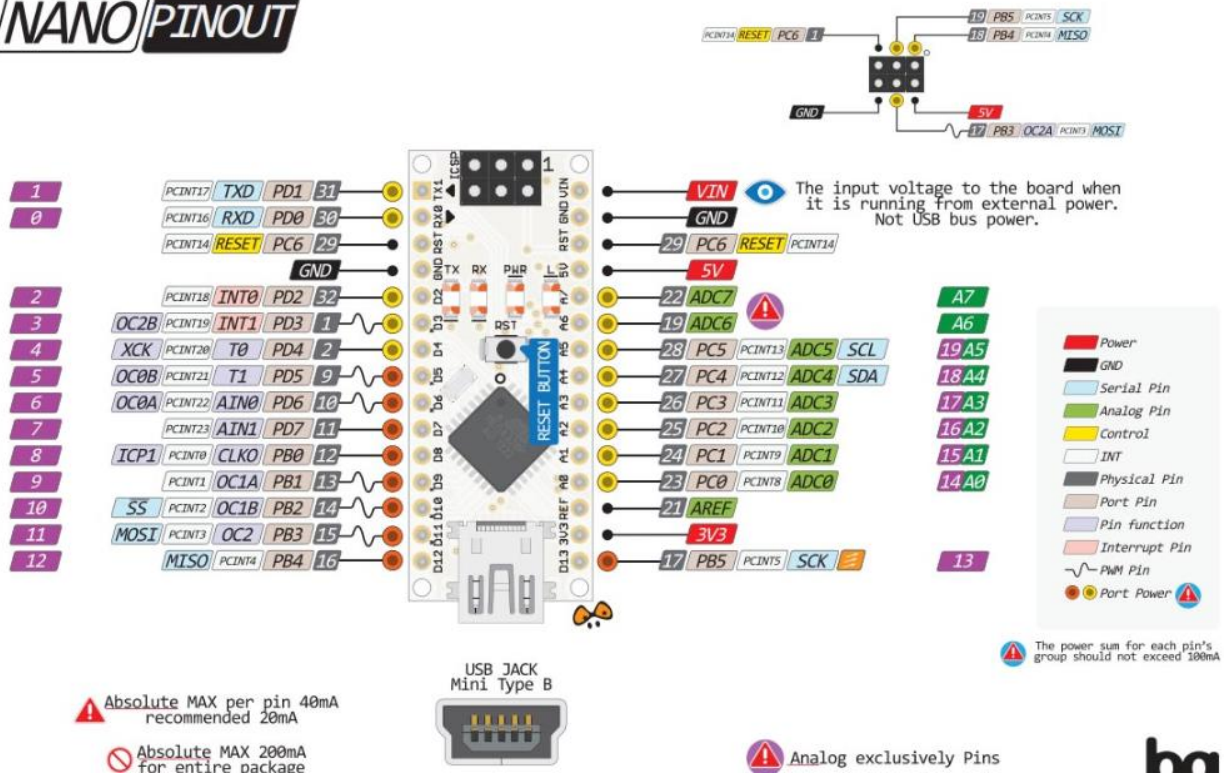
# HARDWARE TUTORIAL

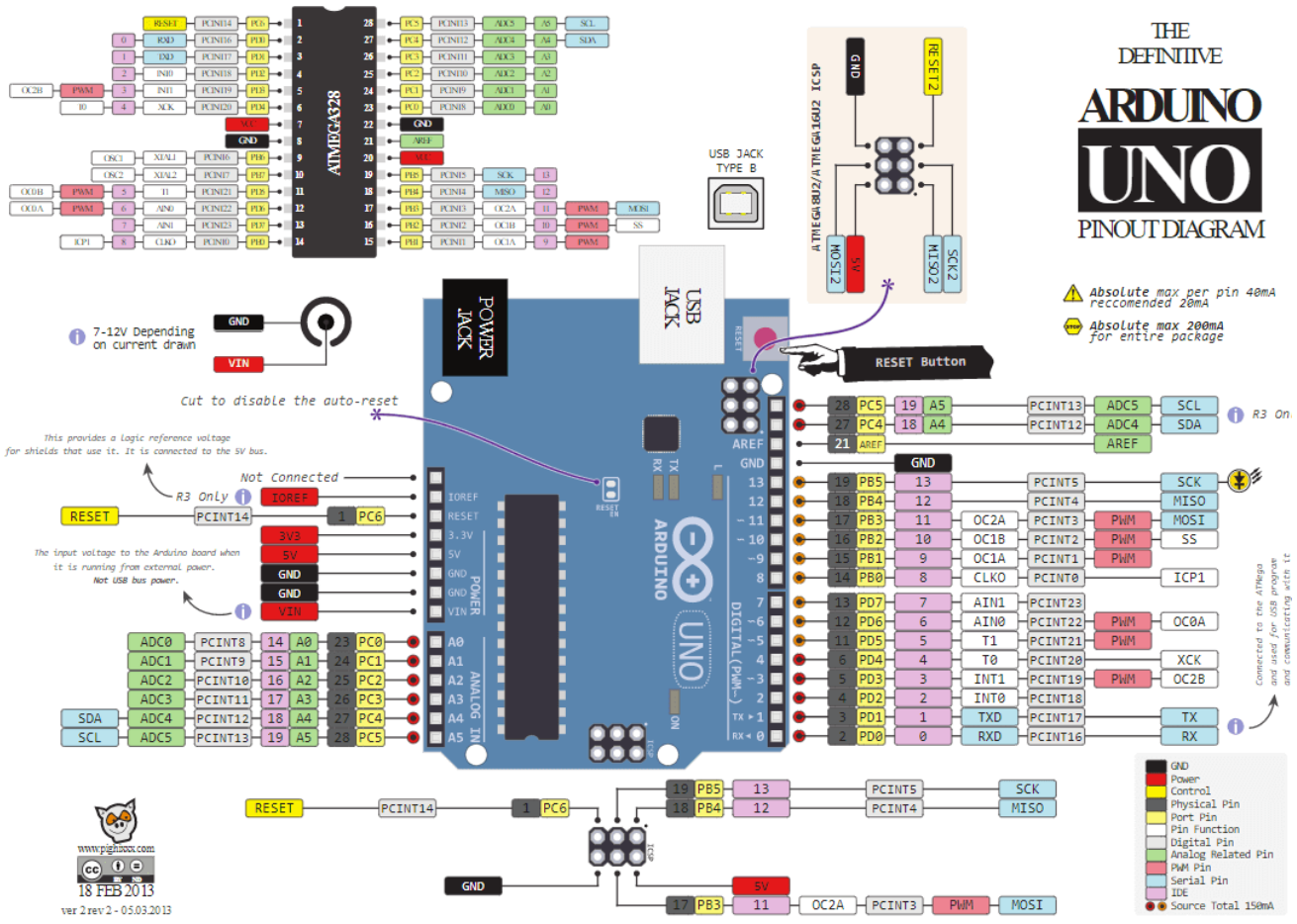
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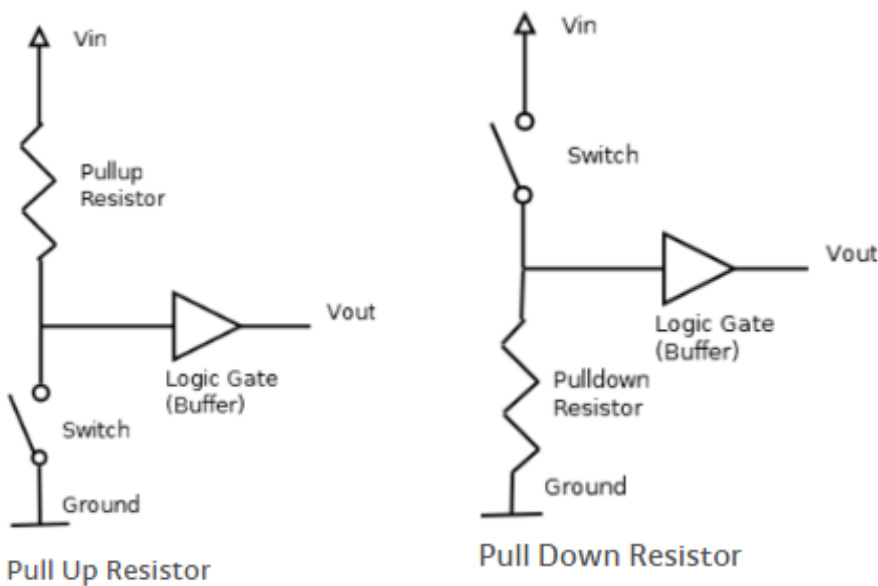
## 1-Pinout/Pinschematics of Arduino Nano and Arduino Uno

### NANO PINOUT





## 2-Pull-up and Pull-down Resistors



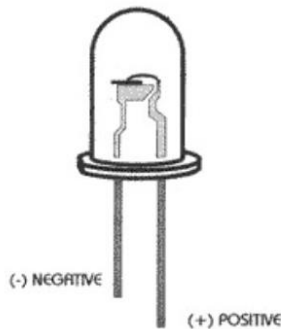
**Pull-up** resistors are used in logic circuits to ensure that inputs to the Arduino settle at expected logic levels if external devices are disconnected or have high-impedance. **'Just because you have nothing at all connected to an input pin doesn't mean it is a logical zero.'**

A **pull-up** resistor weakly "pulls" the voltage of the wire it is connected to towards its voltage source level when the other components on the line are inactive. When the switch on the line is open, it has high-impedance and acts like it is disconnected. Since the other components act as though they are disconnected, the circuit acts as though it is disconnected, and the pull-up resistor brings the wire up to the high logic level. When another component on the line goes active, it will override the high logic level set by the pull-up resistor. The pull-up resistor assures that the wire is at a defined logic level even if no active devices are connected to it.

A **pull-down** resistor works in the same way but is connected to ground. It holds the logic signal near zero volts when no other active device is connected.

The value of a pull down or pull up resistor will vary depending upon your specific devices involved.

Why do you need a resistor with an LED? LEDs are semiconductors, diodes in particular. The current flowing in an LED is an exponential function of voltage across the LED. The important part about that for you is that **a small change in voltage can produce a huge change in current**. That is the most important concept of this article. Resistors aren't like that. The current and voltage in a resistor are linearly related. That means that a change in voltage will produce a proportional change in current. Current versus voltage is a straight line for a resistor, but not at all for an LED.



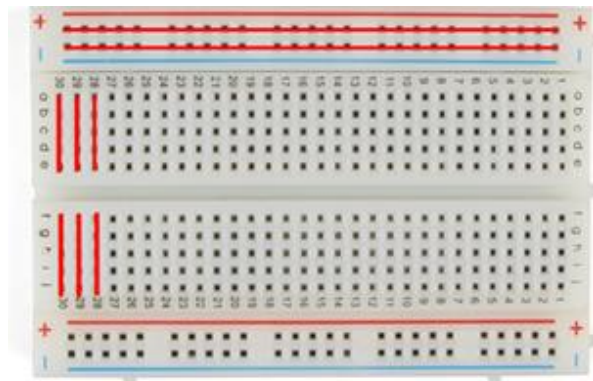
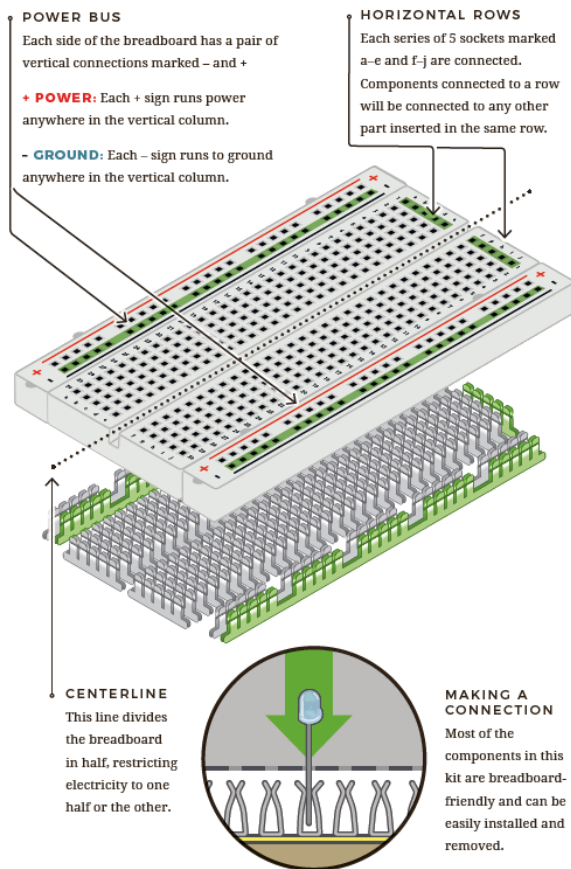
### 3-Breadboard

When you first look at a breadboard, it may not seem that impressive; it's basically just a piece of plastic with a bunch of holes in it. However, the magic lies within where a bunch of metal strips connect the rows of holes. These strips of metal have little clips that match up to the holes in the top of the breadboard and hold wires and components in place — as well as create electrical connections to anything else placed in the same row.

In addition to the horizontal rows, most breadboards feature vertical power rails that allow for easy access to power wherever it is needed within the circuit. Usually they will be labeled with a '+' and a '-' and have a red stripe and a blue or black stripe to indicate the positive and negative side.

# Anatomy of the Breadboard

A breadboard is a circuit-building platform that allows you to connect multiple components without using a soldering iron.



So why do we call this electronic “circuit builder” a breadboard? Many years ago, when electronics were big and bulky, people would grab their mom’s breadboard, a few nails or thumbtacks, and start connecting wires onto the board to give themselves a platform on which to build their circuits.

## 4-Ohm’s Law

Ohm's law states that the current through a conductor between two points is directly proportional to the voltage across the two points. Introducing the constant of proportionality, the resistance.

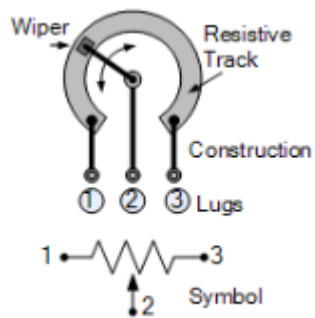
$$V = I R$$

$I$  is the current through the conductor in units of amperes,  $V$  is the voltage measured across the conductor in units of volts, and  $R$  is the resistance of the conductor in units of ohms. More specifically, Ohm's law states that the  $R$  in this relation is constant, independent of the current.

The law was named after the German physicist Georg Ohm, who, in a treatise published in 1827, described measurements of applied voltage and current through simple electrical circuits containing various lengths of wire.

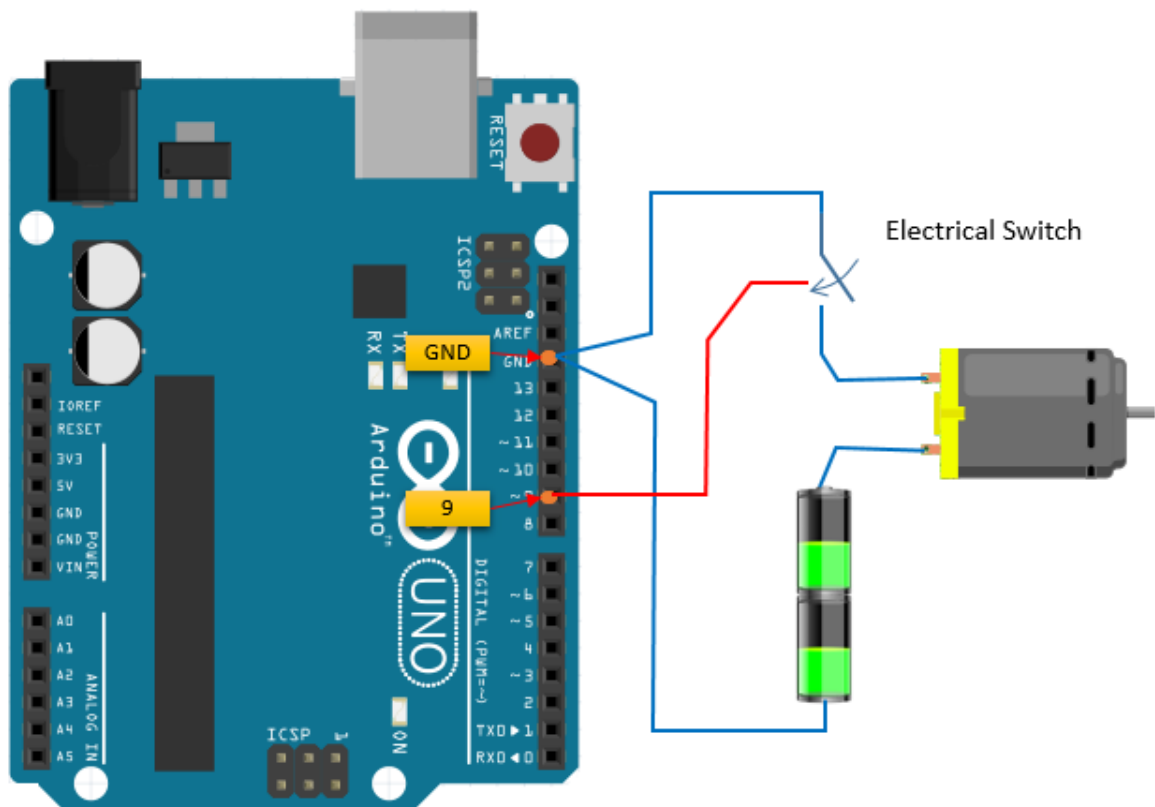
## 5-Potentiometer

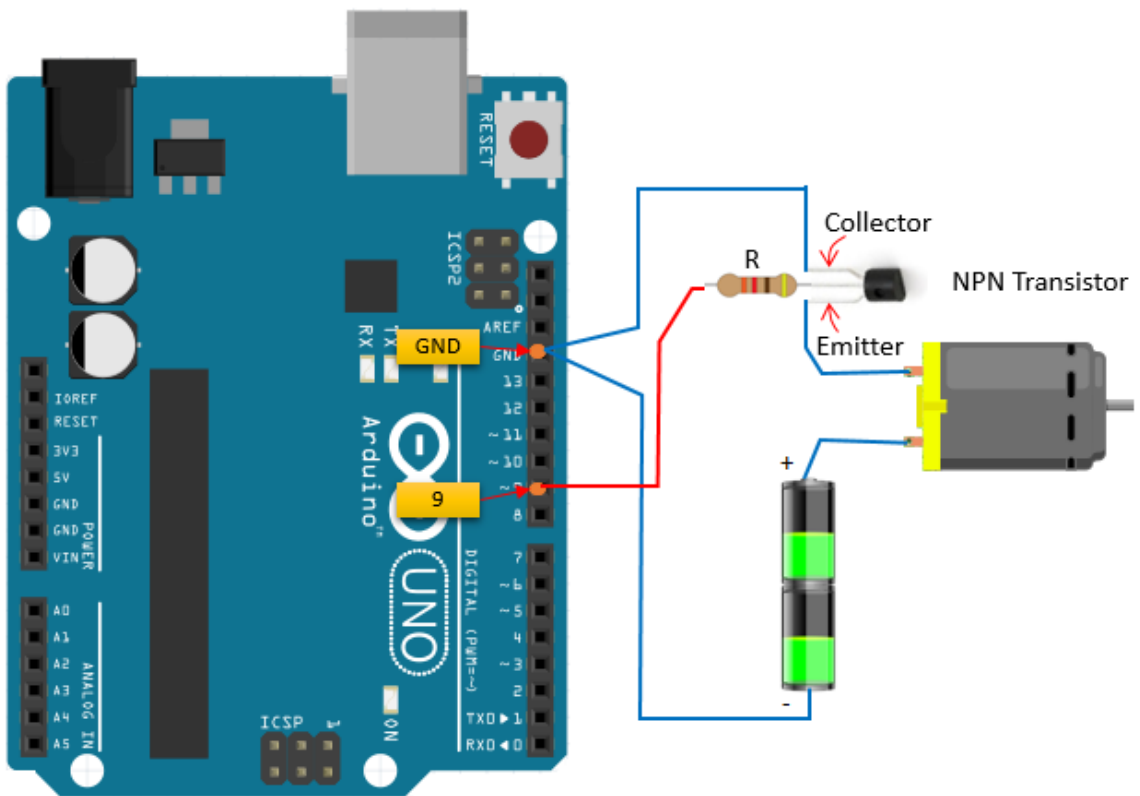
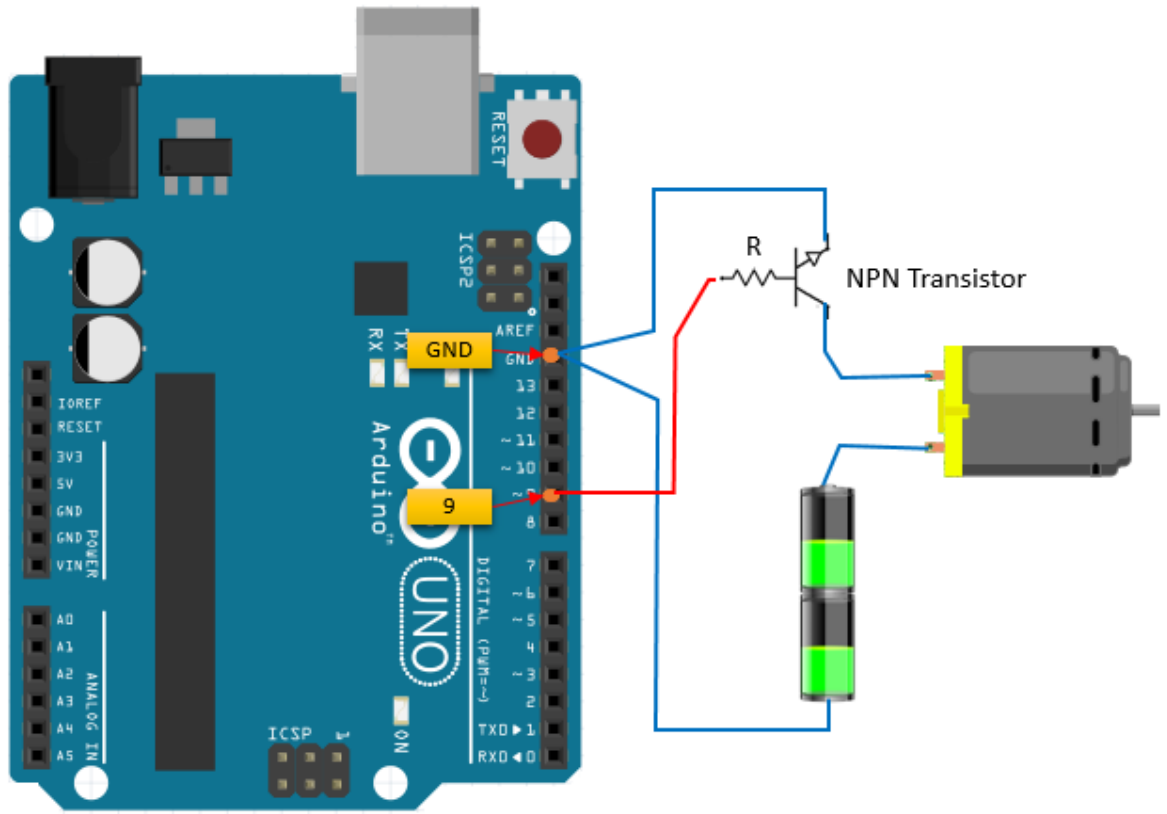
A potentiometer is a simple knob that provides a variable resistance.



The resistor between leg 1 and leg 3 is constant. However between leg 1 and leg 2 or leg 2 and leg 3 is not constant, it is variable.

## 6-DC Motor

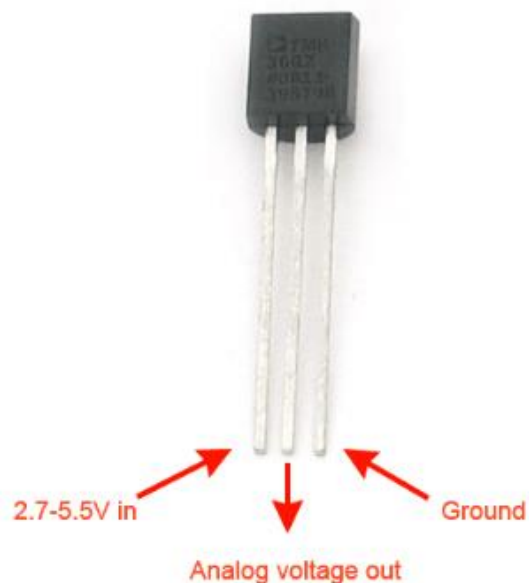
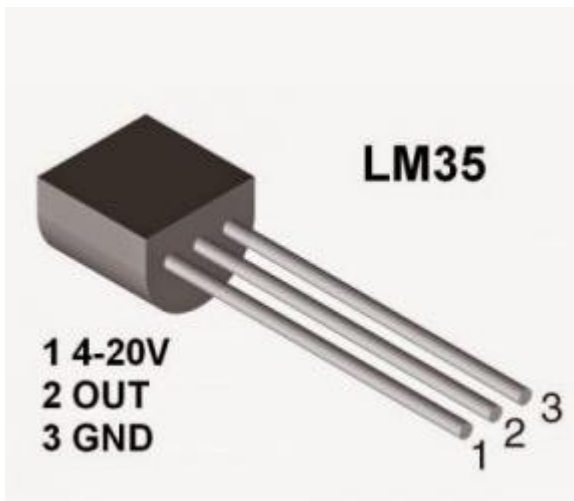






Transistor is a very simple element that is able to turn the DC motor on and off by Arduino commands. As shown in the figures, the Base pin of the transistor is connected to Arduino output pin 9 (or any PWM pin), which is connected the way it is to receive its commands as well as having a resistor in the way. The resistor is connected to prevent excess current flow that can damage the transistor and to control the amount of the current supplied to the motor. You cannot directly connect DC motor to Arduino. Because of its structure, the current flow in the motor will exceed the limit that Arduino can supply. Remember it was 20 mA. In order to prevent damages a transistor which may be NPN is used with a battery. The battery can differ from 3V to 9V depending on its structure. Below you can find a link that describes in detail the working principle: [http://www.sharetechnote.com/html/Arduino\\_MotorBasics.html](http://www.sharetechnote.com/html/Arduino_MotorBasics.html)

## 7-Temperature Sensor



It is an analog sensor. It gives voltage output with respect to temperature change. According to the datasheet information, it is possible to measure the temperature between -50 and 150 degrees. The second temperature sensor can be found on TinkerCad. The left one which is LM35 is most widely used in these kind of projects. It is obvious that they have the same pin legs. The differences between them may be the supply voltage or sensitivity. Analog Voltage Out leg will be connected to ANALOG IN pins of an Arduino.