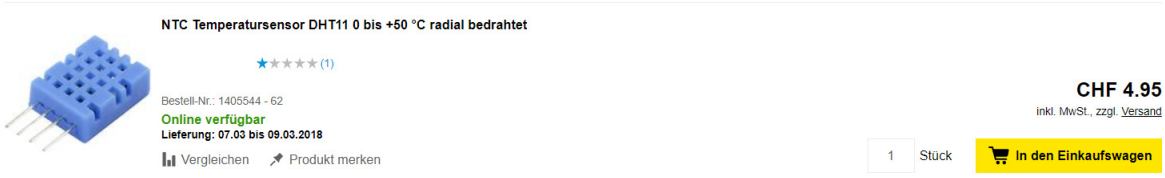
Aytac Akyol

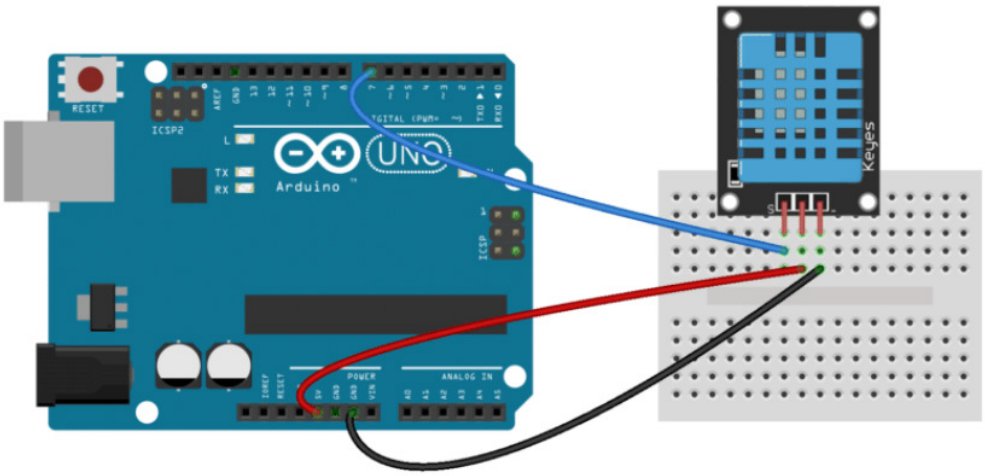
DHT11 Humidity Sensor

Basic Infos:

- Humidity Range: 20-90% RH
- Humidity Accuracy: ±5% RH
- Temperature Range: 0-50 °C
- Temperature Accuracy: ±2% °C
- Operating Voltage: 3V to 5.5V



CONNECTING A THREE PIN DHT11:



DHT11 Library: http://www.circuitbasics.com/wp-content/uploads/2015/10/DHTLib.zip

DHT11 Datasheet: http://www.circuitbasics.com/wp-content/uploads/2015/11/DHT11-Datasheet.pdf

Code:

```
#include <dht.h>
dht DHT;
#define DHT11_PIN 7

void setup(){
  Serial.begin(9600);
}

void loop()
{
  int chk = DHT.read11(DHT11_PIN);
  Serial.print("Temperature = ");
  Serial.println(DHT.temperature);
  Serial.print("Humidity = ");
  Serial.println(DHT.humidity);
  delay(1000);
}
```

WHAT IS RELATIVE HUMIDITY?

The DHT11 measures *relative humidity*. Relative humidity is the amount of water vapor in air vs. the saturation point of water vapor in air. At the saturation point, water vapor starts to condense and accumulate on surfaces forming dew.
The saturation point changes with air temperature. Cold air can hold less water vapor before it becomes saturated, and hot air can hold more water vapor before it becomes saturated.

The formula to calculate relative humidity is:

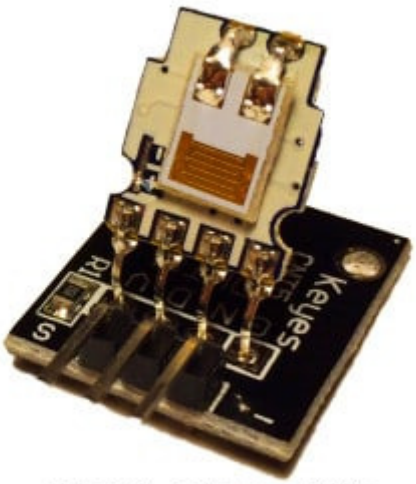
$$RH = (\frac{\rho_w}{\rho_s})\ x\ 100\%$$

$$RH:\ Relative\ Humidity$$
$$\rho_w:\ Density\ of\ water\ vapor$$
$$\rho_s:\ Density\ of\ water\ vapor\ at\ saturation$$

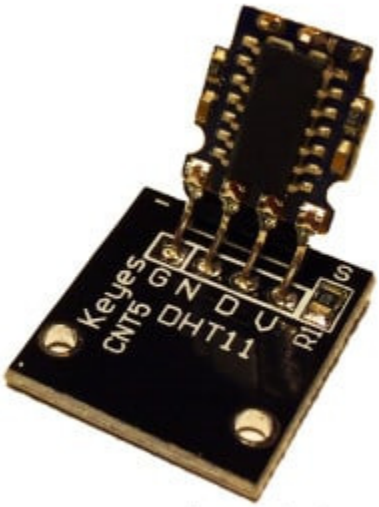
Relative humidity is expressed as a percentage. At 100% RH, condensation occurs, and at 0% RH, the air is completely dry.

The DHT11 detects water vapor by measuring the electrical resistance between two electrodes. The humidity sensing component is a moisture holding substrate with electrodes applied to the surface. When water vapor is absorbed by the substrate, ions are released by the substrate which increases the conductivity between the electrodes. The change in resistance between the two electrodes is proportional to the relative humidity. Higher relative humidity decreases the resistance between the electrodes, while lower relative humidity increases the resistance between the electrodes.

The DHT11 measures temperature with a surface mounted NTC temperature sensor (thermistor) built into the unit. To learn more about how thermistors work and how to use them on the Arduino, check out our Arduino Thermistor Temperature Sensor Tutorial.
With the plastic housing removed, you can see the electrodes applied to the substrate:



Front view with cover removed

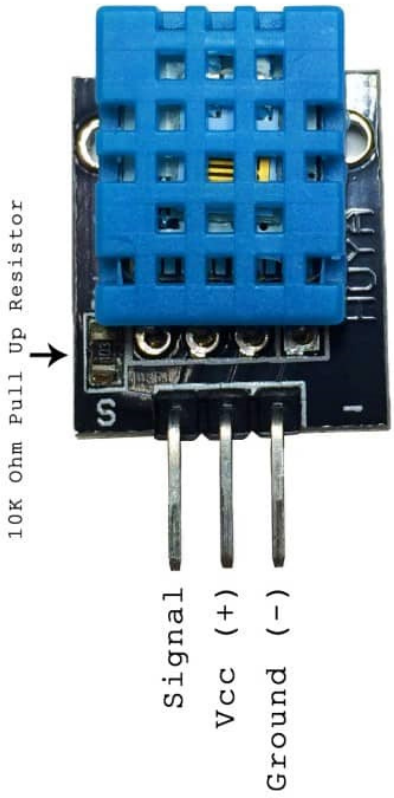


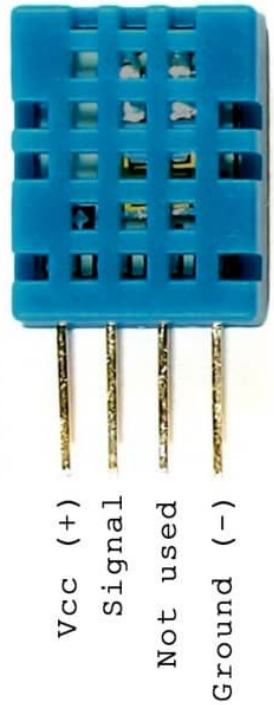
Rear view with cover removed

An IC mounted on the back of the unit converts the resistance measurement to relative humidity. It also stores the calibration coefficients, and controls the data signal transmission between the DHT11 and the Arduino.

The DHT11 uses just one signal wire to transmit data to the Arduino. Power comes from separate 5V and ground wires. A 10K Ohm pull-up resistor is needed between the signal line and 5V line to make sure the signal level stays high by default (see the datasheet for more info).

There are two different versions of the DHT11 you might come across. One type has four pins, and the other type has three pins and is mounted to a small PCB. The PCB mounted version is nice because it includes a surface mounted 10K Ohm pull up resistor for the signal line. Here are the pin outs for both versions:


10K Ohm Pull Up Resistor
S
-
HUYA
Signal
Vcc (+)
Ground (-)


Vcc (+)
Signal
Not used
Ground (-)