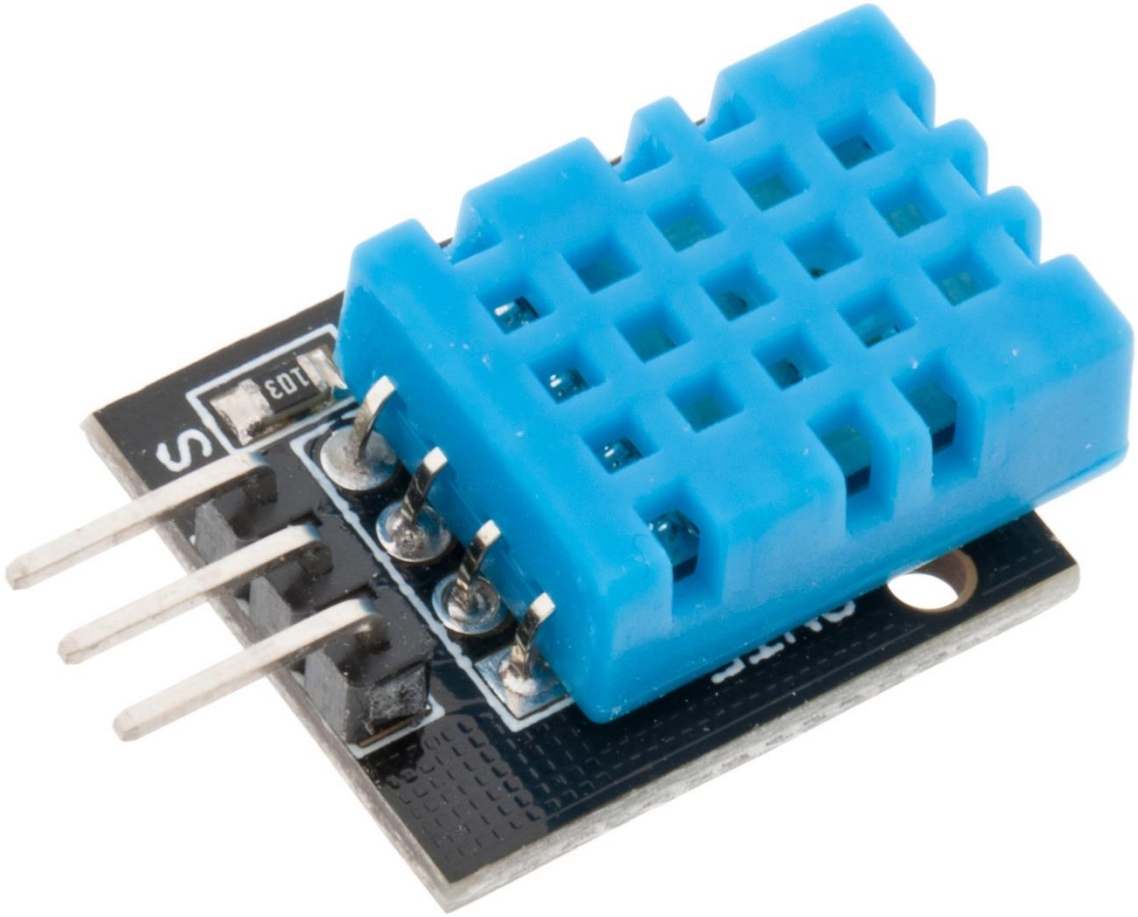
DHT11 TEMPERATURE SENSOR



This temperature and humidity sensor module provides a digital serial interface to measure humidity and temperature. The module consists of a DHT11 digital humidity and temperature sensor and a 1 kΩ resistor. The DHT11 uses an internal thermistor and a capacitive humidity sensor to determine environment conditions, an internal chip is responsible for converting readings to a serial digital signal.

Operating Voltage	3.3V to 5.5V
Humidity range	20% to 90% RH
Humidity accuracy	±5% RH
Humidity resolution	1% RH
Temperature range	0ºC to 50ºC [32ºF to 122ºF]
Temperature accuracy	±2ºC
Temperature resolution	1ºC
Signal transmission range	20m

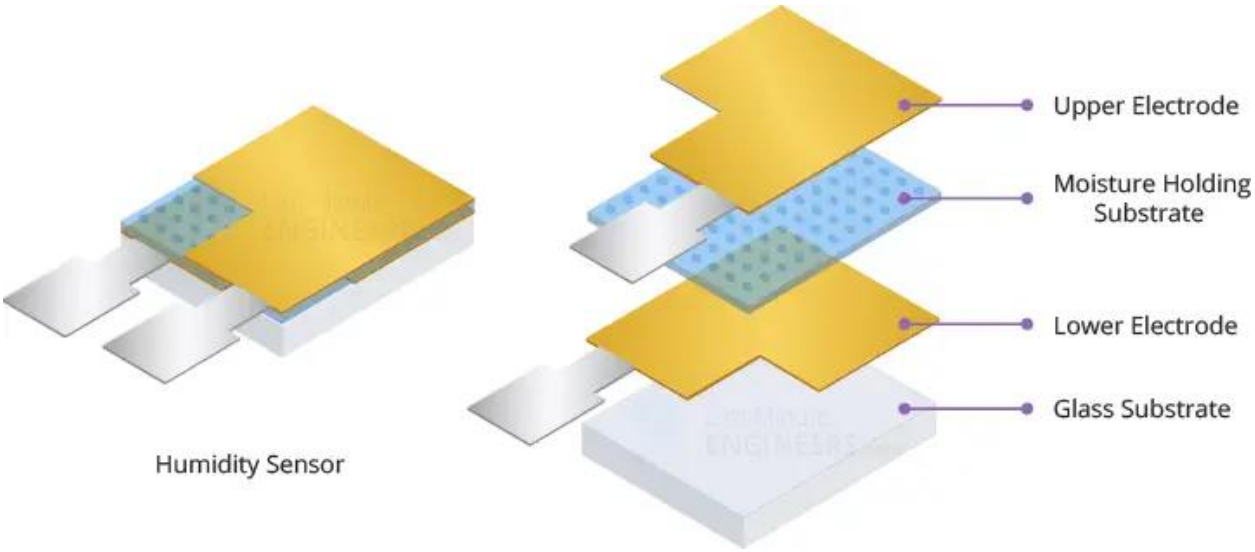
Inside the DHT11 Sensor

If you remove the sensor's casing, you will find an NTC thermistor and a humidity sensing component inside.

The humidity sensing component has two electrodes with a moisture-holding substrate (usually a salt or conductive plastic polymer) in between.

As the humidity rises, the substrate absorbs water vapor, resulting in the release of ions and a decrease in the resistance between the two electrodes.

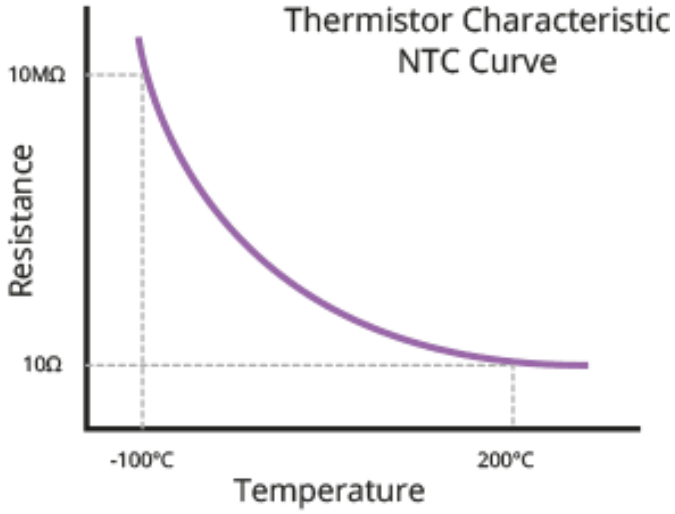
This change in resistance is proportional to the humidity, which can be measured to estimate relative humidity.



DHt11 also includes a NTC thermistor for measuring temperature. A thermistor is a type of resistor whose resistance varies with temperature.

Technically, all resistors are thermistors in the sense that their resistance changes slightly with temperature, but this change is typically very small and difficult to measure. Thermistors are designed so that their resistance changes dramatically with temperature (by 100 ohms or more per degree). The term "NTC" stands for "Negative Temperature Coefficient," which means that resistance decreases as temperature rises.

NTC Thermistor

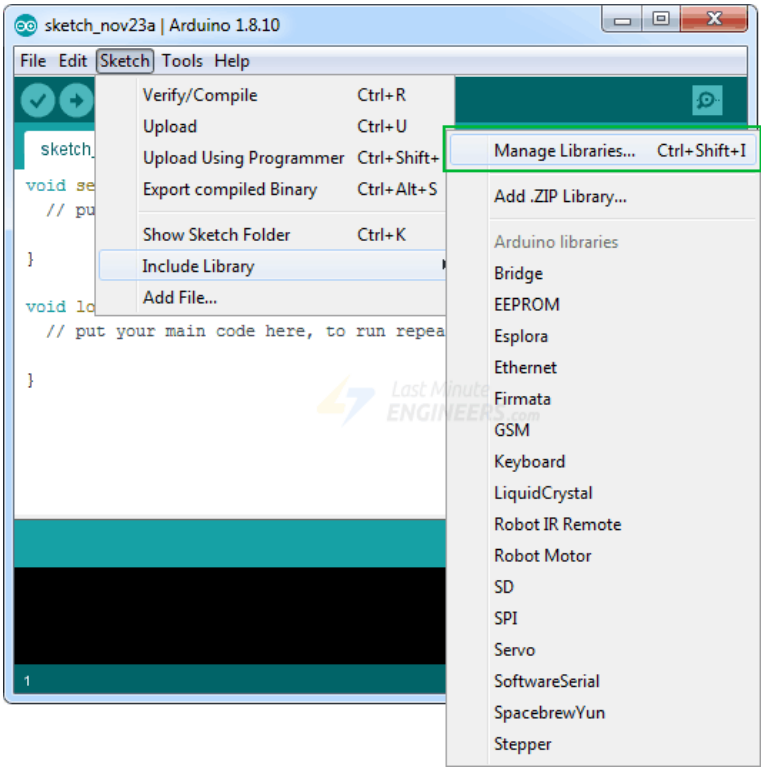


The sensor also includes an 8-bit SOIC-14 packaged IC. This IC measures and processes the analog signal using stored calibration coefficients, converts the analog signal to digital, and outputs a digital signal containing the temperature and humidity.

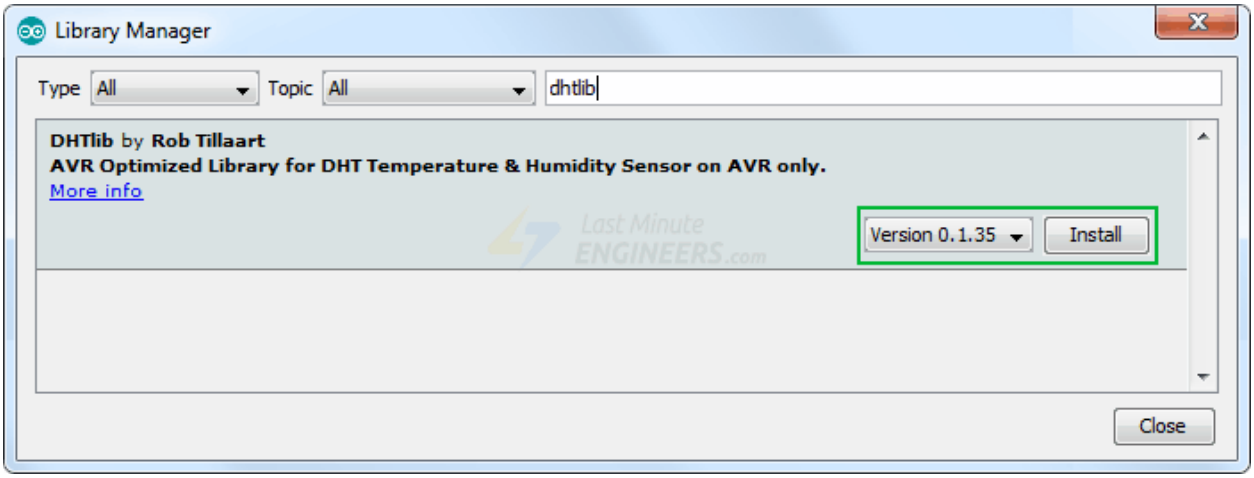
Installing DHT library

The DHT sensors has their own proprietary single-wire data transfer protocol. This protocol requires precise timing. We don't have to worry too much about this, though, because we'll be using the DHTlib library, which handles almost everything.

To install the library, navigate to Sketch > Include Library > Manage Libraries… Wait for the Library Manager to download the libraries index and update the list of installed libraries.

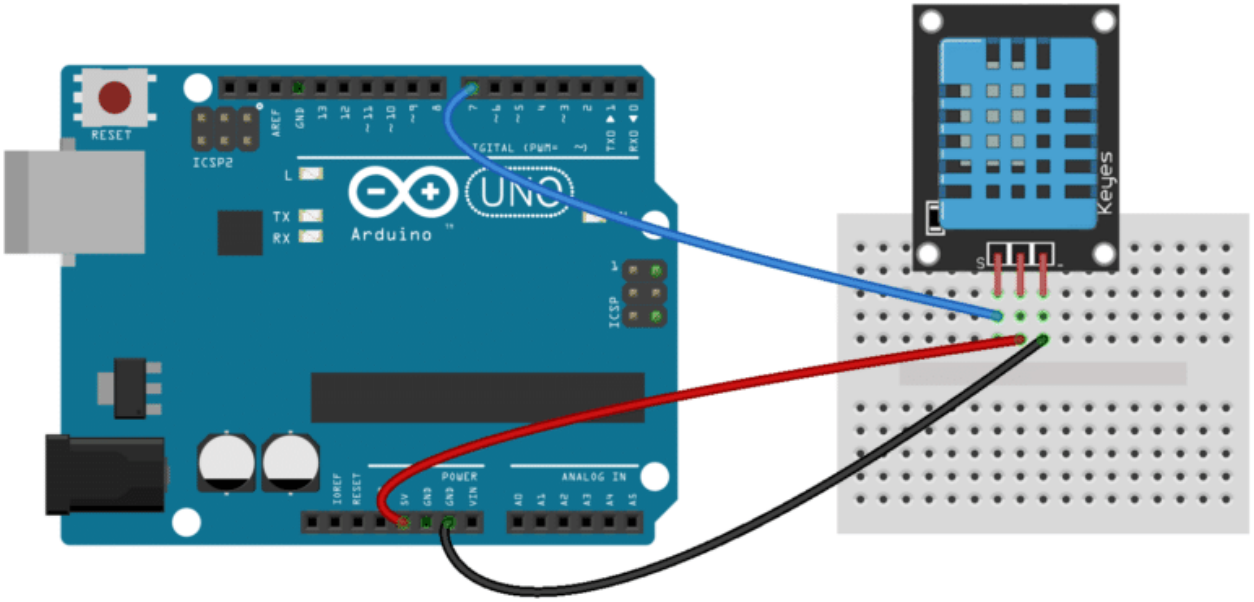


Filter your search by entering 'dhtlib'.There should only be a single entry. Click on that and then choose Install.



Pinout and Connection to Arduino

Connect the Power line (middle) and ground (-) to +5 and GND respectively. Connect signal (S) to pin 8 on the Arduino.



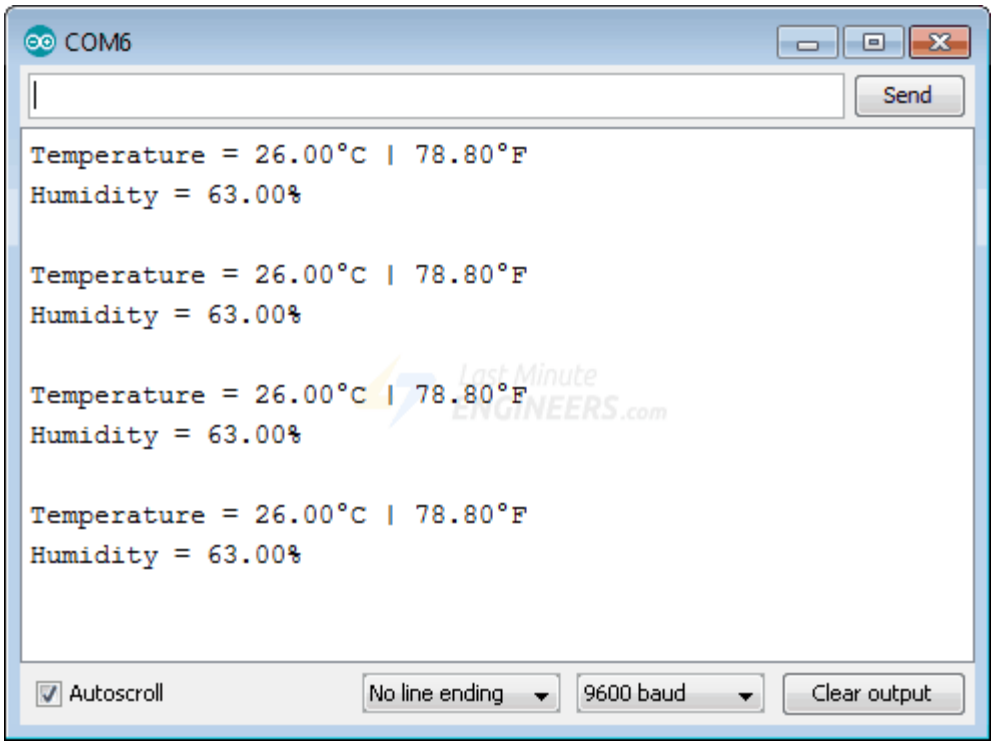
Arduino Example Sketch

The following sketch uses pin 8 on the Arduino to serially send and receive data from the sensor. Serial communication is archived by sending specific high/low signals to the sensor and waiting for a

response. Temperature and humidity data is read bit by bit and returned as an array of bytes.

```
#include <dht.h>        // Include library
#define outPin 8        // Defines pin number to which the sensor is
connected

dht DHT;                // Creates a DHT object

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

void loop() {
        int readData = DHT.read11(outPin);

        float t = DHT.temperature;        // Read temperature
        float h = DHT.humidity;           // Read humidity

        Serial.print("Temperature = ");
        Serial.print(t);
        Serial.print("°C | ");
        Serial.print((t*9.0)/5.0+32.0);        // Convert celsius to
fahrenheit
        Serial.println("°F ");
        Serial.print("Humidity = ");
        Serial.print(h);
        Serial.println("% ");
        Serial.println("");

        delay(2000); // wait two seconds
}
```

After uploading the sketch, you should see the following output on the serial monitor.



Code Explanation:

The sketch begins by including the DHT library. Following that, we specify the Arduino pin number to which our sensor's Data pin is connected and create a `DHT` object.

```
#include <dht.h>
#define outPin 8

dht DHT;
```

In the setup, we initialize the serial communication.

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

In the loop, we use the `read11()` function to read the DHT11 module. This function takes as a parameter the sensor's Data pin number.

```
int readData = DHT.read11(outPin);
```

We can now retrieve the humidity and temperature values by accessing the DHT object's properties using dot `.` notation.

```
float t = DHT.temperature;         // Read temperature
float h = DHT.humidity;            // Read humidity
```

The DHT object returns the temperature in degrees Celsius (°C). It is easy to convert to Fahrenheit (°F) using the following formula:

$$T(°F) = T(°C) \times 9/5 + 32$$

```
Serial.print((t * 9.0) / 5.0 + 32.0);
```

REFERENCES:

https://lastminuteengineers.com/dht11-module-arduino-tutorial/

https://www.electrokit.com/upload/product/41015/41015728/41015728_-_Digital_Temperature_Humidity_Sensor.pdf