DIGITAL OUTPUT TEMPERATURE AND HUMIDITY SENSOR

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OVERVIEW

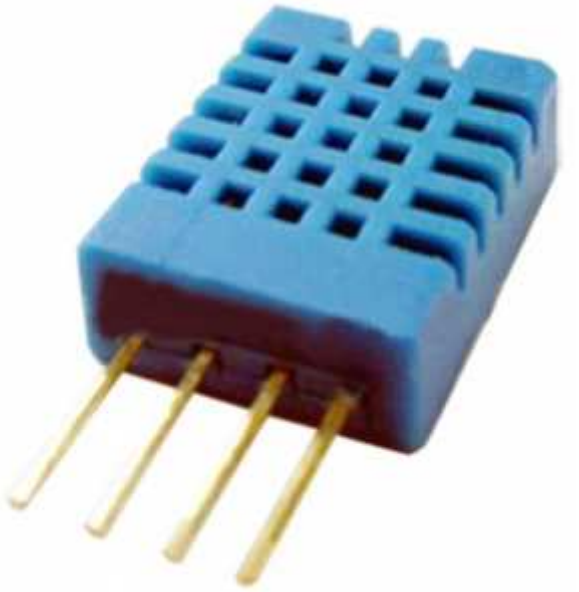
The DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with calibrated digital signal output. By using the exclusive digital-signal-acquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long term stability.

This sensor include a resistive type humidity measurement component and a NTC temperature measurement component, and connect to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interface ability and cost effectiveness.

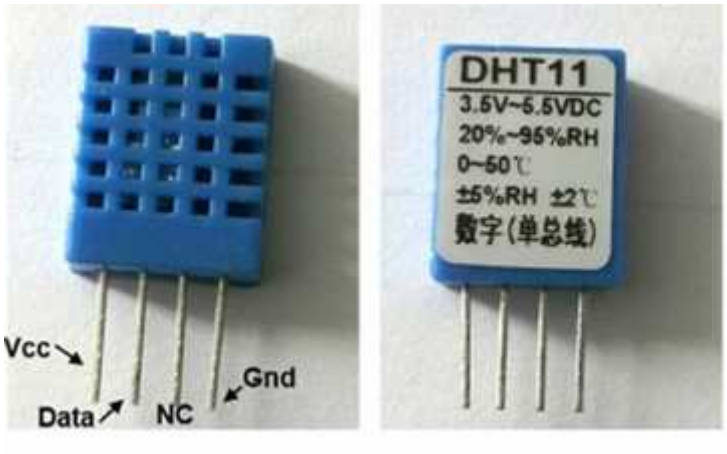
It's of small size, low power consumption and up-to 20 meter signal transmission makes it a best choice for various applications.

FEATURES

- DHT series digital temperature and humidity sensor
- Full range of calibration, in-line digital output;
- Humidity measuring range: 20% ~ 90% RH (0-50 temperature compensation);
- Temperature measuring range: 0 ~ +50 ;
- Humidity measurement accuracy:± 5.0% RH
- Temperature measurement accuracy:± 2.0
- Response time: <5s;
- Low power consumption
- Power: 3-5.5V.



DHT 11 SENSOR



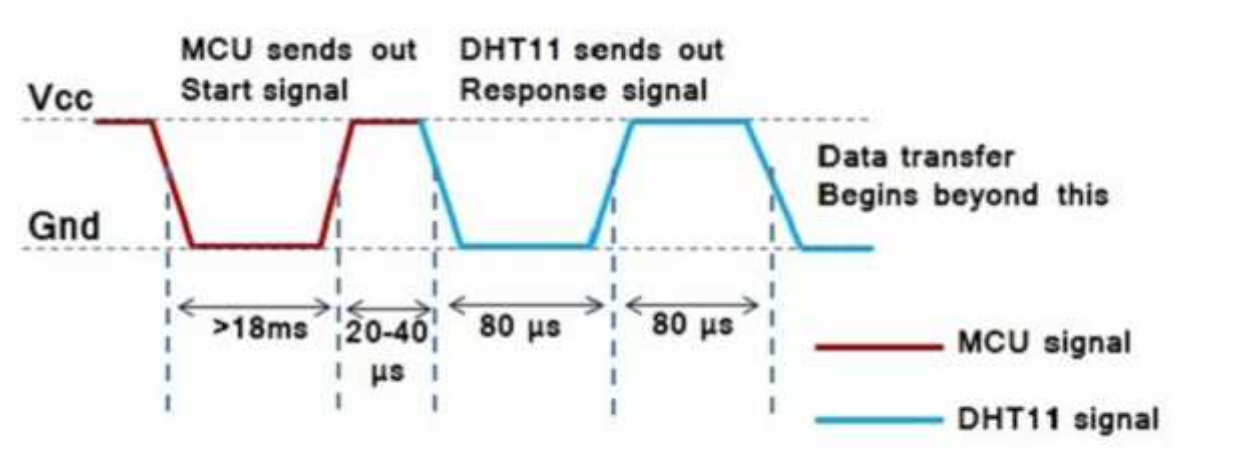
DHT11 sensor comes in a single row 4-pin package

The following timing diagrams describe the data transfer protocol between a MCU and the DHT11 sensor. The MCU initiates data transmission by issuing a “Start” signal. The MCU pin must be configured as output for this purpose.

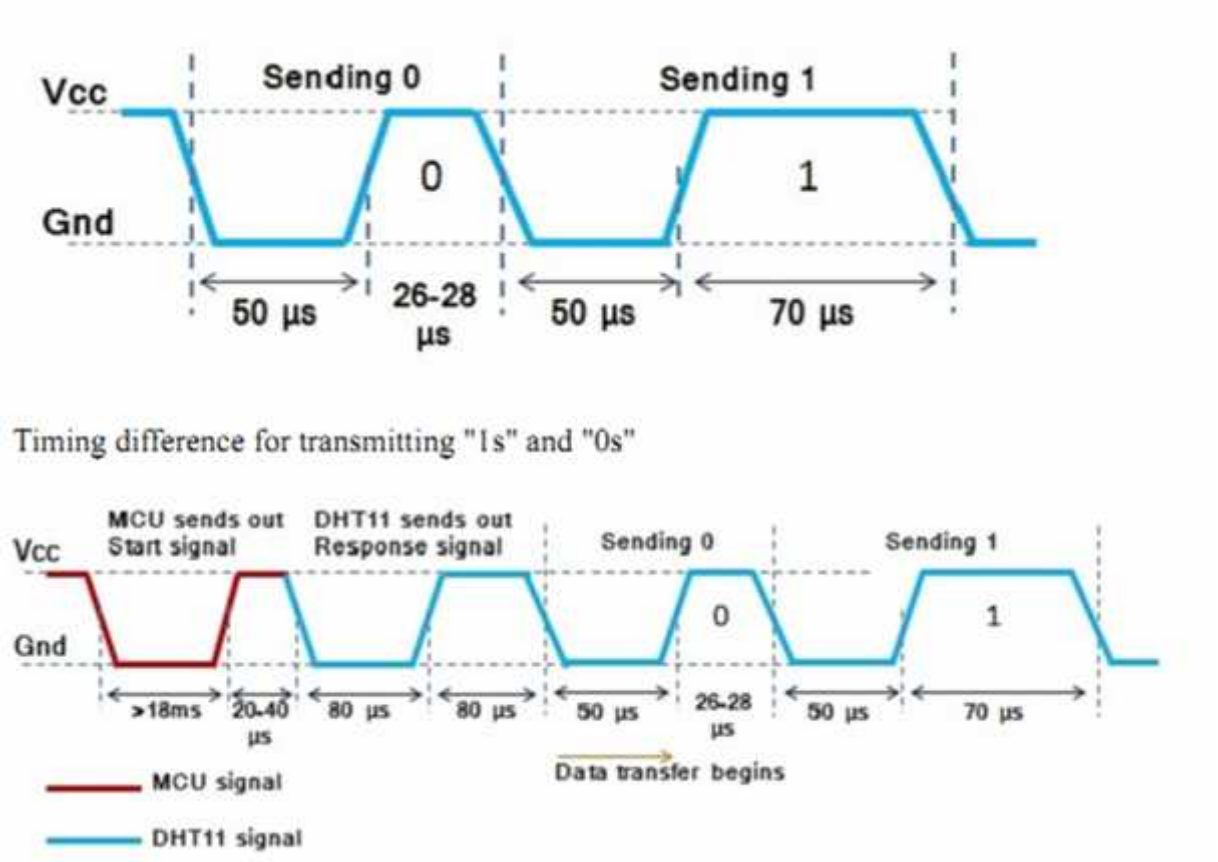
The MCU first pulls the data line low for at least 18 MS and then pulls it high for next 20-40 µs before it releases it. Next, the sensor responds to the MCU “Start“ signal by pulling the line low for 80 µs followed by a logic high signal that also lasts for 80 µs.

Remember that the MCU pin must be configured to input after finishing the “Start“ signal. Once detecting the response signal from the sensor, the MCU should be ready to receive data from the sensor. The sensor then sends 40 bits (5bytes) of data continuously in the data line. Note that while transmitting bytes, the sensor sends the most significant bit first.

Timing diagram



- "Start" and "Response" signals
- The 40-bit data from the sensor has the following structure.
- ***Data (40-bit) = Integer Byte of RH + Decimal Byte of RH + Integer Byte of Temp. + Decimal Byte of Temp. + Checksum Byte***
- For DHT11 sensor, the decimal bytes of temperature and humidity measurements are always zero. Therefore, the first and third bytes of received data actually give the numeric values of the measured relative humidity (%) and temperature (°C). The last byte is the checksum byte which is used to make sure that the data transfer has happened without any error. If all the five bytes are transferred successfully then the checksum byte must be equal to the last 8 bits of the sum of the first four bytes, i.e.,
- ***Checksum = Last 8 bits of (Integer Byte of RH + Decimal Byte of RH + Integer Byte of Temp. + Decimal Byte of Temp.)***
- Now let's talk about the most important thing, which is signaling for transmitting "0" and "1". In order to send a bit of data, the sensor first pulls the line low for 50 µs. Then it raises the line to high for 26-28 µs if it has to send "0", or for 70 µs if the bit to be transmitted is "1". So it is the width of the positive pulse that carries information about 1 and 0.



- Start, Response and Data signals in sequence
- At the end of the last transmitted bit, the sensor pulls the data line low for 50 µs and then releases it. The DHT11 sensor requires an external pull-up resistor to be connected between its Vcc and the data line so that under idle condition, the data line is always pulled high. After finishing the data transmission and releasing the data line, the DHT11 sensor goes to the low-power consumption mode until a new “Start” signal arrives from the MCU

TECHNICAL SPECIFICATION

MODEL	DHT11
Power Supply	3-5.5V DC
Output Signal	Digital Signal via single-bus
Sensing element	Polymer resistor
Measuring range	Humidity 20-90%RH Temperature 0-50 Celsius
Accuracy	Humidity +-4%RH (Max +-5%RH); temperature +- 2.0 Celsius
Resolution or sensitivity	Humidity 1%RH;
Repeatability	Humidity+- 1%RH
Humidity Hysteresis	+-1%RH
Long term Stability	+-0.5%RH/year
Sensing period	Average: 2s
Dimensions	Size 12*15.5*5.5mm

OPERATING SPECIFICATION:

1. Power and Pins
   Power's voltage should be 3-5.5V DC. When power is supplied to sensor, don't send any Instruction to the sensor within one second to pass unstable status. One capacitor valued 100nF Can be added between VDD and GND for power filtering.

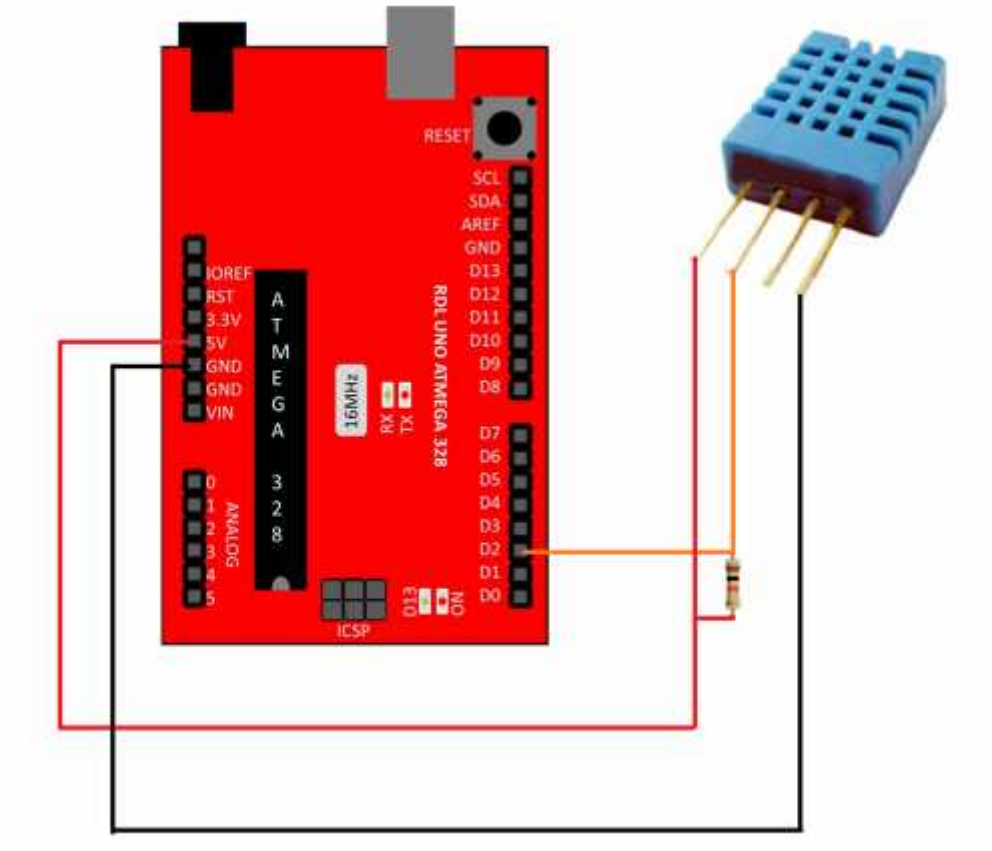
2. Communication and signal
   Single-bus data is used for communication between MCU and DHT11.

ELECTRICAL CHARACTERISTIC

item	condition	min	typical	max	unit
power supply	DC	3	5	5.5	v
current supply	measuring	0.5		2.5	mA
	stand-by	100	NULL	150	uA
	Average	0.2	NULL	1	mA

INTERFACE

1. WITH ARDUINO



CODE

```
     /* DHT library
*/

#include "DHT.h"

DHT::DHT(uint8_t pin, uint8_t type) {
  _pin = pin;
  _type = type;
  firstreading = true;
}

void DHT::begin(void) {
  // set up the pins!
  pinMode(_pin, INPUT);
  digitalWrite(_pin, HIGH);
  _lastreadtime = 0;
}

//boolean S == Scale.  True == Farenheit; False == Celcius
float DHT::readTemperature(bool S) {
  float f;

  if (read()) {
    switch (_type) {
    case DHT11:
      f = data[2];
      if(S)
           f = convertCtoF(f);

      return f;
    case DHT22:
    case DHT21:
      f = data[2] & 0x7F;
      f *= 256;
      f += data[3];
      f /= 10;
      if (data[2] & 0x80)
     f *= -1;
      if(S)
     f = convertCtoF(f);

      return f;
    }
  }
```

```
  Serial.print("Read fail");
  return NAN;
}

float DHT::convertCtoF(float c) {
     return c * 9 / 5 + 32;
}

float DHT::readHumidity(void) {
  float f;
  if (read()) {
    switch (_type) {
    case DHT11:
      f = data[0];
      return f;
    case DHT22:
    case DHT21:
      f = data[0];
      f *= 256;
      f += data[1];
      f /= 10;
      return f;
    }
  }
  Serial.print("Read fail");
  return NAN;
}


boolean DHT::read(void) {
  uint8_t laststate = HIGH;
  uint8_t counter = 0;
  uint8_t j = 0, i;
  unsigned long currenttime;

  // pull the pin high and wait 250 milliseconds
  digitalWrite(_pin, HIGH);
  delay(250);

  currenttime = millis();
  if (currenttime < _lastreadtime) {
    // ie there was a rollover
    _lastreadtime = 0;
  }
  if (!firstreading && ((currenttime - _lastreadtime) < 2000)) {
    return true; // return last correct measurement
    //delay(2000 - (currenttime - _lastreadtime));
  }
  firstreading = false;
```

```
/*
  Serial.print("Currtime: "); Serial.print(currenttime);
  Serial.print(" Lasttime: "); Serial.print(_lastreadtime);
*/
_lastreadtime = millis();

data[0] = data[1] = data[2] = data[3] = data[4] = 0;

// now pull it low for ~20 milliseconds
pinMode(_pin, OUTPUT);
digitalWrite(_pin, LOW);
delay(20);
cli();
digitalWrite(_pin, HIGH);
delayMicroseconds(40);
pinMode(_pin, INPUT);

// read in timings
for ( i=0; i< MAXTIMINGS; i++) {
  counter = 0;
  while (digitalRead(_pin) == laststate) {
    counter++;
    delayMicroseconds(1);
    if (counter == 255) {
      break;
    }
  }
  laststate = digitalRead(_pin);

  if (counter == 255) break;

  // ignore first 3 transitions
  if ((i >= 4) && (i%2 == 0)) {
    // shove each bit into the storage bytes
    data[j/8] <<= 1;
    if (counter > 6)
      data[j/8] |= 1;
    j++;
  }

}

sei();

/*
Serial.println(j, DEC);
Serial.print(data[0], HEX); Serial.print(", ");
Serial.print(data[1], HEX); Serial.print(", ");
Serial.print(data[2], HEX); Serial.print(", ");
```

```
  Serial.print(data[3], HEX); Serial.print(", ");
  Serial.print(data[4], HEX); Serial.print(" =? ");
  Serial.println(data[0] + data[1] + data[2] + data[3], HEX);
  */

  // check we read 40 bits and that the checksum matches
  if ((j >= 40) &&
      (data[4] == ((data[0] + data[1] + data[2] + data[3]) & 0xFF)) )
{
    return true;
  }


  return false;

}
```

LIBRARY

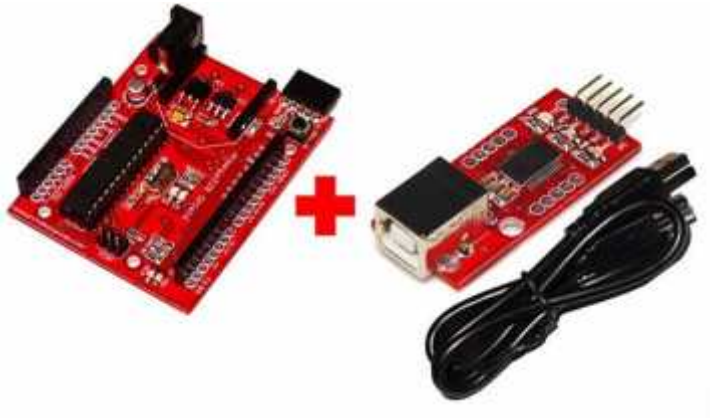
This is the library function that need to be added to the library

```
#if ARDUINO >= 100
 #include "Arduino.h"
#else
 #include "WProgram.h"
#endif

/* DHT library

*/

// how many timing transitions we need to keep track of. 2 * number
bits + extra
#define MAXTIMINGS 85

#define DHT11 11
#define DHT22 22
#define DHT21 21
#define AM2301 21

class DHT {
 private:
  uint8_t data[6];
  uint8_t _pin, _type;
  boolean read(void);
  unsigned long _lastreadtime;
  boolean firstreading;
```

```
 public:
  DHT(uint8_t pin, uint8_t type);
  void begin(void);
  float readTemperature(bool S=false);
  float convertCtoF(float);
  float readHumidity(void);

};
```

Related products

RDL- UNO ATMEGA328 Development Board



8 Channel Analog Data Logger