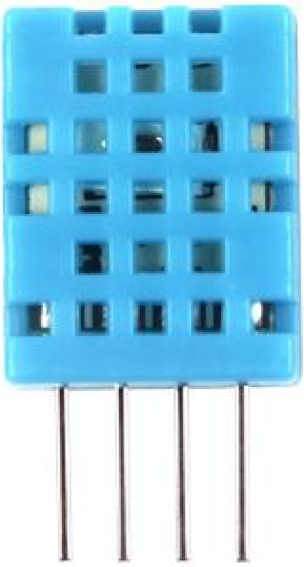
ASAIR®

Temperature and humidity module

DHT11 Product Manual



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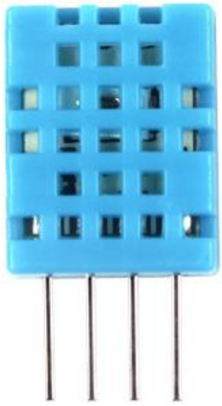
1. Product Overview



The DHT11 digital temperature and humidity sensor is a temperature and humidity composite sensor with calibrated digital signal output. It uses dedicated digital module acquisition technology and temperature and humidity sensing technology to ensure that the product has extremely high reliability and excellent long-term stability. The sensor includes a capacitive humidity sensing element and an NTC temperature measuring element, and is connected to a high-performance 8-bit microcontroller.

2. Scope of application

HVAC, dehumidifiers, agriculture, cold chain warehousing, testing and inspection equipment, consumer goods, automobiles, automatic control, data loggers, weather stations, home appliances, humidity regulators, medical, and other related humidity detection and control.

3. Product Highlights

Low cost, long-term stability, relative humidity and temperature measurement, excellent quality, ultra-fast response, strong anti-interference ability, ultra-long signal transmission distance, digital signal output, precise calibration.

4. Dimensions(unitmm)

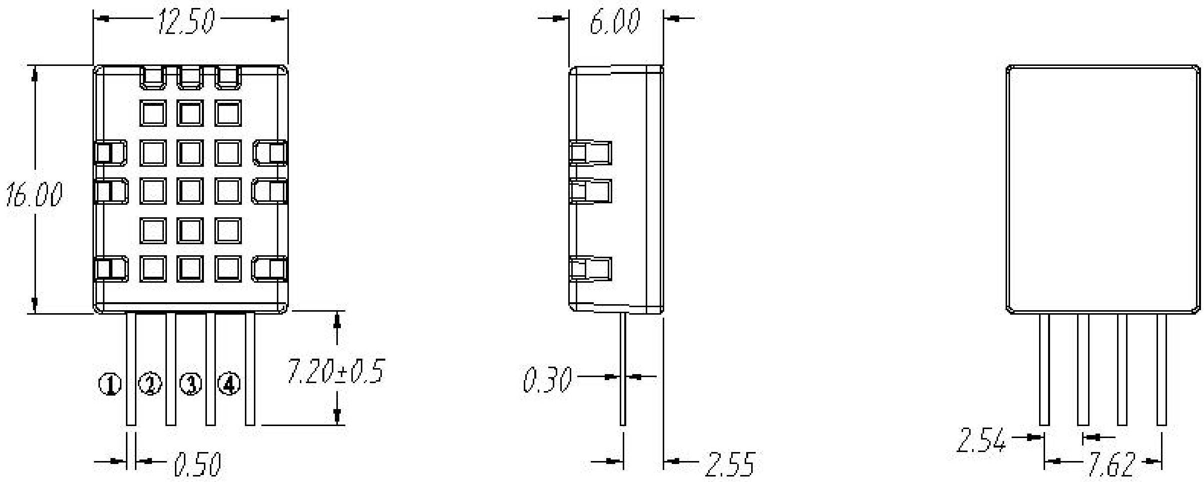


Figure 1 Product dimensions

Pin Description

1. VDD power supply 3.3～5.5V DC

2. DATA serial data, single bus

3. NC Empty feet

4. GND Ground, negative pole of power supply

5. Product parameters

5.1 Relative humidity

Table 1 Relative humidity performance table

parameter	condition	min	type	max	unit
Range		5		95	%RH
Accuracy [1]	25℃		±5		%RH
Repeatability			±1		%RH
Interchangeability		Completely interchangeable			
Response time [2]	1/e(63%)		<6		S
Hysteresis			±0.3		%RH
drift [3]	Typical Value		<±0.5		%RH/year

5.2 Temperature

Table 2 Temperature performance table

parameter	condition	min	type	max	unit
Range		- 20		60	℃
Accuracy [1]	25℃		±2		℃
Repeatability			±1		℃
Interchangeability		Completely interchangeable			
Response time [2]	1/e(63%)		<10		S
Hysteresis			±0.3		℃
drift [3]	Typical Value		<±0.5		℃/year

5.3 Electrical characteristics

Table 3 Electrical characteristics

parameter	condition	min	type	max	unit
Supply voltage		3.3	5.0	5.5	V
Supply current		0.06(Standby)	-	1.0 (measured)	mA
Sampling period	Measurement		> 2		S/times

[1] This accuracy is the accuracy specification of the sensor tested at 25℃ and 5V during factory inspection. It does not include hysteresis and non-linearity and is only suitable for non-condensing environments.

[2] The time required to reach 63% of the first-order response at 25°C and 1 m/s airflow.

[3] Values may be higher in volatile organic mixtures. See data sheet for application and storage information.

6. Typical Circuit

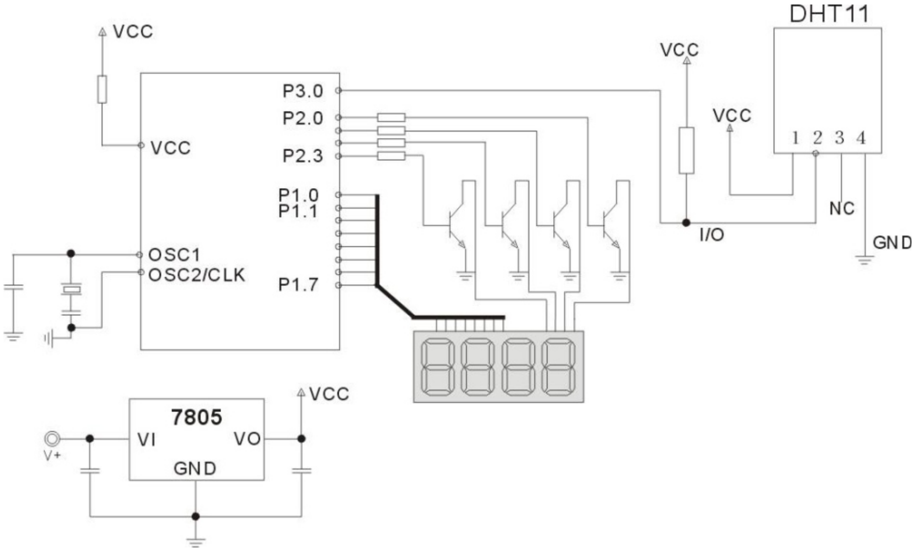


Figure 2 DHT11 typical circuit diagram

The typical application circuit for connecting the microprocessor and DHT11 is shown in the figure above (Figure 2). After DATA is pulled up, it is connected to the I/O port of the microprocessor.

1. In the typical application circuit, it is recommended to use a 4.7K pull-up resistor when the connection line length is shorter than 5m. When it is longer than 5m, the resistance value of the pull-up resistor should be reduced according to the actual situation.

2. When using 3.3V voltage power supply, the connection line should be as short as possible. Too long connection will lead to insufficient power supply of the sensor, resulting in measurement deviation.

3. The temperature and humidity values read each time are the results of the previous measurement. To obtain real-time data, you need to read it twice in succession, but not

It is recommended to read the sensor multiple times in succession, with an interval of more than 2 seconds between each reading to obtain accurate data.

4. If the power supply fluctuates, it will affect the temperature. If a switching power supply is used, the temperature will fluctuate.

7. Serial communication description (single-line bidirectional)

◎Single bus description

The DHT11 device uses a simplified single bus communication. A single bus has only one data line, and the data exchange and control in the system are all completed by the single bus. The device (host or slave) is connected to the data line through an open drain or tri-state port to allow the device to release the bus when it is not sending data, allowing other devices to use the bus; the single bus usually requires an external pull-up resistor of about 4.7kΩ, so that when the bus is idle, its state is high. Because they are master-slave structures, only the master

The slave can only respond when the host calls the slave. Therefore, the host must strictly follow the single bus sequence when accessing the device. If the sequence is disordered, the device will not respond to the host.

◎Single bus transmission data bit definition

DATA is used for communication and synchronization between the microprocessor and DHT11. It adopts a single bus data format, transmitting 40 bits of data at a time, with the high bit first out.

Data format:

8-bit humidity integer data + 8-bit humidity decimal data + 8-bit temperature integer data + 8-bit temperature decimal data + 8-bit check bit. Note: The decimal part of humidity is 0.

◎Parity bit data definition

The 8-bit check digit of "8-bit humidity integer data + 8-bit humidity decimal data + 8-bit temperature integer data + 8-bit temperature decimal data" is equal to the last 8 digits of the result.

name	1-Wire Bus Format Definition
Start signal	The microprocessor pulls the data bus (SDA) low for at least 18ms (maximum no more than 30ms) to notify the sensor to prepare data.
Response signal	The sensor pulls the data bus (SDA) low for 83μs and then high for 87μs in response to the host's start signal.
Data Format	After receiving the start signal from the host, the sensor sends out 40 bits of data from the data bus (SDA) at one time, with the high bit first.
humidity	The high digit of humidity is the integer part of humidity data, and the low digit of humidity is the decimal part of humidity data
temperature	The high bit of temperature is the integer part of temperature data, the low bit of temperature is the decimal part of temperature data, and if the low bit of temperature Bit8 is 1, it indicates negative temperature, otherwise it indicates positive temperature.
Check digit	Check digit = high humidity + low humidity + high temperature + low temperature

Example 1: The 40-bit data received is:

0011 0101	0000 0000	0001 1000	0000 0100	0101 0001
Humidity high 8 bits	Humidity low 8 bits	Temperature high 8 bits	Temperature low 8 bits	Check digit

calculate:

00110101+00000000+00011000+00000100=01010001 The received data is correct:

Humidity: 00110101 (integer) = 35H = 53%RH 00000000 (decimal) = 00H = 0.0%RH => 53%RH + 0.0%RH = 53.0%RH

Temperature: 00011000 (integer) = 18H = 24℃ 00000100 (decimal) = 04H = 0.4℃ => 24℃ + 0.4℃ = 24.4℃

◎**Special instructions:**

When the temperature is below 0°C, the highest position of the lower 8 bits of the temperature data is 1. **Example**: -10.1℃ is represented by 0000101010000001

temperature:00001010 (integer) = 0AH = 10℃, 00000001 (decimal) = 01H = 0.1℃

=>-(10℃+0.1℃)=-10.1℃

Example 2: The 40-bit data received is:

0011 0101	0000 0000	0001 1000	0000 0100	0100 1001
Humidity high 8 bits	Humidity low 8 bits	Temperature high 8 bits	Temperature low 8 bits	Check digit

calculate:

0011 0101+00000000+00011000+00000100= 0101 0001 0101 0001 is not equal to 0100 1001

The data received this time is incorrect, give up and try to receive the data again.

◎Data timing diagram

After the user host (MCU) sends a start signal, DHT11 switches from low power mode to high speed mode and waits for the host to start

After the signal ends, DHT11 sends a response signal, sends out 40 bits of data, and triggers a signal collection.

Signal transmission is shown in the figure3shown.

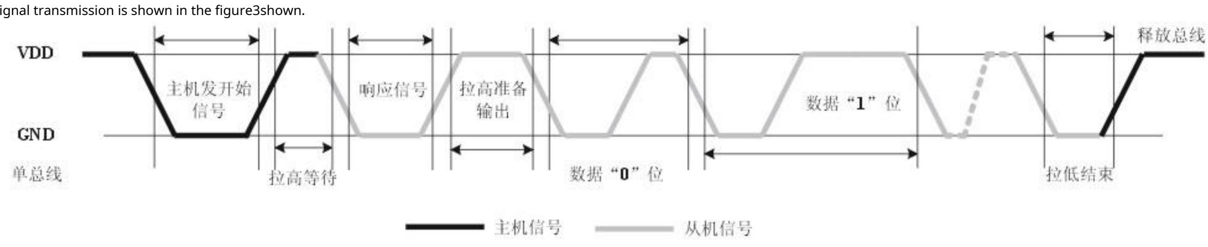


Figure 3 Data timing diagram

Note: The temperature and humidity data read by the host from DHT11 are always the previous measurement values. If the interval between two measurements is very long, please read twice in succession and use the second value as the real-time temperature and humidity value.

◎Peripheral reading steps

The communication between the master and slave can be completed through the following steps (the steps for the peripheral (such as a microprocessor) to read the data of DHT11).

Step 1:

After DHT11 is powered on (DHT11 needs to wait for 1S to overcome the unstable state and no instructions can be sent during this period), the environmental temperature and humidity data are tested and the data is recorded. At the same time, the DATA line of DHT11 is pulled up by the pull-up resistor and maintained at a high level. At this time, the DATA pin of DHT11 is in the input state and detects external signals at all times.

Step 2:

The I/O of the microprocessor is set to output and output low level at the same time, and the low level holding time cannot be less than 18ms (maximum not more than 30ms), and then the I/O of the microprocessor is set to input state. Due to the pull-up resistor, the I/O of the microprocessor, that is, the DATA line of DHT11, also becomes high, waiting for DHT11 to respond. The sending signal is shown in Figure 4:

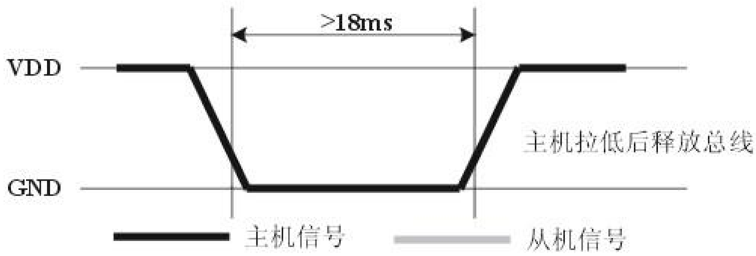


Figure 4 Host sends start signal

Step 3:

When the DATA pin of DHT11 detects a low level of the external signal, it waits for the low level of the external signal to end. After a delay, the DATA pin of DHT11 is in the output state, outputs a low level of 83 microseconds as a response signal, and then outputs a high level of 87 microseconds to notify the peripheral to prepare to receive data. The I/O of the microprocessor is in the input state at this time. After detecting a low level of I/O (DHT11 response signal), it waits for the data to be received after the high level of 87 microseconds. The sending signal is shown in Figure 5:

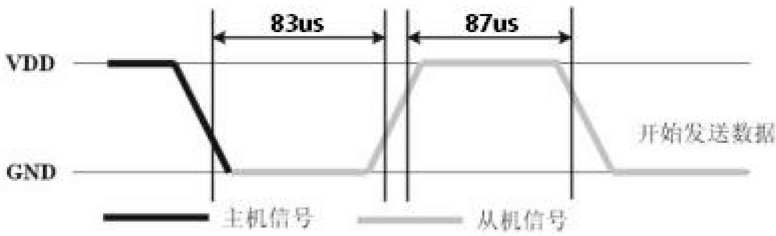


Figure 5 Slave response signal

Step 4:

The DATA pin of DHT11 outputs 40 bits of data. The microprocessor receives 40 bits of data according to the change of I/O level. The format of bit data "0" is: 54 microseconds of low level and 23-27 microseconds of high level. The format of bit data "1" is: 54 microseconds of low level plus 68-74 microseconds of high level. The format signals of bit data "0" and "1" are shown in Figure 6:

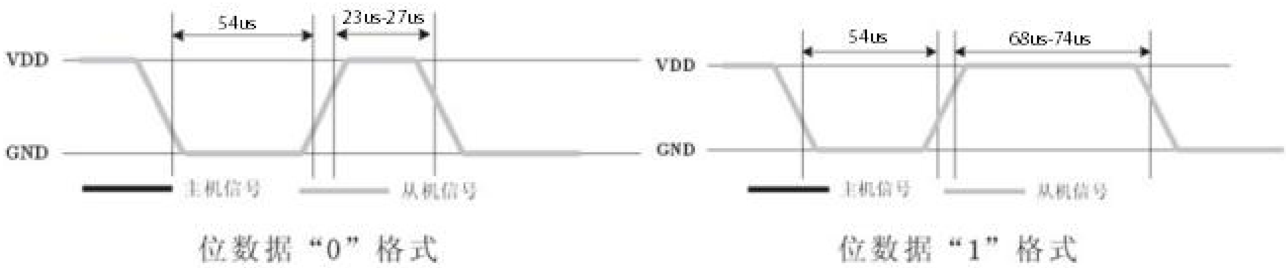


Figure 6

End signal:

After the DATA pin of DHT11 outputs 40 bits of data, it continues to output a low level for 54 microseconds before switching to an input state, and then changes to a high level due to the pull-up resistor. However, DHT11 internally re-measures the ambient temperature and humidity data, records the data, and waits for the arrival of external signals.

Table 4 Single bus signal characteristics

symbol	parameter	min	type	max	unit
T_{be}	Host start signal low time	18	20	30	ms
T_{go}	Host releases bus time	10	13	20	μS
T_{rel}	Response low level time	81	83	85	μS
T_{reh}	Response high level time	85	87	88	μS
T_{LOW}	Signal "0"、 “1” low level time	52	54	56	μS
T_{H0}	Signal "0" high level time	twenty three	twenty four	27	μS
T_{H1}	Signal "1" high level time	68	71	74	μS
T_{en}	Sensor release bus time	52	54	56	μS

Note: To ensure accurate communication of the sensor, the user should strictly follow the parameters and timing in Table 4 and Figure 3 when reading the signal.

8. Application Information

1. Working and storage conditions

Exceeding the recommended operating range may result in a temporary drift signal of up to 3%RH. After returning to normal operating conditions, the sensor will slowly recover to the calibrated state. To speed up the recovery process, refer to "Recovery Process". Prolonged use under abnormal operating conditions will accelerate the aging process of the product.

Avoid leaving the components in a condensation or dry environment for a long time, as well as the following environments.

A. Salt spray;

B. Acidic or oxidizing gases, such as sulfur dioxide, hydrochloric acid;

Recommended storage environment

Temperature: 10~40℃ Humidity: below 60%RH.

2. Effects of exposure to chemicals

The sensing layer of the capacitive humidity sensor is disturbed by chemical vapors. The diffusion of chemicals in the sensing layer may cause measurement drift and sensitivity loss. In a pure environment, the pollutants will be released slowly. The recovery process described below will accelerate this process. High concentrations of chemical contamination will lead to complete destruction of the sensor's sensing layer.

3. Temperature influence

The relative humidity of the gas depends largely on the temperature. Therefore, when measuring humidity, the humidity sensor should be operated at the same temperature as much as possible. If it shares a printed circuit board with electronic components that release heat, the sensor should be installed as far away from the electronic components as possible and installed below the heat source, while maintaining good ventilation of the housing. To reduce heat conduction, the copper plating between the sensor and the rest of the printed circuit board should be as small as possible, and a gap should be left between the two.

4. Lighting

Prolonged exposure to sunlight or strong UV radiation will degrade performance.

5. Recovery Process

Sensors exposed to extreme working conditions or chemical vapors can be restored to their calibrated state by the following treatment procedure: Keep at 45℃ and humidity <10%RH for 2 hours (drying); then keep at 20-30℃ and humidity >70%RH for more than 5 hours.

6. Wiring precautions

The quality of DATA signal cables will affect the communication distance and quality. It is recommended to use high-quality shielded cables.

7. Welding information

1. For manual soldering, the contact time must be less than 3 seconds at a maximum temperature of 300°C. 2. Wave soldering is prohibited.

3. Do not use alcohol, board cleaning water or other liquids for cleaning.

8. Product Upgrade

Please consult our technical department for details.

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③ The product should be within the shelf life.

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