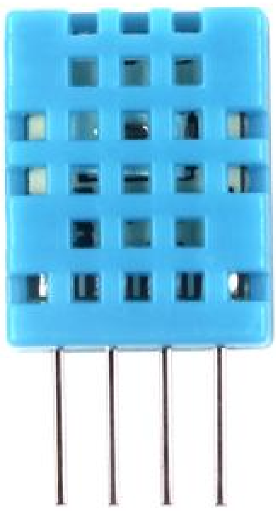
ASAIR®

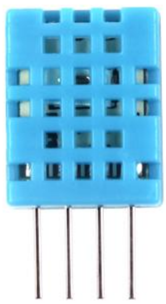
Digital Temperature & Humidity Module

DHT11 User Manual



1. Product Overview

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



2. Applications

Air conditioning, dehumidifier, agriculture, cold chain storage, testing and detection equipment, consumer goods, automotive, automatic control, data logger, weather station, home appliances, humidity regulator, medical, other related humidity detection control.

3. Product Features

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

4. Dimensions

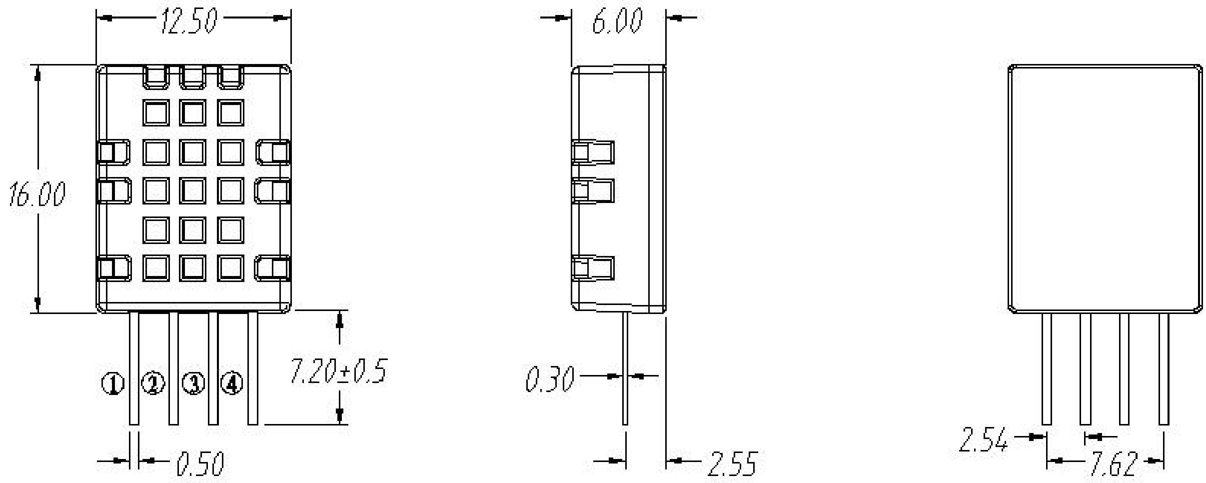


Figure 1 Dimension (Units: mm)

Pin Assignment

1.VDD : Power Supply 3.3～5.5V DC

2.DATA : Serial data bus

3.NC : No Connection

4.GND : Power supply cathode and signal ground

5. Product Parameter

5.1 Relative Humidity

Table 1 Relative Humidity Performance

Parameter	Condition	min	type	max	Units
Range		5		95	%RH
Precision [1]	25℃		±5		%RH
Repetition			±1		%RH
Interchangeability		Completely Interchangeable			
Response time [2]	1/e(63%)		<6		S
Hysteresis			±0.3		%RH
Drifting[3]	Typical		<±0.5		%RH/year

5.2 Temperature

Table 2 Temperature Performance

Parameter	Condition	min	type	max	Units
Range		-20		60	℃
Precision [1]	25℃		±2		℃
Repetition			±1		℃
Interchangeability		Completely Interchangeable			
Response time [2]	1/e(63%)		<10		S
Hysteresis			±0.3		℃
Drifting[3]	Typical		<±0.5		℃/year

5.3 Electrical Characteristics

Table 3 Electrical characteristics

Parameter	Condition	min	type	max	Units
Power		3.3	5.0	5.5	V
Current		0.06(standby)	-	1.0(measured)	mA
Sampling period	measuring		>2		Sec

[1] This accuracy is tested at 25°C and 5V, which does not include hysteresis and non-linearity, and is only suitable for non-condensing environments.

[2] The time required to achieve the 63% of the first-order response In the 25 ℃ and 1m / s air flow conditions.

[3] The value may be higher in the volatile organic mixture. See the instructions to get more information.

6. Typical Circuitry

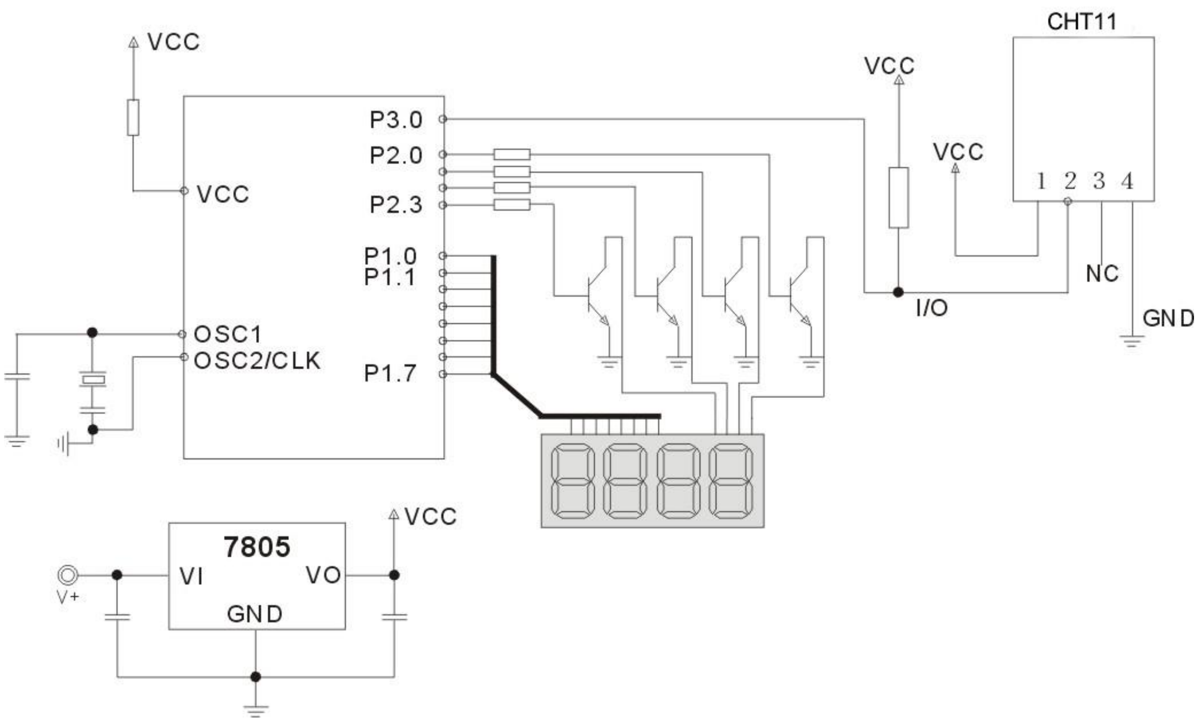


Chart 2 DHT11 Typical Circuit Diagram

The typical application circuit of Microprocessor and DHT11 is shown as above, DATA is pulled up and connected to the microprocessor's I / O port.

1.It is recommended to use the 4.7K pull-up resistor when the cable length is shorter than 5m, and the resistance of the pull-up resistor is reduced according to the actual situation when the connection line is greater than 5m.

2.The cable is as short as possible when using 3.3V power supply. Too long wiring will lead to lack of power supply, resulting in measurement bias.

3. Read the sensor interval every time more than 2 seconds to get accurate data.

4. The fluctuations of the power will affect the temperature.The temperature will fluctuate if using switching power supply.

7. Serial Communication Explanation (Single Line Bidirectional Communication)

◎Serial Communication Explanation

DHT11 devices use simplified single-bus communication.The data exchange and control of system are completed by a single bus. The device (host or slave) is connected to the data line via an open-drain or tri-state port to allow the device to release the bus without sending data while allowing other devices to use the bus.A single bus usually requires an external approximately 4.7 kΩ pull-up resistor, so that when the bus is idle, its state is high. Because they are master-slave structures, the slave accesses the device only when the host is called from the slave, so the host access device must strictly follow the single bus sequence. If there is a sequence of confusion, the device will not respond to the host.

◎Single Bus Transfer Data Bit Definition

DATA is used for communication and synchronization between the microprocessor and the DHT11, using a single bus data format, transferring 40 bits of data at a time,high byte first.

Data format:

8bit Humidity integer data + 8bit Humidity fraction data + 8bit Temperature integer data + 8bit Temperature fraction data + 8bit Check。

Note:The value of Humidity fraction data is 0.

◎**Check Data Definition**

“8bit Humidity integer data + 8bit Humidity fraction data + 8bit Temperature integer data +

8bit Temperature fraction data".The 8 bit check bit is equal to the last 8 bits of the result.

Table 4 Single bus format definition

Name	Single Bus Format Definition
Start	The microprocessor pulls the data bus (SDA) low for at least 18ms（not more than 30ms）,notifying the sensor to prepare the data.
Response	The sensor pulls the data bus (SDA) low by 83μs and then pulls high 87μs in response to the host's start signal.
Data Format	Upon receipt of the host start signal, the sensor sends 40 bits of data from the data bus (SDA) at one time,high byte first.
Humidity	The high byte of humidity is humidity integer data,the low byte of humidity is humidity fraction data.
Temperature	The high byte of temperature is temperature integer data,the low byte of temperature is temperature fraction data,and the low byte Bits8 of temperature is 1 indicates negative temperature, otherwise it is positive temperature.
Check Sum	Check Sum = Humidity high byte + Humidity low byte+Temperature high byte +Temperature low byte.

Example 1：The received 40 bits of data are：

0011 0101	0000 0000	0001 1000	0000 0100	0101 0001
Humidity High	Humidity Low	Temperature High	Temperature Low	Check Sum

Calculation：

0011 0101 + 0000 0000 + 0001 1000 + 0000 0100 = 0101 0001

So

Received data is correct.

Humidity：

0011 0101(integer)=35H=53%RH 0000 0000(fraction)=00H=0.0%RH =>53%RH + 0.0%RH = 53.0%RH

Temperature：

0001 1000(integer)=18H=24℃ 0000 0100(fraction)=04H=0.4℃ =>24℃ + 0.4℃ = 24.4℃

◎**Special Instructions**

The highest bit of the lower byte of the temperature data is 1 when the temperature is below 0 ° C.

Example： -10.1 ℃ => 0000 1010 1000 0001

Temperature：0000 1010(integer)=0AH=10℃，0000 0001(fraction)=01H＝0.1℃

=>-(10℃+0.1℃)＝ -10.1℃

Example 2 The received 40 bits of data are：

0011 0101	0000 0000	0001 1000	0000 0100	0100 1001
Humidity High	Humidity Low	Temperature High	Temperature Low	Check Sum

Calculation

0011 0101+0000 0000+0001 1000+0000 0100＝ 0101 0001

0101 0001 not equal to 0100 1001

The data received is not correct,give up,re-receive data.

◎Data Timing Diagram

After the host computer (MCU) sends a start signal, the DHT11 switches from the low power mode to the high speed mode. After the host starts the signal, the DHT11 sends the response signal, sends the 40bit data and triggers the information once collection. The signal is sent as shown.

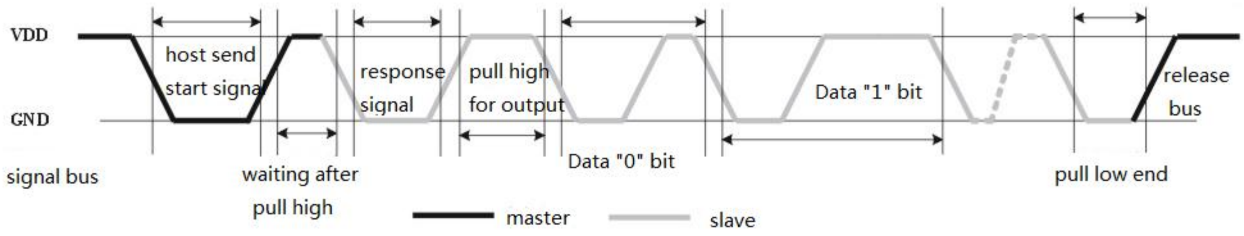


Chart 3 Data timing diagram

Note: The temperature and humidity data read by the host from DHT11 is always the previous measurement. If the interval time between the two tests is very long, read the value again and the second measurement as the real-time temperature and humidity value.

◎Peripheral reading step

The communication between the master and the slave can be accomplished by the following steps (steps of peripheral (eg, microprocessor) reading data from DHT11).

Step 1

After power-up (After power-up,DHT11 should wait 1S to overturn the unstable state during which can not send any instructions), DHT11 test the environment temperature and humidity data, and record data, while DHT11 DATA line has been maintained High level by the pull-up resistance,at this time DHT11 DATA pin is in the input state, always detect the external signal.

Step 2

The microprocessor's I / O is set to output at the same time output low, and the low hold time can not be less than 18ms (maximum can not exceed 30ms),then the microprocessor's I / O is set to input state, due to the pull-up resistor, the microprocessor I / O that DHT11 DATA data line also will become high, waiting for DHT11 to answer the signal.The signal as shown:

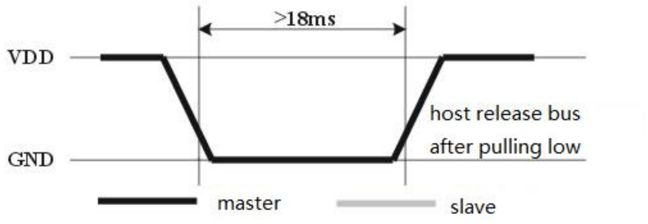


Chart 4 Host send start signal

Step 3

When DHT11 DATA pin detects the external signal is low, waiting for the external signal low is finished.After delay,the DATA pin of DHT11 is in the output state, the output of 83 microseconds low as a response signal, followed by the output high 87 microseconds to inform the peripherals ready to receive data.At this time the microprocessor's I / O is in the input state, after detecting the low level of I / O(DHT11 response signal), wait for 87 microseconds then receive data, The signal as shown:

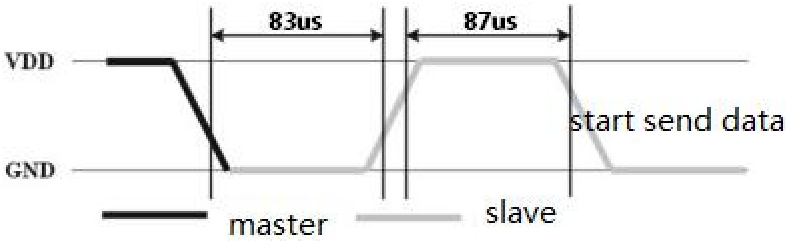
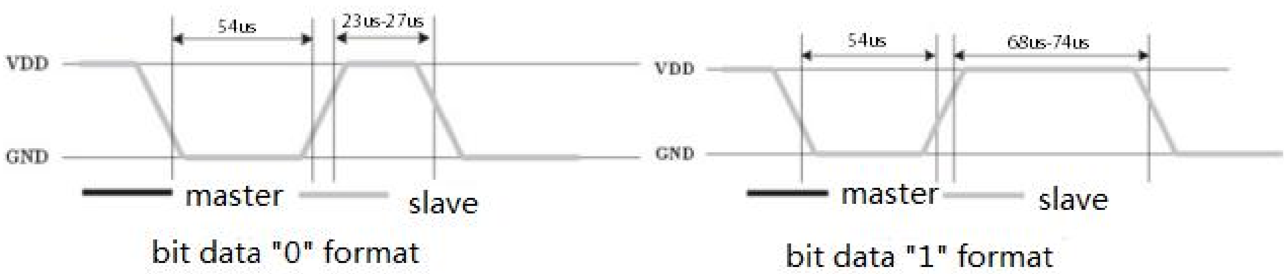


Chart 5 Slave response signal

Step 4

The 40-bit data is output from the DATA pin of DHT11, and the microprocessor receives 40 bits of data according to the I / O level. The format of the bit data "0" is: 54 microsecond low level and 23-27 microsecond high Level, bit data "1" format: 54 microseconds low level plus 68-74 microseconds high level. Bit data "0", "1" format signal as shown:



End signal：

After DATA pin output 40-bit data, DHT11 continue to output low level 54 microseconds then turn to the input state, the level goes high as the pull-up resistor. But DHT11 internal retest environmental temperature and humidity data, and record the data, waiting for the arrival of external signals.

Table 5 Single Bus Signal Characteristics

Symble	Parameter	min	type	max	Units
T_{be}	Time of the host start signal is pulled low	18	20	30	ms
T_{go}	Time of the host releases the bus	10	13	20	μs
T_{rel}	Time to response low level	81	83	85	μs
T_{reh}	Time to response high level	85	87	88	μs
T_{LOW}	Signal"0""1"low level time	52	54	56	μs
T_{H0}	Signal"0"high level time	23	24	27	μs
T_{H1}	Signal"1"high level time	68	71	74	μs
T_{en}	Time of the sensor releases the bus	52	54	56	μs

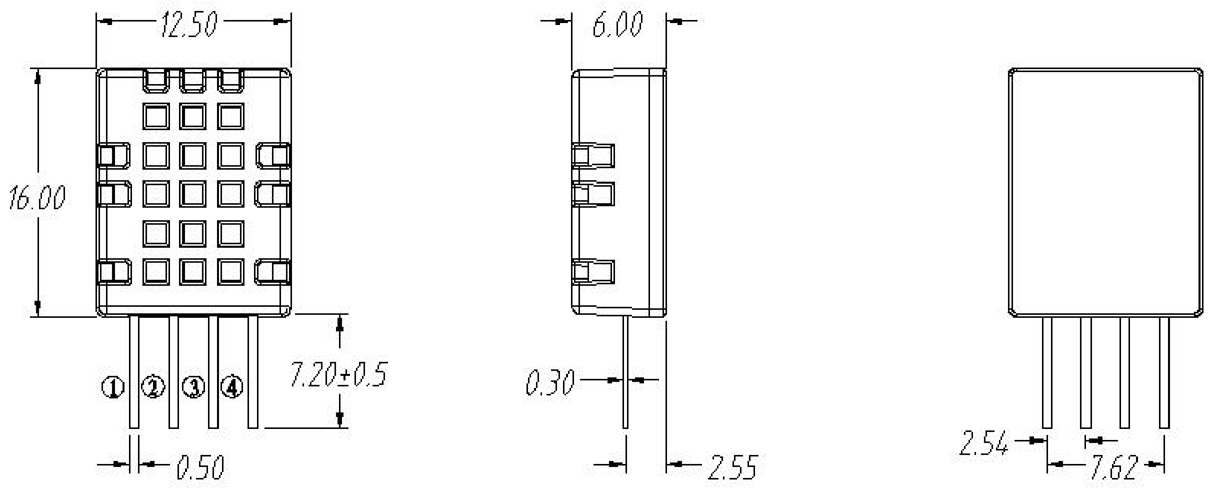
Note: To ensure accurate communication of the sensor, please strictly in accordance with parameters and timing design of Table 5 and Chart 3-5 when reading the sensors.

8. Packing specification

8.1 Each plastic tray packaging 50 sensors.

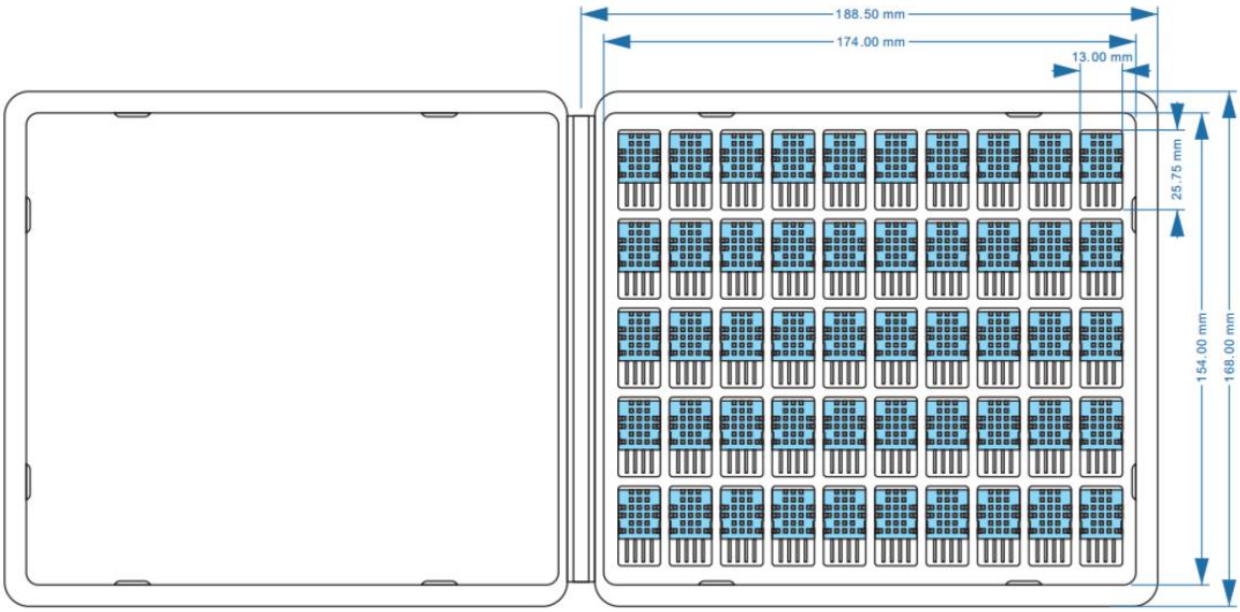
8.2 Each electrostatic shield contains two plastic pallets.

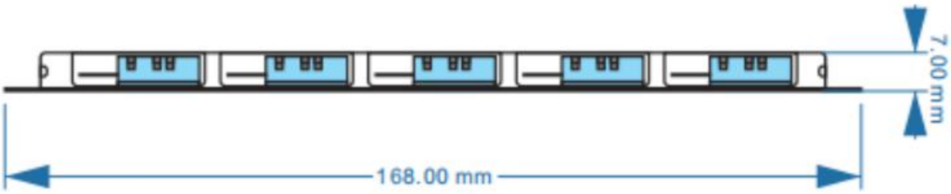
8.3 Each Packing Carton number is 9000.



Product size：16mm*12.5mm*6mm

Net weight：0.9g





Pallet size: 188.5mm*168mm*7mm

Quantity: 50

Net weight: 45g

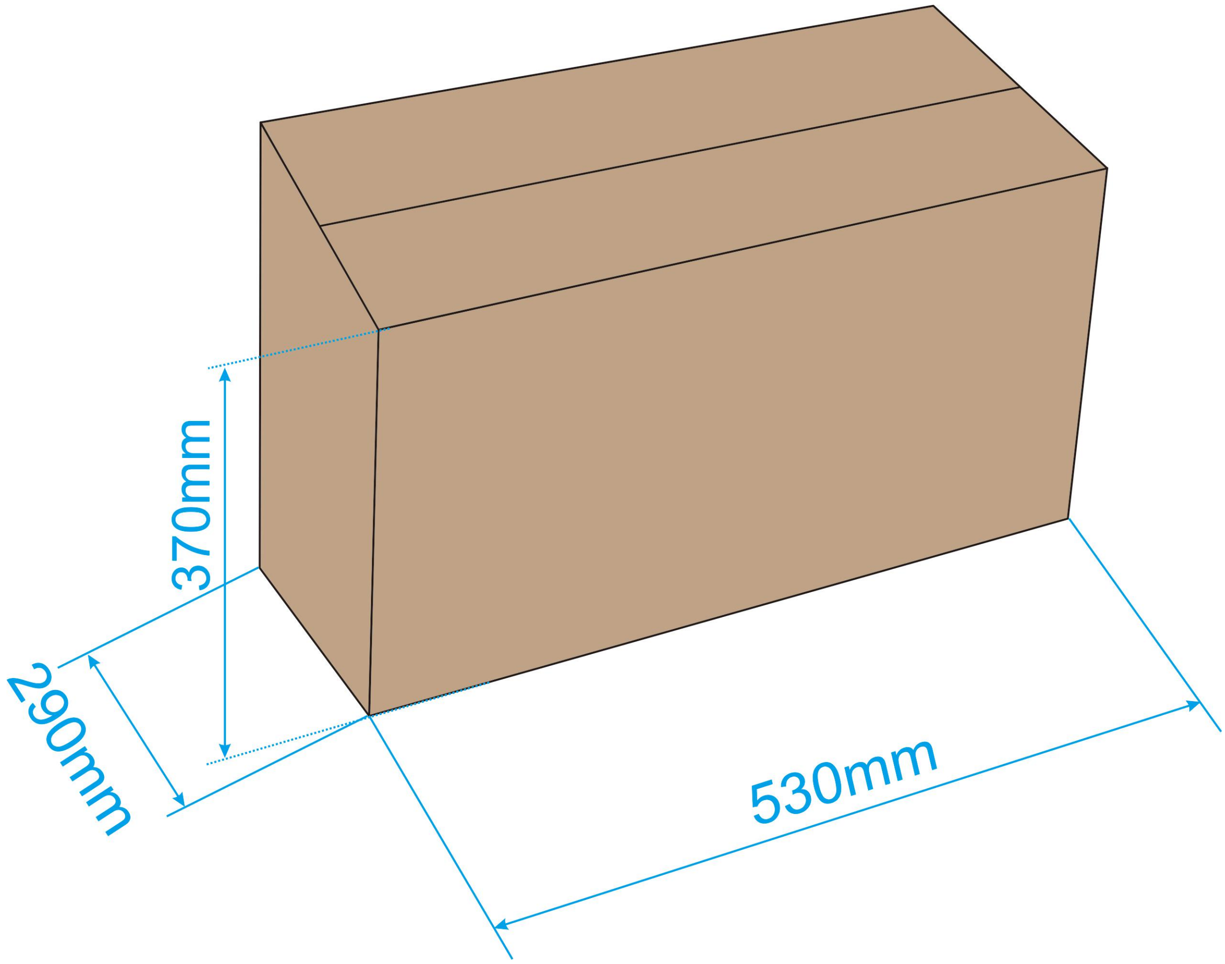
Gross weight：70g

Pallet size: 200mm*220mm

Quantity: 2 X 50（100）

Net weight: 140g

Gross weight：145g



Carton size: 530mm * 290mm * 370mm

Quantity: (45 X100) X 2（9000）

Net weight：13.05kg

Gross weight：13.9kg

9. Application Message

9.1 Working and Storage Conditions

Exceeding the recommended operating range may result in a temporary drift of up to 3% RH.After returning to normal operating conditions, the sensor will slowly return to the calibration state. To speed up the recovery process, see "Recovery processing". Long time use under abnormal operating conditions will accelerate the aging of the product.

Avoid long-term placement of components in exposed and dry environments as well as the following environments:

A、Salt mist；

B、Acidic or oxidizing gases, such as sulfur dioxide,muriatic acid.

Recommended storage environment:

Temperature：10~40℃　　Humidity：Below 60%RH

9.2 Exposure to Chemical Substances

The induction layer of the capacitive humidity sensor is subject to chemical vapor interference, and the diffusion of the chemical substance in the sensing layer may result in drift of measured value and decrease of sensitivity. In pure environment, the pollutants will be released slowly. The recovery process described below will speed up the process. High concentrations of chemical contamination can cause complete damage to the sensor sensing layer.

9.3 Temperature Effect

The relative humidity of the gas, to a large extent, depends on the temperature. Therefore, in the measurement of humidity, should ensure that the humidity sensor at the same temperature as much as possible. If a printed circuit board is shared with the heat-releasing electronic components, the sensor should be installed as far as possible away from the electronic components and installed below the heat source while maintaining good ventilation of the enclosure. To reduce heat transfer, the copper plating of the sensor and other parts of the printed circuit board should be as small as possible and leave a gap between the two.

9.4 Light Effects

Prolonged exposure to sunlight or strong ultraviolet radiation, will reduce performance.

9.5 Recovery Processing

The sensor placed in the extreme operating conditions or in the chemical vapor can be restored to the state at the time of calibration by the following procedure. Held at 45 ° C and <10% RH for 2 hours (drying); then maintained at a temperature of 20-30 ° C and> 70% RH for 5 hours or more.

9.6 Cable Note

DATA signal wire quality will affect the communication distance and communication quality, it is recommended to use high-quality shielded cable.

9.7 Welding Information

1.Manual welding, the contact time under the temperature of 300 ℃ should be less than 3 seconds.

2.Wave soldering is prohibited.

3.Do not use alcohol, wash water or other liquid cleaning.

9.8 Product Upgrade

Please consult our technical department.