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AM2301 Product Manual

Temperature and humidity sensor

- Fully calibrated
- Digital output, Single bus interface
- Excellent long-term stability
- Quick response and anti-interference capability

Product Overview

AM2301 digital temperature and humidity module is a have already calibrated digital composite signal output of the temperature and humidity sensor. It dedicated digital module acquisition technology and the temperature and humidity sensor technology ,ensure that the product has a very high reliability and excellent long-term stability. The product has excellent quality, super fastresponse, strong anti-interference ability, extremely high performance-price ratio. Every sensor in extremely precise humidity calibration laboratory calibration. Calibration coefficient in the form of a program stored in the microcontroller, sensors inside in the process of detecting signal processing to invoke the calibration coefficient. Standard single bus interface, make the system integration becomes simple and fast. Super small volume, low power consumption, signal transmission distance of 20 meters ,making it a all kinds of application of the best choice for even the most demanding applications.

Applied range

Hvac, dehumidifier, testing and inspection equipment, consumer goods, automobile, automatic control, data recorder, meteorology station, home appliance, humidity control, medical treatment and other related temperature and humidity detection control.

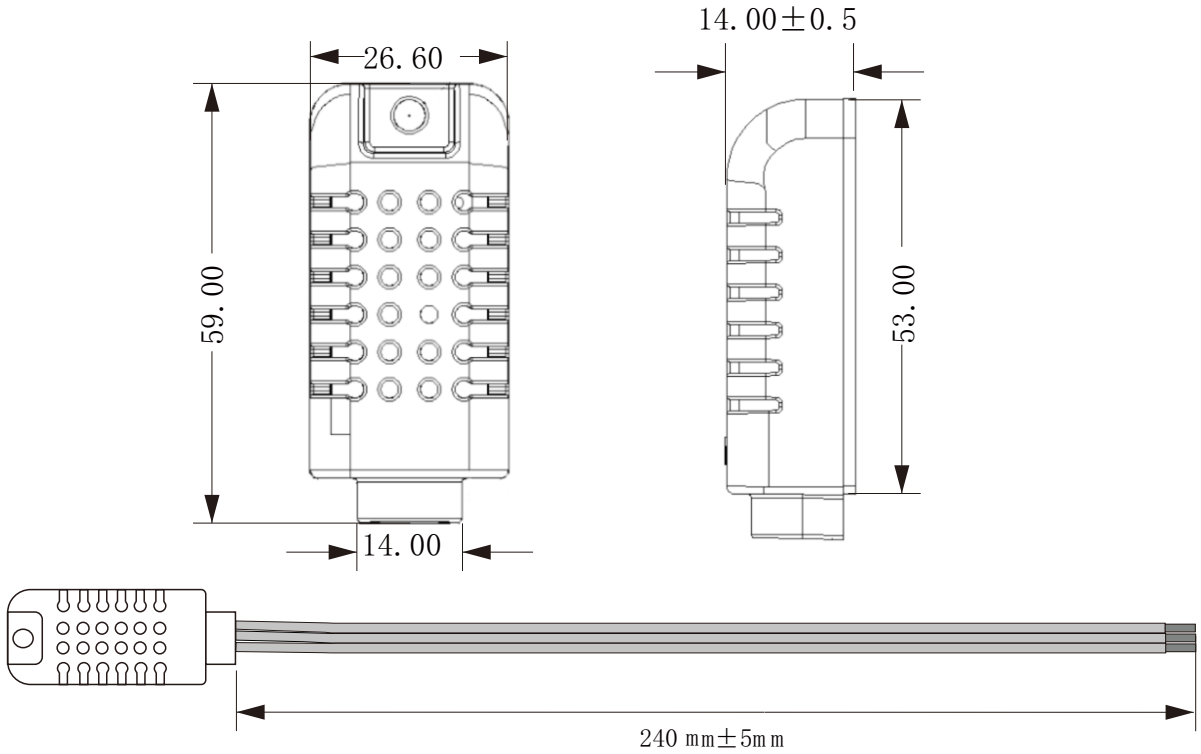


Figure1: AM2301 Sensor package diagrams（Unit: mm Tolerance not specified: 0.2mm)

Sensor capability

Relative humidity

Parameter	Condition	min	typ	max	Unit
Resolution			0.1		%RH
Range ability	extended [1]	0		99.9	%RH
Accuracy [2]			± 3	Figure 2	%RH
Repeatable			± 1		%RH
Interchangeability		Complete interchangeable			
Response time [3]	1/e(63%)		<6		S
Hysteresis			± 0.3		%RH
Drift [4]	Typical value		<0.5		%RH/yr

Table 1 Table of humidity characteristics

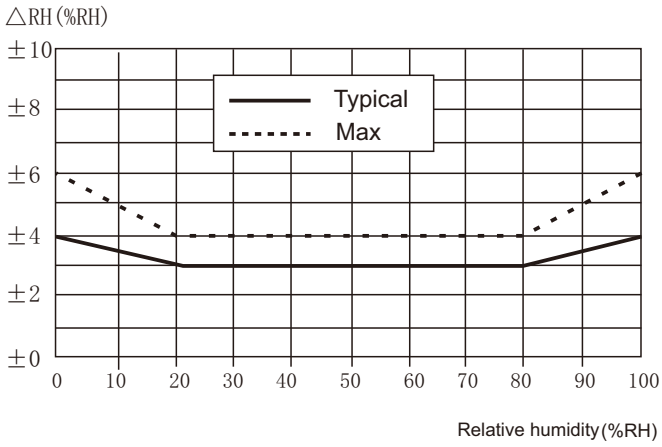


Figure 2 Maximum error in relative humidity at 25°C.

Electrical specification

Parameter	Condition	min	typ	max	Unit
The power supply voltage		3.3	5	5.5	V
Power dissipation [5]	Sleep mode	2	15		μA
	Measure		1200		μA
	Average		600		μA
Low level output voltage	I_{OL} [6]	0		300	mV
High level output voltage	Rp<25 kΩ	90%		100%	VDD
Low level input voltage	Decline			30%	VDD
High level input voltage	Rise	70%		100%	VDD
Rpu [7]	VDD = 5V VIN = VSS	1	5.1	100	kΩ
The output current	Open		8		mA
	Tristate(close)	10	10		μA
Sampling period		2			S

Table 2 Electrical characteristics.

Temperature

Parameter	Condition	min	typ	max	Unit
Resolution			0.1		℃
Accuracy			± 0.5	Figure 3	℃
Range ability		-40		80	℃
Repeatable			± 0.2		℃
Interchangeability		Complete interchangeable			
Response time [8]	1/e(63%)		<10		S
Drift			± 0.3		℃/yr

Table 3 Temperature characteristics table

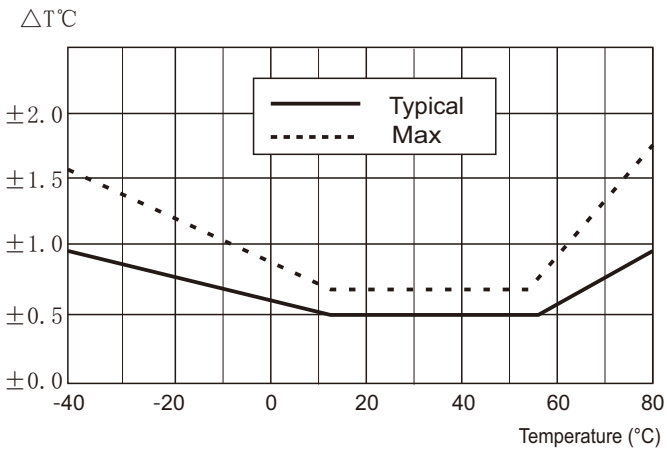


Figure 3 Typical and maximum temperature errors.

1 Work scope: 0-80% RH, beyond this range, sensor readings will have deviation (H humidity 90% after 200 hours, drift < 3% RH). The scope of work further limit in - 40-80 ℃.

2 The accuracy of factory inspection, sensors in 25 ℃ under the condition of the power supply voltage of 5 v test precision .This value does not include the hysteresis and nonlinear and applies only to the cooling conditions.

3 25 ℃ and 1 m/s air conditions, 63% of first order responsetime.

4 If the sensor is surrounded by volatile solvent , with a pungent odor tape, adhesives and packaging materials, reading may be on the high side.Details please refer to the relevant documents.

5 Minimum and maximum values are based on the power consumption of VDD = 5 v and T < 60 ℃ condition. In the average of every two seconds, the value of ameasurement.

6 Low-level output current.

7 Denotes the pull-up resistance.

8 The response time depends on the thermal conductivity of the sensorsubstrate.

AM2301 User Guide

1 Expansion of performance

1. 1 Operating conditions

The performance of the sensor is stable within the Recommended operating range . See Figure 4. Long-term exposure to conditions outside the normal range, Especially when the humidity > 80%, may cause signal temporary sexual drift (drift +3%RH after 60 h). When to return to after normal working conditions, the sensor Will slowly recover to school positive state. See "Recovery Processing" in section 2.3 Accelerate the recovery process. under abnormal conditions for a long time use , will accelerate the aging of the product.

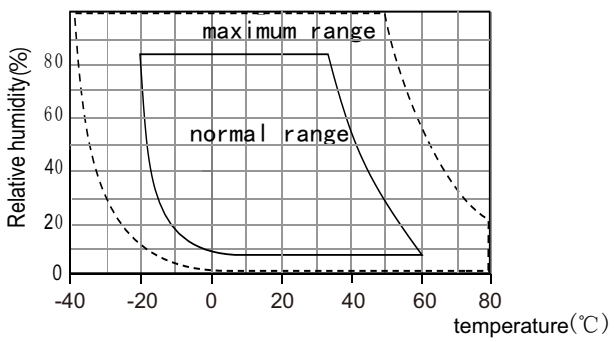


Figure4: Working conditions

1. 2 RH accuracy at different temperatures

The RH accuracy at 25℃ is defined in Figure 2 and shown in Figure 5 maximum humidity error in other temperature segments.

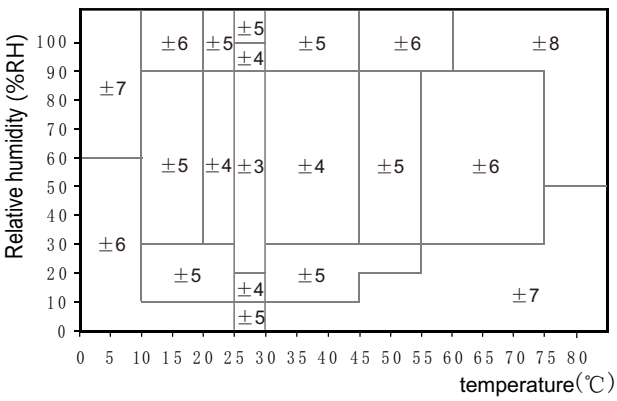


Figure 5 : The maximum error of humidity in the range of 0~80 ℃, unit: (%RH)

Note : the above error is a typical high precision Dew-point meter for your reference instrument testing in error (not including hysteresis).ranges, the typical value is 1/2 of the maximum error value.

2 Applications

2.1 Storage conditions and operating instructions

Humidity Sensitivity Level (MSL) is 1, according to 1PC/JEDEC.J-STD-020 standard. Therefore,it is recommended to be used within one year after shipment.Temperature and humidity sensors are not ordinary electronic components and require careful protection, which the user must pay attention to. Prolonged exposure to high concentrations of chemical vapors will cause the sensor's readings to drift. It is therefore recommended that the sensor be stored in its original packaging, including a sealed ESD pocket, and under the following conditions: Temperature range 10℃-50℃ (0-85℃ for a limited time); Humidity 20- 60%RH (for sensors without ESD package). For those sensors that have been Removed from their original packaging , we recommends to ring them in an ESD bag made of PET/AL/CPE metal inside. The anti-static bag. During production and transport, the sensor should be protected from high concentrations of chemical solvents and prolonged exposure to the elements. Avoid contact with volatile glues, tapes, stickers or volatile packaging materials such as blister packs, foams, etc. The production area should be well ventilated.

2.2 Restoration processing

As mentioned above, readings can drift if the sensor is exposed to extreme operating conditions or chemical vapors. It can be brought back to calibration by the following treatments.Drying: 10 hours at 80-85°C and <5% RH humidity Re-hydration: 24 hours at 20-30°C and >75% RH.

2.3 Temperature effects

The relative humidity of a gas is very much dependent on temperature. When measuring humidity, therefore, it should be ensured, as far as possible, that all sensors measuring the same humidity are operating at the same temperature. When doing the test, ensure that the sensor under test and the reference sensor are at the same temperature and then compare the humidity readings.

In addition, when the measuring frequency is too high, sensor's temperature rises and affect measurement accuracy. If you want to ensure That its own temperature rise of less than 0. 1℃, the activation of AM2301 time should not exceed 10% of the measurement of time suggest data measured once every 2 seconds.

9 75% RH can be readily generated from saturated NaCl

2.4 Product Application Scenario Design

Many material absorbs moisture and will act as a buffer role , this will increase the response time and delays. So material surrounding the sensor should be careful to choose. Recommend the materials used are: metal materials, LCP,POM (Delrin),PTFEK（Teflon), PE,PEEK,PP, PB,PPS, PSU, PVDF, PVF.

Used in sealing and bonding material (conservative recommendation) : it is recommended to use method of epoxy resin for electronic component sencapsulation, or silicone. These materials release gas may also be contaminated AM2301 (see 2.1) . Sensor assembly,therefore,should be thelast, andput it in ventilated place, or in the environment of the 50 ℃ >dry for 24 hours, in order to make it in front of the packaging will pollute gas release.

3 Interface definition

Pins	Color	Name	Describe
1	Red	VDD	Power supply (3.3 V to 5.5 V)
2	Yellow	SDA	Serial Data, Bidirectional Port
3	Black	GND	Ground
4		NC	No connection

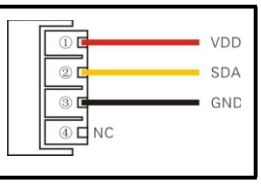


Table 4 interface definition

3.1 The power supply pins（VDD, GND）

AM2301 spoon power supply range of 3.3-5.5 V, recommend to voltage 5v.

3.2 Serial data SDA

SDA pin for three state structure, used to read,write, sensor data sequence specifi ccommunication, see details of your communicationprotocol.

4 Electrical characteristics

4.1 Absolute maximum rating

AM2301 electrical properties defined in table 2.As for the maximum rating as given in table 5. In such conditions, the device for function operation is not desirable. Prolonged exposure to absolute maximum rating conditions , may affect the reliability of the sensor.

Parameter	Min	Max	Unit
VDD to GND	- 0.3	5.5	V
Digital I/O pins (SDA) to GND	- 0.3	VDD + 0.3	V
The input current of each pin	- 10	10	mA

Table 5 Electric absolute maximum rating

ESD static discharge according to JEDEC JESD22-A114 (human mode ± 4KV), JEDEC JESD22-A115 (machine mode ± 200V). If the test conditions exceed the nominal limits, the sensor requires additional protection circuitry.

4. 2 Input／Output characteristics

Electrical characteristics, such as power consumption , input and output high and low level voltages, depend on the power supply voltage. (For smooth sensor communication, it is important to ensure that the signal design is strictly limited to the ranges given in tables 2 and Figure 8.

5 Single bus communication

5.1 Single bus typical circuit

Microprocessor connected with AM2301 typical application circuit is shown in figure 6. Single bus communication mode, the SDA pull-up after connected with the I/O port of the microprocessor.

Single bus communication special instructions:

1. The typical application circuit suggested in cable length less than 30 When, with 5. 1k pull-up resistors , more than 30m according to the actual situation to reduce the resistance of the resistance.

2. The cable length shall not when using 3.3 V voltage supply. In 100cm. Or line pressure drop will cause the sensor power supply shortage, cause measurement deviation.

3. Read sensor minimum time interval for 2s ; Read the time interval is less than 2s , can lead to temperature and humidity or communication is not allowed, you don't succeed, and so on and so forth. Sensor at the beginning of electricity, should wait for more than 2s time, to read the sensors, to overcome the instability of the transducer.

4. Every time the temperature and humidity of the readout value is the result of the last measurement, for real-time data, need to read two consecutive times, suggested that continuous read sensor for many times, and each read sensor interval greater than 2 seconds, can obtain the accurate data.

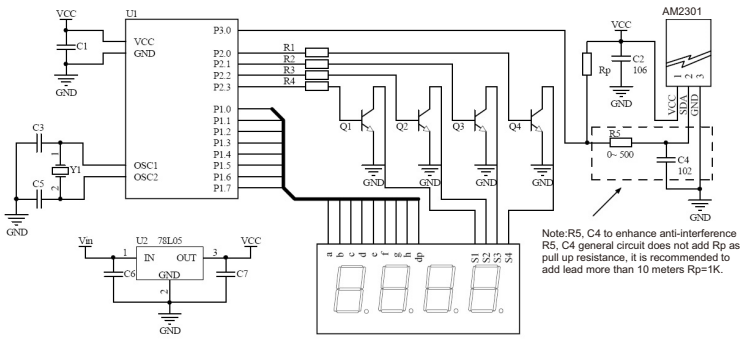


Figure 6: AM2301 single bus typical circuit

5.2 Single bus communication protocol

◎ Single bus specification

AM2301 device adopts a simplified single bus communication. Single bus that is only a data line,the system of data exchange, control are completed by cable. Equipment (microprocessor) through a drain or three states open port, even to the cable to allow equipment when not to send data to release the bus, and other devices to usebus; Single bus usually require an external about 5. 1k pull-up resistor, so, when the bus is idle, its status as a high level. Because they are master-slave structure, only the host contact sensor, the sensor will reply, so host access sensor must be strictly follow the sequence of single bus, if there is a sequence of chaos, the sensor will not respond to the host.

◎ Single bus transmits data definition

SDA with microprocessor and AM2301 communication between and Synchronization,Using the single bus data format, send 40 data at a time, high in first out. Specific communication sequence as shown in figure 7, communication format specification are shown in table 6.

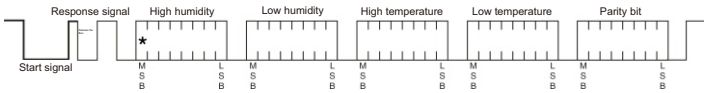


Figure 7: AM2301 single bus communication protocol

Name	Single bus format definition
Start signal	The microprocessor to pull the data bus (SDA) is low for a period of time (at least 1 ms), notify the sensor to data.
Response signal	Sensors to pull the data bus (SDA) 80 us less, after 80 us in response to a start signal in the host.
Data format	After receiving the host start signal, sensor at once from the data bus (SDA) string out 40 bits of data, high out first.
Humidity	High humidity resolution is 16 bit, in the former; Value of humidity Sensor series was 10 times higher than the actual humidity value.
Temperature	The temperature resolution is 16 bit, high in the former; Series of Temperature sensor was 10 times higher than the actual Temperature value, the temperature is highest (Bit15) is equal to 1 For negative temperature, highest temperature (Bit15) is equal to 0 Means positive temperature; In addition to the highest temperature (Bit14Bito) temperature.
Parity bit	Parity bit = humidity high + humidity low + temperature high + temperature low

Table 6: AM2301 communication format specification

◎ Example of single-bus data calculation

Example 1: the received 40 data as follows:

00000010	10010010	00000001	00001101	10100010
HH 8bits	HL8bits	TH8bits	TL8bits	Parity bit

Calculation：

00000010+10010010+00000001+00001101 = 10100010 (parity bit)

Data received correctly:：

Humidity：00000010 10010010 = 0292H(hexadecimal) = 2×256+9×16+2 = 658

=> humidity = 65.8%RH

Temperature：00000001 00001101 = 10DH(hexadecimal) = 1×256+0×16+13=269

=> temperature= 26.9℃

◎ Special note:

When the temperature is lower than 0 ℃ temperature data of the highest position 1.

Example: -10.1 ℃ represented 10000000 01100101

Temperature：00000000 01100101=0065H(hexadecimal)=6×16+5=101

=> temperature = -10.1℃

Example 2：the received 40 data as follows:

00000010	10010010	00000001	00001101	10110010
HH8bits	HL8bits	TH8bits	TL8bits	Parity bit

Calculation：

00000010+10010010+00000001+00001101 = 10100010≠10110010

(ECC Error)

The received data is not correct, give up, to receive data.

5.3 Single bus communication sequence

User host (MCU) to send a start signal (pull data bus SDA low at least 1 ms) after AM2301 from sleep mode conversion to high speed mode. To the host after the start signal, AM2301 to send response signal, from the data bus SDA serial send 40 bits of data, to send the first byte of high; Data of high humidity and low humidity, high Temperature, low temperature, parity, send data over trigger an information acquisition, acquisition end sensor automatically into sleep mode, until the next communication.

Detailed timing signal characteristics are shown in table 7, single bus communication sequence diagram as shown in figure 8.

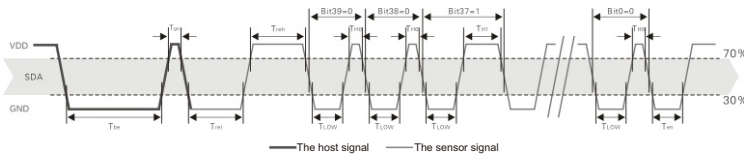


Figure8: AM2301 single bus communication sequence

Note: the temperature and humidity of the host from AM2301 read data is always the last measurements, such as measuring two intervals of time is very long, please read two consecutive times for the second time to obtain the value of the real-time temperature and humidity value, at the same time, the minimum time interval between two reads 2S.

Table 7:Single-bus signal characteristics

Symbol	Parameter	Min	Typ	Max	Unit
T_{be}	Host initial signal pull down time	0.8	1	20	ms
T_{go}	Host releases bus time	10	30	200	us
T_{rel}	Response low level time	75	80	85	us
T_{reh}	Response high level time	75	80	85	us
T_{LOW}	Signal “0”and“1” low level time	48	50	55	us
T_{H0}	Signal “0” low level time	22	26	30	us
T_{H1}	Signal “1” high level time	68	70	75	us
T_{en}	Sensor release bus time	45	50	55	us

Note: to guarantee the accuracy of the sensor's communication, the user when reading out the signals, please in strict accordance with the parameters in table 7 and figure 8 and timing to carry on the design.

5.4 Example of a peripheral read step

The communication between the host and the sensor is accomplished by reading the data in the following three steps.

Step 1 :

AM2301 (such as transistors AM2301 after power on to wait for at least 2s to cross the unstable state, in the meantime reading devices cannot send any instruction), test environment temperature and humidity data, and record the data, since sensors automatically into a dormant state AM2301 pull up resistors by raising the SDA cable has maintained high level , mean while AM2301 SDA input pin, moment external signal detection.

Step 2 :

The I/O of the microprocessor is set as output, and the low level is output and the low level holding time cannot be less than 1ms. Then the microprocessor is set as input mode immediately after I/O is set as high level, and the bus is released. After the host machine releases the bus,AM2301 sends a response signal, that is, it outputs a low level of 80 microseconds as the response signal, and then outputs a high level notification peripheral of 80 microseconds to prepare for receiving data. The signal transmission Is shown in Figure 9:

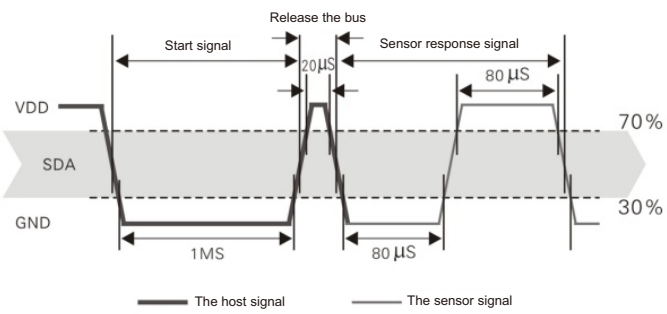


Figure 9: Single bus decomposition sequence diagram

Step 3 :

After AM2301 sends the response, the data bus SDA continuously outputs 40-bit data, and the microprocessor receives 40-bit data according to the change of I/O level. The format of the bit data "0" is: low level of 50 microseconds plus high level of 26-28 microseconds;The format of bit data "1" is: low level of 50 microseconds plus high level of 70 microseconds; The format signal of "0" bit and "1" bit is shown in Figure 10:

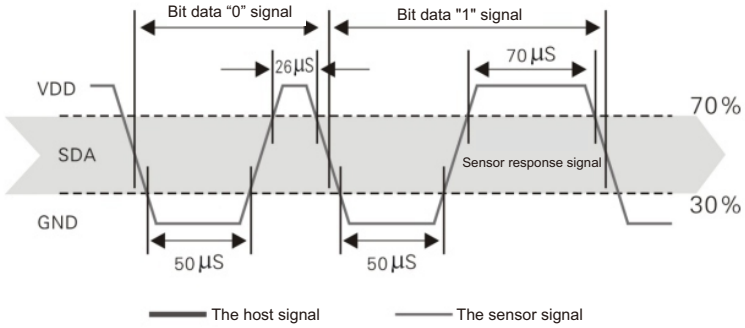


Figure 10: single bus decomposition sequence diagram

AM2301 data bus SDA output after 40 data, keep the output low level 50 microseconds to input state, because the pull-up resistance to high level. AM2301 internal heavy environmental temperature and humidity measurement data at the same time, and record the data, the end of the test records, single chip microcomputer automatic enter a dormant state. MCU only after receiving the host start signal, to awaken the sensors, into the working state.

5.5 Peripherals read flowcharts

The flow diagram of AM2301 sensor reading single bus is shown in Figure 11. Meanwhile, our company also provides the reading code example. For customers who need to download, please log in our website (www.aosong.com) for relevant download.

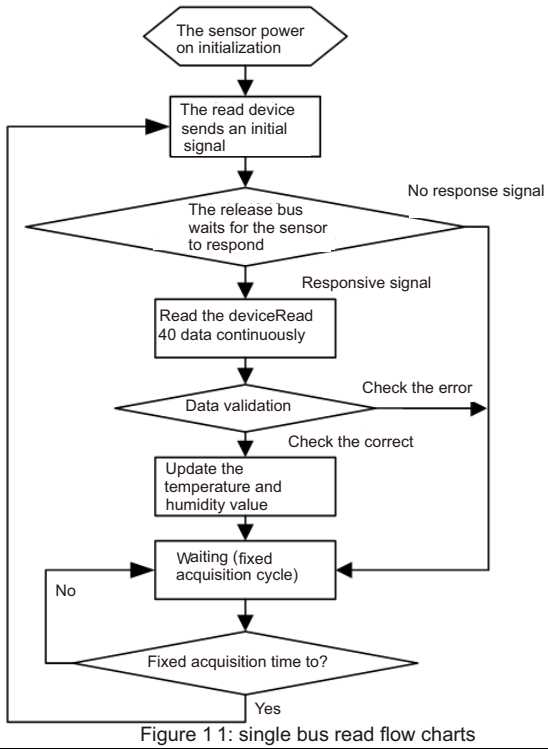


Figure 11: single bus read flow charts

6 Environmental stability

If the sensor is used in equipment or machinery, make sure that the sensor used for measurement senses the same conditions of temperature and humidity as the sensor used for reference. The AM2301 sensor is tested in accordance with the Ozon corporate standard for temperature and humidity sensors . The performance of the sensor under other test conditions is not guaranteed and cannot be considered as part of the sensor's performance. In particular, no promises are made with respect to the specific conditions required by the user.

7 packaging

7.1 Tracking information

All AM2301 sensor with laser logo on the back, see Figure 12.

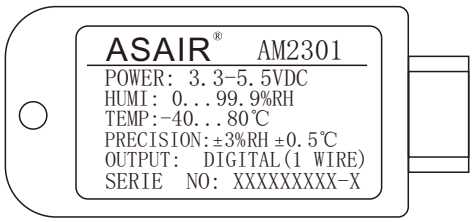


Figure 12 sensor laser logo

7.2 Packaging and transportation

AM2301 uses pallet packaging, each blister plate packs 25 sensors, each 10 blister plates is attached with an empty blister plate as a sealing cover, that is, 11 blister plates are sealed in small cartons, a total of 250 sensors.Each of the four small boxes is packed in a large box, that is, each large box has 1000 sensors. The packaging diagram with sensor positioning is shown in Figure 13. Blister trays are placed in cartons or antistatic shielding bags.

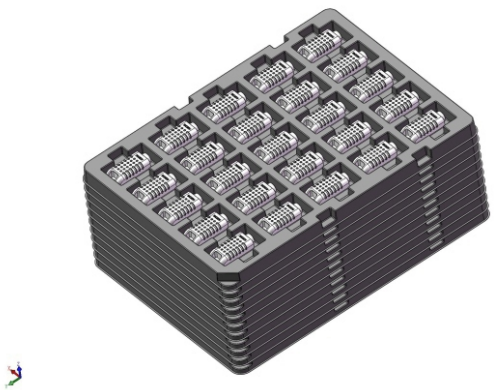
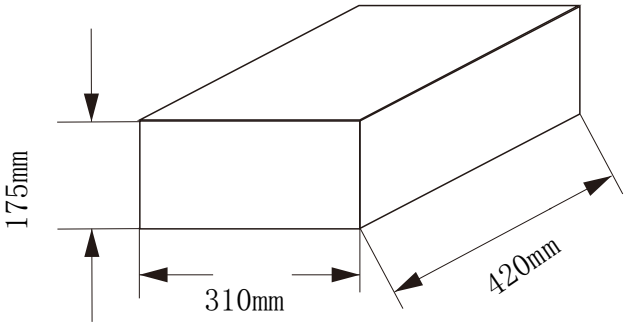
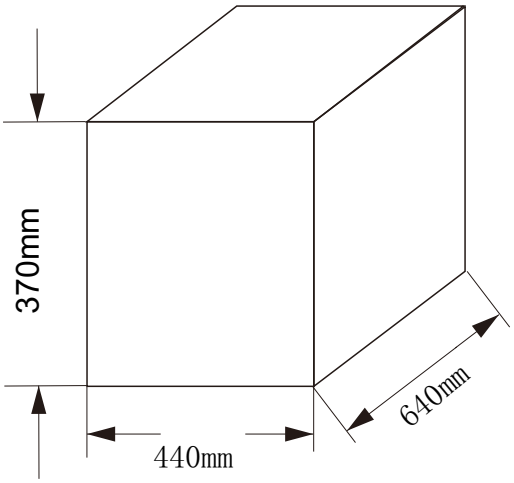


Figure 13: Package diagram with sensor positioning



Small carton size chart: tolerance ±5mm



Big carton size chart: tolerance ±5mm

Figure 14 small carton and big carton size chart

Anti-static bag or labeled on the carton, as shown in figure 15, and provides other tracking information.

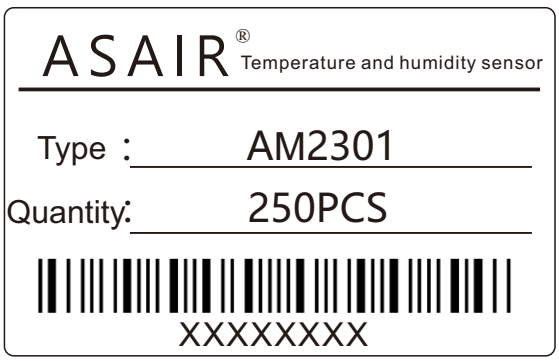


Figure 15: Label on anti-static bag.

AM2301 packaging	Number	The total weight
Each sensor	1pcs	About 13.1g
Sensor per small carton	250pcs	About 4.75kg
Sensor per big carton	1000pcs	About 20kg

Version information

Date	Version	Page	Modify
2020/12	V1.0	1-8	The first version

This manual may be subject to change without prior notice.

Attention

Warning of personal injury

Do not apply this product to safety protection devices or emergency stop equipment, as well as any other applications that may cause personal injury due to the failure of the product. This product cannot be used unless there is a special purpose or with an authorization to use it. Please refer to the product data sheet and Application guide before installing processing, using or maintaining the product. Failure to comply with this recommendation may result in death and serious bodily injury.

If the Buyer intends to purchase or use the Aosong products without any application license and authorization , the buyer shall bear all compensation for personal injury and death resulting therefrom, and shall not claim for compensation including various costs, compensation fees, lawyers, etc. Expenses and so on with the managers and employees of Aosong Company, as well as subsidiaries , agents , distributors, etc.

ESD Protection

Due to the inherent component design , it is sensitive to static electricity. In order to prevent the damage and the reduction of the product's performance caused by static electricity, the necessary anti-static measures should be taken when applying this product.

Quality Assurance

Our company provides 12-month (1-year) quality assurance for buyers of its products (calculated from the date of delivery) based on the technical specifications in the data manual of the product published by Aosong . If the product is found to be defective under warranty. our company will provide free maintenance or replacement. Users need to satisfy the following conditions :

- Notify our company in writing within 14 days after the defect is found.
- The defect of this product will help to find out the deficiency in design, material and technology of our product.
- The product should be sent back to our company at the buyer's expense.
- The product should be within the warranty period.

Our company is only responsible for the defective products which are used in the occasions that meet the technical requirements of the product . Our company makes no warranties or written representations regarding the use of its products in special application occasions at the same time, the company does not make any commitment to the reliability of the products applied to products or circuits.

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