

# AM2302 Technical Manual

ASAIR<sup>®</sup>

## Temperature and Humidity Sensor

- Full calibration
- Digital output, unibus interface
- Excellent long-term stability
- Quick response and strong anti-jamming capability



## Product overview

AM2302 Digital Temperature and Humidity Module is a temperature and humidity composite sensor with its calibrated digital signal output. It applies special digital module acquisition technology and temperature and humidity sensing technology, to ensure that the product has high reliability and excellent long-term stability. The product has the advantages of excellent quality, ultra-fast response, strong anti-interference ability and high cost performance. Each sensor is calibrated in an extremely accurate humidity calibration laboratory. Calibration coefficients are stored in the form of program in the single chip computer. These calibration coefficients are called in the process of processing the detection signal inside the sensor. Standard single bus interface makes system integration easy and fast. Ultra-small size, very low power consumption, signal transmission distance can reach more than 20 meters, making it the best choice for all kinds of applications and even the most demanding applications. Products are cited as 3Wire (single bus interface) connection is convenient. Special encapsulation forms can be provided according to user's needs requirements.

## Application scope

HVAC system, dehumidifier, test and inspection equipment, consumer goods, automobiles, automatic control, data recorder, weather station, household appliances, humidity regulation, medical and other related temperature and humidity detection and control

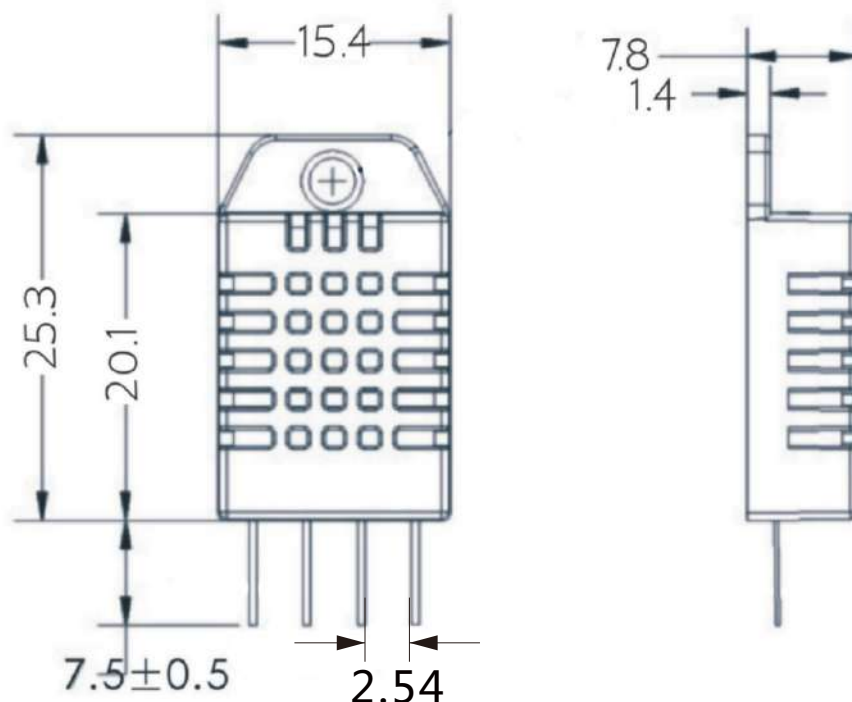


Figure 1: AM2302 Sensor Package Diagram (Unit: mm Unmarked tolerance: 0.1 mm)

# Sensor performance

## Relative humidity

Parameter	Condition	Min	Typical	Max	Unit
Resolution ratio			0.1		%RH
Measuring range	extended <sup>1</sup>	0		99.9	%RH
Accuracy <sup>2</sup>			± 2	See Figure 2	%RH
Repeatability			± 1		%RH
Interchangeability		completely interchangeable			
Response time <sup>3</sup>	1/e(63%)		<6		S
Hysteresis			± 0.3		%RH
Drift <sup>4</sup>			<0.5		%RH/yr

Table 1 Humidity Characteristic

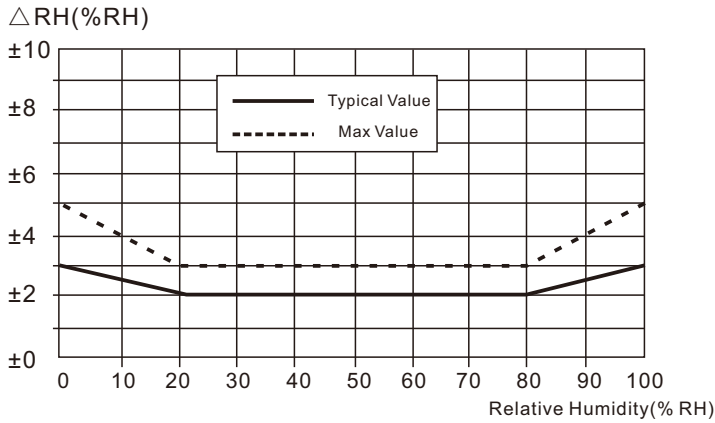


Figure 2 The maximum error of relative humidity at 25°C

## Temperature

Parameter	Condition	Min	Typical	Max	Unit
Resolution ratio			0.1		°C
Accuracy			± 0.5	See Figure 3	°C
Measuring range		-40		80	°C
Repeatability			± 0.2		°C
Interchangeability		completely interchangeable			
Response time <sup>3</sup>	1/e(63%)		<10		S
Drift			± 0.3		°C/yr

Table 3 Temperature Characteristic

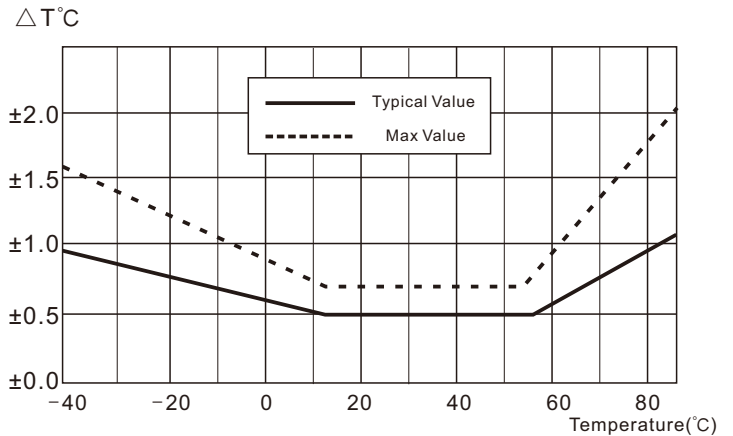


Figure 3 Typical error and maximum error of temperature

## Electric specification

Parameter	Condition	Min	Typical	Max	Unit
Supply Voltage		3.3	5	5.5	V
Power consumption <sup>5</sup>	Sleep	2	15		μA
	measuring		1200		μA
	Average		600		μA
Low level output voltage	I <sub>ol</sub> <sup>6</sup>	0		300	mV
High level output voltage	R <sub>p</sub> <25 kΩ	90%		100%	VDD
Low level input voltage	Decline	0		30%	VDD
High level input voltage	Rise	70%		100%	VDD
R <sub>pu</sub> <sup>7</sup>	VDD = 5V VIN = VSS	1	5.1	100	kΩ
Output current	Open		8		mA
	Tri-state (turn off)	10	20		μA
Sampling period		2			S

Table 2. Electric Specification

- 1 Normal working scope: 0 - 80% RH. Sensor reading will be deviated if beyond this range, (drift < 3% RH after 200 hours at 90% RH humidity). The working scope is further limited to - 40~80°C.
- 2 This precision is the test precision of the sensor with 5V voltage at 25°C excluding hysteresis and nonlinearity, and only suitable for non-condensation conditions.
- 3 The time required to reach 63% of the first-order response under the conditions of 25°C and 1 m/s air flow.
- 4 If the sensor is surrounded by volatile solvents, irritating tapes, adhesives and packaging materials, the reading may be higher. For more information, please refer to the relevant documents.
- 5 The minimum and maximum of power consumption are based on the conditions of VDD = 5 V and T < 60 °C. The average value is value measured every two seconds.
- 6 Low level output current
- 7 Represents pull up resistance.
- 8 The response time depends on the thermal conductivity of the sensor substrate.





## 5.2 One-wire bus communication protocol

### ◎ One-wire bus descriptions

The AM2302 uses simplified one-wire bus communication, the one-wire bus has only one data line, and the data exchange and control in the system are completed by the data line. The micro-controller is connected to the data line via a drain open circuit or a three state port, allows the device to release the bus without sending data, let other devices use the bus. A single bus usually requires an external pull up resistor of about 4.7k, thus, when the bus is idle, the state is high. Because they are the principal and subordinate structure, only the host call sensor, the sensor can response, so the host access sensor must strictly follow the single bus sequence, if the sequence of chaos, sensor will not respond to host.

### ◎ One-wire bus transmits data definitions

SDA is used for communication and synchronization between micro controller and AM2302, and uses single bus data format to transmit 40 bit data at one time. The specific communication sequence is shown in Figure 7, and the communication format specification is shown in Table 6.

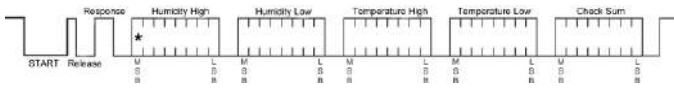


Figure7 One-wire bus communication protocol of AM2302

Name	Single bus format definition
START	The microprocessor pulls the data bus (SDA) down for a period of time (at least 1ms), informing the sensor to prepare the data.
Response	The sensor pulls the data bus (SDA) low by 80µs and pills up by 80µs in response to the host's start signal.
Data format	Once receipted from the host start signal, the sensor collects 40 bits of data from the data bus (SDA) at one time, High first out.
Humidity	Humidity resolution is 16Bit, high bit in the former; sensor string out the humidity value is 10 times the actual humidity value.
Temperature	Temperature resolution is 16Bit, high in the former; sensor string out of the temperature value is 10 times the actual temperature; The highest temperature (Bit15) is equal to 1 for negative temperature, the highest temperature bit (Bit15) is equal to 0 for positive temperature; Temperature in addition to the most significant bit (Bit14 ~ Bit0) that the temperature value.
Check Sum	Check Sum Humidity high bit+Humidity low bit+Temperature high bit+Temperature low bit

Table 6 AM2302 communication format specification

### ◎ Examples for one-wire bus data calculation

Example 1:Received 40 bit data is:

00000010 10010010 00000001 00001101 10100010  
Humidity high Humidity low Temperature high Temperature high Check sum

Calculation:

$00000010+10010010+00000001+00001101=10100010$ (Check sum)

Received data is correct:

Humidity:  $00000010\ 10010010=0292H$ (Hexadecimal)=  $2 \times 256 + 9 \times 16 + 2 = 658$   
=> Humidity = 65.8%RH

Temperature:  $00000001\ 00001101=10DH$ (Hexadecimal)=  $1 \times 256 + 0 \times 16 + 13 = 269$   
=> Temperature= 26.9°C

### ◎ Special instructions:

When the temperature is below 0 ° C, the highest bit of the temperature data is 1

Example 1 : -10.1 °C => 1 000 0000 0110 0101

Temperature:  $0000\ 0000\ 0110\ 0101 = 0065H$ (Hexadecimal)=  $6 \times 16 + 5 = 101$   
=> Temperature = -10.1°C

Example 2 :received 40 bit data is:

00000010 10010010 00000001 00001101 10110010  
Humidity high Humidity low Temperature high Temperature high Check sum

Calculation:

$00000010+10010010+00000001+00001101=10100010 \neq 10110010$

(Check error)

The data received this time is not correct. Give up and re-receive data.

## 5.3 One-wire bus communication timing

The AM2302 switches from Sleep to High Speed mode when the user host (MCU) sends a start signal (pulls the data bus SDA low by at least 800µs). After the host start signal is completed, the AM2302 sends a response signal and sends 40Bit from the data bus SDA serially. The high bit of the data is sent first. The data sent is: the high bits of humidity, the low bits of humidity, the high bits of temperature, the low bits of temperature, the check digit. The information is collected after sending data ends and the sensor is automatically transferred to the sleep mode until the next A communication comes.

Detailed timing signal characteristics shown in Table 7, single bus communication timing diagram shown in Figure 8.

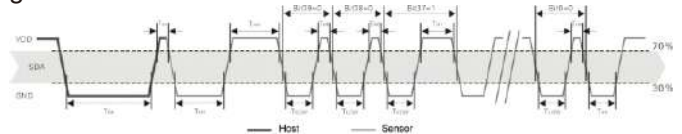


Figure 8 AM2302 Single bus communication timing

Note: The temperature and humidity data the host read from the AM2302 is always the previous measurement. If the two measurement interval is very long, please read twice and use the second measurement value as the value of real-time temperature and humidity values. While reading ,make sure the minimum interval between two measurement is 2 Second.



Table 7 One-wire bus signal characteristics

Symbol	Parameter	min	type	max	Units
T <sub>be</sub>	Time of the host start signal is pulled low	0.8	1	20	mS
T <sub>go</sub>	Time of the host releases the bus	10	30	200	μS
T <sub>rel</sub>	Time to response low level	75	80	85	μS
T <sub>reh</sub>	Time to response high level	75	80	85	μS
T <sub>LOW</sub>	Signal "0" low level time	48	50	55	μS
T <sub>H0</sub>	Signal "0" high level time	22	26	30	μS
T <sub>H1</sub>	Signal "1" high level time	68	70	75	μS
T <sub>en</sub>	Time of the sensor releases the bus	45	50	55	μS

Note: To ensure accurate communication of the sensor, please strictly in accordance with parameters and timing design of Table 7 and Figure 8 when reading the sensors.

### 5.4 Peripheral read step example

Communication between the host and the sensor can complete by the following three steps.

#### Step 1:

After the AM2302 is powered on (the AM2302 will wait 2S to go beyond the unstable state, during which time the device can not send any instructions), test the environment temperature and humidity data, and record the data, then the sensor automatically goes to sleep. AM2302 SDA data line pulled up by the pull-up resistor and then would keep high, at this state, AM2302 is detect the external signal continuously, and its SDA pin in the input state.

#### Step 2:

The I/O of the microprocessor is set to output and the output is low, and the low hold time can not be less than 1ms. Then the microprocessor's I / O is set to the input state, the bus is released. When the host release bus, AM2302 send a response signal, mean 80ms low output as a response signal. After that an 80ms high output to inform the peripherals ready to receive data, the signal transmission shown in Figure 9:

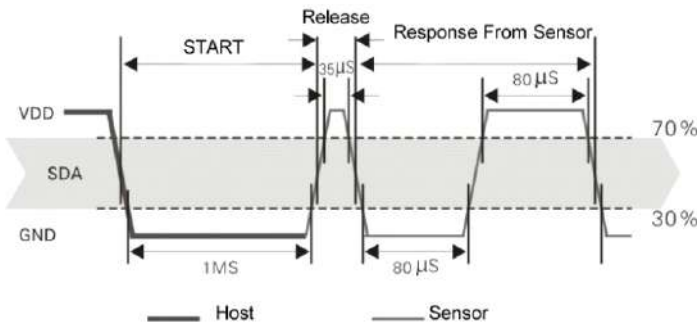


Figure 9 Single Bus Decomposition Timing Diagram

#### Step 3:

After AM2302 sends the response, then the data bus SDA continuously outputs 40 bits of data, and the microprocessor receives 40 bits of data according to the change of I/O level.

The format of the bit data "0" is: 50 ms low level plus 26-28 ms high level;

The format of the bit data "1" is: 50 ms low level plus 70 ms high level;

The format of the bit data "0", bit data "1" are shown in Figure 10.

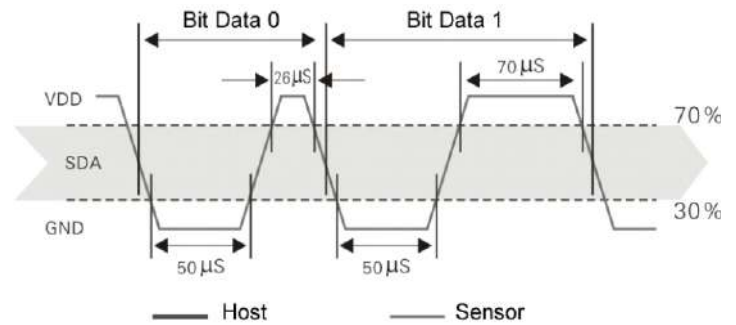


Figure 10 One-wire bus decomposition sequence diagram

After the data bus SDA of AM2302 outputs 40-bit data, it continues to output the low level for 50 microseconds and then turns to the input state. Due to the pull-up resistance, it then changes to the high level. At the same time, the internal temperature and humidity data of AM2302 were retested, and the data were recorded. After the test record was completed, the microcontroller automatically entered the sleep state. MCU only received the host after the start of the signal, to re-wake the sensor, into the working state.

### 5.5 Peripheral read flow chart

The flow chart diagram of AM2302 sensor read one-wire bus is shown in figure 11. At the same time, our company also provides an example of reading code. For customers who need to download, please log on our company's website ([www.aosong.com](http://www.aosong.com)) for relevant downloading.

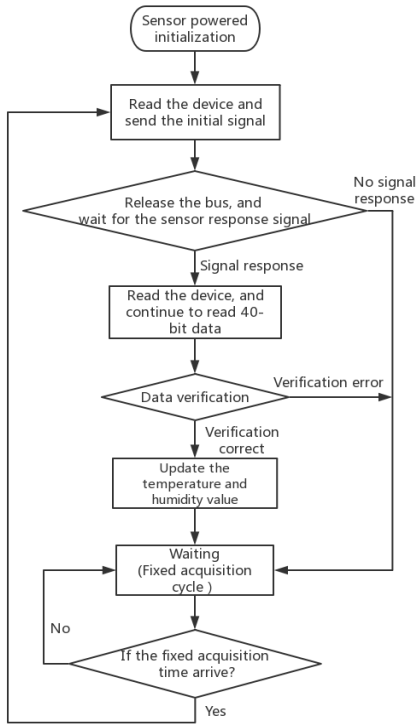


Figure 11 The one-wire bus read flow chart

Antistatic bags are also labeled, as shown in figure 13, and provides additional tracking information.

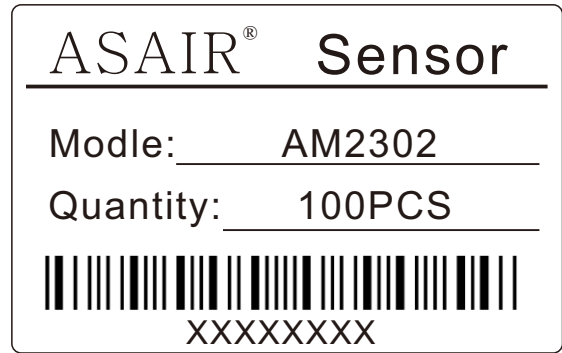


Figure13 Label on anti-static bag

### 7.2 Transport Package

AM2302 is palletized with 50 sensors in each blister box. Each two blister boxes are sealed in an anti-static shielding bag with a total of 100 sensors. The packaging diagram with sensor positioning is shown in figure 14. The blister box is placed in an anti-static shielding bag.

## 6 Environmental stability

If the sensor is used in equipment or machinery, please make sure that it is the same temperature and humidity that the sensor used for measurement and the sensor used for reference that have sensed. If the sensor is placed in the equipment, the reaction time will be prolonged, so it is necessary to ensure that sufficient measurement time is reserved in the programming. The AM2302 sensor is tested according to the enterprise standard of Aosong temperature and humidity sensor. The performance of sensors under other test conditions is not guaranteed and cannot be regarded as a part of sensor performance. Especially for the specific occasions required by users, we do not make any commitments.

## 7 Package

### 7.1 Tracking information

All AM2302 sensors have laser identification on the surface as shown in figure 12.

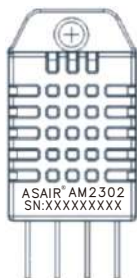


Figure 12 sensor laser identification

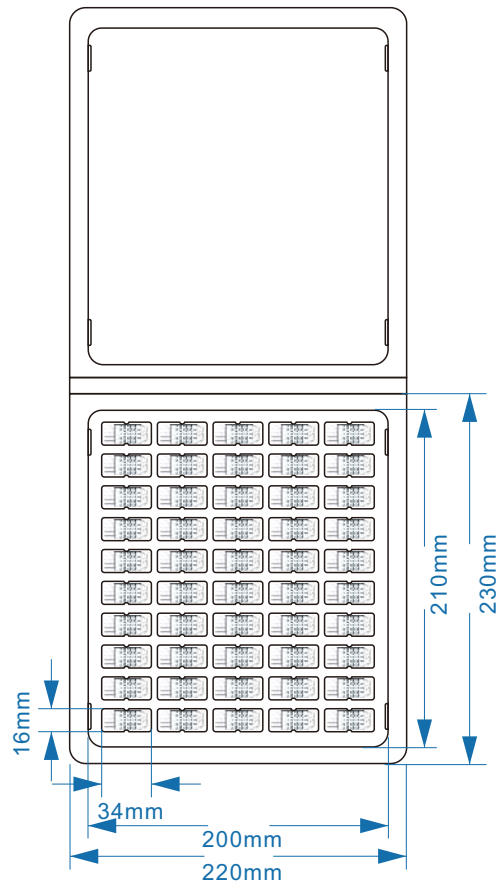


Figure14 Blister box and sensor location diagram

## Version

Date	Version	Page	Alteration
2019/03	V1.0	1-8	Initial Version

This manual is likely to change sometime 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 under warranty.

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.

Copyright©2019 , ASAIR® .