Digital Temperature and Humidity Sensor

AM2315 **Product Manual**

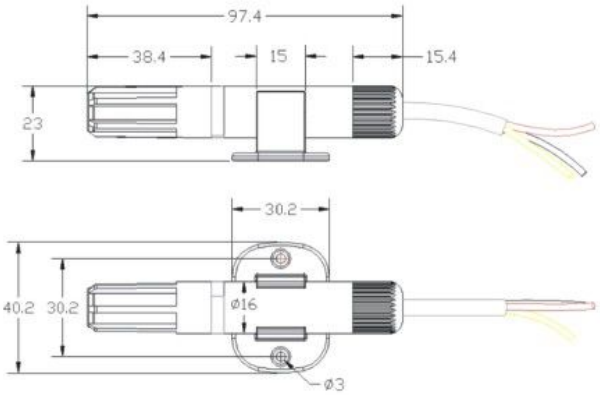
Product Features

- Fully calibrated
- Digital signal output
- Ultra-low power
- Excellent long-term stability
- Standard single-wire output

1. Product Overview

AM2315 humidity capacitance is a digital temperature and humidity module contains a digital IIC output has been calibrated temperature and humidity combined sensor. It uses a dedicated digital module acquisition techniques and temperature and humidity sensor technology to ensure that products with high reliability and excellent long-term stability. Sensor includes a capacitive humidity sensing element and a high-precision temperature measurement devices, and with a high-performance 8-bit microcontroller connected. Therefore, the product has excellent quality, fast response, anti-interference ability, high cost and other advantages. Each sensor is calibrated in a very precise humidity calibration chamber. Calibration coefficients stored in the form of a program the microcontroller, the internal sensor to detect the signal in the process to call these calibration coefficients. Standard single-bus interface, the system integration becomes simpler and quicker. Ultra-small size, low power consumption, signal transmission distance up to 20 meters or more, making it the best choice for all kinds of applications and even the most demanding applications. Products are divided into three leads (single bus interface) for easy connection. Special packages can be provided according to user needs.

Physical figure



Dimensions（unit: mm）

2. Applications

HVAC, dehumidifiers, testing and inspection equipment, consumer goods, automotive, automation, data loggers, appliances, humidifiers, medical, weather, and other relevant humidity detection control.

3. Product Highlights

Ultra-low power, transmission distance, fully automated calibration, using capacitive humidity sensor, completely interchangeable, standard digital single-bus output, excellent long-term stability, high precision temperature measurement devices.

4. Single Bus Interface Definition

4.1 AM2315 pin assignment

Table 1: AM2315 pin assignment

Pin	Color	Name	Description

1	Red	VDD	Power supply (3.3V-5.5V)
2	Yellow	SDA	Serial data, bidirectional
3	Black	GND	Ground
4	White	SCL	Serial clock input port

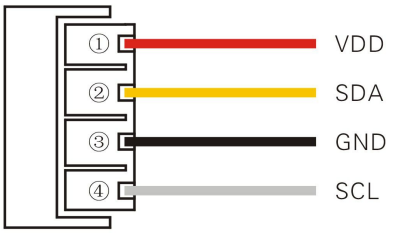


Figure 1: AM2315 pin assignment diagram

4.2 Power supply pins（VDD GND）

AM2315 supply voltage range is 3.3V - 5.5V, recommended supply voltage is 5V.

4.3 Serial Data（SDA）

SDA pin is tri-state structure for reading, writing sensor data. Specific communication timing, see the detailed description of communication protocols.

5. Sensor Performance

5.1 Relative humidity

Table 2: AM2315 relative humidity Performance Table

Parameters	Conditions	min	typ	max	unit
Resolution			0.1		%RH
Range		0		99.9	%RH
Accuracy [1]	25℃		±2		%RH
Repeatability			±0.1		%RH
Interchangeability		Completely interchangeable			
Response time [2]	1/e(63%)		<5		S
Hysteresis			±0.3		%RH
Drift [3]	Typical values		<0.5		%RH/yr

5.2 Temperature

Table 3: AM2315 relative temperature performance table

Parameters	Condition	min	typ	max	unit
Resolution			0.1		℃
			16		bit
Accuracy			±0.3	±0.4	℃
Range		-40		80	℃
Repeatability			±0.2		℃
Interchangeability		Completely interchangeable			
Response time	1/e(63%)		<5		S
Drift			±0.1		℃/yr

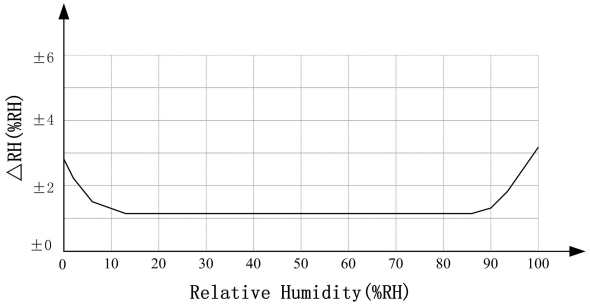


Figure 2: At 25 ℃ relative humidity of maximum error AM2315

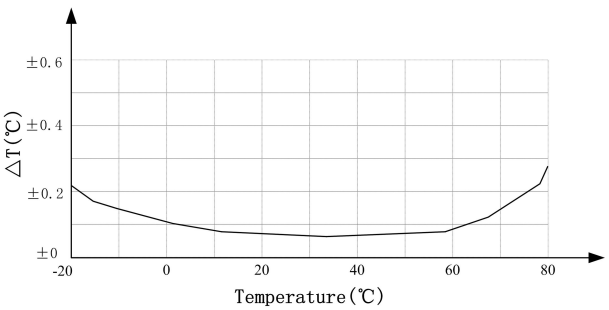


Figure 3: Maximum temperature sensor error

6. Electrical Characteristics

Electrical characteristics such as energy consumption, high, low, input, output voltage, etc., depending on the power supply. Table 4 details the AM2315 electrical characteristics, if not marked, then the supply voltage is 5V. To get the best results with the sensor, in strict accordance with the design conditions shown in Table 4, please design.

Table 4: AM2305 DC characteristics

Parameters	Conditions	min	typ	max	unit
Supply voltage		3.3	5	5.5	V
Power Consumption [4]	Sleep	10	15		μA
	Measurement		500		μA
	Average		300		μA
Low level output voltage	I_{OL} [5]	0		300	mV
High-level output voltage	Rp<25 kΩ	90%		100 %	VDD
Low Input Voltage	Decline	0		30%	VDD
High-level input voltage	Rise	70%		100 %	VDD
Rpu[6]	VDD = 5V VIN = VSS	30	45	60	kΩ
Output Current	Open		8		mA
	Tri-State (Off)	10	20		μA
Sampling period		2			S

[1] The accuracy of factory inspection, precision index sensor at 25 ℃ and 5V, the conditions tested, it does not include hysteresis and non-linearity, and is only suitable for non-condensing environment.

[2] At 25 ℃ and 1m / s airflow conditions, to achieve a first-order response time of 63% required.

[3] In the volatile organic compounds, the value may be higher. See manual application store information.

[4] This value for VDD = 5.0V when the temperature is 25 ℃, 2S / times, the average under conditions.

[5] Low level output current.

[6] Said pull-up resistor.

7. Single bus communication（ONE-WIRE）

7.1 Single Bus typical circuit

Connection with the AM2315 microprocessor typical application circuit shown in Figure 4. When the single-bus communication mode, pull the microprocessor I / O port is connected to the SDA.

Single bus communication Special Instructions:

1. A typical application circuit is recommended cable length shorter than 30 meters with a 5.1K pull-up resistor, when more than 30 meters lower pullup resistor according to the actual situation.

2. When using a 3.3V voltage supply cable length must not be greater than 100cm. Otherwise it will lead to lack of line drop sensor supply, causing measurement bias.

3. The minimum interval for reading sensor 2S; reading interval time is less than 2S, may lead to temperature and humidity are not allowed or communication is unsuccessful and so on.

4. Temperature and humidity values of each read is the result of a measurement To obtain real-time data to be read twice continuously, it is recommended repeatedly reading sensor, and each interval of the read sensor is greater than 2 seconds to get an accurate data.

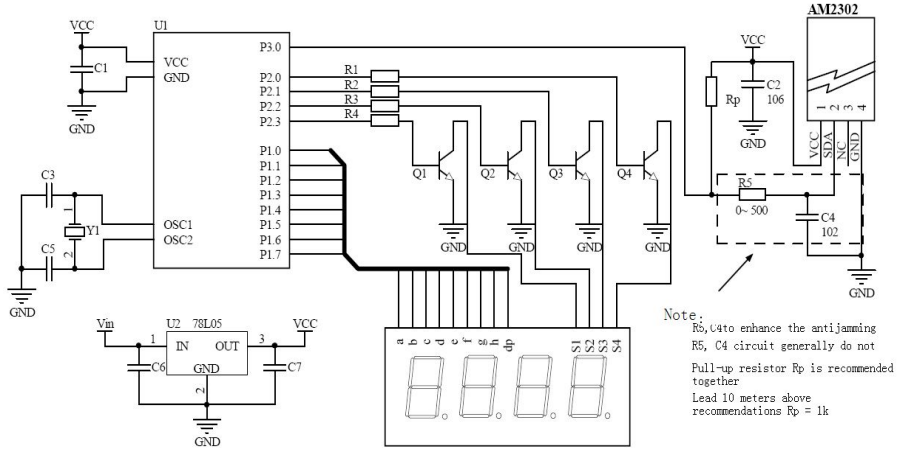


Figure 4: AM2315 **single bus typical circuit**

7.2 Single bus communication protocol

◎Single Bus Description

AM2315 device uses a simplified single-bus communication. Single bus that only one data line, the data exchange system, the control by the data line is completed. Device (microprocessor) through an open-drain or tri-state port connected to the data line to allow the device to send data when not able to release the bus, and let the other devices on the bus; single bus usually requires an external approximately 5.1kΩ of pull up resistor, so when the bus is idle, its status is high. Because they are the master-slave structure, only when the host calls the sensor, the sensor will not answer, so the host access sensor must strictly follow the single-bus sequence, if there is a sequence confusion, the sensor will not respond to the host.

◎Single bus transfer data definitions

SDA and AM2315 microprocessors for communication and synchronization between using single-bus data format, a data transmission 40, a high first-out. , The communication format description of specific communication sequence shown in Figure 5 are shown in Table 5.

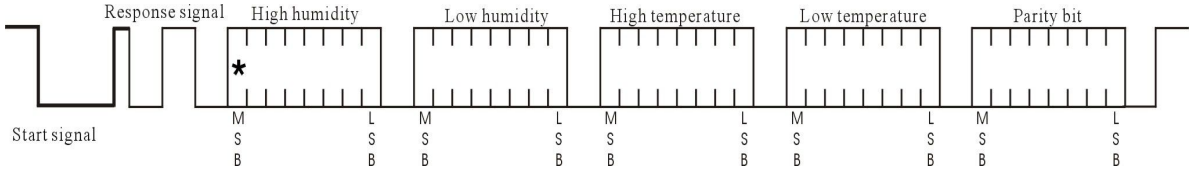


Figure 5: AM2315 **single bus communication protocol**

Table 5: AM2315 communication format description

Name	Single bus format definition
Start signal	The microprocessor data bus (SDA) low period of time (at least 800μs) [1], to prepare the data notification sensor.
Response signal	Sensor data bus (SDA) low 80μs, 80μs response followed by high start signal of the host.
Data Format	Upon receipt of the host start signal, sensor-time from the data bus (SDA) string of 40 data, the high first-out
Humidity	Humidity resolution is 16Bit, the previous high; strings out of the humidity sensor is 10 times the actual humidity values.

Temperature	Temperature resolution is 16Bit, the previous high; sensor string temperature value is 10 times the actual temperature values ; Temperature highest bit (Bit15) equal to 1 indicates a negative temperature, the temperature of the highest bit (Bit15) is equal to 0 indicates a positive temperature; Temperature in addition to the most significant bit (Bit14 ~ Bit0) indicates the temperature value.
Parity bit	Parity bit = High humidity + Low humidity + High temperature + Low temperature

◎Single-bus data calculation example

Example 1: 40-bit data is received as follows:

0000 0010	1001 0010	0000 0001	0000 1101	1010 0010
High humidity 8	Low humidity 8	High temperature 8	Low temperature 8	Parity bit

Calculation:

0000 0010+1001 0010 +0000 0001+0000 1101= 1010 0010（Parity bit）

Receive data correctly:

Humidity: 0000 0010 1001 0010 = 0292H (Hex)= 2×256 + 9×16 + 2 = 658

=> Humidity = 65.8%RH

Temperature: 0000 0001 0000 1101 = 10DH(Hex) = 1×256 + 0×16 + 13 = 269

=> Temperature= 26.9℃

◎Special Instructions:

When the temperature is below 0 ℃ temperature data in a top position.

Example1 : -10.1 ℃ expressed as 1 000 0000 0110 0101

Temperature： 0000 0000 0110 0101 = 0065H(Hex)＝ 6×16 +5 = 101

=> Temperature ＝ -10.1℃

Example 2: The received data is 40-bit:

0000 0010	1001 0010	0000 0001	0000 1101	1011 0010
High humidity 8	Low humidity 8	High temperature 8	Low temperature 8	Parity bit

Calculation:

0000 0010+1001 0010 +0000 0001+0000 1101= 1010 0010 ≠ 1011 0010 （Parity error）

The received data is not correct, give up, again receiving data.

7.3 Single bus communication timing

User Host (MCU) sends a start signal (data bus SDA low for at least 800μs) after, AM2315 transition from sleep mode to high-speed mode. After the start signal to be the host, AM2315 transmits a response signal sent 40Bit data from a serial data bus SDA, the first byte sent high; data transmission were high humidity, low humidity, high temperature, low temperature, parity , sent a message to trigger the end of data collection, collecting end sensor automatically transferred to sleep mode until the next traffic coming.

Detailed timing signal characteristics are shown in Table 6, a single bus communication timing diagram shown in Figure 6.

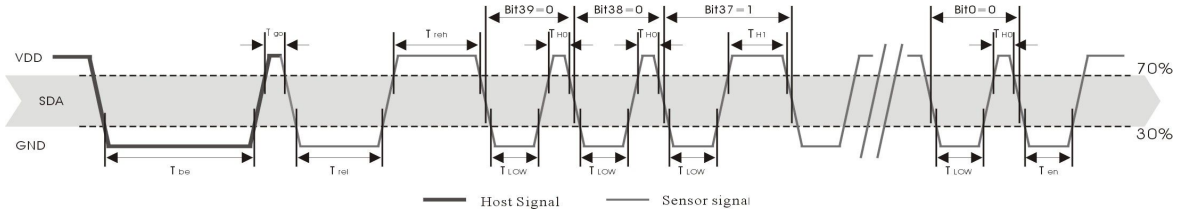


Figure 6: AM2315 **single bus communication timing**

Note: temperature and humidity data from the AM2315 host always read the previous measurements, such as the long time interval between two measurements, please read twice in successive second time is a real-time temperature and humidity values , and twice read take a minimum interval 2S.

Table 6: Single-bus signal characteristics

Symbol	Parameters	min	typ	max	unit
T_{be}	Host starting signal low time	0.8	1	20	mS
T_{go}	Host Bus release time	20	30	200	μS
T_{rel}	Low response time	75	80	85	μS
T_{reh}	High response time	75	80	85	μS
T_{LOW}	Signal "0", "1" low time	48	50	55	μS
T_{H0}	Signal "0" high time	22	26	30	μS
T_{H1}	Signal "1" high time	68	70	75	μS
T_{en}	Sensors release the bus time	45	50	55	μS

Note: To ensure accurate communication sensor signals the user when reading, please strictly in accordance with Table 6 and Figure 6, the design parameters and timing

7.4 Peripheral reading step example

Communication between the host and the sensor reads the data can be done through the following three steps.

Step1:

AM2315 after power (after power-on AM2315 2S to wait to cross the unstable state, during the reading device can not send any instruction), test environment temperature and humidity data, and record the data, then the sensor automatically transferred to a dormant state. AM2315 The SDA data

state, always detect external signals.

Step2:

Microprocessor I / O set to output, while the output low and low retention time can not be less than 800us, typical values are down 1MS, then the microprocessor I / O is set to enter the state, the release of the bus, Since the pull-up resistor, the microprocessor I / O that AM2315 the SDA data line also will become high, and so release the bus after the host, AM2315 sends a response signal that the output of 80 microseconds low as response signal, followed by 80 microsecond high level output of the peripheral is ready to receive data notification signal transmitter shown in Figure 7:

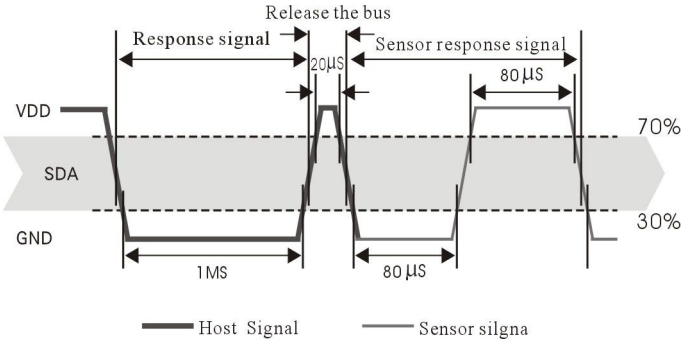


Figure 7: Single bus exploded timing diagram

Step3:

After sending the response AM2315 followed by continuous serial data bus SDA data output 40, the microprocessor 40 receives the data according to the I / O level changes.

Bit data "0" format is: Low high plus 26-28 microseconds 50 microseconds;

Bit data "1" format is: Low high plus 70 microseconds 50 microseconds;

Bit data "0", "1" bit data format signal as shown in figure 8:

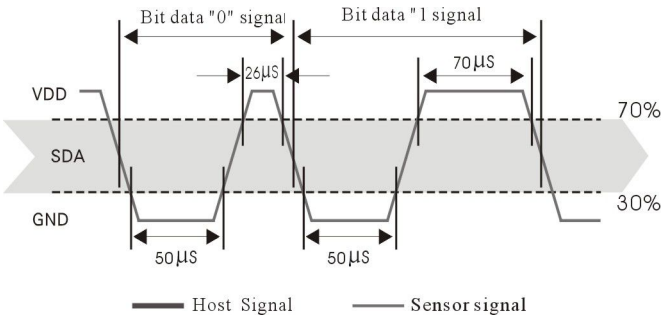


Figure 8: Single bus exploded timing diagram

AM2315 SDA output data bus 40 data, continues to output low 50 microseconds and changed the input state, due to the pull-up resistor subsequently goes high. Meanwhile AM2315 environmental temperature and humidity inside the test-retest data, and record data, test recording ends, the microcontroller automatically goes to sleep. Only after receiving the start signal microcontroller host, only to re-awaken the sensor into working condition.

7.5 Peripheral read flow chart

AM2315 sensor reading single bus flowchart diagram shown in Figure 9, the same time we also read the code examples provided C51, the need to download the client, please visit our website (www.aosong.com) related downloads this manual does not provide code instructions.

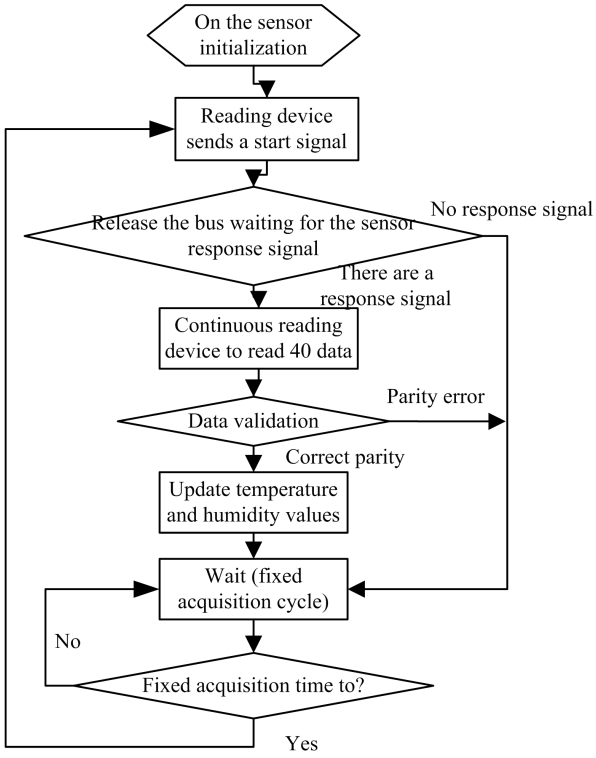


Figure 9: Single-bus read flow chart

8. Application Information

1. Work and storage conditions

The proposed scope of work beyond the sensor could lead to up to 3% RH temporary drift signal. Return to normal operating conditions, sensor calibration status will slowly recover. To speed up the recovery process can be found in "recovery process." Prolonged use under abnormal operating conditions, it will accelerate aging.

Avoid placing components on a long-term condensation and dry conditions and the following environments.

A Smoke

B An acid or an oxidizing gas, such as sulfur dioxide, hydrochloric acid

Recommended Storage Environment

Temperature: 10~40℃ Humidity: 60% RH or less

2. The influence of exposure to chemicals

Capacitive humidity sensor sensing layer would be disturbed chemical vapor diffusion in the sensing layer of chemicals may cause drift and measurement sensitivity. In a clean environment, will slowly release contaminants out. Restore processing described below to achieve this will accelerate the process. High concentrations of chemical pollutants (such as ethanol) can cause damage to the sensor sensing layer completely.

3. Temperature effect

The relative humidity of the gas, is heavily dependent on temperature. Therefore, when measuring the humidity, the humidity should be possible to ensure the sensors at the same temperature. If you share a printed circuit board and electronic components heat released in the

sensor should be installed as far as possible away from the electronic components, and installed under the heat, while maintaining a well-ventilated enclosure. To reduce heat conduction to other parts of the sensor and the copper plating of printed circuit boards to be the smallest possible, and leaving a gap between.

4. Lighting effects

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

5. Recovery process

   Placed under extreme operating conditions or chemical vapor sensors, through the following processing program, you can make it back to the state of calibration. <2 hours (drying) under a humidity of 10% RH; followed by 20-30 ℃ and> 45 ℃ and at a humidity of 70% RH 5 hours or more.

6. Wiring Precautions

   Signal wire quality will affect the voltage output quality, it is recommended to use high quality shielded cable.

7. Welding Information

   Manual soldering contact time must be less than 3 seconds at a temperature up to 300 ℃.

8. Product upgrades

   For details, please consult Aosong electronic technology sector.

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② The product should be mailed back to the company to pay the purchaser;
③ The shelf life of the product should be.

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