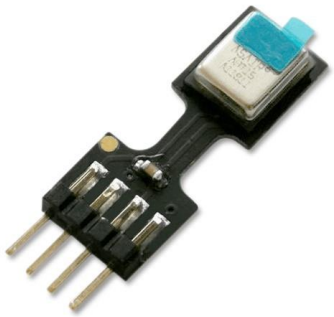
AHT15 Technical Manual

Temperature and humidity sensor

- Fully calibrated
- Digital output, I²C interface
- Excellent long-term stability
- Fast response and strong anti-interference ability



Product review

AHT15 temperature and humidity sensor uses standard pitch plug type. The connector can be easily replaced in the application. AHT15 is in protection waterproof and dustproof PTFE membrane that does not affect RH measurement response time. Allowing the sensor use in harsh environmental conditions (like spray water and high contact) Dust), ensuring the best precision performance, making the AHT15. The best choice in the most demanding application conditions.

Each sensor is rigorously calibrated and tested. by Improved and miniaturized the sensor so it More cost-effective, and all use of AHT15 In the end, the cutting-edge energy-saving operation mode will be realized.

Application range

HVAC, dehumidifiers, test and inspection equipment, consumer goods, automotive, automatic control, data loggers, weather station, home appliances, humidity regulation, medical and other related temperature and humidity detection and control.

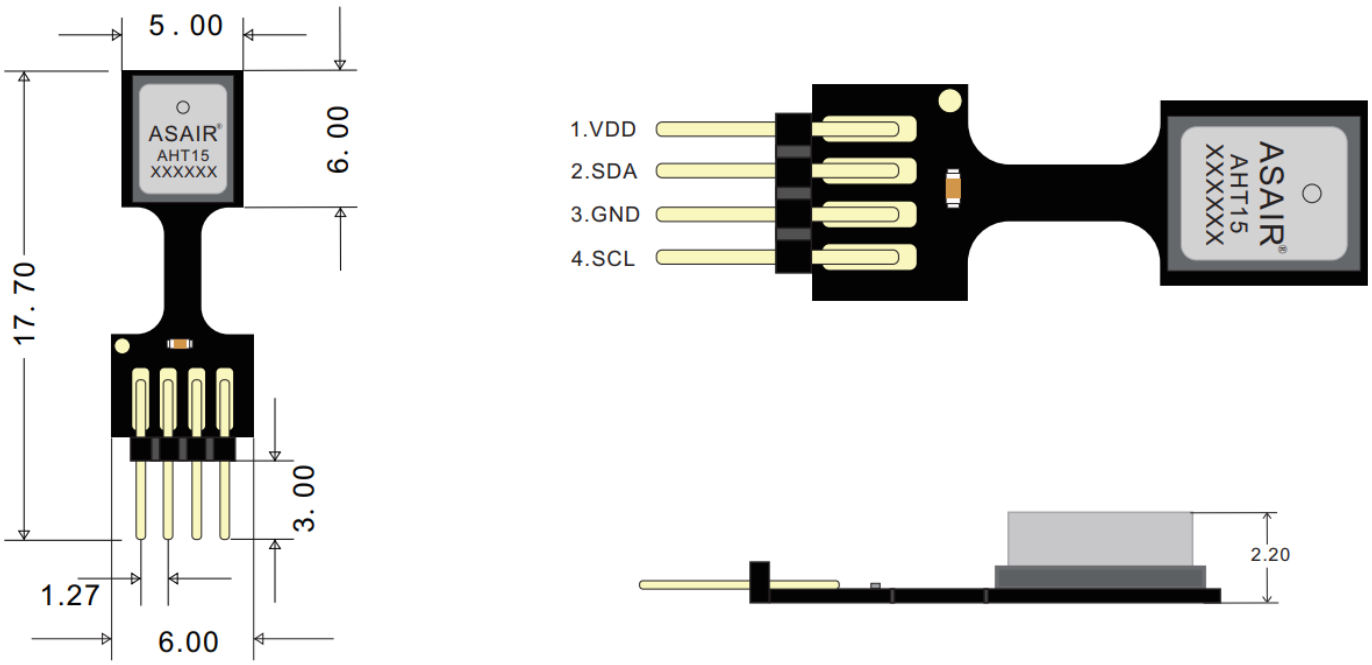
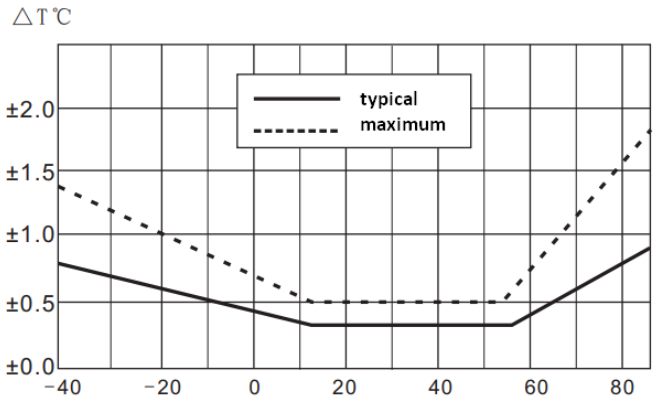


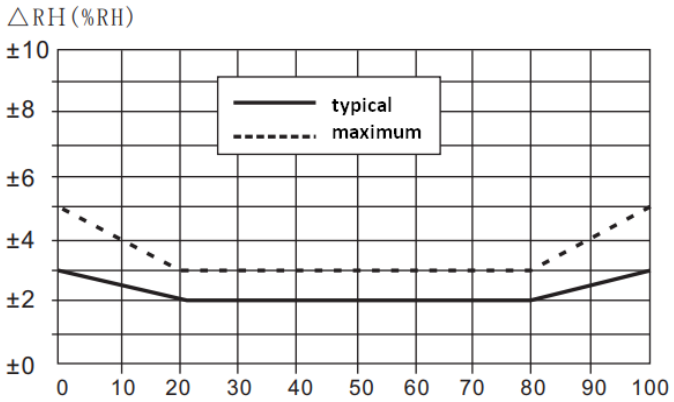
Figure 1: AHT15 sensor package diagram (unit: mm tolerance: 0.1mm)

Sensor performance

parameter	cond	min	typ	max	unit
Resolution	typical		0.01		℃
Precision[1]	typical		±0.3		℃
	typical	See Fig. 3			℃
Repeatability			±0.1		℃
Hysteresis			±0.1		℃
Response time[6]	63%	5		30	S
Scope	extended[3]	-40		85	℃
Drift			<0.04		℃/yr



parameter	cond	min	typ	max	unit
Resolution	typical		0.024		%RH
Precision[1]	typical		±2		%RH
	typical	See Fig. 2			%RH
Repeatability			±0.1		%RH
Hysteresis			±1		%RH
Non-linear			<0.1		%RH
Response [2]	t 63%		8		S
Scope	extended[2]	0		100	%RH
Drift [3]	normal		<0.5		%RH/yr



parameter	cond	min	typ	max	unit
voltage	typical	1.8	3.3	3.6	V
Current	Sleep			0.25	μA
	measure		23		μA
Power	sleep			0.9	μW
	measure		0.07		mW

[1] This accuracy is the test accuracy of the sensor at a factory voltage of 3.3V at 25°C.
This value does not include hysteresis and non-linearity and is only applicable to non-condensing conditions.
[2]The time required to achieve a first-order response of 63% at 25 ° C and 1 m/s airflow
[3] Normal working range: 0-80% RH, beyond this range, the sensor reading will be biased (weak at 90% RH)
After 200 hours, drift <3% RH). The scope of work is further limited to -40– 80 °C

AHT15User Guide

11 expansion performance

1.1 Working conditions

The sensor is stable in the recommended working range, see Figure 4. Long-term exposure to conditions outside the normal range, especially when the humidity is >80%, it may cause the signal to be temporarily signal drift (drift after 60 hours +3% RH). When restored to After normal working conditions, the sensor will slowly recover to calibrated state. See section 2.3, “Recovery Processing” to Speed up the recovery process. Long time under abnormal conditions Use, will accelerate the aging of the product.

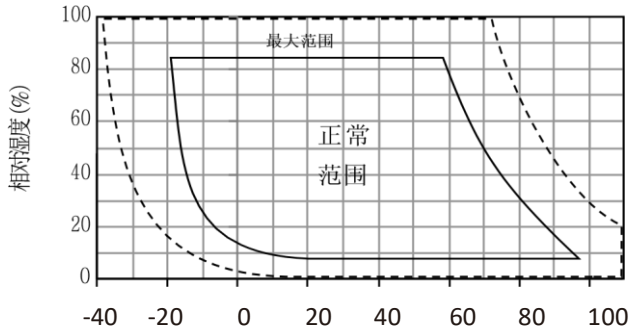


Figure 4 Working conditions

1.2 RH accuracy at different temperatures

The RH accuracy at 25 o'clock is defined in Figure 2, which is shown in Figure 5. °C The maximum humidity error in other temperature ranges

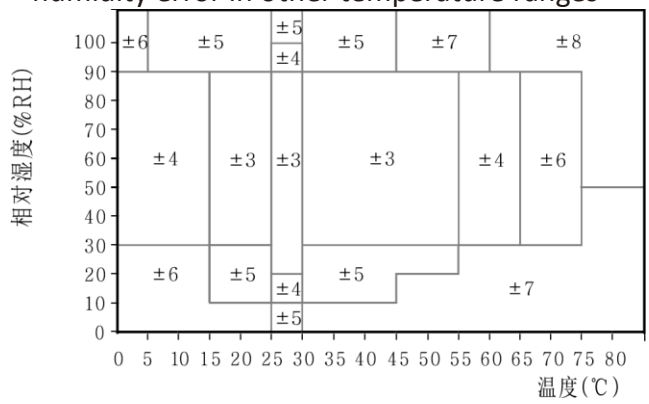


Figure 5 Maximum humidity error corresponding to the range of 0 to 80 °C, unit: (%RH) Maximum error (excluding hysteresis). In the range of ±3% RH The typical error is ±2% RH

1.3 Electrical characteristics

The power consumption and temperature and supply voltage VDD given in Table 2 have turn off. See Figures 6 and 7 for estimates of power consumption. Please note The curves in Figures 6 and 7 are typical natural features and are possible

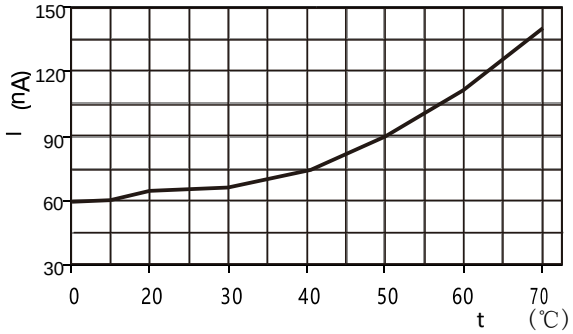


Figure 6 Typical supply current versus temperature for VDD = 3.3V (sleep mode). Please note that these data have a deviation of approximately ±25% from the displayed value。

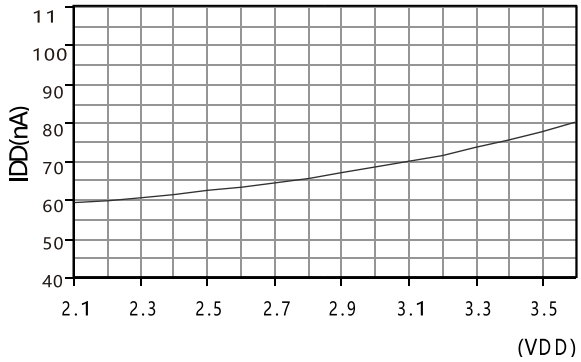


Figure 7 Typical supply current vs. supply voltage at 25 °C Curve (sleep mode). Please note that these data deviate from the displayed values. Can reach ±50% of the displayed value. At 60 ° C, the coefficient is about 15 (Compared with Table 2).

2 Application Information

2.1 Welding instructions

It is forbidden to use reflow or wave soldering for soldering. hand Dynamic welding must be contacted at temperatures up to 350 ° C. Less than 5 seconds
Note: After welding, the sensor needs to be in the ring of >75% RH Store under the environment for at least 12 hours to ensure the re-polymerization Hydration. Failure to do so will cause the sensor reading to drift. Also Place the sensor in a natural environment (>40% RH) for 5 days Above, make it rehydrate. Use low temperature solder (eg: 180 ° C) can reduce the hydration time.

If the sensor is applied to corrosive gases or has condensation Water generation (eg high humidity environment), lead pads and PCB Need to seal (such as: use conformal coating) to avoid Poor touch or short circuit

2.2 Storage conditions and operating instructions

Humidity sensitivity level (MSL) is 1, based on IPC/JEDEC J-STD-020 standard. Therefore, it is recommended Used within one year after shipment. Temperature and humidity sensors are not ordinary electronic components, need Careful protection, this must be taken seriously by users. Long-term exposure In high concentrations of chemical vapors, the sensor will be read The number produces drift. Therefore, it is recommended to store the sensor in the original package. Includes a sealed ESD pocket and meets the following Condition: Temperature range 10 ° C - 50 ° C (for a limited time 0-85 ° C); humidity is 20-60% RH (no ESD seal) Installed sensor). For those who have been removed from the original packaging Removed sensors, we recommend storing them in the inclusion In anti-static bag made of metal PET/AL/CPE material. Sensors should be avoided during production and transportation High concentrations of chemical solvents and prolonged exposure. Avoid contact with volatile glue, tape, stickers Or volatile packaging materials, such as foam, foam Wait. The production area should be well ventilated.

2.3 Recovery Processing

As mentioned above, if the sensor is exposed to extreme work bars In the piece or chemical vapor, the reading will drift. After the following processing, it is restored to the calibration state. Drying: under 80-85 ° C and <5% RH humidity conditions Hold for 10 hours; Rehydration: humidity bars at 20-30 ° C and >75% RH[7]. Keep for 12 hours。

[7]75%RH can be easily produced from saturated NaCl.

2.4 Temperature effects

The relative humidity of the gas depends to a large extent on the temperature. degree. Therefore, when measuring humidity, it should be guaranteed as much as possible. Sensors measuring the same humidity work at the same temperature Work. When testing, the sensor to be tested should be guaranteed And the reference sensor at the same temperature, then compare Humidity reading.

In addition, when the measurement frequency is too high, the sensor's own temperature The degree will increase and affect the measurement accuracy. If you want to guarantee it The temperature rise of itself is lower than 0.1 °C, the activation time of AHT15 is not Should exceed 10% of the measurement time - recommended every 2 seconds The amount of data is 1 time.

2.5 Materials for sealing and packaging

Many materials absorb moisture and act as a buffer, This will increase response time and delay. Therefore sensor periphery The material should be carefully selected. The recommended materials are: Metal material, PTFE (Teflon), POM (Delrin), LCP, PE, PEEK, PP, PB, PPS, PSU, PVDF, PVF。

Material for sealing and bonding (conservative recommendation): recommended Sealing electronic components using epoxy-filled methods Packed, or silicone. The gases released by these materials are also May contaminate AHT15 (see 2.2). Therefore, it

should be done last Assemble the sensor and place it in a well-ventilated place, or Dry in an environment >50 ° C for 24 hours to make it in a package The pollutant gas is released before

2.6 wiring rules and signal integrity

If the SCL and SDA signal lines are parallel to each other and are very connected Nearly, it may cause signal crosstalk and communication failure. Solution The method is to place VDD and / or GND between the two signal lines, Separate the signal lines and use shielded cables. In addition, lower The SCL frequency may also improve the integrity of the signal transmission. must Add a 100nF between the power supply pins (VDD, GND) The tantalum capacitor is used for filtering. This capacitor should be as close as possible sensor. See the next chapter。

3 Interface definition

Pin	name	Interpretation
1	VDD	Supply（1.8-3.6V）
2	SDA	Data ，2-way
3	GND	Ground
4	SCL	Clock ，2-way

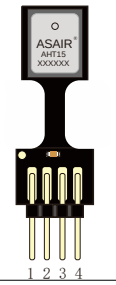


Table 5 AHT15pin distribution（top view）

3.1 Power Supply Pin (VDD,GND)

AHT15's power supply range is 1.8-3.6V, recommended voltage It is 3.3V. Between power supply (VDD) and ground (GND) Connect a 100nF decoupling capacitor with the capacitor Place it as close as possible to the sensor - see Figure 8.

3.2 Serial Clock SCL

SCL is used for communication between the microprocessor and the AHT15. step. Since the interface contains completely static logic, it is not There is a minimum SCL frequency.

3.3 Serial Data SDA

The SDA pin is used for data input and output of the sensor. SDA is on the serial clock when sending commands to the sensor The rising edge of (SCL) is valid, and when SCL is high In normal times, SDA must remain stable. On the falling edge of SCL After that, the SDA value can be changed. To ensure communication Full, the effective time of SDA is before the rising edge of SCL and Should be extended to TSU and THO after the falling edge - Refer to Figure 9. When reading data from the sensor, SDA Active (TV) after SCL goes low, and stays until the next The falling edge of SCL。

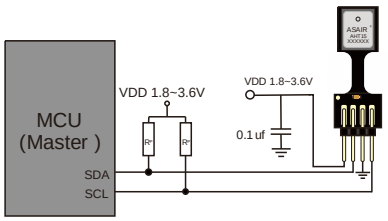


Figure 8 Typical application circuit including pull-up resistor RP and VDD and GND Decoupling capacitor between.

Note: 1. The power supply voltage of the host MCU must be consistent with the sensor when the product is in use.
2. If you need to further improve the reliability of the system, you can control the sensor power supply.
3. Only a single AHT15 can be connected to the I 2 C bus, and other I 2 C devices cannot be connected。

To avoid signal collisions, the microprocessor (MCU) must only Can drive SDA and SCL at low level. Need an outside AHT15 ASAIR XXXXXX ® The pull-up resistor of the part (for example: 10kΩ) pulls the signal High level. Pull-up resistors may usually be included in the micro In the processor's I/O circuitry. Refer to Tables 7 and 8 For detailed information on sensor input/output characteristics interest

4 Electrical characteristics

4.1 Absolute maximum rating

The electrical characteristics of the AHT15 are defined in Table 1. As shown in Table 6 The absolute maximum ratings given in the section are stress ratings only and provide more information. Under such conditions, the device It is not advisable to perform a function operation. Prolonged exposure to Absolute maximum rating conditions that may affect the sensor reliability

parameter	min	max	unit
VDD to G ND	-0.3	3.6	V
Digital I/O pin (SDA, SCL)	-0.3	VDD +0.3	V
Input current	-10	10	mA

Table 6 Electrical Absolute Maximum Ratings

ESD electrostatic discharge meets JEDEC JESD22-A114 standard (Human Body Mode ± 4kV), JEDEC JESD22-A115 (machine mode ± 200V). If the test

condition exceeds the nominal Limiting the indicator, the sensor needs to add an extra protection circuit.

4.2 Input/Output Characteristics

Electrical characteristics such as power consumption, high and low power of input and output The flat voltage, etc., depends on the power supply voltage. In order to make a biography Sensor communication is smooth, it is very important to ensure the signal The design is strictly limited to the vanes given in Tables 7, 8 and 9 Inside)

参数	条件	最小	典型	最大	单位
Output Low Voltage VOL	VDD = 3.3V, -4mA< IOL< 0mA	0	-	0.4	V
Output High Voltage VOH		70% VDD	-	VDD	V
Output sink current IOL		-	-	-4	mA
Input Low Voltage VIL		0	-	30% VDD	V
Input High Voltage VIH		70% VDD	-	VDD	V
Input Current	VDD = 3.6 V, VIN=0Vto3.6V	-	-	±1	uA

Table 7 DC characteristics of digital input and output pads, if there is no special statement, VDD = 1.8 V to 3.6 V, T = -40°C to 85 °C

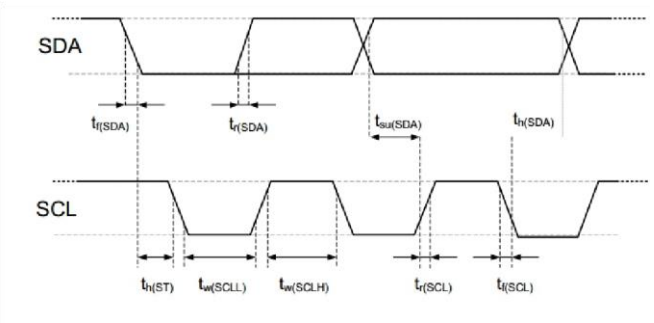


Figure 9 Timing diagrams and abbreviations of the digital input/output are shown in Table 8. Explanation. The thicker SDA line is controlled by the sensor, the normal SDA line Controlled by a single chip microcomputer. Please note that the effective read time of SDA is from the previous one. Triggered by the falling edge of the conversion

parameter	label	I²C typical		I²C high speed		unit
		MIN	MAX	MIN	MAX	
I2C clock freq.	fSCL	0	100	0	400	KHz
Start signal time	tHDSTA					µs
SCL high width	tHIGH	4.7		1.3		µs
SCLlow width	tLOW	4.0		0.6		µs
Data retention time relative to SCL SDA	tHDDAT	0.09	3.45	0.02	0.9	µs
Data setting time relative to SCL SDA	tSUDAT	250		100		µs
Note: Measurements for both pins are from 0.2 VDDand0.8VDD. Note: 2 above The IC timing is determined by the following internal delays: (1) The internal SDI input pin is delayed relative to the SCK pin, typically 100ns (2) The internal SDI output pin is delayed relative to the SCK falling edge, typically 200ns						

Table 8 I²C Timing characteristics of the IC fast mode digital input/output. The specific meaning is shown in Figure 9, unless otherwise noted。

5 Sensor communication

AHT15 uses standard 2 The IC protocol communicates. Want to get Take the following chapters. For information on the IC agreement, please refer to Read the following website: www.aosong.com.

5.1 Starting sensor

The first step is to power up the sensor and the voltage is selected. VDD supply voltage (range between 1.8V and 3.6V) between). After power-on, the sensor takes up to 20 milliseconds Time (SCL is high at this time) to achieve idle State, that is, ready to receive sent by the host (MCU) command。

5.2 Start/Stop Timing

Each transmission sequence starts with the Start state and End with Stop state, as shown in Figure 10 and Figure 11

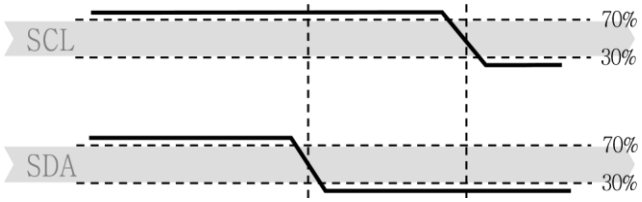


Figure 10 Start Transfer Status (S) - SDA is high when SCL is high. The level is converted to a low level. The starting state is a special kind of total controlled by the host. Line status, indicating the start of the slave transmission (after the Start, the BUS bus is generally Think it is in a busy state）

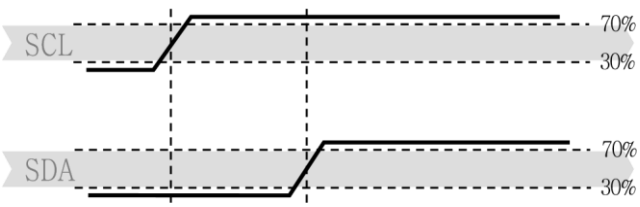


Figure Stop Transfer Status (P) - When SCL is high, the SDA line is from Low level is converted to high level. The stop state is a special type controlled by the host. Bus status, indicating the end of the slave transmission (after Stop, the BUS bus is generally think it is idle)

5.3 Sending commands

After the transfer is initiated, the subsequent transfer 2 IC first byte includes 7 Bit 2 IC device address 0x38 and an SDA direction bit (Read R: '1', write W: '0'). At the 8th SCL After the falling edge of the clock, pull the SDA pin low (ACK Bit), indicating that the sensor data reception is normal. At the beginning of the issue After the initialization command ('1110'0001' stands for initialization, '1010'1100' stands for temperature and humidity measurement), MCU must Wait for the measurement to be completed. The basic commands are in Table 9. Overview. Table 10 shows the status bit descriptions returned by the slave

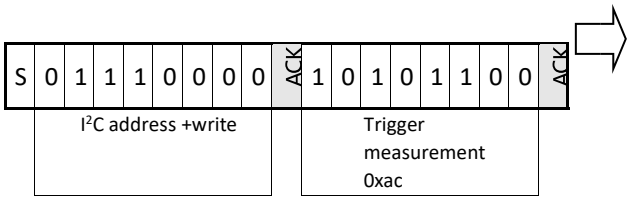
command	Code
Initialization	1110’0001
Measurement trigger	1010’1100
Soft reset	1011’1010

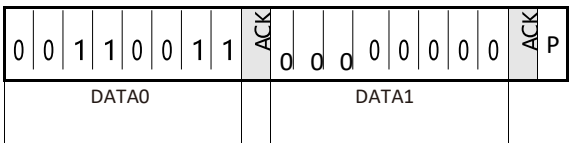
Table 9 basic command set

Bit	significance	description
Bit[7]	Busy (Busy indication)	1 -- Device is busy 0 -- idle, Sleep state
Bit[6:5]	Working mode (Mode Status)	00 NOR mode 01 CYC mode 1x CMD mode
Bit[4]	Reserved	Reserved
Bit[3]	Calibration enable (CAL Enable)	1-calibrated 0-not calibrated
Bit[2：0]	Reserved	Reserved

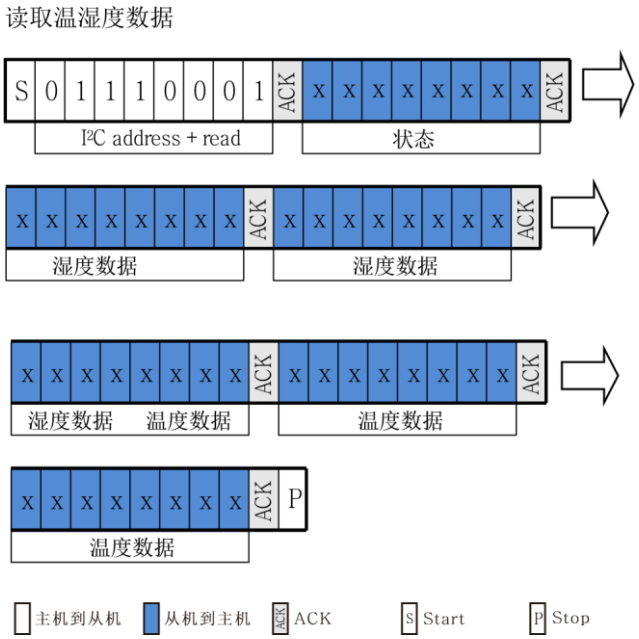
Table 10 Status Bit Description

Trigger measurement data





Read temperature and humidity data



Note: The sensor takes time to acquire, and the host sends a measurement command (0xAC). After that, the delay is more than 75 milliseconds, and then the converted data is read and the returned shape is judged. Whether the status is normal. If the status bit [Bit7] is 0, the data can be normal. Read, when the sensor is busy, the host needs to wait for the data processing to complete.

5.4 Soft Reset

This command (see Table 9) is used for Restart the sensor. After receiving this command, the sensor system begins to re-initialize And restore the default settings state, the time required for soft reset is not exceed 20 milliseconds

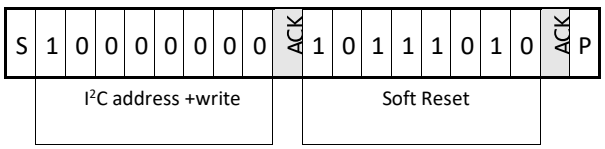


Figure 12 Soft Reset – The gray part is controlled by the AHT15

6 signal conversion

6.1 Relative humidity conversion

Relative humidity RH can be relatively wet according to SDA output The degree signal S RH is calculated by the following formula (The result is expressed in %RH)

$$RH[\%]=\left(\frac{S_{RH}}{2^{20}}\right)*100\%$$

6.2 Temperature conversion

The temperature T can be substituted by the temperature output signal S T The formula below is calculated (Results are expressed in temperature °C)

$$T(℃)=\left(\frac{S_T}{2^{20}}\right)*200-50$$

7 Environmental stability

If the sensor is used in equipment or machinery, be sure to use it for testing The amount of sensor is the same as the sensor used for reference Conditional temperature and humidity. If the sensor is placed in the equipment In the process, the reaction time will be extended, so it is necessary to protect the program design. The certificate reserves enough time for measurement. AHT15 sensor is based on Austria The factory standard for loose temperature and humidity sensors is tested. Sensor in We do not guarantee the performance under other test conditions, and do not Can be used as part of sensor performance. Especially for the user Do not make any promises on specific occasion

8 packaging

8.1 Tracking information

All AHT15 sensor surfaces are laser marked. See Figure 13。

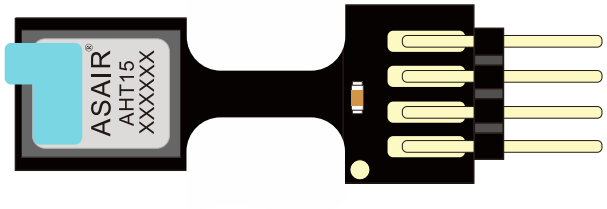


Fig 13 Sensor laser identification

The label is also labeled on the reel, as shown in Figure 14, and provides other tracking information。

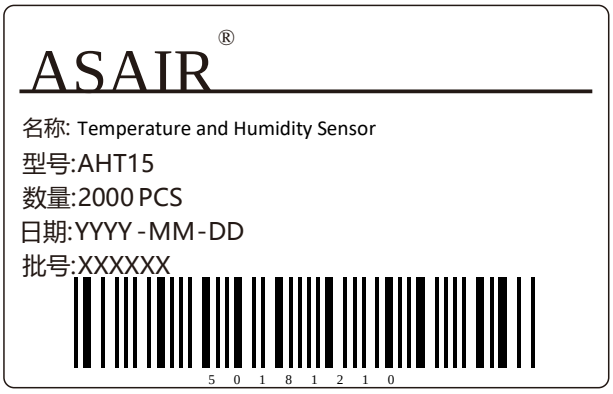


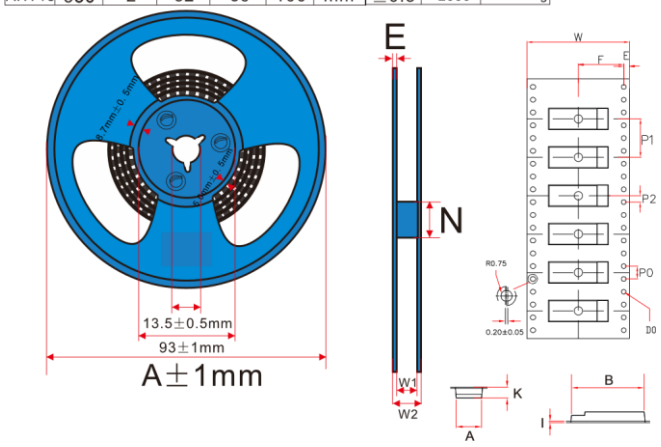
Fig 14 : Label on the reel

8.2 Transport packaging

AHT15 is packaged in tape and reel, sealed in antistatic ESD In the bag. The standard package size is 2000 pieces per roll. for AHT15 package, 240mm after each tape roll (20 sensors Capacity) and the front 240mm (20 sensor capacity) part is empty。

The package diagram with sensor positioning is shown in Figure 15. reel Place it in an antistatic bag

Model	A	E	W1	W2	N	Unit	Tolerance	Quantity	Weight
AHT15	330	2	32	36	100	mm	±0.5	2000	about 870g



Model	A	B	ΦD0	K	W	P0	P1	P2	I	F	E
AHT15	6.3±0.1	18.4±0.1	1.5+0.1 0	2.3±0.1	32.0±0.3	4.0±0.1	12.0±0.1	2.0±0.1	0.3±0.05	14.2±0.1	1.75±0.1

Figure 15 Packaging Tape and Sensor Location Map

Version Information

date	version	pages	Change
2018/11	V1.0	1-9	Initial
2019/07	V1.0-en	1-12	Unofficial English (machine) translation

Precautions

Warning, personal injury

Do not apply this product to safety devices or emergency stop devices. And, as a result of the malfunction of this product, personal injury may result. Any other application. Do not apply this product unless Special purpose or use authorization. In installation, processing, Before using or maintaining this product, please refer to the product data sheet and Use the guide. Failure to follow this advice may result in death and Serious personal injury. The technical specifications are standard. If during the warranty period, the product is Confirmed to be defective, the company will provide free repair or change. The user must meet the following conditions: The product is notified to the company in writing within 14 days of the discovery of the defect; This product defect helps to discover the company's design and materials. Insufficient materials and processes; The product should be returned to the company by the purchaser; This product should be in the warranty period. The company only applies those that meet the technical conditions of the product. The product that is defective in the occasion is responsible. The company's products Applications do not guarantee any special applications, A guarantee or a written statement. At the same time, the company applies its products to products or circuits. Reliability does not make any promises.

ESD protection

Due to the inherent design of the component, its sensitivity to static electricity Sensual. To prevent damage from static electricity or to reduce production Product performance, please take necessary when applying this product Anti-static measures.

Quality Assurance

The company provides a direct purchaser for its products for a period of 12 Monthly (1 year) quality assurance (from the date of shipment) 算), in the data sheet of the product published by Ozon If the buyer is going to buy or use Ozon's product, To obtain any application license and authorization, the buyer will bear All compensation for personal injury and death resulting from this, and And exempted from the Ozon company managers and employees as well Subsidiaries, agents, distributors, etc. may be produced Any claim, including: various costs, Compensation fees, lawyer fees, et。

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