AM3510D Technological Manual

Humidity and Temperature Sensors

ASAIR®

- Full range interchangeability
- highly cost effective
- High reliability, long term stability
- Fast response and strong anti-interference ability

PRODUCT OVERVIEW

AM3510D is a calibrated module with integrated output of temperature and humidity. It adopts high-precision and high-reliability temperature and humidity acquisition technology.
Ensures extremely high reliability and excellent long-term stability. The sensor includes a high performance integrated temperature and humidity sensor
The device is connected with a high-performance 8-bit microcontroller. Therefore, this product has excellent quality, super fast response, strong anti-interference ability,
Very high cost performance advantages. The humidity is linear voltage output and the temperature is 10K NTC direct output. AM3510D is easy to use and applicable
Wide range of fields, can be used in high accuracy requirements of the site.

Application Scope

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.

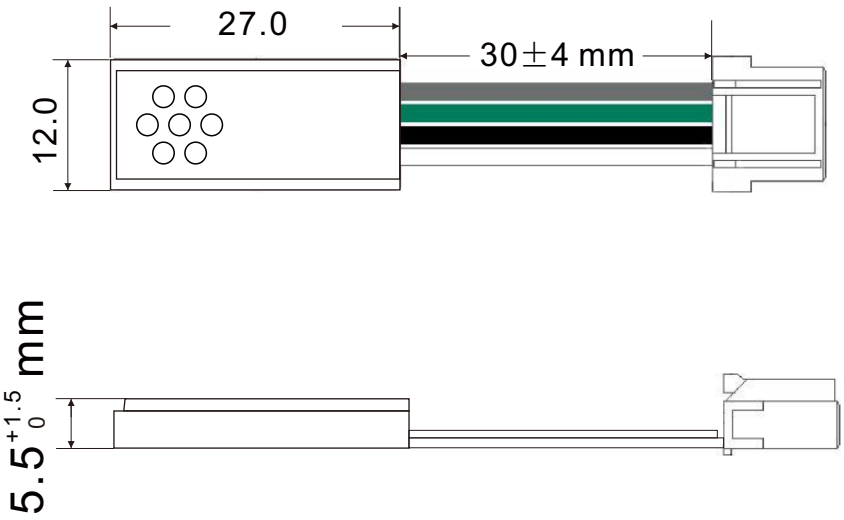


Figure 1: AM3510D Sensor package diagram(unit : mm unspecifed tolerance : 0.2mm)

Sensor Performance

Relative humidity

parameter	Symbol	min	typ	max	unit
Humidity measurement range	RH	0		100	%RH
Relative humidity accuracy (10% RH to 95% RH)			±3	±5	%RH
Average humidity sensitivity	?mV/RH		+26		mV/%RH
Humidity hysteresis			±1		%RH
The response time (63% of signals) 33% RH to 75% RH	τ		5	10	s

Table 1 Humidity characteristic table

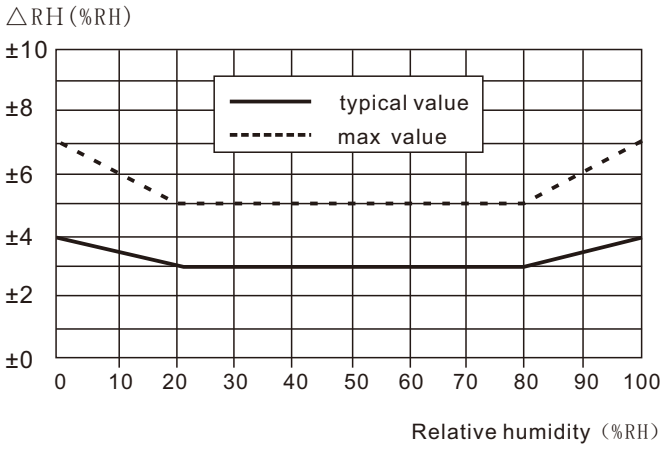


Figure 2 Maximum error of relative humidity at 25℃.

temperature

Temperature measurements are made by direct output of 10K NTC with an accuracy of ±1%.

parameter	symbol	min	typ	max	Unit
temperature coefficient (10℃~50℃)	T_{CC}		0.05	-0.1	%RH/℃
Rated resistance (25℃)	R	9.9	10	10.1	kO
test value：B25/50	B	3346	3380	3414	kO
Temperature measurement range	T_a	-40		80	℃
Tolerance of rated resistance at 25℃	R_n		1		%
B value tolerance	B		1		%
response time	τ		10		S

Table 3 Temperature characteristic table

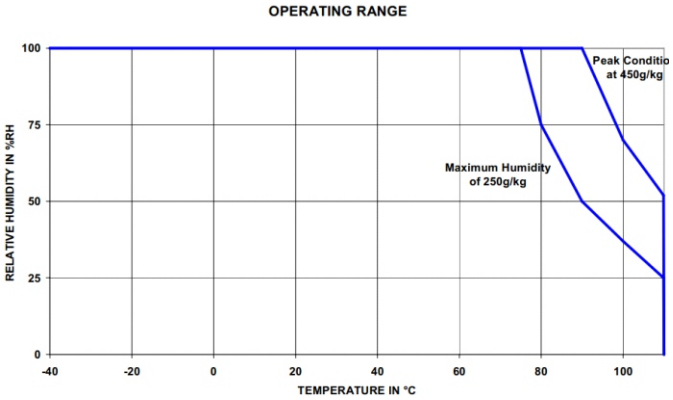


Figure 3 Temperature operating range graph

Electrical Specification

property	Symbol	min	typ	max	Unit
power	P			15	mW
working voltage	V_{CC}	4.75	5	5.5	V_{dc}
nominal output (55%RH)	V_{out}	2.42	2.48	2.54	V
current consumption	I_{CC}		1.5	3	mAdc
output impedance	Z			0.5	O
Sink current capability ($R_{L\ Min}$=8kOhms)	I			1	mA
warm up time	t_w		200		ms

Table 2 Electrical characteristics.

AM3510D User Guide

1 Expansion Performance

1. 1 Working Conditions

The sensor has stable performance within the recommended working range, as shown in Figure 3. Long-term exposure to conditions outside the normal range, especially when the humidity is> 80%, may cause temporary signal drift (drift + 3% RH after 60 hours). After returning to normal working conditions, the sensor will slowly self-recover to the calibration state. Please refer to section 2.2 "Recovery Processing" to speed up the recovery process. Long-term use under abnormal conditions will accelerate the aging of the product.

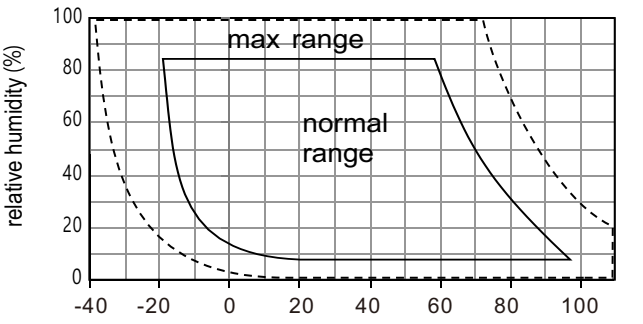


Figure 3 Working condition

1. 2 RH accuracy at different temperatures

The RH accuracy at 25℃ is defined in Figure 2 and shown in Figure 4 Typical humidity error in other temperature segments

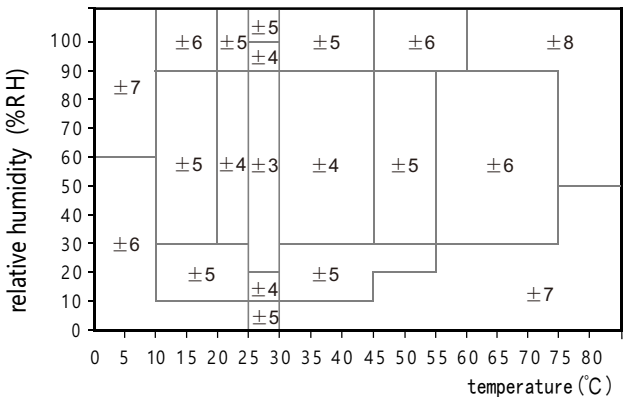


Figure 4 0~80°C Typical humidity error within the range, unit:(%RH)

Please note: the above error is measured by a high precision dew point meter Typical error (excluding hysteresis).

2 Application Message

2.1 Storage Conditions And Instructions

Humidity sensitivity grade (MSL) is 1, according to IPC/JEDEC J-STD-020 standard. Therefore, it is recommended to use within one year after shipment.

Temperature and humidity sensors are not ordinary electronic components, need to be carefully protected, this point users must pay attention to. Prolonged exposure to high levels of chemical vapor will cause the sensor readings to drift. Therefore, it is recommended to store the sensor in the original package including sealed ESD pocket, and meet the following conditions: temperature range of 10℃-50℃(0-85℃ in limited time); Humidity is 20-60%RH (no ESD encapsulated sensor). For sensors that have been removed from their original packaging, we recommend storing them in an anti-static bag made of metal PET/AL/CPE.

During production and transportation, the sensor should avoid exposure to high concentrations of chemical solvents and prolonged exposure. Avoid contact with volatile glues, tapes, stickers or volatile packaging materials, such as foils and foams. The production area should be well ventilated.

2. 2 Recovery Processing

As mentioned above, if the sensor is exposed to extreme working conditions or chemical vapor, the readings will drift. It can be restored to the calibration state by the following treatment. Drying: Keep for 10 hours under the humidity of 80-85℃ and <5%RH; Rehydration: maintained at 20-30℃ and >75%RH for 12 hours 6.

2.3 Temperature Influence

The relative humidity of a gas depends largely on the temperature. Therefore, when measuring humidity, it is necessary to ensure that all sensors measuring the same humidity work at the same temperature. When doing a test, make sure the sensor being tested is at the same temperature as the reference sensor, and then compare the humidity readings.

In addition, when the measurement frequency is too high, the sensor's own temperature will rise and affect the measurement accuracy. To keep its own temperature rise below 0.1℃, the activation time of AM3510D should not exceed 10% of the measurement time -- it is recommended to measure the data every 2 seconds.

6 75%RH can be easily produced from saturated NaCl.

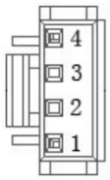
2. 4 Materials used for sealing and sealing

Many materials absorb moisture and will act as buffers, increasing response times and latency. Therefore, the material around the sensor should be carefully selected. Recommended materials are: metallic materials, LCP, POM (Delrin),PTFE (Teflon), PE, PEEK, PP, PB, PPS, PSU, PVDF,PVF. Materials for sealing and bonding(conservative recommendation) : Encapsulation of electronic components using epoxy resin or silicone is recommended. Gases released by these materials may also contaminate AM3510D(see 2.1). Therefore, the sensor should be finally assembled and placed in a well-ventilated place or dried for 24 hours in an environment of >50℃ so that it can release the contaminated gas before packaging.

3 Interface Definition

Table 4 Interface definition description

Pin	Color	Name	Describe
1	White	GND	Power Ground
2	Black	VCC	power supply voltage
3	Green	Tout	temperature (NTC)
4	Grey	Hout	humidity
Note: The other end of NTC is grounded			



3. 1 Power Pins（VDD GND）

The supply voltage of this module is 4.75V~5.5V, and 5.0V is recommended.

3. 2 Humidity Output signal line (Hout)

The humidity signal is output from the signal line in the form of voltage, and the voltage output range is 1~3.6V. For the specific relationship between humidity and voltage, please refer to the voltage and humidity characteristics table (Table 5).

3. 3 Temperature Output line (Tout)

The temperature output is directly produced by a 10K NTC thermistor with an accuracy of 1%.

4 Electrical Specification

Electrical characteristics, such as energy consumption, input and output voltages, depend on the power supply. The electrical characteristics of the sensor are described in detail in Table 2. If not indicated, the supply voltage is 5V. For the best effect with the sensor, please design strictly in accordance with the conditions in Table 2.

4. 1 Standard Humidity Output Voltage

Humidity is output through linear 1~3.6V DC voltage signal
(Conditions: AT25 ℃,Vin=5.0V)

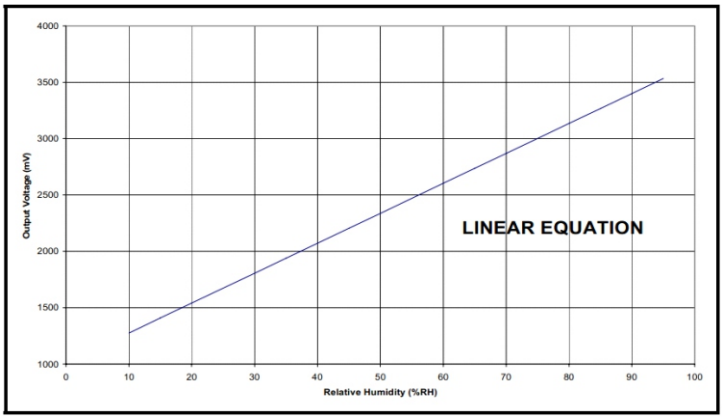


Figure 5: Linear curve of VOLTAGE output and humidity at AM3510D

Table 5: AM3510D standard humidity output voltage corresponding table

RH(%)	Vout(mV)	RH(%)	Vout(mV)
10	1294	55	2475
15	1425	60	2606
20	1557	65	2737
25	1688	70	2868
30	1819	75	2999
35	1950	80	3130
40	2081	85	3262
45	2212	90	3393
50	2344	95	3524

4.2 Calculation method of humidity and output voltage

system of linear equations:
Vout=26.23RH+1032
RH=0.03812V-39.36
Unit of V: mV
Unit of RH: %

4. 3 Typical Temperature Output

According to the required temperature measurement range and relative accuracy, two methods are recommended to obtain the NTC resistance value:

$$①R_T=R_N*e^{\beta(\frac{1}{T}-\frac{1}{T_N})}$$

among: R_TNTC unit : Ω
Temperature(T) unit:K
R_NNTC unit: Ω
Rated temperature（T） unit:K
T, T_N The unit of temperature are K
β:Special constants of NTC materials (expressed as a K)
e:Natural log base e(e=2.71828)

The exponential relation can only describe the actual characteristics of a NTC thermistor roughly. The value of material parameter β also depends on the temperature in practical application, so this method is only suitable for describing the accuracy within the limits of rated temperature or resistance. The actual value of NTC may be influenced by the inherent self-heating performance.

In practical application, a R/T curve is needed to explain in detail. The resistance/temperature relationship is given in a more complex method (such as the Stanhart-Hart formula) or in a tabular form. The following table shows the data obtained by experiments with 1% RH accuracy and temperature increase.

5 Environmental Stability

If the sensor is used in equipment or machinery, make sure that the sensor used for measurement and the sensor used for reference sense the same temperature and humidity. If the sensor is placed in the equipment, the reaction time will be prolonged, so ensure that sufficient measurement time is reserved in the program design. The AM3510D sensor is tested according to the Aosong temperature and humidity sensor corporate standard. The performance of the sensor under other test conditions is not guaranteed and cannot be used as part of the sensor's performance. Especially for specific occasions required by users, no promise is made.

6 Package

6. 1 Trace Information

All AM3510D sensors have a laser identification on the back, as shown in Figure 7.

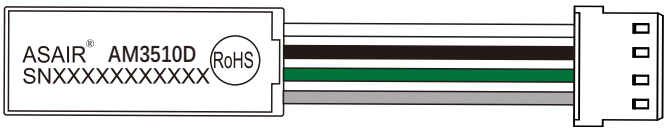


Figure 6 Sensor laser identification

The antistatic bag also has a label on the surface, as shown in Figure 8, and provides additional tracking information.

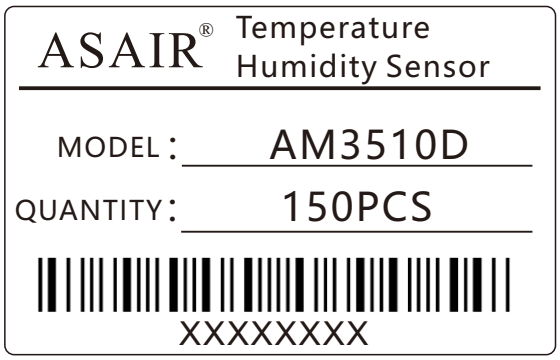


Figure 7 The label on the antistatic bag

7. 2 Transport Package

The AM3510D is packed in anti-static bags, each of the 10 sensors is bundled with straps, each of the bags is packed with 15 bundles, and each of the 4 bags of sensors is placed in the carton, with a total of 600 sensors.

Attention

Warning personal injury

Do not use this product in safety protection devices or emergency stop devices or in any other applications where failure of the product may cause personal injury. This product shall not be used except for special purposes or with authorization. Refer to the product data sheet and application guidelines before installing, handling, using, or maintaining the product. Failure to follow this advice may result in death and serious bodily injury.

If the buyer will buy or use the product without any application permission and authorization, the buyer will bear the resulting all the compensation of personal injury and death, and thus to the company managers and employees, affiliates, agents and distributors of any claim, including: all kinds of costs, damages, attorney fees, etc

ESD Protection

Due to the inherent design of the element, it is sensitive to static electricity. In order to prevent the damage caused by the introduction of static electricity or reduce the performance of the product, please take necessary anti-static measures when applying the product.

Quality Assurance

The Company guarantees the quality of its products to direct buyers for a period of 12 months (1 year) from the date of shipment based on the technical specifications in the Product datasheet published by Aosong.If the product is proved to be defective within the warranty period, the company will provide free repair or replacement. The user shall satisfy the following conditions:

- Notify the Company in writing within 14 days upon discovery of the defect;
- The defects of this product are helpful to the discovery of our design and materials Defects in material and technology;
- The product shall be returned to us at buyer's expense;
- The product should be within its warranty period.

The Company is only responsible for the defects of the products when they are applied in accordance with the technical conditions of the products. The Company makes no warranties, warranties or written representations as to the use of its products in those specific applications. At the same time, the company does not make any commitment to the reliability of its products into products or circuits.

Attached NTC 10K resistance-temperature characteristics table

TEMP. (deg.C)	R-low (k ohm)	R-center (k ohm)	R-high (k ohm)	TEMP. (deg.C)	R-low (k ohm)	R-center (k ohm)	R-high (k ohm)
-40	188.0202	195.6520	203.5731	0	26.6780	27.2186	27.7675
-39	177.8044	184.9171	192.2951	1	25.5690	26.0760	26.5904
-38	168.2141	174.8452	181.7195	2	24.5123	24.9877	25.4698
-37	159.2069	165.3910	171.7981	3	23.5052	23.9509	24.4026
-36	150.7435	156.5125	162.4860	4	22.5450	22.9629	23.3861
-35	142.7877	148.1710	153.7418	5	21.6294	22.0211	22.4175
-34	135.3055	140.3304	145.5274	6	20.7560	21.1230	21.4944
-33	128.2659	132.9576	137.8071	7	19.9227	20.2666	20.6143
-32	121.6397	126.0215	130.5481	8	19.1273	19.4495	19.7751
-31	115.4001	119.4936	123.7198	9	18.3680	18.6698	18.9745
-30	109.5221	113.3471	117.2940	10	17.6430	17.9255	18.2107
-29	103.9894	107.5649	111.2522	11	16.9494	17.2139	17.4807
-28	98.7725	102.1155	105.5611	12	16.2870	16.5344	16.7840
-27	93.8512	96.9776	100.1981	13	15.6541	15.8856	16.1189
-26	89.2071	92.1315	95.1423	14	15.0493	15.2658	15.4838
-25	84.8227	87.5588	90.3741	15	14.4712	14.6735	14.8772
-24	80.6819	83.2424	85.8755	16	13.9184	14.1075	14.2977
-23	76.7698	79.1663	81.6295	17	13.3898	13.5664	13.7439
-22	73.0722	75.3157	77.6204	18	12.8841	13.0489	13.2145
-21	69.5761	71.6768	73.8336	19	12.4002	12.5540	12.7084
-20	66.2694	68.2367	70.2554	20	11.9371	12.0805	12.2244
-19	63.1477	64.9907	66.8807	21	11.4945	11.6281	11.7621
-18	60.1923	61.9190	63.6889	22	11.0703	11.1947	11.3195
-17	57.3933	59.0113	60.6689	23	10.6637	10.7795	10.8955
-16	54.7415	56.2579	57.8105	24	10.2738	10.3815	10.4892
-15	52.2283	53.6496	55.1040	25	9.9000	10.0000	10.1000
-14	49.8456	51.1779	52.5406	26	9.5343	9.6342	9.7342
-13	47.5859	48.8349	50.1117	27	9.1838	9.2835	9.3833
-12	45.4422	46.6132	47.8097	28	8.8477	8.9470	9.0465
-11	43.4078	44.5058	45.6271	29	8.5254	8.6242	8.7234
-10	41.4765	42.5062	43.5570	30	8.2162	8.3145	8.4132
-9	39.6345	40.5997	41.5843	31	7.9204	8.0181	8.1162
-8	37.8855	38.7905	39.7131	32	7.6367	7.7337	7.8312
-7	36.2244	37.0729	37.9374	33	7.3647	7.4609	7.5576
-6	34.6461	35.4417	36.2519	34	7.1038	7.1991	7.2951
-5	33.1462	33.8922	34.6515	35	6.8534	6.9479	7.0430
-4	31.7202	32.4197	33.1313	36	6.6131	6.7067	6.8009
-3	30.3641	31.0200	31.6869	37	6.3825	6.4751	6.5683
-2	29.0740	29.6890	30.3140	38	6.1611	6.2526	6.3449
-1	27.8465	28.4231	29.0088	39	5.9485	6.0390	6.1302

TEMP. (deg.C)	R-low (k ohm)	R-center (k ohm)	R-high (k ohm)
40	5.7443	5.8336	5.9238
41	5.5474	5.6357	5.7248
42	5.3582	5.4454	5.5333
43	5.1764	5.2623	5.3492
44	5.0015	5.0863	5.1720
45	4.8333	4.9169	5.0015
46	4.6715	4.7539	4.8373
47	4.5159	4.5971	4.6793
48	4.3661	4.4461	4.5271
49	4.2220	4.3008	4.3806
50	4.0833	4.1609	4.2395
51	3.9498	4.0262	4.1036
52	3.8213	3.8964	3.9727
53	3.6975	3.7714	3.8465
54	3.5783	3.6510	3.7249
55	3.4634	3.5350	3.6076
56	3.3527	3.4231	3.4946
57	3.2461	3.3152	3.3856
58	3.1432	3.2113	3.2804
59	3.0441	3.1110	3.1790
60	2.9486	3.0143	3.0812
61	2.8578	2.9224	2.9881
62	2.7703	2.8337	2.8984
63	2.6858	2.7482	2.8118
64	2.6044	2.6657	2.7282
65	2.5259	2.5861	2.6476
66	2.4501	2.5093	2.5697
67	2.3770	2.4351	2.4945
68	2.3064	2.3635	2.4218
69	2.2382	2.2943	2.3517
70	2.1724	2.2275	2.2839
71	2.1086	2.1627	2.2181
72	2.0469	2.1001	2.1545
73	1.9873	2.0396	2.0930
74	1.9298	1.9811	2.0335
75	1.8741	1.9245	1.9761
76	1.8204	1.8698	1.9205
77	1.7684	1.8170	1.8667
78	1.7181	1.7658	1.8147
79	1.6695	1.7164	1.7644
80	1.6225	1.6685	1.7157