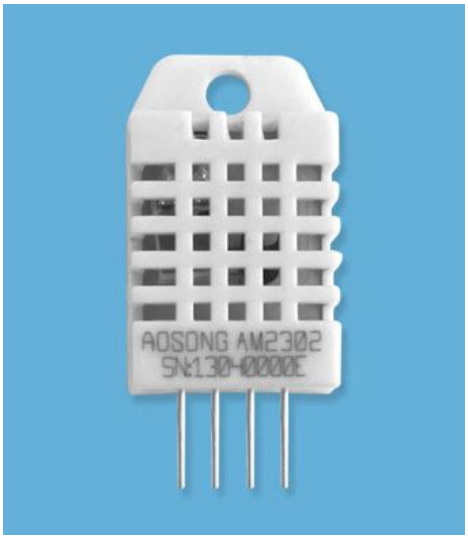
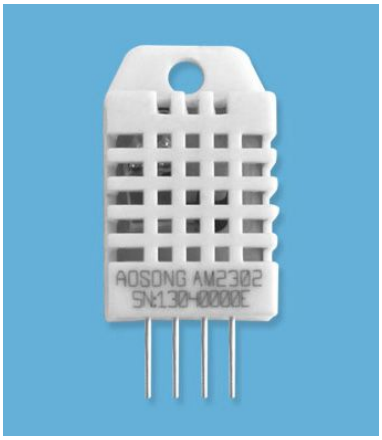
Temperature and Humidity Module
AM2302 Product Manual

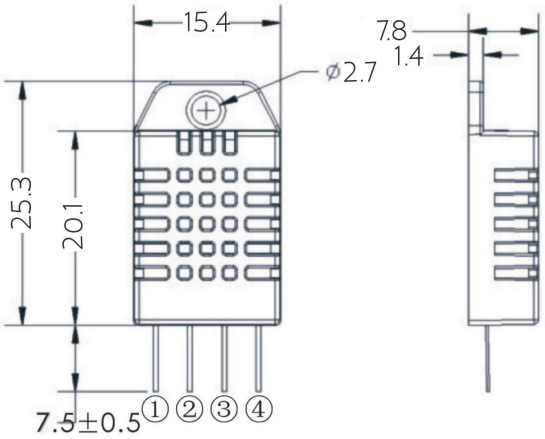


1. Product Overview

AM2302 Humidity-sensitive capacitance digital temperature and humidity module is a digital output signal containing a calibrated temperature and humidity combined sensor. It uses a dedicated digital modules capture technology and the 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 precision 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 easy and quick. Ultra-small size, low power consumption, signal transmission distance up to 20 meters, making it the best choice for all kinds of applications and even the most demanding applications. For the convenience of three lead products (single bus interface) connection. Special packages according to user needs and provide.



Physical map



Dimensions（unit：mm）

2. Applications

HVAC, dehumidifiers, testing and inspection equipment, consumer goods, automotive, automation, data loggers, home appliances, humidity regulator, medical, weather stations, and other related humidity measurement and control, etc.

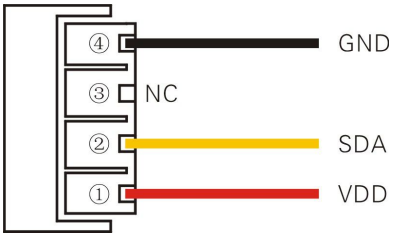
3. Product Highlights

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 AM2302 pin assignment

Table 1: AM2302 pin assignment



Pin	Name	description
①	VDD	Power supply (3.3V-5.5V)
②	SDA	Serial data, bidirectional port
③	NC	NC
④	GND	Ground

Figure 1: AM2302 Pin Assignment

4.2 Pin Description（VDD SDA GND）

AM2302 supply voltage range of 3.3V - 5.5V, recommended supply voltage of 5V.

Data line SDA pin is tri-state structure, the sensor for reading and writing data. See detailed description of a single bus communication protocol.

5. Sensor Performance

5.1 Relative Humidity

Table 2: AM2302 relative humidity Performance Table

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

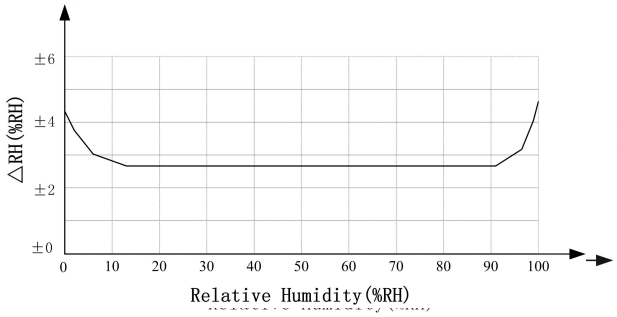


Figure 2: 25 ℃ relative humidity of maximum error AM2302

5.2 Relative Temperature

Table 3: AM2302 relative temperature performance table

Parameter	Condition	min	typ	max	Unit
Resolution			0.1		℃
			16		bit
Accuracy			±0.5	±1	℃
Range		-40		80	℃
Repeatability			±0.2		℃
Interchangeability		Completely interchangeable			
Response time	1/e (63%)		<10		S
Drift			±0.3		℃/yr

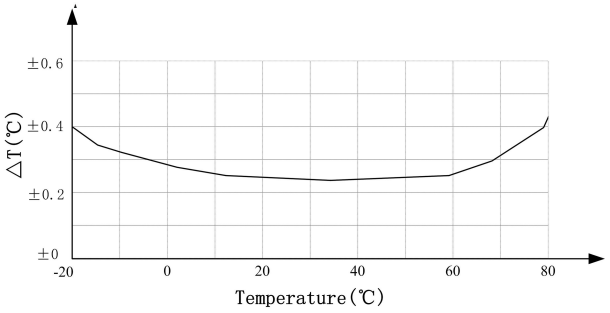


Figure 3: The maximum error of the temperature sensor

6. Electrical Characteristics

Electrical characteristics such as energy consumption, high, low, input and output voltage, etc. depending on the power supply. Table 4 details the AM2302 electrical characteristics, if not marked, it means that the power supply voltage is 5V. To get the best results with the sensor, in strict compliance with the conditions when you design tables 4 design.

Table 3: AM2302 DC characteristics

Parameter	Condition	min	typ	max	Unit
Supply Voltage		3.3	5	5.5	V
Power Consumption [4]	Dormancy	10	15		μA
	Measure		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 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] This accuracy is factory inspection, precision index sensor at 25 ℃ and 5V, test conditions, which does not include hysteresis and non-linearity, and only suitable for non-condensing environment.

[2] at 25 ℃ and 1m / s airflow conditions, reaching 63% of the first-order response time required.

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

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

[5] Low-level output current.

[6] Said pull-up resistor

7. Single bus communication（ONE-WIRE）

7.1 A typical single-bus circuit

Connection with the AM2302 microprocessor typical application circuit shown in Figure 4. When single-bus communication mode, after pulling the SDA microprocessor I / O ports are connected.

Single bus communication Special Instructions:

1. A typical application circuit recommended cable length shorter than 30 meters with a 5.1K pull-up resistor when greater than 30 meters when the pull-up resistor to reduce 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 of the read sensor 2S; reading interval is less than 2S, temperature and humidity might result in denial or communication is unsuccessful and so on.

4. Temperature and humidity values are read out every last measurement result, want to get real-time data, the need to continuously read twice, Repeatedly suggested reading sensor, and each sensor reading interval greater than 2 seconds to obtain accurate data.

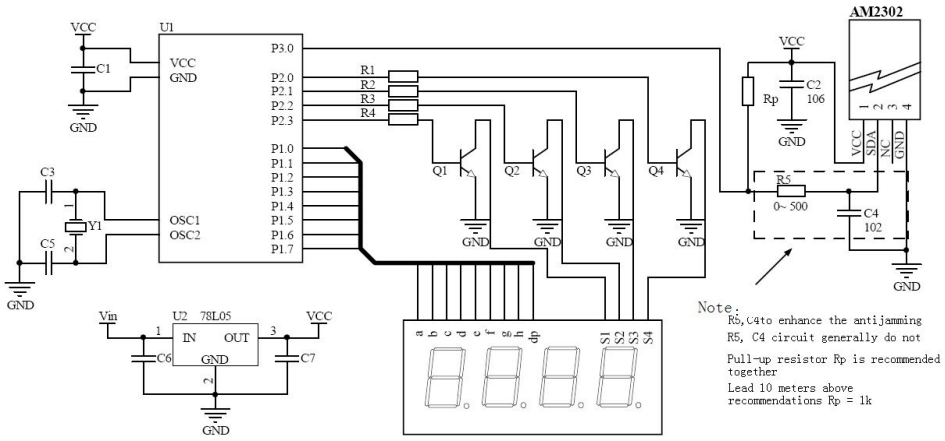


Figure 4: AM2302 single bus typical circuit

7.2 Single bus communication protocol

◎Single Bus Description

AM2302 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 is connected to the data line to allow the device when not transmitting data to release the bus, and let other devices use the bus; single bus usually requires an external 5.1kΩ of approximately pull-up resistors, so that when the bus is idle, the state is high. Because they are master-slave structure, only when the host calls the sensor, the sensor will be answered, so the host access to the sensor must strictly follow the sequence of a single bus, if there is a sequence of confusion, the sensor will not respond to the host.

◎Single bus transfer data definitions

SDA and AM2302 microprocessors for communication and synchronization between using single bus data format, a 40-bit data transfer, high first-out. , The communication format specific communication sequence shown in Figure 5 are shown in Table 5.

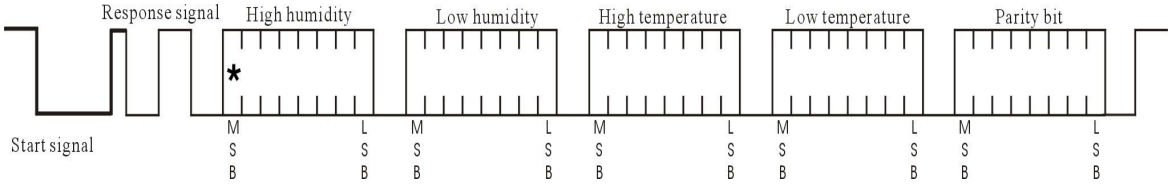


Figure 5: AM2302 single bus communication protocol

Table 5: AM2302 communication format

Name	Single bus format definition
Start signal	The microprocessor data bus (SDA) low period (at least 800μs) [1], to prepare the data notification sensor。
Response signal	Sensor data bus (SDA) low 80μs, 80μs followed by a high signal in response to the initial host。
Data Format	Upon receipt of the host start signal from the data bus disposable sensor (SDA) string of 40-bit 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 value; Temperature highest bit (Bit15) is equal to 1 indicates a negative temperature, the temperature highest bit (Bit15) is equal to 0 indicates a positive temperature; In addition to the temperature of the highest bit (Bit14 ~ Bit0) indicates the temperature value.
Parity bit	Parity bit = humidity high temperature + humidity + high + low temperature low

◎**Single bus data sample calculation**

Example 1: 40 of the received data:

0000 0010 1001 0010 0000 0001 0000 1101

High humidity 8 Low humidity 8 High temperature 8 High temperature 8

1010 0010

Parity bit

Calculated as follows:

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

Receive data is correct：

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 for a top position。

Example：-10.1 ℃ expressed as 1,000,000,001,100,101

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

=> temperature＝ -10.1℃

Example Two：40 receives the data to:

0000 0010 1001 0010 0000 0001 0000 1101 1011 0010

High humidity 8 Low humidity 8 High temperature 8 Low temperature 8 Parity bit

Calculated as follows:

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

Host (MCU) sends a start signal (data bus SDA low for at least 800μs) After, AM2302 transition from sleep mode to high-speed mode. After completion, the master start signal, AM2302 transmit a response signal, the data sent from the data bus 40Bit SDA serial high byte is transmitted first; data is sequentially transmitted high humidity, low humidity, high temperature, low temperature, the parity bit , sent a message to trigger the end of data collection, collecting sensor automatically transferred to the end of the 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.

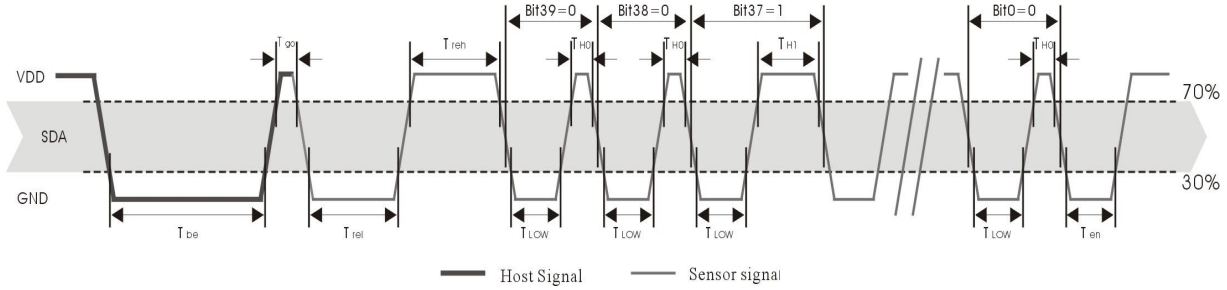


Figure 6: AM2302 single bus communication timing

Note: The host reads temperature and humidity data from AM2302 always previous measurements, such as the long time interval between two measurements, please read twice in a row is the second time the temperature and humidity values in real time, while two read take a minimum interval 2S.

Table 6: Single-bus signal characteristics

Symbol	Parameter	min	typ	max	Unit
T_{be}	Host starting signal low time	0.8	1	20	M S
T_{go}	Host Bus release time	20	30	200	μS
T_{rel}	Response time low	75	80	85	μS
T_{reh}	Response time low	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}	Sensor releases the bus time	45	50	55	μS

NOTE: To ensure accurate communication of the sensor, the user in the read signal, in **s**trict 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.

Step 1:

AM2302 after power (power after AM2302 2S to wait to cross the unstable state, during the reading device can not send any commands), test environment temperature and humidity data, and record the data, then the sensor automatically transferred to a dormant state. AM2302 the SDA line is pulled high by a pull-up resistor remains high, then the AM2302 SDA pin is in the input state, always detect external signals。

Step 2:

Microprocessor I / O is set to output, while the output low and low retention time can not be less than 800us, typical values are pulled 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 data lines that AM2302 the SDA also will go high, and so the host releases the bus, AM2302 sends a response signal, the output low as 80 microseconds response signal, followed by 80 microsecond high output peripheral is ready to receive data notification, the signal transmitter shown in Figure 7:

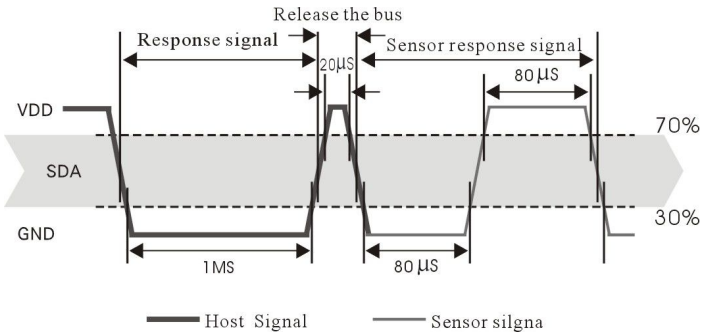


Figure 7: Timing diagram single bus exploded

Step 3:

AM2302 After sending the response, followed by a continuous serial data bus SDA data output 40, the microprocessor 40 receives the data according to I / O level changes.

Bit data "0" in the form: low high 50 microseconds plus 26-28 microseconds;

Bit data "1" format: LOW HIGH plus 70 microseconds 50 microseconds;

1" bit data format as shown in the signal is "0", 8 bit data:

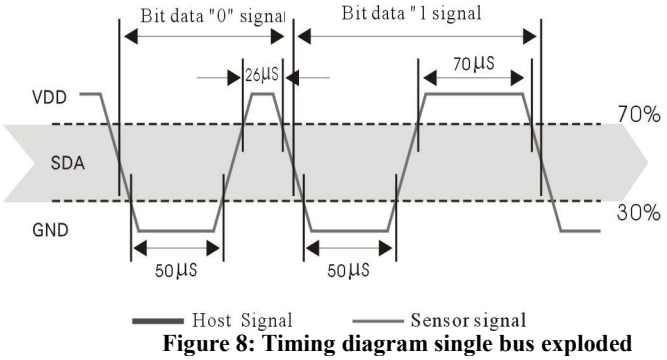


Figure 8: Timing diagram single bus exploded

AM2302 SDA data output 40-bit data bus, the continued output low 50 microseconds after the entry into the state, due to the pull-up resistor attendant goes high. Meanwhile AM2302 retest internal temperature and humidity data, and record data, test recording ends, the microcontroller automatically goes to sleep. Only after receipt of the start signal microcontroller host, only to re-awaken the sensor into working condition.

7.5 Peripheral read flowchart

AM2302 sensor reads a single bus flowchart diagram shown in Figure 9, we also provide sample code reads C51, need to download the client, please visit our website (www.aosong.com) associated download, this manual does not provide code Description.

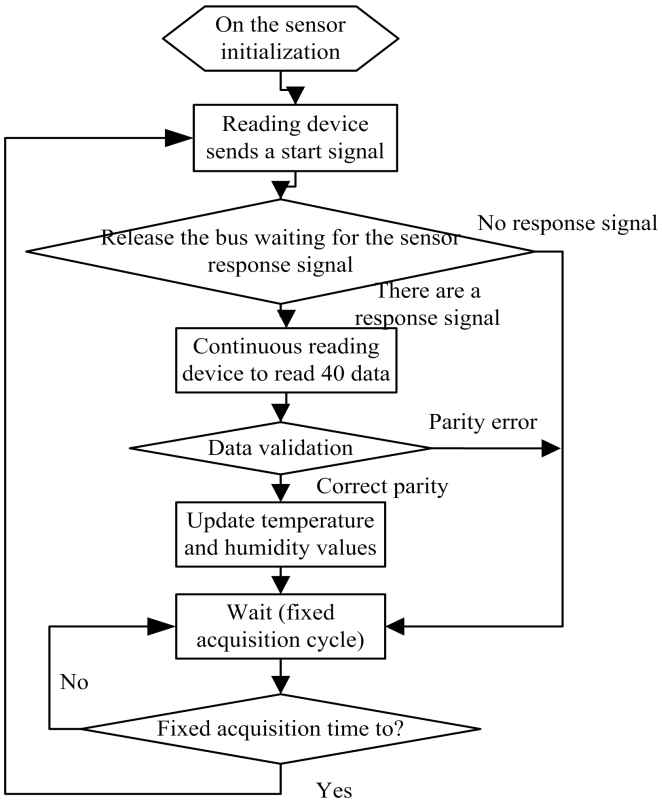


Figure 9: Single-bus read flowchart

8. Application Information

1. Working and storage conditions

The proposed scope of work beyond the sensor may cause 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, will accelerate the aging of the product.

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

A. Smoke

B. The acid or oxidizing gases such as sulfur dioxide, hydrochloric acid

Recommended Storage Environment

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

1. The influence of exposure to chemical substances

Capacitive humidity sensor sensing layer will be disturbed chemical vapors, chemical diffusion layer in the sensor may cause drift and measurement sensitivity. In a clean environment, slowly release contaminants out. The recovery process described below to accelerate the process. High concentrations of chemical contamination (such as ethanol) can cause damage to the sensor sensing Layer completely.

3. Temperature effects

Relative humidity of the gas, is largely dependent on temperature. Therefore, when measuring

the humidity should be possible to ensure that the humidity sensor works at the same temperature. If you share a printed circuit board with electronic components heat released in the sensor should be installed as far as possible away from the electronic components, and installed at the bottom of the heat source, while maintaining a well-ventilated enclosure. To reduce the thermal conductivity, the other part of the copper plating layer of the sensor and the printed circuit board should be as minimal as possible and leave a gap between them.

4. Light effects

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

5. The recovery processing

Placed under extreme operating conditions or chemical vapor sensors, through the following process, you can return it to the state calibration. <2 hours (drying) under 10% RH humidity conditions; then at 20-30 ℃ and> 45 ℃ and humidity under 70% RH conditions were maintained for more than 5 hours.

6. Wiring Precautions

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

7. Welding information

Manual welding, at a temperature of 300 ℃ maximum contact time must be less than 3 seconds.

8. Product upgrades

For details, please consult Aosong electronics sectors.

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The company offers a three-month quality assurance (calculated from the date of shipment from) their direct purchasers of the product. Data sheet of the company published the technical specifications of the product shall prevail. If during the warranty period, the product was confirmed by mass indeed flawed, the company will provide free repair or replacement. Users must satisfy the

following conditions:

① The product is found defective within 14 days written notice to the Company;

② The product shall be paid back to the company by mail;

③ The shelf life of the product should be.

The company only to those used in compliance with the technical condition and defects of products is responsible for. Company for its products used in those special applications without any warranty, guarantee or written statement. The company applied to the product or its products reliability of the circuit does not make any promises.