Temperature and Humidity Sensor Module

(Model: ZS21)

Manual

Version: V1.2

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Zhengzhou Winsen Electronics Technology Co., Ltd

Statement

Thanks for purchasing our product. In order to let customers use it better and reduce the faults caused by misuse, please read the manual carefully and operate it correctly in accordance with the instructions. If users disobey the terms or remove, disassemble, change the components inside of the sensor, we shall not be responsible for the loss.

The specific such as color, appearance, sizes &etc, please in kind prevail.

We are devoting ourselves to products development and technical innovation, so we reserve the right to improve the products without notice. Please confirm it is the valid version before using this manual. At the same time, users' comments on optimized using way are welcome.

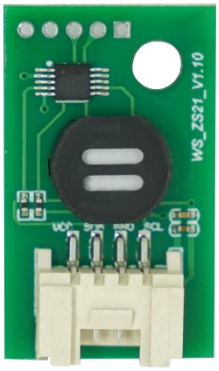
Please keep the manual properly, in order to get help if you have questions during the usage in the future.

Zhengzhou Winsen Electronics Technology CO., LTD

ZS21 Temperature and Humidity Sensor Module

1.Overview

ZS21 is a brand new product equipped with a dedicated ASIC sensor chip, a high-performance semiconductor silicon-based capacitive humidity sensor and a standard on-chip temperature sensor, and is connected with a high-performance 8-bit microcontroller to output standard I2C data signals. At the same time, each sensor is calibrated in a high-precision temperature and humidity verification box, so the product has good consistency; ZS21 products use special humidity-sensitive materials, so that their performance is extremely stable in high-temperature and high-humidity environments. It has the advantages of fast response, strong anti-interference ability, and high cost performance.



Features

- Fully calibrated
- Wide power supply voltage range, from 2.2V to 5.5V
- Digital output, standard I^2C signal
- Quick response and strong anti-interference ability
- Excellent long-term stability under high humidity condition
- Low power consumption and high precision

Application

Home appliance fields: home appliance, humidity control, HVAC, dehumidifiers, smart thermostats, and room monitors ;Industrial fields: automobiles, testing equipment, and automatic control devices; Other fields: data loggers, weather stations, medical and other related temperature and humidity detection devices.

2.Technical specifications

2.1 relative humidity

Parameter	Condition	Min	Typical	Max	Unit
Resolution	Typical	-	0.024	-	%RH
Accuracy error[1]	Typical	-	±3	Refer to Figure 1	%RH
Repeatable	-	-	±0.1	-	%RH
Hysteresis	-	-	±1	-	%RH
Non-linear	-	-	<0.1	-	%RH
Response time[2]	τ63 %	-	<8	-	s
Scope of work[3]	-	0	-	100	%RH
Prolonged Drift[4]	Normal	-	< 1	-	%RH/yr

Table 1

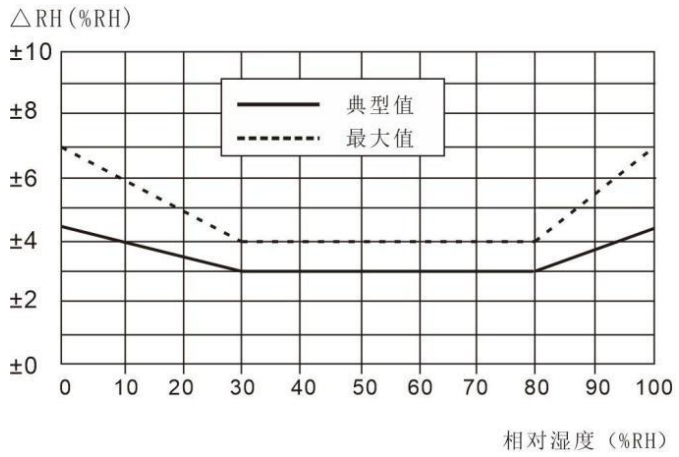


Fig 1 Maximum error of relative humidity at 25°C

2.2 Temperature

Parameter	Condition	Min	Typical	Max	Unit
Resolution	Typical	-	0.01	-	°C
Accuracy error[5]	Typical	-	±0.5	-	°C
	Max	See figure 2			-
Repeatable	-	-	±0.1	-	°C
Hysteresis	-	-	±0.1	-	°C
Response time[6]	τ63%	5	-	30	s
Scope of work	-	-40	-	85	°C
Prolonged Drift	-	-	<0.04	-	°C/yr

Table 2

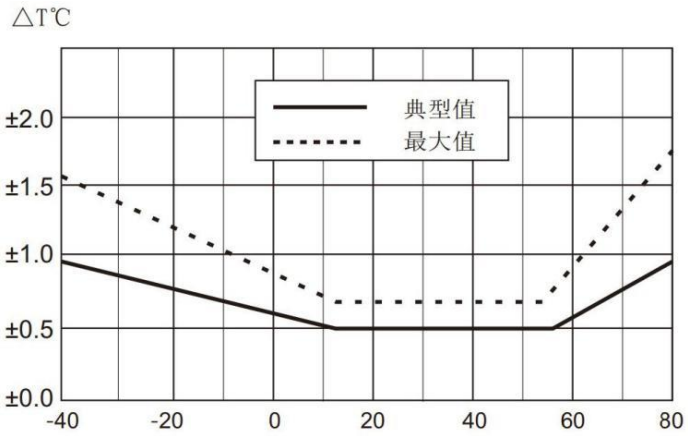


Fig 2 Temperature typical error and maximum error

2.3 Electrical characteristics

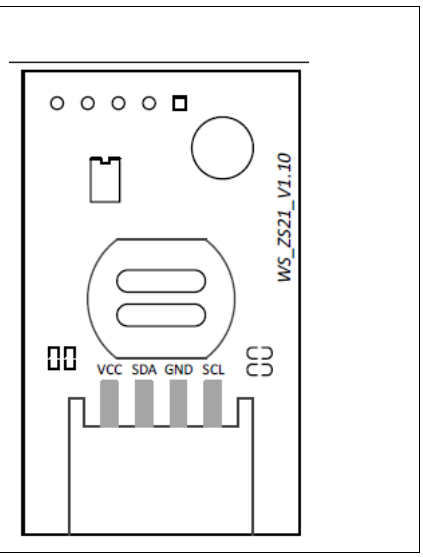
Parameter	Condition	Min	Typical	Max	Unit
Power Supply	Typical	2.2	5	5.5	V
Power Supply, IDD[7]	Measure	-	-	2.5	mA
Low level input voltage	decline	0	-	30%	VDD
High level input voltage	rise	60%	-	100%	VDD
Sampling period	1 second				
Communication Format	I^2C				

Table 3

1. This accuracy is the testing accuracy of the sensor under the condition of 25 ℃ power &supply voltage of 3.3V during delivery inspection. This value excludes hysteresis and nonlinearity and applies only to non condensing conditions.
2 the time required to reach 63% of the first-order response at 25 ℃ and 1m/s air flow.
3. Normal working range: 0-80% RH. Beyond this range, the sensor reading will deviate (after 200 hours under 90% RH humidity, it will temporarily drift < 3% RH). The working range is further limited to - 40 - 85 ℃.
4. If there are volatile solvents, pungent tapes, adhesives and packaging materials around the sensor, the reading may be offset.
5. The accuracy of the sensor is 25.5 ℃ under the factory power supply 3.3V condition. This value excludes hysteresis and nonlinearity and applies only to non condensing conditions.
6.The response time depends on the thermal conductivity of the sensor substrate.
7. The minimum and maximum supply current are based on VDD = 3.3V and T < 60 ℃.

3 Interface definition table4.

PIN	Name	Definition
1	VCC	Power 2.2-5.5V
2	SDA	Serial data, bidirectional
3	GND	Power -Ground
4	SCL	Serial clock, one-way



4.Sensor communication

ZS21 sensor adopts standard I2C communication protocol, which is suitable for a variety of devices. The protocol uses two data lines: serial data bus (SDA) and serial clock bus (SCL). The resistance is generally 4~10 kΩ. Multiple sensor devices can share the bus; however only one host device can be present on the bus, the sensor I2C address is 0x88.

4.1 I2C Communication Interface Features and Timing

On the I2C bus, the ZS21 sensor supports communication rates up to 400kHz as a slave device. When the host sends a start signal (low level), the sensor starts to communicate, and when the host sends a stop signal (high level), the current communication ends. The start and stop signals are only valid when SCL is low, and SCL remains low for at least 300ms after power-on.

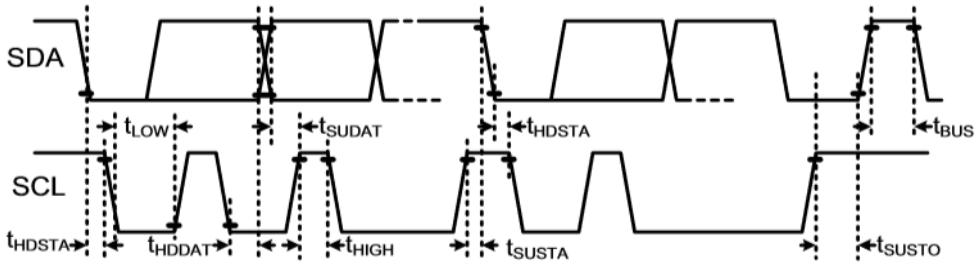


Figure 3 I2C Timing

Parameter	Condition	MIN	TYP	MAX	Unit
I^2C clock frequency	f_{SCL}	20		400	KHz
start signal time	t_{HDSTA}	0.1			μs
SCL Clock high width	t_{HIGH}	0.6			μs
SCL Clock low width	t_{LOW}	0.6			μs
Set time relative to SCL edge start condition	t_{SUSTA}	0.1			μs
Data retention time relative to SCL SDA edge	t_{HDDAT}	0		0.5	μs
Data Setup Time Relative to SCL SDA Edge	t_{SUDAT}	0.1			μs
Set time in SCL stop condition	t_{SUSTO}	0.1			μs
BUS Idle Time Between Stop and Start Condition	t_{BUS}	1			μs

Table 5: I2C parameter

4.2 I²C output

When the host initiates a start signal, and the operation mode of the SCL bus satisfies the above time parameter conditions, the sensor will start communication. Commands or data are always sent when SCL is on the rising edge, until the sensor receives the stop signal sent by the host and ends the communication. .

After the start signal is sent, the host sends an 8-bit read and write command, including the upper 7-bit address, plus the 8th bit of read (1)/write (0), the read and write commands will directly determine the direction of data transmission. When the read command 0X89 is sent, it means that the master reads the slave data. The communication unit of the subsequent sensor reading and writing data includes 8 data bits and 1 response bit. When the response bit is 0 (low level), it is the ACK (data response) of the communication, and when the response bit is 1 (high level) It is NACK (data no response). When the slave receives the ACK signal sent by the master, it will send the next data unit, or when the master sends a stop signal, this communication will be terminated.

- Communication data (information frame) format

Write commands：

Data Format：	I²C address +W	function code
Data Length：	1 byte	2 bytes

Read data：

Data Format：	I²C address +R	temperature data	CRC checksum	Humidity data	CRC Checksum
Data Length：	1 byte	2 bytes	1 byte	2 bytes	1 byte

Communication process：

Send I2C address+W (0x88)——Send 2 bytes of function code (0x21+0x30)——Send I2C address+R——Read 6 bytes of temperature and humidity data

Humidity data format

Temperature High Byte + Temperature Low Byte + Temperature CRC Check + Humidity High Bit + Humidity Low Bit + Humidity CRC Check

- Communication data (information frame) format

I.E：

Temperature：**0110010000100010=6422,** S_T **=100*256+34=25634,** $T[℃] = -45 + 175 \cdot \frac{S_T}{2^{16}-1}$ **=23.4℃**

Humidity：**01011101 10101000=5DA8,** S_{RH} **=93*256+168=23976** $RH = 100 \cdot \frac{S_{RH}}{2^{16}-1}$ **=36.5%RH**

- Check code calculation routine:

//CRC Check type：CRC8/MAXIM
//polynomial：X8+X5+X4+1
//Poly：0011 0001 0x31

```
//Putting the high position in the back becomes 1000 1100 0x8c
//Creal code：
U8 Calc_CRC8(U8 *message,U8 Num)
{
      U8 i;
      U8 byte;
      U8 crc=0xFF;
   for(byte=0; byte<Num; byte++)
   {
      crc^=(message[byte]);
      for(i=8;i>0;--i)
      {
         if(crc&0x80) crc=(crc<<1)^0x31;
         else crc=(crc<<1);
      }
   }
      return crc;
}
```

5 Product Dimension

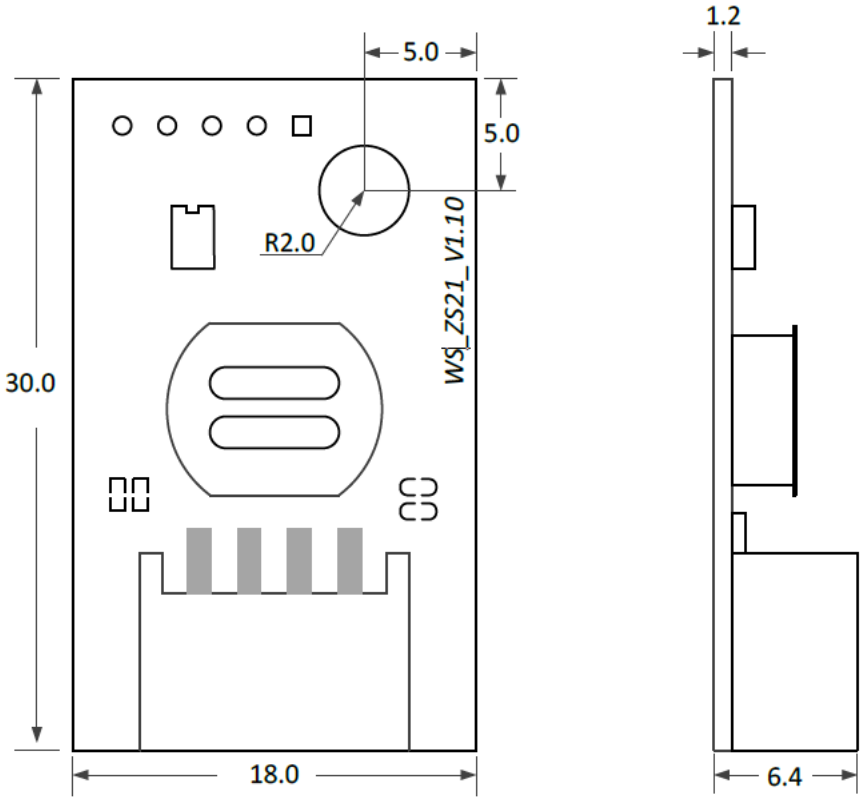


Fig 4 Dimensions（Unit：mm, tolerance ±0.2mm）

6. Performance Supplement

6.1 Suggested working environment

The sensor has stable performance within the recommended operating range, as shown in Figure 5. Prolonged exposure to conditions outside the normal range, especially when the humidity is > 80%, it may cause the signal to drift temporarily (drift +3%RH after 200 hours). After returning to the recommended range environment, the sensor will gradually return to the calibration state. See the "Recovery Processing" section to speed up the recovery process. Long-term use under abnormal conditions will accelerate the aging of the product. In the non-recommended range, it may accelerate the aging of the product.

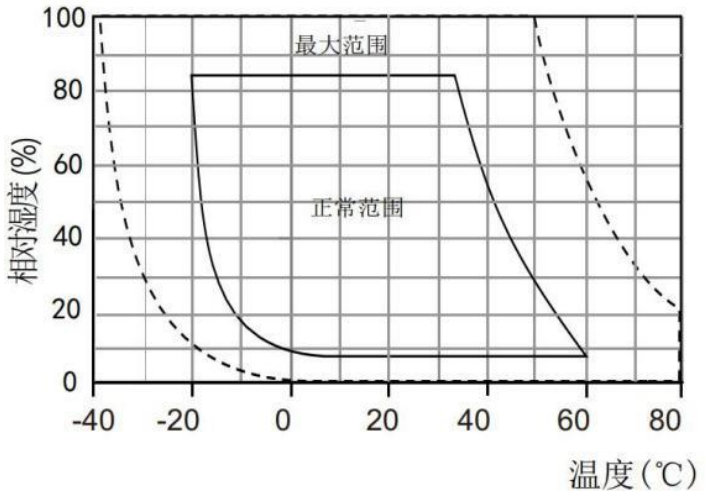


Fig 5 Working scope

6.2 RH accuracy at different temperatures

Figure 1 defines the RH accuracy at 25 ° C, and Figure 6 shows the typical humidity errors for other temperature ranges.

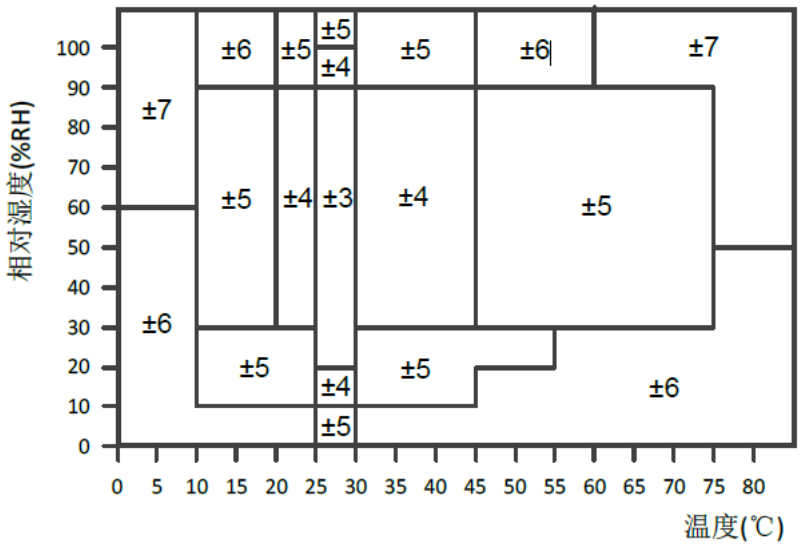


Figure 6 The typical deviation of the humidity in the range of 0-80℃ (unit is %RH)

7.Application guide

7.1 Storage Conditions and Operating instructions

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

Temperature and humidity sensors are not ordinary electronic components and need careful protection, which users must pay attention to. Long term exposure to high concentration of chemical vapor will cause the reading of the sensor to drift. Therefore, it is recommended to store the sensor in the original package, including the sealed ESD pocket, and meet the following conditions: the temperature range is 10 ℃ - 50 ℃ (0-85 ℃ in a limited time); Humidity is 20-60% RH (sensor without ESD package). For those sensors that have been removed from their original packaging, we recommend storing them in antistatic bags made of metal containing PET/AL /CPE materials.

In the process of production and transportation, the sensor should avoid contact with high concentration of chemical solvents and long-term exposure. Avoid contact with volatile glue, tape, stickers or volatile packaging materials, such as foam foil, foam materials, etc. The production area should be well ventilated.

7.2 Recovery Processing

As mentioned above, the readings can drift if the sensor is exposed to extreme operating conditions or chemical vapors. It can be restored to the calibration state by the following processing.

(1) Drying: Keep it at 60-65 ℃ and <5% RH humidity for 6 hours;

(2) Re-hydration: Keep it at 20-30 ℃ and >75% RH humidity for 6 hours.

7.3 Temperature Effect

The relative humidity of gases depends largely on temperature. Therefore, when measuring humidity, all sensors measuring the same humidity should work at the same temperature as possible. When testing, it is necessary to ensure that the same temperature, and then compare the humidity readings.

High measurement frequency will also affect the measurement accuracy, because the temperature of the sensor itself will increase as the measurement frequency increases. To ensure that its own temperature rise is below 0.1°C, the activation time of ZS21 should not exceed 10% of the measurement time. It is recommended to measure the data every 2 seconds.

7.4 Materials for sealing and encapsulation

Many materials absorb moisture and will act as a buffer, which increases response time and hysteresis. Therefore, the material of the surrounding sensor should be selected carefully. Recommended materials are: metal materials, LCP, POM (Delrin), PTFE (Teflon), PE, peek, PP, Pb, PPS, PSU, PVDF, PVF.

Materials for sealing and bonding (conservative recommendation): it is recommended to use the method filled with epoxy resin for the packaging of electronic components, or silicone resin. Gases released from these materials may also contaminate ZS21 (see 2.2). Therefore, the sensor should be finally assembled and placed in a well ventilated place, or dried in an environment of > 50 ℃ for 24 hours, so that it can release the polluting gas before packaging.

8.Cuation

8.1 Warning, Personal Injury

Do not apply this product to safety protection devices or emergency stop equipment, and any other applications that may cause personal injury due to the product's failure. Do not use this product unless there is a special purpose or use authorization. Refer to the product data sheet and application guide before installing, handling, using or maintaining the product. Failure to follow this recommendation may result in death and serious personal injury.

If the buyer intends to purchase or use Winsen's products without obtaining any application licenses and authorizations, the buyer will bear all the compensation for personal injury and death arising therefrom, and exempt Winsen's managers and employees and affiliated subsidiaries from this , Agents, distributors, etc. may incur any claims, including: various costs, compensation fees, attorney fees, etc.

8.2 ESD Protection

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

8.3 Quality Assurance

The company provides a 12-month (1 year) quality guarantee (calculated from the date of shipment) to direct purchasers of its products, based on the technical specifications in the product data manual published by Winsen. If the product is proved to be defective during the warranty period, the company will provide free repair or replacement. Users need to satisfy the following conditions:

1. Notify our company in writing within 14 days after the defect is found.
2. The product should be within the warranty period.

The company is only responsible for products that are defective when used in applications that meet the technical conditions of the product. The company does not make any guarantees, guarantees or written statements about the application of its products in those special applications. At the same time, the company does not make any promises about the reliability of its products when applied to products or circuits.

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