Winsen
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Digital Thermopile Temperature Sensor

(Model: MRTD-3011)

User's Manual

Version: 1.2

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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.

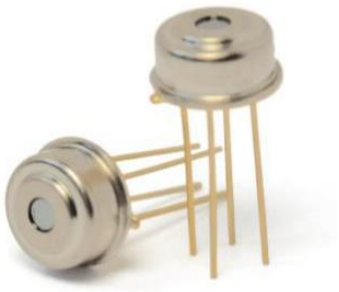
Zhengzhou Winsen Electronics Technology CO., LTD.

MRTD-3011 Digital Thermopile Temperature Sensor

1.Description:

MRTD-3011 is a non-contact type digital thermopile sensor with I2C output. The thermopile chip is based on MEMS technology, consists of hundreds of thermocouples connected in series. Using Seebeck principle, when there is a temperature difference between the target and the environment, the sensor gives the corresponding voltage output, therefore detecting the existence of the target or the temperature of the target. This sensor can be working in the temperature range of -10~85℃, and can measure during the range of -20~+250℃.

2.Features



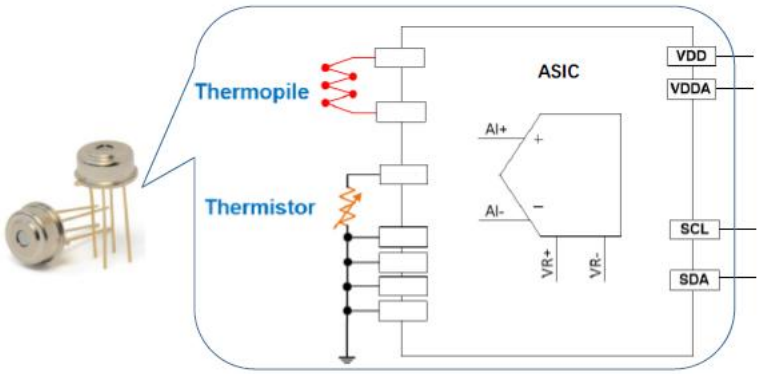
- TO-39 metal package, small viewing angle;
- Full integrated digital infrared thermopile;
- I2C output with internal temperature compensation;
- 2.6V to 5.5V single power supply for continuous operation;
- Signal sampling speed settable: adjustable 16-step speed (0.02Hz~2KHz);
- Good stability and wide working temperature range: -10~85℃;
- Built-in high-precision 20 Bit sigma delta ADC, ENOB up to 16 bits;
- Temperature measurement range: -20~+250℃;
- Temperature measurement accuracy: ±1℃ for below 100℃ range; ±2% for over 100℃;
- Chip sleep mode current 2μA @ 25°C/VDD=3V;

3.Applications

- Non-contact temperature measuring
- Infrared thermometer, such as ear temperature and forehead temperature measurement
- Continuous temperature control of production process
- Household appliances (Microwave oven, hair dryers, air conditioners etc), intelligent temperature induction and control system
- Human presence detection
- Power management system
- Temperature measurement and control of Home appliances (air conditioners, hair dryers, hoods, etc.)
- Interactive power control
- Lighting unit control

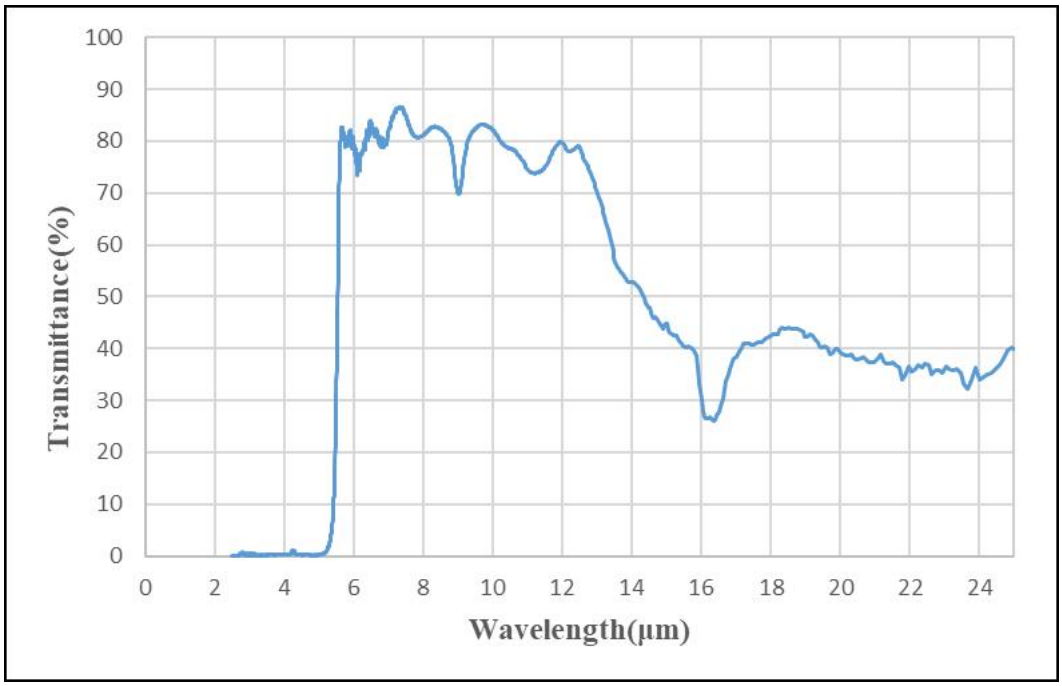
4. Functional diagram

The sensor is encapsulated in a hermetic metal cavity with 4pins, and the materials used comply with RoHS requirement, and can work under -20~85℃ environment.

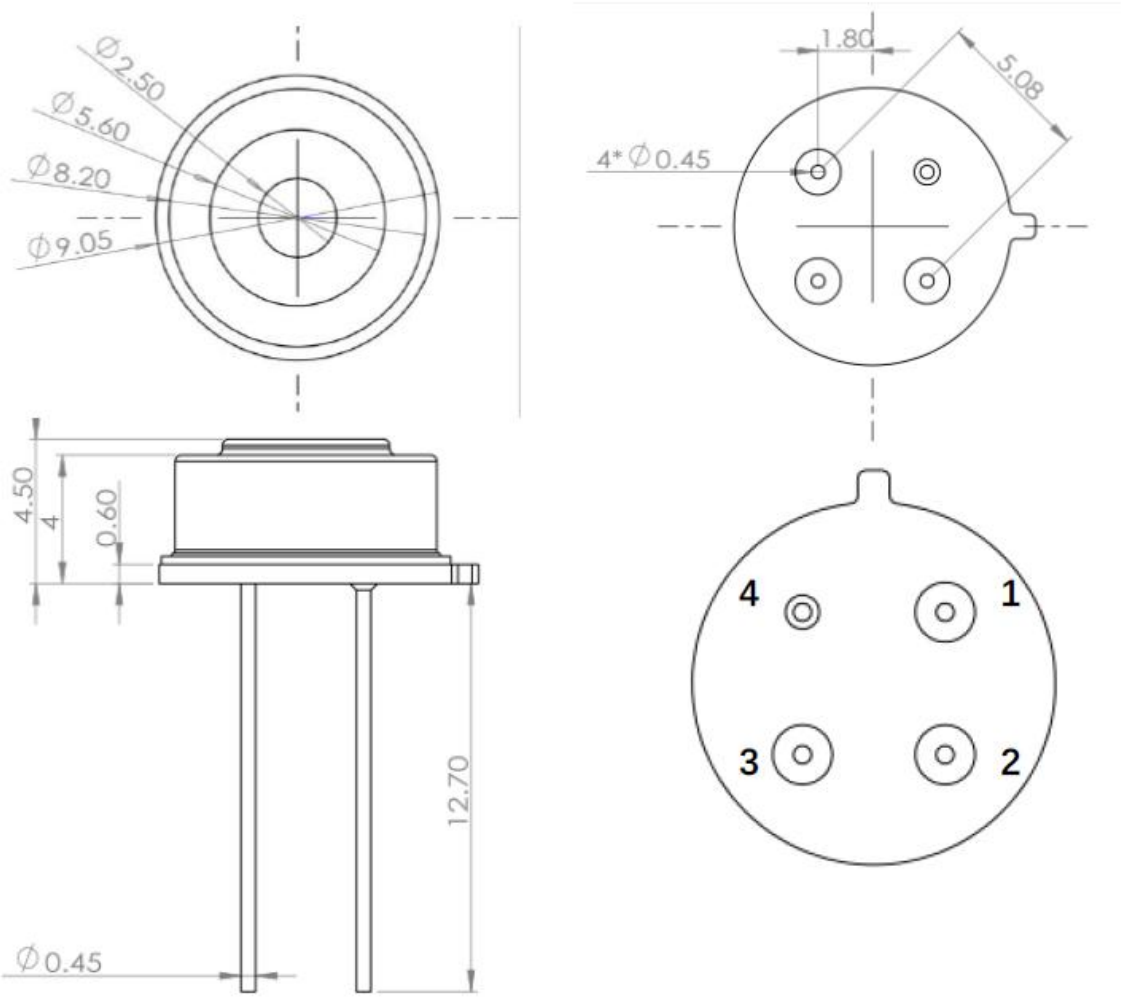


5. MRTD-3011 thermopile parameters

Parameter	Unit	Min	Typical	Max
Sensitive area of thermopile	mm2	/	0.7x0.7	/
Field of view	Degree		54	
Power supply range	V	2.6		5.5
Power current	Ua	/	/	300
Working temperature range	℃	-20	/	+85
Storage temperature range	℃	-40	/	+125
ESD rated power	V	/	±4000	/
Filter wavelength range	um	5.5	/	14
Temperature measurement range	℃	-20		250
Temperature measurement accuracy	℃	/	±1℃ for below 100℃ range; ±2% for over 100℃	/



6. Sensor diagram(unit:mm)



Electrode connection:

Pin Item	Definition	Function
1	SCL	I2C communication
2	SDA	I2C communication
3	VDD	Power supply
4	VSS/GND	GND

7. I2C communication

The following abbreviations are used for the graphical description of I2C:

S Start

S1 Repeat Start

A Acknowledge by slave

A1 Acknowledge by Master

N Not acknowledge by master

P Stop

Device slave address (write)=0x20; Device slave address (Read)=0x21;

7.1 I2C writ mode sequence waveform:

Figure 5 illustrates the I2C Write command protocol in the Command Mode state. Parameters can be set and adjusted in Command Mode.

Byte write:

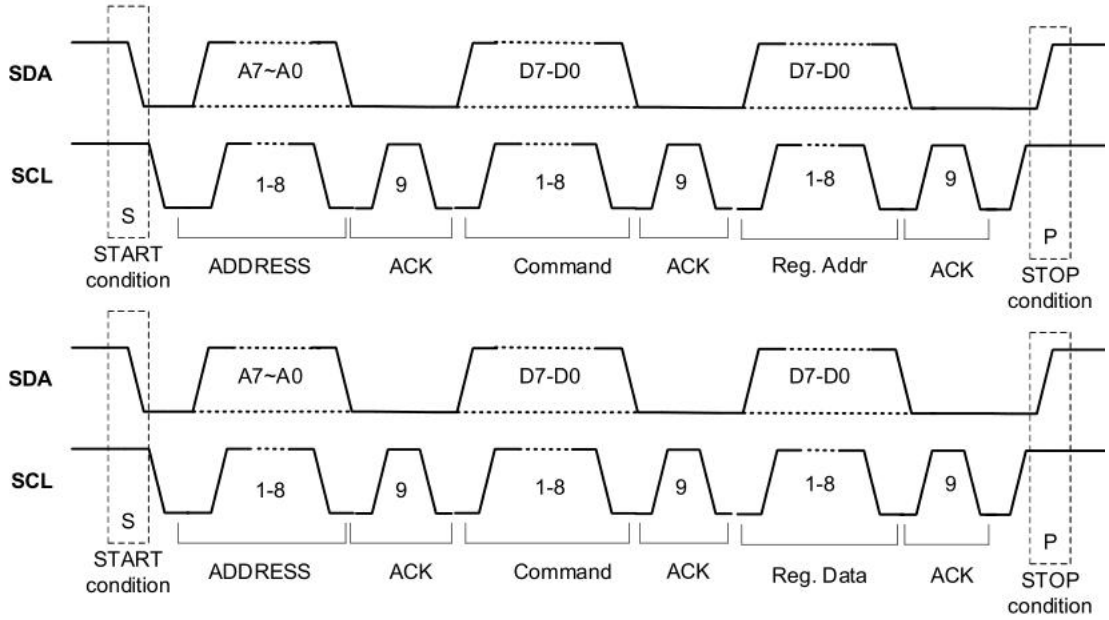


Figure 5 Command mode data packet writing

Note:

SCL stretch time minimum: the minimum time that SCL is pulled to Low by the chip);

After the master control (MCU) writes DATA, it needs to judge the slave side (Slave pulls and releases SCL from Low to High before executing the Stop action to ensure the complete execution of the write action.

7.2 I2C read mode sequence waveform:

Figure 6 illustrates the I2C Read Command protocol in the Command Mode state, and the parameters can be read and confirmed in the Command Mode.

Byte read:

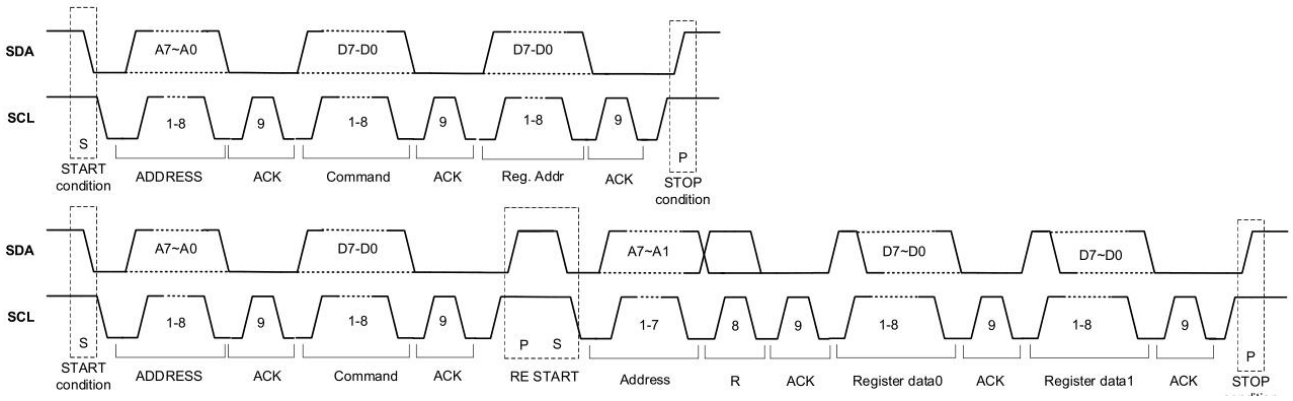


Figure 6 Command mode data packet reading

7.3 Temperatrue reading instructions(I2C):

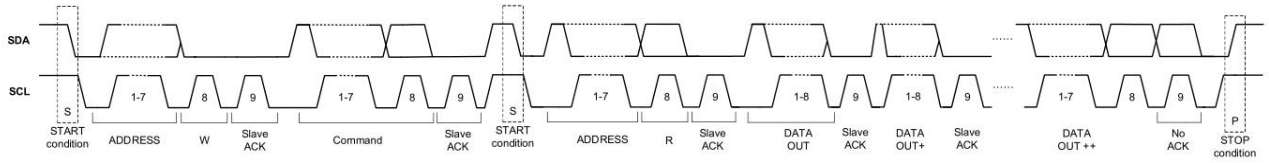


Figure 7: I²C normal mode I2C group reading

Chart 3: Register description

POINTER	ACCESS	Descriptions	Format (bit)
0x00	R	Buffer update (Note1)	0
		Thermistor Temp L (bit6 – bit0)	7 ~ 1
x01	R	Thermistor Temp L (bit7)	0
		Thermistor Temp H (bit6 – bit0)	7 ~ 1
0x02	R	Thermistor Temp H (bit7)	0
		Reserved	7 ~ 1
0x03	R	Buffer update (Note1)	0
		Thermopile Temp L (bit6 – bit0)	7 ~ 1
0x04	R	Thermopile Temp L (bit7)	0
		Thermopile Temp H (bit6 – bit0)	7 ~ 1
0x05	R	Thermopile Temp H (bit7)	0
		Reserved	7 ~ 1
0x06	R	CRC8 Check sum (Note2) for POINTER 0x00 ~ 0x05	7 ~ 0

Note1:
Buffer update: buffer update is completed=1/ buffer update is not completed=0;
Note2:
CRC8 check sum is mainly to process the value of POINTER 0x00~0x05 as CRC8, so the user can use this byte to do the check to confirm whether the read value of POINTER 0x00~0x05 is correct.
Note3:
The IIC read and write functions are bit-wise operations. After reading and writing one bit of data, it needs to be shifted and cycled 8 times to read or write the complete 8-bit data.

ADC sampling rate (OSR) settings:

SET	OSR	SET	OSR	SET	OSR	SET	OSR
0x01	16384	0x02	8192	0x03	4096	0x04	1024
SET	OSR	SET	OSR	SET	OSR		
0x05	512	0x06	256	0x07	128		

Thermistor/thermopile temperature reading process:

The following describes the I2C communication process to let users understand the process of reading the thermistor/thermopile temperature.

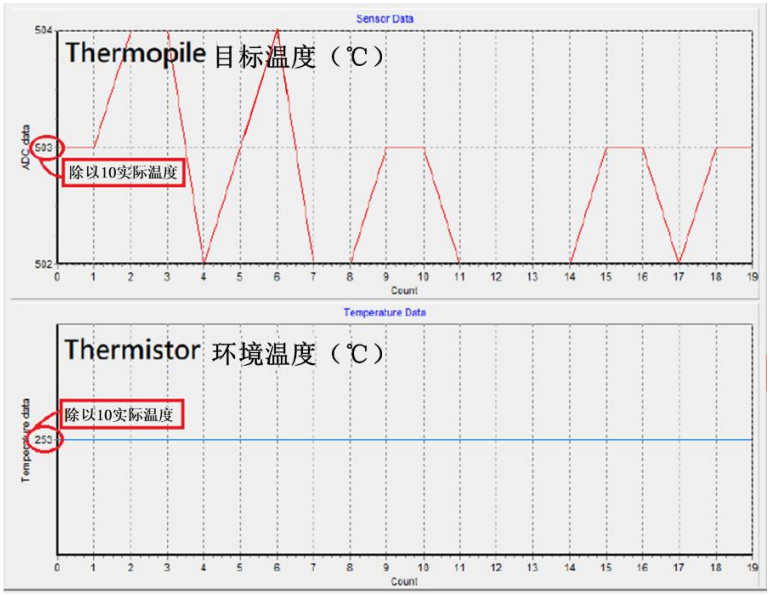
Step1: Read POINTER: 0×00~0×02. Thermistor temperature (TS: ambient temperature = ADC read data ÷10).

Read POINTER 0×03~0×05. Thermopile temperature (TP: target temperature = ADC read data ÷ 10).

Step2: If POINTER 0×00 and 0×03 bit0 == 1b, it means that the new data can be used (to judge whether the data is updated and the data is stable.

Protocol: byte write and continuous byte read

Step3: S + ADW + 0×80 + RS + ADR + Data out0 + …+ Data out5 +P (The read data is hexadecimal).



Note (Calculation of Negative Temperature Values):

When the upper four bits of Poniter 0x02 are F, it means that the TS data is a negative temperature;

When the upper four bits of Poniter 0x05 are F, it means that the TP data is a negative temperature.

Example: TS

Pointer 0x00: 0xE7 Digital Thermopile Temperature Sensor

Pointer 0x01: 0xFD

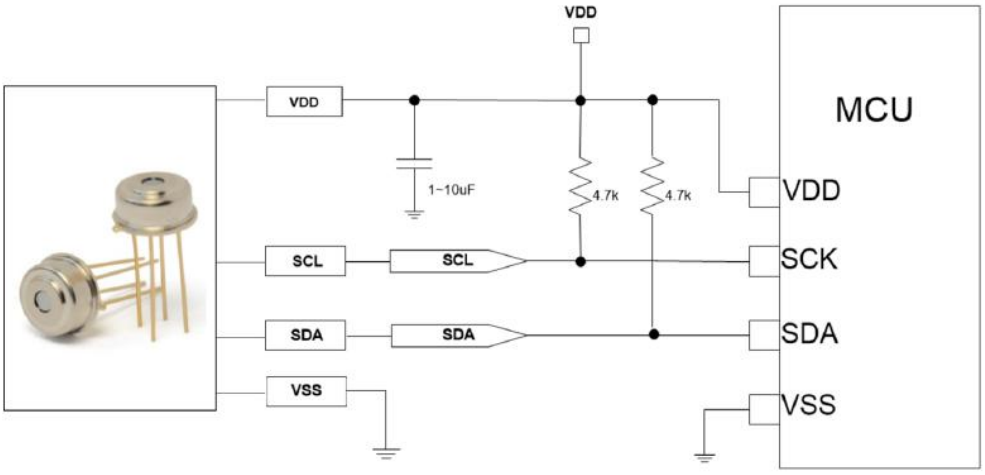
Pointer 0x02: 0xFF

TS = Pointer 0x02, 0x01, 0x00 = 0xFFFDE7;

0x1000002 - TS = 0x1000002 - 0xFFFDE7 = 0x21B;

0x21B shifted right by 1 bit = 0x010D = converted decimal = 269, then the actual temperature of TS is -26.9℃

8. Recommended circuit:



Note:

In order to reduce the thermal interference between the sensor pins, the sensor pins should be thermally isolated when making a PCB;

Hand soldering temperature should be 330±20℃, and single pin soldering time should not exceed 3s;

Frequent, excessive vibration, strong impact or collision will cause resonance inside the sensor to break;

Do not directly touch the sensor window filter with your hands or sharp objects to avoid contamination.

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