Thermopile Temperature Sensor

(Model: RTTA71)

User's Manual

Version: 1.1

Valid from: 2023-03

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.

RTTA71 Thermopile Temperature Sensor

TO-46 Package

RTTA71 is an infrared thermopile temperature sensor that does not require direct contact when measuring the temperature of an object. Core component thermopile chip is based on MEMS technology, consists of hundreds of thermocouples connected in series. The thermopile absorbs infrared energy emitted from the measured object, when there is a temperature difference between the target and the environment, the sensor gives the corresponding voltage output, calibrate through peripheral circuits and standard blackbody sources, therefore detecting the temperature of the target.

Features

- TO-46 small volume package
- High sensitivity
- Quick response
- Good stability
- High filter transmittance
- With temperature compensation, high precision NTC

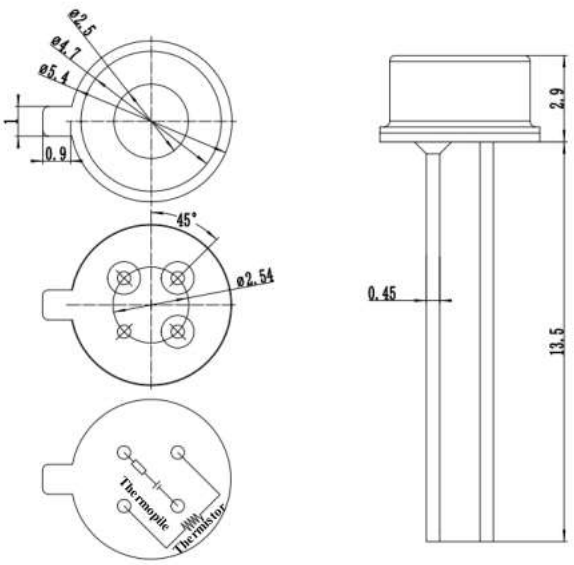
Applications

- Non-contact temperature measuring
- Infrared thermometer, such as ear temperature and forehead temperature measurement
- Continuous temperature control of production process
- Human presence detection
- Temperature measurement for student cards, elderly cards, etc;
- Food temperature detection and control;
- Household appliances (Microwave oven, hair dryers, air conditioners etc);
- Temperature measurement and control system

RTTA71 thermopile parameters

Parameter	Value	Unit	Remarks
Chip size	1.35×1.35	mm	/
Field of view	95	Degree	Above 50%
Thermopile resistor	76±10	KΩ	25℃,1V
Noise voltage	38	nV/Hz1/2	25℃
Noise equivalent power	0.23	nW/Hz1/2	500K, 1Hz, 25℃
Response rate	160±40	V/W	500K, 1Hz, 25℃
Temperature coefficient of resistance	0.06	%/℃	25℃~75℃
Time constant	⩽20	ms	
Detection rate	1.5 ×10^8	cmHz1/2/W	500K, 1Hz, 25℃
NTC resistance	100 ± 1%	KΩ	25℃
NTC(β)	3950 ± 1%	/	25℃/50℃
Working temperature	-30 ~ 85℃	℃	/

Sensor diagram(unit:mm)



Electrode connection:

Pin	1	2	3	4
Definition	Thermopile positive	NTC	Thermopile negative	GND

Sensor Character

1. Thermopile performance (V-T) curve under 25℃ ambient temperature conditions:

Testing condition: TO-46 package, LWP5.5 filter

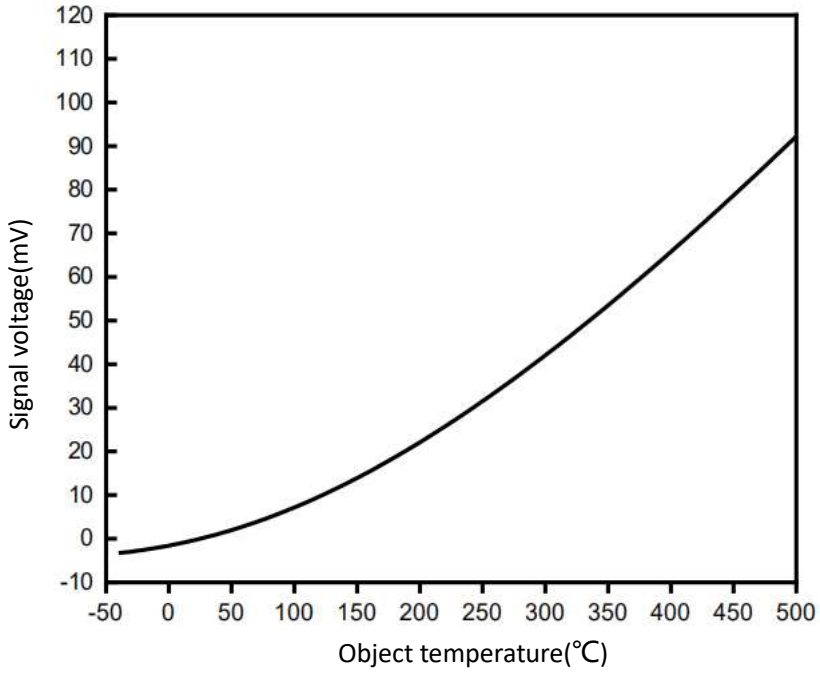


Figure 3: Thermopile performance (V-T) curve under 25℃ ambient temperature conditions

2. Sensor field of view angle

The sensor aperture is facing the heat source and rotates the window of the sensor around the same axis. The sensor signal response is within the range covered by 50% of the maximum signal response of the sensor.

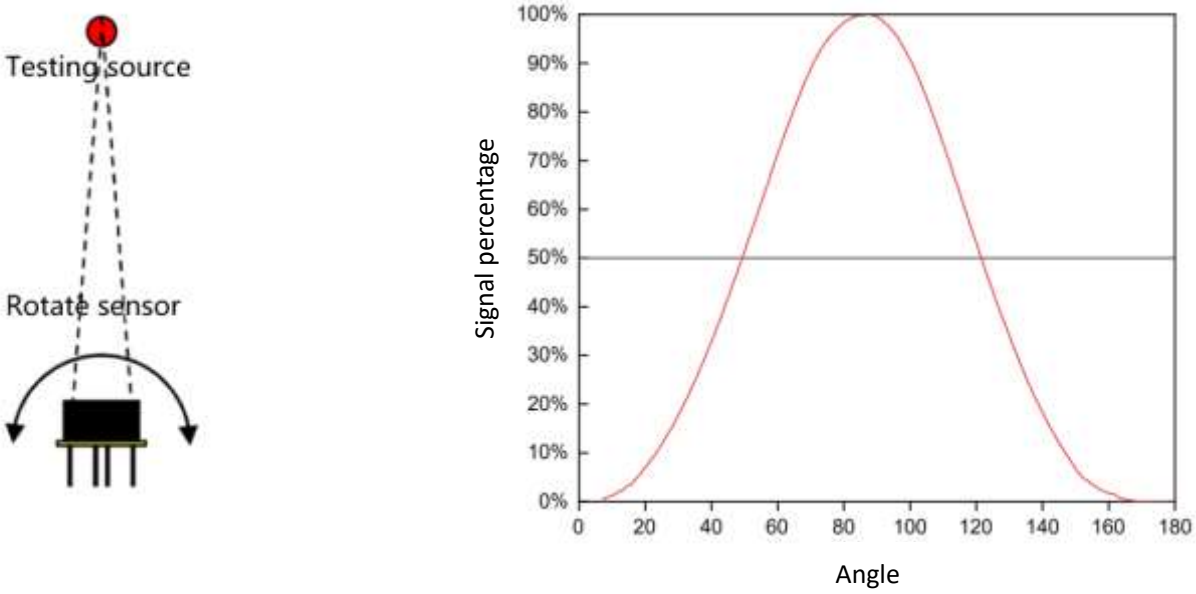


Figure 4: Thermopile performance (V-T)

3. Filter Performance Curve

Parameter	Value	Unit	Remarks
Wavelength range	5.5~14	um	
Transmittance 1	≥75	%	Average, 5.5~14um
Transmittance 2	<1	%	<5μm

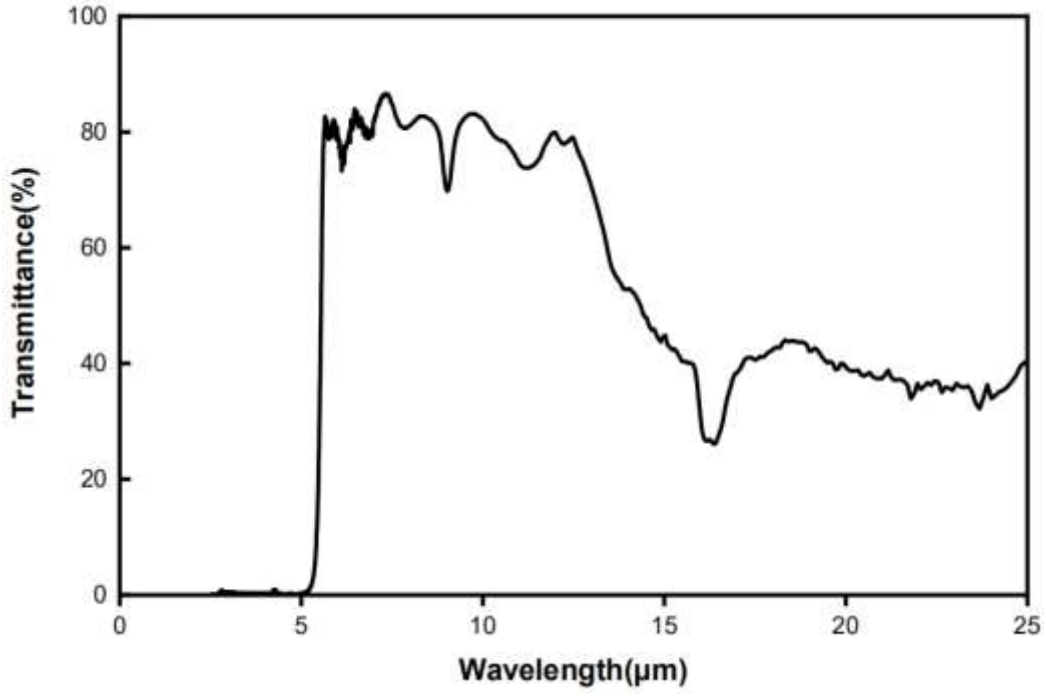
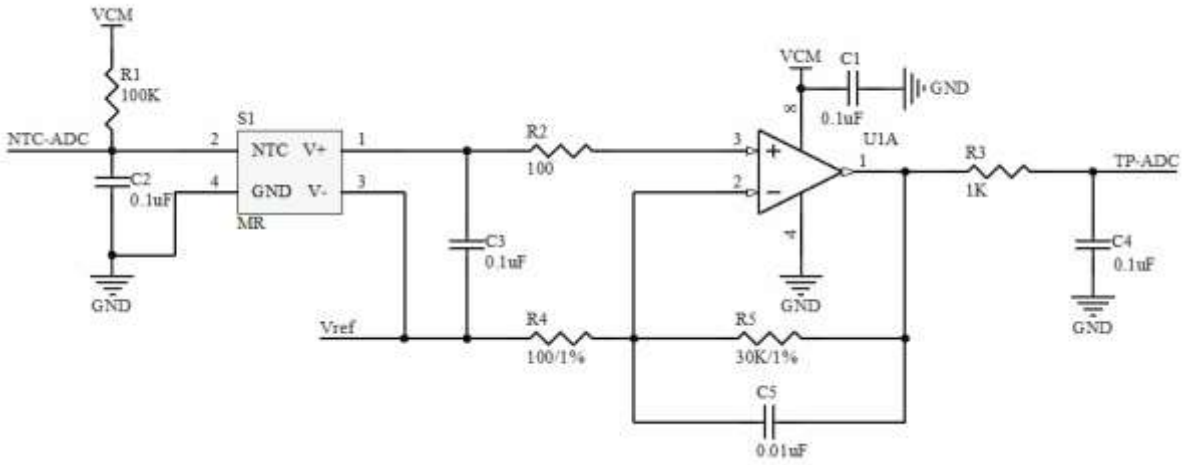


Figure 5: Spectral transmittance of infrared cut-off filter

4. Thermistor (NTC) R-T Table:

T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)
-40	3179.00	**-6**	439.56	**28**	87.80	**62**	22.66	**96**	6.97
-39	2980.73	**-5**	417.22	**29**	84.11	**63**	21.83	**97**	6.75
-38	2796.06	**-4**	396.14	**30**	80.59	**64**	21.05	**98**	6.53
-37	2623.95	**-3**	376.25	**31**	77.24	**65**	20.29	**99**	6.33
-36	2463.46	**-2**	357.47	**32**	74.04	**66**	19.56	**100**	6.13
-35	2313.73	**-1**	339.73	**33**	70.99	**67**	18.86	**101**	5.94
-34	2173.97	**0**	322.98	**34**	68.07	**68**	18.19	**102**	5.75
-33	2043.44	**1**	307.14	**35**	65.29	**69**	17.54	**103**	5.58
-32	1921.48	**2**	292.17	**36**	62.64	**70**	16.92	**104**	5.40
-31	1807.49	**3**	278.02	**37**	60.11	**71**	16.33	**105**	5.24
-30	1700.89	**4**	264.63	**38**	57.68	**72**	15.76	**106**	5.08
-29	1601.17	**5**	251.96	**39**	55.37	**73**	15.21	**107**	4.92
-28	1507.85	**6**	239.96	**40**	53.16	**74**	14.68	**108**	4.77
-27	1420.48	**7**	228.61	**41**	51.05	**75**	14.17	**109**	4.63
-26	1338.66	**8**	217.85	**42**	49.03	**76**	13.68	**110**	4.49
-25	1262.00	**9**	207.66	**43**	47.10	**77**	13.21	**111**	4.36
-24	1190.15	**10**	198.00	**44**	45.25	**78**	12.76	**112**	4.23
-23	1122.79	**11**	188.84	**45**	43.49	**79**	12.32	**113**	4.10
-22	1059.61	**12**	180.16	**46**	41.79	**80**	11.90	**114**	3.98
-21	1000.34	**13**	171.92	**47**	40.18	**81**	11.50	**115**	3.86
-20	944.72	**14**	164.10	**48**	38.63	**82**	11.11	**116**	3.75
-19	892.50	**15**	156.68	**49**	37.15	**83**	10.74	**117**	3.64
-18	843.46	**16**	149.63	**50**	35.88	**84**	10.38	**118**	3.54
-17	797.38	**17**	142.94	**51**	34.37	**85**	10.03	**119**	3.43
-16	754.09	**18**	136.58	**52**	33.06	**86**	9.70	**120**	3.34
-15	713.38	**19**	130.54	**53**	31.81	**87**	9.38	**121**	3.24
-14	675.11	**20**	124.79	**54**	30.62	**88**	9.07	**122**	3.15
-13	639.10	**21**	119.33	**55**	29.47	**89**	8.77	**123**	3.06
-12	605.22	**22**	114.13	**56**	28.37	**90**	8.48	**124**	2.97
-11	573.33	**23**	109.19	**57**	27.32	**91**	8.21	**125**	2.89
-10	543.30	**24**	104.48	**58**	26.31	**92**	7.94		
-9	515.01	**25**	100.00	**59**	25.34	**93**	7.69		
-8	488.36	**26**	95.73	**60**	24.41	**94**	7.44		
-7	463.24	**27**	91.67	**61**	23.51	**95**	7.20		

Recommended circuit:



Basic principle and application method:

1) Before measuring the temperature by the sensor, it is necessary to combine the back-end circuit and algorithm, use a standard blackbody source for calibration, and obtain two calibration coefficients;
2) Calculate the resistance values Ra of pins 2 and 4 of the thermopile temperature sensor based on the reference circuit;
3) Obtain the corresponding ambient temperature T_{amb} based on the resistance value of Ra, the B-value constant of NTC, and the R-T table in the specification (this temperature is not the external atmospheric temperature, usually referring to the internal ambient temperature of the sensor);
4) Combined with the recommended circuit, read the signal voltage V_{obj} of pins 1 and 3 of the sensor,;
5) In actual temperature measurement, the calibration coefficient of the sensor is introduced to obtain the calibrated signal voltage $V_{obj, cal}$;
6) Find a voltage value in the T_{amb} column of the V-T table that is equal to or similar to the $V_{obj, cal}$ values, and the corresponding T_{obj} row is the temperature T_{obj} of the measured object.

Note:

- Due to individual differences and factors such as blackbody temperature, distance, and environment, each sensor must be calibrated before use;
- The sensor itself has a large field of view angle, which usually needs to be adjusted according to the size of the test target object and the test distance during actual use;
- To reduce thermal interference between sensor pins, thermal isolation should be carried out between sensor pins when making PCB;
- Frequent, excessive vibration, strong impact, or collision can cause resonance and fracture within the sensor.

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