Thermopile Temperature Sensor

(Model: MRT313)

User's Manual

Version: 3.0

Valid from: 2022-11

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.

MRT313 Thermopile Temperature Sensor

Product Description:

MRT-313 is an infrared thermopile temperature sensor, direct contact is not required when measuring object temperature. The core component thermopile chip is formed by connecting hundreds of thermocouples in series based on MEMS technology. The thermopile absorbs the infrared energy emitted from the measured object, and uses the Seebeck theory, the sensor outputs the corresponding voltage to detect the temperature of the target.

Features

- TO-39 metal package
- Specific perspective
- Quick response
- Good stability
- High precision NTC

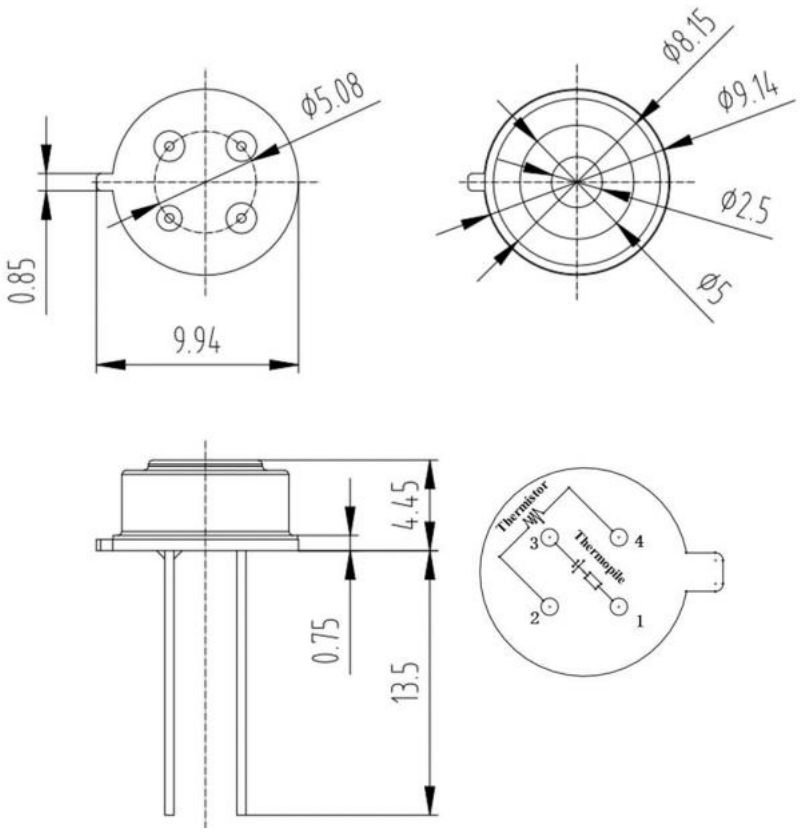
Applications

- Household appliances (Microwave oven, hair dryers, range hood etc), temperature measuring and controlling
- Non-contact temperature measuring
- Continuous temperature control of production process
- Human presence detection
- Power industry temperature monitoring;

Technical parameters

Parameter	Value	Unit	Remarks
Sensitive area	1×1	mm	/
Field of view	60	Degree	Above 50%
Thermopile resistor	75±15	KΩ	25℃
Noise voltage	38	$nV/Hz^{1/2}$	25℃
Noise equivalent power	0.23	$nW/Hz^{1/2}$	500K, 1Hz, 25℃
Response rate	110±30	V/W	500K, 1Hz, 25℃
Temperature coefficient of resistance	0.06	%/℃	25℃~75℃
Time constant	≤20	ms	
Detection rate	1.2×10^8	cmHz1/2/W	500K, 1Hz, 25℃
NTC resistance	100 ± 1%	KΩ	25℃
B-value constant	3950 ± 1%	/	25℃/50℃
Working temperature	-30 ~ 100	℃	/
Storage temperature	-40 ~ 110	℃	/

Sensor diagram(unit:mm)



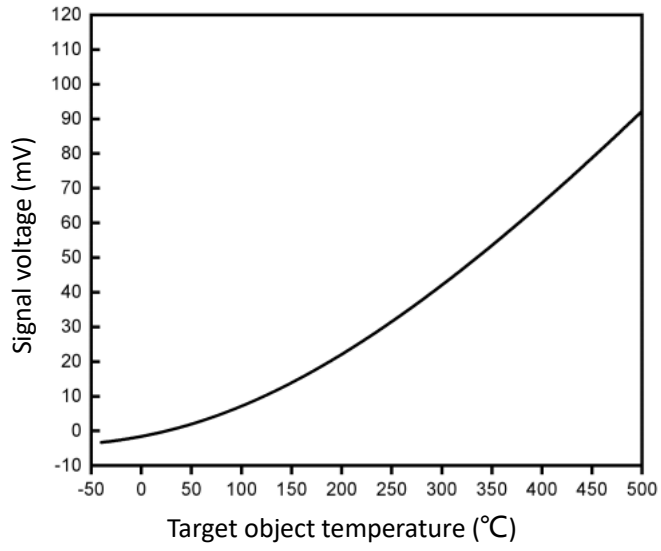
Electrode connection:

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

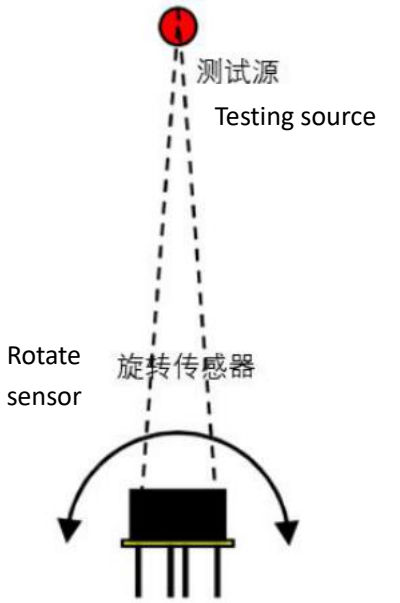
Sensor Character:

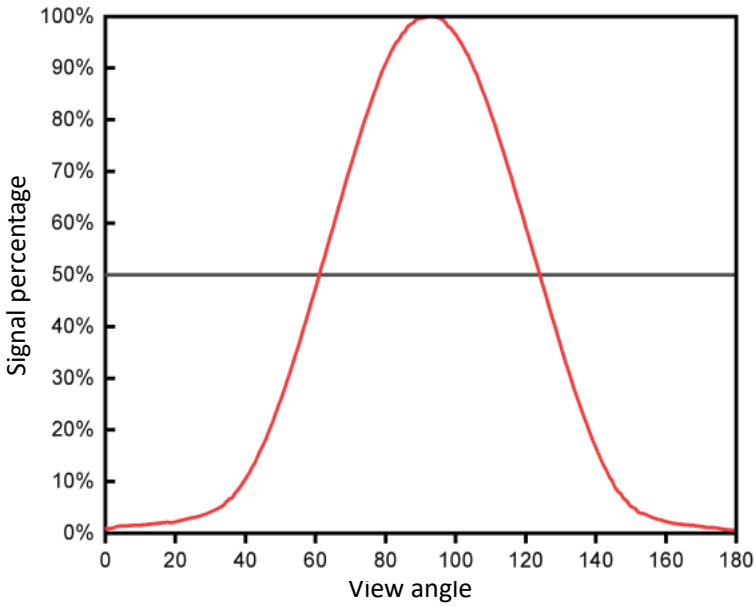
1. Typical thermopile performance (V-T) curve:

Testing condition: 25℃, TO-39 package, LWP5.5 filter



2. Sensor view angle： The light hole of the sensor is facing the heat source, rotate the window of the sensor around the same axis. The sensor signal response is the range covered when the maximum signal response of the sensor at 50%;

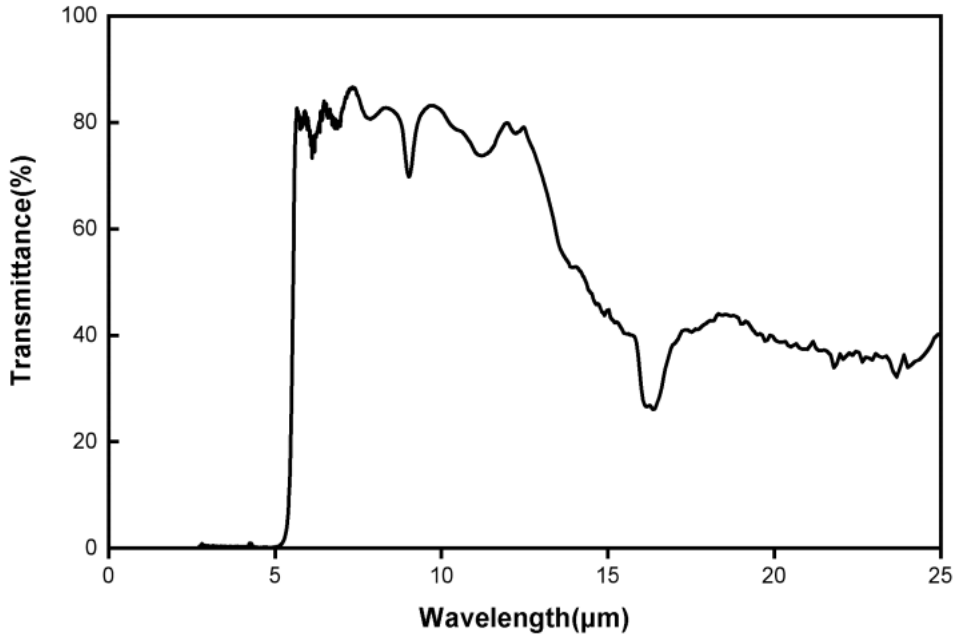




MRT 313 field angle data diagram

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

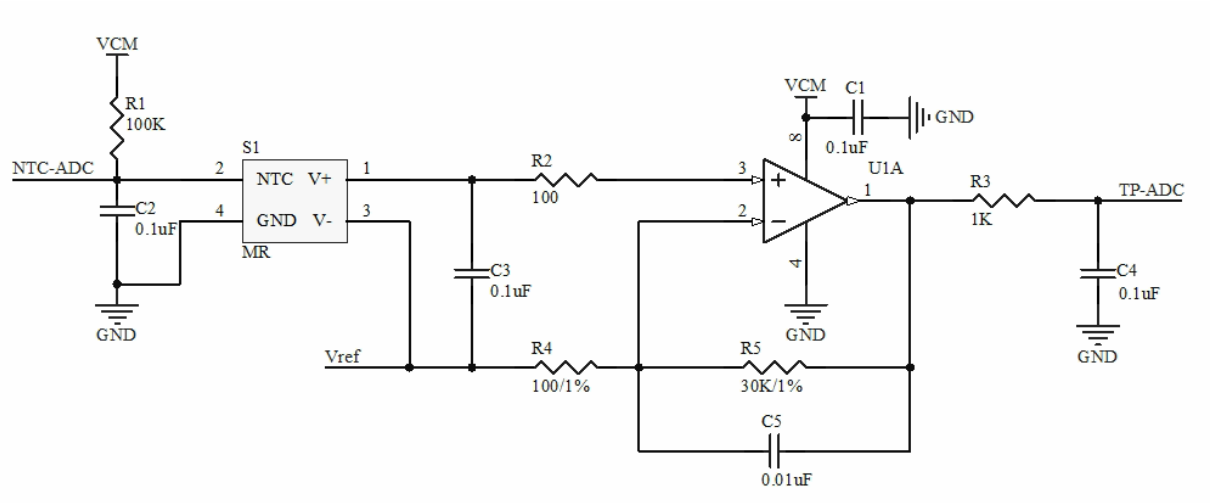


Spectral transmittance of infrared cut-off filter

4. Thermistor (NTC) R-T Table

T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)	T(℃)	R(KΩ)
-30	1787.9797	3	280.9084	36	62.5954	69	17.9562
-29	1679.6017	4	267.2014	37	60.0707	70	17.3452
-28	1578.5061	5	254.2428	38	57.6610	71	16.7578
-27	1484.1584	6	241.9877	39	55.3604	72	16.1930
-26	1396.0662	7	230.3940	40	53.1635	73	15.6499
-25	1313.7754	8	219.4224	41	51.0651	74	15.1276
-24	1236.8685	9	209.0361	42	49.0602	75	14.6251
-23	1164.9598	10	199.2007	43	47.1443	76	14.1417
-22	1097.6941	11	189.8841	44	45.3130	77	13.6764
-21	1034.7432	12	181.0559	45	43.5621	78	13.2286
-20	975.8038	13	172.6881	46	41.8878	79	12.7976
-19	920.5962	14	164.7540	47	40.2862	80	12.3825
-18	868.8615	15	157.2290	48	38.7539	81	11.9828
-17	820.3603	16	150.0898	49	37.2876	82	11.5978
-16	774.8710	17	143.3144	50	35.8842	83	11.2270
-15	732.1889	18	136.8825	51	34.5405	84	10.8697
-14	692.1238	19	130.7749	52	33.2538	85	10.5254
-13	654.4999	20	124.9734	53	32.0214	86	10.1935
-12	619.1540	21	119.4612	54	30.8408	87	9.8736
-11	585.9346	22	114.2223	55	29.7096	88	9.5652
-10	554.7016	23	109.2417	56	28.6253	89	9.2678
-9	525.3245	24	104.5053	57	27.5860	90	8.9809
-8	497.6821	25	100.0000	58	26.5895	91	8.7042
-7	471.6621	26	95.7132	59	25.6338	92	8.4373
-6	447.1599	27	91.6333	60	24.7171	93	8.1797
-5	424.0781	28	87.7492	61	23.8376	94	7.9312
-4	402.3264	29	84.0505	62	22.9937	95	7.6912
-3	381.8204	30	80.5274	63	22.1836	96	7.4596
-2	362.4818	31	77.1707	64	21.4061	97	7.2360
-1	344.2375	32	73.9717	65	20.6594	98	7.0201
0	327.0195	33	70.9222	66	19.9424	99	6.8115
1	310.7640	34	68.0144	67	19.2537	100	6.6101
2	295.4121	35	65.2411	68	18.5920	101	6.4155

Recommended circuit:



Basic principle and use method

(1) Combined with the reference circuit, read the resistance value Ra between pin 2 and 4;

(2) According to the resistance value of Ra, the B value constant of NTC and the R-T table in the specification, to get the corresponding ambient temperature T_{amb} (this temperature is not the ambient temperature of the outside atmosphere, but the internal ambient temperature of the sensor);

(3) Reading the voltage V_{obj} between pin 1 and 3;

(4) The corrected signal voltage $V_{obj,cal}$ is obtained by introducing the correction coefficient of the sensor;

(5) Find the voltage value equal to or close to the $V_{obj,cal}$ value in the T_{amb} column of the V-T table, and The corresponding T_{obj} line is the temperature of the measured object T_{obj}.

Note:

- Due to the existence of individual differences and the influence of blackbody temperature, distance, environment and other factors, each sensor must be calibrated before use;
- The test output voltage of the sensor is easily affected by the NTC resistance value. It is necessary to increase the thermal resistance and thermal capacity to increase the temperature stability. Generally, metal (copper, aluminum) kits are used;
- The view angle of the sensor is large, so it usually need to adjust according to the size of the test target object and the test distance in actual use;
- In order to reduce the thermal interference between the sensor pins, the sensor pins should be thermally isolated when making a PCB;
- Frequent, excessive vibration, strong impact or collision will cause resonance inside the sensor to break.

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