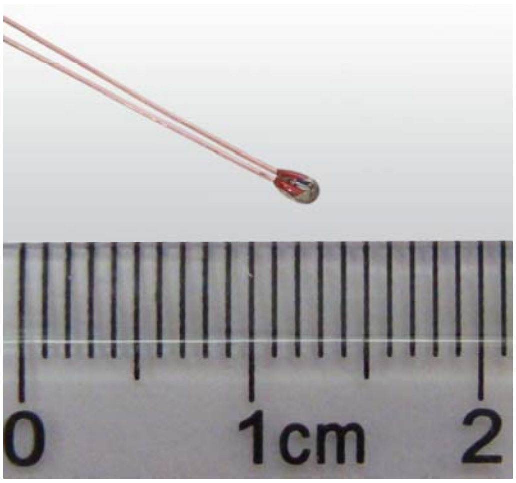

Figure 1.1 Physical Photo of the ATH100K1R25

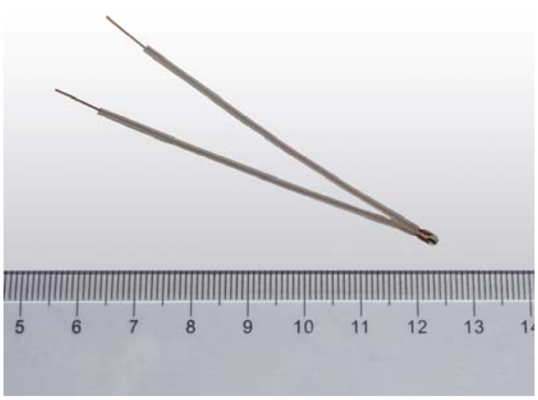

Figure 1.2 Physical Photo of the ATH100K1R25T70

MAIN FEATURES

- Glass Encapsulated for Long Term Stability & Reliability
- High Resistance Accuracy: 1%
- Small Size: ϕ1.25mm×2.0mm
- Maximum Temp. Range: −40°C to 270°C
- 100 % Lead (Pb)-free and RoHS Compliant

APPLICATION AREAS

Temperature sensing for laser diodes, optical components, etc.

DESCRIPTIONS

The ATH100K1R25 series thermistor consists of three versions, ATH100K1R25 as shown in Figure 1.1, ATH100K1R25T70 shown in Figure 1.2 and ATH100K1R25T70S. The ATH100K1R25 has bear leads coated with copper, the ATH100K1R25T70S has the leads covered by high temperature plastic tubing and sealed by epoxy, while the ATH100K1R25T70 is the non-sealed version.

The ATH100K1R25 is of a high stability and high precision glass encapsulated thermistor. Comparing with conventional epoxy encapsulated thermistors, ATH100K1R25 features much wider temperature range, especially on the high end, much better long term stability, smaller size, and shorter response time. In addition, there are two insulation versions available, one of which comes with leads covered by plastic tubing, the ATH100K1R25T70, and the other one, the ATH100K1R25T70S, is sealed between the head and the tubing. They can work under up to 140°C temperature and the latter is of liquid resistant.

The ATH100K1R25 series thermistors can be used to sense the temperatures for laser diodes, optical components, industrial process control, etc., where high temperature sensitivity, long term stability, and/or high sensing temperature are required.

Figure 2 shows the mechanical dimensions of the ATH100K1R25T70S (ATH100K1R25 and ATH100K1R25T70 have the same dimensions). All dimension units are millimeters.

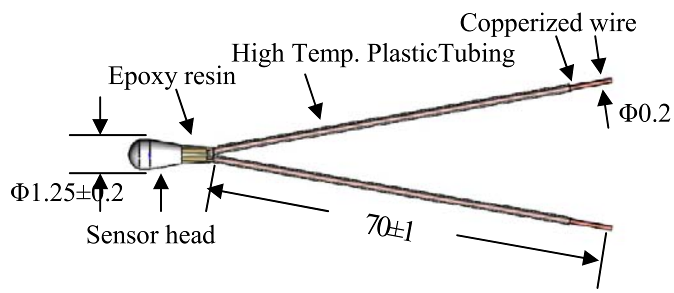

Figure 2. Side View of ATH100K1R25T70S

SPECIFICATIONS

Parameter	Value
Nominal Resistance@ 25°C	100K ± 1%
β Value @ 25°C/50°C	3950K ± 1%
β Value @ 25°C/85°C	3990K ± 1%
R@25˚C / R@50˚C	2.771
R@25˚C / R@85˚C	9.389
Thermistor Diameter	1.25 ± 0.2mm
Thermistor Length	2.0 ± 0.5mm
Lead Diameter	0.2mm
Lead Length	70 ± 1mm
Dissipation Factor	≥ 0.9mW/°C
Insulation Resistance	50MΩ
Thermal Time Constant	2.39s (in still air) 1s (in water)

APPLICATIONS

The thermistor ATH100K1R25, ATH100K1R25T70 and ATH100K1R25T70S are designed to sense solid block temperature with high stability and accuracy. The best way to mount the thermistor is to drill a hole on the object for which the temperature needs to be measured and regulated, and use thermal conductive epoxy to pot the thermistor inside the hole. The hole diameter should be between 1.4 to 1.8mm and the depth should between 3 to 4mm. When a deeper hole is needed, drill a 2 stage hole to prevent epoxy bobbles trapped inside the deep hole which could cause temperature measurement errors. Figure 3 shows the section view of the 2 stage hole.

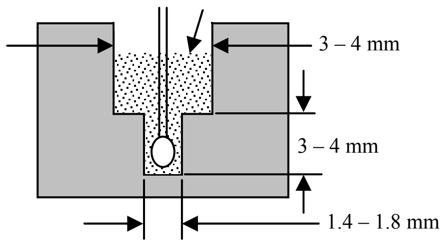

Figure 3. Section View of the 2 Stage Hole

The worst mounting result would be to have air bubbles trapped inside the thermistor mounting hole. These bubbles cause thermal sensing time delay and sensing temperature errors. To avoid the bubbles, in addition to drilling the 2 stage hole, use thin epoxy, vibrate the assembly before curing the epoxy, and cure the epoxy at high temperature, 80°C to 120°C, depending on the epoxy used and the maximum temperature the assembly components allow.

The thermistor lead wires are made of copperized alloy and there is no insulation coating on them, make sure that they do not touch each other after mounting the thermistor.

Some thermal conductive epoxies are also electrically conductive and such epoxies should not be used for mounting the thermistors, since the lead wires are conductive and the epoxy would change the thermistor resistance, thus causing temperature sensing errors.

Notice: Glass encapsulated cannot be used in water or other liquid directly.

CAUTIONS

1. Do not bend the thermistor leads at the location that is too close to the thermistors body, to avoid breaking the glass coating, as shown in Figure 4.1, Figure 4.2, and Figure 4.3 below. Only bend the leads at the location that is at least 2mm away from the thermistor body.

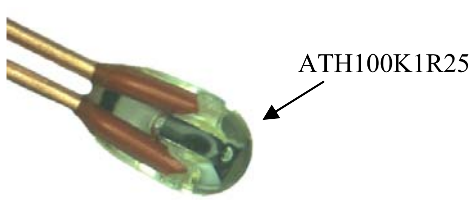

Figure 4.1. Bare Leaded Thermistor Head Photo

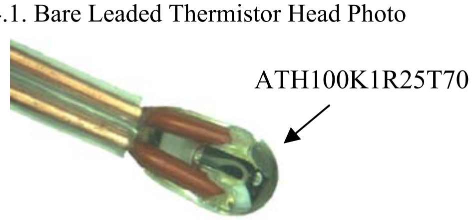

Figure 4.2. Tubing Leaded Non-sealed Thermistor Head Photo

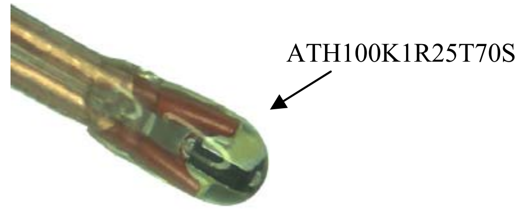

Figure 4.3. Tubing Leaded Sealed Thermistor Head Photo

2. Do not apply a large DC voltage across the thermistor in the temperature sensing circuit. The thermistor's self-heating temperature is about 1°C/mW. By injecting a 10µA current into the thermistor, it consumes 1mW and the self-heating temperature is about 1°C if the thermistor is placed in still air. Therefore, the sensing current needs to be much lower than 10µA when the thermistor is placed in the air for high accuracy applications. Injecting short current pulses into the thermistor is one of the ways to reduce the average current level on the thermistor in order to minimize the self-heating effect.
3. Handle the thermistor with care, do not use metal tools to hold the thermistor body with excessive force, otherwise, the glass body may crack, affecting its accuracy and stability.

Thermistor Resistance

Beta Value (β)

A simple approximation for the relationship between the resistance and temperature for ATH100K1R25 is to use an exponential approximation. This approximation is based on simple curve fitting to experimental data and uses two points on a curve to determine the value of β. The equation relating resistance to temperature using β is:

$$R = \mathrm{A}e^{\frac{\beta}{\mathrm{T}}};$$

Where:

R = thermistor resistance at temp T,
A = constant of equation,
β = beta, the material constant,
T = thermistor temperature in ˚K(Kelvin);

To calculate β for any given temperature range, the following formula applies:

$$\beta = \ln(R_{T1} / R_{T2}) / (1/T1 - 1/T2);$$

Where β is measured in K, R_{T1} is the resistance at T1, while R_{T2} is the resistance at T2.

β can be used to compare the relative steepness of ATH100K1R25 curves. However, the value of β will vary depending on the temperatures used for calculating the value. For example, to calculate β for the temperature range of 25˚C to 50˚C:

T1 = (25 + 273.15)˚K = 298.15˚K,
T2 = (50 + 273.15)˚K = 323.15˚K,
R_{T1} = 100KΩ,
R_{T2}= 35.88KΩ;

This value of β would be referenced as β@25˚C/50˚C, and calculated as:

β@25˚C/50˚C = ln(100/35.88) / (1/298.15 – 1/323.15) = 3950K;

By using the same formula, β25˚C/85˚C, will be:

β25˚C/85˚C = ln(100/10.65) / (1/298.15 – 1/358.15) = 3990K.

When using the β value to compare 2 thermistors, make sure that the β values are calculated based on the same 2 temperature points.

Temperature Coefficient of Resistance (α)

Another way to characterize the R-T curve of the ATH100K1R25 is to use the slope of the resistance versus temperature (R/T) curve at one temperature. By definition, the resistance slope vs. temperature is given by:

$$\alpha = (1/R) \times (dR/dT)\,;$$

Where T is the temperature in ˚C or ˚K, R is the resistance at temperature T.

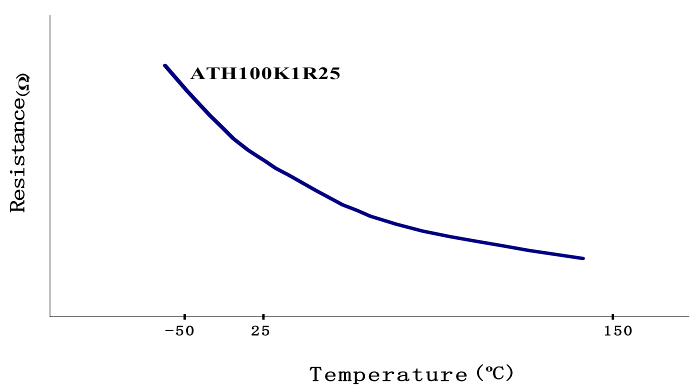

Figure 5. Resistance vs. Temperature for ATH100K1R25

As shown in Figure 5, the steepest position of the ATH100K1R25 curve is at colder temperatures.

The temperature coefficient is one method that can be used for comparing the relative steepness of the curves. It is highly recommended to compare the temperature coefficient at the same temperature because α varies widely over the operating temperature range.

Resistance Ratio (Slope)

The resistance ratio, or slope, for thermistors is defined as the ratio of the resistance at one temperature to the resistance at a higher temperature. As with resistance ratios, this method will vary depending on the temperatures used for calculating the value. This method can also be used to compare the relative steepness of two curves. There is no industry standard for the two temperatures that are used to calculate the ratio, we can select two common temperatures from the table below, for example, 25˚C and 50˚C, then the result of this calculation: R@25˚C / R@50˚C, will be:

R@25˚C / R@50˚C = 100/35.88 = 2.787;

And this calculation: R@25˚C/R@85˚C, will be:

R@25˚C / R@85˚C = 100/10.65 = 9.389.

Steinhart-Hart Thermistor Equation

The Steinhart-Hart Equation is an empirically derived polynomial formula which does best in describing the relationship between the resistance and the temperature of ATH100K1R25, which is much more accurate than β mathod. To solve for temperature when resistance is known, yields the following equation:

$$1/T = a + b(\ln R) + C(\ln R)^3\,;$$

Where:

T = temperature in ˚K(Kelvin),
a, b and c are equation constants,
R = resistance in Ω at temp T;

To solve for resistance when the temperature is known, the form of the equation is:

$$R = e^{\left[\left(-\frac{x}{2}+\left(\frac{x^2}{4}+\frac{\psi^3}{27}\right)^{\frac{1}{2}}\right)^{\frac{1}{3}} + \left(-\frac{x}{2}-\left(\frac{x^2}{4}+\frac{\psi^3}{27}\right)^{\frac{1}{2}}\right)^{\frac{1}{3}}\right]}\,;$$

Where:

$$x = \frac{a - 1/T}{c},\quad \psi = \frac{b}{c}.$$

The a, b and c constants can be calculated for either a thermistor material or for individual values of the thermistors within a material type. To solve for the constants, three sets of data must be used. Normally, for a temperature range, the low end, middle end and high end values are used to calculate the constants, resulting in the best fit for the equation over the range. Using the Steinhart-Hart equation allows for accuracy as good as ±0.001˚C over a 100˚C temperature span.

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Resistance Temperature Characteristics

Temp	Resistance	Temp	Resistance	Temp	Resistance	Temp	Resistance	Temp	Resistance
˚C	KΩ	˚C	KΩ	˚C	KΩ	˚C	KΩ	˚C	KΩ
-40	3493	7	231.5	54	30.86	101	6.550	148	1.915
-39	3265	8	220.3	55	29.74	102	6.365	149	1.871
-38	3053	9	209.9	56	28.66	103	6.185	150	1.828
-37	2856	10	200.0	57	27.62	104	6.008	151	1.786
-36	2673	11	190.5	58	26.64	105	5.840	152	1.745
-35	2503	12	181.6	59	25.68	106	5.675	153	1.706
-34	2345	13	173.2	60	24.78	107	5.517	154	1.667
-33	2198	14	165.2	61	23.90	108	5.362	155	1.629
-32	2062	15	157.6	62	23.06	109	5.214	156	1.593
-31	1934	16	150.4	63	22.26	110	5.069	157	1.557
-30	1816	17	143.6	64	21.48	111	4.931	158	1.523
-29	1705	18	137.1	65	20.73	112	4.796	159	1.489
-28	1602	19	130.9	66	20.02	113	4.666	160	1.456
-27	1506	20	125.1	67	19.34	114	4.540	161	1.424
-26	1416	21	119.5	68	18.68	115	4.417	162	1.393
-25	1332	22	114.3	69	18.05	116	4.296	163	1.363
-24	1254	23	109.3	70	17.44	117	4.182	164	1.333
-23	1181	24	104.5	71	16.86	118	4.069	165	1.304
-22	1112	25	100.0	72	16.29	119	3.961	166	1.276
-21	1048	26	95.71	73	15.75	120	3.857	167	1.249
-20	988.4	27	91.61	74	15.23	121	3.755	168	1.222
-19	932.3	28	87.72	75	14.74	122	3.657	169	1.196
-18	879.6	29	84.00	76	14.25	123	3.562	170	1.171
-17	830.2	30	80.49	77	13.79	124	3.470	171	1.146
-16	784.1	31	77.11	78	13.35	125	3.381	172	1.122
-15	740.7	32	73.92	79	12.92	126	3.294	173	1.099
-14	699.9	33	70.86	80	12.50	127	3.210	174	1.076
-13	661.7	34	67.96	81	12.10	128	3.129	175	1.054
-12	625.9	35	65.19	82	11.72	129	3.050	176	1.032
-11	592.0	36	62.55	83	11.35	130	2.973	177	1.011
-10	560.4	37	60.01	84	11.00	131	2.898	178	0.9870
-9	530.5	38	57.61	85	10.65	132	2.826	179	0.9671
-8	502.4	39	55.32	86	10.32	133	2.756	180	0.9472
-7	476.2	40	53.12	87	10.00	134	2.688	181	0.9282
-6	451.3	41	51.02	88	9.698	135	2.622	182	0.9093
-5	428.0	42	49.02	89	9.401	136	2.557	183	0.8913
-4	405.8	43	47.12	90	9.115	137	2.495	184	0.8734
-3	385.1	44	45.28	91	8.838	138	2.434	185	0.8564
-2	365.4	45	43.54	92	8.573	139	2.376	186	0.8395
-1	347.1	46	41.88	93	8.317	140	2.318	187	0.8225
0	329.5	47	40.28	94	8.068	141	2.263	188	0.8066
1	313.0	48	38.74	95	7.827	142	2.209	189	0.7906
2	297.5	49	37.28	96	7.597	143	2.157	190	0.7757
3	282.7	50	35.88	97	7.374	144	2.106	191	0.7607
4	268.8	51	34.56	98	7.158	145	2.056	192	0.7458
5	255.6	52	33.26	99	6.949	146	2.008	193	0.7308
6	243.2	53	32.04	100	6.749	147	1.961	194	0.7168

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Temp	Resistance	Temp	Resistance	Temp	Resistance	Temp	Resistance	Temp	Resistance
˚C	KΩ	˚C	KΩ	˚C	KΩ	˚C	KΩ	˚C	KΩ
195	0.7039	211	0.5224	226	0.4004	241	0.3126	256	0.2469
196	0.6899	212	0.5125	227	0.3944	242	0.3076	257	0.2429
197	0.6770	213	0.5035	228	0.3874	243	0.3026	258	0.2398
198	0.6640	214	0.4945	229	0.3805	244	0.2977	259	0.2359
199	0.6520	215	0.4851	230	0.3745	245	0.2927	260	0.2329
200	0.6391	216	0.4771	231	0.3685	246	0.2887	261	0.2290
201	0.6281	217	0.4681	232	0.3625	247	0.2837	262	0.2263
202	0.6161	218	0.4602	233	0.3566	248	0.2787	263	0.2220
203	0.6042	219	0.4522	234	0.3506	249	0.2748	264	0.2190
204	0.5932	220	0.4442	235	0.3446	250	0.2708	265	0.2160
205	0.5822	221	0.4372	236	0.3386	251	0.2668	266	0.2130
206	0.5723	222	0.4293	237	0.3337	252	0.2626	267	0.2091
207	0.5613	223	0.4223	238	0.3277	253	0.2588	268	0.2060
208	0.5513	224	0.4143	239	0.3227	254	0.2548	269	0.2031
209	0.5414	225	0.4074	240	0.3176	255	0.2509	270	0.2001
210	0.5314								

ORDERING INFORMATION

Quantity	1 – 9	10 – 49	50 – 199	200 – 499	≥500
ATH100K1R25	$1.90	$1.70	$1.50	$1.30	$1.10
ATH100K1R25T70	$2.05	$1.85	$1.65	$1.45	$1.25
ATH100K1R25T70S	$2.20	$1.99	$1.80	$1.60	$1.40

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