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http://www.shibaura-e.co.jp

201809/TD.1000V

Shibaura Electronics Product Catalogue

SHIBAURA THERMISTORS

ELEMENTS & SENSORS

SHIBAURA ELECTRONICS CO., LTD.

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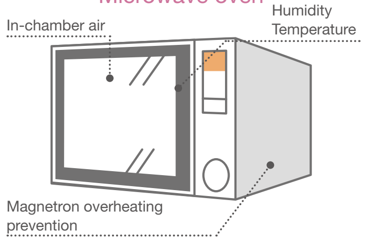
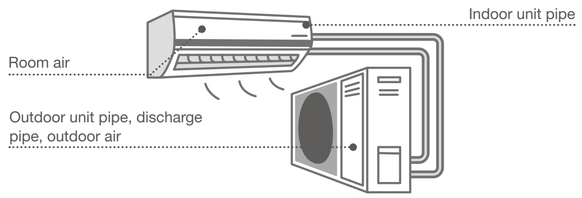
Shibaura's thermistor sensors support your daily lives

House

Microwave oven


Air conditioner


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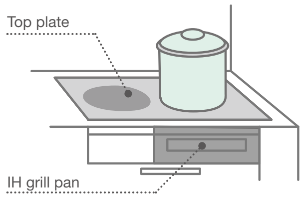

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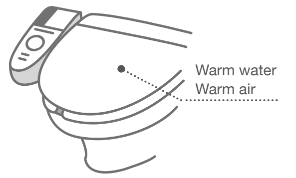
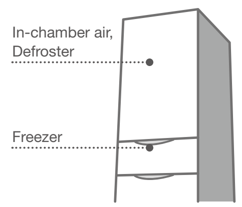
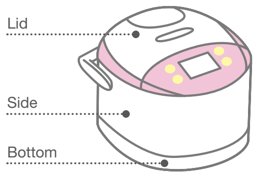


Refrigerator


Rice cooker


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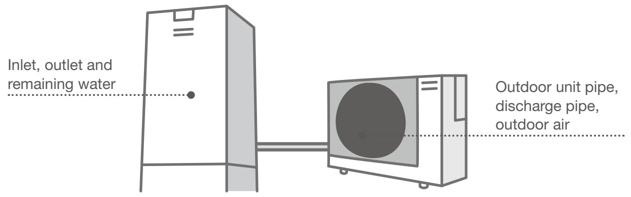
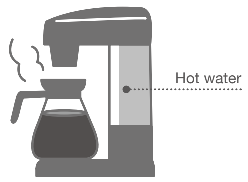
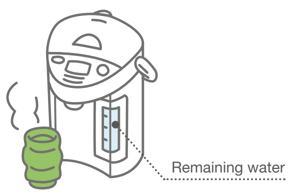
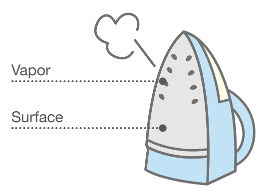
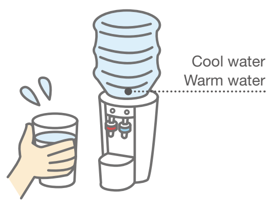
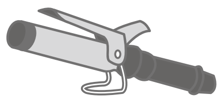


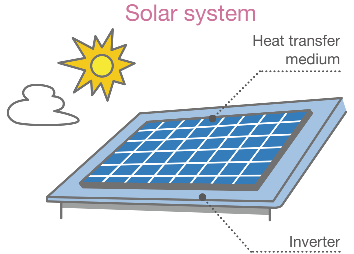
Coffee maker


Electric pot


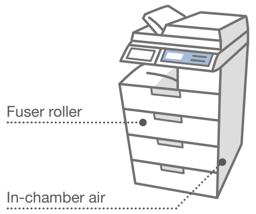
Iron


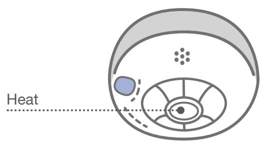
Water server


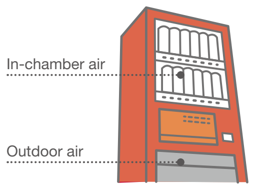
Hair iron & dryer


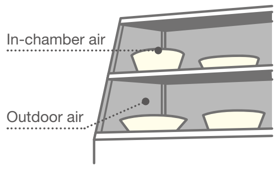
Solar system


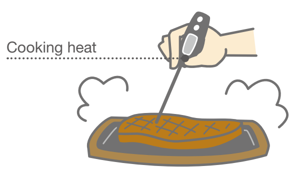
Office

Multi-function printer


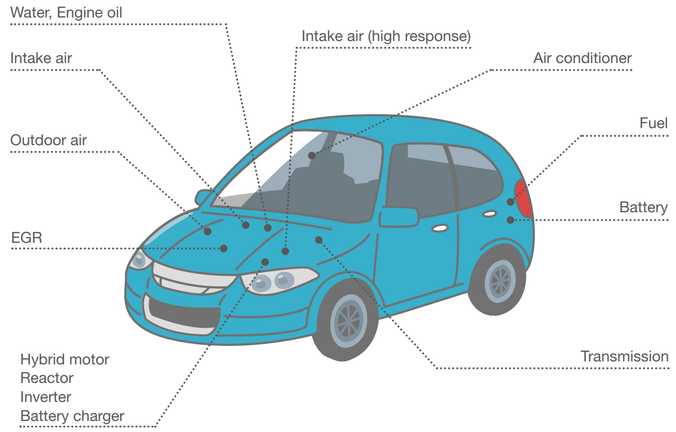
Fire alarm


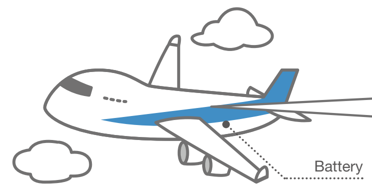
Automatic dispenser


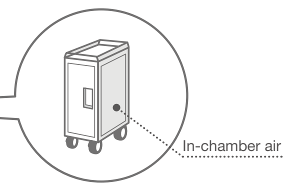
Showcase


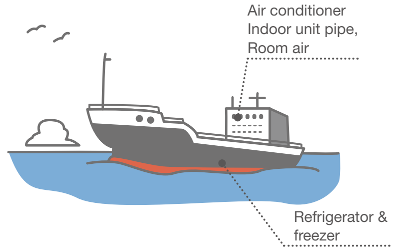
Probe


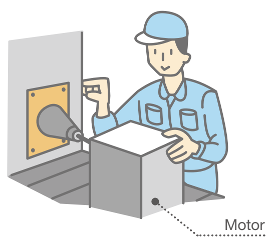
Vehicles, agriculture, industry

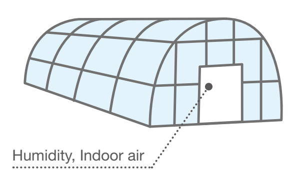
Automobile


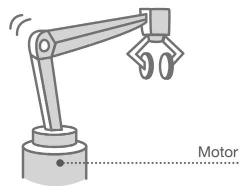
Airplane


Food cart


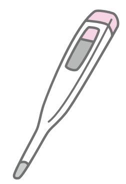
Vessel


Machine tool


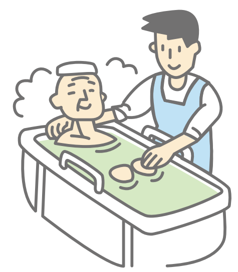
Greenhouse


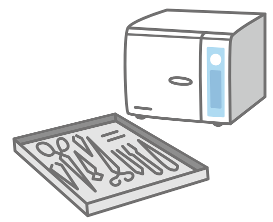
Industrial robot


Hospital

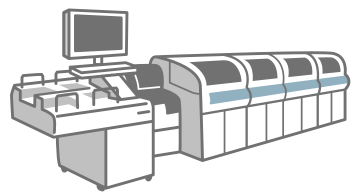
Thermometer


Dialyzer

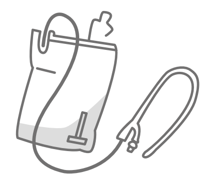

Bathtub


Sterilizer


Incubator


Automatic analyzer


Drug formulation machine


Catheter


What is a Thermistor?

Get the answer from our well-experienced professionals

The King of Temperature Sensors with a Negative Temperature Coefficient

A thermistor is a thermally sensitive element composed of semiconductive fine ceramics

The name thermistor comes from “a thermally sensitive resistor,” and its resistance drastically changes with temperature. The resistance of ordinary materials rises slightly as temperature rises, whereas NTC (negative temperature coefficient) thermistors exhibit a sharp decrease in resistance. Thermistors manufactured and supplied by Shibaura are all NTC thermistors.

The following descriptions are applicable only to NTC thermistors.

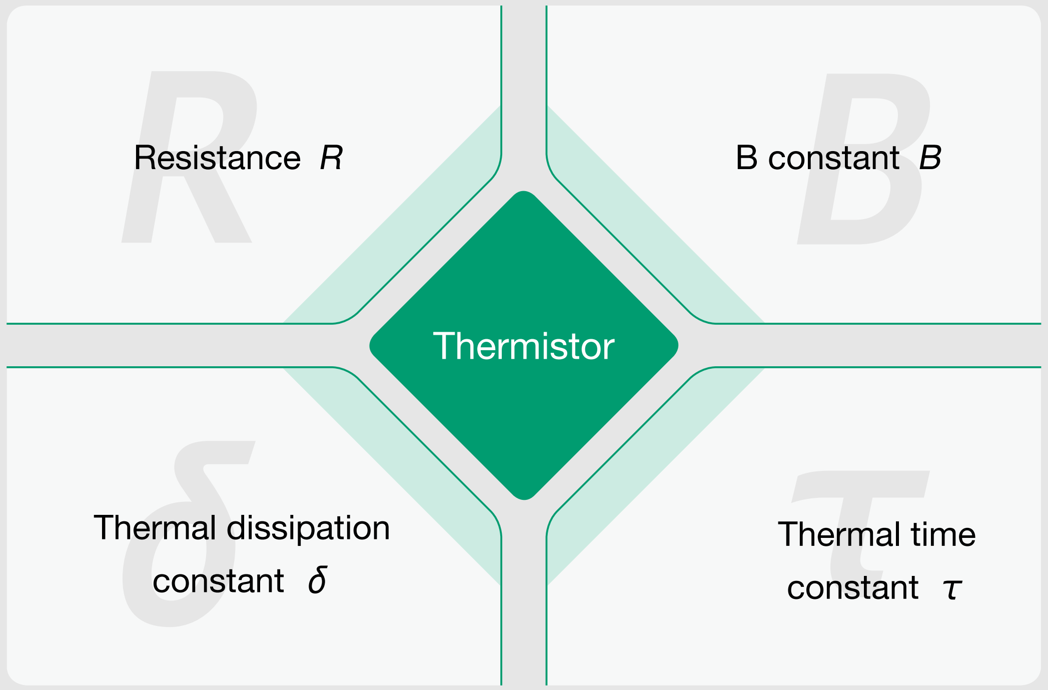
Thermistors are made from several transition metal oxides, primarily of Mn, Ni and Co, sintered into a fine ceramic body.

Shibaura’s thermistors cover a full range of temperatures from -50 to +500℃ that is required for daily temperature control. Our compact, stable and highly sensitive thermistors are used in large quantities as temperature sensors and for temperature compensation in many fields such as home appliances and industrial equipment.

Physical Properties of Thermistors

Four constants that determine the characteristics of a thermistor

The characteristics of a thermistor is basically determined by four constants; resistance R, B constant B, thermal dissipation constant δ, and thermal time constant τ.



In addition to the above four constants, “current - voltage characteristics” and “temperature coefficient of resistance” may also be used as supplementary factors.

You can find the details about the properties of thermistors on the following pages.

Resistance

The resistance of a thermistor is defined in the standard JIS C 5602 as follows:

“The DC resistance value of a thermistor when measured at a specified temperature with sufficiently low power dissipation where its resistance change due to self-heating is negligible as compared to the overall error in measurements.”

Shibaura measures the resistance of thermistors using standardized current values and in-house developed high precision thermostatic baths.

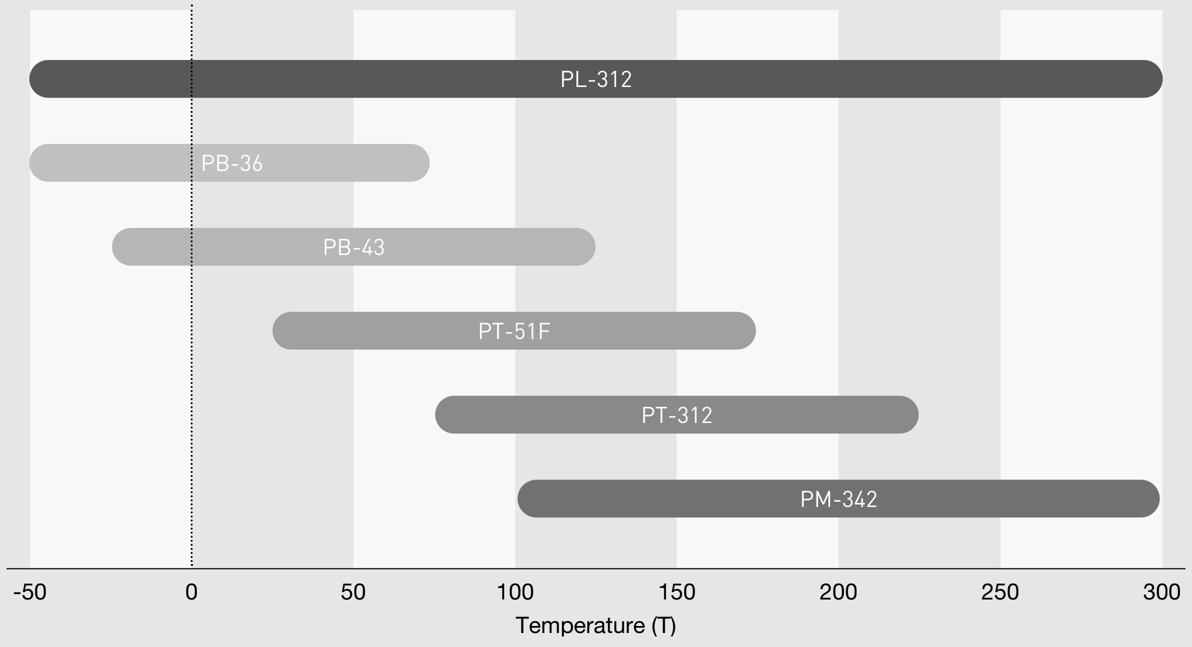
Shibaura’s thermistors are all NTC thermistors and their resistance lowers as temperature rises.

The relationship between resistance R and absolute temperature T can be approximated by the following equation.

$$R_1 = R_2 \exp B \left(\frac{1}{T_1} - \frac{1}{T_2}\right)$$

R_1 : resistance (Ω) at absolute temperature T_1 (K)
R_2 : resistance (Ω) at absolute temperature T_2 (K)
B : B constant (K)

For a desirable circuit design, it is recommended to select a thermistor that exhibits the resistance within a range from **100Ω to 100kΩ** for a usage temperature range. Shibaura offers a variety of options to be selected for your specific thermistors.



The resistance can be varied by changing the size of a thermistor chip.

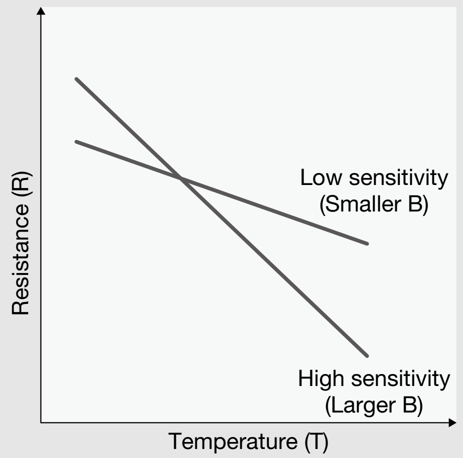
We are ready to customize any of our products in order to fulfill your demands.

B Constant

The B constant expresses a degree of thermistor sensitivity (change rate of its resistance) to temperature changes.

The change rate can also be expressed by the gradient of a line.

The larger the gradient, the higher the sensitivity.



The B constant is derived from the following equation using a change rate in resistance between two given temperatures.

$$B = \frac{\ln R_1 - \ln R_2}{\frac{1}{T_1} - \frac{1}{T_2}} = \frac{2.3026\,(\log R_1 - \log R_2)}{\frac{1}{T_1} - \frac{1}{T_2}}$$

B : B constant (K)
R_1 : resistance (Ω) at absolute temperature T_1 (K)
R_2 : resistance (Ω) at absolute temperature T_2 (K)

The B constant, unlike the resistance, cannot be varied by changing the chip size, but is determined by the material composition of a thermistor chip.

Additionally, in general, the larger the B constant, the higher the resistance of a thermistor will be.

Therefore, **the combination of resistance and B value has a limitation.**

It is, for example, very difficult to create a thermistor which has a very high resistance and a very small B value.

Shibaura has a vast array of combinations of resistances and B values, **and only a part of them are listed in this catalogue.**

We also support you with creating an original B value.

Here is an example of a B value (B0/100) calculation.

$$B = \frac{\ln R_1 - \ln R_2}{\frac{1}{T_1} - \frac{1}{T_2}} = \frac{\ln 162.2 - \ln 3.3}{\frac{1}{273.15} - \frac{1}{373.15}} = 3969.9 \fallingdotseq 3970$$

R_1 : resistance at 0℃ = 162.2kΩ
R_2 : resistance at 100℃ = 3.3kΩ
T_1 : 0℃ + 273.15 = 273.15K
T_2 : 100℃ + 273.15 = 373.15K

Thermal Dissipation Constant

The thermal dissipation constant δ indicates the amount of power required for a thermistor to heat itself up by 1℃ when it is energized in still air (mW/ ℃).

When a power W is applied to the thermistor at an ambient temperature Ta and the temperature of the thermistor finally reaches a temperature T, the following equation is established.

$$\delta = \frac{W}{T-Ta} = \frac{I^2R}{T-Ta}$$

δ : thermal dissipation constant (mW/ ℃)
W : power consumption in a thermistor (mW)
T : temperature at heat equilibrium (℃)
Ta : ambient temperature (℃)
I : current flowing in a thermistor at temperature T (mA)
R : resistance of a thermistor at temperature T (kΩ)

Applying a power equivalent to the thermal dissipation constant makes a thermistor heat itself up by 1℃. This causes an error between the measured and the actual ambient temperatures.

Therefore, it is necessary to **design circuitry to minimize the power to be applied so that measurement errors caused by thermistor's self-heating are eliminated.**

The thermal dissipation constant δ is determined by a balance between "self-heating" and "heat dissipation." As a result, **it varies substantially depending on the thermistor's surroundings.**

Placing materials that have a high thermal conductivity around the thermistor promotes heat release and increases the constant δ.

On the contrary, the construction allowing heat to accumulate decreases it. Therefore, it is essential to select appropriate materials in assembling your thermistor.

It is also important, after assembling your thermistor, to measure the constant δ in its operation environment (air, water, oil, hot plate etc.) to see that the constant meets your requirement.

Thermal Time Constant

The thermal time constant indicates a time required for a thermistor to respond to a change in its ambient temperature.

When the ambient temperature is changed from T_1 to T_2, the relationship between the time elapsed during the temperature change t (sec.) and the thermistor temperature T can be expressed by the following equation.

$$T = (T_2-T_1)\left(1-\exp(-t/\tau)\right) + T_1$$

τ (sec.) in the equation denotes the thermal time constant.

Now, assuming t and τ are equal ($t = \tau$), the equation can be expressed as follows.

$$T = (T_2-T_1)(1-e^{-1}) + T_1$$

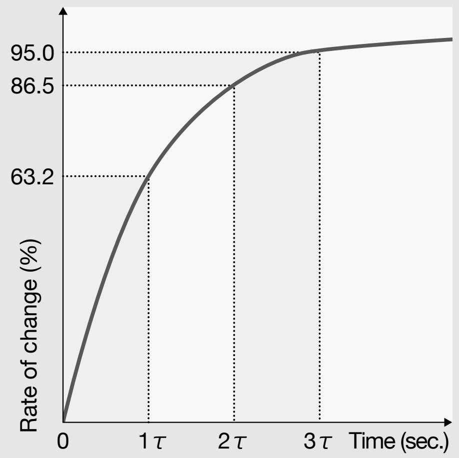
$$\frac{T-T_1}{T_2-T_1} = 1-e^{-1} = 1-\frac{1}{2.718} = 0.632$$

This shows that the constant τ (sec.) is defined as a time for the thermistor to reach 63.2% of the total difference between its initial and final body temperatures.

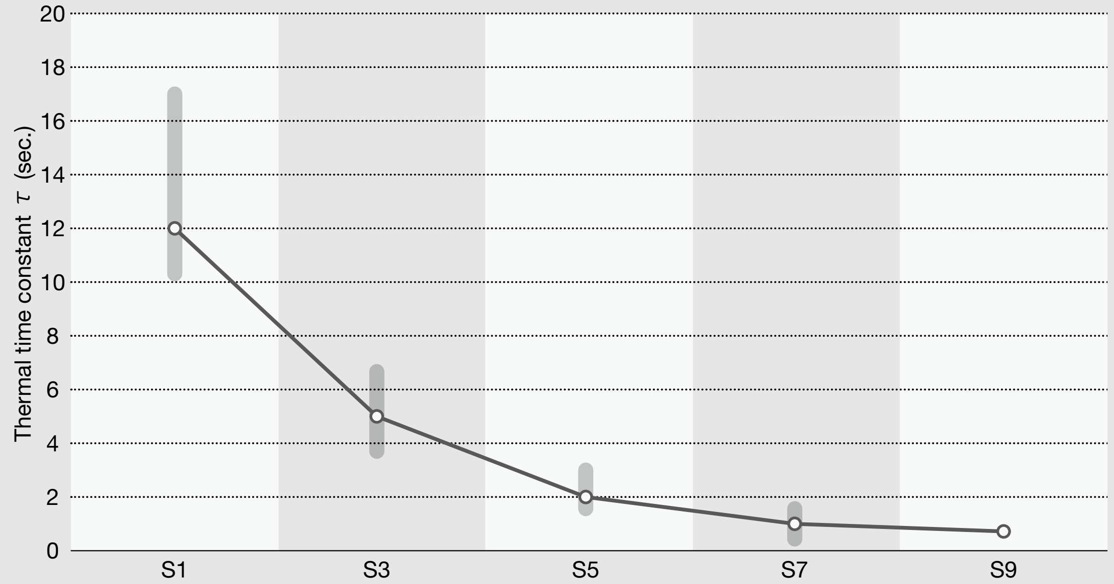
The thermistor body temperature does not reach its ambient temperature when a time period defined by τ is elapsed.

The temperature change rate at n times the constant τ (sec.) is as follows, showing that the thermistor body temperature reaches its ambient temperature approximately within 7 times the constant.

τ = 63.2% 2τ = 86.5% 3τ = 95.0% ・・・・ $7\tau \fallingdotseq$ 100%



Generally, the smaller the size of the thermistor, the faster the thermal response, and thus the smaller the constant τ will be. The constant varies significantly depending on thermistor assemblies. It is necessary to select materials having a high thermal conductivity considering the environment where the thermistor is used.



Current - Voltage (I-V) Characteristics

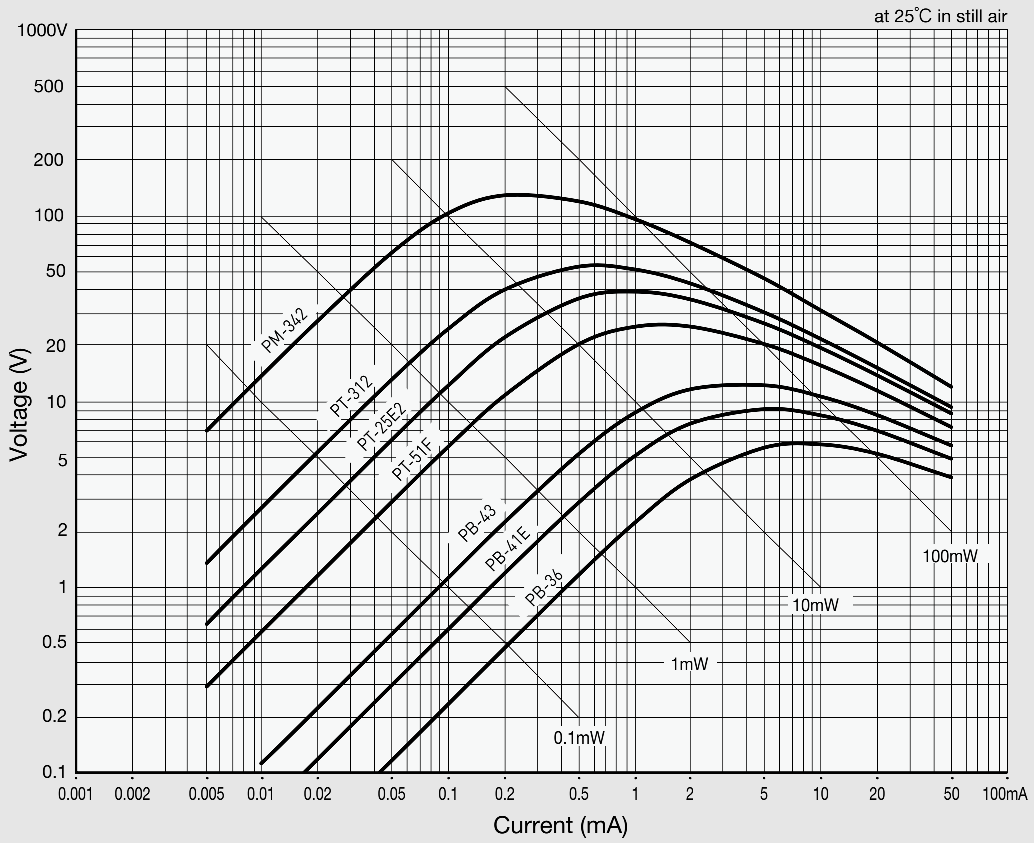
The current - voltage characteristics describes the voltage change as the current flow through a thermistor varies.
I-V curves of NTC thermistors are characterized in that the voltage rises linearly as the current rises. However, the voltage begins to decrease after achieving its peak at a certain current value.

A thermistor begins self-heating when a current is applied, and the amount of heat generated by the thermistor becomes larger as that of current flow increases.
While the heat generation is small, the heat release from the surface and lead wires of the thermistor is large. Thus, the thermistor body temperature will not change and so too its resistance. The current and voltage are directly proportional to each other according to Ohm's Law.

However, once the amount of heat generation becomes larger than that of heat release, the thermistor body temperature rises, its resistance lowers, and the proportional relationship between current and voltage is lost. Then the voltage gradually decreases after achieving its peak at a certain point.

The chart below shows the I-V characteristics of different thermistor elements. **It is important to use a thermistor within the range where a line is straight** and self-heating has little effect on the resistance.

Using voltages over the peaks shown on the chart may bring the thermistors into "a runaway mode" where they glow and break down in a short time. Particular attention should be given to voltages that will be applied.

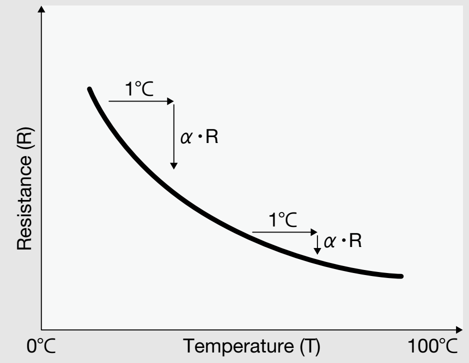


Temperature Coefficient of Resistance α

The temperature coefficient of a thermistor denotes the rate of change of thermistor resistance per 1℃ and is commonly expressed in %/℃.
The coefficient α is defined by $\alpha = \frac{1}{R} \cdot \frac{dR}{dT}$.
Here, the equation given in page 6 is differentiated for temperature T and substituted into the above equation. Then the following equation is obtained.

$$\alpha = \frac{1}{R} \cdot \frac{dR}{dT} \times 100 = -\frac{B}{T^2} \times 100$$

α : temperature coefficient of resistance (%/℃)
R : resistance (Ω) at absolute temperature T (K)
B : B constant (K)



The coefficient α of a thermistor with its B = 3400K and T = 293.15K (20℃), for example, can be determined as follows.

$$\alpha = \frac{-3400}{(273.15+20)^2} \times 100$$

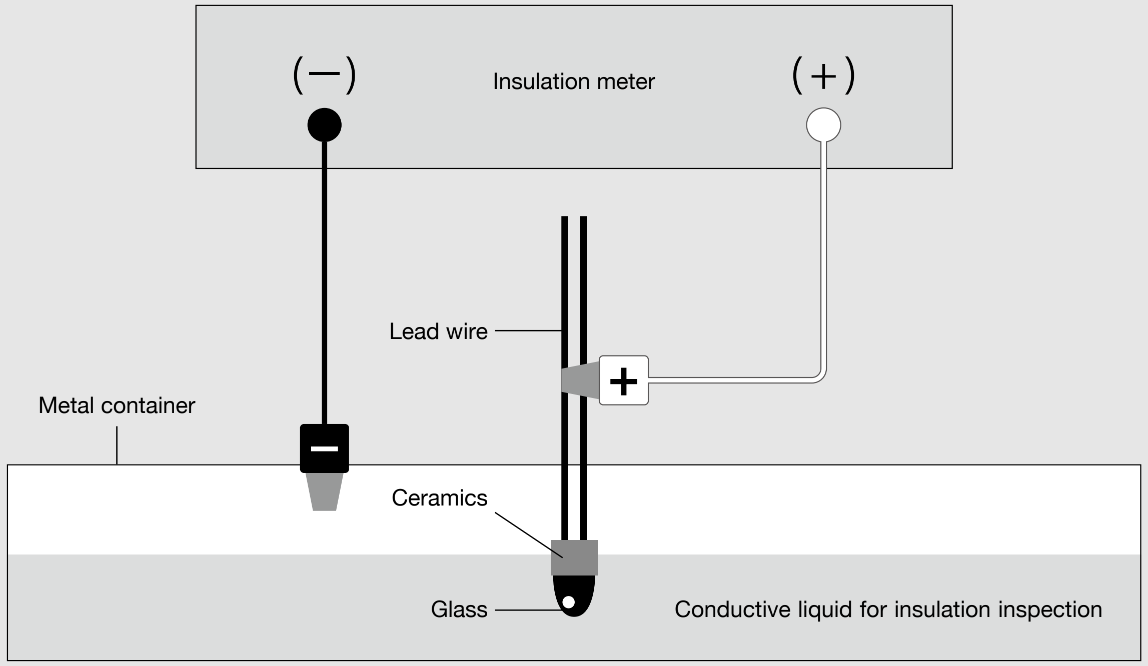
$$\alpha \fallingdotseq -4\%/℃$$

The negative sign of the coefficient α indicates that the thermistor resistance decreases with increasing temperature.

Metals and alloys, in general, raise their resistance as temperature rises. Their temperature coefficients of resistance, for example, are 0.4%/℃ (gold), 0.39%/℃ (platinum), and iron and nickel are relatively larger with 0.66%/℃ and 0.67%/℃, respectively. Thermistors, as compared with these metals, vary their resistance significantly with a small temperature change. Therefore, thermistors are suitable for precise temperature measurements and controlling the temperature by using slight differences in temperature.

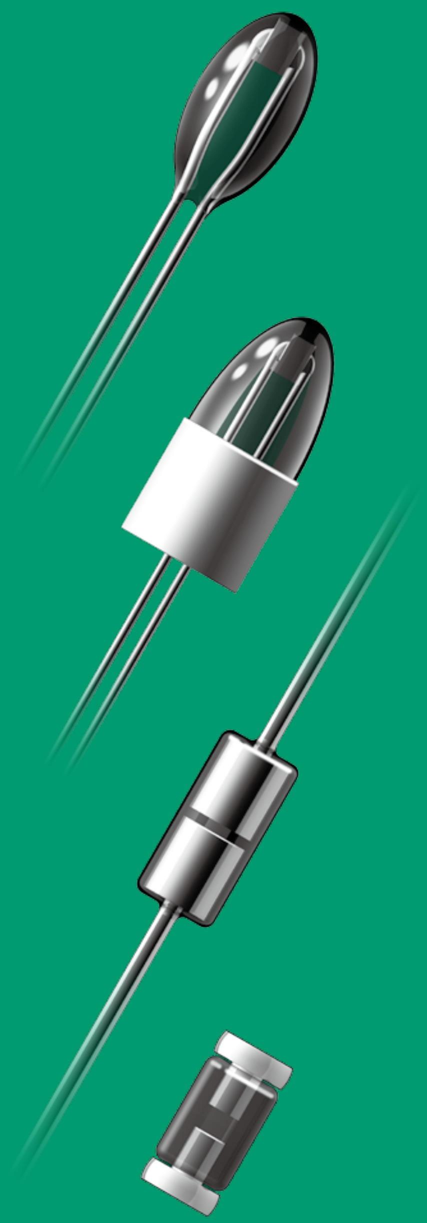
Insulation Resistance

The insulation resistance of a thermistor element is measured between its lead wires and glass.
It is essential that a thermistor provides good electrical insulation to secure its durability.
Shibaura carries out 100% inspection on all products (except PSB-N, RB1-N and KG) by measuring the insulation resistance of each element in manufacturing processes.
The figure below shows the measuring method.
A metal container is filled with conductive liquid. A thermistor is immersed in the liquid in such a way that its glass is submerged below the liquid surface. (For NS elements, the liquid level is on the ceramics.)
The positive pole of the insulation meter is connected to the thermistor lead wires, and the negative pole to the metal container, and the resistance between the lead wires and glass is measured.



#1 Global Brand
Shibaura's Standard Product Lineup

Thermistor Elements



Note) Unless otherwise stated, all thermal time constants and dissipation constants are measured in still air.

PSB Thermistors

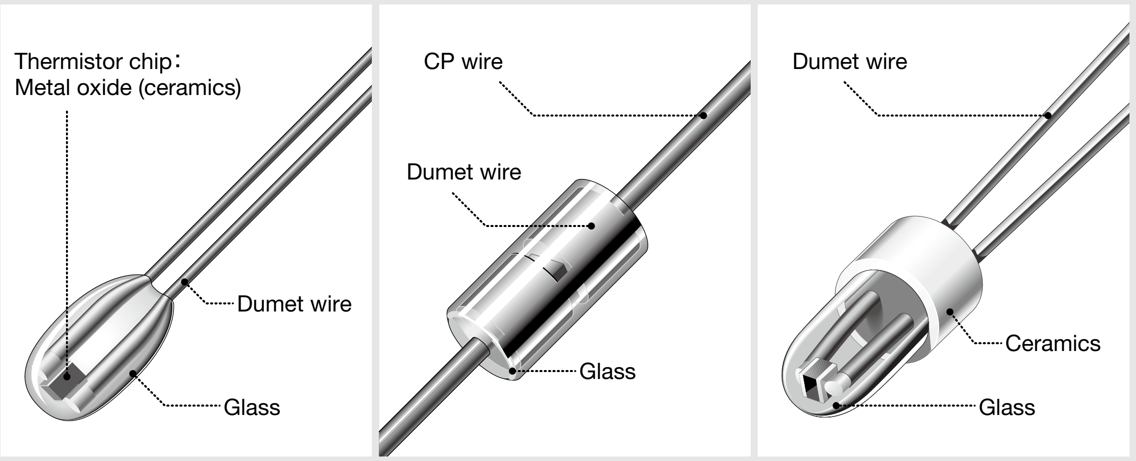
The ultimate thermistors with proven results, patented in eight major countries

PSB thermistors were invented and patented in eight major countries (Japan, the U.S., the U.K., Germany, France, Canada, Italy and Switzerland). They are the most appreciated and the most-used thermistors for temperature measurements and compensations.

Many outstanding features

- Lead wires are bonded to a thermistor chip via gold electrodes (PSB-S, NS).
- Highly stable with a thermistor chip made of fine ceramics.
- Excellent heat and weather proof provided by glass-encapsulation.
- Little variation in shape and characteristics due to automated production.
- Micro thermistors with an excellent thermal response are available.
- High-volume supply in high quality by integrated automatic production.

Structure



Thermistor material properties

Item	Chip	Glass coat	Lead wire	Ceramics
Material	Mn, Ni, Co oxides	Glass	Dumet wire	MgO・SiO_2
Young's modulus (GPa)	150	50	150	150
Poisson's ratio	0.25	0.26	0.33	0.24
Thermal expansion coefficient (25 to 400℃)	90×10^{-7}	91×10^{-7}	88×10^{-7}	97×10^{-7}
Thermal conductivity (W/m・K)	10	0.7	150	5.0
Specific heat (J/kg・K)	200	900	400	800
Density (g/cm^3)	5.0	4.3	8.5	3.0

Note) Typical values.

Thermistor Elements

Resistance - Temperature Characteristics Table

You can directly find the resistance value at your desired temperature

The table below shows the resistance - temperature (R-T) characteristics of the PSB thermistors.

Figures in the parentheses ( ) are the nominal resistances at the reference temperatures.

PSB thermistor standard resistance – temperature characteristics table

Unit: kΩ

Specification	P□□-35G	P□□-36	P□□-42H	P□□-43	P□□-51F	P□□-25E2	P□□-312	P□□-342	P□□-312
B25℃/85℃	3529K	3420K	3435K	3480K	3992K	4066K	4240K	4557K	-
℃ ※	3500K(1)	3390K(1)	3406K(1)	3450K(1)	3970K(1)	4300K(2)	4537K(2)	5133K(3)	2240K(4)
-50	81.20	77.58	364.0	408.0					205.0
-45	59.66	57.69	269.8	301.4					165.5
-40	44.31	43.34	202.2	225.1					134.8
-35	33.24	32.87	153.0	169.8					110.7
-30	25.18	25.17	116.8	129.3					91.60
-25	19.25	19.43	90.05	99.32	657.4	1317			76.37
-20	14.85	15.13	69.99	76.96	487.4	980.5			64.12
-15	11.55	11.88	54.84	60.13	365.0	736.8			54.18
-10	9.051	9.392	43.30	47.34	276.1	558.6			46.07
-5	7.149	7.481	34.44	37.55	210.7	427.2			39.40
0	5.688	(6.000)	27.59	(30.00)	162.2	329.4	806.5		33.88
5	4.557	4.844	22.25	24.13	125.8	255.0	618.9		29.29
10	3.675	3.935	18.05	19.53	98.32	198.9	478.8		25.44
15	2.982	3.217	14.74	15.91	77.45	156.3	373.1		22.20
20	2.435	2.644	12.11	13.03	61.47	123.8	292.9		19.46
25	(2.000)	2.186	(10.00)	10.74	49.12	98.63	231.4	1388	17.13
30	1.652	1.817	8.304	8.896	39.52	79.13	184.1	1085	15.14
35	1.372	1.518	6.931	7.409	32.00	63.87	147.4	853.9	13.43
40	1.145	1.274	5.814	6.201	26.06	51.87	118.7	676.5	11.96
45	0.9602	1.075	4.900	5.215	21.36	42.36	96.13	539.3	10.69
50	0.8092	0.9106	4.149	4.406	17.60	34.79	78.29	432.5	9.582
55	0.6851	0.7749	3.529	3.739	14.58	28.72	64.10	348.9	8.617
60	0.5826	0.6622	3.014	3.186	12.14	23.83	52.76	283.0	7.772
65	0.4976	0.5683	2.584	2.727	10.16	19.87	43.63	230.8	7.031
70	0.4267	0.4895	2.225	2.343	8.541	16.64	36.26	189.2	6.377
75	0.3673	0.4233	1.923	2.021	7.214	14.00	30.27	155.9	5.800
80	0.3175	0.3674	1.667	1.749	6.120	11.83	25.38	129.0	5.288
85	0.2754	0.3200	1.451	1.520	5.213	10.04	21.37	107.3	4.834
90	0.2397	0.2796	1.268	1.325	4.459	8.556	18.06	89.57	4.428
95	0.2094	0.2452	1.111	1.159	3.829	7.318	15.33	75.12	4.066
100	0.1835	0.2156	0.9763	1.017	(3.300)	6.282	13.06	63.26	3.741
105	0.1613	0.1902	0.8608	0.8947	2.854	5.412	11.17	53.48	3.449
110	0.1423	0.1683	0.7612	0.7898	2.478	4.679	9.585	45.38	3.186
115	0.1259	0.1494	0.6751	0.6992	2.158	4.059	8.254	38.65	2.949
120	0.1117	0.1330	0.6004	0.6208	1.886	3.532	7.131	33.04	2.735
125	0.0994	0.1186	0.5354	0.5527	1.653	3.083	6.181	28.34	2.540
130	0.0886	0.1061	0.4787	0.4933	1.453	2.700	5.374	24.39	2.364
135	0.0793	0.0952	0.4290	0.4414	1.281	2.371	4.686	21.05	2.203
140	0.0711	0.0856	0.3855	0.3960	1.133	2.088	4.098	18.23	2.057
145	0.0639	0.0772	0.3472	0.3561	1.004	1.844	3.594	15.84	1.923
150	0.0576	0.0697	0.3134	0.3209	0.8928	1.632	3.161	13.80	1.800
155	0.0520	0.0631	0.2836	0.2899	0.7957	1.449	2.787	12.05	1.688
160	0.0471	0.0573	0.2571	0.2625	0.7109	1.289	2.464	10.56	1.585
165	0.0427	0.0521	0.2336	0.2381	0.6367	1.150	2.184	9.272	1.490
170	0.0389	0.0475	0.2127	0.2165	0.5716	1.028	1.940	8.164	1.402
175	0.0354	0.0433	0.1940	0.1972	0.5142	0.9217	1.728	7.207	1.322
180	0.0323	0.0396	0.1774	0.1800	0.4637	0.8278	1.542	6.377	1.247
185	0.0296	0.0363	0.1624	0.1646	0.4190	0.7451	1.379	5.656	1.178
190	0.0271	0.0334	0.1490	0.1508	0.3793	0.6720	1.237	5.028	1.114
195	0.0249	0.0307	0.1369	0.1384	0.3442	0.6074	1.111	4.480	1.055
200	0.0229	0.0283	0.1261	0.1272	0.3128	(0.5500)	(1.000)	(4.000)	(1.000)
205					0.2849	0.4990	0.9020	3.579	0.9488
210					0.2600	0.4536	0.8151	3.209	0.9010
215					0.2376	0.4130	0.7380	2.882	0.8565
220					0.2176	0.3768	0.6694	2.594	0.8150
225					0.1995	0.3443	0.6083	2.340	0.7762
230					0.1833	0.3151	0.5537	2.114	0.7398
235					0.1686	0.2889	0.5049	1.913	0.7058
240					0.1554	0.2653	0.4611	1.734	0.6739
245					0.1434	0.2440	0.4218	1.575	0.6439
250					0.1326	0.2247	0.3865	1.432	0.6158
255					0.1227	0.2072	0.3547	1.305	0.5893
260					0.1137	0.1914	0.3259	1.191	0.5644
265					0.1056	0.1771	0.3000	1.088	0.5410
270					0.0981	0.1640	0.2765	0.9958	0.5188
275					0.0913	0.1521	0.2552	0.9127	0.4979
280					0.0851	0.1413	0.2358	0.8377	0.4782
285					0.0793	0.1313	0.2182	0.7700	0.4596
290					0.0741	0.1223	0.2022	0.7086	0.4419
295					0.0693	0.1140	0.1876	0.6531	0.4252
300					0.0649	0.1064	0.1743	0.6026	0.4094

※ Measuring temperatures of B constants: (1) 0℃/100℃ (2) 100℃/200℃ (3) 200℃/300℃ (4) 25℃/50℃

Note) Please refer to page 16, "Concept of resistance – temperature characteristics table"

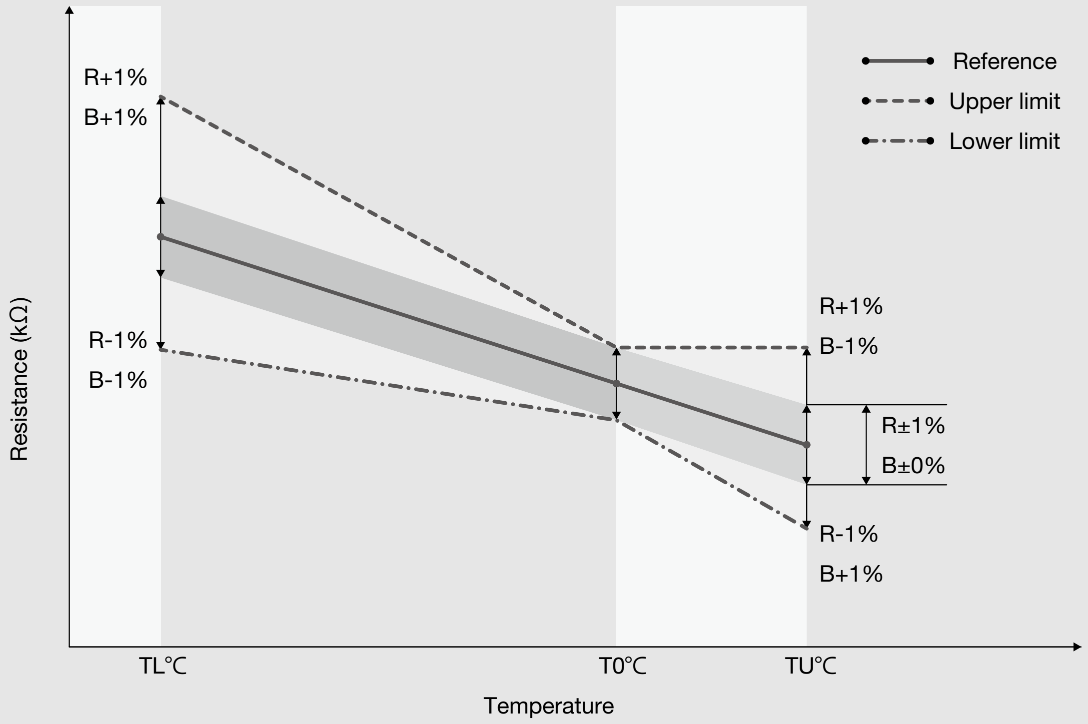
Concept of Resistance - Temperature (R-T) Characteristics Table

The resistance of thermistors varies not linearly with temperature but shows a curve with increasing temperature. Shibaura calculates the values in the R-T characteristics table using the following expression.

$$R=R_0 \exp\left[B\left(\frac{1}{T}-\frac{1}{T_0}\right)+C\ln\frac{T_0}{T}+D\left(\ln\frac{T_0}{T}\right)^2\right]$$

R_0: nominal resistance (kΩ)　T_0: reference temperature (K)　B, C, D: constants specific to the thermistor

The nominal resistance R_0 and the B constant value have tolerances, respectively. The resistance variation is affected by the B constant. As the difference between a given temperature and the reference temperature becomes larger, the resistance variation becomes larger.
The illustration below shows the width of resistance variation in relation to temperature when the tolerance of the resistance and the B constant is set to ±1%.



Our R-T characteristics table is made based on the concept described above.

Specifications for Durability

Shibaura's PSB thermistors, regardless of their shapes or specific characteristics, meet the durability specifications given below.

1 Temperature cycle test

Condition: 500 cycles (see chart 1)

Criteria: Resistance drift rate shall be within ±2.0%, no abnormalities in appearance and shape after testing.

2 Thermal shock test

Condition: 5 cycles (see chart 2)

Criteria: Resistance drift rate within ±1.0%, no abnormalities in appearance and shape after testing.

3 High temperature storage test

Condition: 150 ±5℃ for 1000 hours, then at room temperature for 1 hour

Criteria: Resistance drift rate within ±2.0%.

4 Damp heat test

Condition: 80 ±2℃, 90 to 95%RH for 1000 hours, then at room temperature for 2 hours

Criteria: Resistance drift rate within ±1.0%.

5 High temperature load test

Condition: 150 ±5℃ and energized with 50μA for 1000 hours, then at room temperature for 1 hour

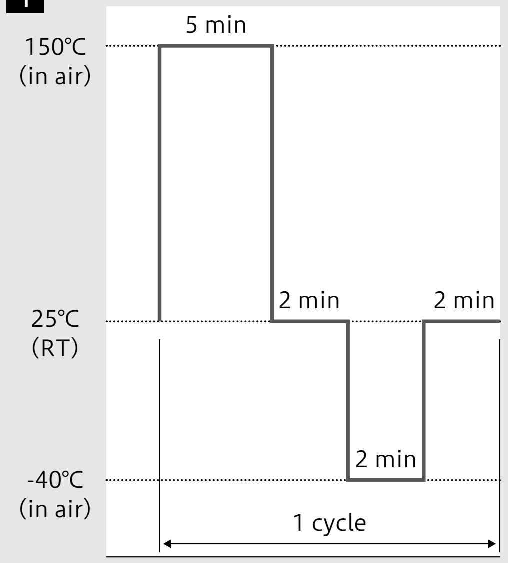
Criteria: Resistance drift rate within ±2.0%.

6 Low temperature storage test

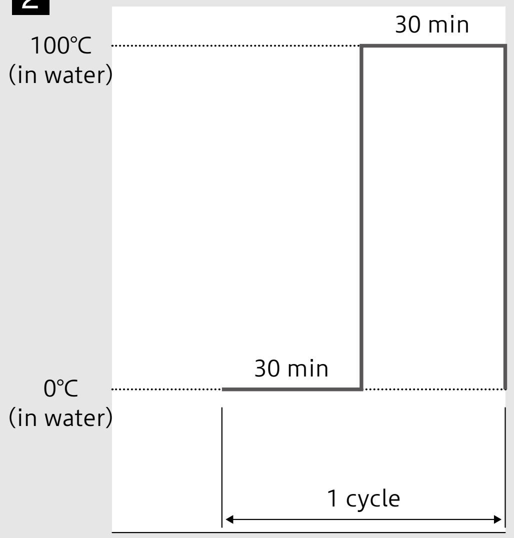
Condition: -40 ±2℃ for 1000 hours, then at room temperature for 1 hour

Criteria: Resistance drift rate within ±1.0%, no abnormalities in appearance and shape after testing.

1



2



Model Names and Thermistor Element Lineup

The PSB product names show the specific characteristics of the thermistors

The PSB thermistors have a model name classified by the shape of the thermistor and a product name that is mainly classified by the characteristics of the thermistor.
A product name also indicates the model of that product.

Thermistor element lineup

Unit: mm

Category	STANDARD				COMPACT			ADVANCED			PL			RB1			KG	
Model name	PSB-S1	PSB-S2	PSB-S3	PSB-N	PSB-S5	PSB-S7	PSB-S9	NS II -E1	NS II -E3	NS III -U1	PL	PL2	PL3	S1	S3	N	KG2	KG3
Operating temperature	-50 to +300°C				-50 to +250°C			-			-50 to +300°C			-50 to +120°C			-50 to +200°C	
Max. operating temperature	-				-			300°C		500°C	-			-			-	
Thermal time constant	Approx. 12 sec.	Approx. 9 sec.	Approx. 5 sec.	Approx. 12 sec.	Approx. 2 sec.	Approx. 1 sec.	Approx. 0.6 sec.	Approx. 18 sec.	Approx. 10 sec.	Approx. 18 sec.	Approx. 12 sec.	Approx. 8 sec.	Approx. 5 sec.	Approx. 12 sec.	Approx. 5 sec.	Approx. 12 sec.	Approx. 5 sec.	Approx. 10 sec.
Dissipation constant	Approx. 1.3mW/°C	Approx. 1.0mW/°C	Approx. 0.75mW/°C	Approx. 2.3mW/°C	Approx. 0.4mW/°C	Approx. 0.25mW/°C	Approx. 0.15mW/°C	Approx. 1.5mW/°C	Approx. 1.2mW/°C	Approx. 1.5mW/°C	Approx. 1.3mW/°C	Approx. 0.9mW/°C	Approx. 0.75mW/°C	Approx. 1.3mW/°C	Approx. 0.75mW/°C	Approx. 2.3mW/°C	Approx. 1.3mW/°C	Approx. 1.4mW/°C
Insulation resistance	DC500V 50MΩ	DC50V 10MΩ		DC500V 100MΩ	DC50V 10MΩ			DC500V 100MΩ	DC50V 10MΩ	DC500V 100MΩ	DC500V 50MΩ	DC50V 10MΩ		DC500V 50MΩ	DC50V 10MΩ	DC500V 100MΩ	-	
Glass dimensions	ϕ2.3±0.2 L4.1±0.5	ϕ1.6±0.2 L2.7±0.4	ϕ1.3±0.2 L2.2±0.4	ϕ1.8±0.2 L3.7±0.4	ϕ0.8±0.1 L1.4±0.4	ϕ0.55±0.1 L1.1±0.3	ϕ0.43±0.1 L0.8±0.3	ϕ2.1±0.2 L4.0±0.3	ϕ1.2±0.2 L2.0±0.3	ϕ2.3±0.3 L2.8±0.3	ϕ2.3±0.2 L4.1±0.5	ϕ1.6±0.2 L2.7±0.4	ϕ1.3±0.2 L2.2±0.4	ϕ2.3±0.2 L4.1±0.5	ϕ1.3±0.2 L2.2±0.4	ϕ1.8±0.2 L3.7±0.4	□1.2±0.1 L1.4±0.1	□1.65±0.1 L2.3±0.1
Lead wire diameter	0.30	0.25	0.20	0.50	0.15	0.10	0.07	0.35	0.20	0.35	0.30	0.25	0.20	0.30	0.20	0.50	-	
Ceramics dimensions	-				-			ϕ2.2±0.2 L1.5±0.2	ϕ1.5±0.2 L3.0±0.2	ϕ2.2±0.2 L1.5±0.2	-			-			-	
Page	P.20	P.21	P.22	P.23	P.24	P.25	P.26	P.27	P.28	P.29	P.30			P.31			P.32	P.33

Format of PSB thermistor product name

Product name example: P T 7 - 2 5 E 2

P

Denotes a PSB thermistor

B constant classification

- L 3000K or smaller
- D 3001 to 3300K
- B 3301 to 3600K
- T 3601 to 4600K
- M 4601 to 5800K
- H 5801 to 9000K
- U 9001K or larger

Model name classification

Blank	PSB-S1
2	PSB-S2
3	PSB-S3
5	PSB-S5
7	PSB-S7
9	PSB-S9
N	PSB-N

Resistance value index

Exponent part of the resistance value X

X10^{X}Ω

Integer part of the resistance value

Fraction part of the resistance value

A	0.1
B	0.2
C	0.3
D	0.4
⋮	⋮
I	0.9
Blank	0

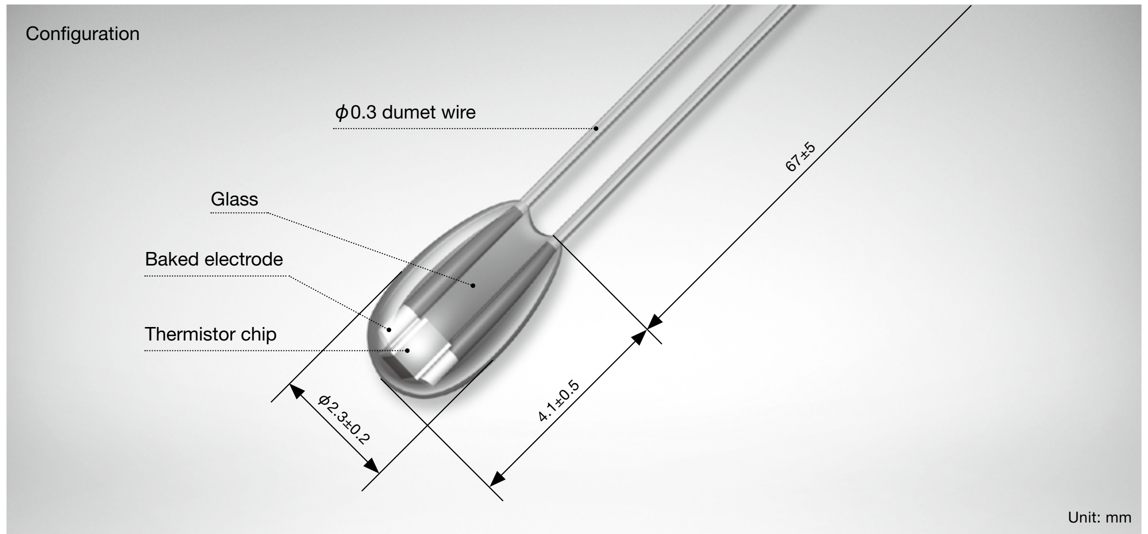
Rated temperature of the resistance value

2	200°C
Blank	0°C

$10^2 \times 5.5\Omega$ at 200°C

2 5 E 2

PSB-S1 thermistor



The standard product in PSB thermistors

With proven results in automotive, home appliances and other fields for more than 30 years, the PSB-S1 is universally recognized as the most reliable thermistor. The PSB-S1 accounts for Shibaura's largest production volume and is a practical global standard for all glass-encapsulated thermistors.

Features

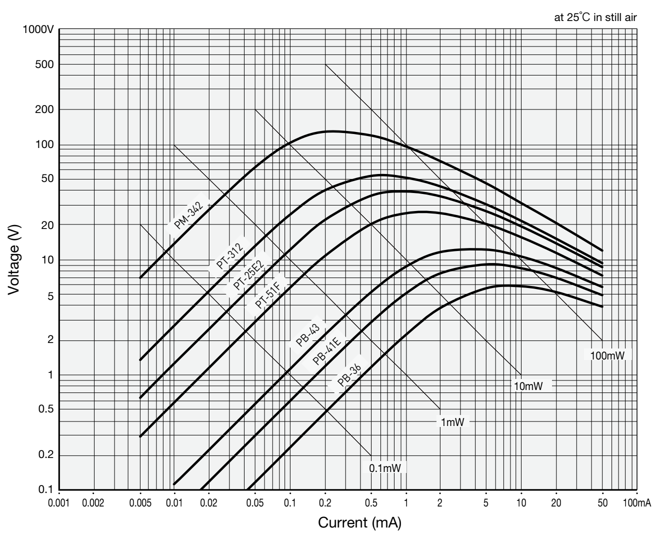
- Chip with gold electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production
- Patented in 8 major countries (Japan, the U.S., Canada, France, the U.K., Germany, Italy and Switzerland)

Applications

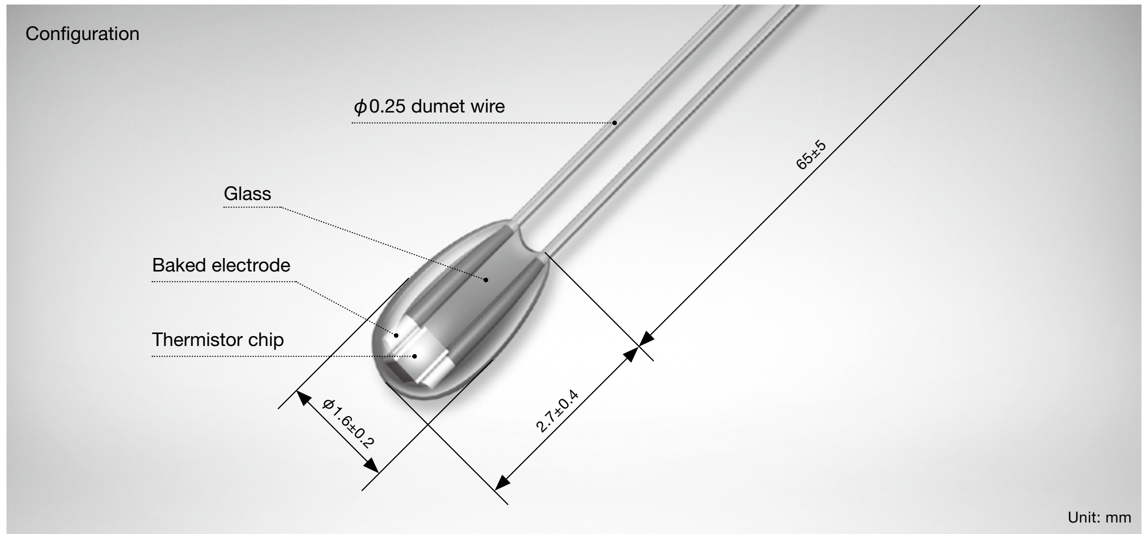
For equipment that requires high reliability in temperature measurement and control in addition to the following equipment
・Air conditioners ・Hot water boilers ・Home appliances
・Automobiles (water, intake air, ambient, battery, motor and fuel)

Operating temperature	-50 to +300℃
Thermal time constant	Approx. 12 sec.
Dissipation constant	Approx. 1.3mW/℃
Insulation resistance	Min. 50MΩ at 500VDC

V-I characteristics



PSB-S2 thermistor



If you need both improved response and mechanical strength

The answer is PSB-S2. It is downsized and 1.5 times faster in response than the PSB-S1. Its ϕ0.25mm dumet wires make the handling of the product easier during processing.

Features

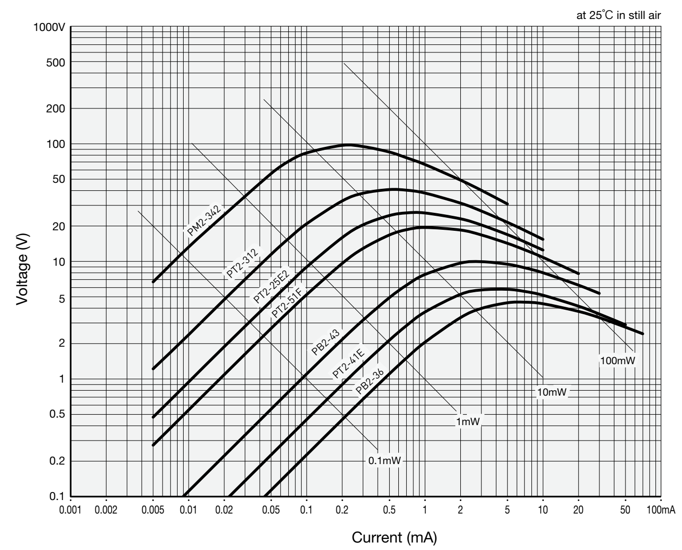
- Chip with gold electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production

Applications

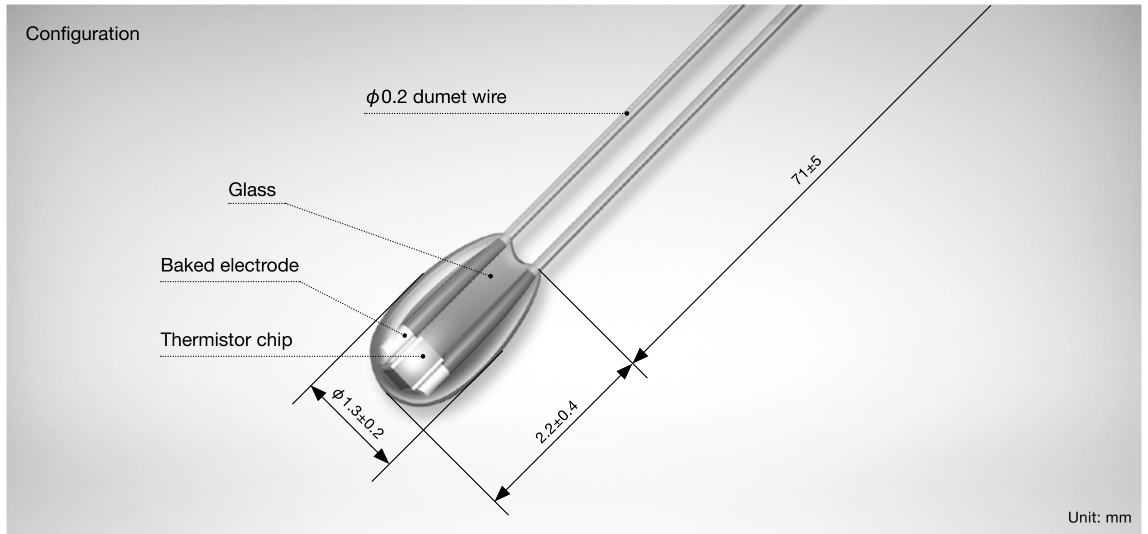
Suitable for applications requiring a fast response by downsizing as well as mechanical strength
・Air conditioners ・Hot water boilers ・Home appliances
・Automobiles (water, intake air, ambient, battery, motor and fuel)

Operating temperature	-50 to +300℃
Thermal time constant	Approx. 9 sec.
Dissipation constant	Approx. 1.0mW/℃
Insulation resistance	Min. 10MΩ at 50VDC

V-I characteristics



PSB-S3 thermistor



If you need thermistors for a faster response

The PSB-S3 has been developed as a standard high response element exhibiting approximately a two times faster response than the PSB-S1 at reasonable cost.

Features

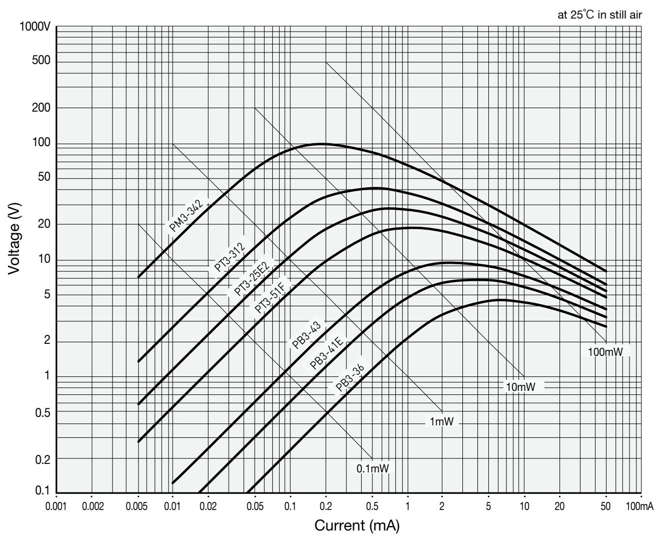
- Chip with gold electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production
- Patented in 8 major countries (Japan, the U.S., Canada, France, the U.K., Germany, Italy and Switzerland)

Applications

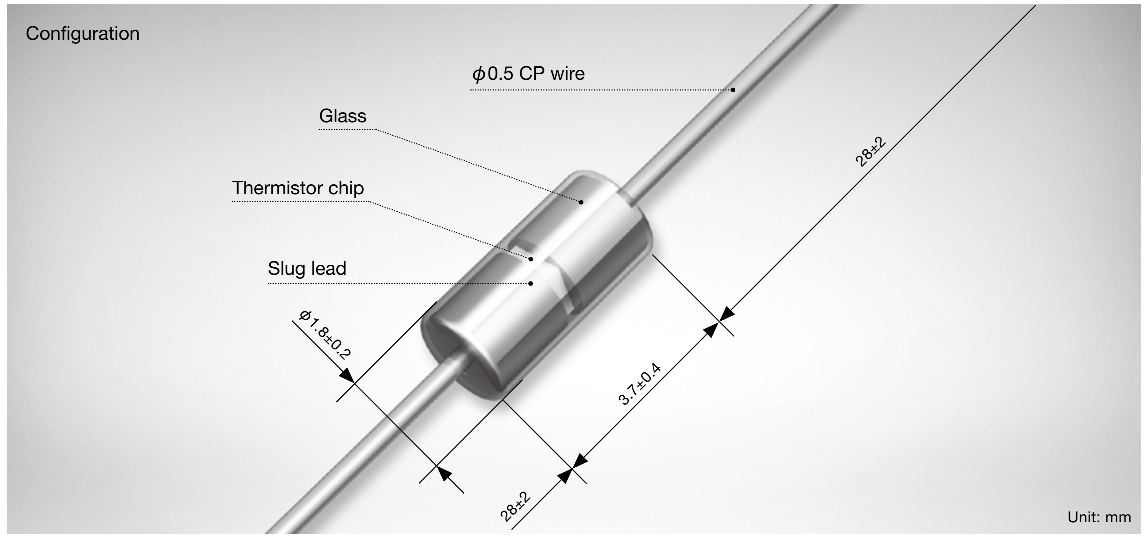
Suitable for equipment requiring a faster response
・Home appliances ・Automobiles (air mass flow, T-MAPS)
・HV/EV motors ・Electronic thermometers

Operating temperature	-50 to +300℃
Thermal time constant	Approx. 5 sec.
Dissipation constant	Approx. 0.75mW/℃
Insulation resistance	Min. 10MΩ at 50VDC

V-I characteristics



PSB-N thermistor



DHD (Double Heatsink Diode) type

A PSB-S thermistor is sealed in a DHD form. It is an axial lead type with wires coming out of both ends of the thermistor element. Heat resistance is provided by glass encapsulation. Wide-spaced lead wires contribute to lower possibilities in measurement error caused by leakage even with a high resistance thermistor chip. This enables PSB-N thermistors to be used in harsh environments such as in oil smoke, dust or humidity.

Features

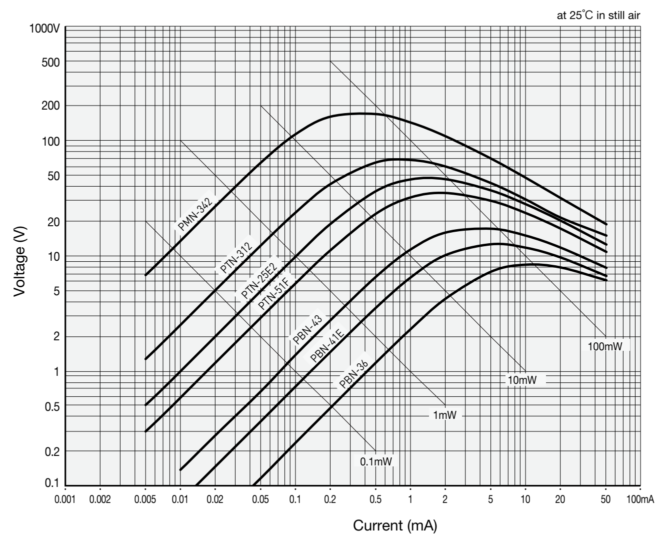
- Chip with gold electrodes
- Suitable for use in severe environments such as oil vapor with its wide-spaced lead wires
- Long-term stability in resistance
- The wire diameter is large enough to support automatic mounting

Applications

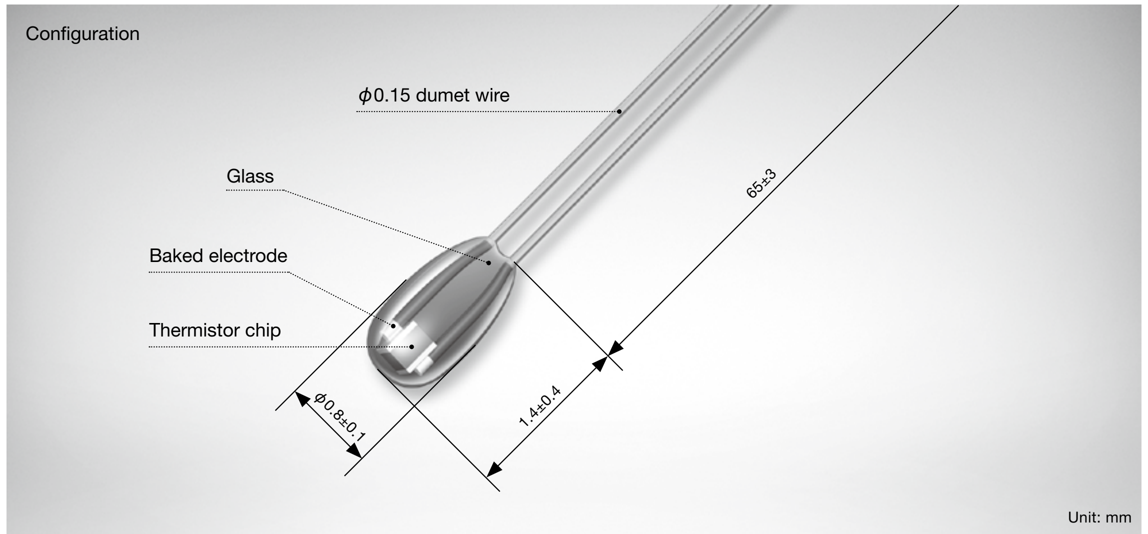
Temperature sensors using an axial lead type thermistor
・Home appliances ・Universal heaters ・Measuring equipment

Operating temperature	-50 to +300℃
Thermal time constant	Approx. 12 sec.
Dissipation constant	Approx. 2.3mW/℃
Insulation resistance	Min. 100MΩ at 500VDC

V-I characteristics



PSB-S5 thermistor



If you need thermistors for a quick response

The PSB-S5 is only available from Shibaura since it was first introduced as the most compact glass-encapsulated thermistor manufactured on an automated mass production line. With its compact design and ϕ0.15mm dumet wires, the PSB-S5 comes into wider use including the automotive field where vibration resistance is required.

Features

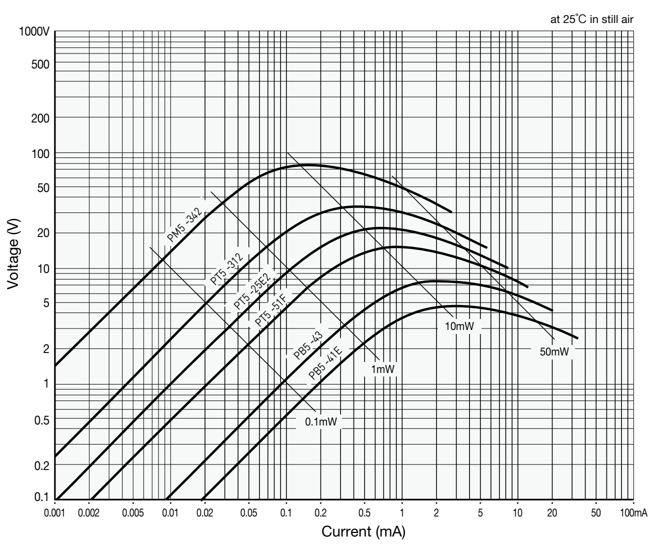
- Chip with gold electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Long-term stability in resistance
- Six times faster in response than the PSB-S1
- High-volume supply in high quality by integrated automatic production
- Patented in 8 major countries (Japan, the U.S., Canada, France, the U.K., Germany, Italy and Switzerland)

Applications

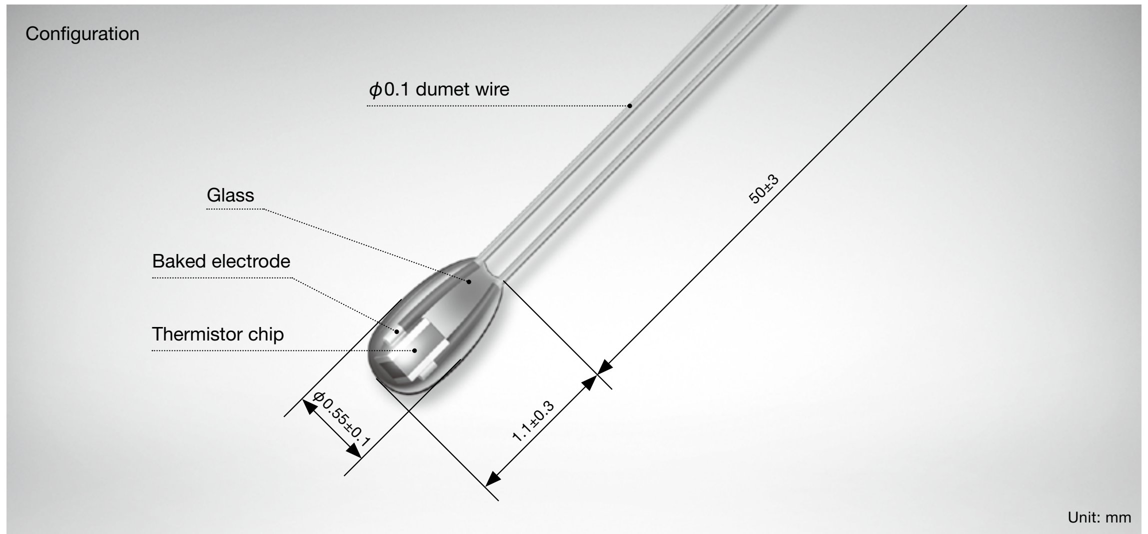
Suitable for equipment requiring a quick response and for measurements in a narrow space
・Energy-saving and green-oriented automobiles (air mass flow, T-MAPS, HV/EV motors)
・Fusers for copying machines

Operating temperature	-50 to +250℃
Thermal time constant	Approx. 2 sec.
Dissipation constant	Approx. 0.4mW/℃
Insulation resistance	Min. 10MΩ at 50VDC

V-I characteristics



PSB-S7 thermistor



A micro-sized thermistor with a very fast response

Suitable for sensors that are placed in thin needle tips or on uneven surfaces. The PSB-S7 has both microsize and durability that have never before been achieved by resin thermistors.

Features

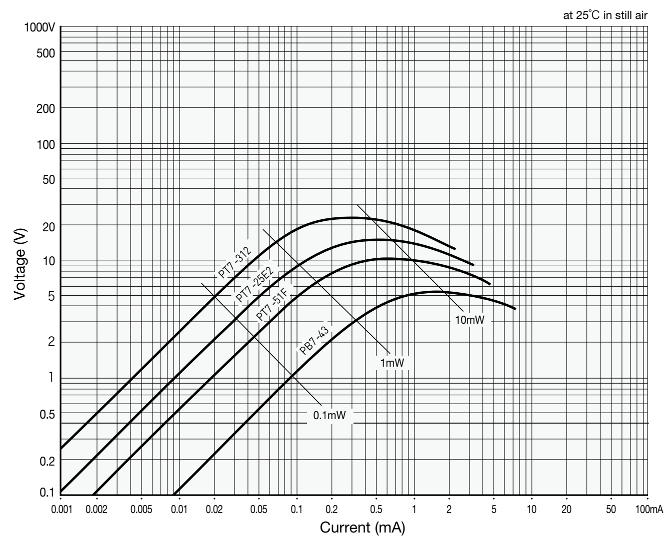
- Chip with gold electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Long-term stability in resistance
- Twelve times faster response than the PSB-S1
- High-volume supply in high quality by integrated automatic production
- Patented in 8 major countries (Japan, the U.S., Canada, France, the U.K., Germany, Italy and Switzerland)

Applications

Suitable for equipment requiring a quick response and for measurements in a narrow space
・Copying machines ・Medical equipment ・Needle sensors

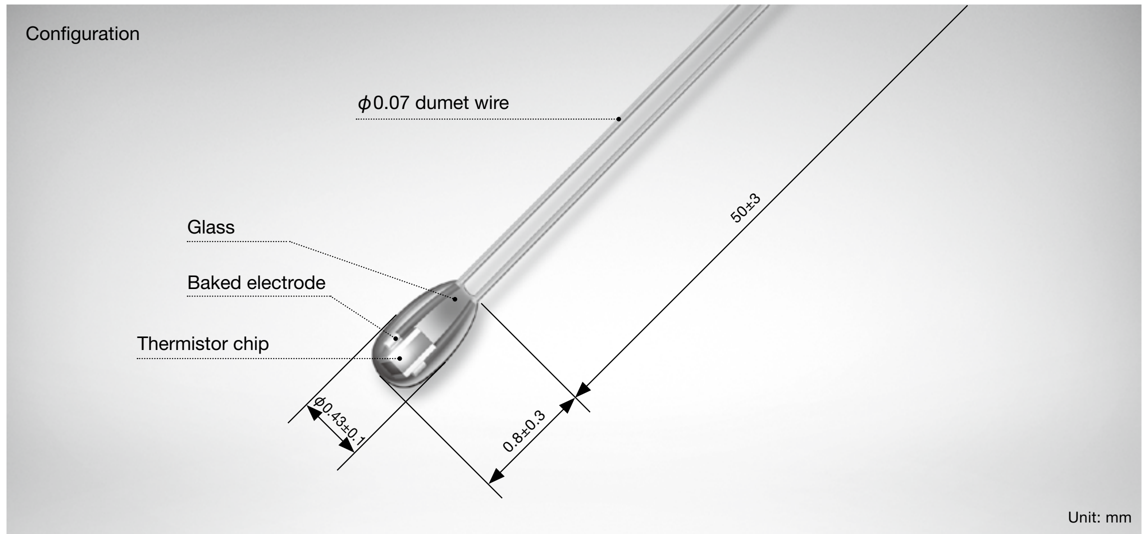
Operating temperature	-50 to +250℃
Thermal time constant	Approx. 1 sec.
Dissipation constant	Approx. 0.25mW/℃
Insulation resistance	Min. 10MΩ at 50VDC

V-I characteristics



COMPACT

PSB-S9 thermistor



A micro-miniature thermistor with a super-fast response

With an external size of ϕ0.43mm, the PSB-S9 is the most compact glass-encapsulated thermistor in the world that can be mass produced. Compared to the PSB-S7, the PSB-S9 has 50% the volume and two times faster in response. It was developed for sensors requiring a very fast response, microsize and high reliability. The PSB-S9 is used for office equipment such as printers and copying machines that require a fast response. It is also used in non-contact sensors and further, such as medical equipment, where micro-miniature sensors are requried.

Features

- The most compact glass-encapsulated thermistor
- Chip with gold electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production

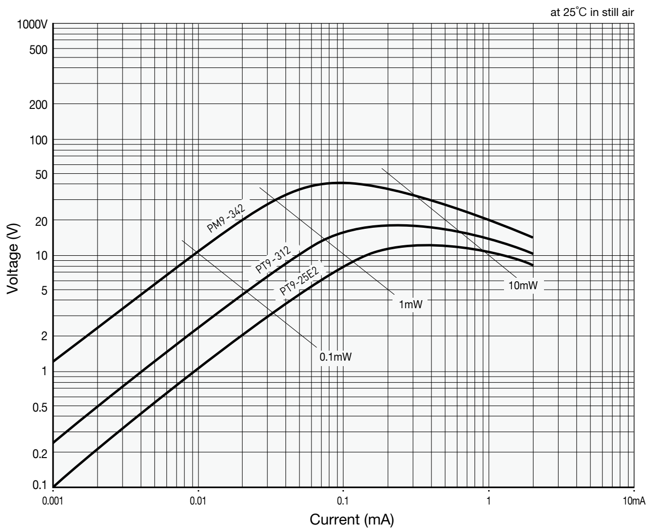
Applications

Suitable for medical and other equipment requiring a super-fast response, and also for test equipment for designing thermal components

･Medical catheters ･High response sensors for copying machine and printer fusers
･Non-contact sensors ･Test equipment requiring accurate measurements

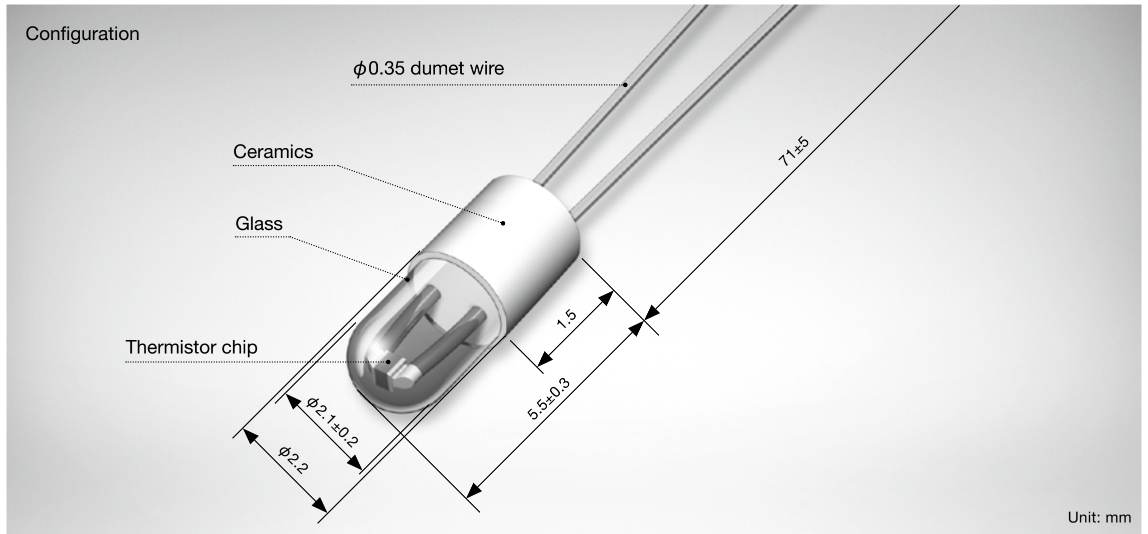
Operating temperature	-50 to +250℃
Thermal time constant	Approx. 0.6 sec.
Dissipation constant	Approx. 0.15mW/℃
Insulation resistance	Min. 10MΩ at 50VDC

V-I characteristics



ADVANCED

NS Ⅱ -E1 thermistor



A thermistor having high resistance to mechanical stress

The NS Ⅱ -E1 has remarkably improved insulation and mechanical strength, with its lead wire outlets mechanically enhanced with ceramics. Suitable for use in humid places.

Features

- Chip with gold electrodes
- Reinforced glass end with high strength ceramics
- Reduced damage to the glass during stress-giving processing
- Improved moisture resistance secured with enough creepage distance between the lead wires
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production

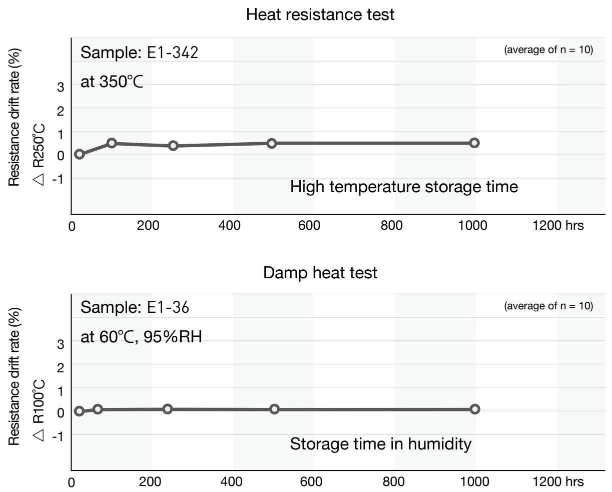
Applications

Suitable for sensors to be used where resin injection is required in protection tube processing, such as for automobiles

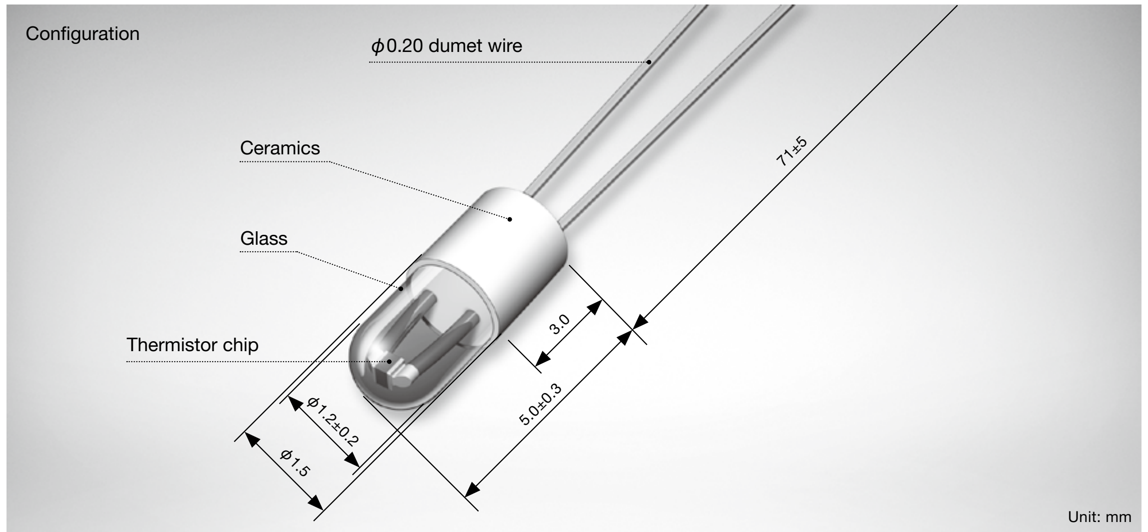
･Vapor generating thermal equipment ･Automobiles (water, intake air, ATF)
･Environments where heating or freezing is repeated and dew condensation is liable to occur ･Other applications requiring mechanical strength

Max. operating temperature	300℃
Thermal time constant	Approx. 18 sec.
Dissipation constant	Approx. 1.5mW/℃
Insulation resistance	Min. 100MΩ at 500VDC

Reliability data



NSⅡ-E3 thermistor



A highly reliable thermistor having enhanced mechanical strength and a reduced size

The NSⅡ-E3 has remarkably improved insulation and mechanical strength with its lead wire outlets mechanically enhanced with ceramics. Suitable for use in humid places. It has been developed by downsizing to the PSB-S3 while keeping the merits of the NSⅡ-E1.

Features

- Chip with gold electrodes
- Reinforced glass end with high strength ceramics
- Downsized equivalent to the PSB-S3
- Reduced damage to the glass during stress-giving processing
- Improved moisture resistance secured with enough creepage distance between the lead wires
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production

Applications

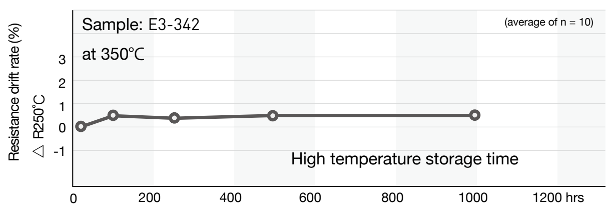
Suitable for equipment requiring moisture resistance, mechanical strength and also a faster response than the NSⅡ-E1

・Water heaters ・Dish dryers ・Tumble dryers ・Bidets ・Coffer makers

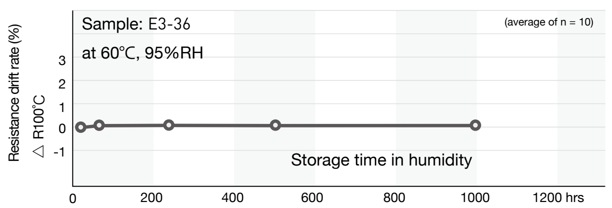
Max. operating temperature	300℃
Thermal time constant	Approx. 10 sec.
Dissipation constant	Approx. 1.2mW/℃
Insulation resistance	Min. 10MΩ at 50VDC

Reliability data

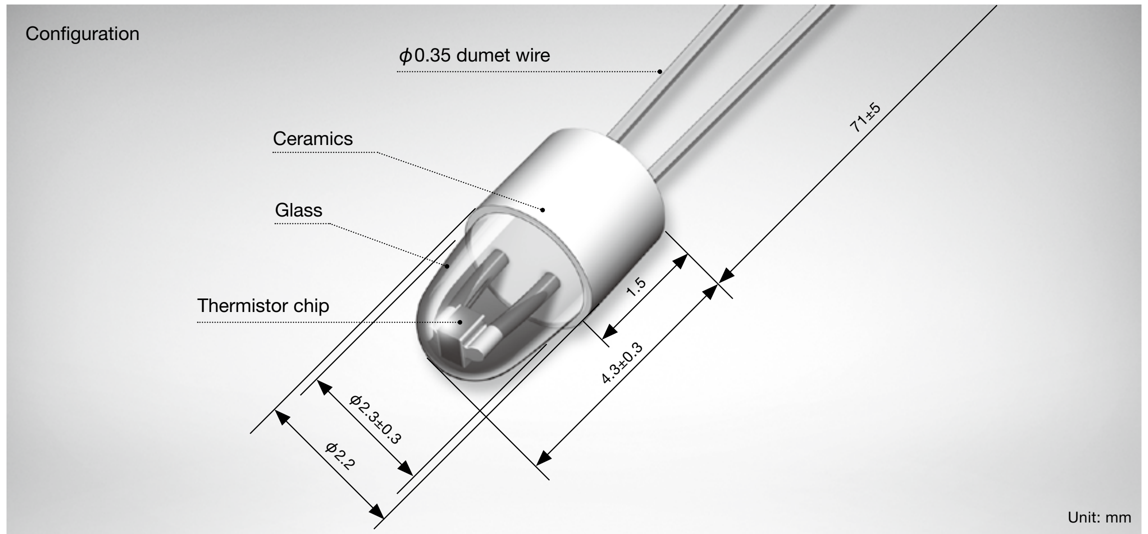
Heat resistance test



Damp heat test



NSⅢ-U1 thermistor



Heat resistance of 500℃ achieved

The world's first thermistor operating at 500℃ has been achieved by full review of thermistor chip manufacturing methods and all material compositions. The NSⅢ-U1 has proven results for over 20 years in measuring engine exhaust gases and for heaters.

Features

- Composed of special materials for use under high temperatures
- Heat resistance of 500℃
- Reinforced glass end with high strength ceramics
- Reduced damage to the glass during stress-giving processing
- Improved reliability against oxide scale secured with enough creepage distance between the lead wires
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production

Applications

Suitable for equipment for high temperature detection

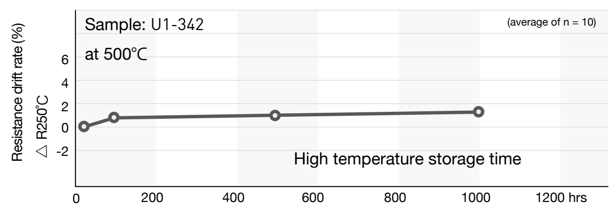
・Exhaust gases from automobiles (EGR systems) ・Microwave ovens

・Fan heaters (kerosene vaporizers) ・Sensors for use under harsh conditions at high temperatures

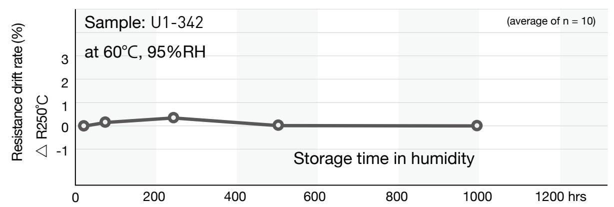
Max. operating temperature	500℃
Thermal time constant	Approx. 18 sec.
Dissipation constant	Approx. 1.5mW/℃
Insulation resistance	Min. 100MΩ at 500VDC

Reliability data

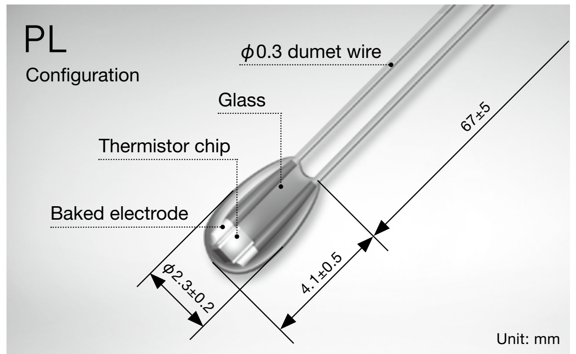
Heat resistance test

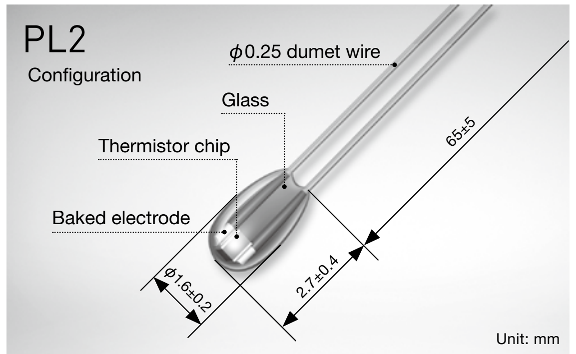


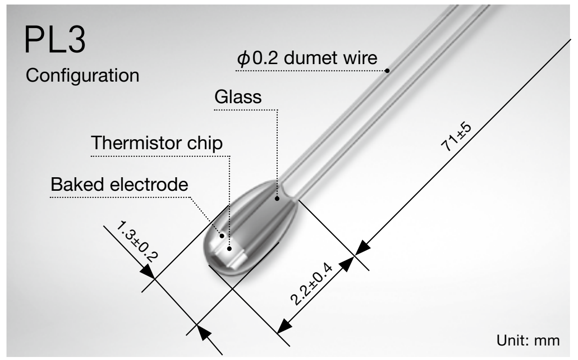
Damp heat test



PL Series







High precision in a wide temperature range

A thermistor chip with low B constant is sealed in glass while keeping the features of PSB-S thermistors.
A PL thermistor can cover a wider temperature control range from -50 to +300℃ which requires switching more than one conventional thermistor.
PL thermistors are available in three different sizes, PSB-S1, -S2 and -S3.

Features

- Low B constant (B25/50 = 2240K)
- Resistance spec. applicable in a wide temperature range
- Covers a wide temperature control range
- Solution to circuit cost reduction
- High-level heat resistance and environmental stability secured by glass encapsulation
- Long-term stability in resistance
- High-volume supply in high quality by integrated automatic production

Applications

(Equipment requiring control from very low to high temperature ranges)
・Alternative solution for platinum resistance thermometers and thermocouples

Operating temperature

-50 to +300℃

Thermal time constant

PL: Approx. 12 sec.　PL2: Approx. 8 sec.　PL3 : Approx. 5 sec.

Dissipation constant

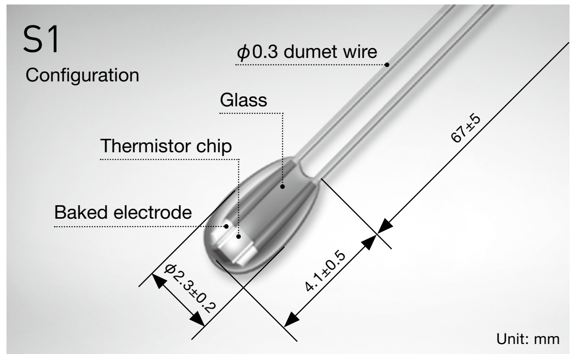
PL: Approx. 1.3mW/℃　PL2: Approx. 0.9mW/℃　PL3: Approx. 0.75mW/℃

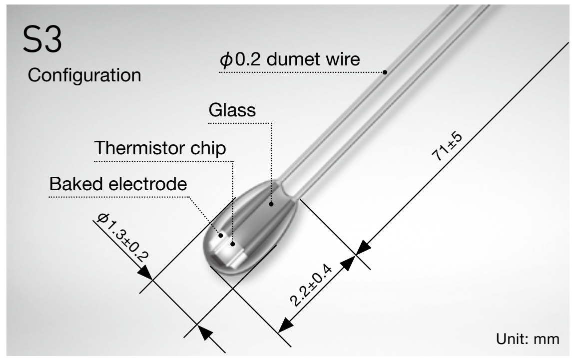
Insulation resistance

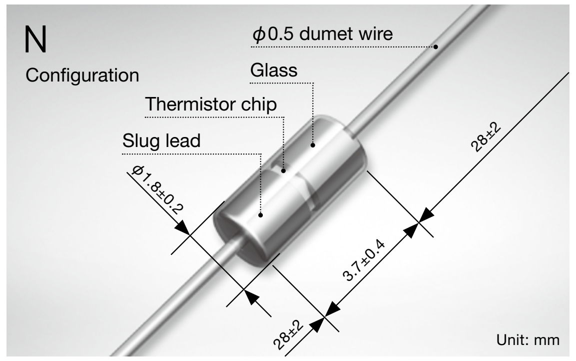
PL: Min. 50MΩ at 500VDC　PL2: Min. 10MΩ at 50VDC　PL3: Min. 10MΩ at 50VDC

Thermistor Elements

RB1 thermistors







High precision of ±1% tolerance in both resistance and B constant value

High precision both in resistance and B constant value has been achieved by reviewing the materials and manufacturing methods. While the maximum operating temperature is set lower than the standard PSB thermistors, the RB1 keeps the basic structure of glass thermistors. Thus, it is more advantageous than general resin thermistors in resistance to soldering and thermal history through processes.

Features

- Chip with silver-palladium electrodes
- Saving cost by setting the upper temperature limit to 120℃
- Resistance and B constant specially designed within the tolerance of ±1%
- High-level heat resistance and environmental stability secured by glass encapsulation
- High-volume supply in high quality by integrated automatic production

Applications

For a variety of uses NOT under high temperatures

Operating temperature

-50 to +120℃

Thermal time constant

S1: Approx. 12 sec.
S3: Approx. 5 sec.
N: Approx. 12 sec.

Dissipation constant

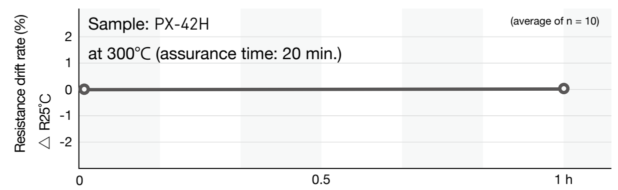
S1: Approx. 1.3mW/℃
S3: Approx. 0.75mW/℃
N: Approx. 2.3mW/℃

Insulation resistance

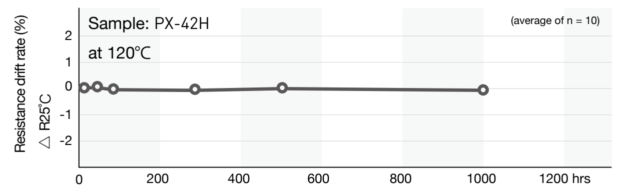
S1: Min. 50MΩ at 500VDC
S3: Min. 10MΩ at 50VDC
N: Min. 100MΩ at 500VDC

Reliability data

Heat resistance test (Capable of high temperature soldering and resin potting.)

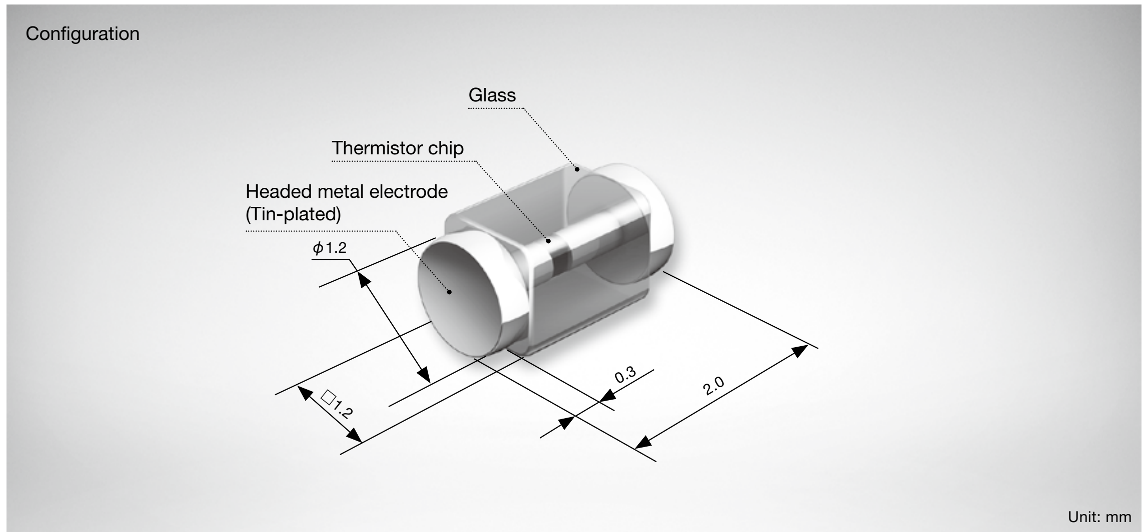


Heat resistance test (The maximum operating temperature is 120℃.)



KG2 thermistor

Configuration



A highly reliable surface mount thermistor

The KG is a highly reliable thermistor that has been developed in response to customer needs. A square glass and headed metal electrodes bring virtually no change for the KG through its lifetime. In addition, the KG provides excellent solderability and mountability.

Features

- Metal electrodes for soldering
- Excellent solder wettability with tin-plated electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Excellent solder dip resistance
- The square glass prevents deviation or falling off while being mounted

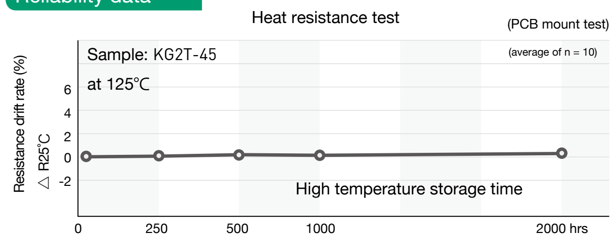
Applications

Suitable to be used in a narrower space

- ・Applications requiring high reliability where general-purpose chip thermistors cannot meet
- ・Overheat prevention for industrial motors ・Temperature assurance for IGBT units
- ・Temperature assurance for surface mount electric/electronic parts

Operating temperature	-50 to +200℃
Thermal time constant	Approx. 5 sec.
Dissipation constant	Approx. 1.3mW/℃
Insulation resistance	3 sec. at 350℃

Reliability data



Resistance-temperature characteristics

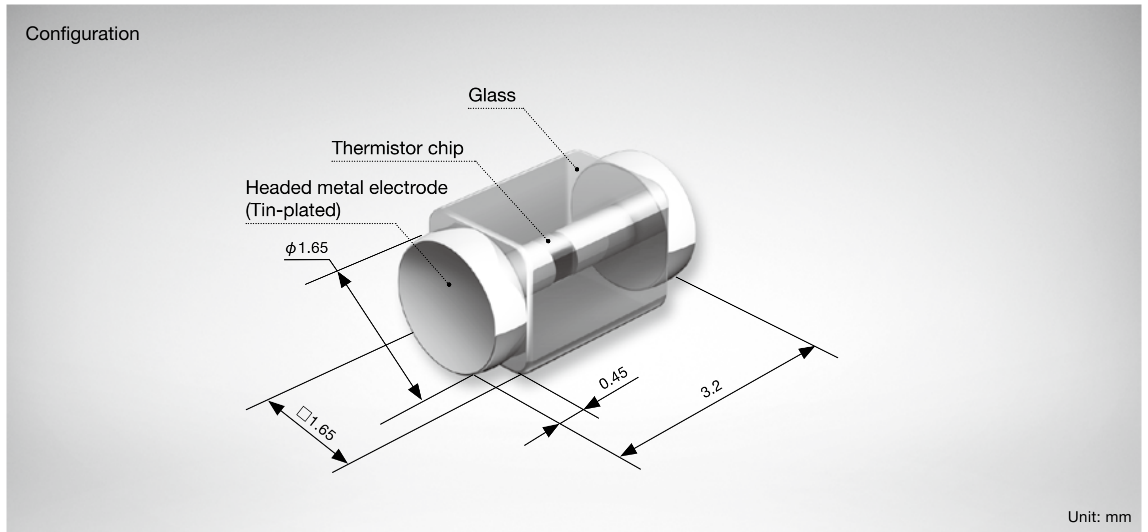
Specification	Nominal resistance note (1)		B constant 25℃/50℃
KG2B-35	13.72kΩ (0℃)	5kΩ (25℃)	3375K±2%
KG2B-41	28.08kΩ (0℃)	10kΩ (25℃)	3450K±2%
KG2T-43	98.90kΩ (0℃)	30kΩ (25℃)	3950K±2%
KG2T-45	164.8 kΩ (0℃)	50kΩ (25℃)	3950K±2%
KG2T-51	332.3 kΩ (0℃)	100kΩ (25℃)	4000K±2%

Note (1): Resistance tolerance: ±3%, ±5%

Thermistor Elements

KG3 thermistor

Configuration



A highly reliable surface mount thermistor

The KG is a highly reliable thermistor that has been developed in response to customer needs. A square glass and headed metal electrodes bring virtually no change for the KG through its lifetime. In addition, the KG provides excellent solderability and mountability.

Features

- Metal electrodes for soldering
- Excellent solder wettability with tin-plated electrodes
- High-level heat resistance and environmental stability secured by glass encapsulation
- Excellent solder dip resistance
- The square glass prevents deviation or falling off while being mounted

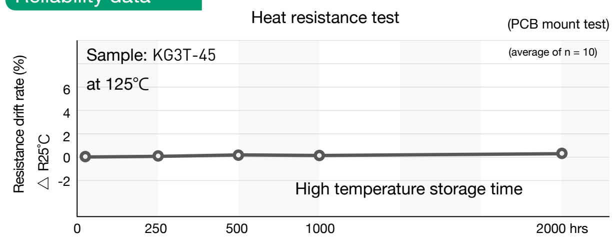
Applications

Suitable to be used in a narrower space

- ・Applications requiring high reliability where general-purpose chip thermistors cannot meet
- ・Overheat prevention for industrial motors ・Temperature assurance for IGBT units
- ・Temperature assurance for surface mount electric/electronic parts

Operating temperature	-50 to +200℃
Thermal time constant	Approx. 10 sec.
Dissipation constant	Approx. 1.4mW/℃
Insulation resistance	3 sec. at 350℃

Reliability data



Resistance-temperature characteristics

Specification	Nominal resistance note (1)		B constant 25℃/50℃
KG3B-35	13.72kΩ (0℃)	5kΩ (25℃)	3375K±2%
KG3B-41	28.08kΩ (0℃)	10kΩ (25℃)	3450K±2%
KG3T-43	98.90kΩ (0℃)	30kΩ (25℃)	3950K±2%
KG3T-45	164.8 kΩ (0℃)	50kΩ (25℃)	3950K±2%
KG3T-51	332.3 kΩ (0℃)	100kΩ (25℃)	4000K±2%

Note (1): Resistance tolerance: ±3%, ±5%

Special Specifications

1 Lead wire plating

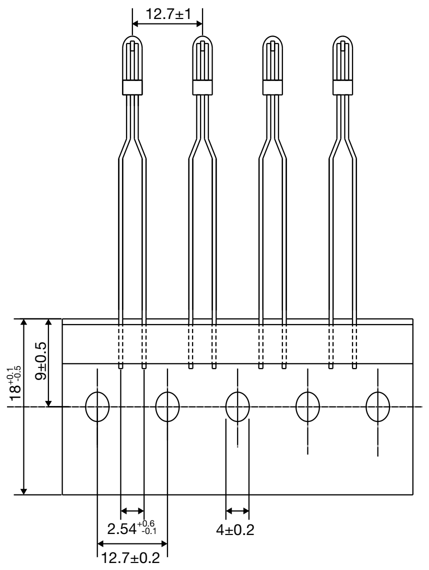
△ Available upon request × Not available

Model name	PSB-S1	PSB-S2	PSB-S3	PSB-N	PSB-S5	NSⅡ-E1	NSⅡ-E3	PL	PL2	PL3	S1	S2	S3
Non-galvanic nickel (Ni) plating	○	○	○	○	○	×	×	○	○	○	○	○	○
Non-galvanic tin (Sn) plating	○	○	○	△	○	×	×	○	○	○	○	○	○
Hot tin dipping	△	△	△	○	×	○	○	△	△	△	△	△	△

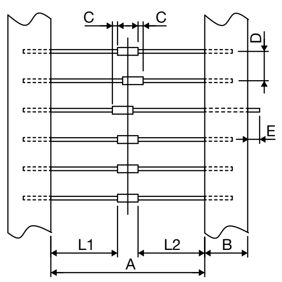
Note) PSB-S7, PSB-S9 and NSⅢ-U1 are provided without plating.

2 Taping

a) PSB-S1, NSⅡ-E1

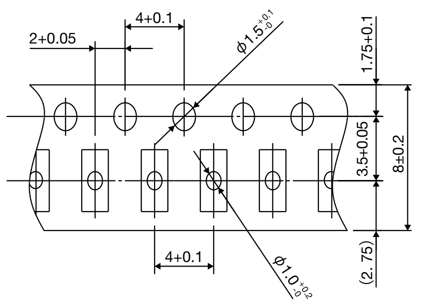


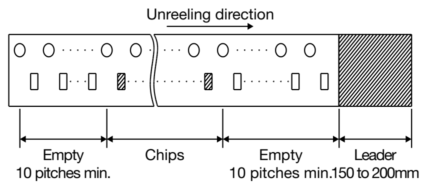
b) PSB-N



52TYPE	
Mark	Length
A	52.4±1.2
B	6±0.5
C	±0.7
D	5.0±0.38
E	0.5 Max.
∣L1－L2∣	1.5 Max.

c) KG2, KG3

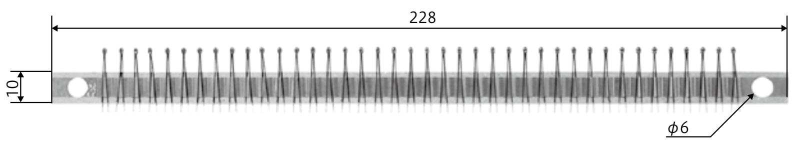


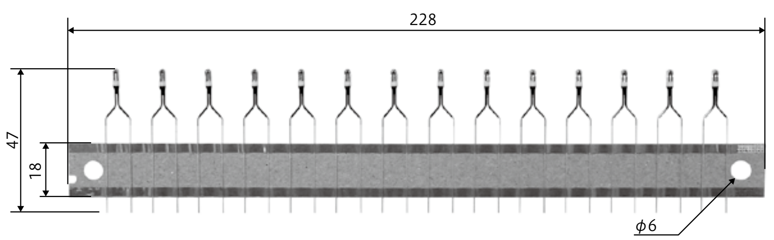


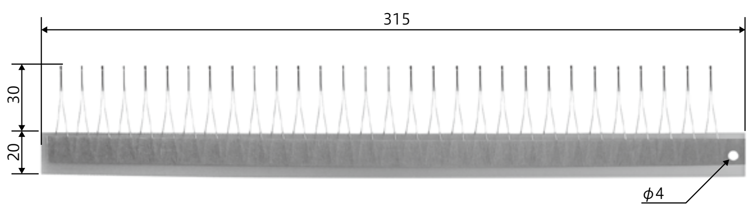
Customization

With outstanding FA technologies, we have developed most of our automatized production facilities.

Please consult us for special forming and taping.



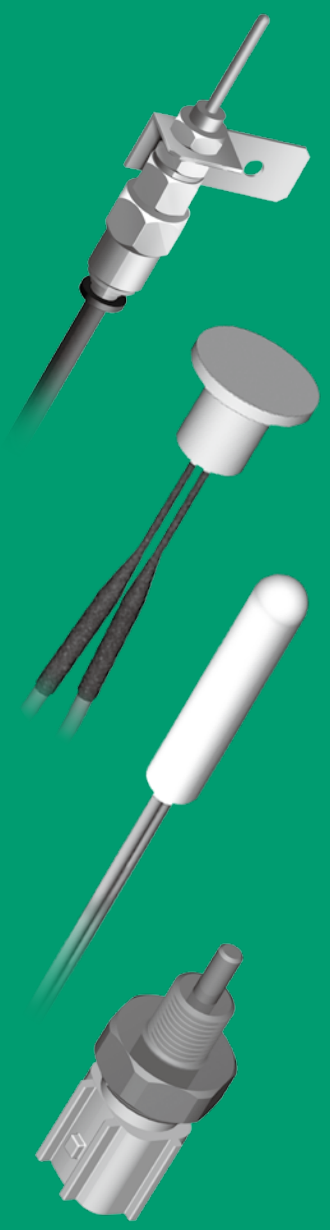




#1 Global Brand

Shibaura's Standard Product Lineup

Thermistor Sensors



Note 1) All specifications in this catalogue are for reference only.

Note 2) Unless otherwise specified, all values of thermal time constant and dissipation constant are measured in still air.

Thermistor Sensors – Standard Product Lineup

Please see the following pages for details.

	For automobiles		
Model name	MP1	CS1	MP3
Shape			
Op. temp.	-30 to +200℃	-30 to +150℃	-40 to +200℃
Applications	EV/HEV motors & inverters, liquid level detection	Engines, engine oil	EV/HV motor coils
Page	P.38	P.38	P.39

	Non-contact		Soft contact	Water temperature					Liquid temperature
Model name	RDS1	NIP1	TSP1	WT1	WT2	WT3	WT4	WT5	MP2
Shape									
Op. temp.	-10 to +150℃	-10 to +200℃	-20 to +200℃	0 to +120℃	-20 to +120℃	-20 to +120℃	-20 to +120℃	-20 to +120℃	-30 to +200℃
Applications	Fuser rollers for copying machines, printers, multi-function printers	Fuser rollers for copying machines, printers, multi-function printers	Fuser rollers for copying machines, printers, multi-function printers	Water heaters (outlet water)	Water heaters, heat pump water heaters, coffee makers, bidets (warm water)	Bidets (warm water & air)	Water heaters, heat pump water heaters, bidets (warm water & air)	Water heaters, coffee makers	Showcase freezers, liquid level detection
Page	P.40	P.40	P.41	P.42	P.42	P.43	P.43	P.43	P.44

	Hermetic	Equipped with a threaded tube		Equipped with a flange			
Model name	HT1	NTN1	MPM1	OCK1-1	OCK2-1	OCK3	ST1
Shape							
Op. temp.	-20 to +180℃	-20 to +105℃	-20 to +150℃	-20 to +300℃	-20 to +300℃	-20 to +260℃	-20 to +500℃
Applications	Electric pots, dishwashers, hot plates, IH grill pans	Hot water boiler tanks, machine tool oil, medical equipment water	Hot water boiler tanks, machine tool oil, medical equipment water	Microwave oven chambers	Microwave oven chambers	Microwave oven chambers (air & vapor), heaters	Heater burners
Page	P.44	P.45	P.45	P.46	P.46	P.47	P.47

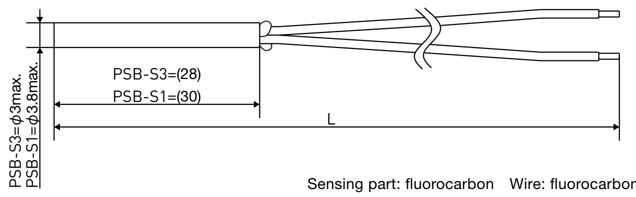
	Equipped with a copper protection tube		Resin dipped		Equipped with a resin protection tube			
Model name	EP1	KTM1	EE1	KT1	CE1	CE2	CC1	CC2
Shape								
Op. temp.	-30 to +120℃	-30 to +100℃	-30 to +100℃	-30 to +80℃	-30 to +80℃	-20 to +90℃	-30 to +80℃	-30 to +180℃
Applications	Air conditioner pipes incl. discharge pipes	Air conditioner pipes	Air conditioners (room & outdoor air)	Air conditioners (room & outdoor air)	Refrigerator chambers	Toilet seats, lithium-ion batteries	Refrigerators, washer dryers	Washer dryers
Page	P.48	P.48	P.49	P.49	P.50	P.50	P.51	P.51

	Equipped with a lug terminal					Surface temperature				Absolute humidity sensors	
Model name	RTZ1	RT1	RT2	EP2	KTEP1	KN1	KN2	KN3	KN4	SP1	SPD1
Shape											
Op. temp.	-20 to +300℃	-10 to +250℃	-20 to +180℃	-30 to +120℃	-30 to +85℃	-20 to +300℃	-20 to +300℃	-20 to +300℃	-20 to +300℃	-5 to +200℃	-5 to +100℃
Applications	Hot plates for cooking devices, automobile braking systems	Irons	Automobile inverters, heat pump water heaters	Heatsinks	Heatsinks	IH cooking devices	IH cooking devices	IH cooking devices, IH rice cookers	IH cooking devices, IH rice cookers	Exhaust air ducts for microwave ovens and tumble dryers, mist sauna rooms	Exhaust air ducts for microwave ovens
Page	P.52	P.52	P.53	P.53	P.53	P.54	P.54	P.55	P.55	P.56	P.57

For automobiles

MP1

Unit: mm



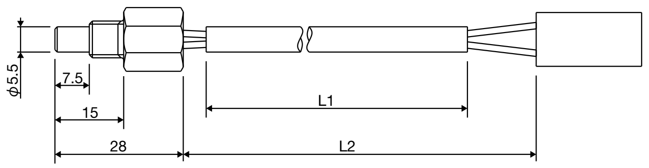
Sensing part: fluorocarbon Wire: fluorocarbon

Heat, oil and solvent proof

Features	Excellent in heat, oil and solvent resistance with fluorocarbon sealing Fixing bracket design is available Applicable to high temperatures and highly accurate measurements
Applications	EV/HEV motors & inverters Liquid level detection (using PSB-S3 glass-encap. thermistor element only)
Operating temperature	-30 to +200℃ Please consult us when higher temperatures are required.
Thermal time constant	PSB-S1 glass-encap. thermistor element τ ≒ 8 sec. (in stirred liquid) PSB-S3 glass-encap. thermistor element τ ≒ 4 sec. (in stirred liquid)
Dissipation constant	PSB-S1 glass-encap. thermistor element δ ≒ 2mW/℃ PSB-S3 glass-encap. thermistor element δ ≒ 1.2mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R100 = 3.3kΩ Other options available
B constant	B0/100 = 3970K Other options available

CS1

Unit: mm



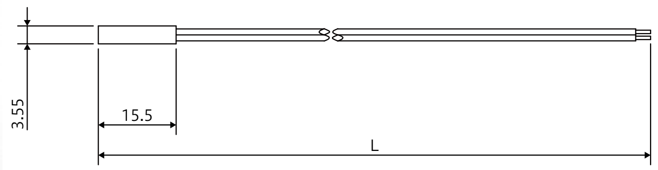
Sensing part: brass Wire: fluorocarbon

Heat and oil proof

Features	Epoxy resin-sealed into a cut protection tube Highly heat and oil resistant epoxy resin
Applications	Engines, engine oil
Operating temperature	-30 to +150℃
Thermal time constant	$\tau \leq$ 5 sec. (in stirred liquid)
Dissipation constant	δ ≒ 5.2mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

MP3

Unit: mm



Sensing part: fluorocarbon Wire: fluorocarbon

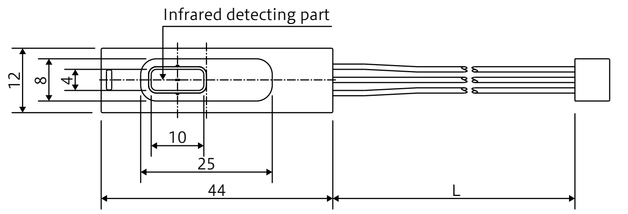
Heat, oil and solvent proof

Features	Excellent in heat, oil and solvent resistance with fluorocarbon sealing Fixing bracket design is available Temperature detection on surface with flat type sensor
Applications	EV/HV motor coils
Operating temperature	-40 to +200℃
Thermal time constant	τ ≒ 4 sec. (in stirred liquid)
Dissipation constant	δ ≒ 1.2mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R200℃ = 1kΩ Other options available
B constant	B25/50 = 2240K Other options available

Non-contact

RDS1

Unit: mm



Wire: cross-linked PE

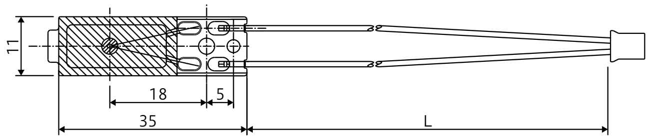
Patent No. 5207329, fast response and high accuracy

Response is compared to other Shibaura non-contact type sensors

Features	• Patent No.5207329, US 9,176,443 • Non-contact temperature detection using infrared rays • Infrared detection type for fuser rollers • Fast response and high accuracy with two compact thermistor elements arranged symmetrically
Applications	Fuser rollers for copying machines, printers and multi-function printers
Operating temperature	-10 to +150℃ (on a compensation thermistor element, except connector) Sensing part: -10 to +450℃ (based on detected temperature of an object) The maximum operating temperature (150℃) shall not be exceeded.
Thermal time constant	τ = 0.6 ±0.2 sec. (at 5mm from ϕ40 black roller)
Dissipation constant	δ ≒ 0.23mW/℃
Withstand voltage	500VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R25 = 220kΩ
B constant	B25/50 = 3750K

NIP1

Unit: mm



Sensing part: polyimide tape   Wire: cross-linked PE

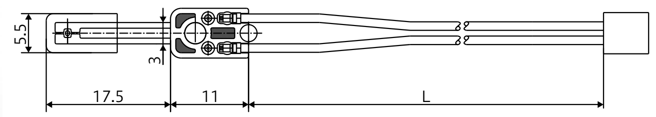
Has a micro-miniature glass-encapsulated thermistor element

Features	• Non-contact type surface temperature detection, with a micro-miniature glass-encapsulated thermistor element, for fuser rollers • Lower cost than infrared detection type • Low cost alternative to a contact type using the same circuit
Applications	Fuser rollers for copying machines, printers and multi-function printers
Operating temperature	-10 to +200℃ (at the sensing part) Please consult us when higher temperatures are required.
Thermal time constant	τ ≤ 3.5 sec. (at 1mm from ϕ25 roller)
Dissipation constant	δ ≒ 0.45mW/℃
Resistance	R150 = 13.80kΩ
B constant	B100/200 = 4875K

Soft contact

TSP1

Unit: mm



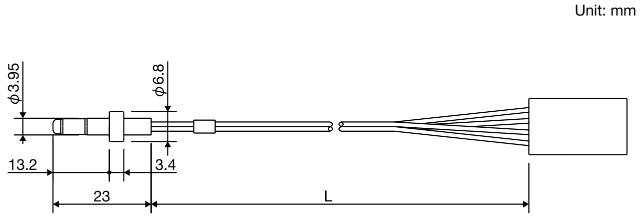
Sensing part: polyimide tape   Wire: cross-linked PE
Other options available

Light touch solution with low cost and high durability

Cost is compared to other Shibaura soft contact type sensors

Features	• A light touch (approx. 1.2g at a push-in depth of 1mm) sensing solution for fuser rollers • Basic and standard contact type available at low cost • Soft contact reduces damage on rollers
Applications	Fuser rollers for copying machines, printers and multi-function printers
Operating temperature	-20 to +200℃ (at the sensing part) Please consult us when higher temperatures are required.
Thermal time constant	τ ≤ 2 sec. (push-in depth of 1mm on ϕ25 roller)
Dissipation constant	δ ≒ 0.4mW/℃
Withstand voltage	1000VAC for 1 min.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R200 = 1kΩ
B constant	B100/200 = 4537K

WT1

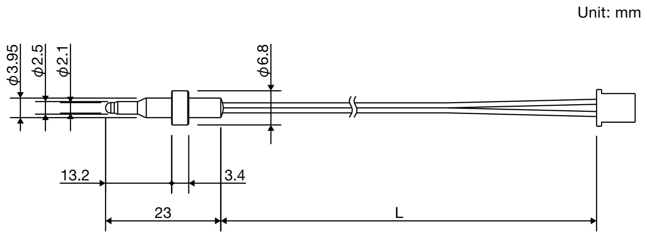


Sensing part: stainless steel Wire: cross-linked fluororubber

Patent No. 5523982
Sensing solution for temperature control and abnormality monitoring/backup functions

Features	● Patent No.5523982, US 9,322,718 ● Sensing solution for temperature control and abnormality monitoring/backup functions ● Has two glass-encapsulated thermistor elements of similar specifications ● A slight difference in response between the two thermistor elements
Applications	Water heaters (outlet water)
Operating temperature	0 to +120℃ (except connector)
Thermal time constant	$\tau \leq$ 1.2 sec.
Response time to 90%	Approx. 2.5 sec. (in stirred water)
Dissipation constant	$\delta \fallingdotseq$ 4.5mW/℃ (in stirred water) With two thermistor elements energized
Withstand voltage	750VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R50 = 3.485kΩ Other options available
B constant	B0/100 = 3450K Other options available

WT2

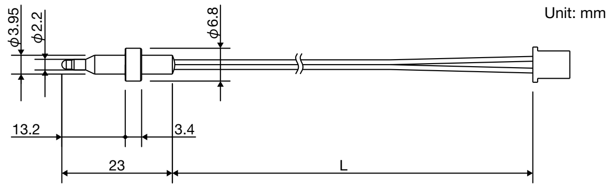


Sensing part: stainless steel Wire: cross-linked fluororubber

Standard water temperature sensor for home appliances

Features	● Highly durable ● Covers the whole water temperature range
Applications	Water heaters, heat pump water heaters, coffee makers, bidets (instant inlet water)
Operating temperature	-20 to +120℃ (except connector)
Thermal time constant	$\tau \leq$ 1 sec. (in stirred water)
Response time to 90%	Approx. 2 sec. (in stirred water)
Dissipation constant	$\delta \fallingdotseq$ 4.8mW/℃ (in stirred water)
Withstand voltage	750VAC for 1 sec. Consultation up to 1800VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R50 = 3.485kΩ Other options available
B constant	B0/100 = 3450K Other options available

WT3



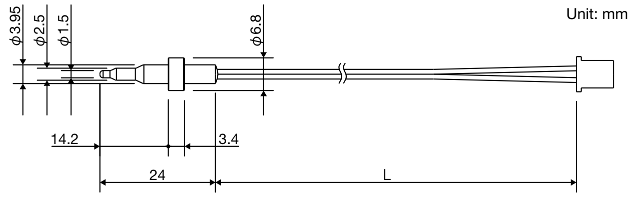
Sensing part: stainless steel Wire: cross-linked fluororubber

Fast response water temperature sensor for home appliances

Response is compared to other Shibaura water temperature sensors

Features	● Water temperature sensor with durability and improved response		
Applications	Bidets (instant outlet warm water & warm air)		
Operating temperature	-20 to +120℃ (except connector)	Withstand voltage	750VAC for 1 sec. Consultation up to 1800VAC for 1 sec.
Thermal time constant	$\tau \leq$ 0.5 sec. (in stirred water)	Insulation resistance	Min. 100MΩ at 500VDC
Response time to 90%	Approx. 1.5 sec. (in stirred water)	Resistance	R40 = 26.06kΩ Other options available
Dissipation constant	$\delta \fallingdotseq$ 4.8mW/℃ (in stirred water)	B constant	B0/100 = 3970K Other options available

WT4



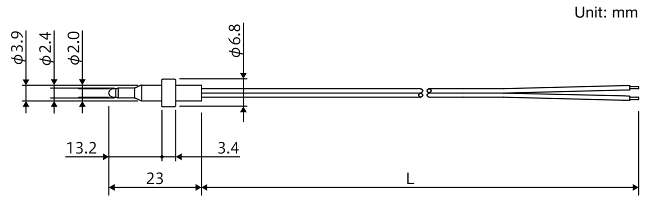
Sensing part: stainless steel Wire: cross-linked fluororubber

The fastest response water temperature sensor for home appliances

Response is compared to other Shibaura water temperature sensors

Features	● The fastest response by using a compact glass-encapsulated thermistor element ● Also applicable to warm air control and liquid level detection		
Applications	Water heaters, heat pump water heaters, bidets (instant outlet warm water & warm air)		
Operating temperature	-20 to +120℃ (except connector)		
Thermal time constant	$\tau \leq$ 0.5 sec. (in stirred water)	Withstand voltage	750VAC for 1 sec. Consultation up to 1800VAC for 1 sec.
Response time to 90%	Approx. 1 sec. (in stirred water)	Insulation resistance	Min. 100MΩ at 500VDC
Dissipation constant	$\delta \fallingdotseq$ 3.5mW/℃ (in stirred water)	Resistance	R50 = 17.60kΩ Other options available
	$\delta \fallingdotseq$ 1.5mW/℃	B constant	B0/100 = 3970K Other options available

WT5



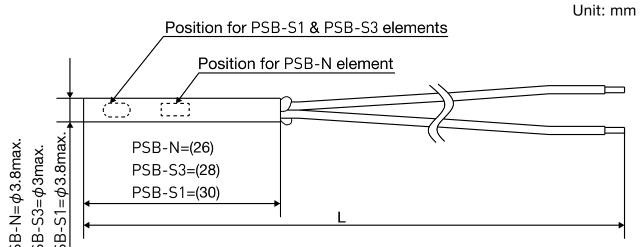
Sensing part: stainless steel Wire: cross-linked PE

Standard water temperature sensor for home appliances with improved response

Features	● Sensor with suppressed variations of response to the minimum		
Applications	Water heaters, coffee makers	Withstand voltage	750VAC or 1 sec. Consultation up to 1800VAC for 1 sec.
Operating temperature	-20 to +120℃ (except connector)		
Thermal time constant	$\tau \leqq$ 0.9 sec. (in stirred water)	Insulation resistance	Min. 100MΩ at 500VDC
Response time to 90%	Approx. 2 sec. (in stirred water)	Resistance	R50 = 3.485kΩ Other options available
Dissipation constant	$\delta \fallingdotseq$ 4.8mW/℃ (in stirred water)	B constant	B0/100 = 3450K Other options available

Liquid temperature

MP2

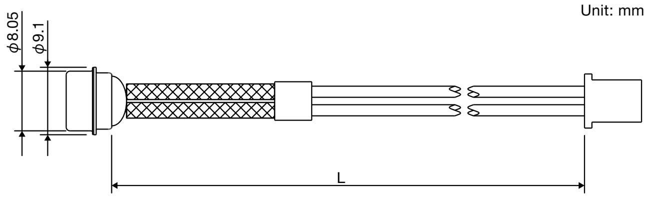
Sensing part: fluorocarbon Wire: fluorocarbon

Heat, oil and solvent proof

Features	Excellent heat, oil and solvent proof with fluorocarbon sealing Fixing bracket design is available Applicable to high temperatures and highly accurate measurements
Applications	Showcase freezers Liquid level detection (using PSB-S3 glass-encap. thermistor element only)
Operating temperature	-30 to +200℃ Please consult us when higher temperatures are required.
Thermal time constant	PSB-S1 & PSB-N glass-encap. thermistor elements τ ≒ 8 sec. (in stirred liquid) PSB-S3 glass-encap. thermistor elements τ ≒ 4 sec. (in stirred liquid)
Dissipation constant	PSB-S1 & PSB-N glass-encap. thermistor elements δ ≒ 2mW/℃ PSB-S3 glass-encap. thermistor elements δ ≒ 1.2mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R100 = 3.3kΩ Other options available
B constant	B0/100 = 3970K Other options available

Hermetic

HT1

Sensing part: iron alloy
Wire: Fluorocarbon, silicone rubber insulated with glass braid, cross-linked PE, PVC
Other options available

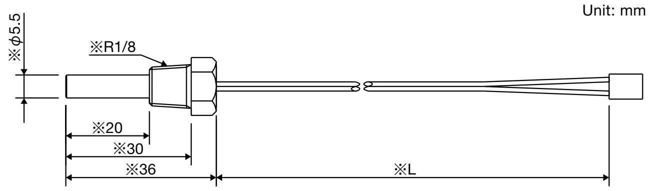
Fast response

Response is compared to other Shibaura hermetic type sensors

Features	Robust casing and fast response Hermetic type standard surface temperature sensor
Applications	Electric pots, dishwashers, hot plates, IH grill pans
Operating temperature	-20 to +180℃ (except connector)
Thermal time constant	τ ≒ 4 sec. (on an aluminium hot plate at 100℃)
Dissipation constant	δ ≒ 3mW/℃
Withstand voltage	1800VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R100 = 3.3kΩ Other options available
B constant	B0/100 = 3970K Other options available

Equipped with a threaded tube

NTN1

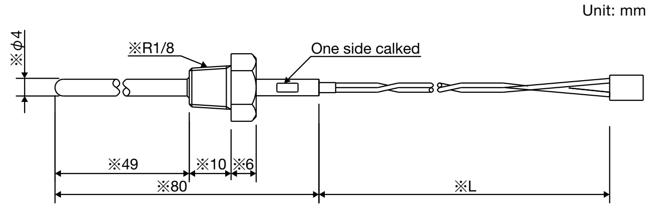



Sensing part: stainless steel, brass
Wire: heatproof PVC parallel, cross-linked fluororubber, PVC, Fluorocarbon

Equipped with a customizable cut protection tube

Features	Standard sensor equipped with a cut nipple protection tube Excellent mechanical strength and humidity resistance with a glass-encapsulated thermistor element sealed in a stainless steel protection tube Customizable dimensions
Applications	Hot water boiler tanks, machine tool oil, medical equipment water
Operating temperature	-20 to +105℃
Thermal time constant	τ ≒ 5 sec. (in stirred water)
Dissipation constant	δ ≒ 3.5mW/℃
Withstand voltage	1000VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

MPM1

Sensing part: stainless steel Wire: cross-linked PE, PVC, fluorocarbon

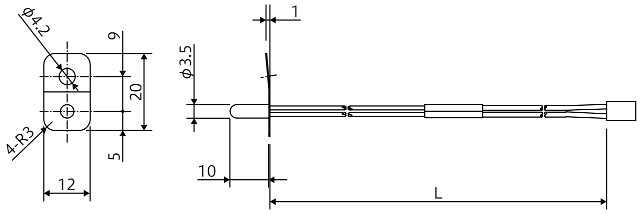
Water proof solution equipped with a stainless protection tube

Features	Superior in mechanical strength with a combination of a stainless protection tube and a glass-encapsulated thermistor element Has a water-sealed thermistor element (using PTFE only for thermistor element lead wires) Longer protection tubes than NTN1 Customizable dimensions
Applications	Hot water boiler tanks, machine tool oil, medical equipment water
Operating temperature	-20 to +150℃
Thermal time constant	τ ≒ 20 sec. (in stirred water)
Dissipation constant	δ ≒ 1.5mW/℃
Withstand voltage	1000VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

OCK1-1

Protection tube variant: ϕ3.5∗L15.5

Unit: mm



Sensing part:stainless steel
Wire:Cross-linked PE, silicone rubber, silicone rubber insulated with glass braid
Other options available

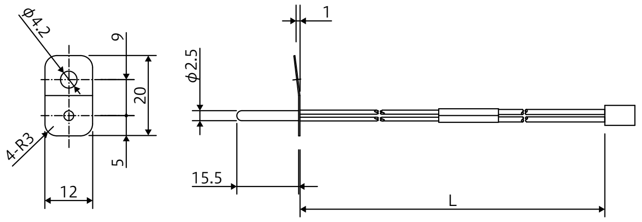
Global standard sensor for microwave ovens

Features	Max. temperature up to 300℃
	Exposed in an oven chamber
Applications	Microwave oven chambers
Operating temperature	-20 to +300℃ (from the tip of protection tube to the flange)
Thermal time constant	τ ≒ 80 sec.
Dissipation constant	δ ≒ 2.1mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R200 = 1kΩ Other options available
B constant	B100/200 = 4537K Other options available

OCK2-1

Protection tube variant: ϕ2.5∗L10.5

Unit: mm



Sensing part:stainless steel
Wire:Cross-linked PE, silicone rubber, silicone rubber insulated with glass braid
Other options available

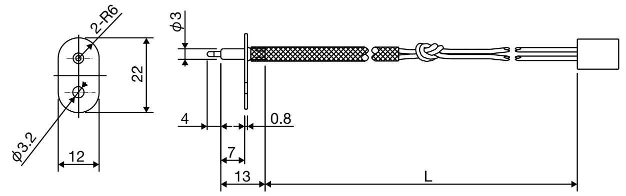
Fast response solution for microwave ovens

Response is compared to other Shibaura flange type sensors

Features	The second generation oven sensor
	Outstanding accuracy and response solution for oven temperature control
	Glass-encapsulated thermistor elements which withstand high voltage are available
Applications	Microwave oven chambers
Operating temperature	-20 to +300℃ (from the tip of protection tube to the flange)
Thermal time constant	τ ≒ 60 sec.
Dissipation constant	δ ≒ 2mW/℃
Withstand voltage	1200VAC for 1 sec. Consultation up to 2000VAC
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R200 = 1kΩ Other options available
B constant	B100/200 = 4537K Other options available

OCK3

Unit: mm



Sensing part: stainless steel
Wire: Cross-linked PE, silicone rubber, silicone rubber insulated with glass braid
Other options available

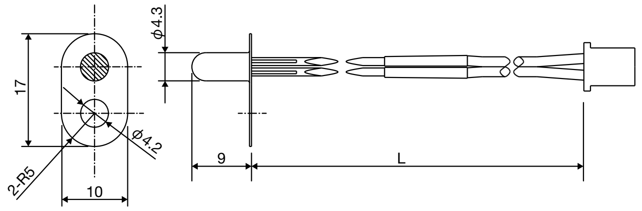
Multi-detection with high sensitivity and response

Sensitivity and response are compared to other Shibaura flange type sensors

Features	A multi-detector for temperature, vapor and air flow speed
Applications	Microwave oven chambers (air & vapor), heaters
Operating temperature	-20 to +260℃ (from the tip of protection tube to the flange)
Thermal time constant	τ ≒ 10 sec. (on an aluminium hot plate)
Dissipation constant	δ ≒ 1.2mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R200 = 1kΩ Other options available
B constant	B100/200 = 4537K Other options available

ST1

Unit: mm



Sensing part: stainless steel
Wire: Cross-linked PE, fluororubber parallel, heatproof PVC parallel

High heat resistance

Heat resistance is compared to other Shibaura flange type sensors

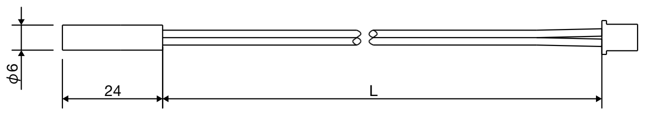
Features	One-piece protection cap
	Standard burner sensor available with a highly heatproof glass-encapsulated thermistor element
Applications	Heater burners
Operating temperature	-20 to +500℃ (from the tip of protection tube to the flange)
Thermal time constant	τ ≒ 80 sec. τ ≤ 7 sec. (in oil to the flange)
Dissipation constant	δ ≒ 3mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R200 = 8kΩ Other options available
B constant	B150/250 = 5300K Other options available

Equipped with a copper protection tube

EP1

Protection tube variants: ϕ4∗L24, ϕ5∗L24 and others

Unit: mm



Sensing part: copper

Wire: cross-linked PE parallel, PVC parallel, cross-linked PE double-insulated, PVC double-insulated

Using a glass-encapsulated thermistor element, low cost

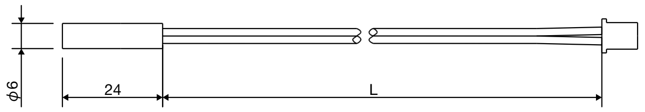
Cost is compared to other Shibaura sensors equipped with a copper protection tube

Features	A glass-encapsulated thermistor element is sealed in a copper protection tube High reliability, applicable to a wide temperature range Many variants of the protection tube are available
Applications	Air conditioner pipes including discharge pipes
Operating temperature	-30 to +120℃
Thermal time constant	τ ≒ 7 sec. (in stirred water)
Dissipation constant	δ ≒ 3.3mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

KTM1

Protection tube variants: ϕ4∗L24, ϕ5∗L24 and others

Unit: mm



Sensing part: copper

Wire: cross-linked PE parallel, PVC parallel, cross-linked PE double-insulated, PVC double-insulated

Using a bare thermistor chip, low cost

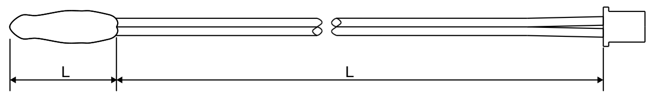
Cost is compared to other Shibaura sensors equipped with a copper protection tube

Features	A bare thermistor chip is sealed in a copper protection tube Lower cost than using a glass-encapsulated thermistor element Many variants of the protection tube are available
Applications	Air conditioner pipes
Operating temperature	-30 to +100℃
Thermal time constant	τ ≒ 7.5 sec. (in stirred water)
Dissipation constant	δ ≒ 5.5mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R25 = 10kΩ, R25 = 5kΩ Other options available
B constant	B25/50 = 4100K, B25/50 = 3950K Other options available

Resin dipped

EE1

Unit: mm



Sensing part: epoxy resin

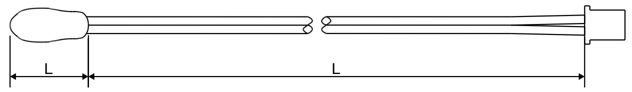
Wire: cross-linked PE parallel, PVC parallel, cross-linked PE double-insulated, PVC double-insulated

Using a glass-encapsulated thermistor element

Features	A glass-encapsulated thermistor element is sealed with epoxy resin Applicable to a wide temperature range
Applications	Air conditioners (room and outdoor air)
Operating temperature	-30 to +100℃
Thermal time constant	τ ≒ 5 sec. (in stirred water)
Dissipation constant	δ ≒ 2.2mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

KT1

Unit: mm



Sensing part: epoxy resin

Wire: cross-linked PE parallel, PVC parallel, cross-linked PE double-insulated, PVC double-insulated

Using a bare thermistor chip

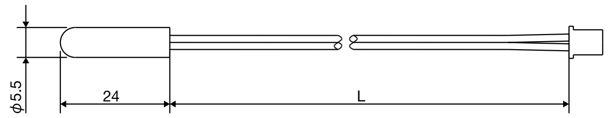
Features	A bare thermistor chip is sealed with epoxy resin Lower cost than using a glass-encapsulated thermistor element
Applications	Air conditioners (room & outdoor air)
Operating temperature	-30 to +80℃
Thermal time constant	τ ≒ 5 sec. (in stirred water)
Dissipation constant	δ ≒ 5mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R25 = 10kΩ, R25 = 5kΩ Other options available
B constant	B25/50 = 4100K, B25/50 = 3950K Other options available

Equipped with a resin protection tube

CE1

Protection tube variants:
PBT; φ5.5∗L24
ABS; φ5.5∗L24, φ6∗L25, φ6.8∗L25, φ7∗L25, φ8∗L25

Unit: mm



Sensing part: plastics Wire: PVC parallel

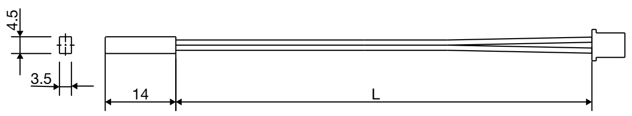
Specialized for refrigerators

Features	Proven results in low temperature ambient measurements Many variants of the ABS protection tube are available
Applications	Refrigerator chambers
Operating temperature	-30 to +80℃
Thermal time constant	τ ≒ 20 sec. (in stirred water)
Dissipation constant	δ ≒ 2.5mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

CE2

Protection tube variant: 2.5∗3.8∗L16.5

Unit: mm



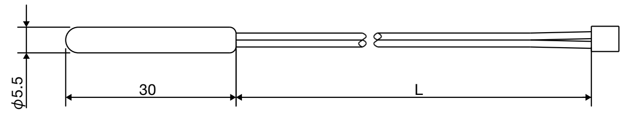
Sensing part: plastics Wire: PVC parallel

Mountable in a narrow space

Features	Equipped with a square resin protection tube, assuming the sensor to be mounted in a narrow space
Applications	Toilet seats, lithium-ion batteries
Operating temperature	-20 to +90℃
Thermal time constant	τ ≒ 3.5 sec. (in stirred water)
Dissipation constant	δ ≒ 1.5mW/℃
Withstand voltage	600VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

CC1

Unit: mm



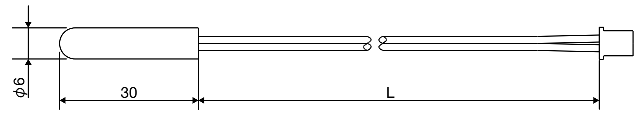
Sensing part: PVC Wire: PVC parallel, PVC double-insulated, PVC circular

Applicable to long wire, available in small volumes

Features	A glass-encapsulated thermistor element is integrated with wires using a PVC cap
Applications	Refrigerators, washer dryers
Operating temperature	-30 to +80℃
Thermal time constant	τ ≒ 13 sec. (in stirred water)
Dissipation constant	δ ≒ 2mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

CC2

Unit: mm



Sensing part: highly heatproof plastics Wire: fluororubber parallel

Applicable to high temperature environments

Environment is compared to other Shibaura sensors equipped with a resin protection tube

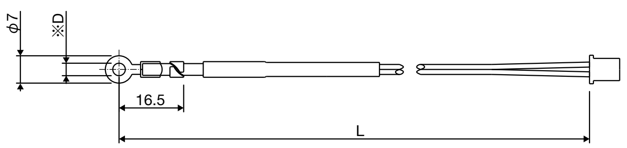
Features	A glass-encapsulated thermistor element is wire-to-wire spliced
Applications	Washer dryers
Operating temperature	-30 to +180℃
Thermal time constant	τ ≒ 10 sec. (in stirred water)
Dissipation constant	δ ≒ 2.5mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

Equipped with a lug terminal

RTZ1

※D: ϕ4.3 (for M4), ϕ3.2 (for M3)

Unit: mm



Sensing part: plated brass
Wire: Fluorocarbon, silicone rubber, silicone rubber insulated with glass braid, cross-linked PE, cross-linked PE parallel, PVC, PVC parallel

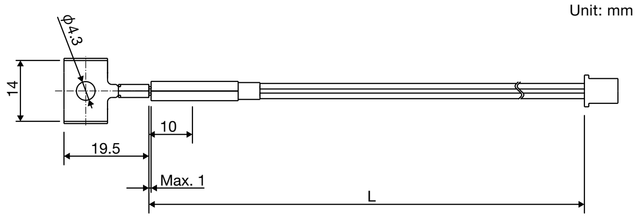
High heat resistance and fast response

Heat resistance and response are compared to other Shibaura sensors equipped with a lug terminal

Features	Sensor with a lug terminal, exhibiting fast response and high heat resistance
Applications	Hot plates for cooking devices, automobile braking systems
Operating temperature	-20 to +300℃
Thermal time constant	τ ≒ 3 sec. (on an aluminium plate at 100℃)
Dissipation constant	δ ≒ 2.5mW/℃
Withstand voltage	500VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	Optional
B constant	Optional

RT1

Unit: mm



Sensing part: aluminium
Wire: Fluorocarbon, silicone rubber, silicone rubber insulated with glass braid

High heat resistance and fast response

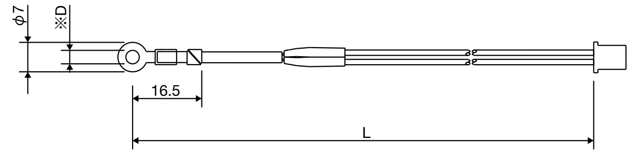
Heat resistance and response are compared to other Shibaura sensors equipped with a lug terminal

Features	Fast response and high heat resistance
Applications	Irons
Operating temperature	-10 to +250℃
Thermal time constant	τ ≒ 3 sec. (on an aluminium plate at 100℃)
Dissipation constant	δ ≒ 3mW/℃
Withstand voltage	1200VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R150 = 3.161kΩ Other options available
B constant	B100/200 = 4537K Other options available

RT2

※D: ϕ4.3 (for M4), ϕ3.2 (for M3)

Unit: mm



Sensing: plated brass
Wire: Fluorocarbon, silicone rubber, silicone rubber insulated with glass braid, cross-linked PE, cross-linked PE parallel, PVC, PVC parallel
Other options available

Standard sensor equipped with a lug terminal having high heat resistance

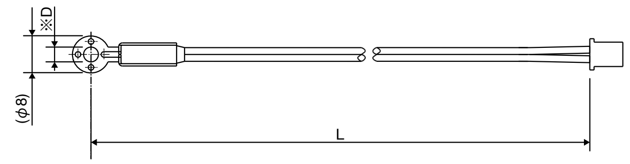
Heat resistance is compared to other Shibaura sensors equipped with a lug terminal

Features	High heat resistance, fast response and designed for assemblability		
Applications	Automobile inverters, heat pump water heaters		
Operating temperature	-20 to +180℃		
Thermal time constant	τ ≒ 6 sec. (on an aluminium plate at 100℃)	Insulation resistance	Min. 100MΩ at 500VDC
Dissipation constant	δ ≒ 2.5mW/℃	Resistance	R100 = 3.3kΩ Other options available
Withstand voltage	1250VAC for 1 min. or 1500VAC for 1 sec.	B constant	B0/100 = 3970K Other options available

EP2

※D: ϕ4.3 (for M4), ϕ3.2 (for M3)

Unit: mm



Sensing part: aluminium Wire: cross-linked PE parallel, PVC parallel

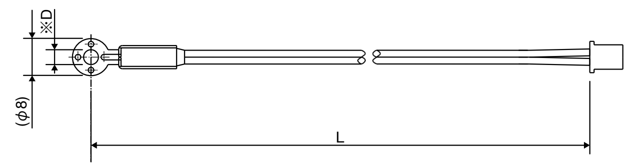
Enhanced insulation: using a glass-encapsulated thermistor element

Features	A glass-encapsulated thermistor element is sealed into a lug terminal Applicable to a wide temperature range		
Applications	Heatsinks	Withstand voltage	1200VAC for 1 sec.
Operating temperature	-30 to +120℃	Insulation resistance	Min. 100MΩ at 500VDC
Thermal time constant	τ ≒ 13 sec. (on an aluminium hot plate)	Resistance	Optional
Dissipation constant	δ ≒ 2.3mW/℃	B constant	Optional

KTEP1

※D: ϕ4.3 (for M4), ϕ3.2 (for M3)

Unit: mm



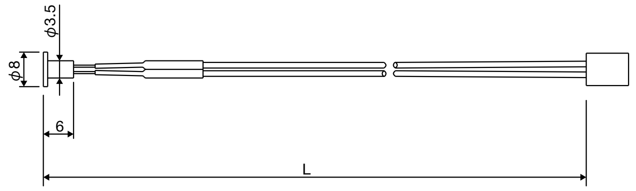
Sensing part: aluminium Wire: cross-linked PE parallel, PVC parallel

Enhanced insulation: using a bare thermistor chip

Features	A bare thermistor chip is sealed into a lug terminal Lower cost than using a glass-encapsulated thermistor element		
Applications	Heatsinks	Withstand voltage	1200VAC for 1 sec.
Operating temperature	-30 to +85℃	Insulation resistance	Min. 100MΩ at 500VDC
Thermal time constant	τ ≒ 20 sec. (on an aluminium hot plate)	Resistance	Optional
Dissipation constant	δ ≒ 5.5mW/℃	B constant	Optional

KN1

Unit: mm



Sensing part: aluminium
Wire: Cross-linked PE, silicone rubber insulated with glass braid, fluorocarbon, silicone rubber
Other options available

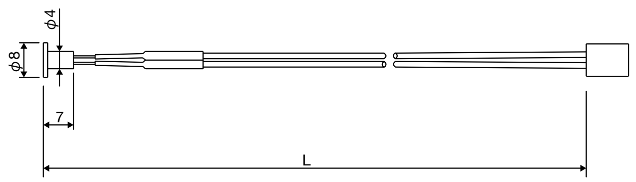
Aluminium casing: fast response

Response is compared to other Shibaura surface temperature sensors

Features	Fast response solution with low cost design
Applications	IH cooking devices
Operating temperature	-20 to +300℃
Thermal time constant	τ ≒ 0.7 sec. (on an aluminium plate at 100℃)
Dissipation constant	δ ≒ 2mW/℃
Withstand voltage	1800VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R100 = 3.3kΩ
B constant	B0/100 = 3970K

KN2

Unit: mm



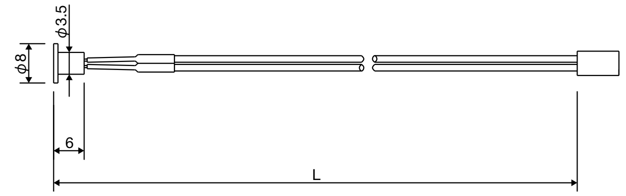
Sensing part: aluminium
Wire: Cross-linked PE, silicone rubber insulated with glass braid, fluorocarbon, silicone rubber
Other options available

Aluminium casing: standard

Features	Surface temperature sensing solution with low cost design
Applications	IH cooking devices
Operating temperature	-20 to +300℃
Thermal time constant	τ ≒ 4 sec. (on an aluminium plate at 100℃)
Dissipation constant	δ ≒ 3mW/℃
Withstand voltage	1000VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R100 = 3.3kΩ
B constant	B0/100 = 3970K

KN3

Unit: mm



Sensing part: ceramics
Wire: Cross-linked PE, silicone rubber insulated with glass braid, fluorocarbon, silicone rubber
Other options available

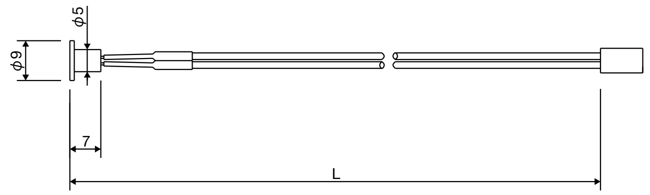
Ceramic casing: fast response

Response is compared to other Shibaura surface temperature sensors

Features	High insulation property and excellent resistance to pressure A ceramic case provides high insulation and a shape securing mountability
Applications	IH cooking devices, IH rice cookers
Operating temperature	-20 to +300℃ (only for the sensing surface)
Thermal time constant	τ ≒ 1.2 sec. (on an aluminium plate at 100℃)
Dissipation constant	δ ≒ 2mW/℃
Withstand voltage	5000VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R100 = 3.3kΩ
B constant	B0/100 = 3970K

KN4

Unit: mm



Sensing part: ceramics
Wire: Cross-linked PE, silicone rubber insulated with glass braid, fluorocarbon, silicone rubber
Other options available

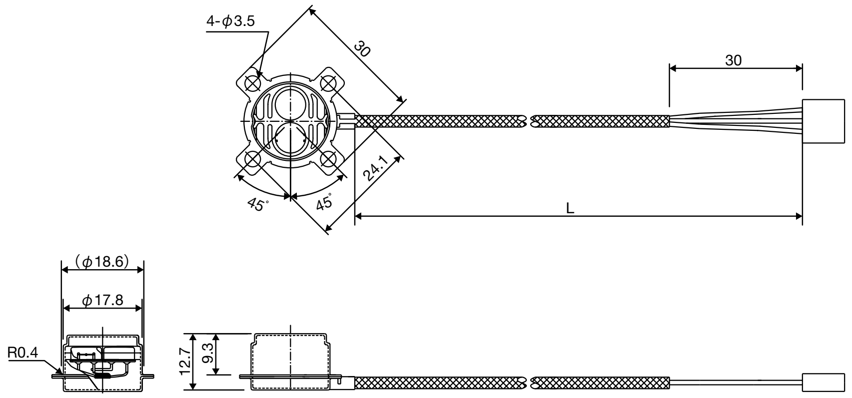
Ceramic casing: standard

Features	High insulation property and excellent resistance to pressure A ceramic case provides high insulation and a shape securing mountability
Applications	IH cooking devices, IH rice cookers
Operating temperature	-20 to +300℃ (only for the sensing surface)
Thermal time constant	τ ≒ 7 sec. (on an aluminium plate at 100℃)
Dissipation constant	δ ≒ 3mW/℃
Withstand voltage	5000VAC for 1 sec.
Insulation resistance	Min. 100MΩ at 500VDC
Resistance	R100 = 3.3kΩ
B constant	B0/100 = 3970K

Absolute humidity sensors

SP1

Unit: mm

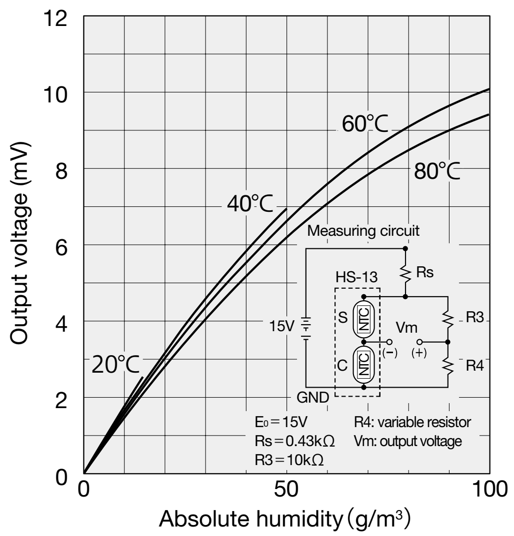


Sensing part: aluminium
Wire: fluororubber shielded, PVC
Other options available

Completey unique in the world

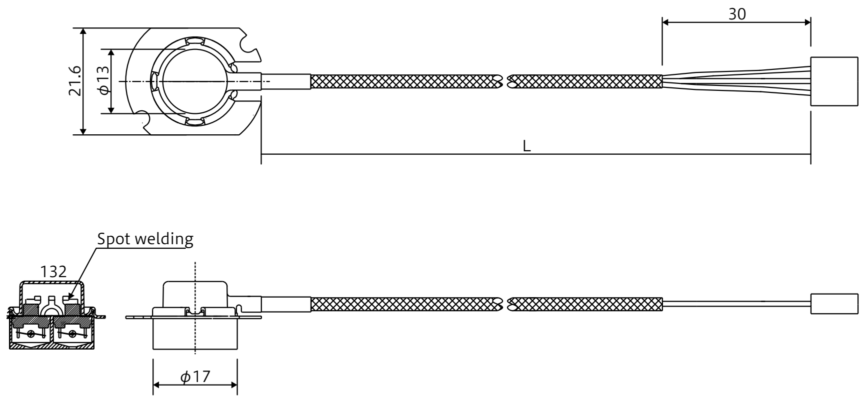
Features	Indispensable sensor for microwave ovens The only absolute humidity sensor in the world using a glass-encapsulated thermistor element Applicable up to 200℃
Applications	Exhaust air ducts for microwave ovens and tumble dryers, mist sauna rooms
Operating temperature	-5 to +200℃ (sensing part except wire harness)
Withstand voltage	500VAC for 1 sec.
Insulation resistance	Min. 50MΩ at 500VDC
Zero balance	-3 to +3mV from +40 to +150℃ (after resistance compensation)
R4 in standard test circuit	10kΩ ±390Ω
Output	5.3 ±1mV at +40℃, 35g/m³
Stabilization time	8 ±5 sec. after being energized
Humidity response	12 ±5 sec. (90% response)
Sensibility to gas/ carbon dioxide	-0.3mV (at 1000ppm)
Sensibility to gas/ ethyl alcohol	-0.3mV (at 1000ppm)
Sensibility to gas/ isobutane	-0.3mV (at 1000ppm)

Standard output characteristics



SPD1

Unit: mm



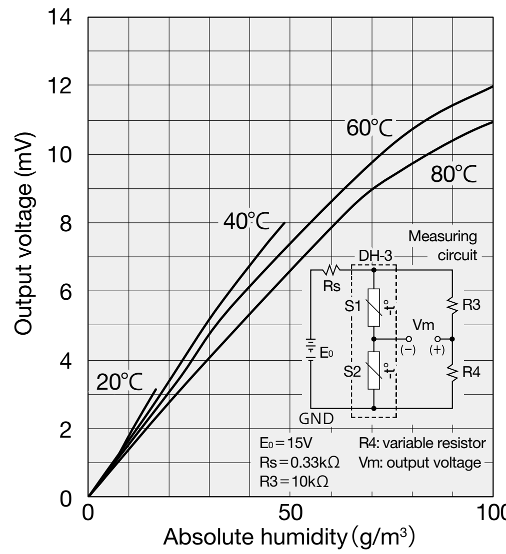
Sensing part: aluminium
Wire: fluororubber shielded, PVC
Other options available

Low cost

Cost is compared to other Shibaura absolute humidity sensors

Features	Indispensable absolute humidity sensor for automatic cooking with single-function microwave ovens Cost effective solution for absolute humidity sensing Detects the difference between the inside and outside of a chamber
Applications	Exhaust air ducts for microwave ovens
Operating temperature	-5 to +100℃ (sensing part except wire harness)
Withstand voltage	500VAC for 1 sec.
Insulation resistance	Min. 50MΩ at 500VDC
Zero balance	-3 to +3mV from +40 to +80℃ (after resistance compensation)
R4 in standard test circuit	10kΩ ±390Ω
Output	6 ±1mV at +40℃, 35g/m³
Stabilization time	Max. 120 sec. after being energized
Humidity response	S1: Max. 50 sec. S2: Min. 5 min.
Sensibility to gas/ carbon dioxide	-0.3mV (at 1000ppm)
Sensibility to gas/ ethyl alcohol	-0.3mV (at 1000ppm)
Sensibility to gas/ isobutane	-0.3mV (at 1000ppm)

Standard output characteristics



Sensing parts for standard products

Model name	Page	Sensing part materials											
		Aluminium	Polyimide tape	Epoxy resin	Brass	Copper	Plastics	Stainless steel	Ceramics	Iron alloy	Fluorocarbon	PVC	Nylon
MP1	P.38										●		
CS1	P.38				●								
MP3	P.39										●		
NIP1	P.40		●										
TSP1	P.41		●										
WT1	P.42							●					
WT2	P.42							●					
WT3	P.43							●					
WT4	P.43							●					
WT5	P.43							●					
MP2	P.44										●		
HT1	P.44									●			
NTN1	P.45				●			●					
MPM1	P.45							●					
OCK1-1	P.46							●					
OCK2-1	P.46							●					
OCK3	P.47							●					
ST1	P.47							●					
EP1	P.48					●							
KTM1	P.48					●							
EE1	P.49			●									
KT1	P.49			●									
CE1	P.50						●						
CE2	P.50						●						
CC1	P.51											●	
CC2	P.51						●						
RTZ1	P.52				●								
RT1	P.52	●											
RT2	P.53				●								
EP2	P.53	●											
KTEP1	P.53	●											
KN1	P.54	●											
KN2	P.54	●											
KN3	P.55								●				
KN4	P.55								●				
SP1	P.56	●											
SPD1	P.57	●											

The table shows typical materials only. Please consult us for your specific requirement.

Wires for standard products

Model name	Page	Wires												
		Fluorocarbon	Silicone rubber	Silicone rubber insulated with glass braid	Cross-linked PE	Cross-linked PE parallel	Cross-linked PE double-insul.	Fluororubber parallel	Cross-linked fluororubber	Fluororubber shielded	PVC	PVC parallel	PVC double-insul.	PVC circular
MP1	P.38	●												
CS1	P.38	●												
MP3	P.39	●												
RDS1	P.40				●									
NIP1	P.40				●									
TSP1	P.41				●									
WT1	P.42								●					
WT2	P.42								●					
WT3	P.43								●					
WT4	P.43								●					
WT5	P.43				●									
MP2	P.44	●												
HT1	P.44	●		●	●						●			
NTN1	P.45	●							●		●	●		
MPM1	P.45	●			●						●			
OCK1-1	P.46		●	●	●									
OCK2-1	P.46		●	●	●									
OCK3	P.47		●	●	●									
ST1	P.47				●			●				●		
EP1	P.48					●	●					●	●	
KTM1	P.48					●	●					●	●	
EE1	P.49					●	●					●	●	
KT1	P.49					●	●					●	●	
CE1	P.50											●		
CE2	P.50											●		
CC1	P.51											●	●	●
CC2	P.51							●						
RTZ1	P.52	●	●	●	●	●					●	●		
RT1	P.52	●	●	●										
RT2	P.53	●	●	●	●	●					●	●		
EP2	P.53					●						●		
KTEP1	P.53					●						●		
KN1	P.54	●	●	●	●									
KN2	P.54	●	●	●	●									
KN3	P.55	●	●	●	●									
KN4	P.55	●	●	●	●									
SP1	P.56									●	●			
SPD1	P.57									●	●			

The table shows typical materials only. Please consult us for your specific requirement.

Find your solution in ***SHIBAURA!!***

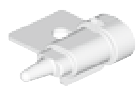
I need a sensor to fit
our mounting conditions.

None of these will fit…

We know who to ask.

For automobiles

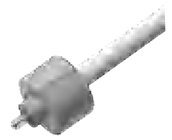
Op. temp. -40 to +200℃
Applications Water & oil temp. for motorcycles & automobiles



Op. temp. -40 to +120℃
Applications Ambient temp. for automobiles

Op. temp. -20 to +150℃
Applications Water & oil temp.

Op. temp. -40 to +150℃
Applications Transmissions



Op. temp. -40 to +230℃
Applications Retarder brake coils

Op. temp. -40 to +120℃
Applications Intale air temp. for motorcycles

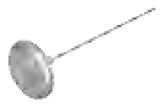
Op. temp. -25 to +150℃
Applications Engine blocks

Op. temp. -40 to +140℃
Applications Batteries

Op. temp. -40 to +85℃
Applications Batteries

For industrial use

Op. temp. -40 to +200℃
Applications Extinguishing systems for kitchens



Op. temp. -20 to +250℃
Applications Rice cookers

Op. temp. -40 to +150℃
Applications Blast chillers
Steam convection ovens
Food processing machines

Custom-designed sensors

**We provide special sensors to precisely fit your needs.
Here is a part of our many custom-designed sensors.**

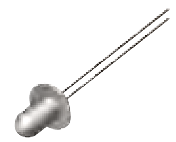
Let's discuss how we can
work it out.

Shibaura will design, test, analyze and
make a sample of your sensor.

It's perfect!

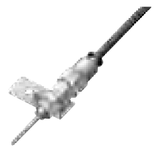
For industrial use

Op. temp. 0 to +50℃
Applications Blood analyzers



Op. temp. 0 to +50℃
Applications Medical equipment

Op. temp. 0 to +190℃
Applications Servo motor for machine tools



Op. temp. -10 to +100℃
Applications Extinguishing systems

Op. temp. 0 to +200℃
Applications Thermostatic baths for liquid & air

Op. temp. 0 to +250℃
Applications Liquid temp.

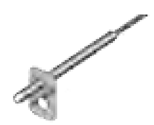
For domestic use

Op. temp. -20 to +180℃
Applications IH rice cookers

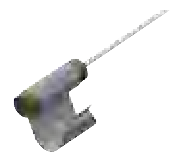
Op. temp. -20 to +450℃
Applications Carbretor for fan heaters

Op. temp. -20 to +60℃
Applications Warm water in toilet tanks

Op. temp. -40 to +120℃
Applications Fire alarms

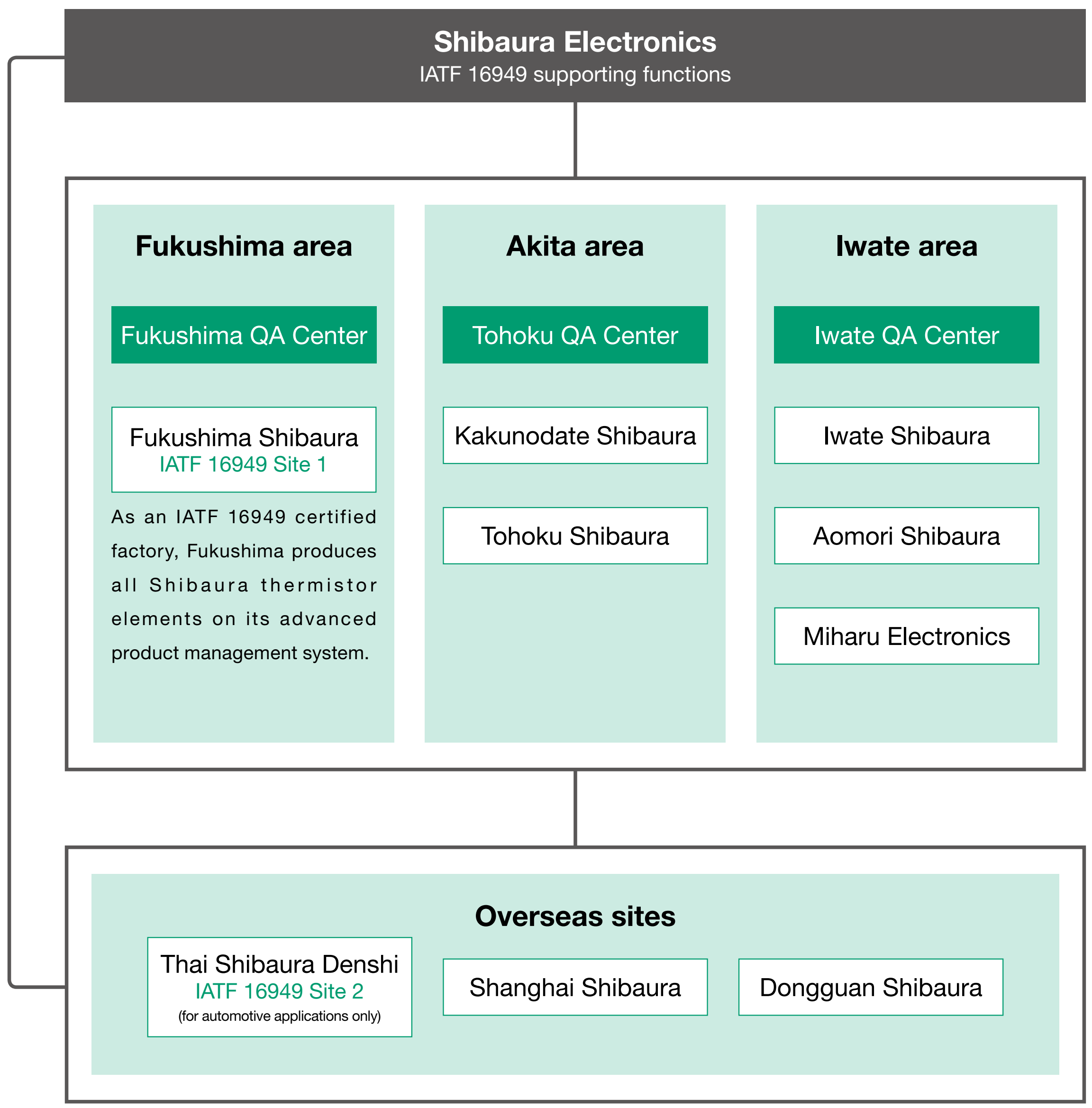


Op. temp. -20 to +300℃
Applications Toaster ovens
Food waste disposers
Dishwashers



Op. temp. -20 to +100℃
Applications Pipes

QMS, EMS, IATF 16949



As of September 2018

Manufacturing sites

Name	Location	Certification
Tohoku Shibaura Electronics Co., Ltd.	Senboku City, Akita Pref.	ISO 9001, ISO 14001 certified
Kakunodate Shibaura Electronics Co., Ltd.	Senboku City, Akita Pref.	ISO 9001, ISO 14001 certified
Iwate Shibaura Electronics Co., Ltd. (1st Factory)	Ninohe-gun, Iwate Pref.	ISO 9001, ISO 14001 certified
Iwate Shibaura Electronics Co., Ltd. (2nd Factory)	Ninohe-gun, Iwate Pref.	ISO 9001, ISO 14001 certified
Aomori Shibaura Electronics Co.,Ltd.	Sannohe-gun, Aomori Pref.	ISO 9001, ISO 14001 certified
Fukushima Shibaura Electronics Co., Ltd. (Motomiya Factory)	Motomiya City, Fukushima Pref.	ISO 9001, ISO 14001, IATF 16949 certified
Fukushima Shibaura Electronics Co., Ltd. (Matsukawa Factory)	Fukushima City, Fukushima Pref.	
Miharu Electronics Co., Ltd.	Sannohe-gun, Aomori Pref.	ISO 9001, ISO 14001 certified
Shanghai Shibaura Electronics Co., Ltd.	Shanghai, China	ISO 9001, ISO 14001 certified
Dongguan Shibaura Electronics Co., Ltd.	Dongguan, Guangdong, China	ISO 9001, ISO 14001 certified
Thai Shibaura Denshi Co., Ltd.	Singburi, Thailand	ISO 9001, ISO 14001, IATF 16949(*) certified (*) Only to manufacturing sites for automotive parts

Directions for using our thermistor elements and sensors

⚠ Warning

For your safety, the directions given below must be followed to minimize the risk of high temperature, heat generation, explosion, electric shock to prevent burns or other personal injuries.
(Check for any protection measures before use.)

・Do not touch a self-heated thermistor with your hands or body.
・Do not use a self-heated thermistor in flammable liquid or gas.

⚠ Caution

The directions given below must be followed to minimize the risk of malfunction or damage of your equipment in use, or desctruction of our product.

・The product is designed for its specified application. Do not use it for any other applications other than that specified in the product specifications, this catalogue or at the original design meetings.
・Please consult us and ask for instructions from our qualified engineers when you need to rework or reprocess the product.
・Be sure to eliminate the risk of breaking the product caused by stress from constructional materials before applying any treatment such as resin molding around the product.
・Be sure there are no abnormalities with the product during reliability evaluation tests. These tests must be conducted in operation mode at the design stage.
・Be careful not to apply any exceeding voltage onto the product, which may cause functional failures of your equipment due to the decrease in resistance by self-heating.
・Be sure not to exceed the conditions described in the product specifications when you set the type, time and amount of inrush current.
・Do not use the product beyond the specified operating temperature range.
・Do not subject the product to any intensive temperature changes exceeding the upper or lower limit of the specified operating temperature range.
・Take every possible safety measure (such as setting a safety circuit, adding another sensing device having equivalent functions to the product, etc.) to avoid any accidents when using the product as a sensor assembly.
・Take the following measures under the conditions that some noise may affect.
　・Protection circuit
　・Shield for the product (incl. wires)
・For sealing, be sure to check the reliability of sealing material by studying the nature (physical and chemical properties and weatherproof), amount to be applied, hardening condition, adhesive property, etc. before processing.
・Do not apply any voltage over the rated value of withstand voltage between the insulation and electrodes of the product.
・Do not use the product beyond the range of the rated or allowed maximum electric power.
・Do not apply any vibration, shock (incl. dropping) or pressure beyond the conditions defined in the product specifications.
・Do not repeatedly bend the wires beyond the conditions defined in the product specifications.
・Do not apply any force to the wires beyond the conditions defined in the product specifications.
・For thermistor sensors using a PVC cap or PVC wires: keep any materials causing flexible PVC to harden, away from the PVC cap or wires. (Such materials include PS, ABS, silicone and rubber into which a plasticizer in PVC can migrate.)
・Do not attach or detach a connector or a thermistor sensor by pulling the wires. Always pull the connector or the protection tube.
・Keep the portions of wires to be connected in clean conditions without contamination or rust to avoid imperfect or loose connection.
・Be careful not to melt solder and insulation materials making up the product when the product is connected by soldering.
・Be careful not to make contact with melted solder or a soldering iron with a thermistor element body and insulation on its wires.
・Do not tighten sensors equipped with a threaded protection tube with any torque over the specified value.
・Do not bend wires or apply any external force near the neck of the product.
・Fix firmly the thermistor element wires, when bending or cutting them.
・Do not use the product in an atmosphere over 85%RH for a long time (except for being used with measures such as waterproofing).
・Be sure to provide warning for consumers not to touch the thermistor installed in an accessible area of your equipment.
・Do not use the product in the following atmospheres (except for being used with measures such as chemicalproofing):
　・Corrosive gas (Cl_2, NH_3, SOx, NOx)
　・Highly conductive atmospheres (electrolyte, water, salt water)
　・Acid, alkali, organic solvent
　・Dusty locations
・When installing the product in your equipment, the following precautions must be taken to avoid possibilities of malfunction in the equipment caused by incorrect temperature detection.
　・For detecting the temperature of gas, liquid and solid inside, install the product so that its sensing part can measure the ambient temperature precisely without being affected by any heating elements or coolers.
　・For detecting temperature of the surface of a solid substance, make the measured surface and the product stick tightly with grease or adhesive which has good thermal conductivity. In addition, be careful not to be affected by ambient air or wind.
・The product equipped with a protection tube or a threaded protection tube may cause malfunction in your equipment due to metal corrosion. The construction and materials to be used must be taken into consideration.
・Please consult us about installation conditions such as mechanical strength in order to prevent any defects when the product is to be fixed by pressing, tightening or insertion.
・Do not place any other components near a self-heated thermistor to prevent malfunction occurring in the components.
・Store the products in their original packed condition at -10 to +40℃ and below 75%RH. Avoid an atmosphere with drastic temperature changes, direct sunlight, corrosive gas, dust and do not apply any load stress. Otherwise, it may deteriorate or damage the products.
・Unpacked thermistor elements must be stored in the minimum pack by resealing it, or keep it in a sealed container with desiccant.

If you have any questions on our products,
please feel free to contact our sales staff.

Precautions

❶ Please contact your nearest sales office for the latest version of product specifications before ordering.
❷ The product specifications described in this catalogue vary according to the actual environment in which the product is used.
❸ The manufacturer's warranty will not cover any defects or damage caused by improper use of the products that deviates from the characteristics, specifications, conditions including operating temperatures described in this catalogue.
❹ Shibaura shall not be responsible or liable for any controversies or disputes that may occur in connection with any third party's intellectual property rights and other related rights arising from usage of the products described in this catalogue.
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❻ For products which are controlled items subject to the Foreign Exchange and Foreign Trade Law of Japan, the export license stipulated by law is required for export.
❼ The descriptions in this catalogue are subject to change without prior notice.
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❾ This catalogue is current as of September 2018.

Shibaura thermistor elements in full scale

PSB-S1	
PSB-S2	
PSB-S3	
PSB-S5	
PSB-S7	
PSB-S9	
NSⅡ-E1	
NSⅡ-E3	
NSⅢ-U1	
PSB-N	(Formed example)▸ 
KG2	
KG3