Panasonic

2013

CATALOG

Thermal Management Solutions

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Thermal Management Solutions CONTENTS

All products in this catalog comply with the RoHS Directive.

The RoHS Directive is "the Directive (2011/65/EU) on the Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment " and its revisions.

The NTC Thermistors

This is a Negative Temperature Coefficient Resistor whose resistance changes as ambient temperature changes. Thermistor comprises 2 or 4 kinds of metal oxides of iron, nickel, cobalt, manganese and copper, being shaped and sintered at high temperature (1200 to 1500 °C)

■ Features

- Temperature Coefficient of Resistance is negative and extremely large
- Various kinds of types especially smaller ones are available.
- Resistance values are available from 22 Ω to 470 kΩ

■ Physical Characteristics of NTC Thermistors

Thermistor is a resistor sensitive to temperature utilizing the large temperature-coefficient of metal oxide semiconductor. And its temperature dependency of resistance value is indicated by the following equation:

$$R=R_0 \exp\left[B\left(\frac{1}{T}-\frac{1}{T_0}\right)\right] \quad \cdots\cdots (1)$$

T_0: Standard Temperature 298.15 K(25 °C)
R_0: Resistance at T_0 K
B: Thermistor Constant (K)

So called Temperature Coefficient (α) is generally indicated as follows:

$$\alpha = -\frac{B}{T^2} \quad \cdots\cdots (2)$$

But α is not adequate for use as a constant, because a change by temperature is considerably large, so B Value is used as a coefficient of thermistor.

■ Major Characteristics of NTC Thermistors

The relation between resistance and temperature of a thermistor is linear as shown in Fig. 2, in which resistance is shown in vertical direction in a logarithmic scale and reciprocal of absolute temperature in horizontal direction. Bias degrees in these straight lines are determined according to the B Value expressed by the following equation.

$$B = \frac{\ell nR_1 - \ell nR_2}{\frac{1}{T_1}-\frac{1}{T_2}} \quad \cdots\cdots (3)$$

R_1: Resistance at T_1 K
R_2: Resistance at T_2 K

When calculated from this equation, B Value is a variable in a strict sense, and the resistance is expressed by the following equation:

$R = AT^{-C} \exp D/T$ ····· (4)

In (4), C is a small positive or negative constant and quite negligible except use in precision temperature-measuring device, thereby the B Value is, in practical usage, to be considered as a constant. In Fig. 1,
the relation between the resistance ratio R_T/R_{25}
(R_{25}: Resistance at 25 °C, R_T: Resistance at T °C) and B Value is shown with T °C, in the horizontal direction.

■ Recommended Applications

- For temperature measurement or temperature detection : thermometer, temperature controller
- For temperature compensation : transistor circuit, measuring instruments

Fig. 1

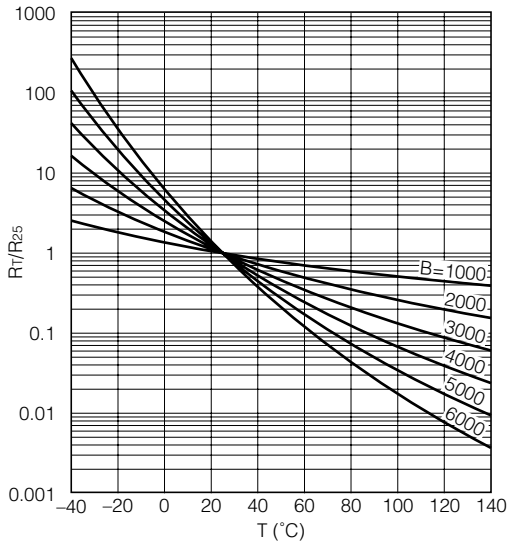
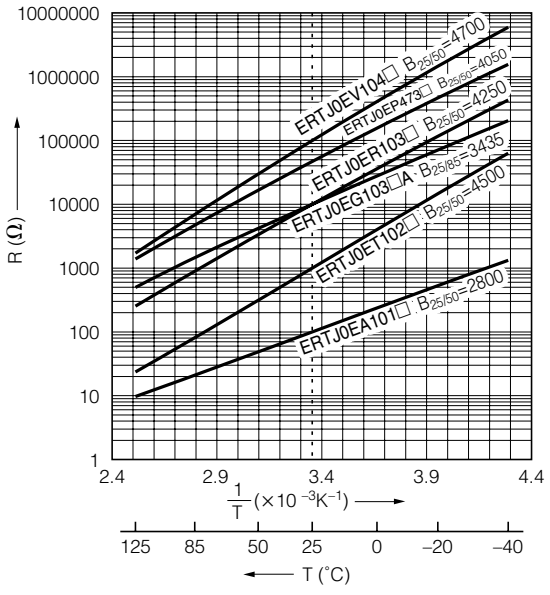
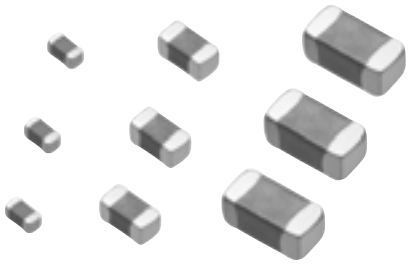


Fig. 2



Multilayer NTC Thermistors

Series: **ERTJ**



■ Features

- Surface Mount Device (0201, 0402, 0603)
- Highly reliable multilayer / monolithic structure
- Wide temperature operating range (–40 to 125 °C)
- Environmentally-friendly lead-free
- RoHS compliant

■ Recommended Applications

- Mobile Phone
  - · Temperature compensation for crystal oscillator
  - · Temperature compensation for semiconductor devices
- Personal Computer
  - · Temperature detection for CPU and memory device
  - · Temperature compensation for ink-viscosity (Inkjet Printer)
- Battery Pack
  - · Temperature detection of battery cells
- Liquid Crystal Display
  - · Temperature compensation of display contrast
  - · Temperature compensation of display backlighting (CCFL)

■ Explanation of Part Numbers

1	2	3	4	5	6	7	8	9	10	11	12	
E	R	T	J	0	E	G	1	0	3	J	A	(Example)

Common Code

Product Code		Type Code	
ERT	NTC Thermistors	J	Chip Type (SMD) Multilayer Type

Size Code

Z	"0201"
0	"0402"
1	"0603"

Packaging Style Code

E	"0201", "0402" Pressed Carrier Taping Punched Carrier Taping (Pitch : 2 mm)
V	"0603" Punched Carrier Taping (Pitch : 4 mm)

B Value Class Code

A	2701 to 2800
G	3301 to 3400
M	3801 to 3900
P	4001 to 4100
R	4201 to 4300
S	4301 to 4400
T	4401 to 4500
V	4601 to 4700

Nominal Resistance R_{25} (Ω)

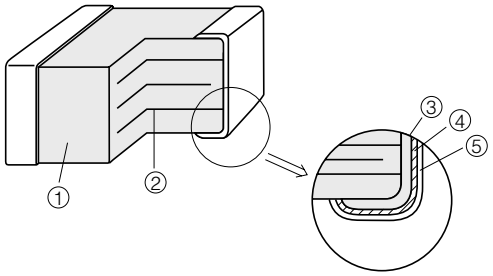
The first two digits are significant figures of resistance and the third one denotes the number of zeros following them.

Resistance Tolerance Code

F	±1%	Narrow Tolerance Type
G	±2%	
H	±3%	Standard Type
J	±5%	

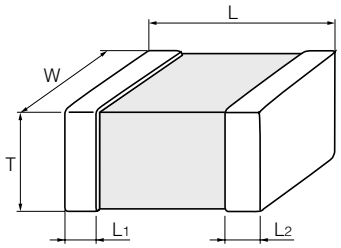
Special Specification

■ Construction



No	Name	
①	Semiconductive Ceramics	
②	Internal electrode	
③	Terminal electrode	Substrate electrode
④		Intermediate electrode
⑤		External electrode

■ Dimensions in mm (not to scale)



(Unit : mm)

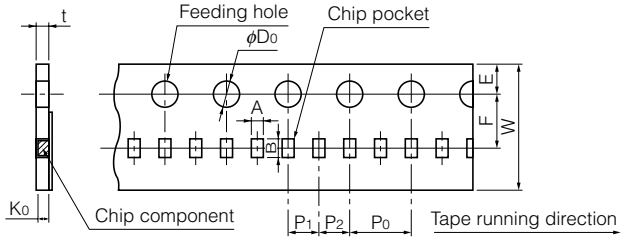
Size Code (EIA)	L	W	T	L_1, L_2
Z(0201)	0.60±0.03	0.30±0.03	0.30±0.03	0.15±0.05
0(0402)	1.0±0.1	0.50±0.05	0.50±0.05	0.25±0.15
1(0603)	1.60±0.15	0.8±0.1	0.8±0.1	0.3±0.2

■ Packaging Methods

● Standard Packing Quantities

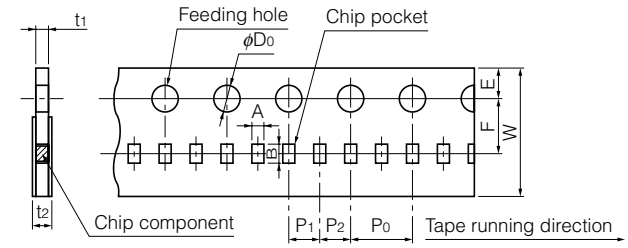
Size Code	Thickness (mm)	Kind of Taping	Pitch (mm)	Quantity (pcs./reel)
Z(0201)	0.3	Pressed Carrier Taping	2	15,000
0(0402)	0.5	Punched Carrier Taping	2	10,000
1(0603)	0.8		4	4,000

● Pitch 2 mm (Pressed Carrier Taping) : Size 0201



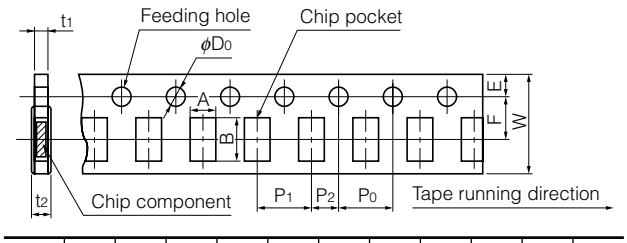
Symbol	A	B	W	F	E	P_1	P_2	P_0	ϕD_0	t	K_0
Dim. (mm)	0.36 ±0.03	0.66 ±0.03	8.0 ±0.2	3.50 ±0.05	1.75 ±0.10	2.00 ±0.05	2.00 ±0.05	4.0 ±0.1	$1.5^{+0.1}_{0}$	0.55 max.	0.36 ±0.03

● Pitch 2 mm (Punched Carrier Taping) : Size 0402



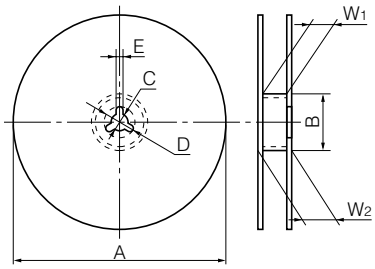
Symbol	A	B	W	F	E	P_1	P_2	P_0	ϕD_0	t_1	t_2
Dim. (mm)	0.62 ±0.05	1.12 ±0.05	8.0 ±0.2	3.50 ±0.05	1.75 ±0.10	2.00 ±0.05	2.00 ±0.05	4.0 ±0.1	$1.5^{+0.1}_{0}$	0.7 max.	1.0 max.

● Pitch 4 mm (Punched Carrier Taping) : Size 0603



Symbol	A	B	W	F	E	P_1	P_2	P_0	ϕD_0	t_1	t_2
Dim. (mm)	1.0 ±0.1	1.8 ±0.1	8.0 ±0.2	3.50 ±0.05	1.75 ±0.10	4.0 ±0.1	2.00 ±0.05	4.0 ±0.1	$1.5^{+0.1}_{0}$	1.1 max.	1.4 max.

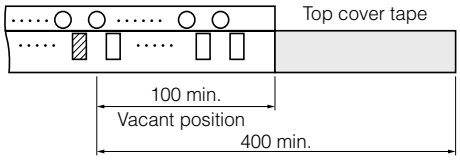
● Reel for Taping



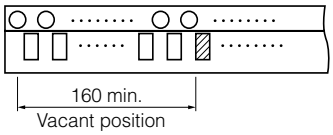
Symbol	ϕA	ϕB	C	D	E	W_1	W_2
Dim. (mm)	180^{0}_{-3}	$60.0^{+1.0}_{0}$	13.0±0.5	21.0±0.8	2.0±0.5	$9.0^{+1.0}_{0}$	11.4±1.0

● Leader Part and Taped End

Leader part



Taped end



(Unit : mm)

■ Minimum Quantity / Packing Unit

Part Number (Size)	Minimum Quantity / Packing Unit	Packing Quantity in Carton	Carton L×W×H (mm)
ERTJZ (0201)	15,000	300,000	250×200×200
ERTJ0 (0402)	10,000	200,000	250×200×200
ERTJ1 (0603)	4,000	80,000	250×200×200

Part No., quantity and country of origin are designated on outer packages in English.

■ Ratings

Size code (EIA)	Z(0201)	0(0402)	1(0603)
Operating Temperature Range	−40 to 125 °C		
Rated Maximum Power Dissipation*1	33 mW	66 mW	100 mW
Dissipation Factor*2	approximately 1 mW/°C	approximately 2 mW/°C	approximately 3 mW/°C

*1 Rated Maximum Power Dissipation : The maximum power that can be continuously applied at the rated ambient temperature.
·The Maximum Power Dissipation under ambient temperature 25 °C or less is the same with the rated maximum power dissipation, and Maximum power dissipation beyond 25 °C depends on the Decreased power dissipation curve.
·Please see "Operating Power" for details paging 371.
*2 Dissipation factor : The constant amount power required to raise the temperature of the Thermistor 1 °C through self heat generation under stable temperatures.
·Dissipation factor is the reference value when mounted on a glass epoxy board (1.6 mmT).

● Resistance ratios to R_{25} at each temperature/Reference values
(for obtaining resistance at each temperature by using R_{25} shown in part number)

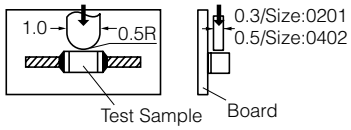
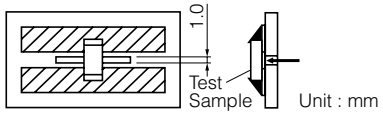
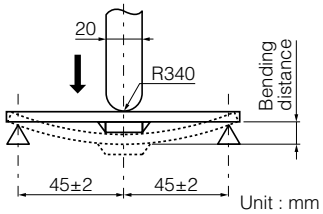
	ERTJ□□A~		ERTJ□□G~	ERTJ□□M~	ERTJ□□P~	ERTJ□□R~	ERTJ0ES~	ERTJ1VS~	ERTJ□□T~	ERTJ0ET104□	ERTJ□□V~
$B_{25/50}$	2750 K	2800 K	(3375 K)	3900 K	4050 K	4250K	4330K	(4330K)	4500K	4500K	4700K
$B_{25/85}$	(2700 K)	(2750 K)	3435 K	(3970 K)	(4100 K)	(4300K)	(4390K)	4390K	(4450K)	(4580K)	(4750K)
T(°C)									*1	*2	
-40	13.05	13.28	20.52	32.11	33.10	43.10	45.67	45.53	63.30	47.07	59.76
-35	10.21	10.40	15.48	23.29	24.03	30.45	32.08	31.99	42.92	33.31	41.10
-30	8.061	8.214	11.79	17.08	17.63	21.76	22.80	22.74	29.50	23.80	28.61
-25	6.427	6.547	9.069	12.65	13.06	15.73	16.39	16.35	20.53	17.16	20.14
-20	5.168	5.261	7.037	9.465	9.761	11.48	11.91	11.89	14.46	12.49	14.33
-15	4.191	4.261	5.507	7.147	7.362	8.466	8.743	8.727	10.30	9.159	10.31
-10	3.424	3.476	4.344	5.444	5.599	6.300	6.479	6.469	7.407	6.772	7.482
-5	2.819	2.856	3.453	4.181	4.291	4.730	4.845	4.839	5.388	5.046	5.481
0	2.336	2.362	2.764	3.237	3.312	3.582	3.654	3.650	3.966	3.789	4.050
5	1.948	1.966	2.227	2.524	2.574	2.734	2.778	2.776	2.953	2.864	3.015
10	1.635	1.646	1.806	1.981	2.013	2.102	2.128	2.126	2.221	2.179	2.262
15	1.380	1.386	1.474	1.567	1.584	1.629	1.642	1.641	1.687	1.669	1.710
20	1.171	1.174	1.211	1.247	1.255	1.272	1.277	1.276	1.293	1.287	1.303
25	1	1	1	1	1	1	1	1	1	1	1
30	0.8585	0.8565	0.8309	0.8072	0.8016	0.7921	0.7888	0.7890	0.7799	0.7823	0.7734
35	0.7407	0.7372	0.6941	0.6556	0.6461	0.6315	0.6263	0.6266	0.6131	0.6158	0.6023
40	0.6422	0.6376	0.5828	0.5356	0.5235	0.5067	0.5004	0.5007	0.4856	0.4876	0.4721
45	0.5595	0.5541	0.4916	0.4401	0.4266	0.4090	0.4022	0.4025	0.3874	0.3884	0.3723
50	0.4899	0.4836	0.4165	0.3635	0.3496	0.3319	0.3251	0.3254	0.3111	0.3111	0.2954
55	0.4309	0.4238	0.3543	0.3018	0.2881	0.2709	0.2642	0.2645	0.2513	0.2504	0.2356
60	0.3806	0.3730	0.3027	0.2518	0.2386	0.2222	0.2158	0.2161	0.2042	0.2026	0.1889
65	0.3376	0.3295	0.2595	0.2111	0.1985	0.1832	0.1772	0.1774	0.1670	0.1648	0.1523
70	0.3008	0.2922	0.2233	0.1777	0.1659	0.1518	0.1463	0.1465	0.1377	0.1348	0.1236
75	0.2691	0.2600	0.1929	0.1504	0.1393	0.1264	0.1213	0.1215	0.1144	0.1108	0.1009
80	0.2417	0.2322	0.1672	0.1278	0.1174	0.1057	0.1011	0.1013	0.09560	0.09162	0.08284
85	0.2180	0.2081	0.1451	0.1090	0.09937	0.08873	0.08469	0.08486	0.08033	0.07609	0.06834
90	0.1974	0.1871	0.1261	0.09310	0.08442	0.07468	0.07122	0.07138	0.06782	0.06345	0.05662
95	0.1793	0.1688	0.1097	0.07980	0.07200	0.06307	0.06014	0.06028	0.05753	0.05314	0.04712
100	0.1636	0.1528	0.09563	0.06871	0.06166	0.05353	0.05099	0.05112	0.04903	0.04472	0.03939
105	0.1498	0.1387	0.08357	0.05947	0.05306	0.04568	0.04340	0.04351	0.04198	0.03784	0.03308
110	0.1377	0.1263	0.07317	0.05170	0.04587	0.03918	0.03708	0.03718	0.03609	0.03218	0.02791
115	0.1270	0.1153	0.06421	0.04512	0.03979	0.03374	0.03179	0.03188	0.03117	0.02748	0.02364
120	0.1175	0.1056	0.05650	0.03951	0.03460	0.02916	0.02734	0.02742	0.02702	0.02352	0.02009
125	0.1091	0.09695	0.04986	0.03470	0.03013	0.02527	0.02359	0.02367	0.02351	0.02017	0.01712

*1 Other than ERTJ0ET104□ in $B_{25/50}$=4500K.
*2 ERTJ0ET104□ only.

$$B_{25/50}=\frac{\ell n\ (R_{25}/R_{50})}{1/298.15-1/323.15} \qquad B_{25/85}=\frac{\ell n\ (R_{25}/R_{85})}{1/298.15-1/358.15}$$

R_{25}=Resistance at 25.0±0.1 °C
R_{50}=Resistance at 50.0±0.1 °C
R_{85}=Resistance at 85.0±0.1 °C

■ Specification and Test Method

Item	Specification	Test Method
Rated Zero-power Resistance (R_{25})	Within the specified tolerance.	The value of the d.c. resistance shall be measured at the rated ambient temperature of 25.0 ±0.1 °C under the power less than 0.1mW which is negligible self heat generation.
B Value	Within the specified tolerance. ✻ Individual Specification shall specify $B_{25/50}$ or $B_{25/85}$.	The Zero-power resistances; R_1 and R_2, shall be measured respectively at T_1 (°C) and T_2 (°C). The B value is calculated by the following equation. $B_{T_1/T_2}=\frac{\ell n\ (R_1)-\ell n\ (R_2)}{1/(T_1+273.15)-1/(T_2+273.15)}$ T_1: $B_{25/50}$ 25.0 ±0.1 °C; $B_{25/85}$ 25.0 ±0.1 °C T_2: $B_{25/50}$ 50.0 ±0.1 °C; $B_{25/85}$ 85.0 ±0.1 °C
Adhesion	The terminal electrode shall be free from peeling or signs of peeling.	Applied force : Size 0201 : 2 N Size 0402, 0603 : 5 N Duration : 10 s Size : 0201, 0402  Size : 0603 
Bending Strength	There shall be no cracks and other mechanical damage. R_{25} change : within ±5 %	Bending distance : 1 mm Bending speed : 1 mm/s 
Resistance to Soldering Heat	There shall be no cracks and other mechanical damage. Nallow Tol. type / Standard type R_{25} change : within ±2 % / within ±3 % B Value change : within ±1 % / within ±2 %	Soldering bath method Solder temperature : 270 ±5 °C Dipping period : 3.0 ±0.5 s Preheat condition : Step 1: 80 to 100 °C, 120 to 180 s Step 2: 150 to 200 °C, 120 to 180 s
Solderability	More than 75 % of the soldered area of both terminal electrodes shall be covered with fresh solder.	Soldering bath method Solder temperature : 230 ±5 °C Dipping period : 4 ±1 s Solder : H63A (JIS–Z–3282)

■ Specification and Test Method

Item	Specification	Test Method
Temperature Cycling	Nallow Tol. type / Standard type R_{25} change : within ±2 % / within ±3 % B Value change : within ±1 % / within ±2 %	Conditions of one cycle Step 1 : –40 °C, 30±3 min Step 2 : Room temp., 3 min max. Step 3 : 125 °C, 30±3 min. Step 4 : Room temp., 3 min max. Number of cycles: 100 cycles
Moisture Resistance	Nallow Tol. type / Standard type R_{25} change : within ±2 % / within ±3 % B Value change : within ±1 % / within ±2 %	Temperature : 85 ±2 °C Relative humidity : 85 ±5 % Test period : 1000 +48/0 h
Damp Heat Load	Nallow Tol. type / Standard type R_{25} change : within ±2 % / within ±3 % B Value change : within ±1 % / within ±2 %	Temperature : 85 ±2 °C Relative humidity : 85 ±5 % Applied power : 10 mW Test period : 500 +24/0 h
Cold Resistance	Nallow Tol. type / Standard type R_{25} change : within ±2 % / within ±3 % B Value change : within ±1 % / within ±2 %	Temperature : –40 ±3 °C Test period : 1000 +48/0 h
Dry Heat Resistance	Nallow Tol. type / Standard type R_{25} change : within ±2 % / within ±3 % B Value change : within ±1 % / within ±2 %	Temperature : 125 ±3 °C Test period : 1000 +48/0 h

■ Part Number List of Narrow Tolerance Type (Resistance Tolerance : ±2 %, ±1 %)

● 0201(EIA)

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code: Nominal B value ✻() Reference value	B value class code: $B_{25/50}$ $B_{25/85}$	G (3375 K) 3435 K±1 %	P 4050 K±1 % (4100 K)	V 4700 K±1 % (4750 K)
10 kΩ	±1 %(F) or ±2 %(G)			ERTJZEG103□A		
47 kΩ					ERTJZEP473□	
100 kΩ						ERTJZEV104□

□ : Resistance Tolerance Code
Avoid flow soldering.

● 0402(EIA)

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code: Nominal B value ✻() Reference value	B value class code: $B_{25/50}$ $B_{25/85}$	G (3375 K) 3435 K±1 %	P 4050 K±1 % (4100 K)	S 4330 K±1 % (4390 K)	V 4700 K±1 % (4750 K)
10 kΩ	±1 %(F) or ±2 %(G)			ERTJ0EG103□A			
47 kΩ					ERTJ0EP473□		
100 kΩ						ERTJ0ES104□	ERTJ0EV104□

□ : Resistance Tolerance Code
Avoid flow soldering.

● 0603(EIA)

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code: Nominal B value ✻() Reference value	B value class code: $B_{25/50}$ $B_{25/85}$	G (3375 K) 3435 K±1 %	S (4330 K) 4390 K±1 %
10 kΩ	±1 %(F) or ±2 %(G)			ERTJ1VG103□A	
100 kΩ					ERTJ1VS104□A

□ : Resistance Tolerance Code
Avoid flow soldering.

■ Part Number List of Standard Type (Resistance Tolerance : ±5 %, ±3 %)

● 0201(EIA)

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code		G	P	T	V
		Nominal B value ✻() Reference value	$B_{25/50}$ $B_{25/85}$	(3375 K) 3435 K±2 %	4050 K±3 % (4100 K)	4500 K±2 % (4450 K)	4700 K±2 % (4750 K)
2.0 kΩ	±3 %(H) or ±5 %(J)					ERTJZET202□	
3.0 kΩ						ERTJZET302□	
4.7 kΩ						ERTJZET472□	
10 kΩ				ERTJZEG103□A			
47 kΩ					ERTJZEP473□		
100 kΩ							ERTJZEV104□

□ : Resistance Tolerance Code
Avoid flow soldering.

● 0402(EIA)

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code		A	
		Nominal B value ✻() Reference value	$B_{25/50}$ $B_{25/85}$	2750 K±3 % (2700 K)	2800 K±3 % (2750 K)
22 Ω	±3 %(H) or ±5 %(J)			ERTJ0EA220□	
33 Ω				ERTJ0EA330□	
40 Ω				ERTJ0EA400□	
47 Ω				ERTJ0EA470□	
68 Ω					ERTJ0EA680□
100 Ω					ERTJ0EA101□
150 Ω					ERTJ0EA151□

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code		G	M	P	R
		Nominal B value ✻() Reference value	$B_{25/50}$ $B_{25/85}$	(3375 K) 3435 K±1 %	3900 K±2 % (3970 K)	4050 K±2 % (4100 K)	4250 K±2 % (4300 K)
3.3 kΩ	±3 %(H) or ±5 %(J)						ERTJ0ER332□
4.7 kΩ							ERTJ0ER472□
6.8 kΩ							ERTJ0ER682□
10 kΩ				ERTJ0EG103□A	ERTJ0EM103□		ERTJ0ER103□
15 kΩ							ERTJ0ER153□
22 kΩ							ERTJ0ER223□
33 kΩ						ERTJ0EP333□	ERTJ0ER333□
47 kΩ						ERTJ0EP473□	
100 kΩ						ERTJ0EP104□	

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code		S	T	V
		Nominal B value ✻() Reference value	$B_{25/50}$ $B_{25/85}$	4330 K±2 % (4390 K)	4500 K±2 % (4450 K, 4580 K)	4700 K±2 % (4750 K)
1.0 kΩ	±3 %(H) or ±5 %(J)				ERTJ0ET102□	
1.5 kΩ					ERTJ0ET152□	
2.0 kΩ					ERTJ0ET202□	
2.2 kΩ					ERTJ0ET222□	
3.0 kΩ					ERTJ0ET302□	
3.3 kΩ					ERTJ0ET332□	
4.7 kΩ					ERTJ0ET472□	
47 kΩ						ERTJ0EV473□
68 kΩ						ERTJ0EV683□
100 kΩ				ERTJ0ES104□	ERTJ0ET104□	ERTJ0EV104□
150 kΩ					ERTJ0ET154□	ERTJ0EV154□
220 kΩ						ERTJ0EV224□
330 kΩ						ERTJ0EV334□
470 kΩ						ERTJ0EV474□

□ : Resistance Tolerance Code
Avoid flow soldering.

● 0603(EIA)

Nominal Resistance at 25 °C	Resistance Tolerance	B value class code		A		G	P
		Nominal B value ✻() Reference value	$B_{25/50}$ $B_{25/85}$	2750 K±3 % (2700 K)	2800 K±3 % (2750 K)	(3375 K) 3435 K±1 %	4050 K±3 % (4100 K)
22 Ω	±3 %(H) or ±5 %(J)			ERTJ1VA220□			
33 Ω				ERTJ1VA330□			
40 Ω					ERTJ1VA400□		
47 Ω					ERTJ1VA470□		
68 Ω					ERTJ1VA680□		
100 Ω					ERTJ1VA101□		
10 kΩ						ERTJ1VG103□A	
47 kΩ							ERTJ1VP473□

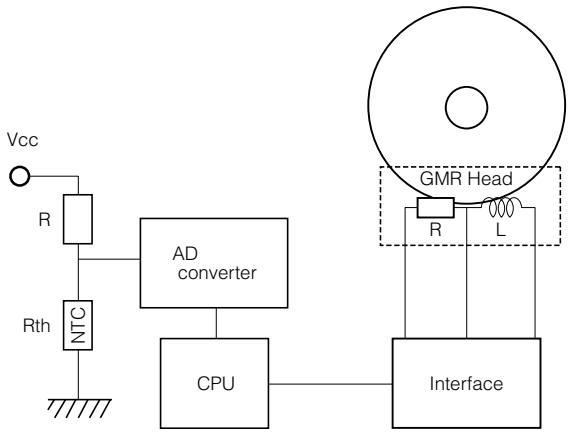
Nominal Resistance at 25 °C	Resistance Tolerance	B value class code		R	S	T	V
		Nominal B value ✻() Reference value	$B_{25/50}$ $B_{25/85}$	4250 K±2 % (4300 K)	(4330 K) 4390 K±1%	4500 K±2 % (4450 K)	4700 K±2 % (4750 K)
1.0 kΩ	±3 %(H) or ±5 %(J)					ERTJ1VT102□	
1.5 kΩ						ERTJ1VT152□	
2.0 kΩ						ERTJ1VT202□	
2.2 kΩ						ERTJ1VT222□	
3.0 kΩ						ERTJ1VT302□	
3.3 kΩ				ERTJ1VR332□		ERTJ1VT332□	
4.7 kΩ				ERTJ1VR472□		ERTJ1VT472□	
6.8 kΩ				ERTJ1VR682□			
10 kΩ				ERTJ1VR103□			
15 kΩ				ERTJ1VR153□			
22 kΩ				ERTJ1VR223□			
33 kΩ				ERTJ1VR333□			
47 kΩ				ERTJ1VR473□			ERTJ1VV473□
68 kΩ				ERTJ1VR683□			ERTJ1VV683□
100 kΩ					ERTJ1VS104□A		ERTJ1VV104□
150 kΩ							ERTJ1VV154□

□ : Resistance Tolerance Code
Avoid flow soldering.

■ Typical Application

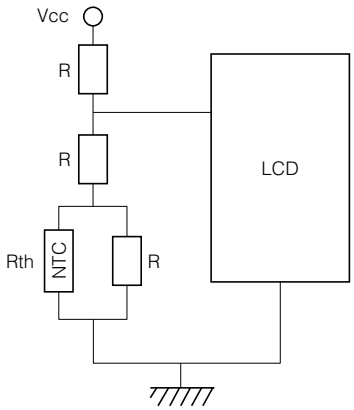
● Temperature Detection

Writing current control of HDD



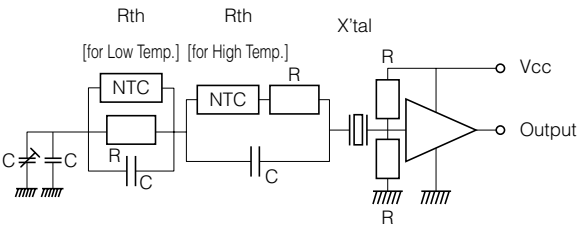
● Temperature Compensation (Pseudo-linearization)

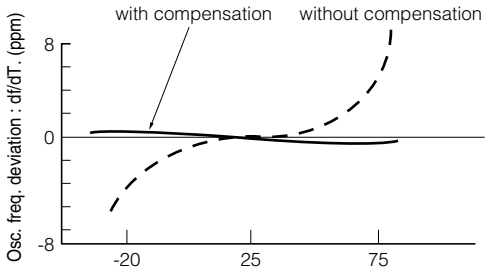
Contrast level control of LCD



● Temperature Compensation (RF circuit)

Temperature compensation of TCXO





Multilayer Chip NTC Thermistors

Series: **ERTJ**

Handling Precautions

⚠Safety Precautions

Multilayer NTC Thermistors (hereafter referred to as "Thermistors") should be used for general purpose applications found in consumer electronics (audio/visual, home, office, information & communication) equipment.
When subjected to severe electrical, environmental, and/or mechanical stress beyond the specifications, as noted in the Ratings and Specified Conditions section, the Thermistor may fail in a short circuit mode or in an open-circuit mode. This case results in a burn-out, smoke or flaming.
For products which require high safety levels, please carefully consider how a single malfunction can affect your product. In order to ensure the safety in the case of a single malfunction, please design products with fail-safe, such as setting up protecting circuits, etc.

- For the following applications and conditions, please contact us for additional not found in this document.
  - · When your application may have difficulty complying with the safety or handling precautions specified below.
  - · For any applications where a malfunction with this product may directly or indirectly cause hazardous conditions which could result in death or injury;
    - ① Aircraft and Aerospace Equipment (artificial satellite, rocket, etc.)
    - ② Submarine Equipment (submarine repeating equipment, etc.)
    - ③ Transportation Equipment (motor vehicles, airplanes, trains, ship, traffic signal controllers, etc.)
    - ④ Power Generation Control Equipment (atomic power, hydroelectric power, thermal power plant control system, etc.)
    - ⑤ Medical Equipment (life-support equipment, pacemakers, dialysis controllers, etc.)
    - ⑥ Information Processing Equipment (large scale computer systems, etc.)
    - ⑦ Electric Heating Appliances, Combustion devices (gas fan heaters, oil fan heaters, etc.)
    - ⑧ Rotary Motion Equipment
    - ⑨ Security Systems
    - ⑩ And any similar types of equipment

■Operating Conditions and Circuit Design

1. Circuit Design

1.1 Operating Temperature and Storage Temperature

The specified "Operating Temperature Range" found in the Specifications is the absolute maximum and minimum temperature rating. Every Thermistor shall be operated within the specified "Operating Temperature Range".
The Thermistors mounted on PCB shall be stored without operating within the specified "Storage Temperature Range" in the Specifications.

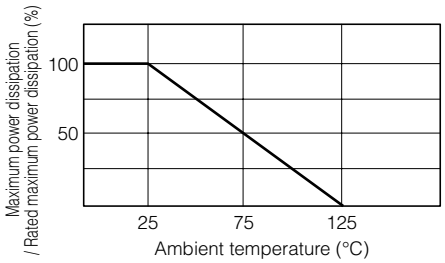
1.2 Operating Power

Thermistors shall not be operated in excess of the "Maximum power dissipation".
If the Thermistors are operated beyond the specified Maximum power dissipation, it may cause burnout and/or damage due to thermal run away.
For temperature detection applications, the accuracy may be greatly influenced by self-heat generation and the heat dissipation of the Thermistor, even if the Thermistor is operated under the specified Maximum Power Dissipation.
Please check the safety and reliability of your circuit.

[Maximum power dissipation]

·The Maximum power that can be continuously applied under static air at a certain ambient temperature. The Maximum power dissipation under an ambient temperature of 25 °C or less is the same with the rated maximum power dissipation, and Maximum power dissipation beyond 25 °C depends on the Decreased power dissipation curve below.

Decreased power dissipation curve



[Dissipation factor]

·The constant amount power required to raise the temperature of the Thermistor 1 °C through self heat generation under stable temperatures.
Dissipation factor (mW/°C) = Power consumption of Thermistor / Temperature rise of element

1.3 Environmental Restrictions

The Thermistors shall not be operated and/or stored under the following conditions.

(1) Environmental conditions
  (a) Under direct exposure to water or salt water
  (b) Under conditions where water can condense and/or dew can form
  (c) Under conditions containing corrosive gases such as hydrogen sulfide, sulfurous acid, chlorine and ammonia

(2) Mechanical conditions
  Under severe conditions of vibration or impact beyond the specified conditions found in the Specifications.

1.4 Measurement of Resistance

The resistance of the Thermistors varies dependent on ambient temperatures and self-heating. Note the following points when measuring resistance values of the Thermistors during inspection or when considering them for circuits.

① Measurement temp : 25±0.1 °C
  Measurement in liquid (silicon oil, etc.) is recommended for a stable measurement temperature.

② Power : 0.10 mW max.
  4 terminal measurement with a constant-current power supply is recommended.

2. Design of Printed Circuit Board

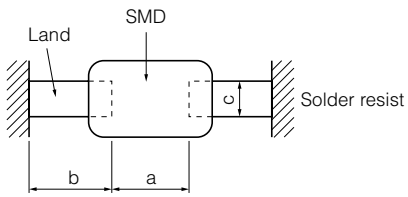
2.1 Selection of Printed Circuit Boards

When the Thermistors are mounted and soldered on an “Alumina Substrate”, the substrate influences the Thermistors’ reliability against “Temperature Cycles” and “Heat shock” due to the difference in the thermal expansion coefficient between them. Confirm that the actual board used does not deteriorate the characteristics of the Thermistors.

2.2 Design of Land Pattern

(1) Recommended land dimensions are shown below. Use the proper amount of solder in order to prevent cracking. Using too much solder places excessive stress on the Thermistors.

Recommended Land Dimensions

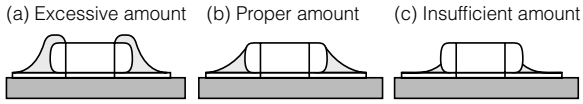


Unit (mm)

Size Code (EIA)	Component dimensions			a	b	c
	L	W	T			
Z(0201)	0.6	0.3	0.3	0.2 to 0.3	0.25 to 0.30	0.2 to 0.3
0(0402)	1.0	0.5	0.5	0.4 to 0.5	0.4 to 0.5	0.4 to 0.5
1(0603)	1.6	0.8	0.8	0.8 to 1.0	0.6 to 0.8	0.6 to 0.8

(2) The size of lands shall be designed to have equal spacing between the right and left sides. If the amount of solder on the right land is different from that on the left land, the component may be cracked by stress since the side with a larger amount of solder solidifies later during cooling.

Recommended Amount of Solder

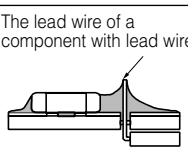
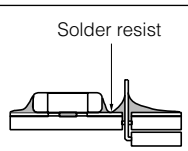
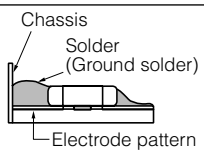
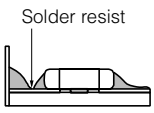
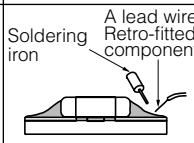
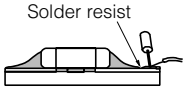
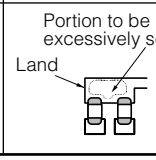
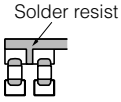


2.3 Utilization of Solder Resist

(1) Solder resist shall be utilized to equalize the amounts of solder on both sides.

(2) Solder resist shall be used to divide the pattern for the following cases;
  ·Components are arranged closely.
  ·The Thermistor is mounted near a component with lead wires.
  ·The Thermistor is placed near a chassis.
  See the table below.

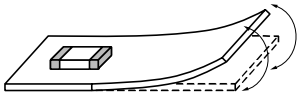
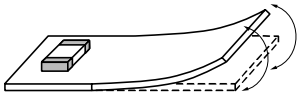
Prohibited Applications and Recommended Applications

Item	Prohibited applications	Improved applications by pattern division
Mixed mounting with a component with lead wires		
Arrangement near chassis		
Retro-fitting of component with lead wires		
Lateral arrangement		

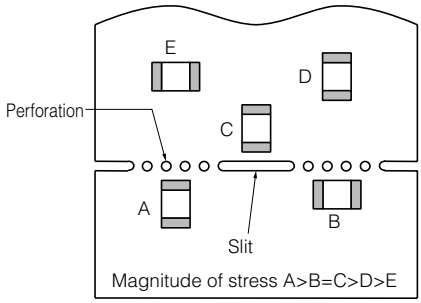
2.4 Component Layout

The Thermistors/components shall be placed on the PC board such that both electrodes are subjected to uniform stresses, or to position the component electrodes at right angles to the grid glove or bending line. This should be done to avoid cracking the Thermistors from bending the PC board after or during placing/mounting on the PC board. Placement of the Thermistors near heating elements also requires that great care be taken in order to avoid stresses from rapid heating and cooling.

(1) To minimize mechanical stress caused by the warp or bending of a PC board, please follow the recommended Thermistors' layout below.

Prohibited layout	Recommended layout
	 Layout the Thermistors sideways against the stressing direction

(2) The following layout is for your reference since mechanical stress near the dividing/breaking position of a PC board varies depending on the mounting position of the Thermistors.



(3) The magnitude of mechanical stress applied to the Thermistors when the circuit board is divided is in the order of push back < slit < V-groove < perforation.
Also take into account the layout of the Thermistors and the dividing/breaking method.

(4) When the Thermistors are placed near heating elements such as heater, etc., cracks from thermal stresses may be caused by the following:
·Soldering the Thermistors directly heating elements.
·Mounting the Thermistors on the same land that another Thermistor is mounted on.
For the above-mentioned mounting and/or placement, please contact us in advance,

2.5 Mounting Density and Spaces

If components are arranged in too narrow a space, the components can be affected by solder bridges and solder balls. The space between components should be carefully determined.

■ Precautions for Assembly

1. Storage

(1) The Thermistors shall be stored between 5 - 40 °C and 20 - 70 % RH, not under severe conditions of high temperature and humidity.

(2) If stored in a place that is humid, dusty, or contains corrosive gasses (hydrogen sulfide, sulfurous acid, hydrogen chloride and ammonia etc.), the solderability of terminal electrodes may deteriorate.
In addition, storage in a place subjected to heating and/or exposure to direct sunlight will cause deformed tapes and reels, and component sticking to tapes, both of which can result in mounting problems

(3) Do not store components longer than 6 months. Check the solderability of products that have been stored for more than 6 months before use

2. Chip Mounting Consideration

(1) When mounting the Thermistors/components on a PC board, the Thermistor bodies shall be free from excessive impact loads such as mechanical impact or stress due to the positioning, pushing force and displacement of vacuum nozzles during mounting.

(2) Maintenance and inspection of the Chip Mounter must be performed regularly.

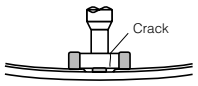
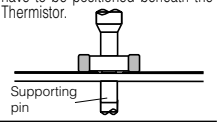
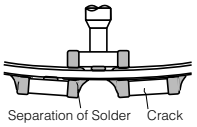
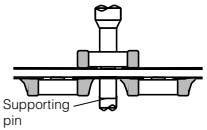
(3) If the bottom dead center of the vacuum nozzle is too low, the Thermistor will crack from excessive force during mounting.

The following precautions and recommendations are for your reference in use.

(a) Set and adjust the bottom dead center of the vacuum nozzles to the upper surface of the PC board after correcting the warp of the PC board.

(b) Set the pushing force of the vacuum nozzle during mounting to 1 to 3 N in static load.

(c) For double surface mounting, apply a supporting pin on the rear surface of the PC board to suppress the bending of the PC board in order to minimize the impact of the vacuum nozzles. Typical examples are shown in the table below.

Item	Prohibited mounting	Recommended mounting
Single surface mouting		The supporting pin does not necessarily have to be positioned beneath the Thermistor. 
Double surface mounting		

(d) Adjust the vacuum nozzles so that their bottom dead center during mounting is not too low.

(4) The closing dimensions of the positioning chucks shall be controlled. Maintenance and replacement of positioning chucks shall be performed regularly to prevent chipping or cracking of the Thermistors caused by mechanical impact during positioning due to worn positioning chucks.

(5) Maximum stroke of the nozzle shall be adjusted so that the maximum bending of PC board does not exceed 0.5 mm at 90 mm span. The PC board shall be supported by an adequate number of supporting pins.

3. Selection of Soldering Flux

Soldering flux may seriously affect the performance of the Thermistors. The following shall be confirmed before use.

(1) The soldering flux should have a halogen based content of 0.1 wt% (converted to chlorine) or below.
Do not use soldering flux with strong acid.

(2) When applying water-soluble soldering flux, wash the Thermistors sufficiently because the soldering flux residue on the surface of PC boards may deteriorate the insulation resistance on the Thermistors' surface.

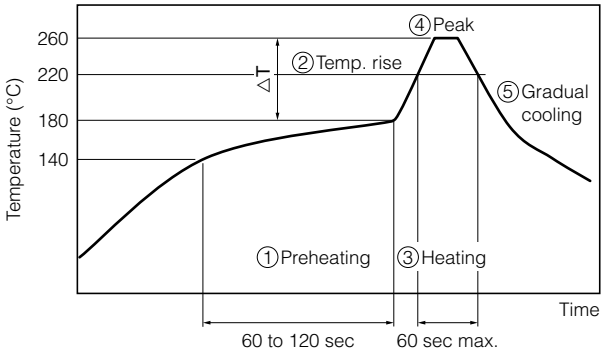
4. Soldering

4.1 Reflow Soldering

The reflow soldering temperature conditions are each temperature curves of Preheating, Temp. rise, Heating, Peak and Gradual cooling. Large temperature difference caused by rapid heat application to the Thermistors may lead to excessive thermal stresses, contributing to the thermal cracks. The Preheating temperature requires controlling with great care so that tombstone phenomenon may be prevented.

Item	Temperature	Period or Speed
①Preheating	140 to 180 °C	60 to 120 sec
②Temp. rise	Preheating temp to Peak temp.	2 to 5 °C /sec
③Heating	220 °C min.	60 sec max.
④Peak	260 °C max.	10 sec max.
⑤Gradual cooling	Peak temp. to 140 °C	1 to 4 °C /sec

Recommended profile of Reflow soldering (EX)



△T : Allowable temperature difference △T ≦ 150 °C

The rapid cooling (forced cooling) during Gradual cooling part should be avoided, because this may cause defects such as the thermal cracks, etc.

When the Thermistors are immersed into a cleaning solvent, make sure that the surface temperatures of the devices do not exceed 100 °C.

Performing reflow soldering twice under the conditions shown in the figure above [Recommended profile of Reflow soldering (EX)] will not cause any problems. However, pay attention to the possible warp and bending of the PC board.

4.2 Hand Soldering

Hand soldering typically causes significant temperature change, which may induce excessive thermal stresses inside the Thermitors, resulting in the thermal cracks, etc. In order to prevent any defects, the following should be observed.

- ·The temperature of the soldering tips should be controlled with special care.
- ·The direct contact of soldering tips with the Thermistors and/or terminal electrodes should be avoided.
- ·Dismounted Thermistors shall not be reused.

(1) Condition 1 (with preheating)

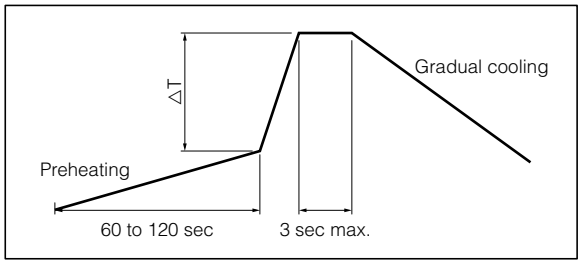
(a) Soldering:
ϕ1.0 mm or below Thread eutectic solder with soldering flux* in the core.
* Rosin-based and non-activated flux is recommended.

(b) Preheating:
The Thermistors shall be preheated so that the "Temperature Gradient" between the devices and the tip of soldering iron is 150 °C or below.

(c) Temperature of Iron tip: 300 °C max.
(The required amount of solder shall be melted in advance on the soldering tip.)

(d) Gradual cooling:
After soldering, the Thermistors shall be cooled gradually at room temperature.

Recommended profile of Hand soldering (EX)



△T : Allowable temperature difference △T ≦ 150 °C

(2) Condition 2 (without preheating)
Hand soldering can be performed without preheating, by following the conditions below:

(a) Soldering iron tip shall never directly touch the ceramic and terminal electrodes of the Thermistors.

(b) The lands are sufficiently preheated with a soldering iron tip before sliding the soldering iron tip to the terminal electrodes of the Thermistors for soldering.

Conditions of Hand soldering without preheating

Item	Condition
Temperature of Iron tip	270 °C max.
Wattage	20 W max.
Shape of Iron tip	ϕ3 mm max.
Soldering time with a soldering iron	3 sec max.

5. Post Soldering Cleaning

5.1 Cleaning solvent

Soldering flux residue may remain on the PC board if cleaned with an inappropriate solvent. This may deteriorate the electrical characteristics and reliability of the Thermistors.

5.2 Cleaning conditions

Inappropriate cleaning conditions such as insufficient cleaning or excessive cleaning may impair the electrical characteristics and reliability of the Thermistors.

(1) Insufficient cleaning can lead to:

(a) The halogen substance found in the residue of the soldering flux may cause the metal of terminal electrodes to corrode.

(b) The halogen substance found in the residue of the soldering flux on the surface of the Thermistors may change resistance values.

(c) Water-soluble soldering flux may have more remarkable tendencies of (a) and (b) above compared to those of rosin soldering flux.

(2) Excessive cleaning can lead to:
(a) Overuse of ultrasonic cleaning may deteriorate the strength of the terminal electrodes or cause cracking in the solder and /or ceramic bodies of the Thermistors due to vibration of the PC boards. Please follow these conditions for Ultrasonic cleaning:

Ultrasonic wave output	: 20 W/L max.
Ultrasonic wave frequency	: 40 kHz max.
Ultrasonic wave cleaning time	: 5 min. max.

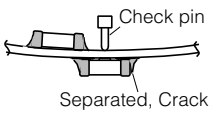
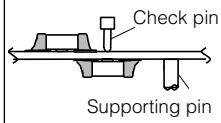
5.3 Contamination of Cleaning solvent

Cleaning with contaminated cleaning solvent may cause the same results as insufficient cleaning due to the high density of liberated halogen.

6.Inspection Process

When mounted PC boards are inspected with measuring terminal pins, abnormal and excess mechanical stress shall not be applied to the PC board or mounted components, to prevent failure or damage to the devices.

(1) Mounted PC boards shall be supported by an adequate number of supporting pins with bend settings of 90 mm span 0.5 mm max.
(2) Confirm that the measuring pins have the right tip shape, are equal in height and are set in the correct positions.
The following figures are for your reference to avoid bending the PC board.

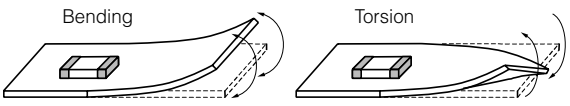
Item	Prohibited setting	Recommended setting
Bending of PC board		

7. Protective Coating

When the surface of a PC board on which the Capacitors have been mounted is coated with resin to protect against moisture and dust, it shall be confirmed that the protective coating which is corrosive or chemically active is not used, in order that the reliability of the Thermistors in the actual equipment may not be influenced. Coating materials that expand or shrink also may lead to damage to the Thermistors during the curing process.

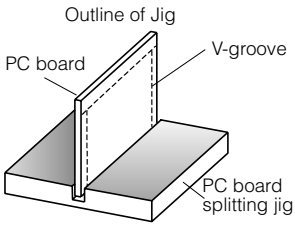
8. Dividing/Breaking of PC Boards

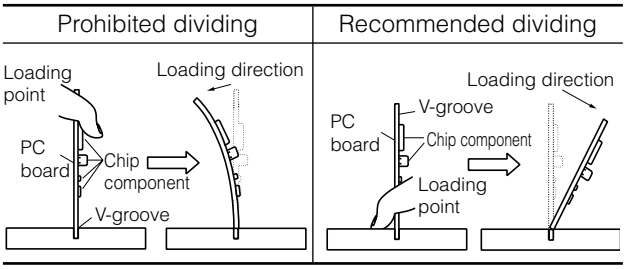
(1) Abnormal and excessive mechanical stress such as bending or torsion shown below can cause cracking in the Thermistors.



(2) Dividing/Breaking of the PC boards shall be done carefully at moderate speed by using a jig or apparatus to prevent the Thermistors on the boards from mechanical damage.

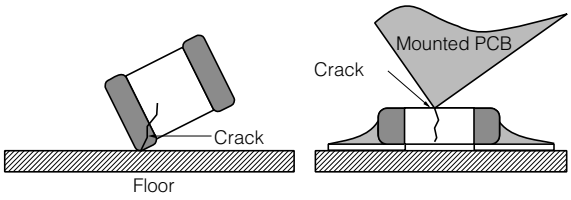
(3) Examples of PCB dividing/breaking jigs:
The outline of PC board breaking jig is shown below. When PC boards are broken or divided, loading points should be close to the jig to minimize the extent of the bending
Also, planes with no parts mounted on should be used as plane of loading, which generates a compressive stress on the mounted plane, in order to prevent tensile stress induced by the bending, which may cause cracks of the Thermistors or other parts mounted on the PC boards.





9. Mechanical Impact

(1) The Thermistors shall be free from any excessive mechanical impact.
The Thermistor body is made of ceramics and may be damaged or cracked if dropped.
Never use a Thermistor which has been dropped; their quality may be impaired and failure rate increased.
(2) When handling PC boards with Thermistors mounted on them, do not allow the Thermistors to collide with another PC board.
When mounted PC boards are handled or stored in a stacked state, impact between the corner of a PC board and the Thermistor may cause damage or cracking and can deteriorate the withstand voltage and insulation resistance of the Thermistor.

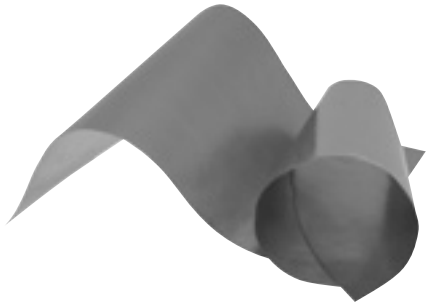


■ Other

The various precautions described above are typical.
For special mounting conditions, please contact us.

"PGS" Graphite Sheets

Type: **EYG**



PGS (Pyrolytic Graphite Sheet) is a thermal interface material which is very thin, synthetically made, has high thermal conductivity, and is made from a higly oriented graphite polymer film. It is ideal for providing thermal management/heat-sinking in limited spaces or to provide supplemental heat-sinking in addition to conventional means. This material is flexible and can be cut into customizable shapes.

■ Features

- Excellent thermal conductivity : 700 to 1950 W/(m·K) (2 to 5 times as high as copper, 3 to 8 time as high as aluminum)
- Lightweight: Specific gravity : 0.85 to 2.13 g/cm^3 (1/4 to 1/10 of copper, 1/1.3 to 1/3 of aluminum in density)
- Flexible and easy to be cut or trimmed. (withstands repeated bending)
- Low thermal resistance
- RoHS compliant

■ Recommended applications

- Smart phones, Mobile phones, DSC, DVC, Tablet PCs, PCs and peripherals, LED Devices
- Semiconductor manufacturing equipment (Sputtering, Dry etching, Steppers)
- Optical communications equipment

■ Explanation of Part Numbers

- PGS only (EYGS******)

1	2	3	4	5	6	7	8	9	10
E	Y	G	S	0	9	1	2	1	0

Product Code

Style	
S	PGS only

Dimension	
0912	90 mm × 115 mm
1218	115 mm × 180 mm
1823	180 mm × 230 mm

PGS Thickness*	
10	100 µm
07	70 µm
05	50 µm
04	40 µm
03	25 µm

* PGS thickness 17 µm, 10 µm do not carry out the correspondence in the one piece of article.

- Taping (EYGA********)

1	2	3	4	5	6	7	8	9	10	11	12
E	Y	G	A	0	9	1	2	1	0	D	M

Product Code

Style	
A	Taping

Dimension**	
0912	90 mm × 115 mm
1218	115 mm × 180 mm

PGS Thickness	
10	100 µm
07	70 µm
05	50 µm
04	40 µm
03	25 µm
02	17 µm
01	10 µm

Suffix	
A	Processing type * Please refer to a constitution example
M	
F	
PA	
PM	
DM	
DF	
V	
RV	
KV	

** Please contact us for other dimensions other than those above.

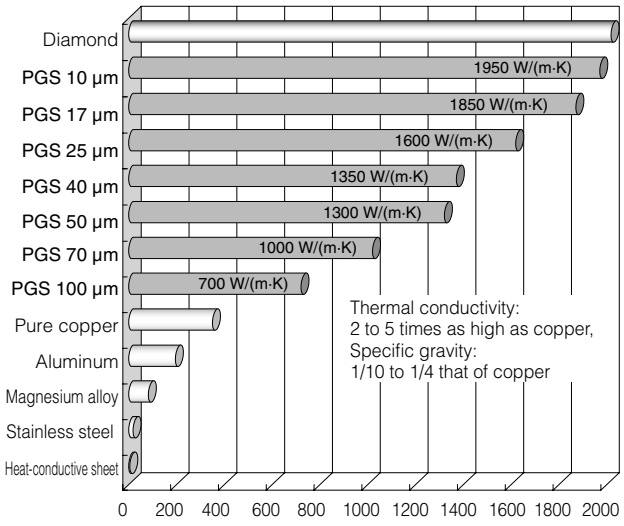
■ Characteristics

Thickness		100 µm	70 µm	50 µm	40 µm
		0.10±0.03 mm	0.07±0.015 mm	0.050±0 .015 mm	0.040±0 .012 mm
Density		0.85 g/cm^3	1.21 g/cm^3	1.70 g/cm^3	1.80 g/cm^3
Thermal conductivity	a-b plane	700 W/(m·K)	1000 W/(m·K)	1300 W/(m·K)	1350 W/(m·K)
Electrical conductivity		10000 S/cm	10000 S/cm	10000 S/cm	10000 S/cm
Extensional strength		20.0 MPa	20.0 MPa	20.0 MPa	25.0 MPa
Expansion coefficient	a-b plane	9.3×10^{-7} 1/K	9.3×10^{-7} 1/K	9.3×10^{-7} 1/K	9.3×10^{-7} 1/K
	c axis	3.2×10^{-5} 1/K	3.2×10^{-5} 1/K	3.2×10^{-5} 1/K	3.2×10^{-5} 1/K
Heat resistance*		400 °C			
Bending(angle 180,R5)		10000 cycles			

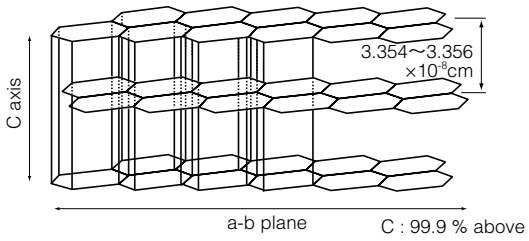
Thickness		25 µm	17 µm	10 µm
		0.025±0 .010 mm	0.017±0 .005 mm	0.010±0 .002 mm
Density		1.90 g/cm^3	2.10 g/cm^3	2.13 g/cm^3
Thermal conductivity	a-b plane	1600 W/(m·K)	1850 W/(m·K)	1950 W/(m·K)
Electrical conductivity		20000 S/cm	20000 S/cm	20000 S/cm
Extensional strength		30.0 MPa	40.0 MPa	40.0 MPa
Expansion coefficient	a-b plane	9.3×10^{-7} 1/K	9.3×10^{-7} 1/K	9.3×10^{-7} 1/K
	c axis	3.2×10^{-5} 1/K	3.2×10^{-5} 1/K	3.2×10^{-5} 1/K
Heat resistance*		400 °C		
Bending(angle 180,R5)		10000 cycles		

✻ The heat-resistant temperature is a thing of the PGS simple substance performance.
(When I do not include processing materials such as the PET tape)
✻✻ Values are for reference, not guaranteed.

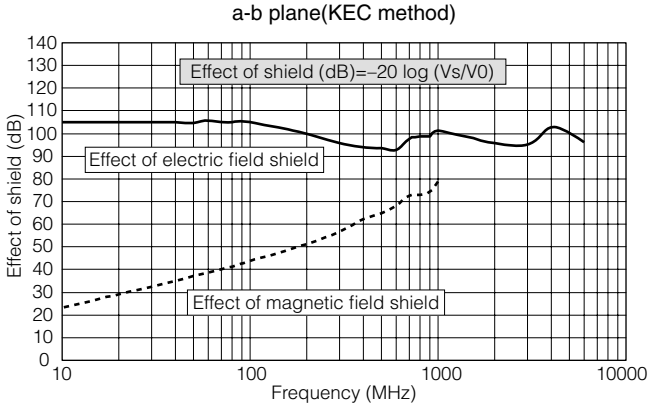
■ Comparison of thermal conductivity (a-b plane)



■ Layered structure of PGS

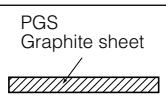
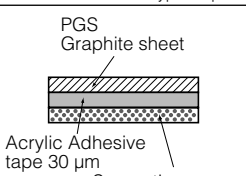
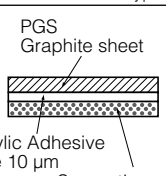
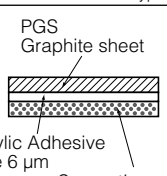


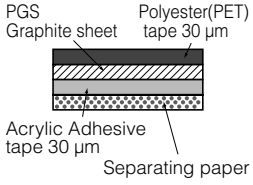
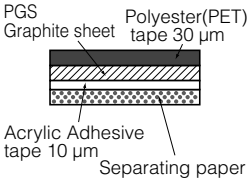
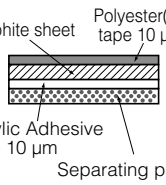
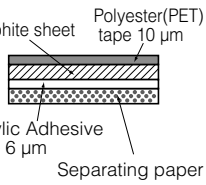
■ Electric field shield performance



■ Constitution example of the artefact

● Standard series (PGS 100, 70, 50, 40, 25, 17, 10 µm)

Type		PGS Only	Adhesive Type		
		S type	A-A type	A -M type	A -F type
Front face		–	–	–	–
Rear face		–	Insulative adhesion type 30 µm	Insulative thin adhesion type 10 µm	Insulative thin adhesion type 6 µm
Structure					
Features		· High Thermal Conductivity High Flexibility · Low Thermal Resistance · Available up to 400 °C · Conductive Material	· With insulation material on one side · With strong adhesive tape for putting chassis · Withstanding Voltage : 2 kV	· With insulation material on one side · Low thermal resistance comparison with A-A type · Withstanding Voltage : 1 kV	· With insulation material on one side · Low thermal resistance comparison with A-A type
Withstand temperature		400 °C	100 °C	100 °C	100 °C
Standard Size		115 × 180 mm	90 × 115 mm	90 × 115 mm	90 × 115 mm
Maximam size		180 × 230 mm (25 µm to)	115 × 180 mm	115 × 180 mm	115 × 180 mm
100 µm	Part No.	EYGS121810	EYGA091210A	EYGA091210M	EYGA091210F
	Thickness	100 µm	130 µm	110 µm	106 µm
70 µm	Part No.	EYGS121807	EYGA091207A	EYGA091207M	EYGA091207F
	Thickness	70 µm	100 µm	80 µm	76 µm
50 µm	Part No.	EYGS121805	EYGA091205A	EYGA091205M	EYGA091205F
	Thickness	50 µm	80 µm	60 µm	56 µm
40 µm	Part No.	EYGS121804	EYGA091204A	EYGA091204M	EYGA091204F
	Thickness	40 µm	70 µm	50 µm	46 µm
25 µm	Part No.	EYGS121803	EYGA091203A	EYGA091203M	EYGA091203F
	Thickness	25 µm	55 µm	35 µm	31 µm
17 µm	Part No.	–	EYGA091202A	EYGA091202M	EYGA091202F
	Thickness	–	47 µm	27 µm	23 µm
10 µm	Part No.	–	EYGA091201A	EYGA091201M	EYGA091201F
	Thickness	–	40 µm	20 µm	16 µm

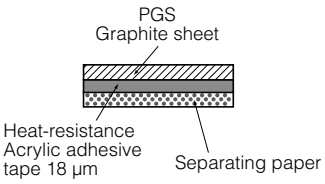
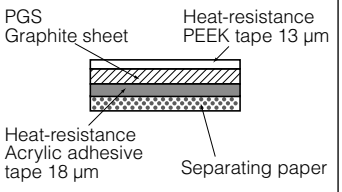
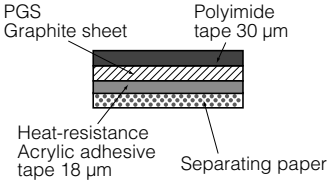
Type		Laminated type (Insulation & Adhesive)			
		A-PA type	A-PM type	A-DM type	A-DF type
Front face		Polyester tape standard type 30 µm	Polyester tape standard type 30 µm	Polyester tape thin type 10 µm	Polyester tape thin type 10 µm
Rear face		Insulative adhesion type 30 µm	Insulative thin adhesion type 10 µm	Insulative thin adhesion type 10 µm	Insulative thin adhesion type 6 µm
Structure					
Features		· With insulation material on both side · Withstanding Voltage PET tape : 4 kV Adhesive Tape : 2 kV	· With insulation material on both side · Withstanding Voltage PET tape : 4 kV Adhesive Tape : 1 kV	· With insulation material on both side · Withstanding Voltage PET tape : 1 kV Adhesive Tape : 1 kV	· With insulation material on both side · Withstanding Voltage PET tape : 1 kV
Withstand temperature		100 °C	100 °C	100 °C	100 °C
Standard Size		90 × 115 mm	90 × 115 mm	90 × 115 mm	90 × 115 mm
Maximam size		115 × 180 mm	115 × 180 mm	115 × 180 mm	115 × 180 mm
100 µm	Part No.	EYGA091210PA	EYGA091210PM	EYGA091210DM	EYGA091210DF
	Thickness	160 µm	140 µm	120 µm	116 µm
70 µm	Part No.	EYGA091207PA	EYGA091207PM	EYGA091207DM	EYGA091207DF
	Thickness	130 µm	110 µm	90 µm	86 µm
50 µm	Part No.	EYGA091205PA	EYGA091205PM	EYGA091205DM	EYGA091205DF
	Thickness	110 µm	90 µm	70 µm	66 µm
40 µm	Part No.	EYGA091204PA	EYGA091204PM	EYGA091204DM	EYGA091204DF
	Thickness	100 µm	80 µm	60 µm	56 µm
25 µm	Part No.	EYGA091203PA	EYGA091203PM	EYGA091203DM	EYGA091203DF
	Thickness	85 µm	65 µm	45 µm	41 µm
17 µm	Part No.	EYGA091202PA	EYGA091202PM	EYGA091202DM	EYGA091202DF
	Thickness	77 µm	57 µm	37 µm	33 µm
10 µm	Part No.	EYGA091201PA	EYGA091201PM	EYGA091201DM	EYGA091201DF
	Thickness	70 µm	50 µm	30 µm	26 µm

✻ Please contact our engineering section or factory about to special applications.

✻✻ Withstanding Voltage are for reference, not guaranteed.

05 Dec. 2013

● High heat resistance series (PGS 100, 70, 50, 40, 25, 17, 10 µm)

Type		high heat resistance type		
		A-V type	A-RV type	A-KV type
Front face		–	High heat resistance and insulation type 13 µm	High heat resistance and insulation type 30 µm
Rear face		High heat resistance and insulation adhesion type 18 µm	High heat resistance and insulation adhesion type 18 µm	High heat resistance and insulation adhesion type 18 µm
Structure				
Features		· With high heat resistance and insulation tape on one side · Withstanding Voltage Adhesive tape : 2 kV	· With high heat resistance and insulation tape on both side · Withstanding Voltage PEEK tape : 2 kV Adhesive tape : 2 kV	· With high heat resistance and more insulated tape on both side · Withstanding Voltage PI tape : 5 kV Adhesive tape : 2 kV
Withstand temperature		150 °C	150 °C	150 °C (Polyimide : 180 °C)
Standard Size		90 × 115 mm	90 × 115 mm	90 × 115 mm
Maximam size		115 × 180 mm	115 × 180 mm	115 × 180 mm
100 µm	Part No.	EYGA091210V	EYGA091210RV	EYGA091210KV
	Thickness	118 µm	131 µm	148 µm
70 µm	Part No.	EYGA091207V	EYGA091207RV	EYGA091207KV
	Thickness	88 µm	101 µm	118 µm
50 µm	Part No.	EYGA091205V	EYGA091205RV	EYGA091205KV
	Thickness	68 µm	81 µm	98 µm
40 µm	Part No.	EYGA091204V	EYGA091204RV	EYGA091204KV
	Thickness	58 µm	71 µm	88 µm
25 µm	Part No.	EYGA091203V	EYGA091203RV	EYGA091203KV
	Thickness	43 µm	56 µm	73 µm
17 µm	Part No.	EYGA091202V	EYGA091202RV	EYGA091202KV
	Thickness	35 µm	48 µm	65 µm
10 µm	Part No.	EYGA091201V	EYGA091201RV	EYGA091201KV
	Thickness	28 µm	41 µm	58 µm

✻ Please contact our engineering section or factory about to special applications.
✻✻ Withstanding Voltage are for reference, not guaranteed.

Minimum order

Item	Type	Part No.	Size	Minimum order
PGS Graphite Sheet Only	S type 100 µm	EYGS091210	90×115 mm	20
		EYGS121810	115×180 mm	10
		EYGS182310	180×230 mm	10
	S type 70 µm	EYGS091207	90×115 mm	20
		EYGS121807	115×180 mm	10
		EYGS182307	180×230 mm	10
	S type 50 µm	EYGS091205	90×115 mm	20
		EYGS121805	115×180 mm	10
		EYGS182305	180×230 mm	10
	S type 40 µm	EYGS091204	90×115 mm	20
		EYGS121804	115×180 mm	10
		EYGS182304	180×230 mm	10
	S type 25 µm	EYGS091203	90×115 mm	20
		EYGS121803	115×180 mm	10
		EYGS182303	180×230 mm	10
PGS 70, 25, 17 µm Adhesive Type [Standard series]	A-A type 70 µm	EYGA091207A	90×115 mm	20
		EYGA121807A	115×180 mm	10
	A-A type 25 µm	EYGA091203A	90×115 mm	20
		EYGA121803A	115×180 mm	10
	A-A type 17 µm	EYGA091202A	90×115 mm	20
		EYGA121802A	115×180 mm	10
	A-M type 70 µm	EYGA091207M	90×115 mm	20
		EYGA121807M	115×180 mm	10
	A-M type 25 µm	EYGA091203M	90×115 mm	20
		EYGA121803M	115×180 mm	10
	A-M type 17 µm	EYGA091202M	90×115 mm	20
		EYGA121802M	115×180 mm	10
PGS 70, 25, 17 µm Laminated Type (Insulation & Adhesive) [Standard series]	A-PA type 70 µm	EYGA091207PA	90×115 mm	20
		EYGA121807PA	115×180 mm	10
	A-PA type 25 µm	EYGA091203PA	90×115 mm	20
		EYGA121803PA	115×180 mm	10
	A-PA type 17 µm	EYGA091202PA	90×115 mm	20
		EYGA121802PA	115×180 mm	10
	A-PM type 70 µm	EYGA091207PM	90×115 mm	20
		EYGA121807PM	115×180 mm	10
	A-PM type 25 µm	EYGA091203PM	90×115 mm	20
		EYGA121803PM	115×180 mm	10
	A-PM type 17 µm	EYGA091202PM	90×115 mm	20
		EYGA121802PM	115×180 mm	10
	A-DM type 70 µm	EYGA091207DM	90×115 mm	20
		EYGA121807DM	115×180 mm	10
	A-DM type 25 µm	EYGA091203DM	90×115 mm	20
		EYGA121803DM	115×180 mm	10
	A-DM type 17 µm	EYGA091202DM	90×115 mm	20
		EYGA121802DM	115×180 mm	10

✻ A 180×230mm shape is only S type.
(17 µm and 10 µm do not carry out the correspondence in the one piece of article).

✻✻ As for the tape processing, the processing that is similar as for PGS 10 µm, 40 µm, the 50 µm type is possible.

✻✻✻ The above-mentioned part number is sample part number for examination.

✻✻✻✻ Because adjustment is necessary separately, please refer for the demand of the custom product to us.

✻✻✻✻✻ Please consult if the quantity of orders is little.

Item	Type	Part No.	Size	Minimum order
PGS 70, 25, 17 µm [High heat resistance type]	A-V type 70 µm	EYGA091207V	90×115 mm	20
		EYGA121807V	115×180 mm	10
	A-V type 25 µm	EYGA091203V	90×115 mm	20
		EYGA121803V	115×180 mm	10
	A-V type 17 µm	EYGA091202V	90×115 mm	20
		EYGA121802V	115×180 mm	10
	A-RV type 70 µm	EYGA091207RV	90×115 mm	20
		EYGA121807RV	115×180 mm	10
	A-RV type 25 µm	EYGA091203RV	90×115 mm	20
		EYGA121803RV	115×180 mm	10
	A-RV type 17 µm	EYGA091202RV	90×115 mm	20
		EYGA121802RV	115×180 mm	10
	A-KV type 70 µm	EYGA091207KV	90×115 mm	20
		EYGA121807KV	115×180 mm	10
	A-KV type 25 µm	EYGA091203KV	90×115 mm	20
		EYGA121803KV	115×180 mm	10
	A-KV type 17 µm	EYGA091202KV	90×115 mm	20
		EYGA121802KV	115×180 mm	10

✻ A 180×230mm shape is only S type.
(17 µm and 10 µm do not carry out the correspondence in the one piece of article).

✻✻ As for the tape processing, the processing that is similar as for PGS 10 µm, 40 µm, the 50 µm type is possible.

✻✻✻ The above-mentioned part number is sample part number for examination.

✻✻✻✻ Because adjustment is necessary separately, please refer for the demand of the custom product to us.

✻✻✻✻✻ Please consult if the quantity of orders is little.

"PGS" (Pyrolytic Graphite Sheet) Heat sink sheet

Handling Precautions

⚠ Safety Precautions

- When using our products, no matter what sort of equipment they might be used for, be sure to make a written agreement on the specifications with us in advance. The design and specifications in this catalog are subject to change without prior notice.
- Do not use the products beyond the specifications described in this catalog.
- This catalog explains the quality and performance of the products as individual components. Before use, check and evaluate their operations when installed in your products.
- Install the following systems for a failsafe design to ensure safety if these products are to be used in equipment where a defect in these products may cause the loss of human life or other significant damage, such as damage to vehicles (automobile, train, vessel), traffic lights, medical equipment, aerospace equipment, electric heating appliances, combustion/gas equipment, rotating equipment, and disaster/crime prevention equipment.

✻ Systems equipped with a protection circuit and a protection device
✻ Systems equipped with a redundant circuit or other system to prevent an unsafe status in the event of a single fault

PGS (Pyrolytic Graphite Sheet) Heat sink sheet (hereafter referred to as PGS) may result in accidents or trouble when subjected to severe conditions of electrical, environmental and /or mechanical stress beyond the specified "Rating" and specified "Conditions" found in the Specifications. Please follow the recommendations in "Safety Precautions" and "Application Notes". Contact our engineering staff or the factory with any questions.

1. ⚠ Safety Precautions

1.1 The PGS shall be used within the specified operating temperature range.
1.2 The PGS is soft, do not rub or touch it with rough materials to avoid scratching it.
1.3 Lines or folds in the PGS may affect thermal conductivity.
1.4 The PGS shall not be used with acid.
The PGS shall not be used in contact with a soldering iron at 400 °C or more
1.5 The PGS shall not be exposed to salt water or direct sunlight during use. The PGS shall not be used in corrosive gases (hydrogen sulfide, sulfurous acid, chlorine, ammonia etc.).
1.6 Our PGS has been developed for general industry applications. Prior to using the PGS for special applications such as medical, work please contact our engineering staff or the factory.
1.7 Never touch a PGS during use because it may be extremely hot.

2. Application notes

2.1 Use protective materials when handling and/or applying the PGS, do not use items with sharp edges as they might tear or puncture the PGS.
2.2 The PGS does not work properly if overheated.
2.3 Thermal conductivity is dependant on the way it is used.
Test the adaptability of PGS to your application before use.
2.4 The PGS has conductivity.
If required, the PGS should be provided insulation.
2.5 Long term storage
- The PGS shall not be stored under severe conditions of salt water, direct sunlight or corrosive gases (hydrogen sulfide, sulfurous acid, chlorine, ammonia etc.).
- The PGS shall not be stored near acid.

<Package markings>
Package markings include the product number, quantity, and country of origin.
In principle, the country of origin should be indicated in English.

CAUTION AND WARNING

1. The electronic components contained in this catalog are designed and produced for use in home electric appliances, office equipment, information equipment, communications equipment, and other general purpose electronic devices.
   Before use of any of these components for equipment that requires a high degree of safety, such as medical instruments, aerospace equipment, disaster-prevention equipment, security equipment, vehicles (automobile, train, vessel),
   please be sure to contact our sales representative.
2. When applying one of these components for equipment requiring a high degree of safety, no matter what sort of application it might be, be sure to install a protective circuit or redundancy arrangement to enhance the safety of your equipment. In addition, please carry out the safety test on your own responsibility.
3. When using our products, no matter what sort of equipment they might be used for, be sure to make a written agreement on the specifications with us in advance.
4. Technical information contained in this catalog is intended to convey examples of typical performances and/or applications and is not intended to make any warranty with respect to the intellectual property rights or any other related rights of our company or any third parties nor grant any license under such rights.
5. In order to export products in this catalog, the exporter may be subject to the export license requirement under the Foreign Exchange and Foreign Trade Law of Japan.
6. No ozone-depleting substances (ODSs) under the Montreal Protocol are used in the manufacturing processes of Automotive & Industrial Systems Company, Panasonic Corporation.

● Please contact

● Factory

Circuit Components Business Division
Automotive & Industrial Systems Company
Panasonic Corporation
401 Sadamasa-cho, Fukui-shi,
Fukui 910-8502,JAPAN

The information in this catalog is valid as of October 2013.