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We are looking forward to setting up business relationship with you and hope to provide you with the best service and solution. Let us make a better world for our industry!



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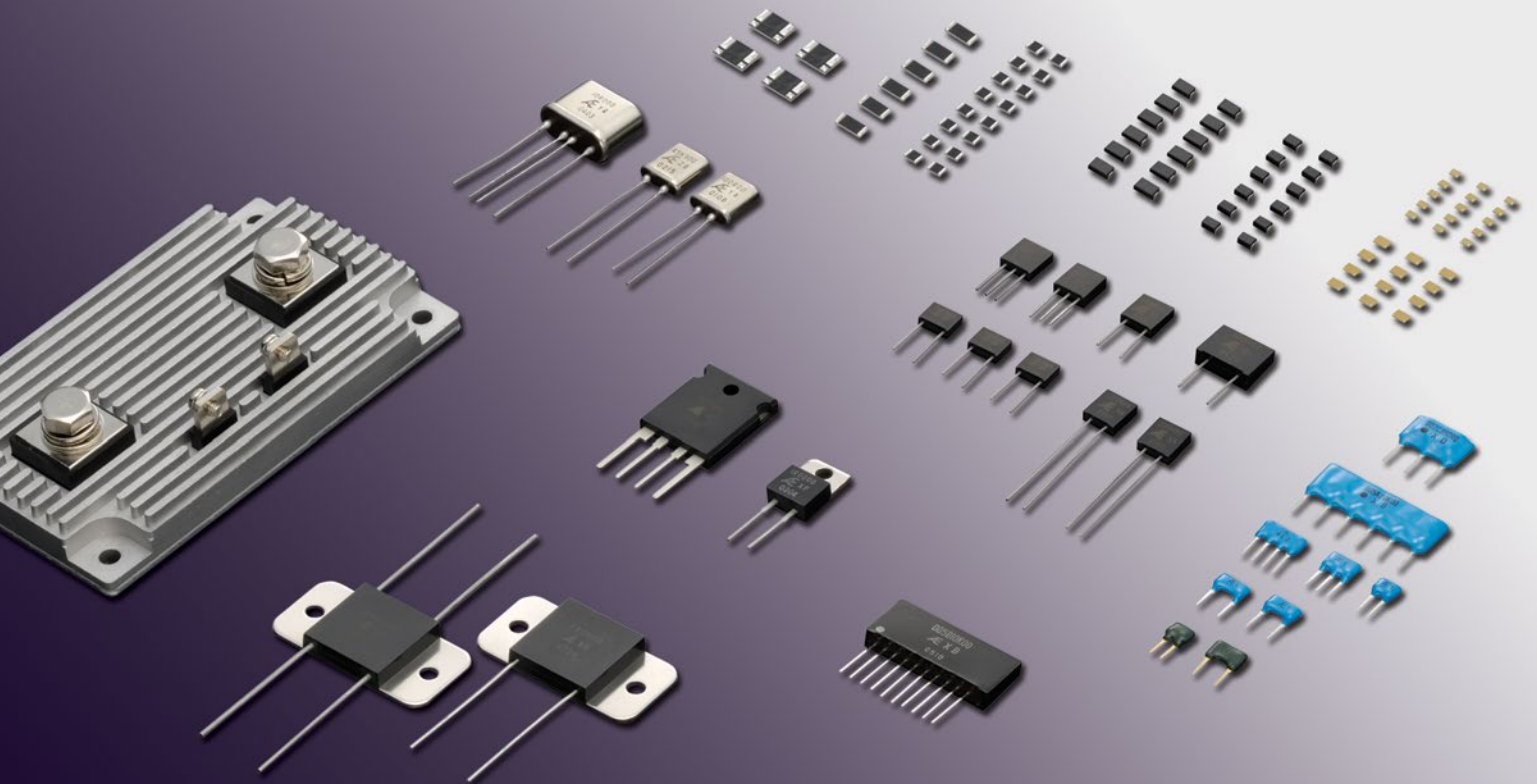
Email & Skype: info@chipsmall.com Web: www.chipsmall.com

Address: A1208, Overseas Decoration Building, #122 Zhenhua RD., Futian, Shenzhen, China



Ultra Precision Resistors

Databook



Bulk Metal® Foil
Thin Film
Thermosensitive

Ultra Precision Resistors

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Manufacturing Process, Adjustment of Resistance Value Construction, and Temperature Characteristics of Resistance

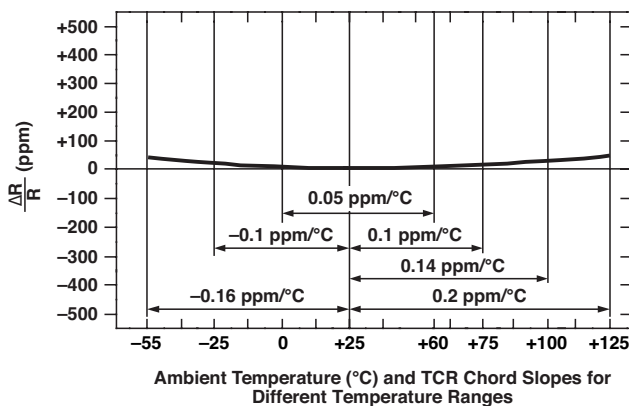
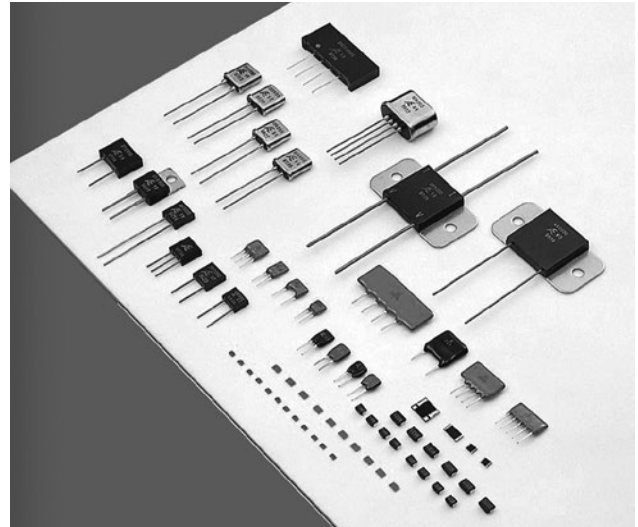
A Bulk Metal® foil high precision resistor, unlike a precision-class metal film resistor or wire-wound resistor, is an ultra precision resistor in which the primary resistance element is a special alloy foil several μm thick.

Use of this Bulk Metal® Foil as the resistance element gives superior performance not found in other resistors, satisfying military specification MIL-PRF-55182/9. In particular, the temperature coefficient of resistance has been reduced to an unprecedented, extremely low value by strict quality control of alloy composition and newly developed foil stabilization treatment technology. In addition, from the point of view of long-term stability, which is an important property of a resistor since the foil has a thickness of several μm instead of the extremely thin film of a metal film resistor, the natural stability of metal is preserved, resulting in very little resistance change over several years.

By developing our own original fine photo-etching technology, we have made it possible to form the complicated resistance pattern required for highly accurate resistance values.

MAIN APPLICATIONS

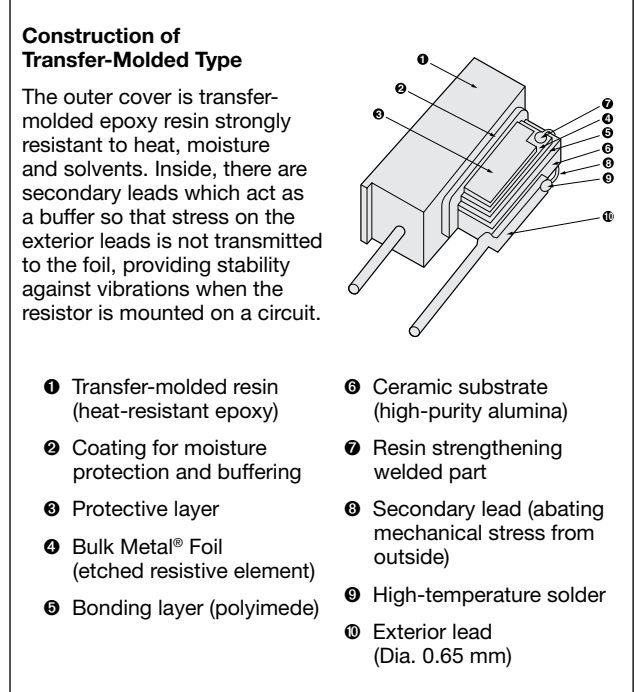
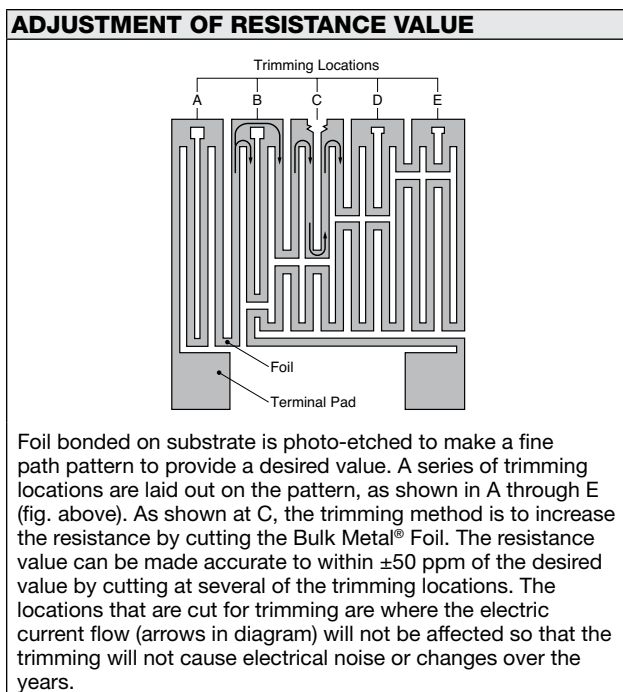
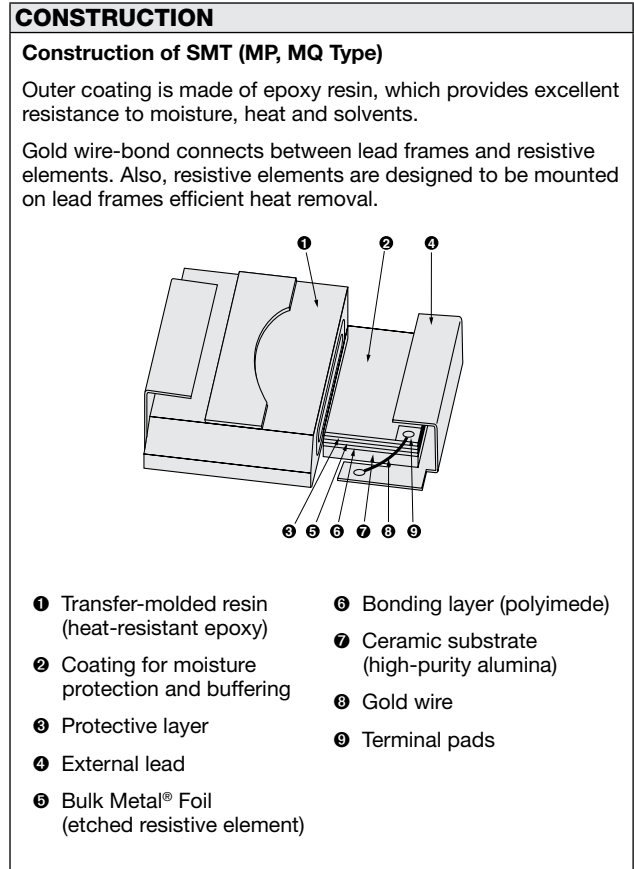
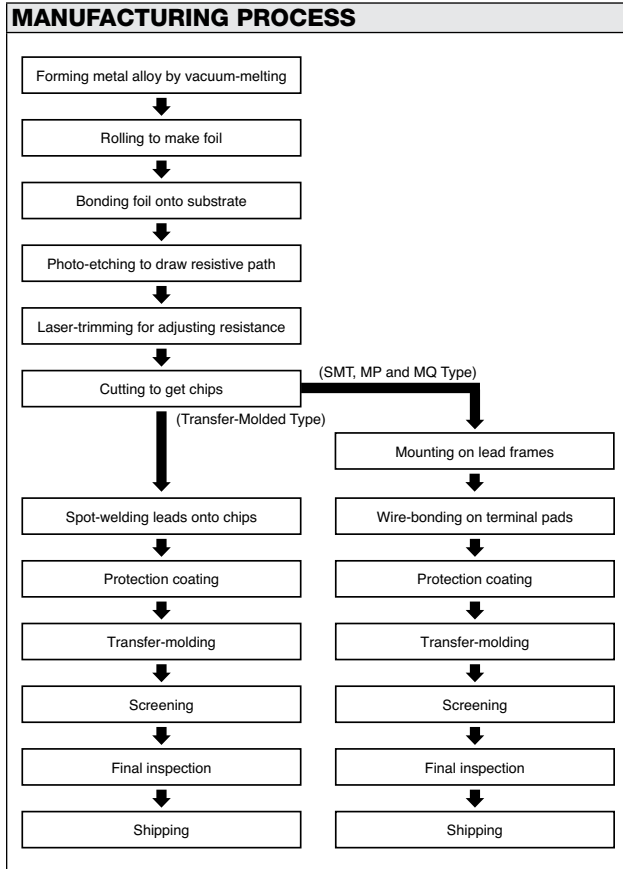
Precise amplifier circuitry and referential power supply in items such, as sophisticated electronic equipment, instrumentation and medical electronic apparatus.



CHARACTERISTICS

- ❶ Temperature Coefficient of Resistance:
0.05 ppm/°C (Typical, 0°C to +60°C)
- ❷ Resistance Tolerance: $\pm 0.005\%$
- ❸ Shelf Life:
25 ppm/year; 50 ppm/3 years
(Hermetically sealed: 5 ppm/year
10 ppm/3 years)
- ❹ Load Life:
0.005%/2,000 hours at Rated Power (typical)
- ❺ Thermal EMF: 0.1 $\mu\text{V}/^\circ\text{C}$ (between leads)
- ❻ Noise: -42 dB
- ❼ Voltage Coefficient: 0.3 ppm/V
- ❽ Frequency Characteristics:
Inductance: 0.08 μH
Capacitance: 0.5 pF

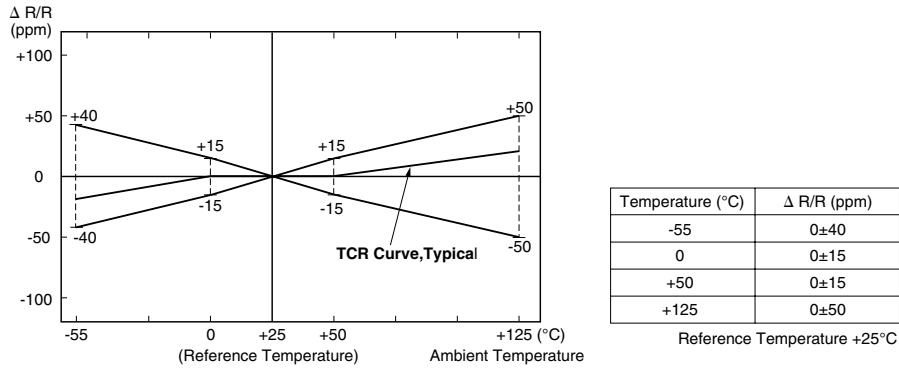
Manufacturing Process, Adjustment of Resistance Value Construction, and Temperature Characteristics of Resistance



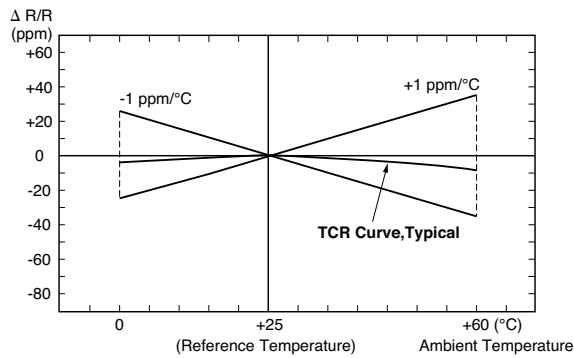
Manufacturing Process, Adjustment of Resistance Value Construction,
and Temperature Characteristics of Resistance

TEMPERATURE CHARACTERISTICS OF RESISTANCE

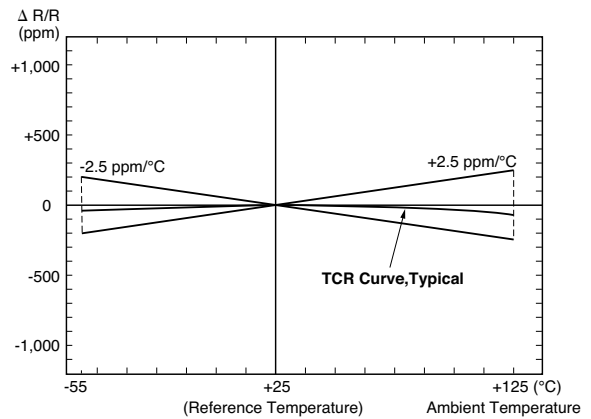
Char.S



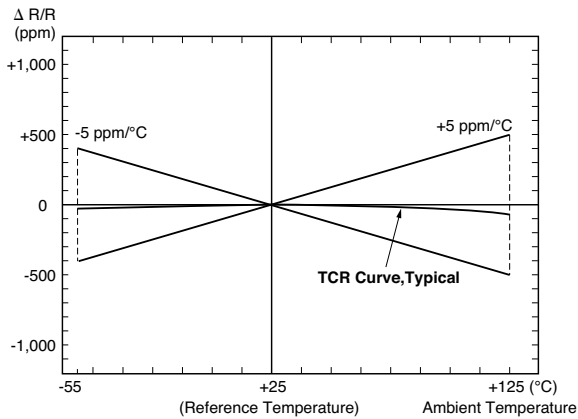
Char.Z (0 ± 1 ppm/°C)



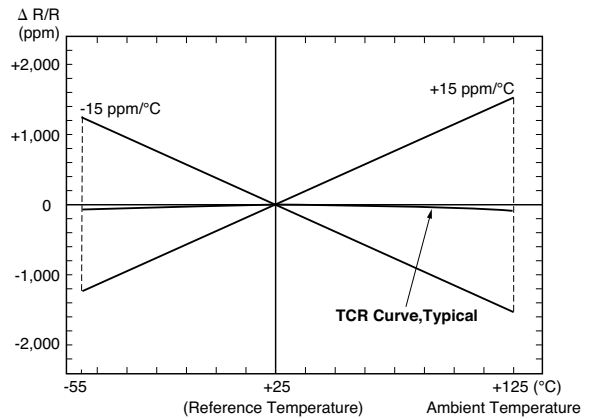
Char.Y (0 ± 2.5 ppm/°C)



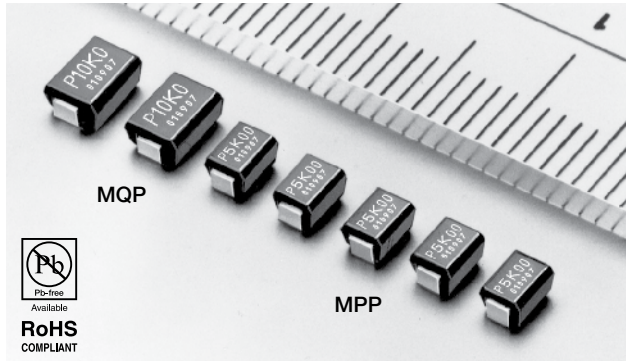
Char.X (0 ± 5 ppm/°C)



Char.W (0 ± 15 ppm/°C)



Z-Foil Ultra High-Precision SMT Resistor (Molded, J-Lead Terminal)



FEATURES	
•	Temperature coefficient of resistance (TCR): 0.05 ppm/°C typical (0°C to +60°C) by New Generation Z-Foil Technology
•	0.2 ppm/°C typical (-55°C to +125°C, +25°C ref.)
•	Resistance tolerance: to ±0.01%
•	Power coefficient “ΔR due to self heating”: 5 ppm at rated power (typical)
•	Power rating: to 200 mW (MPP) and 250 mW (MQP) at +70°C
•	Load life stability: to ±0.005% at 70°C, 2000h at rated power (typical)
•	Not restricted to standard values, we can supply specific “as required” values at no extra cost or delivery (e.g., 1K2345 vs. 1K)

COMPOSITION OF TYPE NUMBER

Example:

MPP 10K005* T L

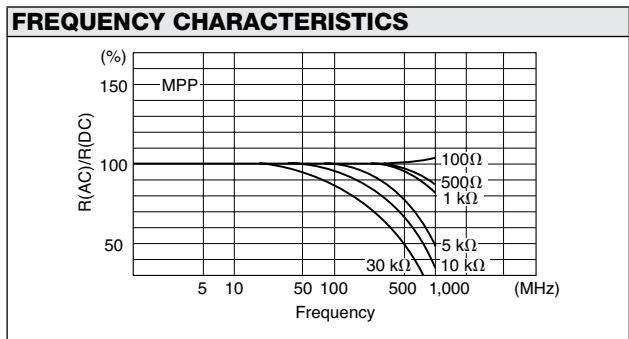
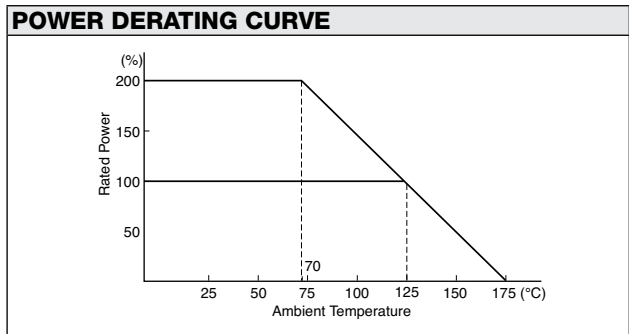
Resistance value, in ohm, is expressed by a series of six characters, five of which represent significant digits. R or K is a dual-purpose letter that designates both the value range (R for ohmic; K for kilo-ohm) and the location of the decimal point.

* Imprinting indicates up to 3 significant digits but ordered resistance value is traceable by date code

TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER				
Type	TCR (ppm/°C) -55°C to +125°C	Resistance Range (Ω)	Resistance Tolerance (%)	Rated Power (W) at 125°C
MPP	±0.2±3.8	30 to <50	±0.1(B)	0.1
	±0.2±2.8	50 to <100	±0.1(B)	
	±0.2±1.8	100 to <1k	±0.1(B) ±0.05(A) ±0.02(Q)	
		1k to <20k	±0.1(B) ±0.05(A) ±0.02(Q) ±0.01(T)	
MQP	±0.2±3.8	30 to <50	±0.1(B)	0.125
	±0.2±2.8	50 to <100	±0.1(B)	
	±0.2±1.8	100 to <1k	±0.1(B) ±0.05(A) ±0.02(Q)	
		1k to <40k	±0.1(B) ±0.05(A) ±0.02(Q) ±0.01(T)	

CONFIGURATION (DIMENSIONS IN mm)

Type	MPP	MQP
L	3.2±0.2	4.5±0.2
W	2.5±0.2	3.2±0.2
H	2.0±0.2	
L1	0.6±0.2	0.8±0.2
W1	1.4±0.3	
W2	2.3±0.2	3.0±0.2
H1	1.5±0.3	
t	0.15±0.05	



PERFORMANCE				
Parameters	Test Condition	Specification		Typical MPP/MQP
		MP/MQ	MPP/MQP	
Maximum Rated Operating Temperature Working Temperature Range Maximum Working Voltage Maximum Working Current		125°C -65°C to +175°C MP = 50V, MQ = 100V 350 mA		
Thermal Shock Overload	-65°C/30 min. ↔ +150°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	±0.05%	±0.01%	±0.005%
Low Temperature Storage and Life Outstanding PC Board Bending	-65°C, No Load, 24 hrs. → Rated Voltage, 45 min. 3 mm Bend, 60 sec.	±0.05%	±0.01%	±0.005%
Dielectric Withstanding Voltage Insulation Resistance Resistance to Soldering Heat Moisture Resistance	AC 200V, 1 min. DC 100V, 1 min. 260°C, 10 sec. +65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.01%	±0.01%	±0.005%
		over 10,000 MΩ		
		±0.05%	±0.03%	±0.01%
		±0.05%	±0.03%	±0.01%
Shock Vibration, High Frequency	100G, 6 ms, Sawtooth Wave, X, Y, Z, each 10 shocks 20G, 10 Hz to 2,000 Hz to 10 Hz, 20 min., X, Y, Z, each 2.5 hrs.	±0.02%	±0.02%	±0.01%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.005%	±0.005%	±0.0025%
High Temperature Exposure	175°C, No Load, 2,000 hrs.	±0.05%	±0.05%	±0.03%
Life	70°C, Rated Power, 1.5 hr. – on, 0.5 hr. – off, 2,000 hrs. 70°C, Rated Power x 2, 1.5 hr. – on, 0.5 hr. – off, 2,000 hrs.	—	±0.01%	±0.005%
		—	±0.03%	±0.01%

TAPE AND REEL PACKAGE (BASED ON EIA-481-1) (DIMENSIONS IN mm)																	
Tape Dimensions										Reel Dimensions							
Type	A	B	C	D	E	F	G	H	J	A	N	B	C	D	W1	W2	r
MPP	2.8 ±0.2	3.9 ±0.2	12.0 ±0.3	5.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Dia. 1.5 ±0.1-0	Dia. 178 ±2	Dia. 60 min.	Dia. 13 ±0.5	Dia. 21 ±0.8	2 ±0.5	12.4 +2.0-0	18.4 max.	1.0 ±0.5
MQP	3.6 ±0.2	5.2 ±0.2	12.0 ±0.3	5.5 ±0.05	1.75 ±0.1	8.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Dia. 1.5 ±0.1-0	Reel Capacity		MPP: 1,200 pieces/reel MQP: 800 pieces/reel					

PRECAUTION IN USING FACE-BONDED CHIP RESISTORS

- Storage**
Storage conditions or environment may adversely affect solderability of the exterior terminals. Do not store in high temperature and humidity. The recommended storage environment is lower than 40°C, has less than 70% RH humidity and is free from harmful gases such as sulphur and chlorine.
- Caution in Soldering**
 - Hand Soldering—Hand soldering is applicable as shown at right. Recommended
 - Temp. of iron tip: 240°C to 270°C
 - Power of iron: 20W or less
 - Diameter of tip: dia. 3 mm max.
 - Solder Reflow in Furnace Recommended
 - Peak temperature: 250±0/-5°C
 - Holding time: 10 sec. max.
 - To cool gradually at room temperature
 - Dipping in Solder (Wave or Still) Recommended
 - Temp. of solder: 260°C max
 - Length of dipping: 10 seconds
 - To cool gradually at room temperature
 - Other
Corrosion-free flux, such as rosin, is recommended. Do not apply pressure to the molded housing immediately after soldering.
- Cleaning**
Use volatile cleaner such as methylalcohol or propyl alcohol.
- Circuit Board Design**
The dimensions of solder land must be determined in conformity with the size of resistors and with the soldering method. They are also subject to the mounting machine and the material of the substrate. See example below.

Type	A	B	C	D
MPP	1.6 to 2.0	0.5 to 1.5	2.2 to 2.6	1.8
MQP				2.5

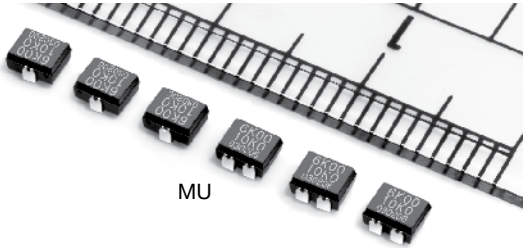
When parts are mounted on a board in high density, solder can possibly attach to the resistors in an excessive amount to affect performance or reliability of the resistors. To prevent this effect, the use of solder resist is recommended to isolate solder lands.

PERFORMANCE			
Parameters	Test Condition	ALPHA Specification	ALPHA Typical Test Data
Maximum Rated Operating Temperature Working Temperature Range Maximum Working Voltage Maximum Working Current			125°C -65°C to +175°C MP=50V, MQ=100V 350 mA
Thermal Shock Overload	-65°C/30 min. ↔ +175°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	±0.05% ±0.05%	±0.01% ±0.01%
Low Temperature Storage and Operation Substrate Bending Test	-65°C, No Load, 24 hrs. → Rated Voltage, 45 min. Substrate Bent 3 mm, 60 sec.	±0.05% ±0.05%	±0.01% ±0.01%
Dielectric Withstanding Voltage Insulation Resistance Resistance to Soldering Heat Moisture Resistance	Atmospheric: AC 200V, 1 min. DC 100V, 1 min. 260°C, 10 sec. +65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.01% over 10,000 MΩ ±0.05% ±0.05%	±0.005% over 10,000 MΩ ±0.01% ±0.03%
Shock Vibration, High Frequency	100G, 6 ms, Sawtooth Wave, X, Y, Z, each 10 shocks 20G, 10 Hz to 2,000 Hz to 10 Hz, 20 min., X, Y, Z, each 2.5 hrs.	±0.02% ±0.02%	±0.01% ±0.01%
Life	125°C, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 2,000 hrs.	±0.05%	±0.03%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.005%	±0.0025%
High Temperature Exposure	175°C, No Load, 2,000 hrs.	±0.05%	±0.03%

TAPE AND REEL PACKAGE (BASED ON EIA-481-1) (DIMENSIONS IN mm)																	
Tape Dimensions										Reel Dimensions							
Type	A	B	C	D	E	F	G	H	J	A	N	B	C	D	W1	W2	r
MP	2.8 ±0.2	3.9 ±0.2	12.0 ±0.3	5.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Dia. 1.5 ±0.1-0	Dia. 178 ±2	Dia. 60 min.	Dia. 13 ±0.5	Dia. 21 ±0.8	2 ±0.5	12.4 +2.0-0	18.4 max.	1.0 ±0.5
MQ	3.6 ±0.2	5.2 ±0.2	12.0 ±0.3	5.5 ±0.05	1.75 ±0.1	8.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Dia. 1.5 ±0.1-0	Reel Capacity MP: 1,200 pieces/reel MQ: 800 pieces/reel							

PRECAUTION IN USING FACE-BONDED CHIP RESISTORS																			
1. Storage Storage conditions or environment may adversely affect solderability of the exterior terminals. Do not store in high temperature and humidity. The recommended storage environment is lower than 40°C, has less than 70% RH humidity and is free from harmful gases such as sulphur and chlorine.		3. Cleaning Use volatile cleaner such as methylalcohol or propyl alcohol.																	
2. Caution in Soldering <ul style="list-style-type: none"> Hand Soldering Hand soldering is applicable as shown at right. Recommended <ul style="list-style-type: none"> Temp. of iron tip: 240°C to 270°C Power of iron: 20W or less Diameter of tip: dia. 3 mm max. Solder Reflow in Furnace Recommended <ul style="list-style-type: none"> Peak temperature: 250+0/-5°C Holding time: 10 sec. max. To cool gradually at room temperature Dipping in Solder (Wave or Still) Recommended <ul style="list-style-type: none"> Temp. of solder: 260°C max Length of dipping: 10 seconds To cool gradually at room temperature Other Corrosion-free flux, such as rosin, is recommended. Do not apply pressure to the molded housing immediately after soldering. 		4. Circuit Board Design The dimensions of solder land must be determined in conformity with the size of resistors and with the soldering method. They are also subject to the mounting machine and the material of the substrate. See example below.																	
		<table border="1"> <thead> <tr> <th>Type</th> <th>A</th> <th>B</th> <th>C</th> <th>D</th> </tr> </thead> <tbody> <tr> <td>MP</td> <td>1.6 to 2.0</td> <td>0.5 to 1.5</td> <td>2.2 to 2.6</td> <td>1.8</td> </tr> <tr> <td>MQ</td> <td></td> <td></td> <td></td> <td>2.5</td> </tr> </tbody> </table> <p style="text-align: right; font-size: small;">Dimensions in mm</p>			Type	A	B	C	D	MP	1.6 to 2.0	0.5 to 1.5	2.2 to 2.6	1.8	MQ				2.5
Type	A	B	C	D															
MP	1.6 to 2.0	0.5 to 1.5	2.2 to 2.6	1.8															
MQ				2.5															
When parts are mounted on a board in high density, solder can possibly attach to the resistors in an excessive amount to affect performance or reliability of the resistors. To prevent this effect, the use of solder resist is recommended to isolate solder lands.																			

Ultra Precision SMT Resistor 1-2-3 Network
(Molded, J-Lead Terminal)



MU

COMPOSITION OF TYPE NUMBER

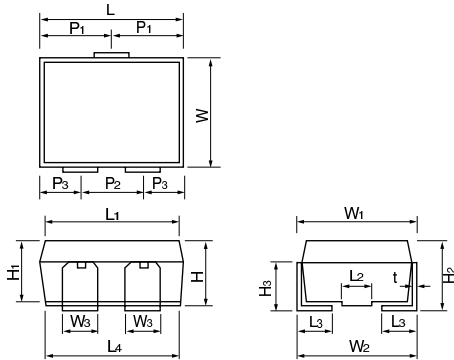
Example:

MU 1K000/ 10K00 B Q L

① ② ③ ④ ⑤ ⑥

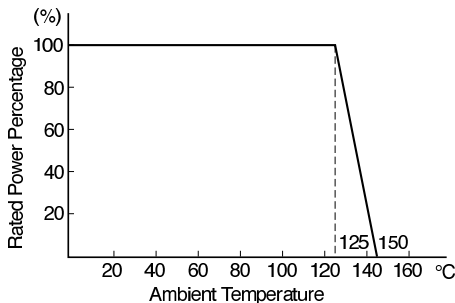
- ① Type
- ② Nominal Resistance Values (R1)
- ③ Nominal Resistance Values (R2)
- ④ Tolerance (Absolute)
- ⑤ Tolerance (Matching)
- ⑥ Tape & Reel Package Being Required

CONFIGURATION (DIMENSIONS IN mm)



L	W	H	H₁	H₂	H₃	P₁	P₂	P₃
3.2 ±0.2	2.5 ±0.2	1.5 ±0.2	1.4 ±0.2	1.6 ±0.2	1.1 ±0.2	1.6 ±0.1	1.4 ±0.1	0.9 ±0.1
W₁	W₂	W₃	L₁	L₂	L₃	L₄	t	
2.7 ±0.2	2.7 ±0.2	0.8 ±0.1	3.0 ±0.2	0.7 ±0.2	0.8 ±0.1	3.0 ±0.2	0.1 ±0.05	

POWER DERATING CURVE



RESISTANCE RANGE, TOLERANCE, RATED POWER

Type	Resistance Range Element**	Resistance Tolerance*		Rated Power/Element (W) at 125°C
		Absolute*	Matching*	
MU	10Ω ≤ R < 100Ω	±0.1% (B) ±0.5% (D)	±0.05% (A) ±0.1% (B) ±0.5% (D)	0.05
	100Ω ≤ R < 1kΩ	±0.05% (A) ±0.1% (B) ±0.5% (D)	±0.02% (Q) ±0.05% (A) ±0.1% (B) ±0.5% (D)	
	1kΩ ≤ R ≤ 20kΩ	±0.02% (Q) ±0.05% (A) ±0.1% (B) ±0.5% (D)	±0.01% (T) ±0.02% (Q) ±0.05% (A) ±0.1% (B) ±0.5% (D)	

* Symbols in parentheses are for type number composition.
** Please contact us for the availability.

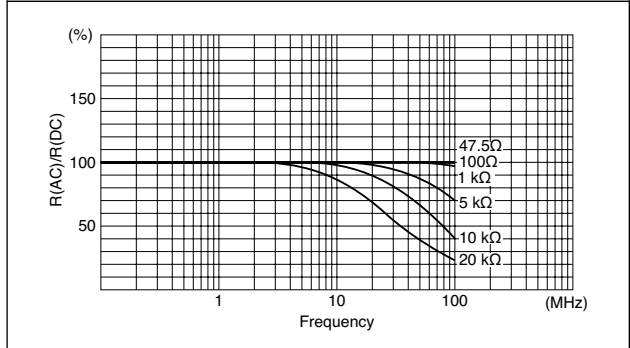
ABSOLUTE TCR

Resistance Range (Ω)	Absolute TCR (ppm/°C) -55°C to +125°C
10Ω ≤ R < 30Ω	±15
30Ω ≤ R < 100Ω	±10
100Ω ≤ R ≤ 20kΩ	±5

TCR TRACKING

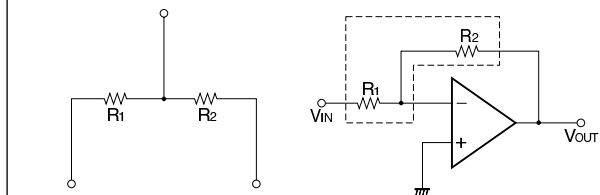
Resistance Ratio	TCR Tracking (ppm/°C) -55°C to +125°C
Ratio = 1	±1
1 < Ratio ≤ 10	±2
10 < Ratio ≤ 100	±3
100 < Ratio	±5

FREQUENCY CHARACTERISTICS



EXAMPLE OF APPLICATIONS

An Application of Type MU (input/feedback resistors for amplifiers)
Because the input and the feedback resistors are incorporated into one single element, amplification is not affected by temperature change.



PERFORMANCE					
Parameters	Test Condition	ALPHA Specification		ALPHA Typical Test Data	
		ΔR	Δ Ratio	ΔR	Δ Ratio
Maximum Rated Operating Temperature Working Temperature Range		125°C -65°C to +150°C			
Thermal Shock Overload	-65°C/30 min. \leftrightarrow +150°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	$\pm 0.05\%$ $\pm 0.05\%$	$\pm 0.02\%$ $\pm 0.02\%$	$\pm 0.01\%$ $\pm 0.01\%$	$\pm 0.005\%$ $\pm 0.005\%$
Low Temperature Storage and Operation Substrate Bending Test	-65°C, No Load, 24 hrs. \rightarrow Rated Voltage, 45 min. 3 mm Bend 60 sec.	$\pm 0.05\%$ $\pm 0.05\%$	$\pm 0.02\%$ $\pm 0.02\%$	$\pm 0.01\%$ $\pm 0.01\%$	$\pm 0.005\%$ $\pm 0.005\%$
Dielectric Withstanding Voltage Insulation Resistance Resistance to Soldering Heat Moisture Resistance	Atom. Pres.: AC 200V, 1 min. DC 100V, 1 min. 260°C, 10 sec. +65°C to -10°C, 90% to 98% RH, Rated Power, 10 cycles (240 hrs.)	$\pm 0.01\%$ $\pm 0.05\%$	$\pm 0.01\%$ $\pm 0.02\%$	$\pm 0.005\%$ $\pm 0.03\%$	$\pm 0.0025\%$ $\pm 0.01\%$
Shock Vibration, High Frequency	100G, 6 ms, Sawtooth Wave, X, Y, Z, each 10 shocks 20G, 10 Hz to 2,000 Hz to 10 Hz, 20 min., X, Y, Z, each 2.5 hrs.	$\pm 0.02\%$ $\pm 0.02\%$	$\pm 0.01\%$ $\pm 0.01\%$	$\pm 0.01\%$ $\pm 0.01\%$	$\pm 0.005\%$ $\pm 0.005\%$
Life	125°C, Rated Power, 1.5 hrs. - ON, 0.5 hrs. - OFF, 2,000 hrs.	$\pm 0.05\%$	$\pm 0.02\%$	$\pm 0.03\%$	$\pm 0.015\%$
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	$\pm 0.005\%$	$\pm 0.0025\%$	$\pm 0.0025\%$	$\pm 0.0015\%$
High Temperature Exposure	150°C, No Load, 2,000 hrs.	$\pm 0.05\%$	$\pm 0.02\%$	$\pm 0.02\%$	$\pm 0.01\%$

TAPE AND REEL PACKAGE (BASED ON EIA-481-1) (DIMENSIONS IN mm)

Tape Dimensions										Reel Dimensions (Reel capacity: 800 pieces/reel)							
Type	A	B	C	D	E	F	G	H	J	A	N	B	C	D	W ₁	W ₂	r
MU	3.6 ± 0.2	3.1 ± 0.2	12.0 ± 0.3	5.5 ± 0.05	1.75 ± 0.1	8.0 ± 0.1	2.0 ± 0.05	4.0 ± 0.1	Dia. 1.5 $\pm 0.1-0$	Dia. 178 ± 2	Dia. 60 min.	Dia. 13 ± 0.5	Dia. 21 ± 0.8	2 ± 0.5	12.4 $\pm 2.0-0$	18.4 max.	1.0 ± 0.5

PRECAUTION IN USING FACE-BONDED CHIP RESISTOR (DIMENSIONS IN mm)

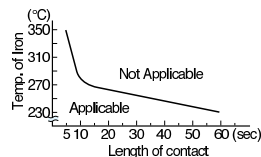
1. Storage

Storage condition or environment may adversely affect solderability of the exterior terminals. Do not store in high temperature and humidity. The recommended storage environment is lower than 40°C, has less than 70% RH humidity and is free from harmful gases such as sulphur and chlorine.

2. Caution in Soldering

① Hand Soldering

- Hand soldering is applicable as shown at right.
- Recommended
 - Temp. of Iron Tip: 240°C to 270°C
 - Power of Iron: 20W or less
 - Diameter of Tip: Dia. 3 mm max.



② Solder Reflow in Furnace

- Recommended
 - Peak Temperature: 250°C +0°C/-5°C
 - Holding time: 10 sec. max.
 - To cool gradually at room temperature

③ Dipping in Solder (Wave or Still)

- Recommended
 - Temp. of Solder: 240°C to 250°C
 - Length of Dipping: 3 to 4 seconds
 - To cool gradually at room temperature

④ Other

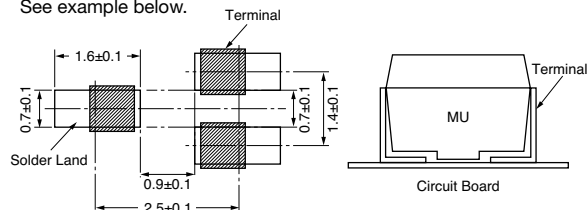
Corrosion-free flux, such as rosin, is recommended. Do not apply pressure to the molded housing immediately after soldering.

3. Cleaning

Use volatile cleaner such as methylalcohol or propylalcohol.

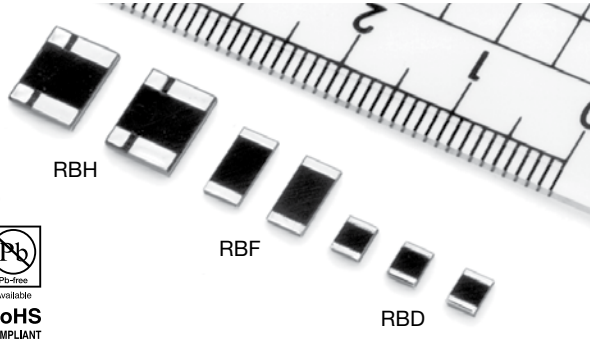
4. Circuit Board Design

The dimensions of solder land must be determined in conformity with the size of resistors and with the soldering method. They are also subject to the mounting machine and the material of the substrate. See example below.



When parts are mounted on a board in high density, solder can possibly attach to the resistors in an excessive amount to affect performance or reliability of the resistors. To prevent this effect, the use of solder resist is recommended to isolate solder lands.

Ultra Precision SMT Current Sense Resistor (Flip-Chip)



TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER				
Type	TCR (ppm/°C) -25°C to 125°C*	Resistance Range (Ω)	Resistance Tolerance (%)*	Rated Power (W) at 70°C
RBD	0±25 (J)	0.01 to 0.1	±1 (F) ±2 (G) ±5 (J)	0.5
	0±10 (C) 0±25 (J)	0.1 to 1	±0.5 (D) ±1 (F) ±2 (G) ±5 (J)	
RBF	0±25 (J)	0.01 to 0.1	±1 (F) ±2 (G) ±5 (J)	1
	0±10 (C) 0±25 (J)	0.1 to 1	±0.5 (D) ±1 (F) ±2 (G) ±5 (J)	
RBH	0±10 (C) 0±25 (J)	0.01 to 0.1	±0.5 (D) ±1 (F) ±2 (G) ±5 (J)	1.5

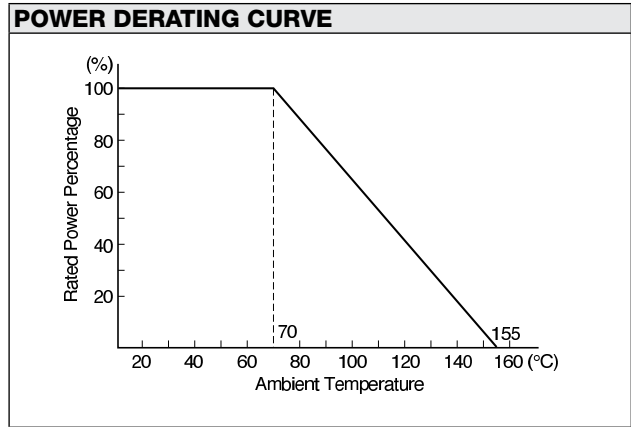
*Symbols parenthesized are for type number composition.

COMPOSITION OF TYPE NUMBER

Example:
RBF J R1000 F L

- Tape & Reel Package Required
- Tolerance
- Resistance Value
- TCR
- Type

Resistance value in ohm is expressed by a series of four significant digits and an R designates the decimal point.



CONFIGURATION (DIMENSIONS IN mm)

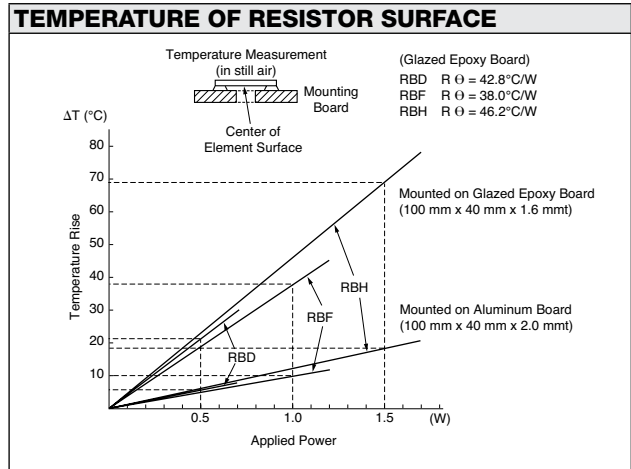
Type	RBD	RBF
L	3.2±0.1	6.3±0.1
W	2.5±0.1	3.2±0.1
L ₁	0.5±0.2	0.7±0.2
L ₂	2.1±0.2	4.7±0.2
W ₁	2.4±0.2	3.0±0.2
T	1.05 max.	

Dimensions in mm

Type	RBH
L	7.5±0.1
W	6.0±0.1
L ₁	1.4±0.2
L ₂	4.4±0.2
W ₁	1.4±0.2
W ₂	0.7±0.2
W ₃	3.6±0.2
T	1.5 max.

Dimensions in mm

I: Current Sensing Terminal
V: Voltage Terminal



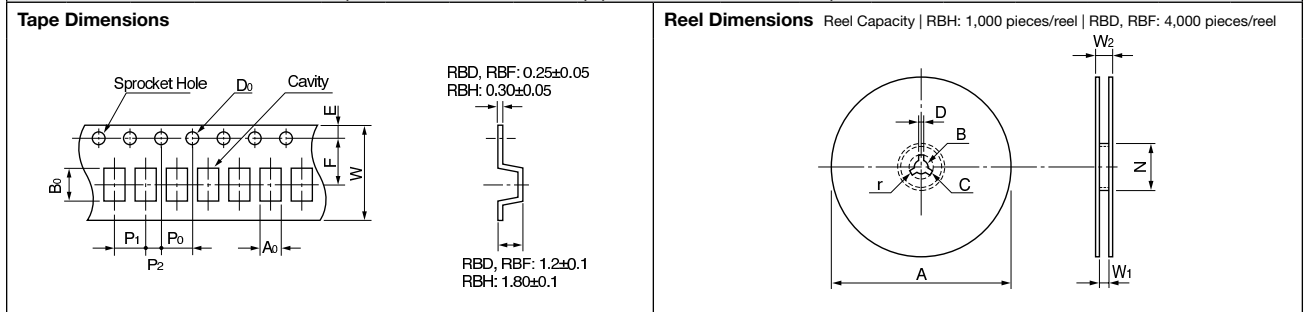
Please use board made of metal for continuous use with 2W at 70°C. Please keep the temperature of board less than 90°C when using the glazed epoxy board.

CONSTRUCTION

- Ceramic Substrate (High-Purity Alumina)
- Heat-Resistant Bonding Layer
- Bulk[®] Metal Foil
- Metal Plating
- Solder
- Solder-Resist

PERFORMANCE			
Parameters	Test Condition	ALPHA Specification	ALPHA Typical Test Data
Maximum Rated Operating Temperature		70°C	
Working Temperature Range		-65°C to +155°C	
Thermal Shock Overload	-65°C/30 min. ↔ +155°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	±0.1% ±0.1%	±0.03% ±0.03%
Low Temperature Storage and Operation	-65°C, No Load, 24 hrs. → Rated Voltage, 45 min.	±0.1% ±0.1%	±0.05% ±0.05%
Substrate Bending Test	Substrate Bent 3 mm, 60 sec.		
Dielectric Withstanding Voltage	Atmo. Pres.: AC 200V, 1 min.	±0.05% over 10,000 MΩ	±0.01% over 10,000 MΩ
Insulation Resistance	DC 100V, 1 min.		
Resistance to Soldering Heat	260°C, 10 sec.	±0.1% ±0.1%	±0.03% ±0.03%
Moisture Resistance	+65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)		
Shock	100G, 6 ms, Sawtooth Wave, X, Y, Z, each 10 shocks	±0.05% ±0.05%	±0.01% ±0.01%
Vibration, High Frequency	20G, 10 Hz to 2,000 Hz to 10 Hz, 20 min., X, Y, Z, each 2.5 hrs.		
Life	70°C, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 2,000 hrs	±0.1% ±0.1%	±0.05% ±0.05%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.05% ±0.05%	±0.01% ±0.01%
High Temperature Exposure	155°C, No Load, 2,000 hrs.	±0.1% ±0.1%	±0.05% ±0.05%

TAPE AND REEL PACKAGE (BASED ON EIA-481-1) (DIMENSIONS IN mm)



Type	A0	B0	W	F	E	P1	P2	P0	D0	Type	A	N	B	C	D	W1	W2	r
RBD	2.85 ±0.1	3.7 ±0.1	8.0 ±0.2	3.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Dia.1.5 +0.1-0	RBD	Dia.178 ±2	Dia.60 min.	Dia.13 ±0.5	Dia.21 ±0.8	2.0 ±0.5	8.4 +2.0-0	14.4 max.	1.0 ±0.5
RBF	3.4 ±0.1	6.7 ±0.1	12.0 ±0.2	5.5 ±0.05	1.75 ±0.1	4.0 ±0.1	2.0 ±0.05	4.0 ±0.1	Dia.1.5 +0.1-0	RBF	Dia.178 ±2	Dia.60 min.	Dia.13 ±0.5	Dia.21 ±0.8	2.0 ±0.5	12.4 +2.0-0	18.4 max.	1.0 ±0.5
RBH	6.3 ±0.1	7.8 ±0.1	16.0 ±0.2	7.5 ±0.1	1.75 ±0.1	8.0 ±0.1	2.0 ±0.1	4.0 ±0.1	Dia.1.5 +0.1-0	RBH	Dia.178 ±2	Dia.60 min.	Dia.13 ±0.5	Dia.21 ±0.8	2.0 ±0.5	17.0 ±0.3	19.4 ±0.1	1.0 ±0.5

PRECAUTION IN USING SMD CURRENT SENSE RESISTORS

1. Storage

Storage condition or environment may adversely affect solderability of the exterior terminals. Do not store in high temperature and humidity. The recommended storage environment is lower than 40°C, has less than 70% RH humidity and is free from harmful gases such as sulphur and chlorine.

2. Caution in Soldering

- ① Solder Reflow in Furnace Recommended
 - Peak Temperature: 250+0/-5°C
 - Holding time: 10 sec. max.
 - To cool gradually at room temperature.
- ② Dipping in Solder (Wave or Still) Recommended
 - Temp. of Solder: 260°C max.
 - Length of Dipping: 10 sec.
- ③ Other
 - Soldering iron is never recommended. Corrosion-free flux such as rosin is recommended.

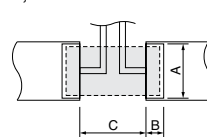
3. Cleaning

Use volatile cleaner such as methylalcohol or propylalcohol.

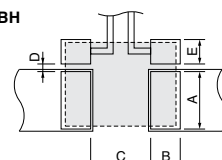
4. Circuit Board Design

- ① Solder Land Dimensions
 - The dimensions of solder land must be determined in conformity with the size of resistors and with the soldering method. They are also subject to the mounting machine and the material of the substrate. See example at right.

RBD, RBF



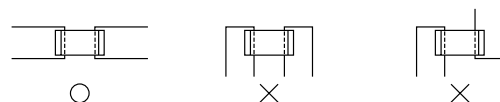
RBH



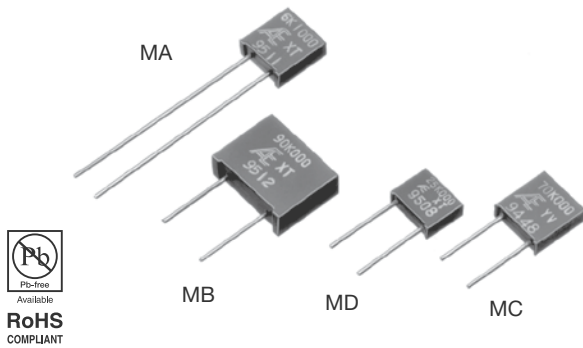
Type	Dimensions in mm				
	A	B	C	D	E
RBD	2.6 to 2.8	0.8	2.0	/	/
RBF	3.4 to 3.6	1.2	4.5		
RBH	3.8 to 4.0	2.0	4.0		

② Circuit Design

It is recommended that the circuit be drawn so that current may approach, cross and go away from the mounted resistor in one direction as illustrated below. Thicker copper foil should be used if possible.



Ultra Precision Resistor (Transfer Molded)



COMPOSITION OF TYPE NUMBER

Example:
MA Y 10K000 A

Labels for the example: Type (MA), TCR (Y), Resistance Value (10K000), Tolerance (A).

Resistance value, in ohm, is expressed by a series of six characters, five of which represent significant digits. R or K is a dual-purpose letter that designates both the value range (R for ohmic; K for kilo-ohm) and the location of decimal point.

TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER

Type	TCR (ppm/°C) -55°C to +125°C*	Resistance Range (Ω)	Resistance Tolerance (%)†‡	Rated Power (W) at 125°C
MA MC	0±15 (W)	1 to 5	±0.5 (D) ±1 (F)	0.3 (0.2 at 150 kΩ or above)
	0±5 (X)	5 to 30	±0.1 (B) ±0.5 (D) ±1 (F)	
	0±5 (X) 0±2.5 (Y) 0±1 (Z)**	30 to 200k	±0.005 (V) ±0.01 (T) ±0.02 (Q) ±0.05 (A) ±0.1 (B) ±0.5 (D) ±1 (F)	
MB	0±5 (X)	5 to 30	±0.1 (B) ±0.5 (D) ±1 (F)	0.5 (0.3 at 200 kΩ or above)
	0±5 (X) 0±2.5 (Y) 0±1 (Z)**	30 to 400k	±0.005 (V) ±0.01 (T) ±0.02 (Q) ±0.05 (A) ±0.1 (B) ±0.5 (D) ±1 (F)	
MD	0±5 (X)	5 to 30	±0.1 (B) ±0.5 (D) ±1 (F)	0.125
	0±5 (X) 0±2.5 (Y)	30 to 100	±0.05 (A) ±0.1 (B) ±0.5 (D) ±1 (F)	
	0±5 (X) 0±2.5 (Y) 0±1 (Z)**	100 to 80k	±0.01 (T) ±0.02 (Q) ±0.05 (A) ±0.1 (B) ±0.5 (D) ±1 (F)	

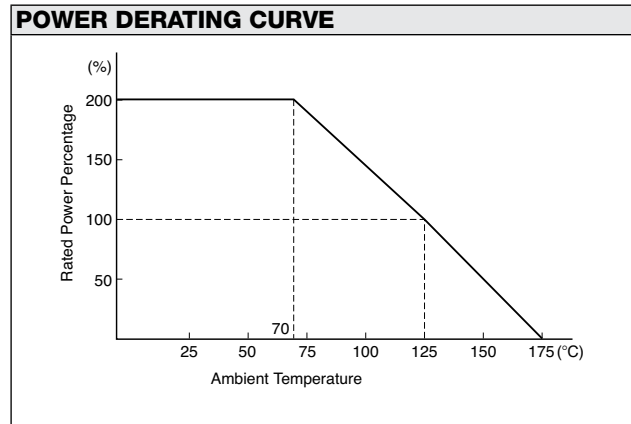
* Symbols in parentheses are for type number composition.

† Resistance figures are the values obtained by measuring the leads at point 12.7±3.2 mm away from the base for Type MA and at point 5.0±1.0 mm for Types MC, MB and MD, but, in case of resistance below 10 ohm, the value at 1.6±0.6 mm away from the base for all types.

**Temperature characteristic Z is applicable for temperature range between 0°C and 60°C.

CONFIGURATION (DIMENSIONS IN mm)

Type	MA	MC	MB	MD
L	7.9±0.2		13.0±0.3	7.4±0.2
L1	1.0 max.		1.5 max.	0.8 max.
W	8.3±0.2		10.0±0.3	6.0±0.2
W1	8.0±0.2		9.5±0.3	5.7±0.2
W2	0.3 max.		0.5 max.	0.4 max.
T	2.8±0.2	2.3±0.2	4.0±0.3	2.3±0.2
F	3.81±0.25	5.08±0.25	7.5±0.5	5.08±0.25
l	25±10		10±3	
d	Dia. 0.65±0.05			

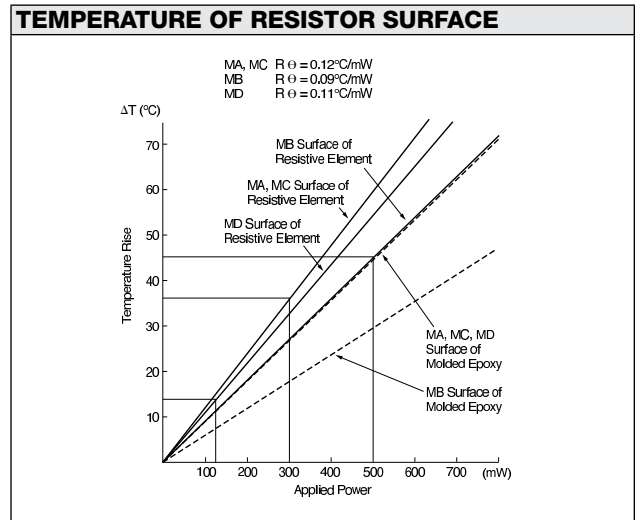
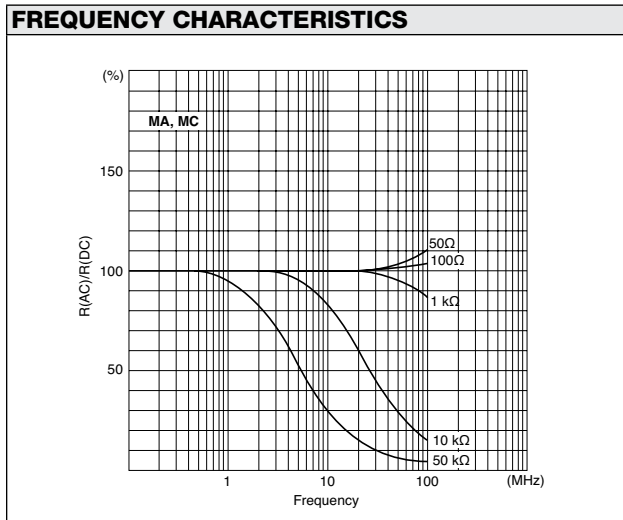


DSCC SPECIFICATIONS

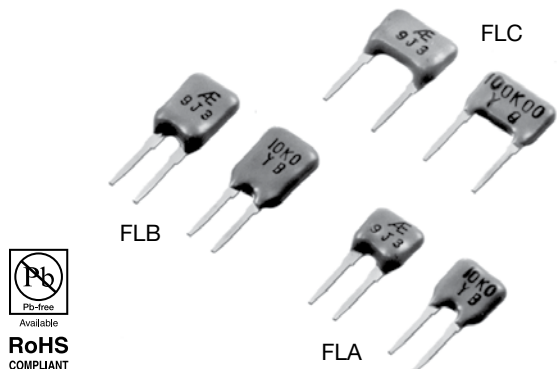
97009
97010
97011

PERFORMANCE			
Parameters	Test Condition	MIL-PRF-55182/9 Specification	ALPHA Typical Test Data
Maximum Rated Operating Temperature Working Temperature Range Maximum Working Voltage			125°C -65°C to +175°C MA, MC=300V, MB=350V, MD=250V
Power Conditioning Thermal Shock Overload	125°C, Rated Power, 100 hrs. -65°C/30 min. ↔ +150°C/30 min., 5 cycles Rated Power x 6.25, 5 sec.	±(0.20%+0.01Ω) ±0.05% ±0.05%	±0.005% ±0.005% ±0.005%
Solderability Resistance to Solvents	Steam Aging 8 hrs., 245°C, 5 sec. ☉ Isopropyl Alcohol + Mineral Spirits ☉ Water + Butyl Cellosolve + Monoethanolamine	over 95% coverage no damage	over 95% coverage no damage
Low Temperature Storage Low Temperature Operation Terminal Strength	-65°C, 24 hrs. -65°C, Rated Voltage, 45 min. 0.908 kg (2 pounds), 10 sec	±0.05% ±0.05% ±0.02%	±0.0025% ±0.0025% ±0.0025%
Dielectric Withstanding Voltage Insulation Resistance Resistance to Soldering Heat Moisture Resistance	Atmo.Pres.: 300V rms. Baro. Pres. 8 mHg: 200V rms. DC 100V, 2 min. +260°C, 10 sec. +65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.02% over 10,000 MΩ ±0.02% ±0.05%	±0.0025% over 10,000 MΩ ±0.0025% ±0.01%
Shock (Specified Pulse) Vibration, High Frequency	100G, 6 ms, Sawtooth Wave, X, Y, each 10 shocks 20G, 10 Hz to 2,000 Hz to 10 Hz, 20min., X, Y, each 4 hrs.	±0.01% ±0.02%	±0.0025% ±0.0025%
Life	125°C, Rated Voltage, 1.5 hr. – ON, 0.5 hr. – OFF, 2,000 hrs.	±0.05%	±0.015%
Life 70°C Power Rating	70°C, Rated Voltage x 2, 1.5 hr. – ON, 0.5 hr. – OFF, 2,000 hrs.	±0.05%	±0.015%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.005%	±0.0025%
High Temperature Exposure	175°C, No Load, 2,000 hrs.	±0.5%	±0.015%
Current Noise Voltage Coefficient Thermal EMF		-32 dB 0,0005%/V 1.0 μV/°C	-42 dB 0,00003%/V 1.0 μV/°C

Type MA meets requirements of MIL-PRF-55182/9.



Precision Resistor (Conformally Coated)



RoHS
COMPLIANT

TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER				
Type	TCR (ppm/°C) -25°C to +125°C*	Resistance Range (Ω)	Resistance Tolerance (%) [†]	Rated Power (W) at 70°C
FLA	0±5 (X) 0±2.5 (Y)	10 to 30	±0.5 (D) ±1.0 (F)	0.125
		30 to 100	±0.1 (B) ±0.5 (D)	
		100 to 100k	±0.05 (A) ±0.1 (B)	
FLB	0±5 (X) 0±2.5 (Y)	10 to 30	±0.5 (D) ±1.0 (F)	0.25
		30 to 100	±0.1 (B) ±0.5 (D)	
		100 to 150k	±0.05 (A) ±0.1 (B)	
FLC	0±5 (X) 0±2.5 (Y)	10 to 30	±0.5 (D) ±1.0 (F)	0.25
		30 to 100	±0.02 (Q) ±0.05 (A) ±0.1 (B) ±0.5 (D)	
		100 to 200k	±0.01 (T) ±0.02 (Q) ±0.05 (A) ±0.1 (B)	

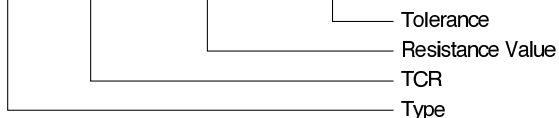
* Symbols parenthesized are for type number composition.

† Resistance figures are the values obtained by measuring at the point 2.5±1.0 mm below the shoulder of leads.

COMPOSITION OF TYPE NUMBER

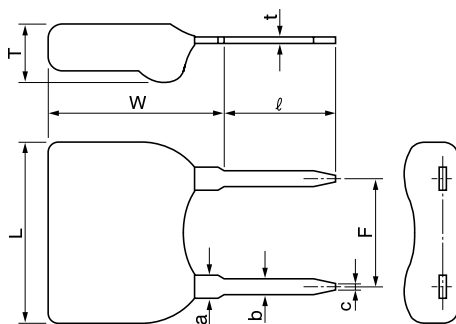
Example:

FLA X 500R00 B



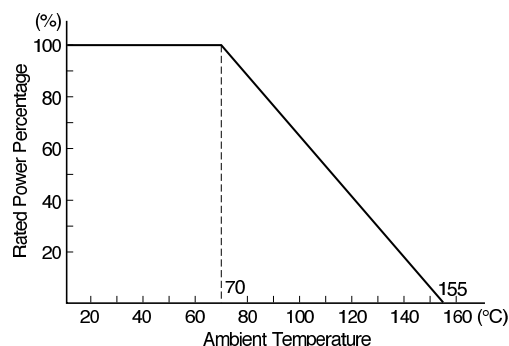
Resistance value, in ohm, is expressed by a series of six characters, five of which represent significant digits. R or K is a dual-purpose letter that designates both the value range (R for ohmic; K for kilo-ohm) and the location of decimal point.

CONFIGURATION (DIMENSIONS IN mm)

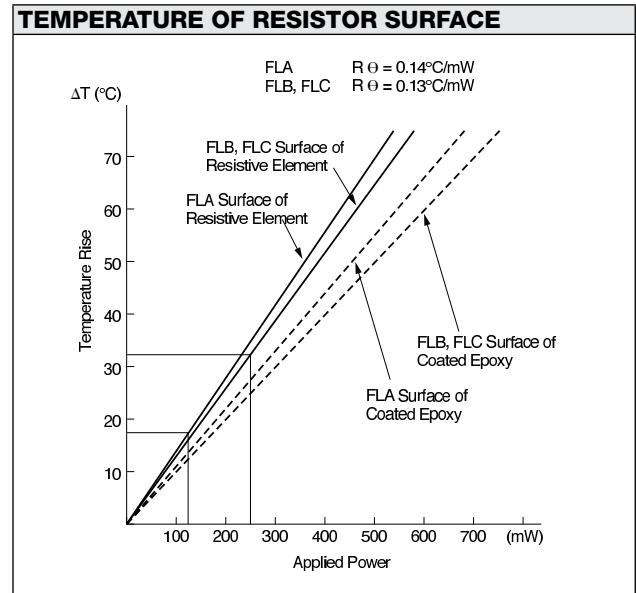
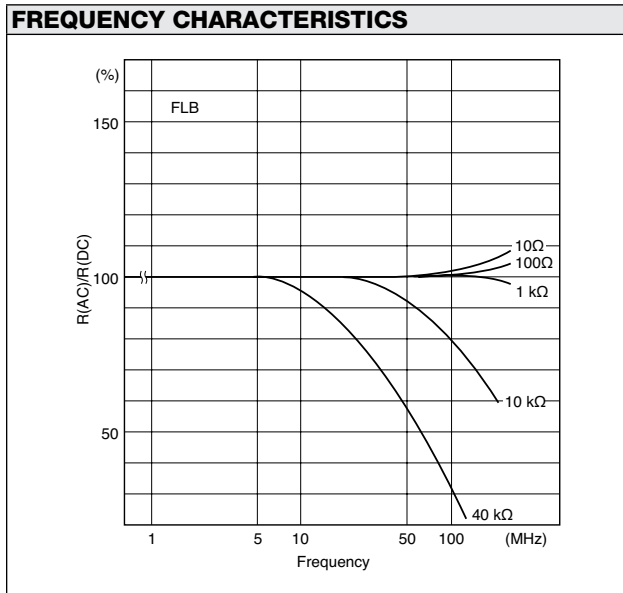


Type	FLA	FLB	FLC
L	5.6±0.5		7.5±0.5
W	6.2±0.5	8.2±0.5	6.2±0.5
T	2.2±0.5		
F	2.54±0.25		5.08±0.25
l	5±1		
t	0.3±0.05		
a	1.0±0.05		
b	0.65±0.05		
c	0.4±0.05		

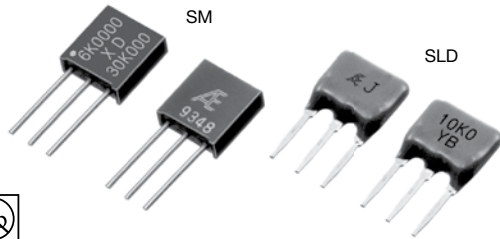
POWER DERATING CURVE



PERFORMANCE			
Parameters	Test Condition	ALPHA Specification	ALPHA Typical Test Data
Maximum Rated Operating Temperature Working Temperature Range Maximum Working Voltage			70°C -25°C to +155°C FLA=250V, FLB/FLC=300V
Temperature Cycling Overload	-25°C/30 min., Room Temperature/5 min., +155°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	±0.05% ±0.05%	±0.01% ±0.0025%
Solderability Resistance to Solvents	235°C, 2 sec. ① Isopropyl Alcohol ② Trichloroethylene	over 75% coverage no damage	over 75% coverage no damage
Low Temperature Storage Terminal Strength	-25°C, No Load, 2 hrs. 0.908 kg (2 pounds), 10 sec.	±0.05% ±0.05%	±0.0025% ±0.0025%
Dielectric Withstanding Voltage Insulation Resistance Resistance to Soldering Heat Moisture Resistance	Atmo. Pres.: AC 300V, 1 min. DC 100V, 1 min. 350°C, 3 sec. +65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.03% over 10,000 MΩ ±0.03% ±0.1%	±0.0025% over 10,000 MΩ ±0.0025% ±0.015%
Shock Vibration	50G, 11 ms, Half-Sine Wave, X, Y, Z, each 3 shocks 20G, 10 Hz to 55 Hz to 10 Hz, 1 min., X, Y, Z, each 2 hrs.	±0.03% ±0.03%	±0.005% ±0.005%
Life (Rated Load)	70°C, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 1,000 hrs.	±0.1%	±0.01%
Life (Moisture Load)	40°C, 90% RH to 95% RH, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 1,000 hrs.	±0.05%	±0.01%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.02%	±0.005%
High Temperature Exposure	155°C, No Load, 1,000 hrs.	±0.05%	±0.01%
Current Noise Pressure Cooker Test	121°C, 100% RH, 2 atmospheric, No Load, 100 hrs.	-25 dB ±0.5%	-42 dB ±0.1%



Ultra Precision Resistor 1-2-3 Network



RoHS
COMPLIANT

DSCC Specification 87026

TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER

Type	TCR (ppm/°C) -55°C to +125°C		Resistance Range/ Element (Ω)**	Resistance Tolerance (%)		Rated Power/ Package (W)
	Absolute*	Tracking		Absolute*	Matching*	
SM	0±5 (X) 0±2.5 (Y)	See Table 1	50 to 30k	±0.02 (Q) ±0.05 (A) ±0.1 (B)	±0.01 (T) ±0.02 (Q) ±0.05 (A) ±0.1 (B)	0.3 at 125°C
SLD	0±5 (X) 0±2.5 (Y)	See Table 1	50 to 100	±0.1 (B) ±0.5 (D)	±0.05 (A) ±0.1 (B)	0.25 at 70°C
			100 to 30k	±0.05 (A) ±0.1 (B)	±0.02 (Q) ±0.05 (A) ±0.1 (B)	

* Symbols parenthesized are for type number composition.

** -25°C to +125°C for SLD type.

*** Please contact us for the availability.

COMPOSITION OF TYPE NUMBER

Example: R₁=R₂

SM 1X 10K00 B A

① ② ③ ④ ⑤ ⑥

Example: R₁≠R₂

SLD 2X 1K000 / 10K00 B Q

① ② ③ ④ ⑤ ⑥

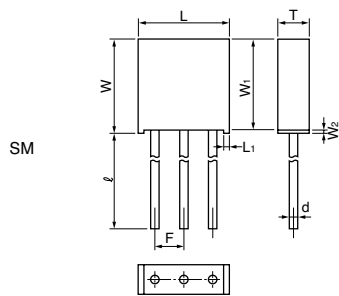
- ① Type
- ② Number of Values
- ③ TCR Absolute
- ④ Nominal Resistance Values
- ⑤ Resistance Tolerance (Absolute)
- ⑥ Resistance Tolerance (Matching)

Resistance value, in ohm, is expressed by a series of five characters, four of which represent significant digits. The fifth R or K is a dual-purpose letter that designates both the value range (R for ohmic; K for kilo-ohm) and the location of decimal point.

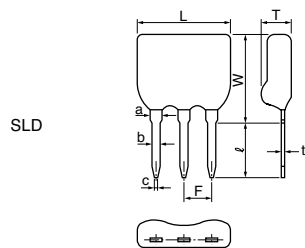
TABLE 1. TCR TRACKING IS SUBJECT TO RESISTANCE RATIO

Resistance Ratio	TCR Tracking (ppm/°C)
Resistance Ratio = 1	±0.5
1 < Resistance Ratio ≤ 10	±1
10 < Resistance Ratio ≤ 100	±2
100 < Resistance Ratio	±3

CONFIGURATION (DIMENSIONS IN mm)

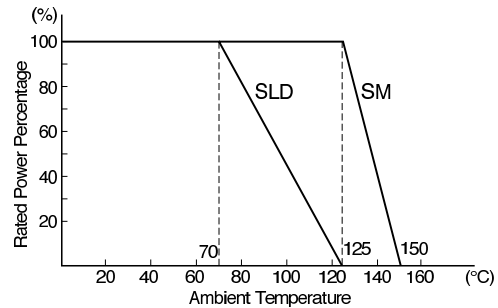


Type	SM
L	7.7±0.2
L ₁	1.0 max.
W	8.1±0.2
W ₁	7.8±0.2
W ₂	0.3 max.
T	2.6±0.2
F	2.54±0.25
l	10±3
d	φ0.65±0.05

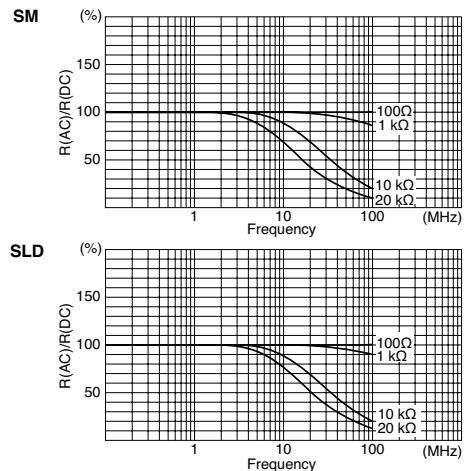


Type	SLD
L	7.5±0.5
W	7.5±0.5
T	2.2±0.5
F	2.54±0.25
l	5±1
t	0.3±0.05
a	1.0±0.05
b	0.65±0.05
c	0.4±0.05

POWER DERATING CURVE



FREQUENCY CHARACTERISTICS

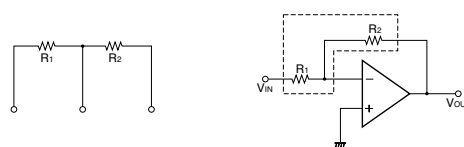


PERFORMANCE – SM					
Parameters	Test Condition	ALPHA Specification		ALPHA Typical Test Data	
		ΔR	$\Delta Ratio$	ΔR	$\Delta Ratio$
Maximum Rated Operating Temperature Working Temperature Range		125°C -65°C to +150°C			
Thermal Shock Overload	-65°C/30 min. ↔ +150°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	±0.02%	±0.01%	±0.005%	±0.0025%
Solderability	245°C, 5 sec.	over 95% coverage		over 95% coverage	
Resistance to Solvents	① Isopropyl Alcohol + Mineral Spirits ② Water + Butyl Cellosolve + Monoethanolamine	no damage		no damage	
Low Temperature Storage and Operation Terminal Strength	-65°C, No Load, 24 hrs. → Rated Voltage, 45 min. 0.908 kg (2 pounds), 10 sec.	±0.05%	±0.02%	±0.0025%	±0.001%
Dielectric Withstanding Voltage Insulation Resistance Resistance to Soldering Heat Moisture Resistance	Atmo. Pres.: AC 300V, 1 min. Baro. Pres. 8 mHg; AC 200V, 1min. DC 500V, 2 min. 350°C, 3 sec. +65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.02%	±0.01%	±0.0025%	±0.001%
		over 10,000 M Ω		over 10,000 M Ω	
		±0.02%	±0.01%	±0.0025%	±0.001%
Shock Vibration, High Frequency	100G, 6 ms, Sawtooth Wave, X, Y, Z, each 10 shocks 20G, 10 Hz to 2,000 Hz to 10 Hz, 20 min., X, Y, Z, each 2.5 hrs.	±0.01%	±0.005%	±0.0025%	±0.001%
		±0.02%	±0.01%	±0.0025%	±0.001%
Life	125°C, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 2,000 hrs.	±0.05%	±0.02%	±0.015%	±0.005%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.005%	±0.0025%	±0.0025%	±0.0015%
High Temperature Exposure	150°C, No Load, 2,000 hrs.	±0.05%	±0.02%	±0.015%	±0.005%
Current Noise Voltage Coefficient Thermal EMF		-32 dB 0.0005%/V 1.0 μ V/°C		-42 dB 0.00003%/V 1.0 μ V/°C	

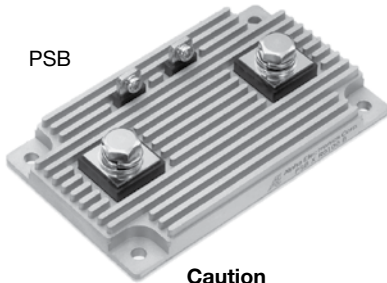
PERFORMANCE – SLD					
Parameters	Test Condition	ALPHA Specification		ALPHA Typical Test Data	
		ΔR	$\Delta Ratio$	ΔR	$\Delta Ratio$
Maximum Rated Operating Temperature Working Temperature Range		70°C -25°C to +125°C			
Thermal Cycling Overload	-25°C/30 min., Room Temperature/5 min., 125°C/30 min., 5 cycles Rated Voltage x 2.5, 5 sec.	±0.05%	±0.01%	±0.01%	±0.005%
Solderability	235°C, 2 sec.	over 75% coverage		over 75% coverage	
Resistance to Solvents	Isopropyl Alcohol	no damage		no damage	
Low Temperature Operation Terminal Strength	-25°C, No Load, 2 hrs. 0.908 kg (2 pounds), 10 sec.	±0.05%	±0.01%	±0.0025%	±0.001%
Dielectric Withstanding Voltage Insulation Resistance Resistance to Soldering Heat Moisture Resistance	Atmo. Pres.: AC 300V, 1 min. DC 100V, 1 min. 350°C, 3 sec. +65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.03%	±0.01%	±0.0025%	±0.001%
		over 10,000 M Ω		over 10,000 M Ω	
		±0.03%	±0.01%	±0.0025%	±0.001%
Shock Vibration	50G, 11 ms, Half-Sine Wave, X, Y, Z, each 3 shocks 20G, 10 Hz to 55 Hz to 10 Hz, 1 min., X, Y, Z, each 2 hrs.	±0.03%	±0.01%	±0.005%	±0.001%
		±0.03%	±0.01%	±0.005%	±0.001%
Life (Rated Load)	70°C, Rated Power, 1.5 hr. – ON, 0.5 hr. – OFF, 1,000 hrs.	±0.1%	±0.05%	±0.01%	±0.005%
Life (Moisture Load)	40°C 90% RH to 95% RH, Rated Power 1.5 hrs – ON, 0.5 hr. – OFF, 1,000 hrs.	±0.05%	±0.01%	±0.01%	±0.005%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs	±0.02%	±0.01%	±0.005%	±0.0025%
High Temperature Exposure	125°C, No Load, 1,000 hrs.	±0.05%	±0.01%	±0.01%	±0.005%

EXAMPLE OF APPLICATION

An application of type SM/SLD (input/feedback resistors for amplifiers) Because the input and the feedback resistors are incorporated into one single element, amplification is not affected by temperature range.



Ultra Precision Shunt Resistor (40 Watts)

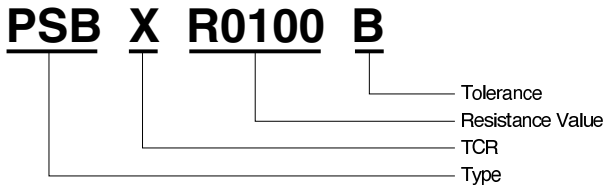


RoHS COMPLIANT

Caution
Please screw current terminals >5N · m, voltage terminal >1N · m

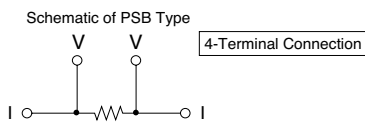
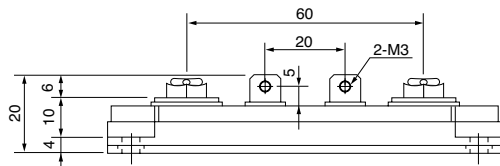
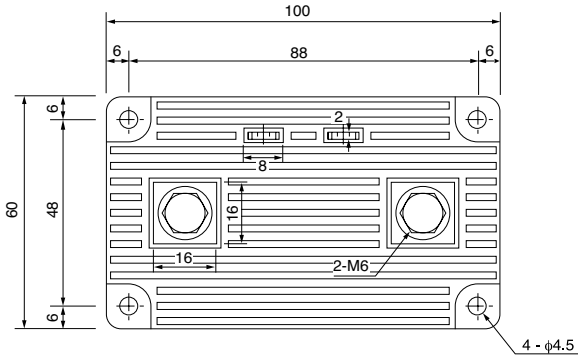
COMPOSITION OF TYPE NUMBER

Example:



Resistance value in ohm is expressed by a series of four significant digits and an R designating the decimal point.

CONFIGURATION (DIMENSIONS IN mm)



Weight = 170g

FEATURES

- Excellent temperature characteristics created by Bulk Metal® foil technology
- Accurate value on four-terminal wiring, even in low extremity of resistance
- High heat dissipation due to aluminum-clad construction with fins
- Readiness to mount to heat sink or water-cooled radiator
- Availability of threaded holes to fix cables with screw

APPLICATIONS

- Current-sensing in precise power supply, motor driver, etc.

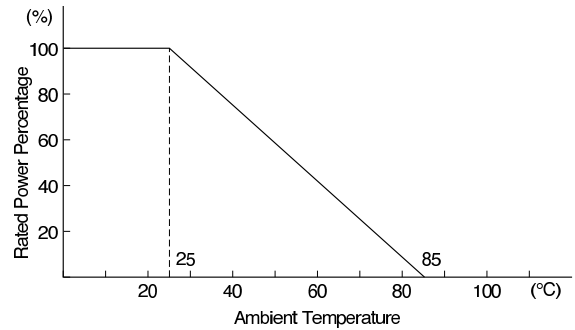
TCR, RESISTANCE RANGE, TOLERANCE, RATED POWER

TCR (ppm/°C) 0°C to +60°C	Resistance Range (Ω)	Resistance Tolerance (%)	Rated Power (W) at 25°C
0±15 (W)	0.001 to 0.005	±0.1 (B) ±0.5 (D) ±1 (F)	12 in free air and 40 On heat sink*
0±5 (X) 0±15 (W)	0.005 to 1		

*Thermal resistance of the heat sink 1°C/W.

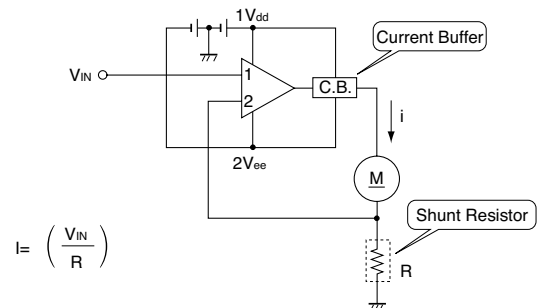
Available to use higher rated power with elevation of cooling effect. Please keep temperature of element surface less than 60°C.

POWER DERATING CURVE



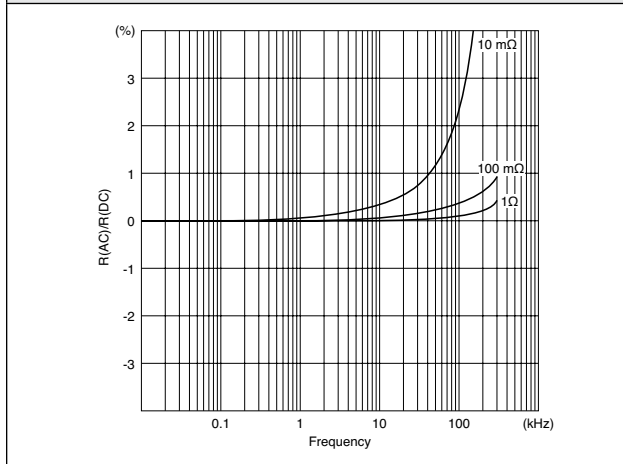
EXAMPLE OF APPLICATIONS

Motor Control Circuit Using Shunt Resistor



PERFORMANCE			
Parameters	Test Condition	ALPHA Specification	ALPHA Typical Test Data
Maximum Rated Operating Temperature Working Temperature Range Maximum Working Current			25°C -55°C to +85°C 100A
Power Conditioning	25°C, Rated Power, 96 hrs.	±0.1%	±0.05%
Low Temperature Storage and Operation	-55°C, No Load, 24 hrs.	±0.1%	±0.05%
Dielectric Withstanding Voltage Insulation Resistance Low Temperature Operation Overload	Atmo. Pres.: AC 750V, 1 min. DC 500V, 2 min. -55°C, Rated Power Rated Power x 2.5, 5 sec.	±0.05% over 10,000 MΩ ±0.1% ±0.1%	±0.01% over 10,000 MΩ ±0.05% ±0.05%
Moisture Resistance	+65°C to -10°C, 90% RH to 98% RH, Rated Voltage, 10 cycles (240 hrs.)	±0.1%	±0.05%
Shock High Frequency Shock	30G, 11 ms., Half-Sine Wave, X, Y, Z, 10 shocks each 10 Hz to 50 Hz to 10 Hz, 1 min. X, Y, Z, 2.0 hrs. each	±0.05% ±0.05%	±0.1% ±0.1%
Life	25°C, Rated Power, 1.5 hrs. – ON, 0.5 hrs. – OFF, 2,000 hrs.	±0.2%	±0.05%
High Temperature Exposure	85°C, No Load, 2,000 hrs.	±0.2%	±0.05%
Storage Life	15°C to 35°C, 15% RH to 75% RH, No Load, 10,000 hrs.	±0.05%	±0.01%
Internal Thermal Resistance	Between resistive element and base plate		0.3°C/W
Thermal Electromotive Force			1 μV/°C

FREQUENCY CHARACTERISTICS



TEMPERATURE OF RESISTOR SURFACE

