

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

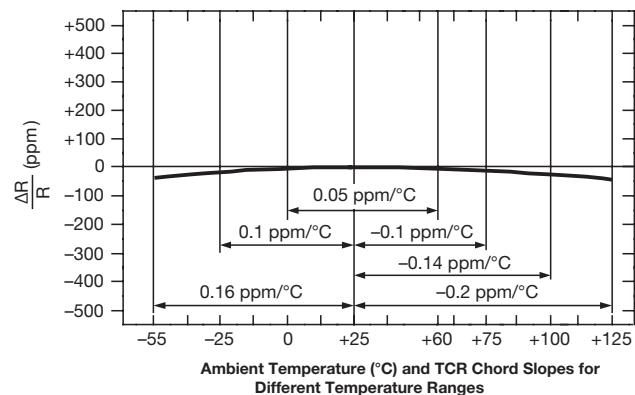
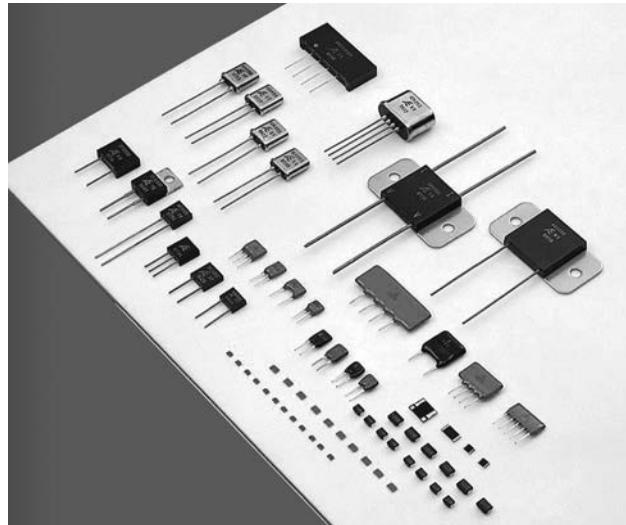
A Bulk Metal® foil high precision resistor, unlike a precision-class metal film resistor or wire-wound resistor, is an ultra precision resistor in which the primary resistance element is a special alloy foil several μm thick.

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.

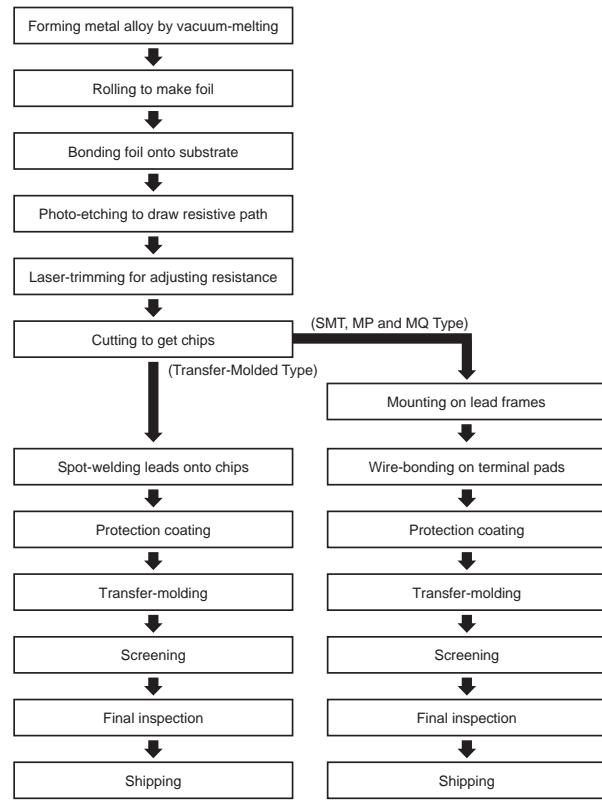


CHARACTERISTICS

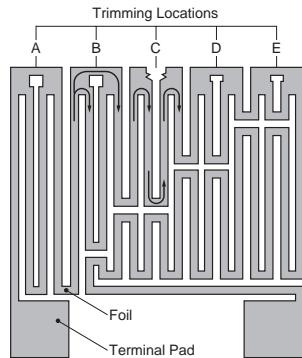
- ① Temperature Coefficient of Resistance:
0.05 ppm/°C (Typical, 0°C to +60°C)
- ② Resistance Tolerance: $\pm 0.005\%$
- ③ Shelf Life:
25 ppm/year; 50 ppm/3 years
(Hermetically sealed: 5 ppm/year
10 ppm/3 years)
- ④ Load Life:
0.005%/2,000 hours at Rated Power (typical)
- ⑤ Thermal EMF: 0.1 $\mu\text{V}/\text{°C}$ (between leads)
- ⑥ Noise: -42 dB
- ⑦ Voltage Coefficient: 0.3 ppm/V
- ⑧ Frequency Characteristics:
Inductance: 0.08 μH
Capacitance: 0.5 pF

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MANUFACTURING PROCESS



ADJUSTMENT OF RESISTANCE VALUE



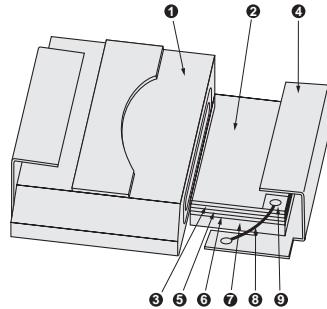
Foil bonded on substrate is photo-etched to make a fine path pattern to provide a desired value. A series of trimming locations are laid out on the pattern, as shown in A through E (fig. above). As shown at C, the trimming method is to increase the resistance by cutting the Bulk Metal® Foil. The resistance value can be made accurate to within ± 50 ppm of the desired value by cutting at several of the trimming locations. The locations that are cut for trimming are where the electric current flow (arrows in diagram) will not be affected so that the trimming will not cause electrical noise or changes over the years.

CONSTRUCTION

Construction of SMT (MP, MQ Type)

Outer coating is made of epoxy resin, which provides excellent resistance to moisture, heat and solvents.

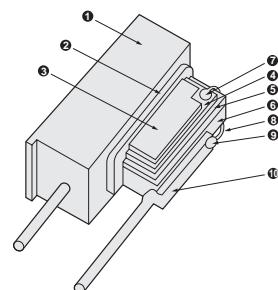
Gold wire-bond connects between lead frames and resistive elements. Also, resistive elements are designed to be mounted on lead frames efficient heat removal.



① Transfer-molded resin (heat-resistant epoxy)	⑥ Bonding layer (polyimide)
② Coating for moisture protection and buffering	⑦ Ceramic substrate (high-purity alumina)
③ Protective layer	⑧ Gold wire
④ External lead	⑨ Terminal pads
⑤ Bulk Metal® Foil (etched resistive element)	

Construction of Transfer-Molded Type

The outer cover is transfer-molded epoxy resin strongly resistant to heat, moisture and solvents. Inside, there are secondary leads which act as a buffer so that stress on the exterior leads is not transmitted to the foil, providing stability against vibrations when the resistor is mounted on a circuit.

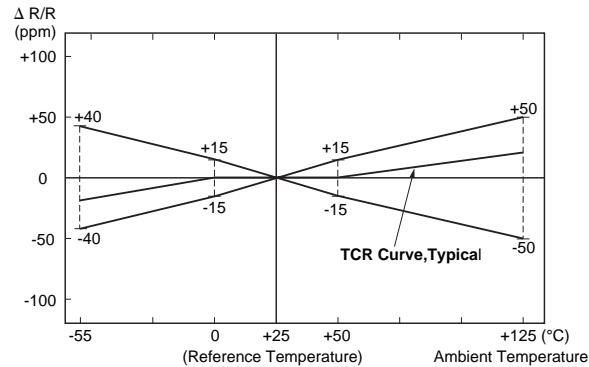


① Transfer-molded resin (heat-resistant epoxy)	⑥ Ceramic substrate (high-purity alumina)
② Coating for moisture protection and buffering	⑦ Resin strengthening welded part
③ Protective layer	⑧ Secondary lead (abating mechanical stress from outside)
④ Bulk Metal® Foil (etched resistive element)	⑨ High-temperature solder
⑤ Bonding layer (polyimide)	⑩ Exterior lead (Dia. 0.65 mm)

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TEMPERATURE CHARACTERISTICS OF RESISTANCE

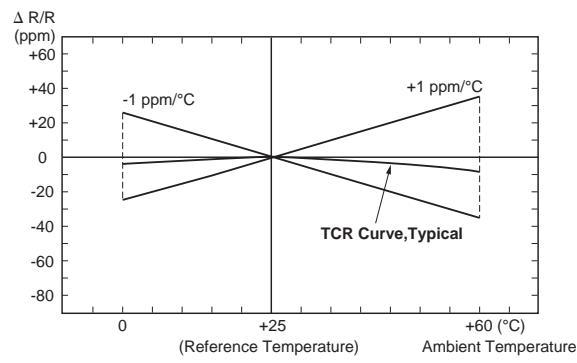
Char.S



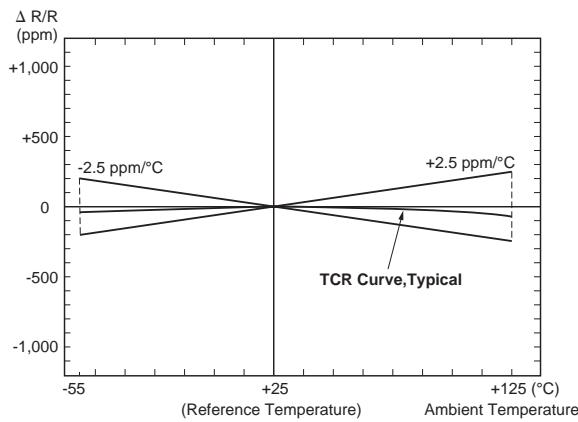
Temperature (°C)	Δ R/R (ppm)
-55	0±40
0	0±15
+50	0±15
+125	0±50

Reference Temperature +25°C

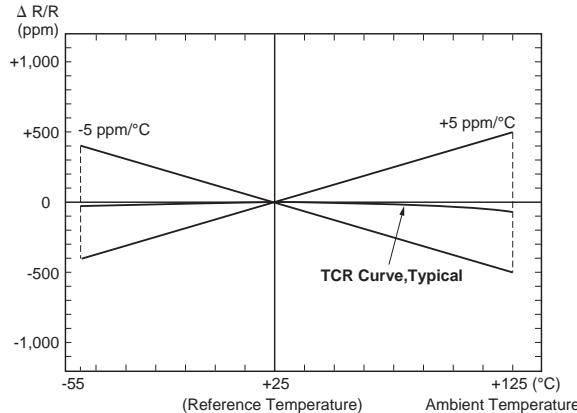
Char.Z (0±1 ppm/°C)



Char.Y (0±2.5 ppm/°C)



Char.X (0±5 ppm/°C)



Char.W (0±15 ppm/°C)

