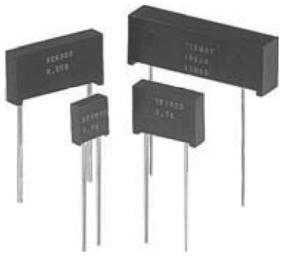
Ultra High Precision Z-Foil Resistor with TCR of ± 0.05 ppm/°C, Tolerance of ± 0.005 % (50 ppm), Load Life Stability of ± 0.005 %, ESD Immunity up to 25 kV and Thermal EMF of 0.05 µV/°C



INTRODUCTION

The Bulk Metal® Foil resistor is based on a special concept where a proprietary bulk metal cold rolled foil is cemented to a ceramic substrate. It is then photoetched into a resistive pattern. Furthermore, it is laser adjusted to any desired value and tolerance. Because the metals used are not drawn, wound or mistreated in any way during manufacturing process, the Bulk Metal Foil resistor maintains all its design, physical and electrical characteristics while winding of wire or sputtering does not. Z foil resistors achieve maximum stability and near-zero TCR. These performance characteristics are built-in for every unit, and do not rely on screening or other artificial means for uniform performances.

The stability of a resistor depends primarily on its history of exposures to temperature. Stability is affected by:

1. Changes in the ambient temperature and heat from adjacent components (defined by the Temperature Coefficient of Resistance, or TCR)
2. Destabilizing thermal shock of suddenly-applied power (defined by the power coefficient, or PCR)
3. Long-term exposure to applied power (load-life stability)
4. Repetitive stresses from being switched on and off

In very high-precision resistors, these effects must be taken into account to achieve high stability with changes in load (Joule Effect) and ambient temperature.

Vishay's new Z-Foil technology provides an order of magnitude reduction in the Bulk Metal Foil element's sensitivity to temperature changes - both external and internal. This technology provides an absolute TCR of ± 0.05 ppm/°C typical (instrument range: 0 °C to +60 °C), ± 0.2 ppm/°C typical (military range: - 55 °C to + 125 °C, + 25 °C ref), and a PCR of 5 ppm at rated power.
In order to take full advantage of this TCR improvement, it is necessary to take into account the differences in the resistor's response to each of the above-mentioned effects. The Z series has been developed to successfully deal with these factors.

FEATURES

- Temperature coefficient of resistance (TCR):
  -± 0.05 ppm/°C typical (0 °C to + 60 °C)
  -± 0.2 ppm/°C typical (- 55 °C to + 125 °C, + 25 °C ref.) (see table 1)
- Rated power: to 1 W at + 125 °C
- Resistance tolerance: to ± 0.005 % (50 ppm)
- Load life stability: to ± 0.005 % at 70 °C, 2000 h or to ±0.015% at 70°C, 10000 h (see table 4)
- Resistance range: 10 Ω to 600 kΩ
- Charcroft Foil Resistors are not restricted to standard values; specific "as required" values can be supplied at no extra cost or delivery (e.g. 1K2345 vs. 1K)
- Total accumulated change in resistance over life (EOL) < 0.05 %
- Electrostatic discharge up to 25 000 V
- Non-inductive, non-capacitive design
- Rise time: 1 ns effectively no ringing
- Current noise: 0.010 µVRMS/V of applied voltage (< - 40 dB)
- Thermal EMF: 0.05 µV/°C typical
- Voltage coefficient: < 0.1 ppm/V
- Low inductance: < 0.08 µH typical
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Pattern design minimizing hot spots
- Terminal Finishes Available:

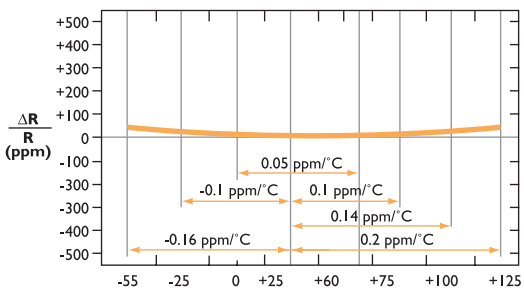
  RoHS Compliant

  Tin/Lead Alloy with minimum 5%, nominally 10% Lead content
- Matched sets are available per request (TCR tracking: to 0.5 ppm/°C)

TABLE 1 -TYPICAL TCR AND MAX. SPREAD (- 55 °C to + 125 °C, + 25 °C ref.)

VALUE	STANDARD TOLERANCE	TYPICAL TCR & MAXI. SPREAD (ppm/°C)
100Ω to 600KΩ	± 0.005%	± 0.2 ± 0.6
80Ω to < 100Ω	± 0.005%	± 0.2 ± 0.8
50Ω to < 80Ω	± 0.01%	± 0.2 ± 1.0
25Ω to < 50Ω	± 0.01%	± 0.2 ± 1.3
10Ω to < 25Ω	± 0.02%	± 0.2 ± 1.6

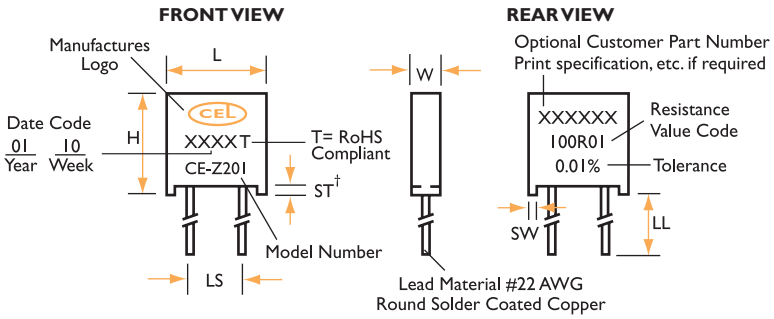
FIGURE 1 -TYPICAL RESISTANCE/ TEMPERATURE CURVE (Z-FOIL)



Ambient Temperature (°C) and TCR Chord Slopes for Different Temperature Ranges

Ultra High Precision Z-Foil Resistor with TCR of ± 0.05 ppm/°C, Tolerance of ± 0.005 % (50 ppm), Load Life Stability of ± 0.005 %, ESD Immunity up to 25 kV and Thermal EMF of 0.05 µV/°C

FIGURE 2 - STANDARD IMPRINTING AND DIMENSIONS



†The standoffs shall be so located as to give a lead clearance of 0.25mm minimum between the resistor body and the printed circuit board when the standoffs are seated on the printed circuit board. This is to allow for proper cleaning of flux and other contaminants from the unit after all soldering processes.

TABLE 2 - MODEL SELECTION

MODEL NUMBER	RESISTANCE RANGE (2) (Ω)	MAXIMUM WORKING VOLTAGE	AMBIENT POWER RATING at+ 70 °C	AMBIENT POWER RATING at+ 125 °C	AVERAGE WEIGHT (g)	DIMENSIONS mm
CE-Z201 (CE-Z201L) (1)	10R to 100K	300	0.6 W	0.3 W	0.6	W: 2.67 ± 0.25 L: 7.62 ± 0.25 H: 8.28 ± 0.25 ST: 0.254 min. SW: 1.02 ± 0.13 LL: 25.4 ± 3.18 LS: 3.81 ± 0.13
CE-Z204	10R to 200K	350	1.0 W	0.5 W	1.4	W: 4.06 max. L: 14.61 max. H: 10.49 max. ST: 0.889 ± 0.13 SW: 1.27 ± 0.13 LL: 25.4 ± 3.18 LS: 10.16 ± 0.51
CE-Z205	10R to 300K	350	1.5 W	0.75 W	1.9	W: 4.06 max. L: 20.83 max. H: 10.49 max. ST: 0.889 ± 0.13 SW: 1.27 ± 0.13 LL: 25.4 ± 3.18 LS: 16.51 ± 0.51
CE-Z206	10R to 600K	500	2.0 W	1.0 W	4.0	W: 6.60 max. L: 30.48 max. H: 10.49 max. ST: 0.889 ± 0.13 SW: 1.27 ± 0.13 LL: 25.4 ± 3.18 LS: 22.86 ± 0.51

Note
(1) 5.08 mm lead spacing available - specify CE-Z201L for CE-Z201.
(2) for non standard values please contact our Application Engineering Department

Ultra High Precision Z-Foil Resistor with TCR of ± 0.05 ppm/°C, Tolerance of ± 0.005 % (50 ppm), Load Life Stability of ± 0.005 %, ESD Immunity up to 25 kV and Thermal EMF of 0.05 µV/°C

FIGURE 3 - POWER DERATING CURVE

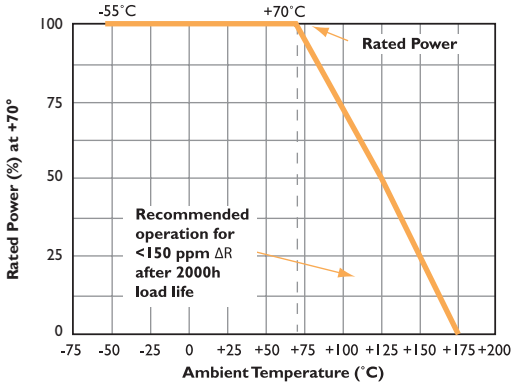


FIGURE 4 -TRIMMING TO VALUES (conceptual illustration)

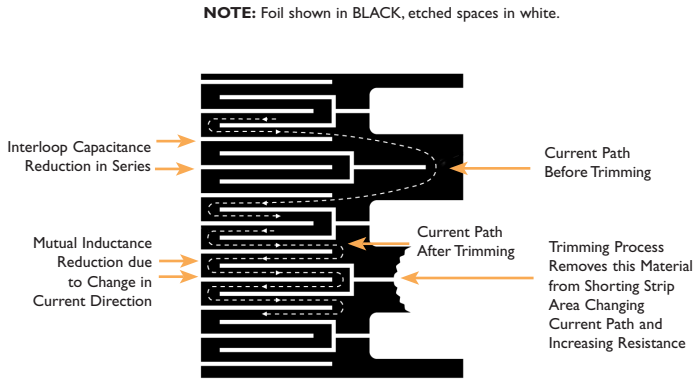


TABLE 3 - ENVIRONMENTAL PERFORMANCE COMPARISON

	MIL-PRF-55182 CHAR J	Z SERIES TYPICAL ΔR	Z SERIES MAXIMUM ΔR
Test Group I			
Thermal Shock 5 x (- 65 °C to + 150 °C)	± 0.2%	± 0.002% (20 ppm)	± 0.01% (100 ppm)
Short time overload, 6.25 x rated power	± 0.2%	± 0.003% (30 ppm)	± 0.01% (100 ppm)
Test Group II			
Resistance Temperature Characteristic	± 25ppm/°C	± 0.05 ppm/°C	see table I
Low temperature storage (24 h at - 65 °C)	± 0.15%	± 0.002% (20 ppm)	± 0.01% (100 ppm)
Low temperature operation (45 min, rated power at - 65 °C)	± 0.15%	± 0.002% (20 ppm)	± 0.01% (100 ppm)
Terminal strength	± 0.2%	± 0.002% (20 ppm)	± 0.01% (100 ppm)
Test Group III			
DWV	± 0.15%	± 0.002% (20 ppm)	± 0.01% (100 ppm)
Resistance to Solder Heat	± 0.1%	± 0.005% (50 ppm)	± 0.01% (100 ppm)
Moisture Resistance	± 0.4%	± 0.01% (100 ppm)	± 0.05 % (500 ppm)
Test Group IV			
Shock	± 0.2%	± 0.002% (20 ppm)	± 0.01% (100 ppm)
Vibration	± 0.2%	± 0.002% (20 ppm)	± 0.01% (100 ppm)
Test Group V			
Life Test @ 0.3 W/+125°C			
2,000 h	± 0.5%	± 0.005% (50 ppm)	± 0.015 % (150 ppm)
10,000 h	± 2.0%	± 0.015% (150 ppm)	± 0.05 % (500 ppm)
Test Group Va			
Life Test at 0.6W (2 x Rated Power) /+70°C, 2000 h	± 0.5%	± 0.005% (50 ppm)	± 0.015% (150 ppm)
Test Group VI			
High Temperature Exposure (2000 h at + 175 °C)	± 2.0%	± 0.05% (500 ppm)	± 0.1% (1000 ppm)
Test Group VII			
Voltage Coefficient	5 ppm/V	< 0.1 ppm/V	< 0.1 ppm/V

Ultra High Precision Z-Foil Resistor with TCR of ± 0.05 ppm/°C, Tolerance of ± 0.005 % (50 ppm), Load Life Stability of ± 0.005 %, ESD Immunity up to 25 kV and Thermal EMF of 0.05 µV/°C

STANDARD OPERATIONS AND TEST CONDITIONS

A. Standard Test Operations:

By 100 % Inspection

- Short-time overload (6.25 x rated power for 5 s)
- Resistance - tolerance check
- Visual and mechanical

By Sample Inspection

- TCR
- Environmental tests per table 3 on a quarterly basis to establish performance by similarity

B. Standard Test Conditions:

- Lead test point: 0.5" (12.7 mm) from resistor body
- Temperature: + 23 °C ± 2 °C
- Relative humidity: per MIL-STD-202

TABLE 4 - "Z" SERIES SPECIFICATIONS

Stability (1)		
Load life at 2000 h	± 0.015 % (150 ppm)	Maximum ΔR at 0.3 W/+ 125 °C
	± 0.005 % (50 ppm)	Maximum ΔR at 0.1 W/+ 70 °C
Load life at 10 000 h	± 0.05 % (500 ppm)	Maximum ΔR at 0.3 W/+ 125 °C
	± 0.01 % (100 ppm)	Maximum ΔR at 0.1 W/+ 70 °C
Current Noise	0.010 µVRMS/V of applied voltage (< - 40 dB)	
High Frequency Operation		
Rise time	1.0 ns at 1 kΩ	
Inductance (L) (2)	0.1 µH maximum; 0.08 µH typical	
Capacitance (C)	1.0 pF maximum; 0.5 pF typical	
Voltage Coefficient	< 0.1 ppm/V (3)	
Thermal EMF (4)	0.05 µV/°C typical	
	1 µV/W	(Model CE-Z201)

Notes

(1) Load life ΔR maximum can be reduced by 80 %, please contact applications engineering department.

(2) Inductance (L) due mainly to the leads.

(3) The resolution limit of existing test equipment (within the measurement capability of the equipment, or "essentially zero".)

(4) µV/°C relates to EMF due to lead temperature difference and µV/watt due to power applied to the resistor.

ORDERING INFORMATION

Specify Charcroft Z Series resistors as follows:

MODEL NO.	TERMINATION	RESISTANCE VALUE	TOLERANCE	PACKAGING
CE-Z201 CE-Z201L CE-Z204 CE-Z205 CE-Z206	T = RoHS compliant None = Tin/Lead alloy	250R00	V = ± 0.005% T = ± 0.01% Q = ± 0.02% A = ± 0.05% B = ± 0.1% C = ± 0.25% D = ± 0.5% F = ± 1.0%	TR = Tape & Reel (CE-Z201 & CE-Z201L only) None = Bulk