

Ultra High Precision Bulk Metal® Z-Foil Surface Mount Power Resistor in TO-220 Configuration with TCR of $\pm 0.05 \text{ ppm/}^\circ\text{C}$, PCR of 4 ppm/W and Load Life Stability of $\pm 0.005 \%$ (50 ppm)



INTRODUCTION

The Z-Foil technology provides a significant reduction of the resistive component's sensitivity to ambient temperature variations (TCR) and applied power changes (PCR).

Model VPR221SZ is a 4 lead kelvin connected surface mount device which provides high rated power, excellent load life stability, low temperature coefficient (TCR) and low power coefficient (PCR) - all in one resistor. $\pm 0.05 \text{ ppm/}^\circ\text{C}$ absolute TCR removes error due to temperature gradients.

By taking advantage of the overall stability and reliability of Bulk Metal® Z-Foil resistors, designers can significantly reduce circuit errors and greatly improve overall circuit performances.

Our application engineering department is available to advise and make recommendations. For non-standard technical requirements and special applications, please contact us.

TABLE 1 - TCR AND TOLERANCE

RESISTANCE RANGE (Ω)	TIGHTEST RESISTANCE TOLERANCE	TYPICAL TCR AND MAX. SPREAD ⁽¹⁾
0.5 to < 1	$\pm 0.05 \%$	$\pm 0.2 \text{ ppm/}^\circ\text{C} \pm 2.8 \text{ ppm/}^\circ\text{C}$
1 to < 10	$\pm 0.02 \%$	$\pm 0.2 \text{ ppm/}^\circ\text{C} \pm 2.3 \text{ ppm/}^\circ\text{C}$
10 to 500	$\pm 0.01 \%$	$\pm 0.2 \text{ ppm/}^\circ\text{C} \pm 1.8 \text{ ppm/}^\circ\text{C}$

Notes

⁽¹⁾ MIL-range (- 55 °C to + 125 °C, + 25 °C ref.)

- Contact applications engineering for other available values

* Pb containing terminations are not RoHS compliant, exemptions may apply

FEATURES

- Temperature coefficient of resistance (TCR):
 $\pm 0.05 \text{ ppm/}^\circ\text{C}$ typical (0 °C to + 60 °C)
 $\pm 0.2 \text{ ppm/}^\circ\text{C}$ typical (- 55 °C to + 125 °C, + 25 °C ref.) (see table 1)
- Tolerance: to $\pm 0.01 \%$
- Power coefficient "ΔR due to self heating": 4 ppm/W typical
- Rated power: 8 W chassis mounted (MIL-PRF-39009)
- Load life stability: to $\pm 0.005 \%$ at 25 °C for 2000 h, at 1.5 W
- Resistance range: 0.5 Ω to 500 Ω
- Foil resistors are not restricted to standard values; specific "as requested" values can be supplied at no extra cost or delivery (e.g. 100R2345 vs. 100R)
- Electrostatic discharge (ESD) up to 25 000 V
- Short time overload $\leq 0.001 \%$ (10 ppm)
- Non-inductive, non-capacitive design
- Rise time: 1 ns effectively no ringing
- Current noise: 0.010 $\mu\text{V}_{\text{RMS}}/\text{V}$ of applied voltage (< - 40 dB)
- Thermal EMF: 0.05 $\mu\text{V/}^\circ\text{C}$ typical
- Voltage coefficient < 0.1 ppm/V
- Non-inductive: < 0.08 μH
- Non hot spot design
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Terminal finish: lead (Pb)-free or tin/lead alloy
- Compliant to RoHS directive 2002/95/EC
- Prototype quantities available in just 5 working days or sooner. For more information, please contact foil@vishaypg.com
- For better performances please contact us



RoHS*
COMPLIANT

FIGURE 1 - SCHEMATICS

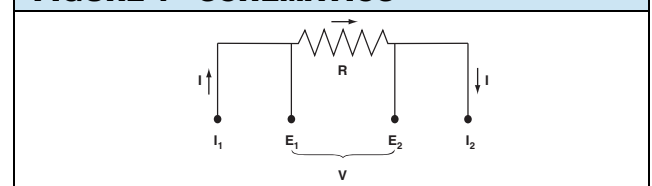


FIGURE 2 - POWER DERATING CURVE

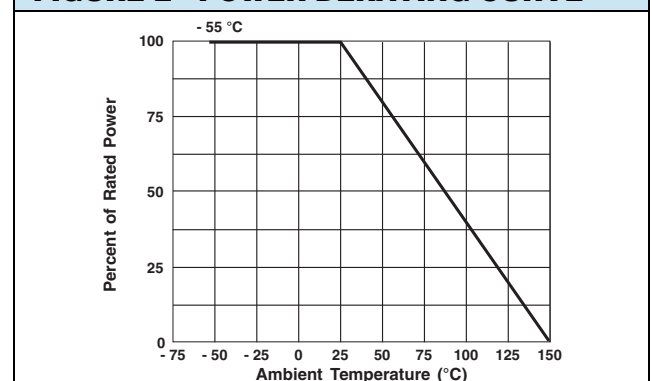
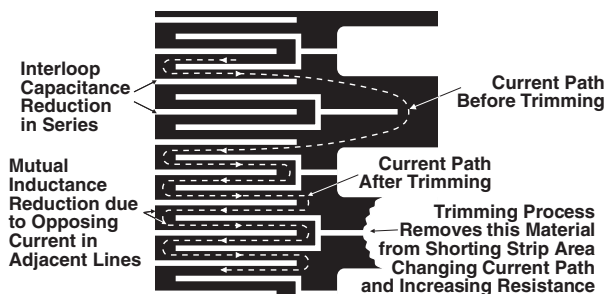


FIGURE 3 - TRIMMING TO VALUES
(conceptual illustration)



Note: Foil shown in black, etched spaces in white

FIGURE 4 - TYPICAL RESISTANCE/TEMPERATURE CURVE
(for more details see table 1)

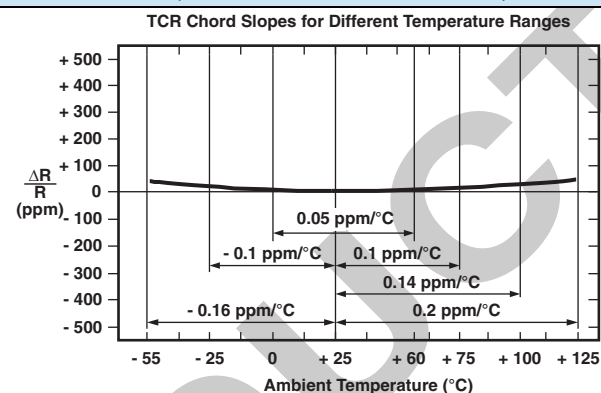


FIGURE 5 - VPR221SZ FORMING DIMENSIONS in inches (millimeters)

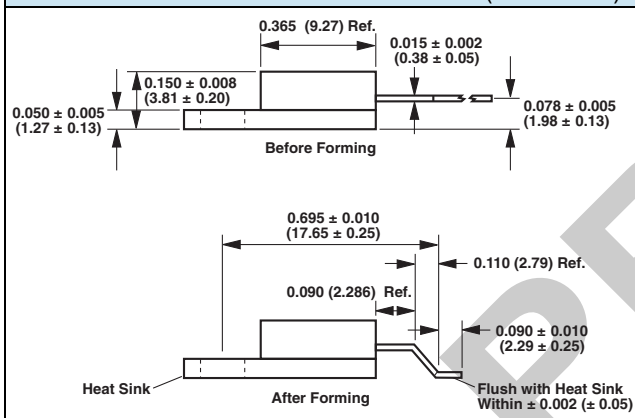


FIGURE 6 - VPR221SZ DIMENSIONS in inches (millimeters)

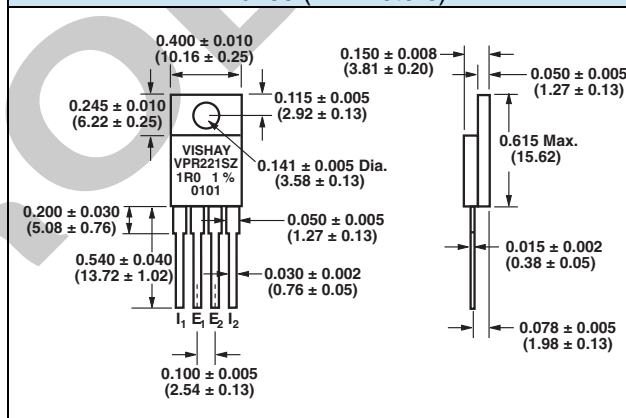


FIGURE 7 - LAND PATTERN DIMENSIONS in inches (millimeters)

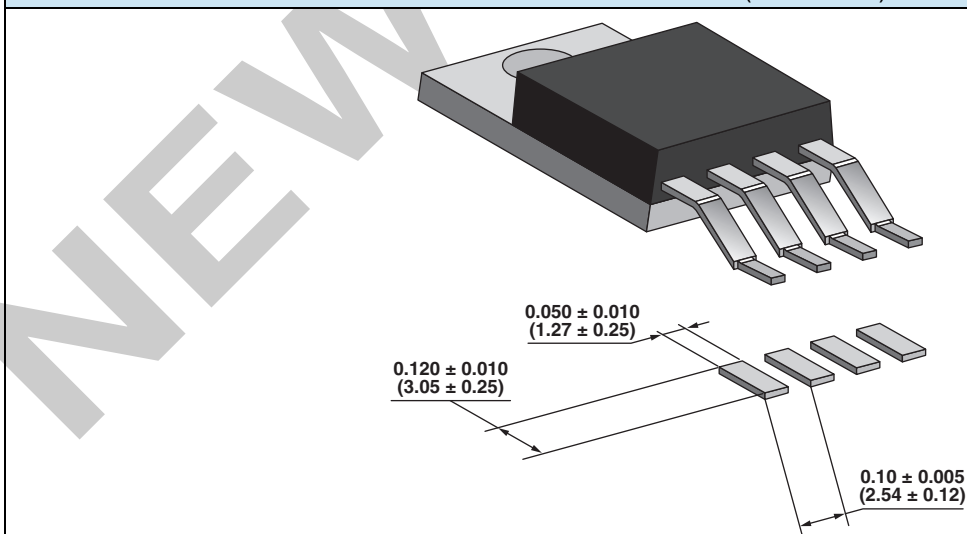


TABLE 2 - SPECIFICATIONS

Power Rating at + 25 °C	8 W or 3 A ⁽¹⁾ on heat sink ⁽²⁾ 1.5 W in free air Further derating not necessary.
Current Noise	< 0.010 $\mu V_{RMS}/V$ of applied voltage (- 40 dB)
High Frequency Operation Rise Time Inductance (L) ⁽³⁾ Capacitance (C)	0.2 ns at 1 W 0.1 μH maximum: 0.03 μH typical 1.0 pF maximum: 0.5 pF typical
Voltage Coefficient ⁽⁴⁾	< 0.1 ppm/V
Operating Temperature Range	- 55 °C to + 150 °C
Maximum Working Voltage	300 V, not to exceed power rating
Thermal EMF ⁽⁵⁾	0.15 $\mu V/^{\circ}C$ maximum (lead effect)
Weight	1.2 g maximum

Notes

(1) Whichever is lower

(2) Heat sink chassis dimensions are requirements per MIL-R-39009/1B:

DIMENSIONS	inches	mm
L	6.00	152.4
W	4.00	101.6
H	2.00	50.8
T	0.04	1.0

(3) Inductance (L) mainly due to the leads

(4) The resolution limit of existing test requirement (within the measurement capability of the equipment, "essentially zero")

(5) $\mu V/^{\circ}C$ relates to EMF due to lead temperature difference

TABLE 3 - PERFORMANCE SPECIFICATIONS ⁽¹⁾ MIL-PRF 39009

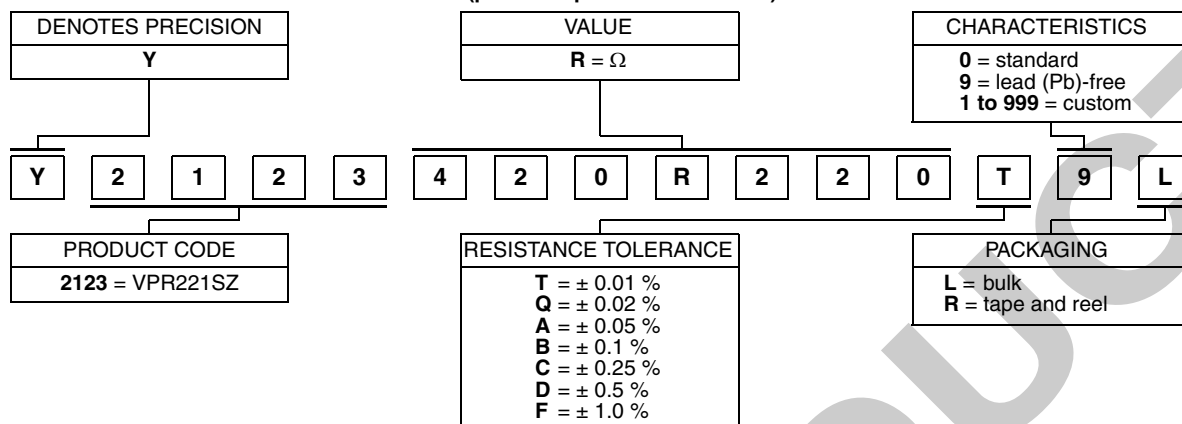
TEST OR CONDITION	MIL-PRF 39009	TYPICAL ΔR	MAXIMUM ΔR
Low temperature storage 24 h at - 55 °C	$\pm 0.3 \% + 0.01 \Omega$	$\pm 0.001 \% (10 \text{ ppm})$	$\pm 0.002 \% (20 \text{ ppm})$
Dielectric withstanding voltage 300 V _{AC} at Atm	$\pm 0.2 \% + 0.01 \Omega$	$\pm 0.001 \% (10 \text{ ppm})$	$\pm 0.002 \% (20 \text{ ppm})$
Dielectric withstanding voltage 200 V _{AC} at Brm	$\pm 0.2 \% + 0.01 \Omega$	$\pm 0.001 \% (10 \text{ ppm})$	$\pm 0.002 \% (20 \text{ ppm})$
Insulation resistance	$> 10^4 M\Omega$		$> 10^4 M\Omega$
Low temperature operation	$\pm 0.3 \% + 0.01 \Omega$	$\pm 0.002 \% (20 \text{ ppm})$	$\pm 0.008 \% (80 \text{ ppm})$
Short time overload 5 x rated power for 5 s (in air)	$\pm 0.3 \% + 0.01 \Omega$	$\pm 0.001 \% (10 \text{ ppm})$	$\pm 0.002 \% (20 \text{ ppm})$
Moisture resistance + 65 °C to - 10 °C, 90 RH to 98 RH, 10 days	$\pm 0.5 \% + 0.01 \Omega$	$\pm 0.005 \% (50 \text{ ppm})$	$\pm 0.015 \% (150 \text{ ppm})$
Terminal strength	$\pm 0.2 \% + 0.01 \Omega$	$\pm 0.001 \% (10 \text{ ppm})$	$\pm 0.002 \% (20 \text{ ppm})$
Load life 8 W at + 25 °C, 2000 h with heat sink	$\pm 1.0 \% + 0.01 \Omega$	$\pm 0.005 \% (50 \text{ ppm})$	$\pm 0.015 \% (150 \text{ ppm})$
Load life 1.5 W at + 25 °C for 2000 h in free air	$\pm 1.0 \% + 0.01 \Omega$	$\pm 0.005 \% (50 \text{ ppm})$	$\pm 0.015 \% (150 \text{ ppm})$
High temperature exposure + 150 °C	$\pm 1.0 \% + 0.05 \Omega$	$\pm 0.005 \% (50 \text{ ppm})$	$\pm 0.01 \% (100 \text{ ppm})$

Note

(1) Measurement error $\pm 0.001 \%$

TABLE 4 - GLOBAL PART NUMBER INFORMATION ⁽¹⁾

NEW GLOBAL PART NUMBER: Y2123420R220T9L (preferred part number format)



FOR EXAMPLE: ABOVE GLOBAL ORDER Y2123 420R220 T 9 L:

TYPE: VPR221SZ

VALUE: 420.22 Ω ABSOLUTE TOLERANCE: $\pm 0.01\%$

TERMINATION: lead (Pb)-free

PACKAGING: bulk

HISTORICAL PART NUMBER: VPR221SZ T 420R22 TCR0.2 T B (will continue to be used)

VPR221SZ	T	420R22	TCR0.2	T	B
MODEL	TERMINATION T = lead (Pb)-free none = tin/lead	OHMIC VALUE 420.22 Ω	TCR CHARACTERISTIC TCR0.2	ABSOLUTE TOLERANCE T = $\pm 0.01\%$ Q = $\pm 0.02\%$ A = $\pm 0.05\%$ B = $\pm 0.1\%$ C = $\pm 0.25\%$ D = $\pm 0.5\%$ F = $\pm 1.0\%$	PACKAGING B = bulk T = tape and reel

Note⁽¹⁾ For non-standard requests, please contact application engineering

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