

Ultra High Precision Bulk Metal® Z-Foil Surface Mount Power Resistor in TO-220 Configuration with TCR of ± 0.05 ppm/°C, PCR of 4 ppm/W and Load Life Stability of ± 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. ± 0.05 ppm/°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 | ± 0.05 % | ± 0.2 ppm/°C ± 2.8 ppm/°C |
| 1 to < 10 | ± 0.02 % | ± 0.2 ppm/°C ± 2.3 ppm/°C |
| 10 to 500 | ± 0.01 % | ± 0.2 ppm/°C ± 1.8 ppm/°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): ± 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)
- Tolerance: to ± 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 ± 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 ≤ 0.001 % (10 ppm)
- Non-inductive, non-capacitive design
- Rise time: 1 ns effectively no ringing
- Current noise: 0.010 μ V_{RMS}/V of applied voltage (< - 40 dB)
- Thermal EMF: 0.05 μ V/°C typical
- Voltage coefficient < 0.1 ppm/V
- Non-inductive: < 0.08 μ H
- 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

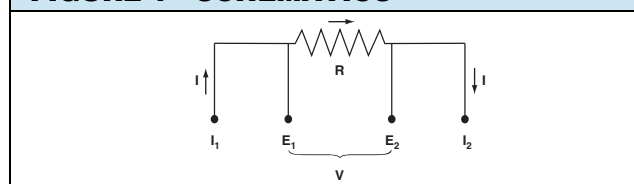


FIGURE 2 - POWER DERATING CURVE

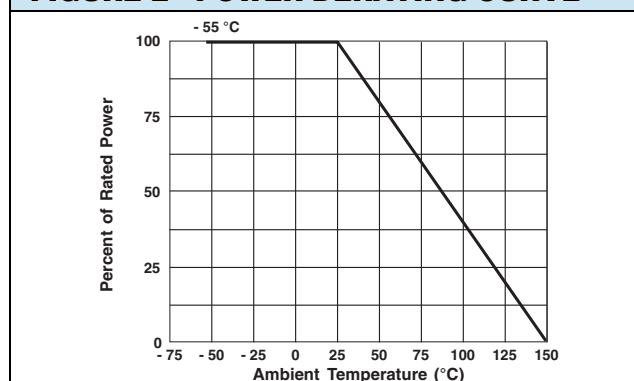


FIGURE 3 - TRIMMING TO VALUES
(conceptual illustration)

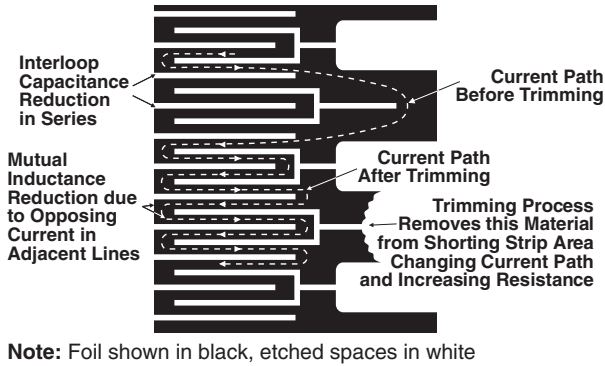


FIGURE 4 - TYPICAL RESISTANCE/TEMPERATURE CURVE
(for more details see table 1)

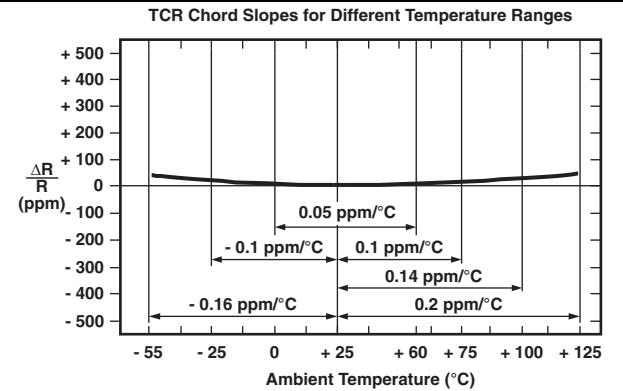


FIGURE 5 - VPR221SZ FORMING DIMENSIONS in inches (millimeters)

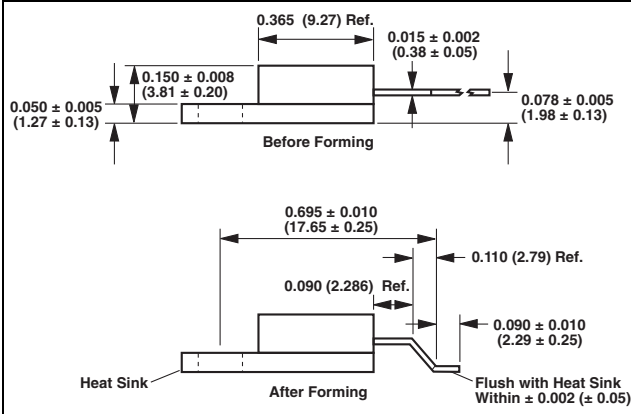


FIGURE 6 - VPR221SZ DIMENSIONS in inches (millimeters)

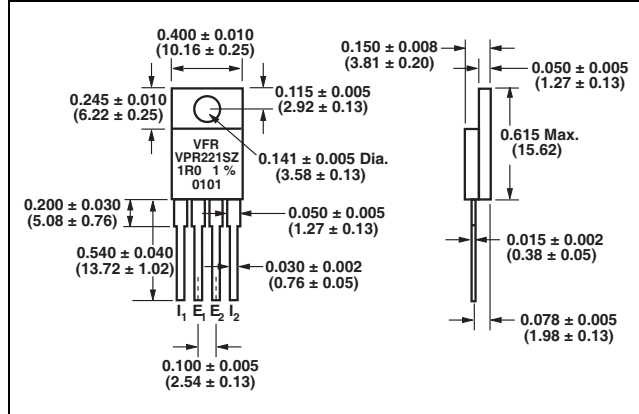
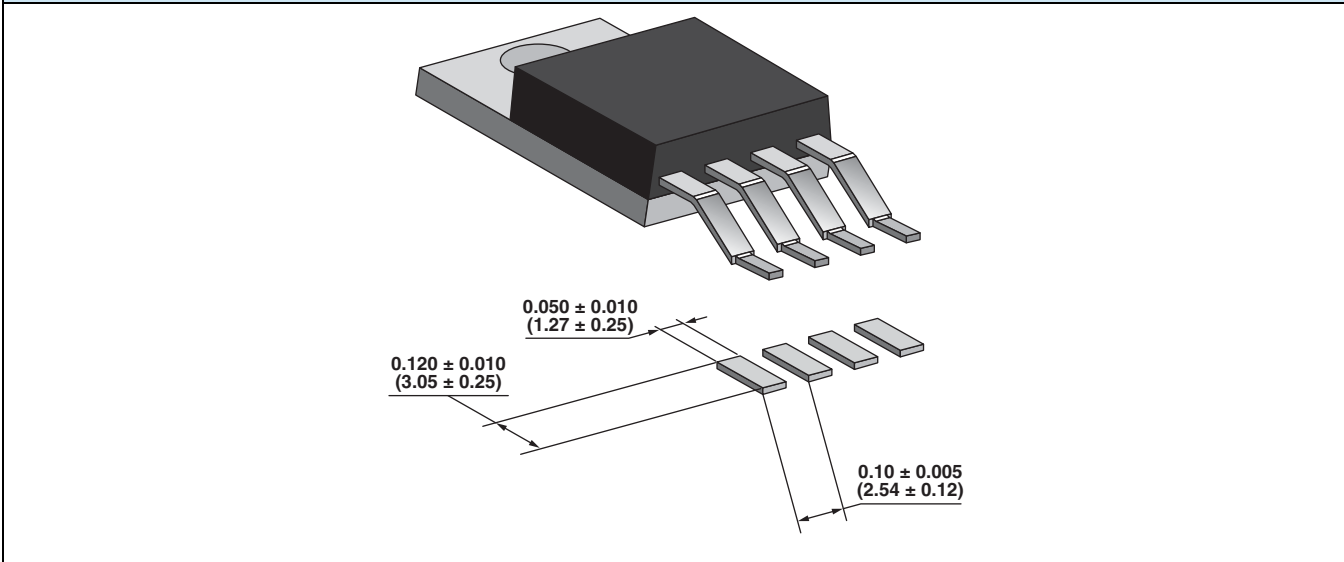


FIGURE 7 - LAND PATTERN DIMENSIONS in inches (millimeters)



| 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 $\mu\text{V}_{\text{RMS}}/\text{V}$ 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 $\mu\text{V}/^\circ\text{C}$ 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) $\mu\text{V}/^\circ\text{C}$ relates to EMF due to lead temperature difference

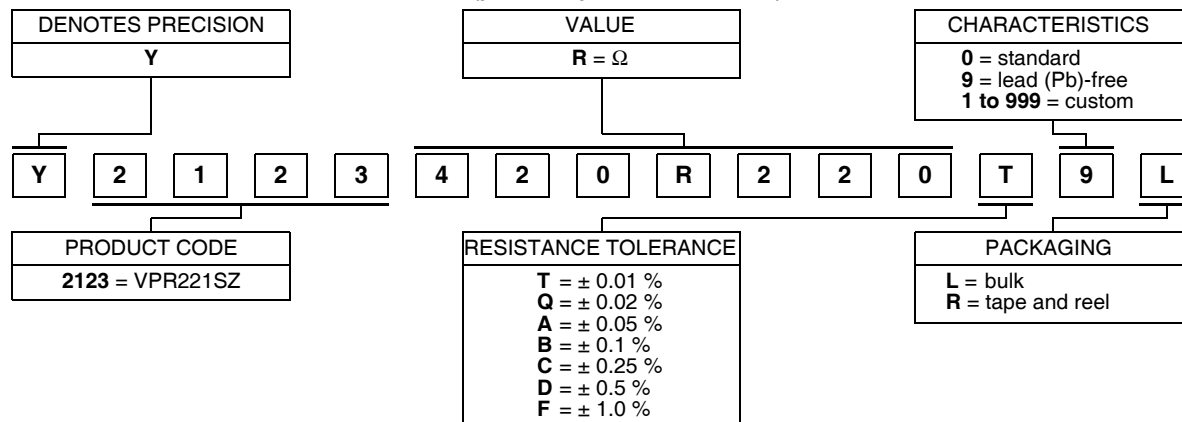
| TABLE 3 - PERFORMANCE SPECIFICATIONS ⁽¹⁾ MIL-PRF 39009 | | | |
|---|----------------------------|------------------------|--------------------------|
| TEST OR CONDITION | MIL-PRF 39009 | TYPICAL ΔR | MAXIMUM ΔR |
| Low temperature storage 24 h at - 55 °C | $\pm 0.3\% + 0.01\ \Omega$ | $\pm 0.001\%$ (10 ppm) | $\pm 0.002\%$ (20 ppm) |
| Dielectric withstanding voltage 300 V_{AC} at Atm | $\pm 0.2\% + 0.01\ \Omega$ | $\pm 0.001\%$ (10 ppm) | $\pm 0.002\%$ (20 ppm) |
| Dielectric withstanding voltage 200 V_{AC} at Brm | $\pm 0.2\% + 0.01\ \Omega$ | $\pm 0.001\%$ (10 ppm) | $\pm 0.002\%$ (20 ppm) |
| Insulation resistance | $> 10^4\ \text{M}\Omega$ | | $> 10^4\ \text{M}\Omega$ |
| Low temperature operation | $\pm 0.3\% + 0.01\ \Omega$ | $\pm 0.002\%$ (20 ppm) | $\pm 0.008\%$ (80 ppm) |
| Short time overload 5 x rated power for 5 s (in air) | $\pm 0.3\% + 0.01\ \Omega$ | $\pm 0.001\%$ (10 ppm) | $\pm 0.002\%$ (20 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 ppm) | $\pm 0.015\%$ (150 ppm) |
| Terminal strength | $\pm 0.2\% + 0.01\ \Omega$ | $\pm 0.001\%$ (10 ppm) | $\pm 0.002\%$ (20 ppm) |
| Load life 8 W at + 25 °C, 2000 h with heat sink | $\pm 1.0\% + 0.01\ \Omega$ | $\pm 0.005\%$ (50 ppm) | $\pm 0.015\%$ (150 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 ppm) | $\pm 0.015\%$ (150 ppm) |
| High temperature exposure + 150 °C | $\pm 1.0\% + 0.05\ \Omega$ | $\pm 0.005\%$ (50 ppm) | $\pm 0.01\%$ (100 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

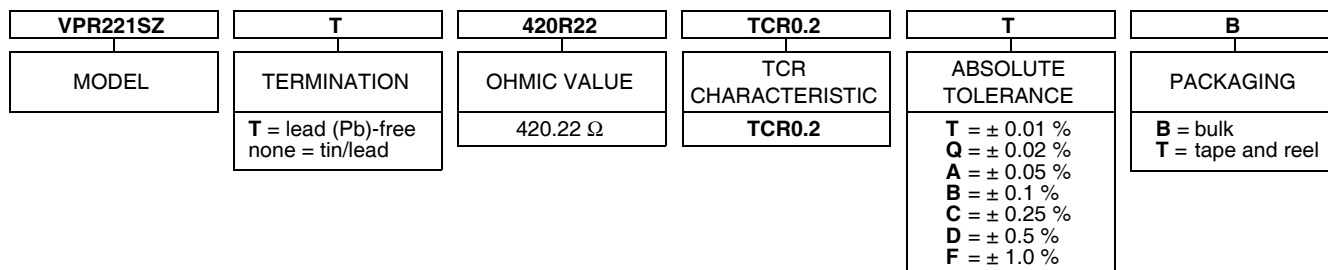
VALUE: 420.22 Ω

ABSOLUTE TOLERANCE: ± 0.01 %

TERMINATION: lead (Pb)-free

PACKAGING: bulk

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



Note

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



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