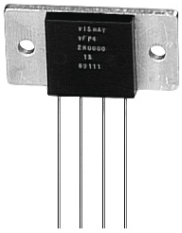
Bulk Metal® Z-Foil Technology Ultra High Precision 4-Terminal Power Current Sensing Resistors with TCR as Low as 0.05 ppm/°C, Tolerance ± 0.01 % and Thermal Stabilization of < 1 s

VHP4Z



VFP4Z

VPR247Z

VCS331Z

VCS332Z

Pb-free Available

RoHS* COMPLIANT

INTRODUCTION

Rapid ΔR stabilization under transient loads, low power coefficient (PCR), and low temperature coefficient (TCR) are features of this new Bulk Metal® Z-Foil series of current sense resistors.

The series should be selected where rapid ΔR stabilization and resistance stability under transient power conditions is required. These products achieve optimum performance when mounted on a chassis or cooled heat sink. The Z-Foil technology provides extremely low PCR under defined conditions (see figure 2 and figure 3). The low absolute TCR provided by the Z-Foil technology is measured over the temperature range of - 55 °C to + 125 °C or 0 °C to + 60 °C, + 25 °C reference (see figure 4).

All of these devices utilizing the Z-Foil technology are provided with a true 4 terminal Kelvin connection. This is a must for precise current sensing when the R-value is less than 100 Ω. The VHP4Z and VPR247Z types add the additional benefit of hermeticity. The welded construction and nitrogen backfill provide maximum protection against environmental stresses and assures long term stability. Typical applications for this new series includes electron beam circuitry, electron microscopes, fire control radar display systems, high speed video display, deflection amplifier circuits, constant current power supplies and forced balance electronic scales.

Custom high power designs can be developed for your specific applications.

FEATURES

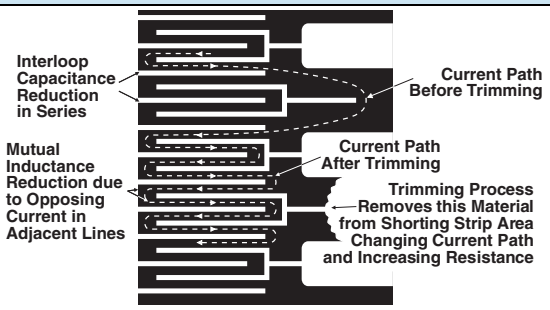
- Rapid ΔR stabilization under transient loads (see figure 2)
- Tenfold improvement of power coefficient of resistance (PCR): 4 ppm/W (see figure 3)
- Low temperature coefficient of resistance (see figure 4):
  0.05 ppm/°C typical (0 °C to + 60 °C)
  0.2 ppm/°C typical (- 55 °C to + 125 °C, + 25 °C ref.)
- Resistance range: 0R25 to 500R
- Resistance tolerance: to ± 0.01 %
- Vishay Foil Resistors are not restricted to standard values; specific “as required” values can be supplied at no extra cost or delivery (e.g. 1R2345 vs. 1R)
- Thermal resistance: 6 °C/W
- Electrostatic discharge (ESD) up to 25 000 V
- Rise time: 1 ns, effectively no ringing
- Power rating: 10 W on heatsink (1) at + 25 °C (see table 2)
  3 W in free air at + 25 °C (see table 2)
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Load life stability:
  ± 0.005 % (50 ppm), 3 W on heatsink at + 25 °C, 2000 h
  ± 0.01 % (100 ppm), 3 W in free air at + 25 °C, 2000 h
- Voltage coefficient: < 0.1 ppm/V
- Current noise: 0.010 μV_{RMS}/V of applied voltage (< - 40 dB)
- Inductance: 0.1 μH maximum; 0.08 μH typical
- Thermal EMF: 0.05 μV/°C
- Non-inductive, non-capacitive design
- Pattern design minimizing hot spots
- 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

Note

(1) Heatsink - aluminum (6" L x 4" W x 2" H x 0.04" THK)

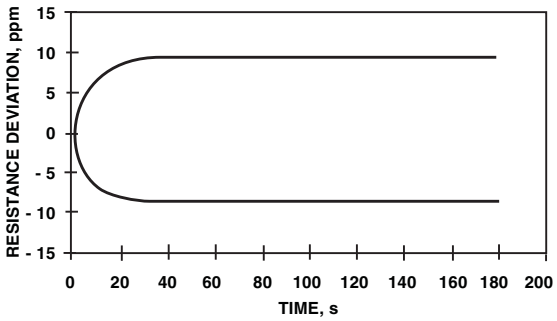
* Pb containing terminations are not RoHS compliant, exemptions may apply

FIGURE 1 - TRIMMING TO VALUES (conceptual illustration)



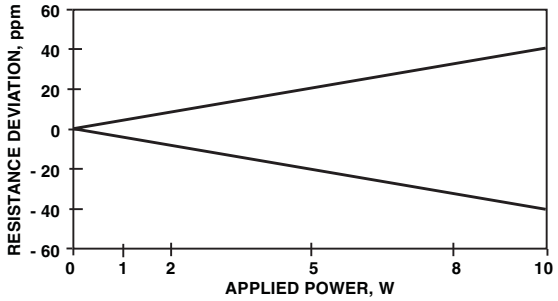
Note: Foil shown in black, etched spaces in white

FIGURE 2 - RAPID STABILIZATION



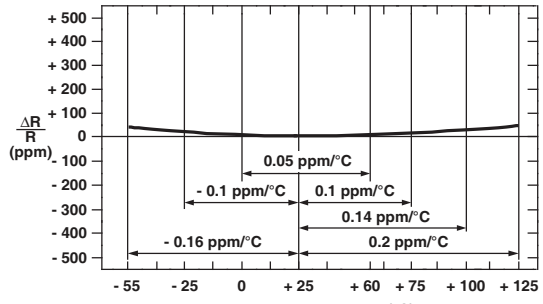
RESISTANCE CHANGE UNDER LOAD AT 10 WATTS
MOUNTED ON COOLED HEAT SINK HELD AT + 25 °C

FIGURE 3 - POWER COEFFICIENT (PCR)



RESISTANCE CHANGE VS APPLIED POWER
MOUNTED ON COOLED HEAT SINK HELD AT + 25 °C

FIGURE 4 - TYPICAL RESISTANCE/ TEMPERATURE CURVE (Z-FOIL)



TCR Chord Slopes for Different Temperature Ranges

FIGURE 5 - POWER DERATING CURVE

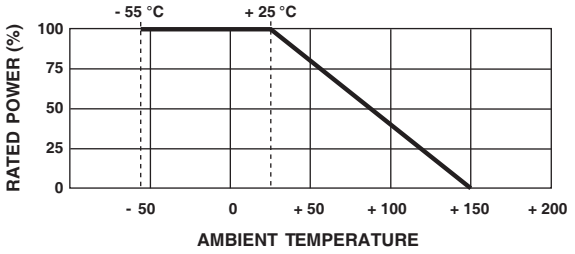
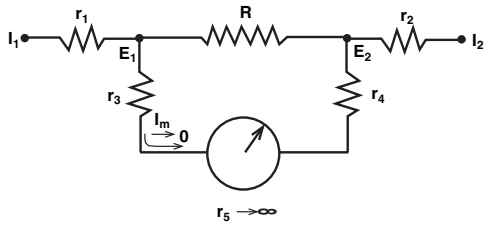


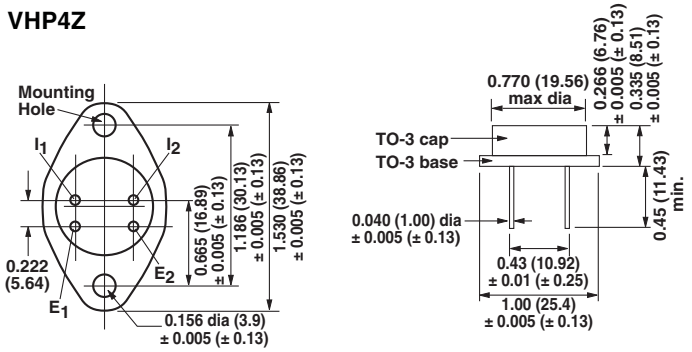
FIGURE 6 - KELVIN CONNECTION



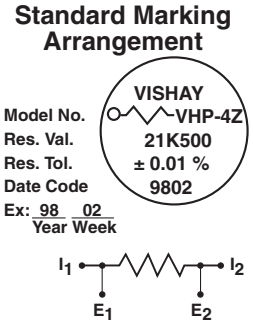
Kelvin, 4-terminal, connections are utilized for these low ohmic value products to measure a precise voltage drop across the resistive element. In these applications the contact resistance, lead resistance, and their TCR effect may be greater than that of the element itself and could cause significant errors if the standard 2-terminal connection is used. Figure 6 shows a high impedance measurement system where r_5 approaches infinity and I_m approaches zero resulting in negligible IR drop through r_3 and r_4 which negates their lead resistance and their TCR effect. With the voltage sense leads E_1 and E_2 inside of r_1 and r_2 the resistance and TCR effect of the current leads, I_1 and I_2 are negated and only the resistance and TCR of the element R are sensed. This method of measurement is essential for precise current sensing.

FIGURE 7 - STANDARD IMPRINTING AND DIMENSIONS

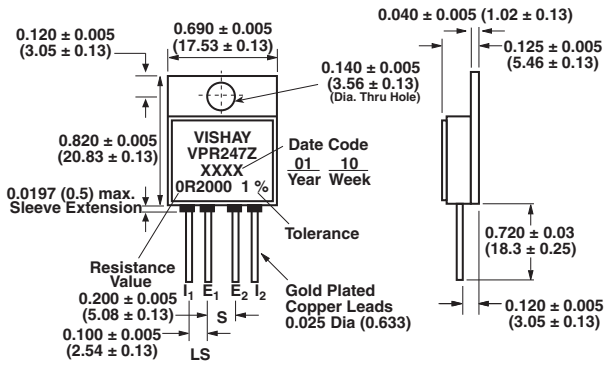
VHP4Z



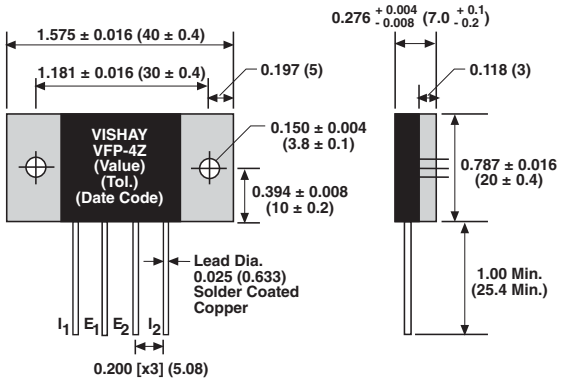
Standard Marking Arrangement



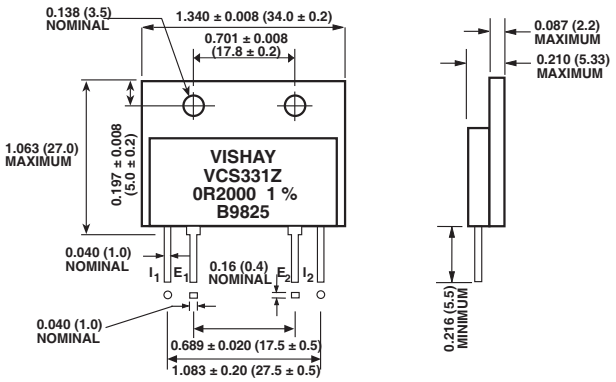
VPR247Z



VFP4Z



VCS331Z



VCS332Z

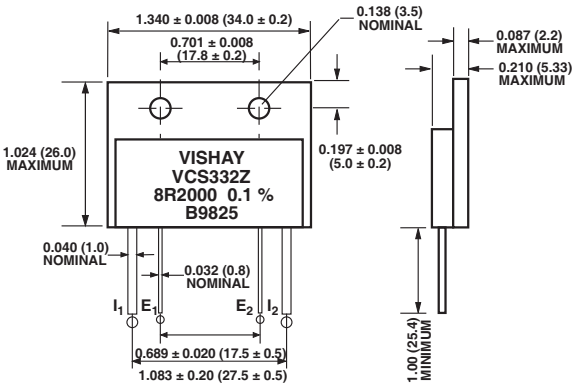


TABLE 1 - RESISTANCE VALUE VS. TOLERANCE	
RESISTANCE RANGE (Ω)	**STANDARD TOLERANCE (%)**
10 to 500	± 0.01 %
5 to < 10	± 0.02 %
2 to < 5	± 0.05 %
1 to < 2	± 0.10 %
0.5 to < 1	± 0.25 %
0.25 to < 0.5	± 0.50 %

TABLE 2 - SPECIFICATIONS		
TEST OR CONDITION		**PERFORMANCE**
Power Coefficient of Resistance (PCR)		4 ppm/Watt Maximum (1)
Temperature Coefficient of Resistance (TCR) **(- 55 °C to + 125 °C, + 25 °C Reference)**		≥ 1.0 Ω to 500 Ω, ± 0.2 ± 1.8 ppm/°C Maximum 0.25 Ω to < 1.0 Ω, ± 0.2 ± 2.8 ppm/°C Maximum
Thermal Resistance		6 °C/W (1)
Power Rating at + 25 °C	**VHP4Z** **VPR247Z** **VFP4Z**	10 W or 3 A Maximum (Heatsink) (2)(3) 3 W or 3 A Maximum (Free Air) (3)
	VCS331Z **VCS332Z**	10 W or 5 A Maximum (Heatsink) (2)(3) 3 W or 5 A Maximum (Free Air) (3)

Notes
(1) Mounted on a cooled heat sink held at + 25 °C
(2) Heatsink - aluminum (6" L x 4" W x 2" H x 0.04" THK)
(3) Whichever is lower

TABLE 3 - ENVIRONMENTAL PERFORMANCE (1)		
TEST OR CONDITION	**TYPICAL ΔR LIMITS**	**MAXIMUM ΔR LIMITS**
Thermal Shock	0.01 %	0.02 %
Short Time Overload (5 x rated power for 5 s)	0.01 %	0.02 %
Terminal Strength	0.02 %	0.05 %
High Temperature Exposure (2000 h at + 150 °C)	0.02 %	0.05 %
Moisture Resistance	0.03 %	0.05 %
Low Temperature Storage (24 h at - 55 °C)	0.005 %	0.01 %
Shock (specified pulse)	0.01 %	0.02 %
Vibration (high frequency)	0.01 %	0.02 %
Load Life (rated power, + 25 °C, 2000 h)	0.01 %	0.02 %
Thermal EMF	0.2 µV/°C max. (E terminal)	

Note
(1) ΔR's plus additional 0.0005 Ω for measurement error

TABLE 4 - GLOBAL PART NUMBER INFORMATION [1]

NEW GLOBAL PART NUMBER: Y1480400R000T9L (preferred part number format)

DENOTES PRECISION	VALUE	CHARACTERISTICS
Y	**R** = Ω	**0** = standard **9** = lead (Pb)-free **1 to 999** = custom

Y	1	4	8	0	4	0	0	R	0	0	0	T	9	L

PRODUCT CODE	RESISTANCE TOLERANCE	PACKAGING
1479 = VHP4Z **1468** = VFP4Z **1480** = VPR247Z **1481** = VCS331Z **1467** = VCS332Z	**T** = ± 0.01 % **Q** = ± 0.02 % **A** = ± 0.05 % **B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 %	**L** = bulk pack

FOR EXAMPLE: ABOVE GLOBAL ORDER Y1480 400R000 T 9 L:
TYPE: VPR247Z
VALUE: 400 Ω
ABSOLUTE TOLERANCE: ± 0.01 %
TERMINATION: lead (Pb)-free
PACKAGING: bulk

HISTORICAL PART NUMBER: VPR247ZT 400R T B (will continue to be used)

VPR247Z	T	400R	T	B
MODEL	TERMINATION	RESISTANCE VALUE	TOLERANCE	PACKAGING
VPR247Z **VHP4Z** **VFP4Z** **VCS331Z** **VCS332Z**	**T** = lead (Pb)-free None = tin/lead alloy	400 Ω	**T** = ± 0.01 % **Q** = ± 0.02 % **H** = ± 0.025 % **Y** = ± 0.03 % **A** = ± 0.05 %	**B** = bulk pack

Note

[1] For non-standard requests, please contact application engineering

Disclaimer

All product specifications and data are subject to change without notice.

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