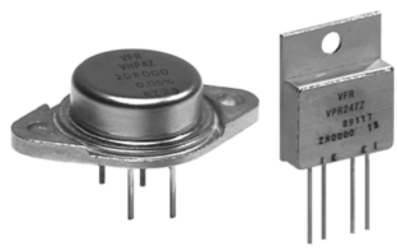
Bulk Metal® Z- Foil Technology Ultra High Precision Hermetically Sealed 4-Terminal Power Current Sensing Resistors with TCR as Low as 0.05 ppm/°C and Power up to 10 Watts



INTRODUCTION

Vishay Foil Resistors (VFR) Model VHP-4Z offers welded construction and screw mounting directly to a metal heat sink for maximum heat transfer. Hermetic sealing and nitrogen back fill provide the maximum protection against environmental stresses, thereby ensuring long term stability. A special feature of this construction is Kovar eyelet's and solder-plated OFHC copper leads providing the lowest thermal EMFs in the industry.

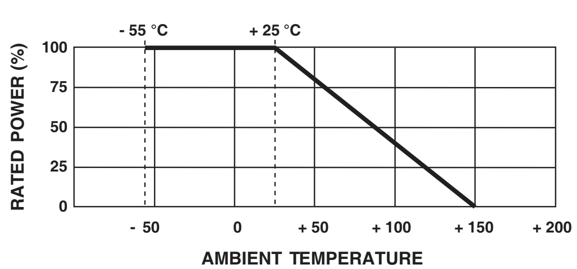
VFR Model VPR247Z has many of the advantages of the VHP4Z but with significantly reduced size and weight. It also has gold plated copper leads.

These 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 7).

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 resistance value is less than 100 Ω (see figure 4).

Custom high power designs can be developed for your specific applications, for more information please contact us.

FIGURE 1 - POWER DERATING CURVE



FEATURES

Pb-free Available RoHS* COMPLIANT

- 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.)
- Resistance range: 0.25Ω to 500Ω
- Tolerance: to ± 0.01 % (see table 1)
- **Power rating (heat-sinked): 10 W (see table 2)**
- Load life stability:
  ± 0.005 % typical (50 ppm), 3 W on heatsink at + 25 °C, 2000 h
  ± 0.01 % typical (100 ppm), 3 W in free air at + 25 °C, 2000 h
  ± 0.01 % typical (100 ppm), 10 W on heatsink at + 25 °C, 2000 h
- Vishay Foil resistors are not restricted to standard values, we can supply specific "as required" values at no extra cost or delivery (e.g. 1K2345 vs. 1K)
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Electrostatic discharge (ESD) at least to 25 kV
- Non inductive, non capacitive design
- Rise time: 1 ns effectively no ringing
- Current noise: 0.010 μVRMS/V of applied voltage (< - 40 dB)
- Voltage coefficient < 0.1 ppm/V
- Non inductive: < 0.08 μH
- Non hot spot design
- Terminal finishes available:
  VHP-4Z: lead (Pb)-free or tin/lead alloy
  VPR247Z: gold plated

TABLE 1 - TOLERANCE AND TCR VS. RESISTANCE VALUE (- 55 °C to + 125 °C, + 25 °C Ref.)

RESISTANCE RANGE (Ω)	TIGHTEST TOLERANCE	TYPICAL TCR AND MAX. SPREAD (ppm/°C)
10 to < 500	± 0.01 %	± 0.2 ± 1.8
5 to < 10	± 0.02 %	
2 to < 5	± 0.05 %	
1 to < 2	± 0.1 %	
0.5 to < 1	± 0.25 %	± 0.2 ± 2.8
0.25 to < 0.5	±0.5 %	

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

TABLE 2 - GENERAL SPECIFICATIONS[4]	
Power Coefficient of Resistance (PCR)	4 ppm/Watt Maximum (Mounted on a cooled heat sink held at + 25 °C)
Power Rating At + 25 °C (see Fig. 1)	10 W or 3 A (whichever is lower) - heat sink[1] 3 W or 3 A (whichever is lower) - free air
Current Noise	< 0.010 μV (RMS)/V of applied voltage (- 40 dB)
High Frequency Operation Rise time Inductance (L)[2] Capacitance (C)	 1.0 ns at 1 kΩ without ringing 0.1 μH maximum; 0.08 μH typical 1.0 pF maximum; 0.5 pF typical
Thermal resistance	6 °C/W
Operating Temperature Range	- 55 °C to + 150 °C
Hermeticity	10^{-7} Atmospheric cc/s maximum
Maximum Working Voltage[3]	600 V
Thermal EMF	0.1 μV/°C maximum (lead effect) 2.5 μV/W maximum (power effect)

Notes

1. Heat sink chassis dimensions and requirements per MIL-PRF-39009/1:

	INCHES	MM
L	6.00	152.4
W	4.00	101.6
H	2.00	50.8
T	0.04	1.0

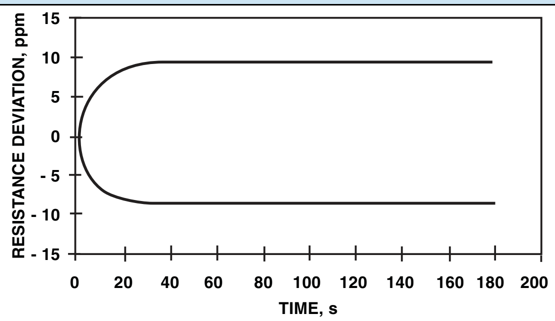
2. Inductance (L) due mainly to the leads.
3. Maximum ambient temperature is + 150 °C.
4. Weight: VHP4Z = 15 g maximum , VPR247Z = 7 g maximum.

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	0.02 %	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[3], + 25 °C, 2000 h)	0.01 %	0.02 %

Note

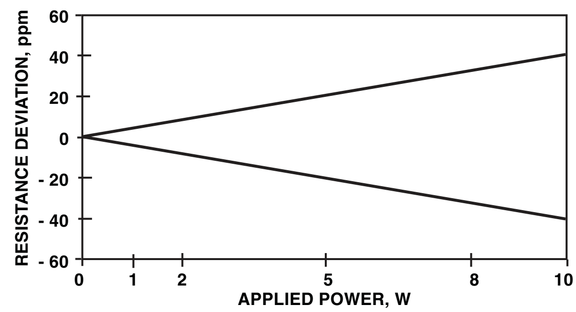
[1] ΔR's plus additional 0.0005 Ω for measurement error
[2] Maximum overload rating is 15 W (5 x rated power in free air; 1.5 x rated power on heatsink), with applied voltage not to exceed 750 V.
[3] 3W in free air or 10W on heat sink

FIGURE 2 - RAPID STABILIZATION



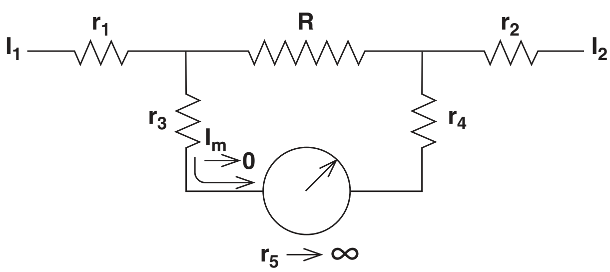
RESISTANCE CHANGE UNDER LOAD AT 10 WATTS
MOUNTED ON COOLED HEAT SINK HELD AT + 25 °C

FIGURE 3 - POWER COEFFICIENT (PCR)



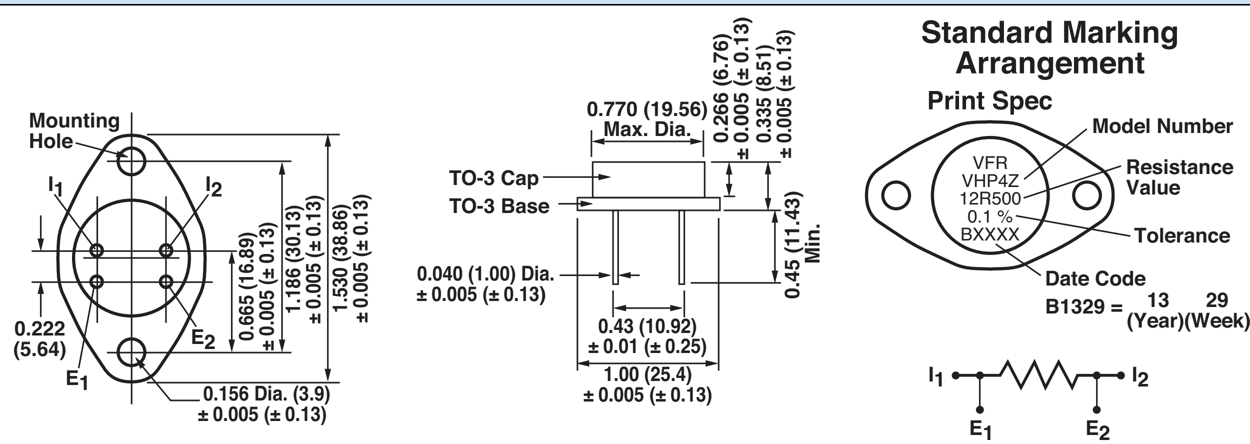
RESISTANCE CHANGE VS APPLIED POWER
MOUNTED ON COOLED HEAT SINK HELD AT + 25 °C

FIGURE 4 - KELVIN CONNECTION



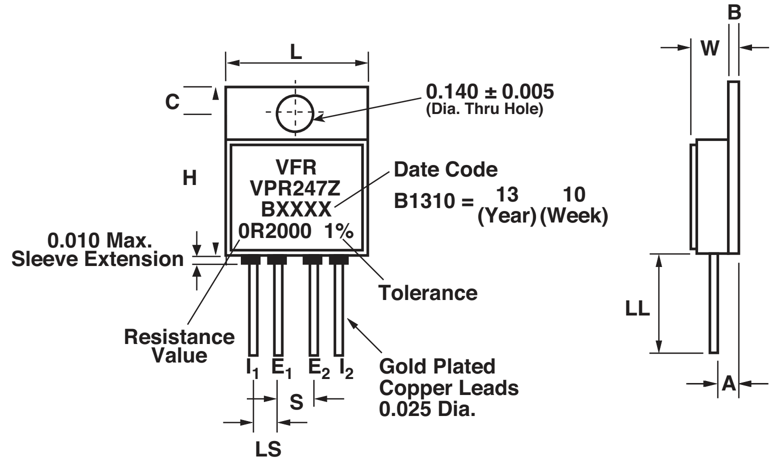
Kelvin (4-terminal) connections are used for these low ohmic value products to measure a precise voltage drop across the resistive element. In these applications the contact resistance, lead resistance, and their TCR effect may be greater than that of the element itself and could cause significant errors if the standard 2-terminal connection is used. Figure 4 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 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 5 - VHP4Z STANDARD IMPRINTING AND DIMENSIONS in inches (millimeters)



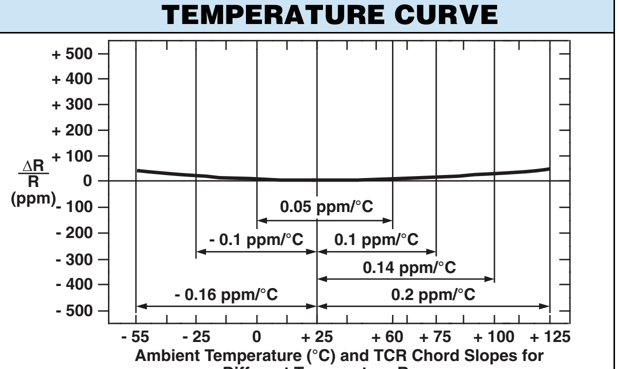
Case not active; insulators not required; mounting hardware not supplied.

FIGURE 6 - VPR247Z STANDARD IMPRINTING AND DIMENSIONS



DIMENSION	INCHES	MM
L	0.690 ± 0.005	17.53 ± 0.13
H	0.820 ± 0.005	20.83 ± 0.13
W	0.215 ± 0.005	5.46 ± 0.13
LL	0.500 minimum	12.70 minimum
LS	0.100 ± 0.005	2.54 ± 0.13
S	0.200 ± 0.005	5.08 ± 0.13
A	0.120 ± 0.005	3.05 ± 0.13
B	0.040 ± 0.005	1.02 ± 0.13
C	0.120 ± 0.005	3.05 ± 0.13

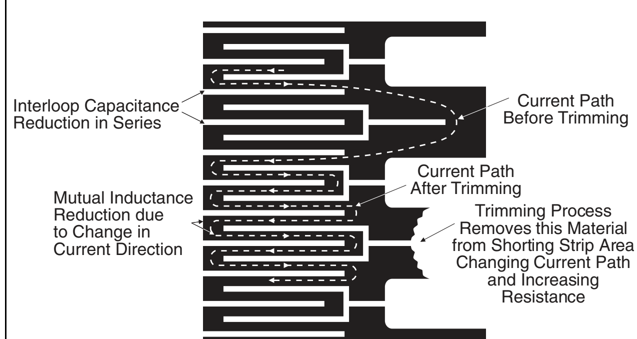
FIGURE 7 - TYPICAL RESISTANCE/ TEMPERATURE CURVE



Note

- The TCR values for < 100 Ω are influenced by the termination composition and result in deviation from this curve

FIGURE 8 - TRIMMING TO VALUES
(Conceptual Illustration)



Note: Foil shown in black, etched spaces in white

TABLE 4 - GLOBAL PART NUMBER INFORMATION

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

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

DENOTES PRECISION

Y

PRODUCT CODE

1479 = VHP4Z
1480 = VPR247Z

VALUE

R = Ω
K = kΩ

RESISTANCE TOLERANCE

T = ± 0.01 %
Q = ± 0.02 %
A = ± 0.05 %
B = ± 0.1 %
C = ± 0.25 %
D = ± 0.5 %

AER*

0 = standard
9 = lead (Pb)-free
1 - 999 = custom

PACKAGING

L = bulk pack

FOR EXAMPLE: ABOVE GLOBAL ORDER Y1480400R000T9L:
TYPE: VPR247Z
VALUE: 400 Ω
ABSOLUTE TOLERANCE: ± 0.01 %
TERMINATION: lead (Pb)-free
PACKAGING: bulk pack

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

VPR247Z	T	400R	T	B
MODEL	TERMINATION	OHMIC VALUE	RESISTANCE TOLERANCE	PACKAGING
VHP4Z **VPR247Z**	**T** = lead (Pb)-free None = tin/lead alloy	400 Ω	**T** = ± 0.01 % **Q** = ± 0.02 % **A** = ± 0.05 % **B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 %	**B** = bulk pack

Note

* For non-standard requests, please contact Application Engineering.

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