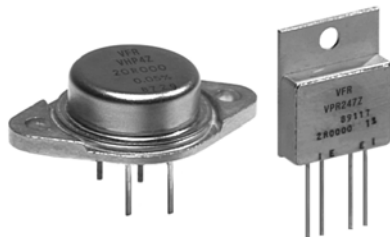


## Bulk Metal® Z- Foil Technology Ultra High Precision Hermetically Sealed 4-Terminal Power Current Sensing Resistors with TCR as Low as 0.05 ppm/°C and Power up to 10 Watts



### INTRODUCTION

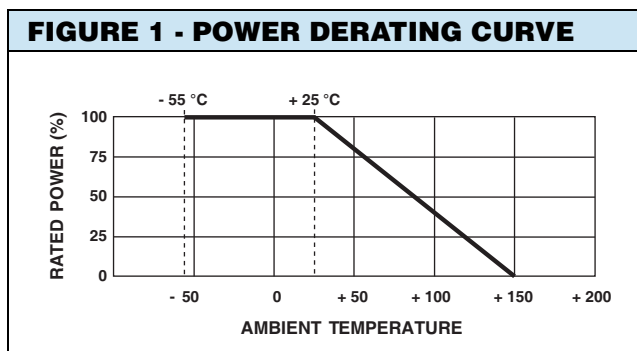
Vishay Foil Resistors (VFR) Model VHP-4Z offers welded construction and screw mounting directly to a metal heat sink for maximum heat transfer. Hermetic sealing and nitrogen back fill provide the maximum protection against environmental stresses, thereby ensuring long term stability. A special feature 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  $\Delta R$  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  $\Omega$  (see figure 4).

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



### 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.)
- Resistance range: 0.25 $\Omega$  to 500 $\Omega$
- Tolerance: to  $\pm$  0.01 % (see table 1)
- **Power rating (heat-sinked): 10 W (see table 2)**
- Load life stability:  $\pm$  0.005 % typical (50 ppm), 3 W on heatsink at + 25 °C, 2000 h  
 $\pm$  0.01 % typical (100 ppm), 3 W in free air at + 25 °C, 2000 h  
 $\pm$  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  $\mu$ V RMS/V of applied voltage (< - 40 dB)
- Voltage coefficient < 0.1 ppm/V
- Non inductive: < 0.08  $\mu$ H
- Non hot spot design
- Terminal finishes available:  
VHP-4Z: lead (Pb)-free or tin/lead alloy  
VPR247Z: gold plated



RoHS\*  
COMPLIANT

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

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

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

**TABLE 2 - GENERAL SPECIFICATIONS<sup>(4)</sup>**

<b>Power Coefficient of Resistance (PCR)</b>	4 ppm/Watt Maximum (Mounted on a cooled heat sink held at + 25 °C)
<b>Power Rating</b> At + 25 °C (see Fig. 1)	10 W or 3 A (whichever is lower) - heat sink <sup>(1)</sup> 3 W or 3 A (whichever is lower) - free air
<b>Current Noise</b>	< 0.010 $\mu$ V (RMS)/V of applied voltage (- 40 dB)
<b>High Frequency Operation</b> Rise time Inductance (L) <sup>(2)</sup> Capacitance (C)	1.0 ns at 1 k $\Omega$ without ringing 0.1 $\mu$ H maximum; 0.08 $\mu$ H typical 1.0 pF maximum; 0.5 pF typical
<b>Thermal resistance</b>	6 °C/W
<b>Operating Temperature Range</b>	- 55 °C to + 150 °C
<b>Hermeticity</b>	10 <sup>-7</sup> Atmospheric cc/s maximum
<b>Maximum Working Voltage<sup>(3)</sup></b>	600 V
<b>Thermal EMF</b>	0.1 $\mu$ V/°C maximum (lead effect) 2.5 $\mu$ V/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 $\Delta$ R LIMITS	MAXIMUM $\Delta$ R LIMITS
<b>Thermal Shock</b>	0.01 %	0.02 %
<b>Short Time Overload</b> (5 x rated power for 5 s)	0.01 %	0.02 %
<b>Terminal Strength</b>	0.02 %	0.05 %
<b>High Temperature Exposure</b> (2000 h at + 150 °C)	0.02 %	0.05 %
<b>Moisture Resistance</b>	0.02 %	0.05 %
<b>Low Temperature Storage</b> (24 h at - 55 °C)	0.005 %	0.01 %
<b>Shock</b> (specified pulse)	0.01 %	0.02 %
<b>Vibration</b> (high frequency)	0.01 %	0.02 %
<b>Load Life</b> (rated power <sup>(3)</sup> , + 25 °C, 2000 h)	0.01 %	0.02 %

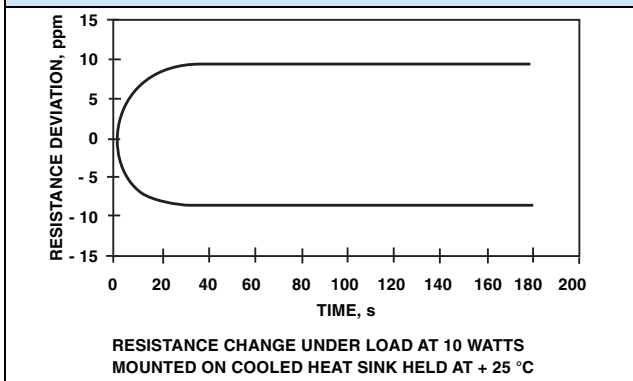
**Note**

(1)  $\Delta$ R's plus additional 0.0005  $\Omega$  for measurement error

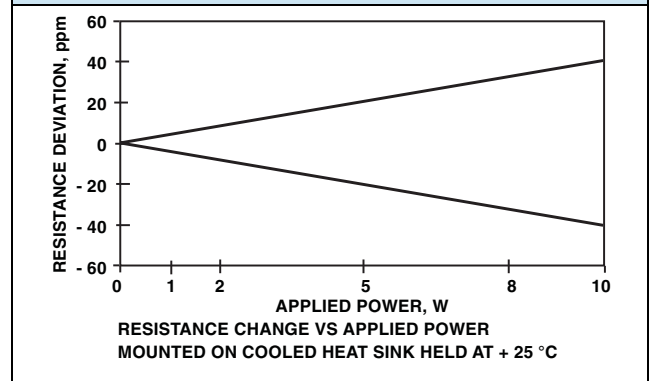
(2) Maximum overload rating is 15 W (5 x rated power in free air; 1.5 x rated power on heatsink), with applied voltage not to exceed 750 V.

(3) 3W in free air or 10W on heat sink

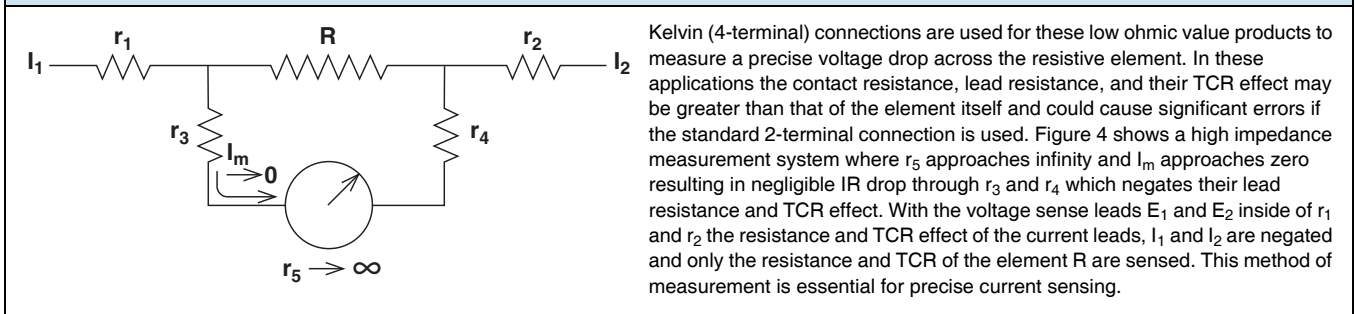
**FIGURE 2 - RAPID STABILIZATION**



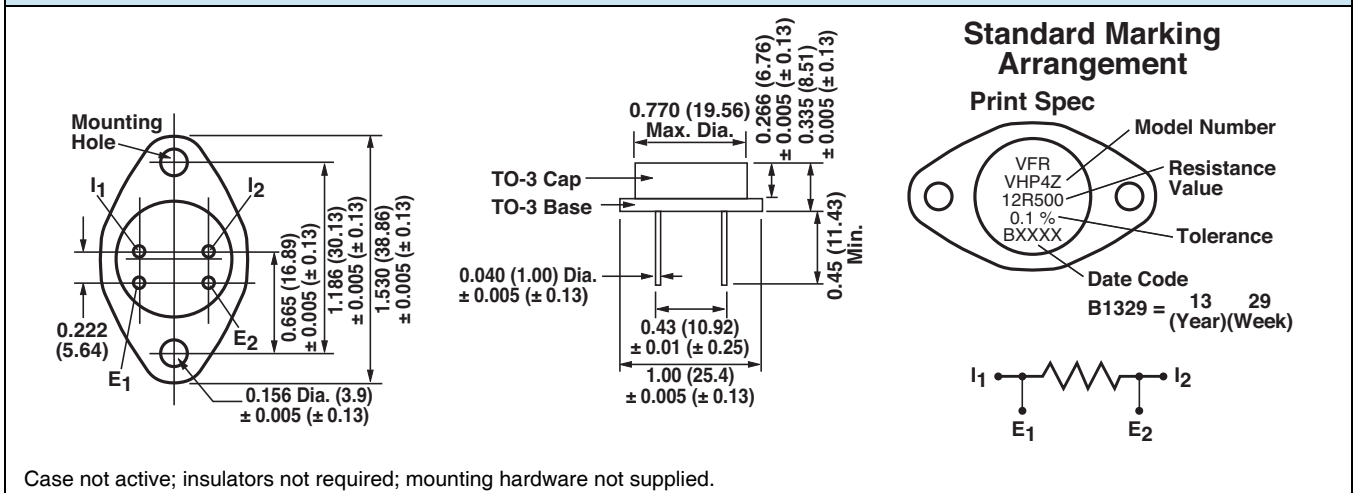
**FIGURE 3 - POWER COEFFICIENT (PCR)**



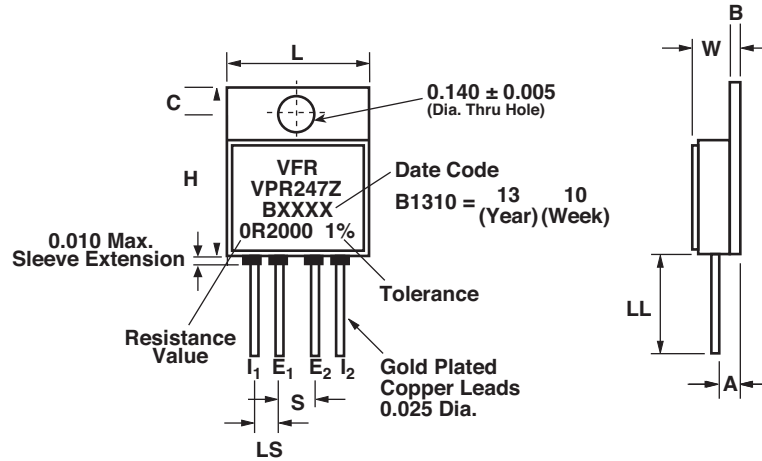
**FIGURE 4 - KELVIN CONNECTION**



**FIGURE 5 - VHP4Z STANDARD IMPRINTING AND DIMENSIONS** in inches (millimeters)

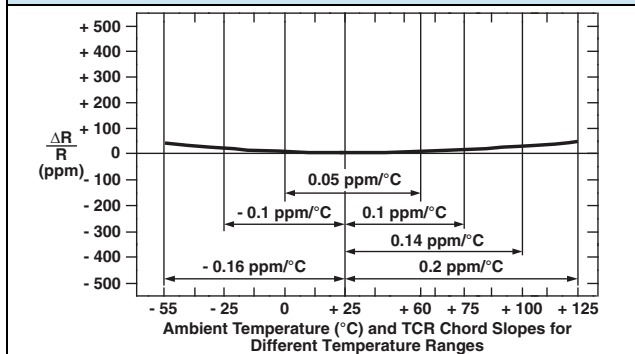


**FIGURE 6 - VPR247Z STANDARD IMPRINTING AND DIMENSIONS**



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

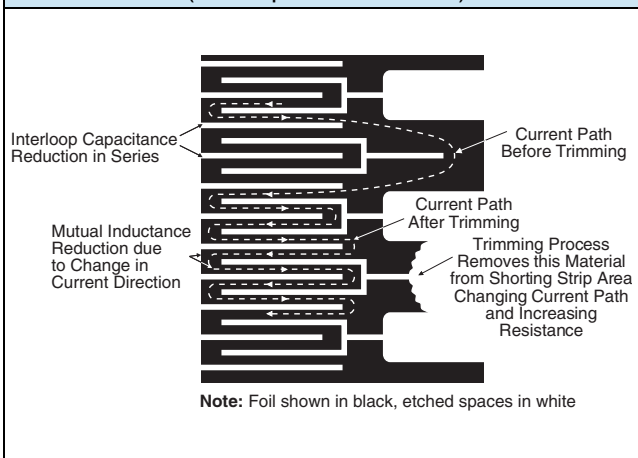
**FIGURE 7 - TYPICAL RESISTANCE/TEMPERATURE CURVE**



**Note**

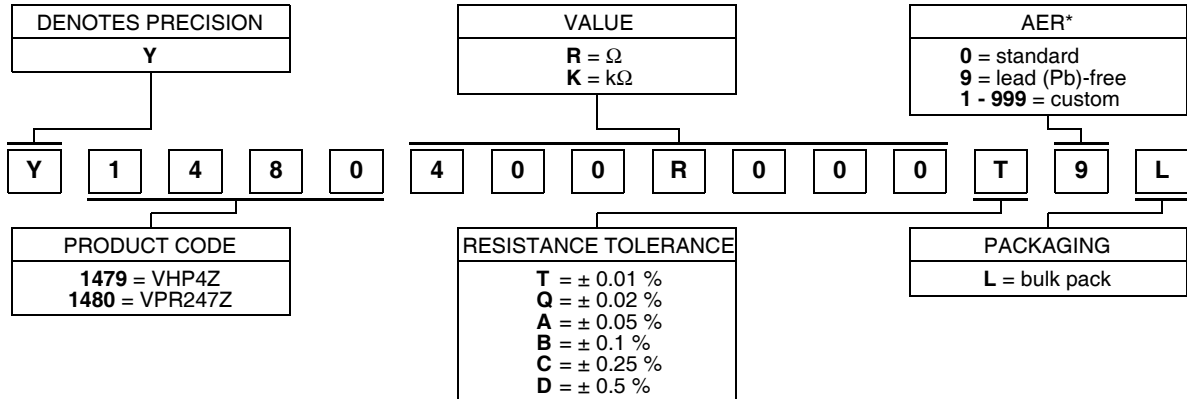
- The TCR values for < 100 Ω are influenced by the termination composition and result in deviation from this curve

**FIGURE 8 - TRIMMING TO VALUES**  
(Conceptual Illustration)



**TABLE 4 - GLOBAL PART NUMBER INFORMATION**

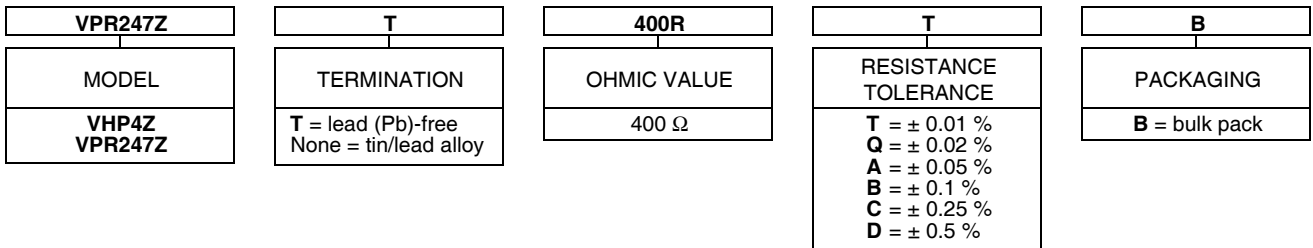
NEW GLOBAL PART NUMBER: Y1480400R000T9L (preferred part number format)



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)



**Note**

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

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