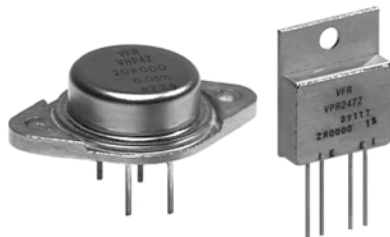


Bulk Metal® Z- Foil Technology Ultra High Precision Hermetically Sealed 4-Terminal Power Current Sensing Resistors with TCR as Low as 0.05 ppm/°C and Power up to 10 Watts



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.

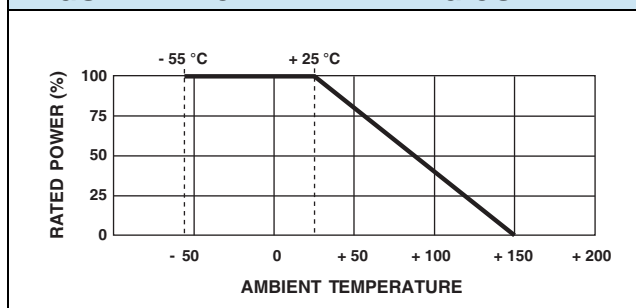
VFR Model VPR247Z has many of the advantages of the VHP4Z but with significantly reduced size and weight. It also has gold plated copper leads.

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

- 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 Ω to 500 Ω
- 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 μ V RMS/V of applied voltage (< - 40 dB)
- Voltage coefficient < 0.1 ppm/V
- Non inductive: < 0.08 μ 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 (Ω)	TIGHTEST TOLERANCE	TYPICAL TCR AND MAX. SPREAD (ppm/°C)
10 to < 500	± 0.01 %	$\pm 0.2 \pm 1.8$
5 to < 10	± 0.02 %	
2 to < 5	± 0.05 %	
1 to < 2	± 0.1 %	
0.5 to < 1	± 0.25 %	$\pm 0.2 \pm 2.8$
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 μ V (RMS)/V of applied voltage (- 40 dB)
High Frequency Operation Rise time Inductance (L) ⁽²⁾ Capacitance (C)	1.0 ns at 1 k Ω without ringing 0.1 μ H maximum; 0.08 μ H 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 μ V/°C maximum (lead effect) 2.5 μ V/W maximum (power effect)

Notes

- Heat sink chassis dimensions and requirements per MIL-PRF-39009/1:
- Inductance (L) due mainly to the leads.
- Maximum ambient temperature is + 150 °C.
- Weight: VHP4Z = 15 g maximum , VPR247Z = 7 g maximum.

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

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⁾ Δ R'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

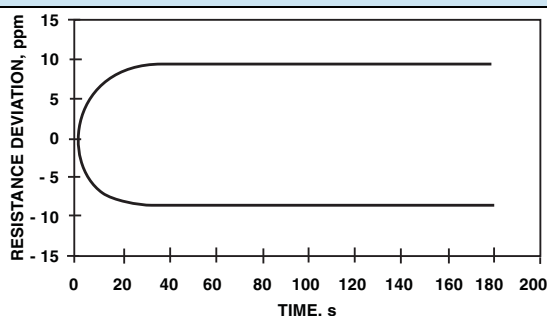


FIGURE 3 - POWER COEFFICIENT (PCR)

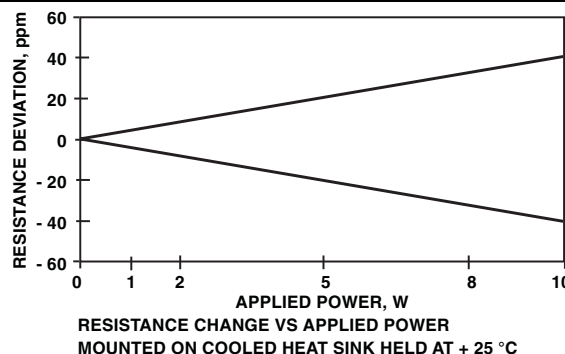
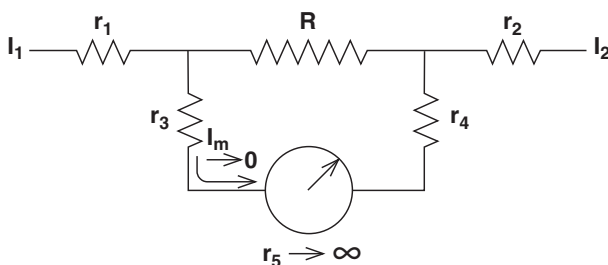
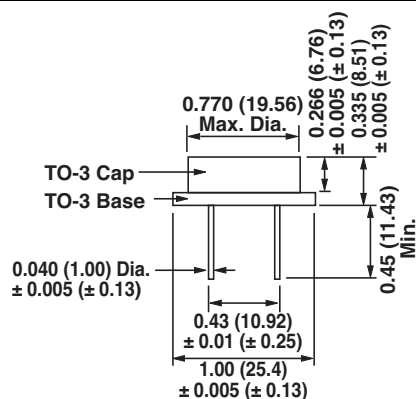
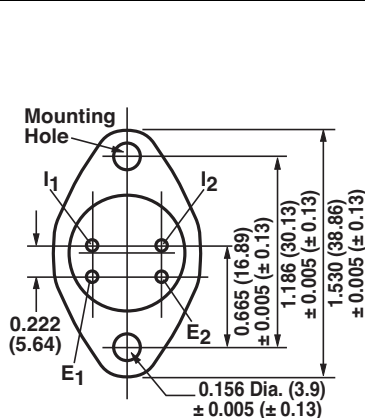


FIGURE 4 - KELVIN CONNECTION

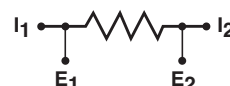
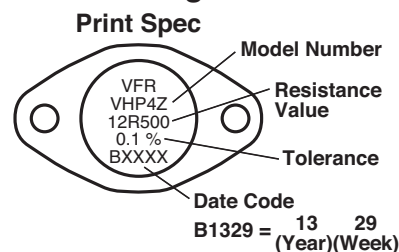


Kelvin (4-terminal) connections are used for these low ohmic value products to measure a precise voltage drop across the resistive element. In these applications the contact resistance, lead resistance, and their TCR effect may be greater than that of the element itself and could cause significant errors 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.

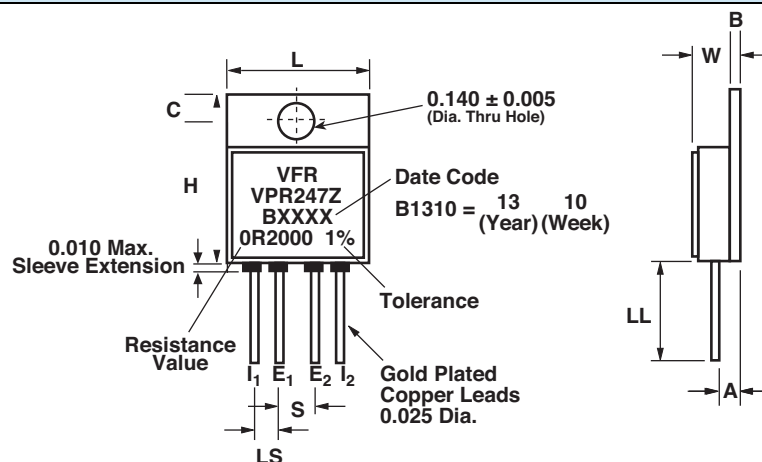
FIGURE 5 - VHP4Z STANDARD IMPRINTING AND DIMENSIONS in inches (millimeters)



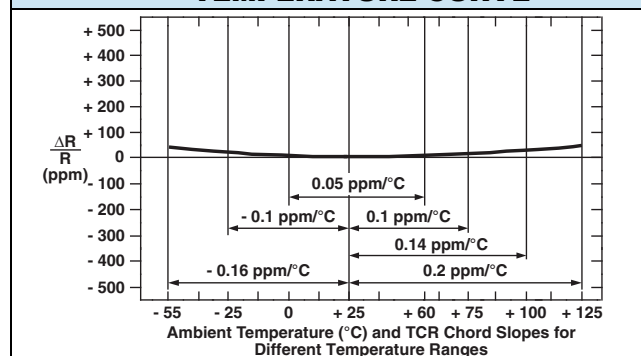
Standard Marking Arrangement



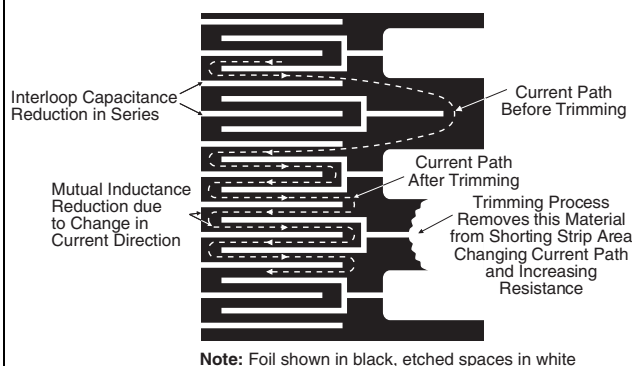
Case not active; insulators not required; mounting hardware not supplied.

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**

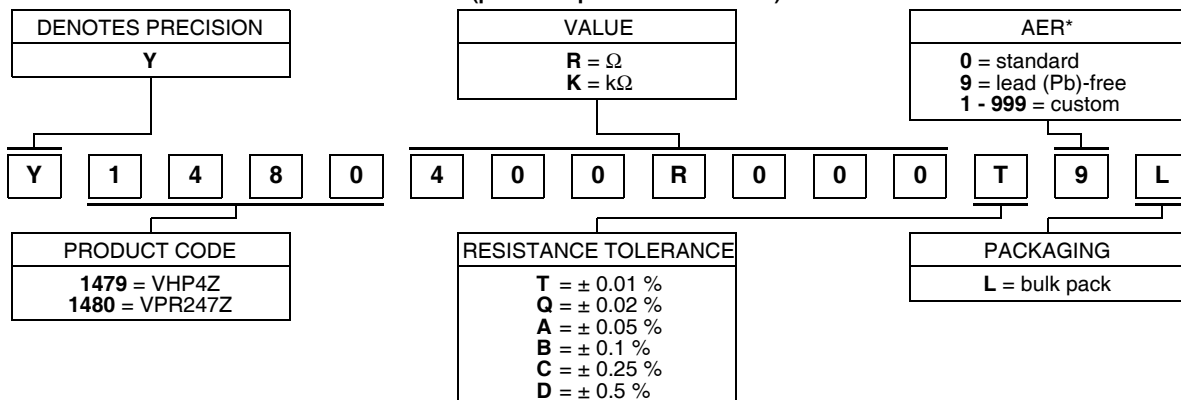
- The TCR values for $< 100 \Omega$ are influenced by the termination composition and result in deviation from this curve

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)



FOR EXAMPLE: ABOVE GLOBAL ORDER Y1480400R000T9L:

TYPE: VPR247Z

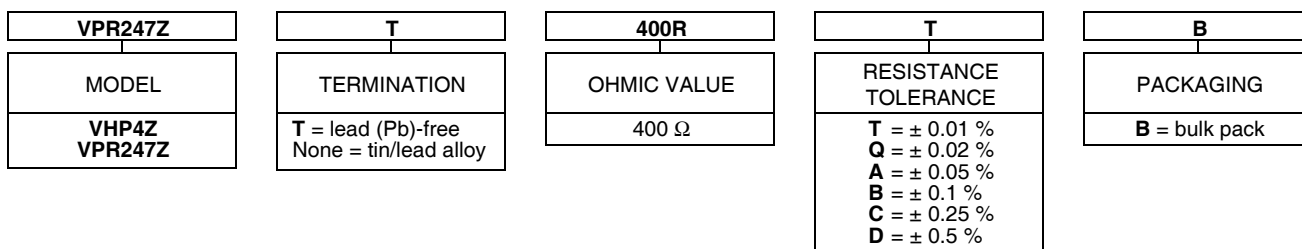
VALUE: $400\ \Omega$

ABSOLUTE TOLERANCE: $\pm 0.01\%$

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.

Disclaimer

ALL PRODUCTS, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Vishay Precision Group, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay Precision Group"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

The product specifications do not expand or otherwise modify Vishay Precision Group's terms and conditions of purchase, including but not limited to, the warranty expressed therein.

Vishay Precision Group makes no warranty, representation or guarantee other than as set forth in the terms and conditions of purchase. **To the maximum extent permitted by applicable law, Vishay Precision Group disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.**

Information provided in datasheets and/or specifications may vary from actual results in different applications and performance may vary over time. Statements regarding the suitability of products for certain types of applications are based on Vishay Precision Group's knowledge of typical requirements that are often placed on Vishay Precision Group products. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application.

No license, express, implied, or otherwise, to any intellectual property rights is granted by this document, or by any conduct of Vishay Precision Group.

The products shown herein are not designed for use in life-saving or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay Precision Group products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay Precision Group for any damages arising or resulting from such use or sale. Please contact authorized Vishay Precision Group personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.

Disclaimer

ALL PRODUCTS, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Vishay Precision Group, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay Precision Group"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

The product specifications do not expand or otherwise modify Vishay Precision Group's terms and conditions of purchase, including but not limited to, the warranty expressed therein.

Vishay Precision Group makes no warranty, representation or guarantee other than as set forth in the terms and conditions of purchase. **To the maximum extent permitted by applicable law, Vishay Precision Group disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.**

Information provided in datasheets and/or specifications may vary from actual results in different applications and performance may vary over time. Statements regarding the suitability of products for certain types of applications are based on Vishay Precision Group's knowledge of typical requirements that are often placed on Vishay Precision Group products. It is the customer's responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application.

No license, express, implied, or otherwise, to any intellectual property rights is granted by this document, or by any conduct of Vishay Precision Group.

The products shown herein are not designed for use in life-saving or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay Precision Group products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay Precision Group for any damages arising or resulting from such use or sale. Please contact authorized Vishay Precision Group personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.