Bulk Metal® Foil Technology
Hermetically Sealed Power and Current Sensing Resistor with TCR of 2 ppm/°C and Power up to 10 Watts

Any value available within resistance range

Vishay Bulk Metal® Foil power resistors offer the best approach to low value power and current sensing when a combination of accuracy, tight TCR, low thermal EMF, low voltage coefficient, Kelvin connection, and long term stability (under power) are required.

Vishay Models VHP-3 and VHP-4 offer all 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 OFHC solder plated copper leads providing the lowest thermal EMFs in the industry.

Vishay Model VPR247 has many of the advantages of the VHP-4 but with significantly reduced size and weight. It also has gold plated copper leads.

Our Application Engineering department is available to advise and to make recommendations. For non-standard technical requirements and special applications, please contact us.

FEATURES

Pb-free Available

RoHS* COMPLIANT

- Temperature coefficient of resistance TCR: ± 2 ppm/°C typical (- 55 °C to + 125 °C, + 25 °C ref.) (see tables 1 and 2)
- Tolerance: to ± 0.01 % (see tables 1 and 2)
- Power rating (heat-sinked): 10 W
- Load life stability: ± 0.01 % at 25 °C, 2000 h at rated power
- Resistance range: 0.05 Ω to 80 kΩ
- Electrostatic discharge (ESD) above 25 000 V
- Non inductive, non capacitive design
- Rise time: 1.0 ns without ringing
- Current noise: < - 40 dB
- Thermal EMF: 0.05 µV/°C typical
- Voltage coefficient: < 0.1 ppm/V
- Non inductive: 0.08 µH
- Non hot spot design
- Terminal finishes available:
  VHP-3 and VHP-4: lead (Pb)-free, tin/lead alloy
  VPR247: gold plated
- Any value available within resistance range (e.g. 1K234)
- Prototype samples available from 48 h. For more information, please contact foil@vishay.com
- For better performances, please contact Application Engineering

TABLE 1 - VHP-3[1] SPECIFICATIONS

RESISTANCE RANGE (Ω)	TIGHTEST TOLERANCE	TYPICAL TCR[3, 4]	MAXIMUM TCR[3]
50 to 80K	± 0.01 %	± 2 ppm/°C	± 5 ppm/°C
25 to < 50	± 0.02 %		± 7 ppm/°C
10 to < 25	± 0.05 %		± 10 ppm/°C
5 to < 10	± 0.1 %		± 13 ppm/°C
2 to < 5	± 0.25 %		± 20 ppm/°C
1 to < 2	± 0.5 %		± 25 ppm/°C
0.5 to < 1	± 1.0 %		± 50 ppm/°C
0.25 to < 0.5	± 2.0 %		
0.1 to < 0.25	± 5.0 %		

TABLE 2 - VHP-4 AND VPR247 SPECIFICATIONS[1, 2]

RESISTANCE RANGE (Ω)	TIGHTEST TOLERANCE	TYPICAL TCR[3, 4]	MAXIMUM TCR[3]
10 to 500	± 0.01 %	± 2 ppm/°C	± 5 ppm/°C
5 to < 10	± 0.02 %		± 6 ppm/°C
2 to < 5	± 0.05 %		± 8 ppm/°C
1 to < 2	± 0.1 %		± 10 ppm/°C
0.5 to < 1	± 0.25 %		± 15 ppm/°C
0.25 to < 0.5	± 0.5 %		± 20 ppm/°C
0.1 to < 0.25	± 1.0 %		± 25 ppm/°C
0.05 to < 0.1	± 2.0 %		± 30 ppm/°C

Notes

1. Weight of VHP-3 and VHP-4 = 15 g maximum
   VPR247 = 7 g maximum
2. Available up to 500 Ω
3. - 55 °C to + 125 °C, + 25 °C ref.
4. See figure 5

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

TABLE 3 - GENERAL SPECIFICATIONS	
Stability	
Load life 2000 h	± 0.05 % maximum ΔR, 3 W in still air at + 25 °C ± 0.05 % maximum ΔR under full rated power (10 W at + 25 °C on heat sink)
Shelf life	± 0.0005 % (5 ppm) maximum ΔR/year
Power Rating	
At + 25 °C (see Fig. 1)	10 W or 3 A - heat sink[2)] 3 W or 3 A - free air
Current Noise	< 0.010 μV (RMS)/V of applied voltage (- 40 dB)
High Frequency Operation	
Rise time	1.0 ns at 1 kΩ without ringing
Inductance (L)[3)]	0.1 μH maximum; 0.08 μH typical
Capacitance (C)	1.0 pF maximum; 0.5 pF typical
Voltage Coefficient	< 0.1 ppm/V
Operating Temperature Range	- 55 °C to + 150 °C
Hermeticity	10^{-7} Atmospheric cc/s maximum
Maximum Working Voltage[7)]	600 V
Thermal EMF[8)]	0.1 μV/°C maximum (lead effect) 2.5 μV/W maximum (power effect)

FIGURE 1 - POWER DERATING CURVE

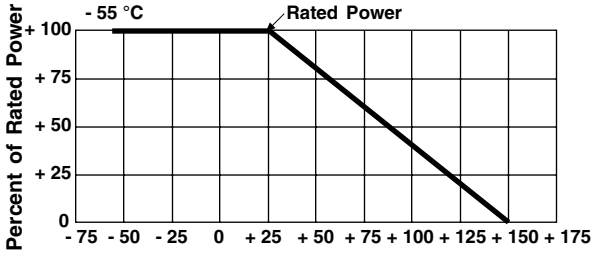
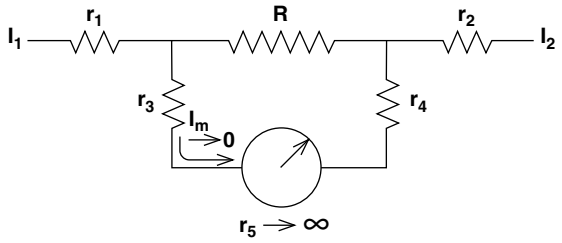
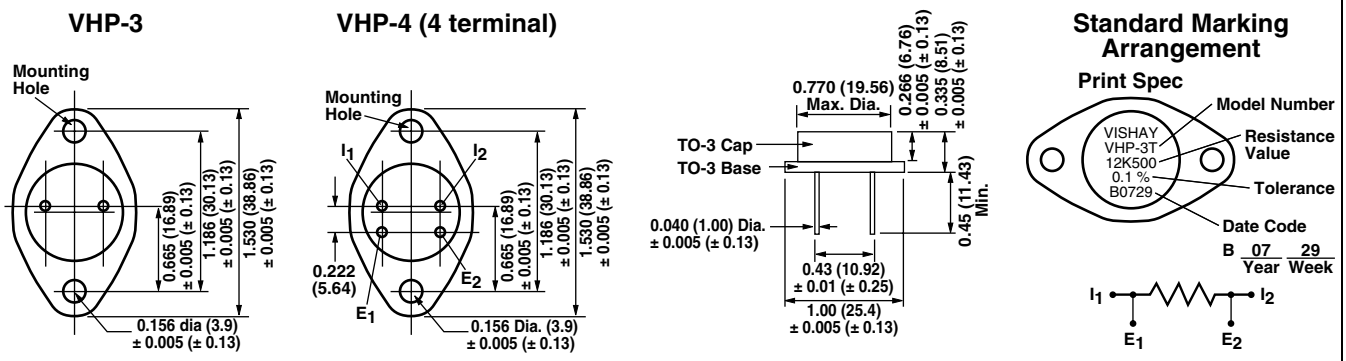


FIGURE 2 - KELVIN CONNECTION



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 2 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 3 - VHP-3, VHP-4 STANDARD IMPRINTING AND DIMENSIONS in inches (millimeters)



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

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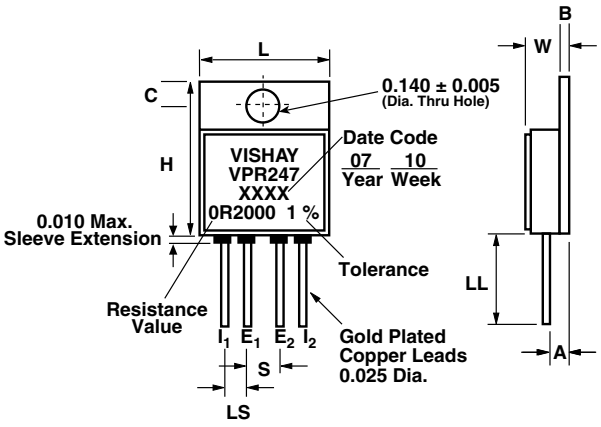
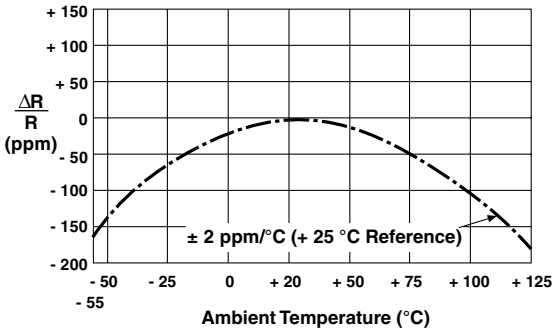
FIGURE 4 - VPR247 STANDARD IMPRINTING AND DIMENSIONS



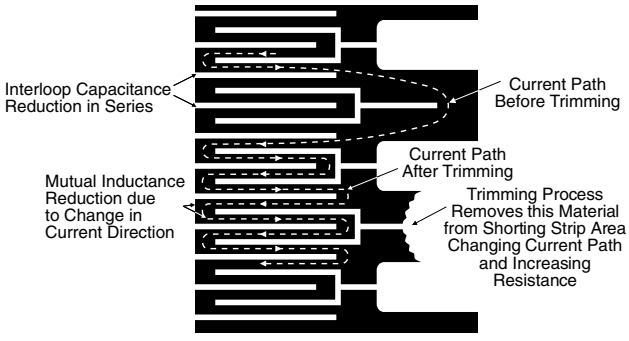
DIMENSION	INCHES	MM
L	0.690 ± 0.005	17.53 ± 0.13
H	0.820 ± 0.005	20.83 ± 0.13
W	0.215 ± 0.005	5.46 ± 0.13
LL	0.500 minimum	12.70 minimum
LS	0.100 ± 0.005	2.54 ± 0.13
S	0.200 ± 0.005	5.08 ± 0.13
A	0.120 ± 0.005	3.05 ± 0.13
B	0.040 ± 0.005	1.02 ± 0.13
C	0.120 ± 0.005	3.05 ± 0.13

FIGURE 5 - TYPICAL TCR CURVE



(For more details, see tables 1 and 2)

FIGURE 6 - TRIMMING TO VALUES



Note: Foil shown in black, etched spaces in white

TABLE 4 - ENVIRONMENTAL PERFORMANCE

	METHOD PARAGRAPH[6]	MIL-PRF-39009 ΔR LIMITS	VHP-3, VHP-4 AND VPR247 TYPICAL ΔR TEST DATA[9]
Test Group I			
Conditioning	4.8.2	± 0.2 % + 0.01 Ω	± 0.03 %
Test Group II			
Resistance temperature Characteristic (- 55 °C to + 125 °C)	4.8.4	< 1 Ω ± 100 ppm/°C; 1 Ω to 19.6 Ω: ± 50 ppm/°C; ≥ 20 Ω: ± 30 ppm/°C	See tables 1 and 2, page 1
Low temperature storage	4.8.16	± 0.3 % + 0.01 Ω	± 0.005 %
DWV (300 V at atmospheric pressure)	4.8.5	± 0.2 % + 0.01 Ω	± 0.005 %
Insulation resistance	4.8.6	10^4 MΩ	> 10^4 MΩ
Low temperature operation	4.8.7	± 0.3 % + 0.01 Ω	± 0.01 %
Short time overload[8] (5 s at 15 W)	4.8.8	± 0.3 % + 0.01 Ω	± 0.03 %
Moisture resistance	4.8.9	± 0.5 % + 0.01 Ω	± 0.02 %
Terminal strength	4.8.10	± 0.2 % + 0.01 Ω	± 0.005 %
Test Group III			
Shock - specified pulse (Post-test DWV at 300 V)	4.8.11	± 0.2 % + 0.01 Ω	± 0.005 %
Vibration - high frequency (Post-test DWV at 300 V)	4.8.12	± 0.2 % + 0.01 Ω	± 0.005 %
Test Group IV			
Life test 10 W at 25 °C for 2000 h	4.8.13	± 1.0 % + 0.01 Ω	± 0.01 %
80 % power at + 70 °C for 2000 h	-	-	± 0.04 %
Test Group V			
High temperature exposure 2000 h at + 150 °C	4.8.14	± 1.0 % + 0.05 Ω	± 0.05 %

Notes

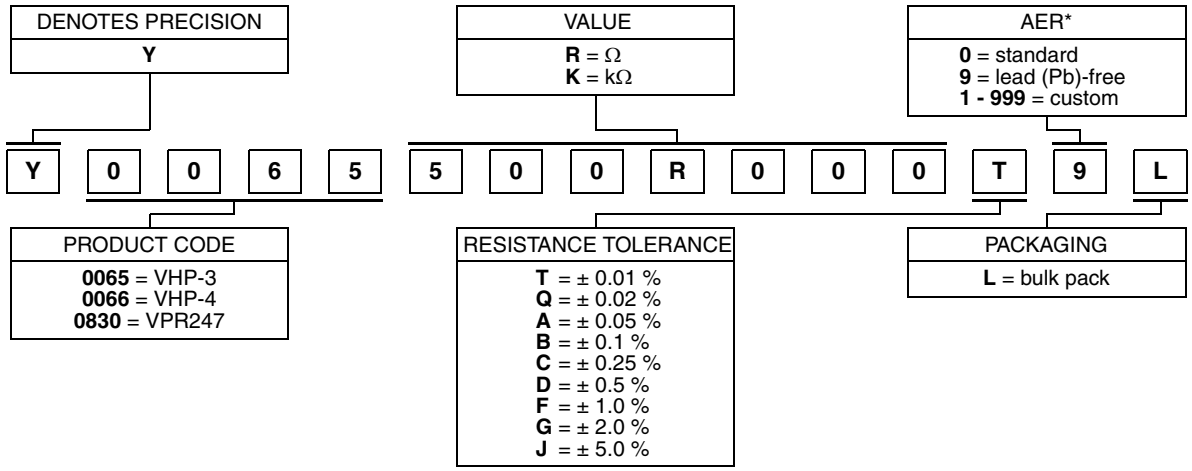
1. Whichever is lower.
2. Heat sink chassis dimensions and requirements per MIL-PRF-39009/1:

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

3. Inductance (L) due mainly to the leads.
4. The resolution limit of existing test equipment (within the measurement capability of the equipment, or “essentially zero”).
5. Not to exceed power rating of resistor.
6. Vishay test data as compared to MIL-PRF-39009 is shown for illustration purposes, Vishay test conditions that deviate from the Mil test method are noted within parentheses.
7. Maximum ambient temperature rating is + 150 °C.
8. 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.
9. ΔR’s are as shown plus 0.001 Ω to allow for measurement errors at low resistance values.

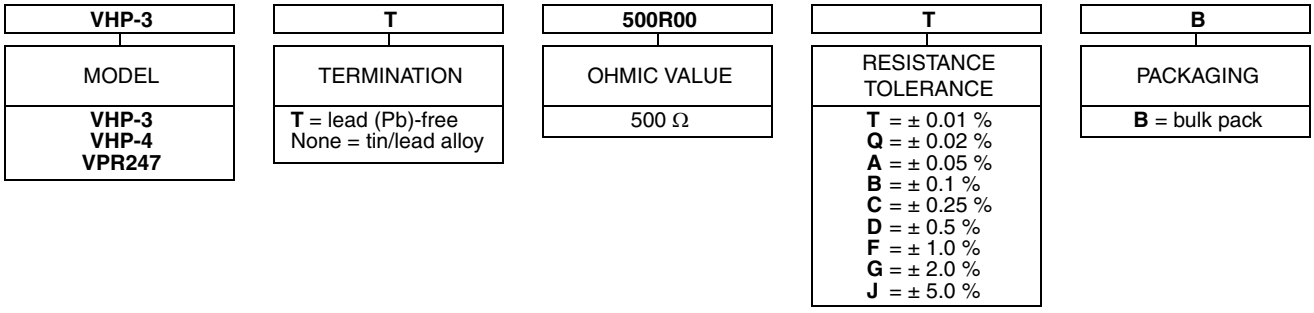
TABLE 5 - GLOBAL PART NUMBER INFORMATION

NEW GLOBAL PART NUMBER: Y0065500R000T9L (preferred part number format)



FOR EXAMPLE: ABOVE GLOBAL ORDER Y0065 500R000 T 9 L:
TYPE: VHP-3
VALUE: 500.0 Ω
ABSOLUTE TOLERANCE: ± 0.01 %
TERMINATION: lead (Pb)-free
PACKAGING: bulk pack

HISTORICAL PART NUMBER: VHP-3T 500R00 T B (will continue to be used)



Note

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

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

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