

New Generation of Secondary Standards Hermetically Sealed High Precision Bulk Metal[®] Foil Technology Resistors with TCR of $\pm 2 \text{ ppm/°C}$, Tolerance of $\pm 0.001 \%$ and Load Life Stability of $\pm 0.005 \%$ (Metrology, Laboratory, Instrumentation, Industrial)



INTRODUCTION

The H series resistors are oil-filled, hermetically sealed ultra precision resistors and are used as secondary standards for metrology applications.

The hermetic sealing eliminates the ingress of moisture and oxygen, while the oil acts as a thermal conductor, thus eliminating the long-term degradation elements of unsealed resistors, while at the same time allowing the device to accept short periods of overload without degradation.

Vishay's Bulk Metal[®] Foil outperforms all other resistor technologies available today for applications that require precision and stability. When combined with the hermetic sealing and oil filling, the H series resistors become **the most precise and stable resistors available**.

With accuracies of 0.001 %, a resistance range from 5 Ω to 1.84 M Ω , and long term shelf life of less than 2 ppm, these devices are virtually secondary standards that can be carried in sets for daily or periodic calibration of factory measurement equipment.

The H series is available with laboratory and metrology level precision and long-term stability with additional in-house oriented processes such as: chip stabilization, special TCR plotting, additional treatments for ultra stability and special post manufacturing operations (PMO). (Please refer to the last page)

TABLE 1 - TCR VS. RESISTANCE VALUE				
RESISTANCE VALUE (Ω)	TYPICAL TCR AND MAX. SPREAD (- 55 °C to + 125 °C, + 25 °C ref.) (ppm/°C)			
100 to < 1M84	± 2 ± 2.5			
50 to < 100	± 2 ± 3.5			
5 to < 50	± 2 ± 4.5			

Note

- For maximum TCR < 1 ppm/°C, see VHP100 and contact application engineering

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

FEATURES

 Temperature coefficient of resistance (TCR): ± 2 ppm/°C typical (- 55 °C to + 125 °C, + 25 °C ref.). For ultra high performances (instrumentation and metrology) please refer to the last page



RoHS³

COMPLIANT

- Resistance range: 5 Ω to 1.84 M Ω (higher or lower values of resistance available)
- Vishay Foil resistors are not restricted to standard values; specific "as required" values can be supplied at no extra cost or delivery (e.g. 1K2345 vs. 1K)
- Power rating: 0.3 W to 2.5 W at + 25 °C (depending on model - see table 2)
- Tolerance: to ± 0.001 % (10 ppm)
- Load life stability to \pm 0.002 % (20 ppm) at 25 °C, 2000 h at rated power
- Load life stability can be considerably improved through in-house stabilization
- Shelf life stability: ± 2 ppm for at least 6 years (unaffected by humidity)
- Electrostatic discharge (ESD) up to 25 000 V
- Rise time: 1 ns effectively no ringing
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Current noise: 0.010 $\mu V_{RMS}/V$ of applied voltage (< 40 dB)
- Thermal EMF: 0.05 μV/°C typical
- Voltage coefficient: < 0.1 ppm/V
- Non-inductive: < 0.08 μH
- Non-inductive, non-capacitive design
- Non hot spot design
- Terminal finish available: lead (Pb)-free or tin/lead alloy
- · Impervious to harmful environments oil-filled
- Compliant to RoHS directive 2002/95/EC
- Prototype quantities available in just 5 working days or sooner. For more information, please contact <u>foil@vishaypg.com</u>
- For better performances (values, TCR, tolerance, stability), please see the HZ series



H Series

Vishay Foil Resistors





** 0.375 H available

See next page for numbered footnotes





TABLE 3 - "H" SERIES SPECIFICATIONS	
Stability ⁽⁸⁾	
Load life at 2000 h	± 0.002 % (20 ppm) at 25 °C at rated power
Shelf life	± 2 ppm (0.0002 %) for at least 6 years
Current Noise	< - 40 dB
High Frequency Operation	
Rise time	1.0 ns without ringing
Inductance (L) ⁽⁵⁾	0.1 μH maximum; 0.08 μH typical
Capacitance (C)	1.0 pF maximum; 0.5 pF typical
Voltage Coefficient	< 0.1 ppm/V ⁽⁶⁾
Thermal EMF ⁽⁷⁾	0.1 μ V/°C maximum; 0.05 μ V/°C typical; 1 μ V/W maximum
Hermeticity	10 ⁻⁷ atmospheric cc/s maximum

Notes

- (1) Upper end of resistance range varies with model selected (i.e. VHP202; the range is to 150 k Ω ; VHA518-10, the range is to 1M67 Ω) per table 2
- (2) Not to exceed power rating of resistor
- (3) Insulating sleeve a special case insulating plastic sleeve is available on VHA models. See table 4 for instructions on how to specify
- (4) 0.200" (5.08 mm) lead spacing available specify VH202J
- ⁽⁵⁾ Inductance (L) due mainly to the leads
- ⁽⁶⁾ The resolution limit of existing test equipment (within measurement capability of the equipment, or "essentially zero")
- $^{(7)}$ µV/°C relates to EMF due to lead temperature difference and µV/W due to power applied to the resistor
- ⁽⁸⁾ Load life ΔR maximum. Can be reduced through in-house oriented processes

POST MANUFACTURING OPERATIONS OR PMO FOR IMPROVED END OF LIFE

Many analog applications can include requirements for performance under conditions of stress beyond the normal and over extended periods of time. This calls for more than just selecting a standard device and applying it to a circuit. The standard device may turn out to be all that is needed but an analysis of the projected service conditions should be made and it may well dictate a routine of stabilization known as post manufacturing operations or PMO. The PMO operations that will be discussed are only applicable to Bulk Metal Foil resistors. They stabilize Bulk Metal Foil resistors while they are harmful to other types. Short time overload, accelerated load life, and temperature cycling are the three PMO exercises that do the most to remove the anomalies down the road. Vishay Bulk Metal Foil resistors are inherently stable as manufactured. These PMO exercises are only of value on Bulk Metal Foil resistors and they improve the performance by amounts that are small but significant when compared to the very tight tolerances. Users are encouraged to contact Vishay Foil applications engineering for assistance in choosing the PMO operations that are right for their application.

H Series

Vishay Foil Resistors





Notes

⁽¹⁾ For non-standard requests, please contact application engineering

 $^{(2)}\,$ 4-terminal construction of these types are available, please quote:

2-Termina	I VHA512	VHA516-4	VHA516-5	VHA516-6	VHA518-7	VHA518-8	VHA518-9	VHA518-10	VHA518-11
4-Termina	I 302073	302074-4	302074-5	302074-6	302075-7	302075-8	302075-9	302075-10	302075-11



ULTRA HIGH PRECISION HERMETICALLY SEALED RESISTORS

INTRODUCTION

The response of Vishay's hermetically sealed resistors under variable conditions and stresses can be made better by additional in-house oriented processes (PMO). Processes such as short time overload, accelerated load life and temperature cycling produce enhanced levels of accuracy, stability and speed, offering immediate answers to many resistor applications currently believed unsolvable, and opens entirely new areas of design where the use of resistors had not been considered.

APPLICATIONS INCLUDE

- Resistance standards
- Feedback devices for operational amplifiers
- Precision voltage dividers
- Meter multipliers
- Precision bridge resistors
- Decade voltage dividers

See table 5 for the improvement to expect in hermetically sealed parts when calling for Vishay in-house oriented processes (PMO).

TABLE 5 - EXAMPLES OF NON-STANDARD REQUIREMENTS									
TYPE	VALUE	TOLE	RANCE	TCR		DEMADKO			
		ABSOLUTE	MATCH	ABSOLUTE	TRACKING				
VHA518-11 Set of 10 Resistors (+ 20 °C to + 30 °C)	1 Ω	0.1 %	0.005 %	0.5 ppm/°C	0.5 ppm/°C	with PMO			
	10 Ω	0.05 %	-	0.5 ppm/°C	-	- with PMO			
	100 Ω	0.01 %	-	0.5 ppm/°C	-				
1/114519.74 Terminal (+ 20 °C to + 20 °C)	120 Ω	0.005 %	-	0.4 ppm/°C	-				
$(+20 \ C \ 10 + 30 \ C)$	1K	0.005 %	-	0.3 ppm/°C	-				
	10K	0.001 %	-	0.3 ppm/°C	-				
	100K	0.001 %	-	0.3 ppm/°C	-				
	10 Ω	0.05 %	0.02 %	0.5 ppm/°C	0.5 ppm/°C	with PMO			
	100 Ω	0.01 %	0.01 %	0.5 ppm/°C	0.5 ppm/°C				
VHA518-7 4- Ierminal Matched Pairs $(+ 20 \degree C \text{ to } + 30 \degree C)$	1K	0.005 %	0.002 %	0.3 ppm/°C	0.3 ppm/°C				
	10K	0.001 %	0.002 %	0.3 ppm/°C	0.3 ppm/°C				
	100K	0.001 %	0.002 %	0.3 ppm/°C	0.3 ppm/°C				
VHA518 Set of 10 Resistors (+ 18 °C to + 28 °C, + 23 °C ref.)	999Ω475	0.05 %	0.005 %	0.5 ppm/°C	0.5 ppm/°C	with PMO			

ORDERING INFORMATION

Resistors are built to your requirements. Send your schematic and electrical requirements to the applications engineering department at <u>foil@vishaypg.com</u>. A unique part number will be assigned which defines all aspects of your resistor.



Vishay Precision Group

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