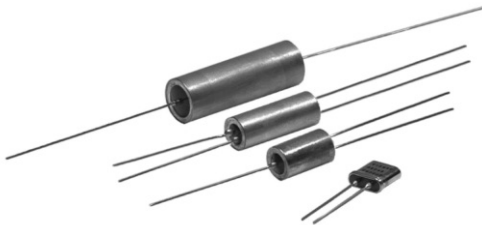


Hermetically Sealed High Precision Bulk Metal® Foil Technology Resistors with TCR of $\pm 2 \text{ ppm}/^\circ\text{C}$, Tolerance of $\pm 0.001 \%$ and Load Life Stability of $\pm 0.005 \%$ (Metrology, Laboratory, Instrumentation, Industrial)



INTRODUCTION

The H series resistors are oil-filled, hermetically sealed ultra precision resistors.

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 also available with laboratory and metrology level precision and long term stability with additional in-house oriented process such as: chip stabilization, special TCR plotting, additional treatments for ultra stability and special post manufacturing operations (PMO).

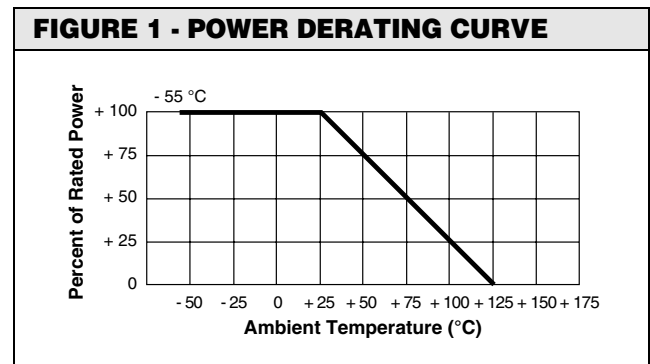
FEATURES

- Temperature coefficient of resistance (TCR): $\pm 2 \text{ ppm}/^\circ\text{C}$ typical (- 55 $^\circ\text{C}$ to + 125 $^\circ\text{C}$, + 25 $^\circ\text{C}$ ref.)
- 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 to 2.5 W at + 25 $^\circ\text{C}$ (depending on model - see table 2)
- Tolerance: to $\pm 0.001 \%$ (10 ppm)
- Load life stability: $\pm 0.005 \%$ (70 $^\circ\text{C}$ for 2000 h at half rated power)
- **Load life stability, TCR and tolerance can be considerably improved through in-house oriented tests (PMO)**
- Shelf life stability: $\pm 2 \text{ ppm}$ for at least 10 years (unaffected by humidity)
- Electrostatic discharge (ESD) up to 25 000 V
- Rise time: 1 ns effectively no ringing
- Current noise: < - 40 dB
- Thermal EMF: 0.05 $\mu\text{V}/^\circ\text{C}$ 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, tin/lead alloy
- Impervious to harmful environments - oil-filled
- Prototype quantities available in just 5 working days or sooner. For more information, please contact foil@vishay.com
- For better performances, please see H series with Z-foil



RoHS*
COMPLIANT

TABLE 1 - TOLERANCE AND TCR VERSUS RESISTANCE VALUE	
RESISTANCE VALUE (Ω)	TYPICAL TCR AND MAX. SPREAD (- 55 $^\circ\text{C}$ to + 125 $^\circ\text{C}$, + 25 $^\circ\text{C}$ ref.) (ppm/ $^\circ\text{C}$)
80 to < 1M84	$\pm 2 \pm 2.5$
50 to < 80	$\pm 2 \pm 3.5$
5 to < 50	$\pm 2 \pm 4.5$



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

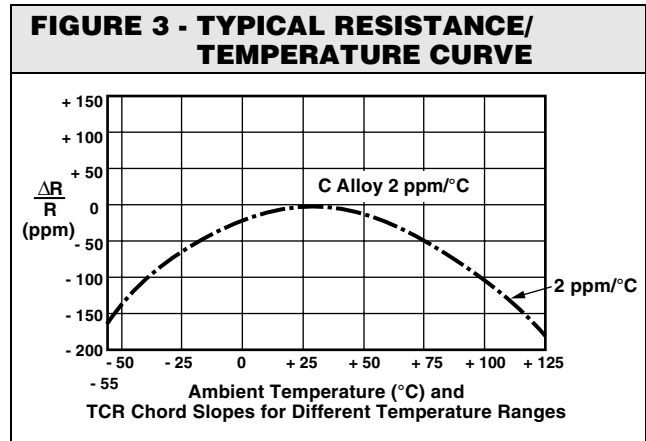
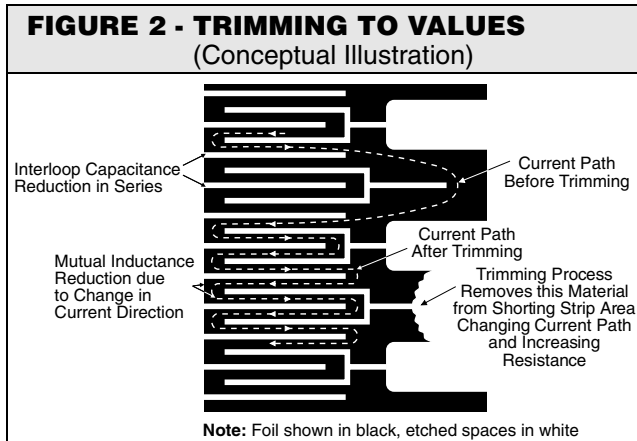


TABLE 2 - MODEL SELECTION										
MODEL NUMBER	RESISTANCE RANGE (Ω)	STANDARD RESISTANCE TOLERANCE		MAXIMUM WORKING VOLTAGE (2)	POWER RATING at + 25 °C	AVERAGE WEIGHT (g)	CONSTRUCTION BRIEF	DIMENSIONS (3)		
		RANGE (Ω)	TIGHTEST (%)					INCHES	mm	
VHP202	5 to 100K > 100K to 150K	1K to □ (1) 500 to < 1K 50 to < 500 30 to < 50 20 to < 30 10 to < 20 5 to < 10	± 0.001 ± 0.1 ± 0.0025 ± 0.1 ± 0.005 ± 0.1 ± 0.01 ± 0.1 ± 0.02 ± 0.1 ± 0.05 ± 0.1 ± 0.1 ± 0.1	300	0.3 W 0.2 W	1.4	Oil-filled, tinned copper leads, nickel shell, kovar and glass header	W: 0.162 ± 0.020	4.11 ± 0.51	
VHA412	5 to 100K > 100K to 150K							250	0.3 W 0.2 W	4.6
VHA414	5 to 200K > 200K to 335K			350	0.5 W 0.3 W	7.3	L: 1.000 ± 0.031 D: 0.375 ± 0.031 LL: 1.000 min.	25.4 ± 0.79 9.53 ± 0.79 25.4 min.		
VHA512*	5 to 300K > 300K to 500K			350	0.75 W 0.4 W	6.3	L: 0.625 ± 0.031 D: 0.500 ± 0.031 LL: 1.000 min.	15.88 ± 0.79 12.7 ± 0.79 25.4 min.		
VHA516-4*	5 to 400K > 400K to 668K			500	± 0.02 ± 0.1	1.0 W 0.5 W 1.25 W	9.2	Oil-filled, tinned copper leads, tinned brass shell, kovar and glass end bells	L: 1.000 ± 0.031 D: 0.500 ± 0.031 LL: 1.000 min.	25.4 ± 0.79 12.7 ± 0.79 25.4 min.
VHA516-5*	5 to 500K > 500K to 835K									
VHA516-6*	5 to 600K > 600K to 1M									
VHA518-7*	5 to 700K > 700K to 1M17			600	± 0.1 ± 0.1	1.75 W 0.8 W 2.0 W 0.9 W 2.25 W 1.0 W 2.5 W 1.1 W 2.5 W 1.2 W	13.5	L: 1.500 ± 0.031 D: 0.500 ± 0.031 LL: 1.000 min.	38.1 ± 0.79 12.7 ± 0.79 25.4 min.	
VHA518-8*	5 to 800K > 800K to 1M34									
VHA518-9*	5 to 900K > 900K to 1M5									
VHA518-10*	5 to 1.0M > 1.0M to 1M67									
VHA518-11*	5 to 1.0M > 1.0M to 1M84									

Notes

* Available in a 4-lead terminal

** 0.375 H available

See next page for numbered footnotes

FIGURE 4 - STANDARD IMPRINTING AND DIMENSIONS

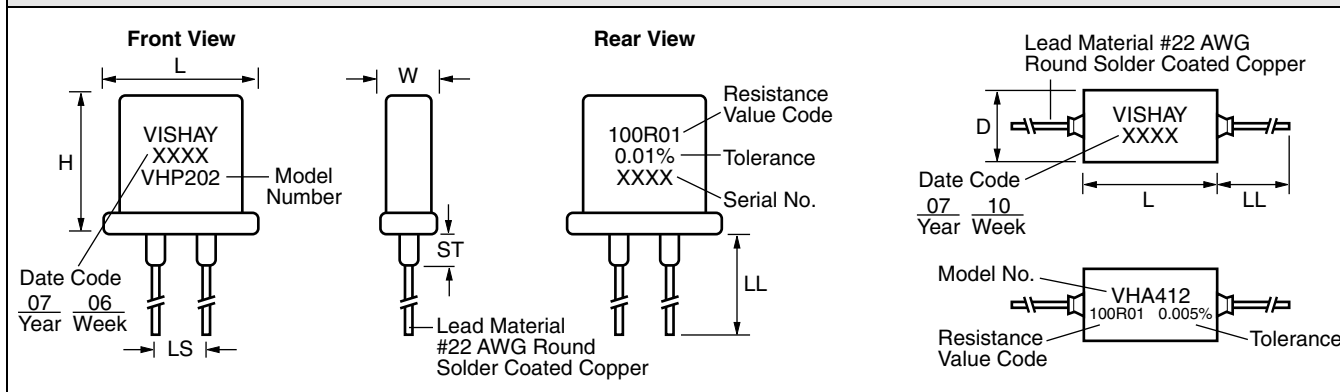


TABLE 3 - "H" SERIES SPECIFICATIONS

Stability ⁽⁸⁾	
Load life at 2000 h	± 0.002 % maximum ΔR at 0.1 W per chip and at + 60 °C
Shelf life	± 2 ppm (0.0002 %) for at least 10 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 $\mu V/^{\circ}C$ maximum; 0.05 $\mu V/^{\circ}C$ typical; 1 $\mu V/W$ 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) $\mu V/^{\circ}C$ relates to EMF due to lead temperature difference and $\mu V/W$ 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 EOL

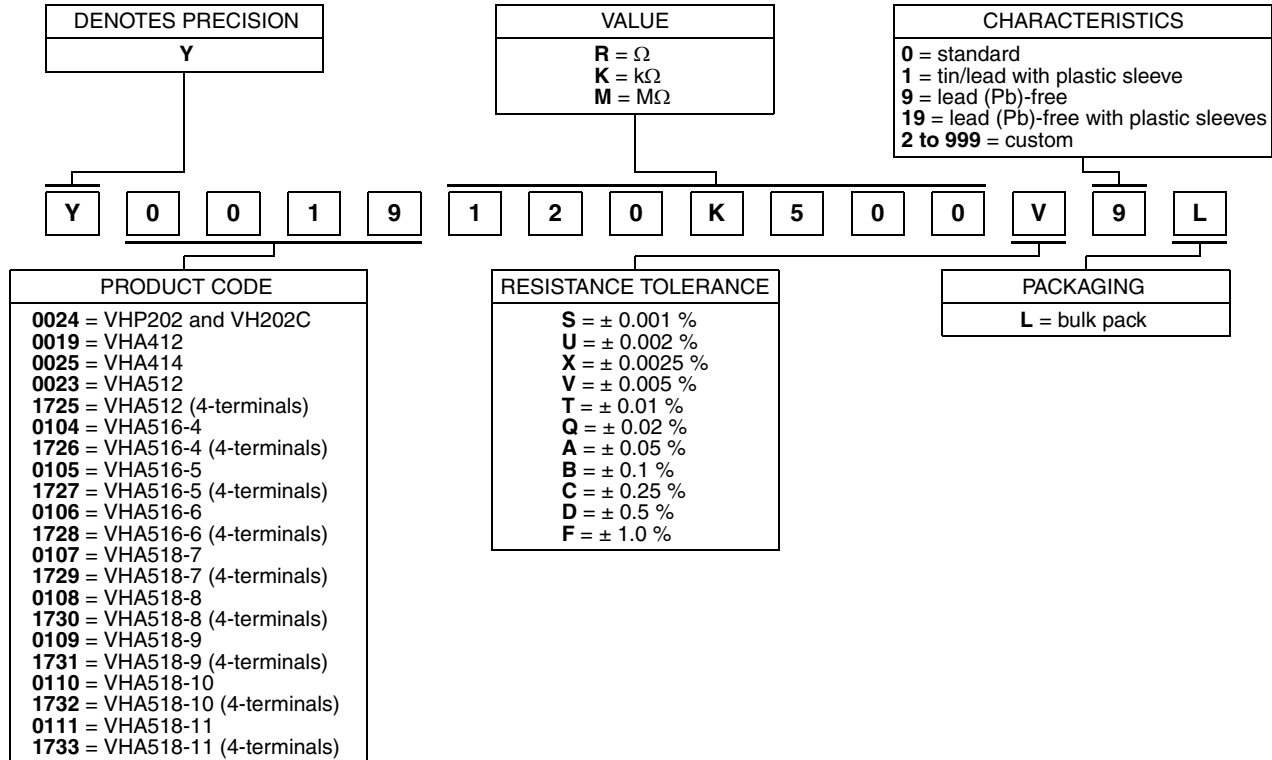
Many analog applications can include requirements for performance under conditions of stress beyond the normal and over extended periods of time. This calls for more than just selecting a standard device and applying it to a circuit. The standard device may turn out to be all that is needed but an analysis 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 small but significant amounts. Users are encouraged to contact Vishay Foil applications engineering for assistance in choosing the PMO operations that are right for their application.



TABLE 4 - GLOBAL PART NUMBER INFORMATION (1)

NEW GLOBAL PART NUMBER: Y0019120K500V9L (preferred part number format)



FOR EXAMPLE: ABOVE GLOBAL ORDER Y0019 120K500 V 9 L:

TYPE: VHA412

VALUE: 120.5 kΩ

ABSOLUTE TOLERANCE: ± 0.005 %

TERMINATION: lead (Pb)-free

PACKAGING: bulk pack

HISTORICAL PART NUMBER: VHA412T 120K50 V B (will continue to be used)

VHA412	T		120K50	V	B
MODEL	TERMINATION	PLASTIC SLEEVE	OHMIC VALUE	TOLERANCE	PACKAGING
VHP202 and VH202C VHA412 VHA414 VHA512 VHA516-4 VHA516-5 VHA516-6 VHA518-7 VHA518-8 VHA518-9 VHA518-10 VHA518-11	T = lead (Pb)-free None = tin/lead	P = plastic sleeve None = standard	120K50 = 120.5 kΩ	S = ± 0.001 % U = ± 0.002 % X = ± 0.0025 % V = ± 0.005 % T = ± 0.01 % Q = ± 0.02 % A = ± 0.05 % B = ± 0.1 % C = ± 0.25 % D = ± 0.5 % F = ± 1.0 %	B = bulk pack

Note

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



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