Hermetically Sealed High Precision Bulk Metal® Foil Technology Aerospace Resistors

TCR of ±1 ppm/°C, Tolerance to ±0.005% and Load-Life Stability of ±0.005%

FEATURES

- **Temperature coefficient of resistance (TCR):** –55°C to +125°C, + 25 °C ref.:
  - VH102K: ±1 ppm/°C typical
  - VHS102: ±2 ppm/°C typical
  - VHS555: ±5 ppm/°C maximum
- Tolerance: to ±0.005%
- Resistance range: 1 Ω to 150 kΩ (higher or lower resistance values are available
- Load-life stability: 0.005% (70°C for 2000 h at rated power)
- Electrostatic discharge (ESD) >25 000 V
- Power rating: 0.6 W at +70°C; 0.3 W at +125°C
- Non-inductive, non-capacitive design
- Non hot spot 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
- Terminal finishes available: lead (Pb)-free; tin/lead alloy
- Impervious to harmful environments—oil filled
- For better performance, please see VH102Z datasheet

Any value at any tolerance available within resistance range

Pb-free Available

RoHS* COMPLIANT

INTRODUCTION

The “VH” series of resistors is the hermetic version of several molded “S” series devices. Hermetic sealing eliminates the ingress of both oxygen, which degrades resistors over long periods, and moisture which degrades resistors more quickly. These parts are made with glass to metal seal enclosures employing Kovar eyelets which allow the copper leads to pass through the enclosure to minimize the thermal EMF from the lead junctions. Rubber fill between the metal housing and resistance element acts both as a mechanical damper and thermal transfer path.

VHS102 and VH102K are the hermetically-sealed counterpart of the S102C and S102K high-performance molded resistors. VHS555 is the hermetically-sealed version of the S555, MIL style RNC90Y.

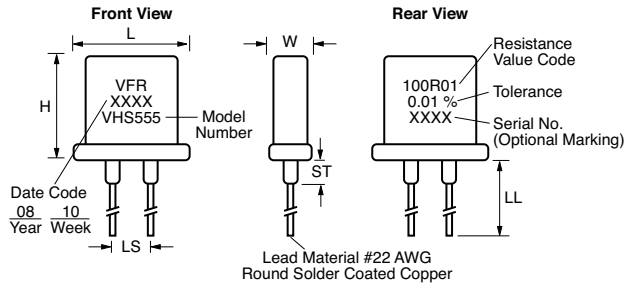
Table 1—Model Selection

Model Number	Resistance Range (Ω)	Standard Resistance Tolerance[1] (%)		Maximum Working Voltage[2]	Ambient Power Rating[3][4]	
		Tightest	Loosest		at +70°C	at +125°C
VH102K[5]	30.1 to 150k 20 to <30.1 10 to <20 5 to <10 1 to <5	±0.005 ±0.01 ±0.05 ±0.10 ±0.25	±1.0	300	0.6 W	0.3 W
VHS102						
VHS555[6]	30.1 to 150k 16.2 to <30.1 4.99 to <16.2 1 to <4.99	±0.005 ±0.05 ±0.10 ±0.25	±1.0			

Notes:
[1] Standard resistance tolerance: ±0.005%; ±0.01%; ±0.02%; ±0.05%; ±0.1%; ±0.25%; ±0.5%; ±1.0%.
[2] Not to exceed power rating of resistor.
[3] See Figure 2.
[4] Above 100 kΩ, VHS102 power is derated to 0.4 W at +70°C, and 0.2 W at +125°C.
[5] Available from 1 Ω to 100 kΩ only.
[6] Contains RNC90Y inside (4.99 Ω to 121 kΩ).

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

Figure 1—Standard Imprinting and Dimensions



Dimensions			Ave. Weight
Parameter	inches	mm	g
W	0.185 max	4.70 max	1.4
L	0.435 max	11.05 max	
H	0.430 max(1)	10.92 max	
LL	1 ±0.125	25.4 ±3.18	
LS	0.150 ±0.010(2)	3.81 ±0.25	
ST	0.095 max	2.41 max	

Notes
(1) 0.375 H available.
(2) 0.200" (5.08 mm) lead spacing available (except VHS555)—specify VH102J (S102C type), VH102L (S102K type).

Table 2—Tolerance and TCR vs. Resistance

Resistor	Resistance Value (Ω)	Typical TCR and Max. Spread –55°C to +125°C, +25°C ref. (ppm/°C)
VHS102	80 to 150k	±2 ±2.5
VH102K	80 to 100k	±1 ±2.5
VHS102	50 to <80	±2 ±3.5
VH102K		±1 ±3.5
VHS102	1 to <50	±2 ±4.5
VH102K		±1 ±4.5

Figure 3—Power Derating Curve

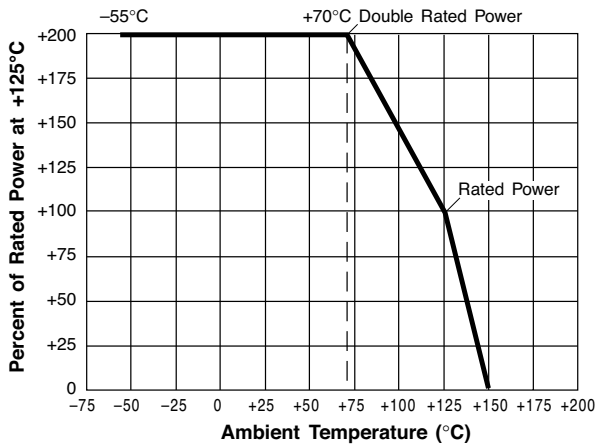
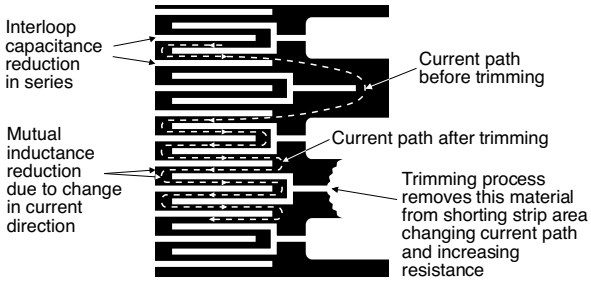


Figure 2—Trimming to Values (conceptual illustration)



Foil shown in black, etched spaces in white

Note
To acquire a precision resistance value, the Bulk Metal Foil chip is trimmed by selectively removing built-in "shorting bars." To increase the resistance in known increments, marked areas are cut, producing progressively smaller increases in resistance. This method reduces the effect of "hot spots" and improves the long-term stability of VFR resistors.

Table 3—Specifications[1] [2] [3]				
Parameter		**Value**		
Selected[4] TCR Tracking[5]		0.5 ppm/°C		
Stability[6]		VH102K	VHS102	VHS555
Load life at 2000 h:	at 0.3 W/+125°C	±0.025%	±0.025%	±0.015%
	at 0.1 W/+60°C	±0.005%	±0.005%	±0.0025%
Load life at 10 000 h:	at 0.05 W/+125°C	±0.02%	±0.02%	±0.01%
Shelf Life Stability		±5 ppm (0.0005%) maximum ΔR after 1 year ±10 ppm (0.001%) maximum ΔR after 3 years		
Current Noise		<0.010 μV_{RMS}/V of applied voltage (–40 dB)		
High Frequency Operation				
Rise time		1.0 ns		
Inductance (L)[7]		0.1 µH maximum; 0.08 µH typical		
Capacitance (C)		1.0 pF maximum; 0.5 pF typical		
Voltage Coefficient		< 0.1 ppm/V[8]		
Thermal EMF[9]		0.1 µV/°C maximum; 0.05 µV/°C typical 1 µV/W		
Hermeticity		10^{-7} atmospheric cc/s maximum		

Notes:

(1) Maximum is 1.0 % A.Q.L. standard for all specifications except TCR. (For TCR information see notes [4] to [7].) Typical is a designers reference which represents that 85% of the units supplied, over a long period of time, will be at least the figure shown or better.

(2) Resistance figures are obtained by measuring the leads at point 0.5" (12.7 mm) ±0.13" (3.2 mm) away from the root.

(3) Selected TCR tracking is available for specially ordered lots of resistors.

(4) Vishay Foil Resistors (VFR) maximum TCR spread is defined as the 3 σ (sigma) limit of a normal Gaussian distribution (99.73% of a production lot) which is within a band, centered on the nominal curve. This VFR maximum TCR spread is no greater than ±2.5 ppm/°C from nominal throughout the full temperature range. This definition of the VFR maximum TCR spread from nominal applies to all resistance values. However, as the resistance value decreases below 80 Ω, the VFR maximum TCR spread from nominal specification starts to increase.

(5) TCR tracking is a measure of the similarity of resistance value change in two or more resistors which are undergoing the same temperature changes. Tracking could be expressed as the difference in the temperature coefficients of the resistors, expressed in ppm/°C as ($\Delta R_1/R_1$ to $\Delta R_2/R_2$) x $10^{-6}/\Delta T$°C. When a number of resistors are referenced to a nominal TCR, the spread or envelope around the nominal would be the difference. If the spread is ±1.5 ppm/°C about a nominal, the tracking, as defined above, will be 3 ppm/°C.

(6) Load life ΔR maximum can be reduced through in-house oriented processes.

(7) Inductance (L) due mainly to the leads.

(8) The resolution limit of existing test equipment (within the measurement capability of the equipment, or “essentially zero”).

(9) µV/°C relates to EMF due to lead temperature difference and µV/W due to power applied to the resistor.

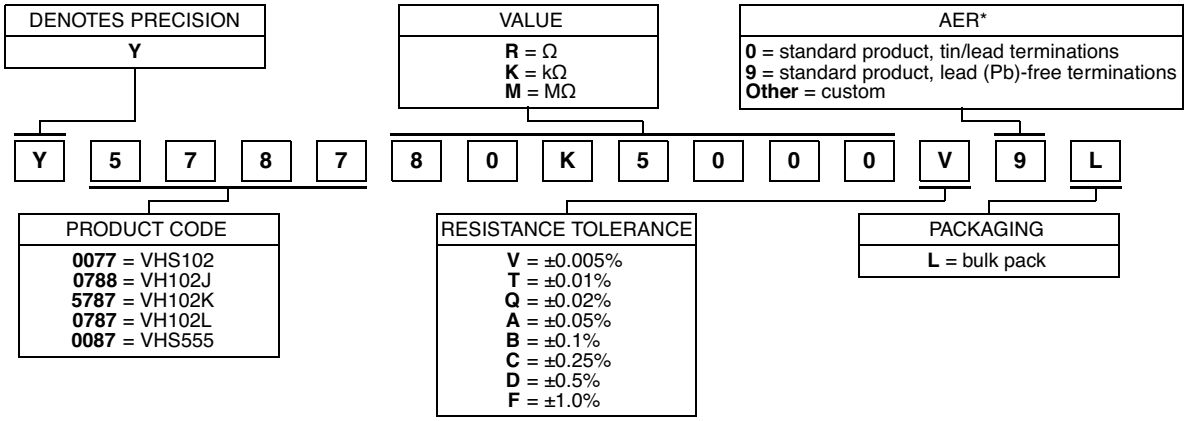
* **Precaution in Usage:** When soldering to mount hermetically sealed resistors on a board, keep the resistor over 0.39" (10 mm) away from board surface by the use of an insulating tube.

Table 4—Environmental Performance					
Group/Parameter		**MIL-PRF-55182/9 Characteristic Y Maximum ΔR**	**VH102K Typical[1] ΔR**	**VHS102 Typical[1] ΔR**	**VHS555 Typical[1] ΔR**
Test Group I					
Thermal shock		±0.05%	±0.002%	±0.002%	±0.002%
Overload		±0.05%	±0.003%	±0.003%	±0.003%
Test Group II					
Resistance temperature characteristics		±5 ppm/°C			
Temperature storage		±0.05%	±0.005%	±0.005%	±0.0025%
Low temperature operation		±0.05%	±0.005%	±0.005%	±0.005%
Terminal strength		±0.02%	±0.002%	±0.002%	±0.002%
Test Group III					
Dielectric withstanding voltage (DWV)		±0.02%	±0.005%	±0.005%	±0.002%
Insulation resistance		10^4 MΩ	40 × 10^5 MΩ	40 × 10^5 MΩ	40 × 10^5 MΩ
Resistance to solder heat		±0.02%	±0.002%	±0.002%	±0.002%
Moisture resistance		±0.05%	±0.005%	±0.005%	±0.005%
Test Group IV					
Shock		±0.01%	±0.002%	±0.002%	±0.002%
Vibration		±0.02%	±0.002%	±0.002%	±0.002%
Test Group V					
Life test at 0.3 W/+125°C	2000 h	±0.05%	±0.03%	±0.03%	±0.01%
	10 000 h	±0.5%	±0.05%	±0.05%	±0.02%
Test Group Va					
+70°C power rating		±0.05%	±0.02%	±0.02%	±0.02%
Test Group VI					
High temperature exposure		±0.05%	±0.05%	±0.05%	±0.04%
Test Group VII					
Voltage coefficient		0.0005%/V	<0.00001%	<0.00001%/V	<0.00001%/V

Note:
[1] Maximum is 1.0 % A.Q.L. standard for all specifications except TCR. (For TCR information see notes [3] to [7] on previous page.) Typical is a designers reference which represents that 85% of the units supplied, over a long period of time, will be at least the figure shown or better.

Figure 4—Global Part Number Information

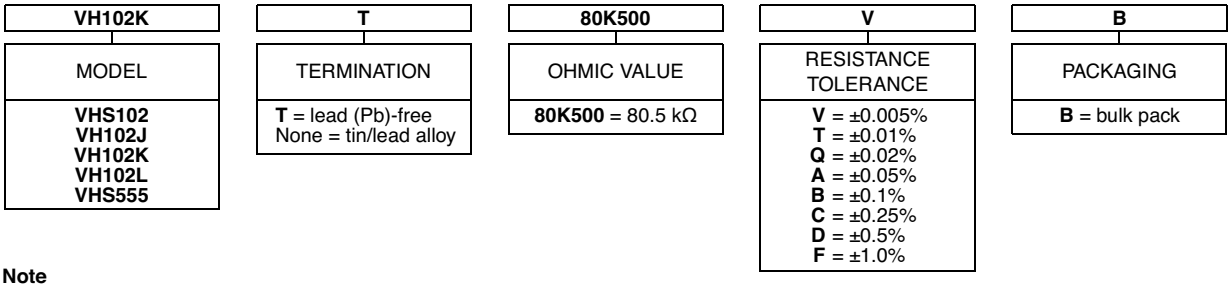
NEW GLOBAL PART NUMBER: Y578780K5000V9L (preferred part number format)



FOR EXAMPLE: ABOVE GLOBAL ORDER Y5787 80K5000 V 9 L:

TYPE: VH102K
VALUE: 80.5 kΩ
ABSOLUTE TOLERANCE: ±0.005%
TERMINATION: lead (Pb)-free
PACKAGING: bulk pack

HISTORICAL PART NUMBER: VH102KT 8K500 V B (will continue to be used)



Note

* Application engineering release: for non-standard requests, please contact application engineering.

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>>Vishay(威世)