

**New Generation of Secondary Standards Hermetically Sealed Construction Ultra High Precision Z-Foil Technology Resistors with TCR of  $\pm 0.2 \text{ ppm}/^\circ\text{C}$ , Tolerance of  $\pm 0.005 \%$  and Load Life Stability of  $\pm 0.005 \%$  for 10 000 h (Metrology, Laboratory, Instrumentation, Industrial)**



**TABLE 1 - TCR VS. RESISTANCE VALUE**

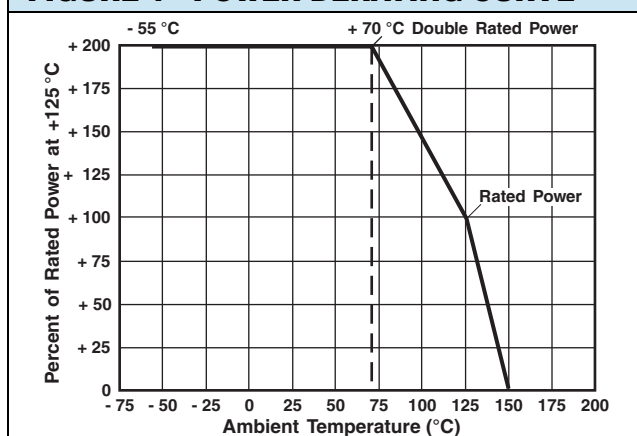
| MODEL                       | VALUE                          | STANDARD TOLERANCE | TYP. TCR AND MAX. SPREAD - 55 °C TO + 125 °C (+ 25 °C ref.) <sup>(2)</sup> |
|-----------------------------|--------------------------------|--------------------|----------------------------------------------------------------------------|
| VH102Z                      | 100 $\Omega$ to 100 k $\Omega$ | $\pm 0.005 \%$     | $\pm 0.2 \pm 0.6 \text{ ppm}/^\circ\text{C}$                               |
|                             | 80 $\Omega$ to < 100 $\Omega$  | $\pm 0.005 \%$     | $\pm 0.2 \pm 0.8 \text{ ppm}/^\circ\text{C}$                               |
|                             | 50 $\Omega$ to < 80 $\Omega$   | $\pm 0.01 \%$      | $\pm 0.2 \pm 1.0 \text{ ppm}/^\circ\text{C}$                               |
|                             | 25 $\Omega$ to < 50 $\Omega$   | $\pm 0.01 \%$      | $\pm 0.2 \pm 1.3 \text{ ppm}/^\circ\text{C}$                               |
|                             | 10 $\Omega$ to < 25 $\Omega$   | $\pm 0.02 \%$      | $\pm 0.2 \pm 1.6 \text{ ppm}/^\circ\text{C}$                               |
| VHZ555 (PMO) <sup>(1)</sup> | 80 $\Omega$ to 121 k $\Omega$  | $\pm 0.005 \%$     | $\pm 0.2 \pm 1.8 \text{ ppm}/^\circ\text{C}$                               |
|                             | 30.1 $\Omega$ to 80 $\Omega$   | $\pm 0.005 \%$     | $\pm 0.2 \pm 2.3 \text{ ppm}/^\circ\text{C}$                               |
|                             | 20 $\Omega$ to < 30.1 $\Omega$ | $\pm 0.01 \%$      | $\pm 0.2 \pm 2.3 \text{ ppm}/^\circ\text{C}$                               |
|                             | 4.99 $\Omega$ to < 20 $\Omega$ | $\pm 0.05 \%$      | $\pm 0.2 \pm 2.8 \text{ ppm}/^\circ\text{C}$                               |

**Note**

<sup>(1)</sup> VHZ555 units are manufactured on the same production line facilities and are subjected to all the same process and lot control requirements imposed on RNC90Z version, as well as all of the special screening, environmental conditioning and documentation stipulations outlined in MIL-PRF 55182/9

<sup>(2)</sup> TCR of  $\pm 0.2 \text{ ppm}/^\circ\text{C}$  Max. is achievable per special request

**FIGURE 1 - POWER DERATING CURVE**



**TABLE 2 - SPECIFICATIONS**

| MAXIMUM WORKING VOLTAGE | RESISTANCE VALUE   | AMBIENT POWER RATING |             | AVERAGE WEIGHT (g) |
|-------------------------|--------------------|----------------------|-------------|--------------------|
|                         |                    | at + 70 °C           | at + 125 °C |                    |
| 300 V                   | $\leq 100\text{K}$ | 0.6 W                | 0.3 W       | 1.4                |
|                         | $> 100\text{K}$    | 0.4 W                | 0.2 W       |                    |

\* Pb containing terminations are RoHS compliant, exemptions may apply

**FEATURES**

- **Temperature coefficient of resistance (TCR):**  $\pm 0.2 \text{ ppm}/^\circ\text{C}$  typical (- 55 °C to + 125 °C, + 25 °C ref.). For ultra high performances (instrumentation and metrology) please contact us
- Load life stability to  $\pm 0.005 \%$  (50 ppm) at 70 °C, 10 000 h at 0.15 W (see table 3)
- Load life stability, can be considerably improved through in-house stabilization (PMO)
- Shelf life stability: 2 ppm for at least 6 years (unaffected by humidity)
- Resistance range: 5  $\Omega$  to 121 k $\Omega$  (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 coefficient "ΔR due to self heating":** 5 ppm at rated power with the Z-Foil technology
- **Tolerance: to  $\pm 0.005 \%$  (50 ppm)**
- Electrostatic discharge (ESD) up to 25 000 V
- Power Rating: 0.6 W at + 70 °C; 0.3 W at + 125 °C
- Thermal EMF: 0.1  $\mu\text{V}/^\circ\text{C}$  maximum, 0.05  $\mu\text{V}/^\circ\text{C}$  typical 1  $\mu\text{V}/^\circ\text{C}$
- Hermeticity:  $10^{-7}$  atmospheric cc/s maximum
- Non-inductive, non-capacitive design
- Non hot spot design
- Rise time: 1 ns effectively no ringing
- Current noise: 0.010  $\mu\text{V}_{\text{RMS}}/\text{V}$  of applied voltage (< - 40 dB)
- Voltage coefficient: < 0.1 ppm/V
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Non-inductive: < 0.08  $\mu\text{H}$
- Terminal finish available: lead (Pb)-free or tin/lead alloy
- Prototype quantities available in just 5 working days or sooner. For more information, please contact [foil@vishaypg.com](mailto:foil@vishaypg.com)
- For better performances (values, TCR, tolerance, stability), please contact us
- Compliant to RoHS directive 2002/95/EC



### ABOUT VHZ HERMETIC

The “VHZ” series of resistors is the hermetically sealed version of the Z201. 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. VH102Z is the hermetically-sealed counterpart of the Z201 high-performance molded resistors. VHZ555 is the hermetically-sealed version of the Z555, MIL style RNC90Z (ER).

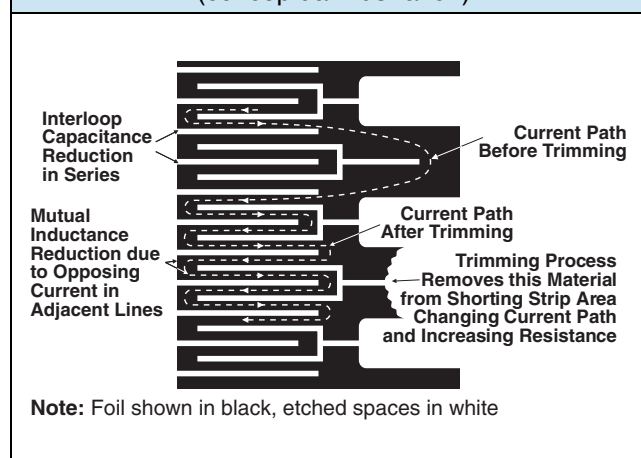
Vishay VHZ resistors are designed and manufactured to eliminate the inter-parameter compromise inherent in all other types of precision resistors. All important characteristics - tolerance, long-term shelf life and load stability, temperature coefficient, noise, capacitance and inductance - are optimum, approaching in total performance the theoretical ideal, a straight wire.

VHZ was developed by Vishay as a new resistor concept, through the use of a proprietary Bulk Metal® Foil and new ultra-fine photo-etching techniques created by the company, so that the conductor can be considered a flat wire. Because the metals used are not drawn, wound or mistreated in any way during the manufacturing process, VHZ resistors maintain all of their design, physical and electrical characteristics.

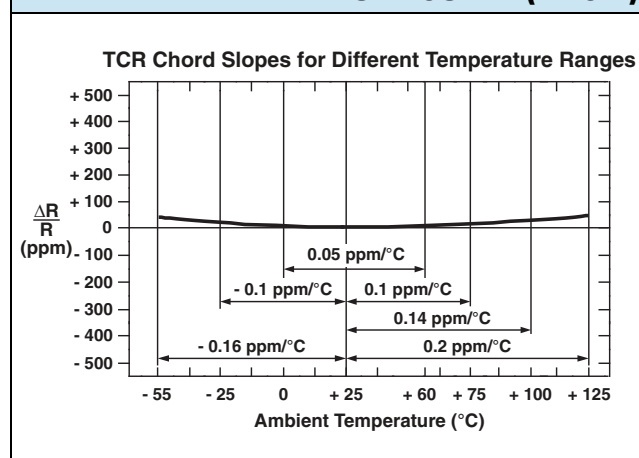
The temperature coefficient of the resistor is carefully controlled through compensation techniques to eliminate the effect of different coefficients of expansions for all materials used in the resistor.

**FIGURE 2 - TRIMMING TO VALUES**

(conceptual illustration)



**FIGURE 3 - TYPICAL RESISTANCE/TEMPERATURE CURVE (Z-FOIL)**

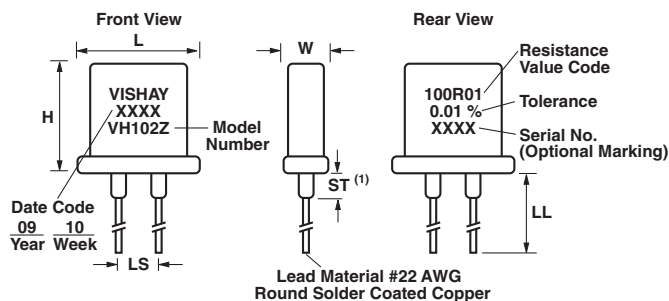


### POST MANUFACTURING OPERATIONS (PMO) FOR IMPROVED END OF LIFE

Many analog applications can include requirements for performance under conditions of stress beyond the norm 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 may be harmful to other types. Short time overload,

accelerated load life, and temperature cycling are the three PMO methods that do the most to remove the anomalies down the road. Vishay Bulk Metal Foil resistors are inherently stable as manufactured. These PMO methods 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.

**FIGURE 4 - DIMENSIONS**



|               | W          | L          | H          | LL          | LS (2)        | ST         |
|---------------|------------|------------|------------|-------------|---------------|------------|
| <b>Inches</b> | 0.185 max. | 0.435 max. | 0.430 max. | 1 ± 0.125   | 0.150 ± 0.010 | 0.095 max. |
| <b>mm</b>     | 4.70 max.  | 11.05 max. | 10.92 max. | 25.4 ± 3.18 | 3.81 ± 0.25   | 2.41 max.  |

**Notes**

- (1) The standoffs shall be so located as to give a lead clearance of 0.010" minimum between the resistor body and the printed circuit board when the standoffs are seated on the printed circuit board. This is to allow for proper cleaning of flux and other contaminants from the unit after all soldering processes
- (2) For 0.200" lead spacing, specify VH102JZ or VHZ555J

**TABLE 3 - LOAD LIFE STABILITY**

|                                                                 | VH102Z/VHZ555                             |                                           |
|-----------------------------------------------------------------|-------------------------------------------|-------------------------------------------|
|                                                                 | TYPICAL $\Delta R$ LIMITS                 | MAXIMUM $\Delta R$ LIMITS                 |
| <b>0.3 W at + 125 °C/0.6 W at + 70 °C</b><br>2000 h<br>10 000 h | ± 0.005 % (50 ppm)<br>± 0.015 % (150 ppm) | ± 0.015 % (150 ppm)<br>± 0.05 % (500 ppm) |
| <b>0.15 W at + 70 °C</b><br>2000 h<br>10 000 h                  | ± 0.002 % (20 ppm)<br>± 0.005 % (50 ppm)  | ± 0.01 % (100 ppm)<br>± 0.015 % (150 ppm) |

**TABLE 4 - ENVIRONMENTAL PERFORMANCE COMPARISON**

|                                                            | VH102Z                          |                                 | VHZ555                          |                                 |
|------------------------------------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
|                                                            | TYPICAL $\Delta R$              | MAXIMUM $\Delta R$              | TYPICAL $\Delta R$              | MAXIMUM $\Delta R$              |
| <b>Test Group I</b>                                        |                                 |                                 |                                 |                                 |
| Thermal Shock, 5 x (- 65 °C to + 150 °C)                   | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| Short Time Overload, 5 s (6.25 x rated power)              | $\pm 0.003\%$ (30 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.003\%$ (30 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| <b>Test Group II</b>                                       |                                 |                                 |                                 |                                 |
| Resistance Temperature Characteristics                     | See table 1                     | See table 1                     | See table 1                     | See table 1                     |
| Low Temperature Storage (25 h at - 65 °C)                  | $\pm 0.005\%$ (50 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.0025\%$ (25 ppm)         | $\pm 0.005\%$ (50 ppm)          |
| Low Temperature Operation (45 min, rated power at - 65 °C) | $\pm 0.005\%$ (50 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.005\%$ (50 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| Terminal Strength                                          | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| <b>Test Group III</b>                                      |                                 |                                 |                                 |                                 |
| DWV                                                        | $\pm 0.005\%$ (50 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.002\%$ (20 ppm)          | $\pm 0.005\%$ (50 ppm)          |
| Insulation Resistance                                      | 40 x 10 <sup>5</sup> M $\Omega$ | 40 x 10 <sup>5</sup> M $\Omega$ | 40 x 10 <sup>5</sup> M $\Omega$ | 40 x 10 <sup>5</sup> M $\Omega$ |
| Resistance to Solder Heat , 20 s at + 260 °C               | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| Moisture Resistance                                        | $\pm 0.005\%$ (50 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.005\%$ (50 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| <b>Test Group IV</b>                                       |                                 |                                 |                                 |                                 |
| Shock                                                      | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| Vibration                                                  | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          | $\pm 0.002\%$ (20 ppm)          | $\pm 0.01\%$ (100 ppm)          |
| <b>Test Group V</b>                                        |                                 |                                 |                                 |                                 |
| Life Test at 0.3 W/+ 125 °C                                |                                 |                                 |                                 |                                 |
| 2000 h                                                     | $\pm 0.005\%$ (50 ppm)          | $\pm 0.015\%$ (150 ppm)         | $\pm 0.005\%$ (50 ppm)          | $\pm 0.015\%$ (150 ppm)         |
| 10 000 h                                                   | $\pm 0.015\%$ (150 ppm)         | $\pm 0.05\%$ (500 ppm)          | $\pm 0.015\%$ (150 ppm)         | $\pm 0.05\%$ (500 ppm)          |
| <b>Test Group Va</b>                                       |                                 |                                 |                                 |                                 |
| Life test at 0.6 W (2 x rated power)/ + 70 °C, 2000 h      | $\pm 0.005\%$ (50 ppm)          | $\pm 0.015\%$ (150 ppm)         | $\pm 0.005\%$ (50 ppm)          | $\pm 0.015\%$ (150 ppm)         |
| <b>Test Group VI</b>                                       |                                 |                                 |                                 |                                 |
| High Temperature Exposure (2000 h at + 150 °C)             | $\pm 0.05\%$ (500 ppm)          | $\pm 0.1\%$ (1000 ppm)          | $\pm 0.04\%$ (400 ppm)          | $\pm 0.1\%$ (1000 ppm)          |
| <b>Test Group VII</b>                                      |                                 |                                 |                                 |                                 |
| Voltage Coefficient                                        | < 0.00001 %/V                   | < 0.00001 %/V                   | < 0.00001 %/V                   | < 0.00001 %/V                   |

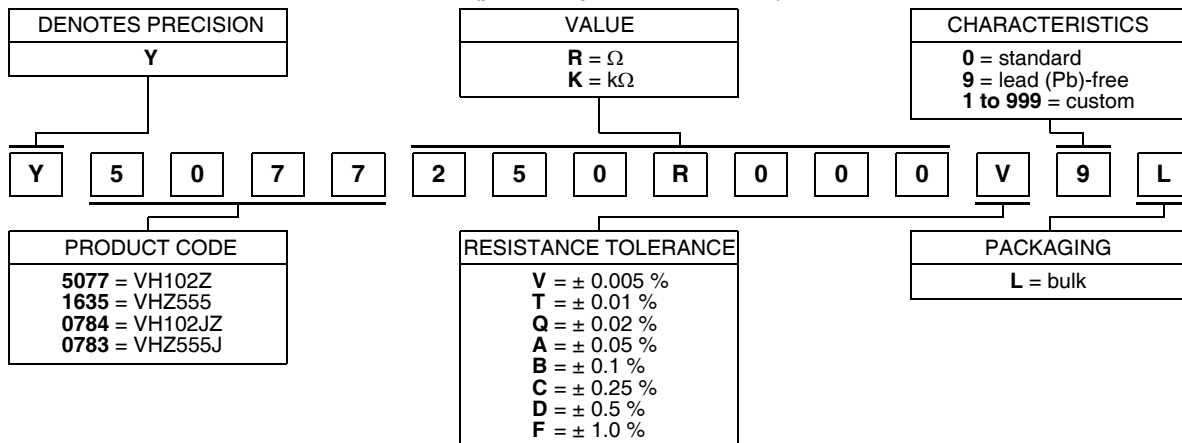
**TABLE 5 - EXAMPLES OF NON-STANDARD REQUIREMENTS <sup>(1)</sup>**

| TYPE   | VALUE | TOLERANCE |
|--------|-------|-----------|
| VH102Z | 4R    | 0.05 %    |
|        | 7R68  | 0.05 %    |
|        | 10R   | 0.01 %    |
|        | 16R   | 0.005 %   |
|        | 39R20 | 0.005 %   |

**Note**
<sup>(1)</sup> PMO is optional for improved stability

**TABLE 6 - GLOBAL PART NUMBER INFORMATION <sup>(1)</sup>**

**NEW GLOBAL PART NUMBER: Y5077250R000V9L (preferred part number format)**



FOR EXAMPLE: ABOVE GLOBAL ORDER Y5077 250R000 V 9 L:

TYPE: VH102Z

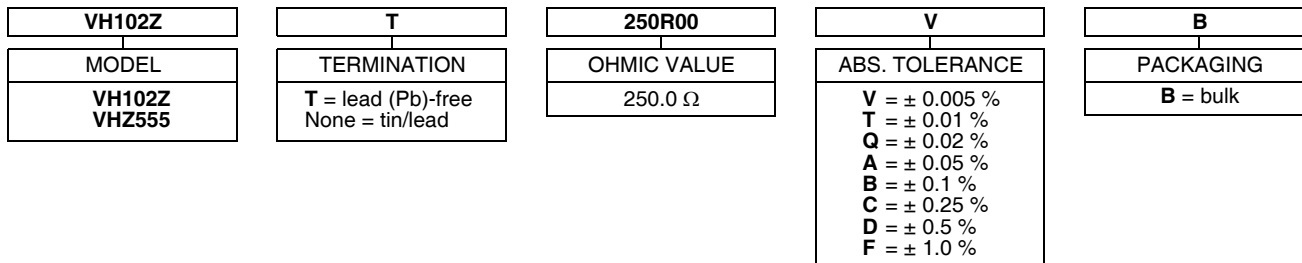
VALUE: 250.0  $\Omega$

ABSOLUTE TOLERANCE:  $\pm 0.005\%$

TERMINATION: lead (Pb)-free

PACKAGING: bulk

**HISTORICAL PART NUMBER: VH102Z T 250R00 V B (will continue to be used)**



**Note**

<sup>(1)</sup> For non-standard requests, please contact application engineering

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