New Generation of Secondary Standards Hermetically Sealed Construction Ultra High Precision Z-Foil Technology Resistors

with TCR of ±0.2 ppm/°C, Tolerance of ±0.005% and Load Life Stability of ±0.005% for 10 000 h (Metrology, Laboratory, Instrumentation, Industrial)

Pb-free Available

RoHS* COMPLIANT

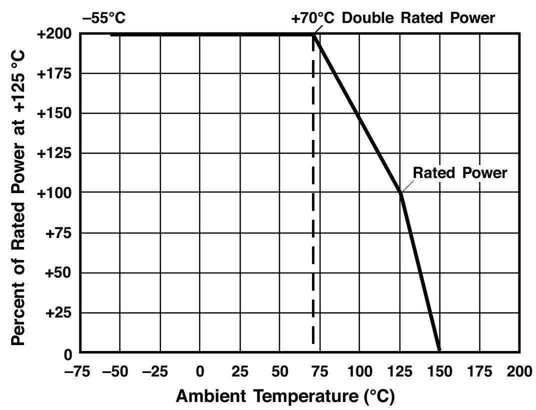
FEATURES

- Temperature coefficient of resistance (TCR): ±0.2 ppm/°C typical (–55°C to +125°C, +25°C ref.). For ultra high performances (instrumentation and metrology) please contact us
- Load life stability to ±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)**
- Resistance range: 5 Ω to 121 kΩ (higher or lower values of resistance available)
- **Power coefficient "ΔR due to self heating":** 5 ppm at rated power with the Z-Foil technology
- **Tolerance: to ±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 μV/°C maximum, 0.05 μV/°C typical 1 μV/°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 μV_{RMS}/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 μH
- 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@vpgsensors.com
- For better performances (values, TCR, tolerance, stability), please contact us

Table 1 – TCR vs. Resistance Value

MODEL	VALUE	STANDARD TOLERANCE	TYP. TCR AND MAX. SPREAD –55°C TO +125°C (+25°C ref.)[(2)]
VH102Z	100 Ω to 100 kΩ	±0.005%	±0.2±0.6 ppm/°C
	80 Ω to <100 Ω	±0.005%	±0.2±0.8 ppm/°C
	50 Ω to <80 Ω	±0.01%	±0.2±1.0 ppm/°C
	25 Ω to <50 Ω	±0.01%	±0.2±1.3 ppm/°C
	10 Ω to <25 Ω	±0.02%	±0.2±1.6 ppm/°C
VHZ555 (PMO)[(1)]	80 Ω to 121 kΩ	±0.005%	±0.2±1.8 ppm/°C
	30.1 Ω to 80 Ω	±0.005%	±0.2±2.3 ppm/°C
	20 Ω to <30.1 Ω	±0.01%	±0.2±2.3 ppm/°C
	4.99 Ω to <20 Ω	±0.05%	±0.2±2.8 ppm/°C

Figure 1 – Power Derating Curve



Notes

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

(1) 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

(2) TCR of ±0.2 ppm/°C Max. is achievable per special request

Table 2 – Specifications[1]				
MAXIMUM WORKING VOLTAGE	RESISTANCE VALUE	AMBIENT POWER RATING		AVERAGE WEIGHT
		at +70°C	at +125°C	
300 V	≤100K	0.6 W	0.3 W	1.4 g
	>100K	0.4 W	0.2 W	

Note

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

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.

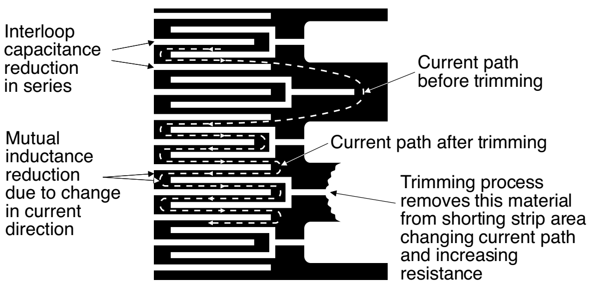
Rubber fill between the metal housing and resistance element acts both as a mechanical damper and thermal transfer path. VH102Z is the hermetically-sealed counterpart of the Z201 high-performance molded resistors. VHZ555 is the hermetically-sealed version of the Z555, MIL style RNC90Z (ER).

The VHZ Series is 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 VFR 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

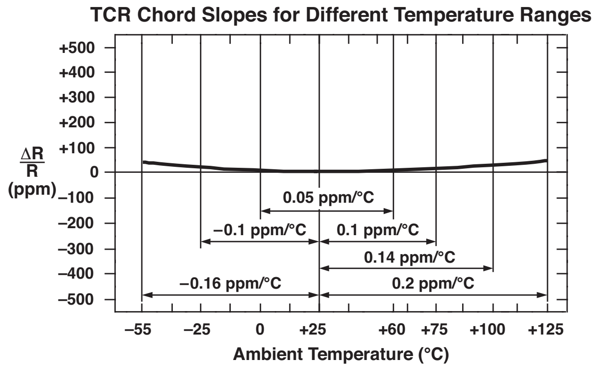


Foil shown in black, etched spaces in white

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 Bulk Metal® Foil resistors.

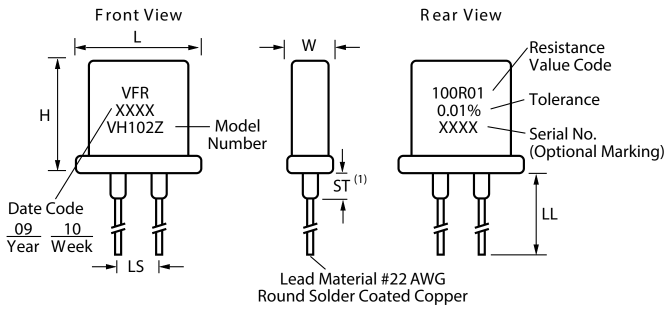
Figure 3 – Typical Resistance/Temperature Curve (Z-Foil)



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. 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 VFR 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
Inches	0.185 max.	0.435 max.	0.430 max.	1±0.125	0.150±0.010	0.095 max.
Millimeters	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 in 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 in lead spacing, specify VH102JZ or VHZ555J

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

Table 3 – Load Life Stability

	VH102Z/VHZ555	
	TYPICAL ΔR LIMITS	**MAXIMUM ΔR LIMITS**
0.3 W at +125°C/0.6 W at +70°C 2000 h 10 000 h	±0.005% (50 ppm) ±0.015% (150 ppm)	±0.015% (150 ppm) ±0.05% (500 ppm)
0.15 W at +70°C 2000 h 10 000 h	±0.002% (20 ppm) ±0.005% (50 ppm)	±0.01% (100 ppm) ±0.015% (150 ppm)

Table 4 – Environmental Performance Comparison

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

Table 5 – Examples of Non-Standard Requirements[(1)]

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

Note

(1) PMO is optional for improved stability

Table 6 – Global Part Number Information[1]

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

Y	5	0	7	7	2	5	0	R	0	0	0	V	9	L

DENOTES PRECISION
- **Y**

VALUE
- **R** = Ω
- **K** = kΩ

CHARACTERISTICS
- **0** = standard
- **9** = lead (Pb)-free
- **1 to 999** = custom

PRODUCT CODE
- **5077** = VH102Z
- **1635** = VHZ555
- **0784** = VH102JZ
- **0783** = VHZ555J

RESISTANCE TOLERANCE
- **V** = ±0.005%
- **T** = ±0.01%
- **Q** = ±0.02%
- **A** = ±0.05%
- **B** = ±0.1%
- **C** = ±0.25%
- **D** = ±0.5%
- **F** = ±1.0%

PACKAGING
- **L** = bulk

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

TYPE: VH102Z
VALUE: 250.0 Ω
ABSOLUTE TOLERANCE: ±0.005%
TERMINATION: lead (Pb)-free
PACKAGING: bulk

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

VH102Z	**T**	**250R00**	**V**	**B**
MODEL	TERMINATION	OHMIC VALUE	ABS. TOLERANCE	PACKAGING
VH102Z **VHZ555**	**T** = lead (Pb)-free None = tin/lead	250.0 Ω	**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

Note

[1] For non-standard requests, please contact application engineering.

Disclaimer

ALL PRODUCTS, PRODUCT SPECIFICATIONS AND DATA ARE SUBJECT TO CHANGE WITHOUT NOTICE.

Vishay Precision Group, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, “VPG”), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

The product specifications do not expand or otherwise modify VPG’s terms and conditions of purchase, including but not limited to, the warranty expressed therein.

VPG makes no warranty, representation or guarantee other than as set forth in the terms and conditions of purchase. **To the maximum extent permitted by applicable law, VPG disclaims (i) any and all liability arising out of the application or use of any product, (ii) any and all liability, including without limitation special, consequential or incidental damages, and (iii) any and all implied warranties, including warranties of fitness for particular purpose, non-infringement and merchantability.**

Information provided in datasheets and/or specifications may vary from actual results in different applications and performance may vary over time. Statements regarding the suitability of products for certain types of applications are based on VPG’s knowledge of typical requirements that are often placed on VPG products. It is the customer’s responsibility to validate that a particular product with the properties described in the product specification is suitable for use in a particular application. You should ensure you have the current version of the relevant information by contacting VPG prior to performing installation or use of the product, such as on our website at vpgsensors.com.

No license, express, implied, or otherwise, to any intellectual property rights is granted by this document, or by any conduct of VPG.

The products shown herein are not designed for use in life-saving or life-sustaining applications unless otherwise expressly indicated. Customers using or selling VPG products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify VPG for any damages arising or resulting from such use or sale. Please contact authorized VPG personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.