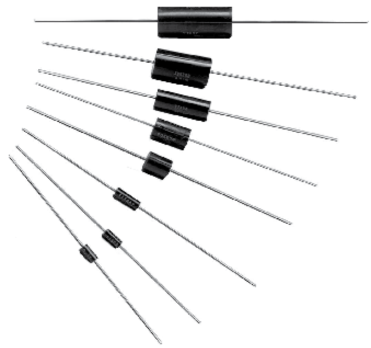
Ultra High-Precision COTS Bulk Metal® Z-Foil Technology Tubular Axial Lead Resistors with TCR of ±0.05 ppm/°C, Tolerance to ±0.01% and Load-Life Stability of ±0.005%

FEATURES

- Temperature coefficient of resistance (TCR): ±0.2 ppm/°C nominal (–55°C to +125°C, +25°C Ref.) ±0.05 ppm/°C ty nominal (0°C to +60°C) (see Table 1)
- Resistance range: 5 Ω to 300 kΩ
- 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)
- Tolerance: to ±0.01%
- Load-life stability: ±0.005% (50 ppm) at 70°C, 2000 h at rated power
- Electrostatic discharge (ESD): up to 25 000 V
- Power rating: 0.2 W to 1.0 W at 70°C
- Rise time: 1 ns effectively no ringing
- Non-inductive, non-capacitive design (low noise)
- Thermal EMF: 0.1 μV/°C maximum, 0.05 μV/°C typical
- Voltage coefficient: <0.1 ppm/V
- Thermal stabilization time: <1 s (to reach within 10 ppm of steady state value)
- Terminal finish: lead (Pb)-free, tin/lead
- Compliant to RoHS directive 2002/95/EC
- For better performances, please contact application engineering
- Prototype quantities available in just 5 working days or sooner. For more information, please contact us.



Pb-free Available

RoHS* COMPLIANT

INTRODUCTION

The VTA series of Bulk Metal® Foil resistors are a superior substitute for wirewound and metal film resistors and are offered in configurations common to wirewound and metal film resistors for direct replacement with better performance. Bulk Metal Foil resistors operate at higher frequencies with higher speed, lower inductance, lower capacitance and smaller phase angles than wirewounds and metal film but also provide higher power density, lower TCR (temperature coefficient of resistance) better load-life stability, and lower current noise. Compared to thin film resistors in similar packaging, the thin films have higher resistance in smaller packages but are significantly worse than foils in all operating characteristics.

Additionally, wirewounds are not practically available in large ranges in the chip format used in most assembly processes. Foil resistors are available in both configurations and can be substituted for wirewounds in the cylindrical axial lead configuration of the VTA series and later switched to the chip configurations with no electrical re-design required—direct substitution/direct conversion.

TCR matching/tracking in wirewounds is especially difficult when the resistors are of unequal values. Same values can be selected for TCR tracking at an extra cost and must be packaged and handled with care to avoid mixing. As resistance values diverge, however, there must be different lengths of the same wire for near values but values of greater divergence require different body sizes or different wire diameters. These components, then, though matched for TCR, respond differently through almost all other performance criteria with consequent deterioration of ratios in other critical areas such as load-life, temperature cycling, etc.

Foil resistors, on the other hand, have the same inherently very low TCR for all values above 100-ohms and all track better than wirewounds without the selection, packaging, and handling costs of wirewounds.

Our applications engineering department is available at foil@vishaypg.com to advise and assist regarding recommendations and selections.

TABLE 1—MAXIMUM TCR PPM/°C AND MAXIMUM SPREAD(1)

Values	–55°C to +125°C, +25°C Ref.
5R to <15R	±0.2 ±4.8
15R to <25R	±0.2 ±3.8
25R to <50R	±0.2 ±2.8
50R to <100R	±0.2 ±2.3
>100R	±0.2 ±1.8

Note

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

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

VISHAY PRECISION GROUP

FIGURE 1—POWER DERATING CURVE

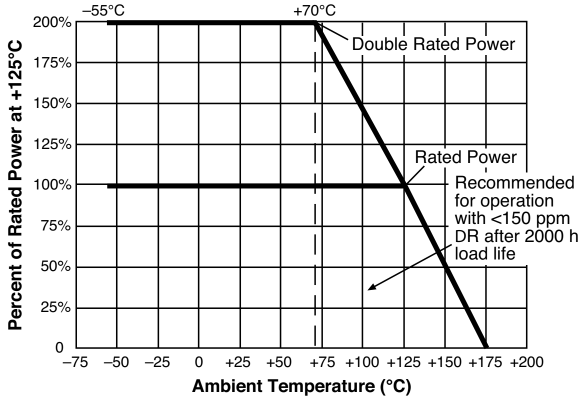


FIGURE 2—NOMINAL RESISTANCE/TEMPERATURE CURVE

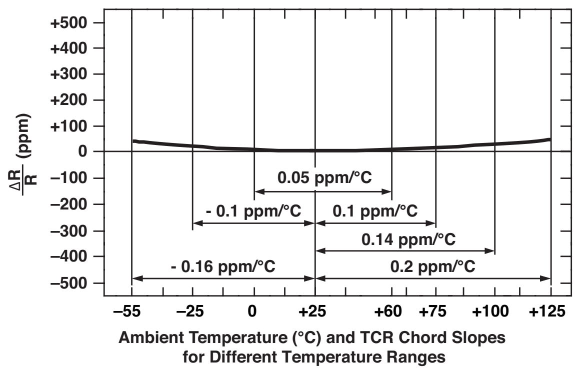
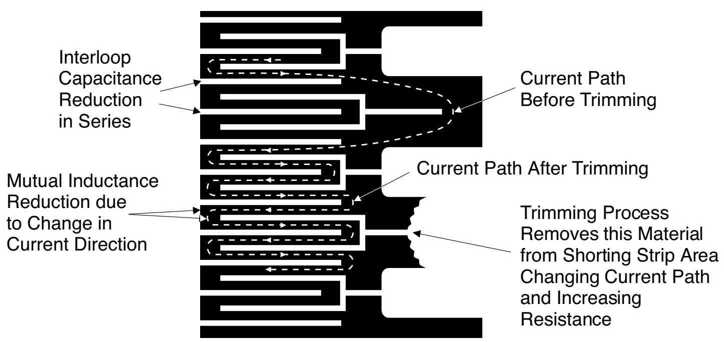


TABLE 2—MODEL SELECTION

Model	MIL Style	Power		Maximum Working Voltage	Resistance Range (Ω)	Tightest Tolerance
		at +70°C	at +125°C			
VTA57Z	RBR57	0.25 W	0.125 W	160 V	5 to 24R9 25 to 100k	±0.1% ±0.01%
VTA56Z	RBR56	0.25 W	0.125 W	160 V	5 to 24R9 25 to 100k	±0.1% ±0.01%
VTA55Z	RBR55	0.3 W	0.15 W	175 V	5 to 24R9 25 to 100k	±0.1% ±0.01%
VTA54Z	RBR54	0.5 W	0.25 W	300 V	5 to 24R9 25 to 200K	±0.1% ±0.01%
VTA53Z	RBR53	0.66 W	0.33 W	350 V	5 to 24R9 25 to 200K	±0.1% ±0.01%
VTA52Z	RBR53	1.0 W	0.5 W	350 V	5 to 24R9 25 to 300K	±0.1% ±0.01%
VMTA55Z	RNC55	0.2 W	0.1 W	75 V	5 to 49R9 50 to 30K	±0.1% ±0.01%
VMTB60Z	RNC60	0.25 W	0.125 W	125 V	5 to 49R9 50 to 60K	±0.1% ±0.01%

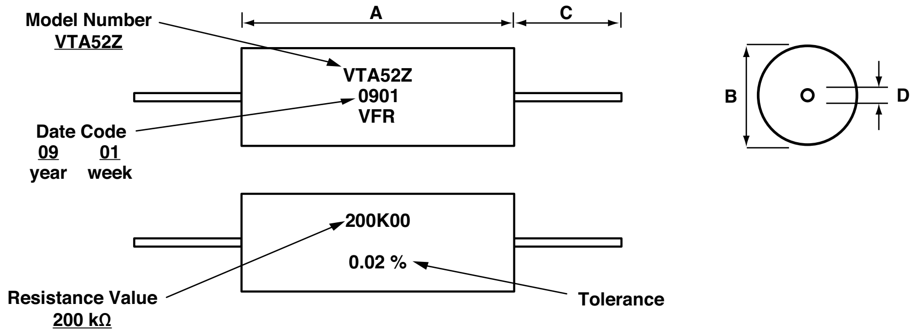
FIGURE 3—TRIMMING TO VALUES
(conceptual illustration)



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 the Vishay Foil resistors.

TABLE 3—VTAZ/VMTAZ SERIES STANDARD PRINTING / DIMENSIONS in Inches and Millimeters



Model	MIL Size	Body								Lead			
		Length (A)				Diameter (B)				Length (C)		Diameter (D)	
		Inch		mm		Inch		mm		Inch	mm	Inch	mm
VTA57Z	RBR57	0.374	+0.020 −0.020	9.5	±0.05	0.189	+0.008 −0.008	4.80	±0.2	1.5 min.	38.10	0.025	0.64
VTA56Z	RBR56	0.356	+0.005 −0.010	9.04	+0.13 −0.25	0.260	+0.005 −0.015	6.60	+0.13 −0.38	1.5 min.	38.10	0.032	0.81
VTA55Z	RBR55	0.500 ±0.020		12.70 ±0.51		0.260	+0.005 −0.010	6.60	+0.13 −0.25	1.5 min.	38.10	0.032	0.81
VTA54Z	RBR54	0.750	+0.020 −0.032	19.05	+0.51 −0.81	0.260	+0.005 −0.010	6.60	+0.13 −0.25	1.5 min.	38.10	0.032	0.81
VTA53Z	RBR53	0.750 ±0.020		19.05 ±0.51		0.375	±0.015	9.53	±0.38	1.5 min.	38.10	0.032	0.81
VTA52Z	RBR52	1.000	+0.020 −0.032	25.40	+0.51 −0.81	0.375	±0.015	9.53	±0.38	1.35 min.	34.29	0.032	0.81
VMTA55Z	RNC55	0.270 ±0.005		6.86 ±0.13		0.120	+0.005 −0.010	3.05	+0.13 −0.25	1.5 min.	38.10	0.025	0.64
VMTB60Z	RNC30	0.375 ±0.005		9.53 ±0.13		0.160	±0.005	4.06	±0.13	1.5 min.	38.10	0.025	0.64

POST MANUFACTURING OPERATIONS (PMO)

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.

SHUNT CALIBRATION

Shunt calibration of a Wheatstone bridge strain gage circuit is a common and convenient method of periodically monitoring the gain or span of a signal conditioner being used in conjunction with a strain gage based transducer. A fixed precision resistor such as the leaded VTAZ-Series is placed, or “shunted,” across one leg of the Wheatstone bridge. This doesn’t amount to a complete calibration, since no mechanical pressure is actually applied. Instead, the shunt calibration provides a simulation of the mechanical input to a transducer by unbalancing the bridge and providing a scenario that shows how to reduce the errors and shifts associated with the electrical characteristics of the strain gages and the connected electrical components. The shunt resistor that is added in parallel to the strain gages simulates what would happen if a real load were measured by the pressure transducer or any other load cell configuration.

IMPROVED PERFORMANCE TESTING (IPT)

The preceding information is based on product directly off the production line. Improved performance (meaning increased time stability with load and other stresses) is available through factory conducted “Improved Performance Testing”. The test routine is usually tailored to the user’s stability objectives and IPT-processed resistors can exhibit improved load-life stability levels of less than 50 ppm.

Various screen test routines are available and all anticipated stresses must be taken into account before settling on one specific test routine. VFR’s application engineering department is prepared to discuss and recommend appropriate routines given the full spectrum of anticipated stresses and stability requirements.

HARMONIC DISTORTION

Harmonic distortion is an important consideration in the choice of precision resistors for sensitive applications. A significant signal voltage across the resistor may change the resistance value depending on the construction, material, and size. Under these conditions Bulk Metal® Foil resistors behave more linearly than other resistor types.

RELATED VIDEO

Refer to Using BMF Precision Resistors to Calibrate RTD Measurements (Demo Video).

TABLE 4—CHARACTERISTICS OF DIFFERENT TYPES OF RESISTORS FOR LITHIUM-ION BATTERY CIRCUITS

Technology	Temperature Coefficient of Resistance (TCR) –55°C to +125°C, +25°C ref.	Initial Tolerance	End of Life Tolerance	Load Life Stability at +70°C, Rated Power 2000 Hours and 10,000 Hours	ESD (V)	Thermal Stabilization	Noise (dB)
Bulk Metal® Foil	**±0.2 ppm/°C**	**From 0.001%**	**<0.05%**	**0.005% (50 ppm) 0.01% (100 ppm)**	**25,000**	**<1 second**	**–42**
Thin Film	±10-25 ppm/°C	From 0.05%	<0.4%	0.05% (500 ppm) 0.15% (1500 ppm)	2500	>few minutes	–20
Thick Film	±75-100 ppm/°C	From 0.5%	<5%	0.5% (5000 ppm) 2% (20,000 ppm)	2000	>few minutes	+20
Wirewound	±3 ppm/°C	From 0.005%	<0.5%	0.05% (500 ppm) 0.15% (1500 ppm)	25,000	>few minutes	–35

TABLE 5—GLOBAL PART NUMBER INFORMATION(1)

NEW GLOBAL PART NUMBER: Y009320K1230Q9L (preferred part number format)

Y	0	0	9	3	2	0	K	1	2	3	0	Q	9	L

DENOTES PRECISION
Y

VALUE
R = Ω
K = kΩ

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

PRODUCT CODE
0090 = VTA52Z
0091 = VTA53Z
0092 = VTA54Z
0093 = VTA55Z
0095 = VTA56Z
0072 = VTA57Z
0096 = VMTA55Z
0097 = VMTB60Z

RESISTANCE TOLERANCE
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 Y0093 20K1230 Q 9 L:

TYPE: VTA55Z
VALUE: 20.123 kΩ
ABSOLUTE TOLERANCE: ±0.02%
TERMINATION: lead (Pb)-free
PACKAGING: bulk

Note
(1) For non-standard requests, please contact Application Engineering

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[>>Vishay(威世)]