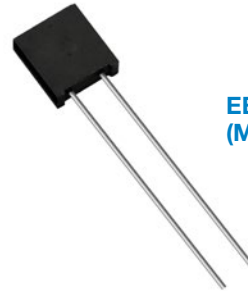


The 303143 Series Ultra High-Precision Fixed Resistor Z-Foil Z201

Screen/Test Flow as modified from S-311-P813 Proposed by NASA

FEATURES AND BENEFITS

- **Temperature coefficient of resistance (TCR):**
± 0.2 ppm/°C typical (-55°C to +125°C, 25°C ref.)
- Power coefficient of resistance “ΔR due to self heating”:
±5 ppm at rated power
- Power rating: 0.6 W at +70°C; 0.3 W at 125°C
- Resistance tolerance: to ±0.005%
- Load-life stability: ±0.005% max ΔR after 2000 h of
0.1 W at +70°C
- Resistance range: 10 Ω to 100 kΩ
- Electrostatic discharge (ESD): at least to 25 kV
- Non-inductive, non-capacitive design
- Rise time: 1.0 ns effectively no ringing
- Current noise: 0.010 μV_{RMS}/V of applied voltage
(<-40 dB)
- Thermal EMF: 0.1 μV/°C max.; 0.05 μV/°C typical
- Voltage coefficient: <0.1 ppm/V
- Low inductance: 0.08 μH
- Terminal finish: tin/lead alloy
- Maximum working voltage: 245 V
- Drop in replacement for S102C/K
- Matched sets are available per request
- For non-flight (prototype) units, append a “U” to the
model number (example: 303143U). These units
include only the 100% Group A screening requirements
(Table 4, page 4). For more information, please contact
foil@vpgsensors.com
- VFR resistors are not restricted to standard values;
specific “as required” values can be supplied at no
extra cost or delivery (e.g., 80R0123 vs. 80 Ω)
- Thermal stabilization time: <1 s (within 10 ppm of
steady state value)
- Low harmonic distortion, linear behavior



EEE-INST-002
(MIL-PRF-55182)

INTRODUCTION

The 303143 Series Bulk Metal® Z-Foil resistors represent the third in a series of ultra-precision resistors since the first Bulk Metal Foil resistor was introduced by Vishay in 1962. Each represents an improvement on the earlier model. The typical TCR of the 303143 is 0.2 ppm/°C (-55°C to +125°C, +25°C ref.) and is an order of magnitude better than the original S102C. The Bulk Metal Z-Foil resistor is the ultimate choice in the most demanding analog applications.

The Z-Foil technology provides a significant reduction of the resistive component’s sensitivity to ambient temperature variations (TCR) and applied power changes (PCR). Designers can now guarantee a high degree of stability and accuracy in fixed-resistor applications using solutions based on Vishay Foil Resistors (VFR) revolutionary Z-Foil technology.

Our application engineering department is available to advise and to make recommendations.

Table 1 – Tolerance and TCR vs. Resistance		
Resistance Value Ω	Tightest Absolute Tolerance (%)	Typical TCR and Max. Spread -55°C to +125°C (+25°C ref.) (ppm/°C)
50 to 100k	±0.005	±0.2 ±1.8 ppm/°C
25 to <50	±0.01	30.1 Ω to <50 Ω: ±0.2 ±1.8 ppm/°C 10 Ω to <30.1 Ω: ±0.2 ±2.8 ppm/°C
10 to <25	±0.05	

Figure 1 – Power Derating Curve

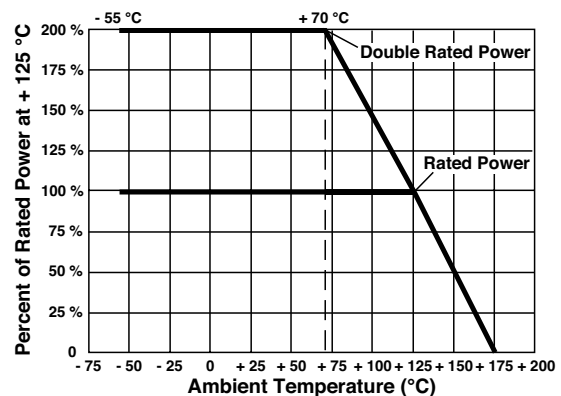


Figure 2 – Trimming to Values (conceptual illustration)

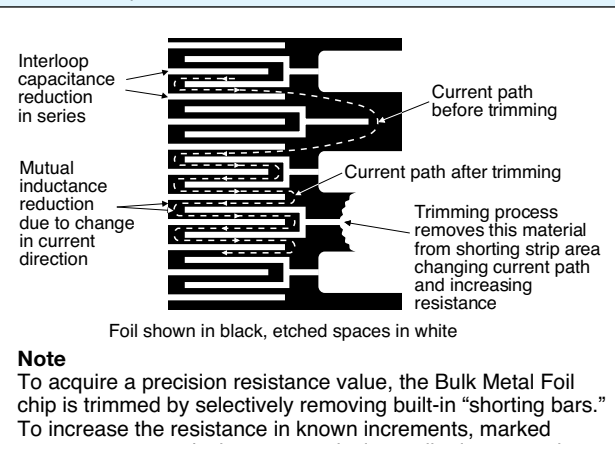


Figure 3 – Nominal Resistance/Temperature Curve

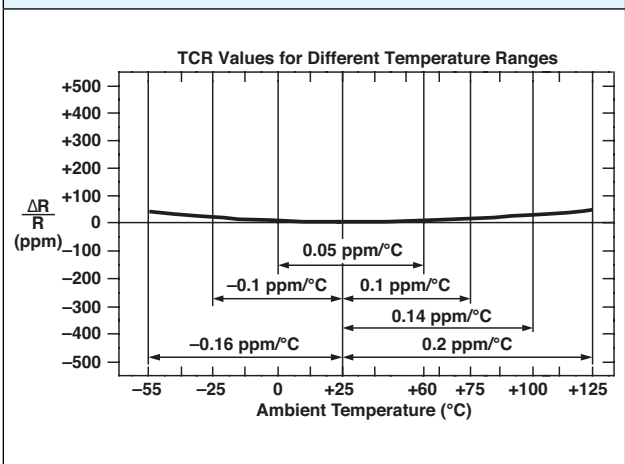
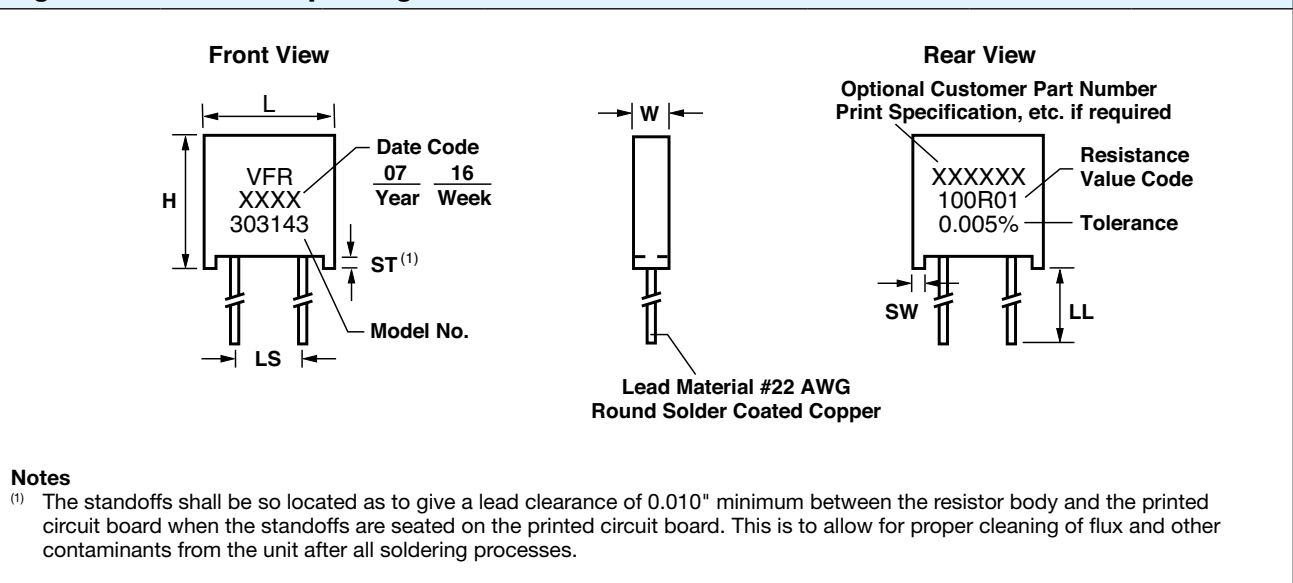


Figure 4 – Standard Imprinting and Dimensions



MODEL	LS	W	L	H	ST	SW	LL
	inches/mm						
303143	0.150 ±0.005 3.81 ±0.13	0.105 ±0.010 2.67 ±0.25	0.300 ±0.010 7.62 ±0.25	0.326 ±0.010 8.28 ±0.25	0.010 min 0.254 min	0.040 ±0.005 1.02 ±0.13	1.000 ±0.125 25.4 ±3.18
303143L	0.200 ±0.005 5.08 ±0.13						

Table 2—Stability Specifications

Load Life at 2000 h	±0.005% max. ΔR (0.1 W/+70°C)	±0.015% max. ΔR (0.3 W/+125°C)
Load Life at 10 000 h	±0.01% max. ΔR (0.05 W/+125°C)	±0.05% max. ΔR (0.3 W/+125°C)

Table 3—Environmental Performance

Group/Parameter	MIL-PRF-55182	303143 Series	
		Maximum ΔR	Nominal ΔR
Test Group I Thermal shock Short time overload	±0.2% ±0.2%	±0.01% (100 ppm) ±0.03% (300 ppm)	± 0.002 % (20 ppm) ± 0.003 % (30 ppm)
Test Group II Resistance Temperature Characteristic Low temperature storage Low temperature operation Terminal strength	±25 ppm/°C ±0.15% ±0.15% ±0.2%	see Table 1 ±0.01% (100 ppm) ±0.01% (100 ppm) ±0.01% (100 ppm)	±0.05 ppm/°C (0°C to +60°C) ±0.002% (20 ppm) ±0.002% (20 ppm) ±0.002% (20 ppm)
Test Group III Dielectric Withstanding Voltage (DWV) Resistance to solder heat Moisture resistance	±0.15% ±0.1% ±0.4%	±0.01% (100 ppm) ±0.01% (100 ppm) ±0.02% (200 ppm)	±0.002% (20 ppm) ±0.005% (50 ppm) ±0.01% (100 ppm)
Test Group IV Shock Vibration	±0.2% ±0.2%	±0.01% (100 ppm) ±0.01% (100 ppm)	±0.002% (20 ppm) ±0.002% (20 ppm)
Test Group V Life test at 0.3 W/+125°C	2000 h 10 000 h	±0.5% ±2.0%	±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		±0.5%	±0.015% (150 ppm)
Test Group VI High temperature exposure		±2.0%	±0.05% (500 ppm)
Test Group VII Voltage coefficient		0.005%/V	<0.00001% <0.00001%/V

STANDARD MEASUREMENT (AT ROOM TEMPERATURE)

Standard Test Conditions:

- Temperature: +23°C ±2°C
- Relative humidity: 35% RH to 65% RH
- Lead test point: 0.5" (12.7 mm) from resistor body

NOTES

- For unqualified pre-flight or prototype units, use models 303143U, 303143LU which include only the 100% Group A screening requirements
- For units with 2000-hour load life testing only, use Models 303143R, 303143LR.
- Measurement error allowed for ΔR limits: 0.01 Ω

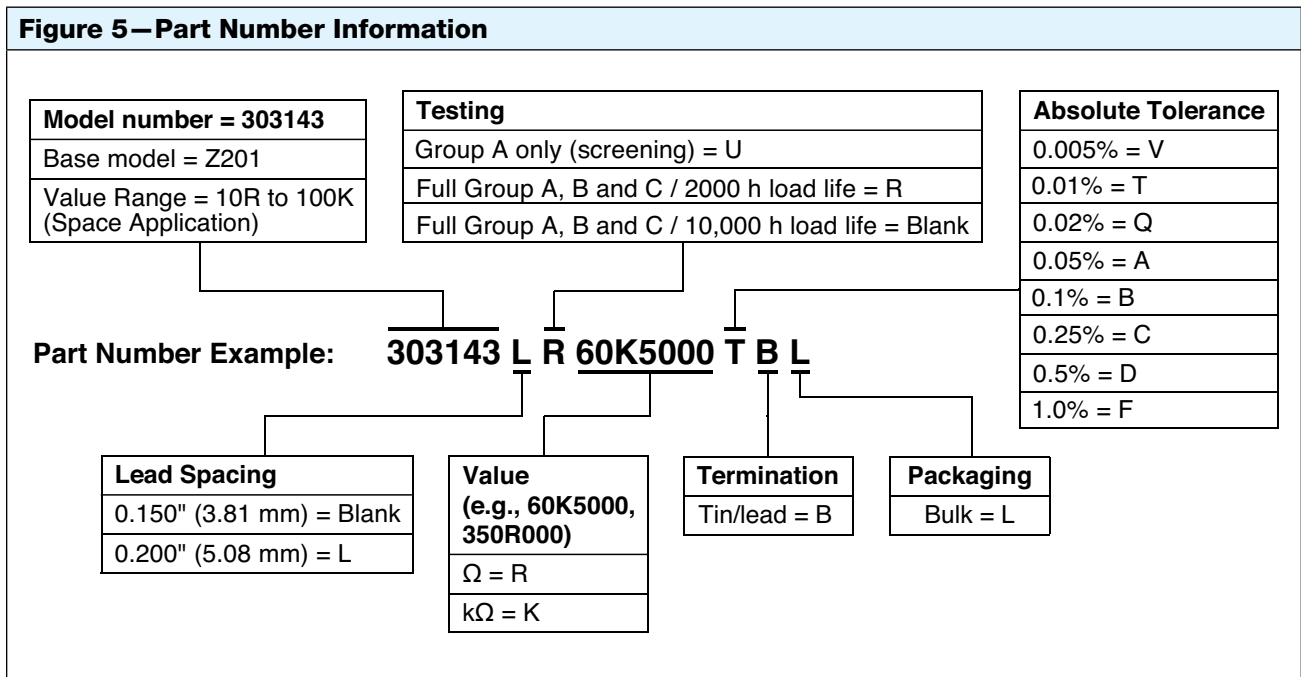
Table 4—Screening and Environmental Tests

Group A			
Subgroup 1	100%		
	RC record—in tolerance		
	Thermal shock (MIL-STD-202 method 107 condition F-1)	25 x, -65°C, +150°C	
	Overload (+25°C, 6.25 x rated power, 5 s)	RC record—in tolerance, $\Delta R = 0.03\%$	
	Power conditioning (+125°C, 0.3 W, 100 h, not to exceed 245 V)	RC record—in tolerance, $\Delta R = 0.05\%$	
	Visual inspection		
Final inspection	PDA—5% on $\Delta R = 0.05\%$		
Subgroup 2	Sample size: 6 pieces, any value, electrical rejects allowed		
	Solderability		
Subgroup 3	Sample size: 3 pieces, any value, non destructive		
	Mechanical/dimensional evaluation		
Final Group A inspection			
Group B			
Subgroup 1	Sample size: 13 pieces or 100 %, any value, zero rejects allowed		
	TCR (MIL-STD-202 method 304 with the following exceptions)	Must maintain temperature for 30 min to 45 min before measurement	
		First test temperatures, +25°C, -15°C, -55°C	
		Second test temperatures, +25°C, +65°C, +125°C	
	+25°C to be used as reference reading		
Subgroup 2	Sample size: 8 pieces, any value, zero rejects allowed		
	Resistance to solvents		
Group C			
Group A and B testing required			
Subgroup 1A: Models 303143R, 303143LR	Sample size: 12 pieces (6 of the highest value, 6 of the lowest value), 0 rejects		
	Life (+125°C, 0.3 W, not to exceed max. voltage 245 V, 2000 h)	RC record at 250 h, 500 h, 1000 h, and 2000 h Maximum ΔR —0.015% for 2000 h (ref. R1)	
Subgroup 1B: Models 303143, 303143L	Sample size: 12 pieces (6 of the highest value, 6 of the lowest value), 0 rejects		
	Life (+125°C, 0.3 W, not to exceed max. voltage 245 V, 10 000 h)	RC record at 250 h, 500 h, 1000 h, 2000 h, 4000 h, 6000 h, 8000 h, and 10 000 h Maximum ΔR —0.015% for 2000 h, 0.05 % for 4000 h up to 10 000 h (ref. R1)	
Subgroup 2	Sample size: 10 pieces (5 high, 5 low), 1 reject allowed		
	Resistance to soldering heat (conditions A and C), max. $\Delta R = 0.01\%$		
	Moisture resistance, max. $\Delta R = 0.02\%$	DWV (300 VRMS, 100 V/s, 1 min, $\Delta R = 0.01\%$) Insulation resistance (500 VDC, 2 min, 100 M Ω)	
Subgroup 3	Sample size: 12 pieces (6 high, 6 low), 1 reject allowed		
	Dielectric withstanding voltage (DWV) (MIL-STD-202 method 301)	300 VRMS, 100 V/s, 1 min (with special fixture requirements)	
		RC record - $\Delta R = 0.01\%$	
	Insulation resistance (MIL-STD-202 method 302)	Same fixture requirements as DWV	
		500 VDC, 2 min	
		10 000 M Ω min.	
	Low temperature storage (LTS) (-65°C , 24 h, 0 W)		
Low temperature operation (LTO) (-65 °C, 45 min, rated V, not to exceed P)	RC record— $\Delta R = 0.01\%$ for both LTS and LTO		
Terminal strength (MIL-STD-202 method 211)	Pull test (condition A, 2 lbf, 5 s to 10 s) Twist test (condition D): RC record— $\Delta R = 0.01\%$		

Table 4—Screening and Environmental Tests (continued)	
Subgroup 4	Sample size: 9 pieces (any value), 0 rejects
	Shock (method 213, condition I—100G, 6 ms, sawtooth), $\Delta R = 0.01\%$
	Vibration (method 204, condition D, 10 Hz to 2 kHz, 20G), $\Delta R = 0.01\%$
Subgroup 5	Sample size: 5 pieces (any value), 0 rejects
	High temperature exposure (2000 h, +175°C, 0 W) RC record— $\Delta R = 0.05\%$

Table 5—Qualification (10R to 100K) (when required)	
Group 1	Group A
Group 2	Group B
Group 3	Sample size: 10 pieces (equally divided between highest and lowest values), 1 reject
	TCR (per group B conditions)
	Low temperature storage (LTS)
	Low temperature operation (LTO) RC record— $\Delta R = 0.01\%$ for LTS and LTO
	Terminal strength (per group C conditions) Pull test (condition A, 2 lbs, 5 s to 10 s) Twist test (condition D): RC record— $\Delta R = 0.01\%$
Group 4	Sample size: 12 pieces (equally divided between highest and lowest values), 1 reject
	Dielectric withstanding voltage (DWV) (MIL-STD-202 method 301) 300 VRMS, 100 V/s, 1 min RC record— $\Delta R = 0.01\%$
	Insulation resistance (MIL-STD-202 method 302) 10 000 M Ω min 500 V _{DC} , 2 min
	Resistance to soldering heat ($\Delta R = 0.01\%$)
	Moisture resistance ($\Delta R = 0.05\%$) DWV (300 V, 1 min, $\Delta R = 0.01\%$) Insulation resistance (500 V _{DC} , 2 min, 100 M Ω)
Group 5	Sample size: 10 pieces (equally divided between highest and lowest values), 1 reject
	Shock (100 G, 6 ms, sawtooth condition I), $\Delta R = 0.01\%$
	Vibration (10 Hz to 2 kHz, condition D), $\Delta R = 0.01\%$
Group 6	Sample size: 10 pieces (equally divided between highest and lowest values), 1 reject
	Solderability Resistance to solvents
Group 7	Sample size: 10 pieces (equally divided between highest and lowest values), 1 reject
	High temperature exposure (2000 h, +175°C, 0 W), $\Delta R = 0.05\%$
Group 8	Sample size: 50 pieces (equally divided between highest and lowest values), 0 reject
	Life (+125°C, 0.3 W, not to exceed max. voltage 245 V, 10 000 h) RC record at 250 h, 500 h, 1000 h, 2000 h, 4000 h, 6000 h, 8000 h, and 10 000 h Maximum ΔR —0.015% for 2000 h, 0.05 % for 10 000 h
Group 9	Sample size: 30 pieces (high/low)
	Thermal shock—100 cycles, -65°C to +150°C, $\Delta R = 0.035\%$
Group 10	Sample size: 10 pieces (highest value only)
	Voltage coefficient ($\Delta R = 1$ ppm/V)

Figure 5 – Part Number Information



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