



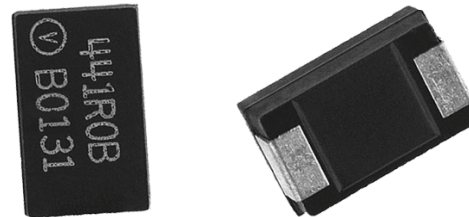
**THE DATASHEET OF  
Y17451K00000T9R**



## Models #303139 and #303140 – Molded Surface Mount Space and Military Grade Resistors SMRxZDZ with Screen/Test Flow in Compliance with EEE-INST-002, (Tables 2A and 3A, Film/Foil, Level 1) and MIL-PRF-55182

### FEATURES

- Temperature coefficient of resistance (TCR):  $\pm 0.2$  ppm/°C typical (–55°C to +125°C, +25°C ref.)
- Tolerance: to  $\pm 0.02\%$
- Power coefficient of resistance (PCR)
- “ $\Delta R$  due to self heating”: 5 ppm at rated power
- Flexible terminations ensure minimal stress transference from the PCB due to a difference in thermal coefficient of expansions (TCE)
- Electrostatic discharge (ESD): at least to 25 000 V
- Load life stability:  $\pm 0.005\%$  (70°C, 2000 h at rated power)
- Resistance range: 5  $\Omega$  to 40 k $\Omega$
- Vishay Foil resistors are not restricted to standard values; specific “as requested” values can be supplied at no extra cost or delivery (e.g., 1K2345 vs. 1K)
- Maximum power: to 600 mW at 70°C
- Non-inductive, non-capacitive design
- Current noise: –40 dB
- Voltage coefficient: <0.1 ppm/V
- Non-inductive: <0.08  $\mu$ H
- Non hot spot design
- Terminal finish; tin/lead alloy
- Matched sets with TCR tracking are available upon request
- For oriented performances, please contact us
- For prototype units, append a “U” to the model number (example: 303139U). These units pass all tests per table 3 (page 4) with no destructive qualification testing required (table 4, page 4). For more information, please contact: [foil@vpgsensors.com](mailto:foil@vpgsensors.com)



### INTRODUCTION

The 303139, 303140 are ultra high precision molded surface mountable resistors offering all the elements of precision; including low TCR, tight tolerance, long term stability, low noise, low thermal EMF, and non-measurable voltage coefficient. One of the important parameters influencing stability is the temperature coefficient of resistance (TCR). Although the TCR of foil resistors is considered extremely low, this characteristic has been further refined over the years. These resistors utilize ultra high precision Bulk Metal<sup>®</sup>Z-Foil.

The Z-Foil technology provides a significant reduction of the resistive element’s sensitivity to ambient temperature variations (TCR) and to self heating when power is applied (power coefficient).

Voltage division with tight tracking <2 ppm/°C can be achieved with 2 **randomly** selected units even with a large ratio between the two values.

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

**Table 1 – Tolerance and TCR Vs. Resistance Value** (–55°C to +125°C, +25°C ref.)

VALUE	ABSOLUTE TOLERANCE	TYPICAL TCR AND MAX. SPREAD (ppm/°C)
250 $\Omega$ to 40 k $\Omega$	$\pm 0.02\%$	$\pm 0.2 \pm 1.8$
50 $\Omega$ to <250 $\Omega$	$\pm 0.05\%$	$\pm 0.2 \pm 1.8$
20 $\Omega$ to <50 $\Omega$	$\pm 0.1\%$	$\pm 0.2 \pm 2.8$
10 $\Omega$ to <20 $\Omega$	$\pm 0.2\%$	$\pm 0.2 \pm 4.8$
5 $\Omega$ to <10 $\Omega$	$\pm 0.5\%$	$\pm 0.2 \pm 6.8$

**Figure 1 – Power Derating Curve**

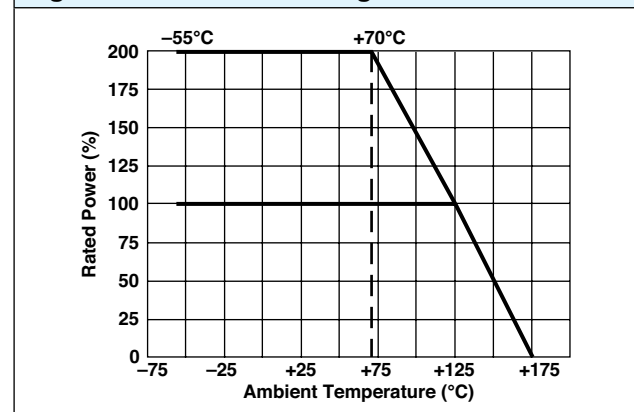
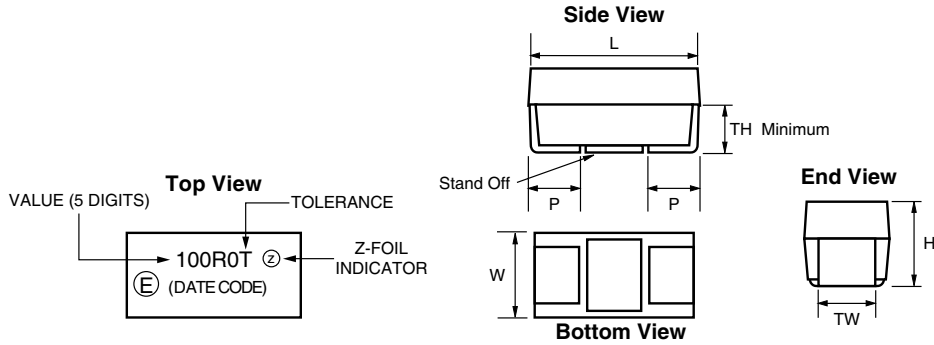


Table 2 – Performance Specifications						
TEST	CONDITIONS				MAXIMUM LIMIT (1)	
	303139		303140		303139	303140
Resistance Range	5 $\Omega$ to 14 k $\Omega$		5 $\Omega$ to 40 k $\Omega$			
Power Rating	5 $\Omega$ to < 10 k $\Omega$ 0.250 W at 70°C 0.125 W at 125°C	10 k $\Omega$ to 14 k $\Omega$ 0.160 W at 70°C 0.08 W at 125°C	5 $\Omega$ to < 30 k $\Omega$ 0.6 W at 70°C 0.3 W at 125°C	30 k $\Omega$ to 40 k $\Omega$ 0.4 W at 70°C 0.2 W at 125°C	See figure 1	
Maximum Working Voltage					47 V	127 V
Maximum Operating Temperature	+175°C (see figure 1)					
Working Temperature Range	–55°C to +125°C (MIL range)					
Thermal Shock	–65°C to +150°C; 25 cycles				0.02% for values higher than 100 $\Omega$ 0.03% for values between 5 $\Omega$ to 100 $\Omega$	
Short Time Overload	6.25 x rated power (at +125°C); 5 s, not to exceed 70.5 V for 303139, 190 V for 303140				$\pm$ 0.01% (100 ppm)	
Low Temperature Operation	–65°C, 24 h (no load); 45 min at rated power				$\pm$ 0.01% (100 ppm)	
Dielectric Withstanding Voltage	Atmospheric pressure; AC 200 V; 1 min				$\pm$ 0.01% (100 ppm)	
Insulation Resistance (M $\Omega$ )	DC 100 V; 1 min				over 10 000 M $\Omega$	
Resistance to Soldering Heat (%)	260°C; 10 s				$\pm$ 0.03%	
Moisture Resistance	+65°C to –10°C; 90% to 98% RH; rated power; 240 h				$\pm$ 0.03% (300 ppm)	
Shock	100 G; sawtooth; axes Y, Z; 10 shocks per each axis				$\pm$ 0.01% (100 ppm)	
Vibration, High Frequency	10 Hz ~ 2000 Hz ~ 10 Hz; 20 G; axes Y, Z; 4 h in each axis				$\pm$ 0.01% (100 ppm)	
Load Life Stability (2000 h)	125°C, rated power				$\pm$ 0.05% (500 ppm)	
High Temperature Exposure	175°C; no load 2000 h				$\pm$ 0.1% (1000 ppm)	
Weight					0.1143 g	0.244 g
Packaging	Bulk (loose) or tape and reel, per EIA-481-1					

**Note**

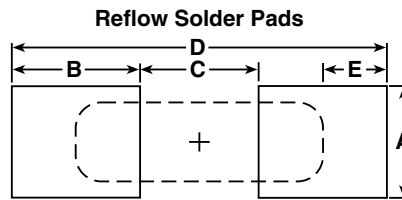
(1) As shown +0.01  $\Omega$  to allow for measurement error at low values

**Figure 2 – Dimensions** in inches (millimeters)



MODEL	L	W	H	P	TW	TH (minimum)
303139	0.236±0.012 (5.99±0.30)	0.126±0.012 (3.20±0.30)	0.098±0.012 (2.49±0.30)	0.051±0.012 (1.30±0.30)	0.087±0.004 (2.21±0.10)	0.039(0.99)
303140	0.287±0.012 (7.29±0.30)	0.170±0.012 (4.32±0.30)	0.110±0.012 (2.79±0.30)	0.051±0.012 (1.30±0.30)	0.095±0.004 (2.41±0.10)	0.039(0.99)

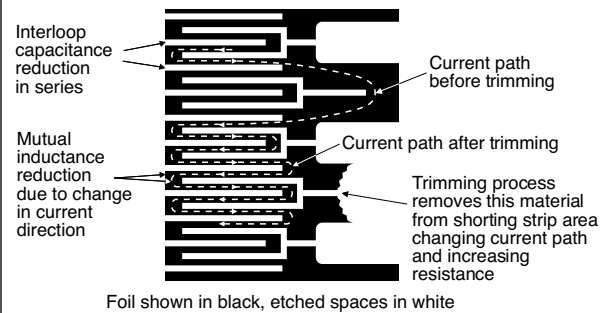
**Figure 3 – Recommended Mounting Pad Geometries** in inches (millimeters)



MODEL	METHOD	A MIN.	B REF	C REF	D ±0.04 (±1.02)	E REF
303139	Reflow	0.110 (2.79)	0.106 (2.69)	0.124 (3.15)	0.337 (8.55)	0.050 (1.27)
303140	Reflow	0.118 (3.00)	0.106 (2.69)	0.175 (4.45)	0.388 (9.86)	0.050 (1.27)

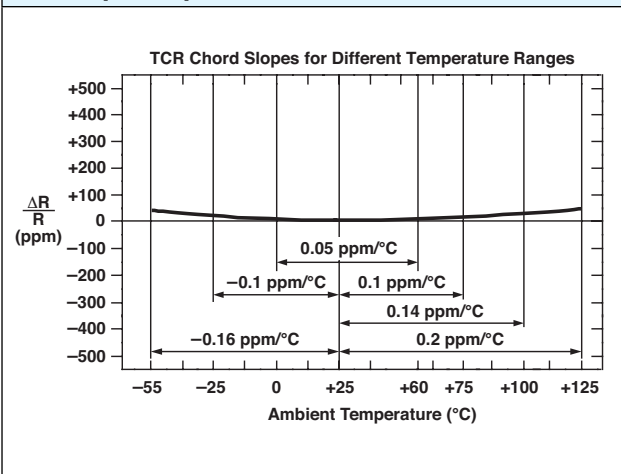
Per IPC-SM-782 Rev A

**Figure 4 – Trimming to Values**



**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 5 – Typical Resistance/Temperature Curve (Z-Foil)**



**NOTES**

- For prototype units, append a “U” to the model number (example: 303139U). These units have all of the table 2A 100% tests performed, with no destructive qualification testing required.
- Measurement error allowed for ΔR limits: 0.01 Ω.

<b>Table 3 – EEE-INST-002 (Table 2A Film/Foil, Level 1) 100% Tests/Inspections</b>	
<b>Pre-cap Visual Inspection</b>	Performed in production flow on welded chip on strip
<b>RC Record</b>	In tolerance
<b>Thermal Shock</b>	25 × (−65°C to +150°C)
<b>Short Time Overload</b>	6.25 × rated power (at +125°C), 5 s, not to exceed 70.5 V for 303139, 190 V for 303140
<b>RC Record</b>	In tolerance, ΔR = 0.02% for values higher than 100 Ω, ΔR = 0.03% for values between 5 Ω to 100 Ω
<b>Power Conditioning</b>	Rated power, 100 h, +125°C
<b>RC Record</b>	In tolerance ΔR ≤200 ppm for R >100 Ω, ΔR ≤500 ppm for R ≤100 Ω
<b>Final Inspection</b>	PDA 3% on ΔR >0.05% only
<b>Visual Inspection</b>	Materials, design, marking, etc.
<b>Mechanical Inspection</b>	Physical dimensions sample size: 3 units. For a min. of one failure –100% inspection

<b>Table 4 – EEE-INST-002 (Table 3A Film/Foil, Level 1) Destructive Tests</b>														
<b>Group 2</b>	Sample size: 3(0)													
	Solderability Resistance to solvents	MIL-STD-202, method 208 MIL-STD-202, method 215												
<b>Group 3</b>	Sample size: 10(0)													
	Thermal shock	25 × (−65°C to +150°C)  ΔR = 0.02% for values higher than 100 Ω ΔR = 0.03% for values between 5 Ω to 100 Ω												
	MIL-STD-202, method 107	<table border="1"> <thead> <tr> <th colspan="2">303139, 303140</th> </tr> <tr> <th>Values</th> <th>TCR limits</th> </tr> </thead> <tbody> <tr> <td>100 Ω to 40 kΩ</td> <td>±2 ppm/°C</td> </tr> <tr> <td>20 Ω to &lt;100 Ω</td> <td>±3 ppm/°C</td> </tr> <tr> <td>10 Ω to &lt;20 Ω</td> <td>±5 ppm/°C</td> </tr> <tr> <td>5 Ω to &lt;10 Ω</td> <td>±7ppm/°C</td> </tr> </tbody> </table>	303139, 303140		Values	TCR limits	100 Ω to 40 kΩ	±2 ppm/°C	20 Ω to <100 Ω	±3 ppm/°C	10 Ω to <20 Ω	±5 ppm/°C	5 Ω to <10 Ω	±7ppm/°C
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	Values	TCR limits												
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20 Ω to <100 Ω	±3 ppm/°C													
10 Ω to <20 Ω	±5 ppm/°C													
5 Ω to <10 Ω	±7ppm/°C													
TCR – mounted on FR4	Temperature range: −55°C/+25°C/+125°C													
Low temperature storage	−65°C no load dwell for 24 h ±4 h +25°C ambient no load dwell for 2 h to 8 h ΔR = 0.01%													
Low temperature operation	−65°C no load dwell for 1 h rated power (at +125°C) for 45 min +25°C ambient no load dwell for 24 h ±4 h													
Short time overload	ΔR = 0.01% 6.25 × rated power (at +125°C), not to exceed 70.5 V for 303139, 190 V for 303140													

**Table 4 – EEE-INST-002 (Table 3A Film/Foil, Level 1) Destructive Tests**

<b>Group 4</b>	Sample size: 9(0) DWV MIL-STD-202, method 301 Insulation resistance MIL-STD-202, method 302 Resistance to soldering heat – mounted on FR4 MIL-STD-202, method 210 condition B Moisture resistance	$\Delta R = 0.01\%$ Atmospheric pressure, 200 VAC, 1 min 100 VDC $IR \geq 10^4 \text{ M}\Omega$ $\Delta R = 0.03\%$ 260°C, 10 s $\Delta R = 0.03\%$
	MIL-STD-202, method 106 DWV, at 200 VAC, 1 min atmospheric pressure Insulation resistance, at 100 VDC	$\Delta R = 0.01\%$ $IR \geq 100 \text{ M}\Omega$
<b>Group 5</b>	Sample size: 9(0) – mounted on FR4 Shock MIL-PRF-55182 and MIL-STD-202, method 213, condition I 10 shocks in each of two mutually perpendicular planes (Y, Z) 100 G, 6 ms, sawtooth Vibration	$\Delta R = 0.01\%$ $\Delta R = 0.01\%$
	MIL-PRF-55182 and MIL-STD-202, method 204, condition D 10 Hz –2000 Hz –10 Hz, 20 G, planes Y, Z In each of two mutually perpendicular planes (Y, Z), 20 G, 4 h in each plane	
<b>Group 6</b>	Sample size: 12(0) – mounted on FR4 Life MIL-STD-202, method 108 1.5 h on, 0.5 h off, 125°C, rated power (at +125°C), 2000 h	$\Delta R = 0.05\%$
<b>Group 8</b>	Sample Size: 5(0) – not mounted Voltage coefficient MIL-PRF-55182 and MIL-STD-202, method 309	5 ppm/V Working voltage Resistance range >1 K
<b>Group 9</b>	Sample size: 5(0) High temperature exposure	$\Delta R = 0.1\%$ +175°C, 2000 h, no load
<b>Group 10</b>	Thermal outgassing	Contact Vishay Foil Resistors application engineering for review

**Note**

The sample units of table 4 should be randomly selected from lots which successfully passed the table 3 tests.

**Table 5 – Global Part Number Information**

<b>Model #</b>	303139	303140
<b>Base Model</b>	SMR1DZ	SMR3DZ
<b>Value Range (Space Applications)</b>	5 $\Omega$ to 14 k $\Omega$	5 $\Omega$ to 40 k $\Omega$

Part Number: **{Model} - {Value} - {Tolerance} - {Termination} - {Packaging}**

Absolute Tolerance	Code	Termination	Code	Packaging	Code
0.02%	Q	Tin/lead	B	Bulk	L
0.05%	A			Tape and reel	T
0.1%	B				
0.2%	E				
0.5%	D				

**Example:** 303139 - 8K0225 - QBT  
303139, 8.0225 k $\Omega$ , 0.02%, tin/lead termination, tape and reel packaging



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