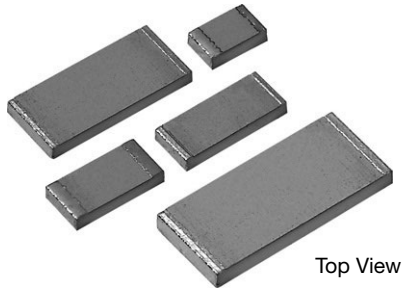
Models 303133 through to 303138 (Ultra High-Precision Surface Mount Chip Resistors, VSMP Z-Foil Technology Configuration)

Screen/Test Flow in Compliance with EEE-INST-002, (Tables 2A and 3A, Film/Foil, Level 1) and MIL-PRF-55342

FEATURES

- Temperature coefficient of resistance (TCR): 0.2 ppm/°C typical (–55°C to +125°C, +25°C ref.)
- Tolerance: to ±0.01%
- Power coefficient "ΔR due to self heating": 5 ppm at rated power
- Power rating: to 400 mW at +70°C
- Load-life stability: to ±0.03% at 70°C, 2000 h at rated power
- Resistance range: 10 Ω to 75 kΩ
- Bulk Metal® Foil resistors are not restricted to standard values, we can supply specific "as required" values at no extra cost or delivery (e.g. 1K2345 vs. 1K)
- Fast thermal stabilization <1 s
- **Electrostatic discharge (ESD) up to 25 000 V**
- Short-time overload: ≤0.02%
- Non-inductive, non-capacitive design
- Rise time: 1 ns effectively no ringing
- Current noise: –42 dB
- Non-inductive: <0.08 μH
- Non-hot-spot design
- Terminal finish: tin/lead alloy
- Matched sets are available on request
- For prototype units, append a "U" to the model number (example: 303134U). These units have all of the table 2A (page 4) 100% tests performed, with no destructive qualification testing required (table 3A, page 4). For more information, please contact foil@vpgsensors.com



Top View

INTRODUCTION

The 303133 through to 303138 series is the first surface mount device to provide high rated power, excellent load-life stability along with extremely low TCR all in one resistor.

One of the most 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. The 303133 through to 303138 series utilizes ultra high-precision Bulk Metal® 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). Along with the inherently low PCR and TCR, Z-Foil technology also provides remarkably improved load-life stability, low noise and availability of tight tolerance.

The 303133 through to 303138 series has a full wraparound termination which ensures safe handling during the manufacturing process, as well as providing stability during multiple thermal cyclings.

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.)

RESISTANCE VALUE (Ω)	TOLERANCE (%)	MAXIMUM TCR (ppm/°C)
250 to 75K	±0.01	±3
100 to <250	±0.05	±3
50 to <100	±0.1	±4
25 to <50	±0.25	±5
10 to <25	±0.5	±5

Figure 1 – Power Derating Curve

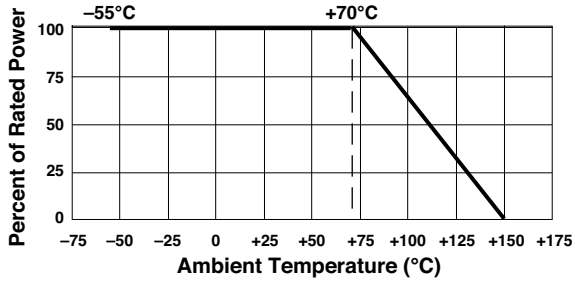
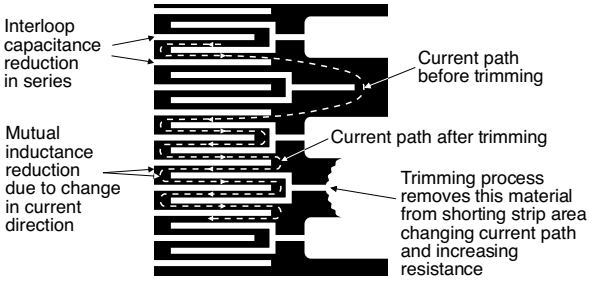


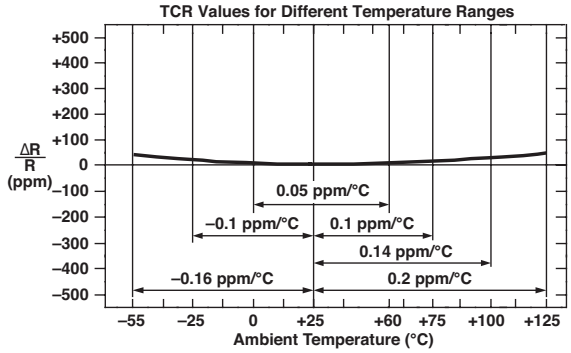
Figure 2 – Trimming to Values
(Conceptual Illustration)



Foil shown in black, etched spaces in white

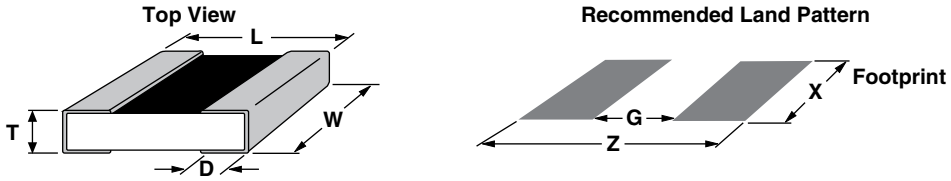
Note
To acquire a precision resistance value, the Bulk Metal® Foil chip is trimmed by selectively removing built-in "shorting bars." To increase the resistance in known increments, marked areas are cut, producing progressively smaller increases in resistance. This method reduces the effect of "hot spots" and improves the long-term stability of Bulk Metal® Foil resistors.

Figure 3 – Typical Resistance/Temperature Curve



Note
The TCR values for <100 Ω are influenced by the termination composition and result in deviation from this curve.

Table 2 – Dimensions and Land Pattern in inches (millimeters)



MODEL (CHIP SIZE)	L ±0.005 (0.13)	W ±0.005 (0.13)	THICKNESS MAXIMUM	D ±0.005 (0.13)	Z(1)	G(1)	X(1)
303133 (0603)	0.063 (1.60)	0.032 (0.81)	0.025 (0.64)	0.011 (0.28)	0.102 (2.59)	0.031 (0.78)	0.031 (0.78)
303134 (0805)	0.080 (2.03)	0.050 (1.27)	0.025 (0.64)	0.015 (0.38)	0.122 (3.10)	0.028 (0.71)	0.050 (1.27)
303135 (1206)	0.126 (3.20)	0.062 (1.57)	0.025 (0.64)	0.020 (0.51)	0.175 (4.45)	0.059 (1.50)	0.071 (1.80)
303136 (1506)	0.150 (3.81)	0.062 (1.57)	0.025 (0.64)	0.020 (0.51)	0.199 (5.05)	0.083 (2.11)	0.071 (1.80)
303137 (2010)	0.198 (5.03)	0.097 (2.46)	0.025 (0.64)	0.025 (0.64)	0.247 (6.27)	0.115 (2.92)	0.103 (2.62)
303138 (2512)	0.249 (6.32)	0.127 (3.23)	0.025 (0.64)	0.032 (0.81)	0.291 (7.39)	0.150 (3.81)	0.127 (3.23)

Note
(1) Land pattern dimensions are per IPC-7351A

Table 3 – Specifications

MODEL (CHIP SIZE)	RATED POWER (mW) at + 70 °C	MAX. WORKING VOLTAGE ($\leq \sqrt{P \times R}$)	RESISTANCE RANGE (Ω)	MAXIMUM WEIGHT (mg)
303133 (0603)	50	14 V	100 to 2K	4
303134 (0805)	100	22 V	10 to 5K	6
303135 (1206)	150	46 V	10 to 14K	12
303136 (1506)	200	57 V	10 to 16K	13
303137 (2010)	300	102 V	10 to 35K	27
303138 (2512)	400	173 V	10 to 75K	40

Table 4 – Performances

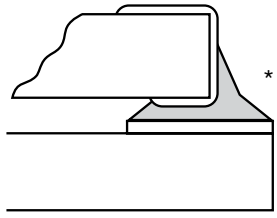
TEST OR CONDITIONS	MIL-PRF-55342 CHARACTERISTIC E ΔR LIMITS	TYPICAL ΔR LIMITS	MAXIMUM ΔR LIMITS[1]
Thermal Shock, 100 x (–65°C to +150°C)	±0.1%	±0.005% (50 ppm)	±0.01% (100 ppm)
Low-Temperature Operation, –65°C, 45 min at rated power	±0.1%	±0.005% (50 ppm)	±0.02% (200 ppm)
Short-Time Overload, 6.25 x rated power, 5 s	±0.1%	±0.005% (50 ppm)	±0.02% (200 ppm)
High-Temperature Exposure, +150°C, 100 h	±0.1%	±0.01% (100 ppm)	±0.03% (300 ppm)
Resistance to Soldering Heat	±0.2%	±0.005% (50 ppm)	±0.02% (200 ppm)
Moisture Resistance	±0.2%	±0.005% (50 ppm)	±0.04% (400 ppm)
Load-Life Stability +70°C for 2,000 h at rated power +70°C for 10,000 h at rated power	±0.5%	±0.005% (50 ppm) ±0.01% (100ppm)	±0.03% (300 ppm) ±0.05% (500ppm)

Note
[1] As shown +0.01 Ω to allow for measurement errors at low values

Figure 4 – Recommended Mounting

1. IR and vapor phase reflow are recommended.
2. Avoid the use of cleaning agents that attack epoxy resins, which form part of the resistor construction.
3. Vacuum pick up is recommended for handling.
4. If the use of a soldering iron becomes necessary, precautionary measures should be taken to avoid any possible damage/overheating of the resistor.

* Recommendation: The solder fillet profile should be such as to avoid running over the top metallization.



Model Number	303133	303134	303135	303136	303137	303138
Chip Size	0603	0805	1206	1506	2010	2512
Value Range (Space Applications)	100 Ω to 2 kΩ	10 Ω to 5 kΩ	10 Ω to 14 kΩ	10 Ω to 16 kΩ	10 Ω to 35 kΩ	10 Ω to 75 kΩ
Rated Power at 70°C	50 mW	100 mW	150 mW	200 mW	300 mW	400 mW

Notes
1. Measurement error allowed for ΔR limits: 0.01 Ω.
2. An additional 54 sample units per lot which successfully pass 100% screening are to be used for destructive testing and are to be kept on file at the plant of manufacture.
3. Lot definition (1 lot = 1 primary flowcard): Each value per chip size should be qualified individually. Contact Vishay Foil Resistors application engineering for alternative lot definitions.
4. For prototype units, append a “U” to the model number (example: 303134U). These units have all of the table 2A 100% tests performed, with no destructive qualification testing required.

Table 5 – EEE-INST-002 (Table 2A Film/Foil, Level 1) 100% Tests/Inspections	
Pre-cap Visual Inspection	Performed in production flow prior overcoating
RC Record	In tolerance
Thermal Shock	25 × (–65°C to +150°C)
Power Conditioning	70°C, 100 h, 1.5 rated power—not to exceed max. voltage
RC Record	In tolerance ΔR = 0.05% for thermal shock and conditioning combined
Final Inspection	5% PDA on ΔR and 10% PDA for final resistance for tolerance ≥0.1%; 5% PDA on ΔR for tolerance <0.1%
Visual Inspection	Materials, design, etc.
Mechanical Inspection	Physical dimensions, sample size: 3 units, zero failure

TABLE 6—EEE-INST-002 (TABLE 3A FILM/FOIL, LEVEL 1) DESTRUCTIVE TESTS		
Group 2	Sample size: 3, zero failure	
	Solderability	
Group 3	Sample size: 10, zero failure—mounted on FR4	
	TCR (–55°C/+25°C/+125°C)	**Values** **TCR Limits** ≥100 Ω ±3 ppm/°C 50 Ω to <100 Ω ±4 ppm/°C 10 Ω to <50 Ω ±5 ppm/°C
	Low temperature storage	ΔR = 0.02%
		–65°C no load dwell for 24 h ±4 h
		+25°C ambient no load dwell for 2 h to 8 h
	Low temperature operation	ΔR = 0.015%
		–65°C no load dwell for 1 h
		rated power for 45 min
		+25°C ambient no load dwell for 2 h to 8 h
	Short time overload	ΔR = 0.02%
		6.25 x rated power, 5 s—no “I” limitation: not to exceed twice the max. voltage
Group 4	Sample size: 9, zero failure—mounted on FR4	
	Resistance to soldering heat	ΔR = 0.02%
		Performed per MIL-PRF-55342 para. 4.8.8.1
Group 6	Sample size: 12, zero failure—mounted on FR4	
	Life	ΔR = 0.02%
		2000 h, +70°C, rated power, 1.5 hours “on” and 0.5 hour “off” cycle
Group 7B	Sample size: 10, zero failure—mounted on FR4	
	Solder mounting integrity	Performed per MIL-PRF-55342
		Force applied: for 0630—1 kg, 30 s / for 0805, 1206, and 1506—2 kg, 30 s
		For 2010, 2512: force applied: 3 kg, 30 s
Group 8	Sample size: 5, zero failure—chips not mounted	
	Voltage coefficient	0603: 12 ppm/V; 0805: 5 ppm/V; 1206, 1506, 2010, 2512: 3 ppm/V
		Applicable resistors ≥1k
		Performed per MIL-STD-202 method 309
Group 9	Sample size: 5, zero failure—mounted on FR4	
	High temperature exposure	ΔR = 0.015%
		Performed per MIL-PRF-55342
		100 h at +150°C ±5°C

Table 7 – Part Number Identification

Model #	303133	303134	303135	303136	303137	303138
Chip Size	0603	0805	1206	1506	2010	2512
Value Range (Space Application)	100 Ω to 2 kΩ	10 Ω to 5 kΩ	10 Ω to 14 kΩ	10 Ω to 16 kΩ	10 Ω to 35 kΩ	10 Ω to 75 kΩ

Part Number:

{Model} - {Value} - {Tolerance} - {Termination} - {Packaging}

Termination	Code
Tin/lead	B

Packaging	Code
Waffle	W
Tape and reel	T

Resistance Value	Tolerance (Tightest)	Code
250R to 75K	0.01%/0.02%/0.05%/0.1%/0.25%/0.5%	T/Q/A/B/C/D
100R to <250R	0.05%/0.1%/0.25%/0.5%	A/B/C/D
50R to <100R	0.1%/0.25%/0.5%	B/C/D
25R <50R	0.25%/0.5%	C/D
10R to <25R	0.5%	D

Example: 303135 - 10K025 - DBW

1206 chip size, 10.025 kΩ, 0.5%, tin/lead termination, waffle packaging

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