



**Texas  
Components  
Corporation**

USA Manufacturer of Precision Resistors featuring Bulk Metal® Foil\*

# TSM Series

High Precision Foil  
Wrap Around Resistor

for Surface Mount Applications



Note: actual color may vary



**+TCR of ± 2 ppm/°C and Load Life Stability of ± 0.01 % (100 ppm)**

**Ultra Low TCR; Ultra High Precision, Accuracy, and Stability**

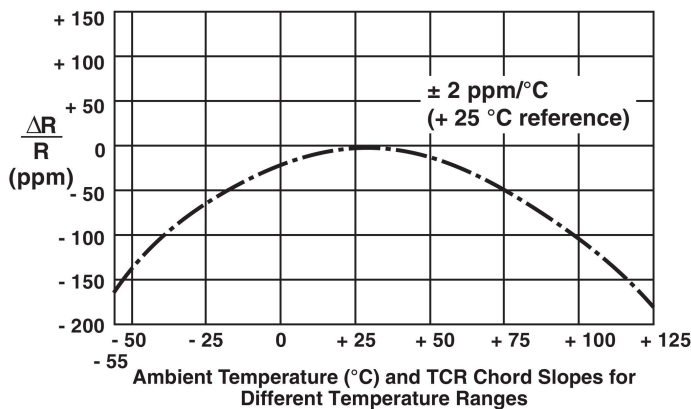
**Tight Tolerance, Low Temperature Coefficient of Resistance (TCR), Low EMF, and Low Voltage Coefficient of Resistance (VCR)**

Resistors featuring Bulk Metal® Foil are renowned for their unique combination of unmatched performance in all major technical areas, including:

Temperature Coefficient of Resistance (TCR)	Voltage Coefficient of Resistance (VCR)	Electrostatic Discharge (ESD)	Thermal Stabilization	Response Time
Power Coefficient of Resistance (PCR)	Thermal Electromotive Force (EMF)	Tolerance	Load Life Stability	Noise

Bulk Metal® Foil technology out-performs all other resistor technologies available today for applications that require high precision and high stability – especially for analog applications. Bulk Metal® Foil delivers an inherently low and predictable Temperature Coefficient of Resistance (TCR), excellent load life stability, tight tolerances, excellent shelf life stability, low current noise, and low voltage coefficient. The TSM Series resistor has a full wraparound termination, which ensures safe handling during the manufacturing process and provides stability during multiple thermal cycles. For non-standard technical requirements or special applications, please contact us at [resistorinfo@texascomponents.com](mailto:resistorinfo@texascomponents.com).

**FIGURE 1 – RESISTANCE/TEMPERATURE CURVE(S)  
[STATISTICALLY COMBINED]**



**Note:** The TCR values for < 100Ω become more influenced by the termination composition and result in a greater effective deviation from this curve than the resistor itself.

### TSM SERIES FEATURES & SPECIFICATIONS

- Temperature coefficient of resistance (TCR): ± 2.0 ppm/°C typical (-55 °C to +125 °C, +25 °C ref). See Table 1.
- Resistance tolerance to ±0.01%. See Table 2.
- Rated power: 100 to 400 mw at +70 °C. See Table 3.
- Exceptional load life stability: ± 0.01 % at +70 °C, 2000 h at rated power
- Resistance range: 10Ω to 125kΩ (contact us for lower or higher values)
- Power coefficient of resistance (ΔR due to self heating): ± 5 ppm at rated power
- Bulk Metal® Foil resistors are not restricted to standard values; specific custom values can be supplied at no extra cost (e.g. 1K2345 vs 1K)
- Electrostatic discharge (ESD): at least to 25 kV
- Short time overload: ≤ 0.01 %
- Capacitance: 0.5 pF typical; 1.0 pF max (non-capacitive design)
- Rise time: 1.0 ns, effectively no ringing
- Current noise: 0.010 μV (rms)/Volt of Applied Voltage (< -42 dB)
- Thermal EMF: 0.05 μV/°C typical (0.10 μV/°C max)
- Voltage coefficient: < 0.1 ppm/V
- Thermal stabilization time: < 1.0 sec (nominal value achieved within 10 ppm of steady state value)
- Inductance: < 0.08 μH typical; 0.1 μH maximum (non-inductive design)
- Non hot spot design
- Matched sets are available
- Terminal Finish: tin/lead alloy standard; Pb free (RoHS directive 2002/95/EC compliant) is available.
- Fast delivery of custom made units: Typical lead time is 2-4 weeks, but expedited delivery in less than 1 week is possible even for custom values

**TABLE 1 – TCR BY RESISTANCE RANGE**

RESISTANCE VALUE (Ω)*	TYPICAL TCR (& MAX SPREAD)
> 250Ω	± 2.0 (± 2.0) (ppm/°C)
50Ω to < 250Ω	± 2.0 (± 3.0) (ppm/°C)
25Ω to < 50Ω	± 2.0 (± 4.0) (ppm/°C)
10Ω to < 25Ω	± 2.0 (± 6.0) (ppm/°C)

\* For resistance values below 10Ω or above 125kΩ, or other tighter and/or extended performance characteristics, please contact us.

**TABLE 2 – AVAILABLE TOLERANCES BY RESISTANCE RANGE**

RESISTANCE VALUE (Ω)*	AVAILABLE TOLERANCE (%)	CODE
250Ω to 175kΩ	±0.01%	T
100Ω to 175kΩ	±0.02%	Q
50Ω to 175kΩ	±0.05%	A
25Ω to 175kΩ	±0.1%	B
10Ω to 175kΩ	±0.25%	C
10Ω to 175kΩ	±0.5%	D
10Ω to 175kΩ	±1.0%	F

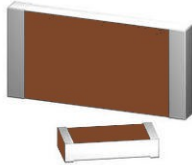

 <b>Texas Components Corporation</b>	<b>TSM Series</b>		 
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TABLE 3 – SPECIFICATIONS				
CHIP SIZE	RATED POWER (mW) at + 70 °C	MAX WORKING VOLTAGE ( $\leq \sqrt{VP \times R}$ )	RESISTANCE RANGE ( $\Omega$ )*	MAX WEIGHT (mg)
<b>0805</b>	100	28 V	10 to 12k	6
<b>1206</b>	150	61 V	10 to 25k	11
<b>1506</b>	200	78 V	10 to 35k	12
<b>2010</b>	300	145 V	10 to 75k	27
<b>2512</b>	400	220 V	10 to 125k	40

\* For other resistance values or for other tighter and extended performance characteristics, please contact us.

TABLE 4 – PERFORMANCES			
TEST OR CONDITIONS	MIL-PRF-55342 CHARACTERISTIC E $\Delta R$ LIMITS	TYPICAL $\Delta R$ LIMITS	MAXIMUM $\Delta R$ LIMITS (1)
Thermal Shock, 100 x (- 65 °C to + 150 °C)	$\pm 0.1 \%$	$\pm 0.005 \%$ (50 ppm)	$\pm 0.02 \%$ (200 ppm)
Low Temperature Operation, - 65 °C, 45 min at Pnom	$\pm 0.1 \%$	$\pm 0.01 \%$ (100 ppm)	$\pm 0.02 \%$ (200 ppm)
Short Time Overload, 6.25 x Rated Power, 5 s	$\pm 0.1 \%$	$\pm 0.01 \%$ (100 ppm)	$\pm 0.02 \%$ (200 ppm)
High Temperature Exposure, + 150 °C, 100 h	$\pm 0.1 \%$	$\pm 0.01 \%$ (100 ppm)	$\pm 0.03 \%$ (300 ppm)
Resistance to Soldering Heat	$\pm 0.2 \%$	$\pm 0.005 \%$ (50 ppm)	$\pm 0.01 \%$ (100 ppm)
Moisture Resistance	$\pm 0.2 \%$	$\pm 0.005 \%$ (50 ppm)	$\pm 0.03 \%$ (300 ppm)
Load Life Stability + 70 °C for 2000 h at Rated Power	$\pm 0.5 \%$	$\pm 0.005 \%$ (50 ppm)	$\pm 0.01 \%$ (100 ppm)

Note: (1) As shown + 0.01  $\Omega$  to allow for measurement errors at low values.

TABLE 5 - DIMENSIONS, LAND PATTERN, and RECOMMENDED MOUNTING							
CHIP SIZE	L $\pm 0.005$ (0.13)	W $\pm 0.005$ (0.13)	T MAXIMUM	D $\pm 0.005$ (0.13)	Z <sup>(2)</sup>	G <sup>(2)</sup>	X <sup>(2)</sup>
<b>0805</b>	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)
<b>1206</b>	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)
<b>1506</b>	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)
<b>2010</b>	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)
<b>2512</b>	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) Measurements are in inches (and millimeters)
- (2) Land Pattern Dimensions are per IPC-7351A
- (3) IR and vapor phase reflow are recommended.
- (4) Avoid the use of cleaning agents which could attack epoxy resins, which form part of the resistor construction.
- (5) Vacuum pick up is recommended for handling.

(6) If the use of a soldering iron becomes necessary, precautionary measures should be taken to avoid any possible damage / overheating of the resistor. Soldering irons may damage the resistor.

**\* (7) The solder fillet profile should be designed and controlled so as to avoid running over the top metallization.** (See illustration above.) A low profile solder fillet is recommended to avoid unnecessary stresses along top edge of metallization. IR and vapor phase reflow are best.



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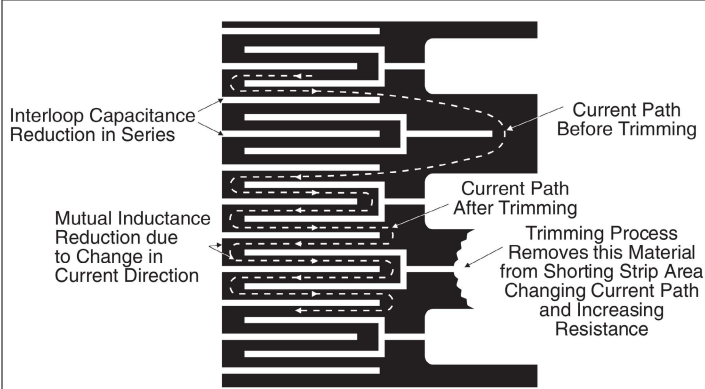


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**FIGURE 2 - TRIMMING TO SPECIFIC VALUES**

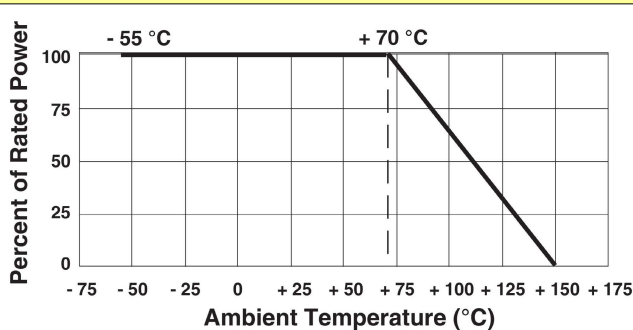
(a conceptual illustration of Bulk Metal® Foil)



Note: Foil shown in black, etched spaces in white

To achieve a precise resistance value, the Bulk Metal® Foil chip is **adjusted 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 resistor.**

**FIGURE 3 - POWER DERATING CURVE**



**TABLE 6 – ESD TEST RESULTS**

Volts	ΔR (%)		
	Thick Film	Thin Film	Bulk Metal® Foil
2500	-2.7	97	< 0.005
3000	-4.2	366	< 0.005
3500	-6.2	Open	< 0.005
4000	-7.4	Open	< 0.005
4500	-8.6	Open	< 0.005

**ELECTROSTATIC DISCHARGE (ESD)**

ESD can be categorized into three types of damages:

Parametric Failure - occurs when the ESD event alters one or more device parameters (resistance in the case of resistors), causing it to shift from its required tolerance. This failure does not directly pertain to functionality; thus a parametric failure may be present while the device is still functional.

Catastrophic Damage - occurs when the ESD event causes the device to immediately stop functioning. This may occur after one or a number of ESD events with diverse causes, such as human body discharge or the mere presence of an electrostatic field.

Latent Damage - occurs when the ESD event causes moderate damage to the device, which is not noticeable, as the device appears to be functioning correctly. However, the load life of the device has been dramatically reduced, and further degradation caused by operating stresses may cause the device to fail during service. Latent damage is the source for greatest concern, since it is very difficult to detect by re-measurement or by visual inspection, because damage may have occurred under the external coating.

**TABLE 7 – HOW TO ORDER THE CORRECT PART NUMBER**

MODEL	CHIP SIZE	RESISTANCE VALUE	TOLERANCE (See Table 3)		TERMINATIONS (FINISH)	PACKAGING
			0.01% to 1.0%	T,Q,A,B, C,D,F		
TSM	0805,1206, 1506, 2010, 2512	10Ω to 175kΩ (R = Ω and K = kΩ) Always given as 6 characters	0.01% to 1.0%	T,Q,A,B, C,D,F	TIN/LEAD (Std) = B LEAD (Pb) FREE = S	T= tape & reel W= waffle pack

A 20,001 ohm resistor, 2512 chip, a tolerance of 0.01%, with lead free terminations, and tape & reel would be ordered as:  
**TSM2512-20K001-TST**

A 15.3 ohm resistor, 0805 chip, a tolerance of 0.5%, with standard terminations, and waffle pack would be ordered as:  
**TSM0805-15R300-BBW**

(Note: Due to limited surface space, the value and tolerance are not printed on TSM series resistors)

For more information about this subject or this product line, please contact us at [resistorinfo@texascomponents.com](mailto:resistorinfo@texascomponents.com). You can also "Follow" Texas Components and Bulk Metal® Foil Resistors on Twitter [@TexasComponents](https://twitter.com/TexasComponents) and/or "Like" Texas Components on [Facebook](https://www.facebook.com/TexasComponents).

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