

# High Precision Bulk Metal® Foil Technology High Precision 4 Resistor Surface Mount Network Dual-In-Line Molded Package 50 MIL Pitch with TCR Tracking $\leq 0.5 \text{ ppm}/^{\circ}\text{C}$



Any value at any tolerance available within the resistance range

## INTRODUCTION

Bulk Metal® Foil Technology outperforms all other resistor technologies available today for applications that require High Precision and High Stability.

This technology has been pioneered and developed by Vishay, and products based on this technology are the most suitable for a wide range of applications.

BMF technology allows us to produce Customer Orientated products designed to satisfy challenging and specific technical requirements.

Model SMN offers Extremely Low TCR (absolute and Tracking), Excellent Load Life Stability, Tight tolerance (absolute and Tracking), Excellent Ratio Stability, Low thermal EMF, Low Current Noise and Low Voltage Coefficient, **all in the same resistor.**

The SMN Surface Mount Network is made up of 4 independent Bulk Metal® Foil resistors in a small standard molded epoxy package with 50 mil lead pitch (Jedec MS-012 package).

The electrical specification of this integrated construction offers improved performance and better real estate utilization over discrete resistors and matched sets. The resistors may be used independently or as divider pairs.

Our Application Engineering Department is available to advise and to make recommendations for non-standard technical requirements and special applications, please contact us.

TABLE 1 - RESISTANCE VALUES AND TOLERANCES**	
RESISTANCE VALUES	100Ω - 10KΩ per Resistor
ABSOLUTE TOLERANCE EACH RESISTOR	$\pm 0.02\%$ , $\pm 0.05\%$ , $\pm 0.1\%$
RESISTANCE RATIO TOLERANCE	$\pm 0.01\%$ , $\pm 0.02\%$ , $\pm 0.05\%$

\*\* Tighter performances are available

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

### SALES

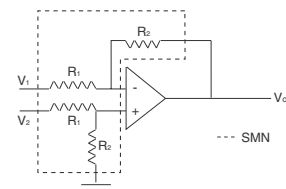
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## FEATURES

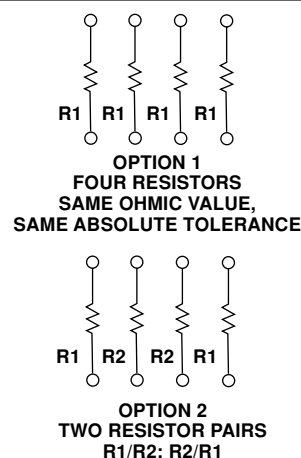
- Large variety of resistance ratios
- Low Temperature Coefficient of Resistance (TCR):  
 $\pm 2 \text{ ppm}/^{\circ}\text{C}$  (absolute)  
 $\leq 0.5 \text{ ppm}/^{\circ}\text{C}$  (tracking)
- Tight Resistance Ratio Tolerance: 0.01%
- Excellent Ratio Stability: 0.005% (0.1 watts, at 70°C, 2000 hours)
- Electrostatic Discharge (ESD) above 25 000 Volts
- Short time overload  $\leq 0.0025\%$
- Voltage Coefficient  $< 0.1 \text{ ppm}/\text{V}$
- Non Inductive:  $< 0.08 \mu\text{H}$
- Power Rating: at 70°C  
Entire Package: 0.4 watts  
Each Resistor: 0.1 watts
- Non Inductive/Capacitive design
- Non hot spot design
- Low thermal EMF:  $0.05 \mu\text{V}/^{\circ}\text{C}$
- Low Current Noise:  $0.01 \mu\text{V}/\text{V}(\text{RMS})$  (- 40dB)
- Rise time: 1ns without ringing
- Terminal Finishes available: Lead (Pb)-free  
Tin/Lead Alloy
- For better performances please contact us
- Available with Z-Foil technology

## APPLICATIONS

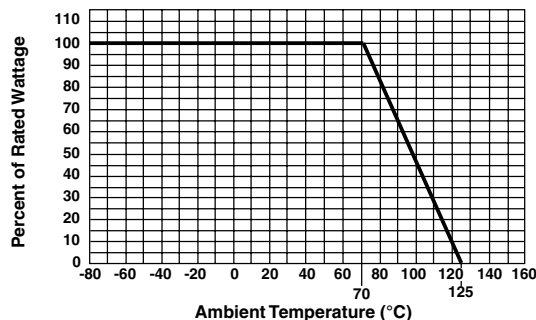
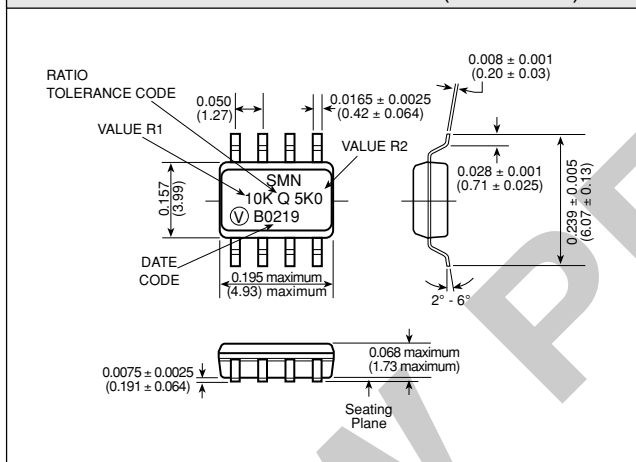
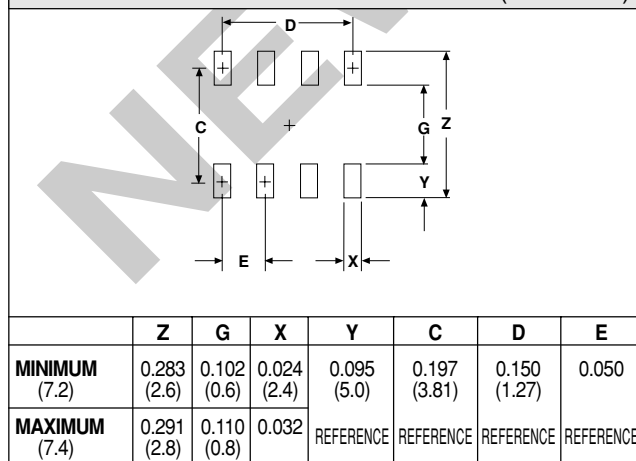
- Instrumentation amplifiers
- Bridge networks
- Differential amplifiers
- Ratio arms in bridge circuits
- Medical and test equipment
- Military
- Airborne etc



**FIGURE 1 - SCHEMATICS**

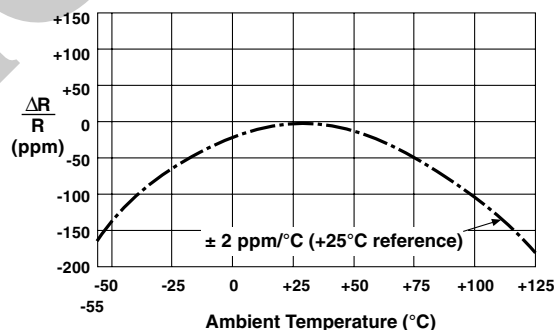


Vishay Foil Resistors High Precision Bulk Metal® Foil Technology  
 High Precision 4 Resistor Surface Mount Network  
 Dual-In-Line Molded Package 50 MIL Pitch  
 with TCR Tracking  $\leq 0.5 \text{ ppm}/^{\circ}\text{C}$

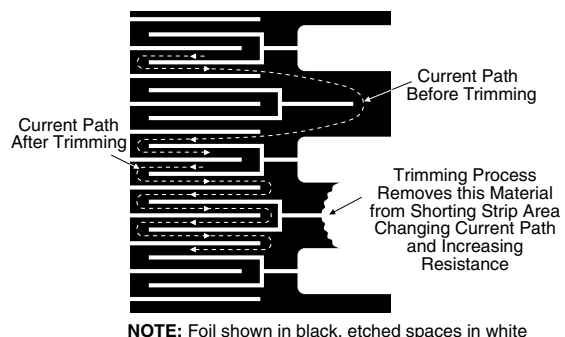
**FIGURE 2 - POWER DERATING CURVE****FIGURE 3 - DIMENSIONS AND IMPRINTING EXAMPLE** in inches (millimeters)**FIGURE 4 - LAND PATTERN** in inches (millimeters)**TABLE 2 - POPULAR RATIOS\***

R1/R2 RESISTANCE RATIO	R1	R2	R1/R2 RESISTANCE RATIO	R1	R2
100	10K	100R	2.5	1K	400R
50	10K	200R		500R	200R
	5K	100R	2	10K	5K
25	10K	400R		2K	1K
	5K	200R		1K	500R
20	10K	500R		400R	200R
	2K	100R		200R	100R
10	10K	1K	1.25	500R	400R
	5K	500R	1.0	100R	100R
	2K	200R		200R	200R
	1K	100R		400R	400R
5	10K	2K		500R	500R
	5K	1K		1K	1K
	2K	400R		2K	2K
	1K	200R		5K	5K
	500R	100R		10K	10K
4	2K	500R			
	400R	100R			

\*Other ratios available per request

**FIGURE 5 - TYPICAL TCR CURVE**

(For more details, see table 3)

**FIGURE 6 - TRIMMING TO VALUES (CONCEPTUAL ILLUSTRATION)**

NOTE: Foil shown in black, etched spaces in white

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High Precision Bulk Metal® Foil Technology Vishay Foil Resistors  
High Precision 4 Resistor Surface Mount Network  
Dual-In-Line Molded Package 50 MIL Pitch  
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**TABLE 3 - PERFORMANCE SPECIFICATIONS (PER MIL-PRF 914 TEST METHODS)**

SPECIFICATIONS	TYPICAL LIMITS
<b>Power Rating</b> at 70°C Each resistor:	Entire package: 0.4 watts 0.1 watts (Note: Power derated to 0 watt at 150°C)
<b>Maximum Working Voltage</b> (each resistor)	$(P \times R)^{1/2}$
<b>TCR</b> - 55°C to + 125°C (25°C reference)	Absolute (typical and max. spread): $\pm 2 \pm 3 \text{ ppm}/^{\circ}\text{C}$ Tracking (maximum): For $R1/R2 = 1$ $\pm 1.0 \text{ ppm}/^{\circ}\text{C}$ (0 $\pm$ 0.5 ppm/°C per request) For $1 < R1/R2 \leq 10$ $\pm 2.0 \text{ ppm}/^{\circ}\text{C}$ (0 $\pm$ 1.0 ppm/°C per request) For $10 < R1/R2 \leq 100$ $\pm 3.0 \text{ ppm}/^{\circ}\text{C}$ (0 $\pm$ 2.0 ppm/°C per request)
<b>Thermal Shock</b> 25 x (- 65°C to + 125°C)	$\Delta R = 0.015\%$ (150 ppm) $\Delta \text{Ratio} = 0.01\%$ (100 ppm)
<b>Thermal Shock</b> 5 x (- 65°C to + 125°C) and <b>Power Conditioning</b> 1.5 rated power at 25°C, 100 hours	$\Delta R = 0.02\%$ (200 ppm) $\Delta \text{Ratio} = 0.015\%$ (150 ppm)
<b>DWV Atm. Pressure</b> 200V (A.C), 1 minute	Successfully passed
<b>Insulation Resistance</b> 100V (D.C), 1 minute	$> 10^4 \text{ M}\Omega$
<b>Resistance To Soldering heat</b>	$\Delta R = 0.01\%$ (100 ppm) $\Delta \text{Ratio} = 0.005\%$ (50 ppm)
<b>Moisture Resistance</b> + 65°C to - 10°C; 90% to 98% RH; 0.1 x rated power; 240 hours	$\Delta R = 0.025\%$ (25 ppm) $\Delta \text{Ratio} = 0.005\%$ (50 ppm)
<b>Shock</b> 100G	$\Delta R = 0.01\%$ (100 ppm) $\Delta \text{Ratio} = 0.01\%$ (100 ppm)
<b>Vibration, High Frequency</b> (10Hz - 2000Hz), 20G	$\Delta R = 0.01\%$ (100 ppm) $\Delta \text{Ratio} = 0.01\%$ (100 ppm)
<b>High Temperature Exposure</b> 100 hours at 125°C	$\Delta R = 0.01\%$ (100 ppm) $\Delta \text{Ratio} = 0.005\%$ (50 ppm)
<b>Low Temperature Storage</b> 24 hours at - 65°C	$\Delta R = 0.005\%$ (50 ppm) $\Delta \text{Ratio} = 0.005\%$ (50 ppm)
<b>Load Life Stability</b> at + 70°C; 0.1 watt per resistor, 2000 hours	$\Delta R = 0.005\%$ (50 ppm) $\Delta \text{Ratio} = 0.005\%$ (50 ppm)
<b>Shelf Life Stability</b> 1 year at + 15°C to + 35°C; 15% to 75% RH, No load	$\Delta R = 0.0025\%$ (25 ppm) $\Delta \text{Ratio} = 0.002\%$ (20 ppm)
<b>Short Time Overload</b> 2.5 x Rated Voltage; 5 seconds	$\Delta R = 0.005\%$ (50 ppm) $\Delta \text{Ratio} = 0.0025\%$ (25 ppm)
<b>Weight</b>	0.08 grams

**TABLE 4 - ORDERING INFORMATION**

MODEL	RESISTANCE VALUE (R1, R2)*			ABSOLUTE TCR	ABSOLUTE TOLERANCE	TOLERANCE RATIO	TERMINATION	PACKAGING
SMN	RESISTANCE RANGE	LETTER DESIGNATOR	MULTIPLIER FACTOR	TCR2	Q = 0.02% A = 0.05% B = 0.1% C = 0.25% D = 0.5% F = 1.0%	T = $\pm 0.01\%$ Q = $\pm 0.02\%$ A = $\pm 0.05\%$	S = Lead (Pb)-free B = Tin/Lead	T = Tape and Reel W = Waffle pack U = Tube
	100 $\Omega$ to < 1K $\Omega$	R	X 1.0					
	1K $\Omega$ to < 20K $\Omega$	K	X 10 <sup>3</sup>					
	Example 249R00 = 249 $\Omega$ Example 10K000 = 10.0K $\Omega$							

\*Specify the resistance value for each resistor of the network - even if all values are the same.

Example:  
SMN 10K 10K TCR2 QTSW  
Model: SMN  
Value: R1 = 10K R2 = 10K R3 = 10K R4 = 10K  
SALES

TCR2: 2 ppm/°C typical refers to any value in the resistance range  
Tolerance: Absolute:  $\pm 0.02\%$  Match:  $\pm 0.01\%$   
Termination: Lead (Pb)-free  
Packaging: Waffle Pack  
TCR Tracking: See table 3

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