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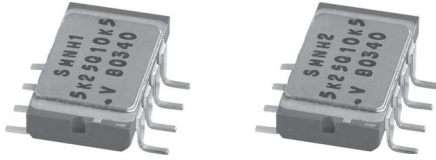
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## Ultra High Precision Bulk Metal® Foil Technology 4 Resistor Surface Mount Hermetic Network with 0.5 ppm/°C TCR Tracking and 0.005 % Tolerance Match



### INTRODUCTION

Vishay model SMNH networks incorporate all the performance features of Vishay Bulk Metal® Foil technology in a product ready for surface mounting. The 8 pin gull wing side brazed DIP is the smallest ceramic package. Ceramic has the advantage of electrical isolation on the underside and high heat dissipation capability.

Resistors in network form, around the operational amplifier for example, are called upon to track at changing ambient temperature, to hold ratio under power and to force the ratio changes over a period of time to be very low.

The hermeticity, the location of the chips within the package and the “heat-sink effect” of the ceramic package itself help preserve uniform conditions inside it. The Bulk Metal Foil Vishay technology advantage in such a construction assures remarkable performance due to the following factors:

- fundamentally low TCR
- very small drift with load over time
- common behavior: all drifts move in the same direction with temperature, load and time
- TCR and tolerance match
- excellent tracking

The major highlights are emphasized by an excellent load life and shelf life ratio stability.

Vishay hermetic resistor networks are based on fabrication from a standing inventory of packages and resistor chips. This permits quick delivery of prototypes since there are no masks to design or trial processings to be made. Further, it allows any combination of values, tolerances and circuits. There are normally no engineering or setup charges, and no minimum quantities are required. Delivery can be in two weeks. (See network express prototype service.)

The sequence of fabrication includes selection of chips, die attachment, wirebonding, value trimming, and hermetic sealing. The finished product provides the stability associated with Foil resistors in a hermetically sealed package.

Hermetic sealing of Vishay’s networks enhances their already inherently stable environmental performance. The result is improved load life stability and better performance during high temperature and moisture exposure.

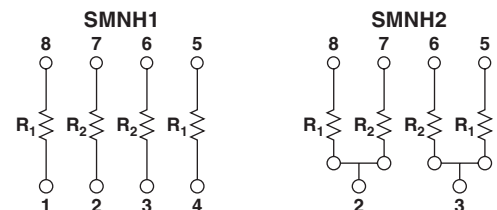
### FEATURES

- Temperature coefficient of resistance (TCR):  
absolute:  $\pm 2$  ppm/°C typical  
(- 55 °C to + 125 °C, + 25 °C ref.)  
tracking:  $\pm 0.5$  ppm/°C typical
- Resistance range: 5  $\Omega$  to 33 k $\Omega$
- Vishay Foil resistors are not restricted to standard values; specific “as required” values can be supplied at no extra cost or delivery (e.g. 1K2345 vs. 1K)
- Power rating: at 70 °C  
Entire package: 0.4 W  
Each resistor: 0.1 W
- Resistance tolerance match:  $\pm 0.005$  %
- Load life stability per resistor: 0.005 % (0.1 W at 70 °C, 1000 h)
- Load life stability ratio: 0.005 % (0.1 W at 70 °C)
- Shelf life stability per resistor: 0.0002 % (2 ppm)
- Shelf life stability ratio: 0.0001 % (1 ppm)
- Electrostatic discharge (ESD) up to 25 000 V
- Short time overload  $\leq 0.002$  % (20 ppm)
- Non-inductive, non-capacitive design
- Rise time: 1 ns effectively no ringing
- Thermal stabilization time < 1 s (nominal value achieved within 10 ppm of steady state value)
- Current noise: 0.010  $\mu$ V<sub>RMS</sub>/V of applied voltage (< - 40 dB)
- Voltage coefficient: < 0.1 ppm/V
- Non inductive: < 0.08  $\mu$ H
- Non hot spot design
- Terminal finish: gold plated (lead (Pb)-free)
- For better performances please contact us
- Available with Z-Foil technology for improved TCR to 0.2 ppm/°C
- Compliant to RoHS directive 2002/95/EC



Available  
**RoHS\***  
COMPLIANT

**FIGURE 1 - SCHEMATICS**



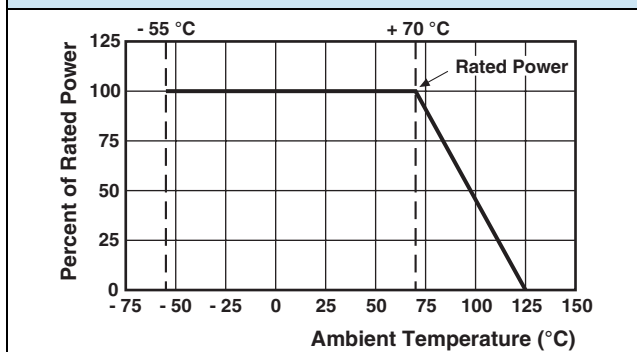
Note: R<sub>1</sub> and R<sub>2</sub> may be same value, if desired

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

**TABLE 1 - MODEL SMNH SPECIFICATIONS**

MODEL	ABSOLUTE TCR (- 55 °C to + 125 °C, + 25 °C ref.)		TOLERANCE		TCR TRACKING (max.)	
	RESISTANCE VALUES	TYPICAL + MAX. SPREAD	ABSOLUTE	MATCH	SAME VALUES	DIFFERENT VALUES
SMNH	500 Ω to 33 kΩ	± 2 ± 2.5 ppm/°C	± 0.005 %	0.005 %	0.5 ppm/°C	1 ppm/°C
	100 Ω to 500Ω		± 0.01 %	0.005 %	2 ppm/°C	3 ppm/°C
	10 Ω to 100 Ω	± 2 ± 3.5 ppm/°C	± 0.02 %	0.01 %	4 ppm/°C	5 ppm/°C
	5 Ω to 10 Ω		± 0.05 %	0.02 %		

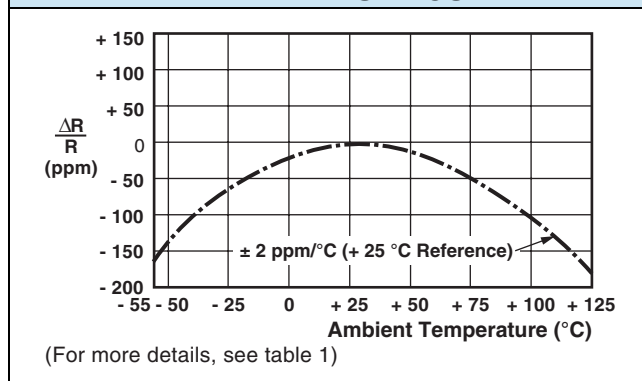
**FIGURE 2 - POWER DERATING CURVE (1)**



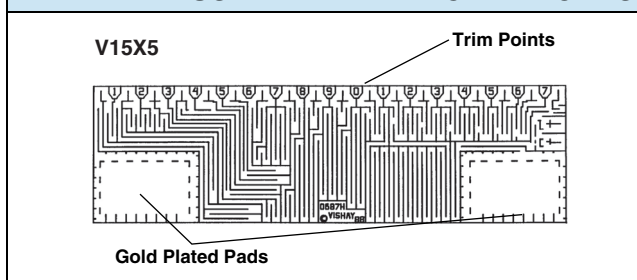
**Note**

(1) Each resistor element 0.1 W at + 70 °C (0.4 W per package)

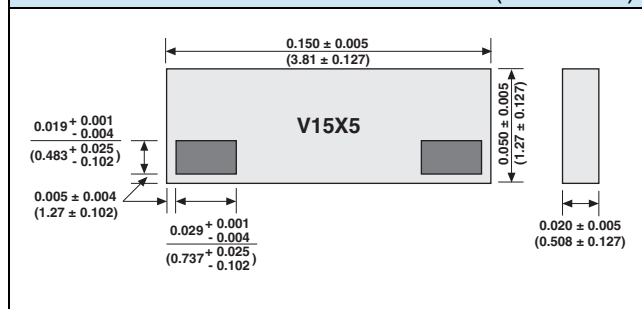
**FIGURE 3 - TYPICAL RESISTANCE/TEMPERATURE CURVE**



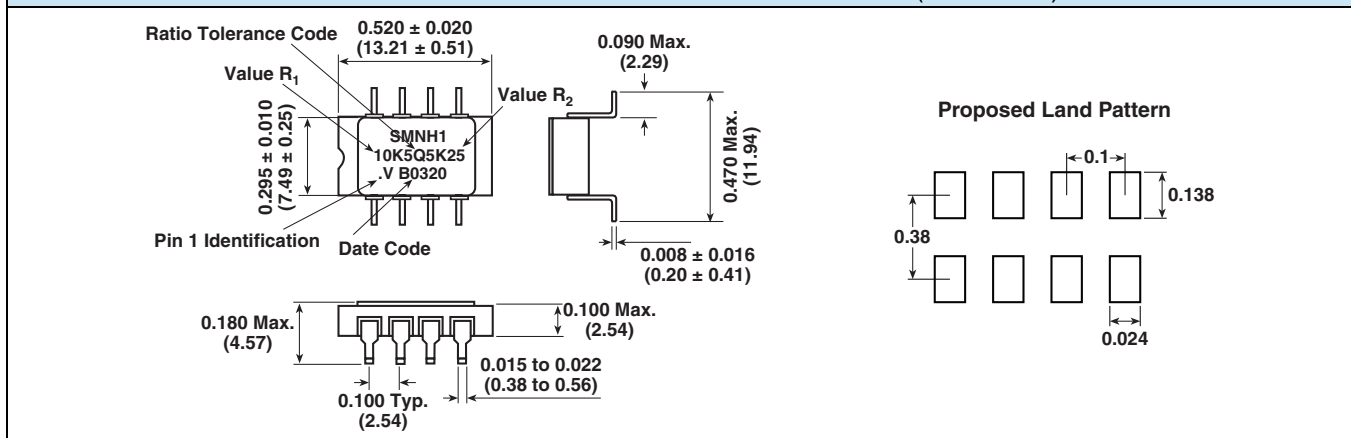
**FIGURE 4 - FORMAT OF CHIP RESISTOR USED IN HERMETIC NETWORKS**



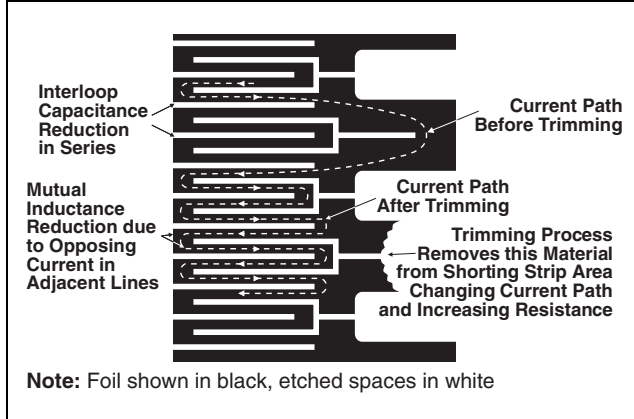
**FIGURE 5 - DIMENSIONS in inches (millimeters)**



**FIGURE 6 - DIMENSIONS AND IMPRINTING EXAMPLE in inches (millimeters)**



**FIGURE 7 - TRIMMING TO VALUES**  
(Conceptual Illustration)



**TABLE 2 - MECHANICAL SPECIFICATIONS**

Resistive Element	High precision Bulk Metal Foil chips
Body	Ceramic package: 94 % alumina (Al <sub>2</sub> O <sub>3</sub> )
Lid	Gold plated kovar
Terminals	Alloy 42 (iron nickel) with 100 μ" gold plating (MIL-STD-1276, type G-21-A)
Internal Connections	Gold wire bonding
Solderability	Per MIL-PRF-83401
Marking Resistance to Solvents	Permanency testing per MIL-PRF-83401

**TABLE 3 - PERFORMANCE SPECIFICATIONS (PER MIL-PRF 83401 TEST METHODS)**

SPECIFICATIONS	TYPICAL LIMITS	MAXIMUM LIMITS
<b>Thermal Shock</b> 5 x (- 65 °C to + 125 °C) and <b>Power Conditioning</b> 1.5 rated power at 25 °C, 100 h	ΔR = 0.003 % (30 ppm) ΔRatio = 0.001 % (10 ppm)	0.015 % (150 ppm) 0.015 % (150 ppm)
<b>Low Temperature Operation</b>	ΔR = 0.005 % (50 ppm) ΔRatio = 0.005 % (50 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Short Time Overload</b> 6.25 rated power; 5 s	ΔR = 0.002 % (20 ppm) ΔRatio = 0.002 % (20 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Terminal Strength</b>	ΔR = 0.001 % (10 ppm) ΔRatio = 0.001 % (10 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Resistance to Soldering Heat</b> 260 °C, 10 s	ΔR = 0.002 % (20 ppm) ΔRatio = 0.001 % (10 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Moisture Resistance</b>	ΔR = 0.003 % (30 ppm) ΔRatio = 0.003 % (30 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Shock</b> 100 G, sawtooth	ΔR = 0.001 % (10 ppm) ΔRatio = 0.001 % (10 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Vibration, High Frequency</b>	ΔR = 0.001 % (10 ppm) ΔRatio = 0.001 % (10 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Load Life</b> 1000 h at + 70 °C; 0.1 W per resistor	ΔR = 0.005 % (50 ppm) ΔRatio = 0.005 % (50 ppm)	0.025 % (250 ppm) 0.01 % (100 ppm)
<b>Load Life</b> 1000 h at + 25 °C; 0.1 W per resistor	ΔR = 0.002 % (20 ppm) ΔRatio = 0.001 % (10 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>High Temperature Exposure</b> 100 h at + 125 °C	ΔR = 0.005 % (50 ppm) ΔRatio = 0.005 % (50 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Low Temperature Storage</b> 24 h at - 65 °C	ΔR = 0.002 % (20 ppm) ΔRatio = 0.002 % (20 ppm)	0.01 % (100 ppm) 0.01 % (100 ppm)
<b>Shelf Life Stability</b> (6 years)	ΔR = 0.0002 % (2 ppm) ΔRatio = 0.0001 % (1 ppm)	
<b>Insulation Resistance</b> 100 V (DC)	> 10 <sup>4</sup> MΩ	
<b>DWV Atm. Pressure</b>	200 V	
<b>Weight</b>	0.95 g	

**Notes**

- ΔR's are not cumulative. For purposes of determining reliability calculations, consider the characteristics shown as figures of merit and allow no more than ± 0.05 ΔR lifetime. Allow proportionately less if the severity of anticipated environmental stresses are small compared to the tests as defined in MIL-PRF-83401.
- Post manufacturing operation (PMO) has the effect of minimizing ΔR's. Consult Vishay applications engineering for details.
- ΔRatio refers to the change in ratio between resistors within the network package from before, to after, the specified test.

## QUALITY INSPECTION AND TESTING

Network performance is established during the engineering design phase and is dependent on the materials of construction. Most characteristics are inherent in the Bulk Metal Foil technology and provide the high order of performance displayed throughout this catalog. Stability and drift levels can be improved beyond those shown in the catalog. Applications engineering is available to recommend screen testing beyond the standard outgoing inspection when catalog limits are insufficient. The chart below shows the standard outgoing testing and the additional user specified screen tests that may be appropriate for a particular application.

## TESTING OF COMMERCIAL PRODUCT - VISHAY NETWORKS

Our standard outgoing testing consists of:

1. DC resistance test 100 %
  - 1.1 Conformity to value
  - 1.2 Conformity to tolerance
2. Visual and Mechanical 100 %
  - 2.1 Conformity to physical size
  - 2.2 Cleanliness of leads
  - 2.3 Conformity of printing
3. Ship check (sample plan)
  - 3.1 Conformity of packaging
  - 3.2 Conformity of count

## ADDITIONAL TESTING TO MIL SPEC

Group A testing to MIL-PRF-83401 imposes the following:

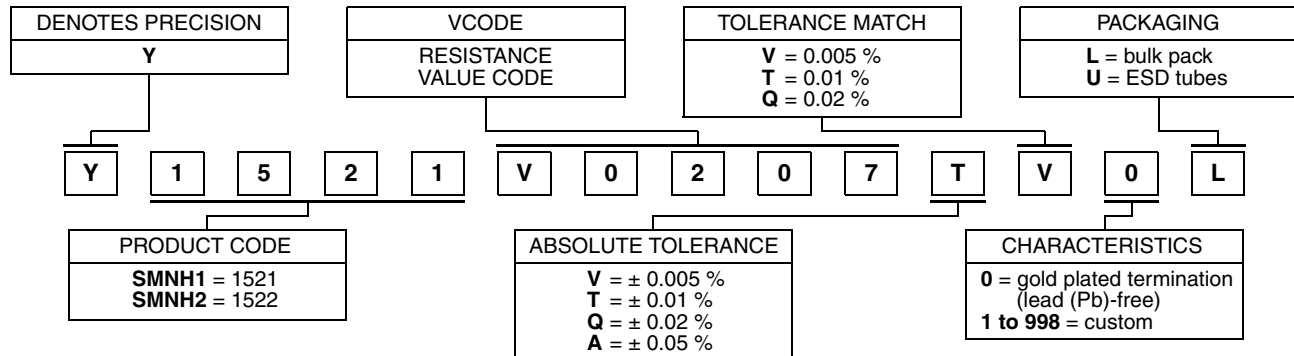
1. Thermal shock 100 %
  - 5X from - 65 °C to + 125 °C
2. Power conditioning 100 %
  - 2.1 100 h at 25 °C, 1.5 x rated power
  - 2.2  $\Delta R$  and  $\Delta R$ Ratio calculation
3. Visual and mechanical after the above tests (sample plan)
  - 3.1 Conformity to physical size
  - 3.2 Workmanship
  - 3.3 Damage due to the above tests
4. 10 % PDA or one piece whichever is greater
5. Solderability (sample plan)

Group B sample testing to MIL-PRF-83401 imposes the following:

1. Temperature coefficient of resistance (sample plan)
2. Resistance to solvents (sample plan)

**TABLE 4 - GLOBAL PART NUMBER INFORMATION (1)**

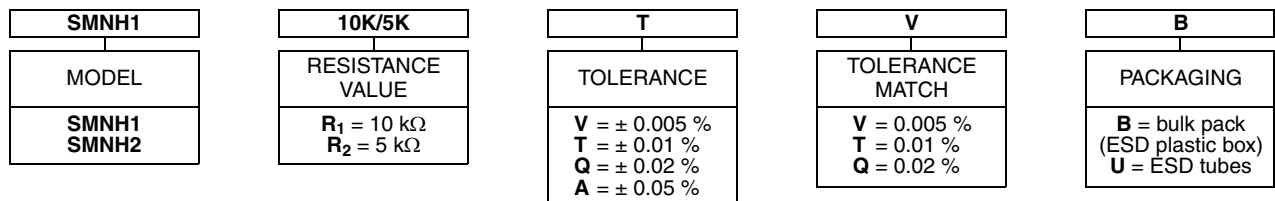
**NEW GLOBAL PART NUMBER: Y1521V0207TV0L (preferred part number format)**



FOR EXAMPLE: ABOVE GLOBAL ORDER Y1521 V0207 T V 0 L:

TYPE: SMNH1  
VALUES: 10K/5K (see VCODE V0207 in table 5 below)  
ABSOLUTE TOLERANCE: ± 0.01 %  
TOLERANCE MATCH: 0.005 %  
TERMINATION: gold plated (lead (Pb)-free)  
PACKAGING: bulk pack

**HISTORICAL PART NUMBER: SMNH1 10K/5K T V B (will continue to be used)**



**Note**

(1) Application engineering release: for non-standard requests, please contact application engineering

**TABLE 5 - RESISTANCE VALUE CODE LIST FOR POPULAR RATIOS**

VCODES	R <sub>1</sub> /R <sub>2</sub> RATIO	R <sub>1</sub>	R <sub>2</sub>	VCODES	R <sub>1</sub> /R <sub>2</sub> RATIO	R <sub>1</sub>	R <sub>2</sub>
V0201	100	10K	100R	V0189	2.5	1K	400R
V0202	50	10K	200R	V0185		500R	200R
V0197		5K	100R	V0207	2	10K	5K
V0203	25	10K	400R	V0175		2K	1K
V0198		5K	200R	V0190		1K	500R
V0204	20	10K	500R	V0182		400R	200R
V0193		2K	100R	V0179	200R	100R	
V0205	10	10K	1K	V0186	1.25	500R	400R
V0194		2K	200R	V0178	1	100R	100R
V0187		1K	100R	V0180		200R	200R
V0200	5	5K	1K	V0183		400R	400R
V0195		2K	400R	V0023		500R	500R
V0188		1K	200R	V0191	1K	1K	
V0184		500R	100R	V0176	2K	2K	
V0196	4	2K	500R	V0019	5K	5K	
V0181		400R	100R	V0008	10K	10K	

**Note**

- Other values available upon request



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