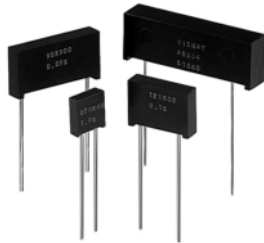


High Precision Foil Resistor with TCR of $\pm 2.0\text{ppm}/^\circ\text{C}$, Tolerance of $\pm 0.005\%$ and Load Life Stability of $\pm 0.005\%$



Any value at any tolerance available within resistance range

INTRODUCTION

Bulk Metal[®] Foil (BMF) 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, 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 S Series made from Vishay BMF offers low TCR, excellent load life stability, tight tolerance, fast response time, low current noise, low thermal EMF and low voltage coefficient, all in one resistor.

The S Series is virtually insensitive to destabilizing factors. The resistor element is a solid alloy that displays the desirable bulk properties of its parent material, thus it is inherently stable and noise free.

Vishay Bulk Metal[®] S Series are the modern generation of precision resistors, their design gives you a unique combination of characteristics found in no other single resistor- and they're all standard.

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

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

SALES

• AMERICAS: foilsales.usa@vishay.com • ASIA/JAPAN: foilsales.asia@vishay.com • UK/HOLLAND/SCANDINAVIA: foilsales.eunorth@vishay.com
 • GERMANY/CZECH REPUBLIC/AUSTRIA: foilsales.eucentral@vishay.com • FRANCE/SWITZERLAND/SOUTHERN EUROPE: foilsales.eusouth@vishay.com • ISRAEL: foilsales.israel@vishay.com

FEATURES

- Very low Temperature Coefficient of Resistance (TCR): ** - 55°C to + 125°C, 25°C Ref
- S102C Series: $\pm 2\text{ppm}/^\circ\text{C}$ typical, $\pm 4.5\text{ppm}/^\circ\text{C}$ max.
- S102K Series: $\pm 1\text{ppm}/^\circ\text{C}$ typical, $\pm 2.5\text{ppm}/^\circ\text{C}$ max.
- Load Life Stability: to $\pm 0.005\%$ at 70°C, 2000hrs
- Tight Tolerance: $\pm 0.005\%$
- Resistance Range: 0.5Ω to 1MΩ (higher or lower values of resistance are available)
- Shelf Life Stability: to Maximum 0.0025%, 1 year
- Rated Power: to 1W at + 125°C
- Matched sets are available per request (TCR Tracking: to 0.5ppm/°C)
- Voltage Coefficient: $< 0.1\text{ppm}/\text{V}$
- Low Inductance: $< 0.08\mu\text{H}$
- Current Noise: $< -40\text{dB}$
- Rise/Decay Time: 1ns without ringing
- Thermal EMF: 0.05μV/°C
- Terminal Finishes Available:
 - Lead (Pb)-free (Sn 100%)
 - Tin/Lead Alloy (Sn 60%, Pb 40%)
- For better performances please review the **Z201** datasheet
- ** For values below 50Ω please contact Application Engineering



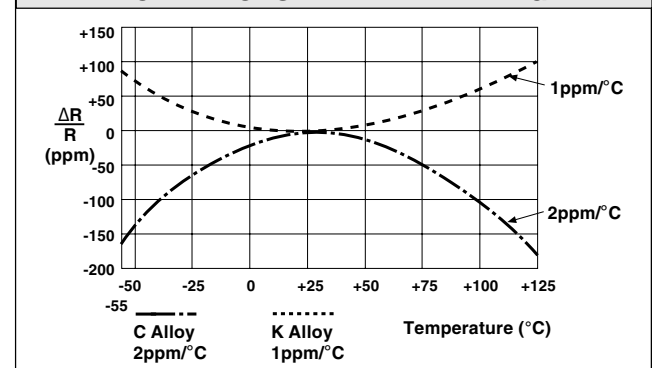
RoHS* COMPLIANT

THROUGH HOLE

APPLICATIONS

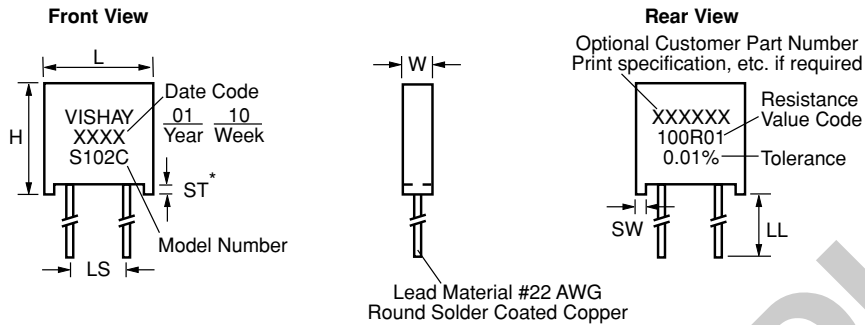
- High Precision Amplifiers
- Down-hole (High Temperature)
- High Precision Instrumentation
- Medical and Test Equipment
- Industrial
- Audio (High End Stereo Equipment)
- EB Applications (electron beam scanning and recording equipment, electron microscopes)
- Military, Airborne
- Measurement Instrumentation

FIG 1 - FOIL RESISTOR TCR COMPARISON OF FOIL ALLOYS IN MILITARY RANGE



Vishay Foil Resistors High Precision Foil Resistor with TCR of $\pm 2.0 \text{ ppm}/^\circ\text{C}$,
Tolerance of $\pm 0.005\%$ and Load Life Stability of $\pm 0.005\%$

FIGURE 2 - STANDARD IMPRINTING AND DIMENSIONS



*The standoffs shall be so located as to give a lead clearance of 0.010" minimum between the resistor body and the printed circuit board when the standoffs are seated on the printed circuit board. This is to allow for proper cleaning of flux and other contaminants from the unit after all soldering processes.

TABLE 1 - MODEL SELECTION

MODEL NUMBER	RESISTANCE RANGE (Ω)	MAXIMUM WORKING VOLTAGE	AMBIENT POWER RATING @ +70°C @ +125°C	AVERAGE WEIGHT IN GRAMS	DIMENSIONS			TIGHTEST TOLERANCE (%) VS. LOWEST RESISTANCE VALUE (Ω)	
					INCHES	mm	*F (INCHES)		
S102C (S102J**)	1 to 150K	300	0.6W 0.3W up to 100K	0.6	W: 0.105 \pm 0.010 L: 0.300 \pm 0.010 H: 0.326 \pm 0.010 ST: 0.010 Minimum SW: 0.040 \pm 0.005 LL: 1.000 \pm 0.125 LS: 0.150 \pm 0.005*	2.67 \pm 0.25 7.62 \pm 0.25 8.28 \pm 0.25 0.254 Minimum 1.02 \pm 0.13 25.4 \pm 3.18 3.81 \pm 0.13		$\pm 0.005 / 50$	
S102K (S102L**)	1 to 100K		0.4W 0.2W over 100K						
S104D (S104F*)	1 to 500K	350	1.0W 0.5W up to 200K	1.4	W: 0.160 Maximum L: 0.575 Maximum H: 0.413 Maximum ST: 0.035 \pm 0.005 SW: 0.050 \pm 0.005 LL: 1.000 \pm 0.125 LS: 0.400 \pm 0.020	4.06 Maximum 14.61 Maximum 10.49 Maximum 0.889 \pm 0.13 1.27 \pm 0.13 25.4 \pm 3.18 10.16 \pm 0.51	(0.138) (0.565) (0.413)		$\pm 0.01 / 25$
S104K	1 to 300K		0.6W 0.3W over 200K						$\pm 0.02 / 12$
S105D (S105F*)	1 to 750K	350	1.5W 0.75W up to 300K	1.9	W: 0.160 Maximum L: 0.820 Maximum H: 0.413 Maximum ST: 0.035 \pm 0.005 SW: 0.050 \pm 0.005 LL: 1.000 \pm 0.125 LS: 0.650 \pm 0.020	4.06 Maximum 20.83 Maximum 10.49 Maximum 0.889 \pm 0.13 1.27 \pm 0.13 25.4 \pm 3.18 16.51 \pm 0.51	(0.138) (0.890) (0.413)		$\pm 0.1 / 2$
S105K	1 to 500K		0.8W 0.4W over 300K				(0.7 \pm 0.02)		$\pm 0.5 / 1$
S106D	0.5 to 1M	500	2.0W 1.0W up to 400K	4.0	W: 0.260 Maximum L: 1.200 Maximum H: 0.413 Maximum ST: 0.035 \pm 0.005 SW: 0.050 \pm 0.005 LL: 1.000 \pm 0.125 LS: 0.900 \pm 0.020	6.60 Maximum 30.48 Maximum 10.49 Maximum 0.889 \pm 0.13 1.27 \pm 0.13 25.4 \pm 3.18 22.86 \pm 0.51			
S106K	0.5 to 600K		1.0W 0.5W over 400K						

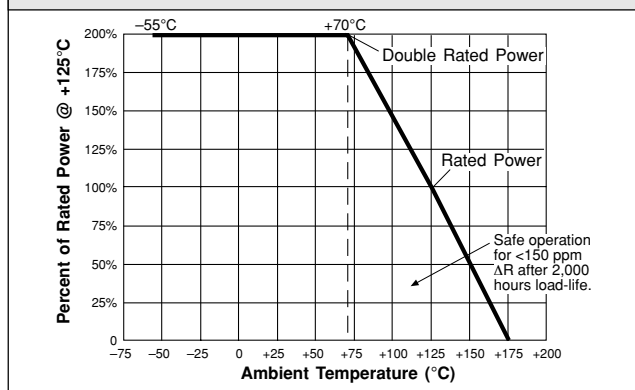
*S104F and S105F have different package dimensions (see last column). All other specifications are the same.

**0.200" (5.08mm) lead spacing available - specify S102J for S102C, and S102L for S102K.

Note its minor outline dimensions variations:

	INCHES	mm
W:	0.098 Maximum	2.49 Maximum
L:	0.295 Maximum	7.49 Maximum
H:	0.315 Maximum	8.00 Maximum
ST:	0.01 Minimum	0.254 Minimum
LL:	0.875 Minimum	22.23 Minimum
LS:	0.200 \pm 0.003	5.08 \pm 0.076

FIG 3 - POWER DERATING CURVE "S" SERIES



SALES

• AMERICAS: foilsales.usa@vishay.com • ASIA/JAPAN: foilsales.asia@vishay.com • UK/HOLLAND/SCANDINAVIA: foilsales.eunorth@vishay.com
• GERMANY/CZECH REPUBLIC/AUSTRIA: foilsales.eucentral@vishay.com • FRANCE/SWITZERLAND/SOUTHERN EUROPE: foilsales.eusouth@vishay.com • ISRAEL: foilsales.israel@vishay.com



High Precision Foil Resistor with TCR of $\pm 2.0 \text{ ppm}/^\circ\text{C}$, Vishay Foil Resistors
Tolerance of $\pm 0.005\%$ and Load Life Stability of $\pm 0.005\%$

TABLE 2 - "S" SERIES SPECIFICATIONS	
Stability¹ Load Life at 2,000 hours.	$\pm 0.015\%$ Maximum ΔR @ 0.3W/+ 125°C $\pm 0.005\%$ Maximum ΔR @ 0.1W/+ 70°C
Load Life at 10,000 hours.	$\pm 0.05\%$ Maximum ΔR @ 0.3W/+ 125°C $\pm 0.01\%$ Maximum ΔR @ 0.05W/+ 125°C
Shelf Life Stability	$\pm 0.0025\%$ Maximum ΔR after 1 year $\pm 0.005\%$ Maximum ΔR after 3 years
Current Noise	0.010 μV (RMS)/Volt of applied voltage (-40dB)
High Frequency Operation Rise/Decay Time Inductance (L) ² Capacitance (C)	1.0ns at 1K Ω 0.1 μH maximum; 0.08 μH typical 1.0pF maximum; 0.5pF typical
Voltage Coefficient	< 0.1ppm/V ³
Thermal EMF⁴	0.1 $\mu\text{V}/^\circ\text{C}$ Maximum; 0.05 $\mu\text{V}/^\circ\text{C}$ typical 1 $\mu\text{V}/\text{watt}$ (Model S102C)

1. Load life ΔR Maximum can be reduced by 80%, please contact Applications Engineering Department.
2. Inductance (L) due mainly to the leads.
3. The resolution limit of existing test equipment (within the measurement capability of the equipment, or "essentially zero.")
4. $\mu\text{V}/^\circ\text{C}$ relates to EMF due to lead temperature difference and $\mu\text{V}/\text{watt}$ due to power applied to the resistor.

TABLE 3 - ORDERING INFORMATION			
Specify Vishay S Series resistors as follows: Example:			
S102C	T = Lead (Pb)-free none = Tin/Lead alloy	250R00	V = $\pm 0.005\%$ T = $\pm 0.01\%$ Q = $\pm 0.02\%$ A = $\pm 0.05\%$ B = $\pm 0.1\%$ C = $\pm 0.25\%$ D = $\pm 0.5\%$ F = $\pm 1.0\%$
MODEL NO.	TERMINATION	RESISTANCE VALUE	TOLERANCE
Resistance Value, in ohms, is expressed by a series of 6 characters, 5 of which represent significant digits while the 6th is a dual purpose letter that designates both the multiplier and the location of the comma or decimal.			
RESISTANCE RANGE	LETTER DESIGNATOR	MULTIPLIER FACTOR	EXAMPLE
10 Ω to <1K Ω 1K Ω to 100K Ω	R K	x 1 x 10 ³	100R01 = 100.01 Ω 5K2310 = 5,231 Ω
For example: S102C T 250R00 V - Model: S102C; Termination: lead (Pb)-free; Value: 250 Ω ; Tolerance: 0.005%			

SALES

• AMERICAS: foilsales.usa@vishay.com • ASIA/JAPAN: foilsales.asia@vishay.com • UK/HOLLAND/SCANDINAVIA: foilsales.eunorth@vishay.com
• GERMANY/CZECH REPUBLIC/AUSTRIA: foilsales.eucentral@vishay.com • FRANCE/SWITZERLAND/SOUTHERN EUROPE: foilsales.eusouth@vishay.com • ISRAEL: foilsales.israel@vishay.com

Vishay Foil Resistors High Precision Foil Resistor with TCR of $\pm 2.0 \text{ ppm}/^\circ\text{C}$,
Tolerance of $\pm 0.005\%$ and Load Life Stability of $\pm 0.005\%$

TABLE 4 - ENVIRONMENTAL PERFORMANCE COMPARISON

	MIL-PRF-55182 CHAR J	S-SERIES MAXIMUM ΔR	S-SERIES TYPICAL ΔR
Test Group I			
Thermal Shock	$\pm 0.2\%$	$\pm 0.01\%$	$\pm 0.002\%$
Short Time Overload	$\pm 0.2\%$	$\pm 0.01\%$	$\pm 0.003\%$
Test Group II			
Resistance Temperature Characteristic	$\pm 25\text{ppm}/^\circ\text{C}$	$\pm 4.5\text{ppm}/^\circ\text{C}$	$\pm 2.0 \text{ ppm}/^\circ\text{C}$
Low Temp Storage	$\pm 0.15\%$	$\pm 0.01\%$	$\pm 0.002\%$
Low Temp Operation	$\pm 0.15\%$	$\pm 0.01\%$	$\pm 0.002\%$
Terminal Strength	$\pm 0.2\%$	$\pm 0.01\%$	$\pm 0.002\%$
Test Group III			
DWV	$\pm 0.15\%$	$\pm 0.01\%$	$\pm 0.002\%$
Resistance to Solder Heat	$\pm 0.1\%$	$\pm 0.01\%$	$\pm 0.005\%$
Moisture Resistance	$\pm 0.4\%$	$\pm 0.05\%$	$\pm 0.015\%$
Test Group IV			
Shock	$\pm 0.2\%$	$\pm 0.01\%$	$\pm 0.002\%$
Vibration	$\pm 0.2\%$	$\pm 0.01\%$	$\pm 0.002\%$
Test Group V			
Life Test at 0.3 W/+125°C			
2,000 Hours	$\pm 0.5\%$	$\pm 0.015\%$	$\pm 0.01\%$
10,000 Hours	$\pm 2.0\%$	$\pm 0.05\%$	$\pm 0.03\%$
Test Group Va			
Life Test at 0.6W (2 x Rated Power)/+70°C, 2000 hrs.	$\pm 0.5\%$	$\pm 0.015\%$	$\pm 0.01\%$
Test Group VI			
High Temperature Exposure	$\pm 2.0\%$	$\pm 0.1\%$	$\pm 0.05\%$
Test Group VII			
Voltage Coefficient	0.0005%/V	< 0.00001%/V	< 0.00001%/V

THROUGH HOLE

STANDARD OPERATIONS & TEST CONDITIONS

A. Standard Test Operations:

By 100% Inspection

- Short-time overload (6.25 x rated power for 5 seconds)
- Resistance – tolerance check
- Visual and mechanical

By Sample Inspection

- TCR
- Environmental tests per Table 4 on a quarterly basis to establish performance by similarity.

B. Standard Test Conditions:

- Lead test point: 0.5" (12.7 mm) from resistor body
- Temperature: $+ 23^\circ\text{C} \pm 2^\circ\text{C}$
- Relative humidity: per MIL-Std-202

IMPROVED PERFORMANCE TESTING (IPT)

The preceding information is based on product directly off the production line. Improved performance (meaning increased time stability with load and other stresses) is available through factory conducted "Improved Performance Testing". The test routine is usually tailored to the users stability objectives and product that has been screened can be brought down to a potential load life of less than 50ppm.

Various screen test routines are available and all anticipated stresses must be taken into account before settling on one specific test routine. Our Applications Engineering Department is prepared to discuss and recommend appropriate routines given the full spectrum of anticipated stresses and stability requirements.

SALES

• AMERICAS: foilsales.usa@vishay.com • ASIA/JAPAN: foilsales.asia@vishay.com • UK/HOLLAND/SCANDINAVIA: foilsales.eunorth@vishay.com
• GERMANY/CZECH REPUBLIC/AUSTRIA: foilsales.eucentral@vishay.com • FRANCE/SWITZERLAND/SOUTHERN EUROPE: foilsales.eusouth@vishay.com • ISRAEL: foilsales.israel@vishay.com



Notice

Specifications of the products displayed herein are subject to change without notice. Vishay Intertechnology, Inc., or anyone on its behalf, assumes no responsibility or liability for any errors or inaccuracies.

Information contained herein is intended to provide a product description only. No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document. Except as provided in Vishay's terms and conditions of sale for such products, Vishay assumes no liability whatsoever, and disclaims any express or implied warranty, relating to sale and/or use of Vishay products including liability or warranties relating to fitness for a particular purpose, merchantability, or infringement of any patent, copyright, or other intellectual property right.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications. Customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Vishay for any damages resulting from such improper use or sale.