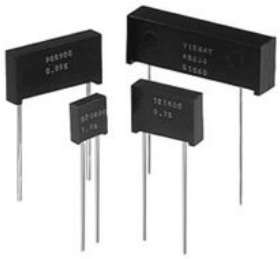


High Precision Foil Resistor with TCR of ± 2.0 ppm/°C, Tolerance of ± 0.005 % and Load Life Stability of ± 0.005 %

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 Foil Resistors (VFR), and products based on this technology are the most suitable for a wide range of applications.

BMF technology allows the production of customer-oriented products, designed to satisfy specific challenging technical requirements.

The S series of BMF resistors 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 destabillizing 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. The standard design of these resistors provides a unique combination of characteristics found in no other single resistor.

VFR's application engineering department is available to advise and to make recommendations. For non-standard technical requirements and special applications, please contact info@bedek.de

FEATURES

• Temperature coefficient of resistance (TCR): - 55 °C to + 125 °C, 25 °C ref.
- S10XC / D series: ± 2 ppm/°C typical (see table 1)
- S10XK series: ± 1 ppm/°C typical (see table 1)
•Power rating: to 1 W at + 125 °C
•Resistance tolerance: to ± 0.005 % (50 ppm)
•Load life stability: ± 0.005 % at 70 °C, 2000 h at rated power
•Resistance range: 0.5 Ω to 1 MΩ (for higher or lower values, please contact Application Engineering)
•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)
•Electrostatic discharge (ESD) at least to 25 kV
•Non inductive, non capacitive design
•Rise time: 1 ns effectively no ringing
•Current noise: 0.010 μVRMS/V of applied voltage (< - 40 dB)
•Thermal EMF: 0.05 μV/°C
•Voltage coefficient: < 0.1 ppm/V
•Low inductance: < 0.08 μH
•Non hot-spot design
•Terminal finishes available: lead (Pb)-free, tin/lead alloy
•Matched sets are available on request
(TCR tracking: to 0.5 ppm/°C)
•Prototype quantities available in just 5 working days or sooner. For more information, please contact info@bedek.de

•For better TCR performances please review the datasheets for the Z Series and Z203

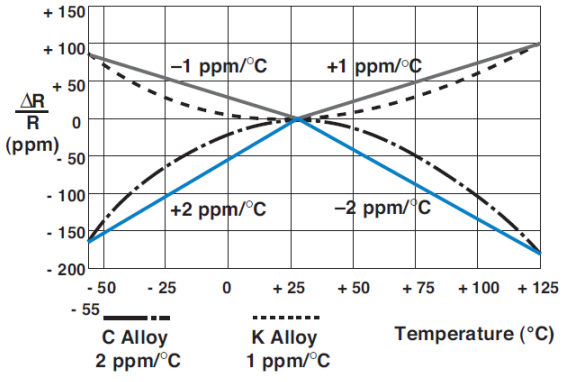
TABLE 1 - RESISTANCE VERSUS TCR (-55°C to +125°C, +25°C ref.)

RESISTOR	RESISTANCE VALUE (Ω)	TYPICAL TCR AND MAX SPREAD (ppm/°C)
S10X(C) / (D)	80 to < 1M	± 2 ±2.5
S10X(K)	80 to < 600K	± 1 ± 2.5
S10X(C) / (D)	50 to < 80	± 2 ± 3.5
S10X(K)		± 1 ± 3.5
S10X(C) / (D)	0.5 to < 50	± 2 ± 4.5
S10X(K)		± 1 ± 4.5

Note
(1) X refers to S Series model number – see Table 2

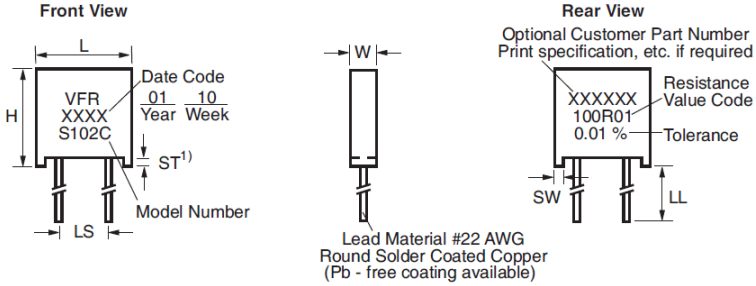
* Pb containing terminations are not RoHS compliant, exemptions may apply

FIGURE 1 - TYPICAL RESISTANCE CHANGE VERSUS TEMPERATURE CURVES AND CHORD SLOPES (TCR) OF TWO ALLOY TYPES IN MILITARY RANGE



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

FIGURE 2 - STANDARD IMPRINTING AND DIMENSIONS



Note
1. Standoffs provided to allow proper flushing of flux, debris, and contaminates from under resistor after all solder operations.
2. 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.

TABLE 2 - MODEL SELECTION

MODEL NUMBER	RESISTANCE RANGE (Ω)	MAXIMUM WORKING VOLTAGE	AMBIENT POWER RATING at + 70 °C	AMBIENT POWER RATING at + 125 °C	AVERAGE WEIGHT IN GRAMS	DIMENSIONS INCHES	DIMENSIONS mm	DIMENSIONS F (1) (INCHES)	TIGHTEST TOLERANCE VS. LOWEST RESISTANCE VALUE
S102C (S102J) (2)	1 to 150K	300	0.6 W up to 100K	0.3 W	0.6	W: 0.105 ± 0.010 L: 0.300 ± 0.010 H: 0.326 ± 0.010 ST: 0.010 min. SW: 0.040 ± 0.005 LL: 1.000 ± 0.125 LS: 0.150 ± 0.005	2.67 ± 0.25 7.62 ± 0.25 8.28 ± 0.25 0.254 min. 1.02 ± 0.13 25.4 ± 3.18 3.81 ± 0.13		0.005 %/50 Ω 0.01 %/25 Ω 0.02 %/12 Ω 0.05 %/5 Ω 0.1 %/2 Ω 0.50 %/1 Ω 1 %/0.5 Ω
S102K (S102L) (2)	1 to 100K		0.4 W over 100K	0.2 W					
S104D (S104F) (1)	1 to 500K	350	1.0 W up to 200K	0.5 W	1.4	W: 0.160 max. L: 0.575 max. H: 0.413 max. ST: 0.035 ± 0.005 SW: 0.050 ± 0.005 LL: 1.000 ± 0.125 LS: 0.400 ± 0.020	4.06 max. 14.61 max. 10.49 max. 0.889 ± 0.13 1.27 ± 0.13 25.4 ± 3.18 10.16 ± 0.51	(0.138) (0.565) (0.413)	
S104K	1 to 300K		0.6 W over 200K	0.3 W					
S105D (S105F) (1)	1 to 750K	350	1.5 W up to 300K	0.75 W	1.9	W: 0.160 max. L: 0.820 max. H: 0.413 max. ST: 0.035 ± 0.005 SW: 0.050 ± 0.005 LL: 1.000 ± 0.125 LS: 0.650 ± 0.020	4.06 max. 20.83 max. 10.49 max. 0.889 ± 0.13 1.27 ± 0.13 25.4 ± 3.18 16.51 ± 0.51	(0.138) (0.890) (0.413) (0.7 ± 0.05)	
S105K	1 to 500K		0.8 W over 300K	0.4 W					
S106D	0.5 to 1M	500	2.0 W up to 400K	1.0 W	4.0	W: 0.260 max. L: 1.200 max. H: 0.413 max. ST: 0.035 ± 0.005 SW: 0.050 ± 0.005 LL: 1.000 ± 0.125 LS: 0.900 ± 0.020	6.60 max. 30.48 max. 10.49 max. 0.889 ± 0.13 1.27 ± 0.13 25.4 ± 3.18 22.86 ± 0.51		
S106K	0.5 to 600K		1.0 W over 400K	0.5 W					

Notes
(1)S104F and S105F have different package dimensions (see the third column of dimensions). All other specifications are the same.
(2)0.200" (5.08 mm) lead spacing available - specify S102J for S102C, and S102L for S102K.

FIGURE 3 - POWER DERATING CURVE

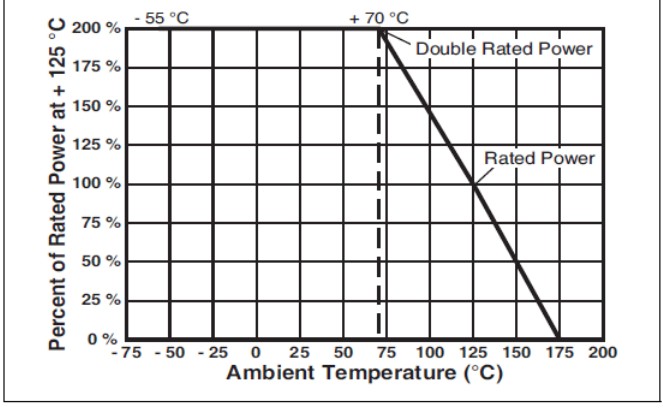
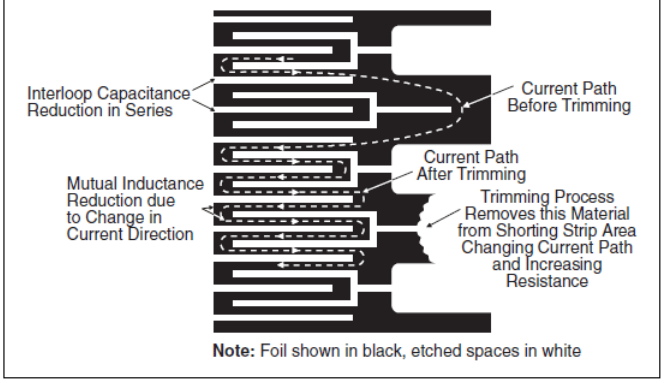


FIGURE 4 - TRIMMING TO VALUES
(conceptual illustration)



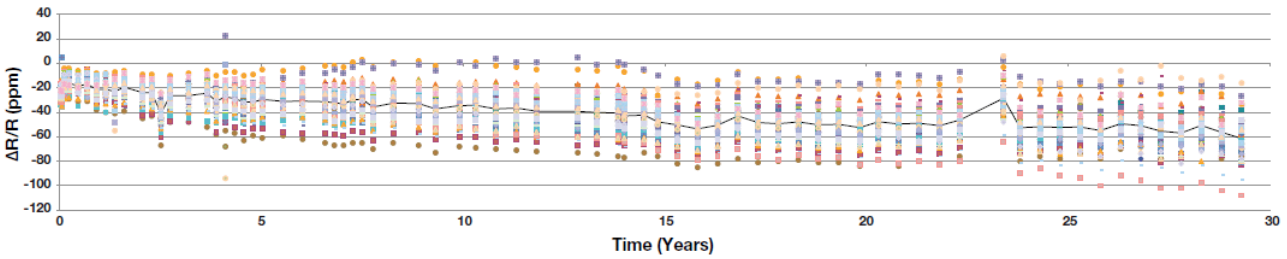
Note: Foil shown in black, etched spaces in white

TABLE 3 – ENVIRONMENTAL PERFORMANCE COMPARISON

	MIL-PRF-55182 CHAR J	S-SERIES MAXIMUM ΔR	S-SERIES TYPICAL ΔR
Test Group I			
Thermal shock, 5x (-65°C to +150°C)	± 0.2 %	± 0.01 % (100ppm)	± 0.002 % (20ppm)
Short time overload, 6,25 x rated power	± 0.2 %	± 0.01 % (100ppm)	± 0.003 % (30ppm)
Test Group II			
Resistance temperature characteristics (1)	± 25 ppm /°C	+6.5 ppm /°C	± 2 ppm/°C
Low temperature storage (24 h at -65 °C)	± 0.15 %	± 0.01 % (100ppm)	± 0.002 % (20ppm)
Low temperature operation (45 min, rated power at -65°C)	± 0.15 %	± 0.01 % (100ppm)	± 0.002 % (20ppm)
Terminal strength	± 0.2 %	± 0.01 % (100ppm)	± 0.002 % (20ppm)
Test Group III			
Dielectric Withstanding Voltage (DWV)	± 0.15 %	± 0.01 % (100ppm)	± 0.002 % (20ppm)
Resistance to solder heat	± 0.1 %	± 0.01 % (100ppm)	± 0.005 % (50ppm)
Moisture resistance	± 0.4 %	± 0.05 % (500ppm)	± 0.01 % (100ppm)
Testgroup IV			
Shock	± 0.2 %	± 0.01 % (100ppm)	± 0.002 % (20ppm)
Vibration	± 0.2 %	± 0.01 % (100ppm)	± 0.002 % (20ppm)
Testgroup V Life test at 0.3 W/+125°C			
2000 h	± 0.5 %	± 0.015 % (150ppm)	± 0.01 % (100ppm)
10 000 h	± 2.0 %	± 0.05 % (500ppm)	± 0.03 % (300ppm)
Test Group Va			
Life test at 0.6 W (2 x rated power)/+70 °C, 2000 h)	± 0.5 %	± 0.015 % (150ppm)	± 0.01 % (100ppm)
Test Group VI			
Hight temperature exposure (2000 h at +175 °C)	± 2.0 %	± 0.1 % (1000ppm)	± 0.05 % (500ppm)
Test Group VII			
Voltage coefficient	5ppm/V	< 0.1 ppm/V	< 0.1 ppm/V

(1) See Table 1.

FIGURE 5 - LONG-TERM STABILITY OVER 29 YEARS (0.1W AT 70°C, 50 SAMPLES S102C, 10KΩ)



STANDARD OPERATIONS AND TEST CONDITIONS

A. Standard Test Operations:
By 100 % Inspection
•Short-time overload (6.25 x rated power for 5 s)
•Resistance - tolerance check
•Visual and mechanical
By Sample Inspection
•TCR
•Environmental tests per table 3 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 °C ± 2 °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 user's stability objectives and IPT-processed resistors can exhibit improved load-life stability levels of less than 50 ppm.

Various screen test routines are available and all anticipated stresses must be taken into account before settling on one specific test routine. VFR's application engineering department is prepared to discuss and recommend appropriate routines given the full spectrum of anticipated stresses and stability requirements.

TABLE 4 – „S" SERIES SPECIFICATIONS

Stability (1)	± 0.015 % (150 ppm)	Maximum ΔR at 0.3 W/+125°C
Load life at 2000 h	± 0.005 % (50 ppm)	Maximum ΔR at 0.1 W/+70°C
Load life at 10 000 h	± 0.05 % (500 ppm)	Maximum ΔR at 0.3 W/+125°C
	± 0.01 % (100 ppm)	Maximum ΔR at 0.05 W/+125°C
Current Noise	0.010 µV	(RMS)/V of applied voltage (-40dB)
High Frequency Operation		
Rise time	1.0 ns t 1kΩ	
Inductance (L) (2)	0.1 µH maximum; 0.08 µH typical	
Capacitance (C)	1.0 pF maximum; 0.5 pF typical	
Voltage Coefficient	< 0.1 ppm/V (3)	
Thermal Electromotive Force (EMF) (4)	0.1 µV/°C Maximum; 0.05µV/°C typical	
	1µV/W	(Model S102C)

Notes

(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)µV/°C relates to EMF due to lead temperature difference and µV/watt due to power applied to the resistor.

TABLE 5 - GLOBAL PART NUMBER INFORMATION (1)

NEW GLOBAL PART NUMBER: Y000780K5000V9L (preferred part number format)

DENOTES PRECISION	VALUE	CHARACTERISTICS
Y	**R** = Ω **K** = kΩ **M** = MΩ	**0** = standard **9** = lead (Pb)-free **1 to 999** = custom

Y	0	0	0	7	8	0	K	5	0	0	0	V	9	L

PRODUCT CODE	RESISTANCE TOLERANCE	PACKAGING
0007 = S102C **0785** = S102J **0062** = S102K **0786** = S102L **0011** = S104D **5011** = S104F **0101** = S104K **4101** = S104L **0012** = S105D **4012** = S105F **0102** = S105K **4102** = S105L **0013** = S106D **0103** = S106K	**V** = ± 0.005 % **T** = ± 0.01 % **Q** = ± 0.02 % **A** = ± 0.05 % **B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 % **F** = ± 1.0 %	**L** = bulk pack

FOR EXAMPLE: ABOVE GLOBAL ORDER Y0007 80K5000 V 9 L:

TYPE: S102C
VALUE: 80.5 kΩ
ABSOLUTE TOLERANCE: ± 0.005 %
TERMINATION: lead (Pb)-free
PACKAGING: bulk pack

HISTORICAL PART NUMBER: S102C T 80K500 V B (will continue to be used)

S102C	T	80K500	V	B
MODEL	TERMINATION	RESISTANCE VALUE	TOLERANCE	PACKAGING
S102C **S102J** **S102K** **S102L** **S104D** **S104F** **S104K** **S104L** **S105D** **S105F** **S105K** **S105L** **S106D** **S106K**	**T** = lead (Pb)-free None = tin/lead alloy	**250R00** = 250.00 Ω **5K2310** = 5.231 kΩ **1M000** = 1 MΩ	**V** = ± 0.005 % **T** = ± 0.01 % **Q** = ± 0.02 % **A** = ± 0.05 % **B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 % **F** = ± 1.0 %	**B** = bulk pack

Note
(1) For non-standard requests, please contact application engineering

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