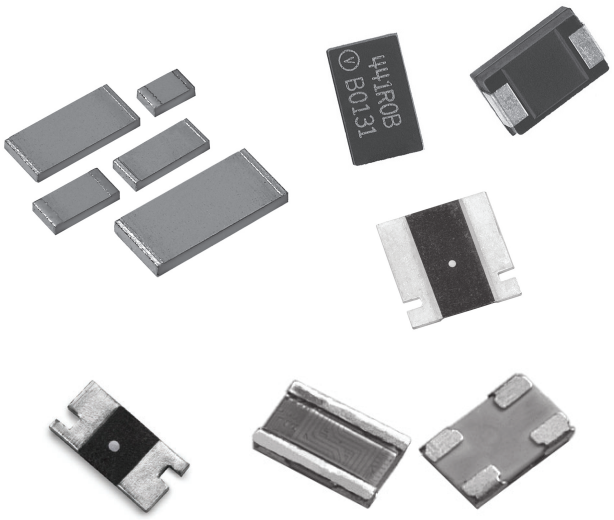
Ultra High Precision Vishay Foil Surface Mount Resistors



INTRODUCTION

Many manufacturers and users of precision electronic equipment suffer unnecessarily with unexplained instabilities and drifts. They resign themselves to the need for constant adjustments and troubleshooting which could in fact be avoided.

Often the instability is traceable to a few “fixed” resistors which are not fixed at all. If these resistors would only retain their original values, there would be no need for costly controls and other compensating circuitry.

The answer? A real precision and stable resistor.

Some precision resistors offer you tight tolerance at the expense of poor load life stability (1000 h or more), thermal stabilization and ESD sensitivity, others offer low TCR at the expense of poor rise time.

Only Vishay Bulk Metal® Foil resistors offer you the complete set of top performance characteristics, including TCR as low as 0.2 ppm/°C with the Z-foil technology, a combination that will most often free your equipment from that tormenting bug.

Vishay now offers you the chance to make your own custom bulk-metal resistors for breadboard, prototype, or even production use.

Call or write for information about our resistors: foil@vishaypg.com

APPLICATIONS

Dc-to-dc converters, feedback circuits, precision amplifiers in test and measurement instrumentation, medical systems, satellites and aerospace systems, commercial and military avionics, weapons systems, audio systems, and high-temperature systems including down-hole drilling.

How to order: foil@vishaypg.com

FEATURES

- Temperature coefficient of resistance (TCR) from 0.2 ppm/°C (military range) with the Z-foil technology
- Load life stability: to 0.005 % at + 70 °C, at rated power for more than 10 000 h
- Tolerance: best to 0.01 %
- Power coefficient (ΔR due to self heating): to 5 ppm at rated power for Z-foil resistors
- Resistance range: from 2 mΩ
- Vishay Foil resistors are not restricted to standard values, we can supply specific “as required” values at no extra cost or delivery (e.g. 1K2345 vs. 1K)
- Electrostatic discharge (ESD) immunity up to 25 000 V
- Fast terminal stabilization < 1 s
- Rise time: 1 ns effectively no ringing
- Thermal EMF < 0.1 µV/°C (Seebeck effect), especially critical for low resistive value in DC current/voltage
- Special non inductive and non capacitive design
- The short time overload test is also part of the standard production process (100 %)
- Vishay Foil resistors have been radiation tested
- There are four main factors which should be considered when designing a board: TCR, PCR, thermal EMF and ESD. Vishay Foil resistors provide the best combination of the above factors
- Data package and test results are available, please contact us (foil@vishaypg.com)

ABOUT THE VISHAY BULK METAL FOIL RESISTOR

Vishay low cost high precision Bulk Metal Foil resistors are the result of an improved concept in resistor manufacturing: a proprietary Bulk Metal Foil of known and controllable properties is applied to a special ceramic substrate.

A resistive pattern is then photo-etched by an ultra-fine technique developed by Vishay. This process results in resistor element characteristics of low TCR, long term stability, non inductive, excellent thermal stabilization, low capacitance and low noise.

The Bulk Metal Foil is a special alloy chosen for its electrical mechanical and thermal characteristics. It is set on the substrate by a unique and proprietary process which does not subject the resistor element to the metallurgical changes that occur during the winding of wire, or during the evaporative process used in other forms of resistor manufacturing. Because the alloy in the Vishay resistor is not drawn, wound, work hardened, or stressed in any way during manufacturing process, the resistor maintains all of its

original design, physical and electrical characteristics. The temperature coefficient of the resistor is carefully controlled through compensating techniques which essentially eliminates the effects of the different coefficients of expansion of the materials used in the resistor.

CUSTOM PRODUCT DESIGN

Customers who require additional performance tests are encouraged to contact our application engineers. Our highly trained application engineers are available to provide technical assistance and can help in developing source control drawings (SCD) which define the proper PMO (post manufacturing operations) needed to achieve optimum component reliability, stability and performance. Examples for PMO tests include: short time overload, power conditioning, thermal shock, thermal conditioning, etc.

POST MANUFACTURING OPERATIONS OR PMO

Military applications can include requirements for performance under conditions of stress beyond the normal and over extended periods of time. This calls for more than just selecting a standard device and applying it to a circuit. The standard device may turn out to be all that is needed but an analysis of the projected service conditions should be made and it may well dictate a routine of stabilization known as post manufacturing operations or PMO. The PMO operations that will be discussed are only applicable to Foil resistors. They stabilize Foil resistors while they are harmful to other types.

Short time overload, accelerated load life, and temperature cycling are the three PMO exercises that do the most to remove the anomalies down the road. Foil resistors are inherently stable as manufactured. These PMO exercises are only of value on foil resistors and they improve the performance by small but significant amounts. Users are encouraged to contact Vishay Foil applications engineering for assistance in choosing the PMO operations that are right for their application.

PRODUCTION

Vishay Foil resistors are manufactured in a modern plants complex under exacting conditions of cleanliness. White rooms are used in several stages of production. The entire process is under close quality control surveillance.

Batch handling, similar to the process used in semiconductor manufacture, ensures uniform quality. Each resistor element is inspected and processed under high magnification microscopes.

All materials used in the resistor and in the manufacturing process are carefully controlled and inspected, with permanent records maintained. All units are tested electrically, mechanically and visually for conformance to specifications.

The resistors are delivered in ESD approved packaging.

TABLE 1 - DSCC, EEE-INST-002, AND EPPL
(In accordance with: MIL-PRF-55342, MIL-PRF-55182, MIL-PRF-49465)

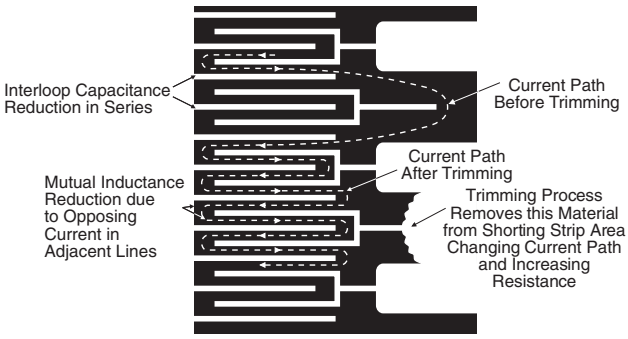
TYPE	CONSTRUCTION	DSCC [1]	EEE-INST-002 [2]	EPPL [3]	TYPICAL TCR MIL RANGE (ppm/°C)	TYPICAL LOAD LIFE STABILITY 2000 h
VSMP0805	Wrap around terminations	07024	√	√	0.2	0.005 %
VSMP1206		07025	√	√		
VSMP1506		03010	√			
VSMP2010		06001	√	√		
VSMP2512		06002	√			
VSM0805		07024	√		2	
VSM1206		07025	√			
VSM1506		03010	√			
VSM2010		06001	√			
VSM2512		06002	√			
SMR1DZ	Molded, flexible terminations with robust construction	06020	√		0.2	
SMR1D		06020	√		2	
SMR3DZ		06021	√		0.2	
SMR3D		06021	√		2	
VCS1625Z	Current sense with Kelvin connections for a high accuracy	08003	√		0.2	
VCS1625		08003	√	√	2	
VCS1610		TBD	√			
CSM2512		07011	√		15 maximum	0.05 %
CSM3637		07012	√			

Notes

[1] DSCC (Defense Supply Center Columbus)
[2] EEE-INST-002 (Instruction for EEE Parts Selection, Screening, Qualification, and Derating)
[3] EPPL (European Preferred Parts List)

- All the above resistors are also available on the shelf as standard products

FIGURE 1 - TRIMMING TO VALUES (Conceptual Illustration)



Note: Foil shown in black, etched spaces in white

TABLE 2 - VSMP0805 (Z-FOIL) SPACE QUALIFICATION TEST RESULTS PER MIL-PRF-55342H VALUE 5K

GROUP	TESTS	CONDITIONS	AVERAGE ΔR (ppm)	MAXIMUM ΔR (ppm)	MINIMUM ΔR (ppm)	ACC./REJ.
I	Visual inspection		X	X	X	84/0
	DC resistance		X	X	X	84/0
II	Resistance to soldering heat	per MIL-PRF-55342	28	45	14	10/0
	TCR	at - 55 °C to + 25 °C	- 0.84	- 0.48	- 1.41	10/0
	TCR	at + 25 °C to + 125 °C	0.23	0.50	- 0.08	10/0
	Low temperature operation	- 65 °C at P_{nom}, 45 min	- 27	- 17	- 33	10/0
	Overload	at 6.25 x P_{nom}, 5 s	47	60	37	10/0
	High temperature operation	100 h at + 150 °C	- 31	- 13	- 55	10/0
III	Resistance to soldering heat	per MIL-PRF-55342	56.70	70	42	10/0
	Moisture	MIL-STD-202, method 106	- 241	- 224	- 261	10/0
IV	Load life:					
	250 h	at 0.2 W at + 70 °C	3.47	24	- 30	34/0
	500 h		- 1.38	19	- 32	34/0
	1000 h		- 6.56	16	- 38	34/0
	2000 h		- 5.94	22	- 35	34/0
V	Solderability	at + 245 °C	X	X	X	10/0
VI	Solderable mounting integrity	30 s at 2 kg	X	X	X	10/0
VIII	Thermal shock	100 x (- 65 °C to + 150 °C)	- 5	10	- 10	10/0

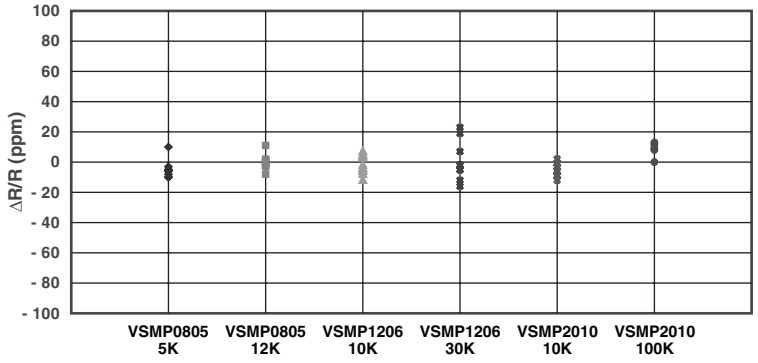
TABLE 3 - CSM2512 EEE-INST-002 QCI PER AER #155518 AND MIL-PRF-49465C F.C. #294499, VALUE 0R01

GROUP	TESTS	CONDITIONS	AVERAGE ΔR (ppm)	MAXIMUM ΔR (ppm)	MINIMUM ΔR (ppm)	REJ./ACC.
I	Resistance to solvent	MIL-STD-202G, method 215	V	V	V	0/4
II	Thermal shock	5 x (- 65 °C to + 125 °C)	43	120	- 40	0/10
	TCR	at - 55 °C to + 25 °C	- 0.08	3.36	- 3.13	0/10
	TCR	at + 25 °C to + 125 °C	- 4.86	- 1.69	- 7.70	0/10
	Low temperature storage	24 h at - 55 °C	9	20	0	0/10
	Overload	at 5 x P_{nom}, 5 s	29	60	- 20	0/10
	Moisture resistance	10 days	42	70	10	0/10
III	Load life:					
	250 h	at 1 W at + 70 °C	129	230	30	0/20
	500 h		177	290	50	0/20
	1000 h		271	420	130	0/20
	2000 h		326	520	150	0/20
IV	Thermal shock	5 x (- 65 °C to + 125 °C)	16	40	- 20	0/30
	Shock	100 G, 6 ms	0	20	- 30	0/30
	Vibration	(10 to 2000 Hz) 20 G	- 8	20	- 40	0/30
V	High temperature exposure					
	250 h	1000 h at + 170 °C	774	1510	300	0/30
	1000 h		1375	2350	780	0/30

Note

• Measurement error RC = 0.0005R - should be added to limits

FIGURE 2 - VSMP 100 CYCLE THERMAL SHOCK - 65 °C TO + 150 °C, 10 UNITS EACH VALUE



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