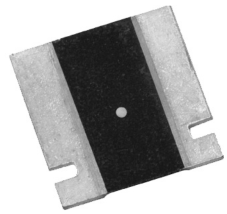
Bulk Metal® Technology High Precision, Current Sensing, Power Surface Mount, Metal Strip Resistor

with Resistance Value from 1 mΩ, Rated Power up to 3 W and TCR to ±25 ppm/°C



Pb-free
Available
RoHS*
COMPLIANT

FEATURES

- Temperature coefficient of resistance: to ±25 ppm/°C (–55°C to +125°C, +25°C ref.)
- Power rating: to 3 W
- Resistance tolerance: ±0.1%
- Resistance range: 1 mΩ to 200 mΩ
- Load life stability to ±0.2% (70°C, 2000 h at rated power)
- Short time overload: ±0.1% typical
- Thermal EMF: 3 μV/°C (DC offset error, significant for low values)
- Maximum current: up to 54 A
- Low inductance <5 nH
- Solderable terminations
- Excellent frequency response to 50 MHz
- Terminal finishes available: lead (Pb)-free, tin/lead alloy
- Quick prototype quantities available, please contact: foil@vpgsensors.com
- For better performance please contact: application engineering: foil@vpgsensors.com

INTRODUCTION

Four terminal (Kelvin) design: allows for precise and accurate measurements.

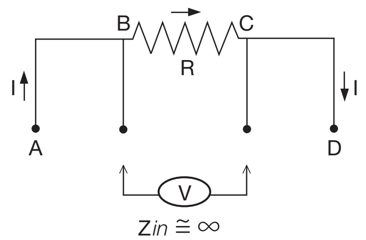
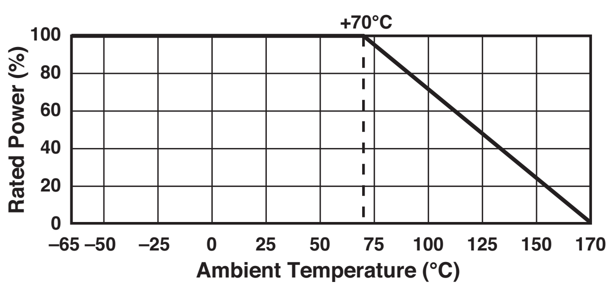


Figure 1 – Power Derating Curve



Notes

* This datasheet provides information about parts that are RoHS-compliant and/or parts that are non-RoHS-compliant. For example, parts with lead (Pb) terminations are not RoHS compliant. Please see the information/tables in this datasheet for details.

Table 1 – Specifications	
PARAMETER	**CSM3637L**
Resistance Range	1 mΩ to 200 mΩ
Power Rating at 70°C	3 W (1 mΩ to 10 mΩ) 2 W (>10 mΩ to 200 mΩ)
Maximum Current(1)	54 A
Tolerance	±0.5% (1 mΩ to <2 mΩ) ±0.1% (2 mΩ to 200 mΩ)
Temperature Coefficient Max. (–55°C to +125°C, +25°C Ref.)	±25 ppm/°C or ±35 ppm/°C (1 mΩ to 200 mΩ)(2)
Operating Temperature Range	−65°C to +170°C
Maximum Working Voltage	$(P \times R)^{1/2}$
Weight (Maximum)	0.29 g

Notes

(1) Maximum current for a given resistance value is calculated using $I = \sqrt{P/R}$

(2) Please refer to Table 3

ABOUT CSM (Low Ohm Value 1 mΩ to 200 mΩ)

New high-precision Bulk Metal® surface-mount Power Metal Strip® resistor of 1 mΩ to 200 mΩ that features an improved load-life stability of ±0.2% at +70°C for 2000 h at rated power, an absolute Low TCR from –55°C to +125°C, +25°C ref., and a tolerance of ±0.1%.

Typical current sensing resistors offer a load-life stability of ≥ 1% through a 2000 h workload. The improved resistance stability of the CSM Series makes it ideal for tightened-stability voltage division and precision current sensing applications in switching linear power supplies, power amplifiers, measurement instrumentation, bridge networks, and medical and test equipment.

Traditional Passive current sensors and shunts generate heat under power, which changes their resistance, and thus their voltage output. The CSM's low absolute TCR reduces errors due to temperature gradients, thus reducing a major source of uncertainty in current measurement. The CSM can withstand unconventional environmental conditions, including the extremely high temperatures and radiation-rich environments of down-hole oil exploration and well logging, or the deep-sea underwater repeaters in cross-ocean communications.

The stability of the CSM can be further enhanced by post-manufacturing operations (PMO), such as temperature cycling, short-time overload, and accelerated load life which are uniquely applicable to Bulk Metal® Foil resistors.

The device features a low thermal electromotive force (EMF) that is critical in many precision applications.

The CSM's all-welded construction is composed of a Bulk Metal® resistive element with welded copper terminations, plated for soldering. The terminations make true ohmic contact with the resistive layer along the entire side of the resistive element, thereby minimizing temperature variations. Also, the resistor element is designed to uniformly dissipate power without creating hot spots, and the welded terminations material is compatible with the element material.

These design factors result in a very low thermal-EMF (3 µV/°C) resistor, because in addition to the low thermal EMF compatibility of the metals, the uniformity and thermal efficiency of the design minimizes the temperature differential across the resistor, thereby assuring low thermal EMF generation at the leads. This further reduces the "battery effect" exhibited by most current-sensing or voltage-reference resistors. Thus, the parasitic voltage generated at the junction of two dissimilar metals, which is especially important in low-value current-sensing resistors, is minimized, while the pure current-to-voltage conversion is protected from such interference in DC applications.

The stability problems associated with analog circuits are very pervasive, but knowledgeable selection of a few high-quality resistors, networks, or trimming potentiometers in critical locations can greatly improve circuit performance, long-term application-related performance, as well as the designer's peace-of-mind.

Notes

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Additionally, the overall system cost is often reduced when a knowledgeable designer concentrates costs in a few exceptionally stable components whose proven minimal-deviation load and environmental stability can often eliminate the necessity of additional compensating circuitry or temperature-controlling systems. The higher reliability and better overall system performances also achieve excellent product results in the field, enhancing market acceptance and product reputation.

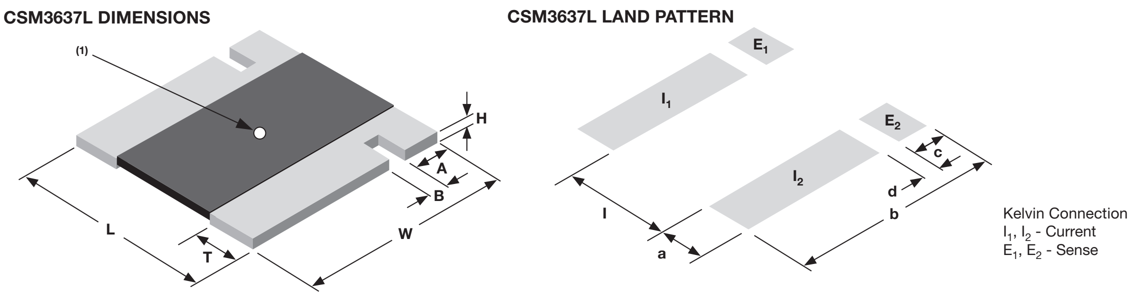
Designers often unnecessarily pay for tighter tolerances than required simply to accommodate the resistance stability shifts they know to be imminent in an application due to the large application-related changes in the components they selected. Selection of a high-stability component like the CSM in these applications eliminates the need for shift allowance due to “planned instability” and allows the use of looser initial tolerances than would be necessary with current-sensing resistors based on other technologies.

The Key Applications

Applications requiring accuracy and repeatability under stress conditions such as the following:

- Switching and linear power supplies
- Precision current-sensing
- Power management systems
- Feedback circuits
- Power amplifiers
- Measurement instrumentation
- Precision instrumentation amplifiers
- Medical and automatic test equipment
- Satellites and aerospace systems
- Commercial and Military avionics
- Test and measurement equipment
- Electronic scales

Figure 2 – Dimensions and Imprinting in inches (millimeters)



Dimensions – Tolerances ±0.010 (±0.254),* ±0.015 (±0.381)

MODEL	RESISTANCE RANGE (mΩ)	L	W	H	T	A	B
CSM3637L	1 to < 2	0.360 (9.144)	0.370 (9.398)	0.025 (0.635)	0.138 (3.505)	0.061 (1.55)	0.032 (0.813)
	2 to 200	0.360 (9.144)	0.370 (9.398)	0.025 (0.635)	0.086 (2.184)	0.061 (1.549)	0.032 (0.813)

Land Pattern Dimensions – Tolerances ±0.003 (±0.076)

MODEL	RANGE	a	b	c	d	e	l
CSM3637L	0R001 to 0R0019	0.168 (4.27)	0.390 (9.91)	0.066 (1.68)	0.024 (0.610)	–	0.074 (1.88)
	0R002 to 0R2	0.116 (2.95)	0.390 (9.91)	0.066 (1.68)	0.024 (0.610)	–	0.178 (4.52)

Note

(1) White dot indicates top side of part for mounting purposes

Table 2 – CSM Series Performance Specifications				
TEST	CONDITIONS	MIL-PRF-49465B ΔR LIMITS	CSM3637L	
			TYPICAL ΔR LIMITS[1]	MAXIMUM ΔR LIMITS [1]
Thermal Shock	–55°C to +150°C, 1000 cycles, 15 min at each extreme	±(0.5%+0.0005R)	0.1%	0.3%
Load Life Stability	2000 h, 70°C at rated power	±(1.0%+0.0005R)	0.2%	1.0%
Bias Humidity	+85°C, 85% humidity 10% bias, 1000 h	±(0.5%+0.0005R)	0.05%	0.2%
Short Time Overload	5 x rated power for 5 s (See note (3) from table 1)	±(0.5%+0.0005R)	0.1%	0.3%
High Temperature Exposure	1000 h, 170°C	±(1.0%+0.0005R)	0.2%	0.3%
Low Temperature Storage	–55°C for 24 h	±(0.5%+0.0005R)	0.05%	0.1%
Moisture Resistance	MIL-STD-202, method 106, 0 power, 7a and 7b not required	±(0.5%+0.0005R)	0.02%	0.05%
Shock	100 g, 6 ms, 5 pulses	±(0.1%+0.0005R)	0.02%	0.05%
Vibration	(10 Hz to 2000 Hz) 20 g	±(0.1%+0.0005R)	0.02%	0.05%
Resistance to Soldering Heat	10 s to 12 s at +260°C	±(0.25%+0.0005R)	0.05%	0.1%
Solderability	MIL-STD-202	95% coverage	–	–

Note

(1) Measurement error allowed for ΔR limits: 0.0005 Ω.

Figure 3 – Thermal Shock Results of CSM3637L

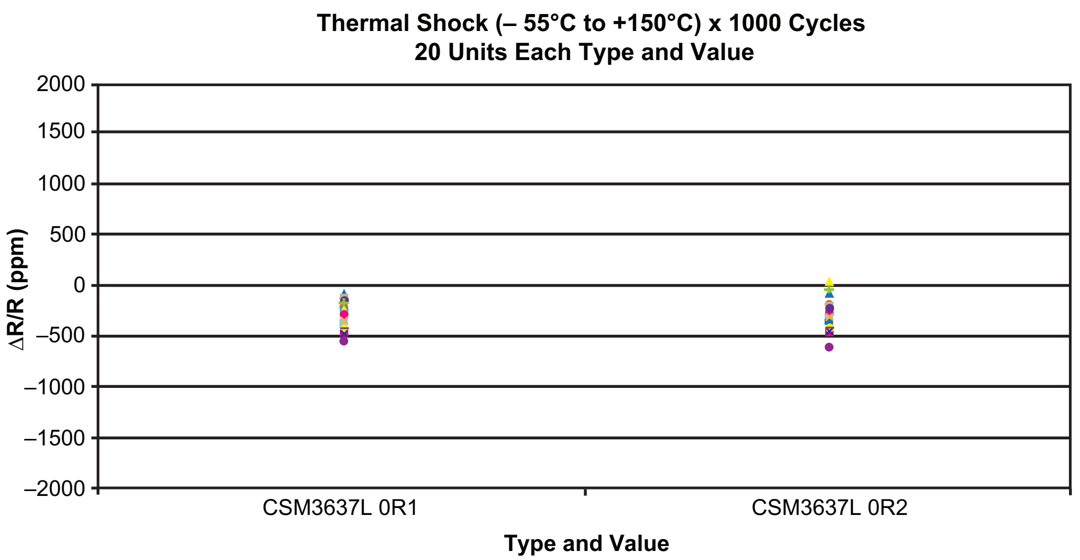


Figure 4 – Bias Humidity Results of CSM3637L

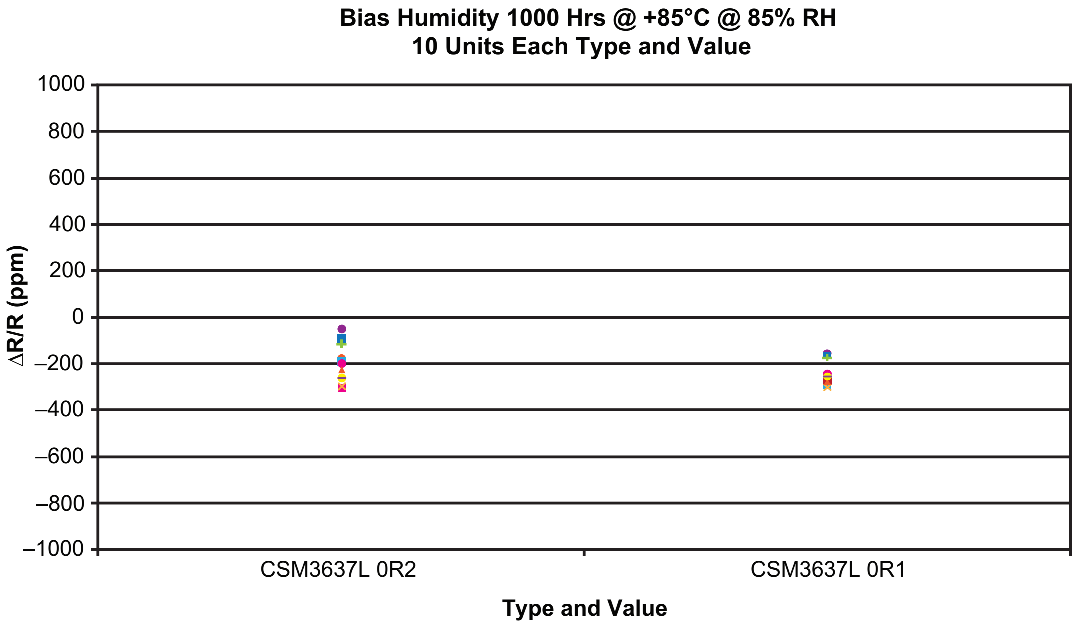


Figure 5 – Pulse Test I

CSM3637L 0R005 Test - 10 units
(5 Pulses of 5 sec @ 30 A, 10 sec @ 0 A)

Average Resistance Deviation: 696 ppm
STD = 305 ppm, Measurement Error = 0.0005R

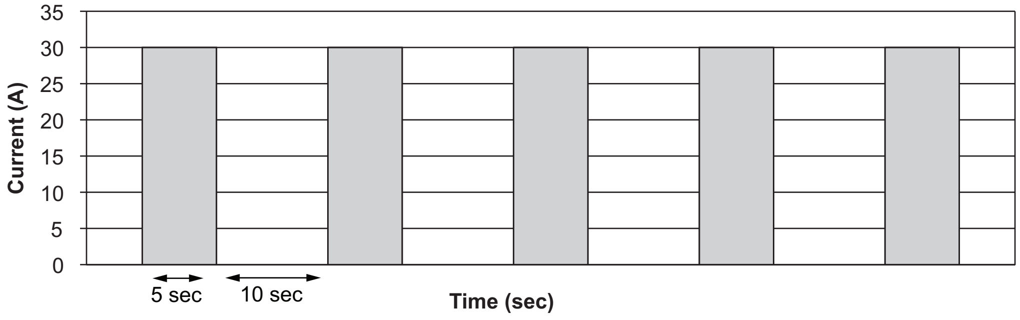


Figure 6 – Pulse Test II

CSM3637L 0R005 Pulse Test - 10 units
(35 Pulses of 0.2 msec @ 20 A, 0.5 msec @ 3 A)

Average Resistance Deviation: 13.3 ppm
STD = 27.3 ppm, Measurement Error = 0.0005R

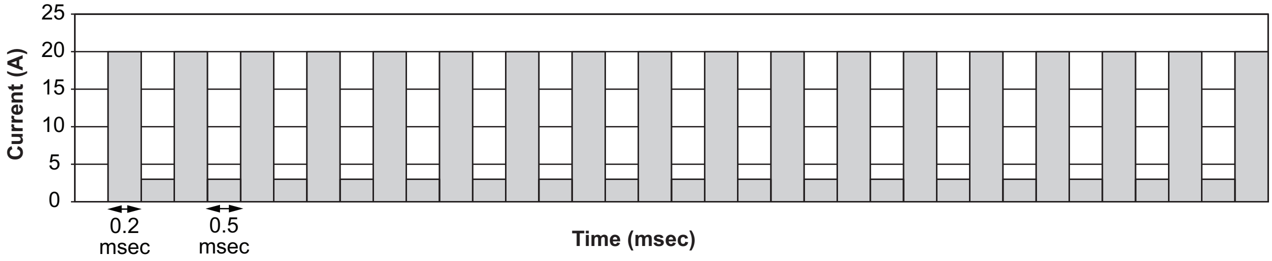


Table 3 – Global Part Number Information[(1)]

GLOBAL PART NUMBER: Y14880R12400B89R

DENOTES PRECISION
Y

VALUE
R = Ω

CHARACTERISTICS
1 to 999 = custom **90** = 25 ppm/°C TCR Tin lead **99** = 25 ppm/°C TCR Lead (Pb)-free **80** = 35 ppm/°C TCR Tin lead **89** = 35 ppm/°C TCR Lead (Pb)-free

Y	1	4	8	8	0	R	1	2	4	0	0	B	89	R

PRODUCT CODE
1488 = CSM3637L

RESISTANCE TOLERANCE
B = ± 0.1% **C** = ± 0.25% **D** = ± 0.5% **F** = ± 1.0%

PACKAGING
W = waffle **R** = tape and reel

FOR EXAMPLE: ABOVE GLOBAL ORDER Y1488 0R12400 B 89 R:

TYPE: CSM3637L
VALUE: 124.0 mΩ
ABSOLUTE TOLERANCE: ± 0.1%
TERMINATION: Lead Free
PACKAGING: tape and reel

Note

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