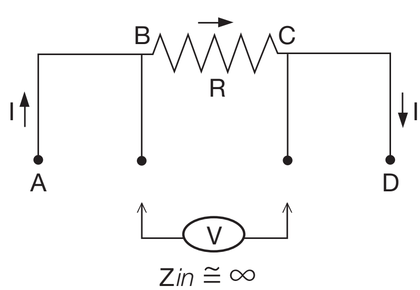
Bulk Metal® Technology High Precision, Current Sensing, Power Surface Mount, Metal Strip Resistor <u>with Improved Stability 0.05 %</u>, Resistance Value from <u>10 mΩ</u>, Rated Power to <u>1 W</u> and TCR to <u>0 ± 15 ppm/°C</u>

The CSM's series of low value current sense resistors provides power and precision in a four terminal, surface mount configuration. Its all welded construction is made up of a Bulk Metal® resistive element with plated copper terminations.

Vishay Foil Resistors' application engineering department is available to advise and make recommendations.

For non-standard technical requirements and special applications, please contact foil@vpgsensors.com.



FEATURES

- Temperature coefficient of resistance (TCR): (- 55 °C to + 125 °C, + 25 °C ref.)
  ± 15 ppm/°C maximum
  ± 10 ppm/°C maximum on special request
- <u>Load life stability to ± 0.05 % (70 °C, 2000 h at rated power)</u>
- Power rating: 1 W
- Resistance tolerance: ± 0.1 %
- Resistance range: 10 mΩ to 100 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. 10.2345 mΩ vs. 10 mΩ)
- Short time overload: ± 0.1 % typical
- Thermal EMF: < 3 μV/°C
- Maximum current: up to 10 A
- Surface mount configuration
- Four terminal (Kelvin) design: allows for precision accurate measurements
- Terminal finishes available: lead (Pb)-free, tin/lead alloy
- **Screening in accordance with EEE-INST002 available (Per MIL-PRF-55342 and MIL-PRF-49465; see datasheets of 303144 and 303145)**
- Prototype quantities available in just 5 working days or sooner. For more information, please contact foil@vpgsensors.com
- For better performances please contact Application Engineering

Pb-free Available

RoHS* COMPLIANT

FIGURE 1 - POWER DERATING CURVE

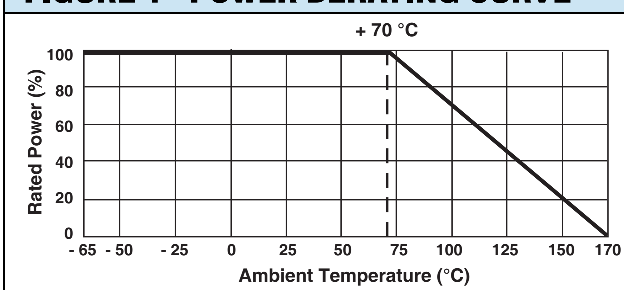


TABLE 1 - PERFORMANCE SPECIFICATIONS

PARAMETER	CSM2512S
Resistance Range	10 mΩ to 100 mΩ
Power Rating at 70 °C	1 W
Maximum Current	10 A
Maximum Working Voltage	$(P \times R)^{1/2}$
Tightest Tolerance	± 0.1 %
Temperature Coefficient Maximum (- 55 °C to + 125 °C, + 25 °C ref.)	± 15 ppm/°C, ± 10 ppm/°C is available
Operating Temperature Range	- 65 °C to + 170 °C
Weight (maximum)	0.09 g

* Pb containing terminations are RoHS compliant, exemptions may apply

ABOUT CSM (Low Ohm Value 10 mΩ to 100 mΩ)

The CSM2512S series of low value current sense resistors provides power and precision in a four terminal, surface mount configuration. Its all welded construction is made up of a Bulk Metal® resistive element with plated copper terminations. For low value resistors in precision applications it is necessary to use four-terminal Kelvin connections to obtain a precise voltage drop across the resistive element.

In these applications, the contact resistance and the terminal resistance may have the same order of magnitude or be even greater than that of the element resistance itself. Thus, significant error is introduced because the high temperature coefficient of resistance of the leads and the contact resistance are unavoidably incorporated into the measurements when the current sense resistor has only two leads.

Because the ability to measure low values to tolerances of 0.1% or tighter is a concern to both the manufacturer and the user, many situations require coordination of measurement standards between both parties. Coordination is often accomplished by exchange of serialized units with recorded readings to align measurement practices and specific reference standards. The problem is compounded when high-precision current sensors under moderate to high power experience self-heating (Joule effect) which causes the in-service resistance value to be different from that obtained using low current measurement equipment. Therefore, the measurement conditions must be defined and accepted at the time of spec preparation-that is, resistance value as determined by specified current and measured IR-drop following a specified period of stabilization.

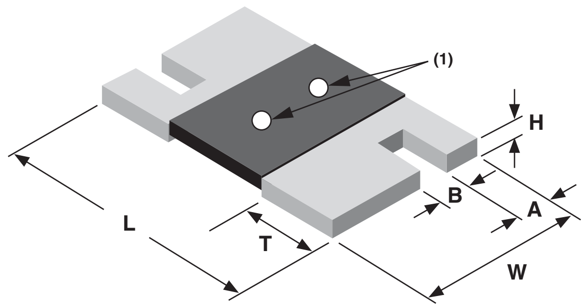
Measurement equipment is available from a number of sources with varying stated accuracies. Traditional passive current sensors and shunts generate heat under power, which changes their resistance, and thus their voltage output. The CSM's low absolute TCR reduces errors due to temperature gradients, 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. Thermal EMF in DC applications induces a voltage offset in the resistor that is equivalent to adding a small battery into the circuit.

The CSM's all-welded construction is a Bulk Metal® resistive element with welded copper terminations, plated for soldering. The terminations make a true continuous 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.

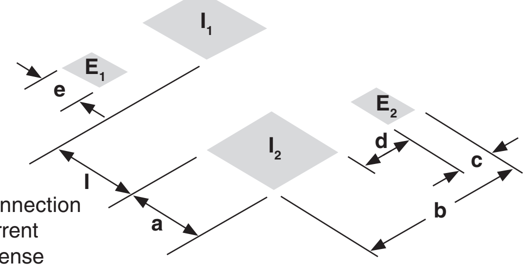
The stability problems associated with analog circuits are very pervasive, but knowledgeable selection of a few high-quality resistors, networks, or trimming potentiometers in critical locations can greatly improve circuit performance, long-term application-related performance, as well as the designer's peace-of-mind. Additionally, the overall system cost is often reduced when a knowledgeable designer concentrates costs in a few exceptionally stable components with minimal deviation and whose 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 otherwise be necessary.

FIGURE 2 - DIMENSIONS AND IMPRINTING in inches (millimeters)

CSM2512S DIMENSIONS



CSM2512S LAND PATTERN



DIMENSIONS - TOLERANCES ± 0.010 (± 0.254), * ± 0.015 (± 0.381)						
RESISTANCE RANGE (Ω)	L	W	H	T	A	B
0.01 to 0.1	0.250 (6.350)	0.125 (3.175)	0.025 (0.635)	0.030 (0.762)	0.030 (0.762)*	0.032 (0.813)*

LAND PATTERN DIMENSIONS - TOLERANCES ± 0.003 (± 0.076)						
RESISTANCE RANGE (Ω)	l	b	e	a	c	d
0.01 to 0.1	0.160 (4.06)	0.145 (3.68)	0.055 (1.39)	0.065 (1.65)	0.045 (1.14)	0.021 (0.53)

Note

(1) White dots indicate top side of part for mounting purposes

TABLE 2 - CSM2512S PERFORMANCE SPECIFICATIONS

TEST	CONDITIONS	MIL-PRF-49465B ΔR LIMITS	TYPICAL ΔR LIMITS	MAXIMUM ΔR LIMITS
Thermal Shock	- 55 °C to + 150 °C, 1000 cycles, 15 min at each extreme	± (0.5 % + 0.0005R)	0.1 %	0.2 %
Load Life Stability	2000 h, 70 °C at rated power	± (1.0 % + 0.0005R)	0.05 %	0.2 %
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	± (0.5 % + 0.0005R)	0.1 %	0.2 %
High Temperature Exposure	1000 h, 170 °C	± (1.0 % + 0.0005R)	0.2 %	0.3 %
Low Temperature Storage	MIL-PRF-49465	± (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	± (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	-	

FIGURE 3 - LOAD LIFE RESULTS OF CSM2512S VS. CSM2512

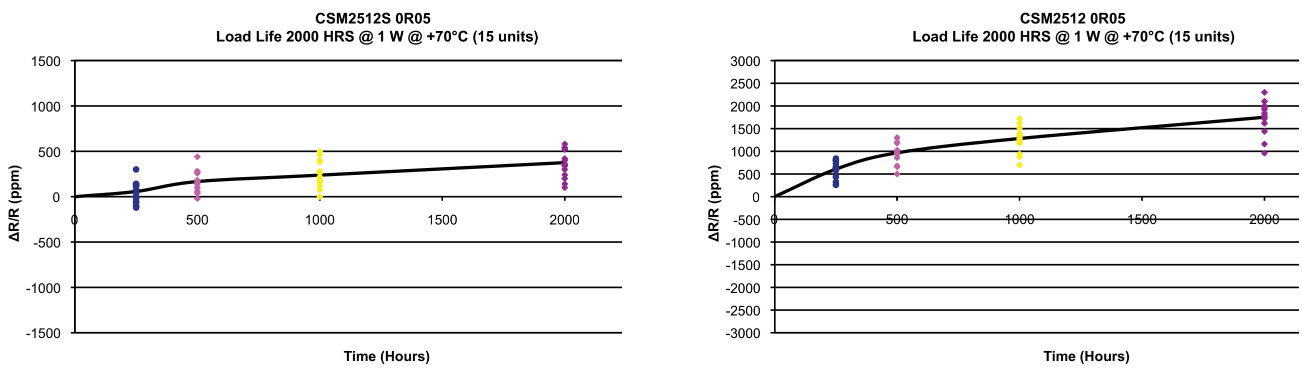


TABLE 3 - GLOBAL PART NUMBER INFORMATION

NEW GLOBAL PART NUMBER: Y44870R10000B0R (preferred part number format)

Y	4	4	8	7	0	R	1	0	0	0	0	B	0	R

DENOTES PRECISION
Y

VALUE
R = Ω

CHARACTERISTICS (1)
0 = standard part, tin/lead termination
9 = standard part, lead (Pb)-free termination
1 - 999 = custom

PRODUCT CODE
4487 = CSM2512S

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

PACKAGING
W = waffle pack
R = tape and reel

FOR EXAMPLE: ABOVE GLOBAL ORDER Y4487 0R10000 B 0 R:

TYPE: CSM2512S
VALUE: 100.0 mΩ
ABSOLUTE TOLERANCE: ± 0.1 %
TERMINATION: standard tin/lead
PACKAGING: tape and reel

HISTORICAL PART NUMBER: CSM2512S 0R1000 B B T (will continue to be used)

CSM2512S	**0R1000**	**B**	**B**	**T**
MODEL	OHMIC VALUE	ABS. TOLERANCE	TERMINATION	PACKAGING
	0R1000 = 0.100 Ω	**B** = ± 0.1 % **C** = ± 0.25 % **D** = ± 0.5 % **F** = ± 1.0 %	**S** = lead (Pb)-free **B** = tin/lead	**T** = tape and reel **W** = waffle pack

Note

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

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