Ultra High Precision, Surface Mount 4-Terminal Precision Resistor with Increased Power to 5W (40A max), Resistance Values from 3 mΩ to 100 mΩ, and TCR to ± 15 ppm/°C

FEATURES
- Resistance range: 3 mΩ to 100 mΩ
- Temperature coefficient of resistance (TCR): 3 mΩ to 100 mΩ: ± 15 ppm/°C maximum
- Load life stability: ± 0.2 % (70 °C, 2000 h at rated power)
- Power rating: to 5 W (see Table 1)
- Resistance tolerance: ± 0.1 %
- Vishay Foil Resistors (VFR) are not restricted to standard values; specific “as required” values can be supplied at no extra cost or delivery (e.g. 10.2345 mΩ vs. 10 mΩ)
- Short time overload: ± 0.2 % typical
- Proprietary processing technique produces extremely low resistance values with improved stability
- All welded construction
- Solderable terminations
- Very low inductance 0.5 nH
- Excellent frequency response to 50 MHz
- Low thermal EMF < 3 µV/°C (DC offset error, significant for low values)
- Maximum current: up to 40 A
- Four terminal (Kelvin) design: allows for precise and accurate measurements
- Terminal finishes available: lead (Pb)-free, tin/lead alloy
- Prototype quantities available in just 5 working days or sooner. For more information, please contact foil@vpgsensors.com
- For better performances, please contact us

* 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.
ABOUT CSM3637P

This new high-precision Bulk Metal® surface-mount Power Metal Strip® resistor features an improved load-life stability of ± 0.2 % at + 70 °C for 2000 h at rated power, an absolute TCR of ± 15 ppm/°C maximum from - 55 °C to + 125 °C, + 25 °C ref., and a tolerance of ± 0.1 %.

Typical current sensing resistors exhibit 2000 hour load-life changes more than 5 times greater than the CSM3637P. 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 of ± 15 ppm/°C reduces errors due to temperature changes, 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 CSM3637P 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 Technology.

The device features a low thermal electromotive force (EMF) that is critical in many precision DC 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 DC 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 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
### TABLE 1 - SPECIFICATIONS

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>CSM3637P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance Range</td>
<td>3 mΩ to 100 mΩ</td>
</tr>
<tr>
<td>Power Rating at 70 °C in free air</td>
<td>5W (3mΩ to 10mΩ) 4W (&gt;10mΩ to 100mΩ)</td>
</tr>
<tr>
<td>Maximum Current</td>
<td>40 A</td>
</tr>
<tr>
<td>Tightest Tolerance</td>
<td>± 0.1 %</td>
</tr>
<tr>
<td>Temperature Coefficient Of Resistance (TCR) (-55 °C to +125 °C, +25 °C ref.)</td>
<td>3 mΩ to 100mΩ :15 ppm/°C maximum</td>
</tr>
<tr>
<td>Thermal EMF</td>
<td>&lt; 3 µV/°C</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>-65 °C to +170 °C</td>
</tr>
<tr>
<td>Weight (maximum)</td>
<td>0.38 g</td>
</tr>
</tbody>
</table>

### FIGURE 2 - DIMENSIONS AND IMPRINTING

#### CSM3637P DIMENSIONS

<table>
<thead>
<tr>
<th>L</th>
<th>W</th>
<th>H1</th>
<th>H2</th>
<th>T</th>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.360 (9.144)</td>
<td>0.370 (9.398)</td>
<td>0.025 (0.635)</td>
<td>0.060 (1.524) max</td>
<td>0.086 (2.184)</td>
<td>0.061 (1.549)</td>
<td>0.032 (0.813)</td>
</tr>
</tbody>
</table>

#### CSM3637P LAND PATTERN

<table>
<thead>
<tr>
<th>l</th>
<th>b</th>
<th>a</th>
<th>c</th>
<th>d</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.178 (4.52)</td>
<td>0.390 (9.91)</td>
<td>-</td>
<td>-</td>
<td>0.116 (2.95)</td>
</tr>
</tbody>
</table>

### CSM3637P CONSTRUCTION

1. Resistive element
2. Copper terminal with solderable finish
3. Terminal-to-element weld
4. Thermal conductive adhesive
5. Anodized aluminum heat sink
### TABLE 2 - CSM3637P ENVIRONMENTAL PERFORMANCE COMPARISON 3 mΩ to 100 mΩ

<table>
<thead>
<tr>
<th>TEST</th>
<th>CONDITIONS</th>
<th>MIL-PRF-49465B ΔR LIMITS</th>
<th>TYPICAL ΔR LIMITS</th>
<th>MAXIMUM ΔR LIMITS(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Cycling</td>
<td>- 55 °C to + 125 °C, 1000 cycles, 15 min at each extreme</td>
<td>± (0.5 % + 0.0005R)</td>
<td>0.1 %</td>
<td>0.3 %</td>
</tr>
<tr>
<td>Load Life Stability</td>
<td>2000 h, 70 °C at rated power</td>
<td>± (1.0 % + 0.0005R)</td>
<td>0.2 %</td>
<td>0.6 %</td>
</tr>
<tr>
<td>Bias Humidity</td>
<td>85 °C, 85 % humidity, 10 % bias, 1000 h</td>
<td>± (0.5 % + 0.0005R)</td>
<td>0.05 %</td>
<td>0.2 %</td>
</tr>
<tr>
<td>Short Time Overload</td>
<td>2.5 x rated power for 5 s</td>
<td>± (0.5 % + 0.0005R)</td>
<td>0.2 %</td>
<td>0.5 %</td>
</tr>
<tr>
<td>High Temperature Exposure</td>
<td>1000 h, 170 °C</td>
<td>± (1.0 % + 0.0005R)</td>
<td>0.2 %</td>
<td>0.3 %</td>
</tr>
<tr>
<td>Low Temperature Storage</td>
<td>MIL-PRF-49465</td>
<td>± (0.5 % + 0.0005R)</td>
<td>0.05 %</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Moisture Resistance</td>
<td>MIL-STD-202, method 106, 0 % power, 7a and 7b not required</td>
<td>± (0.5 % + 0.0005R)</td>
<td>0.02 %</td>
<td>0.05 %</td>
</tr>
<tr>
<td>Shock</td>
<td>100 g, 6 ms</td>
<td>± (0.1 % + 0.0005R)</td>
<td>0.02 %</td>
<td>0.05 %</td>
</tr>
<tr>
<td>Vibration</td>
<td>(10 Hz to 2000 Hz) 20 g</td>
<td>± (0.1 % + 0.0005R)</td>
<td>0.02 %</td>
<td>0.05 %</td>
</tr>
<tr>
<td>Resistance to Soldering Heat</td>
<td>10 s to 12 s at + 260 °C</td>
<td>± (0.25 % + 0.0005R)</td>
<td>0.05 %</td>
<td>0.1 %</td>
</tr>
<tr>
<td>Solderability</td>
<td>MIL-STD-202</td>
<td>95 % coverage</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

(1) Add 0.0005R as per MIL-PRF-49465B

### FIGURE 3 - CSM3637P UNDER LOAD TEMPERATURE RISE OVER AMBIENT, TYPICAL

![Resistor Element Temperature Rise Diagram](image)

- ΔT, °C vs Power, W
### TABLE 3 - GLOBAL PART NUMBER INFORMATION (1)

**NEW GLOBAL PART NUMBER:** Y14740R05000E0W (preferred part number format)

<table>
<thead>
<tr>
<th>DENOTES PRECISION</th>
<th>VALUE</th>
<th>CHARACTERISTICS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Y</td>
<td>R = Ω</td>
<td>0 = standard part, tin/lead termination</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Y</th>
<th>1</th>
<th>4</th>
<th>7</th>
<th>4</th>
<th>0</th>
<th>R</th>
<th>0</th>
<th>5</th>
<th>0</th>
<th>0</th>
<th>0</th>
<th>E</th>
<th>0</th>
<th>W</th>
</tr>
</thead>
<tbody>
<tr>
<td>1474</td>
<td>= CSM3637P</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PRODUCT CODE RESISTANCE TOLERANCE PACKAGING**

- **1474** = CSM3637P
- **B** = ± 0.1%
- **C** = ± 0.25 %
- **D** = ± 0.5 %
- **E** = ± 0.2 %
- **F** = ± 1.0 %
- **W** = waffle pack

*FOR EXAMPLE: ABOVE GLOBAL ORDER Y1474 0R05000 E 0 W:*

- **TYPE:** CSM3637P
- **VALUE:** 50 mΩ
- **ABSOLUTE TOLERANCE:** ± 0.2 %
- **TERMINATION:** standard tin/lead
- **PACKAGING:** waffle pack

**HISTORICAL PART NUMBER:** CSM3637P 0R05 E B T (will continue to be used)

<table>
<thead>
<tr>
<th>MODEL</th>
<th>OHMIC VALUE</th>
<th>ABS. TOLERANCE</th>
<th>TERMINATION</th>
<th>PACKAGING</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSM3637P</td>
<td>0R05 = 0.05 Ω</td>
<td>B = ± 0.1%</td>
<td>S = lead (Pb)-free</td>
<td>W = waffle pack</td>
</tr>
</tbody>
</table>

**Note**

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