OARS
1, 3, and XP - Application Note

Introduction

This Application Note is intended to offer an overview about the various aspects of crossing the other high power low resistance planar surface mount resistors to the OARS product family. Some of the key benefits are as follows:

- Competitive pricing
- Reduced solder joint stress for thermal cycling applications
- Elevated design transfers more heat to the air instead of the printed circuit board
- Wider available resistance ranges

Competitive Pricing

A process with fewer steps to produce a component is more efficient than a process with additional steps to accomplish the same product; fewer steps more cost effective. The OARS product family uses a process of precision material and automation that does not depend on a mechanical trimming process for each part to produce 1% precision resistances. This results in an efficient production process with competitive pricing as a result.

Solder Joint Stress

The OARS product family's elevated and curved construction permits the resistor to flex, reducing the stress generated by differences in thermal expansion coefficients between the heat producing metal and the dissipating circuit board material. Surface mount components that are flat and parallel to the circuit board will apply shear forces to the solder joint that can lead to failure or changes in performance. In high thermal cycling applications, the OARS has been preferred to other similar all metal construction parts because of this flexibility feature.

The figures above illustrates how the forces on each part are dissipated as a result of differences in the thermal expansion coefficient between the metal materials of the current sense resistor and the circuit board materials.

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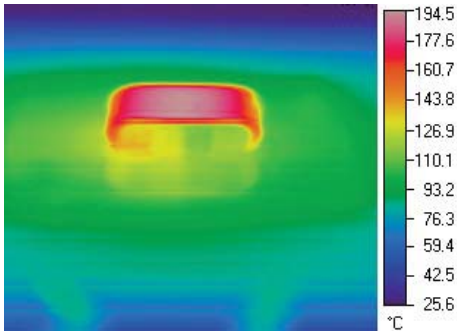
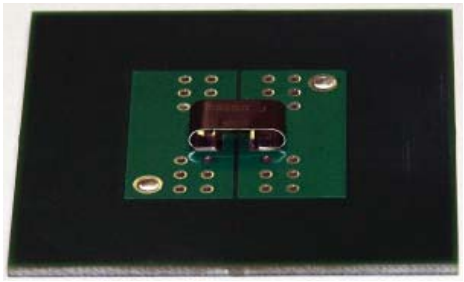
Heat Dissipation Path

The all metal construction is capable of withstanding greater temperatures than the circuit board material (130°C) and the solder joint (235°C). Most surface mounted planar resistors depend on the circuit board material to carry the heat from the part, whereas the OARS and OARS XP uses the air as a heat sink to the greatest extent possible. The elevated construction isolates the circuit board from the temperature of the hot spot and the wide surface area dissipates the heat available to the air; air flow only further improves its performance. Dissipating the generated heat to the air as opposed to the circuit board reduces the affects on local power components, which improves their lifetime and stable performance characteristics.





The thermal image (not a simulation) above is of an OARS XP 2 mΩ running at 5 Watts. Notice the hotpsot is nearly 195°C, but the solder joint is approximately 130°C. The standard test circuit board consists of a four layer FR4 material with 2 ounce outer layers and 1 ounce inner layers, which is typical of many industry designs and serves as the basis for additional tests for these current sense products. Heavier copper, more layers, larger circuit boards, and air flow will reduce the temperatures from the levels indicated. Contact IRC for more details or for other thermal image data for specific resistance values and power levels.

Construction

The OARS is constructed using a precision electron beam welded solder compliant copper terminals to a low TCR resistive alloy. Precision welding provides a high reliability consistent small weld region that is essential for high thermal cycling applications.

All-metal construction assures a lifetime of stable performance in hostile application environments, such as the automotive and aerospace industry. Additionally, the metal design provides a large cross-section for current, which enables the OARS to withstand intense fault surge currents without performance degradation.

The OARS is coated with a low stress application of high silver content solder providing two key benefits. The low stress application method reduces the potential for tin whisker formation, while assuring a compliant bond surface for reliable surface mount assembly. Secondly, the high silver content further reduces whisker formation and provides improved fatigue performance characteristics.

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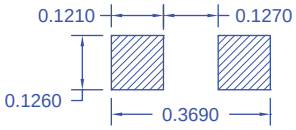
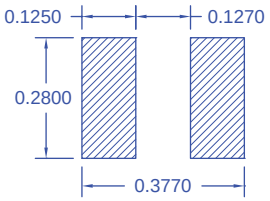
Pad Layout



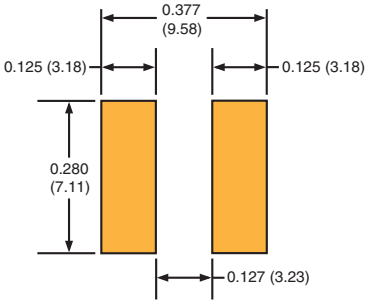
OARS



OARS XP

One other pad layout recommendation that can provide improved measurement accuracy is a four pad layout for a 2 terminal device. This is a cost effective alternative to a four terminal device. One point to not is that the remaining pad area once the isolation region is provided, needs to be sufficient to current carrying requirements of the application.

OARS XP PAD (2 TERMINAL)



OARS XP PAD (4 TERMINAL)