

OARS

Open Air Resistor – Surface Mount

Thermal Performance

Introduction

✓ Construction

- Comparison of material systems
- Material and Shape
- Benefits
 - ❑ Solder Joint Stress
 - ❑ Reduced power dissipation in PCB

✓ Thermal Performance

- OARS 1 – 2 mΩ
- OARS 3 – 5 mΩ, 10 mΩ
- OARS XP – 5 mΩ, 10 mΩ

Construction — Comparison of material systems

✓ Relative cross-section of resistor technologies

➤ Metal element

- ☐ very large cross section for current flow
- ☐ Very robust

➤ Foil

- ☐ Large cross section compared to following technologies.
- ☐ Less robust than Metal element construction.

➤ Thick Films

- ☐ Approximately 10 x thicker deposition than a thin film technology resistor.

➤ Thin Films

- ☐ Precision
- ☐ Least robust of listed technologies



Bulk Resistive Alloy



Foil



Thick Films



Thin Films

- **Depicts metal atoms**
- **Substrate material**

Construction - Material and Shape

- ✓ All metal construction
 - no over-mold that might outgas
 - Robust surge capability
 - Capable of sustained high temperature operation without degradation, alloy rated to 300 °C.
 - Low TCR
- ✓ Large Surface Area
 - Enhances heat transfer to the air instead of to the circuit board
- ✓ Electron beam welded
 - Precision
 - Robust reliable connection



Construction - Benefits

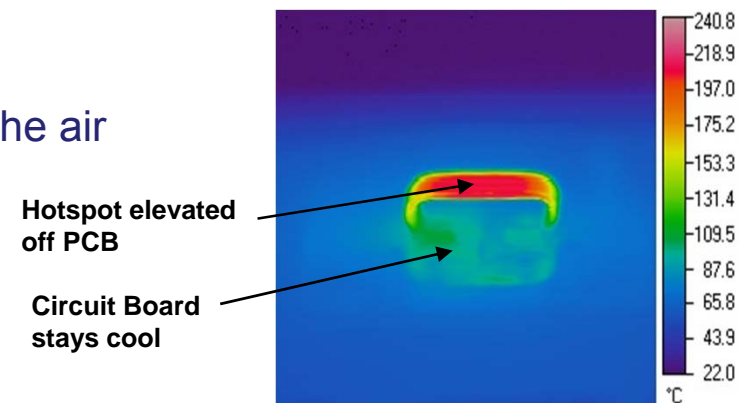
✓ Solder Joint Stress

- TCE – Temperature Coefficient of Expansion – occurs because of differences in thermal expansion between the component and the circuit board material.
- Direction of Force – flat parts apply the stress in a shear plane; whereas the OARS shape permits some of the force to be dissipated through flex.



✓ Hot spot elevated off circuit board

- Prevents damage to circuit board material
- Dissipates generated heat preferentially to the air



Thermal Data — Test Board

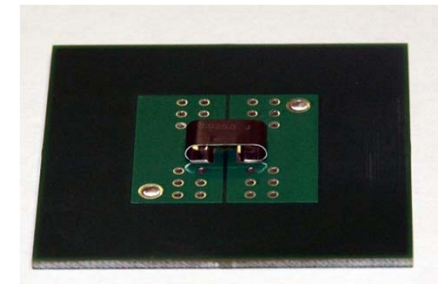
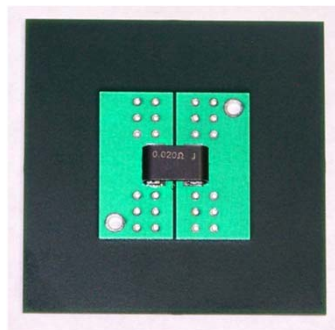
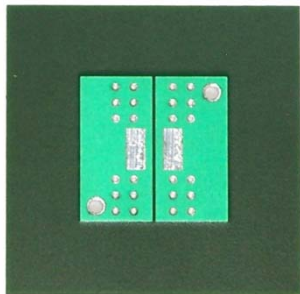
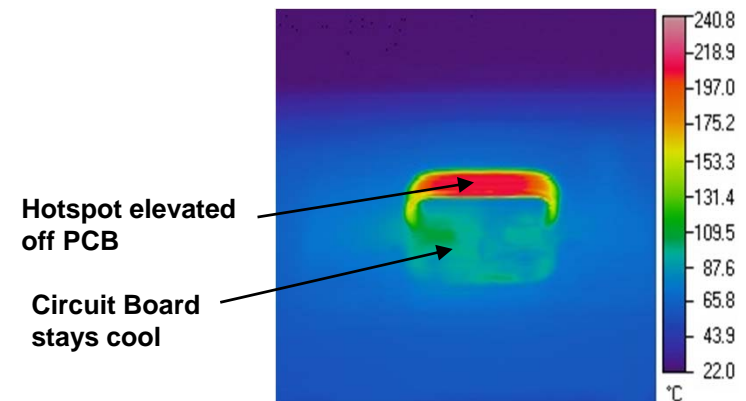
✓ Test Conditions

- Ambient 25°C
- no air circulation
- thermal equilibrium

✓ Substrate - FR4

✓ Conductor

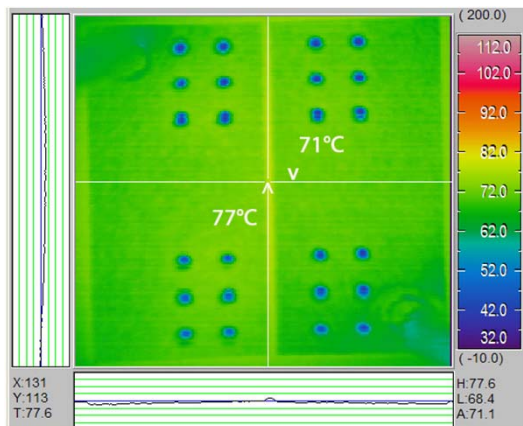
- (2) - 2 oz outer layers – 1 in²
- (2) - 1 oz inner layers – 2 in²



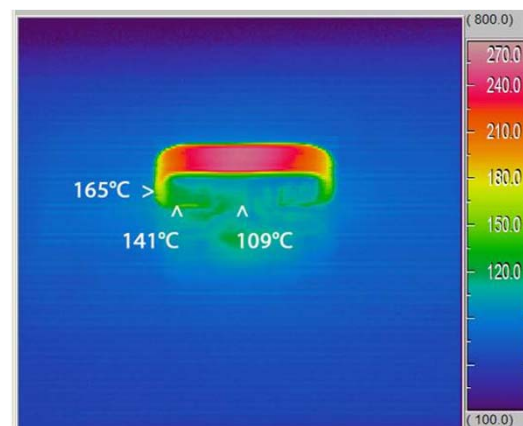
Thermal Data — Test Board

✓ Sample test data

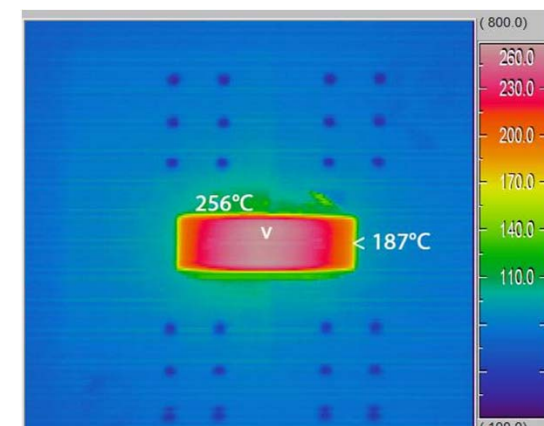
- In the isometric view you can observe the OARS performing at high power, perhaps surge conditions, yet the circuit board and solder joint are cooler by comparison
- no air circulation
- thermal equilibrium



**OARS (4.5 Watts)
Back View**



**OARS (4.5 Watts)
Isometric View**

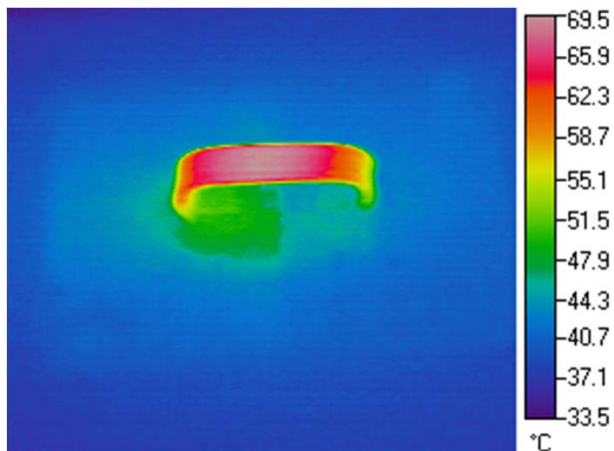


**OARS (4.5 Watts)
Top View**

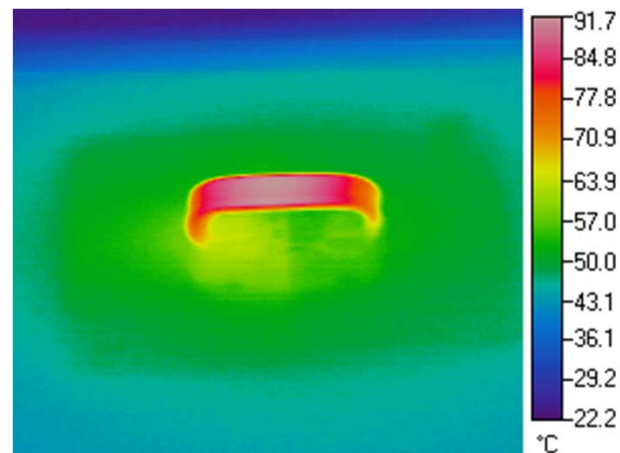
Thermal Data – OARS 1 (2 mΩ)

Temperature profile at power

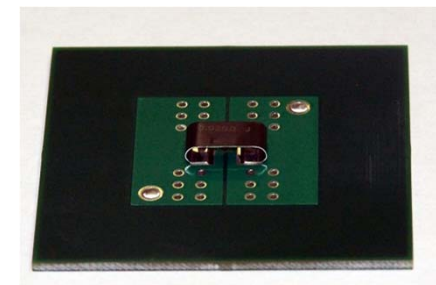
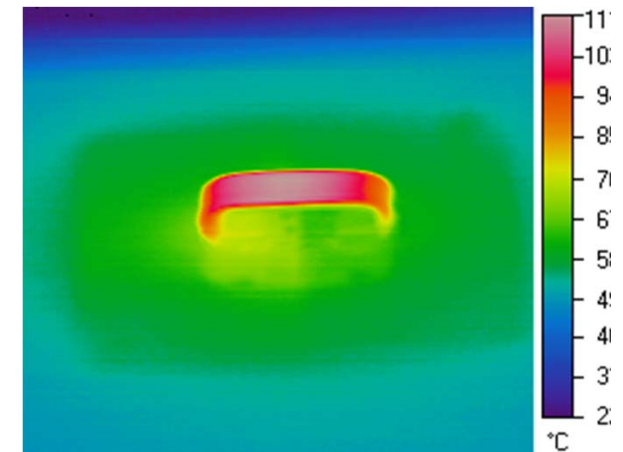
1 Watt



1.5 Watts



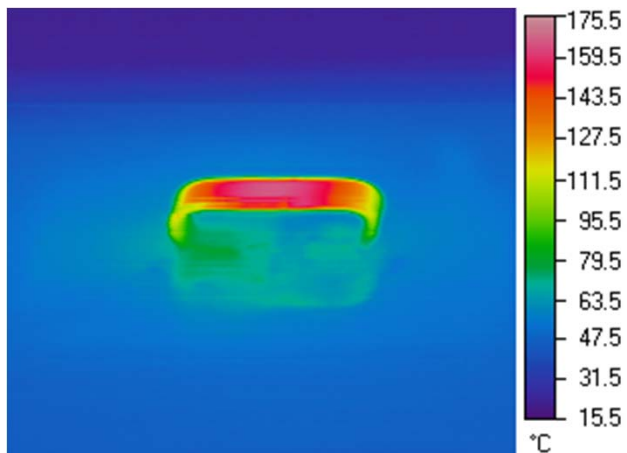
2 Watts



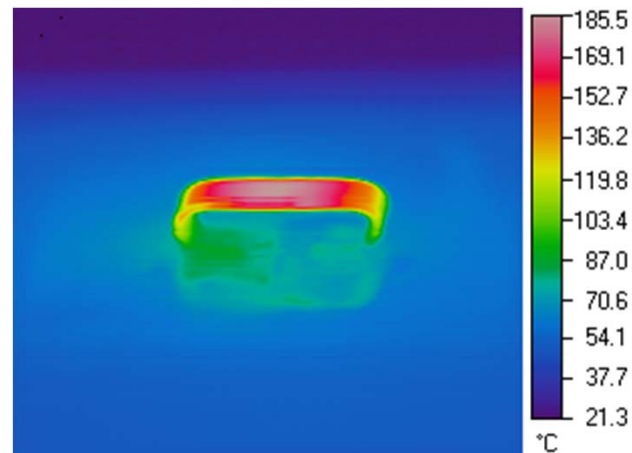
Thermal Data – OARS 3 (5 mΩ)

Temperature profile at power

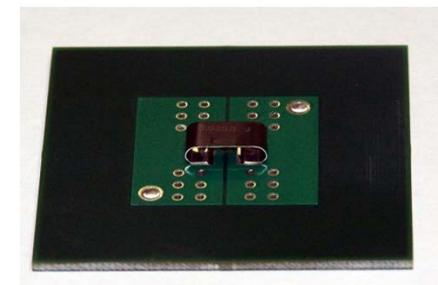
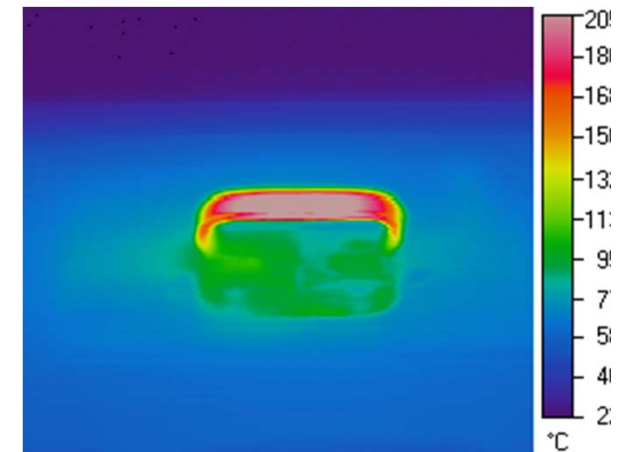
2.5 Watt



3.0 Watts



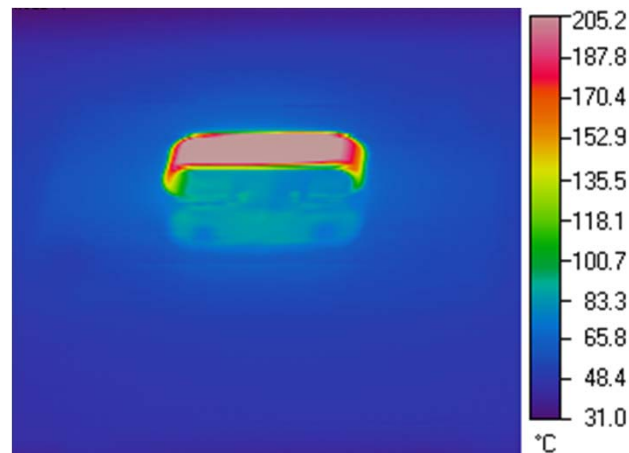
4.0 Watts



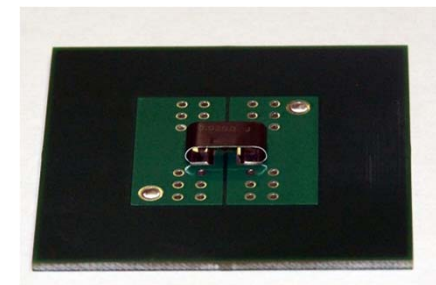
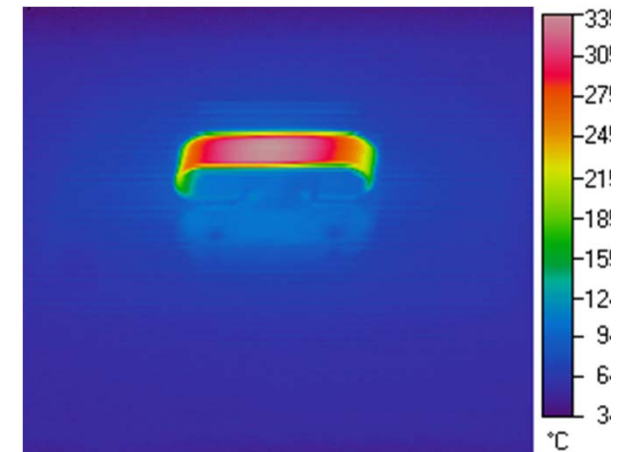
Thermal Data — OARS 3 (10 mΩ)

Temperature profile at power

3.0 Watts



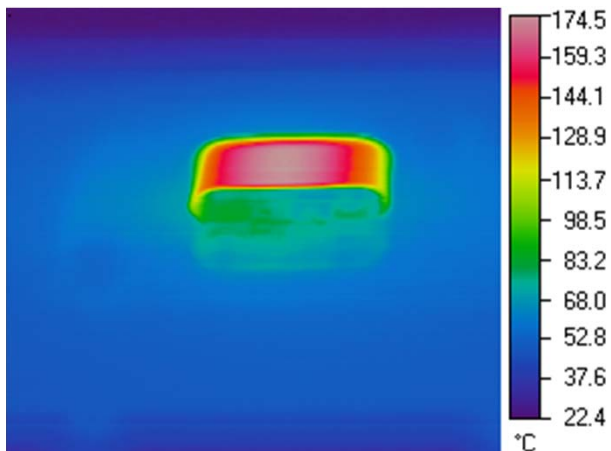
4.0 Watts



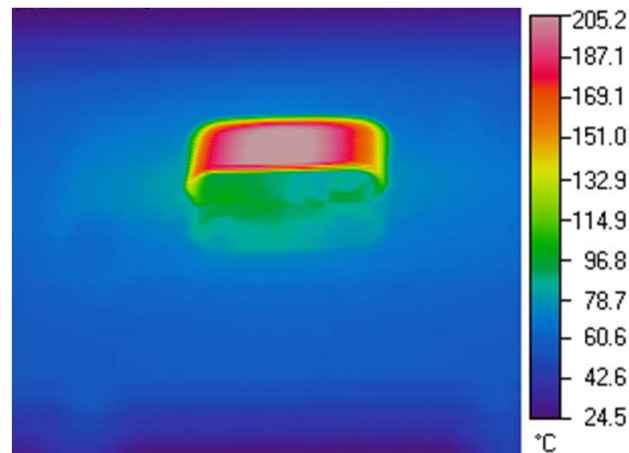
Thermal Data — OARS XP (5 mΩ)

Temperature profile at power

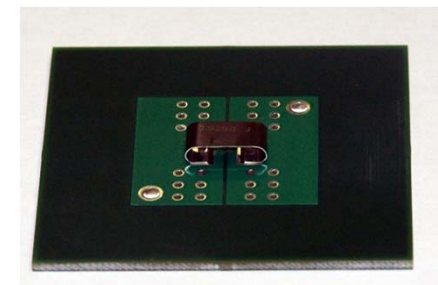
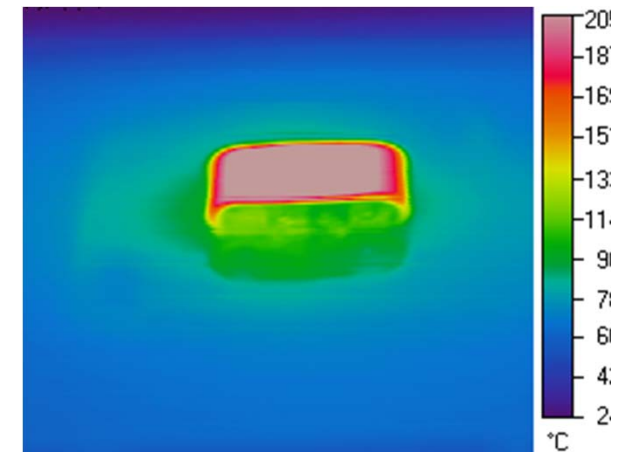
3.0 Watts



4.0 Watts



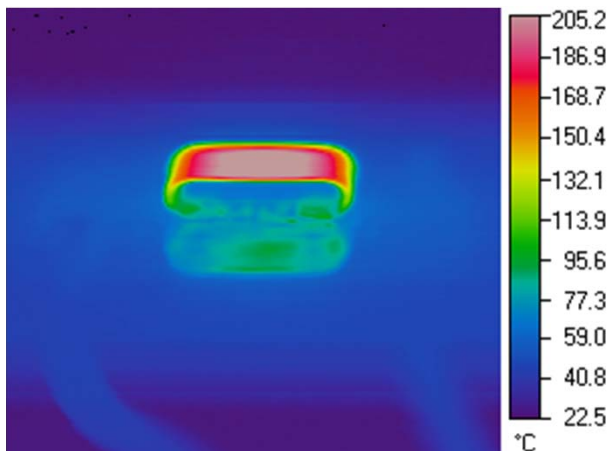
5.0 Watts



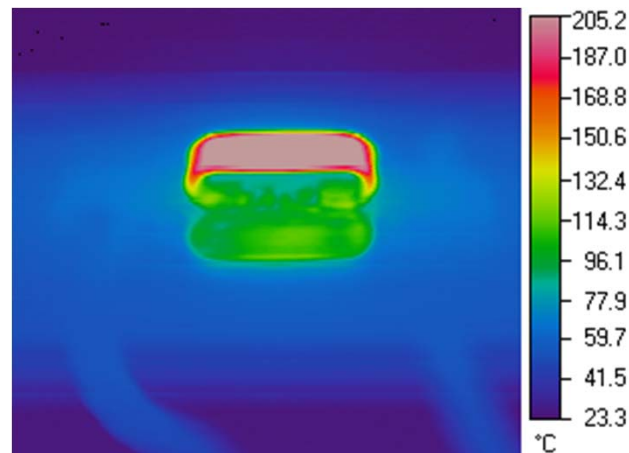
Thermal Data — OARS XP (10 mΩ)

Temperature profile at power

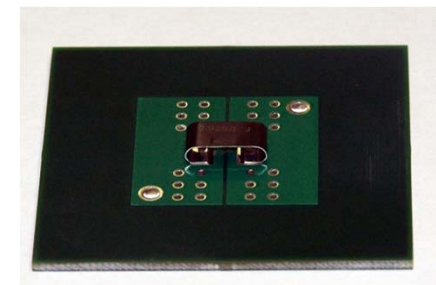
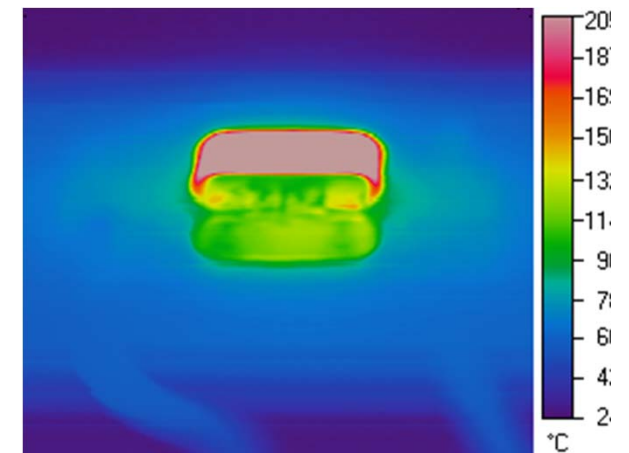
3.0 Watts



4.0 Watts



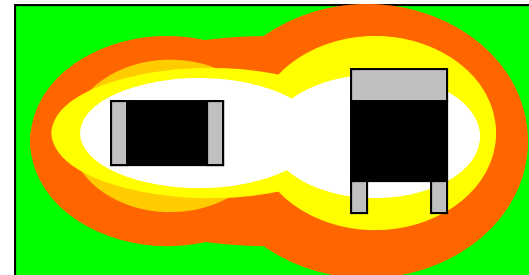
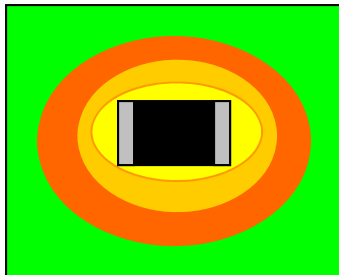
5.0 Watts



Thermal Data – PCB Heat Management

✓ Power Dissipation

- High Power can cause circuit board changes, which could be mis-diagnosed as resistor changes. For example, Solder Joint failure, board traces, plated through hole barrel failure.
- Resistor power dissipation when considered alone may not cause issue, but when evaluated in close proximity to other power components can cause the “system” to exceed limits or accelerate aging of semiconductor components.
- The OARS improves heat dissipation to the air instead of the solely the circuit board material.



Thermal Data – OARS options



OARS – 1 watt

Resistance Range: 2 m Ω - 50 m Ω

Tolerance: 5% and 1%

TCR: 40 ppm and 240 ppm



OARS – 3 watt

Resistance Range: 2 m Ω - 15 m Ω

Tolerance: 5% and 1%

TCR: 40 ppm and 240 ppm



OARS XP – 5 watt

Resistance Range: 1 m Ω - 25 m Ω

Tolerance: 5% and 1%

TCR: 40 ppm and 240 ppm

Any Questions?

http://www.irctt.com/sales_support.aspx

