	Title:	Document No.:	Revision:
BARRY	**Thermal Resistance of Flange Mounted Resistors**	**BAN-THR-1.1**	**A**

Introduction

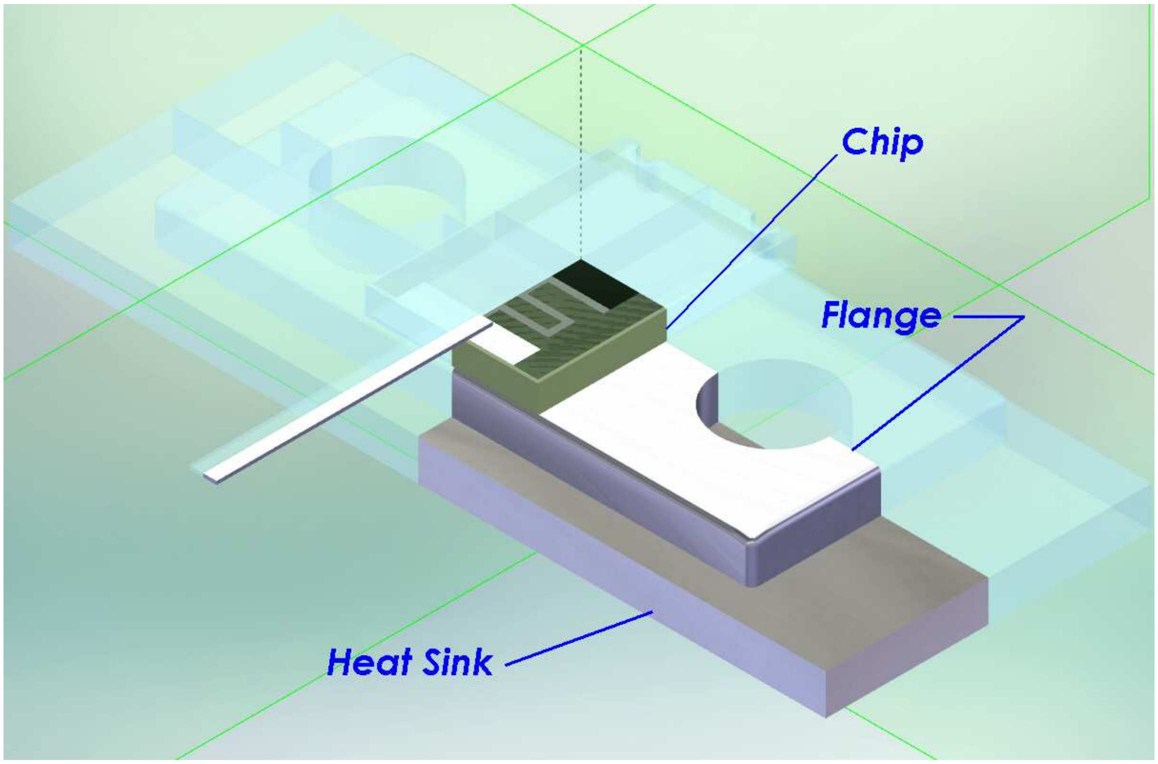
The thermal resistance of a flange mounted resistor is a critical characteristic in determining the average power handling of the component. Given a maximum film temperature ($Tf\max$) for the resistive element and a maximum heat-sink temperature ($Ts\max$), the average power rating of the resistor can be determined using:

$$\text{Pav(max)} = \frac{Tf\max - Ts\max}{\theta}$$

Where θ is the thermal resistance from the film to the flange in °C/watt

Discussion

The difficulty with the apparently simple definition presented above is in the determination of the flange temperature. In a typical application, the flange is mounted to a thermally conductive heat-sink such as a cooled aluminum plate. For the purposes of this discussion, a typical 150 watt flange mounted aluminum nitride termination, Barry Industries, Inc. model TA50R0-150-25X, will be used as an example. The thermal characteristics exhibit symmetry in both the X and Y axes and therefore a quarter symmetry model can be employed for analysis. The resulting quarter symmetry geometry, with the cover removed to allow observation of the resistive film, is shown in Figure 1.



A thermal finite element analysis model of the termination mounted to such a plate yields the temperature distribution shown in Figure 2.

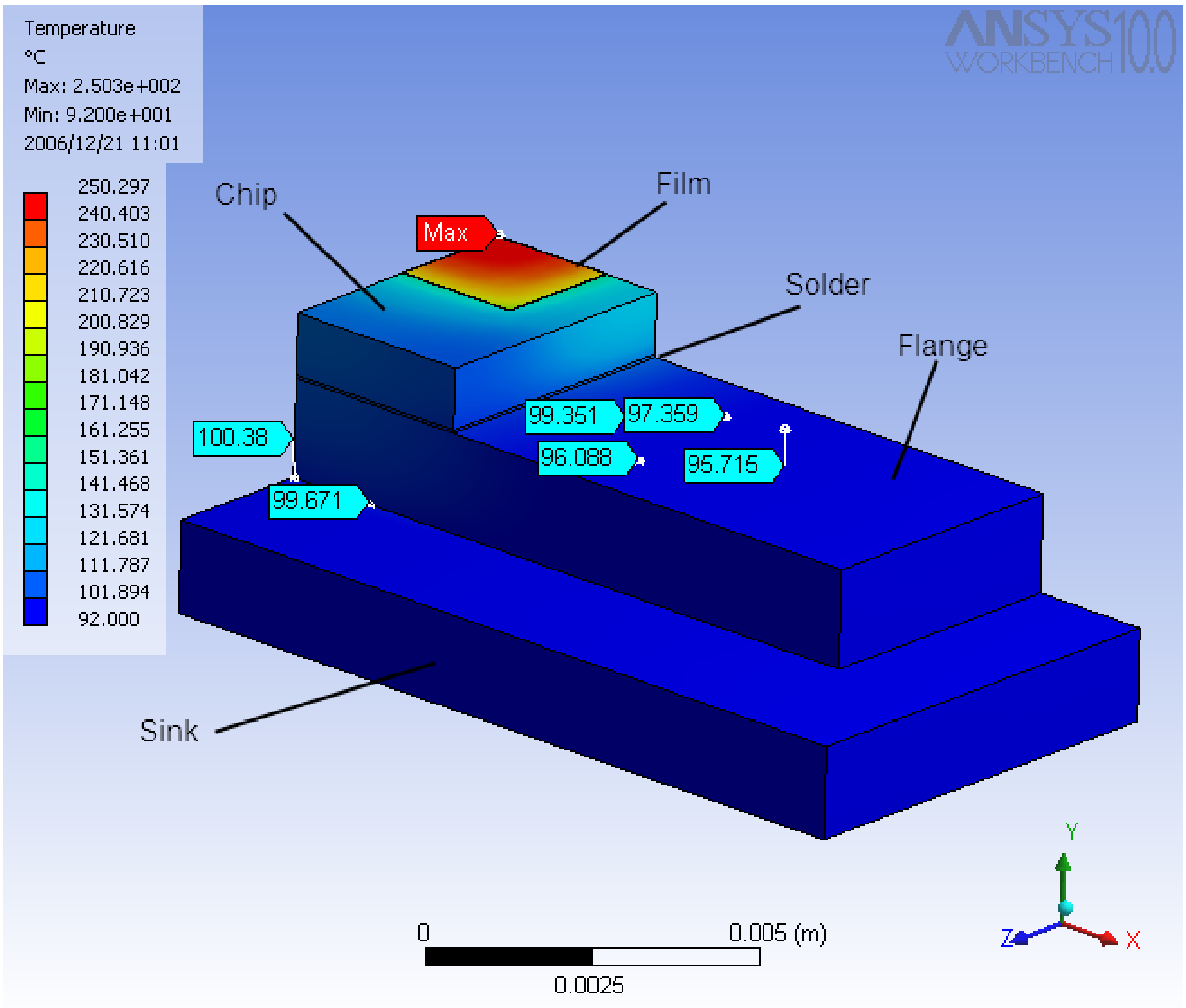


Figure 2 - Temperature Distribution

Since the flange is in intimate contact with the heat-sink, it is not possible to measure the temperature distribution across the interface. In the finite element model, however, the heat-sink can be hidden and the distribution investigated. Figure 3 shows the temperature at a number of locations across this surface.

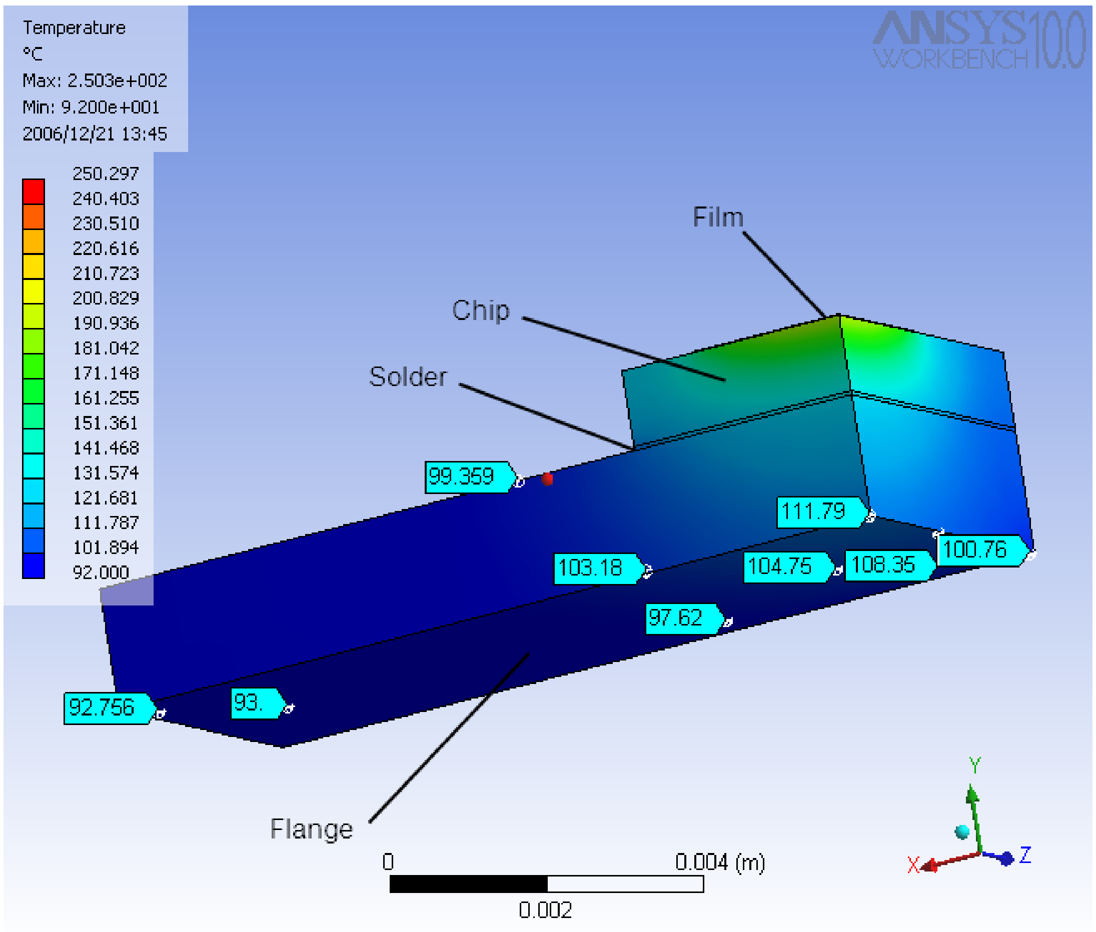


Figure 3 - Temperature Distribution across Flange Interface

It can be seen that the temperature varies by a significant amount due to the thermal gradients in the heat-sink caused by non-uniform thermal flux density. In this case the maximum flange temperature is actually 109°C but it is at the center of the flange surface. The practical solution, therefore, is to measure the flange temperature on the exterior of the flange. Referring again to Figure 2, it can be seen that the temperature variation is relatively small in the area directly under the chip at the heat-sink interface. For this reason this is the location used by convention. In most cases, the area near the mounting screws is close in temperature and can also be used if it is more convenient.