

# Titanium–Aluminum (TAP) Hermetic Microwave Packaging

## Customer Challenge

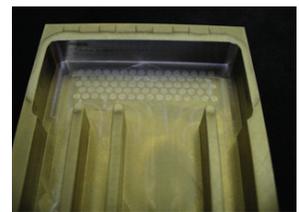
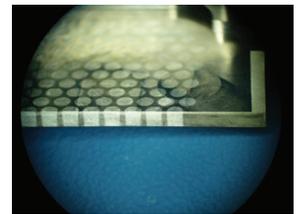
A customer who manufactures aircraft radar systems requested that the hermetic packaging for its Integrated Microwave Assembly (“IMA”) be constructed of a material that has high thermal conductivity, has low coefficient of thermal expansion (“CTE”), and is lightweight. Thermal conductivity is the ability of a material to allow the flow of heat from its warmer surface to its colder surface, whereas CTE is the tendency of materials to change in volume in response to a change in temperature.

## Challenge Review

Although the ideal hermetic microwave packaging material used in aircraft radar systems would be lightweight, have low CTE and high thermal conductivity, no standard materials exist that contain all of these features. Winchester Interconnect™ evaluated potential materials and determined that, although aluminum would provide the higher thermal conductivity and lightweight attributes, it has a high CTE when compared with other metals, and therefore would not achieve the customer’s goals. Other metals have low CTE, but also lower conductivity or are not lightweight. Exotic metals exist that can meet all three of the requirements but are difficult to machine, electroplate, and make the microwave package and connector difficult to join. Ultimately, Winchester decided that multiple materials would have to be used to achieve all the customer’s system requirements.

## Winchester Solution

To address this challenge, Winchester used Titanium–Aluminum Packaging (“TAP”). TAP is an advanced packaging concept that utilizes titanium as its main housing structure material while integrating aluminum into thermally sensitive areas to optimize heat dissipation. Specifically, the titanium housing floor structure is formed with an offset pattern of cylindrical aluminum vias. The webbed area of titanium maintains the low CTE and lightweight attributes, while the aluminum increases the thermal conductivity of the solution. Aluminum is infiltrated into the titanium vias by means of a high temperature vacuum process to eliminate porosity and establish a metallurgical bond with the titanium. The combination of the titanium base material and aluminum lining achieved the customer’s goal of a solution that has high thermal conductivity, low CTE and is lightweight. Additional benefits include titanium’s superior strength to weight characteristics when compared with other common Hermetic Microwave packaging material like Aluminum and Kovar (see table below), and excellent resistance to corrosion.



**Titanium Aluminum (TAP)  
Hermetic Microwave  
Packaging**

**Customer Improvement**

Winchester's Titanium-Aluminum Packaging provides the following benefits:

- Lightweight
- Low Thermal Expansion
- High Thermal Conductivity
- Excellent Strength to Weight
- Corrosion Resistant

Material Examples	Thermal Expansion (CTE)	Thermal Conductivity	Strength to Weight	Density (Mass)
Titanium	8.5 ppm/C	16 W/mK	26 to 1	.15 lb/in <sup>3</sup>
Aluminum	23 ppm/C	220 W/mK	14 to 1	.10 lb/in <sup>3</sup>
Kovar	5.2 ppm/C	17 W/mK	8 to 1	.30 lb/in <sup>3</sup>



Contact our Winchester Interconnect Experts for your custom solution!

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