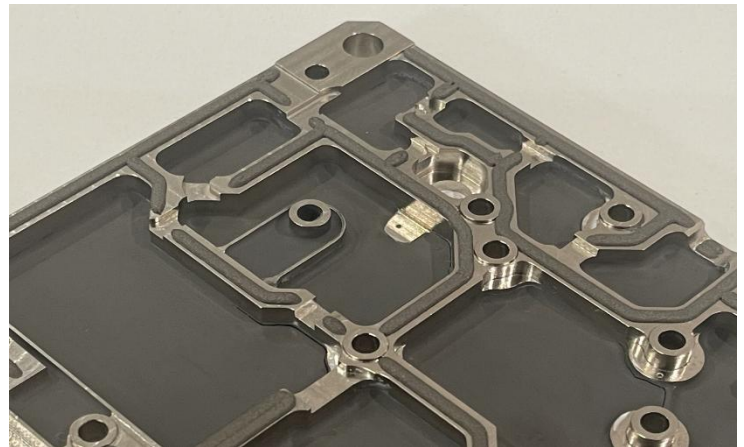


**We offer a full turnkey service to design and supply microwave housings for your high performing RF PCBs. We can integrate RF absorber, thermal pad and RF shielding gasket into low volume or mass production assembly lines**

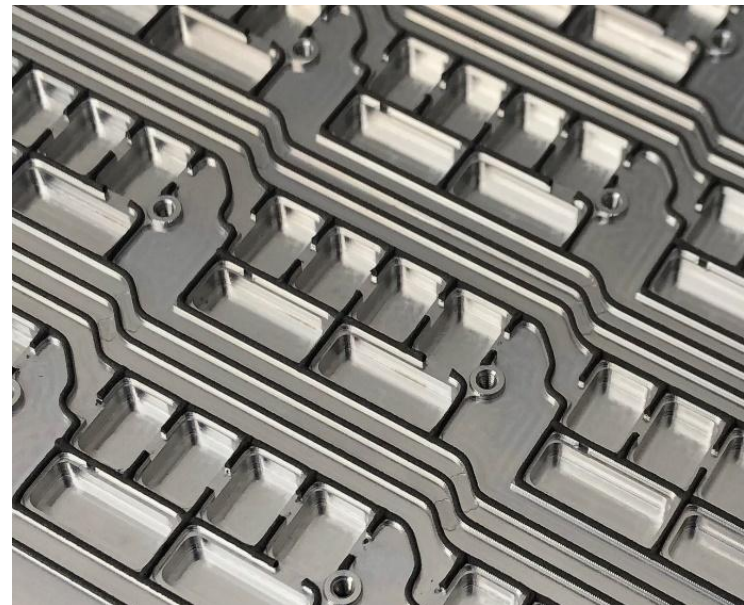
### KEY FEATURES

- Cavity resonance and leakage suppression
- Effective 10MHz to 100GHz
- Wideband performance
- 100dB shielding when used correctly
- Pack RF circuits tightly
- Dispensing on very narrow walls (0.8mm)
- Controllable absorber thickness
- Extremely small features possible
- High accuracy gasket placement (20um)
- Space grade (low outgassing)
- Temperature stable
- Low cost and quick turnaround



### APPLICATIONS

- LNAs, PAs, mixers, filters, attenuators
- Space and Defence
- Quantum computing
- Military and Aerospace equipment
- Space craft RF modules and payloads
- Telecommunications equipment
- Medical equipment
- Consumer electronics
- RF test instrumentation
- General radio equipment



## INTRODUCTION

Introducing our premium custom RF and microwave enclosures, designed to deliver superior electromagnetic isolation and unmatched RF performance. We use this technology in all of our own products which is how we achieve world class RF performance.

Meticulously machined and plated with high-loss tangent nickel, our enclosures provide exceptional suppression of electromagnetic interference (EMI) and resonance. The internal surfaces are precision-roughened to optimize isolation, while the external surfaces remain sleek and professional. Enhanced with our industry-leading isolation gasket and advanced microwave absorber, each enclosure offers best-in-class, repeatable shielding effectiveness. We are also able to add thermal pad where required for easy assembly in production.

Whether you need high-volume production or a single prototype, our scalable solutions are crafted to meet the rigorous standards of RF-sensitive applications over the frequency range 10MHz to 100GHz.

## OUR PROCESS

We begin with a review of the customer requirements, in order to fully understand the shielding requirements. We are able to conduct RF board reviews if required. We can advise on wall thicknesses, tolerances and help you design the enclosure for maximum impact. Alternatively we can design the enclosure for you and provide full fit checking for your design. We provide the design files in either Solidworks or STEP file.

We engage on a new product by proposing a sample run, whereby the absorber thicknesses and gasket placement can be validated and optimised if required. This ensures a production run of greater numbers goes as smoothly as possible.

## DETAILED DESCRIPTION

Our RF and microwave enclosures are fully customizable, with precision machining and plating processes that leverage a high-loss tangent nickel alloy for superior performance. The enclosures feature roughened internal surfaces engineered to maximise RF isolation by reducing internal coupling, while the outer surfaces are polished smooth for a clean, professional appearance.

For optimal performance, we offer an optional integration of either our high-performance isolation gasket or/and advanced microwave absorber, each developed to deliver unparalleled RF shielding and reliability. Our isolation gasket is a form-in-place, silicone elastomer containing silver and nickel-plated graphite particles. When precisely CNC-applied, it provides intricate, highly effective gasket sections that achieve up to 120 dB isolation and ensure reliable, repeatable results across a wide

range of applications. Unlike conventional shielding, our gaskets enable easy assembly, reusability, and stable performance in both high- and low-volume runs.

Our advanced microwave absorber is chemically bonded to the roughened metal surfaces, ensuring full cavity resonance suppression without the need for adhesives, which can compromise performance. Unlike traditional absorbers that require labour-intensive waterjet cutting and adhesive application, our absorber is designed for ultra-wideband performance and can be dispensed

automatically with precise thickness control down to 0.1 mm. This ensures close proximity to circuits and components, allowing for maximized EMI suppression and consistent shielding integrity, regardless of production scale. We chemically bond to the roughened metal for maximum performance (10dB improvement on adhesive or epoxy methods).

It is desirable to fill pockets with absorber that have either loss or gain. Parasitic effects occur around the layout of components where signals leak across causing an unflat through response where the gain or loss is significant. This is made worse when a metal lid is placed above the circuit area. Absorber dampens these parasitically coupled fields resulting in a more ideal response.

## TYPICAL PERFORMANCE

Our RF and microwave enclosures are engineered to deliver unmatched performance in high-frequency applications. By utilizing ultra-high loss nickel plating on roughened internal surfaces, we achieve exceptional isolation and minimize internal coupling, ensuring signal integrity across all channels.

The combination of our Form-in-Place isolation gaskets and advanced microwave absorber materials provides industry-leading EMI suppression, with isolation levels reaching 80 to 120 dB depending on the specific application. The RF PCB design also has an impact as these isolation technologies will control the surface currents and fields that exist above the PCB but cannot suppress leakage signals that may exist internally. EECL can review your PCB design to provide advice where needed.

### Absorber

Our absorber technology is designed for ultra-wideband performance and is chemically bonded for seamless coverage, eliminating gaps and maximizing cavity resonance suppression. This high-performance shielding solution ensures repeatable, reliable RF performance, even in demanding environments, making it ideal for applications that require precision and robust electromagnetic isolation.



Figure 1: Cavity resonance suppression of absorber (wideband)

We are able to effectively screen connectors by printing shielding gasket on walls and curved surfaces.

A test fixture was made consisting of a coupled line in a small cavity (20mm). A measurement was made with and without absorber. It can be seen that cavity resonance suppression is achieved within small cavities showing the effectiveness of the material. This plot shows the absorber we use is extremely wideband and starts being effective around 10MHz (depending on cavity size).

### Gasket

Our gasket technology when used correctly creates a perfect connection from the metal lid to the PCB with no gaps or leakage paths present. The gasket is extremely conductive when compressed by more than 10%. The following plots show one of our products (switch matrix). The measurement shown is two RF traces on a PCB that are 5mm apart. The only thing splitting them on the board is an exposed ground and a metal wall with gasket. Without the gasket wall the coupling is around 30dB. The gasket wall is suppressing the leakage between 80 and 120dB.

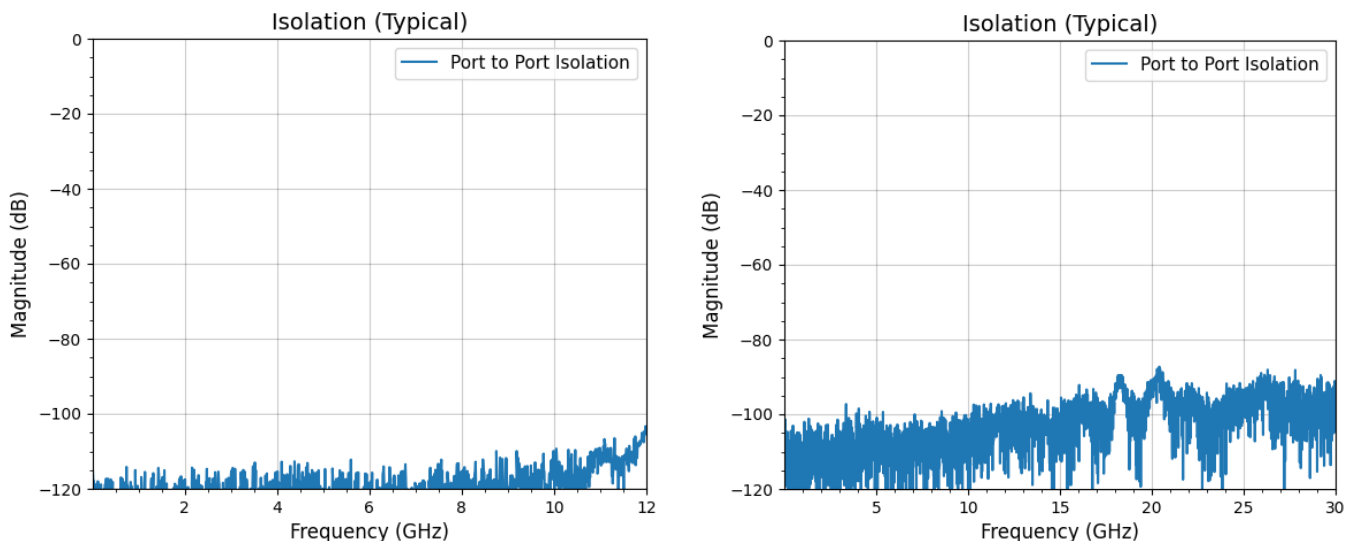
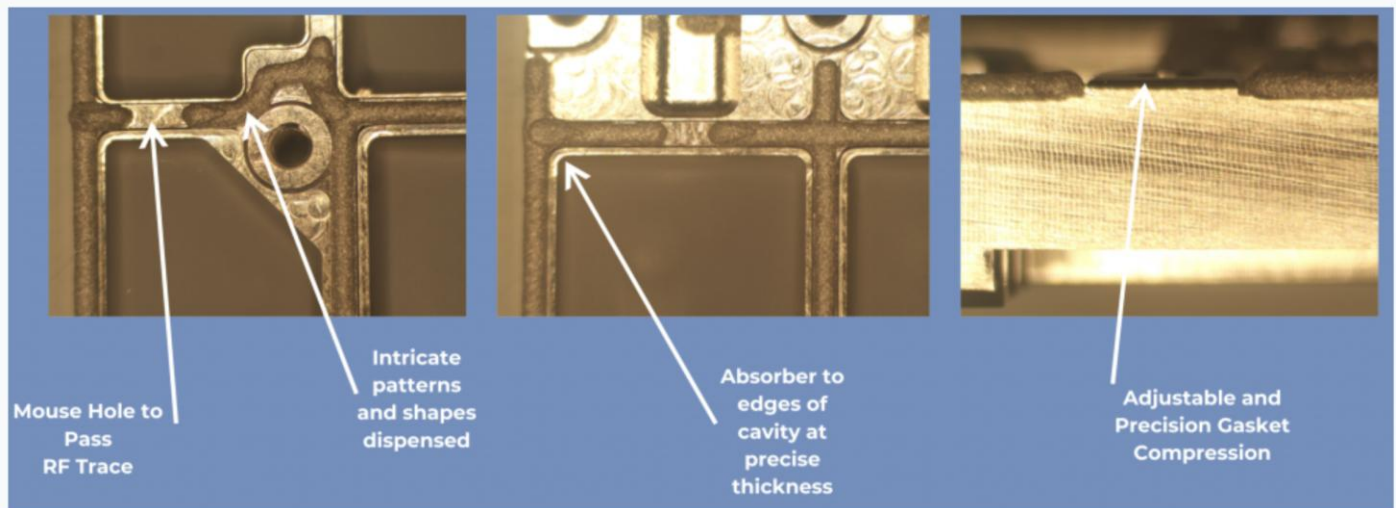


Figure 2: Isolation impact of gasket

### GASKET GUIDELINES

To prevent interference between sensitive circuits, it's recommended to partition areas within the enclosure and encircle each with a grounded ring. This ground ring should be via-stamped to inhibit internal propagation modes, with a minimum width of 0.25 mm on each side beyond the Form-In-Place (FIP) dispensing bead. Use compression stops to limit gasket compression, preventing over-squashing. Compression stops should be positioned near screw fixing holes, which should be distributed evenly across the PCB. Gasket beads can range from 0.8 mm to 3 mm in diameter, with the compression stops set to achieve approximately 30% compression. For RF traces on the top layer that need to exit the cavity, we can add "mouse holes" in the gasket to avoid shorting. Additionally, the exposed ground ring should be free of solder resist to ensure complete grounding.



### ABSORBER GUIDELINES

For optimal absorber performance, design cavities to allow unobstructed coverage, maintaining a minimum clearance of vertical height 0.2mm from circuits. All interfaces should be smooth and free from irregularities to support efficient gasket application and prevent gaps. We can tailor the absorber thickness as required, typically advising it to be dispensed approximately 0.3 mm from the tallest component within each cavity. The thicker the absorber layer the lower in frequency it works, so generally we advise go for the thickest layer that the design facilitates. Just a small amount in contact with the cavity lid is generally enough to suppress most problems.

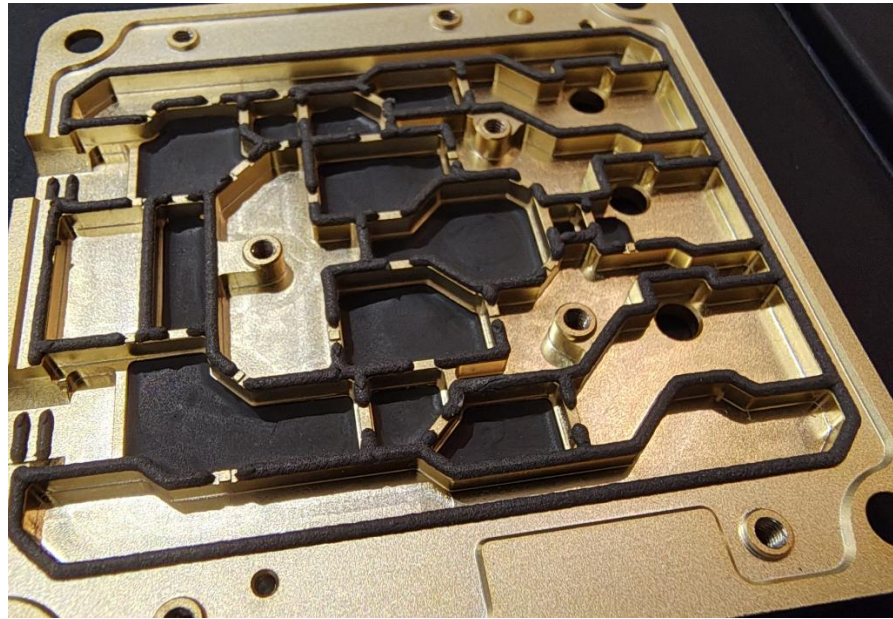
Following these guidelines will help users maximize the effectiveness of our gaskets and absorbers, resulting in consistent, high-quality shielding for RF and microwave applications.

### THERMAL PASTE

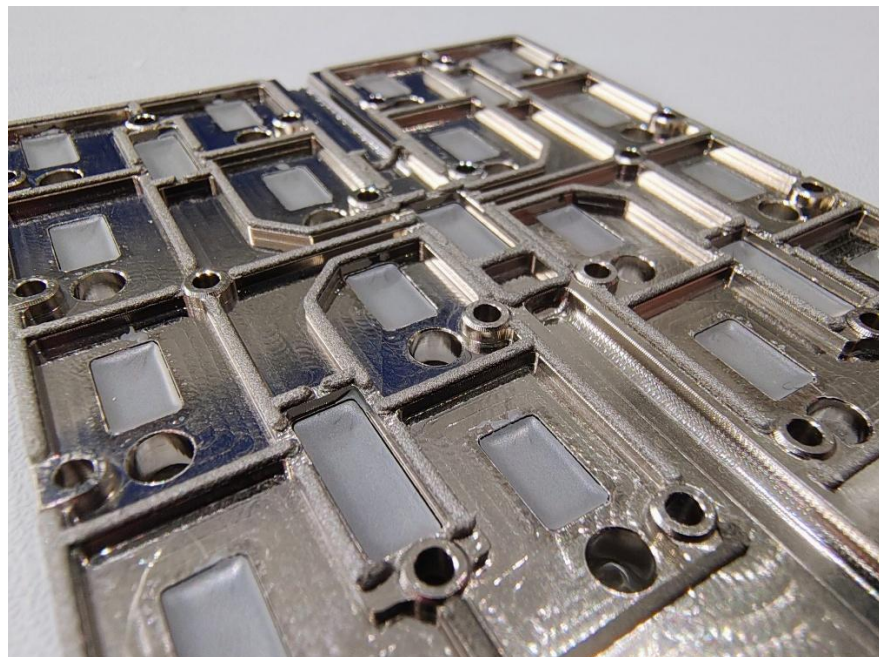
We are able to dispense thermal paste onto parts where heat transfer from the PCB to the enclosure needs to be maximised. We like to use Therm-A-Gap Gel 120 from parker but we are able to dispense other materials as required.

### PRODUCT EXAMPLES

The following images show examples of modules that we have designed for projects. It shows the type of internal structures that can be created and how versatile the technology is. If you require us to design you a housing as well as manufacture and supply it, please get in touch.



*Figure 3: 80 GHz, Gold Plated W-Band Radar Enclosure*



*Figure 4: Microwave routing circuit*

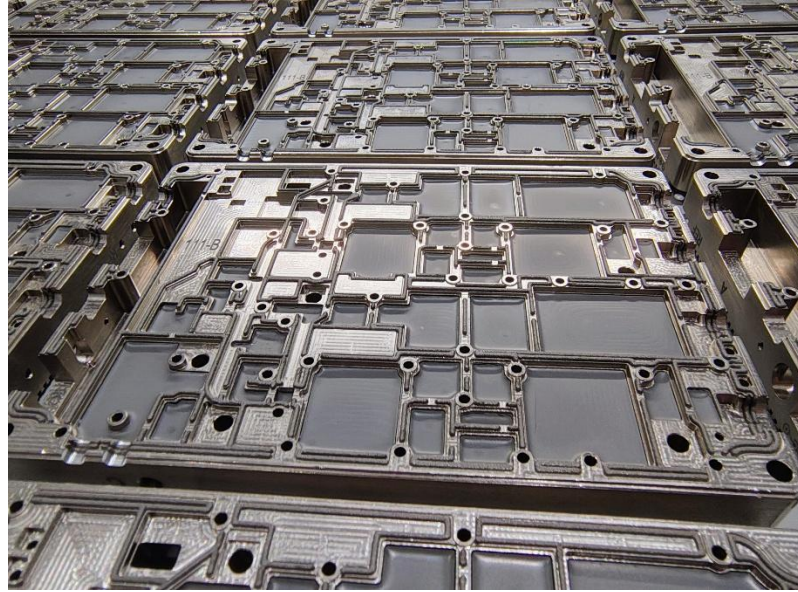


Figure 5: Complex microwave receiver unit (100MHz to 40 GHz)



Figure 6: XBand radar module

### QUALITY CONTROL

We are certified to ISO 9001: 2015 and we operate a strict production process with quality assurance at the heart of what we do. All machined metal is washed using ultrasonics to remove any trace of contamination and debris from the CNC factory. The metal is inspected for form, fit and function. All processes follow strict guidelines and we control the application of materials to a meticulous standard. All items are shipped serialised and packaged separately in sealed enclosures that are suitable for long term storage.



Certificate No:502632025

We have supplied over 10,000 housings so far into defence, space and commercial applications. Our solutions have in flight heritage on European Space Agency missions, on military ships and in high density data centre applications.

### SPECIFICATIONS ABSORBER

Our absorber is a magnetically loaded, RTV silicone rubber materials with high loss in the microwave frequency range. Being a true elastomer, when cured, has a number of distinct advantages over rigid materials.

Frequency Range	10MHz to 100 GHz, (depending on thickness and cavity size)
Service Temperature Range	Cryogenic Zero to 160 C
Density (g/CC)	4.55
Thermal Expansion Coefficient per C	59 x 10 <sup>6</sup>
Thermal Conductivity (W/m-K)	1.0
Hardness, Shore A	75
Water Absorption, % 24 hours	< 0.1
Dielectric Strength, (Kv/mm)	> 10
Volume Resistivity, ohm-cm	> 10 <sup>10</sup>

When bonded to surfaces, the absorber will withstand temperature cycling (even to cryogenic temperatures). It can be deformed and shaped to contoured surfaces and is not subject to damage from impact or shock.

Typical attenuation values in dB/cm are given as follows:

1GHz : 6.5 dB | 30GHz : 20 dB | 8 GHz : 63 dB | 18 GHz, 149, dB | 30GHz : 192 dB | 80 GHz : 212 dB

For low outgassing applications (space use) we have a bakeout process that involves an extended cure time to reduce the outgassing to well within ECSS and NASA limits.

There are no storage limits of supplied housings. We ship them sealed and they can be stored indefinitely.

### SPECIFICATIONS GASKET

The gasket we use is an electrically conductive composite material comprising of silicone elastomer and nickel-plated graphite particles. It is designed for Form-in-Place (CNC application) onto a wide range of components where it cures to form an elastomeric gasket section that has good adhesion to most commonly used substrates. This allows intricate, small section gaskets to be reliably and efficiently applied to any quantity of parts without the requirement for expensive tooling.

When designed in correctly it provides a reusable EMI and environmental seal. Furthermore, if applied in combination with a non-conductive silicone form-in-place seal it is possible to achieve environmental sealing up to IP68 (water immersion).

The gasket has excellent high temperature resistance and long-term ageing characteristics. The nickel-graphite filler used in this material is very effective at making a low impedance connection at low contact pressures. This makes it particularly suited for use on surfaces with relatively high surface contact resistance down to surfaces with excellent conductivity.

Colour	Grey
Density	2.5 gcm <sup>3</sup>
Hardness	50 Shore A
Volume resistivity	< 0.1 ohm-cm
Attenuation 10MHz to 100GHz	85-110dB typical
Compression	10-30 %
Service temperature range	-55C to 150C
Force / Deflection (0.7mm bead)	2.8 Ncm @ 10% 7.4Ncm @ 25% 26.4Ncm @ 50%

For low outgassing applications (space use) we have a bakeout process that involves an extended cure time to reduce the outgassing to well within ECSS and NASA limits.

There are no storage limits of supplied housings. We ship them sealed and they can be stored indefinitely. We always advise to try and recompress the gasket as few times as possible for production and flight grade hardware but in practice the gasket enclosure can be refitted many times without losing performance.

### SPECIFICATIONS THERMAL PASTE

Parker Chomerics Therm-A-Gap Gel 120 is our recommended material to use.

<b>Specifications Met:</b>	UL 94 V-0, RoHS	<b>Dielectric Constant:</b>	5.7 @ 100 KHZ
<b>Color:</b>	Gray	<b>Dissipation Factor:</b>	0.013 @ 1 MHZ
<b>Flow Rate:</b>	25 g/min	<b>Flammability Rating:</b>	UL 94 V-0
<b>Specific Gravity:</b>	3.2	<b>Outgassing Total Mass Loss:</b>	0.56 % TML (0.028% CVCM)
<b>Thermal Conductivity:</b>	12.0 W/m-K	<b>Shelf Life:</b>	6 Months
<b>Heat Capacity:</b>	1 J/g-K	<b>Minimum Bondline Thickness:</b>	0.010 inch, 0.25 mm
<b>Operating Temperature:</b>	-67 to 392 °F, -55 to 200 °C		
<b>Dielectric Strength:</b>	5 VAC/mil		
<b>Volume Resistivity:</b>	10 <sup>13</sup> ohm-cm		