

Termination Solution for X band

Designing high-power terminations for high-frequency applications, specifically in the X band, with substantial power requirements, presents a significant challenge for engineers. Traditionally, high-power applications require large-size terminations. Large-size terminations are usually associated with large parasitic capacitance, which in turn limits the RF performance at these frequencies and often restricts their operating frequency. Individual terminations are typically used only within the band where their return loss is less than 20 dB; use outside of that band is not desirable, highlighting a clear need for an innovative solution

Our Solution: Commercial off the shelf (COTS) - Wideband Termination

The proposed solution utilizes readily available Commercial Off-The-Shelf components to create a wideband termination capable of handling high power dissipation across both X band. This solution consists of one X band Xinger hybrid coupler, two main power terminations, and a smaller termination for the isolated port.

A Xinger 3dB hybrid coupler offers a unique advantage: when its two outputs are connected to identical terminations, any reflected power from those terminations is diverted away from the input port and directed to the hybrid's isolation port, where it's then absorbed by the isolation termination.

Figure 1 illustrates this setup, showing a hybrid coupler connected to Termination 1 at the direct port, Termination 2 at the coupled port, and the isolation termination at the isolation port. It's crucial that Termination 1 and Termination 2 are identical and positioned the same trace length distance away from the coupler to maintain their crucial phase relationship. The majority of the power will be distributed between these two terminations. Any mismatch from them will be reflected to the isolation port, where the isolation termination will absorb the reflected energy.

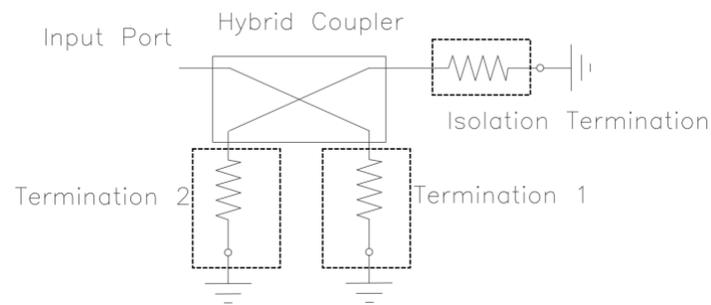


Figure 1. schematic diagram of hybrid coupler solution

Example of Hybrid coupler solution for 50 Watt X-band Termination

The following component were selected:

50-Watt X-Band Hybrid Coupler Part#: XMC0810F1-03G

25-Watt X-Band Termination, as Termination 1, Part#: XMT25N50Z4

25-Watt X-Band Termination, as Termination 2, Part#: XMT25N50Z4

10-Watt X-Band Termination, as Isolation Termination, Part#: XMT10N50Z4

Figure 2 shows the layout of the Xinger 3dB Hybrid coupler with the termination on a Hypothetical customer board

Figure 2, Implementation of hybrid coupler solution on customer test board

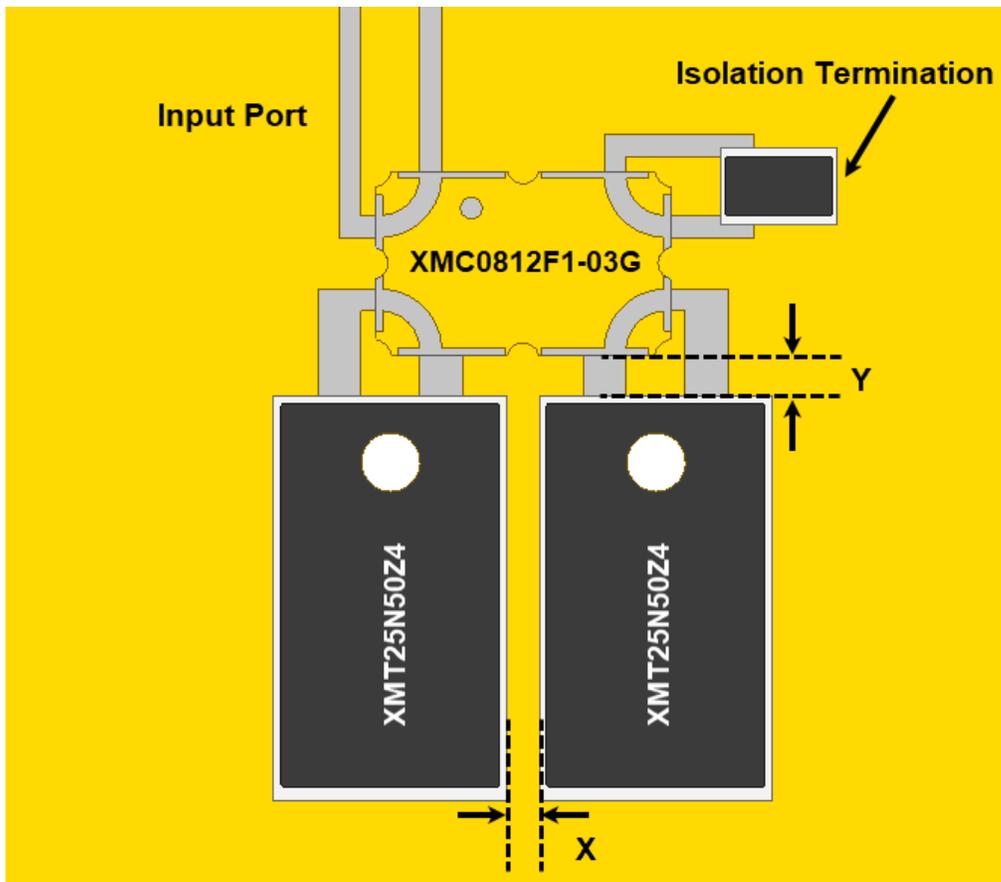


Figure 2, Implementation of hybrid coupler solution on customer test board

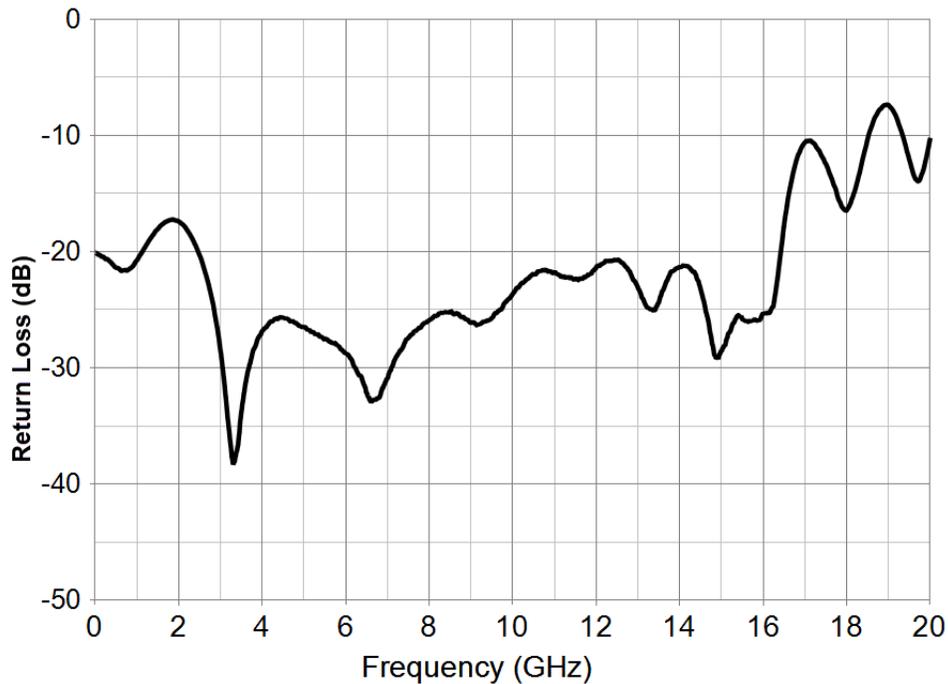


Figure 3, wideband performance of the hybrid solution

A very wideband performance can be achieved with this solution, as depicted in Figure 3. The hybrid coupler isolates the input from the reflected power originating from the two main terminations when their individual return loss is not optimal (worse than 20 dB). This reflected power is directed to the isolation port, where it is absorbed by the isolation termination. Consequently, only a very small, attenuated, and negligible amount of signal leaks back to the input port.

Proper spacing between the components is important for optimum thermal performance. While a reduced overall footprint of the solution is desirable, if the parts are too close together, the thermal performance will suffer. The spacing is determined by the customer and can be minimized by ensuring plated through hole ground vias are constructed below the termination and extend through the entire thickness of the carrier board. Please see individual product footprints for suggested via patterns. Also, please see the application note titled “POWER HANDLING CONSIDERATIONS FOR SMD TERMINATIONS, ATTENUATORS AND RESISTORS” for additional information on optimizing carrier board thermal performance.

Unique Configuration Benefits

As you can see from previous example, this is a highly effective configuration. It uniquely allows for the use of terminations outside their typical band of interest, even if their individual return loss is less than 20dB, while still achieving an overall system performance of better than 20dB when connected in this manner.

Table 1 demonstrates the percentage of power reflected to the isolation port when Termination 1 and Termination 2 are not perfectly matched (i.e. their individual return loss worse than 20dB). For instance, if both terminations individually have a 20dB return loss, only 1% of the power will be reflected to the isolation port. Even when their individual performance degrades to a 10dB return loss, a relatively small amount, about 10%, of the power is still reflected to the isolation port. Table 1 clearly shows that the isolation termination can be relatively small, as the power diverted to it is significantly less than what the two main terminations handle.

Return Loss of Termination 1 and 2 (dB)	Power Reflected to Isolation Port Relative to Input Power
30	0.1%
20	1%
17	2%
14	4%
11	8%
10	10%
5	32%

Table1. Individual Termination Return Loss vs Power Reflected to Isolation Port

TTM offers a variety of COTS Xinger brand 3dB hybrid couplers and terminations that can be used in achieving this configuration.

Options for both terminations and couplers for various power handling and frequency requirement are available on our website TTM.COM

Integrated Solutions for Space Saving and Layout Optimization

In addition to our discrete COTS component solution, TTM can offers integrated solutions for even greater convenience.

Figure 4 illustrates one such solution: the two required main terminations are integrated into a single, size optimized component with two input ports. This "drop-in" design significantly simplifies the customer's implementation, as they no longer need to be concerned about spacing between terminations and benefit from a reduced component count for assembly.

In additions it guarantees identical performance of the two termination which further improves the match at the input port

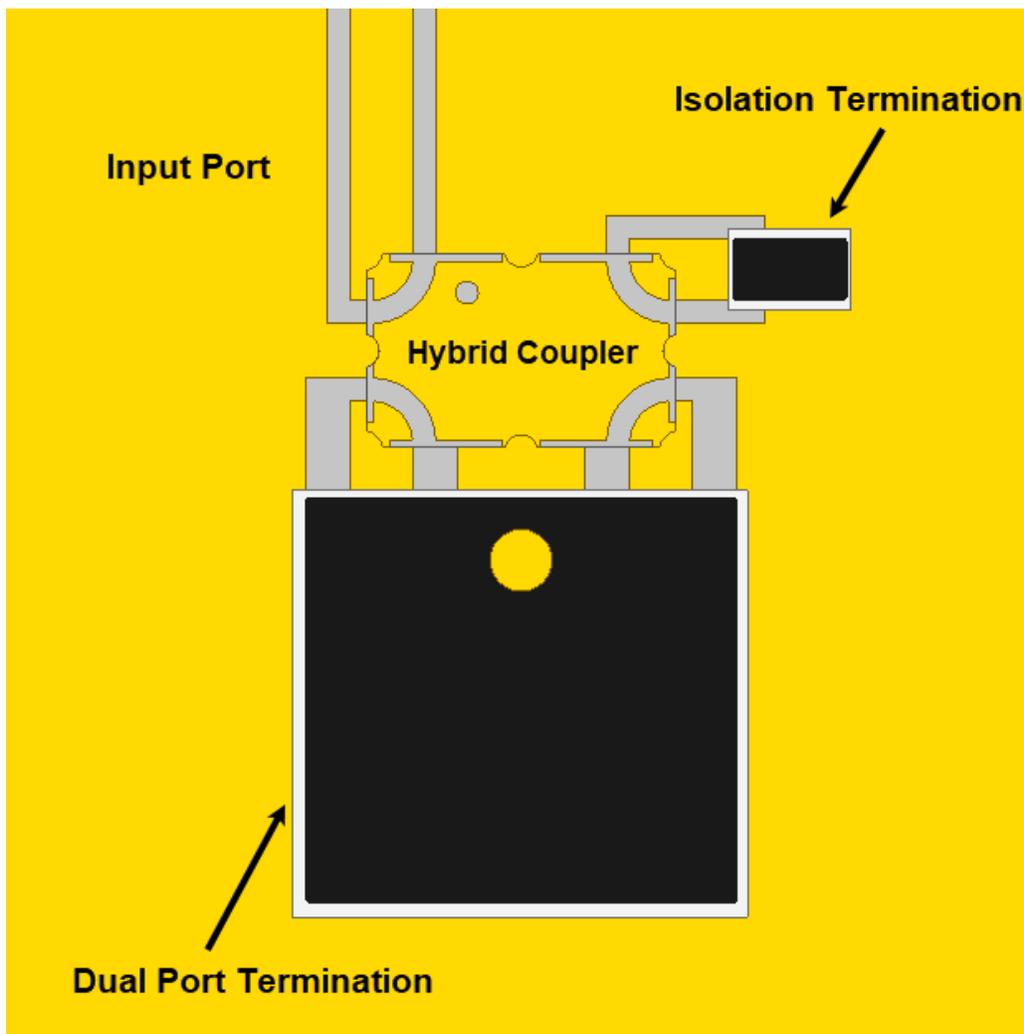


Figure 4, Dual Port Termination with Hybrid Coupler and Isolation Termination

Furthermore, TTM can provide a complete integrated solution where a class leading Xinger hybrid coupler is also incorporated directly onto the termination substrate. This unique offering makes the customer's work more convenient, requiring only one input connection to the integrated termination. With this advanced solution, heat dissipation and spacing are already optimized and taken care of, as shown in Figure 5.

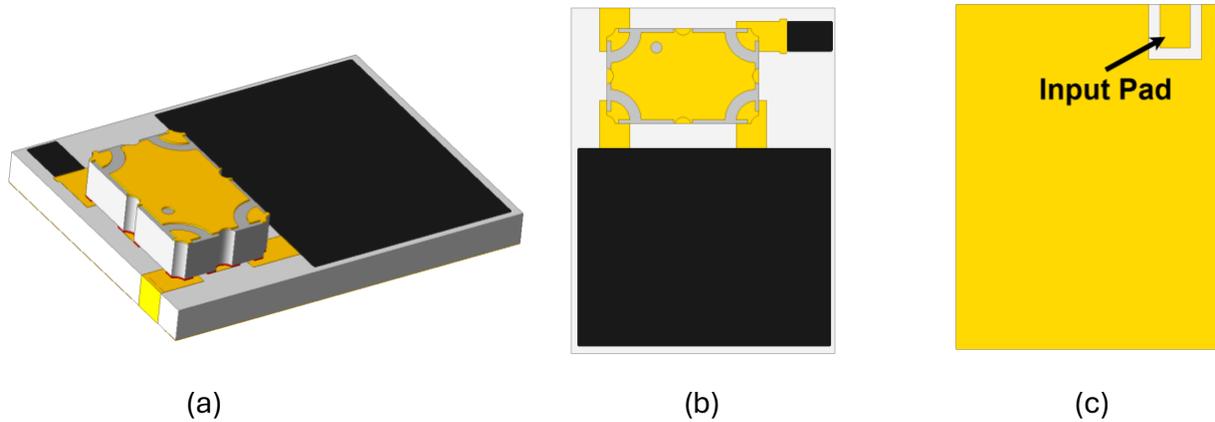


Figure 5. (a) 3D view of fully integrated solution, (b) top view, (c) bottom view

This solution is also applicable to higher frequency bands, including Ku-band and Ka-band. While a standard product for these bands isn't currently available, our team can design a solution based on your specific needs and specifications. Please contact us directly to discuss this request.