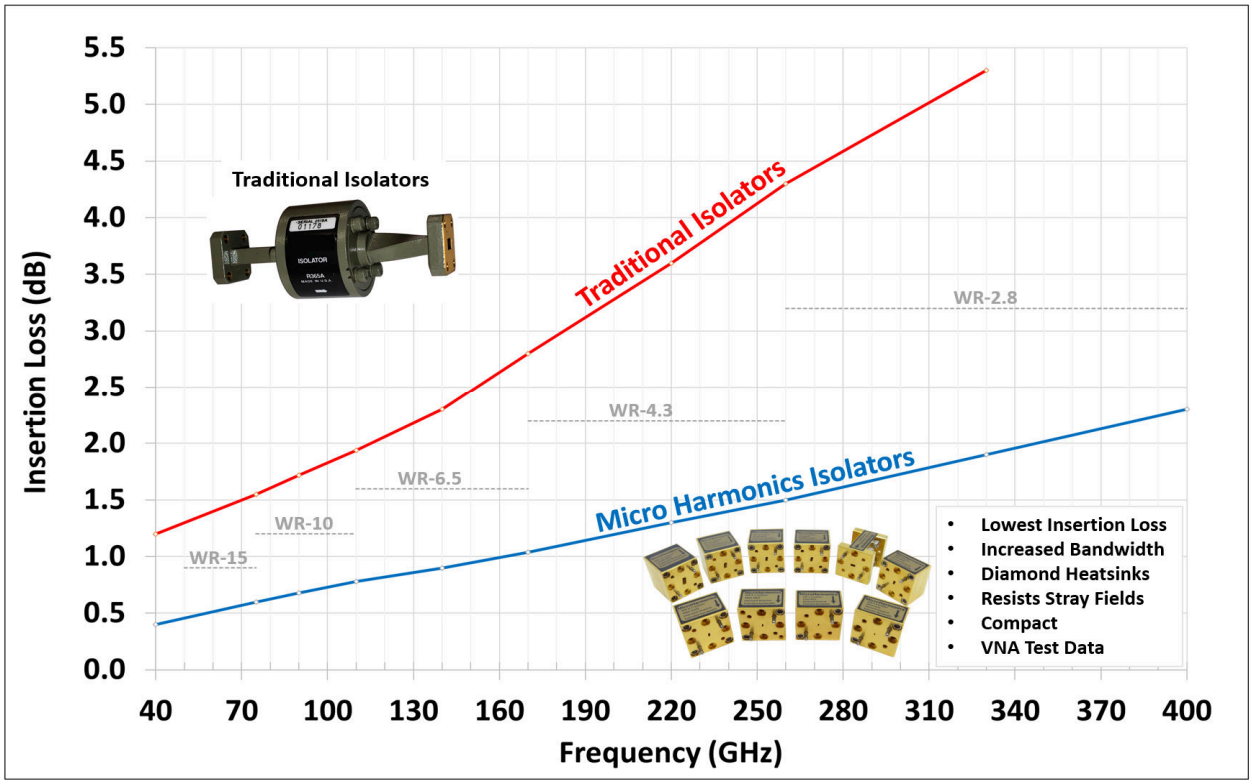
MicroHarmonics
Superior mm-Wave Components

Isolators Designed for Low Insertion Loss

Isolators are useful for suppressing standing waves between mismatched components and improving system performance. But at mm-wave frequencies, the insertion loss of traditional isolators is so high that it precludes their use in many systems. The loss can exceed 2 dB in WR-10 and 5 dB in WR-3.4.

At Micro Harmonics we design isolators that are optimized for low-insertion loss. The typical insertion loss is 0.8 dB in WR-10 and 2 dB in WR-3.4. These numbers are game changers and mm-wave and terahertz system developers are now reconsidering their use.



"The compact size, extremely low insertion loss, and the wide bandwidth have allowed us to use isolators in a wider variety of our systems than was previously possible and have led to significant improvements in key system performance metrics such as source power and sensitivity."

Jeffrey Hesler, Ph.D.
CTO, Virginia Diodes

"They had an isolator with the single most important parameter I needed, low insertion loss. They were ultimately able to select one with just 1.2 dB loss at 240 GHz, which is pretty phenomenal."

Curt Dunnam, Director of Operations
ACERT National Biomedical Center at Cornell

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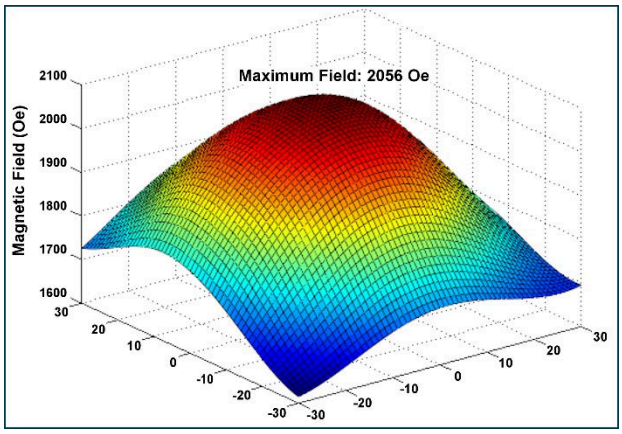
So how do we do it? There are three primary factors: 1) Minimizing Ferrite Loss, 2) Minimizing Waveguide Loss, and 3) Precision Fabrication & Alignment.

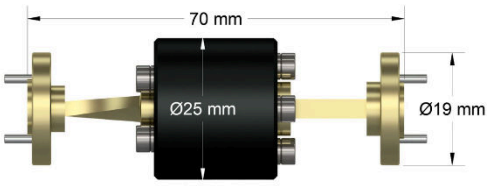
Minimizing Ferrite Loss - The traditional method used to tune Faraday rotation isolators is to use ferrites that are substantially longer than the minimum required length and then tune the magnetic bias field to achieve optimal performance. This approach works very well at the lower frequencies. But at the higher mm-wave frequencies ferrites become very lossy. To minimize loss in mm-wave isolators it is essential that the ferrite length be reduced as much as possible.



At Micro Harmonics we use a saturating magnetic bias field and the minimum possible ferrite length to achieve 45° rotation. We measure our magnetic bias fields to ensure the ferrites are saturated. We use magnetic armatures to achieve a focused, uniform bias field in the ferrite. The graph to the left shows the measured magnetic bias field near the surface of the ferrite core. The peak measured value of 2000 Oe is substantially more than what is required for saturation.

Minimizing Waveguide Loss – Since the EM field is rotated as it passes through the ferrite, it is necessary to realign the flanges. In traditional builds this is accomplished by physically twisting extruded waveguide. The twist must be implemented over a sufficiently long distance to avoid damaging the extruded guide. The photo shows our WR-10 isolator and that of a typical competitor. At Micro Harmonics we use a machined twist step which is substantially shorter than the extruded waveguide twists. The step-twist yields very broadband performance, reduces waveguide loss, and reduces the overall footprint.

MHC



Traditional

Precision Fabrication & Alignment – There are substantial challenges in fabricating the parts and assembling the isolators at the higher bands. The parts become increasingly smaller and some of the materials are very difficult to machine. Precision alignment is required. A small 1° misalignment of the resistive layer in the cones can reduce the isolation by 10 dB.

The assembly process is an art form. No two isolators have identical signatures. At Micro Harmonics we continually strive to improve our assembly techniques and the uniformity of our assemblies. But most importantly, we comprehensively test every isolator on a vector network analyzer to ensure it meets our specifications. We supply the measured data to our customers with every component that we sell. We never spot check components on less sophisticated systems which can lead to erroneous test data and missed signatures in the response. When you purchase an isolator from Micro Harmonics, you know exactly what you are getting.

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