SilentRIM™ Lens for Compact Range Test

Application & Market Opportunity

As the wireless industry evolves, testing demands are changing. Devices such as IoT modules, Wi-Fi routers, smartphones, 5G radio units, satellite terminals, and UAVs must be tested under **far-field conditions** or under planewave.

With the rapid transition to higher frequencies—beyond the traditional sub-6 GHz range—manufacturers are aiming to:

- Save space and reduce packaging size
- Minimize signal loss
- Streamline assembly
- Achieve higher data rates

However, while devices shrink or maintain in physical size, the antennas they contain must operate over greater ranges. This leads to **electrically large but physically compact arrays**, posing new challenges for traditional far-field testing.

For example:

- **Starlink terminals** operate between 12–18 GHz
- **5G mmWave radios** reach up to 24–40 GHz

At these frequencies, the required far-field distance can easily exceed **5 meters**, making conventional test setups **costly, space-consuming, and difficult to implement**. The conventional solution is the compact range based on reflector which can reduce the test distance to around 25% of far field.

Limitations of Reflector-Based Compact Ranges

The industry-standard solution has been the **reflector-based compact range**, which uses carefully shaped reflectors to create planewaves in a quiet zone with minimal field variation (typically within ±1 dB). Techniques like:

- **Scissor-shaped edge**
- **Rolled-back edge**

are employed to reduce edge diffraction and improve field uniformity.

However, reflector systems have significant drawbacks, especially at higher frequencies:

- **Stringent surface smoothness requirements**
- **High production cost**

- **Large size and weight**

These disadvantages are increasingly pronounced in modern test environments targeting mmWave and high-density antenna systems.

Lens-Based Compact Ranges: Challenges and Limitations

Lens-based solutions have long been considered as alternatives to reflectors. While lighter and potentially lower in cost when the quiet zone size is less than 0.7m, **conventional lenses** have not been able to deliver the required **quiet zone performance**—especially for precision antenna or OTA testing.

Some recent systems have introduced lenses into test ranges, but these are typically limited to **EMC/immunity testing and material dielectric constant testing**, where uniformity standards are less stringent. For **precision RF testing**, current lens solutions fall short of the necessary field flatness (±1 dB amplitude, ±10° phase).

The Ascan Innovation: SilentRIM™ Lens

Ascan's SilentRIM™ lens is a breakthrough in lens-based planewave generation, engineered specifically to overcome the limitations of both reflectors and traditional lenses.

What Makes SilentRIM™ Unique?

Our core innovation is the introduction of a **transition zone** at the outer edge of the lens. This unique design feature:

- Gradually guides wave energy toward the outer space of the lens
- Reduces diffraction and edge scattering
- Delivers **exceptionally uniform planewave fields** across the quiet zone

Design Overview

Cross-section of conventional lens versus Ascan SilentRIM™ Lens is shown in Figure 2.

- The **blue region** represents the **Focus Zone**, with the same curvature as a standard lens to form the planewave.
- The **red region** is the **Transition Zone**, exclusive to SilentRIM™, where the lens gradually tapers to manage wave continuity and reduce edge scattering.

Unlike conventional designs, this structure **maintains wave coherence across the lens** and dramatically improves field uniformity.

The SilentRIM™ lens works with multiple geometries, including **plano-convex (either side facing to the device under test) and bi-convex**, with plano-convex preferred for ease of manufacturing.

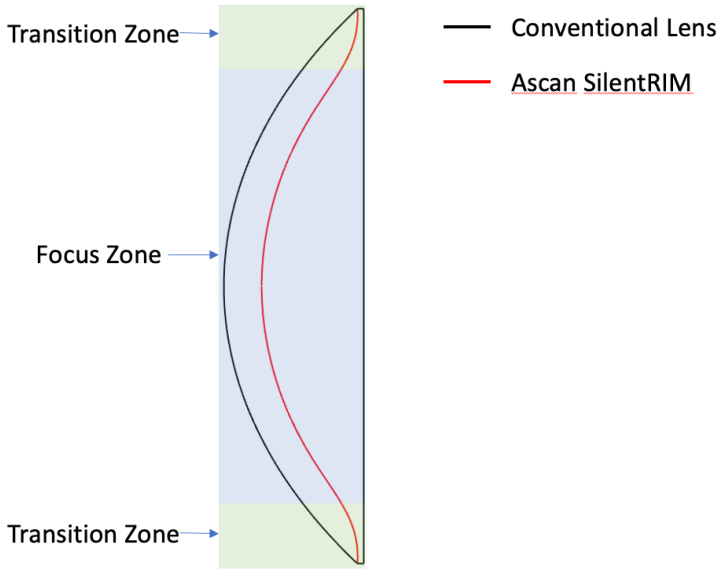

Figure 1 Cross section comparison between conventional and Ascan SilentRIM™ lens

Performance Comparison

Planewave generated from the two lens (Conventional VS SilentRIM™ is shown in Figure 2 and 3.

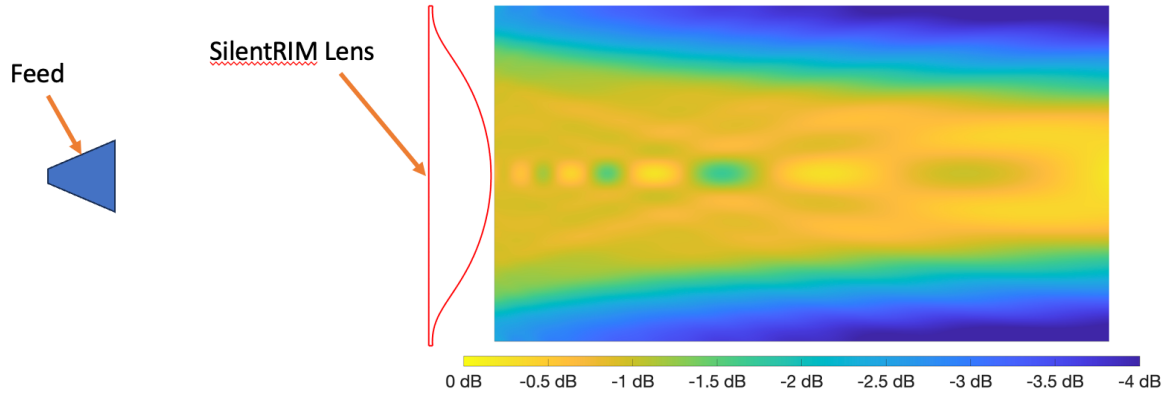

Figure 2 Planewave generated from Ascan SilentRIM™Lens

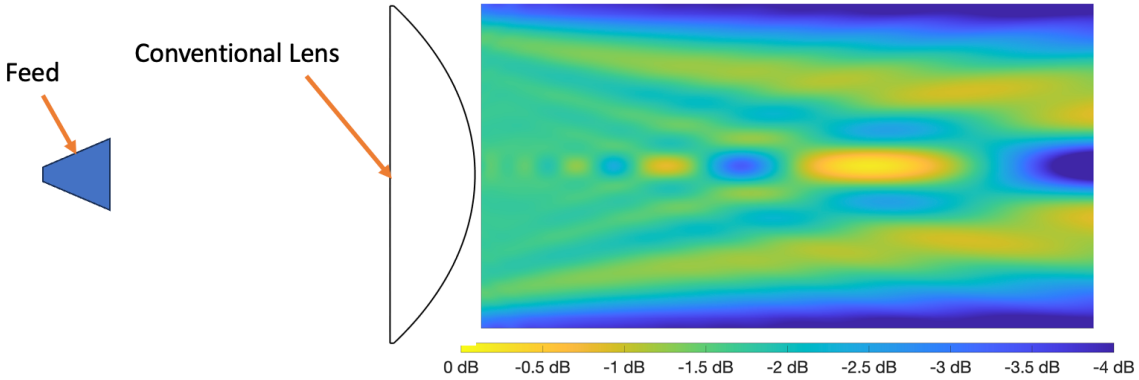

Figure 3 Planewave generated from conventional Lens

Amplitude Contour (Quiet Zone Uniformity)

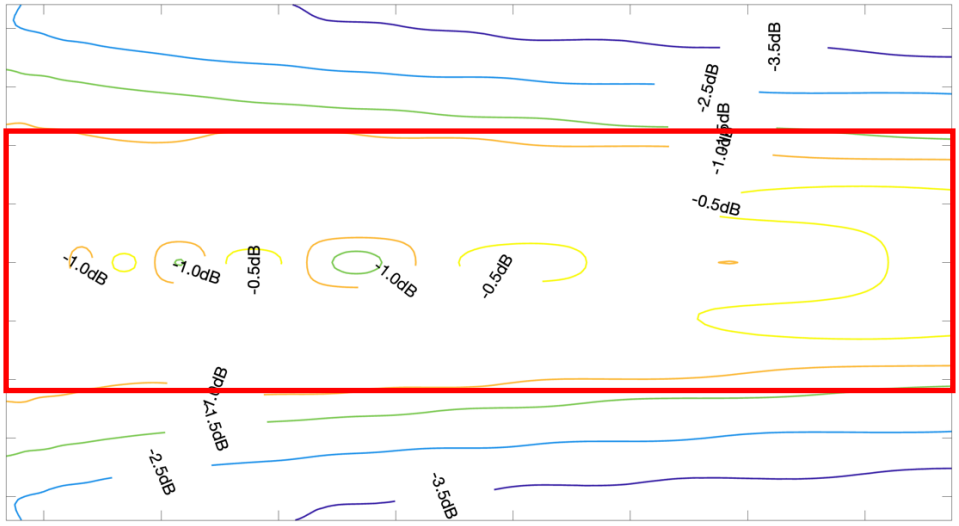

Figure 4: SilentRIM™ lens shows a large central zone within **±0.5 dB**, ideal for antenna and OTA testing.

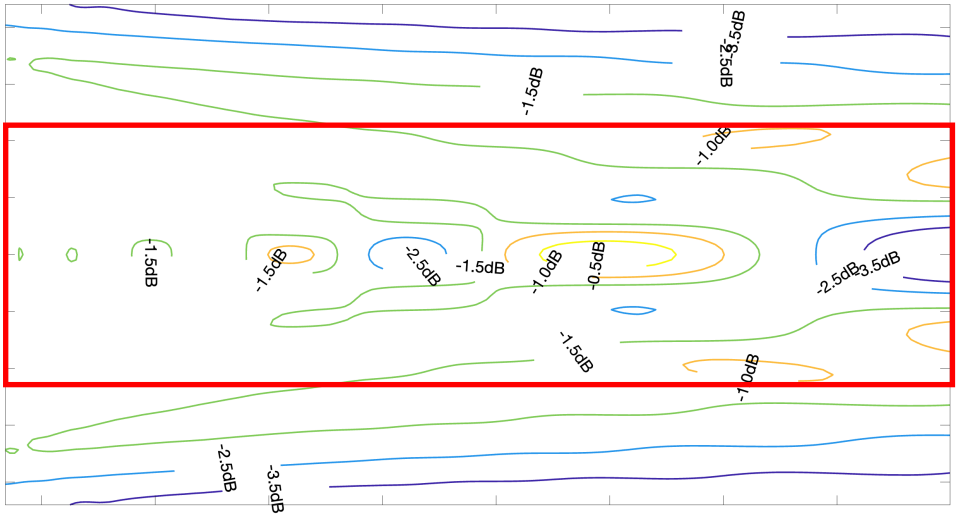

Figure 5: Conventional lens exhibits significant variation, unsuitable for precision applications.

Key Benefits of SilentRIM™ Lens

- ✅ **High-Performance Quiet Zone**
  Meets or exceeds the ±1 dB requirement for OTA and antenna measurements.

- ✅ **Compact and Lightweight**
  Reduces structural weight and size compared to reflector-based setups.
- ✅ **Cost-Efficient**
  Simplifies production and lowers infrastructure costs.
- ✅ **Scalable and Versatile**
  Ideal for use in R&D labs, production lines, or portable test systems.
- ✅ **Future-Ready**
  Designed for the challenges of 5G, satellite, mmWave, and emerging wireless technologies.

Conclusion

Ascan's SilentRIM™ lens redefines compact range testing. By combining precision field generation with an innovative, lightweight design, it delivers **reflector-level performance**—without the cost, complexity, or bulk.

Whether you're testing next-generation communications systems or building scalable OTA test environments, SilentRIM™ is the smarter, more efficient way to achieve high-frequency planewave generation.

SilentRIM™ by Ascan – Precision. Simplified.