

# Low Loss Slotted Substrate Integrated Air Waveguide (SIAW) Antenna Array for Millimeter-Wave Applications

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With the rapid development of 5G communication systems and Millimeter-Wave (mmWave) automotive radars, better quality, lower loss antennas are in high demand. Slotted substrate integrated waveguide (SIW) antennas are very good candidates for these applications because they are easy to fabricate and integrate with other planar circuits. Also, they are capable of handling high power just like the conventional slotted waveguide antennas. However, the slotted SIW antennas have different types of loss such as conductor loss, dielectric loss and surface wave loss which will become more significant at W-band. To minimize these substrate related losses, a slotted substrate integrated air waveguide (SIAW) antenna array compatible with mmWave will be presented in the conference.

The low-loss, high-efficiency property of slotted SIAW array is benefit from the following design concepts. First, the dielectric material within the waveguide is removed from the substrate (Fig. 1) such that the TE<sub>10</sub> mode is propagating through air instead of lossy dielectric media. In this way, the dielectric loss during TE<sub>10</sub> mode propagation is eliminated. Also, the metallized posts used for waveguide are replaced with metal plated substrate edges, which eliminates the need for extremely closely spaced vias at W-band to prevent the wave leakage between adjacent posts. The radiating slots are cut on a 5-mil brass plate which covers the top of the waveguide. Since the dielectric material is replaced with air in the waveguide, the impedance mismatch from waveguide to air during the radiation is further reduced.

To evaluate the performance, the proposed slotted SIAW array and a conventional slotted SIW array operating at K-band (23 – 25 GHz) are both simulated and fabricated. Rogers 5880 (20 mil) is chosen as the substrate for its low-loss property. A single layer FR4 is used as RF ground. The waveguide is formed by soldering the brass plate to edge-plated Rogers 5880 with FR4 bounded on the bottom. The simulated slotted SIAW array shows a 98% radiation efficiency and a 97% antenna efficiency, which are 3% higher than conventional slotted SIW array. This difference will be more obvious at W-band. The antenna design and more detailed comparison will be discussed during the presentation.

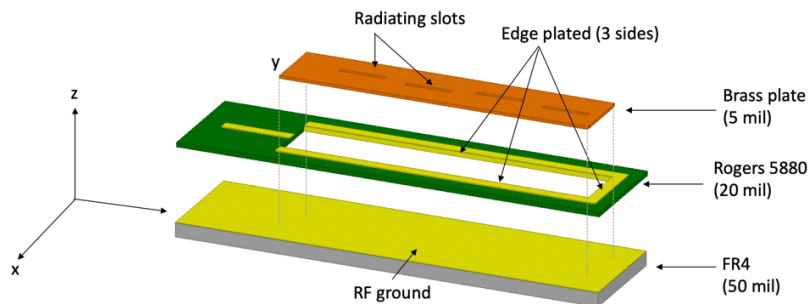


Fig. 1 Structure of Slotted Substrate Integrated Air Waveguide (SIAW) Antenna Array