# Low Temperature, Micromachined, Rotated Rectangular Waveguides at Y-band for Leaky Wave Antenna Applications

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At submillimeter-wave frequencies, hollow metallic waveguides offer better performance in terms of losses compared to conventional planar transmission lines like the microstrip and coplanar waveguide transmission lines. This is especially important for applications where relatively long transmission lines are needed such as high efficiency, on wafer leaky wave antennas. For example, rectangular waveguide based, frequency scanning, leaky wave antennas at Y-band (~240 GHz) have been demonstrated in (A. Jam, K. Sarbandi, and M. Vahidpour, APSURSI 2014, 1371-1372, 2014) with efficiency in excess of 55%. Furthermore, a low temperature fabrication process is highly desirable for possible integration with other pre-fabricated components without sacrificing their performance.

In this paper, we investigate the design, microfabrication and measurement of rotated rectangular waveguides (the broadside of the waveguide is perpendicular to the waver surface) at the Y-band spanning the range between 220 GHz and 325 GHz. The microfabrication of these waveguide at this frequency range is possible because the dimensions of the rotated waveguide are so small such that it can be etched in a standard silicon wafer. For example, the WR-03 waveguide has dimensions of 864µm × 432 µm. The waveguides are fabricated basically by etching two deep trenches of depth 864/2 = 432 um using Bosch standard etching process in two separate silicon wafers. Then, the two wafers are metalized with gold and mated together (after proper alignment) without any bonding step. We show through simulation and measurements that the presence of an airgap between the upper and bottom halves of the waveguide does not deteriorate the performance as it does not affect the surface currents of the dominant $TE_{10}$ mode. We also show how the parameters of the Bosch etching process (undercut, scalloping, sidewall angle) affect the performance of the fabricated waveguide. Furthermore, we propose the design of a simple and optimized single step H-bend to allow accessing the waveguide over a wide bandwidth with minimal loss.