Micromachined Frequency Beam Scanning Patch Array Antenna at Y-Band

Mehrnoosh Vahidpour, Armin Jam*, Jack R. East and Kamal Sarabandi
Radiation Laboratory, Department of Electrical Engineering and Computer Science,
University of Michigan, Ann Arbor, MI, 48109, USA
{mvahid,arminjam,jeast,saraband}@umich.edu

This paper presents the design and fabrication of a frequency beam scanning array antenna operating from 230 GHz to 245 GHz. The array is designed using hollow rectangular waveguides with slot cuts placed on the H-plane of the waveguide wall. The slots in turn excite a linear patch array above it. The progressive phase shift between the slots is facilitated by meandered waveguide lines supporting TE_{10} mode. By changing the frequency, the propagation constant of the waveguide changes, which in turn will change the excitation phase of each slot and hence the antenna beam is steered. To provide the desired phase shift between the two consecutive slots while maintaining a small physical separation between them, the waveguide is meandered as shown in Figure 1.

This one-dimensional array forms a narrow beam width in the plane of slots while generating a wide beam in a plane perpendicular to that. In order to confine the beam in the elevation direction, the antenna aperture is widened by using slot-coupled patch arrays. This two-dimensional structure provides a two-dimensional confined beam. The patches are positioned on top of the slots separated by a dielectric substrate. The center patch is fed by the slot on the bottom layer of the substrate, while the rest are series-fed through the center one.

One method to fabricate the antenna is the micromachining technique where the waveguide trenches are etched in silicon and then covered with gold. Next the slots are fabricated on a wafer and bonded to the other wafer to form the one-dimensional array. Finally, the patches are fabricated on a membrane which is then bonded to the one-dimensional array to form the complete antenna.

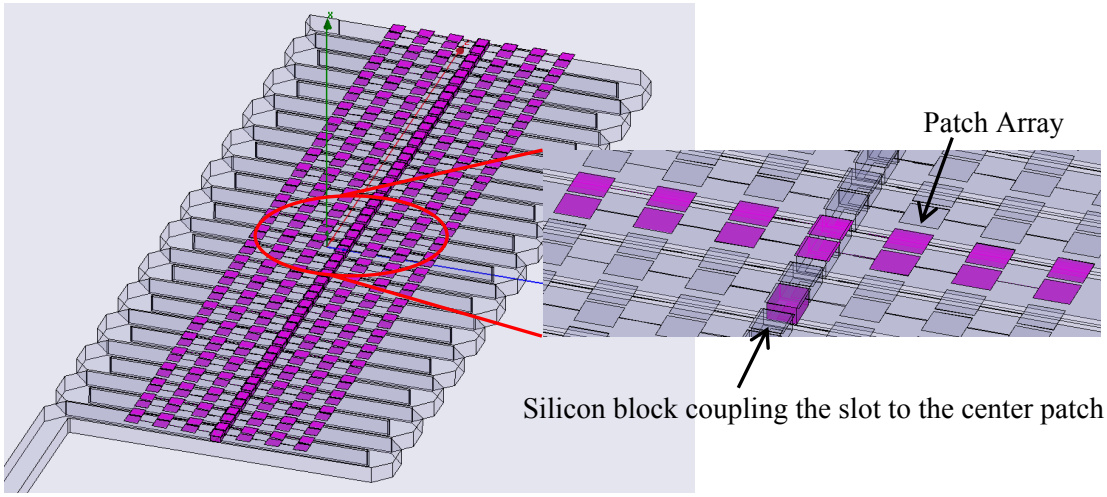

Figure 1. 3D view of the patch array antenna