The Effect of Feeding Techniques on the Bandwidth of Millimeter-Wave Patch Antenna Arrays

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Antenna design at E-band frequencies is recently gaining more interest with the development of automotive radar applications and with research focusing on the possibility of using this frequency band for cell phone and data communication. At E-band frequencies, typical coaxial connectors cannot be used to feed printed antennas because their operation is limited to frequencies below 26.5 GHz. The use of other feeding techniques is needed.

This paper discusses the effect of two different feeding techniques on the bandwidth of an array of rectangular patches used for automotive radar applications. The first feeding technique uses an RF-Probe which will be mounted on a transition from a grounded CPW (GCPW) to a microstrip line. The second feeding technique uses a rectangular waveguide to microstrip line transition. Both feeding techniques designs are easy to fabricate and do not incorporate any via holes connecting the upper ground plane to the lower ground plane.

The array designed to test the differences caused by the feeding techniques consists of 64 elements of rectangular patches, with inset feeds, radiating at a center frequency of 73 GHz. A corporate feed is used to feed the elements of the array in phase. Both feeding techniques are used for comparison. It is shown that the bandwidth of the antenna array fed using GCPW is 3.75 GHz while it is 800 MHz for an antenna array fed using a rectangular waveguide (WR-12). Thus, feeding with an RF probe allows the array to exhibit a bandwidth that is 4.6875 times greater than the bandwidth of the antenna array fed using a rectangular waveguide (WR-12). The difference in the gain between the two arrays is negligible. The radiation pattern exhibits two main lobes in the 45^{o} direction in the E-plane in both designs. The implementation and testing of the waveguide feeding technique is carried out at 34 GHz and show good agreement with simulated results.