STACKED PATCH APPROACH FOR INCREASED BANDWIDTH OF A DUAL-BAND AND DUAL-POLARIZATION ANTENNA

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Previously the authors have demonstrated a concentric substrate approach for shrinking the footprint of a dual band and dual polarization microstrip antenna. By utilizing a co-located S-band annular ring and concentric X-band patch (Fig. 1a) with orthogonal feeds, we achieved efficient radiation at two frequency bands and achieved both linear and vertical polarization. Furthermore, by utilizing a concentric substrate approach (Fig. 1b) where the substrate beneath the annular ring is a high dielectric compared to that under the patch we reduced the total footprint by 32% (G. Mitchell and A. Zaghloul, *Proc. 2018 International ACES Symp.*, 2016). In this case, ε_{r1} is Rogers 3006 and ε_{r2} is Rogers 5880 or Duroid. However, utilizing pin feeds for the microstip antenna yielded a bandwidth of only 6-7% at both frequency bands.

A common way to improve bandwidth in probe-fed microstrip antennas is by using a two layer stacked substrate approach. Waterhouse gives methods of designing and tuning such a stacked patch antenna with up to a 25% bandwidth (R.B. Waterhouse, *IEEE Trans. on Antennas and Prop.*, 1999). However, the guidelines given by Waterhouse assumes a continuous dielectric substrate in the bottom layer as well as a single radiating element. Using a similar stacked substrate approach, we investigate the effect on the bandwidth and gain performance of a concentric dual-band antenna. Our second layer consists of a continuous layer of Duroid (Fig. 1c) with a second co-located annular ring and patch on top. The bottom layer couples to the top layer and both sets of elements contribute to the radiating across the extended bandwidth. The substrate thickness of the bottom and top layers as well as the dimensions of both radiating layers have been optimized using CST Studio Suite 2017. Simulation results show the stacked substrate design yields 18% bandwidth at S-band and 26% bandwidth at X-band based on a -10 dB return loss or better. The realized gain to broadside is relatively flat with an average of 6.0 dB over the bandwidth at both bands.

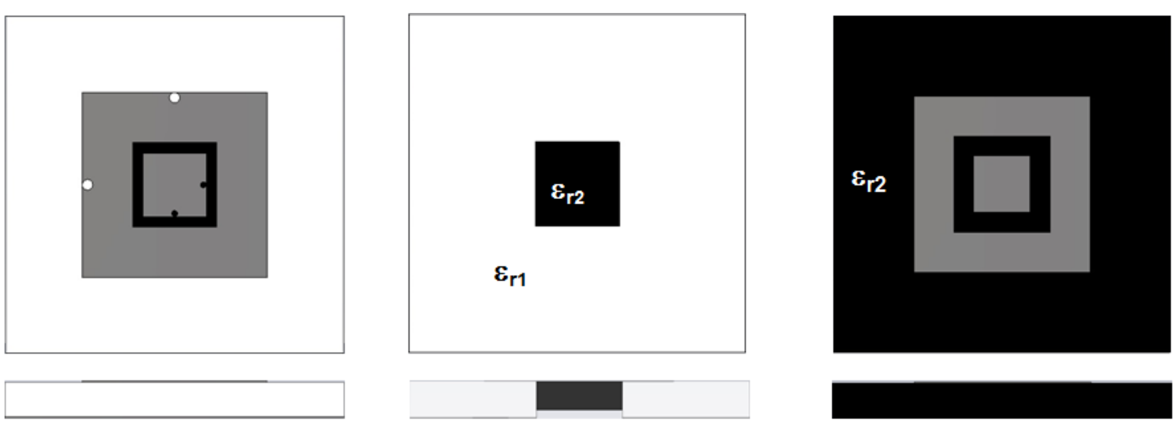

Figure 1. Top and side views of: a) bottom microstrip antenna layer, b) bottom concentric substrate layers, c) top Duroid antenna layer.