Increased Bandwidth of a Dual Band and Dual Polarization Probe-fed Microstrip Antenna

Gregory Mitchell and Amir I. Zaghloul
Army Research Laboratory, Adelphi, MD 20783

A common way to improve bandwidth in probe-fed microstrip antennas is by using a two-layer stacked approach. For example, a microstrip patch or annular ring antenna is covered by a second substrate with a coupled antenna of the same shape on top. The antenna of the first layer is probe-fed and couples to the antenna of the second layer which acts as the radiator. As long as the coupled antenna is larger in area than the probe-fed antenna below it, the dimensions can be tuned such that the -10 dB return-loss bandwidth increases over its single layer microstrip counterpart. R.B. 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).

Using a similar stacked approach, we investigate the effect on the bandwidth and gain performance of a concentric dual-band antenna. The antenna is a microstrip annular ring design at S-band which contains a combined microstrip patch and annular ring slot at X-band. The aperture geometry is shown in Fig. 1. Furthermore, both the S-band annular ring and X-band patch utilize a pair of orthogonal probe feeds to produce dual polarizations at each band. Fig. 1 also shows that stacking the X-band patch/slot element, surrounded by the stacked S-band annular ring may pause a complication in the X-band performance. This complexity in the radiation mechanism did not exist in the designs reported on simple patches when attempting to increase the bandwidth using a stacked substrate approach. We propose to show how our results deviate from those given by Waterhouse and others when designing this type of antenna. Initial simulation results show that our stacked substrate design yields approximately a 12% bandwidth at both S-band and X-band based on a -10 dB return loss or better. The realized gain to broadside of our S-band annular ring is relatively flat between 6.5 dB and 7.5 dB over the bandwidth. There is more significant variation in the realized gain at broadside of the combination X-band patch/annular slot, between 3.5 dB and 6.0 dB. We believe this is due to a phase progression at the coupled aperture as frequency increases. We will present the design process and results of our broadband, dual-band, and dual polarization antenna as well as discuss methods to account for the phase shift originally seen at the coupled aperture.

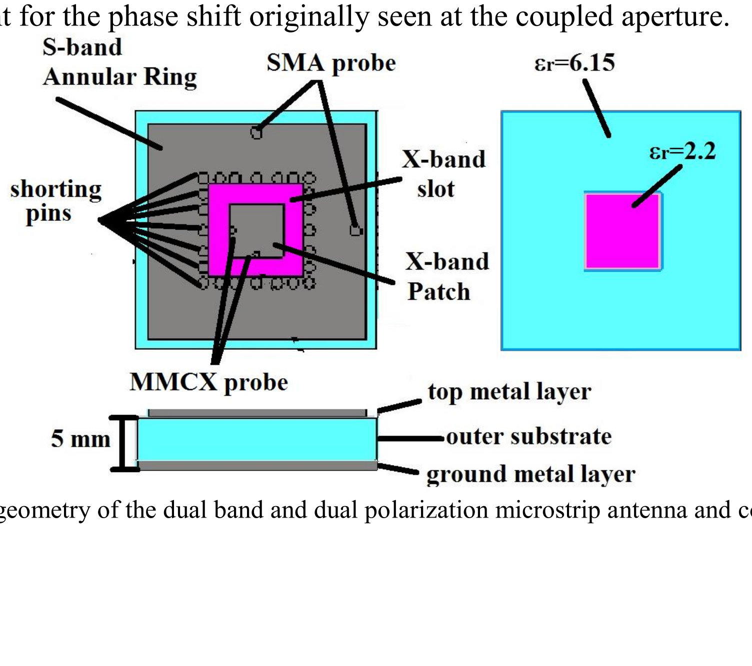

Figure 1. Labeled geometry of the dual band and dual polarization microstrip antenna and concentric substrate