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Dual polarized stacked microstrip patch antenna for channel measurements

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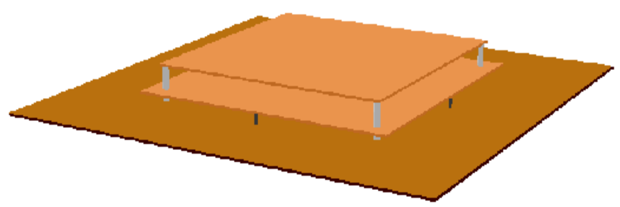
Abstract - A dual half-wave patch antenna for channel measurements is being developed. The polarization isolation and bandwidth are suitable for an antenna array in channel sounding.

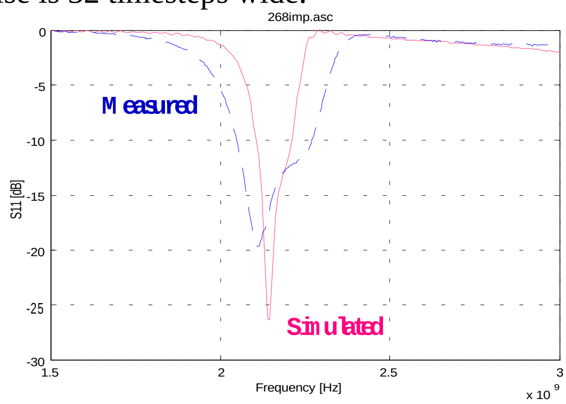
The antenna is designed for the 2154 MHz center frequency and for ±50 MHz 10dB bandwidth ($L_{ret} \geq$ 10dB). The polarization isolation is planned to be comparable with other antennas designed for good polarization isolation [1] where cross-polar levels are 20 dB down within the -3 dB beamwidth and [2] where it is always better that -17dB of the maximum co-polarized value of the antenna.

Dimensions of the antenna: lower patch 60x60 mm, upper patch 54x54 mm (the simulated one was 56x56 mm). Probe feed. Matching capacitor 1pF. The ground plate is 100x100 mm. the antenna is made of 0.5mm thick copper plate. Lower patch is 2 mm above the ground plate and the upper patch is 5 mm above the upper plate or 7 mm above ground plate.

The simulations were done using a commercial FDTD simulator. The material is perfect electric conductor, and the feed is the bottom part of the probe. Grid is 120x120x50 of 1mm cells, 10 000 iteration times and the Gaussian pulse is 32 timesteps wide.



Antenna structure: capacitors black, supports white



Return loss

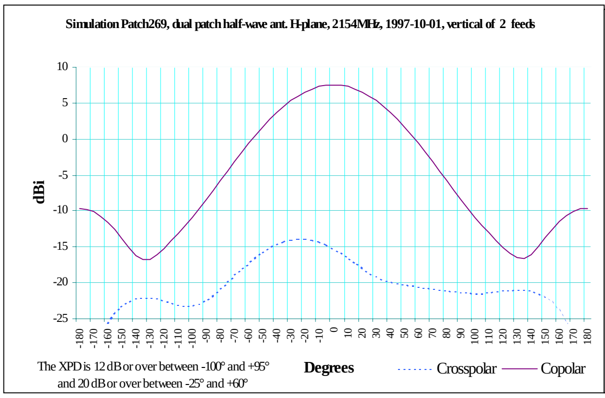
The bandwidth is better in the real antenna, possibly caused by manufacturing tolerances. The simulated maximum L_{ret} = -26 dB and the measured maximum L_{ret} = -19 dB.

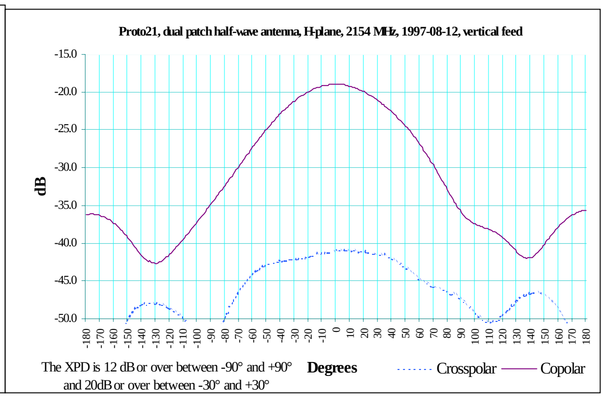
The measured isolation between ports is -21 dB and the simulated is -21 dB. In [2] the isolation is -30 dB. When testing various designs it showed that when the return loss becomes higher, the isolation between the ports increases. It means that improving the return loss by design increases the radiated power only. Therefore there return loss at the central frequency should be maximized in order to reach the maximum isolation between the ports.

The mutual coupling is -24 dB in worst case which is tolerable.

Simulated *Impedance on Smith chart* Measured

The dual resonances are similar, but the measured one has some delay included.





Simulated *Radiation pattern, not normalized yet* Measured

H-plane is more critical, so it is displayed here. The real antenna is better than the simulated.

The simulations and the measurements of the prototype show reasonably good agreement, (5% tolerance for the upper plate dimension), which corresponds the height tolerance of the lower patch (0.1mm). It means that the FDTD method is a useful design tool in this context.

The capacitor in the feed at the edge of the lower plate seems to improve the radiation pattern possibly because in resonance it cancels the radiation of the probe. However, it also seems to be mechanically fragile. An effort to modify the design so that the double resonance gives a good bandwidth without the matching capacitor is under way. The preliminary measurements indicate that the size of the ground plate and therefore probably also the neighboring elements in an array significantly affect the double resonance, so further research is needed.

REFERENCES

[1] I.Nyström, D.Karlsson, "Reduction of back radiation and cross-coupling in dual polarized aperture coupled patch antennas", *Proceedings of IEEE Antennas and Propagation Society International Symposium 1997*, Montreal, Canada, July 13-18 1997, pp. 2222-2225

[2] G.Parker, Y.M.M.Antar, "A dual polarized microstrip ring antenna with good isolation", *Proceedings of IEEE Antennas and Propagation Society International Symposium 1997*, Montreal, Canada, July 13-18 1997, pp. 928-931