Master-Thesis

Topic:. Broadband Feeding Technologies for Tapered Slot Antennas

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Objective:

Prototyping of a planar tapered slot antenna system. Special emphasize was put on the broadband characteristic, the feed and especially to the transition between the antenna and the feed. The frequency range is set from 3 GHz to 10 GHz. The System is manufactured on a printed circuit board (ε_r = 2.2).

It is optimized towards a linear S(1,1) a low cross polarization and 50 Ω input impedance

Theory:

A theoretical observation of different permittivity substrates, planar transmission structures (such as microstrips, slotlines, coplanar waveguides (CPW) and coplanar strips (CPS)) utilizing and comparing known calculation models was performed. Additional different types of tapered slot antennas and transitions were investigated. This investigation lead to two different applicable principles for the transitions, namely magnetic coupling and or phase interference. The observation of the planar transmission structures characteristic impedances suggests to use either microstrip or coplanar waveguides as primary transmission structure and slotline as secondary.

Simulation:

The simulations were mainly computed with CST microwave studio. In a first step the planar transmission line structures dimensions gained from the theoretical considerations were optimized. Then different promising single transitions were simulated and optimized towards best S(1,1), characteristic impedance and the different available substrates. The final simulations were performed to optimize the entire tapered slot antenna system to find a suitable substrate. The final design was exported and sent to a manufacturer. Its dimensions are: width 81.2mm, length 66.8mm, thickness 0.787mm, copper coating 0.017mm. The exponential tapered slot antenna system is fabricated on a Rogers RT/duroid 5880 Substrate. The constants for the exponential taper are: length 1.5 λ_S(6.5[GHz]), exponential factor r = 0.125.

Measurement:

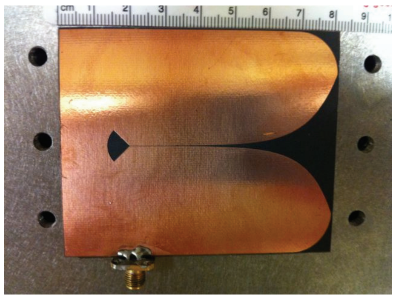
The entire system was measured in the anechoic chamber. The measured characteristics are the reflection parameter S(1,1), the characteristic impedance and the far-field patterns. After post processing the measurement data, one was able to observe a certain match between the simulation and the measurement although the connector and its soldered connection was found to have a major influence on the entire measured system.

Conclusion:

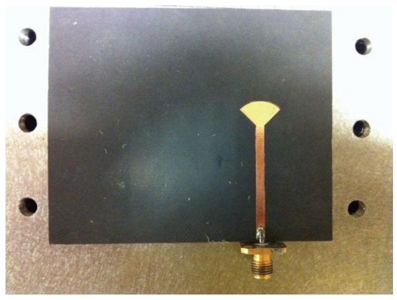
A tapered slot antenna system, which meets the requirements stated above was designed and measured.

It has been shown that it is possible to design a broadband transition for a uni planar tapered slot antenna. Although an antipodal design for transition is used, sufficiently suppressed cross polarization characteristics have been obtained. The simulation of the antenna shows sufficient gain values and directivity considering the wide 7 GHz bandwidth.

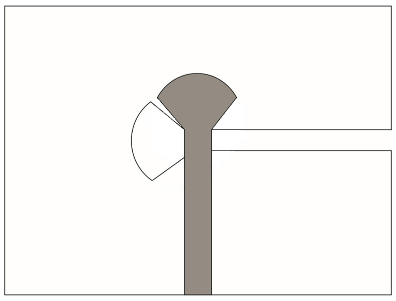
Also it was possible to find a good trade off between the different required optimal permittivity for the transition and the radiation of the antenna taper.



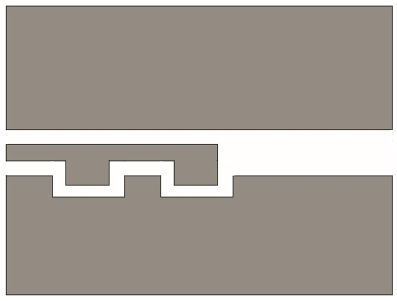
Final system, top view



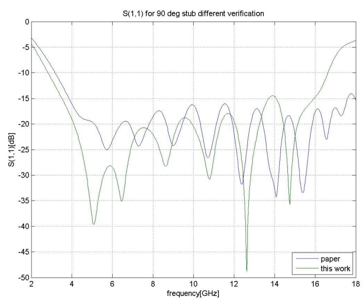
Final system, bottom view



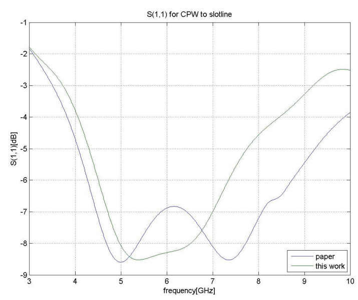
microstrip to slotline,
magnetic coupling



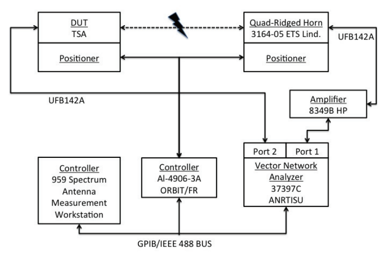
CPW to slotline,
phase interference



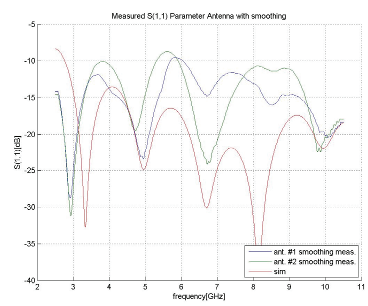
microstrip to slotline simulation,
S(1,1)



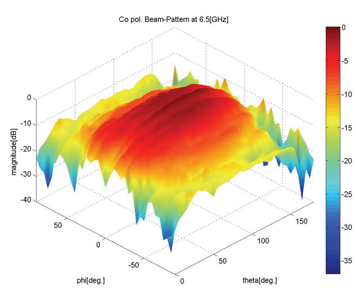
CPW to slotline simulation,
S(1,1)



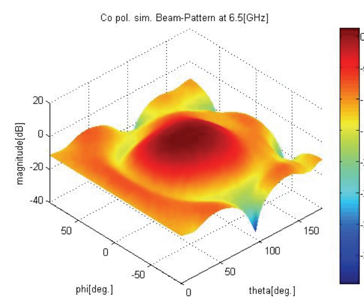
measurement setup



comparison measurement and
Simulation, S(1,1)



Co pol 6.5[GHz] measurement data



Co pol 6.5[GHz] simulation data