Design of 2x2 microstrip patch antenna array fed by SIW for 24 GHz radar application

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Presentation outline

- Motivation
- Topology of the feeding network
- Parts of the feeding network
- Antenna array configuration
- Experimental results
- Work in progress
- Conclusion

Motivation

- MPA+SIW
- Array of 2x2 patches
- Radar application at 24 GHz

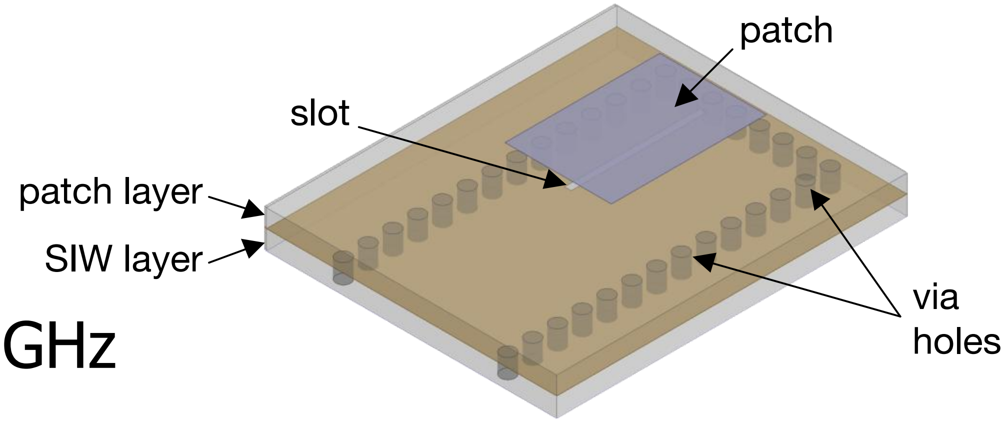


Fig. 1: Single antenna configuration.

- The antenna consists of two dielectric layers:
  - SIW layer, Patch layer
- BW = 7.7 %, G = 8 dBi

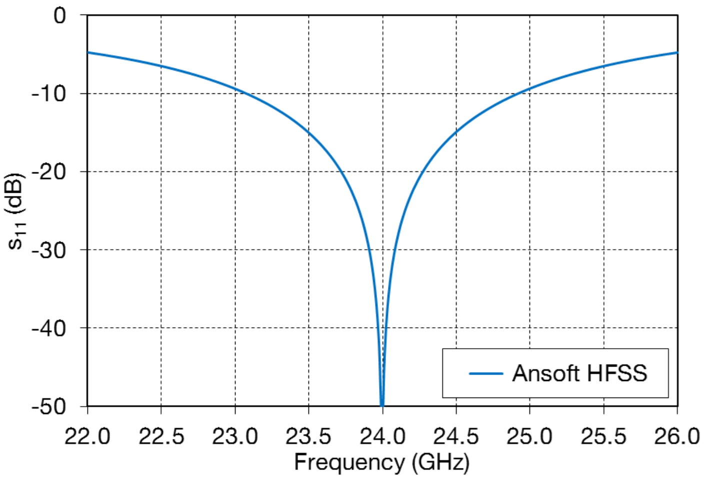


Fig. 2: Reflection coefficient of single antenna.

T. Mikulasek, J. Lacik. "Microstrip Patch Antenna Fed by Substrate Integrated Waveguide", in *Proceedings of the International Conference on Electromagnetics in Advanced Applications ICEAA*. 2011, p. 1209–1212.

Topology of the feeding network

- Common feeding network topology

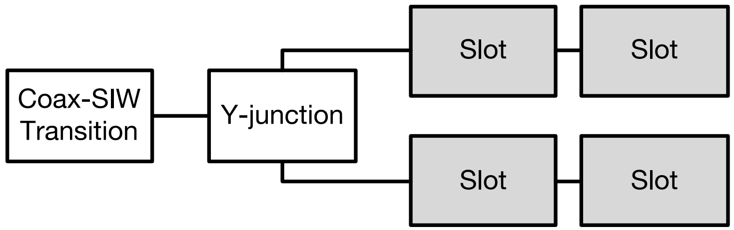


Fig. 3: Topology of waveguide slot antenna array.

- Our approach

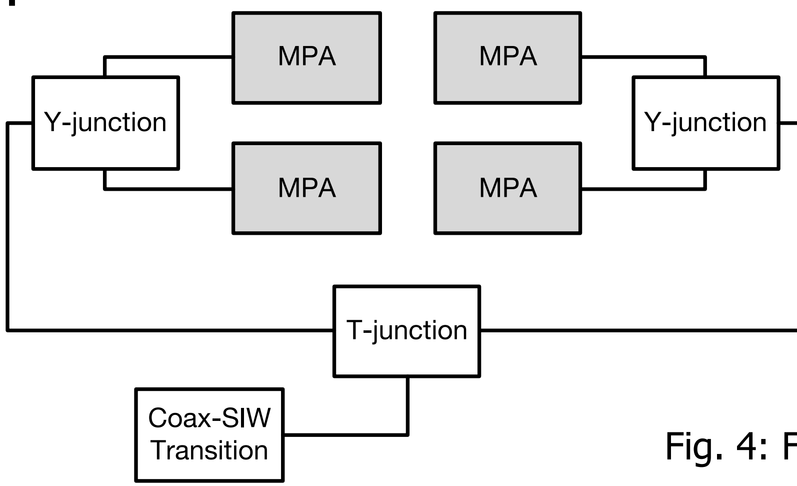
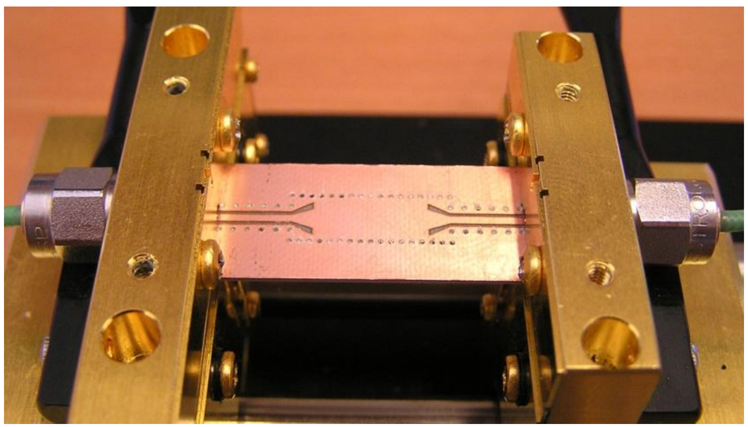


Fig. 4: Feeding network configuration.

Parts of the feeding network (1/4)

- Coax-GCPW-SIW transition
  - Back-to-back configuration
  - Measurement on the test fixture

P1  P2

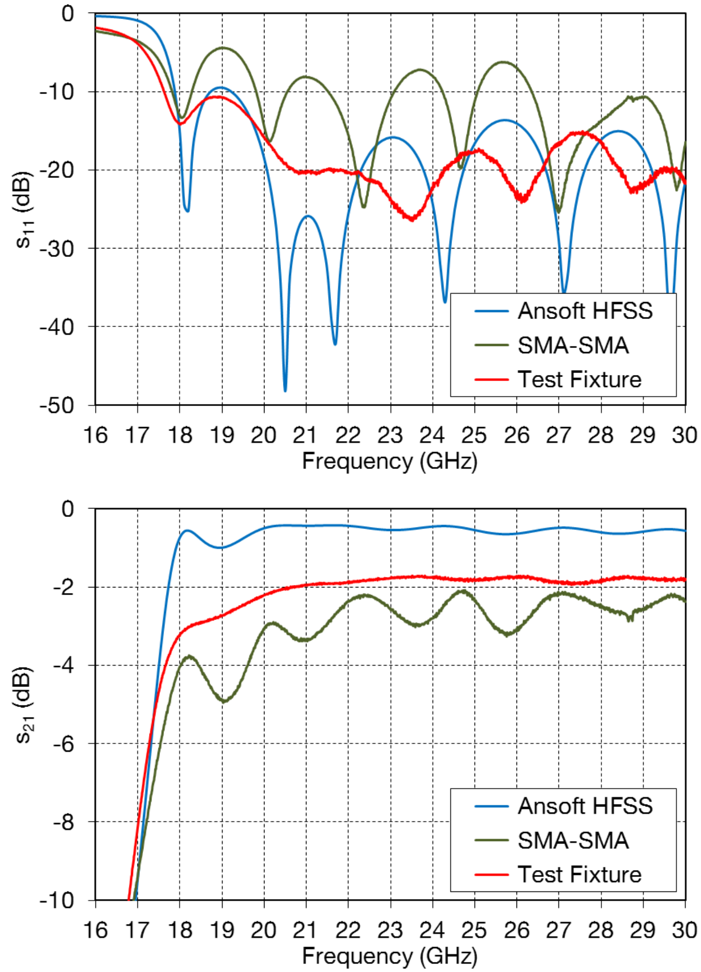


Fig. 6: S-parameters of coax-GCPW-SIW transition.

Parts of the feeding network (2/4)

- T-junction power divider
  - $s_{11} < -31$ dB (23–25 GHz)

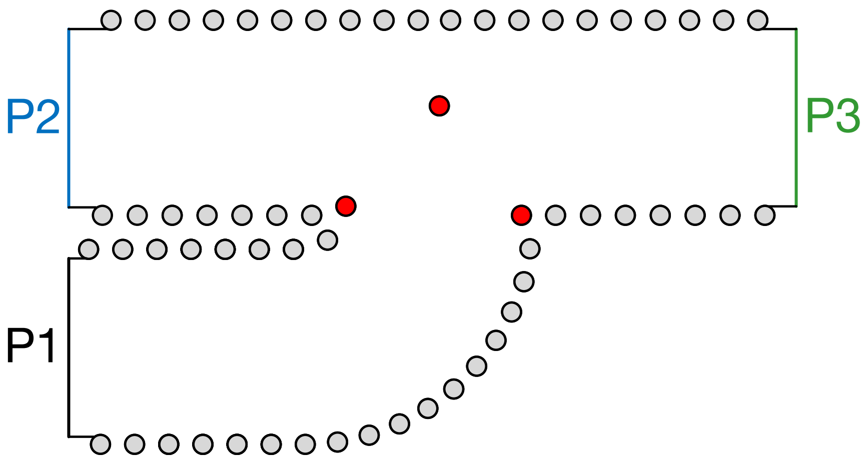


Fig. 7: T-junction power divider.

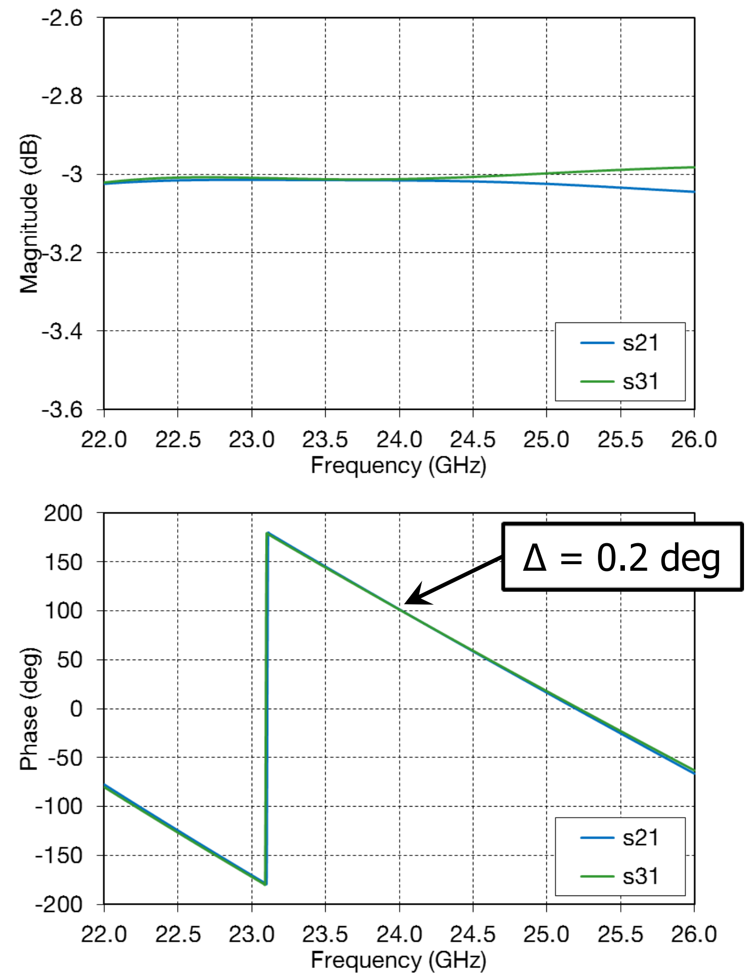


Fig. 8: S-parameters of T-junction power divider.

Parts of the feeding network (3/4)

- Y-junction power divider
  - $s_{11} < -29$ dB (23–25 GHz)

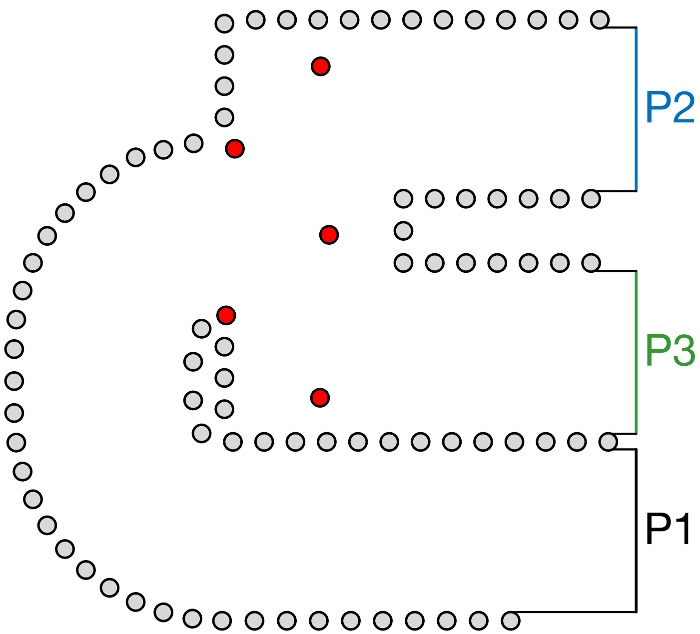


Fig. 9: Y-junction power divider.

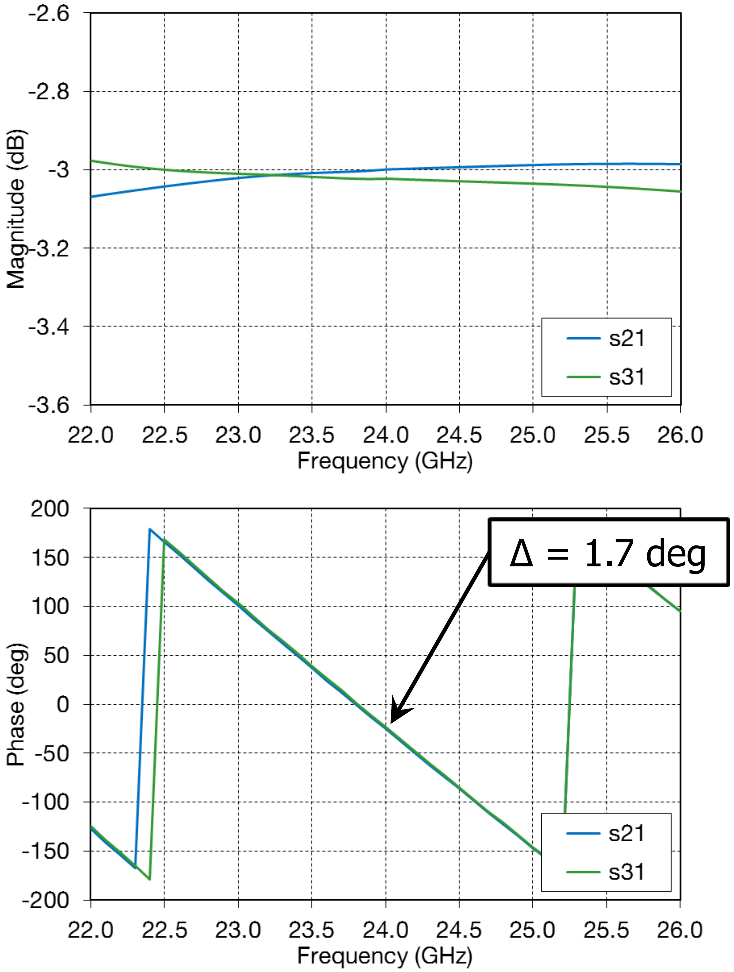


Fig. 10: S-parameters of Y-junction power divider.

Parts of the feeding network (4/4)

- Feeding network:
  - $s_{11} < -18$ dB (23–25 GHz)

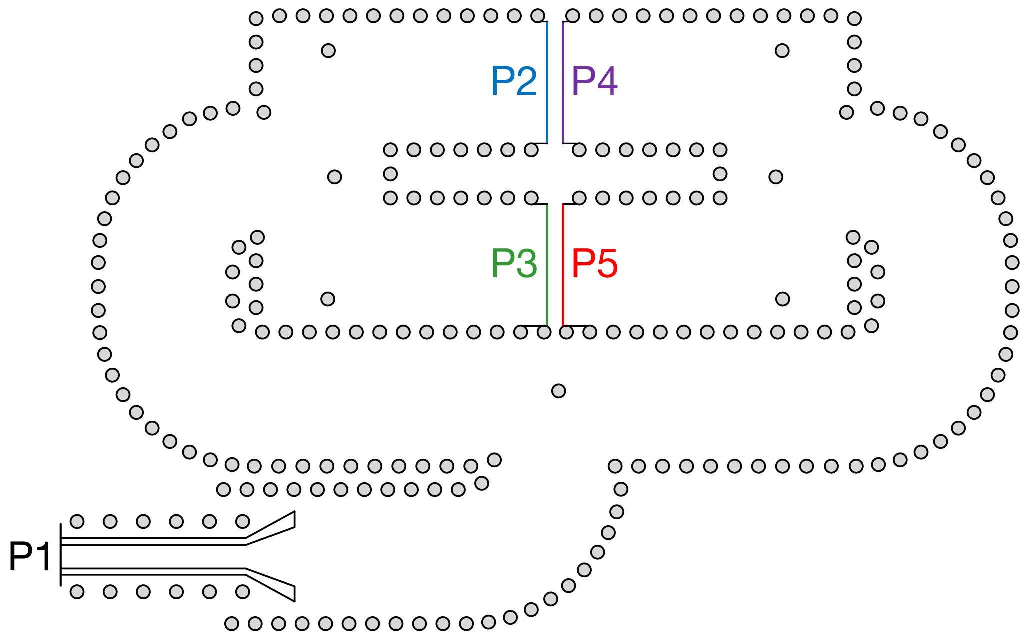


Fig. 11: Feeding network.

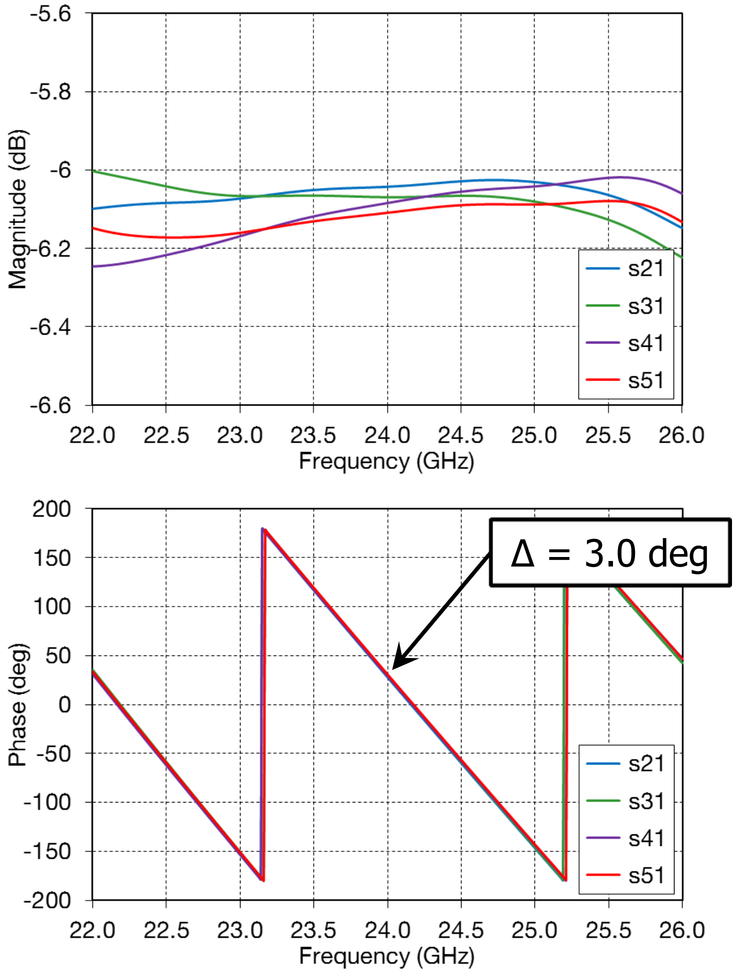


Fig. 12: S-parameters of feeding network.

Antenna array configuration

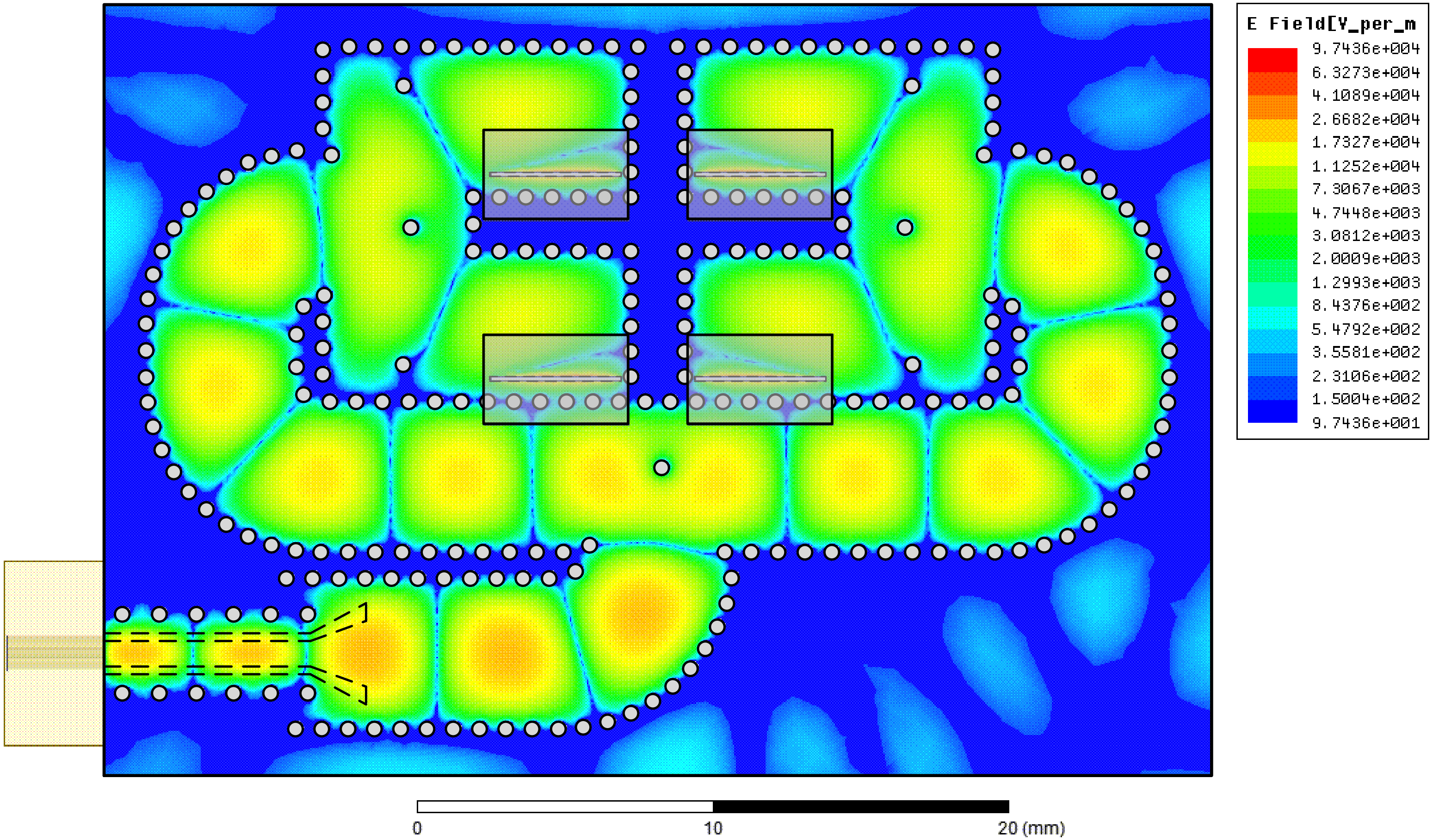


Fig. 13: Antenna array configuration.

Experimental results

- Impedance bandwidth = 14.9 %
- Higher dielectric losses

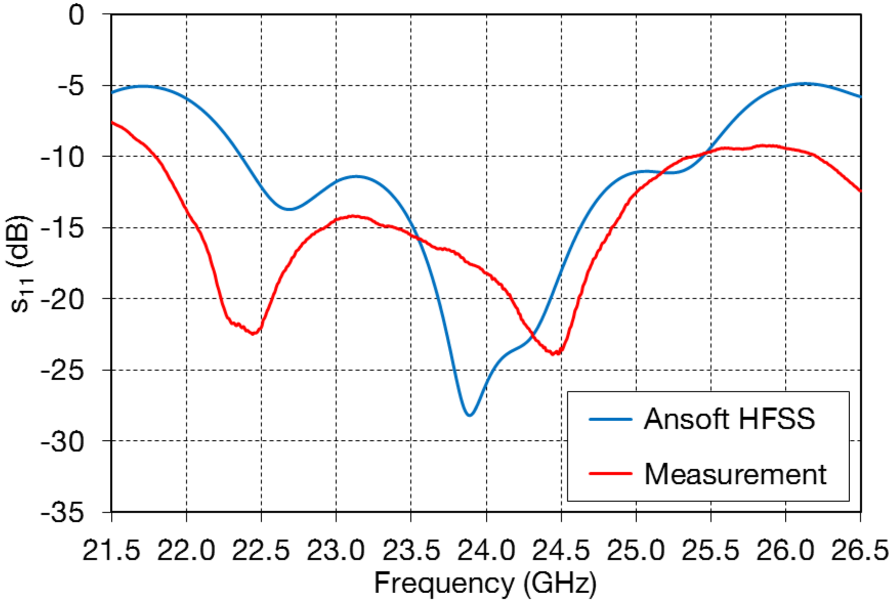
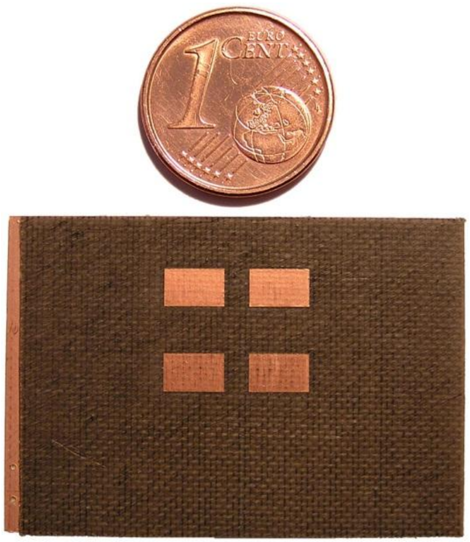
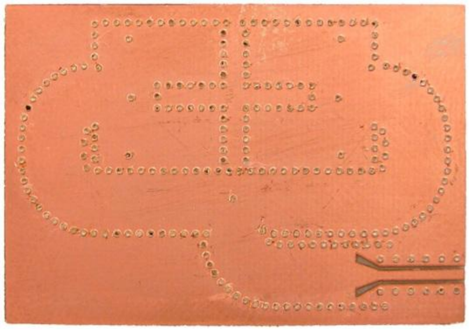


Fig. 14: Reflection coefficient of antenna array.



(a) Top view



(b) Bottom view

Fig. 15: Prototype of antenna array.

Radiation patterns

- Simulated gain = 11.8 dBi
- Measured gain = 7.3 dBi

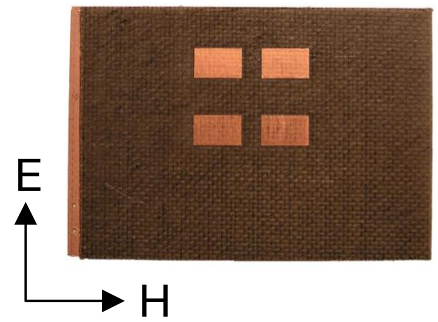
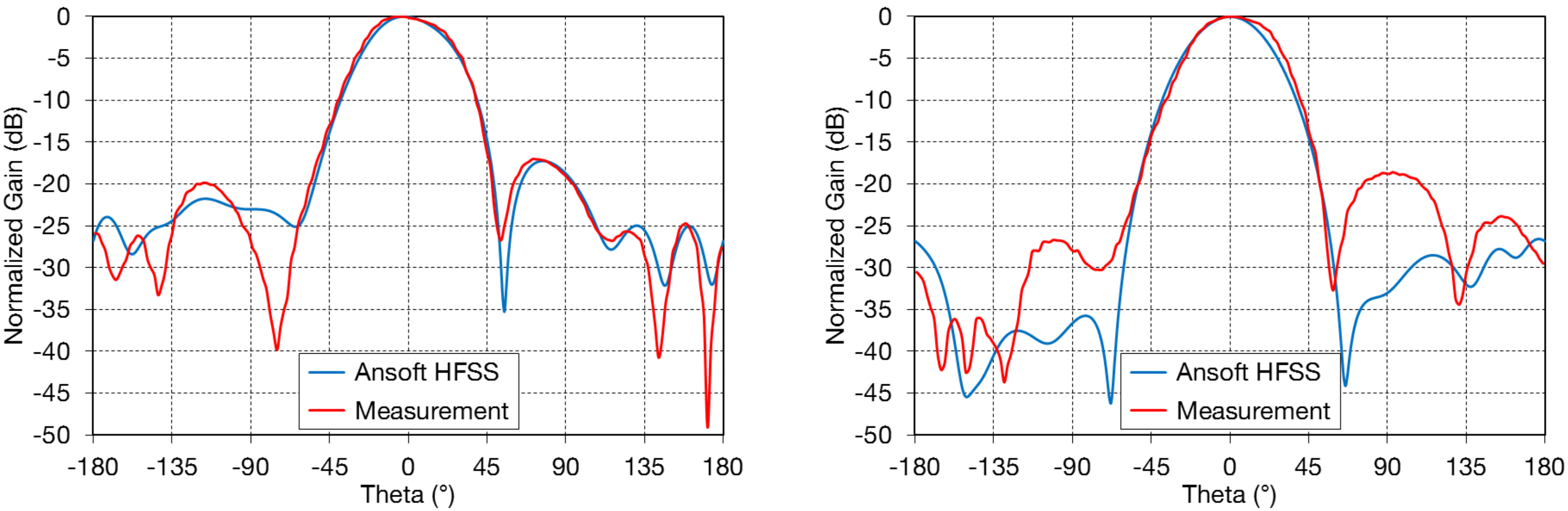


Fig. 16: Measured planes of antenna array.



(a) E-plane (b) H-plane

Fig. 17: Radiation patterns of antenna array.

Work in progress

- 2.92 mm connector

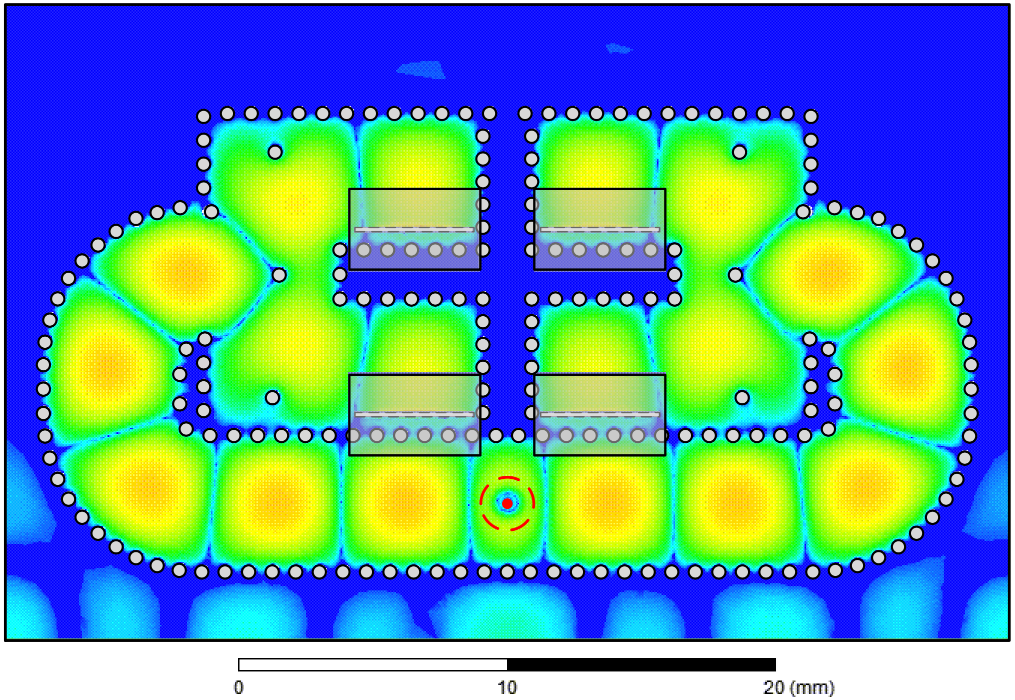


Fig. 18: Antenna array configuration.

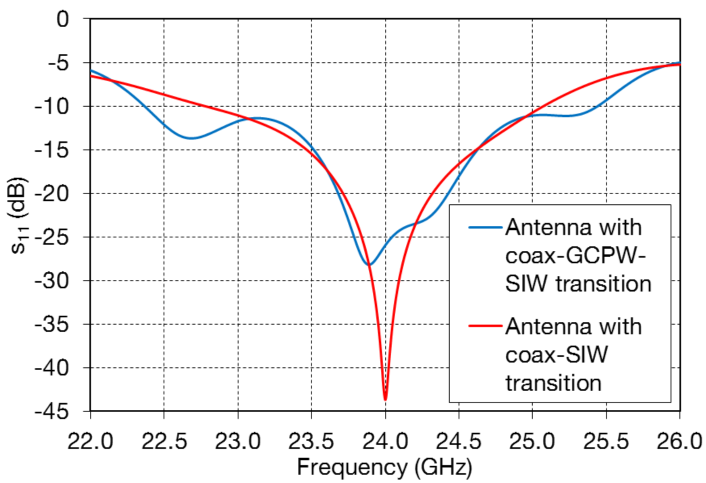


Fig. 19: S-parameters of antenna models.

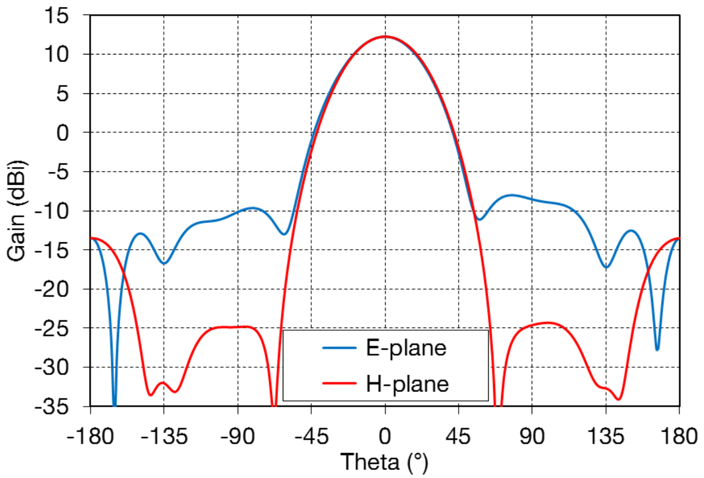


Fig. 20: Radiation patterns of antenna with coax-SIW transition.

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Conclusion

- The configuration of the designed antenna array and its simulated and measured results were presented.
- The measured impedance bandwidth of the fabricated antenna array is wider due to higher dielectric losses in the dielectic substrates.
- Good agreement of the simulated and measured radiation patterns is obtained.

- Fabrication of the improved antenna array and its validation by the measurements.

Acknowledgements

Thank you for your attention

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