Membrane Integrated Asymmetric Dual E-plane Probe Ortho Mode Transducer at 424 GHz

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Abstract—We present a practical low loss GaAs membrane integrated ortho mode transducer (OMT) at 424 GHz composed of two orthogonal open ended E-plane probes in a circular waveguide. The proposed structure is suitable for building compact dual polarisation receivers in the lower THz range (~100 GHz – 1 THz) and is readily integrated directly to the first receiver element, in this case a subharmonic GaAs Schottky diode mixer, without any additional penalty in terms of loss or manufacturability.

A 3-port OMT split block aluminium module, with rectangular WR-2.2 waveguide interfaces for the separated V/H polarisations and 375 μm diameter circular waveguide for the common V/H port has been designed and fabricated. The simulated nominal response of the membrane OMT reaches X-pol levels below 20 dB over 10% bandwidth with a worst case insertion loss of 0.3 dB. The simulated inter probe leakage (isolation) and circular waveguide reflected X-pol levels where around 20 dB. For the particular OMT test additional E-plane probe transitions were integrated on-chip to be able to couple the separated V/H polarisations to the rectangular waveguide test ports.

Measurements on two circular waveguide interconnected back to back OMT modules using VDI WM-570 (WR-2.2) VNAX frequency extenders, show X-pol and isolation levels below 10 dB and return loss levels below 15 dB including effects of standing waves. Translated to a single OMT transition this corresponds to a X-pol and isolation of about 15 dB. The loss of a single OMT probe transition including the membrane circuit and circular waveguide loss was estimated to about 0.2 dB. The results look promising and the next step will be to test the integrated OMT concept in a 424.7 GHz dual polarization receiver currently being pre-developed by Omnisys Instruments AB for the ISMAR instrument.