# P2B

# High Performance Frequency Selective Surfaces for Passive Radiometry

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***Abstract*— Two frequency selective surfaces (FSS), developed for spaceborne millimetre and sub-millimetre characterization of the Earth's atmosphere by passive radiometry, are described. Radiometry provides valuable information on the distribution and dynamics of molecules such as $H_2O$, $NO_2$ and $NO_2$, as well as information on atmospheric temperature and cloud water content. Given that radiometer's receivers usually share a common main antenna, FSS are critical frequency demultiplexing components and demands on their performance in terms of insertion loss and isolation of unwanted channels are stringent. The reported FSS have some common features: they have a very low insertion loss, operate for a range of angles of incidence around 45$^o$, have near-identical behaviour for both TE and TM incident polarizations, and their performance is accurately modelled using Ansoft HFSS or CST Microwave Studio. Both structures have also satisfactorily passed preliminary space qualification trials.**

**The first FSS, designed for a proposed millimetre wave meteorological instrument, operates in low pass mode to separate a transmitted channel at (31.40± 0.09) GHz from a reflection band between 50.2 and 55.7 GHz. It comprises of rectangular patterns of 1.6 mm diameter copper rings produced by photolithography on both sides of a 1.575 mm thick PTFE/glass dielectric sheet. The FSS was designed and optimised using HFSS. The FSS transmission loss at 31.4 GHz was measured as 0.3 dB, whereas reflection loss in the band centred on 53 GHz was found to be 0.2 dB or less.**

**The second FSS, destined for a limb sounding radiometer, operates at sub-millimetre wavelengths to separate the signal and image bands of a double sideband mixer. The filter consists of two identical, 30 mm diameter, 12.5 µm thick, optically flat, freestanding perforated metal screens separated by 450 µm. Each of the ≈5000 micromachined unit cells contains two nested, short circuited, rectangular loop slots and a rectangular dipole slot. Careful optimisation of the shapes of these elements, plus the interactions between the adjacent screens, allows nearly coincident spectral responses to be obtained for both polarisations. The FSS transmission was measured using an ABmm vector network analyser and a quasi-optical test bench. The insertion loss over the transmitted 316.5 - 325.5 GHz signal band was 0.6 dB or less: rejection ≥ 30 dB was achieved in the 349.5 - 358.5 GHz image band. Results are in excellent agreement with the CST predictions. Such a dual polarisation performance, with a band edge frequency ratio of 1.07, has not previously been reported.**