A Full Octave-Band OMT for Millimetre-Wave Receivers

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There is a desire for an increased signal bandwidth within millimetre-wave receivers used in radio astronomy—beyond the single-mode range of rectangular waveguide. One approach is to combine more circuitry using MMICs, as wideband components can be designed using strip transmission lines. Ridged waveguides may also be used to extend the single-mode bandwidth.

In contrast to MMIC receivers, waveguide components are bulkier, but do allow for receiver architectures to be broken up into individual blocks rather than a fully integrated chip.

As a step towards a complete ridged waveguide receiver architecture (e.g., sideband-separating), a turnstile OMT using ridged waveguide is shown in Fig. 1, employing a T-junction combiner, E-bends, and a turnstile junction. The design assumes a platelet-type layout using 6 stacked pieces. Platelet assemblies are suitable for receiver array configurations and are compatible with 2.5-D manufacturing techniques spanning up to THz frequencies.

Here, it is assumed that the OMT will be directly milled and a minimum filleting radius was chosen as 0.8 mm (~0.133×free-space wavelength of the highest frequency). A cloverleaf shape results for the feed horn port, derived from a quad-ridge guide with filleted edges. Simulated performance is shown across 25–50 GHz in Fig. 2, and it is expected that the machined prototype (with transition) will demonstrate 15 dB return loss and 35 dB cross-polarisation separation.

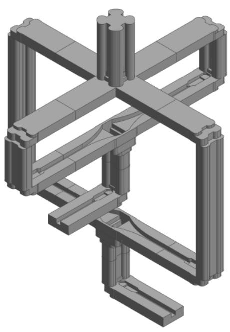

Fig. 1. CAD model of a turnstile OMT using ridged waveguide.

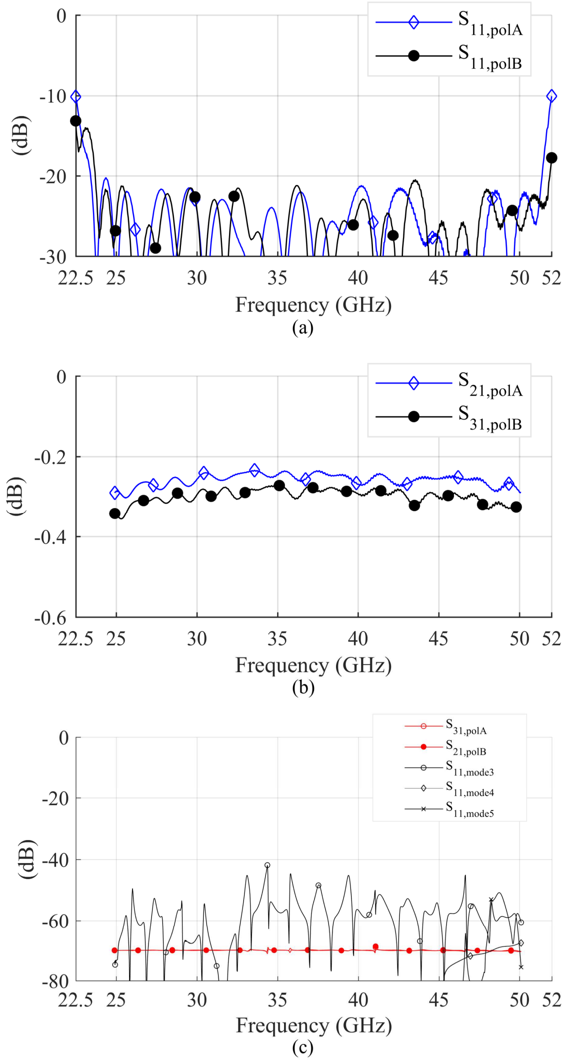

Fig. 2. Simulated performance of a ridged waveguide turnstile OMT: (a) reflected power; (b) insertion gain using a surface conductivity of 1.5E7 S/m; and (c) cross-pol and higher-order reflected modes.

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