6.3.6 The Plane Surface Wave Simulator Cell

A plane surface wave simulator cell (Fig. 6.4) has been designed to measure the complex phase constant of a fundamental E-mode plane surface wave mode at X-band frequencies. The experimental system can be used to measure materials up to approximately 8mm in thickness. A sample of the material under test is placed on the floor of the test cell over its entire length, 800mm for this design. The first section of the test cell, ①, is a section of standard X-band waveguide. A coax to waveguide adaptor fits to the input of the test cell. Along the length of section ①, the sample is tapered in the H-plane to provide a matched transition between the empty and partially filled waveguide sections. The transition converts the fundamental empty waveguide mode TE_{10} into a fundamental (n=1) partially filled waveguide mode. After this transition, the waveguide height is increased to 34.04mm via a taper (section ②) on the upper horizontal wall of the waveguide. A taper from 10.16mm to 34.04 mm (the height of a WG10 S-band waveguide) is quite common in industry and will not convert a lot of fundamental mode energy into higher order modes. Section ③ will support the fundamental partially filled waveguide mode that resembles the plane surface wave. At the furthest end, the test cell is terminated with a short circuit ④. The test cell can be opened at the top. This makes fastening the test material a lot easier. However, this also implies that the waveguide has to be cut along its length. The cut is parallel with the H-plane and located in a corner of the waveguide as field intensities are at their lowest there. Also, the wall thickness of the waveguide is an odd multiple of the trapping distance of a standard WG16 X-band waveguide flange. The screws are positioned at an even multiple of this distance. Detailed engineering drawings are included at the end of this section.

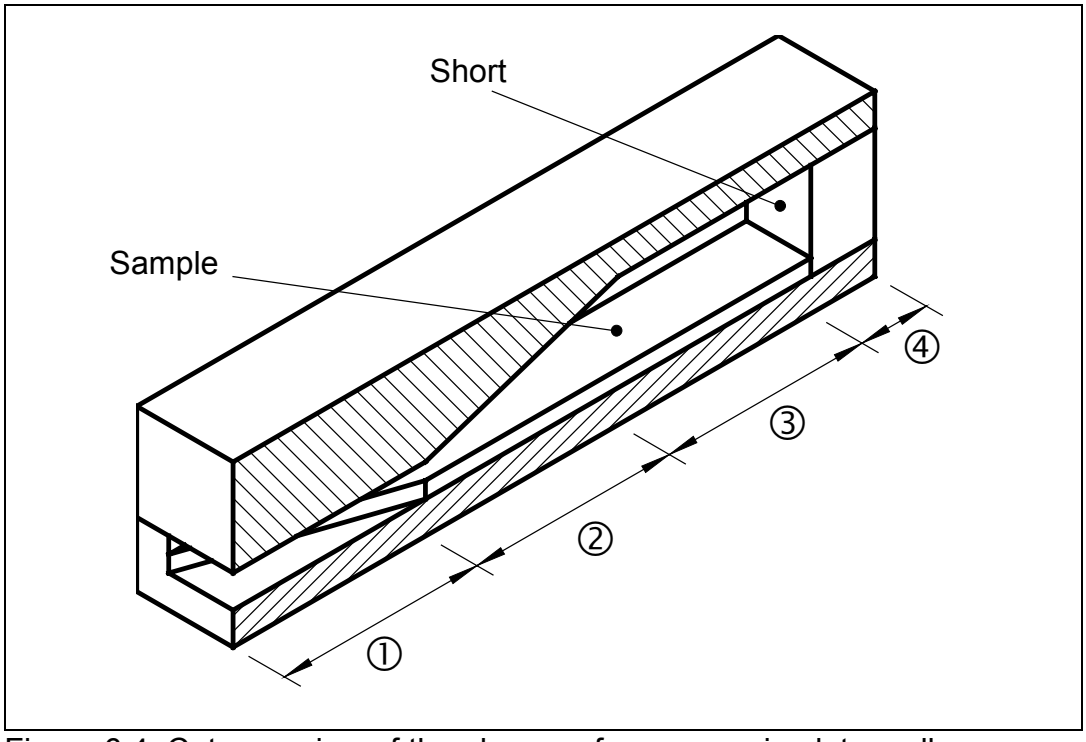

Figure 6.4: Cutaway view of the plane surface wave simulator cell (not to scale)