

A BROADBAND SPECTROSCOPIC SENSOR PROBE

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Abstract- The electrical properties of many materials are closely related to their composition and to their moisture content in particular. For sensor development, characterising the response of a particular volume of material over a broad frequency range is desirable, since separate measurements could generate errors due to spatial variability. A coaxial probe has been designed for measurement of the permittivity of smooth and flat, solid or liquid samples over the frequency range from 1 Hz to 6 GHz. Although the probe is capable of a very wide frequency range, separate instruments are generally required, and here we focus on measurements above 1MHz. We demonstrate measurements in the frequency domain using a vector network analyser, and in the time domain using a broadband oscilloscope. For switching, we employed a coaxial switch and demonstrate how that is included within the instrument calibration. Calibration of the probe used three references: an open circuit, short circuit (indium foil) and a reference liquid, ideally chosen for a permittivity similar to that of the sample. The sample complex permittivity was calculated by a numerical model which used as inputs, the measured reflection coefficient and physical measurements of the probe geometry.