# On the Microstrip Characterization of Artificial Magneto-dielectric Structures

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Wideband measurement methods are needed for extracting effective material parameters of artificially engineered composite materials to enable further development and optimization of these materials. It is obvious that resonator based measurement techniques fail to fulfill the ultimate goal of wideband characterization. Therefore, waveguide measurement methods become necessary. Depending on the characterized material sample, usually two basic guiding structures are utilized: small scatterers or homogeneous blocks of material can be measured using a parallel-plate waveguide or a (quasi-)TEM transmission line, usually a normal microstrip line. Building a parallel-plate waveguide operating at low frequencies (1–3 GHz) is practically difficult, thus, we propose to use a microstrip line. In this presentation we demonstrate an experimental characterization process targeted to extract the material parameters of a uniaxial artificial magneto-dielectric sample with resonant properties. We extract the parameters from measured S-parameters of loaded and empty microstrip line. It is shown that the proposed technique is suitable for characterizing the properties of the material over a rather wide frequency range excluding the thickness resonance bands. We use the comparison of S-parameters of the material block under test and a reference block with known permittivity and no magnetic properties. The novelty of our work is related with modifications of the known characterization methods. These modifications are required when the following three factors simultaneously disturb the characterization procedure:

1. The network analyzer cannot be calibrated with respect to the actual input ports but with respect to the cable connectors, because the properties of two cable connectors and therefore the electric distance between the calibration point and the input ports is unknown.

2. The wavelength in the empty waveguide is not exactly equal to that of free space, and we do not know the possible error.

3. The reference dielectric block with known material parameters (that is used in the proposed comparative method) does not fill the effective cross section of the microstrip line completely.