

Abstract

Soil Dielectric-Spectrum Characterization Based on One-Port VNA Measurement System [†]

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The output of soil moisture and salinity dielectric sensors may significantly depend on soil texture and mineralogy. Therefore, reliable characterization of broadband complex dielectric permittivity (CDP) spectra of soils is of practical importance for improvement of moisture and salinity measurement methods. However, CDP spectra determination of highly heterogeneous materials is problematic in terms of measurement system construction and calibration, especially in the microwave frequency range.

We present a new CDP spectrum determination method which is solely based on one-port vector-network-analyzer (VNA) measurements in the 1 MHz–3 GHz frequency range. The sample was placed in a 1 5/8" coaxial measurement cell. A two-step calibration procedure based on the Bauer-Penfield one-port calibration method [1] was applied in order to obtain scattering parameters of the cell solely from one-port measurements. Next, the CDP spectrum was determined based on classical Nicholson-Ross-Weir algorithms. Comparison with direct two-port VNA measurements shows that our method is more repeatable since the movement of measurement cables is avoided. Another advantage of the presented method is lower cost of the measurement system.

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Reference

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