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Electrical Characterization of Material Thickness Based on Free Space Method Using Patch Antennas

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Abstract

This paper investigates electrical characterization (such as permittivity and permeability) of materials using the free space method . The technique employs a simulation design using full wave software CST consisted of two slotted patch antennas at 2.4 GHz and a slab of FR4 that has been placed in between of the antennas . The S parameters (S11 and S21) were extracted from simulation and the electrical characteristics of FR4 were calculated using Nicolson-Ross-Weir (NRW) and Smith methods. It comes to the knowledge that the NRW technique has limitation in terms of material thickness which affects the value of permittivity and permeability of materials. Thus, a comparison has been made between these two methods by varying the material thickness of FR4 versus its permittivity and permeability. The thickness was varied from 5mm to 60mm. It was observed that these two techniques produce similar values of permittivity and permeability when the thickness has been varied up to 50 mm but differs when it was greater than 50 mm. On top of that, this paper also investigates the slotted patch antenna as a potential of RF sensor to investigate the unknown materials at 2.4 GHz. © 2020 IEEE.

Author keywords

Nicolson- Ross-Weir (NRW); permeability; permittivity; RF sensor; slotted patch antenna

### Engineering controlled terms

Computer software; Mechanical permeability; Microwave antennas; Permittivity; Permittivity measurement; Scattering parameters; Slot antennas

### Engineering uncontrolled terms

Electrical characteristic; Electrical characterization; Free space methods; Full waves; Material thickness; Rf sensors; Simulation Design

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