

# Abstract

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Rectangular waveguide discontinuity analyses using the higher-order method of moments (MoM) are presented in this thesis. The discontinuities considered are of two types – rectangular windows in the transverse plane and slots on waveguide walls radiating into another waveguide with its axis normal to the first (input) guide. For all the slot cases, two different terminations of the other end of the input waveguide – match and short – have been considered. The analysis is carried out by setting up the magnetic field integral equations (MFIE) by invoking the equivalence principle. The magnetic field scattered by the aperture into the window and slot regions is derived using the rectangular cavity dyadic Green's function, those into the shorted input and output guide are expressed using the semi-infinite waveguide dyadic Green's function and, finally, the ones into the matched input guide are represented using the infinite waveguide dyadic Green's function. Higher order hierarchical Legendre basis functions are used to express the unknown magnetic current densities at the apertures. The MFIEs are solved using the MoM with Galerkin's specialization. The analysis of a rectangular window is then extended to estimate the complex permittivity of low loss dielectric solids iteratively with the help of Newton-Raphson technique. The complex permittivity of teflon and plexiglas are estimated using this technique and compared with HP-technique based on Nicolson-Ross technique. A five-pole Ku-band waveguide bandpass filter realized using thick inductive windows is also analyzed and compared with the measured and simulated result. For the slot on the waveguide wall cases, the problems considered are: broadwall transverse slot, broadwall longitudinal slot, narrow wall longitudinal slot, and broadwall longitudinal slot doublets. Analysis results of all these cases are compared with the measured and simulated data. All the analyses results match very well with the measured and simulated results.

**Keywords:** broadwall longitudinal slot, broadwall transverse slot, complex permittivity, Galerkin's technique, Green's function, higher-order bases, Legendre polynomial, longitudinal slot doublet, magnetic field integral equation (MFIE), method of moments (MoM), Newton-Raphson method, Nicolson-Ross technique, narrow wall longitudinal slot, waveguide bandpass filter, waveguide diaphragm.