Abstracts

A new theory of the characteristic impedance of general printed transmission lines applicable when power leakage exists

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Conventional definitions of the characteristic impedance, such as the voltage-current, power-current, and power-voltage methods, which have been commonly used for standard nonleaky transmission lines, become invalid when power leakage occurs. In this paper, we present a new theory of the characteristic impedance for printed transmission lines, applicable under the general conditions with or without power leakage. The theory is founded on dual field and circuit theories of transmission lines, formulated in the spectral domain, and uses a new approach called "the wavenumber perturbation approach." In order to correctly compute the complex characteristic impedance under leakage conditions, the new theory requires to carefully "extract out" the surface-wave or parallel plate-wave poles on the complex k-plane. In obvious difference to this, it is well known that the poles must be "included" for a correct solution of the complex propagation constant of the leaky line. Incidentally, unlike the conventional methods, the new theory derives the complex characteristic impedance together with the solution of the phase and attenuation constants, in a single unified procedure. This avoids additional efforts in computational or analytical/formulational complexity. Results for selected cases of interest are presented, which demonstrate the validity and simplicity/elegance of the new theory.

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