Abstracts

Three-Dimensional Analysis of a Through Hole with Radiation Characteristics by the Spatial Network Method

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In recent electronic devices, a through hole has heen used for mutual connections between layers of printed circuit boards, multi-layer wirings on the silicon surface of LSI, and external connections of IC packages. With recent uses of through holes in superminiaturized systems for super-high-frequency waves and ultra-high-speed pulse waves, the influences of the holes not only on the propagation characteristics of the lines but also on the properties of other elements are becoming more pronounced. Therefore to understand the characteristics of the total system, analyses of the electromagnetic field as affected by through holes become indispensable. It is especially necessary to consider the radiation characteristics from a through hole since the radiation affects other lines and devices. However through holes generate complicated distributions of electromagnetic fields owing to their three-dimensional structures. It is necessary to perform rigorous vectorial analyses for three-dimensional fields by using all field components, boundary conditions, and properties of the medium. Hence we applied the spatial network method to this analysis. The method has many features for analysis of three-dimensional electromagnetic fields in the time domain. We have already simulated the basic field behavior of the through hole by this method. Such a time-dependent analysis of electromagnetic fields has shown its utility not only in clarifying the variation of the fields in time but also in providing information on the mechanisms by which the distributions of a field at the stationary state are brought about. In this paper, the radiation characteristics of the through hole are discussed. For the near field, the Poynting vector is important in knowing the field characteristics by the energy flow property. Therefore the variation of Poynting vector distributions near the through hole is simulated in the time domain. Finally, from the distribution of the electric field on the top plane of the through hole that contains the connected stripline and the land, the far-field patterns are computed by the Fourier transform. It is shown that the fundamental characteristics of the radiation from the through hole are thereby obtained.

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