TIME-DOMAIN COUPLING TO A DEVICE ON A PRINTED CIRCUIT BOARD INSIDE A CAVITY

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A time-domain electromagnetic pulse that impinges on a cavity (metallic enclosure) with an aperture may cause significant interference for a device on a printed circuit board (PCB) that is inside the cavity. The interference may be particularly large when an exterior cable or wire passes through the aperture and makes contact with a conducting trace on the PCB that leads to the device. If the interference is large enough an upset to the device may occur, and the device may even be damaged. Clearly, a calculation of the signal level at the input of the device due to an incident time-domain electromagnetic signal is an important problem.

This investigation focuses on calculating the signal level at the input port of the device on a PCB. The incident electromagnetic field is assumed to be a time-domain plane wave in the form of a pulse, and two pulse shapes are studied. One is a sinusoidal carrier modulated by a Gaussian envelope centered at time zero. The other is a damped sinusoid, i.e., a sinusoidal signal starting at time zero, which is modulated by a decaying exponential envelope.

The time-domain response at the input to the device is calculated by first determining the frequency-domain response for time-harmonic incident plane waves, and then using the Fourier transform. The frequency-domain response is obtained by using an efficient hybrid method, as discussed in (C. Lertsirimit, D. R. Jackson, D. R. Wilton, D. Erricolo, and D. H. Y. Yang, *IEEE AP-S Intl. Symp. Digest*, Monterey, CA, June, 2004).

Results show how different incident pulse characteristics produce different types of signals at the input to the device. The results can be explained by the nature of the frequency-domain cavity response.

The time-harmonic results from the hybrid method are validated by comparing with a rigorous moment-method solution. The time-domain results are validated by comparing with simple expressions based on the resonant frequencies and Q of the cavity.