Using the Antenna Equation to Describe Coupling into and Leakage from Imperfectly Shielded Enclosures

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There has long been a debate about how best to describe coupling into and radiation from imperfectly shielded enclosures. By this, we mean a box (usually metallic) with penetrations or seams, and with an internal port that is either driven (in transmission) or acts as a receiver port (in reception).

Various authors have a variety of ideas about how to describe the coupling into and radiation from such a box. However, there has never been a consistent method adopted by the EMC community. We propose here the simplest and cleanest formulation that seems possible.

Any such description must be equally meaningful in transmission and reception. It must also be consistent in the frequency and time domains. It must use equations that are as simple as possible. Finally, it should be valid for any type of internal port, including waveguide ports.

To address the problem, we note that this problem looks like an unintentional antenna. We therefore apply to the problem the newly developed antenna equation (E.G. Farr, "Characterizing Antennas in the Time and Frequency Domains," *IEEE Antennas and Propagation Magazine*, February 2018, pp. 106-110) and (E. G. Farr, "A Power Wave Theory of Antennas," *Forum for Electromagnetic Methods and Application Technologies* (online), Vol. 7, 2015, www.e-fermat.org). The antenna equation describes antenna performance in a manner that is both compact and elegant. It works in both the time and frequency domains, and in both transmission and reception. It provides the obvious way to standardize antenna characteristics in the time domain. It also adds a meaningful phase to antenna gain and radar cross section. Finally, it works well with waveguide ports.

By standardizing on this approach, we will establish a common language for describing shielded enclosure leakage.