Wire Antenna Attached to a Conducting Body and Coupled to an Enclosed Cavity

John C. Young and Chalmers M. Butler*
Holcombe Department of Electrical and Computer Engineering
336 Fluor Daniel EIB
Clemson University, Clemson, SC 29634-0915 USA
johny@ces.clemson.edu cbutler@eng.clemson.edu

In any evaluation of the immunity of a system containing sensitive electronic devices to deleterious effects caused by spurious signals, the characteristics of the offending signals at the inputs to the devices must be available. Often this signal originates from a source outside the system and couples into the system through an antenna. Ultimately it finds its way to the device via some path. A typical path may be along wires and cables, through enclosed regions, e.g., housings of components, and through apertures where one housing joins another. The influence of transmission paths on the shapes and magnitudes of signals as they pass through a system is important in any investigation of the possible alteration of the performance or output of an electronic device. If a signal of a specified form enters a system at a given point, one would like to be able to predict the characteristics of the signal at another location in the system where a susceptible circuit might be located. From an alternate point of view, one may be interested in a radiation problem instead of a penetration problem. In this case, the signal may originate at some device in the system, propagate through the system, and excite an antenna. Then, interest lies in how the system affects the signal as it propagates to the input of the antenna.

A structure comprising a conducting body that encloses an axisymmetric cavity is analyzed. The cavity is attached to the conducting body by a coaxial transmission line whose center conductor extends through a planar surface of the conducting body to form an antenna. For this investigation, the conducting body is also axisymmetric, but the antenna need not reside on the axis of the body. The transmission line is operated well below cutoff so that the antenna characteristics manifest themselves to the cavity in the form of a lumped load at the end of the transmission line. The "exterior" antenna-conducting body problem is solved independently of the cavity problem to determine the antenna input impedance. Then the cavity problem is solved with the determined antenna input impedance used as a load impedance. Data are presented for the radiation problem, where the source is located inside the conducting body. In particular, the measured and computed input admittance looking into an appropriate plane in the cavity is presented. Good agreement between measured and computed data is observed.