Engineering Trades For Combining Coupling Models and Empirical Effects Data in Susceptibility Analysis

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When dealing with susceptibility predictions, the analyst must, at some point, resort to empirical results to complete the analysis. One limit is to use the empirical results for individual device failure and use various analysis techniques to perform the coupling calculation to the device level. This process places severe strain on the coupling analysis requiring predictions to the sub millimeter level that would require knowing the geometry to that level. At the other limit, one can perform the entire effects analysis empirically, with an observation of failure for a particular set of test conditions. This empirical process can require an unaffordable number of tests to complete a useful experiment matrix.

Digital systems consist of a number of building blocks. These building blocks consist of two processing and storage devices that take data, process and send it over a bus to another similar unit. Upset can occur if the communication is interrupted, the processing is corrupted or the stored data is changed. Buses consist of long (compared to the devices) conductors and hence act as antennas for coupling. The processing and storage devices are form a nonlinear, time dependent and sometimes active load on each of the elements of the line.

There are two compromise approaches that lie between the device level and system level empirical approaches. One of these approaches uses a functional model of the electronics to predict failure for a set of calculable conditions. There are a variety of functional models that are most applicable to predicting upset in a complex digital system. The other approach is to use analytical techniques to predict the currents at ports and use current injection for the empirical part.

In this paper, we will compare and contrast each of these approaches by estimating the cost and potential benefit of each one.