

## Conducting EMI Effects on RF Active Circuits

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Recently, there is increasing effort to understand and model the effects of UWB (ultra wide band) pulse and HPM (high-power microwave) interactions with electronic circuits and systems at all scales. There has been significant EM simulation effort in a large scale to determining the field coupling from UWB and HPM sources into the circuits and systems at the pin levels. An aim of this paper is to investigate the effects of the induced EMI source to the circuit components and as a result, to the overall systems.

The HPM source is characterized as a series of pulses with fixed duration and off time. Its frequency characteristics will be used to determine both the EM and circuit model for analysis.

For analog or mixed-signal communication systems, we investigate the EMI source injected into the system front end, particularly the low noise amplifier (LNA). When the EMI source is sufficiently smaller or comparable to the normal receiving signals, the EMI source is treated as noise and its effect to the overall system is determined through the bit-error rate (BER). When the EMI source is modestly larger than the normal received signals, it has additional effect of introducing higher-order harmonic (IP3) due to the nonlinearity of the voltage gain. The bias point at transistor (CMOS) gate may also vary by the EMI source resulting in unstable transconductance and severe circuit mismatch. If the EMI source level is even higher, the CMOS transistor may be biased into saturation and the circuit is no longer functional. In this paper, we will quantify the EMI source level as related to the three possible scenarios.

In addition, we will discuss the EMI effect on the digital circuits. The emphasis is to determine the EMI source level at the gate such that the transistor logic is altered. Several examples of HPM coupling through apertures will be used to evaluate its threat to the electronics communication systems.