

ANALYSIS OF HIGH-POWER RF INTERFERENCE ON DIGITAL CIRCUITS

H.Y. David Yang, Ronald Kollman²
U. of Illinois at Chicago

Recently, there is significant interest in understanding and mitigating the effects of high power electromagnetic (EM) source on electrical systems and equipment. Most of the focus of EMI investigation has been for interference between circuit components and the interference is well below GHz. There are many research efforts in trying to determine the susceptibility of the systems experimentally coupled with a statistical approach. Most of the theoretical analysis is for large-scale electromagnetic analysis to determine the conducting or radiating EMI at the digital system input due to coupling of high-power microwave sources through cavities with apertures. The detail analysis of the external EMI at the input pins coupling into digital circuit causing spurious waveforms has not been available. The main reason is that typical digital circuitry includes hundreds or thousands of components and complete circuit analysis to determine the cause of distortion is too complicated and impractical. This paper describes the analysis of intentional high-power RF interference on digital circuits. The interference is modelled as a noise in the form of single-frequency sinusoid and is superposed to the pulse trains of the digital signals. Spice simulations for a CMOS inverter and a 4-bit adder are performed to determine the threshold of the state change (error bits) under various interference frequencies and voltage levels. Propagation effect of error bits through the circuits is investigated. It is found that in general the digital circuits will reduce the error bit rates as signals propagate through and EMI effect is smaller when the noise and signal frequencies are farther apart. The phase difference between noise and signal is an important factor to determine the bit error rates. Inverter BER is further related to the external microwave source for the case of a wire penetrating a cavity aperture.

Abstract Submission Form
2004 National Radio Science
Meeting

Abstract: yang17469

Date Received: September 24, 2004

1. (a) H.Y. David Yang
851 S. Morgan Street, 1020 SEO
Chicago, IL
60561 USA
hyang@ece.uic.edu
- (b) 312-9960675
- (c) 312-9966465
2. B - Fields and Waves
3. (a) EMC/EMI Modeling
4. C - Contributed Paper,
Program chair: Danilo
Erricolo
5. No special instructions