A Simple Benchmark Problem for Crosstalk

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***Abstract*: Crosstalk is a cumbersome hurdle in the design of electromagnetically compatible digital systems. To be aware of crosstalk may help deduce design rules and thus avoid it. Therefore, a simple benchmark problem has been manufactured and analyzed. Measurement data are compared with simulations obtained by FDTD and a 2D approximation.**

***Keywords*: Crosstalk, benchmark problem, finite difference time domain method, microwaves.**

I. INTRODUCTION

The data rate in digital electronics increases rapidly and thus, the influence of interconnects has to be considered at the design phase, too. Crosstalk, a near-field coupling problem, is an important aspect in the design of electromagnetically compatible printed circuit boards [1].

II. BENCHMARK

The benchmark shown in Fig. 1 consists of two micro-strips on a dielectric board. It exhibits all three kinds of coupling, i.e., inductive, capacitive and conductive coupling. The loss factor $\tan\delta=\sigma/(2\pi f\varepsilon_r\varepsilon_0)$ of the board was assumed to be 0.0195, . Since ε_r is frequency dependent, an average value of ε_r equal to 4.471 has been selected. Thus, σ equals 2.396mS/m. The width of a micro-strip is 1.016mm, its thickness as well as that of the ground plane are assumed to be 35µm.

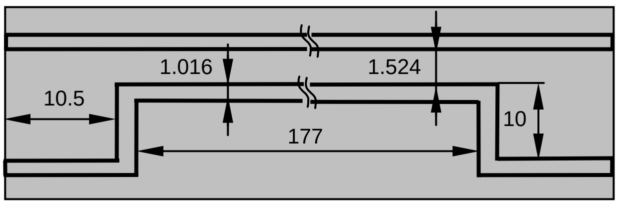

Fig. 1: Benchmark problem for crosstalk (top view), ground plane (gray), all dimensions in mm.

III. NUMERICAL SIMULATIONS

A dedicated software [2] based on the finite difference time domain method has been used to solve the basic field problem. The smallest dimension of the cells was selected to be 5.0µm which is about 2.5 times the penetration depth for copper at 1GHz. Ports on which measurements have been carried out have been terminated by a resistive load of 50Ω. For the sake of simplicity, the other ports have been terminated by an open circuit. No absorbing boundary conditions have been applied. The simulation in the time domain has been carried out in a time interval of 8ns.

In case of the 2D approximation (2D Approx.) the problem was considered as two coupled transmission lines with ground plane. The parameters per unit length have been determined by 2D finite element simulations. An appropriate circuit model has been employed to calculate the S-parameters.

The results for near end crosstalk (NECT) and far end crosstalk (FECT) [1] are presented in Figs. 2 and 3. Only the section where the conducting traces are close to each other has been considered in the simulations.

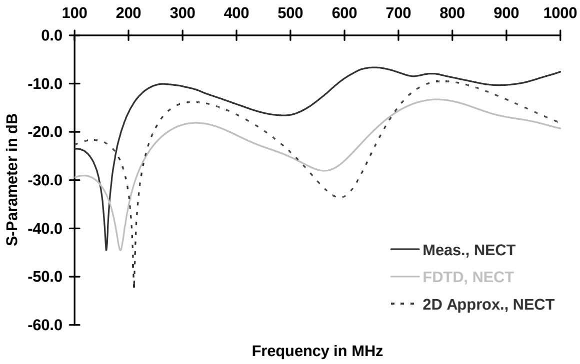

Fig. 2: Comparison of S-parameters for near end crosstalk.

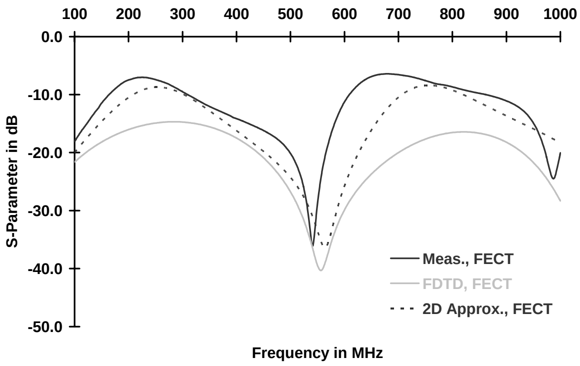

Fig. 3: Comparison of S-parameters for far end crosstalk.

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