

A Brief Model of the Common-mode Excitation in Imbalanced Transmission Lines

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Keywords : EMC, common-mode, imbalance-structure, EM radiation

Abstract (around 200 words)

The common mode is excited when two transmission lines with different cross-sectional profiles are connected even if perfect differential mode current is injected into one of the lines. The excited common mode current further excite the noise radiation, that is the prime interest when an engineer develops a high-speed digital electronic device for commercial use. A simple model to evaluate the quantity of the common mode current/voltage is proposed and exemplified of its convenience. Degree of the imbalance is accounted by the notion of "current division factor" that express the ratio of currents on each line of the couple of the cable, when the cable is

excited only with a common mode current, with no normal mode current. The issue is made under the proposition that the common mode is very weak in comparison to that of differential mode in an actual electric device which is conscious of EMI: TEM mode is almost retained over the two lines, though the strict evaluation is sacrificed here. More rigorous evaluation requires more terms with tedious process which cancels the merit of brief guide as called "rule of thumb". This idea clearly explains how the common-mode is excited and gives engineers an approach to suppress the radiation.

(Two power point pages have been attached.)

Imbalance of a cable/PCB

Printed circuit board

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Original Common-Mode Antenna Model

- Common-mode current get excited when imbalance (CDF: h) changes

$$\Delta V_c = \Delta h V_N \quad (5)$$

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