Shielded Cable Transfer Impedance Determination based on a Combined Model and Measurement based approach on a Discontinuity Triaxial Cell

J-P. Parmantier*[(1)], S. Bertuol[(1)], F. Issac[(1)], I. Junqua[(1)]
(1) ONERA, DEMR, 2 avenue Edouard Belin, 31055 Toulouse Cedex 4, France
jean-philippe.parmantier@onecert.fr

A triaxial cell is made of a coaxial cell on which a small cylindrical discontinuity is practiced on the inner core. The shielded cable under test is placed inside the inner core and its shield is connected at the level of the discontinuity, therefore providing the electric continuation of the core and the concentration of the illumination in a small spherical zone of the cable. By giving access to a measurement of the so called transfer inductance (Lt), this technique is known to be able to provide higher frequency measurements of shielded cable transfer impedances (Zt) than other low frequency oriented techniques (B. Démoulin and al., 9th Zurich Symposium on EMC, 12-14 March, 1991, pp. 169 – 174). However, the technique remains limited by the mismatching brought by the various transition zones of the cell.

In order to get rid of this limitation, but still making the approximation of TEM modes in the cell, we propose to extend the technique by combining the measurements with a precise network multiconductor transmission line model of the entire setup. The reference measurement consists in S-parameters between the injection port on the core of the cell and the reception point on the shielded cable. The model of the setup involves the cell itself, split in different transmission line sections, and the multiconductor shielded cable under test including its propagation characteristics, either measured or simulated. The only unknown of the model is the Zt of the cable.

The frequency variation of the Zt is derived from a simple optimization process carried out in two main steps. The first step is a calculation supposing that the Zt is only made of constant values, Rt. The second step supposes that the Zt is only made of constant values Lt. Adjusting Rt and Lt values for matching the calculations obtained at the two first steps with the reference measurement at low and high frequency respectively, the general variation of the Zt is directly obtained. The intermediate region in which an EM diffusion in the depth of the cable shield can be observed is obtained by completing the model issued from step 1 and 2 with a bypass filter model.

This technique has been applied on various types of cables (coaxial, shielded pairs, several wire shielded cables). The results obtained with this technique have then been used to model EM coupling on some of those cables in various configurations. High frequency results up to 10 GHz will be presented during the conference.