Shield Effectiveness - Transfer Impedance

Broadband installations are regarded as closed systems, and as such operators are allowed to use frequencies normally assigned to over-the-air communications bands - aircraft, FM, Broadcast, TV, CB, etc. Therefore, the drop cable used in these installations must provide adequate isolation to preserve the integrity of the system and to avoid interfering with over-the-air communications. In addition, the expansion of the frequency spectrum utilized by broadband systems has caused the FCC to increase the enforcement of emission regulations. This activity has focused awareness on the need for effective cable shielding. Belden has long been involved in the development of shielding test methods (SEED®, Transfer Impedance Clamp) and new product designs (Duobond® II, Duobond® Plus) to help meet these requirements.

The shield performance of our drop cables is shown in the results of two independent test methods - SEED and Transfer Impedance. These tests give the most consistent and reliable shielding data for the Broadband Industry.
SEED - the Belden - developed test for shield effectiveness - relates a specific test fixture to a measurement of shield performance. To duplicate the data, an equivalent fixture must be used. The ratio (in dB) between an output voltage generated in the fixture to an input voltage applied to a test sample is measured. This ratio depends on the sample length and the coupling between the two systems, in addition to the shield construction.

Transfer Impedance

Transfer impedance is a fundamental value of a shield's performance, (It is *not* a test method.)

Transfer impedance relates a current on one surface of the shield to the voltage drop generated by this current on the opposite surface of the shield. This value depends solely on the shield construction.

Transfer impedance test data is obtained with a terminated triaxial test fixture. This test method, which is a modification of an existing IEC test procedure, is the one that was proposed by Kenneth Simons*. A new test clamp, which incorporates electrical and mechanical improvements over earlier designs, was developed and patented by Belden engineers.

Transfer Impedance is defined as:

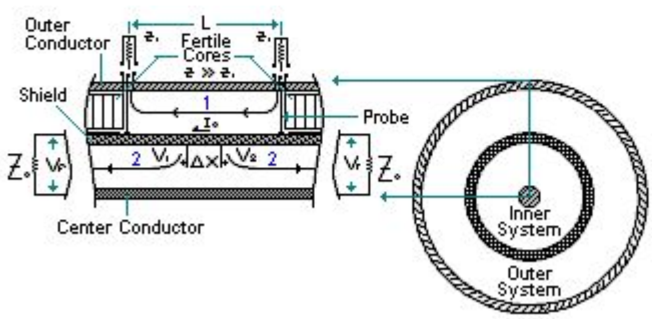
$Z_t = (1 / I_o) \times (dV / dx)$

where I_o is a longitudinal disturbing current generated on one surface (either the inner or the outer surface) of the shield and dV/dx is the longitudinal voltage per unit length, generated by I_o, appearing on the opposite surface of the shield.

In the terminated triaxial test system, the test cable center conductor and the shield form an inner transmission system, with the shield and the outer concentric tube forming an outer transmission system.

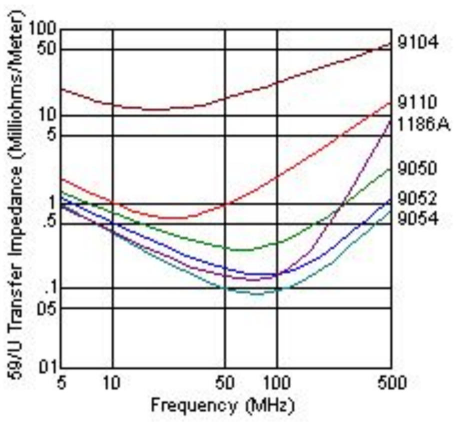
The outer system is driven by a generator and creates a current I_o on the outer surface of the shield. This current causes a voltage difference on the opposite surface shown as

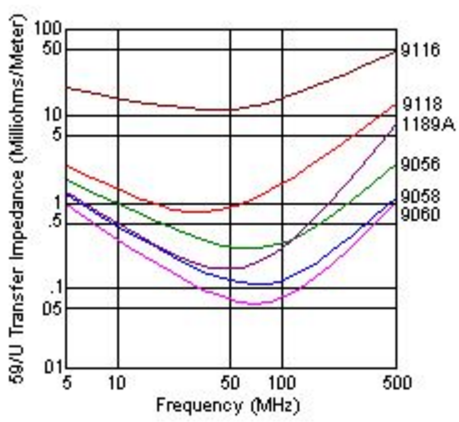
V1, and V2 over a length of shield X. This generates signals in the test cable which can be related to the transfer impedance value of the shield.
The lower the value of the transfer impedance, the more effective the shielding. The charts illustrate Transfer Impedance values for 6 different shield configurations. The transfer impedance value theoretically can be used to determine absolute interference levels. In a real application of a coax cable the shield acts as a barrier between two electromagnetic signal carrying regions. One region is the cable itself. The other region is the ambient environment. To determine how these two regions interact with one another, you need to know how an electromagnetic signal in one region - with its associated voltages and current - couples to the other. The transfer impedance gives this relationship. Currently, no ambient models are sophisticated enough to be used for broadband system applications. However, simplified models can be used to help analyze, if not quantify, interference problems.



1 Input signal from outer system

2 Signal in inner system from coupling through shield. (For simplicity, only one element along the length "L" is illustrated.)





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9052 Duobond Plus with 77% Braid
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1186A Duobond IV

9116 Duobond II with 61% Braid
9118 Duobond III with 61% Braid
9056 Duobond Plus with 61% Braid
9058 Duobond Plus with 77% Braid
9060 Duobond Plus with 95% Braid
1189A Duobond IV