TECHNICAL NOTE / 1062

The Center Conductor Dielectric Coating From The Inside Of The Cored End Of CATV Semiflex Cable At The Cable-Connector Junction

OVERVIEW

With the advent of 1GHz cable, impedance variations at the connector interface that were not a problem to 600MHz should be re-examined for 1GHz applications. One such impedance variation is due to the dielectric coating that remains on the cable center conductor after the cable is cored out. This technical note provides the theoretical return loss versus frequency to 1GHz of the cable-connector junction.

CABLE PREPARATION

Coring

Connectors for CATV type semiflex cables have integral sleeves that fit under the cable's aluminum tube outer conductors. In order for the sleeve to fit, the dielectric between the cable's inner conductor and outer conductor must be removed with a coring tool. The tool has a worm with a cutting edge that bores out approximately 1 inch of dielectric from the end of the cable. There is a hole in the worm of the tool for the center conductor of the cable to pass through. The hole in the worm is larger than the center conductor so that the center conductor will not be scratched, scored or twisted in any way. However, because the dielectric is bonded to the center conductor, a layer of dielectric remains behind after the coring operation.

Center Conductor Coring

The exposed center conductor that extends from the end of the outer conductor can be cleaned with a plastic implement so that electrical contact can be made with the seize basket of the connector or the seizure screw inside the amplifier or tap. The center conductor inside the cored out tube cannot be easily accessed and typically is not cleaned.

RETURN LOSS

Measurement Versus Calculation

With the advent of 1GHz cable, a question arises about the effects of this layer of dielectric on the performance of this junction. The coating of dielectric will have a different impedance from the adjacent section without the coating. To determine the effects of such an impedance discontinuity, the return loss of the junction should be measured with and without the coating. Return loss measurements of this type are sufficiently difficult to warrant another approach. From a theoretical standpoint, the impedance changes through the junction can be calculated based on the dimensions and propagation velocities at each point. From these impedances, their corresponding reflection coefficients can be determined and a first order approximation of return loss versus frequency can be calculated.

From the dimensions of a typical 0.750 inch cable-connector interface, the impedance is calculated at each point along the connector as shown on the following page. The impedance of the connector and amplifier is based on their published return loss values. The amplitude of the first order reflected wave is developed as a function of the reflection coefficients of each junction. The sum of the reflections at the reference plane is then calculated versus frequency and plotted.

DISCUSSION

The following graphs show the theoretical first order return loss characteristics versus frequency of a cable-connector-amplifier housing. Amplifier housings typically have 18dB minimum return loss which can be translated into an impedance that is above and below 75 ohms. One set of graphs reflects a high amplifier impedance, one set for a low amplifier impedance and one set for an amplifier impedance of exactly 75 ohms. The connector body is assumed to have a 30dB minimum return loss which again implies the possibility of a high or low impedance. Each set of graphs includes a high connector impedance, a low connector impedance and a connector impedance of exactly 75 ohms. This makes 9 possible combinations of amplifier-connector impedance combinations. Finally, each graph has a solid line that corresponds to dielectric or fuzz remaining on the center conductor inside the cored outer conductor and a broken line curve that corresponds to a clean center conductor inside the cored cable.

As long as the thickness of the center conductor coating does not vary too much from one coring tool to the next and the relative dimensions of the components stay approximately the same from one size cable-connector junction to the next (with the possible exception of longitudinal length), the result should be very nearly the same for all semiflex cable-connector junctions. The length of the connector is important in the analysis, so its absolute size rather than its relative size should stay the same from one connector to the next for the results to be the same.

CONCLUSIONS

The following graphs show that dielectric inside the cored end of the cable has theoretically very little effect on the return loss of the junction and can be disregarded for all practical purposes. If the return loss of the connector junction becomes more important in the future, perhaps with more stringent requirements of HDTV, the direction should be toward improving the impedance of the amplifier housing. Even if the amplifier housing and connector were made to be perfectly 75 ohms, cleaning the center conductor inside the cored outer conductor will have very little effect.

Figure 1.

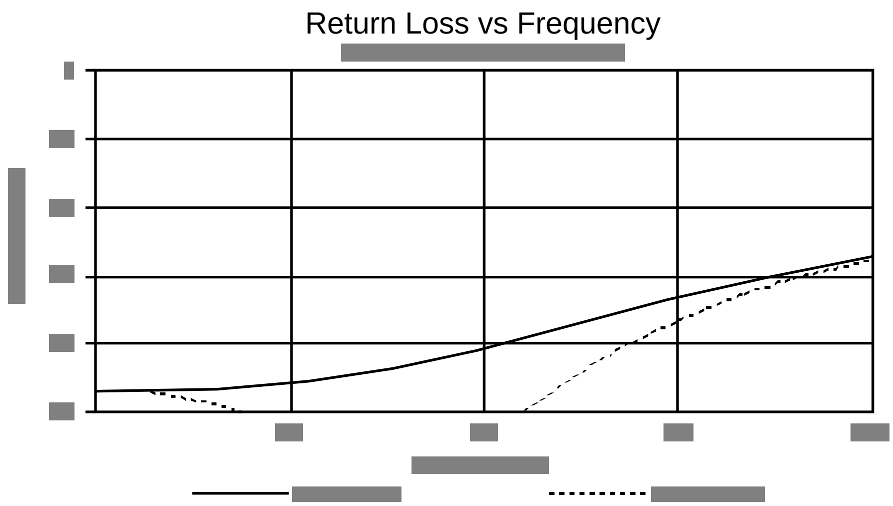


Figure 2.

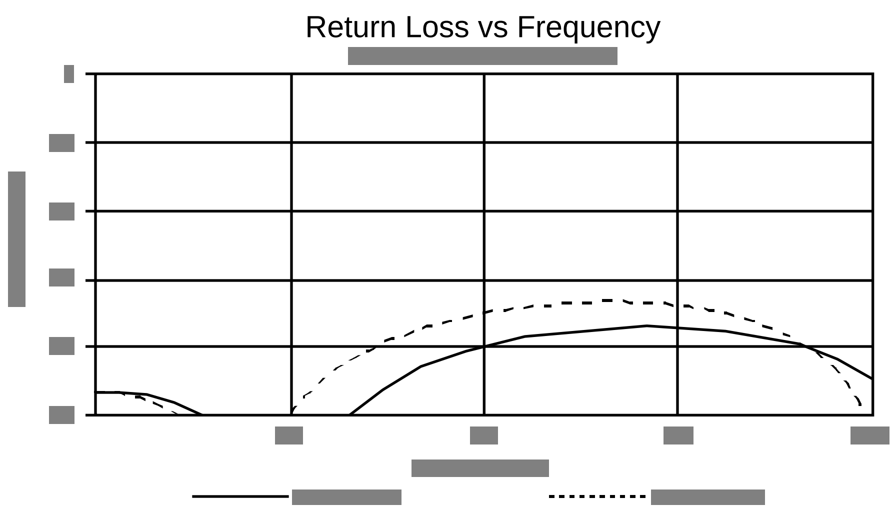


Figure 3.

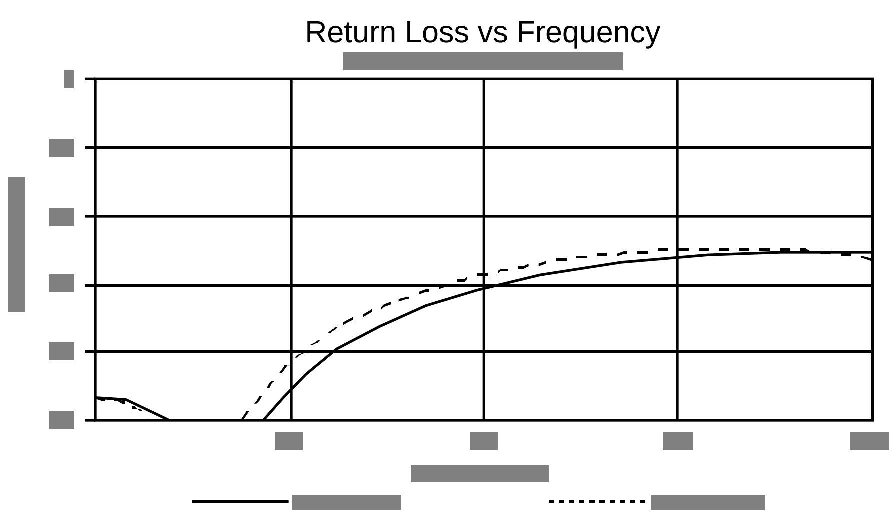


Figure 4.

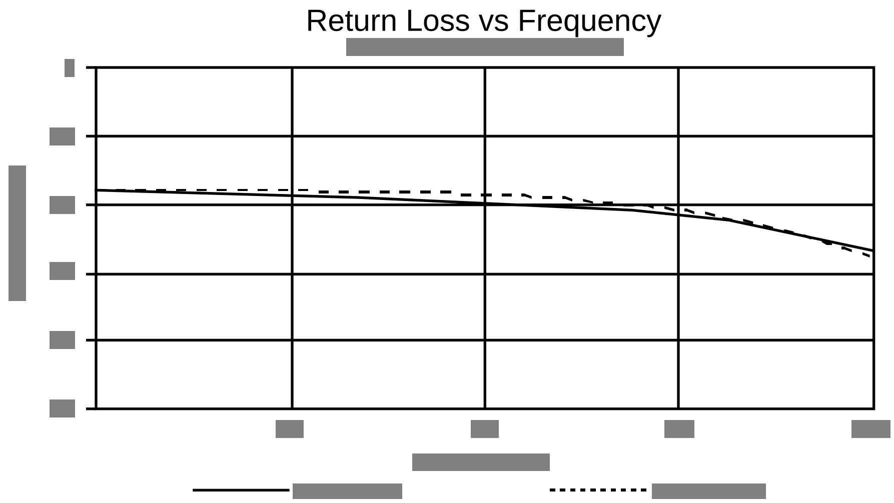


Figure 5.

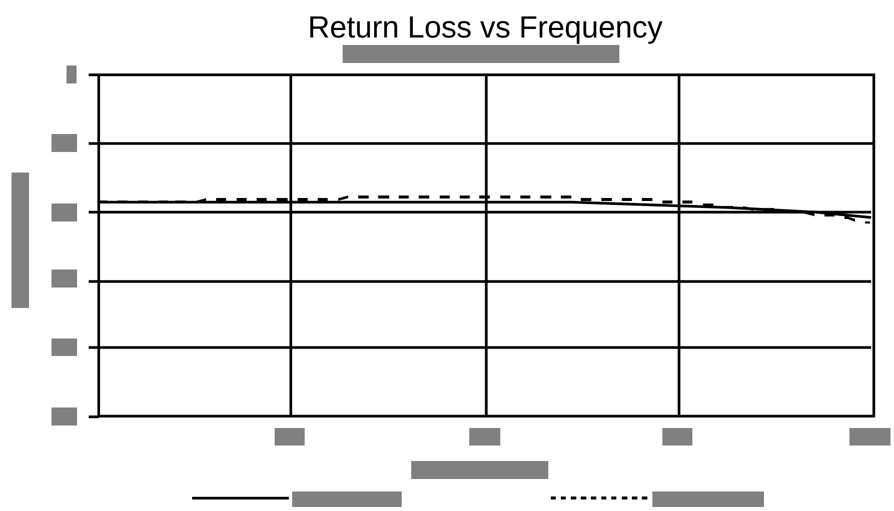


Figure 6.

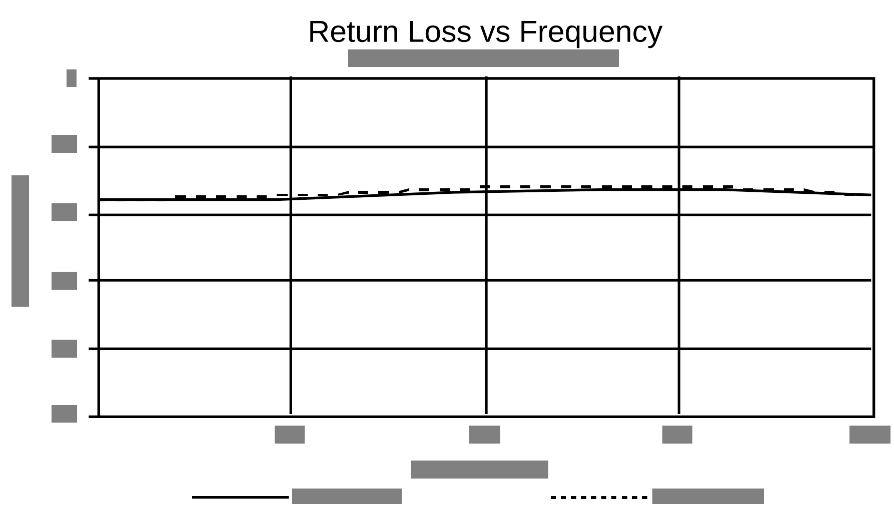


Figure 7.

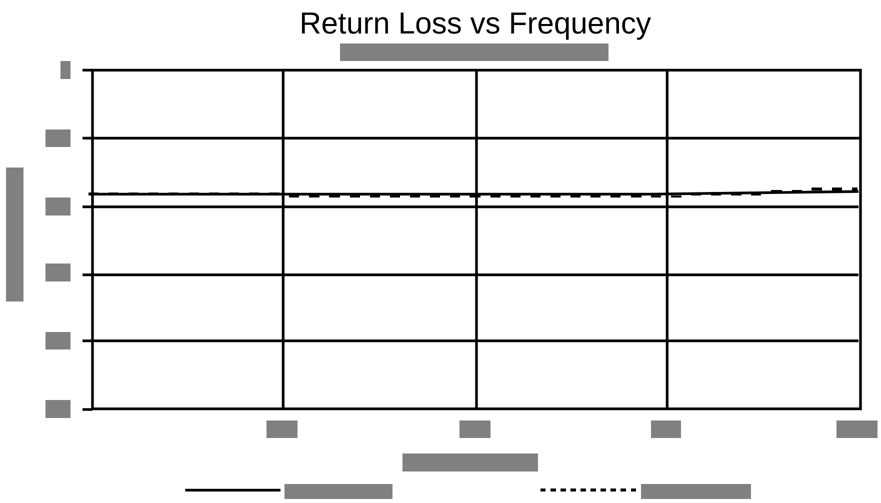


Figure 8.

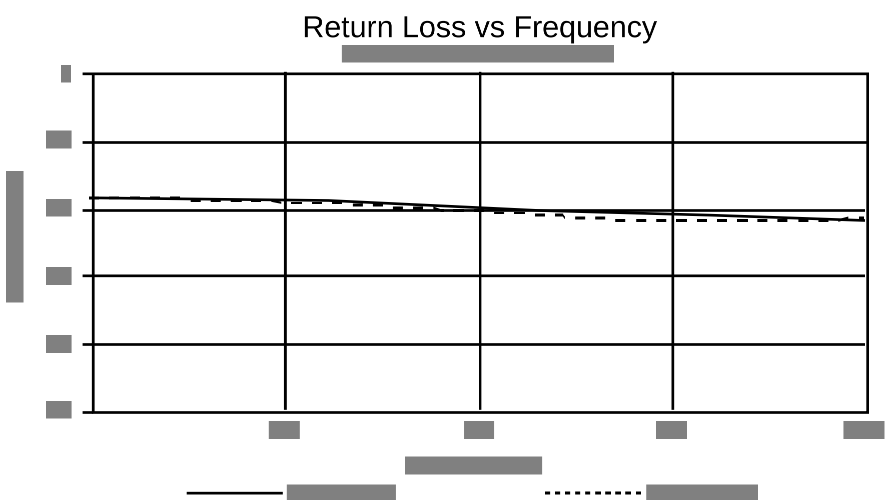
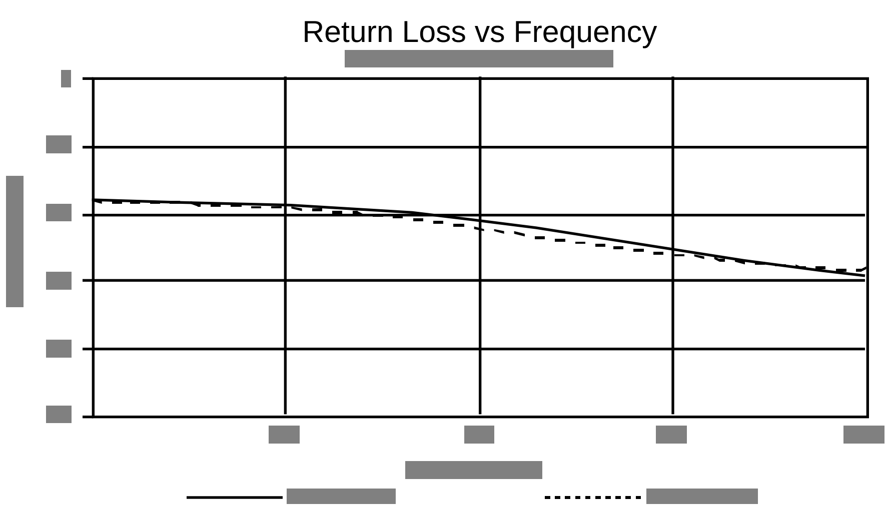
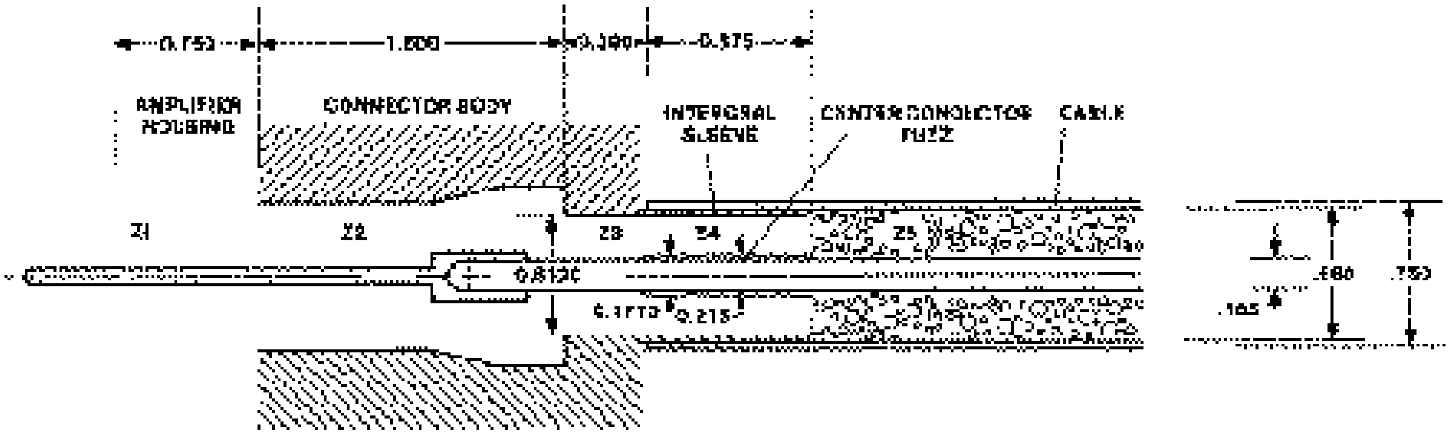


Figure 9.





Z_1 = 58.34Ω - 96.50Ω (amplifier housing with 18dB RL)

Z_2 = 70.40Ω - 79.90Ω (connector ref impedance with 30dB RL)

Z_3 = 78.64Ω D = 0.612, d = 0.165, V_g = 1

$$\begin{array}{llllll} Z_4 = 76.12\Omega & D_A = 0.612, & d_A = 0.215, & V_{gA} = 1.0 & Z_A = 62.76\Omega & \\ & D_B = 0.215, & d_B = 0.171, & V_{gB} = 0.87 & Z_B = 11.95\Omega & \Big\} \Sigma = 76.12 \\ & D_C = 0.171, & d_C - 0.165, & Vg_C = 0.66 & Z_C = 1.41\Omega & \end{array}$$

$$\begin{array}{llllll} Z_5 = 74.3\Omega & D_D = 0.680, & d_D = 0.171, & Vg_D = 0.88 & Z_D = 72.89\Omega & \Big\} 74.3\Omega \\ & D_E = 0.171, & d_E = 0.165, & Vg_E = 0.66 & Z_E = 1.41\Omega & \end{array}$$

$$\Gamma = \frac{Z_2 - Z_1}{Z_2 + Z_1}$$

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