Transmission Loss Measurements with the iVA Cable & Antenna Analyzer

Part 1: Cable Insertion Loss Measurements

Application Note

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Introduction

The testing of cable insertion loss in the field traditionally involves measuring the input return loss of the cable under test with an open or short circuit termination on the far end, and then dividing the result in dB by two. While this method can provide adequate results for low-loss cable assemblies, it becomes increasingly inaccurate as cable loss increases. In such cases, the only solution is to use a two-port instrument like a vector network analyzer (VNA).

Unfortunately, two-port VNAs come with an inherent disadvantage—their test ports are co-located in the same housing. As a result, when measuring physically long cable assemblies, VNAs require a test port cable that is at least as long as the cable under test. Needless to say, this arrangement can be highly impractical in a field environment.

In order to tackle this measurement challenge, Kaelus has developed "Transmission" mode for the iVA. Transmission mode enables two or more iVAs to operate in a coordinated fashion to perform accurate swept insertion loss measurements. As each iVA is an independent, Bluetooth-controlled device, test port cables are not required. Instead, the user connects the iVAs directly to the input & output ports of the cable under test.

Figure 1 depicts a typical use case for Transmission mode. Two iVAs are connected to either end of a long cable assembly. A Bluetooth connection is established between the user device (tablet or laptop) and each iVA. During a measurement sweep, the user device coordinates the measurement process, post-processes the raw data, and displays the insertion loss results on screen at the end of the sweep.

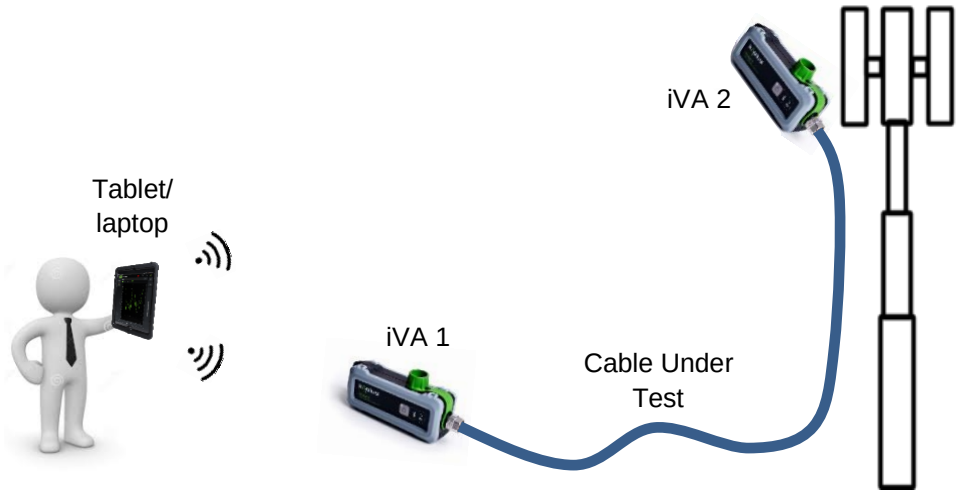

Figure 1. Typical equipment setup for a cable insertion loss measurement.

Calibration Procedure

Before making a Transmission measurement it is necessary to perform a short calibration procedure.

The first step is to pair both iVAs to the same tablet. In practice up to 7 iVAs can be paired to a Windows or Android device, while up to 4 iVAs can be paired to an iOS device. For the sake of brevity, we shall restrict the number of iVAs to 2 in this application note.[1]

[1] In some environments it may not be possible to maintain a continuous Bluetooth connection to both iVAs, in which case Transmission mode cannot be used. Instead, Kaelus recommends an alternative approach involving two tablets and two iVAs operating independently. Refer to Kaelus white paper "Branch Insertion Loss Measurements with the iVA" for details.

The second step is to perform an OSL calibration on each iVA. Once this is complete, connect the two iVAs together using a Type N female-to-female adaptor and perform a Transmission calibration. This function can be accessed on the “Calibrate” screen, under the heading “Port1/Port2”.

The third step is to specify the frequency sweep settings. In this example, set the Start frequency to 700 MHz, the Stop frequency to 2700 MHz, and the number of points to 1001.

An optional final step is to specify the direction of the Transmission measurement, i.e. Port 1 to Port 2, or Port 2 to Port 1. This setting can be accessed in the “Traces” menu.

You are now ready to perform an insertion loss measurement.

Measure Cable Insertion Loss

Connect iVA 1 to the input to the cable assembly, and iVA 2 to the output. Trigger a measurement sweep. After a short delay a plot of insertion loss vs frequency will appear on the screen.

Figure 2 displays a typical set of results. In this example the insertion loss of a 30-metre (98-foot) length of coaxial cable was measured using Transmission mode. For comparison, the insertion loss was measured a second time using the traditional reflection-based method.

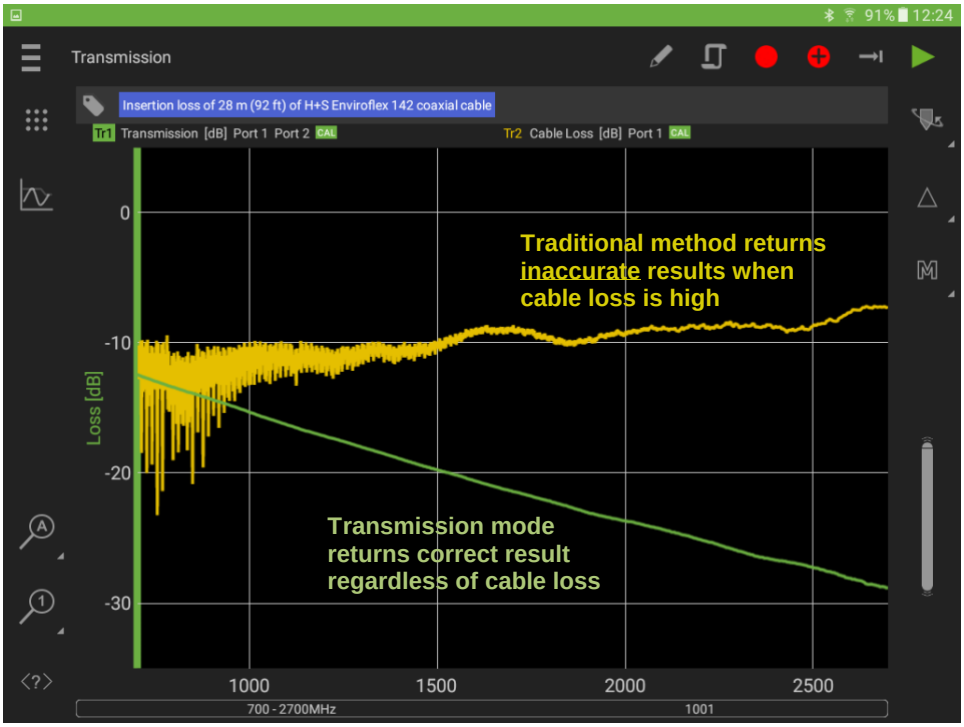

Figure 2. Insertion loss of a 30-metre length of Huber & Suhner Enviroflex 142 coaxial cable. Green trace = Transmission mode sweep with 2 x iVAs. Yellow trace = Traditional reflection-based measurement with 1 x iVA and an open circuit termination on cable output port.

The Transmission mode results in Figure 2 (green trace) agree closely with the attenuation specifications on the cable's datasheet. By contrast, the results obtained using the traditional method (yellow trace) are in very poor agreement with the datasheet values across most of the measured frequency range. This is due to the fact that when the cable loss is high, the results of the traditional method are dominated by the reflection off the cable assembly's input connector, a problem to which Transmission mode is completely immune. For this reason, Transmission mode should be the preferred method for measuring the insertion loss of physically long, lossy cable assemblies in the field.