Amphenol Spectra-Strip
720 Sherman Avenue, Hamden CT 06514 (203) 281-3200

A Periodic Structure, Measured Impedance vs. Sample Length

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Purpose
Unexplained phenomena are observed when using network analyzers to measure swept impedance of cable assemblies and subassemblies having periodic discontinuities. This paper is intended to provoke discussion within the PIP and SSM groups, hopefully leading to a decision regarding preferred sample lengths. No conclusions will be drawn.

Background
Swept impedance measurements of assemblies or subassemblies having periodic structures show many resonance effects. Some resonances are easily explained, such as the spacing between discontinuities. These resonances appear at substantially the same frequencies regardless of the length of the measured sample.

Other resonances change substantially depending on sample length and measurement method. These resonances are not yet clearly understood, at least by the author.

Two common methods are used to measure swept impedance. Both methods provide very similar data at higher frequencies, but different data at lower frequencies, especially for shorter samples.

The "terminated" method terminates the sample at the far end into the device's nominal impedance.

The "square-root" method calculates the impedance by recording the short-circuit impedance and then recording the open-circuit impedance. The characteristic impedance is then calculated using the well known equation

$$Z_0 = \sqrt{Z_{OPEN} * Z_{SHORT}}.$$

Presented Data **
Data are shown from three different items. The first and second, provided for reference, show swept impedance of two uniform cables. The third is a subassembly having periodic structure, measured at six different sample lengths.

The Samples
The uniform samples are shielded jacketed round cables, having 34 twisted pairs made with foam polyolefin dielectric one is 28 AWG stranded, other is 30 AWG.

The periodic subassembly is a flat unshielded cable (Twist 'N' Flat®), having 34 twisted pairs made with 30 AWG solid conductor and solid thermoplastic elastomer dielectric. The uniform twisted pairs are interrupted by flat transition regions at 9.85 inch intervals. Together, the twisted and flat areas form a subassembly.

** Seagate Technology (Umesh Chandra) confirmed these results measuring a very similar sample.

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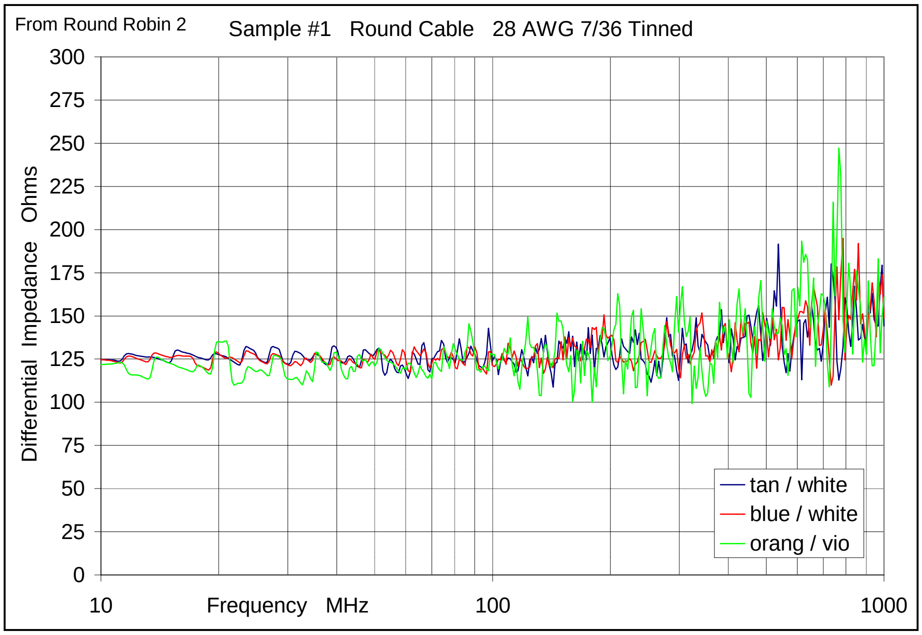
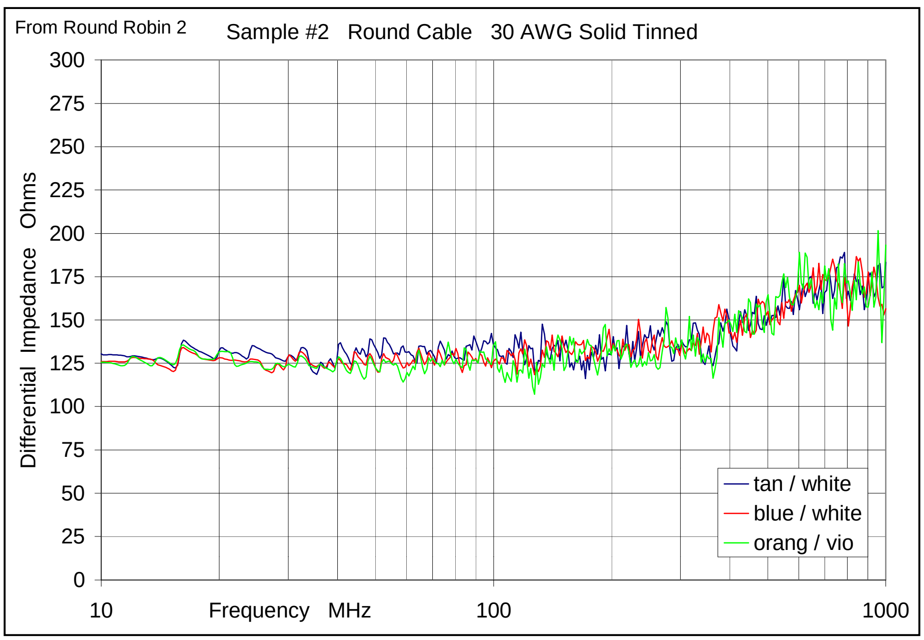
Reference Data – Uniform Cables - 25 meter length samples, Square Root Method





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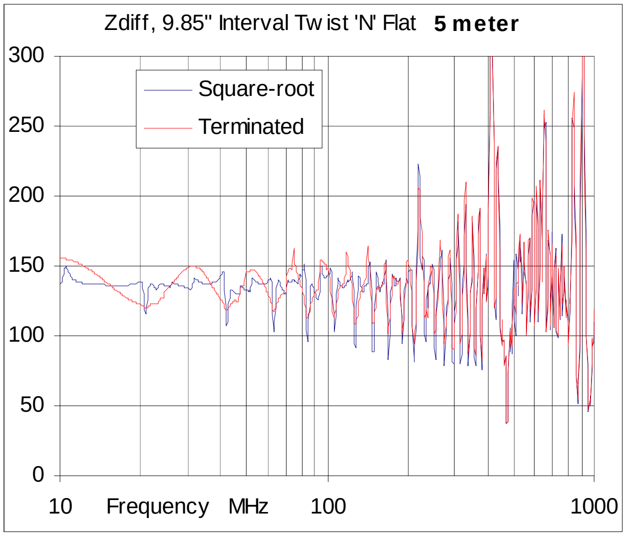
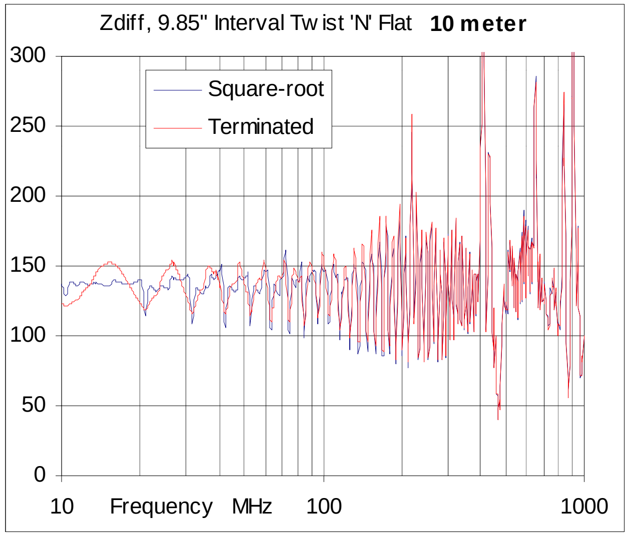
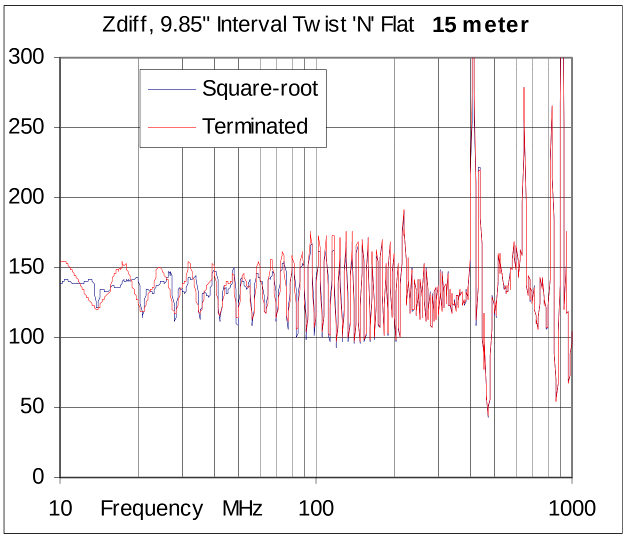
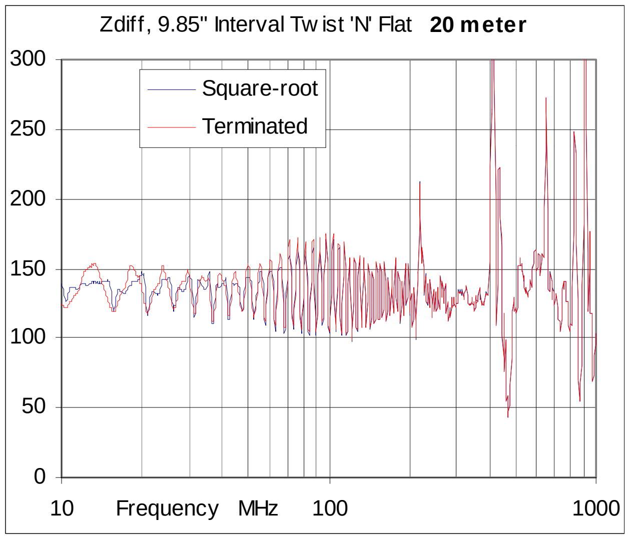
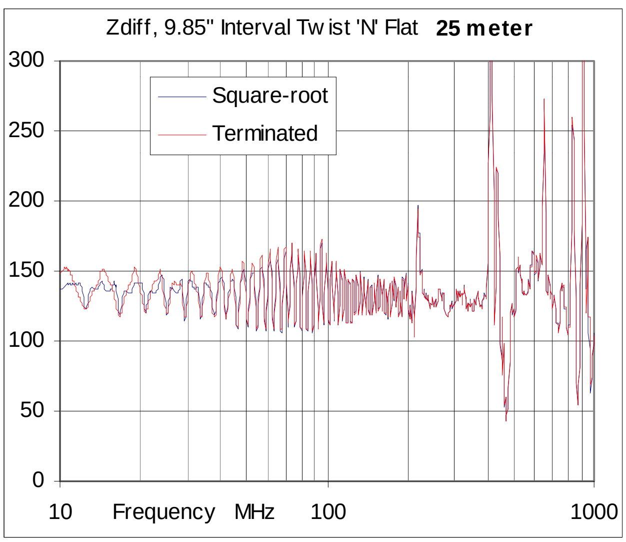
Data – Periodic Subassembly - Blue is Square-root Method, Red is Terminated Method

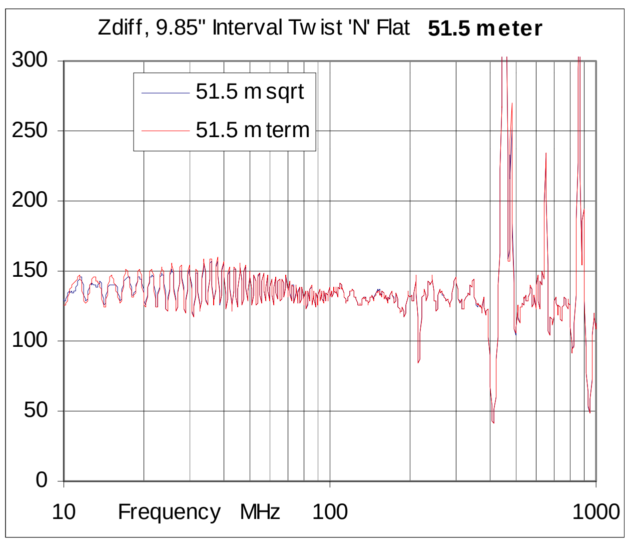












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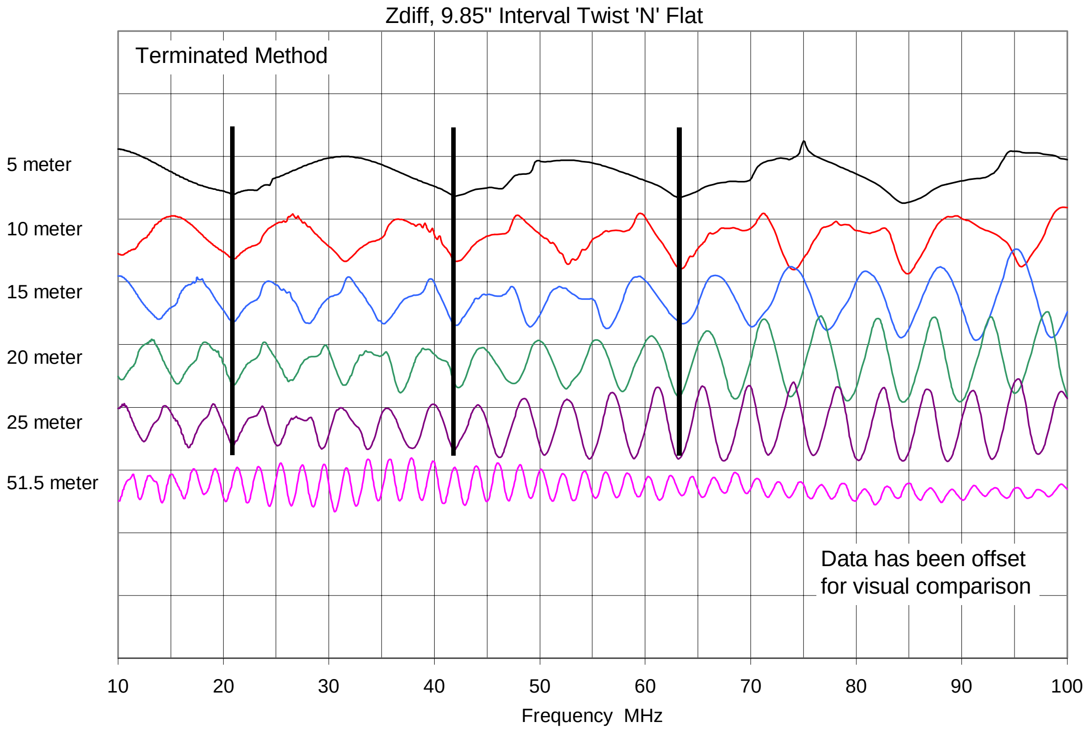
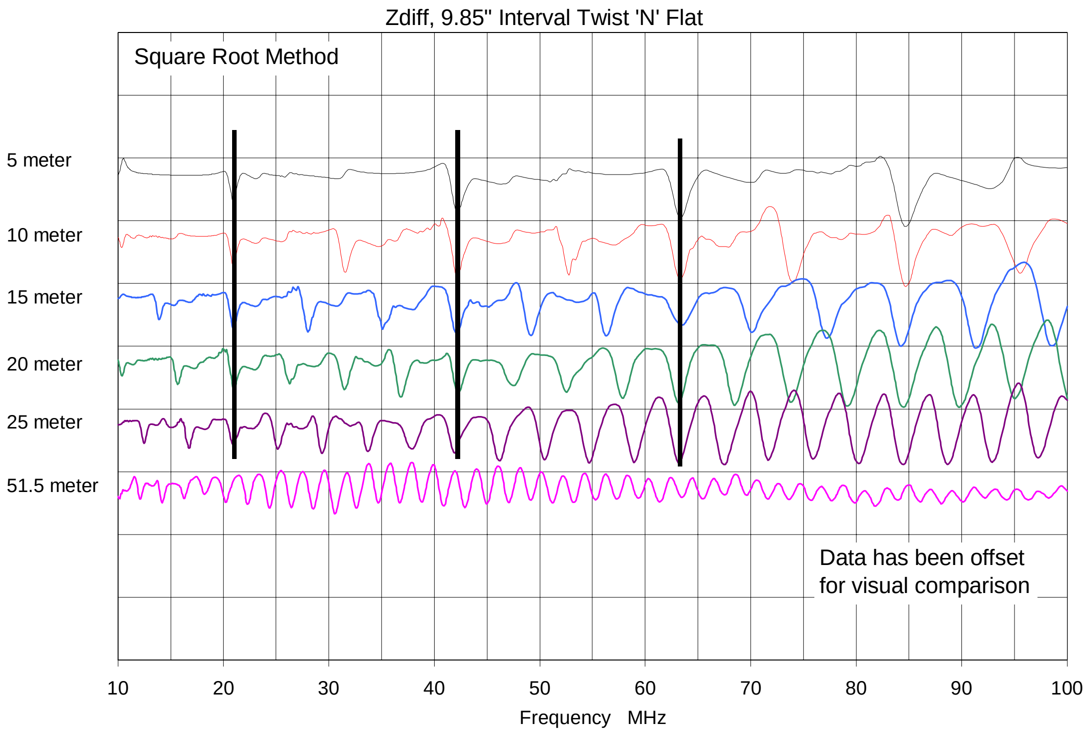
Low Frequency Comparisons – Periodic Subassembly
Data offset vertically for visual clarity





High Frequency Comparisons – Periodic Subassembly
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