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4-port Network Analyzer versus 2-port Network Analyzer With Balun or Hybrid Junction

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Introduction

Questions have arisen concerning comparability of data taken from recently introduced 4-port network analyzers versus traditional 2-port techniques.

Parallel SCSI 'extended distance impedance' has often been measured using a hybrid junction (sometimes, a balun) to convert the 2-port analyzer source from a single-ended to differential at the launch end of a sample, then to reconvert the differential back to single-ended at the load end of the sample.

Parallel SCSI attenuation (really insertion loss) has usually been measured using a balun to convert the 2-port analyzer source from a single-ended to differential at the launch end of a sample, then to reconvert the differential to single-ended at the load end of the sample.

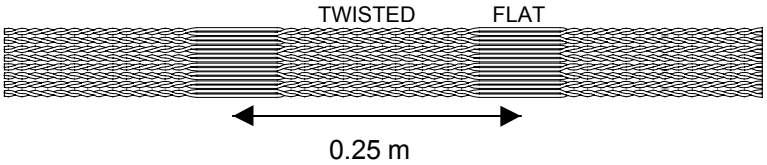
Presently available so-called 4-port analyzers perform an extensive set of single-ended measurements, then assume linearity to calculate the differential response.

Data is presented that shows substantial agreement between 2-port and 4-port measurements.

The Sample

The same piece of cable was used for all measurements described herein. (24.5 meter length)

The sample was a flat ribbon composed of twisted pairs, with flats for termination located on 0.25 meter intervals, as represented below.



This sample was chosen because it has a strong periodic structure with many resonances. These resonances provide obvious comparison locations.

(This sample was similar to sample 4 in "Cable Round Robin 2" described in T10/02-220r0.)

The Measurements

2-port Insertion Loss:
Balun fixtures per T10/00-339r0, having 122 Ω matching networks.
Frequency swept from 1 MHz to 1000 MHz.
The number of data points taken was 201, logarithmic intervals.

4-port Insertion Loss:
Frequency was swept from 1 MHz to 1000 MHz.
The number of data points taken was 1000, linear intervals.

2-port Differential Impedance:
Hybrid junction fixtures per T10/02-220r0 Method D.
Frequency was swept from 10 MHz to 1000 MHz.
The number of data points taken was 201, logarithmic intervals.

4-port Differential Impedance:
Frequency was swept from 1 MHz to 1000 MHz.
The number of data points taken was 1000, linear intervals.

Data Limitations

The 2-port data was taken two years ago, while 4-port data was taken recently (same piece of cable).

Because the sample was measured at different times, the sample was not placed identically for the two measurement sessions. Sample placement affects the measurement, particularly impedance.

The 2-port data was taken using roughly 1/5 as many points as the 4-port data. Worse, the 2-port data was taken on logarithmic intervals, placing most of the 2-port points at lower frequencies.

Comments Regarding Data (pages 3 & 4)

The data, given above limitations, shows decent correspondence. At least some of the differences observed between 2-port data and 4-port data are explained by the substantial differences in data intervals.

Insertion loss and impedance sweeps show very similar structure, resonance placement is similar.

The 4-port data shows more detail at the higher frequencies, which is expected because there are many more high frequency data points.

Data – Insertion Loss

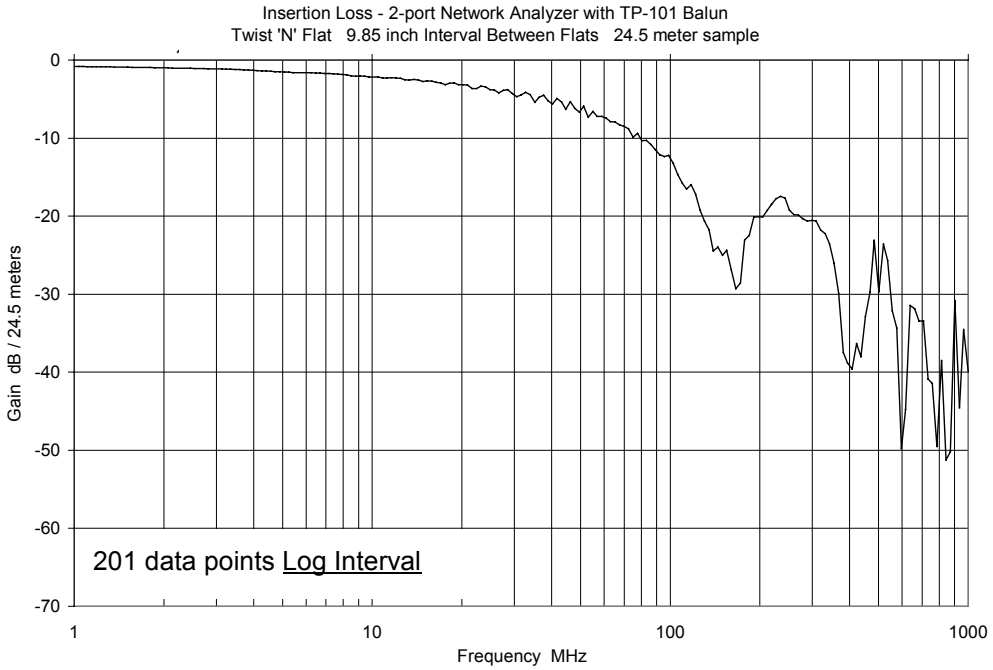


Figure 1: Balun Insertion Loss

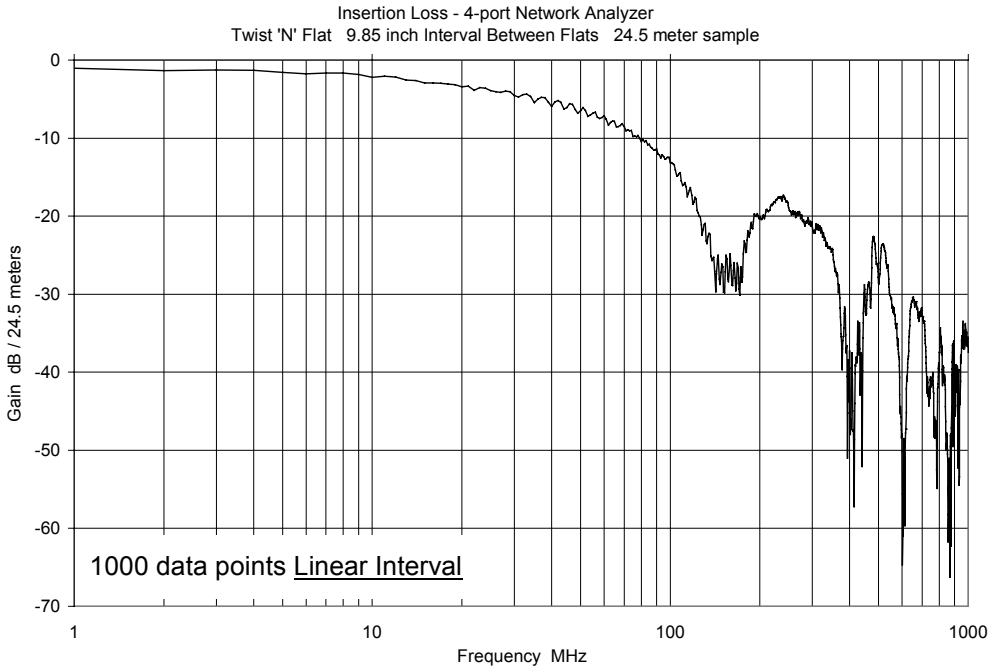


Figure 2: 4-port Insertion Loss

Data – Differential Impedance

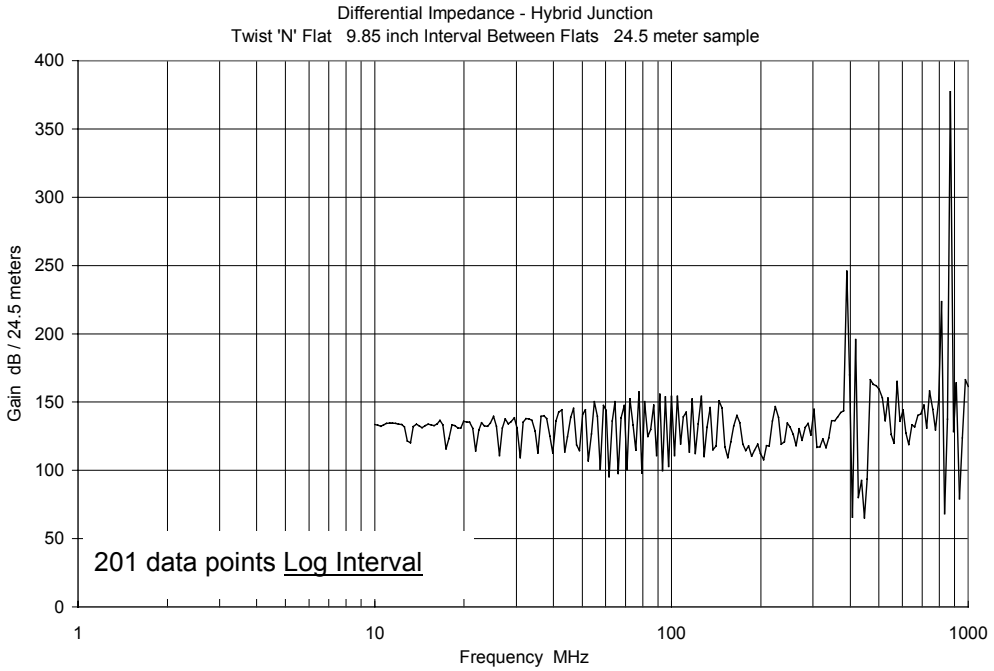


Figure 3: Hybrid Junction Differential Impedance

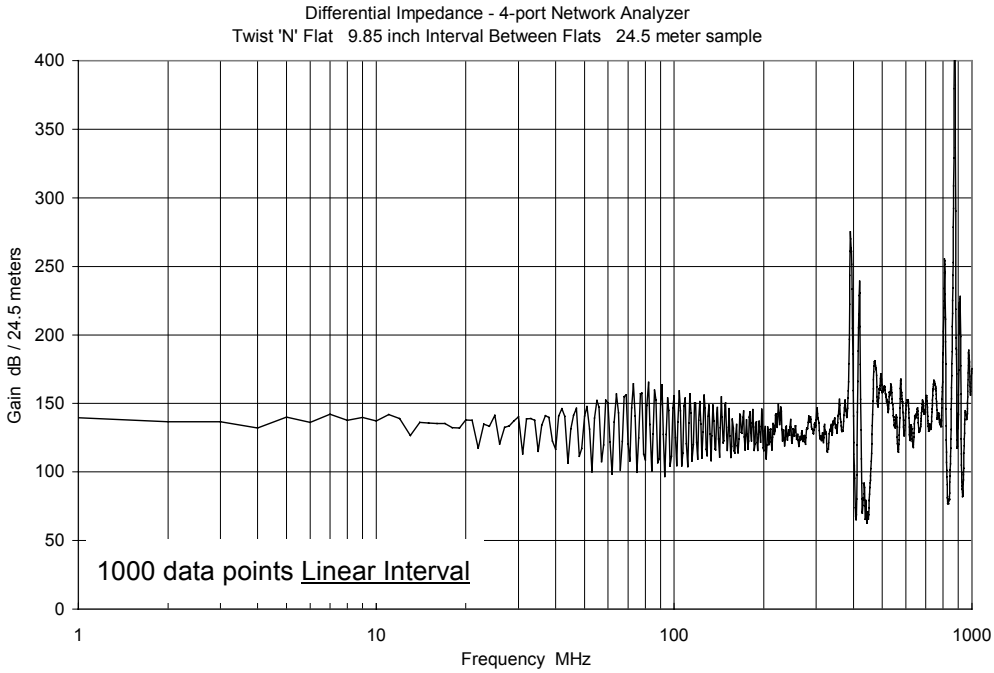


Figure 4: 4-port Differential Impedance