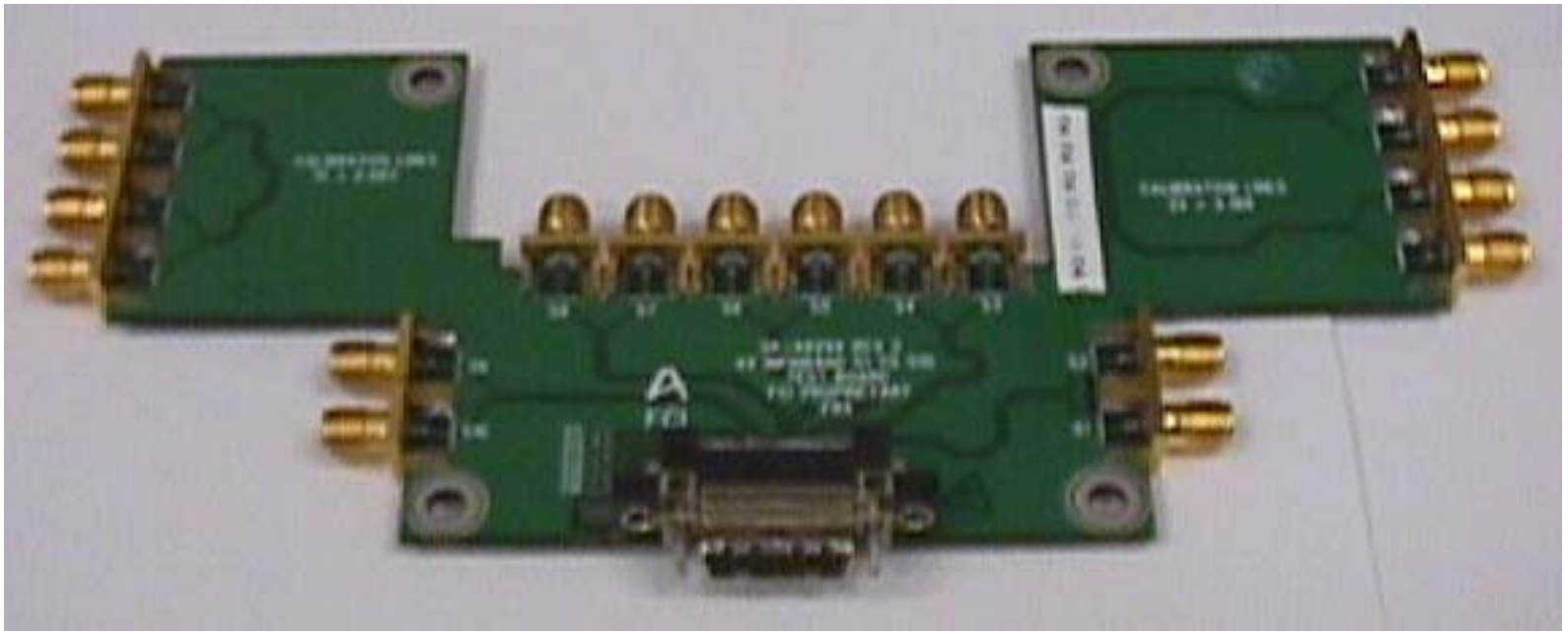
# Test System Risetime

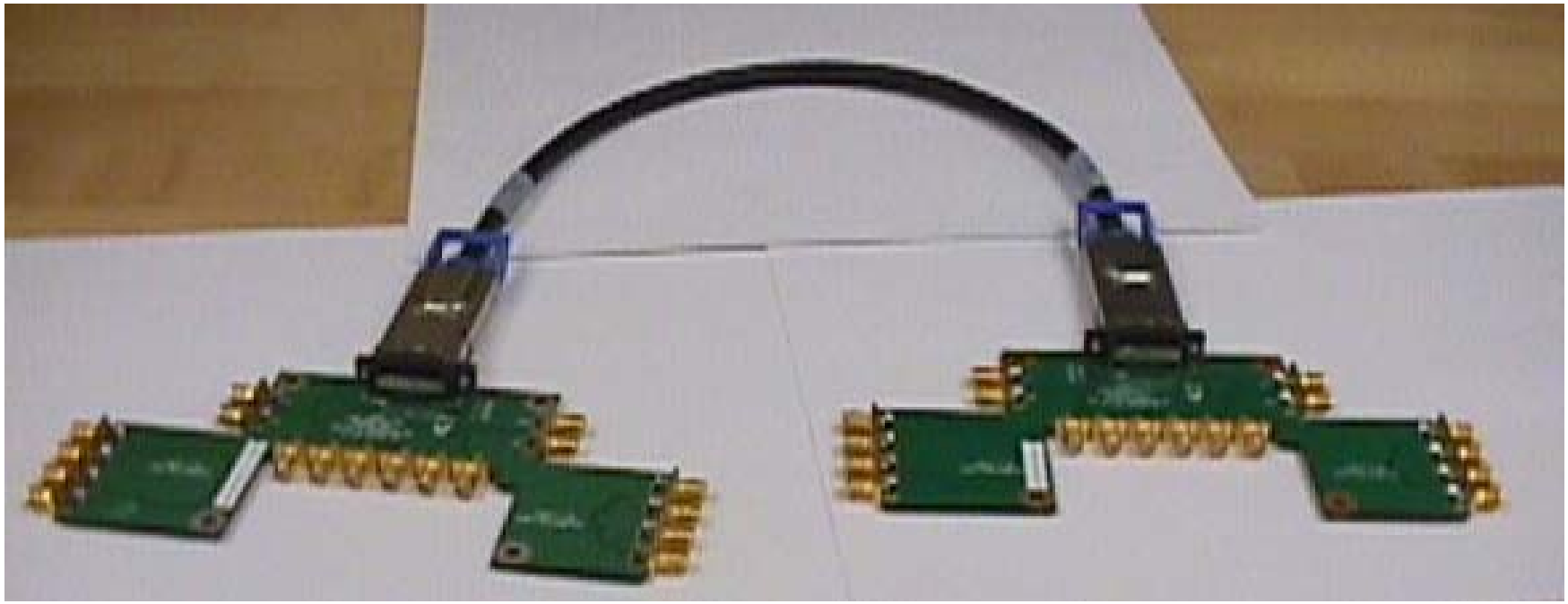
Thinh Nguyen
Dean Vermeersch

- Tektronix 11801C Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- Risetime measurements are made in accordance with SFF-8410.
- This report shows the risetime measurements of the test system with and without filtering.

# Test Fixture



# Test Fixtures with Cable Assembly as DUT



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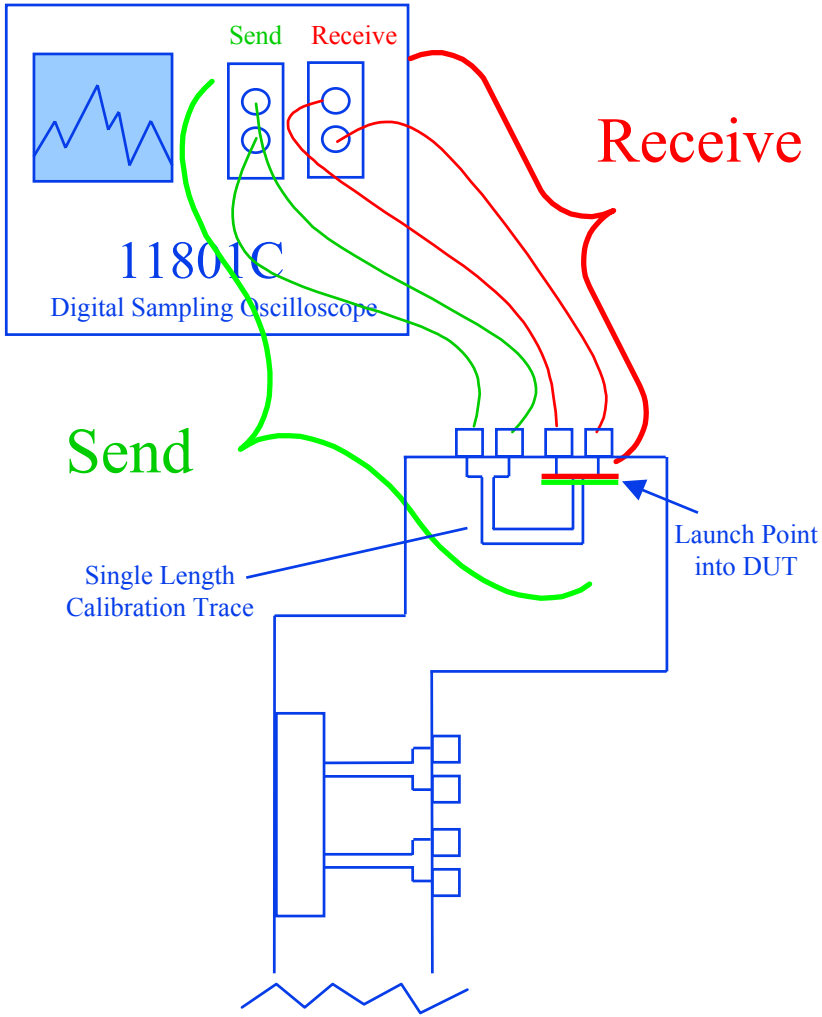
# The FCI test fixture has two sets of calibration traces:

Single Length Calibration Trace:

- One set of calibration traces consists of a trace length the same as in the test fixture, with SMA side launch connectors on both ends of the trace. Risetime measurements through this calibration structure will be refered to as “single length calibration trace.” Many testers use this calibration structure to attempt determining the risetime of the test pulse edge at the point when it enters the device under test.
- Note from the test data, that this calibration structure and method does NOT yield an accurate approximation of risetime at launch into the DUT; ***for this test fixture and test leads.*** In fact a much slower risetime is recorded with this method than actually exists at the launch into the DUT.

# Test System Risetime Measurements for Time Domain Impedance Profile and Crosstalk




Measures single length calibration trace risetime

$(\text{This measurement})^2 = \text{SEND}^2 + \text{RECEIVE}^2$

Note: SEND ≠ RECEIVE, so cannot solve for send, and cannot determine risetime at launch into DUT

Note: Some testers assume RECEIVE = 0 by using very short RECEIVE test leads, but this ignores the large reflection from the RECEIVE SMA launch.

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# The FCI test fixture has two sets of calibration traces: (continued)

Double Length Calibration Trace:

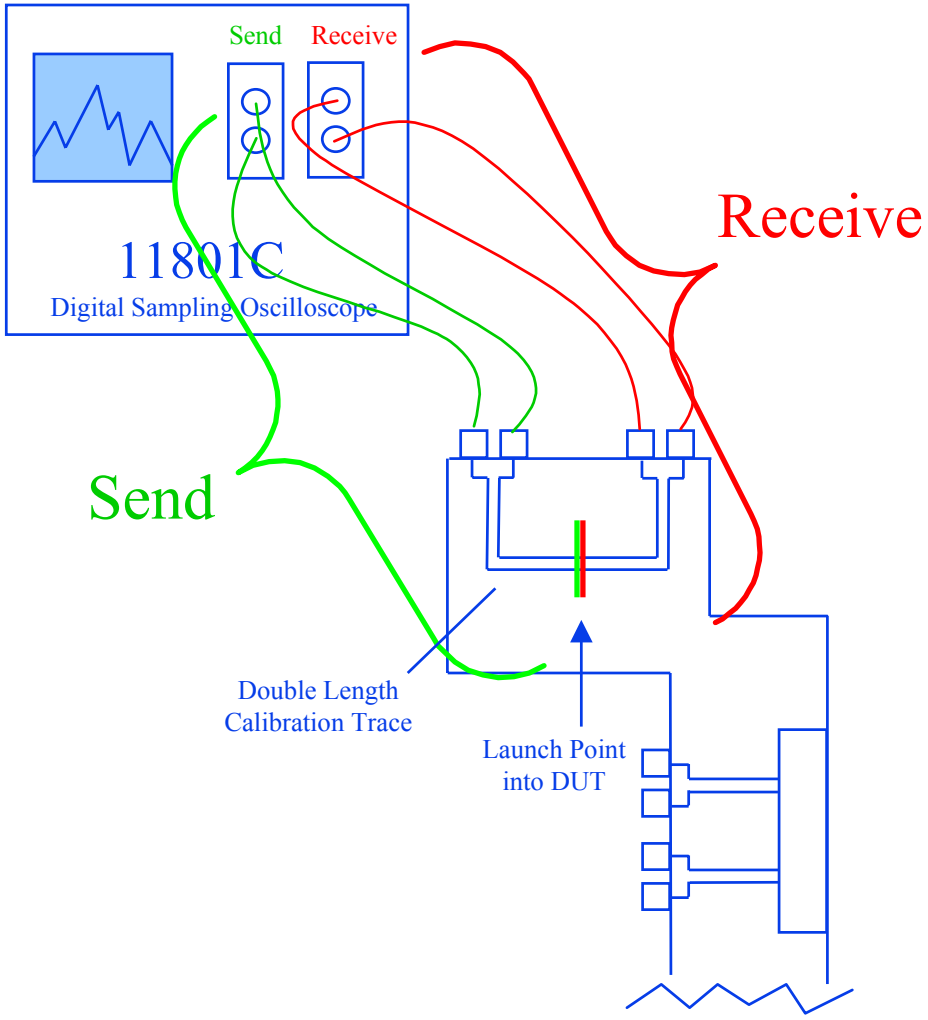
- The other set of calibration traces consists of a trace length that is twice the length of the traces in the test fixture, with SMA side launch connectors on both ends of the double length trace. Risetime measurements through this calibration structure will be refered to as “double length calibration trace.” This calibration structure measures Total Test System Risetime as defined in SFF-8410 and EIA-364-90.

# The FCI test fixture has two sets of calibration traces: (continued)

Risetime of test pulse at launch into the device under test (DUT):

- The structure of the "double length calibration trace" is symmetrical about the test reference plane if identical send and return test leads are used. This symmetry may be utilized to accurately determine the risetime of the pulse edge at the reference plane (at launch into the DUT).
- Total test system risetime equals the square root of the sums of squares of the risetime of the components in the test system. Due to symmetry, there are two components in this calibration test system (send and receive), and the two components are equal to each other. With the total measured, we can solve for the component, which is Risetime of the test pulse at the DUT.
- Risetime at DUT = square root of (Total test system risetime squared / 2).

# Test System Risetime Measurements for Time Domain Impedance Profile and Crosstalk




- Measures total test system risetime
  - Includes all portions of test system, test leads, and test fixtures that are part of the test when the DUT is in place, but are not part of the DUT
- The calibration system is symmetric about the lunch point into the DUT:

  $TOTAL^2 = SEND^2 + RECEIVE^2$

  Due to symmetry SEND = RECEIVE, so substitute:

  $TOTAL^2 = SEND^2 + SEND^2$

  $SEND = \sqrt{TOTAL^2 / 2}$

- SEND = Risetime of pulse edge at launch point into DUT

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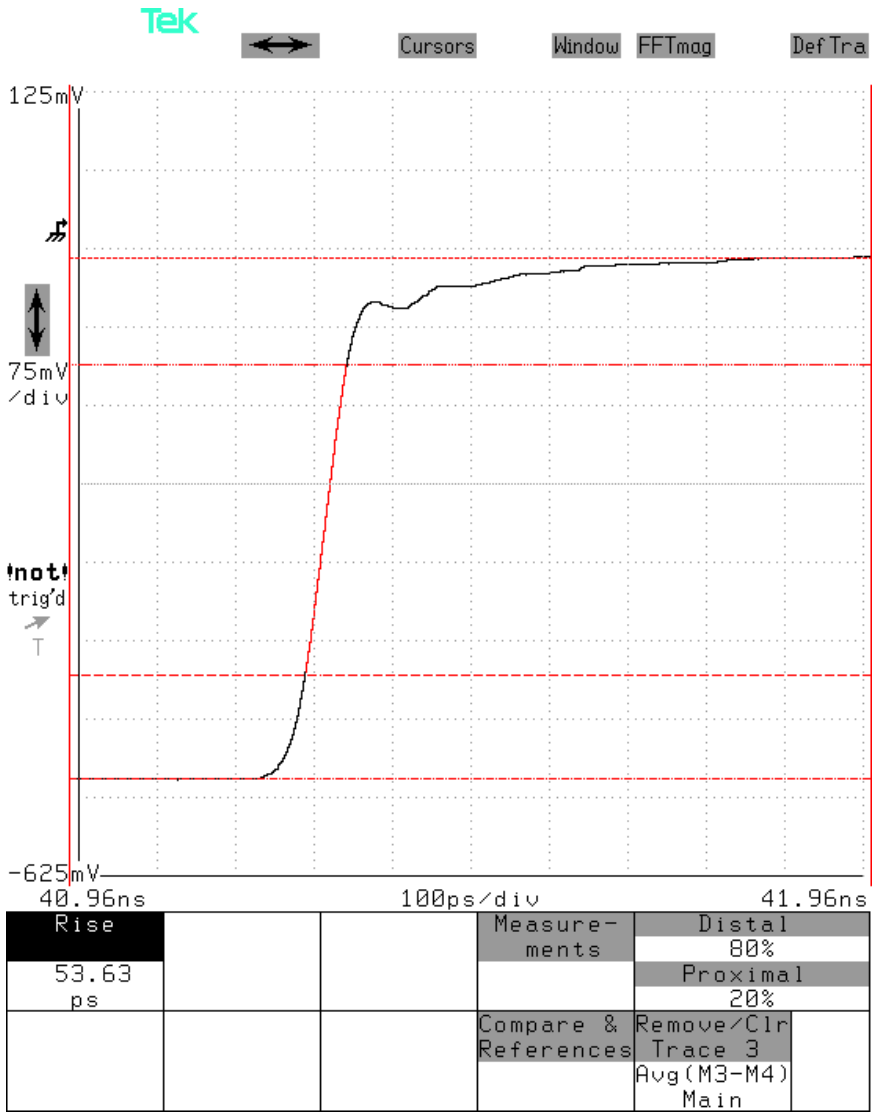
# Risetime Measurements

- The following slides show the risetime waveforms through the various calibration structures, with and without filtering added.
- Waveforms with filtering added are included because it has been requested to measure Impedance Profile and Cross Talk at 50 ps, 75 ps, and 100 ps risetimes.
- Because everyone has a different way of determining the risetime at which a measurement is made, for reference purposes, each time domain data plot for Impedance profile or crosstalk will list:
  - Total Test System Risetime (per SFF-8410 and EIA-364-90)
  - Risetime through single length calibration trace (per SFF-8470)
  - Risetime at DUT {= [(Total^2)/2]^0.5}

# Typical Fixture Rise Time Measurement

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = None

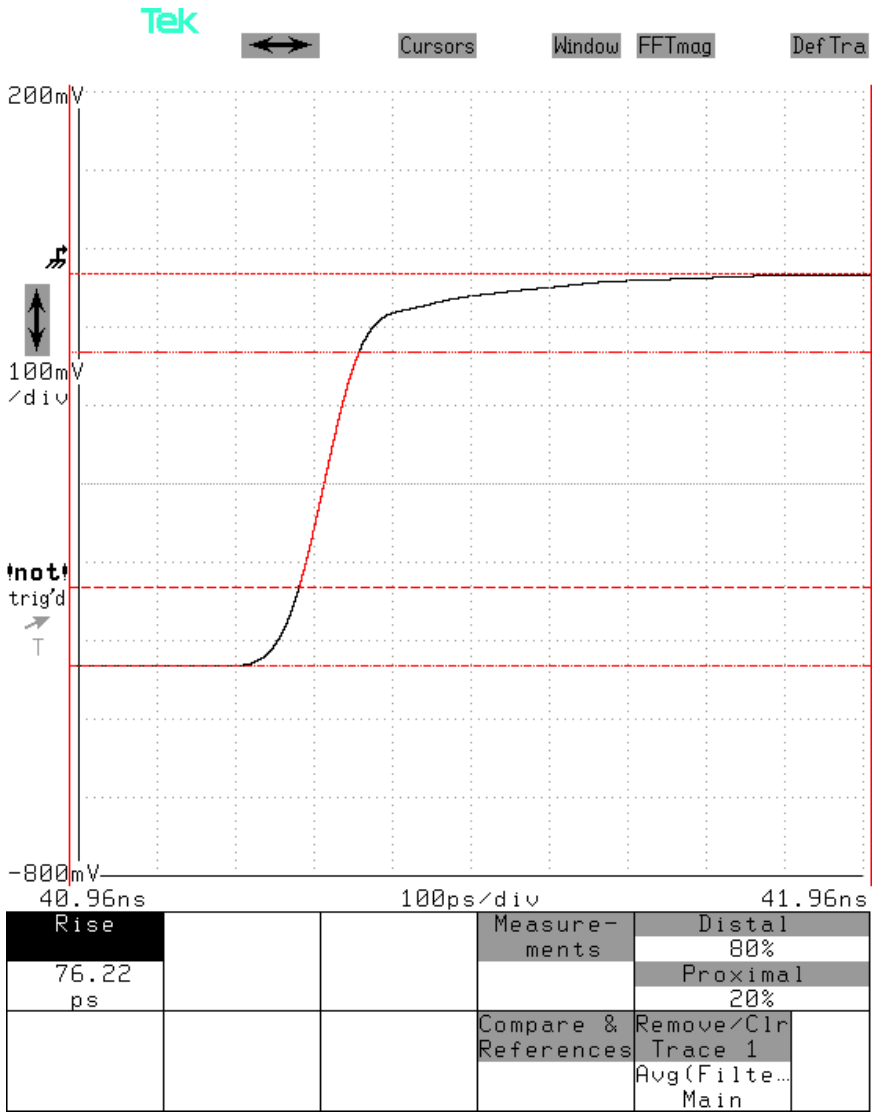
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps



# Typical Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = 70 Pico-seconds

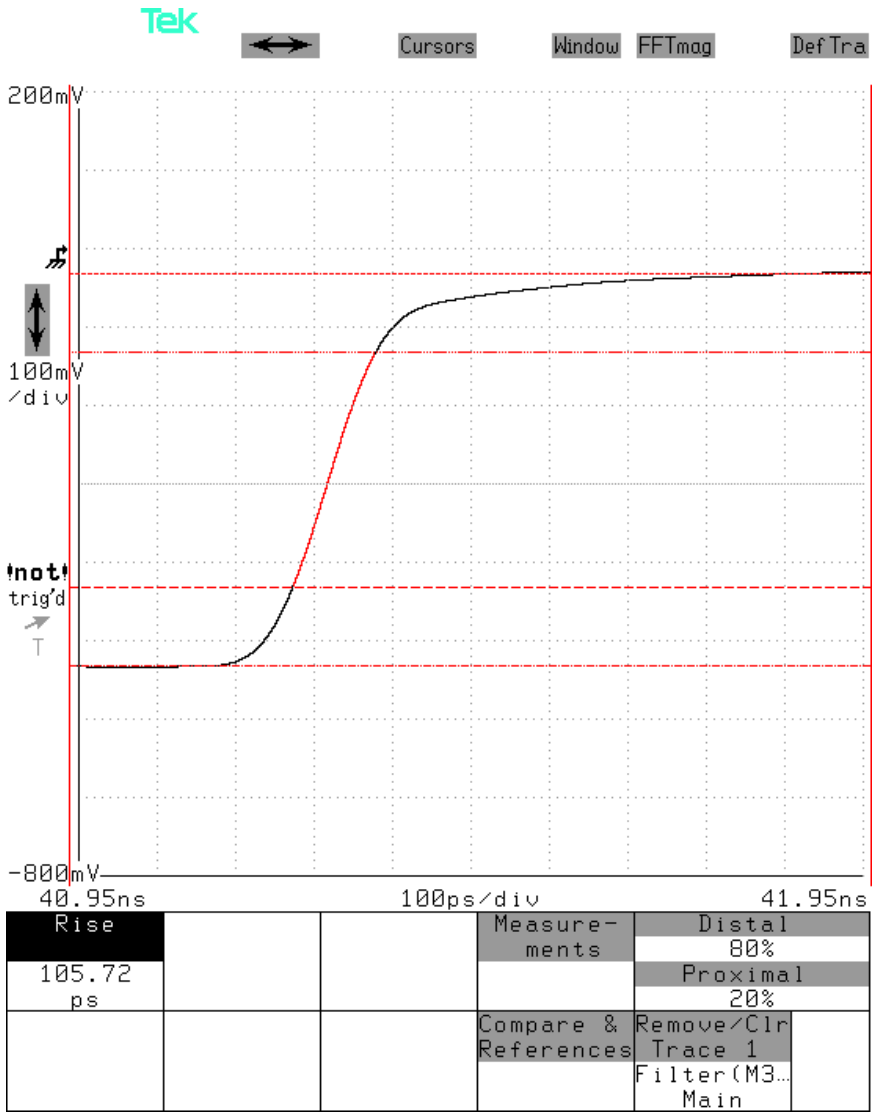
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps



# Typical Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = 120 Pico-seconds

- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps

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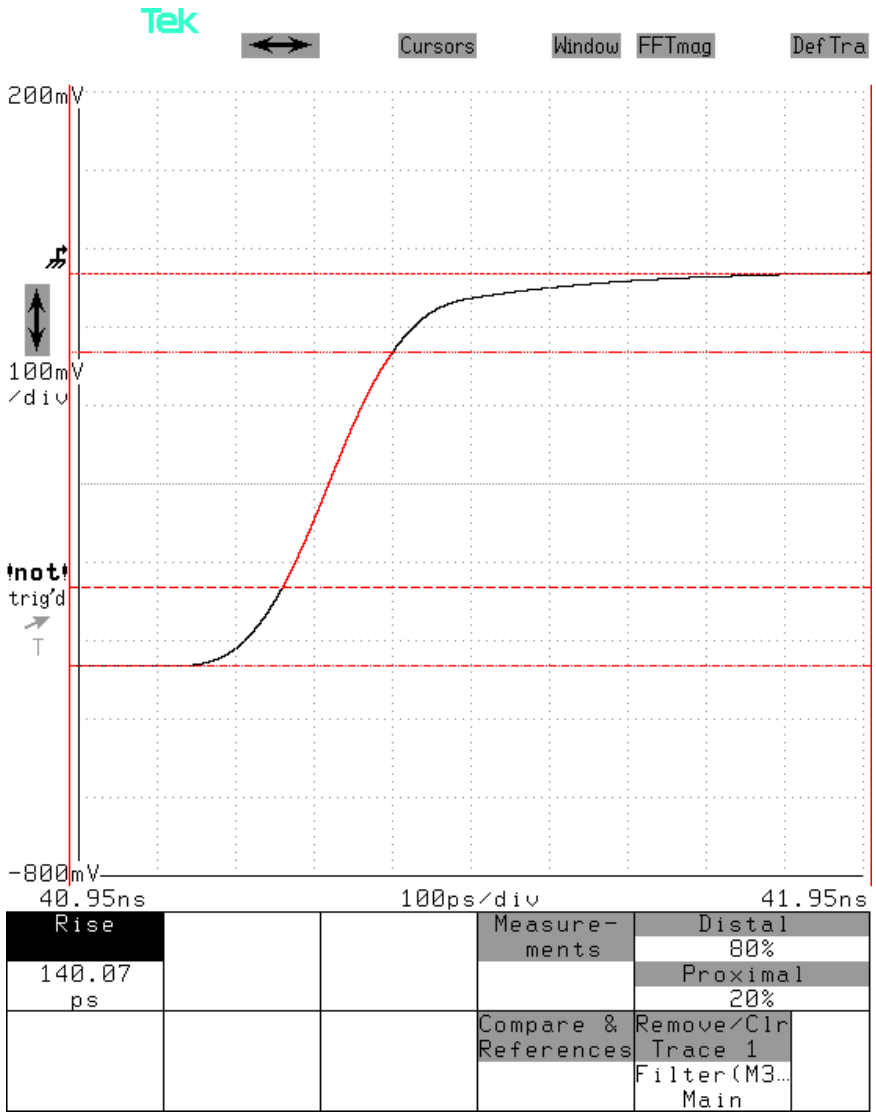
# Typical Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Filter = 175 Pico-seconds

- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps

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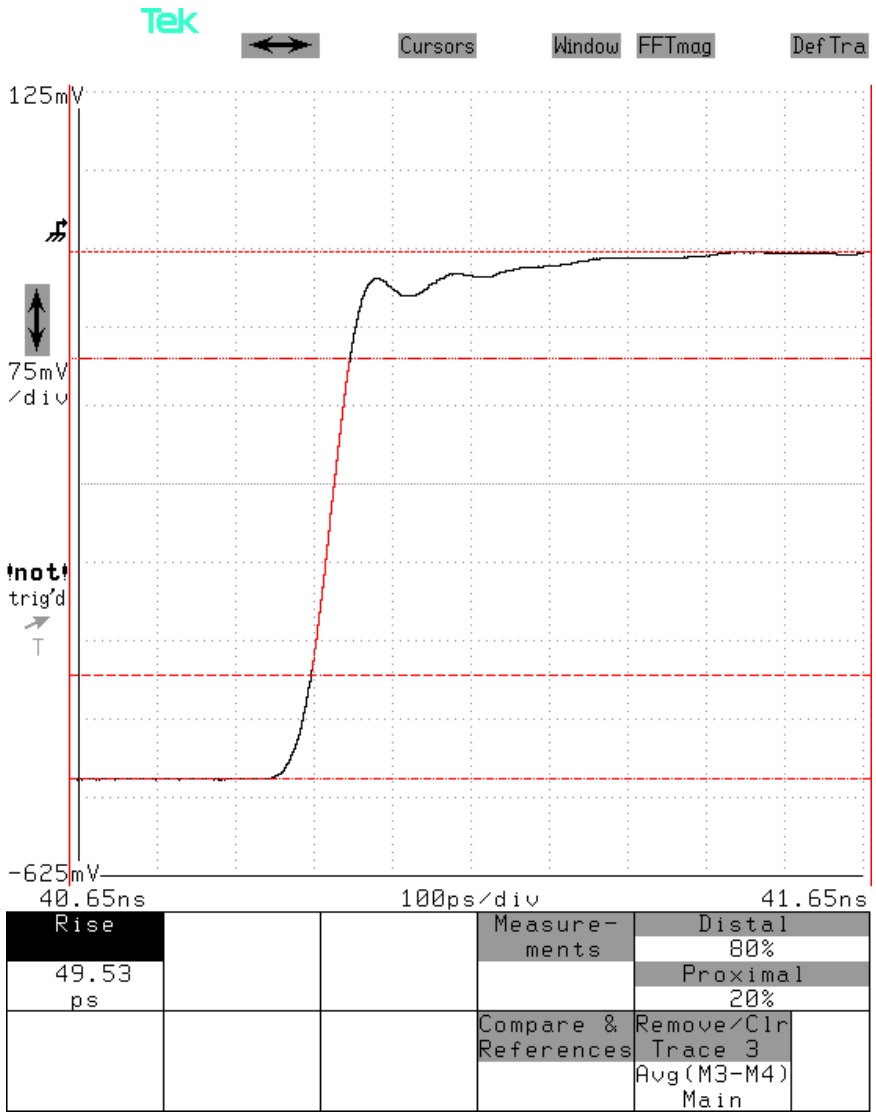
# Typical Through Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = None

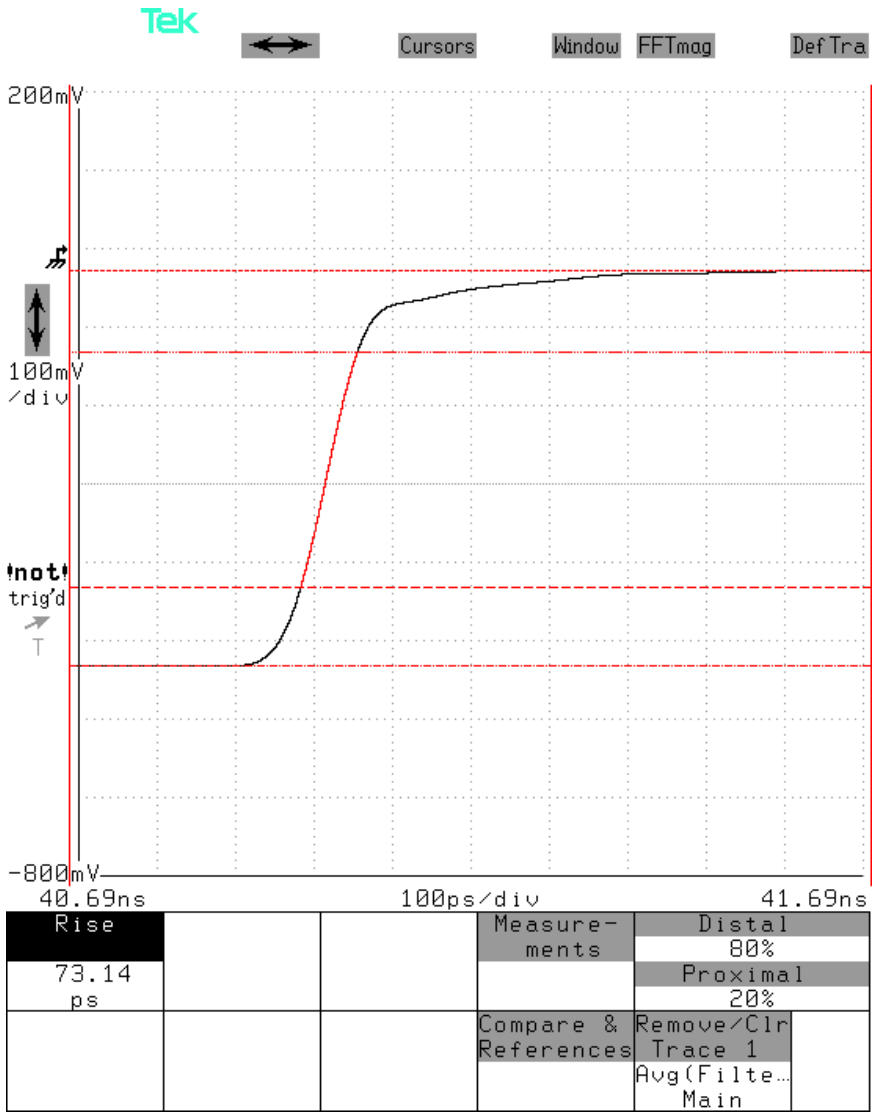
- Single length Risetime = 49.53 ps



# Typical Fixture Rise Time Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = 70 Pico-seconds

- Single length Risetime = 73.14 ps

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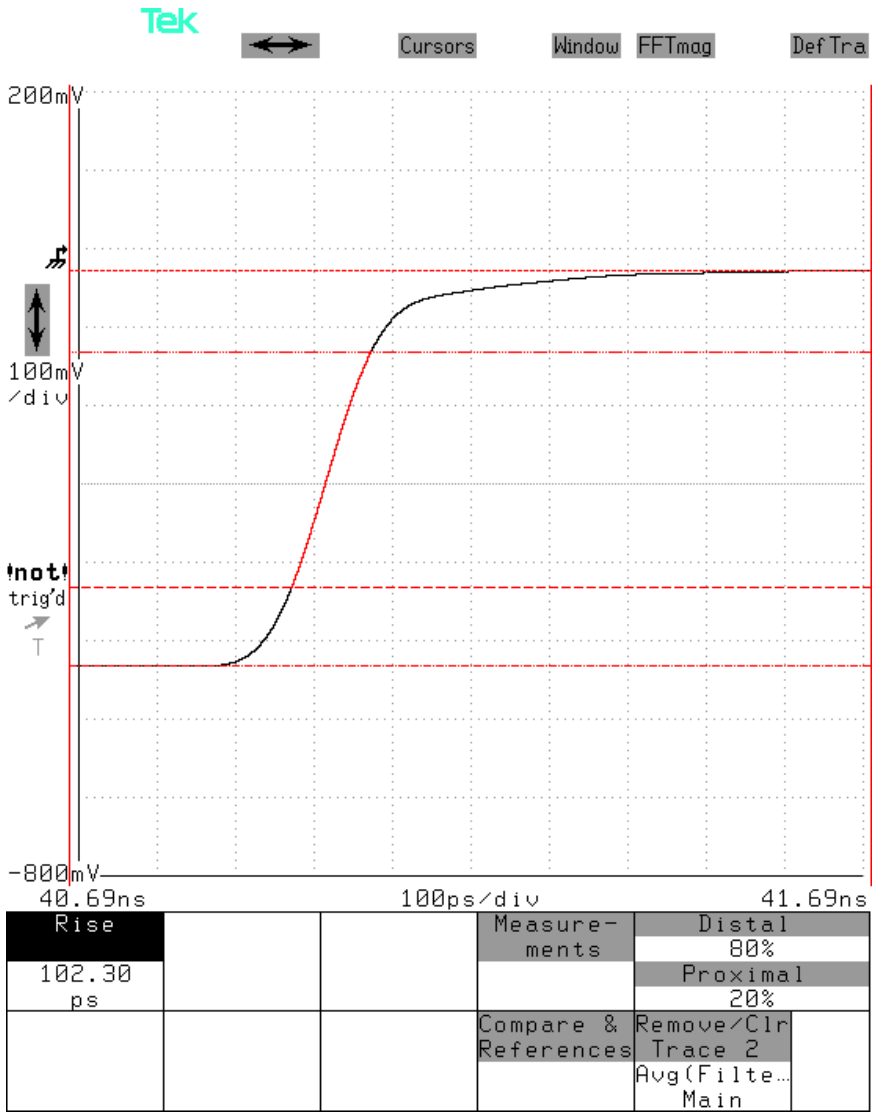
# Typical Fixture Rise Time Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = 120 Pico-seconds

- Single length Risetime = 102.3 ps

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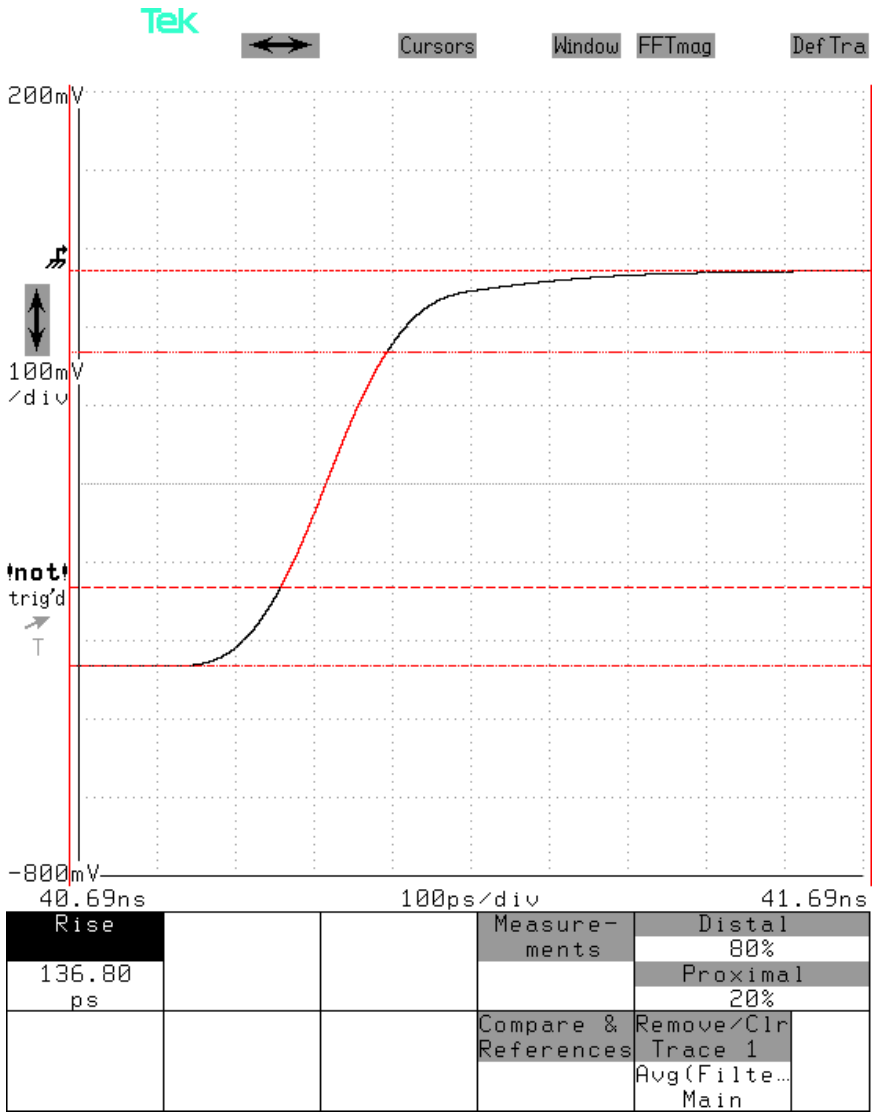
# Typical Fixture Rise Time Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = 175 Pico-seconds

- Single length Risetime = 136.8 ps

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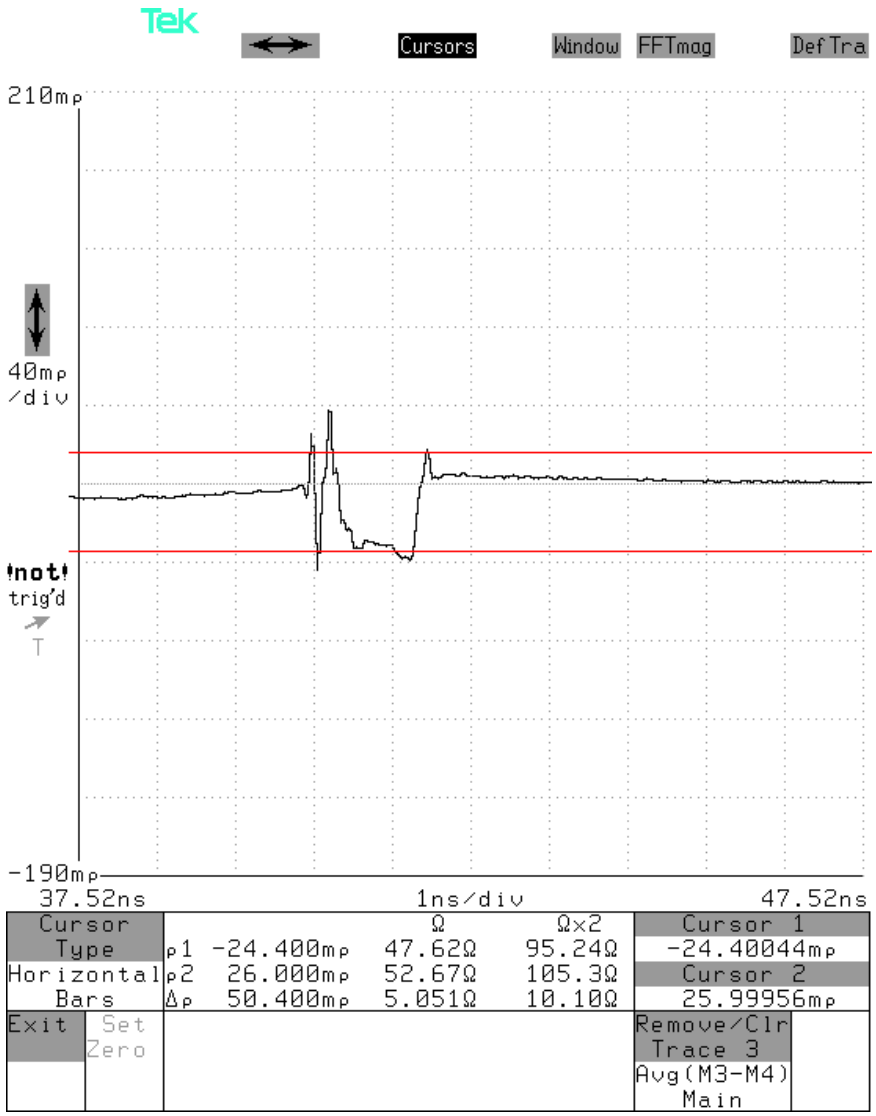
# The FCI test fixture Impedance Profile through the calibration traces

For reference purposes, the following slides show the Impedance Profile through the double length and single length calibration traces of the test fixture.

Compare the profile of these calibration traces to the profile of the test traces when a DUT is measured. Note that no two test traces have the same impedance profile, and no test traces are the same as the calibration traces. This will have an impact on the accuracy of calibrations when using this test fixture.

# Typical Impedance Profile Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDR From Tek. 11801C
- Fixture: FCI test Fixture, 4X Infiniband, SK-48295 Rev 2.
- Double length calibration trace
- Filter = None

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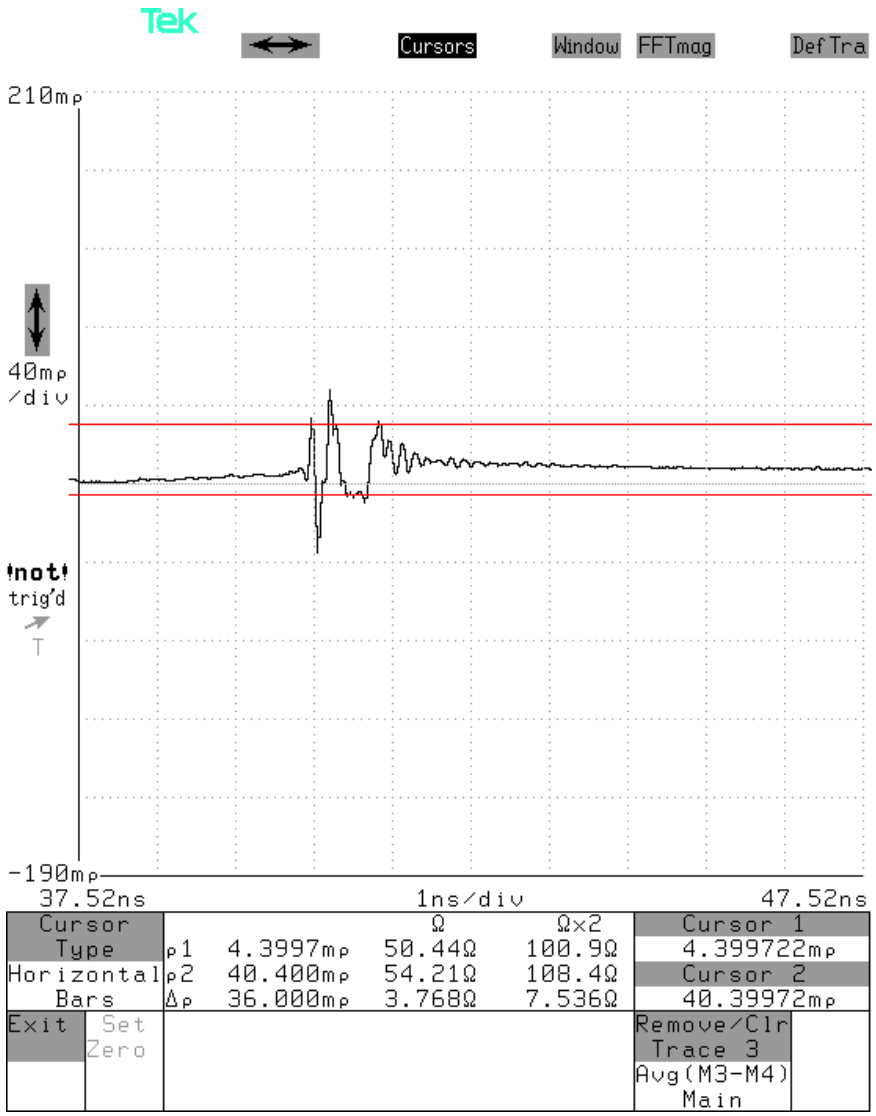
# Typical Impedance Profile Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDR From Tek. 11801C
- Fixture: FCI test Fixture, 4X Infiniband, SK-48295 Rev 2.
- Single length calibration trace
- Filter = None

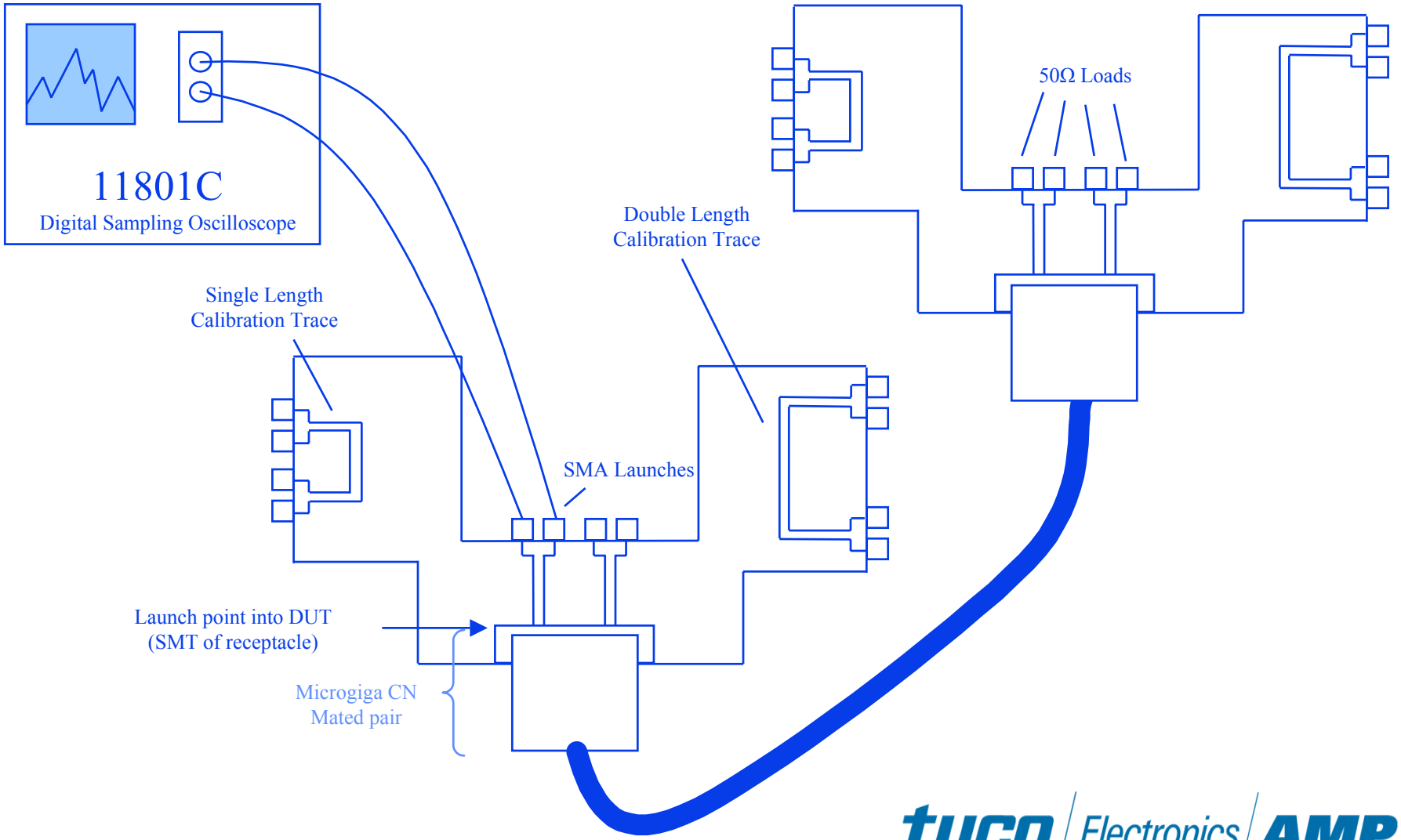


# Impedance Profile Measurements

Thinh Nguyen
Dean Vermeersch

- Tektronix TDS 8000 Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- Impedance Profile measurements are made in accordance with SFF-8410.
- This report shows the Impedance Profile measurements of 0.5 meter length 28 AWG MicroGiga CN cable assembly without filtering. Also included is one pair of 5 meter length 28 AWG, and 10 meter length 24 AWG for comparison.

# Time Domain Impedance Profile Test Set-Up



# Impedance Profile Measurements

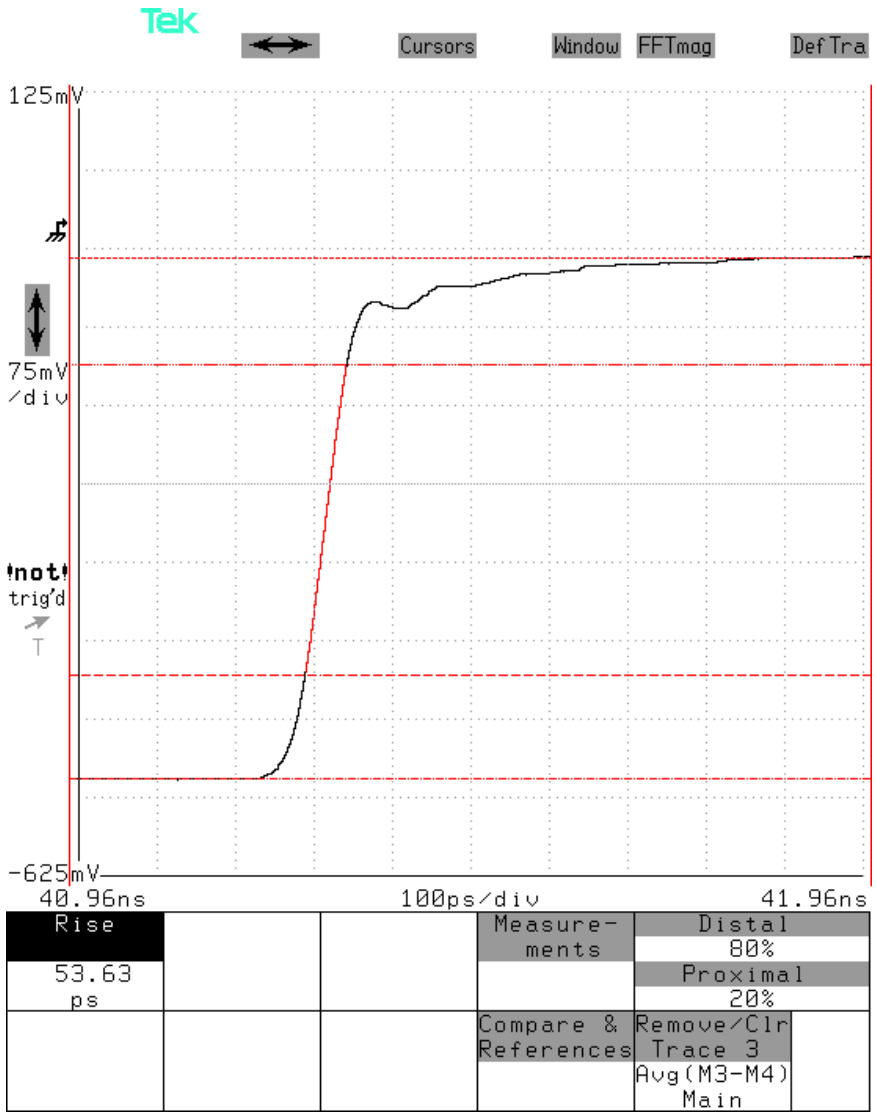
- The following slides show the risetime waveforms for when no filter is used in the test system.
- The first slide labeled double length calibration trace shows total test system risetime of 54 ps and risitime at launch into the DUT of 38 ps.
- The second slide labeled single length calibration trace shows a risetime of 50 ps

- This Impedance Profile data is for those who are interested in total test system risetime, and risetime through the single length traces, of 50 ps.

# Typical Fixture Rise Time Measurement

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = None

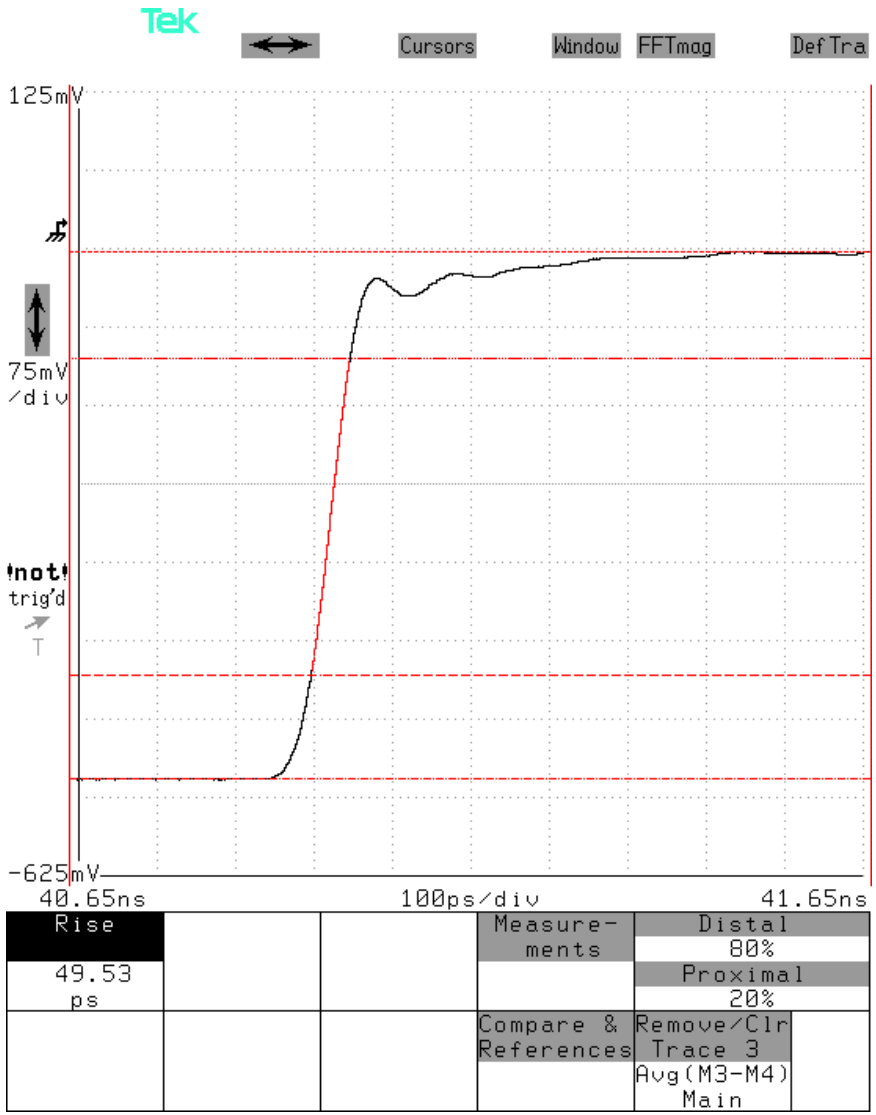
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps



# Typical Through Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = None

- Single length Risetime = 49.53 ps



# Impedance Profile Measurements

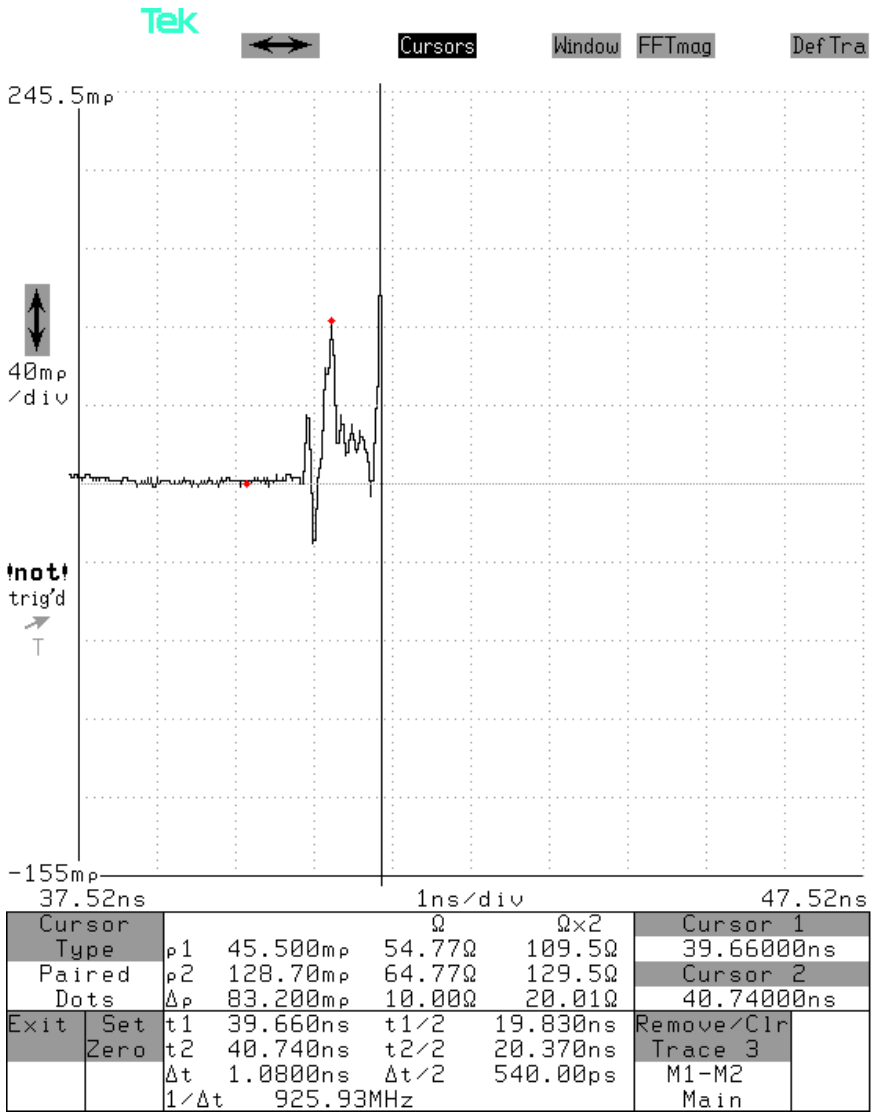
- The following slides show the Impedance Profile of the test fixture with nothing mated to the FCI MicroGiga CN receptacle that is mounted on the fixture.
- Two slides for two different positions in the fixture.
- These slides may be used to roughly determine the location in time of the interface between the board mount receptacle and the cable plug.

- Compare this Impedance profile to the Impedance profiles of the calibration traces (shown in the risetime measurement file). Note that the impedance profile of the calibration traces is not the same as the actual traces, this will yield errors in vector calibrations.

# Typical Impedance Profile Measurement

- Date: 2/6/03
- Temperature: 75.74 F
- Relative Humidity: 8.9 %
- Method: TDR From Tek. 11801C
- Fixture: FCI test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: PC Trace S1, S2 of TB # 2
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

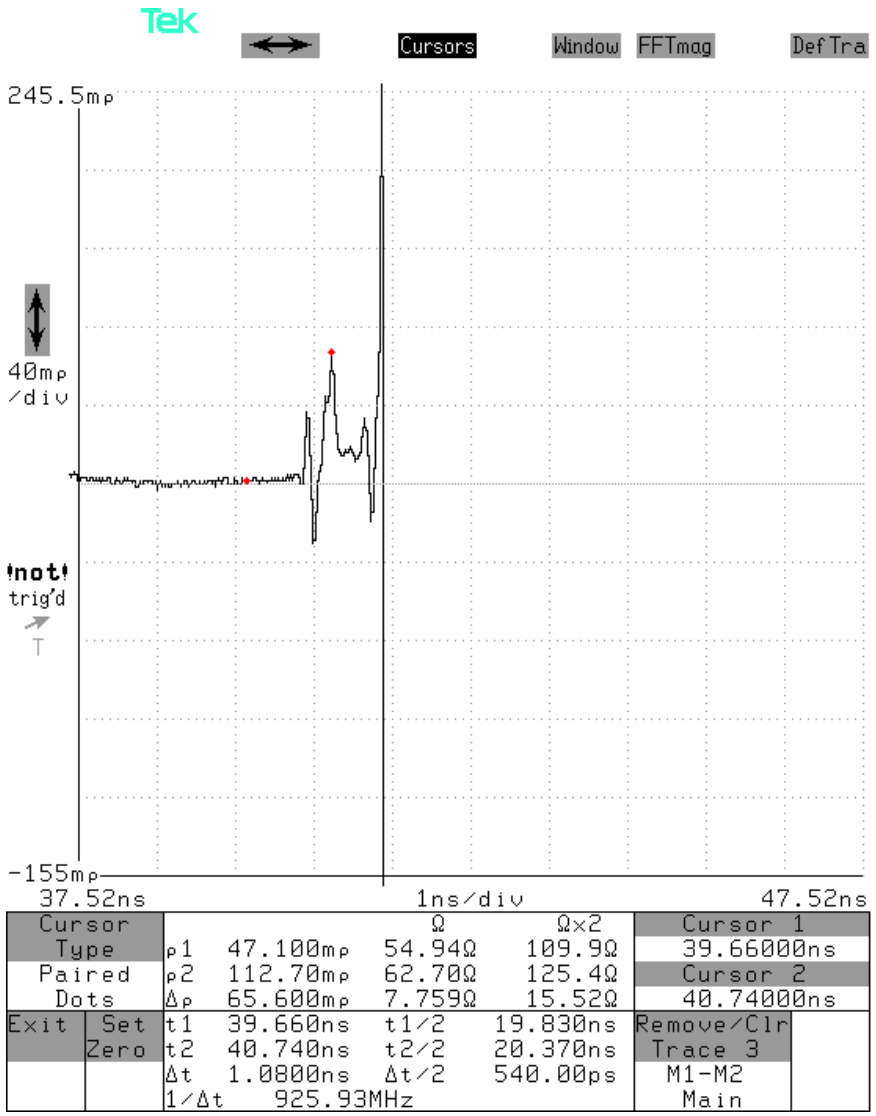
- Impedance Max = 129.5 ohms
- Impedance Min = 109.5 ohms



# Typical Impedance Profile Measurement

- Date: 2/6/03
- Temperature: 75.74 F
- Relative Humidity: 8.9 %
- Method: TDR From Tek. 11801C
- Fixture: FCI test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: PC Trace S5, S6 of TB # 2
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Impedance Max = 125.4 ohms
- Impedance Min = 109.9 ohms



# Impedance Profile Measurements

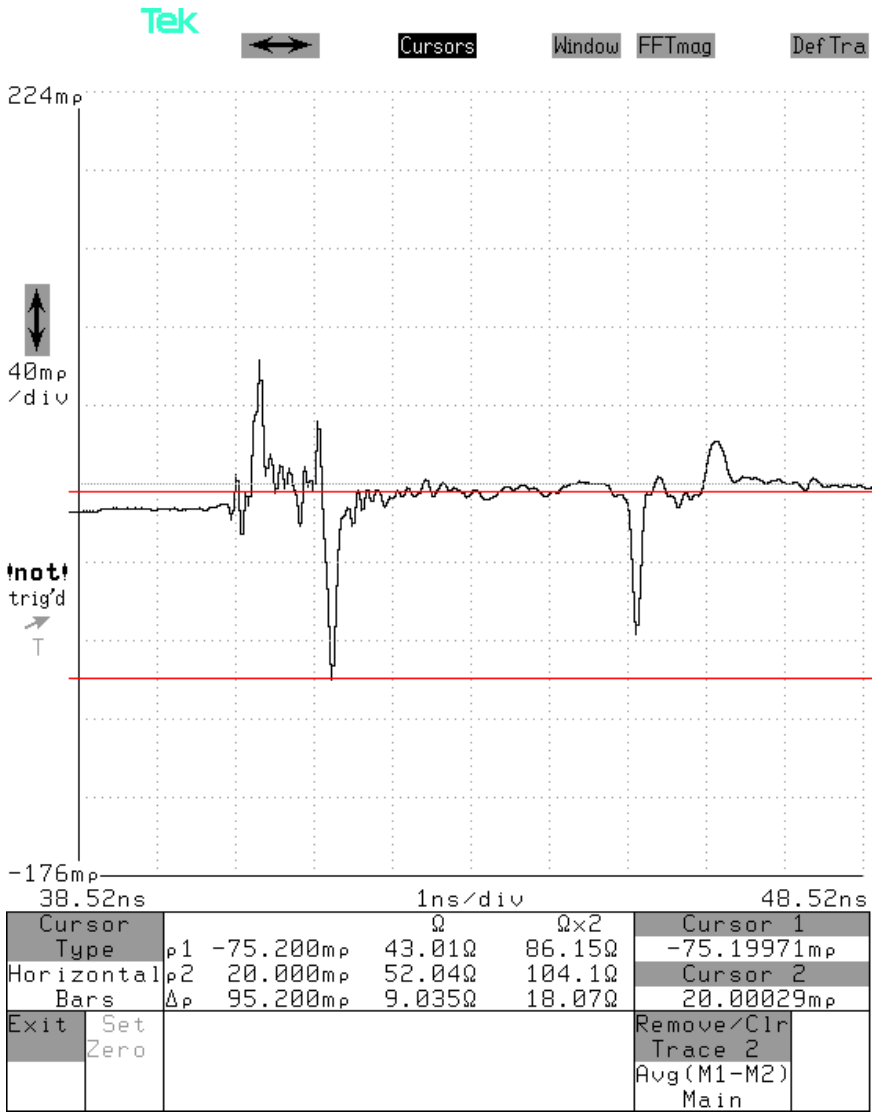
- The following slides show the Impedance Profile of each pair in the cable assembly measured from one end.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S1,S2

- Impedance Max = 104.1 ohms
- Impedance Min = 86.15 ohms

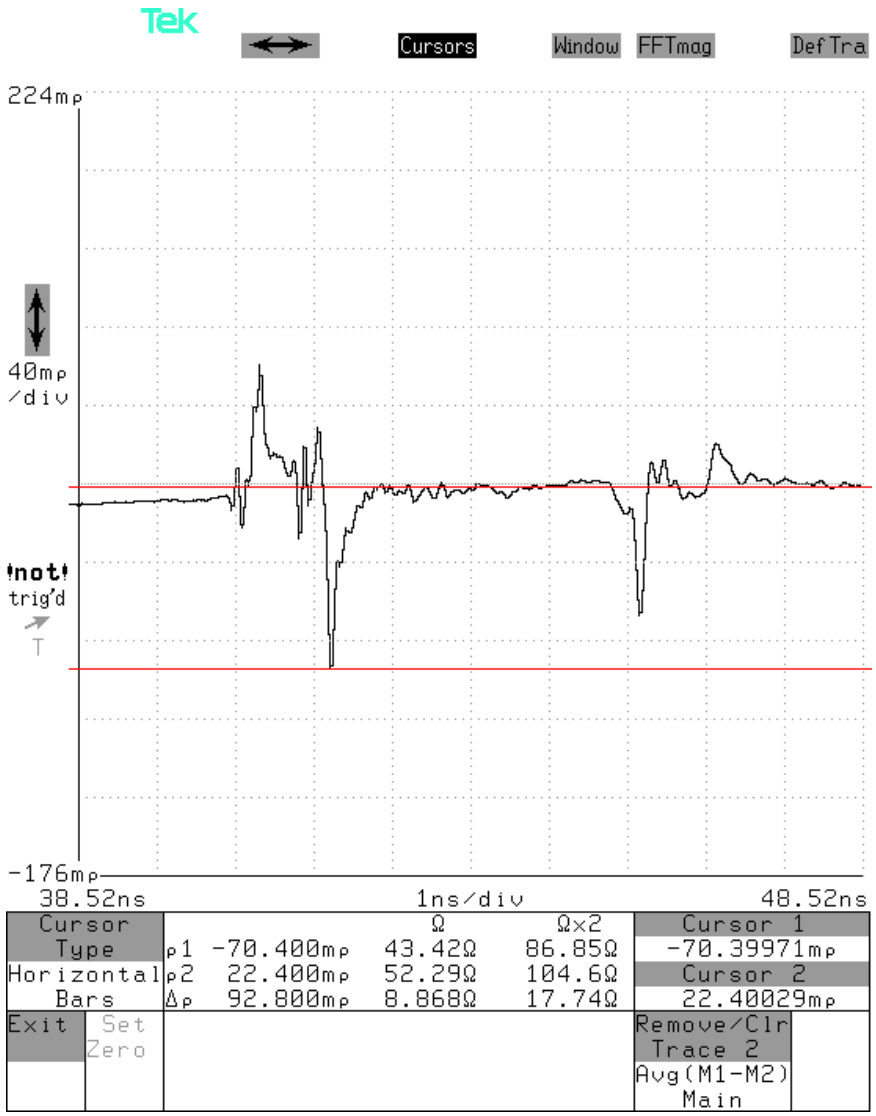


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S3, S4

- Impedance Max = 104.6 ohms
- Impedance Min = 86.85 ohms

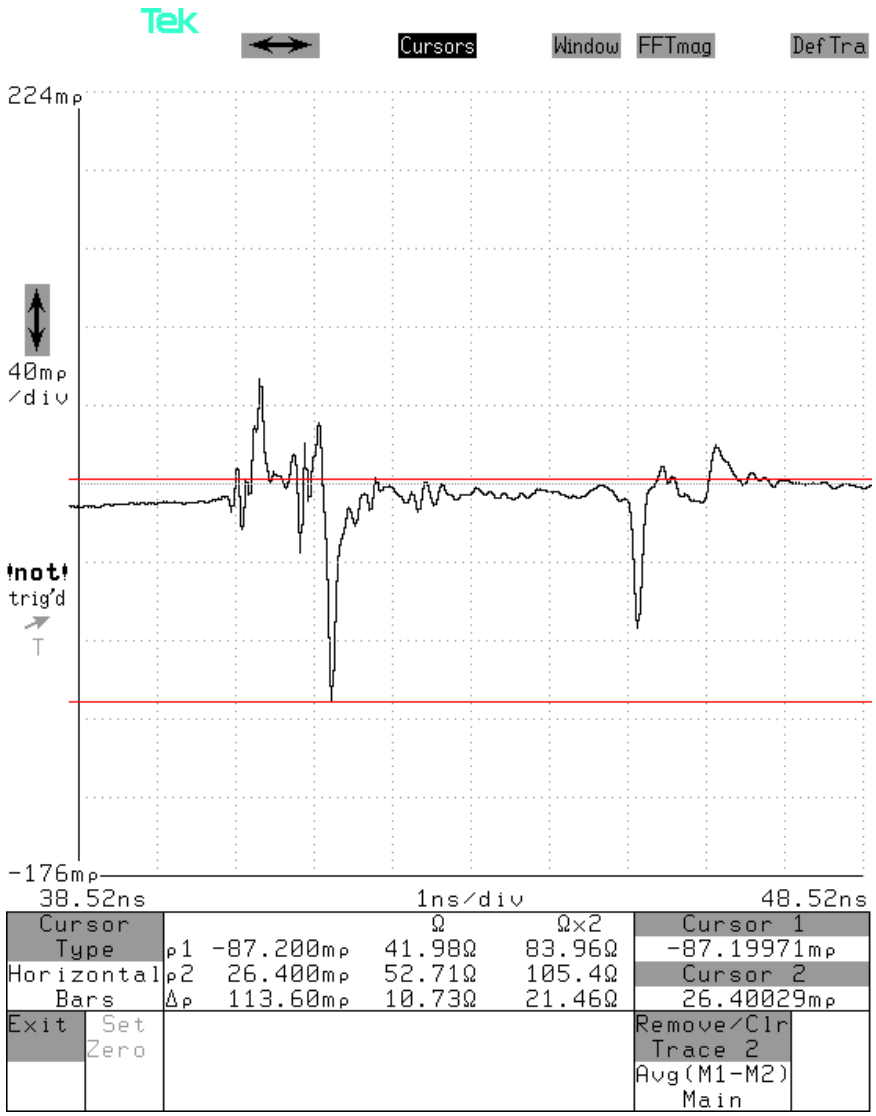


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S5, S6

- Impedance Max = 105.4 ohms
- Impedance Min = 83.96 ohms



# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S7, S8

- Impedance Max = 103.9 ohms
- Impedance Min = 82.62 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S9, S10

- Impedance Max = 104.1 ohms
- Impedance Min = 82.62 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S11, S12

- Impedance Max = 105.3 ohms
- Impedance Min = 81.95 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S13, S14

- Impedance Max = 104.2 ohms
- Impedance Min = 85.19 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S15, S16

- Impedance Max = 104.8 ohms
- Impedance Min = 82.88 ohms

# Impedance Profile Measurements

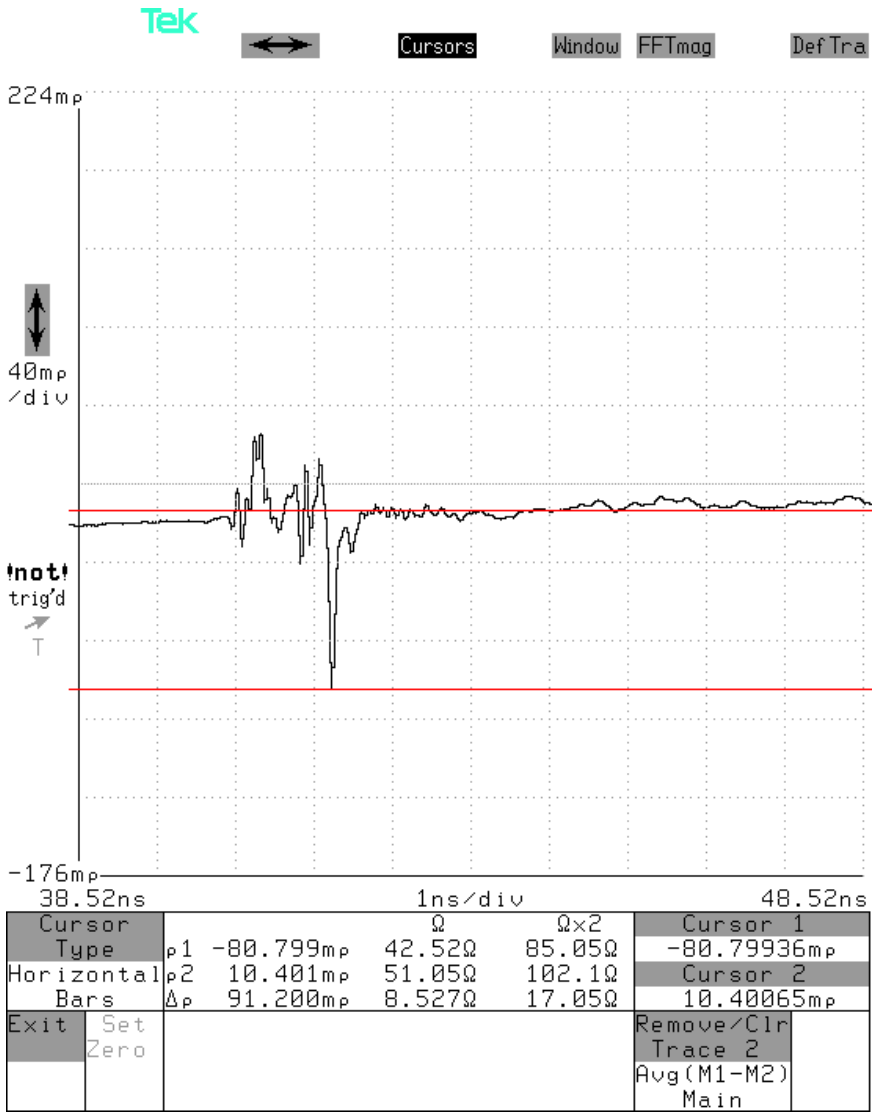
- The following slides show the Impedance Profile of pair S9S10 of the 5 meter length 28 AWG assembly, and of pair S9S10 of the 10 meter length 24 AWG assembly.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 5 meters  Skew-clear, 8 pairs, 28 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S9, S10

- Impedance Max = 102.1 ohms
- Impedance Min = 85.05 ohms

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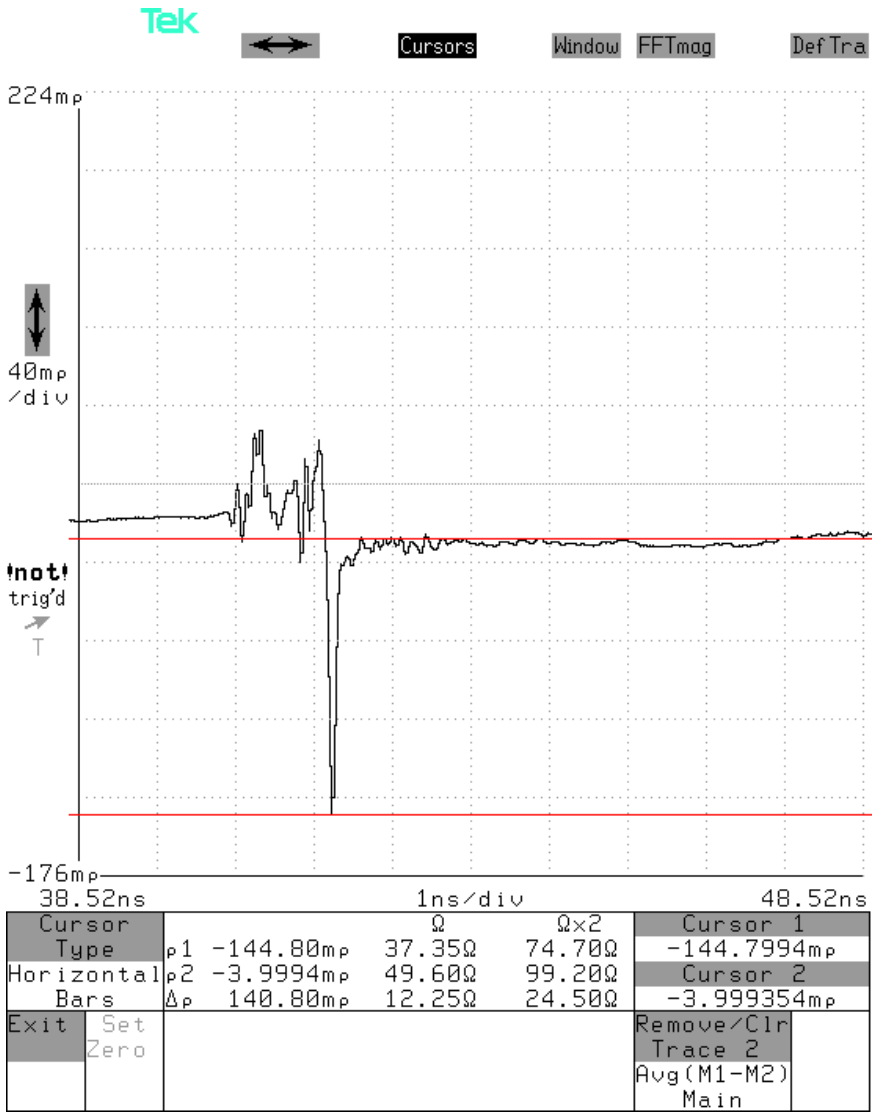
# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 10 meters  Skew-clear, 8 pairs, 24 AWG
- Filter = None
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps
- Single length Risetime = 49.53 ps

- Pair: PC S9, S10

- Impedance Max = 99.20 ohms
- Impedance Min = 74.70 ohms

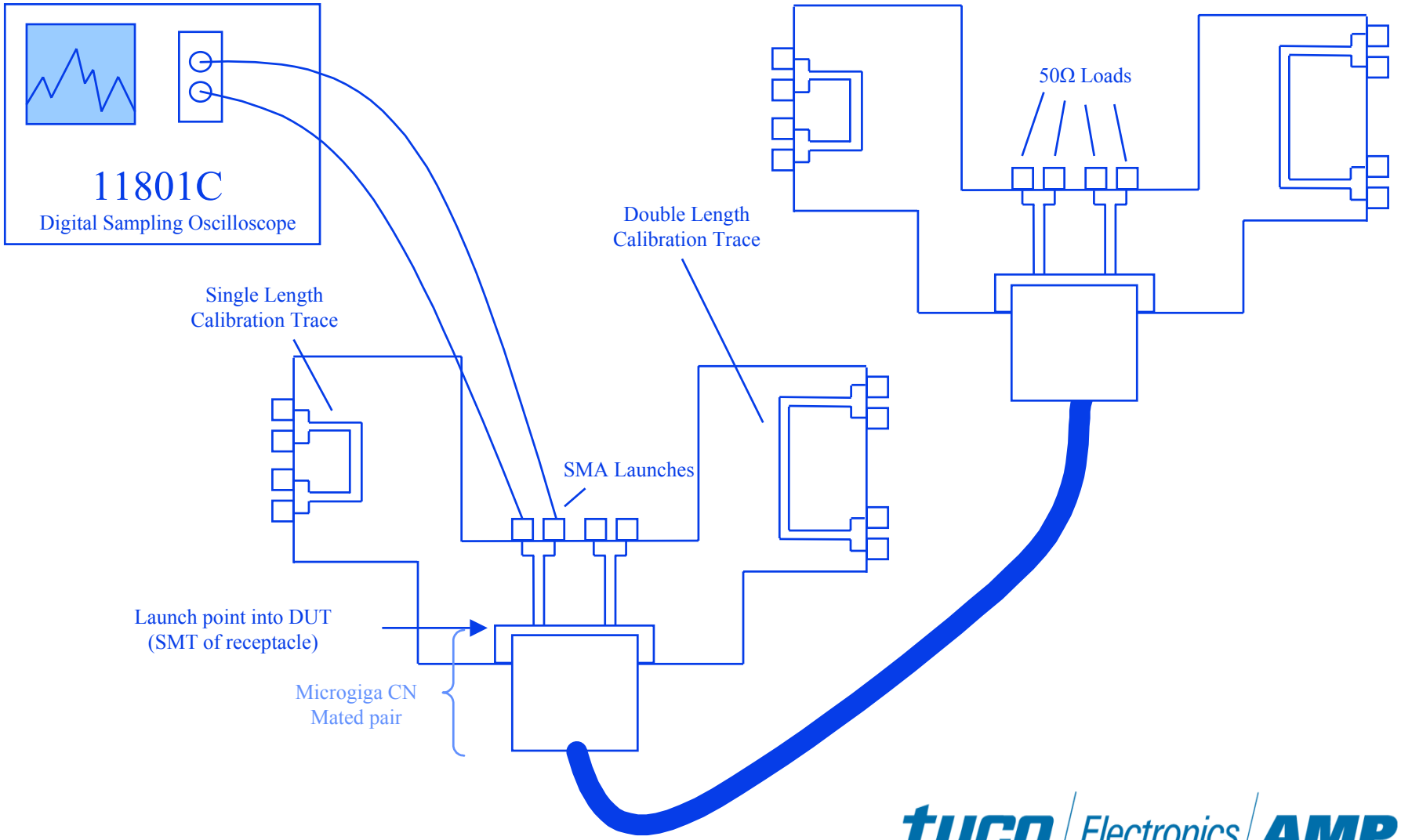


# Impedance Profile Measurements

Thinh Nguyen
Dean Vermeersch

- Tektronix TDS 8000 Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- Impedance Profile measurements are made in accordance with SFF-8410.
- This report shows the Impedance Profile measurements of 0.5 meter length 28 AWG MicroGiga CN cable assembly with filtering to achieve 50ps risetime at launch into the DUT. Also included is one pair of 5 meter length 28 AWG, and 10 meter length 24 AWG for comparison.

# Time Domain Impedance Profile Test Set-Up



# Impedance Profile Measurements

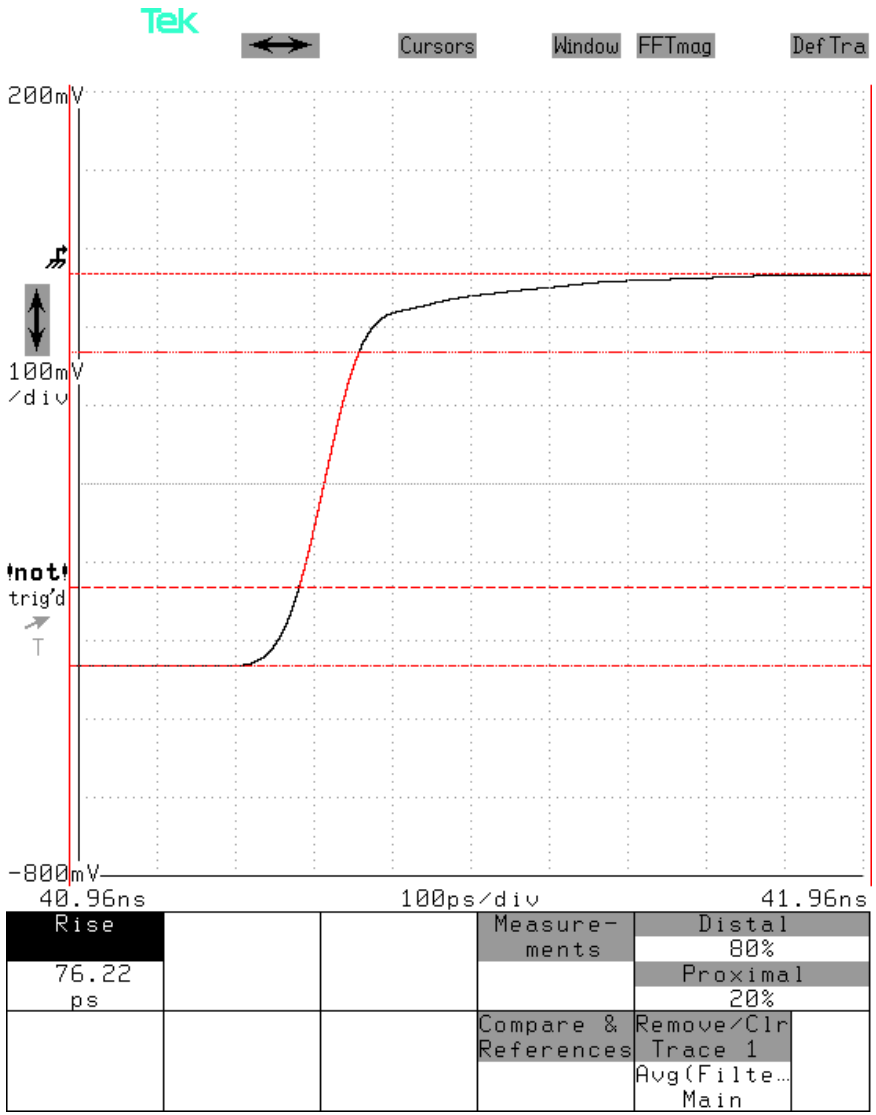
- The following slides show the risetime waveforms for when a 70 ps filter is used in the test system.
- The first slide labeled double length calibration trace shows total test system risetime of 76 ps and risitime at launch into the DUT of 54 ps.
- The second slide labeled single length calibration trace shows a risetime of 73 ps

- This Impedance Profile data is for those who are interested in total test system risetime, and risetime through the single length traces, of 75 ps.
- And for those who are interested in risetime of 50 ps at launch into the DUT.

# Typical Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = 70 Pico-seconds

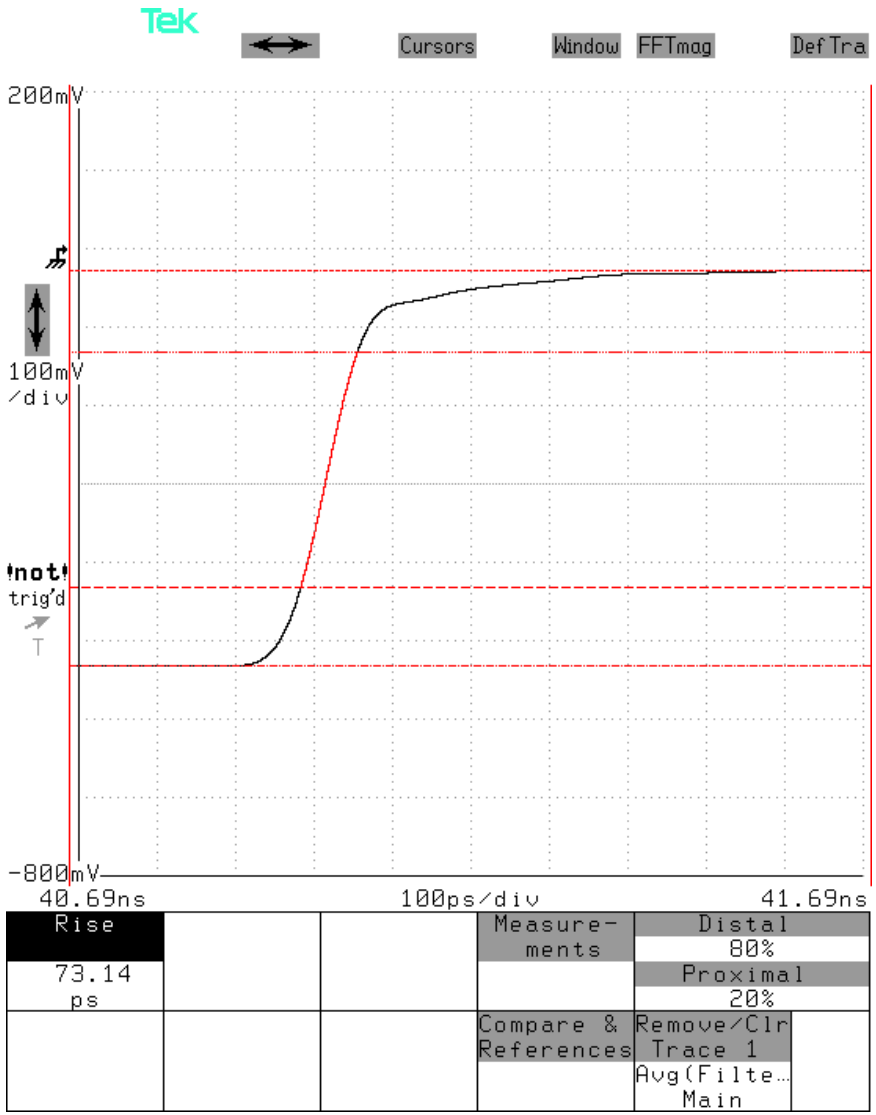
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps



# Typical Fixture Rise Time Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = 70 Pico-seconds

- Single length Risetime = 73.14 ps

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# Impedance Profile Measurements

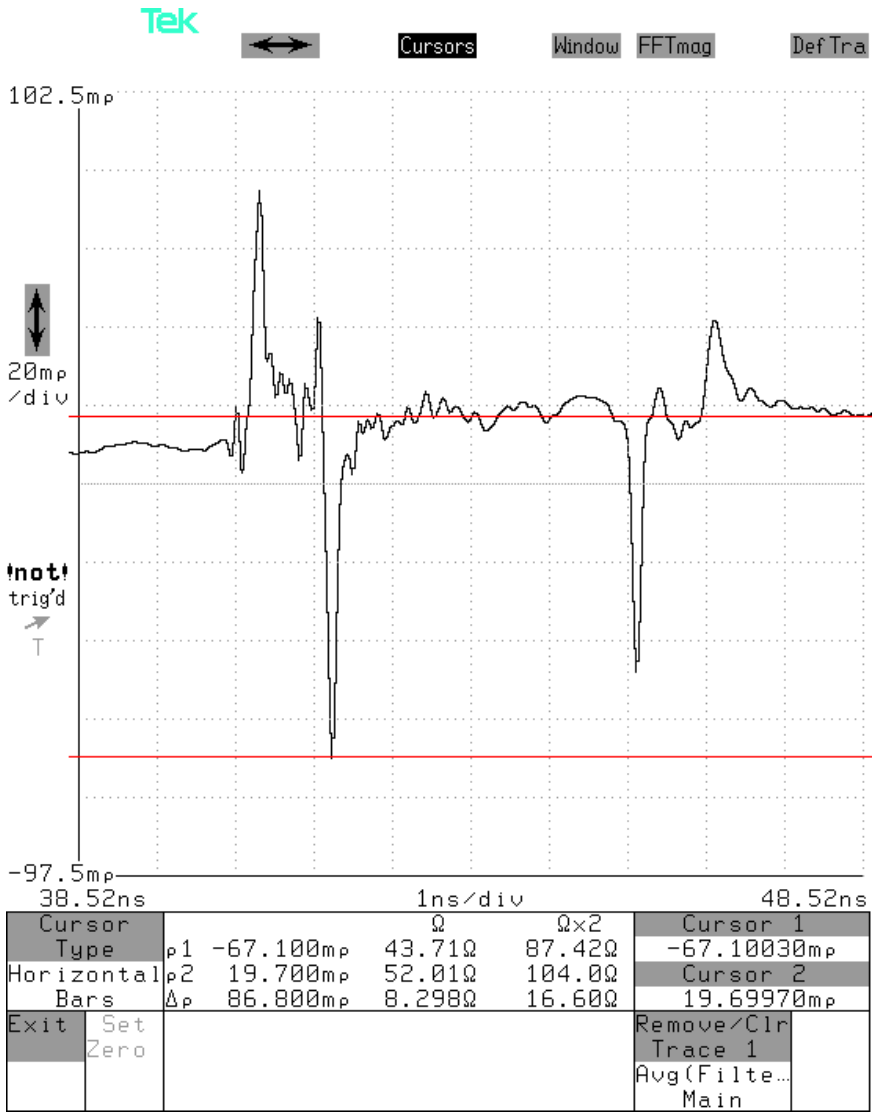
- The following slides show the Impedance Profile of each pair in the cable assembly measured from one end.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S1, S2

- Impedance Max = 104.2 ohms
- Impedance Min = 87.42 ohms

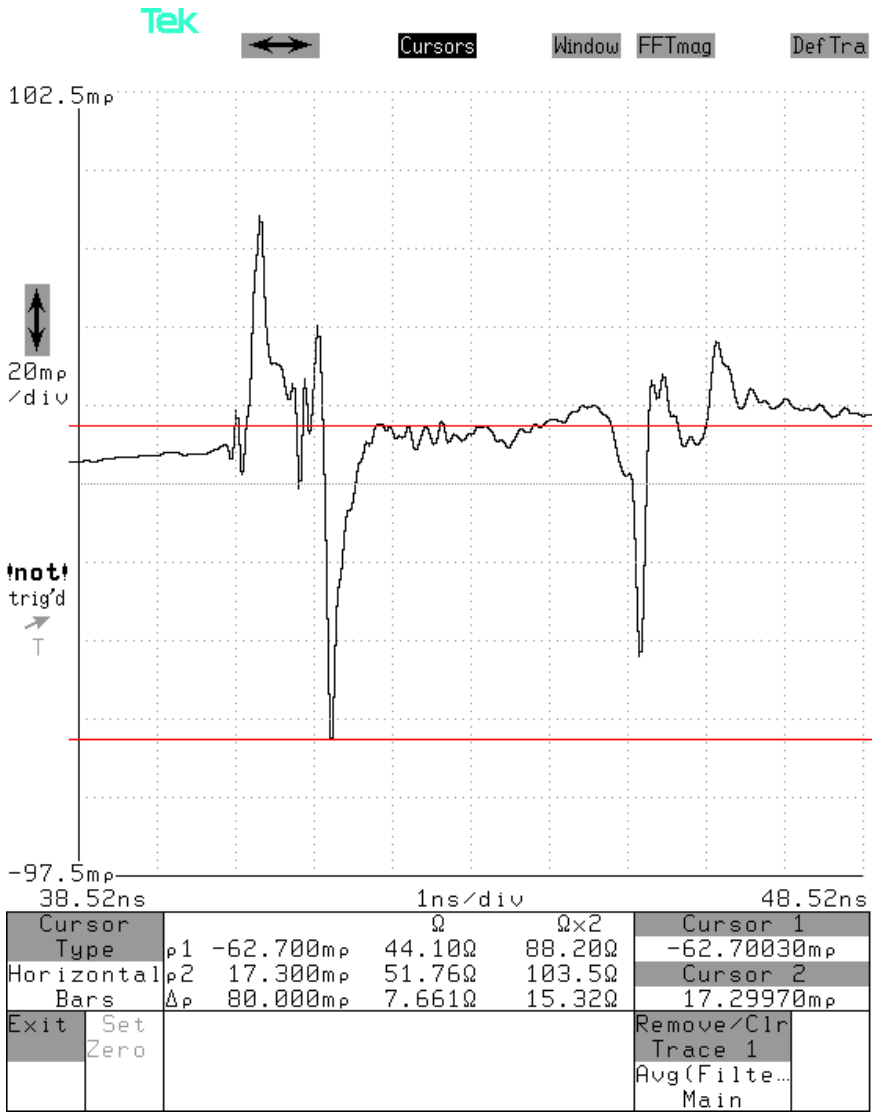


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S3, S4

- Impedance Max = 103.5 ohms
- Impedance Min = 88.20 ohms

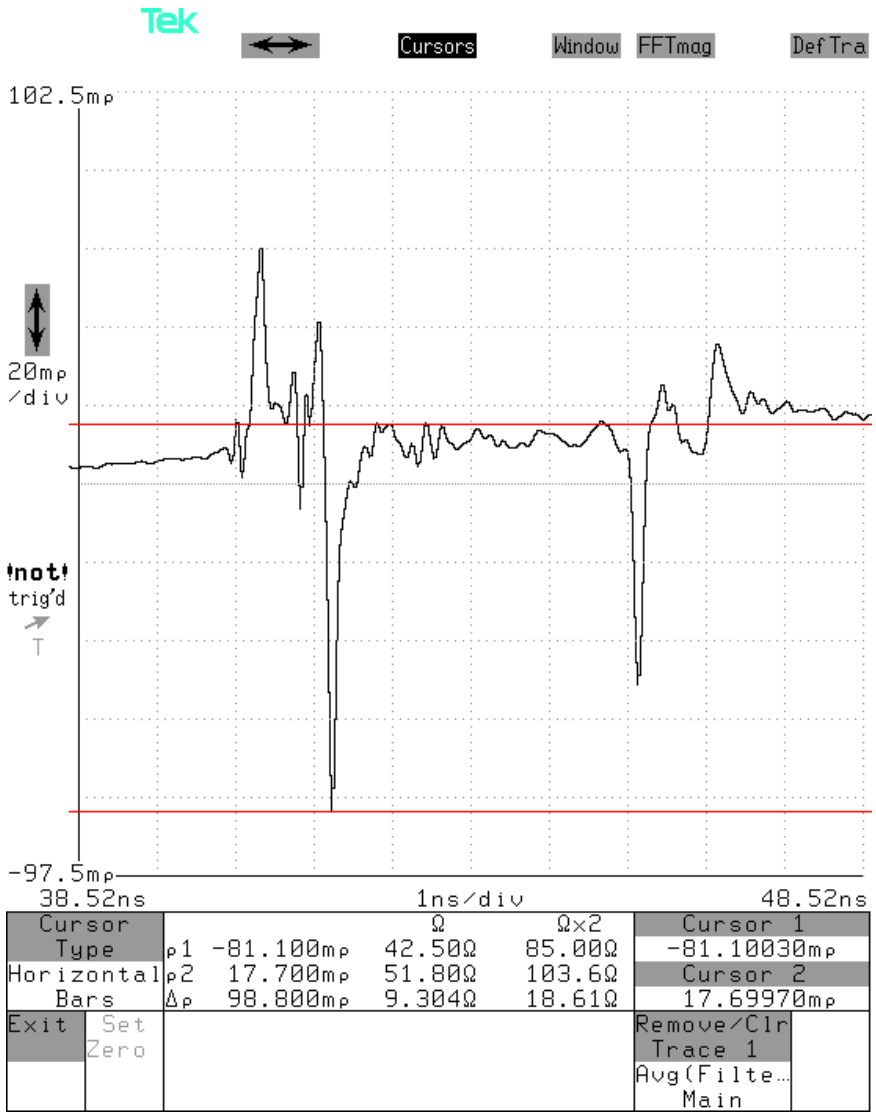


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S5, S6

- Impedance Max = 103.6 ohms
- Impedance Min = 85.0 ohms

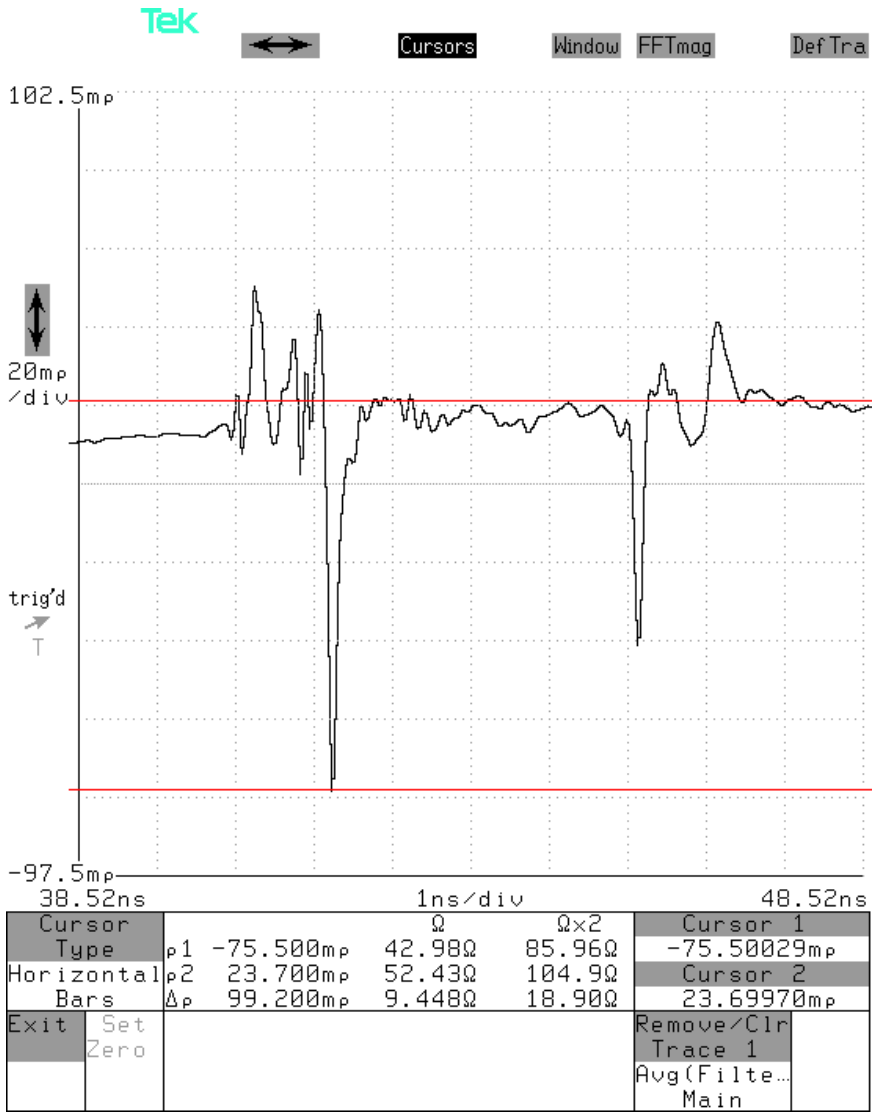


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S7, S8

- Impedance Max = 104.9 ohms
- Impedance Min = 85.96 ohms

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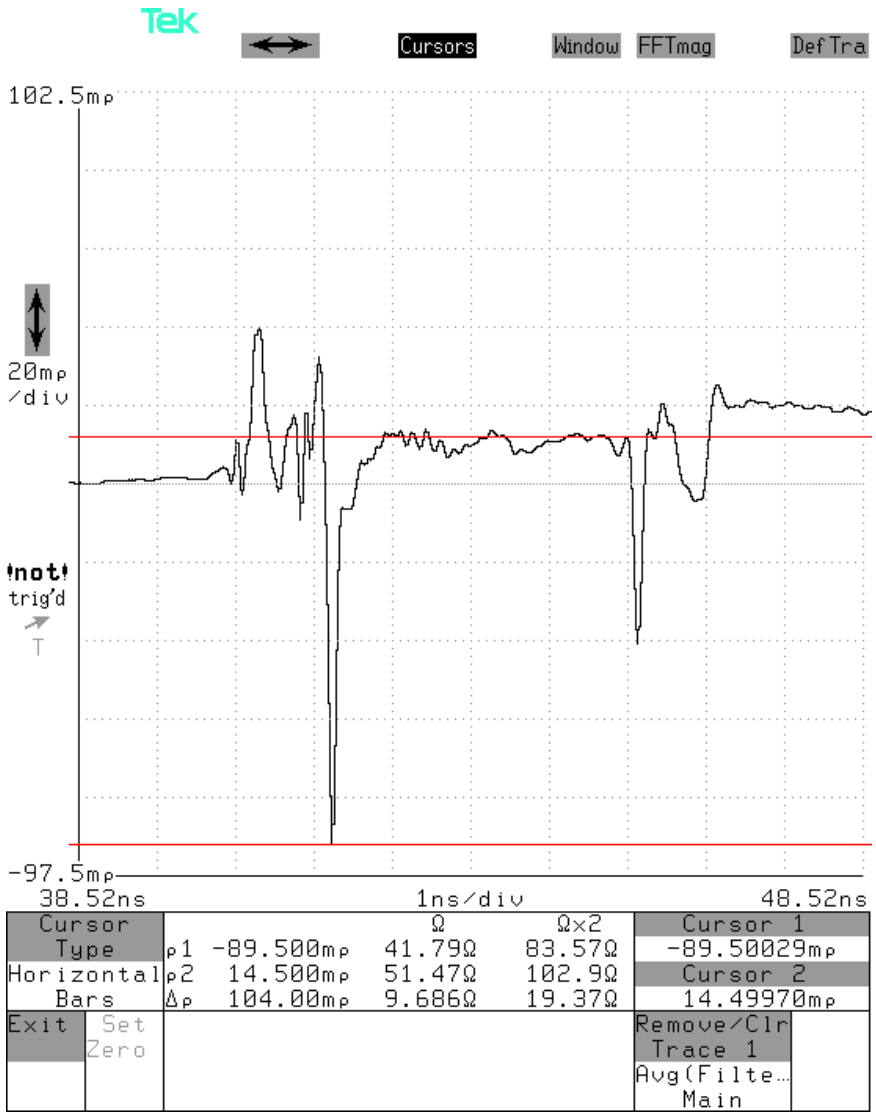
# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S9, S10

- Impedance Max = 102.9 ohms
- Impedance Min = 83.57 ohms



# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S11, S12

- Impedance Max = 104.6 ohms
- Impedance Min = 83.35 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S13, S14

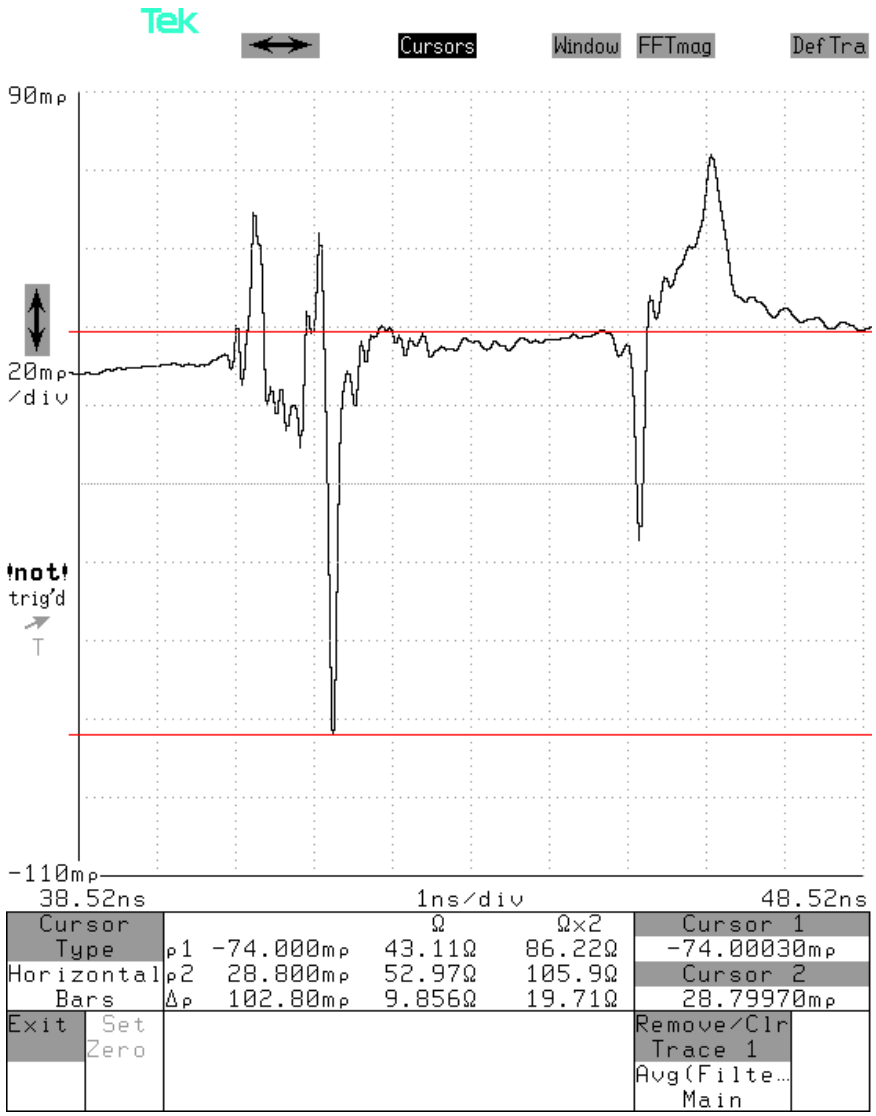
- Impedance Max = 104.2 ohms
- Impedance Min = 87.34 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 70 picoseconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S15, S16

- Impedance Max = 105.9 ohms
- Impedance Min = 86.22 ohms

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# Impedance Profile Measurements

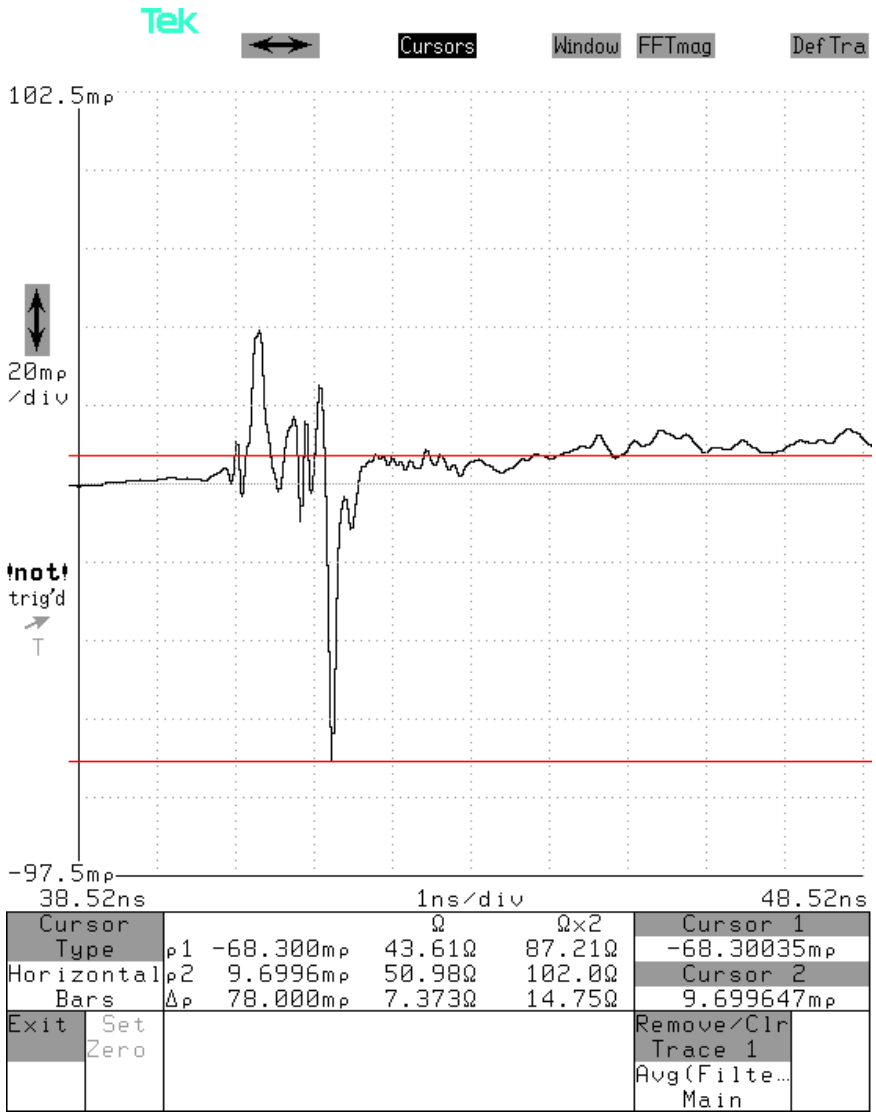
- The following slides show the Impedance Profile of pair S9S10 of the 5 meter length 28 AWG assembly, and of pair S9S10 of the 10 meter length 24 AWG assembly.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 5 meters  Skew-clear, 8 pairs, 28 AWG
- Filter = 70 Pico-seconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S9, S10

- Impedance Max = 102.0 ohms
- Impedance Min = 87.21 ohms

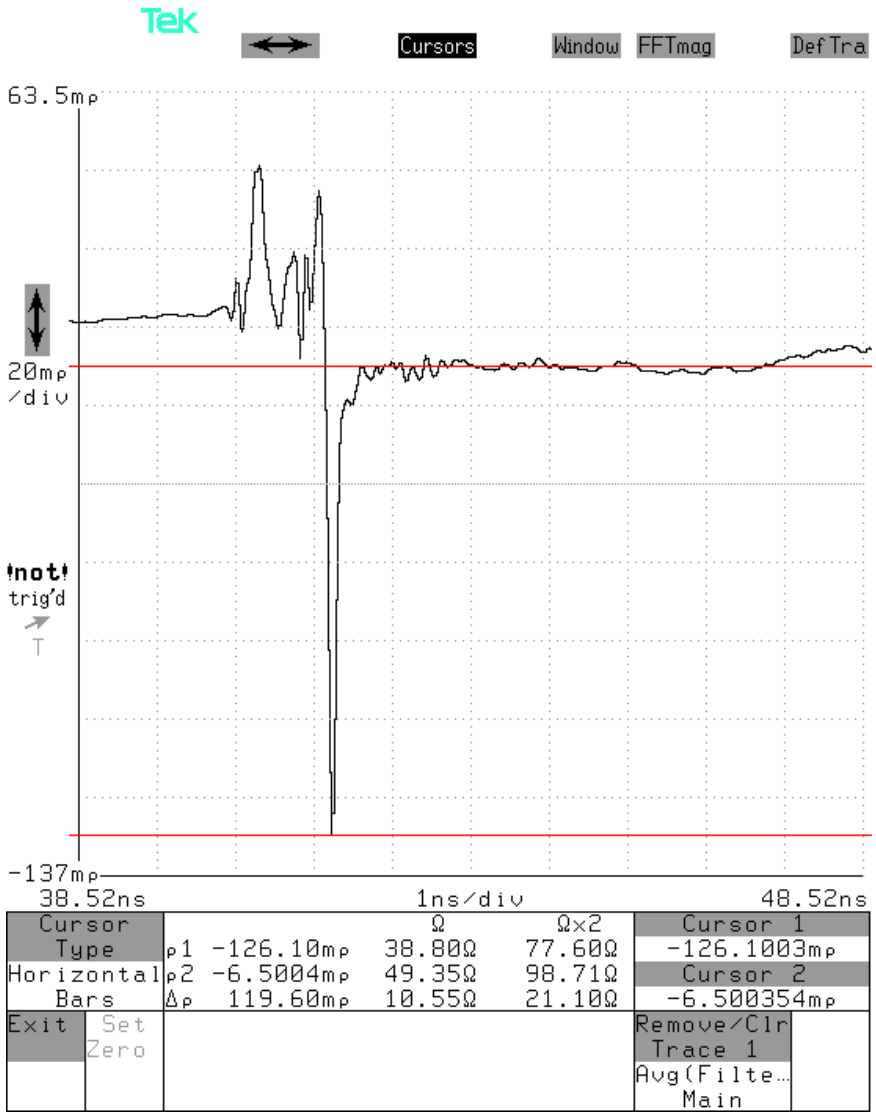


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 10 meters  Skew-clear, 8 pairs, 24 AWG
- Filter = 70 Pico-seconds
- Total Test System Risetime = 76.22 ps
- Risetime at DUT = 53.9 ps
- Single length Risetime = 73.14 ps

- Pair: PC S9, S10

- Impedance Max = 98.71 ohms
- Impedance Min = 77.60 ohms

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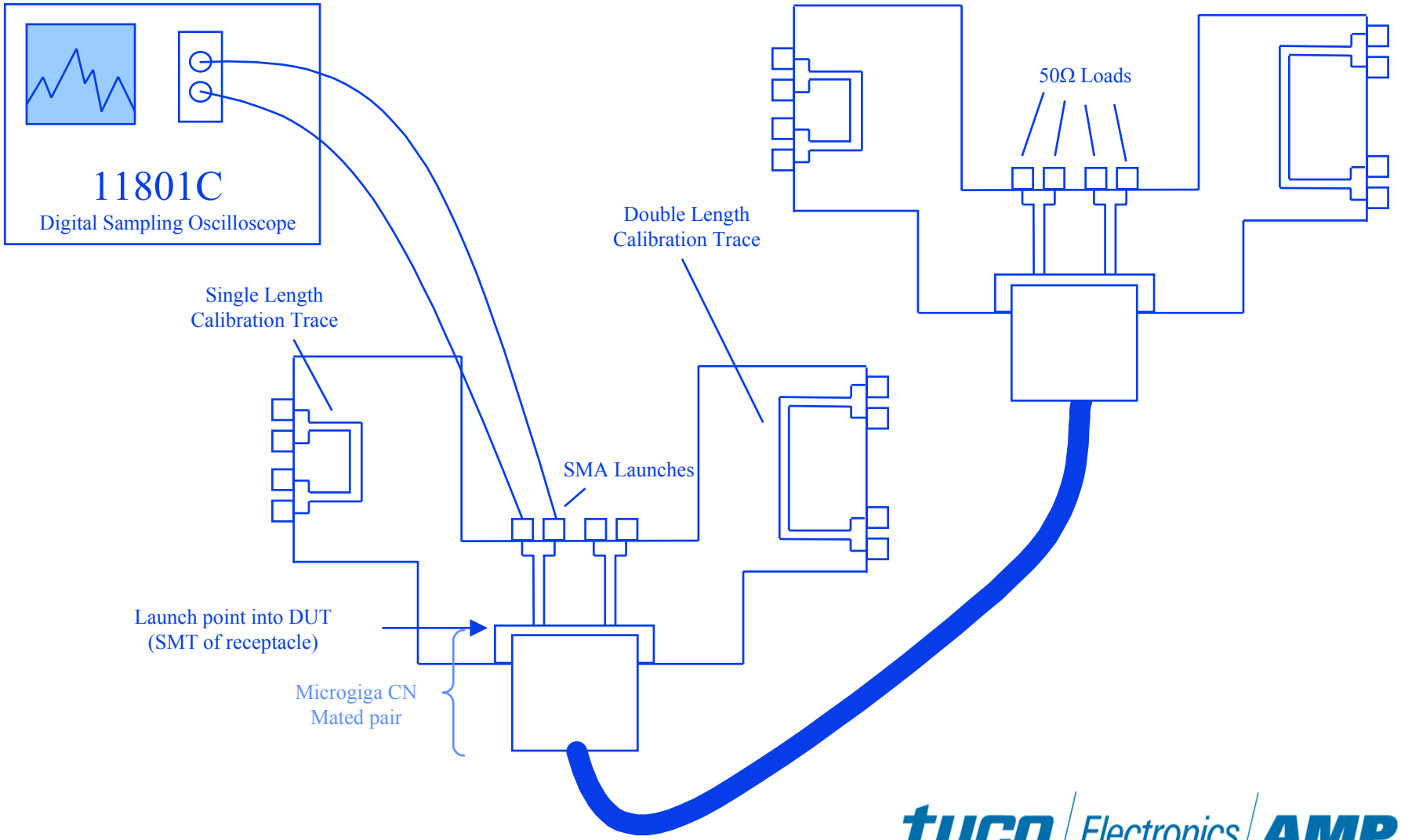
# Impedance Profile Measurements

Thinh Nguyen
Dean Vermeersch

- Tektronix TDS 8000 Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- Impedance Profile measurements are made in accordance with SFF-8410.
- This report shows the Impedance Profile measurements of 0.5 meter length 28 AWG MicroGiga CN cable assembly with filtering to achieve 75 ps risetime at launch into the DUT. Also included is one pair of 5 meter length 28 AWG, and 10 meter length 24 AWG for comparison

# Time Domain Impedance Profile Test Set-Up



# Impedance Profile Measurements

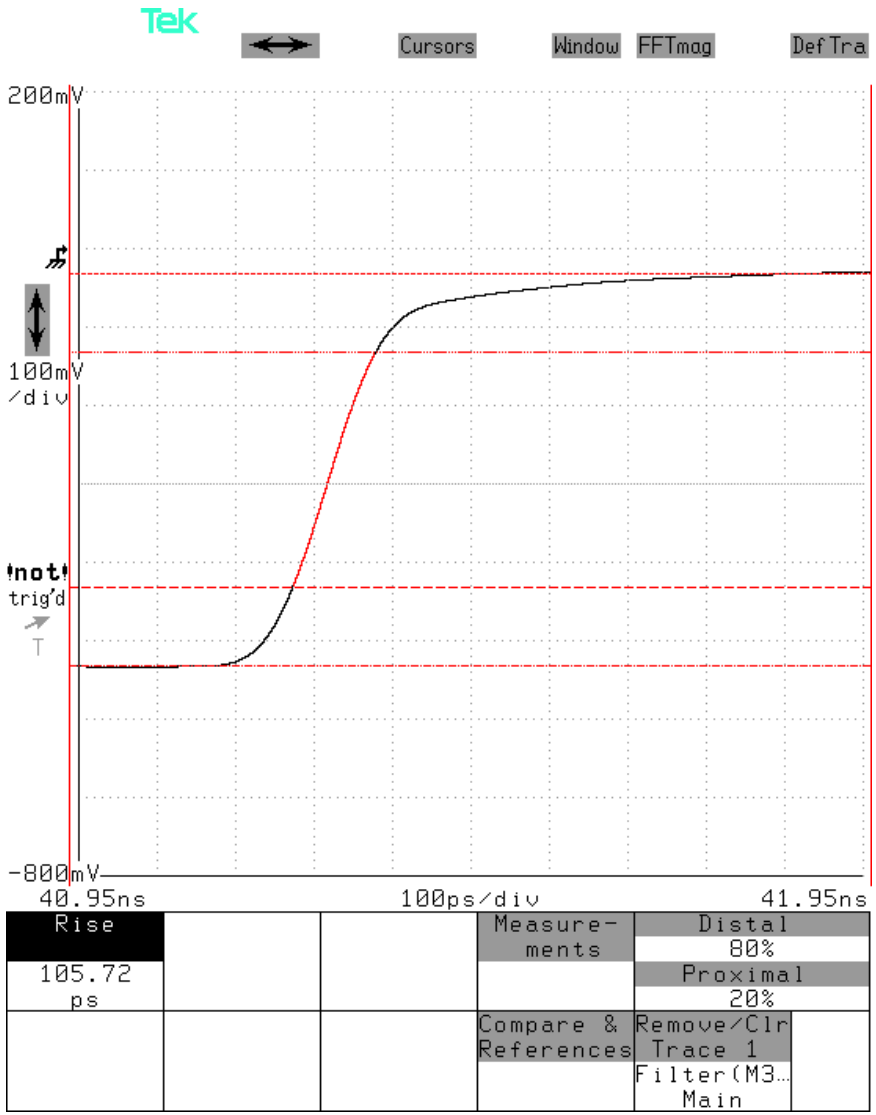
- The following slides show the risetime waveforms for when a 120 ps filter is used in the test system.
- The first slide labeled double length calibration trace shows total test system risetime of 106 ps and risitime at launch into the DUT of 75 ps.
- The second slide labeled single length calibration trace shows a risetime of 102 ps

- This Impedance Profile data is for those who are interested in total test system risetime, and risetime through the single length traces, of 100 ps.
- And for those who are interested in risetime of 75 ps at launch into the DUT.

# Typical Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = 120 Pico-seconds

- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps

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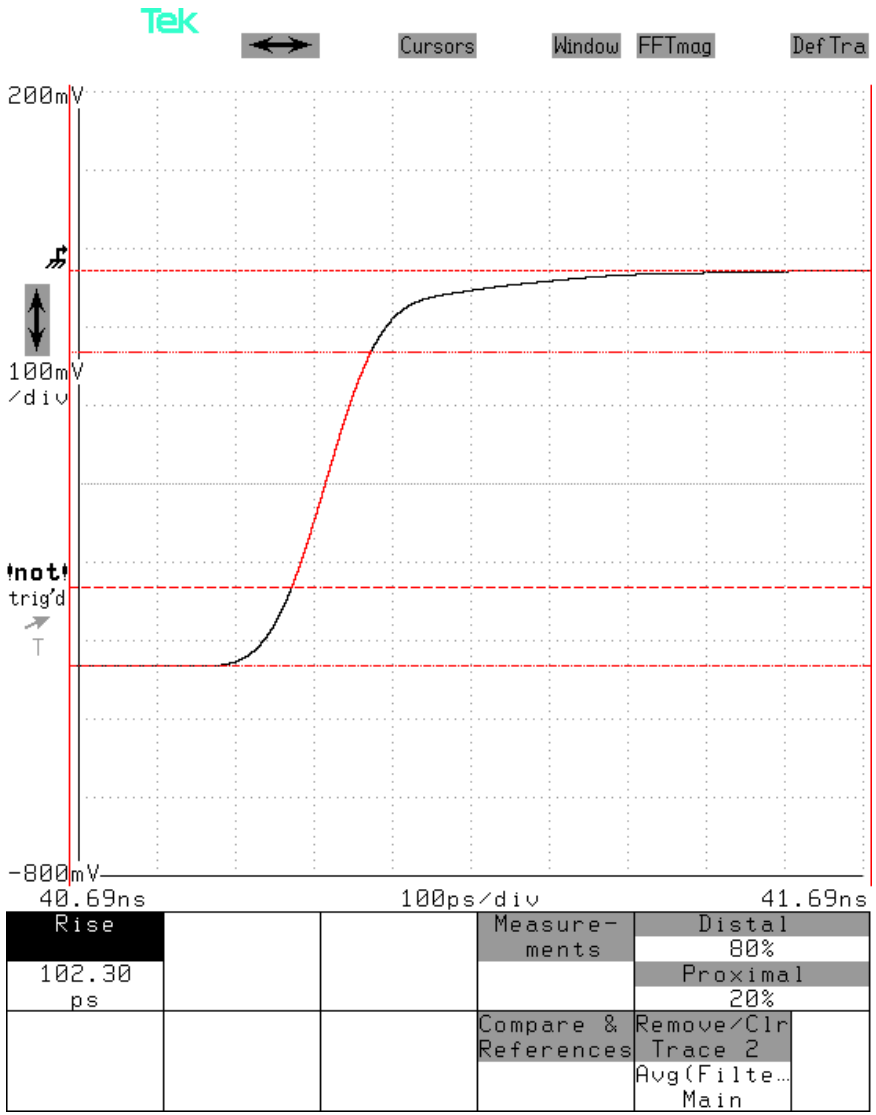
# Typical Fixture Rise Time Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = 120 Pico-seconds

- Single length Risetime = 102.3 ps

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# Impedance Profile Measurements

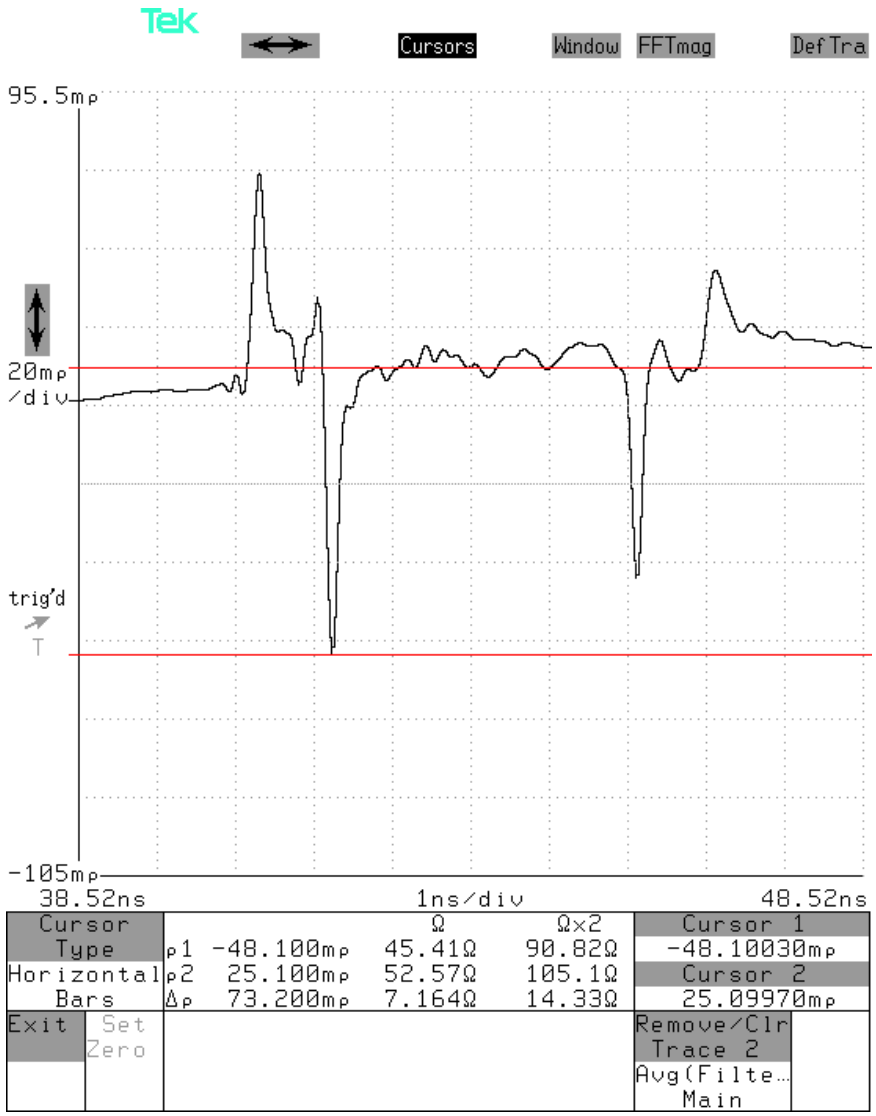
- The following slides show the Impedance Profile of each pair in the cable assembly measured from one end.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S1, S2

- Impedance Max = 105.1 ohms
- Impedance Min = 90.82 ohms

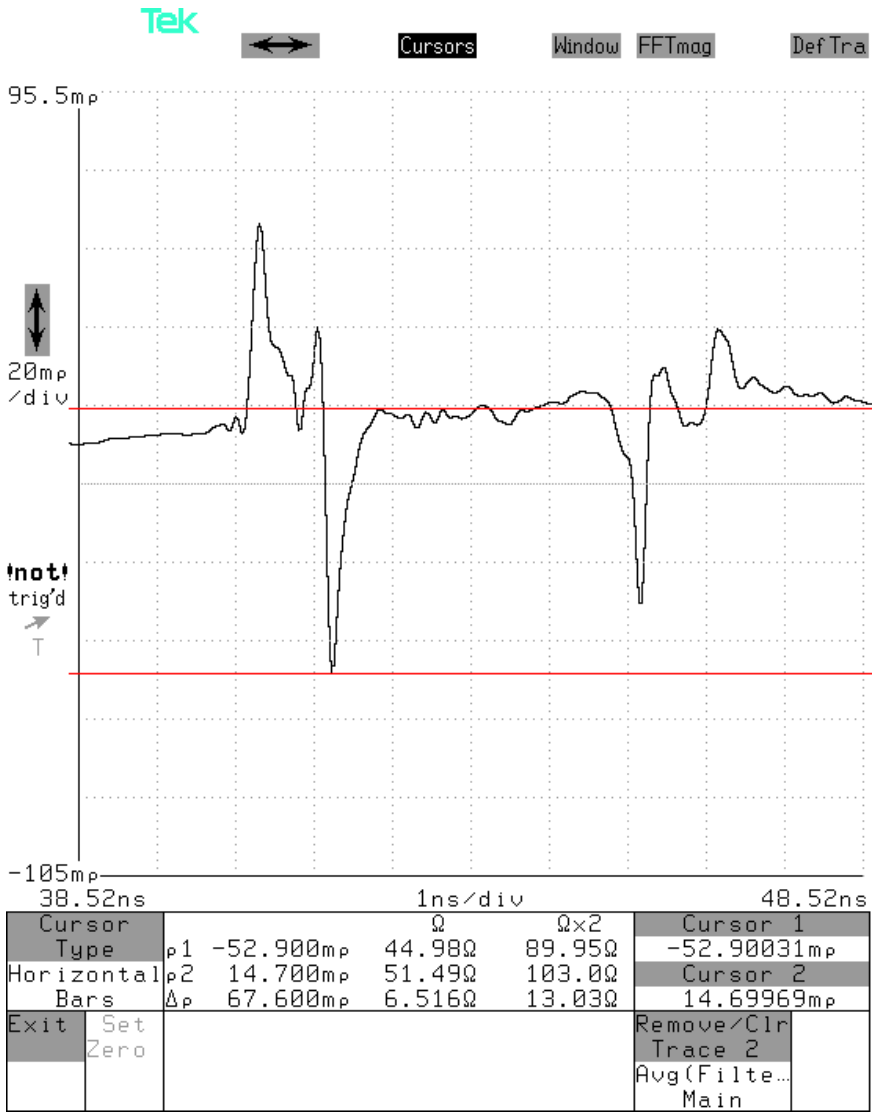


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S3, S4

- Impedance Max = 103.0 ohms
- Impedance Min = 89.95 ohms

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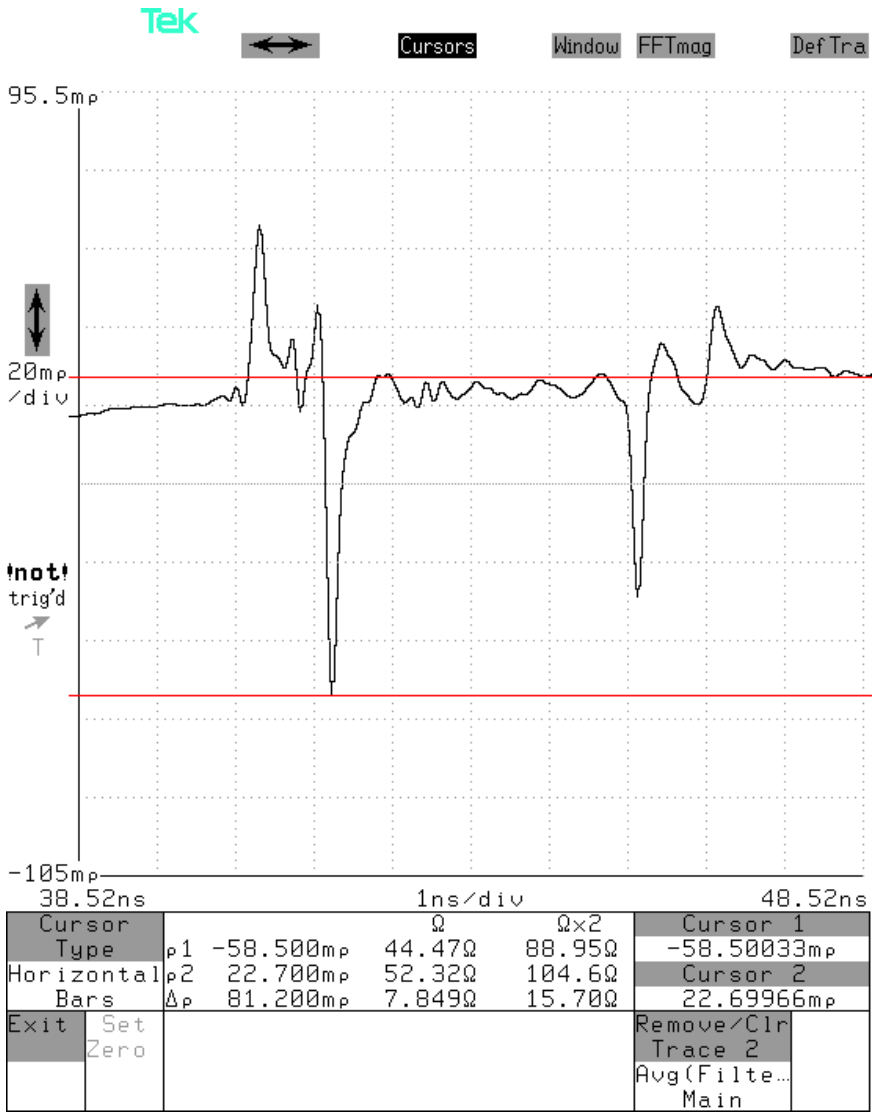
# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S5, S6

- Impedance Max = 104.6 ohms
- Impedance Min = 88.95 ohms

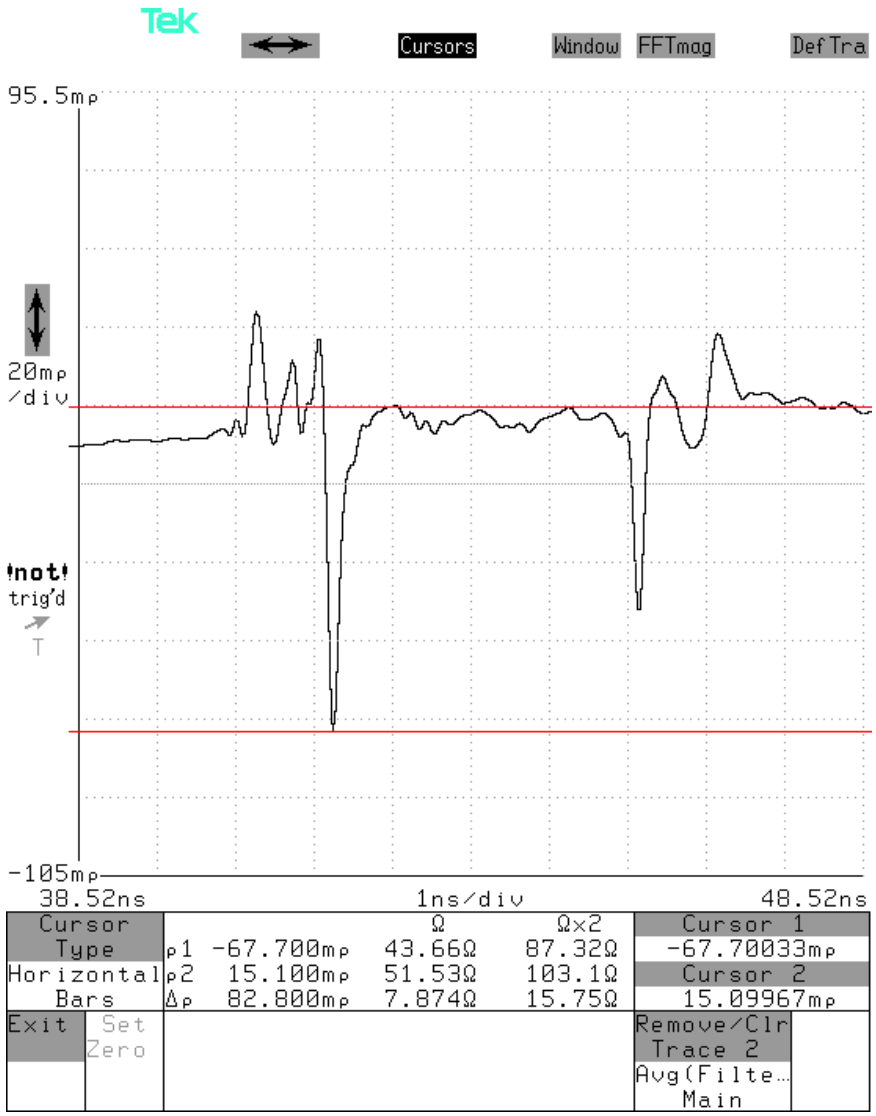


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S7, S8

- Impedance Max = 103.1 ohms
- Impedance Min = 87.32 ohms

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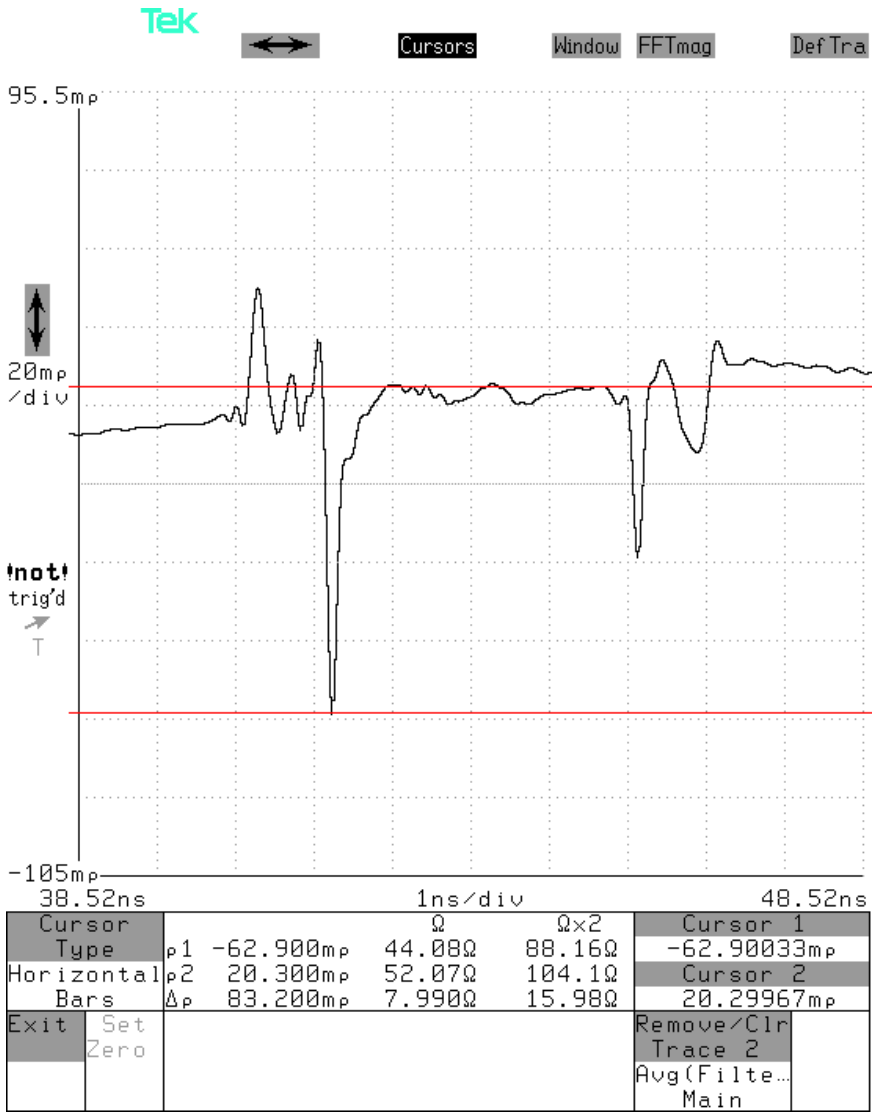
# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S9, S10

- Impedance Max = 104.1 ohms
- Impedance Min = 88.16 ohms



# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S11, S12

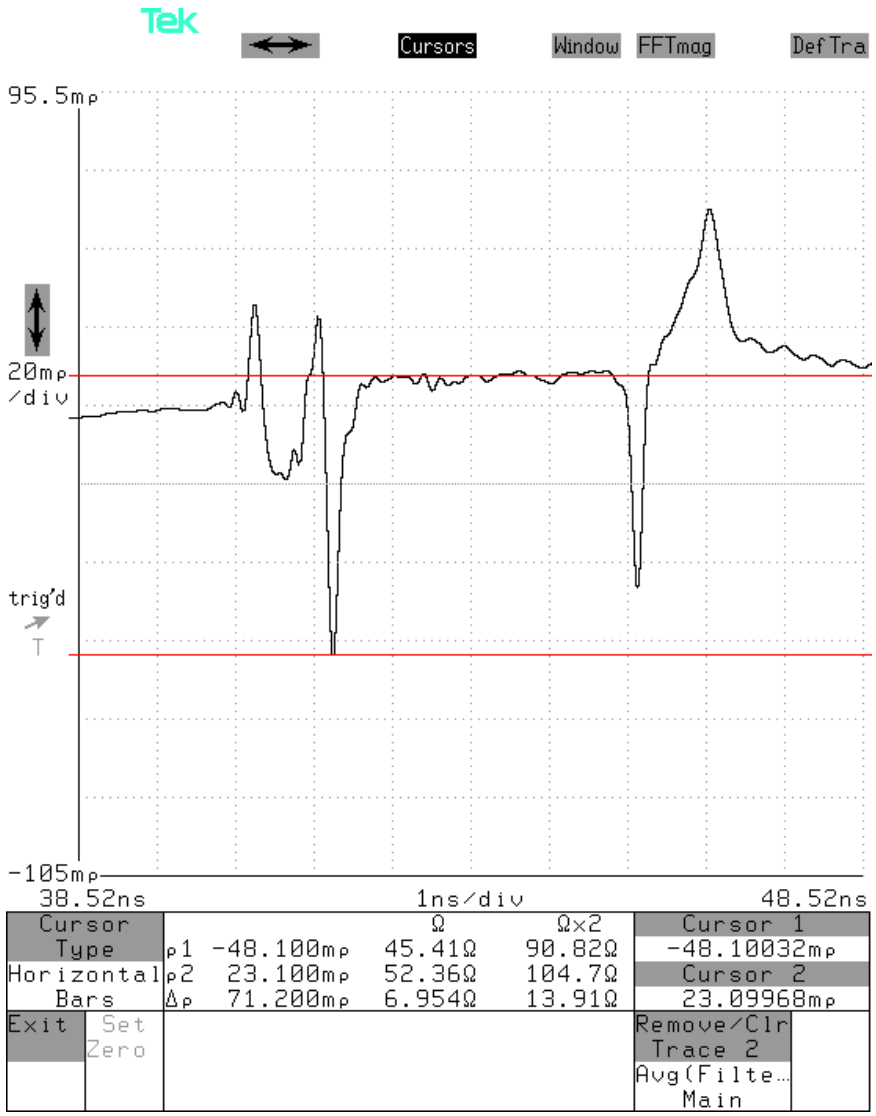
- Impedance Max = 105.4 ohms
- Impedance Min = 87.6 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S13, S14

- Impedance Max = 104.7 ohms
- Impedance Min = 90.82 ohms

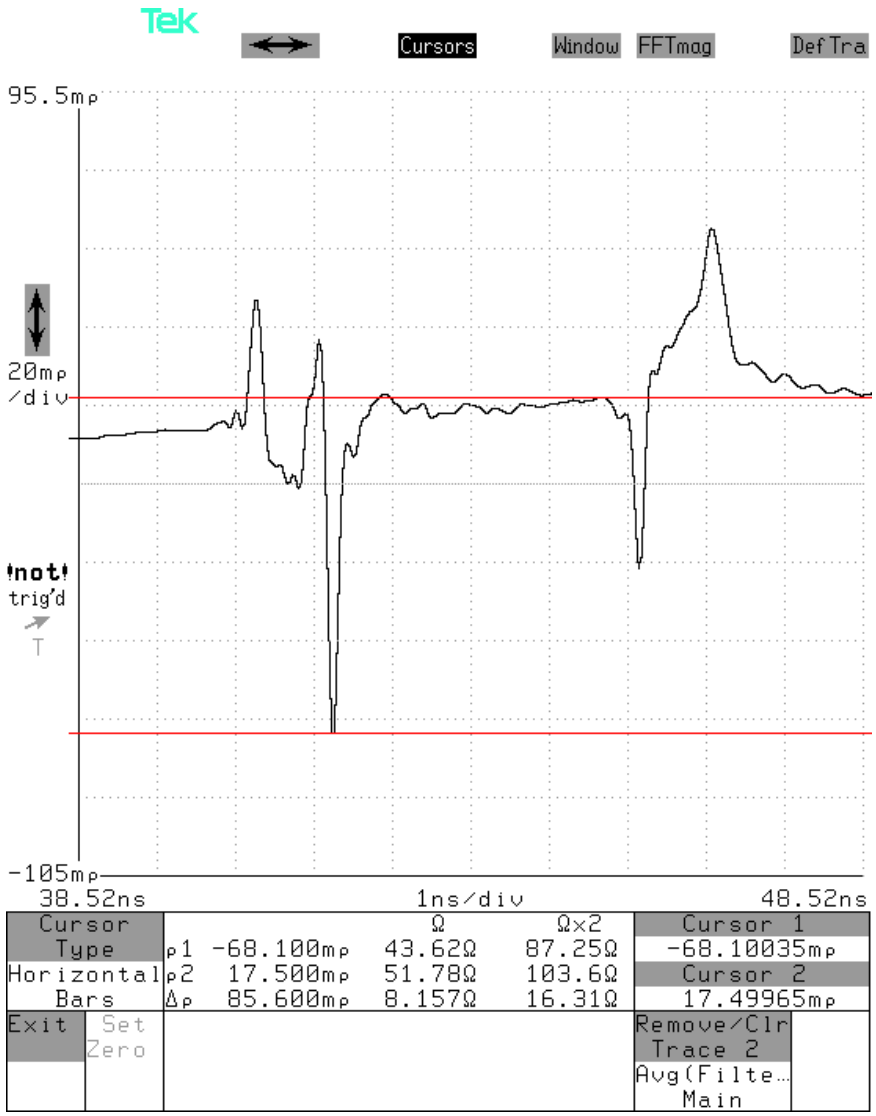


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 120 picoseconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S15, S16

- Impedance Max = 103.6 ohms
- Impedance Min = 87.25 ohms



# Impedance Profile Measurements

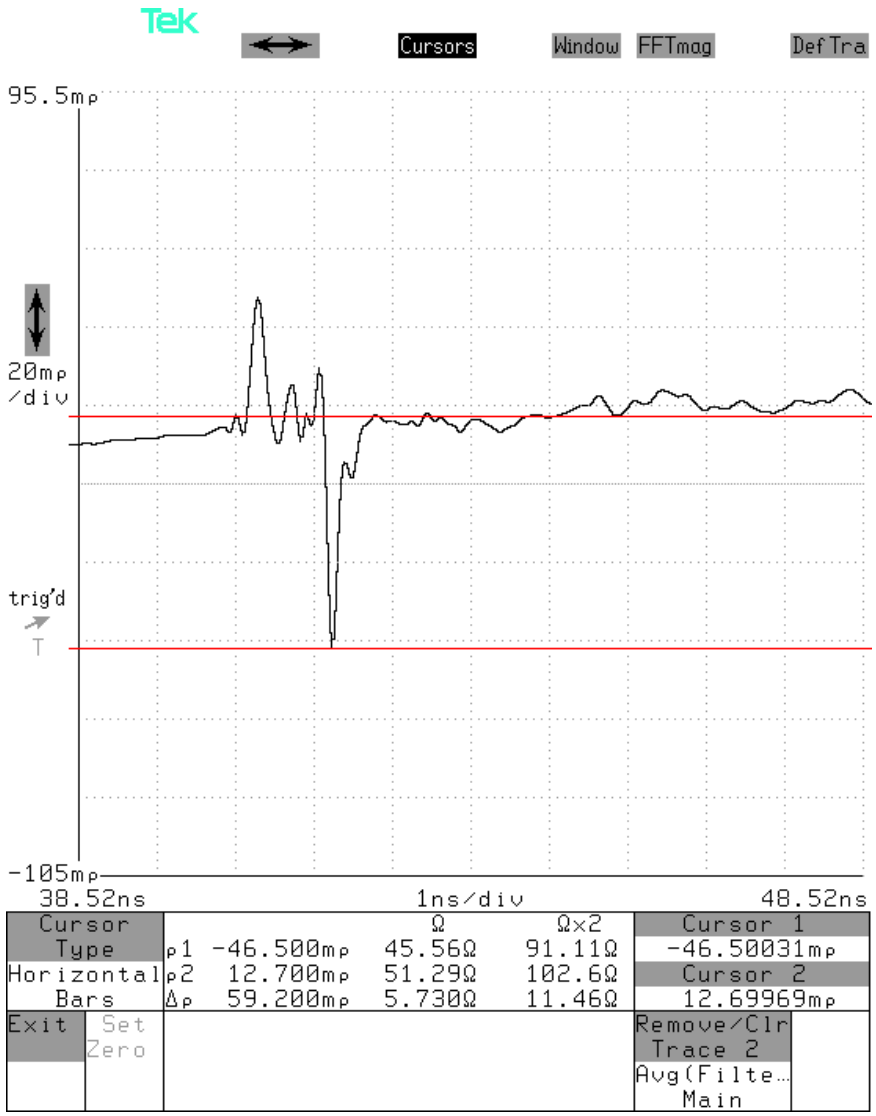
- The following slides show the Impedance Profile of pair S9S10 of the 5 meter length 28 AWG assembly, and of pair S9S10 of the 10 meter length 24 AWG assembly.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 5 meters  Skew-clear, 8 pairs, 28 AWG
- Filter = 120 Pico-seconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S9, S10

- Impedance Max = 102.6 ohms
- Impedance Min = 91.11 ohms

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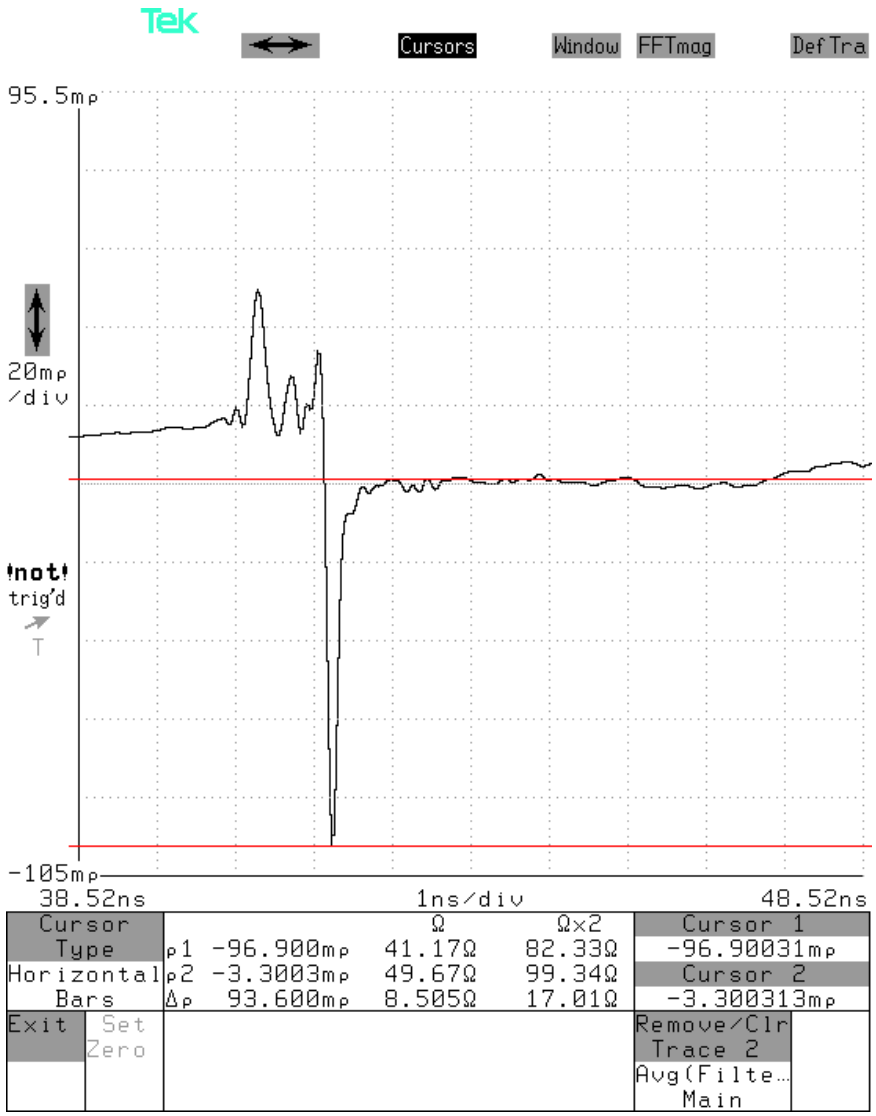
# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 10 meters  Skew-clear, 8 pairs, 24 AWG
- Filter = 120 Pico-seconds
- Total Test System Risetime = 105.72 ps
- Risetime at DUT = 74.75 ps
- Single length Risetime = 102.3 ps

- Pair: PC S9, S10

- Impedance Max = 99.34 ohms
- Impedance Min = 82.33 ohms

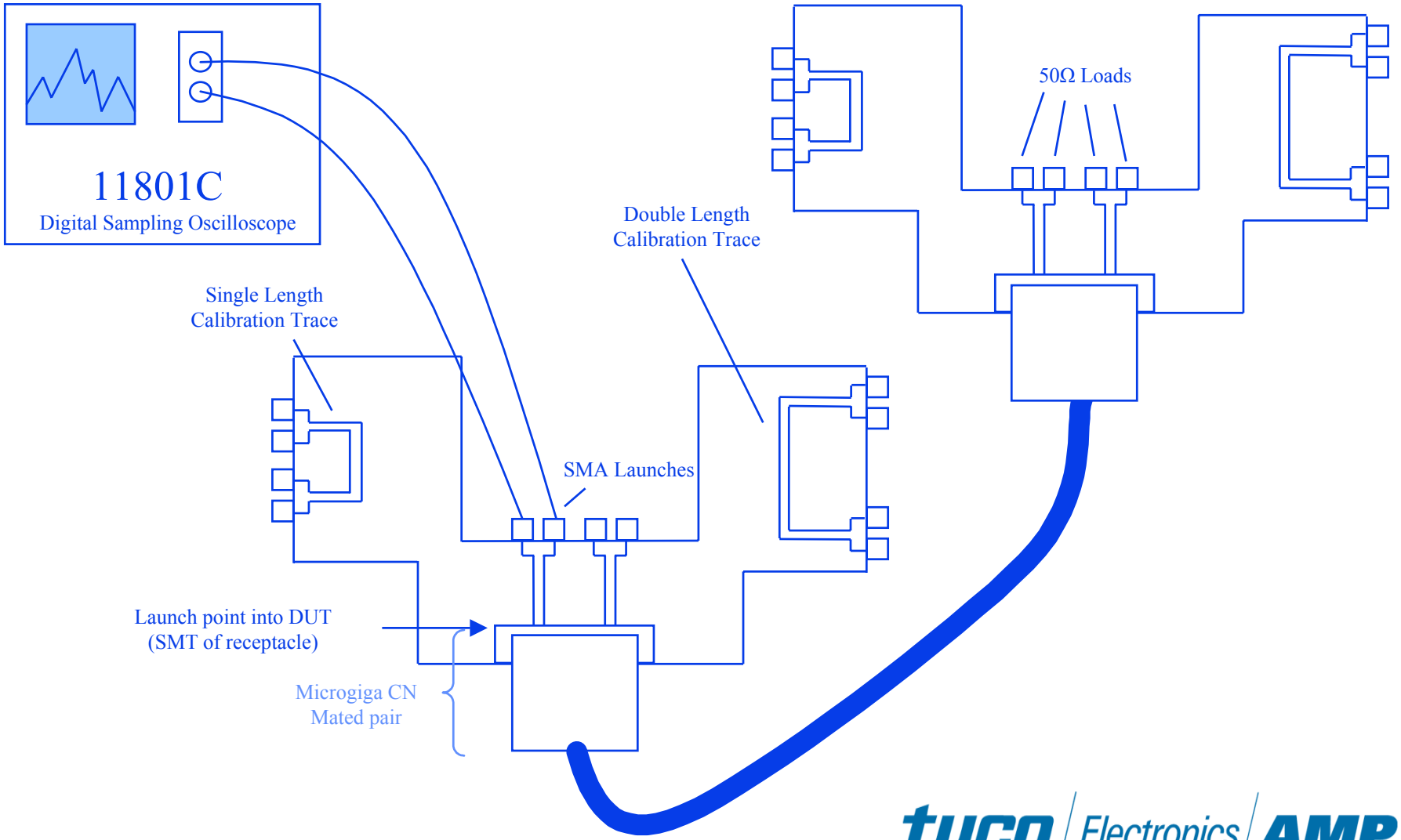


# Impedance Profile Measurements

Thinh Nguyen
Dean Vermeersch

- Tektronix TDS 8000 Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- Impedance Profile measurements are made in accordance with SFF-8410.
- This report shows the Impedance Profile measurements of 0.5 meter length 28 AWG MicroGiga CN cable assembly with filtering to achieve 100 ps risetime at launch into the DUT. Also included is one pair of 5 meter length 28 AWG, and 10 meter length 24 AWG for comparison

# Time Domain Impedance Profile Test Set-Up



# Impedance Profile Measurements

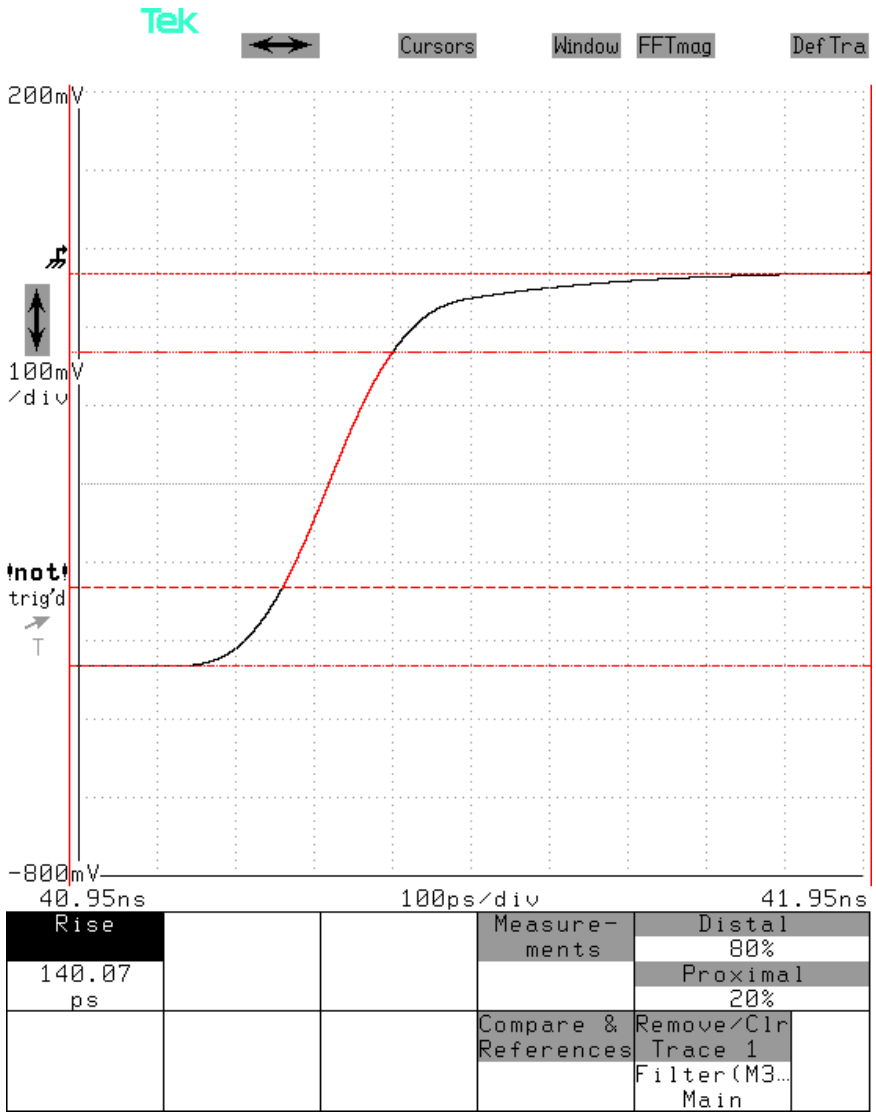
- The following slides show the risetime waveforms for when a 175 ps filter is used in the test system.
- The first slide labeled double length calibration trace shows total test system risetime of 140 ps, and risitime at launch into the DUT of 99 ps.
- The second slide labeled single length calibration trace shows a risetime of 137 ps

- This Impedance Profile data is for those who are interested in risetime of 100 ps at launch into the DUT.
- For reference, in this case, total test system risetime, and risetime through the single length traces, is 140 ps.

# Typical Fixture Rise Time Measurement with Filter

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Filter = 175 Pico-seconds

- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps

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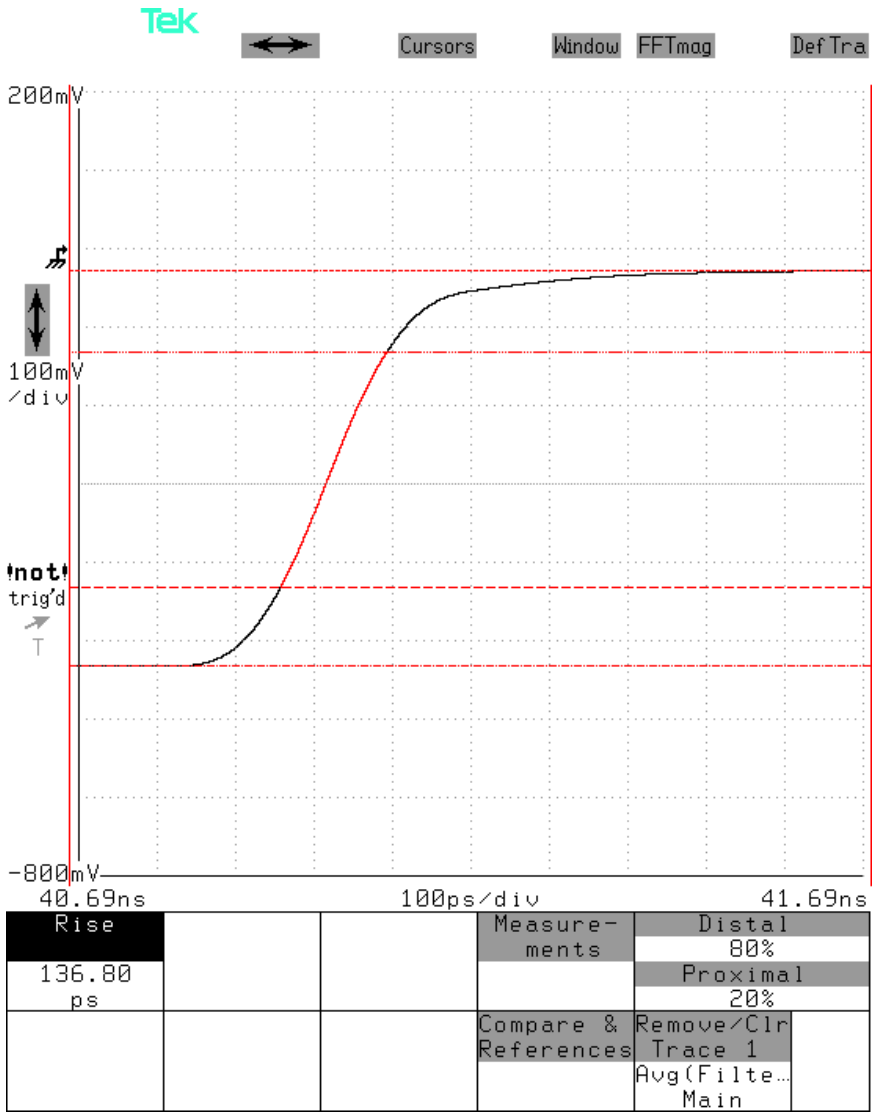
# Typical Fixture Rise Time Measurement

- Date: 2/14/03
- Temperature: 77.54  F
- Relative Humidity: 10.1 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Single length calibration trace
- Filter = 175 Pico-seconds

- Single length Risetime = 136.8 ps

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# Impedance Profile Measurements

- The following slides show the Impedance Profile of each pair in the cable assembly measured from one end.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S1, S2

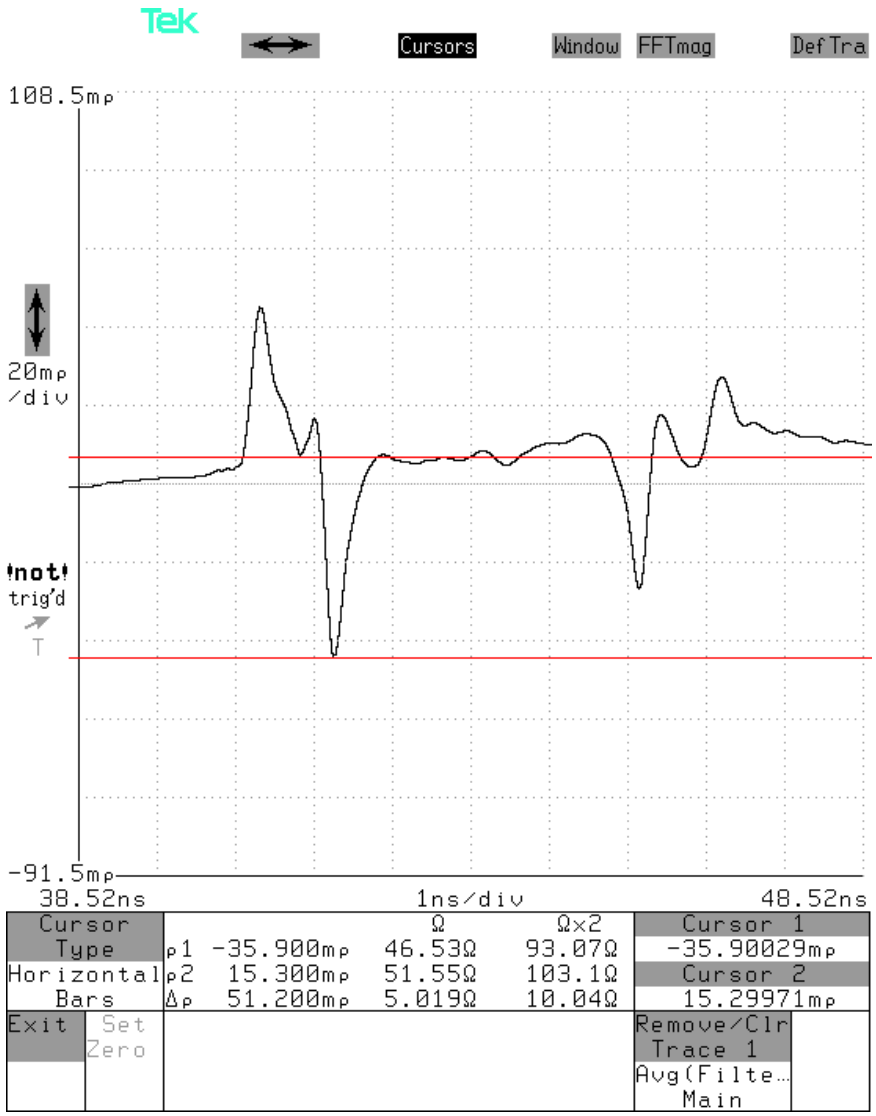
- Impedance Max = 104.1 ohms
- Impedance Min = 93.82 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S3, S4

- Impedance Max = 103.1 ohms
- Impedance Min = 93.07 ohms



# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S5, S6

- Impedance Max = 104.4 ohms
- Impedance Min = 92.85 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S7, S8

- Impedance Max = 105.7 ohms
- Impedance Min = 93.67 ohms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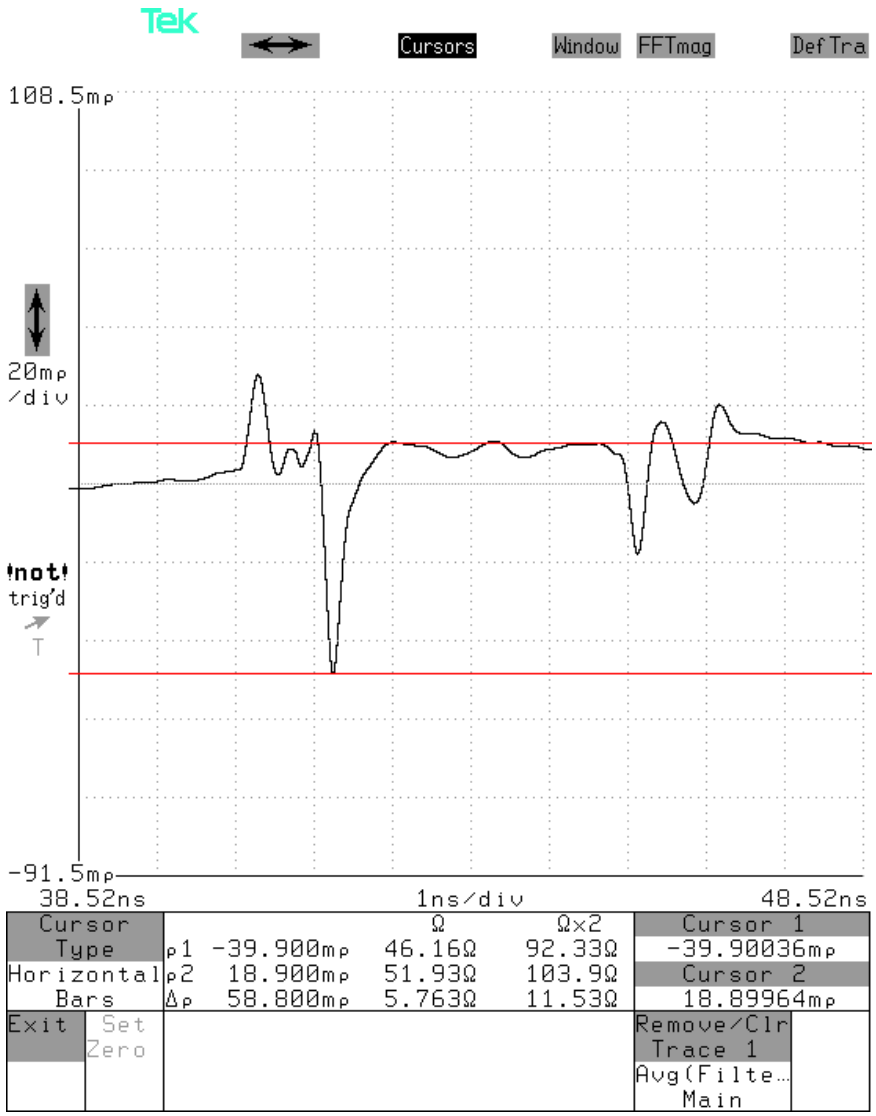
# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S9, S10

- Impedance Max = 103.9 ohms
- Impedance Min = 92.33 ohms

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# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S11, S12

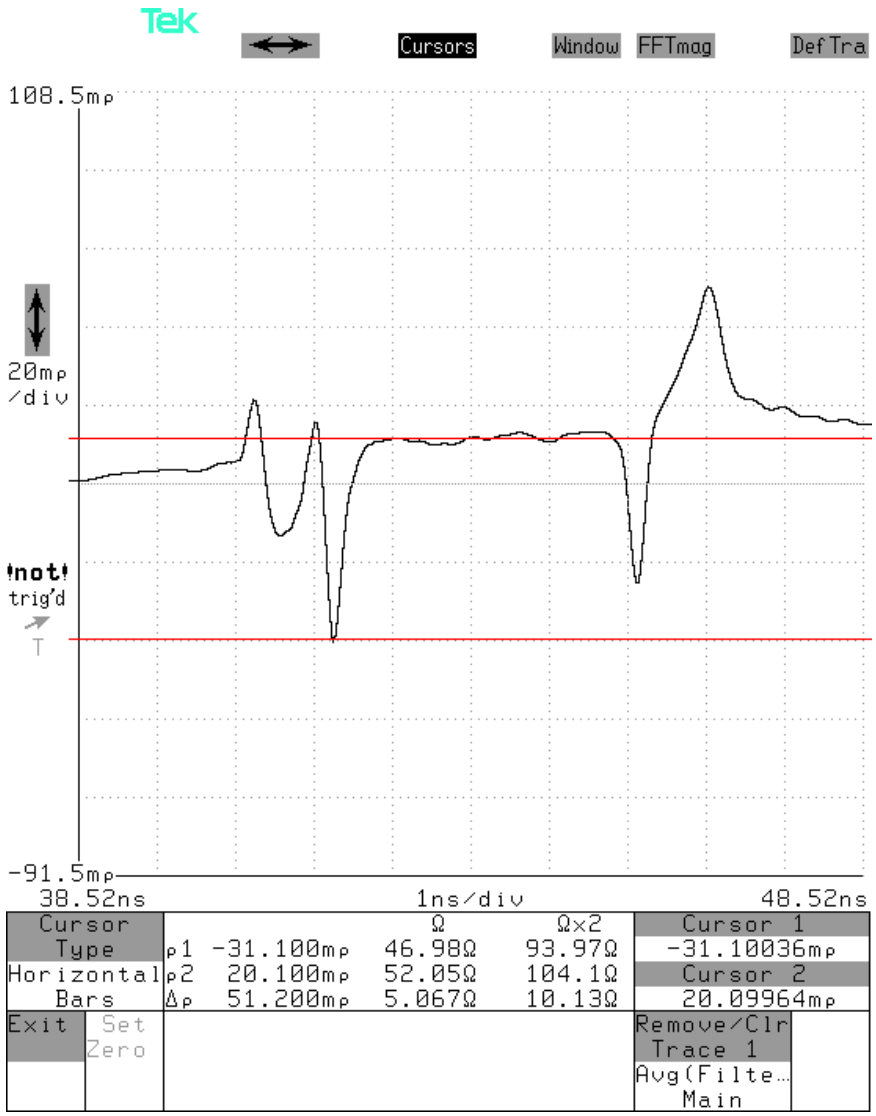
- Impedance Max = 103.8 ohms
- Impedance Min = 90.64 ohms

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S13, S14

- Impedance Max = 104.1 ohms
- Impedance Min = 93.97 ohms

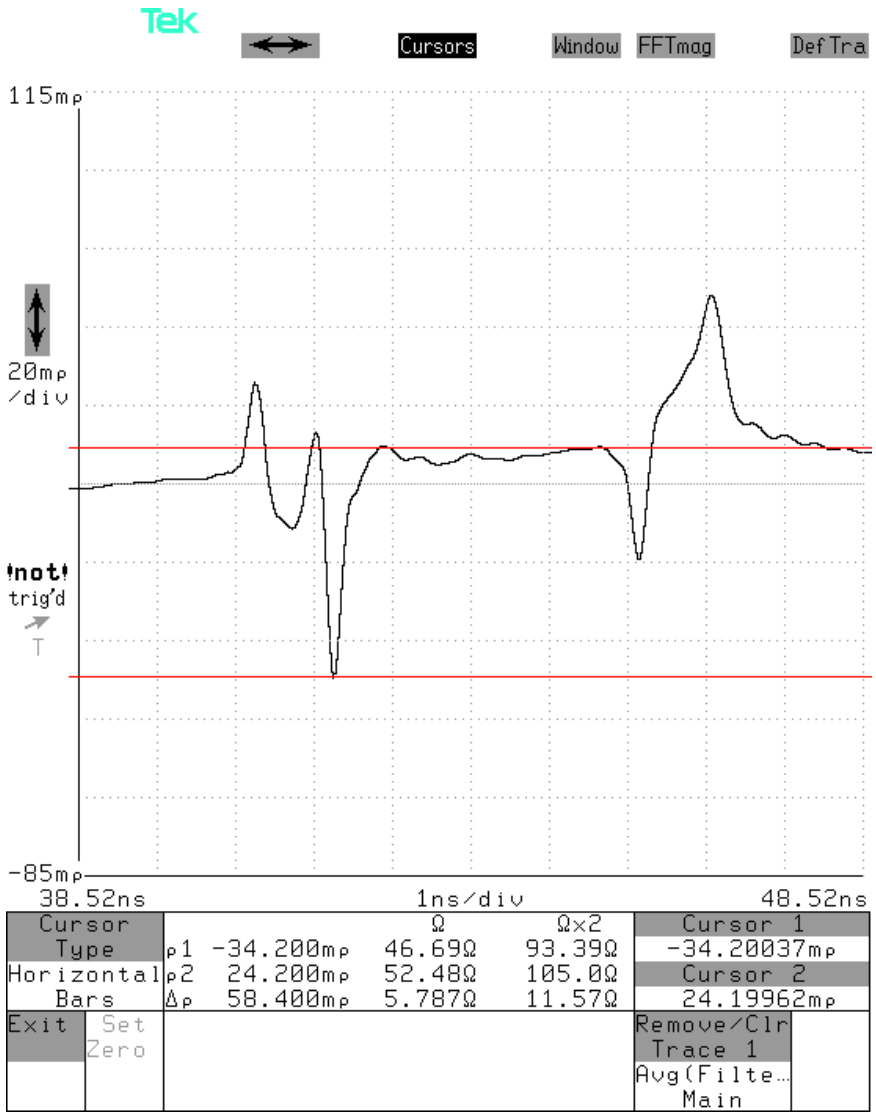


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 0.5 meter Skew-clear, 8 pairs, 28 AWG
- Filter = 175 picoseconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S15, S16

- Impedance Max = 105.0 ohms
- Impedance Min = 93.39 ohms



# Impedance Profile Measurements

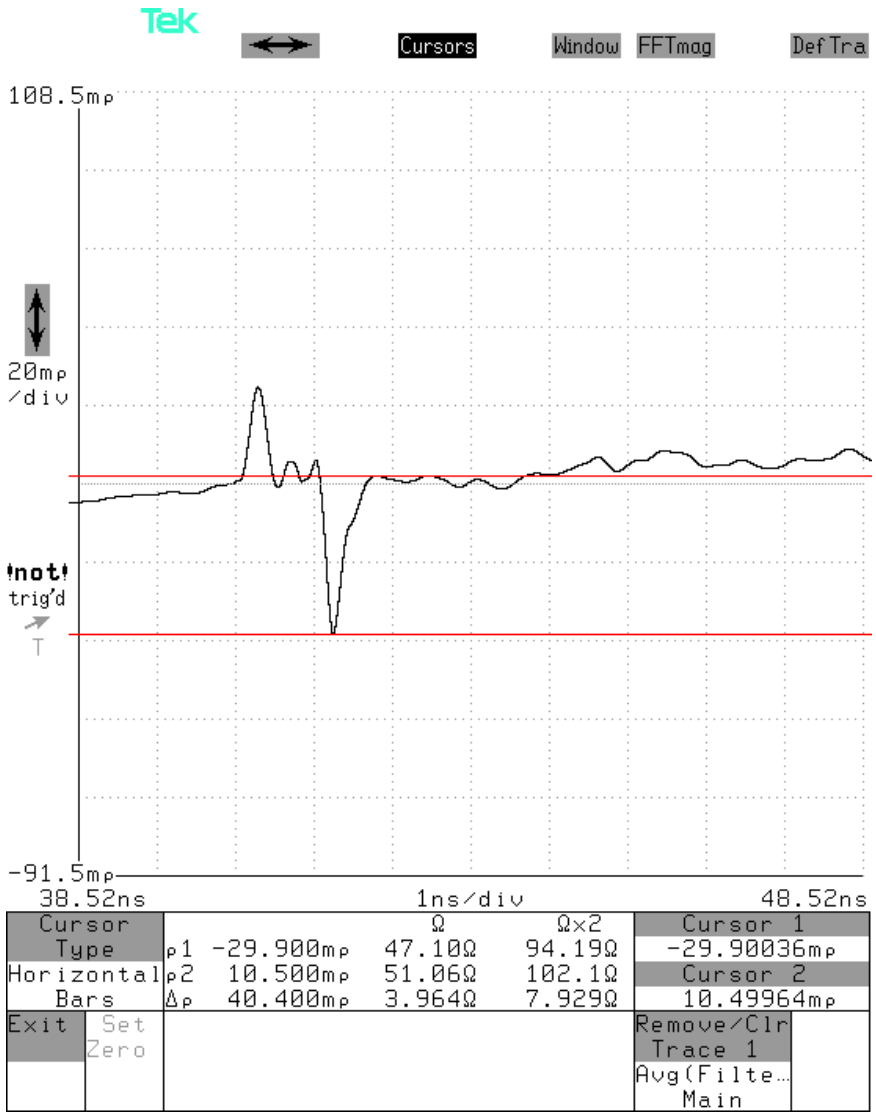
- The following slides show the Impedance Profile of pair S9S10 of the 5 meter length 28 AWG assembly, and of pair S9S10 of the 10 meter length 24 AWG assembly.

# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 5 meters  Skew-clear, 8 pairs, 28 AWG
- Filter = 175 Pico-seconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S9, S10

- Impedance Max = 102.1 ohms
- Impedance Min = 94.19 ohms

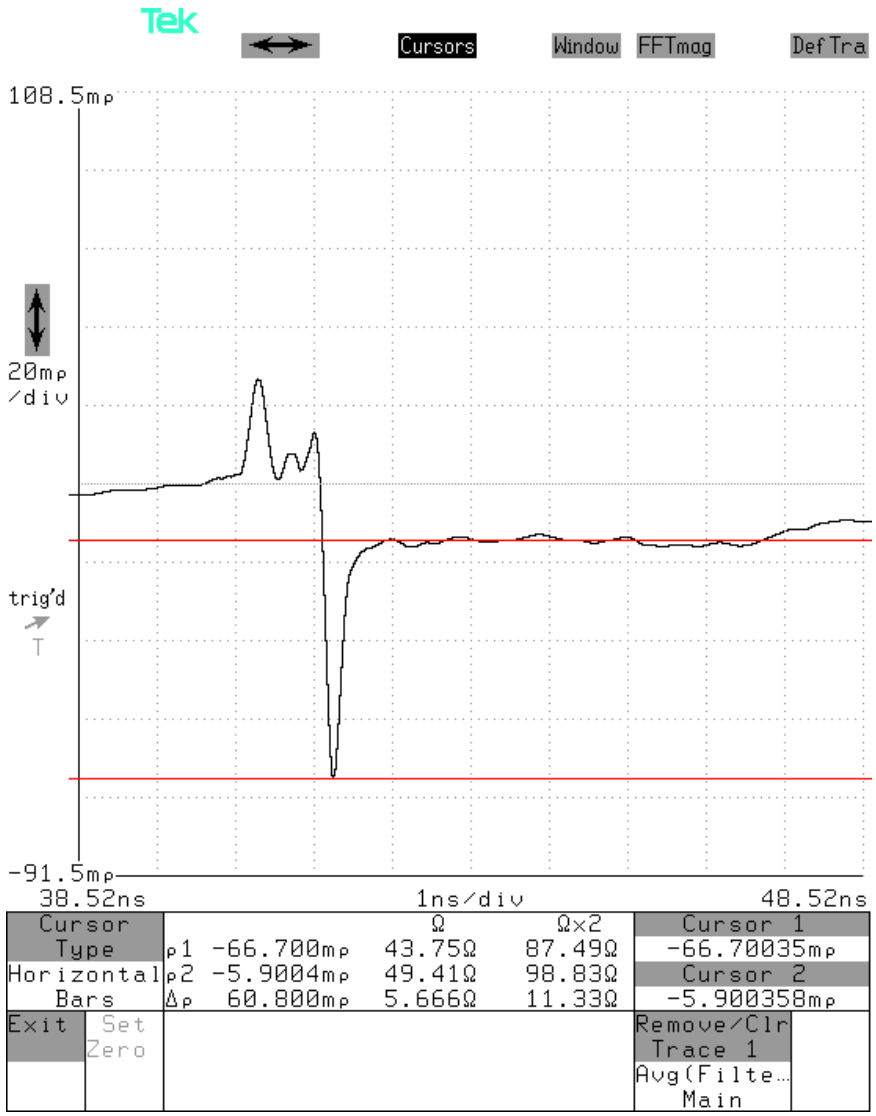


# Typical Impedance Profile Measurement

- Date: 2/28/03
- Temperature: 77.43  F
- Relative Humidity: 11.5 %
- Method: TDR From Tek. 11801C
- Fixture: FCI Test Fixture, 4X Infiniband, SK-48295 Rev 2.
- DUT: End P1, 10 meters  Skew-clear, 8 pairs, 24 AWG
- Filter = 175 Pico-seconds
- Total Test System Risetime = 140.07 ps
- Risetime at DUT = 99.04 ps
- Single length Risetime = 136.8 ps

- Pair: PC S9, S10

- Impedance Max = 98.83 ohms
- Impedance Min = 87.49 ohms

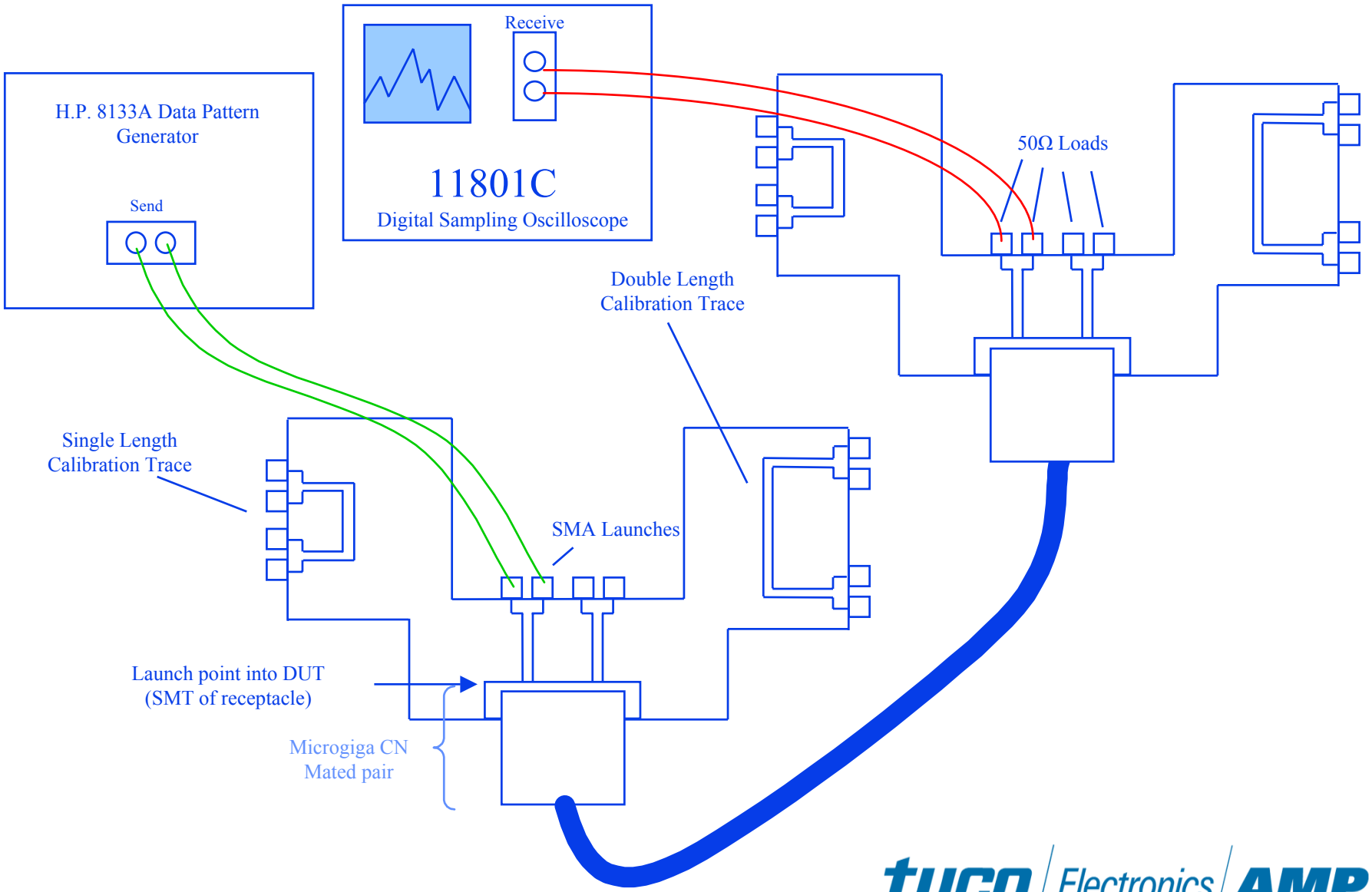


# Simplex Eye Pattern Measurements

Thinh Nguyen
Dean Vermeersch

- Tektronix 11801C Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- Simplex Eye Pattern measurements are made in accordance with SFF-8410.
- This report shows the Eye Pattern measurements of MicroGiga CN cable assemblies made with FCI supplied cable connectors. 0.5 meter length 28 AWG, 5 meter length 28 AWG, and 10 meter length 24 AWG.

# Time Domain Simplex Eye Pattern Test Set-Up

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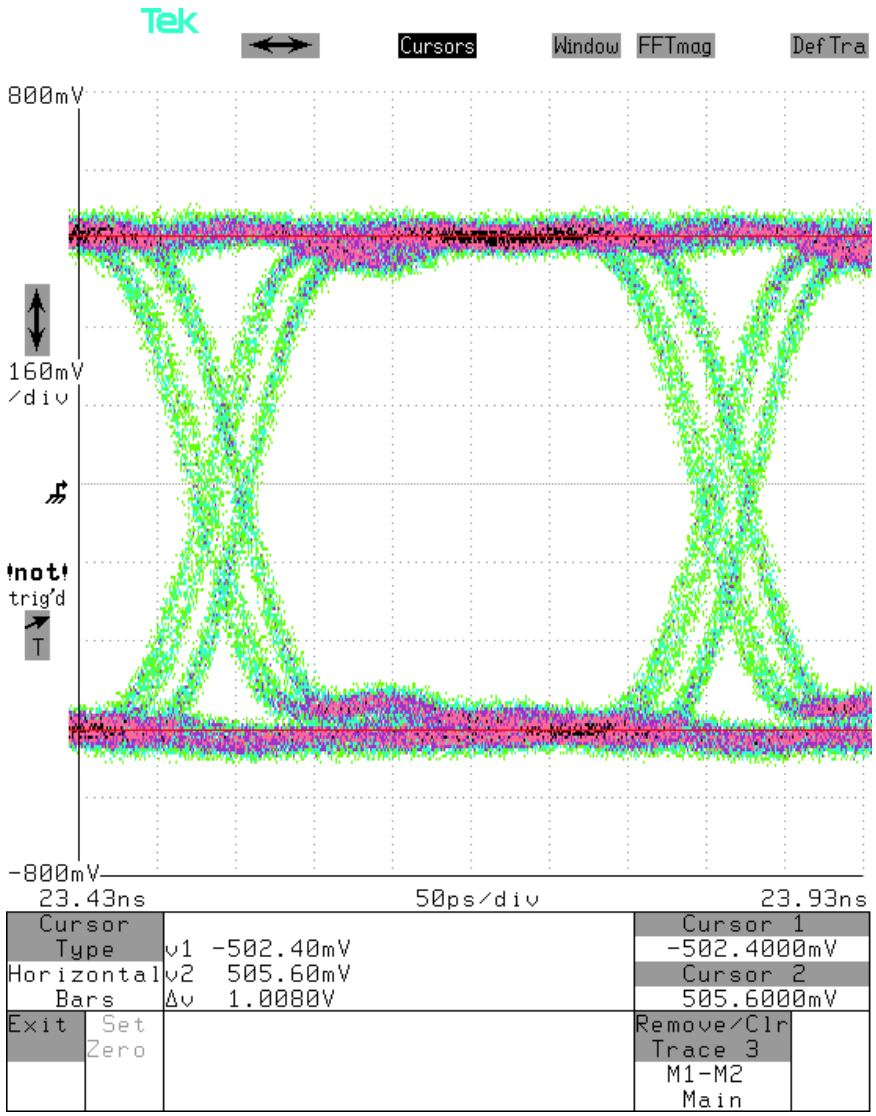
# Simplex Eye Pattern Measurements

- The following slides show the scalar calibration of the test system. The measurement is made through the double length calibration traces.
- This verifies that the test system is transmitting a 1.0 Volt peak to peak differential signal at the launch point into the mated pair.
- The first slide shows launch amplitude calibration.
- The second slide shows that the correct data rate has been selected.

# Typical Eye Pattern Measurement **Through Double Length Calibration Traces**

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- **Data Pattern: 2^23-1 PRBS**
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- **Input Voltage: 1000 mV**
- Calibration: Center Rail to Center Rail of FCI Test Board, double length calibration trace

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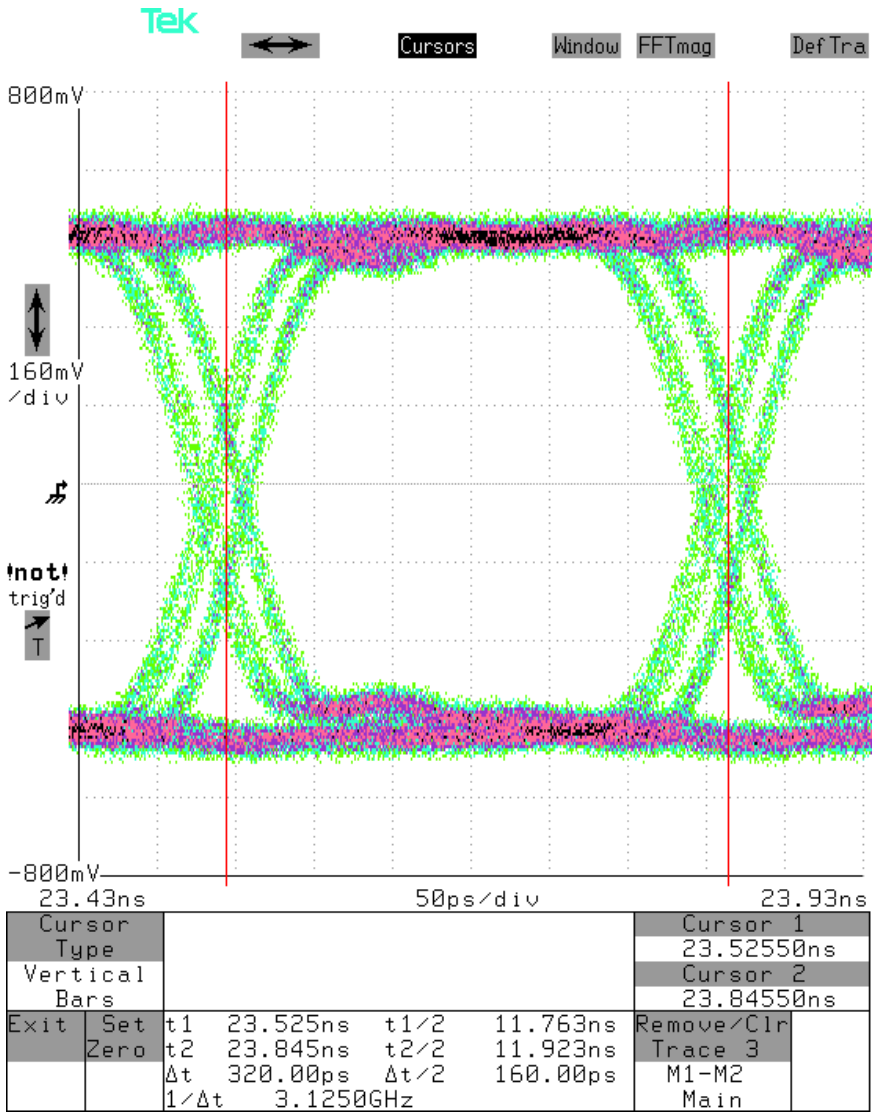
# Typical Eye Pattern Measurement **Through Double Length Calibration Traces**

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- **Data Pattern: 2^23-1 PRBS**
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- **Input Voltage: 1000 mV**
- Calibration: Center Rail to Center Rail of FCI Test Board, double length calibration trace

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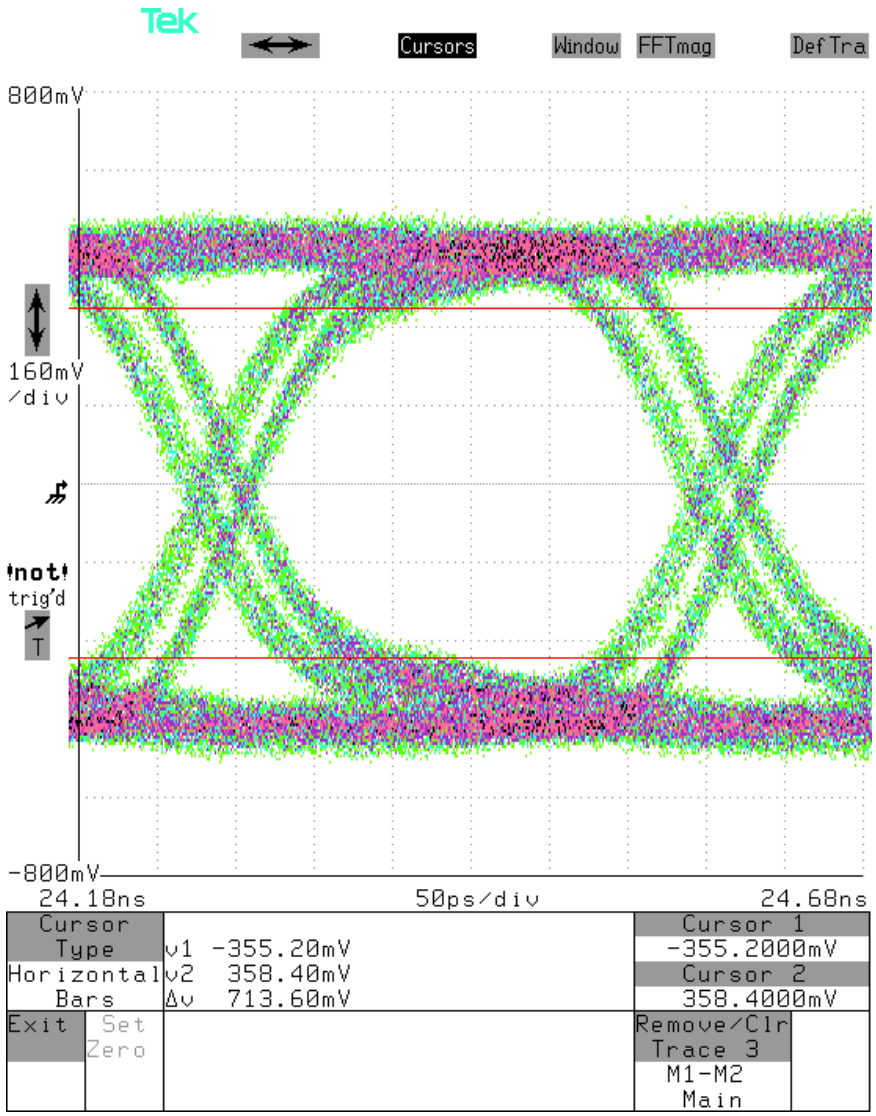
# Simplex Eye Pattern Measurements

- The following slides show each pair of the 0.5 meter length 28 AWG cable assembly.

# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 15, S 16
- Received Line: test port S 1, S 2

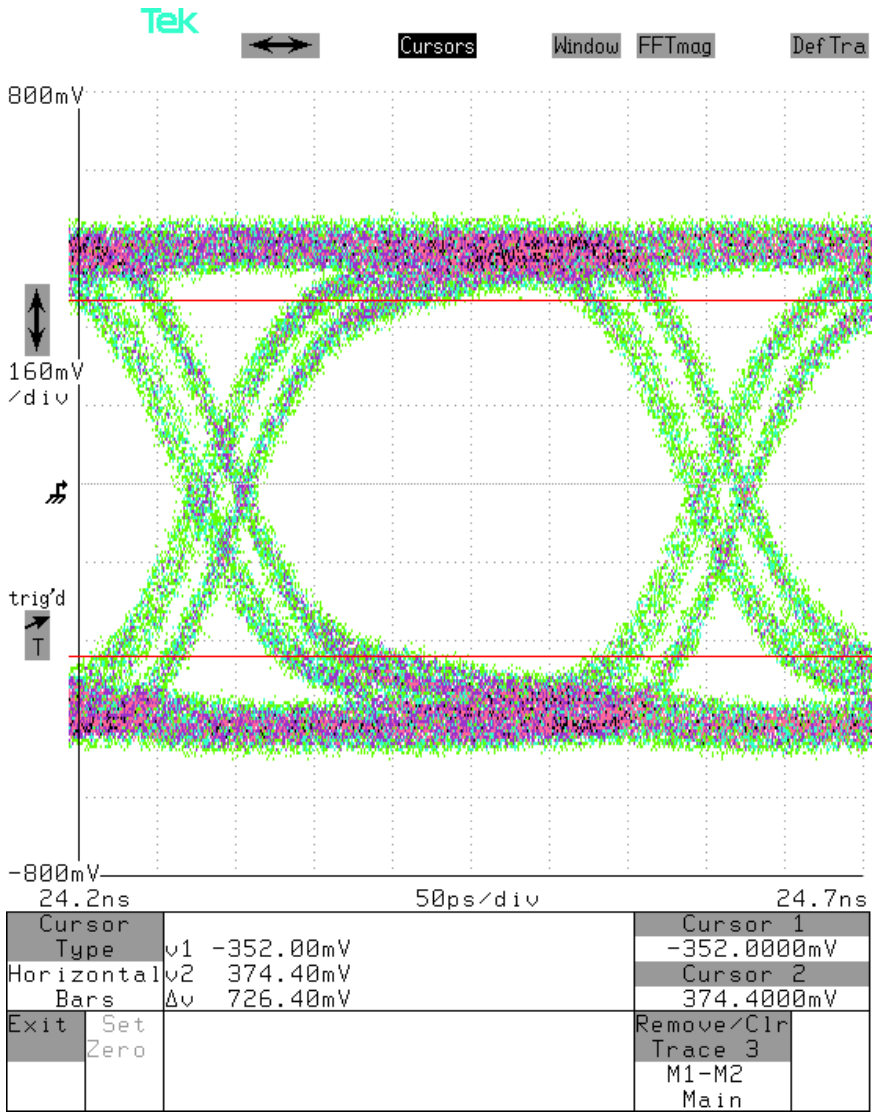
- **Eye open = 713.60 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 13, S 14
- Received Line: test port S 3, S 4

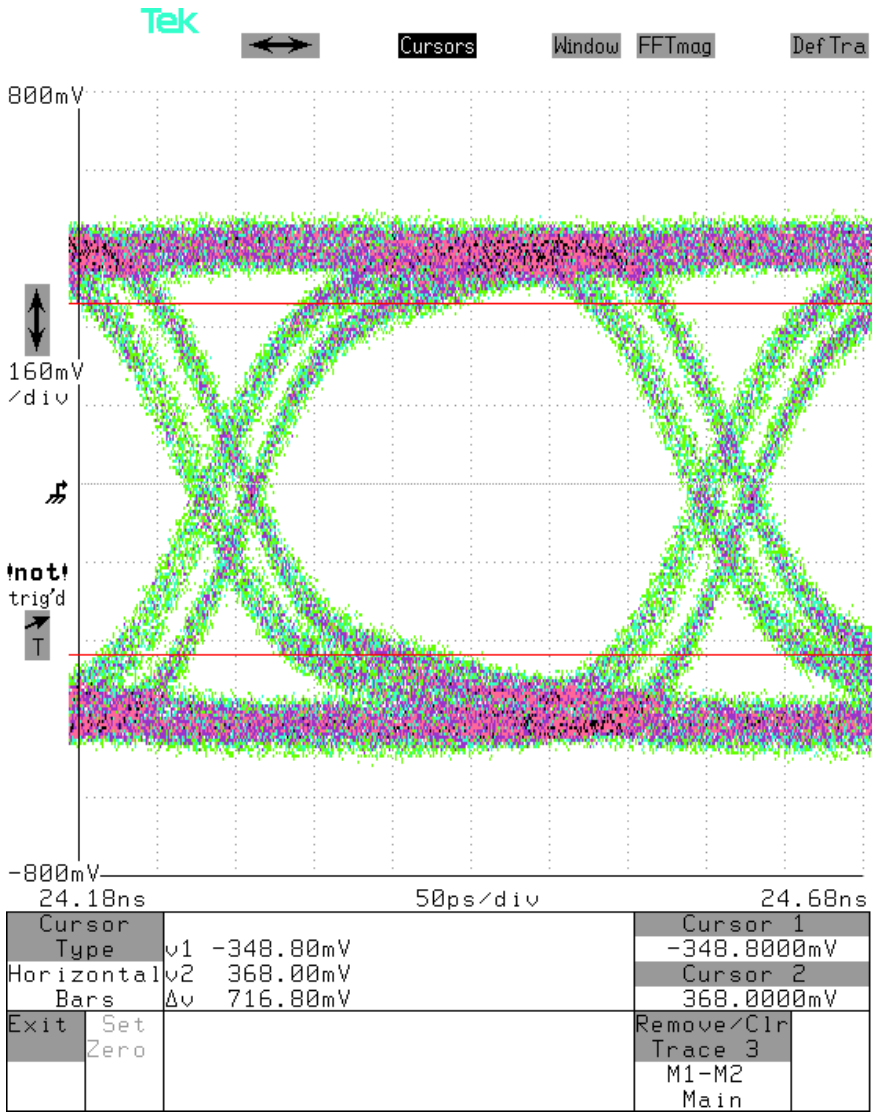
- **Eye open = 726.40 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 11, S 12
- Received Line: test port S 5, S 6

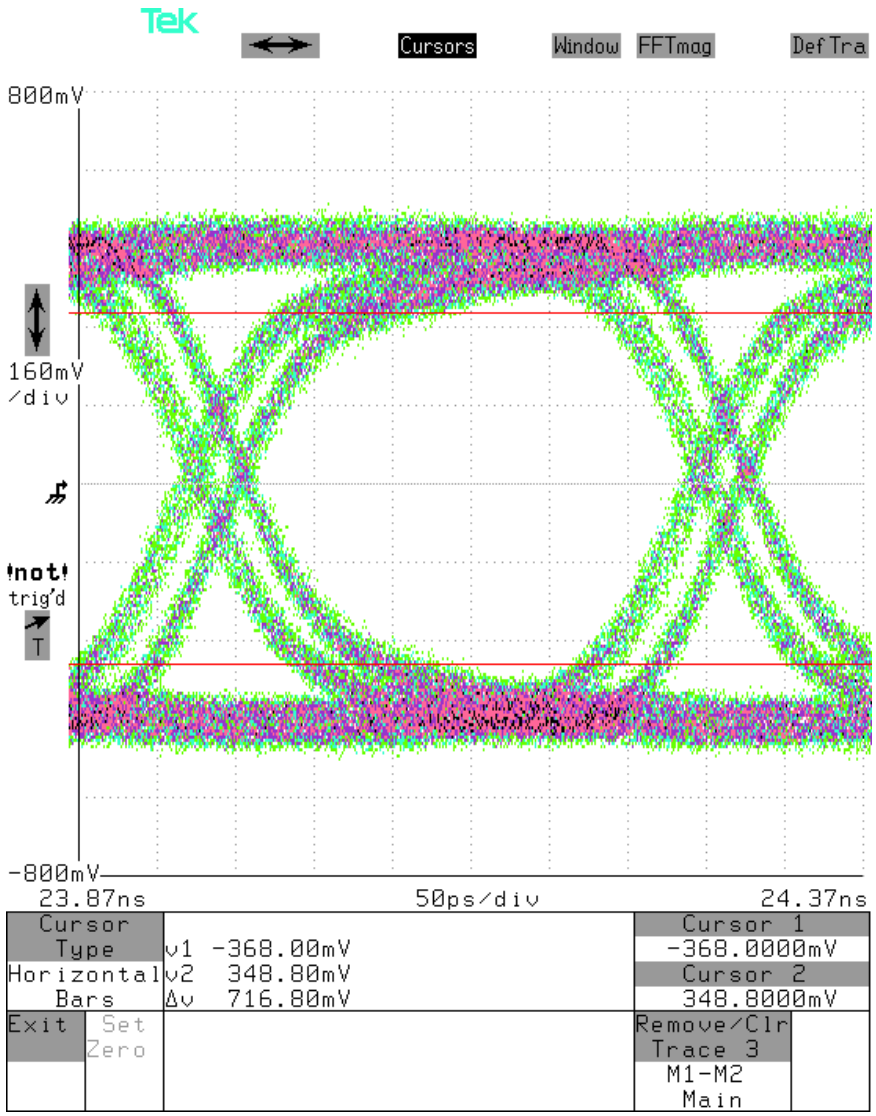
- **Eye open = 716.80 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 9, S 10
- Received Line: test port S 7, S 8

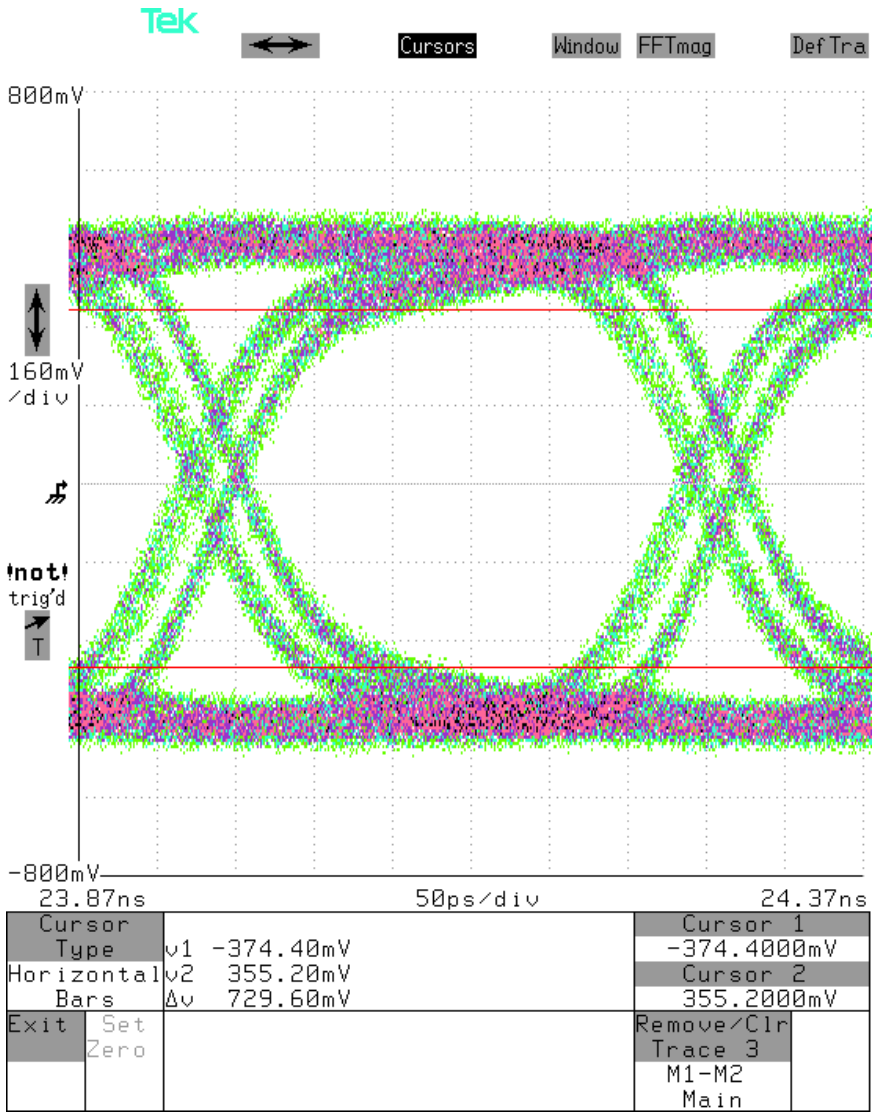
- **Eye open = 716.80 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 7, S 8
- Received Line: test port S 9, S 10

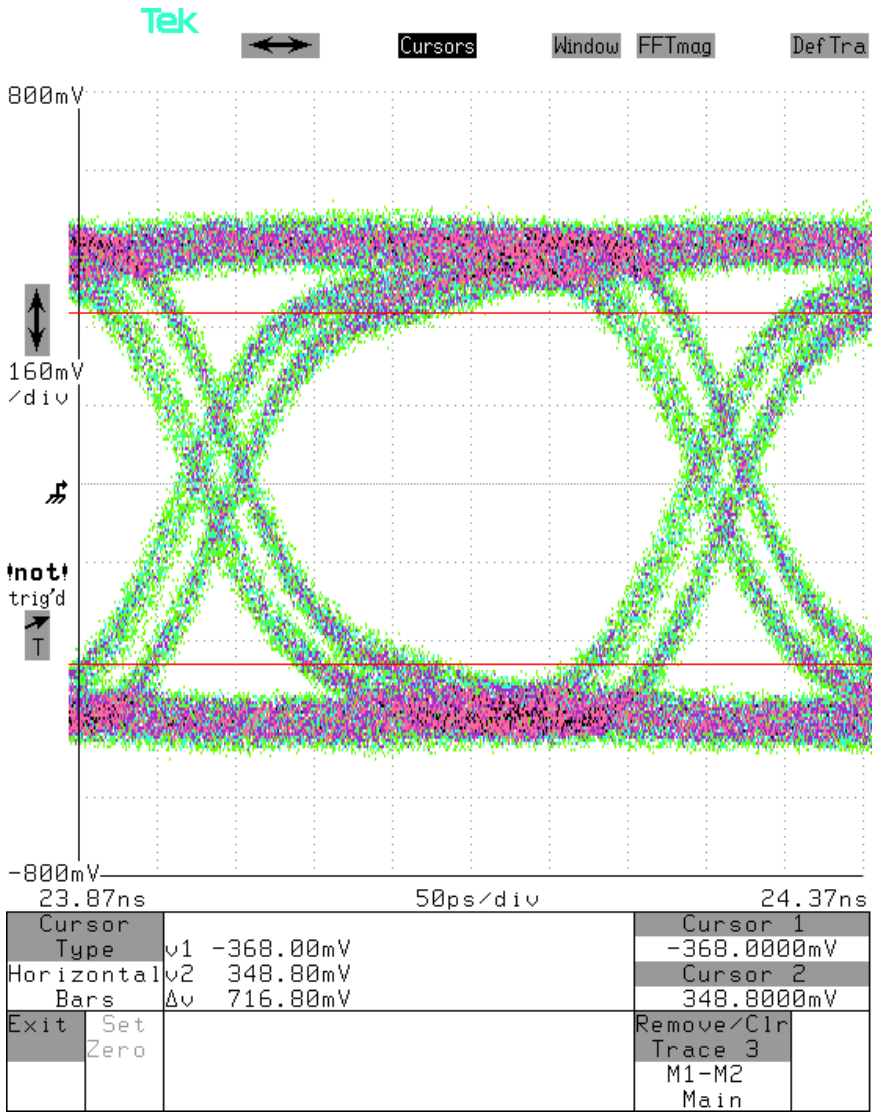
- **Eye open = 729.60 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 5, S 6
- Received Line: test port S 11, S 12

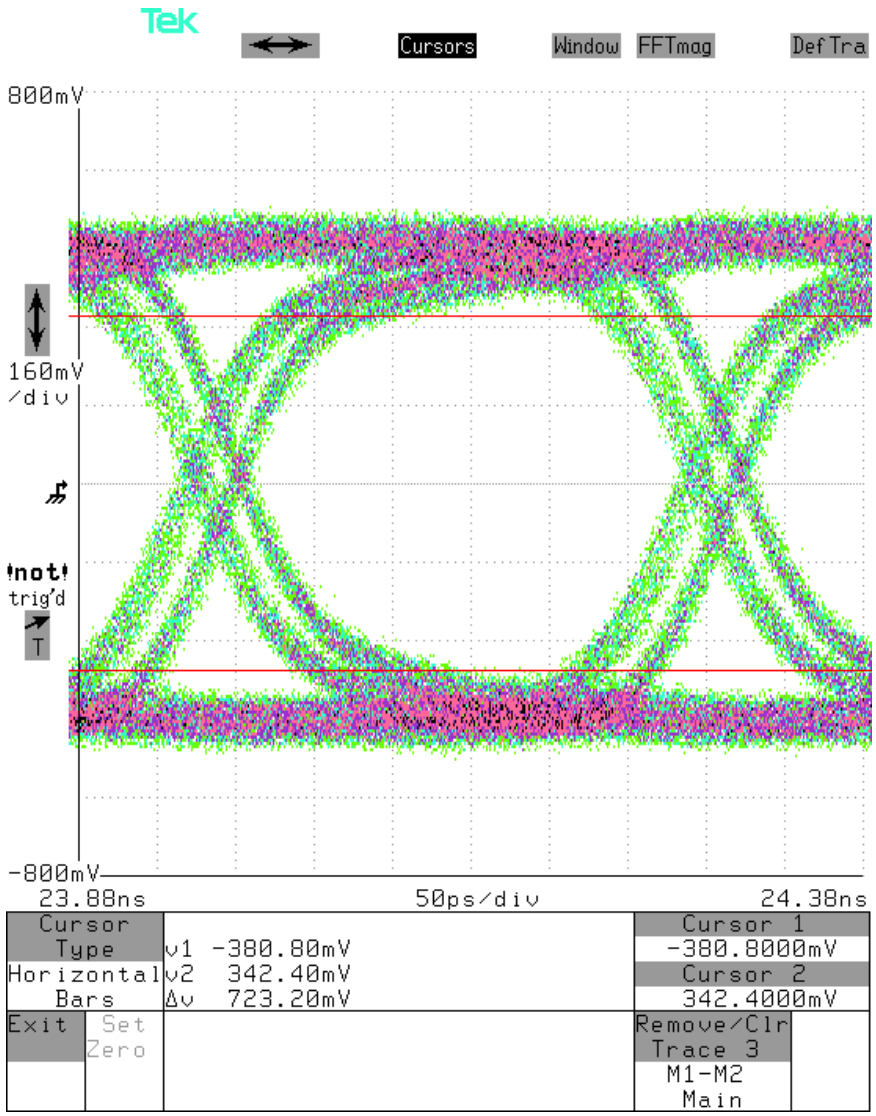
- **Eye open = 716.80 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 3, S 4
- Received Line: test port S 13, S 14

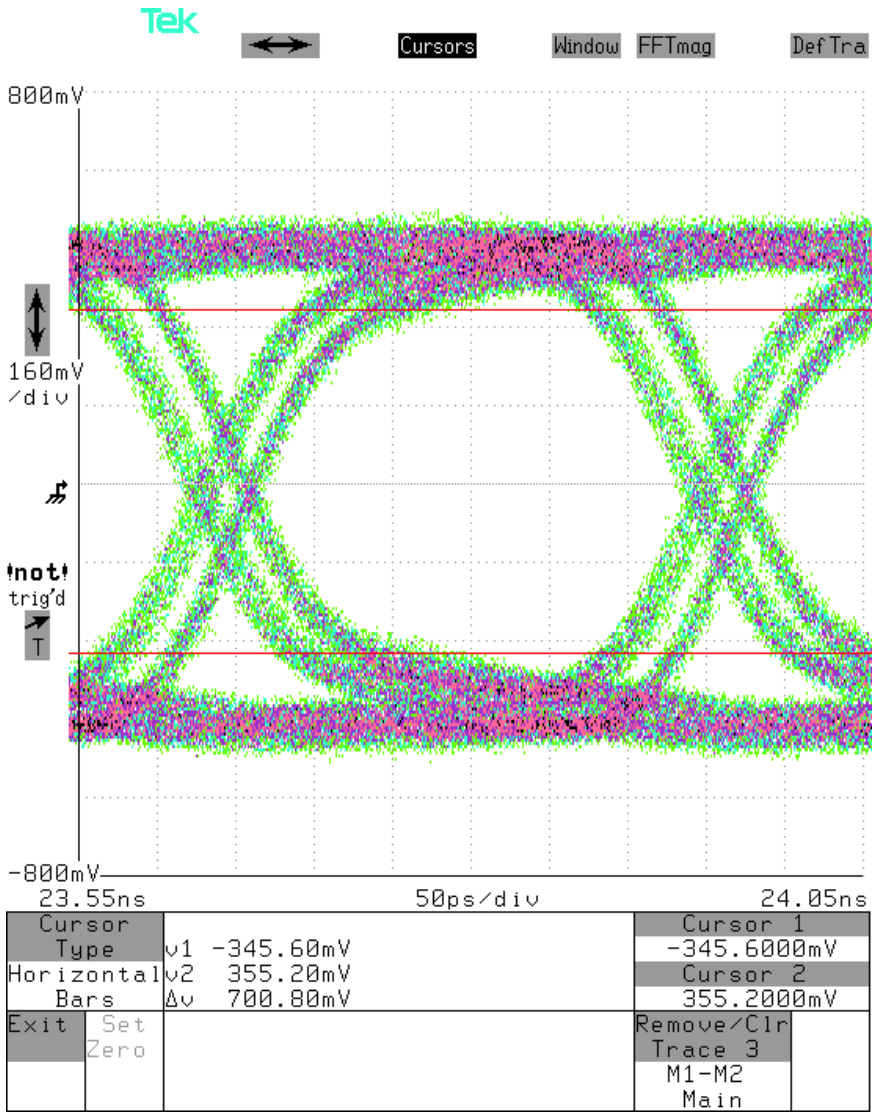
- **Eye open = 723.20 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 1, S 2
- Received Line: test port S 15, S 16

- **Eye open = 700.80 mV**



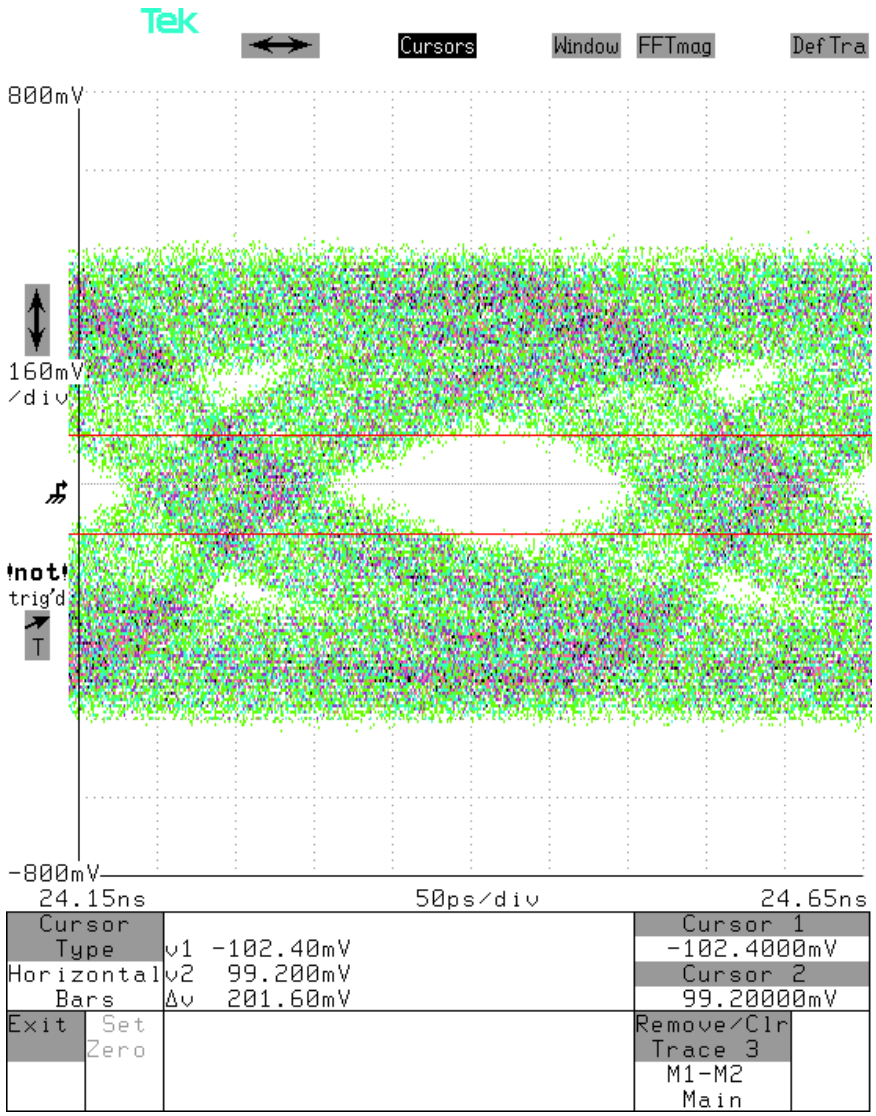
# Simplex Eye Pattern Measurements

- The following slides show each pair of the 5.0 meter length 28 AWG cable assembly.

# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 15, S 16
- Received Line: test port S 1, S 2

- **Eye open = 201.60 mV**

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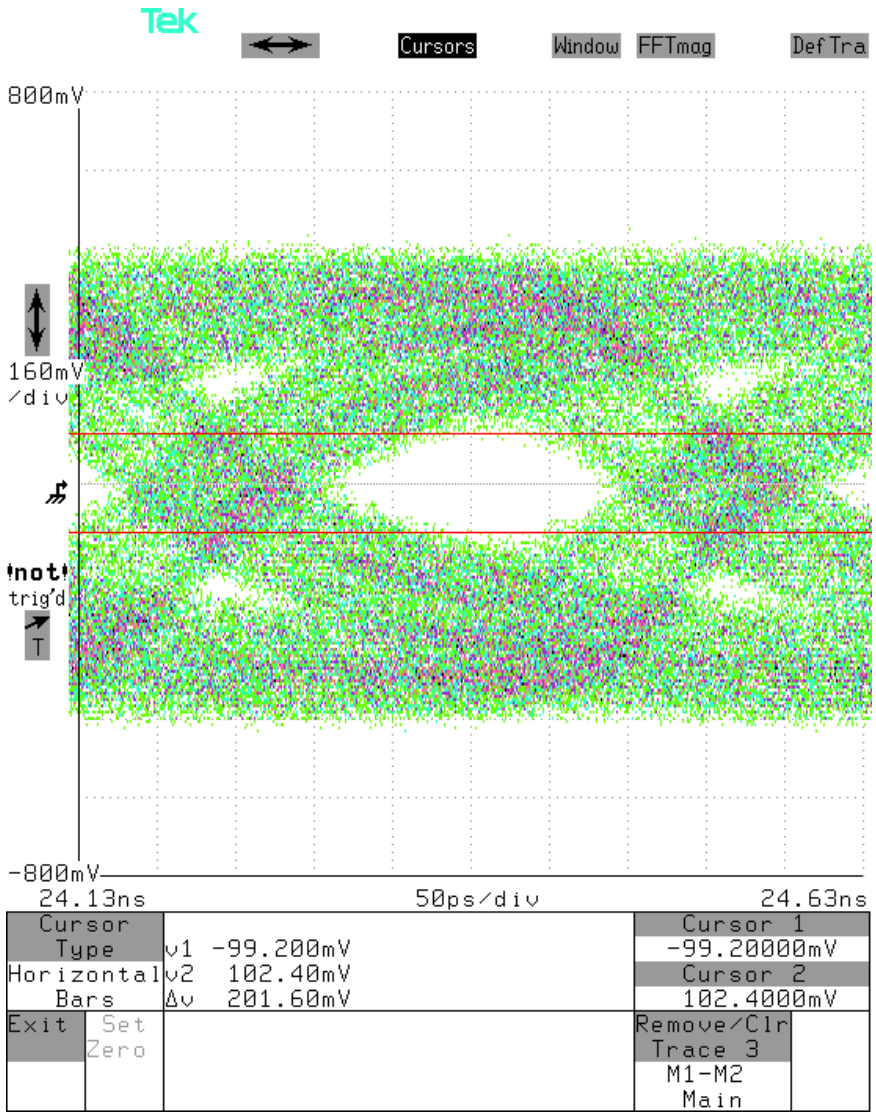
# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 13, S 14
- Received Line: test port S 3, S 4

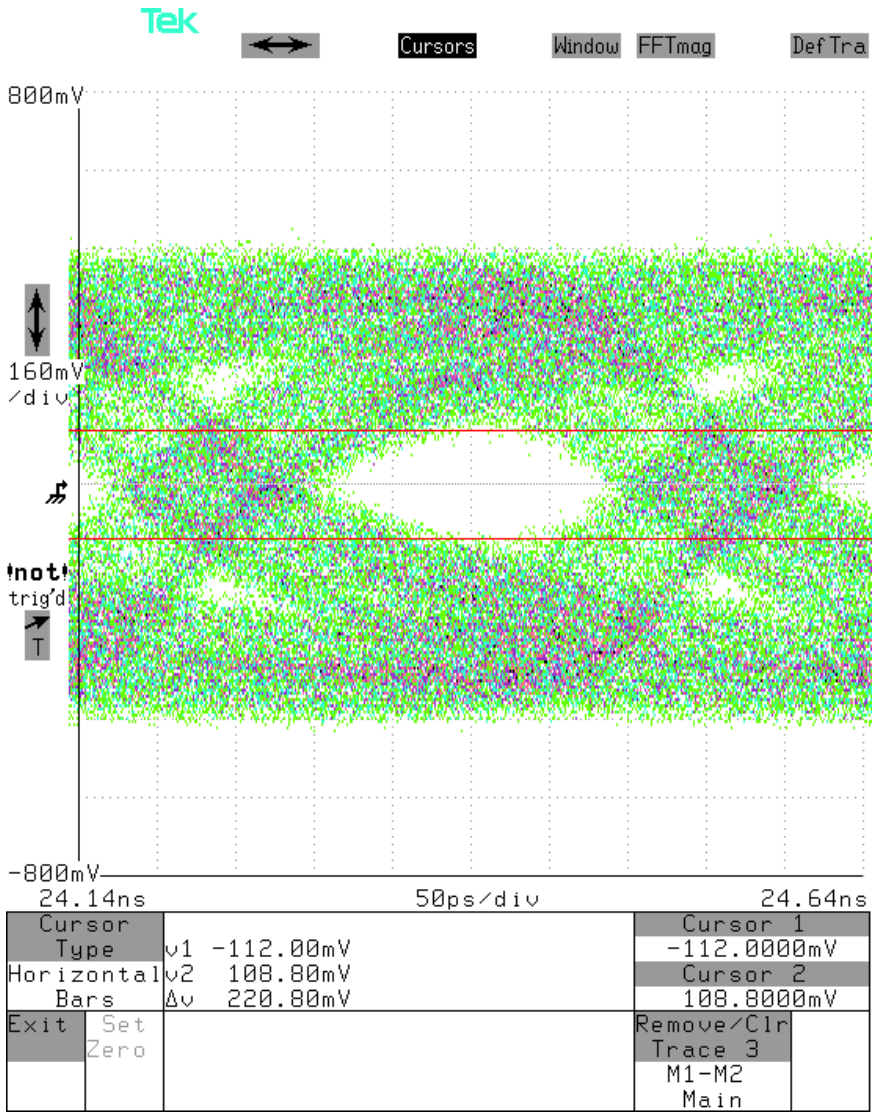
- **Eye open = 201.60 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 11, S 12
- Received Line: test port S 5, S 6

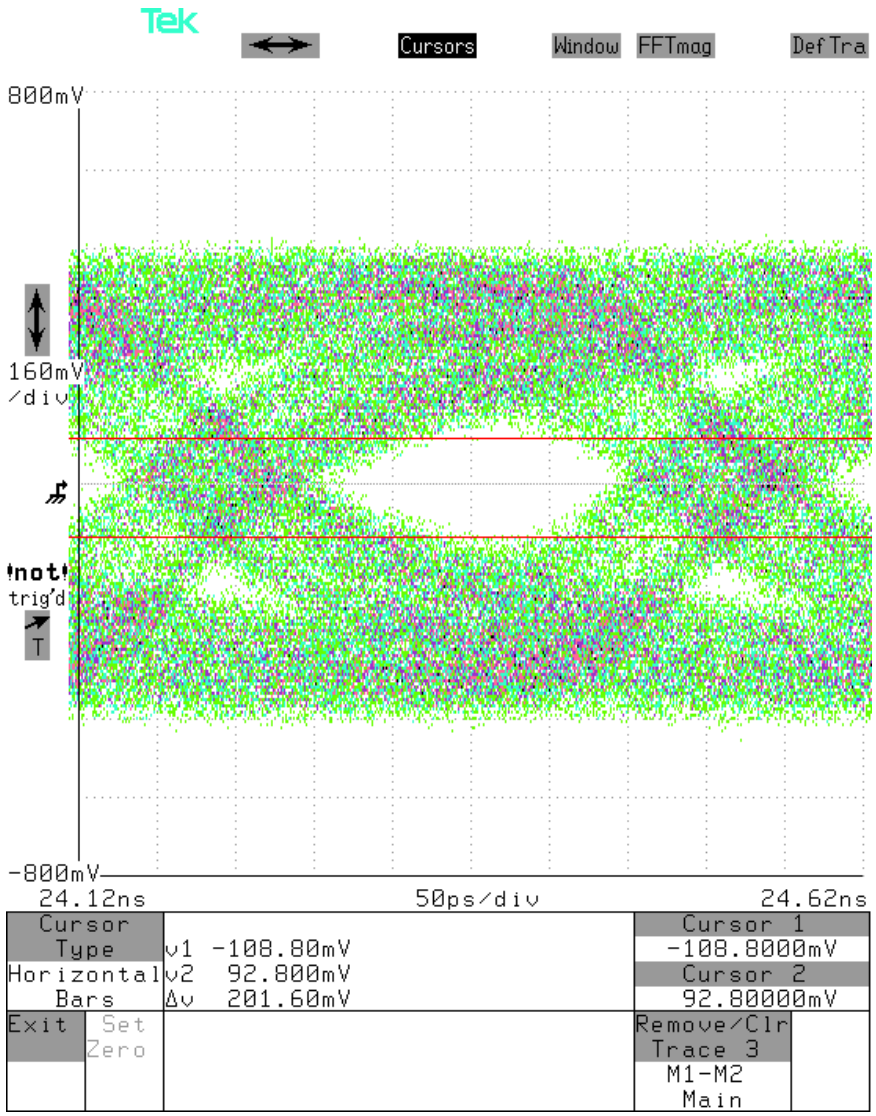
- **Eye open = 220.80 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 9, S 10
- Received Line: test port S 7, S 8

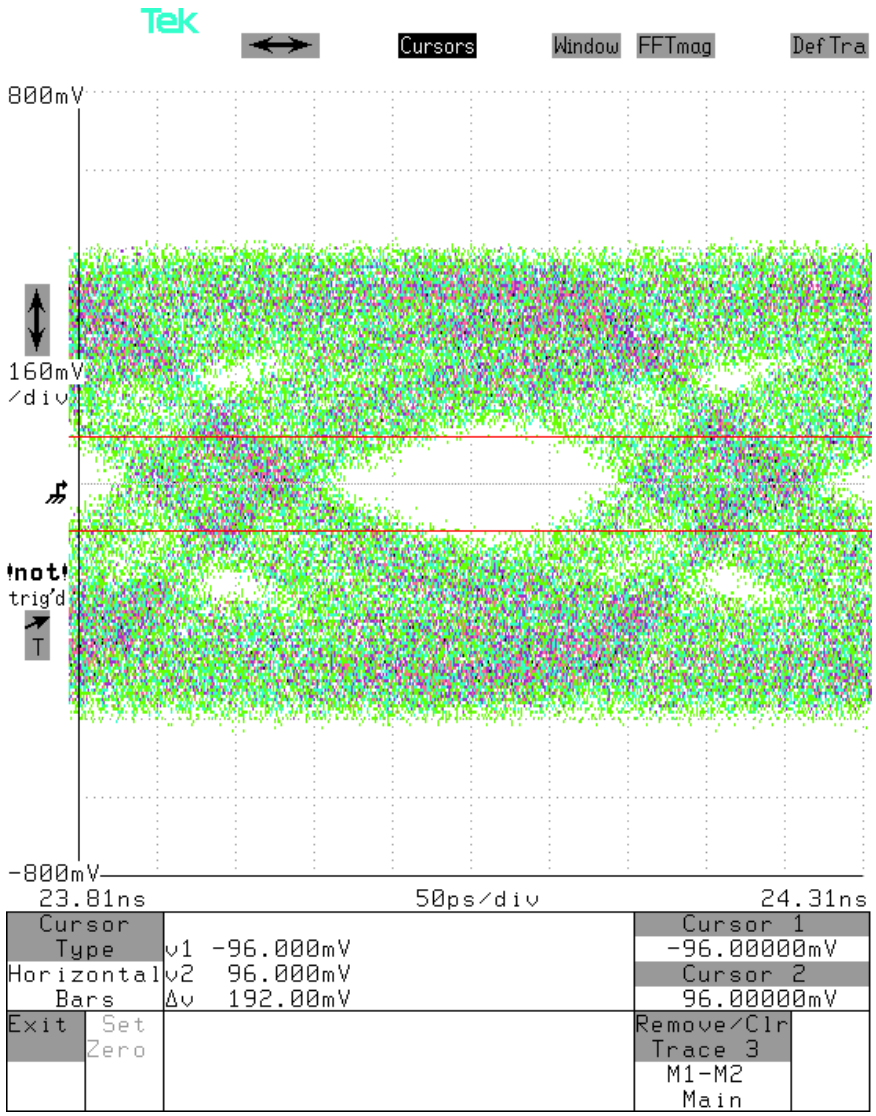
- **Eye open = 201.60 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 7, S 8
- Received Line: test port S 9, S 10

- **Eye open = 192.00 mV**

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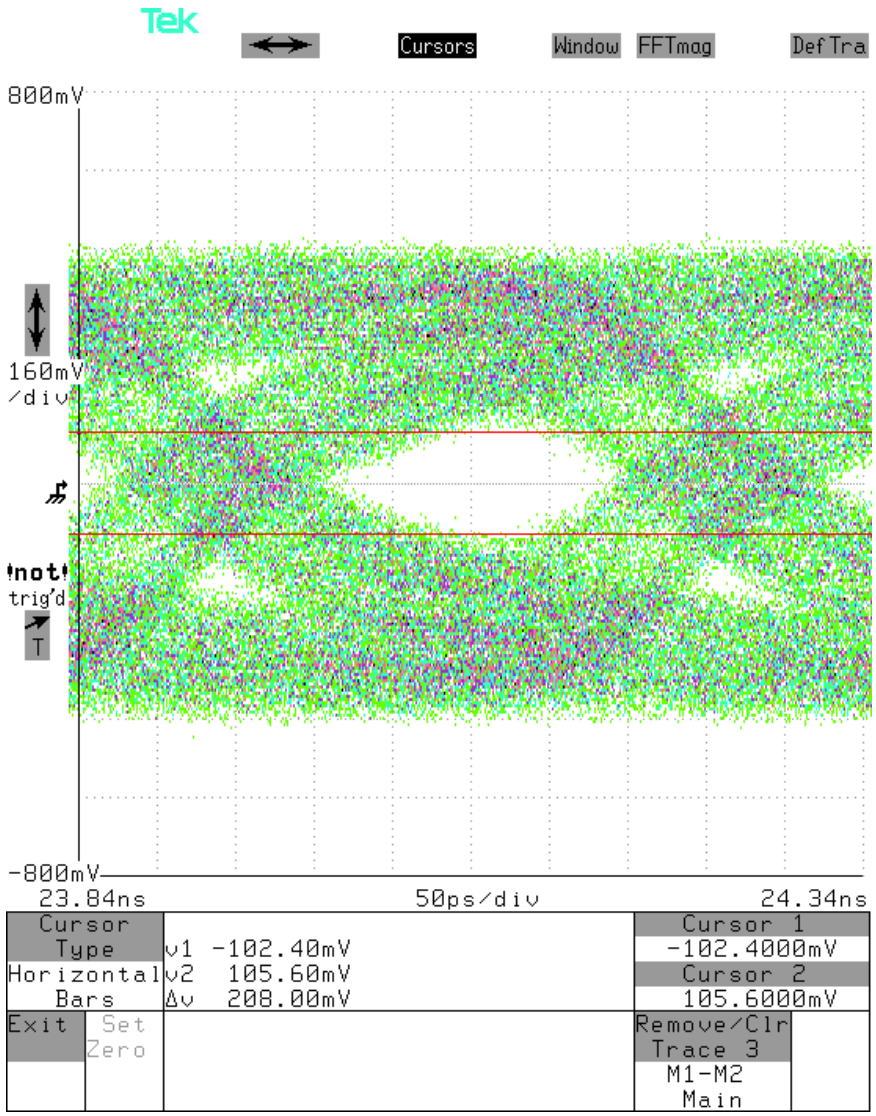
# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 5, S 6
- Received Line: test port S 11, S 12

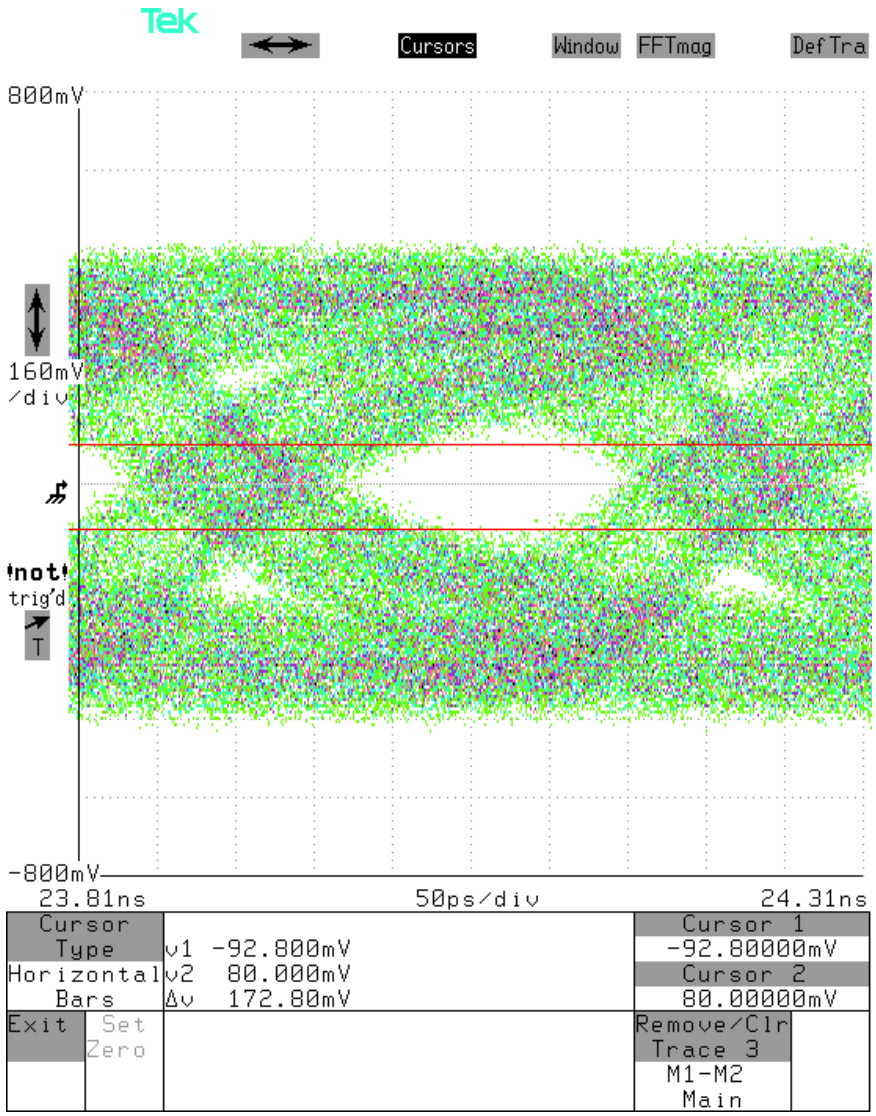
- **Eye open = 208.0 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 3, S 4
- Received Line: test port S 13, S 14

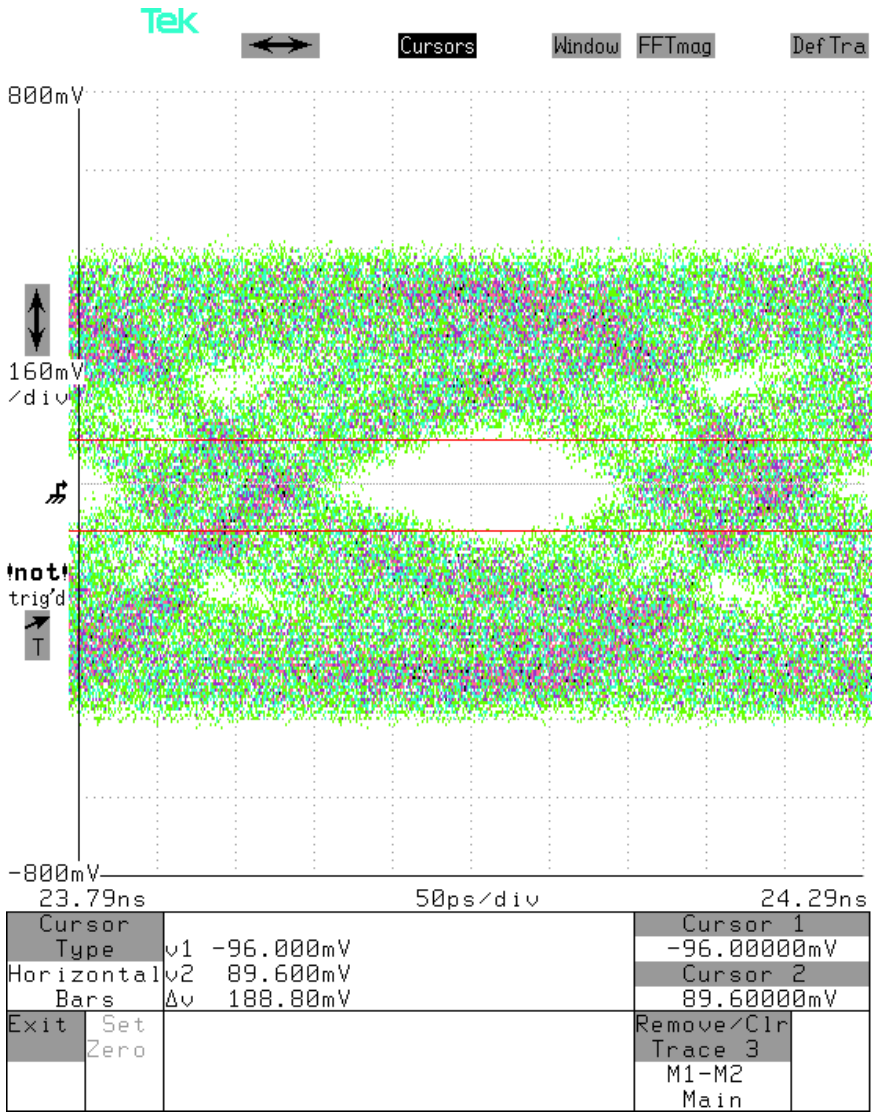
- **Eye open = 172.80 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 1, S 2
- Received Line: test port S 15, S 16

- **Eye open = 188.80 mV**



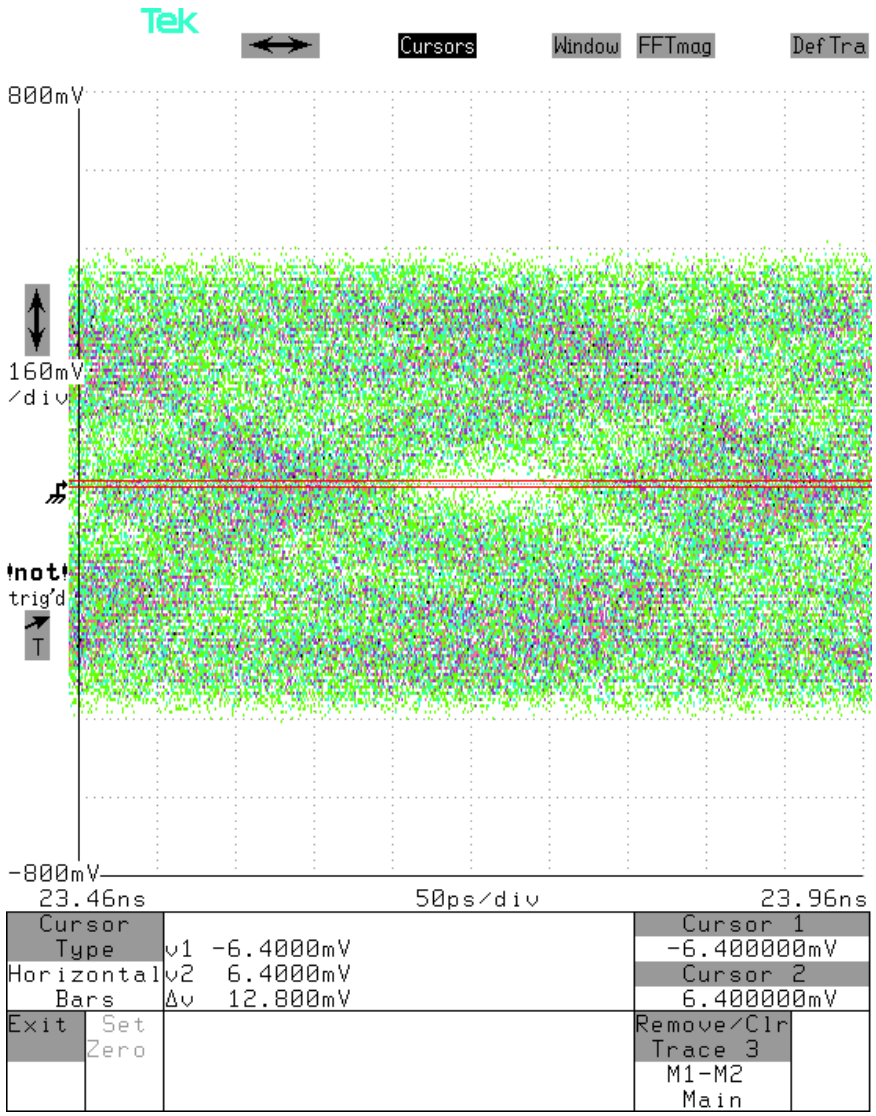
# Simplex Eye Pattern Measurements

- The following slides show each pair of the 10.0 meter length 24 AWG cable assembly.

# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S15, S16
- Received Line: Test port S1, S2

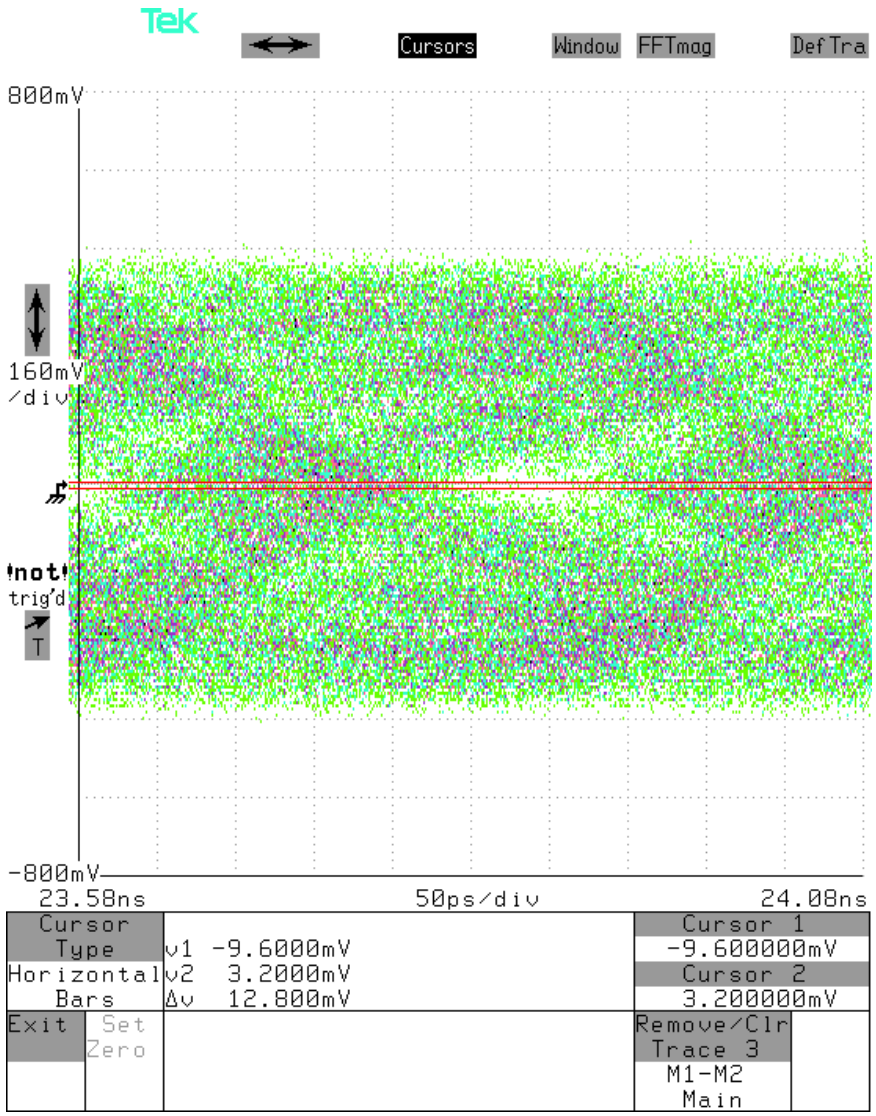
- **Eye open = 12.80 mV**



# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S13, S14
- Received Line: Test port S3, S4

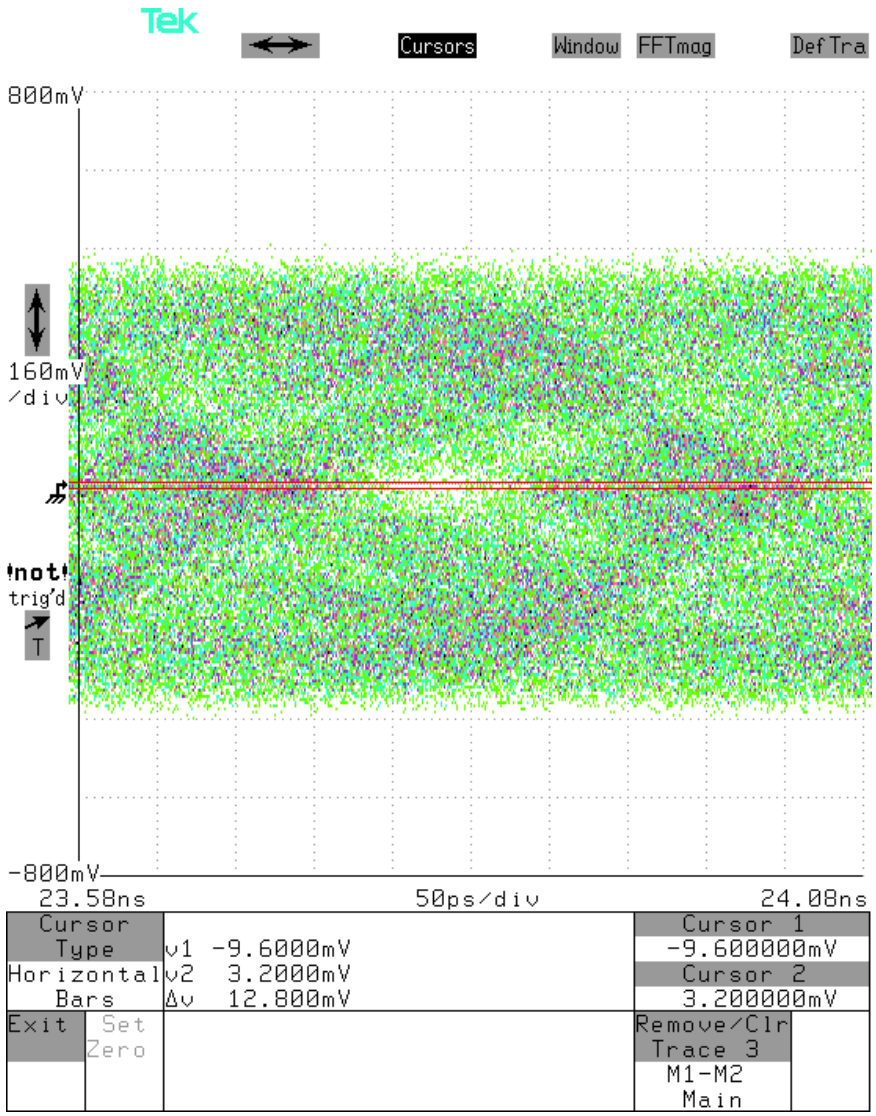
- **Eye open = 12.8 mV**



# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S11, S12
- Received Line: Test port S5, S6

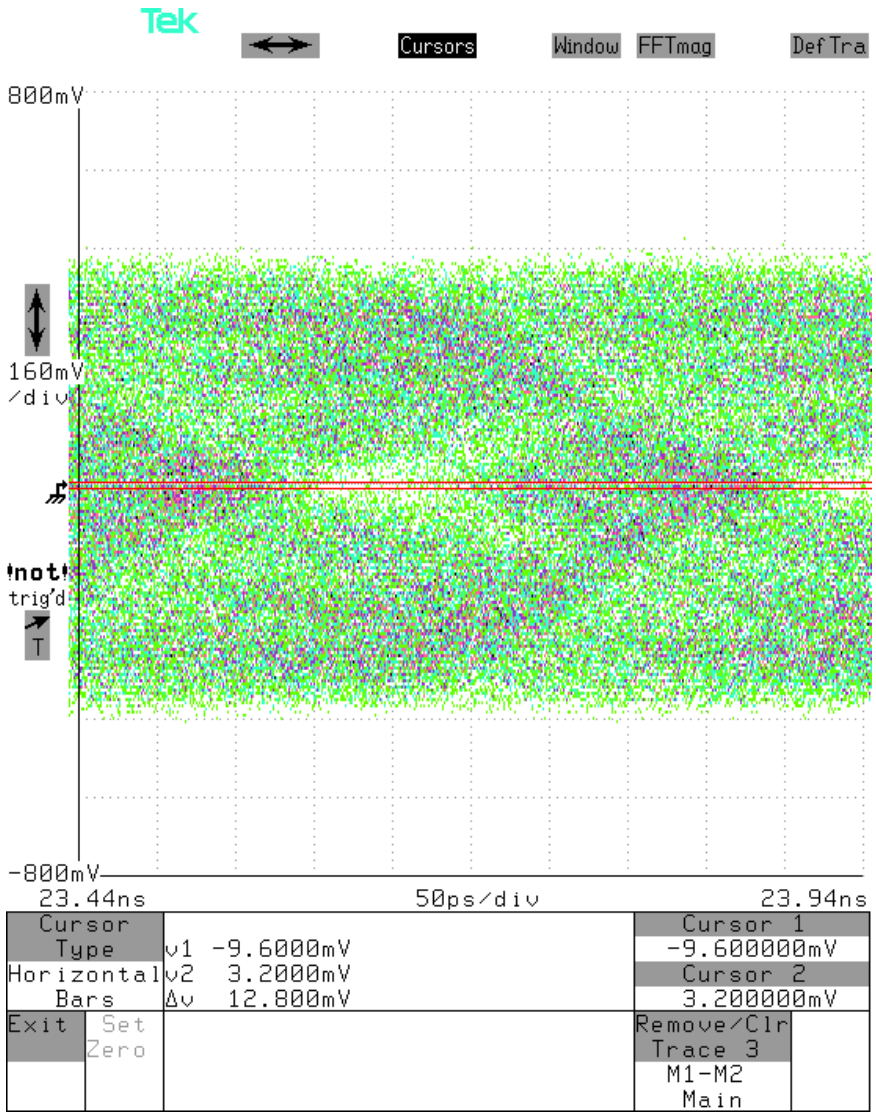
- **Eye open = 12.8 mV**



# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S9, S10
- Received Line: Test port S7, S8

- **Eye open = 12.8 mV**



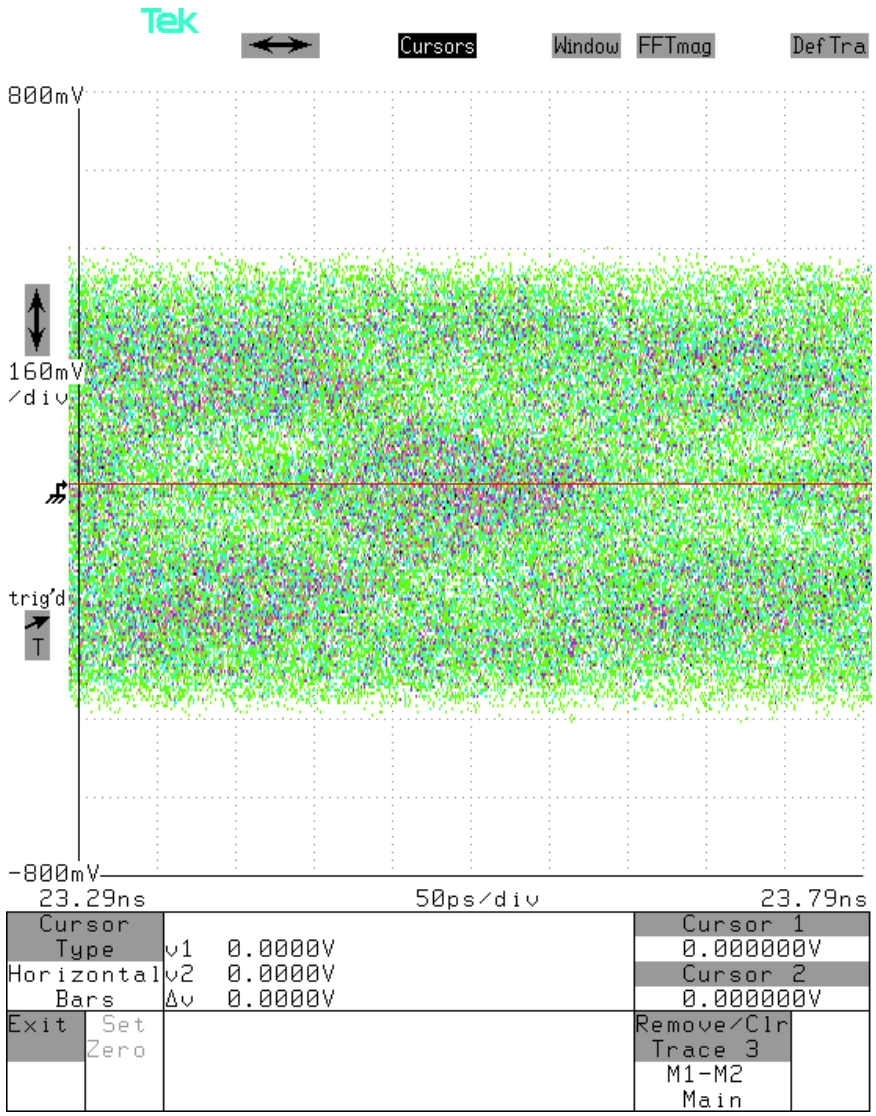
# Comment On Quality of Bulk Cable

- The following slide shows a more closed Eye than the other pairs.
- The insertion loss of transmit port S7S8 to receive port S9S10 (following slide) is 37% greater than the other pairs in the assembly.
- Note that this pair passes the proposed Insertion Loss specification of 17 dB maximum, but may not function in a system because the emphasis and equalization are not designed for this different loss curve.
- Cursory examination of mode conversion measurements hint that the problem is related to mode conversion, and that this cable will also have Cross Talk and EMI performance issues.
- It would be of great value if someone used this data to evaluate if this different performing pair has an effect on system performance.
- Bulk cable suppliers have so far been unable to prevent shipment of product with significant performance variation from pair to pair.
- Perhaps this issue warrants discussion in the standard.

# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S7, S8
- Received Line: Test port S9, S10

- **Eye open = 0.0 mV**

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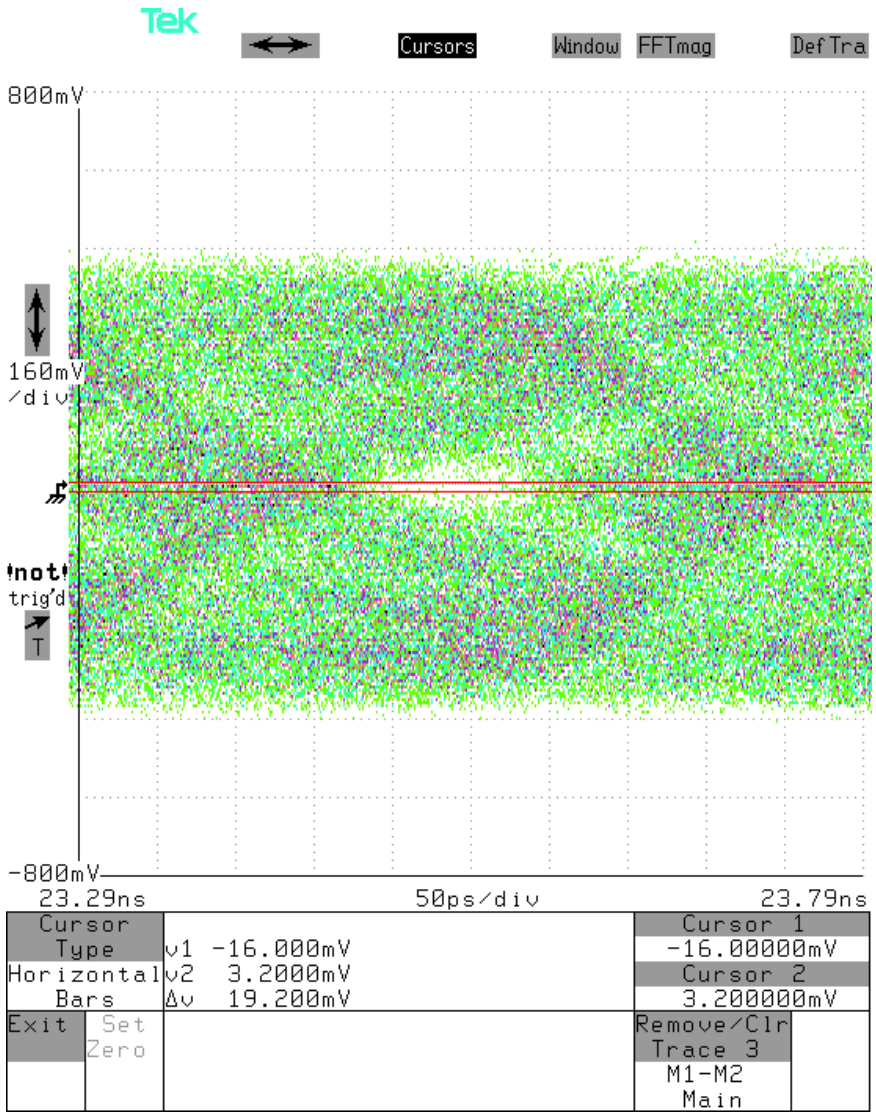
# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S5, S6
- Received Line: Test port S11, S12

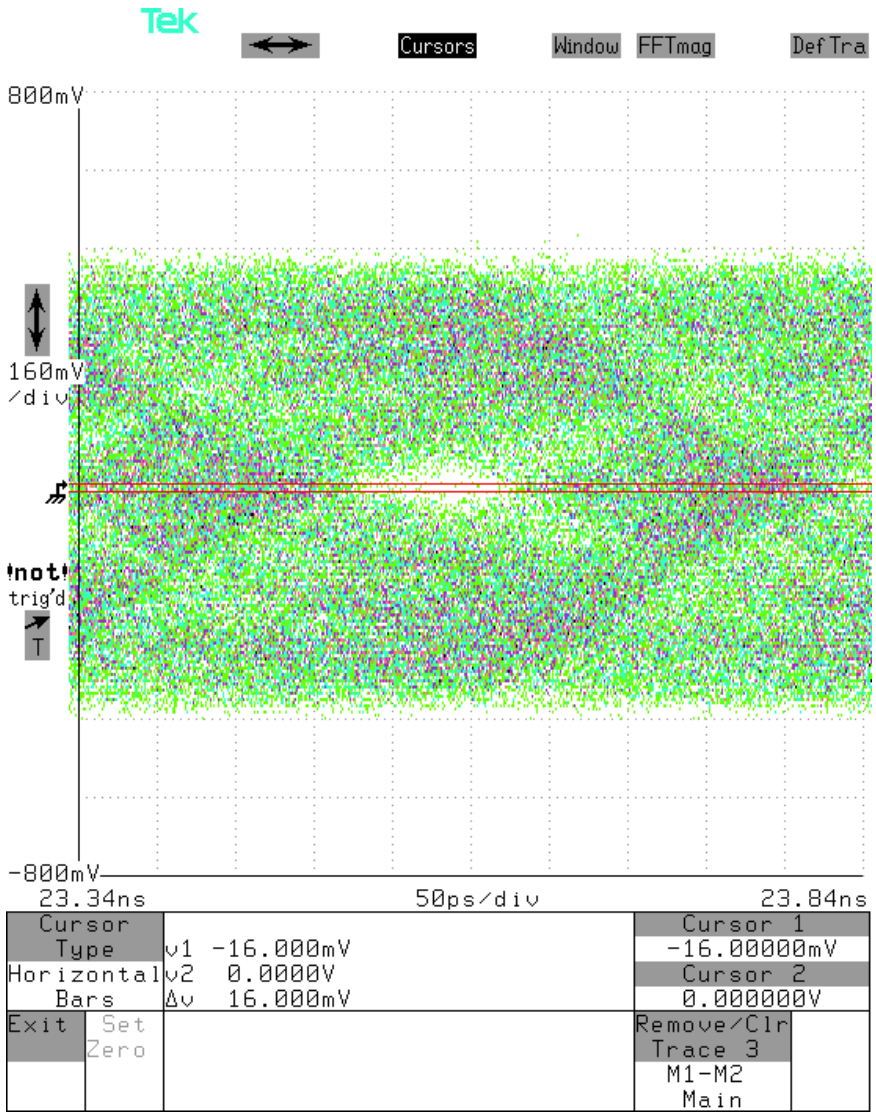
- **Eye open = 19.2 mV**



# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S3, S4
- Received Line: Test port S13, S14

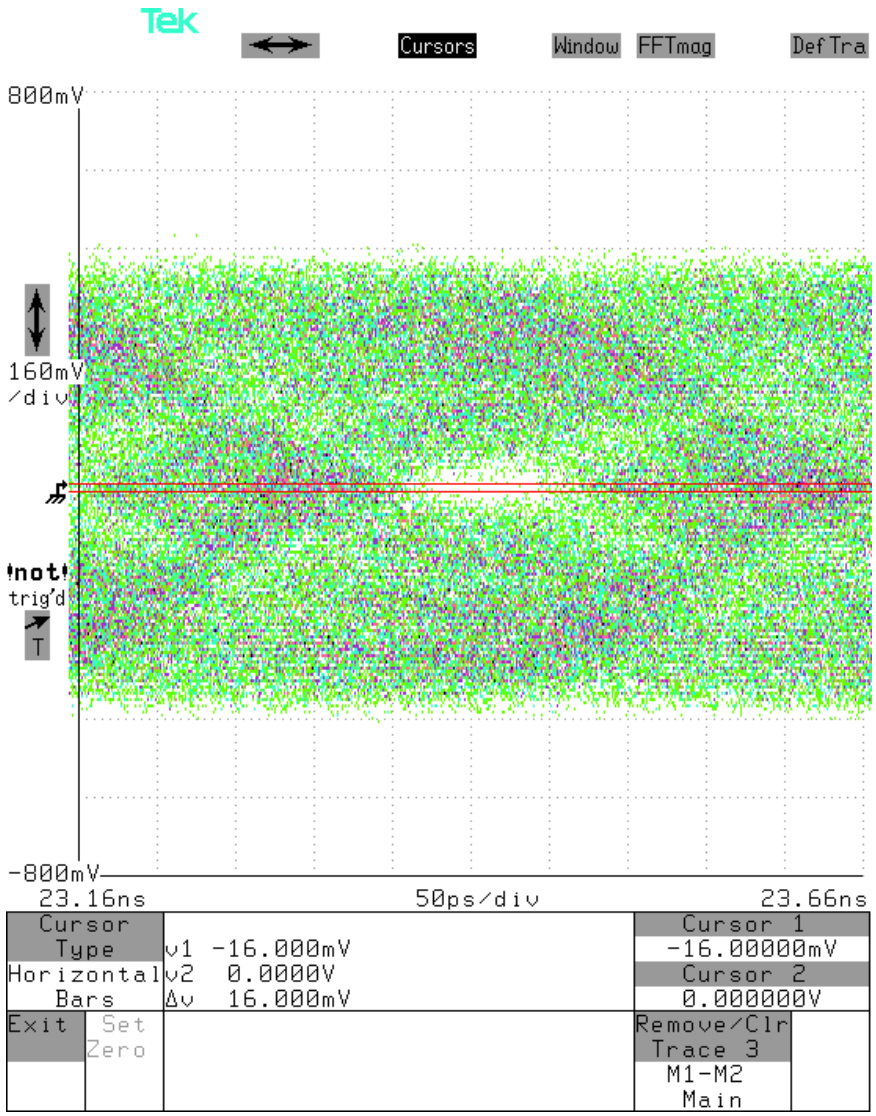
- **Eye open = 16.0 mV**



# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: PRBS
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S1, S2
- Received Line: Test port S15, S16

- **Eye open = 16.0 mV**

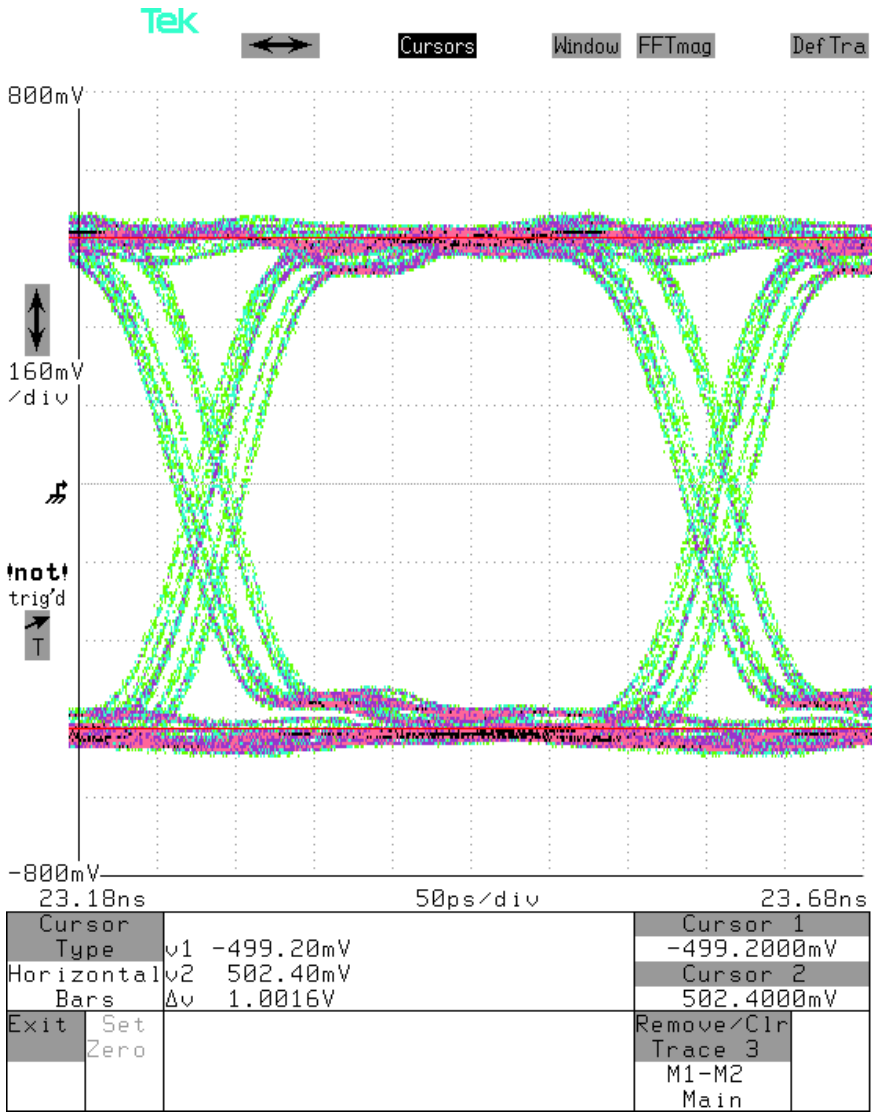


# Eye Pattern – Measurement Methods Data Pattern Generator Compared to Derived from Spectral Characteristics [S-Parameter]

- The two test systems use K28.5 thirty two bit repeating data sequence as that is a data pattern available in both systems.
- The Spectral Characteristic test system has had the fixture effects added, so a direct comparison may be made to the Data Pattern Generator system (which cannot remove fixture effects).
- Note that at data rates above 2.5 Gbps, the data pattern generator contributes Jitter error to the measurement, and the zero crossing of the data pattern generator is NOT at zero volts.

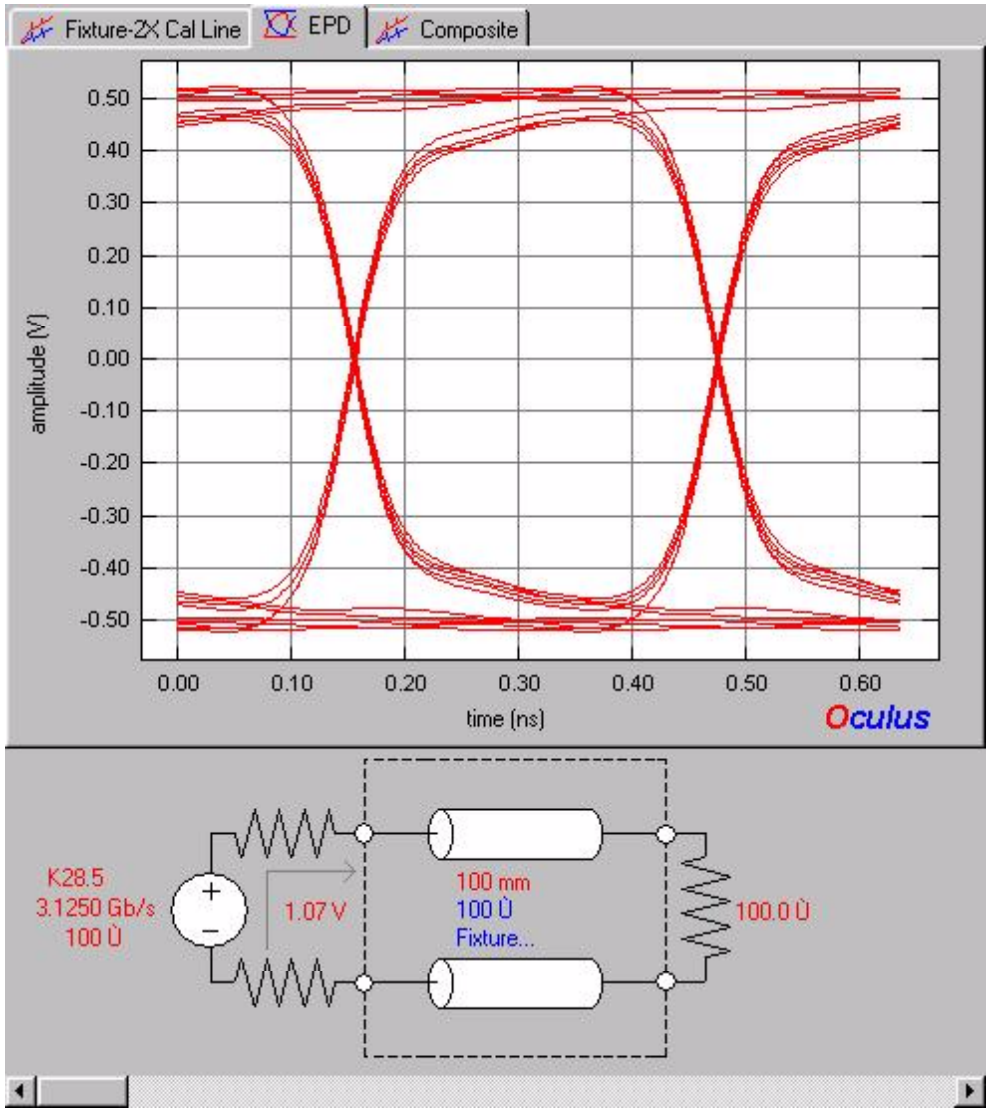
# Typical Eye Pattern Measurement **Through Double Length Calibration Traces**

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- **Data Pattern: 32 bit K28.5**
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- **Input Voltage: 1000 mV**
- Calibration: Center Rail to Center Rail of FCI Test Board, double length calibration trace



# Typical Eye Opening Measurement By Oculus Software Through 2X Calibration Trace

- Date: 3/12/03
- Temperature: 77.490F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Board: FCI, 4X Infiniband
- **Bit Rate: 3.125 Gb/s**
- Data Pattern: **K28.5**
- Oculus Set Rise-time: 15 %
- **Input Voltage: 1000 mVp-p**
- DUT: 2X Calibration Trace of 4X Infiniband Fixture

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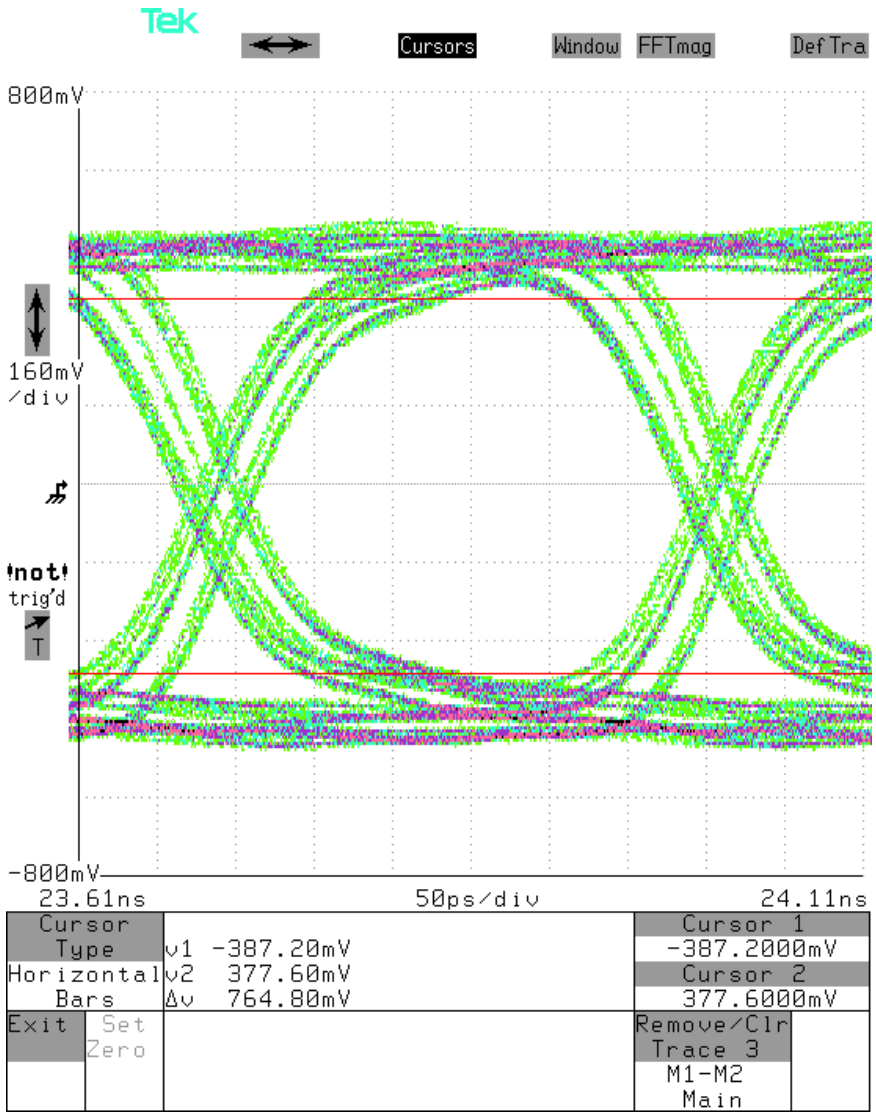
# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: **K28.5**
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Cable: 0.5m, 28AWG, Skewclear, 4X Infiniband cable assembly
- Set up: Received End P1
- Transmitted Line: test port S 7, S 8
- Received Line: test port S 9, S 10

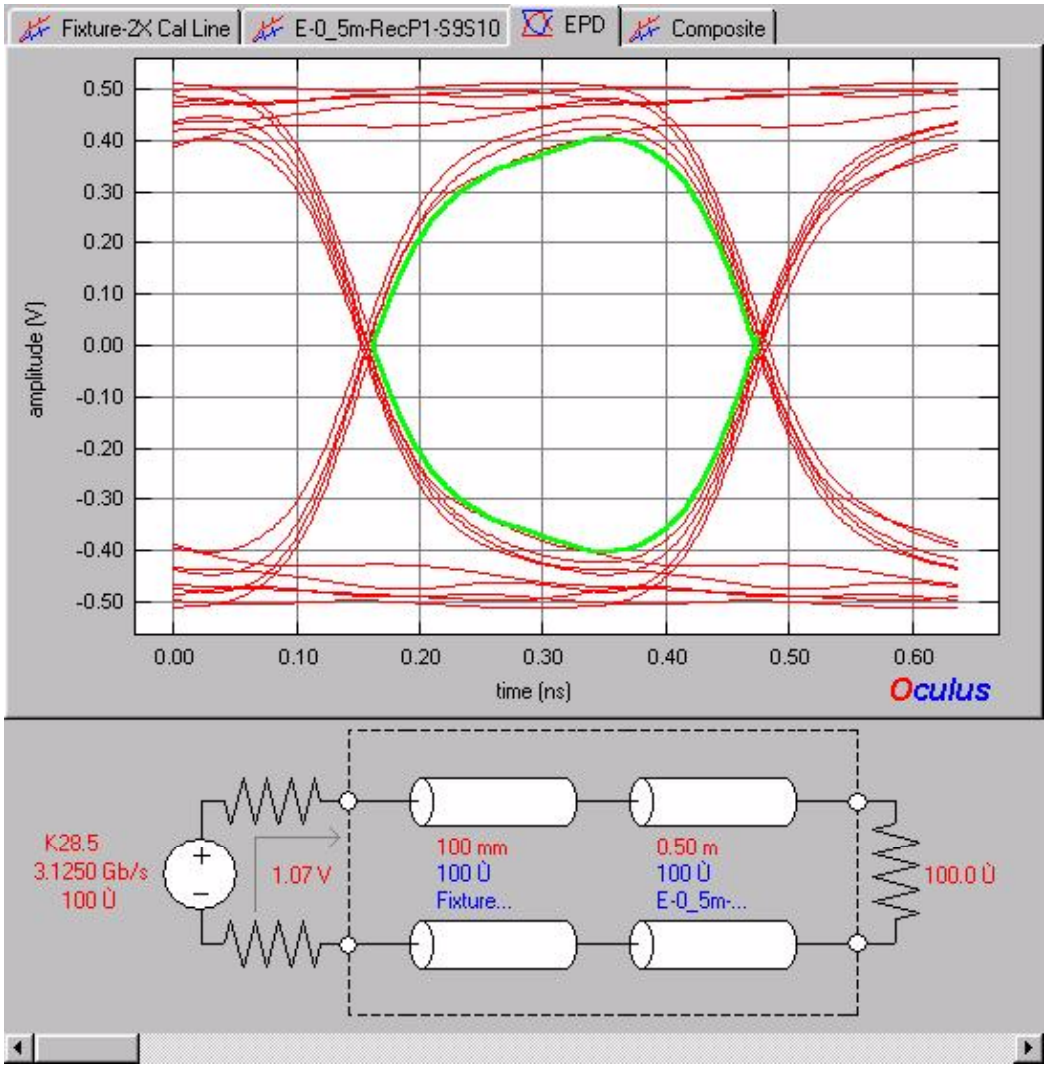
- **Eye open = 764.80 mV**



# Typical Eye Opening Measurement By Oculus Software

- Date: 3/12/03
- Temperature: 77.490F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Board: FCI, 4X Infiniband
- **Bit Rate: 3.125 Gb/s**
- Data Pattern: **K28.5**
- Oculus Set Rise-time: 15 %
- **Input Voltage: 1000 mVp-p**
- Cable : 0.5 m, 28 AWG, 100 ohms, Skewclear, 4X Infiniband cable assembly with FCI Plug Board
- **With Test System**
- **Transmitted line: S 7, S 8**
- **Received line: S 9, S 10**

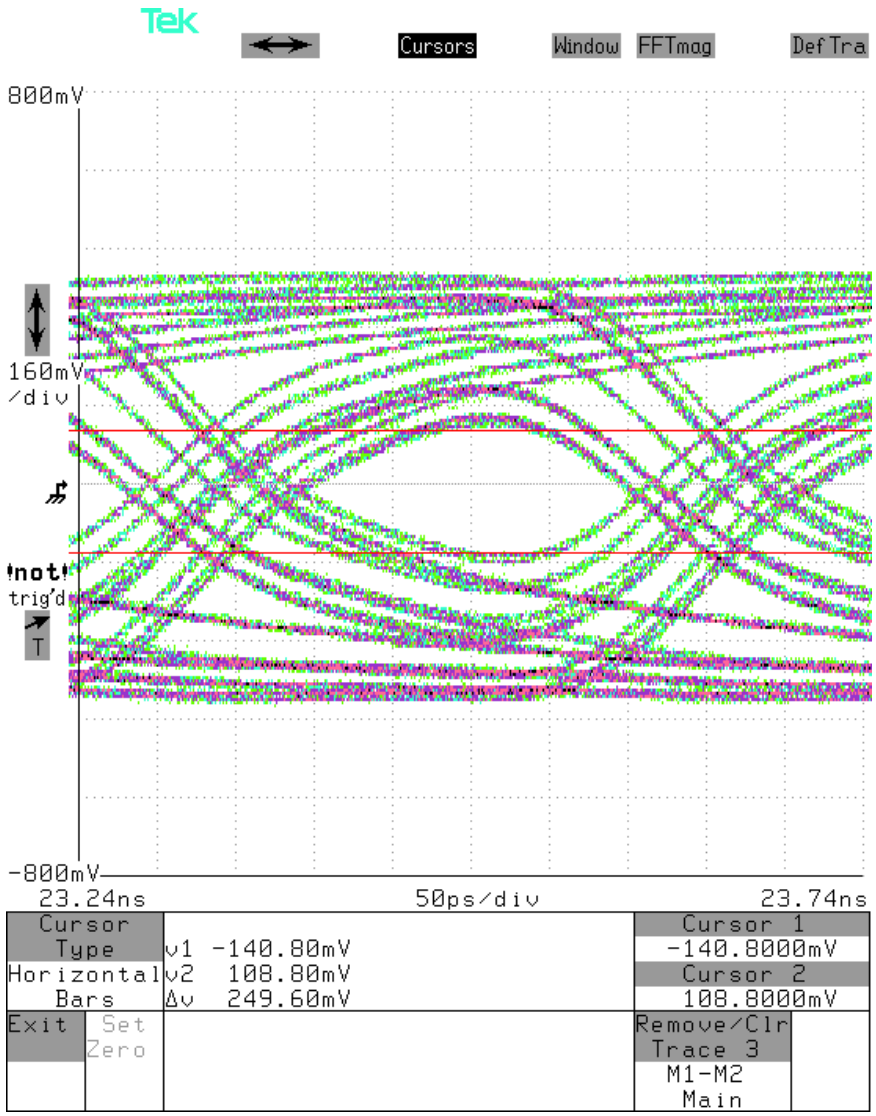
- **Eye open = Approximate 760.0 mV**



# Typical Eye Pattern Measurement

- Date: 2/21/03
- Temperature: 76.82 F
- Relative Humidity: 14.6 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: **K28.5**
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail
- Cable: 5m, 28AWG, Skew-Clear, 4X Infiniband cable assembly with FCI plug board
- Set up: Received End P1
- Transmitted Line: test port S 7, S 8
- Received Line: test port S 9, S 10

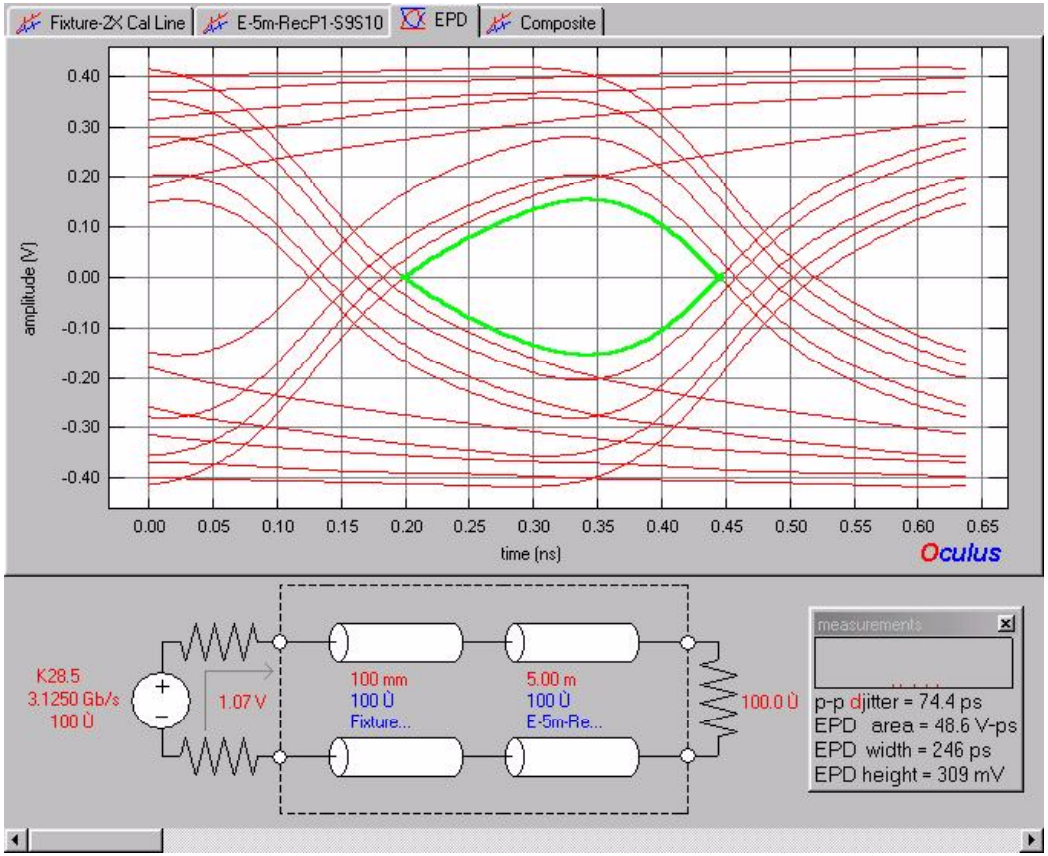
- **Eye open = 249.60 mV**



# Typical Eye Opening Measurement By Oculus Software

- Date: 3/12/03
- Temperature: 77.490F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Board: FCI, 4X Infiniband
- **Bit Rate: 3.125 Gb/s**
- Data Pattern: **K28.5**
- Oculus Set Rise-time: 15 %
- **Input Voltage: 1000 mVp-p**
- Cable : 5 m, 28 AWG, 100 ohms, Skewclear, 4X Infiniband cable assembly with FCI Plug Board
- **With Test System**
- **Transmitted line: S 7, S 8**
- **Received line: S 9, S 10**

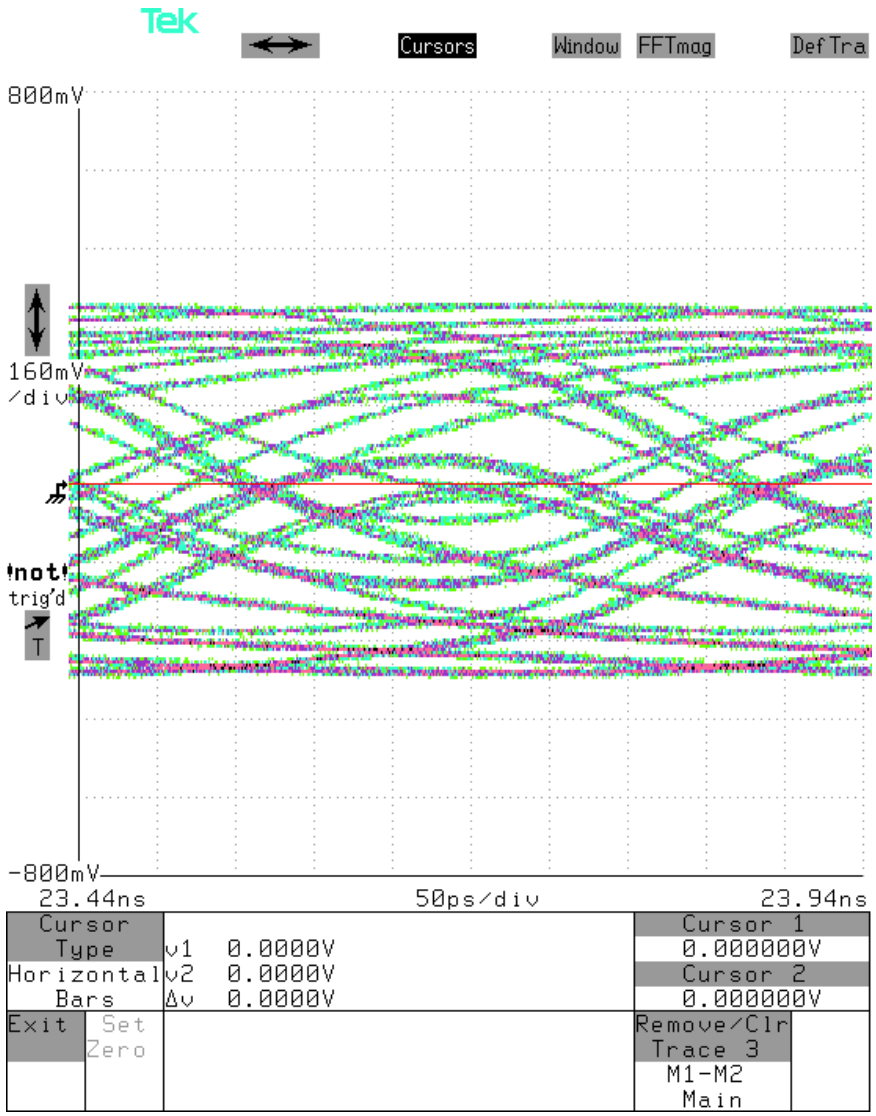
- **Eye open = Approximate 280.0 mV**



# Typical Eye Pattern Measurement

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- **Bit Rate: 3.125 Gb/s**
- Source : HP 8133 A
- Scope: Tektronix 11801C
- Data Pattern: K28.5
- Test Fixture: 4X Infiniband, FCI # SK-48294 Rev 2
- Source Output: 680 mVp-p
- Attenuation Setting: x1.60
- Input Voltage: 1000 mV
- Calibration: Center Rail to Center Rail of FCI Test Board
- Set up: Received End P1
- Transmitted Line: Test port S7, S8
- Received Line: Test port S9, S10

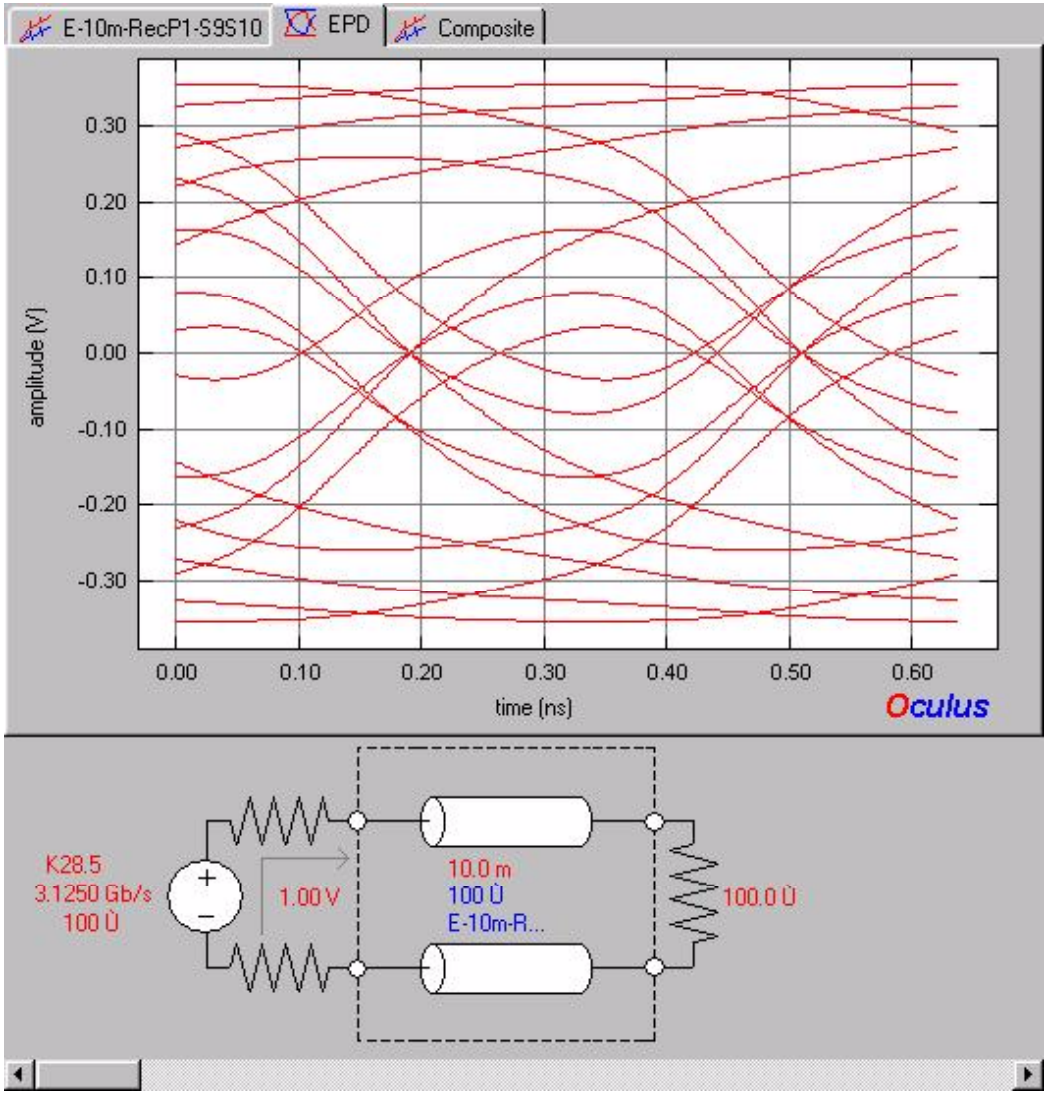
- **Eye open = 0.0 mV**



# Typical Eye Opening Measurement By Oculus Software

- Date: 3/12/03
- Temperature: 77.490F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Board: FCI, 4X Infiniband
- **Bit Rate: 3.125 Gb/s**
- Data Pattern: **K28.5**
- Oculus Set Rise-time: 15 %
- **Input Voltage: 1000 mVp-p**
- Cable : 10 m, 24 AWG, 100 ohms, Skewclear, 4X Infiniband cable assembly with FCI Plug Board
- **With-out Test System**
- **Transmitted line: S 7, S 8**
- **Received line: S 9, S 10**

- **Eye open = Approximate 60.0 mV**

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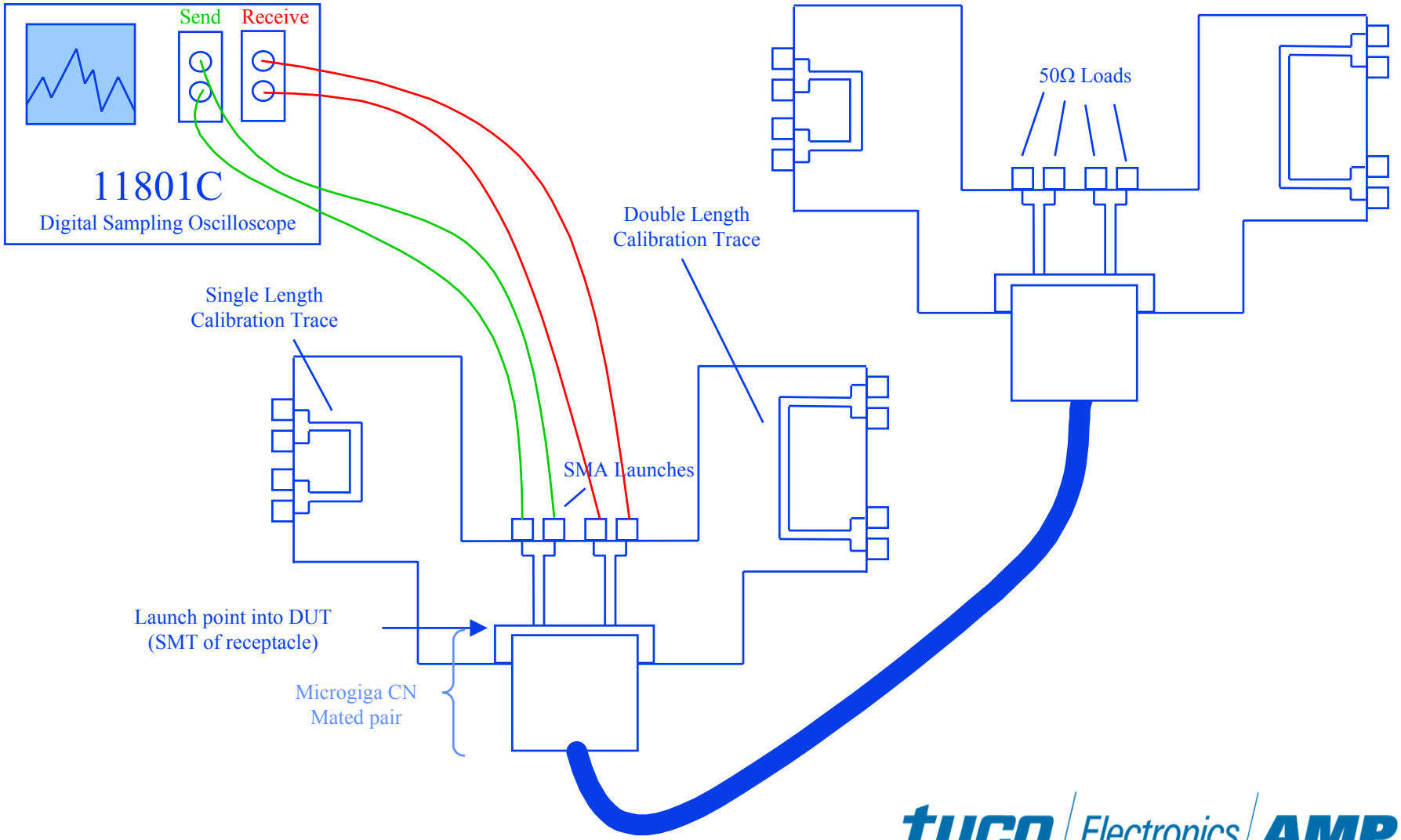
# Time Domain Transmission (TDT) Near End Cross Talk (NEXT) Measurements

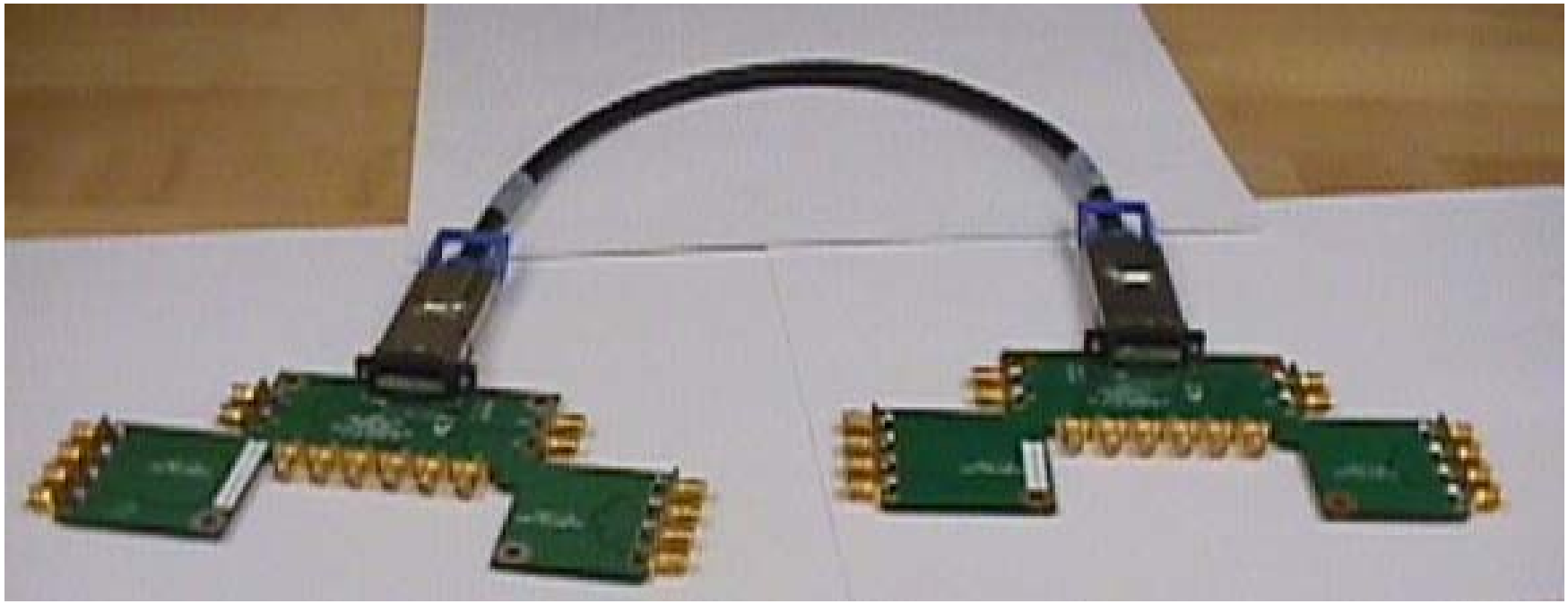
Thinh Nguyen
Dean Vermeersch

- Tektronix 11801C Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- TDT NEXT measurements are made in accordance with SFF-8410.
- This report shows the NEXT measurements of MicroGiga CN cable assemblies made with FCI supplied cable connectors. 0.5 meter length 28 AWG, 5 meter length 28 AWG, and 10 meter length 24 AWG.

# Time Domain Near End Cross Talk Test Set-Up



# Test Fixtures with Cable Assembly as DUT



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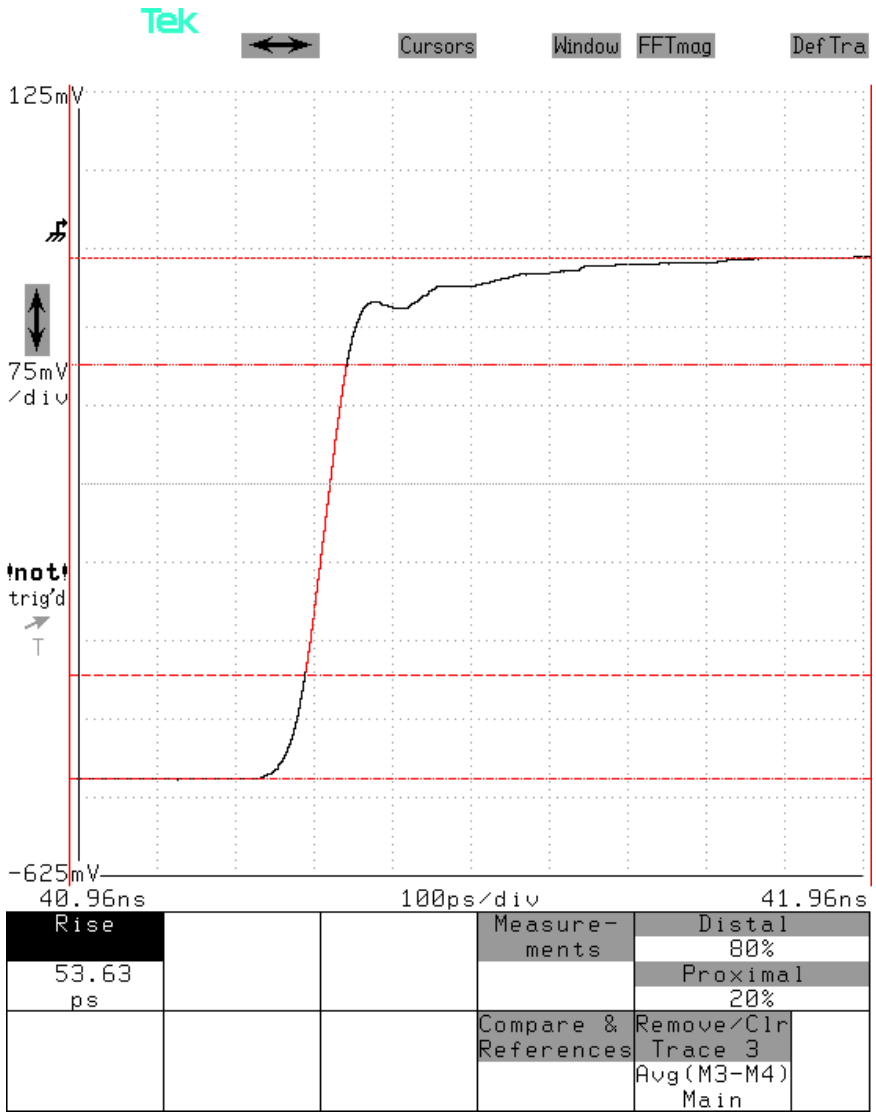
# TDT NEXT Measurements

- The following slides show the scalar calibration of the test system. The measurement is made through the double length calibration traces.
- The first slide shows test system Risetime and the Risetime of the pulse edge at launch into the DUT.
- The second slide shows launch amplitude calibration, used for calculating NEXT percent.

# Typical Fixture Rise Time Measurement

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = None

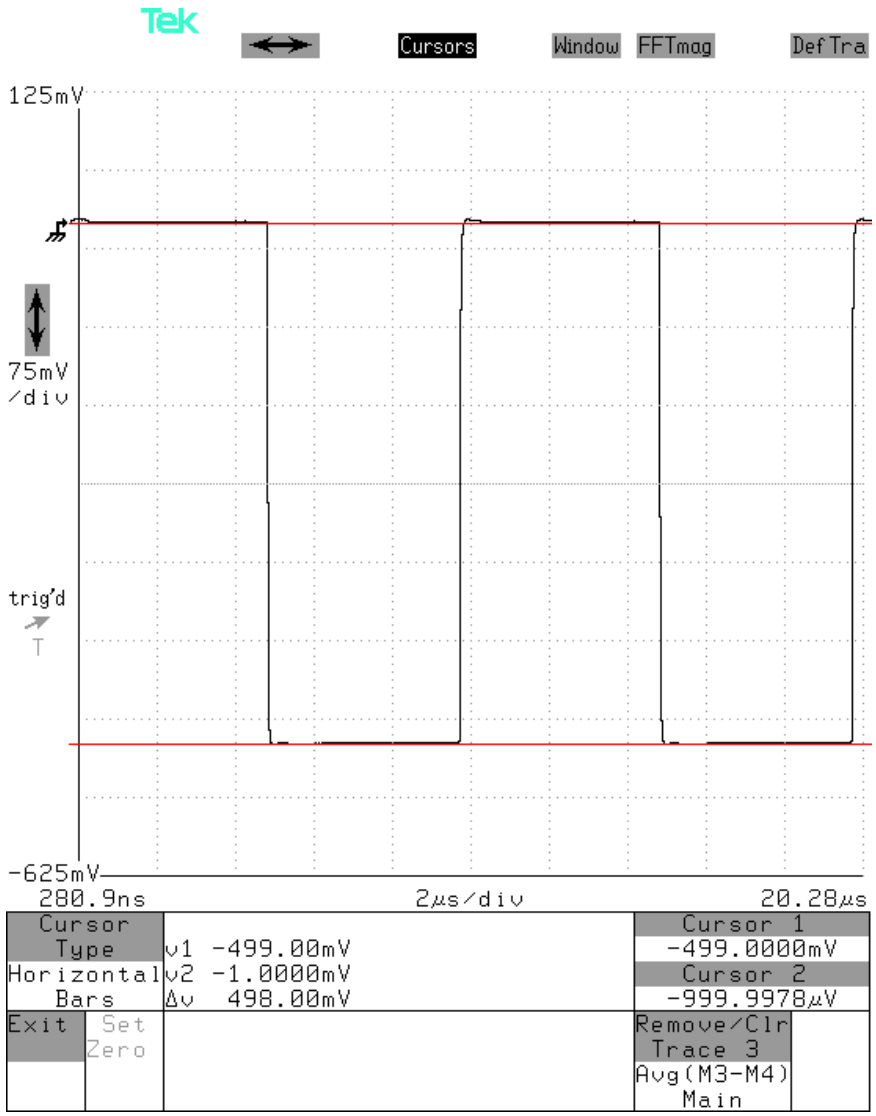
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps



# Differential Amplitude Measurement

- Date: 2/25/03
- Temperature: 77.54  F
- Relative Humidity: 9.7 %
- Method: TDT (Tek. 11801C)
- Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise Time: 54.0 ps

- **Fixture Amplitude=498.0 mV**

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# TDT NEXT Measurements

- The following slides show each pair of the 0.5 meter length 28 AWG cable assembly.
- Test port S9 S10 is always the victim line. This was selected because it is one of the pairs in the center of the connector, and is most susceptible to NEXT and FEXT from the other pairs.

- Note that symmetry permits applying results from this victim to other victims.

# TDT NEXT Measurements

- MicroGiga CN pin-out for XAUI applications:

| Transmit | | | | | Receive | | | | |
|---|---|---|---|---|---|---|---|---|---|
| G | S1S2 | G | S3S4 | G | S5S6 | G | S7S8 | G | S9S10 | G | S11S12 | G | S13S14 | G | S15S16 | G |

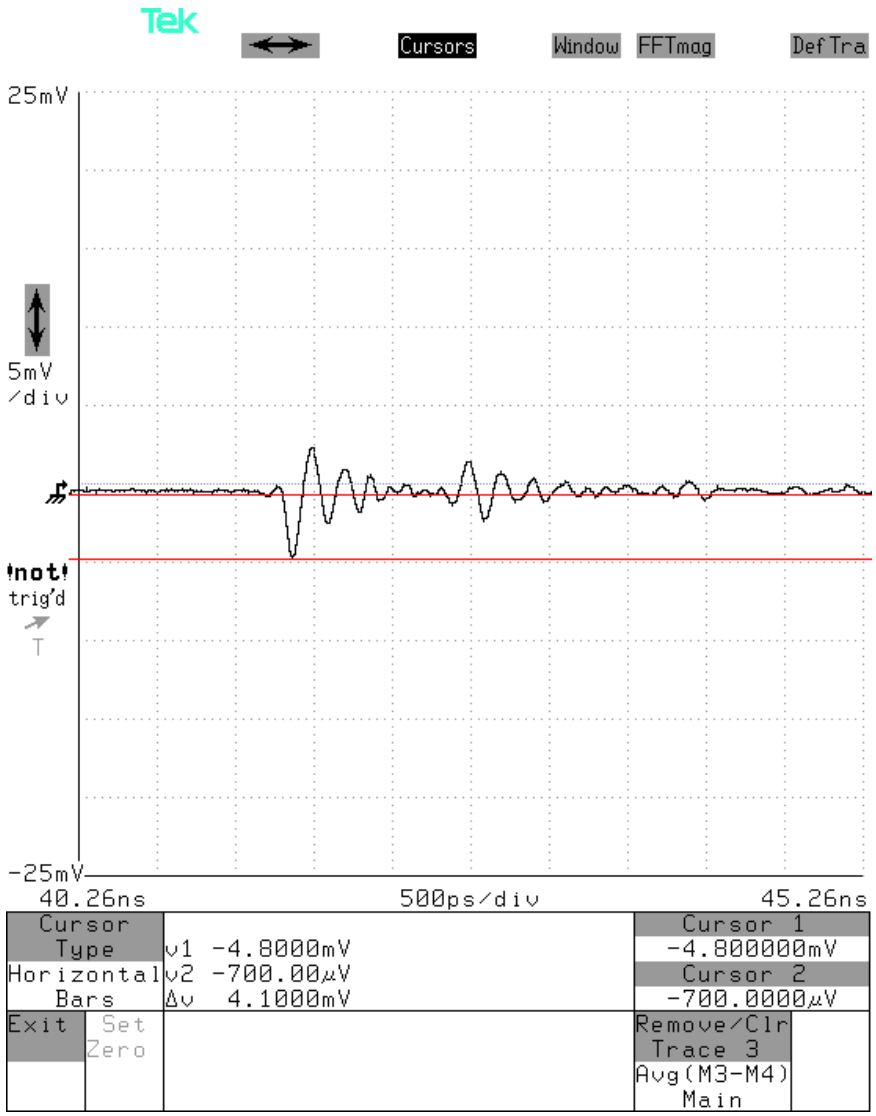
- Based on the XAUI application of operating four lanes in one direction, and four lanes in the opposite direction, with the split down the middle; it is recommended to use just the S1 S2, S3 S4, S5 S6, and S7 S8 as aggressors for determining total NEXT. This would be combined with FEXT from the other lines as aggressors to determine total Cross Talk as used in the application.
- **Total NEXT** = 0.82 + 0.98 + 1.20 + 2.05 = **5.05%** at 54 ps risetime. Not including FEXT, or NEXT from the other three receive pairs.

# Typical Near End Cross-talk Measurement by TDT method

- Date: 2/24/03
- Temperature: 77.62 F
- Relative Humidity: 10.5 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 1, S 2
- Victim line: Test port S 9, S 10

NEXT = 4.1 mV

NEXT = (4.1 / 498)x100% = 0.82 %

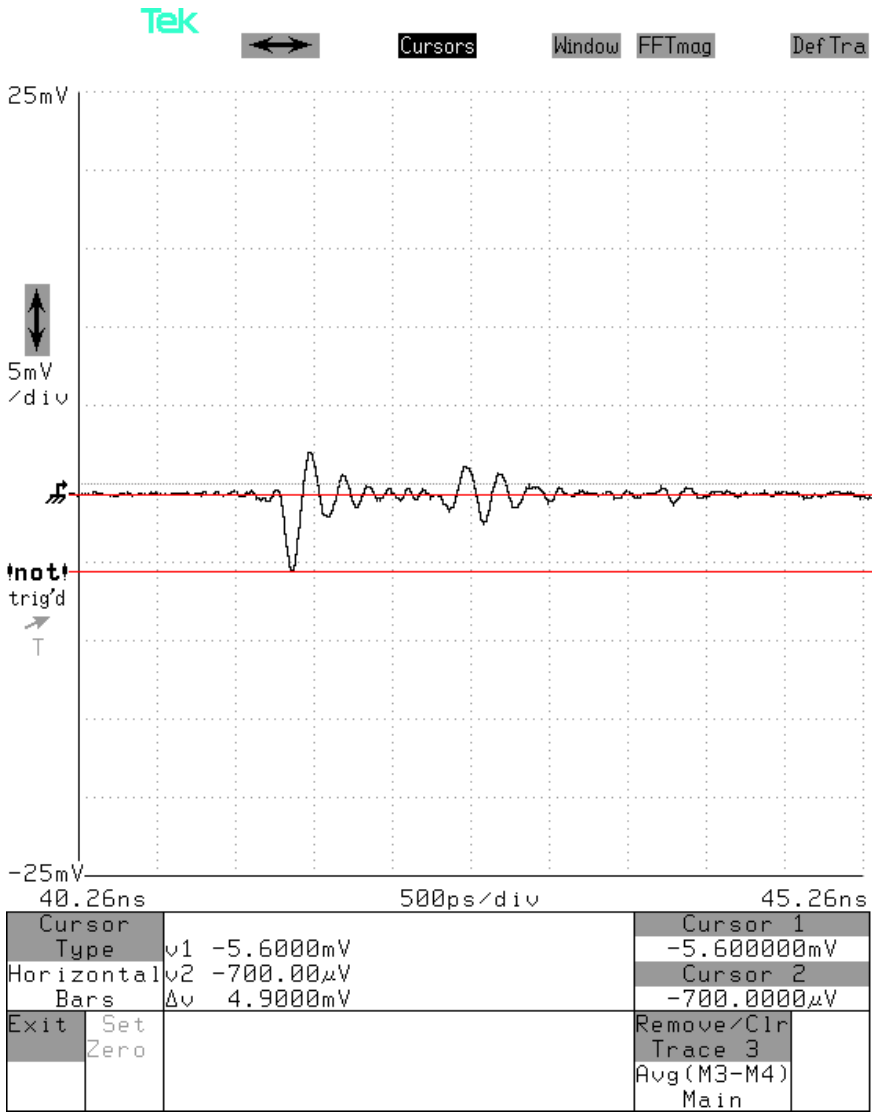


# Typical Near End Cross-talk Measurement by TDT method

- Date: 2/24/03
- Temperature: 77.62 F
- Relative Humidity: 10.5 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 3, S 4
- Victim line: Test port S 9, S 10

NEXT = 4.9 mV

NEXT = (4.9 / 498)x100% = 0.98 %

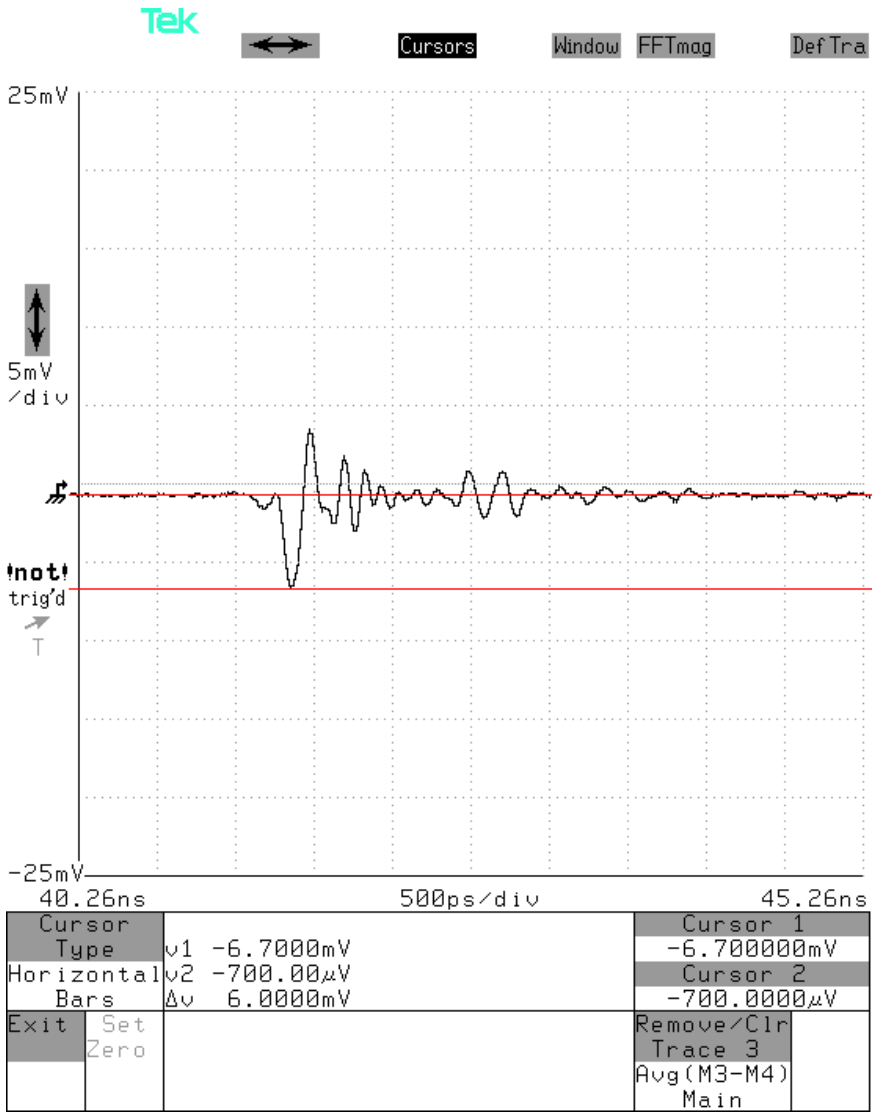


# Typical Near End Cross-talk Measurement by TDT method

- Date: 2/24/03
- Temperature: 77.62 F
- Relative Humidity: 10.5 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 5, S 6
- Victim line: Test port S 9, S 10

NEXT = 6.0 mV

NEXT = (6.0 / 498)x100% = 1.20 %

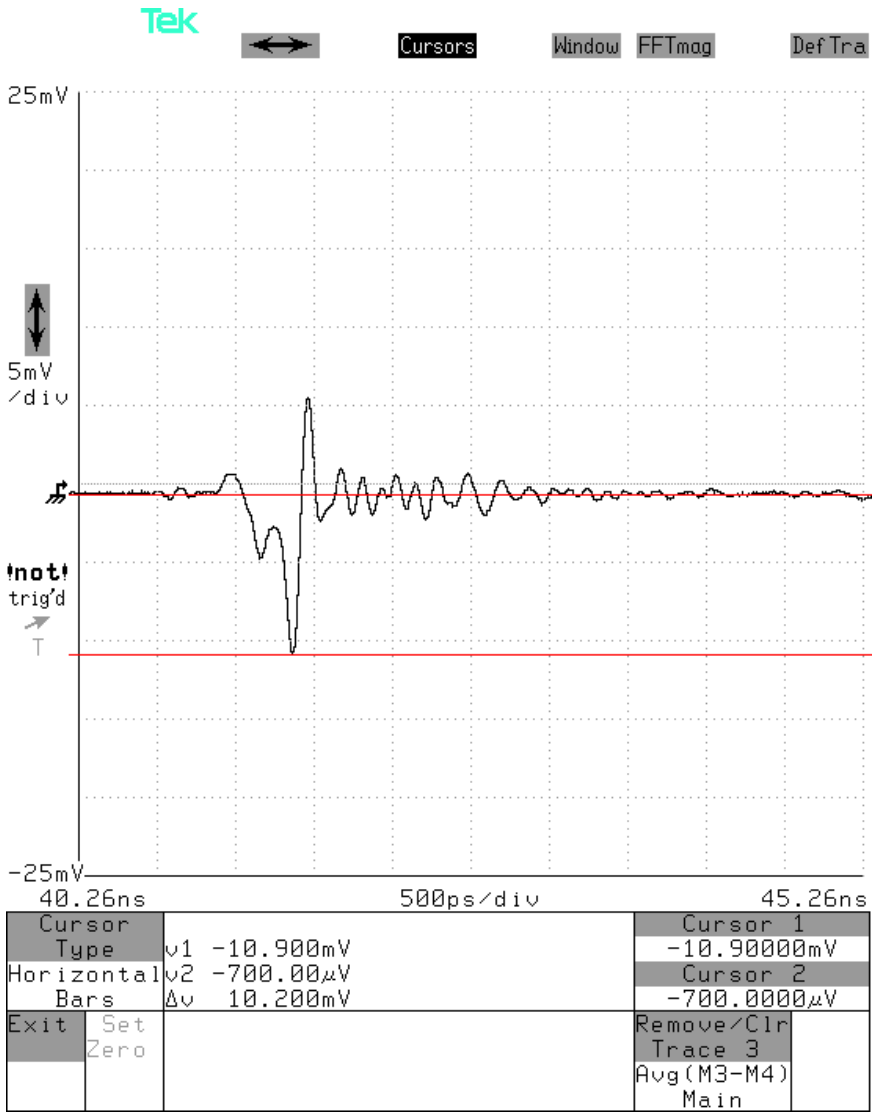


# Typical Near End Cross-talk Measurement by TDT method

- Date: 2/24/03
- Temperature: 77.62 F
- Relative Humidity: 10.5 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 7, S 8
- Victim line: Test port S 9, S 10

NEXT = 10.2 mV

NEXT = (10.2 / 498)x100% = 2.05 %



# Typical Near End Cross-talk Measurement by TDT method

- Date: 2/24/03
- Temperature: 77.62 F
- Relative Humidity: 10.5 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 11, S 12
- Victim line: Test port S 9, S 10

NEXT = 9.3 mV

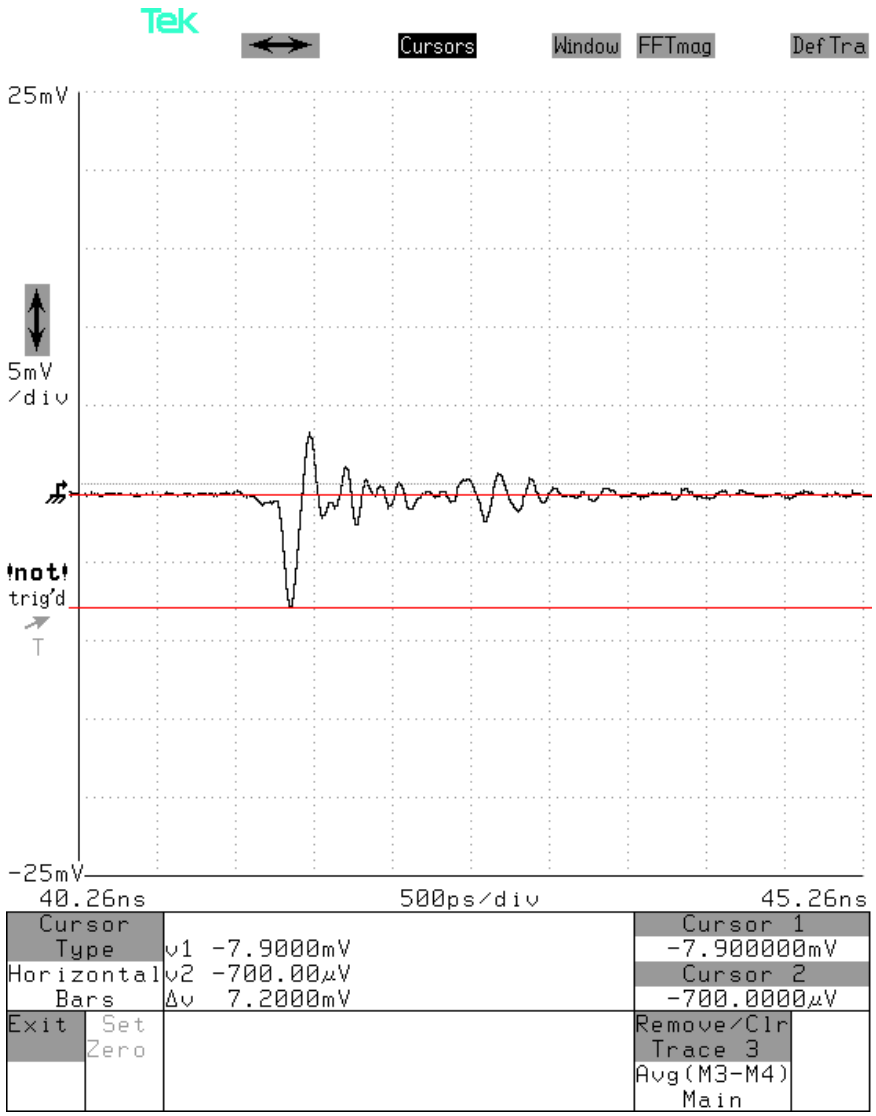
NEXT = (9.3 / 498)x100% = 1.87 %

# Typical Near End Cross-talk Measurement by TDT method

- Date: 2/24/03
- Temperature: 77.62 F
- Relative Humidity: 10.5 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 13, S 14
- Victim line: Test port S 9, S 10

NEXT = 7.2 mV

NEXT = (7.2 / 498)x100% = 1.45 %

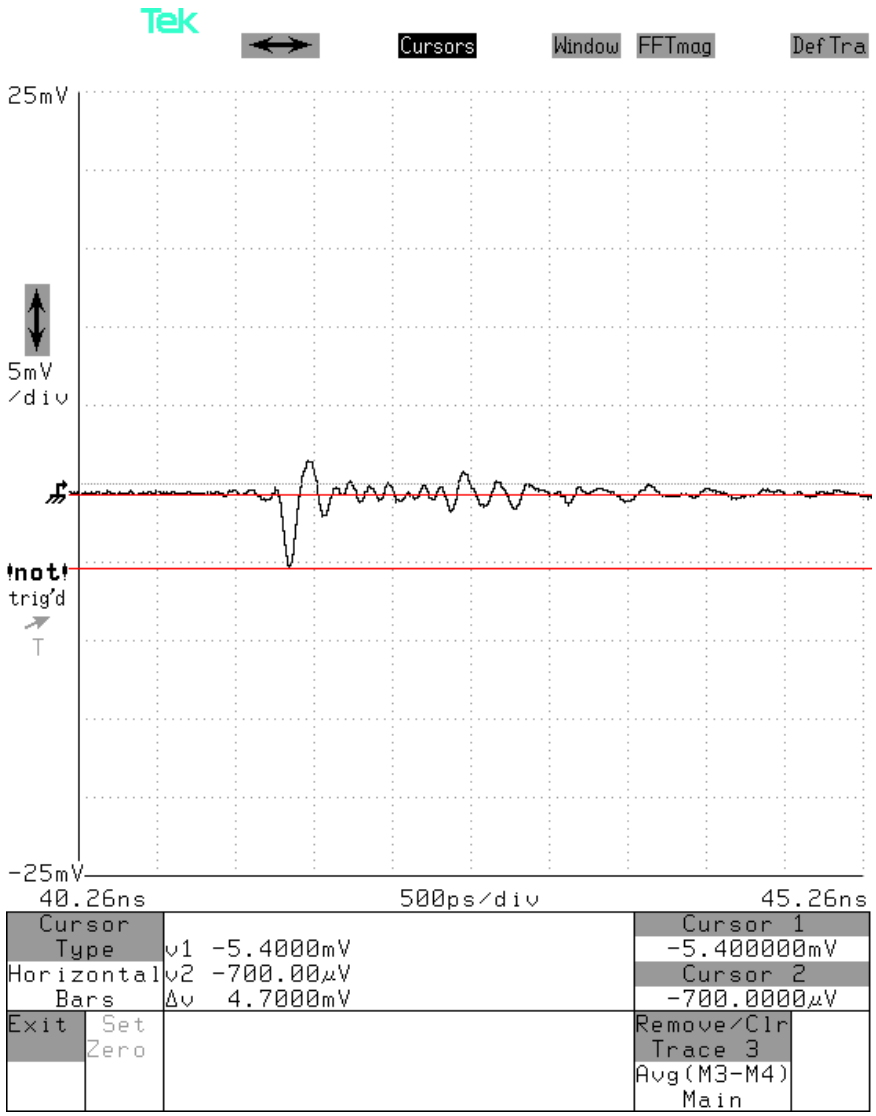


# Typical Near End Cross-talk Measurement by TDT method

- Date: 2/24/03
- Temperature: 77.62 F
- Relative Humidity: 10.5 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 15, S 16
- Victim line: Test port S 9, S 10

NEXT = 4.7 mV

NEXT = (4.7 / 498)x100% = 0.94 %



# TDT NEXT Measurements

- The following slide shows NEXT of the 5.0 meter length 28 AWG cable assembly.
- Aggressor S7 S8 with Victim S9 S10 is shown for comparison to results from the 0.5 meter length.
- This basically confirms TDT NEXT results are independent of cable assembly length.

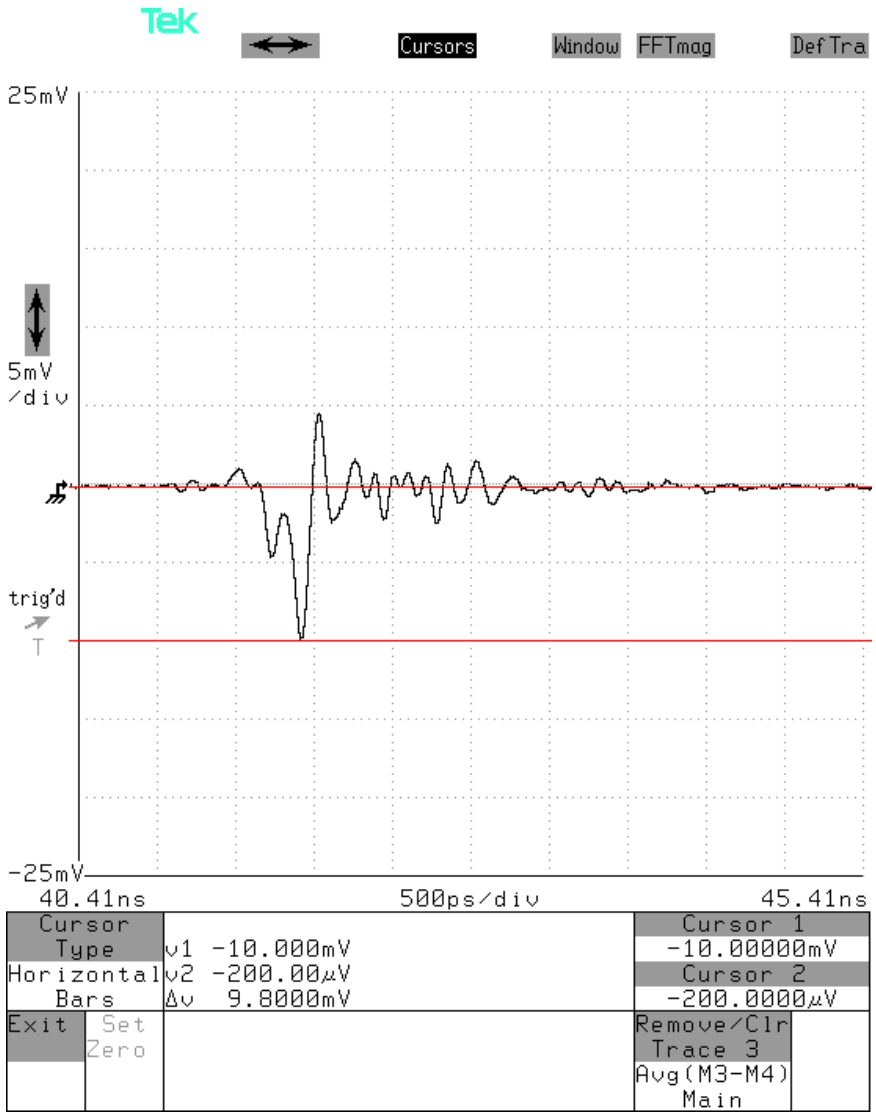
- Note that symmetry permits applying TDT NEXT results from the 0.5 meter length to other lengths.

# Typical Near End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1.
- Aggressor line: Test port S 7, S 8
- Victim line: Test port S 9, S 10

NEXT = 9.8 mV

NEXT = (9.8 / 498)x100% = 1.97 %

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# TDT NEXT Measurements

- The following slide shows NEXT of the 10.0 meter length 24 AWG cable assembly.
- Aggressor S7 S8 with Victim S9 S10 is shown for comparison to results from the 0.5 meter length.
- This basically confirms TDT NEXT results are independent of cable assembly length AND cable size. Caveat that the cable size is not so different as to require different wire management.

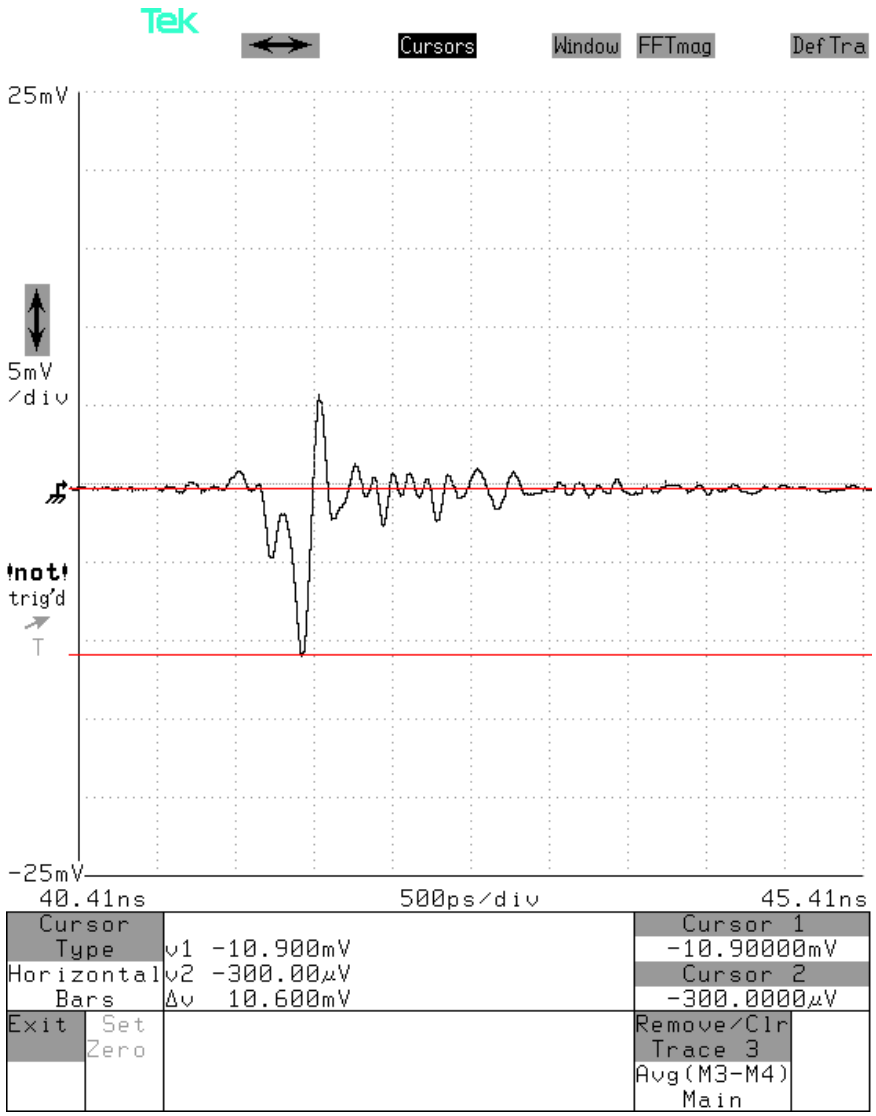
- Note that symmetry permits applying TDT NEXT results from the 0.5 meter length to other lengths, AND other cable sizes.

# Typical Near End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 7, S 8
- Victim line: Test port S 9, S 10

NEXT = 10.6 mV

NEXT = (10.6 / 498)x100% = 2.13 %



# Comment On Quality of Bulk Cable and Effects on TDT NEXT

- The victim pair in the 10 meter length 24 AWG assembly is the same pair that exhibits greater Insertion Loss than the other pairs in the assembly. Refer to the Frequency Domain Insertion Loss data.
- The insertion loss of transmit port S7S8 to receive port S9S10 is 37% greater than the other pairs in the assembly.
- Note that pair S9 S10 passes the proposed Insertion Loss specification of 17 dB maximum.
- Cursory examination of mode conversion measurements hint that the problem is related to mode conversion, and that this cable will also have Cross Talk and EMI performance issues.

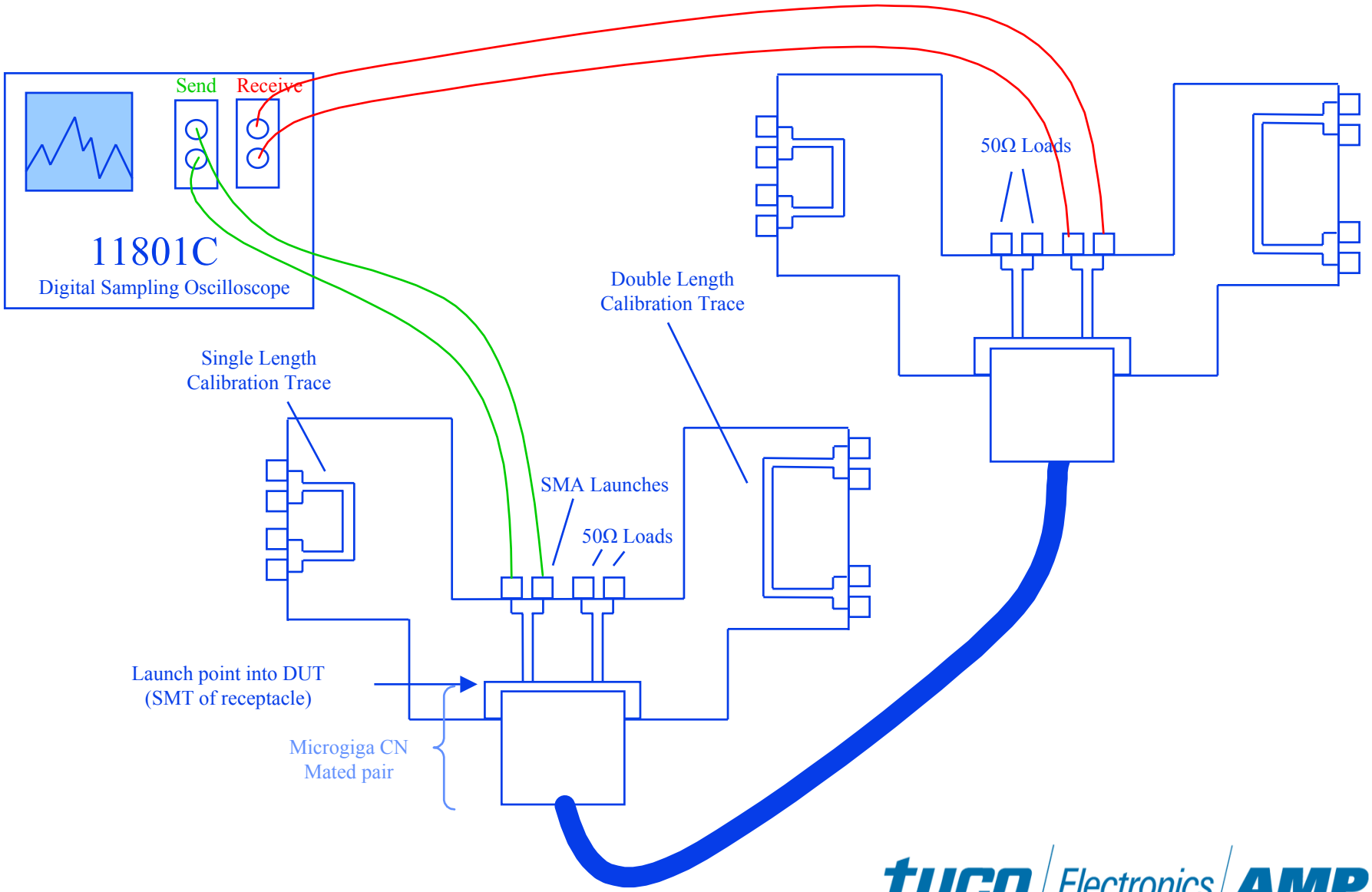
- **Note that the TDT NEXT results show that this high loss, mode converting, pair has NOT caused higher TDT NEXT when the lossy pair is the victim.**

# Time Domain Transmission (TDT) Far End Cross Talk (FEXT) Measurements

Thinh Nguyen
Dean Vermeersch

- Tektronix 11801C Digital Sampling Oscilloscope.
- MicroGiga CN test fixture supplied by FCI, SK-48294 Rev 2.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- TDT FEXT measurements are made in accordance with SFF-8410.
- This report shows the FEXT measurements of MicroGiga CN cable assemblies made with FCI supplied cable connectors. 0.5 meter length 28 AWG, 5 meter length 28 AWG, and 10 meter length 24 AWG.

# Time Domain Far End Cross Talk Test Set-Up

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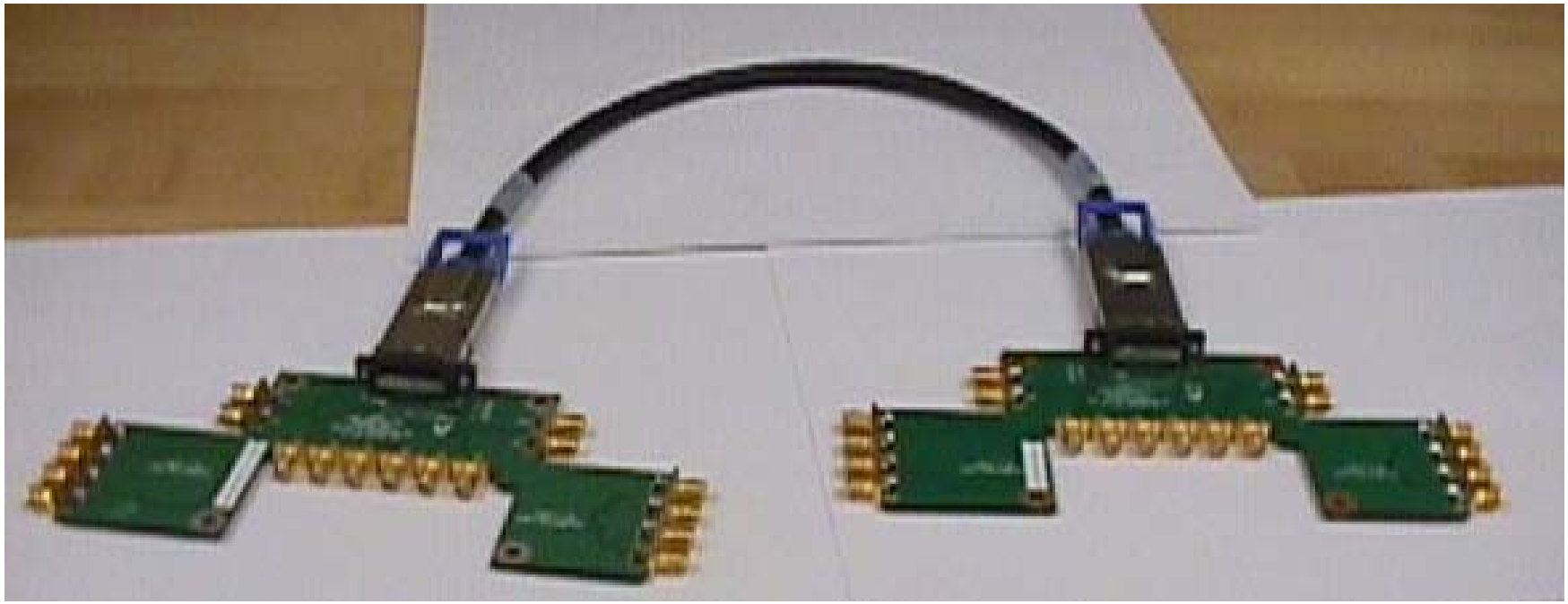
# Test Fixtures with Cable Assembly as DUT



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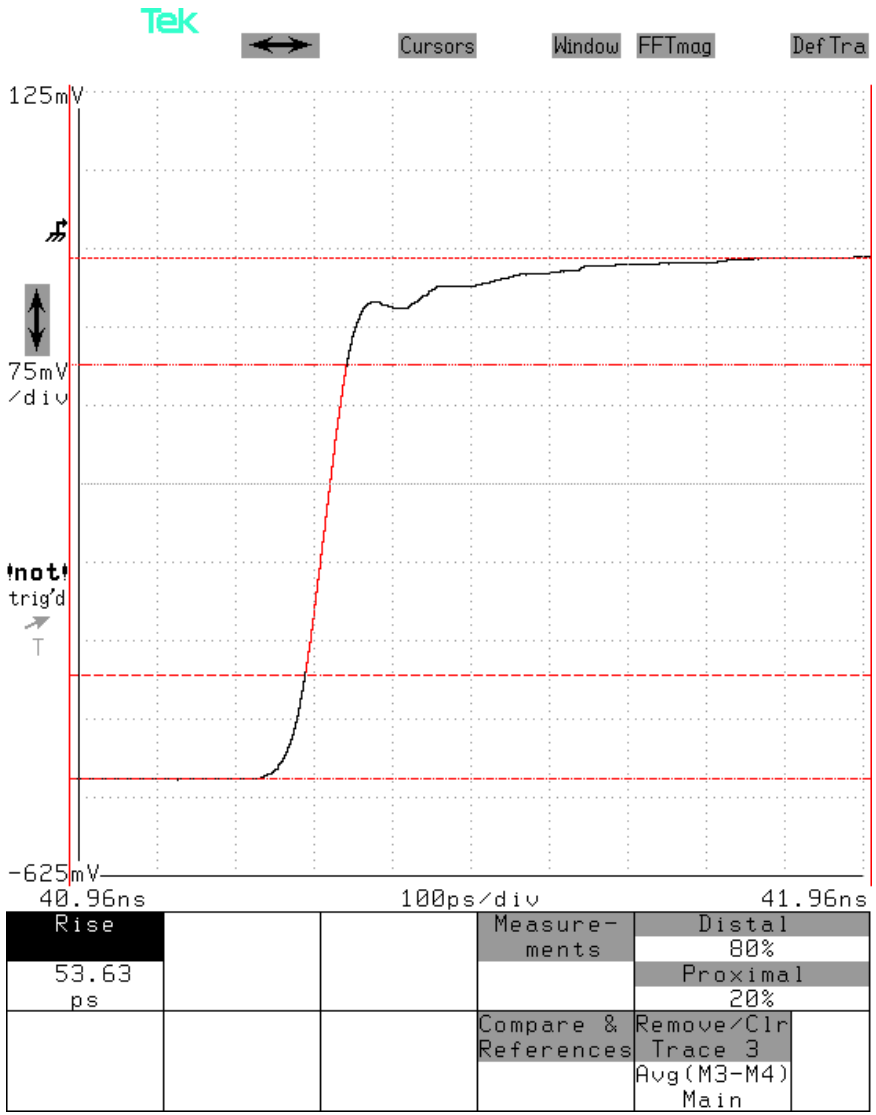
# TDT FEXT Measurements

- The following slides show the scalar calibration of the test system. The measurement is made through the double length calibration traces.
- The first slide shows test system Risetime and the Risetime of the pulse edge at launch into the DUT.
- The second slide shows launch amplitude calibration, used for calculating FEXT percent.

# Typical Fixture Rise Time Measurement

- Date: 2/6/03
- Temperature: 75.74  F
- Relative Humidity: 8.9 %
- Method: TDT
- Test Fixture: FCI Test Fixture, 4X-Infiniband, SK-48294 Rev 2
- Double length calibration trace
- Filter = None

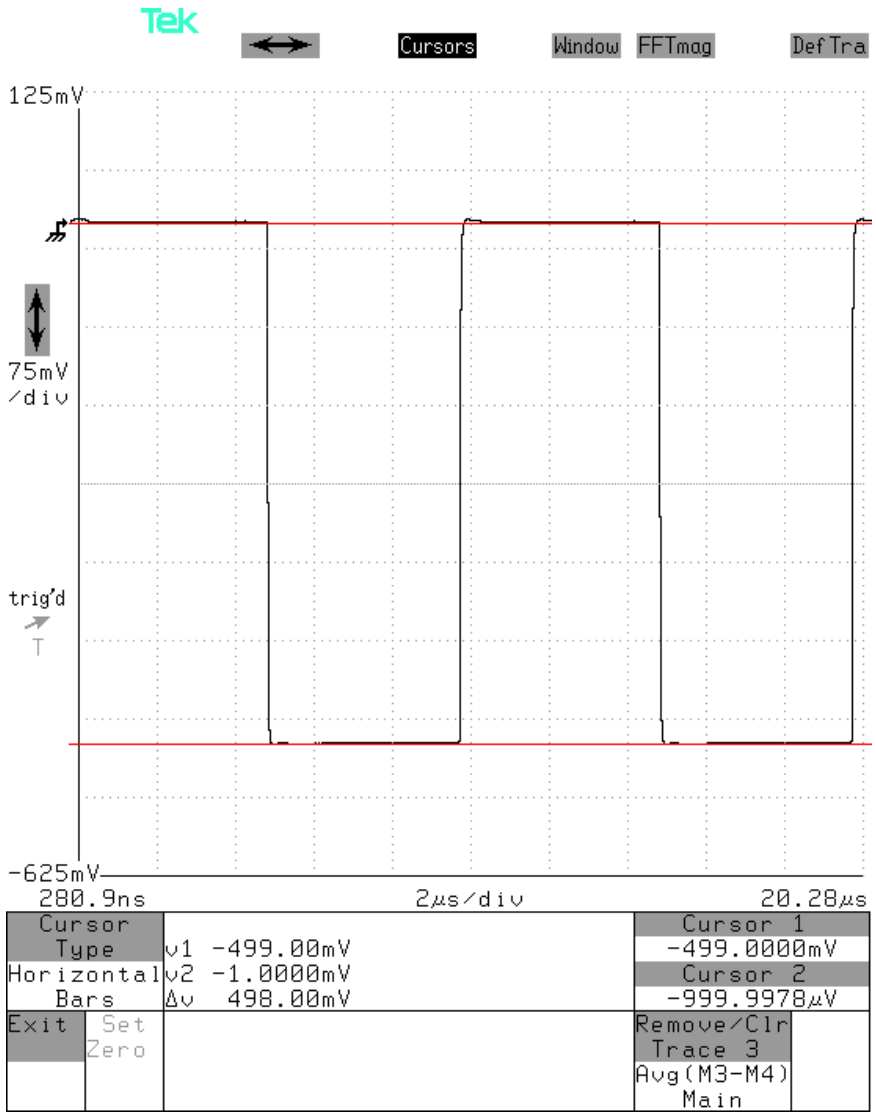
- Total Test System Risetime = 53.63 ps
- Risetime at DUT = 37.92 ps



# Differential Amplitude Measurement

- Date: 2/25/03
- Temperature: 77.54  F
- Relative Humidity: 9.7 %
- Method: TDT (Tek. 11801C)
- Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise Time: 54.0 ps

- **Fixture Amplitude=498.0 mV**

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# TDT NEXT Measurements

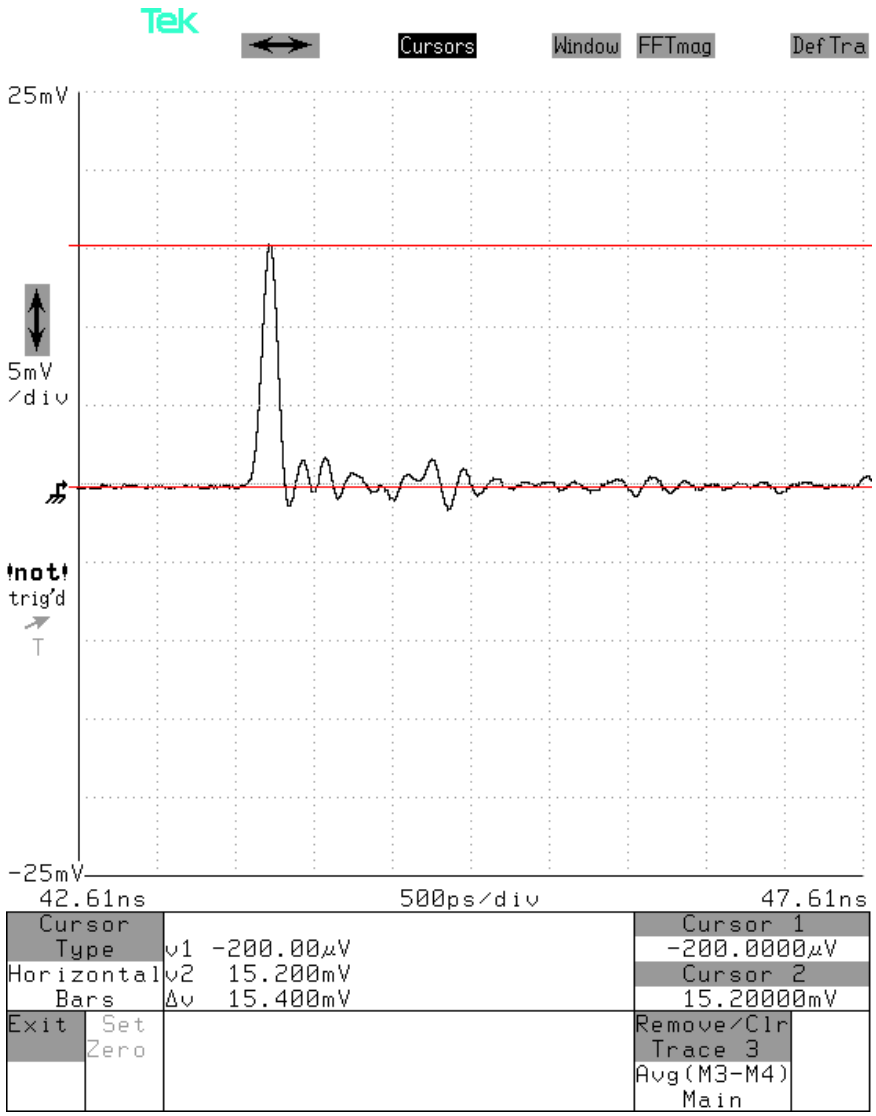
- The following slide shows FEXT of the 0.5 meter length 28 AWG cable assembly.
- Aggressor S7 S8 with Victim S9 S10 is shown for comparison to results from the 5.0 and10.0 meter lengths.

# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 0.5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 7, S 8
- Victim line: Test port S 9, S 10

FEXT = 15.4 mV

FEXT = (15.4 / 498)x100% = 3.09 %



# TDT FEXT Measurements

- The following slides show each pair of the 5.0 meter length 28 AWG cable assembly.
- Test port S9 S10 is always the victim line. This was selected because it is one of the pairs in the center of the connector, and is most susceptible to NEXT and FEXT from the other pairs.

- Note that symmetry permits applying results from this victim to other victims.

# TDT FEXT Measurements

- MicroGiga CN pin-out for XAUI applications:

| Transmit | Receive |
|---|---|
| G S1S2 G S3S4 G S5S6 G S7S8 G | S9S10 G S11S12 G S13S14 G S15S16 G |

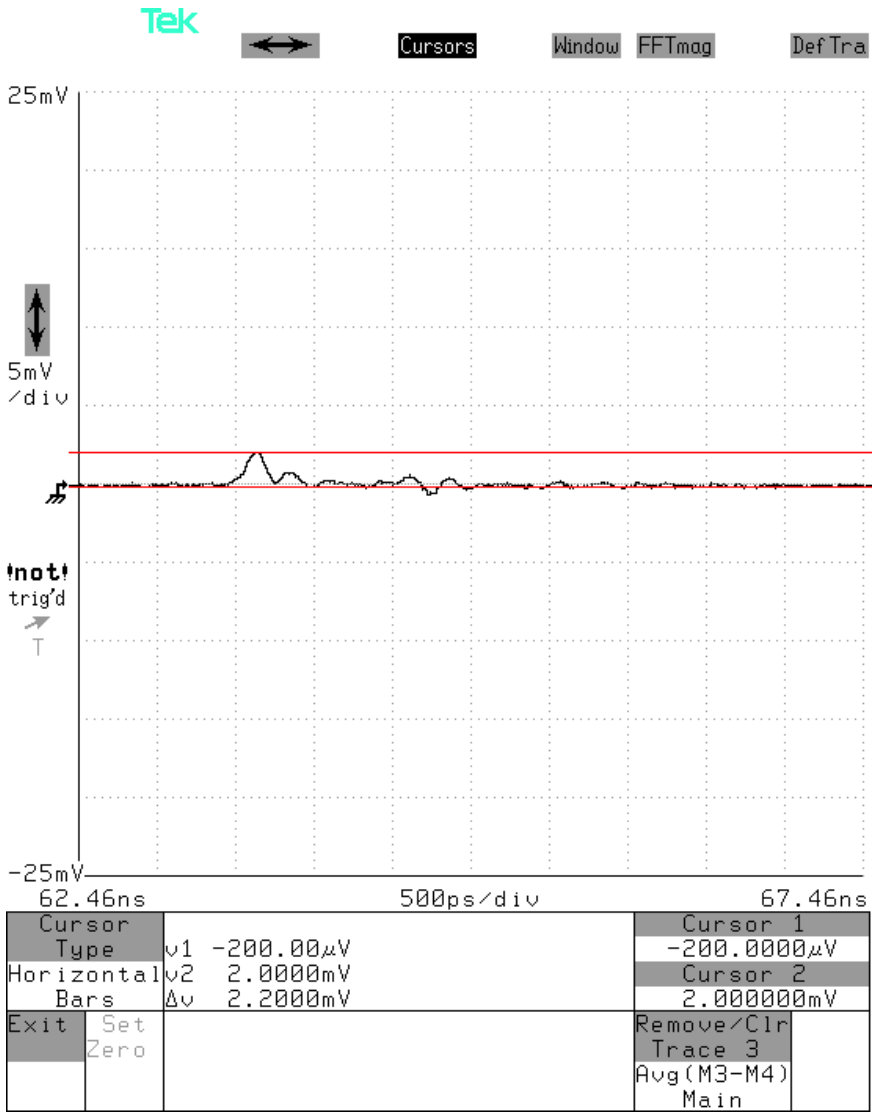
- Based on the XAUI application of operating four lanes in one direction, and four lanes in the opposite direction, with the split down the middle; it is recommended to use just the S11 S12, S13 S14, and S15 S16 as aggressors for determining total FEXT. This would be combined with NEXT from the other lines as aggressors to determine total Cross Talk as used in the application.
- **Total FEXT** = 0.70 + 0.52 + 0.30 = **1.42%** at 54 ps risetime. Not including NEXT, or FEXT from the other four transmit pairs.

# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 1, S 2
- Victim line: Test port S 9, S 10

FEXT = 2.2 mV

FEXT = (2.2 / 498)x100% = 0.44 %

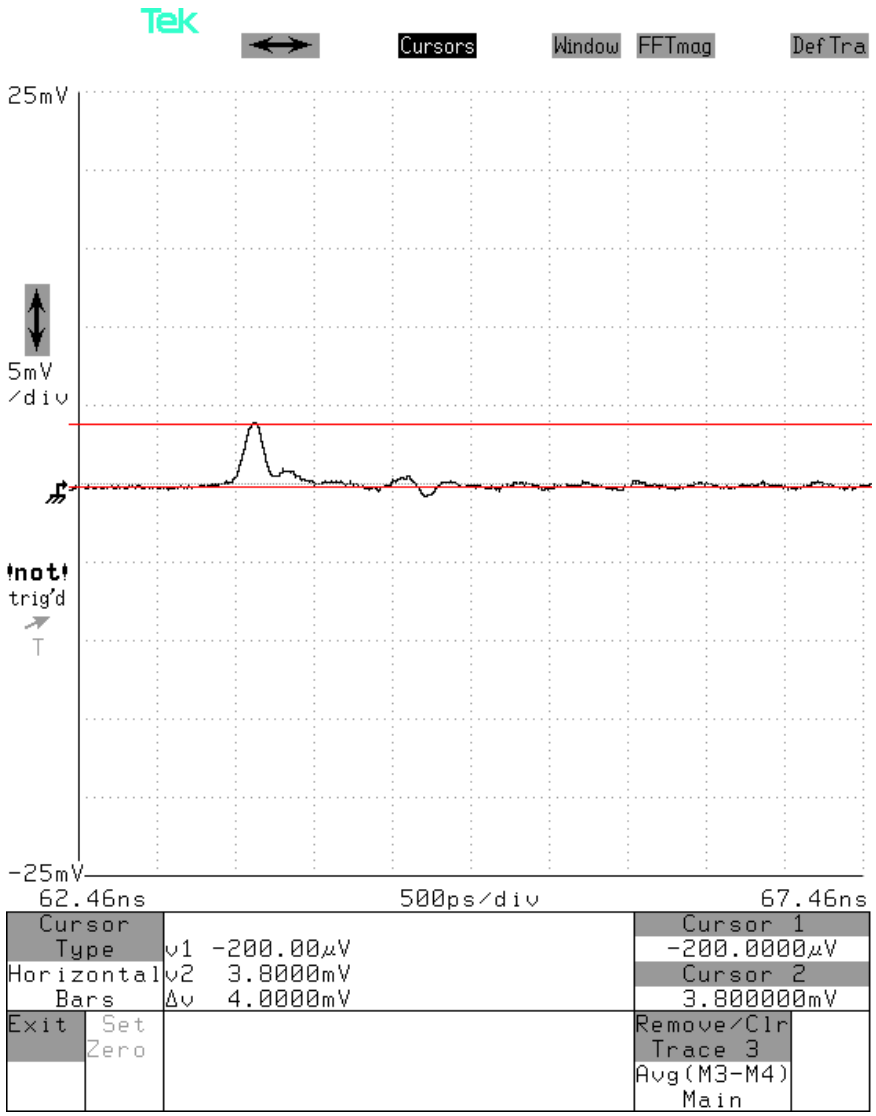


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 3, S 4
- Victim line: Test port S 9, S 10

FEXT = 4.0 mV

FEXT = (4.0 / 498)x100% = 0.80 %

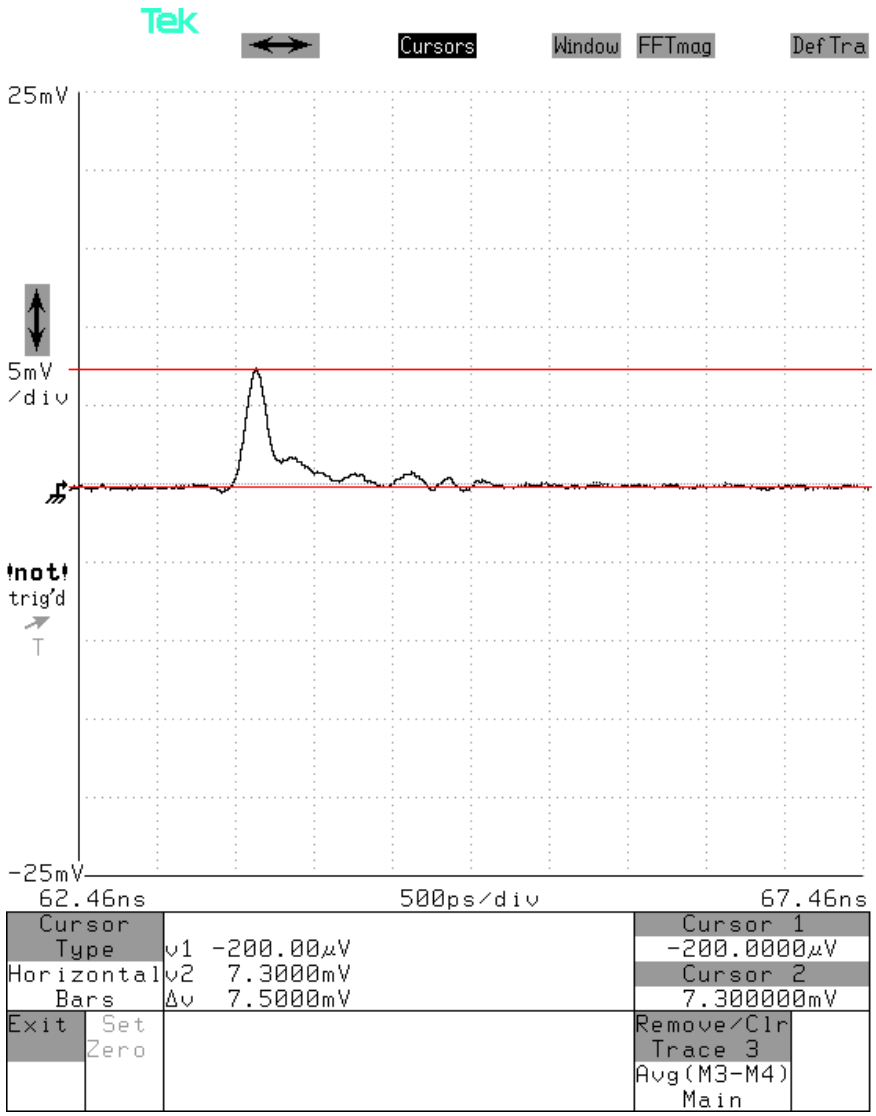


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 5, S 6
- Victim line: Test port S 9, S 10

FEXT = 7.5 mV

FEXT = (7.5 / 498)x100% = 1.51 %

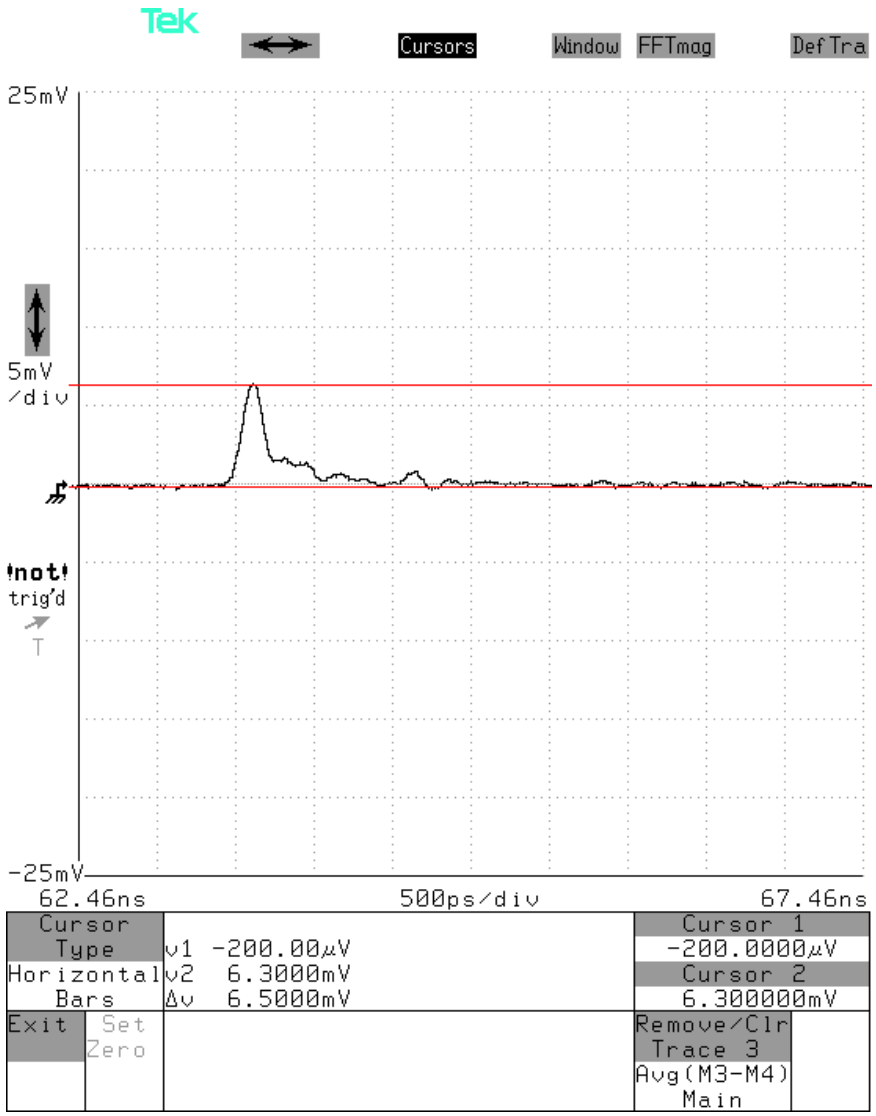


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 7, S 8
- Victim line: Test port S 9, S 10

FEXT = 6.5 mV

FEXT = (6.5 / 498)x100% = 1.31 %

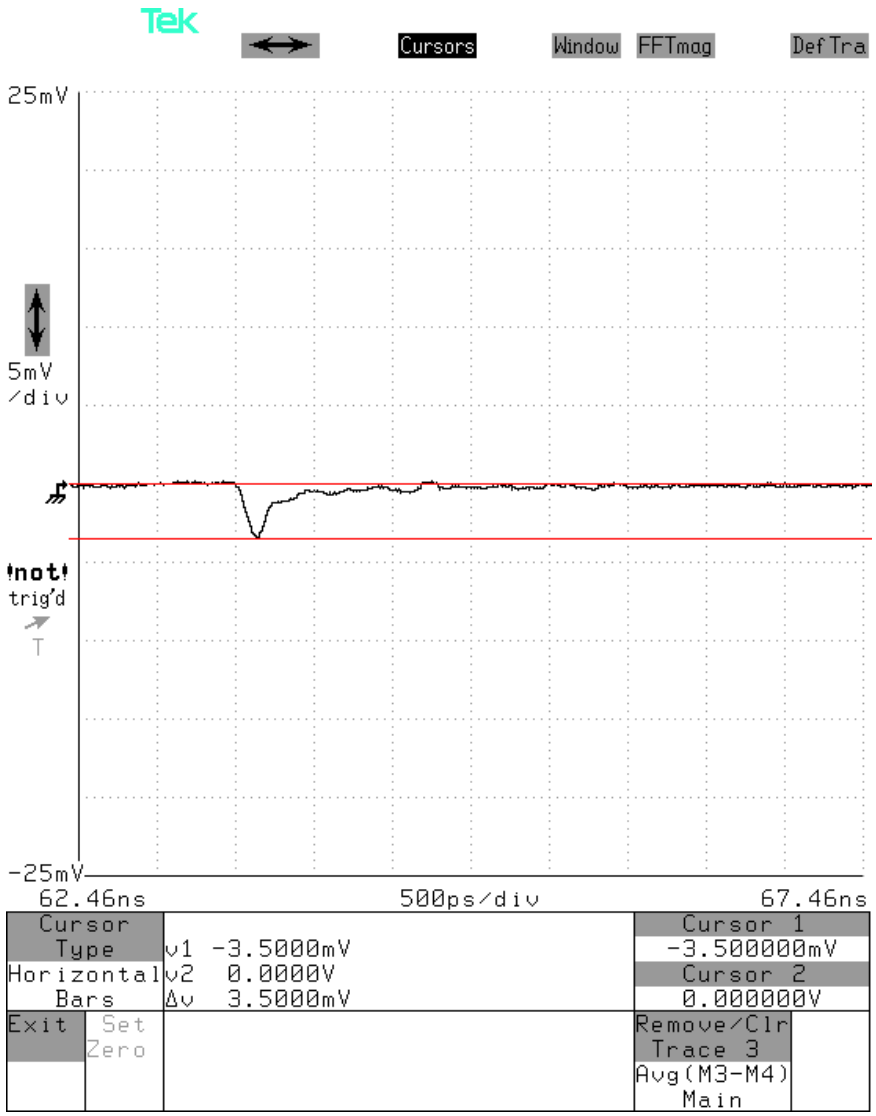


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 11, S 12
- Victim line: Test port S 9, S 10

FEXT = 3.5 mV

FEXT = (3.5 / 498)x100% = 0.70 %

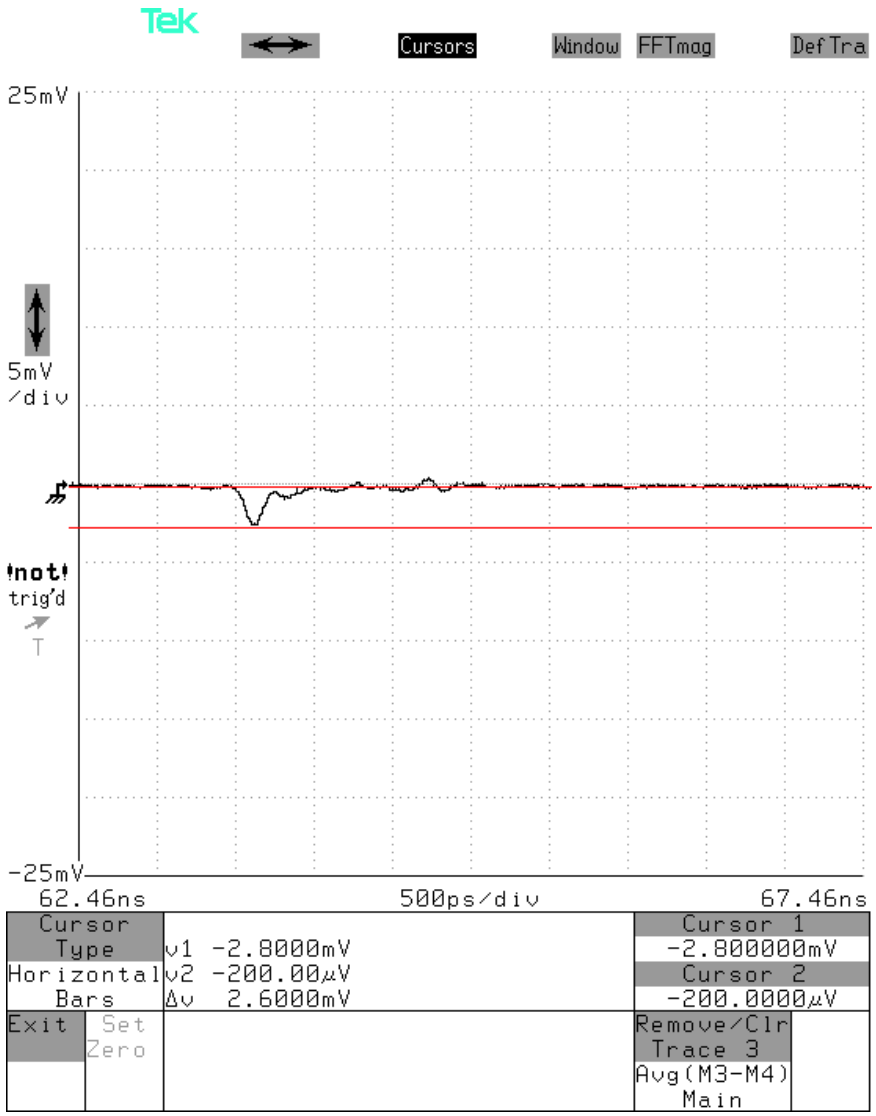


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 13, S 14
- Victim line: Test port S 9, S 10

FEXT = 2.6 mV

FEXT = (2.6 / 498)x100% = 0.52 %

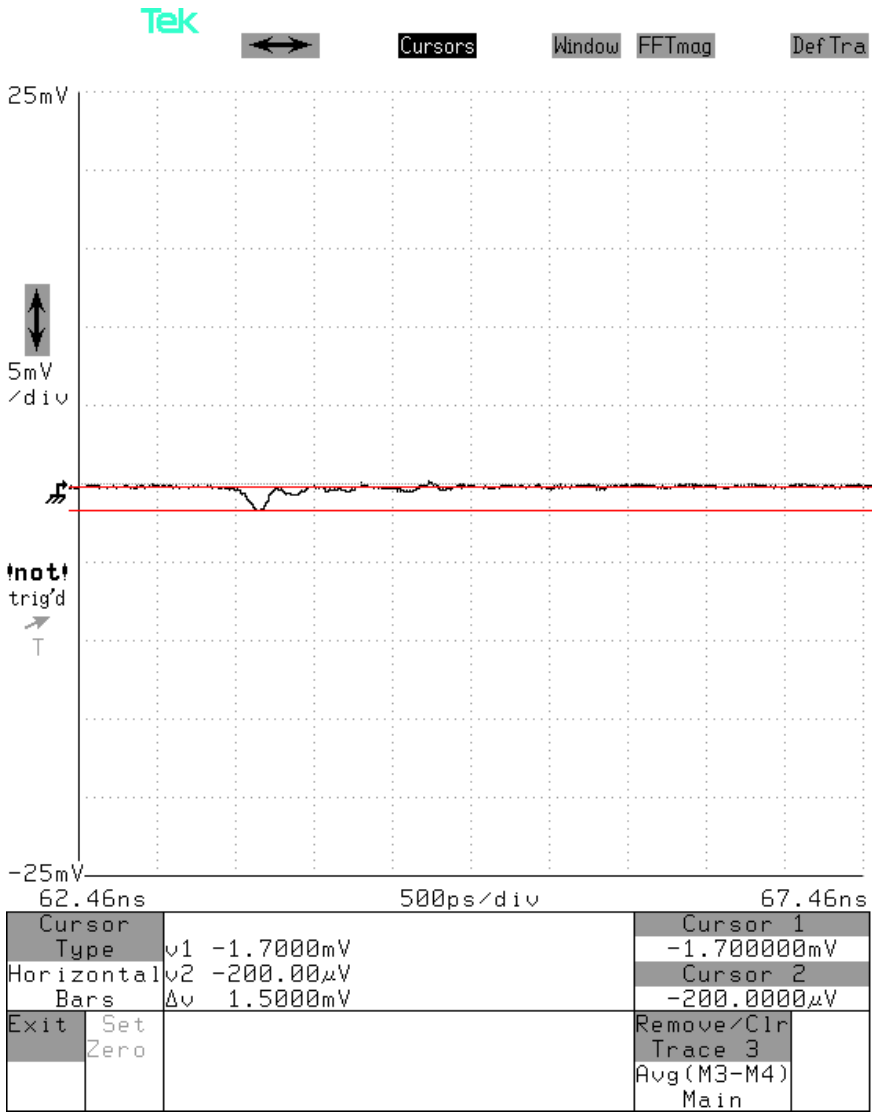


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 5 m, 28 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 15, S 16
- Victim line: Test port S 9, S 10

FEXT = 1.5 mV

FEXT = (1.5 / 498)x100% = 0.30 %



# TDT FEXT Measurements

- The following slides show each pair of the 10.0 meter length 28 AWG cable assembly.
- Test port S9 S10 is always the victim line. This was selected because it is one of the pairs in the center of the connector, and is most susceptible to NEXT and FEXT from the other pairs.

- Note that symmetry permits applying results from this victim to other victims.

# TDT FEXT Measurements

- MicroGiga CN pin-out for XAUI applications:

| Transmit | | | | | Receive | | | | |
|---|---|---|---|---|---|---|---|---|---|
| G | S1S2 | G | S3S4 | G | S5S6 | G | S7S8 | G | S9S10 | G | S11S12 | G | S13S14 | G | S15S16 | G |

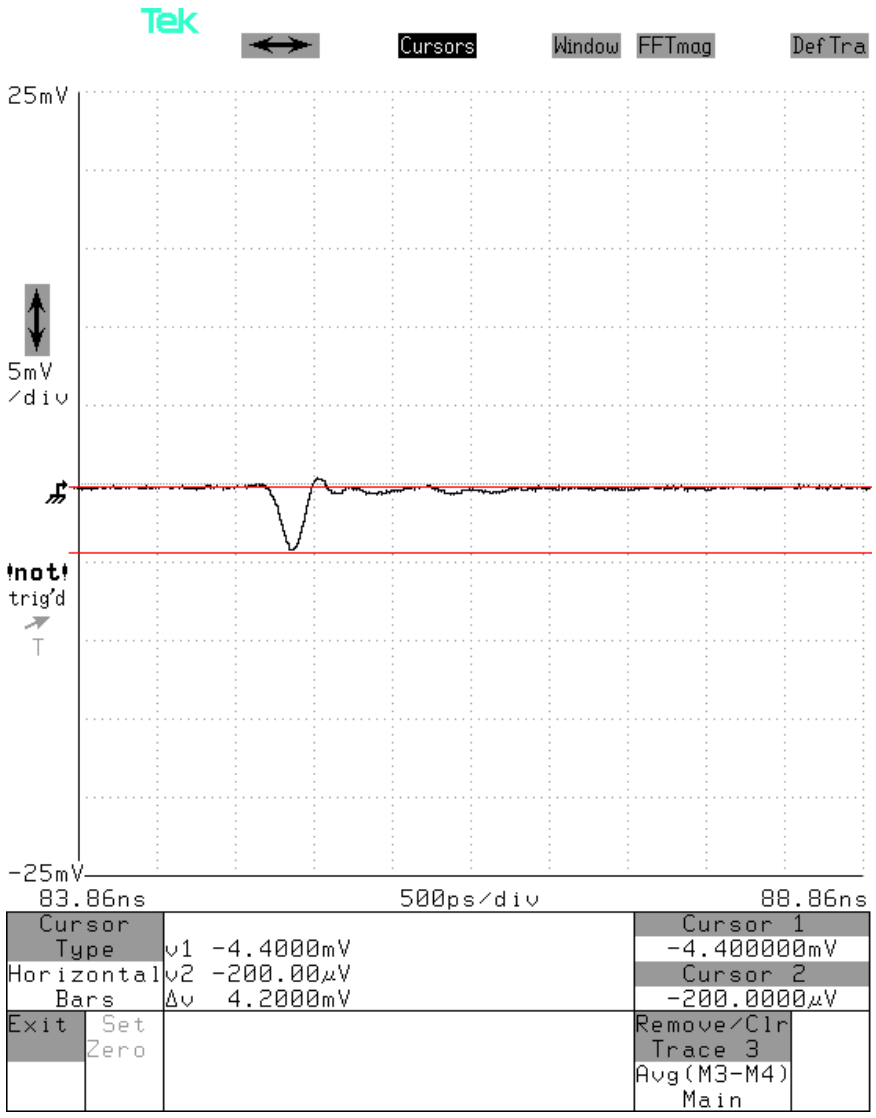
- Based on the XAUI application of operating four lanes in one direction, and four lanes in the opposite direction, with the split down the middle; it is recommended to use just the S11 S12, S13 S14, and S15 S16 as aggressors for determining total FEXT. This would be combined with NEXT from the other lines as aggressors to determine total Cross Talk as used in the application.
- **Total FEXT** = 0.32 + 0.34 + 0.32 = **0.98%** at 54 ps risetime. Not including NEXT, or FEXT from the other four transmit pairs.

# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 1, S 2
- Victim line: Test port S 9, S 10

FEXT = 4.2 mV

FEXT = (4.2 / 498)x100% = 0.84 %

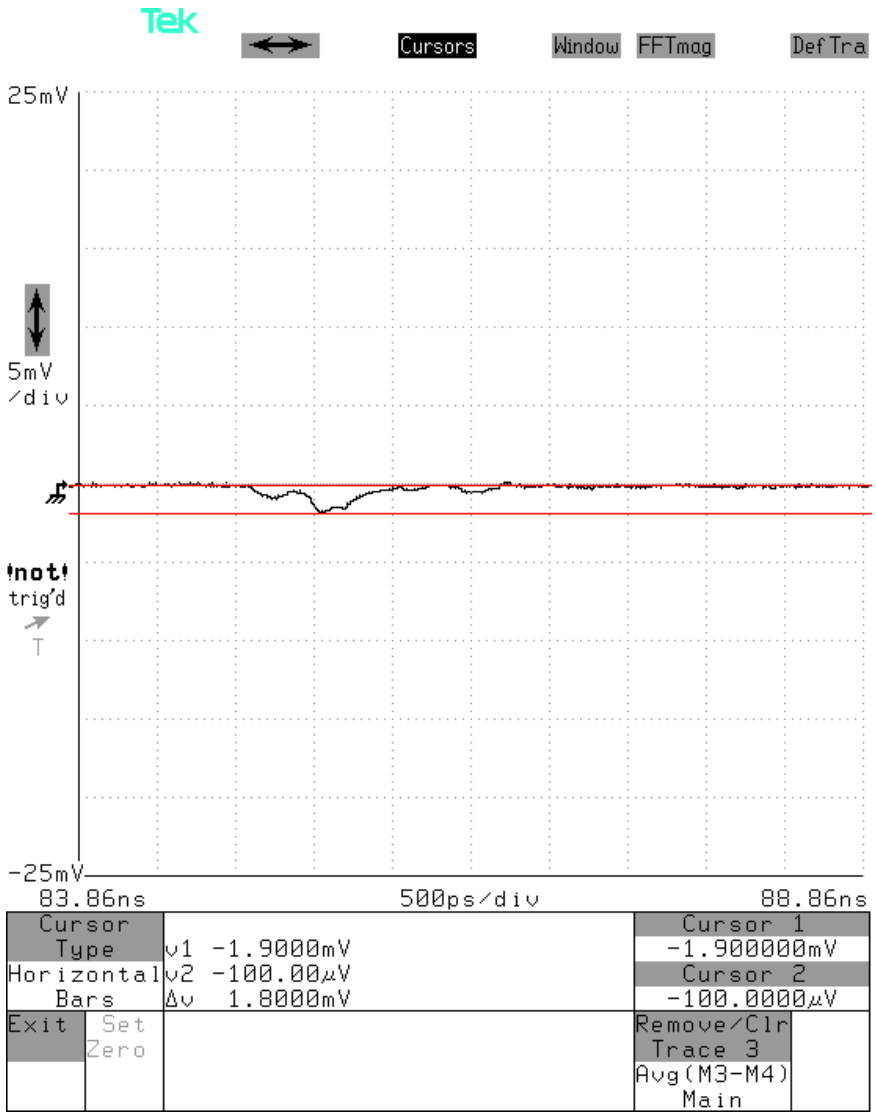


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 3, S 4
- Victim line: Test port S 9, S 10

FEXT = 1.8 mV

FEXT = (1.8 / 498)x100% = 0.36 %

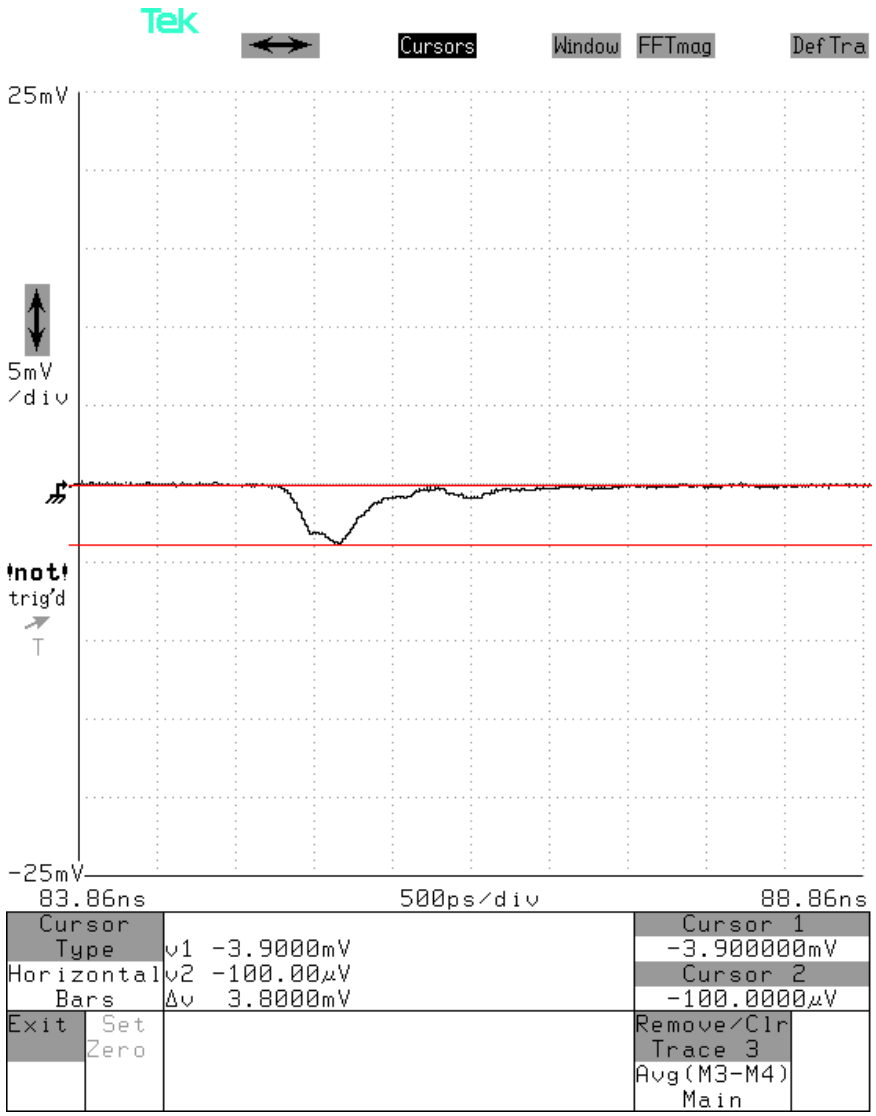


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 5, S 6
- Victim line: Test port S 9, S 10

FEXT = 3.8 mV

FEXT = (3.8 / 498)x100% = 0.76 %

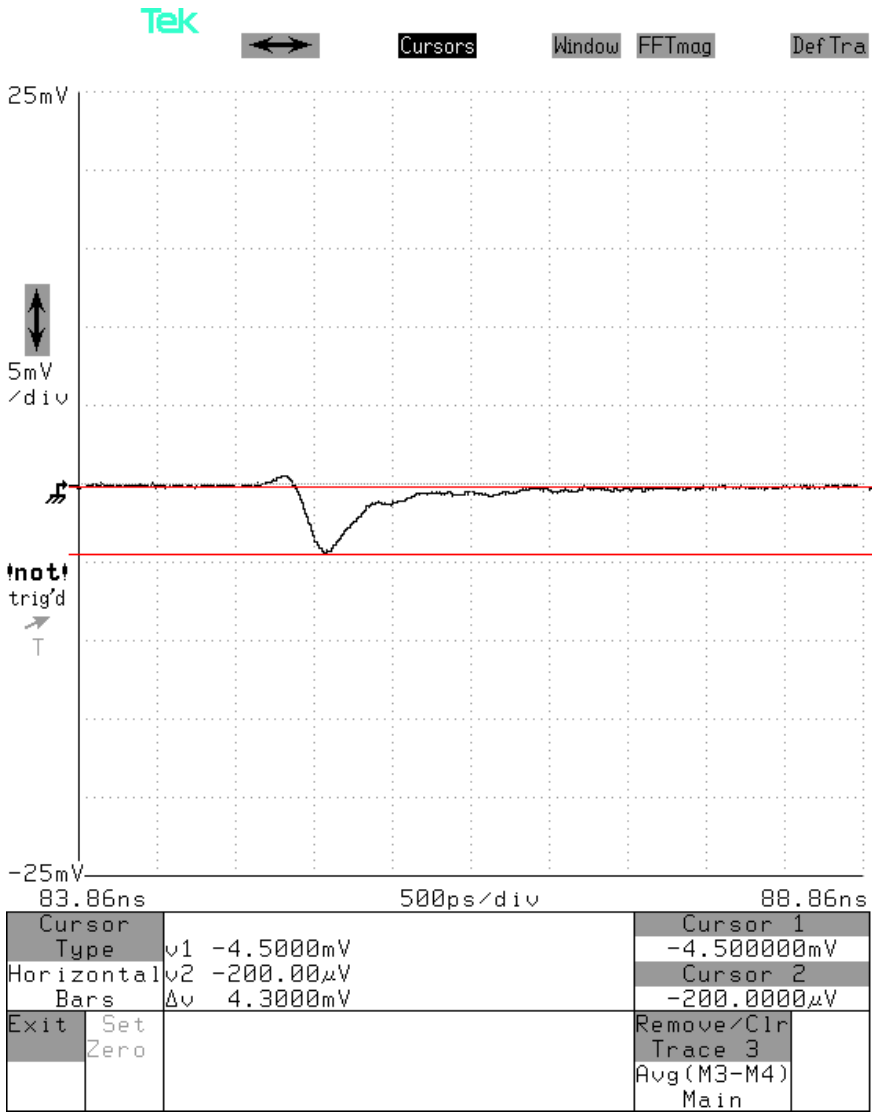


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 7, S 8
- Victim line: Test port S 9, S 10

FEXT = 4.3 mV

FEXT = (4.3 / 498)x100% = 0.86 %

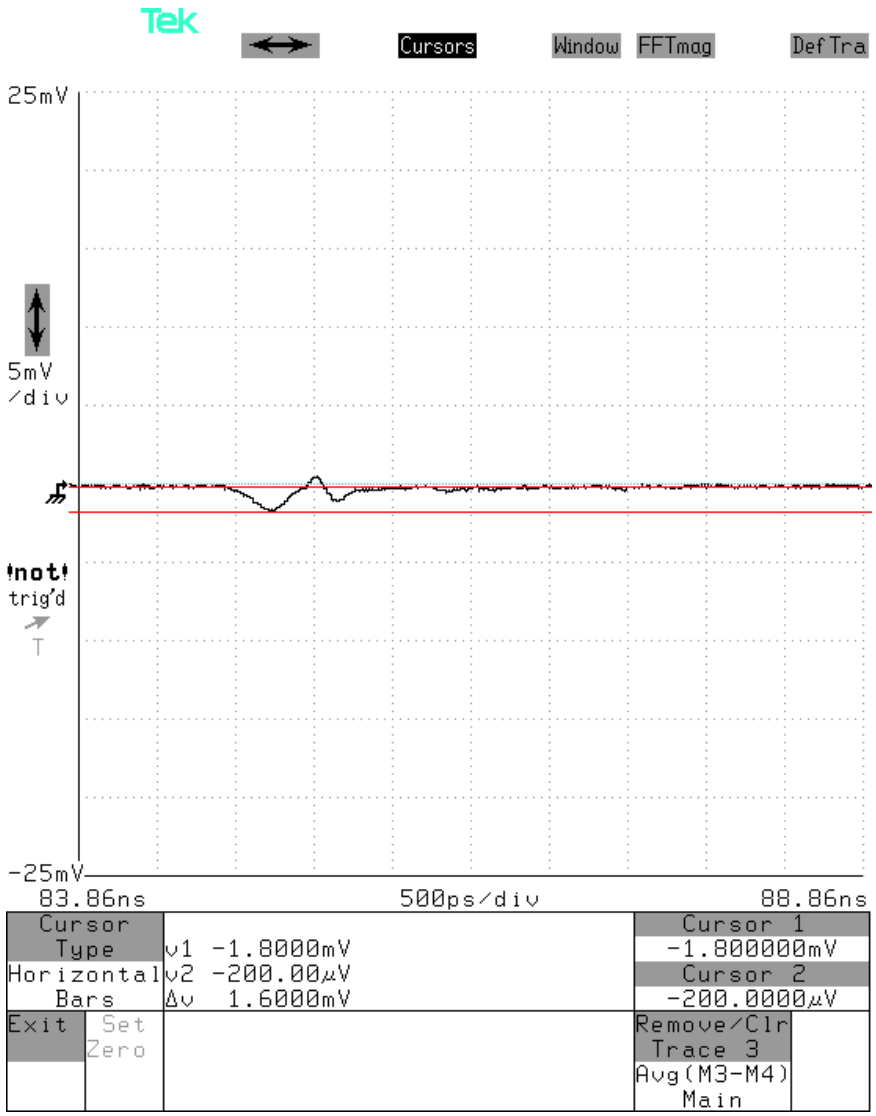


# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 11, S 12
- Victim line: Test port S 9, S 10

FEXT = 1.6 mV

FEXT = (1.6 / 498)x100% = 0.32 %

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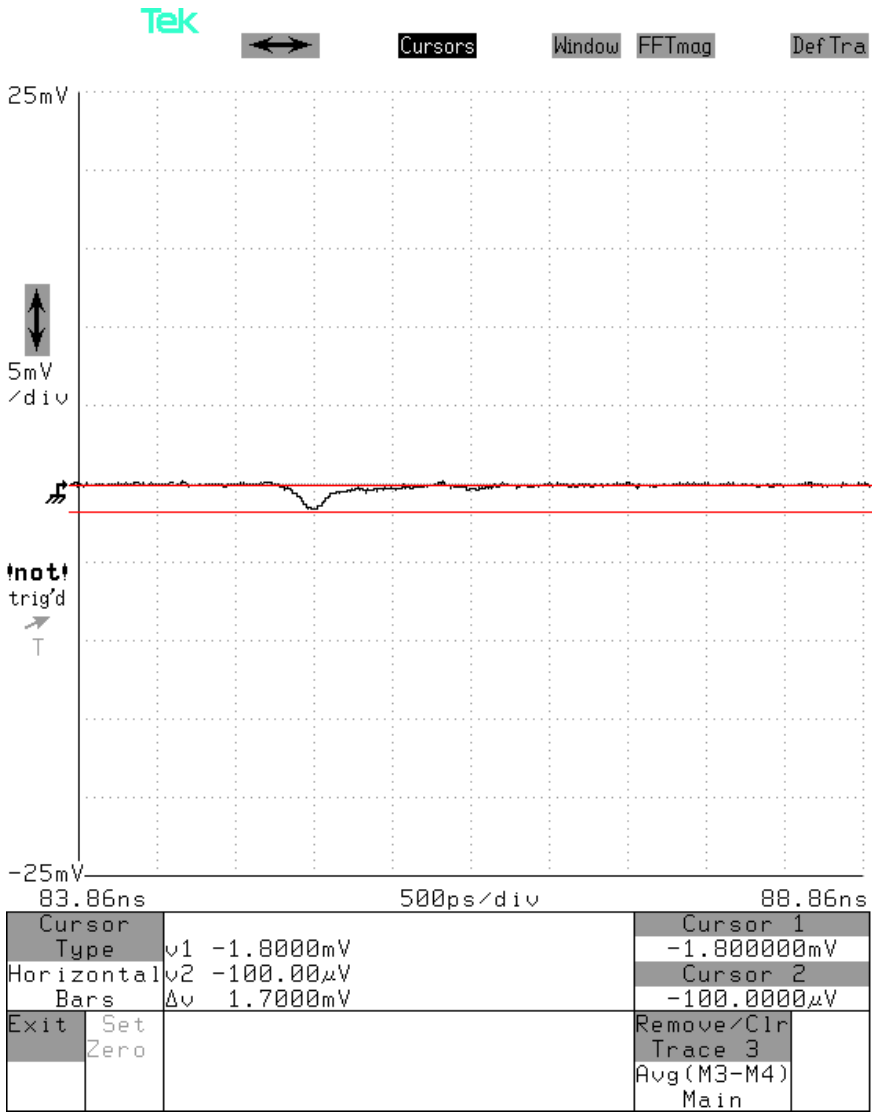
# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 13, S 14
- Victim line: Test port S 9, S 10

FEXT = 1.7 mV

FEXT = (1.7 / 498)x100% = 0.34 %

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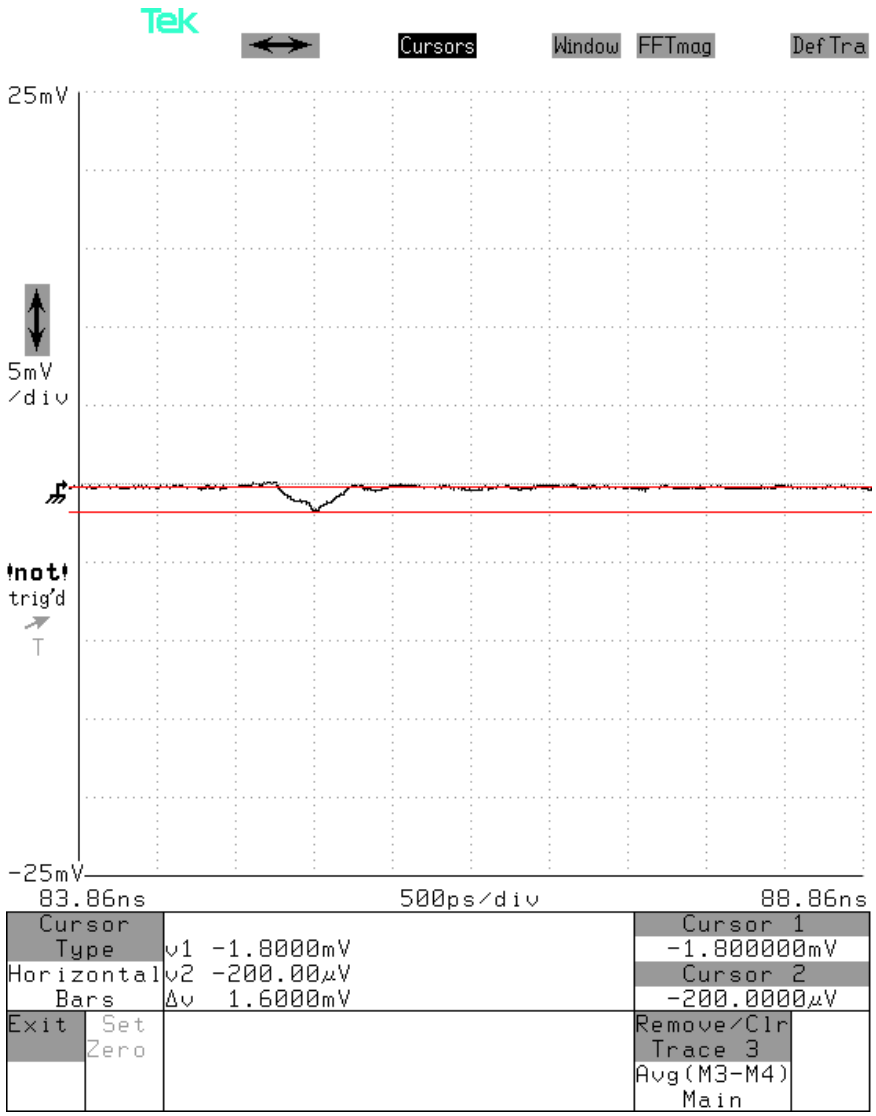
# Typical Far End Cross-talk Measurement by TDT method

- Date: 3/11/03
- Temperature: 77.36 F
- Relative Humidity: 14.6 %
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- Fixture Rise-time: 54.0 ps
- Method: TDT
- Cable : 10 m, 24 AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board.
- Cable End: P1
- Aggressor line: Test port S 15, S 16
- Victim line: Test port S 9, S 10

FEXT = 1.6 mV

FEXT = (1.6 / 498)x100% = 0.32 %

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# Comment On Quality of Bulk Cable and Effects on TDT FEXT

- The victim pair in the 10 meter length 24 AWG assembly is the same pair that exhibits greater Insertion Loss than the other pairs in the assembly. Refer to the Frequency Domain Insertion Loss data.
- The insertion loss of transmit port S7S8 to receive port S9S10 is 37% greater than the other pairs in the assembly.
- Note that pair S9 S10 passes the proposed Insertion Loss specification of 17 dB maximum.
- Cursory examination of mode conversion measurements hint that the problem is related to mode conversion, and that this cable will also have Cross Talk and EMI performance issues.

- **Note that the TDT FEXT results show that this high loss, mode converting, pair has NOT caused higher TDT FEXT when the lossy pair is the victim.**

# Frequency Domain (FD)
# Near End Cross Talk (NEXT) Measurements

Thinh Nguyen
Dean Vermeersch

- Test system Reference Plane is the SMA interface of the launch connectors on the test fixture.
- Network Analyzer HP8720ES & ATN 4112A, 3.5mm calibration kit 85052C.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- S-Parameter measurements are made in accordance with SFF-8410.
- This report shows the FD NEXT measurements of the FCI MicroGiga CN fixture mated to a 0.5, and 5.0, meter length, 28 AWG, and 10 meter length 24 AWG, 100 ohm differential, cable assembly with FCI MicroGiga CN connectors.

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

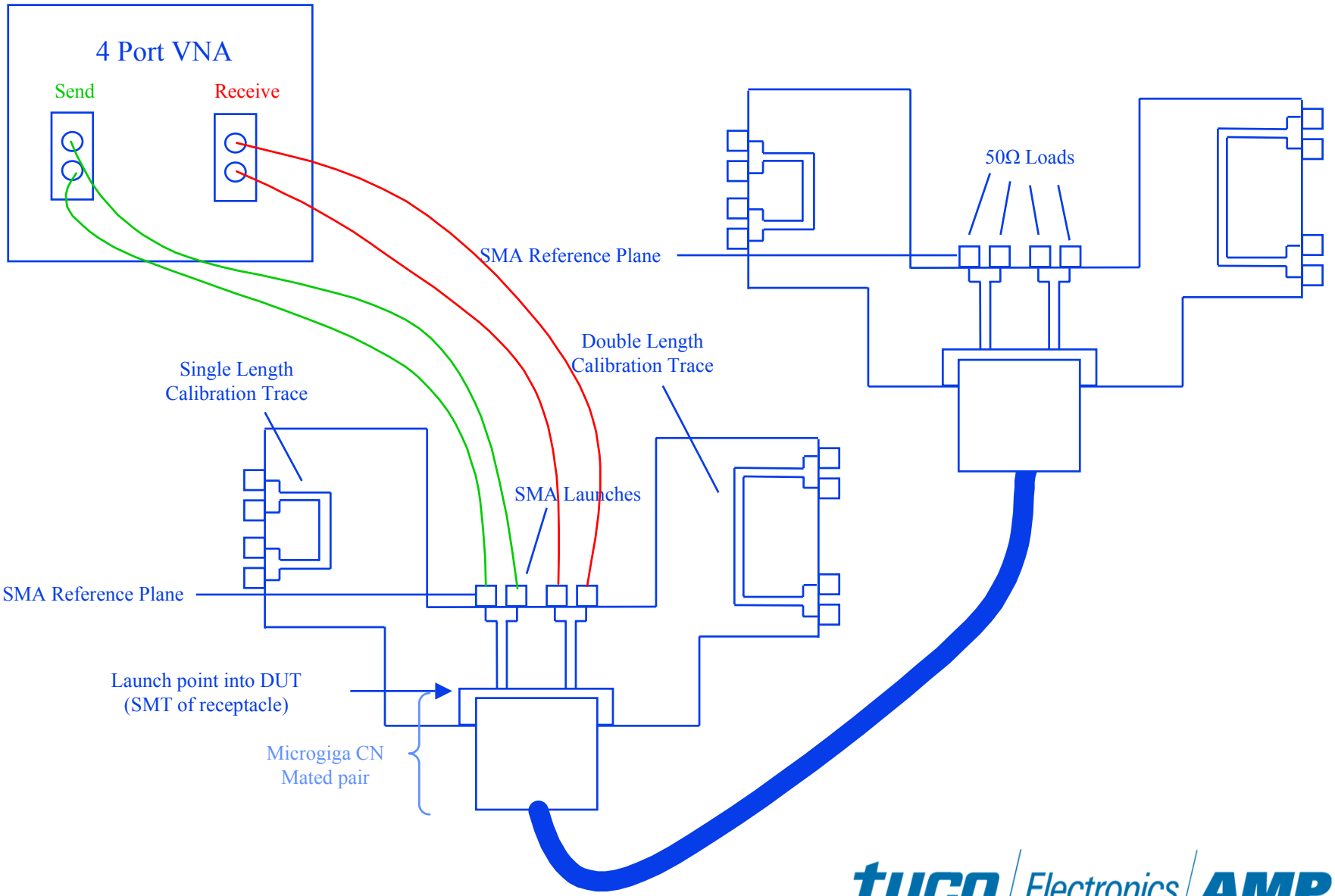
- Cable assembly measurements made at this reference plane includes the test fixture as part of the device under test.

# S-Parameter Measurements

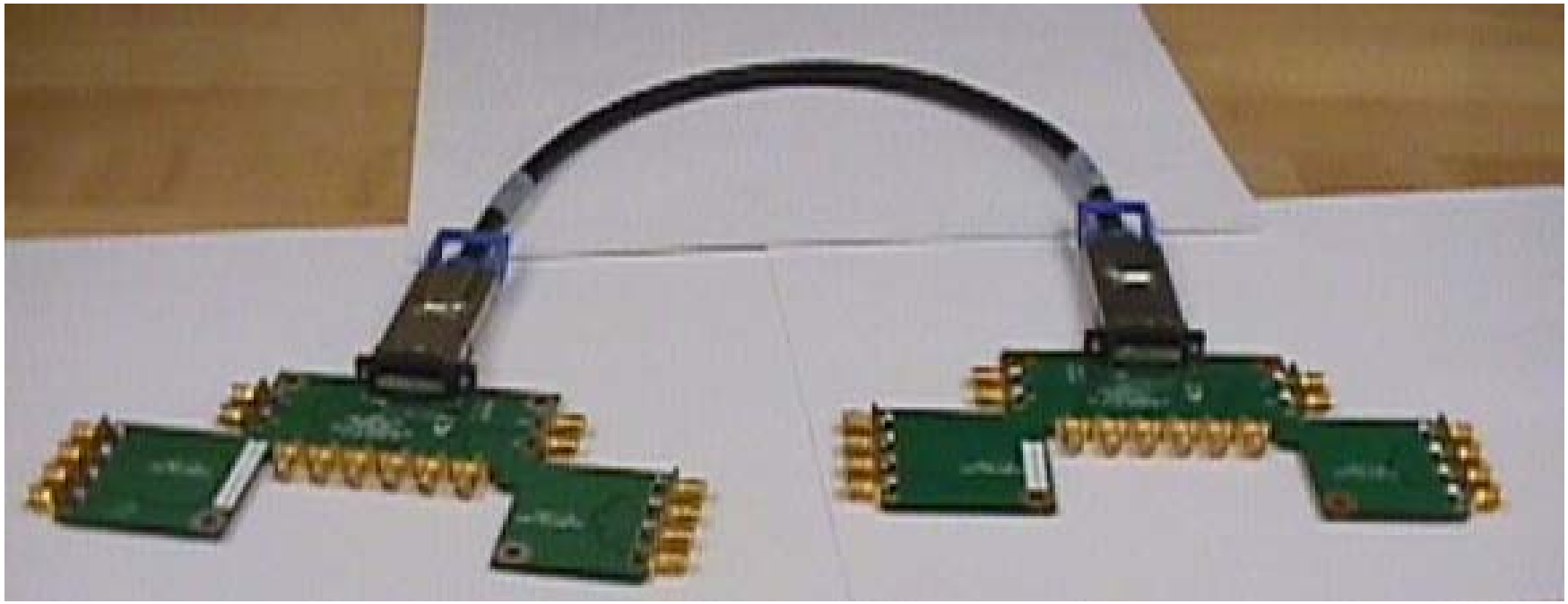
Thinh Nguyen
Dean Vermeersch

- Note that all S-Parameter data will be made available as full complex export files for those who wish.
- Please contact Thinh Nguyen (717-985-2027) tpnguyen@tycoelectronics.com, or Dean Vermeersch (717-986-3143) dean@tycoelectronics.com and advise what export format is desired.

# Frequency Domain Near End Cross Talk Test Set-Up



# Test Fixtures with Cable Assembly as DUT



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# FD NEXT Measurements

- The following slides show each pair of the 0.5 meter length 28 AWG cable assembly.
- Test port S9 S10 is always the victim line. This was selected because it is one of the pairs in the center of the connector, and is most susceptible to NEXT and FEXT from the other pairs.

- Note that symmetry permits applying results from this victim to other victims.

# TDT NEXT Measurements

- MicroGiga CN pin-out for XAUI applications:

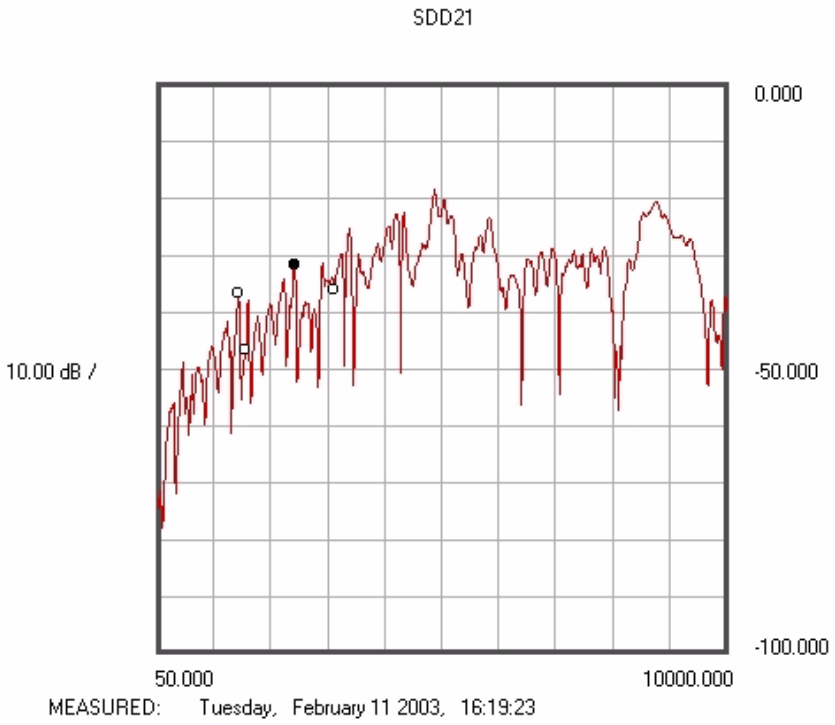
| Transmit | Receive |
|---|---|
| G S1S2 G S3S4 G S5S6 G S7S8 G | S9S10 G S11S12 G S13S14 G S15S16 G |

- Based on the XAUI application of operating four lanes in one direction, and four lanes in the opposite direction, with the split down the middle; it is recommended to use just the S1 S2, S3 S4, S5 S6, and S7 S8 as aggressors for determining total NEXT. This would be combined with FEXT from the other lines as aggressors to determine total Cross Talk as used in the application.

# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1
- Victim Line: S 9, S 10
- Aggressor Line: S 1, S 2




| | | |
|---|---|---|
| 1450.000 | -36.609 dB | |
| 1560.000 | -46.499 dB | |
| 2430.000 | -31.706 dB | <--- |
| 3120.000 | -36.082 dB | |

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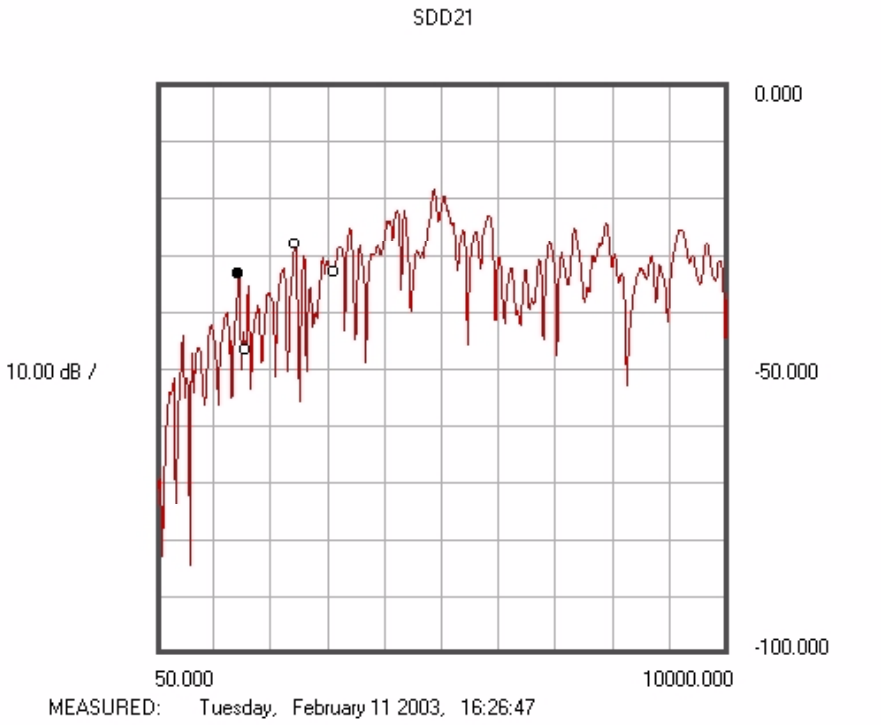
# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1
- Victim Line: S 9, S 10
- Aggressor Line: S 3, S 4



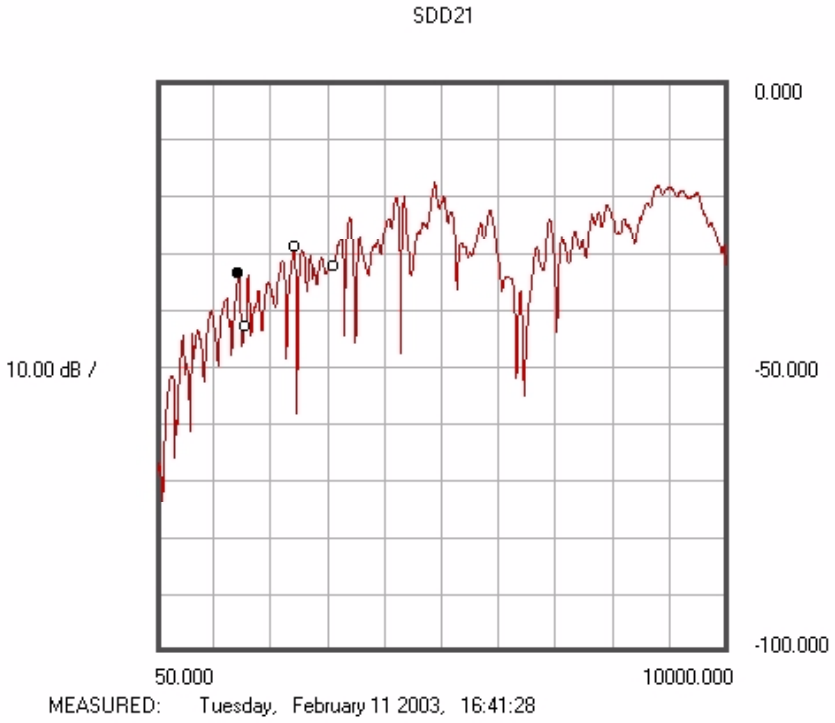

Near End Cross-talk of 0.5 meter, 28AWG, 100 ohm, Skew-clear, 4X Infiniband cable assembly with FCI plug board.
Cable End: P1
Victim Line: Test port S 9, S 10 of Test board
Aggressor line: Test port S 3, S 4 of Test board

| | |
|---|---|
| 1450.000 | -33.337 dB <--- |
| 1560.000 | -46.458 dB |
| 2440.000 | -27.938 dB |
| 3120.000 | -33.005 dB |

# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1
- Victim Line: S 9, S 10
- Aggressor Line: S 5, S 6




| | | |
|---|---|---|
| 1450.000 | -33.641 dB | <--- |
| 1560.000 | -42.772 dB | |
| 2420.000 | -28.853 dB | |
| 3120.000 | -32.292 dB | |

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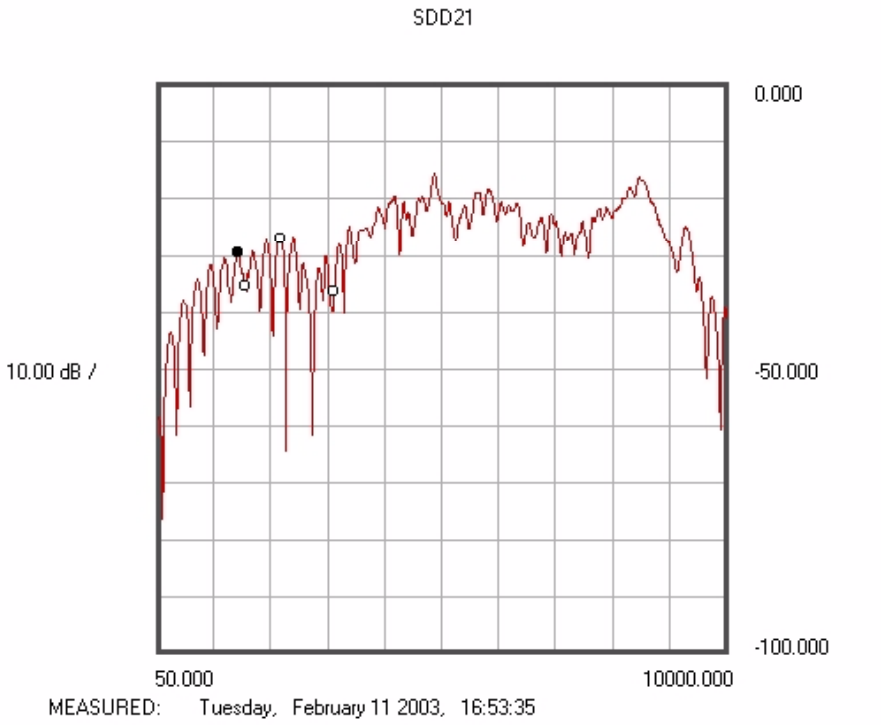
# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1
- Victim Line: S 9, S 10
- Aggressor Line: S 7, S 8

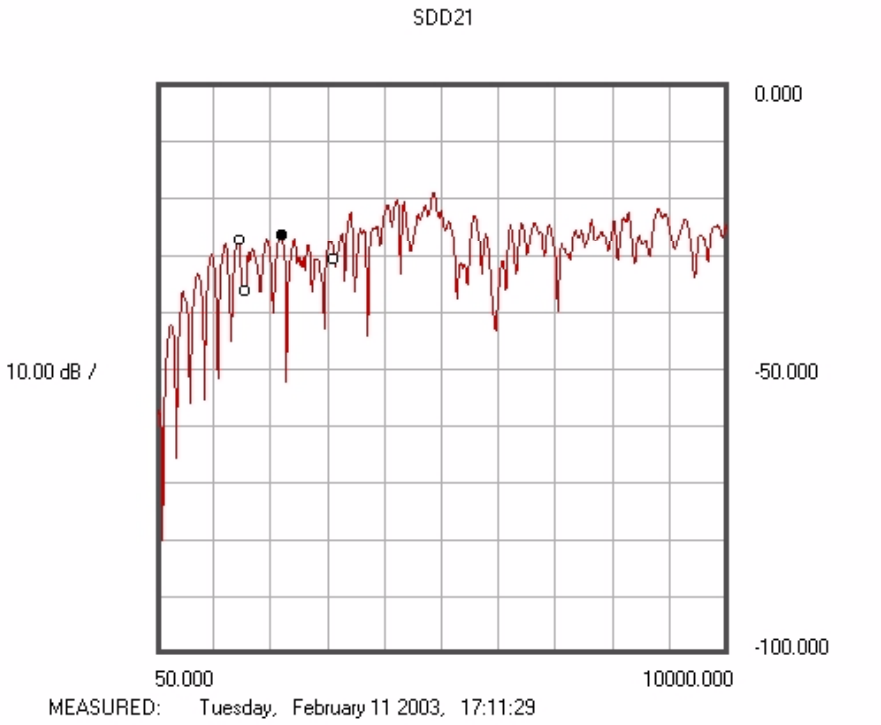



| | |
|---|---|
| 1450.000 | -29.567 dB <--- |
| 1560.000 | -35.311 dB |
| 2190.000 | -27.140 dB |
| 3120.000 | -36.339 dB |

# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1
- Victim Line: S 9, S 10
- Aggressor Line: S 11, S 12

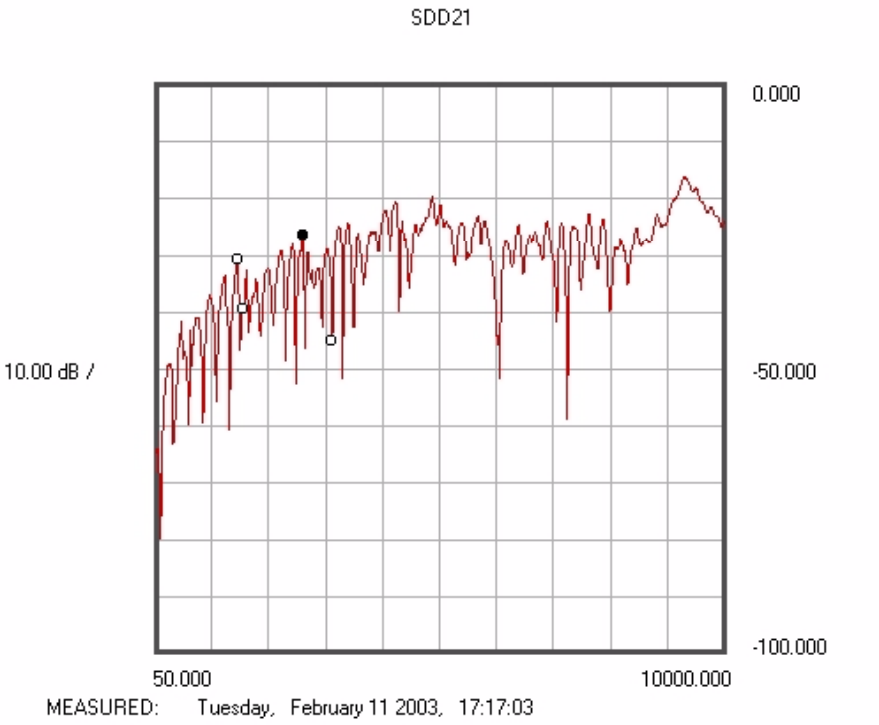



| | | |
|---|---|---|
| 1460.000 | -27.246 dB | |
| 1560.000 | -36.252 dB | |
| 2200.000 | -26.538 dB | <--- |
| 3120.000 | -30.794 dB | |

# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1
- Victim Line: S 9, S 10
- Aggressor Line: S 13, S 14




| | | |
|---|---|---|
| 1460.000 | -30.717 dB | |
| 1560.000 | -39.532 dB | |
| 2600.000 | -26.336 dB | <--- |
| 3120.000 | -45.106 dB | |

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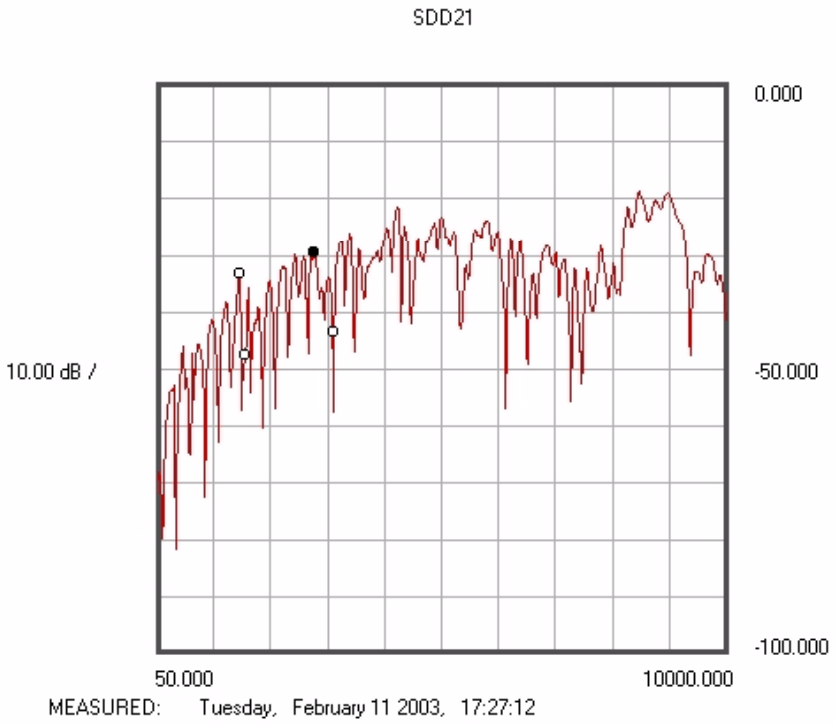
# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1
- Victim Line: S 9, S 10
- Aggressor Line: S 15, S 16




| | |
|---|---|
| 1470.000 | -33.341 dB |
| 1560.000 | -47.574 dB |
| 2770.000 | -29.402 dB <--- |
| 3120.000 | -43.604 dB |

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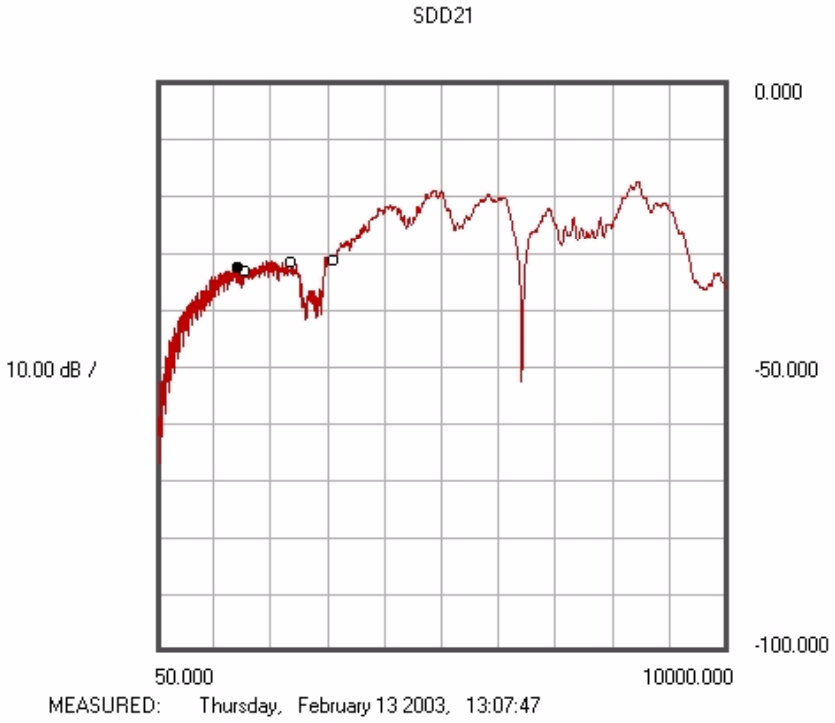
# FD NEXT Measurements

- The following slide shows NEXT of the 5.0 meter length 28 AWG cable assembly.
- Aggressor S7 S8 with Victim S9 S10 is shown for comparison to results from the 0.5 meter length.
- Note that the 0.5 meter length measures higher FD NEXT than the 5.0 meter length 28 AWG, and the 10.0 meter length 24 AWG.

# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Victim Line: S 9, S 10
- Aggressor Line: S 7, S 8




| | | |
|---|---|---|
| 1440.000 | -32.604 dB | <--- |
| 1560.000 | -33.096 dB | |
| 2380.000 | -31.786 dB | |
| 3120.000 | -31.391 dB | |

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# TDT NEXT Measurements

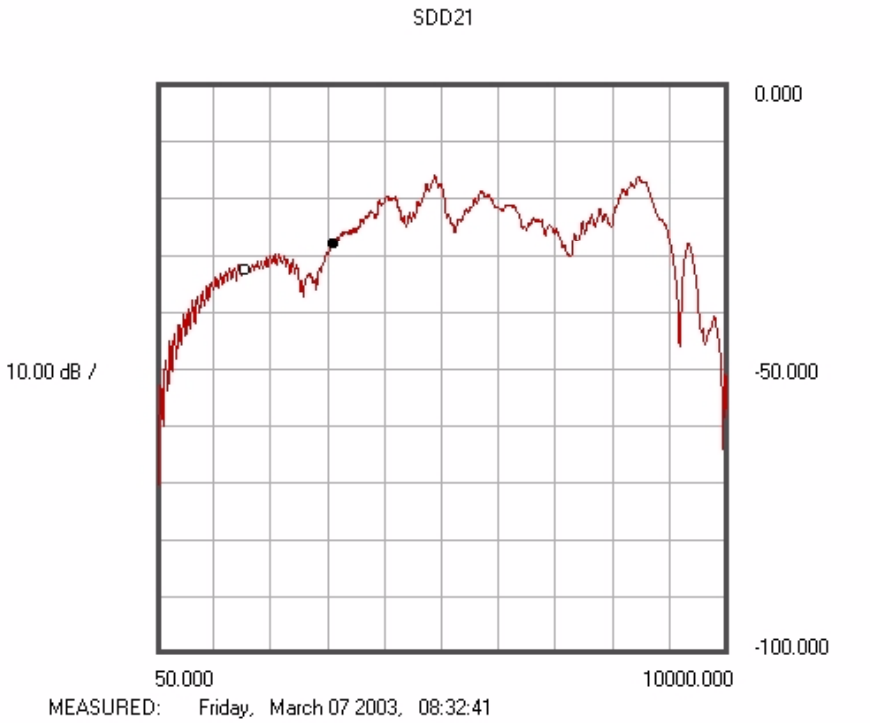
- The following slide shows NEXT of the 10.0 meter length 24 AWG cable assembly.
- Aggressor S7 S8 with Victim S9 S10 is shown for comparison to results from the 0.5 meter length.
- This basically confirms FD NEXT results are independent of cable assembly length AND cable size. Caveat that the cable size is not so different as to require different wire management.

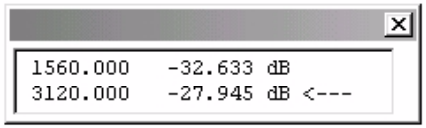
- Note that symmetry permits applying FD NEXT results from the 0.5 meter length to other lengths, AND other cable sizes, caveat that accurate phase corrections are used.

# Typical NEXT Measurement By Network Analyzer - ATN

- Date: 3/7/03
- Temperature: 77.89 F
- Relative Humidity: 13.49 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 10 m, 24 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Victim Line: S 9, S 10
- Aggressor Line: S 7, S 8

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# Comment On Quality of Bulk Cable and Effects on TDT NEXT

- The victim pair in the 10 meter length 24 AWG assembly is the same pair that exhibits greater Insertion Loss than the other pairs in the assembly. Refer to the Frequency Domain Insertion Loss data.
- The insertion loss of transmit port S7S8 to receive port S9S10 is 37% greater than the other pairs in the assembly.
- Note that pair S9 S10 passes the proposed Insertion Loss specification of 17 dB maximum.
- Cursory examination of mode conversion measurements hint that the problem is related to mode conversion, and that this cable will also have Cross Talk and EMI performance issues.

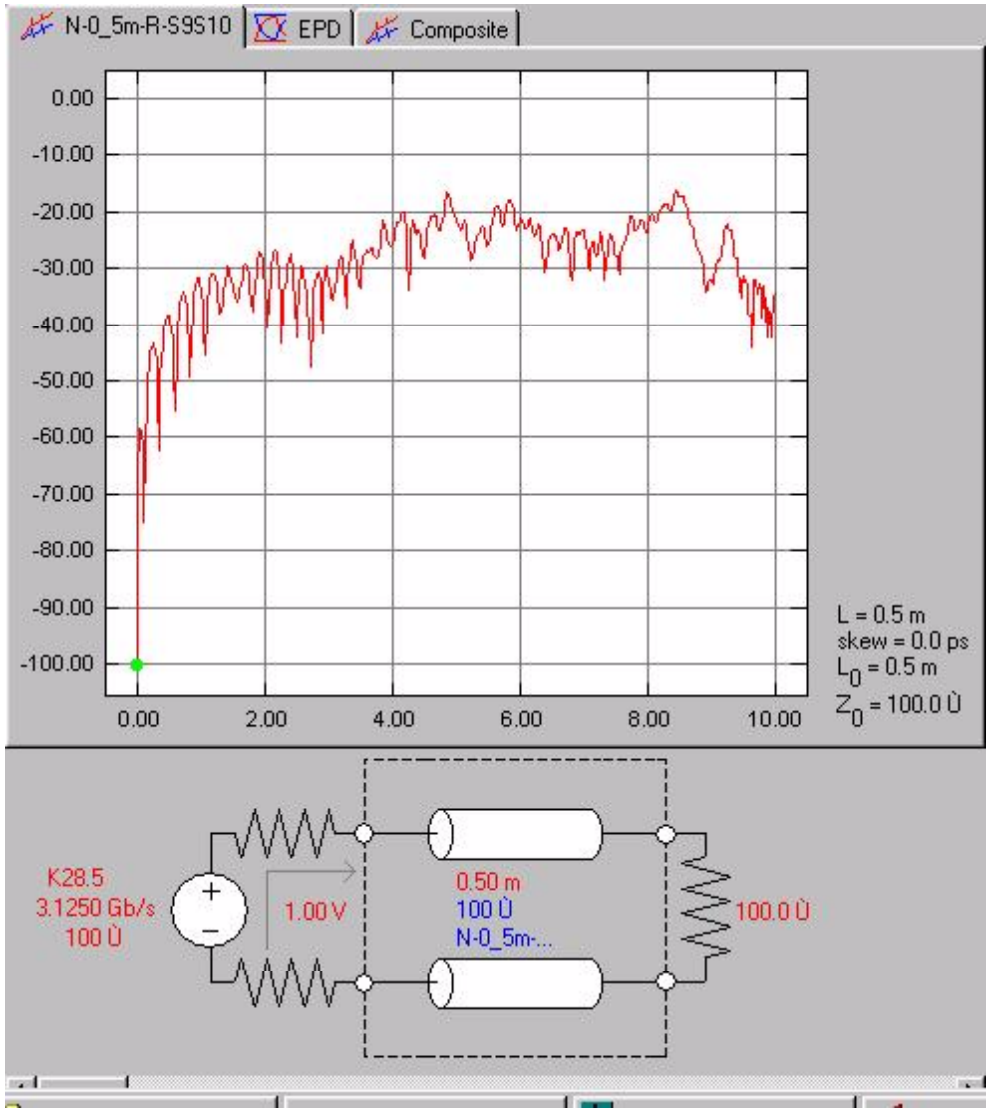
- **Note that the FD NEXT results show that this high loss, mode converting, pair has NOT caused higher FD NEXT when the lossy pair is the victim.**

# FD NEXT – Measurement Methods Frequency Domain Acquisition Compared to Time Domain Acquisition Spectral Characteristics [S-Parameter]

- The Time Domain system (Tektronix TDS 8000 Digital Sampling Oscilloscope) used the same test leads as the Frequency Domain system.
- The Time Domain test system has had the fixture effects added, so a direct comparison may be made to the Frequency Domain system (which cannot remove fixture effects).
- The following slides show the Time Domain acquisition results, and are to be compared to the same aggressor/victim combination in the preceding Frequency Domain acquisition results.

# Typical NEXT (S21) Measurement By Oculus Software

- Date: 3/12/03
- Temperature: 77.49 F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 0.5 m , 28AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Aggressor Line: Test port S 7, S 8
- Victim Line: Test port S 9, S 10

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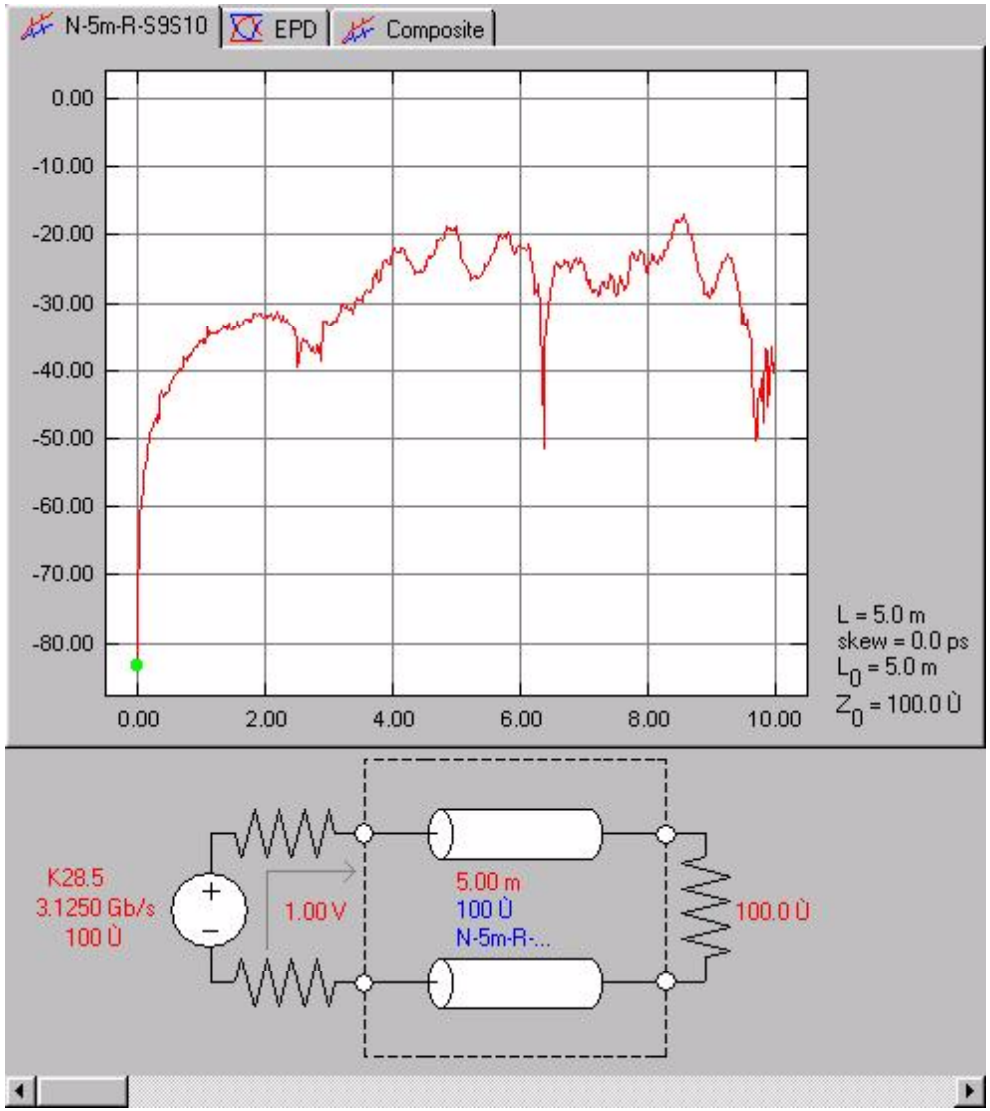
# Typical NEXT (S21) Measurement By Oculus Software

- Date: 3/12/03
- Temperature: 77.49 F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5 m , 28AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Transmitted Line: Test port S 7, S 8
- Received Line: Test port S 9, S 10

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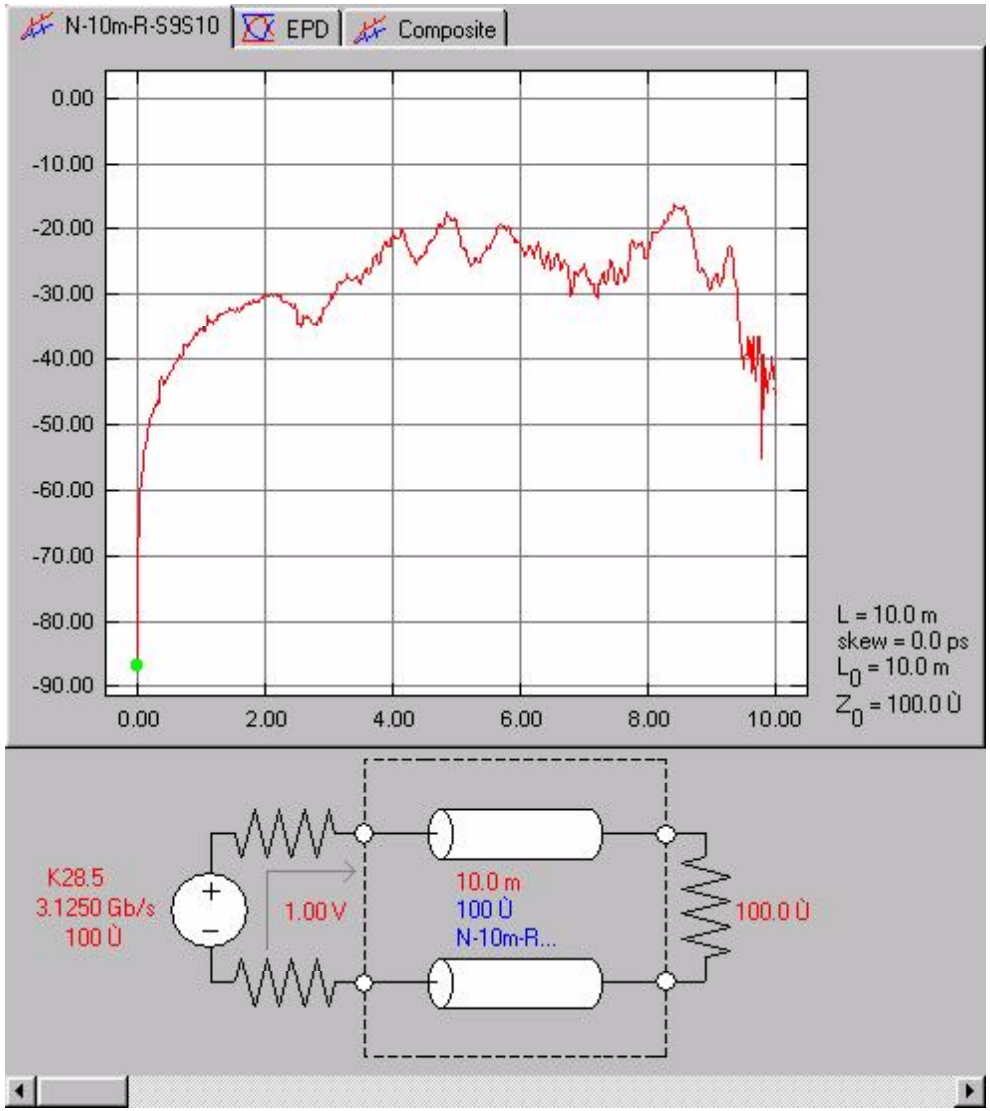
# Typical NEXT (S21) Measurement By Oculus Software

- Date: 3/12/03
- Temperature: 77.49 F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 10 m , 24AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Transmitted Line: Test port S 7, S 8
- Received Line: Test port S 9, S 10



# Frequency Domain (FD)
# Far End Cross Talk (FEXT) Measurements

Thinh Nguyen
Dean Vermeersch

- Test system Reference Plane is the SMA interface of the launch connectors on the test fixture.
- Network Analyzer HP8720ES & ATN 4112A, 3.5mm calibration kit 85052C.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- S-Parameter measurements are made in accordance with SFF-8410.
- This report shows the FD FEXT measurements of the FCI MicroGiga CN fixture mated to a 0.5, and 5.0, meter length, 28 AWG, and 10 meter length 24 AWG, 100 ohm differential, cable assembly with FCI MicroGiga CN connectors.

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

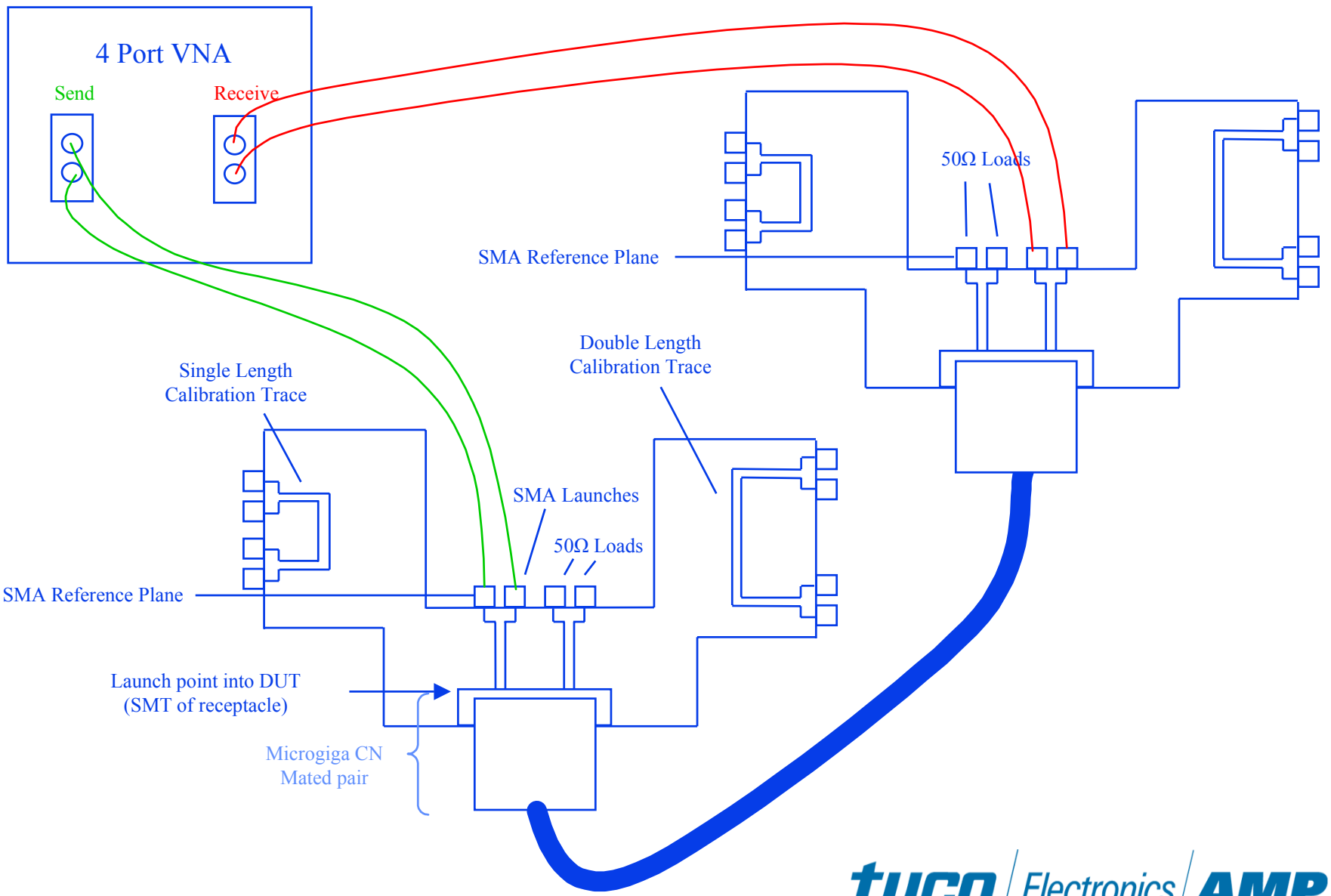
- Cable assembly measurements made at this reference plane includes the test fixture as part of the device under test.

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- Note that all S-Parameter data will be made available as full complex export files for those who wish.
- Please contact Thinh Nguyen (717-985-2027) tpnguyen@tycoelectronics.com, or Dean Vermeersch (717-986-3143) dean@tycoelectronics.com and advise what export format is desired.

# Frequency Domain Far End Cross Talk Test Set-Up

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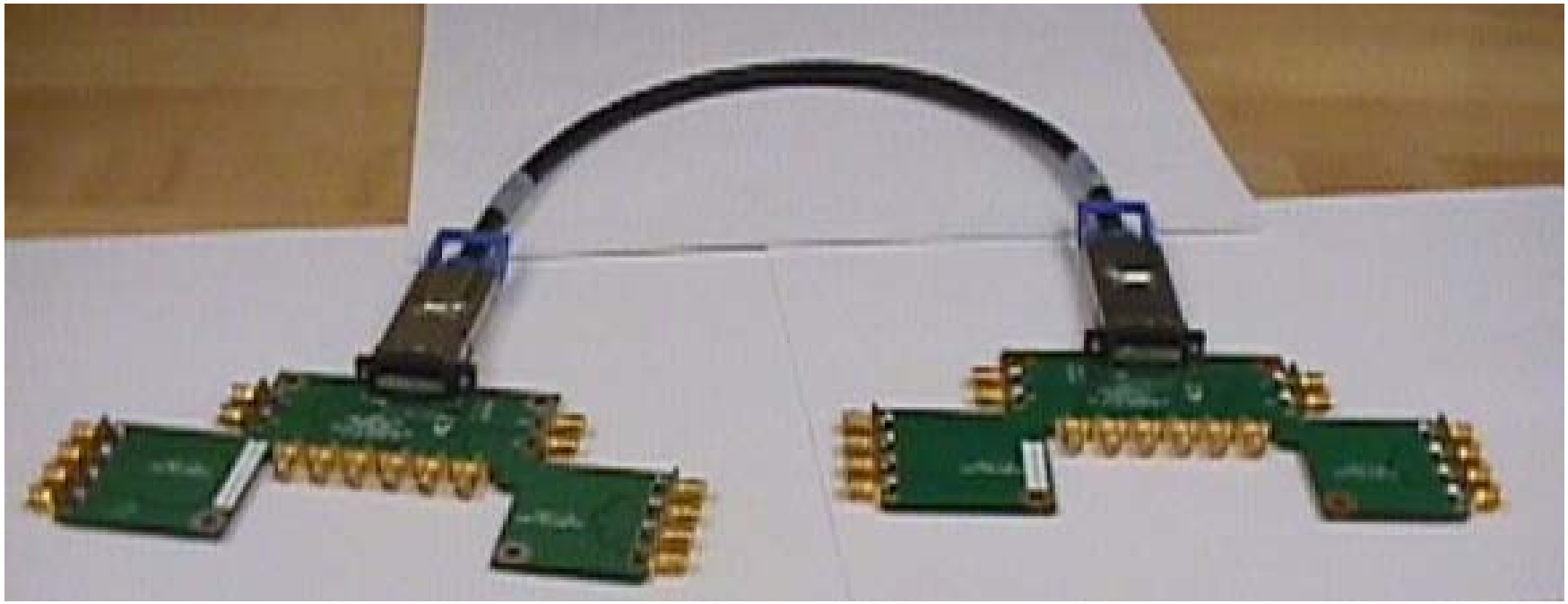
# Test Fixtures with Cable Assembly as DUT



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# FD FEXT Measurements

- MicroGiga CN pin-out for XAUI applications:

| Transmit | Receive |
|---|---|
| G S1S2 G S3S4 G S5S6 G S7S8 G | S9S10 G S11S12 G S13S14 G S15S16 G |

- Based on the XAUI application of operating four lanes in one direction, and four lanes in the opposite direction, with the split down the middle; it is recommended to use just the S11 S12, S13 S14, and S15 S16, as aggressors for determining total FEXT. This would be combined with NEXT from the other lines as aggressors to determine total Cross Talk as used in the application.

# FD FEXT Measurements

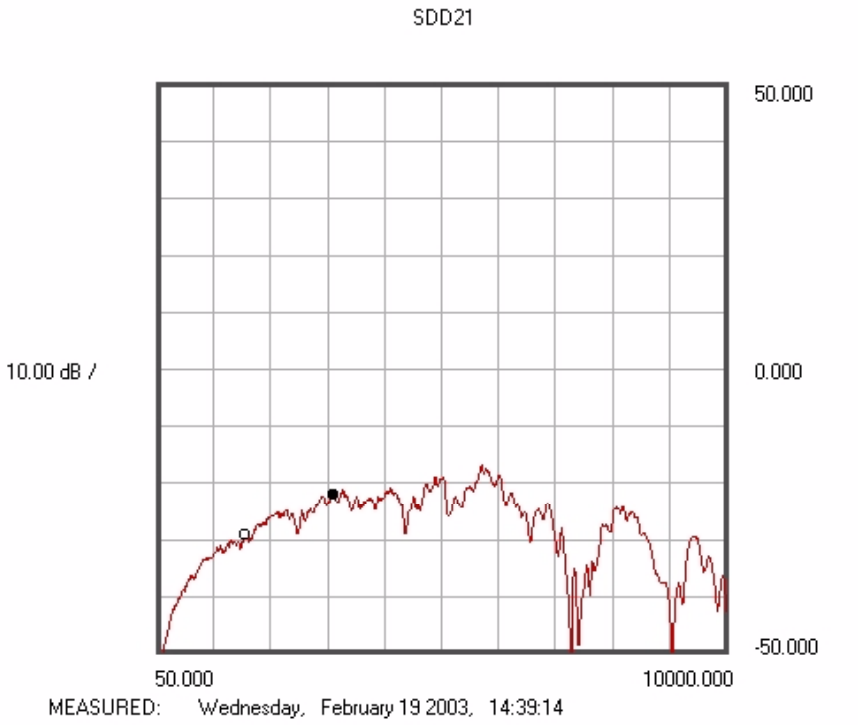
- The following slide shows FD FEXT of the 0.5 meter length 28 AWG cable assembly.
- Aggressor S7 S8 with Victim S9 S10 is shown for comparison to results from the 5.0 and 10.0 meter lengths.

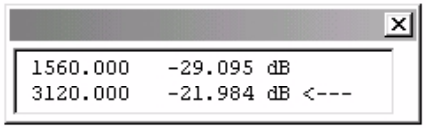
- Note that the 0.5 meter length measures higher FD FEXT than the 5.0 meter length 28 AWG, and the 10.0 meter length 24 AWG.

# Typical FEXT Measurement By Network Analyzer - ATN

- Date: 2/19/03
- Temperature: 76.46 F
- Relative Humidity: 16.6 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 0.5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 7, S 8

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# FD FEXT Measurements

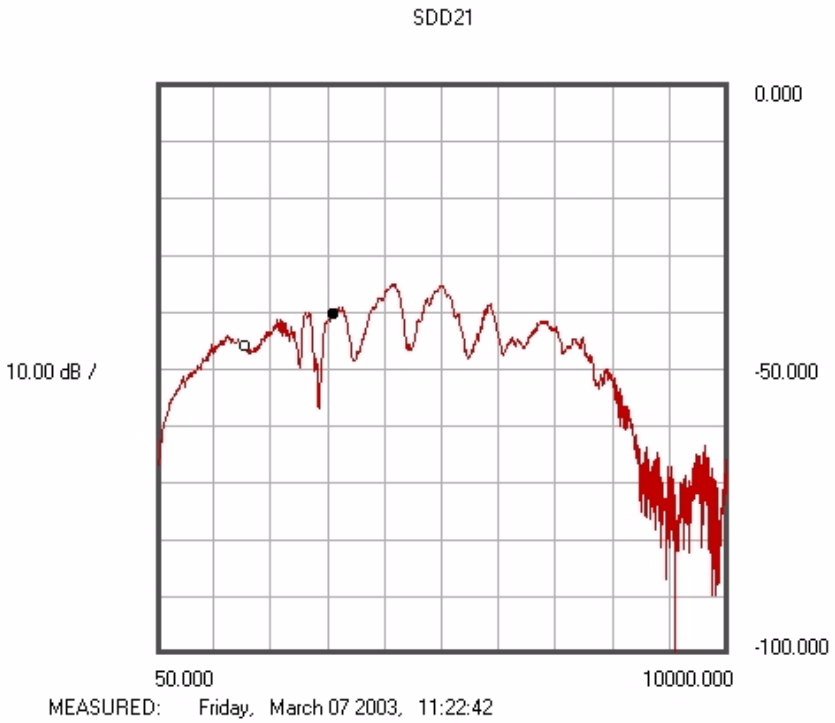
- The following slides show each pair of the 5.0 meter length 28 AWG cable assembly.
- Test port S9 S10 is always the victim line. This was selected because it is one of the pairs in the center of the connector, and is most susceptible to NEXT and FEXT from the other pairs.

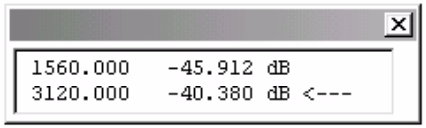
- Note that symmetry permits applying results from this victim to other victims.

# Typical FEXT Measurement By Network Analyzer - ATN

- Date: 3/7/03
- Temperature: 77.89 F
- Relative Humidity: 13.49 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 1, S 2

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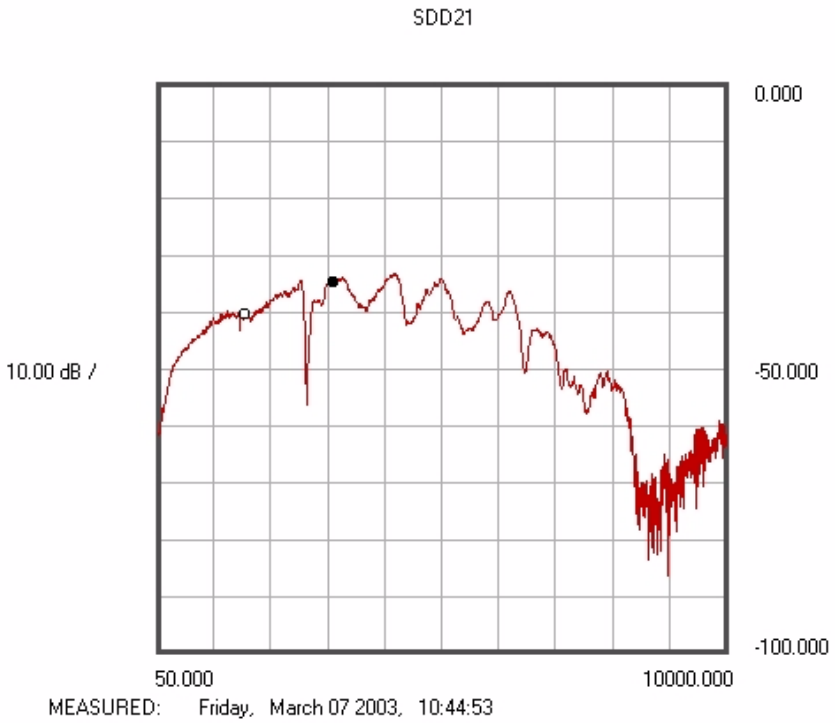
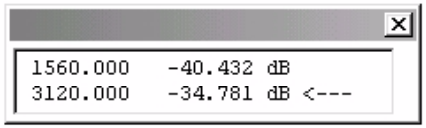
# Typical FEXT Measurement By Network Analyzer - ATN

- Date: 3/7/03
- Temperature: 77.89 F
- Relative Humidity: 13.49 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 3, S 4

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- Date: 3/7/03
- Temperature: 77.89 F
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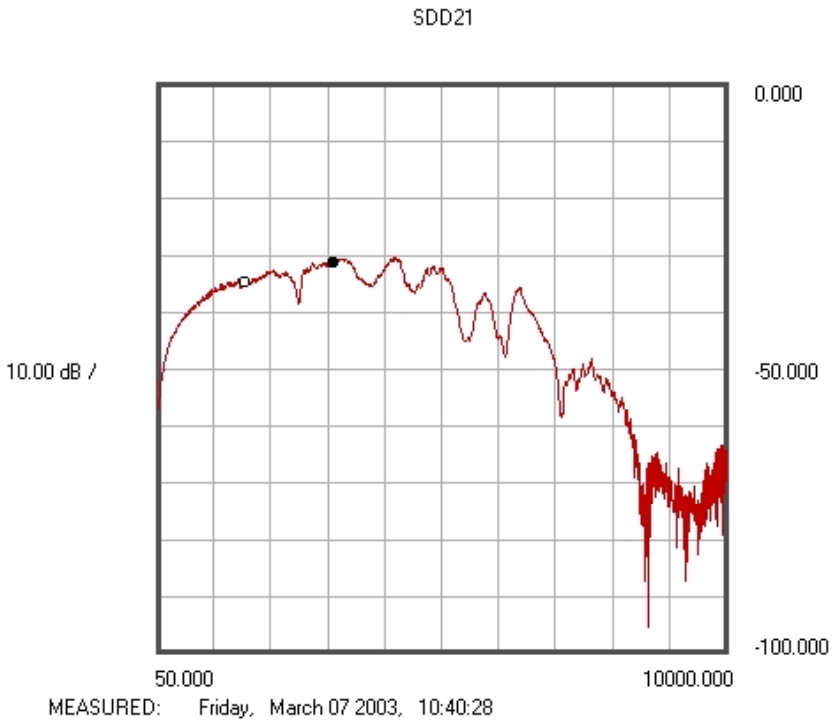
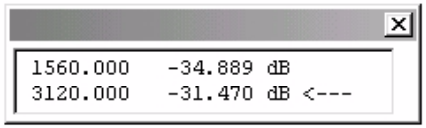
- **DUT: 5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 5, S 6

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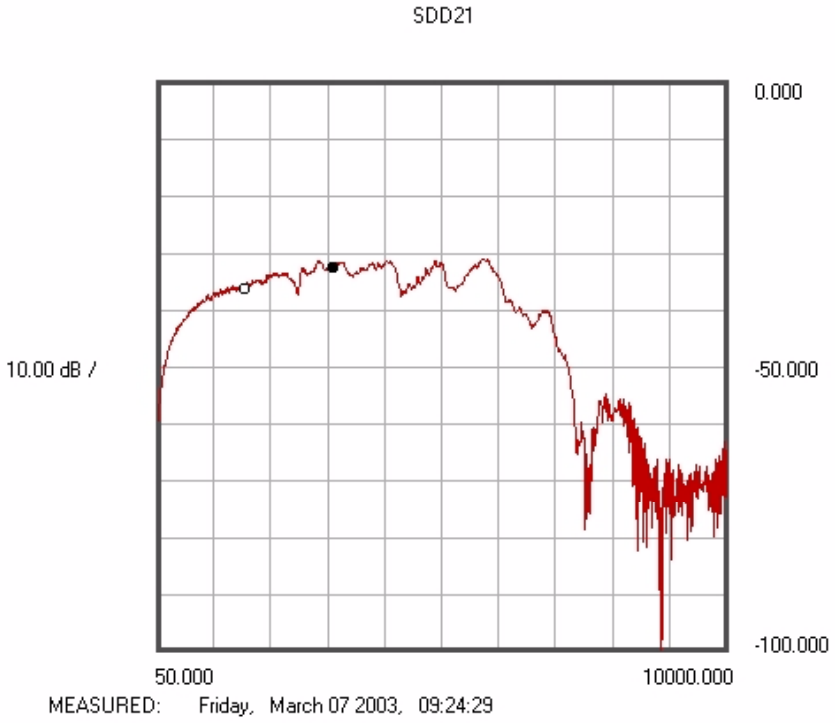


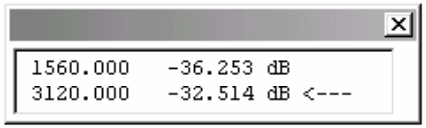


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- Date: 3/7/03
- Temperature: 77.89 F
- Relative Humidity: 13.49 %
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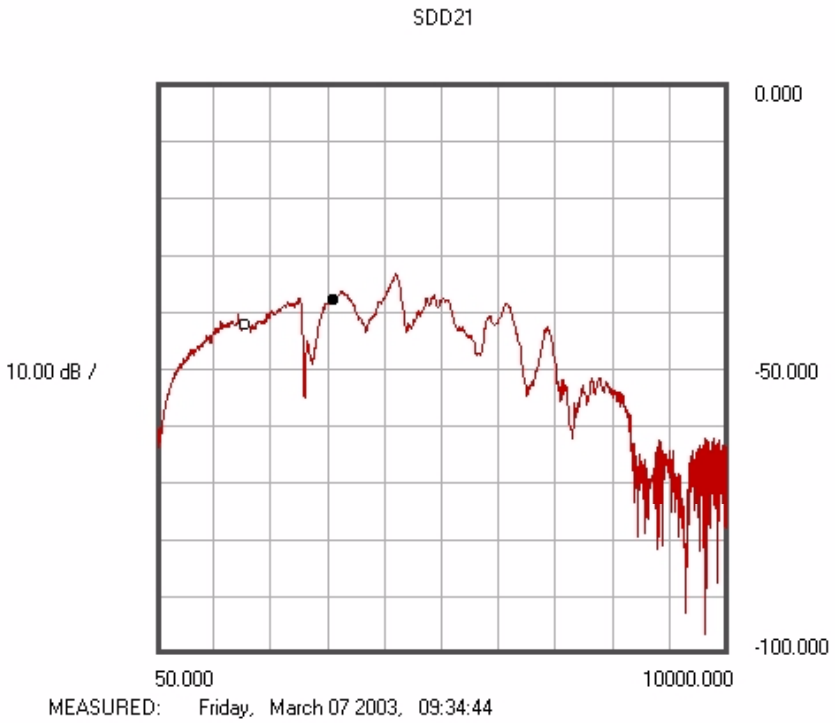
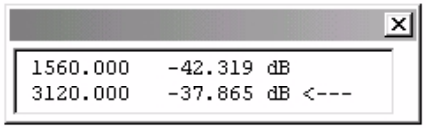
- **DUT: 5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 11, S 12

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- Date: 3/7/03
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- Cable End: P1 for Victim Line
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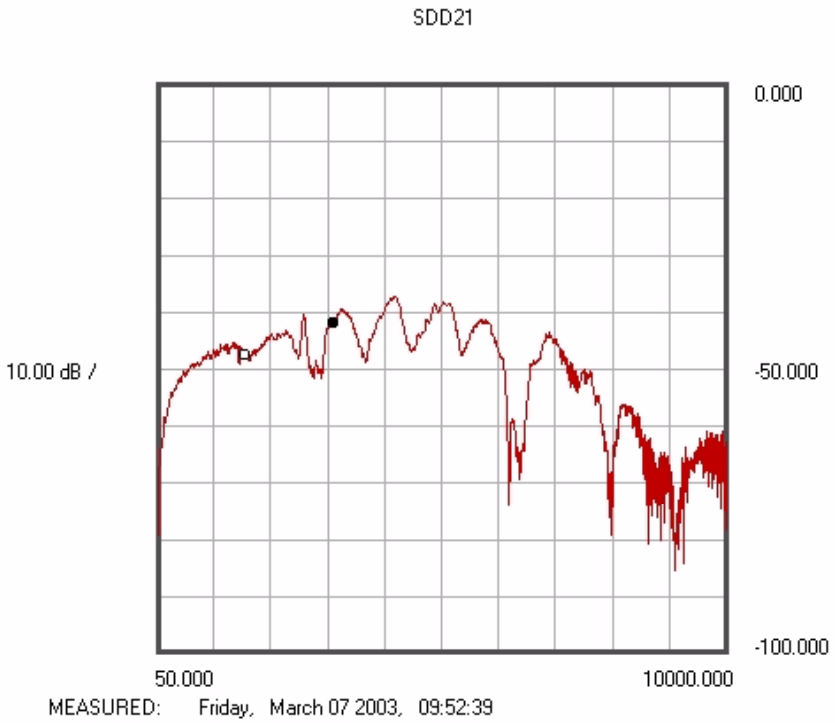
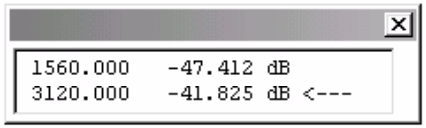
- Aggressor Line: S 13, S 14

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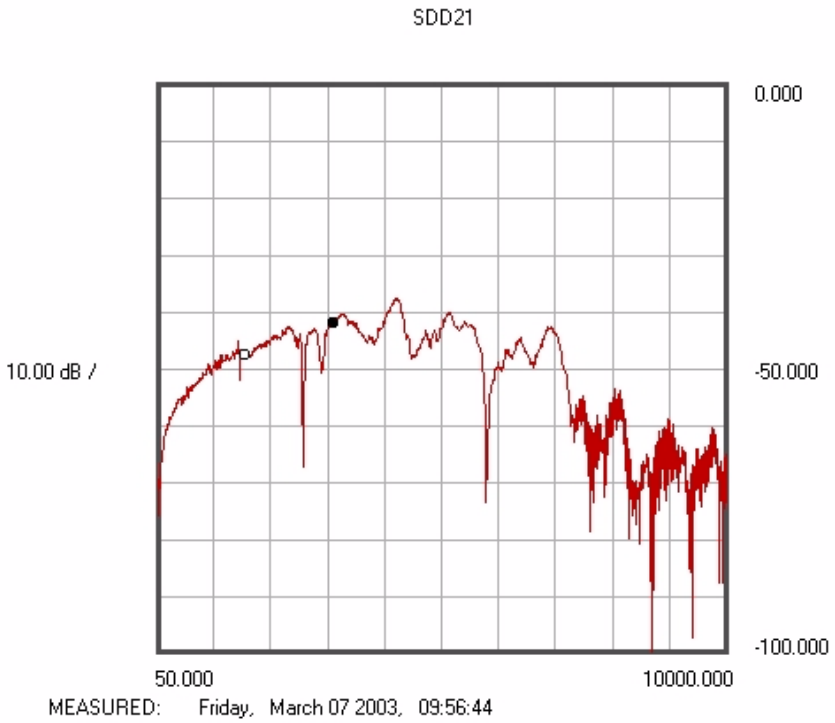
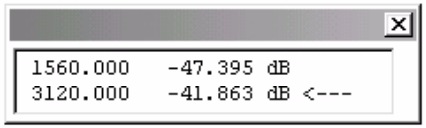
# Typical FEXT Measurement By Network Analyzer - ATN

- Date: 3/703
- Temperature: 77.89 F
- Relative Humidity: 13.49 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 5 m, 28 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 15, S 16

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# FD FEXT Measurements

- The following slides show each pair of the 5.0 meter length 28 AWG cable assembly.
- Test port S9 S10 is always the victim line. This was selected because it is one of the pairs in the center of the connector, and is most susceptible to NEXT and FEXT from the other pairs.

- Note that symmetry permits applying results from this victim to other victims.

# Comment On Quality of Bulk Cable and Effects on FD FEXT

- The victim pair in the 10 meter length 24 AWG assembly is the same pair that exhibits greater Insertion Loss than the other pairs in the assembly. Refer to the Frequency Domain Insertion Loss data.
- The insertion loss of transmit port S7S8 to receive port S9S10 is 37% greater than the other pairs in the assembly.
- Note that pair S9 S10 passes the proposed Insertion Loss specification of 17 dB maximum.
- Cursory examination of mode conversion measurements hint that the problem is related to mode conversion, and that this cable will also have Cross Talk and EMI performance issues.
- **Note that the FD FEXT results seem to show that the plot of FEXT verses frequency is affected by the high loss mode converting pair, but overall FEXT of this length is less than that of the 0.5 meter and 5.0 meter lengths.**

# Typical FEXT Measurement By Network Analyzer - ATN

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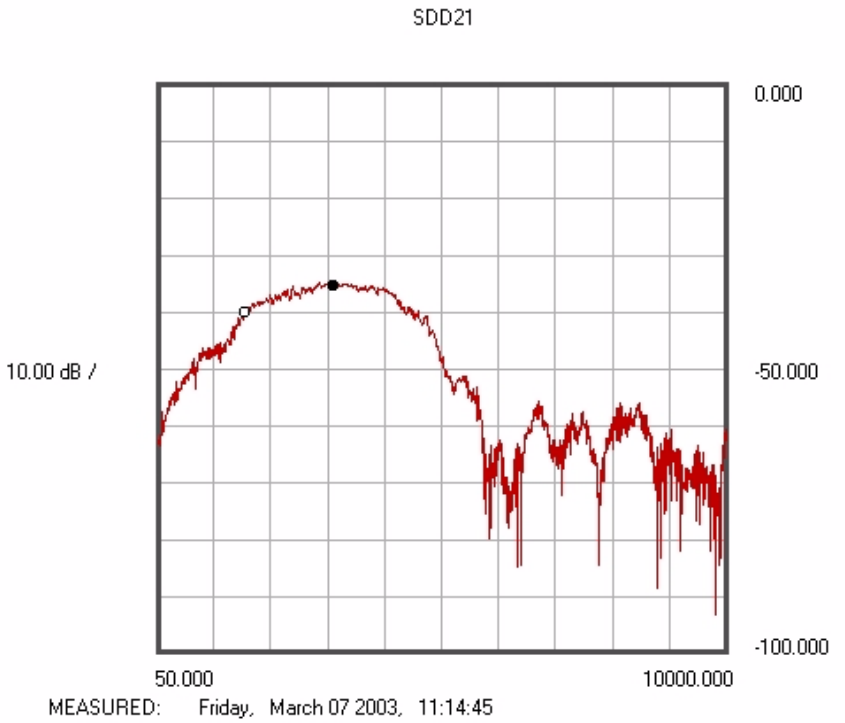
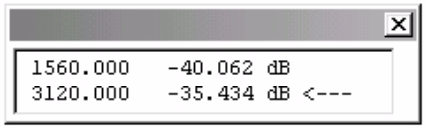
- Temperature: 77.89 F
- Relative Humidity: 13.49 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

- **DUT: 10 m, 24 AWG, 100 ohm, Skew-clear, 4X infiniband cable assembly with FCI plug board**
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 1, S 2

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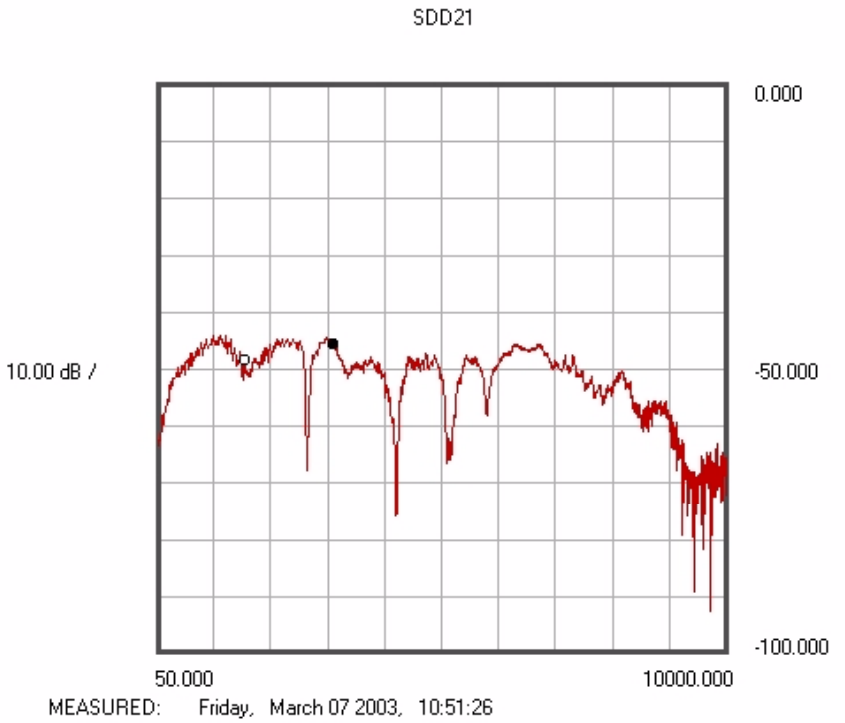


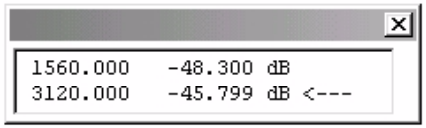


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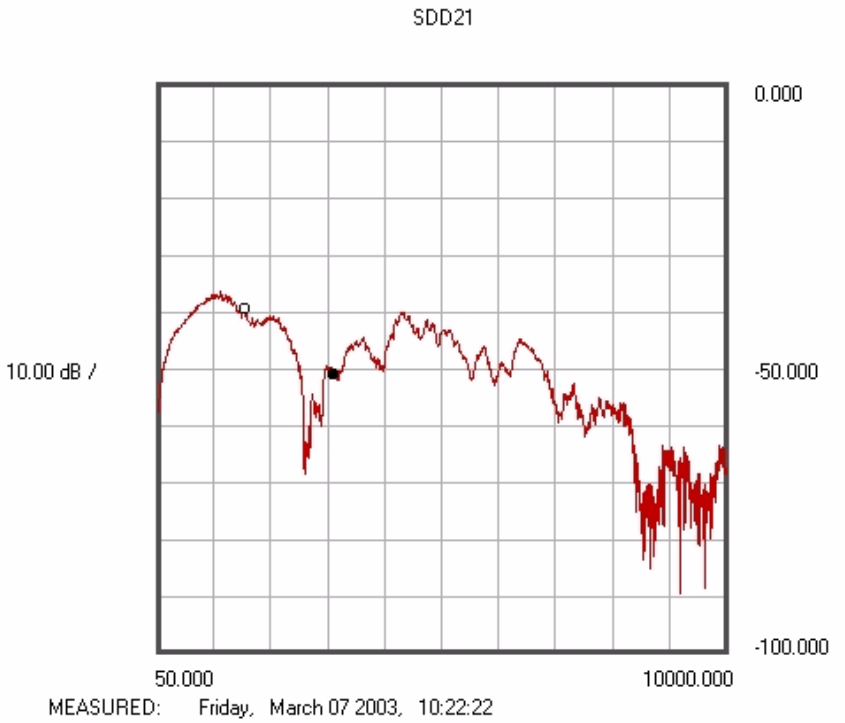


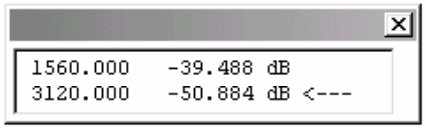


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# Typical FEXT Measurement By Network Analyzer - ATN

- Date: 3/7/03
- Temperature: 77.89 F
- Relative Humidity: 13.496 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: FCI 4X Infiniband Test board

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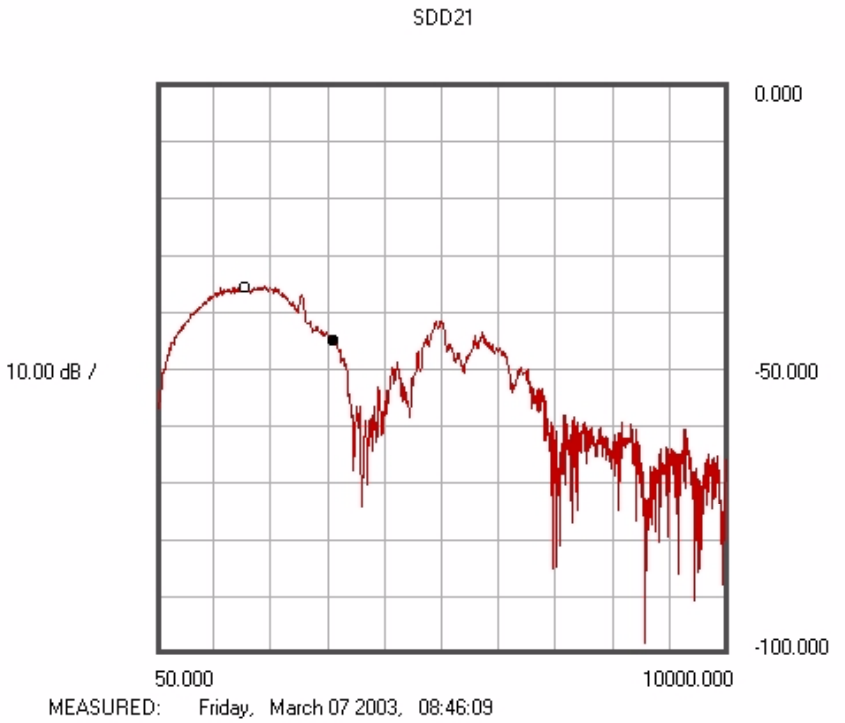


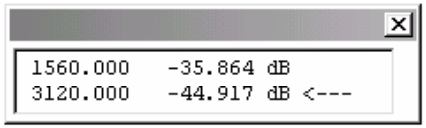


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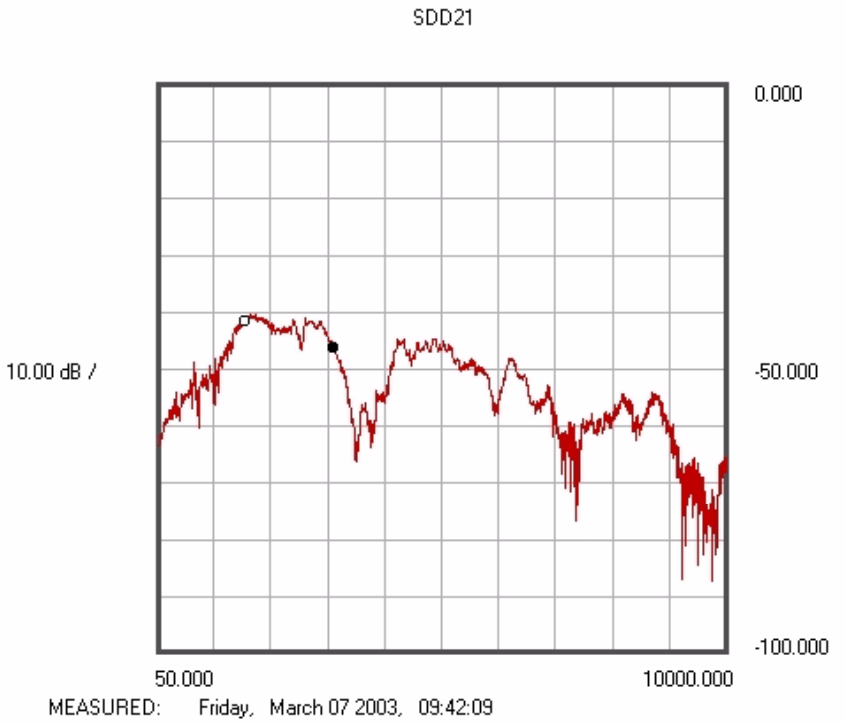


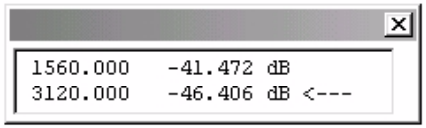


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- Temperature: 77.89 F
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- Cable End: P1 for Victim Line
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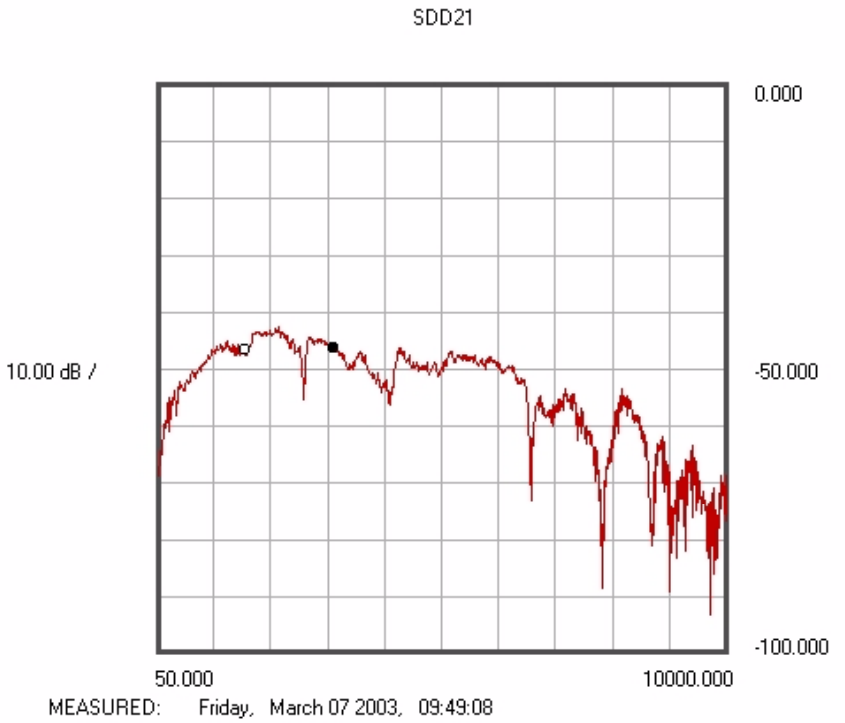
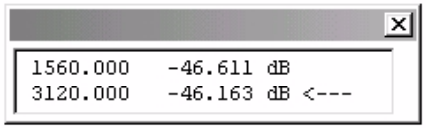
- Aggressor Line: S 13, S 14



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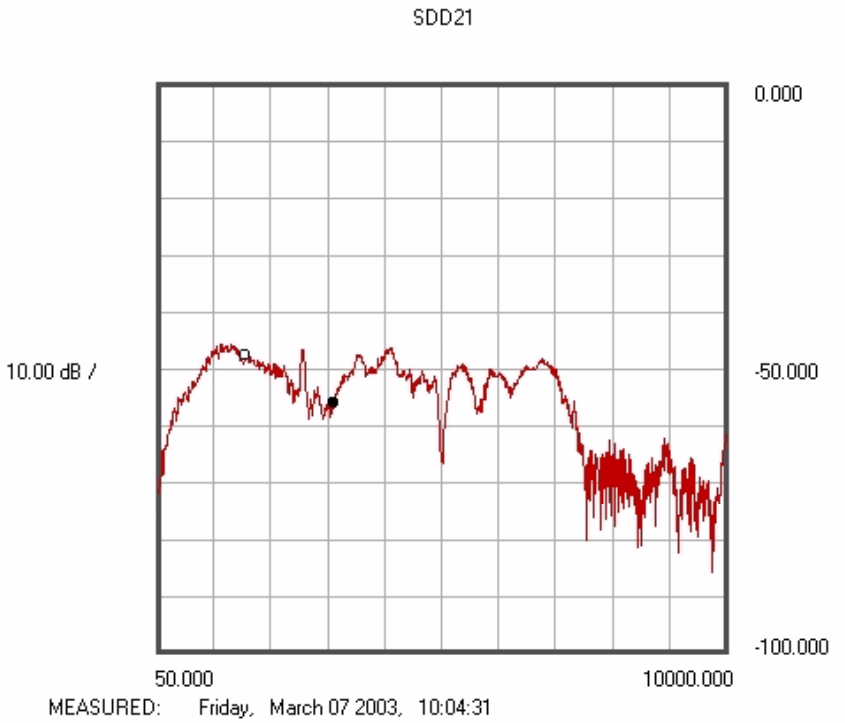
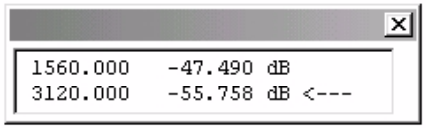
- Cable End: P1 for Victim Line
- Victim Line: S 9, S 10
- Aggressor Line: S 15, S 16

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# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

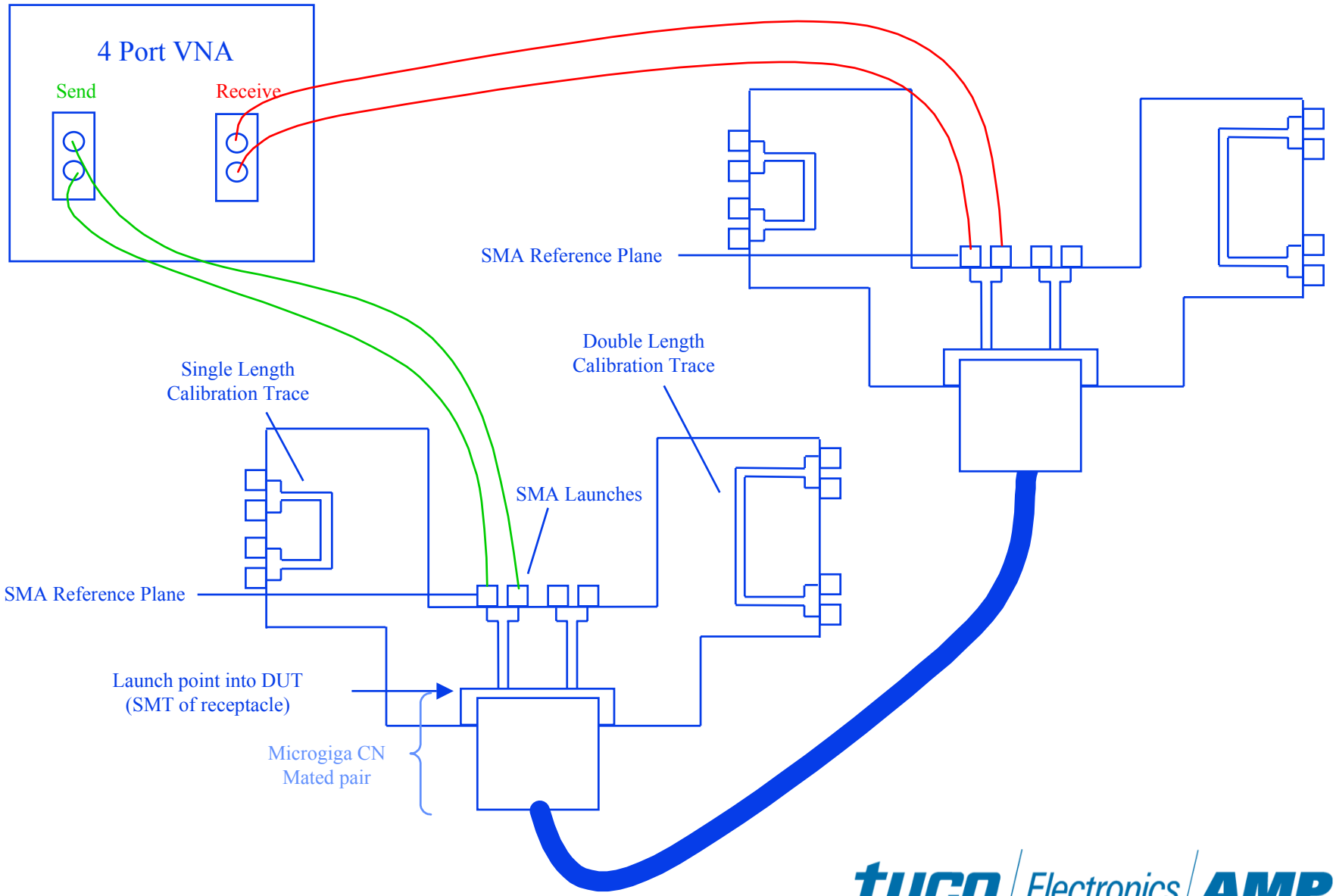
- Test system Reference Plane is the SMA interface of the launch connectors on the test fixture.
- Network Analyzer HP8720ES & ATN 4112A, 3.5mm calibration kit 85052C.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- S-Parameter measurements are made in accordance with SFF-8410.
- This report shows the S-Parameter measurements of the FCI MicroGiga CN fixture calibration structures ( SK-48295 Rev 2).

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- Note that all S-Parameter data will be made available as full complex export files for those who wish.
- Please contact Thinh Nguyen (717-985-2027) tpnguyen@tycoelectronics.com, or Dean Vermeersch (717-986-3143) dean@tycoelectronics.com and advise what export format is desired.

# Frequency Domain Insertion Loss Test Set-Up

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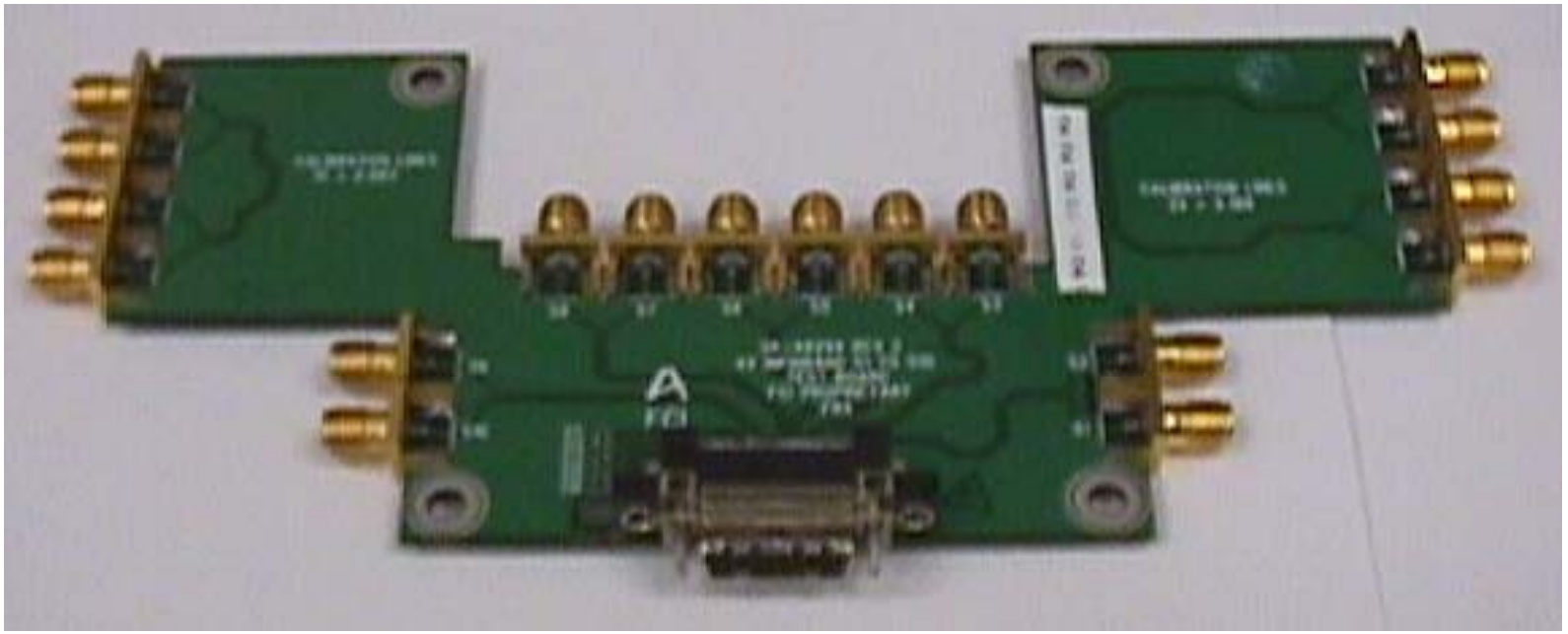
# Test Fixture



# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- The purpose of supplying data of the calibration structures is for those who wish to manually subtract out the fixture contribution from the total Insertion Loss.
- Cable assembly measurements made at this reference plane includes the test fixture as part of the device under test.

# The FCI test fixture has two sets of calibration traces:

Single Length Calibration Trace:

- One set of calibration traces consists of a trace length the same as in the test fixture, with SMA side launch connectors on both ends of the trace. S-Parameter measurements through this calibration structure will be referred to as “single length calibration trace.”

# The FCI test fixture has two sets of calibration traces: (continued)

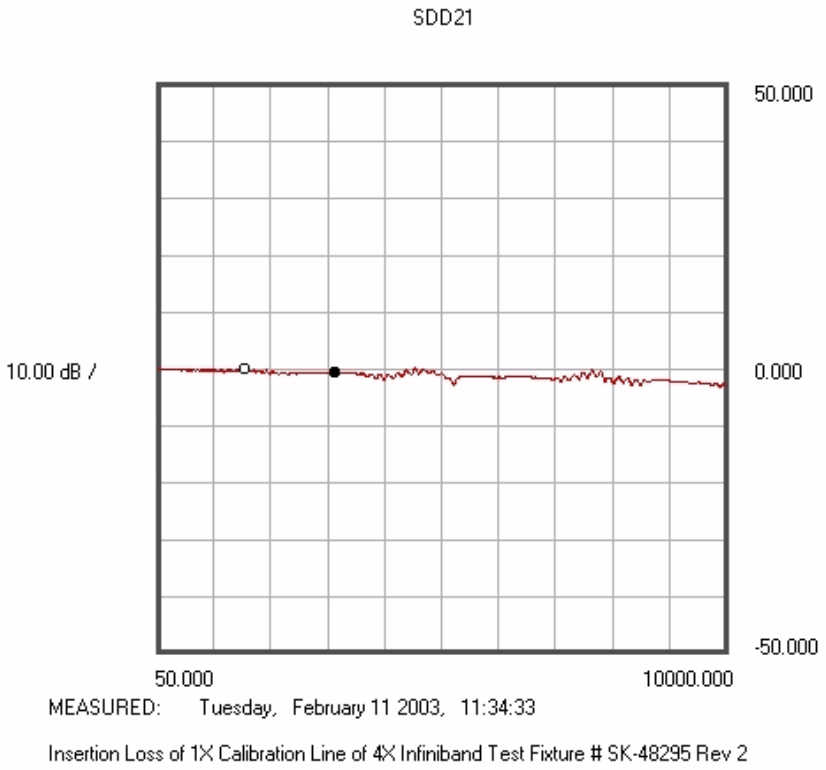
Double Length Calibration Trace:

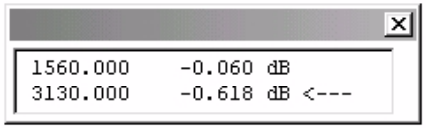
- The other set of calibration traces consists of a trace length that is twice the length of the traces in the test fixture, with SMA side launch connectors on both ends of the double length trace. S-Parameter measurements through this calibration structure will be referred to as “double length calibration trace.”
- This is the calibration structure that needs to be subtracted from the measurements.

# Typical S-parameters (SDD21) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Single length calibration trace of FCI Test Board

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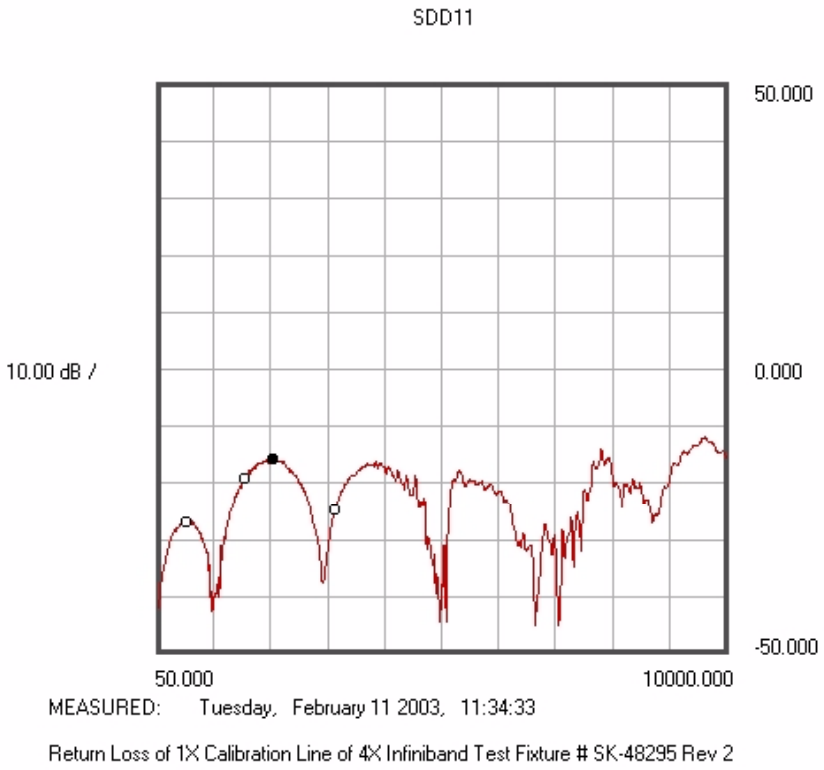
# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Single length calibration trace of FCI Test Board

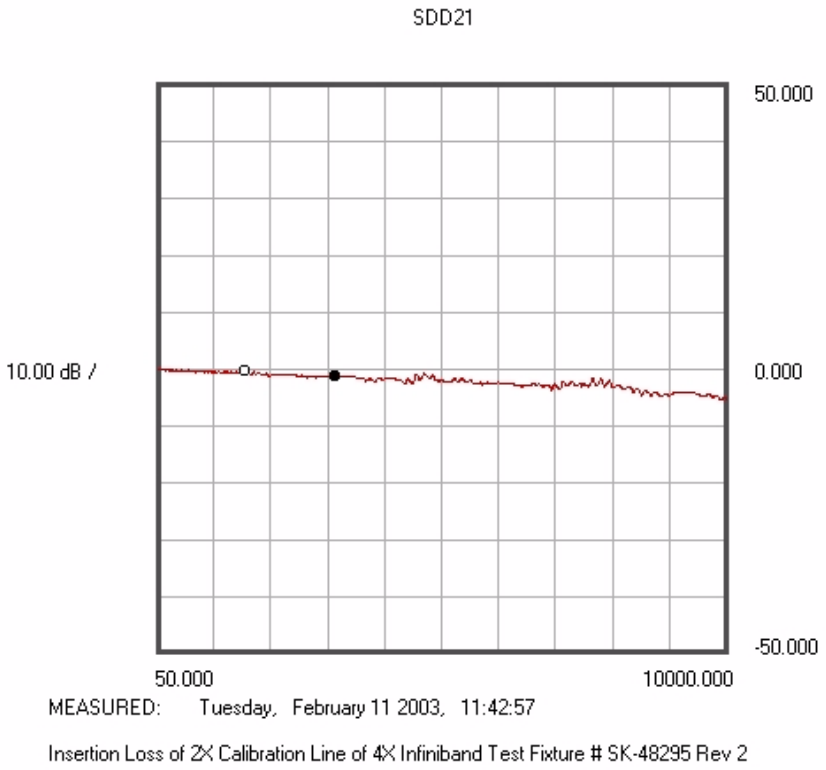


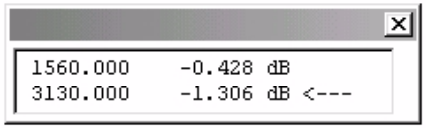

| | | |
|---|---|---|
| 540.000 | -27.090 dB | |
| 1560.000 | -19.197 dB | |
| 2060.000 | -15.896 dB | <--- |
| 3130.000 | -24.691 dB | |

# Typical S-parameters (SDD21) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Double length calibration trace of FCI Test Board

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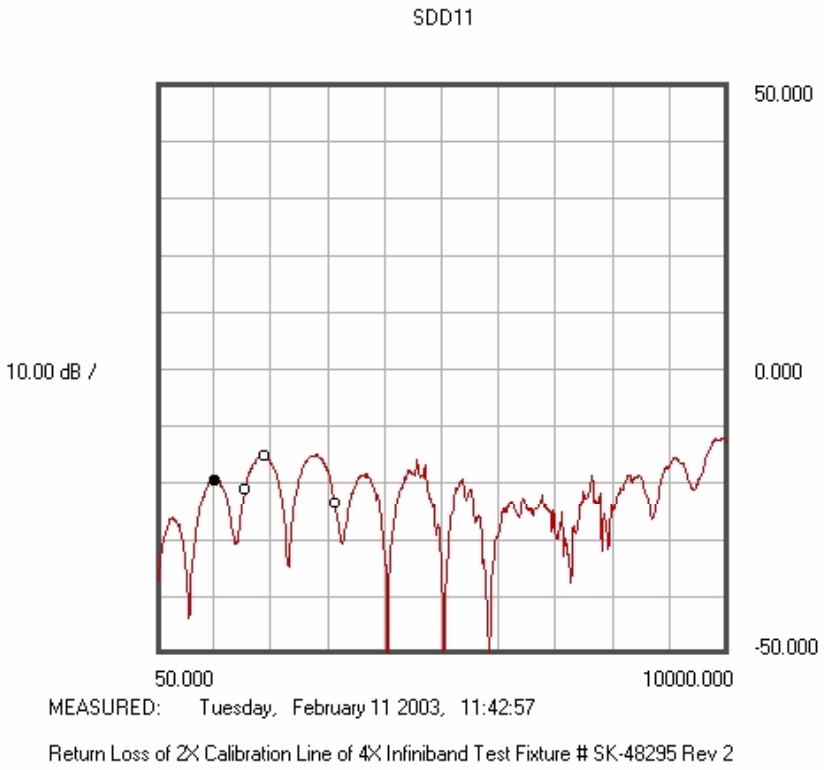
# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Double length calibration trace of FCI Test Board




| | | |
|---|---|---|
| 1040.000 | -19.671 dB | <--- |
| 1560.000 | -21.255 dB | |
| 1910.000 | -15.254 dB | |
| 3130.000 | -23.675 dB | |

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# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

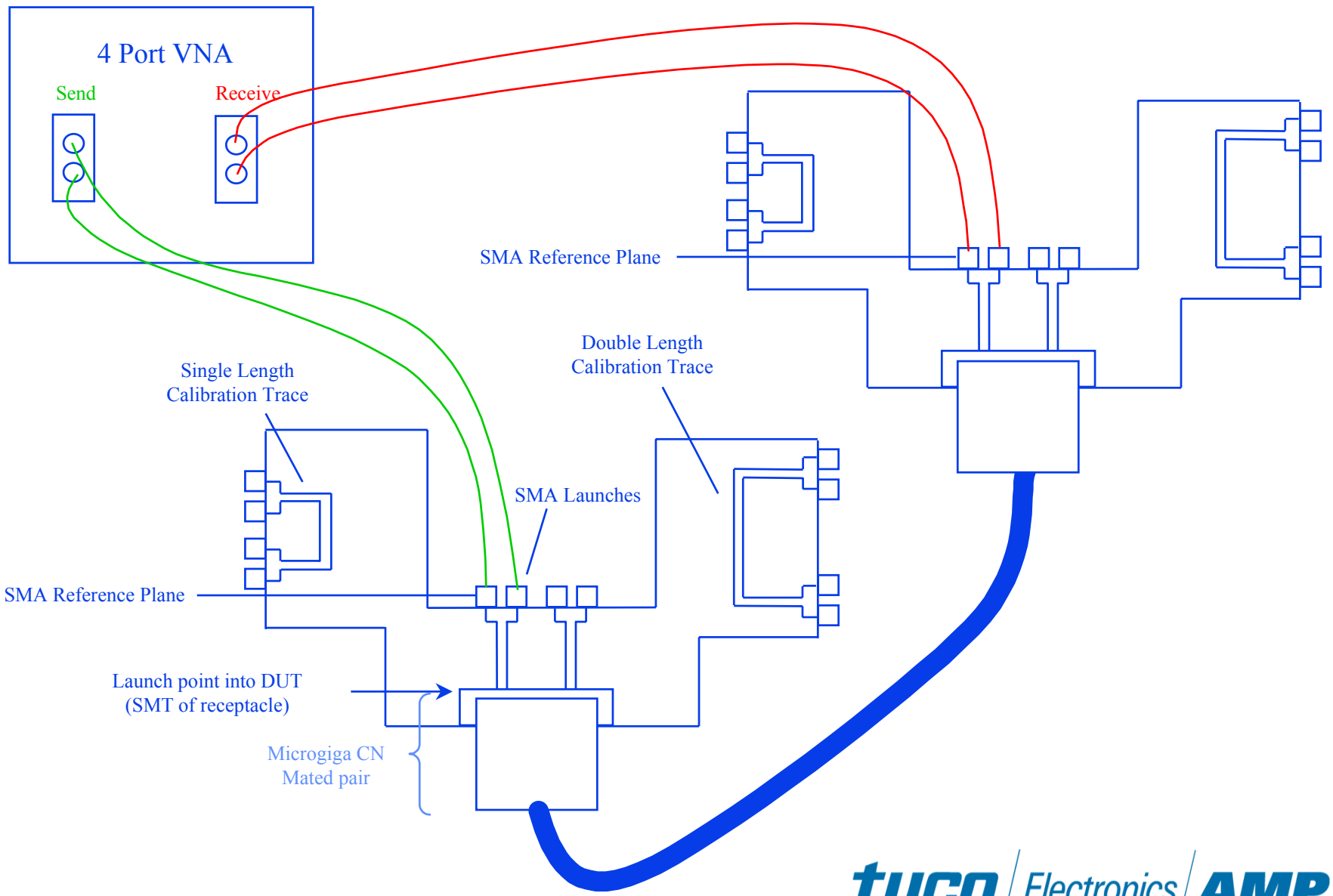
- Test system Reference Plane is the SMA interface of the launch connectors on the test fixture.
- Network Analyzer HP8720ES & ATN 4112A, 3.5mm calibration kit 85052C.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- S-Parameter measurements are made in accordance with SFF-8410.
- This report shows the S-Parameter measurements of the FCI MicroGiga CN fixture mated to a 0.5 meter length, 28 AWG, 100 ohm differential, cable assembly with FCI MicroGiga CN connectors.

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- Note that all S-Parameter data will be made available as full complex export files for those who wish.
- Please contact Thinh Nguyen (717-985-2027) tpnguyen@tycoelectronics.com, or Dean Vermeersch (717-986-3143) dean@tycoelectronics.com and advise what export format is desired.

# Frequency Domain Insertion Loss Test Set-Up

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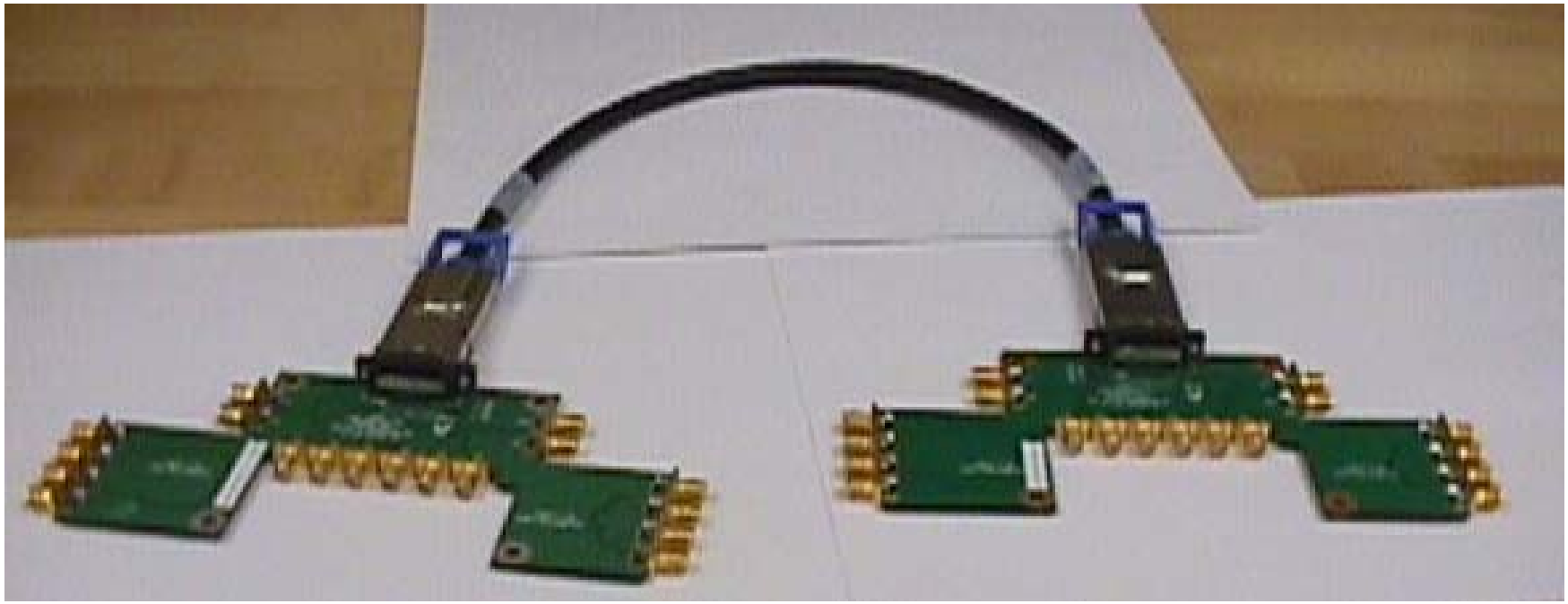
# Test Fixtures with Cable Assembly as DUT



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# S-Parameter Measurements

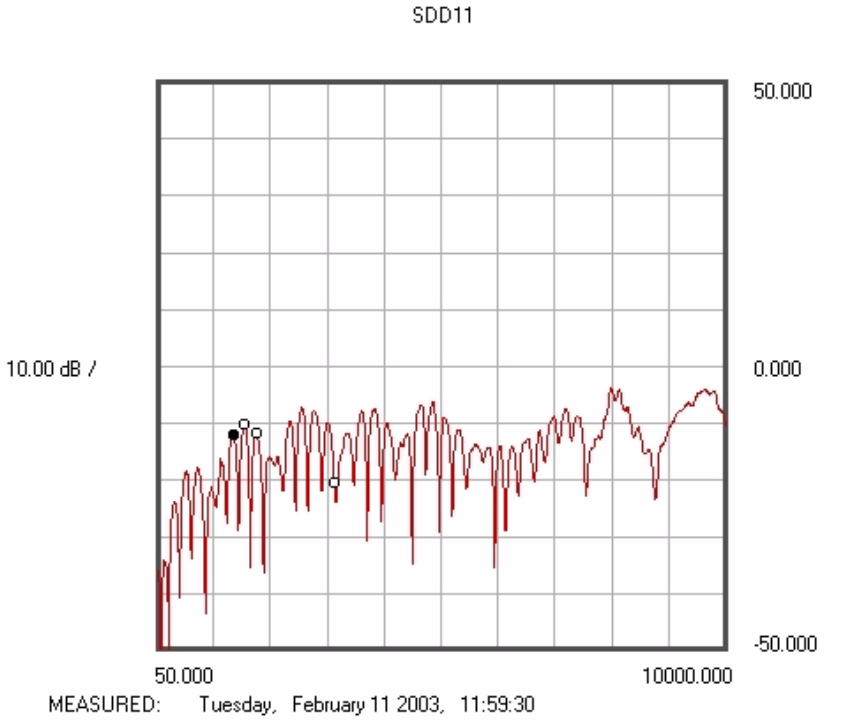
Thinh Nguyen
Dean Vermeersch

- Cable assembly measurements made at this reference plane includes the test fixture as part of the device under test.
- The long lengths, 5 meter 28 AWG and 10 meter 24 AWG, will measure S21 of every pair, but measure S11 of just pair S9S10.
- The short length, 0.5 meter 28 AWG, will measure S21 of just pair S9S10, but measure S11 of every pair.

# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 1, S 2**
- **Receive pair: Test port S 15, S 16**

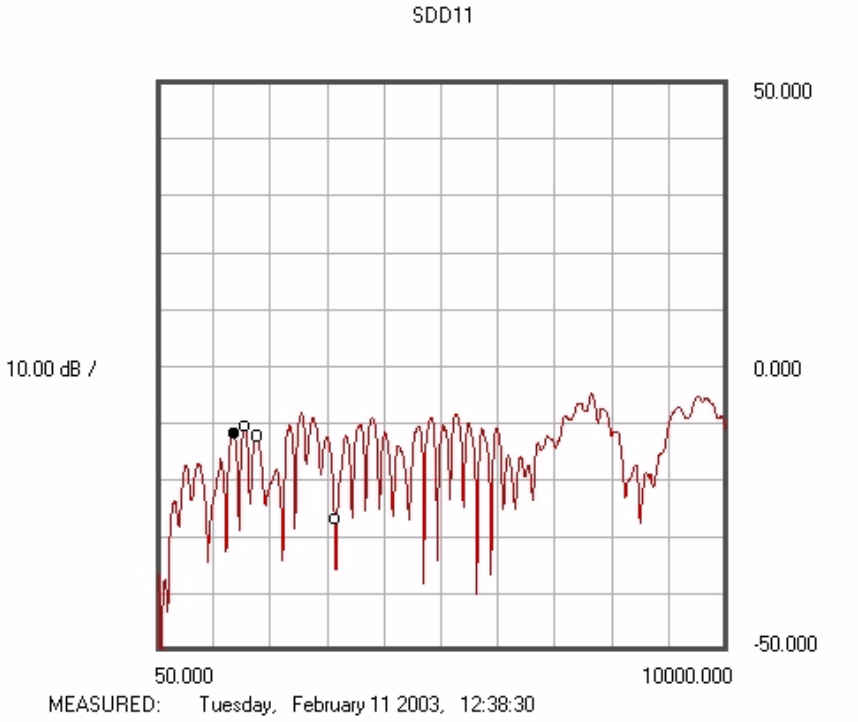



| | | |
|---|---|---|
| 1370.000 | -12.239 dB | <--- |
| 1560.000 | -10.122 dB | |
| 1780.000 | -11.808 dB | |
| 3130.000 | -20.444 dB | |

# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 3, S 4**
- **Receive pair: Test port S 13, S 14**




| | | |
|---|---|---|
| 1370.000 | -11.662 dB | <--- |
| 1560.000 | -10.598 dB | |
| 1780.000 | -12.263 dB | |
| 3130.000 | -26.988 dB | |

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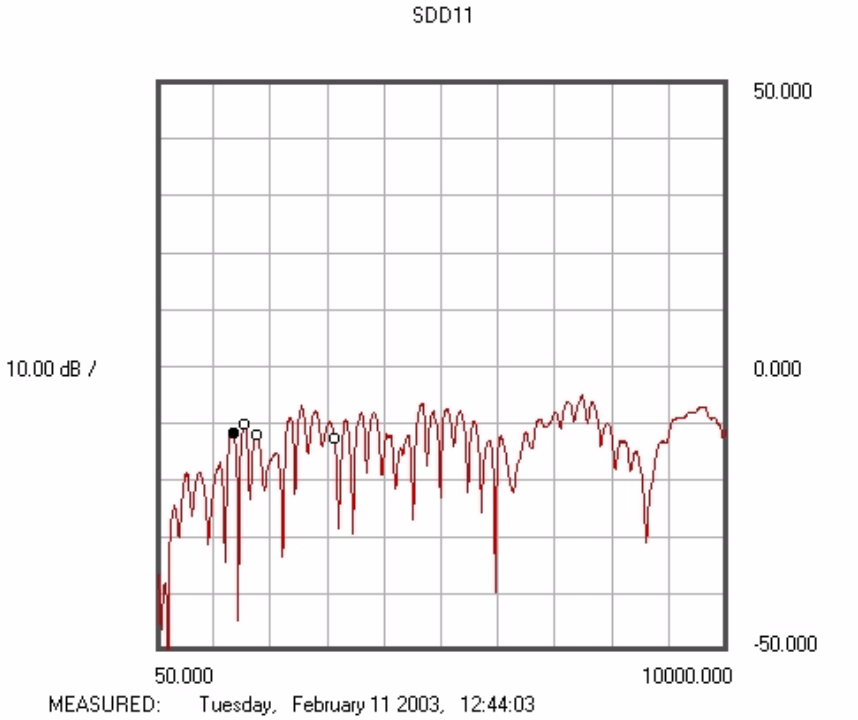
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 5, S 6**
- **Receive pair: Test port S 11, S 12**




| | | |
|---|---|---|
| 1370.000 | -11.690 dB | <--- |
| 1560.000 | -10.102 dB | |
| 1780.000 | -11.973 dB | |
| 3130.000 | -12.793 dB | |

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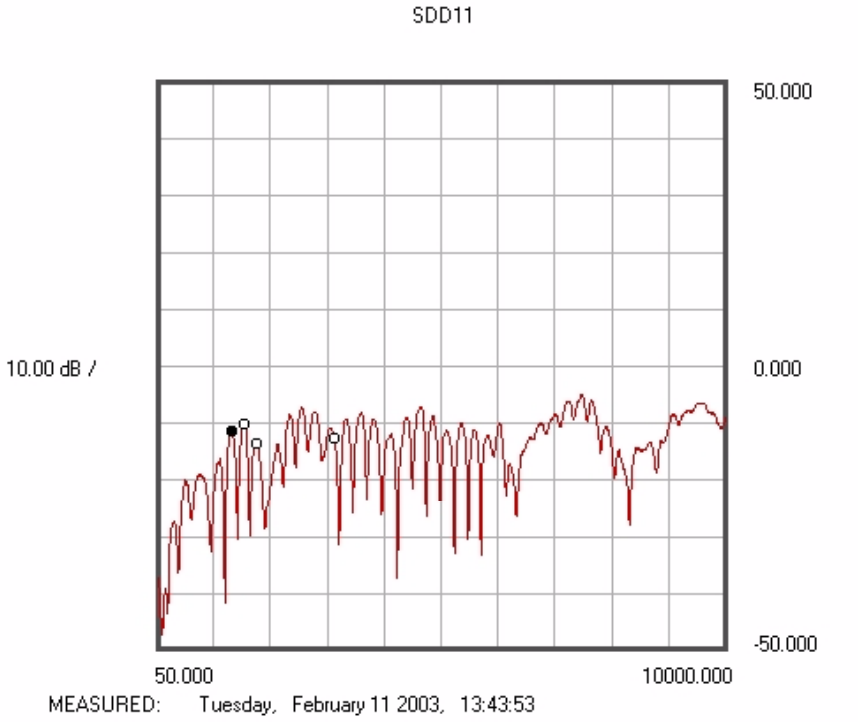
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**




| | | |
|---|---|---|
| 1350.000 | -11.583 dB | <--- |
| 1560.000 | -10.228 dB | |
| 1780.000 | -13.567 dB | |
| 3130.000 | -12.787 dB | |

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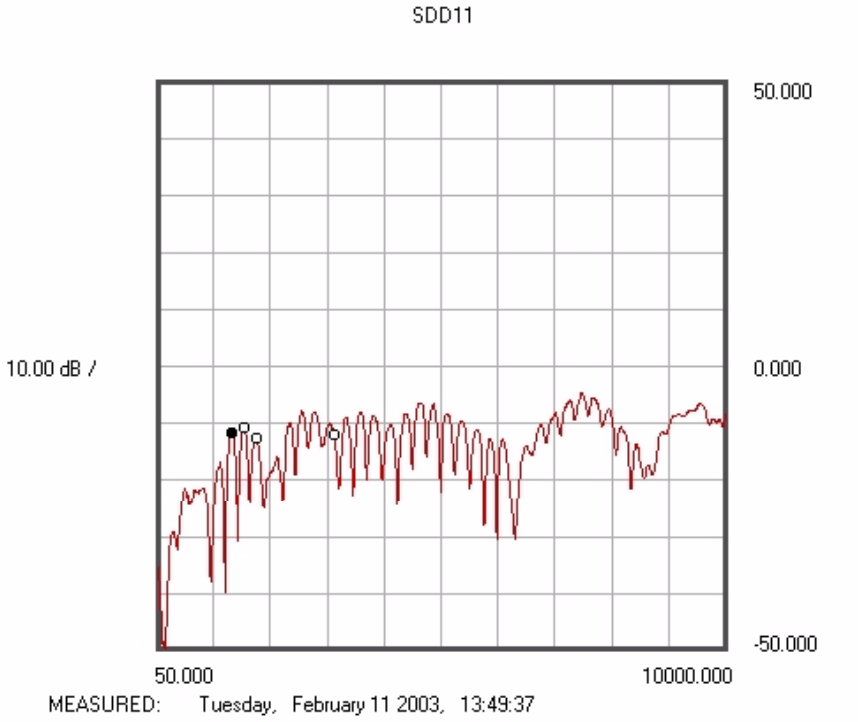
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 9, S 10**
- **Receive pair: Test port S 7, S 8**




| | |
|---|---|
| 1350.000 | -11.845 dB <--- |
| 1560.000 | -10.879 dB |
| 1780.000 | -12.764 dB |
| 3130.000 | -12.234 dB |

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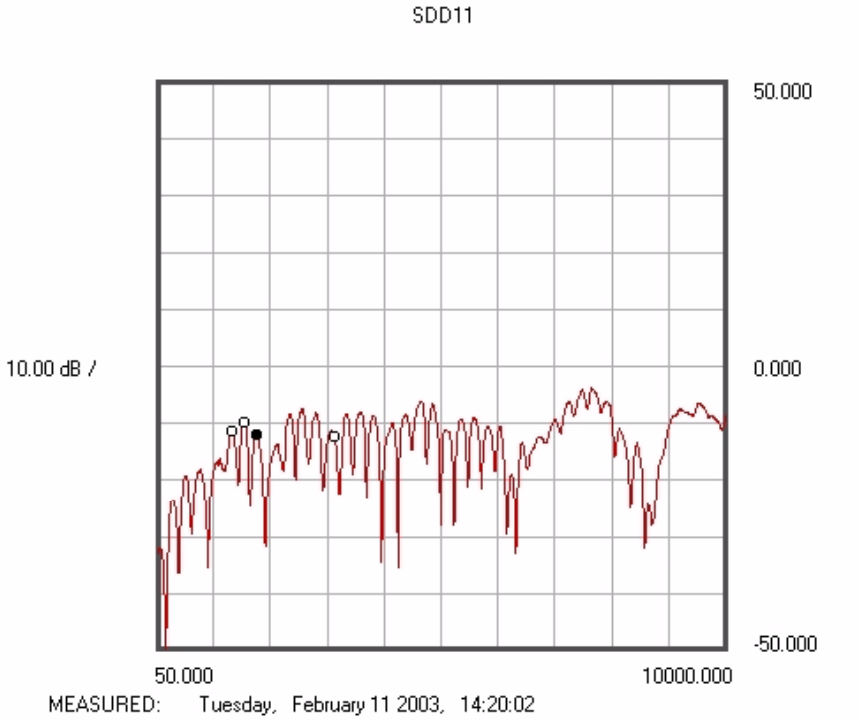
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 11, S 12**
- **Receive pair: Test port S 5, S 6**




| | | |
|---|---|---|
| 1350.000 | -11.544 dB | |
| 1560.000 | -9.799 dB | |
| 1780.000 | -12.016 dB | <--- |
| 3130.000 | -12.296 dB | |

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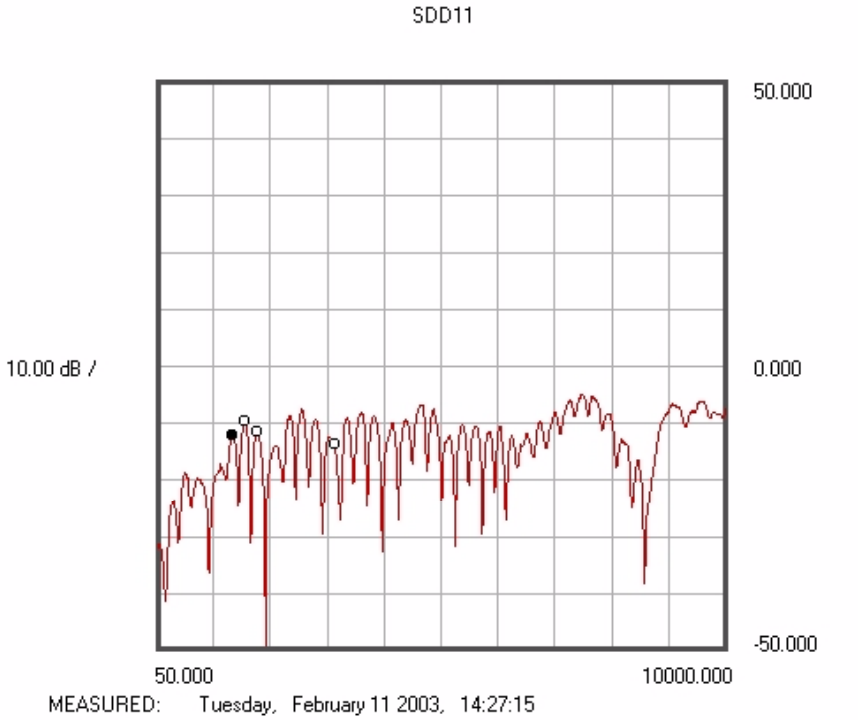
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 13, S 14**
- **Receive pair: Test port S 3, S 4**




| | | |
|---|---|---|
| 1350.000 | -11.963 dB | <--- |
| 1560.000 | -9.609 dB | |
| 1780.000 | -11.523 dB | |
| 3130.000 | -13.612 dB | |

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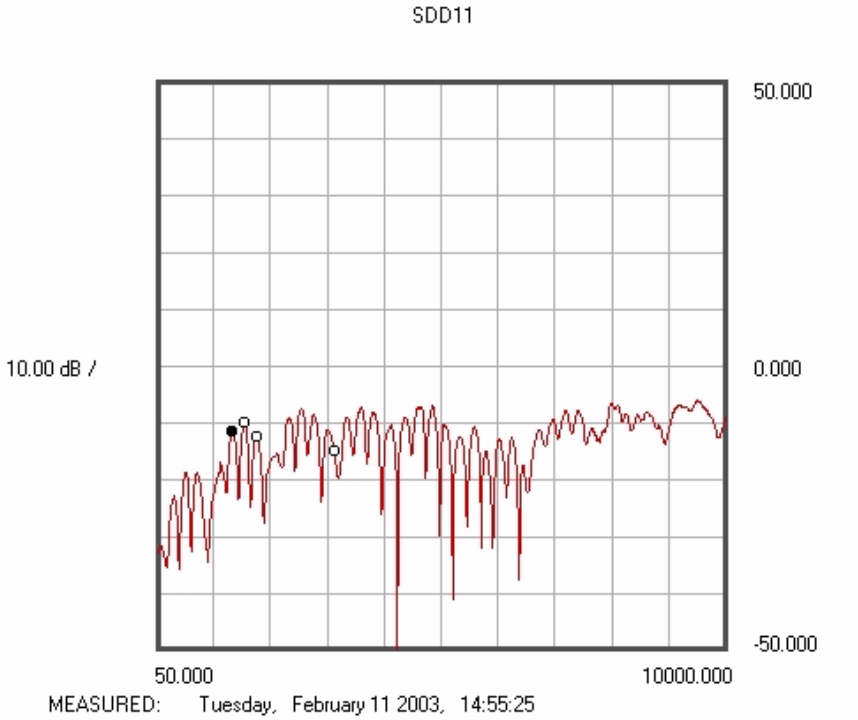
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 15, S 16**
- **Receive pair: Test port S 1, S 2**




| | | |
|---|---|---|
| 1350.000 | -11.478 dB | <--- |
| 1560.000 | -9.945 dB | |
| 1780.000 | -12.417 dB | |
| 3130.000 | -15.047 dB | |

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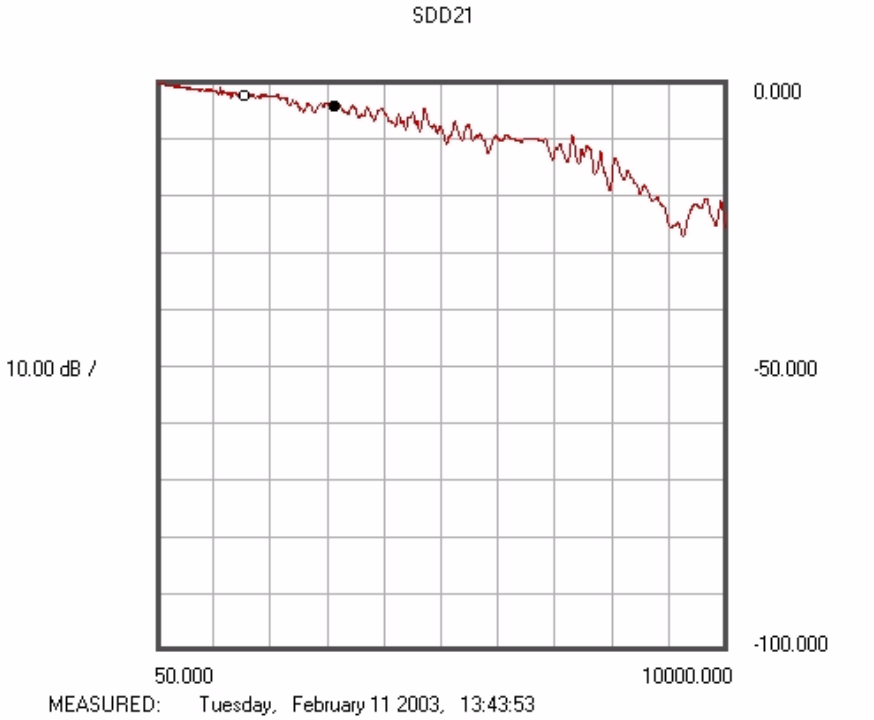
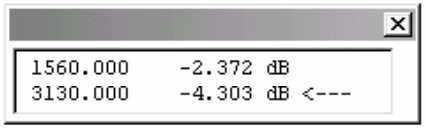
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**

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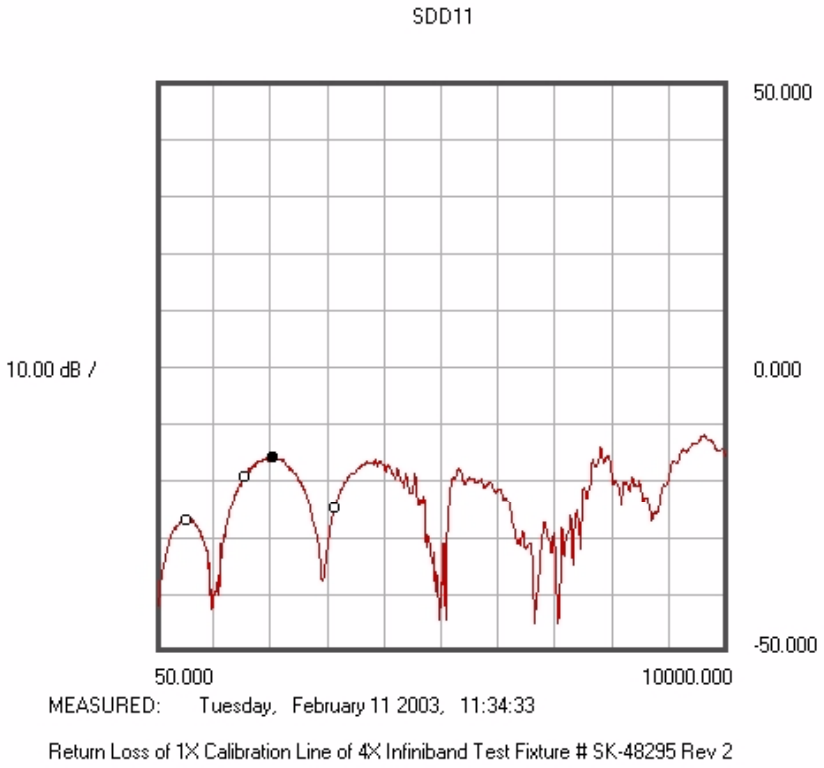
# Comment On Accuracy of Fixture Calibration Structures

- The following two slides are Return Loss measurements of the calibration structures of the fixture.
- Comparing these measurements to those where the test fixture and cable assembly are the devise under test shows that the return loss of the calibration fixture exhibits phase errors relative to the actual test fixture traces. Note that the fine return loss structure of the cable assembly length is superimposed on the coarse return loss structure due to the fixture contribution, and that the coarse structure due to the fixture does not match the coarse structure when measuring just the calibration portions of the fixture.
- This means great care must be taken if an attempt is made to manually subtract fixture contribution from the cable assembly measurements.
- This means that complex mathematic subtraction of fixture contribution from the cable assembly measurement is NOT accurate because of an error in the phase.
- Similar errors occur with Insertion Loss measurements, but the effect is not as easily seen as it is for Return Loss measurements.

# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Single length calibration trace of FCI Test Board

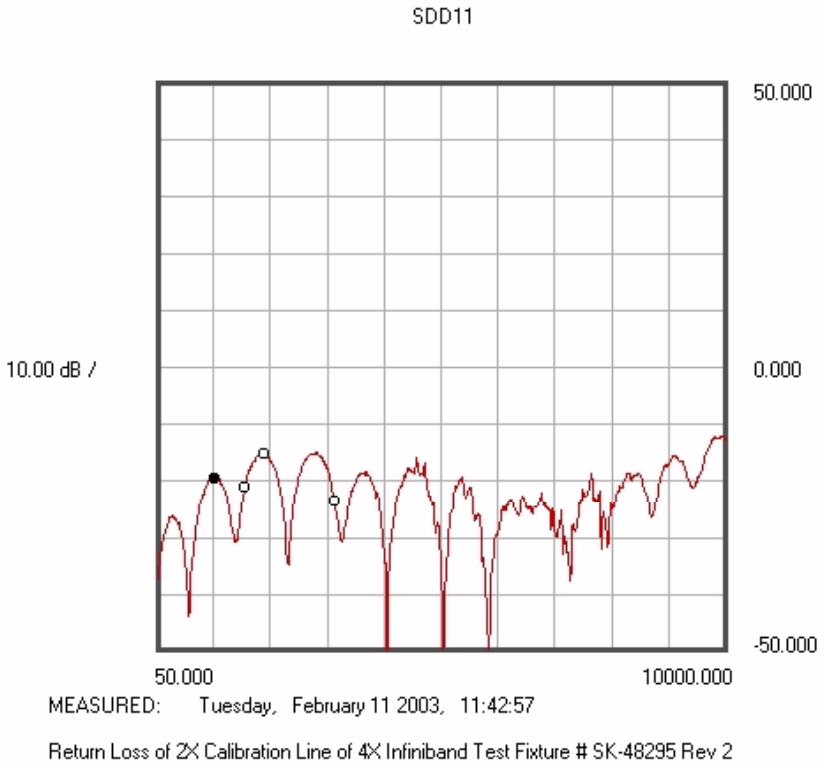



| | | |
|---|---|---|
| 540.000 | -27.090 dB | |
| 1560.000 | -19.197 dB | |
| 2060.000 | -15.896 dB | <--- |
| 3130.000 | -24.691 dB | |

# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Double length calibration trace of FCI Test Board




| | | |
|---|---|---|
| 1040.000 | -19.671 dB | <--- |
| 1560.000 | -21.255 dB | |
| 1910.000 | -15.254 dB | |
| 3130.000 | -23.675 dB | |

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

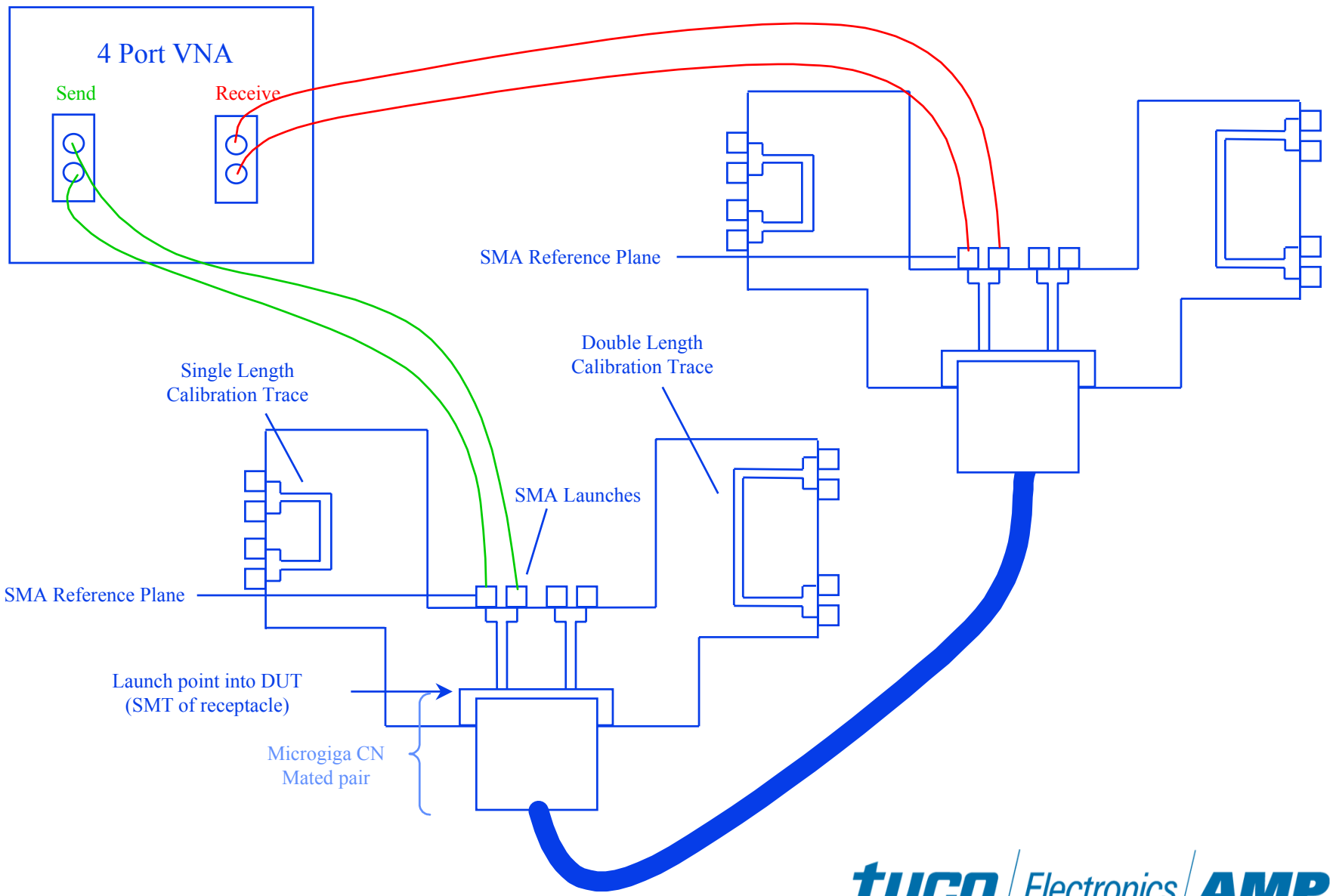
- Test system Reference Plane is the SMA interface of the launch connectors on the test fixture.
- Network Analyzer HP8720ES & ATN 4112A, 3.5mm calibration kit 85052C.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- S-Parameter measurements are made in accordance with SFF-8410.
- This report shows the S-Parameter measurements of the FCI MicroGiga CN fixture mated to a 5.0 meter length, 28 AWG, 100 ohm differential, cable assembly with FCI MicroGiga CN connectors.

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- Note that all S-Parameter data will be made available as full complex export files for those who wish.
- Please contact Thinh Nguyen (717-985-2027) tpnguyen@tycoelectronics.com, or Dean Vermeersch (717-986-3143) dean@tycoelectronics.com and advise what export format is desired.

# Frequency Domain Insertion Loss Test Set-Up

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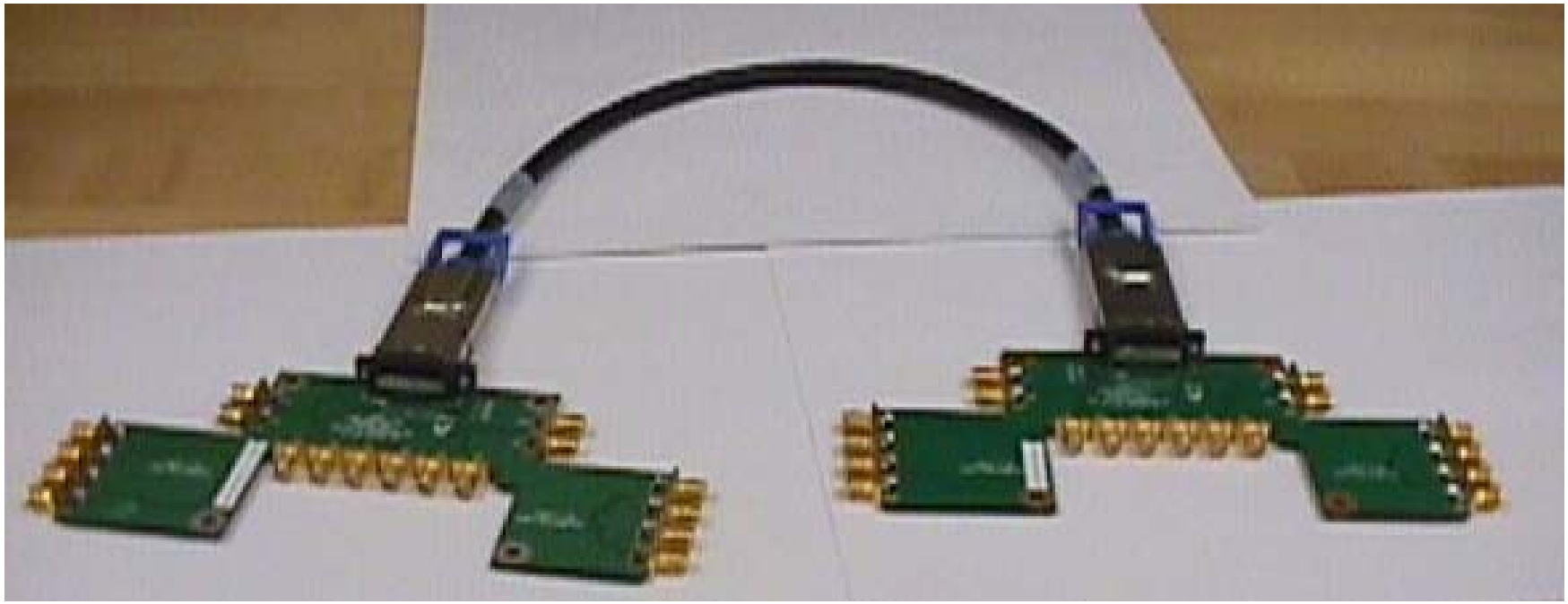
# Test Fixtures with Cable Assembly as DUT



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# S-Parameter Measurements

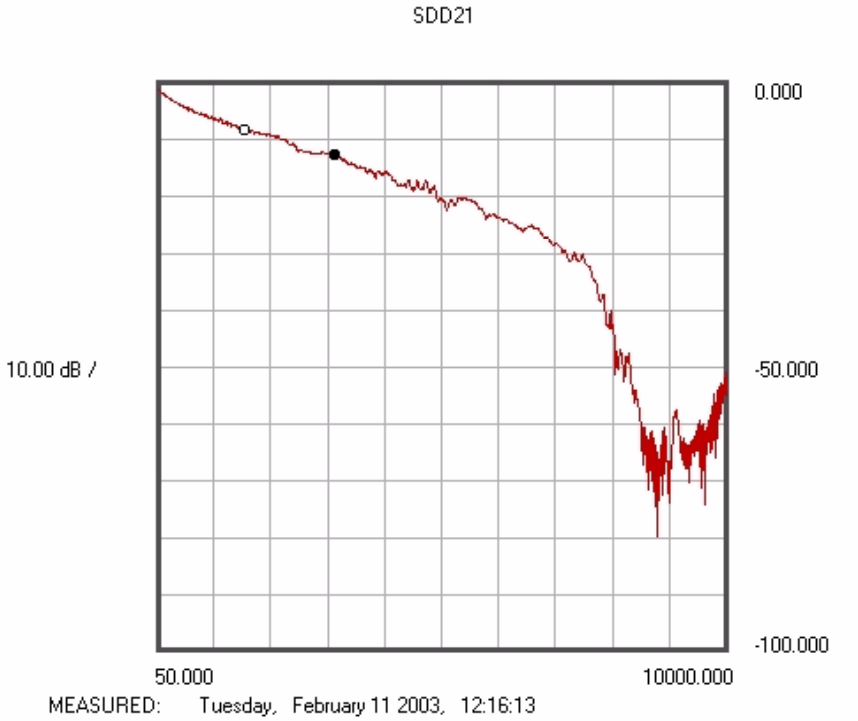
Thinh Nguyen
Dean Vermeersch

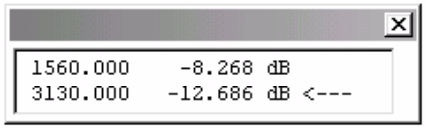
- Cable assembly measurements made at this reference plane includes the test fixture as part of the device under test.
- The long lengths, 5 meter 28 AWG and 10 meter 24 AWG, will measure S21 of every pair, but measure S11 of just pair S9S10.
- The short length, 0.5 meter 28 AWG, will measure S21 of just pair S9S10, but measure S11 of every pair.

# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 1, S 2**
- **Receive pair: Test port S 15, S 16**

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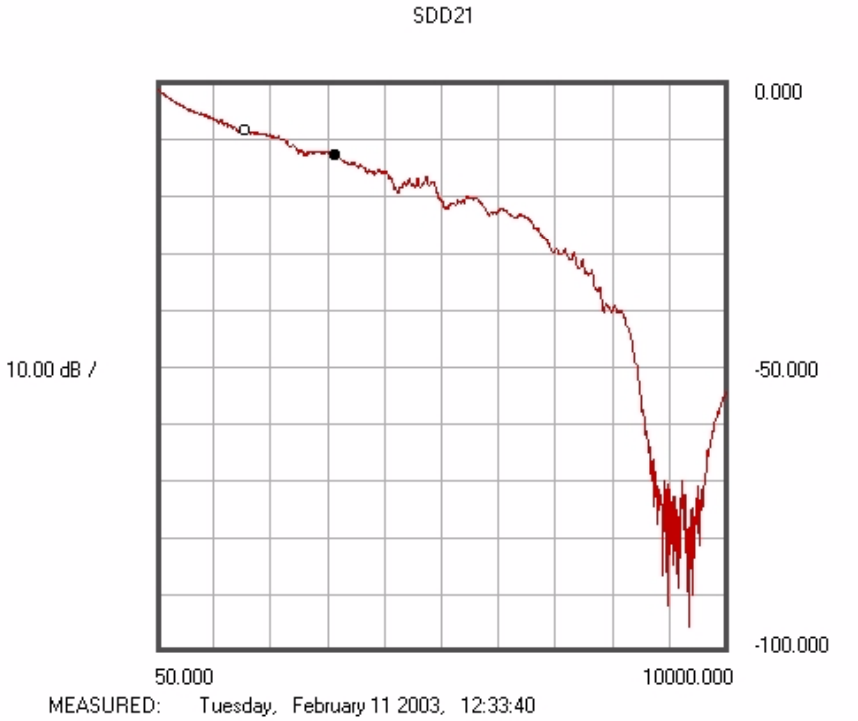
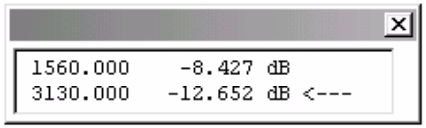
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 3, S 4**
- **Receive pair: Test port S 13, S 14**

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- Date: 2/11/03
- Temperature: 77.83 F
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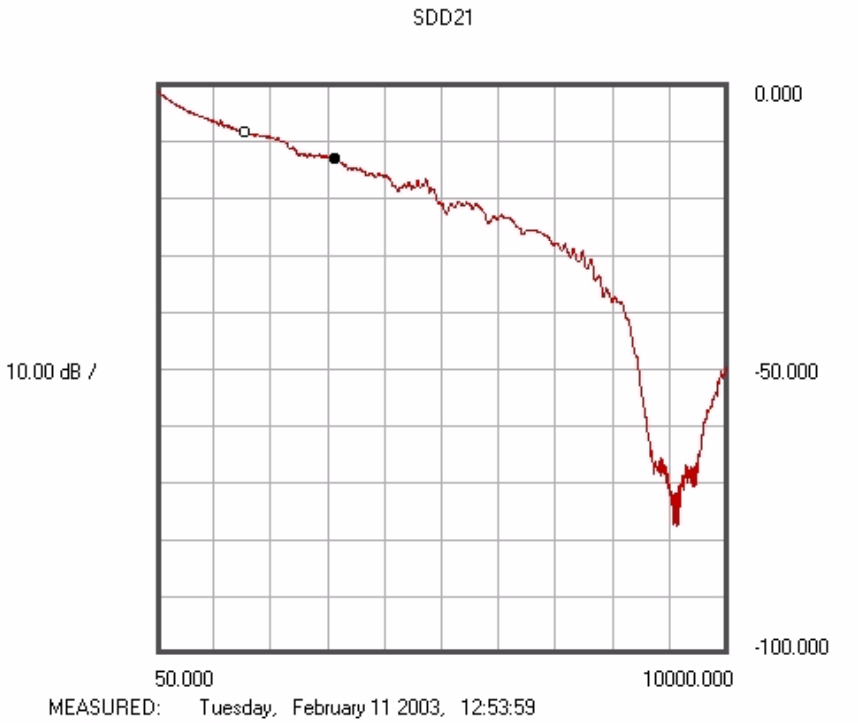
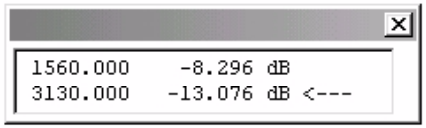
- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 5, S 6**
- **Receive pair: Test port S 11, S 12**

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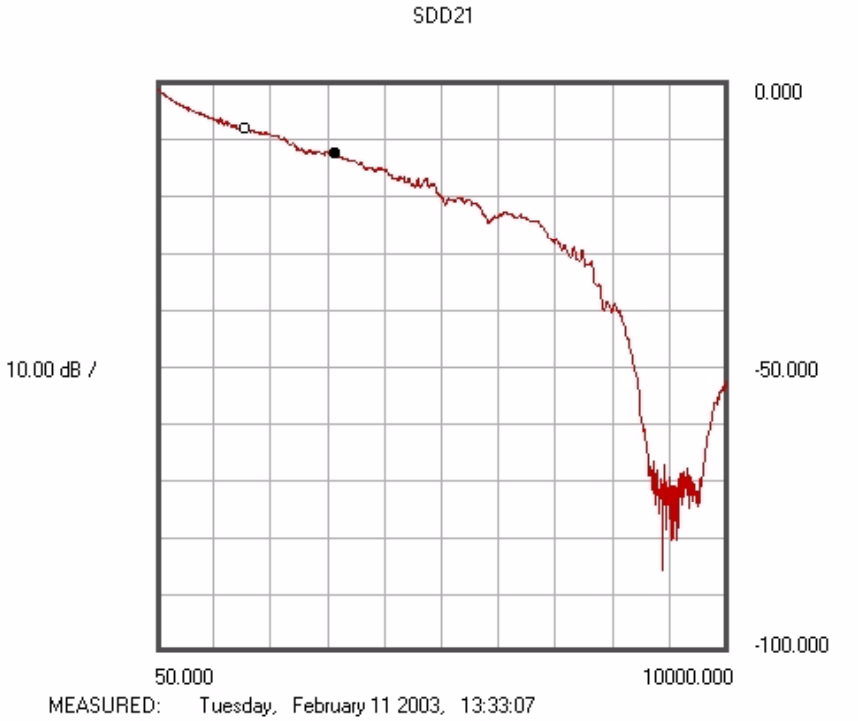
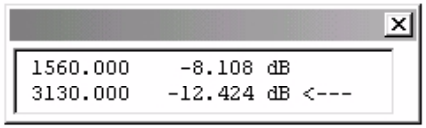
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**

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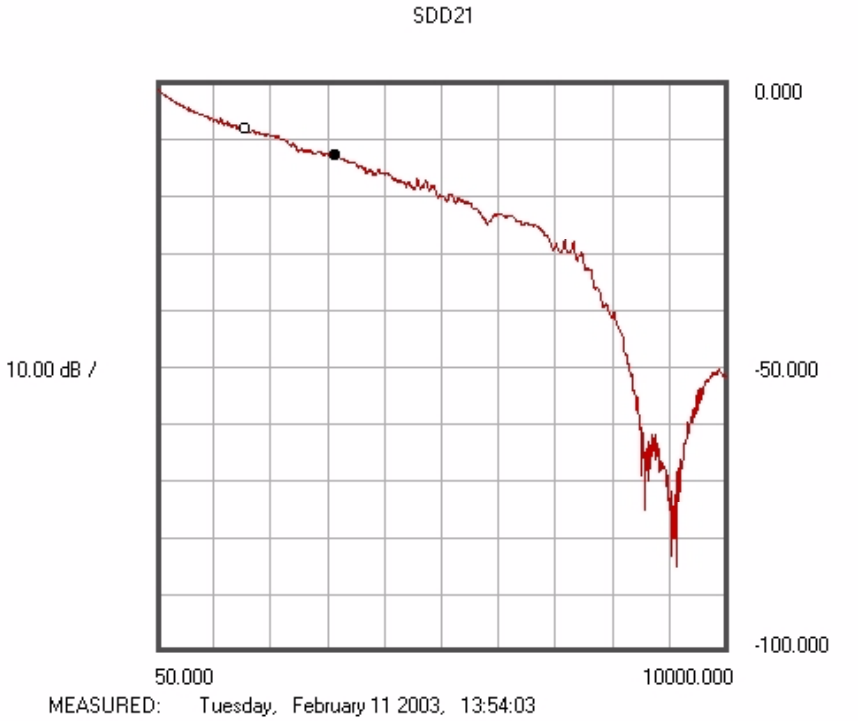
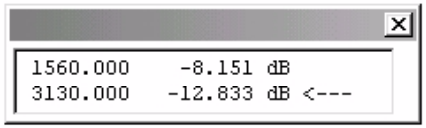
- **Receive pair: Test port S 7, S 8**



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- Date: 2/11/03
- Temperature: 77.83 F
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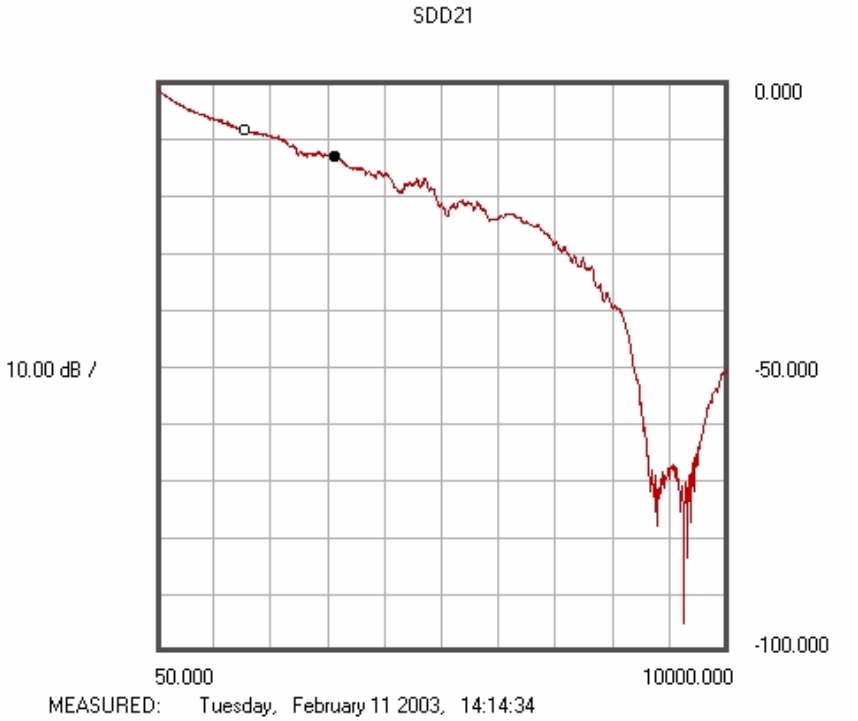
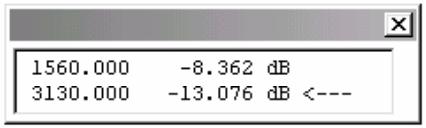
- **Transmit pair: Test port S 11, S 12**
- **Receive pair: Test port S 5, S 6**

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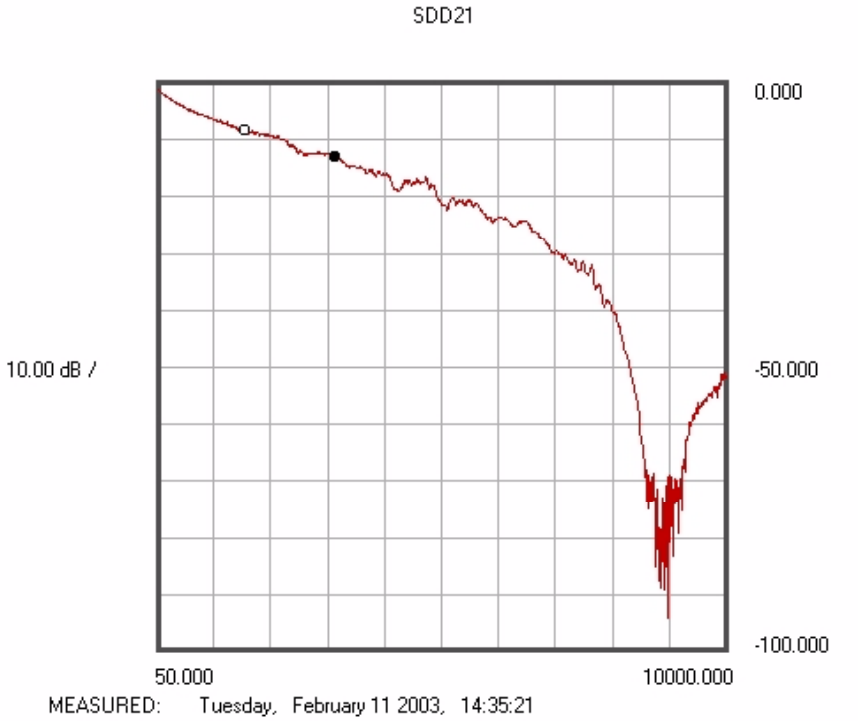
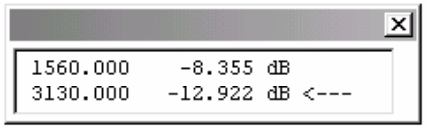
- **Transmit pair: Test port S 13, S 14**
- **Receive pair: Test port S 3, S 4**

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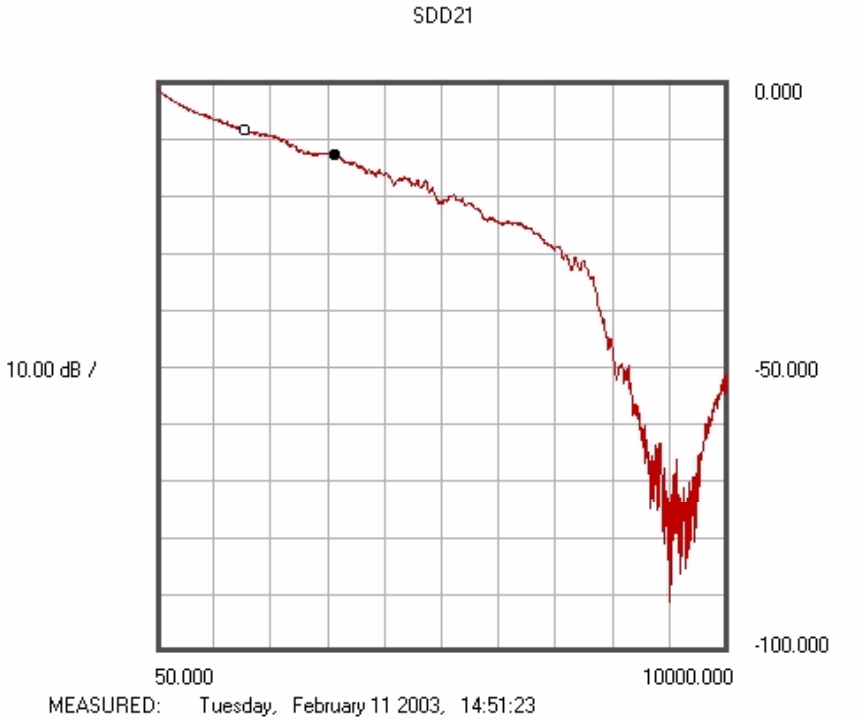
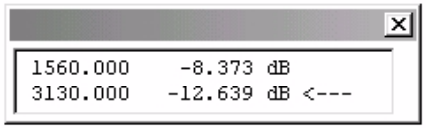
- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 15, S 16**
- **Receive pair: Test port S 1, S 2**

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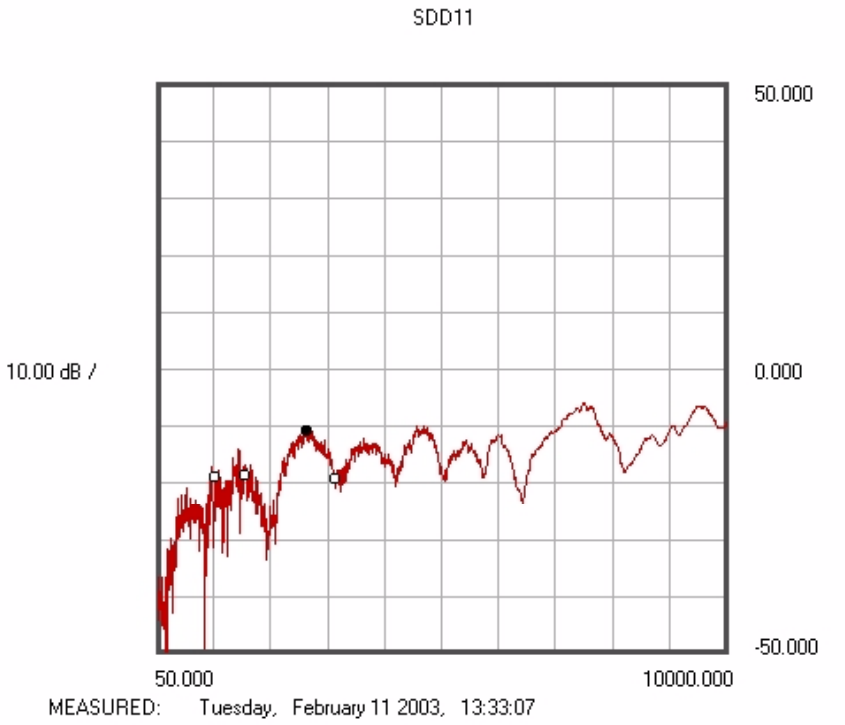
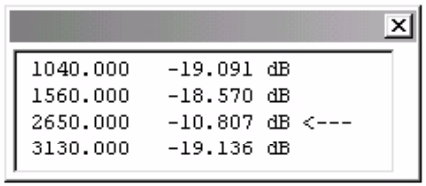
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**



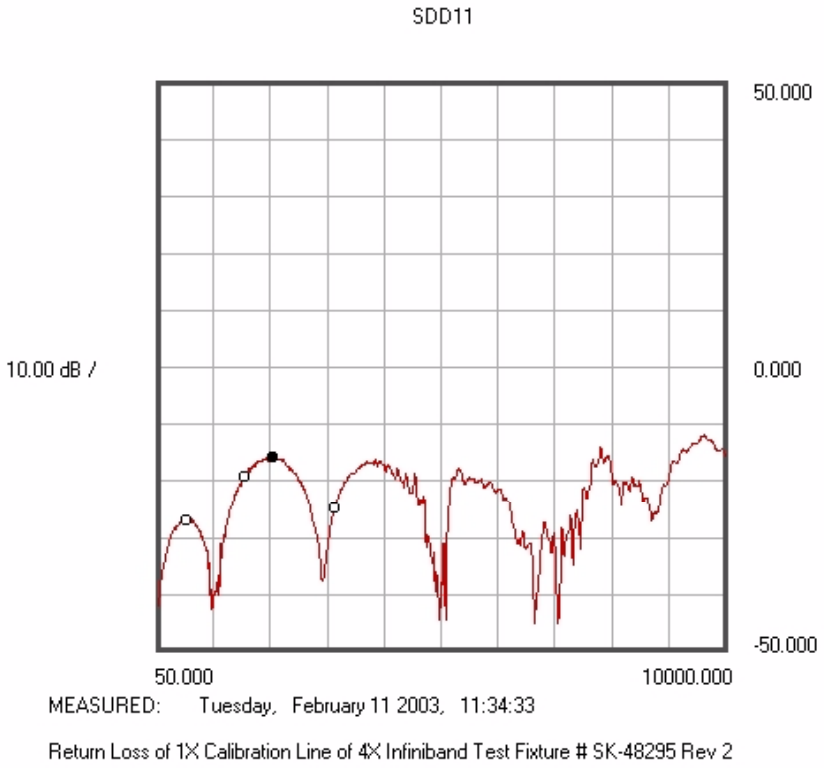
# Comment On Accuracy of Fixture Calibration Structures

- The following two slides are Return Loss measurements of the calibration structures of the fixture.
- Comparing these measurements to those where the test fixture and cable assembly are the devise under test shows that the return loss of the calibration fixture is not the same as the actual test fixture traces. Note that the fine return loss structure of the cable assembly length is superimposed on the coarse return loss structure due to the fixture contribution, and that the coarse structure due to the fixture does not match the coarse structure when measuring the calibration portions of the fixture.
- This means great care must be taken if an attempt is made to manually subtract fixture contribution from the cable assembly measurements.
- This means that complex mathematic subtraction of fixture contribution from the cable assembly measurement is NOT accurate because the calibration performance is not the same as the actual fixture.
- Similar errors occur with Insertion Loss measurements, but the effect is not as easily seen as it is for Return Loss measurements.

# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Single length calibration trace of FCI Test Board

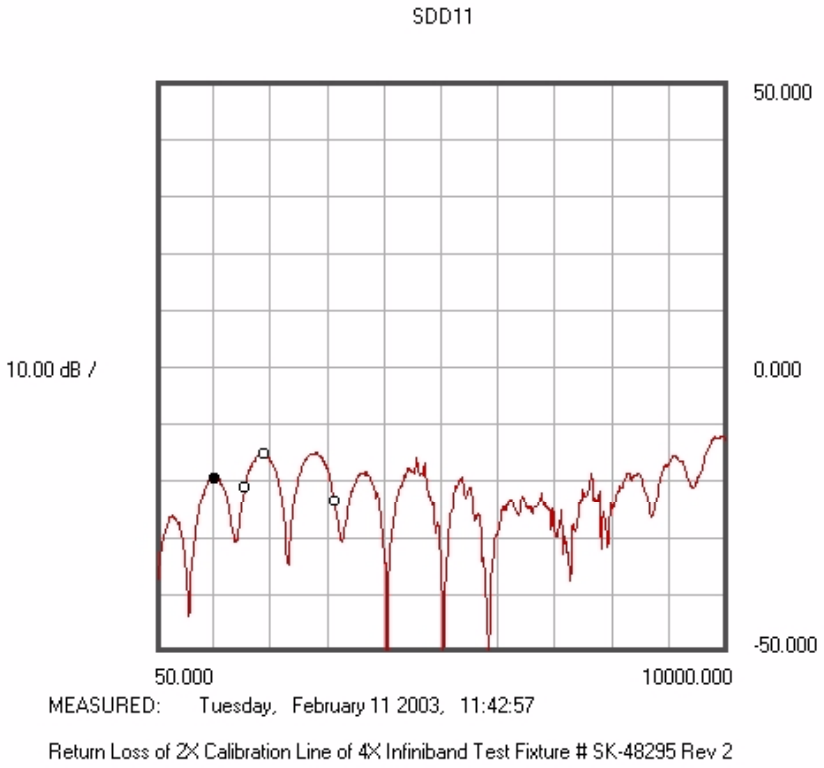



| | | |
|---|---|---|
| 540.000 | -27.090 dB | |
| 1560.000 | -19.197 dB | |
| 2060.000 | -15.896 dB | <--- |
| 3130.000 | -24.691 dB | |

# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Double length calibration trace of FCI Test Board




| | | |
|---|---|---|
| 1040.000 | -19.671 dB | <--- |
| 1560.000 | -21.255 dB | |
| 1910.000 | -15.254 dB | |
| 3130.000 | -23.675 dB | |

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

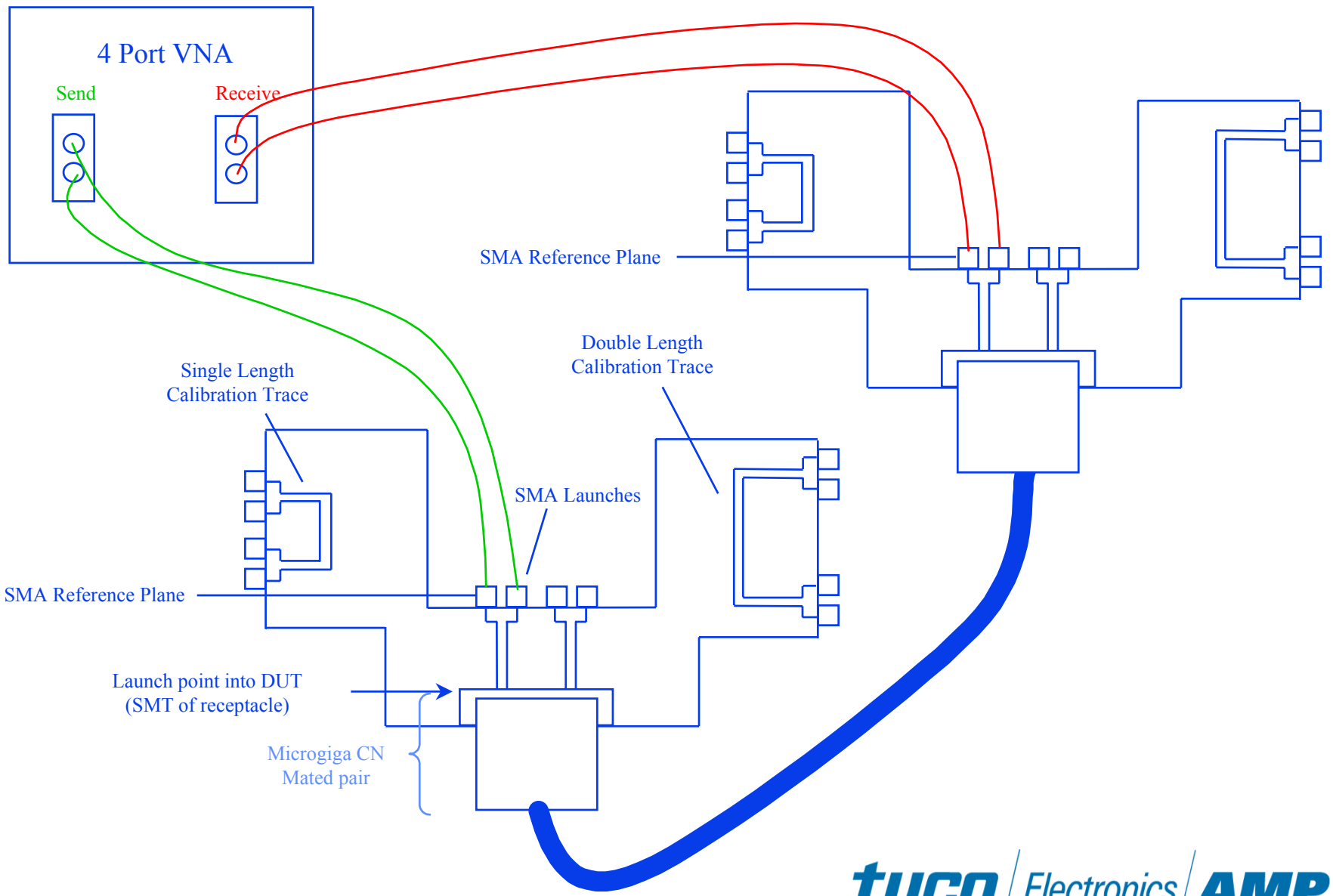
- Test system Reference Plane is the SMA interface of the launch connectors on the test fixture.
- Network Analyzer HP8720ES & ATN 4112A, 3.5mm calibration kit 85052C.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- S-Parameter measurements are made in accordance with SFF-8410.
- This report shows the S-Parameter measurements of the FCI MicroGiga CN fixture mated to a 10.0 meter length, 24 AWG, 100 ohm differential, cable assembly with FCI MicroGiga CN connectors.

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- Note that all S-Parameter data will be made available as full complex export files for those who wish.
- Please contact Thinh Nguyen (717-985-2027) tpnguyen@tycoelectronics.com, or Dean Vermeersch (717-986-3143) dean@tycoelectronics.com and advise what export format is desired.

# Frequency Domain Insertion Loss Test Set-Up

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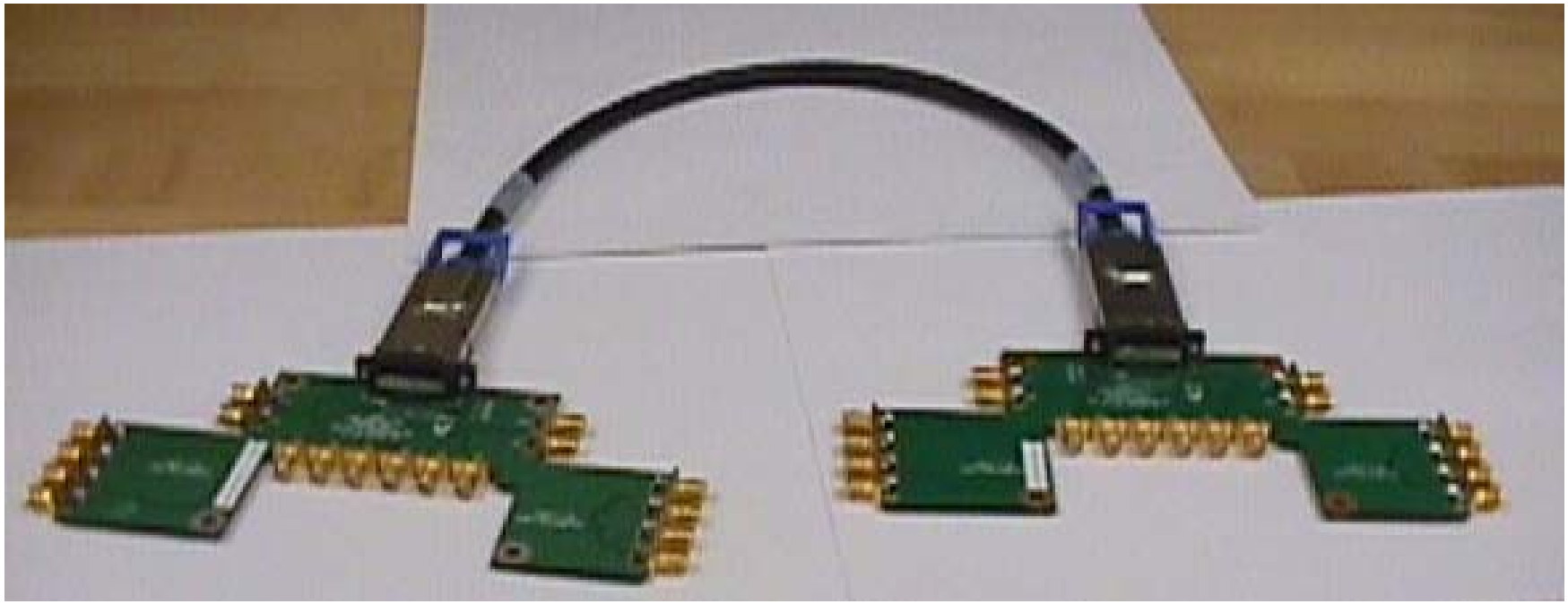
# Test Fixtures with Cable Assembly as DUT



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# S-Parameter Measurements

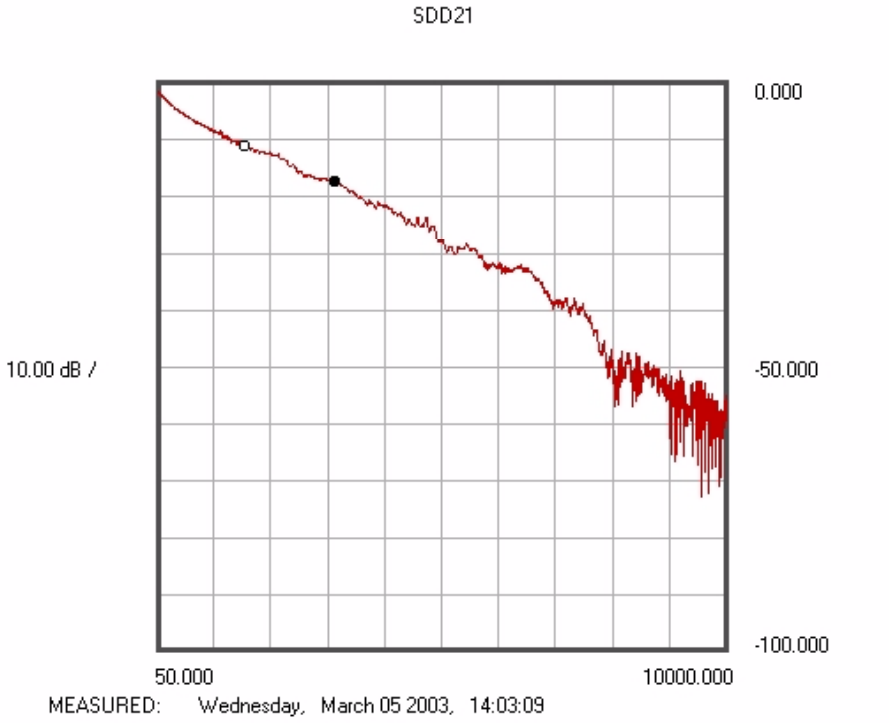
Thinh Nguyen
Dean Vermeersch

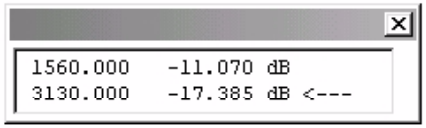
- Cable assembly measurements made at this reference plane includes the test fixture as part of the device under test.
- The long lengths, 5 meter 28 AWG and 10 meter 24 AWG, will measure S21 of every pair, but measure S11 of just pair S9S10.
- The short length, 0.5 meter 28 AWG, will measure S21 of just pair S9S10, but measure S11 of every pair.

# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 3/5/03
- Temperature: 77.65 F
- Relative Humidity: 12.09 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End : P1
- **Transmit pair: Test port S 1, S 2**
- **Receive pair: Test port S 15, S 16**

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- Cable End: P1
- **Transmit pair: Test port S 3, S 4**
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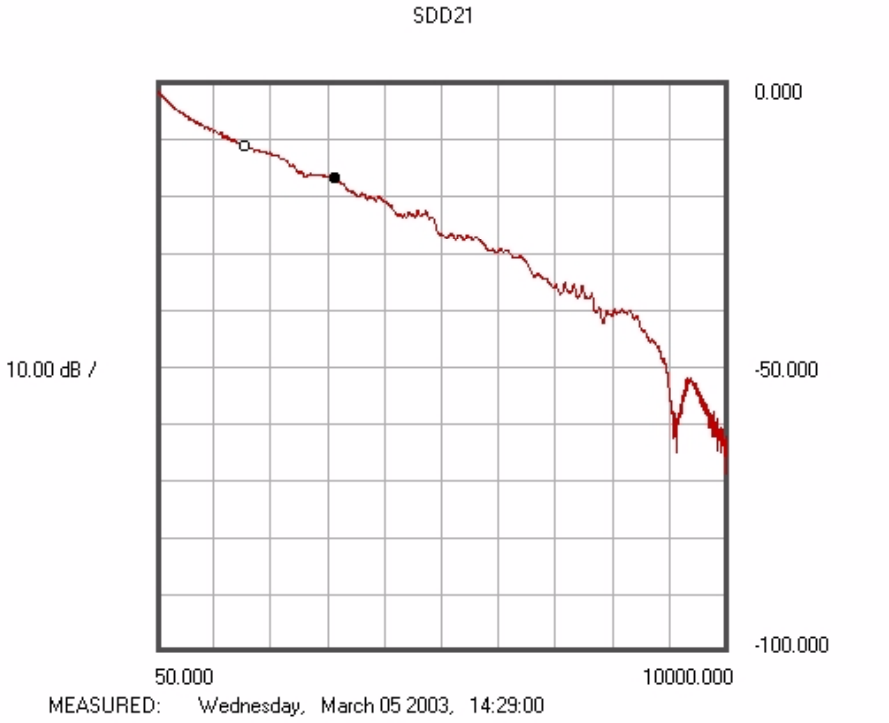


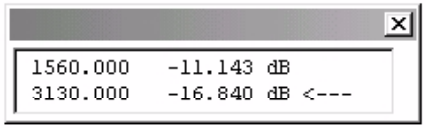


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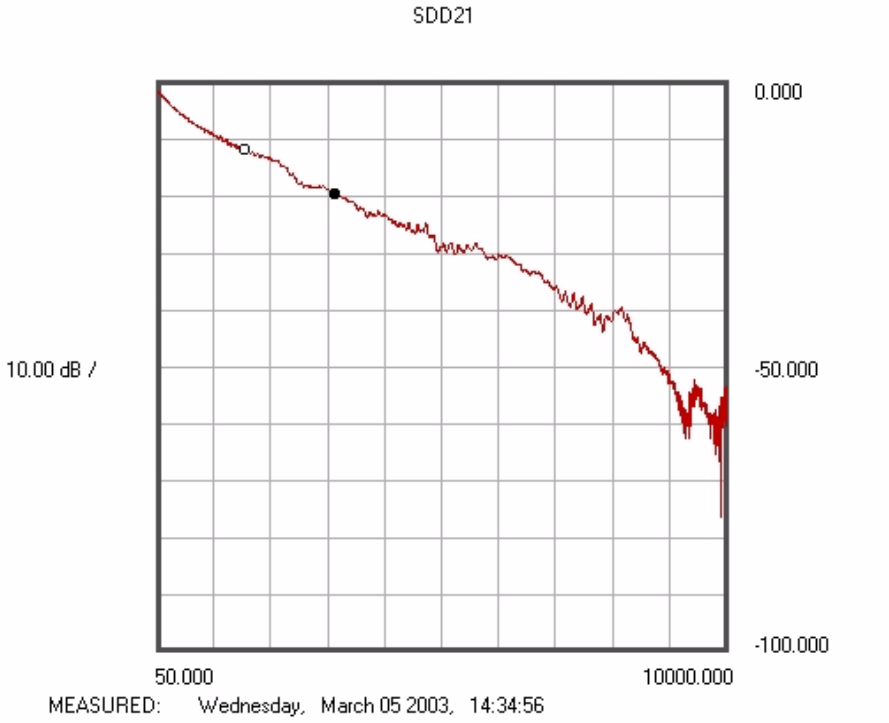


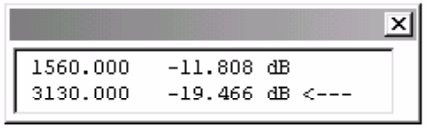


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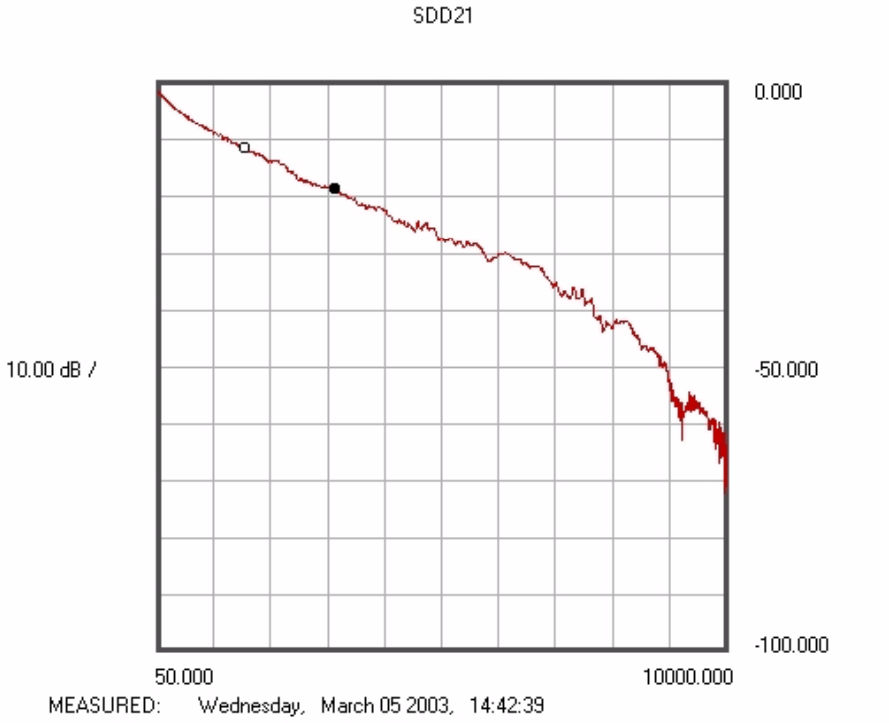
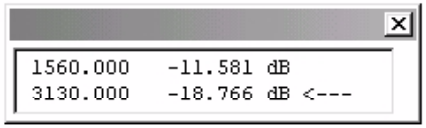
- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**

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# Comment On Quality of Bulk Cable

- The insertion loss of pair S9S10 is 37% greater than the other pairs in the assembly (following slide).
- Note that this pair passes the proposed Insertion Loss specification of 17 dB maximum, but may not function in a system because the emphasis and equalization are not designed for this different loss curve.
- Cursory examination of mode conversion measurements hint that the problem is related to mode conversion, and that this cable will also have Cross Talk and EMI performance issues.
- It would be of great value if someone used this data to evaluate if this different performing pair has an effect on system performance.
- Bulk cable suppliers have so far been unable to prevent shipment of product with significant performance variation from pair to pair.
- Perhaps this issue warrants discussion in the standard.

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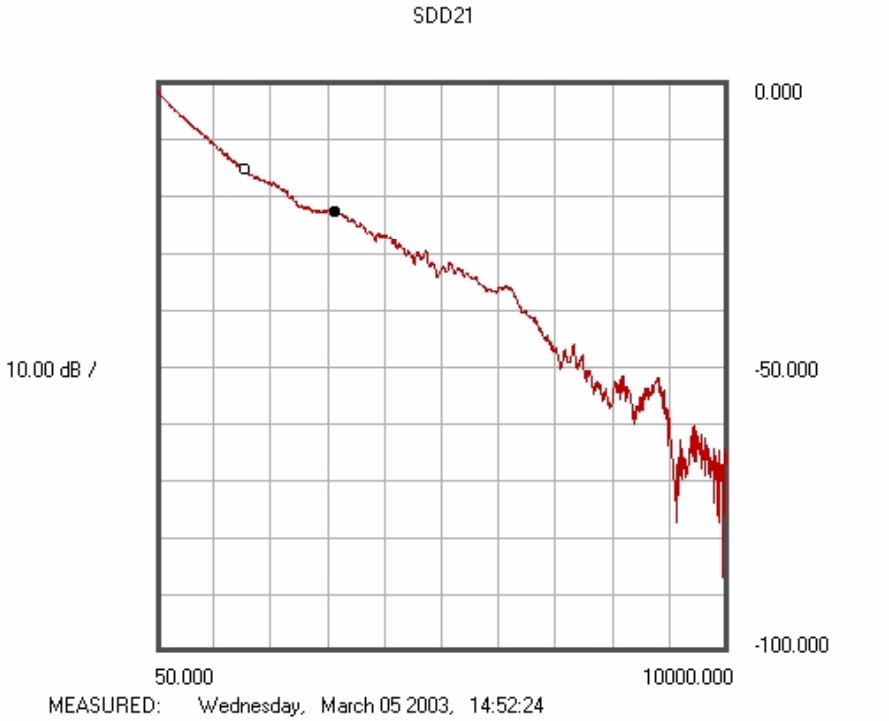


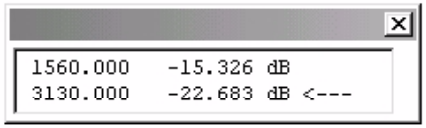


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- Cable End: P1
- **Transmit pair: Test port S 11, S 12**
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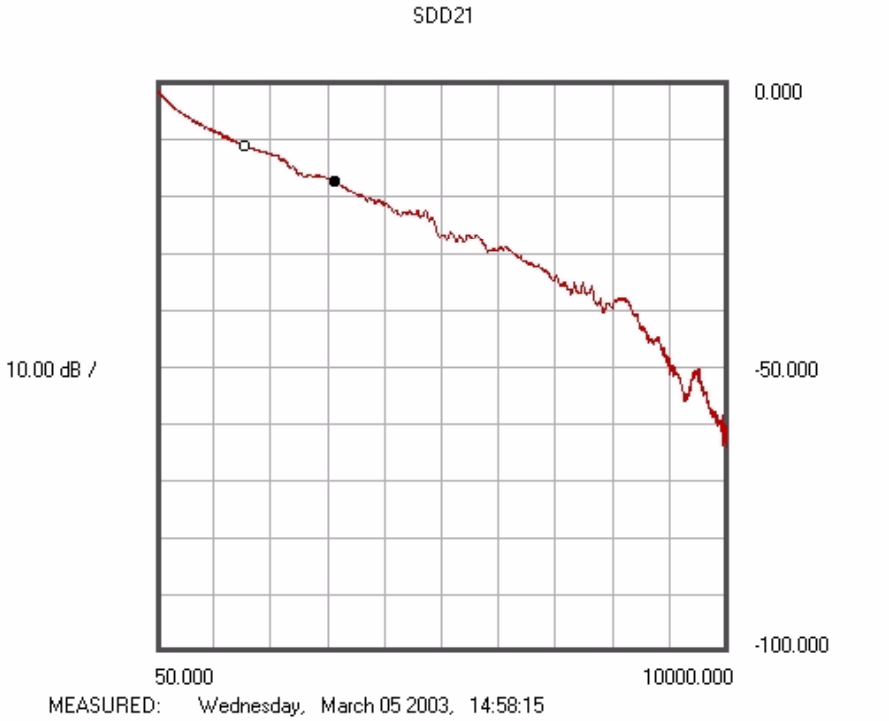


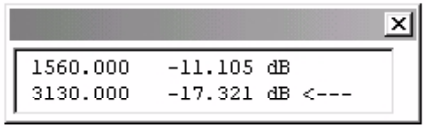


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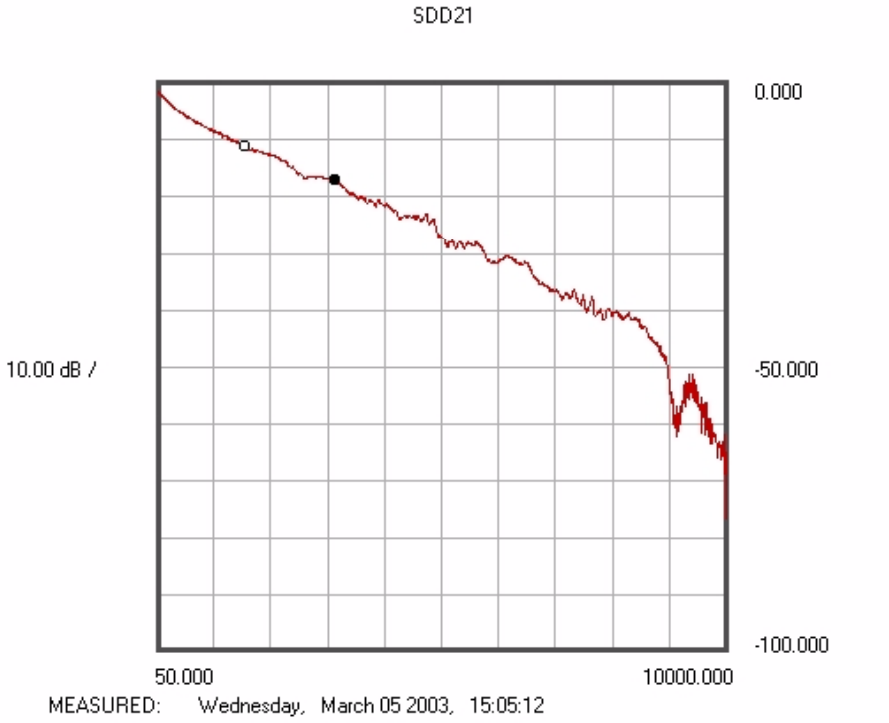
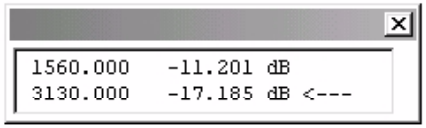
- Relative Humidity: 12.09 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1
- **Transmit pair: Test port S 13, S 14**
- **Receive pair: Test port S 3, S 4**

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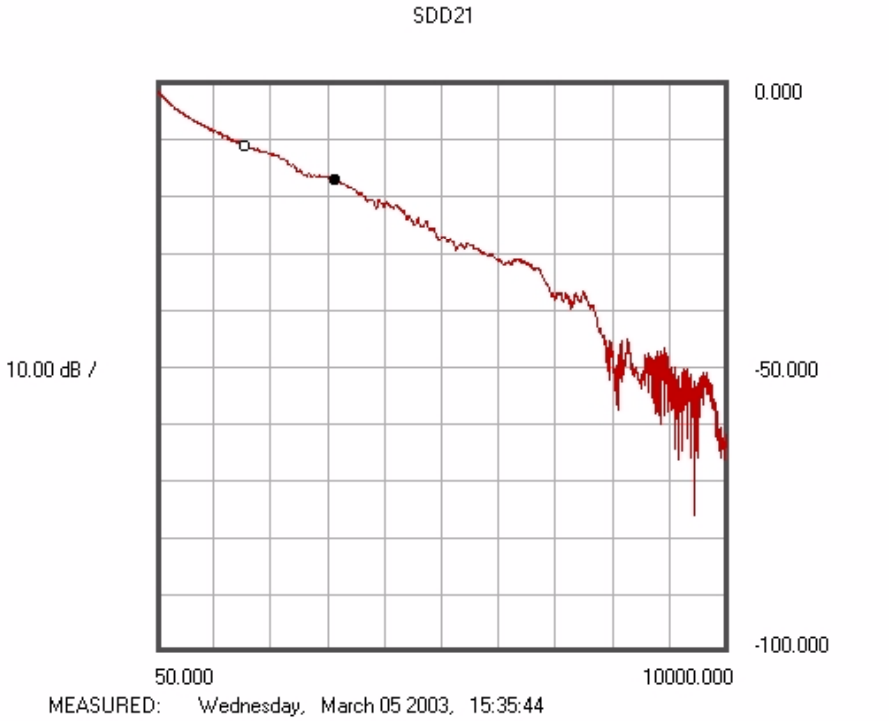
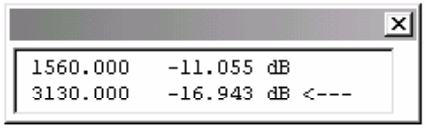
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 3/5/03
- Temperature: 77.65 F
- Relative Humidity: 12.09 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1
- **Transmit pair: Test port S 15, S 16**
- **Receive pair: Test port S 1, S 2**

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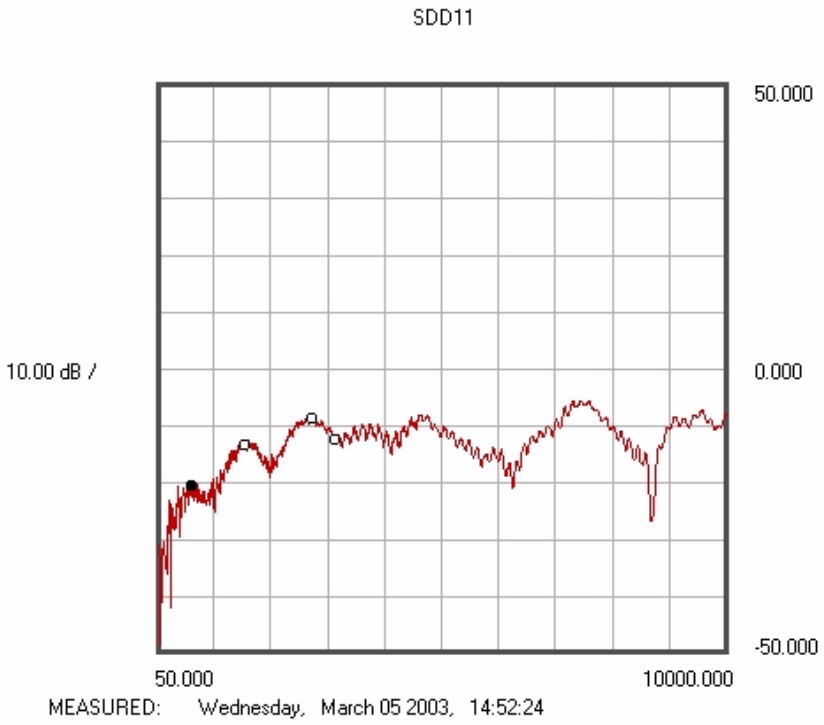
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 3/5/03
- Temperature: 77.65 F
- Relative Humidity: 12.09 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1
- **Transmit pair: Test port S 9, S 10**
- **Receive pair: Test port S 7, S 8**




| | | |
|---|---|---|
| 640.000 | -20.410 dB | <--- |
| 1560.000 | -13.371 dB | |
| 2730.000 | -8.626 dB | |
| 3130.000 | -12.428 dB | |

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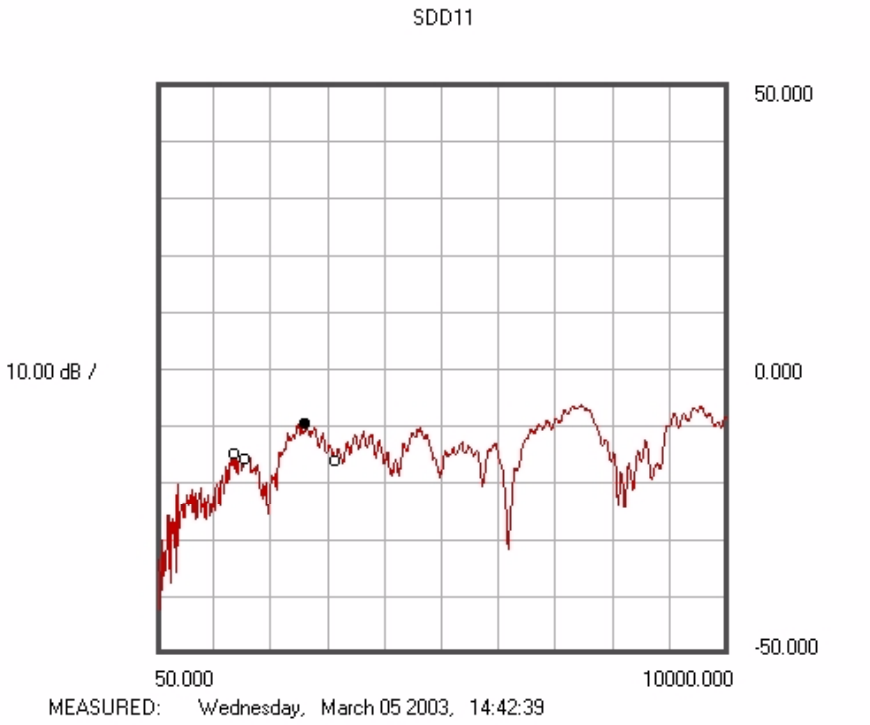
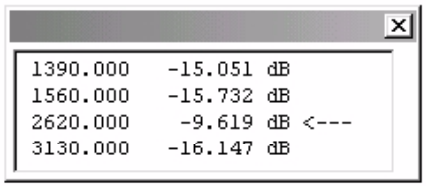
# Typical **S-parameters (SDD11)** Measurement By Network Analyzer - ATN

- Date: 3/5/03
- Temperature: 77.65 F
- Relative Humidity: 12.09 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**

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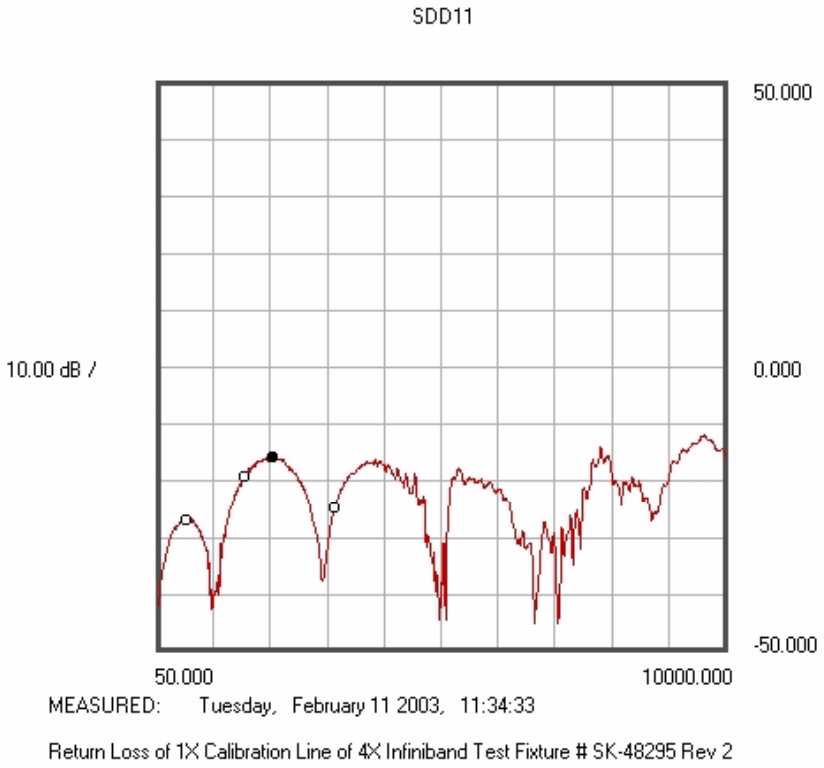
# Comment On Accuracy of Fixture Calibration Structures

- The following two slides are Return Loss measurements of the calibration structures of the fixture.
- Comparing these measurements to those where the test fixture and cable assembly are the devise under test shows that the return loss of the calibration fixture exhibits phase errors relative to the actual test fixture traces. Note that the fine return loss structure of the cable assembly length is superimposed on the coarse return loss structure due to the fixture contribution, and that the coarse structure due to the fixture does not match the coarse structure when measuring just the calibration portions of the fixture.
- This means great care must be taken if an attempt is made to manually subtract fixture contribution from the cable assembly measurements.
- This means that complex mathematic subtraction of fixture contribution from the cable assembly measurement is NOT accurate because of an error in the phase.
- Similar errors occur with Insertion Loss measurements, but the effect is not as easily seen as it is for Return Loss measurements.

# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Single length calibration trace of FCI Test Board

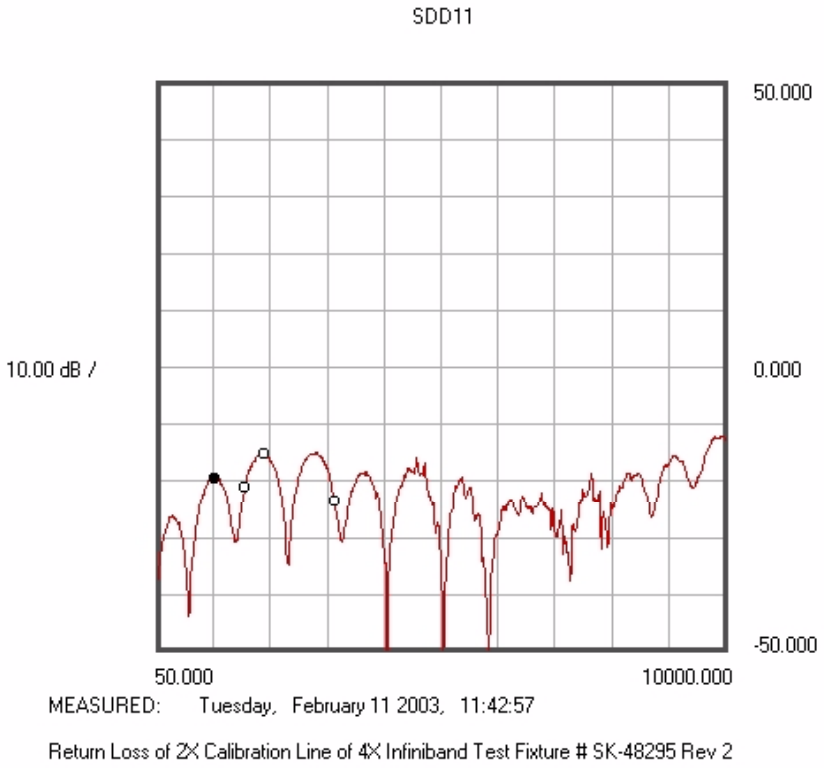



| | | |
|---|---|---|
| 540.000 | -27.090 dB | |
| 1560.000 | -19.197 dB | |
| 2060.000 | -15.896 dB | <--- |
| 3130.000 | -24.691 dB | |

# Typical S-parameters (SDD11) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: Double length calibration trace of FCI Test Board



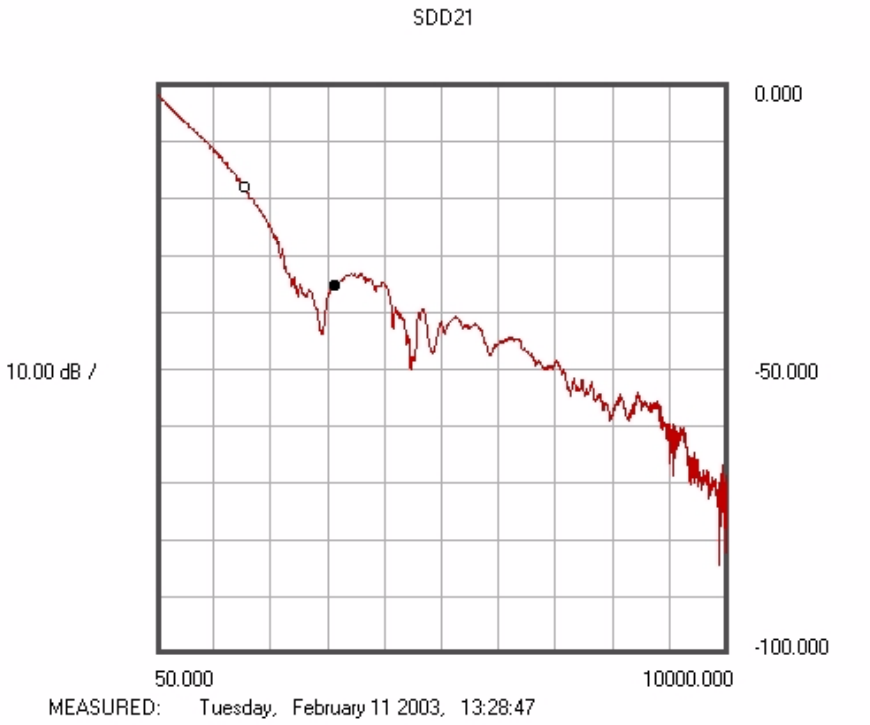

| | | |
|---|---|---|
| 1040.000 | -19.671 dB | <--- |
| 1560.000 | -21.255 dB | |
| 1910.000 | -15.254 dB | |
| 3130.000 | -23.675 dB | |

# Comment On Quality of Bulk Cable

- The following slide shows the Insertion Loss measurement of a different 10 meter length assembly, wherein one of the differential pairs of the bulk cable performs differently than all the other pairs.
- Note that this pair fails the proposed Insertion Loss specification of 17 dB maximum. A similar defect could occur that barely passes 17 dB, but may not function in a system because the emphasis and equalization are not designed for the defective loss curve.
- This data is included for those who wish to evaluate the effects of this type of defect on system performance.
- Bulk cable suppliers have so far been unable to prevent shipment of this type of defective product.
- Perhaps this issue warrants discussion in the standard.

# Typical S-parameters (S21) Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2
- DUT: 4X Infiniband Test Board & 10m, 24 AWG, Skew-clear, 100 ohm differential, cable assembly with FCI plug board
- Transmitted Line: Test port S7, S8
- Received Line: Test port S 9, S10

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# Insertion Loss Measurement Methods Frequency Domain Acquisition Compared to Time Domain Acquisition Spectral Characteristics [S-Parameter]

- The Time Domain system (Tektronix TDS 8000 Digital Sampling Oscilloscope) used the same test leads as the Frequency Domain system.
- The Time Domain test system has had the fixture effects added, so a direct comparison may be made to the Frequency Domain system (which cannot remove fixture effects).

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

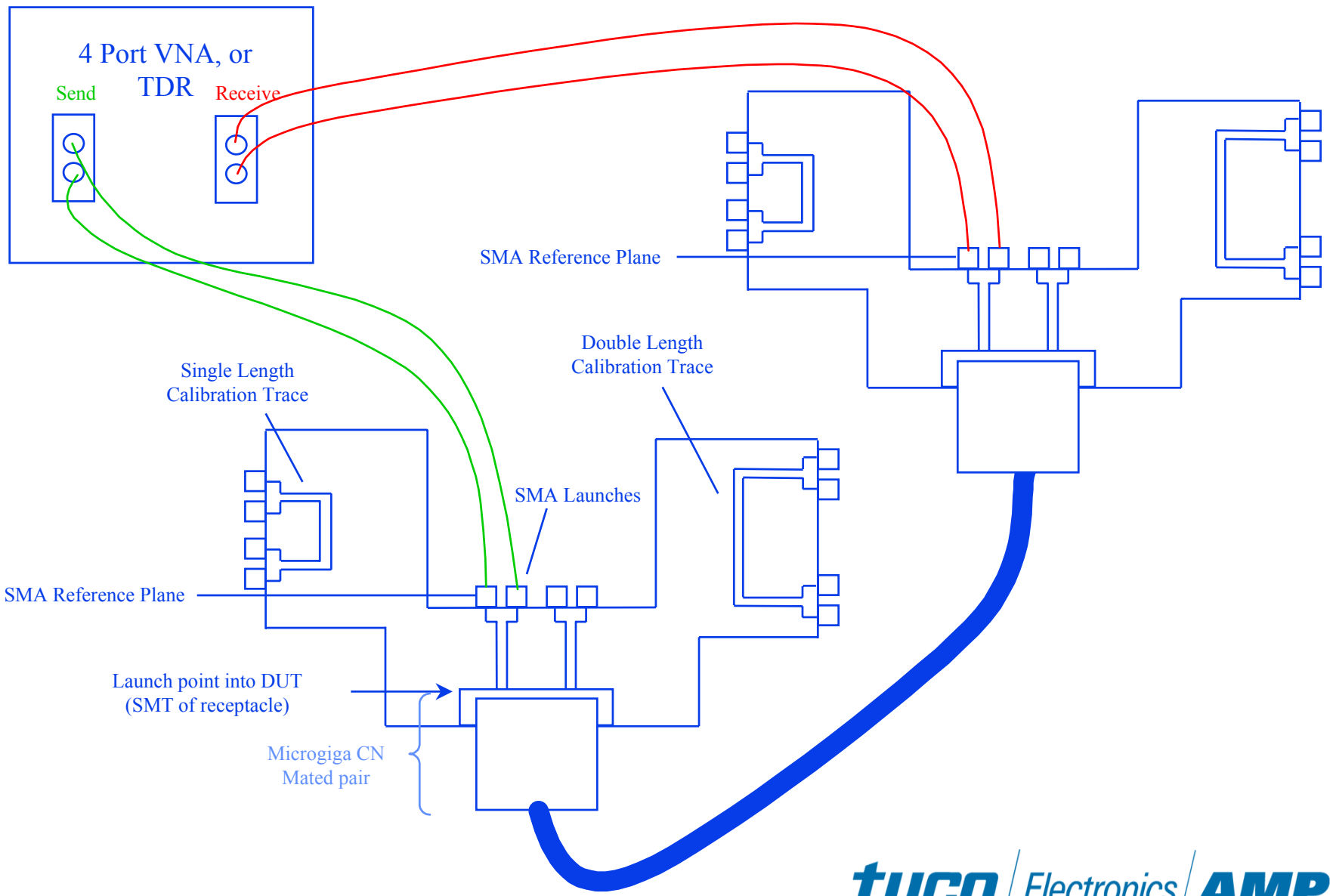
- Test system Reference Plane is the SMA interface of the launch connectors on the test fixture.
- Network Analyzer HP8720ES & ATN 4112A, 3.5mm calibration kit 85052C.
- 18 inch length RG-58 Coaxial test leads with SMA plugs both ends.
- S-Parameter measurements are made in accordance with SFF-8410.
- This report shows the S-Parameter measurements of the FCI MicroGiga CN fixture mated to a 0.5 meter, 5.0 meter length 28 AWG, and 10.0 meter length, 24 AWG, 100 ohm differential, cable assembly with FCI MicroGiga CN connectors.

# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- Note that all S-Parameter data will be made available as full complex export files for those who wish.
- Please contact Thinh Nguyen (717-985-2027) tpnguyen@tycoelectronics.com, or Dean Vermeersch (717-986-3143) dean@tycoelectronics.com and advise what export format is desired.

# Frequency Domain Insertion Loss Test Set-Up

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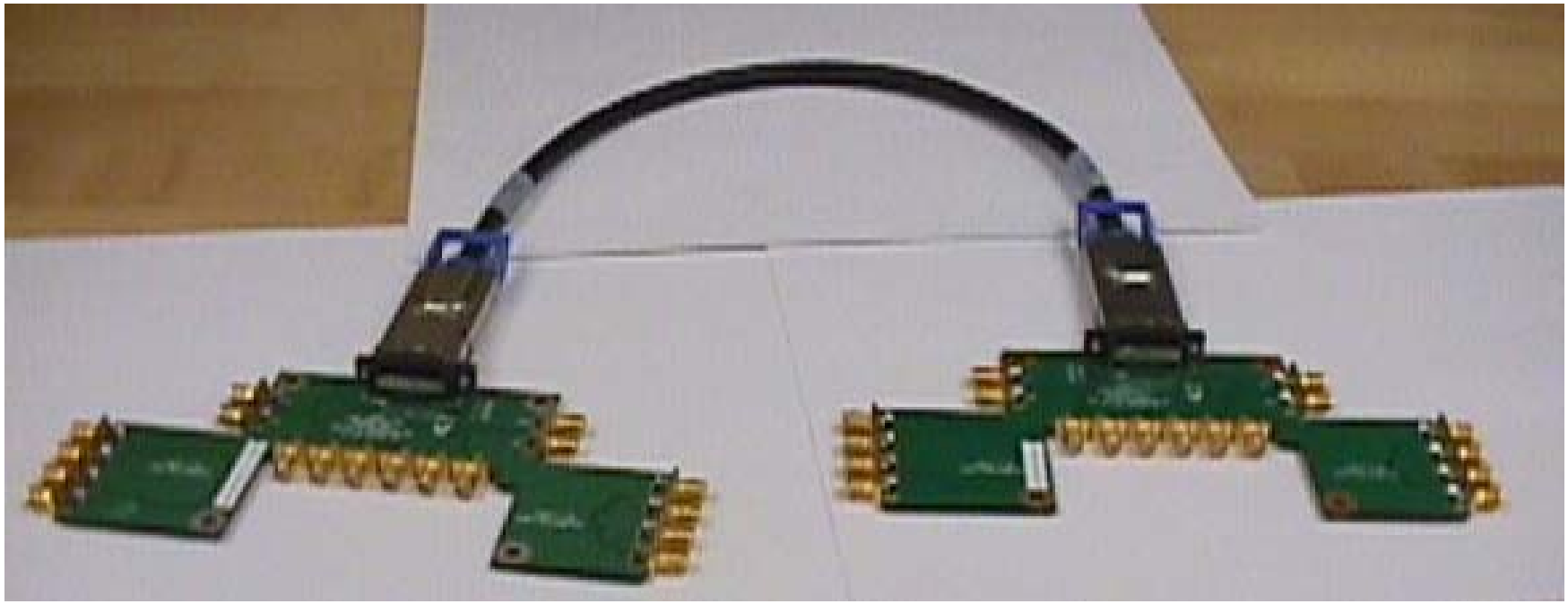
# Test Fixtures with Cable Assembly as DUT



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# S-Parameter Measurements

Thinh Nguyen
Dean Vermeersch

- Cable assembly measurements made at this reference plane includes the test fixture as part of the device under test.
- The long lengths, 5 meter 28 AWG and 10 meter 24 AWG, will measure S21 of every pair.
- The short length, 0.5 meter 28 AWG, will measure S21 of just pair S9S10.

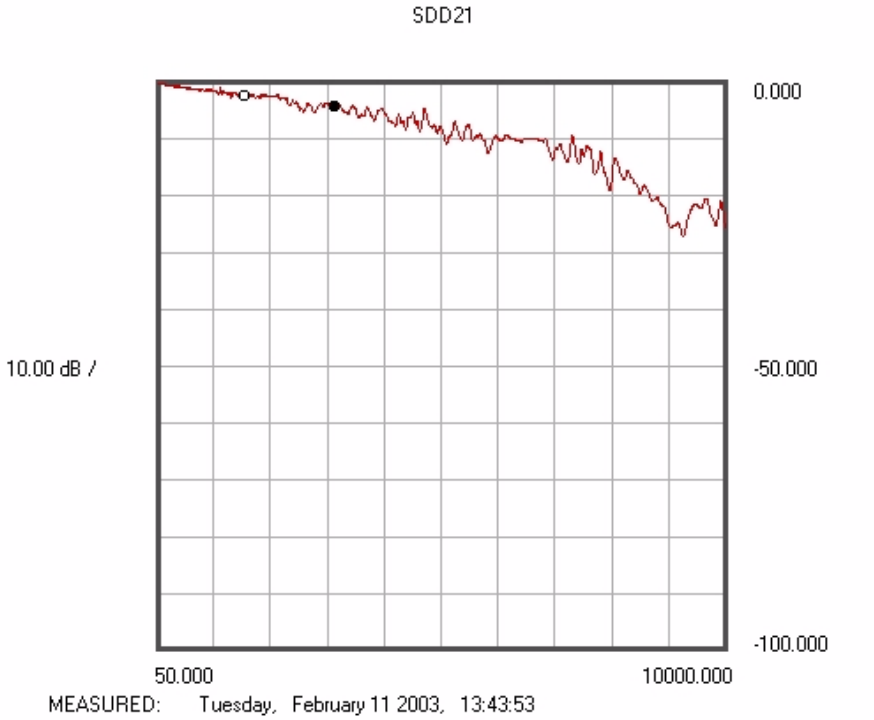
# Insertion Loss Measurement Methods Frequency Domain Acquisition Compared to Time Domain Acquisition Spectral Characteristics [S-Parameter]

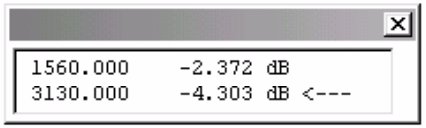
- The following slides will be in the order of Frequency Domain acquisition data, followed by Time Domain acquisition data of the exact same device under test.

# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **0.5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**

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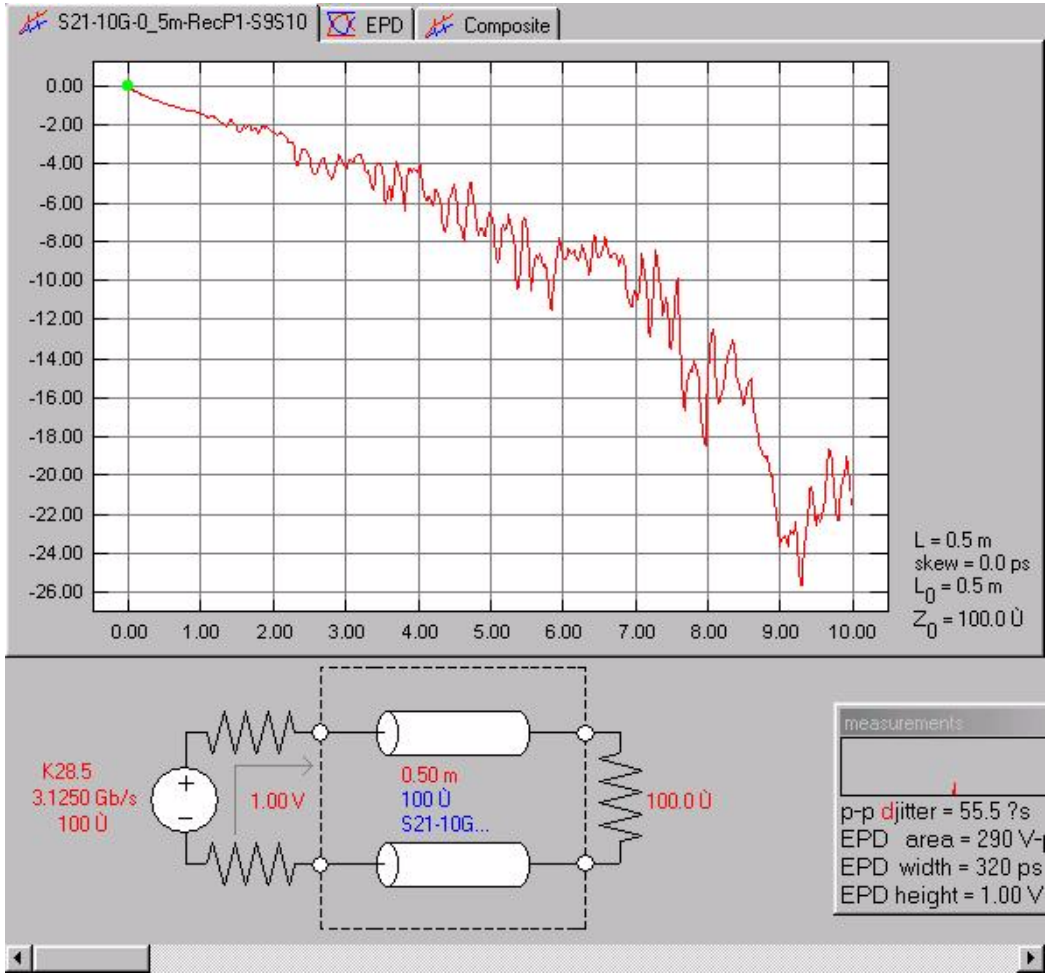
# Typical S-parameters (S21) Measurement By Oculus Software

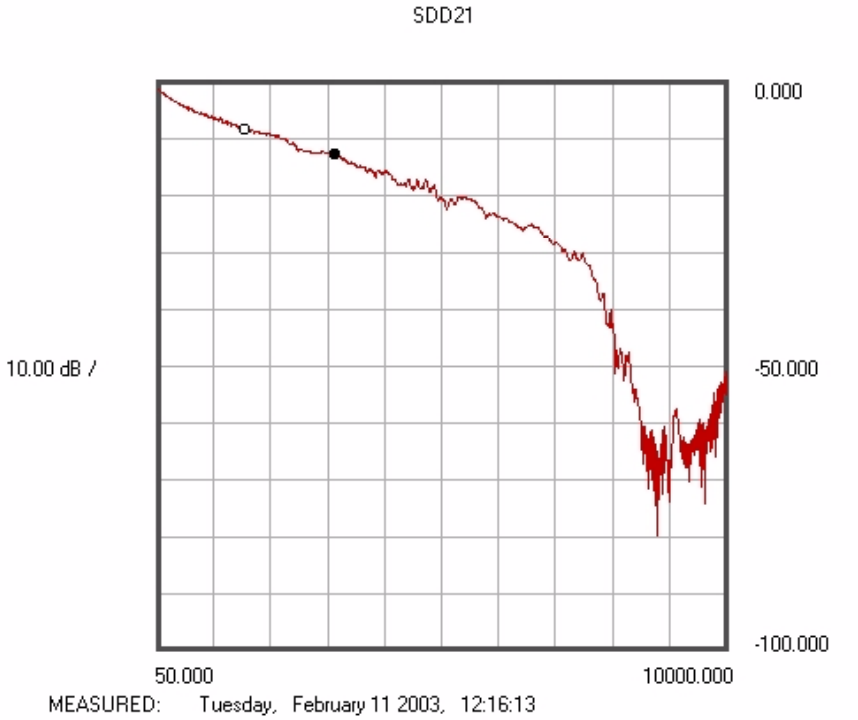
- Date: 3/12/03
- Temperature: 77.49 F
- Relative Humidity: 14.39 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 0.5 m , 28AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Transmitted Line: Test port S 7, S 8
- Received Line: Test port S 9, S 10

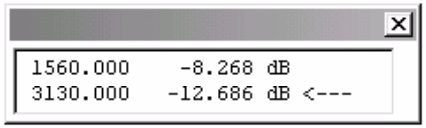


# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 1, S 2**
- **Receive pair: Test port S 15, S 16**

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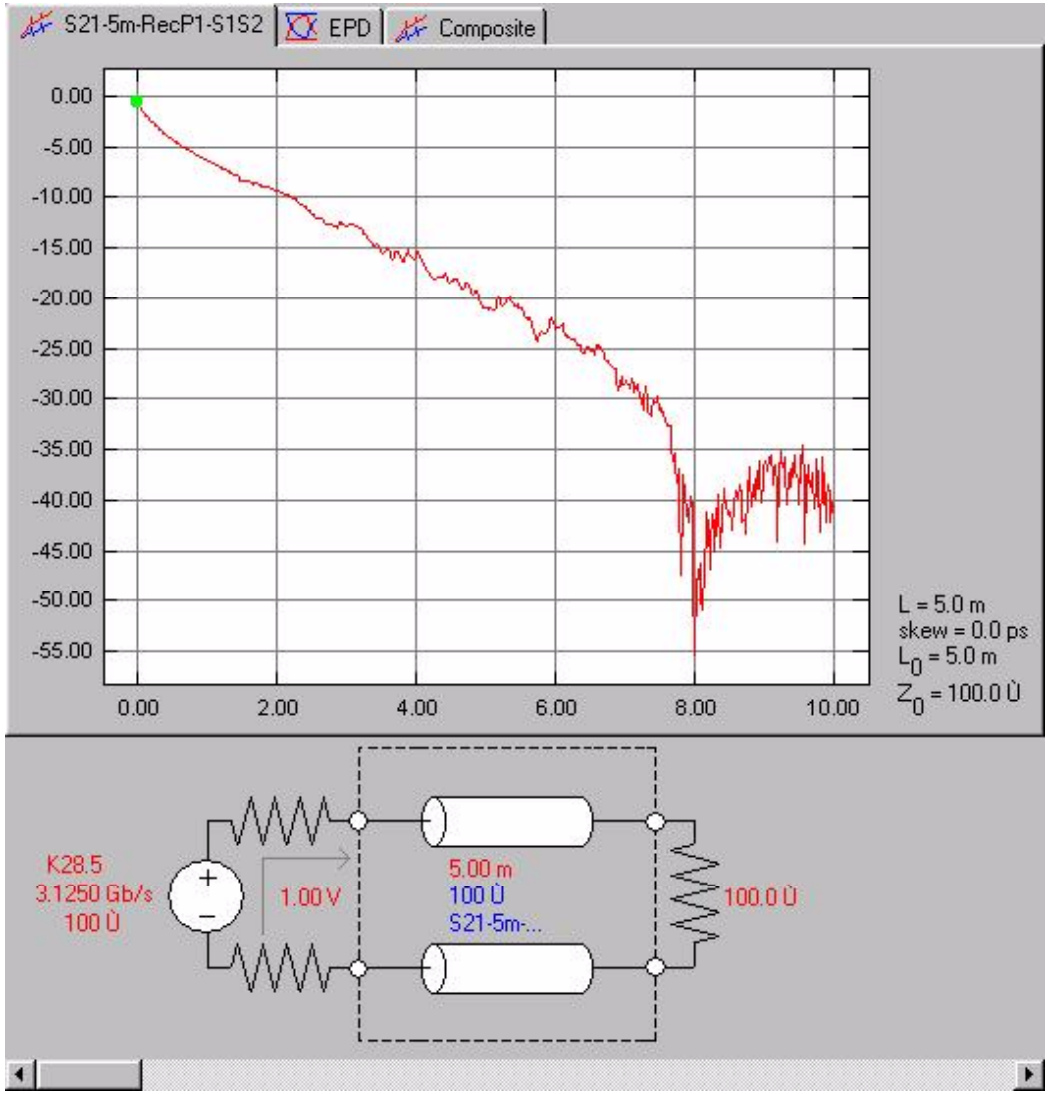
# Typical S-parameters (S21) Measurement By Oculus Software

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5m , 28 AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Received End: P1
- Transmitted Line: Test port S 15, S 16
- Received Line: Test port S 1, S 2

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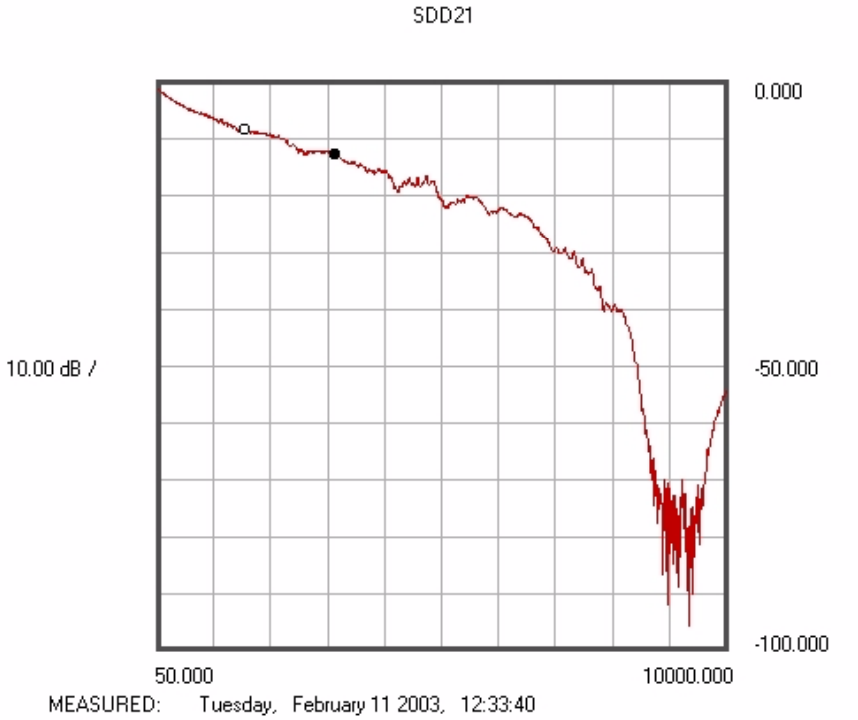
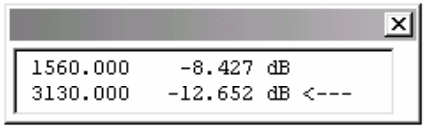
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 3, S 4**
- **Receive pair: Test port S 13, S 14**

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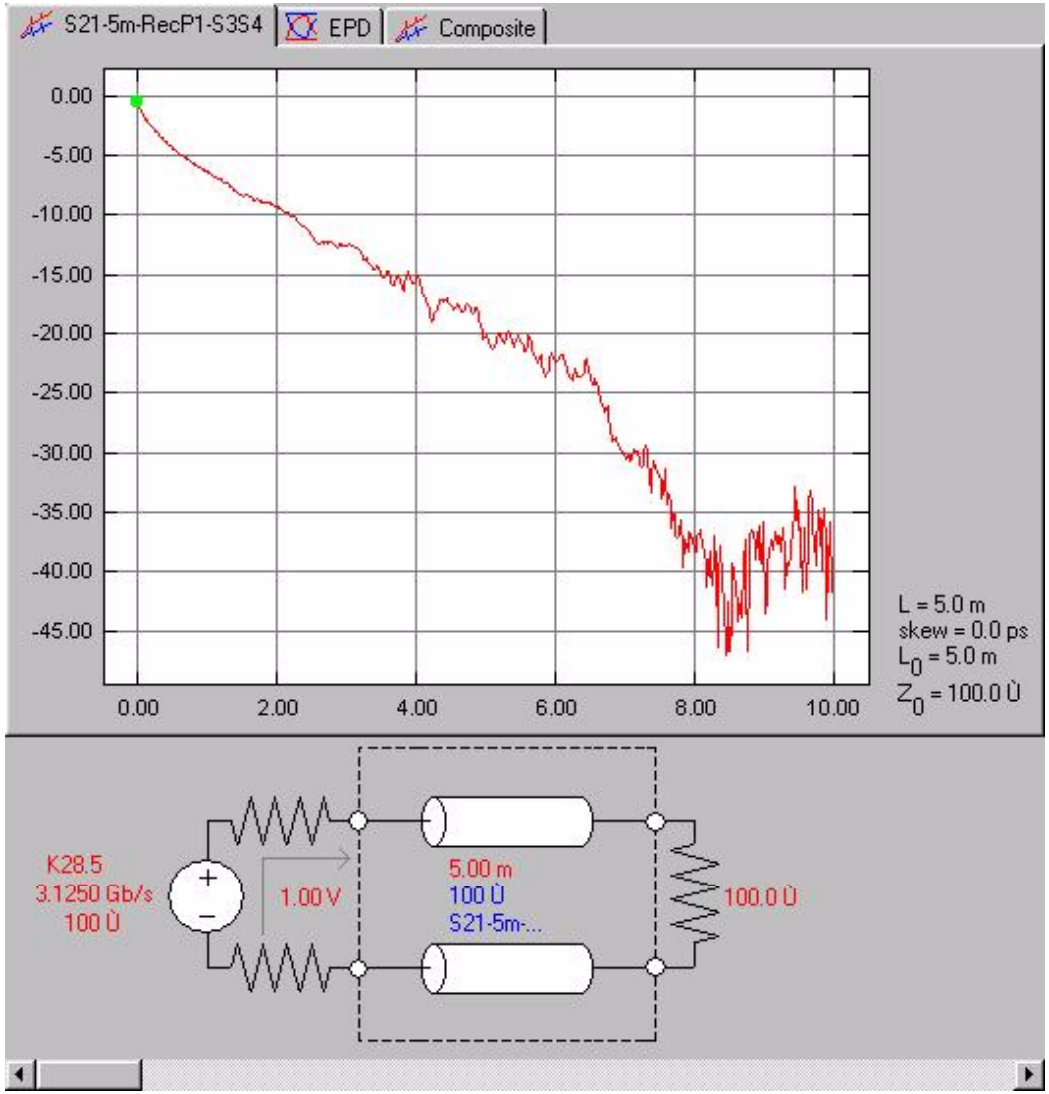
# Typical S-parameters (S21) Measurement By Oculus Software

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5m , 28 AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Received End: P1
- Transmitted Line: Test port S 13, S 14
- Received Line: Test port S 3, S 4

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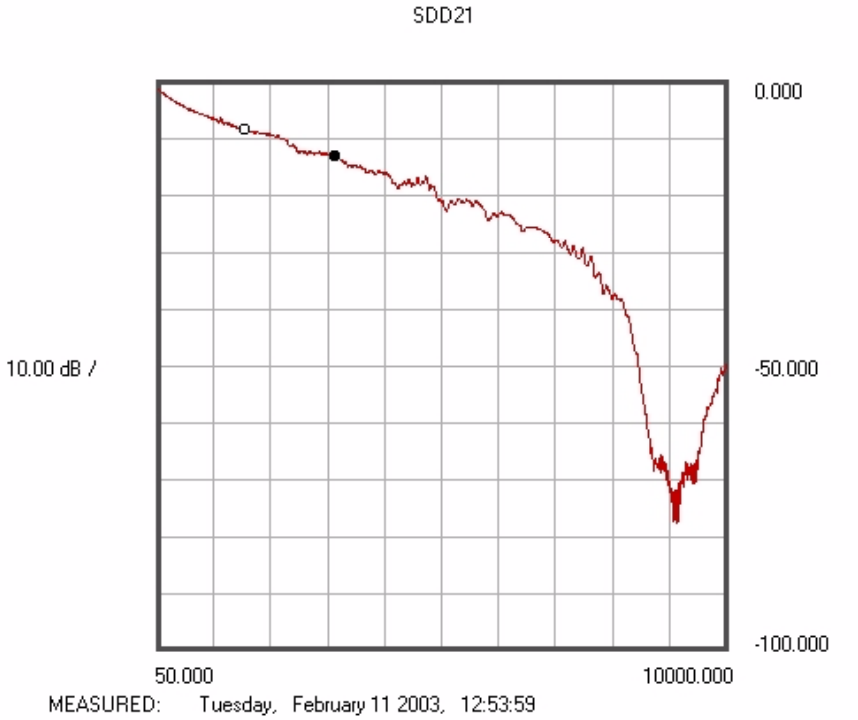
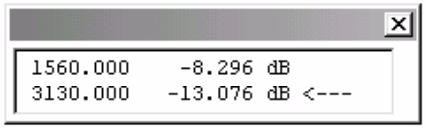
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 5, S 6**
- **Receive pair: Test port S 11, S 12**

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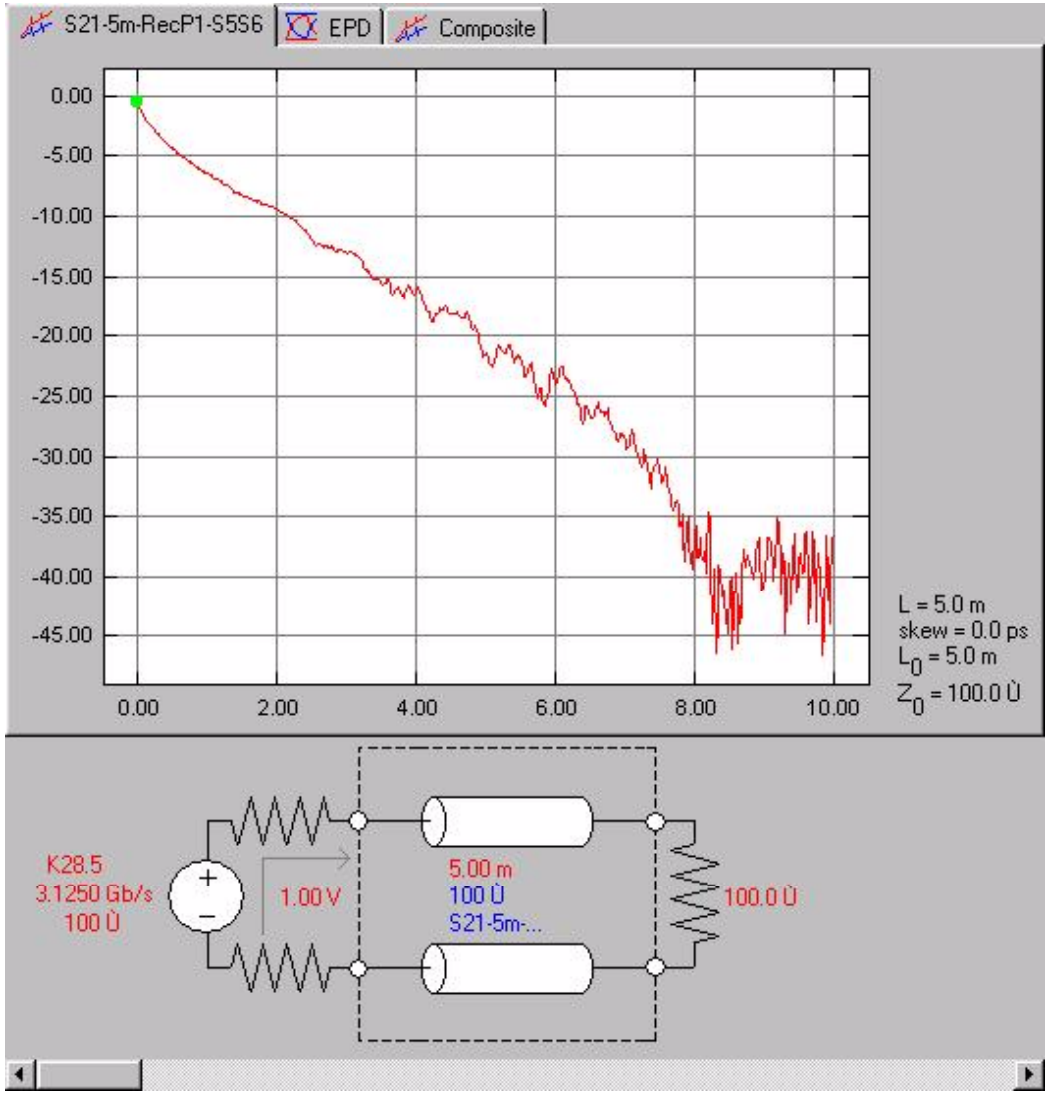
# Typical S-parameters (S21) Measurement By Oculus Software

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5m , 28 AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Received End: P1
- Transmitted Line: Test port S 11, S 12
- Received Line: Test port S 5, S 6

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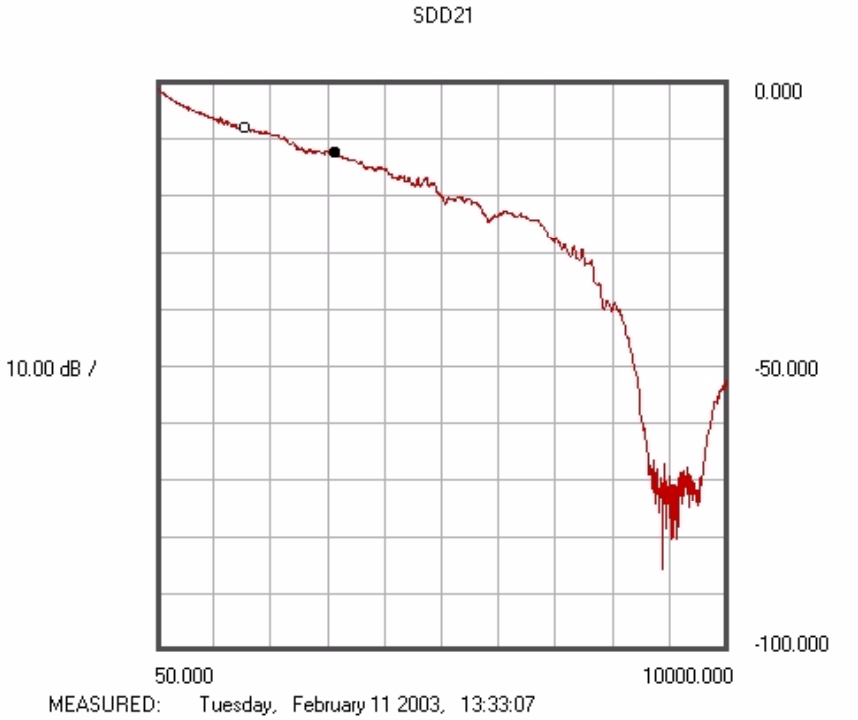
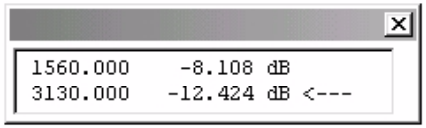
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**

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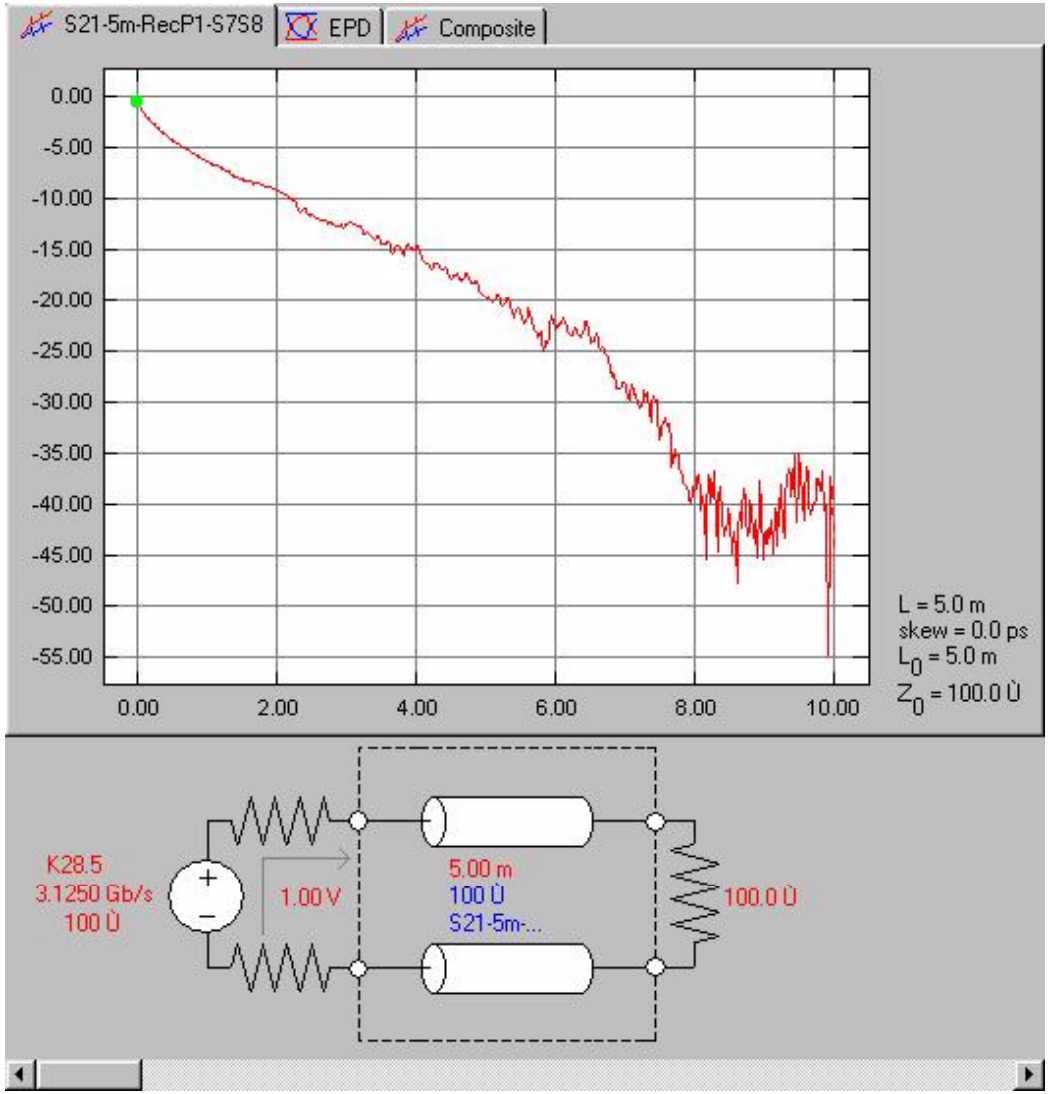
# Typical S-parameters (S21) Measurement By Oculus Software

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5m , 28 AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Received End: P1
- Transmitted Line: Test port S 9, S 10
- Received Line: Test port S 7, S 8

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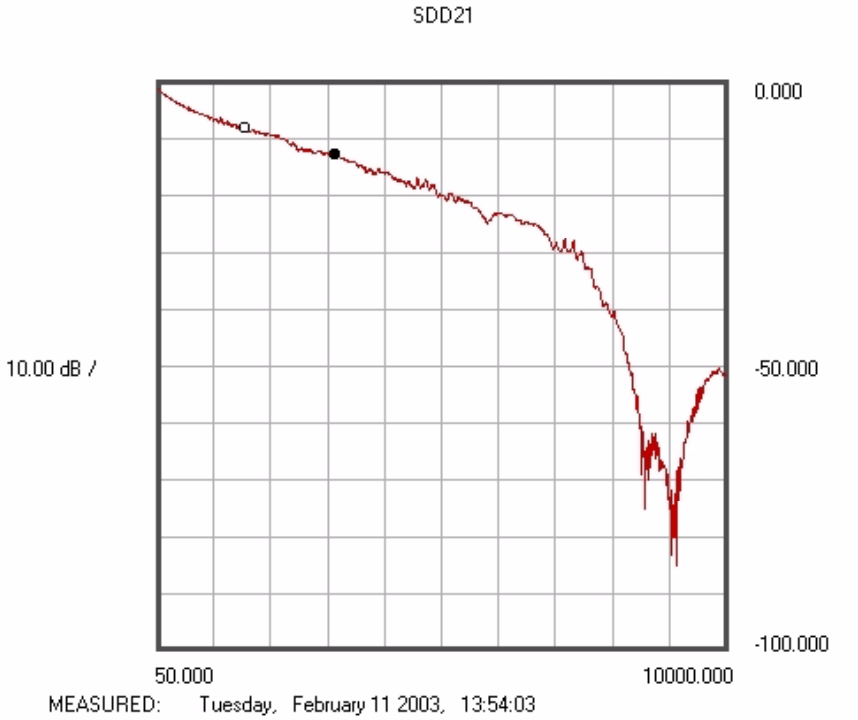
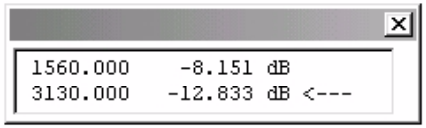
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

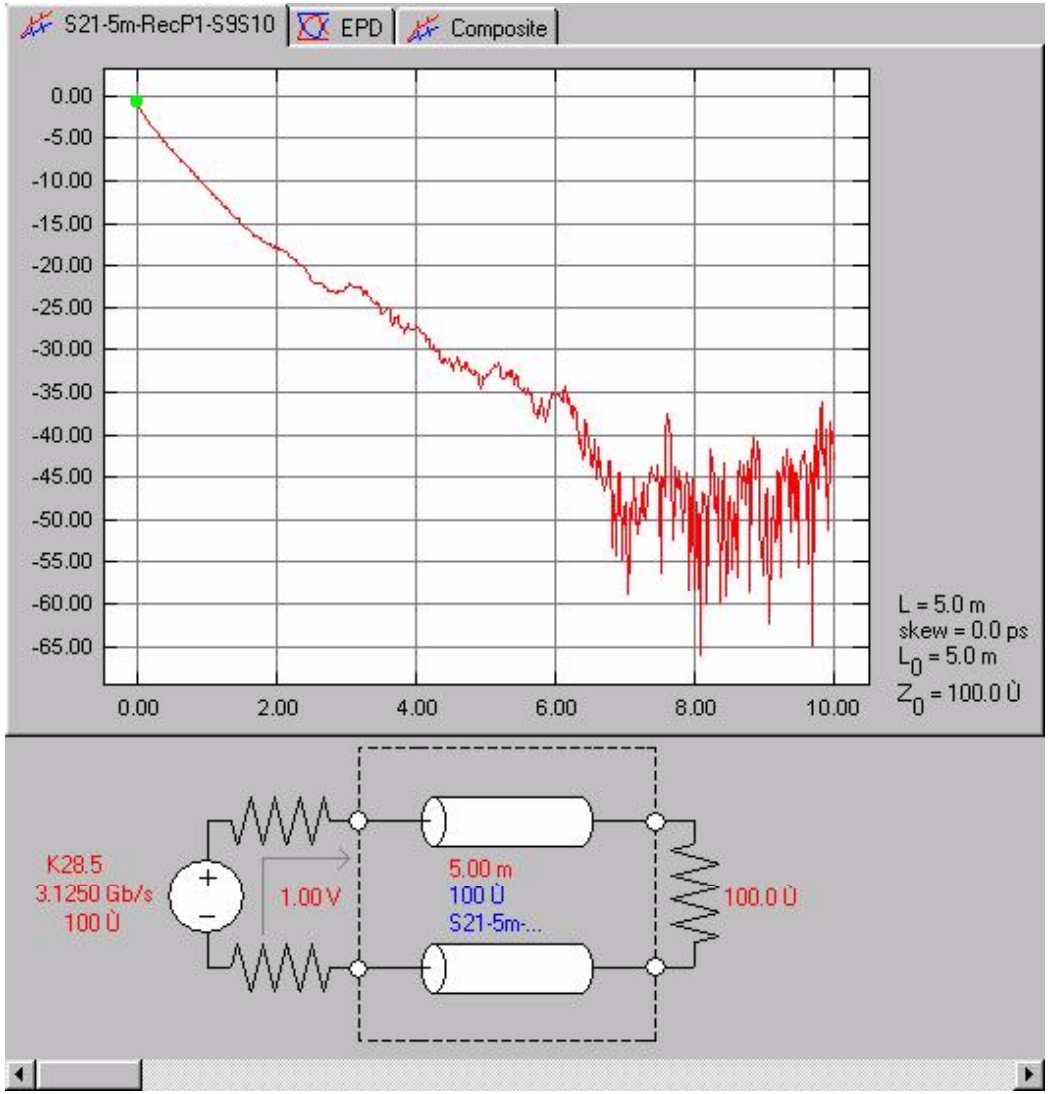
- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 9, S 10**
- **Receive pair: Test port S 7, S 8**



# Typical S-parameters (S21) Measurement By Oculus Software

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5m , 28 AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Received End: P1
- Transmitted Line: Test port S 7, S 8
- Received Line: Test port S 9, S 10

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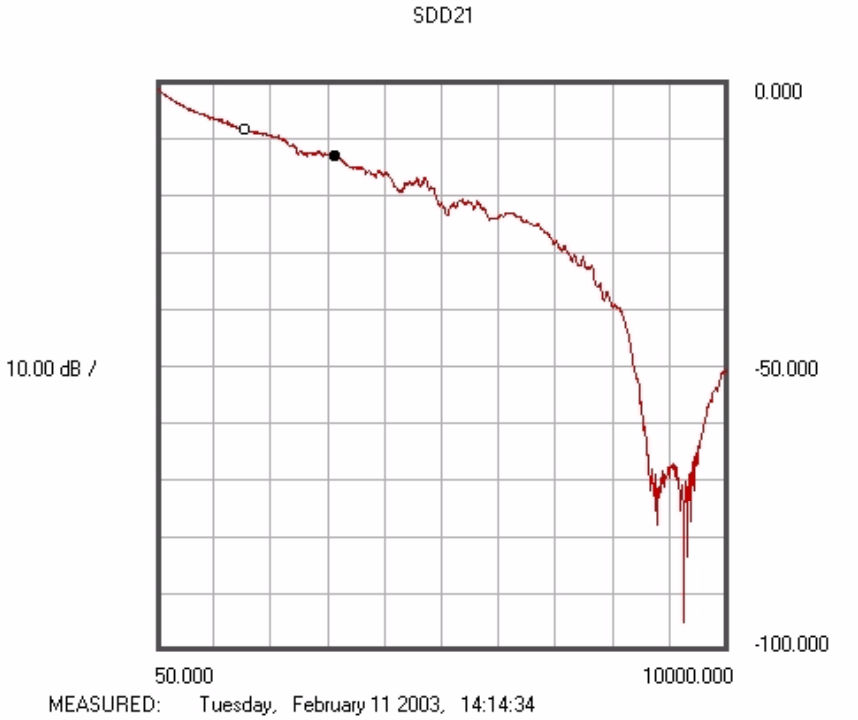
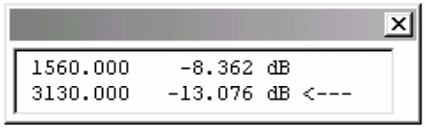
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 11, S 12**
- **Receive pair: Test port S 5, S 6**

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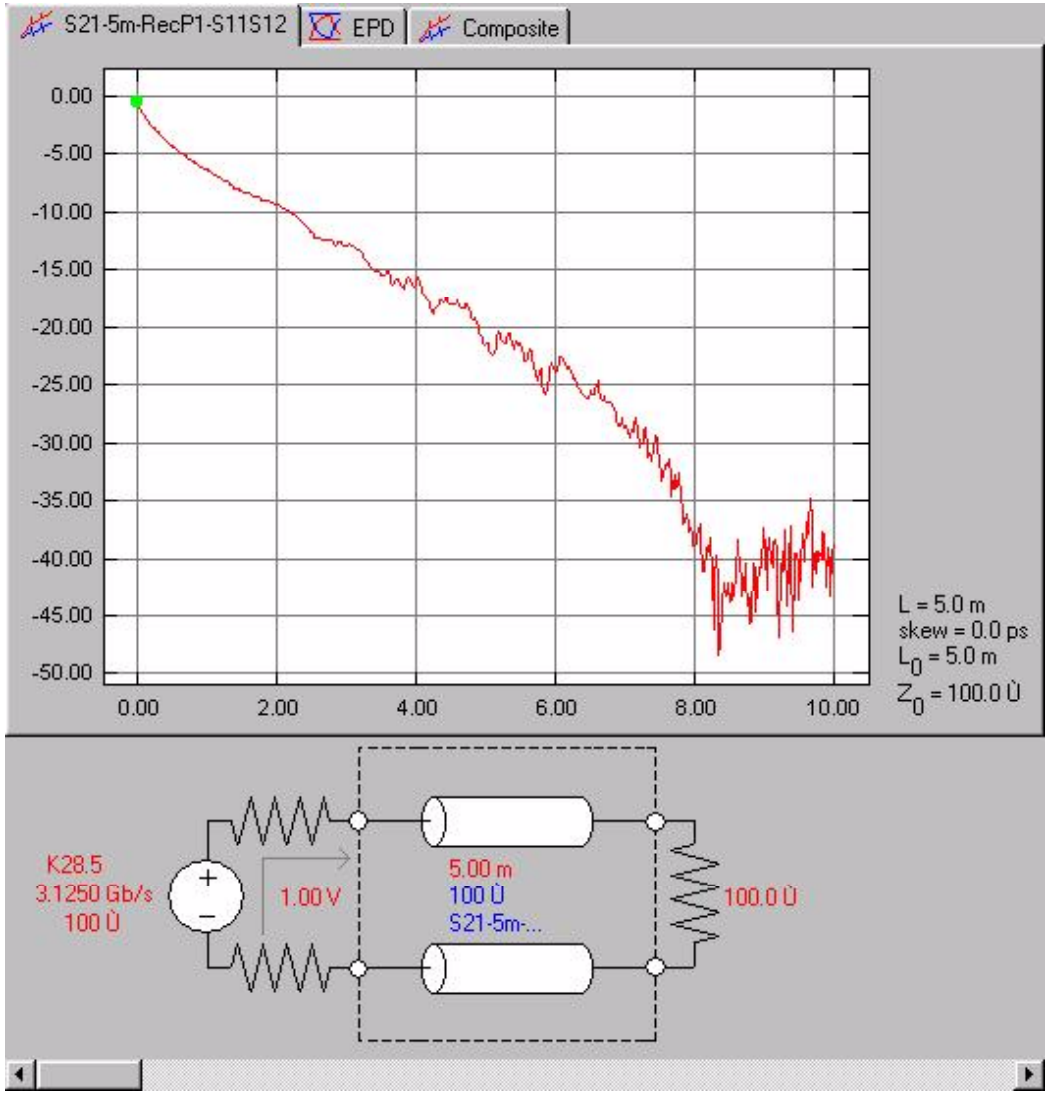
# Typical S-parameters (S21) Measurement By Oculus Software

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5m , 28 AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Received End: P1
- Transmitted Line: Test port S 5, S 6
- Received Line: Test port S 11, S 12

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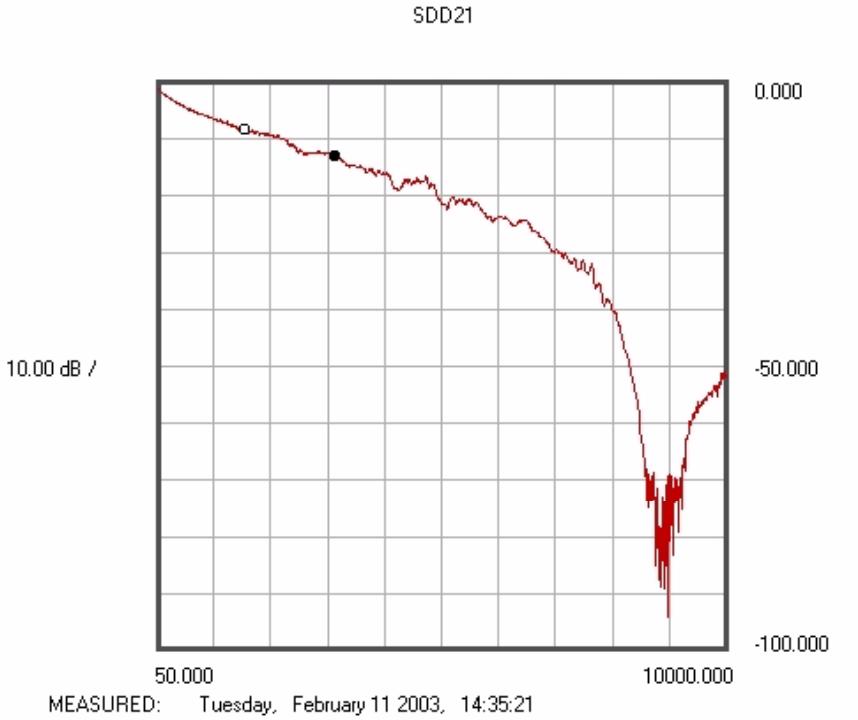
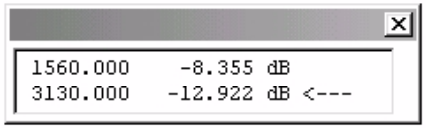
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 13, S 14**
- **Receive pair: Test port S 3, S 4**

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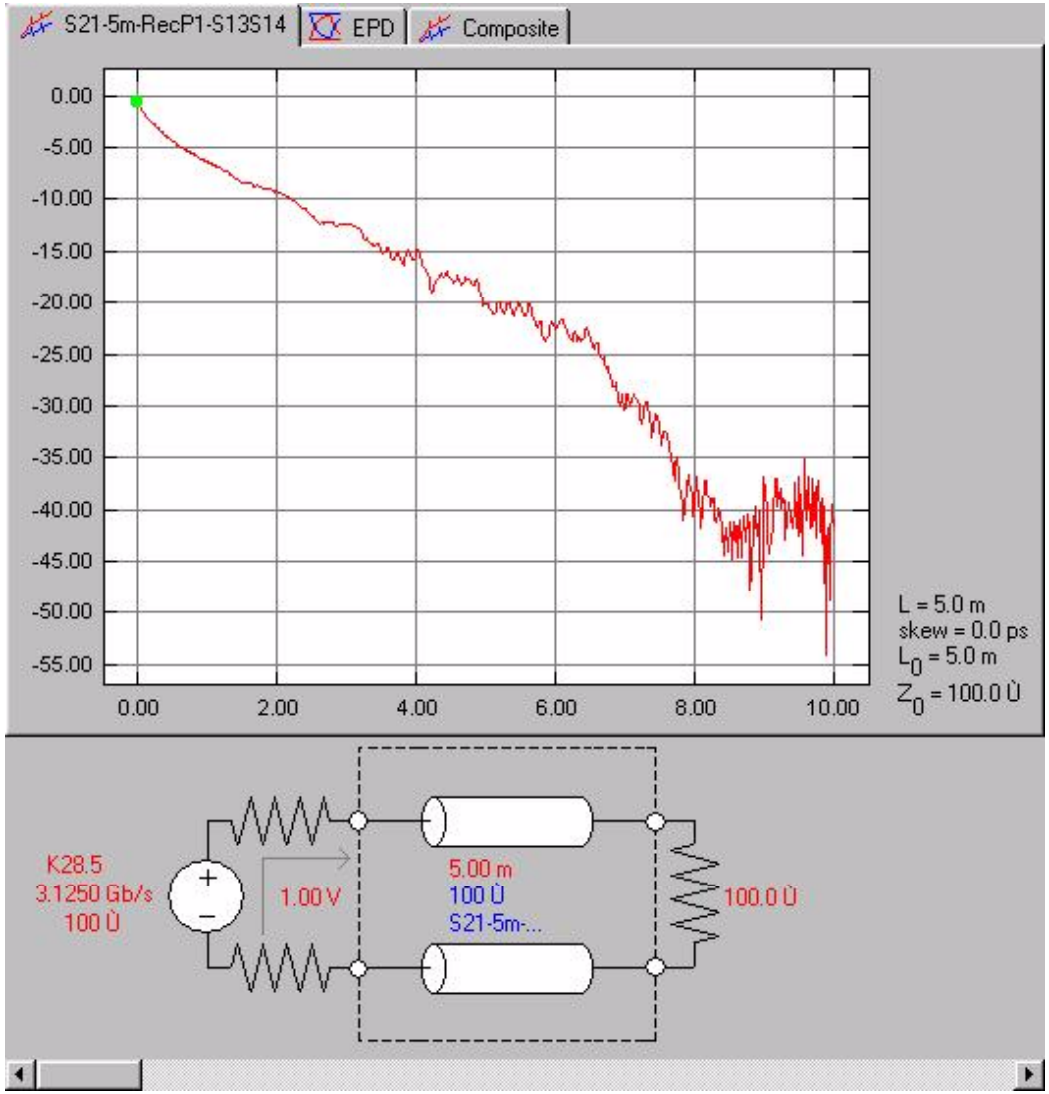
# Typical S-parameters (S21) Measurement By Oculus Software

- Date: 3/13/03
- Temperature: 77.87 F
- Relative Humidity: 16.25 %
- Simulated: Oculus Software
- Test Fixture: 4X Infiniband, FCI Test Board
- Oculus Set Rise-Time: 15 %
- Cable: 5m , 28 AWG, 100 ohm, Skew-clear cable assembly with FCI plug board
- **With Test Fixture**
- Received End: P1
- Transmitted Line: Test port S 3, S 4
- Received Line: Test port S 13, S 14

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- Date: 2/11/03
- Temperature: 77.83 F
- Relative Humidity: 11.9 %
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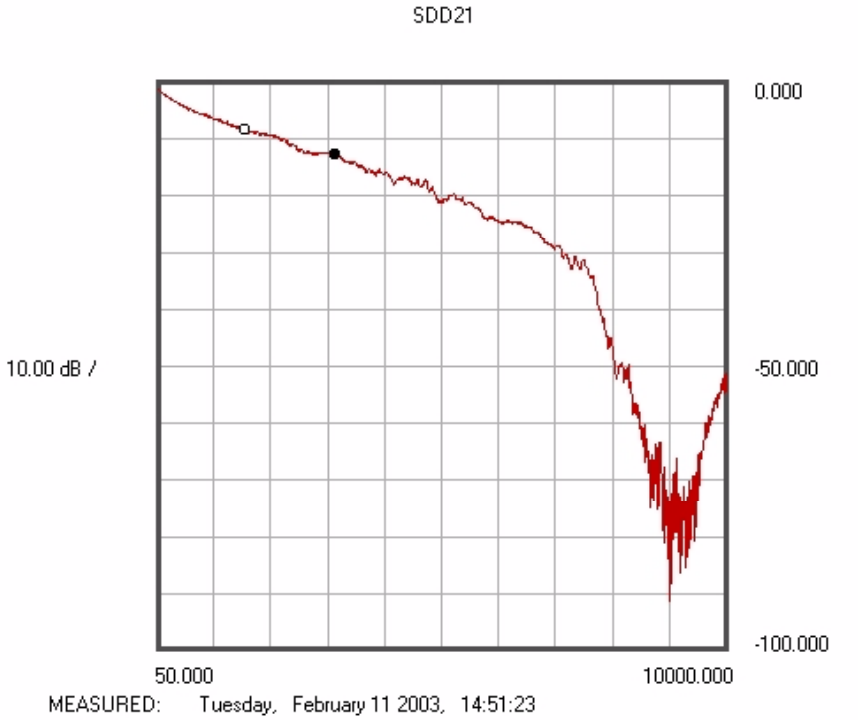
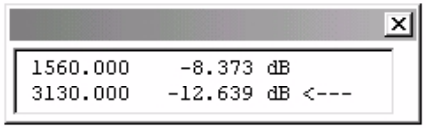
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & **5m**, 28AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- **Transmit pair: Test port S 15, S 16**
- **Receive pair: Test port S 1, S 2**

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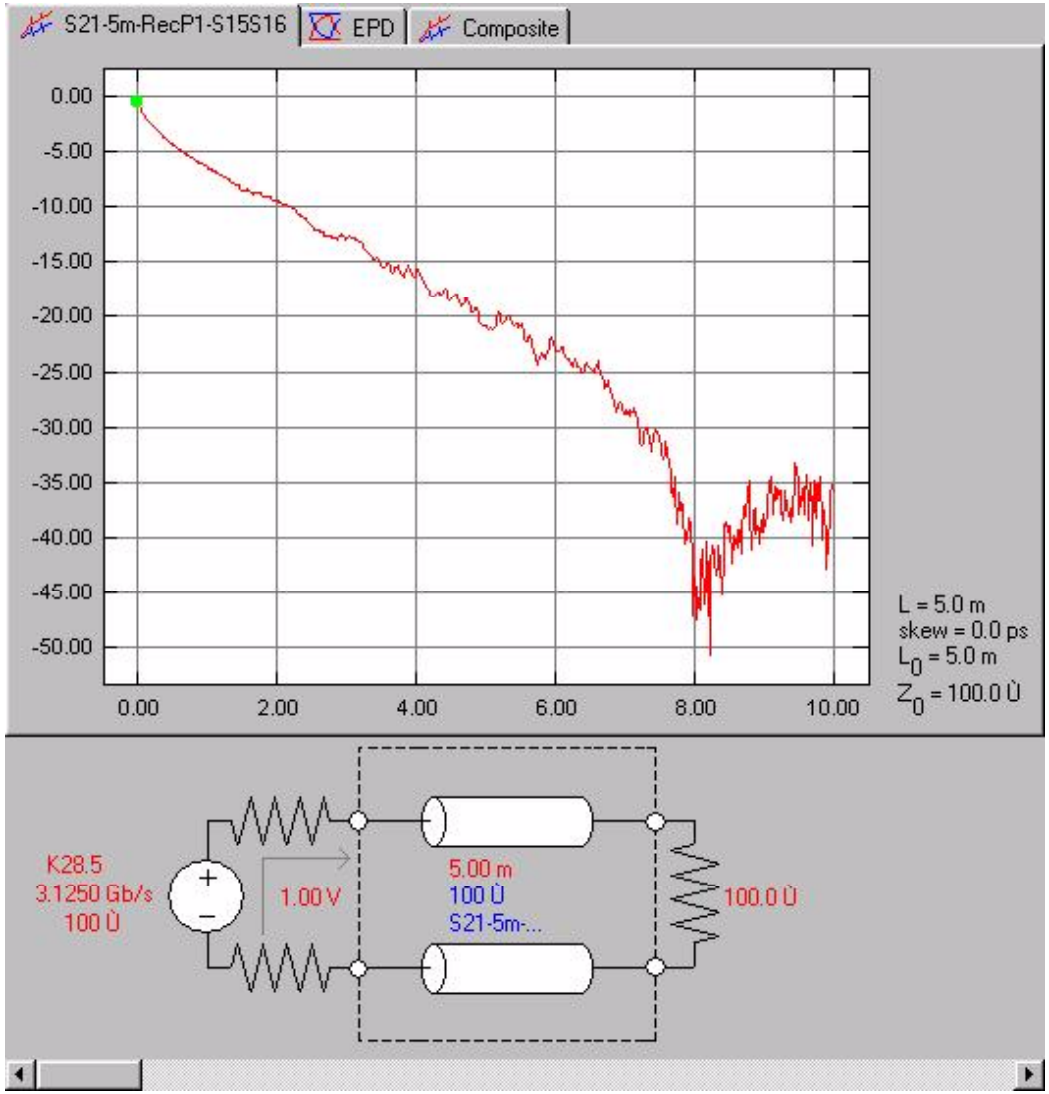
- Received Line: Test port S 15, S 16

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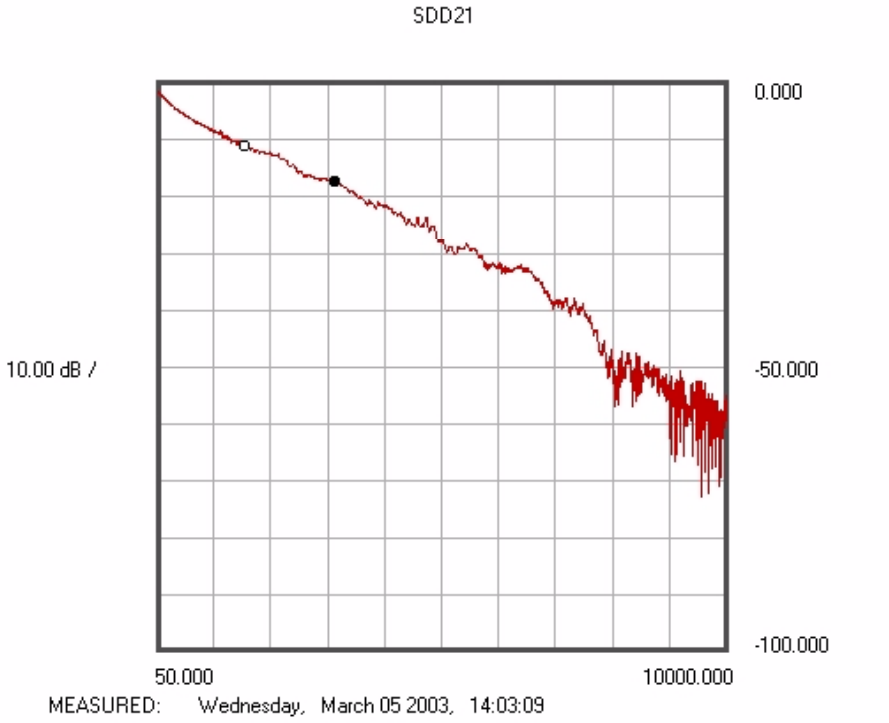
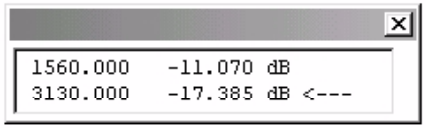
# Typical **S-parameters (SDD21)** Measurement By Network Analyzer - ATN

- Date: 3/5/03
- Temperature: 77.65 F
- Relative Humidity: 12.09 %
- Instrument: Network Analyzer HP8720ES & ATN 4112A
- Test Fixture: 4X Infiniband, FCI # SK-48295 Rev 2

- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End : P1
- **Transmit pair: Test port S 1, S 2**
- **Receive pair: Test port S 15, S 16**

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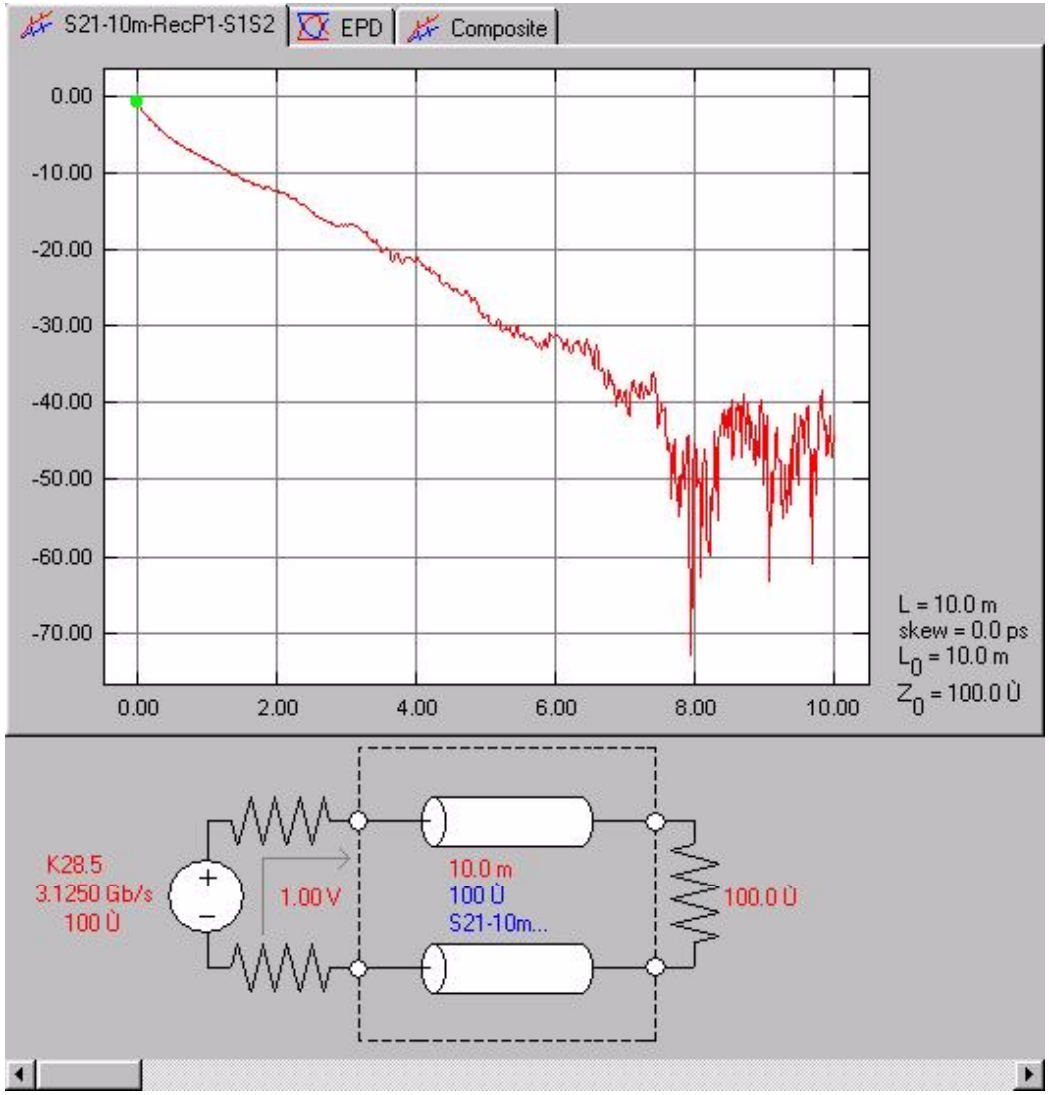


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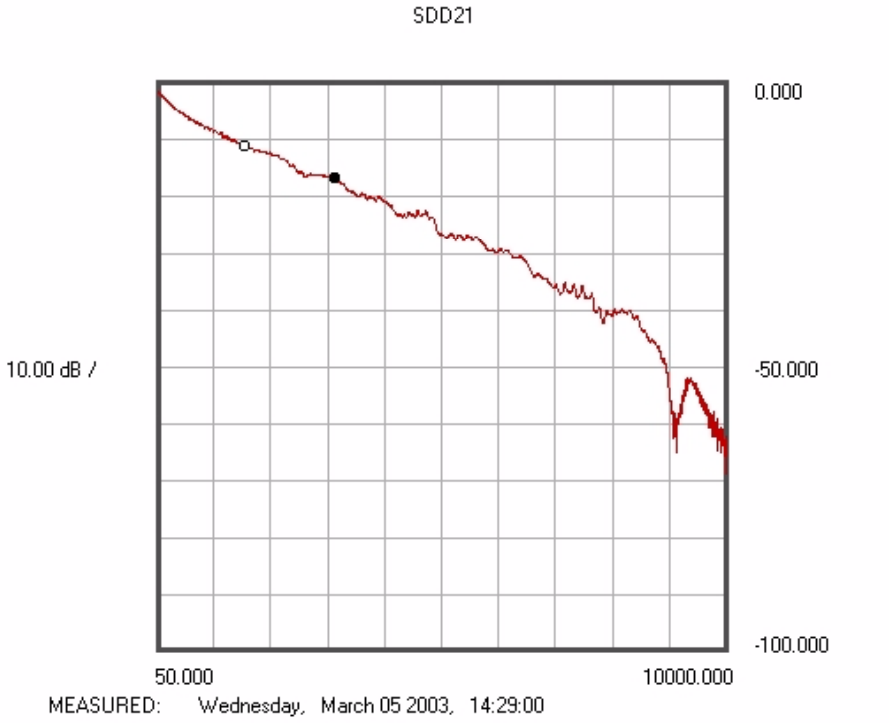
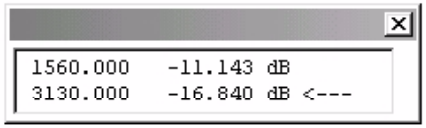
- Cable End: P1
- **Transmit pair: Test port S 3, S 4**
- **Receive pair: Test port S 13, S 14**

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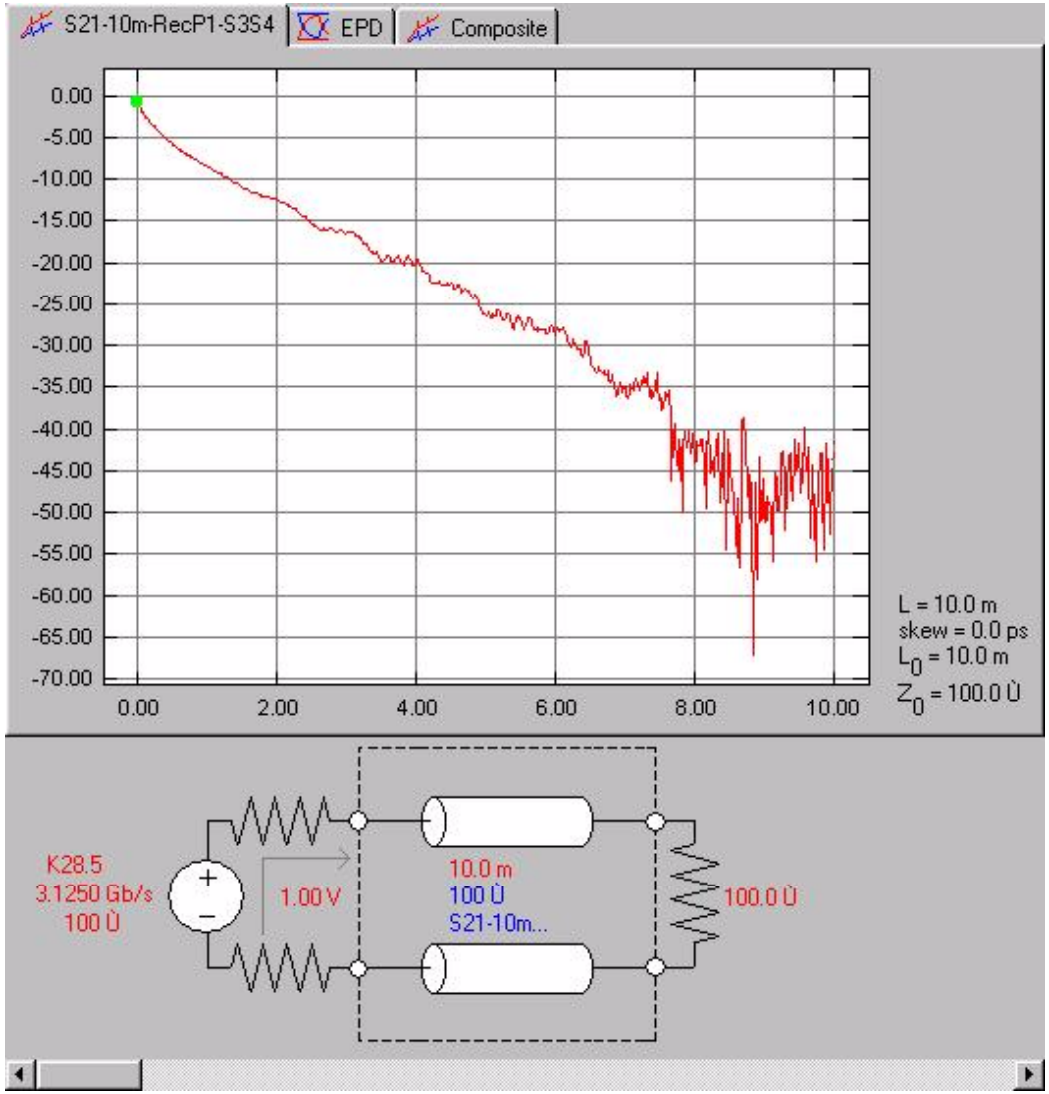


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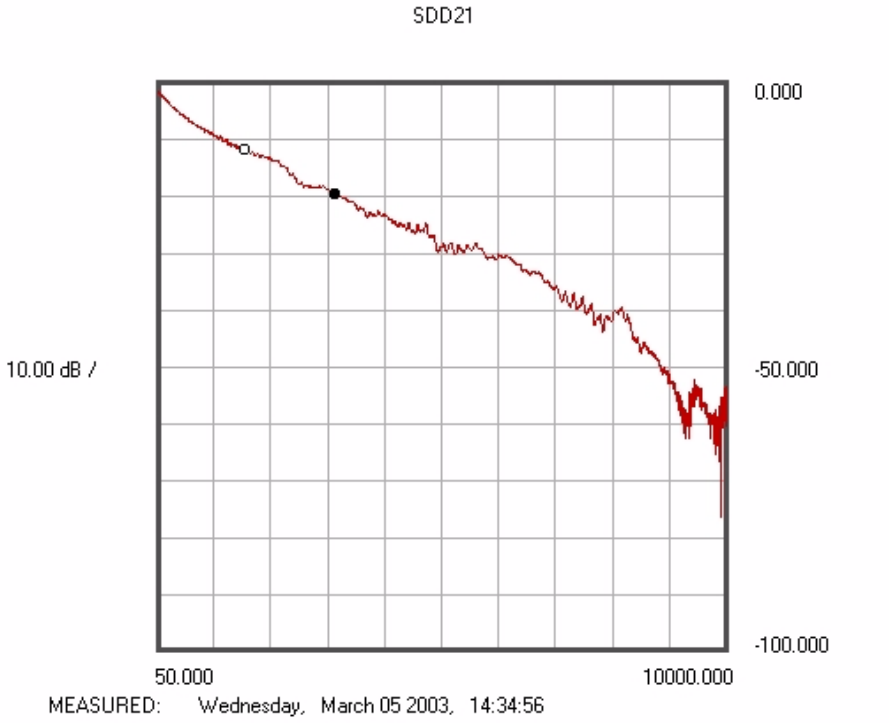
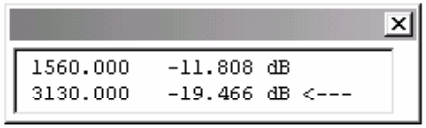
- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1
- **Transmit pair: Test port S 5, S 6**
- **Receive pair: Test port S 11, S 12**

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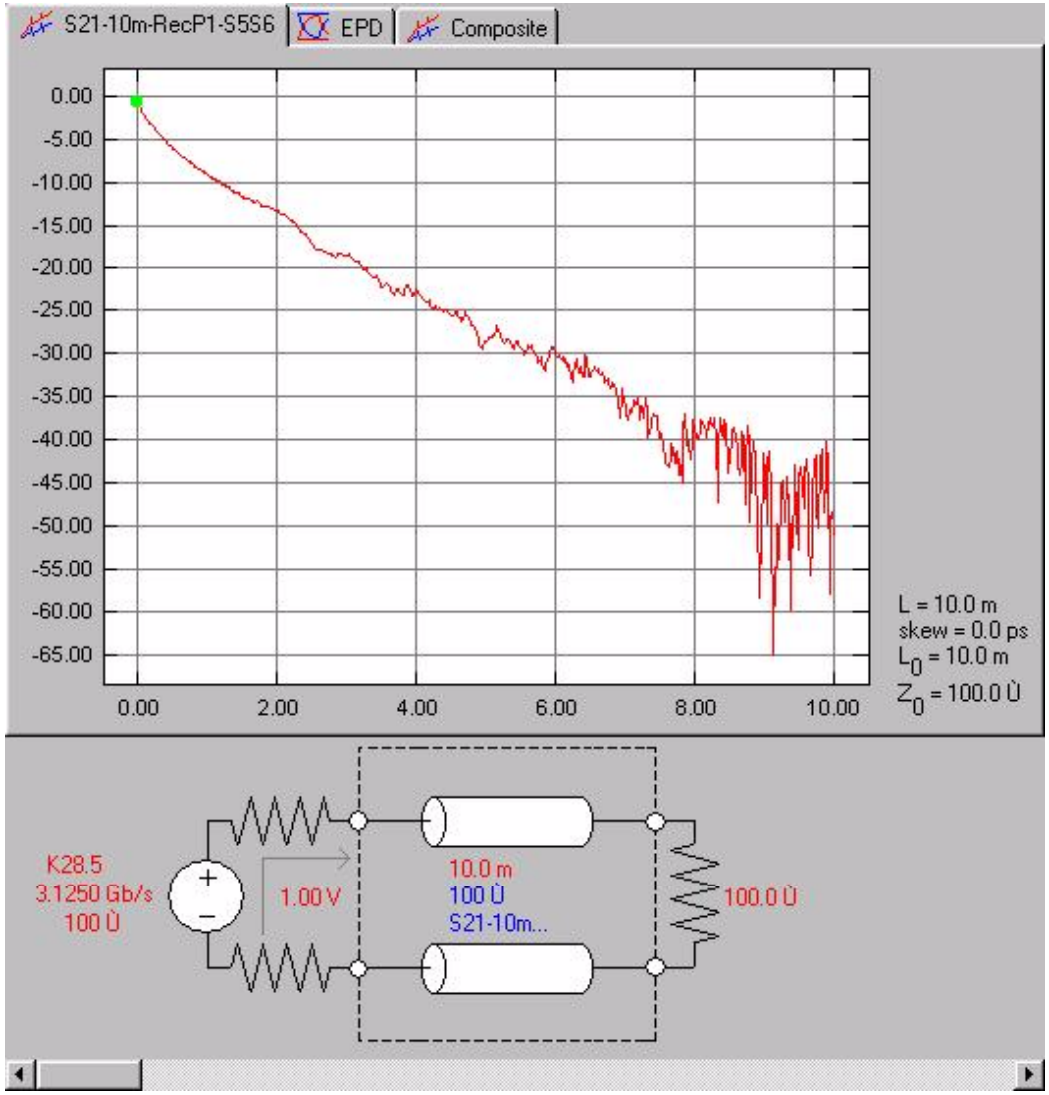


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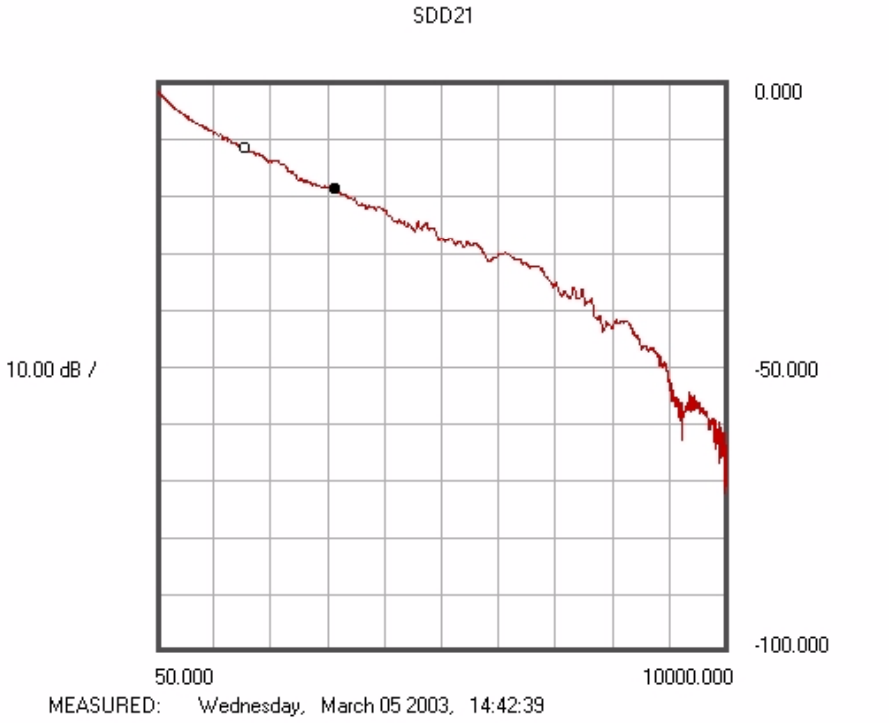
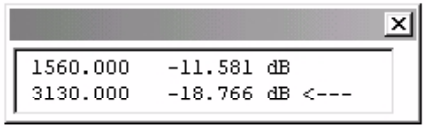
- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
- Cable End: P1
- **Transmit pair: Test port S 7, S 8**
- **Receive pair: Test port S 9, S 10**

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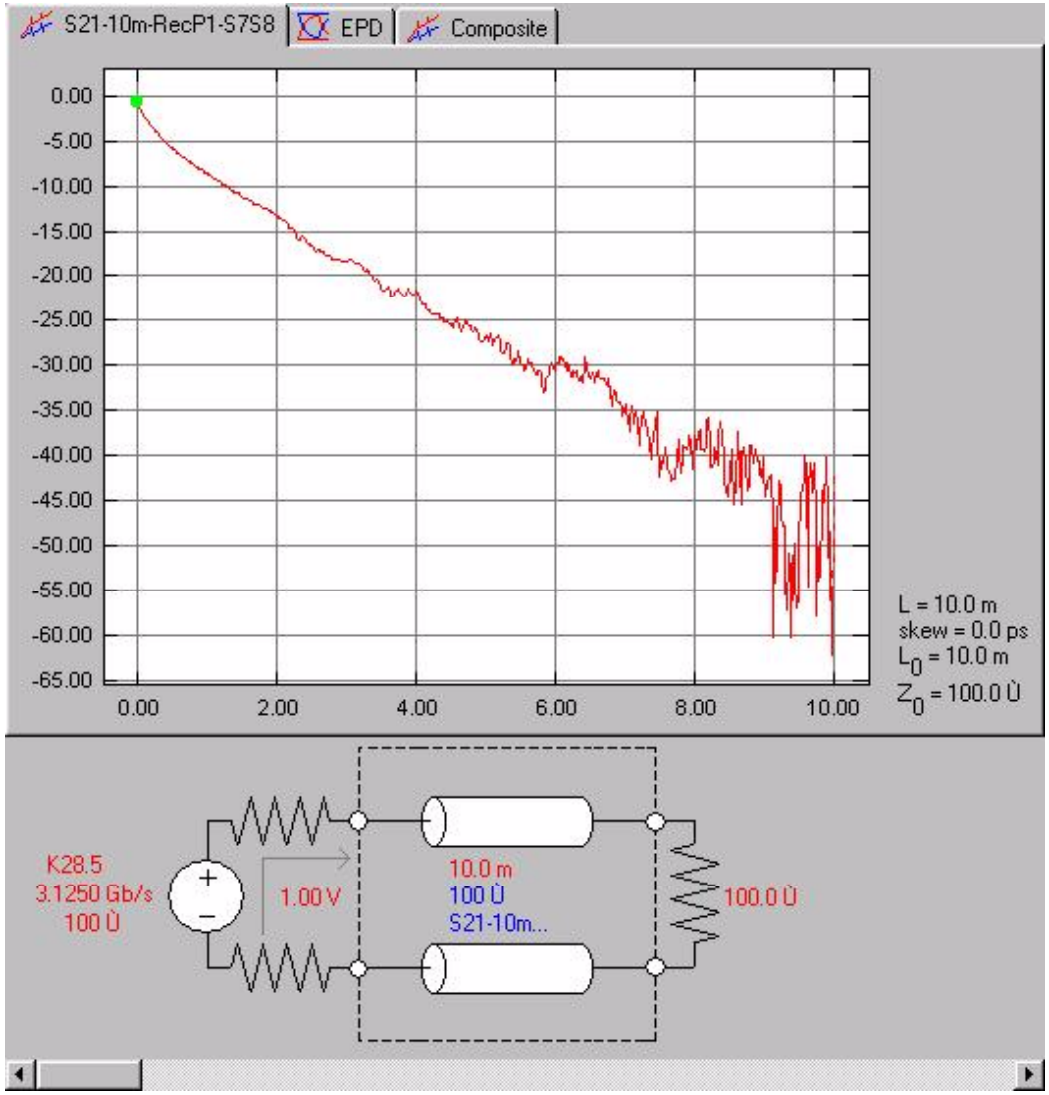
- Received Line: Test port S 7, S 8

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- Cable End: P1
- **Transmit pair: Test port S 9, S 10**
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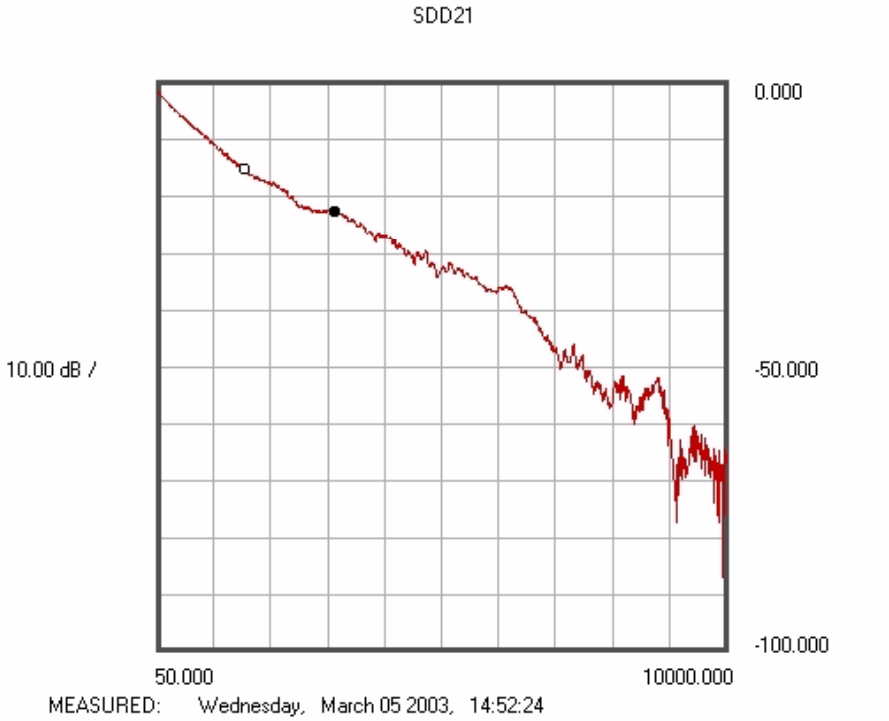


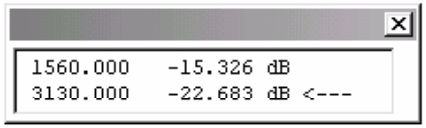


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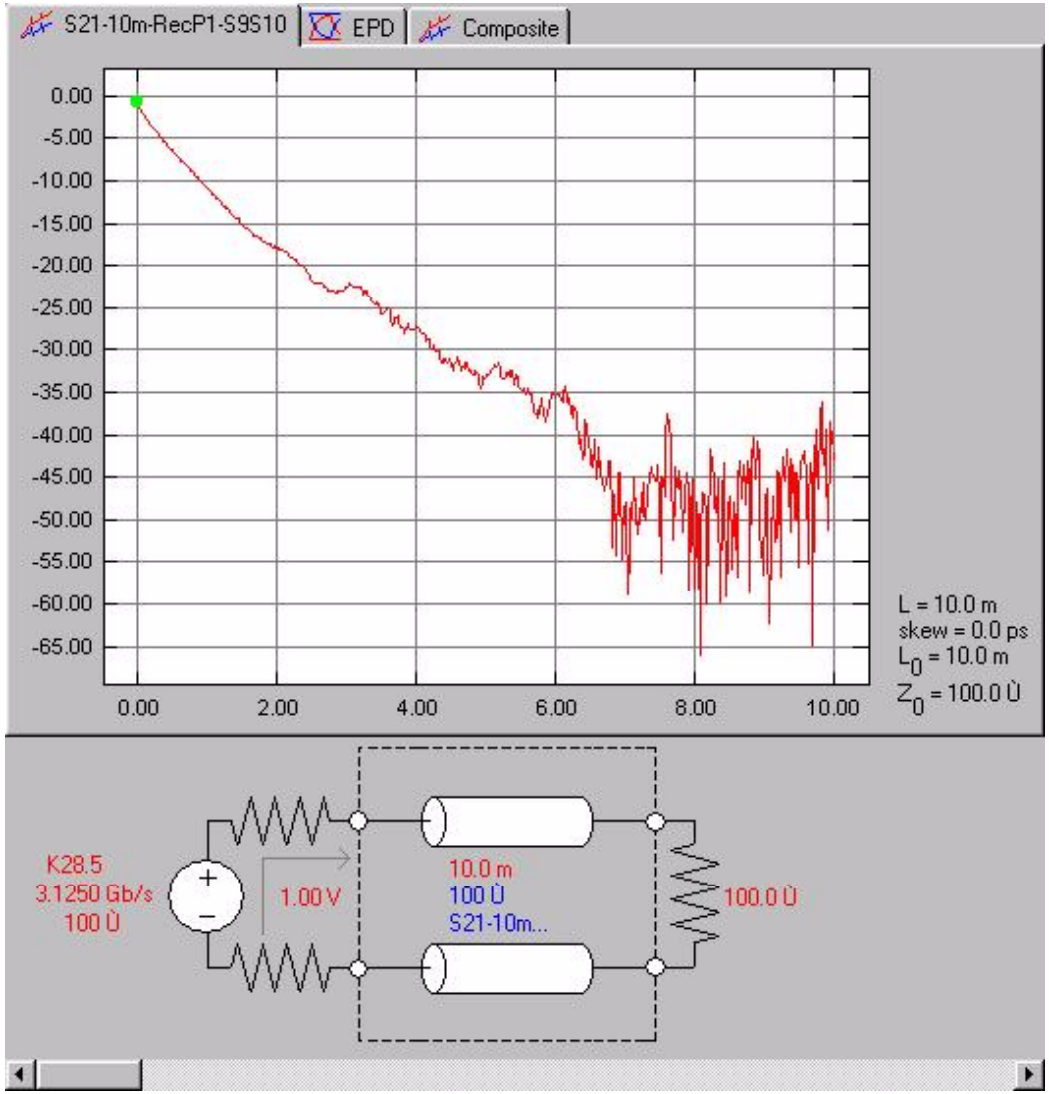


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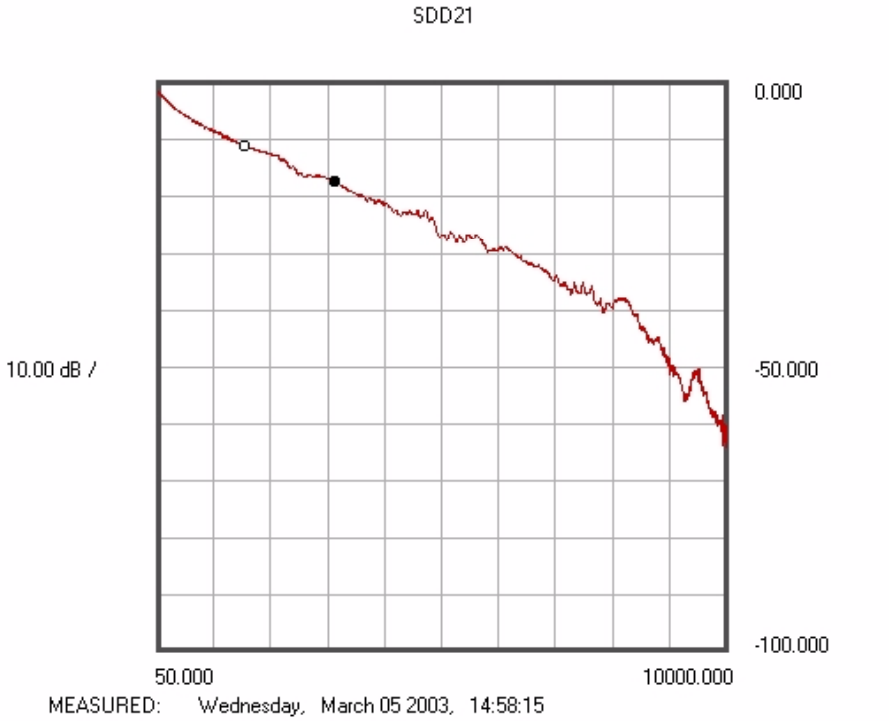


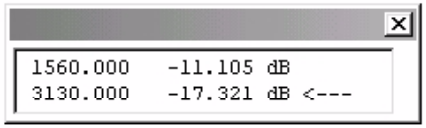


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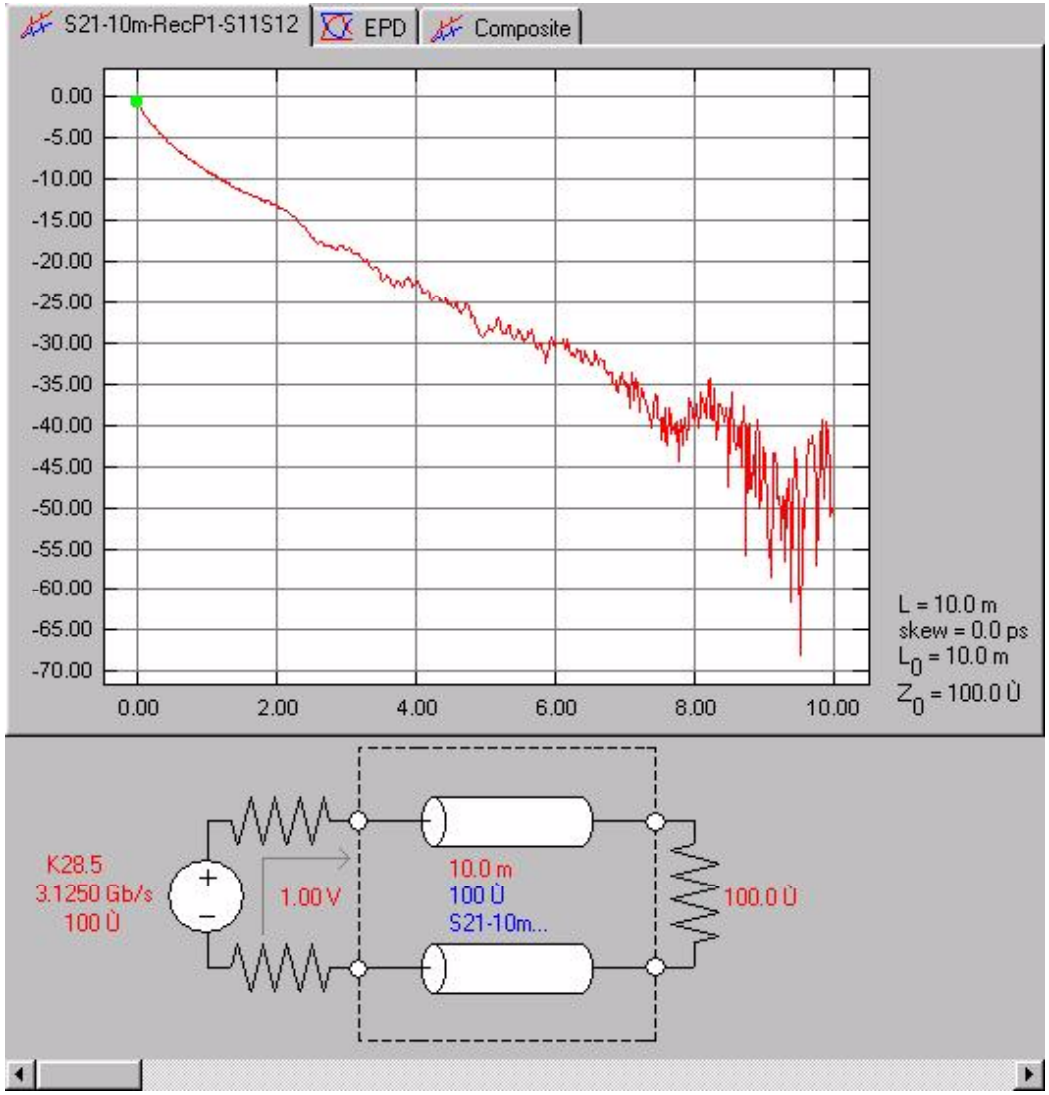


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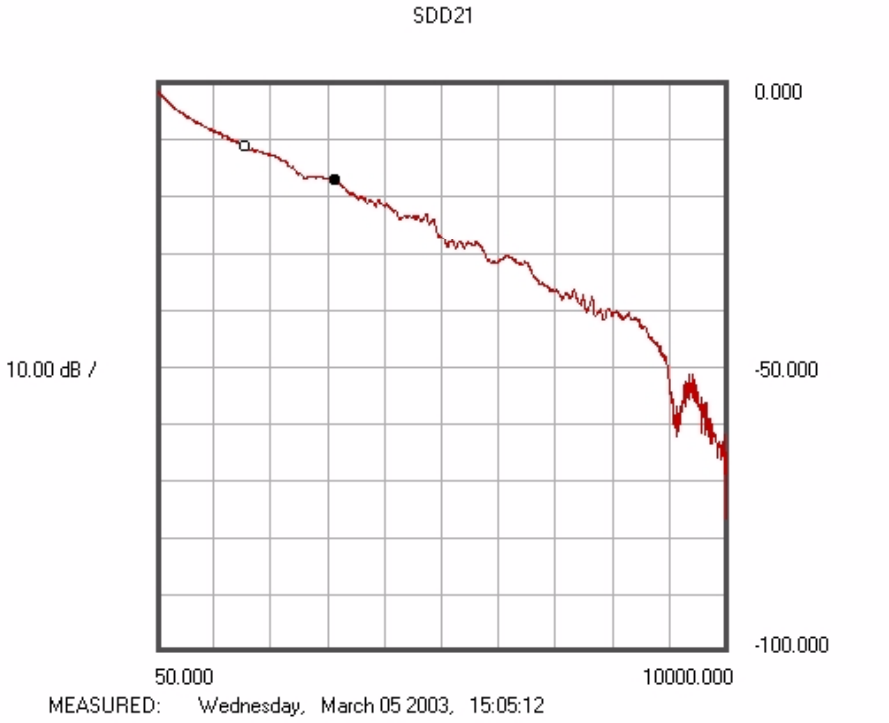


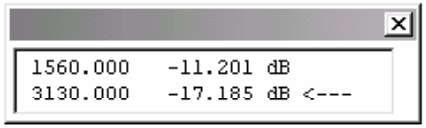


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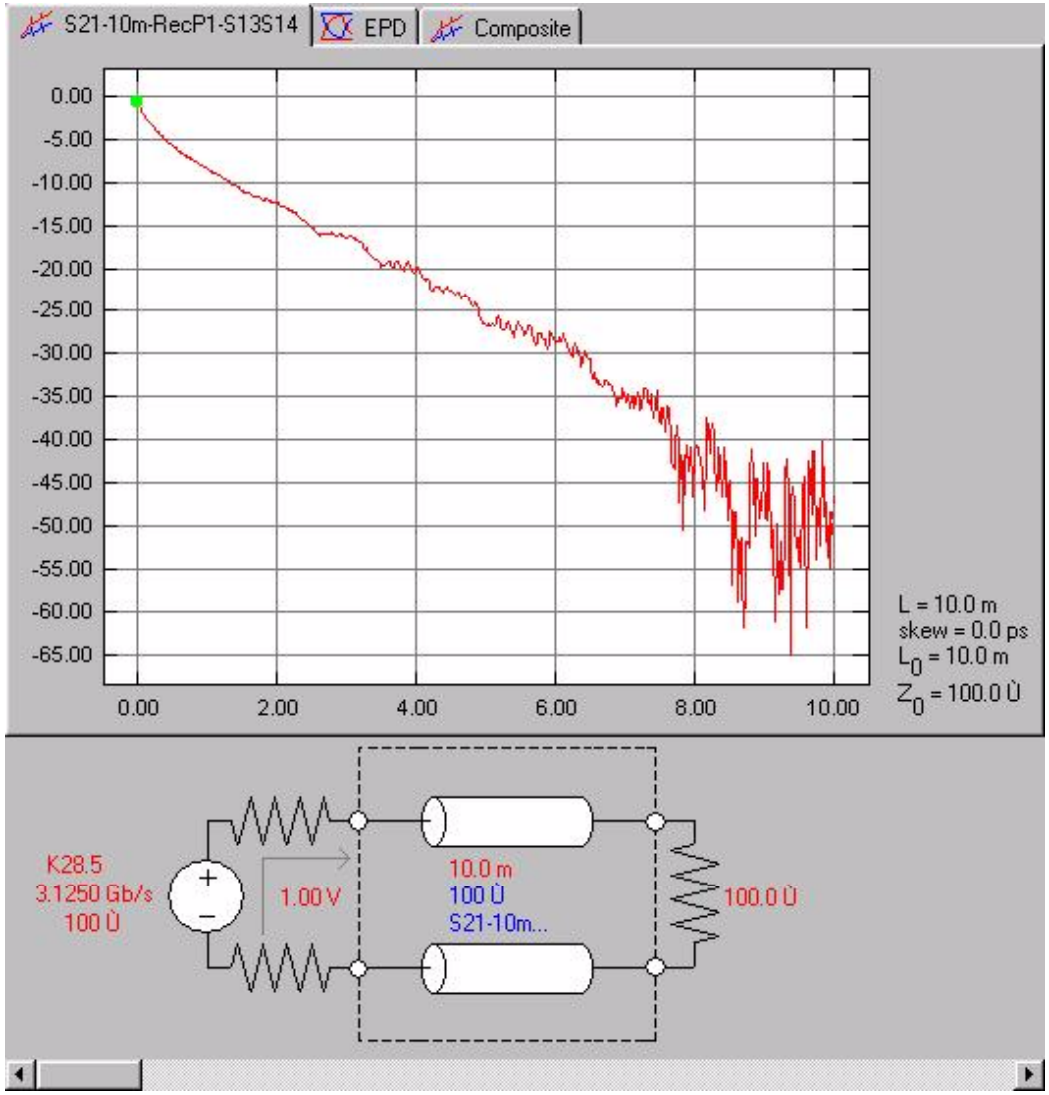


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- DUT: 4X Infiniband Test Board & 10m, 24AWG, Skewclear, 100 ohm differential, cable assembly with FCI plug board
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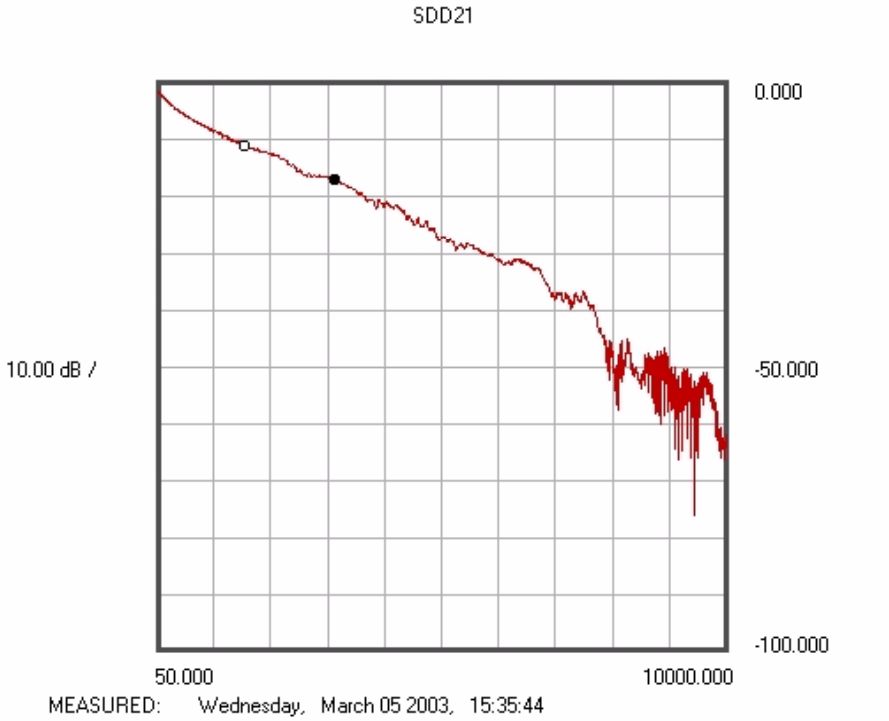
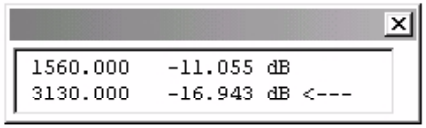
- **Transmit pair: Test port S 15, S 16**
- **Receive pair: Test port S 1, S 2**

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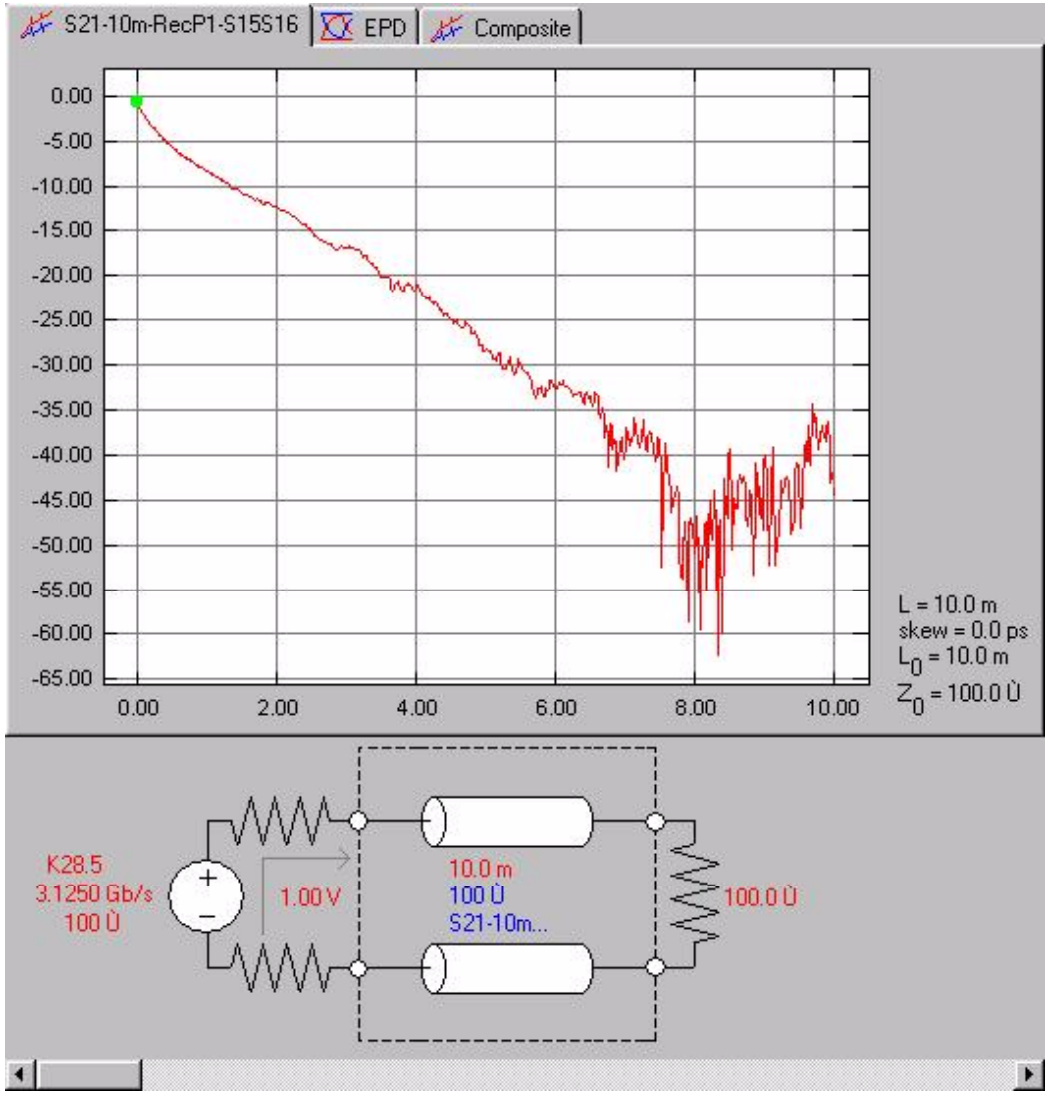


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