SFF-8470 (CX-4) / Copper Concepts for 802.3ba

Connector Business Group

FUJITSU COMPONENT LIMITED

Contributors

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Supporters

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IEEE 802.3ba Objectives

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The following are Fujitsu's commitments to the IEEE 802.3ba Objectives

- Support full-duplex operation only
- Preserve the 802.3 / Ethernet frame format utilizing the 802.3 MAC
- Preserve minimum and maximum Frame Size of current 802.3 standard
- Support a BER better than or equal to 10^{-12} at the MAC/PLS service interface
- Provide appropriate support for OTN
- Support a MAC data rate of 40 Gb/s
  - Provide Physical Layer specifications which support 40 Gb/s operation over:
    - ✓at least 100m on OM3 MMF
    - ✓at least 10m over a copper cable assembly
- Support a MAC data rate of 100 Gb/s
  - Provide Physical Layer specifications which support 100 Gb/s operation over:
    - ✓at least 40km on SMF
    - ✓at least 10km on SMF
    - ✓at least 100m on OM3 MMF
    - ✓at least 10m over a copper cable assembly

Presentation Objectives

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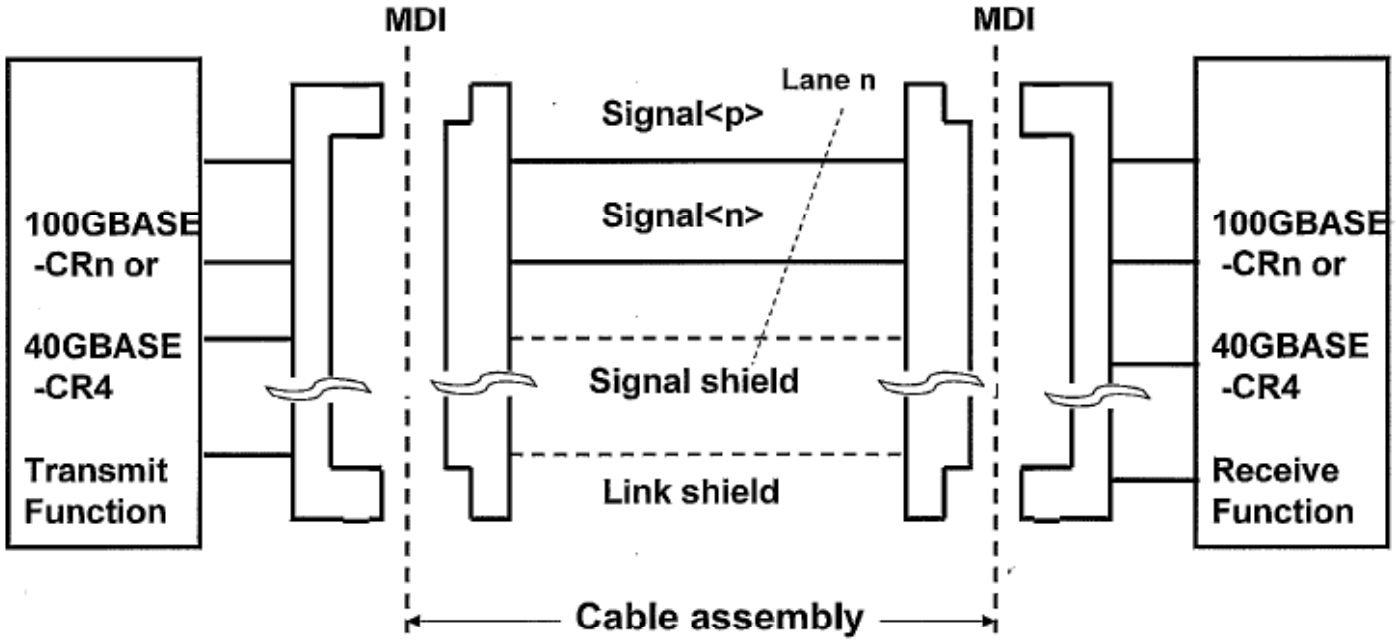
This presentation will provide information regarding:

- The 10Gbps/lane performance adherence of the SFF-8470 (current IEEE 802.3ak CX-4 I/O interface) connector and 10 meter cable link reach according to the S-Parameter Return Loss, Insertion Loss and Cross-talk criteria as defined by 10GBASE-KR.
- The measurement and HSPICE simulation of the SFF-8470 (current CX-4) connector and 10 meter cable link.
- Demonstrate the performance of the SFF 8470 connector and 10 meter cable assembly with the CX4/IBTA MDI.
- The feasibility of the SFF 8470 connector as a viable connector candidate for IEEE 802.3ba compliant cable system.

IEEE 802.3ba Link Model



SFF-8470 / CX-4 Connector Structure

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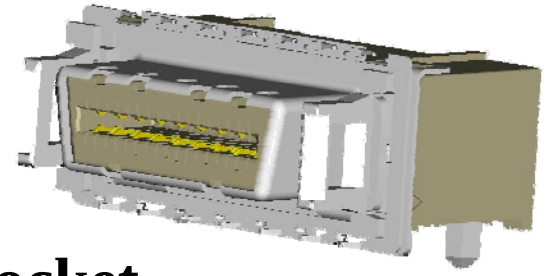
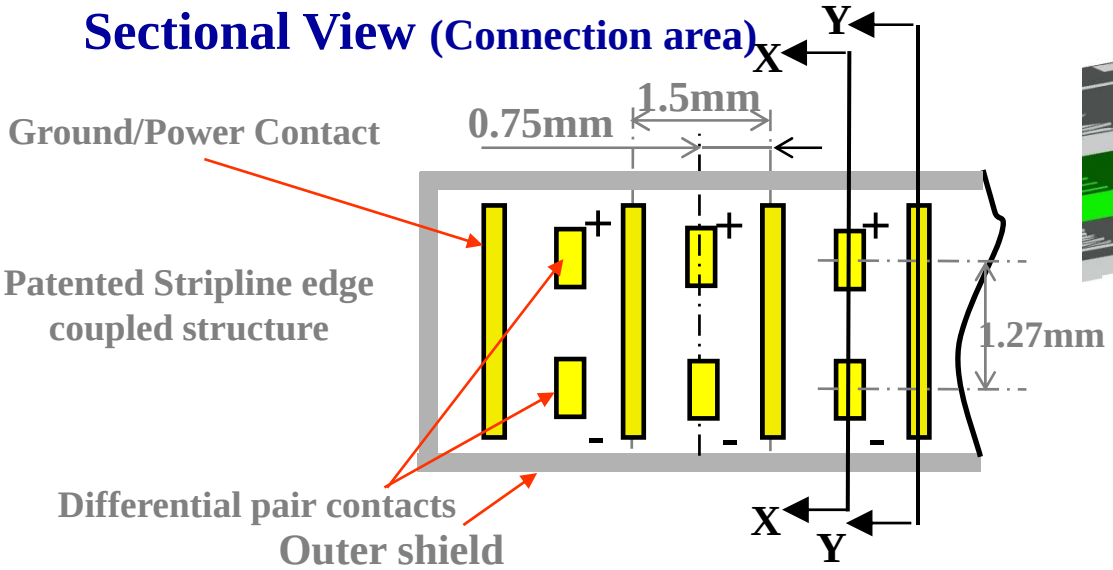
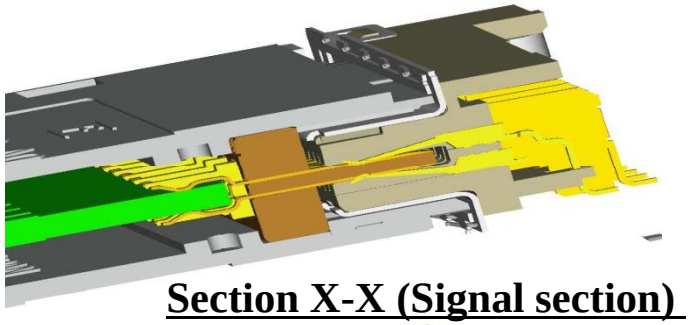
Cover , Plug



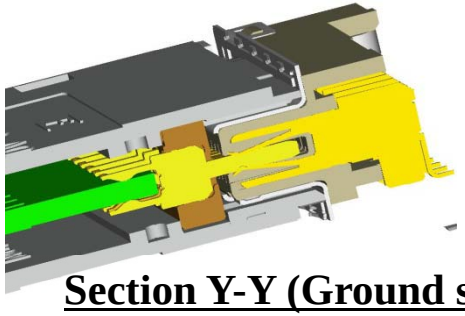
Socket

Sectional View (Connection area)





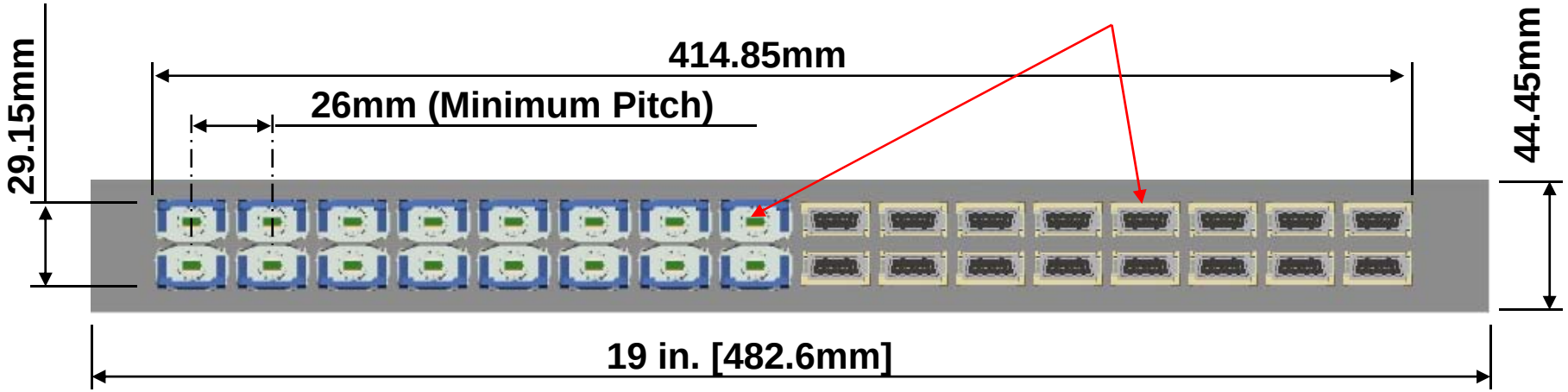
Section X-X (Signal section)



Section Y-Y (Ground section)

SFF-8470 (CX-4) Rack Density

4 Full Duplex Lanes/Connector



2 Lines x 16 connectors = 32 Connectors
4 Lanes/Connector x 32 Connector = 128 Lanes

Connector and Cable assembly 24AWG 10m Frequency Domain Measurement Set-up

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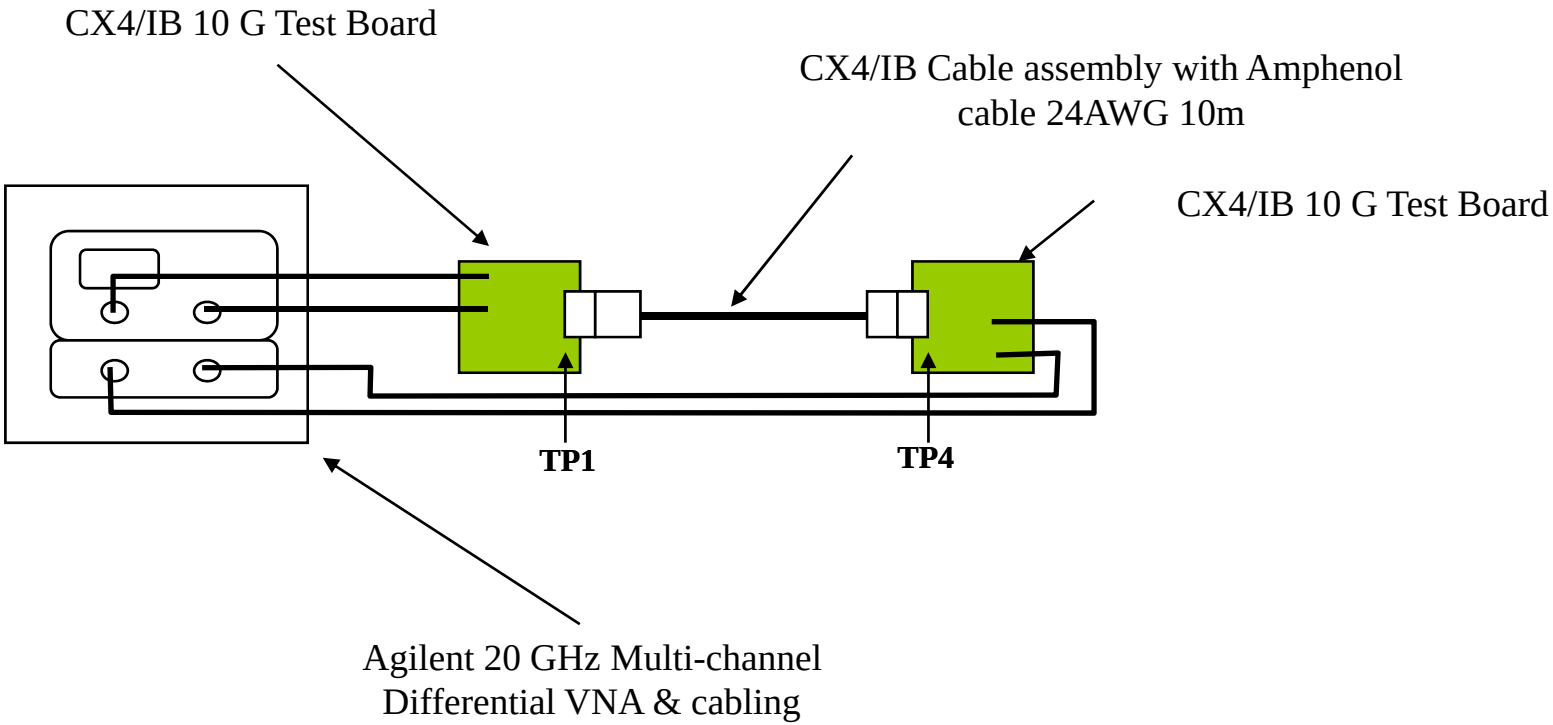
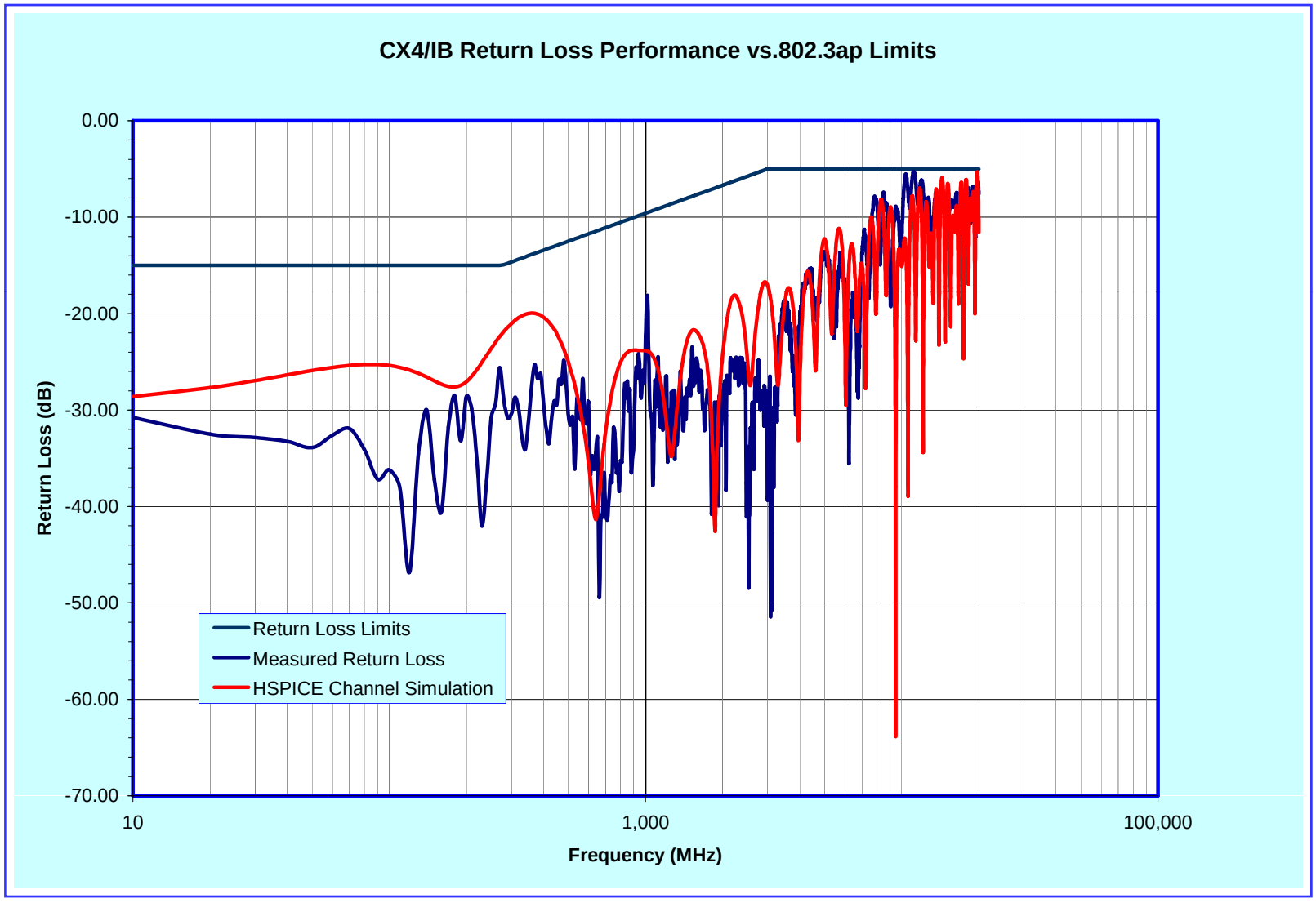
Return Loss (IL(f) Measurement



SFF-8470 (CX-4) + 10 meter SkewClear EXD Cable Channel Return Loss Compliance



Connector and Cable assembly 24AWG 10m Frequency Domain Measurement Set-up

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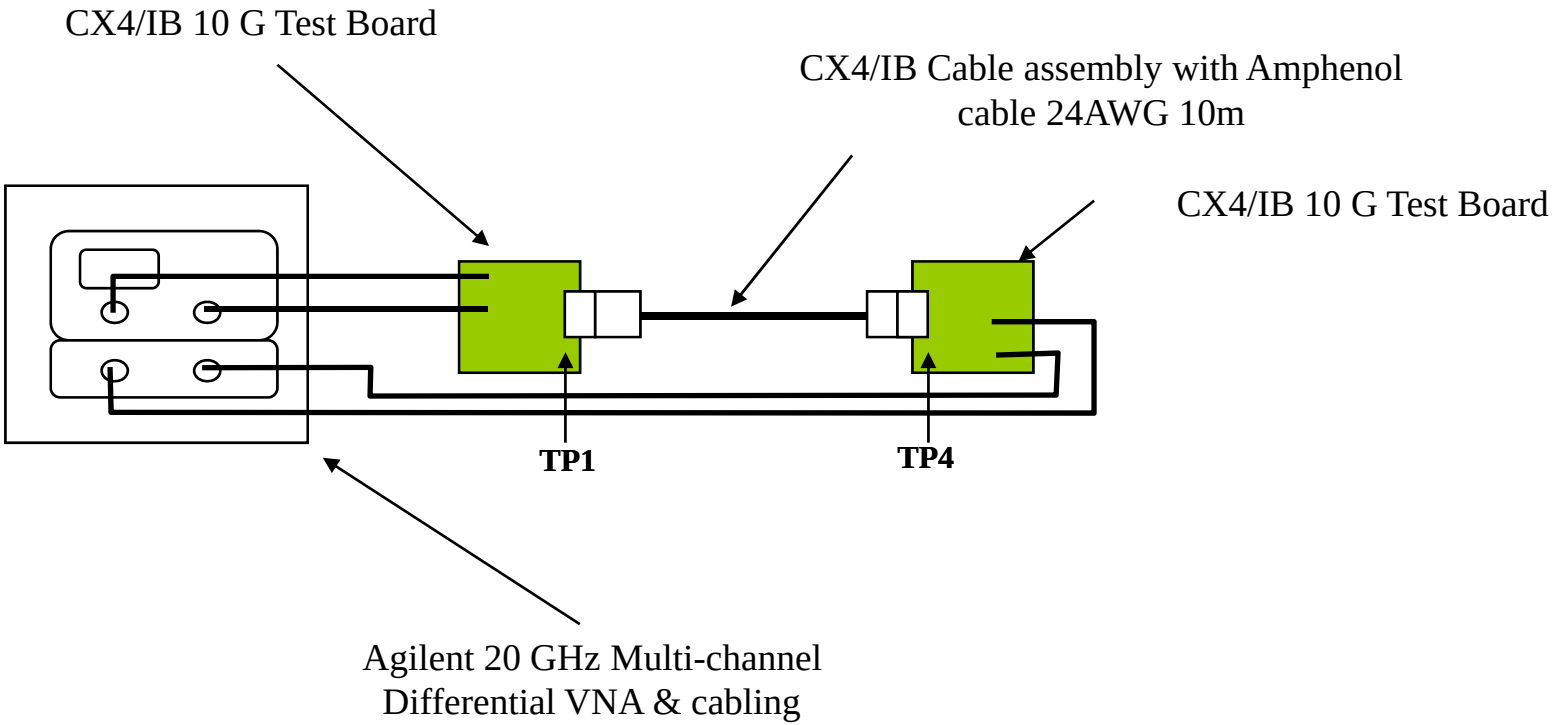
Insertion Loss IL(f) Measurement Set-up



SFF-8470 / CX-4 + 10 meter SkewClear EXD Cable
Channel Insertion Loss Compliance

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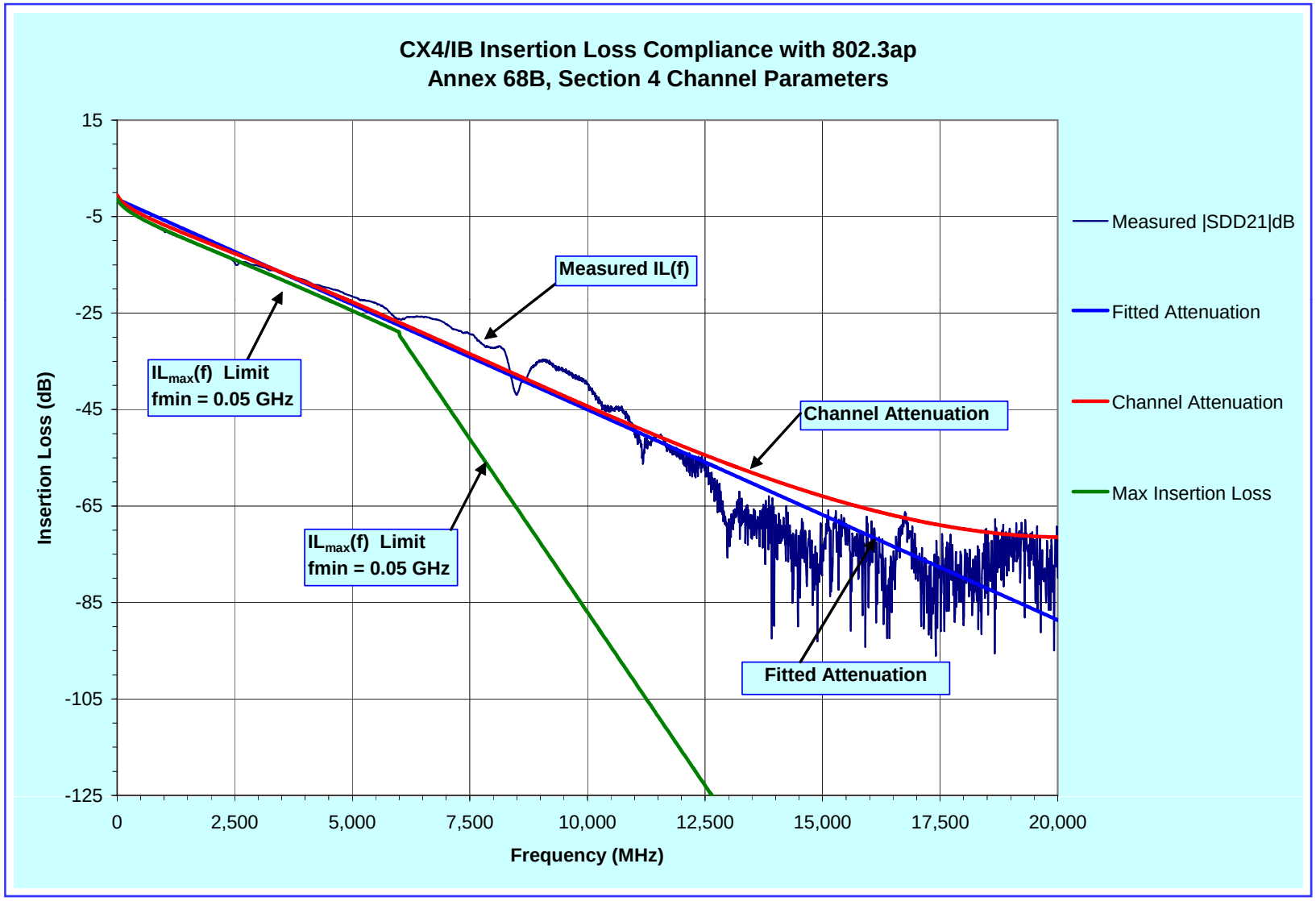
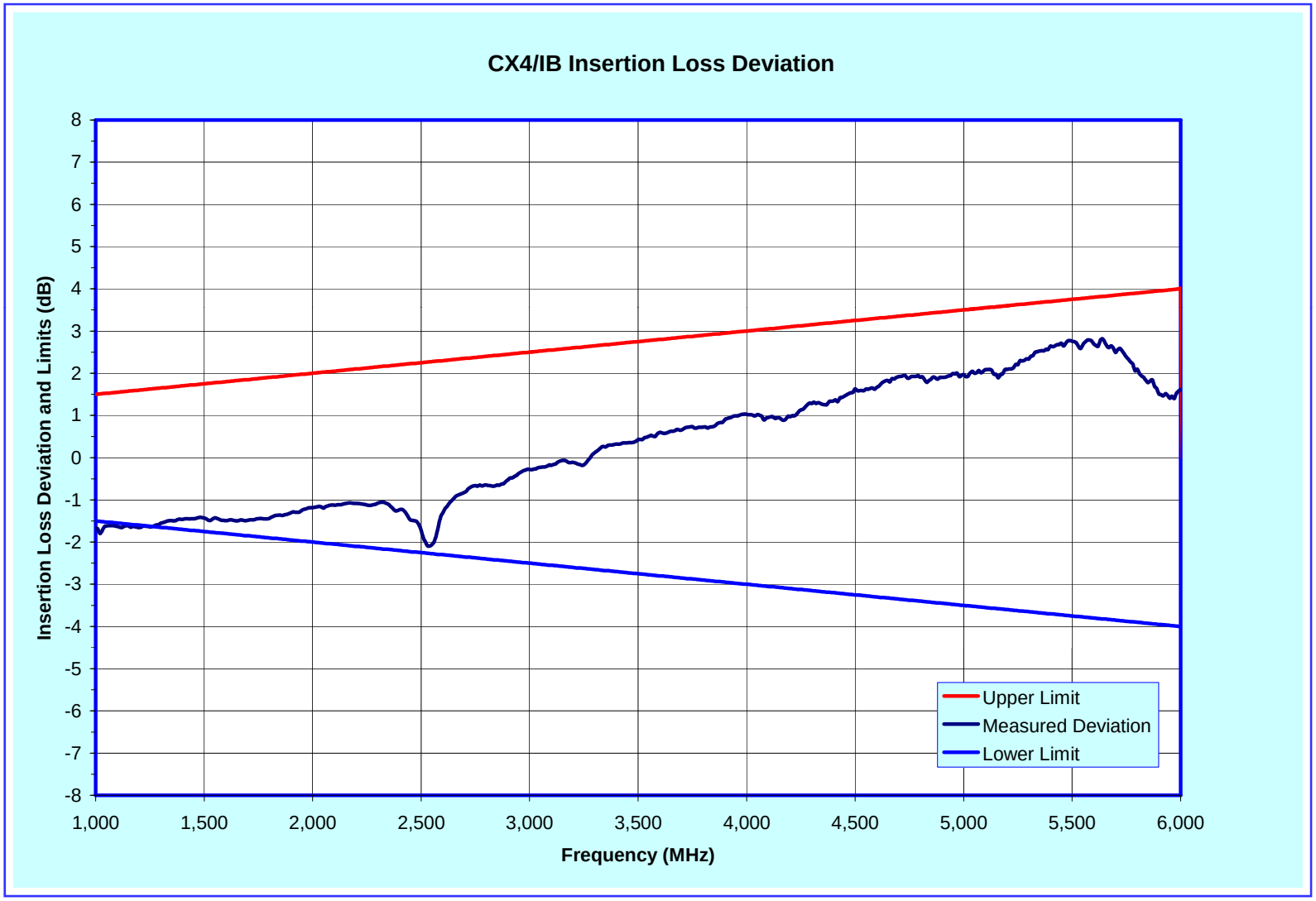
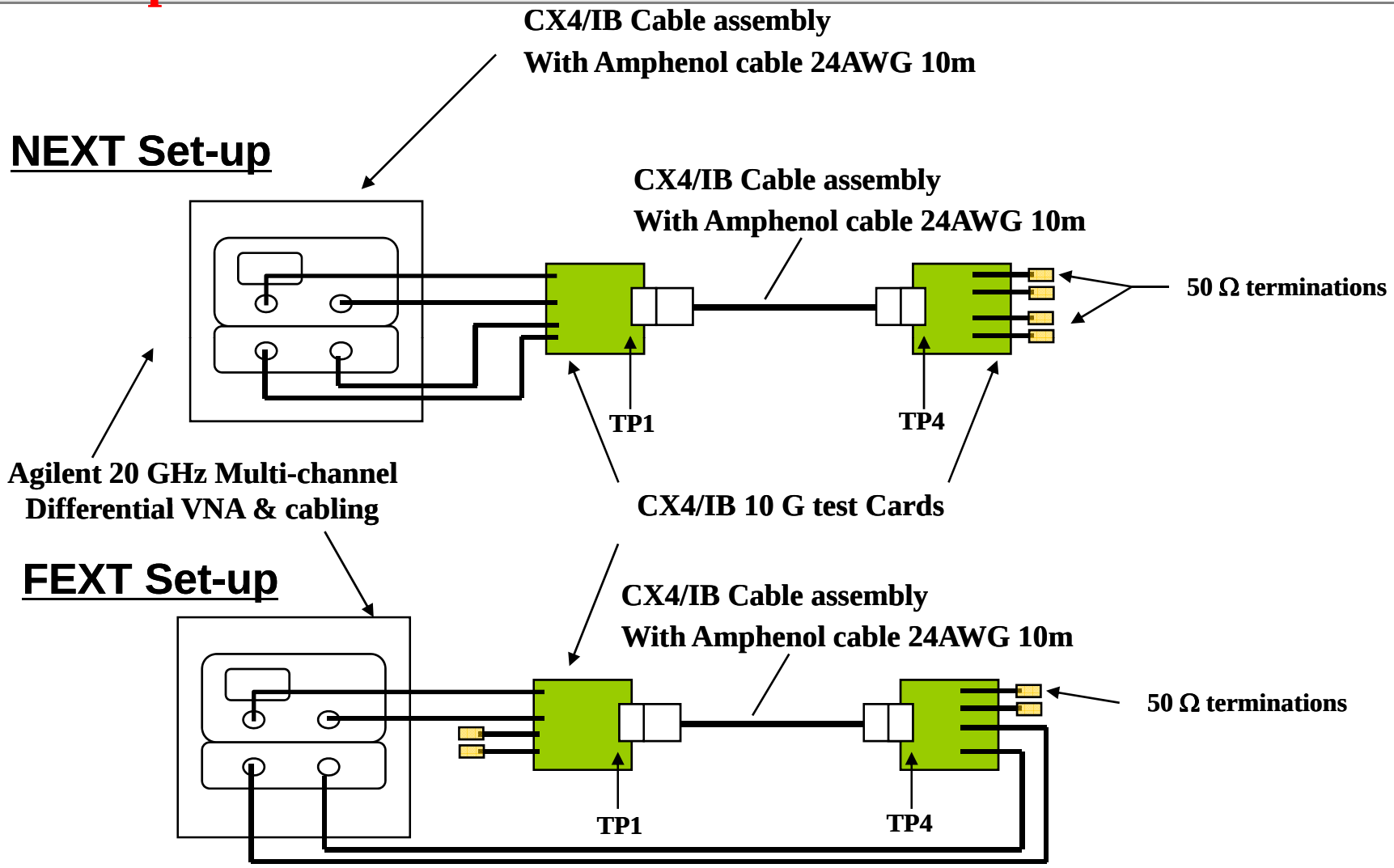


SFF-8470 (CX-4 CN) + 10 meter SkewClear EXD Cable Insertion Loss Deviation

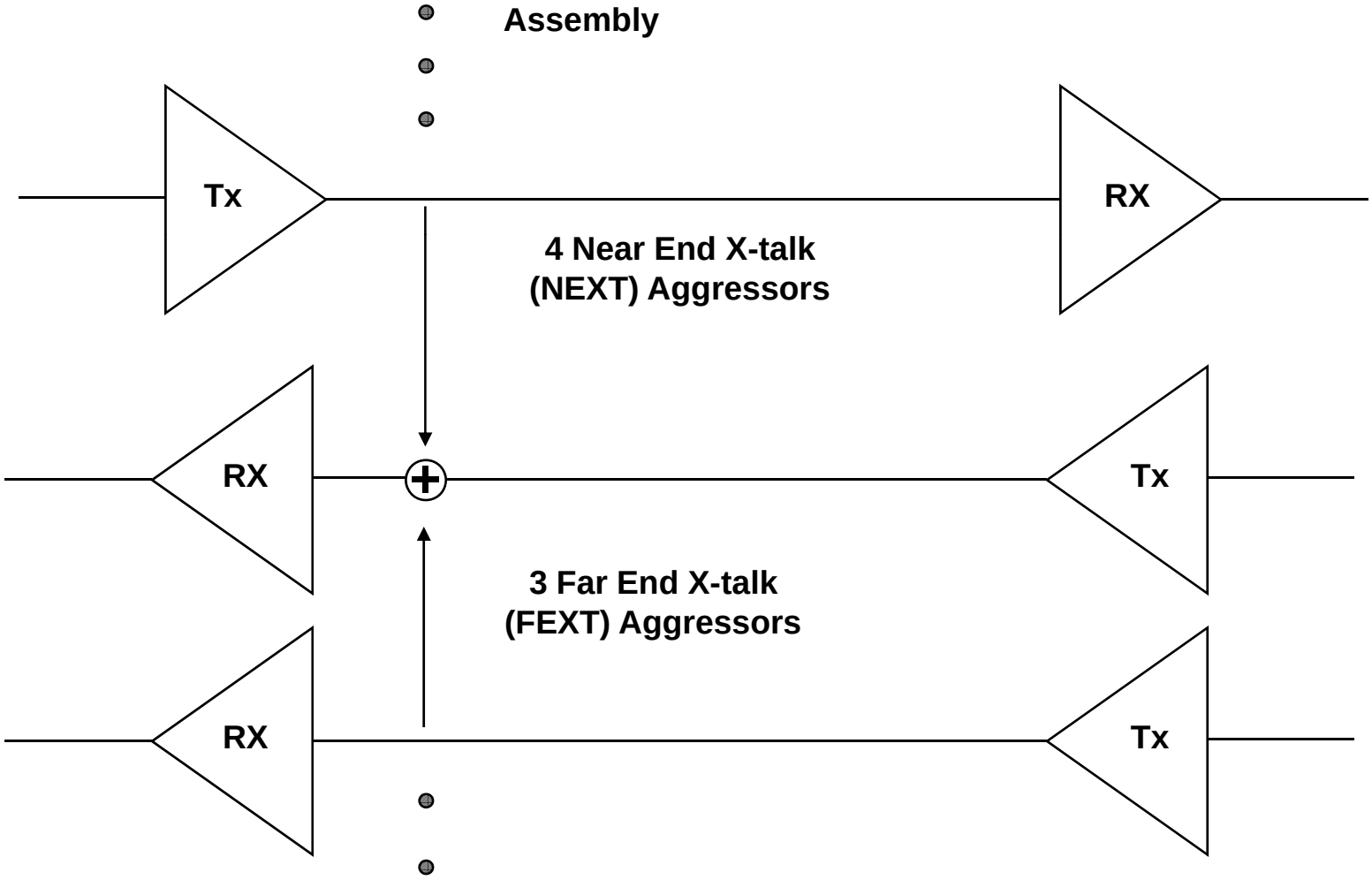


SFF-8470 (CX4 CN) NEXT/FEXT Measurement Set-ups



802.3 CX-4 Channel Insertion Loss to Crosstalk Ratio

Insertion Loss to Crosstalk Ratio computed from S-Parameter Insertion Loss and Crosstalk Components of the 10 meter CX-4 SkewClear EXD Copper Cable Assembly



SFF-8470 Insertion Loss and Crosstalk Parameters: NEXT, FEXT, PSNEXT, PSFEXT and PSXT(f)

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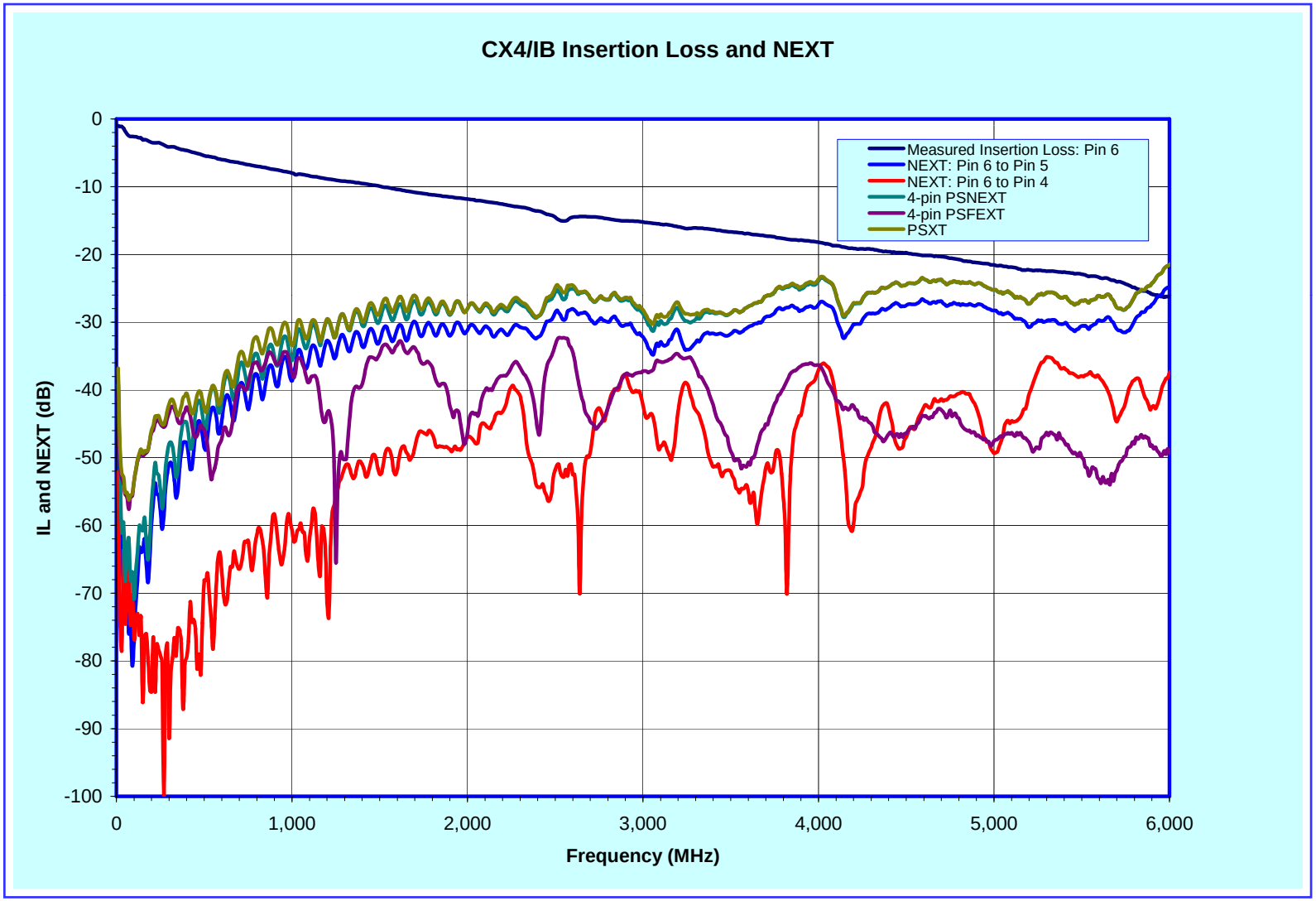
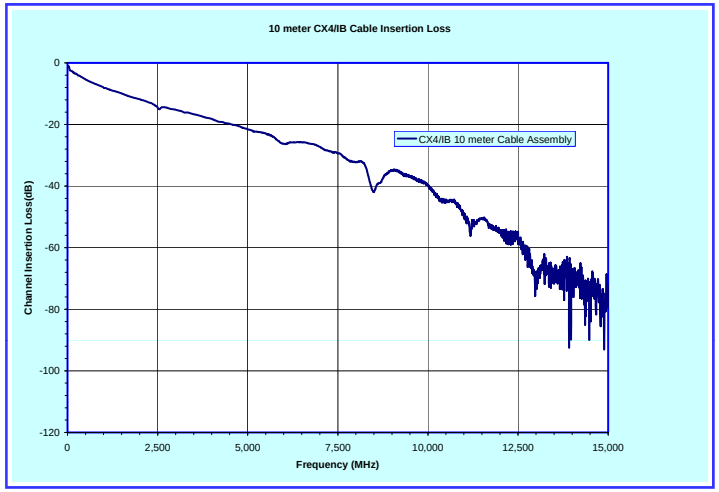
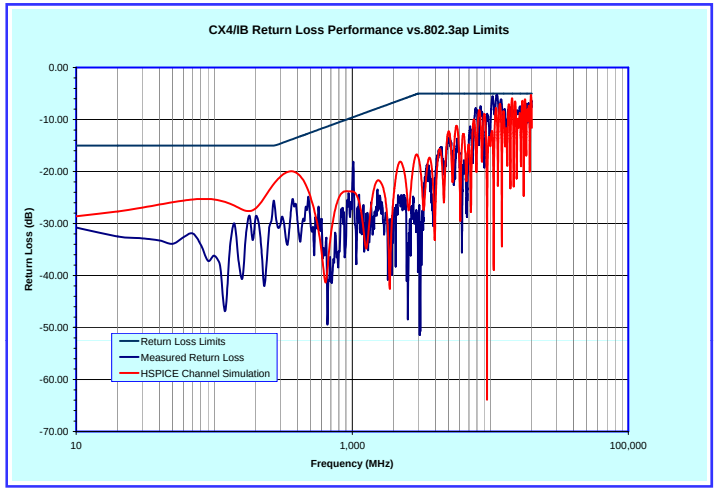
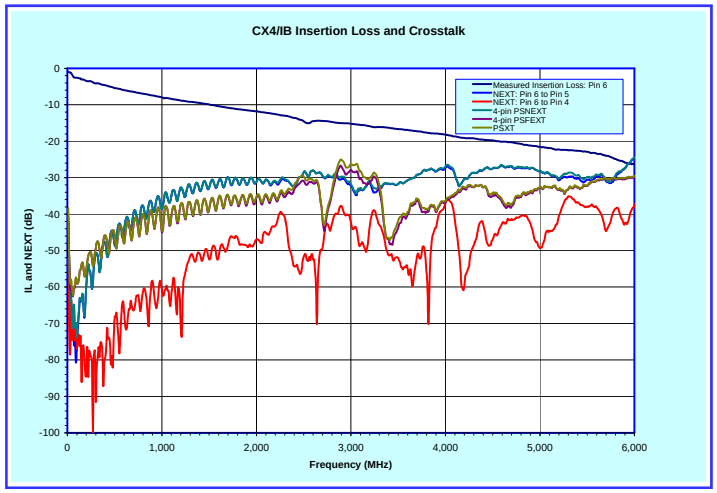
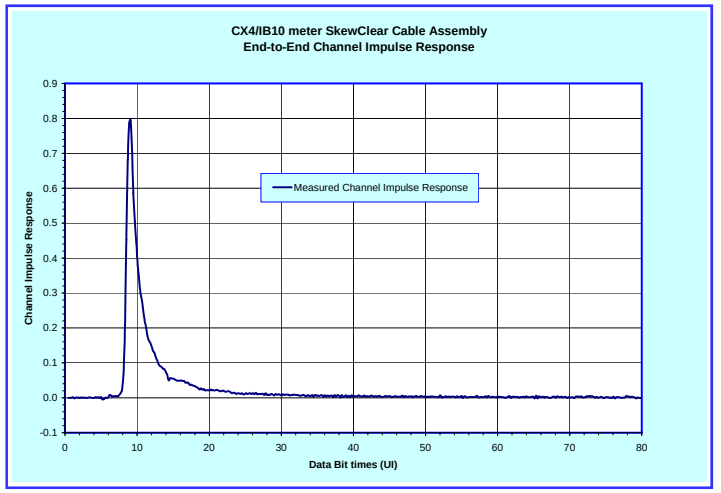


SFF-8470 10 meter Cable Assembly Impulse Response Channel Model









NESA HSPICE Modeling Results

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- A circuit element model for the SFF-8470 connector has been developed from TDR measurements. The model includes both the signal and ground paths as well as the receptacle paddle card. Vias and transmission lines are individually accounted for. Model and footprint adjustments are straightforward. Extremely useful for 802.3ba channel studies.
- The 10 meter SkewClear EXD RLGC model used is measurement based and optimized to match the Insertion Loss and Return Loss at multiple frequency points.
- The 10G test cards have been end-to-end modeled including the high performance SMA differential launches. Channel model easily extracted as well as S-Parameter file. Extremely useful for 802.3ba channel studies.

Summary of SFF-8470 (CX-4) Measurement and Modeling Results for IEEE 802.3ba Compliance

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- The measurements, modeling and analyses of the SFF-8470 (CX-4) connector and attached 10 meter cable assembly show the following compliance:
  - The Return Loss, both measured and HSPICE end-to-end circuit model meet the 802.3ap Return Loss limits.
  - The measured Insertion Loss satisfies the maximum attenuation limit. The fitted data as well as the HSPICE end-to-end circuit model are lower than the 802.3ap maximum attenuation limit.
  - The channel model is well behaved and what is to be expected from a dispersive interconnect.
  - The current SFF-8470 based cable assemblies will meet the requirements of 802.3ba.

Applying SFF-8470 (CX-4) to 802.3ba

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- Fujitsu states that the following is possible for SFF-8470 connectorized cable assemblies:
  - Incrementally improve the existing SFF-8470 connector receptacle to improve Signal Integrity performance through the introduction of improved ground shields and signal contacts.
  - Develop a direct cable attach connector solution for passive cable assemblies that is interface compatible with existing passive or active receptacles to improve SFF-8470 connector crosstalk. Compatible with existing passive receptacles.
  - An active cable design(1) using 10 G or 25 G semiconductor equalizer components mounted on a paddle card behind the connector plug and compatible with existing passive and/or powered receptacles.

(1) “Considerations for Active Cables for Higher Speed Ethernet”, Gourgen Oganessyan, Quellan, Inc. , Presentation to IEEE802.3 November 2007

SFF-8470 CX4/IB Option for 802.3ba

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Interconnect Options Supporting Active Cable

- A power delivery option to the plug connector
- A twin-ax type cable
- There are two connector candidates for a 4x10G Solution already supporting this

QSFP

InfiniBand/CX4

QUELLAN
MORE SIGNAL | LESS NOISE

(1) “Considerations for Active Cables for Higher Speed Ethernet”, Gourgen Oganessyan, Quellan, Inc. , Presentation to IEEE802.3 November 2007

SFF-8470 (CX-4) Active Paddle Card Concept

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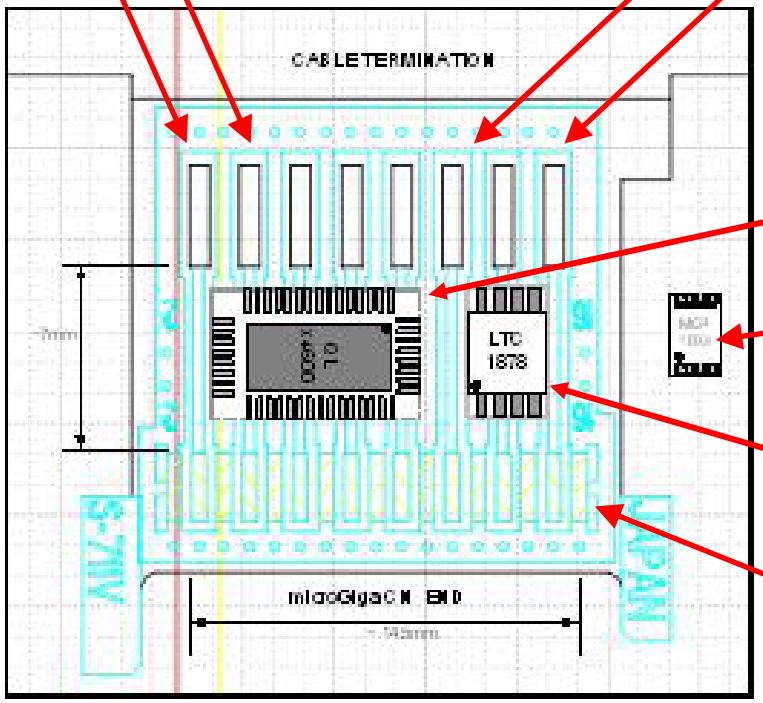

Summary

- SFF-8470 (CX-4) cable connector and 10 meters of twinaxial cable be considered for 40GBASE-CR4 cable assembly.