SFF-8470 (CX4) / Copper Concepts for 802.3ba

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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
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 and 0.5 meter cable link reach according to the S-Parameter Return Loss, Insertion Loss and Cross-talk criteria as defined by 10GBASE-KR.
IEEE 802.3ba Link Model

100GBASE-CRn or
40GBASE-CR4
Transmit Function

MDI

Signal<p>
Lane n

Signal<n>

Signal shield

Link shield

Cable assembly

MDI

100GBASE-CRn or
40GBASE-CR4
Receive Function
SFF-8470 / CX4 Connector Structure

Cover, Plug

Sectional View (Connection area)

Ground/Power Contact

Patented Stripline edge coupled structure

Differential pair contacts

Outer shield

Socket

Section X-X (Signal section)

Section Y-Y (Ground section)
Connector and Cable assembly 24AWG 10m and 0.5m
Frequency Domain Measurement Set-up

Return Loss RL(f) Measurement

CX4/IB 10 G Test Board

CX4/IB Cable assembly with Amphenol cable 24AWG 10m and 0.5m

CX4/IB 10 G Test Board

Agilent 20 GHz Multi-channel Differential VNA & cabling

TP1

TP4
SFF-8470 (CX4) + 10 and 0.5 meter SkewClear EXD Cable
Channel Return Loss Compliance

Measured Return Loss for 0.5 and 10 meter Cables and SFF-8470 (CX4) Connectors

Return Loss

Return Loss Limit
0.5 m Cable Return Loss
10 m Cable Return Loss

Frequency (MHz)
Insertion Loss IL(f) Measurement Set-up

CX4/IB 10 G Test Board

CX4/IB Cable assembly with Amphenol cable 24AWG 10m and 0.5m

CX4/IB 10 G Test Board

TP1

Agilent 20 GHz Multi-channel Differential VNA & cabling
SFF-8470 (CX4) + 10 and 0.5 meter SkewClear EXD Cable
Channel Insertion Loss Compliance

Insertion Loss (dB) for 0.5 and 10 meter cables
with IEC 8470 Connectors

Frequency (MHz)
SFF-8470 (CX4) + 10 and 0.5 meter SkewClear EXD Cable
Insertion Loss Deviation

Insertion Loss Deviation (dB)
for 0.5 and 10 meter cables with IEC 8470 Connectors

Max Deviation Limit
0.5 m Cable Insertion Loss Deviation
10 m Cable Insertion Loss Deviation
Min Deviation Limit

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

NEXT Set-up
CX4/IB Cable assembly
With Amphenol cable 24AWG 10m and 0.5m

Agilent 20 GHz Multi-channel Differential VNA & cabling

FEXT Set-up
CX4/IB Cable assembly
With Amphenol cable 24AWG 10m and 0.5m

50 Ω terminations

CX4/IB 10 G test Cards

50 Ω terminations
Insertion Loss to Crosstalk Ratio computed from S-Parameter Insertion Loss and Crosstalk Components of the 10 and 0.5 meter CX4 SkewClear EXD Copper Cable Assembly

4 Near End X-talk (NEXT) Aggressors

3 Far End X-talk (FEXT) Aggressors
SFF-8470 Insertion Loss and Crosstalk Parameters:
0.5 meter NEXT, FEXT, PSNEXT, PSFEXT and PSXT(f)

NEXT, PSNEXT, FEXT, PSFEXT and PSXT Crosstalk (dB)
for IEC 8470 Connectors + 0.5 meter cable
SFF-8470 Insertion Loss and Crosstalk Parameters: 10 meter NEXT, FEXT, PSNEXT, PSFEXT and PSXT(f)

NEXT, PSNEXT, FEXT, PSFEXT and PSXFT Crosstalk (dB)
for IEC 8470 Connectors + 10 meter cable
CX4/IB Insertion Loss to Crosstalk Ratio – 0.5 m

Insertion Loss to Power Sum Crosstalk Ratio (dB)
for IEC 8470 Connectors + 0.5 meter cable

Measured ICR(f)
Fitted ICR(f)
ICRmin(f) [2007]

Frequency (MHz)

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CX4/IB Insertion Loss to Crosstalk Ratio – 10 m

**Insertion Loss to Power Sum Crosstalk Ratio (dB)**

for IEC 8470 Connectors + 10 meter cable

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**Measured ICR(f)**

**Fitted ICR(f)**

**ICRmin(f)**

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**Frequency (MHz)**

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CX4/IB Insertion Loss to Crosstalk Ratio – 10 m

**Insertion Loss to Power Sum Crosstalk Ratio (dB)**
for Meritec IEC 8470 Connectors + 10 meter cable

- ICR measured
- ICR (fit)
- ICR min

Frequency (MHz)

May 2008
Channel Model Componentss

**Insertion Loss (dB) for 0.5 and 10 meter cables with IEC 8470 Connectors**

-20 -10 0

**Measured Return Loss for 0.5 and 10 meter Cables and SFF-8470 (CX4) Connectors**

-10.00 0.00

**NEXT, PSNEXT, FEXT, PSFEXT and PSXFT Crosstalk (dB) for IEC 8470 Connectors + 0.5 meter cable**

**10 meter Cable Assembly Channel Model**
Simulation Results

Results Courtesy: Vivek Talang, Broadcom
The measurements analyses of the SFF-8470 (CX4) connector and attached 10 and 0.5 meter cable assembly show the following compliance:

- The measured Return Loss meets the 802.3ap Return Loss limits.
- The measured Insertion Loss satisfies the maximum attenuation limit. The fitted data are lower than the 802.3ap maximum attenuation limit.
- The measured ICR satisfies the 802.3ap minimum limit for 0.5 meter and 10 meter with low crosstalk connector.
- The current SFF-8470 based cable assemblies will meet the requirements of 802.3ap.
The data suggests that SFF-8470 (CX4) cable connector with 0.5 thru 10 meters of twinaxial cable be considered for 40GBASE-CR4 cable assembly.