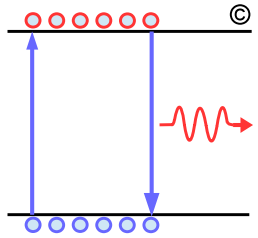

Revisiting MCBHCB Requirements in Support of 50G/lane PAM4

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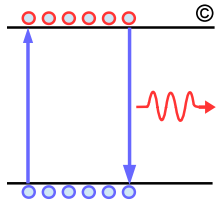
IEEE 802.3cd Task Force Meeting

San Diego

July 26, 2016

Background



- **Comment 128 was submitted on P802.3bs draft 1.4 that mated board of CL92 crosstalk is excessive in support of 50G Cu cabling**
  - Comment was rejected as P802.3bs does not define Cu cabling
  - After further investigation P802.3bs C2M simulation were all based on channels having < ¼ the amount of crosstalk in CL92
  - Mated board crosstalk of CL92 need to reduced for 50G PAM4 C2M and Cu cabling applications

Cl **120E** *SC* **120E.4.1** *P* **368** *L* **16** # 128

Ghiasi, Ali — Ghiasi Quantum LLC

Comment Type **TR** *Comment Status* **R**

MCB/HCB characteristics is referenced from CL92.11.1 and CL92.11.2. The crosstalk for the mated MCB-HCB is defined by 92.11.3.6 inaccordance to meet 100GBASE-CR4 with following parameters:
MDNEXT <= 1.8 mV RMS
MDFEXT <= 4.8 mV RMS
But the cable under considearionfor 50G operation have significantly lower crosstalk than early BJ cables
http://www.ieee802.org/3/cd/public/May16/ghiasi_3cd_02a_0516.pdf
http://www.ieee802.org/3/cd/public/May16/roth_3cd_01a_0516.pdf

SuggestedRemedy

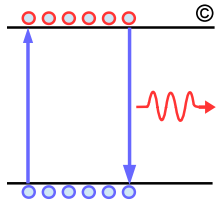
With typical newer cable hainvg PSXT of ~ 1 mV, a matted board having 4.8 mV of FEXT and 1.8 mV NEXT will have significant burden on the Cu reach and COM margin. The fact that we have cable data with PSXT ~ 1mV indicate technology has improved and limits in the BJ are overly pessimistic.

Response *Response Status* **C**

REJECT.
[Editor's note: This comment was sent after the close of the comment period.]

Although there appears to be some justification for a reduction in MDNEXT/MDFEXT for copper cabling, the impact of this on Annex 120E is not clear: The P802.3bs draft does not specify copper cables, and the commenter has not indicated what changes (if any) are required to the Annex.

50G Mated Board References Legacy CL92 MCB/HCB Specifications

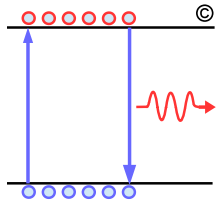


- **Currently CL 120E.4.1 MCB/HCB specifications references**
  - CL 92.11.1 for HCB specifications
  - CL 92.11.2 for the MCB specifications
  - CL 92.11.3.6 defines mated text fixture ICN
    - MDFEXT of 4.8 mV is excessive for 50G PAM4 link!

Table 92–13—Mated test fixtures integrated crosstalk noise

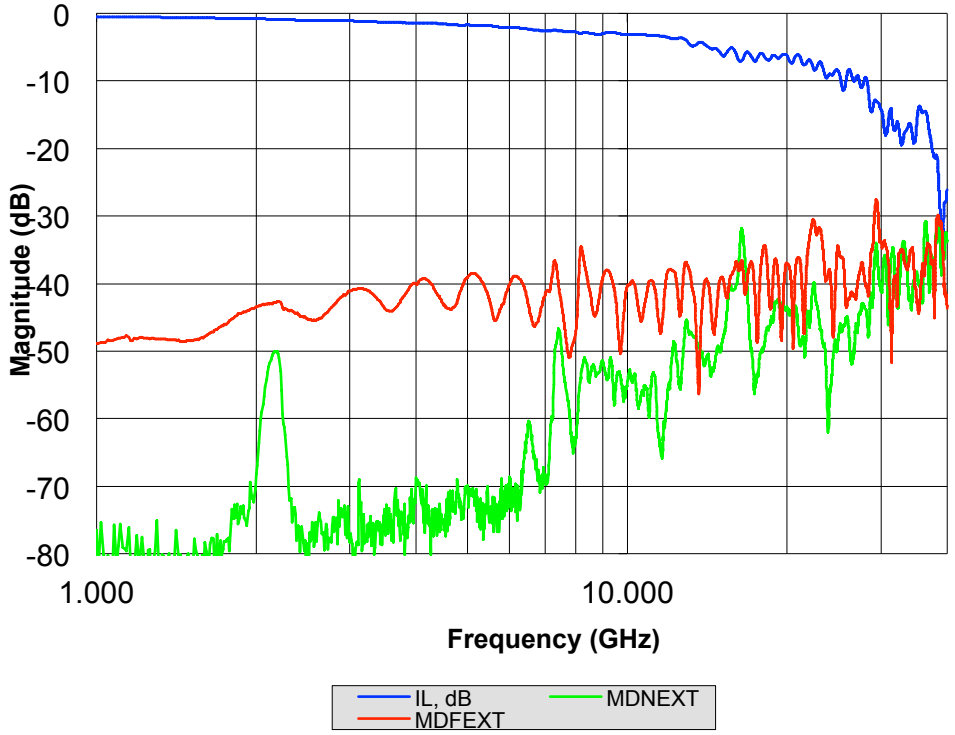
Parameter	100GBASE-CR4	Units
MDNEXT integrated crosstalk noise voltage	Less than 1.8	mV
MDFEXT integrated crosstalk noise voltage	Less than 4.8	mV

Bases for the Mated MCB/HCB MDFEXT/MDNEXT in CL92

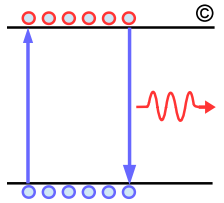


- **Vintage QSFP+ connector provided bases for the CL92 MDFEXT and MDNEXT**
  - http://www.ieee802.org/3/bj/public/sep12/ghiasi_3bj_01a_0912.pdf

MCB-HCB Crosstalk	10.3125 GBd ICN (mV)	25.78 GBd ICN (mV)	28.0 GBd ICN (mV)
Rise Time 20-80% (ps)	24.000	9.600	8.840
MDNEXT	0.323	1.390	1.612
MDFEXT	3.593	4.562	4.673
ICN	3.607	4.769	4.943



802.3bs C2M Base Analysis Used Channels with Significantly Lower NEXT/FEXT

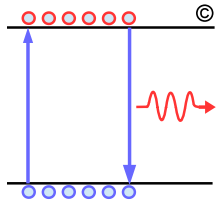


- **CDAUI-8/CCAUI-4 base channels**
  - http://www.ieee802.org/3/bs/public/adhoc/elect/24Aug_15/dallaire_01_082415_elect.pdf

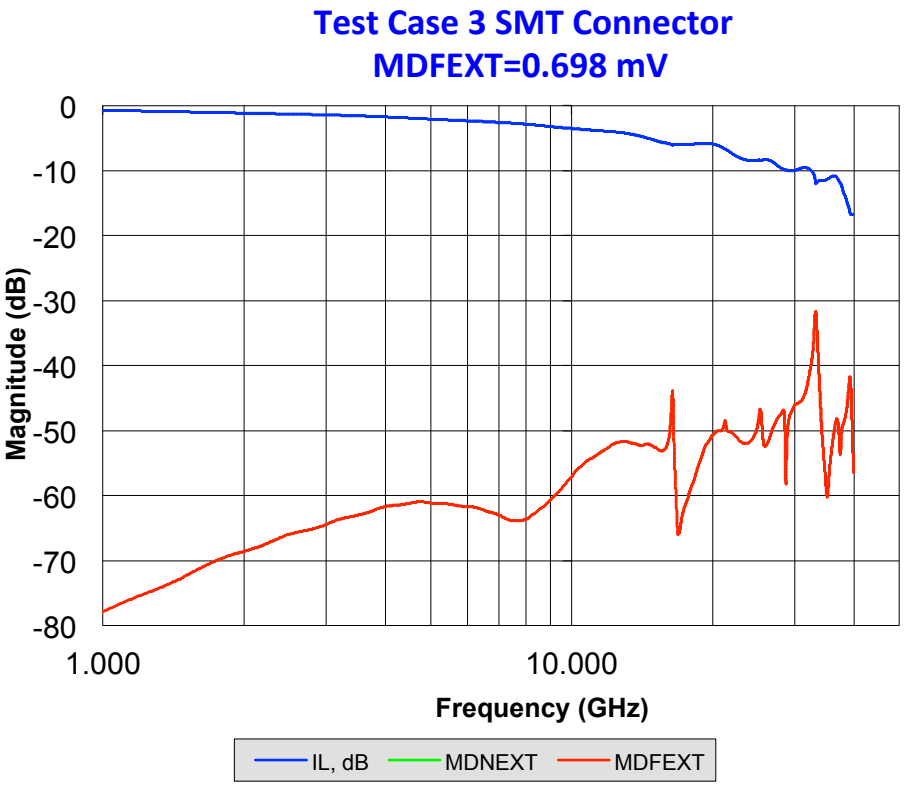
CHANNEL	FEXT	NEXT	IL @ 13.28125 GHz (dB)	ILD (dBrms)
From IEEE 802.3bs shanbhag_3bs_14_0623:				
(1) Nelco 4000-13SI Host PCB + next gen 28Gb/s high density SMT IO	5	0	8.7	0.110
(2) EM-888 Host PCB + next gen 28Gb/s press-fit stacked IO	7	0	8.9	0.051
From IEEE 802.3bs shanbhag_3bs_01_1014:				
(3) 4in Megtron6 Host PCB + next gen 28Gb/s high density SMT IO	5	0	4.3	0.110
(4) 10in Megtron6 Host PCB + next gen 28Gb/s high density SMT IO	5	0	8.8	0.106
(5) 4in Megtron6 Host PCB + next gen 28Gb/s press-fit stacked IO	7	0	4.5	0.051
(6) 10in Megtron6 Host PCB + next gen 28Gb/s press-fit stacked IO	7	0	9.0	0.052
Cisco Channels:				
(7) Cisco 2in Stacked	0	0	8.5	0.237
(8) Cisco 5in Stacked	0	0	11.3	0.245

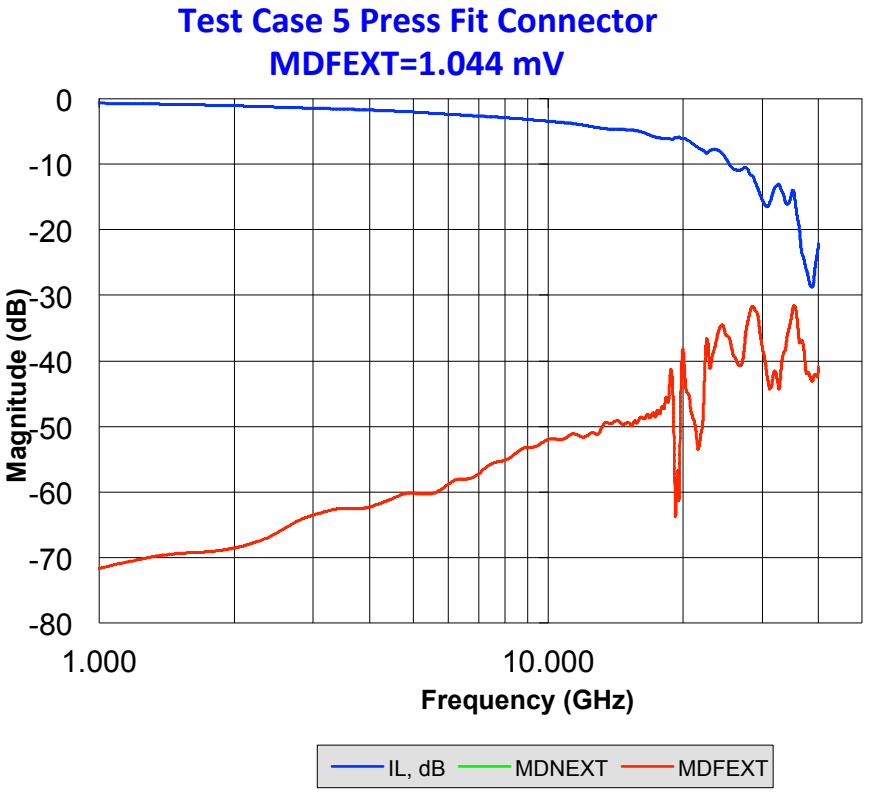
Test case 3 and 5 Used for Crosstalk Analysis

Crosstalk for C2M Test Case 3 and 5

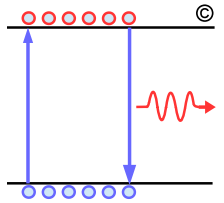


- **Mated board had no NEXT and with excellent FEXT**
  - http://www.ieee802.org/3/bs/public/channel/TEC/shanbhag_3bs_01_1014.pdf
  - The C2M analysis in P802.3bs are based on channels with 5-7x lower crosstalk than mated board referenced currently!





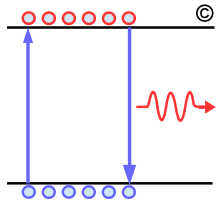
Cable Under Consideration for 3 m Objective



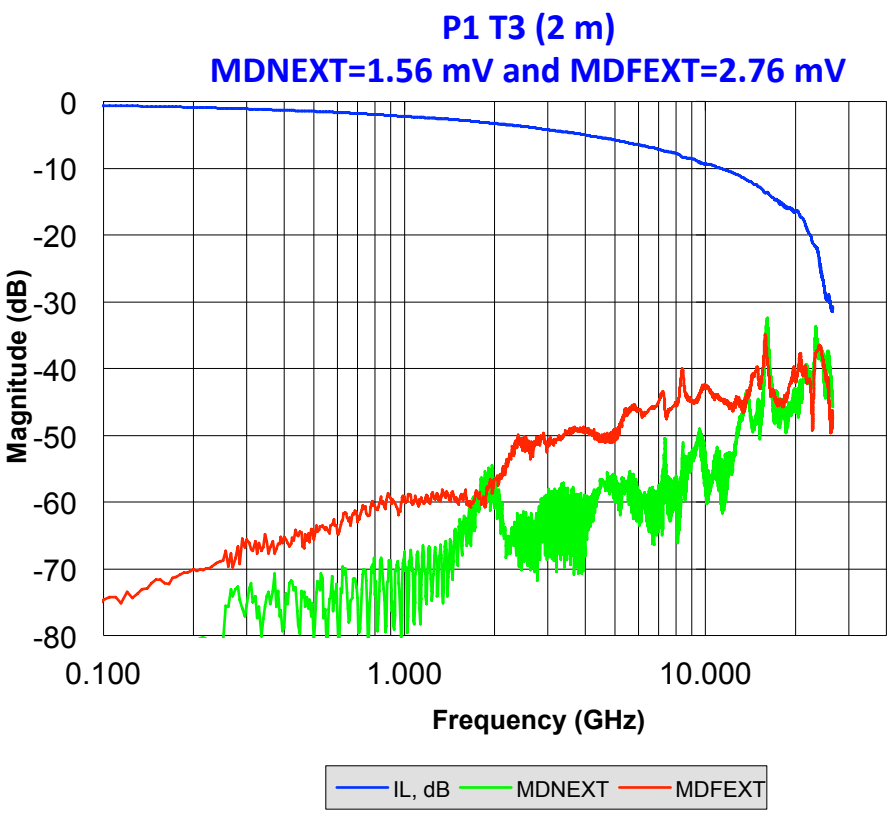
- **Cable under consideration as tested meet the 3 m objective with excellent ICN and PSXT**
  - http://www.ieee802.org/3/50G/public/Mar16/ghiasi_50GE_NGOATH_01a_0316.pdf
  - To set the limit on mated board crosstalk the cable text board (MCB) should be measured with a well constructed HCB
  - PSXT result below are damped by the host channel.

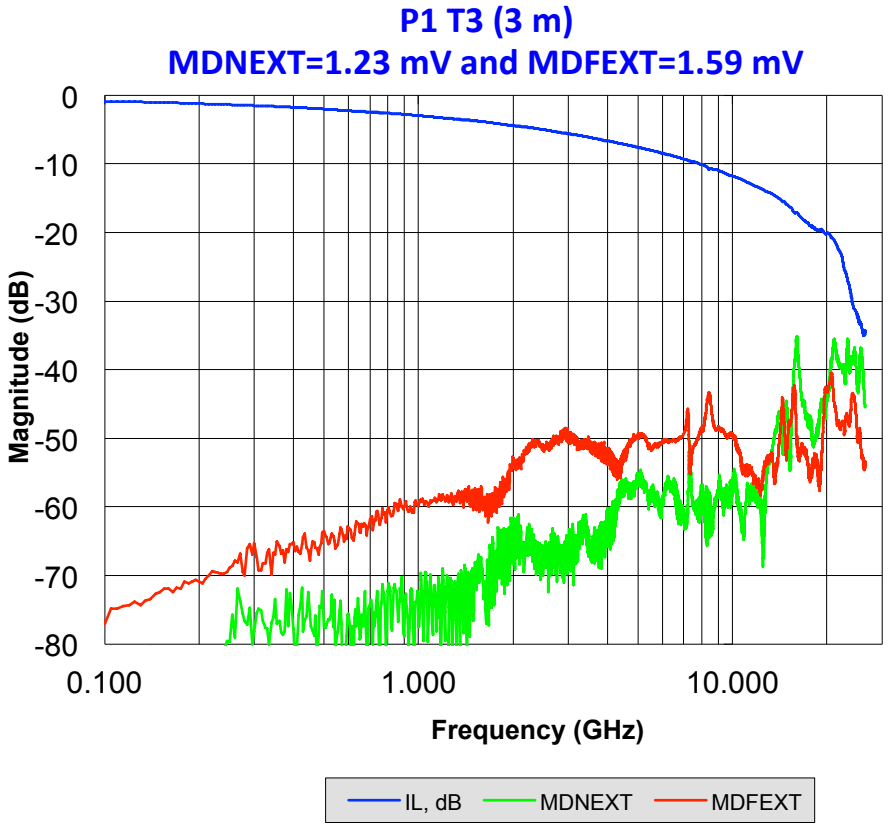
Test Cases	Cable IL (dB)	Channel IL (dB)	ISI/Noise/ XTALK	ILD	ICN (mV)	PSXT (mV)	COM (dB)
zQSFP T3-R3 3 m 26 AWG (Leoni Cable) 12 mm PKG	16.4	29.4	23/65/12%	0.26	1.09	1.30	4.82
zQSFP T3-R3 3 m 26 AWG (Leoni Cable) 30 mm PKG	16.4	29.4	20/70/10%	0.26	0.79	1.02	4.26
zQSFP T4-R4 3 m 26 AWG (Leoni Cable) 12 mm PKG	16.6	29.5	27/64/9	0.23	1.09	1.27	4.97
zQSFP T4-R4 3 m 26 AWG (Leoni Cable) 30 mm PKG	16.6	29.5	22/69/9	0.23	1.09	0.99	4.39
zQSFP T3-R3 3 m 26 AWG (Newer Cable P1) 12 mm PKG	14.3	27.3	24/69/6%	0.13	0.79	1.03	5.87
zQSFP T3-R3 3 m 26 AWG (Newer Cable P1) 30 mm PKG	14.3	27.3	24/71/5%	0.13	0.79	0.83	5.29
zQSFP T4-R4 3 m 26 AWG (Newer Cable P2) 12 mm PKG	14.4	27.3	19/75/6%	0.10	0.66	0.89	6.00
zQSFP T4-R4 3 m 26 AWG (Newer Cable P2) 30 mm PKG	14.4	27.3	24/72/4%	0.10	0.66	0.72	5.40

Crosstalk for Newer Molex 2 m and 3 m Cable

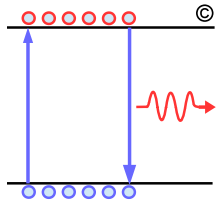


- **MDFEXT and MDNEXT for cable assembly includes two connectors isolated by cable attenuation and is not directly representative of mated board crosstalk**
  - http://www.ieee802.org/3/50G/public/Jan16/roth_50GE_NGOATH_01a_0116.pdf
  - The 3 m cable meets the objective with excellent COM margin, measuring the matted crosstalk on the MCB cable tested can provide direct crosstalk!



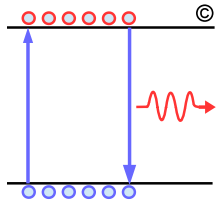


Other MCB/HCB Parameters that Need Touch Up



- **Best to create updated clause for inclusion into 802.3bs or cd draft**
  - MCB frequency response Fig 92-16 need to be extended to 26.55 GHz
  - Mated test board frequency response Fig 92-19 need to be extended to 26.55 GHz
  - Mated test board return loss Fig 92-20 need to be extended to 26.55 GHz
  - Mated board common mode conversion loss 92-21 need to be extended to 26.55 GHz
  - Mated board common mode return loss 92-22 need to be extended to 26.55 GHz
  - Mated board common mode to differential return loss 92-23 need to be extended to 26.55 GHz
- **CL 92 limits preferably should be scaled to have the same value at 26.55 GHz.**

Summary



- **CL92 mated board MDFEXT (4.8 mV) and MDNEXT (1.8 mV) too high for 50G/lane PAM4 C2M or Cu cabling applications**
- **All of the mated board frequency response need to extend to new PAM4 Baudrate of 26.55 GHz, slight change**
- **However the MDNEXT and MDFEXT limits of CL 92 for mated MCB/HCB maybe too high to support 50G PAM4 operation**
  - The Molex 3 m 26 AWG cable data show excellent proof of feasibility supporting the 3m objective
  - Additional measurement is needed to more accurately set MCB/HCB limits
  - Baseline simulation of 802.3bs C2M simulation had no NEXT and with optimistic MDFEXT level that might be difficult to meet with QSFP56 connector
- **May want to consider new clause to define mated MCB/HCB instead of referencing CL92**
  - Based on limited data available the MCB/HCB crosstalk should be ~ halved from limits of CL92.