# ERL Consensus Discussion

For the purpose of closing comments on Draft 1.2

Beth Kochuparambil

7/21/2020

# ERL Comments

- Tr Values – 14, 44
- N Values – 45*, 50, 51, 52
- Nbx Values – 6, 46, 47, 48, 15, 49
- ERL Values – 68*, 5, 8, 10, 16, 18, 23
- COM Qualifier – 11163

- TDR method – 43

- "beginning of the ____ connector" – 110, 111, 112, 113
- C2M/TP4 table reference - 51*, 50, 52, 19 (21, 24, 26 from bucket)
- Editorial Fixes

# ERL Parameter Comments

The Goal:  Adopt parameter changes indicated on Slide 4 of kochuparambil_3ck_01_0720 into Comment 45 or 68 (depending on where there is consensus)

- If needed, make modifications into new rev of these slides based on straw poll consensus.

- Tr Values – 14, 44

- N Values – 45*, 50, 51, 52

- Nbx Values – 6, 46, 47, 48, 15, 49

- ERL Values – 68*, 5, 8, 10, 16, 18, 23

- COM Qualifier – 11163

# Nbx Value Discussion, if needed

| $N_{bx}$ | 162.9.3.4 CR TX | 162.9.4.5 CR RX | 162.11.3 Cable Ass. | 163.9.1.1 KR TX | 163.9.2.1 KR RX | 163.10.2 KR Chan. | 120F.3.1.1 C2C TX | 120F.3.2.1 C2C RX | 120F.4.3 C2C Chan. | 120G.3.1.3 Host output | 120G.3.2.2 Module output | 120G.3.3.1 Host input | 120G.3.4.2 Module input |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 UI | | 0 UI | ~~TBD~~ 21 UI | | ~~TBD~~ 21 UI | ~~TBD~~ 6 UI | | ~~TBD~~ 6 UI | 0 UI | | | |

- 6/10 Ad Hoc discussion AND 2 comments submitted both propose 21

- Proposed Accept
  - Mau-lin and Rich to kick off discussion, if needed



CL 163 KR channel $N_{bx}$ option

Option A:
- ❏ $N_{bx}$ of 35 correlates best to channels which have reflections near the end of the channel
  - I.e. 40 UI from Tp0 or Tp5
  - See backup data
- ❏ $N_{bx}$ of 35 may pass channel with considerable reflections up to 40 UI which could fail in a system
  - I.e. Beyond the capability of floating taps.

Option B
- ❏ $N_{bx}$ of 21 is the conservative tact
  - The physical location would be a the bga interface just after the 30 mm package
  - Takes care of the device.

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http://www.ieee802.org/3/ck/public/adhoc/jun10_20/mellitz_3ck_adhoc_01a_061020.pdf
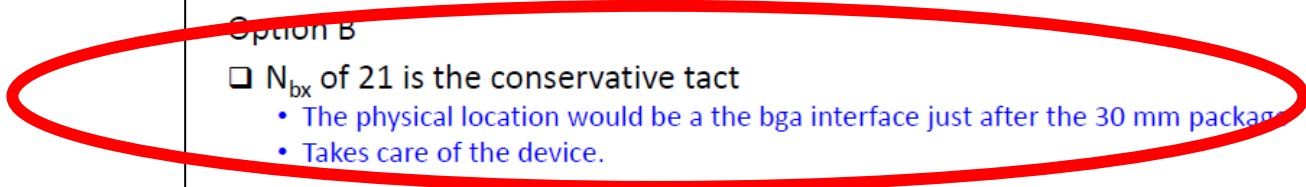
# ERL Value Discussion, if needed

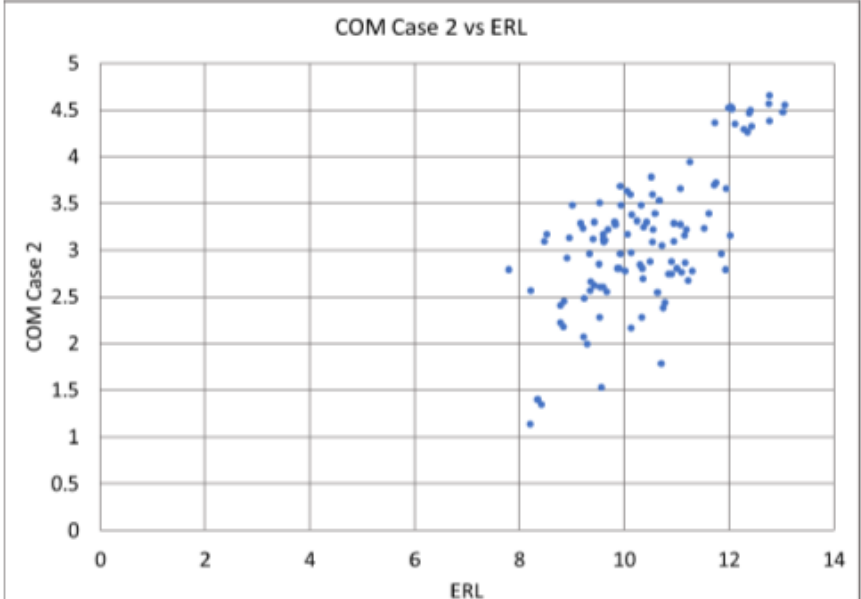| | 162.9.3.4 CR TX | 162.9.4.5 CR RX | 162.11.3 Cable Ass. | 163.9.1.1 KR TX | 163.9.2.1 KR RX | 163.10.2 KR Chan. | 120F.3.1.1 C2C TX | 120F.3.2.1 C2C RX | 120F.4.3 C2C Chan. | 120G.3.1.3 Host output | 120G.3.2.2 Module output | 120G.3.3.1 Host input | 120G.3.4.2 Module input |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ERL | TBD (equation) | TBD dB | ~~TBD~~ 8 dB for cable assemblies that have a COM less than 4 dB | ~~TBD~~ 13 dB | ~~TBD~~ 13 dB | TBD dB | ~~TBD~~ 11 dB | ~~TBD~~ 11 dB | TBD dB | ~~TBD~~ 9.5 dB | TBD dB | ~~TBD~~ 9.5 dB | TBD dB |

- ## Proposed Accept
  - Bruce, Mau-lin, and Rich to kick off discussion, if needed

## COM vs ERL using Varying Eta_0 Values

- Plot on right shows COM vs ERL for 110 channels

- Min ERL is 8.7

- A min ERL of 8 is recommended for specification to allow room to limit for other forms factors in addition to cable assembly and connector variation

COM Case 2 vs ERL



http://www.ieee802.org/3/ck/public/20_07/champion_3ck_01_0720.pdf

# Summary of ERL Parameter Comments

| | 162.9.3.4 CR TX | 162.9.4.5 CR RX | 162.11.3 Cable Ass. | 163.9.1.1 KR TX | 163.9.2.1 KR RX | 163.10.2 KR Chan. | 120F.3.1.1 C2C TX | 120F.3.2.1 C2C RX | 120F.4.3 C2C Chan. | 120G.3.1.3 Host output | 120G.3.2.2 Module output | 120G.3.3.1 Host input | 120G.3.4.2 Module input |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Table 162-11 | | Table 162-15 | Table 163-6 | | Table 163-11 | Table 120F-2 | | Table 120F-7 | | Table 120G-2 | | |
| Tr | 0.01 ns | | ~~TBD~~ 0.01 ns | 0.01 ns | | 0.01 ns | ~~TBD~~ 0.01 ns | | ~~TBD~~ 0.01 ns | | 0.01 ns | | |
| Bx | 0 GHz | 0 GHz | | 0 GHz | 0 GHz | | 0 GHz | 0 GHz | | 0 GHz | | | |
| Px | 0.618 | 0.618 | | 0.618 | 0.618 | | 0.618 | 0.618 | | 0.618 | | | |
| N | 800 UI | | ~~7000~~ 3500 UI | 200 UI | 3500 UI | | 200 UI | 2000 UI | | 800 UI | ~~800~~ 400 UI | 800 UI | ~~800~~ 400 UI |
| $N_{bx}$ | 0 UI | 0 UI | | ~~TBD~~ 21 UI | ~~TBD~~ 21 UI | | ~~TBD~~ 6 UI | ~~TBD~~ 6 UI | | 0 UI | | | |
| | Table 163-9 | Table 163-12 | Table 162-14 | Table 163-5 | Table 163-7 | | Table 120F-1 | Table 120F-3 | | Table 120G-1 | Table 120G-3 | Table 120G-4 | Table 120G-7 |
| ERL | TBD (equation) | TBD dB | TBD dB for cable | TBD dB | TBD dB | | TBD dB | TBD dB | | TBD dB | TBD dB | TBD dB | TBD dB |
| | | | 4 dB | | | | | | | | | | |

No consensus to set ERL values at this time; general sense was that more work was needed with stable parameters. Leave as TBD at this time.

# ERL Method Comment

CI **93A**    SC **93A.5**                    P **195**              L **1**              # 43

Mellitz, Richard                              Samtec

*Comment Type*    **TR**        *Comment Status*  **D**                                    *ERL*

Creating a TDR (or PTDR) from return loss data may result in factious noise in the TDR response. The reason is high frequency data may not be well behaved enough to perform a reliable Inverse Fourier Transform. Instrument manufacturers may employ proprietary windowing when determining TDR from frequency domain data. A Tukey window (non-proprietary) is a cosine window which will give good consistent results between implementation of the inverse Fourier Transform. See https://en.wikipedia.org/wiki/Window_function#Tukey_window

*SuggestedRemedy*

Add term H_tw to 93A-58. I.e. $H\_ii(f)=H\_t(f)^* \ s\_ii(f)^*H\_r(f)^*H\_Tw(f)$

Define $f\_tw\_period=2^*(f\_b- f\_b^*(1-f\_r))$;
Define: H_tw
When f<- f_r,          H_tw=1
When f> f_r <= f_b, $H\_tw=0.5^*cos(2^*pi^*(f-f\_b)/f\_tw\_period=-pi)+.5$
When f> f_v,          H_tw=0

*Proposed Response*            *Response Status*  **W**

PROPOSED ACCEPT IN PRINCIPLE

Implement the suggested remedy with editorial license.

# ERL Wording Comments

# Wording Discussion for "beginning of the connector"

Comments 110, 111, 112, 113

CI 120G    SC 120G.3.1.3         P 222         L 38         # 110

Hidaka, Yasuo                    Credo Semiconductor

Comment Type    T        Comment Status   D

"The beginning of the host connector" is not clear.

SuggestedRemedy

Change "the beginning of the host connector" to "the mating interface of the connector between HCB and host under test".

Proposed Response        Response Status   W

PROPOSED REJECT

It is not clear that the proposed modification improves the specification. The term "under test" is superfluous so if there is consensus to adopt the proposed change, change "the beginning of the host connector" to "the mating interface of the connector between HCB and host".

Resolve with comments 112, 111, and 113.

**Draft 1.2**

120G.3.1.3  Host output effective return loss (ERL)                                33
                                                                                    34
ERL of the host output at TP1a is computed using the procedure in 93A.5 with the values in Table 120G–2.   35
Parameters that do not appear in Table 120G–2 take values from Table TBD. The value of $T_{fx}$ is twice the   36
delay from the measurement point TP1a to the beginning of the host connector.      37
                                                                                    38
Host output ERL at TP1a shall be greater than TBD.                                 39
                                                                                    40

- This was a cross functional discussion that resulted in this text on draft 1.0/1.1

- Proposed Reject as experts associated with connectors and cables agreed this was clear in previous draft

**Draft 1.1**

120G.3.1.3  Host output effective return loss (ERL)

ERL of the host output at TP1a is computed using the procedure in 93A.5 with the values in Table 120G–2. Parameters that do not appear in Table 120G–2 take values from Table TBD. The value of $T_{fx}$ is twice the delay associated with the TP1a test fixture being used. $N_{bx}$ is set to the value of $N_b$ in Table TBD.

CI 120G      SC 120G.3.1.3         P 222         L 37         # 10057

Dudek, Mike                      Marvell

Comment Type    T        Comment Status   A                              ERL

[Comment resubmitted from Draft 1.0. Subcl. 120G.3.1.3 - Pg 215 - ln 29]

The test fixture delay should be clarified so that the connector is not included in the delay that is removed

SuggestedRemedy

Change "associated with the TP1a test fixture" to from the measurement point TP1a to the beginning of the TP1a test fixture MDI connector".

Response                 Response Status   C

ACCEPT IN PRINCIPLE.

"The value of T_fx is twice the delay from the measurement point TP1a to the beginning of the host connector."

Add similar text for the module input and output.

Implement with editorial license.

# Wording Discussion for C2M/TP4 table reference

Comments 51* ,50, 52, 19, 21, 24, 26

**120G.3.4.2 Module input effective return loss (ERL)**

ERL of the module input at TP1 is computed using the procedure in 93A.5 with the values in Table 120G–2. Parameters that do not appear in Table 120G–2 take values from Table TBD. The value of $T_{fx}$ is twice the delay from the measurement point TP1 to the beginning of the MCB connector.

Module input ERL at TP1 shall be greater than TBD.

http://www.ieee802.org/3/ck/public/adhoc/jun10_20/wu_3ck_adhoc_01_061020.pdf

**Other COM parameter values for C2M**

- We need to confirm the referenced COM parameter tables for ERL calculation for C2M
  - 120G.3.1.3 Host output ERL
    - "ERL of the host output at TP1a is computed using the procedure in 93A.5 with the values in Table 120G-2. Parameters that do not appear in Table 120G-2 take values from Table **TBD**."
- Table 120G-9 had been used for eye opening calculation
  - Table 120G-9 – Eye opening reference receiver parameter values
- Proposal
  - Adopt 120G-9 for ERL calculation
  - The same for module output, host input, & module input as well

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- Comments point out the TBD in the second sentence
  - One commenter proposes to put in reference 120G-9
  - Another commenter proposes to strike this sentence, but add onto the previous sentence if a value differs from Table 120G-2

- Recommend to AIP #51.
  - Implement suggested remedy and apply similar fix with editorial license to 120G.3.1.3 (Host output), 120G.3.2.2 (Module output), & 120G.3.4.2 (Module input)

| CI 120G | SC 120G.3.3.1 | P 227 | L 30 | # 51 |

Mellitz, Richard                     Samtec

Comment Type    T        Comment Status  D                    ERL parameters

    There doesn't see to be a need for table TBD

SuggestedRemedy

    Remove sentence: "
    Parameters that do not appear in Table 120G–2 take values from Table TBD "

Proposed Response        Response Status  W

    PROPOSED ACCEPT IN PRINCIPLE

    For task force review.

# Editorial Fixes

- ERL value is in 2 places… wording AND table.  Change wording to point to the table.
  - Proposed Accept in Principle of similar changes in Bucket comments
  - Remove the TBD equation (162-6) & have 162.9.3.4 point to the ERL value in Table 162-9
  - Replace the TBD ERL value in 162.9.4.5 point to the ERL value in Table 162-12
  - Replace the TBD ERL value in 162.11.3 point to the ERL value in Table 162-14
- Table 120F-7 label says TX and RX ERL Parameter Values.  Correct table label to match contents "Channel ERL Parameter values"

### 162.9.3.4 Transmitter effective return loss (ERL)

ERL of the transmitter at TP2 is computed using the procedure in 93A.5 with the values in Table 162–11. Parameters that do not appear in Table 162–11 take values from Table 162–16. The value of $T_{fx}$ is twice the delay from TP2 to the beginning of the TP2 test fixture MDI connector being used.

**Table 162–11—Transmitter and receiver ERL parameter values**

| Parameter | Symbol | Value | Units |
|---|---|---|---|
| Transition time associated with a pulse | $T_r$ | 0.01 | ns |
| Incremental available signal loss factor | $\beta_x$ | 0 | GHz |
| Permitted reflection from a transmission line external to the device under test | $\rho_x$ | 0.618 | — |
| Length of the reflection signal | $N$ | 800 | UI |
| Equalizer length associated with reflection signal | $N_{bx}$ | 0 | UI |

Transmitter ERL at TP2 shall meet Equation (162–6).

$$ERL \geq TBD \quad (dB) \qquad (162\text{–}6)$$

where
- $ERL$     is the effective return loss in dB
- $v_f$     is the steady-state voltage, defined in 162.9.3.1.2
- $p(k)$     is the linear fit pulse at preset 1 (no equalization) (see 162.9.3.1.2)

**Table 162–9—Summary of transmitter specifications at TP2**

| Parameter | Subclause reference | Value | Units |
|---|---|---|---|
| Signaling rate | | 53.125 ± 100 ppm | GBd |
| Differential pk-pk voltage with Tx disabled (max.)[a] | 93.8.1.3 | 30 | mV |
| DC common-mode voltage (max.)[a] | 93.8.1.3 | 1.9 | V |
| AC common-mode RMS voltage, $v_{cmt}$ (max.)[a] | 93.8.1.3 | 30 | mV |
| Differential pk-pk voltage, $v_{df}$ (max.)[a] | 93.8.1.3 | 1200 | mV |
| Effective return loss (ERL) (min.) | 162.9.3.4 | TBD | dB |
| Common-mode to differential mode return loss (min.) | 92.8.3.3 | See Equation (TBD) | dB |
| Common-mode to common-mode return loss (min.) | 92.8.3.4 | See Equation (TBD) | dB |
| Transmitter steady-state voltage, $v_f$ (min.) / Transmitter steady-state voltage, $v_f$ (max.) | 162.9.3.1.2 | 0.387 / 0.6 | V |
| Linear fit pulse peak (min.) | 162.9.3.1.2 | $0.397 \times v_f$ | V |
| Level separation mismatch ratio $R_{LM}$ (min.) | 120D.3.1.2 | 0.95 | — |
| Transmitter output waveform[b] abs step size for all taps (min.) | 162.9.3.1.4 | 0.005 | — |
| abs step size for all taps (max.) | 162.9.3.1.4 | 0.025 | — |
| value at minimum state for $c(1)$ (max.) | 162.9.3.1.5 | −0.2 | — |
| value at minimum state for $c(-1)$ (max.) | 162.9.3.1.5 | −0.34 | — |
| value at maximum state for $c(-2)$ (min.) | 162.9.3.1.5 | 0.12 | — |
| value at minimum state for $c(-3)$ (max.) | 162.9.3.1.5 | −0.06 | — |
| Signal-to-noise-and-distortion ratio, SNDR (min.)[c] | 120D.3.1.6 | 31.5 | dB |