Comment Resolution
Draft 3.2 Comments

Matt Brown, Huawei, 802.3ck Editor-in-Chief
Howard Heck, Intel

Cross-Clause

AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9

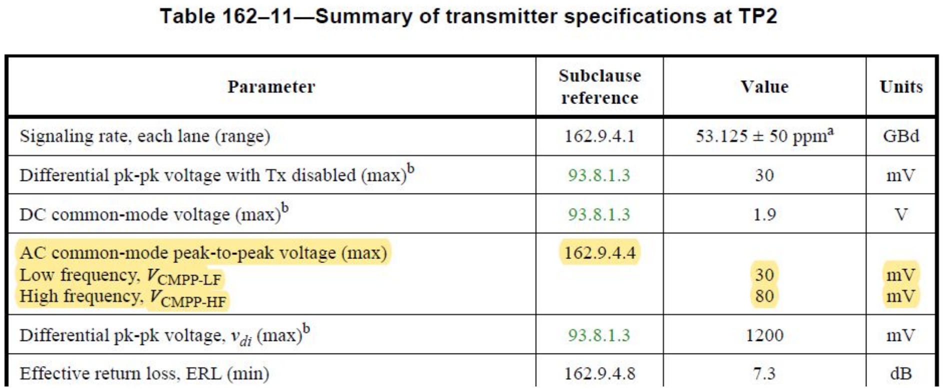
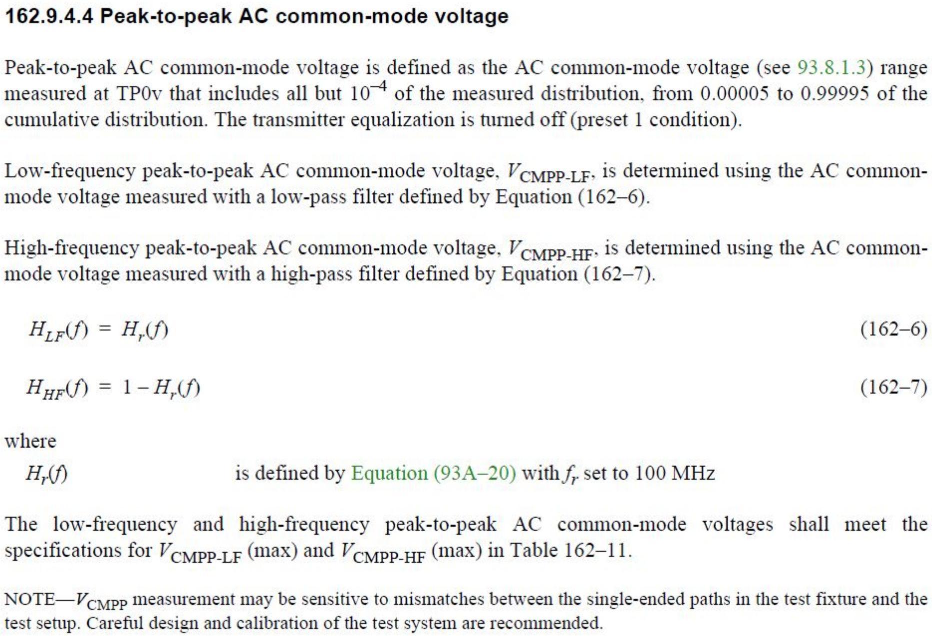


Table 162–11—Summary of transmitter specifications at TP2

Parameter	Subclause reference	Value	Units
Signaling rate, each lane (range)	162.9.4.1	53.125 ± 50 ppm[a]	GBd
Differential pk-pk voltage with Tx disabled (max)[b]	93.8.1.3	30	mV
DC common-mode voltage (max)[b]	93.8.1.3	1.9	V
AC common-mode peak-to-peak voltage (max) Low frequency, $V_{\text{CMPP-LF}}$ High frequency, $V_{\text{CMPP-HF}}$	162.9.4.4	 30 80	 mV mV
Differential pk-pk voltage, v_{di} (max)[b]	93.8.1.3	1200	mV
Effective return loss, ERL (min)	162.9.4.8	7.3	dB



162.9.4.4 Peak-to-peak AC common-mode voltage

Peak-to-peak AC common-mode voltage is defined as the AC common-mode voltage (see 93.8.1.3) range measured at TP0v that includes all but 10^{-4} of the measured distribution, from 0.00005 to 0.99995 of the cumulative distribution. The transmitter equalization is turned off (preset 1 condition).

Low-frequency peak-to-peak AC common-mode voltage, $V_{\text{CMPP-LF}}$, is determined using the AC common-mode voltage measured with a low-pass filter defined by Equation (162–6).

High-frequency peak-to-peak AC common-mode voltage, $V_{\text{CMPP-HF}}$, is determined using the AC common-mode voltage measured with a high-pass filter defined by Equation (162–7).

$$H_{LF}(f) = H_r(f) \qquad (162\text{–}6)$$

$$H_{HF}(f) = 1 - H_r(f) \qquad (162\text{–}7)$$

where

$H_r(f)$ is defined by Equation (93A–20) with f_r set to 100 MHz

The low-frequency and high-frequency peak-to-peak AC common-mode voltages shall meet the specifications for $V_{\text{CMPP-LF}}$ (max) and $V_{\text{CMPP-HF}}$ (max) in Table 162–11.

NOTE—V_{CMPP} measurement may be sensitive to mismatches between the single-ended paths in the test fixture and the test setup. Careful design and calibration of the test system are recommended.

AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9

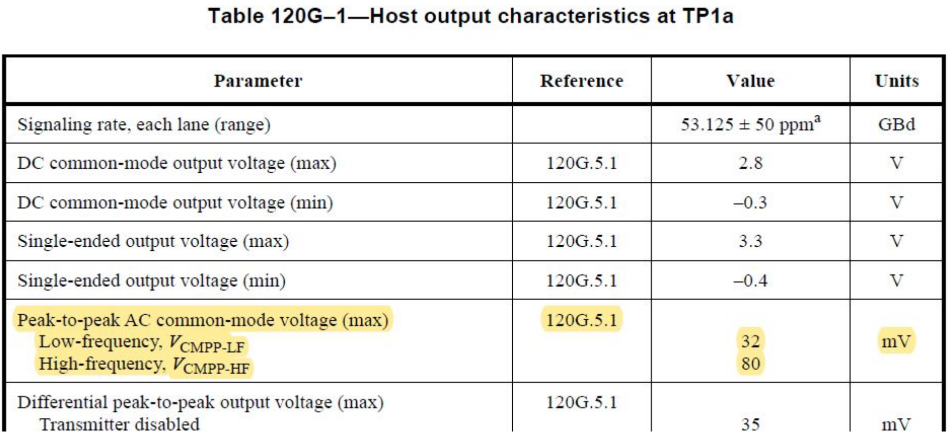


Table 120G–1—Host output characteristics at TP1a

Parameter	Reference	Value	Units
Signaling rate, each lane (range)		53.125 ± 50 ppm[a]	GBd
DC common-mode output voltage (max)	120G.5.1	2.8	V
DC common-mode output voltage (min)	120G.5.1	–0.3	V
Single-ended output voltage (max)	120G.5.1	3.3	V
Single-ended output voltage (min)	120G.5.1	–0.4	V
Peak-to-peak AC common-mode voltage (max) Low-frequency, $V_{CMPP\text{-}LF}$ High-frequency, $V_{CMPP\text{-}HF}$	120G.5.1	 32 80	 mV
Differential peak-to-peak output voltage (max) Transmitter disabled	120G.5.1	 35	 mV

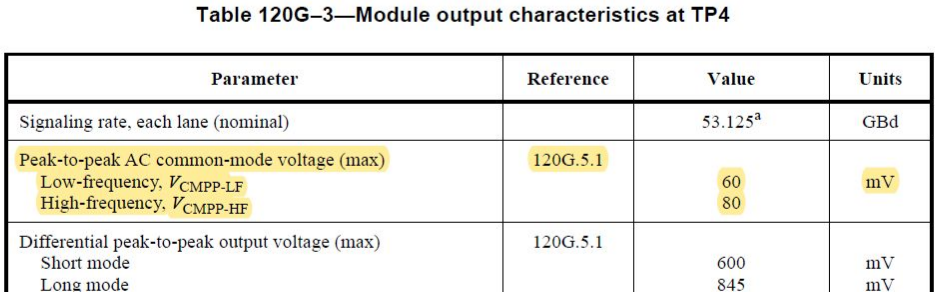
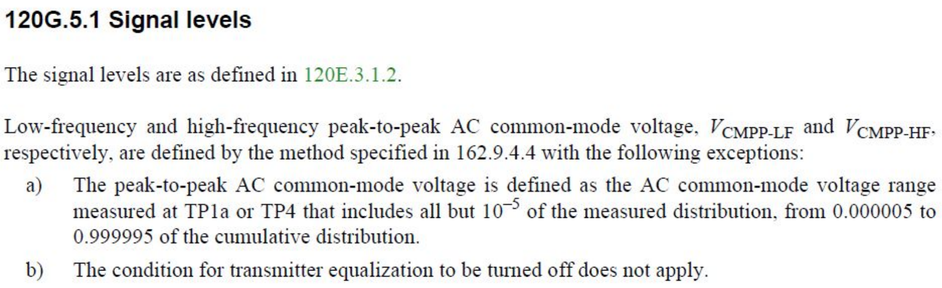


Table 120G–3—Module output characteristics at TP4

Parameter	Reference	Value	Units
Signaling rate, each lane (nominal)		53.125[a]	GBd
Peak-to-peak AC common-mode voltage (max) Low-frequency, $V_{CMPP\text{-}LF}$ High-frequency, $V_{CMPP\text{-}HF}$	120G.5.1	 60 80	 mV
Differential peak-to-peak output voltage (max) Short mode Long mode	120G.5.1	 600 845	 mV mV



120G.5.1 Signal levels

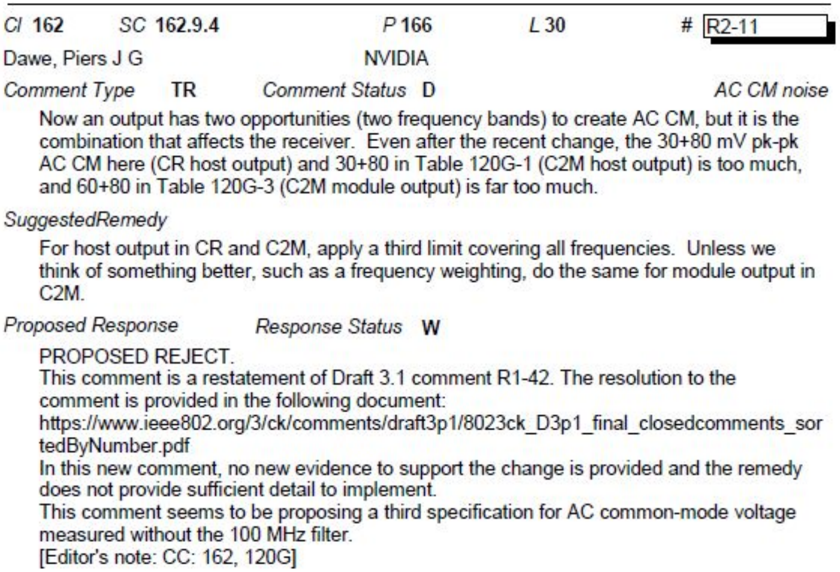
The signal levels are as defined in 120E.3.1.2.

Low-frequency and high-frequency peak-to-peak AC common-mode voltage, $V_{CMPP\text{-}LF}$ and $V_{CMPP\text{-}HF}$, respectively, are defined by the method specified in 162.9.4.4 with the following exceptions:

a) The peak-to-peak AC common-mode voltage is defined as the AC common-mode voltage range measured at TP1a or TP4 that includes all but 10^{-5} of the measured distribution, from 0.000005 to 0.999995 of the cumulative distribution.

b) The condition for transmitter equalization to be turned off does not apply.

AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9



Cl 162 *SC* 162.9.4 *P* 166 *L* 30 # R2-11

Dawe, Piers J G NVIDIA

Comment Type TR *Comment Status* D *AC CM noise*

Now an output has two opportunities (two frequency bands) to create AC CM, but it is the combination that affects the receiver. Even after the recent change, the 30+80 mV pk-pk AC CM here (CR host output) and 30+80 in Table 120G-1 (C2M host output) is too much, and 60+80 in Table 120G-3 (C2M module output) is far too much.

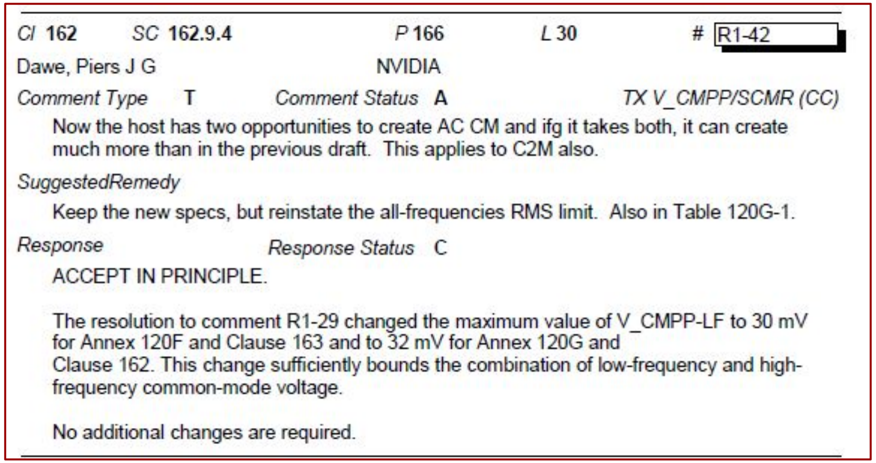
SuggestedRemedy

For host output in CR and C2M, apply a third limit covering all frequencies. Unless we think of something better, such as a frequency weighting, do the same for module output in C2M.

Proposed Response *Response Status* W

PROPOSED REJECT.
This comment is a restatement of Draft 3.1 comment R1-42. The resolution to the comment is provided in the following document:
https://www.ieee802.org/3/ck/comments/draft3p1/8023ck_D3p1_final_closedcomments_sortedByNumber.pdf
In this new comment, no new evidence to support the change is provided and the remedy does not provide sufficient detail to implement.
This comment seems to be proposing a third specification for AC common-mode voltage measured without the 100 MHz filter.
[Editor's note: CC: 162, 120G]

Draft 3.1 comment R1-42



Cl 162 *SC* 162.9.4 *P* 166 *L* 30 # R1-42

Dawe, Piers J G NVIDIA

Comment Type T *Comment Status* A *TX V_CMPP/SCMR (CC)*

Now the host has two opportunities to create AC CM and ifg it takes both, it can create much more than in the previous draft. This applies to C2M also.

SuggestedRemedy

Keep the new specs, but reinstate the all-frequencies RMS limit. Also in Table 120G-1.

Response *Response Status* C

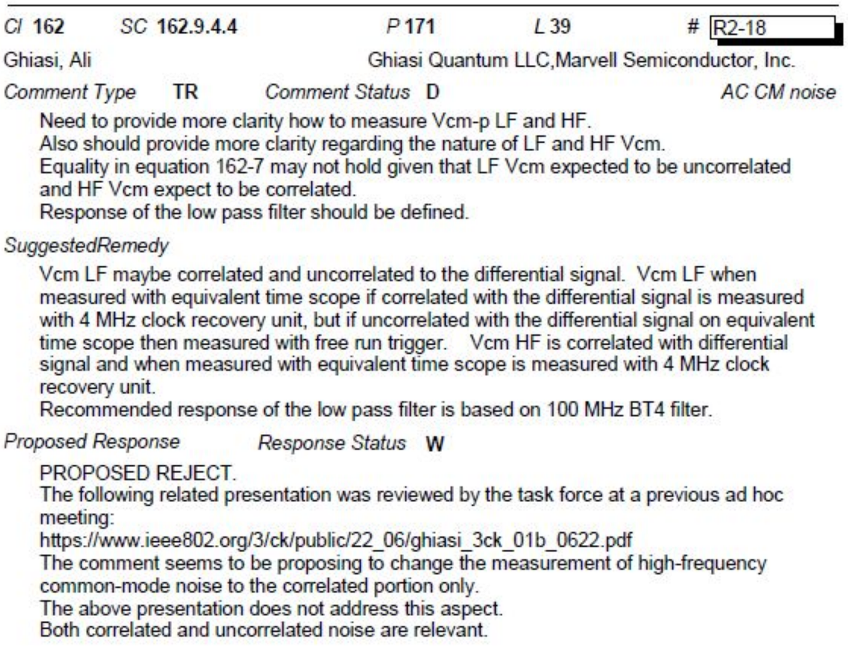
ACCEPT IN PRINCIPLE.

The resolution to comment R1-29 changed the maximum value of V_CMPP-LF to 30 mV for Annex 120F and Clause 163 and to 32 mV for Annex 120G and Clause 162. This change sufficiently bounds the combination of low-frequency and high-frequency common-mode voltage.

No additional changes are required.

For CR TX, C2M host output, and C2M module output…
Add 3rd limit with V_CMPP measured from DC to the measurement bandwidth (40 GHz). Maximum values not proposed in the comment.

AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9



Cl **162** *SC* **162.9.4.4** *P* **171** *L* **39** # R2-18

Ghiasi, Ali — Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **D** *AC CM noise*

Need to provide more clarity how to measure Vcm-p LF and HF.
Also should provide more clarity regarding the nature of LF and HF Vcm.
Equality in equation 162-7 may not hold given that LF Vcm expected to be uncorrelated and HF Vcm expect to be correlated.
Response of the low pass filter should be defined.

SuggestedRemedy

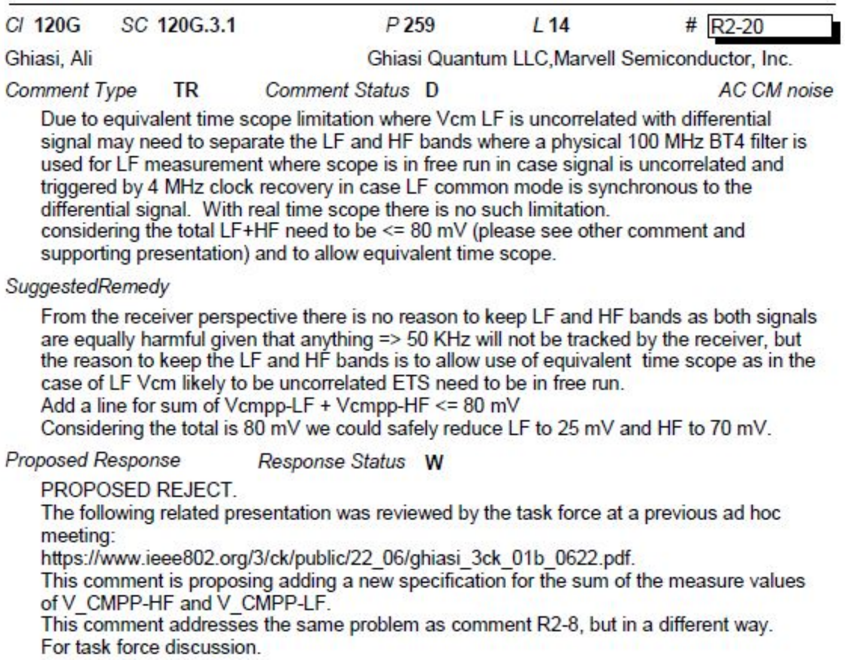
Vcm LF maybe correlated and uncorrelated to the differential signal. Vcm LF when measured with equivalent time scope if correlated with the differential signal is measured with 4 MHz clock recovery unit, but if uncorrelated with the differential signal on equivalent time scope then measured with free run trigger. Vcm HF is correlated with differential signal and when measured with equivalent time scope is measured with 4 MHz clock recovery unit.
Recommended response of the low pass filter is based on 100 MHz BT4 filter.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The following related presentation was reviewed by the task force at a previous ad hoc meeting:
https://www.ieee802.org/3/ck/public/22_06/ghiasi_3ck_01b_0622.pdf
The comment seems to be proposing to change the measurement of high-frequency common-mode noise to the correlated portion only.
The above presentation does not address this aspect.
Both correlated and uncorrelated noise are relevant.

For CR TX, C2M host output this comment suggests that…
LF component be measured differently depending on whether correlated with signal or not. HF component is assumed to be correlated. For the correlated cases the scope is synchronized with the data signal.

AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9



CI 120G *SC* 120G.3.1 *P* 259 *L* 14 # R2-20

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type TR *Comment Status* D *AC CM noise*

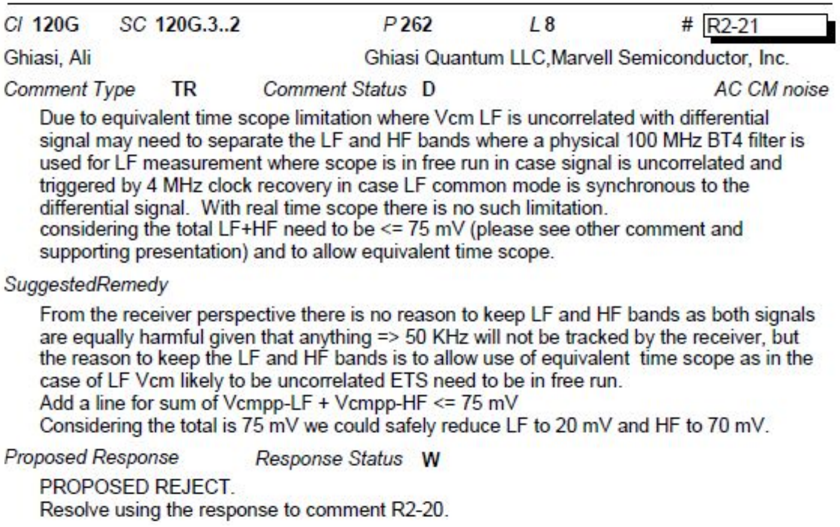
Due to equivalent time scope limitation where Vcm LF is uncorrelated with differential signal may need to separate the LF and HF bands where a physical 100 MHz BT4 filter is used for LF measurement where scope is in free run in case signal is uncorrelated and triggered by 4 MHz clock recovery in case LF common mode is synchronous to the differential signal. With real time scope there is no such limitation.
considering the total LF+HF need to be <= 80 mV (please see other comment and supporting presentation) and to allow equivalent time scope.

SuggestedRemedy

From the receiver perspective there is no reason to keep LF and HF bands as both signals are equally harmful given that anything => 50 KHz will not be tracked by the receiver, but the reason to keep the LF and HF bands is to allow use of equivalent time scope as in the case of LF Vcm likely to be uncorrelated ETS need to be in free run.
Add a line for sum of Vcmpp-LF + Vcmpp-HF <= 80 mV
Considering the total is 80 mV we could safely reduce LF to 25 mV and HF to 70 mV.

Proposed Response *Response Status* W

PROPOSED REJECT.
The following related presentation was reviewed by the task force at a previous ad hoc meeting:
https://www.ieee802.org/3/ck/public/22_06/ghiasi_3ck_01b_0622.pdf.
This comment is proposing adding a new specification for the sum of the measure values of V_CMPP-HF and V_CMPP-LF.
This comment addresses the same problem as comment R2-8, but in a different way.
For task force discussion.



CI 120G *SC* 120G.3..2 *P* 262 *L* 8 # R2-21

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type TR *Comment Status* D *AC CM noise*

Due to equivalent time scope limitation where Vcm LF is uncorrelated with differential signal may need to separate the LF and HF bands where a physical 100 MHz BT4 filter is used for LF measurement where scope is in free run in case signal is uncorrelated and triggered by 4 MHz clock recovery in case LF common mode is synchronous to the differential signal. With real time scope there is no such limitation.
considering the total LF+HF need to be <= 75 mV (please see other comment and supporting presentation) and to allow equivalent time scope.

SuggestedRemedy

From the receiver perspective there is no reason to keep LF and HF bands as both signals are equally harmful given that anything => 50 KHz will not be tracked by the receiver, but the reason to keep the LF and HF bands is to allow use of equivalent time scope as in the case of LF Vcm likely to be uncorrelated ETS need to be in free run.
Add a line for sum of Vcmpp-LF + Vcmpp-HF <= 75 mV
Considering the total is 75 mV we could safely reduce LF to 20 mV and HF to 70 mV.

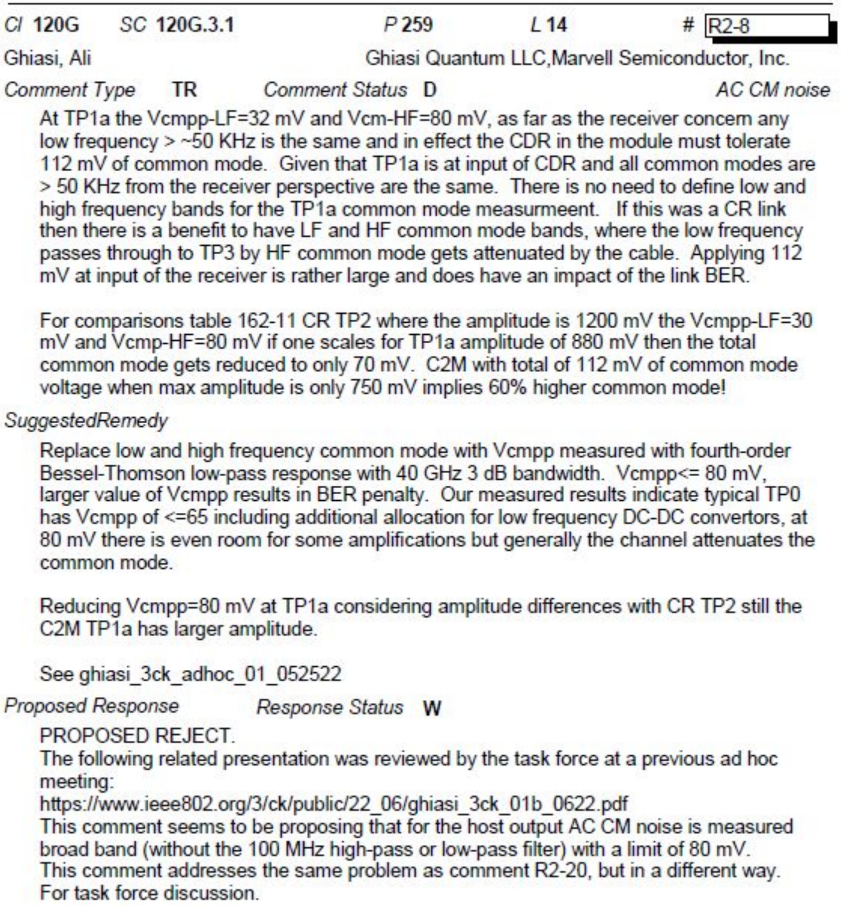
Proposed Response *Response Status* W

PROPOSED REJECT.
Resolve using the response to comment R2-20.

For C2M host output this comment suggests that…
Add a new component equal to sum of measured V_CMPPLF and V_CMPPHF with maximum limit of 80 mV.
Also, reduce limit on V_CMPPLF to 25 mV and V_CMPPHF to 70 mV.

For C2M module output this comment suggests that…
Same idea as R2-20 with different limits:
Sum < 75 mV
Also, reduce limit on V_CMPPLF to 20 mV and V_CMPPHF to 70 mV.

AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9



Cl **120G** *SC* **120G.3.1** *P* **259** *L* **14** # R2-8

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **D** *AC CM noise*

At TP1a the Vcmpp-LF=32 mV and Vcm-HF=80 mV, as far as the receiver concern any low frequency > ~50 KHz is the same and in effect the CDR in the module must tolerate 112 mV of common mode. Given that TP1a is at input of CDR and all common modes are > 50 KHz from the receiver perspective are the same. There is no need to define low and high frequency bands for the TP1a common mode measurmeent. If this was a CR link then there is a benefit to have LF and HF common mode bands, where the low frequency passes through to TP3 by HF common mode gets attenuated by the cable. Applying 112 mV at input of the receiver is rather large and does have an impact of the link BER.

For comparisons table 162-11 CR TP2 where the amplitude is 1200 mV the Vcmpp-LF=30 mV and Vcmp-HF=80 mV if one scales for TP1a amplitude of 880 mV then the total common mode gets reduced to only 70 mV. C2M with total of 112 mV of common mode voltage when max amplitude is only 750 mV implies 60% higher common mode!

SuggestedRemedy

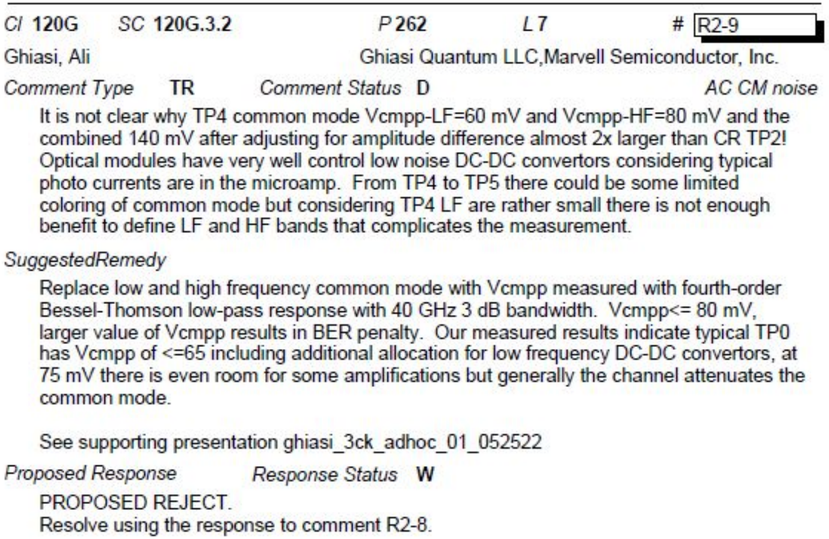
Replace low and high frequency common mode with Vcmpp measured with fourth-order Bessel-Thomson low-pass response with 40 GHz 3 dB bandwidth. Vcmpp<= 80 mV, larger value of Vcmpp results in BER penalty. Our measured results indicate typical TP0 has Vcmpp of <=65 including additional allocation for low frequency DC-DC convertors, at 80 mV there is even room for some amplifications but generally the channel attenuates the common mode.

Reducing Vcmpp=80 mV at TP1a considering amplitude differences with CR TP2 still the C2M TP1a has larger amplitude.

See ghiasi_3ck_adhoc_01_052522

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The following related presentation was reviewed by the task force at a previous ad hoc meeting:
https://www.ieee802.org/3/ck/public/22_06/ghiasi_3ck_01b_0622.pdf
This comment seems to be proposing that for the host output AC CM noise is measured broad band (without the 100 MHz high-pass or low-pass filter) with a limit of 80 mV.
This comment addresses the same problem as comment R2-20, but in a different way.
For task force discussion.



Cl **120G** *SC* **120G.3.2** *P* **262** *L* **7** # R2-9

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **D** *AC CM noise*

It is not clear why TP4 common mode Vcmpp-LF=60 mV and Vcmpp-HF=80 mV and the combined 140 mV after adjusting for amplitude difference almost 2x larger than CR TP2! Optical modules have very well control low noise DC-DC convertors considering typical photo currents are in the microamp. From TP4 to TP5 there could be some limited coloring of common mode but considering TP4 LF are rather small there is not enough benefit to define LF and HF bands that complicates the measurement.

SuggestedRemedy

Replace low and high frequency common mode with Vcmpp measured with fourth-order Bessel-Thomson low-pass response with 40 GHz 3 dB bandwidth. Vcmpp<= 80 mV, larger value of Vcmpp results in BER penalty. Our measured results indicate typical TP0 has Vcmpp of <=65 including additional allocation for low frequency DC-DC convertors, at 75 mV there is even room for some amplifications but generally the channel attenuates the common mode.

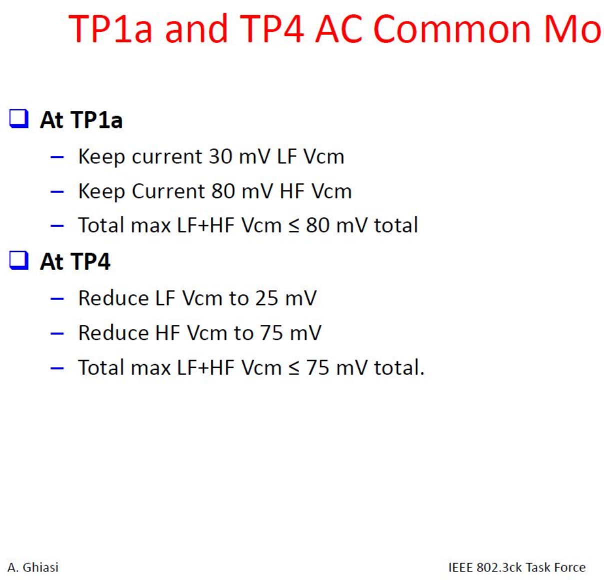
See supporting presentation ghiasi_3ck_adhoc_01_052522

Proposed Response *Response Status* **W**

PROPOSED REJECT.
Resolve using the response to comment R2-8.

R2-8 and R2-9 appear to be proposing changes as an alternative to R2-20 and R2-21 for the C2M host output and module output…
Replace the V_CMPPLF and V_CMPPHF with a single parameter V_CMPP measured from DC to the measurement bandwidth (40 GHz) with a maximum limit of 80 mV.

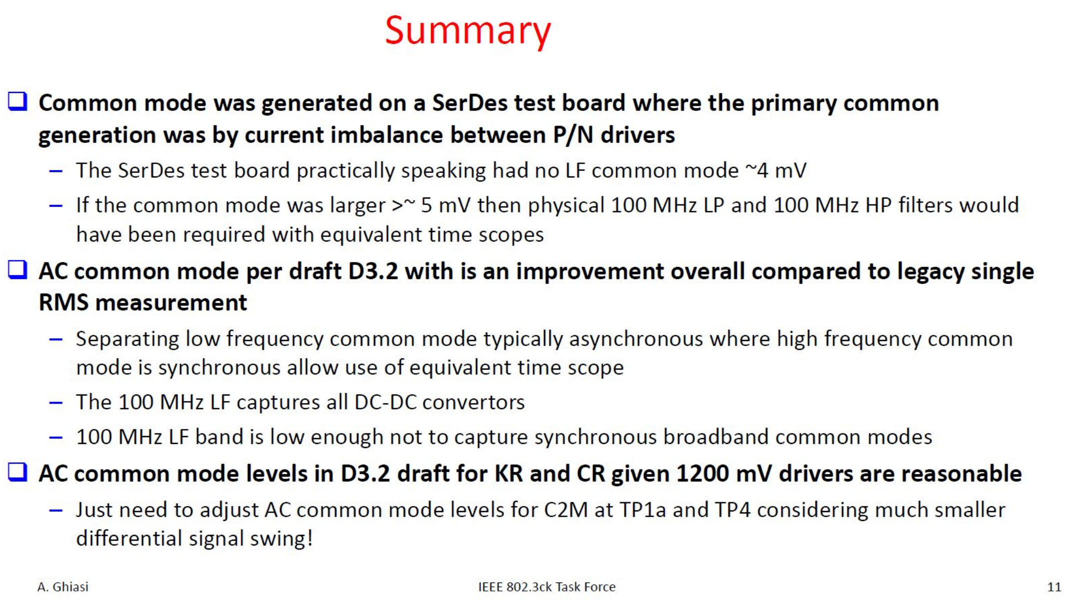
AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9



TP1a and TP4 AC Common Mode Proposal

- **At TP1a**
  - Keep current 30 mV LF Vcm
  - Keep Current 80 mV HF Vcm
  - Total max LF+HF Vcm ≤ 80 mV total
- **At TP4**
  - Reduce LF Vcm to 25 mV
  - Reduce HF Vcm to 75 mV
  - Total max LF+HF Vcm ≤ 75 mV total.

A. Ghiasi IEEE 802.3ck Task Force



Summary

- **Common mode was generated on a SerDes test board where the primary common generation was by current imbalance between P/N drivers**
  - The SerDes test board practically speaking had no LF common mode ~4 mV
  - If the common mode was larger >~ 5 mV then physical 100 MHz LP and 100 MHz HP filters would have been required with equivalent time scopes
- **AC common mode per draft D3.2 with is an improvement overall compared to legacy single RMS measurement**
  - Separating low frequency common mode typically asynchronous where high frequency common mode is synchronous allow use of equivalent time scope
  - The 100 MHz LF captures all DC-DC convertors
  - 100 MHz LF band is low enough not to capture synchronous broadband common modes
- **AC common mode levels in D3.2 draft for KR and CR given 1200 mV drivers are reasonable**
  - Just need to adjust AC common mode levels for C2M at TP1a and TP4 considering much smaller differential signal swing!

A. Ghiasi IEEE 802.3ck Task Force 11

Slides 10 and 11 from:
https://www.ieee802.org/3/ck/public/22_06/ghiasi_3ck_01b_0622.pdf

AC CM Noise, components
Comments 11, 18, 20, 21, 8, 9

Comments pertain only to 162 and 120G.

If we make changes there should these propagate to 163 and 120F?

Resolution options:

1. No changes.
2. Retain current parameters, but adjust values.
3. Add new parameter V_CMPPSUM = V_CMPPLF+V_CMPPHF with new max value

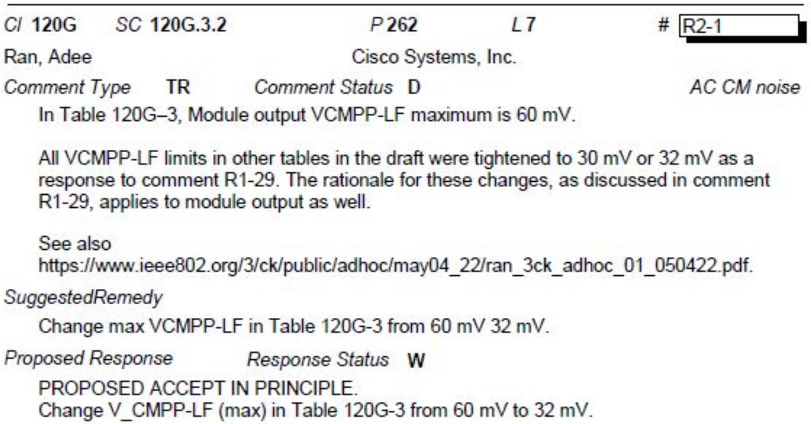
3a. Same as 3, but delete limit for V_CMPPHF.

4. Add new parameter V_CMPP measured without 100 MHz LPF or HPF (e.g., DC to 40 GHz) with new max value

4a. Same as 4, but delete parameter V_CMPPHF.

4b. Same as 4, but delete parameters V_CMPPHF and V_CMPPLF.

AC CM Noise, LF value Comment 1



Cl 120G *SC* 120G.3.2 *P* 262 *L* 7 # R2-1

Ran, Adee Cisco Systems, Inc.

Comment Type TR *Comment Status* D *AC CM noise*

In Table 120G–3, Module output VCMPP-LF maximum is 60 mV.

All VCMPP-LF limits in other tables in the draft were tightened to 30 mV or 32 mV as a response to comment R1-29. The rationale for these changes, as discussed in comment R1-29, applies to module output as well.

See also https://www.ieee802.org/3/ck/public/adhoc/may04_22/ran_3ck_adhoc_01_050422.pdf.

SuggestedRemedy

Change max VCMPP-LF in Table 120G-3 from 60 mV 32 mV.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
Change V_CMPP-LF (max) in Table 120G-3 from 60 mV to 32 mV.

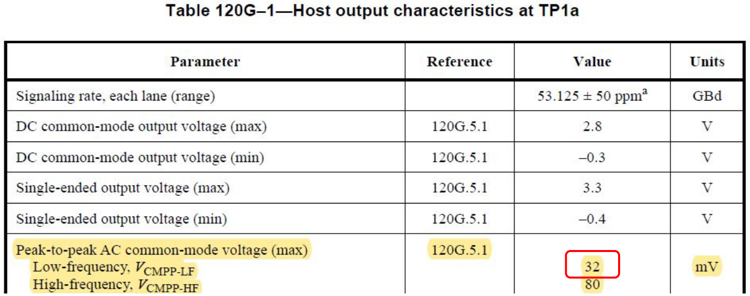


Table 120G–1—Host output characteristics at TP1a

Parameter	Reference	Value	Units
Signaling rate, each lane (range)		53.125 ± 50 ppm[a]	GBd
DC common-mode output voltage (max)	120G.5.1	2.8	V
DC common-mode output voltage (min)	120G.5.1	–0.3	V
Single-ended output voltage (max)	120G.5.1	3.3	V
Single-ended output voltage (min)	120G.5.1	–0.4	V
Peak-to-peak AC common-mode voltage (max) Low-frequency, $V_{CMPP-LF}$ High-frequency, $V_{CMPP-HF}$	120G.5.1	 32 80	mV

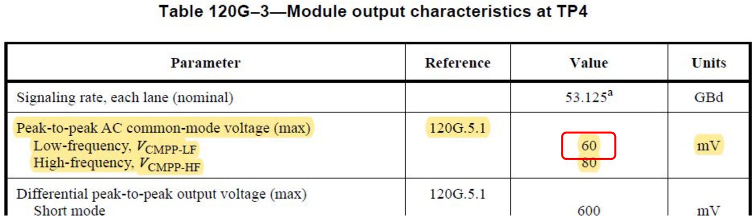
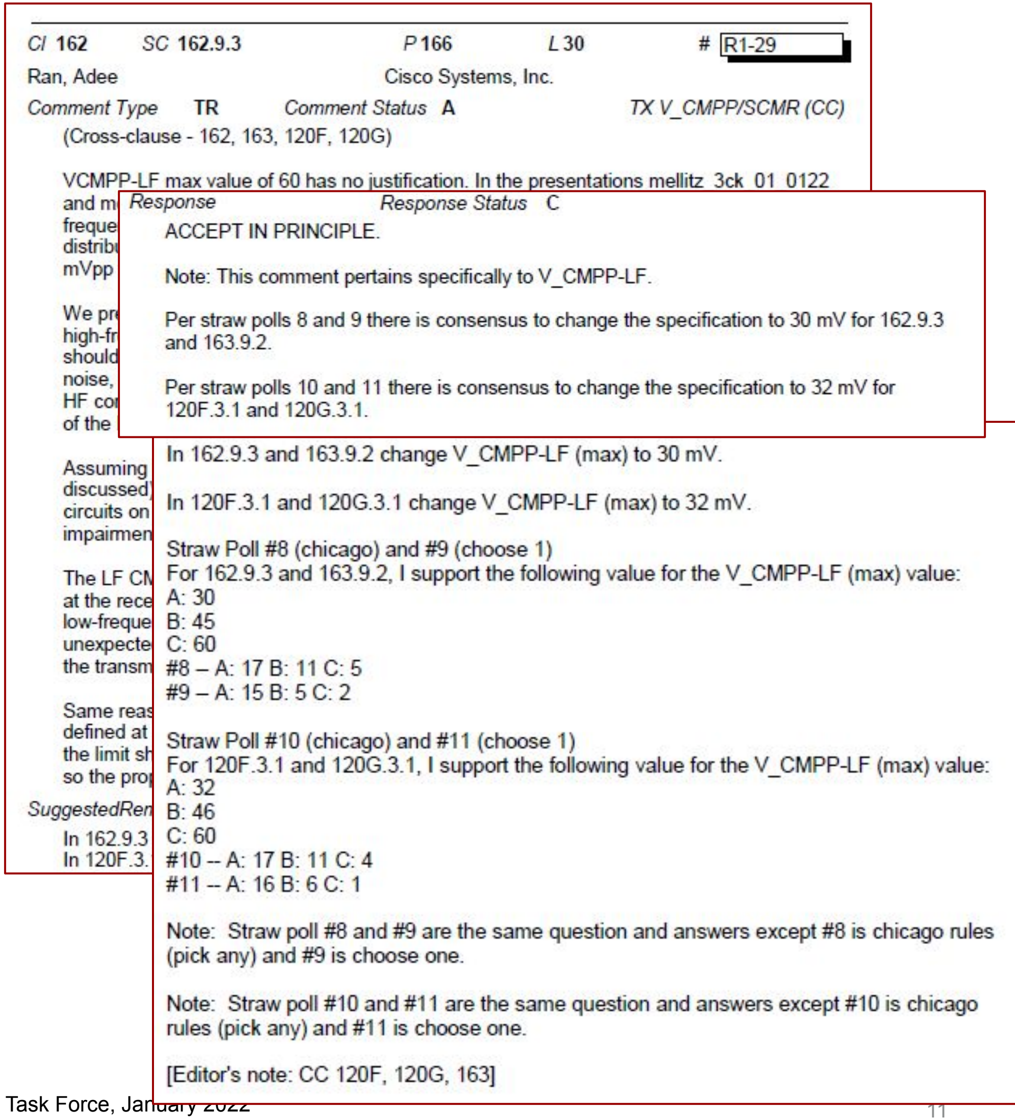


Table 120G–3—Module output characteristics at TP4

Parameter	Reference	Value	Units
Signaling rate, each lane (nominal)		53.125[a]	GBd
Peak-to-peak AC common-mode voltage (max) Low-frequency, $V_{CMPP-LF}$ High-frequency, $V_{CMPP-HF}$	120G.5.1	 60 80	mV
Differential peak-to-peak output voltage (max) Short mode	120G.5.1	600	mV

Draft 3.1 comment R1-29



Cl 162 *SC* 162.9.3 *P* 166 *L* 30 # R1-29

Ran, Adee Cisco Systems, Inc.

Comment Type TR *Comment Status* A *TX V_CMPP/SCMR (CC)*

(Cross-clause - 162, 163, 120F, 120G)

VCMPP-LF max value of 60 has no justification. In the presentations mellitz_3ck_01_0122
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In 162.9.3
In 120F.3.

Response *Response Status* C

ACCEPT IN PRINCIPLE.

Note: This comment pertains specifically to V_CMPP-LF.

Per straw polls 8 and 9 there is consensus to change the specification to 30 mV for 162.9.3 and 163.9.2.

Per straw polls 10 and 11 there is consensus to change the specification to 32 mV for 120F.3.1 and 120G.3.1.

In 162.9.3 and 163.9.2 change V_CMPP-LF (max) to 30 mV.

In 120F.3.1 and 120G.3.1 change V_CMPP-LF (max) to 32 mV.

Straw Poll #8 (chicago) and #9 (choose 1)
For 162.9.3 and 163.9.2, I support the following value for the V_CMPP-LF (max) value:
A: 30
B: 45
C: 60
#8 – A: 17 B: 11 C: 5
#9 – A: 15 B: 5 C: 2

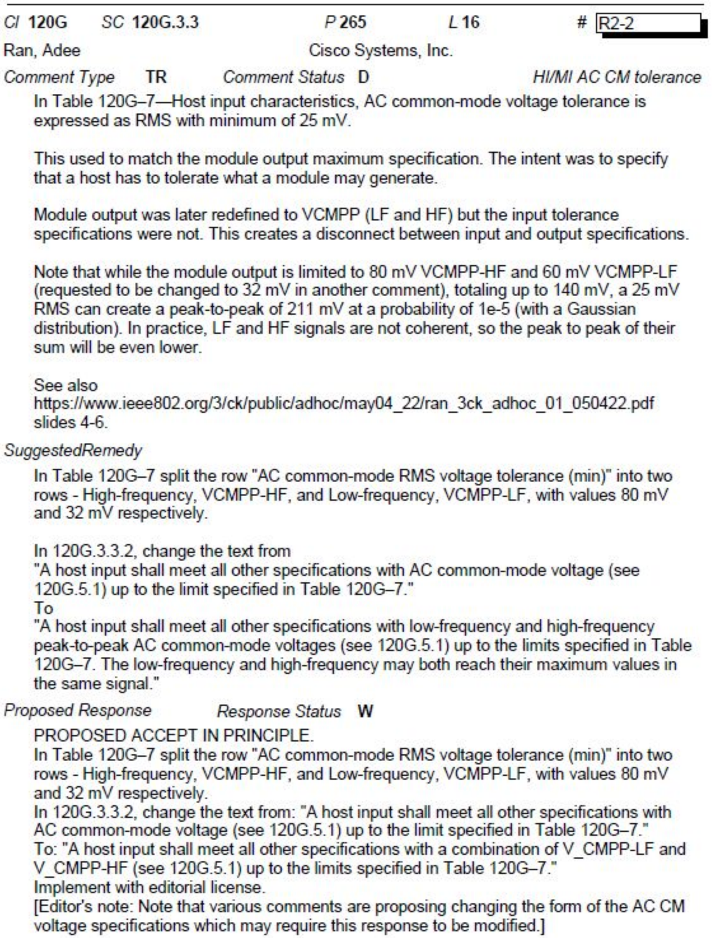
Straw Poll #10 (chicago) and #11 (choose 1)
For 120F.3.1 and 120G.3.1, I support the following value for the V_CMPP-LF (max) value:
A: 32
B: 46
C: 60
#10 -- A: 17 B: 11 C: 4
#11 -- A: 16 B: 6 C: 1

Note: Straw poll #8 and #9 are the same question and answers except #8 is chicago rules (pick any) and #9 is choose one.

Note: Straw poll #10 and #11 are the same question and answers except #10 is chicago rules (pick any) and #11 is choose one.

[Editor's note: CC 120F, 120G, 163]

AC CM Noise, tolerance
Comments 2, 3, 22



Cl **120G** *SC* **120G.3.3** *P* **265** *L* **16** # R2-2

Ran, Adee Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **D** *HI/MI AC CM tolerance*

In Table 120G–7—Host input characteristics, AC common-mode voltage tolerance is expressed as RMS with minimum of 25 mV.

This used to match the module output maximum specification. The intent was to specify that a host has to tolerate what a module may generate.

Module output was later redefined to VCMPP (LF and HF) but the input tolerance specifications were not. This creates a disconnect between input and output specifications.

Note that while the module output is limited to 80 mV VCMPP-HF and 60 mV VCMPP-LF (requested to be changed to 32 mV in another comment), totaling up to 140 mV, a 25 mV RMS can create a peak-to-peak of 211 mV at a probability of 1e-5 (with a Gaussian distribution). In practice, LF and HF signals are not coherent, so the peak to peak of their sum will be even lower.

See also
https://www.ieee802.org/3/ck/public/adhoc/may04_22/ran_3ck_adhoc_01_050422.pdf
slides 4-6.

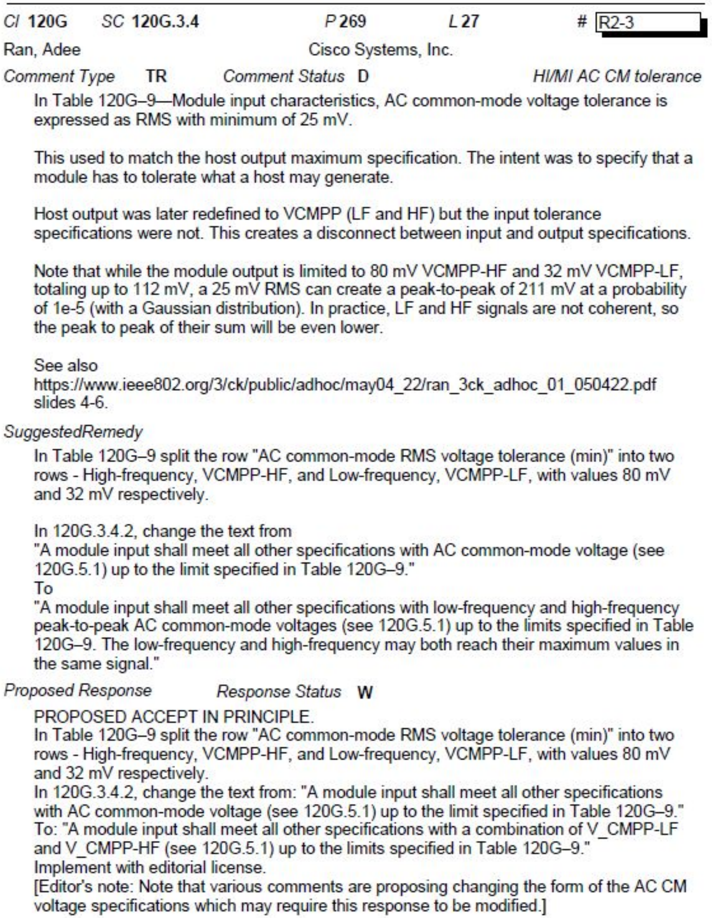
SuggestedRemedy

In Table 120G–7 split the row "AC common-mode RMS voltage tolerance (min)" into two rows - High-frequency, VCMPP-HF, and Low-frequency, VCMPP-LF, with values 80 mV and 32 mV respectively.

In 120G.3.3.2, change the text from
"A host input shall meet all other specifications with AC common-mode voltage (see 120G.5.1) up to the limit specified in Table 120G–7."
To
"A host input shall meet all other specifications with low-frequency and high-frequency peak-to-peak AC common-mode voltages (see 120G.5.1) up to the limits specified in Table 120G–7. The low-frequency and high-frequency may both reach their maximum values in the same signal."

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
In Table 120G–7 split the row "AC common-mode RMS voltage tolerance (min)" into two rows - High-frequency, VCMPP-HF, and Low-frequency, VCMPP-LF, with values 80 mV and 32 mV respectively.
In 120G.3.3.2, change the text from: "A host input shall meet all other specifications with AC common-mode voltage (see 120G.5.1) up to the limit specified in Table 120G–7."
To: "A host input shall meet all other specifications with a combination of V_CMPP-LF and V_CMPP-HF (see 120G.5.1) up to the limits specified in Table 120G–7."
Implement with editorial license.
[Editor's note: Note that various comments are proposing changing the form of the AC CM voltage specifications which may require this response to be modified.]



Cl **120G** *SC* **120G.3.4** *P* **269** *L* **27** # R2-3

Ran, Adee Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **D** *HI/MI AC CM tolerance*

In Table 120G–9—Module input characteristics, AC common-mode voltage tolerance is expressed as RMS with minimum of 25 mV.

This used to match the host output maximum specification. The intent was to specify that a module has to tolerate what a host may generate.

Host output was later redefined to VCMPP (LF and HF) but the input tolerance specifications were not. This creates a disconnect between input and output specifications.

Note that while the module output is limited to 80 mV VCMPP-HF and 32 mV VCMPP-LF, totaling up to 112 mV, a 25 mV RMS can create a peak-to-peak of 211 mV at a probability of 1e-5 (with a Gaussian distribution). In practice, LF and HF signals are not coherent, so the peak to peak of their sum will be even lower.

See also
https://www.ieee802.org/3/ck/public/adhoc/may04_22/ran_3ck_adhoc_01_050422.pdf
slides 4-6.

SuggestedRemedy

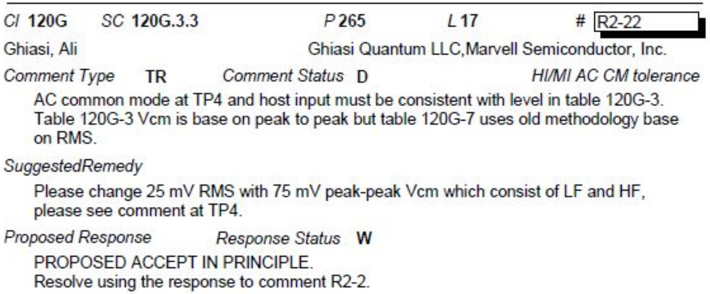
In Table 120G–9 split the row "AC common-mode RMS voltage tolerance (min)" into two rows - High-frequency, VCMPP-HF, and Low-frequency, VCMPP-LF, with values 80 mV and 32 mV respectively.

In 120G.3.4.2, change the text from
"A module input shall meet all other specifications with AC common-mode voltage (see 120G.5.1) up to the limit specified in Table 120G–9."
To
"A module input shall meet all other specifications with low-frequency and high-frequency peak-to-peak AC common-mode voltages (see 120G.5.1) up to the limits specified in Table 120G–9. The low-frequency and high-frequency may both reach their maximum values in the same signal."

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
In Table 120G–9 split the row "AC common-mode RMS voltage tolerance (min)" into two rows - High-frequency, VCMPP-HF, and Low-frequency, VCMPP-LF, with values 80 mV and 32 mV respectively.
In 120G.3.4.2, change the text from: "A module input shall meet all other specifications with AC common-mode voltage (see 120G.5.1) up to the limit specified in Table 120G–9."
To: "A module input shall meet all other specifications with a combination of V_CMPP-LF and V_CMPP-HF (see 120G.5.1) up to the limits specified in Table 120G–9."
Implement with editorial license.
[Editor's note: Note that various comments are proposing changing the form of the AC CM voltage specifications which may require this response to be modified.]

AC CM Noise, tolerance
Comments 2, 3, 22



Cl **120G** *SC* **120G.3.3** *P* **265** *L* **17** # R2-22

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **D** *HI/MI AC CM tolerance*

AC common mode at TP4 and host input must be consistent with level in table 120G-3. Table 120G-3 Vcm is base on peak to peak but table 120G-7 uses old methodology base on RMS.

SuggestedRemedy

Please change 25 mV RMS with 75 mV peak-peak Vcm which consist of LF and HF, please see comment at TP4.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
Resolve using the response to comment R2-2.

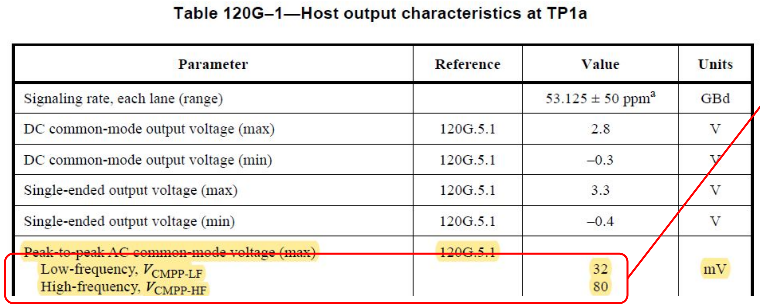


Table 120G–1—Host output characteristics at TP1a

Parameter	Reference	Value	Units
Signaling rate, each lane (range)		53.125 ± 50 ppm[a]	GBd
DC common-mode output voltage (max)	120G.5.1	2.8	V
DC common-mode output voltage (min)	120G.5.1	–0.3	V
Single-ended output voltage (max)	120G.5.1	3.3	V
Single-ended output voltage (min)	120G.5.1	–0.4	V
Peak-to-peak AC common-mode voltage (max) Low-frequency, $V_{\text{CMPP-LF}}$ High-frequency, $V_{\text{CMPP-HF}}$	120G.5.1	 32 80	mV

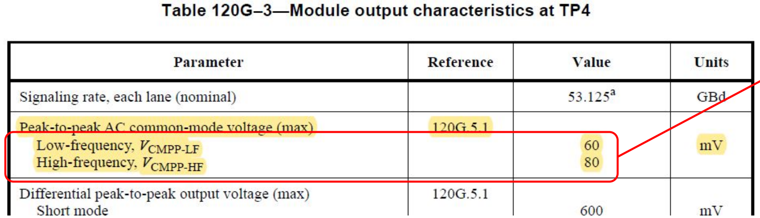


Table 120G–3—Module output characteristics at TP4

Parameter	Reference	Value	Units
Signaling rate, each lane (nominal)		53.125[a]	GBd
Peak-to-peak AC common-mode voltage (max) Low-frequency, $V_{\text{CMPP-LF}}$ High-frequency, $V_{\text{CMPP-HF}}$	120G.5.1	 60 80	mV
Differential peak-to-peak output voltage (max) Short mode	120G.5.1	600	mV

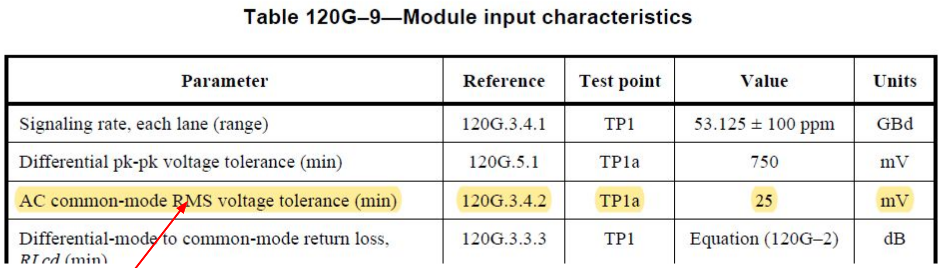
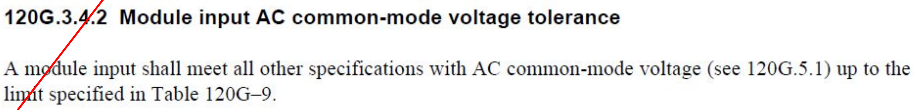


Table 120G–9—Module input characteristics

Parameter	Reference	Test point	Value	Units
Signaling rate, each lane (range)	120G.3.4.1	TP1	53.125 ± 100 ppm	GBd
Differential pk-pk voltage tolerance (min)	120G.5.1	TP1a	750	mV
AC common-mode RMS voltage tolerance (min)	120G.3.4.2	TP1a	25	mV
Differential-mode to common-mode return loss, *RLcd* (min)	120G.3.3.3	TP1	Equation (120G–2)	dB



120G.3.4.2 Module input AC common-mode voltage tolerance

A module input shall meet all other specifications with AC common-mode voltage (see 120G.5.1) up to the limit specified in Table 120G–9.

"A module input shall meet all other specifications with a combination of $V_{\text{CMPP-LF}}$ and $V_{\text{CMPP-HF}}$ (see 120G.5.1) up to the limits specified in Table 120G–9."

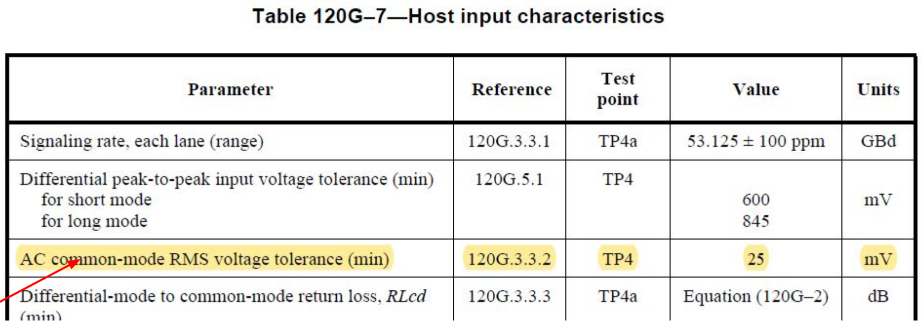
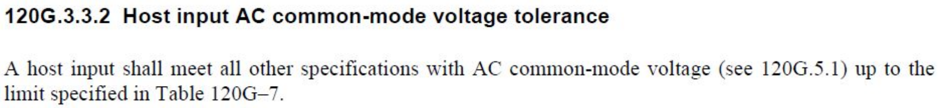


Table 120G–7—Host input characteristics

Parameter	Reference	Test point	Value	Units
Signaling rate, each lane (range)	120G.3.3.1	TP4a	53.125 ± 100 ppm	GBd
Differential peak-to-peak input voltage tolerance (min) for short mode for long mode	120G.5.1	TP4	 600 845	mV
AC common-mode RMS voltage tolerance (min)	120G.3.3.2	TP4	25	mV
Differential-mode to common-mode return loss, *RLcd* (min)	120G.3.3.3	TP4a	Equation (120G–2)	dB

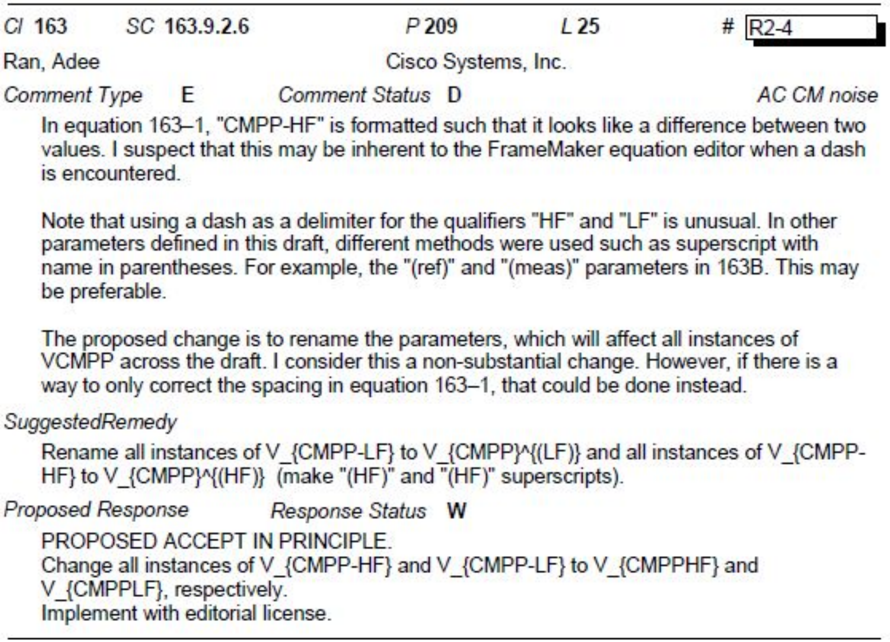


120G.3.3.2 Host input AC common-mode voltage tolerance

A host input shall meet all other specifications with AC common-mode voltage (see 120G.5.1) up to the limit specified in Table 120G–7.

"A host input shall meet all other specifications with a combination of $V_{\text{CMPP-LF}}$ and $V_{\text{CMPP-HF}}$ (see 120G.5.1) up to the limits specified in Table 120G–7."

AC CM Noise, variable names
Comment 4



Cl 163 *SC* 163.9.2.6 *P* 209 *L* 25 # R2-4

Ran, Adee Cisco Systems, Inc.

Comment Type E *Comment Status* D *AC CM noise*

In equation 163–1, "CMPP-HF" is formatted such that it looks like a difference between two values. I suspect that this may be inherent to the FrameMaker equation editor when a dash is encountered.

Note that using a dash as a delimiter for the qualifiers "HF" and "LF" is unusual. In other parameters defined in this draft, different methods were used such as superscript with name in parentheses. For example, the "(ref)" and "(meas)" parameters in 163B. This may be preferable.

The proposed change is to rename the parameters, which will affect all instances of VCMPP across the draft. I consider this a non-substantial change. However, if there is a way to only correct the spacing in equation 163–1, that could be done instead.

SuggestedRemedy

Rename all instances of V_{CMPP-LF} to V_{CMPP}^{(LF)} and all instances of V_{CMPP-HF} to V_{CMPP}^{(HF)} (make "(HF)" and "(HF)" superscripts).

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
Change all instances of V_{CMPP-HF} and V_{CMPP-LF} to V_{CMPPHF} and V_{CMPPLF}, respectively.
Implement with editorial license.

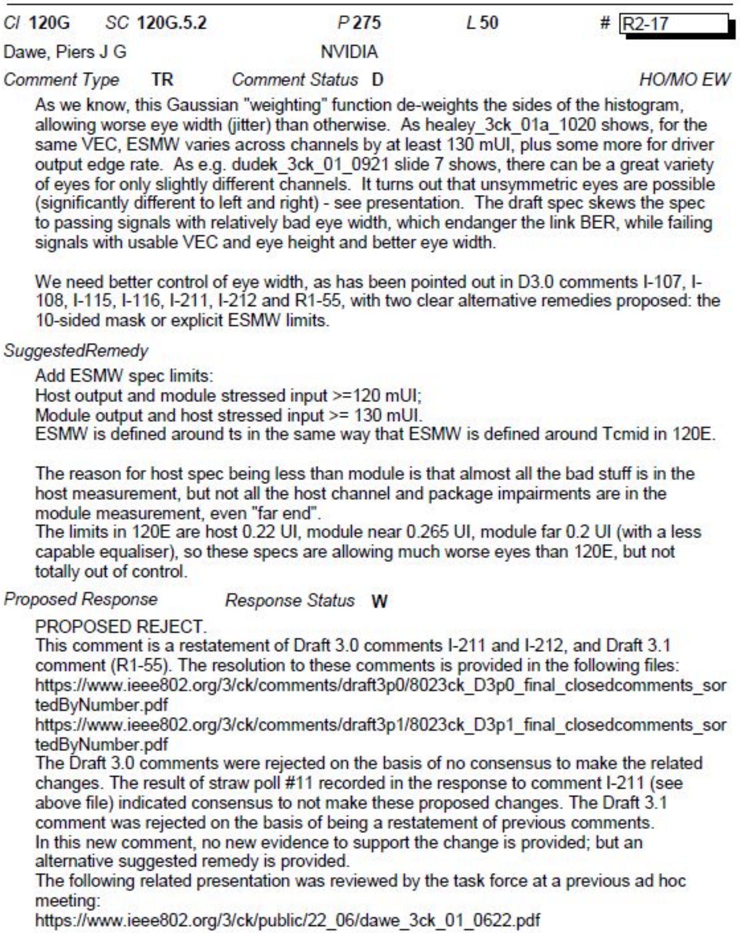
Propose to rename as follows:

$$V_{\text{CMPP-LF}} \rightarrow V_{\text{CMPPLF}}$$

$$V_{\text{CMPP-HF}} \rightarrow V_{\text{CMPPHF}}$$

Annex 120G

120G HO/MO eye width Comments 17, 19



CI **120G** *SC* **120G.5.2** *P* **275** *L* **50** # R2-17

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **D** *HO/MO EW*

As we know, this Gaussian "weighting" function de-weights the sides of the histogram, allowing worse eye width (jitter) than otherwise. As healey_3ck_01a_1020 shows, for the same VEC, ESMW varies across channels by at least 130 mUI, plus some more for driver output edge rate. As e.g. dudek_3ck_01_0921 slide 7 shows, there can be a great variety of eyes for only slightly different channels. It turns out that unsymmetric eyes are possible (significantly different to left and right) - see presentation. The draft spec skews the spec to passing signals with relatively bad eye width, which endanger the link BER, while failing signals with usable VEC and eye height and better eye width.

We need better control of eye width, as has been pointed out in D3.0 comments I-107, I-108, I-115, I-116, I-211, I-212 and R1-55, with two clear alternative remedies proposed: the 10-sided mask or explicit ESMW limits.

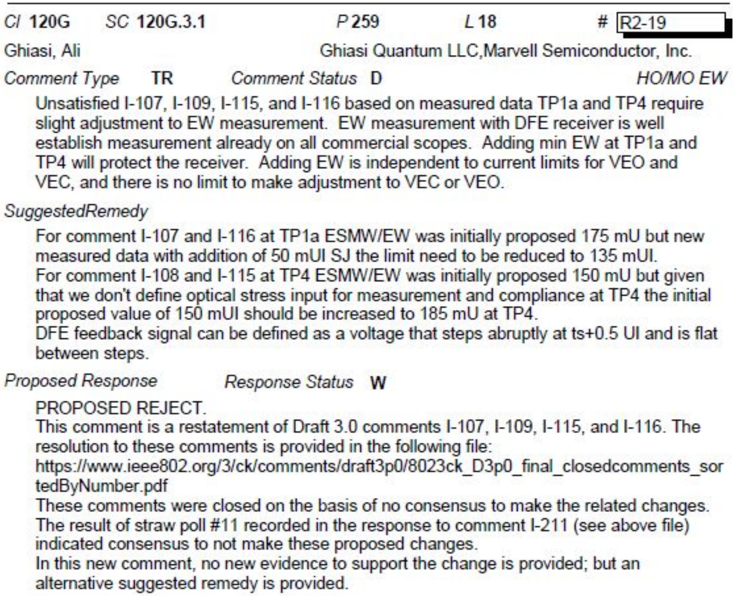
SuggestedRemedy

Add ESMW spec limits:
Host output and module stressed input >=120 mUI;
Module output and host stressed input >= 130 mUI.
ESMW is defined around ts in the same way that ESMW is defined around Tcmid in 120E.

The reason for host spec being less than module is that almost all the bad stuff is in the host measurement, but not all the host channel and package impairments are in the module measurement, even "far end".
The limits in 120E are host 0.22 UI, module near 0.265 UI, module far 0.2 UI (with a less capable equaliser), so these specs are allowing much worse eyes than 120E, but not totally out of control.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
This comment is a restatement of Draft 3.0 comments I-211 and I-212, and Draft 3.1 comment (R1-55). The resolution to these comments is provided in the following files:
https://www.ieee802.org/3/ck/comments/draft3p0/8023ck_D3p0_final_closedcomments_sortedByNumber.pdf
https://www.ieee802.org/3/ck/comments/draft3p1/8023ck_D3p1_final_closedcomments_sortedByNumber.pdf
The Draft 3.0 comments were rejected on the basis of no consensus to make the related changes. The result of straw poll #11 recorded in the response to comment I-211 (see above file) indicated consensus to not make these proposed changes. The Draft 3.1 comment was rejected on the basis of being a restatement of previous comments.
In this new comment, no new evidence to support the change is provided; but an alternative suggested remedy is provided.
The following related presentation was reviewed by the task force at a previous ad hoc meeting:
https://www.ieee802.org/3/ck/public/22_06/dawe_3ck_01_0622.pdf



CI **120G** *SC* **120G.3.1** *P* **259** *L* **18** # R2-19

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **D** *HO/MO EW*

Unsatisfied I-107, I-109, I-115, and I-116 based on measured data TP1a and TP4 require slight adjustment to EW measurement. EW measurement with DFE receiver is well establish measurement already on all commercial scopes. Adding min EW at TP1a and TP4 will protect the receiver. Adding EW is independent to current limits for VEO and VEC, and there is no limit to make adjustment to VEC or VEO.

SuggestedRemedy

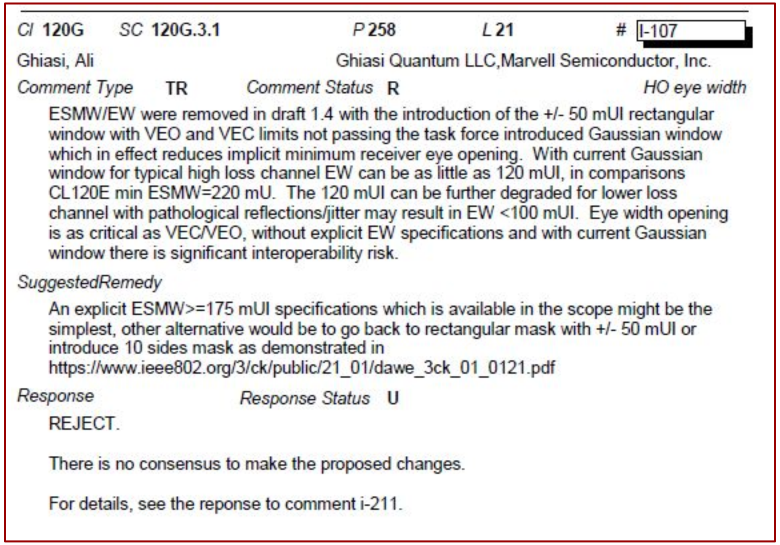
For comment I-107 and I-116 at TP1a ESMW/EW was initially proposed 175 mU but new measured data with addition of 50 mUI SJ the limit need to be reduced to 135 mUI.
For comment I-108 and I-115 at TP4 ESMW/EW was initially proposed 150 mU but given that we don't define optical stress input for measurement and compliance at TP4 the initial proposed value of 150 mUI should be increased to 185 mU at TP4.
DFE feedback signal can be defined as a voltage that steps abruptly at ts+0.5 UI and is flat between steps.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
This comment is a restatement of Draft 3.0 comments I-107, I-109, I-115, and I-116. The resolution to these comments is provided in the following file:
https://www.ieee802.org/3/ck/comments/draft3p0/8023ck_D3p0_final_closedcomments_sortedByNumber.pdf
These comments were closed on the basis of no consensus to make the related changes.
The result of straw poll #11 recorded in the response to comment I-211 (see above file) indicated consensus to not make these proposed changes.
In this new comment, no new evidence to support the change is provided; but an alternative suggested remedy is provided.

120G HO/MO eye width Comments 17, 19

D3.0 comment I-107



Cl **120G** *SC* **120G.3.1** *P* **258** *L* **21** # I-107

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **R** *HO eye width*

ESMW/EW were removed in draft 1.4 with the introduction of the +/- 50 mUI rectangular window with VEO and VEC limits not passing the task force introduced Gaussian window which in effect reduces implicit minimum receiver eye opening. With current Gaussian window for typical high loss channel EW can be as little as 120 mUI, in comparisons CL120E min ESMW=220 mU. The 120 mUI can be further degraded for lower loss channel with pathological reflections/jitter may result in EW <100 mUI. Eye width opening is as critical as VEC/VEO, without explicit EW specifications and with current Gaussian window there is significant interoperability risk.

SuggestedRemedy

An explicit ESMW>=175 mUI specifications which is available in the scope might be the simplest, other alternative would be to go back to rectangular mask with +/- 50 mUI or introduce 10 sides mask as demonstrated in https://www.ieee802.org/3/ck/public/21_01/dawe_3ck_01_0121.pdf

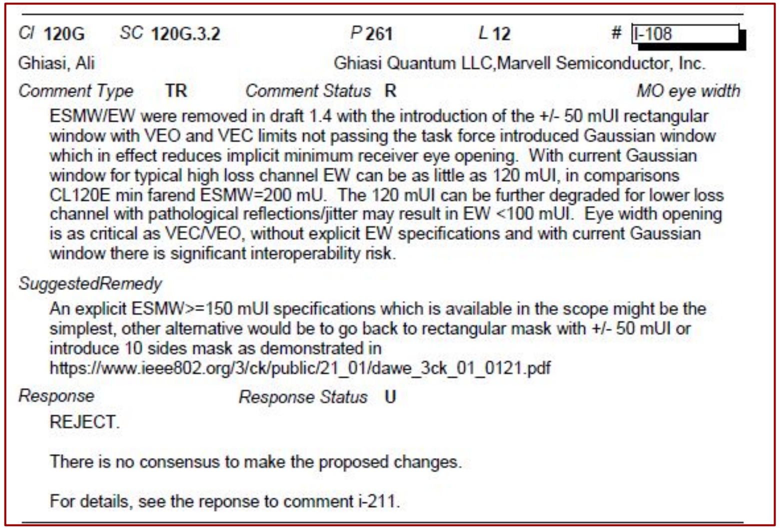
Response *Response Status* **U**

REJECT.

There is no consensus to make the proposed changes.

For details, see the reponse to comment i-211.

D3.0 comment I-108



Cl **120G** *SC* **120G.3.2** *P* **261** *L* **12** # I-108

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **R** *MO eye width*

ESMW/EW were removed in draft 1.4 with the introduction of the +/- 50 mUI rectangular window with VEO and VEC limits not passing the task force introduced Gaussian window which in effect reduces implicit minimum receiver eye opening. With current Gaussian window for typical high loss channel EW can be as little as 120 mUI, in comparisons CL120E min farend ESMW=200 mU. The 120 mUI can be further degraded for lower loss channel with pathological reflections/jitter may result in EW <100 mUI. Eye width opening is as critical as VEC/VEO, without explicit EW specifications and with current Gaussian window there is significant interoperability risk.

SuggestedRemedy

An explicit ESMW>=150 mUI specifications which is available in the scope might be the simplest, other alternative would be to go back to rectangular mask with +/- 50 mUI or introduce 10 sides mask as demonstrated in https://www.ieee802.org/3/ck/public/21_01/dawe_3ck_01_0121.pdf

Response *Response Status* **U**

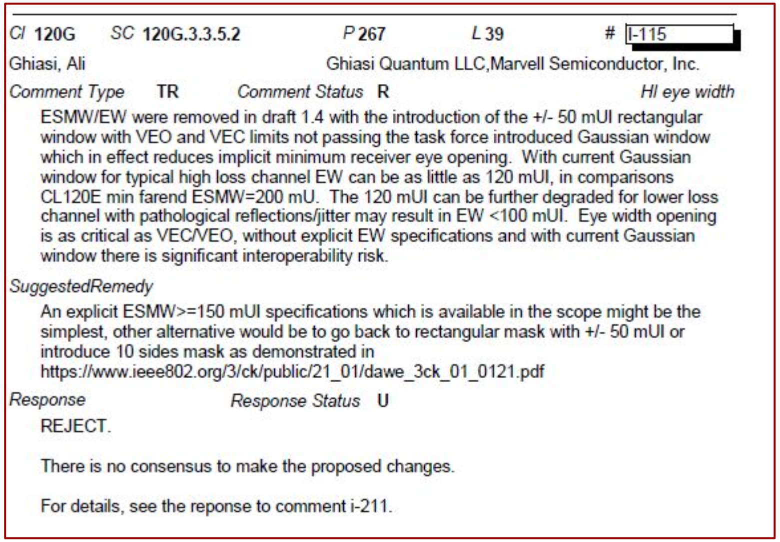
REJECT.

There is no consensus to make the proposed changes.

For details, see the reponse to comment i-211.

120G HO/MO eye width
Comments 17, 19

D3.0 comment I-115



Cl **120G** *SC* **120G.3.3.5.2** *P* **267** *L* **39** # I-115

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **R** *HI eye width*

ESMW/EW were removed in draft 1.4 with the introduction of the +/- 50 mUI rectangular window with VEO and VEC limits not passing the task force introduced Gaussian window which in effect reduces implicit minimum receiver eye opening. With current Gaussian window for typical high loss channel EW can be as little as 120 mUI, in comparisons CL120E min farend ESMW=200 mU. The 120 mUI can be further degraded for lower loss channel with pathological reflections/jitter may result in EW <100 mUI. Eye width opening is as critical as VEC/VEO, without explicit EW specifications and with current Gaussian window there is significant interoperability risk.

SuggestedRemedy

An explicit ESMW>=150 mUI specifications which is available in the scope might be the simplest, other alternative would be to go back to rectangular mask with +/- 50 mUI or introduce 10 sides mask as demonstrated in https://www.ieee802.org/3/ck/public/21_01/dawe_3ck_01_0121.pdf

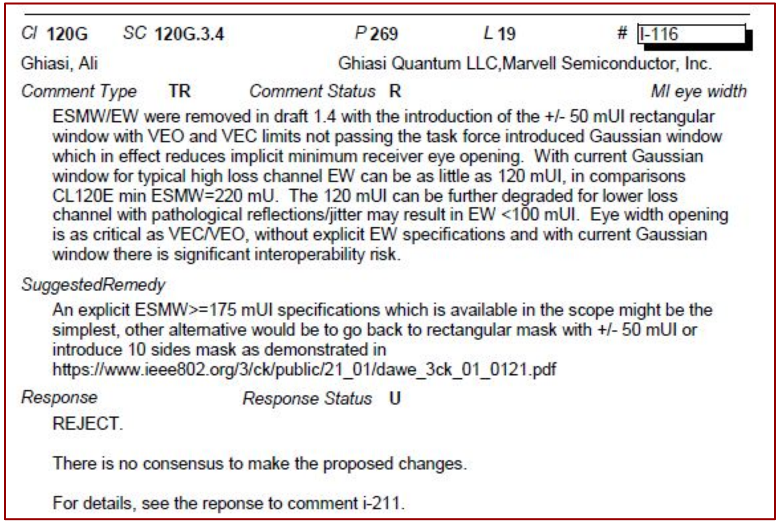
Response *Response Status* **U**

REJECT.

There is no consensus to make the proposed changes.

For details, see the reponse to comment i-211.

D3.0 comment I-116



Cl **120G** *SC* **120G.3.4** *P* **269** *L* **19** # I-116

Ghiasi, Ali Ghiasi Quantum LLC,Marvell Semiconductor, Inc.

Comment Type **TR** *Comment Status* **R** *MI eye width*

ESMW/EW were removed in draft 1.4 with the introduction of the +/- 50 mUI rectangular window with VEO and VEC limits not passing the task force introduced Gaussian window which in effect reduces implicit minimum receiver eye opening. With current Gaussian window for typical high loss channel EW can be as little as 120 mUI, in comparisons CL120E min ESMW=220 mU. The 120 mUI can be further degraded for lower loss channel with pathological reflections/jitter may result in EW <100 mUI. Eye width opening is as critical as VEC/VEO, without explicit EW specifications and with current Gaussian window there is significant interoperability risk.

SuggestedRemedy

An explicit ESMW>=175 mUI specifications which is available in the scope might be the simplest, other alternative would be to go back to rectangular mask with +/- 50 mUI or introduce 10 sides mask as demonstrated in https://www.ieee802.org/3/ck/public/21_01/dawe_3ck_01_0121.pdf

Response *Response Status* **U**

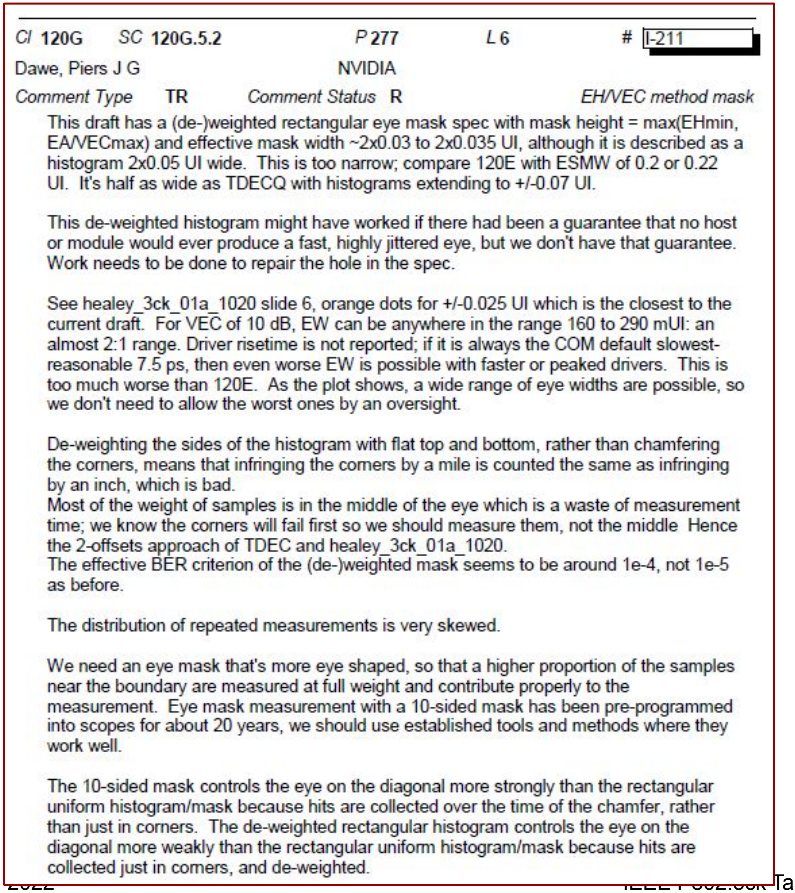
REJECT.

There is no consensus to make the proposed changes.

For details, see the reponse to comment i-211.

120G HO/MO eye width
Comments 17, 19

D3.0 comment I-211



Cl **120G** *SC* **120G.5.2** *P* **277** *L* **6** # I-211

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **R** *EH/VEC method mask*

This draft has a (de-)weighted rectangular eye mask spec with mask height = max(EHmin, EA/VECmax) and effective mask width ~2x0.03 to 2x0.035 UI, although it is described as a histogram 2x0.05 UI wide. This is too narrow; compare 120E with ESMW of 0.2 or 0.22 UI. It's half as wide as TDECQ with histograms extending to +/-0.07 UI.

This de-weighted histogram might have worked if there had been a guarantee that no host or module would ever produce a fast, highly jittered eye, but we don't have that guarantee. Work needs to be done to repair the hole in the spec.

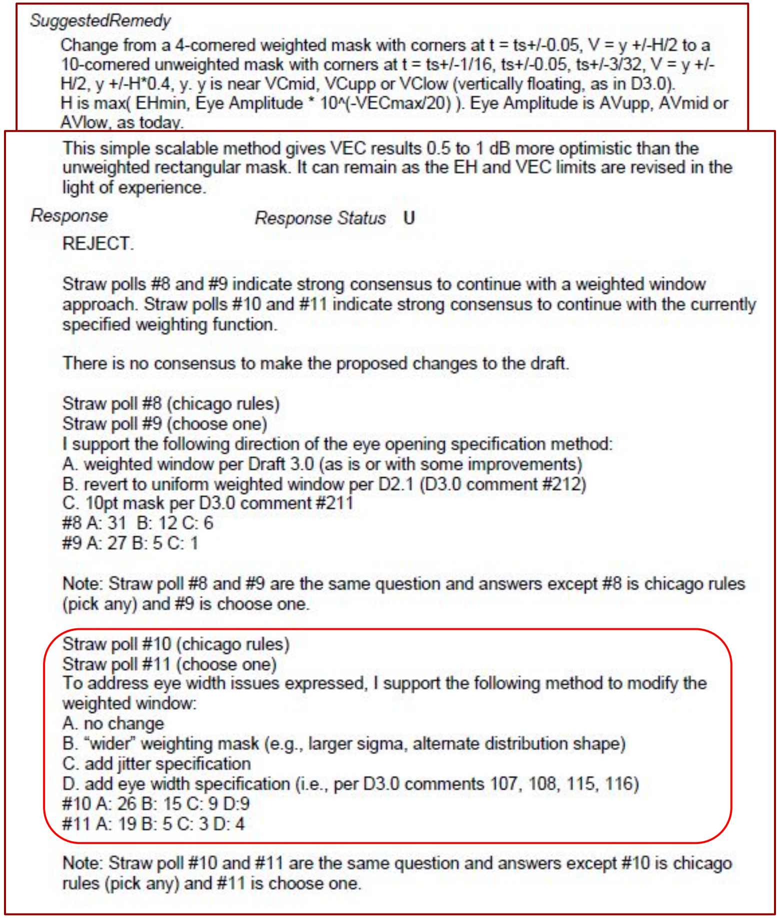
See healey_3ck_01a_1020 slide 6, orange dots for +/-0.025 UI which is the closest to the current draft. For VEC of 10 dB, EW can be anywhere in the range 160 to 290 mUI: an almost 2:1 range. Driver risetime is not reported; if it is always the COM default slowest-reasonable 7.5 ps, then even worse EW is possible with faster or peaked drivers. This is too much worse than 120E. As the plot shows, a wide range of eye widths are possible, so we don't need to allow the worst ones by an oversight.

De-weighting the sides of the histogram with flat top and bottom, rather than chamfering the corners, means that infringing the corners by a mile is counted the same as infringing by an inch, which is bad.
Most of the weight of samples is in the middle of the eye which is a waste of measurement time; we know the corners will fail first so we should measure them, not the middle Hence the 2-offsets approach of TDEC and healey_3ck_01a_1020.
The effective BER criterion of the (de-)weighted mask seems to be around 1e-4, not 1e-5 as before.

The distribution of repeated measurements is very skewed.

We need an eye mask that's more eye shaped, so that a higher proportion of the samples near the boundary are measured at full weight and contribute properly to the measurement. Eye mask measurement with a 10-sided mask has been pre-programmed into scopes for about 20 years, we should use established tools and methods where they work well.

The 10-sided mask controls the eye on the diagonal more strongly than the rectangular uniform histogram/mask because hits are collected over the time of the chamfer, rather than just in corners. The de-weighted rectangular histogram controls the eye on the diagonal more weakly than the rectangular uniform histogram/mask because hits are collected just in corners, and de-weighted.



SuggestedRemedy

Change from a 4-cornered weighted mask with corners at t = ts+/-0.05, V = y +/-H/2 to a 10-cornered unweighted mask with corners at t = ts+/-1/16, ts+/-0.05, ts+/-3/32, V = y +/-H/2, y +/-H*0.4, y. y is near VCmid, VCupp or VClow (vertically floating, as in D3.0).
H is max(EHmin, Eye Amplitude * 10^(-VECmax/20)). Eye Amplitude is AVupp, AVmid or AVlow, as today.

This simple scalable method gives VEC results 0.5 to 1 dB more optimistic than the unweighted rectangular mask. It can remain as the EH and VEC limits are revised in the light of experience.

Response *Response Status* **U**

REJECT.

Straw polls #8 and #9 indicate strong consensus to continue with a weighted window approach. Straw polls #10 and #11 indicate strong consensus to continue with the currently specified weighting function.

There is no consensus to make the proposed changes to the draft.

Straw poll #8 (chicago rules)
Straw poll #9 (choose one)
I support the following direction of the eye opening specification method:
A. weighted window per Draft 3.0 (as is or with some improvements)
B. revert to uniform weighted window per D2.1 (D3.0 comment #212)
C. 10pt mask per D3.0 comment #211
#8 A: 31 B: 12 C: 6
#9 A: 27 B: 5 C: 1

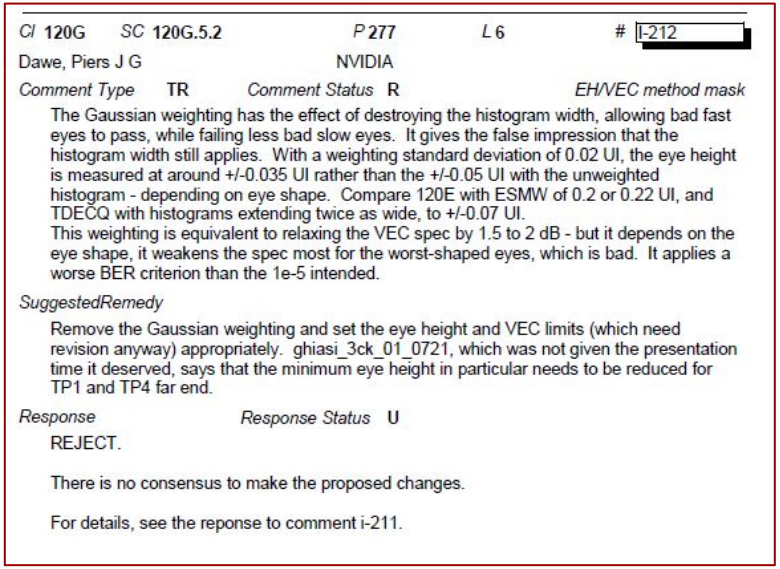
Note: Straw poll #8 and #9 are the same question and answers except #8 is chicago rules (pick any) and #9 is choose one.

Straw poll #10 (chicago rules)
Straw poll #11 (choose one)
To address eye width issues expressed, I support the following method to modify the weighted window:
A. no change
B. "wider" weighting mask (e.g., larger sigma, alternate distribution shape)
C. add jitter specification
D. add eye width specification (i.e., per D3.0 comments 107, 108, 115, 116)
#10 A: 26 B: 15 C: 9 D:9
#11 A: 19 B: 5 C: 3 D: 4

Note: Straw poll #10 and #11 are the same question and answers except #10 is chicago rules (pick any) and #11 is choose one.

120G HO/MO eye width
Comments 17, 19

D3.0 comment I-212



Cl **120G** *SC* **120G.5.2** *P* **277** *L* **6** # I-212

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **R** *EH/VEC method mask*

The Gaussian weighting has the effect of destroying the histogram width, allowing bad fast eyes to pass, while failing less bad slow eyes. It gives the false impression that the histogram width still applies. With a weighting standard deviation of 0.02 UI, the eye height is measured at around +/-0.035 UI rather than the +/-0.05 UI with the unweighted histogram - depending on eye shape. Compare 120E with ESMW of 0.2 or 0.22 UI, and TDECQ with histograms extending twice as wide, to +/-0.07 UI.
This weighting is equivalent to relaxing the VEC spec by 1.5 to 2 dB - but it depends on the eye shape, it weakens the spec most for the worst-shaped eyes, which is bad. It applies a worse BER criterion than the 1e-5 intended.

SuggestedRemedy

Remove the Gaussian weighting and set the eye height and VEC limits (which need revision anyway) appropriately. ghiasi_3ck_01_0721, which was not given the presentation time it deserved, says that the minimum eye height in particular needs to be reduced for TP1 and TP4 far end.

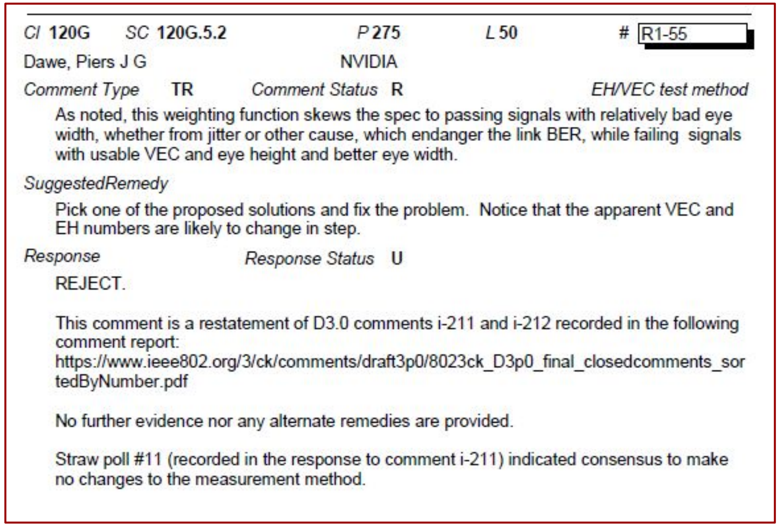
Response *Response Status* **U**

REJECT.

There is no consensus to make the proposed changes.

For details, see the reponse to comment i-211.

D3.1 comment R1-55



Cl **120G** *SC* **120G.5.2** *P* **275** *L* **50** # R1-55

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **R** *EH/VEC test method*

As noted, this weighting function skews the spec to passing signals with relatively bad eye width, whether from jitter or other cause, which endanger the link BER, while failing signals with usable VEC and eye height and better eye width.

SuggestedRemedy

Pick one of the proposed solutions and fix the problem. Notice that the apparent VEC and EH numbers are likely to change in step.

Response *Response Status* **U**

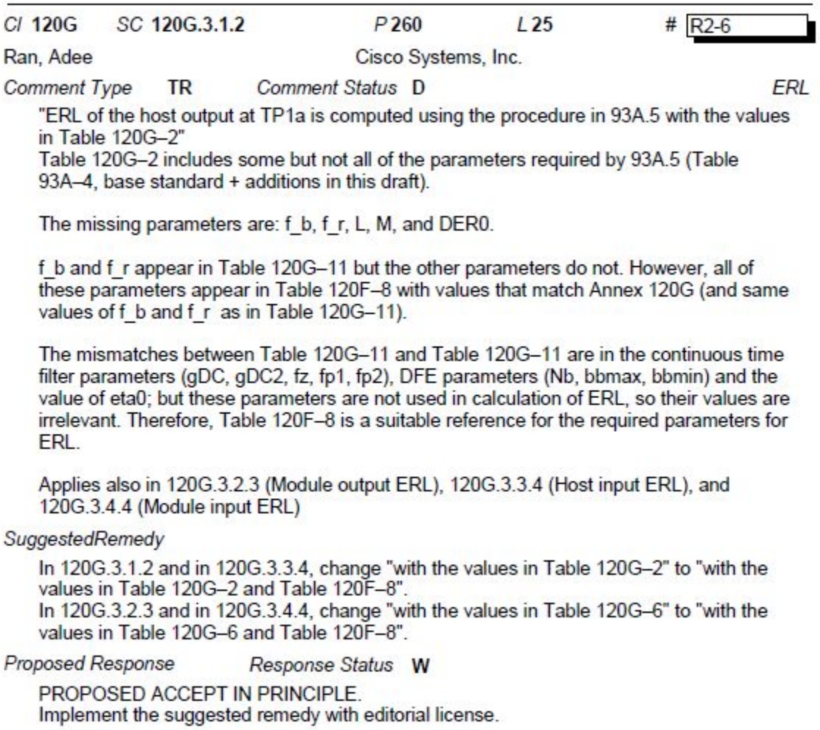
REJECT.

This comment is a restatement of D3.0 comments i-211 and i-212 recorded in the following comment report:
https://www.ieee802.org/3/ck/comments/draft3p0/8023ck_D3p0_final_closedcomments_sortedByNumber.pdf

No further evidence nor any alternate remedies are provided.

Straw poll #11 (recorded in the response to comment i-211) indicated consensus to make no changes to the measurement method.

120G ERL parameters Comments 6



Cl **120G** *SC* **120G.3.1.2** *P* **260** *L* **25** **#** R2-6

Ran, Adee Cisco Systems, Inc.

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

"ERL of the host output at TP1a is computed using the procedure in 93A.5 with the values in Table 120G–2"
Table 120G–2 includes some but not all of the parameters required by 93A.5 (Table 93A–4, base standard + additions in this draft).

The missing parameters are: f_b, f_r, L, M, and DER0.

f_b and f_r appear in Table 120G–11 but the other parameters do not. However, all of these parameters appear in Table 120F–8 with values that match Annex 120G (and same values of f_b and f_r as in Table 120G–11).

The mismatches between Table 120G–11 and Table 120G–11 are in the continuous time filter parameters (gDC, gDC2, fz, fp1, fp2), DFE parameters (Nb, bbmax, bbmin) and the value of eta0; but these parameters are not used in calculation of ERL, so their values are irrelevant. Therefore, Table 120F–8 is a suitable reference for the required parameters for ERL.

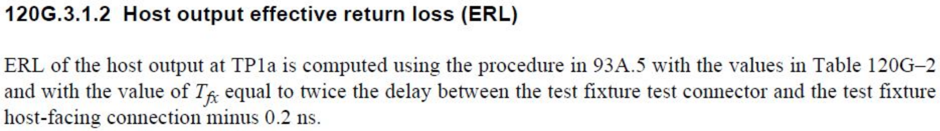
Applies also in 120G.3.2.3 (Module output ERL), 120G.3.3.4 (Host input ERL), and 120G.3.4.4 (Module input ERL)

SuggestedRemedy

In 120G.3.1.2 and in 120G.3.3.4, change "with the values in Table 120G–2" to "with the values in Table 120G–2 and Table 120F–8".
In 120G.3.2.3 and in 120G.3.4.4, change "with the values in Table 120G–6" to "with the values in Table 120G–6 and Table 120F–8".

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
Implement the suggested remedy with editorial license.



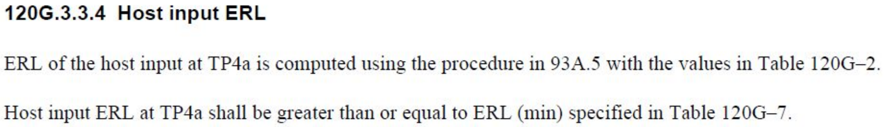
120G.3.1.2 Host output effective return loss (ERL)

ERL of the host output at TP1a is computed using the procedure in 93A.5 with the values in Table 120G–2 and with the value of T_{fx} equal to twice the delay between the test fixture test connector and the test fixture host-facing connection minus 0.2 ns.

Change as follows:

ERL of the host output at TP1a is computed using the procedure in 93A.5 with the values in Table 120G–2 and Table 120F–8, and with the value of Tfx equal to twice the delay between the test fixture test connector and the test fixture host-facing connection minus 0.2 ns.

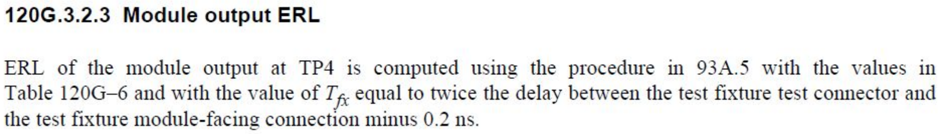
Similar for the other subclauses below.



120G.3.3.4 Host input ERL

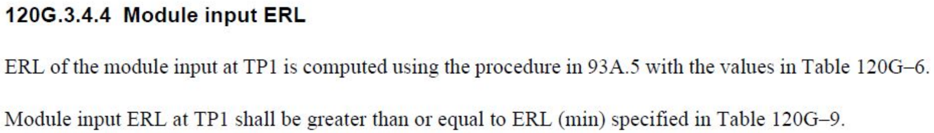
ERL of the host input at TP4a is computed using the procedure in 93A.5 with the values in Table 120G–2.

Host input ERL at TP4a shall be greater than or equal to ERL (min) specified in Table 120G–7.



120G.3.2.3 Module output ERL

ERL of the module output at TP4 is computed using the procedure in 93A.5 with the values in Table 120G–6 and with the value of T_{fx} equal to twice the delay between the test fixture test connector and the test fixture module-facing connection minus 0.2 ns.



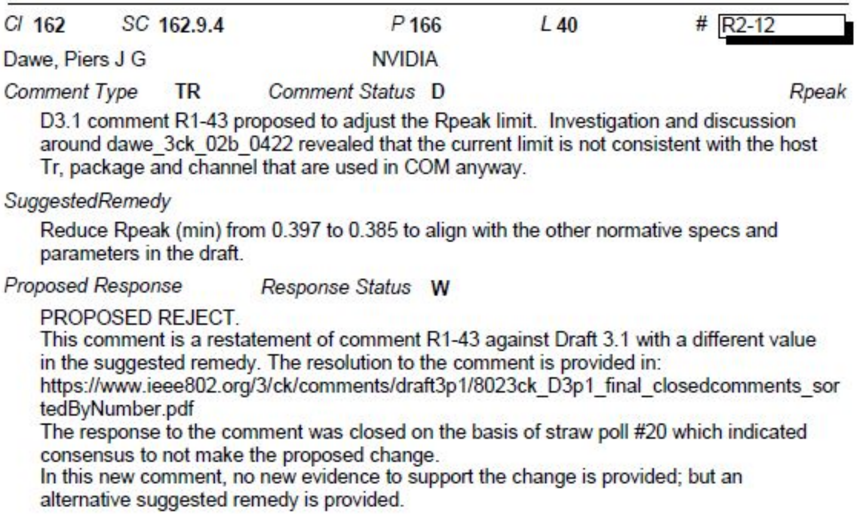
120G.3.4.4 Module input ERL

ERL of the module input at TP1 is computed using the procedure in 93A.5 with the values in Table 120G–6.

Module input ERL at TP1 shall be greater than or equal to ERL (min) specified in Table 120G–9.

Clause 162

TX R_peak
Comment #12



Cl **162** *SC* **162.9.4** *P* **166** *L* **40** # R2-12

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **D** *Rpeak*

D3.1 comment R1-43 proposed to adjust the Rpeak limit. Investigation and discussion around dawe_3ck_02b_0422 revealed that the current limit is not consistent with the host Tr, package and channel that are used in COM anyway.

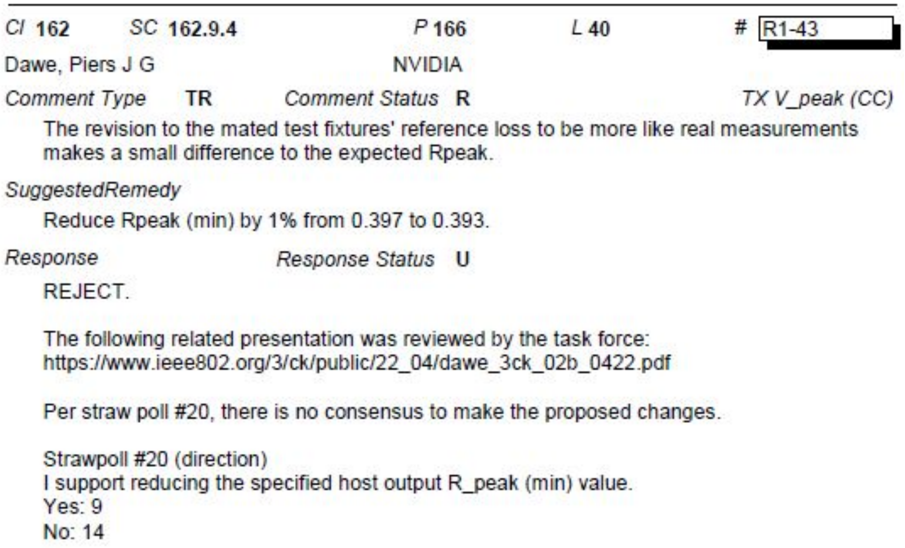
SuggestedRemedy

Reduce Rpeak (min) from 0.397 to 0.385 to align with the other normative specs and parameters in the draft.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
This comment is a restatement of comment R1-43 against Draft 3.1 with a different value in the suggested remedy. The resolution to the comment is provided in:
https://www.ieee802.org/3/ck/comments/draft3p1/8023ck_D3p1_final_closedcomments_sortedByNumber.pdf
The response to the comment was closed on the basis of straw poll #20 which indicated consensus to not make the proposed change.
In this new comment, no new evidence to support the change is provided; but an alternative suggested remedy is provided.

D3.1 R1-43



Cl **162** *SC* **162.9.4** *P* **166** *L* **40** # R1-43

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **R** *TX V_peak (CC)*

The revision to the mated test fixtures' reference loss to be more like real measurements makes a small difference to the expected Rpeak.

SuggestedRemedy

Reduce Rpeak (min) by 1% from 0.397 to 0.393.

Response *Response Status* **U**

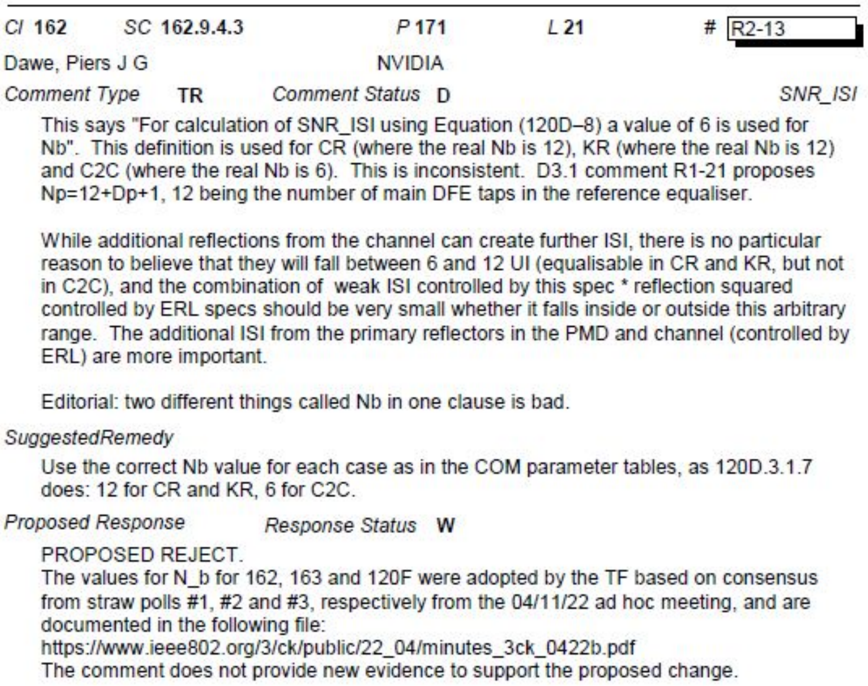
REJECT.

The following related presentation was reviewed by the task force:
https://www.ieee802.org/3/ck/public/22_04/dawe_3ck_02b_0422.pdf

Per straw poll #20, there is no consensus to make the proposed changes.

Strawpoll #20 (direction)
I support reducing the specified host output R_peak (min) value.
Yes: 9
No: 14

TX SNR_ISI
Comment 13



Cl **162** *SC* **162.9.4.3** *P* **171** *L* **21** # R2-13

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **D** *SNR_ISI*

This says "For calculation of SNR_ISI using Equation (120D–8) a value of 6 is used for Nb". This definition is used for CR (where the real Nb is 12), KR (where the real Nb is 12) and C2C (where the real Nb is 6). This is inconsistent. D3.1 comment R1-21 proposes Np=12+Dp+1, 12 being the number of main DFE taps in the reference equaliser.

While additional reflections from the channel can create further ISI, there is no particular reason to believe that they will fall between 6 and 12 UI (equalisable in CR and KR, but not in C2C), and the combination of weak ISI controlled by this spec * reflection squared controlled by ERL specs should be very small whether it falls inside or outside this arbitrary range. The additional ISI from the primary reflectors in the PMD and channel (controlled by ERL) are more important.

Editorial: two different things called Nb in one clause is bad.

SuggestedRemedy

Use the correct Nb value for each case as in the COM parameter tables, as 120D.3.1.7 does: 12 for CR and KR, 6 for C2C.

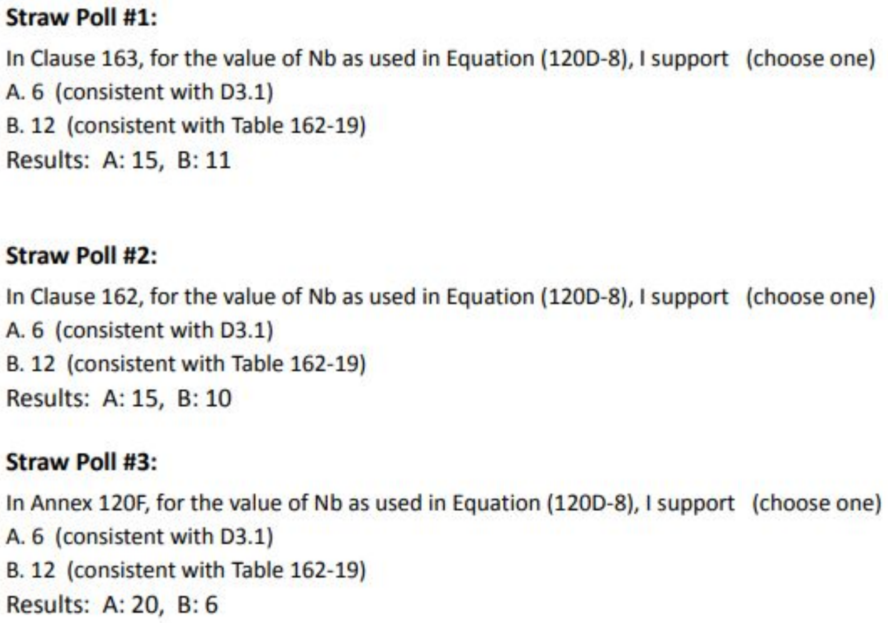
Proposed Response *Response Status* **W**

PROPOSED REJECT.
The values for N_b for 162, 163 and 120F were adopted by the TF based on consensus from straw polls #1, #2 and #3, respectively from the 04/11/22 ad hoc meeting, and are documented in the following file:
https://www.ieee802.org/3/ck/public/22_04/minutes_3ck_0422b.pdf
The comment does not provide new evidence to support the proposed change.

Suggested remedy:

- Nb = 12 for 162 & 163
- Nb = 6 for 120F

https://www.ieee802.org/3/ck/public/22_04/minutes_3ck_0422b.pdf



Straw Poll #1:

In Clause 163, for the value of Nb as used in Equation (120D-8), I support (choose one)

A. 6 (consistent with D3.1)

B. 12 (consistent with Table 162-19)

Results: A: 15, B: 11

Straw Poll #2:

In Clause 162, for the value of Nb as used in Equation (120D-8), I support (choose one)

A. 6 (consistent with D3.1)

B. 12 (consistent with Table 162-19)

Results: A: 15, B: 10

Straw Poll #3:

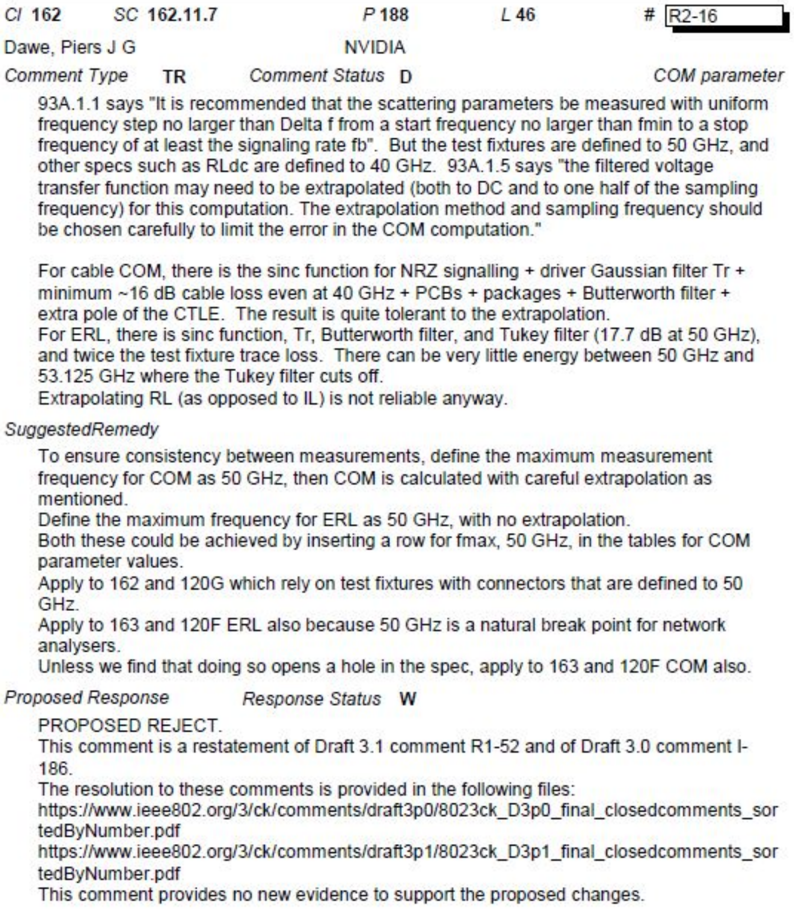
In Annex 120F, for the value of Nb as used in Equation (120D-8), I support (choose one)

A. 6 (consistent with D3.1)

B. 12 (consistent with Table 162-19)

Results: A: 20, B: 6

CA Com Parameter Comment 16



Cl **162** *SC* **162.11.7** *P* **188** *L* **46** # R2-16

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **D** *COM parameter*

93A.1.1 says "It is recommended that the scattering parameters be measured with uniform frequency step no larger than Delta f from a start frequency no larger than fmin to a stop frequency of at least the signaling rate fb". But the test fixtures are defined to 50 GHz, and other specs such as RLdc are defined to 40 GHz. 93A.1.5 says "the filtered voltage transfer function may need to be extrapolated (both to DC and to one half of the sampling frequency) for this computation. The extrapolation method and sampling frequency should be chosen carefully to limit the error in the COM computation."

For cable COM, there is the sinc function for NRZ signalling + driver Gaussian filter Tr + minimum ~16 dB cable loss even at 40 GHz + PCBs + packages + Butterworth filter + extra pole of the CTLE. The result is quite tolerant to the extrapolation.
For ERL, there is sinc function, Tr, Butterworth filter, and Tukey filter (17.7 dB at 50 GHz), and twice the test fixture trace loss. There can be very little energy between 50 GHz and 53.125 GHz where the Tukey filter cuts off.
Extrapolating RL (as opposed to IL) is not reliable anyway.

SuggestedRemedy

To ensure consistency between measurements, define the maximum measurement frequency for COM as 50 GHz, then COM is calculated with careful extrapolation as mentioned.
Define the maximum frequency for ERL as 50 GHz, with no extrapolation.
Both these could be achieved by inserting a row for fmax, 50 GHz, in the tables for COM parameter values.
Apply to 162 and 120G which rely on test fixtures with connectors that are defined to 50 GHz.
Apply to 163 and 120F ERL also because 50 GHz is a natural break point for network analysers.
Unless we find that doing so opens a hole in the spec, apply to 163 and 120F COM also.

Proposed Response *Response Status* **W**

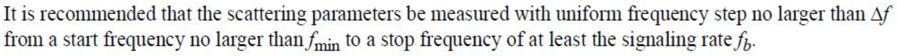
PROPOSED REJECT.
This comment is a restatement of Draft 3.1 comment R1-52 and of Draft 3.0 comment I-186.
The resolution to these comments is provided in the following files:
https://www.ieee802.org/3/ck/comments/draft3p0/8023ck_D3p0_final_closedcomments_sortedByNumber.pdf
https://www.ieee802.org/3/ck/comments/draft3p1/8023ck_D3p1_final_closedcomments_sortedByNumber.pdf
This comment provides no new evidence to support the proposed changes.

Suggested remedy:

- COM max frequency = 50 GHz
- ERL max frequency = 50 GHz

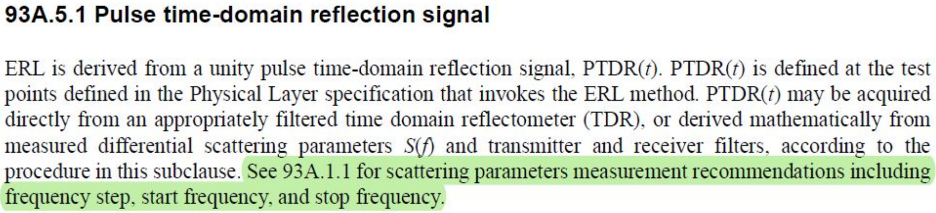
Apply to 162, 162, 120F and 120G

93A.1.1 (COM)



It is recommended that the scattering parameters be measured with uniform frequency step no larger than Δf from a start frequency no larger than f_{min} to a stop frequency of at least the signaling rate f_b.

93A.51.1 (ERL)

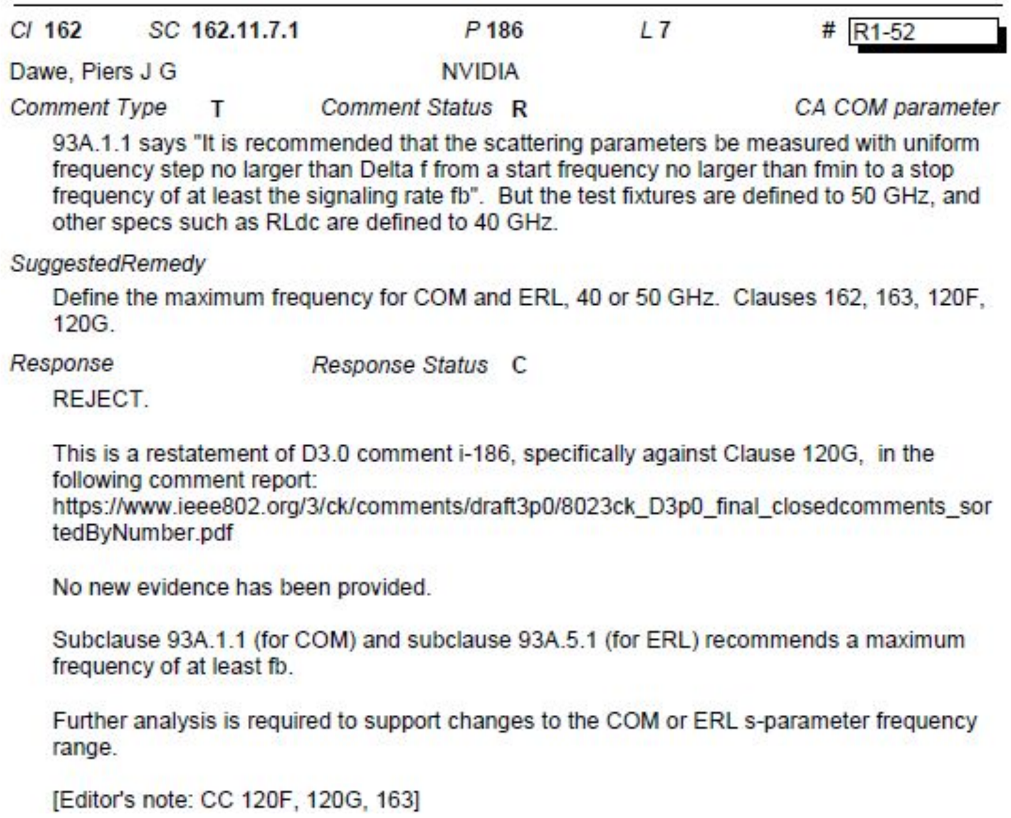


93A.5.1 Pulse time-domain reflection signal

ERL is derived from a unity pulse time-domain reflection signal, PTDR(t). PTDR(t) is defined at the test points defined in the Physical Layer specification that invokes the ERL method. PTDR(t) may be acquired directly from an appropriately filtered time domain reflectometer (TDR), or derived mathematically from measured differential scattering parameters $S(f)$ and transmitter and receiver filters, according to the procedure in this subclause. See 93A.1.1 for scattering parameters measurement recommendations including frequency step, start frequency, and stop frequency.

CA Com Parameter Comment 16

D3.1 C#52



Cl **162** *SC* **162.11.7.1** *P* **186** *L* **7** **#** R1-52

Dawe, Piers J G NVIDIA

Comment Type **T** *Comment Status* **R** *CA COM parameter*

93A.1.1 says "It is recommended that the scattering parameters be measured with uniform frequency step no larger than Delta f from a start frequency no larger than fmin to a stop frequency of at least the signaling rate fb". But the test fixtures are defined to 50 GHz, and other specs such as RLdc are defined to 40 GHz.

SuggestedRemedy

Define the maximum frequency for COM and ERL, 40 or 50 GHz. Clauses 162, 163, 120F, 120G.

Response *Response Status* C

REJECT.

This is a restatement of D3.0 comment i-186, specifically against Clause 120G, in the following comment report:
https://www.ieee802.org/3/ck/comments/draft3p0/8023ck_D3p0_final_closedcomments_sortedByNumber.pdf

No new evidence has been provided.

Subclause 93A.1.1 (for COM) and subclause 93A.5.1 (for ERL) recommends a maximum frequency of at least fb.

Further analysis is required to support changes to the COM or ERL s-parameter frequency range.

[Editor's note: CC 120F, 120G, 163]