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

Ran, Adee
Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **X**

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* **O**

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

Ran, Adee
Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **X**

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* **O**

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

Ran, Adee Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **X**

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* **O**

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

Ran, Adee Cisco Systems, Inc.

Comment Type **E** *Comment Status* **X**

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* **O**

Cl **0** *SC* **0** *P* **0** *L* **0** # R2-5

Ran, Adee Cisco Systems, Inc.

Comment Type **E** *Comment Status* **X**

This comment lists some editorial issues across the draft which may be fixed with non-substantial changes.

In 45.2.1.161 through 45.2.1.167, Table 45–129, Table 45–130, Table 45–131, Table 45–132, are all split across two pages but there is no "continued" indication. There may be other tables which need to set the "continuation" bit.
In Table 73–7, "interval_timer" units, "ns" is unnecessarily underlined.
In Table 80–3a (new table), the bottom row has a thin bottom border.
In Table 163B–1, the last row has a hyphen in "Units" instead of em-dash.

SuggestedRemedy

Address listed issues as appropriate.

Proposed Response *Response Status* **O**

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

Ran, Adee — Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **X**

"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* **O**

Cl **FM** *SC* **FM** *P* **1** *L* **2** # R2-7

Ran, Adee — Cisco Systems, Inc.

Comment Type **G** *Comment Status* **X**

P802.3 was approved as a revision standard by the IEEE SA Standards Board on 13 May 2022.

SuggestedRemedy

Change "IEEE Std 802.3™-202x" to "IEEE Std 802.3™-2022" in the page header.

Apply across the document where appropriate, with editorial license.

Proposed Response *Response Status* **O**

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* **X**

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* **O**

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* **X**

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* **O**

Cl **161** *SC* **161.5.4.2.1** *P* **141** *L* **47** # R2-10

Dawe, Piers J G — NVIDIA

Comment Type **E** *Comment Status* **X**

fec_lane

SuggestedRemedy

fec_lane_mapping

Proposed Response *Response Status* **O**

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

Dawe, Piers J G — NVIDIA

Comment Type **TR** *Comment Status* **X**

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* **O**

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

Dawe, Piers J G — NVIDIA

Comment Type **TR** *Comment Status* **X**

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* **O**

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

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **X**

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* **O**

Cl **162** *SC* **162.9.4.7** *P* **172** *L* **22** # R2-15

Dawe, Piers J G NVIDIA

Comment Type **E** *Comment Status* **X**

-3

SuggestedRemedy

For consistency, –3
Alternatively, change –4 to -4 in e.g. 162.9.4.4.

Proposed Response *Response Status* **O**

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

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **X**

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* **O**

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

Dawe, Piers J G NVIDIA

Comment Type **TR** *Comment Status* **X**

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* **O**

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* **X**

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* **O**

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

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

Comment Type **TR** *Comment Status* **X**

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* **O**

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

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

Comment Type **TR** *Comment Status* **X**

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* **O**

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

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

Comment Type **TR** *Comment Status* **X**

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* **O**

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* **X**

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* **O**