802.3ck D2.1 Comment Resolution Cross-Clause Topics

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Comment summary

Clause	Topic	Comments
162/163/120F/120G	AC CM voltage	[123, mellitz_01], [46, 121], [51, 55, ran_03]
162B/163	transition time	[73, 74, 7], 15
162/163	COM bbgmax	95
163/162	RIT TX off	35
120G/120F/162/163	signal level	37
120G/162	ERL Tfx	100
162/162A/162B/163/120F/120G	IL terminology	[13, 14, 116]
162/163	units	101
162/163/163A/163B	Np value, residual ISI	29, 75, 76

162/163/120F/120G TX AC CM voltage, part 1
Comments 46, 121, 123

Cl **120G** *SC* **120G.3.1** *P* **250** *L* **12** # 46

Ran, Adee Cisco systems

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

"AC common-mode RMS output voltage (max)" specification of 17.5 mV is not feasible for high-volume, multi-port products. The common-mode output may include a component correlated to the differential output, e.g. from mode conversion on the host channel. A module receiver is expected to be quite tolerant to a correlated common-mode signal.

As suggested in ran_3ck_adhoc_20210630, there are two reasonable alternatives:
a) increase the allowed RMS voltage to 30 mV (as is allowed for the CR transmitter measured on an HCB - likely the same point - and where the common-mode concern is greater due to conversion in the cable assembly).
b) Keep the 17.5 mV specification but only for the component uncorrelated to the differential signal; use the linear fitted pulse response method (which is already referred to in 120G.5.2) to calculate the linear fitted pulse response characteristics of the common-mode output, and define the AC common-mode noise as the RSS of sigma_n and sigma_v.

Note: This comment is only about the host output; module output is more controlled and modules can be designed to have low mode conversion so the correlated component is expected to be small. Modules should not be allowed to generate 30 mV RMS, so if option a is chosen, the module output specification should not be changed.

SuggestedRemedy

Preferably implement option a in the comment.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
Comment 134 proposes to increase the value to 25 mV.
This comment proposes to either:
(a) change the value to 30 mV
(b) change the parameter to relate to only the uncorrelated noise
There is not sufficient evidence that the correlated noise is indeed tolerable by the receiver (e.g., conversion from CM to DM in receiver might be non-linear or CM might have much larger channel transit time than DM)
The comment does not provide sufficient evidence for either approach.
For task force discussion.

Cl **120G** *SC* **120G.3.1** *P* **250** *L* **12** # 121

Dawe, Piers Nvidia

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

As discussed, AC common-mode output voltage (max) 17.5 mV isn't reasonable at double the signalling rate of 120E with the same connectors and layout skew.

SuggestedRemedy

Increase to 25 mV, both host and module output.

Proposed Response *Response Status* **W**

PROPOSED REJECT.

This comment does not apply to the substantive changes between IEEE P802.3ck D2.1 and D2.0 or the unsatisfied negative comments from the initial ballot.
Hence it is not within the scope of the recirculation ballot.

Resolve using the response to comment #46.

Cl **163** *SC* **163.9.3** *P* **163** *L* **10** # 123

Mellitz, Richard Samtec

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

Table 162-10 specifies AC common-mode RMS voltage, vcmi (max) note b just changes to a PRBS13Q with method described in 93.8.1.3. The problem is that coherent CM signal are included in differential measurements like SNDR, Jitter, and Linear fit pulse peak ratio. That means it is the coherent part if AC CM is double counted.

SuggestedRemedy

Add note to line 10 (vcmi) indicating that the CM mode measurement is only for the non-coherent CM part of the measurement.

This applies to Tables 163-5, 120F-1, 120G-1, and 120G-3

Proposed Response *Response Status* **W**

PROPOSED REJECT.
[change clause/subclause to 162.9.3]
The comment does not provide sufficient evidence to support the proposed change.
The following presentation was provided by the commenter for review:
https://www.ieee802.org/3/ck/public/21_07/mellitz_3ck_01_0721.pdf.
Resolve in conjunction with comment #46.
[Editor's note: CC: 163, 120F, 120G]

162/163/120F/120G TX AC CM voltage, part 2
Comments 46, 121, 123

comment #123

- relates to KR/C2C TX and C2M host/module output
- presentation: https://www.ieee802.org/3/ck/public/21_07/mellitz_3ck_01a_0721.pdf
- “coherent” CM is already accounted for in the DM parameters
- proposes measuring only the “non-coherent portion”
- proposed procedure on slide 13 of presentation (see right)
- no new values are proposed

comment #46

- relates only to host output
- proposes 2 options
- option 1: change value to 30 mV
- option 2: leave value alone, but measure only uncorrelated noise; expects that RX should be more tolerant to correlated noise; similar to method proposed for #123

comment #121

- proposes 25 mV for C2M host output and module output

- Use modification of σ_n method in 120D.3.1.6
- 120D.3.1.6:
  - “Using the same configuration of the transmitter equalizer, measure the RMS deviation from the mean voltage at a fixed low-slope point in runs of at least 6 consecutive identical PAM4 symbols. PRBS13Q includes such a run for each of the PAM4 levels. The average of the four measurements is denoted as σ_n. “
- Consider: the CM and DM signal are time synchronized because both are combines of “A” and “B”.
- Measure AC common-mode (CM) output voltage $\sigma_{AC\text{-}CM}$ using the following procedure.
  - “Using the same configuration of the transmitter equalizer, measure the RMS deviation from the mean of the CM voltage at a time point corresponding to where the DM signal is at a fixed low-slope point in runs of at least 6 consecutive identical PAM4 symbols. PRBS13Q includes such a run for each of the PAM4 levels. The average of the four measurements is denoted as $\sigma_{AC\text{-}CM}$. “
- A sufficiently large number of repeats of the data pattern is required.

162/163/120F/120G AC CM voltage, part 3
Comments 51, 55

Cl 120G *SC* 120G.3.3 *P* 255 *L* 34 # 51

Ran, Adee Cisco systems

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

The host should tolerate the AC common mode output allowed for the module output. Even if this is not included in the stressed input test, this expectation should be part of the host input specification.

SuggestedRemedy

Add a row to Table 120G–7 with parameter "AC common-mode input voltage tolerance (RMS)" and value based on Table 120G–3.

Proposed Response *Response Status* W

PROPOSED REJECT.
Comment #55 proposes a similar change to the host input.
A parameter with only a value is not sufficient. A test method including some constraints on the CM noise, e.g., frequency spectrum, PDF, etc., is necessary.
For task force discussion.

Cl 120G *SC* 120G.3.4 *P* 260 *L* 9 # 55

Ran, Adee Cisco systems

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

The module should tolerate the AC common mode output allowed for the host output. Even if this is not included in the stressed input test, this expectation should be part of the module input specification.

SuggestedRemedy

Add a row to Table 120G–9 with parameter "AC common-mode input voltage tolerance (RMS)" and value based on Table 120G–1.

Proposed Response *Response Status* W

PROPOSED REJECT.
Comment #51 proposes a similar change to the host input.
Resolve using the response to comment #51.

- relates to C2M host input and module input
- proposes adding new input CM noise tolerance.
- comments propose adding new parameter, but no method or characteristics (other than value)
- presentation provides context and a plan: https://www.ieee802.org/3/ck/public/21_07/ran_3ck_03_0721.pdf

163 transition time, part 1
7, 73, 74

Cl 163 *SC* 163.9.3.5 *P* 204 *L* 45 # 73

Dudek, Mike Marvell

Comment Type TR *Comment Status* D *transition time*

The filtered Ht(f) should be using the transition time of the signal generator, however the measured transition time might be interpreted as measured with the 40GHz 3dB bandwidth used for all Tx measurements. Also nothing is stated as to how the signal is measured at the transmitter output and what the Tx FFE is set to.

SuggestedRemedy

Change "where Tr is the same as the measured 20% to 80% transition time of the signal at the transmitter output" to "where Tr is the same as the measured transition time of the signal at the transmitter output corrected for the measurement bandwidth. The transition time is measured using the method in 120E.3.1.5 with a 40GHz 3dB bandwidth and the risetime is corrected to remove the effect of this measurement bandwidth.

Proposed Response *Response Status* W

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

Cl 163 *SC* 163.9.3.5 *P* 204 *L* 50 # 74

Dudek, Mike Marvell

Comment Type TR *Comment Status* D *transition time*

The method of measuring the transition time in 120E.3.1.5 uses a 33GHz measurement filter in the measurement which isn't appropriate for 100G PAM4 however bullet k states that the 40GHz 3dB bandwidth is used. The method in 163A.3.1.3 does not have any measurement filter. These need to be the same.

SuggestedRemedy

Change "is equal to the transmitter transition time measured at TP0v using the method in 120E.3.1.5 with the transmitter equalizer turned off." to "is equal to the transmitter transition time measured at TP0v with the transmitter equalizer turned off. The transition time is measured using the method in 120E.3.1.5 with a 40GHz 3dB bandwidth and the risetime is corrected to revmoe the effect of this measurement bandwidth.

Proposed Response *Response Status* W

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

Cl 163 *SC* 163.9.3.5 *P* 204 *L* 39 # 7

Brown, Matt Huawei

Comment Type E *Comment Status* D *transition time*

Transition time is presumably per the method in 120E.3.1.5 for all instances in this subclause. Also, given that transition time is fully defined in 120E.3.1.5 and the common term used in the draft is simply "transition time", "20% to 80% transition time" should be "transition time".

SuggestedRemedy

On page 204 line 39, change "transition time" (first instance) to "transition time (see 120E.3.1.5)".
On page 204 line 45 change "20% to 80% transition time" to "transition time (see 120E.3.1.5)".
Consider adding text in one place specifying that transition time is per 120E.3.1.5 so this does not have to be repeated multiple times.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
The definition for transition time Tr on page 204 line 39 is ambiguous. There is a definition for Tr in 93A.2, but this is for an NRZ signal and is measured at TP0a.
For page 204 line 39, add a sentence as follows "Tr is determined at the die bump and defined according to 120E.3.1.5 except there is no observation filter.".
For page 204 line 45, resolve using the responses to comment #73 and #74.

From 93A.2...

If the test transmitter presents a high-quality termination, e.g., it is a piece of test equipment, the transmitter device package model $S^{(tp)}$ is omitted from the calculation of $S_p^{(k)}$ and the filtered voltage transfer function $H^{(k)}(f)$ in 93A.1.4 includes the filter $H_t(f)$ defined by Equation (93A–46) where T_r is the 20% to 80% transition time (see 86A.5.3.3) of the signal as measured at TP0a.

$$H_t(f) = \exp(-2(\pi f T_r / 1.6832)^2) \qquad (93A–46)$$

162B/163 transition time, part 2
7, 73, 74

163.9.3.5 Receiver interference tolerance

Receiver interference tolerance is defined by the procedure in Annex 93C. The receiver on each lane shall meet the FEC symbol error ratio requirement with channels matching the Channel Operating Margin (COM) and loss parameters for Test 1 and Test 2 in Table 163–9. The following additional considerations apply to the interference tolerance test.

a) TP0v (TP5v) replaces TP0a (TP5a) in Annex 93A and Annex 93C.

b) The test transmitter is constrained such that for any transmitter equalizer setting the differential peak-to-peak voltage (see 93.8.1.3) is less than or equal to 800 mV.

c) The ERL of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the requirements in 163.10.3.

d) The lower frequency bound for the noise spectral density constraints, f_{NSD1}, is 1 GHz.

e) For the calculation of test channel COM, the transmitter model is determined in one of the following ways.

- If the transmitter is a device with known S-parameters and transition time T_r, these parameters should be used instead of the transmitter package model in 93A.1.2.
- If a calibrated instrument-grade transmitter is used, the TP0 to TP0a trace in Figure 93C–2 and Figure 93C–3 and TP0 to TP0a replica trace in Figure 93C–4 are omitted and the transmitter device package model $S^{(p)}$ is omitted from Equation (93A–3). The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (93A–19) uses the filter $H_t(f)$ defined by Equation (93A–46), ~~where T_r is the same as the measured 20% to 80% transition time of the signal at the transmitter output.~~
- If the transmitter is not a device with known S-parameters and transition time nor a calibrated instrument-grade transmitter, T_r in Equation (93A–46) is calibrated such that the reference transition time $T_r^{(ref)}$ determined according to 163A.3.1.3 ~~is equal to the transmitter transition time measured at TP0v using the method in 120E.3.1.5 with the transmitter equalizer turned off.~~

120E.3.1.5 Transition time

In this annex, transition times are specified for transitions between three consecutive "zero" symbols and three consecutive "three" symbols, or vice versa. The specified times are between the crossings of 20% and 80% levels of the signal.

The test pattern used is PRBS13Q, the transitions within sequences of three zeros and three threes, and three threes and three zeros, respectively, are measured. These are PAM4 symbols 1820 to 1825 and 2086 to 2091, respectively, where symbols 1 to 7 are the run of seven threes. The 0% level and the 100% level are defined as the average signal within windows from –1.5 UI to –1 UI and from 1.5 UI to 2 UI relative to the edge.

The waveform is observed through a fourth-order Bessel-Thomson low-pass response with a 3 dB bandwidth of 33 GHz.

Comment #7 (reworded)
Insert: "Tr is determined at the die bump and defined according to the method in 120E.3.1.5 except there is no observation filter."

Comment #7, #73 (reworded)
"where Tr is the transmitter transition time, which is measured using the method in 120E.3.1.5 with a 3 dB bandwidth of 40 GHz and corrected to remove the effect of the observation filter."

Comment #74 (reworded)
"is the transmitter transition time measured at TP0v with the transmitter equalizer turned off, using the method in 120E.3.1.5 with a 3 dB bandwidth of 40 GHz, and corrected to remove the effect of the observation filter."

162B/163 transition time, part 3 15

Cl **162B** *SC* **162B.1.3.5** *P* **286** *L* **43** **#** 15

Brown, Matt Huawei

Comment Type **T** *Comment Status* **D** *transition time*

Measurement method for transition times is never specified. I assume it is the same as for PMD specifications per 120E.3.1.5. To be consistent with other clauses and annexes should be "transition time" not "rise and fall timers". Given explicit methodology in 120E.3.1.5 and to be common with other clauses can delete "20% to 80%" since this is helpful but not complete.

SuggestedRemedy

With editorial license specify that the transition time is measured according to 120E.3.1.5. Throughout 162B, change "20% to 80% rise and fall times" to "transition time".

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
Comments #73 and #74 propose that the reference to 120E.3.1.5 should also include an exception to the measurement bandwidth.
Implement suggested remedy along with the measurement bandwidth proposed in comments 73 and 74 with editorial license.

Table 162B–2—SFP+ mated test fixture integrated near-end crosstalk noise parameters

Description	Symbol	Value	Units
Symbol rate	f_b	53.125	GBd
3 dB reference receiver bandwidth	f_r	39.84	GHz
Near-end disturber peak differential output amplitude	A_{nt}	600	mV
Near-end disturber 20% to 80% rise and fall times	T_{nt}	8.5	ps

Table 162B–4—Multi-lane mated test fixture integrated crosstalk noise parameters

Description	Symbol	Value	Units
Symbol rate	f_b	53.125	GBd
3 dB reference receiver bandwidth	f_r	39.84	GHz
Near-end disturber peak differential output amplitude	A_{nt}	600	mV
Far-end disturber peak differential output amplitude	A_{ft}	600	mV
Near-end disturber 20% to 80% rise and fall times	T_{nt}	8.5	ps
Far-end disturber 20% to 80% rise and fall times	T_{ft}	8.5	ps

Add the following sentence in 162B.1.3.6 to specify how transition time is measured ...

“Transition time is measured using the method in 120E.3.1.5 with a 3 dB bandwidth of 40 GHz and corrected to remove the effect of the observation filter.”
or alternately
“Transition time is determined according to the method in 120E.3.1.5, except there is no observation filter.”

162/163 COM bbgmax
95

Cl **162** *SC* **162.11.7** *P* **183** *L* **39** # 95

Dawe, Piers Nvidia

Comment Type **TR** *Comment Status* **D** *COM bbgmax*

The normalized DFE coefficient minimum limit bbmin for taps 3 to 12 is -0.03. It doesn't make sense that taps 13 to 40 could be worse, -0.05. If I have understood the data correctly, the example channels we have don't need this. (Remember, these are reference receiver limits not hard cable or channel limits anyway; a cable or channel can go beyond a tap limit if it makes up the COM another way, e.g. with acceptable crosstalk.)

SuggestedRemedy

Change bgmax 0.05 to bbgmax 0.05, bbgmax -0.03. Also in 163.

Proposed Response *Response Status* **W**

PROPOSED REJECT.

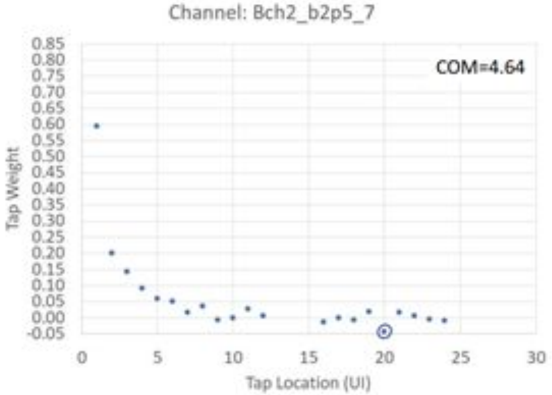
This comment does not apply to the substantive changes between IEEE P802.3ck D2.1 and D2.0 or the unsatisfied negative comments from the initial ballot.
Hence it is not within the scope of the recirculation ballot.

The following presentation showed that some backplane channels had floating tap coefficient values of <-0.03.
https://www.ieee802.org/3/ck/public/19_09/heck_3ck_01_0919.pdf
The comment does not provide an assessment of the impact to those channels.
[Editor's note: CC: 162, 163]

Tap Weights: Bch2_b2p5_7 with 31mm package

This channel has the WC minimum tap weight (-0.043 @ UI=20).

UI	b(n)
1	0.594
2	0.200
3	0.144
4	0.092
5	0.060
6	0.051
7	0.017
8	0.036
9	-0.006
10	-0.001
11	0.028
12	0.005
16	-0.013
17	-0.001
18	-0.007
19	0.018
20	-0.043
21	0.017
22	0.006
23	-0.005
24	-0.010



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https://www.ieee802.org/3/ck/public/19_09/heck_3ck_01_0919.pdf

163/162, RIT TX off (wording) 35

Cl 163 *SC* 163.9.3.5 *P* 204 *L* 51 # 35

Ran, Adee Cisco systems

Comment Type E *Comment Status* D *RIT TX off*

"with the transmitter equalizer turned off" - preferably be consistent with most other places in this draft which use the wording "set to preset 1 (no equalization)".

Also is 162.9.4.3.3 with a variation on the wording - preferably change that one too.

SuggestedRemedy

Use the term "preset 1 (no equalization)" in all places.

Proposed Response *Response Status* W

PROPOSED ACCEPT.
[Editor's note: CC: 163, 162]

162.9.4.3.3 Test channel calibration

The scattering parameters of the test channel are measured at the test references as illustrated in Figure 110–3b using the cable assembly test fixtures specified in Annex 162B.1.

The insertion loss at 26.56 GHz of the signal path between the test references in Figure 110–3b is within the limits in Table 162–15.

The COM is calculated using the method and parameters of 162.11.7 with the following considerations:

a) The channel signal path is $SCHS_p$ = cascade($S^{(CTSP)}$, $S^{(HOSPR)}$), where cascade() is defined in 93A.1.2.1, $S^{(HOSPR)}$ is defined in 162.11.7.1.1, and $S^{(CTSP)}$ is the measured channel between the test references in Figure 110–3b.

b) COM is calculated using both Test 1 and Test 2 device package model transmission line lengths listed in Table 162–19 on the receiver side. The value of COM is taken as the lower of the two calculated values.

c) The augmented signal path in 93A.1.2 is replaced by S_p determined from Equation (162–6) (effectively omitting the transmitter device package model $S^{(tp)}$). The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (93A–19) uses T_r equal to the 20% to 80% transition time at the Tx test reference. T_r is measured using the method in 120E.3.1.5 with the transmit equalizer turned off (i.e., coefficients set to the preset 1 values, see 162.9.3.1.3) with an exception that the waveform is observed through a fourth-order Bessel-Thomson low-pass response with a 3 dB bandwidth of 40 GHz.

163.9.3.5 Receiver interference tolerance

Receiver interference tolerance is defined by the procedure in Annex 93C. The receiver on each lane shall meet the FEC symbol error ratio requirement with channels matching the Channel Operating Margin (COM) and loss parameters for Test 1 and Test 2 in Table 163–9. The following additional considerations apply to the interference tolerance test.

a) TP0v (TP5v) replaces TP0a (TP5a) in Annex 93A and Annex 93C.

b) The test transmitter is constrained such that for any transmitter equalizer setting the differential peak-to-peak voltage (see 93.8.1.3) is less than or equal to 800 mV.

c) The ERL of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the requirements in 163.10.3.

d) The lower frequency bound for the noise spectral density constraints, f_{NSD1}, is 1 GHz.

e) For the calculation of test channel COM, the transmitter model is determined in one of the following ways.

— If the transmitter is a device with known S-parameters and transition time T_r, these parameters should be used instead of the transmitter package model in 93A.1.2.

— If a calibrated instrument-grade transmitter is used, the TP0 to TP0a trace in Figure 93C–2 and Figure 93C–3 and TP0 to TP0a replica trace in Figure 93C–4 are omitted and the transmitter device package model $S^{(tp)}$ is omitted from Equation (93A–3). The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (93A–19) uses the filter $H_t(f)$ defined by Equation (93A–46), where T_r is the same as the measured 20% to 80% transition time of the signal at the transmitter output.

— If the transmitter is not a device with known S-parameters and transition time nor a calibrated instrument-grade transmitter, T_r in Equation (93A–46) is calibrated such that the reference transition time $T_r^{(ref)}$ determined according to 163A.3.1.3 is equal to the transmitter transition time measured at TP0v using the method in 120E.3.1.5 with the transmitter equalizer turned off.

162.9.4.3.5 Test procedure

The pattern generator is first configured to transmit the training pattern defined in 162.8.11. During this initialization period, the device under test (DUT) configures the pattern generator transmit equalizer to the coefficient settings it would select using the protocol described in 162.8.11 and the receiver is tuned using its optimization method. The coefficient settings may be communicated via the start-up protocol or by other means.

After the pattern generator equalizer has been configured and the receiver tuned, the pattern generator is set to generate the test pattern specified in Table 162–15. During the test, the transmitters in the device under test transmit the same pattern type specified for the test, with equalization turned off (preset 1 condition).

Alternately…
AIP
In 162.9.4.3.3, 162.9.4.3.5, and 163.9.3.5 use the following:
"with transmitter coefficients set to preset 1 values (see 162.9.3.1.3).

120G/120F/162/163 signal level, part 1
37

Cl **120G** *SC* **120G.5.1** *P* **264** *L* **31** # 37

Ran, Adee Cisco systems

Comment Type **TR** *Comment Status* **D** *signal level*

This clause is referred to in Table 120G-1 and Table 120G-3 for the parameter differential PtP output voltage (max), among others.

The content is only a reference back to 120E.3.1.2: "The signal levels are as defined in 120E.3.1.2". 120E.3.1.2 does have a definition of differential signal but also states that "Unless otherwise noted, differential and common-mode signal voltages are measured with a PRBS13Q test pattern".

But PRBS13Q is not an appropriate signal for measurement of the PtP output voltage, because it has a maximum run length of 7 symbols and does not have any spectral content below 3 MHz. Much longer runs are possible in real data. Measurement with PRBS13Q over a lossy channel between the transmitter and the measurement point, without sufficient equalization, can thus yield peak-to-peak value lower than the value that real data would create.

Since there is no way to control the transmitter's swing or equalization, this may cause events of higher signal levels than the receiver expects, and cause periods of high BER, which can span many FEC symbols and cause uncorrectable codewords.

It is proposed to define the differential PtP explicitly as a requirement for any data pattern, and recommend to measure it using a pattern that contains low-frequency content, such as PRBS31Q or SSPRQ.

The definition of signal levels measurement using PRBS13Q also applies for CR/KR/C2C but in these cases the transmitter can be controlled to reduce the signal to an adequate level for the receiver, so it is less of an issue.

SuggestedRemedy

Replace the content of 120G.5.1 with the following:

"The definition of differential and common-mode signals can be found in 120E.3.1.2. The signal levels specifications for host and module outputs hold for any data pattern. It is recommended to measure differential peak to peak signal levels with PRBS31Q or SSPRQ test pattern."

Consider applying similar changes in 162, 163, and 120F, with editorial license.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

This comment does not apply to the substantive changes between IEEE P802.3ck D2.1 and D2.0 or the unsatisfied negative comments from the initial ballot.
Hence it is not within the scope of the recirculation ballot.

The proposal to refer "any data pattern" is rather broad.

SSPRQ has been previously used only for optical transmitter testing and has no advantages for this test.
It is not clear that similar changes are warranted for 162, 163, and 120F since the insertion loss to the test point is smaller.
Change the text in 120G.5.1 to the following:
"The signal levels are as defined in 120E.3.1.2, with the exception that differential and common-mode signal voltages are measured with a PRBS31Q test pattern."
For task force discussion.
[Editor's note: CC: 120F, 120G, 162, 163]

120G/120F/162/163 signal level, part 2
37

120G.5.1 Signal levels

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

replace with… "The signal levels are as defined in 120E.3.1.2, with the exception that differential and common-mode signal voltages are measured with a PRBS31Q test pattern."

120E.3.1.2 Signal levels

The differential output voltage v_{di} is defined to be the difference between the single-ended output voltages, SL*i*<p> minus SL*i*<n>. The common-mode voltage v_{cmi} is defined to be one half of the sum of SL*i*<p> and SL*i*<n>. These definitions are illustrated by Figure 120E–7.

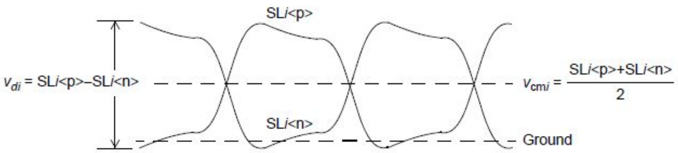

Figure 120E–7—Voltage definitions

The DC common-mode output voltage and AC common-mode output voltage are defined with respect to signal ground.

Unless otherwise noted, differential and common-mode signal voltages are measured with a PRBS13Q test pattern.

120G/162 ERL Tfx 100

Cl 120G *SC* 120G.3.1.2 *P* 251 *L* 41 # 100

Dawe, Piers Nvidia

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

This fixed time value of time-gated propagation delay Tfx is unworkable because the HCB is defined by its loss not its transit time. While HCBs for connectors with few lanes such as SFP+ may be constructed from PCB, those for connectors with many lanes such as QSFP-DD are challenged by fanout and may use cabled construction with the same loss and much greater delay than a PCB. The discontinuity at cable-PCB interface which is in the connector body, several inches from the coax connector and near the module connector, should be windowed out just like the coax connector itself, it's not part of the DUT. The HCB transit time is known, just as its loss is, so we can use that in the windowing. Notice that in 163 and 120F, "The value of Tfx is twice the delay from TP5v to TP5", so it's known there.

SuggestedRemedy

Change 0.3 ns to twice the delay between the test fixture test connector and the test fixture host-facing connection minus 0.2 ns, or 85% of the delay. This gives the cabled HCB designer the length of the module PCB less about 30 mm to position up to 16 coax-PCB transitions. Make a similar change in 162.9.3.5 (HCB for CR).
Make similar changes in 120G.3.2.3 and 162.11.3 (MCB).

Proposed Response *Response Status* W

PROPOSED REJECT.
Discussion on this topic required.
For task for review.
[Editor's note: CC: 120G, 162]

Table 120G–2—Host output and input ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.01	ns
Incremental available signal loss factor	β_x	0	GHz
Permitted reflection from a transmission line external to the device under test	ρ_x	0.618	—
Length of the reflection signal	N	800	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0.3	ns
Tukey window flag	*tw*	1	—

Table 120G–6—Module output and input ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.01	ns
Incremental available signal loss factor	β_x	0	GHz
Permitted reflection from a transmission line external to the device under test	ρ_x	0.618	—
Length of the reflection signal	N	400	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0.3	ns
Tukey window flag	*tw*	1	—

Table 162–13—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	β_x	0	GHz
Permitted reflection from a transmission line external to the device under test	ρ_x	0.618	—
Length of the reflection signal	*N*	800	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0.3	ns
Tukey window flag	*tw*	1	—

Table 162–18—Cable assembly ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.01	ns
Incremental available signal loss factor	β_x	0	GHz
Permitted reflection from a transmission line external to the device under test	ρ_x	0.618	—
Length of the reflection signal	*N*	4500	UI
Equalizer length associated with reflection signal	N_{bx}	0	UI
Time-gated propagation delay	T_{fx}	0.3	ns
Tukey window flag	*tw*	1	—

162/162A/162B/163/120F/120G IL terminology, part 1
116, 13, 14

This topic was covered at the July 14 ad hoc with the following presentation:
https://www.ieee802.org/3/ck/public/adhoc/july14_21/brown_3ck_adhoc_01_071421.pdf

Comments 13, 14, 116

Cl 162 *SC* 162.B.1.3.3 *P* 283 *L* 33 # 13
Brown, Matt Huawei
Comment Type ER *Comment Status* X
Throughout 802.3cd, the terminology for insertion loss and conversion loss parameters is inconsistent. In this subclause alone two terms are used.
SuggestedRemedy
Select and use common terminology throughout the draft. A summary presentation will be provided.
Proposed Response *Response Status* O

Cl 162 *SC* 162.B.1.3.3 *P* 283 *L* 37 # 14
Brown, Matt Huawei
Comment Type ER *Comment Status* X
Throughout 802.3ck, the variable names used to describe insertion loss and conversion loss are inconsistent. In D2.1, the return loss variables were updated so that they were common throughout the draft. A similar convention is encouraged for IL and CL.
SuggestedRemedy
Select and use common variable names throughout the draft. A summary presentation will be provided.
Proposed Response *Response Status* O

Cl 162 *SC* 162.11.5 *P* 181 *L* 2 # 116
Dawe, Piers Nvidia
Comment Type E *Comment Status* X
Follow the nomenclature we chose last round.
SuggestedRemedy
Change Conversion_loss(f) to ILcd(f), in 4 places
Proposed Response *Response Status* O

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Parameter and Variable name proposal

- Use consistent parameter names and variable names throughout 802.3ck.
- Adopt the variable formats based on return loss variable names used adopted for D2.1.
- Table below shows proposed parameter names and variable names.
  - ILcc is never referenced in 3ck, but is included in this table for completeness.
  - The name for ILdd might alternately be “differential insertion loss”, “differential-mode insertion loss”, or “differential-mode to differential-mode insertion loss”, but due to the broad, consistent, and long-term use of simply “insertion loss”, this is the proposed name.

Parameter name	Variable name
Insertion loss	ILdd
Common-mode to common-mode insertion loss	ILcc
Common-mode to differential conversion loss	ILdc
Differential to common-mode conversion loss	ILcd

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162/162A/162B/163/120F/120G IL terminology, part 2
116, 13, 14

- Based on ad hoc conversation, there was some preference for the changes to the proposed terminology as shown below.
- The table below also provides derivation from mixed mode s-parameters for reference.

Parameter name	Variable name	Derivation (dB)
Differential-mode to differential mode insertion loss	*ILdd*	-20*log10(SDD21(f))
Common-mode to common-mode insertion loss	*ILcc*	-20*log10(SCC21(f))
Common-mode to differential-mode ~~conversion~~insertion loss	*ILdc*	-20*log10(SDC21(f))
Differential-mode to common-mode ~~conversion~~insertion loss	*ILcd*	-20*log10(SCD21(f))

162/163 units
101

Cl **162** *SC* **162.9.3** *P* **163** *L* **20** # 101

Dawe, Piers — Nvidia

Comment Type **T** *Comment Status* **D** *units*

The units for a ratio should be spelled out so the reader knows which of V/V, W/W or A/A, is meant.

SuggestedRemedy

Change the long dash to V/V. This may be desirable for some other ratios also, and in 163.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The suggested remedy does not add clarity to the existing specification.
[Editor's note: CC: 162, 163]

Linear fit pulse peak ratio (min)	162.9.3.1.2	0.397	—

162/163/163A/163B Np Value and residual ISI, part 1
75, 76, 29

Cl 163 *SC* 163.9.2 P200 *L* 12 # 75

Dudek, Mike Marvell

Comment Type TR *Comment Status* D *TX residual ISI*

In dudek_3ck_01_0521 it was shown that with larger values of Cp it is possible to have transmitters that pass all the transmitter specifications but only provide 1.5dB COM on channels that pass the channel specifications. This was confirmed in li_3ck_adhoc_01_063021. In Li_3ck_adhoc_01_063021 it was also shown that a tightening of ERL specifications to fail these bad transmitters would also fail transmitters with varying values of Rd and other paramters that give 3.0dB COM on these same channels. Another Tx parameter is needed to fail the high Cp Tx's while still passing the Tx's with variable Rd. A presentation will be made in support of this comment.

SuggestedRemedy

Add an extra Tx specification "Residual ISI (max) value 0.027". Defined as the value of Sigma_e/Vpeak where sigma_e and Vpeak are as defined in 162.9.3.3 except that Np=11 is used instead of Np=29.

Proposed Response *Response Status* W

PROPOSED REJECT.

This comment does not apply to the substantive changes between IEEE P802.3ck D2.1 and D2.0 or the unsatisfied negative comments from the initial ballot.
Hence it is not within the scope of the recirculation ballot.

Resolve using the response to comment #76.
[Editor's note: CC: 163, 120F]

Cl 120F *SC* 120F.3.1 *P* 232 *L* 32 # 76

Dudek, Mike Marvell

Comment Type TR *Comment Status* D *TX residual ISI*

The value for SNDR is measured using the method in 162.9.3.3 which uses Np=29, however chip to chip reference receiver is only a 6 tap DFE. Transmitters with significant residual ISI beyond the length of the DFE will pass this Tx specification and will not work in the system.

SuggestedRemedy

Add an extra Tx specification "Residual ISI (max) value 0.027". Defined as the value of Sigma_e/Vpeak where sigma_e and Vpeak are as defined in 162.9.3.3 except that Np=11 is used instead of Np=29.

Proposed Response *Response Status* W

PROPOSED REJECT.
It might be reasonable to reduce the value of Np from 29 to 11, but it is not clear that adding the new residual ISI parameter is justified.
For task force discussion.
The following presentation was provided by the commenter for discussion:
https://www.ieee802.org/3/ck/public/21_07/dudek_3ck_01_0721.pdf
[Editor's note: CC: 163, 120F]

Addition of new parameter residual ISI may obviate increasing Np to 200 as discussed in comment #29 and wu_3ck_adhoc_01b_071421.

See the following presentations:
https://www.ieee802.org/3/ck/public/21_07/dudek_3ck_01_0721.pdf
https://www.ieee802.org/3/ck/public/adhoc/july14_21/wu_3ck_adhoc_01b_071421.pdf

162/163/163A/163B Np Value and residual ISI, part 2
75, 76, 29

CI **162** SC **162.9.3.1.1** P **165** L **5** # 29

Ran, Adee — Cisco systems

Comment Type **TR** *Comment Status* **D** *Np value*

Here it is stated that Np takes the value 29, but this value is only effective for calculation of SNDR. Other invocations of this procedure, for vf and vpeak, use Nv=200 instead. Nv appears several times and looks like a parameter, but it is not - it is a value that replaces Np; this is not stated anywhere.

In the remaining use of the linear fit, for calculation of the equalizer coefficients used in 162.9.3.1.3, 162.9.3.1.4, and 162.9.3.1.5, it does not matter whether 29 or 200 UI are used. So Np=29 is important only for SNDR, which is the exception.

Having two parameters instead of one parameter which takes two values is unnecessary and confusing.

SuggestedRemedy

In 162.9.3.1.1, change "Np=29" to "Np=200".

In 162.9.3.3 (Output SNDR) change "with the exception that the linear fit procedure in 162.9.3.1.1 is used" to "with the exception that the linear fit procedure in 162.9.3.1.1 is used with Np=29 instead of 200".

In 162.9.3.1.2 (Steady-state voltage and linear fit pulse peak) delete "using Nv=200".

In 163.9.2.3 (Difference steady state voltage) delete "with Nv = 200".

In 163A.3.1.1 (Steady-state voltage and pulse peak reference values) change "Nv" to "Np" (3 times).

In 163B.2 (Characteristics) delete "With Nv = 200".

With editorial license, change any remaining occurrence of Nv to Np.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
The following presentation was reviewed by the task force at a previous ad hoc meeting.
https://www.ieee802.org/3/ck/public/adhoc/july14_21/wu_3ck_adhoc_01a_071421.pdf.
Implement the suggested remedy.
[Editor's note: CC: 162, 163, 163A, 163B]

from 162.9.3.1.1

Compute the linear fit pulse response $p(k)$, k=1 to $M \times N_p$, from the captured waveform, as specified in 85.8.3.3.5, with $N_p = 29$ and $D_p = 4$, where the aligned symbols $x(n)$ are assigned normalized amplitudes −1, −*ES*, *ES*, and 1 to represent the PAM4 symbol values 0, 1, 2, and 3 respectively. *ES* is defined as $(|ES1| + |ES2|)/2$ where *ES1* and *ES2* are calculated according to 120D.3.1.2.

162.9.3.3 Output SNDR

The transmitter SNDR is defined by the measurement method described in 120D.3.1.6 with the exception that the linear fit procedure in 162.9.3.1.1 is used.

162.9.3.1.2 Steady-state voltage and linear fit pulse peak

The steady-state voltage v_f is defined in 136.9.3.1.2, and is determined using N_v=200 and the linear fit pulse peak ratio calculated by the procedure in 162.9.3.1.1. The steady-state voltage shall be greater than or equal to 0.387 V and less than or equal to 0.6 V after the transmit equalizer initial condition has been set to preset 1 (no equalization).

163.9.2.3 Difference steady-state voltage

The difference steady-state voltage of the transmitter at TP0v is computed using the procedure in 163A.3.2.1 with $N_v = 200$ and other parameter values specified in Table 163–11.

The difference steady-state voltage at TP0v shall meet the specification dv_f(min) in Table 163–5.

from 163A.3.1.1

From the output pulse response calculate the reference value for the transmitter output steady state voltage, $v_f^{(ref)}$, using Equation (163A–3). The values for parameters N_v, M, and D_p are provided by the clause that invokes this method.

163B.2 Characteristics

This example test fixture is defined using the PCB trace model in 162.11.7.1, with z_p = 71 mm, and parameter values in Table 162–20, with the exception that C_0 and C_1 are both 0. This results in a TP0 to TP0v insertion loss of 2.8 dB at 26.5625 GHz. The reference values are calculated for the transmitter characteristics of Clause 163. The reference transmitter device and package model uses the parameter values T_r = 7.5 ps, $f_r = 0.75 \times f_b$ = 39.8438 GHz, z_p = 31 mm, and A_v = 0.413 V. The values of v_{peak} and v_f are calculated with f_b = 53.125 GBd and N_v = 200.