802.3dj D1.2
Comment Resolution
Electrical Track

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<main topic>

<comment list>

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Comments <comment #>

Output Voltage Range

Comments 313-314, 345-360, 403, 409-410, 413, 82

Related presentations: simms_3dj_01_2411, ran_3dj_05_2411

Differential pk-pk & v_f

TX Differential pk-pk voltage, v_f, A_ne, amplitude tolerance (cc)
Comments 314, 345-360, 403, 410

CI 178 *SC* 178.9.2 *P* 322 *L* 18 # 345

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 178-6 has the Differential pk-pk voltage (max) Transmit enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500

SuggestedRemedy

Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled

Proposed Response *Response Status* O

KR

CI 179 *SC* 179.9.4 *P* 356 *L* 40 # 347

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 179-7 has the Differential pk-pk voltage (max) Transmit enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500

SuggestedRemedy

Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled

Proposed Response *Response Status* O

CR

CI 179 *SC* 179.9.4 *P* 356 *L* 51 # 348

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 179-7 has Transmitter steady-state voltage, Vf (range) 0.4 to 0.6 V. This range should be reduced to 0.4 to 0.5 to be consistent with Vf of 0.500

SuggestedRemedy

change Transmitter steady-state voltage, Vf (range) to 0.4 to 0.5V

Proposed Response *Response Status* O

CR

CI 176D *SC* 176D.5.3 *P* 700 *L* 24 # 353

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176D-1 has the Differential pk-pk voltage (max) Output enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500

SuggestedRemedy

Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled

Proposed Response *Response Status* O

AUI-C2M

CI 176D *SC* 176D.5.4 *P* 701 *L* 19 # 355

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176D-2 has the Differential pk-pk voltage (max) Output enabled as 1.2V. This should be reduced to 1.0V to be consistent with Vf of 0.500

SuggestedRemedy

Reduce Differential pk-pk voltage (max) to 1.0V when Transmitter enabled

Proposed Response *Response Status* O

AUI-C2M

The comments propose to change TX specs across 178, 179, 176C, 176D.

- diff pk-pk (max): 1.2 V → 1.0 V
- v_f 0.6 V → 0.5 V
- A_ne: 0.6 V → 0.5 V
- Amplitude tolerance: 1.2 V → 1.0 V

Differential pk-pk & v_f

TX Differential pk-pk voltage, v_f, A_ne, amplitude tolerance (cc)
Comments 314, 345-360, 403, 410

Cl 179 *SC* 179.9.4 *P* 356 *L* 39 # 403

Dawe, Piers Nvidia

Comment Type TR *Comment Status* X

Supply voltages and voltage swing trend downwards over the years. This 1.2 V max has not changed since 10GBASE-KR, a long time ago. In 3ck and D1.0, C2M had 750 mV, and other C2M had 900 mV. PCIe have moved from 1.2 V to 1 V max. A high max is harmful when a receiver can ask someone else's transmitter to turn up to the max, causing the second party to suffer unnecessary NEXT in its receiver.

SuggestedRemedy

Reduce 1.2 mV to 1 V, here, in the receiver Table 179-10 and in the text in 179.9.5.2.
Reduce the steady-state voltage vf max from 0.6 V to 0.5 V. Make appropriate adjustments to Av Afe Ane and eta0 in COM tables.
Similarly for KR and C2C. See another comment for C2M.

Proposed Response *Response Status* O

CR

Cl 176D *SC* 176D.4.3 *P* 700 *L* 23 # 410

Dawe, Piers Nvidia

Comment Type TR *Comment Status* X

1.2 V is quite excessive for C2M, and, considering modern silicon processes, excessive for anything high speed in 2024.

SuggestedRemedy

Change to 0.9 V, as is normal for C2M. Similarly, reduce vf max to 450 mV.

Proposed Response *Response Status* O

AUI-C2M

Cl 176D *SC* 176D.5.4 *P* 701 *L* 31 # 314

Ghiasi, Ali Ghiasi Quantum

Comment Type T *Comment Status* X

C2M historically had Vmax of 900 mV or Vf of 450 mV, increasing Vf to 600 mV add additional power and may result in compatability issue with legacy module

SuggestedRemedy

Reduce Vf max from 600 mV to 500 mV which offers all the benefit but with reduced crosstalk penalty as was shown in simms_3dj_01a_2409
Also if we increase Vf to 600 mV the current common mode voltage would need to scale up by the ratio of 600/450 otherwise it will be very diffcult to meet common mode limits that came from CK!

Proposed Response *Response Status* O

AUI-C2M

Cl 176D *SC* 176D.5.3 *P* 700 *L* 34 # 354

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176D-1 has Transmitter steady-state voltage, Vf (range) 0.4 to 0.6 V. This range should be reduced to 0.4 to 0.5 to be consistent with Vf of 0.500

SuggestedRemedy

change Transmitter steady-state voltage, Vf (range) to 0.4 to 0.5V

AUI-C2M

Cl 176D *SC* 176D.5.4 *P* 701 *L* 31 # 356

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176D-2 has Transmitter steady-state voltage, Vf (max) 0.6 V. This should be reduced to 0.5 to be consistent with Vf of 0.500

SuggestedRemedy

change Transmitter steady-state voltage, Vf (range) to 0.4 to 0.5V

Proposed Response *Response Status* O

AUI-C2M

Amplitude tolerance

TX Differential pk-pk voltage, v_f, A_ne, amplitude tolerance (cc)
Comments 314, 345-360, 403, 410

Cl 179 *SC* 179.9.5 *P* 365 *L* 40 # 349

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 179-10 has the Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V

SuggestedRemedy

Change Amplitude tolerance to 1.0V

Proposed Response *Response Status* O

CR

Cl 179 *SC* 179.9.5.2 *P* 366 *L* 4 # 350

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V

SuggestedRemedy

Change Amplitude tolerance to 1.0V

Proposed Response *Response Status* O

CR

Cl 176D *SC* 176D.5.5 *P* 702 *L* 27 # 357

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176D-3 has the Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V

SuggestedRemedy

Change Amplitude tolerance to 1.0V

Proposed Response *Response Status* O

AUI-C2M

Cl 176D *SC* 176D.5.6 *P* 703 *L* 17 # 358

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176D-4 has the Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V

SuggestedRemedy

Change Amplitude tolerance to 1.0V

Proposed Response *Response Status* O

AUI-C2M

Cl 176D *SC* 176D.7.11 *P* 710 *L* 36 # 360

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Amplitude tolerance set to 1.2V. This should be reduced to 1.0V to be consistent with Vf reduced to 0.5V

SuggestedRemedy

Change Amplitude tolerance to 1.0V

Proposed Response *Response Status* O

AUI-C2M

A_ne

TX Differential pk-pk voltage, v_f, A_ne, amplitude tolerance (cc)

Comments 314, 345-360, 403, 410

Cl 178 *SC* 178.10.1 *P* 333 *L* 12 # 346

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 178-13 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V

SuggestedRemedy

Reduce Ane to 0.482

Proposed Response *Response Status* O

KR

Cl 179 *SC* 179.11.7.1 *P* 378 *L* 34 # 351

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 179-17 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V

SuggestedRemedy

Reduce Ane to 0.482

Proposed Response *Response Status* O

CR

Cl 176C *SC* 176C.5.1 *P* 688 *L* 9 # 352

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176C-7 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V

SuggestedRemedy

Reduce Ane to 0.482

Proposed Response *Response Status* O

AUI-C2C

Cl 176D *SC* 176D.6.2 *P* 706 *L* 9 # 359

Simms, William (Bill) NVIDIA

Comment Type TR *Comment Status* X

Table 176D=6 has Ane set to 0.578V which is consistent with 0.6Vf but should be reduced to 0.482 to match Vf of 0.5V

SuggestedRemedy

Reduce Ane to 0.482

Proposed Response *Response Status* O

AUI-C2M

Editors recommendation: REJECT.
The values in D1.2 are based on the resolution to comment #160 against D1.1, which chose a v_f range from 0.4 to 0.6 V and corresponding maximum differential pk-pk voltage, Av, Afe, and Ane, for all electrical interfaces.
In the discussion of a group of comments that includes comment #160 in the September 2024 interim meeting, several options were considered, including the one suggested in this comment (and others related to it). See slides 19-23 in https://www.ieee802.org/3/dj/public/24_09/ran_3dj_04a_2409.pdf.
Straw poll #TF-8 from the September 2024 interim meeting indicated task force consensus on the direction that was chosen.

The comment does not provide sufficient justification to support the suggested remedy, which would change the direction taken after the previous discussion.

TX Output Voltage Range
Comment 82

Cl **176D** *SC* **176D.5.3** *P* **700** *L* **22** # 82

Ran, Adee Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **D** *Output voltage range*

The specification of "Differential peak-to-peak voltage (max)" in Table 176D–1 points to 176D.7.1. In addition, it has footnote a, saying that the measurement uses the method in 93.8.1.3 except that PRBS13Q test pattern is used.

The footnote is not required since there is a full description in 176D.7.1.

As noted in comment #416 against D1.1, the peak-to-peak of PRBS13Q is not indicative of the values that can occur in mission data, unless the channel+equalization attenuate low frequencies that are not present in PRBS13Q.

The specified max peak-to-peak voltage is intended to hold with any data pattern, not just PRBS13Q, and at any equalization setting. It is a clear design requirement that does not require a specific measurement method (the standard is not a measurement specification). Designers and testers know what peak-to-peak voltage is without the reference to 93.8.1.3 (which does not actually define it, it only specifies a test pattern which is inappropriate for this project).

This also applies to module output in Table 176D–2 and to CR and KR transmitter output specifications, although the loss to the measurement point for those is smaller.

SuggestedRemedy

Delete footnote a in this table.

Add a paragraph in 176D.7.1 stating that differential peak-to-peak requirements apply at any equalization setting and with any pattern presented at the service interface.

In Table 176C–1, Table 178–6, and Table 179–7, delete footnote a and replace the reference to 93.8.1.3 with a reference to 176D.7.1

A presentation with measurement results and a detailed suggested remedy is planned.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

Pending CRG review of the referenced contribution.

Editors recommendation: ACCEPT IN PRINCIPLE.
Pending CRG review of
https://www.ieee802.org/3/dj/public/24_11/ran_3d_05_2411.pdf

Tx Spec Methodology

Comments 404, 308, 411, 416, 405, 315, 316, 401

Tx spec Methodology (cc)
Comments 404, 308, 411, 416, 405, 400, 401

Cl 179 *SC* 179.9.4 *P*357 *L*22 # 404

Dawe, Piers Nvidia

Comment Type TR *Comment Status* D *Tx spec methodology*

Our way of measuring jitter doesn't work well enough with the increased max host loss over 3ck: it is very sensitive to signal amplitude, loss to the point of observation, and allowed reflections, so it is very inaccurate. It is not clear that it can or should be fixed. Our way of defining SNDR doesn't work correctly over host loss either. This can be fixed, but "vertical and horizontal noise" act together to degrade BER: more of one goes with less of the other. Attempting to separate them out is diagnostics; it is not the standard's concern how a signal got to be the way it is, only whether it is good enough or not. See calvin_3dj_02a_2407 and successor.

SuggestedRemedy

Delete the SNDR and jitter specs. Add a VEC-like, TDECQ-like spec (see dawe_3dj_01_2409) using this clause's COM reference receiver which can be implemented in a scope. Similarly for KR and C2C.
Delete SNR_ISI because it is a contributor to eye opening.
RLM is a contributor to eye opening defined right, too: see another comment.
Define VEC and Eye Amplitude (based on the equalised scope measurement) for nominal maximum signals; don't ask the scope to resolve very small signals (same idea as SNDR being defined for the presents in Table 179-8 today, not for every possible case).

Proposed Response *Response Status* W

PROPOSED REJECT.
The comment does not provide sufficient justification to support the suggested remedy. SNDR has been redefined in D1.1 to address degradation with loss with the previous definition. The comment does not seem to account for the change.

Jitter measurement has been shown to be quite feasible with losses of <<30 dB to the measurement point as expected in CR hosts. There are different limits for different host classes to address slope degradation with loss and the possible conversion of loss to jitter.

The claim that all noise sources are equal is unjustified and is contrary to presentations provided to the task force and to other venues such as OIF. Limiting jitter is important regardless of other noises, especially due to its potential of creating correlated errors.

In addition, the suggested remedy does not provide sufficient detail to implement.

Cl 176D *SC* 176D.5.3 *P*700 *L*34 # 411

Dawe, Piers Nvidia

Comment Type TR *Comment Status* D *Tx spec methodology*

Several inappropriate backplane-style "micro-managing" many-quotas spec items have appeared that are wasteful and unnecessary diagnostics, and some are not measurable with the losses allowed in C2M with reasonable reflections. This is not the way to specify an observable signal. Remember, our task is to specify the *signal at the interface* not hypothesise about the silicon 20-ish dB behind it.
See other comments noting the impracticality of the 120D style jitter measurement method for this project. See dawe_3dj_01a_2406, calvin_3dj_02a_2407 and successor.

SuggestedRemedy

Remove vf (min), Rpeak, SNDR, SNR_ISI and output jitter. Add a VEC-like, TDECQ-like spec, which can be measured in a scope using the COM reference receiver parameters from Table 176D-6 (see dawe_3dj_01_2409). The VEC limit is derived from the COM table too.
Remove RLM; in 120E we decided we didn't need a separate eye linearity spec.
Add an Eye Amplitude spec based on the same measurement (note that dawe_3dj_01_2409 says Eye Height: Eye Amplitude is meant).
Note that because of instrument noise, VEC and Eye Amplitude (like SNDR) should not be measured on small signals, but on nominal-minimum signals before any training process has reduced them ("presets").
Apply to C2M throughout 176D.
Another comment proposes the same approach for 179, CR.

Proposed Response *Response Status* W

PROPOSED REJECT.
Resolve using the response to comment #404.

Tx spec Methodology (cc)
Comments 404, 308, 411, 416, 405, 400, 401

Cl 179 *SC* 179.9.4.2 *P*361 *L*26 # 416

Dawe, Piers Nvidia

Comment Type TR *Comment Status* D *Tx spec methodology*

If we look at the signal at TP2 and its equalised eye rather than just hypothesising about it (see other comments), we probably don't need a separate RLM spec. Today, COM doesn't address RLM carefully. 3ck C2M doesn't have an equivalent; if a signal has enough nonlinearity to matter, it shows up in a worse VEC.

SuggestedRemedy

Delete the RLM spec and 179.9.4.2. See another comment for the holistic VEC-like, TDECQ-like spec that includes it.

Proposed Response *Response Status* W

PROPOSED REJECT.
RLM is measured directly from the signal without "hypothesising".
RLM is specified to limit the level mismatch in the transmitter output. Removing RLM would enable any level mismatch, which some receivers may not be able to handle in practice.
VEC is not defined for CR interfaces.

The comment does not provide sufficient justification for the suggested remedy.

Cl 179 *SC* 179.9.4.3 *P*361 *L*33 # 405

Dawe, Piers Nvidia

Comment Type TR *Comment Status* D *Tx spec methodology*

SNR_ISI is not needed as a separate spec: it is a component of eye opening. There is no need for a not-quite-consistent special equalizer with its special Nb for this.

SuggestedRemedy

Delete the SNR_ISI section and the editor's note. See other comments and dawe_3dj_01_2409 for the holistic VEC-like, TDECQ-like spec that includes it.

Proposed Response *Response Status* W

PROPOSED REJECT.
SNR_ISI has been added in clause 179 after recognizing that reflections within the transmitter's internal host channel can create excessive degradation that cannot be equalized by the reference receiver and such reflections are not captured in other Tx measurements. SNR_ISI guards against large difference between the host under test and the reference host channel (which is a package+PCB model with limited reflections).
Since the refernce equalizer is long, removing SNR_ISI specification from CR hosts will enable hosts with internal reflections to pass, and give rise to potential interoperability issues.

The comment does not provide sufficient justification to support the suggested remedy.

Cl 179A *SC* 179A.5 *P*698 *L* # 308

Ghiasi, Ali Ghiasi Quantum

Comment Type T *Comment Status* D *Tx spec methodology*

Transmitter jitter specifications is ineffective and. Not sensitive for farend TP1a specifications as was demonstrted by Rysin_3dj_01_2407.pdf
It makes no sense to use transmit jitter at TP1a when TP1a is actually at receiver pin, and what receiver care about is VEO, VEC, and possibly EW.

SuggestedRemedy

Replace Ouput jitter and SNDR with, see ghiasi_01_2407
VEO=8 mV
VEC=10.7 dB
If you want jitter then we should consider adding EW.

Proposed Response *Response Status* W

PROPOSED REJECT.
Resolve using the response to comment #404.

It is unclear what this comment is against. Page, subclause, and comment text do not match..

Cl 179 *SC* 179.9.4.6 *P*362 *L*16 # 400

Dawe, Piers Nvidia

Comment Type TR *Comment Status* D *Tx spec methodology*

As explained in other comments (and see dawe_3dj_01a_2406), up to 3ck the SNDR spec acted together with the jitter spec and others to protect the link performance - but we don't have a satisfactory way of measuring jitter at today's speeds and losses with reasonable reflections. Basically, measurements can't tell jitter from noise, and trying to separate the two things out "leaves margin on the table". See calvin_3dj_02a_2407 and successor.

SuggestedRemedy

Delete the SNDR section. Add a VEC-like, TDECQ-like spec using this clause's COM reference receiver which can be implemented in a scope, as in dawe_3dj_01_2409.
Similarly for KR and C2C.

Proposed Response *Response Status* W

PROPOSED REJECT.
Resolve using the response to comment #404.

Tx spec Methodology (cc)
Comments 404, 308, 411, 416, 405, 400, 401

Cl 179	*SC* 179.9.4.7	*P*363	*L*1	# 401

Dawe, Piers — Nvidia

Comment Type TR *Comment Status* D *Tx spec methodology*

Measuring jitter separately to other impairments relies on a better slew rate to noise ratio than we have at the observation point, and better than what is needed to make good links. calvin_3dj_01b_2407 shows that most of what is measured is not jitter. Also see calvin_3dj_02a_2407 and successor, and zivny_3dj_01_2409 which does not establish if any of the jitter measurements give measure the right thing.

SuggestedRemedy

Delete the jitter section. Add a VEC-like, TDECQ-like spec using this clause's COM reference receiver which can be implemented in a scope, as in dawe_3dj_01_2409. Similarly for KR and C2C.

Proposed Response *Response Status* W

PROPOSED REJECT.
The comment does not provide sufficient justification to support the suggested remedy.

Jitter measurement has been shown to be feasible with losses of over 30 dB to the measurement point, which is much higher than what is expected in CR hosts. There are different limits for different host classes to address slope degradation with loss. Jitter measurements with values lower than these limits have been demonstrated.
The referenced presentation (https://www.ieee802.org/3/dj/public/24_09/dawe_3dj_01_2409.pdf) does not include sufficient detail to implement in the draft. In addition, the idea that all transmitter impairments can be combined together into one metric is a deviation from established CR methodology and consensus has not been demonstrated.

Summary: The comments propose to replace multiple Tx specifications (jitter, SNDR, RLM, SNR_ISI, vf, Rpeak) with VEC,VEO/eye amplitude.

Editors recommendation: REJECT these comments with the responses to comments #401, #404, #405, #416,
For CRG discussion.

Tx spec Methodology
Comment 315, 316

Cl 176D *SC* 176D.5.3 *P*700 *L*49 # 315

Ghiasi, Ali Ghiasi Quantum

Comment Type T *Comment Status* D *Tx spec methodology*

We currenlty have no effective output compliance test method for C2M or input caliburtion of stressor. We replaced VEC with with JRMS, EOJ, and J4U wihout any demonstration that using transmit jitter is sufficent for receive compliance.

SuggestedRemedy

TDECQ method works given all the data presentated and with the work of OIF LPO and RTLR developing. TDECQ/EECQ already captrues the jitter as shown in ghiasi_3dj_01a_2409 but also captures amplitude penalty and the effect of PM to AM conversion in thre same way as receiver will observe the penalty. EECQ for receive stress measurement and caliburation we need to do the follwing:
Add editor note encouraging data if current jitter test method can be used for receive compliance and encourage data on EECQ for receive compliance.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

The host output specification methodology has been adopted by the response to comment #186 against D1.0 following support shown in straw poll #3 in the May 2024 meeting:
<start of poll>
I would support the approach for the AUI-C2M host and module output specifications outlined in ran_3dj_02_2405
Results (all): Y: 38, N: 9, NMI: 9, A: 42
<end of poll>

The host input specification methodology has been adopted by the response to comment #188 against D1.0 following support shown in straw poll #2 in the May 2024 meeting:
<start of poll>
I would support the approach for the AUI-C2M host and module input specifications outlined in ran_3dj_01_2405
Results (all) Y: 31, N: 15, NMI: 6, A: 39
<end of poll>

These methodologies have been demonstrated to support interoperability of CR PHYs for multiple generations. Specifically, jitter tolerance is included in the host/module input specifications.

The comment does not provide sufficient justification to support the suggested remedy. Contributions as in the suggested remedy are always encouraged, and this does not require an editor's note.

Cl 176D *SC* 176D.5.4 *P*701 *L*46 # 316

Ghiasi, Ali Ghiasi Quantum

Comment Type T *Comment Status* D *Tx spec methodology*

We currenlty have no effective output compliance test method for C2M or input caliburtion of stressor. We replaced VEC with with JRMS, EOJ, and J4U wihout any demonstration that using transmit jitter is sufficent for receive compliance.

SuggestedRemedy

TDECQ method works given all the data presentated and with the work of OIF LPO and RTLR developing. TDECQ/EECQ already captrues the jitter as shown in ghiasi_3dj_01a_2409 but also captures amplitude penalty and the effect of PM to AM conversion in thre same way as receiver will observe the penalty. EECQ for receive stress measurement and caliburation we need to do the follwing:
Add editor note encouraging data if current jitter test method can be used for receive compliance and encourage data on EECQ for receive compliance.

Proposed Response *Response Status* W

PROPOSED REJECT.
Resolve using the response to comment #315.

Editors recommendation: REJECT.
For CRG discussion.

Rx Test Methodology

Comments 96, 406, 91, 99, 208, 418, 296, 318, 320

RX Test Methodology (cc)
Comments 96, 406

Cl 179 *SC* 179.9.5.2 *P*366 *L*3 # 96

Ran, Adee Cisco Systems, Inc.

Comment Type T *Comment Status* D *Rx test methodology*

Compliance with receiver amplitude tolerance is defined in terms of a test with a specific amplitude which has an associated "shall". This test can either pass or fail. But the requirement in Table 179-10 is in terms of voltage.
This is how it's been for a long time - but it can be improved.

The test would better be defined as having a parameter, A_0, which is the PtP amplitude at preset 1.
The test result would be the maximum A_0 that the DUT can tolerate. Compliance will be defined as having the maximum no lower than 1200 mV - which matches Table 179-10 as part of the normative requirements.

This would be more like the way tests are performed in many practical cases (e.g. checking for margin over the specification).

The definition of amplitude tolerance in 176D.7.11 was written in a similar manner to this proposal.

If accepted, this change should be applied in KR and C2C as well.

SuggestedRemedy

Rewrite the definition of amplitude tolerance based on the definition in 176D.7.11.

Implement for CR, KR, and C2C, with editorial license.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
The suggested change enables expressing amplitude tolerance by a numeric value in the summary table, without changing the meaning of the amplitude tolerance requirement. It is therefore an improvement to the draft.
For CRG discussion.

Cl 179 *SC* 179.9.5.2 *P*366 *L*4 # 406

Dawe, Piers Nvidia

Comment Type TR *Comment Status* D *Rx test methodology*

Signal Vpkpk are defined and measured and calibrated with PRBS13Q. When used for stressed input testing, the signal is changed to PRBS31Q. This is settled policy. The envelope of the signal depends on the pattern, the loss to the observation point and the Tx emphasis. These are known, so the dependency is known.

SuggestedRemedy

Assuming that the intent is a 1 V swing at the silicon, the Vpkpk for calibration (with PRBS13Q) at the MCB output is a little less. Add a row to the table for this voltage.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
The intent is to verify interoperation with the maximum initial swing, which is currently 1.2 V PtP at the transmitter reference point (effectively TP0d).
The calibration point for this voltage is not at the MCB (channel output) but the transmitter's output (which is either an instrument output or an HCB). The loss to this point should be low enough that the peak-to-peak of the training signal (which includes long runs of 0s and 3s in the marker) is observed correctly.
However, the definition of the test condition could be improved by requiring that the transmitter has the maximum allowed v_f, instead of referring to the peak to peak voltage.
v_f would be less dependent on the channel, and is defined specifically without equalization.

Change from
"a compliant transmitter whose peak-to-peak differential output voltage (see Table 179–7) measured at the preset 1 equalizer setting is 1.2 V"
to
"a compliant transmitter that has the maximum allowed steady-state voltage (see Table 179–7)".
Implement with editorial license for all electrical interfaces, aligned with the resolution of comment #96.

RX Test Methodology (cc)
Comments 96, 406

179.9.5.2 Receiver amplitude tolerance

When a PMD receiver is connected to a compliant transmitter whose peak-to-peak differential output voltage (see Table 179–7) measured at the preset 1 equalizer setting is 1.2 V, using a compliant cable assembly with the minimum insertion loss specified in 179.11.2, the PMD receiver operation shall enable a block error ratio as specified in 179.2.

The receiver is allowed to control the transmitter equalizer coefficients, using the ILT function (see 179.8.9) or an equivalent process, to meet these requirements.

176D.7.11 Amplitude tolerance

Amplitude tolerance of a receiver is defined as the maximum initial peak-to-peak output that the receiver can tolerate at its input, such that it satisfies the error ratio allocation requirements specified in 176D.4 when it operates in DATA mode (see Annex 178B).

The initial peak-to-peak output is defined as the peak-to-peak differential output (see 176D.7.1), with equalization set to preset 1 (see Table 176D–8), of the transmitter that is connected to the input of the device under test. A device under test is allowed to control the transmit equalizer coefficients of its partner using the ILT protocol (see 176D.7.6) to create suitable output signal.

For a host, the input signal is applied at TP4a and measured at TP4. For a module, the input signal is applied at TP1 and measured at TP1a.

The amplitude tolerance of a receiver shall be at least 1.2 V.

179.9.5.2 Receiver amplitude tolerance

When a PMD receiver is connected to a compliant transmitter whose peak-to-peak differential output voltage (see Table 179–7) measured at the preset 1 equalizer setting is 1.2 V, using a compliant cable assembly with the minimum insertion loss specified in 179.11.2, the PMD receiver operation shall enable a block error ratio as specified in 179.2.

a compliant transmitter that has the maximum allowed steady-state voltage (see Table 179–7)

Editors recommendation: ACCEPT IN PRINCIPLE.

The suggested change enables expressing amplitude tolerance by a numeric value in the summary table, without changing the meaning of the amplitude tolerance requirement. It is therefore an improvement to the draft.
For CRG discussion.

Note: amplitude tolerance is not currently specified in KR or C2C.

RX Test Methodology (cc)
Comment 91

Cl **179** *SC* **179.9.5.4** *P* **349** *L* **42** # 91

Ran, Adee Cisco Systems, Inc.

Comment Type **T** *Comment Status* **D** *Rx test methodology*

Compliance with receiver jitter tolerance is defined in terms of a test with a specific jitter profile and a binary result (pass/fail). This does not provide a clear means of assessing how much margin a DUT has. For this test, the margin should be in terms of jitter stress, not in terms of the block error ratio achieved (which is a likely misunderstanding).

The jitter stress definition has been like that for a long time - and should be improved.

The test would better be defined based on a parameter, SJ_0, which is the SJ PtP amplitude at 40 MHz; and all jitter test cases are defined based on this parameter (using the same profile as today, but scaled by SJ_0).

The test result would be the maximum SJ_0 that the DUT can tolerate. Compliance will be defined as having the maximum no lower than 0.05 UI - which can be put in Table 179-10 as part of the normative requirements.

This would allow defining the margin over the specification in a standardized way

If accepted, this change should be applied in KR, C2C, and C2M as well.

SuggestedRemedy

Rewrite the definition of jitter tolerance as a value rather than a procedure. Change the test procedure to use a parameter SJ_0 as described in the comment.

Change the value of "jitter tolerance" in Table 179-10 from "table 179-12" to the minimum SJ_0 required, 0.05 UI. Delete the test requirement ("shall") from the procedure.

Implement for CR, KR, C2C, and C2M, with editorial license.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
The suggested change enables expressing jitter tolerance by a numeric value in the summary table, without changing the meaning of the jitter tolerance requirement. It is therefore an improvement to the draft.
Pending CRG discussion, implement the suggested remedy.

Proposed changes:

- Change JTOL definition to be a value.
- Change procedure to use SJ_0, the pk-pk SJ amplitude @ 40 GHz.
- Define test cases in terms of SJ_0.
- Change Jitter tolerance requirement in Table 179-10 to be 0.05 UI.

Editors recommendation: ACCEPT IN PRINCIPLE.
The suggested change enables expressing jitter tolerance by a numeric value in the summary table without changing the meaning of the JTOL requirement.
For CRG discussion.

RX Test Methodology
Comment 99

Cl **179** *SC* **179.9.5.3.4** *P* **369** *L* **22** # 99

Ran, Adee — Cisco Systems, Inc.

Comment Type **T** *Comment Status* **D** *Rx test methodology*

Figure 179-6 is empty.
Equations 179-17 through 179-19 are identical to equations 162-15 through 162-17 respectively, and are written with fb as a parameter, but the values of f1 and f2 are fixed in GHz. Therefore the figure should be the similar to Figure 162-6 but not identical.

It is not clear whether f1 and f2 should be scaled to the new fb. If they are, then the figure would be the same as Figure 162-6, and the equations and figure can be replaced with references to clause 162.
The suggested remedy assumes that f1 and f2 are fixed (not scaled).

SuggestedRemedy

Create Figure 179-6 based on the equations.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

If the intent is to use the same f1 and f2 as in clause 162 (without scaling to the signaling rate), the suggested remedy can be implemented.
However, it can be argued that the noise spectrum should be consistent with channel loss, and thus it would be appropriate to change f1 from 8 to 16 GHz and f2 from 5 to 10 GHz, and then generate the figure accordingly.

For CRG discussion.

To avoid excessive low-frequency weighting to the receiver input noise, the noise added to the signal is bounded by the normalized spectral density mask defined in Equation (179–17), Equation (179–18), and Equation (179–19) with $f_1 = 8$ GHz and $f_2 = 5$ GHz, and illustrated in Figure 179–6.

$$NSD_{avg} = \frac{1}{(f_b/2 - f_1)} \int_{f_1}^{f_b/2} NSD(f)df \tag{179–17}$$

$$10\log_{10}\left(\frac{NSD(f)}{NSD_{avg}}\right) \geq -3 + 3.6(f/f_b) \qquad f_1 \leq f \leq f_b/2 \tag{179–18}$$

$$10\log_{10}\left(\frac{NSD(f)}{NSD_{avg}}\right) \leq \begin{cases} -12 + 15(f/f_2) & 0 \leq f < f_2 \\ 3 & f_2 \leq f \leq f_b/2 \end{cases} \tag{179–19}$$

Editors recommendation: ACCEPT IN PRINCIPLE.
Change f1 from 8 to 16 GHz and f2 from 5 to 10 GHz, and generate the figure accordingly.

RX Test Methodology
Comment 208

Cl 179 *SC* 179.9.5.3.3 *P*367 *L*16 # 208

Healey, Adam Broadcom Inc.

Comment Type T *Comment Status* D *Rx test methodology*

Now that the host channel model is included in the calculation of COM defined in Annex 178A, it is no longer necessary to treat the concatenation of host channels as a separate step in the process. It is now simply a matter of stating which parameters are to be used to calculate the host channel model, or that the model is to be omitted.

SuggestedRemedy

Consolidate items a) and b) into the following basic statements. First, the test channel is measured between the Tx and Rx test references shown in Figure 110-3b. Second, that COM is calculated using the the receiver host channel, package, and device models in Table 179–16 corresponding to the class of the receiver under test. A third statement, conditional on different "tests" being defined for a given host class, is that the COM is calculated for all of the tests defined for a given host class and the COM value for the test channel is taken to be the lowest value from the tests. All other information in items a) and b) is redundant with the content of Annex 178A.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
The receiver host channel parameters are proposed by comment #92. According to the resolution of that comment, there may be one host channel (one "test case") per host class. Implement the suggested remedy aligned with the resolution of comment #92.

179.9.5.3.3 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 179B.3.

The insertion loss at 53.125 GHz of the signal path between the test references in Figure 110–3b is within the limits in Table 179–11.

The COM is calculated using the method and parameters of 179.11.7 with the following considerations:

a) The channel signal path is $SCHS_p$ = cascade($S^{(CTSP)}$, $S^{(HOSPR)}$), where $S^{(CTSP)}$ is the measured channel between the test references in Figure 110–3b and $S^{(HOSPR)}$ is calculated as defined in 179.11.7.2.1, using the host channel, package, and device models in Table 179–16 corresponding to the class of the receiver under test. The function cascade() is defined in 93A.1.2.1.

b) COM is calculated using both Test 1 and Test 2 device package model transmission line lengths listed in Table 179–16 on the receiver side. The value of COM is taken as the lower of the two calculated values.

c) The calculation of the channel S-parameters in 178A.1.2 is performed with $S^{(t)} = 1$ (effectively omitting the transmitter S-parameter model). The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (178A–10) uses a rise time filter $H_t(f)$ (see 178A.1.6.2) calculated with T_r equal to the transition time at the Tx test reference. The transition time 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 179.9.4.1.3) with an exception that the waveform is observed through a fourth-order Bessel-

a) The test channel is measured between the Tx and Rx test references shown in Figure 110-3b. COM is calculated using the the receiver host channel, package, and device models in Table 179–16 corresponding to the class of the receiver under test. COM is calculated for all of the different tests defined for a given host class. The COM value for the test channel is taken to be the lowest value from the tests.

Editors recommendation: ACCEPT IN PRINCIPLE.
The receiver host channel parameters are proposed by comment #92. According to the resolution of that comment, there may be one host channel (one "test case") per host class. Implement the suggested remedy aligned with the resolution of comment #92.

RX Test Methodology (cc)
Comments 418, 296

Cl **179** *SC* **179.9.5.4.2** *P***370** *L***40** # 418

Dawe, Piers Nvidia

Comment Type **T** *Comment Status* **D** *Rx test methodolog*

Missing jitter tolerance frequency point ("case")

SuggestedRemedy

Insert a case at 0.1333 MHz, 1.5 UI. Similarly in Table 176D-10.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The jitter test cases are consistent with ones used in previously defined PMDs at lower signaling rates. See Table 162–17 and Table 120D–7.

The existing test cases include jitter frequencies of 40 kHz (case A) and 400 kHz (case B). The comment does not provide justification for adding another test case between these frequencies.

Note that comment #296 is similar (but with different suggested remedy) for Annex 176D.

For CRG discussion.

Cl **176D** *SC* **176D.7.13.2** *P***715** *L***18** # 296

Ghiasi, Ali Ghiasi Quantum

Comment Type **T** *Comment Status* **D** *Rx test methodology*

Receiver jitter tolerance frequencies are seperated by ~3x but in the case of test case A and B the frequencies are seperated by a decade which may mask possible jitter peaking and sensitivity issue in this band

SuggestedRemedy

Add one additional test point between case A and B at frequency of 0.125 MHz with jitter amplitude of 1.6 UI

Proposed Response *Response Status* **W**

PROPOSED REJECT.
Resolve using the response to comment #418.

Editors recommendation: REJECT.
The jitter test cases are consistent with ones used in previously defined PMDs at lower signaling rates. See Table 162–17 and Table 120D–7.
The existing test cases include jitter frequencies of 40 kHz (case A) and 400 kHz (case B).
The comment does not provide justification for adding another test case between these frequencies.

For CRG discussion.

RX Test Methodology
Comment 318

Cl 176D	*SC* 176D.6.2	*P*706	*L*38	# 318

Ghiasi, Ali — Ghiasi Quantum

Comment Type **T** *Comment Status* **D** *Rx test methodology*

Typical gDC1 gain for C2M is just few dB's, and there is no reason to have the same gDC1 as KR/CR

SuggestedRemedy

Reduce gDC1 to -12 dB

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The comment does not provide sufficient justification to support the suggested remedy.
It is unclear what benefit the change would achieve. The reference receiver is only used to calibrate the noise in input tests. Even if the typical gDC1 value is limited as stated (without data to support this claim) the results would not change by reducing the range.

Table 176D-6

Gain 1	g_1		
Minimum value		–20	dB
Maximum value		0	dB
Step size		1	dB

Editors recommendation: REJECT.
Reducing the gain range would not affect the results obtained.

RX Test Methodology
Comment 320

Cl **176D** *SC* **176D.7.13.2** *P* **715** *L* **5** # 320

Ghiasi, Ali Ghiasi Quantum

Comment Type **T** *Comment Status* **D** *Rx test methodology*

The test procedure for jitter tolerance is not comprehensive and doesn't stress the receiver at maximum input stress if the noise source is turned off then you turn on the SJ source. Given all the concern about block erros not having comprehensive JTOL only will result in block over compliant links.

SuggestedRemedy

What has been done for several generation of C2M and optical interfaces the noise source is dialed by 0.05 UI then SJ in table 176D-10 is applied. All the SJ in tbale 176D-10 integrate to 0.05 UI.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
Jitter tolerance is part of the receiver specification methodology that has been demonstrated to support interoperability of CR PHYs for multiple generations.

The comment does not provide sufficient justification to support the suggested remedy, nor sufficient detail to implement it in the draft.

Editors recommendation: REJECT.

Jitter

Comments 213, 211, 212

Jitter (cc)
Comments 211, 212, 213

Cl **176D** *SC* **176D.5.3** *P* **700** *L* **50** # 211

Rysin, Alexander NVIDIA

Comment Type **TR** *Comment Status* **D** *Jitter*

J3u and JRMS measurements at TP1a are highly affected by the effects of slew rate and noise and do not reflect actual uncorrelated jitter. These effects are exacerbated by the characteristics of practical channels between TP0d and TP1a - loss and reflections, and are highly dependent on the transmitted signal amplitude. Accounting only for the faster edges does not work for practical channels at 106.25 Gbd rate and the currently proposed numbers cannot be met (and sometimes cannot be measured) even with commercial test equipment PPG. The issue was demonstrated in rysin_3dj_01a_2407.

SuggestedRemedy

Other method of uncorrelated jitter measurement should be considered.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
Resolve using the response to comment #213.

Editors recommendation: REJECT.
The suggested remedy is not actionable.

Cl **176D** *SC* **176D.5.4** *P* **701** *L* **47** # 212

Rysin, Alexander NVIDIA

Comment Type **TR** *Comment Status* **D** *Jitter*

J4u and JRMS measurements at TP4 are highly affected by the effects of slew rate and noise and do not reflect actual uncorrelated jitter. These effects are exacerbated by the characteristics of practical test fixtures - loss and reflections, and are highly dependent on the transmitted signal amplitude. Accounting only for the faster edges does not work for practical channels at 106.25 Gbd rate. The issue was demonstrated in rysin_3dj_01a_2407.

SuggestedRemedy

Other method of uncorrelated jitter measurement should be considered.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
Resolve using the response to comment #213.

Cl **179** *SC* **179.9.4** *P* **357** *L* **22** # 213

Rysin, Alexander NVIDIA

Comment Type **TR** *Comment Status* **D** *Jitter*

J3u and JRMS measurements at TP2 are highly affected by the effects of slew rate and noise and do not reflect actual uncorrelated jitter. These effects are exacerbated by the characteristics of practical channels between TP0d and TP2 - loss and reflections, and are highly dependent on the transmitted signal amplitude. Accounting only for the faster edges does not work for practical channels at 106.25 Gbd rate and the currently proposed numbers cannot be met (and sometimes cannot be measured) even with commercial test equipment PPG. The issue was demonstrated in rysin_3dj_01a_2407.

SuggestedRemedy

Other method of uncorrelated jitter measurement should be considered.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The referenced presentation is
https://www.ieee802.org/3/dj/public/24_07/rysin_3dj_01a_2407.pdf.
Ideas for improvements of uncorrelated jitter measurement have been presented, e.g., in https://www.ieee802.org/3/dj/public/24_07/calvin_3dj_01b_2407.pdf. Further work in this direction is encouraged.
The suggested remedy is not actionable

Test Fixtures

Comments 149, 65, 189, 190, 193, 192

KR Itol
Comment 149

Cl 178 *SC* 178.9.3.3 *P*327 *L*53 # 149

Dudek, Mike Marvell

Comment Type TR *Comment Status* D *RX Itol*

Even if the package class is known of a transmitter of unknown S parameters it is only known what the maximum package loss might be. The package loss of the specific port of the package being used could have maybe 8dB less loss than this maximum loss. This would result in the interference test being performed with 8dB too little loss which is unacceptable.

SuggestedRemedy

Delete this option.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
The comment and the suggested remedy are reasonable, but consensus is not obvious.
For CRG discussion.

Editors recommendation: ACCEPT IN PRINCIPLE.
The comment and suggested remedy are reasonable, but consensus is not obvious. For CRG discussion.

178.9.3.3 Receiver interference tolerance

Receiver interference tolerance is defined by the procedure in Annex 93C. The receiver on each lane shall meet the expected block error ratio specified in 178.2 with channels matching the Channel Operating Margin (COM) and loss parameters for Test 1 and Test 2 in Table 178–10. The following additional considerations apply to the interference tolerance test.

a) TP0v (TP5v) replaces TP0a (TP5a) in 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 0.8 V.

c) The ERL of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the requirements in 178.10.3.

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 are used instead of the transmitter package model in 178A.1.4, and the ILdd in Table 178–10 is the ILdd of the concatenated S-parameters of the device and the channel between TPt and TP5 replica. T_r should be provided as the value at the input of the device S-parameters network, as defined in 120G.3.1.4 but with no observation filter.

— 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 model $S^{(t)}$ is omitted from Equation (178A–2). In this case, the ILdd in Table 178–10 is the ILdd of the channel between TPt and TP5 replica. The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (178A–10) uses the filter $H_t(f)$ defined in 178A.1.6.2, where T_r is the measured transmitter transition time (see 120G.3.1.4).

— If the transmitter is composed of a device with unknown S-parameters or unknown transition time, then the transmitter device package model $S^{(tp)}$ in 178A.1.4 is used with the parameters

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from Table 178–12 for the package class to which the transmitter adheres. In this case, the ILdd in Table 178–10 is the ILdd of the concatenated S-parameters of $S^{(tp)}$ and the channel between TPt and TP5 replica. T_r is determined from measurement at TP0v and the TP0 to TP0v S-parameters. The transmitter transition time (see 120G.3.1.4) is measured at TP0v with transmit equalization turned off by setting coefficients to preset 1 values (see 179.9.4.1.3). T_r is set as the value in Equation (93A–46) that would result in the reference transition time $T_r^{(ref)}$, determined according to 163A.3.1.3 with f_b and A_v equal to values in Table 178–13, being equal to the measured transition time.

KR MTF IL/ILD
Comments 65, 189, 190

Cl 178 *SC* 178.9.2.1.1 *P*323 *L*35 # 189

Mellitz, Richard Samtec

Comment Type TR *Comment Status* D *TF IL, delay*

The insertion loss and the delay for the test fixture needs to be tightly controlled to minimize the variability. That is because there will be load variability in the measurement equipment. The idea should be to add enough loss so as not to significantly signal degrade the signal but dampen the effects of test equipment load variability.

SuggestedRemedy

Change to:
The insertion loss of the test fixture shall be between 4 dB and 5 dB at 53.125 GHz. With a delay between 500 and 650 ps. (based on 1.2 dB /inch and 150 ps /inch and e_r approximately 3.2)

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

Resolve using the response to comment #65.

Cl 178 *SC* 178.9.2.1.1 *P*323 *L*36 # 190

Mellitz, Richard Samtec

Comment Type TR *Comment Status* D *TF ILdd*

The fixture frequency content needs to extend beyond the Nyquist rate. S-parameter measurements are required for this test fixture for ERL. This fixture is also required for s-parameter measurements when computing COM for receiver compliance. A transition time of 5 ps is used for ERL computation and is trending to around 4 ps for COM. A frequency range needs to be chosen to minimize the Gibbs Phenomena. There can be significant error due to this for ERL or COM computation. Filtering can help, however, there is still an error. Consider the data has a sinc response, the loss difference of between 53 GHz and 85 GHz with a BT filter is about 10 dB which is just about amount of filtering need to minimize this error. The loss difference between 53 GHz and 67 GHz is about 4 dB which is likely to start showing this error.

SuggestedRemedy

Change to:
The magnitude of the insertion loss deviation of the test fixture shall be less than or equal to 0.2 dB from 0.05 GHz to 85 GHz. Insertion loss deviation is calculated as specified in 93A.4, where Tt is 0.005 ns, and fb and fr values are taken from Table 178–12.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

Resolve using the response to comment #65.

Cl 178 *SC* 178.9.2.1.1 *P*323 *L*35 # 65

Ran, Adee Cisco Systems, Inc.

Comment Type TR *Comment Status* D *TF IL, ILdd*

TP0 to TP0v test fixture specifications has multiple TBDs.

As initial values, we can use the values from clause 163 scaled by a factor of 2.

SuggestedRemedy

Use:
ILdd between 3.4 dB and 10 dB at 53.125 GHz
ILD magnitude up to 0.4 dB from 0.05 GHz to 53.125 GHz
Tt is 0.005 ns

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
The comment addresses an open TBD and the comment and the suggested remedy are reasonable, but consensus is not obvious.
Comments #189 and #190 suggest a different ILdd range, different frequency range for ILD, and additional restrictions.
For CRG discussion.

53.125 or 85

3.4-10 or 4-5

0.4 or 0.2

0.05

5

178.9.2.1.1 Test fixture insertion loss

The insertion loss of the test fixture shall be between TBD dB and TBD dB at 53.125 GHz. The magnitude of the insertion loss deviation of the test fixture shall be less than or equal to TBD dB from TBD GHz to 53.125 GHz. Insertion loss deviation is calculated as specified in 93A.4, where T_t is TBD ns, and f_b and f_r values are taken from Table 178–12.

Editor's note (to be removed by D2.0, or if values are adopted):
Test fixture insertion loss and insertion loss parameters and requirements were left to be determined in the adopted baseline proposal. Contributions in this area are encouraged.

Editors recommendation: ACCEPT IN PRINCIPLE
The comments address TBD items in D1.2.

KR Test Fixture Frequency Mask
Comment 63 (bucket)

Cl **178** *SC* **178.9.2.1.3** *P***314** *L***34** *#* 63

Ran, Adee Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **D** *TX fixture RLcc (bucket)*

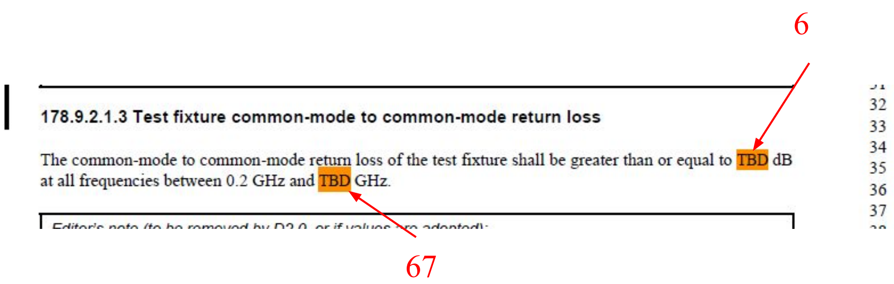
Test fixture RLcc parameters are TBD.
In 163.9.2.1.3 the specification is >=6 dB up to 40 GHz.
The suggested remedy is the same minimum with the frequency range adopted for 802.3dj.
Alternatively, this specification can be deleted, since RLcc of a bare TP0-TP0v test fixture (without a DUT attached to it) may be impractical to measure.

SuggestedRemedy

Change to "6 dB at all frequencies between 0.2 GHz and 67 GHz".

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.



178.9.2.1.3 Test fixture common-mode to common-mode return loss

The common-mode to common-mode return loss of the test fixture shall be greater than or equal to TBD dB at all frequencies between 0.2 GHz and TBD GHz.

Editors recommendation: ACCEPT.
The comment addresses TBD items in D1.2.

KR Test Fixture Differential Skew
Comment 193

Cl 178 *SC* 178.9.2.1.3 *P*324 *L*33 *#* 193

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **D** *TF skew*

CD or DC are better quality indictor of line the quality of line imbalance because it will catch skew and should augment CC.

SuggestedRemedy

Add section:
178.9.2.1.x Test fixture differential-mode to common-mode return loss
The differential-mode to common-mode return loss of the test fixture at either port shall be less than or than or equal to 10 dB at all frequencies between 0.2 GHz and 85 GHz.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The comment does not provide sufficient justification to support the suggested remedy.

178.9.2.1.3 Test fixture common-mode to common-mode return loss

The common-mode to common-mode return loss of the test fixture shall be greater than or equal to TBD dB at all frequencies between 0.2 GHz and TBD GHz.

Editor's note (to be removed by D2.0, or if values are adopted):
Test fixture common-mode to common-mode return loss requirements were left to be determined in the adopted baseline proposal. Contributions in this area are encouraged.

178.9.2.1.4 Text fixture differential-mode to common-mode return loss

The differential-mode to common mode return loss of the test fixture at either port shall be less than or equal to 10 dB at all frequencies between 0.2 GHz and 85 GHz.

Editors recommendation: REJECT
The comment and suggested remedy are reasonable, but the comment does not provide sufficient justification to support the suggested remedy.
For CRG discussion.

KR Test Fixture Nbx
Comment 192

Cl **178** *SC* **178.9.2.1.2** *P* **324** *L* **17** # 192

Mellitz, Richard Samtec

Comment Type **TR** *Comment Status* **D** *TF Nbx*

N_bx in the Table 187A-7 should be 0 so test fixture will not interfere with measurement as in IEEE802.3ck.

SuggestedRemedy

Relace with the row 5 with:
Equalizer length associated with reflection signal: N_bx : 0

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.

Table 178–7—Test fixture ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	0.005	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}	16	UI
Time-gated propagation delay	T_{fx}	0	ns
Tukey window flag	tw	1	—

0

Editors recommendation: ACCEPT.

Tx Equalization

Comment 408

Tx Equalization
Comment 408

Cl **176D** *SC* **176D.4.3** *P* **700** *L* **40** # 408

Dawe, Piers Nvidia

Comment Type **TR** *Comment Status* **D** *Tx equalization*

In 3ck, C2M had just two modes for its "transmitter output waveform training". In this project, COM seems to think that TxFIR setting is not important, although that may be a feature of the abstract COM receiver not real receivers. It is not clear whether CR needs such careful transmitter output waveform rules, and if it does, it does not necessarily follow that C2M, with less loss, also needs them. The editor's note under the COM table says some of this.

SuggestedRemedy

Relax the transmitter output waveform limits as appropriate.
Do the same in other clauses if appropriate.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The comment does not provide sufficient justification to support the suggested remedy.
The suggested remedy does not provide sufficient detail to implement.

Editors recommendation: Reject.

AC Common Mode

Comment 399

AC Common Mode
Comment 399

Cl **176D** *SC* **176D.5.4** *P* **701** *L* **23** # 399

Dawe, Piers Nvidia

Comment Type **T** *Comment Status* **D** *AC common mode*

AC common-mode voltages are not as large as this in practice, even at 200G/lane. Notice that while the full-band VCM is lower than for host output, the low-frequency VCM is the same, which is not realistic; a module does not have the very heavy-duty power supply that a host uses.

SuggestedRemedy

Halve the LF ACCM limit for module output (Table 176E-2) because the module output is measured in the MCB which should have a clean power supply.
Also in Table 176E-3, host input ACCM tolerance.
We may need a sentence of explanation: the host must tolerate this much module-generated ACCM, as well as any that it generates itself.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.
The suggested remedy may be reasonable, but consensus is not obvious.
For CRG discussion.

Table 176D–2—Summary of module output specifications at TP4

Parameter	Reference	Value	Units
Signaling rate (range)[a]		106.25 ± 50 ppm	GBd
Differential peak-to-peak voltage (max) Output disabled Output enabled	176D.7.1	 0.03 1.2	 V V
DC common-mode voltage tolerance (range)	176D.7.1	–0.05 to 1.05	V
AC common-mode peak-to-peak voltage (max) Low-frequency, VCM_{LF} Full-band, VCM_{FB}	176D.7.1	 0.03 0.06	 V V

Editors recommendation: ACCEPT IN PRINCIPLE.
For CRG discussion.

CA Specifications

Comments 100, 101, 102

CA Specifications
Comment 100

Cl 179	*SC* 179.11	*P*372	*L*23	# 100

Ran, Adee — Cisco Systems, Inc.

Comment Type TR *Comment Status* D *CA specifications*

The four cable assembly classes are mentioned here and described as differing in only their maximum insertion loss, with reference to 179.11.2, but there is no indication of the classes there. The max Nyquist ILdd per class are listed in Table 179–13.

Also, there is nothing in this draft about cable reach. In previous standards there was some indication of the reach provided by the cable.

It would be helpful for readers to have in this subclause a table that lists the maximum reach and Nyquist ILdd for each cable assembly class. This is more important than the existing dashed list of CR1/CR2/CR4/CR8; the cable types per width are described in detail in Annex 179C and Annex 179D.

The suggested remedy is based on slide 5 in https://www.ieee802.org/3/dj/public/23_07/tracy_3dj_01a_2307.pdf with lengths interpolated between 1 m and 2 m.

SuggestedRemedy

Change the reference from 179.11.2 to Table 179-13.
In Table 179-13, create four columns for CA-A through CA-D. Move the "Insertion loss at 53.125 GHz, ILdd (max)" values to these columns.
Add a row with expected reach in meters: CA-A: 1, CA-B: 1.33, CA-C: 1.66, CA-D: 2.
Make other parameters common to all classes (straddled cells).

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

For task force discussion.

Editors recommendation: ACCEPT IN PRINCIPLE.
Implement the changes shown on this slide with editorial license.

Proposed change to 179.11

For each of the cable assembly types, four cable assembly classes are defined, labeled CA-A, CA-B, CA-C, and CA-D. The cable assembly classes differ by the maximum insertion loss (see ~~179.11.2~~ Table 178-13).

Proposed changes to Table 179-13

Table 179–13—Cable assembly characteristics summary

Description	Reference	Value	Unit
Insertion loss at 53.125 GHz, *ILdd* (max) CA-A CA-B CA-C CA-D	179.11.2	 19 24 29 34	 dB dB dB dB
Insertion loss at 53.125 GHz, *ILdd* (min)	179.11.2	16	dB
Minimum cable assembly ERL[a]	179.11.3	TBD	dB
Differential-mode to common-mode return loss, *RLcd*	179.11.4	Equation (179–20)	dB
Differential-mode to common-mode insertion loss, *ILcd*	179.11.5	Equation (179–22)	dB
Common-mode to common-mode return loss, *RLcc*	179.11.6	Equation (179–9)	dB
Minimum COM	179.11.7	3	dB

[a] Cable assemblies with a COM greater than 4 dB are not required to meet minimum ERL.

Description	Reference	Value				Unit
Cable class	179.11	CA-A	CA-B	CA-C	CA-D	
Insertion Loss at 53.125 GHz, ILdd (max)	179.11.2	19	24	29	34	dB
Insertion Loss at 53.125 GHz, ILdd (min)	179.11.2	16				dB
Expected Reach		1	1.33	1.66	2	m
Minimum cable assembly ERL	179.11.3	TBD				dB
Differential-mode to common-mode return loss, RLcd	179.11.4	Equation (179–20)				dB
Differential-mode to common-mode insertion loss, ILcd	179.11.5	Equation (179–22)				dB
Common-mode to common-mode return loss, RLcc	179.11.6	Equation (179–9)				dB
Minimum COM	179.11.7	3				dB

CA Nbx
Comment 101

Cl **179** *SC* **179.11.3** *P* **374** *L* **47** # 101

Ran, Adee Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **D** *CA specifications*

Cable assembly ERL parameters N and Nbx are TBD.
In 162.11.3 the values were 4500 and 0 respectively. In 802.3dj, the UI is halved and the maximum length is assumed to be the same (2 m for CA-D class).

SuggestedRemedy

Use N=9000 and Nbx=0.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.

Editors recommendation: ACCEPT.

CA ILcd
Comment 102

Cl **179** *SC* **179.11.5** *P* **375** *L* **15** # 102

Ran, Adee Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **D** *CA specifications*

Differential-mode to common-mode insertion loss equation is TBD. The reference in the text is to an equation in clause 162.

The parameter name in 178.10.5 was changed to "mode conversion insertion loss" to cover both ILcd and ILdc. It should be applied here too.

In 802.3ck the specification of this parameter are the same in KR (163.10.5) and CR (162.11.5). Therefore we can use the same equation and figure as in KR (178.10.5).

SuggestedRemedy

Rename the parameter to "mode conversion insertion loss" and use the same equation and figure as in 178.10.5. Implement with editorial license.
Change the reference in the text to point to the correct equation and figure.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT.

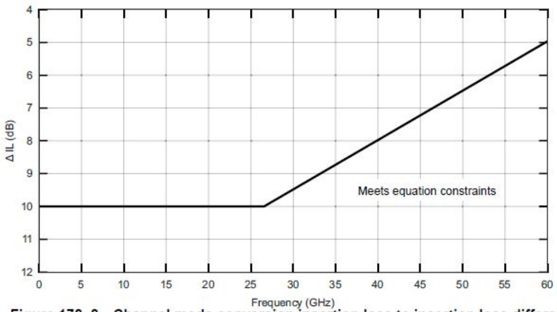


Figure 178–8—Channel mode conversion insertion loss to insertion loss difference

178.10.5 Channel mode conversion insertion loss

The difference between the TP0 to TP5 channel differential-mode to common-mode insertion loss and the TP0 to TP5 channel insertion loss shall meet Equation (178–7).

$$ILcd(f) - ILdd(f) \geq \Delta IL(f) \quad (178\text{–}7)$$

where

$ILcd(f)$	is the TP0 to TP5 channel differential-mode to common-mode insertion loss at frequency f in dB
$ILdd(f)$	is the TP0 to TP5 insertion loss at frequency f in dB
$\Delta IL(f)$	is defined by Equation (178–9) and illustrated in Figure 178–8
f	is the frequency in GHz

The difference between the TP0 to TP5 channel common-mode to differential-mode insertion loss and the TP0 to TP5 channel insertion loss shall meet Equation (178–8).

$$ILdc(f) - ILdd(f) \geq \Delta IL(f) \quad (178\text{–}8)$$

where

$ILdc(f)$	is the TP0 to TP5 channel common-mode to differential-mode insertion loss at frequency f in dB
$ILdd(f)$	is the TP0 to TP5 insertion loss at frequency f in dB
$\Delta IL(f)$	is defined by Equation (178–9) and illustrated in Figure 178–8
f	is the frequency in GHz

$$\Delta IL(f) = \begin{cases} 10 & 0.05 \leq f < 26.5625 \\ 10 - 4\dfrac{f - 26.5625}{26.5625} & 26.5625 \leq f \leq 60 \end{cases} \quad (178\text{–}9)$$

Editors recommendation: ACCEPT.

ppm (cc)
Comment 163

Cl 178 *SC* 178.1 *P*314 *L*36 # 163

Dudek, Mike Marvell

Comment Type TR *Comment Status* D *50 or 100 ppm*

The optional clause 120PMA is allowed to operate with a 100ppm clock frequency tolerance whereas the tolerance for the normative clause 176 PMA is only 50ppm.

SuggestedRemedy

Add a footnote to the clause 120PMA stating. "Usable within an extender without restriction. If used between PCSs the transmitter frequency tolerance is reduced to <=50ppm Add the same footnote to all the equivalent tables in the other clauses.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.
Implement the suggested remedy with editorial license in this table and corresponding table in all PMD clauses.

Editors recommendation: ACCEPT IN PRINCIPLE.
Implement the suggested remedy with editorial license in this table and corresponding tables in all PMD clauses.

Tables: 118-a, 118-b, 178-1, 178-2, 179-1, 179-2, 180-1, 180-2, 182-1, 182-2

Table 178–1—Physical Layer clauses associated with the 200GBASE-KR1 PMD

Associated clause	200GBASE-KR1
117—200 Gb/s RS	Required
117—200GMII[a]	Optional
118—200GMII extender	Optional
119—200GBASE-R PCS	Required
120—200GBASE-R BM-PMA	Conditional[b]
120B—200GAUI-8 C2C	Optional[c]
120D—200GAUI-4 C2C	Optional[c]
120F—200GAUI-2 C2C	Optional[c]
176—200GBASE-R SM-PMA	Required[b]
178B—ILT	Required
176C—200GAUI-1 C2C	Optional[c]
73—AN	Required
90—Time Synchronization	Optional

[a] The 200GMII is an optional interface. However, if the 200GMII is not implemented, a conforming implementation behaves functionally as though the RS and 200GMII were present.
[b] If a 200GAUI-n is implemented in a PHY, additional 200GBASE-R BM-PMA or SM-PMA sublayers are required according to the guidelines in 176B.4.1.
[c] A 200GBASE-KR1 PHY may include one instance of 200GAUI-n C2C as described in 176B.4.1.

[d] Usable within an extender without restriction. If used between PCSs the transmitter frequency tolerance is reduced to ≤ 50 ppm.

New footnote

Minimum ERL (cc)
Comments 66, 191, 361

Cl **178** *SC* **178.9.2.1.2** *P* **324** *L* **23** # 66

Ran, Adee — Cisco Systems, Inc.

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

Multiple ERL limits are TBD.

Using 802.3ck as a reference:
For KR test fixture at Tp0v, in 163.9.2.1.2 the minimum is 15 dB.
For CR transmitter at TP2, in 162.9.4 the minimum is 7.3 dB.
For CR receiver at TP3, in 162.9.5 the minimum is 7.3 dB.
For copper cables, in 162.11.2 the minimum is 8.25 dB.
For C2C at Tp0v, in 120F.3.1 dERL is -3 dB (as it is in 802.3dj Table 178–6 for KR).
For C2C channel, in 120F.4.3 the minimum is 9.7 dB.
For C2M host, in 120G.3.1 and in 120G.3.3 the minimum is 7.3 dB.
For C2M module, in 120G.3.2 and in 120G.3.4 the minimum is 8.5 dB.
For mated test fixture, in 162B.4.2 the minimum is 10.3 dB.

Unless shown otherwise, the same ERL requirements are appropriate for this project.

SuggestedRemedy

Use the values in the comment to replace the corresponding TBDs in 178, 179, 176C, 176D, and 179B.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

The comment provides suggested values for multiple TBDs in D1.2.
For CRG discussion.

Cl **178** *SC* **178.9.2.1.2** *P* **324** *L* **23** # 191

Mellitz, Richard — Samtec

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

Consider ERL of 7 dB maybe minimal, 10 dB may be marginal, 15 dB may be good, and about 20 dB may be very good. Since ERL was scaled with T_r then relative amount of reflection from the test fixture should be the same as in 803.3ck.

SuggestedRemedy

Change to:
The ERL at TP0v shall be greater than or equal to 15 dB.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

Resolve using the response to comment #66.

Cl **176C** *SC* **176C.4.3** *P* **680** *L* **24** # 361

Sakai, Toshiaki — Socionext

Comment Type **T** *Comment Status* **D** *ERL*

In "Table 176C-1 Transmitter electrical characteristics at TP0v", Difference effective return loss, dERL (min) is still TBD. In "Table 176C-3 Receiver characteristics at TP5v", the dERL value for receiver is "-3dB". In CL178 (KR), the ERL values for transmitter and receiver are the same. (-3dB)
There is no reason not to set the dERL value for tranmitter to "-3dB".

SuggestedRemedy

Change C2C tranmitter dERL value from "TBD" to "-3dB".

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE.

Resolve using the response to comment #66.

Editors recommendation: ACCEPT IN PRINCIPLE.
The comments address TBD items in D1.2.
Implement the suggested remedy.

KR recommended channel insertion loss Comment 67

Cl 178	*SC* 178.10.2	*P* 334	*L* 35	# 67

Ran, Adee — Cisco Systems, Inc.

Comment Type **TR** *Comment Status* **D** *Channel ILdd*

Channel insertion loss (recommended) is a TBD equation.
As the editor's note says, this recommendation was not included in the baseline proposal and "Contributions in this area are encouraged".

SuggestedRemedy

A contribution providing a recommendation is solicited.

Proposed Response *Response Status* **W**

PROPOSED REJECT.
The comment does not provide an actionable suggested remedy.
However, the editorial team proposes that the subclause and references be deleted, unless a specific proposal is provided.
For task force discussion.

Editors recommendation: REJECT
The comment does not provide an actionable suggested remedy.
Alternate proposal: Delete the subclause and references in absence of a specific proposal.
For CRG discussion.