Meeting 2
Comment Discussion

Matt Brown
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P802.3ck Chief Editor

C2C RX interference tolerance (11156)

Cl 120F SC 120F.3.2.3 P 209 L 9 # 11156

LI, Mike Intel

Comment Type TR *Comment Status* D

[Comment resubmitted from Draft 1.1. 120F.3.2.3, P207, L5]

Np TBD

SuggestedRemedy

Change it to 18 (length of TX pre-taps + RX DFE taps+main tap)

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

Comment proposes 18 based on span of TX + RX EQ. However, span is 3 + 1 + 6 = 10.

Possible responses:
#1 ACCEPT
#2 AIP, set Np to different value
#3 REJECT, no consensus to select a value at this time

120F.3.2.3 Receiver interference tolerance

Receiver interference tolerance is defined by the procedure in Annex 93C with the exception that transmitter equalization is configured by management (see 120D.3.2.3) to the settings that provide the lowest FEC symbol error ratio. 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 120F–4. The following additional considerations apply to the interference tolerance test.

a) 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.

b) The return loss of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the requirements of Equation (TBD).

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

d) The transmitter device package model $S^{(tp)}$ is omitted from Equation (93A–3) in the calculation of COM. The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (93A–19) uses the filter $H_r(f)$ defined by Equation (93A–46), where T_r is calculated as $T_r = 1.09 \times T_{rm} - 4.32$ ps and T_{rm} is the measured 20% to 80% transition time of the signal at TP0a. T_{rm} is measured using the method in 120E.3.1.5. T_{rm} is measured with *Local_eq_cm1* and *Local_eq_c*1 set to zero (see 120D.3.1.5).

e) For the calculation of test channel COM, the following parameters are based on values measured from the test transmitter. The parameter SNR_{TX} is set to the measured value of SNDR with Np=TBD, the parameter R_{LM} is set to the measured value of R_{LM}, and the parameters A_{DD} and σ_{RJ} are calculated from the measured values of J4u and J_{RMS} using Equation (120D–10), and Equation (120D–11), respectively.

C2C Test fixture RL (11078, 170)

Cl 120F SC 120F.3.2.3 P 208 L 53 # 170

Ran, Adee Intel

Comment Type T *Comment Status* D

Addressing TBD in test setup requirements.

"The return loss of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the
requirements of Equation (TBD)."

The test fixture can be considered as a channel that the transmitter is connected to. As such, it should meet the ERL requirements of the channel. There are no return loss requirements for a channel.

SuggestedRemedy

Change the quoted sentence to

"The effective return loss of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the
requirements of 120F.4.3."

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

Resolve using the response to comment #11078.

Cl 120F SC 120F.3.2.3 P 208 L 54 # 11078

Healey, Adam Broadcom Inc.

Comment Type T *Comment Status* D

[Comment resubmitted from Draft 1.1. 120F.3.2.3, P206, L48]

I believe the intent is for the return loss of the test setup to have "test fixture" grade performance.

SuggestedRemedy

In item b), change "Equation (TBD)" to "Equation (163-2)" (Test fixture reference return loss limit).

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

Comment #170 proposes using ERL in 120F.4.3.
Comment #11078 proposes using DRL in 163.9.1.2 (KR test fixture specification).

It seems more relevant to use the same return loss specification as specified for the KR test fixture.

For task force discussion.

Comments 170 and 11078 are proposing return loss requirements for module output (TP4) test channel.
Comment #170 proposes using ERL in 120F.4.3.
Comment #11078 proposes using DRL in 163.9.1.2 (KR test fixture specification).

120F.3.2.3 Receiver interference tolerance

Receiver interference tolerance is defined by the procedure in Annex 93C with the exception that transmitter equalization is configured by management (see 120D.3.2.3) to the settings that provide the lowest FEC symbol error ratio. 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 120F–4. The following additional considerations apply to the interference tolerance test.

a) 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.

b) The return loss of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the requirements of Equation (TBD).

120F.4.3 Channel effective return loss

ERL of the channel at TP0 and at TP5 is computed using the procedure in 93A.5 with the values in Table 120F–7. For parameters that do not appear in Table 120F–7, take values from Table 120F–6. The value of T_{fx} is 0. Channel ERL at TP0 and at TP5 shall be greater than or equal to TBD dB.

Table 120F–7—Transmitter and receiver ERL parameter values

Parameter	Symbol	Value	Units
Transition time associated with a pulse	T_r	TBD	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	2000	UI
Equalizer length associated with reflection signal	N_{bx}	TBD	UI

163.9.1.2 Transmitter test fixture

The differential return loss of the test fixture shall meet Equation (163–2).

$$RL_d(f) \geq \begin{cases} 20 - f & 0.05 \leq f \leq 5 \\ 15 & 5 < f \leq 25 \\ 22.5 - 0.3f & 25 < f \leq 53.125 \end{cases} \quad (163\text{–}2)$$

C2C TX Jitter (168)

Cl 120F SC 120F.3.1 P 205 L 29 # 168

Ran, Adee Intel

Comment Type T *Comment Status* D

Jitter specifications refer to 120D.3.1.8 which explicitly states that they hold at any equalization setting. But this is not feasible and not important.

In C162 and C163 there is a footnotw that jitter is measured in a single equalizer setting. Another comment suggests making it more explicit.

SuggestedRemedy

If my other comment does not apply here:
Add a table footnote that "J3u, JRMS, and even-odd jitter measurements are made with a single transmit equalizer setting selected to compensate for the loss of the transmitter package and TP0 to TP0a test fixture" similar to Table 163-5.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

It is not clear which comment is referenced by "another comment suggests.

Suggested response:
AIP
Implement suggested remedy.

Table 120F–1—Transmitter electrical characteristics at TP0a

Parameter	Reference	Value	Units
Signaling rate per lane (range)		53.125 ± 100 ppm	GBd
Differential peak-to-peak output voltage[a] (max)	93.8.1.3		
Transmitter disabled		35	mV
Transmitter enabled		1200	mV
Common-mode voltage[a] (max)	93.8.1.3	1.9	V
Common-mode voltage[a] (min)	93.8.1.3	0	V
AC common-mode output voltage[a] (max, RMS)	93.8.1.3	30	mV
Effective return loss (min)	120F.3.1.1	TBD	dB
Common-mode output return loss (min)	120F.3.1.2	Equation (120F–1)	dB
Output waveform[b]			
Level separation mismatch ratio R_{LM}(min)	120D.3.1.2	0.95	—
Steady state voltage v_f(max)	162.9.3.1.2	0.6	V
Steady state voltage v_f(min)	162.9.3.1.2	TBD	V
Linear fit pulse peak (min)	120D.3.1.4	TBD × v_f	V
abs. step size for all taps (min.)	136.9.3.1.4	0.005	—
abs. step size for all taps (max.)	136.9.3.1.4	0.025	—
value at min. state for c(–3) (max.)	136.9.3.1.5	–0.06	—
value at max. state for c(–2) (min.)	136.9.3.1.5	0.12	—
value at min. state for c(–1) (max.)	136.9.3.1.5	–0.34	—
value at min. state for c(1) (max.)	136.9.3.1.5	–0.1	—
Signal-to-noise-and-distortion ratio SNDR (min)	120D.3.1.6	32.5	dB
Output jitter			
J_{RMS} (max)	120D.3.1.8	0.023	UI
J4u (max)	120D.3.1.8	0.118	UI
Even-odd jitter (max)	120D.3.1.8	0.019	UI

[a]Measurement uses the method described in 93.8.1.3 with the exception that the PRBS13Q test pattern is used.
[b]The state of the transmit equalizer is controlled by management interface.

C2C RX IT RSSDFE4 (171)

Cl **120F** *SC* **120F.3.2.3** *P* **209** *L* **39** # **171**

Ran, Adee Intel

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

Addressing minimum RSS_DFE4 which is TBD.

The corresponding parameter in Table 163–8 is 0.05. This is a very mild requirement when the reference receiver in COM has large b_max. There is no reason not to use this value here too.

SuggestedRemedy

Change TBD to 0.05 twice.

Proposed Response *Response Status* **W**

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

Suggested response:
ACCEPT

Table 163–8—Receiver interference tolerance parameters

Parameter	Test 1 (low loss)			Test 2 (high loss)			Units
	Min	Max	Target	Min	Max	Target	
FEC Symbol error ratio[a]	—	10^{-3}	—	—	10^{-3}	—	—
Insertion loss at 26.5625 GHz[b]	13.5	14.5	—	27.5	28.5	—	dB
RSS_DFE4[c]	0.05	—	—	0.05	—	—	—
COM including effects of broad-band noise[d]	—	—	3	—	—	3	dB

[a] The FEC symbol error ratio is measured in step 10 of the receiver interference tolerance method defined in 93C.2
[b] Measured between TPt and TP5 (see Figure 93C–4).
[c] RSS_DFE4 is described in 93A.2.
[d] The COM value is the target for the receiver noise level calibration defined in 93C.2 step 7. The channel noise voltage applied in 93C.2 step 8 should be as close as practical to the value needed to produce the target COM. If higher amplitude values are used, this would demonstrate margin to the specification but this is not required for compliance.

Table 120F–4—Receiver interference tolerance parameters

Parameter	Test 1 (low loss)			Test 2 (high loss)			Units
	Min	Max	Target	Min	Max	Target	
FEC Symbol error ratio[a]	—	10^{-4}	—	—	10^{-4}	—	—
Insertion loss at 26.5625 GHz[b]	9.5	10.5	—	19.5	20.5	—	dB
RSS_DFE4[c]	TBD	—	—	TBD	—	—	—
COM including effects of broadband noise[d]	—	—	3	—	—	3	dB

[a] The FEC symbol error ratio is measured in step 10 of the receiver interference tolerance method defined in 93C.2
[b] Measured between TPt and TP5 (see Figure 93C–4).
[c] RSS_DFE4 is described in 93A.2.
[d] The COM value is the target for the receiver noise level calibration defined in 93C.2 step 7. The channel noise voltage applied in 93C.2 step 8 should be as close as practical to the value needed to produce the target COM. If higher amplitude values are used, this would demonstrate margin to the specification but this is not required for compliance.

KR/C2M TX vfmin, part 1 (58,59,165)

CI 163 SC 163.9.1 P 177 L 42 # 58

Mellitz, Richard Samtec

Comment Type TR *Comment Status* D *TX Vf*

Vf(min) should align with Av in COM table 163-10 since Nv=200

SuggestedRemedy

Replace 0.4 with 0.413

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

[Editor's note: Change page from 148.]

Av and Vf need to be aligned. For task force discussion whether the value should be 0.4 or 0.413.

CI 120F SC 120F.3.1 P 205 L 20 # 59

Mellitz, Richard Samtec

Comment Type TR *Comment Status* D *TX vfmin*

Vf(min) should align with Av in COM table 120F-6 since Nv=200

SuggestedRemedy

Replace TBD for Vf(min) with V(fmin)=0.413

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

Comment #59 proposes 0.413.
Comment #165 proposes 0.4.

For task force discussion.

CI 120F SC 120F.3.1 P 205 L 20 # 165

Ran, Adee Intel

Comment Type T *Comment Status* D

(cross clause)
Addressing Vf (min) in C2C which is TBD.

The minimum allowed value should be 0.4 as in C163.

C162 has a lower value 0.387, possibly due to measurement with Nv=13 in clause 136. As the measurement in C162 is done with Nv=200, it isn't clear why the value should be lower than in C163. If there is a reason, a footnote or informative NOTE would be helpful to avoid confusion.

SuggestedRemedy

Change TBD to 0.4.

Consider changing the value in Table 162–9 to 0.4, or adding a note with explanation of the different value.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

Resolve comment using the response to comment #59.

KR:
#58 change 0.4 to 0.413
CR:
#165 change 0.387 to 0.4
C2C:
#59 change TBD to 0.413
#165 change TBD to 0.4

KR/C2M TX vfmin, part 2 (58,59,165)

Table 120F–1—Transmitter electrical characteristics at TP0a

Parameter	Reference	Value	Units
Signaling rate per lane (range)		53.125 ± 100 ppm	GBd
Differential peak-to-peak output voltage[a] (max) Transmitter disabled Transmitter enabled	93.8.1.3	 35 1200	 mV mV
Common-mode voltage[a] (max)	93.8.1.3	1.9	V
Common-mode voltage[a] (min)	93.8.1.3	0	V
AC common-mode output voltage[a] (max, RMS)	93.8.1.3	30	mV
Effective return loss (min)	120F.3.1.1	TBD	dB
Common-mode output return loss (min)	120F.3.1.2	Equation (120F–1)	dB
Output waveform[b] Level separation mismatch ratio R_{LM}(min) Steady state voltage v_f(max) Steady state voltage v_f(min) Linear fit pulse peak (min) abs. step size for all taps (min.) abs. step size for all taps (max.) value at min. state for c(–3) (max.) value at max. state for c(–2) (min.) value at min. state for c(–1) (max.) value at min. state for c(1) (max.)	 120D.3.1.2 162.9.3.1.2 162.9.3.1.2 120D.3.1.4 136.9.3.1.4 136.9.3.1.4 136.9.3.1.5 136.9.3.1.5 136.9.3.1.5 136.9.3.1.5	 0.95 0.6 TBD TBD × v_f 0.005 0.025 –0.06 0.12 –0.34 –0.1	 — V V V — — — — — —

Table 163–5—Summary of transmitter specifications at TP0a

Parameter	Reference	Value	Units
Signaling rate		53.125 ± 100 ppm	GBd
Differential pk-pk voltage (max.)[a] Transmitter disabled Transmitter enabled	93.8.1.3	 30 1200	 mV mV
DC common-mode voltage (max.)[a]	93.8.1.3	1.0	V
DC common-mode voltage (min.)[a]	93.8.1.3	0.2	V
AC common-mode RMS voltage (max.)[a]	93.8.1.3	30	mV
Effective return loss (ERL) (min.)	163.9.1.1	TBD	dB
Common-mode return loss (min.)	93.8.1.4	TBD	dB
Transmitter steady-state voltage, v_f(min.) Transmitter steady-state voltage, v_f(max.)	162.9.3.1.2	0.4 0.6	V
Linear fit pulse peak (min.)	162.9.3.1.2	TBD × v_f	V
Level separation mismatch ratio R_{LM} (min.)	120D.3.1.2	0.95	—

Table 162–9—Summary of transmitter specifications at TP2

Parameter	Subclause reference	Value	Units
Signaling rate		53.125 ± 100 ppm	GBd
Differential pk-pk voltage with Tx disabled (max.)[a]	93.8.1.3	30	mV
DC common-mode voltage (max.)[a]	93.8.1.3	1.9	V
AC common-mode RMS voltage, v_{cmi} (max.)[a]	93.8.1.3	30	mV
Differential pk-pk voltage, v_{di} (max.)[a]	93.8.1.3	1200	mV
Effective return loss (ERL) (min.)	162.9.3.4	TBD	dB
Common-mode to differential mode return loss (min.)	92.8.3.3	See Equation (TBD)	dB
Common-mode to common-mode return loss (min.)	92.8.3.4	See Equation (TBD)	dB
Transmitter steady-state voltage, v_f(min.) Transmitter steady-state voltage, v_f(max.)	162.9.3.1.2	0.387 0.6	V

TX linear fit pulse, reference (166)

Cl 120F *SC* 120F.3.1 *P* 205 *L* 21 # 166

Ran, Adee Intel

Comment Type T *Comment Status* D

The reference for linear fit pulse peak is 120D.3.1.4, which uses Nv=13. This is inadequate for the higher loss in this project.

Also, 120D.3.1.4 includes control of the 3-tap equalizer, but here we have 5 taps.

SuggestedRemedy

Change reference for linear fit pulse peak to 162.9.3.1.2.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE

For task force discussion.

Suggested response:
ACCEPT

Output waveform[b]			
Level separation mismatch ratio R_{LM}(min)	120D.3.1.2	0.95	—
Steady state voltage v_f(max)	162.9.3.1.2	0.6	V
Steady state voltage v_f(min)	162.9.3.1.2	TBD	V
Linear fit pulse peak (min)	120D.3.1.4	TBD × v_f	V
abs. step size for all taps (min.)	136.9.3.1.4	0.005	—
abs. step size for all taps (max.)	136.9.3.1.4	0.025	—
value at min. state for c(–3) (max.)	136.9.3.1.5	–0.06	—
value at max. state for c(–2) (min.)	136.9.3.1.5	0.12	—
value at min. state for c(–1) (max.)	136.9.3.1.5	–0.34	—
value at min. state for c(1) (max.)	136.9.3.1.5	–0.1	—

120D.3.1.4 Steady-state voltage and linear fit pulse peak

The linear fit pulse, $p(k)$, is determined according to the linear fit procedure in 120D.3.1.3 with *Local_eq_cm1* and *Local_eq_c1* set to zero. The steady-state voltage v_f is defined to be the sum of the linear fit pulse $p(1)$ through $p(M \times N_v)$ divided by M, determined in step 3 of the linear fit procedure. Here, N_v represents the number of symbols to take into account for the steady-state voltage v_f and has a value of 13.

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. 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).

The peak value of $p(k)$ shall be greater than 0.397 × v_f after the transmit equalizer initial condition has been set to preset 1 (no equalization).

KR TX SNDR Np value (155)

Cl 163 *SC* 163.9.2.3 *P* 181 *L* 6 # 155

Ran, Adee Intel

Comment Type T *Comment Status* D *TX SNDR Parameter*

(cross-clause)
Addressing Np in SNDR calculation for receiver interference tolerance testing, which is TBD.

The corresponding test in clause 162 sets Np to 15 UI . This value may be debated, but there seems to be no reason to have a different value here.

Note that linear fit is done with Nv=200 for the vf measurement. A smaller number can create lower SNDR, by converting the tail of the pulse to noise. Using this SNDR as SNR_TX, lower SNR_TX results in lower COM, so less noise should be injected to reach the COM target. This may favor the DUT in the RITT measurement.

Also applies in 120F.3.2.3.

SuggestedRemedy

Change TBD to 15 in both places.

Proposed Response *Response Status* W

PROPOSED ACCEPT IN PRINCIPLE.

Nbx value is subject to task force discussion. It may be necessary to cover transmitter package length.

163.9.2.3 Receiver interference tolerance

Receiver interference tolerance is defined by the procedure in Annex 93C with the exception that transmitter equalization is configured by management (see 120D.3.2.3) to the settings that provide the lowest FEC symbol error ratio. 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 163–8. The following additional considerations apply to the interference tolerance test.

a) 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.

b) The return loss of the test setup in Figure 93C–4 measured at TP5 replica towards TPt meets the requirements of Equation (163–2).

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

d) The transmitter device package model $S^{(tp)}$ is omitted from Equation (93A–3) in the calculation of COM. The filtered voltage transfer function $H^{(k)}(f)$ calculated in Equation (93A–19) uses the filter $H_r(f)$ defined by Equation (93A–46), where T_r is calculated as Tr = TBD ps and T_{rm} is the measured 20% to 80% transition time of the signal at TP0a. T_{rm} is measured using the method in 120E.3.1.5. T_{rm} is measured with transmitter equalizer turned off.

e) For the calculation of test channel COM, the following parameters are based on values measured from the test transmitter. The parameter SNR_{TX} is set to the measured value of SNDR with Np = TBD, the parameter R_{LM} is set to the measured value of R_{LM}, and the parameters A_{DD} and σ_{RJ} are calculated from the measured values of J3u and J_{RMS} using Equation (163–3) and Equation (163–4) respectively, where $Q3$ is 3.2905.

f) Other COM parameters are set according to the values in Table 163–10.

Thanks