Proposal for Receiver Sensitivity (RS) Equation References in Table 140-7 and Table 151-8 (comments #77, #83)

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Background

At the January task force meeting in Geneva it was agreed to remove the equation reference entry for RS in Table 140-7 and Table 151-8, and replacing it with the minimum values and associated footnote as proposed in cole_01b_0120. This was based on Straw Poll #5:

Straw Poll#5:

I would support removing the equation reference entry for RS in Table 140-7 for 100GBASE-FR1 and 100GBASE-LR1, and in Table 151-8 for 400GBASE-FR4 and 400GBASE-LR4-6 and replacing it with the minimum value and associated footnote as proposed in cole_01b_0120.

Yes: 23 No: 0

Table 140-7 in D2.0

Table 140–7—100GBASE-DR, 100GBASE-FR1, and 100GBASE-LR1 receive characteristics

Description	~~Value~~ 100GBASE-DR	100GBASE-FR1	100GBASE-LR1	Unit
Signaling rate (range)	53.125 ± 100 ppm			GBd
Modulation format	PAM4			—
Wavelengths (range)	1304.5 to 1317.5			nm
Damage threshold[a]	5	5	5.8	dBm
Average receive power (max)	4	4	4.8	dBm
Average receive power[b] (min)	–5.9	–6.9	–8.3	dBm
Receive power (OMA_{outer}) (max)	4.2	4.2	5	dBm
Receiver reflectance (max)	–26	–26	–26	dB
Receiver sensitivity (OMA_{outer})[c] (max)	Equation (140–1)	–4.5	–6.1	dBm
Stressed receiver sensitivity (OMA_{outer})[d] (max)	–1.9	–2.5	–4.1	dBm
Conditions of stressed receiver sensitivity test:[e]				
Stressed eye closure for PAM4 (SECQ)	3.4	3.4	3.4	dB
SECQ – $10\log_{10}(C_{eq})$[f] (max)	3.4	3.4	3.4	dB

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this input power.

[b]Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

[c]Receiver sensitivity (OMA_{outer}) (max) for 100GBASE-DR is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. Receiver sensitivity (OMAouter) (max) for 100GBASE-FR1 and 100GBASE-LR1 is defined for a transmitter with a value of SECQ up to 1.4 dB, and for values of SECQ greater than 1.4 dB see Equation (140–2) and Equation (140–3), respectively.

[d]Measured with conformance test signal at TP3 (see 140.8) for the BER specified in 140.1.1.

[e]These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

[f]C_{eq} is a coefficient defined in 121.8.5.3, which accounts for the reference equalizer noise enhancement.

140.7.9 in D2.0

140.7.9 Receiver sensitivity

Change the contents of 140.7.9 and Figure 140-5 as follows:

Receiver sensitivity for 100GBASE-DR is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. Receiver sensitivity for 100GBASE-DR should meet Equation (140–1), which is illustrated in Figure 140–5.

$$RS = \max(-3.9, SECQ - 5.3) \quad \text{(dBm)} \qquad (140–1)$$

Receiver sensitivity for 100GBASE-FR1 is defined for a transmitter with a value of SECQ up to 3.4 dB. Receiver sensitivity should meet Equation (140–2), which is illustrated in Figure 140–5.

$$RS = \max(-4.5, SECQ - 5.9) \quad \text{(dBm)} \qquad (140–2)$$

Receiver sensitivity for 100GBASE-LR1 is defined for a transmitter with a value of SECQ up to 3.4 dB. Receiver sensitivity should meet Equation (140–3), which is illustrated in Figure 140–5.

$$RS = \max(-6.1, SECQ - 7.5) \quad \text{(dBm)} \qquad (140–3)$$

where

RS	is the receiver sensitivity
SECQ	is the SECQ of the transmitter used to measure the receiver sensitivity

Discussion

In hindsight this change may not have been an improvement to the draft.

For example, the values for Receiver Sensitivity (max) for 100GBASE-FR1 and 100GBASE-LR1 in Table 140-7 only apply for values of SECQ up to 1.4 dB, whereas receivers need to work with SECQ up to 3.4 dB (the full normative specification for Receiver Sensitivity).

The full normative spec is only captured in a footnote to Table 140-7, and even here only with reference to the equations in 140.7.9. In addition the text in the footnote is somewhat convoluted and confusing, and not self-consistent with the text in 140.7.9.

It would be clearer to revert back to having the equation references in Table 140-7 (with the embedded link to 140.7.9) and simplifying the footnote.

Comments #77 and #83 were submitted proposing to make this change for clauses 151 and 140 respectively.

Proposed change to Table 140-7

Table 140–7—100GBASE-DR, 100GBASE-FR1, and 100GBASE-LR1 receive characteristics

Description	~~Value~~ 100GBASE-DR	100GBASE-FR1	100GBASE-LR1	Unit
Signaling rate (range)		53.125 ± 100 ppm		GBd
Modulation format		PAM4		—
Wavelengths (range)		1304.5 to 1317.5		nm
Damage threshold[a]	5	5	5.8	dBm
Average receive power (max)	4	4	4.8	dBm
Average receive power[b] (min)	–5.9	–6.9	–8.3	dBm
Receive power (OMA_{outer}) (max)	4.2	4.2	5	dBm
Receiver reflectance (max)	–26	–26	–26	dB
Receiver sensitivity (OMA_{outer})[e] (max)	Equation (140–1)[c]	Equation (140–2)	Equation (140–3)	dBm
Stressed receiver sensitivity (OMA_{outer})[d] (max)	–1.9	–2.5	–4.1	dBm
Conditions of stressed receiver sensitivity test:[e]				
Stressed eye closure for PAM4 (SECQ)	3.4	3.4	3.4	dB
SECQ – $10\log_{10}(C_{eq})$[f] (max)	3.4	3.4	3.4	dB

[a]The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level. The receiver does not have to operate correctly at this input power.

[b]Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

[c]Receiver sensitivity (OMA_{outer}) (max) for 100GBASE-DR is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. ~~Receiver sensitivity (OMAouter) (max) for 100GBASE-FR1 and 100GBASE-LR1 is defined for a transmitter with a value of SECQ up to 1.4 dB, and for values of SECQ greater than 1.4 dB see Equation (140–2) and Equation (140–3), respectively.~~

[d]Measured with conformance test signal at TP3 (see 140.8) for the BER specified in 140.1.1.

[e]These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

[f]C_{eq} is a coefficient defined in 121.8.5.3, which accounts for the reference equalizer noise enhancement.

Proposed change to Table 151-8

Table 151–8—400GBASE-FR4 and 400GBASE-LR4-6 receive characteristics

Description	400GBASE-FR4	400GBASE-LR4-6	Unit
Signaling rate, each lane (range)	53.125 ± 100 ppm		GBd
Modulation format	PAM4		—
Lane wavelengths (range)	1264.5 to 1277.5 1284.5 to 1297.5 1304.5 to 1317.5 1324.5 to 1337.5		nm
Damage threshold[a], each lane	4.5	6.6	dBm
Average receive power, each lane (max)	3.5	5.6	dBm
Average receive power, each lane[b] (min)	–7.3	–9.1	dBm
Receive power (OMA_{outer}), each lane (max)	3.7	4.4	dBm
Difference in receive power between any two lanes (OMA_{outer}) (max)	4.1	4.3	dB
Receiver reflectance (max)	–26		dB
Receiver sensitivity (OMA_{outer}), each lane[c] (max)	Equation (151–1)	Equation (151–2)	dBm
Stressed receiver sensitivity (OMA_{outer}), each lane[d] (max)	–2.6	–4.7	dBm
Conditions of stressed receiver sensitivity test:[e]			
Stressed eye closure for PAM4 (SECQ), lane under test	3.4	3.5	dB
SECQ – $10\log_{10}(C_{eq})$, lane under test (max)	3.4	3.5	dB
OMA_{outer} of each aggressor lane	1.5	–0.4	dBm

[a] The receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

[b] Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

[c] ~~Receiver sensitivity (OMAouter), each lane (max) is defined for a transmitter with a value of SECQ up to 1.4 dB. For values of SECQ greater than 1.4 dB, see Equation (151–1) and Equation (151–2) for 400GBASE-FR4 and 400GBASE-LR4-6, respectively.~~

[d] Measured with conformance test signal at TP3 (see 151.8.11) for the BER specified in 151.1.1.

[e] These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Updated response to comment #85

PROPOSED ACCEPT IN PRINCIPLE.

Implement the changes to Table 140-7 and associated footnote from slide 6 of nicholl_3cu_02_040720 with editorial license.

Updated response to comment #77

PROPOSED ACCEPT IN PRINCIPLE.

Implement the changes to Table 151-8 and associated footnote from slide 7 of nicholl_3cu_02_040720 with editorial license.

Thanks !