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25 Gbd Stressed RX Sensitivity specs and methodology for 802.3ca

- background on Cmt. 418 SRS proposal

Rev. 1a

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D2.0 - Comment #418

SC 141.5.2

Submitter Comment:

If these PMDs use FEC, probably the stressed receive signal should be defined by SEC, J2 and J4, as 25GBASE-SR, LR and ER, rather than VECP, J2 and J9 as 40GBASE-SR4.

Submitter Suggested Remedy:

But as the pre-BER is $1e-2$, even J4 is wrong. Maybe Jrms and J3 would be suitable. SEC can easily be defined for a BER of $1e-2$.

From private discussion with Steve Trowbridge

(Difference between SRS based on 100GBASE-LR/ER vs. 25GBASE-SR/LR/ER)

- The methodology is different. The original 100GBASE-LR/ER were without FEC, so had 10-12 BER straight up and used more of a traditional eye mask. The 25GBASE-LR/ER were assuming RS(528,514) FEC, so something like $1e-5$ BER pre-FEC decoder, and used a more statistical method.
- I think it was based on a TDP parameter rather than an eye mask, but I don't remember the details from the top of my head

100GBASE-SR4 Stressed Receiver Sensitivity (SRS)

(Four 25.73125 Gbd lanes)

95.8.8 Stressed receiver sensitivity

Stressed receiver sensitivity shall be within the limits given in Table 95-7 if measured using the method defined by 95.8.8.1 and 95.8.8.5, with the conformance test signal at TP3 as described in 95.8.8.2.

Stressed receiver sensitivity is defined with all transmit and receive lanes in operation. Pattern 3 or Pattern 5, or a valid 100GBASE-SR4 signal is sent from the transmit section of the PMD under test. The signal being transmitted is asynchronous to the received signal. The interface BER of the PMD receiver is the average of the BER of all receive lanes while stressed and at the specified receive OMA.

Table 95-7—100GBASE-SR4 receive characteristics (continued)

Description	Value	Unit
Stressed eye closure (SEC), lane under test	4.3	dB
Stressed eye J2 Jitter lane under test	0.39	UI
Stressed eye J4 Jitter lane under test (max)	0.53	UI
OMA of each aggressor lane	3	dBm
Stressed receiver eye mask definition {X1, X2, X3, Y1, Y2, Y3} Hit ratio 5×10^{-5} hits per sample	{0.28, 0.5, 0.5, 0.33, 0.33, 0.4}	

^aThe receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level on one lane. The receiver does not have to operate correctly at this input power.

^bAverage 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.

^cMeasured with conformance test signal at TP3 (see 95.8.8) for the BER specified in 95.1.1.

^dThese test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

141.7.11 Stressed receiver conformance test

Compliance with stressed receiver sensitivity is mandatory for PMDs listed in Table 141-7. The stressed receiver conformance test is intended to screen against receivers with poor frequency response or timing characteristics that could cause errors when combined with a distorted but compliant signal. To be compliant with stressed receiver sensitivity, the receiver shall meet the specified bit error ratio at the power level and signal quality defined in Table 141-15, Table 141-16, Table 141-19, or Table 141-20 as appropriate, according to the measurement procedures of 52.9.9 for 10 Gb/s PHYs and 88.8.10 for 25 Gb/s PHYs.

Comment 418 D2.0 clause reference

CL 141.5.2 - Receiver specifications

Conditions of stressed receiver sensitivity test			
Vertical eye closure penalty, ^f each channel	2	See Table 75-6 ^a	dB
Stressed eye J2 Jitter, ^e each channel	0.3		UI
Stressed eye J9 Jitter, ^e each channel	0.47		UI

^aIndividual 10G-EPON PMD parameters are reused without change at a higher pre-FEC bit error ratio shown in Table 141-15.

^bThe BER of 10^{-12} is achieved by the utilization of FEC as described in 142.2.4.1.

^cThe receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

^dReceiver sensitivity (OMA), each channel (max) is informative and is defined for a transmitter with VECP = 0.5 dB. For reference, this implies that the maximum average power unstressed receiver sensitivity measured with an ideal transmitter signal at minimum extinction ratio is -22 dBm. This value is informative only.

^eMeasured with conformance test signal at TP3 (see 141.7.11) for BER = 10^{-2} .

^fVertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J9 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

From 802.3ca D2.0, Table 141-15

25GBASE-SR/LR/ER SRS

SRS based on VECP, J2, J4, and SRS eye mask

Tamura Slide 3

Receiver Characteristics TBD's

Table 200-7—25GBASE-LR and 25GBASE-ER receive characteristics

Description	25GBASE-LR	25GBASE-ER	Unit
Signaling rate (range)	25.78125 ± 100 ppm		GBd
Center wavelength (range)	1295 to 1325		nm
Damage threshold ^a (min)	5.5	TBD	dBm
Average receive power (max)	2	-5	dBm
Average receive power ^b (min)	-12.8	-16	dBm
Receive power (OMA) (max)	3	-5	dBm
Receiver reflectance (max)	-26		dB
Receiver sensitivity (OMA) ^c (max)	-11.3	-17.6	dBm
Stressed receiver sensitivity (OMA) ^d (max)	TBD	TBD	dBm
Conditions of stressed receiver sensitivity test			
Vertical eye closure penalty ^e	TBD	TBD	dB
Stressed eye J2 Jitter ^f	TBD	TBD	UI
Stressed eye J4 Jitter ^f	TBD	TBD	UI
SRS eye mask definition {X1, X2, X3, Y1, Y2, Y3}	TBD	TBD	

^aThe receiver shall be able to tolerate, without damage, continuous exposure to an optical input signal having this average power level.

^bAverage 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.

^cReceiver sensitivity (OMA) (max) is informative.

^dMeasured with conformance test signal at TP3 (see 200.7.10) for the BER specified in 200.1.1

^eVertical eye closure penalty, stressed eye J2 Jitter, and stressed eye J4 Jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

Existing SRS Comparisons

Existing SRS Specifications

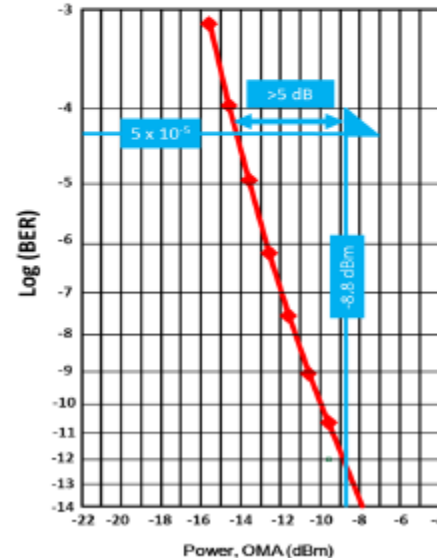
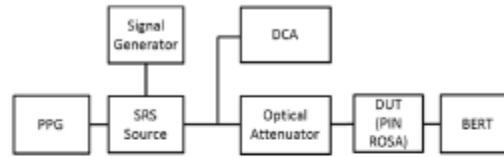
From Tamura, Slide 4

	Units	Proposed						
		100GBASE-LR4	100GBASE-ER4	PSM4	CWDM4	25GBASE-LR	25GBASE-ER	25GBASE-SR
Receiver Sensitivity	dBm	-8.6	-21.4	-11.35	-10	-11.3	-17.6	-
Stressed Receiver Sensitivity	dBm	-6.8	-17.9	-8.8	-7.3	-8.8	TBD	-5.2
Vertical Eye Closure Penalty	dB	1.8	3.5	1.9	1.9	1.9	TBD	-
Stressed Eye Closure	dB	-	-	-	-	-	-	4.3
J2 Jitter	UI	0.3		0.27	0.33	0.27	TBD	0.39
J4 Jitter	UI	-	-	0.39	0.48	0.39	TBD	0.53
J9 Jitter	UI	0.47		-	-	-	-	-
SRS Eye Mask Definition	{X1, X2, X3, Y1, Y2, Y3}	-	-	{0.24, 0.5, 0.5, 0.24, 0.24, 0.4}	{0.39, 0.5, 0.5, 0.39, 0.39, 0.4}	{0.24, 0.5, 0.5, 0.24, 0.24, 0.4}		{0.28, 0.5, 0.5, 0.33, 0.33, 0.4}
Pattern	-	PRBS31 or Scrambled Idle		PRBS31	PRBS31 or RS-FEC Encoded Scramble	PRBS31 or RS-FEC Encoded Scramble		PRBS31 or RS-FEC Encoded Scramble
BER	-	10 ⁻¹²		5 x 10 ⁻⁵	5 x 10 ⁻⁵	5 x 10 ⁻⁵		5 x 10 ⁻⁵

SRS Comparisons

- From Tamura - Slide 5
- It appears that 25GBASE-SR/LR/ER were aiming at a breakout matching specification
- This study asserts that VECP, J2, & J9 methodology of SRS are more severe than any of the specs on the previous slide, which includes all of the 25GBASE-SR/ER/LR applications

SRS BER Measurement



Test Conditions:

Rx type:	PIN PD (TO-CAN)
Bit rate:	25.78125 Gbps
Wavelength:	~1300 nm
Extinction ratio:	5.4 dB
Temperature:	70 degC
VECP:	1.95 dB
J2:	0.39 UI
J9:	0.85 UI
J4 (calc):	0.56 UI

1. SRS test conditions (VECP, J2, J9) are more severe than any of the specifications on previous slide.
2. Even so, margin > 5 dB obtained.
3. Any of the specs on previous page can be applied → match PSM4 for interoperability with breakout application.

P802.3cc TF, IEEE 802.3 Interim, Ft. Worth, TX Sept. 2016

Summary and Recommendation

- 802.3ca has no 25Gbd breakout matching requirement
- From Tamura, it appears that our current .3ca method of SRS measurement based on 100GBASE-LR/ER SRS is more severe than SRS based on 25GBASE-SR/LR/ER
- Changing stressed receiver sensitivity methodologies at this point could require a substantial amount of work and potential new measurements (new eye masks & J4 measurements)
- It's recommended that we retain our current D2.0 VECP, J2, J9 stressed receiver sensitivity methodology and specification



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