LUMENTUM

Extending wavelength for –VR PMD - in support of D1.1 comments 13, 14, 15, 16, and 17

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[Updates from lewis_3db_01_070121 highlighted in red]

IEEE 802.3db 100 Gb/s, 200 Gb/s, and 400 Gb/s Short Reach Fiber Task Force
July 19, 2021

Summary

- 802.3db_D1p1 has TBDs for the wavelength ranges of 100GBASE-VR, 200GBASE-VR2, and 400GBASE-VR4
  - A previous contribution, lewis_3db_01_041521 provided data on reliability testing and RIN testing for 100 Gb/s 940 nm VCSELs
  - This contribution provides additional test data on prototype 940 nm VCSELs, including S21 measurements and PAM4 optical eye diagrams

- Based on these results, the TBD for wavelength should be replaced by a range from 844 to 948 nm, enabling –VR links to deploy any center wavelength between 850 and 940 nm, with tolerance at both ends of the range.

- The prior presentation lewis_3db_01_070121 is updated here in response to Q&A at the last meeting.

~~Scope~~ Fiber bandwidth for TDECQ test needs to vary with wavelength

- Effective fiber bandwidth (-3 dBo) for 30 m OM3 and 50 m OM4 or OM5

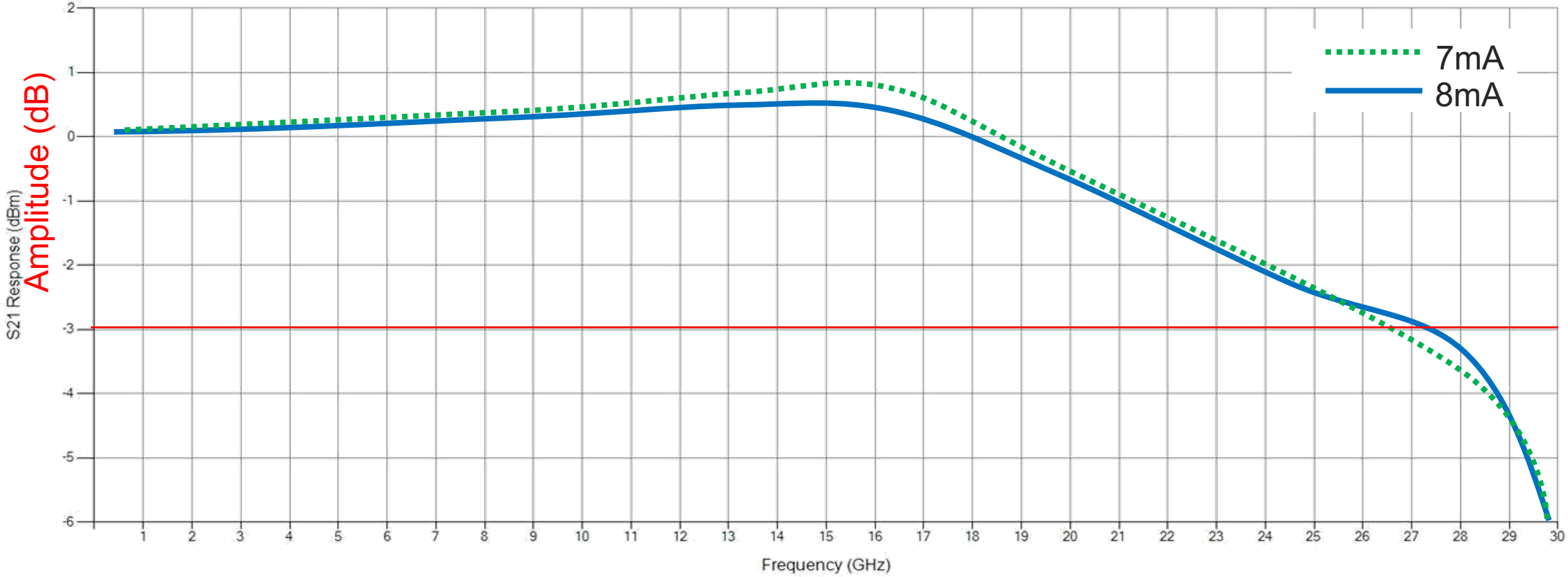
Wavelength	Spectral width	Fiber EMB			Fiber BWcd		Fiber BWeff			~~Bwtest~~
nm	nm	OM3_30m	OM4_50m	OM5_50m	OM3_30m	OM4/5_50m	OM3_30m	OM4_50m	OM5_50m	~~OM4_50m~~
844	0.65	63.2	76.8	76.8	94.8	56.9	52.6	45.7	45.7	~~23.0~~
863	0.65	59.3	72.9	87.1	103.2	61.9	51.4	47.2	50.4	~~23.1~~
932	0.65	37.5	33.0	50.2	141.0	84.6	36.2	30.7	43.2	~~20.1~~
948	0.65	35.0	29.8	49.8	151.8	91.1	34.1	28.3	43.7	~~19.4~~

Ref: IEC60793-2-10 for EMB and worst-case chromatic dispersion
king_3cm_adhoc_01_062818 for Fiber BWeff calculation

- The effect of fiber bandwidth versus wavelength can be reflected in the TDECQ test script by applying a fiber emulation function that is wavelength dependent
- This requirement is similar to SMF PMDs which require TDECQ test with the worst-case dispersion at the wavelength under test

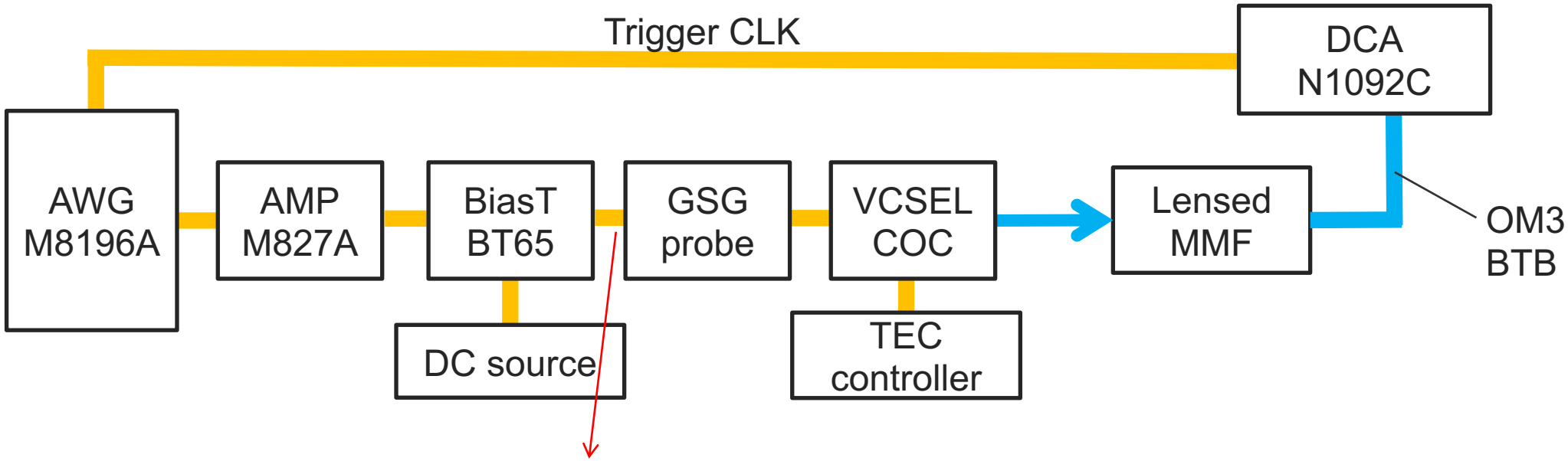
S21 measurements (smoothed)

On-wafer modulation bandwidth test using network analyzer, bias-tee, and high-speed photo detector

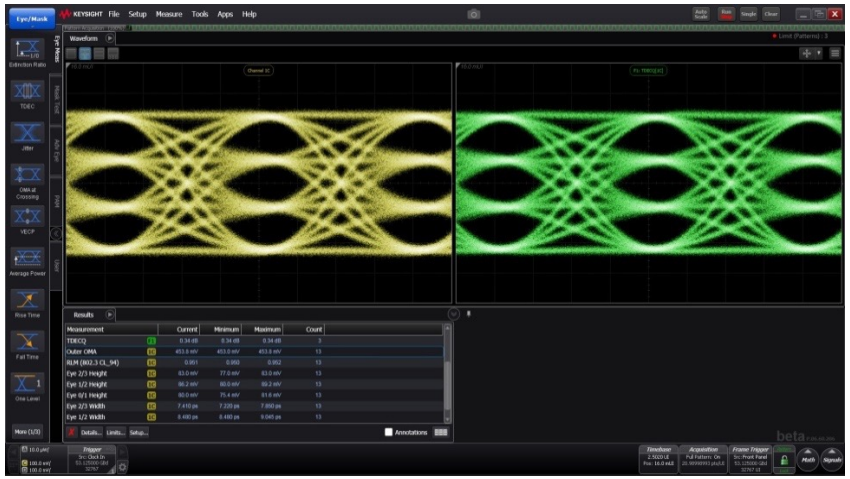


	7 mA	8 mA
Resonance Peak:	0.8132 dB	0.4196 dB
Bandwidth:	25.288 GHz	25.737 GHz

Setup for Eye/RIN-OMA Measurement



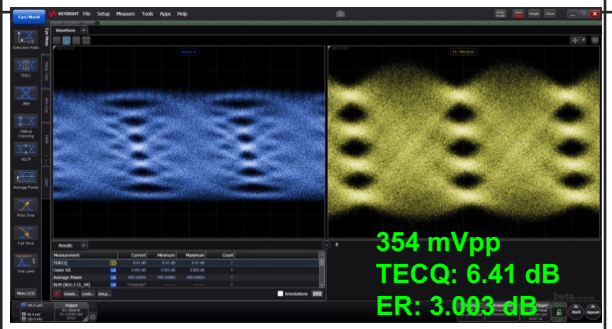
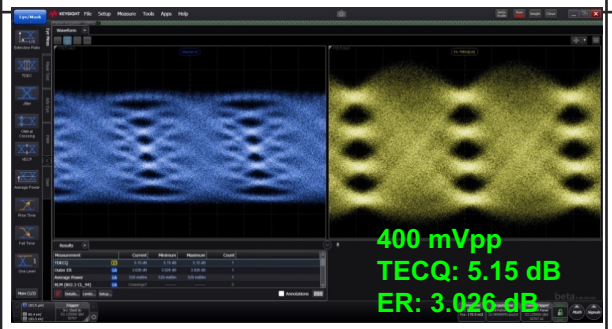
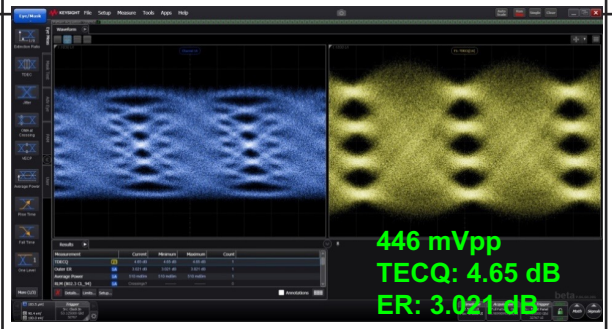
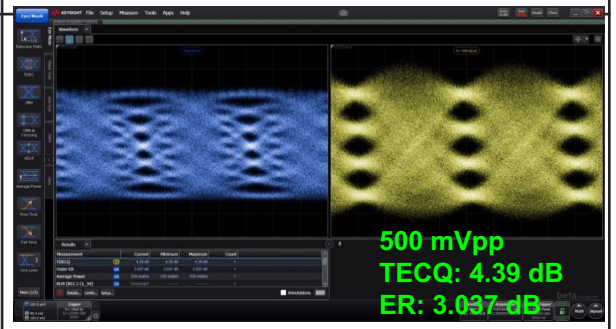
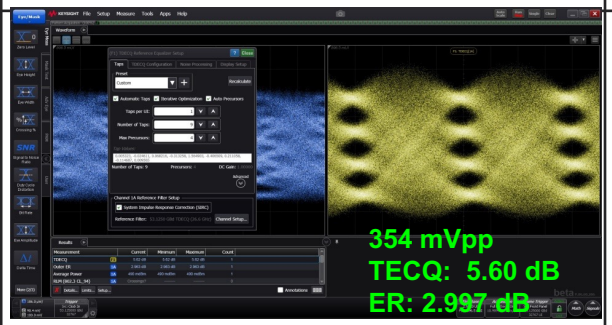
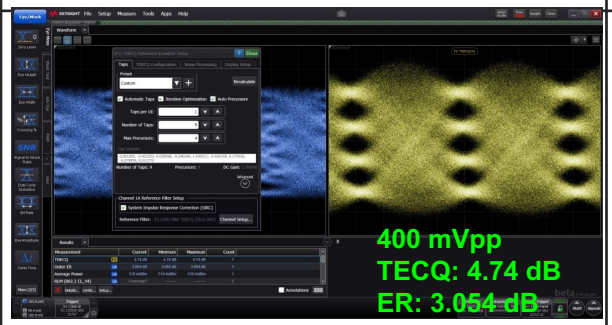
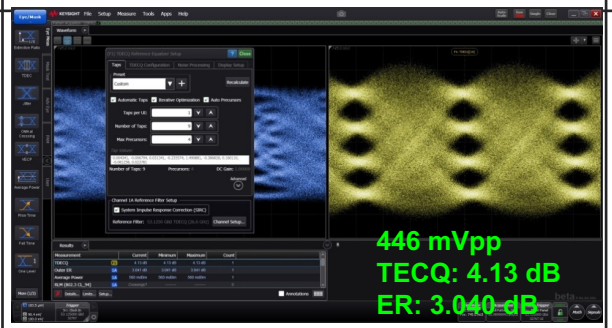
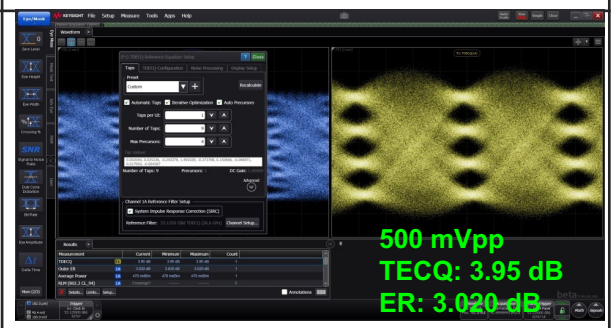
53.125-Gbd Electrical Eye Waveform



- *Electrical eye is not pre-emphasized*
- *Scope image includes equalized eye (in green)*

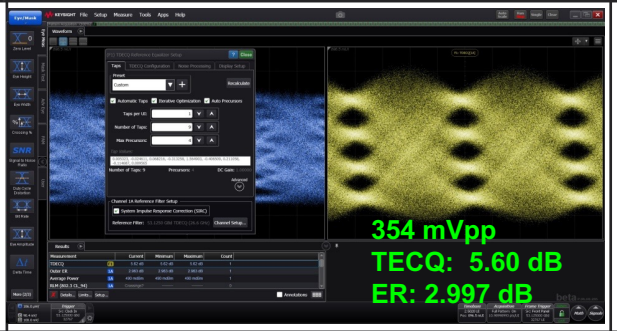
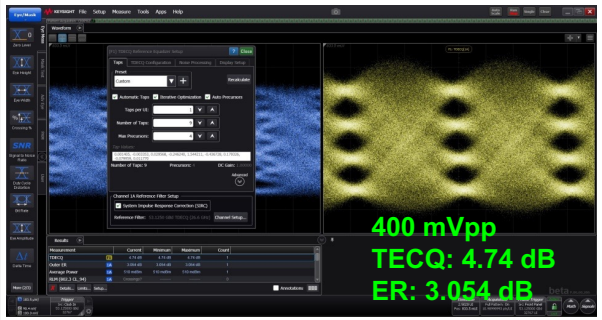
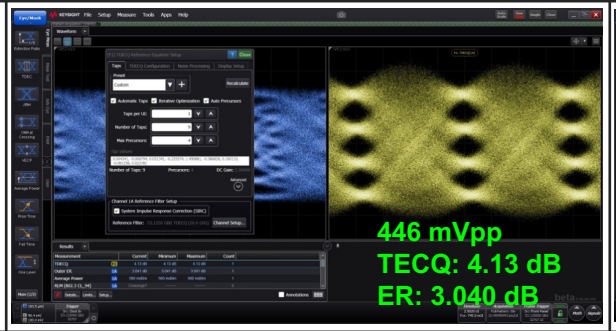
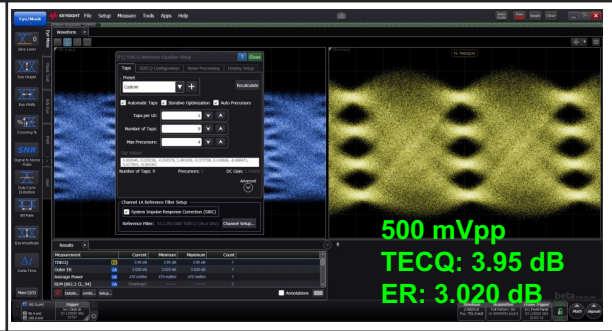
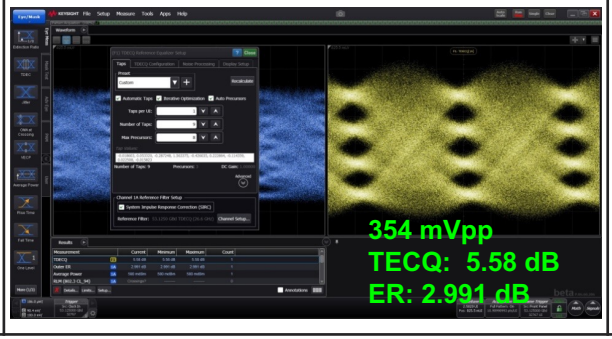
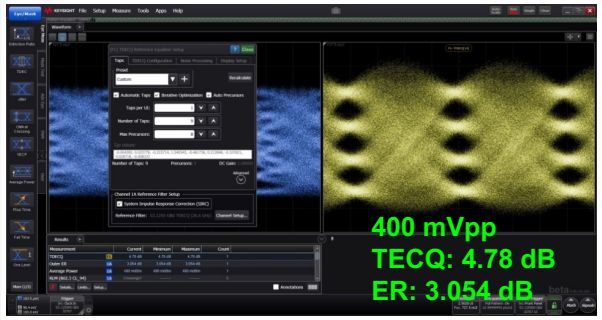
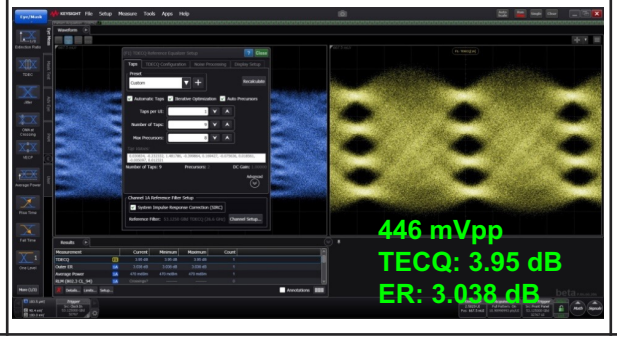
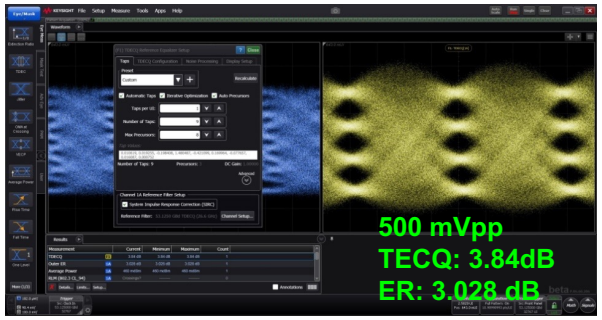
53.125-Gbd (**PRBS15**) Optical Eye Waveforms

- Tried 9-tap with the constraint that the largest tap is either 1,2,3,4 or 5.
- TECQ was improved by around 0.5 dB with 9-tap compared to 5-tap. [Version _01 incorrectly used TDECQ]

	Receiver filter = 26.6 GHz			
	20C			
	7 mA	8 mA	9 mA	10 mA
5tap				
9tap				

53.125-Gbd (**PRBS15**) Optical Eye Waveforms (cont'd)

- Compared 9-tap with and w/o the constraint.
- TECQ is almost the same with and w/o the constraint.

	Receiver filter = 26.6 GHz 20C			
	7 mA	8 mA	9 mA	10 mA
9tap				
9tap w/o cons traint				

Published report on wideband receivers (850 to 1080 nm) for SWDM

JOURNAL OF LIGHTWAVE TECHNOLOGY, VOL. 35, NO. 15, AUGUST 1, 2017 3149

SWDM PAM4 Transmission From 850 to 1066 nm Over NG-WBMMF Using 100G PAM4 IC Chipset With Real-Time DSP

Yi Sun, *Senior Member, IEEE*, Robert Lingle, Frank Chang, *Senior Member, IEEE*, Alan H. McCurdy, *Member, IEEE*, Kasyapa Balemarthy, Roman Shubochkin, Hideyuki Nasu, *Senior Member, IEEE*, Timo Gray, Kristine Scott, Wenjuan Fan, David Braganza, *Senior Member, IEEE*, John Kamino, Tomofumi Kise, Jim A. Tatum, and Sudeep Bhoja

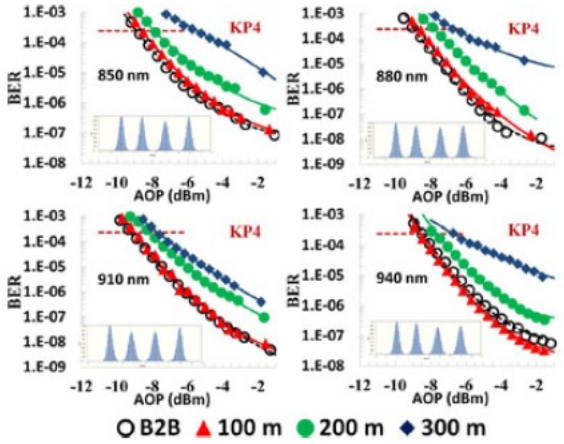


Fig. 4. BER waterfall curves of PAM4 transmission over NG-WBMMF at 100, 200, and 300 m with TOSAs wavelength of (a) 850, (b) 880, (c) 910, and (d) 940 nm. The inset in each sub-plot is the DSP recovered PAM4 histogram for the 300 m NG-WBMMF link.

- Reported results at 53G PAM4 with wideband ROSA operating from 850 to 1080 nm
  - BER sensitivity at KP4 pre-FEC threshold is similar for 850, 880, 910 and 940 nm
- ROSAs designed for 25 Gbps NRZ operation with responsivities of 0.65, 0.71, 0.65, 0.60, 0.60 and 0.49 A/W at 853, 881, 912, 942, 976 and 1066 nm, respectively.

Conclusions

- Preliminary test data on 940 nm 53 GBd VCSEL is encouraging
- Further work to improve performance is in progress
- Recommend that the 802.3db task force accept the suggested remedies in comments 13, 14, 15, 16, 17 with the caveat that effective fiber bandwidth changes with wavelength need to be included in the TDECQ test method

Thank you