Test Validation of 800G-LR4 Transceivers

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Introduction

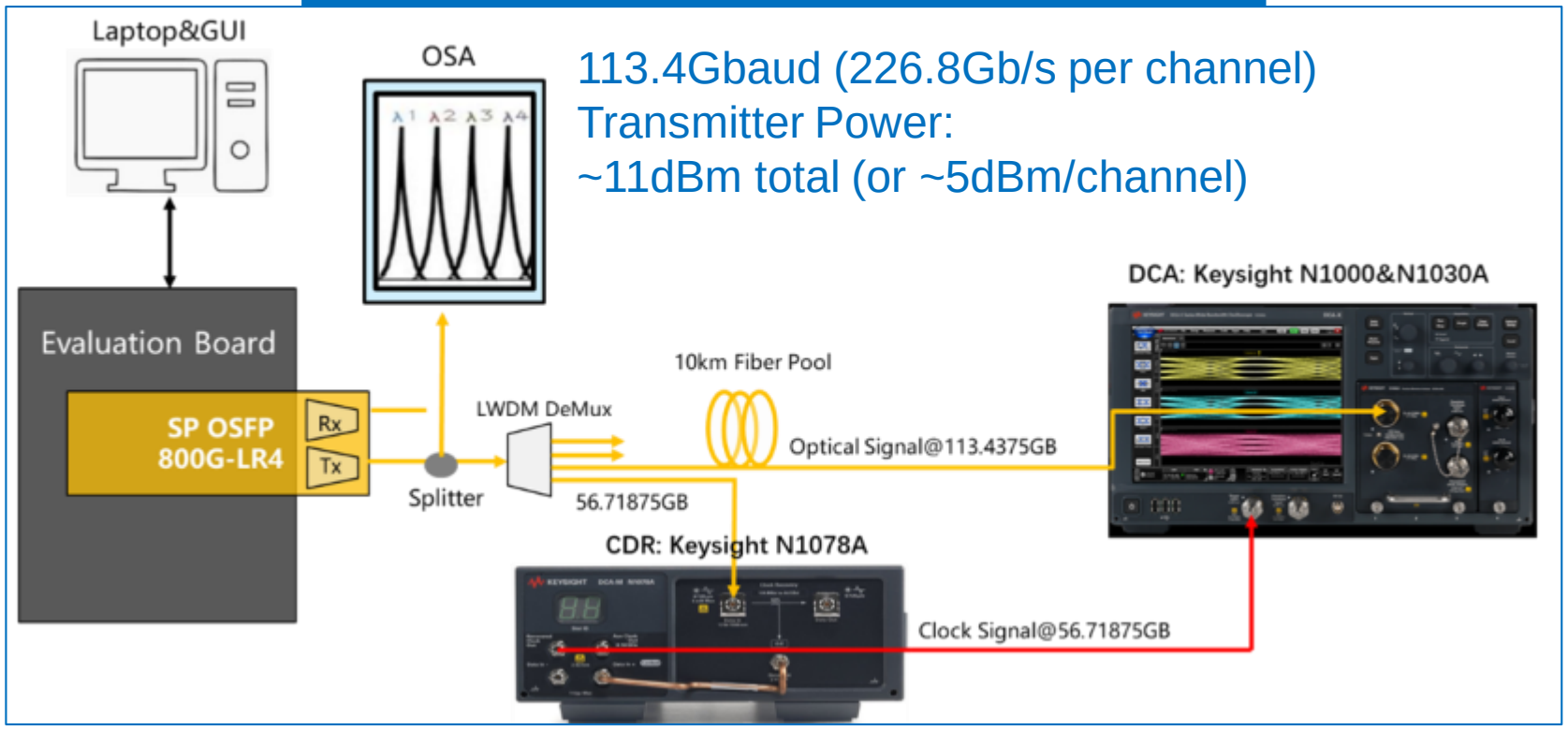
- In the announcement of the Oct/Nov P802.3dj joint Optics & Logic ad hoc meetings, the following topics are anticipated
  - FEC Modes discussion
  - Optical baseline updates incl test validation data
  - Coherent ER1 baseline proposal(s)

- Here, we show the first set of test validation data for 800G-LR4 based on real pluggable modules using EML's in terms of TECQ and TDECQ with differential group delay (DGD) etc. (*Note that this presentation is only about the LR4 transmitter performance, not yet the receiver performance.)*

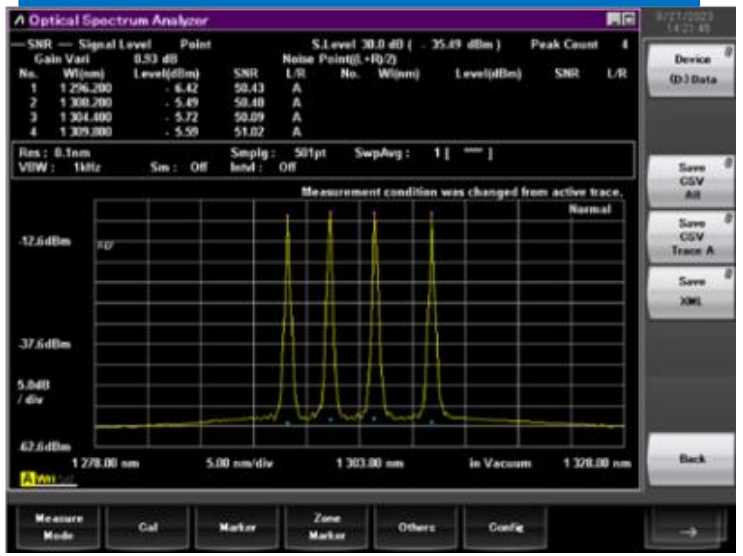
- The test results validate the DGD tolerance reported in kuschnerov_3dj_optx_01_230829, and support the 800G-LR4 baseline described in rodes_3dj_01_2309.

800G-LR4 OSFP Transceivers at ECOC 2023

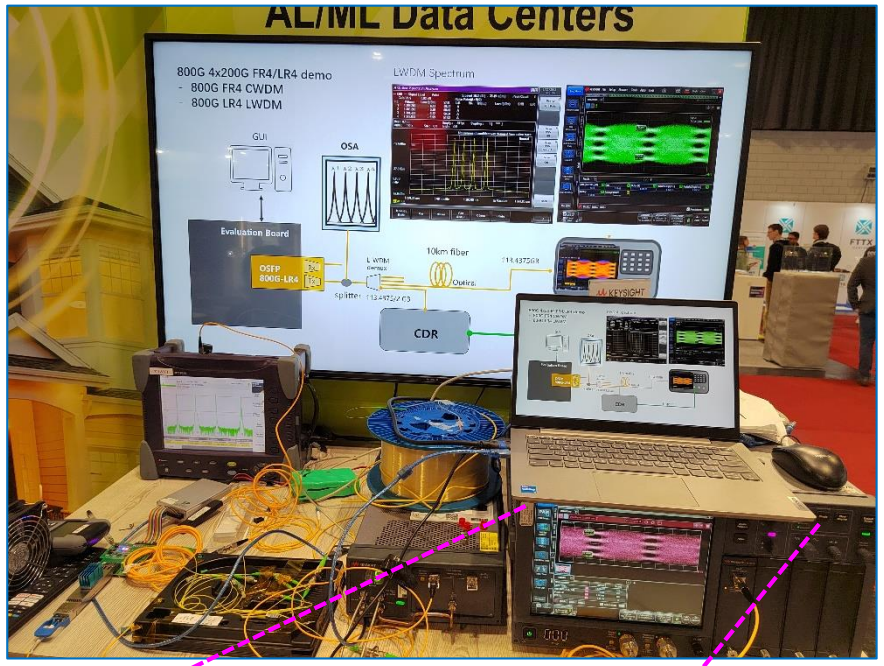
800G-LR4 OSFP on-site demo test platform



800G-LR4 Optical Spectrum



800G-LR4 Test Setup at ECOC 2023



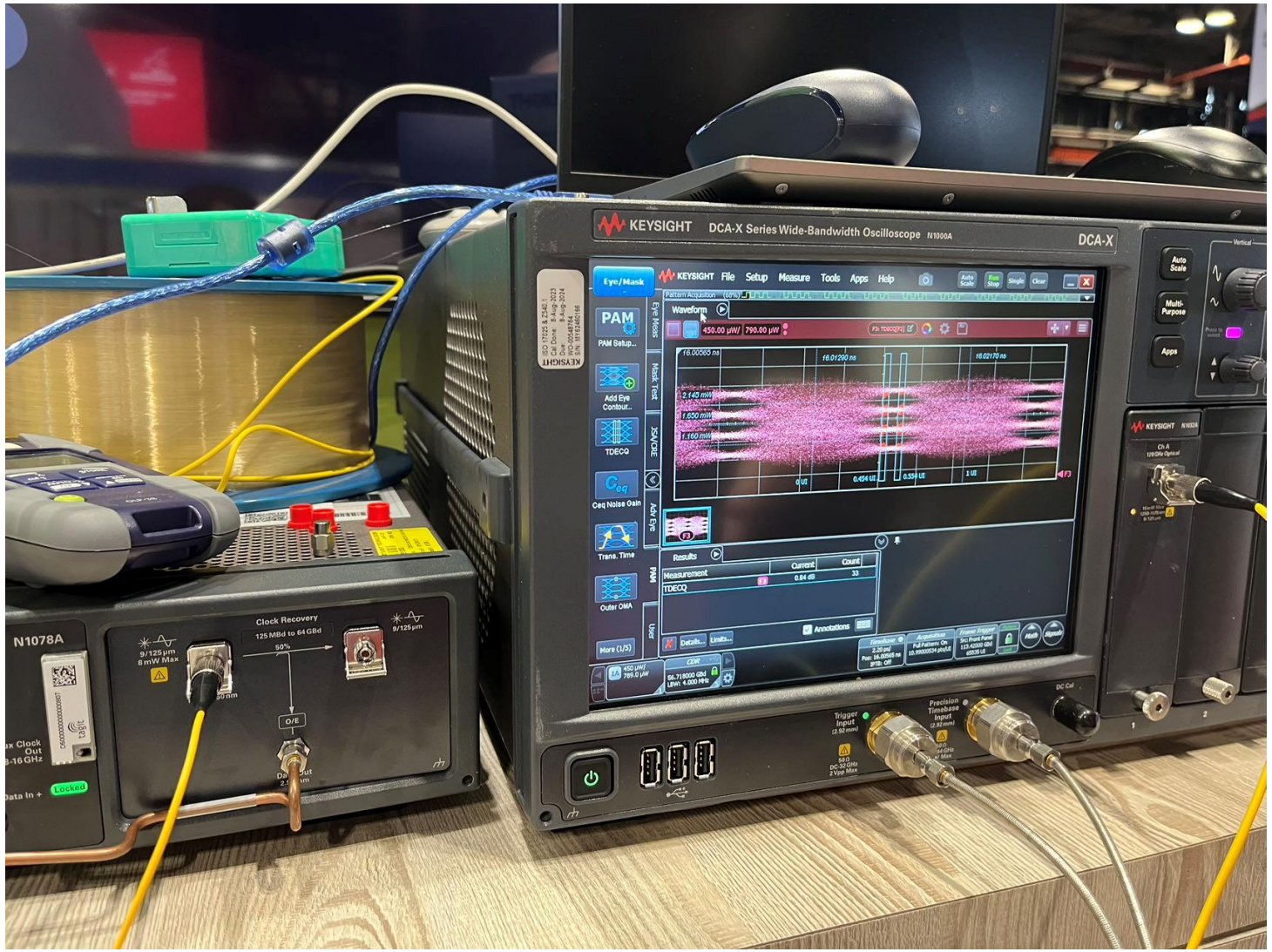
ECOC Live Demo (L3)

Pattern: SSPRQ

TDECQ = 0.84dB

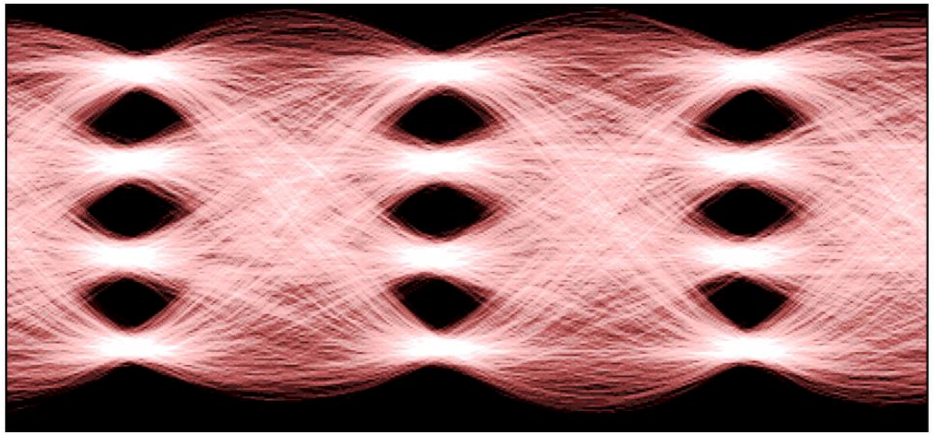
FFE: 11 taps

SER: 9.7E-3

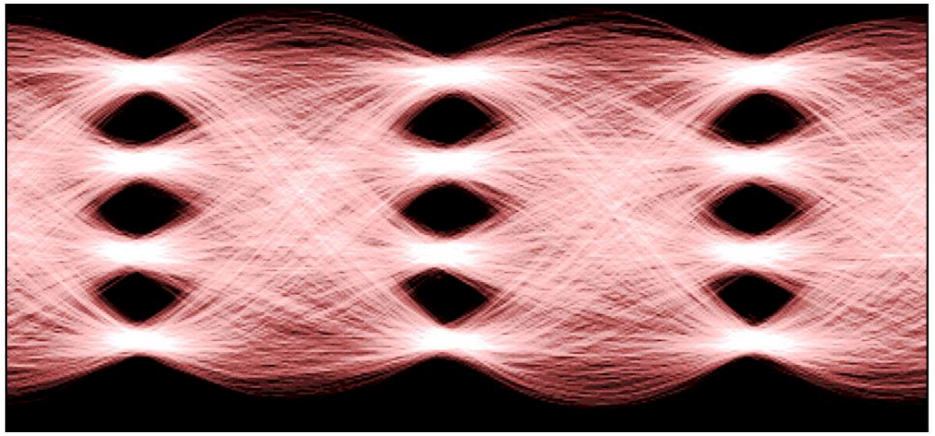


800G-LR4 Eye Diagrams at Different DGD's

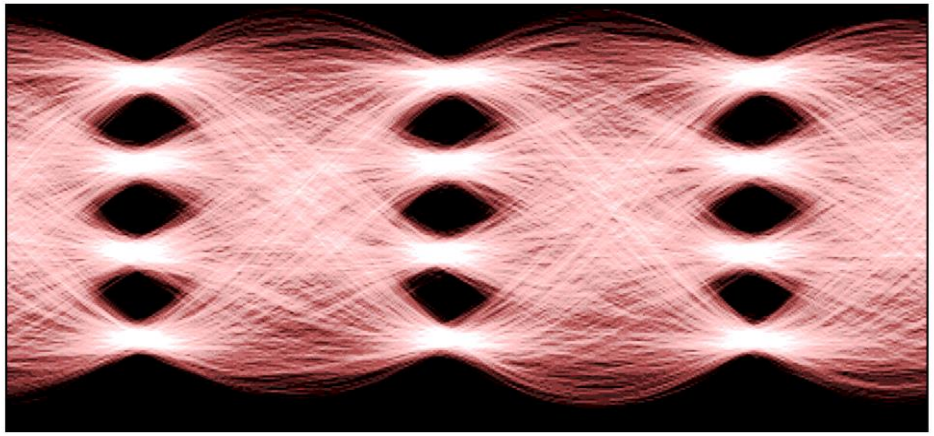
DGD=0 ps



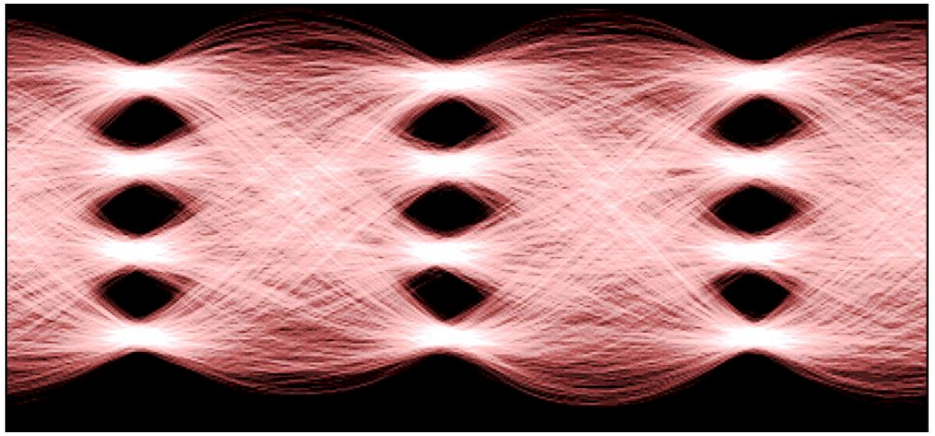
DGD=3 ps



DGD=4 ps



DGD=5 ps

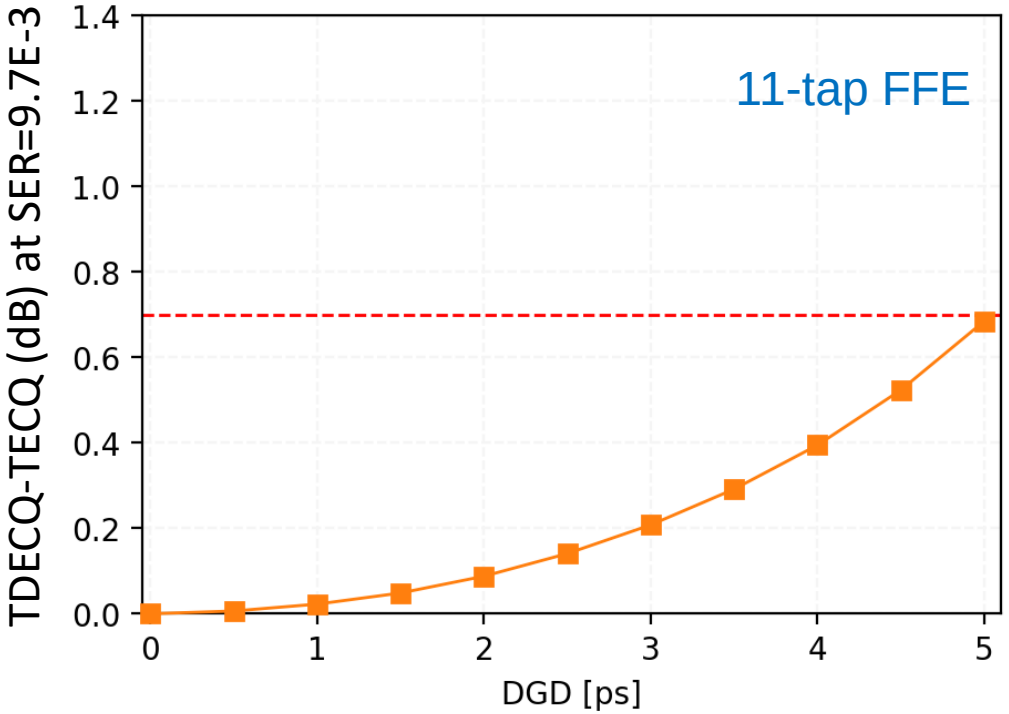


Pattern used: SSPRQ (Short Stress Pattern Random Quaternary) with 65535 symbols.

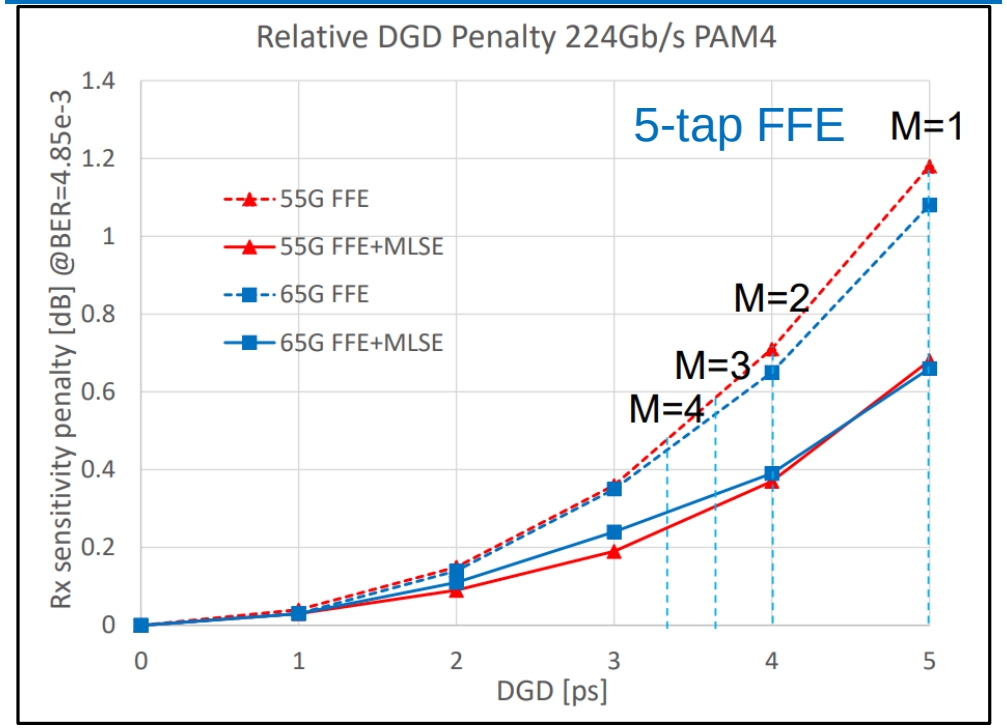
Note: As the DGD-induced ISI is due to the addition of the original signal power waveform and its delayed copy, we performed the PMD emulation in the digital domain on the measured signal power waveform, followed by a 11-tap FFE.

800G-LR4 “TDECQ-TECQ” as a Function of DGD

Measured with the 800G-LR4 pluggable

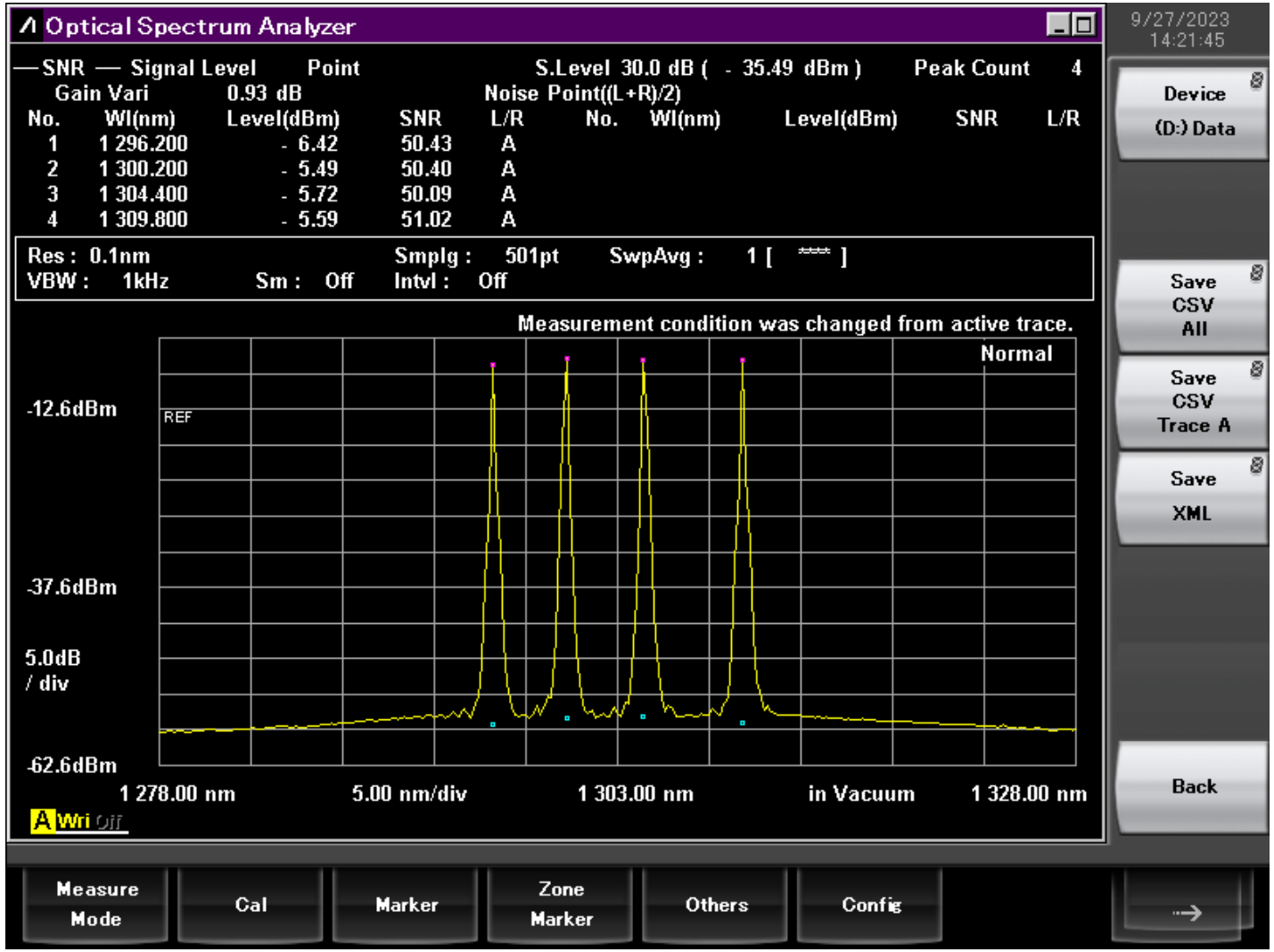


Previous results (kuschnerov_3dj_optx_01_230829)



✓ The test results validate the DGD tolerance reported in kuschnerov_3dj_optx_01_230829.

800G LR4 LWDM Spectrum



800G OSFP LR4 B2B Typical Performance

L1

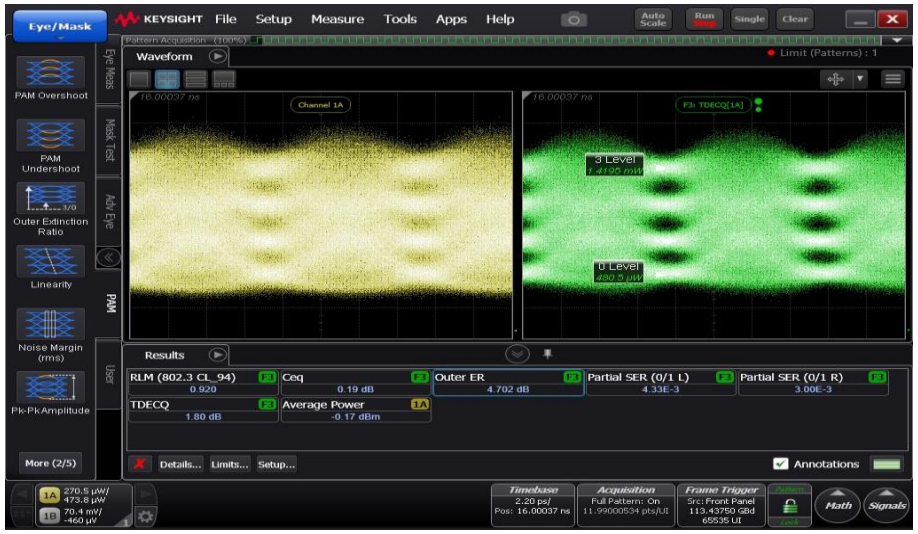
L2

L3

L4

800G OSFP LR4 10km Typical Performance

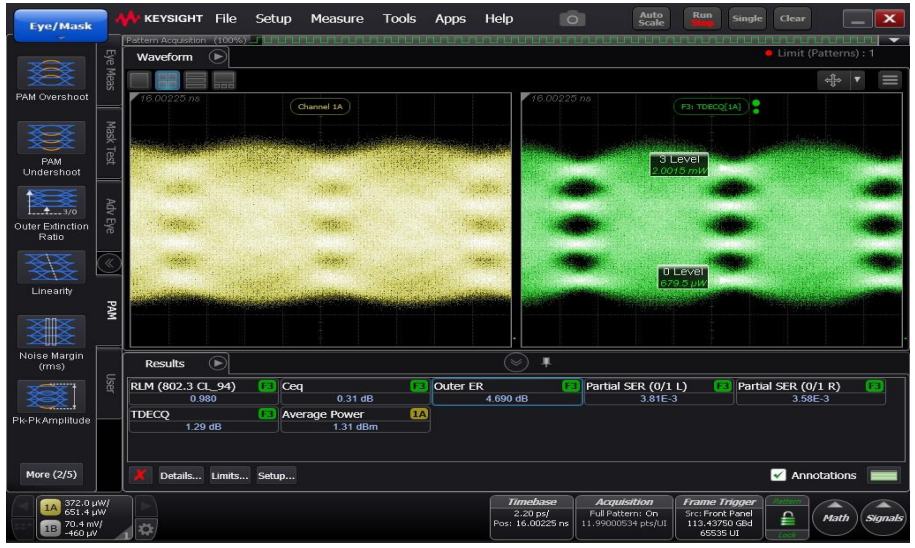
L1



L2

L3

L4



800G OSFP LR4 B2B vs 10km Typical Performance

At BTB

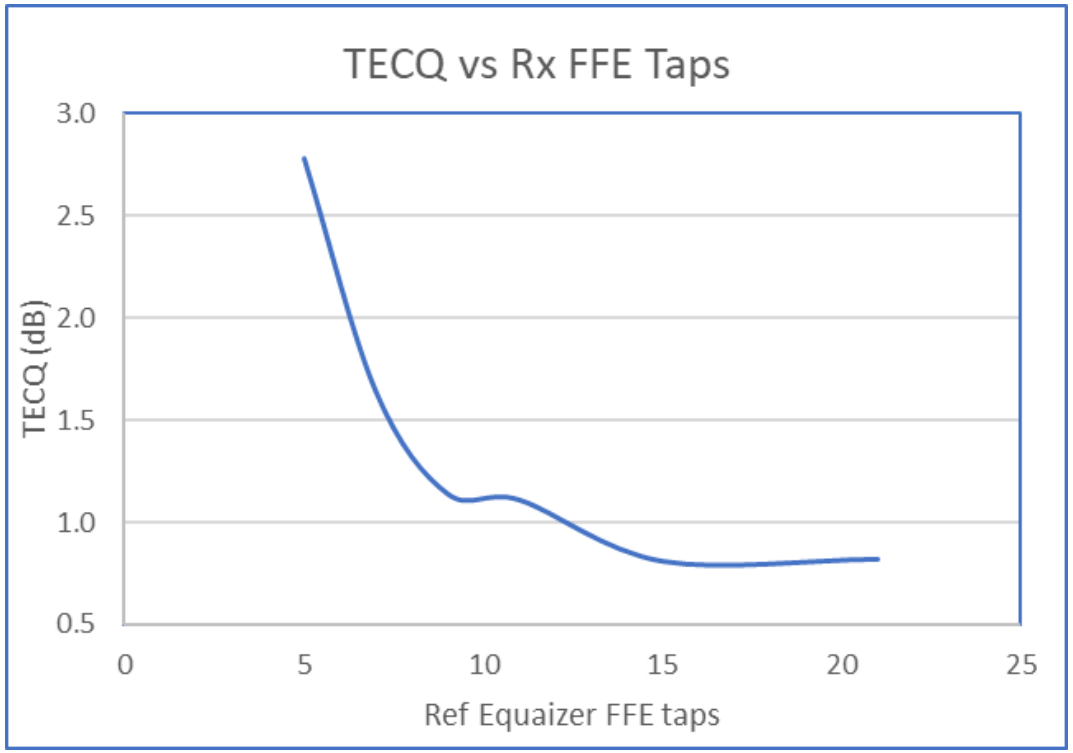
Lane	Wavelength (nm)	TDECQ (dB)	Ceq (dB)	ER (dB)	RLM
L1	1296	1.49	0.36	4.632	0.946
L2	1300	1.21	0.28	4.299	0.985
L3	1304	1.27	0.32	4.437	0.970
L4	1309	1.22	0.21	4.659	0.973

After 10km fiber

Lane	Wavelength (nm)	TDECQ (dB)	Ceq (dB)	ER (dB)	RLM
L1	1296	1.80	0.19	4.702	0.920
L2	1300	0.97	-0.03	4.258	0.924
L3	1304	1.08	0.15	4.573	0.942
L4	1309	1.29	0.31	4.690	0.980

800G OSFP LR4 TECQ vs Ref Rx Equalizers

Measured TECQ on EML-based 800G-LR4 module @ 113.4GBd and SER = 9.7E-3



800G LR4 EML Typical AOP Performance

Sample #1: TEC temp = 53C, EA = 0V

	Lane 0 (mW) Ibias = 50mA	Lane 1 (mW) Ibias = 40mA	Lane 2 (mW) Ibias = 40mA	Lane 3 (mW) Ibias = 40mA
After coupling	4.85	4.5	4.3	4.9
After UV Cure	4.45	4.3	4	4.6
Before Bake	2.78	4.3	3.18	3.6
Ater Bake	4.45	4.2	4	4.6

Sample #2: TEC temp = 53C, EA = 0V

	Lane 0 (mW) Ibias = 50mA	Lane 1 (mW) Ibias = 50mA	Lane 2 (mW) Ibias = 50mA	Lane 3 (mW) Ibias = 50mA
After coupling				
After UV Cure	5.1	5.4	6	6.8
Before Bake	5	5.18	5.6	6.5
Ater Bake	5.06	5.2	5.6	6.5

Validation on Key 800G-LR4 Baseline Specs

	Baseline[1]	Test	Remark
Transmitter Power/Channel	-0.9~5.5 dBm	~5 dBm	Pass
Extinction ratio	≥3.5 dB	~4.2 dB	Pass
OMA_{outer}	1.9~5.7 dBm	~4.5 dBm	Pass
TDECQ @SER=9.7E-3	≤3.2 dB	1.2 dB	Pass
TDECQ-TECQ (after 10km)[2]	≤2.5 dB	0.6 dB	Measured under a typical (non-worst-case) condition[2]
TDECQ-TECQ at DGD=4 ps[3]	≤0.7dB	<0.7dB	Pass

[1]: rodes_3dj_01_2309;

[2]: The actual CD in the measurement is most likely within the CD_Q limits, and more FFE taps would be needed under CD_{max}, CD_{min}, and other extreme conditions;

[3]: Assuming, conservatively, 2 extreme fiber DGD sections (e.g., out of M=4 sections).

✓ The test results support the 800G-LR4 baseline described in rodes_3dj_01_2309.

Conclusion

- Based on real 800G-LR4 pluggable modules, we have conducted the first test validation on the transmitter power, extinction ratio, OMA, TECQ and TDECQ with DGD.
- The first set of test results validate the DGD tolerance reported in kuschnerov_3dj_optx_01_230829, and support the 800G-LR4 baseline described in rodes_3dj_01_2309.
- More validation test results (including the receiver performance results) will be reported in the near future.

Thank you!