DVT Report

QSFP-DD 400GE FR4 2km (RSMD4BFR400CT)

1. Table of Contents

2. Product Description

This document describes the DVT result of QSFP-DD 400GE LR4 optical transceiver. The general characteristics of module is as follow:

Device	Description
RSMD4BFR400CT	QSFP-DD, FR4 , 2 km, Ethernet, 400GBE, SM, LAN-WDM(4x), 0-70°C, LC, pull-tab, DDM

3. Test Conditions

The DVT tests were performed at the following conditions, unless otherwise noted.

- Data rate: 53.125 Gbps (each lane)
- Pattern: PRBS31Q
- Case temperatures: 0°C, 35°C and 70°C
- Tested at normal voltage (3.3 V)

4. Test Specifications

Parameters	Unit	Min	Typ	Max	Sample Size	Pass/Fail
Electrical Power Consumption						
Power Consumption	W			12	11	Pass
Supply Current	A			3.63	11	Pass
Receiver 26.5625 GBd Electrical Interface						
Differential voltage pk-pk	mV			900	3	Pass
Common Mode Noise, RMS	mV			17.5	3	Pass
Common Mode Voltage (Vcm)	mV	-350		2850	3	Pass
Transition Time-Rise Time (20% to 80%)	ps	9.5			3	Pass
Transition Time-Fall Time (20% to 80%)	ps	9.5			3	Pass
Near-End Eye Height at 10-6 Probability (EH6)	mV	70			3	Pass
Near-End Eye Width at 10-6 Probability (EW6)	UI	0.265			3	Pass

Far-End Eye Height at 10-6 Probability (EH6)	mV	30			3	Pass
Far-End Eye Width at 10-6 Probability (EW6)	UI	0.2			3	Pass
Transmitter 53.125 GBd						
Transmit Wavelegnths	nm	1264.5	1271	1277.5	11	Pass
		1284.5	1291	1297.5	11	Pass
		1304.5	1311	1317.5	11	Pass
		1324.5	1331	1337.5	11	Pass
Total Average Launch Power	dBm			9.5	11	Pass
Average Launch Power, Each Lane	dBm	-3.3		3.5	11	Pass
Optical Modulation Amplitude (OMA), Each Lane	dBm	-0.2		3.7	11	Pass
Extinction Ratio ER	dB	3.5			11	Pass
Side-Mode Suppression Ratio (SMSR)	dB	30			11	Pass
Launch Power in OMA minus TDECQ, Each Lane	dB	-1.7			11	Pass
Transmitter and Dispersion Eye Closure for PAM4, Each Lane (TDECQ)	dB			3.4	11	Pass
Difference in Launch Power between any two lanes (OMAouter)	dB			4	11	Pass
RIN17.1OMA	dB/Hz			-136	11	Pass
Transmitter Reflectance	dB			-26	11	Pass
Average Launch Power of OFF transmitter, Each Lane	dBm			-16	11	Pass
Receiver 53.125 GBd						
Data Reach Each Lane	Gbps	53.125 ± 100 ppm			11	Pass
Average Receiver Power, Each Lane	dBm	-7.3		3.5	11	Pass
Receiver Power (OMA), Each Lane	dBm			3.7	11	Pass
Receiver Sensitivity (OMA), Each Lane	dBm			-4.6@2.4e-4	11	Pass
LOS Assert	dBm	-20			11	Pass
LOS Deassert	dBm			-8.6	11	Pass

LOS Hysteresis	dB	0.5			11	Pass
Receiver Reflectance	dB			-26	11	Pass
DDM						
Module Temperature	°C	-3		3	3	Pass
Module Voltage	%	-3		3	11	Pass
Transmitter Optical Power	dB	-3		3	11	Pass
Receiver Optical Power	dB	-3		3	11	Pass

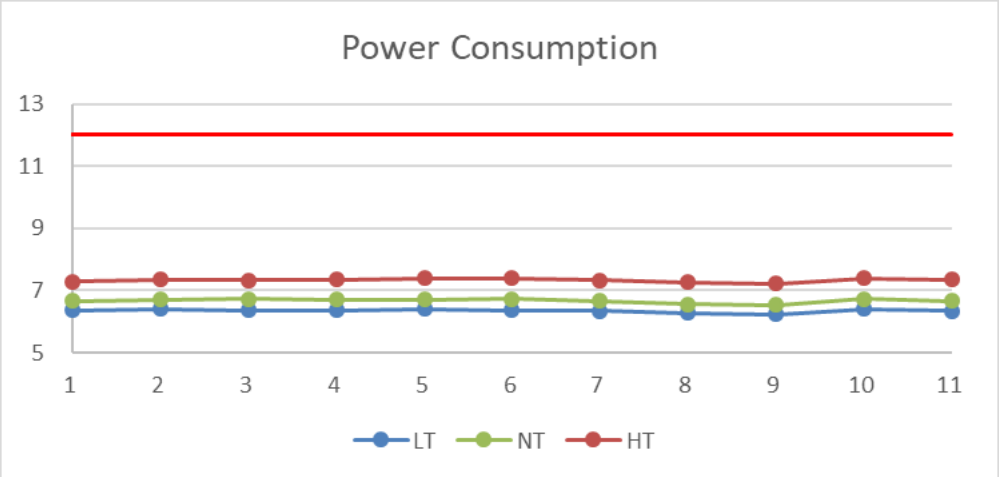
5. Test Data

Power Consumption

Table 1 Power Consumption (W)

Parameters	Min	Max	Avg	Spec
Power Consumption	6.24	7.39	6.79	≤ 12.00

Figure 1 : Power Consumption

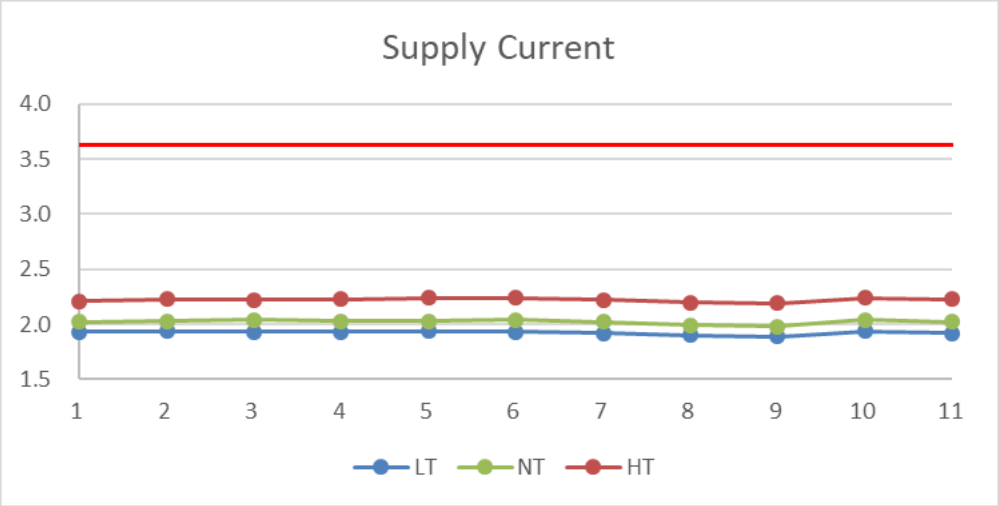


Supply Current

Table 2 Supply Current (A)

Parameters	Min	Max	Avg	Spec
Supply Current	1.89	2.24	2.06	≤ 3.63

Figure 2 Supply Current



Receiver Electrical Interface

Table 3 Receiver 25G Electrical Interface

Parameters	Min	Max	Avg	Spec
Differential Output Voltage pk-pk (mV)	454	752	715.38	≤ 900
Common Mode Noise, RMS (mV)	2.80	12.41	5.75	≤ 17.5
Common Mode Voltage (mV)	-39.33	-9.97	-21.11	-350 to + 2850
Transition Time-Rise Time (20% to 80%) (ps)	15.92	18.29	17.05	≥ 9.5
Transition Time Fall Time (20% to 80%) (ps)	14.65	18.83	16.74	≥ 9.5
Near-End Eye Height at 10-6 Probability (EH6) (mV)	97.60	119.40	107.19	≥ 70
Near-End Eye Width at 10-6 Probability (EW6) (mUI)	327	366	350.19	≥ 265
Far-End Eye Height at 10-6 Probability (EH6) (mV)	50	60.30	54.33	≥ 30

Far-End Eye Width at 10-6 Probability (EW6) (mUI)	306.00	344.00	323.19	≥ 200

Line Wavelenghts

Table 4 Line wavelengths (nm)

Parameters	Min	Max	Avg	Spec
Line Wavelenghts	1267.45	1275.01	1271.75	1264.5 to 1277.5
	1286.76	1294.56	1291.03	1284.5 to 1297.5
	1306.92	1315.50	1311.74	1304.5 to 1317.5
	1327.5	1334.85	1331.35	1324.5 to 1337.5

Figure 3 Line Wavelengths CH1

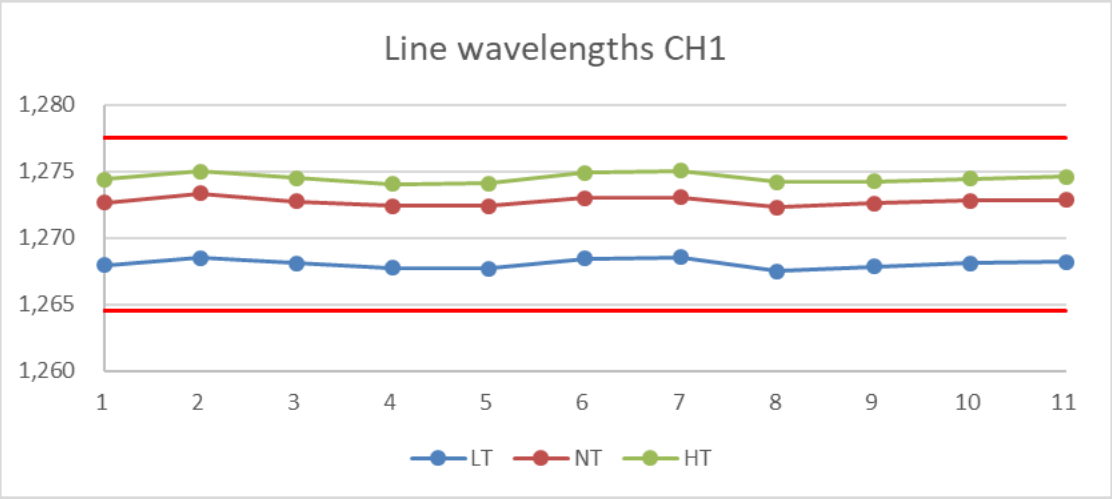


Figure 4 Line Wavelengths CH2

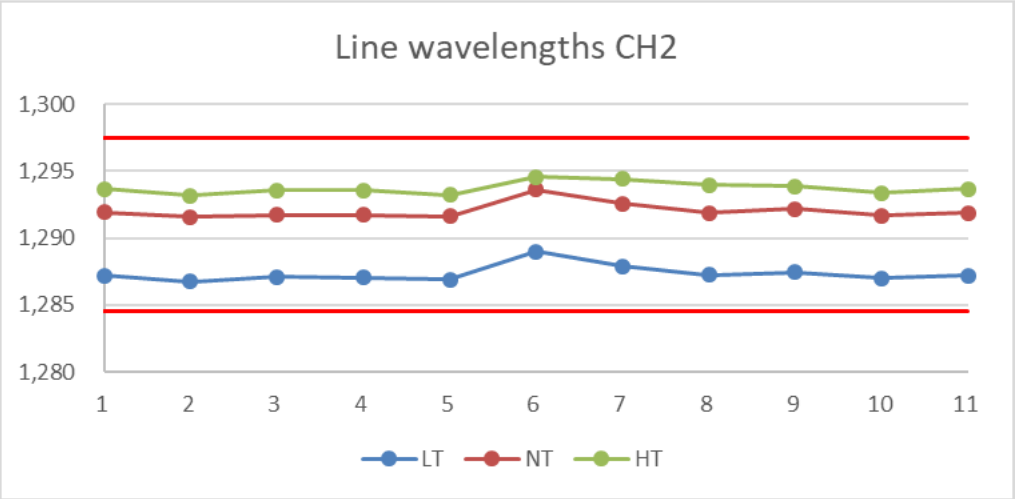


Figure 5 Line Wavelengths CH3

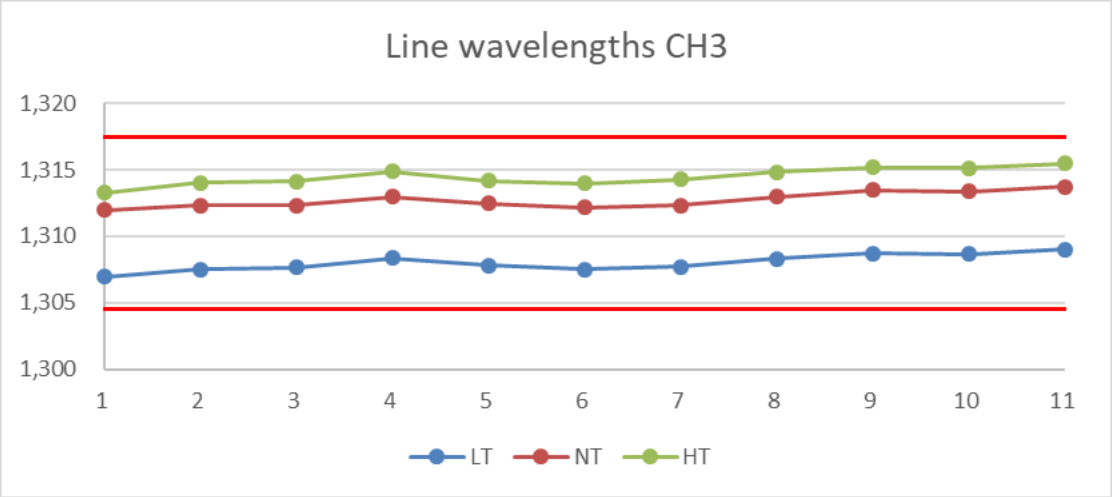
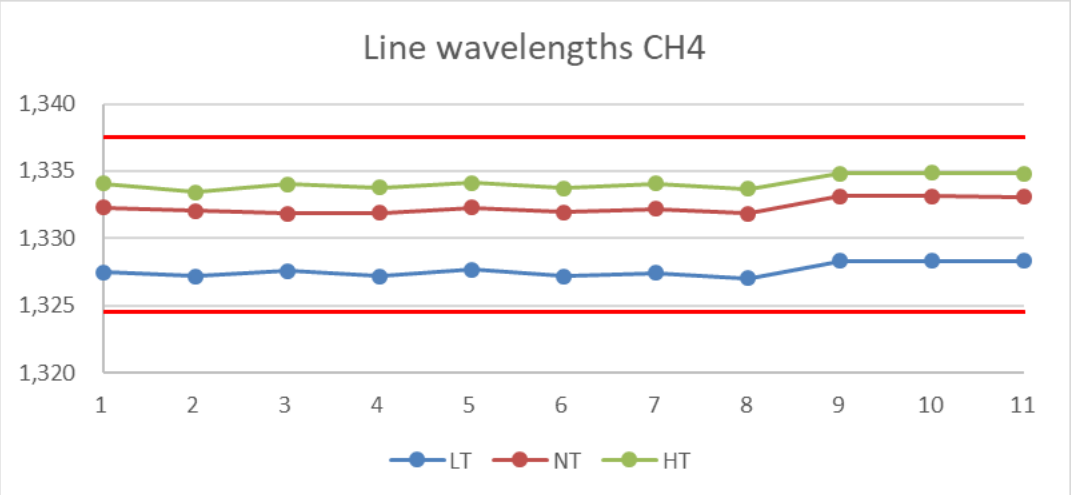


Figure 6 Line Wavelengths CH4

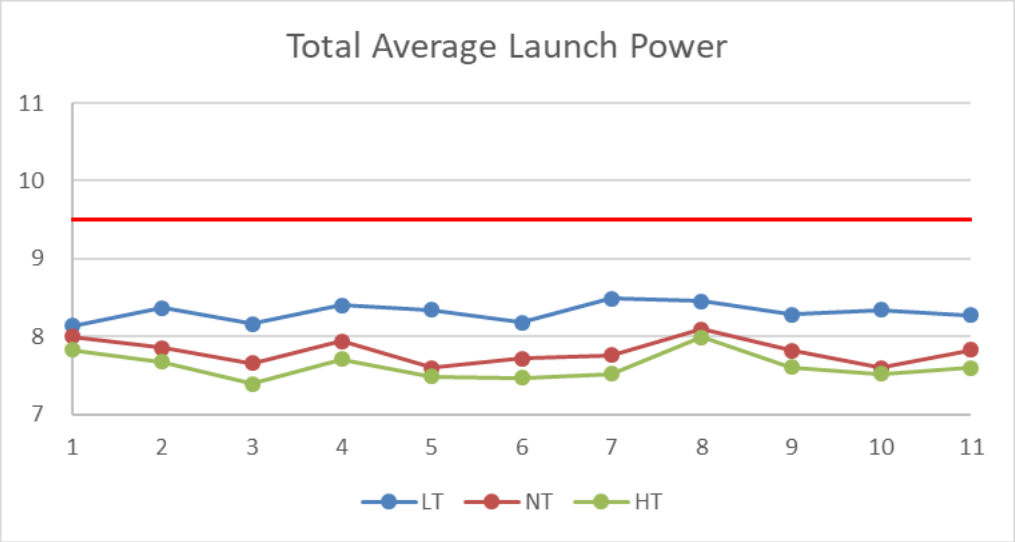


Total Average Lauch Power

Table 5 Total Average Launch Power (dBm)

Parameters	Min	Max	Avg	Spec
Total Average Launch Power	8.09	9.31	8.80	≤ 11.1

Figure 7 Total Average Launch Power

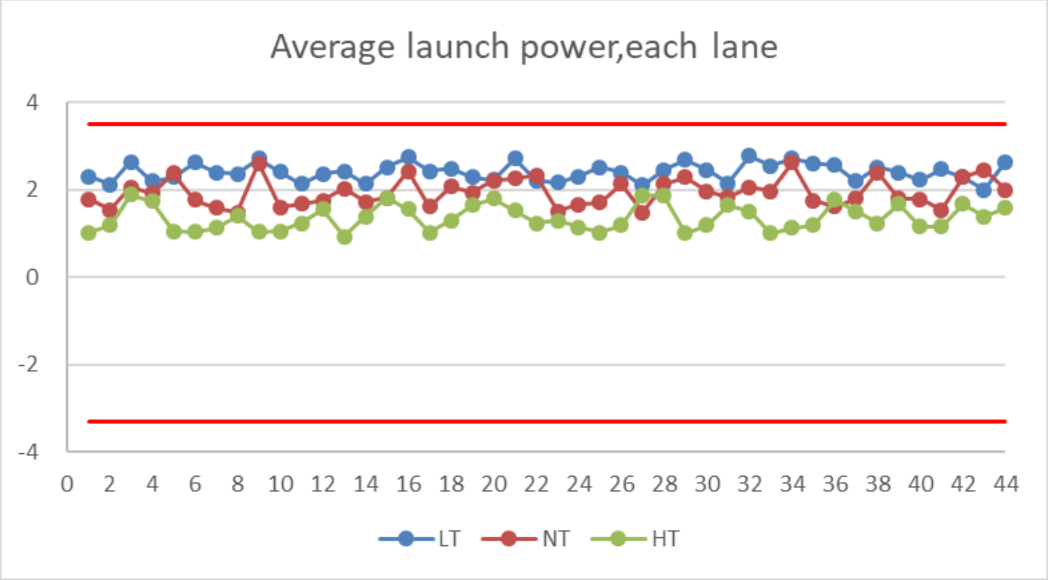


Average Launch Power, Each Lane

Table 6 Average Launch Power, Each Lane (dBm)

Parameters	Min	Max	Avg	Spec
Average Launch Power, Each Lane	0.93	2.77	1.90	-3.30 to +3.50

Figure 8 Average Launch Power, Each Lane

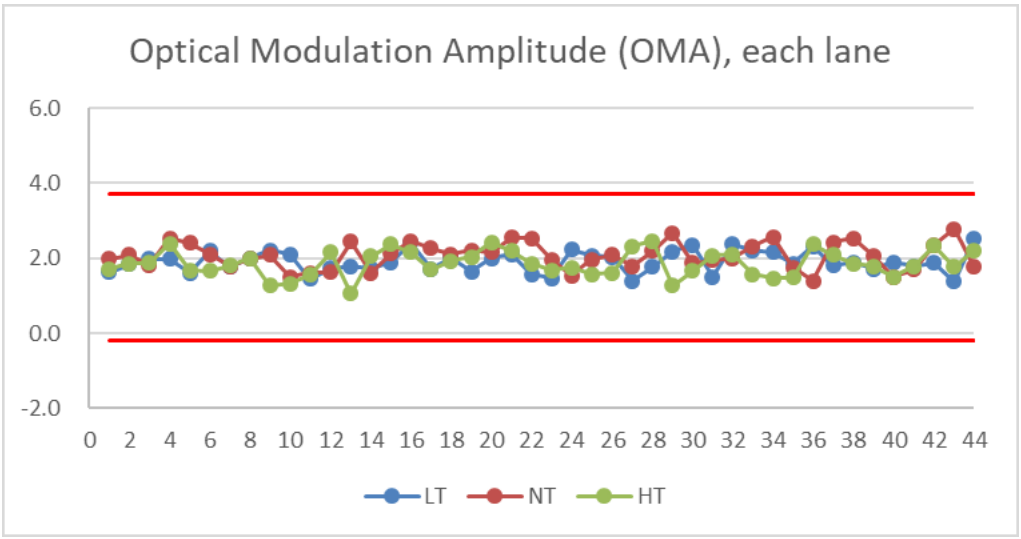


Optical Modulation Amplitude (OMA), Each Lane

Table 7 Optical Modulation Amplitude (OMA), Each Lane (dBm)

Parameters	Min	Max	Avg	Spec
Optical Modulation Amplitude (OMA), Each Lanes	1.06	2.78	1.95	-0.2 to +3.7

Figure 9 Optical Modulation Amplitude (OMA), Each Lane

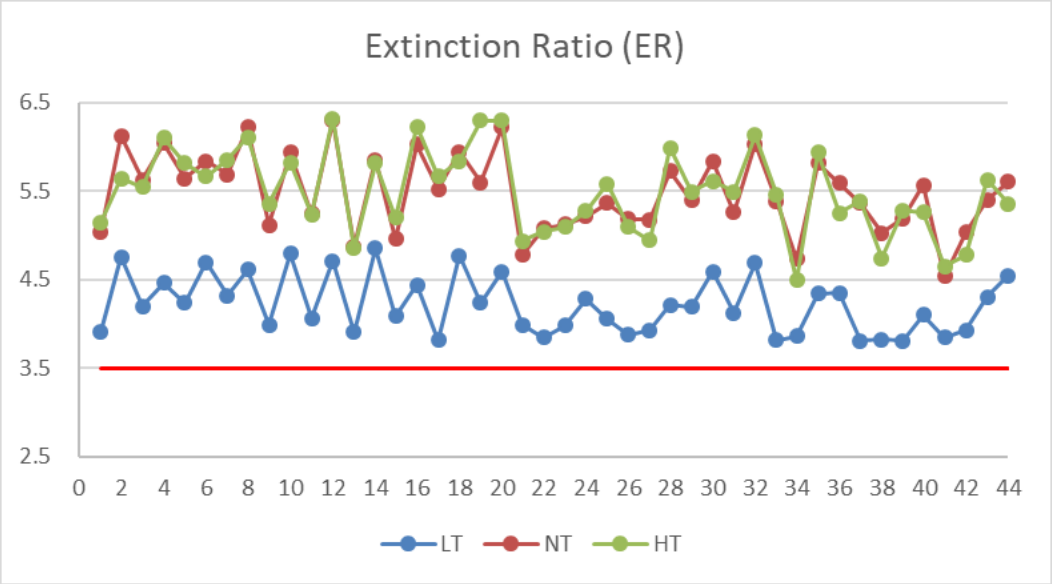


Extinction Ratio (ER)

Table 8 Extinction Ratio (ER) (dB)

Parameters	Min	Max	Avg	Spec
ER	3.81	6.32	5.07	≥ 3.5

Figure 10 Extinction Ratio (ER)

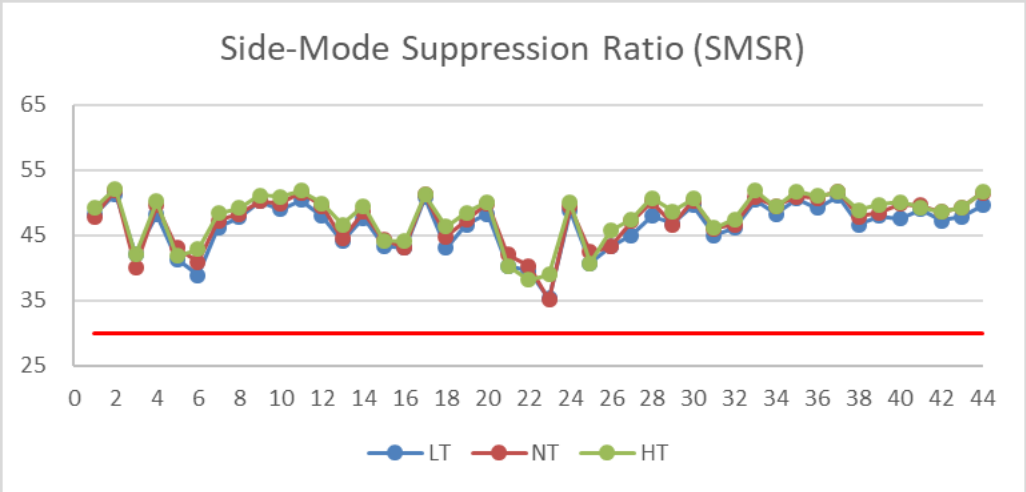


Side-Mode Suppression Ratio (SMSR)

Table 9 Side-Mode Suppression Ratio (SMSR) (dB)

Parameters	Min	Max	Avg	Spec
SMSR	35.11	52.18	47.21	≥ 30

Figure 11 Side-Mode Suppression Ration (SMSR)

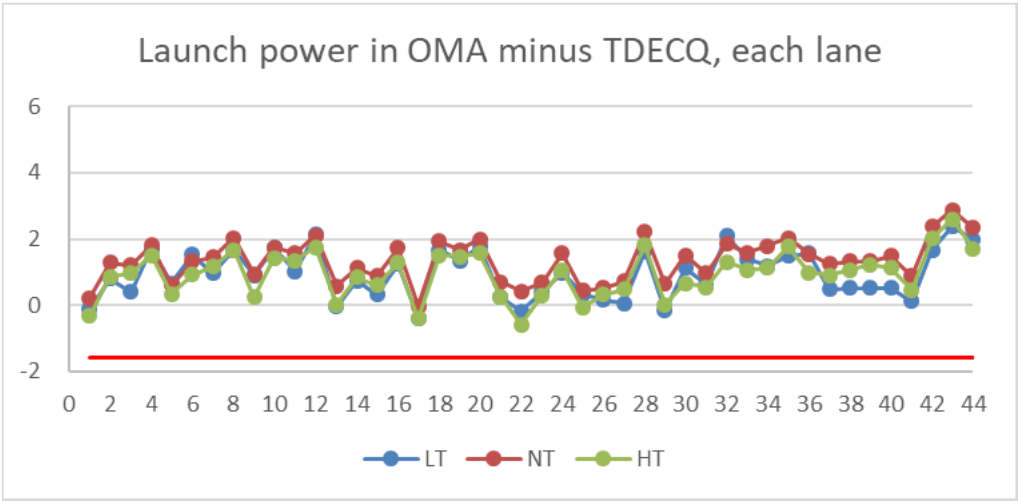


Launch Power in OMA minus TDECQ, Each Lane

Table 10 Launch Power in OMA minus TDECQ, Each Lane

Parameters	Min	Max	Avg	Spec
Launch Power in OMA minus TDECQ, Each lane	-0.58	2.89	1.07	≥-1.7 (For ER≥ 4.5dB) ≥-1.6 (For ER< 4.5dB)

Figure 12 Launch Power in OMA minus TDECQ, Each Lane

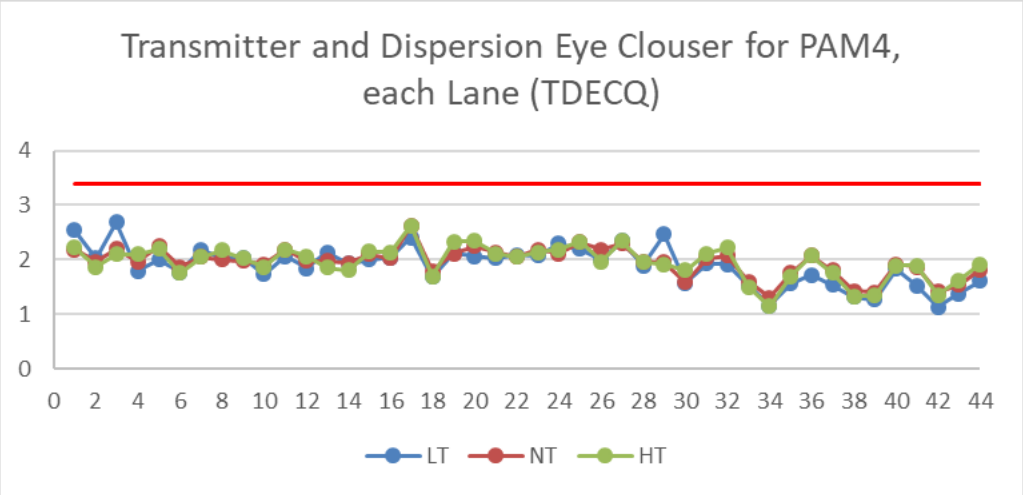


Transmitter and Dispersion Eye Closure for PAM4, Each Lane (TDECQ)

Table 11 Transmitter and Dispersion Eye Closure for PAM4 (TDECQ), Each Lane

Parameters	Min	Max	Avg	Spec
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ) Each Lane	1.13	2.68	1.94	≤ 3.4

Figure 13 Transmitter and Dispersion Eye Closure for PAM4 (TDECQ), Each Lane

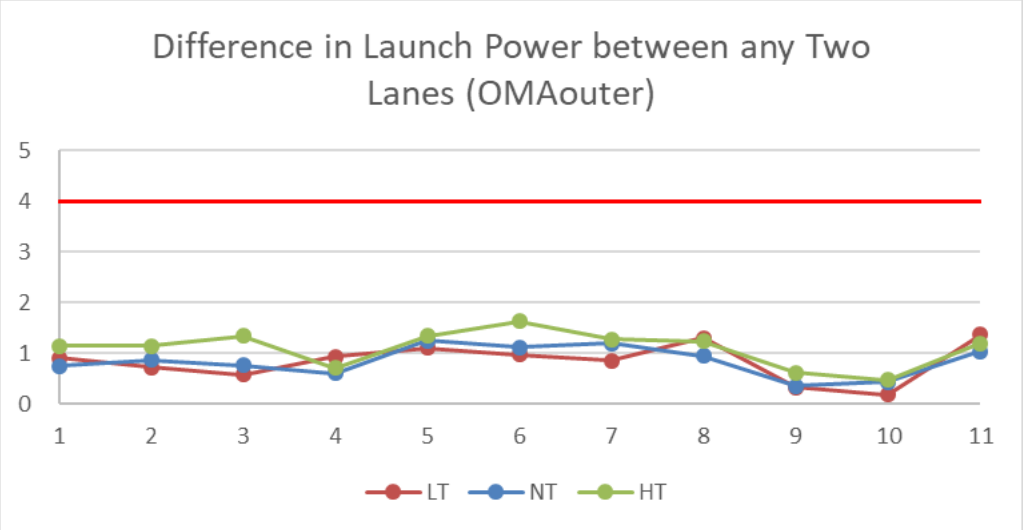


Difference in launch Power between any two Lanes (OMAouter)

Table 12 Difference in launch Power between any two Lanes (OMAoute)

Parameters	Min	Max	Avg	Spec
Difference in launch Power between any two Lanes (OMAoute)	0.18	1.63	0.93	≤ 4.0

Figure 14 Difference in launch Power between any two Lanes (OMAoute)

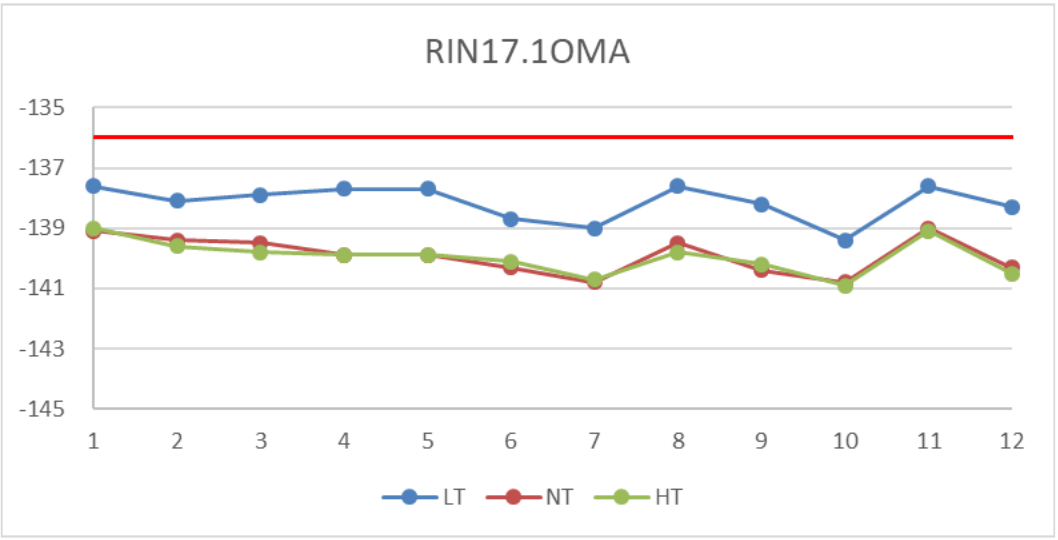


RIN17.1OMA

Table 13 RIN17.1OMA(dB/Hz)

Parameters	Min	Max	Avg	Spec
RIN17.1OMA(dB/Hz)	-140.90	-137.60	-139.39	≤ -136

Figure 15 RIN17.1OMA(dB/Hz)r

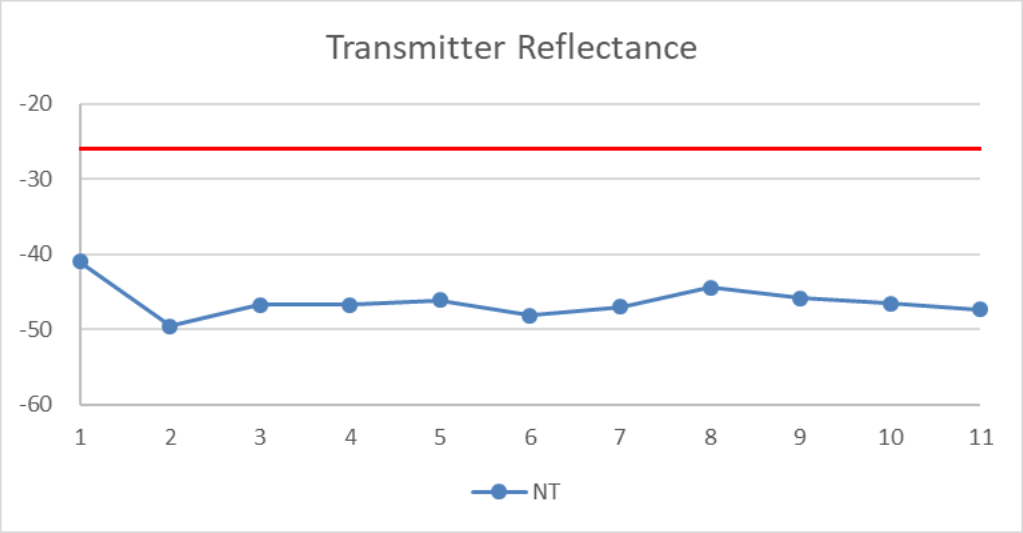


Transmitter Reflectance

Table 14 Transmitter Reflectance (dB)

Parameters	Min	Max	Avg	Spec
Transmitter Reflectance	-49.56	-41.01	-46.30	≤ -26

Figure 16 Transmitter Reflectance

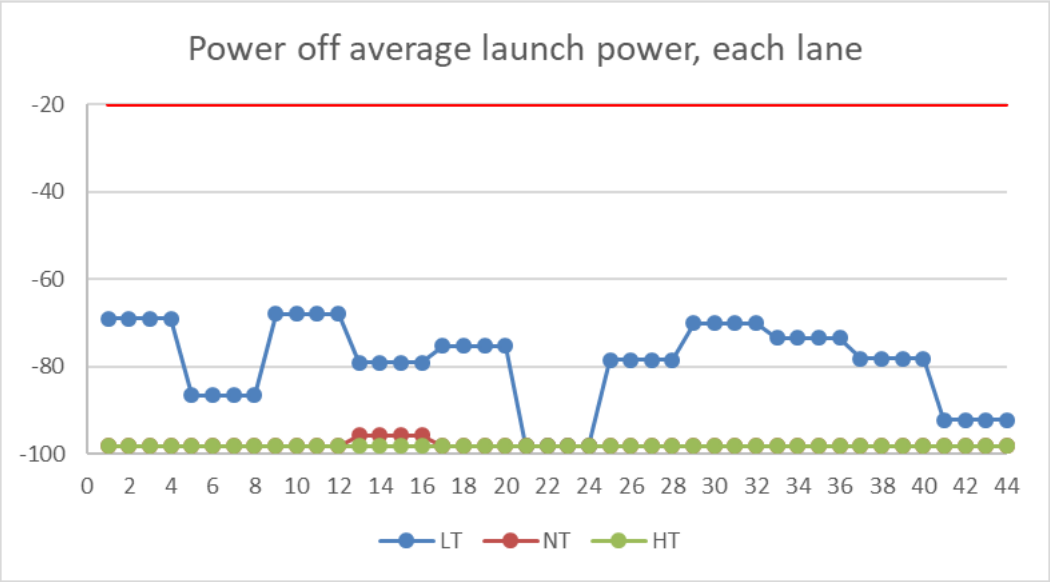


Power Off Average Launch Power, Each Lane,

Table 15 Power off Average Launch Power, Each Lane

Parameters	Min	Max	Avg	Spec
Power off Average Launch Power, Each Lane	-98.28	-67.94	-91.77	≤ -20

Figure 17 Power Off Average Launch Power, Each Lane



Receiver Power, Each Lane (OMA)

Measurement conditions:

- Data rate: 53.125 Gbps
- Receiver power (OMA): +3.7 dBm
- No bit errors in 1 minute

Table 16 Receiver Power, Each Lane (OMA)

Module SN	0°C	40°C	70°C
Module 1	Pass	Pass	Pass
Module 2	Pass	Pass	Pass
Module 3	Pass	Pass	Pass
Module 4	Pass	Pass	Pass
Module 5	Pass	Pass	Pass
Module 6	Pass	Pass	Pass
Module 7	Pass	Pass	Pass
Module 8	Pass	Pass	Pass

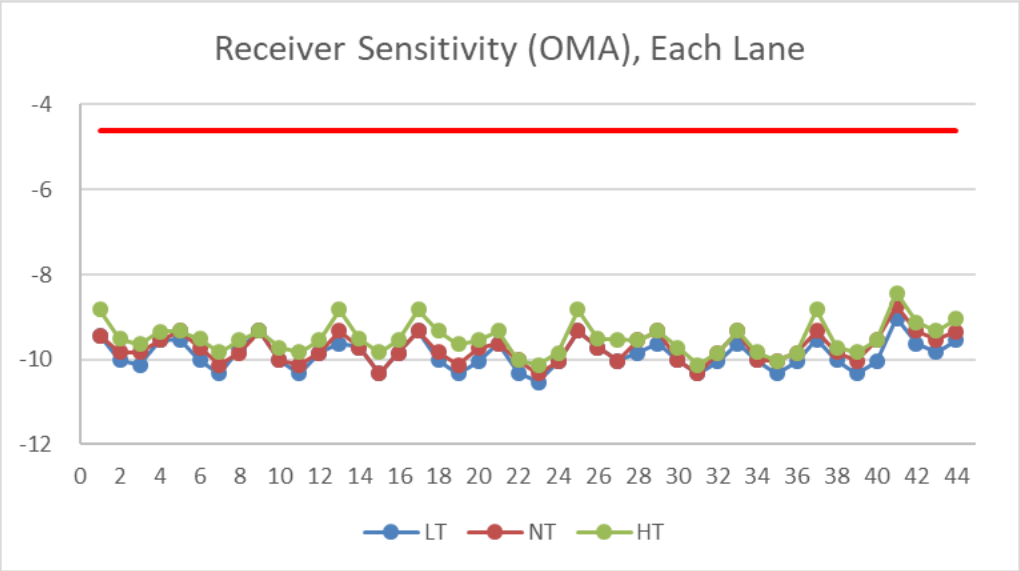
Module 9	Pass	Pass	Pass
Module 10	Pass	Pass	Pass
Module 11	Pass	Pass	Pass

Receiver Sensitivity (OMA), Each Lane

Table 17 Receiver Sensitivity (OMA), Each Lane (dBm)

Parameters	Min	Max	Avg	Spec
Receiver Sensitivity (OMA), Each Lane	-10.53	-8.43	-9.70	≤ -4.6@2.4e-4

Figure 18 Receiver Sensitivity (OMA), Each Lane (dBm)

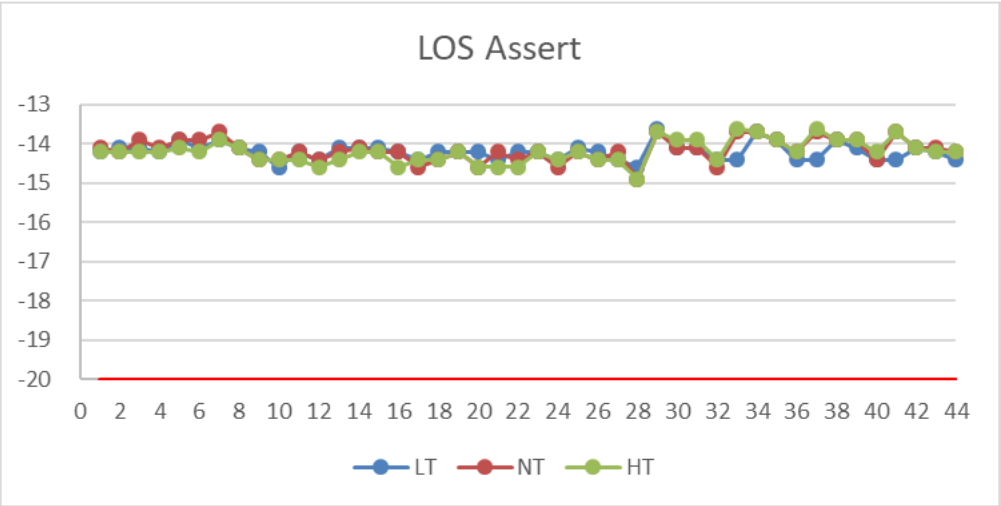


LOS Assert

Table 18 LOS Assert (dBm)

Parameters	Min	Max	Avg	Spec
Los Assert	-14.90	-13.60	-14.18	≥-20

Figure 19 LOS Assert

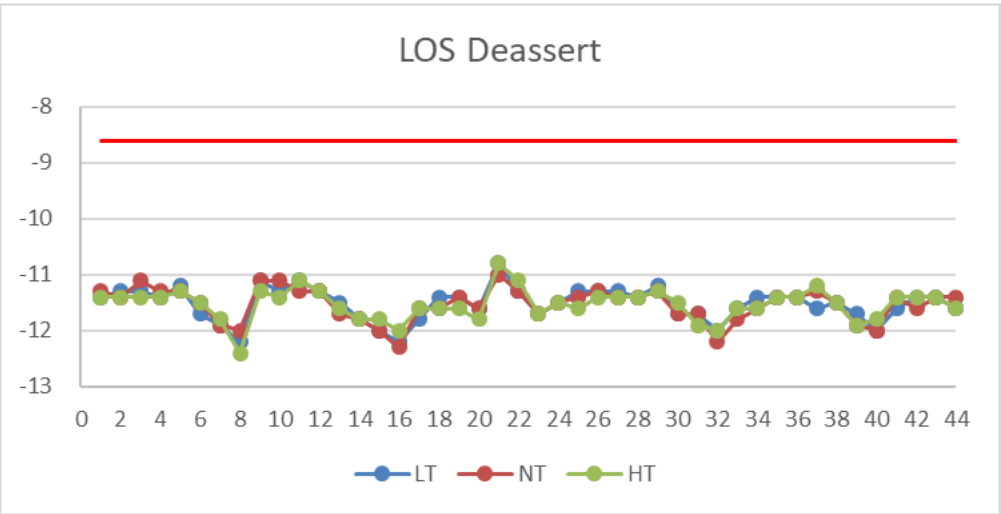


LOS Deassert

Table 19 LOS Deassert (dBm)

Parameters	Min	Max	Avg	Spec
LOS Deassert	-12.40	-10.80	-11.52	≤ -8.6

Figure 20 LOS Deassert

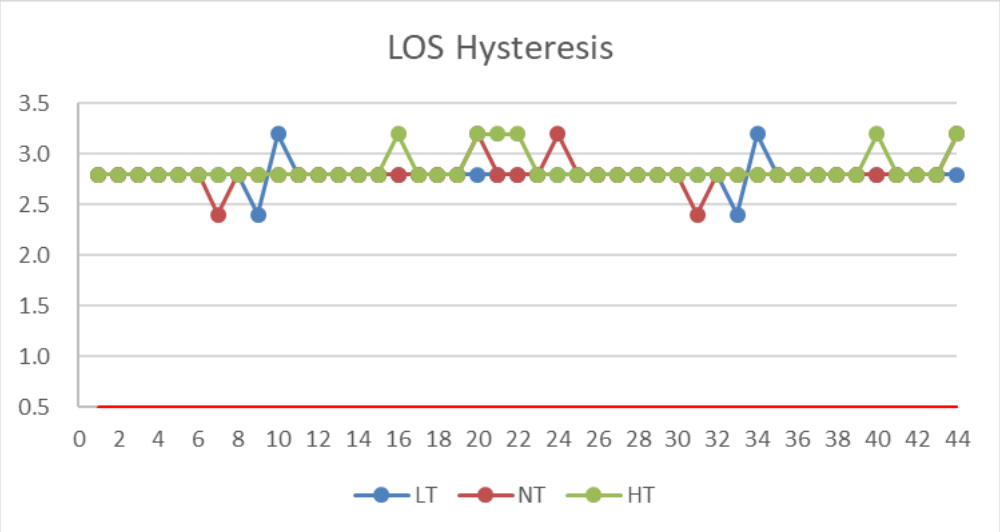


LOS Hysteresis

Table 20 LOS Hysteresis (dB)

Parameters	Min	Max	Avg	Spec
LOS Hysteresis	2.40	3.20	2.82	≥ 0.5

Figure 21 LOS Hysteresis

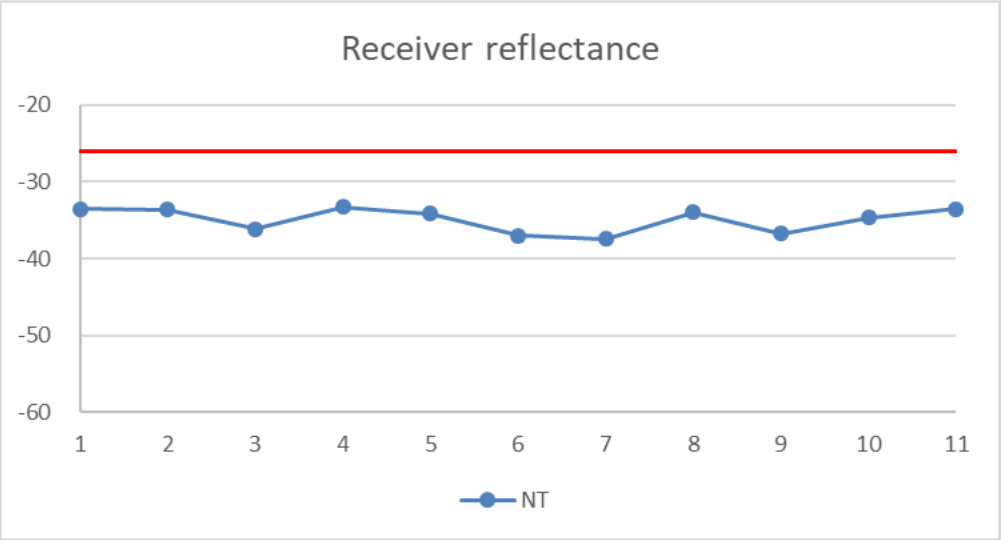


Receiver reflectance

Table 21 Receiver Reflectance

Parameters	Min	Max	Avg	Spec
Receiver Reflectance	-37.48	-33.27	-34.93	≤ -26

Figure 22 Receiver Reflectance



Long Term Transmission Test with 2 km fiber

Measurement conditions

- Data rate: 53.125 Gbps
- No bit errors in 48 hours
- Temperature cycling: 0–70°C (case temperature). Temperature cycling curve as below :

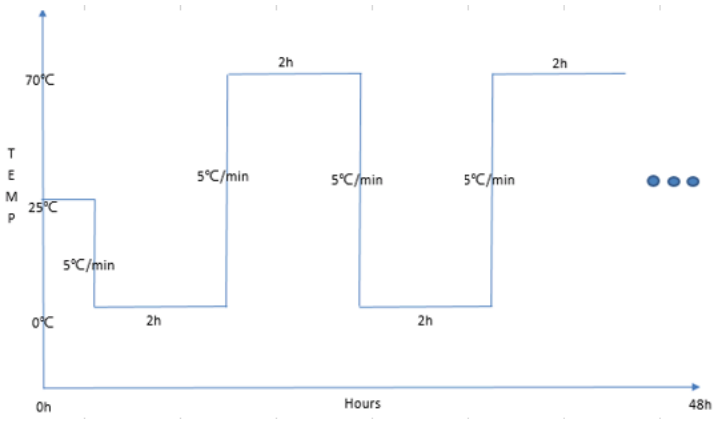


Table 22 Long Term Transmission Test with 10 km fiber

Module SN	70°C
Module 1	Pass
Module 2	Pass

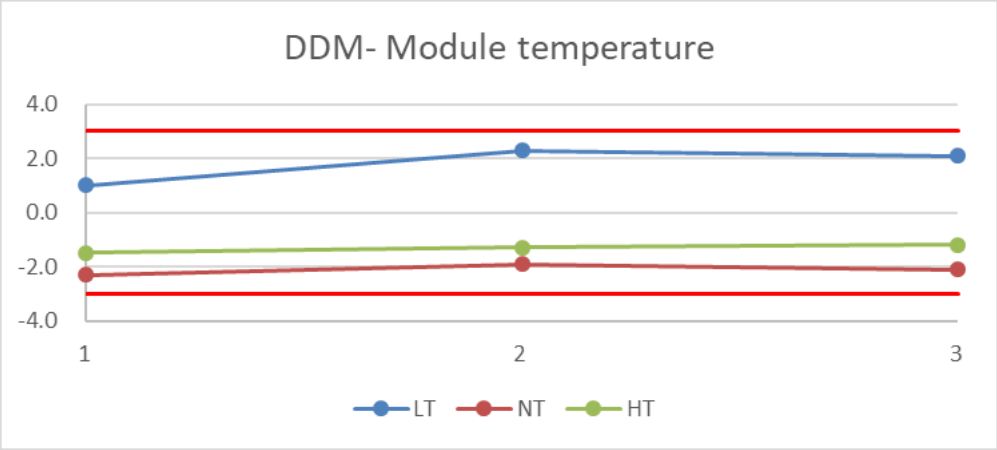
Module 3	Pass
Module 4	Pass
Module 5	Pass
Module 6	Pass
Module 7	Pass
Module 8	Pass
Module 9	Pass
Module 10	Pass
Module 11	Pass

DDM-Module Temperature

Table 23 DDM-Module Temperature

Parameters	Min	Max	Avg	Spec
DDM-Module Temperature	-2.30	2.30	-0.54	-3 to +3

Figure 23 DDM Module Temperature

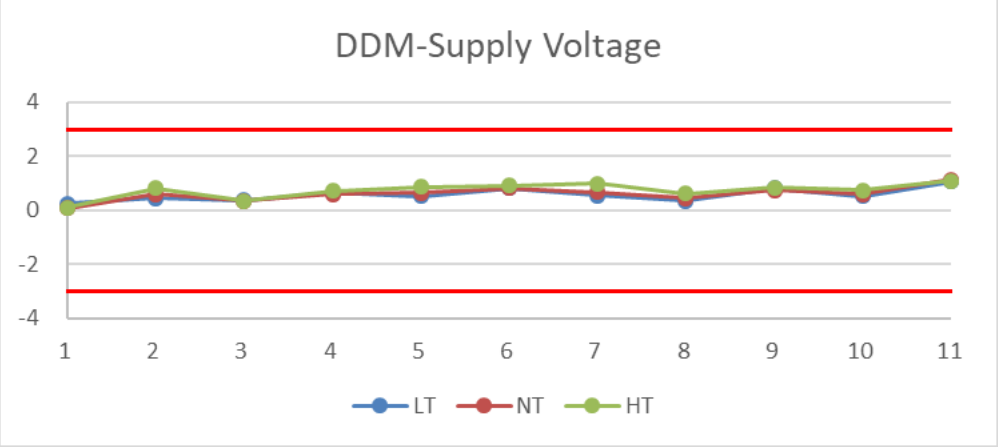


DDM Supply Voltage

Table 24 DDM Supply voltage (%)

Parameters	Min	Max	Avg	Spec
DDM-Supply Voltage	0.7	1.13	0.64	-3 to +3

Figure 24 DDM-Supply voltage

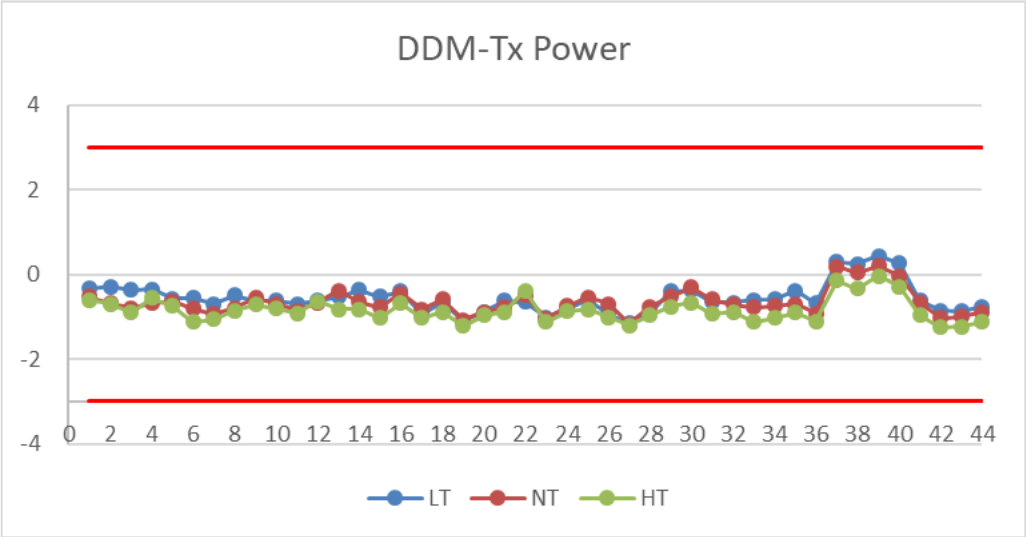


DDM-TX Power

Table 25 DDM-TX Power (dB)

Parameters	Min	Max	Avg	Spec
DDM-TX Power	-1.25	0.43	-0.69	-3 to +3

Figure 25 DDM-TX Power

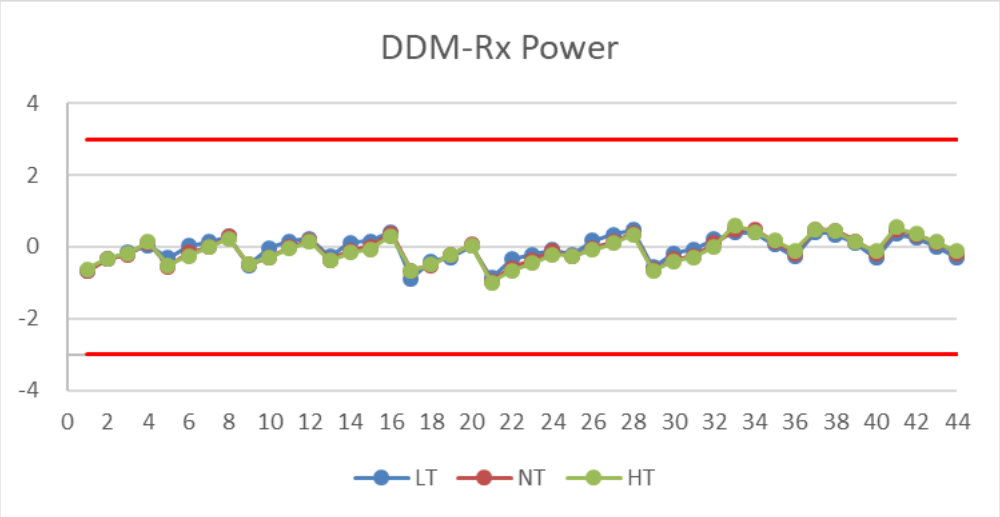


DDM-RX Power

Table 26 DDM-RX Power (dB)

Parameters	Min	Max	Avg	Spec
DDM-RX Power	-0.99	0.59	-0.08	-3 to +3

Figure 26 DDM-RX Power



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