

QDD-400G-ER8 Design Verification Testing Report

Reviewers

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TABLE OF CONTENTS

1. Description	1
PRODUCT FEATURES	1
2. Test Specification	2
3. Test Conditions	4
4. Test Data	5
4.1. Power dissipation	5
Table 1 Power dissipation	5
4.2. Supply Current	6
Table 2 Supply Current	6
4.3. Receiver 26.5625G Baud Electrical Interface	7
4.4. Transmit wavelengths	8
4.5. Total Average Launch Power	11
4.6. Average launch power, each lane	11
4.7. Optical Modulation Amplitude (OMA), each lane	12
4.8. Extinction Ratio (ER)	12
4.9. Side-Mode Suppression Ratio (SMSR)	13
4.10. Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane	13
4.11. Power off average launch power, each lane	14
4.12. Transmitter reflectance	14
4.13. DDM-Tx Power	15
4.14. Signaling Speed per Lane	15
4.16. Difference in receiver power between any two lanes (OMA outer)	16
4.17. Damage threshold, each lane	17
4.18. Receiver sensitivity (OMA), each lane	17
4.19. LOS Assert	18
4.20. LOS Deassert	18
4.21. LOS Hysteresis	19
4.22. Receiver reflectance	19
4.23. DDM-Rx Powers	20
4.24. DDM-Module voltage	20
4.25. DDM-Module temperatures	21
4.26. Long Term Transmission Test with 40km Fiber	22

1. Description

This document describes the DVT results of Hisilicon 400GBASE-ER8 QSFP-DD Optical Transceiver. The general characteristics of module are as follow:

Device	Description
OM9660ES100	40km 400GE(8*50G) QSFP-DD Transceiver (Straight LC Receptacle)

PRODUCT FEATURES

- Compliant with QSFP-DD MSA (Rev 5.0) type 2 form factor
- I2C Management Interface, compliant with Common Management Interface Specification for 8X/16X Pluggable Transceivers (Rev 4.0)
- Compliant with IEEE 802.3cn 400Gigabit Ethernet (400GbE) 400GBASE-ER8
- Support 425 Gbit/s aggregate bit rate
- Host side 8 x 26.5625GBaud electrical Interface
- Line side 8 x 26.5625GBaud optical Interface
- Transmission distance range to 40km
- EML transmitter with 8 Lane LAN-WDM wavelength
- APD receiver
- Maximum power dissipation 15.4W
- Case temperature range of 0°C~+70°C
- Support duplex LC receptacles
- Hot-Pluggable with 76 pin connector
- Compliant with RoHS 6 ≡ Single +3.3V power supply

APPLICATIONS

- 400GBASE-ER8 400G Ethernet
- Telecom networking
- Data Center Interconnect
- Enterprise networking

2. Test Specification

Parameters	Unit	Min	Type	Max	Sample Size	Pass/Fail
Electrical Power Consumption						
Power dissipation	W			15.4	11	Pass
Supply Current	A			4.444	11	Pass
Receiver 26.5625GBaud electrical interface						
Differential Voltage pk-pk	mV			900	4	Pass
AC Common Mode Noise, RMS	mV			17.5	4	Pass
Near-end ESMW	UI		0.265		4	Pass
Near-end Eye height, differential (min)	mV	70			4	Pass
Far-end ESMW	UI	0.2			4	Pass
Far-end Eye height, differential (min)	mV	30			4	Pass
Transmit wavelengths	nm	1272.55	1273.54	1274.54	11	Pass
		1276.89	1277.89	1278.89	11	Pass
		1281.25	1282.26	1283.27	11	Pass
		1285.65	1286.66	1283.27	11	Pass
		1294.53	1295.56	1296.59	11	Pass
		1299.02	1300.05	1301.09	11	Pass
		1303.54	1304.58	1305.63	11	Pass
		1308.09	1309.14	1310.19	11	Pass
Total Average Launch Power	dBm			14.6	11	Pass
Average launch power, each lane	dBm	-0.6		5.6	11	Pass
Optical Modulation Amplitude (OMA), each lane (max)	dBm	2.4		6.4	11	Pass
Extinction Ratio (ER)	dB	6			11	Pass
Side-mode suppression ratio	dB	30			11	Pass
Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane	dB			3.4	11	Pass
Average launch power of OFF transmitter, each lane	dBm			-30	11	Pass
Optical return loss tolerance	dB			15	11	Pass
Transmitter reflectance	dB			-26	11	Pass
DDM-Tx Power	dB	-3		+3	11	Pass
Receiver						
Signaling Speed per Lane	G Baud	26.5625±100ppm			11	Pass
Receive power (OMA outer), each lane	dBm			-3.6	11	Pass
Difference in receiver power between any two lanes(OMA)	dB			5.8	11	Pass
Damage threshold, each lane	dBm	-3.4			11	Pass
Receiver sensitivity (OMA), each lane	dBm			-16.1	11	Pass
LOS Assert	dBm	-30			11	Pass
LOS Deassert	dBm			-20.6	11	Pass
LOS Hysteresis	dB	0.5			11	Pass

Receiver reflectance	dB			-26	11	Pass
DDM-Rx Power	dB	-3		+3	11	Pass
DDM-Module voltage	%			5	11	Pass
DDM-Module temperature	°C	-3		+3	11	Pass

3. Test Conditions

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

Data Rate: 26.5625 G Baud (each lane)

Pattern: PRBS31Q and SSPRQ for TDECQ

Case Temperatures: 0°C, 35°C and 70°C

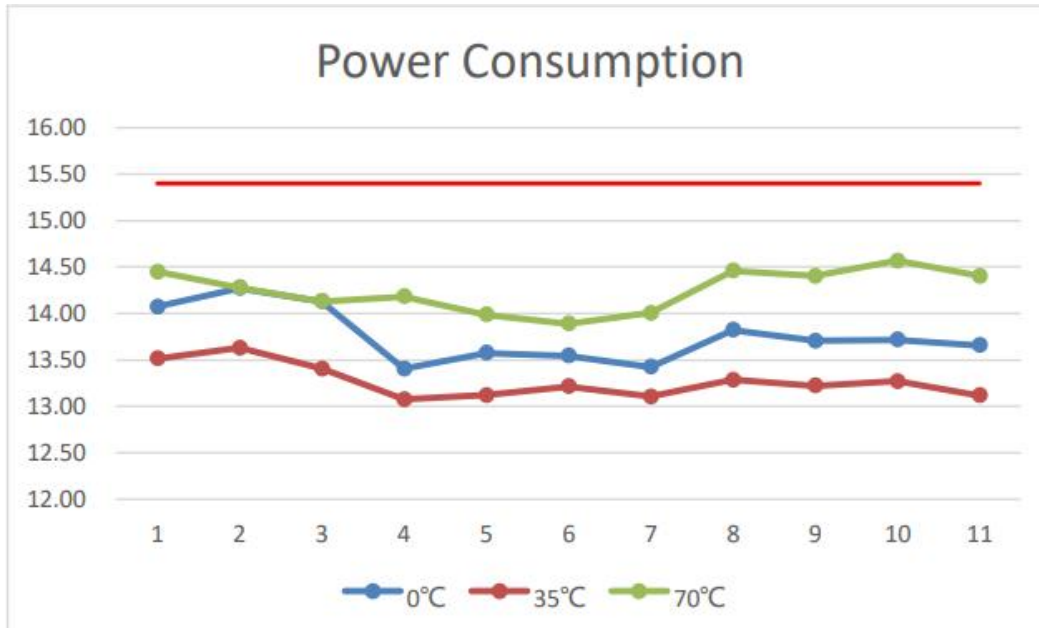
Tested at normal voltage: + 3.3V

4. Test Data

4.1. Power dissipation

Table 1 Power dissipation

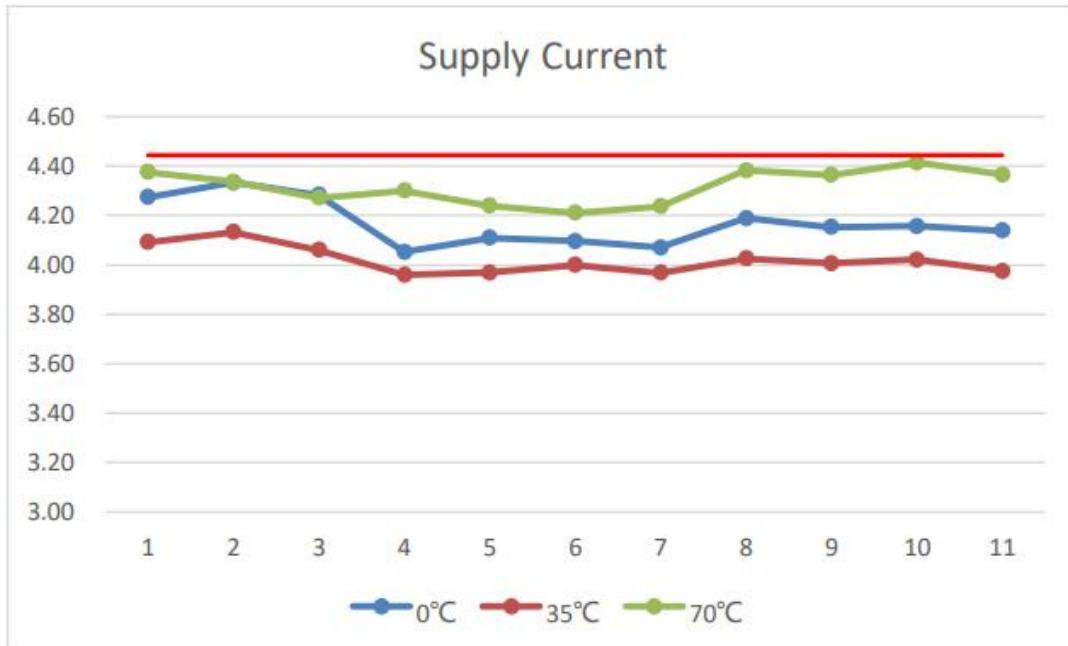
Parameters	Min	Max	Avg	Spec	unit
Power dissipation	13.08	14.57	13.76	≤ 15.4	W



4.2. Supply Current

Table 2 Supply Current

Parameters	Min	Max	Avg	Spec	unit
Supply current	3.96	4.41	4.17	↯ 4.444	A



4.3. Receiver 26.5625G Baud Electrical Interface

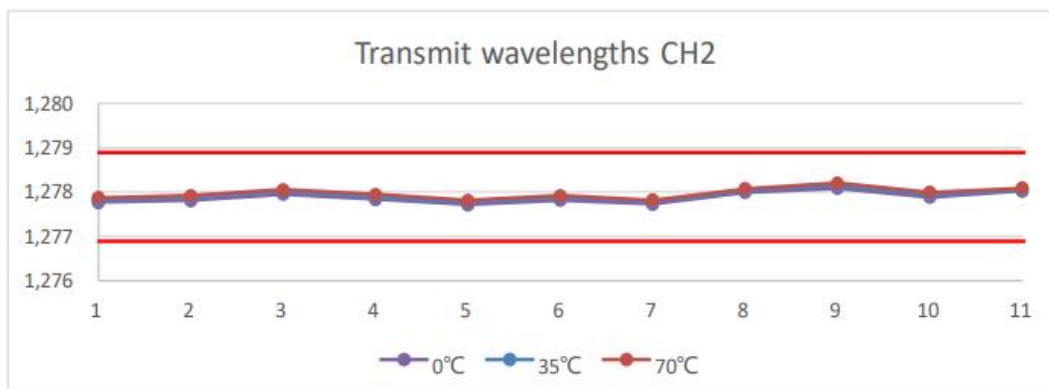
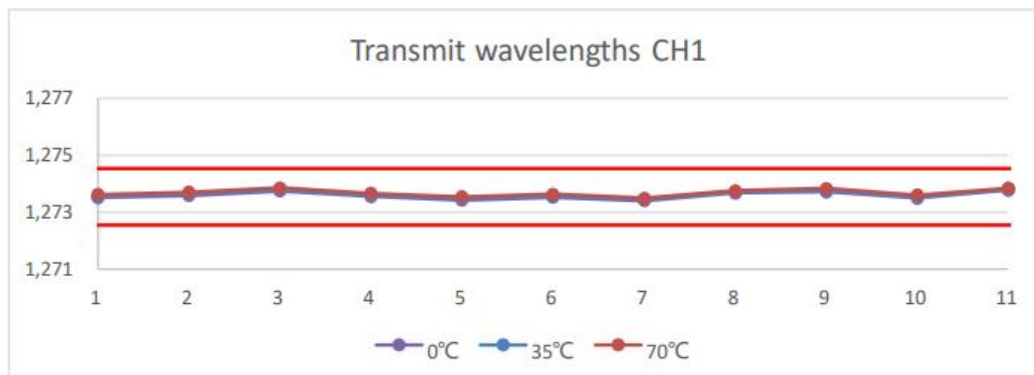
Table 3 Receiver 26.5625G Baud Electrical Interface

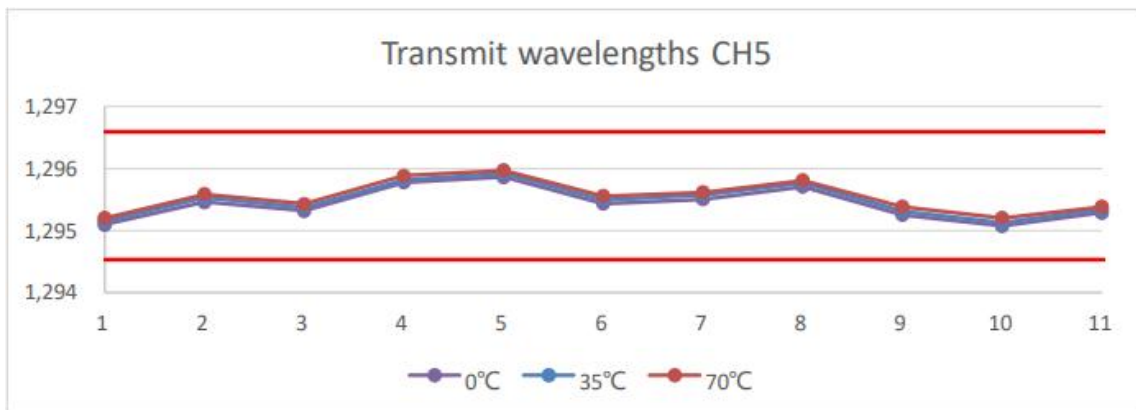
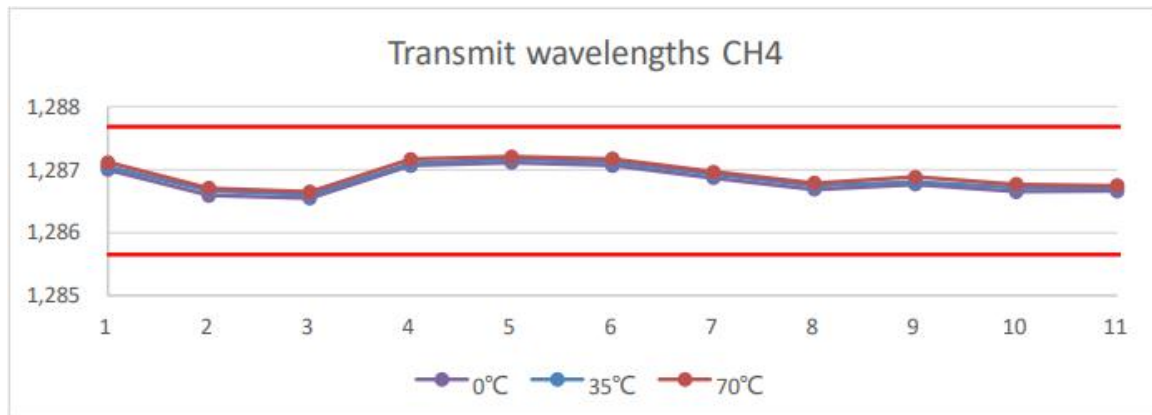
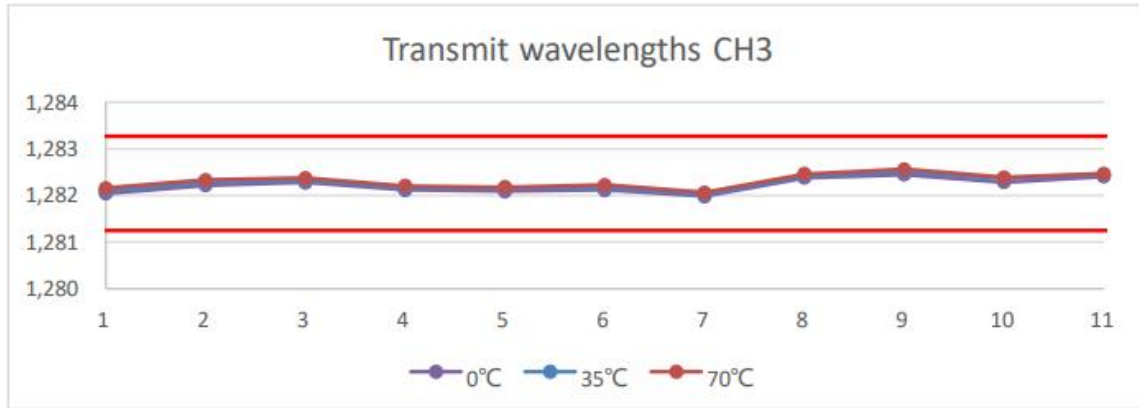
Parameters	Min	Max	Avg	Spec	unit
Differential Voltage pk-pk	349.50	496.50	422.89	⋈ 900	mV
Common Mode Noise, RMS	3.52	10.22	5.84	⋈ 17.5	mV
Transition Time-Rise time (20%-80%)	15.00	20.00	17.17	⋈ 9.5	ps
Transition Time-Rise time (20%-80%)	15.00	21.00	17.33	⋈ 9.5	ps
Near-end ESMW(UI)	0.28	0.41	0.36	⋈ 0.265	UI
Near-end Eye height, differential (mV)	70.30	104.00	85.90	⋈ 70	mV
Far-end ESMW(UI)	0.26	0.37	0.33	⋈ 0.2	UI
Far-end Eye height, differential (mV)	30.70	57.15	44.26	⋈ 30	mV

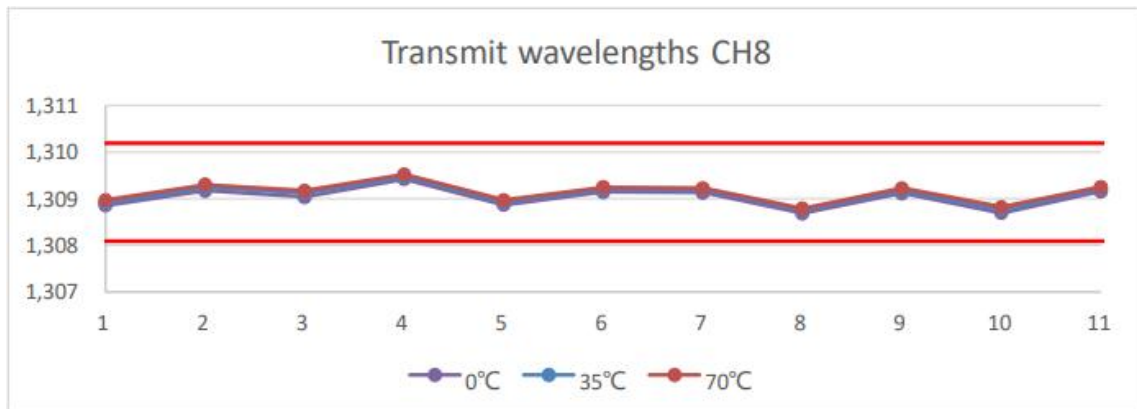
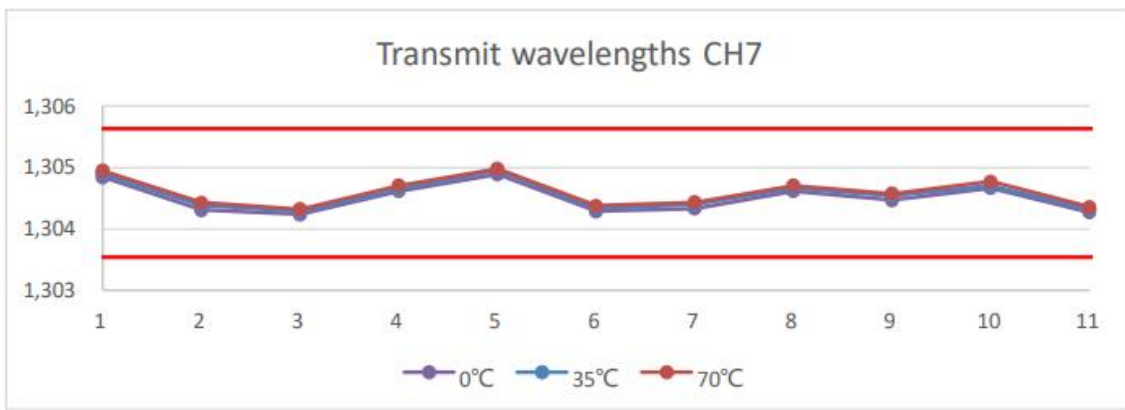
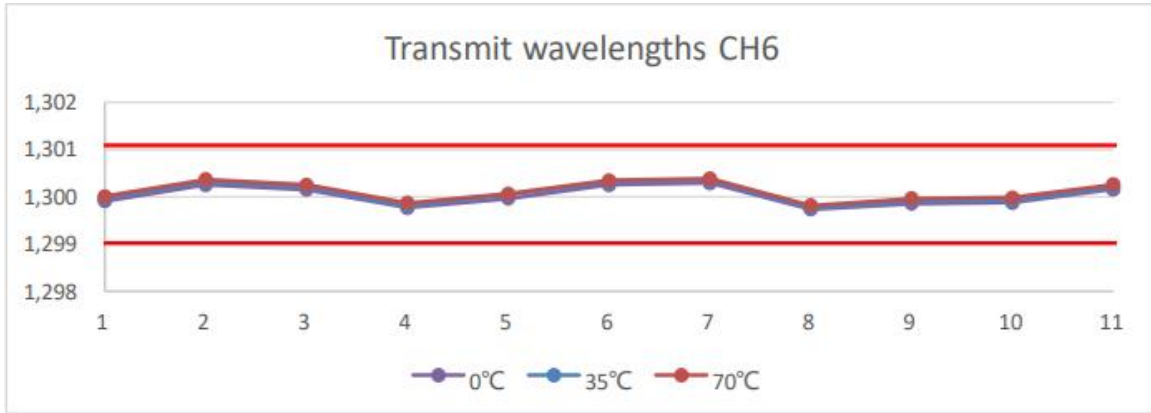
4.4. Transmit wavelengths

Table 4 Transmit wavelengths

Parameters	Min	Max	Avg	Spec	unit
Transmit wavelengths	1273.33	1274.01	1273.64	1272.55~1274.54	nm
	1277.62	1278.34	1277.94	1276.89~1278.89	nm
	1281.95	1282.72	1282.28	1281.25~1283.27	nm
	1286.54	1287.21	1286.89	1285.65~1287.68	nm
	1295.07	1295.96	1295.45	1294.53~1296.59	nm
	1299.73	1300.38	1300.06	1299.02~1301.09	nm
	1304.12	1304.97	1304.54	1303.54~1305.63	nm
	1308.68	1309.52	1309.05	1308.09~1310.1	nm



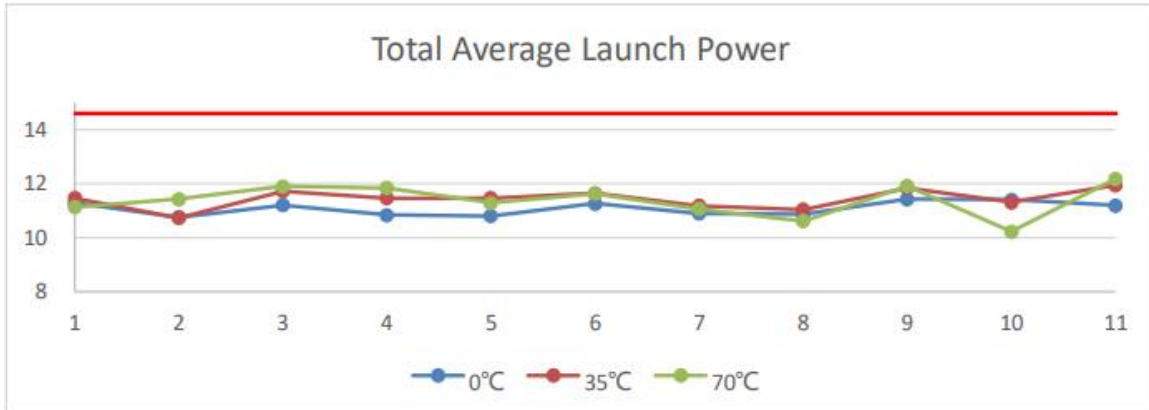




4.5. Total Average Launch Power

Table 5 Total Average Launch Power

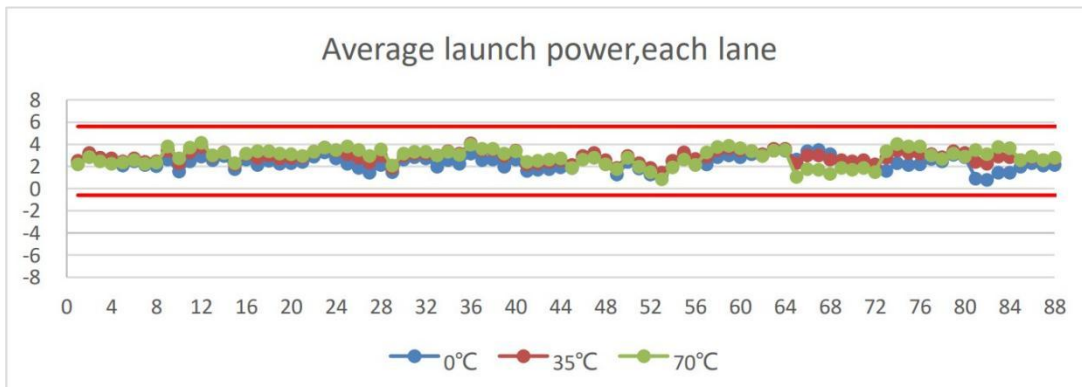
Parameters	Min	Max	Avg	Spec	unit
Average launch launch power	10.23	12.17	11.28	⋈ 14.6	dBm



4.6. Average launch power, each lane

Table 6 Average launch power, each lane

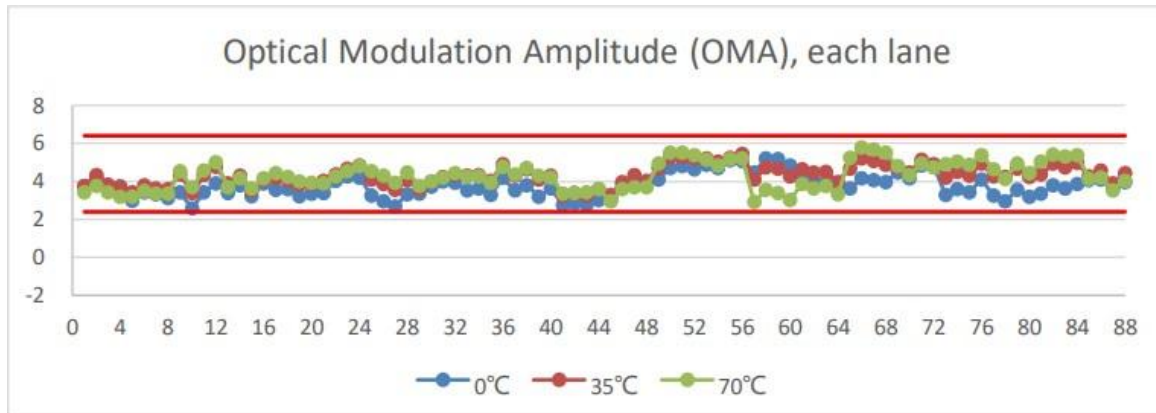
Parameters	Min	Max	Avg	Spec	unit
Average launch power, each lane	0.77	4.13	2.65	-0.6~5.6	dBm



4.7. Optical Modulation Amplitude (OMA), each lane

Table 7 Optical Modulation Amplitude (OMA), each lane

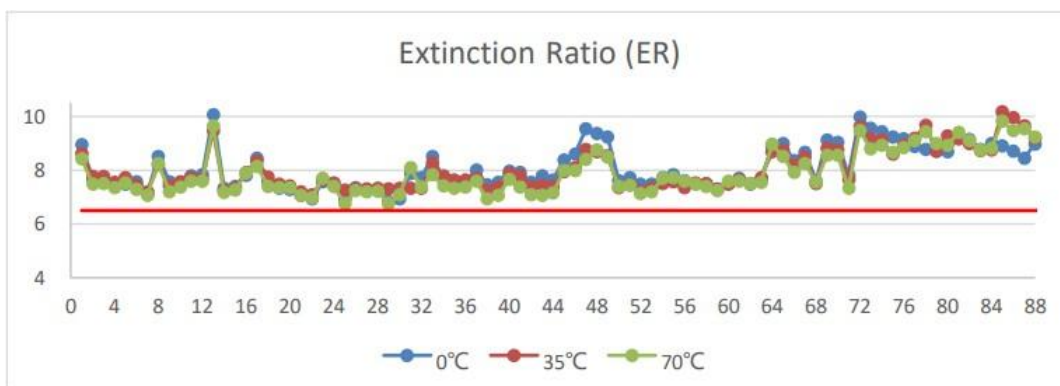
Parameters	Min	Max	Avg	Spec	unit
Optical Modulation Amplitude (OMA), each lane	2.6	5.79	4.13	2.4~6.4	dBm



4.8. Extinction Ratio (ER)

Table 8 Extinction Ratio (ER)

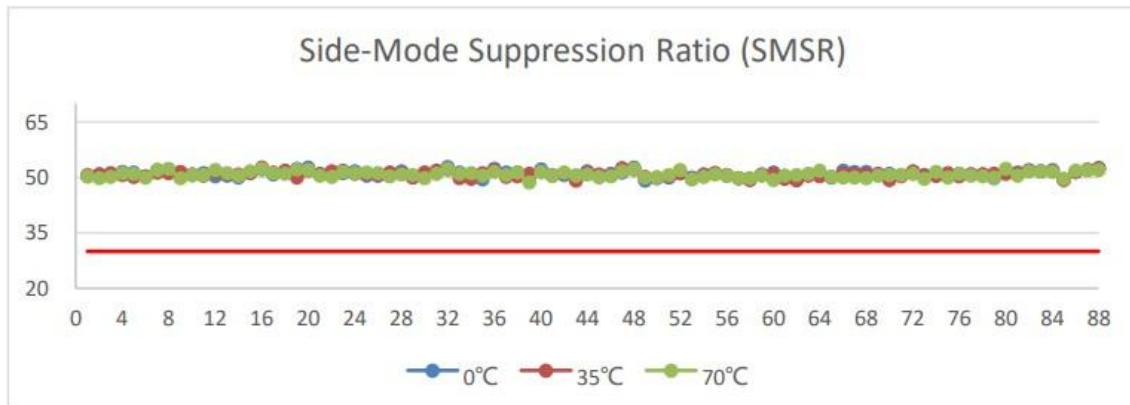
Parameters	Min	Max	Avg	Spec	unit
ER	6.26	9.68	7.75	7.6	A



4.9. Side-Mode Suppression Ratio (SMSR)

Table 9 Side-Mode Suppression Ratio (SMSR)

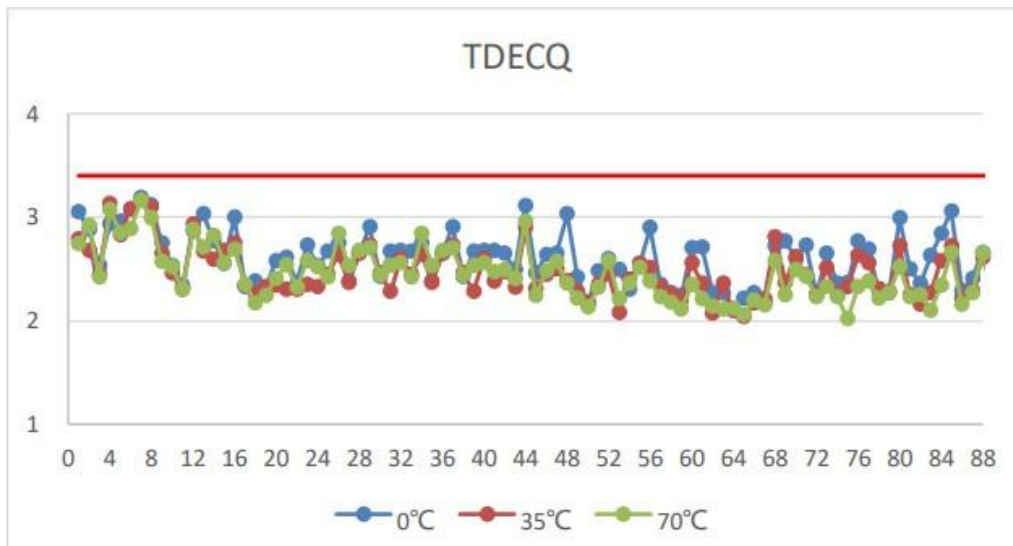
Parameters	Min	Max	Avg	Spec	unit
SMER	48.65	52.77	50.82	≥30	dB



4.10. Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane

Table 10 Transmitter and dispersion eye closure for PAM4 (TDECQ), each lane

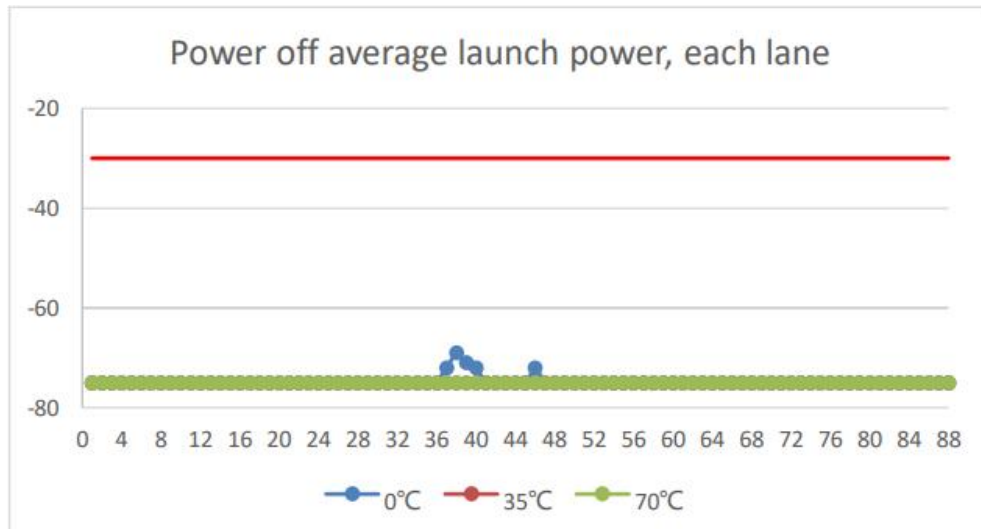
Parameters	Min	Max	Avg	Spec	unit
TDECQ	2.02	3.19	2.51	≥3.4	dB



4.11. Power off average launch power, each lane

Table 11 Power off average launch power, each lane

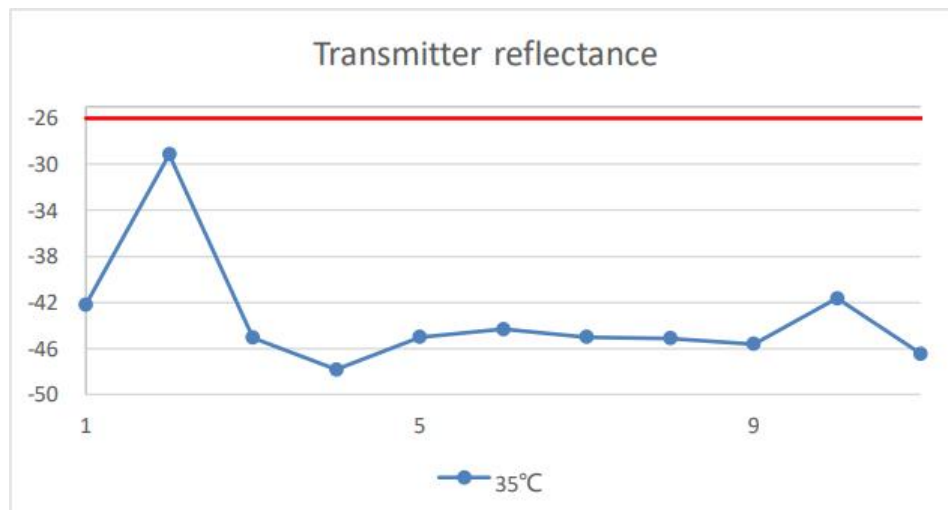
Parameters	Min	Max	Avg	Spec	unit
Power off average launch power, each lane	-75	-69	-74.93	κ-30	dBm



4.12. Transmitter reflectance

Table 12 Transmitter reflectance

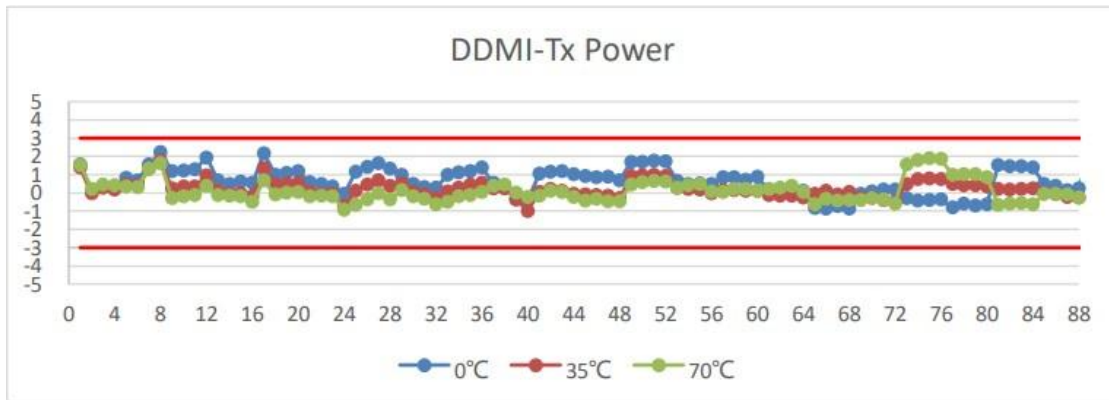
Parameters	Min	Max	Avg	Spec	unit
Transmitter reflectance	-47.83	29.15	-42.65	κ-26	dB



4.13. DDM-Tx Power

Table 13 DDM-Tx Power

Parameters	Min	Max	Avg	Spec	unit
DDMI-Tx Power	-1.00	2.33	0.36	-3~3	dB



4.14. Signaling Speed per Lane

Measurement Conditions

- Data Rate: 26.5625GBaud
- Frequency Offset ± 190 ppm

Table 14 Signaling Speed per Lane

Module SN	35°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

4.15. Receiver power (OMA outer), each lane (max)

Measurement Conditions

- Data Rate: 26.5625GB/s
- Receiver power (OMA outer): -3.6dBm

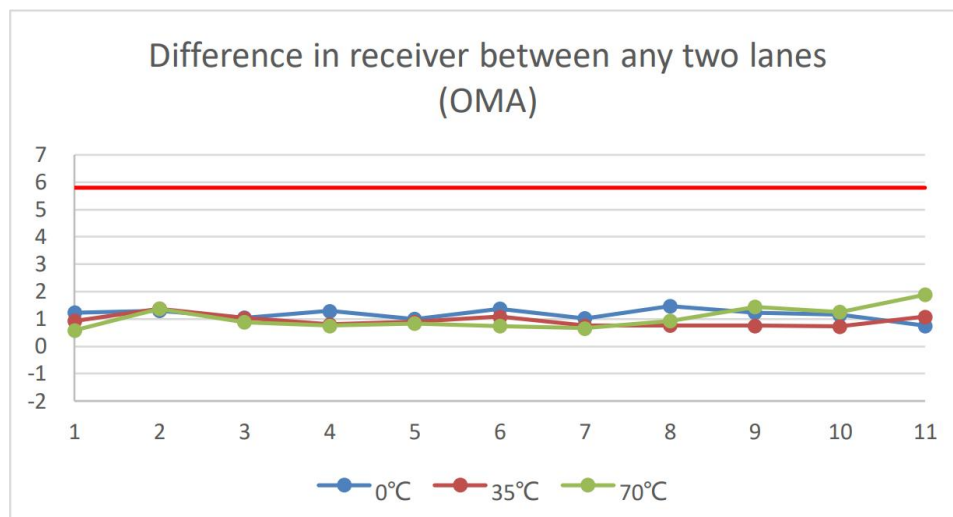
Table 15 Receiver power, each lane (OMA)

Module SN	0~70℃
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

4.16. Difference in receiver power between any two lanes (OMA outer)

Table 16 Difference in receiver power between any two lanes (OMA outer)

Parameters	Min	Max	Avg	Spec	unit
Difference in receiver power between any two lanes(OMA outer)	0.58	1.89	1.04	≦ 5.8	dB



4.17. Damage threshold, each lane

Measurement Conditions

- Data Rate: 26.5625GB/s
- Receiver power (OMA outer): -3.4dBm

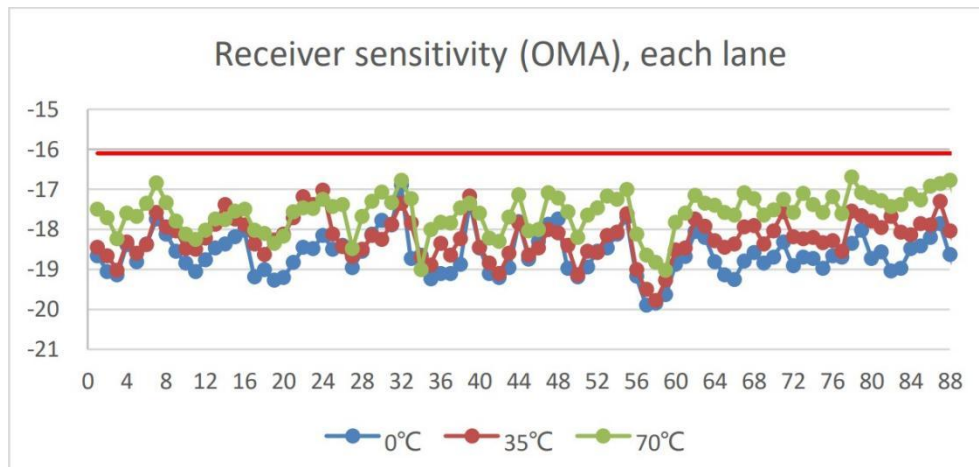
Table 17 Damage threshold, each lane

Module SN	0~70°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

4.18. Receiver sensitivity (OMA), each lane

Table 18 Receiver sensitivity (OMA), each lane

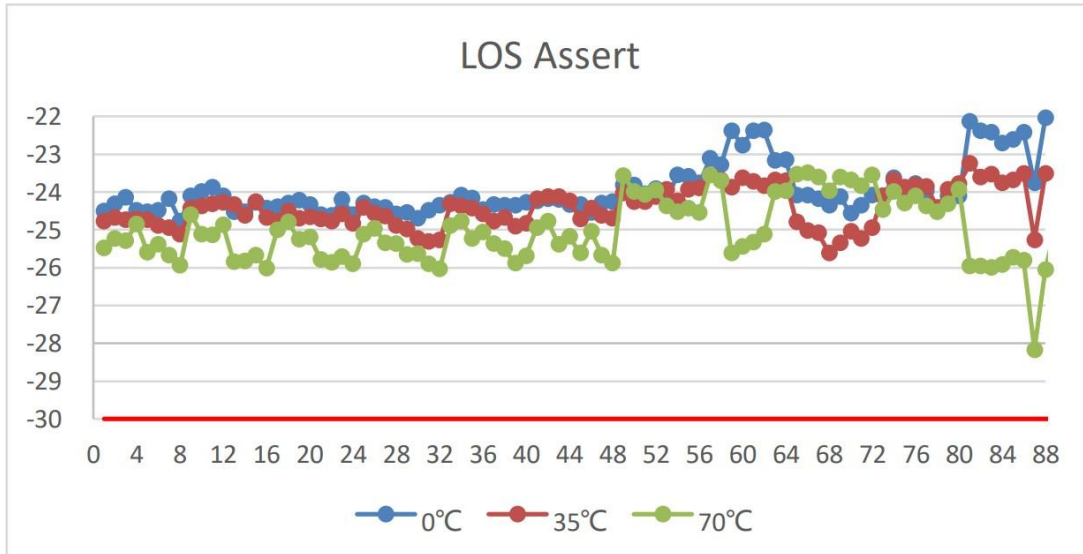
Parameters	Min	Max	Avg	Spec	unit
Receiver sensitivity (OMA), each lane	-19.9	-16.68	-18.16	-16.1	dBm



4.19. LOS Assert

Table 19 LOS Assert

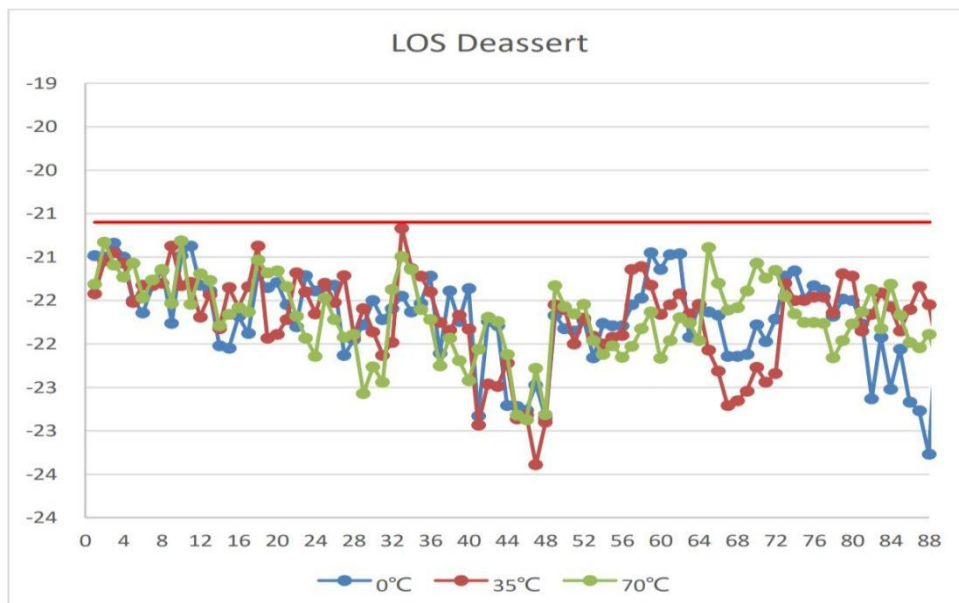
Parameters	Min	Max	Avg	Spec	unit
LOS Assert	-28.17	-22.05	-24.46	-30	dBm



4.20. LOS Deassert

Table 20 LOS Deassert

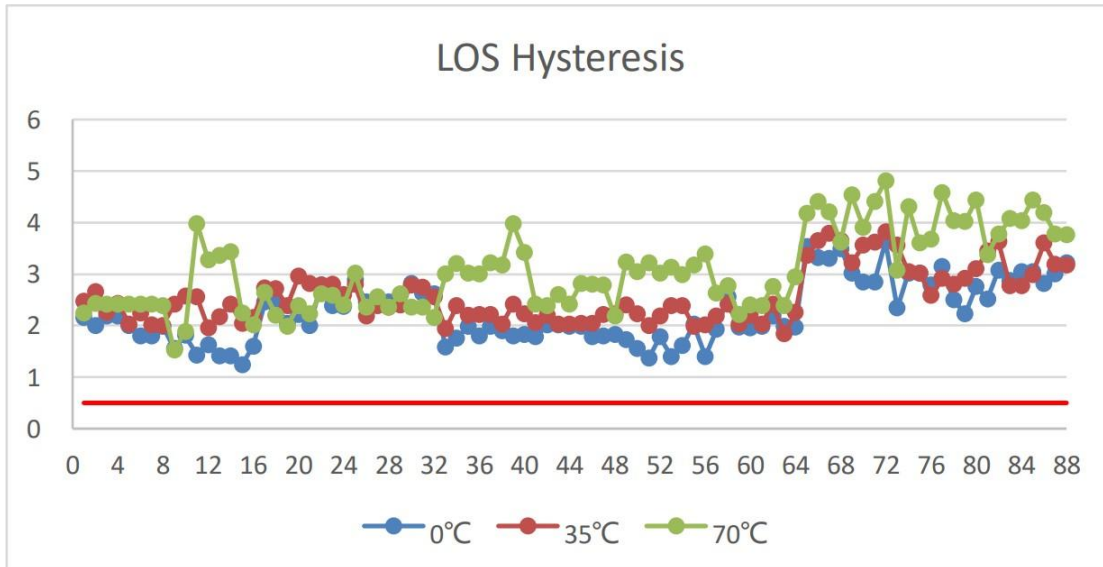
Parameters	Min	Max	Avg	Spec	unit
LOS Deassert	-23.39	-20.67	-21.70	-20.6	dBm



4.21. LOS Hysteresis

Table 21 LOS Hysteresis

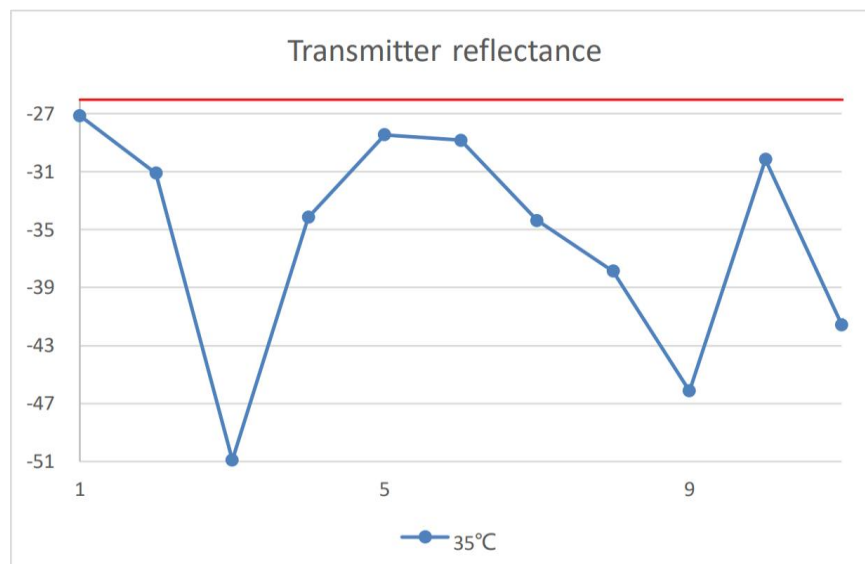
Parameters	Min	Max	Avg	Spec	unit
LOS Hysteresis	1.24	4.81	2.62	±0.5	dB



4.22. Receiver reflectance

Table 22 Receiver reflectance

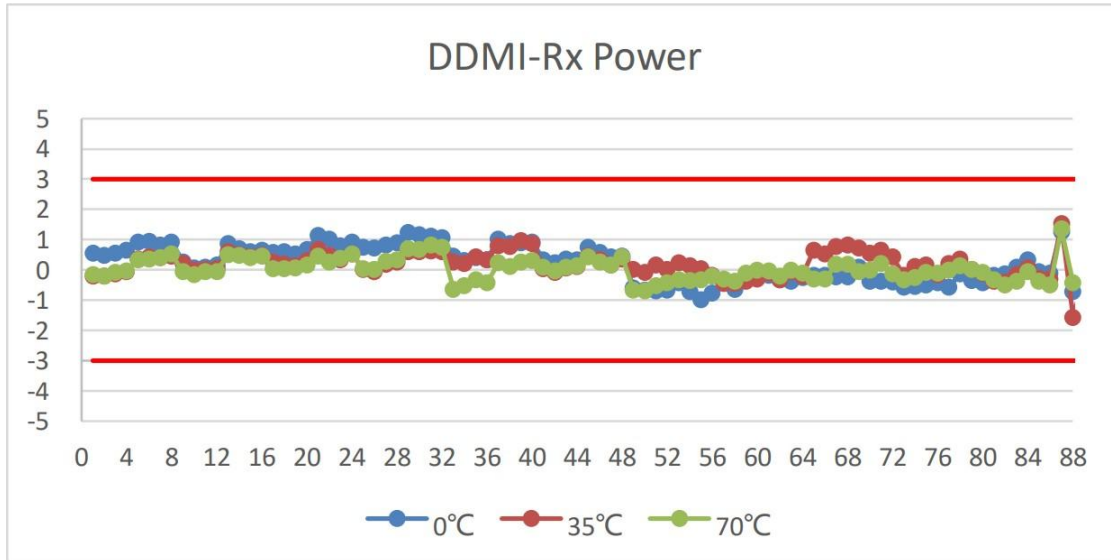
Parameters	Min	Max	Avg	Spec	unit
Receiver reflectance	-50.90	-27.14	-35.03	±26	dB



4.23. DDM-Rx Powers

Table 23 DDM-Rx Power

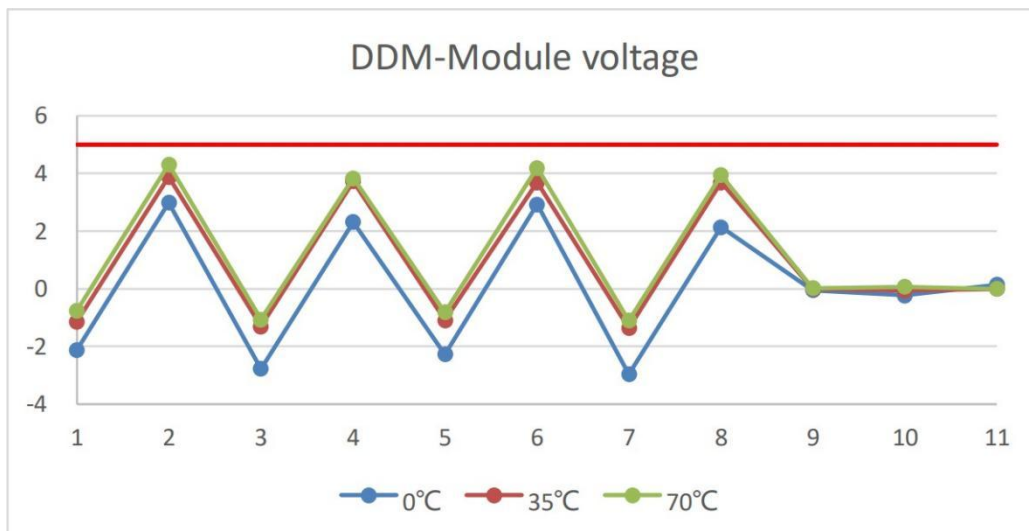
Parameters	Min	Max	Avg	Spec	unit
DDMI-Rx Power	-1.56	1.52	0.15	-3~3	dB



4.24. DDM-Module voltage

Table 24 DDM-Module voltage

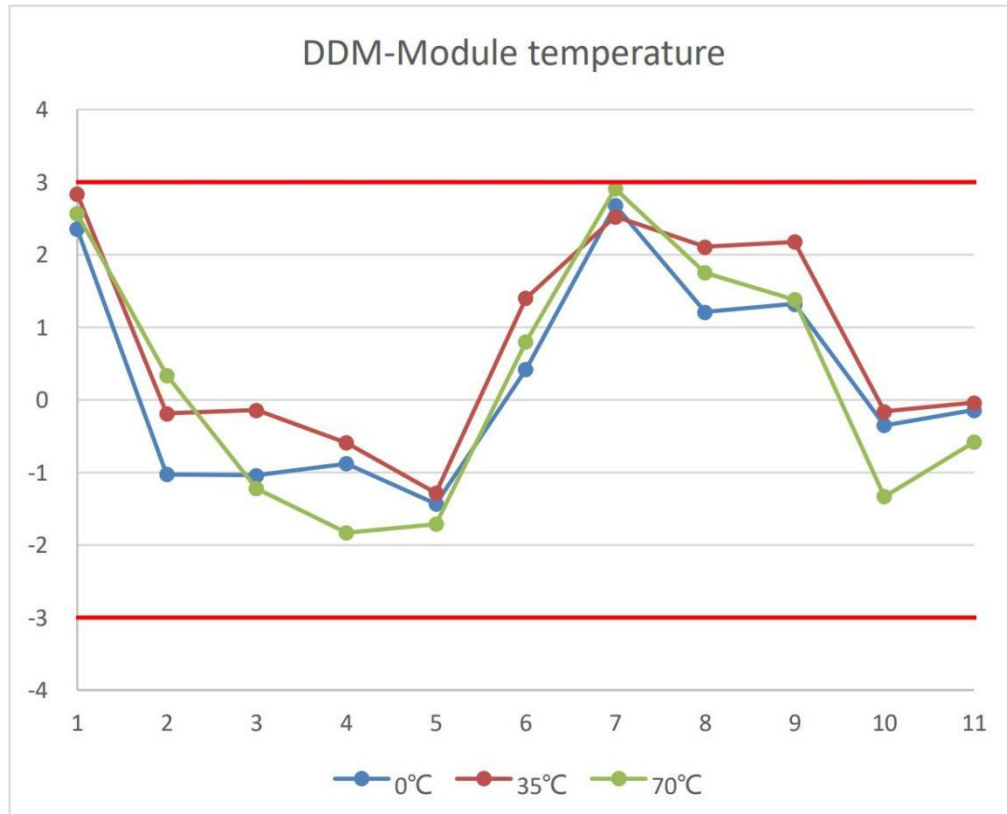
Parameters	Min	Max	Avg	Spec	unit
DDMI-Rx Power	-2.96	4.31	0.69	±5	%



4.25. DDM-Module temperatures

Table 25 DDM-Module temperature

Parameters	Min	Max	Avg	Spec	unit
DDMI-Module temperature	-1.83	2.91	0.43	0.43	°C



4.26. Long Term Transmission Test with 40km Fiber

Measurement Conditions

- Data Rate: 26.5625GB/s
- No Bit Errors in 48h
- Temperature Cycling: 0~70°C(Case Temperature).Temperature cycling curve as below

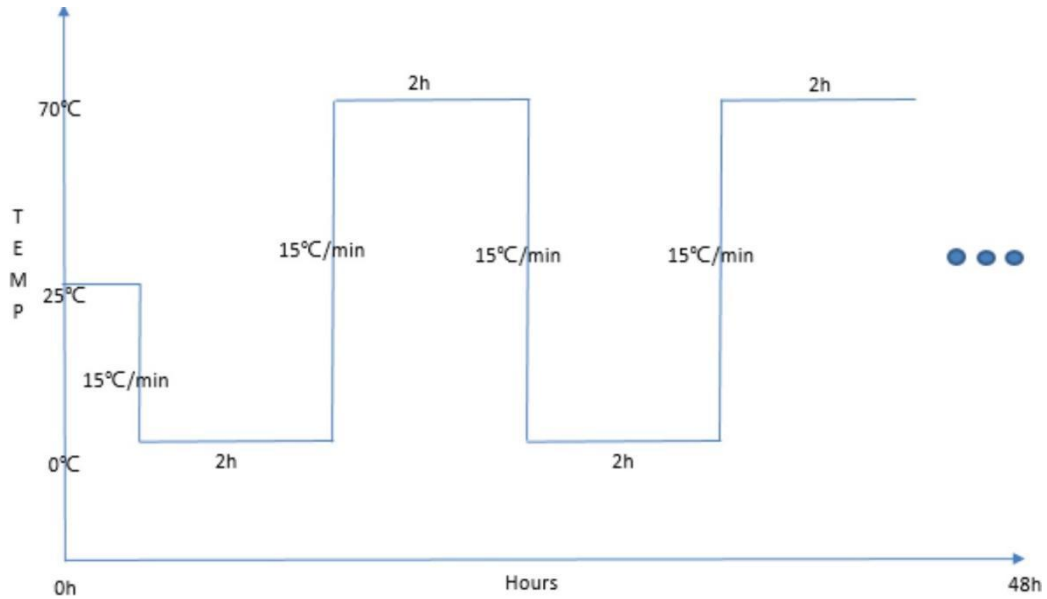


Table 26 Long Term Transmission Test with 40km Fiber

Module SN	0~70°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