QSFP-40G-LR4 Design Verification Testing Report

Reviewers

Department	Name	Review Date
Technical Testing Department	YangQin	2022-7-8

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Introduction

This report illustrates the electrical/ optical characterization of NADDOD Technologies' QSFP-40G-LR4 fiber optic transceivers as well as any special part numbers that shares the same build standard and specification.

Compliant with 40G Ethernet IEEE802.3ba and 40GBASE-LR4 Standard QSFP+ MSA compliant.

lanes MUX/DEMUX design. Up to 10km transmission Operating case temperature: 0~70C

Listed below are major configurations of the transceiver which has been tested for this report.

REFERENCE

1. 40GBASE-LR4 IEEE 802.3ba
2. SFF-8436 QSFP+ COPPER AND OPTICAL MODULES

Wavelength Information

Channel 1:1271nm

Channel 2:1291nm

Channel 3:1311nm

Channel 4:1331nm

DVT Result Summary

A. General Information

Sample No	Serial ID	QSFP+ L R 4 Product Information		
1	Sample No. 1	Internal		
2	Sample No. 2	Part No		
3	Sample No. 3	Code		RT-Q40LCM-C00
4	Sample No. 4			
5	Sample No. 5	Revision		1A
6	Sample No. 6			
7	Sample No. 7	Application		QSFP+ LR4
8	Sample No. 8			
9	Sample No. 9	Operating T- case	Low	0
10	Sample No. 10		Room	25
11	Sample No. 11		High	70
Test Spec:				
ASFF-8436 QSFP+ COPPER AND OPTICAL MODULES				

B. Test Results Summary

Table No	Description	Pass / Fail	Comments
1	Transmitter Performance over Temperature	Pass	
2	Receiver Performance over Temperature	Pass	
3	Diagnostic Monitoring Performance over Temperature	Pass	
4	Limit Test Summary	Pass	
5	Serial ID EEPROM Contents	Pass	
6	Digital Diagnostic EEPROM Contents	Pass	

Table 1. Transmitter Performance over Temperature

Test No.	Parameters	Unit	Specification		T case	Test Data			
			Min	Max		Avg	Min	Max	Stdev
1a	Optical Peak Wavelength Ch_1 1270nm	nm	1264.50	1277.50	Low				
					Room	1268.70	1267.80	1275.30	0.21
					High	1269.80	1268.70	1276.20	0.17
1b	Optical Peak Wavelength Ch_2 1290nm	nm	1284.50	1297.50	Low	1286.10	1284.60	1294.80	0.21
					Room	1288.70	1287.70	1295.20	0.22
					High	1289.40	1288.20	1296.50	0.19
1c	Optical Peak Wavelength Ch_3 1310nm	nm	1304.50	1317.50	Low	1306.20	1304.90	1314.50	0.22
					Room	1308.50	1307.50	1315.80	0.21
					High	1309.60	1308.60	1316.20	0.22
1d	Optical Peak Wavelength Ch_4 1330nm	nm	1324.50	1337.50	Low	1326.10	1324.80	1334.30	0.21
					Room	1328.50	1327.60	1335.20	0.22
					High	1329.80	1328.70	1336.70	0.20
2	RMS Spectral Width / -30dB Spectral Width	nm		1.00	Low	0.37	0.37	0.38	0.01
					Room	0.34	0.34	0.35	0.01
					High	0.33	0.33	0.34	0.01
3	SMSR				Low	37.20	36.02	38.17	1.09
					Room	39.19	35.57	41.20	3.14
					High	35.91	33.01	37.36	2.51
4	Total Average Launch Power	dBm		8.30	Low	7.40	6.83	7.96	1.02
					Room	7.12	6.54	7.86	1.34
					High	7.23	6.88	8.02	1.22
5a	Average Optical Power Ch_1 1270nm	dBm	-4.00	2.30	Low	1.59	0.13	2.72	0.98
					Room	0.93	-0.34	1.98	0.88
					High	0.76	-0.58	2.49	1.19
5b	Average Optical Power Ch_2 1290nm	dBm	-4.00	2.30	Low	1.26	-0.42	2.38	0.96
					Room	0.95	-0.54	2.22	1.03
					High	1.25	-0.72	2.18	1.08
5c	Average Optical Power Ch_3 1310nm	dBm	-4.00	2.30	Low	1.77	-0.52	2.61	1.18
					Room	0.84	-0.35	1.62	0.68
					High	1.72	1.01	2.89	0.77
5d	Average Optical Power Ch_4 1330nm	dBm	-4.00	2.30	Low	1.21	-0.57	2.60	1.21
					Room	0.72	-0.94	1.86	1.05
					High	0.71	-0.11	2.12	0.92
					Low	4.11	3.83	4.56	0.25

6a	Ch_1 1270nm				Room	4.17	3.74	4.50	0.26
					High	4.28	4.02	4.71	0.27

6b	Extinction Ratio Ch_2 1290nm				Low	4.03	4.08	4.81	0.28
					Room	4.18	3.78	4.18	0.13
					High	4.24	4.14	4.52	0.14
6c	Extinction Ratio Ch_3 1310nm				Low	3.98	3.78	4.18	0.13
					Room	4.28	4.14	4.52	0.14
					High	4.20	3.97	4.66	0.25
6d	Extinction Ratio Ch_4 1330nm				Low	4.11	3.88	4.34	0.18
					Room	4.16	4.06	4.22	0.06
					High	4.34	4.00	5.06	0.42
7a	Eye Mask Margin Ch_1 1270nm				Low	36.00	26.00	46.00	6.42
					Room	35.33	28.00	46.00	6.74
					High	21.00	11.00	28.00	7.56
7b	Eye Mask Margin Ch_2 1290nm				Low	29.17	17.00	38.00	7.03
					Room	24.67	17.00	35.00	6.77
					High	16.67	13.00	19.00	2.73
7c	Eye Mask Margin Ch_3 1310nm				Low	29.50	20.00	38.00	6.02
					Room	26.83	16.00	35.00	7.03
					High	17.83	15.00	21.00	2.64
7d	Eye Mask Margin Ch_4 1330nm				Low	38.83	24.00	47.00	7.99
					Room	31.17	14.00	43.00	13.50
					High	21.50	16.00	29.00	5.58
8	Disabled Optical Power	dBm		-30.00	Low	-45.00	-45.00	-45.00	-45.00
					Room	-45.00	-45.00	-45.00	-45.00
					High	-45.00	-45.00	-45.00	-45.00

Table 2.Receiver Performance over Temperature

Test NO.	Parameters	Unit	Specification		T case	Test Data			
			Min	Max		Avg	Min	Max	Stedv
1a	Sensitivity (With Golden Light source; 1E-12 BER Ch_1 1270nm)	dBm		-13.70	Low	-15.64	-15.20	-15.89	0.25
					Room	-15.41	-15.09	-15.55	0.40
					High	-15.74	-15.46	-15.95	0.60
1b	Sensitivity (With Golden Light source; 1E-12 BER Ch_2 1290nm)	dBm		-13.70	Low	-15.57	-15.34	-15.73	0.63
					Room	-15.84	-15.73	-15.86	0.74
					High	-15.46	-15.28	-15.53	0.83
1c	Sensitivity (With Golden Light source; 1E-12 BER Ch_3 1310nm)	dBm		-13.70	Low	-15.75	-15.28	-15.81	0.51
					Room	-15.40	-15.03	-15.69	0.24
					High	-15.35	-15.02	-15.66	0.42
1d	Sensitivity (With Golden Light source; 1E-12 BER Ch_4 1330nm)	dBm		-13.70	Low	-15.32	-15.00	-15.56	0.56
					Room	-15.39	-15.13	-15.88	0.30
					High	-15.68	-15.30	-15.91	0.47
2	LOS Assert Level	dBm	-28.00		Low	-27.50	-27.50	-27.50	0.00
					Room	-27.50	-27.50	-27.50	0.00
					High	-27.50	-27.50	-27.50	0.00
3	LOS Deassert Level	dBm		-16.00	Low	-16.00	-16.00	-16.00	0.00
					Room	-16.00	-16.00	-16.00	0.00
					High	-16.00	-16.00	-16.00	0.00
4	LOS Hysteresis	dB	0.50	5.00	Low	OK	OK	OK	OK
					Room	OK	OK	OK	OK
					High	OK	OK	OK	OK
5	Overload	dBm	2.30		Room	2.30	2.30	2.30	2.30

Table 3.Diagnostic Monitoring Performance over Temperature

Test NO.	Parameters	Unit	Specification		T case	Test Data		
			Min	Max		Avg	Min	Max
1	DD-Supply Voltage (ATS)	V	3.13	3.46	Low	3.31	3.29	3.33
					Room	3.29	3.26	3.31
					High	3.27	3.25	3.29
2	DD-Temperature (ATS)	Deg C	-8.00	-2.0	Low	-5.48	-6.24	-3.93
			22.00	28.0	Room	25.66	23.56	27.38
			72.00	78.0	High	75.21	73.51	77.97
3a	DD-Tx Output Power Err 1270nm	dB	-3.00	3.0	Low	-0.08	-0.31	0.03
					Room	-0.05	-0.15	0.09
					High	0.00	-0.11	0.21
3b	DD-Tx Output Power Err 1290nm	dB	-3.00	3.0	Low	-0.05	-0.15	0.01
					Room	-0.19	-0.74	0.17
					High	0.02	-0.12	0.13
3c	DD-Tx Output Power Err 1310nm	dB	-3.00	3.0	Low	-0.03	-0.08	0.06
					Room	-0.19	-0.73	0.10
					High	-0.03	-0.09	0.04
3d	DD-Tx Output Power Err 1330nm	dB	-3.00	3.0	Low	-0.01	-0.08	0.04
					Room	-0.15	-0.43	0.03
					High	-0.04	-0.11	0.08
4a	DD-Rx Power Reading Err 1270nm	dB	-3.00	3.0	Low	-0.31	-0.50	-0.15
					Room	-0.23	-0.50	0.23
					High	0.42	-0.23	0.80
4b	DD-Rx Power Reading Err 1290nm	dB	-3.00	3.0	Low	-0.48	-0.74	-0.15
					Room	-0.20	-0.46	0.22
					High	0.16	-0.27	0.95
4c	DD-Rx Power Reading Err 1310nm	dB	-3.00	3.0	Low	-0.41	-0.80	-0.06
					Room	-0.15	-0.67	0.35
					High	0.12	-0.18	0.27
4d	DD-Rx Power Reading Err 1330nm	dB	-3.00	3.0	Low	-0.36	-0.53	-0.13
					Room	-0.30	-0.61	-0.05
					High	0.50	0.09	1.45

Table 4.Limit Test Summary

Test NO.	Parameters	Unit	Specification		Conditions	Test Data			
			Min	Max		Avg	Min	Max	Stdev
1	Total Power Dissipation	mW		3500	DC P.S. Voltage : 3.14V;3.3V;3.46V Temperature : Low;Room;High Pattern :2^31-1;Rate :10.3125G	1821.34	1798.65	2000.78	108.34
2	Tx Average Power	dBm	-7	2.3		1.89	-1.78	1.98	0.89
3	Extinction Ratio	dB	3.5			4.35	3.78	4.89	0.56
4	Eye Mask Margin	%	10			24.33	12	45	4.87
5	Sensitivity	dBm		-11.5		-12.89	-11.86	-14.22	0.98
6	LOS Assert level	dBm				-27.5	-27.5	-27.5	0
7	LOS Deassert level	dBm		-15		-15.5	-15.5	-15.5	0
8	LOS Hysteresis	dB	0.5	5		OK	OK	OK	0
9	DD-Tx Power Err	dB	-3	3		-0.89	-1.86	1.54	0.89
10	DD-Rx Power Err	dB	-3	3		0.34	-1.56	1.32	0.56

Table 5.Serial ID EEPROM Content Check

Serial ID EEPROM Table					CRC Verification result:	PASS
I2C Addr	Byte Address		Serial ID Section ($A0)			
	(Dec)	(Hex)	Test data (Hex)	Content (Dec)	Item	Description
A0	128	80	D	13	Identifier	QSFP+
A0	129	81	C4	196	Extended Identifier	3.5W max. power consumption
A0	130	82	7	7	Connector Type	LC Fiber Connector
A0	131	83	2	2	Transceiver application supported	40GBASE- LR4
A0	132	84	0	0		0
A0	133	85	0	0		0
A0	134	86	0	0		0
A0	135	87	10	16		Long Distance
A0	136	88	10	16		Longwave Laser (LL)
A0	137	89	1	1		1
A0	138	8A	80	128		1200 Mbytes/Sec
A0	139	8B	3	3	Encoding	NRZ
A0	140	8C	67	103	Nominal Bit Rate	10300Mbps
A0	141	8D	0	0	Rate Select	QSFP+ Rate Select Version 1.
A0	142	8E	A	10	Link Length(Standard SM Fiber)	10km
A0	143	8F	0	0	Link Length(OM3)	Not supported
A0	144	90	0	0	Link Length(OM2)	Not supported
A0	145	91	0	0	Link Length(OM1)	Not supported
A0	146	92	0	0	Link Length(Cooper)	Not supported
A0	147	93	40	64	Device Tech	1310nm DFB;No wavelength control;Uncooled transmitter device;PINdetector;Transmitter not tuneable
A0	148	94	52	82	Vendor Name	RAYOPTEK
A0	149	95	41	65		
A0	150	96	59	89		
A0	151	97	4F	79		
A0	152	98	50	80		
A0	153	99	54	84		
A0	154	9A	45	69		
A0	155	9B	4B	75		
A0	156	9C	20	32		
A0	157	9D	20	32		
A0	158	9E	20	32		
A0	159	9F	20	32		
A0	160	A0	20	32		
A0	161	A1	20	32		

A0	162	A2	20	32		
A0	163	A3	20	32		
A0	164	A4	7	7	Electronic or optical interfaces for InfiniBand	4x SDR Speed(2.5Gb/s),DDR Speed(5.0Gb/s),QDR Speed(10Gb/s).

A0	165	A5	00	00	Vendor OUI	
A0	166	A6	00	00		
A0	167	A7	00	00		
A0	168	A8	20	32	Vendor PN	
A0	169	A9	20	32		
A0	170	AA	20	32		
A0	171	AB	20	32		
A0	172	AC	20	32		
A0	173	AD	20	32		
A0	174	AE	20	32		
A0	175	AF	20	32		
A0	176	B0	20	32		
A0	177	B1	20	32		
A0	178	B2	20	32		
A0	179	B3	20	32		
A0	180	B4	20	32		
A0	181	B5	20	32		
A0	182	B6	20	32		
A0	183	B7	20	32		
A0	184	B8	31	49	Vendor Rev	Rev.1A
A0	185	B9	41	65		
A0	186	BA	65	101	Wavelength	1300nm
A0	187	BB	90	144		
A0	188	BC	17	23	Wavelength Tolerance	±30nm
A0	189	BD	70	112		
A0	190	BE	46	70	Max Case Temp	Max Case Temp 70°C
A0	191	BF	0	0	Check Sum	Address 192-222
A0	192	C0	0	0		0
A0	193	C1	0	0		0
A0	194	C2	0	0		0
A0	195	C3	DE	222		222
A0	196	C4	20	32	Vendor SN	
A0	197	C5	20	32		
A0	198	C6	20	32		
A0	199	C7	20	32		
A0	200	C8	20	32		
A0	201	C9	20	32		
A0	202	CA	20	32		
A0	203	CB	20	32		
A0	204	CC	20	32		
A0	205	CD	20	32		

A0	206	CE	20	32		
A0	207	CF	20	32		
A0	208	D0	20	32		
A0	209	D1	20	32		

A0	210	D2	20	32		
A0	211	D3	20	32		
A0	212	D4	31	49	Date Code	2017.02.01
A0	213	D5	37	55		
A0	214	D6	30	48		
A0	215	D7	32	50		
A0	216	D8	32	50		
A0	217	D9	30	48		
A0	218	DA	31	49	Lot Number	49
A0	219	DB	39	57		57
A0	220	DC	8	8		8
A0	221	DD	0	0		0
A0	222	DE	0	0		0
A0	223	DF	0	0	Check Sum	Address 192-222

Table 6.Digital Diagnostic EEPROM Content

Diagnostic EEPROM Content		CRC Verification result:		PASS
Byte Address		Alarm/Warning Section ($A0, Page 3)		
(Dec)	(Hex)	Test data (Hex)	Content (Dec/Bin)	Item	Interpretation
128	80	50	80	Temperature High alarm threshold (deg C)	80
129	81	0	0		
130	82	F6	246	Temperature Low alarm threshold	-10
131	83	0	0		
132	84	4B	75	Temperature High warning threshold	75
133	85	0	0		
134	86	FB	251	Temperature Low warning threshold	-5.00
135	87	0	0		
136	88	FF	255	Reserved	
137	89	FF	255		
138	8A	FF	255		
139	8B	FF	255		
140	8C	FF	255		
141	8D	FF	255		
142	8E	FF	255		
143	8F	FF	255		
144	90	90	144	Voltage High alarm threshold (V)	3.70
145	91	88	136		
146	92	71	113	Voltage Low alarm threshold	2.90
147	93	70	112		
148	94	8C	140	Voltage High warning threshold	3.60
149	95	70	112		
150	96	75	117	Voltage Low warning threshold	3.00
151	97	48	72		
152	98	FF	255	Reserved	
153	99	FF	255		
154	9A	FF	255		
155	9B	FF	255		
156	9C	FF	255		
157	9D	FF	255		
158	9E	FF	255		
159	9F	FF	255		
160	A0	FF	255	Vendor specific	
161	A1	FF	255		
162	A2	FF	255		
163	A3	FF	255		
164	A4	FF	255		
165	A5	FF	255		
166	A6	FF	255		
167	A7	FF	255		
168	A8	FF	255		

169	A9	FF	255		
170	AA	FF	255		
171	AB	FF	255		
172	AC	FF	255		
173	AD	FF	255		
174	AE	FF	255		
175	AF	FF	255		
176	B0	6E	110	RX power High alarm threshold (dBm)	5
177	B1	18	24		
178	B2	2	2	RX power Low alarm threshold	-13
179	B3	32	50		
180	B4	62	98	RX power High warning threshold	4
181	B5	1F	31		
182	B6	2	2	RX power Low warning threshold	-11
183	B7	C4	196		
184	B8	92	146	Bias High alarm threshold (mA)	75
185	B9	7C	124		
186	BA	13	19	Bias Low alarm threshold	10
187	BB	88	136		
188	BC	88	136	Bias High warning threshold	70
189	BD	B8	184		
190	BE	1D	29	Bias Low warning threshold	15
191	BF	4C	76		
192	C0	6E	110	TX power High alarm threshold (dBm)	5
193	C1	18	24		
194	C2	8	8	TX power Low alarm threshold	-6.5
195	C3	BF	191		
196	C4	62	98	TX power High warning threshold	4
197	C5	1F	31		
198	C6	9	9	TX power Low warning threshold	-6
199	C7	D0	208		
200	C8	FF	255	Reserved	
201	C9	FF	255		
202	CA	FF	255		
203	CB	FF	255		
204	CC	FF	255		
205	CD	FF	255		
206	CE	FF	255		
207	CF	FF	255		
208	D0	FF	255	Vendor specific	
209	D1	FF	255		
210	D2	FF	255		
211	D3	FF	255		
212	D4	FF	255		
213	D5	FF	255		
214	D6	FF	255		
215	D7	FF	255		
216	D8	FF	255		
217	D9	FF	255		
218	DA	FF	255		
219	DB	FF	255		

220	DC	FF	255		
221	DD	FF	255		
222	DE	FF	255		
223	DF	FF	255		
224	E0	FF	255	Reserved	
225	E1	FF	255		
226	E2	FF	255	Vendor specific	
227	E3	FF	255		

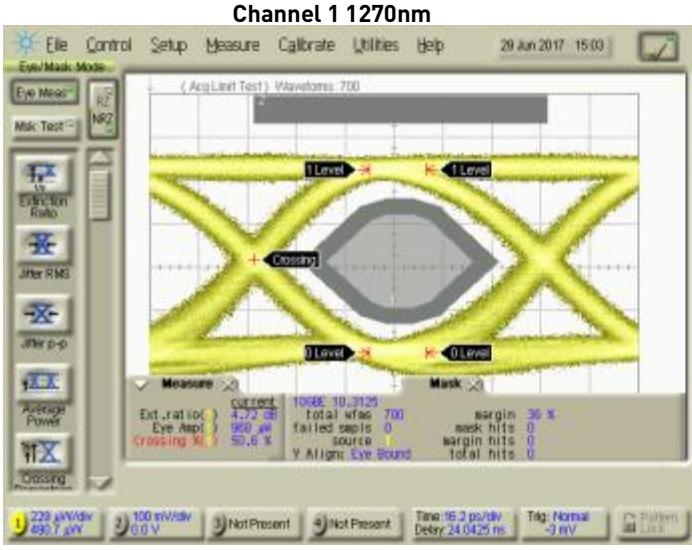
228	E4	FF	255		
229	E5	FF	255		
230	E6	FF	255		
231	E7	FF	255		
232	E8	FF	255		
233	E9	FF	255		
234	EA	FF	255		
235	EB	FF	255		
236	EC	FF	255		
237	ED	FF	255		
238	EE	FF	255	RX1/2 output amplitude	
239	EF	FF	255	RX3/4 output amplitude	
240	F0	0	0	Optional Channel Controls	
241	F1	0	0		
242	F2	0	0	Channel Monitor Masks	
243	F3	0	0		
244	F4	0	0		
245	F5	0	0		
246	F6	FF	255	Reserved	
247	F7	FF	255		
248	F8	FF	255		
249	F9	FF	255		
250	FA	FF	255		
251	FB	FF	255		
252	FC	FF	255		
253	FD	FF	255		
254	FE	FF	255		
255	FF	FF	255		

Annex 1:EEPROM Write and Read

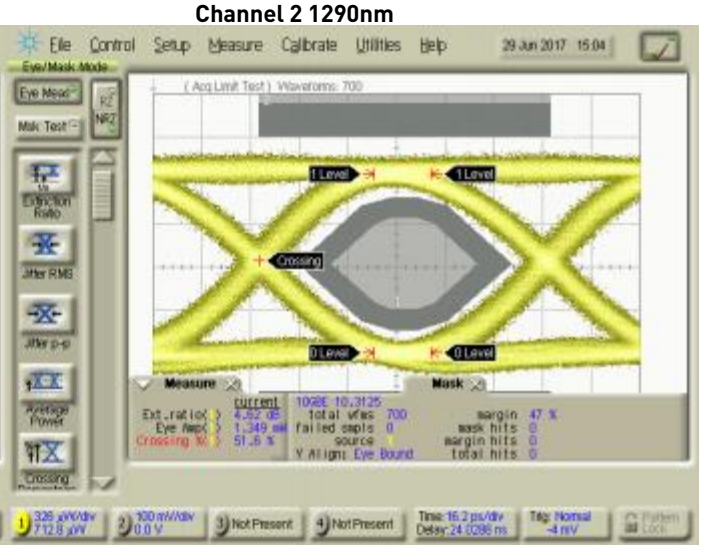
(Rate: 10.3125G; Pattern:2^31-1;T-case: RT-LT-HT; From Top to Bottom)

T-Case: Room temperature

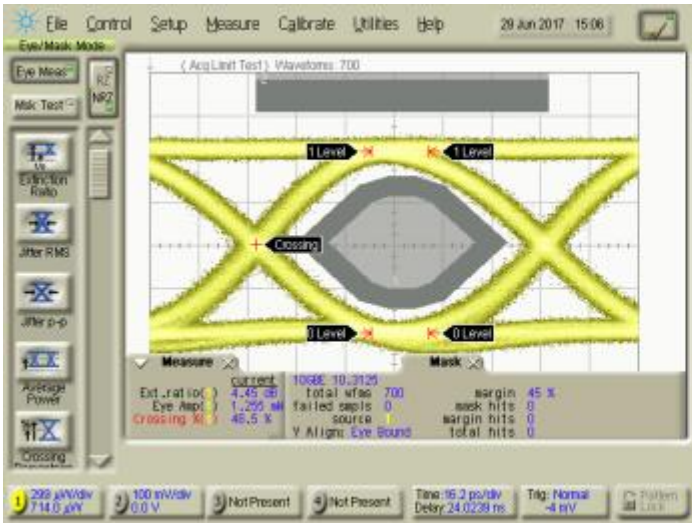
Channel 1 1270nm



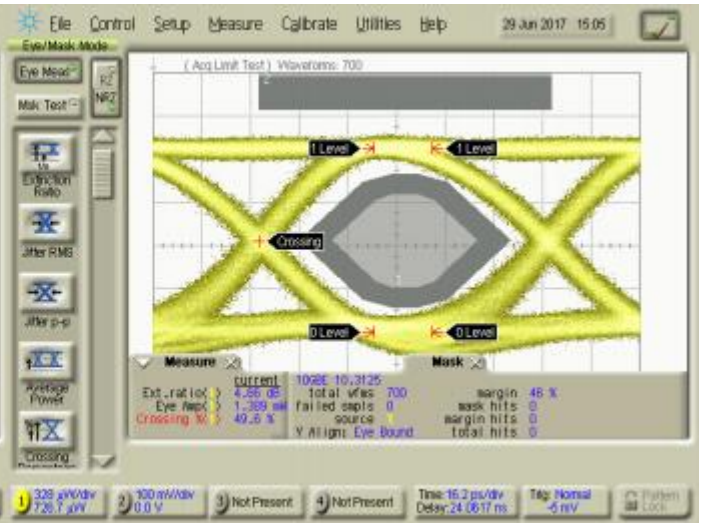
Channel 2 1290nm



Channel 3 1310nm

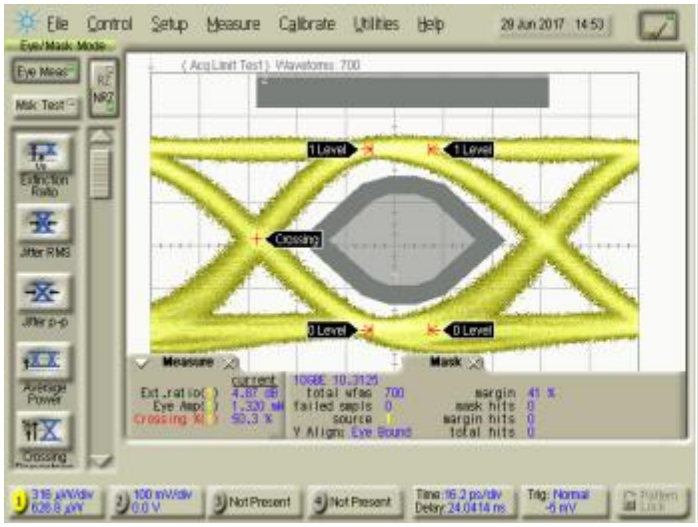


Channel 4 1330nm

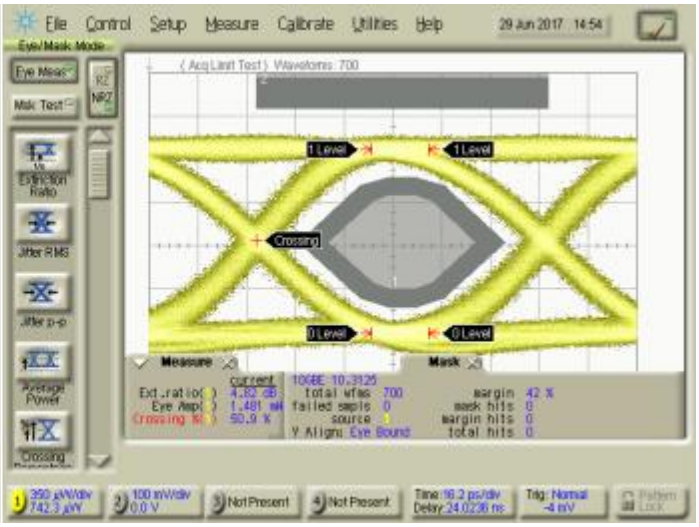


T-Case: Low temperature

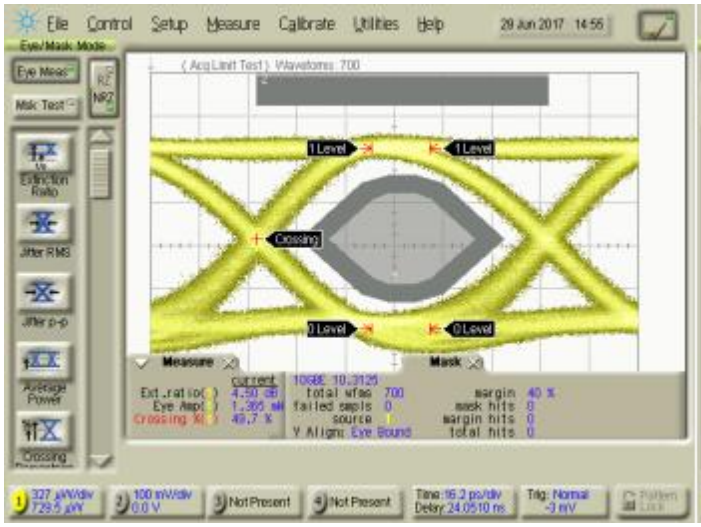
Channel 1 1270nm



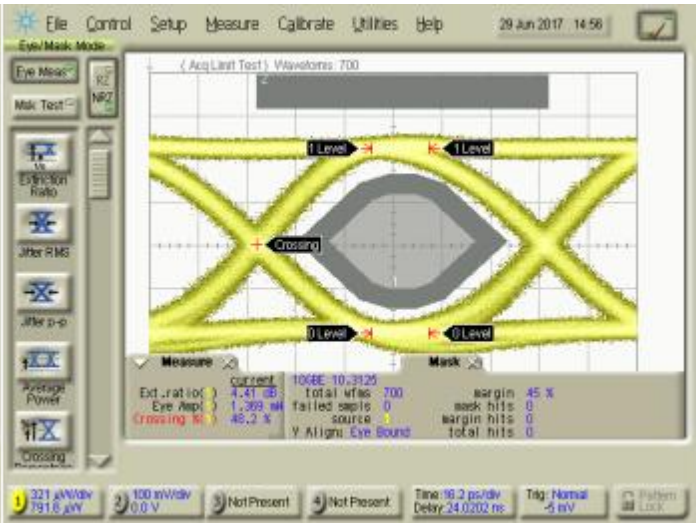
Channel 2 1290nm



Channel 3 1310nm

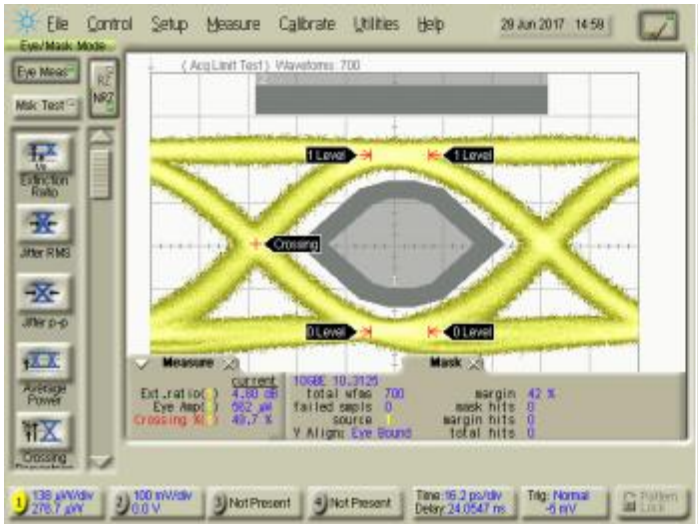


Channel 4 1330nm

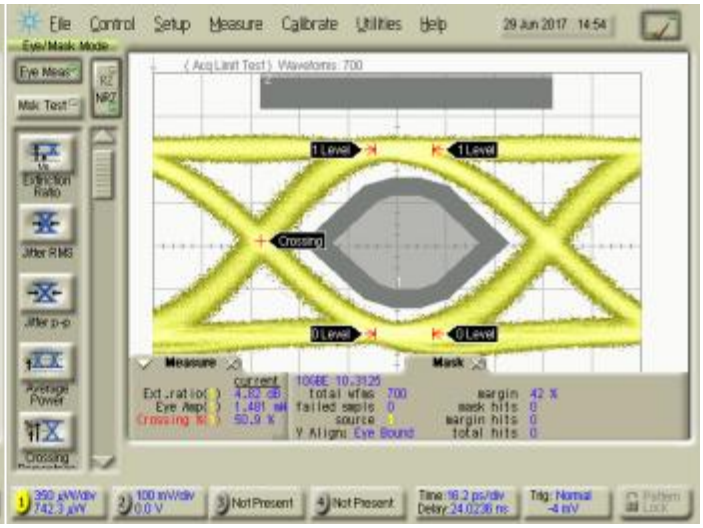


T-Case: High temperature

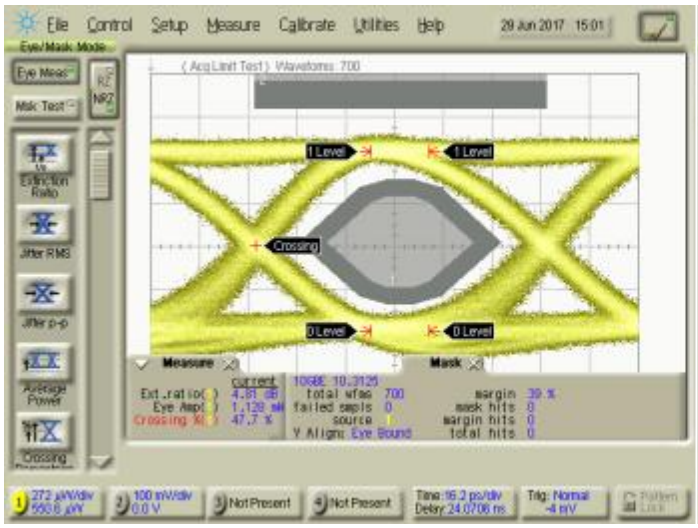
Channel 1 1270nm



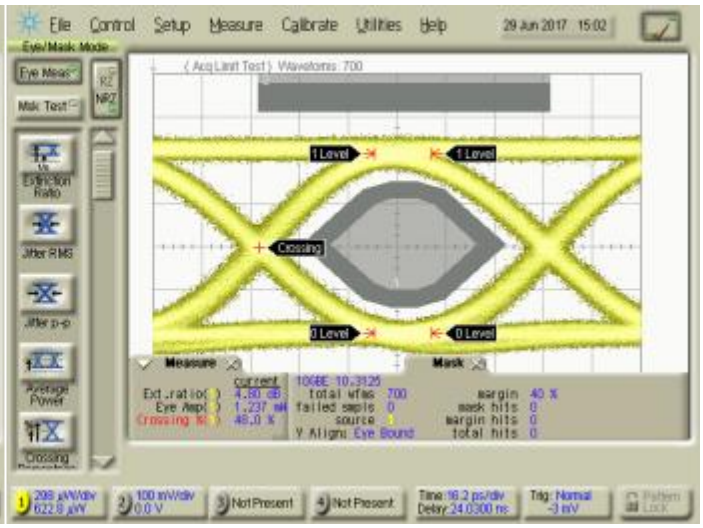
Channel 2 1290nm



Channel 3 1310nm



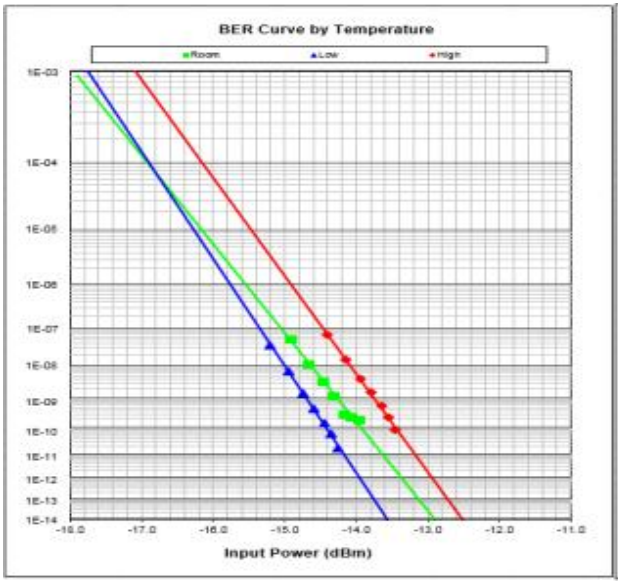
Channel 4 1330nm



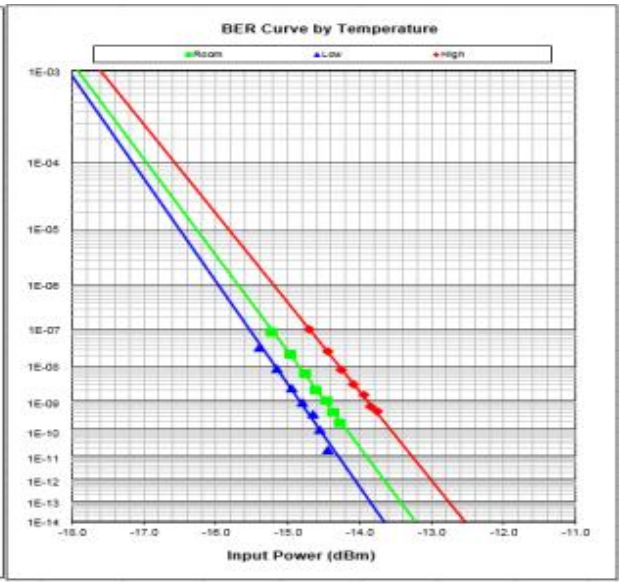
Annex 2:BER Curve by Temperature

(S/N: Sample No.9;Test condition: Vcc=+3.3V; Rate :10.3125G; Pattern: 2^31-1)

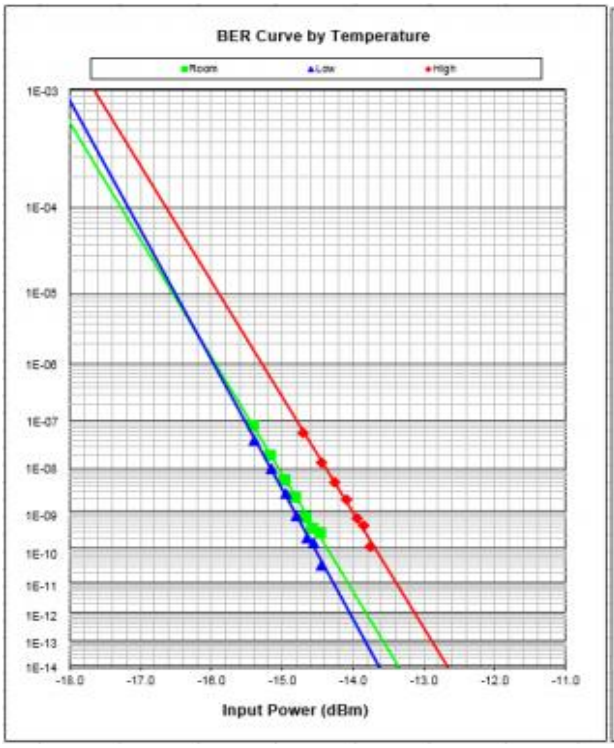
CH 1



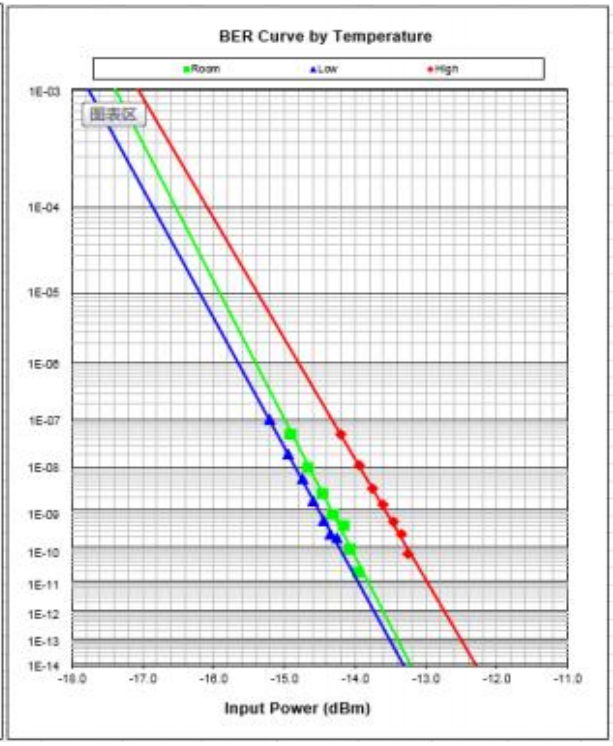
CH 2



CH 3



CH 4



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