

# 40GBASE-UNIV QSFP+ 1310nm 2km DOM Optical Transceiver Module for SMF/MMF

BN-CKM-SP-ER-LL



## Application

- 40G Ethernet over MMF and SMF
- Infiniband QDR and DDR interconnects

## Features

- Hot-pluggable QSFP+ form factor
- Operates over duplex multimode and single mode fiber with dual LC receptacles
- Supports 41.2 Gb/s aggregate bit rate
- Power dissipation <3.5W
- Commercial case temperature range 0° C to 70° C
- Maximum link length of 150m on OM3, and 2km on SMF
- Uncooled 4x10Gb/s CWDM transmitter
- XLPI electrical interface
- Built-in digital diagnostic functions, including Tx/Rx power monitoring
- RoHS-6 Compliant

## Description

The BN-CKM-SP-ER-LL is a transceiver module designed for 2km (SMF) / 150m (MMF) optical communication applications. They are compliant with the IEEE 802.3ba 40GBASE-LR4 referred to as LM4. The module converts 4 input channels (ch) of 10Gb/s electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 40Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 40Gb/s input into 4 CWDM channels signals, and converts them to 4 channel output electrical data.

## Product Specifications

### I. General Specifications

Parameter	Value	Unit	Notes
<b>Module Form Factor</b>	QSFP+		
<b>Maximum Aggregate Data Rate</b>	41.2	Gb/s	
<b>Maximum Data Rate per Lane</b>	10.3125	Gb/s	
<b>Protocols Supported</b>	40G Ethernet		
<b>Electrical Interface and Pin-out</b>	38-pin edge connector		Pin-out as defined by the QSFP+ MSA
<b>Maximum Power Consumption</b>	3.5	Watts	
<b>Management Interface</b>	Serial, I2C-based, 400 kHz maximum frequency		As defined by the QSFP+ MSA

Data Rate Specifications	Symbol	Min	Typ.	Max	Units	Ref.
<b>Bit Rate per Lane</b>	BR			10,313	Mb/sec	1
<b>Bit Error Ratio</b>	BER			10-12		2
<b>Link distance on OM3</b>	d			150	meters	
<b>Link distance on OM4</b>	d			160	meters	
<b>Link distance on SMF</b>	d			2000	meters	

**Notes:**

1. Adapted from 40GBASE-LR4, IEEE 802.3ba
2. Tested with a PRBS 231-1 test pattern.

**II. Absolute Maximum Ratings**

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Maximum Supply Voltage</b>	Vcc1, VccTx, VccRx	-0.5		4	V	
<b>Storage Temperature</b>	Ts	-40		85	° C	
<b>Case Operating Temperature</b>	Top	0		70	° C	
<b>Relative Humidity</b>	RH	0		85	%	1
<b>Damage Threshold, per Lane</b>	DT	3.4			dBm	

**Notes:**

Non-condensing.

### III. Electrical Characteristics (TOP= 0 to 70°C, VCC = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Supply Voltage</b>	Vcc1, VccTx, VccRx	3.1		3.47	V	
<b>Supply Current</b>	Icc			1.13	A	
<b>Transmit turn-on time</b>				2000	ms	1
<b>Transmitter (per Lane)</b>						
<b>Single ended input voltage tolerance</b>	VinT	-0.3		4.0	V	
<b>Differential data input swing</b>	Vin,pp	120		1200	mVpp	2
<b>Differential input threshold</b>			50		mV	
<b>AC common mode input voltage tolerance (RMS)</b>		15			mV	
<b>Differential input return loss</b>			Per IEEE P802.3ba,Section 86A.4.1.1		dB	3
<b>J2 Jitter Tolerance</b>	Jt2	0.17			UI	
<b>J9 Jitter Tolerance</b>	Jt9	0.29			UI	
<b>Data Dependent Pulse Width Shrinkage</b>	DDPWS	0.07			UI	
<b>Eye mask colordinates {X1, X2 ,Y1, Y2}</b>			0.11, 0.31 95, 350		UI mV	4

### Receiver (per Lane)

<b>Single-ended output voltage</b>		-0.3		4.0	V	
<b>Differential data output swing</b>	V <sub>out,pp</sub>	0		800	mVpp	5
<b>AC common mode output voltage (RMS)</b>				7.5	mV	
<b>Termination mismatch at 1 MHz</b>				5	%	
<b>Differential output return loss</b>		Per IEEE P802.3ba,Section 86A.4.2.1			dB	3
<b>Common mode output return loss</b>		Per IEEE P802.3ba,Section 86A.4.2.2			dB	3
<b>Output transition time, 20% to 80%</b>		28			ps	
<b>J2 Jitter output</b>	Jo2			0.42	UI	
<b>J9 Jitter output</b>	Jo9			0.65	UI	
<b>Eye mask coordinates #1 {X1, X2, Y1, Y2}</b>			0.29, 0.5 150, 425		UI mV	4
<b>Power Supply Ripple Tolerance</b>	PSR	50			mVpp	

#### Notes:

1. From power-on and end of any fault conditions.
2. After internal AC coupling. Self-biasing 100Ω differential input.
3. 10 MHz to 11.1 GHz range
4. Hit ratio = 5 x 10E-5.
5. AC coupled with 100Ω differential output impedance.

#### IV. Optical Characteristics (TOP = 0 to 70°C, VCC = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Transmitter (per Lane)</b>						
<b>Signaling Speed per Lane</b>				11.2	GBd	1
<b>Lane center wavelengths (range)</b>		1264.5 – 1277.5 1284.5 – 1297.5 1304.5 – 1317.5 1324.5 – 1337.5			nm	
<b>Total Average Launch Power</b>	POUT			8.3	dBm	
<b>Average Launch Power per Lane, MMF</b>	TXPx	-7.0		4.3	dBm	2
<b>Average Launch Power per Lane, SMF</b>		-10.0		2.3		
<b>Transmit OMA per Lane, MMF</b>	TxOMA	-3.0		4.8	dBm	
<b>Transmit OMA per Lane, SMF</b>		-6.0		3.5	dBm	
<b>Transmitter Dispersion Penalty, MMF</b>	TXP-TDP			4.7	dBm	3
<b>Transmitter Dispersion Penalty, SMF</b>				2.6		
<b>Average launch power of OFF transmitter, per Lane</b>				-30	dBm	
<b>Relative Intensity Noise</b>	RIN			-128	dB/Hz	4
<b>Sidemode Suppression ratio</b>	SSRmin	30			dB	
<b>Optical Extinction Ratio</b>	ER	3.5			dB	
<b>Optical Return Loss Tolerance</b>				20	dB	
<b>Transmitter Reflectance</b>				-12	dB	
<b>Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}</b>		(0.25, 0.4, 0.45, 0.25, 0.28, 0.4)				

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Receiver(per Lane)</b>						
<b>Signaling Speed per Lane</b>				11.2	GBd	5
<b>Lane center wavelengths(range)</b>		1264.5 – 1277.5 1284.5 – 1297.5 1304.5 – 1317.5 1324.5 – 1337.5			nm	
<b>Receive Power (OMA) per Lane, MMF</b>				4.8		
	RXOMA				dBm	
<b>Receive Power (OMA) per Lane, SMF</b>				3.3		
<b>Damage Threshold per Lane</b>	PMAX			5.5	dBm	
<b>Average Receive Power per Lane, MMF</b>		-10.0		4.3		
	RXPx				dBm	
<b>Average Receive Power per Lane, SMF</b>		-13.7		2.3		6
<b>Receiver Sensitivity (OMA) per Lane, MMF</b>				-10.5		
	Rxsens				dBm	
<b>Receiver Sensitivity (OMA) per Lane, SMF</b>				-10.5		7
<b>Stressed Receiver Sensitivity (OMA) per Lane, MMF</b>				-5.0		
	SRS				dBm	
<b>Stressed Receiver Sensitivity (OMA) per Lane, SMF</b>				-8.5		

<b>Return Loss</b>	RL			-20	dB	
<b>Vertical eye closure penalty, per lane</b>				3.6	dB	
<b>Receive electrical 3 dB upper cutoff frequency, per lane</b>				12.3	dB	
<b>LOS De-Assert</b>	LOSD			-12	dBm	8
<b>LOS Assert</b>	LOSA	-28			dBm	8
<b>LOS Hysteresis</b>			1		dB	

**Notes:**

1. Transmitter consists of 4 lasers operating at 10.3Gb/s each.
2. Minimum value is informative.
3. Even if TDP < 0.5 dB (MMF) or TDP < 0.8 dB (SMF), TxP – TDP must be greater than this value.
4. RIN is scaled by  $10 \cdot \log(10/4)$  to maintain SNR outside of transmitter.
5. Receiver consists of 4 photodetectors operating at 10.3Gb/s each.
6. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.
7. SMF receiver sensitivity guaranteed by design, but not measured in production.
8. LOS Assert and De-Assert values are informative and may vary between MMF and SMF uses.



## V. Pin Description

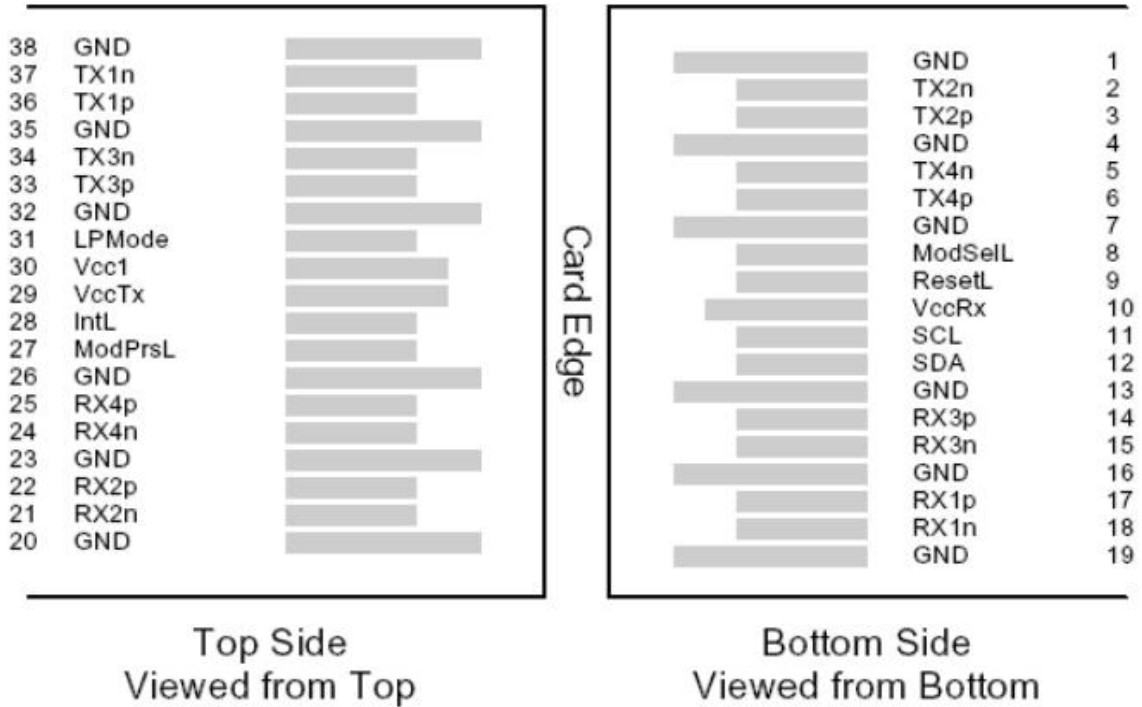


Figure 1 – QSFP+ MSA-compliant 38-pin connector

Pin	Symbol	Name/Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	

10	Vcc Rx	+3.3 V Power supply receiver	
11	SCL	2-wire serial interface clock	
12	SDA	2-wire serial interface data	
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	Vcc Tx	+3.3 V Power supply transmitter	
30	Vcc1	+3.3 V Power Supply	
31	LPMoDe	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	

34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

**Note:**

1.Circuit ground is internally isolated from chassis ground.

## VI. Mechanical Specifications

The mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

