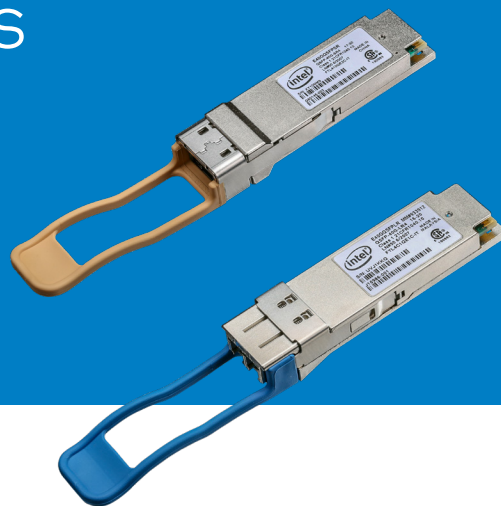


# Intel® Ethernet QSFP+ Optics



## QSFP+ 40GBASE-SR4 and 40GBASE-LR4 Optics for Intel® Ethernet Network Adapters

### Key Features

- Support for 40GBASE Ethernet
- Hot-swappable 40GbE I/O transceiver that plugs into a QSFP+ port
- Supports the 4x10 GbE mode to connect to four 10GBASE-SR or 10GBASE-LR optical interfaces
- Four channel, full duplex transceiver module
- Single MPO receptacle (SR)
- Single LC receptacle (LR)
- Maximum power dissipation < 1.5 W SR4; < 3.5 W LR4
- RoHS-6 compliant (lead-free)
- Commercial temperature range 0-70 °C
- Maximum link length 10 km on Single Mode Fiber (SMF)
- Maximum link length 100 m on Multimode Fiber (MMF)
- 1.06 Gb/s to 10.5 Gb/s per channel multi-rate capability
- Compatible with Intel® Ethernet Network Adapters

### Overview

Intel® Ethernet QSFP+ Optics offer customers an efficient way to move to 40GbE for high bandwidth application requirements such as content distribution, high-end virtualization using multiple CPUs, network appliances, and Applications Delivery Controllers (ACD). When used with the Intel® Ethernet Network Adapter XL710, these optics support either 40GbE or 4x10GbE mode for four 10GBASE-SR or 10GBASE-LR optical interfaces.

To ensure maximum flexibility, Intel supports the ability to use either Intel® Ethernet QSFP+ Optics or direct attach twinaxial cables. This helps customers create the configuration that best meets the needs of their data center environment, while ensuring compatibility between adapter and accessories.

## General Specifications

Module Form Factor	QSFP+
Network Standards Physical Layer Interface	40GBASE-SR4 and 40GBASE-LR4 (4 x 10 GbE and 1 x 40 GbE)
QSFP+ Module Specifications	<ul style="list-style-type: none"> <li>• INF-8438i Specification for QSFP (Quad Small Form factor Pluggable) Transceiver</li> <li>• SFF-8436 – Specification for QSFP+ Copper and Optical Transceiver</li> <li>• IEEE 802.3ba – PMD Type 40GBASE-SR4 or 40GBASE-LR4</li> </ul>
Number of Lanes	4 Tx and 4 Rx
Airflow and Temperature Guidelines	Refer to adapter product brief for specific airflow and temperature requirements <sup>1</sup>
NOTE: When two Intel® Ethernet Network Adapter X520 and XL710 Series QSFP+ devices are connected back to back, they should be configured with the same Speed/Duplex setting. Results may vary if speed settings are mixed.	

## Product Order Code

E40GQSFP  
E40GQSFP+  
E40GQSFP+LR

## SR4 Optical Characteristics

(T<sub>op</sub> = 0 °C to 70 °C, VCC=3.15 to 3.45 V)

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Transmitter (per Lane)</b>						
Signaling Speed per Lane			10.5		Gb/s	1
Center Wavelength		840		860	nm	
RMS Spectral Width	SW			0.65	nm	
Average Launch Power per Lane	TXP <sub>x</sub>	-7.6		-1.0	dBm	
Transmit OMA per Lane	TxOMA	-5.6		3.0	dBm	2
Difference in Power between any two lanes (OMA)	DP <sub>x</sub>			4.0	dB	
Peek Power per Lane	PP <sub>x</sub>			4.0	dBm	
Launch Power (OMA) minus TDP per Lane	P-TDP	-6.5			dBm	
TDP per Lane	TDP			3.5	dBm	
Optical Extinction Ratio	ER	3.0			dB	
Optical Return Loss Tolerance	ORL			12	dB	
Encircled Flux	FLX		> 86% at 19 um < 30% at 4.5 um		dBm	
Average launch power of OFF transmitter per lane				-30	dBm	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter eye mask definition	(X1, X2, X3) (Y1, Y2, Y3)		0.23, 0.34, 0.43 0.27, 0.35, 0.4			

### Notes:

1. Transmitter consists of four lasers operating at a maximum rate of 10.5 Gb/s each.
2. Even if TDP is < 0.9 dB, the OMA min must exceed this value.

## SR4 Optical Characteristics (Continued)

(T<sub>op</sub> = 0 °C to 70 °C, VCC=3.15 to 3.45 V)

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Receiver (per Lane)</b>						
Signaling Speed per Lane			10.5		GBd	1
Center Wavelength		840		860	nm	
Damage Threshold	DT	3.4			dBm	
Average Receive Power per Lane	RXP <sub>x</sub>	-9.5		2.4	dBm	
Receive Power (OMA) per Lane	RxOMA			3.0	dBm	
Stressed Receiver Sensitivity (OMA) per Lane	SRS			-5.4	dBm	
Peak Power per Lane	PP <sub>x</sub>			4	dBm	
Receiver Reflectance	Rfl			-12	dB	
Loss of Optic Signal (LOS) De-Assert	LOS <sub>D</sub>			-12	dBm	
Loss of Optic Signal (LOS) Assert	LOS <sub>A</sub>	-30			dBm	
Loss of Optic Signal (LOS) Hysteresis		0.5			dBm	

Notes:

1. Receiver consists of four photodetectors operating at a maximum rate of 10.5 Gb/s each.

## SR4 Electrical Characteristics

(T<sub>op</sub> = 0 °C to 70 °C, VCC=3.15 to 3.45 V)

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	Vcc1 VccTx VccRx	3.15		3.45	V	
Supply Current	Icc			350	mA	
<b>Link Turn-On Time</b>						
Transmit turn-on time				2000	ms	1
<b>Transmitter (per Lane)</b>						
Single-ended input voltage tolerance	VinT	-0.3		4.0	V	
Differential data input swing	Vin,pp	180		1200	mVpp	2
Differential input threshold			50		mV	
AC common mode input voltage tolerance (RMS)		15			mV	
Differential input return loss		Per IEEE P802.3ba, Section 86A.4.1.1			dB	3
J2 Jitter Tolerance	Jt2	0.17			UI	
J9 Jitter Tolerance	Jt9	0.29			UI	
Data Dependent Pulse Width Shrinkage	DDPWS	0.07			UI	
Eye mask coordinates	(X1, X2) (Y1, Y2)		0.11, 0.31 95, 350		UI mV	4

Notes:

1. From power-on and end of any fault conditions.
2. After internal AC coupling. Self-biasing 100 Ω differential input.
3. 10 MHz to 11.1 GHz range.
4. Hit ratio = 5 x 10E-5. Valid for all settings in Figure 1.

## SR4 Electrical Characteristics (Continued)

(T<sub>op</sub> = 0 °C to 70 °C, VCC=3.15 to 3.45 V)

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Receiver (per Lane)</b>						
Single-ended output voltage		-0.3		4.0	V	
Differential data output swing	V <sub>out,pp</sub>	0		800	mVpp	1, 2
AC common mode output voltage (RMS)				7.5	mV	
Termination mismatch at 1 MHz				5	%	
Differential output return loss		Per IEEE P802.3ba, Section 86A.4.2.1			dB	3
Common mode output return loss		Per IEEE P802.3ba, Section 86A.4.2.2			dB	3
Output transition time, 20% to 80%		28			ps	
J2 Jitter output	Jo2			0.42	UI	
J9 Jitter output	Jo9			0.65	UI	
Eye mask coordinates #1	(X1, X2) (Y1, Y2)		0.29, 0.5 150, 425		UI mV	4
Eye mask coordinates #2	(X1, X2) (Y1, Y2)		0.29, 0.5 125, 500		UI mV	5
Power Supply Ripple Tolerance	PSR	50			mVpp	

Notes:

1. AC coupled with 100 Ω differential output impedance.
2. Settable in four discrete steps via the I<sup>2</sup>C interface. See Figure 1 for V<sub>out</sub> setting.
3. 10 MHz to 11.1 GHz range.
4. Hit ratio = 5 × 10E-5. Valid only for the shaded setting in Figure 1.
5. Hit ratio = 5 × 10E-5. Valid for all settings in Figure 1.

Power (mW)		Pre-Emphasis into 100 Ohms (mV)			
		0	125	175	325
V <sub>out</sub> (mV)	0	599			
	317	751	935	971	1075
	422	787	971	1007	1111
	739	883	1055	1103	1190

Figure 1 - Power Dissipation (mW, maximum) vs. Rx Output Conditions

## LR4 Optical Characteristics

( $T_{op}$  = 0 °C to 70 °C, VCC=3.1 to 3.47 V)

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Transmitter (per Lane)</b>						
Signaling Speed per Lane				10.3125	Gb/s	1
Lane Center Wavelengths (Range)			1264.5 - 1277.5 1284.5 - 1297.5 1304.5 - 1317.5 1324.5 - 1337.5		nm	
Total Average Launch Power	$P_{OUT}$			8.3	dBm	
Transmit OMA per Lane	TxOMA	-4.0		3.5	dBm	
Average Launch Power per Lane	TPX <sub>x</sub>	-7.0		2.3	dBm	2
Optical Extinction Ratio	ER	3.5			dB	
Sidemode Suppression Ratio	SSRP <sub>MIN</sub>	30			dB	
Average Launch Power of OFF Transmitter per Lane				-30	dBm	
Relative Intensity Noise	RIN			-128	dB/Hz	3
Optical Return Loss Tolerance				20	dB	
Transmitter Reflectance				-12	dB	
Transmitter Eye Mask Definition	(X1, X2, X3) (Y1, Y2, Y3)		0.25, 0.4, 0.45 0.25, 0.28, 0.4			
<b>Receiver (per Lane)</b>						
Signaling Speed per Lane				10.3125	GBd	4
Lane Center Wavelengths (Range)			1264.5 - 1277.5 1284.5 - 1297.5 1304.5 - 1317.5 1324.5 - 1337.5		nm	
Receive Power (OMA) per Lane	RxOMA			3.5	dBm	
Average Receive Power per Lane	RXP <sub>x</sub>	-13.7		2.3	dBm	5
Receive Sensitivity (OMA) per Lane	Rxsens			-11.5	dBm	
Stressed Receiver Sensitivity (OMA) per Lane	SRS			-9.6	dBm	
Damage Threshold per Lane	$P_{MAX}$			3.4	dBm	
Return Loss	RL			-26	dB	
Vertical Eye Closure Penalty per Lane				1.9	dB	
Receive Electrical 3 dB Upper Cutoff Frequency per Lane				12.3	GHz	
Loss of Optic Signal (LOS) De-Assert	LOS <sub>D</sub>			-12	dBm	
Loss of Optic Signal (LOS) Assert	LOS <sub>A</sub>	-280			dBm	
Loss of Optic Signal (LOS) Hysteresis			1		dB	

### Notes:

1. Transmitter consists of four lasers operating at 10.3 Gb/s each.
2. Minimum value is informative.
3. RIN is scaled by  $10 \cdot \log(10/4)$  to maintain SNR outside of transmitter.
4. Receiver consists of four photodetectors operating at 10.3 Gb/s each.
5. Minimum value is informative, equals min TxOMA with infinite ER and maximum channel insertion loss.

## LR4 Electrical Characteristics

(T<sub>op</sub> = 0 °C to 70 °C, VCC=3.1 to 3.47 V)

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	Vcc1, VccTx, VccRx	3.1		3.47	V	
Supply Current	Icc			1.13	A	
<b>Link Turn-on Time</b>						
Transmit turn-on time				2000	ms	1
<b>Transmitter (per Lane)</b>						
Single Ended Input Voltage Tolerance	VinT	-0.3		4.0	V	
Differential Data Input Swing	Vin,pp	120		1200	mVpp	2
Differential Input Threshold	RIN		50		mV	
AC Common Mode Input Voltage Tolerance (RMS)		15			mV	
Differential Input Return Loss		Per IEEE P802.3ba, Section 86A.4.1.1			dB	3
J2 Jitter Tolerance	Jt2	0.17			UI	
J9 Jitter Tolerance	Tj9	0.29			UI	
Data Dependent Pulse Width Shrinkage	DDPWS	0.07			UI	
Eye Mask Coordinates	(X1, X2) (Y1, Y2)		0.11, 0.31 95, 350		UI mV	4
<b>Receiver (per Lane)</b>						
Single Ended Output Voltage		-0.3		4	V	
Differential Data Output Swing	Vout,pp	200 300 400 600	550	400 600 800 1200	mVpp	5, 6
AC Common Mode Output Voltage (RMS)				7.5	mV	
Termination Mismatch at 1 MHz				5	%	
Differential Output Return Loss		Per IEEE P802.3ba, Section 86A.4.2.1			dB	
Common Mode Output Return Loss		Per IEEE P802.3ba, Section 86A.4.2.2			dB	
Output Transition Time, 20%-to-80%		28			ps	
J2 Jitter Output	Jo2			0.42	UI	
J9 Jitter Output	Jo9			0.65	UI	
Eye Mask Coordinates #1	(X1, X2) (Y1, Y2)		0.29, 0.5 150, 425		UI mV	
Power Supply Ripple Tolerance	PSR	50			mVpp	

### Notes:

1. From power on and end of any fault conditions.
2. After internal AC coupling. Self-biasing 100 Ω differential input.
3. 10 MHz-to-11.1 GHz range.
4. Hit ratio = 5 x 10E-5.
5. AC coupled with 100 Ω differential output impedance.
6. Output voltage can be set using four discrete steps via I<sup>2</sup>C. Default is 400-800 mV.

## Regulatory Compliance

Transceivers are Class 1 Laser Products and comply with US FDA regulations. These products are certified to meet the Class 1 eye safety requirements of EN (IEC) 60825 and the electrical safety requirements of EN (IEC) 60950. Copies of certificates are available from Intel Corporation upon request.

## For Product Information

For information about all Intel® Ethernet Products, visit:  
[intel.com/ethernet](http://intel.com/ethernet)

## Warranty

Intel® Ethernet Optics have a **limited warranty** of three years from the date of shipment.

## Customer Support

For customer support options in North America visit:  
[intel.com/content/www/us/en/support/contact-support.html](http://intel.com/content/www/us/en/support/contact-support.html)

<sup>1</sup> Optical Module Requirements for Intel® Ethernet Network Adapters with QSFP+ Open Optics Support

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