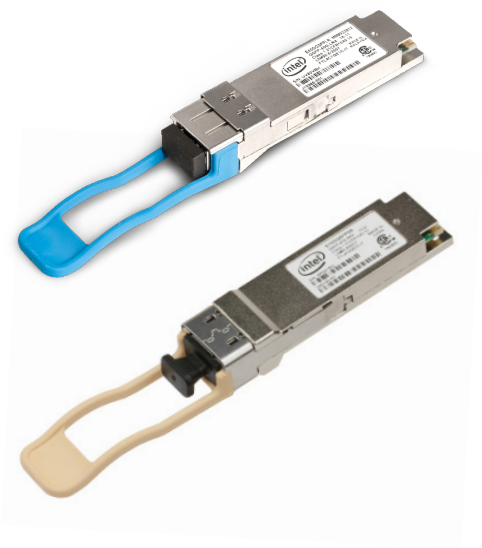
PRODUCT BRIEF
Intel® Ethernet QSFP+ Optics
Network Connectivity

Intel® Ethernet QSFP+ Optics

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



Key Features

- Support for 40GBASE Ethernet
- Hot-swappable 40 GbE 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 Multi-mode Fiber (MMF)
- 1.06 Gb/s to 10.5 Gb/s per channel multi-rate capability
- Compatible with Intel® Ethernet Converged Network Adapters

Overview

The Intel® Ethernet QSFP+ Optics are available for customers who would like to deploy Intel® Ethernet Converged Network Adapters with a QSFP+ SR/LR optic. Intel® Ethernet Converged Network Adapters with QSFP+ connectivity deliver proven, reliable solutions for deployments of high density Ethernet for unified 10GbE and 40 GbE network connections.

Customers can move efficiently to 40 GbE for high bandwidth application requirements such as content distribution, high-end virtualization using multiple CPUs, network appliances, and Applications Delivery Controllers (ACD) used for content caching, load balancing, and compression. To ensure maximum flexibility,

Intel supports the ability to use Intel® Ethernet QSFP+ Optics, Intel® Ethernet QSFP+ Twinaxial Cables, or Intel® Ethernet QSFP+ Breakout 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 Specificatons	
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	• INF-8438i Specification for QSFP (Quad Small Form factor Pluggable) Transceiver • SFF-8436 – Specification for QSFP+ Copper and Optical Transceiver • IEEE 802.3ba – PMD Type 40GBASE-SR4 or 40GBASE-LR4
Number of Lanes	4 Tx and 4 Rx
Product Code	E40GQSFPSR or E40GQSFPLR
Airflow and Temperature Guidelines	Refer to adapter product brief for specific airflow and temperature requirements[1]

NOTE: When two Intel® Ethernet Converged 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.

Compatible Intel® Ethernet Network Adapter Product Codes

Configuration	No. of Ports	Single Pack	Bulk 5 Pack
Intel® Ethernet Converged Network Adapter XL710-QDA1	1	XL710QDA1	XL710QDA1BLK
Intel® Ethernet Converged Network Adapter XL710-QDA2	2	XL710QDA2	XL710QDA2BLK
Intel® Ethernet Server Adapter XL710-QDA1 for OCP	1		XL710QDA1OCP
Intel® Ethernet Server Adapter XL710-QDA2 for OCP	2		XL710QDA2OCP

Optical Characteristics SR4

(T_{OP} = 0 °C to 70 °C, VCC=3.15 to 3.45 V)

Parameter		Symbol	Min	Typ	Max	Unit	Note
Transmitter (per Lane)							
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_x	-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_x			4.0	dB	
Peek Power per Lane		PP_x			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	
Reletive 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			
Receiver (per Lane)							
Signaling Speed per Lane				10.5		GBd	3
Center Wavelength			840		860	nm	
Damage Threshold		DT	3.4			dBm	
Average Receive Power per Lane		RXP_x	-9.5		2.4	dBm	
Receive Power (OMA) per Lane		RxOMA			3.0	dBm	
Stressed Reveiver Sensitivity (OMA) per Lane		SRS			-5.4	dBm	
Peak Power per Lane		PP_x			4	dBm	
Receiver Reflectance		Rfl			-12	dB	
Conditions of stressed receiver sensitivity test:							
Vertical Eye Closure Penalty (VECP) per lane					1.9	dB	
Stressed eye J2 jitter per lane					0.3	UI	
Stressed eye J9 jitter per lane					0.47	UI	
OMA of each aggressor lane					-0.4	dBm	
Rx jitter tolerance in OMA per lane				Max	-5.4	dBm	
Conditions of receiver jitter tolerance test:							
Jitter frequency and peak-to-peak amplitude					(75, 5)	KHz, UI	
Jitter frequency and peak-to-peak amplitude					(357, 1)	KHz, UI	
OMA of each aggressor lane					-0.4	dBm	
Loss of Optic Signal (LOS) De-Assert		LOS_D			-12	dBm	
Loss of Optic Signal (LOS) Assert		LOS_A	-30			dBm	
Loss of Optic Signal (LOS) Hysteresis			0.5			dBm	

Notes:
1. Transmitter consists or 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.
3. Receiver consists of four photodetectors operating at a maximum rate of 10.5 Gb/s each.

Electrical Characteristics SR4

(T_{OP} = 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	
Link Turn-On Time							
Transmit turn-on time					2000	ms	2
Transmitter (per Lane)							
Single-ended input voltage tolerance		VinT	-0.3		4.0	V	
Differential data input swing		Vin,pp	180		1200	mVpp	3
Differential input threshold				50		mV	
AC common mode input voltage tolerance (RMS)			15			mV	
Differential imput return loss			Per IEEE P802.3ba, Section 86A.4.1.1			dB	4
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	5
Receiver (per Lane)							
Single-ended output voltage			-0.3		4.0	V	
Differential data output swing		Vout,pp	0		800	mVpp	7, 8
AC common mode output voltage (RMS)					7.5	mV	
Termination mismatch at 1 MHz					5	%	
Differnetial output return loss			Per IEEE P802.3ba, Section 86A.4.2.1			dB	4
Common mode output return loss			Per IEEE P802.3ba, Section 86A.4.2.2			dB	4
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	6
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. Maximum total power value is specified across the full temperature and voltage range.
2. From power-on and end of any fault conditions.
3. After internal AC coupling. Self-biasing 100 Ω differential input.
4. 10 MHz to 11.1 GHz range.
5. Hit ratio = 5 x 10E-5. Valid for all settings in Figure 1.
6. Hit ratio = 5 x 10E-5. Valid only for the shaded setting in Figure 1.
7. AC coupled with 100 Ω differential output impedence.
8. Settable in four diecrete steps via the I^2C interface. See Figure 1 for Vout setting.

Power (mW)		Pre-Emphasis into 100 Ohms (mV)			
		0	125	175	325
Volt (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

Optical Characteristics LR4

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

Parameter		Symbol	Min	Typ	Max	Unit	Note
Transmitter (per Lane)							
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_X	-7.0		2.3	dBm	2
Optical Extinction Ratio		ER	3.5			dB	
Sidemode Suppression Ratio		$SSRP_{MIN}$	30			dB	
Average Launch Power of OFF Transmiter 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			
Receiver (per Lane)							
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_X	-13.7		2.3	dBm	5
Receive Sensitivity (OMA) per Lane		Rxsens			-11.5	dBm	
Stressed Reveiver 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_D			-12	dBm	
Loss of Optic Signal (LOS) Assert		LOS_A	-280			dBm	
Loss of Optic Signal (LOS) Hysteresis				1		dB	

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

Electrical Characteristics LR4

(T_{OP} = 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	
Link Turn-on Time						
Transmit turn-on time				2000	ms	1
Transmitter (per Lane)						
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 Corrdinates (X1, X2, Y1, Y2)		0.11, 0.31, 95, 350			UI mV	4
Receiver (per Lane)						
Single Ended Output Voltage		-0.3		4	V	
Differential Data Output Swing	Vout,pp	200		400	mVpp	5, 6
		300		600		
		400	550	800		
		600		1200		
AC Common Mode Output Voltage (RMS)				7.5	mV	
Termination Mismatch at 1 MHx				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^2C. 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.

Customer Support

For customer support documentation visit: intel.com/support.

To contact customer support in North America visit: intel.com/content/www/us/en/support/contact-support.html.

For Product Information

For information about all Intel® Ethernet Products, visit: intel.com/ethernet.

[1] Optical Module Requirements for Intel® Ethernet Converged Network Adapters with QSFP+ Open Optics Support

Intel® Ethernet Converged Network adapters with QSFP+ Open Optics Support are designed to support either Power Class 1 modules or Power Class 4 modules as defined in the SFF-8679 specification. Consult the Intel documentation for the recommended Intel Ethernet Converged Network adapter for the supported Power Class. When Intel® QSFP+ Ethernet Optics modules are used, adapter use conditions for ambient temperature and airflow have been verified to meet the Standard Temperature Class of Operation as defined in the SFF-8679 specification. For use of other optics modules, it is the system integrator's responsibility to determine the necessary ambient temperature and airflow necessary for the third party optical modules to operate within the Temperature Class of Operation at all times. Operating optical modules outside the supplier specified Temperature Class of Operation range will permanently reduce the performance of the optical module over time.

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