

# Intel® Ethernet QSFP28 Optic



**Intel® Ethernet QSFP28 Optic delivers high-performing computing interconnect for deployments of 100GbE**

## Key Features

- Hot-pluggable QSFP28 optical transceiver
- Up to 100 m link on OM4 multi-mode fiber (MMF)
- Up to 10km link on single mode fiber (SMF)
- Four independent parallel optical channels
- Max power 2.5 W (SR), 4.5W (LR)
- QSFP28 MSA compliance
- Power class 3 (SR)
- Power class 6 (LR)
- Extended case operating temperature 0 to 85 °C
- RoHS II Compliance
- Meets standard BER of 5E-5

## Overview

Intel® Ethernet QSFP28 Optics are an excellent choice for fiber systems in high-speed communications equipment. Both short range and long-range transceiver modules are available for maximum customer flexibility. The extended case operating temperature allows customers to support a range of server requirements.

These 100GbE optical transceivers come integrated with four independent transmit and receive channels, each capable of 25GbE operation, for an aggregate data rate of 100GbE. The QSFP28 SR4 transceiver is a high-performing module for SR optical links over OM4 MMF, and is ideal for short-range, multi-lane data communication, and interconnects applications. The QSFP28 LR4 module is designed for extended reach and supports links up to 10km of single mode fiber.

When used with Intel® Ethernet Network Adapters with QSFP28 connectivity, these optics provide interoperability and secure connections for virtualized platforms, high-speed networking, and consistently reliable performance.

## General Specifications

Module Form Factor	QSFP28
Network Standards Physical Layer Interface	100GBASE-SR4 100GBASE-LR4
Airflow and Temperature Guidelines	Refer to adapter product brief for specific airflow and temperature requirements
Module Specifications	Electrical: SFF-8679 I2C Register interface: SFF-8636 Mechanical: SFF-8661

## Product Order Code

Intel® Ethernet QSFP28 Optic, short range, extended temp E100GQSFP28SRX

Intel® Ethernet QSFP28 Optic, long range, extended temp E100GQSFP28LRX\*

\*Use with single port Intel Ethernet 800 Series Network Adapters

## SR4 Transmitter Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Units	Note
Average Launch Power, each lane	P <sub>OUT</sub>	-8.4	-	2.4	dBm	Average Optical Output
Optical modulation Amplitude, each lane	OMA	-6.4	-	3	dBm	
Extinction Ratio	ER	2	-	-	dB	
Optical Output with Tx OFF	P <sub>OFF</sub>	-	-	-30	dBm	
Center Wavelength	λ	840	850	860	nm	
RMS Spectral Width	Δλ	-	-	0.6	nm	
Optical return loss tolerance	ORL	-	-	12	dB	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}						{0.3, 0.38, 0.45, 0.35, 0.41, 0.5}
Hit ratio 1.5 × 10 <sup>-3</sup> hits per sample						

## SR4 Receiver Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Units	Note
Average power at receive input, each lane	P <sub>IN</sub>	-	-	2.4	dBm	1
Average power at receive input, each lane	P <sub>IN</sub>	-10.3	-	-	dBm	1, 2
Unstressed receiver sensitivity, each lane (max)	Sen	-	-	-7.2	dBm	1
Center Wavelength	λ	840	850	860	nm	
Receiver Reflectance	RFL	-	-	-12	dB	
Rx_LOS of Signal - Assert	P <sub>A</sub>	-30	-	-	dBm	
Rx_LOS of Signal - Deassert	P <sub>D</sub>	-	-	-7.5	dBm	
Rx_LOS of Signal - Hysteresis	P <sub>Hy</sub>	-	1.5	-	dBm	

### Notes:

1. Average received power where the BER = 5x10<sup>-5</sup>, measured with a PRBS 2<sup>31</sup>-1 test pattern@25.78Gb/s.
2. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

### SR4 Transmitter Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Tx_Data Differential Input Voltage	$V_{IN}$	200	-	900	mV	
Tx_Data Differential Input Impedance	$Z_{IN}$	-	100	-	$\Omega$	
Differential Input Return Loss	SDD11	Compatible with IEEE P802.3bm	-	-	dB	10MHz to 19GHz
Differential to Common Mode Conversion Loss	SCD11	10	-	-	dB	10MHz to 19GHz

### SR4 Receiver Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Rx_Data Differential Output Voltage	$V_{OUT}$	-	480	-	mV	
Rx_Data Differential Output Impedance	$Z_{OUT}$	-	100	-	$\Omega$	
Differential Output Return Loss			Per IEEE P802.3bm		dB	10MHz to 19GHz
Common Mode Output Return Loss			Per IEEE P802.3bm		dB	10MHz to 19GHz

### SR4 Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Note
Storage Ambient Temperature	$T_{stg}$	-40	-	+85	$^{\circ}C$	1
Relative Humidity - Storage	$RH_s$	0	-	95	%	1
Relative Humidity - Operating	$RH_o$	0	-	85	%	1
Module Supply Voltage	Vcc	-0.5	-	3.6	V	1

Notes:

1. Exceeding the Absolute Maximum Ratings may cause irreversible damage to the device. The device is not intended to be operated under the condition of simultaneous Absolute Maximum Ratings, a condition which may cause irreversible damage to the device.

### SR4 Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units	Note
Case Operating Temperature	$T_{case}$	0	+25	+85	$^{\circ}C$	Temperature Range = E
Module Supply Voltage	Vcc	3.14	3.3	3.46	V	
Module Supply Current	$I_{IN}$	-	540	-	mA	
Signaling Speed Per Channel	S	-	25.78	-	Gb/s	

## LR4 Transmitter Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Units	Note
Signaling Speed per Lane		25.78125 ± 100 ppm			Gb/s	1
Lane center wavelengths (range)		1294.53 – 1296.59 1299.02 – 1301.09 1303.54 – 1305.63 1308.09 – 1310.19			nm	
Total Average Launch Power	P <sub>OUT</sub>	-	-	10.5	dBm	
Transmit OMA per Lane	TxOMA	-1.3	-	4.5	dBm	
Average Launch Power per Lane	TXPx	-4.3	-	4.5	dBm	2,7
Optical Extinction Ratio	ER	4	-	-	dB	
Sidemode Suppression ratio	SSR <sub>min</sub>	30	-	-	dB	
Average launch power of OFF transmitter, per lane		-	-	-30	dBm	
Relative Intensity Noise	RIN	-	-	-130	dB/Hz	
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}				3

## LR4 Receiver Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Units	Note
Signaling Speed per Lane		25.78125 ± 100 ppm			GBd	4
Lane center wavelengths (range)		1294.53 – 1296.59 1299.02 – 1301.09 1303.54 – 1305.63 1308.09 – 1310.19			nm	
Receive Power (OMA) per Lane	RxOMA	-	-	4.5	dBm	1
Average Receive Power per Lane	RXP <sub>x</sub>	-10.6	-	4.5	dBm	5,7
Receiver Sensitivity (OMA) per Lane	Rxsens	-	-	-8.6	dBm	
Return Loss	RL	-26	-	-	dB	
Stressed Receiver Sensitivity (OMA) per Lane	SRS	-	-	-6.8	dBm	6
Receive electrical 3 dB upper cutoff frequency, per lane		-	-	31	GHz	
LOS De-Assert	LOS <sub>D</sub>	-	-	-11.6	dBm	
LOS Assert	LOS <sub>A</sub>	-24	-	-13.6	dBm	
LOS Hysteresis		-	1.5	-	dBm	

1. Transmitter consists of 4 lasers operating at 25.78Gb/s each.
2. Minimum value is informative.
3. Hit ratio 5x10<sup>-5</sup>.
4. Receiver consists of 4 photodetectors operating at 25.78Gb/s each.
5. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.
6. SRS is measured with vertical eye closure penalty of 1.8 dB max, J2 of 0.30 UI, and J9 of 0.47 UI.
7. Power value and power accuracy are with all channels on.

## LR4 Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	V <sub>cc</sub>	3.135	-	3.465	V	
Supply Current	I <sub>cc</sub>	-	-	1.6	A	
Module total power	P	-	-	4.5	W	1

### Notes:

1. Maximum total power value is specified across the full temperature and voltage range. Power consumption ≤ 4.5W when stabilized (both Tx and Rx CDR locked), but may be ≤ 5W during locking acquisition.

## LR4 Transmitter Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Signaling rate per lane		25.78125 ± 100 ppm			GBd	
Differential data input swing per lane	V <sub>IN</sub> , pp	-	-	900	mV	
Differential input return loss (min)	RLd(f)	9.5 – 0.37f, 0.01 ≤ f < 8 4.75 – 7.4log <sub>10</sub> (f/14), 8 ≤ f < 19			dB	
Differential to common mode input return loss (min)	RLdc(f)	22-20(f/25.78), 0.01 ≤ f < 12.89 15-6(f/25.78), 12.89 ≤ f < 19			dB	
Differential termination mismatch		-	-	10	%	
Stressed input parameters						
Eye width		-	0.46	-	UI	
Applied pk-pk sinusoidal jitter		Per IEEE 802.3bm Table 88-13				
Eye height		-	95	-	mV	
DC common mode voltage		-350	-	2850	mV	

## LR4 Receiver Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Signaling rate per lane		25.78125 ± 100 ppm			GBd	
Differential data output swing	V <sub>OUT</sub> , pp	100 300 400 600		400 600 800 1200	mVpp	2
Eye width		0.57	-	-	UI	
Vertical eye closure		-	-	5.5	dB	
Differential output return loss (min)	RLd(f)	9.5 – 0.37f, 0.01 ≤ f < 8 4.75 – 7.4log <sub>10</sub> (f/14), 8 ≤ f < 19			dB	
Common to differential mode conversion return loss (min)	RLdc(f)	22-20(f/25.78), 0.01 ≤ f < 12.89 15-6(f/25.78), 12.89 ≤ f < 19			dB	
Differential termination mismatch		-	-	10	%	
Transition time, 20% to 80%	t <sub>r</sub> , t <sub>f</sub>	12	-	-	ps	

### Notes:

2. Output voltage is settable in 4 discrete ranges via I2C. Default range is 400 – 800 mV.

## LR4 Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Note
Maximum Supply Voltage	V <sub>cc</sub>	-0.5	-	3.6	V	
Storage Temperature	T <sub>s</sub>	-40	-	+85	°C	
Case Operating Temperature	T <sub>OP</sub>	0	-	+85	°C	
Relative Humidity	RH	15	-	85	%	1
Receiver Damage Threshold, per Lane	P <sub>Rdmg</sub>	5.5	-	-	dBm	

### Notes:

1. Non-condensing.

## 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)

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