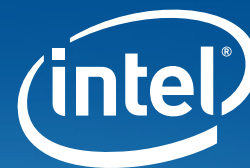


## Product Brief

Intel® Ethernet SFP28 Optics  
Network Connectivity



# Intel® Ethernet SFP28 Optics



Intel® Ethernet SFP28 Optics deliver a proven reliable solution for deployments of high-density Ethernet

## Key Features

- Hot-pluggable SFP28 optical transceivers
- Support for commercial and extended temperature ranges
- RoHS 6 compliant (lead-free)

## Overview

Intel® Ethernet SFP28 Optics are an excellent choice for high-speed communications equipment where extraordinary performance and reliability are essential. These hot-pluggable optical modules consume low-power and are offered in the extended temperature range.

When used with Intel® Ethernet Network Adapters with SFP28 connectivity, these optics provide more secure connections for virtualization, flexibility for LAN and SAN networking, and consistently reliable performance.

Fiber optics are more immune to harsh environmental factors. The light used for data transmission does not carry an electrical current so it cannot be impacted by electrical transmissions or radio frequency interference. Also, light has a superior signal strength that is near impervious to unwanted network taps.

## GENERAL SPECIFICATIONS

### Network Standards Physical Layer Interface

Module Form Factor	SFP28
Network Standards Physical Layer Interface	10G/25GBASE-SR (Commercial) 25GBASE-SR (Extended Temp) 25GBASE-LR (Extended Temp)
Product Codes	E25GSFP28SR (Commercial Temp) E25GSFP28SRX (Extended Temp) E25GSFP28LRX (Extended Temp)
Airflow and Temperature Guidelines	Refer to adapter product brief for specific airflow and temperature requirements
SFP28 Module Specifications	Electrical: SFF-8431 Rev 4.1 I <sup>2</sup> C Register interface: SFF-8472 Rev 12.2 and SFF-8402 Mechanical: SFF-8432 Rev 5

## SR OPTICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Transmitter</b>						
Average Output Power: 50 or 62.5 MMF	P <sub>OUT</sub>	-8.4		2.4	dBm	1
Optical Wave Length	λ	840		860	nm	
Spectral Width (RMS)	Δλ <sub>rms</sub>			0.60	nm	
Optical Modulation amplitude (OMA)	OMA	-6.4		3	dBm	
Transmitter and Dispersion Penalty	TDP				dBm	
25.78 Gb/s				5		2
10.3 Gb/s				2.5		3
Relative Intensity Noise	RIN			-128	dB/Hz	
Extinction Ratio	ER	2				
<b>Receiver</b>						
Stressed Receiver Sensitivity OMA Sensitivity @ 25.78 Gb/s	RxSENS			5.6	dBm	
Average Receiver Power	Rx <sub>MAX</sub>	-11		3	dBm	
Unstressed Receiver OMA Sensitivity @ 10.3 Gb/s	Rx <sub>SENS</sub>			-11.1	dBm	
Stressed Receiver Sensitivity (OMA) 10.3 Gb/s	Rx <sub>SENS2</sub>			-7.5	dBm	
Optical Center Wavelength	λ <sub>C</sub>	840		860	nm	
Optical Return Loss		12			dB	
LOS Assert	LOS <sub>A</sub>	-30			dBm	
LOS De-Assert	LOS <sub>D</sub>			-13	dBm	
Loss Hysteresis		0.5			dB	

#### Notes:

- Class 1 Laser Safety limit per FDA/CDRH, and EN (IEC) 60825 laser safety standards.
- Informative Only.
- The TDP transversal filter should be scaled from SR: for 100m OM3 and 0.65nm spectral bandwidth, the TDP filter should have tap separation of 21ps. This would introduce ~0.3dB eye closure penalty.

## SR ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	V <sub>cc</sub>	3.15		3.46	V	
Supply Current	I <sub>cc</sub>			350	mA	1
<b>Transmitter</b>						
Input Differential Impedance	R <sub>in</sub>		100	2.4	Ω	2
Single-ended Data Input Swing	V <sub>in,pp</sub>	90		800	mV	
Transmit Disable Voltage	V <sub>D</sub>	2		V <sub>cc</sub>	VA	3
Transmit Enable Voltage	V <sub>EN</sub>	V <sub>ee</sub>		V <sub>cc</sub> +0.8	V	
Transmitter and Dispersion Penalty	TDP				dBm	
25.78 Gb/s				5		2
10.3 Gb/s				2.5		3
<b>Receiver</b>						
Single-ended Data Output Swing	V <sub>out,pp</sub>	185		425	mV	4
LOS Fault	V <sub>LOS fault</sub>	2		V <sub>cc,HOST</sub>	V	5
LOS Normal	V <sub>LOS norm</sub>	V <sub>ee</sub>		V <sub>ee</sub> +0.8	V	5
Power Supply Rejection	PSR	100			mVpp	6

### Notes:

1. With established link. The total power dissipation can exceed 1 W when the module is attempting to establish link at operating case temperature below 25 °C.
2. Connected directly to Tx data input pins. AC coupling from pins into laser driver IC.
3. Or open circuit.
4. Into 100 Ω differential termination.
5. LOS is an open collector output. Should be pulled up with 4.7 K – 10 KΩ on the host board. Normal operation is logic 0; loss of signal is logic 1. Maximum pull-up voltage is 5.5V.
6. Receiver sensitivity is compliant with power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value applied through the recommended power supply filtering network.

## SR ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Maximum Supply Voltage	V <sub>cc</sub>	-0.5		4.0	V	
Storage Temperature	T <sub>s</sub>	-40		85	°C	
Case Operating Temperature	T <sub>case</sub>	0		70	°C	
Relative Humidity (non-condensing)	RH	0		85	%	

## SR SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Bit Rate	BR		25.78		Gb/s	
Bit Rate Error Ratio	BER			10 <sup>-12</sup>		1,4
				10 <sup>-8</sup>		2
				5E(-5)		3
Fiber Length on 50/125µm high-bandwidth (OM3/M5E) MMF	L			30	m	1
				50	m	2
				70	m	3
				100	m	4
Fiber Length on 50/125µm high-bandwidth (OM4/M5F) MMF	L			40	m	1
				70	m	2
				100	m	3

### 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.

## SR ENVIRONMENTAL SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Units	Note
Case Operating Temperature	T <sub>op</sub>	0		70	°C	
Storage Temperature	T <sub>sto</sub>	-40		85	°C	

## SRX OPTICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Transmitter</b>		850nm VCSEL				
Average Launch Power	$P_{OUT}$	-8.4		2.4	dBm	
Average Launch Power (Laser Off)	$P_{OFF}$			-30	dBm	
Optical Center Wave Length	$\lambda$	840	850	860	nm	
Spectral Width (RMS)	$\Delta\lambda$			0.60	nm	
Dispersion Penalty	DP			4.3	dB	
Optical Return Loss Tolerance	ORL			12	dB	
Extinction Ratio	ER	2			dB	
<b>Receiver</b>		850nm PIN/TIA CW Mode				
Optical Center Wave Length	$\lambda$	840	850	860	nm	
Receiver Sensitivity OMA	$P_{IN}$					
25G		-10.3		2.4	dBm	1
10G				-9.9	dBm	2
Stressed Receiver Sensitivity (OMA)	$P_{IN(OMA)}$					
25G				-5.2	dBm	1
10G				-7.5	dBm	2
Receiver Optical Overload	$P_{IN(SAT)}$			3	dBm	
Receiver Reflectance	RFL			-12	dB	
LOS Assert	$P_A$	-30			dBm	
LOS De-Assert	$P_D$			-12	dBm	
LOS Hysteresis	$P_{Hy}$	0.5			dB	
Notes:						
1. BER<5x10 <sup>-5</sup> , PRBS 2 <sup>31</sup> -1						
2. BER<1x10 <sup>-12</sup> , PRBS 2 <sup>31</sup> -1						

## SRX ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	V <sub>CC</sub>	3.14	3.3	3.46	V	
Supply Current	I <sub>IN</sub>			300	mA	
<b>Transmitter</b>						
Input Differential Impedance	Z <sub>IN</sub>		100		Ω	
Differential Data Input Swing	V <sub>IN</sub>	200		1000	mV	
Transmit Disable Voltage	V <sub>D</sub>	2.0		V <sub>CC</sub> T+0.3	V	
Transmit Enable Voltage	V <sub>EN</sub>	-0.3		0.8	V	
<b>Receiver</b>						
Output Differential Impedance	Z <sub>OUT</sub>	300		850	Ω	
Differential Data Output Swing	V <sub>OUT</sub>		100		mV	
LOS Assert Voltage	V <sub>LOSA</sub>	2.0		V <sub>CC</sub> +0.3	V	
LOS De-Assert Voltage	V <sub>LOSD</sub>	-0.3		0.4	V	

## SRX SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Bit Rate	BR		25.78		Gb/s	
	BR		10.3125		Gb/s	
10G Effective Reach/50 $\mu$ m (OM3) MMF	L			300	m	1
10G Effective Reach/50 $\mu$ m (OM4) MMF	L			400	m	3
25G Effective Reach/50 $\mu$ m (OM3) MMF	L			30	m	1
				70	m	2
25G Effective Reach/50 $\mu$ m (OM4) MMF	L			70	m	3
				100	m	4

### Notes:

1. 2000MHz-km BER $<1 \times 10^{-12}$ , PRBS 2<sup>31</sup>-1
2. 2000MHz-km BER $<5 \times 10^{-5}$ , PRBS 2<sup>31</sup>-1
3. 4700MHz-km BER $<1 \times 10^{-12}$ , PRBS 2<sup>31</sup>-1
4. 4700MHz-km BER $<5 \times 10^{-5}$ , PRBS 2<sup>31</sup>-1

## SRX ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Maximum Supply Voltage	V <sub>cc</sub>	0		3.6	V	
Storage Temperature	T <sub>stg</sub>	-40		85	°C	
Relative Humidity - Storage	RH <sub>s</sub>	0		95	%	
Relative Humidity - Operating	RH <sub>o</sub>	0		85	%	

## SRX ENVIRONMENTAL SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Units	Note
Case Operating Temperature	T <sub>case</sub>		25	85	°C	1
Storage Temperature	T <sub>stg</sub>	-40		85	°C	

### Notes:

1. Temperature Range = E

## LRX OPTICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit	Note
<b>Transmitter</b>		850nm VCSEL				
Average Launch Power	$P_{OUT}$	-8.4		2.4	dBm	
Average Launch Power (Laser Off)	$P_{OFF}$			-30	dBm	
Optical Center Wave Length	$\lambda$	840	850	860	nm	
Spectral Width (RMS)	$\Delta\lambda$			0.60	nm	
Dispersion Penalty	DP			4.3	dB	
Optical Return Loss Tolerance	ORL			12	dB	
Extinction Ratio	ER	2			dB	
<b>Transmitter Output Eye</b>		IEEE802.3bm				
<b>Receiver</b>		850nm PIN/TIA CW Mode				
Optical Center Wave Length	$\lambda$	840	850	860	nm	
Receiver Sensitivity OMA	$P_{IN}$					
25G		-10.3		2.4	dBm	1
10G				-9.9	dBm	2
Stressed Receiver Sensitivity (OMA)	$P_{IN(OMA)}$					
25G				-5.2	dBm	1
10G				-7.5	dBm	2
Receiver Optical Overload	$P_{IN(SAT)}$			3	dBm	
Receiver Reflectance	RFL			-12	dB	
LOS Assert	$P_A$	-30			dBm	
LOS De-Assert	$P_D$			-12	dBm	
LOS Hysteresis	$P_{Hy}$	0.5			dB	
Notes:						
1. BER<5x10 <sup>-5</sup> , PRBS 2 <sup>31</sup> -1						
2. BER<1x10 <sup>-12</sup> , PRBS 2 <sup>31</sup> -1						

## LRX ELECTRICAL CHARACTERISTICS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Supply Voltage	V <sub>CC</sub>	3.14	3.3	3.46	V	
Supply Current	I <sub>IN</sub>			300	mA	
<b>Transmitter</b>						
Input Differential Impedance	Z <sub>IN</sub>		100		Ω	
Differential Data Input Swing	V <sub>IN</sub>	200		1000	mV	
Transmit Disable Voltage	V <sub>D</sub>	2.0		V <sub>CC</sub> +0.3	V	
Transmit Enable Voltage	V <sub>EN</sub>	-0.3		0.8	V	
<b>Receiver</b>						
Differential Data Output Swing	V <sub>OUT</sub>	300		850	mV	
Differential Data Output Swing	Z <sub>OUT</sub>		100		Ω	
LOS Assert Voltage	V <sub>LOSA</sub>	2.0		V <sub>CC</sub> +0.3	V	
LOS De-Assert Voltage	V <sub>LOSD</sub>	-0.3		0.4	V	

## LRX SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Data Rate	BR		25.78		Gb/s	
	BR		10.3125		Gb/s	
10G Effective Reach/50μm (OM3) MMF	L			300	m	1
				400	m	2
10G Effective Reach/50μm (OM4) MMF	L			70	m	3
				100	m	4
				30	m	5
				70	m	6

Notes:

1. OM3 2000MHz-km BER<1x10<sup>-12</sup>, PRBS 231-1
2. OM4 4700MHz-km BER<1x10<sup>-12</sup>, PRBS 231-1
3. OM3 2000MHz-km BER<5x10<sup>-5</sup>, PRBS 231-1
4. OM4 4700MHz-km BER<5x10<sup>-5</sup>, PRBS 231-1
5. OM3 2000MHz-km BER<1x10<sup>-12</sup>, PRBS 231-1
6. OM4 4700MHz-km BER<1x10<sup>-12</sup>, PRBS 231-1

## LRX ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Min	Typ	Max	Unit	Note
Storage Ambient Temperature	T <sub>stg</sub>	-40		+85	°C	1
Relative Humidity - Storage	RH <sub>s</sub>	0		95	%	1
Relative Humidity - Operating	RH <sub>o</sub>	0		85	%	1
Module Supply Voltage	V <sub>cc</sub>	0		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.

## LRX ENVIRONMENTAL SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Units	Note
Case Operating Temperature	T <sub>case</sub>		25	85	°C	1
Storage Temperature	T <sub>stg</sub>	-40		85	°C	

Notes:

1. Temperature Range = E



## 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 limited lifetime hardware warranty, 90-day money-back guarantee (U.S. and Canada) and worldwide support.

## 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)

No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document. Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.

This document contains information on products, services and/or processes in development. All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest forecast, schedule, specifications and roadmaps.

The products and services described may contain defects or errors which may cause deviations from published specifications.

© Intel Corporation. Intel, the Intel logo, and other Intel marks are trademarks of Intel Corporation or its subsidiaries. Other names and brands may be claimed as the property of others.

