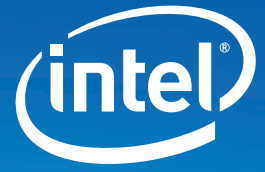


## Product Brief

Intel® Ethernet SFP+ Optics  
Network Connectivity



# Intel® Ethernet SFP+ Optics



Intel® Ethernet SFP+ SR, SRX (extended temp), and LR Optics, offer dependable interoperability and consistent performance across the network when used with Intel® Ethernet 500 and 700 Series Network Adapters

## Key Features

- Hot-pluggable SFP+ MSA compliant module
- SR and LR support 1GbE and 10GbE
- SRX (extended temperature) supports 10GbE only
- Duplex LC connector
- Built-in digital diagnostic functions
- RoHS-6 compliant (lead-free)

## Overview

For customers looking for Ethernet connections over 15 meters, Intel® Ethernet SFP+ Optics can extend the reach to 300 meters or longer. These optical modules support both short range and long range distances with 10 Gigabit Intel® Ethernet Network Adapters.

The flexibility provided through reach and range enables customers to create networking configurations that best meet the needs of their data center environment. Other installation benefits include: Smaller physical dimensions, use less power, tighter bend radius, lighter weight, and have a longer reach compared to copper media options.

Fiber optics are also 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. And, light has a superior signal strength that is near impervious to unwanted network taps.

10 Gigabit Intel® Ethernet Network Adapters with SFP+ connectivity are also the most scalable – providing more secure connections for virtualization, flexibility for LAN and SAN networking, and proven reliable performance. Other use cases include connecting servers to End of Row (EoR) and Top of Rack (ToR) switches.

## GENERAL SPECIFICATIONS

### Network Standards Physical Layer Interface

SR • 1000BASE-SX 1GbE  
• 10GBASE-SR 10GbE

SRX • 10GBASE-SR 10GbE

LR • 1000BASE-LX 1GbE  
• 10GBASE-LR 10GbE

### SFP+ Module Specifications

- Electrical interface: SFF-8431 Rev 4.1
- I<sup>2</sup>C Register interface: SFF-8472 Rev 10.4
- Mechanical: SFF-8432 Rev 5.0

## SR OPTICAL CHARACTERISTICS

Optical Characteristics for RS0 = HIGH  
(10 Gb Operation) (T<sub>OP</sub> = 0 °C to 70 °C, V<sub>CC</sub>=3.14 Vdc to 3.46 Vdc)

| Parameter                                     | Symbol                | Min  | Typ                              | Max   | Unit  | Note |
|---|-----------------------|------|----------------------------------|-------|-------|------|
| <b>Transmitter</b>                            |                       |      |                                  |       |       |      |
| Optical Modulation amplitude (OMA)            | P <sub>OMA</sub>      |      | -1.5                             |       | dBm   | 1    |
| Average Launch Power                          | P <sub>AVE</sub>      | -5   |                                  | -1    | dBm   | 2    |
| Optical Wave Length                           | λ                     | 840  | 850                              | 860   | nm    | 1    |
| RMS Spectral Width                            | Δλ <sub>rms</sub>     |      |                                  | 0.45  | dB    | 1    |
| Optical Extinction Ratio                      | ER                    | 3.0  | 5.5                              |       | dB    |      |
| Transmitter and Dispersion Penalty            | TDP                   |      |                                  | 3.9   | dB    |      |
| Average Launch Power of OFF Transmitter       | P <sub>OFF</sub>      |      |                                  | -30   | dBm   |      |
| Tx Jitter                                     | Tx                    |      | Per IEEE 802.3-2008 Requirements |       |       |      |
| Encircled Flux                                | <4.5 μm               |      |                                  | 30    | %     | 3    |
|   | <19 μm                | 86   |                                  |       |       |      |
| Relative Intensity Noise                      | RIN <sub>12</sub> OMA |      |                                  | -128  | dB/Hz |      |
| <b>Receiver</b>                               |                       |      |                                  |       |       |      |
| Receiver Sensitivity (OMA) @ 10.3 Gb/s        | R <sub>SENS1</sub>    |      |                                  | -11.1 | dBm   | 4    |
| Stressed Receiver Sensitivity (OMA) 10.3 Gb/s | R <sub>SENS2</sub>    |      |                                  | -7.5  | dBm   | 5    |
| Maximum Input Power                           | P <sub>MAX</sub>      | +0.5 |                                  |       | dBm   |      |
| Wavelength Range                              | λ <sub>C</sub>        | 840  |                                  | 860   | nm    |      |
| Receiver Reflectance                          | R <sub>rx</sub>       |      |                                  | -12   | dB    |      |
| LOS De-Assert                                 | LOS <sub>D</sub>      |      |                                  | -14   | dBm   |      |
| LOS Assert                                    | LOS <sub>A</sub>      | -30  | -23                              |       | dBm   |      |
| Loss Hysteresis                               |                       | 0.5  |                                  |       | dB    |      |

Notes:

1. Per Tradeoff Table 52.8, IEEE 802.3-2008
2. Average Power figures are informative only, per IEEE802.3-2008.
3. Measured into Type A1a (50/125 μm multimode) fiber per ANSI/TIA/EIA-455-203-2.
4. Measured with worst ER; BER<10<sup>-12</sup>; 2<sup>31</sup> – 1 PRBS.
5. Per IEEE 802.3-2008.

## SR OPTICAL CHARACTERISTICS (CONTINUED)

| Parameter            | Symbol | Min  | Typ | Max               | Unit | Note |
|----------------------|--------|------|-----|-------------------|------|------|
| Bit Rate             | BR     | 9.95 |     | 10.5              | Gb/s | 1    |
| Bit Rate Error Ratio | BER    |      |     | 10 <sup>-12</sup> | Gb/s | 2    |

Notes:

- 10GBASE-SR/SW.
- Tested with a 2<sup>31</sup> – 1 PRBS.

## SR OPTICAL CHARACTERISTICS (CONTINUED)

| Parameter  | Symbol                | Maximum Supported Distance |           | Units |   |
|------------|-----------------------|----------------------------|-----------|-------|---|
|            |                       | @ 1 Gb/s                   | @ 10 Gb/s |       |   |
| Distance   |                       |                            |           |       |   |
| Fiber Type | 850 nm OFL Band-width |                            |           |       |   |
| 6.25 μm    | 160 MHz-km            | L <sub>max</sub>           | 220       | 26    | m |
|            | OM1 200 MHz-Km        |                            | 275       | 33    |   |
| 50 μm      | 400 MHz-Km            | L <sub>max</sub>           | 500       | 66    | m |
|            | OM2 500 MHz-Km        |                            | 550       | 82    |   |
|            | OM3 2000 MHz-Km       |                            | >550      | 300   |   |

## SR ENVIRONMENTAL SPECIFICATIONS

850 nm SFP transceivers have a commercial operating temperature range from 0 °C to +70 °C case temperature

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

## SRX OPTICAL CHARACTERISTICS

Optical Characteristics for RSO = HIGH  
(10 Gb Operation) ( $T_{OP} = -5\text{ }^{\circ}\text{C}$  to  $85\text{ }^{\circ}\text{C}$ ,  $V_{CC}=3.14\text{ Vdc}$  to  $3.46\text{ Vdc}$ )

| Parameter                               | Symbol                | Min | Typ                              | Max   | Unit  | Note |
|---|-----------------------|-----|----------------------------------|-------|-------|------|
| <b>Transmitter</b>                      |                       |     |                                  |       |       |      |
| Optical Modulation amplitude (OMA)      | $P_{OMA}$             |     | -1.5                             |       | dBm   | 1    |
| Average Launch Power                    | $P_{AVE}$             | -5  |                                  | -1    | dBm   | 2    |
| Optical Wave Length                     | $\lambda$             | 840 | 850                              | 860   | nm    | 1    |
| RMS Spectral Width                      | $\Delta\lambda_{rms}$ |     |                                  | -0.45 | dB    | 1    |
| Optical Extinction Ratio                | ER                    | 3.0 | 5.5                              |       | dB    |      |
| Transmitter and Dispersion Penalty      | TDP                   |     |                                  | 3.9   | dB    |      |
| Average Launch Power of OFF Transmitter | $P_{OFF}$             |     |                                  | -30   | dBm   |      |
| Tx Jitter                               | $T_{Xj}$              |     | Per IEEE 802.3-2012 Requirements |       |       |      |
| Encircled Flux                          | <4.5 $\mu\text{m}$    |     |                                  | 30    | %     | 3    |
|   | <19 $\mu\text{m}$     | 86  |                                  |       |       |      |
| Relative Intensity Noise                | $RIN_{12OMA}$         |     |                                  | -128  | dB/Hz |      |

## Receiver

|   |             |      |     |       |     |   |
|---|-------------|------|-----|-------|-----|---|
| Receiver Sensitivity (OMA) @ 10.3 Gb/s        | $R_{SENS1}$ |      |     | -11.1 | dBm | 4 |
| Stressed Receiver Sensitivity (OMA) 10.3 Gb/s | $R_{SENS2}$ |      |     | -7.5  | dBm | 5 |
| Maximum Input Power                           | $P_{MAX}$   | +0.5 |     |       | dBm |   |
| Wavelength Range                              | $\lambda_C$ | 840  |     | 860   | nm  |   |
| Receiver Reflectance                          | $R_{rx}$    |      |     | -12   | dB  |   |
| LOS De-Assert                                 | $LOS_D$     |      |     | -14   | dBm |   |
| LOS Assert                                    | $LOS_A$     | -30  | -23 |       | dBm |   |
| Loss Hysteresis                               |             | 0.5  |     |       | dB  |   |

### Notes:

1. Per Tradeoff Table 52.8, IEEE 802.3-2012
2. Average Power figures are informative only, per IEEE802.3-2012.
3. Measured into Type A1a (50/125  $\mu\text{m}$  multimode) fiber per ANSI/TIA/EIA-455-203-2.
4. Measured with worst ER; BER< $10^{-12}$ ;  $2^{31} - 1$  PRBS.
5. Per IEEE 802.3-2012.

## SRX OPTICAL CHARACTERISTICS (CONTINUED)

| Parameter             | Symbol | Min  | Typ | Max        | Unit | Note |
|-----------------------|--------|------|-----|------------|------|------|
| Bit Rate (RSO = LOW)  | BR     | 9.95 |     | 10.5       | Gb/s | 1    |
| Bit Rate (RSO = HIGH) | BER    |      |     | $10^{-12}$ | Gb/s | 2    |

### Notes:

1. 10GBASE-SR/SW. Contact your Intel Representative for higher data-rate support.
2. Tested Tested with a  $2^{31} - 1$  PRBS. See note above for conditions.

## SRX OPTICAL CHARACTERISTICS (CONTINUED)

| Parameter    | Symbol                | Maximum Supported Distance | Units |
|--------------|-----------------------|----------------------------|-------|
| Fiber Type   | 850 nm OFL Band-width |                            |       |
| 6.25 $\mu$ m | 160 MHz-km            | 26                         | m     |
|              | OM1 200 MHz-Km        | 33                         |       |
| 50 $\mu$ m   | 400 MHz-Km            | 66                         | m     |
|              | OM2 500 MHz-Km        | 82                         |       |
|              | OM3 2000 MHz-Km       | 300                        |       |
|              | OM4 4700 MHz-Km       | 400                        |       |

## SRX ENVIRONMENTAL SPECIFICATIONS

| Parameter                  | Symbol           | Min | Typ | Max | Units |
|----------------------------|------------------|-----|-----|-----|-------|
| Case Operating Temperature | T <sub>op</sub>  | -5  |     | 85  | °C    |
| Storage Temperature        | T <sub>sto</sub> | -40 |     | 85  | °C    |

## LR OPTICAL CHARACTERISTICS

Optical Characteristics for RS0 = HIGH  
(10 Gb Operation) (T<sub>OP</sub> = 0 °C to 70 °C, V<sub>CC</sub>=3.14 Vdc to 3.46 Vdc)

| Parameter                                     | Symbol             | Min   | Typ                              | Max   | Unit  | Note |
|---|--------------------|-------|----------------------------------|-------|-------|------|
| <b>Transmitter</b>                            |                    |       |                                  |       |       |      |
| Optical Modulation amplitude (OMA)            | P <sub>OMA</sub>   | -5.2  |                                  |       | dBm   |      |
| Average Launch Power                          | P <sub>AVE</sub>   | -8.2  |                                  | 0.5   | dBm   | 1    |
| Optical Wave Length                           | $\lambda$          | 1260  |                                  | 1355  | nm    |      |
| Side-mode Suppression Ratio                   | RIN                | 30    |                                  |       | dB    |      |
| Optical Extinction Ratio                      | ER                 | 3.5   |                                  |       | dB    |      |
| Transmitter and Dispersion Penalty            | TDP                |       |                                  | 3.2   | dB    |      |
| Average Launch Power of OFF Transmitter       | P <sub>OFF</sub>   |       |                                  | -30   | dBm   |      |
| Tx Jitter                                     | Tx                 |       | Per IEEE 802.3-2008 Requirements |       |       |      |
| Relative Intensity Noise                      | RIN                |       |                                  | -128  | dB/Hz |      |
| <b>Receiver</b>                               |                    |       |                                  |       |       |      |
| Receiver Sensitivity (OMA) @ 10.3 Gb/s        | R <sub>SENS1</sub> |       |                                  | -12.6 | dBm   | 2    |
| Stressed Receiver Sensitivity (OMA) 10.3 Gb/s | R <sub>SENS2</sub> |       |                                  | -10.3 | dBm   | 3    |
| Average Receiver Power                        | P <sub>AVE</sub>   | -14.2 |                                  | 0.5   | dB    |      |
| Optical Center Wavelength                     | $\lambda_C$        | 1260  |                                  | 1600  | nm    |      |
| Receiver Reflectance                          | R <sub>Rx</sub>    |       |                                  | -12   | dB    |      |
| LOS De-Assert                                 | LOS <sub>D</sub>   |       |                                  | -17   | dBm   |      |
| LOS Assert                                    | LOS <sub>A</sub>   | -30   |                                  |       | dBm   |      |
| Loss Hysteresis                               |                    | 0.5   |                                  |       | dB    |      |

Notes:

1. Average power figures are informative only, per IEEE 802.3-2008.
2. Valid between 1260 and 1355 nm. Measured with worst ER; BER < 10<sup>-12</sup>; 2<sup>31</sup> – 1 PRBS.
3. Valid between 1260 and 1355 nm. Per IEEE 802.3-2008

## LR GENERAL SPECIFICATIONS

| Parameter                     | Symbol           | Min  | Typ  | Max | Unit | Note |
|-------------------------------|------------------|------|------|-----|------|------|
| Bit Rate (RSO = LOW)          | BR               |      | 1.25 |     | Gb/s | 1    |
| Bit Rate (RSO = HIGH)         | BR               | 9.95 | 10.3 |     | Gb/s | 2    |
| Maximum Supported Link Length | L <sub>MAX</sub> |      | 10   |     | Km   |      |

### Notes:

1. 1000BASE-LX. Tested with a 2<sup>7</sup> – 1 PRBS. (Transceiver data rate selected through the 2-wire bus in accordance with SFF-8472 Rev. 10.3. Soft RSO is set at Bit3, Byte 110, Address A2h. Soft RSO default state on power up is 0 LOW, and the state is reset following a power cycle. Writing 1 HIGH selects max. data rate operation. Transceiver data rate is the logic OR of the input state of the RSO pin and soft RSO bit. Thus, if either the RSO pin OR the soft RSO bit is HIGH, then the selected data rate will be 9.95 and 10.3 Gb/s. Conversely, to select data rate 1.25 Gb/s, both the RSO pin and the soft RSO bit are set LOW.)

2. 10GBASE-LR/LW. Tested with a 2<sup>31</sup> – 1 PRBS. (See note above for conditions.)

## LR ENVIRONMENTAL SPECIFICATIONS

Transceivers have an operating temperature range from -5 °C to +70 °C case temperature

| Parameter                  | Symbol           | Min | Typ | Max | Units |
|----------------------------|------------------|-----|-----|-----|-------|
| Case Operating Temperature | T <sub>op</sub>  | -5  |     | 70  | °C    |
| Storage Temperature        | T <sub>sto</sub> | -40 |     | 85  | °C    |

## INTEL® ETHERNET SFP+ OPTIC PRODUCT CODES

| Configuration          | Product Code | Intel Order Numbers (Retail / OEM Generic) |
|------------------------|--------------|--|
| SR Optic               | E10GSFSPSR   | 903239/909923                              |
| SRX Optic <sup>1</sup> | E10GSFSPSRX  | 954746                                     |
| LR Optic               | E10GSFPLR    | 903240/903240                              |

<sup>1</sup>Extended temp

Note: Other brands of SFP+ optical modules will not work with the Intel® Ethernet Converged Network Adapter X520 Series.

Note: When two Intel® Ethernet Converged Network Adapter X520 Series SFP+ devices are connected back to back, they should be configured with the same Speed/Duplex setting. Results may vary if speed settings are mixed.

## 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)

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