10GBASE-LR SFP+ 1310nm 10km DOM Transceiver
SFP-10GLR-31

Features

• Hot-pluggable SFP+ footprint
• Supports 9.95 to 10.5Gb/s bit rates
• Power dissipation < 1W
• RoHS-6 compliant (lead-free)
• Industrial temperature range -40°C to 85°C
• Single 3.3V power supply
• Maximum link length of 10km
• Uncooled 1310nm DFB laser
• Receiver limiting electrical interface
• Duplex LC connector
• Built-in digital diagnostic functions

Application

• 10GBASE-LR/LW 10G Ethernet
• 1200-SM-LL-L 10G Fibre Channel
10Gb/s Enhanced Small Form Factor Pluggable SFP+ transceivers are designed for use in 10-Gigabit Ethernet links up to 10km over Single Mode fiber. They are compliant with SFF-8431, SFF-8432 and IEEE 802.3ae 10GBASE-LR/LW, and 10G Fibre Channel 1200-SM-LL-L. Digital diagnostics functions are available via a 2-wire serial interface. The transceiver is a “limiting module”, i.e., it employs a limiting receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer’s recommended settings for interoperating the host-board EDC PHY with a limiting receiver SFP+ module. The optical transceiver is compliant per the RoHS Directive 2011/65/EU.

Product Specifications

I. General Specifications

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bit Rate</td>
<td>BR</td>
<td>9.95</td>
<td>10.5</td>
<td>10.5</td>
<td>Gb/s</td>
<td>1</td>
</tr>
<tr>
<td>Bit Error Ratio</td>
<td>BER</td>
<td></td>
<td></td>
<td>10(^{-12})</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Max. Supported Link Length</td>
<td>(L_{\text{MAX}})</td>
<td>10</td>
<td></td>
<td></td>
<td>km</td>
<td>1</td>
</tr>
</tbody>
</table>

Notes:
1. 10GBASE-LR, 10GBASE-LW, 1200-SM-LL-L 10GFC.
2. Tested with a \(2^{31} - 1\) PRBS.
## II. Absolute Maximum Ratings

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum Supply Voltage</td>
<td>Vcc</td>
<td>-0.5</td>
<td></td>
<td>4.0</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>Tₚ</td>
<td>-40</td>
<td></td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Case Operating Temperature</td>
<td>Tᵦₚ</td>
<td>-40</td>
<td></td>
<td>85</td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>RH</td>
<td>0</td>
<td></td>
<td>85</td>
<td>%</td>
<td>1</td>
</tr>
<tr>
<td>Receiver Optical Damage Threshold</td>
<td>RxDamage</td>
<td>5</td>
<td></td>
<td></td>
<td>dBm</td>
<td></td>
</tr>
</tbody>
</table>

Note: Non-condensing.

## III. Electrical Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>Vᵥcc</td>
<td>3.14</td>
<td>3.30</td>
<td>3.46</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Supply Current</td>
<td>Iᵥcc</td>
<td>200</td>
<td>285</td>
<td></td>
<td>mA</td>
<td></td>
</tr>
</tbody>
</table>

**Transmitter (Tx)**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input differential impedance</td>
<td>Rᵥin</td>
<td>100</td>
<td>120</td>
<td></td>
<td>Ω</td>
<td>1</td>
</tr>
<tr>
<td>Differential data input swing</td>
<td>Vᵥin,pp</td>
<td>180</td>
<td></td>
<td>850</td>
<td>mV</td>
<td></td>
</tr>
<tr>
<td>Transmit Disable Voltage</td>
<td>VᵥD</td>
<td>2</td>
<td></td>
<td>Vcc</td>
<td>V</td>
<td></td>
</tr>
<tr>
<td>Transmit Enable Voltage</td>
<td>VᵥEₚ</td>
<td>Vᵥee</td>
<td>0.8</td>
<td>V</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Receiver (Rx)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Differential data output swing</td>
<td>$V_{out,pp}$</td>
<td>300 mV</td>
</tr>
<tr>
<td>Output rise time and fall time</td>
<td>$T_r, T_f$</td>
<td>28 ps</td>
</tr>
<tr>
<td>LOS Fault</td>
<td>$V_{LOS\text{ fault}}$</td>
<td>2 Vcc</td>
</tr>
<tr>
<td>LOS Normal</td>
<td>$V_{LOS\text{ norm}}$</td>
<td>$V_{ee}$</td>
</tr>
<tr>
<td>Power Supply Noise Tolerance</td>
<td>$V_{CCT}/V_{CCR}$</td>
<td>Per SFF-8431 Rev 4.1</td>
</tr>
</tbody>
</table>

### Notes:

1. Connected directly to TX data input pins. AC coupling from pins into laser driver IC.
2. Into 100 $\Omega$ differential termination.
3. 20 – 80%. Measured with Module Compliance Test Board and OMA test pattern. Use of four 1’s and four 0’s sequence in the PRBS 9 is an acceptable alternative.
4. LOS is an open collector output. Should be pulled up with 4.7k $\Omega$ – 10k $\Omega$ on the host board. Normal operation is logic 0; loss of signal is logic 1.
5. The transceiver is a “limiting module”, i.e., it employs a limiting receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer’s recommended settings for interoperating the host-board EDC PHY with a limiting receiver SFP+ module.
## IV. Optical Characteristics (TOP = 0 to 70 °C, VCC = 3.14 to 3.46 V)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Unit</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transmitter</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optical Modulation Amplitude (OMA)</td>
<td>$P_{OMA}$</td>
<td>-5.2</td>
<td></td>
<td></td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Average Launch Power</td>
<td>$P_{AVE}$</td>
<td>-8.2</td>
<td></td>
<td>+0.5</td>
<td>dBm</td>
<td>1</td>
</tr>
<tr>
<td>Optical Wavelength</td>
<td>$\lambda$</td>
<td>1260</td>
<td></td>
<td>1355</td>
<td>nm</td>
<td></td>
</tr>
<tr>
<td>Side-Mode Suppression Ratio</td>
<td>SMSR</td>
<td>30</td>
<td></td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Optical Extinction Ratio</td>
<td>ER</td>
<td>3.5</td>
<td></td>
<td></td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Transmitter and Dispersion Penalty</td>
<td>TDP</td>
<td></td>
<td></td>
<td>3.2</td>
<td>dB</td>
<td></td>
</tr>
<tr>
<td>Average Launch power when Tx is OFF</td>
<td>$P_{OFF}$</td>
<td></td>
<td>-30</td>
<td></td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Tx Jitter</td>
<td>Txj</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Per 802.3ae requirements</td>
</tr>
<tr>
<td>Relative Intensity Noise</td>
<td>RIN</td>
<td></td>
<td></td>
<td>-128</td>
<td>dB/Hz</td>
<td></td>
</tr>
<tr>
<td>Receiver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receiver Sensitivity (OMA) @ 10.3Gb/S</td>
<td>$R_{SENS1}$</td>
<td></td>
<td>-12.6</td>
<td></td>
<td>dBm</td>
<td>2</td>
</tr>
<tr>
<td>Receiver Sensitivity (OMA) @ 10.3Gb/s</td>
<td>$R_{SENS2}$</td>
<td></td>
<td>-10.3</td>
<td></td>
<td>dBm</td>
<td>3</td>
</tr>
<tr>
<td>Average Receive Power</td>
<td>$P_{AVE}$</td>
<td>-14.2</td>
<td></td>
<td>+0.5</td>
<td>dBm</td>
<td></td>
</tr>
<tr>
<td>Optical Center Wavelength</td>
<td>$\lambda_C$</td>
<td>1260</td>
<td></td>
<td>1600</td>
<td>nm</td>
<td></td>
</tr>
<tr>
<td>Receiver Reflectance</td>
<td>Rrx</td>
<td></td>
<td></td>
<td>-12</td>
<td>dB</td>
<td></td>
</tr>
</tbody>
</table>
### Documentation

**Optical Communication System**

**Datasheet**

<table>
<thead>
<tr>
<th>LOS De-Assert</th>
<th>LOSD</th>
<th>-17 dBm</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOS Assert</td>
<td>LOSA</td>
<td>-30 dBm</td>
</tr>
<tr>
<td>LOS Hysteresis</td>
<td></td>
<td>0.5 dB</td>
</tr>
</tbody>
</table>

**Notes:**
1. Average power figures are informative only, per IEEE 802.3ae.
2. Valid between 1260 and 1355 nm. Measured with worst ER; BER<10-12; 231 – 1 PRBS.
3. Valid between 1260 and 1355 nm. Per IEEE 802.3ae.

### V. Digital Diagnostic Specifications

10GBASE-LR SFP+ transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Min</th>
<th>Typ.</th>
<th>Max</th>
<th>Units</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internally measured transceiver temp.</td>
<td>ΔDD_temperature</td>
<td>3</td>
<td>3ºC</td>
<td></td>
<td>°C</td>
<td></td>
</tr>
<tr>
<td>Internally measured transceiver volt.</td>
<td>ΔDD_voltage</td>
<td>3</td>
<td>3%</td>
<td></td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Measured TX bias current</td>
<td>ΔDD_Bias</td>
<td>10</td>
<td>10%</td>
<td></td>
<td>%</td>
<td>1</td>
</tr>
<tr>
<td>Measured TX output power</td>
<td>ΔDD_Tx-Power</td>
<td>2</td>
<td>2 dB</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measured RX received avg. optical power</td>
<td>ΔDD_Rx-Power</td>
<td>2</td>
<td>2 dB</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Dynamic Range for Rated Accuracy

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DD&lt;sub&gt;Temperature&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Voltage&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Bias&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Tx-Power&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Rx-Power&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internally measured transceiver</td>
<td>-40</td>
<td>3.1</td>
<td>10</td>
<td>-8.2</td>
<td>-14.2</td>
</tr>
<tr>
<td>Internally measured transceiver</td>
<td>85</td>
<td>3.5</td>
<td>90</td>
<td>+0.5</td>
<td>+0.5</td>
</tr>
<tr>
<td>temperature</td>
<td>°C</td>
<td>V</td>
<td>mA</td>
<td>dBm</td>
<td>dBm</td>
</tr>
<tr>
<td>measured transceiver temperature</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Max Reporting Range

<table>
<thead>
<tr>
<th>Parameter</th>
<th>DD&lt;sub&gt;Temperature&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Voltage&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Bias&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Tx-Power&lt;/sub&gt;</th>
<th>DD&lt;sub&gt;Rx-Power&lt;/sub&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internally measured transceiver</td>
<td>-40</td>
<td>2.8</td>
<td>0</td>
<td>-10</td>
<td>-22</td>
</tr>
<tr>
<td>Internally measured transceiver supply</td>
<td>125</td>
<td>4.0</td>
<td>20</td>
<td>+2</td>
<td>+2</td>
</tr>
<tr>
<td>supply voltage</td>
<td>°C</td>
<td>V</td>
<td>mA</td>
<td>dBm</td>
<td>dBm</td>
</tr>
<tr>
<td>measured transceiver</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Notes:

1. Accuracy of measured Tx bias current is 10% of the actual bias current from the laser driver to the laser.
<table>
<thead>
<tr>
<th>Pin</th>
<th>Symbol</th>
<th>Name/Description</th>
<th>Ref.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$V_{\text{EET}}$</td>
<td>Transmitter Ground</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>$T_{\text{FAULT}}$</td>
<td>Transmitter Fault</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>$T_{\text{DIS}}$</td>
<td>Transmitter Disable. Laser output disabled on high or open.</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>SDA</td>
<td>2-wire Serial Interface Data Line</td>
<td>2</td>
</tr>
<tr>
<td>5</td>
<td>SCL</td>
<td>2-wire Serial Interface Clock Line</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>MOD_ABS</td>
<td>Module Absent. Grounded within the module</td>
<td>2</td>
</tr>
<tr>
<td>7</td>
<td>RS0</td>
<td>Rate Select 0.</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>RX_LOS</td>
<td>Loss of Signal indication. Logic 0 indicates normal operation.</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>RS1</td>
<td>Rate Select 1.</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>$V_{\text{EER}}$</td>
<td>Receiver Ground</td>
<td>1</td>
</tr>
<tr>
<td>11</td>
<td>$V_{\text{EER}}$</td>
<td>Receiver Ground</td>
<td>1</td>
</tr>
<tr>
<td>12</td>
<td>RD-</td>
<td>Receiver Inverted DATA out. AC Coupled.</td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>RD+</td>
<td>Receiver Non-inverted DATA out. AC Coupled.</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>$V_{\text{EER}}$</td>
<td>Receiver Ground</td>
<td>1</td>
</tr>
<tr>
<td>15</td>
<td>$V_{\text{CCR}}$</td>
<td>Receiver Power Supply</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>$V_{\text{CCT}}$</td>
<td>Transmitter Power Supply</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>$V_{\text{EET}}$</td>
<td>Transmitter Ground</td>
<td>1</td>
</tr>
</tbody>
</table>
18 | TD+ | Transmitter Non-Inverted DATA in.  
    |     | AC Coupled. |

19 | TD- | Transmitter Inverted DATA in.  
    |     | AC Coupled. |

20 | V_EET | Transmitter Ground | 1

Notes:
1. Circuit ground is internally isolated from chassis ground.
2. TFAULT is an open collector/drain output, which should be pulled up with a 4.7kΩ -10kΩ Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to Vcc + 0.3V. A high output indicates a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
3. Laser output disabled on T_DIS >2.0V or open, enabled on T_DIS <0.8V.
4. Internally pulled down per SFF-8431 Rev 2.0. See Sec. X for the logic table to use for the internal CDRs locking modes.
5. LOS is open collector output. Should be pulled up with 4.7kΩ -10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
VII. Mechanical Specifications
VIII. Host Board SFP+ Connector Recommendations
NOTES:

△ MINIMUM PITCH ILLUSTRATED. ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY

2. NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS
Test Center

FS.COM transceivers are tested to ensure connectivity and compatibility in our test center before shipped out. FS.COM test center is supported by a variety of mainstream original brand switches and groups of professional staff, helping our customers make the most efficient use of our products in their systems, network designs and deployments.

The original switches could be found nowhere but at FS.COM test center, eg: Juniper MX960 & EX 4300 series, Cisco Nexus 9396PX & Cisco ASR 9000 Series, HP 5900 Series & HP 5406R ZL2 V3(J9996A), Arista 7050S-64, Brocade ICX7750-26Q & ICX6610-48, Avaya VSP 7000 MDA 2, etc.
Test Assured Program

FS.COM truly understands the value of compatibility and interoperability to each optics. Every module FS.COM provides must run through programming and an extensive series of platform diagnostic tests to prove its performance and compatibility. In our test center, we care of every detail from staff to facilities—professionally trained staff, advanced test facilities and comprehensive original-brand switches, to ensure our customers to receive the optics with superior quality.

Our smart data system allows effective product management and quality control according to the unique serial number, properly tracing the order, shipment and every part.

Our in-house coding facility programs all of our parts to standard OEM specs for compatibility on all major vendors and systems such as Cisco, Juniper, Brocade, HP, Dell, Arista and so on.

With a comprehensive line of original-brand switches, we can recreate an environment and test each optics in practical application to ensure quality and distance.

The last test assured step to ensure our products to be shipped with perfect package.
Order Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFP-10GSR-85</td>
<td>10GBASE-SR SFP+ 850nm 300m DOM Transceiver</td>
</tr>
<tr>
<td>SFP-10GLRM-31</td>
<td>10G SFP+ 1310nm 2km DOM Transceiver</td>
</tr>
<tr>
<td>SFP-10GLR-31</td>
<td>10GBASE-LR SFP+ 1310nm 10km DOM Transceiver</td>
</tr>
<tr>
<td>SFP-10GER-55</td>
<td>10GBASE-ER SFP+ 1550nm 40km DOM Transceiver</td>
</tr>
<tr>
<td>SFP-10GZR-55</td>
<td>10GBASE-ZR SFP+ 1550nm 80km DOM Transceiver</td>
</tr>
<tr>
<td>SFP-10GZR-55C</td>
<td>10G SFP+ 1550nm 100km DOM Transceiver</td>
</tr>
<tr>
<td>SFP-10GSR-85C</td>
<td>Dual-Rate 1000BASE-SX and 10GBASE-SR SFP+ 850nm 300m DOM Transceiver</td>
</tr>
<tr>
<td>SFP-10GLR-31C</td>
<td>Dual-Rate 1000BASE-LX and 10GBASE-LR SFP+ 1310nm 10km DOM Transceiver</td>
</tr>
</tbody>
</table>

Note:
10G SFP+ transceiver module is individually tested on corresponding equipment such as Cisco, Arista, Juniper, Dell, Brocade and other brands, and passes the monitoring of FS.COM intelligent quality control system.
Contact Us

<table>
<thead>
<tr>
<th>Region</th>
<th>Address</th>
<th>Phone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>North America</td>
<td>Fiberstore INC 820 SW 34th Street Bldg W7 Suite H, Renton, WA 98057</td>
<td>+1(877) 205 5306</td>
</tr>
<tr>
<td>Eastern America</td>
<td>FS.COM INC 380 Centerpoint Blvd New Castle, DE 19720</td>
<td></td>
</tr>
<tr>
<td>Europe (Germany)</td>
<td>FS.COM GmbH NOVA Gewerbepark Building 7, Am Gfild 7, 85375 Neufahrn bei Munich, Germany</td>
<td>+49 (0) 89 414176412</td>
</tr>
<tr>
<td>Europe (UK)</td>
<td>Fiberstore LTD 2nd Floor, Quayside Tower, Broad Street, Birmingham, B1 2HF</td>
<td>+44 (0) 121 698 2099</td>
</tr>
<tr>
<td>Asia (China)</td>
<td>Fiberstore Co., Limited Room 2702, 27 Floor Yisibo Software Building Haitian Second Road, Yuehai Street Nanshan District Shenzhen, 518054, China</td>
<td>+86 (755) 8300 3611</td>
</tr>
<tr>
<td>Australia</td>
<td>FS.COM PTY LTD 57-59 Edison Rd, Dandenong South, VIC3175, Australia</td>
<td>+61 (2)8317 1119</td>
</tr>
</tbody>
</table>

Addresses, phone number and fax number also have been listed at [www.fs.com](http://www.fs.com). Please e-mail us at [sales@fs.com](mailto:sales@fs.com) or call us for assistance.

All statements, technical information, and recommendations related to the products here are based upon information believed to be reliable or accurate. However, the accuracy or completeness thereof is not guaranteed, and no responsibility is assumed for any inaccuracies. Please contact FS for more information.