

## SFP+ 10G 1310nm Singlemode Optical Transceiver



### Description

The BlueOptics® BO35J13610D SFP+ transceiver is a high performance, cost effective module supporting a data rate up to 10Gbps with 10 Kilometer link length on singlemode fiber.

BlueOptics® transceivers are 100% compliant with SFP+ Multi-Source Agreement (MSA).

All BlueOptics® SFP+ transceivers are always equipped with digital diagnostic function compliant to MSA SFF-8472.

Using digital diagnostic, BlueOptics® SFP+ transceivers provide the following real time information:

- Supply voltage
- Laser bias current
- Laser average output power
- Laser received input power
- Temperature

The transceiver consists of five sections: A DFB transmitter, a PIN photodiode, a trans-impedance preamplifier (TIA), the LD Driver and the digital diagnostic function.

### Applications

- ✓ 10GBase-LR/LW
- ✓ Ethernet / Fiber Channel
- ✓ Switch to Switch Interface
- ✓ Router/Server Interface
- ✓ Other optical links

### Features

- ✓ 10Gb/s serial optical interface compliant to 802.3ae 10GBASE-LR
- ✓ DFB laser transmitter
- ✓ PIN photo-detector
- ✓ Hot-pluggable SFP+ footprint compliant to SFF-8431
- ✓ Duplex LC/UPC type pluggable optical interface
- ✓ 2-wire interface for management
- ✓ Metal enclosure, for lower EMI
- ✓ RoHS compliant and lead-free
- ✓ Single +3.3V power supply
- ✓ Compliant with SFF-8472
- ✓ Case operating temperature
  - Commercial: 0°C to +70°C
  - Extended: -10°C to +80°C
  - Industrial: -40°C to +85°C

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended.

**Laser Safety:** Even small radiation emitted by laser devices can be dangerous to human eyes and lead to permanent eye injuries. Be sure to avoid eye contact with direct or indirect radiation.

## Warranty

Every BlueOptics® transceiver comes with a 5 year replacement warranty and lifetime support.

For a warranty inquiry, please contact your CBO sales representative.

This warranty only covers the first user of the equipment.

## Important Notice

Performance figures, data and any illustrative material provided in this data sheet are typical and must be specifically confirmed in writing by CBO before they become applicable to any particular order or contract. In accordance with the CBO policy of continuous improvement specifications may change without notice.

The publication of information in this data sheet does not imply freedom from patent or other protective rights of CBO or others.

Further details are available from any CBO sales representative.

## Installation

Before installation attach an ESD-preventive wrist to ensure not to damage the transceiver or hardware.

BlueOptics® BO35J13610D can be installed in any Small Form Factor Pluggable+ (SFP+) port. You can install the BO35J13610D regardless if the system is powered on or off, because it is hot-swappable.

Insert the transceiver into the SFP port and remove the dust cap.

You can now connect your cable.

## Order Information

| Part No.      | Temp.          | DDM |
|---------------|----------------|-----|
| BO35J13610D   | 0°C to +70°C   | ✓   |
| BO35J13610DEX | -10°C to +80°C | ✓   |
| BO35J13610DIN | -40°C to +80°C | ✓   |

## Regulatory Compliance

| Feature                            | Standard                                                | Co.          |
|------------------------------------|---------------------------------------------------------|--------------|
| Electrostatic Discharge (ESD)      | - IEC/EN 61000-4- 2                                     | ✓            |
| Electromagnetic Interference (EMI) | - FCC Part 15 Class B EN 55022<br>- Class B (CISPR 22A) | ✓            |
| Laser Eye Safety                   | - FDA 21CFR 1040.10, 1040.11<br>- IEC/EN 60825-1, 2     | Class 1<br>✓ |
| Component Recognition              | - IEC/EN 60950, UL                                      | ✓            |
| RoHS                               | - 2002/95/EC                                            | ✓            |
| EMC                                | - EN61000-3                                             | ✓            |

## 1. Absolute Maximum Ratings

| Parameter                | Symbol | Min. | Typ. | Max. | Unit |
|--------------------------|--------|------|------|------|------|
| Storage Temperature      | Ts     | -40  |      | 85   | °C   |
| Storage Ambient Humidity | HA     | 5    |      | 95   | %    |

## 2. Recommended Operating Conditions

| Parameter             | Symbol           | Min. | Typ. | Max. | Unit | Note          |
|-----------------------|------------------|------|------|------|------|---------------|
|                       |                  | 0    |      | 70   |      | BO35J13610D   |
|                       |                  | -10  |      | 80   | °C   | BO35J13610DEX |
|                       |                  | -40  |      | 85   |      | BO35J13610DIN |
| Ambient Humidity      | HA               | 5    |      | 70   | %    |               |
| Transmission Distance |                  |      |      | 10   | KM   |               |
| Coupled Fiber         | Singlemode fiber |      |      |      |      | 9/125µm SMF   |

## 3. Electrical Interface Characteristics

| Parameter                      | Symbol     | Min.    | Typ. | Max.    | Unit | Note |
|--------------------------------|------------|---------|------|---------|------|------|
| Power Supply Voltage           | Vcc        | 3.13    | 3.3  | 3.47    | V    |      |
| Signal Input Voltage           | Icc        |         |      | 250     | mA   |      |
| <b>Transmitter</b>             |            |         |      |         |      |      |
| Input differential impedance   | Rin        |         | 100  |         | Ω    | 1    |
| Single ended data input swing  | Vin,pp     | 180     |      | 700     | mV   |      |
| Transmit Disable Voltage       | VD         | Vcc-1.3 |      | Vcc     | V    |      |
| Transmit Enable Voltage        | VEN        | Vee     |      | Vee+0.8 | V    | 2    |
| Transmit Disable Assert Time   |            |         |      | 10      | µs   |      |
| <b>Receiver</b>                |            |         |      |         |      |      |
| Differential data output swing | Vout,pp    | 300     |      | 850     | mV   | 3    |
| Data output rise time          | tr         | 28      |      |         | Ps   | 4    |
| Data output fall time          | tf         | 28      |      |         | Ps   | 4    |
| LOS Fault                      | VLOS fault | Vcc-1.3 |      | VccHOST | V    | 5    |
| LOS Normal                     | VLOS norm  | Vee     |      | Vee+0.8 | V    | 5    |
| Power Supply Rejection         | PSR        | 100     |      |         | mVpp | 6    |

### Notes:

1. Internally AC coupled.
2. Or open circuit.
3. Into 100Ω differential termination.
4. 20-80%
5. LOS is an open collector output. Should be pulled up with 4.7KΩ on the host board.
6. All transceiver specifications are compliant with a power supply sinusoidal modulation of 20 Hz to 1.5 MHz up to specified value through the power supply filtering network shown on page 23 of the Small Form - factor Pluggable (SFP) Transceiver Multi Source Agreement (MSA), September 14, 2000.

#### 4. Transmitter Specifications - Optical

| Parameter                          | Symbol                                               | Min. | Typ. | Max. | Unit  | Note |
|------------------------------------|------------------------------------------------------|------|------|------|-------|------|
| Average Output Power               | P <sub>OUT</sub>                                     | -6   |      | 0.5  | dBm   |      |
| Extinction Ratio                   | ER                                                   | 3.5  |      |      | dB    |      |
| Center Wavelength                  | λ <sub>C</sub>                                       | 1260 | 1310 | 1355 | nm    |      |
| Spectral Width (-20dB)             | σ                                                    |      |      | 1    | dB    |      |
| Transmitter and Dispersion Penalty | TDP                                                  |      |      | 3.2  | dB    |      |
| RIN                                | RIN                                                  |      |      | -128 | dB/Hz |      |
| Output Eye Mask                    | Compliant with IEEE802.3ae<br>(class 1 laser safety) |      |      |      |       |      |

#### 5. Receiver Specifications - Optical

| Parameter                         | Symbol                         | Min. | Typ. | Max. | Unit | Note |
|-----------------------------------|--------------------------------|------|------|------|------|------|
| Input Optical Wavelength          | λ <sub>IN</sub>                | 1270 |      | 1610 | nm   |      |
| Receiver Sensitivity              | P <sub>IN</sub>                |      |      | -15  | dBm  | 1    |
| Input Saturation Power (Overload) | P <sub>SAT</sub>               | 0.5  |      |      | dBm  |      |
| LOS Assert                        | P <sub>A</sub>                 | -30  |      |      | dBm  |      |
| LOS De-assert                     | P <sub>D</sub>                 |      |      | -17  | dBm  |      |
| LOS Hysteresis                    | P <sub>A</sub> -P <sub>D</sub> | 0.5  | 1.0  |      | dB   |      |

##### Notes:

1. Measured with Light source 1310nm, ER=3.5dB; BER =<10<sup>-12</sup> @PRBS=2<sup>31</sup>-1 non-return-to-zero.

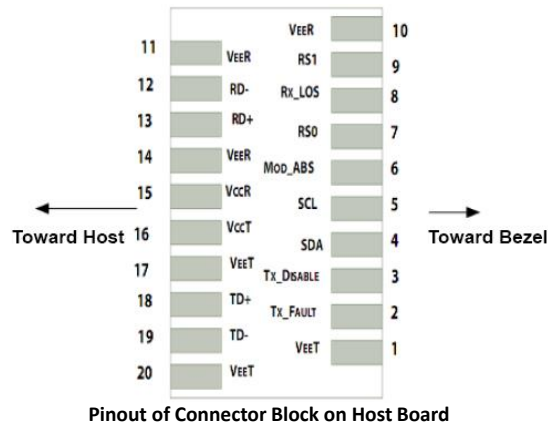
#### 6. SFP+ to Host Connector Pin Out

| Pin | Symbol             | Name / Description                               | Note |
|-----|--------------------|--------------------------------------------------|------|
| 1   | V <sub>EET</sub>   | Transmitter Ground (Common with Receiver Ground) | 1    |
| 2   | T <sub>FAULT</sub> | Transmitter Fault indication                     | 2    |
| 3   | T <sub>DIS</sub>   | Transmitter Disable                              | 3    |
| 4   | SDA                | 2-wire Serial Interface Data Line                | 4    |
| 5   | SCL                | 2-wire Serial Interface Clock Line               | 4    |
| 6   | MOD-ABS            | Module Absent. Grounded within the module        | 4    |
| 7   | RS0                | Rate Select 0                                    | 5    |
| 8   | LOS                | Loss of Signal indication                        | 6    |
| 9   | RS1                | No connection required                           | 1    |
| 10  | V <sub>EER</sub>   | Receiver Ground (Common with Transmitter Ground) | 1    |
| 11  | V <sub>EER</sub>   | Receiver Ground (Common with Transmitter Ground) | 1    |
| 12  | RD-                | Inv. Received Data Out                           |      |
| 13  | RD+                | Received Data Out                                |      |
| 14  | V <sub>EER</sub>   | Receiver Ground (Common with Transmitter Ground) | 1    |
| 15  | V <sub>CCR</sub>   | Receiver Power Supply                            |      |
| 16  | V <sub>CCT</sub>   | Transmitter Power                                |      |
| 17  | V <sub>EET</sub>   | Transmitter Ground (Common with Receiver Ground) | 1    |
| 18  | TD+                | Transmit Data In                                 |      |
| 19  | TD-                | Inv. Transmit Data In                            |      |
| 20  | V <sub>EET</sub>   | Transmitter Ground (Common with Receiver Ground) | 1    |

##### Notes:

1. Circuit ground is isolated from chassis ground.
2. Needs to be pulled up with 4.7k – 10kΩ on host board to a voltage from 2.0V to Vcc + 0.3V.

3. Tx\_Disable is an input contact with a 4.7 kΩ to 10 kΩ pullup to VccT inside the module.
4. Mod\_ABS is connected to VeeT or VeeR in the SFP+ module. The host may pull this contact up to Vcc\_Host with a resistor from 4.7 kΩ up to 10 kΩ.
5. RS1 are module inputs and are pulled low to VeeT with > 30 kΩ resistors in the module.
6. This is an open collector output, which should only be pulled with a resistor of 4.7k - 10kΩ. Pull up voltage between 2.0V and 3.6V. Logic 1 indicates loss of signal; logic 0 indicates normal operation. The output will be pulled to less than 0.8V.



## 7. EEPROM Information

The SFP MSA defines a 256-byte memory map in EEPROM describing the transceivers capabilities, standard interfaces, manufacturer, and other information, which is accessible over a 2 wire serial interface at the 8-bit address 1010000X (A0h).

| Data Address | Field Size (Bytes) | Name of Field     | Contents (Hex)                                     | Description                        |
|--------------|--------------------|-------------------|----------------------------------------------------|------------------------------------|
| 0            | 1                  | Identifier        | XX                                                 | Formfactor                         |
| 1            | 1                  | Ext. Identifier   | XX                                                 |                                    |
| 2            | 1                  | Connector         | XX                                                 |                                    |
| 3-10         | 8                  | Transceiver       | XX XX XX XX XX XX XX XX                            | Transmittter Code                  |
| 11           | 1                  | Encoding          | XX                                                 |                                    |
| 12           | 1                  | BR, Nominal       | XX                                                 | Transceiver Speed                  |
| 13           | 1                  | Reserved          | 00                                                 |                                    |
| 14           | 1                  | Length (9μm) km   | XX                                                 | Max. link length in KM             |
| 15           | 1                  | Length (9μm) 100m | XX                                                 | Max. link length in M              |
| 16           | 1                  | Length (50μm) 10m | XX                                                 | Max. link length in M              |
| 17           | 1                  | Length(62.5μm)10m | XX                                                 | Max. link length in M              |
| 18           | 1                  | Length (Copper)   | XX                                                 | Max. link length in M              |
| 29           | 1                  | Reserved          | 00                                                 |                                    |
| 30-35        | 16                 | Vendor name       | XX XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX XX | Vendor name - OEM                  |
| 36           | 1                  | Reserved          | 00                                                 |                                    |
| 37-39        | 3                  | Vendor OUI        | XX XX XX                                           |                                    |
| 40-55        | 16                 | Vendor PN         | XX XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX XX | Product Number - depending on Part |
| 56-59        | 4                  | Vendor rev        | XX XX XX XX                                        | Vendor revision                    |
| 60-61        | 2                  | Wavelength        | XX XX                                              | Transceiver Wavelength             |
| 62           | 1                  | Reserved          | 00                                                 |                                    |
| 63           | 1                  | CC BASE           | XX                                                 | Checksum of bytes 0-62             |

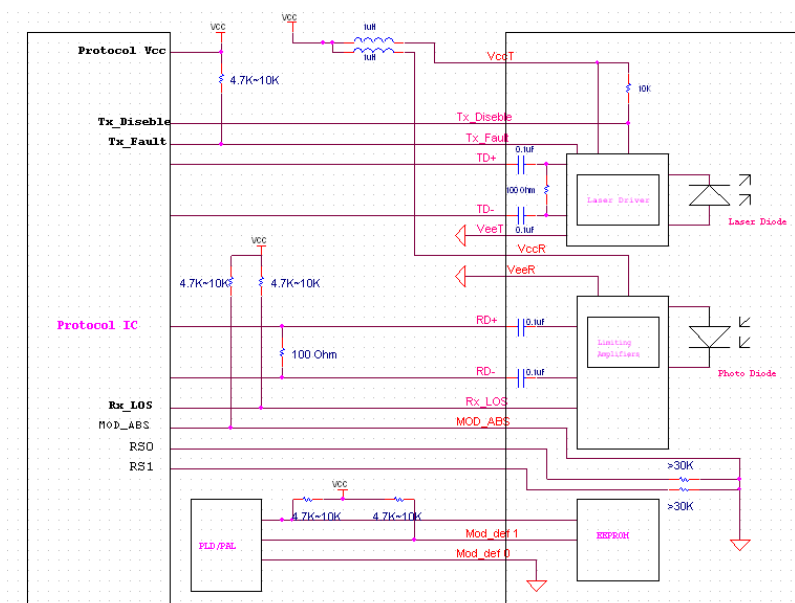
|        |     |                  |                                                    |                         |
|--------|-----|------------------|----------------------------------------------------|-------------------------|
| 64-65  | 2   | Options          | XX XX                                              |                         |
| 66     | 1   | BR, max          | XX                                                 |                         |
| 67     | 1   | BR, min          | XX                                                 |                         |
| 68-83  | 16  | Vendor SN        | XX XX XX XX XX XX XX XX<br>XX XX XX XX XX XX XX XX | Part serial number      |
| 84-91  | 8   | Vendor date code | XX XX XX XX XX XX 20 20                            | Year, Month, Day        |
| 92     | 1   | Diagnostic type  | XX                                                 | Diagnostics             |
| 93     | 1   | Enhanced option  | XX                                                 | Diagnostics             |
| 94     | 1   | SFF-8472         | XX                                                 | Diagnostics             |
| 95     | 1   | CC_EXT           | XX                                                 | Checksum of bytes 64-94 |
| 96-255 | 160 | Vendor Specific  |                                                    |                         |

## 8. Digital Diagnostics / Digital Optical Monitoring

The transceiver provides serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA).

The diagnostic information with internal calibration or external calibration are all implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

## 9. Recommended Interface Circuit



**10. Mechanical Specifications** (Unit: mm)