

## SFP 1.25G 1310nm Single mode Optical Transceiver



### Description

The BlueOptics® BO05U13602 SFP transceiver is a high performance, cost effective module supporting a data rate up to 1.25Gbps with 2 Kilometer link length on multi mode fiber.

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

All BlueOptics® SFP transceivers can be 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 FP transmitter, a PIN photodiode, a trans-impedance preamplifier (TIA), the LD Driver and the digital diagnostic function.

### Applications

- ✓ 1000Base-LX
- ✓ Ethernet / Fiber Channel
- ✓ Switch to Switch Interface
- ✓ Router/Server Interface
- ✓ Other optical links

### Features

- ✓ 1.25Gb/s serial optical interface compliant to 802.3z 1000BASE-X
- ✓ FP laser transmitter
- ✓ PIN photo-detector
- ✓ Hot-pluggable SFP footprint compliant to SFF-8074i
- ✓ 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® BO05U13602 can be installed in any Small Form Factor Pluggable (SFP) port. You can install the BO05U13602 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 |
|---------------|----------------|-----|
| BO05U13602    | 0°C to +70°C   | -   |
| BO05U13602EX  | -10°C to +80°C | -   |
| BO05U13602IN  | -40°C to +80°C | -   |
| BO05U13602D   | 0°C to +70°C   | ✓   |
| BO05U13602DEX | -10°C to +80°C | ✓   |
| BO05U13602DIN | -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   |      | BO05U13602<br>BO05U13602D     |
|                       |                  | -10  |           | 80   | °C   | BO05U13602EX<br>BO05U13602DEX |
|                       |                  | -40  |           | 85   |      | BO05U13602IN<br>BO05U13602DIN |
| Ambient Humidity      | HA               | 5    |           | 70   | %    |                               |
| Data Rate             |                  |      | 1250/1250 |      | Mbps | TX Rate/RX Rate               |
| Transmission Distance |                  |      |           | 2    | KM   |                               |
| Coupled Fiber         | Multi mode fiber |      |           |      |      | 9/125µm MMF                   |

## 3. Electrical Interface Characteristics

| Parameter                      | Symbol            | Min. | Typ. | Max.                 | Unit | Note |
|--------------------------------|-------------------|------|------|----------------------|------|------|
| <b>Transmitter</b>             |                   |      |      |                      |      |      |
| Total Supply Current           | I <sub>CC</sub>   |      |      | A                    | mA   | 1    |
| Transmitter Disable Input-High | V <sub>DISH</sub> | 2    |      | V <sub>CC</sub> +0.3 | V    |      |
| Transmitter Disable Input-Low  | V <sub>DISL</sub> | 0    |      | 0.8                  | V    |      |
| Transmitter Fault Input-High   | V <sub>TXFH</sub> | 2    |      | V <sub>CC</sub> +0.3 | V    |      |
| Transmitter Fault Input-Low    | V <sub>TXFL</sub> | 0    |      | 0.8                  | V    |      |
| <b>Receiver</b>                |                   |      |      |                      |      |      |
| Total Supply Current           | I <sub>CC</sub>   |      |      | B                    | mA   | 1    |
| LOSS Output Voltage-High       | V <sub>LOSH</sub> | 2    |      | V <sub>CC</sub> +0.3 | V    |      |
| LOSS Output Voltage-Low        | V <sub>LOSL</sub> | 0    |      | 0.8                  | V    |      |

### Notes:

1. A (TX) + B (RX) = 280mA (without termination circuit)

## 4. Transmitter Specifications - Optical

| Parameter                         | Symbol                                              | Min. | Typ. | Max. | Unit | Note |
|-----------------------------------|-----------------------------------------------------|------|------|------|------|------|
| Average Output Power              | P <sub>OUT</sub>                                    | -11  |      | -3   | dBm  |      |
| Extinction Ratio                  | ER                                                  | 9    |      |      | dB   |      |
| Center Wavelength                 | λ <sub>C</sub>                                      | 1270 | 1310 | 1360 | nm   |      |
| Spectrum Bandwidth(RMS)           | σ                                                   |      |      | 3.5  | nm   |      |
| Transmitter OFF Output Power      | P <sub>Off</sub>                                    |      |      | -45  | dBm  |      |
| Differential Line Input Impedance | R <sub>IN</sub>                                     | 90   | 100  | 110  | Ohm  |      |
| Output Eye Mask                   | Compliant with IEEE802.3z<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> |      |      | -19  | dBm  | 1    |
| Input Saturation Power (Overload) | PSAT            | -3   |      |      | dBm  |      |
| LOS Assert                        | PA              |      |      | -20  | dBm  |      |
| LOS De-assert                     | PD              | -35  |      |      | dBm  |      |
| LOS Hysteresis                    | PA-PD           | 0.5  | 2.0  | 6.0  | dB   |      |

### Notes:

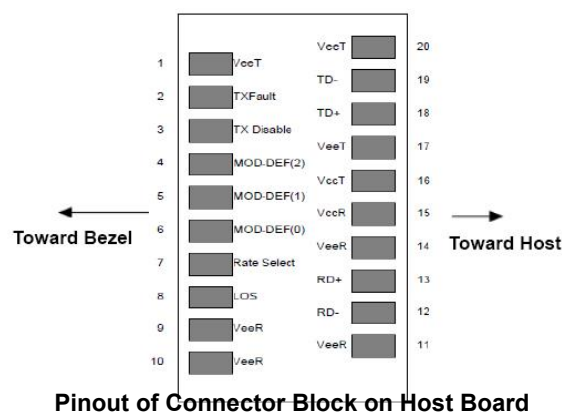
1. Measured with Light source 1310nm, ER=9dB; BER =<10<sup>-12</sup> @PRBS=2<sup>7</sup>-1 non-return-to-zero.

## 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                     |      |
| 3   | T <sub>DIS</sub>   | Transmitter Disable                              | 2    |
| 4   | MOD_DEF(2)         | Module Definition 2. Data line for Serial ID.    | 3    |
| 5   | MOD_DEF(1)         | Module Definition 1. Data line for Serial ID.    | 3    |
| 6   | MOD_DEF(0)         | Module Definition 0. Data line for Serial ID.    | 3    |
| 7   | RS0                | Rate Select 0                                    |      |
| 8   | LOS                | Loss of Signal indication                        | 4    |
| 9   | V <sub>EER</sub>   | Receiver Ground (Common with Transmitter Ground) | 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:

- Circuit ground is internally isolated from chassis ground.
- TDis is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7k~10kΩ resistor. Its states are:  
Low (0 to 0.8V): Transmitter on  
(>0.8V, < 2.0V): Undefined  
High (2.0 to 3.465V): Transmitter Disabled  
Open: Transmitter Disabled
- Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7k~10kΩ resistor on the host board. The pull-up voltage shall be VccT or VccR.  
Mod-Def 0 is grounded by the module to indicate that the module is present  
Mod-Def 1 is the clock line of two wire serial interface for serial ID  
Mod-Def 2 is the data line of two wire serial interface for serial ID
- LOS is an open collector output, which should be pulled up with a 4.7k~10kΩ resistor. Pull up voltage between 2.0V and Vcc+0.3V. Logic 1 indicates loss of signal; Logic 0 indicates normal operation. In the low state, 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).

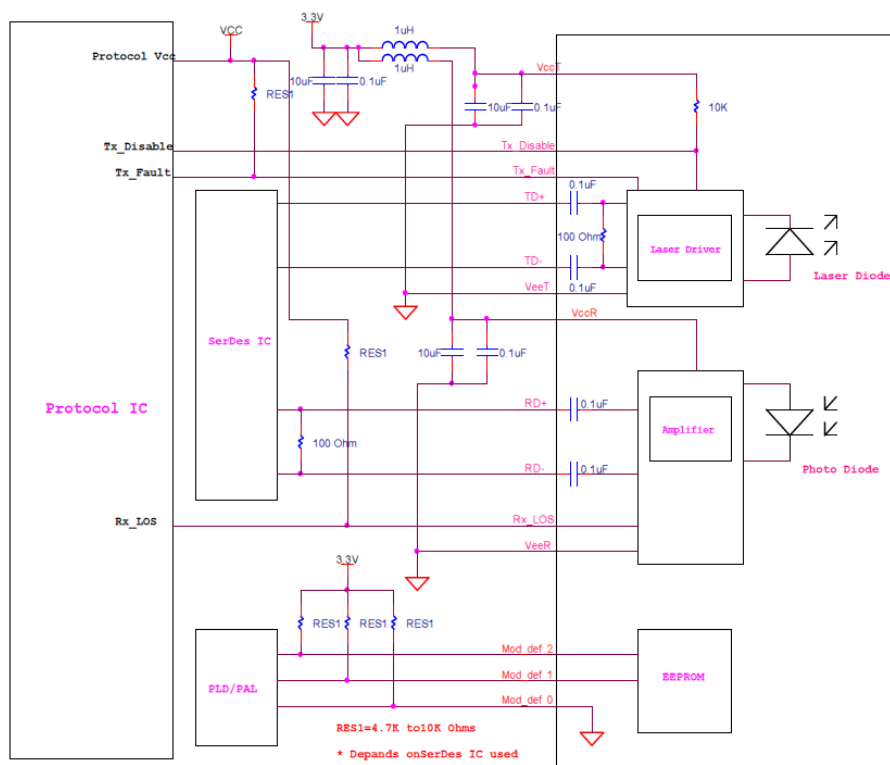
| Data Address | Field Size (Bytes) | Name of Field     | Contents (Hex)                                  | Description                        |
|--------------|--------------------|-------------------|-------------------------------------------------|------------------------------------|
| 0            | 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 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 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 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)

