

## QSFP28 100G CWDM4 Single mode Optical Transceiver



### Description

The BlueOptics® BO28L13602D QSFP28 transceiver is a high performance, cost effective module supporting a data rate up to 103.125Gbps with 2 Kilometer link length on single mode fiber.

BlueOptics® transceivers are 100% compliant with QSFP28 Multi-Source Agreement (MSA).

All BlueOptics® QSFP28 transceivers are always equipped with digital diagnostic function compliant to MSA SFF-8436.

Using digital diagnostic, BlueOptics® QSFP28 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 CWDM transmitter, a PIN photodiode, a trans-impedance preamplifier (TIA), the LD Driver and the digital diagnostic function.

### Applications

- ✓ Ethernet
- ✓ Infiniband
- ✓ Fibre Channel

### Features

- ✓ 27.952 Gb/s data rate per channel compliant to IEEE 802.3bm and IEEE 802.3ba
- ✓ Hot-pluggable QSFP28 footprint compliant to SFF-8665
- ✓ Duplex LC/UPC type pluggable optical interface
- ✓ Link length up to 2 Kilometer on SM
- ✓ Build in CDR
- ✓ Digital Diagnostics SFF-8436 compliant
- ✓ 2-wire interface for management
- ✓ Metal enclosure, for lower EMI
- ✓ RoHS compliant and lead-free
- ✓ Low power dissipation: maximum 3.5W
- ✓ Single +3.3V power supply
- ✓ 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 covers the first user of the equipment only.

## 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® BO28L13602D can be installed in any Small Form Factor Pluggable (QSFP28) port. You can install the BO28L13602D regardless if the system is powered on or off, because it is hot-swappable.

Insert the transceiver into the QSFP28 port and remove the dust cap.

You can now connect your cable.

## Order Information

| Part No.      | Temp.          | DDM |
|---------------|----------------|-----|
| BO28L13602D   | 0°C to +70°C   | ✓   |
| BO28L13602DIN | -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) | ✓   |
| 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          |
|----------------------------|-------------------|------|----------|------|------|---------------|
| Case Operating Temperature | Tcase             | 0    |          | 70   |      | BO28L13602D   |
|                            |                   | -40  |          | 85   |      | BO28L13602DIN |
| Ambient Humidity           | HA                | 5    |          | 70   | %    |               |
| Transmission Distance      |                   |      |          | 2    | KM   |               |
| Data Rate                  | BR                |      | 25.78125 |      | Gbps | per channel   |
| Coupled Fiber              | Single mode 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        |         |      | 1060    | mA   |      |
| <b>Transmitter</b>             |            |         |      |         |      |      |
| Input differential impedance   | Rin        |         | 100  |         | Ω    | 1    |
| Transmit Disable Voltage       | VD         | Vcc-1.3 |      | Vcc     | V    |      |
| Transmit Enable Voltage        | VEN        | Vee     |      | Vee+0.8 | V    | 2    |
| Differential data input swing  | Vin,pp     | 180     |      | 1000    |      |      |
| <b>Receiver</b>                |            |         |      |         |      |      |
| Differential data output swing | Vout,pp    | 300     |      | 850     | mV   | 3    |
| LOS Fault                      | VLOS fault | Vcc-1.3 |      | VccHOST | V    | 4    |
| LOS Normal                     | VLOS norm  | Vee     |      | Vee+0.8 | V    | 4    |
| Power Supply Rejection         | PSR        | 100     |      |         | mVpp |      |
| Data output rise time          | tr         | 28      |      |         | ps   | 5    |
| Data output fall time          | tf         | 28      |      |         | ps   | 5    |

### Notes:

1. Connected directly to TX data input pins. AC coupled thereafter.
2. Or open circuit.
3. Into 100 ohms differential termination.
4. Loss Of Signal is LVTTTL. Logic 0 indicates normal operation; logic 1 indicates no signal detected.
5. 20 – 80 %

## 4. Transmitter Specifications - Optical

| Parameter                                   | Symbol | Min.    | Typ.    | Max.    | Unit  | Note |
|---------------------------------------------|--------|---------|---------|---------|-------|------|
| Average Output Power                        | POUT   |         |         | 8.5     | dBm   |      |
| Wavelength Assignment                       | λ 0    | 1294.53 | 1295.56 | 1296.59 | nm    |      |
|                                             | λ 1    | 1299.02 | 1300.05 | 1301.09 | nm    |      |
|                                             | λ 2    | 1303.54 | 1304.58 | 1305.63 | nm    |      |
|                                             | λ 3    | 1308.09 | 1309.14 | 1310.19 | nm    |      |
| Extinction Ratio                            | ER     | 3.5     |         |         | dB    |      |
| Average Launch Power Per lane               |        | -6.5    |         | 2.5     | dBm   |      |
| Spectral Width (-20dB)                      | σ      |         |         | 1       | nm    |      |
| RIN                                         | RIN    |         |         | -128    | dB/Hz |      |
| SMSR                                        |        | 30      |         |         | dB    |      |
| Average launch Power off per lane           | Poff   |         |         | -30     | dBm   |      |
| Transmitter and Dispersion Penalty per lane | TDP    |         |         | 3.3     | dB    |      |

## 5. Receiver Specifications - Optical

| Parameter                         | Symbol            | Min. | Typ. | Max. | Unit | Note |
|-----------------------------------|-------------------|------|------|------|------|------|
| Receiver Sensitivity per lane     | R <sub>SENS</sub> |      |      | -10  | dBm  | 1    |
| Input Saturation Power (Overload) | P <sub>SAT</sub>  |      |      | 2.5  | dBm  |      |
| Receiver Reflectance              | R <sub>r</sub>    |      |      | -26  | dB   |      |

### Notes:

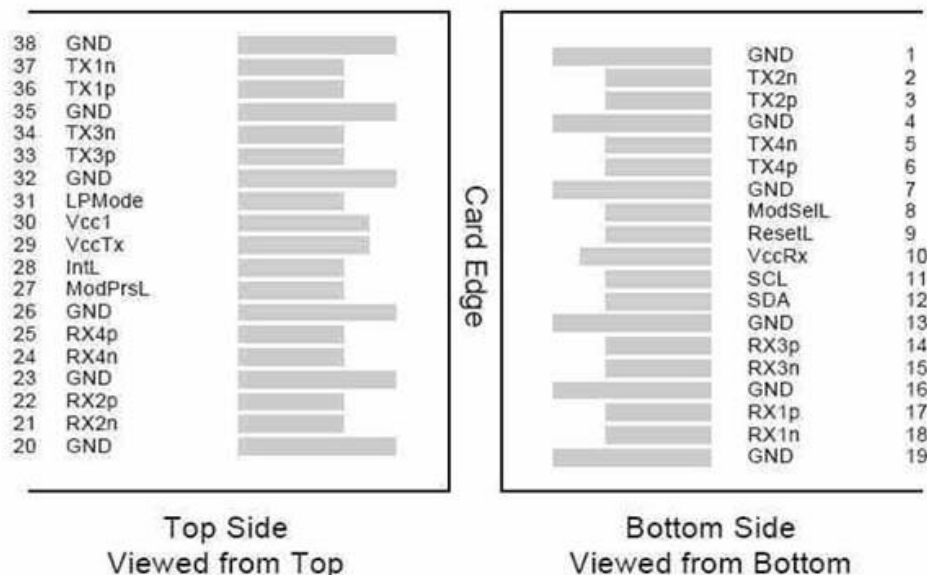
1. Measured with BER =  $<10^{-12}$  @PRBS=2<sup>31</sup>-1 @25.78Gb/s

## 6. QSFP28 to Host Connector Pin Out

| Pin | Symbol  | Name / Description                               | Note |
|-----|---------|--------------------------------------------------|------|
| 1   | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 2   | Tx2n    | Transmitter Inverted Data Input                  |      |
| 3   | Tx2p    | Transmitter Non-Inverted Data output             |      |
| 4   | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 5   | Tx4n    | Transmitter Inverted Data Input                  |      |
| 6   | Tx4p    | Transmitter Non-Inverted Data output             |      |
| 7   | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 8   | ModSelL | Module Select                                    |      |
| 9   | ResetL  | Module Reset                                     |      |
| 10  | VccRx   | 3.3V Power Supply Receiver                       | 2    |
| 11  | SCL     | 2-Wire serial Interface Clock                    |      |
| 12  | SDA     | 2-Wire serial Interface Data                     |      |
| 13  | GND     | Transmitter Ground (Common with Receiver Ground) |      |
| 14  | Rx3p    | Receiver Non-Inverted Data Output                |      |
| 15  | Rx3n    | Receiver Inverted Data Output                    |      |
| 16  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 17  | Rx1p    | Receiver Non-Inverted Data Output                |      |
| 18  | Rx1n    | Receiver Inverted Data Output                    |      |
| 19  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 20  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 21  | Rx2n    | Receiver Inverted Data Output                    |      |
| 22  | Rx2p    | Receiver Non-Inverted Data Output                |      |
| 23  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 24  | Rx4n    | Receiver Inverted Data Output                    | 1    |
| 25  | Rx4p    | Receiver Non-Inverted Data Output                |      |
| 26  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 27  | ModPrsl | Module Present                                   |      |
| 28  | IntL    | Interrupt                                        |      |
| 29  | VccTx   | 3.3V power supply transmitter                    | 2    |
| 30  | Vcc1    | 3.3V power supply                                | 2    |
| 31  | LPMode  | Low Power Mode                                   |      |
| 32  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 33  | Tx3p    | Transmitter Non-Inverted Data Input              |      |
| 34  | Tx3n    | Transmitter Inverted Data Output                 |      |
| 35  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |
| 36  | Tx1p    | Transmitter Non-Inverted Data Input              |      |
| 37  | Tx1n    | Transmitter Inverted Data Output                 |      |
| 38  | GND     | Transmitter Ground (Common with Receiver Ground) | 1    |

### Notes:

1. GND is the symbol for signal and supply (power) common for QSFP modules. All are common within the QSFP module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.
2. VccRx, Vcc1 and VccTx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.



Pinout of Connector Block on Host Board

## 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                  | Description                                                                                                  |
|--------------|--------------------|--------------------------------|--------------------------------------------------------------------------------------------------------------|
| 128          | 1                  | Identifier                     | Formfactor                                                                                                   |
| 129          | 1                  | Ext. Identifier                |                                                                                                              |
| 130          | 1                  | Connector                      |                                                                                                              |
| 131-138      | 8                  | Transceiver                    | Transmitter Code                                                                                             |
| 139          | 1                  | Encoding                       |                                                                                                              |
| 140          | 1                  | BR, Nominal                    | Transceiver Speed                                                                                            |
| 141          | 1                  | Extended RateSelect Compliance | Tags for Extended RateSelect compliance                                                                      |
| 142          | 1                  | Length (9µm) km                | Max. link length in KM                                                                                       |
| 143          | 1                  | Length (9µm) 100m              | Max. link length in M                                                                                        |
| 144          | 1                  | Length (50µm) 10m              | Max. link length in M                                                                                        |
| 145          | 1                  | Length(62.5µm)10m              | Max. link length in M                                                                                        |
| 146          | 1                  | Length (Copper)                | Max. link length in M                                                                                        |
| 147          | 1                  | Device Tech                    | Device technology                                                                                            |
| 148-163      | 16                 | Vendor name                    | Vendor name - OEM                                                                                            |
| 164          | 1                  | Extended Transceiver           | Extended Transceiver Codes for InfiniBand                                                                    |
| 165-167      | 3                  | Vendor OUI                     |                                                                                                              |
| 168-183      | 16                 | Vendor PN                      | Product Number - depending on Part                                                                           |
| 184-185      | 2                  | Vendor rev                     | Vendor revision                                                                                              |
| 186-187      | 2                  | Wavelength                     | Transceiver Wavelength                                                                                       |
| 188-189      | 2                  | Wavelength tolerance           | Guaranteed range of laser wavelength (+/- value) from Nominal wavelength (Wavelength Tol. = value/200 in nm) |
| 190          | 1                  | Max Case Temp                  | Maximum Case Temperature in Degrees C                                                                        |
| 191          | 1                  | CC_BASE                        | Check code for Base ID Fields (addresses 128-190)                                                            |
| 192-195      | 4                  | Options                        | Rate Select, TX Disable, TX Fault, LOS                                                                       |
| 196-211      | 16                 | Vendor SN                      | Part serial number                                                                                           |
| 212-219      | 8                  | Vendor date code               | Year, Month, Day                                                                                             |

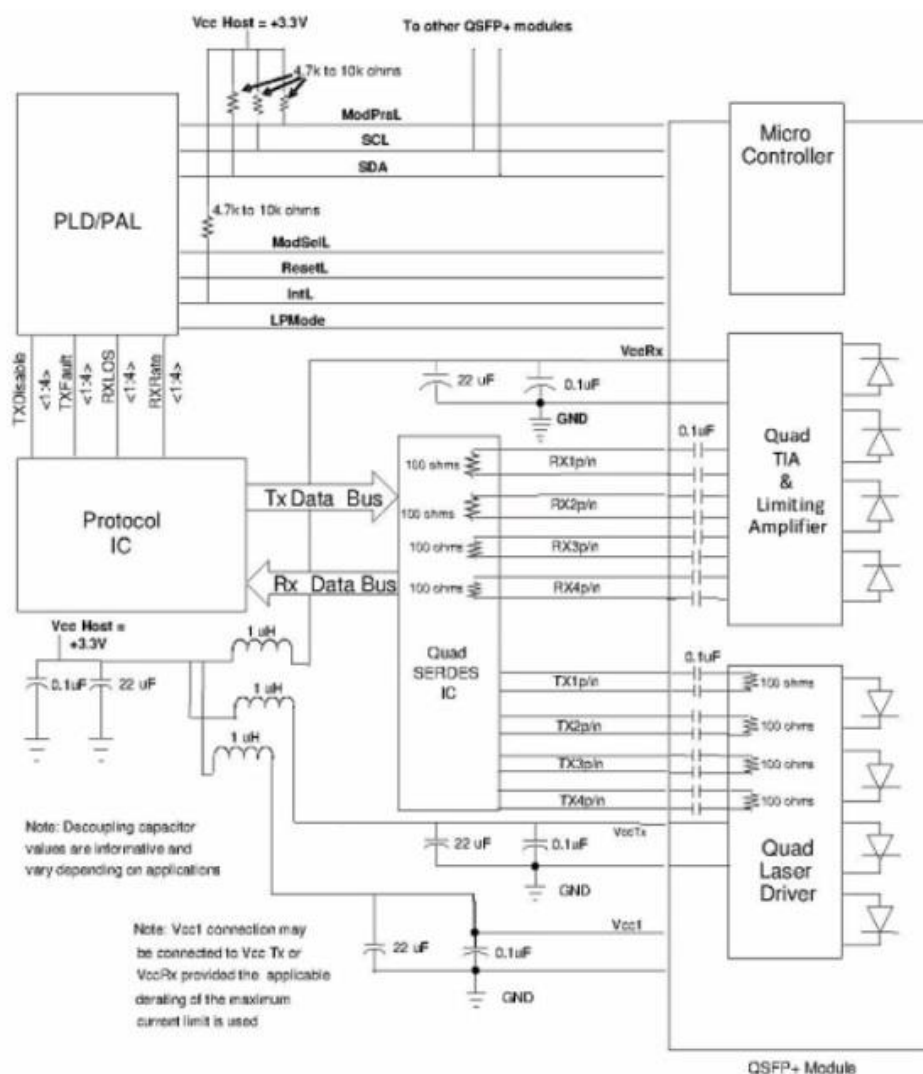
|         |    |                 |                                                                                |
|---------|----|-----------------|--------------------------------------------------------------------------------|
| 220     | 1  | Diagnostic type | Diagnostics                                                                    |
| 221     | 1  | Enhanced option | Indicates which optional enhanced features are implemented in the transceiver. |
| 222     | 1  | Reserved        | Reserved                                                                       |
| 223     | 1  | CC_EXT          | Check code for the Extended ID Fields (addresses 192-222)                      |
| 224-255 | 32 | Vendor Specific | Vendor Specific EEPROM                                                         |

## 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)