

### 16G-SFPP-ERD-1558-98-C

Brocade® 16G-SFPP-ERD-1558-98 Compatible TAA 16Gbs Fibre Channel DWDM 100GHz SFP+ Transceiver (SMF, 1558.98nm, 40km, LC, DOM)

#### Features:

- SFF-8432 and SFF-8472 Compliance
- Duplex LC Connector
- Single-mode Fiber
- Commercial Temperature 0 to 70 Celsius
- Hot Pluggable
- Metal with Lower EMI
- Excellent ESD Protection
- RoHS Compliant and Lead Free



#### Applications:

- Ethernet over DWDM
- Access, Metro and Enterprise

#### Product Description

This Brocade® 16G-SFPP-ERD-1558-98 compatible SFP+ transceiver provides 16GBase-DWDM Fibre Channel throughput up to 40km over single-mode fiber (SMF) using a wavelength of 1558.98nm via an LC connector. It is guaranteed to be 100% compatible with the equivalent Brocade® transceiver. This easy to install, hot swappable transceiver has been programmed, uniquely serialized and data-traffic and application tested to ensure that it will initialize and perform identically. Digital optical monitoring (DOM) support is also present to allow access to real-time operating parameters. This transceiver is Trade Agreements Act (TAA) compliant. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

ProLabs' transceivers are RoHS compliant and lead-free.

TAA refers to the Trade Agreements Act (19 U.S.C. & 2501-2581), which is intended to foster fair and open international trade. TAA requires that the U.S. Government may acquire only "U.S. – made or designated country end products."



## Regulatory Compliance

- ESD to the Electrical PINs: compatible with MIL-STD-883E Method 3015.4
- ESD to the LC Receptacle: compatible with IEC 61000-4-3
- EMI/EMC compatible with FCC Part 15 Subpart B Rules, EN55022:2010
- Laser Eye Safety compatible with FDA 21CFR, EN60950-1& EN (IEC) 60825-1,2
- RoHS compliant with EU RoHS 2.0 directive 2015/863/EU

## ITU-T Grid Channel (100GHz Spacing)

| Channel | THz   | nm      | Channel | THz   | nm      |
|---------|-------|---------|---------|-------|---------|
| 17*     | 191.7 | 1563.86 | 40      | 194   | 1545.32 |
| 18      | 191.8 | 1563.05 | 41      | 194.1 | 1544.53 |
| 19      | 191.9 | 1562.23 | 42      | 194.2 | 1543.73 |
| 20      | 192.0 | 1561.42 | 43      | 194.3 | 1542.94 |
| 21      | 192.1 | 1560.61 | 44      | 194.4 | 1542.14 |
| 22      | 192.2 | 1559.79 | 45      | 194.5 | 1541.35 |
| 23      | 192.3 | 1558.98 | 46      | 194.6 | 1540.56 |
| 24      | 192.4 | 1558.17 | 47      | 194.7 | 1539.77 |
| 25      | 192.5 | 1557.36 | 48      | 194.8 | 1538.98 |
| 26      | 192.6 | 1556.55 | 49      | 194.9 | 1538.19 |
| 27      | 192.7 | 1555.75 | 50      | 195.0 | 1537.40 |
| 28      | 192.8 | 1554.94 | 51      | 195.1 | 1536.61 |
| 29      | 192.9 | 1554.13 | 52      | 195.2 | 1535.82 |
| 30      | 193.0 | 1553.33 | 53      | 195.3 | 1535.04 |
| 31      | 193.1 | 1552.52 | 54      | 195.4 | 1534.25 |
| 32      | 193.2 | 1551.72 | 55      | 195.5 | 1533.47 |
| 33      | 193.3 | 1550.92 | 56      | 195.6 | 1532.68 |
| 34      | 193.4 | 1550.12 | 57      | 195.7 | 1531.90 |
| 35      | 193.5 | 1549.32 | 58      | 195.8 | 1531.12 |
| 36      | 193.6 | 1548.51 | 59      | 195.9 | 1530.33 |
| 37      | 193.7 | 1547.72 | 60      | 196.0 | 1529.55 |
| 38      | 193.8 | 1546.92 | 61*     | 196.1 | 1528.77 |
| 39      | 193.9 | 1546.12 |         |       |         |

\*This channel is supported with limited availability.

## Absolute Maximum Ratings

| Parameter                  | Symbol | Min. | Typ.   | Max. | Unit | Notes |
|----------------------------|--------|------|--------|------|------|-------|
| Supply Voltage             | Vcc    | -0.5 |        | 3.6  | V    |       |
| Storage Temperature        | TS     | -40  |        | 85   | °C   |       |
| Operating Case Temperature | Tc     | 0    |        | 70   | °C   |       |
| Input Voltage              | Vin    | -0.5 |        | Vcc  | V    |       |
| Baud Rate                  |        | 4.25 | 14.025 |      | Gbps |       |

## Electrical Characteristics

| Parameter                              |      | Symbol | Min.  | Typ. | Max.    | Unit | Notes                |
|----------------------------------------|------|--------|-------|------|---------|------|----------------------|
| Module Supply Voltage                  |      | Vcc    | +3.15 | 3.3  | 3.45    | V    |                      |
| Power Supply Current                   |      | ICC    |       | 430  | 610     | mA   |                      |
| Surge Current                          |      | Isurge |       |      | +30     | mA   |                      |
| Transmitter                            |      |        |       |      |         |      |                      |
| CML Inputs (Differential)              |      | Vin    | 250   |      | 1000    | mVpp | AC coupled inputs    |
| Input Impedance (Differential)         |      | Zin    | 85    | 100  | 115     | ohm  | Rin > 100 kohms @DC  |
| Differential Input S-parameter         |      | SDD11  |       |      | -10     | dB   |                      |
| Differential to Common Mode Conversion |      | SCD11  |       |      | -10     | dB   |                      |
| Tx_DISABLE Input Voltage               | High |        | 2     |      | 3.45    | V    |                      |
|                                        | Low  |        | 0     |      | 0.8     | V    |                      |
| Tx_Fault Output Voltage                | High |        | 2     |      | Vcc+0.3 | V    | Io = 400µA; Host Vcc |
|                                        | Low  |        | 0     |      | 0.5     | V    | Io = -4.0mA          |
| Receiver                               |      |        |       |      |         |      |                      |
| CML Outputs (Differential)             |      | Vout   | 350   |      | 700     | mVpp | AC coupled outputs   |
| Output AC Common Mode Voltage          |      |        | 0     |      | 15      | mV   | RMS                  |
| Output Impedance (Differential)        |      | Zout   | 85    | 100  | 115     | ohm  |                      |
| Differential Output S-parameter        |      | SD22   |       |      | -10     | dB   |                      |
| Rx_LOS Output Voltage                  | High |        | 2     |      | Vcc+0.3 | V    | Io = 400µA; Host Vcc |
|                                        | Low  |        | 0     |      | 0.8     | V    | Io = -4.0mA          |
| MOD_DEF (0:2)                          |      | VoH    | 2.5   |      |         | V    | With Serial ID       |
|                                        |      | VoL    | 0     |      | 0.5     | V    |                      |

## Optical Characteristics

| Parameter                                     |      | Symbol             | Min. | Typ.   | Max.                 | Unit     | Notes |
|-----------------------------------------------|------|--------------------|------|--------|----------------------|----------|-------|
| 9µm Core Diameter SMF                         |      |                    |      | 40     |                      | Km       |       |
| Data Rate                                     |      |                    | 4.25 | 14.025 |                      | Gbps     |       |
| Transmitter                                   |      |                    |      |        |                      |          |       |
| Center Wavelength Spacing                     |      |                    |      | 50     |                      | GHz      |       |
|                                               |      |                    |      | 0.4    |                      | nm       |       |
| Side Mode Suppression Ratio                   |      | SMSR               | 30   |        |                      | dB       |       |
| Average Output Power                          |      | P <sub>out</sub>   | 0    |        | +4                   | dBm      | 1     |
| Extinction Ratio                              |      | ER                 | 8.2  |        |                      | dB       |       |
| Average Power of OFF Transmitter              |      | P <sub>off</sub>   |      |        | -30                  | dBm      |       |
| Transmitter Dispersion Penalty                |      | TDP                |      |        | 2                    | dB       |       |
| TX Disable Assert Time                        |      | t <sub>off</sub>   |      |        | -30                  | dBm      |       |
| TX_DISABLE Negate Time                        |      | t <sub>on</sub>    |      |        | 1                    | ms       |       |
| TX_DISABLE time to start reset                |      | t <sub>reset</sub> | 10   |        |                      | us       |       |
| Time to initialize, include reset of TX_FAULT |      | t <sub>init</sub>  |      |        | 300                  | ms       |       |
| TX_FAULT from fault to assertion              |      | t <sub>fault</sub> |      |        | 100                  | us       |       |
| Total Jitter                                  |      | TJ                 |      |        | 0.28                 | UI (p-p) |       |
| Data Dependent Jitter                         |      | DDJ                |      |        | 0.1                  | UI (p-p) |       |
| Uncorrelated Jitter                           |      | UJ                 |      |        | 0.023                | RMS      |       |
| Receiver                                      |      |                    |      |        |                      |          |       |
| Center Wavelength                             |      | λ                  | 1260 |        | 1565                 | nm       |       |
| Sensitivity                                   |      | P <sub>min</sub>   |      |        | -14                  | dBm      | 2     |
| Receiver Overload                             |      | P <sub>max</sub>   | 0    |        |                      | dBm      |       |
| Optical Return Loss                           |      | ORL                |      |        | -12                  | dBm      |       |
| LOS De-Assert                                 |      | LOSD               |      |        | -16                  | dBm      |       |
| LOS Assert                                    |      | LOSA               | -26  |        |                      | dBm      |       |
| LOS                                           | High |                    | 2    |        | V <sub>cc</sub> +0.3 | V        |       |
|                                               | Low  |                    | 0    |        | 0.8                  | V        |       |

### Notes:

- Output is coupled into a 9/125µm SMF
- Minimum average optical power measured at the BER less than 1E-12, back to back. The measure pattern is PRBS 2<sup>31</sup>-1.

## Pin Descriptions

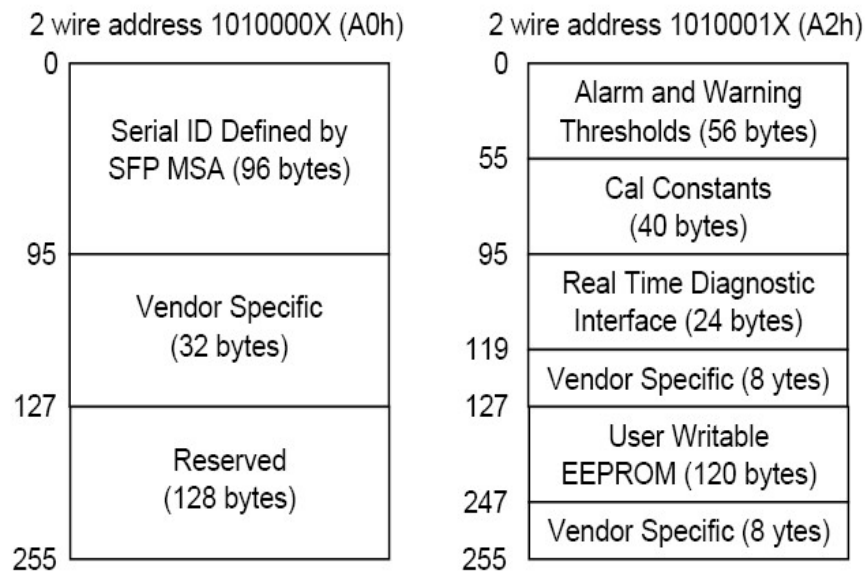
| Pin | Symbol     | Descriptions                 | Sequence | Notes                                                                                                           |
|-----|------------|------------------------------|----------|-----------------------------------------------------------------------------------------------------------------|
| 1   | VeeT       | Transmitter Ground           | 1        | Note 5                                                                                                          |
| 2   | TX Fault   | Transmitter Fault Indication | 3        | Note 1                                                                                                          |
| 3   | TX Disable | Transmitter Disable          | 3        | Note 2, Module disables on high or open                                                                         |
| 4   | SDA        | Module Definition 2          | 3        | 2-wire Serial Interface Data Line.                                                                              |
| 5   | SCL        | Module Definition 1          | 3        | 2-wire Serial Interface Clock.                                                                                  |
| 6   | MOD-ABS    | Module Definition 0          | 3        | Note 3                                                                                                          |
| 7   | RS0        | RX Rate Select(LVTTL).       | 3        | Rate Select 0, optionally controls SFP+ module receiver. This pin is pulled low to VeeT with a >30K resistor.   |
| 8   | LOS        | Loss of Signal               | 3        | Note 4                                                                                                          |
| 9   | RS1        | TX Rate Select(LVTTL).       | 1        | Rate Select 1, optionally controls SFP+module transmitter. This pin is pulled low to VeeT with a >30K resistor. |
| 10  | VeeR       | Receiver Ground              | 1        | Note 5                                                                                                          |
| 11  | VeeR       | Receiver Ground              | 1        | Note 5                                                                                                          |
| 12  | RD-        | Inv. Received Data Out       | 3        | Note 6                                                                                                          |
| 13  | RD+        | Received Data Out            | 3        | Note 7                                                                                                          |
| 14  | VeeR       | Receiver Ground              | 1        | Note 5                                                                                                          |
| 15  | VccR       | Receiver Power               | 2        | 3.3V $\pm$ 5%, Note 7                                                                                           |
| 16  | VccT       | Transmitter Power            | 2        | 3.3V $\pm$ 5%, Note 7                                                                                           |
| 17  | VeeT       | Transmitter Ground           | 1        | Note 5                                                                                                          |
| 18  | TD+        | Transmit Data In             | 3        | Note 8                                                                                                          |
| 19  | TD-        | Inv. Transmit Data In        | 3        | Note 8                                                                                                          |
| 20  | VeeT       | Transmitter Ground           | 1        | Note 5                                                                                                          |

### Notes:

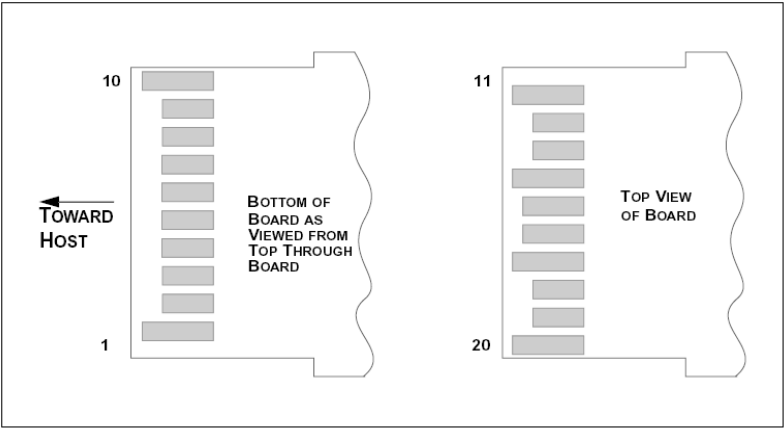
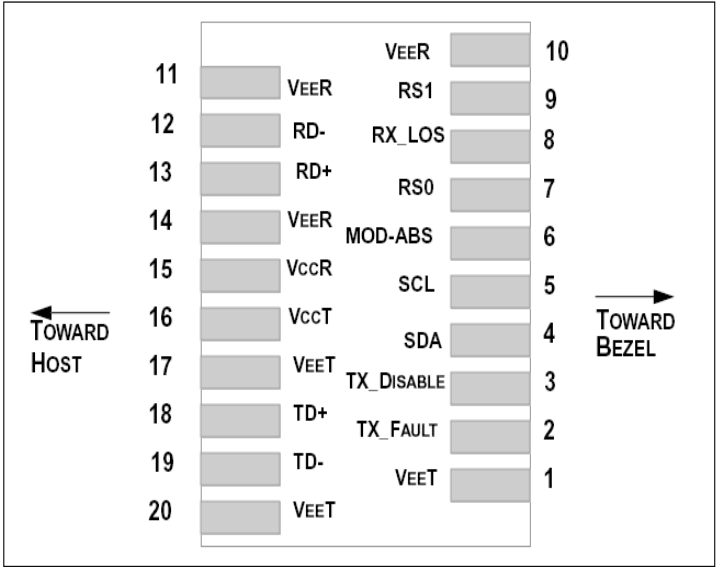
1. TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10K $\Omega$  resistor on the host board. Pull up voltage between 2.0V and VccT/R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
2. TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7K – 10 K $\Omega$  resistor. Its states are:  
Low(0-0.8V): Transmitter on  
(>0.8, <2.0V): Undefined  
High (2.0-3.465V): Transmitter Disabled  
Open: Transmitter Disabled
3. Module Absent, connected to VeeT or VeeR in the module.
4. LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10K $\Omega$

resistor. Pull up voltage between 2.0V and  $V_{ccT}/R+0.3V$ . When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to  $< 0.8V$ .

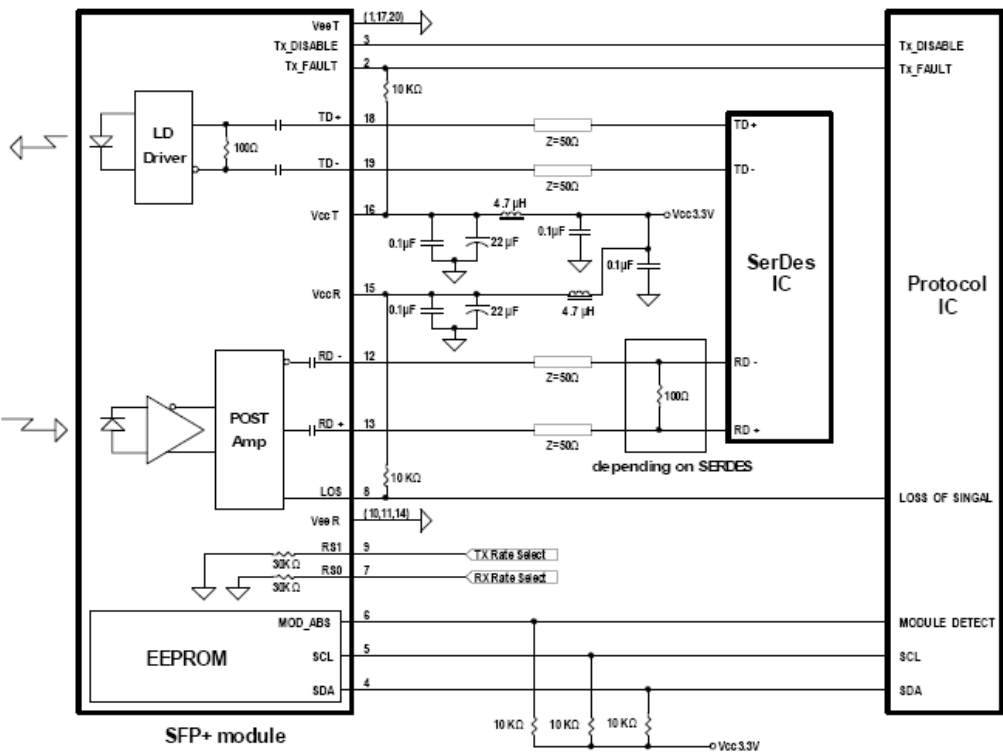
5. The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.
6. RD-/+ : These are the different receiver outputs. They are AC coupled  $100\Omega$  differential lines which should be terminated with  $100\Omega$  (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.
7. VccR and VccT are the receiver and transmitter power supplies. They are defined as  $3.3V \pm 5\%$  at the SFP+ connector pin. Maximum supply current is 610mA. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP+ input pin with 3.3V supply voltage. When the recommended supply-filtering network is used, hot plugging of the SFP+ transceiver module will result in an inrush current of no more than 30mA greater than the steady state value. VccR and VccT may be internally connected within the SFP+ transceiver module.
8. TD -/+ : These are the differential transmitter inputs. They are AC-coupled, differential lines with  $100\Omega$  differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.



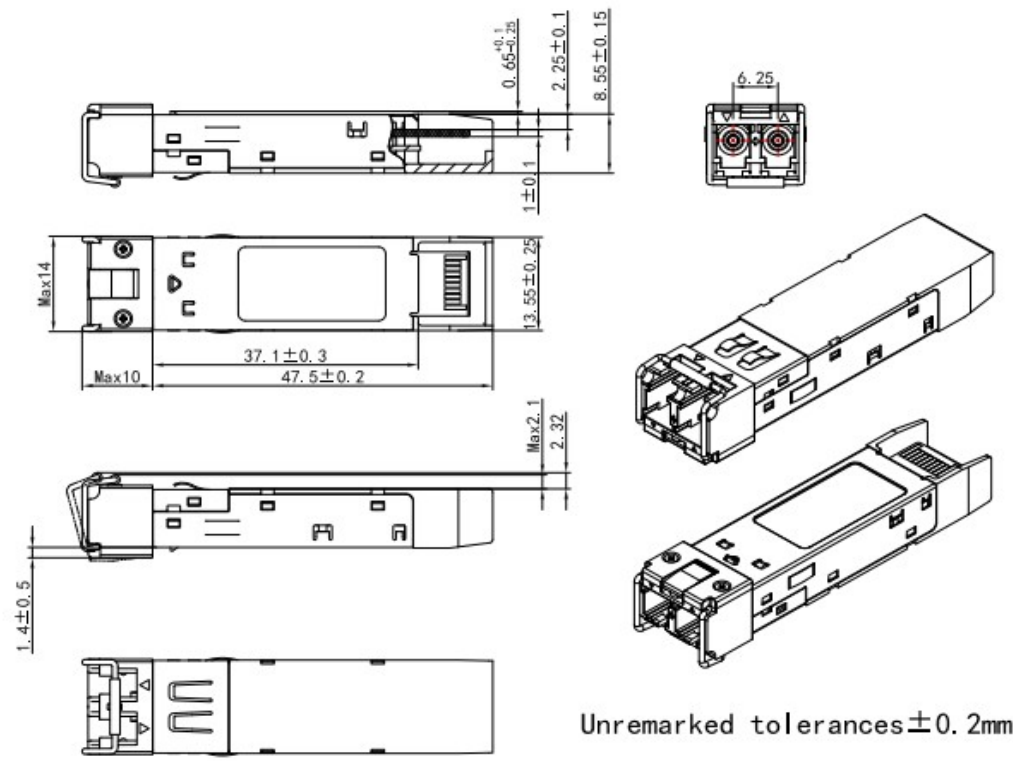
SFP+ Transceiver Electrical Pad Layout



Recommended Circuit Schematic



Mechanical Specifications



## **About ProLabs**

Our experience comes as standard; for over 15 years ProLabs has delivered optical connectivity solutions that give our customers freedom and choice through our ability to provide seamless interoperability. At the heart of our company is the ability to provide state-of-the-art optical transport and connectivity solutions that are compatible with over 90 optical switching and transport platforms.

## **Complete Portfolio of Network Solutions**

ProLabs is focused on innovations in optical transport and connectivity. The combination of our knowledge of optics and networking equipment enables ProLabs to be your single source for optical transport and connectivity solutions from 100Mb to 400G while providing innovative solutions that increase network efficiency. We provide the optical connectivity expertise that is compatible with and enhances your switching and transport equipment.

## **Trusted Partner**

Customer service is our number one value. ProLabs has invested in people, labs and manufacturing capacity to ensure that you get immediate answers to your questions and compatible product when needed. With Engineering and Manufacturing offices in the U.K. and U.S. augmented by field offices throughout the U.S., U.K. and Asia, ProLabs is able to be our customers best advocate 24 hours a day.

## **Contact Information**

ProLabs US

Email: [sales@prolabs.com](mailto:sales@prolabs.com)

Telephone: 952-852-0252

ProLabs UK

Email: [salessupport@prolabs.com](mailto:salessupport@prolabs.com)

Telephone: +44 1285 719 600