

DWDM SFP+ Transceiver

With Digital Diagnostic Function



Features:

- Hot Pluggable SFP+ MSA package
- Available in all C-Band Wavelengths on the 100GHz DWDM ITU Grid
- Cooled 1550nm DWDM EML laser
- Compliant with SFF-8431 and SFF-8432
- Compliant with 802.3ae 10GBASE Ethernet
- Duplex LC Connector Interface
- Operating Case Temperature: 0°C ~+70°C

Applications:

- 10GBASE-ER/EW Ethernet or
- 10GBASE-ZR/ZW Ethernet

Product Description

The DWDM SFP+ Series optical transceivers are designed for use in 10G DWDM networks. It's complying with SFF-8431, SFF-8432, and 10-Gigabit Ethernet IEEE802.3ae. This module is designed for single mode fiber and operates at a nominal DWDM wavelength from 1528nm to 1566nm as specified by the ITU-T. It is designed to deploy in the DWDM networking equipment in metropolitan access and core networks. Digital diagnostics are available via 2-wire serial interface as specified in the SFF-8472. The transceiver is RoHS-6 compliant and lead-free per Directive 2002/95/EC.

Ordering information

| Part No. ^{*Note1} | Data Rate | Laser and Receiver | Fiber Type | Link Budget | Optical Interface | DDMI |
|----------------------------|-----------|--------------------|------------|-------------|-------------------|------|
| TPD-TG40-XXDCR | 10.3G | DWDM EML and PIN | SMF | 14dB | LC | YES |
| TPD-TG80-XXDCR | 10.3G | DWDM EML and PIN | SMF | 23dB | LC | YES |

Note1: XX refers to DWDM Wavelength channel as ITU-T specified.

DWDM Wavelength Guide (XX value) ^{*Note2}

| (XX) Value | Channel | Frequency (THz) | Wavelength (nm) | (XX) Value | Channel | Frequency (THz) | Wavelength (nm) |
|------------|---------|-----------------|-----------------|------------|---------|-----------------|-----------------|
| A0 | C13 | 191.3 | 1567.13 | C5 | C38 | 193.8 | 1546.92 |
| A1 | C14 | 191.4 | 1566.31 | C6 | C39 | 193.9 | 1546.12 |
| A2 | C15 | 191.5 | 1565.50 | C7 | C40 | 194.0 | 1545.32 |
| A3 | C16 | 191.6 | 1564.70 | C8 | C41 | 194.1 | 1544.53 |
| A4 | C17 | 191.7 | 1563.86 | C9 | C42 | 194.2 | 1543.73 |
| A5 | C18 | 191.8 | 1563.05 | D0 | C43 | 194.3 | 1542.94 |
| A6 | C19 | 191.9 | 1562.23 | D1 | C44 | 194.4 | 1542.14 |
| A7 | C20 | 192.0 | 1561.42 | D2 | C45 | 194.5 | 1541.35 |
| A8 | C21 | 192.1 | 1560.61 | D3 | C46 | 194.6 | 1540.56 |
| A9 | C22 | 192.2 | 1559.79 | D4 | C47 | 194.7 | 1539.77 |
| B0 | C23 | 192.3 | 1558.98 | D5 | C48 | 194.8 | 1538.98 |
| B1 | C24 | 192.4 | 1558.17 | D6 | C49 | 194.9 | 1538.19 |
| B2 | C25 | 192.5 | 1557.36 | D7 | C50 | 195.0 | 1537.40 |
| B3 | C26 | 192.6 | 1556.55 | D8 | C51 | 195.1 | 1536.61 |
| B4 | C27 | 192.7 | 1555.75 | D9 | C52 | 195.2 | 1535.82 |
| B5 | C28 | 192.8 | 1554.94 | E0 | C53 | 195.3 | 1535.04 |
| B6 | C29 | 192.9 | 1554.13 | E1 | C54 | 195.4 | 1534.25 |
| B7 | C30 | 193.0 | 1553.33 | E2 | C55 | 195.5 | 1533.47 |
| B8 | C31 | 193.1 | 1552.52 | E3 | C56 | 195.6 | 1532.68 |
| B9 | C32 | 193.2 | 1551.72 | E4 | C57 | 195.7 | 1531.90 |
| C0 | C33 | 193.3 | 1550.92 | E5 | C58 | 195.8 | 1531.12 |
| C1 | C34 | 193.4 | 1550.12 | E6 | C59 | 195.9 | 1530.33 |
| C2 | C35 | 193.5 | 1549.32 | E7 | C60 | 196.0 | 1529.55 |
| C3 | C36 | 193.6 | 1548.51 | E8 | C61 | 196.1 | 1528.77 |
| C4 | C37 | 193.7 | 1547.72 | E9 | C62 | 196.2 | 1527.99 |

Note2: Please contact with TRIXON for the channel availability.

Regulatory Compliance

| Feature | Standard | Performance |
|--|-------------------------------|--------------------|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883G Method 3015.7 | Class 1C (>1000 V) |

| | | |
|--|--|--|
| Electrostatic Discharge to the enclosure | EN 55024:1998+A1+A2 IEC-61000-4-2 GR-1089-CORE | Compliant with standards |
| Electromagnetic Interference (EMI) | FCC Part 15 Class B EN55022:2006 CISPR 22B :2006 VCCI Class B | Compliant with standards Noise frequency range: 30 MHz to 6 GHz. Good system EMI design practice required to achieve Class B margins. System margins depend on customer host board and chassis design. |
| Immunity | EN 55024:1998+A1+A2 IEC 61000-4-3 | Compliant with standards. 1kHz sine-wave, 80% AM, from 80 MHz to 1 GHz. No effect on transmitter/receiver performance is detectable between these limits. |
| Laser Eye Safety | FDA 21CFR 1040.10 and 1040.11 EN (IEC) 60825-1:2007 EN (IEC) 60825-2:2004+A1 EN (IEC) 60950-1:2006+A1+A11+A12 | CDRH compliant and Class I laser product. TUV Certificate No. R50271605 |
| Component Recognition | UL and CUL EN60950-1:2006 | TUV Certificate No. E344594 (CB:JPTUV-053877) |
| RoHS2.0 | 20011/65/EU | Compliant with standards |

Absolute Maximum Ratings*^{Note3}

| Parameter | Symbol | Min | Max | Unit |
|---------------------|-----------------|-----|-----|------|
| Storage Temperature | T _s | -40 | +85 | °C |
| Supply Voltage | V _{CC} | 0 | 3.6 | V |
| Operating Humidity | | 5 | 85 | % |

Note3: Exceeding any one of these values may destroy the device permanently.

Recommended Operating Conditions

| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
|----------------------------|-----------------|------|---------|------|------|-------|
| Operating Case Temperature | T _c | 0 | | 70 | °C | |
| Power Supply Voltage | V _{CC} | 3.14 | 3.3 | 3.47 | V | |
| Supply Current | I _{CC} | | | 400 | mA | |

Performance Specifications – Electrical

| Parameter | Symbol | Min | Typ. | Max | Unit | Notes |
|---------------------------------|-----------------|-----|------|----------------------|------|--------------------------------|
| Transmitter | | | | | | |
| CML Inputs(Differential) | V _{in} | 180 | | 800 | mVpp | AC coupled inputs |
| Input Impedance (Differential) | Z _{in} | | 100 | | ohm | R _{in} > 100 ohms @DC |
| Tx_DISABLE Input Voltage – High | | 2 | | V _{CC} +0.3 | V | |
| Tx_DISABLE Input Voltage – Lo | | 0 | | 0.8 | V | |
| Tx_FAULT Output Voltage – High | | 2 | | V _{CC} +0.3 | V | |

| | | | | | |
|---------------------------------|-----------------|-----|-----|------|--|
| Tx_FAULT Output Voltage – Low | | 0 | 0.8 | V | |
| Receiver | | | | | |
| CML Outputs (Differential) | Vout | 340 | 800 | mVpp | AC coupled outputs |
| Output Impedance (Differential) | Zout | 100 | | ohm | |
| Rx_LOS Output Voltage – High | | 2 | | V | OC output, should be pull up with 4.7K – 10 K Ω on the host board |
| Rx_LOS Output Voltage – Low | | 0 | 0.5 | V | |
| MOD_DEF (0:2) | V _{OH} | 2.5 | | V | With Serial ID |
| | V _{OL} | 0 | 0.5 | V | |

I/O Timing for Control & Status Functions Timing

| Parameter | Symbol | Min | Typ. | Max | Unit |
|---|------------|-----|------|-----|------|
| TX Disable Assert Time | t_off | | | 100 | us |
| TX_DISABLE Negate Time | t_on | | | 2 | ms |
| Time to initialize, include reset of TX_FAULT | t_init | | | 300 | ms |
| TX Fault Assert Time | t_fault | | | 1 | ms |
| TX Disable to reset | t_reset | 10 | | | us |
| LOS Assert Time | t_loss_on | | | 100 | us |
| LOS De-Assert Time | t_loss_off | | | 100 | us |

Performance Specifications – Optical

(10.3Gbps · 14dB Power budget)

| Parameter | Symbol | Min | Typ. | Max | Unit | Note |
|------------------------------------|-----------------------------|---------|------|---------|-------|----------|
| Transmitter | | | | | | |
| Centre Wavelength | λ_c | 1527.99 | XX | 1567.13 | nm | XX:Note1 |
| | f _c | 191.3 | | 196.2 | THz | |
| Average Output Power | P _{OUT} | -1 | | 4 | dBm | |
| Extinction Ratio | ER | 3.5 | | | dB | |
| Side Mode Suppression Ratio | SMSR | 30 | | | dB | |
| Average Power of OFF Transmitter | P _{OFF} | | | -30 | dBm | |
| Transmitter and Dispersion Penalty | TDP | | | 2 | dB | |
| Relative Intensity Noise | Rin | | | -128 | dB/Hz | |
| Output Optical Eye | Compliant with IEEE 802.3ae | | | | | |
| Receiver | | | | | | |
| Sensitivity* ^{Note4} | P _{IN} | | | -15 | dBm | Note5 |
| Receiver Overload | Overload | -1 | | | dBm | |
| LOS Assert | LOSA | -28 | | | dBm | |
| LOS De-Assert | LOSD | | | -16 | dBm | |
| LOS Hysteresis | | 0.5 | | 4 | dB | |

(10.3Gbps · 23 dB Power budget)

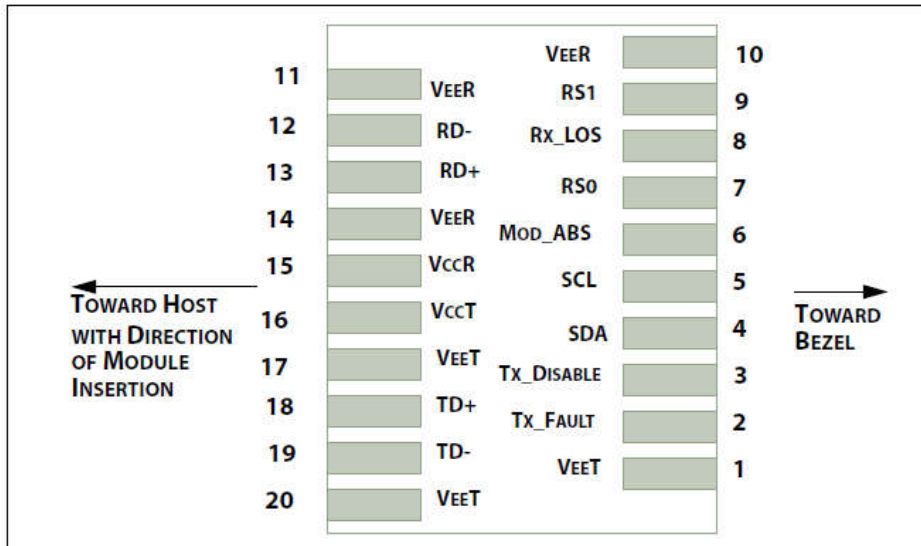
| Parameter | Symbol | Min | Typ. | Max | Unit | Note |
|------------------------------------|-----------------------------|---------|------|---------|-------|----------|
| Transmitter | | | | | | |
| Centre Wavelength | λ_c | 1527.99 | XX | 1567.13 | nm | XX:Note1 |
| | fc | 191.3 | | 196.2 | THz | |
| Average Output Power | P _{OUT} | 0 | | 5 | dBm | |
| Extinction Ratio | ER | 3.5 | | | dB | |
| Side Mode Suppression Ratio | SMSR | 30 | | | dB | |
| Average Power of OFF Transmitter | P _{OFF} | | | -30 | dBm | |
| Transmitter and Dispersion Penalty | TDP | | | 3.5 | dB | |
| Relative Intensity Noise | Rin | | | -128 | dB/Hz | |
| Output Optical Eye | Compliant with IEEE 802.3ae | | | | | |
| Receiver | | | | | | |
| Sensitivity* ^{Note4} | P _{IN} | | | -23 | dBm | Note6 |
| Receiver Overload | Overload | -6 | | | dBm | |
| LOS Assert | LOSA | -35 | | | dBm | |
| LOS De-Assert | LOSD | | | -24 | dBm | |
| LOS Hysteresis | | 0.5 | | 4 | dB | |

Note4: Minimum average optical power measured at the BER less than 1E-12@pattern is PRBS2³¹-1@ER=4dB.

Note5: PIN receiver

Note6: APD receiver

SFP Transceiver Electrical Pad Layout



Pin Function Definitions:

| Pin Num. | Name | Function | Plug Seq. | Notes |
|----------|------------|------------------------------|-----------|--|
| 1 | VeeT | Transmitter Ground | 1 | Note 11 |
| 2 | TX Fault | Transmitter Fault Indication | 3 | Note 7 |
| 3 | TX Disable | Transmitter Disable | 3 | Note 8, 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 9 |
| 7 | RS0 | RX Rate Select (LVTTTL). | 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 10 |
| 9 | RS1 | TX Rate Select (LVTTTL). | 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 11 |
| 11 | VeeR | Receiver Ground | 1 | Note 11 |
| 12 | RD- | Inv. Received Data Out | 3 | Note 12 |
| 13 | RD+ | Received Data Out | 3 | Note 13 |
| 14 | VeeR | Receiver Ground | 1 | Note 11 |
| 15 | VccR | Receiver Power | 2 | 3.3V ± 5%, Note 13 |
| 16 | VccT | Transmitter Power | 2 | 3.3V ± 5%, Note 13 |
| 17 | VeeT | Transmitter Ground | 1 | Note 11 |
| 18 | TD+ | Transmit Data In | 3 | Note 14 |
| 19 | TD- | Inv. Transmit Data In | 3 | Note 14 |
| 20 | VeeT | Transmitter Ground | 1 | Note 11 |

Note7: TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10K_ 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.

Note8: 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_ 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.

Note9: Module Absent, connected to VeeT or VeeR in the module.

Note10: LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K –10K_ resistor. Pull up voltage between 2.0V and VccT/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.

Note11: The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.

Note12: RD-/+: These are the differential receiver outputs. They are AC coupled 100_ differential lines which should be terminated with 100_ (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.

Note13: VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±5% at the SFP connector pin. Maximum supply current is 300mA. 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.

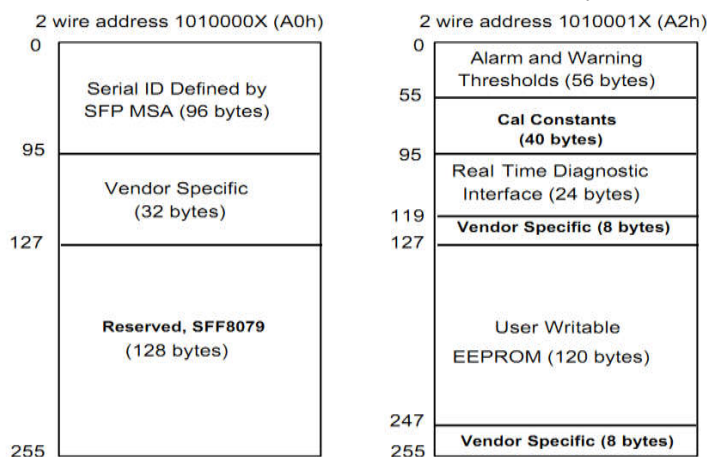
Note14: TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100_ differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.

Digital Diagnostic Functions:

- 1) SFP transceiver supports the 2-wire serial communication protocol as defined in SFP MSA: in which defines a 256-byte memory map in EEPROM at 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface be assigned with 8 bit address 1010001X (A2h). Additionally, SFP transceivers provide a unique digital diagnostic

monitoring interface (DDMI), which allows real-time access to product operating parameters such as transceiver supply voltage, transceiver temperature, transmitted optical power, laser bias current and received optical power. It also defines alarm and warning threshold, which alerts end-users when particular operating parameters are outside of factory setting.

- When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host. The positive edge clocks data into those segments of the EEPROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA, Mod Def 2) is bi-Directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.



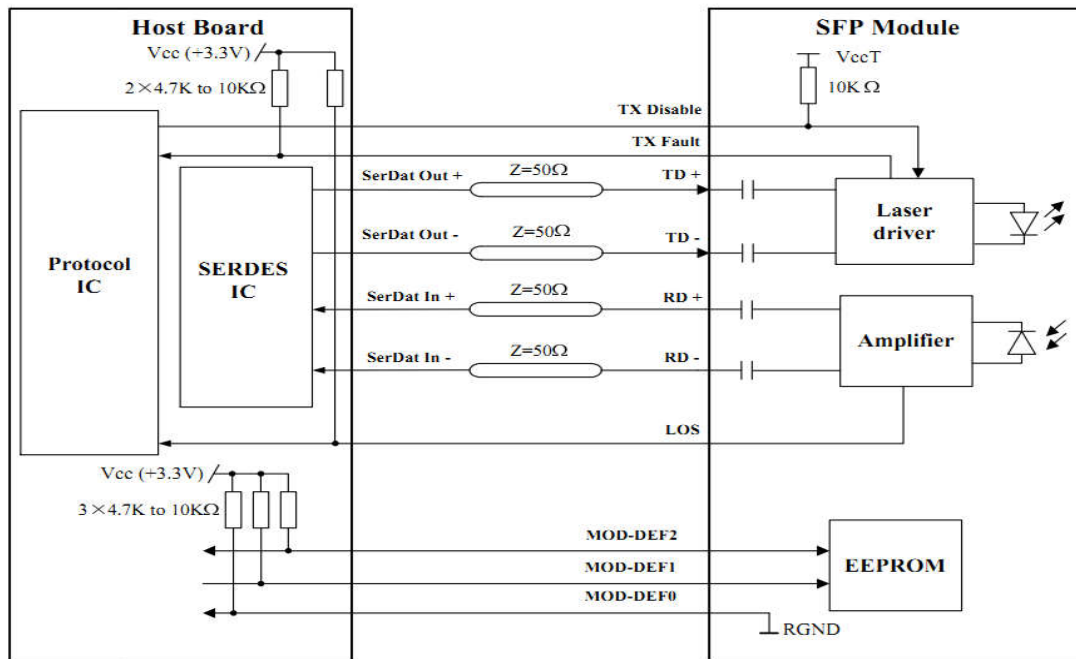
Digital Diagnostic Monitoring Specifications

- Additionally, SFP transceivers TPD-xxxx-xxDCR^{*Note15} provide a unique digital diagnostic monitoring interface (DDMI) be assigned with 8 bit address 1010001X (A2h) as defined in SFP MSA , which allows real-time access to product operating parameters such as transceiver supply voltage, transceiver temperature, transmitted optical power, laser bias current and received optical power. It also defines alarm and warning threshold, which alerts end-users when particular operating parameters are outside of factory setting.
- Digital diagnostics for the TPD-xxxx-xxDCR are internally calibrated by default. Calibration and alarm/warning threshold data is written during device manufacturing.

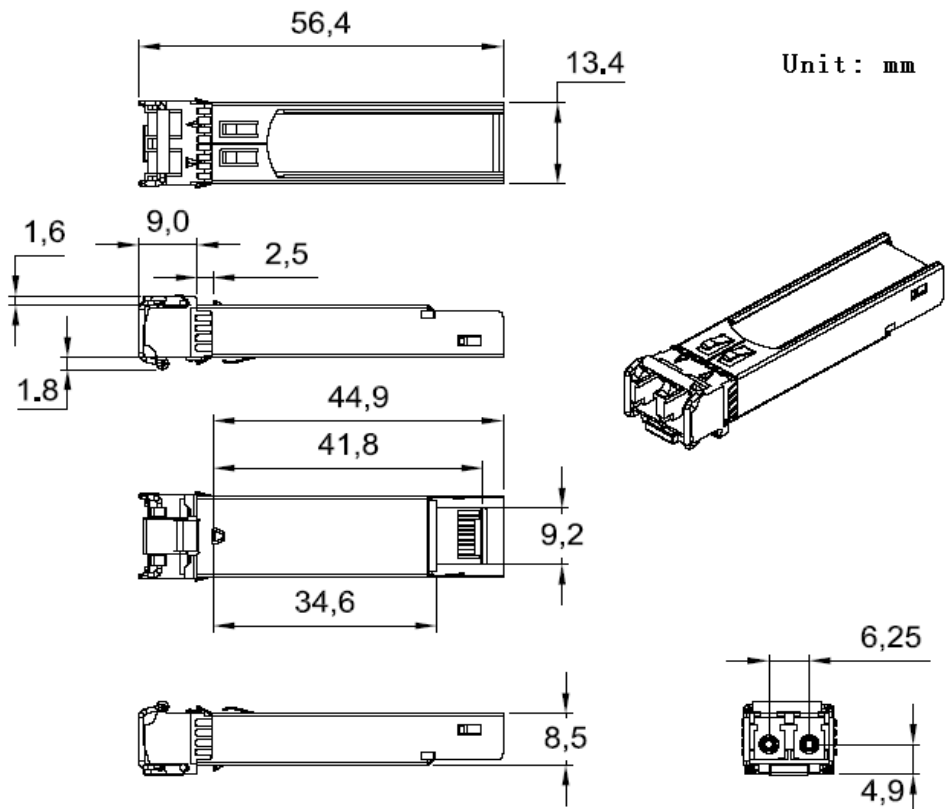
| Monitor accuracy | | | | | | |
|--|------------|-----------|-----------------|--------------------|-------|------|
| Parameter | Min | Typ | Max | Units | | |
| Internally measured transceiver temperature | | | ±3 | °C | | |
| Internally measured transceiver supply voltage | | | ±3% | V | | |
| Measured TX bias current | | | ±10 | % | | |
| Measured TX output power | | | ±3 | dB | | |
| Measured RX received average optical power | | | ±3 | dB | | |
| Dynamic range for operation | | | | | | |
| Parameter | H-Alarm | H-warning | L-Warnin g | L- Alarm | Units | Note |
| Internally measured transceiver temperature | +85 | 80 | 0 | -5 | °C | |
| Internally measured transceiver supply voltage | 3.9 | 3.6 | 3.0 | 2.7 | V | |
| Measured TX bias current | 130 | 120 | 2 | 1 | mA | |
| Measured TX output power | Pout_max+1 | Pout_max | Pout_min | Pout_min-1 | dBm | |
| Measured RX received average optical power | Overload+1 | Overload | P _{IN} | P _{IN} -2 | dBm | |

Note15: TPD-xxxx-xxxCR provides an EEPROM addressed 1010000X (A0h) as defined in SFP MSA, and only TPD-xxxx-xxDCR is compliant with digital diagnostic monitoring interface (DDMI) be assigned with 8 bit address 1010001X (A2h) .

Recommended Circuit



Mechanical Dimension



Eye Safety

This single-mode transceiver is a Class 1 laser product. It complies with IEC-60825 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated within the specified temperature and voltage limits. The optical ports of the module shall be terminated with an optical connector or with a dust plug.

Obtaining Document

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