
PTE02-D0X-T1

Features

- ◆ Supports 9.95Gb/s to 10.5Gb/s bit rates
- ◆ 1310nm FP Laser and PIN photo detector
- ◆ Duplex LC receptacle optical interface compliant
- ◆ Single +3.3V power supply
- ◆ Hot-pluggable
- ◆ AC coupling of CML signals
- ◆ International Class1 laser safety certified
- ◆ Operating temperature range:
Commercial: 0°C~70°C
Industrial: -40°C~85°C
- ◆ RoHS Compliant
- ◆ DDMI function available with internally calibrated mode

Application

- ◆ 10GBASE-LR/LW
- ◆ 10G Fiber Channel

Standard

- ◆ Compliant with MSA SFP+ specification(SFF-8431)
- ◆ Compliant with SFF-8472
- ◆ CPRI Line Rate Option: 9830.4Mbps
- ◆ Compliant to IEEE 802.3ae

Specification

| Absolute Maximum Ratings | | | | |
|--------------------------|--------|------|-----|------|
| Parameter | Symbol | Min | Max | Unit |
| Storage temperature | TS | -40 | 85 | °C |
| Power Supply Voltage | Vcc | -0.5 | +4 | V |
| Relative Humidity | RH | 5 | 95 | % |

| Recommended Operating Conditions | | | | | |
|---|--------|------|---------|------|------|
| Parameter | Symbol | Min | Typical | Max | Unit |
| Operating Case Temperature (Commercial) | Tc | 0 | | 70 | °C |
| Operating Case Temperature (Industrial) | | -40 | | 85 | |
| Power Supply Voltage | Vcc | 3.13 | 3.3 | 3.47 | V |
| Supply Current ¹ | Icc | | | 300 | mA |
| Data Rate | | - | 10.3125 | - | Gbps |
| Fiber Length 9/125µm core SMF | | - | 1.4 | - | km |

| Electrical Characteristics | | | | | | |
|--|--------|------|---------|---------|------|-------|
| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
| Transmitter differential input voltage | | 180 | | 1200 | mV | |
| Receiver differential output Voltage | | 300 | | 1200 | mV | |
| Transmit Fault (TX_Fault) | Voh | 2.4 | | Vcc+0.3 | V | LVTTL |
| | Vol | -0.3 | | 0.4 | V | LVTTL |
| Loss of Signal (LOS) | Voh | 2.4 | | Vcc+0.3 | V | LVTTL |
| | Vol | -0.3 | | 0.4 | V | LVTTL |
| TX Disable | Vih | 2 | | Vcc+0.3 | V | LVTTL |
| | Vil | -0.3 | | 0.8 | V | LVTTL |

| Optical transmitter Characteristics | | | | | | |
|-------------------------------------|--------|------|---------|------|------|-------|
| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
| Launched Power (avg.) | Pout | -8.2 | | +0.5 | dBm | |
| Operating Wavelength Range | λc | 1260 | 1310 | 1355 | nm | |

| Spectral Width (RMS) | $\Delta\lambda$ | | | 2.8 | nm | |
|------------------------------------|---|-------|---------|-------|-------|-------|
| Extinction Ratio | ER | 3.5 | | | dB | 2 |
| Optical Modulation Amplitude | P_{OMA} | -5.2 | | | dBm | |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | |
| Optical Return Loss Tolerance | | | | 12 | dB | |
| Transmitter and Dispersion Penalty | TDP | | | 3.2 | dB | |
| Optical Rise/Fall Time | Tris/Tfall | 28 | | | PS | 3 |
| Optical Tx Output disable | P_{dis} | | | -30 | dBm | |
| Output Eye Diagram | Complies with IEEE802.3ae eye masks when filtered | | | | | |
| Optical receiver Characteristics | | | | | | |
| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
| Receiver Sensitivity | S | | | -14.4 | dBm | 4 |
| Wavelength Range | λ_c | 1260 | | 1355 | nm | |
| Receiver Reflectance | | | | -12 | dB | |
| Optical Power Input Overload | P_{in-max} | 0.5 | | | dBm | 4 |
| LOS | Optical De-assert | P_d | | -17 | dBm | 4 |
| | Optical Assert | P_a | -30 | | | |
| LOS hysteresis | | 0.5 | | 5 | dB | 5 |

Note1. The supply current is SFP+ module's working current.

Note2. For the measurements, the device was driven with $2^{31}-1$ PRBS pattern

Note3. Optical transition time is the time interval required for the rising or falling edge of an optical pulse to transition between the 20% and 80% amplitudes relative to the logical 1 and 0 levels.

Note4. Measured with a PRBS $2^{31}-1$ test pattern, @10.3125Gbps, ER=4.5dB, BER< 10^{-12}

Note5. The LOS Hysteresis minimizes 'chatter' on the output line. In principle, Hysteresis alone does not guarantee chatter-free operation.

Digital Diagnostic Monitoring Information

| Parameter | Accuracy | Calibration | Range |
|--------------|-----------------------|-------------|---------------------------|
| Temperature | $\pm 3^\circ\text{C}$ | internal | -40 to 85°C |
| Voltage | $\pm 3\%$ | internal | 3.1 to 3.5V |
| Bias Current | $\pm 10\%$ | internal | 5 to 100mA |
| TX Power | $\pm 2\text{dB}$ | internal | -8.2 to 0.5dBm |
| RX Power | $\pm 2\text{dB}$ | internal | -14.4 to 0.5dBm |

Pin definition

The SFP+ modules are hot-pluggable. Hot pluggable refers to plugging in or unplugging a module while the host board is powered. The SFP+ host connector is a 0.8 mm pitch 20 position right angle improved connector specified by SFF-8431, or stacked connector with equivalent electrical performance. Host PCB contact assignment is shown in Figure 1 and contact definitions are given in Table following. SFP+ module contacts mates with the host in the order of ground, power, followed by signal as illustrated by Figure 2 and the contact sequence order listed in the table.

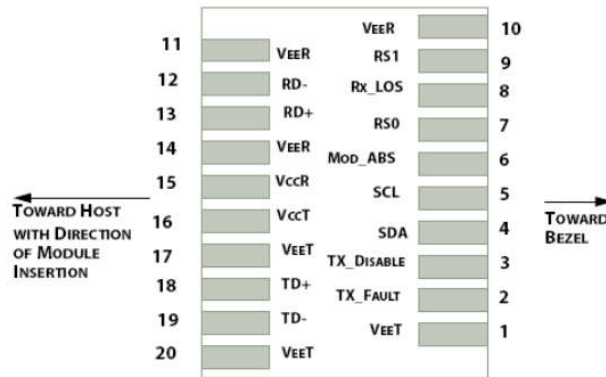


Figure 1 SFP+ Pad Assignment Top View



Figure 2 SFP+ Module Contact Assignments

| Pin | Symbol | Name/Description | Power Seq. | Ref. |
|-----|------------|---|------------|------|
| 1 | VeeT | Transmitter Ground (Common with Receiver Ground) | 1st | 1 |
| 2 | TX_Fault | Transmitter Fault, Low: normal; High: abnormal | 3rd | 2 |
| 3 | TX_Disable | Transmitter Disable High: Transmitter off Low: Transmitter on | 3rd | 3 |
| 4 | SDA | 2-Wire Serial Interface Data Line | 3rd | 4 |

| | | | | |
|----|---------|--|-----|----|
| | | (Same as MOD-DEF2 in INF-8074i) | | |
| 5 | SCL | 2-Wire Serial Interface Data Line (Same as MOD-DEF2 in INF-8074i) | 3rd | 4 |
| 6 | Mod_ABS | Module Absent, Connect to VeeT or VeeR in Module | 3rd | 5 |
| 7 | RS0 | Rate Select 0, optionally controls SFP+ module receiver | 3rd | 6 |
| 8 | RX_LOS | Receiver Loss of Signal indication High: loss of signal Low: signal detected | 3rd | 7 |
| 9 | RS1 | Rate Select 1, optionally controls SFP+ module transmitter | 3rd | 8 |
| 10 | VeeR | Receiver Ground | 1st | 1 |
| 11 | VeeR | Receiver Ground | 1st | 1 |
| 12 | RD- | Receiver Inverted DATA out. AC Coupled. CML-O | 3rd | 9 |
| 13 | RD+ | Receiver Non-inverted DATA out. AC Coupled. CML-O | 3rd | 9 |
| 14 | VeeR | Receiver Ground | 1st | 1 |
| 15 | VccR | Receiver Power Supply | 2nd | 10 |
| 16 | VccT | Transmitter Power Supply | 2nd | 10 |
| 17 | VeeT | Transmitter Ground | 1st | 1 |
| 18 | TD+ | Transmitter Non-Inverted DATA in. AC Coupled. CML-I | 3rd | 11 |
| 19 | TD- | Transmitter Inverted DATA in. AC Coupled. CML-I | 3rd | 11 |
| 20 | SDA | Transmitter Ground | 1st | 1 |

SFP+ Module PIN Definition

Power Seq.: Pin engagement sequence during hot plugging.

Note1. The module signal ground contacts.

Note2. This pin is an open drain/collector and should be pulled up to Vcc-host in the host with a 4.7k~10k Ohm resistor.

Note3. This pin should be pulled up to Vcct with a 4.7k~10k Ohm resistor in modules.

Note4. SDA&SCL (IIC) are needed pull up 4.7k~10k Ohm resistors on host board.

Note5. Mod_ABS is connected to VeeT or VeeR in the SFP+ module.

Note6. Rate Select 0.

Note7. Module RX_Los of signal indication need pull up 4.7k~10k Ohm resistor on host board.

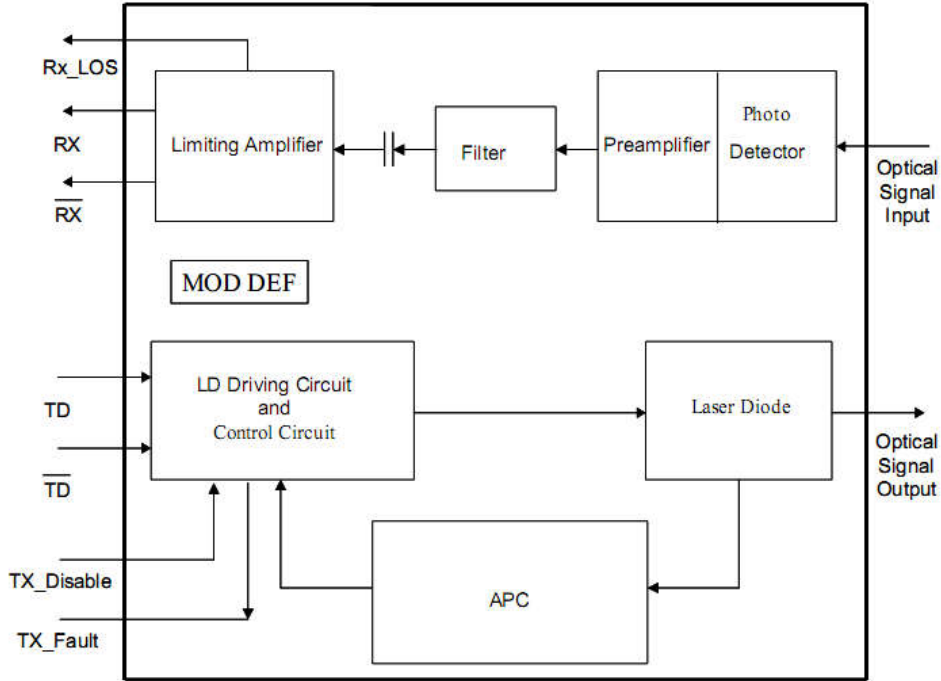
Note8. Rate Select 1.

Note9. RD -/+: These are the differential receiver outputs. They are CML AC-coupled with 100 Ohm terminal resistor matching internal.

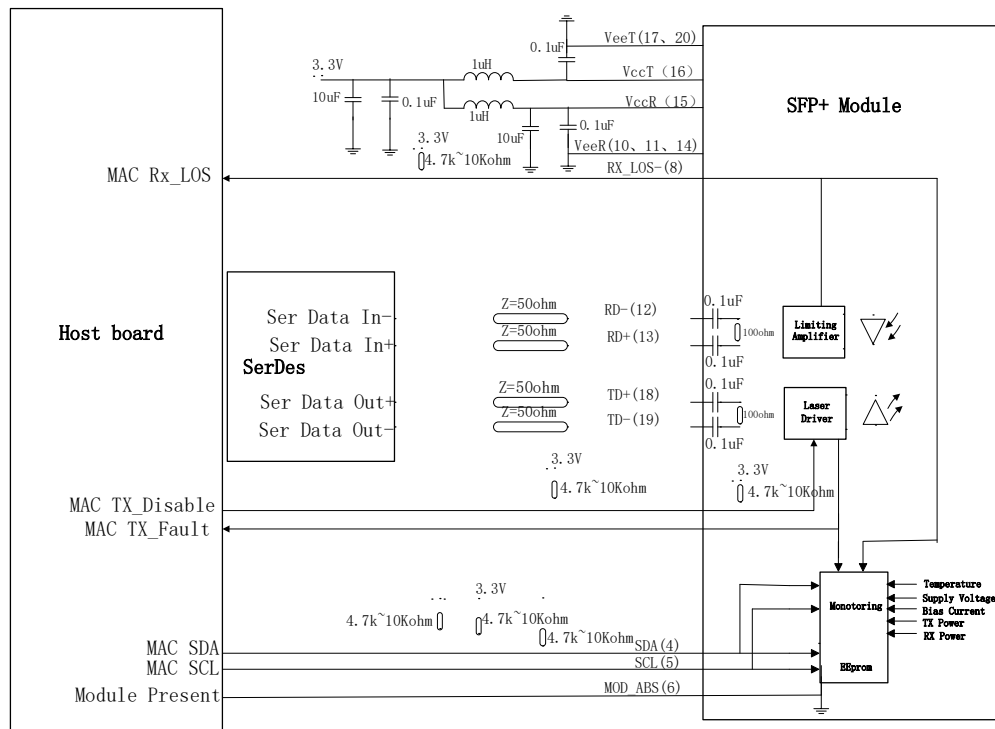
Note10. VccR and VccT are the receiver and transmitter power supplies.

Note11. TD -/+: These are the differential transmitter inputs. They are CML AC-coupled with 100 Ohm terminal resistor matching internal.

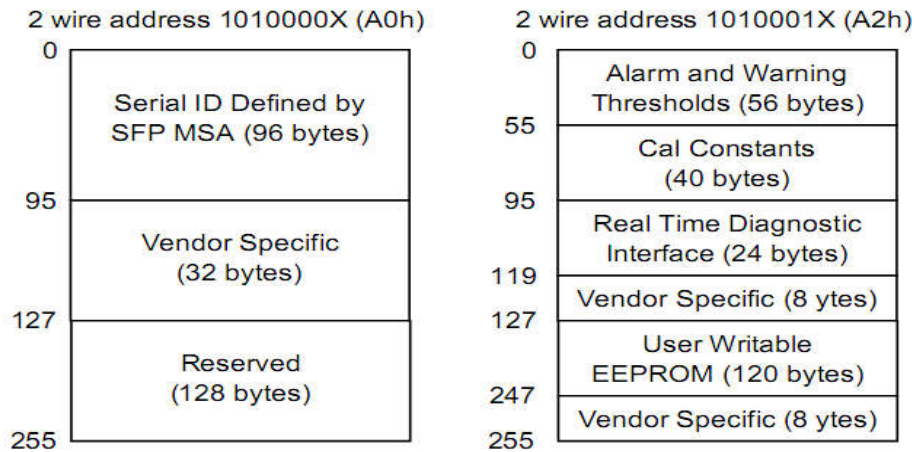
Block Diagram



Typical application Circuit



Digital Diagnostic Memory Map



EEPROM Serial ID Memory Contents

The optical transceiver contains an EEPROM. It provides access to sophisticated identification information that describes the transceiver's capabilities, standard interfaces, manufacturer, and other information. When the serial protocol is activated, the host generates the serial clock signal (SCL, Mod Def 1). The positive edge clocks data into those segments of the EEPROM that are not writing protected within the SFP+ transceiver. 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.

The Module provides diagnostic information about the present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. The diagnostic data are raw A/D values and must be converted to real world units using calibration constants stored in EEPROM locations 56–95 at wire serial bus address A2h. The digital diagnostic memory map specific data fields define as following.

EEPROM Serial ID Memory Contents (2-Wire Address A0h)

| Address | Name of field | Hex | Description |
|-----------------------|-------------------|----------|------------------------------------|
| BASE ID Fields | | | |
| 00 | Identifier | 03 | SFP transceiver |
| 01 | Ext. Identifier | 04 | Serial ID module supported for SFP |
| 02 | Connector | 07 | LC |
| 03-05 | Transceiver Codes | 20 00 00 | 10G Base-LR |

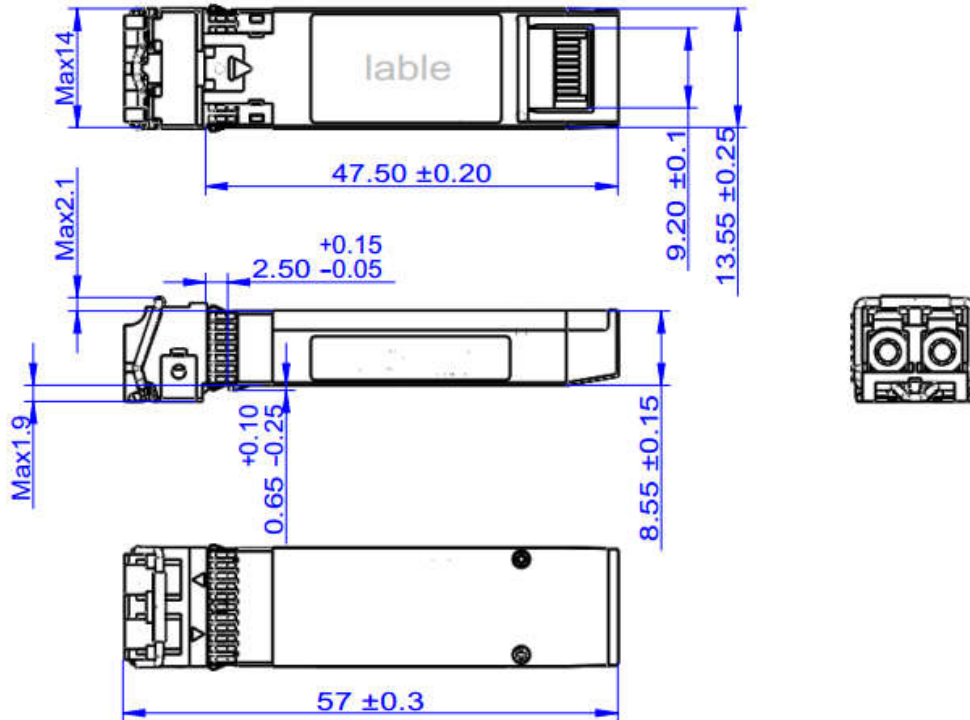
| | | | |
|---------------------------------|----------------------------|--|--|
| 06 | Transceiver Codes | 00 | Not defined |
| 07-10 | Transceiver Codes | 00 00 00 | Not defined |
| 11 | Encoding | 06 | 64B/66B |
| 12 | BR, Nominal | 67 | 10.3Gbps |
| 13 | Rate Identifier | 00 | Not defined |
| 14 | Length(9um)-km | 02 | 2(km) |
| 15 | Length(9um)-m | 0E | 2000(m) |
| 16 | Length(50um) | 00 | Transceiver transmit distance |
| 17 | Length(62.5um) | 00 | |
| 18 | Length(cable) | 00 | Not support cable |
| 19 | Length(OM3) | 00 | Not support OM3 |
| 20-35 | Vendor Name | 4D 45 4E 54 45 43 48 4F 50 54 4F... | "MENTECHOPTO"(ASCII character) |
| 36 | Reserved | 00 | Not defined |
| 37-39 | Vendor OUI | 00 00 00 | Not defined |
| 40-55 | Vendor P/N | | PTE02-D0X-T1 |
| 56-59 | Vendor P/N Rev. | 31 2E 30 20 | "1.0"(ASCII character) |
| 60-61 | Laser Wavelength | 05 1E | 1310nm |
| 62 | Reserved | 00 | Not defined |
| 63 | CC_BASE | XX | Check sum of bytes 0-62 |
| Extended ID Fields | | | |
| 64-65 | Options | 00 1A | RX_LOS, TX_Fault are implemented |
| 66 | BR, max | 14 | 12360Mbps |
| 67 | BR, min | 14 | 8240Mbps |
| 68-83 | Vendor SN | | Vendor Serial Number in ASCII character |
| 84-91 | Date Code | Data Code | Vendor Date Code in ASCII character |
| 92 | Diagnostic Monitoring Type | 68 | Internally calibrated, RX DDM represents average input optical power |
| 93 | Enhanced options | F0 | Optional Alarm/warning flags, soft Tx_Disable control and monitoring, soft Tx_Fault and soft RX_LOS monitoring are implemented |
| 94 | SFF-8472 compliant | 08 | SFF-8472 compliant with revision 12.0 |
| 95 | CC-EXT | XX | Check sum of bytes 64-94 |
| Vendor Specific ID Field | | | |
| 96-127 | Vendor Specific | 00 | Vendor specific EEPROM |
| 128-255 | Reserved | 00 | Reserved for future use |

Digital Diagnostic Monitoring Interface: Alarm and Warning Thresholds

(2-Wire Address A2h)

| Address | #Bytes | Name | Real Value | | Unit | Hex |
|---------|--------|-----------------------|------------|------------|------|-----|
| | | | Commercial | Industrial | | |
| 00-01 | 2 | Temp High Alarm | 80 | 100 | °C | |
| 02-03 | 2 | Temp Low Alarm | -10 | -50 | °C | |
| 04-05 | 2 | Temp High Warning | 70 | 85 | °C | |
| 06-07 | 2 | Temp Low Warning | 0 | -40 | °C | |
| 08-09 | 2 | Voltage High Alarm | 3.7 | | V | |
| 10-11 | 2 | Voltage Low Alarm | 3 | | V | |
| 12-13 | 2 | Voltage High Warning | 3.5 | | V | |
| 14-15 | 2 | Voltage Low Warning | 3.1 | | V | |
| 16-17 | 2 | Bias High Alarm | 100 | | mA | |
| 18-19 | 2 | Bias Low Alarm | 5 | | mA | |
| 20-21 | 2 | Bias High Warning | 80 | | mA | |
| 22-23 | 2 | Bias Low Warning | 10 | | mA | |
| 24-25 | 2 | TX Power High Alarm | 2.5 | | dBm | |
| 26-27 | 2 | TX Power Low Alarm | -10.2 | | dBm | |
| 28-29 | 2 | TX Power High Warning | 0.5 | | dBm | |
| 30-31 | 2 | TX Power Low Warning | -8.2 | | dBm | |
| 32-33 | 2 | RX Power High Alarm | 2.5 | | dBm | |
| 34-35 | 2 | RX Power Low Alarm | -16.4 | | dBm | |
| 36-37 | 2 | RX Power High Warning | 0.5 | | dBm | |
| 38-39 | 2 | RX Power Low Warning | -14.4 | | dBm | |
| 40-55 | 16 | Reserved | Reserved | | | |

Package Outline



Regulatory Compliance

| Feature | Test | Method |
|--|---|--|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883E Method 3015.7 | Class 1(>1000V for SFI pins, >2000V for other pins.) |
| Electrostatic Discharge (ESD) Immunity | IEC61000-4-2 | Class 2(>4.0kV) |
| Electromagnetic Interference (EMI) | CISPR22 ITE Class B FCC Class B CENELEC EN55022 VCCI Class 1 | Comply with standard |
| Immunity | IEC61000-4-3 | Comply with standard |
| Eye Safety | FDA 21CFR 1040.10 and 1040.11 EN (IEC) 60825-1,2 | Compatible with Class I laser Product |

Ordering information

| Part. No | Specifications | | | | | | | | |
|------------------|----------------|-------------|------------|----------|-----|-----------|-----------|------------|--------------|
| | Pack | Rate (Gbps) | Tx (nm) | Po (dBm) | RX | Sen (dBm) | Temp (°C) | Reach (km) | DDM |
| PTE02-D0C -T1 | SFP+ | 10.3125 | 1310 FP | -8.2~0.5 | PIN | <-14.4 | 0~+70 | 1.4 | DDM; RoHS |
| PTE02-D0I -T1 | SFP+ | 10.3125 | 1310 FP | -8.2~0.5 | PIN | <-14.4 | -40~+85 | 1.4 | DDM; RoHS |