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# PTE40-D0C-T1

## Features

- ◆ Up to 10.3125Gbps data rate
- ◆ 1550nm EML cooled transmitter and High performance PIN receiver
- ◆ Duplex LC receptacle optical interface compliant
- ◆ Single +3.3V power supply
- ◆ Hot-pluggable
- ◆ AC coupling of CML signals
- ◆ International Class1 laser safety certified
- ◆ Up to 40km transmission distance over Single Mode Fiber
- ◆ Operating temperature range: 0°C~+70°C
- ◆ RoHS Compliant
- ◆ DDMI function available with internally calibrated mode

## Application

- ◆ 10G BASE-ER/EW
- ◆ STM-64 L-64.2/L-64.3

## Standard

- ◆ Complies with SFP+MSA(SFF-8431)
- ◆ Complies with SFF-8472
- ◆ Complies with IEEE802.3ae

**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       | Tc     | 0    |         | 70   | °C   |
| Power Supply Voltage             | Vcc    | 3.13 | 3.3     | 3.47 | V    |
| Supply Current <sup>1</sup>      | Icc    |      |         | 500  | mA   |
| Data Rate                        |        |      | 10.3125 |      | Gbps |
| Fiber Length 9/125µm core SMF    |        | -    | -       | 40   | km   |

| Electrical Characteristics             |         |      |         |         |      |       |
|--|---------|------|---------|---------|------|-------|
| Parameter                              | Symbol  | Min  | Typical | Max     | Unit | Notes |
| Transmitter differential input voltage | Vin,pp  | 180  |         | 700     | mV   |       |
| Receiver differential output Voltage   | Vout,pp | 300  |         | 850     | 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   | -1   |         | +4   | dBm  |       |
| Operating Wavelength Range          | λc     | 1530 | 1550    | 1565 | nm   |       |

| Spectral Width                     | $\Delta\lambda$                                   |       |         | 0.5   | nm    |       |
|------------------------------------|---|-------|---------|-------|-------|-------|
| Side Mode Suppression Ratio        | SMSR  | 30    |         |       | dB    |       |
| Extinction Ratio                   | ER  | 3.5   | 7       |       | dB    | 2     |
| Relative Intensity Noise           | RIN   |       |         | -128  | dB/Hz |       |
| Optical Rise/Fall Time             | Tris/Tfall  | 28    |         |       | Ps    | 3     |
| Transmitter and Dispersion Penalty | TDP   |       |         | 2     | dB    |       |
| Optical Tx Output disable          | $P_{dis}$   |       |         | -45   | 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   |       |         | -15.8 | dBm   | 4     |
| Wavelength Range                   | $\lambda_c$                                       | 1260  | 1550    | 1610  | nm    |       |
| Receiver Reflectance               |   |       |         | -27   | dB    |       |
| Optical Power Input Overload       | $P_{in-max}$                                      | 0.5   |         |       | dBm   | 4     |
| LOS                                | Optical De-assert                                 | $P_d$ |         | -16   | 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=6dB, 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 | Note                      |
|--------------|-------------------------|-------------|---------------------------|
| Temperature  | $\pm 3^{\circ}\text{C}$ | internal    | 0~70°C                    |
| Voltage      | $\pm 3\%$               | internal    | 3.1~3.5V                  |
| Bias Current | $\pm 10\%$              | internal    | Specified by normal value |
| TX Power     | $\pm 2\text{dB}$        | internal    | -1~4dBm                   |
| RX Power     | $\pm 2\text{dB}$        | internal    | -16~0.5dBm                |

## 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.

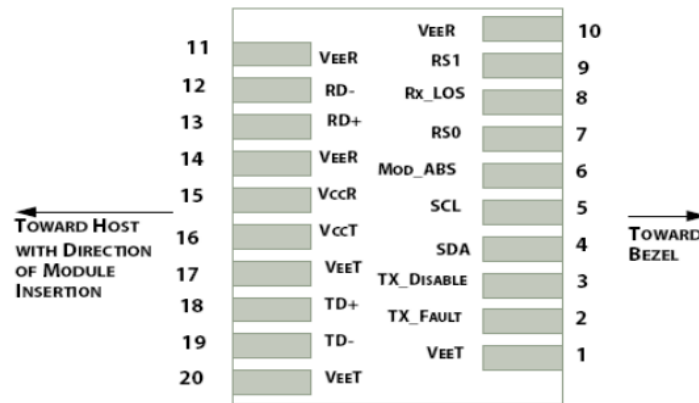


Figure 1 SFP+ Pad Assignment Top View

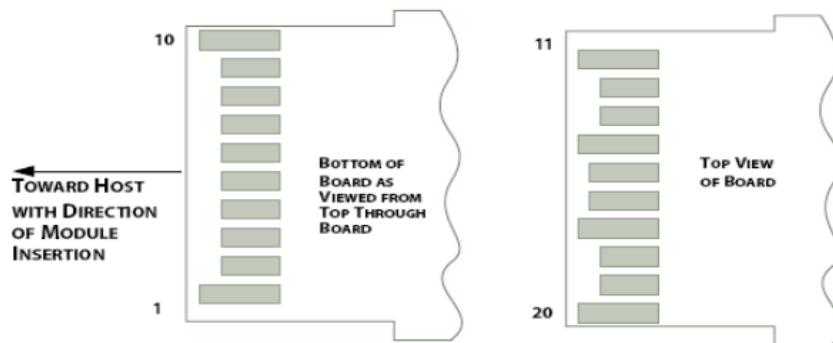


Figure 2 SFP+ Module Contact Assignment

| 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<br>High: Transmitter off<br>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<br>(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<br>High: loss of signal<br>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, Optionally controls SFP+ module receiver, High: RX input signaling rate > 4.25GBd and Low: RX input signaling rate ≤ 4.25GBd.

**Note7.** Module RX\_Los of signal indication need pull up 4.7k~10k Ohm resistor on host board.

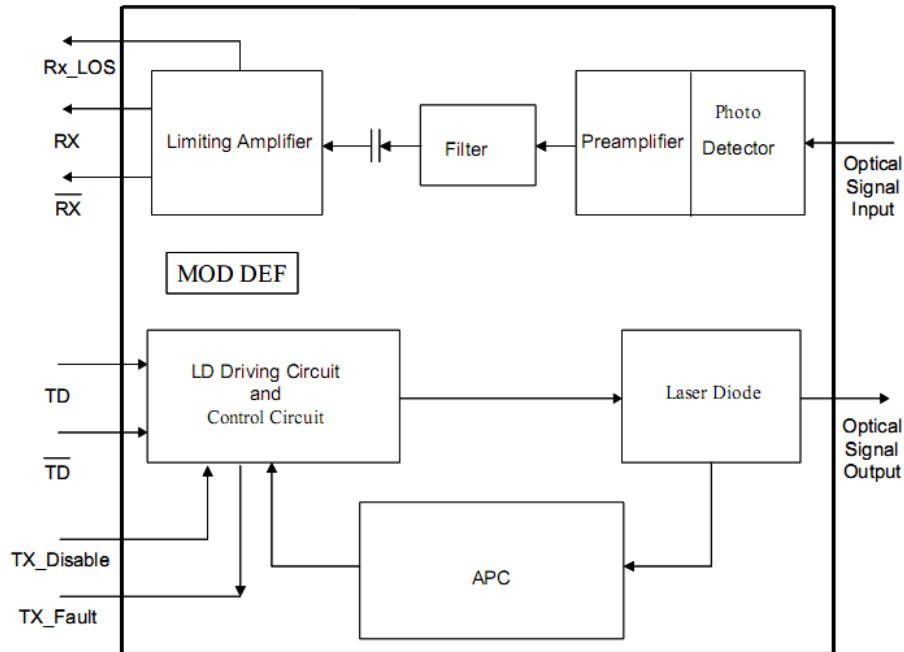
**Note8.** Rate Select 1, Optionally controls SFP+ module transmitter, High: Tx input signaling rate > 4.25GBd and Low: Tx input signaling rate ≤ 4.25GBd.

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

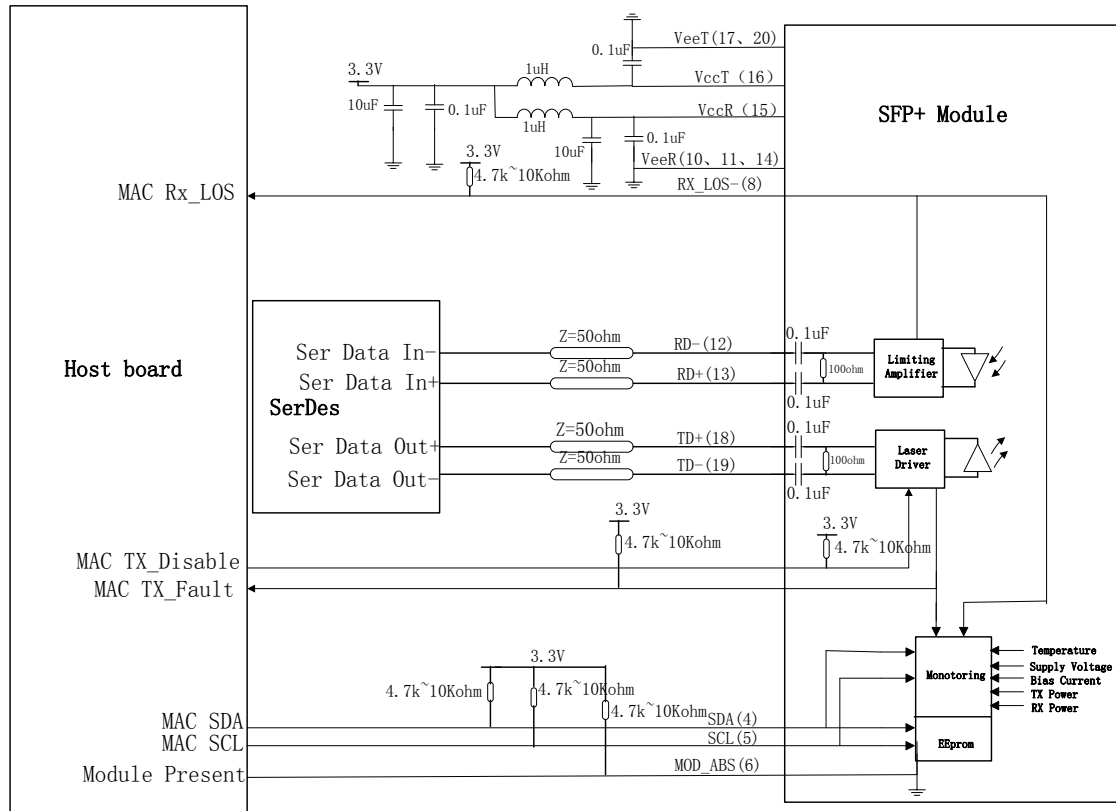
**Note10.** VccR and VccT are the receiver and transmitter power supplies.

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

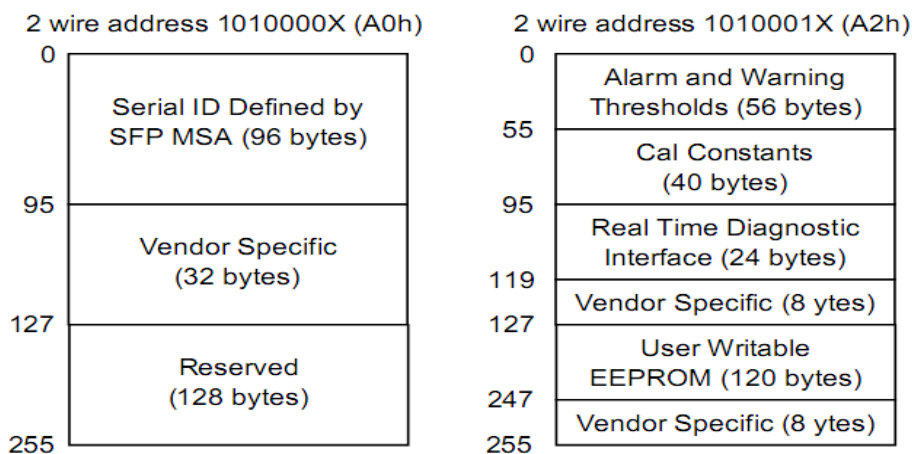
## Block Diagram



## 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                |
|-----------------------|-----------------|-----|----------------------------|
| <b>BASE ID Fields</b> |                 |     |                            |
| 00                    | Identifier      | 03  | SFP/SFP+ transceiver       |
| 01                    | Ext. Identifier | 04  | Serial ID module supported |
| 02                    | Connector       | 07  | LC                         |

|                                 |                            |  |  |
|---------------------------------|----------------------------|--|--|
| 03-10                           | Transceiver Codes          |  |  |
| 11                              | Encoding                   | 06                                     | 64B/66B  |
| 12                              | BR, Nominal                | 67                                     | 10.3GHz  |
| 13                              | Rate Identifier            | 00                                     | Not defined  |
| 14                              | Length(9um)-km             | 28                                     | Transceiver transmit distance  |
| 15                              | Length(9um)-m              | FF                                     |  |
| 16                              | Length(50um)               | 00                                     |  |
| 17                              | Length(62.5um)             | 00                                     |  |
| 18                              | Length(cable)              | 00                                     |  |
| 19                              | Length(OM3)                | 00                                     |  |
| 20-35                           | Vendor Name                | 4D 45 4E 54 45 43 48<br>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                 |  |  |
| 56-59                           | Vendor P/N Rev.            | 31 2E 30 20                            | "1.0"(ASCII character)   |
| 60-61                           | Laser Wavelength           | 06 0E                                  | 1550nm   |
| 62                              | Reserved                   | 00                                     | Not defined  |
| 63                              | CC_BASE                    | XX                                     | Check sum of bytes 0-62  |
| <b>Extended ID Fields</b>       |                            |  |  |
| 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                                     | Digital Diagnostic monitoring implemented "Internally calibrated" is implemented, RX measurement type is "Average 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         | 05                                     | SFF-8472 compliant with revision 11.0  |
| 95                              | CC-EXT                     | XX                                     | Check sum of bytes 64-94   |
| <b>Vendor Specific ID Field</b> |                            |  |  |
| 96-127                          | Vendor Specific            | 00                                     | Vendor specific EEPROM   |
| 128-255                         | Reserved                   | 00                                     | Reserved for future use  |



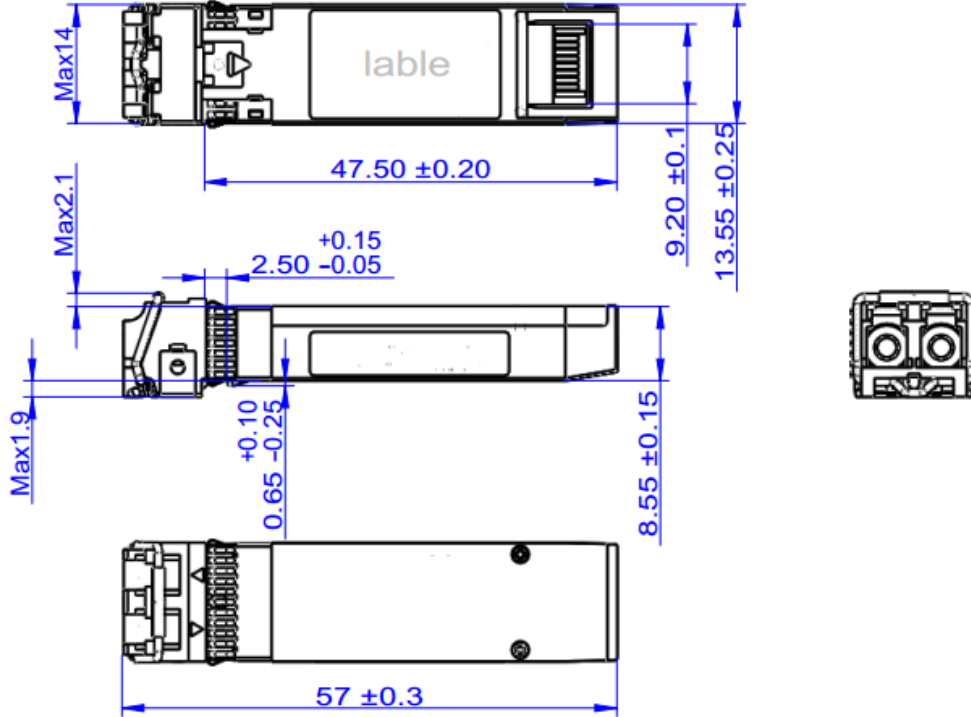
## Digital Diagnostic Monitoring Interface: Alarm and Warning Thresholds

### (2-Wire Address A2h)

| Address | #Bytes | Name                  | Real Value | Unit | Hex |
|---------|--------|-----------------------|------------|------|-----|
| 00-01   | 2      | Temp High Alarm       | 80         | °C   |     |
| 02-03   | 2      | Temp Low Alarm        | -10        | °C   |     |
| 04-05   | 2      | Temp High Warning     | 70         | °C   |     |
| 06-07   | 2      | Temp Low Warning      | 0          | °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       | 110        | mA   |     |
| 18-19   | 2      | Bias Low Alarm        | 4          | mA   |     |
| 20-21   | 2      | Bias High Warning     | 100        | mA   |     |
| 22-23   | 2      | Bias Low Warning      | 5          | mA   |     |
| 24-25   | 2      | TX Power High Alarm   | 6          | dBm  |     |
| 26-27   | 2      | TX Power Low Alarm    | -3         | dBm  |     |
| 28-29   | 2      | TX Power High Warning | 4          | dBm  |     |
| 30-31   | 2      | TX Power Low Warning  | -1         | dBm  |     |
| 32-33   | 2      | RX Power High Alarm   | 2.5        | dBm  |     |
| 34-35   | 2      | RX Power Low Alarm    | -18        | dBm  |     |
| 36-37   | 2      | RX Power High Warning | 0.5        | dBm  |     |
| 38-39   | 2      | RX Power Low Warning  | -16        | dBm  |     |
| 40-55   | 16     | Reserved              | Reserved   |      |     |

## Package Outline

Dimensions are in millimeters. (unit: mm)



## Regulatory Compliance

| Feature  | Test  | Method   |
|--|---|--|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883E<br>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<br>FCC Class B<br>CENELEC EN55022<br>VCCI Class 1 | Comply with standard                                 |
| Immunity   | IEC61000-4-3  | Comply with standard                                 |
| Eye Safety   | FDA 21CFR 1040.10 and 1040.11<br>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 |
| PTE40-D0C-T1 | SFP+           | 10.3125     | 1550 EML | -1~4     | PIN | <-15.8    | 0~70      | 40         | Y   |