# SOE22-xDCC-xxT1

## Features

◆ Single Fiber EPON ONU Transceiver
     1310nm burst-mode 1.25 Gb/s transmitter with FP laser
     1490nm continuous-mode 1.25Gb/s PIN-TIA receiver

◆ Compliant with IEEE802.3 ah™ - 2004

◆ Compliant with IEC60825 Class I

◆ Compliant with SFF-8472 v11.0

◆ Digital diagnostic monitoring interface (DDMI) with internal calibration

◆ Small Form-Factor Hot Pluggable (SFP) Metallic Package with SC/APC receptacle optical interface

◆ Burst On/Off time is less than 16 bits

◆ +3.3V separated power supply

◆ LVTTL interface logic level for AC or DC coupled data input

◆ CML interface logic level for AC coupled data output

◆ LVTTL for burst signal input

◆ LVTTL for receiver loss of signal detect indication

◆ Compliant with RoHS-6

◆ Operating temperature range：0℃~+70℃

## Application

◆ Gigabit Ethernet P2MP application

◆ Gigabit-Ethernet Passive Optical Network (EPON) ONU side

◆ FTTx

## Description

The transmitter is designed for single mode fiber and operates at wavelength of 1310nm. The transmitter module uses a FP laser diode and fully compliant with IEC60825 and CDRH class 1 eye safety. It contains APC functions, a temperature compensation circuit to ensure compliance with IEEE802.3 ah™ - 2004 requirement at operating temperature, data inputs and AC or DC coupling circuit.

The receiver section uses a hermetic packaged PIN-TIA (PIN with trans-impedance amplifier) and a limiting amplifier. The PIN converts optical power into electrical current and the current is transformed to voltage by the trans-impedance amplifier. The differential DATA and /DATA CML data signals are produced by the limiting amplifier. The PIN-TIA is AC coupled to the limiting amplifier through a low pass filter.

## Specification

| Absolute Maximum Ratings | | | | | |
|---|---|---|---|---|---|
| Parameter | Symbol | Min. | Max. | Unit | Note |
| Storage Ambient Temperature | $T_{STG}$ | -40 | 85 | ℃ | |
| Operating Humidity | $H_{OPR}$ | 5 | 95 | % | |
| Power Supply Voltage | Vcc | 0 | 4 | V | |
| Input Voltage | | GND | Vcc | V | |
| Receiver Damaged Threshold | | 7 | | dBm | |
| Soldering Temperature | | | 260 | ℃ | 10s |

| Recommended Operating Conditions | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
| Power Supply Voltage | Vcc | 3.135 | 3.3 | 3.465 | V | 3.3V±5% |
| Operating Case Temperature | Tcase | 0 | | 70 | ℃ | |
| Operating Humidity Range | $H_{OPR}$ | 5 | | 95 | % | |
| Data Rate | | | 1.25 | | Gbps | |
| Data Rate Drift | | -100 | | +100 | PPM | |

| Transmitter Optical and Electrical Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
| Optical Center Wavelength | $\lambda_C$ | 1290 | 1310 | 1330 | nm | |
| Optical Spectrum Width (-20dB) | $\triangle \lambda$ | | | 1 | nm | |
| Average Launch Power(BOL) | $P_{OUT}$ | 0 | | +4 | dBm | 1 |
| Average Launch Power-OFF Transmitter | $P_{OFF}$ | | | -45 | dBm | 1 |
| Extinction Ratio | ER | 9 | | | dB | 2 |
| Rise/Fall Time (20%-80%) | $T_R/T_F$ | | | 260 | ps | 3 |
| Burst Turn On Time | $T_{BURST\_ON}$ | | | 30 | ns | 4 |
| Burst Turn Off Time | $T_{BURST\_OFF}$ | | | 30 | ns | 4 |
| Burst Enable Duration | $T_{EN\_DUR}$ | 600 | | | ns | 4 |
| Burst Disable Duration | $T_{DIS\_DUR}$ | 100 | | | ns | 4 |
| Transmitter Reflectance | | | | -10 | dB | $\lambda$=1310nm |
| Optical Return Loss Tolerance | | | | 15 | dB | |
| $RIN_{15}OMA$ | | | | -115 | dB/Hz | |
| Transmitter and Dispersion Penalty | TDP | | | 1.8 | dB | |
| Optical Eye Diagram | Compliant With IEEE Std 802.3ah™ - 2004 | | | | | 2,5 |
| Data Input Differential Swing | $V_{IN}$ | 200 | | 1600 | mV | 6 |
| Input Differential Impedance | $Z_{IN}$ | 90 | 100 | 110 | Ω | 6 |
| Power Supply Current | $I_{CC\_TX}$ | | | 200 | mA | |
| LVTTL Voltage - Low | $V_{LVTTL,L}$ | 0 | | 0.8 | V | 7 |
| LVTTL Voltage - High | $V_{LVTTL,H}$ | 2.4 | | Vcc | V | 7 |
| Total Jitter | Tj | | | 0.2 | UI | 8 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tx_SD Assert | $t_A$ | | | 200 | ns | optional |
| Tx_SD Deassert | $t_D$ | | | 200 | ns | optional |

Note 1: Launched into 9/125um SMF, mode 1, 2 are implemented by power leveling mechanism in 2×10 SFP.

Note 2: Measured with PRBS $2^7$-1 test pattern @1.25Gbit/s, and the Bessel-Thompson filter is turned on.

Note 3: Measured with PRBS $2^7$-1 test pattern @1.25Gbit/s, and the Bessel-Thompson filter is turned off.

Note 4: Refer to Timing Parameter Definition in Burst Mode Sequence.

Note 5: Transmitter eye mask definition in IEEE Std 802.3ah™ - 2004.

Note 6: Compatible with LVPECL input.

Note 7: Included Tx_SD, Tx_Dis or Burst ON, Tx_Fault (See Pin Function Definitions).

Note 8: IEEE Std 802.3ah™ - 2004 Compliant

| Receiver Optical and Electrical Characteristics | | | | | | |
|---|---|---|---|---|---|---|
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
| Operating Wavelength | $\lambda_C$ | 1480 | 1490 | 1500 | nm | |
| Receiver Sensitivity | $P_{SEN}$ | | | -27.5 | dBm | 1 |
| Overload Input Optical Power | $P_{SAT}$ | -3 | | | dBm | |
| Signal-Detected Assert Level | $P_{SDA}$ | | | -28 | dBm | 2 |
| Signal-Detected Deassert Level | $P_{SDD}$ | -39 | | | dBm | 3 |
| Signal-Detected Hysteresis | $P_{SDA}$-$P_{SDD}$ | 0.5 | | 6 | dBm | |
| Receiver Reflectance | | | | -12 | dB | $\lambda$ =1490nm |
| 1310nm Tx to 1490nm Rx Crosstalk | | | | -45 | dB | |
| Power Supply Current | $I_{CC\_RX}$ | | | 120 | mA | |
| Data Output Differential Swing | $V_{OUT}$ | 400 | | 1600 | mV | 4 |
| LVTTL Voltage - Low | $V_{LVTTL,L}$ | 0 | | 0.8 | V | 5 |
| LVTTL Voltage - High | $V_{LVTTL,H}$ | 2.4 | | Vcc | V | |
| Signal-Detected Assert Time | $T_{ASS}$ | | | 100 | us | |
| Signal-Detected Deassert Time | $T_{DAS}$ | | | 100 | us | |

Note 1: Measured with PRBS $2^7$-1 @1.25Gbit/s, ER=10dB, BER =$10^{-12}$ .

Note 2:H-L,A decrease in optical power below the specified level will cause the Signal Detect output to switch from a high state to a low state.

Note 3: L-H ,An increase in optical power above the specified level will cause the Signal Detect output to switch from a low state to a high state.

Note 4: CML output, AC coupled internally, guaranteed in the full range of input optical power.

Note 5: Rx_SD

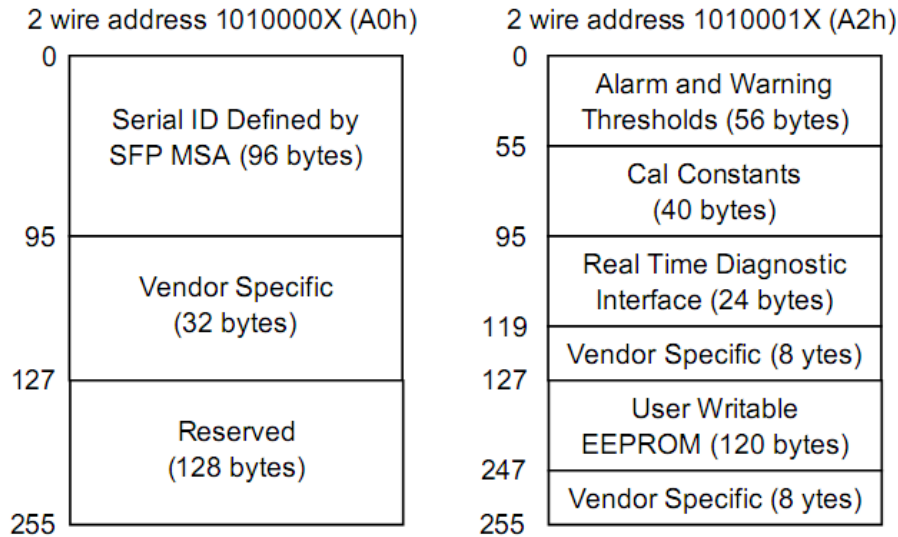## Digital Diagnostic Memory Map



Figure1

## 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. 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 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.

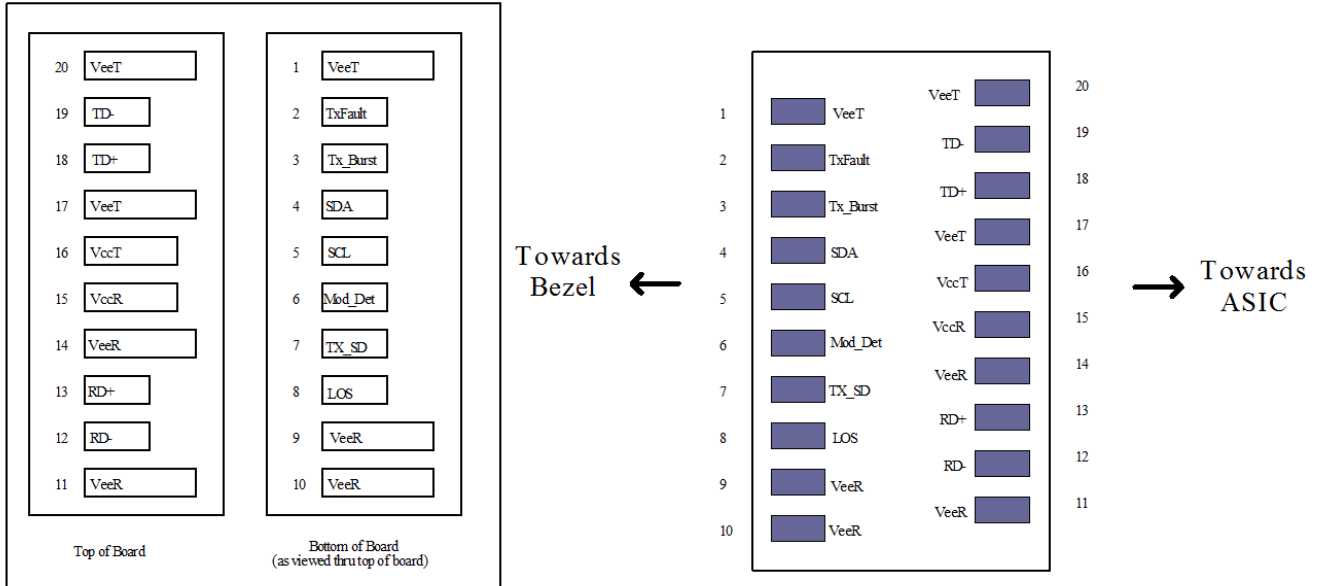## EEPROM Serial ID Memory Contents (2-Wire Address A0h)

| Address | Name of field | Hex | Description |
|---|---|---|---|
| BASE ID Fields | | | |
| 00 | Identifier | 03 | SFP transceiver |
| 01 | Ext. Identifier | 04 | Not defined |
| 02 | Connector | 01 | SC |
| 03-05 | Transceiver Codes | 00 00 00 | Not defined |
| 06 | Transceiver Codes | 02 | 1000BASE-LX |
| 07-10 | Transceiver Codes | 00 00 00 00 | Not defined |
| 11 | Encoding | 01 | 8B/10B |
| 12 | BR, Nominal | 0C | 1200 MBps |
| 13 | Rate Identifier | 00 | Not defined |
| 14 | Length(9um)-km | 14 | 20 km |
| 15 | Length(9um)-m | C8 | 20000 m |
| 16 | Length(50um) | 00 | Transceiver transmit distance |
| 17 | Length(62.5um) | 00 | Transceiver transmit distance |
| 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 20 20 20 20 20 | "MENTECHOPTO"(ASCII character) |
| 36 | Reserved | 00 | Not defined |
| 37-39 | Vendor OUI | 00 00 00 | Not defined |
| 40-55 | Vendor P/N | 53 4F 45 32 32 2D 4C 44 36 43 2D 41 43 20 20 20 | "SOE22-LD6C-AC"(ASCII character) |
| 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 0A | TX_Fault and RX_SD are implemented |
| 66 | BR，max | 14 | 1560 MBps |
| 67 | BR，min | 14 | 1040 MBps |
| 68-83 | Vendor SN | xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx | Vendor Serial Number in ASCII character |
| 84-91 | Date Code | xx xx xx xx xx xx xx xx | 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 RX_LOS monitoring are implemented |
| 94 | SFF-8472 compliant | 05 | SFF-8472 compliant with revision 11 |
| 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 |
|---|---|---|---|---|---|
| 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 | 3.6 | 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 | 70 | mA | |
| 18-19 | 2 | Bias Low Alarm | 2 | mA | |
| 20-21 | 2 | Bias High Warning | 60 | mA | |
| 22-23 | 2 | Bias Low Warning | 4 | mA | |
| 24-25 | 2 | TX Power High Alarm | 6 | dBm | |
| 26-27 | 2 | TX Power Low Alarm | -2 | dBm | |
| 28-29 | 2 | TX Power High Warning | 4 | dBm | |
| 30-31 | 2 | TX Power Low Warning | 0 | dBm | |
| 32-33 | 2 | RX Power High Alarm | 0 | dBm | |
| 34-35 | 2 | RX Power Low Alarm | -30 | dBm | |
| 36-37 | 2 | RX Power High Warning | -3 | dBm | |
| 38-39 | 2 | RX Power Low Warning | -27 | dBm | |
| 40-55 | 16 | Reserved | Reserved | | |

## Pin Description



Figure2

| Pin Num. | Name | Function | Plug seq. | Note |
|---|---|---|---|---|
| 1 | VeeT | Transmitter Ground | 1 | 1 |
| 2 | Tx Fault | Transmitter Fault indication | 3 | 2 |
| 3 | Tx_Burst | Transmitter Burst control, (LVTTL) | 3 | 3 |
| 4 | SDA | Module Definition 2, SDA Serial Data Signal | 3 | 4 |
| 5 | SCL | Module Definition 1, SCL Serial Clock Signal | 3 | 4 |
| 6 | MOD_Det | Module Definition 0 | 3 | 4 |
| 7 | TX_SD | Transmitter signal detect | 3 | 5 |
| 8 | LOS | Loss of Signal, need external 4.7k~10k pull up resistor | 3 | 6 |
| 9 | VeeR | Receiver Ground (optional no connection) | 1 | 1 |
| 10 | VeeR | Receiver Ground | 1 | 1 |
| 11 | VeeR | Receiver Ground | 1 | 1 |
| 12 | RD- | Inv. Received Data Out (AC coupled) | 3 | 7 |
| 13 | RD+ | Received Data Out (AC coupled) | 3 | 7 |
| 14 | VeeR | Receiver Ground | 1 | 1 |
| 15 | VccR | Receiver Power | 2 | 8 |
| 16 | VccT | Transmitter Power | 2 | 8 |
| 17 | VeeT | Transmitter Ground | 1 | 1 |
| 18 | TD+ | Transmit Data In (AC coupled) | 3 | 9 |
| 19 | TD- | Inv. Transmit Data In (AC coupled) | 3 | 9 |

| 20 | VeeT | Transmitter Ground | 1 | 1 |

Plug Seq.: Pin engagement sequence during hot plugging.

Note 1: VeeR and VeeT internally connected within the PON module.

Note 2: TX Fault indicates the status of module with pull up resistor of 10 KΩ externally. 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.

Note 3: TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 10KΩ resistor. (See Timing Parameter Definition in Burst Mode Sequence)

Note 4: These are the module definition pins.

SDA is serial data signal with 10 KΩ pull up resistor externally.

SCL is serial clock signal with 10 KΩ pull up resistor externally.

MOD_Det is grounded internally and need 10 KΩ pull up resistor externally to indicate that the module is present.

Note 5: TX_SD function with 1 KΩ pull up resistor internally ,it monitors the state of the LD laser,when the MAC enables the module,the TX_SD goes high within a short time.

Note 6: LOS (Loss of Signal) indicates the status of received optical power with 10 KΩ pull up resistor externally. 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.

Note 7: RD -/+: These are the differential receiver outputs. They are AC-coupled with CML voltage level, and required 100ohm resistor to match the differential termination.

Note 8: 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 300 mA. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1Ω 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 30 mA greater than the steady state value. VccR and VccT may be internally connected within the SFP transceiver module.

Note 9: TD-/+: These are the differential transmitter inputs. They are AC or DC-coupled, differential lines with 100Ω differential termination inside the module. The AC or DC coupling is done inside the module and is thus not required on the host board.
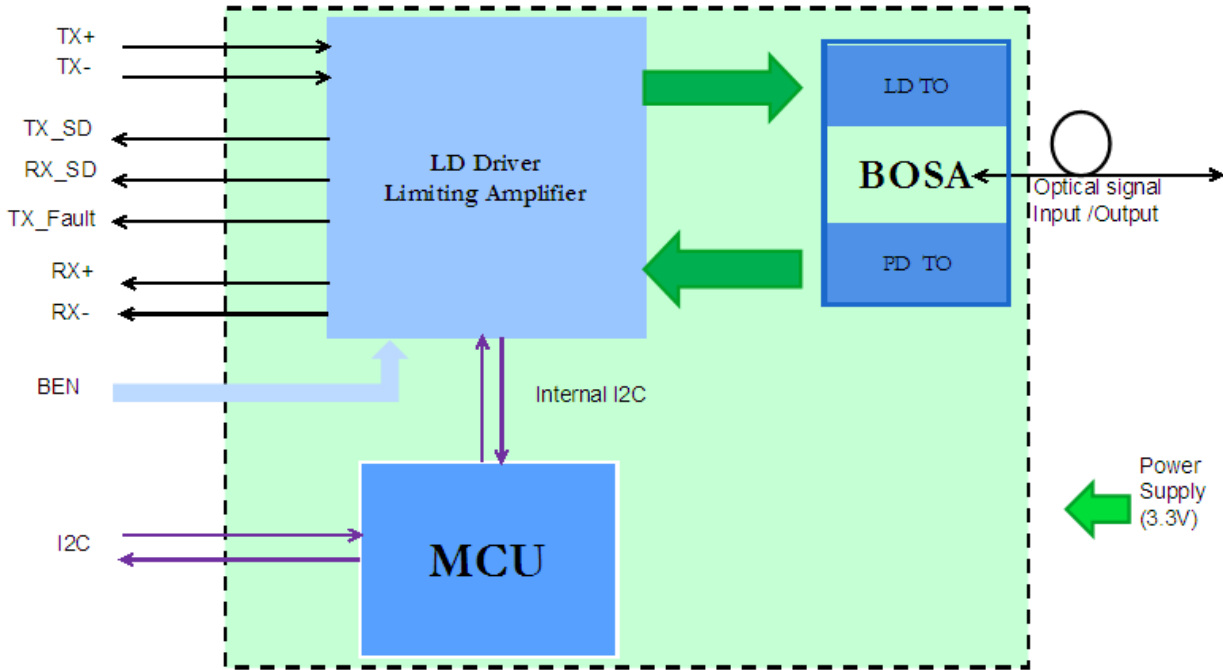
## Function Description

Figure3 Block diagram

The burst-mode transmitter part has a 1310nm FP laser. It features AC or DC-coupled differential data inputs. Tx_Burst is a LVTTL input for TX shut down control. When Tx_Burst is "H", Logic "1" open the LD driver; When Tx_Burst is "L", Logic "0" open the LD driver.

The 1490nm continuous-mode receiver part has a high performance photo detector. The preamplifier (TIA) and limiting amplifier amplify the incoming optical signal into the stable range and convert the signal to differential AC-coupled CML outputs. LOS is LVTTL output, which logic"1" indicates the input power is lower than the threshold, logic"0" indicates the input power is above the threshold.
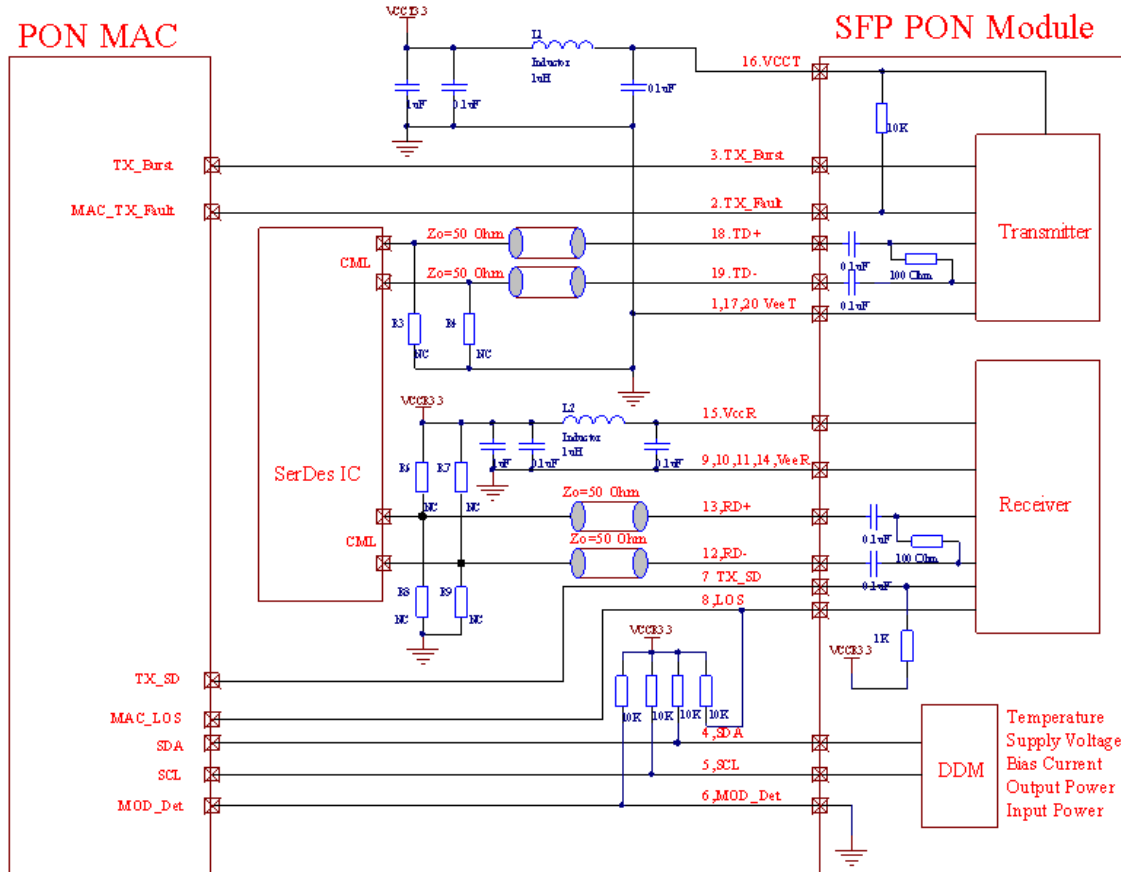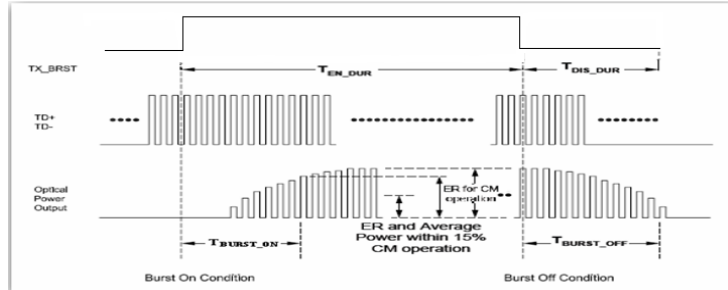
## Interface Circuit



Figure4

## Burst Mode Sequence

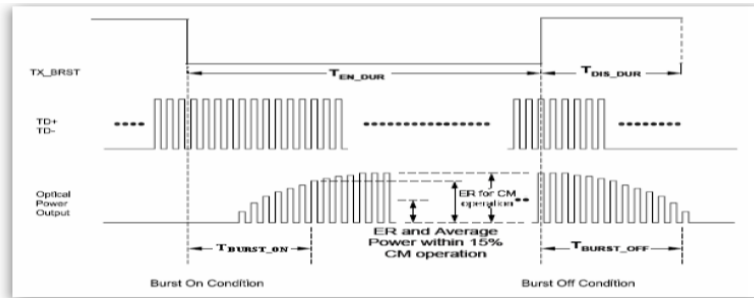When the Tx_Burst is "H":



When the Tx_Burst is "L":



Figure5

　　　　　　　　　　表单编号 FORM NO.: FORM-MT-0539REV.05

## Package Outline



Figure6

## Ordering information

| PART NO. | Specifications | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Type | Rate Tx/Rx | Tx (nm) | Po (dBm) | Rx (nm) | Sen (dBm) | Temp (℃) | Reach (Km) | DDM | Others |
| SOE22-DCC-ACT1 | SFP | 1.25/1.25 G | 1310 FP | 0~4 | 1490 PIN | <-27.5 | 0~+70 | 20 | Y | SC/APC Receptacle, High-Burst On, TD+/-:AC |
| SOE22-DCC-DCT1 | SFP | 1.25/1.25 G | 1310 FP | 0~4 | 1490 PIN | <-27.5 | 0~+70 | 20 | Y | SC/APC Receptacle, High-Burst On, TD+/-:DC |
| SOE22-LDCC-ACT1 | SFP | 1.25/1.25 G | 1310 FP | 0~4 | 1490 PIN | <-27.5 | 0~+70 | 20 | Y | SC/APC Receptacle, LOW-Burst On, TD+/-:AC |
| SOE22-LDCC-DCT1 | SFP | 1.25/1.25 G | 1310 FP | 0~4 | 1490 PIN | <-27.5 | 0~+70 | 20 | Y | SC/APC Receptacle, LOW –Burst On, TD+/-:DC |

表单编号 FORM NO.: FORM-MT-0539REV.05