

---

# NOG22-xD9I-xxT1

## Features

- ◆ Single Fiber GPON ONU Transceiver
  - 1310nm burst-mode 1.24416 Gb/s transmitter with DFB laser
  - 1490nm continuous-mode 2.488Gb/s APD receiver
- ◆ Compliant with ITU-T G.984.2 Class B+
- ◆ Compliant with ITU-T G.984.5
- ◆ Digital diagnostic monitoring (DDM) with internal calibration
- ◆ 2×10 Small Form Factor (SFF) Metallic Package with SC/ APC pigtail optical interface
- ◆ Burst On/Off time is less than 16 bits
- ◆ +3.3V separated power supply
- ◆ LVTTTL interface logic level for AC or DC coupled data input
- ◆ CML interface logic level for AC coupled data output
- ◆ LVTTTL for burst signal input
- ◆ LVTTTL for receiver loss of signal detect indication
- ◆ Compliant with RoHS-6
- ◆ Operating temperature range: -40°C~+85°C

## Applications

- ◆ Gigabit-Passive Optical Network (GPON) ONT
- ◆ FTTx

## Description

The transmitter is designed for single mode fiber and operates at wavelength of 1310nm. The transmitter module uses a DFB 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 G.984.2 requirement at operating temperature, data inputs and AC or DC coupling circuit.

The receiver section uses a hermetic packaged APD-TIA (APD with trans-impedance amplifier) and a limiting amplifier. The APD 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 APD-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 <sub>STG</sub> | -40  | 85   | °C   |      |  |
| Operating Humidity          | H <sub>OPR</sub> | 5    | 95   | %    |      |  |
| Power Supply Voltage        | V <sub>CC</sub>  | -0.3 | 4    | V    |      |  |
| Receiver Damaged Threshold  |                  | 3    |      | dBm  |      |  |
| Soldering Temperature       |                  |      | 260  | °C   | 10s  |  |

| Recommended Operating Conditions |                   |       |      |       |      |         |
|----------------------------------|-------------------|-------|------|-------|------|---------|
| Parameter                        | Symbol            | Min.  | Typ. | Max.  | Unit | Note    |
| Power Supply Voltage             | V <sub>CC</sub>   | 3.135 | 3.3  | 3.465 | V    | 3.3V±5% |
| Operating Case Temperature       | T <sub>case</sub> | -40   |      | 85    | °C   |         |
| Operating Humidity Range         | H <sub>OPR</sub>  | 5     |      | 95    | %    |         |
| Data Rate                        |                   |       | 1244 |       | Mbps |         |
| Data Rate Drift                  |                   | -100  |      | +100  | PPM  |         |

| Transmitter Optical and Electrical Characteristics |                             |      |      |                 |      |      |
|--|-----------------------------|------|------|-----------------|------|------|
| Parameter  | Symbol                      | Min. | Typ. | Max.            | Unit | Note |
| Optical Transmitter Power                          | P <sub>OUT</sub>            | 0.5  | 2.5  | 5               | dBm  | 1    |
| Output Center Wavelength                           | λ <sub>C</sub>              | 1290 | 1310 | 1330            | nm   |      |
| Output Spectrum Width                              | Δλ                          |      |      | 1               | nm   |      |
| Side Mode Suppression Ratio                        | SMSR                        | 30   |      |                 | dB   |      |
| Output Power At Transmit Off                       | P <sub>OFF</sub>            |      |      | -45             | dBm  |      |
| Extinction Ratio                                   | ER                          | 10   |      |                 | dB   |      |
| Tx Enable/Disable Time                             |                             |      |      | 12.8            | ns   | 3    |
| Transmitter and Dispersion Penalty                 | TDP                         |      |      | 1.0             | dB   |      |
| Optical Eye Diagram                                | Compliant With ITU-T G984.2 |      |      |                 |      | 2,4  |
| Data Input Differential Swing                      | V <sub>IN</sub>             | 200  |      | 1600            | mV   | 5    |
| Input Differential Impedance                       | Z <sub>IN</sub>             | 90   | 100  | 110             | Ω    |      |
| LVTTTL Voltage - Low                               | V <sub>LVTTTL,L</sub>       | 0    |      | 0.8             | V    | 6    |
| LVTTTL Voltage - High                              | V <sub>LVTTTL,H</sub>       | 2.4  |      | V <sub>CC</sub> | V    |      |
| Total Jitter                                       | T <sub>j</sub>              |      |      | 0.2             | UI   | 7    |
| Tx_SD Assert                                       | t <sub>A</sub>              |      |      | 200             | ns   |      |
| Tx_SD Deassert                                     | t <sub>D</sub>              |      |      | 200             | ns   |      |

Note 1: Launched into 9/125um SMF.

Note 2: Measured with PRBS 2<sup>23</sup>-1 @1244.16Mbit/s, and the Bessel-Thompson filter is turned on.

Note 3: Refer to Timing Parameter Definition in Burst Mode Sequence.

Note 4: Transmitter eye mask definition in ITU-T G984.2.

Note 5: Compatible with LVPECL input.

Note 6: Included Tx\_SD, Tx\_Dis, Burst ON or Tx\_Fault (See Pin Function Definitions).

Note 7: ITU-T G984.2 Compliant

| Receiver Optical and Electrical Characteristics |                   |      |      |      |      |                  |
|---|-------------------|------|------|------|------|------------------|
| Parameter                                       | Symbol            | Min. | Typ. | Max. | Unit | Notes            |
| Operating Wavelength                            | $\lambda_C$       | 1480 | 1490 | 1500 | nm   |                  |
| Receiver Sensitivity                            | $P_{SEN}$         |      |      | -28  | dBm  | 1                |
| Overload Input Optical Power                    | $P_{SAT}$         | -8   |      |      | dBm  |                  |
| Signal-Detected Assert Level                    | $P_{SDA}$         |      |      | -30  | dBm  | 2                |
| Signal-Detected De-assert Level                 | $P_{SDD}$         | -44  |      |      | dBm  | 3                |
| Signal-Detected Hysteresis                      | $P_{SDA}-P_{SDD}$ | 0.5  | 3    | 6    | dBm  |                  |
| Receiver Reflectance                            |                   |      |      | -20  | dB   | $\lambda=1490nm$ |
| WDM Filter Isolation                            | ISO(1550)         | 38   |      |      | dB   | 1550nm           |
|   | ISO(1650)         | 35   |      |      | dB   | 1650nm           |
| 1310nm Tx to 1490nm Rx Crosstalk                |                   |      |      | -45  | dB   |                  |
| Data Output Differential Swing                  | $V_{OUT}$         | 300  |      | 1200 | mV   | 4                |
| LVTTL Voltage – Low                             | $V_{LVTTLL}$      | 0    |      | 0.4  | V    | 5                |
| LVTTL Voltage - High                            | $V_{LVTTLH}$      | 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<sup>23</sup>-1 @2488.32Mbit/s, ER=10dB, BER =10<sup>-10</sup>.

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 or Rx\_Los (See Pin Function Definitions).

## Digital Diagnostic Memory Map

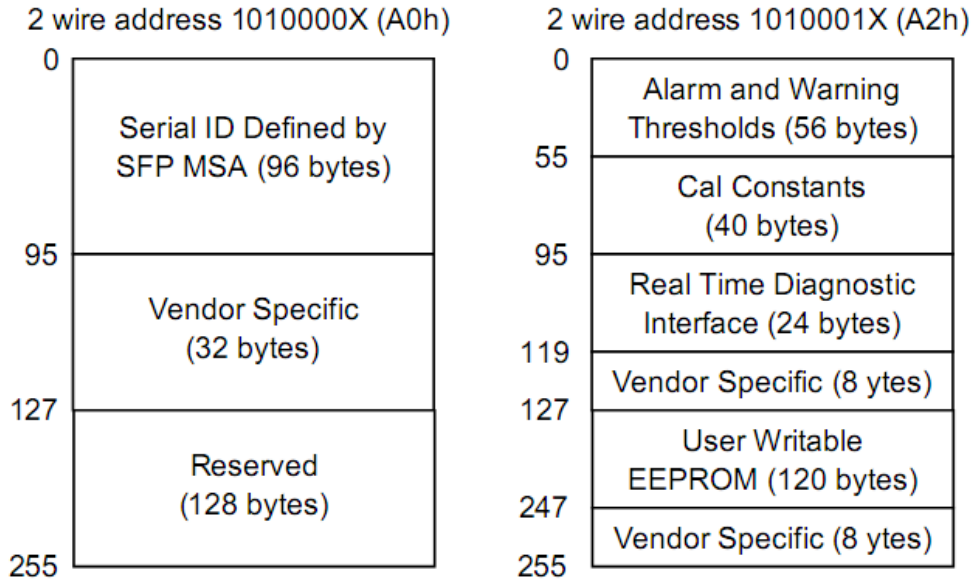


Figure1

## 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 SFF transceiver. The negative edge clocks data from the SFF 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  |
|---------------------------|----------------------------|--|--|
| <b>BASE ID Fields</b>     |                            |  |  |
| 00                        | Identifier                 | 02   | SFF transceiver  |
| 01                        | Ext. Identifier            | 08   | Not defined  |
| 02                        | Connector                  | 0B   | Optical pigtail  |
| 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                   | 03   | NRZ  |
| 12                        | BR, Nominal                | 0D   | 1300 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   |  |
| 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<br>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                 | 4E 4F 47 32 32 2D 4C 44<br>38 49 2D 41 43 20 20 20 | "NOG22-LD8I-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  |
| <b>Extended ID Fields</b> |                            |  |  |
| 64-65                     | Options                    | 00 1C  | TX_Disable、TX_Faultand 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<br>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   | E0 | Optional Alarm/warning flags, soft Tx_Disable control and monitoring, soft Tx_Fault monitoring are implemented |
| 94                              | SFF-8472 compliant | 02 | SFF-8472 compliant with revision 9.5   |
| 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       | 120        | °C   |     |
| 02-03   | 2      | Temp Low Alarm        | -45        | °C   |     |
| 04-05   | 2      | Temp High Warning     | 110        | °C   |     |
| 06-07   | 2      | Temp Low Warning      | -40        | °C   |     |
| 08-09   | 2      | Voltage High Alarm    | 3.6        | V    |     |
| 10-11   | 2      | Voltage Low Alarm     | 2.9        | V    |     |
| 12-13   | 2      | Voltage High Warning  | 3.5        | V    |     |
| 14-15   | 2      | Voltage Low Warning   | 3          | V    |     |
| 16-17   | 2      | Bias High Alarm       | 70         | mA   |     |
| 18-19   | 2      | Bias Low Alarm        | 2          | mA   |     |
| 20-21   | 2      | Bias High Warning     | 65         | mA   |     |
| 22-23   | 2      | Bias Low Warning      | 3          | 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 | 5          | dBm  |     |
| 30-31   | 2      | TX Power Low Warning  | 0          | dBm  |     |
| 32-33   | 2      | RX Power High Alarm   | -6         | dBm  |     |
| 34-35   | 2      | RX Power Low Alarm    | -37        | dBm  |     |
| 36-37   | 2      | RX Power High Warning | -8         | dBm  |     |
| 38-39   | 2      | RX Power Low Warning  | -34        | dBm  |     |
| 40-55   | 16     | Reserved              | Reserved   |      |     |

## Pin Description

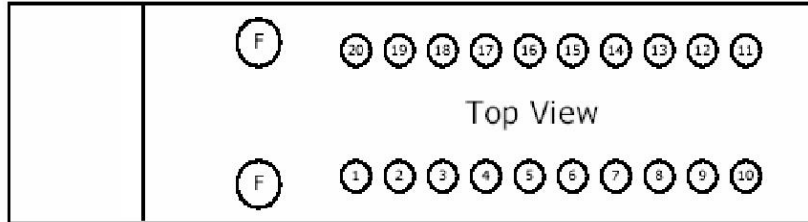


Figure2

| Pin No | Name             | Default Description  | Note |
|--------|------------------|--|------|
| 1      | NC               | No Function Definition   |      |
| 2      | GND              | Ground   |      |
| 3      | GND              | Ground   |      |
| 4      | NC               | No Function Definition   |      |
| 5      | NC               | No Function Definition   |      |
| 6      | V <sub>EER</sub> | Receiver Signal Ground   |      |
| 7      | V <sub>CCR</sub> | Receiver Power Supply  |      |
| 8      | Rx_SD            | Receiver Signal-Detected Indication (LVTTTL), internally pull up, (LVTTTL) "1": Optical Signal-Detected. | 1    |
| 9      | RD-              | Inverted Receiver Data Output(CML/AC coupled internally)   |      |
| 10     | RD+              | Non-inverted Receiver Data Output(CML/AC coupled internally)   |      |
| 11     | V <sub>CCT</sub> | Transmitter Power Supply   |      |
| 12     | V <sub>EET</sub> | Transmitter Signal Ground  |      |
| 13     | Tx_Burst         | Transmitter Burst Control (LVTTTL)   | 2    |
| 14     | TD+              | Non-inverted Transmitter Data Input  | 3    |
| 15     | TD-              | Inverted Transmitter Data Input  | 3    |
| 16     | V <sub>EET</sub> | Transmitter Signal Ground  |      |
| 17     | SCL              | Clock Line of the I <sup>2</sup> C interface (LVTTTL)  | 4    |
| 18     | SDA              | Data Line of the I <sup>2</sup> C interface (LVTTTL)   | 4    |
| 19     | Tx_Fault         | Transmitter Fault Indication (LVTTTL), internally pull up, "1": Fault.                                   |      |
| 20     | Tx_SD            | Transmitter Signal-Detected Indication (LVTTTL), "1": Optical Signal-Detected.                           | 5    |
| F      | MS               | Mounting Studs   | 6    |

Note 1: LVTTTL logic output, with internal 10KΩ pull-up resistor. Optical Signal-Detected: High.

Note 2: A positive level enable optical signal output under burst mode. Optional, a negative level enable.

(See Timing Parameter Definition in Burst Mode Sequence)

Note 3: Optional AC or DC coupled internally.

Note 4: I<sup>2</sup>C interface, they should be pulled up with two 4.7-10KΩ resistors on the host board.

Note 5: Optional Tx\_SD.

Note 6: The mounting studs are provided for transceiver mechanical attachment to circuit board. They may also provide an optional connection of the transceiver to the equipment chassis ground. The holes in the circuit board must be tied to chassis ground. It is not recommended that the mounting studs be connected to signal ground.



## Function Description

The transceiver provides high-speed Bi-directional serial optical link for GPON application up to 20km.

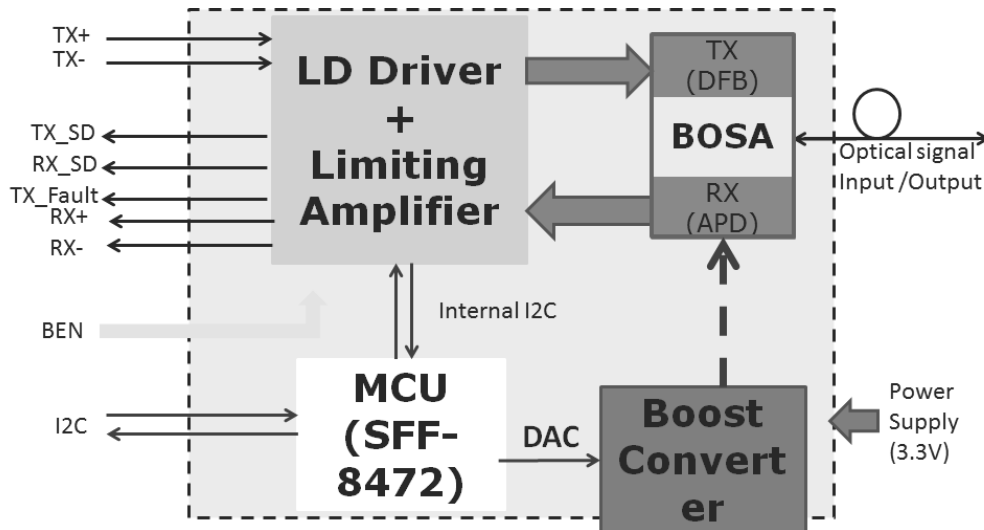


Figure3 Block diagram

The burst-mode transmitter part has a 1310nm DFB laser. It features AC or DC-coupled differential data inputs. Tx\_Burst is a LVTTTL 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. SD is LVTTTL output, which logic"0" indicates the input power is lower than the threshold, logic"1" indicates the input power is above the threshold.



## Interface Circuit

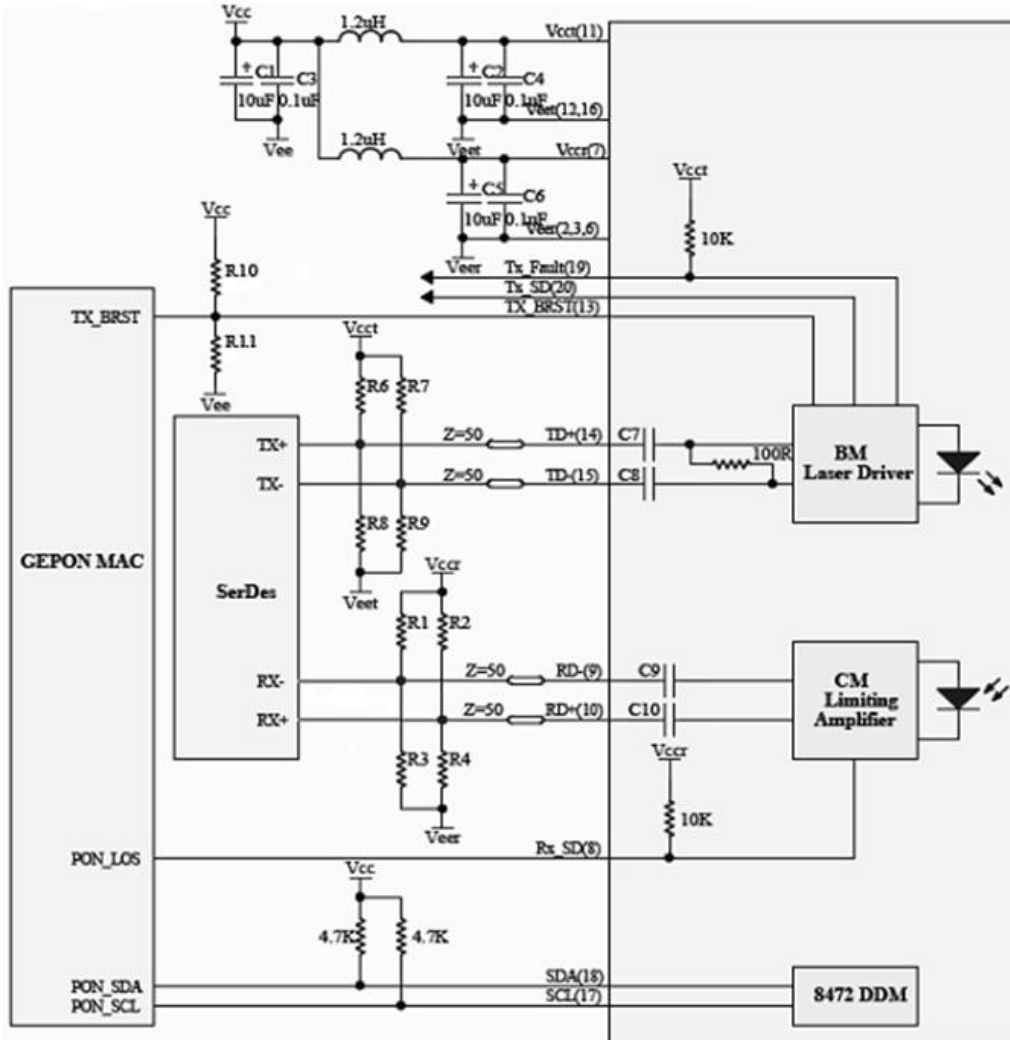


Figure4

Note A: When the Tx\_Burst is "H", The configure is R10=NC, R11=10K;

When the Tx\_Burst is "L", The configure is R10=10K, R11=NC;

Note B: When input is "DC" coupled internally, The configure is R6=R7=130Ω, R8=R9=82Ω, C7=C8=0Ω;

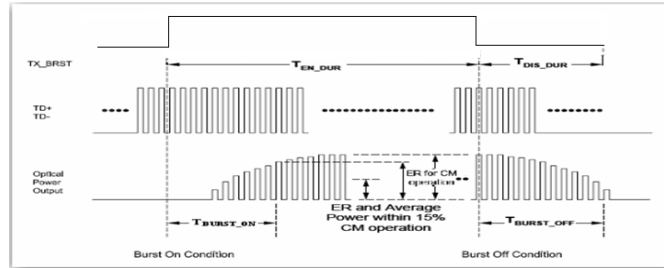
When input is "AC" coupled internally, The configure is R6=R7=R8=R9=NC, C7=C8=0.1uF;

Note C: For LVPECL output, AC coupled internally, R1=R2=82Ω, R3=R4=130Ω;

Other the R1=R2=R3=R4=NC;

## Burst Mode Sequence

When the Tx\_Burst is "H":



When the Tx\_Burst is "L":

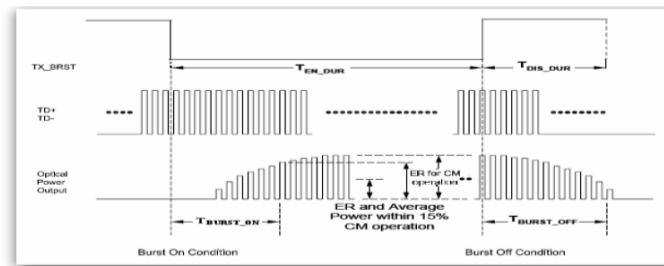


Figure5

## Regulatory Compliance

| Feature  | Test   | Method   |
|--|--|--|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883E<br>Method 3015.7                          | Class 1 (>1.5kV) – Human Body Model  |
| Electrostatic Discharge (ESD) Immunity               | IEC61000-4-2   | Class 2 (>4.0kV)   |
| Electromagnetic Interference (EMI)                   | CISPR22 ITE Class B<br>EN55022 Class B                 | Compliant with standards   |
| Immunity   | IEC61000-4-3 Class 2<br>EN55024                        | Typically show no measurable effect from a 3V/m field swept from 80 to 1000MHz applied to the transceiver without a chassis enclosure. |
| Eye Safety   | FDA 21 CFR 1040.10 and 1040.11<br>UL<br>TUV EN 60825-1 | Compliant with Class 1 laser product   |
| Component Recognition                                | UL and CSA   | Compliant with standards   |
| RoHS   | 2002/95/EC 4.1&4.2                                     | Compliant with standards   |

**Package Outline**

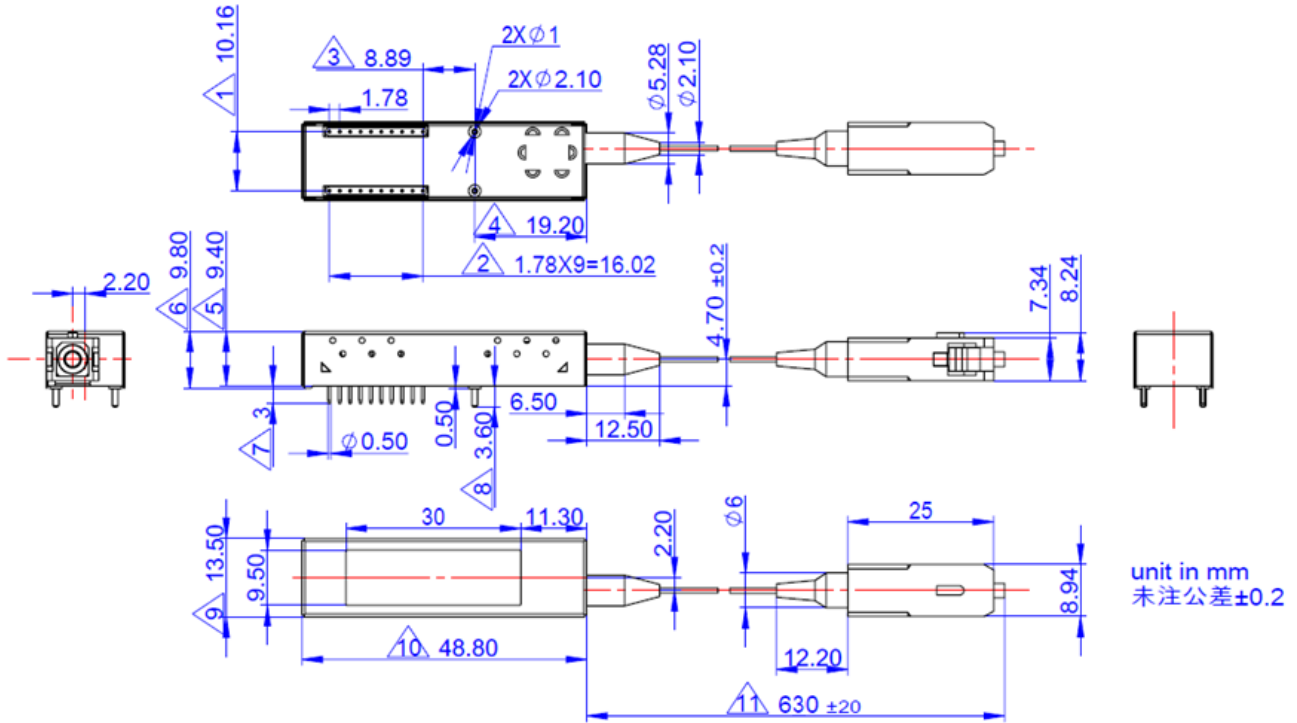


Figure 6

## Ordering information

| PART NO.        | Specifications |            |          |          |          |           |           |            |     |   |
|-----------------|----------------|------------|----------|----------|----------|-----------|-----------|------------|-----|---|
|                 | Type           | Rate Tx/Rx | Tx (nm)  | Po (dBm) | Rx (nm)  | Sen (dBm) | Temp (°C) | Reach (Km) | DDM | Others                                  |
| NOG22-D9I-ACT1  | SFF            | 1.25/2.5G  | 1310 DFB | 0.5~5    | 1490 APD | <-28      | -40~85    | 20         | Y   | SC/APC pigtail, High-Burst On, TD+/-:AC |
| NOG22-D9I-DCT1  | SFF            | 1.25/2.5G  | 1310 DFB | 0.5~5    | 1490 APD | <-28      | -40~85    | 20         | Y   | SC/APC pigtail, High-Burst On, TD+/-:DC |
| NOG22-LD9I-ACT1 | SFF            | 1.25/2.5G  | 1310 DFB | 0.5~5    | 1490 APD | <-28      | -40~85    | 20         | Y   | SC/APC pigtail, LOW-Burst On, TD+/-:AC  |
| NOG22-LD9I-DCT1 | SFF            | 1.25/2.5G  | 1310 DFB | 0.5~5    | 1490 APD | <-28      | -40~85    | 20         | Y   | SC/APC pigtail, LOW-Burst On, TD+/-:DC  |