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LTE3680M SFP GPON OLT Transceiver

CLASS B+ 2488/1244Mb/s With Digital RSSI Function

The LTE3680M is a low cost point-to-multipoint (P2MP) Fiber to the Home, Business or Curb (FTTX) GPON OLT transceiver. It is designed for 2488Mb/s downstream / 1244Mb/s upstream duplex data links that employ high-speed burst mode TDM receivers/transmitters. It is based on the ITU-T G.984.2 Class B+ specifications for bidirectional communications over a single fiber and incorporates a high performance 1310nm Burst Mode APD/TIA receiver and 1490nm CW mode DFB transmitter with internal optical isolator. The Burst Signal Detect (BSD), the Burst Mode Receiver Reset (Rx_RESET), Transmit Disable (Tx_DIS), Transmit Fault (Tx_FAULT) and the SFF-8472 I²C diagnostic interface monitor and control functions are LVTTTL compatible. The industry standard 2x10 small form pluggable (SFP) package incorporates the SC receptacle. It is fabricated with a rugged die cast metal housing and cage assembly. It is IEC 60825-1 Class I laser safety compliant and meets the EEC Directive 2002/95/EC for RoHS compliance.



Applications

- Access Networks
- Fiber to the Home, Curb, Office (FTTx)
- Point to Multi Point Service (P2MP)
- ITU-T G.984.2
- FSAN Class B+
- SFF-8472

Bidirectional Transceiver

- Dual Wavelength
- Single Fiber
- Full Duplex Operation
- Single 3.3V DC supply
- Low Power Consumption
- 2x10 SFP Package Outline
- Bail Latching Mechanism
- SC Optical Receptacle
- Rx Squelch
- Fast Rx SIGNAL DETECT
- G.984.2 Compliant

Downstream CW Mode Transmitter

- Data Rate: 2488Mb/s
- 1490nm DFB Laser
- Internal Optical Isolator
- LVTTTL Tx FAULT monitor
- LVTTTL Tx DISABLE control

Tx_DATA Electrical Characteristics

- LVPECL Differential Data Interface
- Internally AC Coupled & Terminated

Upstream Burst Mode Receiver

- Data Rate: 1244Mb/s
- BER<10⁻¹⁰, PRBS 2²³-1
- 1310nm APD/TIA Detector/Amplifier
- LVTTTL Rx RESET
- LVTTTL Rx BM Signal Detect (BSD)
- LVTTTL RSSI Trigger

Rx_DATA Electrical Characteristics

- LVPECL Differential Data Interface
- Internally DC Coupled

Case Operating Temperature Options:

- Commercial: 0 to 70°C
- Industrial: -40 to 85°C

I²C Digital Diagnostic Monitor

- LVTTTL Serial Data
 - Module Temperature
 - Supply Voltage
 - Laser Bias Current
 - Tx Optical Power Output
 - Digital RSSI
- LVTTTL Serial Clock

Recommended Operating Conditions

| Parameter | Symbol | Min | Typ | Max | Units |
|--|-------------------|-------|------|-------|-------|
| Case Operating Temperature | T _{case} | 0 | 25 | 70 | °C |
| | | -40 | 25 | 85 | °C |
| Module Supply Voltage | V _{CC} | 3.135 | 3.3 | 3.465 | V |
| Module Supply Current | I _{IN} | - | 350 | 500 | mA |
| Downstream Signaling Speed +/- 100 ppm | S _{down} | - | 2488 | - | Mb/s |
| Upstream Signaling Speed +/- 100 ppm | S _{up} | - | 1244 | - | Mb/s |

Ordering Information

| Part Number | Case Operating Temperature |
|-------------|----------------------------|
| LTE3680M-BC | 0 to 70 °C |
| LTE3680M-BH | -40 to 85 °C |

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LTE3680M SFP GPON OLT Transceiver**CLASS B+ 2488/1244Mb/s With Digital RSSI Function****Absolute Maximum Ratings**

| Parameter | Symbol | Min | Max | Units | Notes |
|---------------------------------------|-------------------|-----|-----|-------|---|
| Storage Ambient Temperature | T _{slg} | -40 | +85 | °C | Exceeding the Absolute Maximum Ratings may cause irreversible damage to the device. The device is not intended to be operated under the condition of simultaneous. Absolute Maximum Ratings, a condition which may cause irreversible damage to the device. |
| Industrial Case Operating Temperature | T _{case} | -40 | +85 | °C | |
| Commercial Case Operating Temperature | T _{case} | 0 | +70 | °C | |
| Relative Humidity - Storage | RH _S | 0 | 95 | % | |
| Relative Humidity - Operating | RH _O | 0 | 85 | % | |
| Module Supply Voltage | V _{CC} | 0 | 3.6 | V | |

Absolute Maximum Ratings: Control Function Logic Levels

| Parameter | Symbol | Min | Max | Units | Notes |
|---|----------|-----|----------------------|-------|----------------------------------|
| Transmit DISABLE Logic HIGH State | Tx_DIS | 0 | V _{CC} +0.5 | V | LVTTTL (Tx is OFF / DISABLED) |
| Transmit FAULT Logic HIGH State | Tx_FAULT | 0 | V _{CC} +0.5 | V | LVTTTL (Laser is OFF / FAULT) |
| BSD Logic HIGH State | BSD | 0 | V _{CC} +0.5 | V | LVTTTL |
| Receiver RESET Logic HIGH State | Rx_RESET | 0 | V _{CC} +0.5 | V | LVTTTL (Receiver is being RESET) |
| I ² C Serial Data Logic HIGH State | SDA | - | V _{CC} +0.5 | V | LVTTTL |
| I ² C Serial Clock HIGH State | SCL | - | V _{CC} +0.5 | V | LVTTTL |

Transmitter Electrical Specifications

| Parameter | Symbol | Min | Typ | Max | Units | Conditions / Notes |
|--|----------------------------------|-----|-----|----------------------|-------|----------------------------------|
| Tx_Data Differential Input Voltage | V _{IH} .V _{IL} | 200 | - | 1600 | mV | LVPECL Tx_DATA Electrical Signal |
| Tx_DIS = HIGH (Transmitter OFF / DISABLED) | V _{IH} | 2.2 | - | V _{CC} +0.3 | V | LVTTTL (Control INPUT) |
| Tx_DIS = LOW (Transmitter ON / ENABLED) | V _{IL} | 0 | - | 0.8 | V | LVTTTL (Control INPUT) |
| Tx_FAULT = HIGH (Laser OFF / FAULT) | V _{OH} | 2.4 | - | V _{CC} +0.3 | V | LVTTTL (Monitor OUTPUT) |
| Tx_FAULT = LOW (Laser ON / NORMAL) | V _{OL} | 0 | - | 0.4 | V | LVTTTL (Monitor OUTPUT) |

Receiver Electrical Specifications

| Parameter | Symbol | Min | Typ | Max | Units | Conditions / Notes |
|---------------------------------------|----------------------------------|-----|-----|-----------------------|-------|----------------------------------|
| Rx_Data Differential Output Voltage | V _{OH} .V _{OL} | 200 | - | 1600 | mV | LVPECL Rx_DATA Electrical Signal |
| BSD (Burst Signal Detect) = HIGH | V _{OH} | 2.0 | - | V _{CC} + 0.3 | V | LVTTTL |
| BSD (Burst Signal Detect) = LOW | V _{OL} | 0 | - | 0.8 | V | LVTTTL |
| Rx_RESET = HIGH (Receiver RESET) | V _{IH} | 2.2 | - | V _{CC} +0.3 | V | LVTTTL (Control Input) |
| Rx_RESET = LOW (Receiver ON / NORMAL) | V _{IL} | 0 | - | 0.8 | V | LVTTTL (Control Input) |

I²C Serial Logic

| Parameter | Symbol | State | Logic | Min | Max | Units |
|-------------------------------|--------|-------|--------|-----|----------------------|-------|
| I ² C Serial Data | SDA | HIGH | LVTTTL | 2.2 | V _{CC} +0.3 | V |
| | SDA | LOW | LVTTTL | 0 | 0.8 | V |
| I ² C Serial Clock | SCL | HIGH | LVTTTL | 2.2 | V _{CC} +0.3 | V |
| | SCL | LOW | LVTTTL | 0 | 0.8 | V |

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| Transmitter Optical Specifications | | | | | | |
|--|--------------------------------|------|------|------|-------|----------------------|
| Parameter | Symbol | Min | Typ | Max | Units | Conditions / Notes |
| Transmitter Type | 1490nm DFB Laser with Isolator | | | | | CW Mode |
| Downstream Signaling Speed | S_{down} | | 2488 | | Mb/s | |
| Average Launch Power (9/125 μ SMF) | P_{OUT} | 1.5 | - | 5.0 | dBm | |
| Average Launch Power with Tx OFF | P_{OFF} | - | - | -45 | dBm | |
| Optical Rise and Fall Time | t_r / t_f | - | 150 | 180 | ps | 20% to 80% |
| Optical Center Wavelength | λ | 1480 | 1490 | 1500 | nm | |
| Spectral Line Width @ -20 dB | $\Delta\lambda$ | - | - | 1.0 | nm | |
| Side Mode Suppression Ratio | SMSR | 30 | - | - | dB | |
| Extinction Ratio | ER | 8.2 | - | - | dB | |
| Output Eye | Compliant with G.984.2 | | | | | Data Rate = 2488Mb/s |

| Receiver Optical Specifications | | | | | | |
|---|---------------------------|---------------------|------|------|-------|---|
| Parameter | Symbol | Min | Typ | Max | Units | Conditions / Notes |
| Receiver Type | 1310nm APD/TIA Burst Mode | | | | | |
| Optical Signal Indicator | | Burst Packet Detect | | | | |
| Signaling Speed | S_{up} | | 1244 | | Mb/s | |
| Optical Center Wavelength | λ | 1260 | 1310 | 1360 | nm | |
| Receiver Sensitivity | P_{IN} | - | - | -28 | dBm | BER<10 ⁻¹⁰ , 1244Mb/s, PRBS 2 ²³ -1 |
| Receiver Optical Overload | $P_{IN}(SAT)$ | -8 | - | - | dBm | BER<10 ⁻¹⁰ , 1244Mb/s, PRBS 2 ²³ -1 |
| Maximum Input Optical Power | $P_{IN}(MAX)$ | - | - | 2 | dBm | Damage Threshold |
| Immunity from Continuous Identical Digits | CID | 72 | - | - | Bits | |
| Receiver Burst Mode Dynamic Range | - | 15 | - | - | dB | Input power difference between two subsequent high and low burst data |



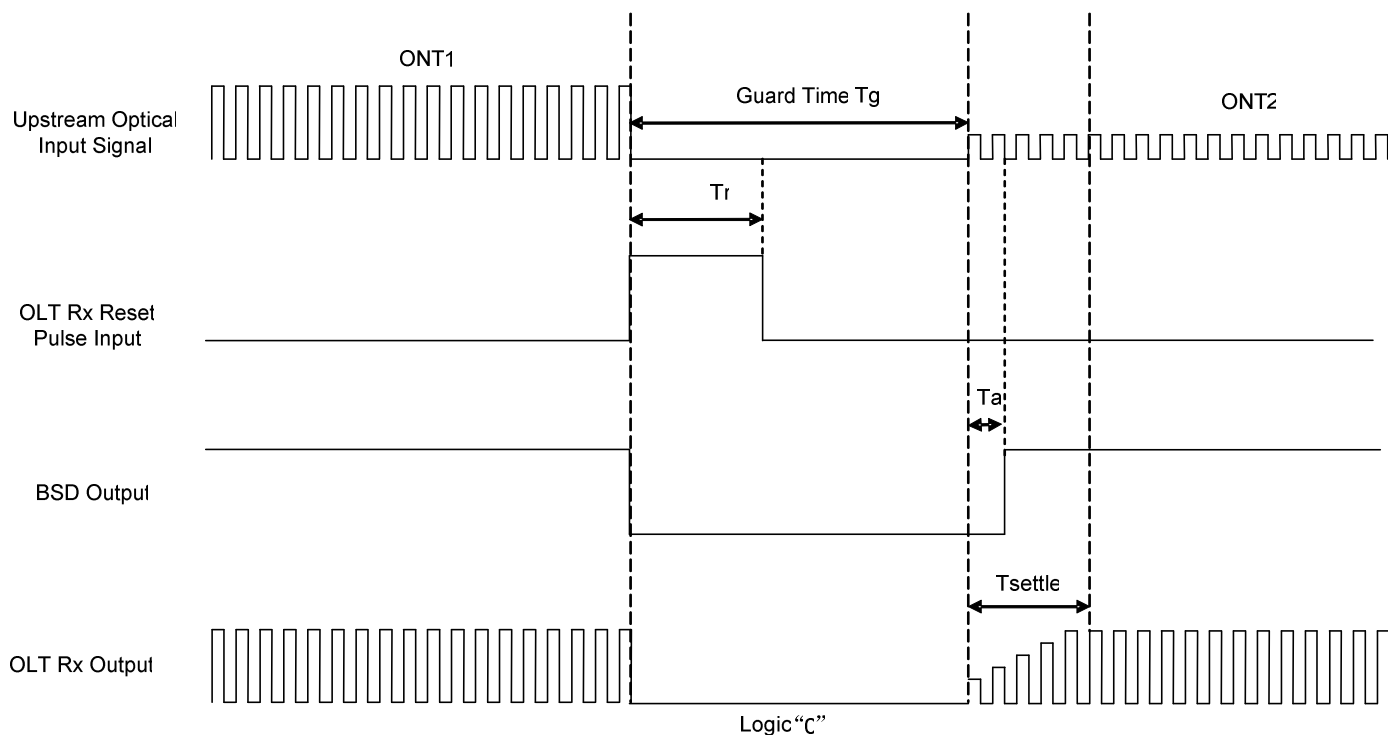
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CLASS B+ 2488/1244Mb/s With Digital RSSI Function

LTE3680M Timing Diagram



LTE3680M Timing Characteristics

| Parameter | Symbol | Min | Typ | Max | Units | Notes |
|-----------------------------|--------------|-----|-----|-----|-------|-------|
| Guard Time | T_g | 4 | - | - | Bytes | |
| RESET Pulse Width | T_r | 3 | 16 | - | Bits | 1 |
| Burst SIGNAL DETECT Assert | T_a | - | - | 5 | ns | 2 |
| BURST MODE Rx Settling Time | T_{settle} | - | - | 44 | Bits | |

Notes

1. The RESET signal should occur in the GUARD BAND time slot and commence immediately at the end of the ONT signal.
2. The Rx BURST MODE SIGNAL DETECT (BSD) asserts LOW when the RESET signal is applied; asserts HIGH when an incoming burst is detected and latches HIGH until the next RESET signal.



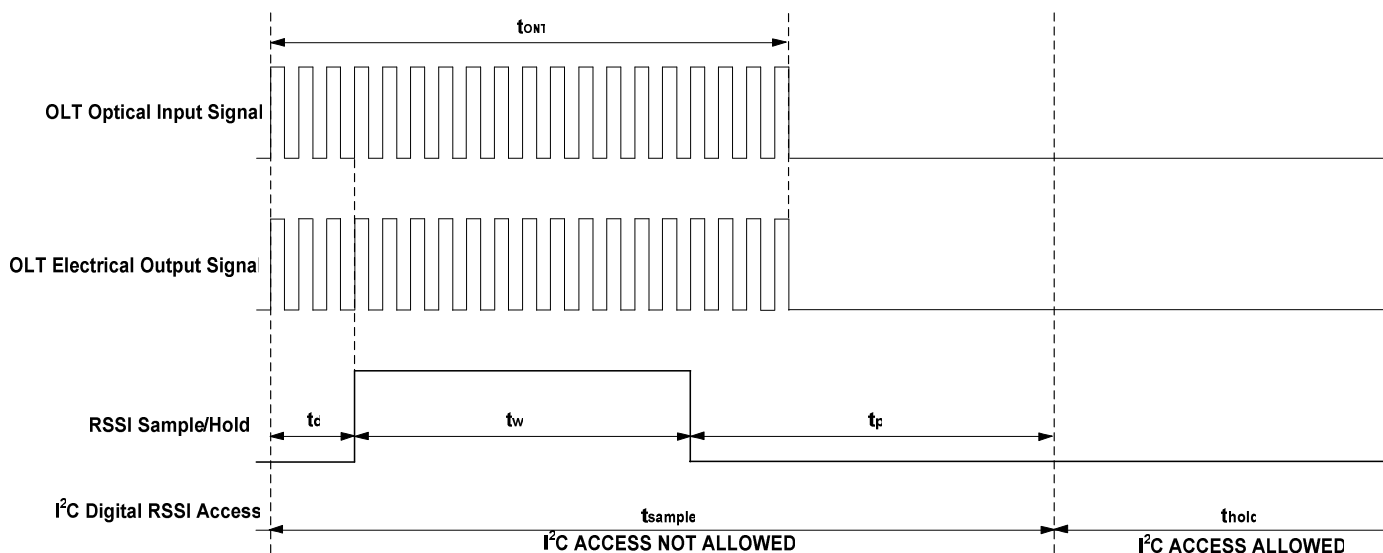
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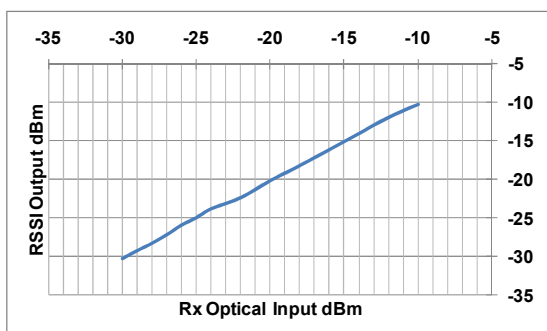
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CLASS B+ 2488/1244Mb/s With Digital RSSI Function

LTE3680M Digital RSSI Sample & Hold Timing Characteristics



I²C RSSI Output (typ) vs. Rx Optical Input (Tcase = +25°C)



Digital RSSI Characteristics

| Parameter | Symbol | Min | Typ | Max | Units |
|---|-----------|-----|------|-------------------|---------|
| Optical Input Signal Width | t_{ont} | 300 | - | - | ns |
| RSSI Trigger Delay | t_d | 0 | 6.4 | - | ns |
| RSSI Trigger Width | t_w | 300 | - | $(t_{ont} - t_d)$ | ns |
| I ² C Access "Invalid" Time Interval | t_p | - | - | 500 | μ s |
| RSSI Monitor Range | Pmon | -10 | - | -30 | dBm |
| RSSI Monitor Precision | Prssi | -2 | +/-1 | 2 | dB |

Digital RSSI Description

The RSSI function consists of a photo detector current mirror, sample/hold circuits, analog to digital converter (ADC) and embedded microcontroller (MCU). The RSSI provides digital data via the I²C data bus (SDA) to the host system at memory locations 104H and 105H on Page A2H.

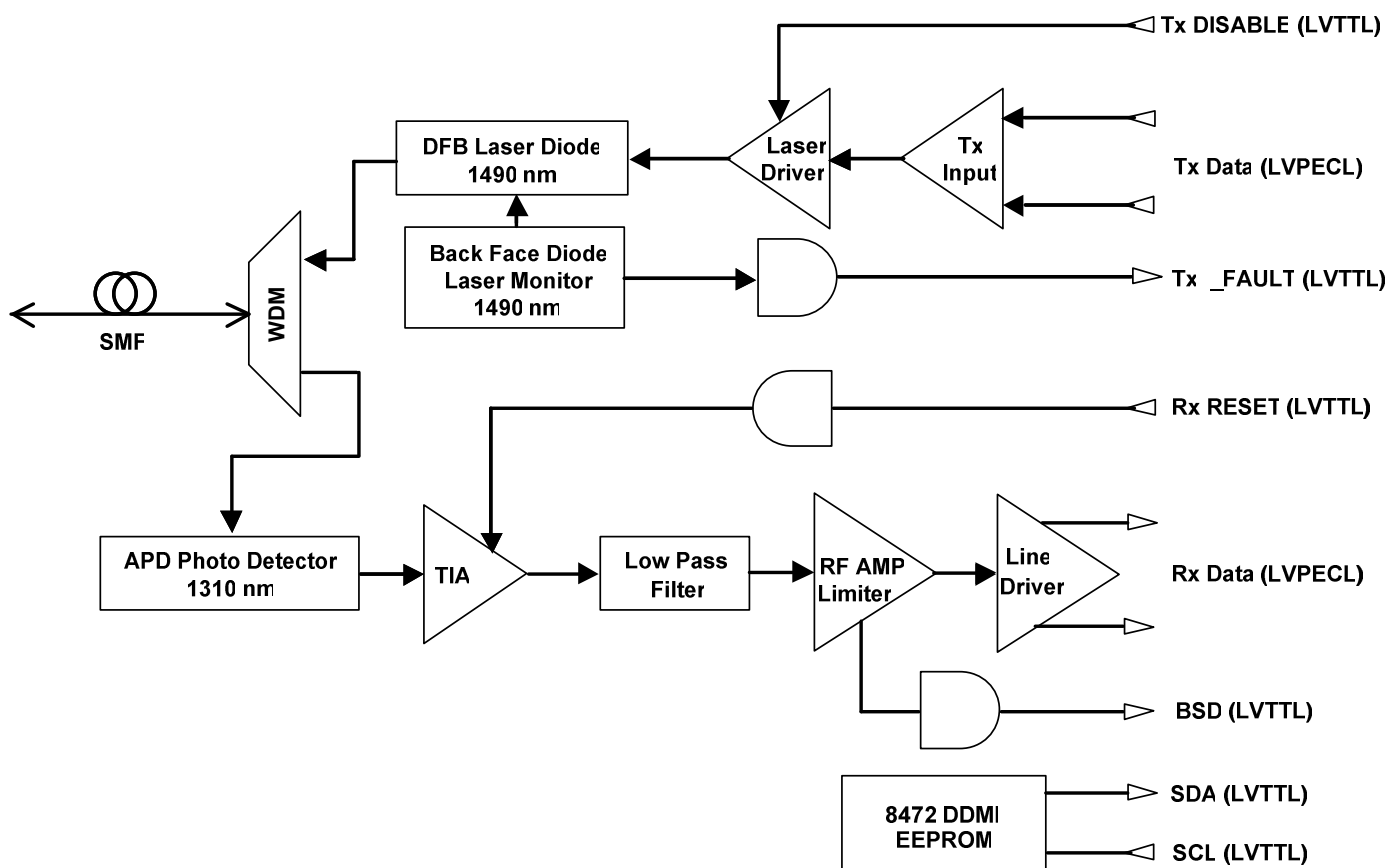
The three timing functions that control the flow of RSSI data include the RSSI Trigger Delay t_d , the RSSI Trigger Width t_w and the Data Transfer Interval t_p . The sum of $t_d + t_w + t_p = t_{sample}$ represents the timing interval where the RSSI data is being sampled and the I²C data is being updated. The RSSI Trigger Delay t_d is required to allow time for the electrical data to reach its steady state conditions. Attempting to read the RSSI data during the t_{sample} period will result in corrupt data. Terminating the sampling process early by pulling t_w LOW will result in corrupt data.

At the time the transceiver is powered ON the I²C RSSI memory registers are cleared to zero and t_w is held LOW. The RSSI data will not change until PON traffic is present and the system requests an update to the RSSI by pulling t_w HIGH after delay t_d .

The RSSI Trigger t_w performs the Sample (HIGH) and Hold (LOW) operations and are triggered by the rising and falling edges of t_w . The Data Transfer Interval t_p is the time required for the MCU to capture the ADC data, calculate the RSSI and output the data to the I²C memory registers at 104H and 105H.



LTE3680M Block Diagram



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LTE3680M SFP GPON OLT Transceiver**CLASS B+ 2488/1244Mb/s With Digital RSSI Function****Memory Map(Page 0xA0 HEX, Unlisted Fields are Blank/Empty, Memory is WRITE PROTECTED, SDA Communications is READ ONLY)**

| Address | Size (Byte) | Name of Field | Description | Values (HEX) |
|----------|-------------|----------------------------|--|-------------------------|
| 0 | 1 | Identifier | SFP | 03 |
| 1 | 1 | Ext. Identifier | Non Standard GBIC Interface | 04 |
| 2 | 1 | Connector | SC | 01 |
| 3-10 | 8 | Transceiver | OC-48 IR-2 | 00 0A 00 00 00 00 00 00 |
| 11 | 1 | Encoding | NRZ | 03 |
| 12 | 1 | BR, Nominal | 2488Mb/s | 19 |
| 13 | 1 | Reserved | 1244Mb/s | 0C |
| 14 | 1 | Length(9μm)-km | 20(units = km) | 14 |
| 15 | 1 | Length (9μm)-100m | 200(units = 100m) | 00 |
| 16 | 1 | Length (50μm)-10m | MMF Not Supported | 00 |
| 17 | 1 | Length (62.5μm)-10m | MMF Not Supported | 00 |
| 18 | 1 | Length (Copper) | Copper Not Supported | 00 |
| 19 | 1 | Reserved | | 00 |
| 20-35 | 16 | Vendor name | "Ligent Photonics" | ASCII Format |
| 36 | 1 | Reserved | | 00 |
| 37-39 | 3 | Vendor OUI | Programmed by Factory | Programmed by Factory |
| 40-55 | 16 | Vendor PN | The Part Number in the ordering information | ASCII Format |
| 56-59 | 4 | Vendor Rev No. | Programmed by Factory | Programmed by Factory |
| 60 to 61 | 1 | Tx Wavelength | Tx wavelength = 1490nm | 05 D2 |
| 62 | 1 | Reserved | Reserved | 00 |
| 63 | 1 | CC_BASE | Check sum of bytes 0-62 | Programmed by Factory |
| 64-65 | 2 | Transceiver Options | Rx_Los, Tx_Fault, Tx_Dis | 00 1A |
| 66 | 1 | BR, max | 20% | 14 |
| 67 | 1 | BR, min | 20% | 14 |
| 68-83 | 16 | Vendor SN | Programmed by Factory | Programmed by Factory |
| 84-91 | 8 | Date code | Year,Month,Day | Programmed by Factory |
| 92 | 1 | Diagnostic Monitoring Type | Compliant with SFF-8472 V9.3 Internally Calibrated Received power measurement type-Average Power | 68 |
| 93 | 1 | Enhanced Options | Optional Alarm/warning implemented Soft Tx_DISABLE,Tx_FAULT implemented | E0 |
| 94 | 1 | SFF-8472 Compliance | SFF-8472 V9.3 | 01 |
| 95 | 1 | CC_EXT | Check sum of bytes 64-94 | Programmed by Factory |
| 96-127 | 32 | Vendor Specific | Vendor Specific | Programmed by Factory |
| 128-255 | 128 | Vendor Specific | Vendor Specific | Programmed by Factory |



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DDMI A2 (HEX) Address Table for Alarm and Warning Data

| DDMI Parameter | Alarm Threshold Data | | | | Warning Threshold Data | | | | Measured Values | | Alarm Bit (Set) Address + Position | | Warning Bit (Set) Address + Position | |
|-------------------|----------------------|-----|-----------|-----|------------------------|-----|-----------|-----|-----------------|-----|---------------------------------------|---------|---|---------|
| | High Value | | Low Value | | High Value | | Low Value | | | | | | | |
| | MSB | LSB | MSB | LSB | MSB | LSB | MSB | LSB | MSB | LSB | High | Low | High | Low |
| Temperature | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 96 | 97 | 112 (7) | 112 (6) | 116 (7) | 116 (6) |
| Vcc | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 98 | 99 | 112 (5) | 112 (4) | 116 (5) | 116 (4) |
| Tx Bias | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 100 | 101 | 112 (3) | 112 (2) | 116 (3) | 116 (2) |
| Tx Power | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 102 | 103 | 112 (1) | 112 (0) | 116 (1) | 116 (0) |
| Rx Power | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 104 | 105 | 113 (7) | 113 (6) | 117 (7) | 117 (6) |



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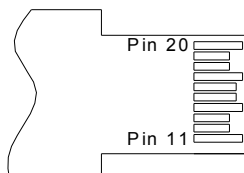
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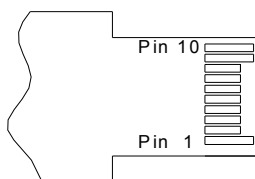
CLASS B+ 2488/1244Mb/s With Digital RSSI Function

Pin Assignment

TOP VIEW
OF BOARD



BOTTOM VIEW
OF BOARD



SFP Pin Assignment

| Pin | Symbol | Description | Notes |
|-----|------------------|---|--------------|
| 1 | V _{EET} | Transmitter Ground | |
| 2 | Tx_FAULT | Transmitter Fault, LOW = Normal Operation, HIGH = Fault Indication | Note 1 |
| 3 | Tx_DIS | Transmit Disable, LOW = Normal Operation, HIGH = Disables Module | Note 1 |
| 4 | MOD_DEF 2 | Module Definition 2 - Two-Wire Interface - Serial Data | Note 1 |
| 5 | MOD_DEF 1 | Module Definition 1 - Two-Wire Interface - Clock Signal | Note 1 |
| 6 | MOD_DEF 0 | Module Definition 0 - Two-Wire Interface Digital Ground | |
| 7 | Rx_RESET | RX Reset Pulse Input, High Level Input at the end of Previous Packet | |
| 8 | BSD | Burst Mode Signal Detect. Asserts HIGH at start of Burst Mode Packet. Asserts LOW at start of RESET Pulse | |
| 9 | RSSI_TRI | RSSI Trigger Input | |
| 10 | V _{EER} | Receiver Ground | |
| 11 | V _{EER} | Receiver Ground | |
| 12 | RD- | Rx_Data Output (Inverted) | Note 2 |
| 13 | RD+ | Rx_Data Output (Non Inverted) | Note 2 |
| 14 | V _{EER} | Receiver Ground | |
| 15 | V _{CCR} | Receiver DC Power | 3.3 V +/- 5% |
| 16 | V _{CCT} | Transmitter DC Power | 3.3 V +/- 5% |
| 17 | V _{EET} | Transmitter Ground | |
| 18 | TD+ | Tx_Data Input (Non Inverted) | Note 3 |
| 19 | TD- | Tx_Data Input (Inverted) | Note 3 |
| 20 | V _{EET} | Transmitter Ground | |

Notes

1. The uncommitted Tx_Fault, MOD_DEF 1 and MOD_DEF 2 LVTTTL monitor and control pins each require a pull up resistor of 4.7k to 10k Ohms
2. The 100 Ohm differential Rx Data output is internally DC coupled.
3. The 100 Ohm differential Tx Data input is internally AC coupled and terminated.



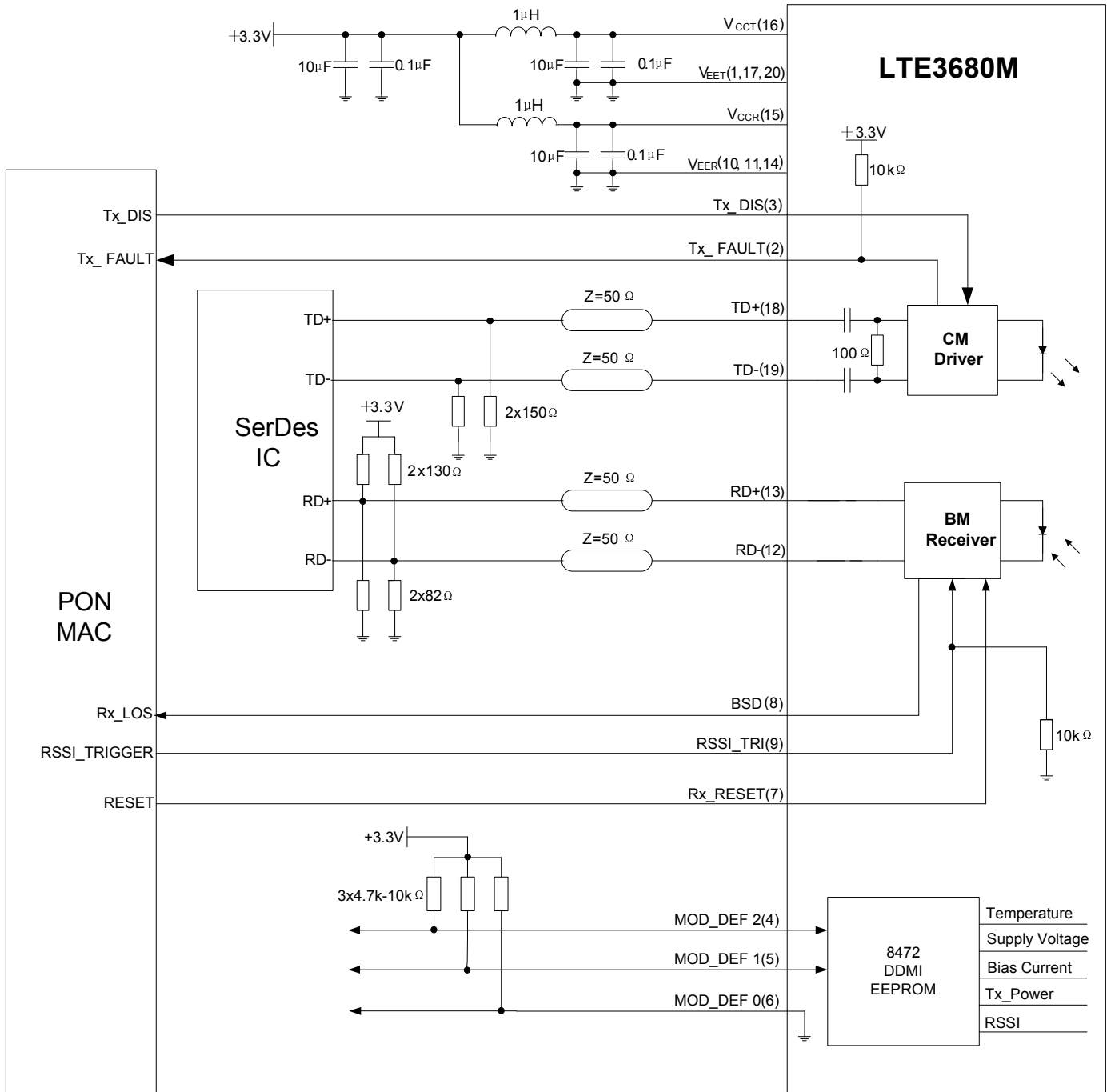
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Electrical Interface





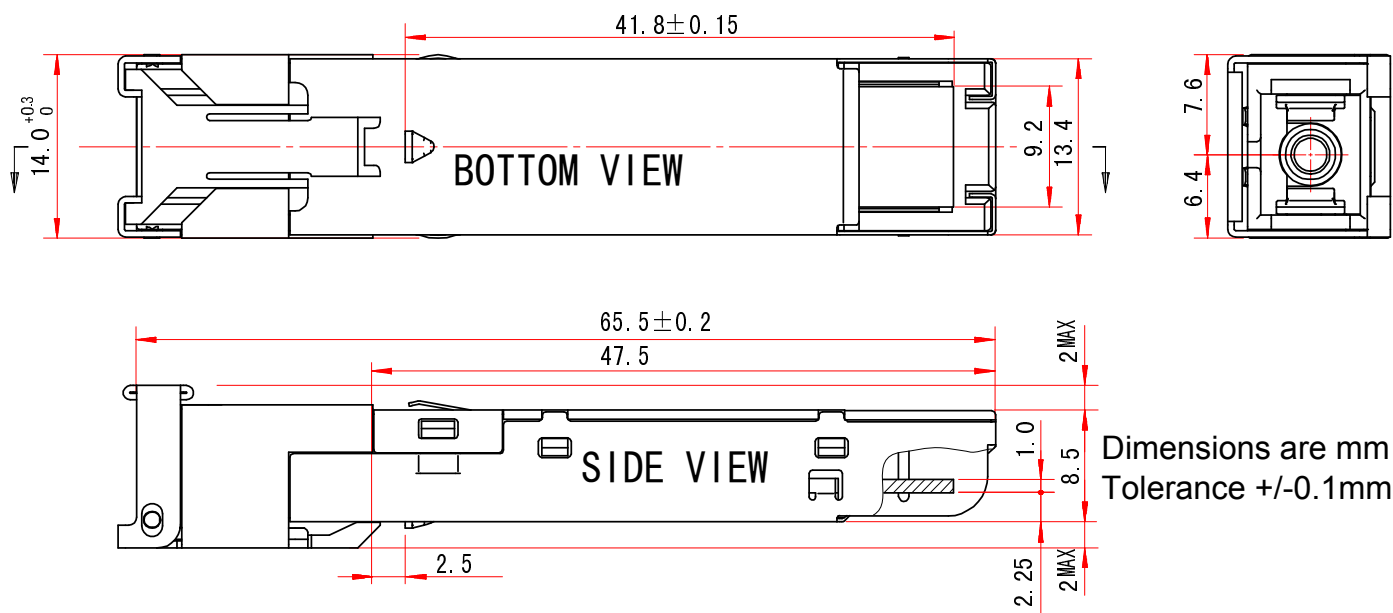
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LTE3680M SFP GPON OLT Transceiver

CLASS B+ 2488/1244Mb/s With Digital RSSI Function

Mechanical Dimensions



EYE SAFETY

The transceiver is a Class 1 eye-safe device according to FDA 21CFR1040.10 and 1040.11, IEC 60825-1 and IEC 60825-2.

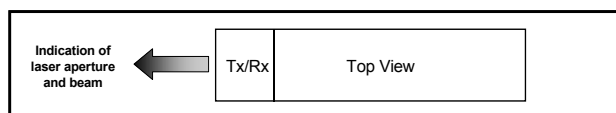
REQUIRED LABEL AND LASER EMISSION

This device is labeled in accordance with FDA and IEC requirements for laser safety.

ELECTROMAGNETIC INTERFERENCE (EMI), IMMUNITY AND PRODUCT SAFETY

The transceiver is ESD safe (electrical pins) when tested according to MIL-STD-883, Method 3015.4 and ESD safe (optical connector) when tested according to IEC 61000-4-2. The device is immune to strong RF fields when tested in accordance with IEC 61000-4-3. The device complies with (US) FCC, Part 15, Subpart J; (Europe) CENELEC EN 55022; (Canada) Class B (CISPR22A); and (Japan) VCCI Class 1. The device has been designed to conform to product safety requirements including UL1950, CSA 22.2, and IEC 60950, and has been designed to meet the flammability requirements of UL94.

REQUIRED LABEL



LASER EMISSION

| FDA | IEC |
|--|----------------------|
| Complies with 21 CFR 1040.10 and 1040.11 | Class 1 Laser Device |

NOTICE

The factory has made all adjustments to this device prior to shipment. No adjustments or modifications to the device are required or permitted. Any adjustment, modification or tampering of the device voids the product warranty. The US Food and Drug Administration may consider that any adjustment or modification to this device is an act of manufacturing and therefore will require that the device be recertified in accordance with 21 CFR 1040.10.

LASER RADIATION INFORMATION

| | |
|---|----------------|
| Wavelength | 1490nm |
| FDA Total Pout: 7mm aperture at 20 cm distance | < 195μwatts |
| IEC Total Pout : 7mm aperture at 10 cm distance | < 15,600μwatts |
| Beam Divergence | 17.25° |