



LTB3447 622 Mbps Tx / 155 Mbps Rx P2MP OLT 2x10 SFF B-PON Class C Transceiver

The LTB3447 is a low cost point to multi point (P2MP) Fiber to the Home, Business or Curb (FTTx) B-PON OLT transceiver. It is designed for 622.08 Mb/s downstream / 155.52 Mb/s upstream duplex data links that employ high-speed burst mode TDM receivers/transmitters. It is based on the ITU-TG.983.1 and G.983.3 specification for bidirectional communications over a single fiber and incorporates a high performance 1310 nm Burst Mode APD/TIA receiver and 1490 nm CW mode DFB transmitter. It is intended to serve up to 32 subscribers over distances of up to 20 km. The Receiver Signal Detect (Rx_SD), Transmit Disable (Tx_DIS), Transmit Fault (Tx_FAULT) and the Page A0 (HEX) I²C diagnostic interface (equivalent to SFP MSA specification) monitor and control functions are LVCMOS compatible. The high-speed Receiver Reset (Rx_RESET) control function is LVPECL compatible. The industry standard 2x10 small form factor (SFF) package incorporates a pigtail fiber with SC/APC or SC/UPC optical connector. It is fabricated with a rugged die cast metal housing and cage assembly and operates over the temperature range from 0°C to +75°C.



Applications

- Access Networks
- Fiber to the Home, Curb, Office (FTTx)
- Point to Multi Point Service (P2MP)
 - Up to 20 km Reach (32:1 Split)
 - Class C FSAN B-PON OLT

Features

- Dual Wavelength Bidirectional Transceiver
- 622.08 Mb/s Downstream
- 155.52 Mb/s Upstream
- BER<10⁻¹⁰, 155 Mb/s, PRBS 2²³-1
- 1310 nm APD/TIA Burst Mode Receiver
- 1490 nm CW Mode DFB Laser
- ITU-G.983.1 and G.983.3 Complaint
- Single 3.3 Volt DC supply
- Low Power Consumption
- 2x10 SFF Package Outline
- Single Fiber, Full Duplex Operation
- Fiber Pigtail with Optional Optical Connector
- 0°C to 75°C Operating Temperature Range

Tx DATA

- LVPECL Differential Data Interface
- Internally AC Coupled and Terminated

Rx DATA

- LVPECL Differential Data Interface
- Internally DC Coupled

LVCMOS Monitor and Control Interfaces

- Rx Signal Detect
- Tx Disable
- Tx Fault
- I²C Serial Data (Page A0 HEX)
- I²C Serial Clock
- LVPECL Differential Control Interface
- Rx RESET

Recommended Operating Conditions

Parameter	Symbol	Min	Typ	Max	Units
Ambient Operating Temperature	T _{amb}	0	25	75	°C
DC Supply Voltage	V _{CC}	3.135	3.3	3.465	Volts
Module Supply Current	I _{IN}	-	200	250	mA
Module Power Dissipation	P _D	-	660	850	mW
Downstream Signaling Speed +/- 100 ppm	Sdown	-	622.08	-	Mb/s
Upstream Signaling Speed +/- 100 ppm	Sup	-	155.52	-	Mb/s
Useful Reach (32:1 Split)	D	-	20	-	km

Ordering Information

Part Number	Package Option (X)	Pigtail Length
LTB3447 X	A Pigtail, no connector	1000 ± 30 mm
	B Pigtail, SC/APC	1000 ± 30 mm (Includes Connector)
	C Pigtail, SC/PC	1000 ± 30 mm (Includes Connector)



Absolute Maximum Ratings					
Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	T_{stg}	-40	+85	°C	Exceeding the Absolute Maximum Ratings may cause irreversible damage to the device.
Operating Temperature	T_O	0	+75	°C	
Relative Humidity - Storage	RH_S	0	95	%	
Relative Humidity - Operating	RH_O	0	85	%	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.
DC Supply Voltage	V_{CC}	0	3.6	V	
Soldering Temperature	T_{slid}	0	260	°C	
Soldering Duration	t_{slid}	0	10	sec	

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	LVC MOS
Transmit FAULT Logic HIGH State	Tx_FAULT	0	$V_{CC}+0.5$	V	LVC MOS
Receiver SIGNAL DETECT Logic HIGH State	Rx_SD	0	$V_{CC}+0.5$	V	LVC MOS
Receiver RESET Logic HIGH State	Rx_RESET	0	$V_{CC}+0.5$	V	LVPECL
I ² C Serial Data Logic HIGH State	SDA	-	$V_{CC}+0.5$	V	LVC MOS
I ² C Serial Clock HIGH State	SCL	-	$V_{CC}+0.5$	V	LVC MOS

Transmitter Electrical Specifications						
Parameter	Symbol	Min	Typ	Max	Units	Conditions / Notes
Tx DC Supply Current	I_{CC}	-	-	150	mA	
Tx_Data Differential Input Voltage	V_{IH}, V_{IL}	300	-	1900	mV p-p	LVPECL Tx_DATA Electrical Signal
Tx_DIS = HIGH (Transmitter ON / ENABLED)	V_{IH}	2.0	-	$V_{CC}+0.3$	V	LVC MOS (Control INPUT)
Tx_DIS = LOW (Transmitter OFF / DISABLED)	V_{IL}	0	-	0.8	V	LVC MOS (Control INPUT)
Tx_FAULT = HIGH (Laser OFF / FAULT Condition)	V_{OH}	2.0	-	$V_{CC}+0.3$	V	LVC MOS (Monitor OUTPUT)
Tx_FAULT = LOW (Laser ON / NORMAL)	V_{OL}	0	-	0.8	V	LVC MOS (Monitor OUTPUT)

Receiver Electrical Specifications						
Parameter	Symbol	Min	Typ	Max	Units	Conditions / Notes
Rx DC Supply Current	I_{RX}	-	-	125	mA	Not Including the Output Load Current
Rx_Data Differential Output Voltage	V_{IH}, V_{IL}	600	-	1900	mV p-p	LVPECL Rx_DATA Electrical Signal
Rx_SD = HIGH (Receiver ON / NORMAL)	V_{OH}	2.0	-	$V_{CC}+0.3$	V	LVC MOS (Monitor OUTPUT)
Rx_SD = LOW (Receiver OFF / LOSS OF SIGNAL)	V_{OL}	0	-	0.8	V	LVC MOS (Monitor OUTPUT)
Rx_RESET = HIGH (Receiver RESET)	V_{IH}	$V_{CC}-1.165$	-	$V_{CC}-0.88$	V	LVPECL (Control Input)
Rx_RESET = LOW (Receiver ON / NORMAL)	V_{IL}	0	-	0.8	V	LVPECL (Control Input)
Rx_RESET Differential Control Voltage	V_{p-p}	150	-	1100	mV p-p	Differential Control Voltage

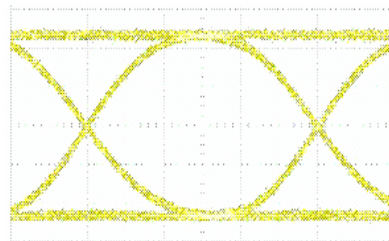
I ² C Serial Logic						
Parameter	Symbol	State	Logic	Min	Max	Units
I ² C Serial Data	SDA	HIGH	LVC MOS	2.0	$V_{CC}+0.3$	V
	SDA	LOW	LVC MOS	0	0.8	V
I ² C Serial Clock	SCL	HIGH	LVC MOS	2.0	$V_{CC}+0.3$	V
	SCL	LOW	LVC MOS	0	0.8	V



Transmitter Optical Specification						
Parameter	Symbol	Min	Typ	Max	Units	Conditions / Notes
Transmitter Type		1490 nm DFB CW Mode				
Average Output Power (9/125 μ SMF)	P _{out}	0	-	4	dBm	
Optical Output with Tx OFF	P _{out}	-	-	-45	dBm	
Optical Rise and Fall Time	t _r / t _f	-	500	600	ps	20% to 80%
Tx 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	10	-	-	dB	
Relative Intensity Noise	RIN	-	-	-118	dB/Hz	
Optical Return Loss	RL	-	-	15	dB	
Total Jitter	T _J	-	-	0.2	UI	
Optical Cross Talk	C _{RT}	-	40	-	dB	

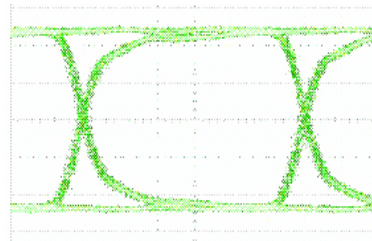
Receiver Optical Specifications						
Parameter	Symbol	Min	Typ	Max	Units	Conditions / Notes
Receiver Type		1310 nm APD/TIA Burst Mode				
Optical Signal Indicator		Signal Detect				
Wavelength	λ	1260	1310	1360	nm	
Received Optical Power	P _{in}	-33	-	-8	dBm	BER<10 ⁻¹⁰ , 155 Mb/s, PRBS 2 ²³ -1
Maximum Input Optical Power	P _{in(max)}	-	-	-8	dBm	
Receiver Reflectance	RFL	-	-	-20	dB	
Receiver Settling Time	t _{rx}	-	-	200	ns	
Rx_Signal Detect Assert	P _a	-42	-	-33	dBm	
Rx_Signal Detect Deassert	P _d	-42.5	-	-33.5	dBm	
Rx_Signal Detect Hysteresis	P _{hy}	0.5	-	5	dB	
Rx_Signal Detect Settling Time	P _t	-	1.12	-	μ s	

Eye Diagram



Transmitter Test Conditions

- Optical Output Power = 0 dBm
- Test Pattern = 2²³-1 NRZ PRBS



Receiver Test Conditions

- Optical Input Power = -20 dBm
- Test Pattern = 2²³-1 NRZ PRBS



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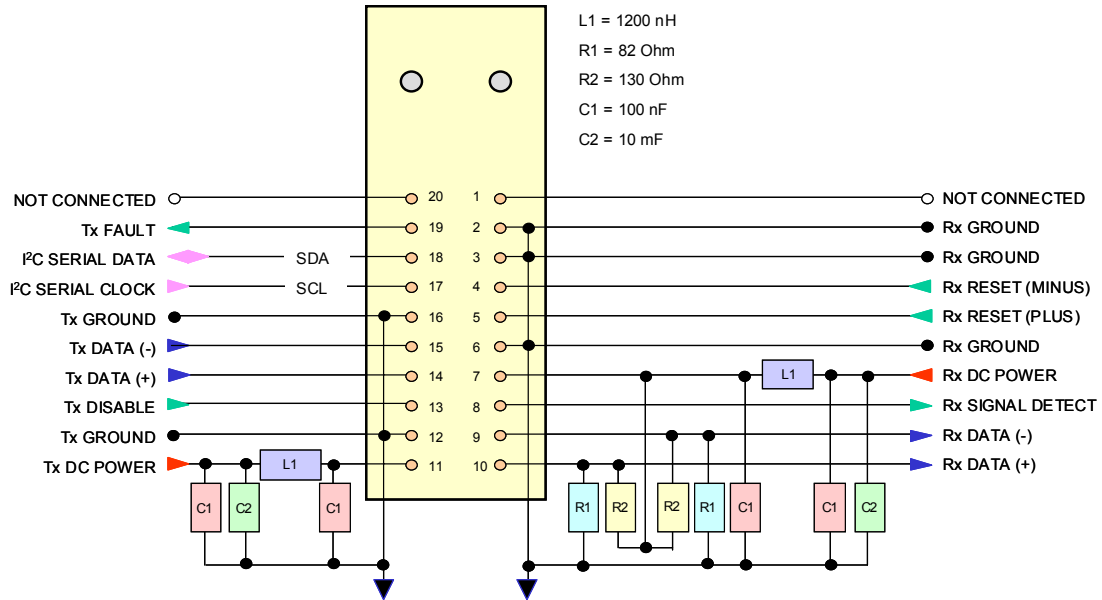
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LTB3447 622 Mbps Tx / 155 Mbps Rx P2MP OLT 2x10 SFF B-PON Class C Transceiver

LTB3447 I2C Memory Map (Page A0 HEX, UNLISTED FIELDS ARE BLANK / EMPTY)							
Address		Memory Contents		Description	Name of Field	SFP MSA Reference	Notes
Decimal	HEX	ASCII	HEX				
0	00	002	02	Module is soldered to PCB	Identifier	Table 3.2	
1	01	004	04	Non Standard GBIC Interface	Extended Identifier	Table 3.3	
2	02	128	80	Pigtail Fiber with SC/PC Connector	Connector Values	Table 3.4	LTB3447 C
2	02	129	81	Pigtail Fiber with SC/APC Connector	Connector Values	Table 3.4	LTB3447 B
2	02	130	82	Pigtail Fiber without Connector	Connector Values	Table 3.3	LTB3447 A
4	04	016	10	Intermediate Reach	Transceiver Codes	Table 3.5a	
5	05	032	20	OC-12 Intermediate Reach	Transceiver Codes	Table 3.5	
11	0B	003	03	NRZ Encoding	Encoding Codes	Table 3.6	
12	0C	006	06	Nominal 622 Mb/s Data Rate	Nominal Bit Rate		
14	0E	020	14	Link Length in km Units = 20	9 micron fiber length		
15	0F	200	C8	Link Length in 100 m Units = 200	9 micron fiber length		
20 to 35	14 to 23	XXX	XX	Vendor Name	"Ligent Photonics"		ASCII Format
40 to 48	28 to 30	XXX	XX	Vendor Part Number	"LTB3447 X"		ASCII Format
56 to 59	37 to 3B	XX	XX	Vendor Revision Number	Revision 1.1		
60	3D	014	0E	Wavelength = 1490 nm			
61	3E	090	5A	Wavelength = 1490 nm			
65	41	28	1C	Tx_DIS, Tx_FAULT, Rx_SD	Option Values	Table 3.6	
66	42	20	14	Maximum Bit Rate Tolerance			
67	43	20	14	Minimum Bit Rate Tolerance			
68 to 83	44 to 53	XXX	XX	Vendor Serial Number	Ligent Serial Number		
84 to 91	54 to 5B	XXX	XX	Vendor Date Code	Ligent Date Code		



LTB3447 2x10 SFF Interface (Bottom View)



2x10 SFF PIN ASSIGNMENT

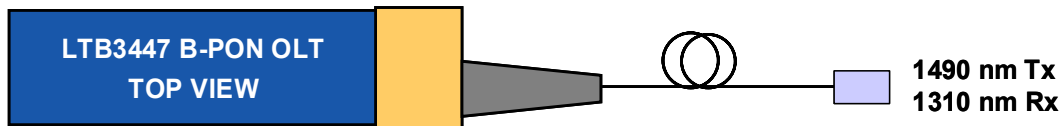
Pin	Symbol	Description	Pin	Symbol	Description
1	N/C	Not Connected	20	N/C	Not Connected
2	V _{EER}	Receiver Ground	19	Tx_Fault	Transmitter Fault (LVCMOS)
3	V _{EER}	Receiver Ground	18	SDA	I2C Serial Data (LVCMOS)
4	Rx_RESET (-)	Differential (Minus) Receiver Burst Mode Reset (LVPECL)	17	SCL	I2C Serial Clock (LVCMOS)
5	Rx_RESET (+)	Differential (Plus) Receiver Burst Mode Reset (LVPECL)	16	V _{EET}	Transmitter Ground
6	V _{EER}	Receiver Ground	15	TD-	Tx_DATA Inverted Differential Input (AC-Coupled)
7	V _{CCR}	Receiver +3.3 VDC Power Supply	14	TD+	Tx_DATA Non Inverted Differential Input (AC-Coupled)
8	Rx_SD	Receiver SIGNAL DETECT (LVCMOS)	13	Tx_DIS	Transmit Disable (LVCMOS)
9	RD-	Rx_DATA Inverted Differential Output DC-Coupled)	12	V _{EET}	Transmitter Ground
10	RD+	Rx_DATA Non Inverted Differential Output (DC-Coupled)	11	V _{CC1}	Transmitter +3.3 VDC Power Supply
Mounting Posts	The mounting posts are provided for mechanically attaching the transceiver to the circuit board. They should not be connected to the circuit ground but can be connected to the chassis ground.				
Housing Leads	The housing leads should be connected to circuit ground				



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LTB3447 622 Mbps Tx / 155 Mbps Rx P2MP OLT 2x10 SFF B-PON Class C Transceiver



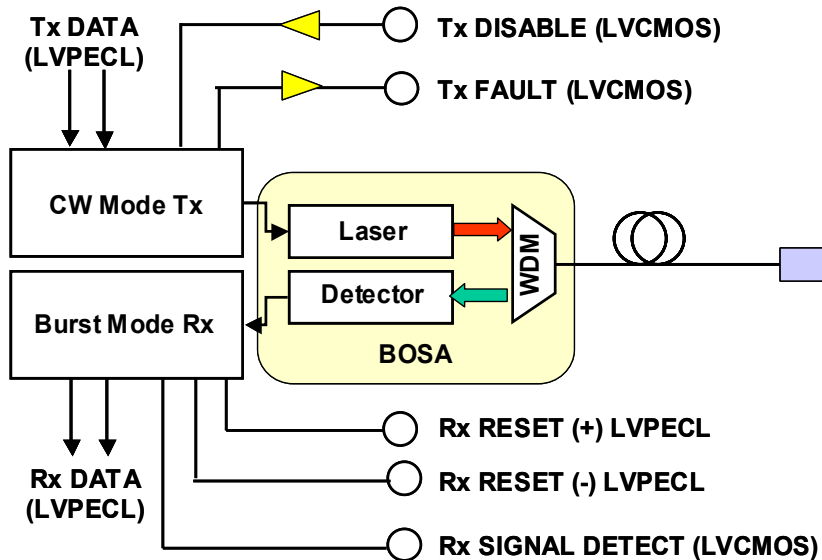
Applications Information

The LTB3447 is designed for B-PON OLT service. It contains an Upstream Burst Mode Optical Receiver operating in the 1310 nm wavelength band and an Downstream Continuous Mode Optical Transmitter operating in the 1490 nm wavelength band. The optical transmitter and the optical receiver are coupled to a single fiber via an internal optical wave division multiplexer. The optical transmitter, the optical receiver and the optical wave division multiplexer are manufactured as a single unit and is known as the BOSA or bidirectional optical assembly. In order to improve signal bandwidth, noise performance, dynamic range and high-speed operation the trans-impedance amplifier is mounted in the optical section of the BOSA.

The optical transmitter consists of a 1490 nm distributed feedback laser (DFB) with a back facet monitor diode. The purpose of the back facet monitor diode is to produce an electrical signal that is proportional to the light output of the laser. The light output of the DFB laser changes as a function of operating temperature and operating life. In order to keep the light output of the laser relatively constant over all operating conditions, the electrical signal developed by the back facet monitor diode is used as part of an overall control system., which also monitors the laser operating temperature and the laser current. The automatic power control system (APC) assures that the DFB laser is operating at peak efficiency under all operating conditions.

The electrical signal supplied by the MAC/PHY system interface to the AC-Coupled Tx DATA input lines of the LTB3447 is a differential voltage compatible with standard LVPECL. The LTB3447 inputs the differential voltage and converts the signal such that it can modulate the DFB laser. The transmitter has a monitor and a control feature to provide additional functionality to the system. The Tx DISABLE function is under the control of the MAC/PHY system and can switch the transmitter ON or OFF depending on a number of system requirements. The Tx FAULT function is a monitor function that will shut down the transmitter if a major fault occurs within the DFB laser and APC controller. For example, if the maximum current or the maximum temperature of the laser is exceeded the Tx FAULT function will shut down the transmitter. The Tx FAULT will latch when a fault occurs effectively locking out the transmitter. To RESET the transmitter, the Tx DISABLE line can be toggled from ON to OFF whereby the Tx FAULT will RESET to the NORMAL state. If the FAULT condition is still in effect, the Tx FAULT will lock out the transmitter. It is also possible to REST the Tx FAULT by switching off the DC power to the transceiver. When the DC voltage is re-applied, the logic states RESET to normal operating conditions. If the Tx FAULT is still active, the Tx FAULT will lock out the transmitter. In a PON system a provision should be made at the MAC/PHY layer to avoid constant recycling of the TX FAULT line in those cases where there is a permanent fault in the transmitter. The Tx DISABLE control function does not latch. The Tx DISABLE and Tx FAULT lines are LVCMOS compatible.

The DC-Coupled electrical signal output by the Rx DATA lines of the LTB3447 to the MAC/PHY system interface are interrupted by a periodic RESET pulse, which is under the control of the MAC/PHY. The optical signal input to the photo detector and TIA of the BOSA are output to signal conditioning circuits that convert the single-ended RF signal to a differential LVPECL voltage capable of driving the MAC/PHY interface. Since the LTB3447 Rx DATA lines are DC-Coupled, it is necessary to provide the appropriate LVPECL termination.



The Burst Mode Receiver has a monitor and a control function. The LVCMOS Rx SIGNAL DETECT monitor function will DE-ASSERT if there is no light arriving at the receiver. If light is present the Rx SIGNAL DETECT line will automatically ASSERT itself. The Rx SIGNAL DETECT has been adjusted to have a relatively long time constant to avoid false setting of the RX SIGNAL DETECT line in those cases where a long string of optical "zeros" is present. The Rx SIGNAL DETECT time constant is internally set to approximately 1 microsecond. The Rx SIGNAL DETECT monitor function has hysteresis, that is, the amount of light required to disable the Rx SIGNAL DETECT function is different than the amount of light required to enable the Rx SIGNAL DETECT function. The hysteresis range is 0.5 to 5.0 dB.

The Burst Mode RESET function is differential LVPECL in order to achieve the fast switching time required by the B-PON system. The duration and timing of the RESET pulse is determined by the MAC/PHY interface. The LTB3447 has been designed to operate with a fast reset pulse.

B-PON System

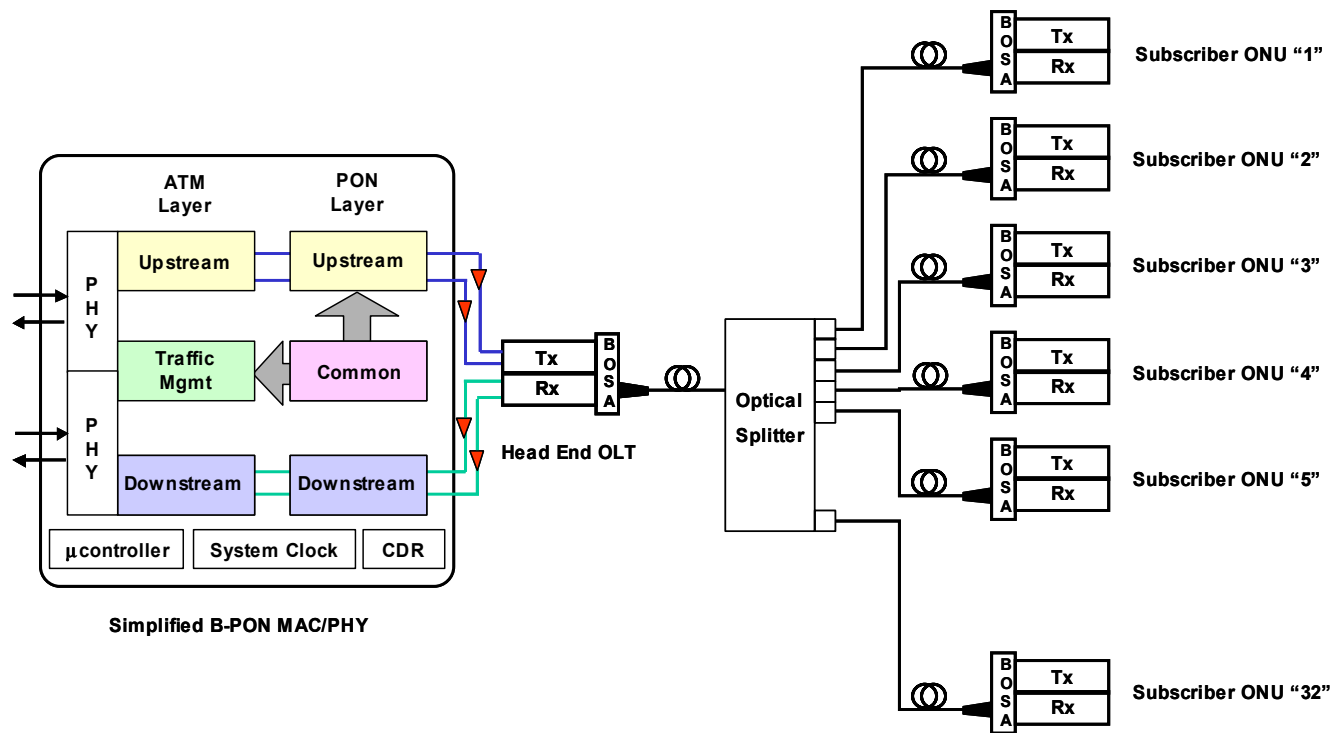
This section is not intended to be a complete description of the B-PON system, rather it provides the reader with some basic information about how the B-PON interacts with the LTB3447 OLT transceiver. The OLT transceiver provides the optical to electrical interface between the OLT head end and the subscriber ONU terminal equipment. The OLT transceiver is virtually protocol agnostic in that the electrical or optical data passes through the device without the device acting upon the data flowing through it. However, the OLT transceiver does perform two important functions that contribute to the overall efficiency of the B-PON system:

- (1) As the optical data from each ONU is received at the OLT, the transceiver adjusts the magnitude of the received electrical signal such that the electrical output at the Rx DATA ports falls within a narrow range. The function of adjusting the amplitude of the received signal is called the automatic gain control or AGC.
- (2) The OLT receives information from up to 32 subscribers. The continuous sequence of data arriving from the subscribers is gated by a RESET pulse from the MAC/PHY. The timing of the RESET pulse is critical to maintaining a constant data throughput.



In order to understand the Burst Mode Timing operation of the OLT transceiver it is necessary to have a basic understanding of the B-PON system. Time slots are allocated to each subscriber or optical network unit (ONU). The OLT transmitter operates in the "broadcast mode" by sending the same information to all subscribers in the node (up to 32 subscribers), a point-to-multi-point system. To assure the integrity of the signal, the B-PON system makes some adjustments when the system is initialized as described in the following section.

In the B-PON system, the Downstream traffic is broadcast to all subscribers and the Upstream traffic from each subscriber is gated according to a time division multiplexing (TDM) scheme. Data packets addressed to the individual subscriber are received while all others are ignored.



If the OLT is serving 32 subscribers (for example), the round trip time for a packet of data will differ according to the actual length of fiber between the OLT head end equipment and each individual subscriber. Since timing is critical to the successful operation of the B-PON system, it is necessary to introduce a phase correction for each subscriber such that all packets arriving at the OLT have the exact same timing phase. The B-PON specification refers to the time division multiplexing equalization as "ranging". Each subscriber ONU controller is programmed to delay the Upstream signal by a specified amount such that all packets arriving at the OLT have exactly the same phase. The accuracy of the timing is assured by a stable reference clock at the B-PON MAC/PHY interface.

In the B-PON system, the time division multiplexing is scrambled according to a fixed algorithm, which changes for every Tx or Rx Time Slot. The OLT does not poll the subscriber units in a fixed sequence but rather in a sequence determined by the TDM algorithm. This scrambling of the data packets provides a low level of security to the system.



In order that the B-PON OLT and ONU transceivers can communicate with each other, the system controller end must provide the subscriber terminal with information about ranging, the TDM sequence, "grants" and other important system parameters. This is accomplished by sending the state information to each subscriber in a 53-byte PLOAM cell (physical layer operations, administration and maintenance). The PLOAM cell is the first cell of data in either a 155 Mb/s or a 622 Mb/s B-PON Downstream packet stream. Without the ranging parameter, collisions of packets could occur thereby rendering the received data useless. A "grant" is permission given to the ONU to transmit data to the OLT.

B-PON Data Packets

The Upstream data rate for a B-PON is normally 155.52 Mb/s. The Downstream data rate can be either 155.52 MB/s or 622.08 Mb/s. The higher data rate enables four times more data to be transmitted to the subscriber's ONU. The time slot description for a Downstream set of packets for both 155.52 Mb/s and 622.08 Mb/s data rates is presented in the table "B-PON Downstream Time Slots".

For completeness, the architecture of the 155.52 Mb/s and the 622.08 Mb/s is slightly different.

1. In the 155.52 Mb/s time slot, ATM cells 1 through 27 are addressed in two frames. Each frame contains a PLOAM cell, so the actual number of cells is $(2 \times \text{PLOAM}) + (2 \times 27 \text{ ATM}) = 56$ cells. The two frames equal a single Time Slot.
2. In the 622.08 Mb/s time slot, ATM cells 1 through 216 are addressed in serial order. Each group of 27 ATM cells is preceded by a PLOAM cell, so the actual number of cells is $(1 \times \text{PLOAM} + 27 \times \text{ATM}) = 28$ cells. There are 8×28 "PLOAM +ATM" cells in a single Time Slot for a total of 224 cells of which 216 cells are ATM and 8 cells are PLOAM. A single frame is therefore consists of a PLOAM cell and 27 ATM cells.

B-PON Downstream Time Slots							
Data Rate	Bit Width	Bits / Byte	Bytes per Cell	Bits per Cell	Cell Time	Frame Length	Time Slot
	= 1 / DR	Definition	Definition	= (8 x 53)	= BW x Bits/Cell	Definition	= Cell Time x Cells
155.52 Mb/s	6.43 ns	8	53	424	2726.32 ns	56 Cells x 53 Bytes	152673.92 ns
622.08 Mb/s	1.6075 ns	8	53	424	681.58 ns	(4x56) Cells x 53 Bytes	152673.92 ns

The B-PON Upstream data is organized slightly differently than the Downstream data because it is necessary for the system controller to discover the packets arriving for each subscriber. The Upstream data arriving at the OLT transceiver operates in Burst Mode. However, the stream of bits arriving at the OLT transceiver is continuous. A RESET pulse sent to the OLT transceiver is also sent to the MAC/PHY such that the synchronization of data arriving at the MAC/PHY can be properly decoded. Three bytes are inserted in front of each arriving data packet: the Guard bytes, the Preamble bytes and the Delimiter bytes. This configuration reduces the data throughput of the receiver slightly due to the addition of the extra bytes. Whereas the Downstream packets contain 56 cells or (4×56) cells, the addition of the extra bytes to the Upstream data reduces the number of packets to 53. The table on the next page shows how the Time Slot for the Upstream data is calculated. The Time Slots for Upstream or Downstream data are identical. Therefore the Tx/Rx duty cycle is 50 percent and the Time Slot repetition rate is approximately 655 KHz/s.

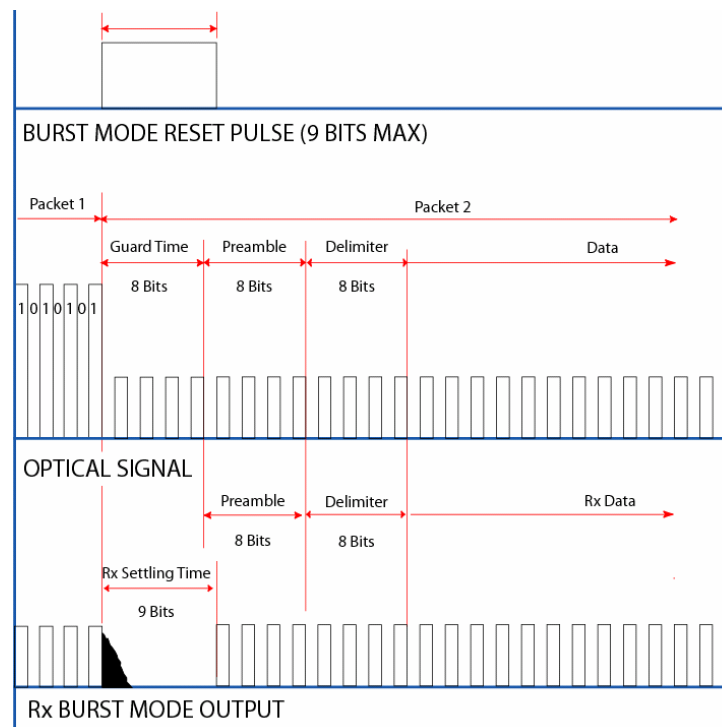


B-PON Upstream Time Slots							
Data Rate	Bit Width	Bits / Byte	Bytes per Cell	Bits per Cell	Cell Time	Frame Length	Time Slot
	= 1 / DR	Definition	Definition	= (8 x 56)	= BW x Bits/Cell	Definition	= Cell Time x Cells
155.52 Mb/s	6.43 ns	8	56	448	2880.64 ns	53 Cells x 56 Bytes	152673.92 ns

The Guard, Preamble and Delimiter bits are part of the decoding sequence sent by each ONU to the OLT:

1. Guard Bits provide sufficient space between consecutive cells to avoid collisions.
2. Preamble Bits contain extinction ratio, eye pattern and clock information. The Preamble extracts the phase of the arriving cell relative to the local timing of the OLT and/or acquires bit synchronization and amplitude recovery.
3. Delimiter Bits contain a unique pattern indicating the start of the cell, which can be used to perform byte synchronization.

The information in the Guard, Preamble and Delimiter bits is determined by the Upstream data contained in the PLOAM cells. During the Guard cycle, which is up to one byte in length (8 bits), the OLT transceiver and the MAC/PHY must perform a REST to clear the registers such that the next set of packets can be decoded properly. At the OLT transceiver, the arriving data packets may vary in amplitude as each ONU subscriber is polled. This instantaneous increase or decrease in signal amplitude must be completely settled before the Guard cycle is complete. The start and stop time of the RESET pulse is under the control of the MAC/PHY and typically can start at bit two and continue until bit 6 for a total duration of $(5 \times 6.43) = 32.15$ ns. The RESET pulse can be of a single bit duration (6.43 ns) if the transceiver has sufficiently fast response time. If the amplitude of the input signal has not leveled before the end of the Guard time, the information in the Preamble could be lost.





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.

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 610004-3. 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.

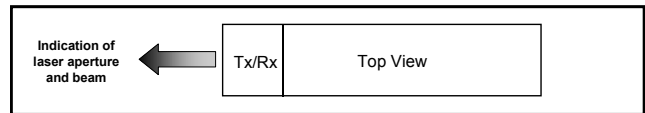
Notice

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 Subpart j.

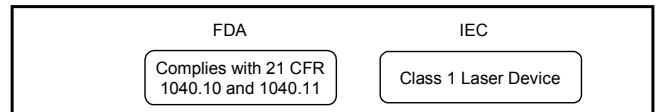
Required Label and Laser Emission

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

Required Label



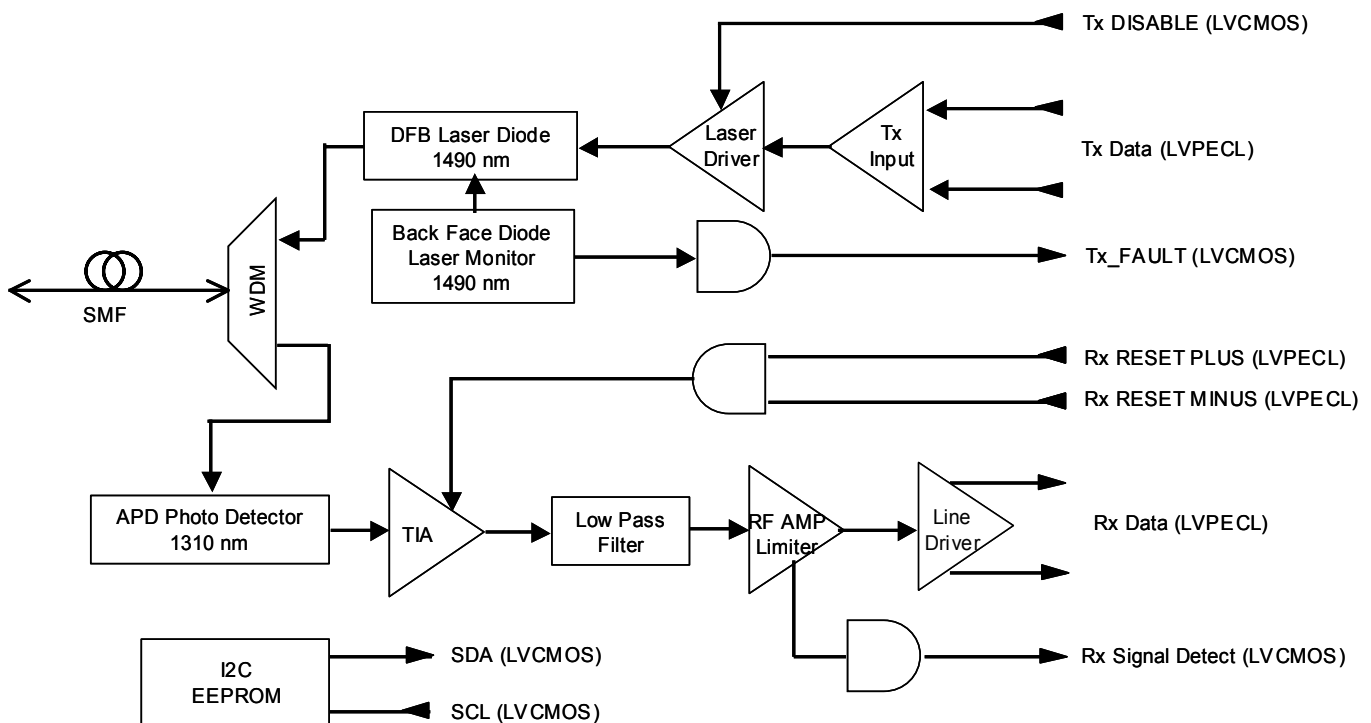
Laser Emission



Laser Radiation Information

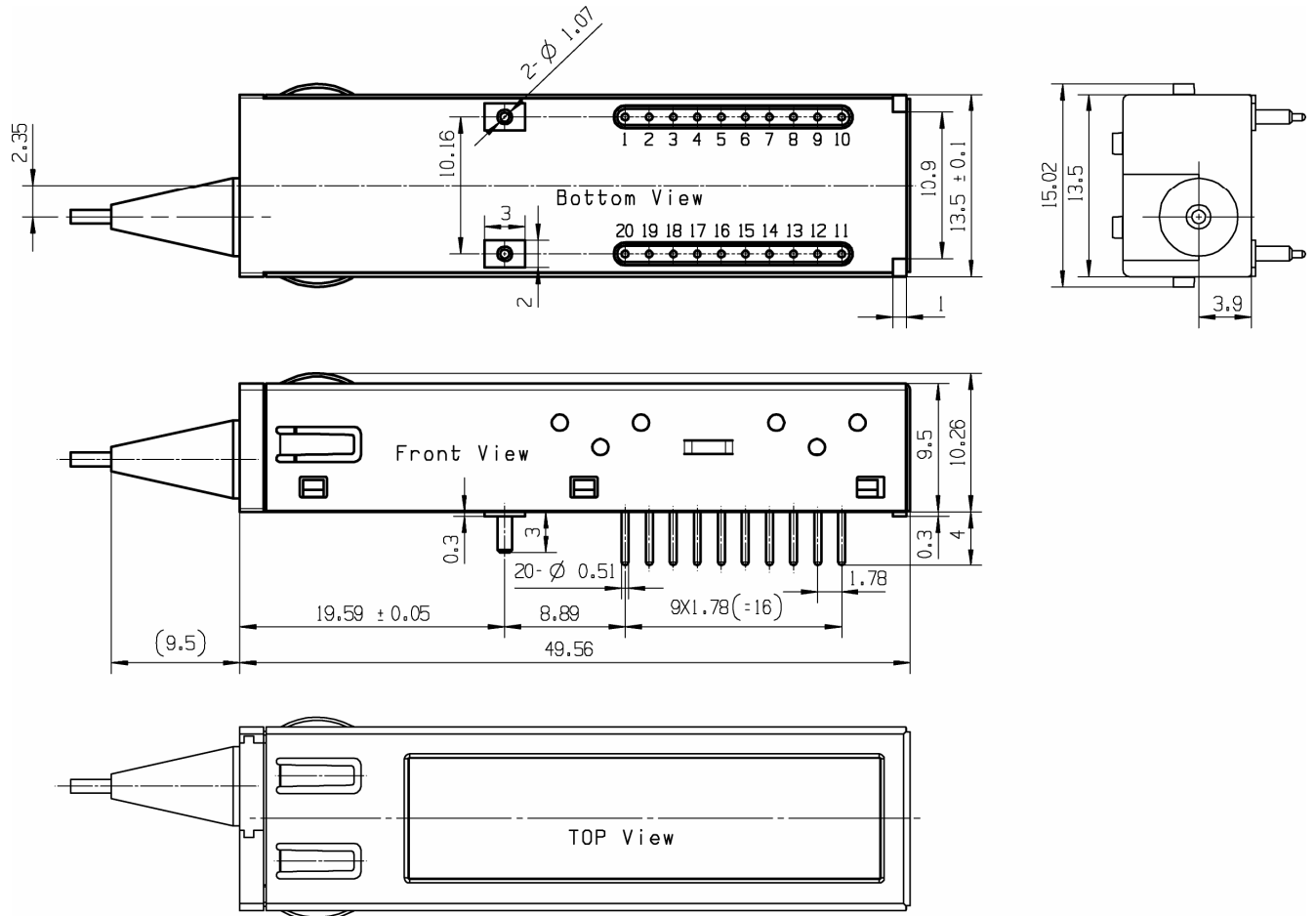
Wavelength	1490 nm
FDA Total Optical Pout : 7 mm aperture at 20 cm distance	< 790 microwatts
IEC Total Optical Pout: 7 mm aperture at 14 cm distance	< 10000 microwatts
Beam Divergence	17.25°

LTB3447 Block Diagram





2x10 SFF Outline Drawing (Fiber Pigtail)





Ligent

intelligent photonics

LTB3447 622 Mbps Tx / 155 Mbps Rx P2MP OLT 2x10 SFF B-PON Class C Transceiver

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