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# LTE3680P SFP GPON OLT Transceiver

## CLASS C+ 2488/1244Mb/s With Digital RSSI

The LTE3680P 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 C+ 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 I<sup>2</sup>C 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 C+
- 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<sup>-10</sup>, PRBS 2<sup>23</sup>-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

### I<sup>2</sup>C 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 <sub>case</sub>	0	25	70	°C
		-40	25	85	°C
Module Supply Voltage	V <sub>CC</sub>	3.135	3.3	3.465	V
Module Supply Current	I <sub>IN</sub>	-	350	500	mA
Downstream Signaling Speed +/- 100 ppm	S <sub>down</sub>	-	2488	-	Mb/s
Upstream Signaling Speed +/- 100 ppm	S <sub>up</sub>	-	1244	-	Mb/s

### Ordering Information

Part Number	Case Operating Temperature
LTE3680P-BC	0 to 70 °C
LTE3680P-BH	-40 to 85 °C

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### Absolute Maximum Ratings

Parameter	Symbol	Min	Max	Units	Notes
Storage Ambient Temperature	T <sub>stg</sub>	-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 <sub>case</sub>	-40	+85	°C	
Commercial Case Operating Temperature	T <sub>case</sub>	0	+70	°C	
Relative Humidity - Storage	RH <sub>S</sub>	0	95	%	
Relative Humidity - Operating	RH <sub>O</sub>	10	90	%	
Module Supply Voltage	V <sub>CC</sub>	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 <sub>CC</sub> +0.5	V	LVTTTL (Tx is OFF / DISABLED)
Transmit FAULT Logic HIGH State	Tx_FAULT	0	V <sub>CC</sub> +0.5	V	LVTTTL (Laser is OFF / FAULT)
BSD Logic HIGH State	BSD	0	V <sub>CC</sub> +0.5	V	LVTTTL
Receiver RESET Logic HIGH State	Rx_RESET	0	V <sub>CC</sub> +0.5	V	LVTTTL (Receiver is being RESET)
I <sup>2</sup> C Serial Data Logic HIGH State	SDA	-	V <sub>CC</sub> +0.5	V	LVTTTL
I <sup>2</sup> C Serial Clock HIGH State	SCL	-	V <sub>CC</sub> +0.5	V	LVTTTL

### Transmitter Electrical Specifications

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

### Receiver Electrical Specifications

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

### I<sup>2</sup>C Serial Logic

Parameter	Symbol	State	Logic	Min	Max	Units
I <sup>2</sup> C Serial Data	SDA	HIGH	LVTTTL	2.2	V <sub>CC</sub> +0.3	V
	SDA	LOW	LVTTTL	0	0.8	V
I <sup>2</sup> C Serial Clock	SCL	HIGH	LVTTTL	2.2	V <sub>CC</sub> +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	STx		2488		Mb/s	
Average Launch Power (9/125 $\mu$ SMF)	P <sub>out</sub>	3.0	-	7.0	dBm	
Average Launch Power with Tx OFF	P <sub>out</sub>	-	-	-40	dBm	
Optical Rise and Fall Time	t <sub>r</sub> / t <sub>f</sub>	-	150	180	ps	20% to 80%
Optical Center Wavelength	$\lambda$	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	
Output Eye	Compliant with G.984.2					Data Rate = 2488Mb/s

### Receiver Optical Specifications

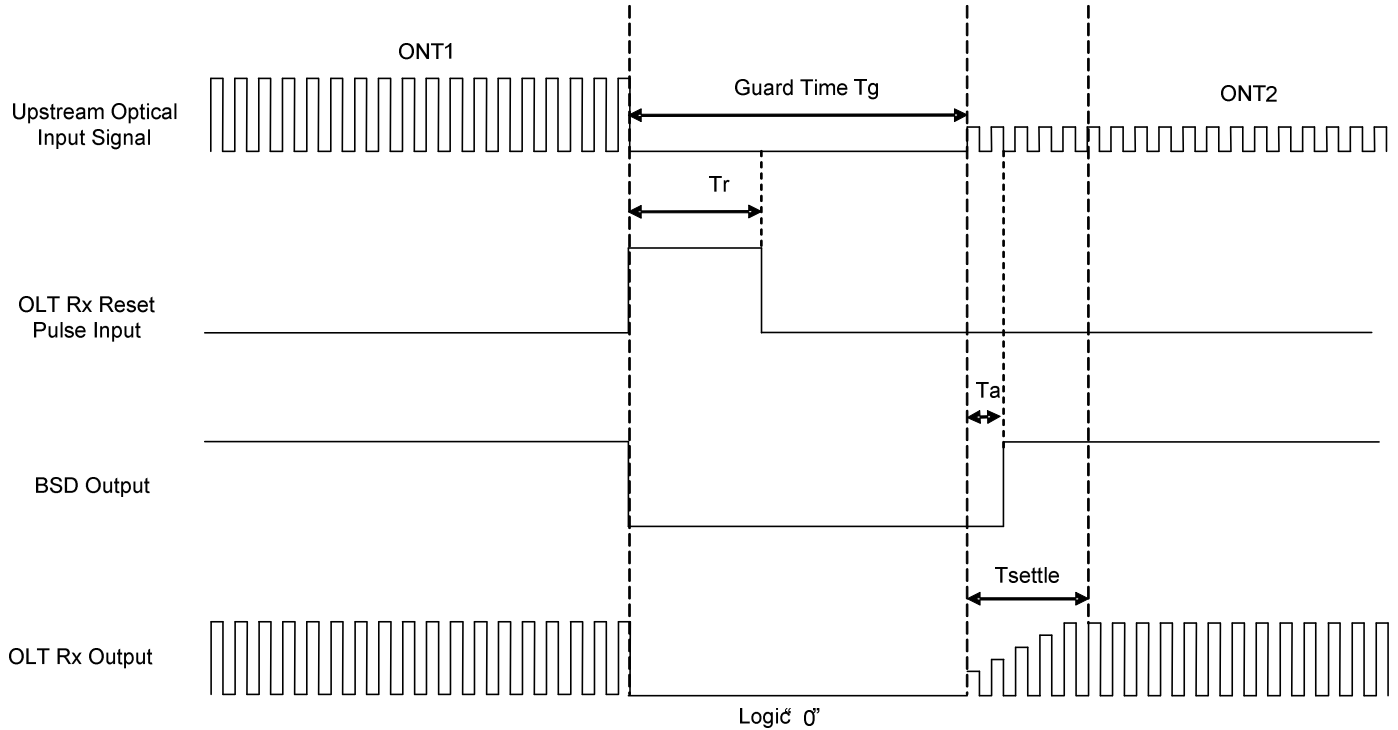
Parameter	Symbol	Min	Typ	Max	Units	Conditions / Notes
Receiver Type	1310nm APD/TIA Burst Mode					
Optical Signal Indicator		Burst Packet Detect				
Signaling Speed	SRx		1244		Mb/s	
Optical Center Wavelength	$\lambda$	1260	1310	1360	nm	
Receiver Sensitivity	P <sub>IN</sub>	-	-	-32	dBm	BER<10 <sup>-10</sup> , 1244 Mb/s, PRBS 2 <sup>23</sup> -1
Receiver Optical Overload	P <sub>in</sub> (SAT)	-12	-	-	dBm	BER<10 <sup>-10</sup> , 1244 Mb/s, PRBS 2 <sup>23</sup> -1
Maximum Input Optical Power	P <sub>in</sub> (MAX)	-	-	2	dBm	Damage Threshold
Immunity from Continuous Identical Digits	CID	72	-	-	Bits	
Receiver Burst Mode Dynamic Range	-	15	20	-	dB	Input power difference between two subsequent high and low burst data



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## CLASS C+ 2488/1244Mb/s With Digital RSSI

**LTE3680P Timing Diagram**



**LTE3680M Timing Characteristics**

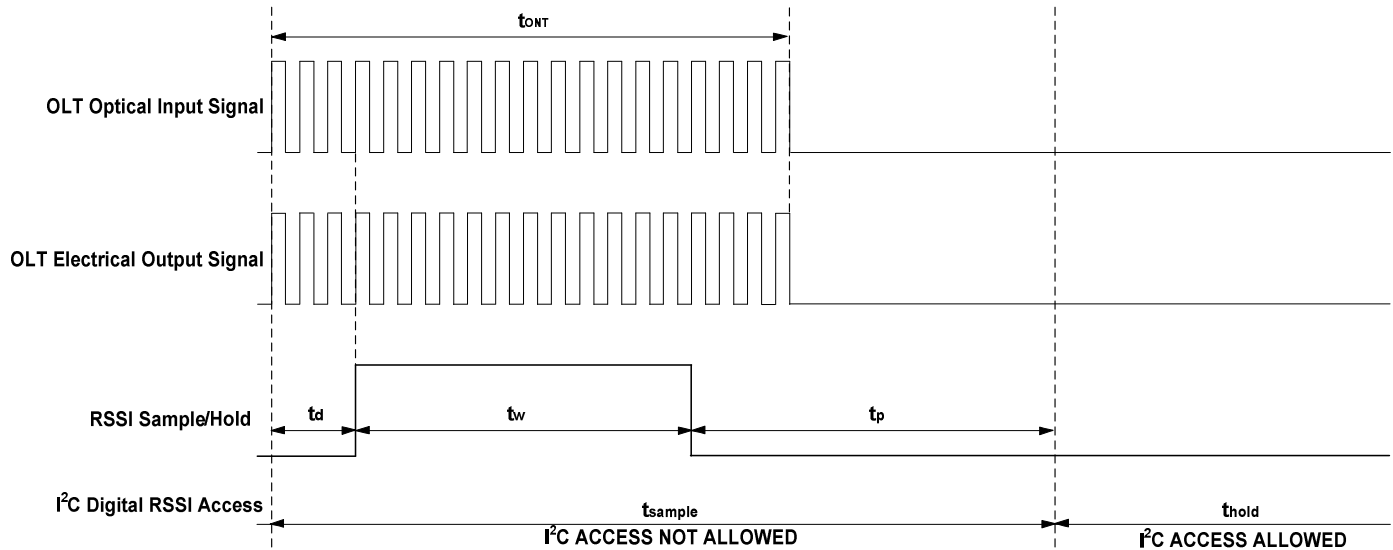
Parameter	Symbol	MIN	TYP	MAX	Units	Notes
Guard Time	$T_g$	4	-	-	Bytes	
RESET Pulse Width	$T_r$	3	16	-	Bits	1
Burst SIGNAL DETECT Assert	$T_a$	-	-	5	ns	2
BURST MODE Rx Settling Time	$T_{settle}$	-	-	44	Bits	

**Notes**

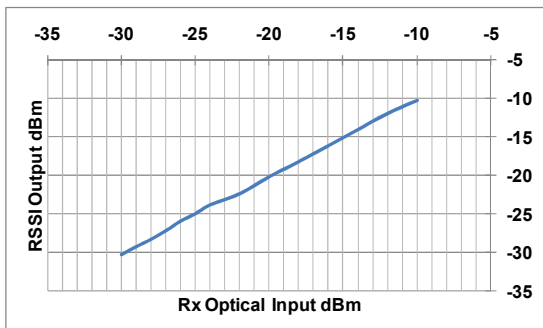
1. The RESET signal should occur in the GUARD BAND time slot and commence immediately at the end of the ONT signal.
2. The Rx BURST MODE SIGNAL DETECT (BSD) asserts LOW when the RESET signal is applied; asserts HIGH when an incoming burst is detected and latches HIGH until the next RESET signal.



#### LTE3680P 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
I²C Access "Invalid" Time Interval	$t_p$	-	-	500	$\mu$ 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 micro-controller (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.



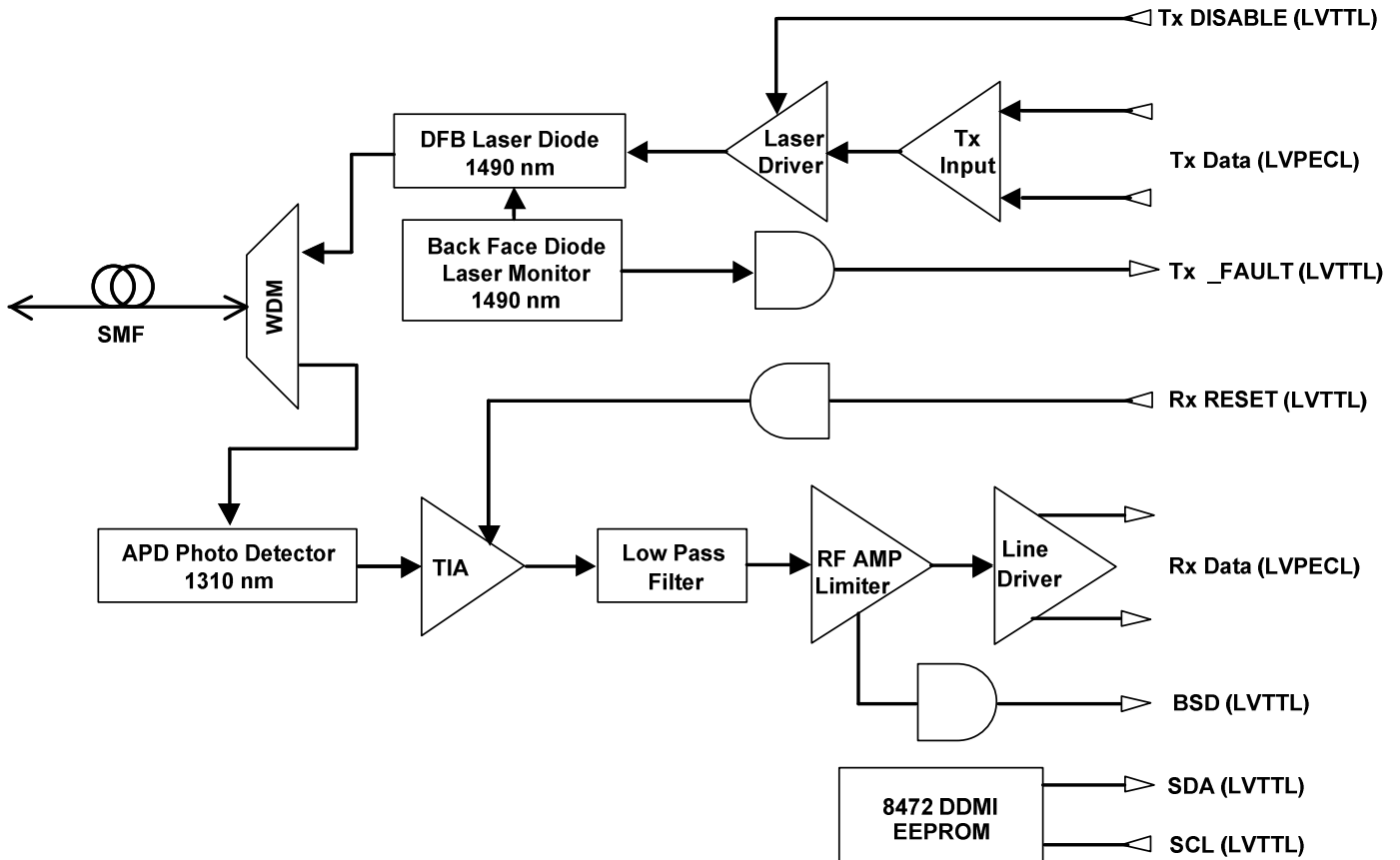
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## CLASS C+ 2488/1244Mb/s With Digital RSSI

LTE3680P Block Diagram



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# LTE3680P SFP GPON OLT Transceiver

## CLASS C+ 2488/1244Mb/s With Digital RSSI

**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 14 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	60 (units = km)	3C
15	1	Length (9μm)-100m	600 (units = 100m)	FF
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 1C
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	00
128-255	128	Vendor Specific	Vendor Specific	00



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## LTE3680P SFP GPON OLT Transceiver CLASS C+ 2488/1244Mb/s With Digital RSSI

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

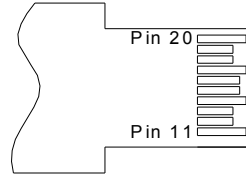
DDMI Parameter	Alarm Threshold Data				Warning Threshold Data				Measured Values		Alarm Bit (Set) Address + Position		Warning Bit (Set) Address + Position	
	High Value		Low Value		High Value		Low Value							
	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	MSB	LSB	High	Low	High	Low
Temperature	00	01	02	03	04	05	06	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)



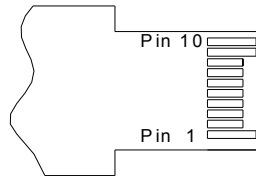


### Pin Assignment

TOP VIEW  
OF BOARD



BOTTOM VIEW  
OF BOARD



SFP Pin Assignment

Pin	Symbol	Description	Notes
1	V <sub>EET</sub>	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 <sub>EER</sub>	Receiver Ground	
11	V <sub>EER</sub>	Receiver Ground	
12	RD-	Rx_Data Output (Inverted)	Note 2
13	RD+	Rx_Data Output (Non Inverted)	Note 2
14	V <sub>EER</sub>	Receiver Ground	
15	V <sub>CCR</sub>	Receiver DC Power	3.3 V +/- 5%
16	V <sub>CCT</sub>	Transmitter DC Power	3.3 V +/- 5%
17	V <sub>EET</sub>	Transmitter Ground	
18	TD+	Tx_Data Input (Non Inverted)	Note 3
19	TD-	Tx_Data Input (Inverted)	Note 3
20	V <sub>EET</sub>	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.



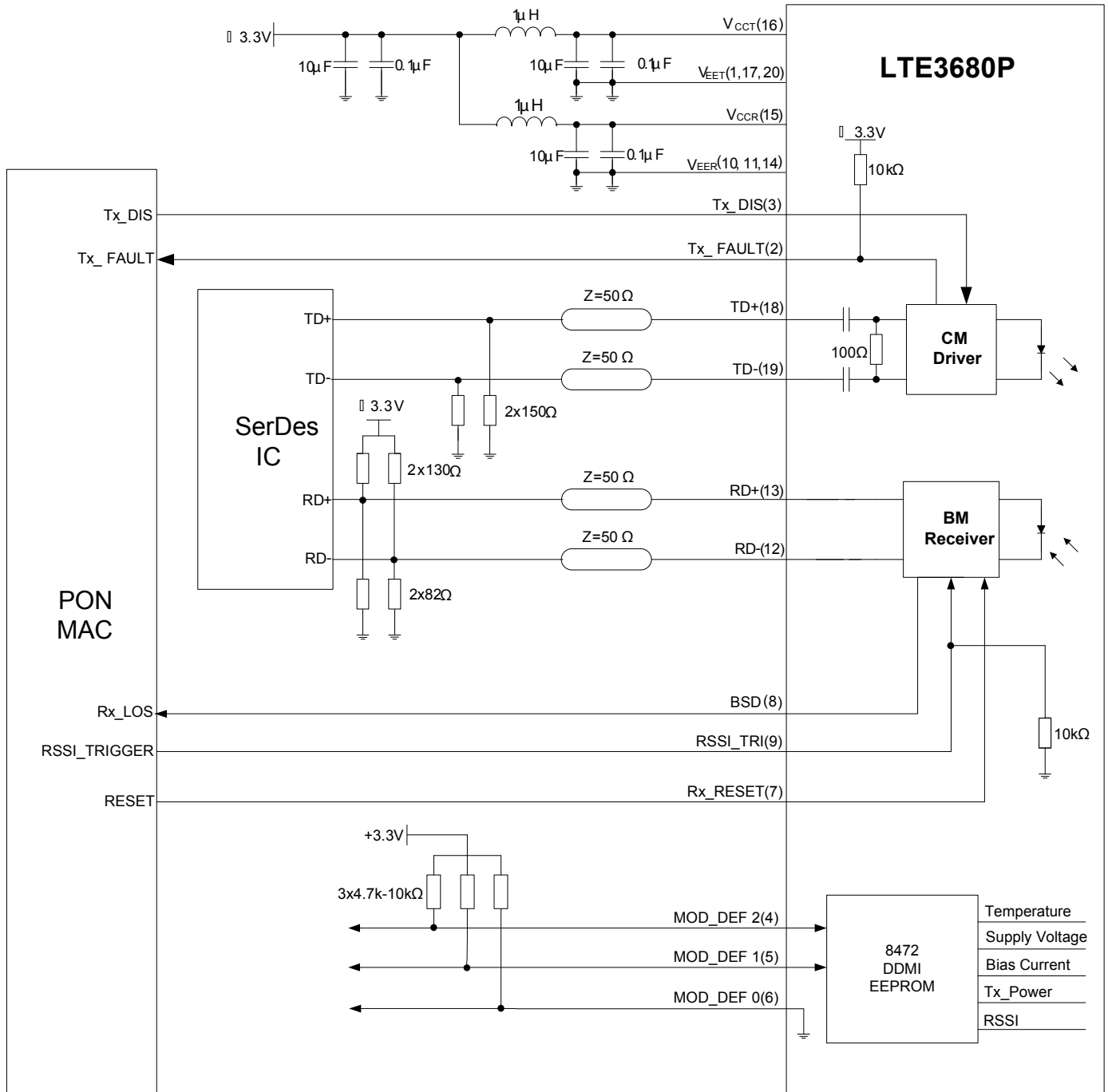
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### Electrical Interface

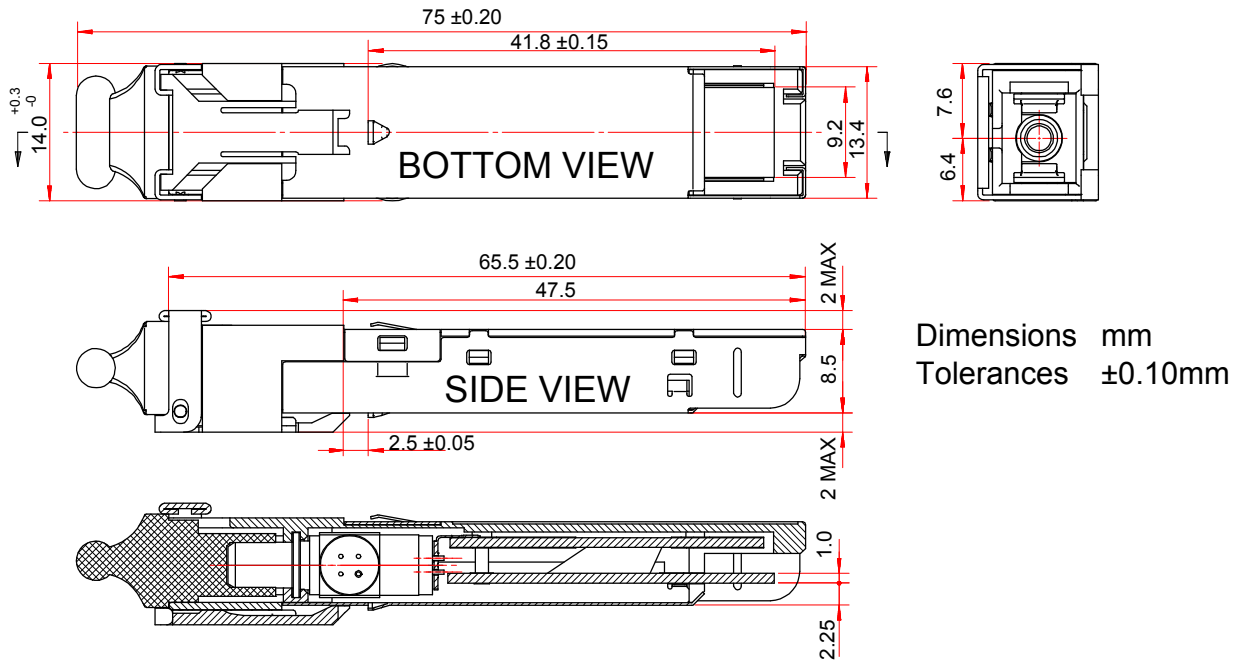




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### Mechanical Dimensions



### 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.

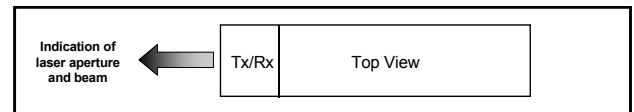
### REQUIRED LABEL AND LASER EMISSION

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

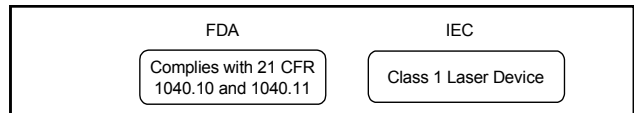
### ELECTROMAGNETIC INTERFERENCE (EMI), IMMUNITY AND PRODUCT SAFETY

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



### 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°