PRODUCT SPECIFICATION

Accelink File No. : SPEC-ONU-011V01

Product Name : RTXM167-431-C00

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	Drafter	Reviewer	Approver
Signature	Wu Chaoqun	Zhou Jie	Ge Jianjun
Date	2017-04-16	2017-04-16	2017-04-16

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Document History

VER. & STATUS	DATE	DESCRIPTION OF CHANGE	Modifier
0.1	2017-03-16	First Draft.	Wu Chaoqun
0.2	2017-04-18	Modify information of A0 3-10bit.	Wu Chaoqun

1 DESCRIPTION

1.1 Features

- Integrated Single fiber bi-directional optical subassembly
- 1310nm DFB laser Burst-mode Transmitter and 1490nm APD Continuous receiver(with WDM)
- SFP metallic package
- +3.3V single power supply
- Low power consumption
- Single SC receptacle optical interface compliant
- -40 to 85°C operating case temperature
- LVPECL compatible data input
- CML compatible data output
- LVTTL transmitter burst mode control
- Burst Enable:L-active
- LVTTL receiver signal-detected indication
- Class 1 Laser eye safety
- Excellent EMI and EMC characteristics
- DDM Function implemented
- Compliant with RoHs&WEEE

1.2 Applications

Optical transceiver for Gigabit-capable Passive Optical Networks (GPON) ONU side

1.3 Standard

- ITU-T G.984.2ClassB+；FSAN G.984.5
- Compliant with IEEE 802.3ah PX20 and CTC 2.1 PX20+
- Compliant with SFF-8472 v9.5

1.4 Description

The GPON ONU Transceiver is designed for Gigabit-capable Passive Optical Network（GPON）transmission. The module incorporates 1310nm burst-mode transmitter and 1490nm continuous-mode receiver.

The transmitter section uses a 1310nm DFB laser and an integrated BM laser driver which designed to perform very small burst enable/disable delay time. The laser driver also includes digital APC and temperature compensation circuit, which are used for keeping the launch optical power and extinction ratio constant over temperature and aging.

The receiver section uses an integrated 1490nm APD photodiode and preamplifier mounted together. It has the function that indicates receiver signal-detected status (active high).

An integrated WDM coupler can separate 1490nm input light and 1310nm output light.

The metallic package guarantees excellent EMI and EMC characteristics, which totally comply with international relevant standards.

1.5 Related Product List

Note: SPEC-ONU-011V01.xls

2 Absolute Maximum Ratings

Parameter	Symbol	Unit	Min	Max
Operating Case Temperature Range	T_c	°C	-40	85
Storage Temperature Range	T_s	°C	-40	85
Relative Humidity	RH	%	5	95
Power Supply Voltage	V_{cc}	V	0	4.6
Pin Input Voltage		V	GND	Vcc
Receiver Damage Threshold		dBm	+7	–

3 Recommended operating conditions

Parameter	Symbol	Unit	Min	Typ	Max
Operating Voltage	V_{cc}	V	3.13	3.3	3.47
Operating CaseTemperature Range	T_c	°C	-40	-	85

4 Specifications (-40°C<T_c<85°C and 3.13V<V_{cc}<3.47V)

Parameter	Symbol	Unit	Min	Typ	Max	Notes
Electrical Characteristics						
Supply Current	I_{cc}	mA	–	–	350	
LVPECL Single Ended Data Input Swing		mV	100	–	800	1
CML Single Ended Data Output Swing		mV	400	–	600	2
Differential Data input impedance		Ω	–	100	–	1
Signal Level(LVTTL H)		V	2.4	–	Vcc	
Signal Level(LVTTL L)		V	0	–	0.8	
Optical transmitter Characteristics						
Data Rate		Mbps	–	1244.16	–	
Center Wavelength Range	λ_c	nm	1290	–	1330	
Spectral Width(@-20dB)	$\Delta\lambda$	nm	–	–	1	
Side Mode Suppression Ratio		dB	30			
Launch Optical Power	P_o	dBm	0.5	–	+5	3
Off level light		dBm	–	–	-45	
Extinction Ratio	EX	dB	10	–	–	4
Burst turn on/off time	Ton/Toff	ns	–	–	12.8	5
Rise/Fall time (20%~80%)	Tr/Tf	ps	–	–	260	6
$RIN_{15}OMA$		dB/Hz	–	–	-115	
Optical Return Loss Tolerance		dB	–	–	15	
Maximum reflectance		dB	–	–	-12	λ=1.31μm
Transmitter dispersion penalty	TDP	dB	–	–	1	7
TX_SD delay	Ttx_sd_delay	ns			1000	10
TX_SD response error		ns			350	11
Eye Diagram	Compliant with ITU-T G.984.2					8
Optical receive Characteristics						

Parameter		Symbol	Unit	Min	Typ	Max	Notes
Data Rate			Mbps	–	2488.32-	–	
Receiver Sensitivity		S	dBm	–	–	-28	9
Overload Input Optical Power		P_{in}	dBm	-8	–	–	9
Center Wavelength Range		λ_c	nm	1480	1490	1500	
Receiver reflectance			dB	–	–	-20	λ=1.49μm
SD(LVTTL)	Optical Deassert		dBm	-44	–	–	
	Optical Assert			–	–	-31	
SD Hysteresis			dB	0.5	–	6	
1310nm Tx to 1490nm Rx Crosstalk			dB			-47	
1555nm Rx to 1490nm Isolation			dB	30			
G.984.5 Wavelength Blocking Filter (WBF)			dB	7			1530nm to1539nm
				22			1540nm to1625nm

Note1: DC coupled internally.
Note2: CML output,AC coupled internally (see the recommended circuit below).
Note3: Coupled into 9/125 SMF
Note4: Measured with PRBS 2^{23}-1 test pattern @1.25Gbps.
Note5: See Figure 1.
Note6: These are unfiltered 20-80% values.
Note7: Transmit on 20km SMF.
Note8: See Figure 2.
Note9: Measured with PRBS 2^{23}-1 test pattern @2.5Gbps with Tx on,ER=10dB,BER=10E-12.
Note10: TX_SD delay is the edge between TX_SD and TX_Burst_EN, See Figure 3.
Note11: TX_SD response error is the difference between TX_SD and TX_Burst_EN, defined by |Tw_burst_en – Tw_tx_sd|, See Figure 3.

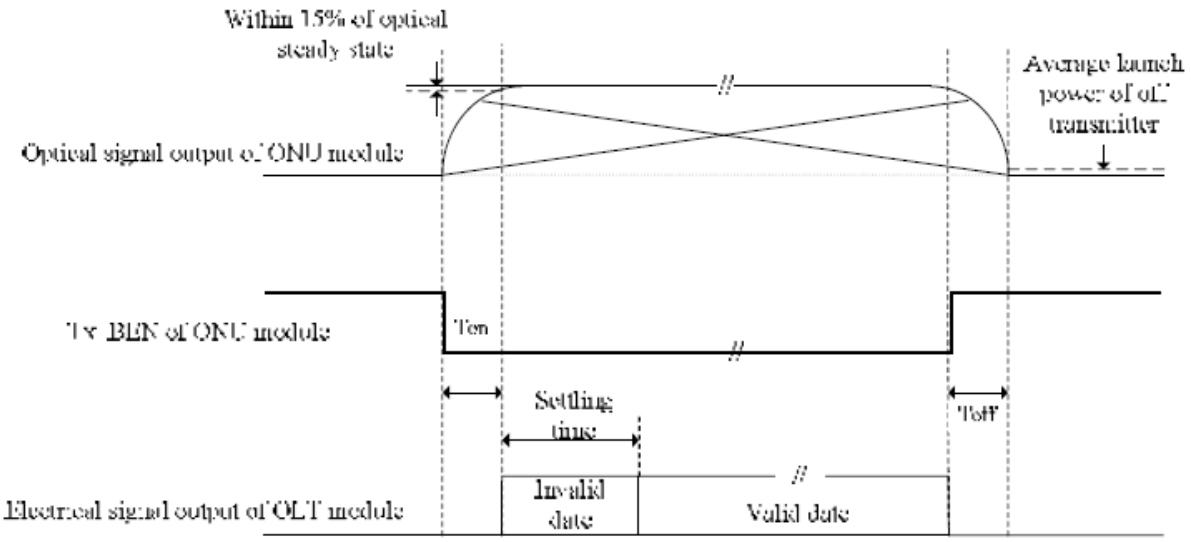


Figure 1 Burst_mode Receiver Dynamic range in GPON system

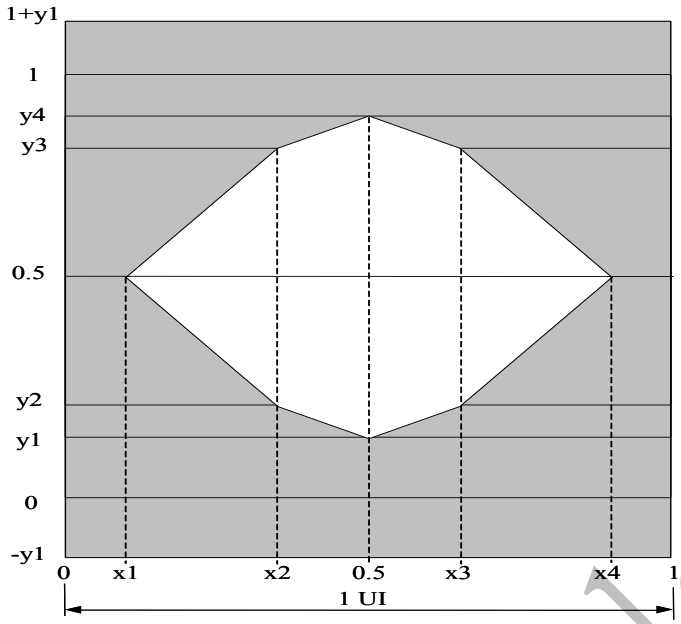


Figure 2 Mask of diagram

	155.52 Mbit/s	622.08 Mbit/s	1244.16 Mbit/s	2488.32 Mbit/s
x1/x4	0.10/0.90	0.20/0.80	0.22/0.78	For further study
x2/x3	0.35/0.65	0.40/0.60	0.40/0.60	For further study
y1/y4	0.13/0.87	0.15/0.85	0.17/0.83	For further study
y2/y3	0.20/0.80	0.20/0.80	0.20/0.80	For further study

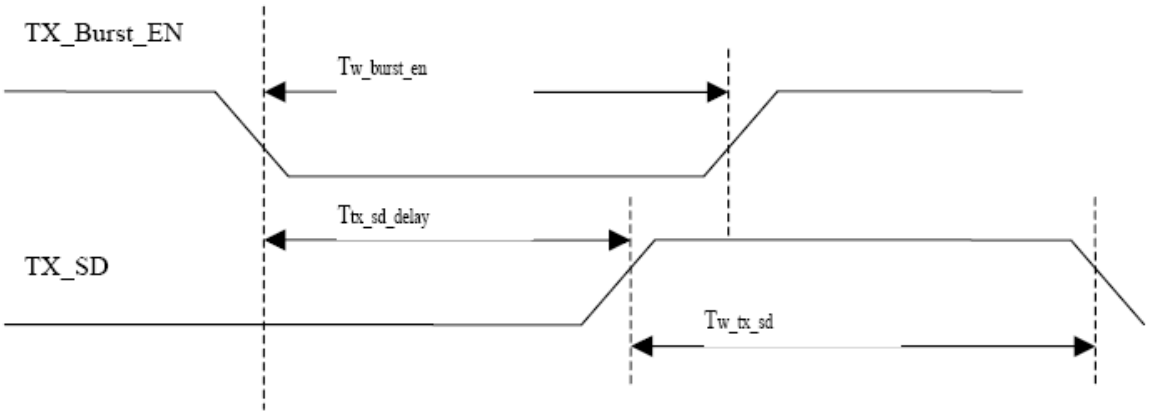
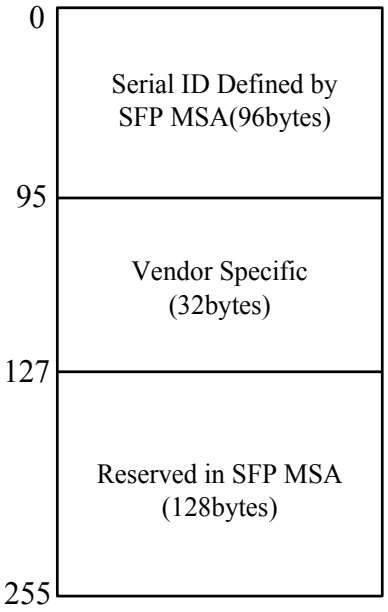


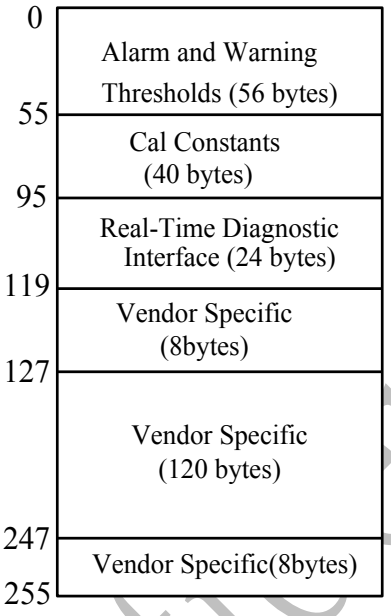
Figure 3 Timing diagram of TX_SD

5 Digital Diagnostic Memory Map

2 wire address 1010000X (A0)



2 wire address 1010001X(A2)



6 EEPROM Serial ID Memory Contents

Accessing Serial ID Memory uses the 2 wire address 1010000X (A0). Memory Contents of Serial ID are shown in the Table 1.

Table 1 Serial ID Memory Contents

Data Address	Size (Bytes)	Name of Field	Contents(Hex)	Description
BASE ID FIELDS				
0	1	Identifier	03	SFP
1	1	Extended. Identifier	04	SFP function is defined by serial ID only
2	1	Connector	01	Connector
3-10	8	Transceiver	00 00 00 00 00 00 00 00	Transceiver Codes
11	1	Encoding	03	NRZ
12	1	BR, Nominal	0C	12*100Mb/s=1.25Gb/s
13	1	Reserved	00	
14	1	Length (9μm) km	14	Transceiver transmit distance :20km
15	1	Length (9μm) 100m	C8	
16	1	Length (50μm) 10m	00	Not compliant
17	1	Length(62.5μm)10m	00	
18	1	Length (Copper)	00	
19	1	Length(50um,OM3)	00	
20-35	16	Vendor name	57 54 44 20 20 20 20 20	"WTD"(ASCII)

Data Address	Size (Bytes)	Name of Field	Contents(Hex)	Description
			20 20 20 20 20 20 20 20	
36	1	Reserved	00	
37-39	3	Vendor OUI	00 00 00	
40-55	16	Vendor PN	52 54 58 4D 31 36 37 2D 34 31 30 20 20 20 20 20	Transceiver part number : "RTXM167-431" (ASCII)
56-59	4	Vendor rev	20 20 20 20	
60-61	2	Wavelength	05 1E	Transceiver wavelength :1310nm
62	1	Reserved	00	
63	1	CC_BASE	Check Sum (Variable)	Check code for Base ID Fields
EXTENDED ID FIELDS				
64-65	2	Options	00 1C	TX_DISABLE, TX_FAULT and RX_SD implemented.
66	1	BR,max	00	
67	1	BR,min	00	
68-83	16	Vendor SN	42 30 30 39 38 32 32 20 20 20 20 20 20 20 20 20	Serial Number of transceiver (ASCII). For example "B009822".
84-91	8	Date code	30 32 31 30 30 35 20 20	Manufactory date code. For example "021005".
92	1	Diagnostic Monitoring Type	68	Digital diagnostic monitoring implemented, "internally calibrated" is implemented, RX measurement type is "Average Power".
93	1	Enhanced Options	B0	Optional Alarm/warning implemented. Soft TX_FAULT,RX_SD implemented
94	1	SFF_8472 Compliance	03	Includes functionality described in Rev10.2 SFF-8472.
95	1	CC_EXT	Check Sum (Variable)	Check sum for Extended ID Field.
VENDOR SPECIFIC ID FIELDS				
96-127	32	Vendor Specific	Read only	Depends on customer information
128-255	128	Reserved	Read only	

Table 2 Memory contents of Diagnostic Monitor Function

Data Address	Field Size (bytes)	Name	Contents and Description

Data Address	Field Size (bytes)	Name	Contents and Description
Alarm and Warning Thresholds			
00-01	2	Temperature High Alarm	Set to 95℃
02-03	2	Temperature Low Alarm	Set to -50℃
04-05	2	Temperature High Warning	Set to 90℃
06-07	2	Temperature Low Warning	Set to -45℃
08-09	2	Vcc High Alarm	Set to 3.6 V
10-11	2	Vcc Low Alarm	Set to 3.0 V
12-13	2	Vcc High Warning	Set to 3.5 V
14-15	2	Vcc Low Warning	Set to 3.1 V
16-17	2	Bias High Alarm	90mA
18-19	2	Bias Low Alarm	0 mA
20-21	2	Bias High Warning	70mA
22-23	2	Bias Low Warning	0 mA
24-25	2	TX Power High Alarm	6.0dBm
26-27	2	TX Power Low Alarm	-0.5 dBm
28-29	2	TX Power High Warning	5.0dBm
30-31	2	TX Power Low Warning	0.5dBm
32-33	2	RX Power High Alarm	-6.0 dBm
34-35	2	RX Power Low Alarm	-29.0dBm
36-37	2	RX Power High Warning	-7.0 dBm
38-39	2	RX Power Low Warning	-28.0dBm
40-55	16	Reserved	
Calibration Constants			
56-59	4	RX Power Calibration Data4	00 00 00 00 (fixed)
60-63	4	RX Power Calibration Data3	00 00 00 00 (fixed)
64-67	4	RX Power Calibration Data2	00 00 00 00 (fixed)
68-71	4	RX Power Calibration Data1	3F 80 00 00 (fixed)
72-75	4	RX Power Calibration Data0	00 00 00 00 (fixed)
76-77	2	Bias Calibration Data1	01 00 (fixed)
78-79	2	Bias Calibration Data0	00 00 (fixed)
80-81	2	TX Power Calibration Data1	01 00 (fixed)
82-83	2	TX Power Calibration	00 00 (fixed)

Data Address	Field Size (bytes)	Name	Contents and Description
		Data0	
84-85	2	Temperature Calibration Data1	01 00 (fixed)
86-87	2	Temperature Calibration Data0	00 00 (fixed)
88-89	2	Vcc Calibration Data1	01 00 (fixed)
90-91	2	Vcc Calibration Data0	00 00 (fixed)
92-94	3	Reserved	00 00 00 (fixed)
95	1	Check Sum	Checksum of bytes 0-94
Real Time Diagnostic Monitor Interface			
96-97	2	Measured Temperature	Internally measured module temperature
98-99	2	Measured Vcc	Internally measured supply voltage in module
100-101	2	Measured Bias	Internally measured Tx Bias current
102-103	2	Measured TX Power	Internally measured Tx Optical Power
104-105	2	Measured RX Power	Measured Rx input power
106-109	4	Reserved	
110	1	Logic Status	See Table 3.1
111	1	AD Conversion Updates	See Table 3.1
112-119	8	Alarm and Warning Flags	See Table 3.2
Vendor Specific			
120-127	8	Vendor Specific	Don't Access
128-247	120	User writable EEPROM	
248-255	8	Vendor Specific	Don't Access

Notes: Temperature (Signed twos complement value)

A2h Byte 96 (Temperature MSB)								A2h Byte 97 (Temperature LSB)							
S	2^6	2^5	2^4	2^3	2^2	2^1	2^0	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}	2^{-7}	2^{-8}

Supply Voltage, Tx Bias Current, Tx Optical Power, Rx Received Power (Unsigned values)

A2h Byte 98 (Vcc MSB)								A2h Byte 99 (Vcc LSB)							
A2h Byte 100 (Bias MSB)								A2h Byte 101 (Bias LSB)							
A2h Byte 102 (TX Power MSB)								A2h Byte 103 (TX Power LSB)							
A2h Byte 104 (RX Power MSB)								A2h Byte 105 (RX Power LSB)							
2^{15}	2^{14}	2^{13}	2^{12}	2^{11}	2^{10}	2^9	2^8	2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0

All the measured values are "Internally Calibrated", Each measurement could be obtained by multiplying digital value by corresponding LSB value:

Temperature = Temp (Digital Value) X (1/256); when Temperature<128

Temperature = [Temp (Digital Value) X (1/256)]-256; when Temperature≧128

V_{CC}=V_{CC}(Digital Value) X 100μV

TX Bias Current = TX Bias Current (Digital Value) X 2μA

TX Power = TX Power (Digital Value) X 0.1μW
RX Power = RX Power (Digital Value) X 0.1μW

Table 2.1 Logic Status and AD Conversion Updates

Byte	Bit	Name	Description
110	7	Reserved	
110	6	Soft Tx Disable Control	1= disable, 0= enable.
110	5	Reserved	Set to 0.
110	4	Rx Rate Select State	Not supported (set to 0).
110	3	Soft Rate Select Control	Not supported (set to 0).
110	2	Tx Fault	1= fault, 0= normal.
110	1	RX-SD	1= SD, 0= LOS.
110	0	Power on Logic	Not supported (set to 0).
111	7-0	Temp A/D Valid	Not supported (set to 0).

Each of the measured values has a corresponding high alarm, low alarm, high warning and low warning threshold level at location 00-39(x0A2) written as the data format of a corresponding valued shown in Table 2.2. Alarm and warning flags at bytes 112-119(0xA2) are defined as follows.

(1) Alarm flags indicate conditions likely to result (or have resulted) in link failure and cause for immediate action.

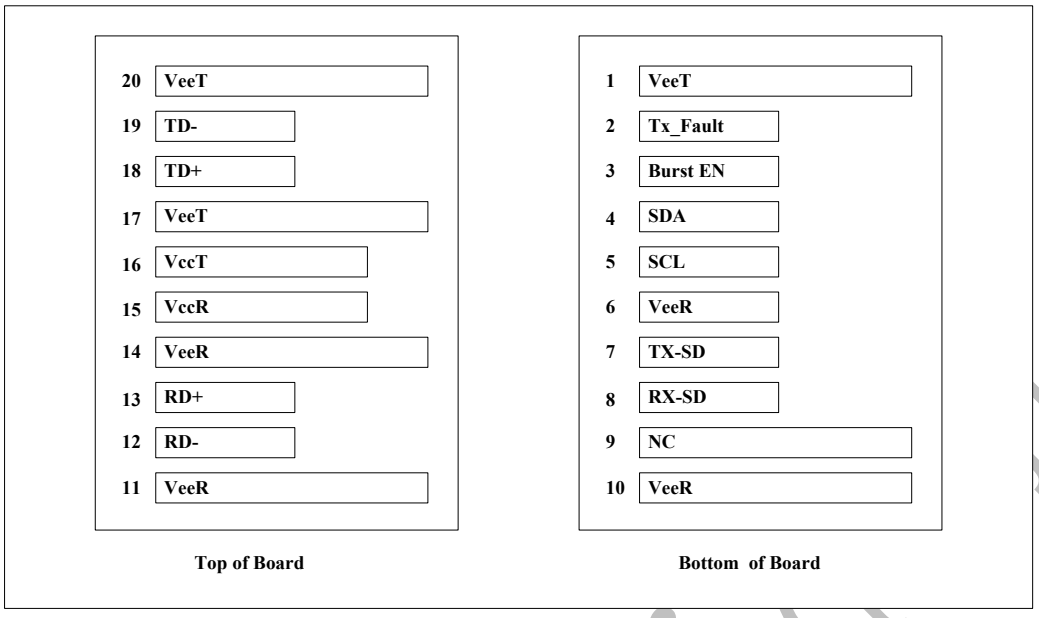
(2) Warning flags indicate conditions outside the guaranteed operating specification of transceiver but not necessarily causes of immediate link failures.

Table 2.2 Alarm and Warning Flags

Byte	Bit(s)	Name	Description
112	7	Temperature High Alarm	Set when temperature monitor value exceeds high alarm level.
112	6	Temperature Low Alarm	Set when temperature monitor value exceeds low alarm level.
112	5	Vcc High Alarm	Set when Vcc monitor value exceeds high alarm level.
112	4	Vcc Low Alarm	Set when Vcc monitor value exceeds Low alarm level.
112	3	Laser Bias High Alarm	Set when laser bias monitor value exceeds high alarm level.
112	2	Laser Bias Low Alarm	Set when laser bias monitor value exceeds low alarm level.
112	1	Tx Power High Alarm	Set when Tx power monitor value exceeds high alarm level
112	0	Tx Power Low Alarm	Set when Tx power monitor value exceeds low alarm level.
113	7	Rx Power High Alarm	Set when Rx power monitor value exceeds high alarm level
113	6	Rx Power Low Alarm	Set when Rx power monitor value exceeds low alarm level
113	5-0	Reserved	
114	7-0	Reserved	
115	7-0	Reserved	
116	7	Temperature High warning	Set when temperature monitor value exceeds high warning level.
116	6	Temperature Low warning	Set when temperature monitor value exceeds low warning level.
116	5	Vcc High warning	Set when Vcc monitor value exceeds high warning level.

116	4	Vcc Low warning	Set when Vcc monitor value exceeds Low warning level.
116	3	Laser Bias High warning	Set when laser bias monitor value exceeds high warning level.
116	2	Laser Bias Low warning	Set when laser bias monitor value exceeds low warning level.
116	1	Tx Power High warning	Set when Tx power monitor value exceeds high warning level
116	0	Tx Power Low warning	Set when Tx power monitor value exceeds low warning level.
117	7	Rx Power High warning	Set when Rx power monitor value exceeds high warning level
117	6	Rx Power Low warning	Set when Rx power monitor value exceeds low warning level
117	5-0	Reserved	
118	7-0	Reserved	
119	7-0	Reserved	

7 Pin Description



As Viewed Through Top of Board

Pin	Name	Description
1	VeeT	Transmitter ground
2	TX_FAULT	LVTTL Transmitter Fault, internally pull up.Asserts high when the fault is detected by the laser driver.
3	Burst EN	LVTTL Transmitter burst mode control, "L": Tx ON,internal pull-up.
4	SDA	I^2C Serial Data (LVTTL), internal pull-up
5	SCL	I^2C Serial Clock (LVTTL),internal pull-up
6	VeeR	Receiver ground
7	TX-SD	Tx Transmitter State Indication, TX_Indication Assert high When Transmitter ON
8	RX-SD	LVTTL Signal detect output, internally pull up.Asserts high when input optical power level is above threshold.Internal pull-up.
9	NC	Not connect
10	VeeR	Receiver ground
11	VeeR	Receiver ground
12	RD-	Receiver data output-, AC coupled internally
13	RD+	Receiver data output+, AC coupled internally
14	VeeR	Receiver ground
15	VccR	Receiver power supply
16	VccT	Transmitter power supply
17	VeeT	Transmitter ground
18	TD+	LVPECL Data input+ ,DC coupled internally
19	TD-	LVPECL Data input- ,DC coupled internally
20	VeeT	Transmitter ground

8 Block Diagram

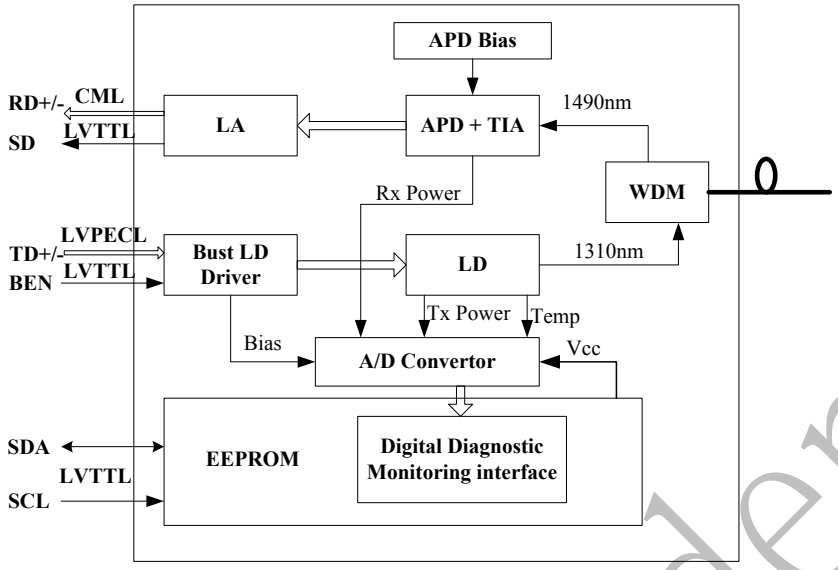
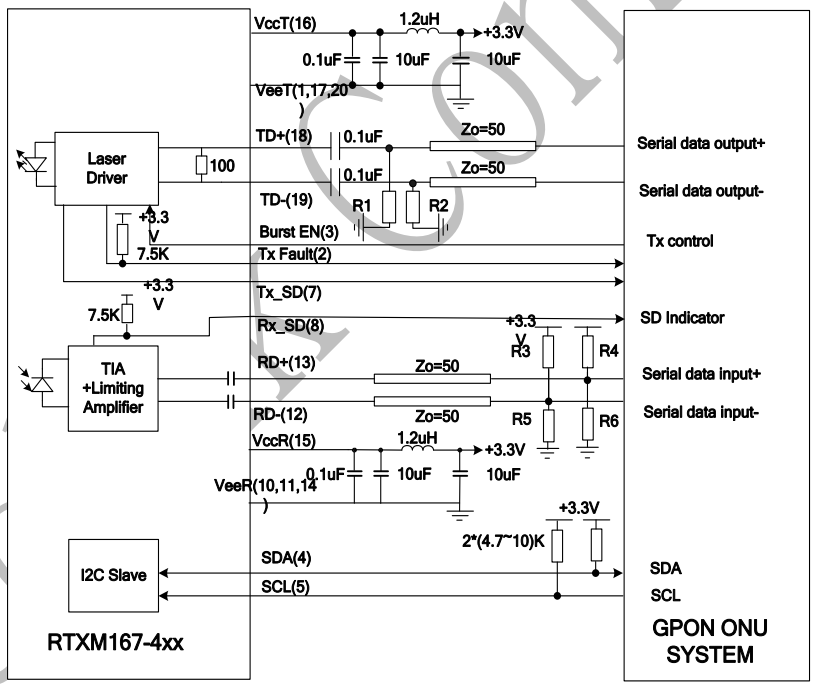


Figure 4 Functional block diagram

9 Typical Application Circuit



R1=R2=150Ω
R3=R4=82Ω R5=R6=130Ω

Note:

If output+/- in source(PON MAC IC) are CML buffer, R1,R2 can be omitted.

If input+/- in source(PON MAC IC) are CML buffer, R3,R4,R5,R6 can be omitted.

Default both are LVPECL.

10 Package Outline

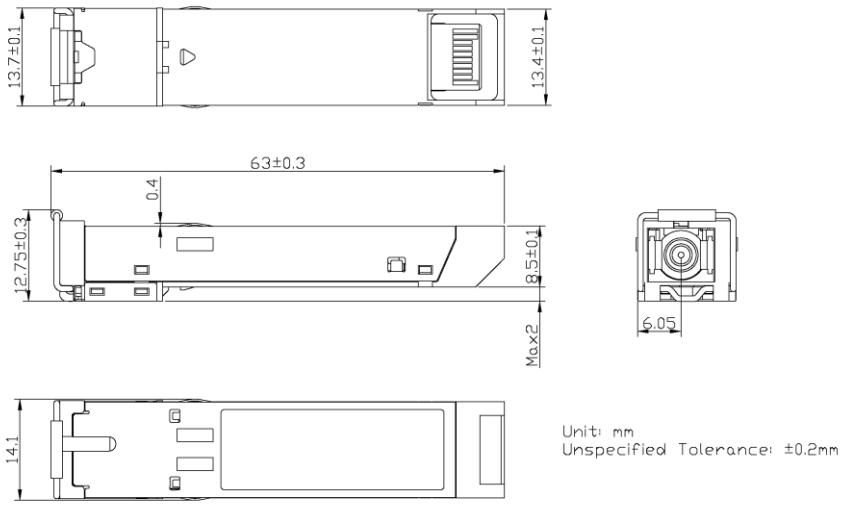


Figure 5 Package outline

11 Regulatory Compliance

Feature	Test Method	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E 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 EN55022 Class B	Compliant with standards
Immunity	IEC61000-4-3 Class 2 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	Compliant with Class 1 laser product
	UL	
	TUV EN 60825-1	

12 Ordering Information

Part No	Specification									Application Code
	Package	Datarate	Laser	Optical Power	Detector	Sensitivity	Temp	Reach	BM control logic	
RTXM167-431	SFP	1.25Gb/s US 2.5Gb/s DS	1310nm DFB	0.5 ~ 5dBm	APD	-28dBm	-40~85°C	20km	L Enable	CLASS B+