

VerA

38J0-6537E-STH1+

38J0-6537E-STH2+

38J0-6537E-STH3+

GPON SFP OLT Transceiver with Digital RSSI

1 Features

- 1.1 Single Fiber Transceiver with single mode SC receptacle
 - 1490nm continuous-mode 2.488Gb/s DFB transmitter
 - 1310nm burst-mode 1.244Gb/s APD receiver
- 1.2 Complies with ITU-T G.984.2
- 1.3 Digital Diagnostic Monitoring (DDM) with external calibrations
- 1.4 LVPECL compatible data input /output
- 1.5 LVTTTL for Tx disable input and Tx_fault output
- 1.6 LVTTTL receiver Fast Burst Packet Detect indication
- 1.7 Burst mode received signal strength indication (RSSI) function
- 1.8 Complies with RoHS directive (2002/95/EC)

2 Application

Gigabit Passive Optical Network (GPON) OLT

3 General

38J0-6537E-STH1+, 38J0-6537E-STH2+ and 38J0-6537E-STH3+ are high performance transceiver modules for single fiber communications using a 1490nm continuous-mode transmitter and a 1310nm burst-mode receiver. It is designed to meet ITU G.984.2 requirements for optical line terminal (OLT) applications.

The 1490nm DFB LD transmitter has automatic power control (APC) function and temperature compensation circuitry to ensure stable optical power and extinction ratio over all operating temperature range. The transmitter meets Class 1 eye safety per IEC60825 and CDRH standards

The receiver has a hermetically packaged APD-TIA (trans-impedance amplifier) pre-amplifier and a limiting amplifier with LVPECL compatible differential outputs. It features a Burst Packet Detect (SD) output which is LVTTTL compatible. The SD output will come high after receiving the burst packet.

The module provides digital diagnostic information of its operating conditions and status, including transmitting power, laser bias current, module temperature, and supply voltage. Calibration and alarm/warning threshold data are written and stored in the internal memory (EEPROM).

4 Performance Specifications

4.1 Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Units	Notes
Storage Temperature	Tst	-40	+85	°C	-
Operating Humidity	RH	5	85	%	Non-condensing
Input Voltage	-	GND	Vcc	V	-
Power Supply Voltage	Vcc-Vee	0	3.6	V	-

4.2 Recommended Operating Conditions

Parameter	Symbol	Min.	Max.	Unit	Notes
Operating Case Temperature	Tc	0	70	°C	4.2.1
Power Supply Voltage	Vcc	3.14	3.47	V	
Power Supply Current	Icc	-	500	mA	

Note 4.2.1: LD can't be shutdown in temperature range from -25 °C-0 °C and 70 °C-85 °C.

4.3 1490nm Digital Transmitter E-O Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Units	Notes	
Optical							
Data Rate	-	-	2.488	-	Gb/s		
Optical Transmitter Power (EOL) _full temperature	Po	4		10	dBm	38J0-6537E-STH1+	
Optical Transmitter Power (EOL) _full temperature	Po	5		10	dBm	38J0-6537E-STH2+	
Optical Transmitter Power (EOL) _full temperature	Po	6		10	dBm	38J0-6537E-STH3+	
Output power monitor accuracy (Full temperature)	-	-3		-3	dB	4.3.1	
Output power monitor accuracy (Room temperature)	-	-1		+1	dB		
Output Center Wavelength	λ	1480	-	1500	nm		
Output Spectrum Width	$\Delta\lambda$	-	-	1.0	nm		
Side Mode Suppression Ratio	SMSR	30	-	-	dB		
Extinction Ratio	ER	8.2	-	-	dB		
Output power at transmit off	-	-	-	-39	dBm		
Optical Eye Diagram	Compliant with ITU-T G.984.2 Mask						
Electrical							
Differential Input Voltage	Vpp	300	-	1600	mV		
Differential Input Impedance	Vin	80	100	120	Ω		
Tx_fault Output Voltage- High	V _{IH}	2.0	-	-	V		
Tx_fault Output Voltage- Low	V _{IL}	-	-	0.8	V		

Note 4.3.1: 2.488Gbps continuous-mode , PRBS2²³-1.

4.4 1310nm Digital Receiver O-E Characteristics

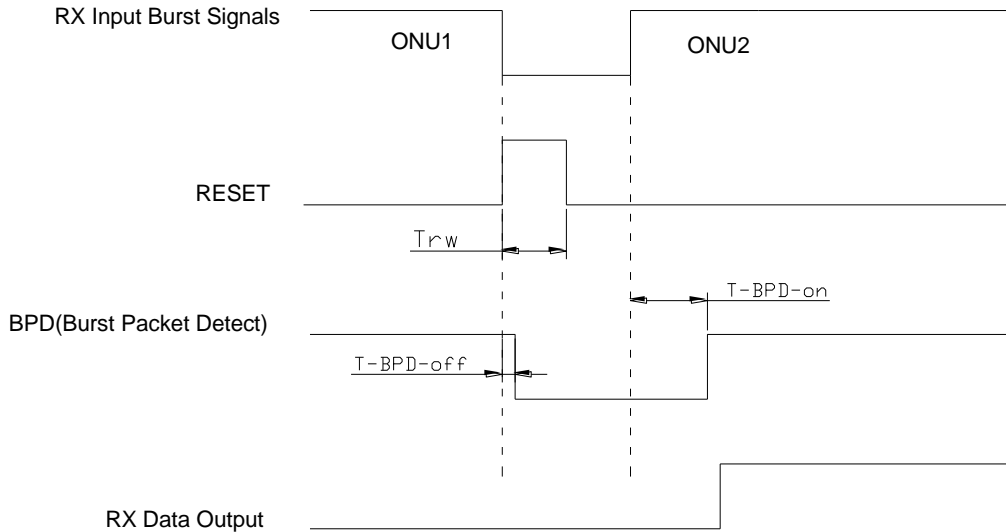
Parameter	Sym bol	Min.	Typ.	Max.	Units	Notes
Optical						
Wavelength of Operation	-	1290	-	1330	nm	-
Data Rate	-	-	1.244	-	Gb/s	-
Sensitivity (EOL) Full temperature; BER=1x10 ⁻¹⁰	Sen			-31	dBm	38J0-6537E-STH1+
				-32	dBm	38J0-6537E-STH2+
				-33	dBm	38J0-6537E-STH3+
Saturation Optical Power	Sat	-15	-	-	dBm	4.4.1
Reflectance of equipment	-	-	-	-20	dB	at 1310nm
Receiver Burst-mode Dynamic Range	-	15	-	-	dB	4.4.2
Data Output Voltage - High	VOH	VccR -1.05	-	VccR - 0.85	V	
Data Output Voltage - Low	VOL	VccR -1.84	-	VccR - 1.60	V	
RSSI accuracy		-3		+3		4.4.3
SD Output Voltage- High	VIH	2.4	-	-	V	-
SD Output Voltage- Low	VIL	-	-	0.8	V	-

Note4.4.1: Measured with 1310nm, 1.244Gbps PRBS2²³-1 burst-mode optical input, ER=10dB, BER=1x10⁻¹⁰; Single burst packet length is 40us and packet interval is 40us

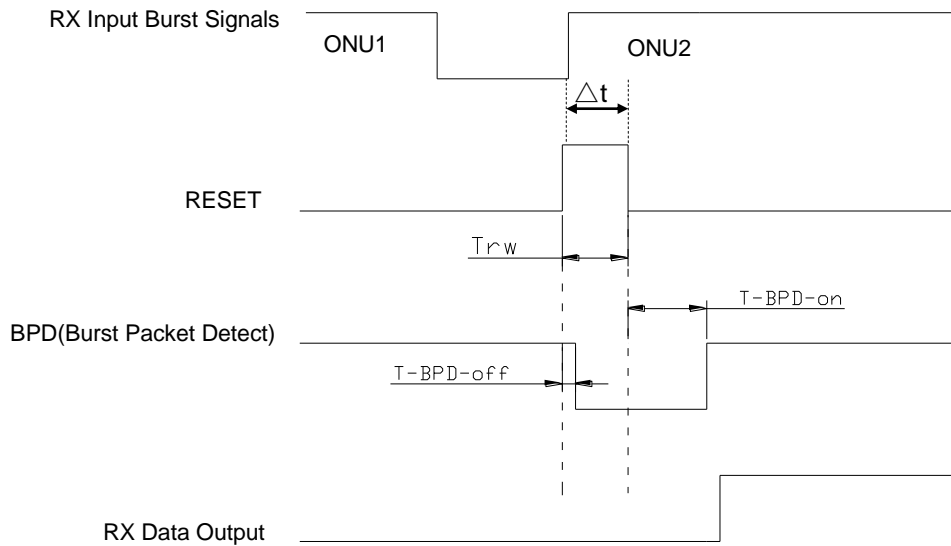
Note4.4.2: Input optical power level difference of adjacent burst packets.

Note4.4.3: RSSI DDM working range is between -15 to -33dBm. RSSI DDM accuracy is better than +/- 2dB (25°C) or +/- 3dB (0°C-70°C) for input power levels between -15 to -33dBm, the accuracy reduces to +/- 5dB for power levels larger than -15dBm.. Measured with 1310nm, 1.244Gbps PRBS2⁷-1 burst-mode optical input, ER=10dB, 50%duty cycle.

4.5 Reset Timing Characteristics



Reset Signal in Guard Time



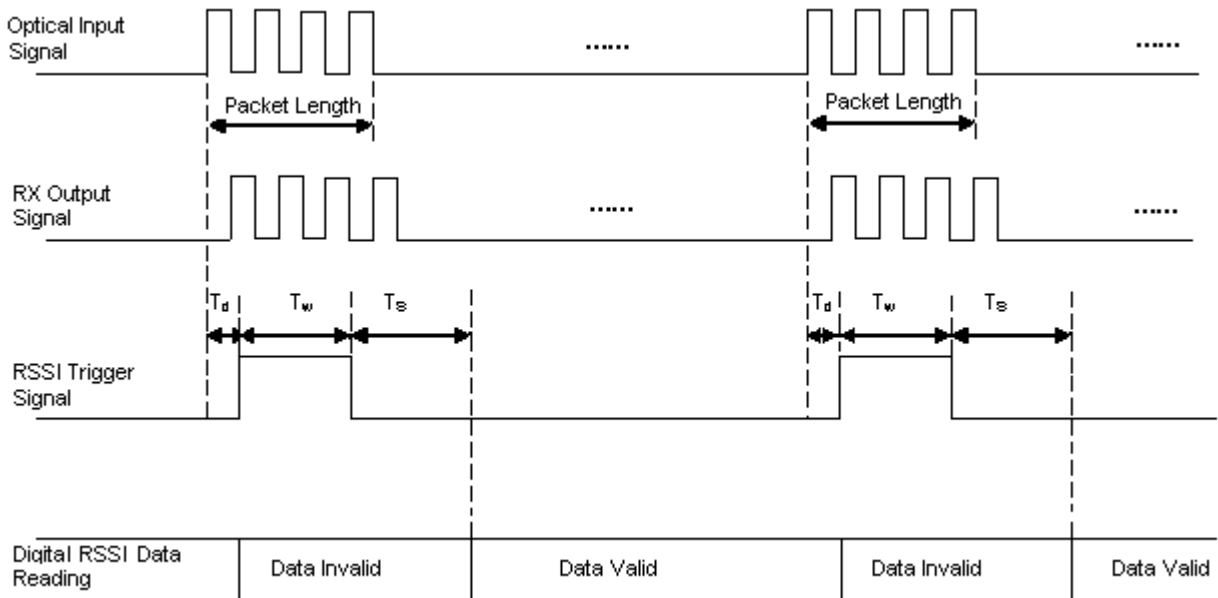
Reset Signal Cross Guard Time and Preamble

Symbol	Description	Min	Typical	Max	Units
Trw	Reset pulse width	24	-	-	Bit
Tg	Guard Time	32	-	-	Bit
Tp@1	Preamble time@1	44	-	-	Bit
Tp@2	Preamble time@2	44+ Δt	-	-	Bit
T-BPD-off	Burst Packet Detect off	-	10	20	ns
T-BPD-on	Burst Packet Detect on	-	10	20	ns

Notes:

- 1, BPD is a LVTTTL output. High level indicates that burst packet is detected by the receiver.
- 2, Output of RX data during guard time is squelched.
- 3, Measured with 1310nm, 1.244Gbps PRBS2²³-1 burst-mode optical input, ER=10dB, 50%duty cycle.

4.6 Timing Characteristics for Digital RSSI



PARAMETER	SYMBOL	MIN	TYP	MAX	UNITS
Packet Length	-	375	-	-	ns
Trigger delay	T _d	25	-	-	ns
RSSI Trigger and Sample Time	T _w		-	350	ns
Internal delay	T _s		-	500	us

4.7 Truth Table of Transmitter Disable Function (1: High, 0: Low)

Case	Tx_Dis	Status of LD	Note
1	0	LD Bias is set and modulation is ON.	LVTTTL
2	1	LD bias is OFF and modulation is OFF.	

4.8 Truth Table of Transmitter Fault Function (1: High, 0:Low)

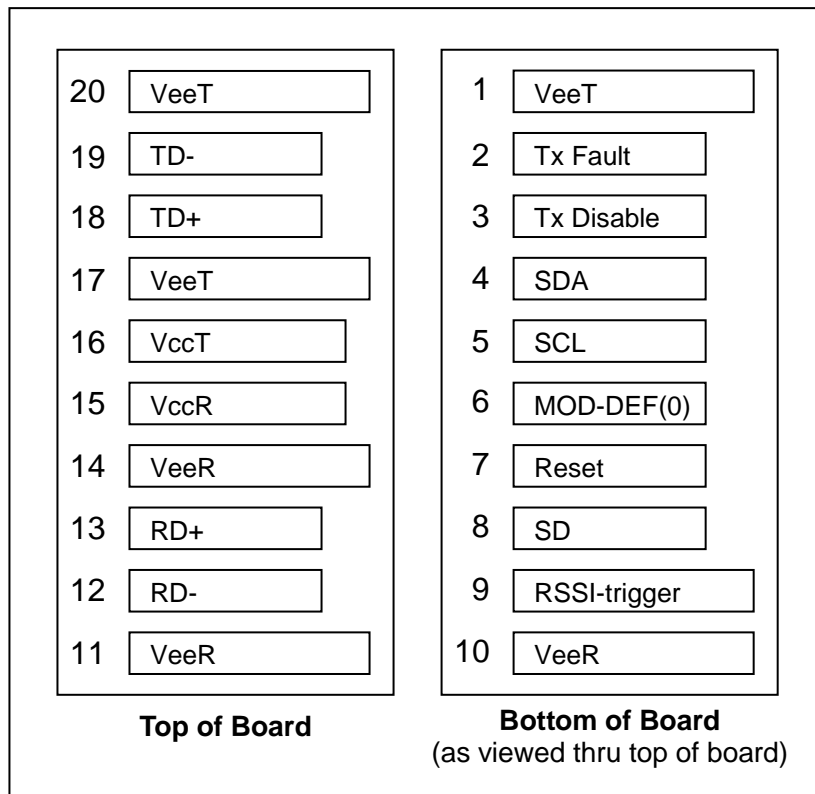
Case	Tx_Fault	Status of Tx_Fault	Note
1	0	Tx is normal	LVTTTL
2	1	Tx is failed	

4.9 Truth Table of Receiver Signal Detect Function (1: High, 0:Low)

Case	SD	Status of Burst Packet Detect	Note
1	0	SD off	LVTTTL
2	1	SD on	

5 Pin Definitions

5.1 Pin Diagram



5.2 Pin Descriptions

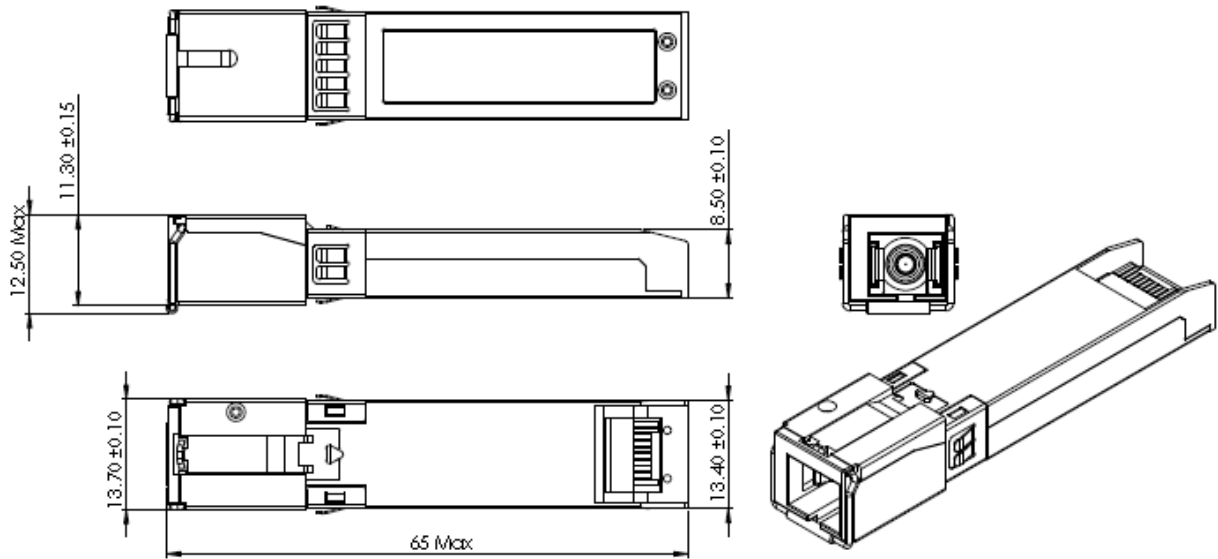
Pin#	Name	Function	Notes
1	VeeT	Transmitter Ground	Note 7
2	TX_Fault	Transmitter Fault Indication (LVTTTL)	Note 1
3	TX_Disable	Transmitter Disable (LVTTTL)	Note 2
4	SDA	I ² C Data	Note 3
5	SCL	I ² C Clock	Note 3
6	MOD-DEF(0)	Internally grounded	

Pin#	Name	Function	Notes
7	Reset	Receiver Reset (LVTTL)	Note 4
8	SD	Burst Packet Detect (LVTTL)	Note 5
9	RSSI_Trigger	RSSI Trigger Signal from Host	Note 6
10	VeeR	Receiver Ground	Note7
11	VeeR	Receiver Ground	Note 7
12	RD-	Inv. Received Data Out	Note 8
13	RD+	Received Data Out	Note 8
14	VeeR	Receiver Ground	Note 7
15	VccR	Receiver Power	Note 9
16	VccT	Transmitter Power	Note 9
17	VeeT	Transmitter Ground	Note 7
18	TD+	Transmit Data In	Note 10
19	TD-	Inv. Transmit Data In	Note 10
20	VeeT	Transmitter Ground	Note 7

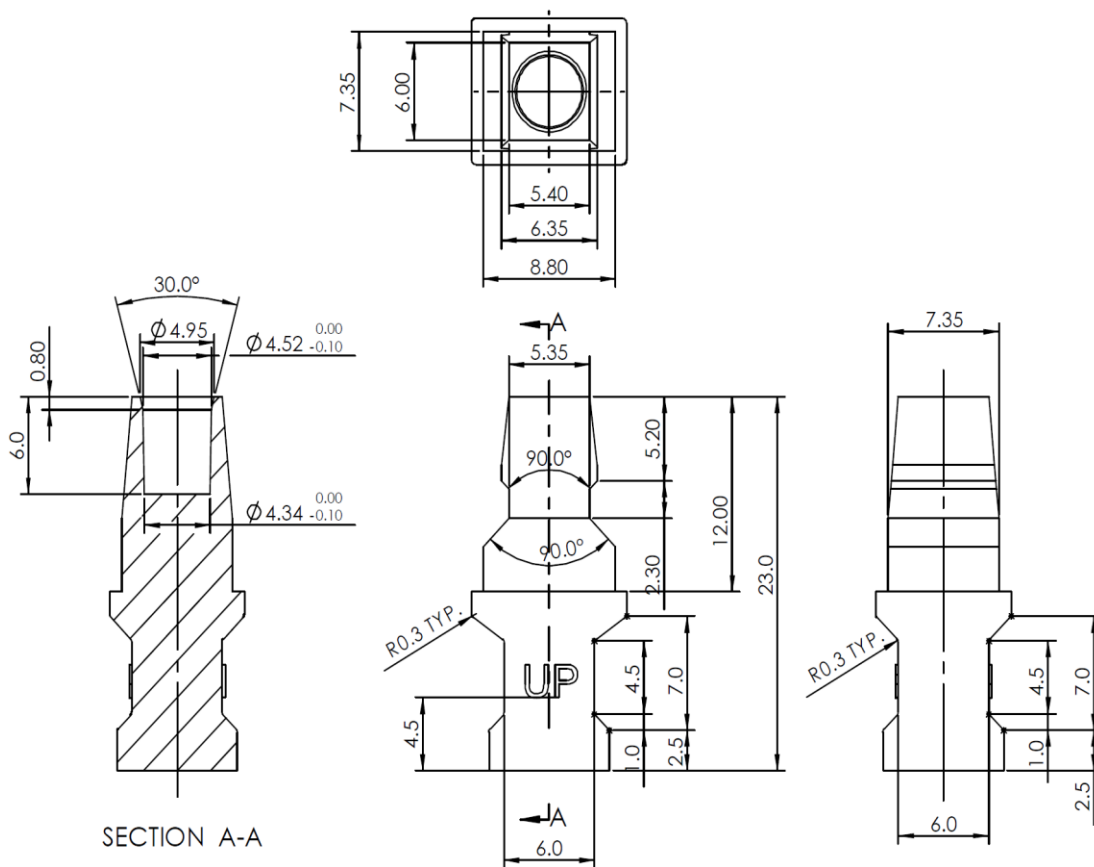
Notes:

1. TX Fault is an open collector/drain output, which should be pulled up with a 4.7K–10KΩ resistor on the user host board. Pull up voltage between 2.0V and $V_{ccT}/V_{ccR}+0.3$ V. When it is high level, output indicates a laser fault of some kind, and Low indicates normal operation.
2. TX disable is an external input which be used to shut down the transmitter optical output, it is pulled up in module.
3. SDA and SCL is communication interface for I²C . They should be pulled up with a 4.7K – 10KΩ resistor on the host board. The pull-up voltage should be V_{ccT} or V_{ccR} .
4. Reset is a LVTTL input which is used to clear receiver status before receiving the next burst packet.
5. SD is a LVTTL output. High level indicates that burst packet is detected by the receiver.
6. RSSI_Trigger is a LVTTL input from host for starting ADC of digital RSSI circuit to sample the analog RSSI signal.
7. VeeR and VeeT are connected inside the SFP OLT transceiver.
8. RD- and RD+ are LVPECL differential outputs of the receiver, and externally DC-coupled to 100Ω differential lines at the user host board.
9. V_{ccR} and V_{ccT} are the receiver and transmitter power supply, respectively. They are defined as 3.3V ±5% at the SFP connector pin. Maximum supply current is 500mA (surge current should be less than 2A when the module is plugged in or pulled out). Inductors with DC resistance of less than 1Ω should be used in order to maintain the required voltage at the SFP input pin with 3.3V supply voltage. V_{ccR} and V_{ccT} are internally connected inside the SFP OLT transceiver.
10. TD- and TD+ are the differential inputs to the transmitter. They are AC-coupled to differential lines with 100Ω differential termination inside the SFP OLT transceiver.

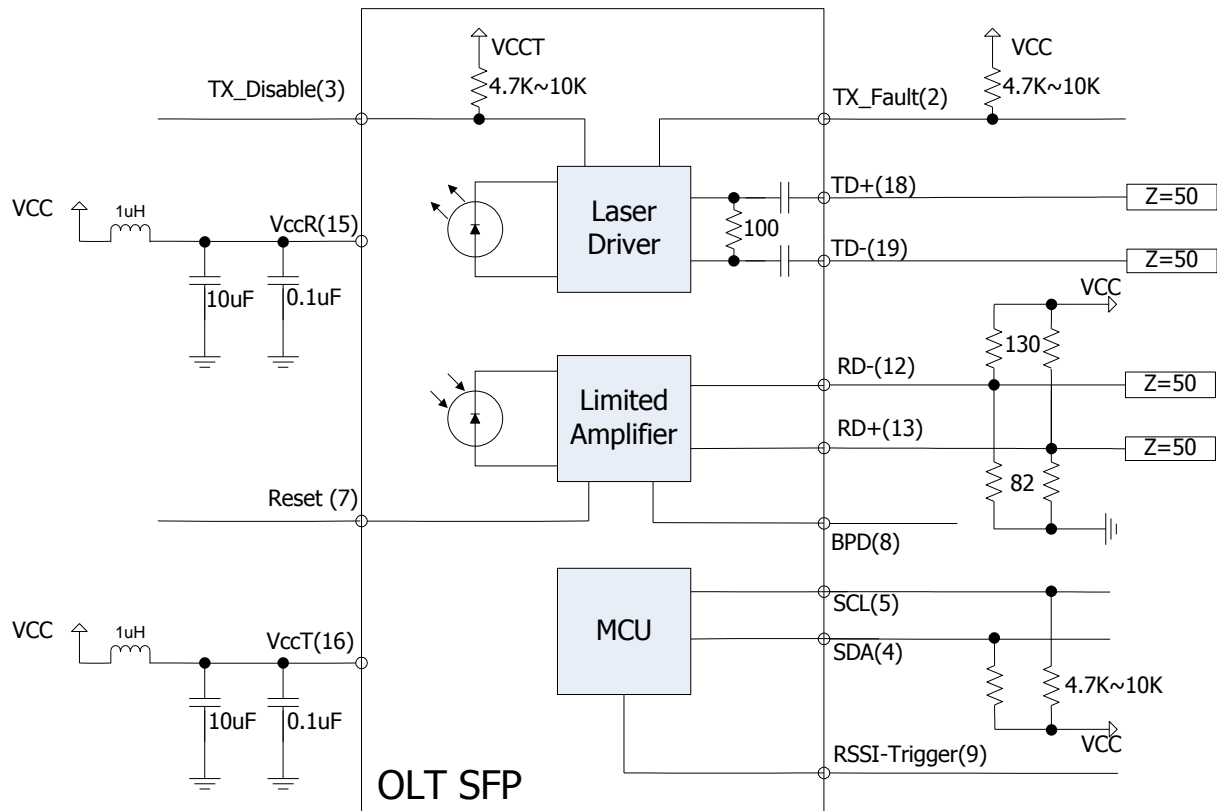
6 Mechanical dimension (Unit: mm)



7 Dust cap dimension (Unit: mm)



8 Recommended Circuit



9 EEPROM information.

9.1 EEPROM serial ID memory contents (A0h)

Address	Field Size (Byte)	Name of Field	Hex	Dec	Description
0	1	Identifier	03	3	SFP-GPON
1	1	Ext. Identifier	04	4	
2	1	Connector	01	1	SC
3-10	8	Transceiver	00 00 00 00 00 00 00 00	0 0 0 0 0 0 0 0	No defined
11	1	Encoding	03	3	NRZ
12	1	BR, Nominal	19	25	2.5 Gbps
13	1	Reserved	0	0	
14	1	Length (9um)-km	14	20	20(km)
15	1	Length (9um)	C8	200	200(100m)
16	1	Length (50um)	0	0	Not Support MMF

Address	Field Size (Byte)	Name of Field	Hex	Dec	Description
17	1	Length (62.5um)	0	0	Not Support MMF
18	1	Length (Copper)	0	0	Not Support Copper
19	1	Reserved	0	0	
20-35	16	Vendor name	4E 45 4F 50 48 4F 54 4F 4E 49 43 53 20 20 20 20	78 69 79 80 72 79 84 79 78 73 67 83 32 32 32 32	"NEOPHOTONICS" (ASCII)
36	1	Reserved	00	0	
37-39	3	Vendor OUI	00 21 06	0 21 6	Vender OUI of NEOPHOTONICS
(1)40-55	16	Vendor PN	33 38 4A 30 2D 36 35 33 37 45 2D 53 54 48 31 2B	51 56 74 48 45 54 53 51 55 69 45 83 84 72 49 43	"38J0-6537E-STH1+"(ASCII)
(2)40-55	16	Vendor PN	33 38 4A 30 2D 36 35 33 37 45 2D 53 54 48 32 2B	51 56 74 48 45 54 53 51 55 69 45 83 84 72 50 43	"38J0-6537E-STH2+"(ASCII)
(3)40-55	16	Vendor PN	33 38 4A 30 2D 36 35 33 37 45 2D 53 54 48 33 2B	51 56 74 48 45 54 53 51 55 69 45 83 84 72 51 43	"38J0-6537E-STH3+"(ASCII)
56-59	4	Vendor Rev	31 2E 30 20	49 46 48 32	"1.0" (ASCII)
60-61	2	Wavelength	05 D2	5 210	1490nm Laser Wavelength
62	1	Reserved	00	0	
63	1	CC_BASE	xx	xx	Check sum of byte 0-62
64-65	2	Options	00 1C	0 28	SD,TX_FAULT and TX_DISABLE
66	1	BR, max	00	0	
67	1	BR, min	00	0	
68-83	16	Vendor SN	xx.....xx	x...x	ASCII
84-91	8	Date code	YYMMDD 20 20	x...x	Year,Month,Day
92	1	Diagnostic Monitoring Type	58	88	Externally Calibrated Received power measurement type-Average Power
93	1	Enhanced Options	E0	224	Alarm/warning flags implemented Soft TX_DISABLE control and monitoring implemented Soft TX_FAULT monitoring implemented; Soft RX_LOS control and monitoring implemented

Address	Field Size (Byte)	Name of Field	Hex	Dec	Description
94	1	SFF-8472 Compliance	02	2	Diagnostics Compliance(SFF-8472 V9.5)
95	1	CC_EXT	xx	x	Check sum of byte 64-94
96-255	160	Vendor Specific	xx	x	Vendor Specific

9.2 Alarm and Warning Thresholds

Address	Field Size (Byte)	Bits	Name of Field	Description
00~01	2	ALL	Temp High Alarm Thresholds	MSB at low address,80°C
02~03	2	ALL	Temp Low Alarm Thresholds	MSB at low address,-13°C
04~05	2	ALL	Temp High Warning Thresholds	MSB at low address,75°C
06~07	2	ALL	Temp Low Warning Thresholds	MSB at low address,-8°C
08~09	2	ALL	Voltage High Alarm Thresholds	MSB at low address,3.6V
10~11	2	ALL	Voltage Low Alarm Thresholds	MSB at low address,3.0V
12~13	2	ALL	Voltage High Warning Thresholds	MSB at low address,3.5V
14~15	2	ALL	Voltage Low Warning Thresholds	MSB at low address,3.1V
16~17	2	ALL	Bias High Alarm Thresholds	MSB at low address,90mA
18~19	2	ALL	Bias Low Alarm Thresholds	MSB at low address,0mA
20~21	2	ALL	Bias High Warning Thresholds	MSB at low address,70mA
22~23	2	ALL	Bias Low Warning Thresholds	MSB at low address,0mA
24~25	2	ALL	TX Power High Alarm Thresholds	MSB at low address,10.5dBm
26~27	2	ALL	TX Power Low Alarm Thresholds	MSB at low address,3.5dBm
28~29	2	ALL	TX Power High Warning Thresholds	MSB at low address,10dBm
30~31	2	ALL	TX Power Low Warning Thresholds	MSB at low address,4dBm
32~33	2	ALL	RX Power High Alarm Thresholds	MSB at low address,-11 dBm
34~35	2	ALL	RX Power Low Alarm Thresholds	MSB at low address,-34dBm
36~37	2	ALL	RX Power High Warning Thresholds	MSB at low address,-12dBm
38~39	2	ALL	RX Power Low Warning Thresholds	MSB at low address, -33dBm
40~55	16	ALL	Reserved	Reserved
56~59	4	ALL	Rx_PWR(4)	Single precision floating point calibration data - Rx optical power. Bit 7 of byte 56 is MSB. Bit 0 of byte 59 is LSB. For "internally calibrated" devices, Rx_PWR(4) should be set to zero , and useless.
60~63	4	ALL	Rx_PWR(3)	Single precision floating point calibration data - Rx optical power. Bit 7 of byte 60 is MSB. Bit 0 of byte 63 is LSB. For "internally calibrated" devices, Rx_PWR(3) should be set to zero , and useless.
64~67	4	ALL	Rx_PWR(2)	Single precision floating point calibration data, Rx optical

Address	Field Size (Byte)	Bits	Name of Field	Description
				power. Bit 7 of byte 64 is MSB, bit 0 of byte 67 is LSB. For “internally calibrated” devices, Rx_PWR(2) should be set to zero, and useless.
68~71	4	ALL	Rx_PWR(1)	Single precision floating point calibration data, Rx optical power. Bit 7 of byte 68 is MSB, bit 0 of byte 71 is LSB. For “internally calibrated” devices, Rx_PWR(1) should be set to 1 , and useless.
72~75	4	ALL	Rx_PWR(0)	Single precision floating point calibration data, Rx optical power. Bit 7 of byte 72 is MSB, bit 0 of byte 75 is LSB. For “internally calibrated” devices, Rx_PWR(0) should be set to zero , and useless.
76~77	2	ALL	Tx_I(Slope)	Fixed decimal (unsigned) calibration data, laser bias current. Bit 7 of byte 76 is MSB, bit 0 of byte 77 is LSB. For “internally calibrated” devices, Tx_I(Slope) should be set to 1, and useless.
78~79	2	ALL	Tx_I(Offset)	Fixed decimal (signed two’s complement) calibration data, laser bias current. Bit 7 of byte 78 is MSB, bit 0 of byte 79 is LSB. For “internally calibrated” devices, Tx_I(Offset)should be set to zero , and useless.
80~81	2	ALL	Tx_PWR(Slope)	Fixed decimal (unsigned) calibration data, transmitter coupled output power. Bit 7 of byte 80 is MSB, bit 0 of byte 81 is LSB.For “internally calibrated” devices, Tx_PWR(Slope) should be set to 1 , and useless.
82~83	2	ALL	Tx_PWR(Offset)	Fixed decimal (signed two’s complement) calibration data, transmitter coupled output power. Bit 7 of byte 82 is MSB, bit 0 of byte 83 is LSB. For “internally calibrated” devices, Tx_PWR(Offset) should be set to zero , and useless.
84~85	2	ALL	T (Slope)	Fixed decimal (unsigned) calibration data, internal module temperature. Bit 7 of byte 84 is MSB, bit 0 of byte 85 is LSB.For “internally calibrated” devices,T(Slope) should be set to 1 , and useless.
86~87	2	ALL	T (Offset)	Fixed decimal (signed two’s complement) calibration data, internal module temperature. Bit 7 of byte 86 is MSB, bit 0 of byte 87 is LSB.For “internally calibrated” devices,T(Offset) should be set to zero , and useless.
88~89	2	ALL	V (Slope)	Fixed decimal (unsigned) calibration data, internal module supply voltage. Bit 7 of byte 88 is MSB, bit 0 of byte 89 is LSB. For “internally calibrated” devices, V(Slope)should be set to 1 , and useless.
90~91	2	ALL	V (Offset)	Fixed decimal (signed two’s complement) calibration data,

Address	Field Size (Byte)	Bits	Name of Field	Description
				internal module supply voltage. Bit 7 of byte 90 is MSB. Bit 0 of byte 91 is LSB. For "internally calibrated" devices, V(Offset) should be set to zero , and useless.
92~94	3	ALL	Reserved	Reserved
95	1	ALL	Checksum	Byte 95 contains the low order 8 bits of the sum of bytes 0 – 94.
96	1	ALL	Temperature MSB	Internally measured module temperature.
97	1	ALL	Temperature LSB	
98	1	ALL	Vcc MSB	Internally measured supply voltage in transceiver.
99	1	ALL	Vcc LSB	
100	1	ALL	TX Bias MSB	Internally measured TX Bias Current.
101	1	ALL	TX Bias LSB	
102	1	ALL	TX Power MSB	Measured TX output power.
103	1	ALL	TX Power LSB	
104	1	ALL	RX Power MSB	Measured RX input power.
105	1	ALL	RX Power LSB	
106~109	4	ALL	Reserved	Reserved
110	1	7	Reserved	Reserved
		6	Soft TX Disable	Read/write bit that allows software disable of laser. Writing '1' disables laser.
		5	Reserved	Reserved
		4	Reserved	Reserved
		3	Reserved	Reserved
		2	TX Fault	Tx Fail Status: 1=TX Fail; 0=TX Normal
		1	LOS	Signal Detect Status. Active High.
		0	Reserved	Reserved
111	1	ALL	Reserved	Reserved
112	1	7	Temp High Alarm	Set when internal temperature exceeds high alarm level.
		6	Temp Low Alarm	Set when internal temperature is below low alarm level.
		5	Vcc High Alarm	Set when internal supply voltage exceeds high alarm level.
		4	Vcc Low Alarm	Set when internal supply voltage is below low alarm level.
		3	TX Bias High Alarm	Set when TX Bias current exceeds high alarm level.
		2	TX Bias Low Alarm	Set when TX Bias current is below low alarm level.
		1	TX Power High Alarm	Set when TX output power exceeds high alarm level.
		0	TX Power Low Alarm	Set when TX output power is below low alarm level.
113	1	7	RX Power High Alarm	Set when Received Power exceeds high alarm level. For burst receiver, don't set this bit.
		6	RX Power Low Alarm	Set when Received Power is below low alarm level. For burst receiver, don't set this bit.

Address	Field Size (Byte)	Bits	Name of Field	Description
		5	Reserved	Reserved
		4	Reserved	Reserved
		3	Reserved	Reserved
		2	Reserved	Reserved
		1	Reserved	Reserved
		0	Reserved	Reserved
114	1	ALL	Reserved	Reserved
115	1	ALL	Reserved	Reserved
116	1	7	Temp High Warning	Set when internal temperature exceeds high warning level.
		6	Temp Low Warning	Set when internal temperature is below low warning level.
		5	Vcc High Warning	Set when internal supply voltage exceeds high warning level.
		4	Vcc Low Warning	Set when internal supply voltage is below low warning level.
		3	TX Bias High Warning	Set when TX Bias current exceeds high warning level.
		2	TX Bias Low Warning	Set when TX Bias current is below low warning level.
		1	TX Power High Warning	Set when TX output power exceeds high warning level.
		0	TX Power Low Warning	Set when TX output power is below low warning level.
117	1	7	RX Power High Warning	Set when Received Power exceeds high warning level. For burst receiver, don't set this bit.
		6	RX Power Low Warning	Set when Received Power is below low warning level. For burst receiver, don't set this bit.
		5	Reserved	Reserved
		4	Reserved	Reserved
		3	Reserved	Reserved
		2	Reserved	Reserved
		1	Reserved	Reserved
		0	Reserved	Reserved
118	1	ALL	Reserved	Reserved
119	1	ALL	Reserved	Reserved
120-127	8	ALL	Vendor Specific	Vendor Specific
128-247	120	ALL	User EEPROM	User writable EEPROM
248-255	8	ALL	Vendor Specific	Vendor Specific

10 Specification for Environmental Protection

The materials (excluded exempted material) comply with threshold value of RoHS6 banned substance in homogenous material.

11 Label Information

Schematic of the labeling on the SFP facet



12 Ordering Information

Part Number	Product Description	RoHS Compliant
38J0-6537E-STH1+	GPON SFP OLT with digital RSSI, 0~70C	RoHS-6
38J0-6537E-STH2+	GPON SFP OLT with digital RSSI, 0~70C	RoHS-6
38J0-6537E-STH3+	GPON SFP OLT with digital RSSI, 0~70C	RoHS-6

13 Change History

Version	Change Description	Changed by	Date
A	Initially issued	Mi Zhang	7/May/2015