



DATA SHEET

H650SFP

GPON SFP Stick

Issue History

Version	Date of Issue	Reason for Update
V1	09/2016	-. Initial release

1 Product Overview

1.1 Overview

The H650SFP is a Gigabit Passive Optical Network (GPON) Stick type ONT in a compact SFP package. The GPON Stick provides a pluggable GPON interface for FTTx and wireless backhaul applications with a compact size and lower power consumption.

The H650SFP supports a sophisticated ONT management system, including alarms, provisioning, and IGMP functions. The H650SFP can be managed from the OLT over the GPON using G.988 OMCI.

The H650SFP fits seamlessly into existing communications equipment, providing service providers with a smooth upgrade to GPON. The H650SFP solution vastly decreases the installation costs of deploying fiber access in MDUs and enables service providers to improve their revenue streams while decreasing OPEX.

The reduced complexity, reduced power consumption, and increased reliability of a single box solution are very attractive to both the operator and their customers or subscribers.

Our product includes transceiver in FTTx networks such as GPON sticks that provide “plug & play” PON interface for home-gateway, switches, routers, DSLAMs, BTS, EOCs.

1.2 Product Features

- Simplex SC Connector, Integrated Diplexer Transceiver
- SFP MSA, digital diagnostics SFF-8472 Compliant
- Compliance with ITU-T G.984.2
- 1244Mbps Tx, 2488Mbps Rx Asymmetric Data Rate
- OMCI supports per ITU-T G.988
- 28 dB link budget ; Class B+, 20 Km reach
- Compliant to IEC-60825 Class 1 laser diode
- RoHS compliant
- Providing pluggable GPON ONU interface for Ethernet switches, routers, DSLAMs, home gateway and other customer premises equipment

1.3 Service Scenario

By being plugged into the L2/L3 switch or CPE with standard SFP uplink port directly, the H650SFP provides a 1.244 Gbps upstream and a 2.488 Gbps downstream data link over a single fiber. Any standard Ethernet SFP switch port can simply convert to a GPON ONT port and interconnect to an existing GPON network with the insertion of the module.

The H650SFP supports many new applications, including FTTx and mobile/pico backhaul services without separate power supply and cables.

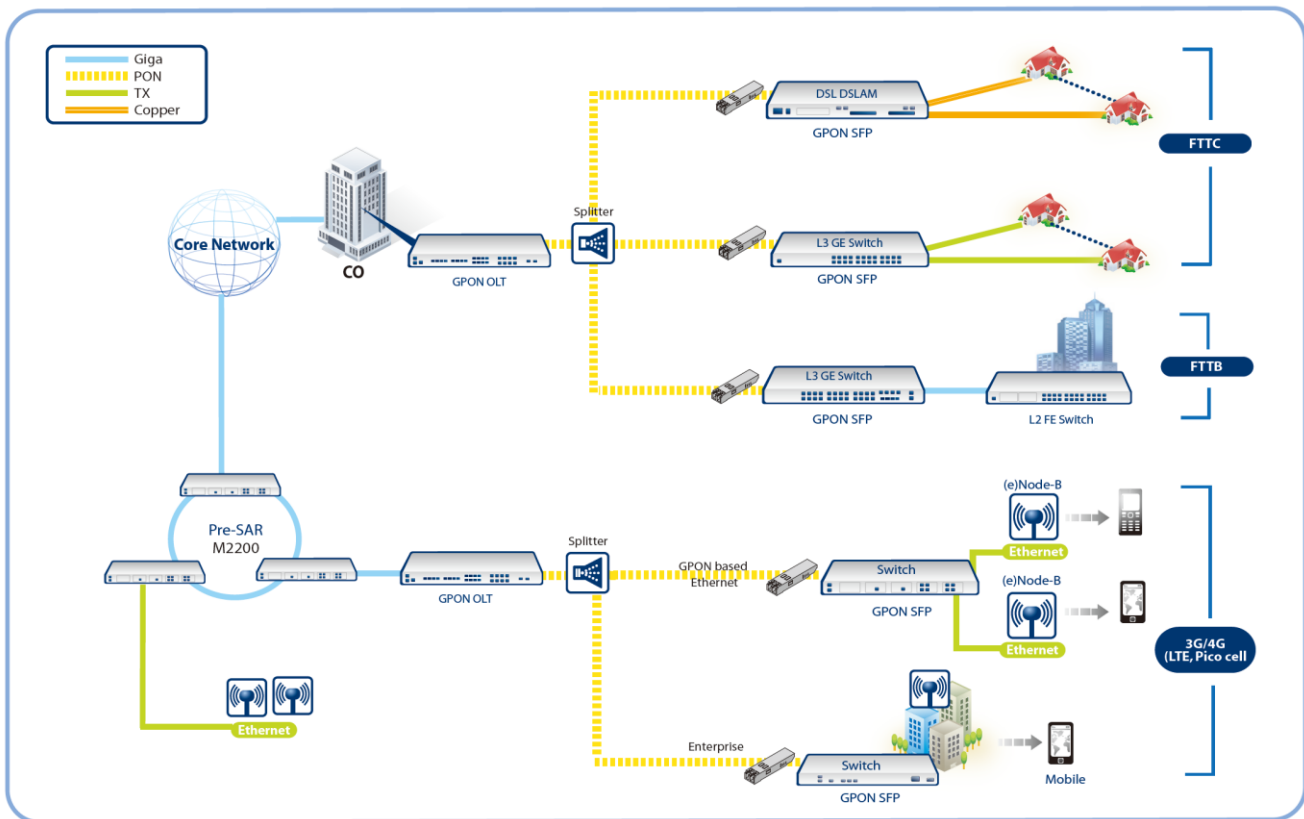


Figure 1 H650SFP Network Deployments

2 Product Specification

2.1 Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class 1 (>500V for data pins, >2000V for other pins)
Electrostatic Discharge (ESD) to the Duplex LC Receptacle	IEC 61000-4-2	Compatible with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022 Class B (CISPR 22B) VCCI Class B	Compatible with standards
Immunity	IEC 61000-4-3	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN(IEC) 60825-1, 2	Compatible with Class 1 laser product
RoHS	2011/65/EC	Compatible with standards

2.2 Absolute Maximum Ratings

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Storage Temperature	T _s	-40		+85	°C	
Power Supply Voltage	V _{cc_Rx}	-0.3		+4.2	V	
	V _{cc_Tx}	-0.3		V _{cc_Rx} +1	V	
Operating Relative Humidity	RH	5	-	95	%	

2.3 Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	T _c	-40		85	°C	
Operating Voltage	V _{cc}	3.14	3.30	3.46	V	
Total Tx and Rx Supply Current	I _{cc}	-	600	-	mA	
Power Dissipation	P _D	-	2.5	2	W	
Bit Rate (Tx)	BR		1244.16		Mbps	
Bit Rate (Rx)	BR		2488.32		Mbps	
Transmission Distance	TD			20,000	m	

2.4 Optical Characteristics

Parameter	Symbol	Min	Typical	Max.	Unit	Note
Transmitter						
Center Wavelength Range (CW)	λ_c	1290	1310	1330	nm	
Average Output Power	P_{OUT}	0.5	-	5	dBm	
Average Output Power (Laser Off)	$P_{OUT-OFF}$	-	-	-40	dBm	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	
Spectral Width (-20dB)	λ_{20}	-	-	1	nm	
Extinction Ratio	ER	10	-	-	dB	1
Optical Rise and Fall Time (20-80%)	T_R/T_F	-	-	250	ps	
Jitter Generation	JG	-	-	0.2	UI	2
Transmitter Output eye	Compliant with ITU-T G.984.2					
Receiver						
Center Wavelength Range	λ_c	1480	1490	1500	nm	
Receiver Overload		-8	-	-	dBm	
Average Rx Sensitivity	S_{en}	-28	-	-	dBm	3
Signal Detect Assertion Level	SDA	-	-	-29	dBm	
Signal Detect De-Assertion Level	SDD	-45	-	-	dBm	
Hysteresis	$P_{SDA-SDD}$	0.5	-	-	dB	
1310nm Tx to 1490 Rx Crosstalk		-	-	-47	dB	
1555nm Rx to 1490nm Isolation		30	-	-	dB	
(1550-1560nm) Ext to 1490 Rx Isolation		34	-	-	dB	
Back Reflection @1310nm		-	-	-12	dB	
Back Reflection @1490nm		-	-	-27	dB	
Rx Reflectance		-	-	-20	dB	
1530nm to 1490nm Rx Isolation		7	-	-	dB	
1539nm to 1490nm Rx Isolation		22	-	-	dB	
1625nm to 1490nm Rx Isolation		22	-	-	dB	

Notes:

Note1. Measured by Ethernet package with random payload

Note2. 4kHz to 10MHz

Note3. Measured with Ethernet package with random payload and ER=8.2dB, BER=10⁻¹²;

2.5 Electrical Characteristics

Transmitter						
Parameter	Symbol	Min.	Typical	Max.	Unit	Note
Differential Data Input Voltage	$V_{IN, P-P}$	300	-	1800	mVpp	4
Input Differential Impedance	Z_{in}	-	100	-	Ω	5
Tx Burst Enable Time	T_{BURST_EN}	-	-	12.86	ns	6
Tx Burst Disable Time	T_{BURST_DIS}	-	-	12.86	ns	6
Tx Disable Assert Time	T_{DIS_A}	-	-	10	μ s	
Tx Disable De-assert Time	T_{DIS_D}	-	-	1	ms	
Receiver						
Differential Output Voltage		300	-	1200	mV	7
Signal Detect Output HIGH Voltage	V_{SD_High}	2.4	-	-	V	8
Signal Detect Output LOW Voltage	V_{SD_Low}	0	-	0.8	V	9
Data Output Rise and Fall Time	T_R/T_F	-	160	-	ps	

Notes:

4. TXD+/- . DC-coupled.
5. TXD+/-
6. 16 bits data @1244Mbps
7. CML output, AC coupled (0.1 μ F)
8. LVTTTL with internal 1k Ω pull up resistor. Asserts HIGH when input data amplitude is above threshold.
9. LVTTTL De-asserts LOW when input data amplitude is below threshold.

2.6 Pin Definitions

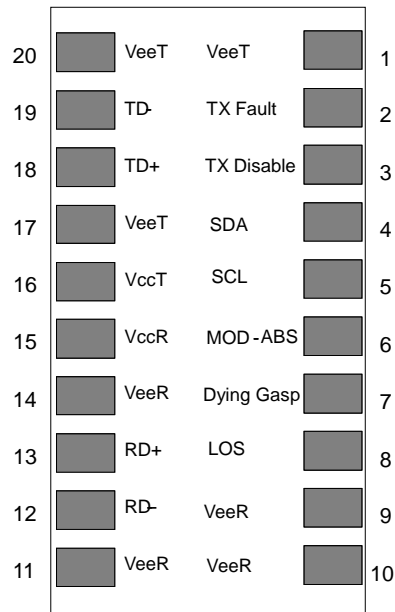


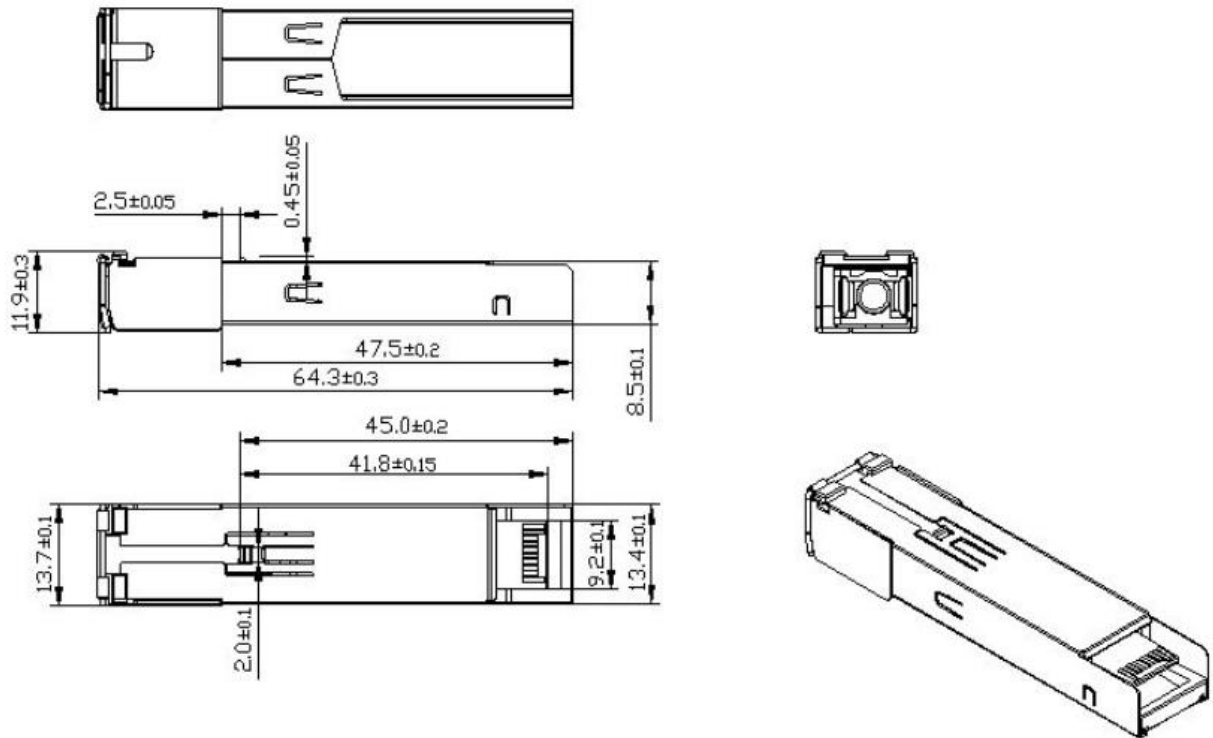
Figure 2 Pin Assignment

Pin	Symbol	Logic	Name/Description	Notes
1	VeeT	NA	Module Transmitter Ground	
2	TX_FAULT	LVTTL-O	Module Transmitter Fault.	
3	TX_DISABLE	LVTTL-I	Transmitter shut-off	
4	SDA	LVTTL-I/O	2-Wire serial interface Data Line (MOD-DEF2)	1
5	SCL	LVTTL-I	2-Wire serial interface clock (MOD-DEF1)	1
6	MOD_ABS	NA	Module Absent, connected to VeeT or VeeR in the module	
7	DYING GASP	LVTTL-I	Dying Gasp message indicator	
8	RX_SD	LVTTL-O	Receiver Signal Detect	
9	VeeR	NA	Module Receiver Ground	
10	VeeR	NA	Module Receiver Ground	
11	VeeR	NA	Module Receiver Ground	
12	RXD-	CML-O	Receiver Inverted DATA output	
13	RXD+	CML-O	Receiver Non-inverted DATA output	
14	VeeR	NA	Module Receiver Ground	
15	VccR	NA	Module Receiver 3.3V Supply	
16	VccT	NA	Module Transmitter 3.3V Supply	
17	VeeT	NA	Module Transmitter Ground	
18	TXD+	CML-I	Transmitter Non-Inverted DATA input, CML, 100ohm differential impedance	
19	TXD-	CML-I	Transmitter Inverted DATA input, CML, 100ohm differential impedance	
20	VeeT	NA	Module Transmitter Ground	

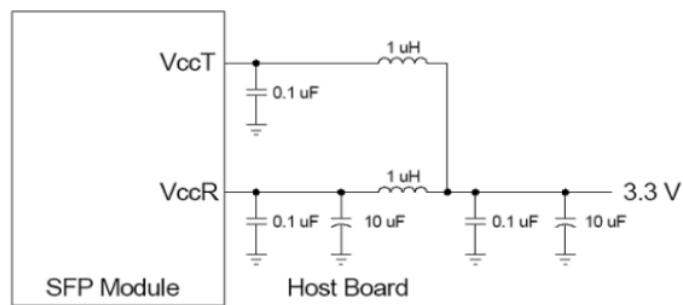
Note

1. This pin is an open collector/drain output pin and shall be pulled with 4.7K-10K ohms to a Host_Vcc on the hos board.

2.7 Mechanical Specifications (unit: mm)



2.8 Recommended Host Board Power Supply Circuit



2.9 EEPROM Information

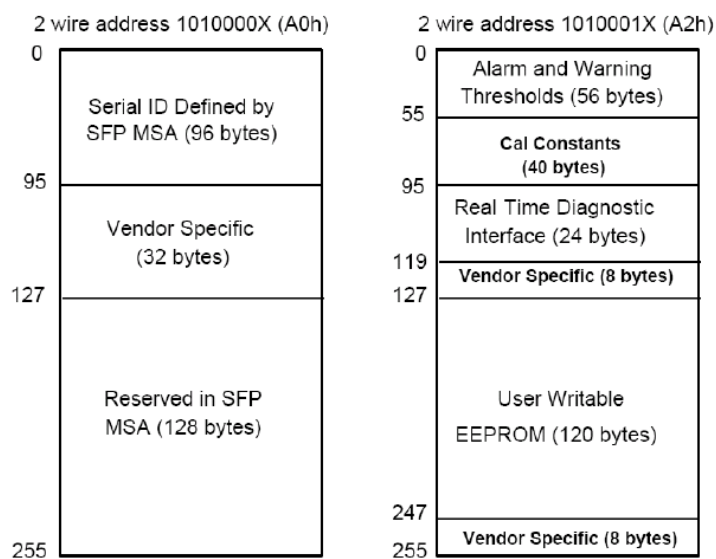


Table 1 EEPROM Memory Content (A0h)

Addr.	Field Size (Bytes)	Name of Field	Hex	Description
0	1	Identifier	03	SFP transceiver
1	1	Ext. Identifier	04	MOD4
2	1	Connector	01	SC
3-10	8	Transceiver	00 00 00 00 00 00 00 00	
11	1	Encoding	03	NRZ
12	1	BR, Nominal	0C	1.244Gbps
13	1	Reserved	00	
14	1	Length (9um)-km	14	20(km)
15	1	Length (9um)	C8	200(100m)
16	1	Length (50um)	00	Not Support MMF
17	1	Length(62.5um)	00	Not Support MMF
18	1	Length (Copper)	00	Not Support Copper
19	1	Reserved	00	
20-35	16	Vendor name		
36	1	Reserved	00	
37-39	3	Vendor OUI	00 00 00	
40-55	16	Vendor PN	53 50 53 33 34 32 34 54 48 50 54 44 46 4F 20 20	
56-59	4	Vendor Rev	xx xx 20 20	ASCII

Addr.	Field Size (Bytes)	Name of Field	Hex	Description
60-61	2	Wavelength	83 95	60: 0x83 is expected for 1310nm 61: 0x95 is expected for 1490nm
62	1	Reserved	00	
63	1	CC_BASE	xx	Check sum of byte 0-62
64-65	2	Options	00 1A	64 = 0x00, reserved 65 = 0x1A, TX_DISABLE / TX_FAULT/RX_LOS supported
66	1	BR, max	00	
67	1	BR, min	00	
68-83	16	Vendor SN	xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx xx	ASCII
84-91	8	Date code	xx xx xx xx xx xx 20 20	Year(2 bytes), Month(2 bytes), Day(2 bytes)
92	1	Diagnostic Monitoring Type	68	Compliant with SFF-8472 V10.3 Internally Calibrated Received power measurement type – Average Power
93	1	Enhanced Options	F0	Diagnostics (Optional Alarm/warning flags) Soft TX_FAULT monitoring implemented. Soft RX_LOS monitoring implemented.
94	1	SFF-8472 Compliance	05	Indicates the revision of SFF-8472 with which the transceiver complies. Value depends on module features.
95	1	CC_EXT	xx	Check sum of byte 64-94
96-255	64	Vendor Specific		

Table 2 EEPROM Memory Content (A2h)

Addr.		Field Size (Bytes)	Name of Field	Hex	Description
0	00	2	Temp High Alarm	64 00	100°C
2	02	2	Temp Low Alarm	CE 00	-50°C
4	04	2	Temp High Warning	5F 00	95°C
6	06	2	Temp Low Warning	D8 00	-40°C
8	08	2	Voltage High Alarm	8C A0	3.6V
10	0A	2	Voltage Low Alarm	75 30	3.0V
12	0C	2	Voltage High Warning	88 B8	3.5V
14	0E	2	Voltage Low Warning	79 18	3.1V
16	10	2	Bias High Alarm	AF C8	90mA
18	12	2	Bias Low Alarm	00 00	0mA
20	14	2	Bias High Warning	88 B8	70mA
22	16	2	Bias Low Warning	00 00	0mA
24	18	2	TX Power High Alarm	7B 86	5dBm
26	1A	2	TX Power Low Alarm	22 D0	-0.5dBm
28	1C	2	TX Power High Warning	6E 17	4.5dBm
30	1E	2	TX Power Low Warning	27 10	0dBm
32	20	2	RX Power High Alarm	07 CB	-7dBm
34	22	2	RX Power Low Alarm	00 0F	-28dBm
36	24	2	RX Power High Warning	06 30	-8dBm
38	26	2	RX Power Low Warning	00 14	-27dBm
40-45	28-2D	6	MAC address	xx xx xx xx xx xx	MAC address
46-55	2E-37	10	Reserved	00.....000	Reserved
56	38	4	RX_PWR(4) Calibration	00 00 00 00	4 th order RSSI calibration coefficient
60	3C	4	RX_PWR(3) Calibration	00 00 00 00	3 rd order RSSI calibration coefficient
64	40	4	RX_PWR(2) Calibration	00 00 00 00	2 nd order RSSI calibration coefficient
68	44	4	RX_PWR(1) Calibration	3F 80 00 00	1 st order RSSI calibration coefficient
72	48	4	RX_PWR(0) Calibration	00 00 00 00	0 th order RSSI calibration coefficient
76	4C	2	TX_I(Slope) Calibration	01 00	Slope for Bias calibration
78	4E	2	TX_I(Offset) Calibration	00 00	Offset for Bias calibration
80	50	2	TX_PWR(Slope) Calibration	01 00	Slope for TX power calibration
82	52	2	TX_PWR(Offset) Calibration	00 00	Offset for TX power calibration
84	54	2	T(Slope) Calibration	01 00	Slope for Temperature calibration
86	56	2	T(Offset) Calibration	00 00	Offset for Temperature calibration
88	58	2	V(Slope) Calibration	01 00	Slope for VCC calibration
90	5A	2	V(Offset) Calibration	00 00	Offset for VCC calibration
92	5C	3	Reserved	00 00 00	Reserved
95	5F	1	Checksum	Xx	Checksum
96	60	2	Transceiver Temp.	xx xx	Temperature in C/256

Addr.		Field Size	Name of Field	Hex	Description
98	62	2	Supply Voltage	xx xx	Vcc
100	64	2	TX Bias Current	xx xx	BIASMON
102	66	2	TX Optical Output Power	xx xx	Back facet monitor
104	68	2	RX Optical Input Power	xx xx	RSSI
106	6A	2	Reserved	00 00	Reserved
108	6C	2	Reserved	00 00	Reserved
110	6E.7	1bit	TX_DIS State	x	Soft TX disable state
	6E.6		Soft TX Disable	x	Write bit that allows software disable laser output
	6E.5		Reserved	0	Reserved
	6E.4		Rate Select State	0	Not supported
	6E.3		Rate Select	0	Not supported
	6E.2		TX_FAULT	x	Digital state of the TX Fault Output
	6E.1		Rx LOS	x	Digital state of the RX LOS Output
	6E.0		Data Ready Bar	x	Indicates transceiver has achieved power up and data is ready
111	6F.7	1bit	Reserved	0	Reserved
	6F.6			0	
	6F.5			0	
	6F.4			0	
	6F.3			0	
	6F.2			x	
	6F.1			0	
	6F.0			x	
112	70.7	1bit	Temp. too high alarm	x	Temperature too high alarm
	70.6		Temp. too low alarm	x	Temperature too low alarm
	70.5		VCC too high alarm	x	VCC too high alarm
	70.4		VCC too low alarm	x	VCC too low alarm
	70.3		BIASMON too high alarm	x	BIASMON too high alarm
	70.2		BIASMON too low alarm	x	BIASMON too low alarm
	70.1		TX Power too high alarm	x	TX Power too high alarm
	70.0		TX Power too low alarm	x	TX Power too low alarm
113	71.7	1bit	RX Power too high alarm	x	RX Power too high alarm
	71.6		RX Power tool low alarm	x	RX Power tool low alarm
	71.5		ROGUE ONU alarm	x	"0"=no rogue ONU alarm "1"= rogue alarm
	71.4		Reserved interrupt status bit	x	Reserved interrupt status bit
	71.3			x	
	71.2			x	
	71.1			x	
	71.0			x	

Addr.		Field Size	Name of Field	Hex	Description	
114	72	1	Reserved	00	Reserved	
115	73	1	Reserved	00	Reserved	
116	74.7	1bit	Temp. too high warning	x	Temperature too high warning	
	74.6		Temp. too low warning	x	Temperature too low warning	
	74.5		VCC too high warning	x	VCC too high warning	
	74.4		VCC too low warning	x	VCC too low warning	
	74.3		BIASMON too high warning	x	BIASMON too high warning	
	74.2		BIASMON too low warning	x	BIASMON too low warning	
	74.1		TX Power too high warning	x	TX Power too high warning	
	74.0		TX Power too low warning	x	TX Power too low warning	
117	75.7	1bit	RX Power too high warning	x	RX Power too high warning	
	75.6		RX Power too low warning	x	RX Power too low warning	
	75.5		Reserved interrupt status bit	Reserved interrupt status bit	0	Reserved interrupt status bit
	75.4				0	
	75.3				0	
	75.2				0	
	75.1				0	
	75.0				0	
118	76.	1	Reserved	00	Reserved	
119	77	1	Reserved	00	Reserved	
120	78	8	Vendor Specific	00 00 00 00 00 00 00 00	Vendor Specific	

Table 3 Digital Diagnostic Specification (A2h)

Data Addr.	Parameter	Range	Accuracy
96-97	Temperature	-40 to 85°C	± 3°C
98-99	Vcc Voltage	0 to Vcc	± 3%
100-101	Bias Current	0 to 131mA (Note)	± 10%
102-103	TX Power	-10 to 8dBm	± 2dBm
104-105	RX Power	-34 to -8dBm	± 2dBm

Note: Only for continuous mode

2.10 Ordering Information

Part Number	Description
H650SFP	GPON ONT (Class B+, ITU-T G.984) / SFP Module - PON MAC - Wavelength: 1490nm/1310nm, Mode: Singlemode - Connector: SC/APC - Data rate: 2488 Mbps (Down), 1244 Mbps (Up) - Core type: SingleCore - Operating Temperature: -40°C ~ 85 °C - SFF-8472 MSA compliant