



### Features

- Burst receive GPON Class C+ CWDM OLT transceiver with RSSI
- Small Form Factor Pluggable, Dual LC Connector
- "Fast Signal Detect" feature reduces ranging overhead
- Simplified OLT "reset" timing
- CWDM DFB Tx with isolator
- 1310 nm APD Rx
- 2488 Mbps downstream Tx/1244 Mbps upstream Rx
- Single 3.3 V supply
- ITU-T G.984.2 compliant
- 20 km reach; 30 dB link budget
- RoHS compliant

## General Parameters

Table 1 – General Operating Parameters

Parameter	Minimum	Typical	Maximum	Unit/Conditions
Operating Voltage, Vcc	3.135	3.3	3.465	V
Total Current, Icc	-	-	550	mA
Case Operating Temperature	0	-	70	°C
Storage Temperature	-40	-	85	°C

Table 1 – General Optical Parameters

Parameter	Minimum	Typical	Maximum	Unit/Conditions
Back Reflection at 1490 nm	-	-	-20	dB
Back Reflection at 1310 nm	-	-	-20	dB

## Functional Characteristics

The following tables list the performance specifications for the various functional blocks of the integrated optical transceiver module.

**Table 2 – Transmitter Specifications (Optical)**

Parameter	Minimum	Typical	Maximum	Unit	Notes
Average Optical Output Power, P <sub>o</sub> (BOL)	4.0	-	7	dBm	
Average Optical Output Power, P <sub>o</sub> (EOL)	3.0		7	dBm	
Output Power at Transmit Off	-	-	-40	dBm	
Extinction Ratio	8.2	-	-	dB	PRBS 2 <sup>23</sup> -1, NRZ, 50% duty cycle
Transmitter Output Eye	G.984.2 Figure 2				
Optical Rise and Fall Time	-	-	160	ps	20% to 80%
Center Wavelength1, λ <sub>1</sub>	1445.5	1451	1454.0	nm	a)
Center Wavelength2, λ <sub>2</sub>	1465.5	1471	1474.0	nm	a)
Center Wavelength3, λ <sub>3</sub>	1485.5	1491	1494.0	nm	a)
Center Wavelength4, λ <sub>4</sub>	1505.5	1511	1514.0	nm	a)
Center Wavelength5, λ <sub>5</sub>	1525.5	1531	1534.0	nm	a)
-20 dB Spectral Width	-	-	1	nm	
Side Mode Suppression Ratio (SMSR)	30	-	-	dB	
Bit Rate	-	2488	-	Mbps	
Tolerance to TX Back Reflection <sup>b</sup>	-15	-	-	dB	

a) The max and min wavelength tolerance value may be subjected to change.

b) 1 dB degradation of ONT Rx sensitivity. TBD.

**Table 4 – Transmitter Specifications (Electrical)**

Parameter	Minimum	Typical	Maximum	Unit	Notes
Input Differential Impedance	80	100	120	Ω	
Differential Data Input Swing	200	-	1600	mV	
Tx Disable (LVTTL)	2	-	V <sub>cc</sub>	V	
Tx Enable (LVTTL)	0	-	0.8	V	
TX_Fail_High	2.4	-	V <sub>cc</sub>	V	
TX_Fail_Normal	0	-	0.4	V	

**Table 5 – Receiver Specifications (Optical)**

Parameter	Minimum	Typical	Maximum	Unit	Notes
Operational Wavelength Range	1260	1310	1610	nm	TBD
Data Rate (burst mode)	-	1244	-	Mbps	
Receiver Burst-Mode Sensitivity	-	-	-30	dBm	At 10 <sup>-10</sup> BER, PRBS 2 <sup>23</sup> -1

Parameter	Minimum	Typical	Maximum	Unit	Notes
Receiver Overload	-12	-	-	dBm	
Burst Detect Assert	-	-	-33	dBm	
Burst Detect De-Assert	-45			dBm	
Receiver Burst Mode Dynamic Range	15	20	-	dB	Input power difference between two subsequent high and low burst data
Damage Threshold for Receiver	+5	-	-	dBm	
Maximum Reflectance of Receiver	-	-	-20	dB	

**Table 6 – Receiver Specifications (Electrical)**

Parameter	Minimum	Typical	Maximum	Unit	Notes
PECL Differential Data Output Swing (LVPECL)	400	-	1600	mV	
Data Output Rise Time	-	250	-	ps	20% to 80%
Data Output Fall Time	-	250	-	ps	20% to 80%
Signal Detect Output HIGH	2.4	-	Vcc	V	
Signal Detect Output LOW <sup>a</sup>	0	-	0.4	V	
Signal Detect Response Time	-	-	12.8	ns	

a) Signal Detect assert low when module receive “reset” signal, assert high when incoming burst is detected and latch to high state until next “Reset” signal.

**Table 7 – Digital RSSI Timing Specification**

Parameter	Minimum	Typical	Maximum	Unit	Notes
RSSI Trigger Delay <sup>a</sup>	25	-	-	ns	
RSSI Sampling Time <sup>a</sup>	300	-	-	ns	
Internal I <sup>2</sup> C Delay <sup>a</sup>	-	-	500	us	
Receiver Power DDM (RSSI) Error <sup>b</sup>	-	-	+/- 3	dB	

a) RSSI\_ACQ input signal rising edge will trigger RSSI sampling, and falling edge will trigger internal digital RSSI information written to I2C. It is recommended that host shall not trigger RSSI\_ACQ input again until RSSI data is valid in I2C from previous RSSI trigger.

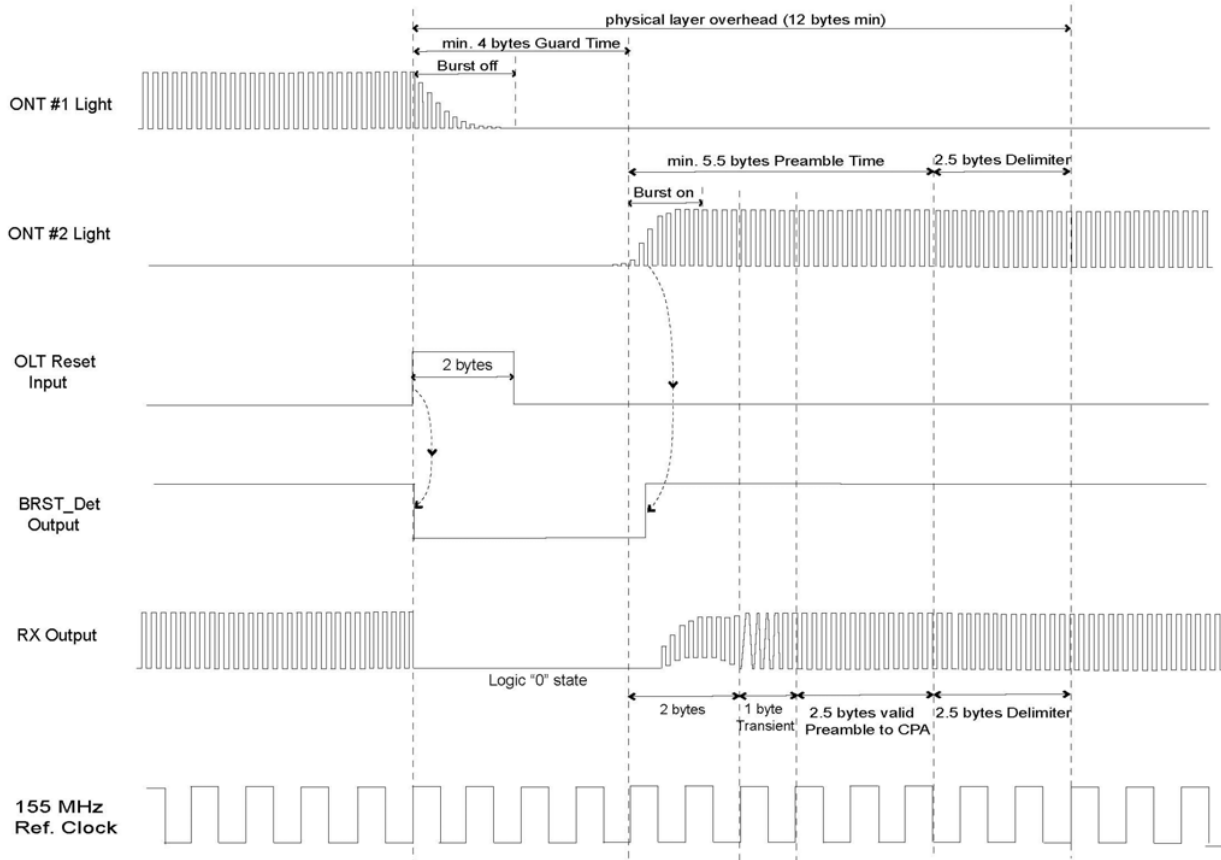
b) RSSI DDM working range is between -12 to -32 dBm. RSSI DDM accuracy is better than +/- 3dB for input power levels between -15 to -32 dBm, the accuracy reduces to +/- 5 dB for input power level larger between -12 to -15dBm. Testing condition is ONT ER 10dB.

## Pin Definitions

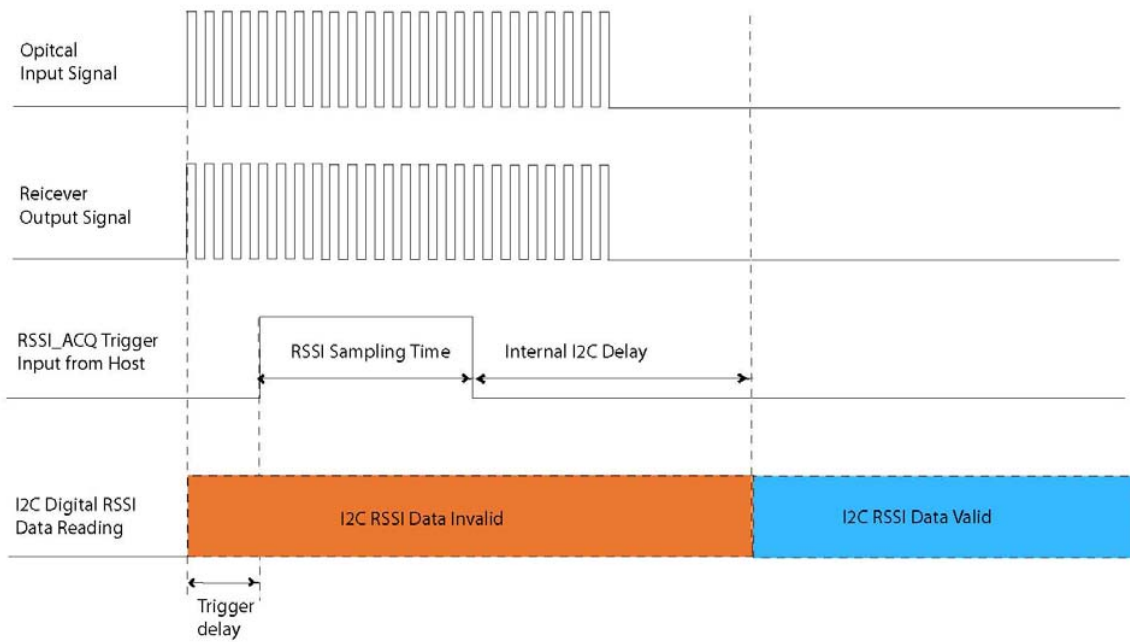
Refer to Table for a description of the function of each I/O pin.

Pin Number	Label	Definition
1	Veet	Tx Ground
2	Tx_Fail (Tx_Fault)	Tx Fail Alarm. LVTTTL Output Active High
3	Tx_Disable	Tx Disable. LVTTTL input. Laser output is disabled when this pin is asserted high or left unconnected. Laser output is enabled when this pin is asserted low.
4	MOD_DEF (2)	2-Wire Serial Data I/O Pin.
5	MOD_DEF (1)	2-Wire Serial Clock Input.
6	MOD_DEF (0)	Internally Grounded
7	Reset	CMOS input. Assert "Reset" high at the end of previous burst, 2 bytes in duration
8	SD	LVTTTL output. BRST_Det assert low when module receives "reset" signal, assert high when incoming burst is present.
9	RSSI_Trig	RSSI acquire/hold LVTTTL Input. Digital RSSI output through I2C
10	Veer	Rx Ground
11	Veer	Rx Ground
12	RXD-	Negative Data Output, LVPECL; DC coupled
13	RXD+	Positive Data Output, LVPECL; DC coupled
14	Veer	Rx Ground
15	Vcc_R	Rx Vcc
16	Vcc_T	Tx Vcc
17	Veet	Tx Ground
18	TXD+	Positive Data Input, LVPECL or CML (AC coupled; internally 100 ohms differential termination)
19	TXD-	Negative Data Input, LVPECL or CML (AC coupled; internally 100 ohms differential termination)
20	Veet	Tx Ground

## Timing Diagram



## Digital RSSI Acquire/Hold Timing Specification



**Table 8 – EEPROM Content (A0h)**

I2C A0h Address					
DEC Addr.	HEX Addr.	Field Size (bytes)	Name	Default Value	Description
0	00	1	Identifier	03h	SFP transceiver
1	01	1	Extended Identifier	04h	Function defined by serial ID
2	02	1	Connector	01h	SC Receptacle
3	03	8	Transceiver	00 00 00 00 00 00 00 00h	Transceiver Code Field, not applicable
11	0B	1	Encoding	03h	NRZ encoding
12	0C	1	Nominal Bit Rate in 100 MBps	19h	2488.32 Mbps
13	0D	1	Reserved	00h	Reserved
14	0E	1	Length (9 $\mu$ ,km) in km	14h	20km
15	0F	1	Length (9 $\mu$ ,m) in 100m	C8h	20km
16	10	1	Length (50 $\mu$ ) in 10m	00h	Not Supported
17	11	1	Length (62.5 $\mu$ ) in 10m	00h	Not Supported
18	12	1	Length (Copper) in m	00h	Not Supported
19	13	1	Reserved	00h	Reserved
20	14	16	Vendor Name (ASCII)	"SOURCEPHOTONICS"	Vendor Name (ASCII)
36	24	1	Reserved	00h	Reserved
37	25	3	Vender IEEE Company ID	00 06 B5h	Source Photonics IEEE ID
40	28	16	Vendor Part Number (ASCII)	"SPWLC48HPCDFHW"	Vendor Part Number
56	38	4	Vendor Rev (ASCII)	31 20 20 20h	Revision
60	3C	2	Laser Wavelength in nm	05 D2h	1491nm Tx Wavelength
62	3E	1	Reserved	00h	Reserved
63	3F	1	Check Code for Base ID Fields	xxh	Checksum from byte 0-62
64	40	2	Options	00 1Ch	TX_DIS, TX_Fault, SD
66	42	1	Upper Bit Rate Margin in %	00h	BR, Max not specified
67	43	1	Lower Bit Rate Margin in %	00h	BR, Min not specified
68	44	16	Vendor Serial Number (ASCII)	"xxxxxxxxxxxxxxxx"	16 byte Serial number field (ASCII)

84	54	8	Date Code	xx xx xx xx xx xx 20 20h	Year(2 bytes) month(2 bytes) day(2 bytes)
92	5C	1	Diagnostic Monitoring Type	58h	Ext Calibration, Average Power Measurement
93	5D	1	Enhanced Options	E0h	Optical Alarm/warning implemented Soft TX_DIS, TX_FAULT implemented
94	5E	1	SFF-8472 Compliance	02h	Compliance to SFF-8472 Rev 9.4
95	5F	1	Check Code for Extended ID Fields	xxh	Checksum from byte 64-69
96	60	26	Vendor Specific	"SPWLC48HCPCDFHW"	SP Part Number
126	7E	2	Vendor Specific	00 00h	Reserved
128	80	128	Reserved	00....00h	Reserved; return to 0

Note: The "xx" byte should be filled in according to practical case. For more information, please refer to the related document of SFF-8472 Rev 9.5.

**Table 9 – EEPROM Content (A2h)**

**I2C A2h Address**

DEC Addr.	HEX Addr.	Field Size (bytes)	Name	Default Value	Description
0	00	2	Temp High Alarm	xx xxh	High temperature alarm
2	02	2	Temp Low Alarm	xx xxh	Low temperature alarm
4	04	2	Temp High Warning	xx xxh	Temperature high warning threshold
6	06	2	Temp Low Warning	xx xxh	Temperature high warning threshold
8	08	2	Voltage High Alarm	94 70h	3.8V
10	0A	2	Voltage Low Alarm	6D 60h	2.8V
12	0C	2	Voltage High Warning	8C A0h	3.6V
14	0E	2	Voltage Low Warning	75 30h	3.0V
16	10	2	Bias High Alarm	83 81h	110mA
18	12	2	Bias Low Alarm	02 64h	2mA
20	14	2	Bias High Warning	77 8Ch	100mA
22	16	2	Bias Low Warning	03 96h	3mA
24	18	2	TX Power High Alarm	xx xxh	+7.5 dBm
26	1A	2	TX Power Low Alarm	xx xxh	+3.5dBm
28	1C	2	TX Power High Warning	xx xxh	+7.0dBm
30	1E	2	TX Power Low Warning	xx xxh	+3.0dBm
32	20	2	RX Power High Alarm	FF FFh	No alarm

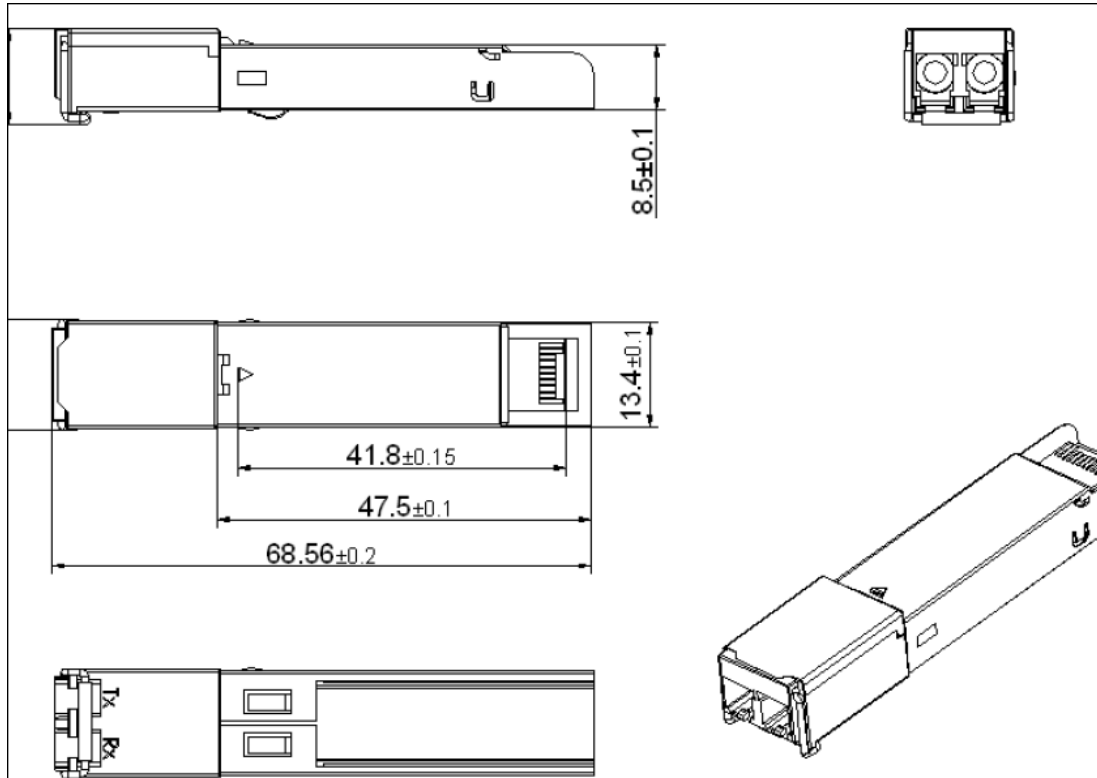


34	22	2	RX Power Low Alarm	00 00h	No alarm
36	24	2	RX Power High Warning	FF FFh	No alarm
38	26	2	RX Power Low Warning	00 00h	No alarm
40	28	16	Reserved	00...000h	Reserved
56	38	4	RX_PWR(4) Calibration	xx xx xx xxh	4 <sup>th</sup> order RSSI calibration coefficient
60	3C	4	RX_PWR(3) Calibration	xx xx xx xxh	3 <sup>rd</sup> order RSSI calibration coefficient
64	40	4	RX_PWR(2) Calibration	xx xx xx xxh	2nd order RSSI calibration coefficient
68	44	4	RX_PWR(1) Calibration	xx xx xx xxh	1 <sup>st</sup> order RSSI calibration coefficient
72	48	4	RX_PWR(0) Calibration	xx xx xx xxh	0 <sup>th</sup> order RSSI calibration coefficient
76	4C	2	TX_I(Slope) Calibration	01 A3h	Slope for Bias calibration
78	4E	2	TX_I(Offset) Calibration	00 00h	Offset for Bias calibration
80	50	2	TX_PWR(Slope) Calibration	xx xxh	Slope for TX Power calibration
82	52	2	TX_PWR(Offset) Calibration	00 00h	Offset for TX Power calibration
84	54	2	T(Slope) Calibration	01 00h	Slope for Temperature calibration
86	56	2	T(Offset) Calibration	xx xxh	Offset for Temperature calibration, in units of 256ths C
88	58	2	V(Slope) Calibration	01 00h	Slope for VCC calibration
90	5A	2	V(Offset) Calibration	00 00h	Offset for VCC calibration
92	5C	3	Reserved	00h	reserved
95	5F	1	Checksum	xxh	Checksum
96	60	2	Transceiver Temperature	xx xxh	Temperature in C/256
98	62	2	Supply Voltage	xx xxh	Vcc
100	64	2	TX Bias Current	xx xxh	BIASMON
102	66	2	TX Optical Output Power	xx xxh	Back facet monitor
104	68	2	RX Optical Input Power	xx xxh	RSSI
106	6A	2	Reserved	0000h	Reserved
108	6C	2	Reserved	0000h	Reserved
110	6E.7	1bit	TX_DIS State	x	Digital state of the TX Disable Input Pin.
	6E.6	1bit	Soft TX Disable	x	Read/write bit that allows software disable of laser.
	6E.5	1bit	Reserved.	0	Reserved.
	6E.4	1bit	Rate Select State	0	NOT SUPPORTED.
	6E.3	1bit	Rate Select	0	NOT SUPPORTED.
	6E.2	1bit	TX_FAULT	x	Digital state of the TX Fault Output Pin.
	6E.1	1bit	LOS	0	Digital state of the LOS Output Pin.

					NOT SUPPORTED
	6E.0	1bit	Data_ready_bar	x	Indicates transceiver has achieved power up and data is ready.
111	6F.7	1bit	Reserved	0	Reserved
	6F.6	1bit	Reserved	0	Reserved
	6F.5	1bit	Reserved	0	Reserved
	6F.4	1bit	Reserved	0	Reserved
	6F.3	1bit	Reserved	0	Reserved
	6F.2	1bit	Reserved	x	Reserved
	6F.1	1bit	Reserved	0	Reserved
	6F.0	1bit	Reserved	x	Reserved
112	70.7	1bit	Temperature too high alarm	x	Temperature too high alarm
	70.6	1bit	Temperature too low alarm	x	Temperature too low alarm
	70.5	1bit	VCC too high alarm	x	VCC too high alarm
	70.4	1bit	VCC too low alarm	x	VCC too low alarm
	70.3	1bit	BIASMON too high alarm	x	BIASMON too high alarm
	70.2	1bit	BIASMON too low alarm	x	BIASMON too low alarm
	70.1	1bit	BFMON too high alarm	x	BFMON too high alarm
	70	1bit	BFMON too low alarm	x	BFMON too low alarm
113	71.7	1bit	RSSI too high alarm	x	RSSI too high alarm
	71.6	1bit	RSSI too low alarm	x	RSSI too low alarm
	71.5	1bit	Reserved interrupt status bit	x	Reserved interrupt status bit
	71.4	1bit	Reserved interrupt status bit	x	Reserved interrupt status bit
	71.3	1bit	Reserved interrupt status bit	x	Reserved interrupt status bit
	71.2	1bit	Reserved interrupt status bit	x	Reserved interrupt status bit
	71.1	1bit	Reserved interrupt status bit	x	TX Fail went HIGH
	71	1bit	Reserved interrupt status bit	x	APD Shutdown event detected
114	72	1	Reserved	00h	Interrupt Mask for ISRC0
115	73	1	Reserved	00h	Interrupt Mask for ISRC1
116	74.7	1bit	Temperature too high	x	Temperature too high warning

			warning		
	74.6	1bit	Temperature too low warning	x	Temperature too low warning
	74.5	1bit	VCC too high warning	x	VCC too high warning
	74.4	1bit	VCC too low warning	x	VCC too low warning
	74.3	1bit	BIASMON too high warning	x	BIASMON too high warning
	74.2	1bit	BIASMON too low warning	x	BIASMON too low warning
	74.1	1bit	BFMON too high warning	x	BFMON too high warning
	74	1bit	BFMON too low warning	x	BFMON too low warning
117	75.7	1bit	RX Power High Warning	x	RSSI too high warning
	75.6	1bit	RX Power Low Warning	x	RSSI too low warning
	75.5	1bit	Reserved	0	Reserved
	75.4	1bit	Reserved	0	Reserved
	75.3	1bit	Reserved	0	Reserved
	75.2	1bit	Reserved	0	Reserved
	75.1	1bit	Reserved	0	Reserved
	75	1bit	Reserved	0	Reserved
118	76	1	Reserved	00h	Interrupt Mask for ISRC2
119	77	1	Reserved	00h	Interrupt Mask for ISRC3
120	78	8	Vendor Specific	00 00 00 00 00 00 00 00h	Vendor Specific

## Package Diagram



**Table 12 - Device Handling/ESD Protection**

The devices are static sensitive and may easily be damaged if care is not taken during handling. The following handling practices are recommended.

1	Devices should be handled on benches with conductive and grounding surfaces.
2	All personnel, test equipment and tools shall be grounded.
3	Do not handle the devices by their leads.
4	Store devices in protective foam or carriers.
5	Avoid the use of non-conductive plastics, rubber, or silk in the area where the devices are handled
6	All modules shall be packaged in materials that are anti-static to protect against adverse electrical environments.
7	Avoid applications of any voltage higher than maximum rated voltages to this part. For proper operation, any VIN or VOUT should be constrained to the range $GND \leq (VIN \text{ or } VOUT) \leq VCC$ . Unused inputs must always be tied to an appropriate logic voltage (e.g. either GND or VCC). Unused outputs must be left open.

## Ordering Information

### SPW-xx-48H-CP-CDFA-yy

XX: JA (1451nm Tx and 1271nm Rx); KB (1471nm Tx and 1291nm Rx); LC (1491nm Tx and 1311nm Rx); MD (1511nm Tx and 1331nm Rx); NE (1531nm Tx and 1351nm Rx)

yy: customer code

## Warnings

**Handling Precautions:** This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

**Laser Safety:** Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

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### Contact

SOURCE PHOTONICS  
20550 NORDHOFF ST.  
CHATSWORTH, CA 91311

[sales@sourcephotonics.com](mailto:sales@sourcephotonics.com)

Tel: 818-773-9044 Fax: 818-576-9486

Or visit our website: <http://www.sourcephotonics.com>