



## **XGSPON Symmetric OLT SFP+ Transceiver**

### **Hot Pluggable, Bidi SC, Tx1577nm EML / Rx1270nm APD, SMF 20KM, DDM**

**Part Number: FSPP-H2-PX6-20x**



### **Overview**

FSPP-H2-PX6-20x Small Form Factor Pluggable SFP+ transceivers are compliant with the current SFP+ Multi-Source Agreement (MSA) Specification. The high performance uncooled 1577nm EML transmitter and high sensitivity APD-TIA receiver provides superior performance for XGSPON applications up to SMF 20km optical links in FTTx projects.

### **Applications**

- XGSPON OLT for P2MP applications
- FTTx projects

### **Features**

- Compliant with ITU-T G.9807.1 XGSPON OLT
- Compliant with SFF-8431, SFF-8432 SFP+ MSA
- XGSPON upstream signals are in Time Division Multiplex mode
- 9.953G continuous mode transmission with 1570nm EML laser transmitter
- 9.953G burst-mode receiver with APD-TIA receiver (with RESET, TDM)
- Digital receiving signal strength indication (RSSI)
- Hot Pluggable
- Simplex SC/UPC connector
- 2-wire interface for management and diagnostic monitor compliant with SFF-8472
- Single +3.3V power supply
- Link distance 20km over SM fiber
- RoHS Compliant

### **Laser Safety**

- This is a Class 1 Laser Product complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.
- Caution: Use of control or adjustments or performance of procedure other than those specified herein may result in hazardous radiation exposure.



## Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Storage Temperature	T <sub>ST</sub>	-40	+85	°C
Storage Relative Humidity	RH	5	95	%
Supply Voltage	V <sub>CC</sub>	-0.5	+4.0	V

## Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Unit
Case Operating Temperature	T <sub>OP</sub>	0	-	+70	°C
Supply Voltage	V <sub>CC</sub>	+3.13	+3.3	+3.47	V
Supply Current	I <sub>CC</sub>			750	mA
Power Consumption	P			2.5	W

## Transmitter Electro-optical Characteristics

V<sub>CC</sub> = 3.13V to 3.47V, T<sub>OP</sub> = 0 °C to 70 °C

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Data Rate	DR		9.953		Gb/s	
Optical Launch Power (N1 BOL)	P <sub>o</sub>	+2.5		+5	dBm	1
Optical Launch Power (N1 EOL)	P <sub>o</sub>	+2		+5	dBm	1
Optical Launch Power (N2 BOL)	P <sub>o</sub>	+4.5		+7	dBm	1
Optical Launch Power (N2 EOL)	P <sub>o</sub>	+4		+7	dBm	1
Optical Center Wavelength	λ <sub>c</sub>	1575	1577	1580	nm	
Spectral Width (-20dB)	Δλ			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Optical Extinction Ratio	ER	8.2			dB	
Optical Eye Mask (PRBS2 <sup>31</sup> -1@9.953G)		ITU-T G.987.2				
Average Launch Power OFF	P <sub>OFF</sub>			-39	dBm	
Differential Data Input Swing	V <sub>IN</sub>	120		850	mV	
Tx Disable Input Voltage-Low (Tx ON)	TDISV <sub>L</sub>	GND		0.8	V	
Tx Disable Input Voltage-High (Tx OFF)	TDISV <sub>H</sub>	2.0		V <sub>CC</sub>	V	

**Note1:** The optical power is launched into a 9/125μm single mode fiber.



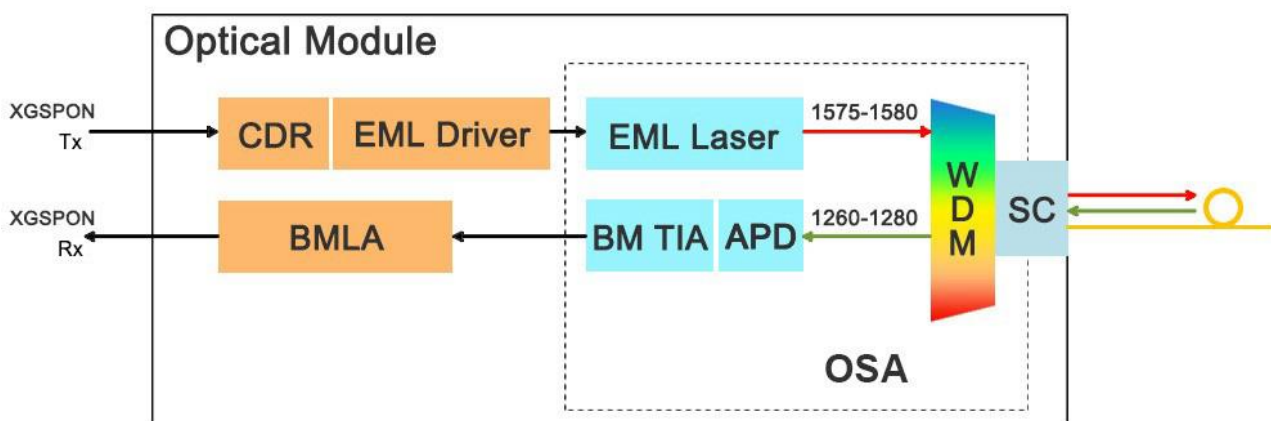
## Receiver Electro-optical Characteristics

V<sub>CC</sub> = 3.13V to 3.47V, T<sub>OP</sub> = 0 °C to 70 °C

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Data Rate	DR		9.953		Gb/s	
Receiver Sensitivity (N1 BOL)	SEN			-26.5	dBm	
Receiver Sensitivity (N1 EOL)	SEN			-26	dBm	1
Receiver Sensitivity (N2 BOL)	SEN			-29	dBm	1
Receiver Sensitivity (N2 EOL)	SEN			-28.5	dBm	1
Maximum Receive Power (N1)	P <sub>RX_MAX</sub>	-4.5			dBm	1
Maximum Receive Power (N2)	P <sub>RX_MAX</sub>	-6.5			dBm	1
Optical Center Wavelength	$\lambda_c$	1260	1270	1280	nm	
Setting time				800	ns	
LOS De-Assert	LOS <sub>D</sub>			-29	dBm	
LOS Assert	LOS <sub>A</sub>	-45			dBm	
LOS Hysteresis	LOS <sub>HY</sub>	0.5		6	dB	
Differential Data Output Swing	V <sub>OUT</sub>	340		850	mV	
Receiver LOS Signal Output Voltage-Low	LOS <sub>VL</sub>	GND		0.8	V	
Receiver LOS Signal Output Voltage-High	LOS <sub>VH</sub>	2.4		V <sub>CC</sub>	V	

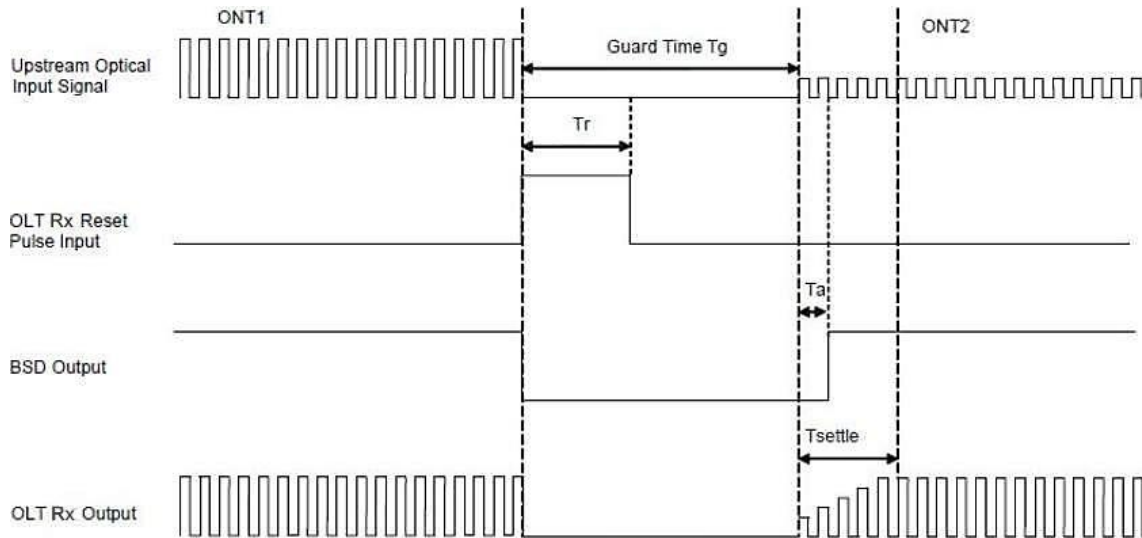
**Note1:** Measured with a PRBS 2<sup>31</sup>-1 test pattern @9.953Gbps, ER=8.2dB, BER<10<sup>-3</sup>.

## Function Diagram





## Timing Sequence for Burst Receiver



### Burst Timing Characteristics

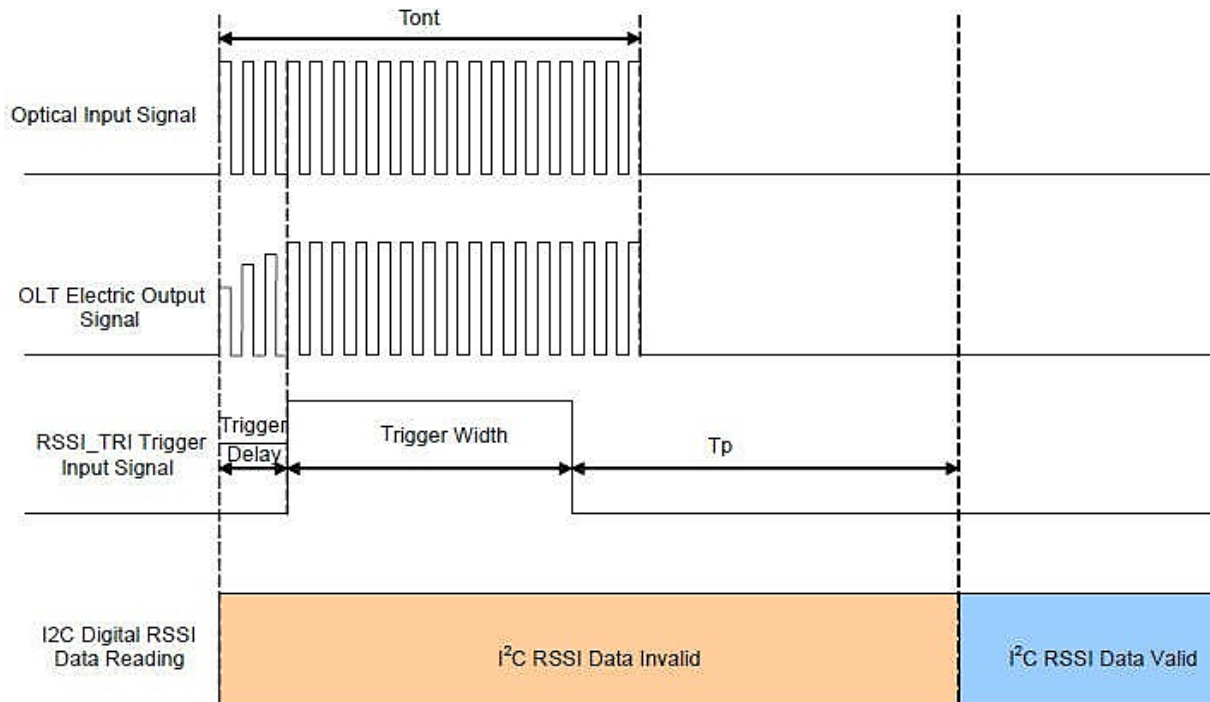
Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
XGSPON Guard Time	Tg		TBD		ns	
XGSPON Setting Time	Ts		100		ns	
XGSPON Reset Pulse Width	Tr		12.8		ns	1
XGSPON SD De-assert Time	T <sub>SD</sub>			10	ns	2

**Note1:** The XGSPON OLT Rx RESET signal can be effective when in the Guard Time duration (Ranging Mode) or in the Preamble Time duration (Working Mode).

**Note2:** The XGSPON OLT Rx SD signal will be level '0' when the Rx RESET signal equals to '1', and it will be level '1' after the input ONU optical signal detected, and its level will be held before the next Rx RESET pulse coming.



## Timing Sequence for RSSI

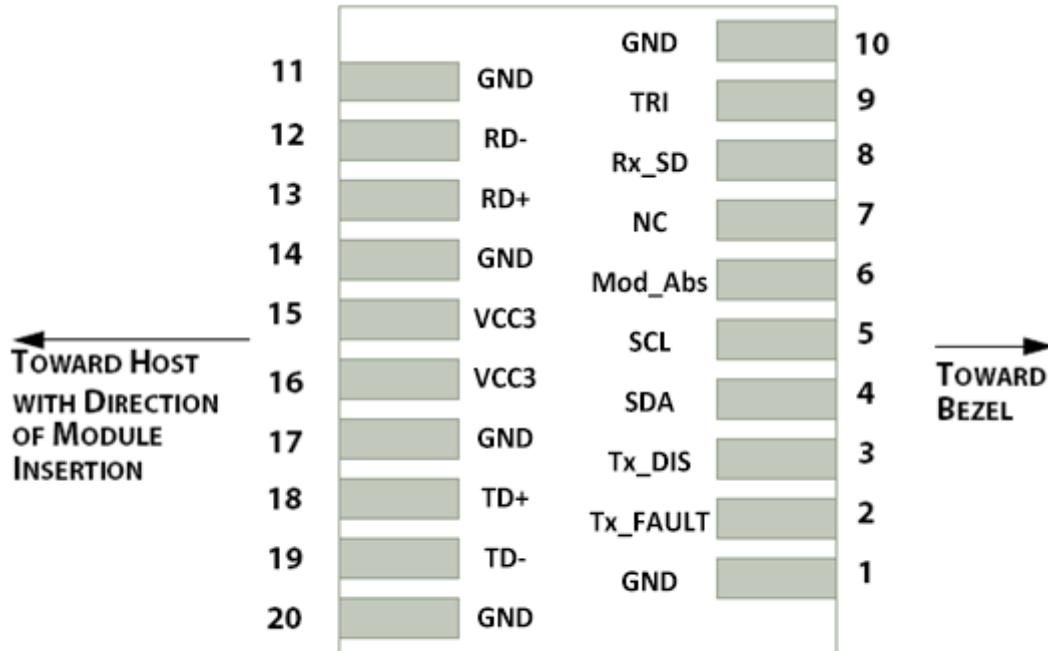


## RSSI Timing Characteristics

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
ONU Package Length	$T_{ont}$	500				
RSSI Trigger Delay	$T_{td}$	500		3000	ns	
RSSI Trigger Pulse Width	$T_w$	600		$T_{ont} - T_{td}$	ns	
Internal I2C Delay	$T_p$			500	ns	
XGSPON ONU Power Range	$P_{ont}$	-31		-11	dBm	
RSSI Monitoring Error			+/-2		dB	



## Pin Assignment



Host PCB SFP+ pad assignment top view

## Pin Description

Pin	Name	Function / Description
1	GND	Module Ground
2	Tx_FAULT	Transmitter Fault Indication (1)
3	Tx_DISABLE	Transmitter Disable – Turns off transmitter laser output (2)
4	SDA	2-wire Serial Interface Data Line (SDA: Serial Data Signal) (3)
5	SCL	2-wire Serial Interface Clock (SCL: Serial Clock Signal) (3)
6	MOD_ABS	Module Absent, connected to Ground in the module (3)
7	NC	Not connected inside the module
8	Rx_LOS	Receiver Loss of Signal Indication (4)
9	TRI	Receiver Signal Strength Indication trigger input
10	GND	Module Ground
11	GND	Module Ground
12	RD-	Receiver Inverted Data output, Differential DC coupled
13	RD+	Receiver Non-Inverted Data output, Differential DC coupled



14	GND	Module Ground
15	Vcc3	3.3V Power Supply
16	Vcc3	3.3V Power Supply
17	GND	Module Ground
18	TD+	Transmitter Non-Inverted Data Input, Differential AC coupled
19	TD-	Transmitter Inverted Data Input, Differential AC coupled
20	GND	Module Ground

**Note1:** Tx Fault is open collector/drain output which should be pulled up externally with a 4.7K~10KΩ resistor on the host board to supply  $<V_{ccT}+0.3V$  or  $V_{ccR}+0.3V$ . When high, this output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to  $<0.8V$ .

**Note2:** Tx Disable input is used to shut down the laser output per the state table below. It is pulled up within the module with a 4.7K~10KΩ resistor. 1) Low(0~0.8V): Transmitter on; 2) Between (0.8V and 2V): Undefined; 3) High (2.0~  $V_{ccT}$ ): Transmitter Disabled; 4) Open: Transmitter Disabled.

**Note3:** These are the module definition pins. They should be pulled up with a 4.7K~10KΩ resistor on the host board to supply less than  $V_{ccT}+0.3V$  or  $V_{ccR}+0.3V$ . Mod-ABS is grounded by the module to indicate that the module is present.

**Note4:** LOS (Loss of signal) is an open collector/drain output which should be pulled up externally with a 4.7K~10KΩ resistor on the host board to supply  $<V_{ccT}+0.3V$  or  $V_{ccR}+0.3V$ . When high, this output indicates the received optical power is below the worst case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to  $<0.8V$ .

## Digital Diagnostic Functions

As defined by the SFP MSA (SFF-8472) Ficer's SFP+ transceivers provide digital diagnostic functions via a 2-wire serial interface, which allows real-time access to the following operating parameters:

- Transceiver temperature
- Laser bias current
- Transmitted optical power
- Received optical power
- Transceiver supply voltage

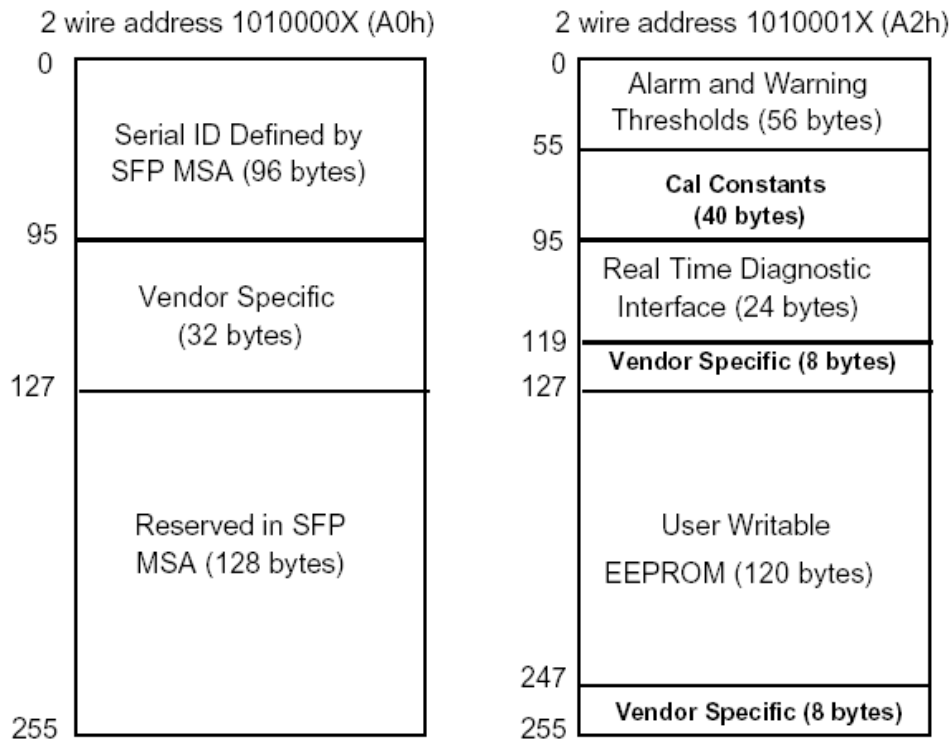
It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Controller (DDC) inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the SFP+ transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the SFP+ transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.



For more detailed information including memory map definitions, please see the SFP MSA (SFF-8472) Specification.

### Digital Diagnostic Memory Map



### Digital Diagnostic Monitoring Characteristics

Parameter	Accuracy	Unit	Note
Temperature	±3	°C	Internal Calibration
Supply Voltage	±0.1	V	Internal Calibration
Tx Bias Current	±5	mA	Internal Calibration
Tx Output Power	±3	dB	Internal Calibration
Rx Received Optical Power	±3	dB	Internal Calibration

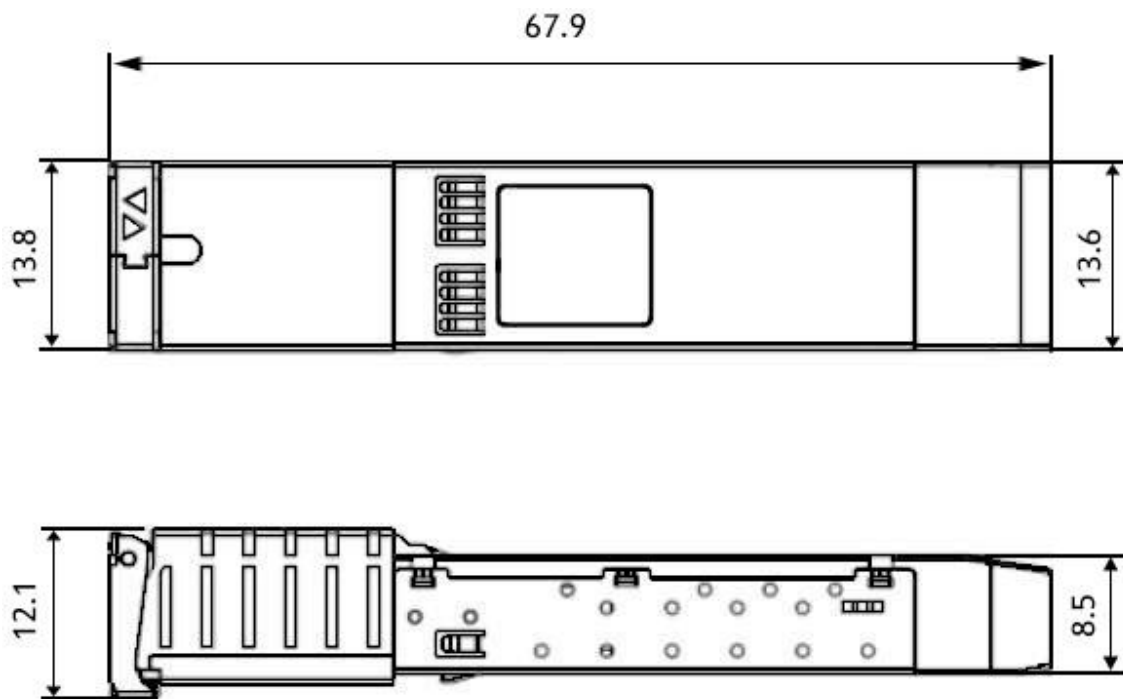




### EEPROM(0xA2) RSSI selection

Address	Bit	Name	Description
118	7	RSSI select	Writing "0" for XGSPON RSSI Monitor; Writing "1" for XGPON RSSI Monitor. Default power-up value is "0".
118	6	RSSI/TX dis able Select	When set "0", PIN9 input as TX Disable input; When set "1", PIN9 as RSSI input. Default power-up value is "0".

### Mechanical Dimensions



(All Dimensions are  $\pm 0.20\text{mm}$  Unless Otherwise Specified, Unit: mm)



## Ordering Information

Part No.	Tx	Rx	Link	DDM	ODN Class	Temp.
FSPH-H2-PX6-201	1577nm	1270nm	20km	Yes	N1	0~70°C
FSPH-H2-PX6-205					N2	

**Note1:** Distances are indicative only. To calculate a more precise link budget based on specific conditions in your application, please refer to the optical characteristics.