

## SFF GE-PON PX20 ONU Transceiver

### FTM-9412P-F20(G)/F20i(G)

(IEEE 802.3ah™-2004 1000BASE-PX20-U)

Members of Flexon™ Family



#### Features

- ◆ Single fiber bi-directional data links with symmetric 1.25Gbps upstream and 1.25Gbps downstream
- ◆ Integrated with micro-optics WDM filter for dual wavelength Tx/Rx operation at 1310/1490nm
- ◆ 1310nm burst-mode transmitter with DFB laser
- ◆ 1490nm continuous-mode receiver with PIN-TIA and 1550nm optical signal rejection
- ◆ Different operating temperature class
  - 0 to 70°C Standard Class
  - 40 to 85°C Industrial Class
- ◆ 2x5 SFF package with SC/UPC pigtail
- ◆ Single 3.3V power supply
- ◆ LVPECL compatible data input/output interface
- ◆ LVTTTL transmitter burst-mode control
- ◆ LVTTTL receiver signal-detected indication
- ◆ Low EMI and excellent ESD protection
- ◆ Class I laser safety standard IEC-60825 compliant
- ◆ RoHS compliance(FTM-9412P-F20G/F20iG)

#### Applications

- ◆ Gigabit Ethernet Passive Optical Networks (GE-PON) – ONU side
- ◆ Gigabit Ethernet Point-to-Point Bi-directional Transmission
- ◆ Media Converts for Fiber-In-The-Loop (FITL)

#### Standard

- ◆ Compliant with SFF MSA
- ◆ Compliant with IEEE Std 802.3ah™ -2004 1000BASE-PX20-U
- ◆ Compliant with FCC 47 CFR Part 15, Class B
- ◆ Compliant with FDA 21 CFR 1040.10 and 1040.11, Class I

#### Description

2x5 SFF GE-PON PX20 ONU transceiver family is Optical Network Unit (ONU) for IEEE802.3ah™-2004 1000BASE-PX20-U application

The transceiver is the high performance module for 1.25Gbps data link in single fiber by using 1310nm burst-mode transmitter and 1490nm continuous-mode receiver with 1550nm optical signal rejection.

The transmitter section uses a multiple quantum well 1310nm DFB laser and is Class I laser compliant product according to international safety standard IEC-60825. The receiver section uses an integrated 1490nm PIN and preamplifier mounted in an optical header and limiting post-amplifier IC.

The optical burst output can be enabled by a LVTTTL logic high-level input of TX\_BRST. Signal Detected (SD) output is provided to indicate the detection of an input optical signal of receiver.

## Regulatory Compliance

The transceivers have been tested according to American and European product safety and electromagnetic compatibility regulations (See Table 1). For further information regarding regulatory certification, please refer to Flexon™ regulatory specification and safety guidelines, or contact with Fiberxon, Inc. America sales office listed at the end of documentation.

**Table 1 - Regulatory Compliance**

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class I (>500 V)
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022 Class B (CISPR 22B) VCCI Class B	Compliant with standards
Immunity	IEC 61000-4-3	Compliant with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN (IEC) 60825-1,2	Compliant with Class I laser product
Component Recognition	UL and CSA	Compliant with standards
RoHS	2002/95/EC 4.1&4.2	Compliant with standards

## Absolute Maximum Ratings

Absolute Maximum Ratings are those values, beyond which, some damages may occur to the devices. Exposure to conditions above the Absolute Maximum Ratings listed in Table 2 may negatively impact the reliability of the products.

**Table 2 - Absolute Maximum Ratings**

Parameter	Symbol	Min.	Max.	Unit	Note
Storage Ambient Temperature	T <sub>STG</sub>	-40	85	°C	
Operating Ambient Temperature (Note 1)	T <sub>OPR</sub>	0	70	°C	FTM-9412P-F20(G)
		-40	85		FTM-9412P-F20i(G)
Operating Humidity	H <sub>OPR</sub>	5	95	%	
Power Supply Voltage	V <sub>CC</sub>	0	4	V	
Input Voltage		GND	V <sub>cc</sub>	V	
Receiver Damaged Threshold		+7		dBm	
Soldering Temperature			400	°C	Note 2
Bending Radius		30		mm	
Pigtail Fiber Contact Temperature			85	°C	

Note 1: With airflow 1m/sec when ambient temperature is above 60°C

Note 2: Only for soldering by iron and 10 seconds on leads only

## Recommended Operating Conditions

**Table 3 - Recommended Operating Conditions**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	$V_{CC}$	3.13	3.3	3.47	V	3.3V±5%
Operating Ambient Temperature (Note 1)	$T_{OPR}$	0		70	°C	FTM-9412P-F20(G)
		-40		85		FTM-9412P-F20i(G)
Operating Humidity Range	$H_{OPR}$	5		95	%	
Data Rate			1.25		Gbit/s	
Data Rate Drift		-100		+100	PPM	

Note 1: When ambient temperature is above 60°C, airflow at rate higher than 1m/sec is required

## Optical and Electrical Characteristics

**Table 4 - Transmitter Optical and Electrical Characteristics**

FTM-9412P-F20(G) 0°C <  $T_{OPR}$  < 70°C and 3.13V <  $V_{CC}$  < 3.47V

FTM-9412P-F20i(G) -40°C <  $T_{OPR}$  < 85°C and 3.13V <  $V_{CC}$  < 3.47V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note	
Optical Center Wavelength	$\lambda_c$	1260		1360	nm		
Optical Spectrum Width (-20dB)	$\Delta\lambda$			1	nm		
Side Mode Suppression Ratio	SMSR	30			dB		
Average Launch Power (BOL)	$P_{OUT}$	0		+4	dBm	1	
Average Launch Power (EOL)		-1		+4			
Average Launch Power-OFF Transmitter	$P_{OFF}$			-45	dBm		
Extinction Ratio	ER	9			dB	2	
Rise/Fall Time (20%-80%)	$T_R/T_F$			260	ps	2.3	
Burst Turn On Time	$T_{BURST\_ON}$			30	ns	4	
Burst Turn Off Time	$T_{BURST\_OFF}$			30	ns		
Burst Enable Duration	$T_{EN\_DUR}$	600			ns		
Burst Disable Duration	$T_{DIS\_DUR}$	100			ns		
RIN <sub>15</sub> OMA				-115	dB/Hz		
Optical Return Loss Tolerance				15	dB		
Transmitter Reflectance				-10	dB		
Transmitter and Dispersion Penalty	TDP			1.8	dB	5	
Optical Eye Diagram	Compliant With IEEE Std 802.3ah™-2004						2,6
Data Input Differential Swing	$V_{IN}$	200		1600	mV	7	
Input Differential Impedance	$Z_{IN}$	90	100	110	Ω		
Power Supply Current	$I_{CC\_TX}$			200	mA		
Transmitter Burst Control Voltage - Low	$V_{BURST\_L}$	0		0.8	V	8	
Transmitter Burst Control Voltage - High	$V_{BURST\_H}$	2.0		$V_{CC}$	V		

Note 1: Launched into 9/125um Single Mode Fiber.

Note 2: Measured with PRBS 2<sup>7</sup>-1 test pattern @1.25 Gbit/s.

Note 3: Measured with the fourth-order Bessel-Thomson filter OFF.

Note 4: Refer to [Timing Parameter Definition in Burst Mode Sequence](#).

Note 5: Maximum sensitivity penalty due to transmitter and dispersion effect through 20km of SMF optical fiber.

Note 6: Transmitter eye mask definition is {0.22UI, 0.375UI, 0.20UI, 0.20UI, 0.30UI}.

Note 7: Compatible with LVPECL/CML input (See [Recommended Interface Circuit](#))

Note 8: TX\_BRST (See [Pin Function Definitions](#))

**Table 5 - Receiver Optical and Electrical Characteristics**

FTM-9412P-F20(G)      0°C <T<sub>OPR</sub><70°C and 3.13V<V<sub>CC</sub><3.47V

FTM-9412P-F20i(G)    -40°C <T<sub>OPR</sub><85°C and 3.13V<V<sub>CC</sub><3.47V

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Wavelength		1480	1490	1500	nm	
Sensitivity	P <sub>SEN</sub>			-26.5	dBm	1
Saturation	P <sub>SAT</sub>	-3			dBm	
Signal-Detected Assert Level	P <sub>SDA</sub>			-27	dBm	2
Signal-Detected Deassert Level	P <sub>SDD</sub>	-39			dBm	3
Signal-Detected Hysteresis	P <sub>SDA</sub> - P <sub>SDD</sub>	0.5		6	dBm	
Receiver Reflectance				-12	dB	
WDM Filter Isolation	ISO(1550)	38			dB	1550nm
	ISO(1650)	35			dB	1650nm
Power Supply Current	I <sub>CC,RX</sub>			120	mA	
Data Output Differential Swing	V <sub>OUT</sub>	400		1600	mV	4
Signal-Detected Voltage - Low	V <sub>SD,L</sub>	0		0.8	V	5
Signal-Detected Voltage - High	V <sub>SD,H</sub>	2.0		V <sub>CC</sub>	V	
Signal-Detected Assert Time	T <sub>ASS</sub>			100	μs	
Signal-Detected Deassert Time	T <sub>DAS</sub>			100	μs	

Note 1: Measured with a PRBS 2<sup>7</sup>-1 test pattern @1.25Gbit/s and ER=9dB, BER =10<sup>-12</sup>.

Note 2: An increase in optical power above the specified level will cause the Signal Detect output to switch from a low state to a high state.

Note 3: A decrease in optical power below the specified level will cause the Signal Detect output to switch from a high state to a low state.

Note 4: LVPECL output, AC coupled internally, guaranteed in the full range of input optical power (-3dBm to -27dBm)(See [Recommended Interface Circuit](#))

Note 5: SD (See [Pin Function Definitions](#))

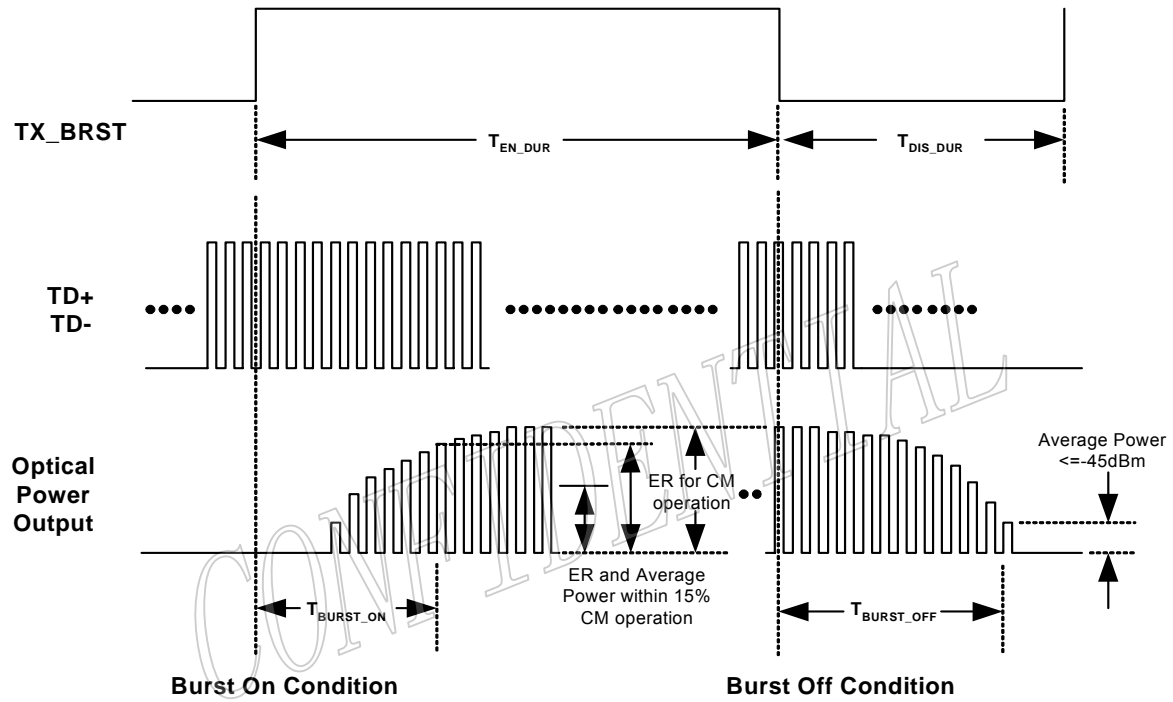


Figure 1 Timing Parameter Definition in Burst Mode Sequence

### Recommended Interface Circuit

Figure 2 shows the recommended interface scheme for FTM-9412P-F20(G)/F20i(G)

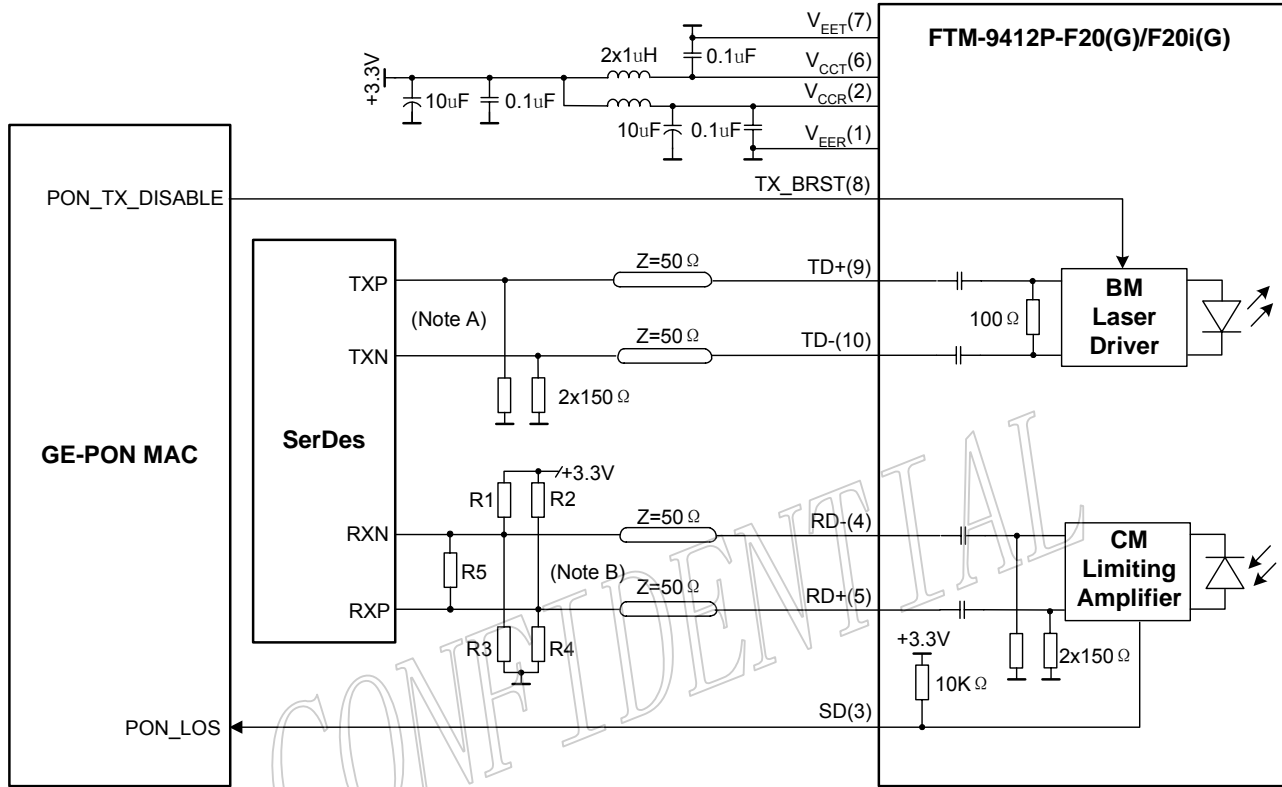


Figure 2 Recommended Interface Circuit

Note A: Open emitter output internally.

Note B: LVPECL output, AC coupled internally.

Input stage in SerDes IC is assumed with high impedance and internal bias to Vcc-1.3V

R1=R2=R3=R4=N.C, R5=100 Ω

Input stage in SerDes IC is assumed without internal bias to Vcc-1.3V

R1=R2=82 Ω ,R3=R4=130 Ω ,R5=N.C

## Pin Definitions

2×5 SFF planform in Figure 3 below shows the pin information of electrical interface and mounting studs. Functions are described in Table 6 with some accompanying notes.

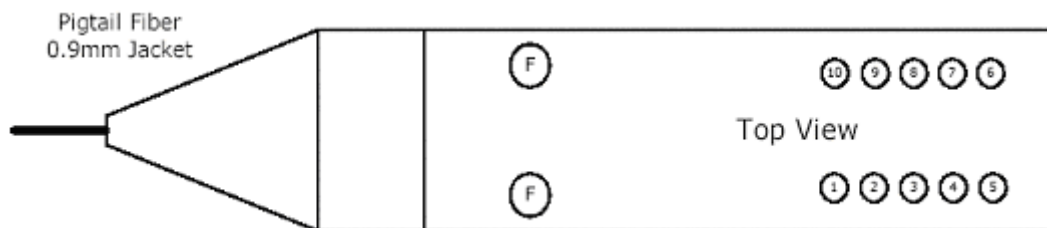


Figure 3 2×5 SFF Planform

Table 6 - Pin Function Definitions

Pin No.	Name	Description	Notes
1	V <sub>EER</sub>	Receiver Signal Ground	
2	V <sub>CCR</sub>	Receiver Power Supply	
3	SD	Receiver Signal-Detected Indication	1
4	RD-	Inverted Receiver Data Output	2
5	RD+	Non-inverted Receiver Data Output	
6	V <sub>CCT</sub>	Transmitter Power Supply	
7	V <sub>EET</sub>	Transmitter Signal Ground	
8	TX_BRST	Transmitter Burst Control	3
9	TD+	Transmitter Non-inverted Data Input	4
10	TD-	Transmitter Inverted Data Input	
F	MS	Mounting Studs	5

Note 1: LVTTTL logic output, with internal 10KΩ pull-up resistor.

Optical Signal-Detected: High; Optical Signal Loss: Low

Note 2: LVPECL logic output, AC coupled internally. (See [Recommended Interface Circuit](#))

Note 3: A positive level enable optical signal output under burst mode.

(See [Timing Parameter Definition in Burst Mode Sequence](#))

Note 4: Compatible with LVPECL/CML input

(See [Recommended Interface Circuit](#))

Note 5: The mounting studs are provided for transceiver mechanical attachment to circuit board. They may also provide an optional connection of the transceiver to the equipment chassis ground. The holes in the circuit board must be tied to chassis ground. It is not recommended that the mounting studs be connected to signal ground.

### Mechanical Design Diagram

The form factor is 2X5 SFF with pigtail fiber. The pigtail fiber has a length 520 - 550mm and 30mm minimum bending radius. The fiber connector type is SC/UPC. The mechanical design diagram is shown in Figure 4. (Dimension in mm)

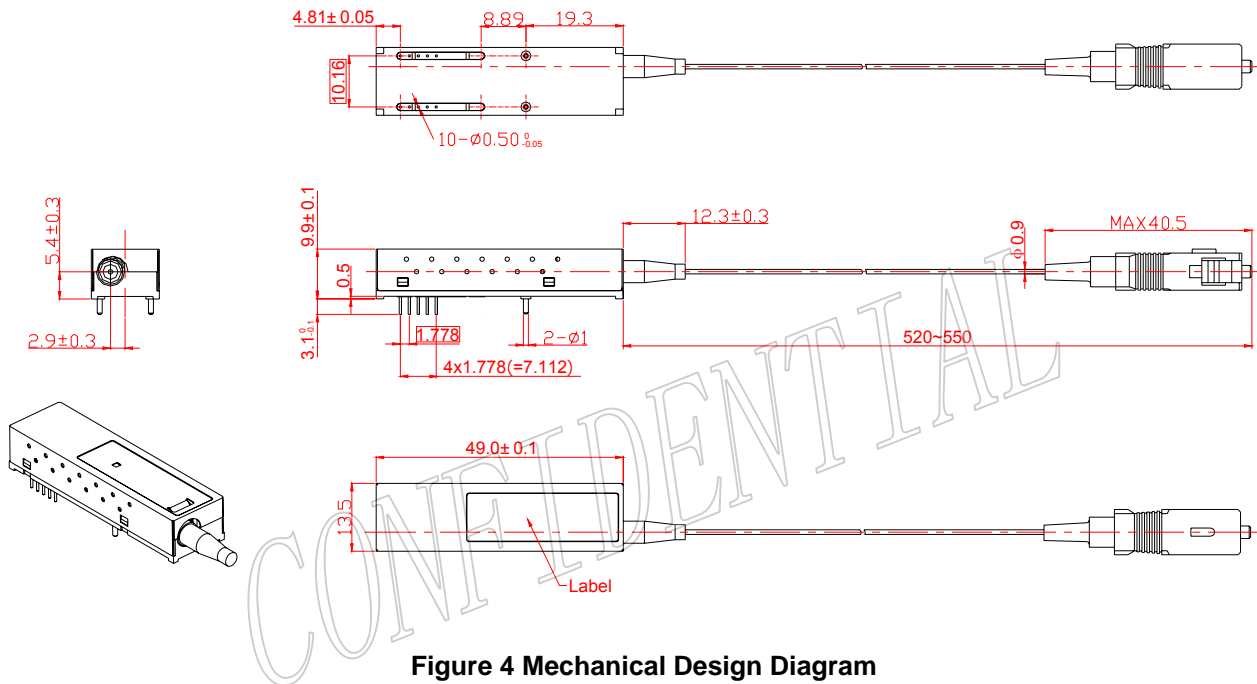


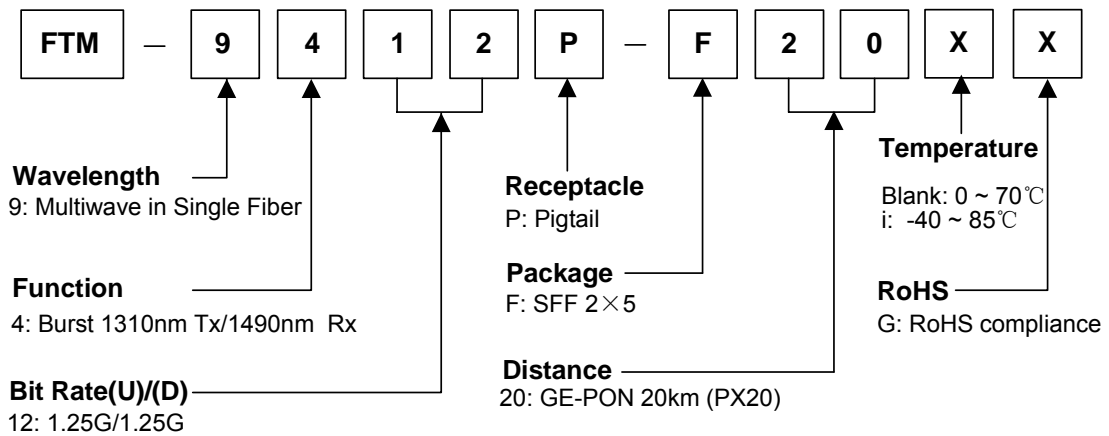
Figure 4 Mechanical Design Diagram

Table 7 - Pigtail Fibre Characteristics

Parameter	Min.	Typical	Max.	Unit
Mode Field Diameter		9		µm
Cladding Diameter		125		µm
Jacket Diameter		0.9		mm
Bending Radius of Pigtail Fiber	30			mm
Tension Force on Pigtail Fiber			1	Kg
Pigtail Fiber Length	520		550	mm
Optical Return Loss (UPC type) -1310nm	50			dB



### Ordering Information



Part No.	Product Description
FTM-9412P-F20	1310nm(TX)/1490nm(RX), SC/UPC Pigtailed 2x5 SFF for GE-PON ONU 20km application, with 1550nm optical signal blocked, 0°C ~ 70°C, Tx AC Coupling, Rx AC Coupling
FTM-9412P-F20G	1310nm(TX)/1490nm(RX), SC/UPC Pigtailed 2x5 SFF for GE-PON ONU 20km application, with 1550nm optical signal blocked, 0°C ~ 70°C, Tx AC Coupling, Rx AC Coupling, RoHS compliance
FTM-9412P-F20i	1310nm(TX)/1490nm(RX), SC/UPC Pigtailed 2x5 SFF for GE-PON ONU 20km application, with 1550nm optical signal blocked, -40°C ~ 85°C, Tx AC Coupling, Rx AC Coupling
FTM-9412P-F20iG	1310nm(TX)/1490nm(RX), SC/UPC Pigtailed 2x5 SFF for GE-PON ONU 20km application, with 1550nm optical signal blocked, -40°C ~ 85°C, Tx AC Coupling, Rx AC Coupling, RoHS compliance

### Related Documents

For further information, please refer to the following documents:

- IEEE Std 802.3ah™-2004.PDF

### Obtaining Document

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## Revision History

Reversion	Initiate	Review	Approve	Subject	Release Date
Pre 1a	Zachary Lu	Johnny Yang	Peter Tang	Initial datasheet (Using External ONU BOSA) Only including FTM-9412P-F20 (Doc No. DS3493001-1a)	Feb.23,2005
Pre 1b	Zachary Lu	Johnny Yang	Peter Tang	Revised datasheet (Using External ONU BOSA) Modify sensitivity form -27.5dBm to -26.5dBm In page4 (Doc No. DS3493001-1b)	Apr.12,2004
Pre 2a	Zachary Lu	Johnny Yang	Peter Tang	Revised datasheet (Using Internal ONU BOSA) 1. Add new P/N: FTM-9412P-F20i 2. Update Mechanical Design Diagram in Figure 4, Page 8 (Doc No. DS3493001-2a)	Sep.19,2005
Pre 2b	Zachary Lu	Johnny Yang	Peter Tang	Add new P/N: FTM-9412P-F20G/F20iG (Doc No. DS3493001-2b)	Nov.10,2005

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