

## 155M Bi-directional SFP Transceiver

(For 20km Point to Point Transmission)

Members of Flexon™ Family



### Features

- ◆ 125~155Mbps data links
- ◆ 20km point-point transmission
- ◆ 1310nm FP Tx/1550nm PIN Rx for FTM-9301C-SL20G
- ◆ 1550nm FP Tx/1310nm PIN Rx for FTM-9501C-SL20G
- ◆ Class I laser product
- ◆ Low EMI and excellent ESD protection
- ◆ SFP MSA package with LC receptacle
- ◆ Operation case temperature: 0 to +70°C
- ◆ Detailed product information in EEPROM

### Applications

- ◆ Fast Ethernet
- ◆ Point to Point FTTH Application

### Standard

- ◆ Compatible with SFP MSA
- ◆ Compatible with IEEE 802.3ah
- ◆ Compliant with RoHS

### Description

Fiberxon FTM-9301C-SL20G/FTM-9501C-SL20G is high performance, cost effective transceiver. It is designed point-point FTTH applications at data rates of 155Mbps for 20km transmission.

FTM-9301C-SL20G is normally used in the client (ONU), which transmits 1310nm and receives 1550nm optical signal; while FTM-9501C-SL20G is used in the central office (OLT), which transmits 1550nm and receives 1310nm optical signal.

FTM-9301C-SL20G/FTM-9501C-SL20G features an EEPROM that contains the detailed product information stored for retrieval by host equipment. This information is accessed via the 2-wire serial CMOS EEPROM protocol. For further information, please refer to SFP Multi-Source Agreement (MSA).

An enhanced Digital Diagnostic Monitoring Interface compatible with SFF-8472 has been incorporated into the transceivers. It allows real time access to the transceiver operating parameters such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage by reading a built-in memory with I2C interface.

FTM-9301C-SL20G and FTM-9501C-SL20G are compliant with RoHS

## 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 the documentation.

**Table 1 - Regulatory Compliance**

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class 2(>2000 V)
Electrostatic Discharge (ESD) to LC Receptacle	IEC 61000-4-2 GR-1089-CORE	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.
Component Recognition	UL and CSA	Compatible with standards
RoHS	2002/95/EC 4.1&4.2 2005/747/EC	Compliant with standards <sup>note</sup>

Note:

In light of item 5 in Annex of 2002/95/EC, “Pb in the glass of cathode ray tubes, electronic components and fluorescent tubes.” and item 13 in Annex of 2005/747/EC, “Lead and cadmium in optical and filter glass.”, the two exemptions are being concerned for Fiberxon’s transceivers, because Fiberxon’s transceivers use glass, which may contain Pb, for components such as lenses, windows, isolators, and other electronic components.

## Absolute Maximum Ratings

Absolute Maximum Ratings are those values beyond which damage to the devices may occur.

**Table 2– Absolute Maximum Ratings**

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T <sub>S</sub>	-40	+85	°C
Supply Voltage	V <sub>CC</sub>	-0.5	3.6	V
Operating Humidity	-	5	95	%

## Recommended Operating Conditions

**Table 3 - Recommended Operating Conditions**

Parameter	Symbol	Min.	Typical	Max.	Unit
Operating Case Temperature	$T_C$	0		+70	°C
Power Supply Voltage	$V_{CC}$	3.13	3.3	3.47	V
Power Supply Current	$I_{CC}$			300	mA
Power Dissipation	P		0.65	0.8	W
Data Rate			125/155		Mbps

### Optical and Electrical Characteristics (FTM-9301C-SL20G)

Table 4– Optical and Electrical Characteristics ( $T_C=0$  to  $70^\circ\text{C}$ ,  $V_{CC}=3.13$  to  $3.47\text{V}$ )

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes	
<b>Transmitter</b>							
Centre Wavelength	$\lambda_C$	1260		1360	nm		
Average Output Power	$P_{Out}$	-14		-8	dBm	1	
Spectral Width (RMS)	$\Delta\lambda$		2.5	7	nm		
Extinction Ration	EX	10			dB		
Output Optical Eye		ITU-T G.957 Compatible					2
Data Input Swing Differential	$V_{IN}$	370		2000	mV	3	
Input Differential Impedance	$Z_{IN}$	90	100	110	$\Omega$		
TX Disable	Disable	2.0		$V_{CC}+0.3$	V		
	Enable	0		0.8	V		
TX Fault	Fault	2.0		$V_{CC}+0.3$	V		
	Normal	0		0.8	V		
<b>Receiver</b>							
Centre Wavelength	$\lambda_C$	1480		1580	nm		
Receiver Sensitivity				-32	dBm	4	
Receiver Overload		-8			dBm	4	
Return Loss		14			dB		
LOS De-Assert	$LOS_D$			-34	dBm		
LOS Assert	$LOS_A$	-45			dBm		
LOS Hysteresis		0.5		4	dB		
Data Output Swing Differential	$V_{OUT}$	370		2000	mV	5	
LOS	High	2.0		$V_{CC}+0.3$	V		
	Low	0		0.8	V		

Note:

1. The optical power is launched into SMF.
2. Measured with a PRBS  $2^{23}-1$  test pattern @155Mbps.
3. Internally AC coupled and terminated.
4. Measured with PRBS  $2^{23}-1$  test pattern@155Mbps,  $BER \leq 1 \times 10^{-10}$ .
5. Internally AC coupled.

## Optical and Electrical Characteristics (FTM-9501C-SL20G)

**Table 5 –Optical and Electrical Characteristics (T<sub>C</sub>=0 to 70°C, V<sub>CC</sub>=3.13 to 3.47V)**

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
<b>Transmitter</b>						
Centre Wavelength	$\lambda_C$	1480		1580	nm	
Average Output Power	P <sub>Out</sub>	-14		-8	dBm	1
Spectral Width (RMS)	$\Delta\lambda$		2.5	4.6	nm	
Extinction Ration	EX	10			dB	
Output Optical Eye	ITU-T G.957 Compatible					2
Data Input Swing Differential	V <sub>IN</sub>	370		2000	mV	3
Input Differential Impedance	Z <sub>IN</sub>	90	100	110	$\Omega$	
TX Disable	Disable	2.0		V <sub>CC</sub> +0.3	V	
	Enable	0		0.8	V	
TX Fault	Fault	2.0		V <sub>CC</sub> +0.3	V	
	Normal	0		0.8	V	
<b>Receiver</b>						
Centre Wavelength	$\lambda_C$	1260		1360	nm	
Receiver Sensitivity				-32	dBm	4
Receiver Overload		-8			dBm	4
Return Loss		14			dB	
LOS De-Assert	LOS <sub>D</sub>			-34	dBm	
LOS Assert	LOS <sub>A</sub>	-45			dBm	
LOS Hysteresis		0.5		4	dB	
Data Output Swing Differential	V <sub>OUT</sub>	370		2000	mV	5
LOS	High	2.0		V <sub>CC</sub> +0.3	V	
	Low	0		0.8	V	

Note:

1. The optical power is launched into SMF.
2. Measured with a PRBS 2<sup>23</sup>-1 test pattern @155Mbps.
3. Internally AC coupled and terminated.
4. Measured with PRBS 2<sup>23</sup>-1 test pattern@155Mbps, BER ≤ 1 × 10<sup>-10</sup>.
5. Internally AC coupled.

## EEPROM Information

The SFP MSA defines a 256-byte memory map in EEPROM describing the transceiver's capabilities, standard interfaces, manufacturer, and other information, which is accessible over a 2 wire serial interface at the 8-bit address 1010000X (A0h). The memory contents refer to Table 6.

**Table 6 - EEPROM Serial ID Memory Contents (A0h)**

Addr.	Field Size (Bytes)	Name of Field	Hex	Description
0	1	Identifier	03	SFP
1	1	Ext. Identifier	04	MOD4
2	1	Connector	07	LC
3—10	8	Transceiver	00 xx 02 00 00 00 00 00	Transmitter Code xx:10 for FTM-9301C-SL20G and 08 for FTM-9501C-SL20G
11	1	Encoding	03	NRZ
12	1	BR, nominal	02	155Mbps
13	1	Reserved	00	
14	1	Length (9um)-km	14	20km
15	1	Length (9um)	C8	20km
16	1	Length (50um)	00	
17	1	Length (62.5um)	00	
18	1	Length (copper)	00	
19	1	Reserved	00	
20—35	16	Vendor name	46 49 42 45 52 58 4F 4E 20 49 4E 43 2E 20 20 20	"FIBERXON INC." (ASC II)
36	1	Reserved	00	
37—39	3	Vendor OUI	00 00 00	
40—55	16	Vendor PN	46 54 4D 2D 39 xx 30 31 43 2D 53 4C 32 30 47 20	"FTM-9x01C-SL20G" (ASC II)
56—59	4	Vendor rev	xx xx xx xx	ASC II ( "31 30 20 20" means 1.0 revision)
60-61	2	Wavelength	05 1E/06 0E	1310nm/1550nm
62	1	Reserved	00	
63	1	CC BASE	xx	Check sum of bytes 0 - 62
64—65	2	Options	00 1A	LOS, TX_FAULT and TX_DISABLE
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	ASC II .
84—91	8	Vendor date code	xx xx xx xx xx xx 20 20	Year (2 bytes), Month (2 bytes), Day (2 bytes)
92	1	Diagnostic type	58	Diagnostics(Ext.Cal)
93	1	Enhanced option	B0	Diagnostics (Optional Alarm/warning flags, Soft TX_FAULT and Soft TX_LOS monitoring)
94	1	SFF-8472	02	Diagnostics(SFF-8472 Rev 9.4)
95	1	CC EXT	xx	Check sum of bytes 64 - 94
96—255	160	Vendor specific		

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.

### Monitoring Specification

The digital diagnostic monitoring interface also defines another 256-byte memory map in EEPROM, which makes use of the 8 bit address 1010001X (A2h). Please see Figure 1. For detail EEPROM information, please refer to the related document of SFF-8472 Rev 9.5. The monitoring specification of this product is described in Table 7.

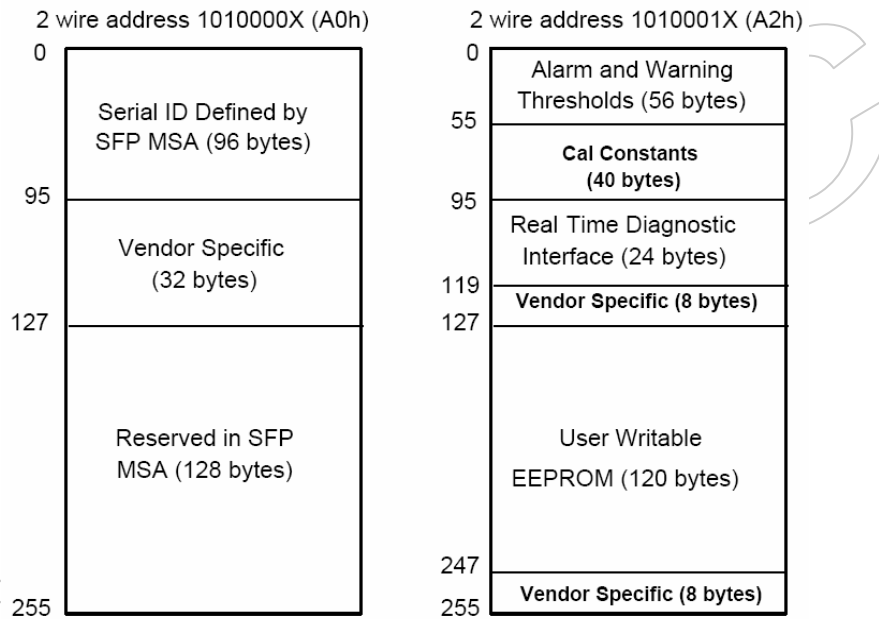


Figure 1, EEPROM Memory Map Specific Data Field Description

Table 7 - FTM-9301C-SL20G / FTM-9501C-SL20G Monitoring Specification

Parameter	Range	Accuracy	Calibration*
Temperature	-5 to +90°C	±3°C	External
Voltage	2.97 to 3.63V	±3%	External
Bias Current	3mA to 80mA	±10%	External
TX Power	-8 to -14dBm	±3dB	External
RX Power	-8 to -32dBm	±3dB	External

### Recommended Host Board Power Supply Circuit

Figure 2 shows the recommended host board power supply circuit.

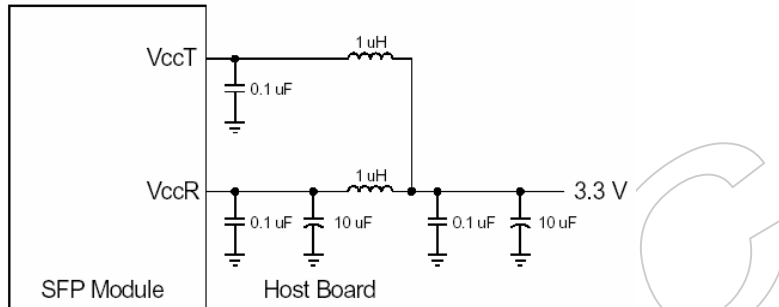


Figure 2, Recommended Host Board Power Supply Circuit

### Recommended Interface Circuit

Figure 3 shows the recommended interface circuit.

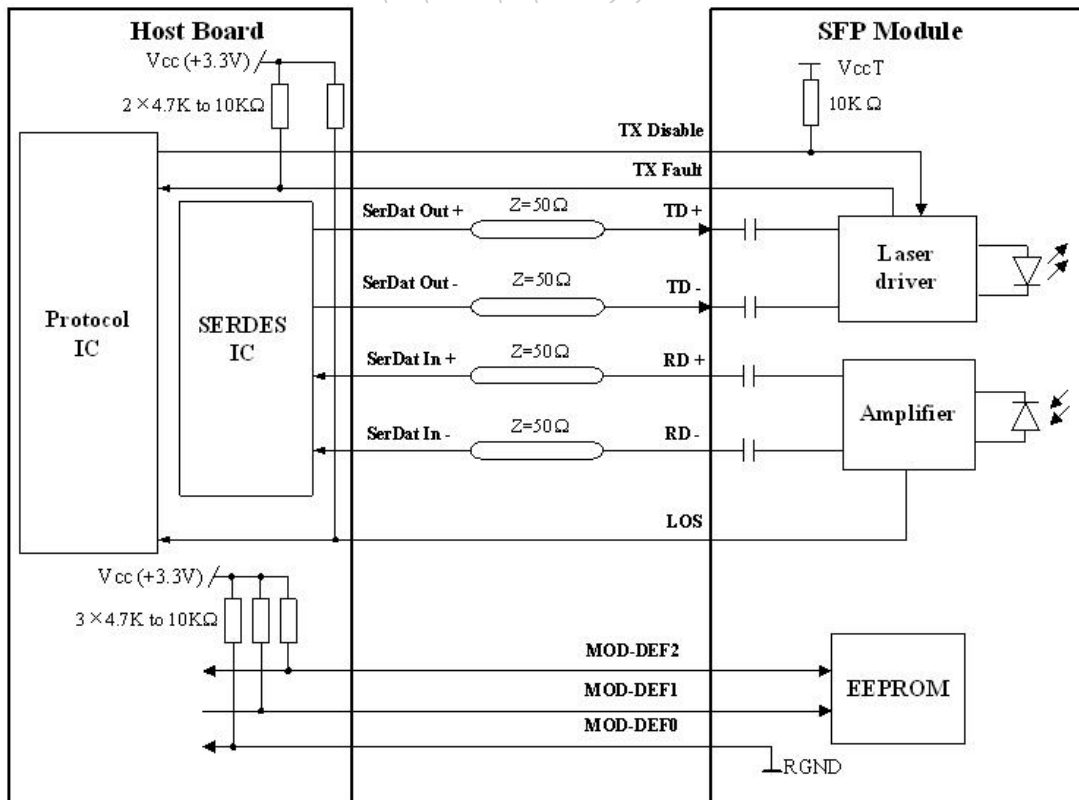


Figure 3, Recommended Interface Circuit

### Pin Definitions

Figure 4 below shows the pin numbering of SFP electrical interface. The pin functions are described in Table

and the accompanying notes.

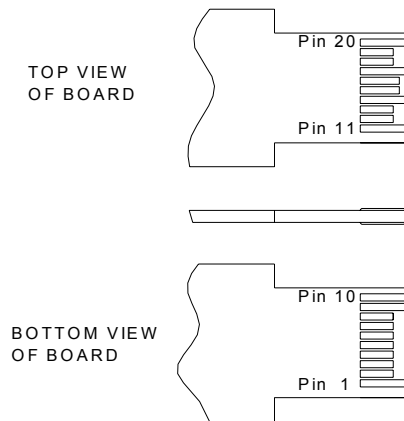


Figure 4, Pin View

Table 8– Pin Function Definitions

Pin No.	Name	Function	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	
2	TX Fault	Transmitter Fault Indication	3	Note 1
3	TX Disable	Transmitter Disable	3	Note 2
4	MOD-DEF2	Module Definition 2	3	Note 3
5	MOD-DEF1	Module Definition 1	3	Note 3
6	MOD-DEF0	Module Definition 0	3	Note 3
7	Rate Select	Not Connected	3	
8	LOS	Loss of Signal	3	Note 4
9	VeeR	Receiver Ground	1	
10	VeeR	Receiver Ground	1	
11	VeeR	Receiver Ground	1	
12	RD-	Inv. Received Data Out	3	Note 5
13	RD+	Received Data Out	3	Note 5
14	VeeR	Receiver Ground	1	
15	VccR	Receiver Power	2	
16	VccT	Transmitter Power	2	
17	VeeT	Transmitter Ground	1	
18	TD+	Transmit Data In	3	Note 6
19	TD-	Inv. Transmit Data In	3	Note 6
20	VeeT	Transmitter Ground	1	

**Notes:**

1. TX Fault is an open collector output, which should be pulled up with a 4.7k~10kΩ resistor on the host board to a voltage between 2.0V and Vcc+0.3V. Logic 0 indicates normal operation; logic 1 indicates a laser fault of some kind. In the low state, the output will be pulled to less than 0.8V.
2. TX Disable is an input that is used to shut down the transmitter optical output. It is pulled up within the



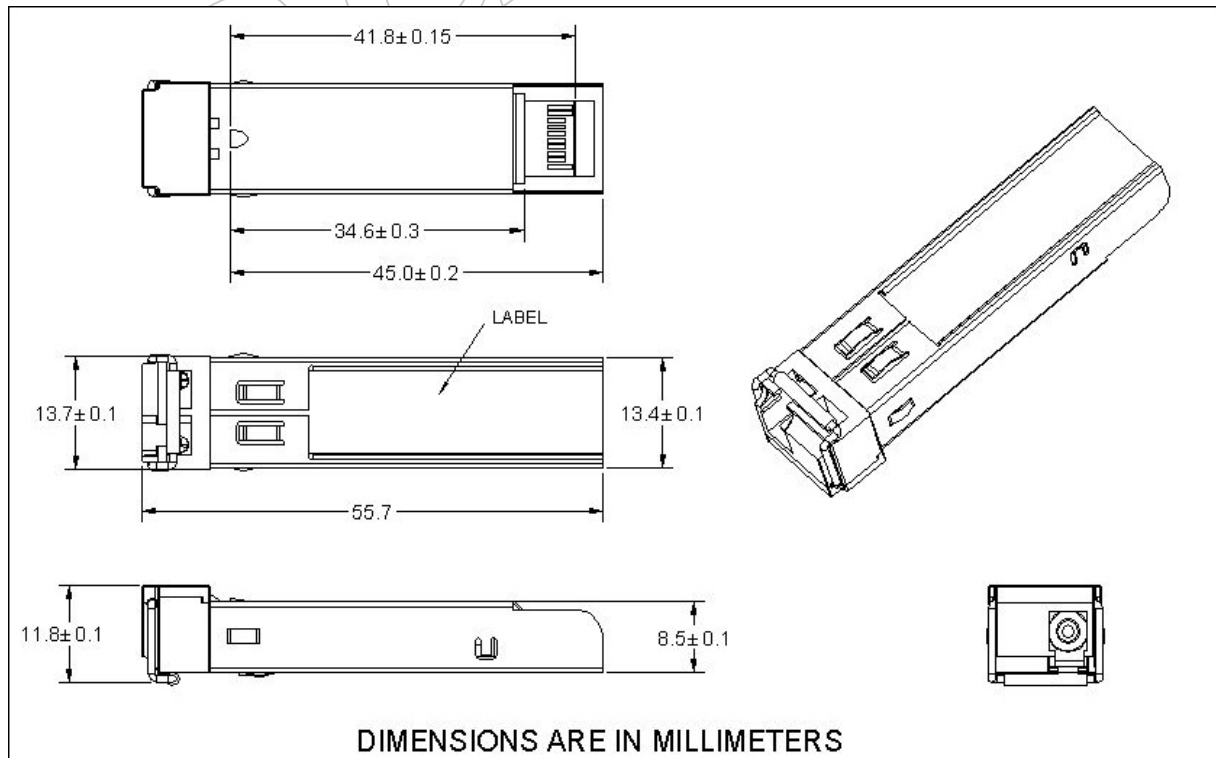
module with a 4.7k~10kΩ resistor. Its states are:

- Low (0~0.8V): Transmitter on
- (>0.8V, <2.0V): Undefined
- High (2.0~3.465V): Transmitter Disabled
- Open: Transmitter Disabled

3. MOD-DEF 0,1,2 are the module definition pins. They should be pulled up with a 4.7k~10kΩ resistor on the host board. The pull-up voltage shall be VccT or VccR.  
 MOD-DEF 0 is grounded by the module to indicate that the module is present  
 MOD-DEF 1 is the clock line of two wire serial interface for serial ID  
 MOD-DEF 2 is the data line of two wire serial interface for serial ID
4. LOS is an open collector output, which should be pulled up with a 4.7k~10kΩ resistor on the host board to a voltage between 2.0V and Vcc+0.3V. Logic 0 indicates normal operation; logic 1 indicates loss of signal. In the low state, the output will be pulled to less than 0.8V.
5. These are the differential receiver outputs. They are AC-coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES.
6. These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module.

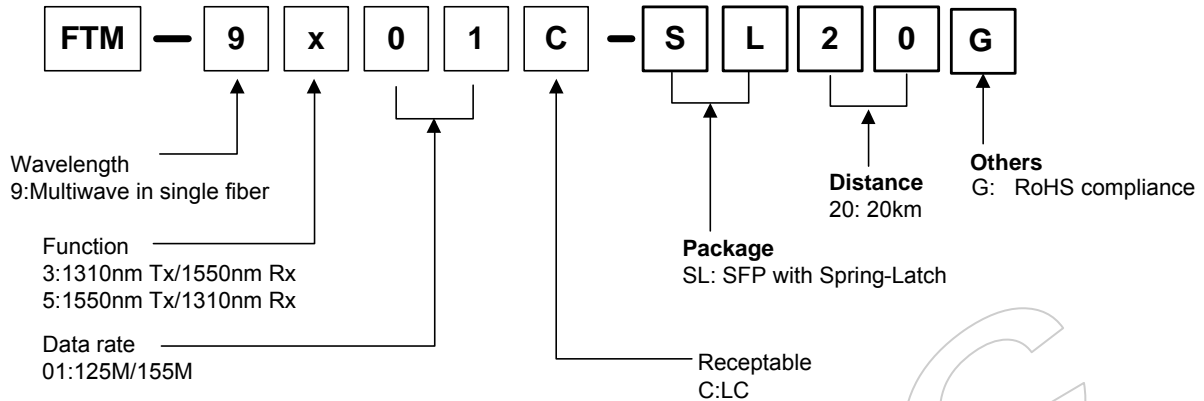
### Mechanical Design Diagram

The mechanical design diagram is shown in Figure 5.



**Figure 5, Mechanical Design Diagram of the SFP with Spring Latch**

**Ordering information**



Part No.	Product Description
FTM-9301C-SL20G	1310nm(TX)/1550nm(RX), 125~155Mbps, bi-directional SFP for ONU, Compliant with RoHS; 0 to 70°C
FTM-9501C-SL20G	1550nm(TX)/1310nm(RX), 125~155Mbps, bi-directional SFP for OLT, Compliant with RoHS; 0 to 70°C

**Related Documents**

For further information, please refer to the following documents:

- ◆ *Flexon™ SFP Installation Guide*
- ◆ *Flexon™ SFP Application Notes*
- ◆ *SFP Multi-Source Agreement (MSA)*

**Obtaining Document**

You can visit our website:

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**Revision History**

Revision	Initiate	Review	Approve	Subject	Release Date
Rev. 1a	Solaris Zhu	Monica Wei	Walker.Wei	Initial datasheet	Sep. 21, 2006
Rev. 1b	Solaris Zhu	Monica Wei	Walker.Wei	Updated the content of A0h address to compliant with SFF 8472 Rev 9.5; and updated datasheet version from preliminary to formal	Dec 27, 2006
Rev. 1c	Solaris Zhu	Monica Wei	Walker.Wei	Updated the contact info.	Feb. 12, 2007

Rev. 1d	Solaris Zhu	Monica Wei	Walker.We	Updated Electrostatic Discharge (ESD) to the Electrical Pins to Class 2(>2000 V)	Jun. 18, 2007
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