



### Features

- 0.622~2.67Gb/s bi-directional data links
- Up to 40km point-point transmission
- 1490nm DFB transmitter and 1570nm PIN receiver for SPL-45-MR-IR2-IDFM
- 1570nm DFB transmitter and 1490nm PIN receiver for SPL-54-MR-IR2-IDFM
- Digital diagnostic monitor interface compatible with SFF-8472
- SFP MSA package with single LC receptacle
- +3.3V single power supply
- Power consumption less than 1W
- Operating case temperature: -40~+85°C
- RoHS compliant

### Regulatory Compliance

Table 1 - Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class 1
Electrostatic Discharge (ESD) to the Duplex LC Receptacle	IEC 61000-4-2	Compatible with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN (IEC) 60825-1,2	Compatible with Class I laser product.
RoHS	2002/95/EC 4.1&4.2 2005/747/EC	Compliant with RoHS

### Absolute Maximum Ratings

Table 2 - Absolute Maximum Ratings

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Storage Temperature	T <sub>s</sub>	-40	-	+85	°C	
Supply Voltage	V <sub>CC</sub>	0	-	+4	V	
Operating Relative Humidity	RH	+5	-	+95	%	

## Recommended Operating Conditions

Table 3 – Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Operating Case Temperature	$T_C$	-40	-	+85	°C	
Power Supply Voltage	$V_{CC}$	3.13	3.3	3.47	V	
Power Supply Current	$I_{CC}$	-	-	300	mA	
Data Rate		0.622	2.5	2.67	Gbps	

## Optical Characteristics

Table 4 – Optical Characteristics: SPL-45-MR-IR2-IDFM

Transmitter						
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Centre Wavelength	$\lambda_C$	1480	1490	1500	nm	
Average Output Power	$P_{OUT}$	-2	0.5	3	dBm	1
Average Launch Power of OFF Transmitter				-45	dBm	
Spectral Width (-20dB)	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Extinction Ratio	EX	8.2			dB	
Jitter Generation (RMS)				0.01	UI	
Jitter Generation (pk-pk)				0.1	UI	
Optical Eye Mask		ITU-T G.957 Compatible				2
Receiver						
Centre Wavelength	$\lambda_C$	1530	1570	1610	nm	
Receiver Sensitivity	$P_{IN}$			-18	dBm	3
Receiver Overload	$P_{IN}$	0			dBm	3
LOS Assert	$LOS_A$	-37			dBm	
LOS Deassert	$LOS_D$			-19	dBm	
LOS Hysteresis		0.5		5	dB	

Notes:

1. The optical power is launched into SMF
2. Measured with a PRBS  $2^{23}-1$  test pattern @2.5Gbps.
3. Measured with a PRBS  $2^{23}-1$  test pattern@2.5Gbps,  $BER \leq 1 \times 10^{-10}$

**Table 5 – Optical Characteristics: SPL-54-MR-IR2-IDFM**

Transmitter						
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Centre Wavelength	$\lambda_C$	1560	1570	1580	nm	
Average Output Power	$P_{OUT}$	-2	0.5	3	dBm	1
Average Launch Power of OFF Transmitter				-45	dBm	
Spectral Width (-20dB)	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Extinction Ratio	EX	8.2			dB	
Jitter Generation (RMS)				0.01	UI	
Jitter Generation (pk-pk)				0.1	UI	
Optical Eye Mask	ITU-T G.957 Compatible					2
Receiver						
Centre Wavelength	$\lambda_C$	1410	1490	1510	nm	
Receiver Sensitivity	$P_{IN}$			-18	dBm	3
Receiver Overload	$P_{IN}$	0			dBm	3
LOS Assert	$LOS_A$	-37			dBm	
LOS Deassert	$LOS_D$			-19	dBm	
LOS Hysteresis		0.5		5	dB	

Notes:

1. The optical power is launched into SMF
2. Measured with a PRBS  $2^{23}-1$  test pattern @2.5Gbps.
3. Measured with a PRBS  $2^{23}-1$  test pattern@2.5Gbps, BER $\leq 1 \times 10^{-10}$

## Electrical Characteristics

**Table 6 – Electrical Characteristics**

Transmitter						
Parameter	Symbol	Min.	Typical	Max.	Unit	Notes
Data Input Swing Differential	$V_{IN}$	500		2400	mV	1
Input Differential Impedance	$Z_{IN}$	80	100	120	$\Omega$	
Tx_DIS Disable	$V_D$	2		$V_{CC}$	V	
Tx_DIS Enable	$V_{EN}$	GND		GND+0.8	V	
TX_ Fault (Fault)		2.0		Vcc+0.3	V	
TX_ Fault (Normal)		0		0.8	V	
Receiver						
Data Output Swing Differential	$V_{OUT}$	370		1600	mV	1

Rx_LOS Fault	V <sub>LOS-Fault</sub>	2.0		V <sub>cc</sub> +0.3	V	
Rx_LOS Normal	V <sub>LOS-Normal</sub>	GND		GND+0.8	V	

Notes:

- Internally AC coupled

### Recommended Host Board Power Supply Circuit

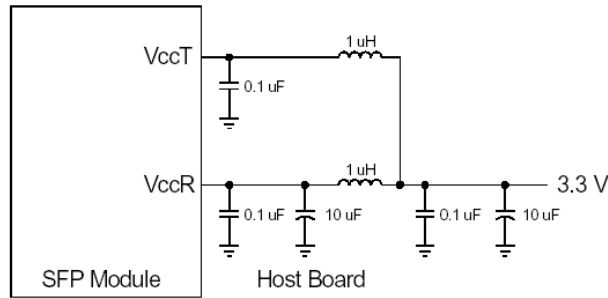


Figure 1, Recommended Host Board Power Supply Circuit

### Recommended Interface Circuit

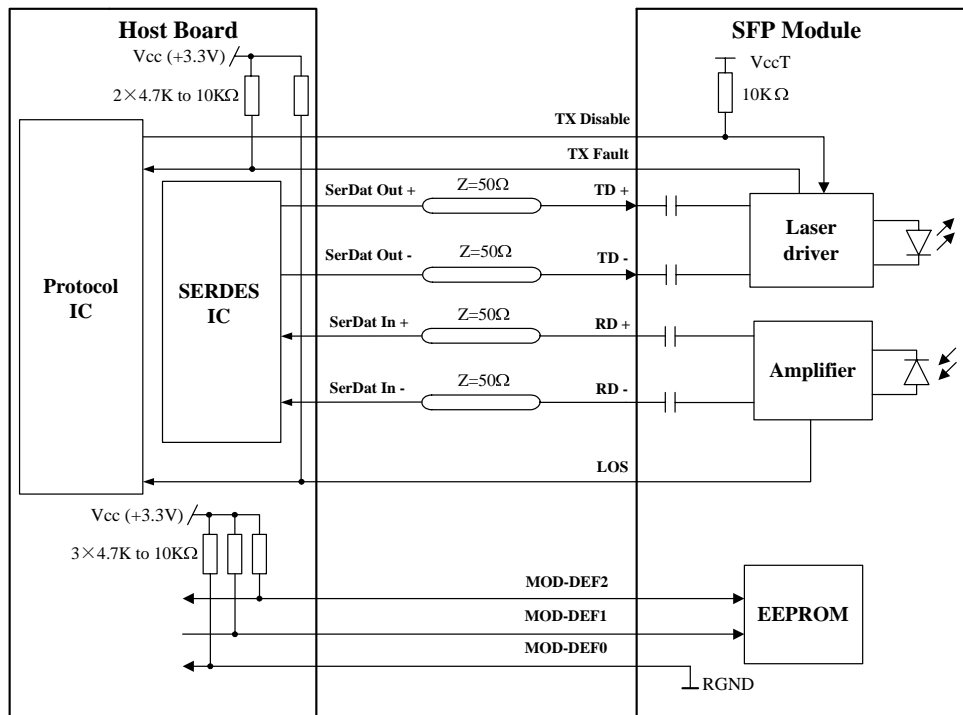


Figure 2, Recommended Interface Circuit

### Pin Definitions

Figure 3 below shows the pin numbering of SFP electrical interface. The pin functions are described in Table 7 with some accompanying notes.

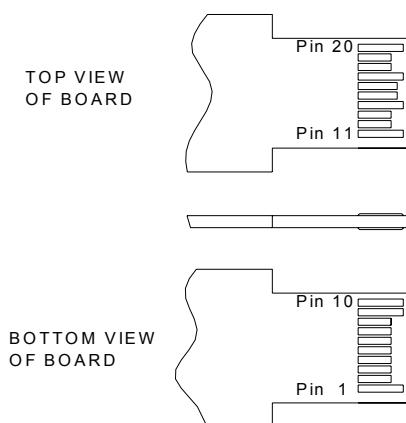


Figure 3, Pin View

Table 7 - 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 wires serial interface for serial ID
  - MOD-DEF 2 is the data line of two wires 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 output. They are internally 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.

**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 8.

**Table 8 - 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 12 00 00 00 00 00 00	OC-48
11	1	Encoding	05	
12	1	BR, nominal	19	2.5Gbps
13	1	Reserved	00	
14	1	Length (9um)-km	28	40km
15	1	Length (9um)	FF	

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	53 4F 55 52 43 45 50 48 4F 54 4F 4E 49 43 53 20	“SOURCEPHOTONICS”(ASC II)
36	1	Reserved	00	
37—39	3	Vendor OUI	00 1F 22	
40—55	16	Vendor PN	53 50 4C xx 4D 52 49 52 32 49 44 46 4D 20 20 20	“SPLxxMRIR2IDFM” (ASC II)
56—59	4	Vendor rev	31 30 20 20	ASC II ( “31 30 20 20” means 1.0 revision)
60-61	2	Wavelength	05 D2/06 22	1490/1570nm
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	08	
67	1	BR, min	60	
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 30 31	Year(2 bytes), Month(2 bytes), Day (2 bytes)
92	1	Diagnostic type	58	Diagnostics(External Calibration)
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 9.5)
95	1	CC_EXT	xx	Check sum of bytes 64 - 94
96-127	32	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 4. 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 9.

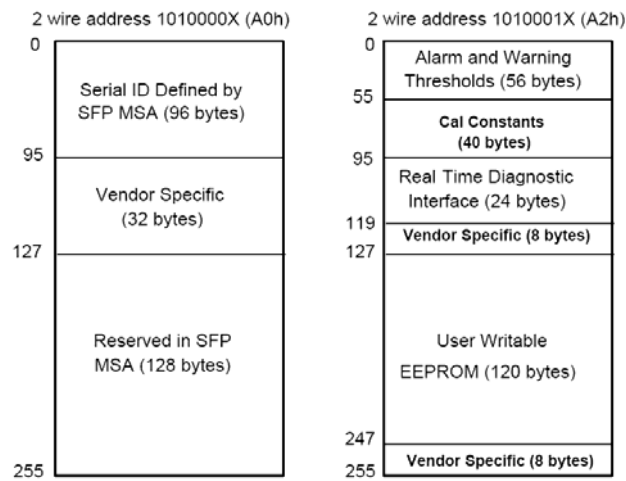


Figure 4, EEPROM Memory Map Specific Data Field Descriptions

Table 9- Monitoring Specification

Parameter	Range	Accuracy	Calibration
Temperature	-40 to + 90°C	±3°C	External
Voltage	2.97 to 3.63V	±3%	External
Bias Current	3mA to 80mA	±10%	External
TX Power	-2 to 3dBm	±3dB	External
RX Power	-18 to 0dBm	±3dB	External

### Mechanical Diagram

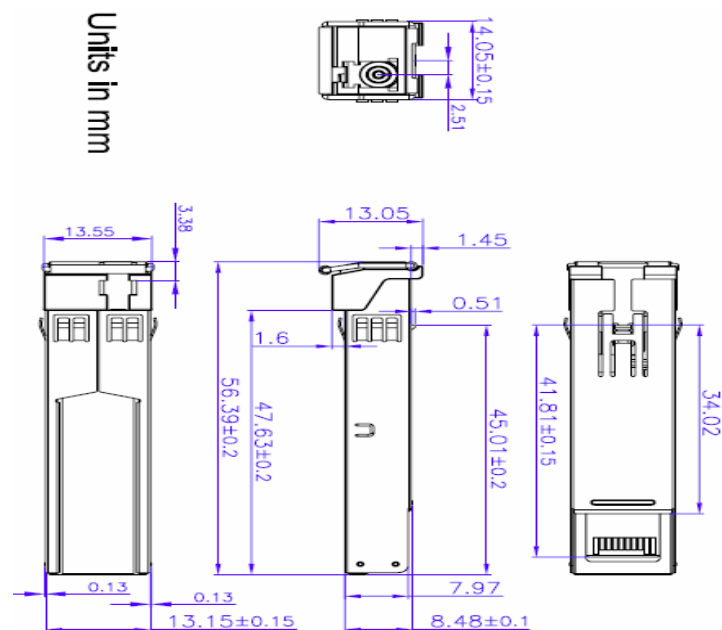


Figure 5, Mechanical Design Diagram of the SFP with Spring-Latch



**Table 10 – Order Information**

Part No.	Data Rate	Laser Source	Fiber Type
SPL-45-MR-IR2-IDFM	2.5G	1490nm DFB Tx/1570nm PIN Rx	SMF
SPL-54-MR-IR2-IDFM	2.5G	1570nm DFB Tx/1490nm PIN Rx	SMF

## 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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