

# **Product Specification**

**1.5G SDI Video Optical SFP Transceiver Module  
Low Power  
with 1310 FP Laser and PIN Photodiode**

**EP-SFP-1G-31L1**

**ePHOTON**

Ver. A

**EP-SFP-1G-31L1**  
*1.5G SDI Video Optical SFP Transceiver Module  
for SMPTE 259M/292M(Low Power)***1 Features**

- 1.1 Transceiver unit with independent laser disable pins and  
1310nm FP Laser diode transmitter  
PIN photodiode receiver
- 1.2 SMPTE 297-2006 compatible
- 1.3 -6dBm typical launch power,
- 1.4 Robust error-free transmission of signals from 50Mbps to 1.5Gbps  
for up to 10Km single mode fiber;
- 1.5 Supports video pathological patterns for SD-SDI,HD-SDI
- 1.6 Diagnose and control via I<sup>2</sup>C interface including:  
Monitoring laser bias current, average output power, supply voltage,  
receiver power and temperature
- 1.7 Industry standard SFP form factor;
- 1.8 Single +3.3V power supply
- 1.9 Low power consumption, typically 650mW
- 1.10 Hot pluggable
- 1.11 RoHS-6 compliant

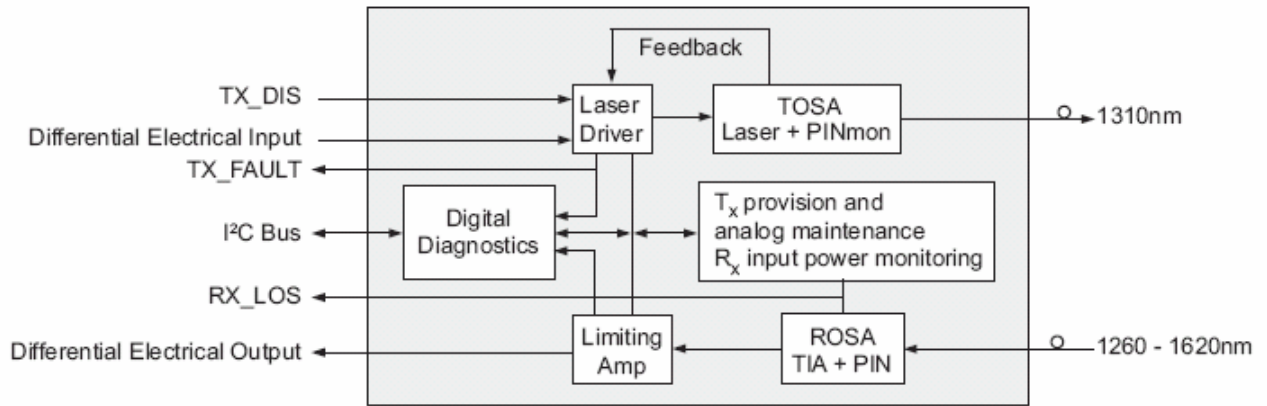
**2 Applications**

- 2.1 1.5G HD SDI video application
- 2.2 SMPTE 297-2006 compatible OE interfaces
- 2.3 Broadcast cameras

**3 General**

The Modules are optical transceiver or transmitter and receiver modules designed to transmit and receive optical and electrical serial digital signals as defined in SMPTE 297-2006. The transceiver or transmitter and receiver are specifically designed for the application with the performance of SDI pathological patterns for SMPTE 259M, 344M, 292M serial rates.

**4 Functional Block Diagram**



**5 Performance Specifications**

**5.1 Absolute Maximum Ratings**

Parameter	Symbol	Min.	Max.	Unit	Note
Storage Temperature (Non-Operating)	Tstg	-40	+85	°C	
Case Temperature (Operating)	Tc	0	+70	°C	1
Input Voltage	-	GND	Vcc	V	
Power Supply Voltage	Vcc-Vee	-0.5	+3.6	V	
Lead Soldering	T/Sec		260/10	°C/Sec	

Note

1. Measured on top side front center of SFP module.

**5.2 Operating Environment**

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Power Supply Voltage	Vcc	+3.1	+3.3	+3.5	V	-
Power Consumption	Icc	-	650	1000	mW	-
Case Temperature (Operating)	Tc	0	-	70	°C	-
Data Rate	-	-	-	1.5	Gb/s	-

### 5.3 Transmitter Specifications

(Over Operating Case Temperature Range, Vcc = 3.135V to 3.465V)

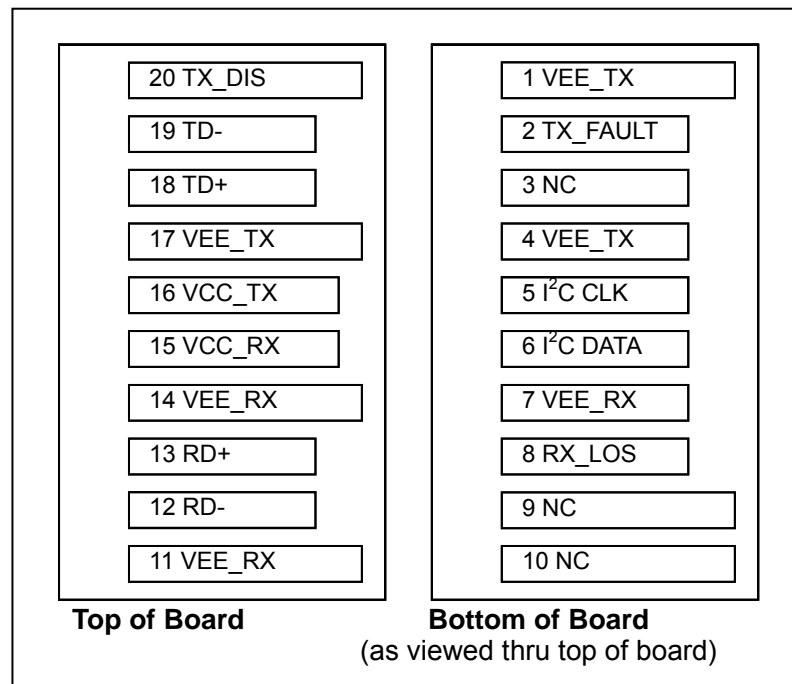
<b>Electrical Characteristics</b>						
Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Differential Data Input Swing	V <sub>in,pp</sub>	300	-	1200	mV	-
Differential Input Impedance	R <sub>in</sub>	95	100	105	ohm	-
Tx Disable Voltage	V <sub>d</sub>	2.0	-	V <sub>cc</sub> +0.3	V	-
Tx Enable Voltage	V <sub>en</sub>	0	-	0.8	V	-
<b>Optical Characteristics</b>						
Optical Power	P <sub>out</sub>	-12	-	-3	dBm	1
Optical Extinction Ratio	ER	5	7.5	-	dB	-
Transmitter Optical Wavelength	λ <sub>t</sub>	1270	1310	1350	nm	
Spectral Width (RMS)	σ	-	-	10	nm	
Optical Rise Time	Tr			270	ps	2,5
				800	ps	3,5
Optical Fall Time	Tf			270	ps	2,5
				800	ps	3,5
Optical Signal Intrinsic Jitter	JTX	-	-	100	ps	5
Optical Sensitivity	P <sub>sen</sub>	-	-23	-20	dBm	1,2,3,4
Optical Overload	P <sub>sat</sub>	0	-	-	dBm	1,2,3,4
Receiver Optical Wavelength	λ <sub>r</sub>	1260	-	1620	nm	
Loss of Signal Asserted		-31	-	-	dBm	
Loss of Signal De-Asserted		-	-	-23	dBm	
Loss of Signal Optical Hysteresis		0.5	-	-	dB	
Receiver Maximum Back Reflection		-	-	-27	dB	-

Notes:

1. Using 9/125 SMF
2. SMPTE 292M, 1.485Gbps;
3. SMPTE 259M, 270Mbps;
4. Measured with PRBS 2<sup>23</sup>-1 and color bar test signal at 1.485Gbps, 270Mbps;
5. 20%~80%, Measured following a fourth-order Bessel-Thompson filter with a bandwidth of 0.75 x clock frequency

## 6 Pin Definitions

### 6.1 Pin Diagram



### 6.2 Pin Descriptions

Pin#	Name	Function	Notes
1	VEE_TX	Transmitter Ground	-
2	TX_FAULT	Transmitter Fault Indicator	Active High, Open-Drain
3	NC	Not Connect	-
4	VEE_TX	Transmitter Ground	-
5	I <sup>2</sup> C CLK	I <sup>2</sup> C Clock	Note 2, 2 wire serial ID interface
6	I <sup>2</sup> C DATA	I <sup>2</sup> C, Data	Note 2, 2 wire serial ID interface
7	VEE_RX	Receiver Ground	-
8	NC	Not Connect	
9	NC	Not Connect	
10	NC	Not Connect	
11	VEE_RX	Receiver Ground	-
12	RD-	Negative Differential Output	AC Coupled Internally
13	RD+	Positive Differential Output	AC Coupled Internally
14	VEE_RX	Receiver Ground	-
15	VCC_RX	Receiver Power Supply	Note 2, 3.3V 5%
16	VCC_TX	Transmitter Power Supply	Note 4, 3.3V 5%
17	VEE_TX	Transmitter Ground	-
18	TD+	Transmitter Data Positive In	Note 5
19	TD-	Transmitter Data Negative In	Note 5
20	TX_DIS	Transmitter Disable	Note 1

**Notes:**

1. TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7–10 K $\Omega$  resistor. Its states are:  
Low (0–0.8V): Transmitter on  
(>0.8, <2.0V): Undefined  
High (2.0–3.465V): Transmitter Disabled  
Open: Transmitter Disabled
2. These are the module definition pins. They should be pulled up with a 4.7K–10K $\Omega$  resistor on the host board. The pull-up voltage shall be VCC.
3. VEE may be internally connected within the SFP module.
4. VCC\_TX and VCC\_RX are the transmitter and receiver power supplies. It is defined as 3.3V $\pm$ 5% at the SFP connector pin. Maximum supply current is 400mA. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1 $\Omega$  should be used in order to maintain the required voltage at the SFP input pin with 3.3V supply voltage. When the recommended supply filtering network is used, hot plugging of the SFP transceiver module will result in an inrush current of no more than 30 mA greater than the steady state value.
5. TD+/-, RD+/-: These are the differential transmitter inputs and receiver outputs. They are AC-coupled, differential lines with 100 $\Omega$  differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.

**6.3 Optical Connector**

An LC connector with PC/UPC is required for each port.

## 7. Serial interface memory map

Module identification and diagnostic information is accessible through the address map shown in the following tables .

### 7.1 EEPROM serial ID memory contents (A0h)

Addr	Hex	ASCII	Description	Addr	Hex	ASCII	Description	Addr	Hex	ASCII	Description	
0	85		Transceiver	32	20		Vendor name	64	00			
1	04		SFP function is defined by serial ID only	33	20			65	18		TX_DISABLE, TX_FAULT active; LOS not active	
2	07		LC connector	34	20			66	00		BR, Max	
3	40		SMPTE259M/344M/292M and 297M	35	20			67	00		BR, Min.	
4	00		Reserved(SFP MSA does not specify SMPTE compliance codes)	36	XX		Reserved	68	XX		Vendor Serial number	
5	00			37	00		Vendor OUI	69	XX			
6	00			38	00			70	XX			
7	00			39	00			71	XX			
8	00			40	45	E	Vendor part number	72	XX			
9	00			41	50	P		73	XX			
10	00			42	2D	-		74	XX			
11	03			43	53	S		75	XX			
12	0F			BR in 100Mbps	44	46	F		76	XX		
13	00			Reserved	45	50	P		77	XX		
14	0A	10	Length(9u)*Km	46	2D	-		78	XX			
15	00		Length(9u)*100m	47	31	1		79	XX			
16	00		Length(50u)*10m	48	47	G		80	XX			
17	00		Length(62.5u)*10m	49	2D	-		81	XX			
18	00		Length(Copper)	50	33	3		82	XX			
19	XX		Reserved	51	31	1		83	XX			
20	65	e	Vendor name	52	52	L		84	XX		Vendor data code: Year	
21	50	P		53	31	1		85	XX			
22	48	H		54	20			86	XX		Vendor data code: Month	
23	4F	O		55	20			87	XX			
24	54	T		56	00			88	XX		Vendor data code: Day	
25	4F	O		57	00	.		89	XX			
26	4E	N		58	00			90	20		Blank	
27	20			59	0A	10	Vendor PN reversion Ver 1.0	91	20			
28	20			60	1F	31	For the two middle digits of channel 1 wavelength: 1310nm	92	20		Calibrated average output power	
29	20			61	00		Reserved	93	E0		Enhanced alarm/warning flags	
30	20		62	00		Reserved	94	XX		Reserved		
31	20		63	XX		CC_BASE(0-62)	95	XX		CC_EXT(64-94)		

96-127: 00, Vendor specific  
 128-255: 00, Reserved  
 XX: denotes hex values which varies from module to module

## 7.2 EEPROM serial ID memory contents (A2h)

### 7.2.1 Alarm and Warning Thresholds, OM Output Calibration ID Fields

Addr. (DEC)	# Bytes	Name	Value
00-01	2	Temp high alarm	+120°C
02-03	2	Temp low alarm	-13°C
04-05	2	Temp high warning	+110°C
06-07	2	Temp low warning	-8°C
08-09	2	Supply voltage high alarm	+3.6V
10-11	2	Supply voltage low alarm	+3.0V
12-13	2	Supply voltage high warning	+3.47V
14-15	2	Supply voltage low warning	+3.14V
16-17	2	Bias high alarm	100mA
18-19	2	Bias low alarm	0mA
20-21	2	Bias high warning	80mA
22-23	2	Bias low warning	0mA
24-25	2	Tx power high alarm	-1dBm
26-27	2	Tx power low alarm	-13dBm
28-29	2	Tx power high warning	-2dBm
30-31	2	Tx power low warning	-12dBm
32-33	2	Rx Power High Alarm	1.5dBm
34-35	2	Rx Power Low Alarm	-25dBm
36-37	2	Rx Power High Warning	0dBm
38-39	2	Rx Power Low Warning	-23dBm
40-94	55	Reserved	
95	1	Check sum	Byte 95 contains the low order 8 bits of the sum of bytes 0-94

### 7.2.2 A/D Values and Status Bits

Addr. (DEC)	Bit	Name	Description
96	All	Temperature MSB	Internally measured module temperature, see table 7.2.3
97	All	Temperature LSB	
98	All	Vcc MSB	Internal measured supply voltage, see table 7.2.3
99	All	Vcc LSB	
100	All	Tx bias MSB	TBD
101	All	Tx bias LSB	
102	All	Tx power MSB	Measured TX output power, see table 7.2.3
103	All	Tx power LSB	
104	All	Rx Power MSB	Internally Measured Rx Power
105	All	Rx Power LSB	Internally Measured Rx Power
106-109	All	Reserved	
<b>Optional status/control bits</b>			
110	7	N/A	
110	6	N/A	
110	5	Reserved	
110	4	N/A	
110	3	N/A	
110	2	TX fault	Tx fail status:1=TX fail; 0=TX normal
110	1	LOS	Indicates Rx_LOS state
110	0	Data_Ready	
111	7	Temp Update	Goes to high after a temperature update
	6	Vcc_Update	Goes to high after a Vcc update
	5	Mon 1 Update	Goes to high after a Tx bias current update
	4	Mon 2 Update	Goes to high after a TX power update
	3	Mon 3 Update	Goes to high after a Tx modulation current update
	2-0	Reserved	

### 7.2.3 Transceiver only

A2h address	Parameter	Calibration	Accuracy	Range
96-97	Temperature	Internal	+/- 3°C	Note 1
98-99	Vcc	Internal	+/- 3%	3.135 to 3.465
100-101	Bias	TBD	TBD	TBD
102-103	Tx power	External	+/- 3dB	-12 to -3dBm
104-105	Rx power	External	+/- 3dB	-23 to 0dBm

**Notes:**

- Junction temperature of temperature sensing device

### 7.2.4 Alarm and Warning Flags

Addr. (DEC)	Bit	Name	Description
112	7	Temp high alarm	Set when internal temperature exceeds high alarm level
	6	Temp low alarm	Set when internal temperature below low alarm level
	5	Vcc high alarm	Set when internal supply voltage exceeds high alarm level
	4	Vcc low alarm	Set when internal supply voltage below low alarm level
	3	Tx bias high alarm	Set when internal Tx bias current exceeds high alarm level
	2	Tx bias low alarm	Set when internal Tx bias current below low alarm level
	1	Tx power high alarm	Set when internal Tx output power exceeds high alarm level
	0	Tx power low alarm	Set when internal Tx output power below low alarm level
113	7	Rx power high alarm	Set when the monitored Rx power exceeds the Rx power high alarm threshold
	6	Rx power low alarm	Set when the monitored Rx power goes below the Rx power low alarm threshold
	5-0	Reserved	
114-115	All	Reserved	
116	7	Temp high warning	Set when internal temperature exceeds high warning level
	6	Temp low warning	Set when internal temperature below low warning level
	5	Vcc high warning	Set when internal supply voltage exceeds high warning level
	4	Vcc low warning	Set when internal supply voltage below low warning level
	3	Tx bias high warning	Set when internal Tx bias current exceeds high warning level
	2	Tx bias low warning	Set when internal Tx bias current below low warning level
	1	Tx power high warning	Set when internal Tx output power exceeds high warning level
	0	Tx power low warning	Set when internal Tx output power below low warning level
117	7	Rx Power High Warning	Set when the monitored Rx power exceeds the Rx power high warning threshold
	6	Rx Power Low Warning	Set when the monitored Rx power goes below the Rx power low alarm threshold
	5-0	Reserved	
118-119	all	Reserved	

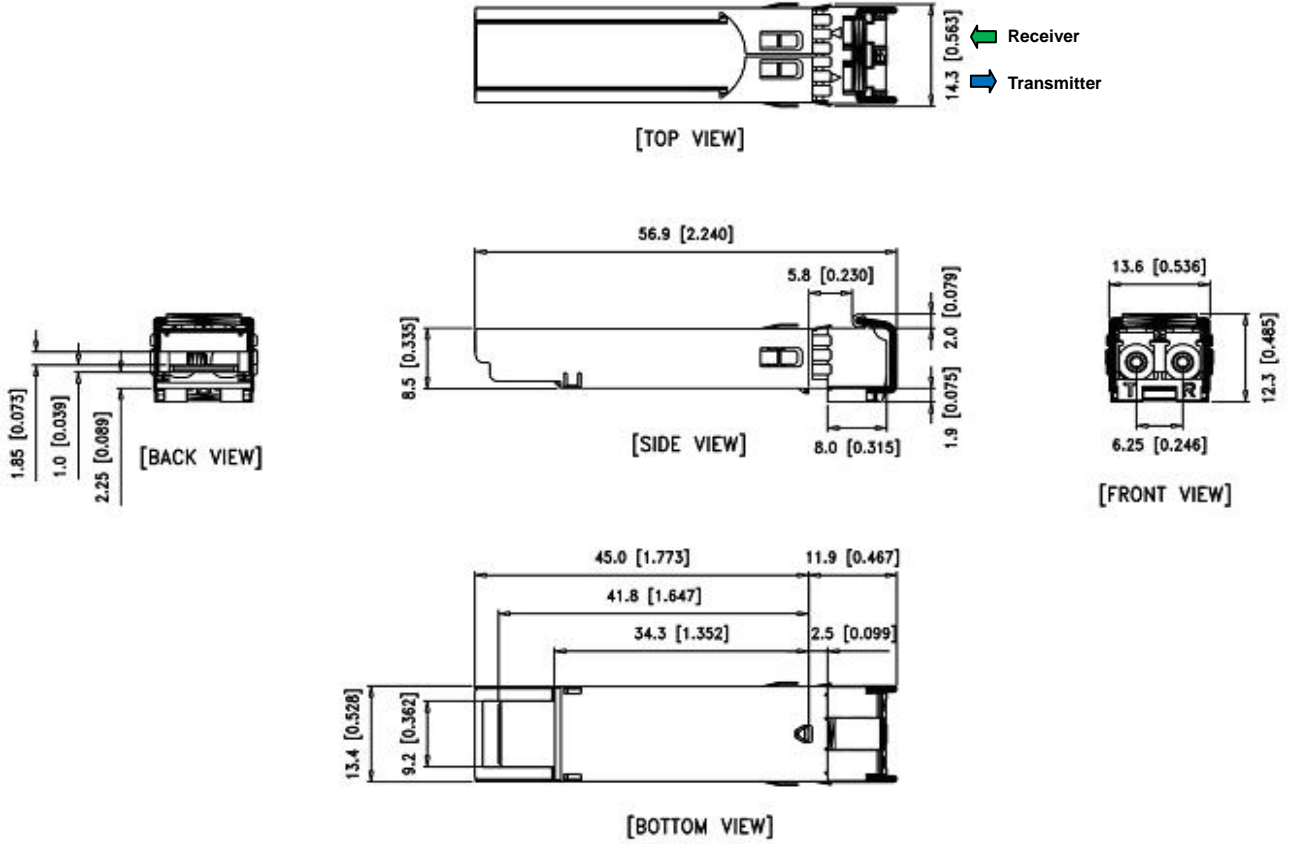
### 7.2.5 Vendor Specific Memory Addresses

Addr. (DEC)	# Bytes	Name	Description
120-127	8	Vendor specific	Vendor specific

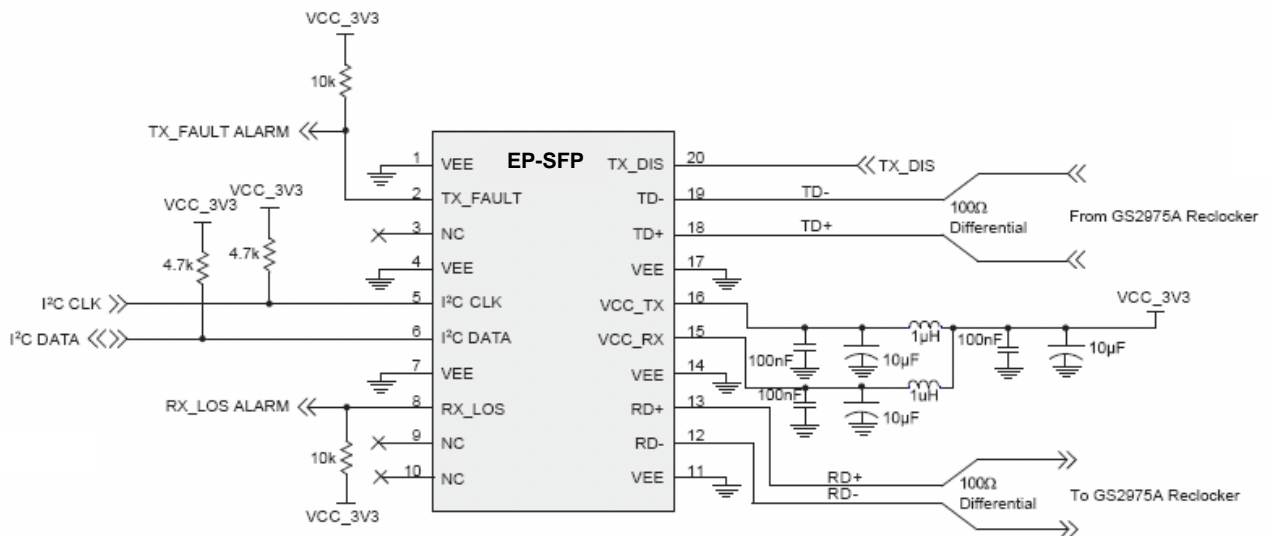
### 7.2.6 User EEPROM

Addr. (DEC)	# Bytes	Name	Description
128-247	120	Vendor Writable Area	Vendor writable EEPROM
248-255	8	Vendor specific	Vendor specific control functions

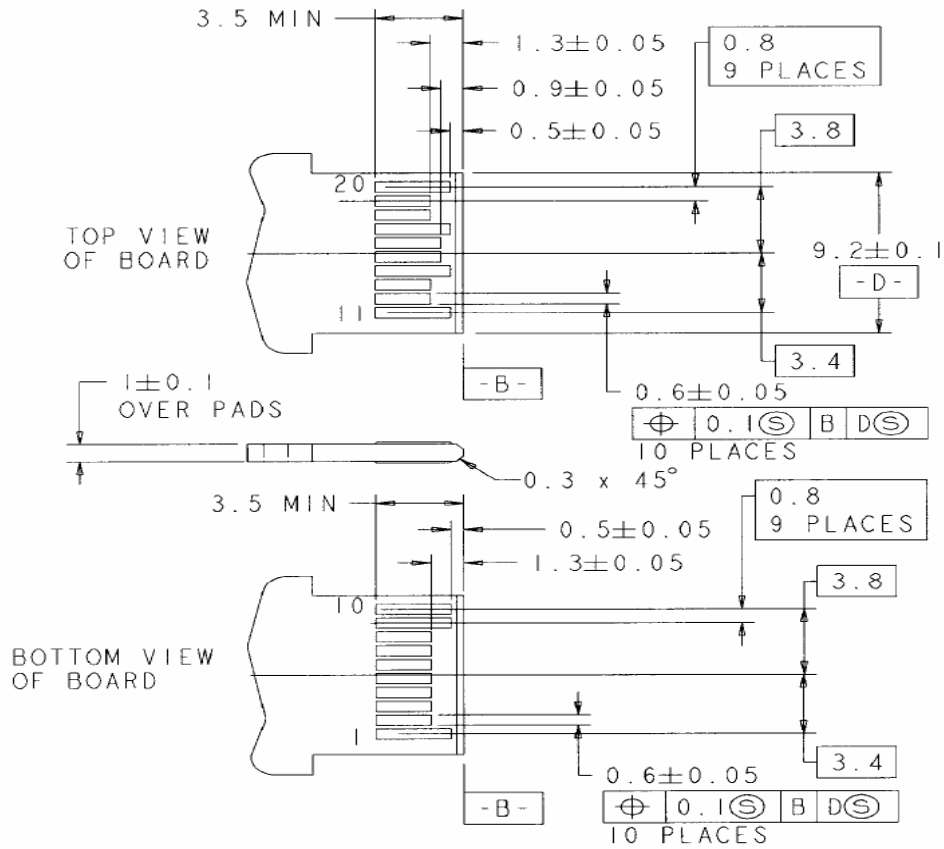
**8 Package Information**



**9 Recommended Circuit**



**10 Pattern Layout of SFP Printed Circuit Board**



(Unit: mm)

