

# **Product Specification**

**1.5G SDI Video Optical SFP Transmitter Module  
Low Power Dual Channels  
with 1310 FP Lasers**

**EP-2TP-1G-3131L1**

**ePHOTON**

Ver. A

**EP-2TP-1G-3131L1**  
*1.5G SDI Video Optical SFP Transmitter Module  
for SMPTE 292M(Low Power)***1 Features**

- 1.1 Dual Transmitter units with independent laser disable pins and  
1310nm FP Laser diode transmitter  
1310nm FP Laser diode transmitter
- 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  
and temperature;
- 1.7 Industry standard SFP form factor;
- 1.8 Single +3.3V power supply
- 1.9 Low power consumption, typically 680mW
- 1.10 Hot pluggable
- 1.11 RoHS-6 compliant

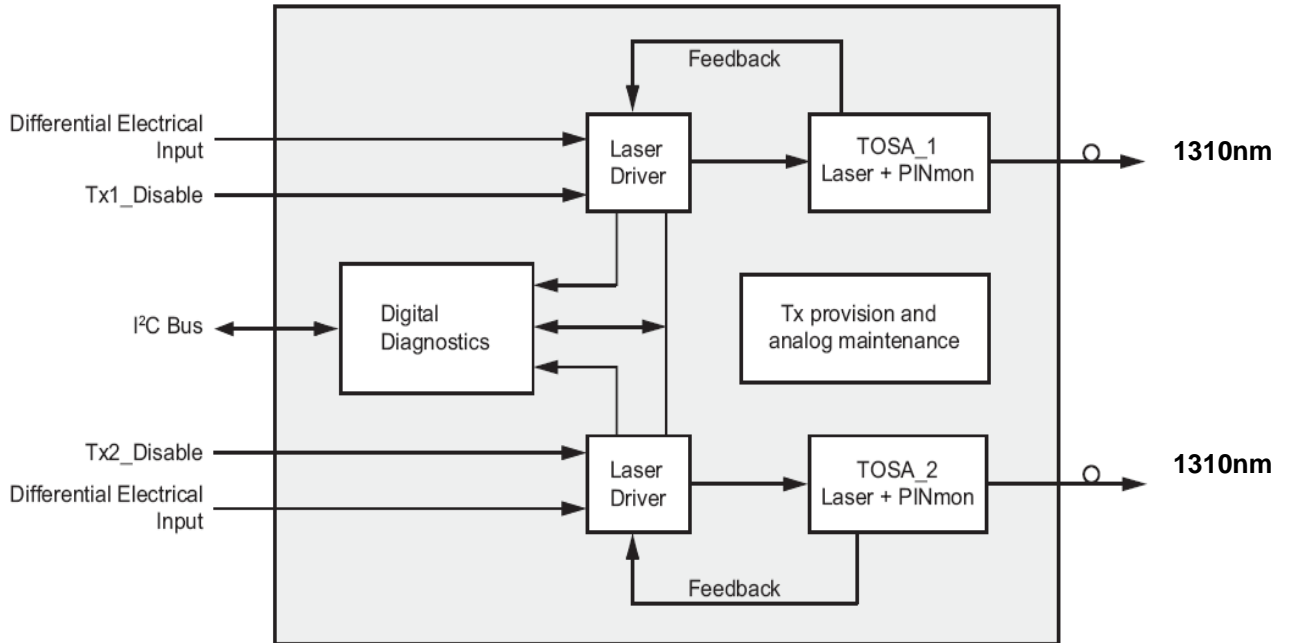
**2 Applications**

- 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    | -    | 680  | 1100 | 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)

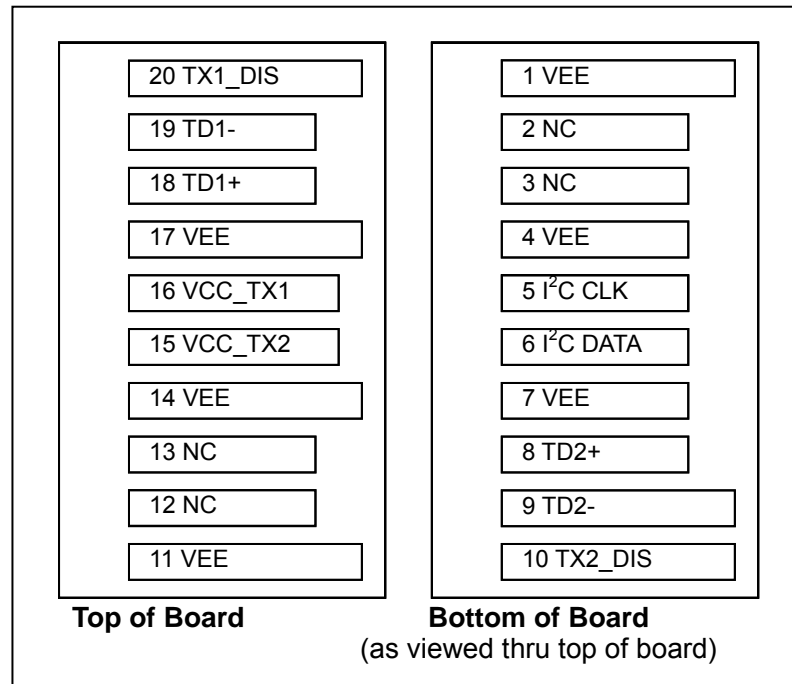
| <b>Electrical Characteristics</b> |                    |             |             |                      |             |              |
|-----------------------------------|--------------------|-------------|-------------|----------------------|-------------|--------------|
| <b>Parameter</b>                  | <b>Symbol</b>      | <b>Min.</b> | <b>Typ.</b> | <b>Max.</b>          | <b>Unit</b> | <b>Notes</b> |
| 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          | -            |
| Optical Wavelength(Channel 1)     | λ <sub>1</sub>     | 1270        | 1310        | 1350                 | nm          | 6            |
| Optical Wavelength(Channel 2)     | λ <sub>2</sub>     | 1270        | 1310        | 1350                 | nm          |              |
| Spectral Width (RMS)              | σ                  | -           | -           | 10                   | nm          |              |
| Optical Rise Time                 | T <sub>r</sub>     |             |             | 270                  | ps          | 2,5          |
|                                   |                    |             |             | 800                  | ps          | 3,5          |
| Optical Fall Time                 | T <sub>f</sub>     |             |             | 270                  | ps          | 2,5          |
|                                   |                    |             |             | 800                  | ps          | 3,5          |
| Optical Signal Intrinsic Jitter   | JTX                | -           | -           | 100                  | ps          | 5            |

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 corresponding to the serial data rate bar test signal @2.97Gb/s and differential input data;
6. Channel 1 and 2 definition, see the information in "8 Package Information"

## 6 Pin Definitions

### 6.1 Pin Diagram



### 6.2 Pin Descriptions

| Pin# | Name     | Function                       | Notes                              |
|------|----------|--------------------------------|------------------------------------|
| 1    | VEE      | Ground                         | -                                  |
| 2    | NC       | Not Connect                    | -                                  |
| 3    | NC       | Not Connect                    | -                                  |
| 4    | GND      | Ground                         | -                                  |
| 5    | I2C CLK  | I2C Clock                      | Note 2, 2 wire serial ID interface |
| 6    | I2C DATA | I2C, Data                      | Note 2, 2 wire serial ID interface |
| 7    | VEE      | Ground                         | -                                  |
| 8    | TD2+     | Transmitter 2 Data Positive In | Note 5                             |
| 9    | TD2-     | Transmitter 2 Data Negative In | Note 5                             |
| 10   | TX2 DIS  | Transmitter 2 Disable          | Note 1                             |
| 11   | VEE      | Ground                         | -                                  |
| 12   | NC       | Not Connect                    | -                                  |
| 13   | NC       | Not Connect                    | -                                  |
| 14   | VEE      | Ground                         | -                                  |
| 15   | VCC TX2  | Transmitter 2 Power Supply     | Note 4, 3.3V 5%                    |
| 16   | VCC TX1  | Transmitter 1 Power Supply     | Note 4, 3.3V 5%                    |
| 17   | VEE      | Ground                         | -                                  |
| 18   | TD1+     | Transmitter 1 Data Positive In | Note 5                             |
| 19   | TD1-     | Transmitter 1 Data Negative In | Note 5                             |
| 20   | TX1 DIS  | Transmitter 1 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\_TX1 and VCC\_TX2 are the transmitter 1 and 2 power supplies. They are defined as 3.3V $\pm$ 5% at the SFP connector pin. Maximum supply current is 1100mA. 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.  
VCC\_TX1 and VccTX2 may be internally connected within the SFP transceiver module.
5. TD-/+: These are the differential transmitter inputs. 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. Block addresses starting with the letter "A" refer to Channel 1 and block addresses starting with the letter "B" refer to Channel 2

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

| Addr | Hex | ASCII | Description   | Addr          | Hex | ASCII | Description   | Addr  | Hex | ASCII | Description            |   |                                 |  |
|------|-----|-------|---|---------------|-----|-------|---------------|---|-----|-------|------------------------|---|---------------------------------|--|
| 0    | 81  |       | Dual Transmitter  | 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  |       |   | Vendor OUI    | 37  | 00    |               |   | 69  | XX    |                        |   |                                 |  |
| 6    | 00  |       |   |               | 38  | 00    |               |   | 70  | XX    |                        |   |                                 |  |
| 7    | 00  |       |   |               | 39  | 00    |               | Vendor part number  | 71  | XX    |                        |   |                                 |  |
| 8    | 00  |       |   |               | 40  | 45    | E             |   |     | 72    |                        | XX  |                                 |  |
| 9    | 00  |       |   |               | 41  | 50    | P             |   |     | 73    |                        | XX  |                                 |  |
| 10   | 00  |       |   |               | 42  | 2D    | -             |   |     | 74    |                        | XX  |                                 |  |
| 11   | 03  |       |   | NRZ           | 43  | 32    | 2             |   | 75  | XX    |                        |   |                                 |  |
| 12   | 0F  |       |   | BR in 100Mbps | 44  | 54    | T             |   | 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            | 33  | 3     |               | 84  | XX  |       | Vendor data code: Year |   |                                 |  |
| 21   | 50  | P     |   |               | 53  | 31    | 1             |   | 85  | XX    |                        |   |                                 |  |
| 22   | 48  | H     |   |               | 54  | 52    | L             |   | 86  | XX    |                        | Vendor data code: Month                     |                                 |  |
| 23   | 4F  | O     |   |               | 55  | 31    | 1             |   | 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  | 1F    | 31            | For the two middle digits of channel 2 wavelength: 1310nm | 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 and B2h)**

**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   |
| 32-94       | 64      | 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    |   |
| 104-109                             | 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   | N/A             |   |
| 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 Transmitter 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   |

**Notes:**

1. 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      |
| 113-115     | 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    |
| 117-119     | all | Reserved              |  |

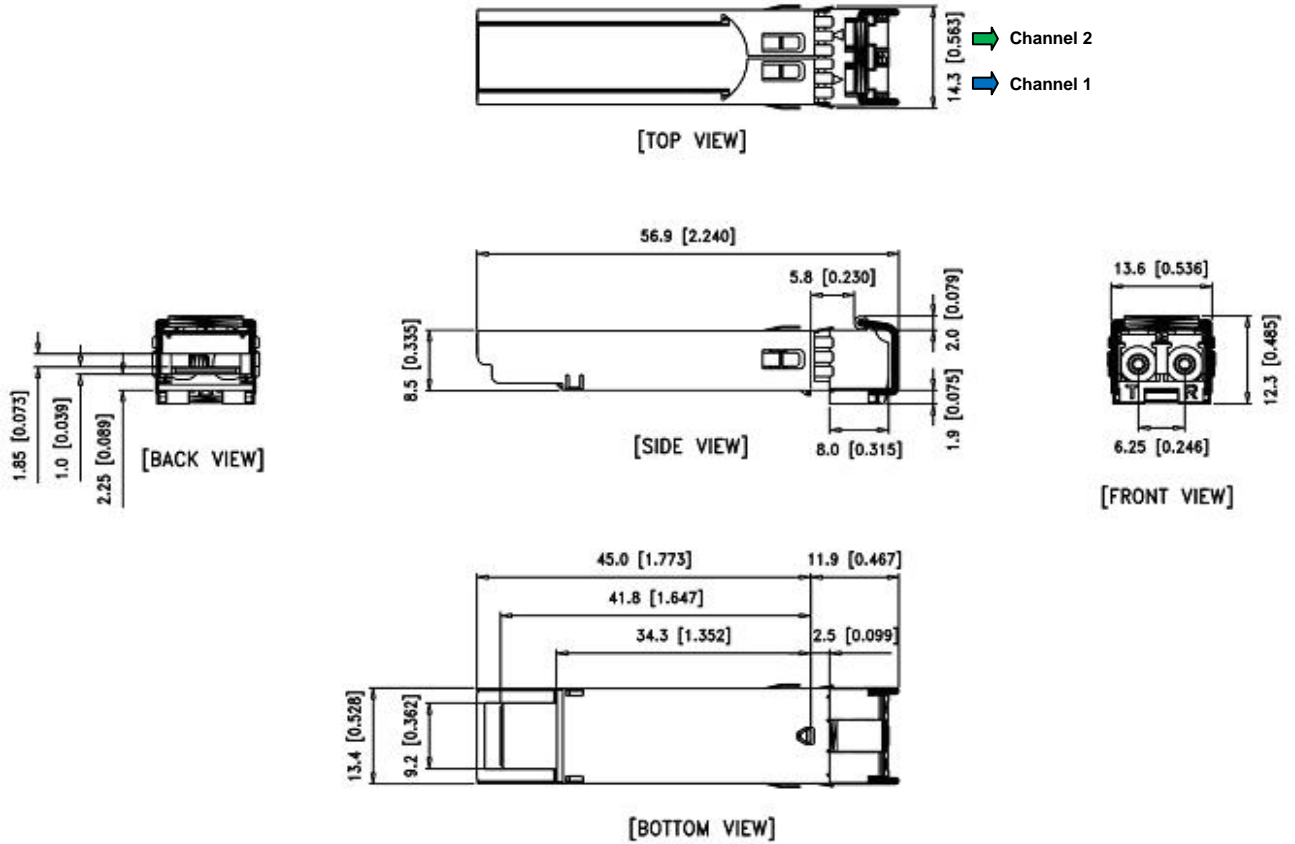
### 7.2.5 Vendor Specific Memory Addresses

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

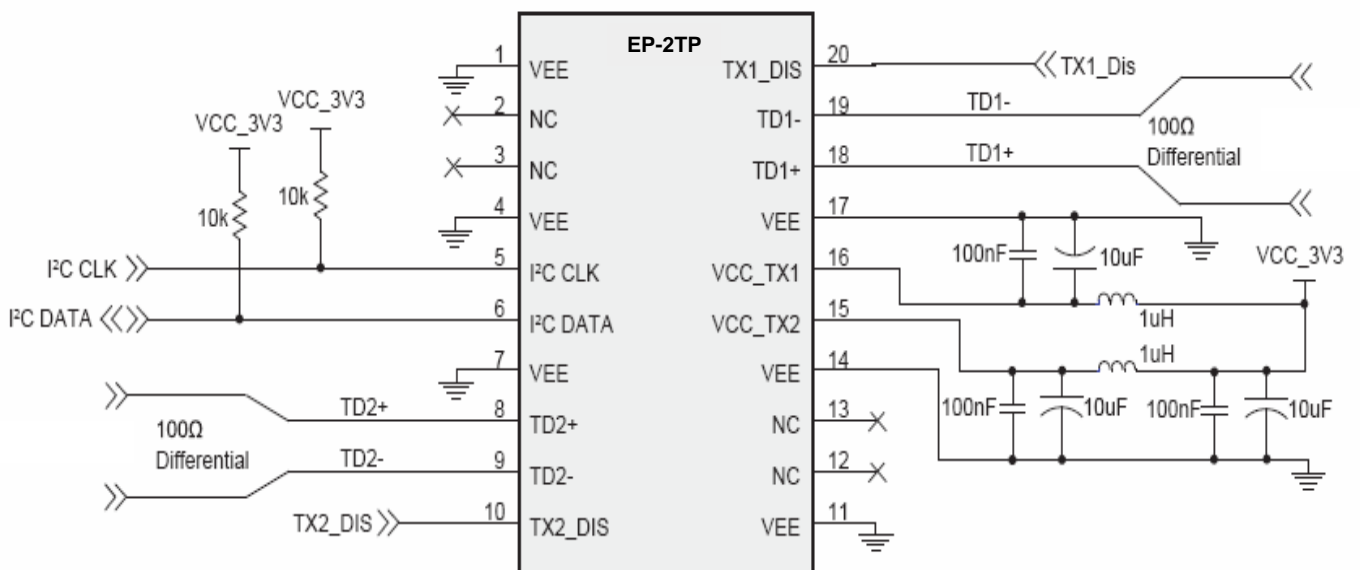
### 7.2.6 User EEPROM

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

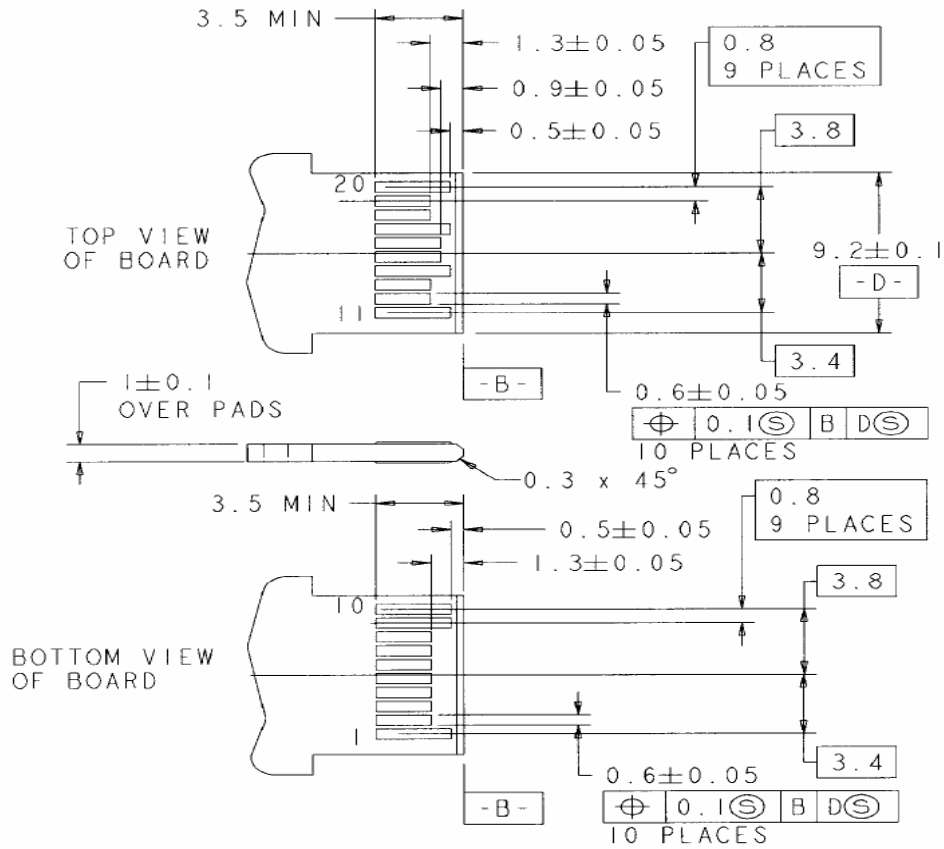
### 8 Package Information



### 9 Recommended Circuit



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



(Unit: mm)

