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## HLP-3103-L2(D)

### 155Mbps SFP Optical Transceiver, 20km Reach

#### Features

- ◆ Up to 155Mbps data-rate
- ◆ 1310nm FP laser and PIN photodetector for 20km transmission
- ◆ Compliant with SFP MSA and SFF-8472 with duplex LC receptacle
- ◆ Digital Diagnostic Monitoring:  
Internal Calibration or External Calibration
- ◆ Compatible with RoHS
- ◆ +3.3V single power supply
- ◆ Operating case temperature:  
Standard : 0 to +70°C  
Industrial : -40 to +85°C

#### Applications

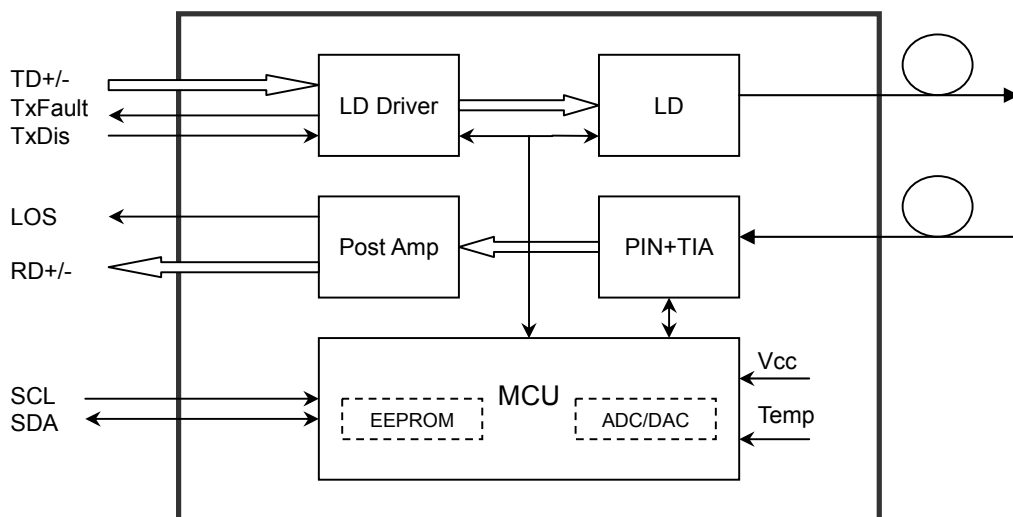
- ◆ SDH STM-1, S-1.1, L-1.1, L-1.2
- ◆ SONET OC-3 IR1, LR1, LR2
- ◆ Other optical links

#### Description

The SFP transceivers are high performance, cost effective modules supporting 155Mbps data-rate and 20km transmission distance with SMF.

The transceiver consists of three sections: a FP laser transmitter, a PIN photodiode integrated with a trans-impedance preamplifier (TIA) and MCU control unit. All modules satisfy class I laser safety requirements.

The transceivers are compatible with SFP Multi-Source Agreement (MSA) and SFF-8472. For further information, please refer to SFP MSA.



## Absolute Maximum Ratings

Table 1 - Absolute Maximum Ratings

| Parameter           | Symbol | Min  | Max | Unit |
|---------------------|--------|------|-----|------|
| Supply Voltage      | Vcc    | -0.5 | 4.5 | V    |
| Storage Temperature | Ts     | -40  | +85 | °C   |
| Operating Humidity  | -      | 5    | 85  | %    |

## Recommended Operating Conditions

Table 2 - Recommended Operating Conditions

| Parameter                  | Symbol     | Min  | Typical | Max  | Unit |
|----------------------------|------------|------|---------|------|------|
| Operating Case Temperature | Standard   | 0    |         | +70  | °C   |
|                            | Industrial | -40  |         | +85  | °C   |
| Power Supply Voltage       | Vcc        | 3.13 | 3.3     | 3.47 | V    |
| Power Supply Current       | Icc        |      |         | 300  | mA   |
| Data Rate                  |            |      | 155     |      | Mbps |

## Optical and Electrical Characteristics

HLP-3103-L2(D): (FP and PIN, 1310nm, 20km Reach)

Table 3 - Optical and Electrical Characteristics

| Parameter                      |         | Symbol           | Min  | Typical | Max             | Unit     | Notes |
|--------------------------------|---------|------------------|------|---------|-----------------|----------|-------|
| Transmitter                    |         |                  |      |         |                 |          |       |
| Centre Wavelength              |         | $\lambda_c$      | 1260 | 1310    | 1360            | nm       |       |
| Spectral Width (RMS)           |         | $\Delta\lambda$  |      |         | 4               | nm       |       |
| Average Output Power           |         | P <sub>out</sub> | -14  |         | -8              | dBm      | 1     |
| Extinction Ratio               |         | ER               | 9    |         |                 | dB       |       |
| Data Input Swing Differential  |         | V <sub>IN</sub>  | 400  |         | 1800            | mV       | 2     |
| Input Differential Impedance   |         | Z <sub>IN</sub>  | 90   | 100     | 110             | $\Omega$ |       |
| TX Disable                     | Disable |                  | 2.0  |         | V <sub>cc</sub> | V        |       |
|                                | Enable  |                  | 0    |         | 0.8             | V        |       |
| TX Fault                       | Fault   |                  | 2.0  |         | V <sub>cc</sub> | V        |       |
|                                | Normal  |                  | 0    |         | 0.8             | V        |       |
| Receiver                       |         |                  |      |         |                 |          |       |
| Centre Wavelength              |         | $\lambda_c$      | 1260 |         | 1580            | nm       |       |
| Receiver Sensitivity           |         |                  |      |         | -32             | dBm      | 3     |
| Receiver Overload              |         |                  | -3   |         |                 | dBm      | 3     |
| LOS De-Assert                  |         | LOS <sub>D</sub> |      |         | -34             | dBm      |       |
| LOS Assert                     |         | LOS <sub>A</sub> | -45  |         |                 | dBm      |       |
| LOS Hysteresis                 |         |                  | 1    |         | 4               | dB       |       |
| Data Output Swing Differential |         | V <sub>out</sub> | 370  |         | 1800            | mV       | 4     |
| LOS                            | High    |                  | 2.0  |         | V <sub>cc</sub> | V        |       |
|                                | Low     |                  |      |         | 0.8             | V        |       |

**Notes:**

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

## Timing and Electrical

Table 4 - Timing and Electrical

| Parameter                                       | Symbol         | Min | Typical | Max             | Unit |
|---|----------------|-----|---------|-----------------|------|
| Tx Disable Negate Time                          | t_on           |     |         | 1               | ms   |
| Tx Disable Assert Time                          | t_off          |     |         | 10              | μs   |
| Time To Initialize, including Reset of Tx Fault | t_init         |     |         | 300             | ms   |
| Tx Fault Assert Time                            | t_fault        |     |         | 100             | μs   |
| Tx Disable To Reset                             | t_reset        | 10  |         |                 | μs   |
| LOS Assert Time                                 | t_loss_on      |     |         | 100             | μs   |
| LOS De-assert Time                              | t_loss_off     |     |         | 100             | μs   |
| Serial ID Clock Rate                            | f_serial_clock |     |         | 400             | KHz  |
| MOD_DEF (0:2)-High                              | V <sub>H</sub> | 2   |         | V <sub>cc</sub> | V    |
| MOD_DEF (0:2)-Low                               | V <sub>L</sub> |     |         | 0.8             | V    |

## Diagnostics

**Table 5 – Diagnostics Specification**

| Parameter    | Range      | Unit | Accuracy | Calibration         |
|--------------|------------|------|----------|---------------------|
| Temperature  | 0 to +70   | °C   | ±3°C     | Internal / External |
|              | -40 to +85 |      |          |                     |
| Voltage      | 3.0 to 3.6 | V    | ±3%      | Internal / External |
| Bias Current | 0 to 100   | mA   | ±10%     | Internal / External |
| TX Power     | -14 to -8  | dBm  | ±3dB     | Internal / External |
| RX Power     | -28 to -3  | dBm  | ±3dB     | Internal / External |

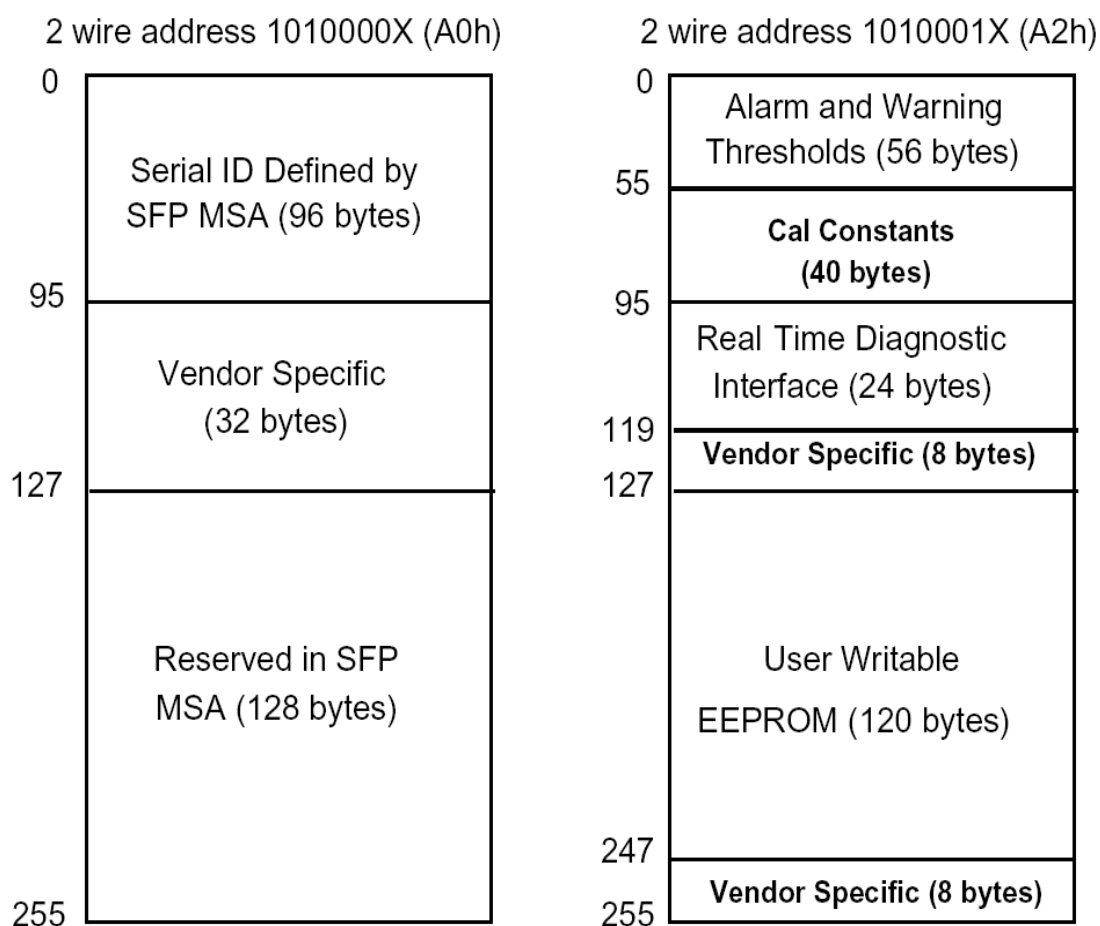
## Digital Diagnostic Memory Map

The transceivers provide serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA).

The diagnostic information with internal calibration or external calibration all are implemented, including

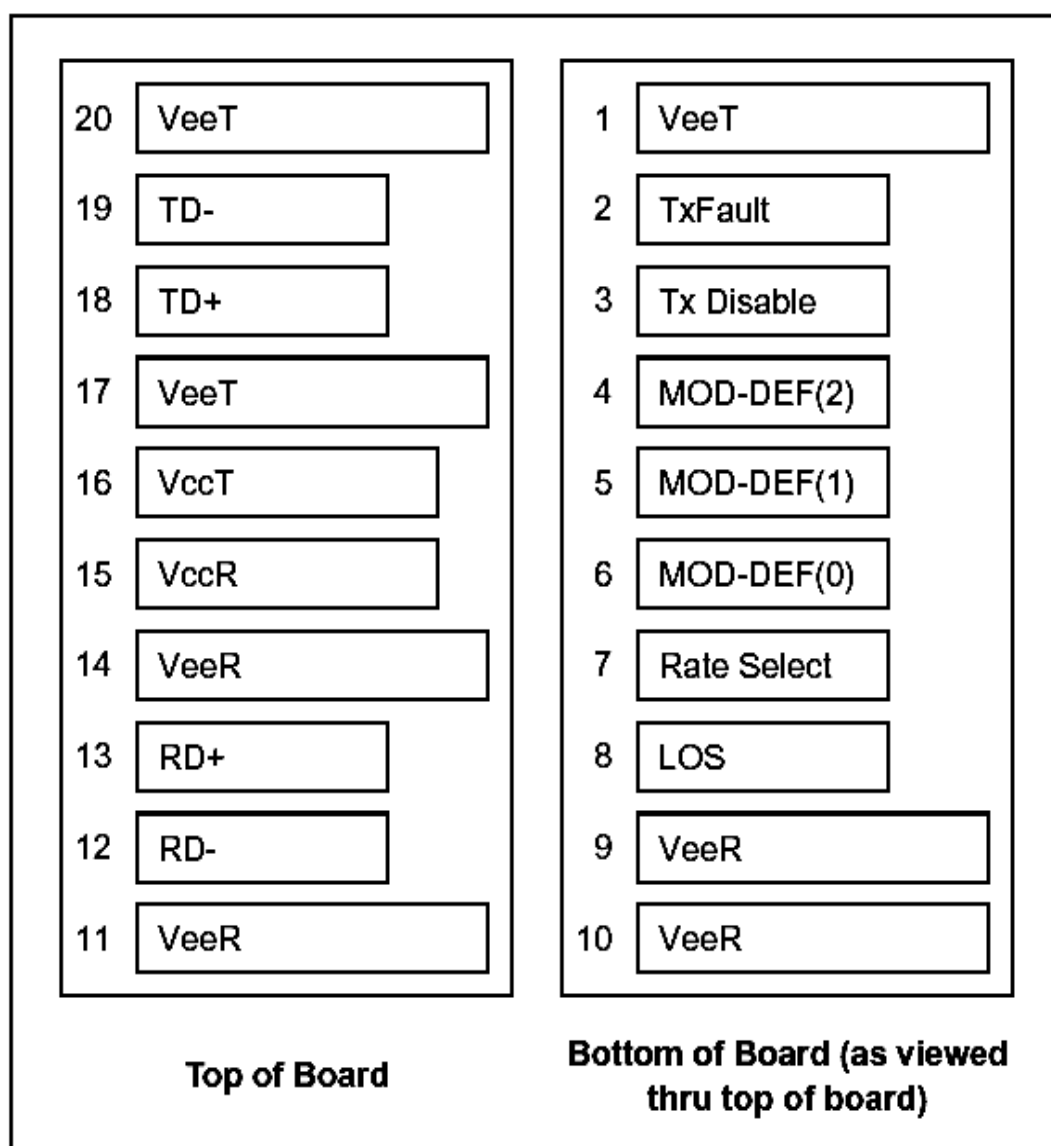
received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

The digital diagnostic memory map specific data field defines as following.



## Pin Definitions

Pin Diagram



### Pin Descriptions

| Pin | Signal Name | Description                  | 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 |

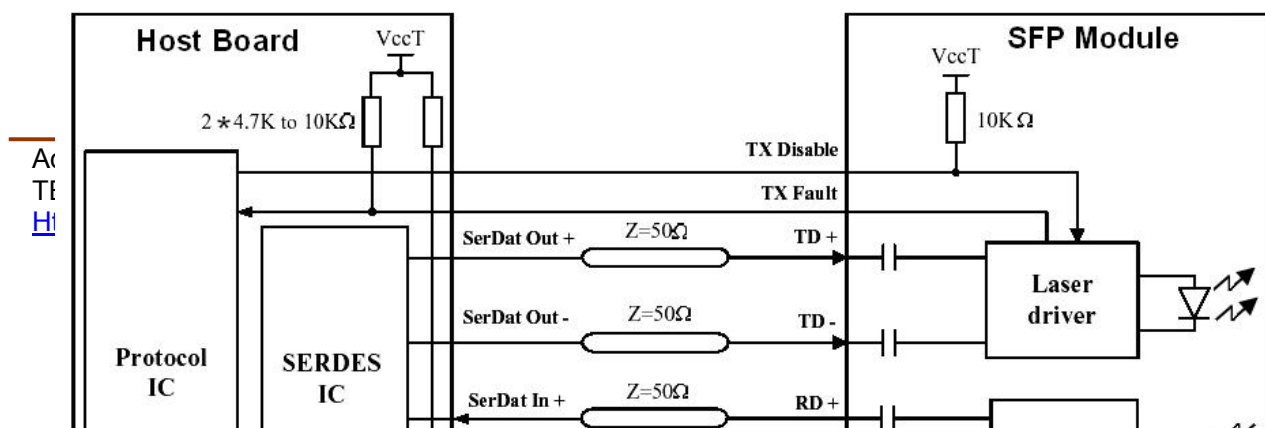
|    |                  |                          |   |        |
|----|------------------|--------------------------|---|--------|
| 4  | MOD_DEF(2)       | SDA Serial Data Signal   | 3 | Note 3 |
| 5  | MOD_DEF(1)       | SCL Serial Clock Signal  | 3 | Note 3 |
| 6  | MOD_DEF(0)       | TTL Low                  | 3 | Note 3 |
| 7  | Rate Select      | Not Connected            | 3 |        |
| 8  | LOS              | Loss of Signal           | 3 | Note 4 |
| 9  | V <sub>EER</sub> | Receiver ground          | 1 |        |
| 10 | V <sub>EER</sub> | Receiver ground          | 1 |        |
| 11 | V <sub>EER</sub> | Receiver ground          | 1 |        |
| 12 | RD-              | Inv. Received Data Out   | 3 | Note 5 |
| 13 | RD+              | Received Data Out        | 3 | Note 5 |
| 14 | V <sub>EER</sub> | Receiver ground          | 1 |        |
| 15 | V <sub>CCR</sub> | Receiver Power Supply    | 2 |        |
| 16 | V <sub>CCT</sub> | Transmitter Power Supply | 2 |        |
| 17 | V <sub>EET</sub> | Transmitter Ground       | 1 |        |
| 18 | TD+              | Transmit Data In         | 3 | Note 6 |
| 19 | TD-              | Inv. Transmit Data In    | 3 | Note 6 |
| 20 | V <sub>EET</sub> | Transmitter Ground       | 1 |        |

#### Notes:

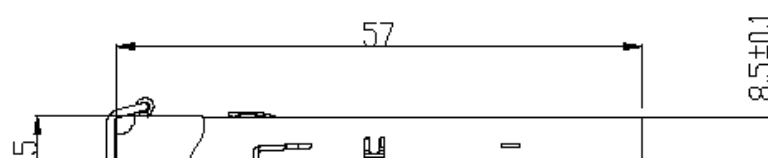
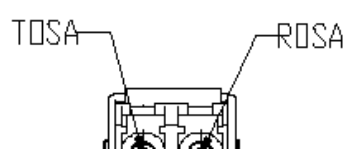
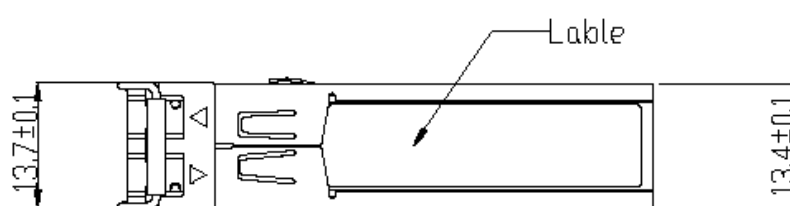
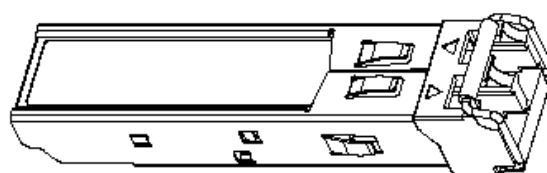
Plug Seq.: Pin engagement sequence during hot plugging.

- 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 V<sub>cc</sub>+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 to 0.8V): Transmitter on  
 (>0.8V, < 2.0V): Undefined  
 High (2.0 to 3.465V): Transmitter Disabled  
 Open: Transmitter Disabled
- 3) Mod-Def 0,1,2. These 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 V<sub>ccT</sub> or V<sub>ccR</sub>.  
 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. Pull up voltage between 2.0V and V<sub>cc</sub>+0.3V. Logic 1 indicates loss of signal; Logic 0 indicates normal operation. In the low state, the output will be pulled to less than 0.8V.
- 5) RD-/+ : These are the differential receiver outputs. They are internally AC-coupled 100 differential lines which should be terminated with 100Ω (differential) at the user SERDES.
- 6) TD-/+ : These are the differential transmitter inputs. They are internally AC-coupled, differential lines with 100Ω differential termination inside the module.

## Recommended Interface Circuit



## Mechanical Dimensions





## Ordering information

| Part Number   | Product Description  |
|---------------|--|
| HLP-3103-L2C  | 1310nm, 155Mbps, 20km, 0°C ~ +70°C                                       |
| HLP-3103-L2CD | 1310nm, 155Mbps, 20km, 0°C ~ +70°C, With Digital Diagnostic Monitoring   |
| HLP-3103-L2T  | 1310nm, 155Mbps, 20km, -40°C ~ +85°C                                     |
| HLP-3103-L2TD | 1310nm, 155Mbps, 20km, -40°C ~ +85°C, With Digital Diagnostic Monitoring |

E-mail: [sales@gigalight.com.cn](mailto:sales@gigalight.com.cn)

Web : <http://www.gigalight.com.cn>