

**Features:**

- Compliant with SFP MSA standard
- 3.3V DC power supply
- Uncooled 1550nm DFB with isolator,
- 2.5Gbps PIN-TIA
- 2.5Gbps, 40km
- Built-in digital diagnostic functions
- Difference LVPECL inputs and outputs
- Duplex LC connector
- Compliant with SFF-8472
- Hot Pluggable
- ROHS compliant
- Operating Temperature 0~70°C

**Application:**

- SONET OC-48 /SDH STM L-16

**Description**

Honlus 2.5Gbps single-mode SFP is a high performance and cost effective transceiver. It is designed to meet SONET OC-48 /SDH STM L-16 application. The transceiver consists of two sections: the transmitter section consists of a high reliability 1550nm DFB laser diode (LD) with monitor photo detector (PD) in eye safety and an isolator to maintain the high performance of the transmitter; the receiver section consists of a high-speed InGaAs APD and trans-impedance preamplifier TIA. The SFP is compatible with the Small Form Factor Pluggable Multi-Sourcing Agreement (MSA) and SONET and SDH standard at OC-48/STM L-16. Digital diagnostics functions are available via the 2-wire serial bus specified in the SFP MSA.

**Ordering Information**

| Part Number      | Wavelength | Monitor | LD Type | Temperature |
|------------------|------------|---------|---------|-------------|
| HOLS-P2154-LN-CD | 1550nm     | No DDM  | DFB     | 0°C~70°C    |
| HOLS-P2154-LD-CD | 1550nm     | DDM     | DFB     | 0°C~70°C    |

### Absolute Maximum Ratings

| Parameter                 | Symbol           | Min | Max | Unit |
|---------------------------|------------------|-----|-----|------|
| Storage Temperature       | T <sub>S</sub>   | -40 | 85  | °C   |
| Storage Relative Humidity | RH <sub>S</sub>  | -   | 95  | %    |
| Power Supply              | VCC              | -   | 4   | V    |
| Lead Solder Temperature   | T <sub>SLD</sub> | -   | 260 | °C   |
| Lead Solder Duration      | t <sub>SLD</sub> | -   | 10  | s    |

### Operating Temperature Conditions

| Parameter             | Symbol             | Min  | Max  | Unit |
|-----------------------|--------------------|------|------|------|
| Operating Temperature | T <sub>O</sub>     | 0    | 70   | °C   |
| Power Supply          | VCC                | 3.15 | 3.45 | V    |
| Operating Current     | I <sub>TX+RX</sub> | -    | 300  | mA   |

### Performance Specification

| Transmitter Electro-Optical Characteristics |                      |      |      |                 |      |               |
|---|----------------------|------|------|-----------------|------|---------------|
| Parameter                                   | Symbol               | min  | Typ  | Max             | Unit | Note          |
| Supply Voltage                              | VCC                  | 3.15 | 3.3  | 3.45            | V    |               |
| Differential Input Voltage                  | V <sub>IN</sub>      | 500  | -    | 2400            | mV   | AC coupled    |
| Data Rate                                   | Rate                 | -    | 2.5G | -               | Mbps |               |
| Optical Output Power                        | P <sub>O</sub>       | -5   | -    | 0               | dBm  | 9/125μm fiber |
| Extinction Ratio                            | ER                   | 8.2  | -    | -               | dB   |               |
| Central Wavelength                          | λ/DFB                | 1500 | 1550 | 1580            | nm   |               |
| Output Spectrum Width                       | Δλ/DFB               | -    | -    | 1               | nm   | -20dB Width   |
| Optical Rise Time                           | T <sub>r</sub>       | -    | -    | 150             | ps   | 20%~80%       |
| Optical Fall Time                           | T <sub>f</sub>       | -    | -    | 150             | ps   | 20%~80%       |
| Tx_Fault - High                             | V <sub>Fault_H</sub> | 2    |      | V <sub>cc</sub> | V    |               |

|                             |                        |                 |  |                      |    |  |
|-----------------------------|------------------------|-----------------|--|----------------------|----|--|
| Tx_Fault - Low              | V <sub>Fault_L</sub>   | V <sub>ee</sub> |  | V <sub>ee</sub> +0.8 | V  |  |
| Tx_Disable -High            | V <sub>Disable_H</sub> | 2               |  | V <sub>cc</sub>      | V  |  |
| Tx_Disable - Low            | V <sub>Disable_L</sub> | V <sub>ee</sub> |  | V <sub>ee</sub> +0.8 | V  |  |
| Side Mode Suppression Ratio | SMSR                   | 30              |  |                      | dB |  |
| Eye Diagram                 | Compliant IEEE802.3z   |                 |  |                      |    |  |

| Receiver Electro-Optical Characteristics |                       |      |     |      |      |      |
|--|-----------------------|------|-----|------|------|------|
| Parameter                                | Symbol                | min  | Typ | Max  | Unit | Note |
| Supply Voltage                           | V <sub>CC</sub>       | 3.15 | 3.3 | 3.45 | V    |      |
| Differential Output Voltage              | V <sub>OUT</sub>      | 400  | -   | 2000 | mV   | 1    |
| Data Rate                                | Rate                  | -    | 2.5 | -    | Gbps |      |
| Receiver Sensitivity                     | S                     | -    | -28 | -25  | dBm  | 2    |
| Optical Input Overload                   | P <sub>OL</sub>       | -8   | -   | -    | dBm  |      |
| Operating Central Wavelength             | λ                     | 1270 | -   | 1610 | nm   |      |
| Loss of Signal-Asserted                  | P <sub>RX_LOS A</sub> | -45  | -   | -    | dBm  |      |
| Loss of Signal-Deasserted                | P <sub>RX_LOS D</sub> | -    | -   | -25  | dBm  |      |
| Los of Signal Hysteresis                 | P <sub>H</sub>        | 0.5  | 1.5 | 5    | dB   |      |

Note 1: Internally AC coupled.

Note 2: Average received power where the BER = 10<sup>-12</sup>, measured with a 2<sup>23</sup>-1 NRZ test pattern..

**Block Diagram**

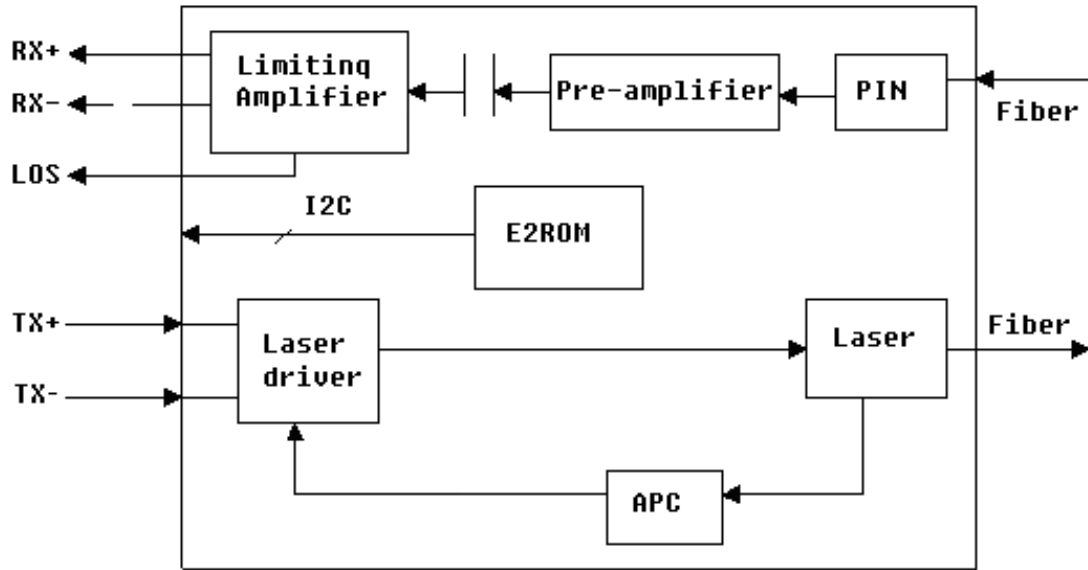


Figure1. Block Diagram

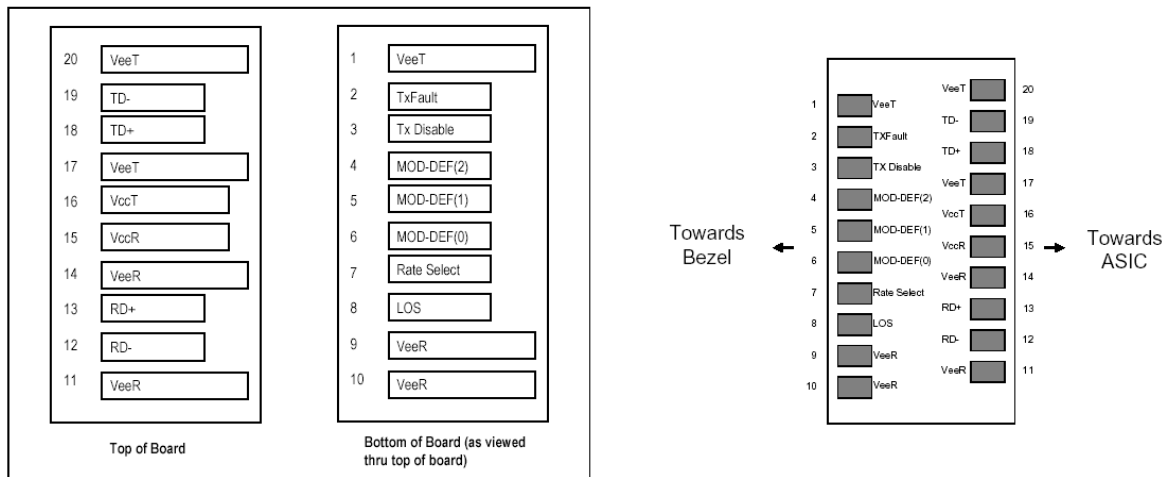
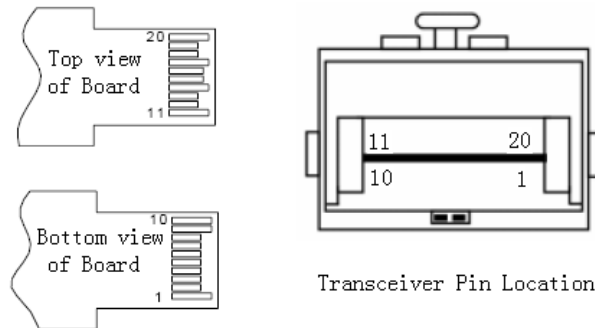
**PECL Logic Level**

| Logic State | Unit | Min      | Typ | Max      |
|-------------|------|----------|-----|----------|
| Low         | V    | VCC-1.84 | -   | VCC-1.60 |
| High        | V    | VCC-1.10 | -   | VCC-0.90 |

**TTL Logic Level**

| Logic State | Unit | Min | Typ | Max |
|-------------|------|-----|-----|-----|
| Low         | V    | 0   | -   | 0.8 |
| High        | V    | 2.4 | -   | VCC |

## Transceiver Pin Locations



SFP Transceiver Electric Pad Layout

Diagram of Host Board Connector  
Block Pin Number and Names

Figure2. Transceiver Pin Locations

### Pin Descriptions

| Pin | Name       | Description                  | Plug Sequence | Note |
|-----|------------|------------------------------|---------------|------|
| 1   | VeeT       | Transmitter Ground           | 1             |      |
| 2   | TX Fault   | Transmitter Fault Indication | 3             | 1    |
| 3   | TX Disable | Transmitter Disable          | 3             | 4    |
| 4   | MOD_DEF2   | Module Definition 2          | 3             | 3    |

|    |             |   |   |   |
|----|-------------|---|---|---|
| 5  | MOD_DEF1    | Module Definition 1                               | 3 | 3 |
| 6  | MOD_DEF0    | Module Definition 0                               | 3 | 3 |
| 7  | Rate Select | Select between Full or Reduced Receiver Bandwidth | 3 | 4 |
| 8  | LOS         | Loss of Signal                                    | 3 | 5 |
| 9  | VeeR        | Receiver Ground                                   | 1 | 6 |
| 10 | VeeR        | Receiver Ground                                   | 1 | 6 |
| 11 | VeeR        | Receiver Ground                                   | 1 | 6 |
| 12 | RD-         | Inverse Received Data Out                         | 3 | 7 |
| 13 | RD+         | Received Data Out                                 | 3 | 7 |
| 14 | VeeR        | Receiver Ground                                   | 1 | 6 |
| 15 | VccR        | Receiver Power                                    | 2 | 8 |
| 16 | VccT        | Transmitter Power                                 | 2 | 8 |
| 17 | VeeT        | Transmitter Ground                                | 1 | 6 |
| 18 | TD+         | Transmit Data In                                  | 3 | 9 |
| 19 | TD-         | Inverse Transmit Data In                          | 3 | 9 |
| 20 | VeeT        | Transmitter Ground                                | 1 | 6 |

Note:

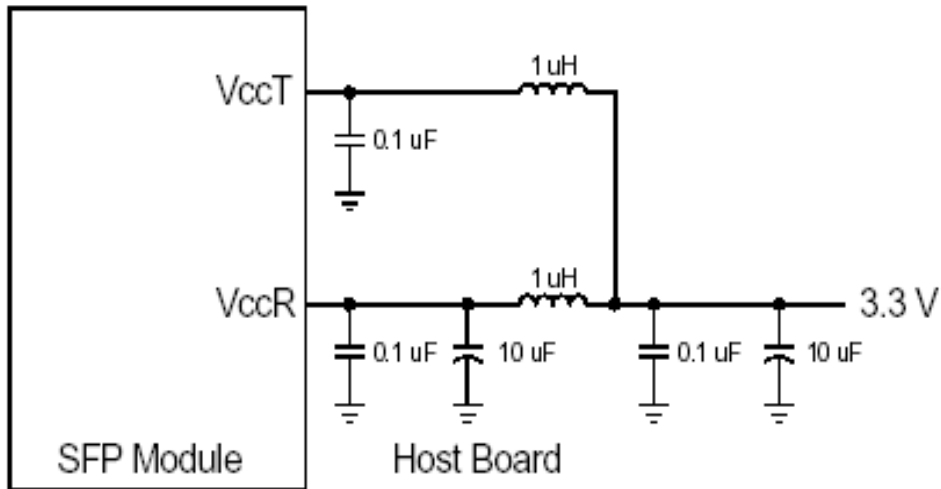
1. TX Fault is an open collector/drain output, which should be pulled up with a 4.7k ~ 10kΩ resistor on the host board to a voltage between 2.0V and Vcc+0.3V. Logic 1 indicates a laser fault of some kind; Logic 0 indicates normal operation. In the low state, the output will be pulled to less than 0.8V.
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 ~ 10 kΩ resistor. Its states are:
  - Low (0~0.8V): Transmitter on
  - (>0.8V, <2.0V): Undefined
  - High (2.0~3.465V): Transmitter Disabled
  - Open: Transmitter Disable
3. MOD-DEF 0, 1, 2 are the module definition pins. They should be pulled up with a 4.7k ~ 10 kΩ 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. Rate select is not connected
  5. LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7k ~ 10 k $\Omega$  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.
  6. VeeR and VeeT may be internally connected within the SFP module.
  7. These are the differential receiver outputs. They are AC-coupled 100 $\Omega$  differential lines which should be terminated with 100 $\Omega$  (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board. The voltage swing on these lines will be between 370 and 2000mV differential (185-1000mV single ended) when properly terminated.
  8. VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V +/-5% at the SFP connector pin. Maximum supply current is 300mA. 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 30mA greater than the steady state value. VccR and VccT may be internally connected within the SFP transceiver module.
  9. 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. The inputs will accept differential swing of 500mV – 2400mV (250mV-1200mV single-ended), though it is recommended that values between 500 and 1200mV differential (250mV-600mV single ended) be used for best EMI performance.

## Power Supply

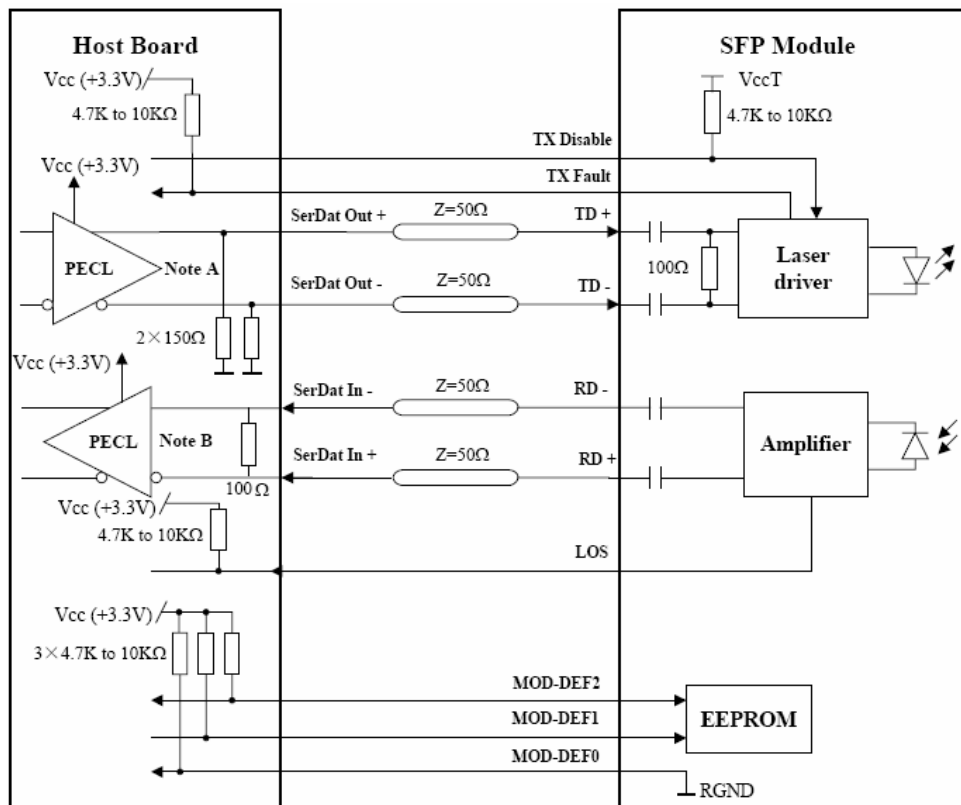
The Transceiver includes internal circuit components to filter power supply noise. Under some conditions of EMI and power supply noise, external power supply filtering may be necessary. If receiver sensitivity is found to be degraded by power supply noise, the filter network illustrated in the following figure may be used to improve performance. The values of the filter components are general recommendations and may be changed to suit a particular system environment. Shielded inductors are recommended.

**Recommended Host Board Supply Filtering Circuit**



**Figure3. Host Board Supply Filtering Circuit**

**Recommended Application Circuits**



**Figure4. Application Circuits**



## I<sup>2</sup>C Specifications

The SFP Module defines a 256-byte memory map in EEPROM describing the modules capabilities, standard interfaces, manufacturer, and other information that is accessible over a two wire serial interface at the 8-bit address 10100000 (A0h). The memory contents refer to Tables 6. The digital diagnostic monitoring interface defines another 256-byte memory map in EEPROM that use the 8 bit address 1010001X (A2h) (see figure 1 for details).

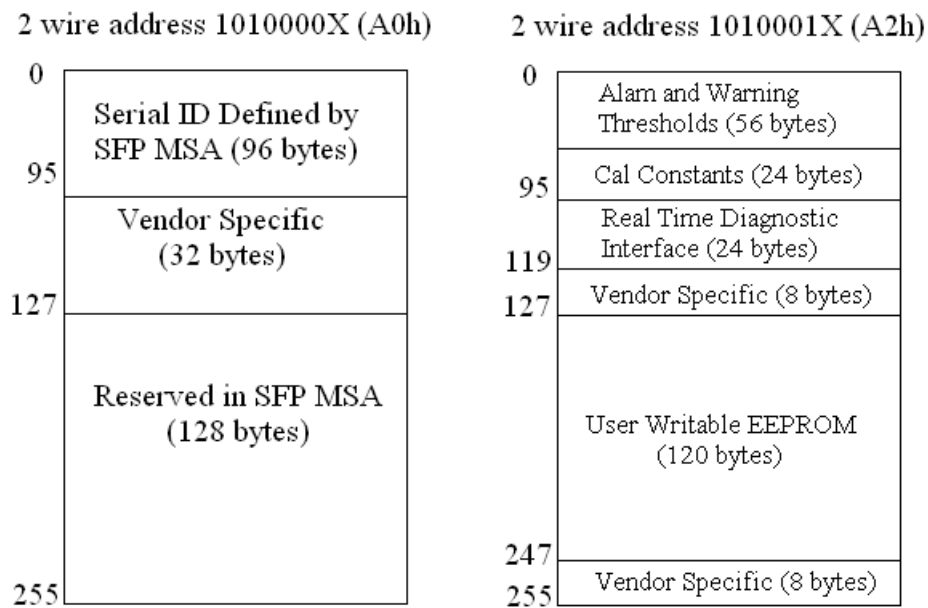


Figure5. EEPROM Serial ID Memory Contents

### I<sup>2</sup>C Read/Write Memory Contents (A0h) Information

| Address | Size<br>(Bytes) | Name of Field   | Contents (Hex)          | Description              |
|---------|-----------------|-----------------|-------------------------|--------------------------|
| 0       | 1               | Identifier      | 03                      | <b>SFP</b>               |
| 1       | 1               | Ext. Identifier | 04                      | <b>MOD4</b>              |
| 2       | 1               | Connector       | 07                      | <b>LC</b>                |
| 3-10    | 8               | Transceiver     | xx xx xx xx xx xx xx xx | <b>Transceiver Codes</b> |
| 11      | 1               | Encoding        | 03                      | <b>NRZ</b>               |
| 12      | 1               | BR, nominal     | 19                      | <b>2.5Gbps</b>           |
| 13      | 1               | Reserved        | 00                      |                          |

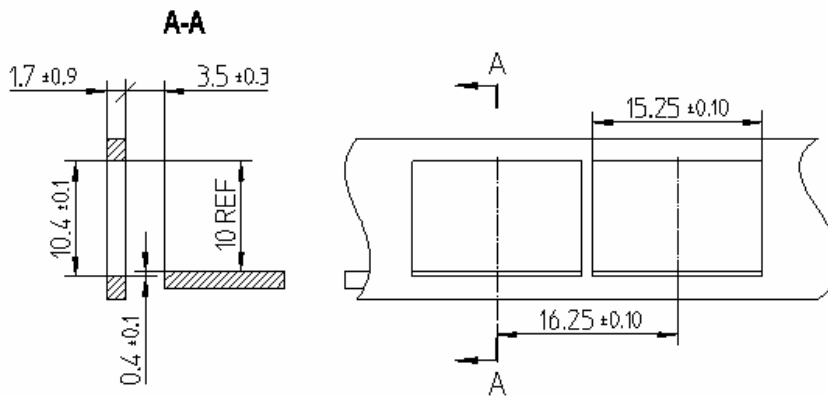
|        |     |                  |                         |  |
|--------|-----|------------------|-------------------------|--|
| 14     | 1   | Length (9um)-km  | xx                      | Transmit distance  |
| 15     | 1   | Length (9um)     | xx                      |  |
| 16     | 1   | Length (50um)    | 00                      |  |
| 17     | 1   | Length (62.5um)  | 00                      |  |
| 18     | 1   | Length (copper)  | 00                      |  |
| 19     | 1   | Reserved         | 00                      |  |
| 20-35  | 16  | Vendor name      | xxx                     | Company Name (ASC II)<br>"Honlus"  |
| 36     | 1   | Reserved         | 00                      |  |
| 37-39  | 3   | Vendor OUI       | 00 00 00                |  |
| 40-55  | 16  | Vendor PN        |                         | Transceiver product number (ASC II)  |
| 56-59  | 4   | Vendor rev       |                         | ASC II (31 30 20 20 means 1.0 revision)  |
| 60-61  | 2   | Wavelength       |                         | Transceiver wavelength   |
| 62     | 1   | Reserved         | 00                      |  |
| 63     | 1   | CC BASE          | Check Sum (variable)    | Check code for base ID fields  |
| 64-65  | 2   | Options          | 00 1A                   | TX_DISABLE, TX_FAULT and Loss of Signal implemented                                  |
| 66     | 1   | BR, max          |                         | Vendor Assigned Part Number  |
| 67     | 1   | BR, min          |                         |  |
| 68-83  | 16  | Vendor SN        | xxx                     | Serial Number (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 (External Calibrated)  |
| 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 for extended ID fields                                     |
| 96-255 | 160 | Vendor specific  |                         |  |

**I<sup>2</sup>C Read/Write Memory Contents (A2h) Monitoring Interface**

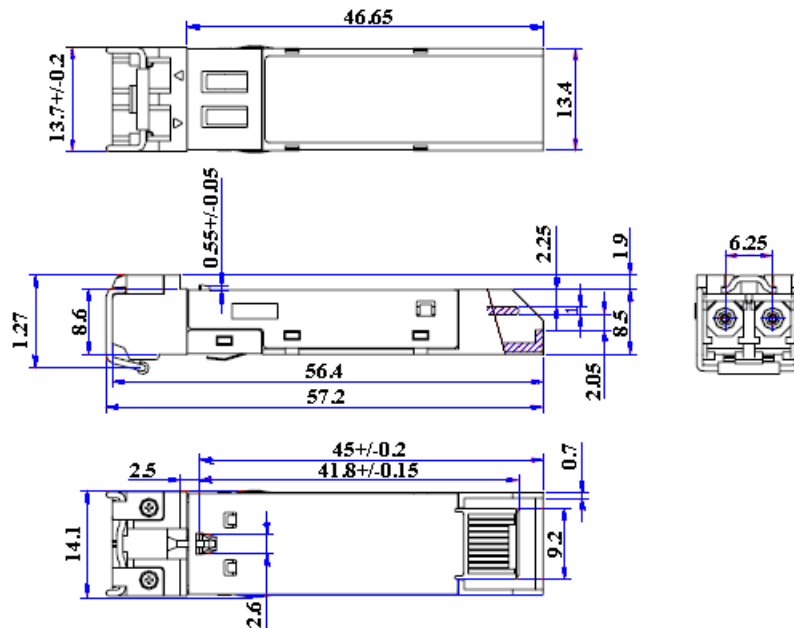
| Address                                | Size (Bytes) | Name of Field                  | Description                            |
|--|--------------|--------------------------------|--|
| 00-01                                  | 2            | Temperature High Alarm         | Temperature set to 100°C               |
| 02-03                                  | 2            | Temperature Low Alarm          | Temperature set to -45°C               |
| 04-05                                  | 2            | Temperature High Warning       | Temperature set to 90°C                |
| 06-07                                  | 2            | Temperature Low Warning        | Temperature set to -40°C               |
| 08-09                                  | 2            | Vcc High Alarm                 | Set to 3.6V                            |
| 10-11                                  | 2            | Vcc Low Alarm                  | Set to 3.0V                            |
| 12-13                                  | 2            | Vcc High Warning               | Set to 3.5V                            |
| 14-15                                  | 2            | Vcc Low Warning                | Set to 3.1V                            |
| 16-17                                  | 2            | Bias High Alarm                | 2 * IBias(25°C)+30                     |
| 18-19                                  | 2            | Bias Low Alarm                 | 25%*IBias(25°C)                        |
| 20-21                                  | 2            | Bias High Warning              | 2*IBias(25°C)+20                       |
| 22-23                                  | 2            | Bias Low Warning               | 50%*IBias(25°C)                        |
| 24-25                                  | 2            | TX Power High Alarm            | Manufacture measurement plus 2dB       |
| 26-27                                  | 2            | TX Power Low Alarm             | Manufacture measurement minus 2dB      |
| 28-29                                  | 2            | TX Power High Warning          | Manufacture measurement plus 1dB       |
| 30-31                                  | 2            | TX Power Low Warning           | Manufacture measurement minus 1dB      |
| 32-33                                  | 2            | RX Power High Alarm            | Maximum input optical power            |
| 34-35                                  | 2            | RX Power Low Alarm             | Minimum input optical power            |
| 36-37                                  | 2            | RX Power High Warning          | Maximum input optical power minus 3dB  |
| 38-39                                  | 2            | RX Power Low Warning           | Minimum input optical power plus 3dB   |
| 40-55                                  | 16           | Reserved                       |  |
| Calibration Constants                  |              |                                |  |
| 56-59                                  | 4            | RX Power Calibration Data 4    | Single precision floating-point number |
| 60-63                                  | 4            | RX Power Calibration Data 3    |  |
| 64-67                                  | 4            | RX Power Calibration Data 2    |  |
| 68-71                                  | 4            | RX Power Calibration Data 1    |  |
| 72-75                                  | 4            | RX Power Calibration Data 0    |  |
| 76-77                                  | 2            | Bias Calibration Data 1        | 01 00 Fixed                            |
| 78-79                                  | 2            | Bias Calibration Data 0        | 00 00 Fixed                            |
| 80-81                                  | 2            | TX Power Calibration Data 1    | 01 00 Fixed                            |
| 82-83                                  | 2            | TX Power Calibration Data 0    | 00 00 Fixed                            |
| 84-85                                  | 2            | Temperature Calibration Data 1 | 01 00 Fixed                            |
| 86-87                                  | 2            | Temperature Calibration Data 0 | 00 00 Fixed                            |
| 88-89                                  | 2            | Vcc Calibration Data 1         | 01 00 Fixed                            |
| 90-91                                  | 2            | Vcc Calibration Data 0         | 00 00 Fixed                            |
| 92-94                                  | 3            | Reserved                       |  |
| 95                                     | 1            | Check Sum                      | Checksum of bytes 0-94                 |
| Real Time Diagnostic Monitor Interface |              |                                |  |

|                 |     |                          |  |
|-----------------|-----|--------------------------|--|
| 96              | 1   | Measured Temperature MSB | Internally measured transceiver temperature.                                       |
| 97              | 1   | Measured Temperature LSB | Comply with external calibration of SFF-8472                                       |
| 98              | 1   | Measured Vcc MSB         | Internally measured transceiver supply voltage                                     |
| 99              | 1   | Measured Vcc LSB         | Vcc. Comply with external calibration of SFF-8472                                  |
| 100             | 1   | Measured LD Bias MSB     | Measured transceiver LD bias current. Comply with external calibration of SFF-8472 |
| 101             | 1   | Measured LD Bias LSB     |  |
| 102             | 1   | Measured TX Power MSB    | Measured transceiver TX power. Comply with external calibration of SFF-8472        |
| 103             | 1   | Measured TX Power LSB    |  |
| 104             | 1   | Measured RX Power MSB    | Measured transceiver RX power. Comply with external calibration of SFF-8472        |
| 105             | 1   | Measured RX Power LSB    |  |
| 106-109         | 4   | Reserved                 |  |
| 110             | 1   | Logic Status             |  |
| 111             | 1   | AD Conversion            |  |
| 112-119         | 8   | Alarm and Warning Flags  |  |
| Vendor Specific |     |                          |  |
| 120-127         | 8   | Vendor Specific          | Don't Access   |
| 128-247         | 120 | User writable EEPROM     |  |
| 248-255         | 8   | Vendor Specific          | Don't Access   |

### Recommended Front Panel Layout Opening for LC



## Outline Specification



## Safety Information

All versions of this laser are Class 1 laser products per IEC\* 60825-1:2001. Users should observe safety precautions such as those recommended by ANSI\*\* Z136.1-2000, ANSI Z36.2-1997 and IEC 60825-1:2001.

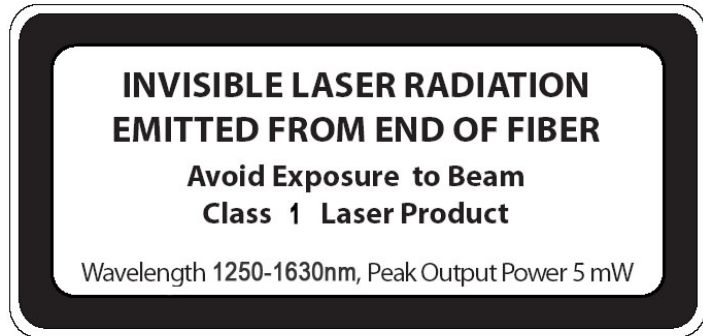
This product does not conform to 21 CFR 1040.10 and 1040.11. Consequently, this laser module is only intended for use as a component by manufacturers of electronic products and equipment.

Wavelength = 1.31  $\mu\text{m}$   
Maximum Power = 5 mW  
Single-mode fiber pigtail  
Fiber Numerical Aperture = 0.14

Labeling is not affixed to the laser module due to size constraints; rather, labeling is placed on the outside of the shipping box.

This product is not shipped with a power supply.

**Caution: use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.**



classified in accordance with IEC 60825-1: 2001-08

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\*\*ANSI is a registered trademark of the American National Standards Institute