

## EOLS-1512-X Series

Single-Mode 1550nm 1.25Gbps FC/GBE  
 Duplex SFP Transceiver  
 RoHS6 Compliant

### Features

- ◆ Operating Data Rate up to 1.25Gbps
- ◆ 1550nm DFB Laser Transmitter
- ◆ 40km with 9/125 μm SMF  
 60km with 9/125 μm SMF  
 80km with 9/125 μm SMF
- ◆ Single 3.3V Power Supply and TTL Logic Interface
- ◆ Hot-Pluggable SFP Footprint Duplex LC Connector Interface
- ◆ Class 1 FDA and IEC60825-1 Laser Safety Compliant
- ◆ Operating Case Temperature  
 Standard: 0°C~+70°C  
 Industrial: -40°C~+85°C
- ◆ Compliant with MSA SFP Specification
- ◆ Compliant with SFF-8472



### Applications

- ◆ Gigabit Ethernet Switches and Routers
- ◆ Fiber Channel Switch Infrastructure
- ◆ Other Optical Links

### Ordering Information

| Part No.                         | Data Rate | Fiber | Distance <sup>*(note2)</sup> | Interface | Temperature | DDMI |
|----------------------------------|-----------|-------|------------------------------|-----------|-------------|------|
| EOLS-1512-40 <sup>*(note1)</sup> | 1.25Gbps  | SMF   | 40km                         | LC        | 0°C~+70°C   | NO   |
| EOLS-1512-40I                    | 1.25Gbps  | SMF   | 40km                         | LC        | -40°C~+85°C | NO   |
| EOLS-1512-40D                    | 1.25Gbps  | SMF   | 40km                         | LC        | 0°C~+70°C   | YES  |
| EOLS-1512-40DI                   | 1.25Gbps  | SMF   | 40km                         | LC        | -40°C~+85°C | YES  |
| EOLS-1512-60 <sup>*(note1)</sup> | 1.25Gbps  | SMF   | 60km                         | LC        | 0°C~+70°C   | NO   |
| EOLS-1512-60I                    | 1.25Gbps  | SMF   | 60km                         | LC        | -40°C~+85°C | NO   |
| EOLS-1512-60D                    | 1.25Gbps  | SMF   | 60km                         | LC        | 0°C~+70°C   | YES  |
| EOLS-1512-60DI                   | 1.25Gbps  | SMF   | 60km                         | LC        | -40°C~+85°C | YES  |

|                                 |          |     |      |    |             |     |
|---------------------------------|----------|-----|------|----|-------------|-----|
| EOLS-1512-80 <sup>(note1)</sup> | 1.25Gbps | SMF | 80km | LC | 0°C~+70°C   | NO  |
| EOLS-1512-80I                   | 1.25Gbps | SMF | 80km | LC | -40°C~+85°C | NO  |
| EOLS-1512-80D                   | 1.25Gbps | SMF | 80km | LC | 0°C~+70°C   | YES |
| EOLS-1512-80DI                  | 1.25Gbps | SMF | 80km | LC | -40°C~+85°C | YES |

Note1: Standard version

Note2: With 9/125µm SMF

## Regulatory Compliance

| Feature  | Standard   | Performance  |
|--|--|--|
| Electrostatic Discharge (ESD) to the Electrical Pins | MIL-STD-883G<br>Method 3015.7  | Class 1C (>1000 V)   |
| Electrostatic Discharge to the Enclosure             | EN 55024:1998+A1+A2<br>IEC-61000-4-2<br>GR-1089-CORE                               | Compliant with Standards   |
| Electromagnetic Interference (EMI)                   | FCC Part 15 Class B<br>EN55022:2006<br>CISPR 22B :2006<br>VCCI Class B             | Compliant with standards<br>Noise frequency range:<br>30MHz to 6GHz. Good system<br>EMI design practice required<br>to achieve Class B margins.<br>System margins are<br>dependent on customer host<br>board and chassis design. |
| Immunity   | EN 55024:1998+A1+A2<br>IEC 61000-4-3   | Compliant with standards.<br>1KHz sine-wave, 80% AM,<br>from 80MHz to 1GHz. No<br>effect on transmitter/receiver<br>performance is detectable<br>between these limits.   |
| Laser Eye Safety                                     | FDA 21CFR 1040.10 and 1040.11<br>EN (IEC) 60825-1:2007<br>EN (IEC) 60825-2:2004+A1 | CDRH compliant and Class I<br>laser product.<br>TüV Certificate No. 50135086   |
| Component Recognition                                | UL and CUL<br>EN60950-1:2006   | UL file E317337<br>TüV Certificate No. 50135086<br>(CB Scheme )  |
| RoHS6  | 2002/95/EC 4.1&4.2<br>2005/747/EC 5&7&13   | Compliant with Standards <sup>*note3</sup>   |

Note3: For update of the equipments and strict control of raw materials, EOPTOLINK has the ability to supply the customized products since Jan 1<sup>st</sup>, 2007, which meet the requirements of RoHS6 (Restrictions on use of certain Hazardous Substances) of European Union.

In light of item 5 in RoHS exemption list of RoHS Directive 2002/95/EC, Item 5: Lead in glass of cathode ray tubes, electronic components and fluorescent tubes.

In light of item 13 in RoHS exemption list of RoHS Directive 2005/747/EC, Item 13: Lead and cadmium in optical and filter glass. The three exemptions are being concerned for Eoptolink's transceivers, because Eoptolink's transceivers use glass, which may contain Pb, for components such as lenses, isolators and other components.

## Product Description

The EOLS-1512-X series single-mode transceiver is small form factor pluggable module for serial optical data communications such as Gigabit Ethernet 1000BASE-ZX and Fiber Channel 1x SM-LC-L FC-PI. It is with the SFP 20-pin connector to allow hot plug capability. This module is designed for single mode fiber and operates at a nominal wavelength of 1550nm.

The transmitter section uses a multiple quantum well 1550nm DFB laser and is a class 1 laser compliant according to International Safety Standard IEC-60825. The receiver section uses an integrated InGaAs detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

The EOLS-1512-XD series are designed to be compliant with SFF-8472 SFP Multi-Source Agreement (MSA).

## Absolute Maximum Ratings

| Parameter                   | Symbol   | Min. | Max. | Unit |
|-----------------------------|----------|------|------|------|
| Storage Temperature         | $T_s$    | -40  | +85  | °C   |
| Supply Voltage              | $V_{CC}$ | -0.5 | 3.6  | V    |
| Operating Relative Humidity |          | -    | 95   | %    |

\*Exceeding any one of these values may destroy the device immediately.

## Recommended Operating Conditions

| Parameter                  | Symbol   | Min.         | Typical | Max. | Unit |    |
|----------------------------|----------|--------------|---------|------|------|----|
| Operating Case Temperature | $T_A$    | EOLS-1512-X  | 0       |      | +70  | °C |
|                            |          | EOLS-1512-XI | -40     |      | +85  |    |
| Power Supply Voltage       | $V_{CC}$ | 3.15         | 3.3     | 3.45 | V    |    |
| Power Supply Current       | $I_{CC}$ |              |         | 300  | mA   |    |
| Data Rate                  | GBE      |              | 1.25    |      | Gbps |    |
|                            | FC       |              | 1.063   |      |      |    |

## Performance Specifications - Electrical

| Parameter                      | Symbol   | Min. | Typical | Max.     | Unit | Notes                                 |
|--------------------------------|----------|------|---------|----------|------|---------------------------------------|
| <b>Transmitter</b>             |          |      |         |          |      |                                       |
| LVPECL Inputs(Differential)    | $V_{in}$ | 400  |         | 2000     | mVpp | AC Coupled Inputs <sup>*(note4)</sup> |
| Input Impedance (Differential) | $Z_{in}$ | 85   | 100     | 115      | ohm  | $R_{in} > 100$ kohm @ DC              |
| TX_Dis                         | Disable  | 2    |         | $V_{CC}$ | V    |                                       |
|                                | Enable   | 0    |         | 0.8      |      |                                       |

|                                 |        |                  |     |     |                      |                  |  |
|---------------------------------|--------|------------------|-----|-----|----------------------|------------------|--|
| TX_FAULT                        | Fault  |                  | 2   |     | V <sub>CC</sub> +0.3 | V                |  |
|                                 | Normal |                  | 0   |     | 0.5                  |                  |  |
| <b>Receiver</b>                 |        |                  |     |     |                      |                  |  |
| LVPECL Outputs (Differential)   |        | V <sub>out</sub> | 400 |     | 2000                 | mV <sub>pp</sub> | AC Coupled Outputs <sup>*(note4)</sup> |
| Output Impedance (Differential) |        | Z <sub>out</sub> | 85  | 100 | 115                  | ohms             |  |
| RX_LOS                          | LOS    |                  | 2   |     | V <sub>CC</sub> +0.3 | V                |  |
|                                 | Normal |                  | 0   |     | 0.8                  | V                |  |
| MOD_DEF ( 0:2 )                 |        | VoH              | 2.5 |     |                      | V                | With Serial ID                         |
|                                 |        | VoL              | 0   |     | 0.5                  | V                |  |

## Optical and Electrical Characteristics

### (1550nm DFB and PIN, 40km)

| Parameter                                | Symbol  | Min. | Typical    | Max. | Unit |
|--|---|------|------------|------|------|
| 9μm Core Diameter SMF                    | L   |      | 40         |      | km   |
| Data Rate                                |   |      | 1.063/1.25 |      | Gbps |
| <b>Transmitter</b>                       |   |      |            |      |      |
| Center Wavelength                        | λ <sub>C</sub>  | 1500 | 1550       | 1580 | nm   |
| Spectral Width (-20dB)                   | Δλ  |      |            | 1    | nm   |
| Average Output Power <sup>*(note5)</sup> | P <sub>out</sub>                                      | -5   |            | 0    | dBm  |
| Side Mode Suppression Ratio              | SMSR  | 30   |            |      | dB   |
| Extinction Ratio <sup>*(note6)</sup>     | ER  | 9    |            |      | dB   |
| Rise/Fall Time(20%~80%)                  | tr/tf   |      |            | 0.26 | ns   |
| Total Jitter                             | TJ  |      |            | 0.43 | UI   |
| Output Optical Eye <sup>*(note6)</sup>   | Compliant with IEEE 802.3ah-2004 <sup>*(note10)</sup> |      |            |      |      |
| TX_Disable Assert Time                   | t <sub>off</sub>                                      |      |            | 10   | μs   |
| P <sub>out</sub> @TX Disable Asserted    | P <sub>out</sub>                                      |      |            | -45  | dBm  |
| <b>Receiver</b>                          |   |      |            |      |      |
| Center Wavelength                        | λ <sub>C</sub>  | 1260 |            | 1600 | nm   |
| Receiver Sensitivity <sup>*(note7)</sup> | P <sub>min</sub>                                      |      |            | -21  | dBm  |
| Receiver Overload                        | P <sub>max</sub>                                      | -3   |            |      | dBm  |
| Return Loss                              |   | 12   |            |      | dB   |
| Optical Path Penalty <sup>*(note8)</sup> |   |      |            | 1    | dB   |
| LOS De-Assert                            | LOSD  |      |            | -22  | dBm  |
| LOS Assert                               | LOSA  | -42  |            |      | dBm  |
| LOS Hysteresis <sup>*(note9)</sup>       |   | 0.5  |            |      | dB   |

### (1550nm DFB and PIN, 60km)

| Parameter             | Symbol | Min. | Typical    | Max. | Unit |
|-----------------------|--------|------|------------|------|------|
| 9μm Core Diameter SMF | L      |      | 60         |      | km   |
| Data Rate             |        |      | 1.063/1.25 |      | Gbps |
| <b>Transmitter</b>    |        |      |            |      |      |

|  |   |      |      |      |     |
|--|---|------|------|------|-----|
| Center Wavelength                        | $\lambda_C$   | 1500 | 1550 | 1580 | nm  |
| Spectral Width (-20dB)                   | $\Delta\lambda$                                       |      |      | 1    | nm  |
| Average Output Power <sup>*(note5)</sup> | P <sub>out</sub>                                      | -5   |      | 0    | dBm |
| Side Mode Suppression Ratio              | SMSR  | 30   |      |      | dB  |
| Extinction Ratio <sup>*(note6)</sup>     | ER  | 9    |      |      | dB  |
| Rise/Fall Time(20%~80%)                  | tr/tf   |      |      | 0.26 | ns  |
| Total Jitter                             | TJ  |      |      | 0.43 | UI  |
| Output Optical Eye <sup>*(note6)</sup>   | Compliant with IEEE 802.3ah-2004 <sup>*(note10)</sup> |      |      |      |     |
| TX_Disable Assert Time                   | t <sub>off</sub>                                      |      |      | 10   | □us |
| P <sub>out</sub> @TX Disable Asserted    | P <sub>out</sub>                                      |      |      | -45  | dBm |
| <b>Receiver</b>                          |   |      |      |      |     |
| Center Wavelength                        | $\lambda_C$   | 1260 |      | 1600 | nm  |
| Receiver Sensitivity <sup>*(note7)</sup> | P <sub>min</sub>                                      |      |      | -24  | dBm |
| Receiver Overload                        | P <sub>max</sub>                                      | -3   |      |      | dBm |
| Return Loss                              |   | 12   |      |      | dB  |
| Optical Path Penalty <sup>*(note8)</sup> |   |      |      | 1    | dB  |
| LOS De-Assert                            | LOSD  |      |      | -25  | dBm |
| LOS Assert                               | LOSA  | -42  |      |      | dBm |
| LOS Hysteresis <sup>*(note9)</sup>       |   | 0.5  |      |      | dB  |

**(1550nm DFB and PIN, 80km)**

| Parameter                                | Symbol  | Min. | Typical    | Max. | Unit |
|--|---|------|------------|------|------|
| 9μm Core Diameter SMF                    | L   |      | 80         |      | km   |
| Data Rate                                |   |      | 1.063/1.25 |      | Gbps |
| <b>Transmitter</b>                       |   |      |            |      |      |
| Center Wavelength                        | $\lambda_C$   | 1500 | 1550       | 1580 | nm   |
| Spectral Width (-20dB)                   | $\Delta\lambda$                                       |      |            | 1    | nm   |
| Average Output Power <sup>*(note5)</sup> | P <sub>out</sub>                                      | 0    |            | 5    | dBm  |
| Side Mode Suppression Ratio              | SMSR  | 30   |            |      | dB   |
| Extinction Ratio <sup>*(note6)</sup>     | ER  | 9    |            |      | dB   |
| Rise/Fall Time(20%~80%)                  | tr/tf   |      |            | 0.26 | ns   |
| Total Jitter                             | TJ  |      |            | 0.43 | UI   |
| Output Optical Eye <sup>*(note6)</sup>   | Compliant with IEEE 802.3ah-2004 <sup>*(note10)</sup> |      |            |      |      |
| TX_Disable Assert Time                   | t <sub>off</sub>                                      |      |            | 10   | □us  |
| P <sub>out</sub> @TX Disable Asserted    | P <sub>out</sub>                                      |      |            | -45  | dBm  |
| <b>Receiver</b>                          |   |      |            |      |      |
| Center Wavelength                        | $\lambda_C$   | 1260 |            | 1600 | nm   |
| Receiver Sensitivity <sup>*(note7)</sup> | P <sub>min</sub>                                      |      |            | -24  | dBm  |
| Receiver Overload                        | P <sub>max</sub>                                      | -3   |            |      | dBm  |
| Return Loss                              |   | 12   |            |      | dB   |
| Optical Path Penalty <sup>*(note8)</sup> |   |      |            | 1    | dB   |
| LOS De-Assert                            | LOSD  |      |            | -25  | dBm  |
| LOS Assert                               | LOSA  | -42  |            |      | dBm  |

|                        |  |     |  |  |    |
|------------------------|--|-----|--|--|----|
| LOS Hysteresis*(note9) |  | 0.5 |  |  | dB |
|------------------------|--|-----|--|--|----|

Note4: LVPECL logic, internally AC coupled.

Note5: Output is coupled into a 9/125µm single-mode fiber.

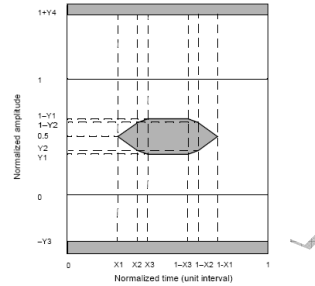
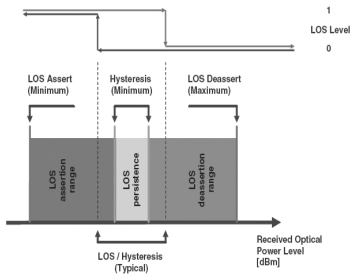
Note6: Filtered, measured with a PRBS 2<sup>7</sup>-1 test pattern @1.25Gbps

Note7: Minimum average optical power measured at BER less than 1E-12, with a 2<sup>7</sup>-1 NRZ PRBS and ER=9dB.

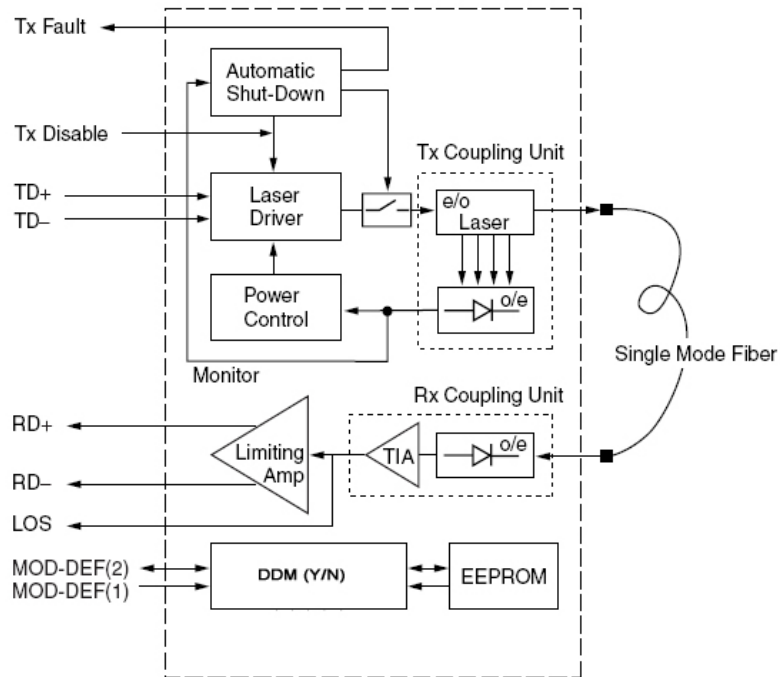
Note8: Measured with a PRBS 2<sup>7</sup>-1 test pattern @1.25Gbps, over 40km G.652 SMF, BER ≤1×10<sup>-10</sup>.

Note9: LOS Hysteresis

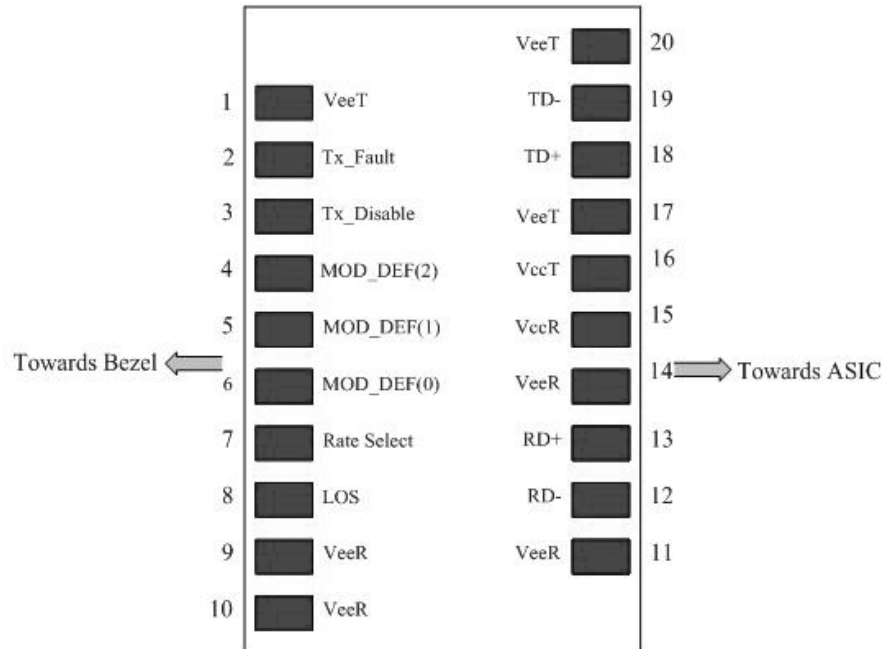
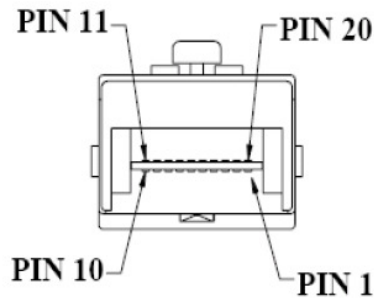
Note10: Eye Pattern Mask



## Functional Description of Transceiver



## SFP Transceiver Electrical Pad Layout



## Pin Function Definitions

| Pin Num. | Name        | Function                     | Plug Seq. | Notes                              |
|----------|-------------|------------------------------|-----------|------------------------------------|
| 1        | VeeT        | Transmitter Ground           | 1         | 5)                                 |
| 2        | TX Fault    | Transmitter Fault Indication | 3         | 1)                                 |
| 3        | TX Disable  | Transmitter Disable          | 3         | 2) Module disables on high or open |
| 4        | MOD-DEF2    | Module Definition 2          | 3         | 3) Data line for Serial ID.        |
| 5        | MOD-DEF1    | Module Definition 1          | 3         | 3) Clock line for Serial ID.       |
| 6        | MOD-DEF0    | Module Definition 0          | 3         | 3) Grounded within the module.     |
| 7        | Rate Select | Not Connect                  | 3         | Function not available             |
| 8        | LOS         | Loss of Signal               | 3         | 4)                                 |
| 9        | VeeR        | Receiver Ground              | 1         | 5)                                 |
| 10       | VeeR        | Receiver Ground              | 1         | 5)                                 |

|    |      |                        |   |             |
|----|------|------------------------|---|-------------|
| 11 | VeeR | Receiver Ground        | 1 | 5)          |
| 12 | RD-  | Inv. Received Data Out | 3 | 6)          |
| 13 | RD+  | Received Data Out      | 3 | 7)          |
| 14 | VeeR | Receiver Ground        | 1 | 5)          |
| 15 | VccR | Receiver Power         | 2 | 7) 3.3 ± 5% |
| 16 | VccT | Transmitter Power      | 2 | 7) 3.3 ± 5% |
| 17 | VeeT | Transmitter Ground     | 1 | 5)          |
| 18 | TD+  | Transmit Data In       | 3 | 8)          |
| 19 | TD-  | Inv. Transmit Data In  | 3 | 8)          |
| 20 | VeeT | Transmitter Ground     | 1 | 5)          |

### Notes:

1) TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor on the host board. Pull up voltage between 2.0V and VccT, R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 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 4.7 – 10 KΩ 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

3) Modulation Absent, connected to VEET or VEER in the module.

4) LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor. Pull up voltage between 2.0V and VccT, R+0.3V. When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.

5) VeeR and VeeT may be internally connected within the SFP module.

6) RD-/+: These are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω (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 400 and 2000 mV differential (200 –1000 mV single ended) when properly terminated.

7) 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 ohm 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.

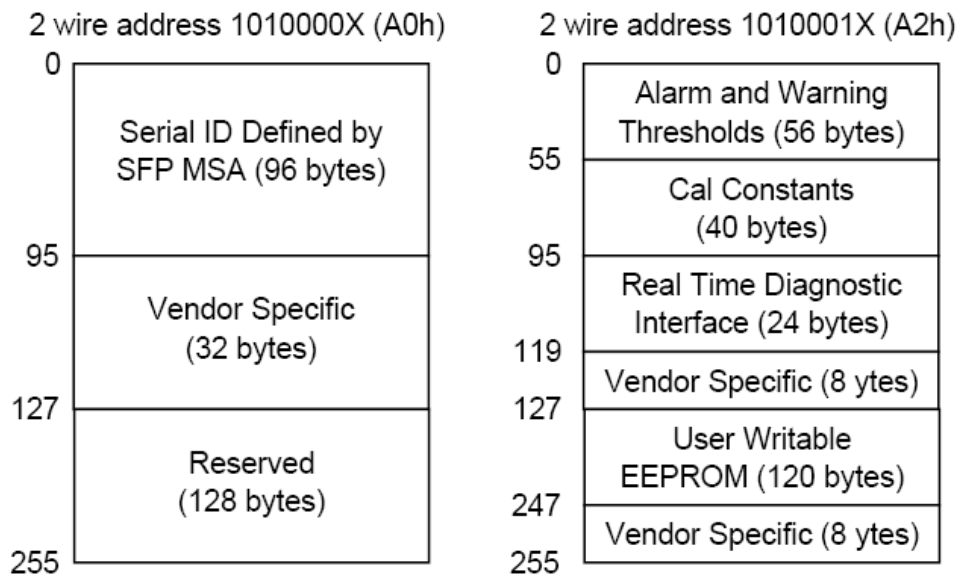
VccR and VccT may be internally connected within the SFP transceiver module.

8) TD-/+ : These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω 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 swings of 400 – 2000 mV (200 – 1000mV single-ended).

## EEPROM

The serial interface uses the 2-wire serial CMOS EEPROM protocol defined for the ATMEL AT24C02/04 family of components. When the serial protocol is activated, the host generates the serial clock signal (SCL). The positive edge clocks data into those segments of the EEPROM that are not write protected within the SFP transceiver. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

The Module provides diagnostic information about the present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. If the module is defined as external calibrated, the diagnostic data are raw A/D values and must be converted to real world units using calibration constants stored in EEPROM locations 56 – 95 at wire serial bus address A2H. The digital diagnostic memory map specific data field define as following .For detail EEPROM information, please refer to the related document of SFF 8472 Rev 9.3.



## EEPROM Serial ID Memory Contents

Accessing Serial ID Memory uses the 2 wire address 1010000X(A0H). Memory Contents of

Serial ID are shown in Table 1.

**Table 1 Serial ID Memory Contents**

| Add.                      | Size (Bytes) | Name of Field     | Hex  | Description  |
|---------------------------|--------------|-------------------|--|--|
| <b>BASE ID FIELDS</b>     |              |                   |  |  |
| 0                         | 1            | Identifier        | 03   | SFP  |
| 1                         | 1            | Ext. Identifier   | 04   | SFP function is defined by serial ID only            |
| 2                         | 1            | Connector         | 07   | LC Connector   |
| 3-10                      | 8            | Transceiver       | 00 00 00 02 12 00 0D 01  | Transmitter Code                                     |
| 11                        | 1            | Encoding          | 01   | 8B10B  |
| 12                        | 1            | BR, Nominal       | 0D   | 1.25Gbps   |
| 13                        | 1            | Reserved          | 00   |  |
| 14                        | 1            | Length (9μm) km   | 28/3C/50   | Transceiver Transmit Distance                        |
| 15                        | 1            | Length(9μm)100m   | FF   |  |
| 16                        | 1            | Length (50μm) 10m | 00   |  |
| 17                        | 1            | Length(62.5μm)10m | 00   |  |
| 18                        | 1            | Length (Copper)   | 00   | Not Compliant  |
| 19                        | 1            | Reserved          | 00   |  |
| 20-35                     | 16           | Vendor name       | 45 4F 50 54 4F 4C 49 4E 4B 20 20 20 20 20 20 20 20                 | ELOPTOLINK (ASCII)                                   |
| 36                        | 1            | Reserved          | 00   |  |
| 37-39                     | 3            | Vendor OUI        | 00 00 00   |  |
| 40-55                     | 16           | Vendor PN         | 45 4F 4C 53 2D 31 35 31 32 2D 34 30 44 20 20 20 <sup>(note9)</sup> | EOLS-1512-XD   |
| 56-59                     | 4            | Vendor Rev        | XX XX XX XX <sup>(note9)</sup>                                     | ASCII (31 30 20 20 means 1.0 revision)               |
| 60-61                     | 2            | Wavelength        | 06 0E  | 1550nm   |
| 62                        | 1            | Reserved          | 00   |  |
| 63                        | 1            | CC_BASE           | Check Sum (Variable)   | Check code for Base ID Fields                        |
| <b>EXTENDED ID FIELDS</b> |              |                   |  |  |
| 64-65                     | 2            | Options           | 00 1A  | TX_DISABLE, TX_FAULT and Loss of Signal Implemented. |
| 66                        | 1            | BR, max           | 00   |  |
| 67                        | 1            | BR,min            | 00   |  |

|                                  |     |                            |  |  |
|----------------------------------|-----|----------------------------|--|--|
| 68-83                            | 16  | Vendor SN                  | XX XX XX XX XX XX<br>XX XX 20 20 20 20<br>20 20 20 20 <sup>(note9)</sup> | Serial Number of Transceiver (ASCII). For example "B000822". |
| 84-91                            | 8   | Date Code                  | XX XX XX XX XX XX<br>XX XX <sup>(note9)</sup>                            | Manufactory Date Code. For example "080405".                 |
| 92                               | 1   | Diagnostic Monitoring Type | XX <sup>(note9)</sup>  | Digital Diagnostic Monitoring Implemented                    |
| 93                               | 1   | Enhanced Options           | XX <sup>(note9)</sup>  | Optional Flags   |
| 94                               | 1   | SFF_8472 Compliance        | XX <sup>(note9)</sup>  | 01 for Rev9.3 SFF-8472.                                      |
| 95                               | 1   | CC_EXT                     | Check Sum (Variable)   | Check Sum for Extended ID Field.                             |
| <b>VENDOR SPECIFIC ID FIELDS</b> |     |                            |  |  |
| 96-127                           | 32  | Vendor Specific            | Read Only  | Depends on Customer Information                              |
| 128-255                          | 128 | Reserved                   | Read Only  |  |

Note9: The "XX" byte should be filled in according to practical case. For more information, please refer to the related document of SFP Multi-Source Agreement (MSA).

## Digital Diagnostic Monitoring Interface (2-Wire Address A2H)

### Alarm and Warning Thresholds (2 Wire Address A2H)

| Address | # Bytes | Name of Field         | HEX   | Real Value | Unit     |
|---------|---------|-----------------------|-------|------------|----------|
| 00-01   | 2       | Temp High Alarm       | 6E 00 | 110        | Degree C |
| 02-03   | 2       | Temp Low Alarm        | D3 00 | -45        | Degree C |
| 04-05   | 2       | Temp High Warning     | 5F 00 | 95         | Degree C |
| 06-07   | 2       | Temp Low Warning      | D3 00 | -42        | Degree C |
| 08-09   | 2       | Voltage High Alarm    | 8C A0 | 3.6        | V        |
| 10-11   | 2       | Voltage Low Alarm     | 71 48 | 2.9        | V        |
| 12-13   | 2       | Voltage High Warning  | 88 B8 | 3.5        | V        |
| 14-15   | 2       | Voltage Low Warning   | 0B B8 | 3.0        | V        |
| 16-17   | 2       | Bias High Alarm       | AF C8 | 90         | mA       |
| 18-19   | 2       | Bias Low Alarm        | 03 F8 | 3          | mA       |
| 20-21   | 2       | Bias High Warning     | 9C 40 | 80         | mA       |
| 22-23   | 2       | Bias Low Warning      | 05 DC | 2          | mA       |
| 24-25   | 2       | TX Power High Alarm   | XX XX | XX         | dBm      |
| 26-27   | 2       | TX Power Low Alarm    | XX XX | XX         | dBm      |
| 28-29   | 2       | TX Power High Warning | XX XX | XX         | dBm      |
| 30-31   | 2       | TX Power Low Warning  | XX XX | XX         | dBm      |
| 32-33   | 2       | RX Power High Alarm   | XX XX | XX         | dBm      |
| 34-35   | 2       | RX Power Low Alarm    | XX XX | XX         | dBm      |
| 36-37   | 2       | RX Power High Warning | XX XX | XX         | dBm      |
| 38-39   | 2       | RX Power Low Warning  | XX XX | XX         | dBm      |

|       |    |          |  |  |   |
|-------|----|----------|--|--|---|
| 40-55 | 16 | Reserved |  |  | - |
|-------|----|----------|--|--|---|

### Calibration Constants (2 Wire Address A2H)

| Address | # Bytes | Name of Field   | HEX            | Description                                      |
|---------|---------|-----------------|----------------|--|
| 56-59   | 4       | RX_PWR (4)      | 00 00 00<br>00 | Set to zero for “internally calibrated” devices. |
| 60-63   | 4       | RX_PWR (3)      | 00 00 00<br>00 | Set to zero for “internally calibrated” devices. |
| 64-67   | 4       | RX_PWR (2)      | 00 00 00<br>00 | Set to zero for “internally calibrated” devices. |
| 68-71   | 4       | RX_PWR (1)      | 3F 80 00<br>00 | Set to 1 for “internally calibrated” devices.    |
| 72-75   | 4       | RX_PWR (0)      | 00 00 00<br>00 | Set to zero for “internally calibrated” devices. |
| 76-77   | 2       | TX_I (Slope)    | 01 00          | Set to 1 for “internally calibrated” devices.    |
| 78-79   | 2       | TX_I (Offset)   | 00 00          | Set to zero for “internally calibrated” devices. |
| 80-81   | 2       | TX_PWR (Slope)  | 01 00          | Set to 1 for “internally calibrated” devices.    |
| 82-83   | 2       | TX_PWR (Offset) | 00 00          | Set to zero for “internally calibrated” devices. |
| 84-85   | 2       | T (Slope)       | 01 00          | Set to 1 for “internally calibrated” devices.    |
| 86-87   | 2       | T (Offset)      | 00 00          | Set to zero for “internally calibrated” devices. |
| 88-89   | 2       | V (Slope)       | 01 00          | Set to 1 for “internally calibrated” devices.    |
| 90-91   | 2       | V (Offset)      | 00 00          | Set to zero for “internally calibrated” devices. |
| 92-94   | 3       | Reserved        | 00 00 00       | Reserved   |
| 95      | 1       | Checksum        | XX             | Checksum of bytes 0 – 94.                        |

### A/D Value (2 Wire Address A2H)

| Address | # Bytes | Name of Field                | Description                                  |
|---------|---------|------------------------------|--|
| 96-97   | 2       | Temperature (MSB, LSB)       | Internally measured module temperature       |
| 98-99   | 2       | Supply Voltage (MSB, LSB)    | Internally measured supply voltage in module |
| 100-101 | 2       | TX Bias Current (MSB, LSB)   | Internally measured TX Bias current          |
| 102-103 | 2       | TX Optical Power (MSB, LSB)  | Internally measured TX Optical Power         |
| 104-105 | 2       | RX Received Power (MSB, LSB) | Measured RX input power                      |
| 106-109 | 4       | Reserved                     |  |

\*Temperature (Signed two complement values)

|                               |                |                |                |                |                |                |                |                               |                |                |                |                |                |                |                |
|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|-------------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| A2H Byte 96 (Temperature MSB) |                |                |                |                |                |                |                | A2H Byte 97 (Temperature LSB) |                |                |                |                |                |                |                |
| S                             | 2 <sup>6</sup> | 2 <sup>5</sup> | 2 <sup>4</sup> | 2 <sup>3</sup> | 2 <sup>2</sup> | 2 <sup>1</sup> | 2 <sup>0</sup> | 2 <sup>1</sup>                | 2 <sup>2</sup> | 2 <sup>3</sup> | 2 <sup>4</sup> | 2 <sup>5</sup> | 2 <sup>6</sup> | 2 <sup>7</sup> | 2 <sup>8</sup> |

Supply Voltage, TX Bias Current, TX Optical Power, RX Received Power (Unsigned Values)

|                             |                 |                 |                 |                 |                 |                |                |                             |                |                |                |                |                |                |                |
|-----------------------------|-----------------|-----------------|-----------------|-----------------|-----------------|----------------|----------------|-----------------------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| A2H Byte 98 (Vcc MSB)       |                 |                 |                 |                 |                 |                |                | A2H Byte 99 (Vcc LSB)       |                |                |                |                |                |                |                |
| A2H Byte 100 (TX Bias MSB)  |                 |                 |                 |                 |                 |                |                | A2H Byte 101 (TX Bias LSB)  |                |                |                |                |                |                |                |
| A2H Byte 102 (TX Power MSB) |                 |                 |                 |                 |                 |                |                | A2H Byte 103 (TX Power LSB) |                |                |                |                |                |                |                |
| A2H Byte 104 (RX Power MSB) |                 |                 |                 |                 |                 |                |                | A2H Byte 105 (RX Power LSB) |                |                |                |                |                |                |                |
| 2 <sup>15</sup>             | 2 <sup>14</sup> | 2 <sup>13</sup> | 2 <sup>12</sup> | 2 <sup>11</sup> | 2 <sup>10</sup> | 2 <sup>9</sup> | 2 <sup>8</sup> | 2 <sup>7</sup>              | 2 <sup>6</sup> | 2 <sup>5</sup> | 2 <sup>4</sup> | 2 <sup>3</sup> | 2 <sup>2</sup> | 2 <sup>1</sup> | 2 <sup>0</sup> |

The digital value conversions are updated every 13ms (nominal) or 20ms (max) in rotation. After getting digital value, each measurement could be obtained by multiplying digital value by corresponding LSB value:

Temperature = Temp (Digital Value) × LSB<sub>Temp</sub> = Temp (Digital Value) × 1/256; when Temperature < 128

Temperature = Temp (Digital Value) × LSB<sub>Temp</sub> = [Temp (Digital Value) × 1/256] - 256; when Temperature ≥ 128

V<sub>cc</sub> = V<sub>cc</sub>(Digital Value) × LSB<sub>V<sub>cc</sub></sub> = V<sub>cc</sub>(Digital Value) × 100μV

TX Bias Current = TX Bias Current (Digital Value) × LSB<sub>TX,Bias</sub> = TX Bias Current (Digital Value) × 2μA

TX Power = TX Power (Digital Value) × LSB<sub>TX Power</sub> = TX Power (Digital Value) × 0.1μW

RX Power = RX Power (Digital Value) × LSB<sub>RX Power</sub> = RX Power (Digital Value) × 0.1μW

### Status Bits and Alarm/Warning Flag Bits (2 Wire Address A2H)

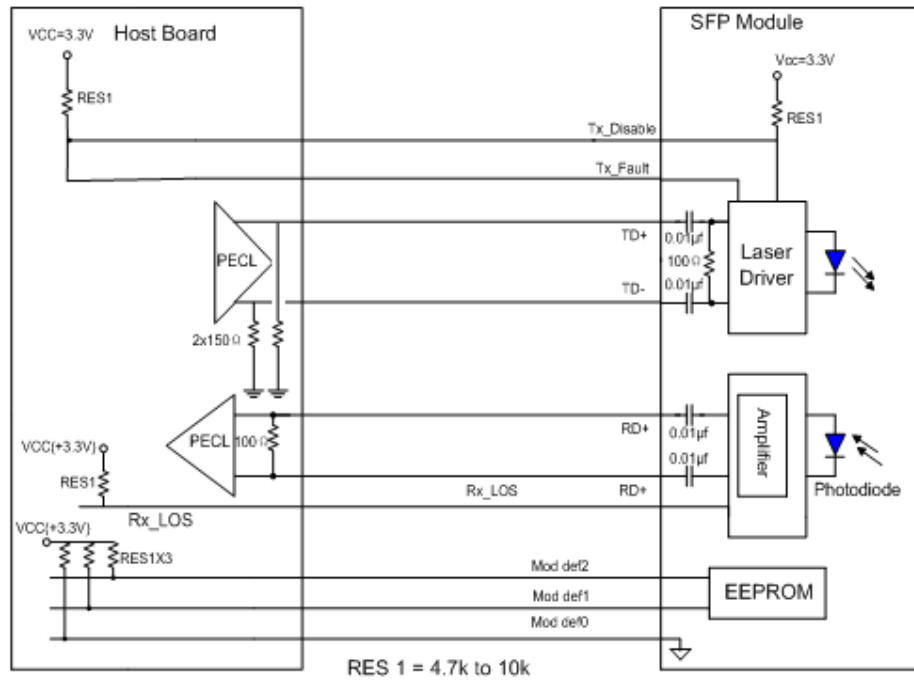
| Address | Bit | Name                | Description  |
|---------|-----|---------------------|--|
| 110     | 7   | TX Disable State    | Digital state of TX disable (1) and enabled (0)  |
| 110     | 6   | Soft TX Disable     | Not implemented  |
| 110     | 5-3 | Reserved            |  |
| 110     | 2   | TX Fault State      | 1=TX failure state, 0=TX normal state  |
| 110     | 1   | LOS                 | Digital state of LOS output pin. 0=optical signal detected, 1=no optical signal detected |
| 110     | 0   | Data_Ready_Bar      | Not implemented.   |
| 111     | 7-0 | Reserved            | Reserved   |
| 112     | 7   | Temp High Alarm     | Set when internal temperature exceeds high alarm level.                                  |
| 112     | 6   | Temp Low Alarm      | Set when internal temperature is below low alarm level.                                  |
| 112     | 5   | Vcc High Alarm      | Set when internal supply voltage exceeds high alarm level.                               |
| 112     | 4   | Vcc Low Alarm       | Set when internal supply voltage is below low alarm level.                               |
| 112     | 3   | TX Bias High Alarm  | Set when TX Bias current exceeds high alarm level.                                       |
| 112     | 2   | TX Bias Low Alarm   | Set when TX Bias current is below low alarm level.                                       |
| 112     | 1   | TX Power High Alarm | Set when TX Power exceeds high alarm level.  |
| 112     | 0   | TX Power Low Alarm  | Set when TX Power is below low alarm level.  |
| 113     | 7   | RX Power High Alarm | Set when Received Power exceeds high alarm level.  |
| 113     | 6   | RX Power Low Alarm  | Set when Received Power is below low alarm level.  |

|         |     |                       |   |
|---------|-----|-----------------------|---|
| 113     | 5-0 | Reserved Alarm        |   |
| 114-115 | All | Reserved              |   |
| 116     | 7   | Temp High Warning     | Set when internal temperature exceeds high warning level. |
| 116     | 6   | Temp Low Warning      | Set when internal temperature is below low warning level. |
| 116     | 5   | Vcc High Warning      | Set when internal supply voltage > high warning level.    |
| 116     | 4   | Vcc Low Warning       | Set when internal supply voltage < low warning level.     |
| 116     | 3   | TX Bias High Warning  | Set when TX Bias current exceeds high warning level.      |
| 116     | 2   | TX Bias Low Warning   | Set when TX Bias current is below low warning level.      |
| 116     | 1   | TX Power High Warning | Set when TX Power exceeds high warning level.             |
| 116     | 0   | TX Power Low Warning  | Set when TX Power is below low warning level.             |
| 117     | 7   | RX Power High Warning | Set when Received Power exceeds high warning level.       |
| 117     | 6   | RX Power Low Warning  | Set when Received Power is below low warning level.       |
| 117     | 5-0 | Reserved Warning      |   |
| 118-119 | All | Reserved              |   |

### Vendor Specific and User Accessible EEPROM (2 Wire Address A2H)

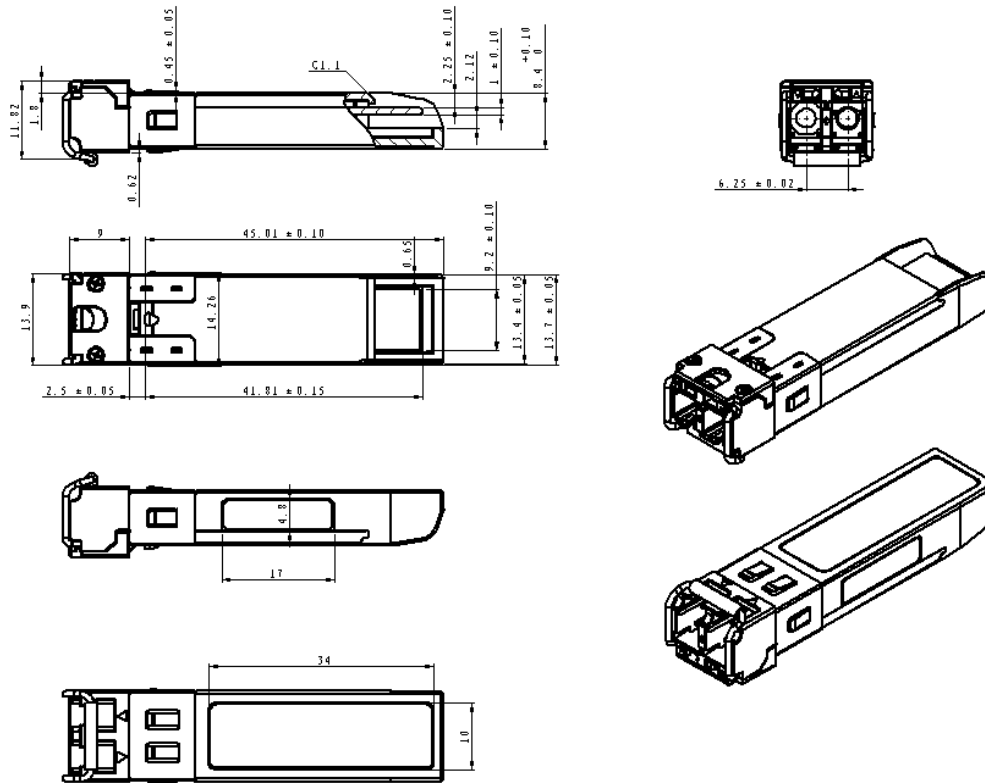
| Address | # Bytes | Name                 | Description  |
|---------|---------|----------------------|--------------|
| 120-127 | 8       | Vendor Specific      | Don't Access |
| 128-247 | 120     | User writable EEPROM |              |
| 248-255 | 8       | Vendor Specific      | Don't Access |

### Recommended Circuit Schematic

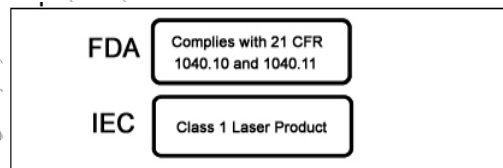


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**Mechanical Specifications**



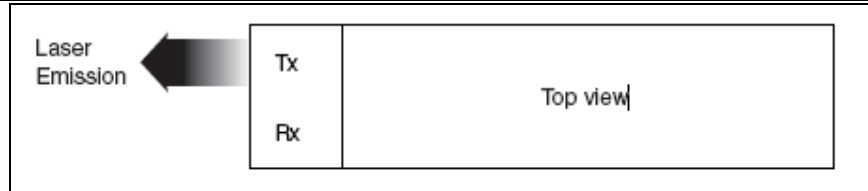
**Class 1 Labels**



**Laser Emission Data**

|   |         |
|---|---------|
| Wavelength  | 1550nm  |
| Total output power (as defined by FDA: 7mm aperture at 20cm distance) | <0.79mW |
| Total output power (as defined by IEC: 7mm aperture at 10cm distance) | <10mW   |
| Beam divergence   | 12.5°   |

**Laser Emission**



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## Revision History

| Revision | Initiated | Reviewed | Approved | Revision History | Release Date |
|----------|-----------|----------|----------|------------------|--------------|
| V3.a     | Kelly     |          |          | Released.        | Feb 10, 2010 |

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