# EOLP-8596-02-X

**850nm SFP+ Multi-Mode Transceiver, With Diagnostic Monitoring**
**10G BASE-SW/SR**
**0.6~10Gb/s CPRI/OBSAI**
**Duplex SFP+ Transceiver, RoHS Compliant**

## Features

- Operating Data Rate up to 11.3Gbps
- 850nm VCSEL Transmitter
- Distance up to 300m @50 / 125 um MMF
- Single 3.3V Power Supply and TTL Logic Interface
- Duplex LC Connector Interface, Hot Pluggable
- Compliant with MSA SFP+ Specification SFF-8431
- Compliant with IEEE 802.3ae 10GBASE-SR/SW
- Power Dissipation < 1.0W
- Dispersion Tolerance up to 40ps/nm over G.651
- Operating Case Temperature

  Standard: 0℃~+70℃

  Industrial: -40℃~85℃

  Extended：-20℃~75℃
- Safety Certification: TUV/UL/FDA*Note1
- RoHS Compliant

## Applications

- 10GBASE-SW at 9.953 Gbps
- 10GBASE-SR at 10.3125 Gbps
- OBSAI Rates 6.144 Gb/s, 3.072 Gb/s, 1.536 Gb/s, 0.768 Gb/s
- CPRI Rates 10.138 Gb/s, 9.830 Gb/s, 7.373 Gb/s, 6.144 Gb/s, 4.915 Gb/s, 2.458 Gb/s, 1.229 Gb/s, 0.614 Gb/s
- Other Optical Link

## Ordering information

| Part No. | Data Rate | Laser | Fiber Type | Distance | Temp. | DDMI |
|---|---|---|---|---|---|---|
| EOLP-8596-02 | 0.614Gbps to 11.3Gbps | 850nm VCSEL | MMF | 300m | Standard | YES |
| EOLP-8596-02-I | 0.614Gbps to 11.3Gbps | 850nm VCSEL | MMF | 300m | Industrial | YES |
| EOLP-8596-02-E | 0.614Gbps to 11.3Gbps | 850nm VCSEL | MMF | 300m | Extended | YES |

Note 1: For the latest certification information, please check with Eoptolink.

*The product image only for reference purpose.

## Product Description

The EOLP-8596-02-X series multi-mode transceiver is SFP+ module for duplex optical data communications such as 10GBASE-SR and 10GBASE-SW. It is with the SFP+ 20-pin connector to allow hot plug capability. Digital diagnostic functions are available via an $I^2C$. This module is designed for multi-mode fiber and operates at a nominal wavelength of 850 nm.

The transmitter section uses a Vertical Cavity Surface Emitted Laser (VCSEL) and is a Class 1 laser compliant according to International Safety Standard IEC 60825. The receiver section uses an integrated GaAs detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

## Absolute Maximum Ratings*Note2

| Parameter | Symbol | Min. | Max. | Unit |
|---|---|---|---|---|
| Storage Temperature | $T_S$ | -40 | +85 | °C |
| Supply Voltage | $V_{CC}$ | -0.5 | 3.6 | V |
| Input Voltage | Vin | -0.5 | Vcc | V |
| Output Current | Io | - | 50 | mA |
| Relative Humidity*Note3 | RH | 0 | 85 | % |

Note 2: Exceeding any one of these values may destroy the device permanently.

Note 3: Non-condensing.

## Recommended Operating Conditions

| Parameter | Symbol | | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| Operating Case Temperature | $T_C$ | EOLP-8596-02 | 0 | | 70 | °C |
| | | EOLP-8596-02-I | -40 | | 85 | |
| | | EOLP-8596-02-E | -20 | | 75 | |
| Power Supply Voltage | $V_{CC}$ | | 3.15 | 3.3 | 3.45 | V |
| Power Supply Current | $I_{CC}$ | | | | 300 | mA |
| Surge Current | $I_{Surge}$ | | | | +30 | mA |
| Baud Rate | | | 0.6 | | 11.3 | Gbps |

## Performance Specifications – Electrical

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|---|---|---|---|---|---|---|
| **Transmitter** | | | | | | |
| CML Inputs (Differential) | Vin | 150 | | 1200 | mVpp | AC coupled inputs |
| Input Impedance (Differential) | Zin | 85 | 100 | 115 | ohms | Rin > 100 kohms @ DC |

| | | | | | | |
|---|---|---|---|---|---|---|
| Tx_DISABLE Input Voltage – High | | 2 | | Vcc+0.3 | V | |
| Tx_DISABLE Input Voltage – Low | | 0 | | 0.8 | V | |
| Tx_FAULT Output Voltage – High | | 2 | | Vcc+0.3 | V | Io = 400μA; Host Vcc |
| Tx_FAULT Output Voltage – Low | | 0 | | 0.8 | V | Io = -4.0mA |
| **Receiver** | | | | | | |
| CML Outputs (Differential) | Vout | 350 | | 700 | mVpp | AC coupled outputs |
| Output Impedance (Differential) | Zout | 85 | 100 | 115 | ohms | |
| Rx_LOS Output Voltage – High | | 2 | | Vcc+0.3 | V | Io = 400μA; Host Vcc |
| Rx_LOS Output Voltage – Low | | 0 | | 0.8 | V | Io = -4.0mA |
| MOD_DEF (2:0) | VoH | 2.5 | | | V | With Serial ID |
| | VoL | 0 | | 0.5 | V | |

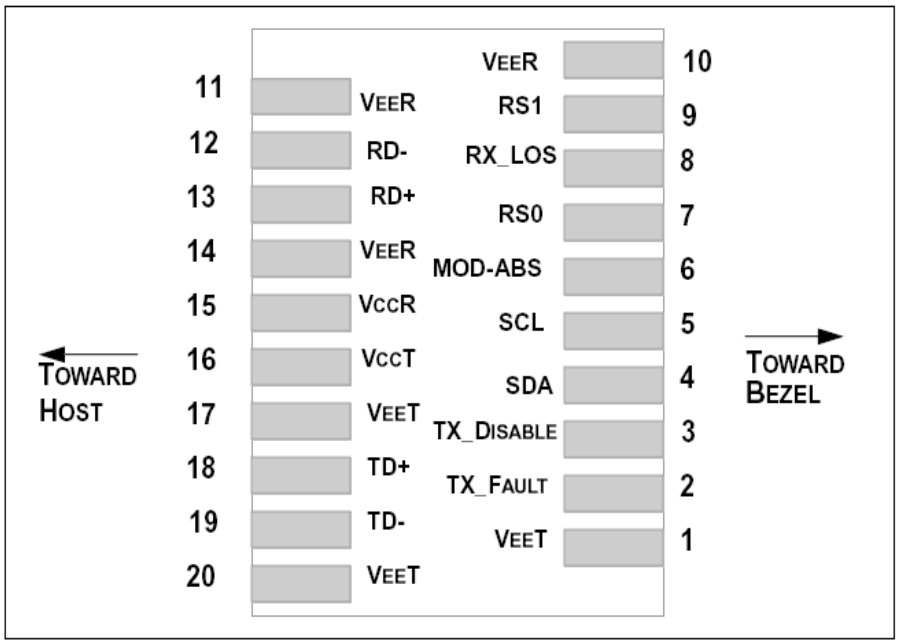
## Optical and Electrical Characteristics

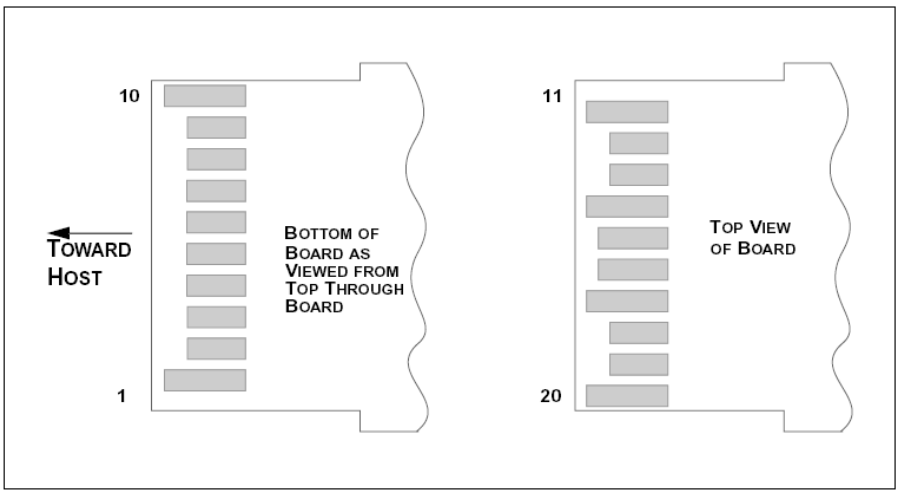
| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|
| 50 / 125 um MMF | | | 300 | | m |
| Data Rate | | 0.6 | | 11.3 | Gbps |
| **Transmitter** | | | | | |
| Centre Wavelength | $\lambda_C$ | 840 | 850 | 860 | nm |
| Spectral Width (RMS) | Δλ | | | 0.45 | nm |
| Average Output Power | $P_{out}$ | -6 | | -1 | dBm |
| Extinction Ratio | ER | 3.0 | 5.0 | | dB |
| Output Optical Eye | | IEEE 802.3-2005 Compliant | | | |
| Transmitter Dispersion Penalty | TDP | | | 3.9 | dB |
| TX_Disable Assert Time | t_off | | | 10 | us |
| TX_DISABLE Negate Time | t_on | - | - | 1 | ms |
| TX_BISABLE time to Start Reset | t_reset | 10 | - | - | us |
| Time to Initialize, Include Reset of TX_FAULT | t_init | - | - | 300 | ms |
| TX_FAULT from Fault to Assertion | t_fault | - | - | 100 | us |
| Total Jitter | TJ | - | - | 0.28 | UI(p-p) |
| Data Dependent Jitter | DDJ | - | - | 0.1 | UI(p-p) |
| Uncorrelated Jitter | UJ | - | - | 0.023 | RMS |

| Receiver | | | | | |
|---|---|---|---|---|---|
| Centre Wavelength | $\lambda_C$ | 840 | 850 | 860 | nm |
| Receiver Sensitivity (OMA) *Note4 | Pmin | | | -11.1 | dBm |
| Stressed Receiver Sensitivity (OMA) *Note4 | Pmin | | | -7.5 | dBm |
| Receiver Overload | Pmax | -1 | | | dBm |
| Optical Return Loss | ORL | | | -12 | dB |
| LOS De-Assert | $LOS_D$ | | | -12.5 | dBm |
| LOS Assert | $LOS_A$ | -25 | | | dBm |
| LOS Hysteresis | | 0.5 | | | dB |

Note 4: Measured with a PRBS $2^{31}$ -1 test pattern @ 10.3125Gbps, BER$\leqslant 10^{-12}$

## SFP+ Transceiver Electrical Pad Layout



## Pin Function Definitions

| Pin Num. | Name | Function | Plug Seq. | Notes |
|---|---|---|---|---|
| 1 | VeeT | Transmitter Ground | 1 | Note 5 |
| 2 | TX Fault | Transmitter Fault Indication | 3 | Note 1 |
| 3 | TX Disable | Transmitter Disable | 3 | Note 2, Module disables on high or open |
| 4 | SDA | Module Definition 2 | 3 | 2-wire Serial Interface Data Line. |
| 5 | SCL | Module Definition 1 | 3 | 2-wire Serial Interface Clock. |
| 6 | MOD-ABS | Module Definition 0 | 3 | Note 3 |
| 7 | RS0 | RX Rate Select (LVTTL). | 3 | No Function Implement |
| 8 | LOS | Loss of Signal | 3 | Note 4 |
| 9 | RS1 | TX Rate Select (LVTTL). | 1 | No Function Implement |
| 10 | VeeR | Receiver Ground | 1 | Note 5 |
| 11 | VeeR | Receiver Ground | 1 | Note 5 |
| 12 | RD- | Inv. Received Data Out | 3 | Note 6 |
| 13 | RD+ | Received Data Out | 3 | Note 6 |
| 14 | VeeR | Receiver Ground | 1 | Note 5 |
| 15 | VccR | Receiver Power | 2 | 3.3V ± 5%, Note 7 |
| 16 | VccT | Transmitter Power | 2 | 3.3V ± 5%, Note 7 |
| 17 | VeeT | Transmitter Ground | 1 | Note 5 |
| 18 | TD+ | Transmit Data In | 3 | Note 8 |
| 19 | TD- | Inv. Transmit Data In | 3 | Note 8 |
| 20 | VeeT | Transmitter Ground | 1 | Note 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 4.7K~10 K Ω 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) Module 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) The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.

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 370 and 700 mV differential (185 –350 mV single ended) when properly terminated.

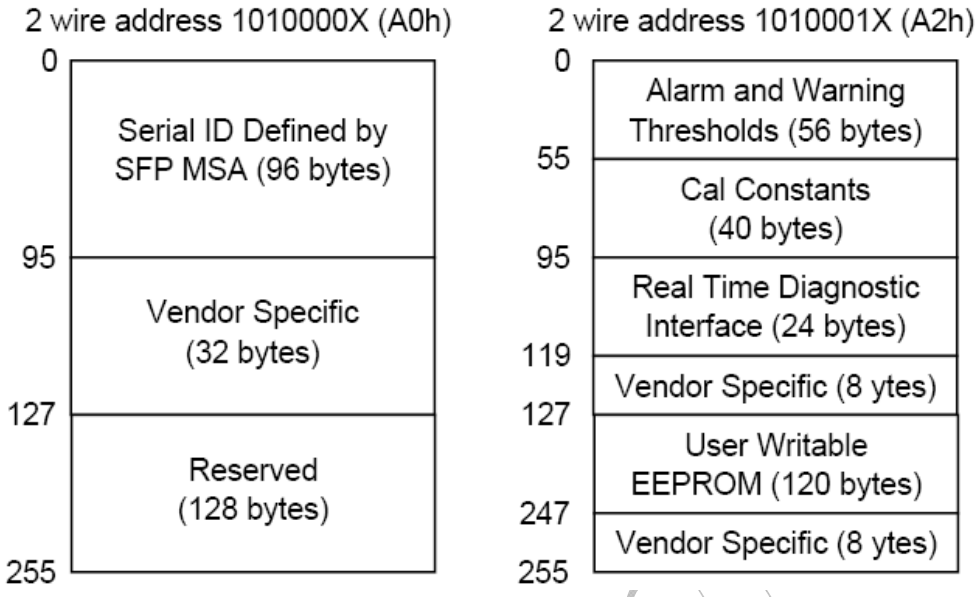
7) VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±5% at the SFP+ connector pin. Maximum supply current is 300mA. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP+ input pin with 3.3V supply voltage. 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 150 – 1200 mV (75 – 600mV single-ended), though it is recommended that values between 150 and 1200 mV differential (75 – 600mV single-ended) be used for best EMI performance.

## EEPROM

The serial interface uses the 2-wire serial CMOS EEPROM protocol. 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 writing 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 10.2.



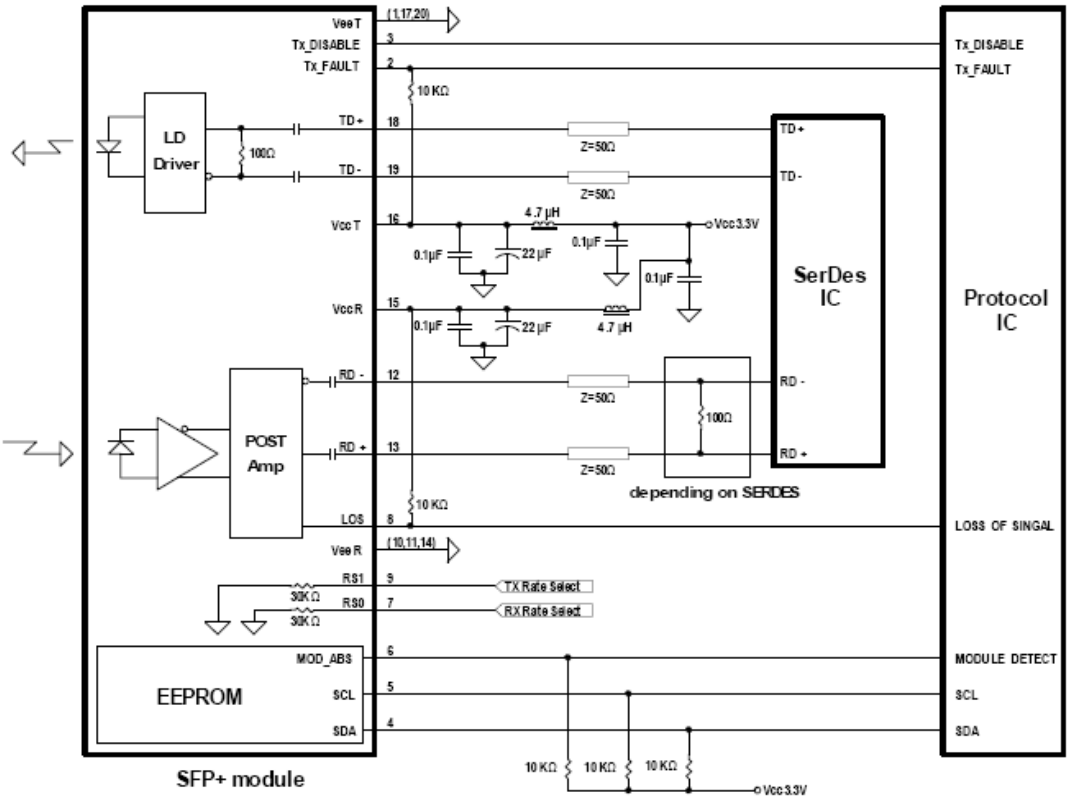

| Data Addr | Field Size (Byte) | Name Of filed | Description of field | Coded value | Hex |
|---|---|---|---|---|---|
| **BASE ID FIELDS** | | | | | |
| 0 | 1 | Identifier | Type of serial transceiver | SFP+ | 03 |
| 1 | 1 | Ext.Identifier | Extended identifier of Type of serial transceiver | MOD_DEF 4 | 04 |
| 2 | 1 | Connector | Code for connector type | LC | 07 |
| 3 | 8 | Transceiver | 10G Ethernet Compliance Codes & Infiniband Compliance Codes | 10G Base-SR | 10 |
| 4 | | | Part of SONET Compliance Codes | | 00 |
| 5 | | | SONET Compliance Codes | | 00 |
| 6 | | | Ethernet Compliance Codes | | 00 |
| 7 | | | Fiber Channel link length & part of Fibre Channel technology | | 00 |
| 8 | | | Part of Fiber Channel transmitter technology | | 00 |
| 9 | | | Fiber Channel Transmission media | | 00 |
| 10 | | | Fiber Channel speed | | 00 |
| 11 | 1 | Encoding | Code for high speed serial encoding algorithm | 64B/66B | 06 |
| 12 | 1 | BR, Nominal | Nominal signalling rate, units of 100MBd. | 10.3Gbps | 67 |
| 13 | 1 | Rate Identifier | Type of rate select functionality | | 00 |

| | | | | | |
|---|---|---|---|---|---|
| 14 | 1 | Length(SMF,km) | Link length supported for single mode fiber, units of km | | 00 |
| 15 | 1 | Length (SMF) | Link length supported for single mode fiber, units of 100 m | | 00 |
| 16 | 1 | Length (50um) | Link length supported for 50 um OM2 fiber, units of 10 m | 80(m) | 08 |
| 17 | 1 | Length (62.5um) | Link length supported for 62.5 um OM1 fiber, units of 10 m | 30(m) | 03 |
| 18 | 1 | Length (Copper) | Link length supported for copper, units of meters | | 00 |
| 19 | 1 | Length (OM3) | Link length supported for 50 um OM3 fiber, units of 10 m | 300(m) | 1E |
| 20 | 16 | Vendor name | Vendor name (ASCII) | E | 45 |
| 21 | | | | o | 6F |
| 22 | | | | p | 70 |
| 23 | | | | t | 74 |
| 24 | | | | o | 6F |
| 25 | | | | l | 6C |
| 26 | | | | i | 69 |
| 27 | | | | n | 6E |
| 28 | | | | k | 6B |
| 29 | | | | <space> | 20 |
| 30 | | | | <space> | 20 |
| 31 | | | | <space> | 20 |
| 32 | | | | <space> | 20 |
| 33 | | | | <space> | 20 |
| 34 | | | | <space> | 20 |
| 35 | | | | <space> | 20 |
| 36 | 1 | Reserved | | | 00 |
| 37 | 3 | Vendor OUI | SFP vendor IEEE company ID | | 00 |
| 38 | | | | | 00 |
| 39 | | | | | 00 |
| 40 | 16 | Vendor PN | Part number provided by vendor (ASCII) | E | 45 |
| 41 | | | | O | 4F |
| 42 | | | | L | 4C |
| 43 | | | | P | 50 |
| 44 | | | | - | 2D |
| 45 | | | | 8 | 38 |
| 46 | | | | 5 | 35 |
| 47 | | | | 9 | 39 |
| 48 | | | | 6 | 36 |
| 49 | | | | - | 2D |

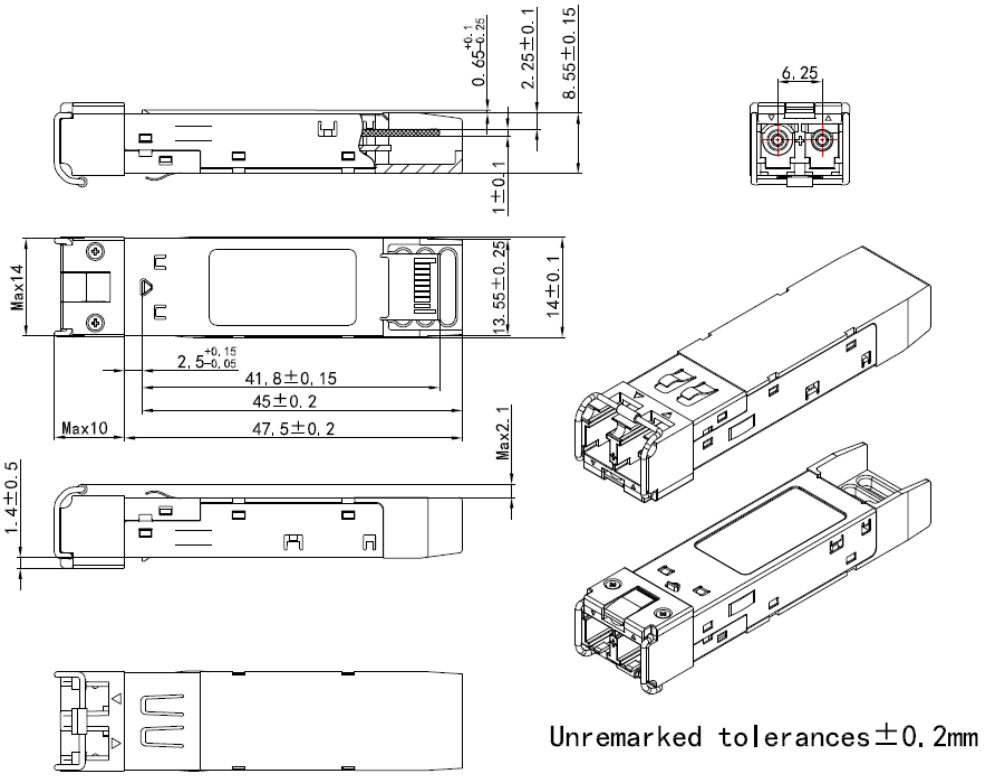
| | | | | | |
|---|---|---|---|---|---|
| 50 | | | | 0 | 30 |
| 51 | | | | 2 | 32 |
| 52 | | | | - | 2D |
| 53 | | | | I/<space> | 49/20 |
| 54 | | | | <space> | 20 |
| 55 | | | | <space> | 20 |
| 56 | 4 | Vendor rev | Revision level for part number provided by vendor (ASCII) | 1 | 31 |
| 57 | | | | . | 2E |
| 58 | | | | 0 | 30 |
| 59 | | | | <space> | 20 |
| 60 | 2 | Wavelength | Laser Wavelength | 850nm | 05 |
| 61 | | | | | 32 |
| 62 | 1 | Reserved | | | 00 |
| 63 | 1 | CC_BASE | Check code for Base ID Fields (addresses 0 to 62) | Note5 | xx |
| 64 | 2 | Options | Indicates which optional transceiver signals are implemented | TX_DISABLE, TX_FAULT signal,Rx_LOS | 00 |
| 65 | | | | | 1A |
| 66 | 1 | BR, max | Upper bit rate margin, units of % | | 00 |
| 67 | 1 | BR, min | Lower bit rate margin, units of % | | 00 |
| 68 | 16 | Vendor SN | Serial number provided by vendor (ASCII) | x | xx |
| 69 | | | | x | xx |
| 70 | | | | x | xx |
| 71 | | | | x | xx |
| 72 | | | | x | xx |
| 73 | | | | x | xx |
| 74 | | | | x | xx |
| 75 | | | | x | xx |
| 76 | | | | x | xx |
| 77 | | | | x | xx |
| 78 | | | | <space> | 20 |
| 79 | | | | <space> | 20 |
| 80 | | | | <space> | 20 |
| 81 | | | | <space> | 20 |
| 82 | | | | <space> | 20 |
| 83 | | | | <space> | 20 |
| 84 | 8 | Date code | Vendor's manufacturing date code | Year | xx |
| 85 | | | | Year | xx |
| 86 | | | | Month | xx |
| 87 | | | | Month | xx |

| | | | | | |
|---|---|---|---|---|---|
| 88 | | | | Day | xx |
| 89 | | | | Day | xx |
| 90 | | | | <Space> | 20 |
| 91 | | | | <Space> | 20 |
| 92 | 1 | Diagnostic Monitoring Type | Type of diagnostic monitoring is implemented | DD Implemented; Internally Calibrated; Average Power | 68 |
| 93 | 1 | Enhanced Options | Optional enhanced features are implemented | Optional Alarm/warning Flags Implemented,Optional soft TX_FAULT monitoring,Optional soft RX_LOS monitoring | B0 |
| 94 | 1 | SFF-8472 Compliance | Revision of SFF-8472 the transceiver complies with | Rev 10.2 of SFF-8472. | 03 |
| 95 | 1 | CC_EXT | Check code for the Extended ID Fields (addresses 64 to 94) | Note6 | |
| **Note5**: The check code shall be the low order 8 bits of the sum of the contents of all the bytes from byte 0 to byte 62, inclusive. | | | | | |
| **Note6**: The check code shall be the low order 8 bits of the sum of the contents of all the bytes from byte 64 to byte 94, inclusive. | | | | | |

## Recommend Circuit Schematic




## Mechanical Specifications




*This 2D drawing only for reference, please check with Eoptolink before ordering

## Eye Safety

This single-mode transceiver is a Class 1 laser product. It complies with IEC-60825 and FDA 21 CFR 1040.10 and 1040.11. The transceiver must be operated within the specified temperature and voltage limits. The optical ports of the module shall be terminated with an optical connector or with a dust plug.

## Obtaining Document

You can visit our website:

http://www.eoptolink.com

Or contact Eoptolink Technology Inc., Ltd. Listed at the end of the documentation to get the latest documents.

## Revision History

| Revision | Initiate | Review | Approve | Revision History | Release Date |
|---|---|---|---|---|---|
| V1.a | Tim | Kelly | | Released | 2008-9-13 |
| V1.b | Phlio | Kelly | | Adding the suitable applications. | 2009-7-17 |
| V1.c | Kelly | | | Change the logo. | 2010-1-4 |
| V1.d | Cathy | | | Update the low operating case temperature. | 2010-7-15 |
| V1.e | Cathy | | | Updated receiver sensitivity. | 2011-4-8 |
| V1.f | Kelly | | | Updating the extended type. | 2011-5-13 |
| V2.0 | Alex/ Twonie | Kelly | | Update part name | Aug 10, 2011 |
| V2.a | Townie | Kelly | | Add power dissipation. | Aug 23, 2011 |
| V2.b | Kelly | | | Add dispersion tolerance. | Sep 6, 2011 |
| V2.c | Kelly | | | Update SR/SW rate. | July 11, 2012 |
| V2.d | Angela | Kelly | | Update the part number for extended range. | July 19, 2012] |
| V2.e | Angela, | Kelly | | Update pin definition notes | Jan 30, 2013 |
| V2.f | Angela | Kelly | | Add CPRI&OBSAI application | June 18, 2013 |
| V2.g | Angela | Vina/Fing/ Jp/Eason/ Jason | | Add industrial temperature range. Update max data rate, regulatory compliance and the tolerances of 2D drawing. | April 21,2015 |
| V2.h | Angela | | | Update a slip of the pen. | July 8,2015 |
| V2.i | Angela | Kelly | | Update the regulatory compliance and corrected some slip of the pen. | April 14,2016 |
| V2.j | Angela | Kelly/Vina | | Update the CPRI data rates | July 17, 2017 |

| | | | | | |
|---|---|---|---|---|---|
| | | /Dean/ Chao.Wang | | and 2D drawing. | |
| V2.k | Angela/ Yi.Wan | Young | | Add the EEPROM contents of A0h. | August 11, 2017 |
| V2.l | Elaine | Kelly/Marvin/ Fing | | Add the extended temperature and update the contact. | Jan 23, 2018 |
| V2.m | Angela | Kelly/Fing/ JP/Eason/ William/ Chao.Wang | Phlio | Update the RS0/RS1 Pin function definition notes. Update the picture and 2D drawing. | March 23, 2018 |
| V2.n | Angela | Kelly | | Updated the regulatory compliance. | August 27, 2018 |
| V2.o | Nico | Marvin/Kelly/ Angela/Yi Wan | | Add the parameter of stressed receiver sensitivity(OMA). Changed the “receiver sensitivity” to “receiver sensitivity(OMA)” . Updated the regulatory compliance. | Jul 18, 2019 |

## Notice:

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## Contact:

Add: No.127 West Wulian Street, Gongxing Town, Shuangliu district, Chengdu City, Sichuan, China.

Tel: (+86) 028-67087999

Fax: (+86) 28-67087979-8010

Postal: 610213

E-mail: sales@eoptolink.com

http://www.eoptolink.com