

SFP-10GB-DW-C-E-C

MSA and TAA 10GBase-DWDM 100GHz SFP+ Transceiver (SMF, Tunable, 80km, LC, DOM, -20 to 85C)

Features:

- Small Form Factor Pluggable WDM Optical Transceiver from 191.3 to 196.3THz with 100GHz Spacing
- Self-Tuning Function Enables Automatic Link-Up
- 10G Electrical Interface (SFF-8418)
- Up to 80km Over SMF (ITU-T G.652)
- Loss of Signal (LOS) Function
- Operating Data Rate: 9.83 to 10.31Gbps
- LC Connector Interface
- Single Voltage 3.3V Power Supply
- Hot-Pluggable Electrical Interface
- Operating Temperature: -20 to 85 Celsius, -40C Cold Start
- RoHS Compliant and Lead-Free



Applications:

- 10GBase Ethernet

Product Description

This MSA Compliant SFP+ transceiver provides 10GBase-DWDM throughput up to 80km over single-mode fiber (SMF) using a tunable wavelength via an LC connector. It is built to MSA standards and is uniquely serialized and data-traffic and application tested to ensure that they will integrate into your network seamlessly. Digital optical monitoring (DOM) support is also present to allow access to real-time operating parameters. This transceiver is Trade Agreements Act (TAA) compliant. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

ProLabs' transceivers are RoHS compliant and lead-free.

TAA refers to the Trade Agreements Act (19 U.S.C. & 2501-2581), which is intended to foster fair and open international trade. TAA requires that the U.S. Government may acquire only "U.S. – made or designated country end products."



ITU Channel Wavelength Guide

| ITU Channel | Frequency (THz) | Center Wavelength (nm) | ITU Channel | Frequency (THz) | Center Wavelength (nm) |
|-------------|-----------------|------------------------|-------------|-----------------|------------------------|
| 13 | 191.30 | 1567.13 | 39 | 193.90 | 1546.12 |
| 14 | 191.40 | 1566.31 | 40 | 194.00 | 1545.32 |
| 15 | 191.50 | 1565.50 | 41 | 194.10 | 1544.53 |
| 16 | 191.60 | 1564.68 | 42 | 194.20 | 1543.73 |
| 17 | 191.70 | 1563.86 | 43 | 194.30 | 1542.94 |
| 18 | 191.80 | 1563.05 | 44 | 194.40 | 1542.14 |
| 19 | 191.90 | 1562.23 | 45 | 194.50 | 1541.35 |
| 20 | 192.00 | 1561.42 | 46 | 194.60 | 1540.56 |
| 21 | 192.10 | 1560.61 | 47 | 194.70 | 1539.77 |
| 22 | 192.20 | 1559.79 | 48 | 194.80 | 1538.98 |
| 23 | 192.30 | 1558.98 | 49 | 194.90 | 1538.19 |
| 24 | 192.40 | 1558.17 | 50 | 195.00 | 1537.40 |
| 25 | 192.50 | 1557.36 | 51 | 195.10 | 1536.61 |
| 26 | 192.60 | 1556.56 | 52 | 195.20 | 1535.82 |
| 27 | 192.70 | 1555.75 | 53 | 195.30 | 1535.04 |
| 28 | 192.80 | 1554.94 | 54 | 195.40 | 1534.25 |
| 29 | 192.90 | 1554.13 | 55 | 195.50 | 1533.47 |
| 30 | 193.00 | 1553.33 | 56 | 195.60 | 1532.68 |
| 31 | 193.10 | 1552.52 | 57 | 195.70 | 1531.90 |
| 32 | 193.20 | 1551.72 | 58 | 195.80 | 1531.12 |
| 33 | 193.30 | 1550.92 | 59 | 195.90 | 1530.33 |
| 34 | 193.40 | 1550.12 | 60 | 196.00 | 1529.55 |
| 35 | 193.50 | 1549.32 | 61 | 196.10 | 1528.77 |
| 36 | 193.60 | 1548.52 | 62 | 196.20 | 1527.99 |
| 37 | 193.70 | 1547.72 | 63 | 196.30 | 1527.22 |
| 38 | 193.80 | 1546.92 | | | |

Absolute Maximum Ratings

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|------------------------------------|------------------|-------------------------|------|---------|------|----------|
| Relative Humidity (Non-Condensing) | | 5 | | 85 | % | |
| Operating Case Temperature | T _c | -20 | | 85 | °C | 1 |
| Storage Temperature | T _{stg} | -40 | | 85 | °C | |
| Supply Voltage | V | -0.3 | | 3.6 | | |
| Data Rate | Gbps | 9.8304 | | 10.3125 | | ± 100ppm |
| Ambient Humidity (Non-Condensing) | % | 5 | | 85 | | |
| Modulation Type | | 8B/10B, 64B/66B (NRZ) | | | | 2 |
| Transmission Cable | | SMF (ITU-T G.6520) 80km | | | | |

Notes:

1. Cold start temperature: -40°C.
2. 9.83, 10.31Gbps.

Electrical Characteristics

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|--|--------|-------|------|-----------------------|------------------|-------|
| Voltage on LVTTTL Input | | -0.3 | | V _{cc} +0.3 | V | |
| Tx Input Data Signal Levels (AC Coupled) | | | | 1.2 | V _{ppd} | |
| Static Discharge Voltage HBM Per JEDEC JESD22-A224-B | | -1000 | | 1000 | V | |
| | | -2000 | | 2000 | | |
| Peak Optical Input Power | | | | -6 | dBm | |
| Power Supply Voltage | | 3.14 | 3.3 | 3.46 | V _{cc} | |
| Power Consumption | | | | 2.5 | W | |
| Low-Speed Electrical Interface | | | | | | |
| Tx_Fault, Rx_LOS | VOL | -0.3 | | 0.4 | V | 1 |
| | IOH | -50 | | 37.5 | uA | |
| Tx_Disable, RS0, RS1 | VIL | -0.3 | | 0.8 | V | |
| | VIH | 2.0 | | V _{cc} T+0.3 | V | |

Notes:

1. Positive values indicate current flowing into the module. At 0.7mA.

Optical Characteristics

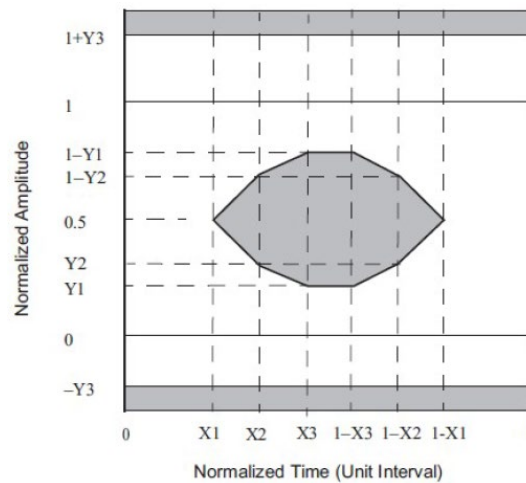
| Parameter | Symbol | Min. | Typ. | Max. | Unit | Notes |
|------------------------------------|-----------------|----------------------|------|-------|------|-------|
| Transmitter | | | | | | |
| Center Frequency Range | FR | 191.3 | | 196.3 | THz | |
| Central Frequency Accuracy (EOL) | | -12.5 | | 12.5 | GHz | |
| Frequency Spacing | | | 100 | | GHz | |
| Side-Mode Suppression Ratio | SMSR | 30 | | | dB | |
| Spectral Width (-20dB) | $\Delta\lambda$ | | | 1 | nm | |
| Average Optical Power | Pavg | -1 | | 3 | dBm | |
| Extinction Ratio | ER | 8.2 | | | dB | |
| Average Launch Power of Tx_Disable | | | | -30 | dBm | |
| Optical Return Loss Tolerance | ORL | | | 20 | dB | |
| Transmitter Reflectance | TR | | | -12 | dB | |
| Transmitter Eye Mask | | Transmitter Eye Mask | | | | 1 |
| Receiver | | | | | | |
| Center Frequency Range | FR | 191.3 | | 196.3 | THz | |
| Rx Sensitivity in Average | Pr_Avg | | | -24 | dBm | 2 |
| | | | | -21 | dBm | 3 |
| Rx Overload in Average | OL | -7 | | | dBm | 2 |

| | | | | | | |
|----------------------|------|-----|--|-----|-----|--|
| Receiver Reflectance | RR | | | -27 | dB | |
| LOS Assert Level | LOSA | -32 | | | dBm | |
| LOS De-Assert Level | LOSD | | | -25 | dB | |
| LOS Hysteresis | LOSH | 0.5 | | | dB | |

Notes:

1. 9.8304Gbps to 10.3125Gbps, PRBS31 NRZ, 10GBase-LR mask and filter, at least 500 waveforms, and Hit Ratio meets the standard of $1E^{-12}$ under margin.
2. 10.3125Gbps, PRBS31 NRZ, ER>8.2dB, and BER= $1E^{-12}$, back-to-back.
3. 10.3125Gbps, PRBS31 NRZ, ER>8.2dB, BER= $1E^{-12}$, CD=1400ps/nm, and OSNR>35dB.

Transmitter Eye Mask



$$\{X1, X2, X3, Y1, Y2, Y3\} = \{0.25, 0.40, 0.45, 0.25, 0.28, 0.40\}$$

Timing Specifications

| Parameter | Symbol | Min. | Max. | Unit | Notes |
|---|--------------------|------|------|------|-------|
| Tx_Disable Assert Time | T_off | | 100 | us | 1 |
| Tx_Disable Negate Time | T_on | | 2 | ms | 2 |
| Time to Initialize Cooled Module & Time to Power-Up a Cooled Module to Power Level II | T_start_up_cooled | | 90 | s | 3 |
| Tx_Fault Assert for Cooled Module | Tx_fault_on_cooled | | 50 | ms | 4 |
| Tx_Fault Reset | T_reset | 10 | | us | 5 |
| RS0, RS1: Rate Select Timing for Low Input | T_RS0_L, T_RS1_L | | N/A | | 6 |
| RS0, RS1: Rate Select Timing for High Input | T_RS0_H, T_RS1_H | | N/A | | 6 |
| Rx_LOS Assert Delay | T_los_on | | 100 | | 7 |
| Rx_LOS Negate Delay | T_los_off | | 20 | | 8 |
| Wavelength Tuning Time | T_wave_change | 3 | 10 | | 9 |

Notes:

1. Rising edge of Tx_Disable to fall of output signal below 10% of normal.
2. Falling edge of Tx_Disable to rise of output signal above 90% of nominal. This only applies in normal operation, not during start-up or fault recovery.
3. From power on or hot plug, or Tx_Disable negated during power-up or Tx_Fault recovery, until cooled Power Level I part (or cooled Power Level II part during fault recovery) is fully operational. Also, from stop bit low-to-high SDA transition enabling Power Level II until cooled module is fully operational.
4. From occurrence of fault to assertion of Tx_Fault.
5. Time Tx_Disable must be held "high" to reset Tx_Fault.
6. From assertion until stable output.
7. From occurrence of loss of signal to assertion of Rx_LOS.
8. From occurrence of presence of signal to negation of Rx_LOS.
9. From writing of wavelength set command to completion of the wavelength tuning and output signal above 90%.

Two-Wire I/O

| Parameter | Symbol | Min. | Max. | Unit | Notes |
|--|--------------|------|------|-------|-------|
| Clock Frequency | fSCL | 0.1 | 400 | KHz | 1 |
| Clock Pulse Width - Low | tLOW | 1.3 | | us | |
| Clock Pulse Width - High | tHIGH | 0.6 | | us | |
| START Hold Time | tHD:STA | 0.6 | | us | |
| START Set-Up Time | tSU:STA | 0.6 | | us | |
| Data In Hold Time | tHD:DAT | 0 | | ns | |
| Data In Set-Up Time | tSU:DAT | 100 | | ns | |
| Input Rise Time (100KHz) from (VIL, Max.-0.15) to (VIH, Min.+0.15) | Tr,100 | | 1000 | ns | |
| Input Rise Time (400KHz) from (VIL, Max.-0.15) to (VIH, Min.+0.15) | Tr,400 | | 300 | ns | |
| Input Fall Time (100KHz) from (VIH, Min.+0.15) to (VIL, Max.-0.15) | Tf,100 | | 300 | ns | |
| Input Fall Time (400KHz) from (VIH, Min.+0.15) to (VIL, Max.-0.15) | Tf,400 | | 300 | ns | |
| STOP Set-Up Time | tSU:STO | 0.6 | | us | |
| Time Bus is Free Before a New Transmission Can Start | tBUF | 20 | | us | |
| Time to Initialize | T_init | | 300 | ms | |
| Clock Stretching | T_clock_hold | | 500 | us | |
| Complete Single or Sequential Write Up to 4 Byte | tWR | | 40 | ms | |
| Complete Sequential Write of 5-8 Bytes | tWR | | 80 | ms | |
| Endurance of User Writable EEPROM (Write Cycles) | | 10k | | cycle | |

Notes:

1. The module shall operate with fSCL up to 100kHz without requiring clock stretching. The module may clock stretch with fSCL greater than 100kHz and up to 400kHz.

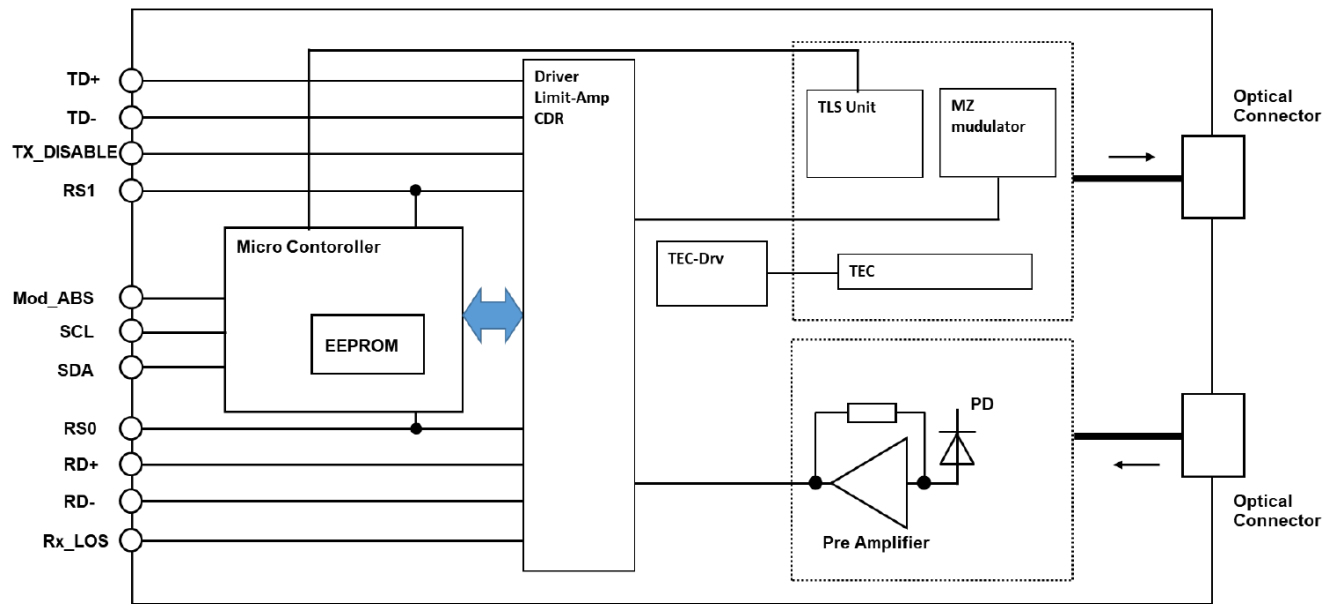
Pin Descriptions

| Pin | Symbol | Name/Description | Plug Seq. | Notes |
|-----|------------|--------------------------------------|-----------|-------|
| 1 | VeeT | Transmitter Ground. | 1 | |
| 2 | Tx_Fault | Transmitter Fault Indication. | 3 | |
| 3 | Tx_Disable | Transmitter Disable. | 3 | |
| 4 | SDA | 2-Wire Serial Interface Data. | 3 | |
| 5 | SCL | 2-Wire Serial Interface Clock. | 3 | |
| 6 | MOD_ABS | Module Absent. | 3 | |
| 7 | RS0 | Rate Select 0. Optionally controls. | 3 | |
| 8 | Rx_LOS | Receiver Loss of Signal Indication. | 3 | |
| 9 | RS1 | Rate Select 1. Optionally controls. | 3 | |
| 10 | VeeR | Receiver Ground. | 1 | |
| 11 | VeeR | Receiver Ground. | 1 | |
| 12 | RD- | Receiver Inverted Data Output. | 3 | |
| 13 | RD+ | Receiver Non-Inverted Data Output. | 3 | |
| 14 | VeeR | Receiver Ground. | 1 | |
| 15 | VccR | Receiver 3.3V Supply. | 2 | |
| 16 | VccT | Transmitter 3.3V Supply. | 2 | |
| 17 | VeeT | Transmitter Ground. | 1 | |
| 18 | TD+ | Transmitter Non-Inverted Data Input. | 3 | |
| 19 | TD- | Transmitter Inverted Data Input. | 3 | |
| 20 | VeeT | Transmitter Ground. | 1 | |

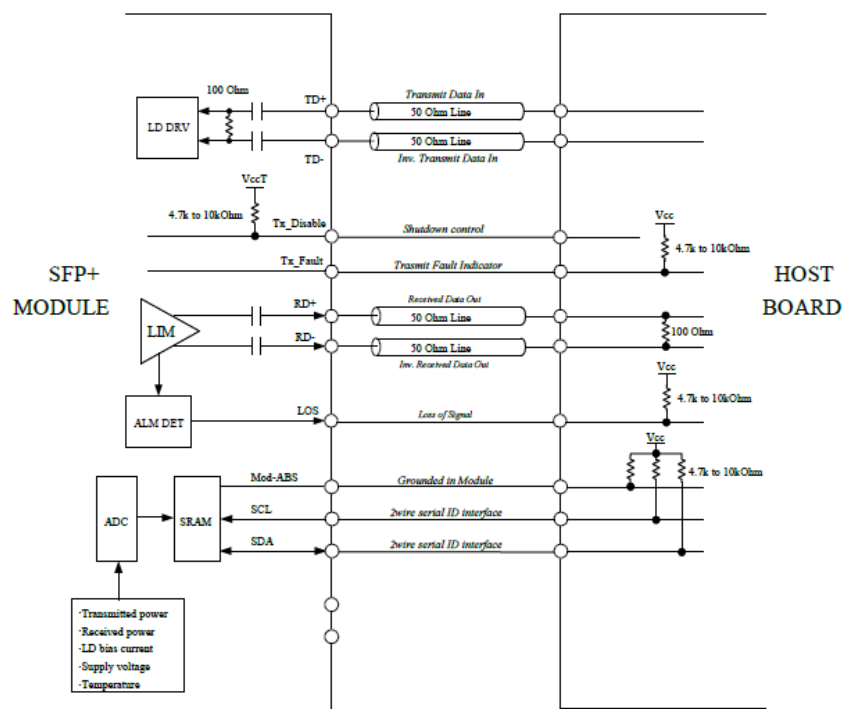
Notes:

1. The case makes electrical contact to the cage before any of the board edge contacts are made.
2. The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.
3. SCL, SDA, and MOD_ABS should be pulled up with a 4.7k Ω to 10k Ω resistor on the host board.
The pull-up voltage shall be VccT or VccR.
SCL is the clock line of the 2-wire serial interface for serial ID.
SDA is the data line of the 2-wire serial interface for serial ID.
MOD_ABS is grounded by the module to indicate that the module is present.
4. VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V \pm 5% at the SFP+ connector pin. Recommended host board power supply filtering is shown below.
5. TD- and TD+ are the differential transmitter inputs. They are AC coupled, differential lines with 100 Ω differential termination inside the module.
6. RD- and RD+ are the differential receiver outputs. They are AC coupled, 100 Ω differential lines which should be terminated with 100 Ω (differential) at the host.

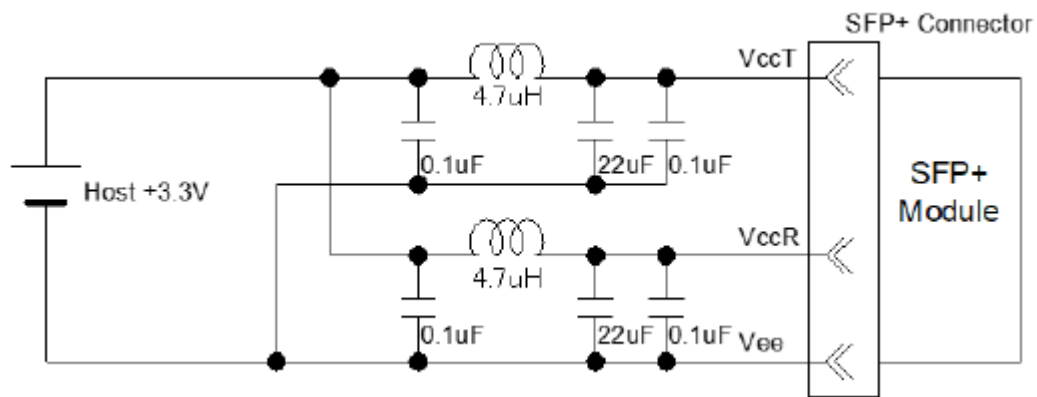
Block Diagram of the Transceiver



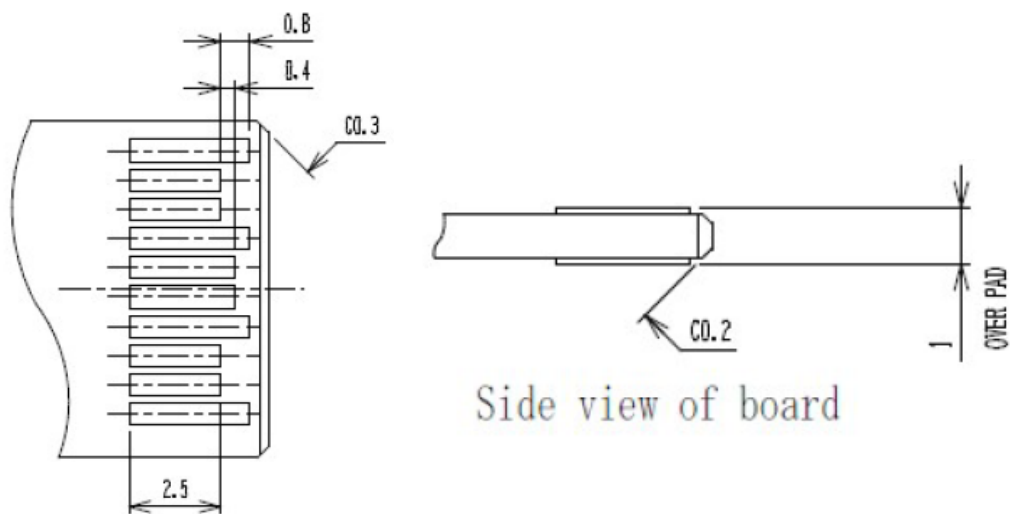
Recommended Interface Circuit



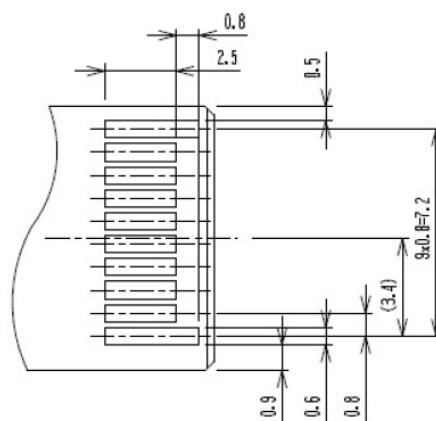
Power Supply Filter



Circuit Board Connector Layout

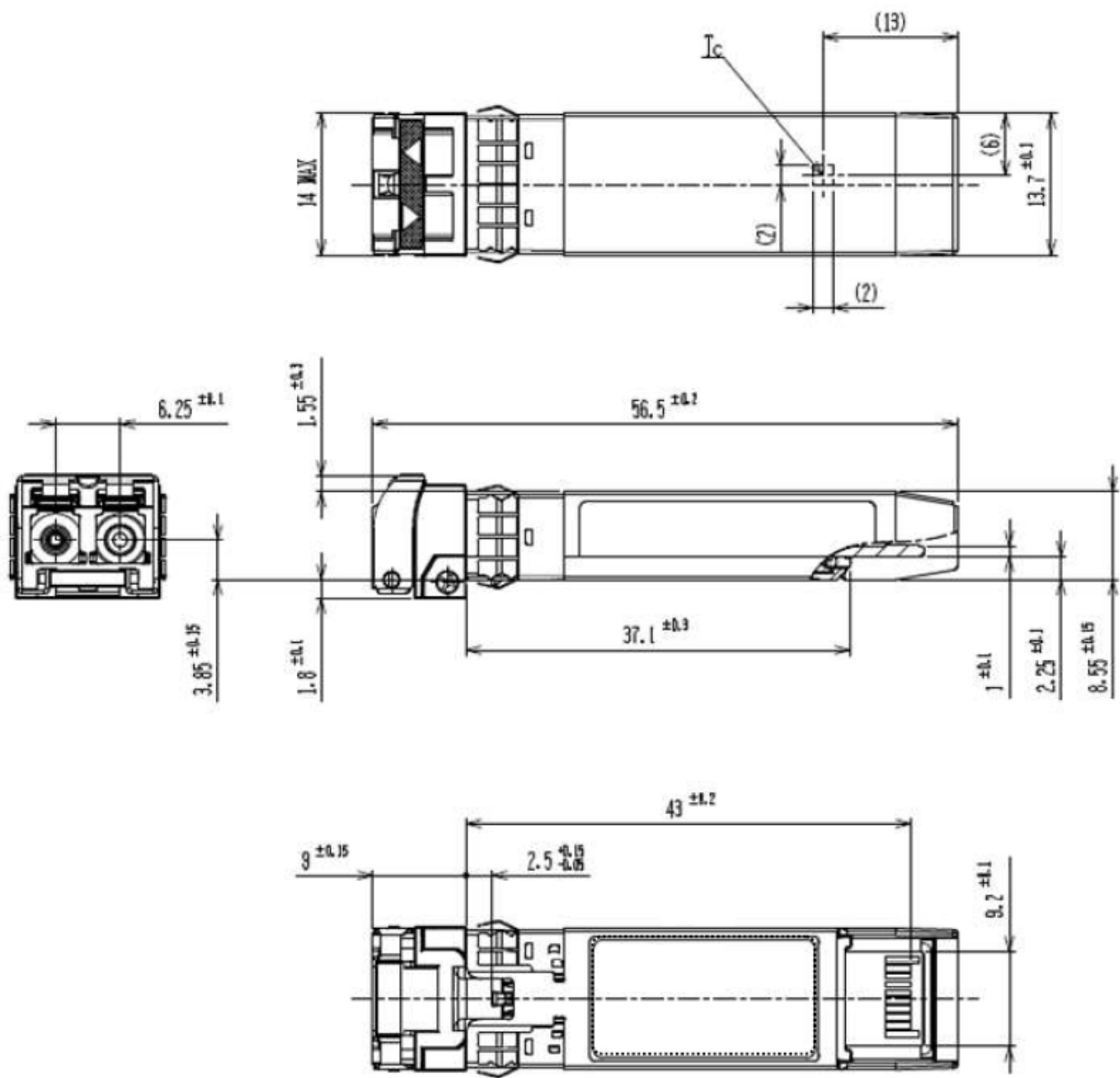


Top view of board



Bottom view of board

Mechanical Specifications



About ProLabs

Our experience comes as standard; for over 15 years ProLabs has delivered optical connectivity solutions that give our customers freedom and choice through our ability to provide seamless interoperability. At the heart of our company is the ability to provide state-of-the-art optical transport and connectivity solutions that are compatible with over 90 optical switching and transport platforms.

Complete Portfolio of Network Solutions

ProLabs is focused on innovations in optical transport and connectivity. The combination of our knowledge of optics and networking equipment enables ProLabs to be your single source for optical transport and connectivity solutions from 100Mb to 400G while providing innovative solutions that increase network efficiency. We provide the optical connectivity expertise that is compatible with and enhances your switching and transport equipment.

Trusted Partner

Customer service is our number one value. ProLabs has invested in people, labs and manufacturing capacity to ensure that you get immediate answers to your questions and compatible product when needed. With Engineering and Manufacturing offices in the U.K. and U.S. augmented by field offices throughout the U.S., U.K. and Asia, ProLabs is able to be our customers best advocate 24 hours a day.



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