

### **SFP-25GB-DW-C-A1-15-I-OPC**

MSA and TAA 25GBase-DWDM SFP28 Transceiver C-Band 100GHz (SMF, Auto-Tunable, 15km, LC, DOM, -40 to 85C)

#### **Features**

- Retimed Data Rate 24.33-25.78Gbps
- Un-Retimed Data Rates Greater Than 1.2Gbps are Supported
- SFF-8432 and SFF-8472 Compliance
- Duplex LC Connector
- ITU-T C-Band 100GHz Spacing
- SmartTune MSA is Supported for Self-Tuning
- Industrial Temperature: -40 to 85 Celsius
- Single-Mode Fiber
- Hot Pluggable
- Excellent ESD Protection
- RoHS Compliant and Lead-Free



#### **Applications:**

- 25x Gigabit Ethernet over DWDM
- Access, Metro and Enterprise

#### **Product Description**

This MSA compliant SFP28 transceiver provides 25GBase-DWDM throughput up to 15km over single-mode fiber (SMF) using a auto-tunable wavelength via an LC connector. It is capable of withstanding rugged environments and can operate at temperatures between -40 and 85C. All of our transceivers are built to comply with Multi-Source Agreement (MSA) standards and are uniquely serialized and tested for data-traffic and application to ensure seamless network integration. Additional product features include Digital Optical Monitoring (DOM) support which allows 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.

OptioConnect's transceivers are RoHS compliant and lead-free.

### DWDM Wavelength ITU Channels - 100GHz Spacing

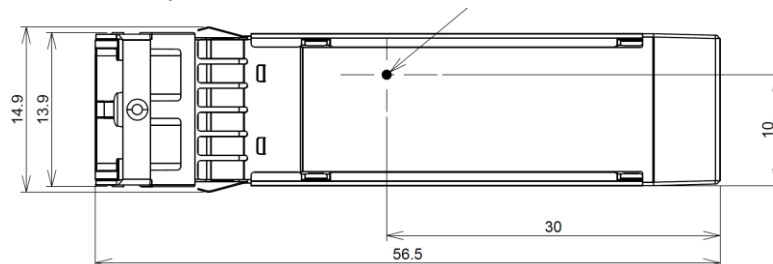
| ITU Channel | Center Wavelength (nm) | Frequency (THz) | ITU Channel | Center Wavelength (nm) | Frequency (THz) |
|-------------|------------------------|-----------------|-------------|------------------------|-----------------|
| 14          | 1566.31                | 191.4           | 38          | 1546.92                | 193.8           |
| 15          | 1565.50                | 191.5           | 39          | 1546.12                | 193.9           |
| 16          | 1564.68                | 191.6           | 40          | 1545.32                | 194.0           |
| 17          | 1563.86                | 191.7           | 41          | 1544.53                | 194.1           |
| 18          | 1563.05                | 191.8           | 42          | 1543.73                | 194.2           |
| 19          | 1562.23                | 191.9           | 43          | 1542.94                | 194.3           |
| 20          | 1561.42                | 192.0           | 44          | 1542.14                | 194.4           |
| 21          | 1560.61                | 192.1           | 45          | 1541.35                | 194.5           |
| 22          | 1559.79                | 192.2           | 46          | 1540.56                | 194.6           |
| 23          | 1558.98                | 192.3           | 47          | 1539.77                | 194.7           |
| 24          | 1558.17                | 192.4           | 48          | 1538.98                | 194.8           |
| 25          | 1557.36                | 192.5           | 49          | 1538.19                | 194.9           |
| 26          | 1556.55                | 192.6           | 50          | 1537.4                 | 195.0           |
| 27          | 1555.75                | 192.7           | 51          | 1536.61                | 195.1           |
| 28          | 1554.94                | 192.8           | 52          | 1535.82                | 195.2           |
| 29          | 1554.13                | 192.9           | 53          | 1535.04                | 195.3           |
| 30          | 1553.33                | 193.0           | 54          | 1534.25                | 195.4           |
| 31          | 1552.52                | 193.1           | 55          | 1533.47                | 195.5           |
| 32          | 1551.72                | 193.2           | 56          | 1532.68                | 195.6           |
| 33          | 1550.92                | 193.3           | 57          | 1531.9                 | 195.7           |
| 34          | 1550.12                | 193.4           | 58          | 1531.12                | 195.8           |
| 35          | 1549.32                | 193.5           | 59          | 1530.33                | 195.9           |
| 36          | 1548.51                | 193.6           | 60          | 1529.55                | 196.0           |
| 37          | 1547.72                | 193.7           | 61          | 1528.77                | 196.1           |

### Absolute Maximum Ratings

| Parameter                  | Symbol            | Min. | Typ. | Max. | Unit | Notes   |
|----------------------------|-------------------|------|------|------|------|---------|
| Maximum Supply Voltage     | V <sub>ccT</sub>  | 0    |      | +3.6 | V    | +3.3V   |
| Maximum Supply Voltage     | V <sub>ccR</sub>  | 0    |      | +3.6 | V    | +3.3V   |
| Optical Receiver Input     | P <sub>IMAX</sub> |      |      | +5   | dBm  | Average |
| Storage Temperature        | T <sub>stg</sub>  | -40  |      | +85  | °C   |         |
| Operating Case Temperature | T <sub>c</sub>    | -40  |      | +85  | °C   | 1       |
| ESD SFI Pins               | ESD1              |      |      | 1    | KV   | HBM     |
| ESD Except for SFI Pins    | ESD2              |      |      | 2    | KV   | HBM     |

### Notes:

- Case temperature reference point is shown below:



## Electrical Characteristics

| Parameter                                      | Symbol | Min.              | Typ. | Max.  | Unit | Notes |
|------------------------------------------------|--------|-------------------|------|-------|------|-------|
| Supply Voltage                                 | Vcc    | 3.135             | 3.3  | 3.465 | V    | +3.3V |
| Power Consumption                              |        |                   |      | 2.5   | W    |       |
| Inrush Current                                 |        |                   |      |       |      |       |
| Icc Instantaneous Peak Current                 |        |                   |      | 600   | mA   | 1, 2  |
| Icc Sustained Peak Current                     |        |                   |      | 500   | mA   | 1, 2  |
| Transceiver                                    |        |                   |      |       |      |       |
| Signaling Rate Per Lane (Range)                |        | 25.78125 ± 100ppm |      |       | GBd  |       |
| AC Common-Mode Output Voltage                  | RMS    |                   |      | 17.5  | mV   |       |
| Differential Output Voltage                    |        |                   |      | 900   | mV   |       |
| Eye Width                                      | EW8    | 0.57              |      |       | UI   |       |
| Eye Height (Differential)                      | EH8    | 228               |      |       | mV   |       |
| Vertical Eye Closure                           | VEC8   |                   |      | 5     | dB   |       |
| Differential Output Return Loss                |        | Equation (83E-2)  |      |       | dB   |       |
| Common- to Differential-Mode Conversion Return |        | Equation (83E-3)  |      |       | dB   |       |
| Differential Termination Mismatch              |        |                   |      | 10    | %    |       |
| Transition Time (20-80%)                       |        | 12                |      |       | ps   |       |
| DC Common-Mode Voltage                         |        | -350              |      | 2850  | mV   | 3     |
| Receiver                                       |        |                   |      |       |      |       |
| Signaling Rate Per Lane (Range)                | TP1    | 25.78125 ± 100ppm |      |       | GBd  |       |
| Differential Pk-Pk Input Voltage Tolerance     | TP1a   | 900               |      |       | mV   |       |
| Differential Input Return Loss                 | TP1    | Equation (83E-5)  |      |       | dB   |       |
| Differential to Common-Mode Input Return Loss  | TP1    | Equation (83E-6)  |      |       | dB   |       |
| Differential Termination Mismatch              | TP1    |                   |      | 10    | %    |       |
| Module Stressed Input Test                     | TP1a   | See 109B.3.4.2    |      |       |      |       |
| Single-Ended Voltage Tolerance Range           | TP1a   | -0.4 to 3.3       |      |       | V    |       |
| DC Common-Mode Voltage                         | TP1    | -350              |      | 2850  | mV   | 3     |

### Notes:

1. The maximum currents are the allowed currents for each power supply VccT or VccR, therefore the total module peak currents can be twice this value. The Instantaneous Peak Current is allowed to exceed the specified maximum current capacity of the connector contact for a short period.
2. Not to exceed the sustained peak limit for more than 50µs - may exceed this limit for shorter durations.
3. DC Common-Mode Voltage is generated by the host. Specification includes the effects of ground offset voltage.

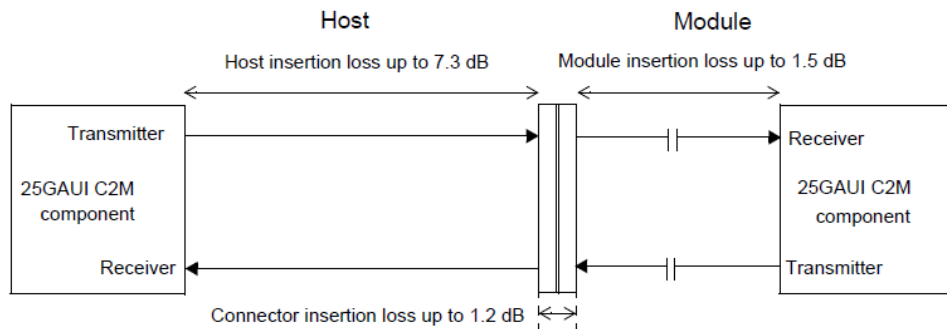
4. Meets BER specified in 109B.3.4.2.

## Optical Characteristics

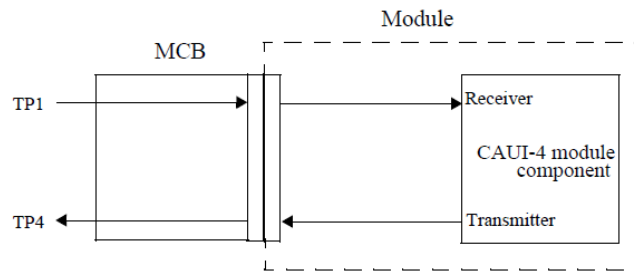
| Parameter                                     | Symbol          | Min.                        | Typ. | Max.          | Unit  | Notes                   |
|-----------------------------------------------|-----------------|-----------------------------|------|---------------|-------|-------------------------|
| <b>Transmitter</b>                            |                 |                             |      |               |       |                         |
| Chromatic Dispersion                          |                 | 0                           |      | 270           | ps/nm |                         |
| Operating Distance 25G                        |                 | 10                          |      | 15            | km    | 1                       |
| Data Rate Retimed                             |                 | 24.33                       |      | 25.78         | Gbps  | NRZ                     |
| Data Rate Un-Retimed                          |                 | 1.2                         |      | 11.3          | Gbps  |                         |
| Wavelength                                    |                 | 1528.773                    |      | 1566.314      | nm    | 2                       |
| Center Wavelength Spacing                     |                 | 100                         |      |               | GHz   |                         |
| Frequency Range                               |                 | 191.40                      |      | 196.1         | THz   |                         |
| Maximum Shift of Center Wavelength            |                 |                             |      | ITU $\pm$ 100 | ppm   | EOL                     |
| Optical Transmit Power                        | Po              | 0                           |      | 4             | dBm   | EOL                     |
| Shuttered Output Power                        |                 |                             |      | -35           | dBm   |                         |
| Optical Power Stability                       | $\Delta P_o$    | -1                          |      | 1             | dB    | All Channels, BOL       |
| Side-Mode Suppression                         | SMSR            | 35                          |      |               | dB    | $\pm 2.5$ nm, Modulated |
| Spectral Width                                | $\Delta\lambda$ |                             | 0.3  | 0.5           | nm    | -20dB, Modulated        |
| Extinction Ratio                              | ER              | 7.5                         |      |               | dB    | Filtered, 25Gbps        |
| Eye Mask                                      |                 | ITU-T G.959.1 NRZ 25G Ratio |      |               |       | 3                       |
| Mask Margin                                   |                 | 10                          |      |               | %     |                         |
| Tuning Speed                                  |                 |                             |      | 150           | ms    | 4                       |
| <b>Receiver</b>                               |                 |                             |      |               |       |                         |
| Data Rate Retimed                             |                 | 24.33                       |      | 25.78         | Gbps  | NRZ                     |
| Data Rate Un-Retimed                          |                 | 1.2                         |      | 11.3          | Gbps  |                         |
| Input Operating Wavelength                    |                 | 1260                        |      | 1620          | nm    | 5                       |
| Minimum Receiver Sensitivity 25G Back-to-Back | Prmin:B2B       | -20                         |      |               | dBm   | 6                       |
| Maximum Input Power (Overload) 25G            | Pro             | -7                          |      |               | dBm   |                         |
| Receiver Reflectance                          | RL              |                             |      | -35           | dB    |                         |
| LOS Assert                                    |                 |                             |      | -27           | dBm   |                         |
| LOS De-Assert                                 |                 |                             |      | -24           | dBm   |                         |
| LOS Hysteresis                                |                 | 0.5                         |      | 5.0           | dB    |                         |
| LOS Assert Time                               |                 |                             |      | 100           | us    |                         |
| LOS De-Assert Time                            |                 |                             |      | 100           | us    |                         |

**Notes:**

1. Maximum pre-FEC bit-error ratio =  $5 \times 10^{-5}$ .
2. 100GHz grid, 48 channels.
3. See G.959.1, Figure 7-4.
4. Warmed-up, from any Ch to any other Ch.
5. Specs guaranteed between 1529.55nm to 1560.61nm.
6. 25.78Gbps,  $5E^{-5}$ , OSNR>35dB.
7. The module electrical characteristics shall conform to the 25GAUI C2M (chip-to-module 25 Gigabit Attachment Unit Interface) in Annex 109B of IEEE Std 802.3, also with reference to Annex 83E the CAUI-4 C2M interface.



25GAUI C2M Insertion Loss Budget at 12.89GHz (IEEE 802.3, Figure 109B-2)



Module 25GAUI Test Points

**Auto Tuning**

The autotuning process is a host-independent scheme 100% compliant with the SmartTune MSA. The transceiver is automatically tuned to the port wavelength of an attached DWDM mux/demux.

## TSFP+ Detail Function Setting

| Parameter                   | Specifications                         |
|-----------------------------|----------------------------------------|
| Rx Interface                | APD, Limiting I/F                      |
| CDR                         | Tx: Not Supported<br>Rx: Not Supported |
| Rx Decision Threshold (RDT) | Adjustable                             |
| Ch Frequency Coverage       | 191.40 to 196.10THz                    |
| Default Ch at Shipping      | Ch 1 (191.40THz)                       |
| Ch After Start-Up           | Persisting Last Saved Ch               |

### Notes:

1. Tx\_Fault is masked during wavelength tuning including at cold/warm start-up.
2. Wavelength switch is feasible when Tx\_Disable is applied.

## SFP+ 2-Wire Interface Timing Requirements

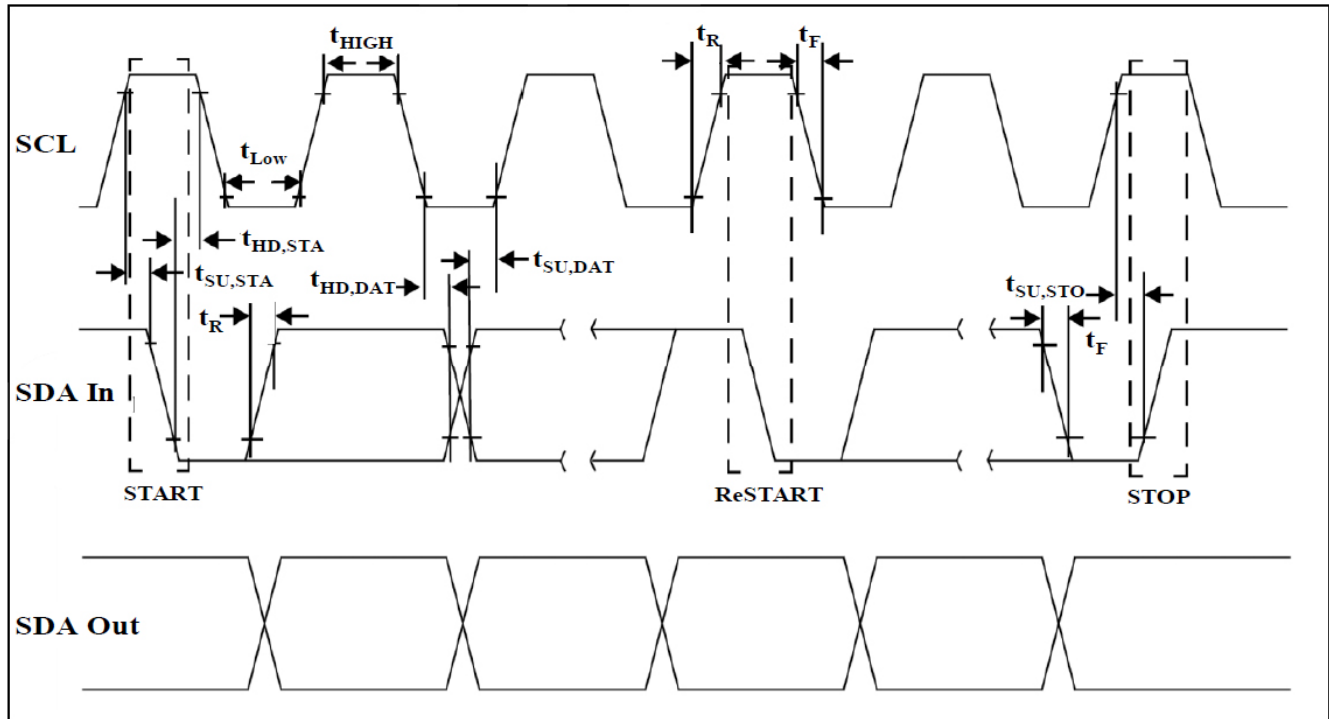
| Parameter                                         | Symbol       | Min. | Max. | Unit   | Conditions             |
|---------------------------------------------------|--------------|------|------|--------|------------------------|
| Clock Frequency                                   | fSCL         | 100  | 400  | kHz    |                        |
| Clock Pulse Width - Low                           | tLOW         | 1.3  |      | μs     |                        |
| Clock Pulse Width - High                          | tHIGH        | 0.6  |      | μs     |                        |
| Time Bus Free Before New Transaction Can Start    | tBUF         | 20   |      | μs     | Between STOP and START |
| START Hold Time                                   | tHD,STA      | 0.6  |      | μs     |                        |
| START Set-Up Time                                 | tSU,STA      | 0.6  |      | μs     |                        |
| Data In Hold Time                                 | tHD,DAT      | 0    |      | μs     |                        |
| Data In Set-Up Time                               | tSU,DAT      | 0.1  |      | μs     |                        |
| Input Rise Time (100kHz)                          | tR,100       |      | 1000 | ns     | 1                      |
| Input Rise Time (400kHz)                          | tR,400       |      | 300  | ns     | 1                      |
| Input Fall Time (100kHz)                          | tF,100       |      | 300  | ns     | 1                      |
| Input Fall Time (400kHz)                          | tF,400       |      | 300  | ns     | 1                      |
| STOP Set-Up Time                                  | tSU,STO      | 0.6  |      | μs     |                        |
| Serial Interface Clock Holdoff "Clock Stretching" | T_clock_hold |      | 500  | μs     | 2                      |
| Complete Single or Sequential Write               | tWR          |      | 40   | ms     | 3                      |
| Endurance (Write Cycles)                          |              | 10k  |      | Cycles | 4                      |

### Notes:

1. From (VIL, MAX – 0.15) to (VIH, MIN + 0.15).
2. Maximum time the SFP+ may hold the SCL line low before continuing R or W operation.

3. Complete (up to) 8-Byte write.
4. At maximum operating temperature.

### SFP+ Timing Diagram



### SFP+ Timing Requirements

| Parameter                                                                               | Symbol             | Min. | Max. | Unit          | Conditions |
|-----------------------------------------------------------------------------------------|--------------------|------|------|---------------|------------|
| Tx_Disable Assert Time                                                                  | T_off              |      | 100  | $\mu\text{s}$ | 1          |
| Tx_Disable Negate Time                                                                  | T_on               |      | 2    | ms            | 2          |
| Time to Initialize 2-Wire Interface                                                     | T_2w_start_up      |      | 300  | ms            | 3          |
| Time to Initialize Cooled Module and Time to Power-Up a Cooled Module to Power Level II | T_start_up_cooled  |      | 90   | sec           | 4          |
| Tx_Fault Assert for a Cooled Module                                                     | Tx_fault_on_cooled |      | 1    | ms            | 5          |
| Tx_Fault_Reset                                                                          | T_reset            | 10   |      | $\mu\text{s}$ | 6          |
| Rx_LOS Assert Delay                                                                     | T_los_on           |      | 100  | $\mu\text{s}$ | 7          |
| Rx_LOS Negate Delay                                                                     | T_los_off          |      | 100  | $\mu\text{s}$ | 8          |

### Notes:

1. Rising edge of Tx\_Disable to fall of output signal below 10% of nominal.
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 after the supply meeting.
4. From power supplies meeting or hot plug, or Tx\_Disable negated during power-up or Tx\_Fault recovery, until 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 the cooled module is fully operational.
5. From occurrence of fault to assertion of Tx\_Fault.
6. Time Tx\_disable must be held high to reset Tx\_Fault.
7. From occurrence of loss of signal to assertion of Rx\_LOS.
8. From occurrence of presence of signal to negation of Rx\_LOS.

## Pin Descriptions

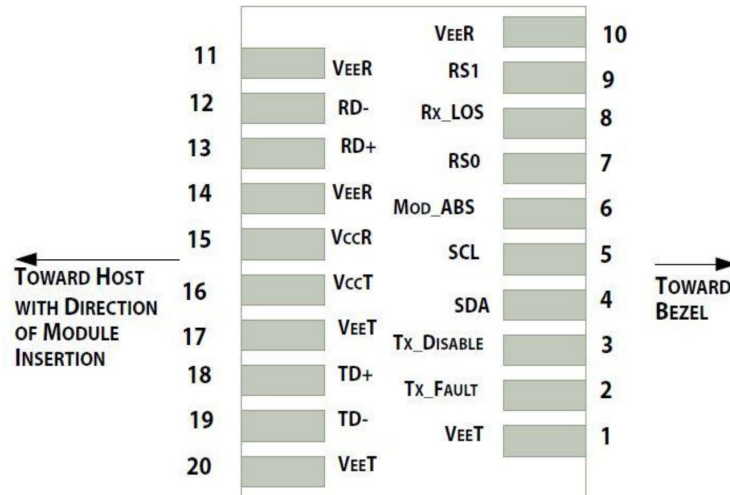
| Pin | Symbol     | Name/Description                                            | Notes |
|-----|------------|-------------------------------------------------------------|-------|
| 1   | VeeT       | Module Transmitter Ground.                                  | 1     |
| 2   | Tx_Fault   | Module Transmitter Fault.                                   | 2     |
| 3   | Tx_Disable | Transmitter Disable. Turn off laser output.                 | 3     |
| 4   | SDA        | 2-Wire Serial Interface Data.                               | 4     |
| 5   | SCL        | 2-Wire Serial Interface Clock.                              | 4     |
| 6   | MOD_ABS    | Module Absent. Connected to the VeeT or VeeR in the module. | 5     |
| 7   | RS0        | N/A. 30kΩ pull-down inside the module.                      |       |
| 8   | Rx_LOS     | Receiver Loss of Signal Indicator.                          | 2     |
| 9   | RS1        | N/A. 30kΩ pull-down inside the module.                      |       |
| 10  | VeeR       | Module Receiver Ground.                                     | 1     |
| 11  | VeeR       | Module Receiver Ground.                                     | 1     |
| 12  | RD-        | Receiver Inverted Data Output (SFI).                        |       |
| 13  | RD+        | Receiver Non-Inverted Data Output (SFI).                    |       |
| 14  | VeeR       | Module Receiver Ground.                                     | 1     |
| 15  | VccR       | +3.3V Receiver Power Supply.                                | 6     |
| 16  | VccT       | +3.3V Transmitter Power Supply.                             | 6     |
| 17  | VeeT       | Module Transmitter Ground.                                  | 1     |
| 18  | TD+        | Transmitter Non-Inverted Data Output (SFI).                 |       |
| 19  | TD-        | Transmitter Inverted Data Output (SFI).                     |       |
| 20  | VeeT       | Module Transmitter Ground.                                  | 1     |

## Notes:

1. The module signal ground pins, VeeR and VeeT, are isolated from the module case.
2. This pin is an open drain output pin and shall be pulled up with 4.7kΩ to 10kΩ to the Host\_Vcc on the host board. Pull-ups can be connected to multiple power supplies; however, the host board design

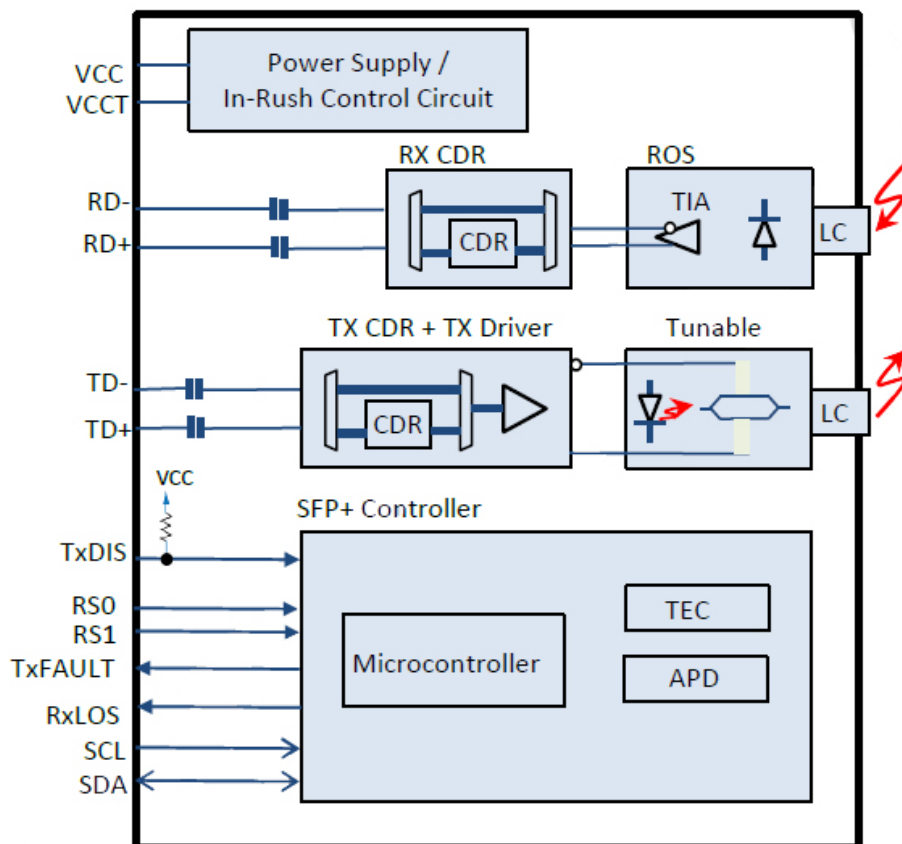
shall ensure that no module pin has voltage exceeding module  $V_{ccT}/R+0.5V$ .

3. This pin is an input pin with 10k $\Omega$  pull-up to the  $V_{ccT}$  in the module.
4. 2-Wire Electrical Specifications.
5. This pin shall be pulled up with 4.7k $\Omega$  to 10k $\Omega$  to the Host\_  $V_{cc}$  on the host board.
6.  $V_{ccT}$  and  $V_{ccR}$  are tied together inside the module.

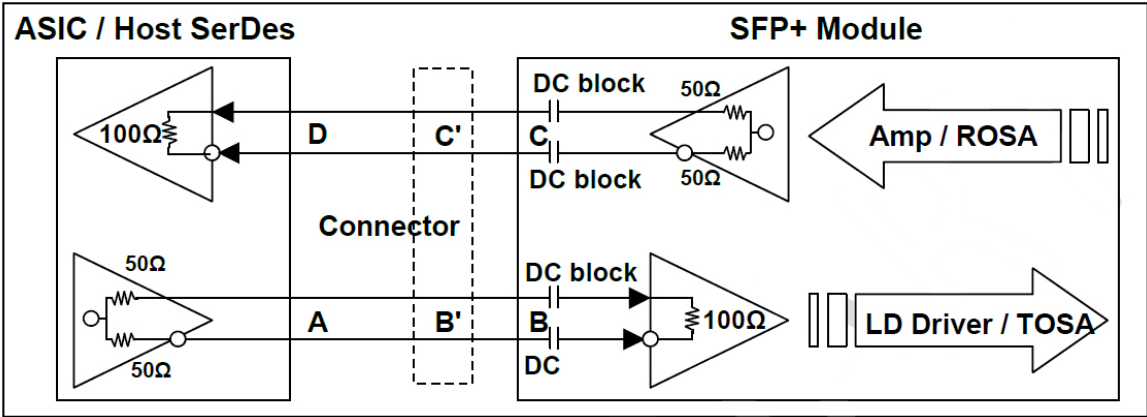


Pin-Out of Connector Block on the Host Board

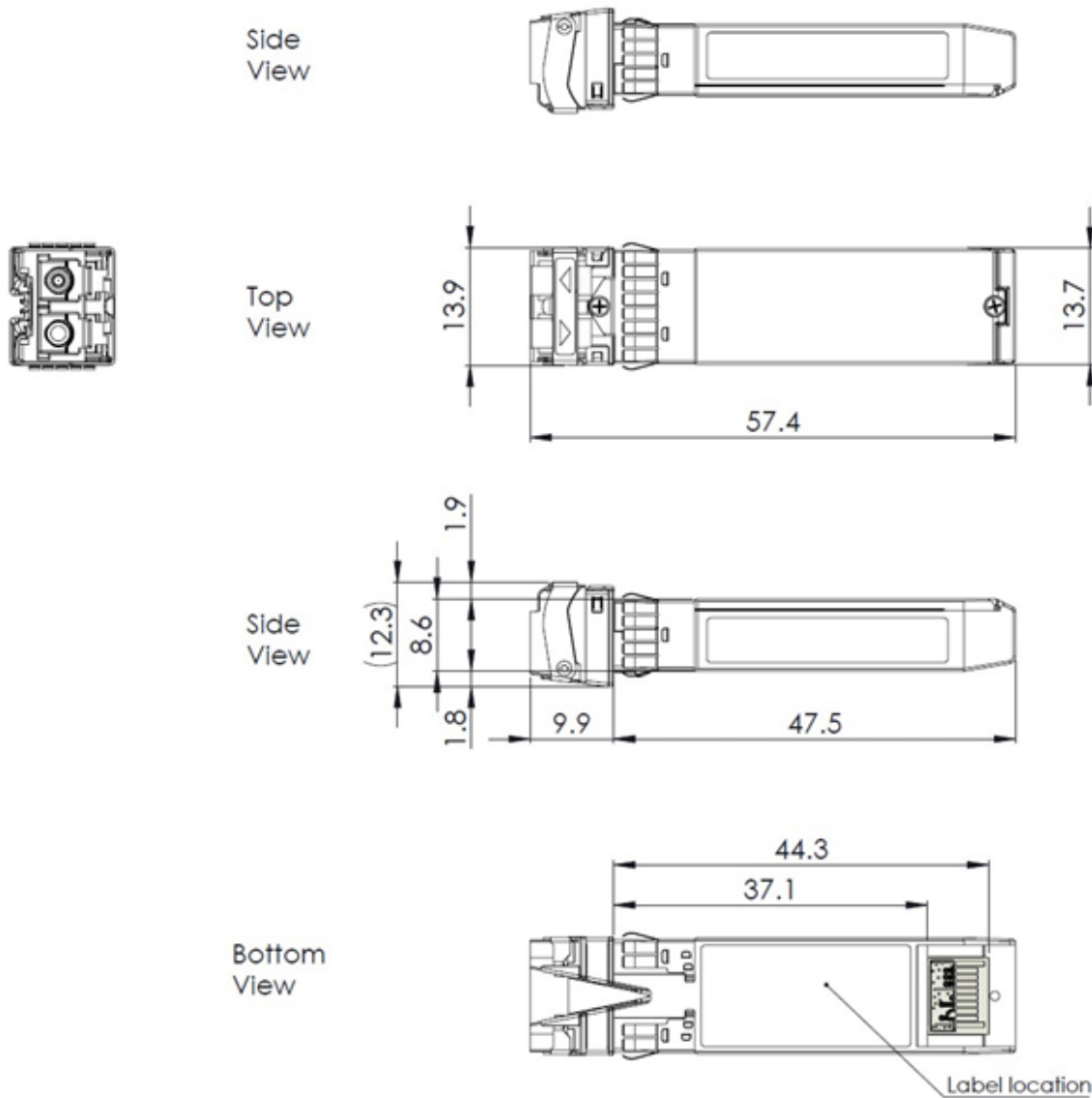
## Block Diagram



Interface to Host



Mechanical Specifications



## **OptioConnect**

### **Innovation for the Future of High-Speed Networking**

#### **Who We Are**

OptioConnect is reshaping the landscape of communication and high-speed networking through intelligent technology. With a core focus on cutting edge technology, we deliver smarter fiber optic solutions for enterprise networks, data centers, and next-gen telecom infrastructures.

#### **What We Do**

At OptioConnect, we fuse advanced engineering with intelligent automation to drive the future of networking. Our AI-integrated solutions are designed to optimize performance and streamline operations with:

- Superior Performance
- Network and traffic optimization
- Intelligent energy management
- Seamless OEM compatibility
- Scalable cost-efficiency

#### **Smarter Networks by Design**

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