



## SPDTU040100D000

MSA Compliant 10GBase-DWDM 50GHz SFP+ Transceiver (SMF, Tunable, 40km, LC, DOM)

### Product Description

This MSA compliant SFP+ transceiver provides 10GBase-DWDM throughput up to 40km over single-mode fiber (SMF) using a wavelength of 1530nm to 1565nm 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. We stand behind the quality of our products and proudly offer a limited lifetime warranty.

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

### Features:

- SFF-8432 and SFF-8472 Compliance
- Duplex LC Connector
- Commercial Temperature 0 to 70 Celsius
- Single-mode Fiber
- Hot Pluggable
- Excellent ESD Protection
- Metal with Lower EMI
- RoHS Compliant and Lead Free



### Applications:

- 10x Gigabit Ethernet over DWDM
- Access, Metro and Enterprise
- 8x/10x Fibre Channel

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*For your product safety, please read the following information carefully before any manipulation of the transceiver:*



#### ESD

This transceiver is specified as ESD threshold 1kV for SFI pins and 2kV for all others electrical input pins, tested per MIL-STD-883G, Method 3015.4 / JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module.



#### LASER SAFETY

This is a Class1 Laser Product according to IEC 60825-1:2007. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

*The optical ports of the module need to be terminated with an optical connector or with a dust plug in order to avoid contamination.*

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**100GHz Duplex Full Band Auto-Tune Channel Map**

| Channel | Frequency (THz) | Wavelength (nm) | Channel | Frequency (THz) | Wavelength (nm) |
|---------|-----------------|-----------------|---------|-----------------|-----------------|
| 14      | 191.4           | 1566.31         | 38      | 193.8           | 1546.92         |
| 15      | 191.5           | 1565.5          | 39      | 193.9           | 1546.12         |
| 16      | 191.6           | 1564.68         | 40      | 194.0           | 1545.32         |
| 17      | 191.7           | 1563.86         | 41      | 194.1           | 1544.53         |
| 18      | 191.8           | 1563.05         | 42      | 194.2           | 1543.73         |
| 19      | 191.9           | 1562.23         | 43      | 194.3           | 1542.94         |
| 20      | 192.0           | 1561.42         | 44      | 194.4           | 1542.14         |
| 21      | 192.1           | 1560.61         | 45      | 194.5           | 1541.35         |
| 22      | 192.2           | 1559.79         | 46      | 194.6           | 1540.56         |
| 23      | 192.3           | 1558.98         | 47      | 194.7           | 1539.77         |
| 24      | 192.4           | 1558.17         | 48      | 194.8           | 1538.98         |
| 25      | 192.5           | 1557.36         | 49      | 194.9           | 1538.19         |
| 26      | 192.6           | 1556.55         | 50      | 195.0           | 1537.4          |
| 27      | 192.7           | 1555.75         | 51      | 195.1           | 1536.61         |
| 28      | 192.8           | 1554.94         | 52      | 195.2           | 1535.82         |
| 29      | 192.9           | 1554.13         | 53      | 195.3           | 1535.04         |
| 30      | 193.0           | 1553.33         | 54      | 195.4           | 1534.25         |
| 31      | 193.1           | 1552.52         | 55      | 195.5           | 1533.47         |
| 32      | 193.2           | 1551.72         | 56      | 195.6           | 1532.68         |
| 33      | 193.3           | 1550.92         | 57      | 195.7           | 1531.9          |
| 34      | 193.4           | 1550.12         | 58      | 195.8           | 1531.12         |
| 35      | 193.5           | 1549.32         | 59      | 195.9           | 1530.33         |
| 36      | 193.6           | 1548.51         | 60      | 196.0           | 1529.55         |
| 37      | 193.7           | 1547.72         | 61      | 196.1           | 1528.77         |

## Absolute Maximum Ratings

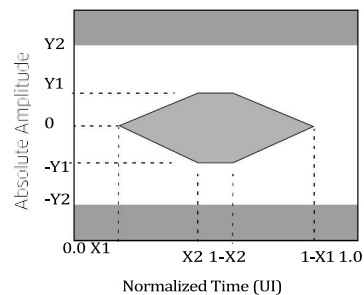
| Parameter                  | Symbol | Min. | Max. | Unit | Notes   |
|----------------------------|--------|------|------|------|---------|
| Maximum Supply Voltage     | VCCT   | 0    | +3.6 | V    | +3.3V   |
| Maximum Supply Voltage     | VCCR   | 0    | +3.6 | V    | +3.3V   |
| Storage Temperature        | TS     | -40  | 85   | °C   |         |
| Operating Case Temperature | Tc     | 0    | 70   | °C   |         |
| Optical Receiver Input     | PIMAX  |      | +5   | dBm  | Average |
| ESD SFI pins               | ESD1   |      | 1    | kV   | HBM     |
| ESD except for SFI pins    | ESD2   |      | 2    | kV   | HBM     |

## Electrical Characteristics

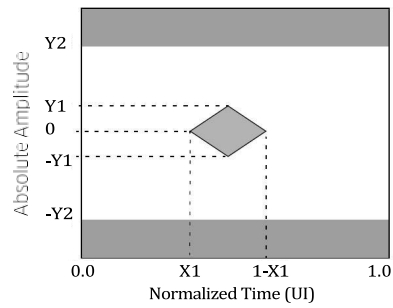
| Parameter                                     | Symbol | Min.  | Typ.  | Max.  | Unit | Notes |
|-----------------------------------------------|--------|-------|-------|-------|------|-------|
| Supply Voltage                                | VCCT   | 3.135 | 3.300 | 3.465 | V    |       |
| Supply Voltage                                | VCCR   | 3.135 | 3.300 | 3.465 | V    |       |
| Supply Current                                | Icc3   |       |       | 0.73  | A    |       |
| Power Consumption                             | PDS    |       |       | 2.3   | W    |       |
| Transmitter Electrical Characteristics at B'' |        |       |       |       |      |       |
| Eye mask                                      | X1     |       |       | 0.12  | UI   | 1     |
| Eye mask                                      | X2     |       |       | 0.33  | UI   | 1     |
| Eye mask                                      | Y1     | 95    |       |       | mV   | 1     |
| Eye mask                                      | Y2     |       |       | 350   | mV   | 1     |
| Receiver Electrical Characteristics at C'     |        |       |       |       |      |       |
| Eye mask                                      | X1     |       |       | 0.35  | UI   | 2     |
| Eye mask                                      | Y1     | 150   |       |       | mV   | 2     |
| Eye mask                                      | Y2     |       |       | 425   | mV   | 2     |

### Notes:

1. Eye mask at B''



## 2. Eye mask at C'



## Inrush Current

| Parameter                                  | Symbol | Min. | Max. | Unit | Notes |
|--------------------------------------------|--------|------|------|------|-------|
| I <sub>cc</sub> instantaneous peak current |        |      | 800  | mA   | 1, 2  |
| I <sub>cc</sub> sustained peak current     |        |      | 600  | mA   | 1, 2  |

### Notes:

1. The maximum currents are the allowed currents for each power supply V<sub>ccT</sub> or V<sub>ccR</sub>, 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 50 μs; may exceed this limit for shorter durations

## Optical Characteristics

| Parameter                                         | Symbol              | Min.   | Typ. | Max.   | Unit   | Notes             |
|---------------------------------------------------|---------------------|--------|------|--------|--------|-------------------|
| Transmitter                                       |                     |        |      |        |        |                   |
| Data Rate                                         |                     | 1.2    |      | 11.3   | Gbit/s | NRZ               |
| Optical Extinction Ratio                          | ER                  | 8.2    |      |        | dB     | 1                 |
| Side Mode Suppression Ratio                       | SMSR                | 35     |      |        | dB     | 2                 |
| Frequency Range                                   |                     | 191.35 |      | 196.10 | THz    | 4                 |
| Frequency Accuracy                                |                     | -2.5   |      | +2.5   | GHz    | EOL               |
| Optical Transmit Power                            | Po                  | -1.0   |      | +3.0   | dBm    | EOL               |
| Shuttered Output power                            |                     |        |      | -35    | dBm    |                   |
| Optical power stability                           | ΔPo                 | -1.0   |      | +1.0   | dB     | All channels, SOL |
| Spectral Width (-20dB)                            | Δλ                  |        | 0.3  | 0.5    | nm     | modulated         |
| Tuning speed                                      |                     |        |      | 10     | sec    | 5                 |
| Mask margin                                       |                     | 10     |      |        | %      |                   |
| Eye Diagram                                       | GR-253, ITU-T G.691 |        |      |        |        |                   |
| Receiver                                          |                     |        |      |        |        |                   |
| Input Operating Wavelength                        |                     | 1525   |      | 1575   | nm     |                   |
| Data Rate                                         |                     | 1.2    |      | 11.3   | Gbit/s | NRZ               |
| Minimum Receiver Sensitivity (Back to back)       | Prmin               |        |      | -24    | dBm    | 3                 |
| Minimum Receiver Sensitivity (+1100ps/nm)         | Prmin               |        |      | -23    | dBm    | 3                 |
| Minimum Receiver Sensitivity (-300 to +1400ps/nm) | Prmin               |        |      | -21    | dBm    | 3                 |
| Maximum input power (overload)                    | Pro                 | -7     |      |        | dBm    | 3                 |
| Receiver Reflectance                              | RL                  |        |      | -27    | dB     |                   |
| LOS assert                                        |                     | -27.5  |      |        | dBm    |                   |
| LOS de-assert                                     |                     |        |      | -24    | dBm    |                   |
| LOS Hysteresis                                    |                     | 0.1    |      |        | dB     |                   |
| LOS assert time                                   |                     |        |      | 100    | us     |                   |
| LOS de-assert time                                |                     |        |      | 100    | us     |                   |

### Notes:

1. Filtered, 10.3Gb/s
2.  $\pm 2.5$ nm, modulated
3. 10.3Gb/s, 1E-12, OSNR>35dB
4. 50GHz grid, 96 channels
5. Warmed-up, from any CH to any other CH

## Auto Tuning

The auto tuning process is a host independent scheme. When the TSFP+ modules with auto-tuning implemented are inserted into the corresponding electrical ports at a central office and a remote site, both modules will automatically start the automatic tuning process.

The process ensures that the TSFP+ modules tune to the channel defined by the DWDM filter (MUX/DeMUX) which both modules are connected to. The first module to converge on the correct channel initiates a unique process, which helps both sides of the link communicate properly.

After completion of the auto-tune process, both modules fix their wavelengths and move into normal 10 Gbit/s operation. A LOS condition, a shutdown condition (Tx Disable) and a power cycle shall trigger a restart of the auto tuning process.

The TSFP+ module shall appear as a regular Tunable product to the host system once Auto-tune is completed.

## Tuning Parameter

| Parameter                                    | Min                        | Max   | Unit   | Description              |
|----------------------------------------------|----------------------------|-------|--------|--------------------------|
| Channel to Channel Switch Time During Tuning |                            | 3.256 | s      |                          |
| Tuning Convergence Time                      |                            | 340   | s      | Not including cold start |
| Timeout (t1)                                 | 400                        |       | s      |                          |
| LOS Timeout (t2)                             | 15                         | 16    | s      |                          |
| Default Channel                              | 191.35                     |       | THz    |                          |
| Channel Sequence                             | 191.35<br>191.40,...,196.1 |       | THz    | 50GHz grid               |
| Modulation Rate                              | 125                        |       | Baud/s | Manchester encoding      |
| Bit Rate                                     | 62.5                       |       | Bit/s  |                          |

The TSFP+ module shall follow standard MSA behavior according to SFF-8472 and SFF-8690 with the following exceptions:

- During the auto-tune phase, the TSFP+ shall accept host tuning command and restart the auto-scanning from the channel set by host
- When the auto-tune phase is completed and the operational state is reached, the TSFP+ shall accept host tuning commands and set the channel accordingly (just a pure wavelength switch, no message protocol)
- When a loss-of-signal occurs (after a 15s time-out) the TSFP+ shall go back into the auto-tune phase

## SFP+ Module Timing

In the table below figures are shown the required timing for TX\_Fault and TX\_Disable in various conditions. For more detail, please refer to SFF-8431.

| Parameter                                                                               | Symbol             | Min. | Max. | Unit | Conditions                                           |
|-----------------------------------------------------------------------------------------|--------------------|------|------|------|------------------------------------------------------|
| TX_disable assert time                                                                  | t_off              |      | 100  | μs   | 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 cooled module                                                       | Tx_fault_on_cooled |      | 1    | ms   | From occurrence of fault to assertion of TX_Fault    |
| Tx_fault_reset                                                                          | t_reset            | 10   |      | μs   | Time TX_disable must be held high to reset TX_Fault. |
| RX_LOS assert delay                                                                     | t_los_on           |      | 100  | μs   | 5                                                    |
| RX_LOS negate delay                                                                     | t_los_off          |      | 100  | μs   | 6                                                    |

### Conditions:

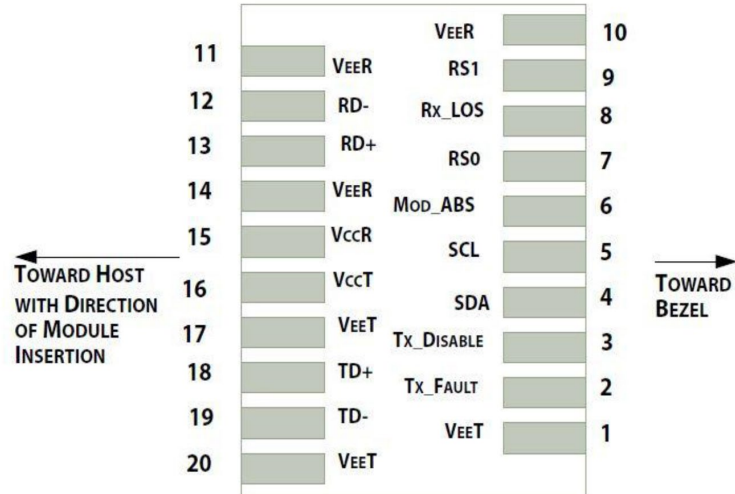
1. Rising edge of TX\_disable to fall of output signal below 10% of nominal.
2. Falling edge of TX\_disable to rise of output signal above 90% of nominal. This only applies in normal operation, not during start up or fault recovery.
3. From power on or hot plug after the supply meeting as shown in Electrical Characteristics table.
4. From power supplies meeting as shown in Electrical Characteristics table 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 cooled module is fully operational.
5. From occurrence of loss of signal to assertion of RX\_LOS
6. From occurrence of presence of signal to negation of RX\_LOS

## Pin Descriptions

| Pin | Symbol     | Name/Descriptions                                                              | Ref. |
|-----|------------|--------------------------------------------------------------------------------|------|
| 1   | VeeT       | Transmitter Ground (Common with Receiver Ground).                              | 1    |
| 2   | TX Fault   | Transmitter Fault. LVTTTL-O                                                    | 2    |
| 3   | TX Disable | Transmitter Disable. Laser output disabled on high or open. LVTT-I.            | 3    |
| 4   | SDA        | 2-Wire Serial Interface Data Line (Same as MOD-DEF2 in INF-8074i). LVTTTL-I/O. |      |
| 5   | SCL        | 2-Wire Serial Interface Data Line (Same as MOD-DEF2 in INF-8074i). LVTTTL-I.   |      |
| 6   | MOD_ABS    | Module Absent, Connect to VeeT or VeeR in Module.                              | 4    |
| 7   | RS0        | Rate Select 0. Not used                                                        | 5    |
| 8   | LOS        | Loss of Signal indication. Logic 0 indicates normal operation. LVTTTL-O.       | 2    |
| 9   | RS1        | Rate Select 1. Not used                                                        | 5    |
| 10  | VeeR       | Receiver Ground (Common with Transmitter Ground).                              | 1    |
| 11  | VeeR       | Receiver Ground (Common with Transmitter Ground).                              | 1    |
| 12  | RD-        | Receiver Inverted DATA out. AC Coupled. CML-O.                                 |      |
| 13  | RD+        | Receiver Non-inverted DATA out. AC Coupled. CML-O.                             |      |
| 14  | VeeR       | Receiver Ground (Common with Transmitter Ground).                              | 1    |
| 15  | VccR       | Receiver Power Supply.                                                         |      |
| 16  | VccT       | Transmitter Power Supply.                                                      |      |
| 17  | VeeT       | Transmitter Ground (Common with Receiver Ground).                              | 1    |
| 18  | TD+        | Transmitter Non-Inverted DATA in. AC Coupled. CML-I.                           |      |
| 19  | TD-        | Transmitter Inverted DATA in. AC Coupled. CML-O.                               |      |
| 20  | VeeT       | Transmitter Ground (Common with Receiver Ground).                              | 1    |

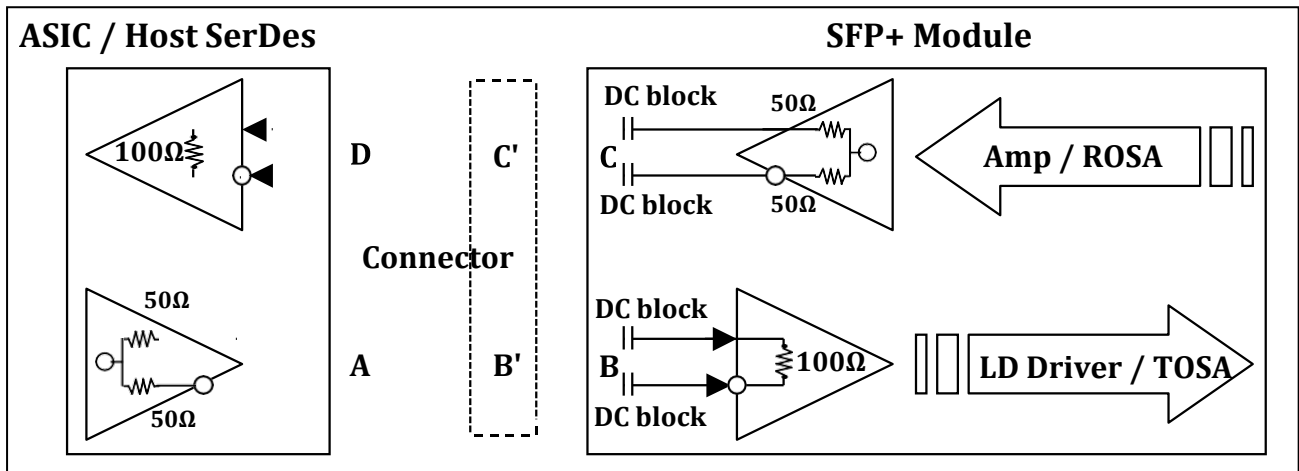
## Notes:

1. The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.
2. This contact is an open collector/drain output and should be pulled up to the Vcc\_Host with resistor in the range 4.7KΩ to 10KΩ. Pull ups can be connected to one or several power supplies, however the host board design shall ensure that no module contract has voltage exceeding module VccT/R +0.5.V.
3. Tx\_Disable is an input contact with a 4.7KΩ to 10KΩ pull-up resistor to VccT inside module.
4. Mod\_ABS is connected to VeeT or VeeR in the SFP+ module. The host may pull the contract up to Vcc\_Host with a resistor in the range from 4.7KΩ to 10KΩ. Mod\_ABS is asserted "High" when the SFP+ module is physically absent from a host slot.
5. Internally pulled down per SFF-8431

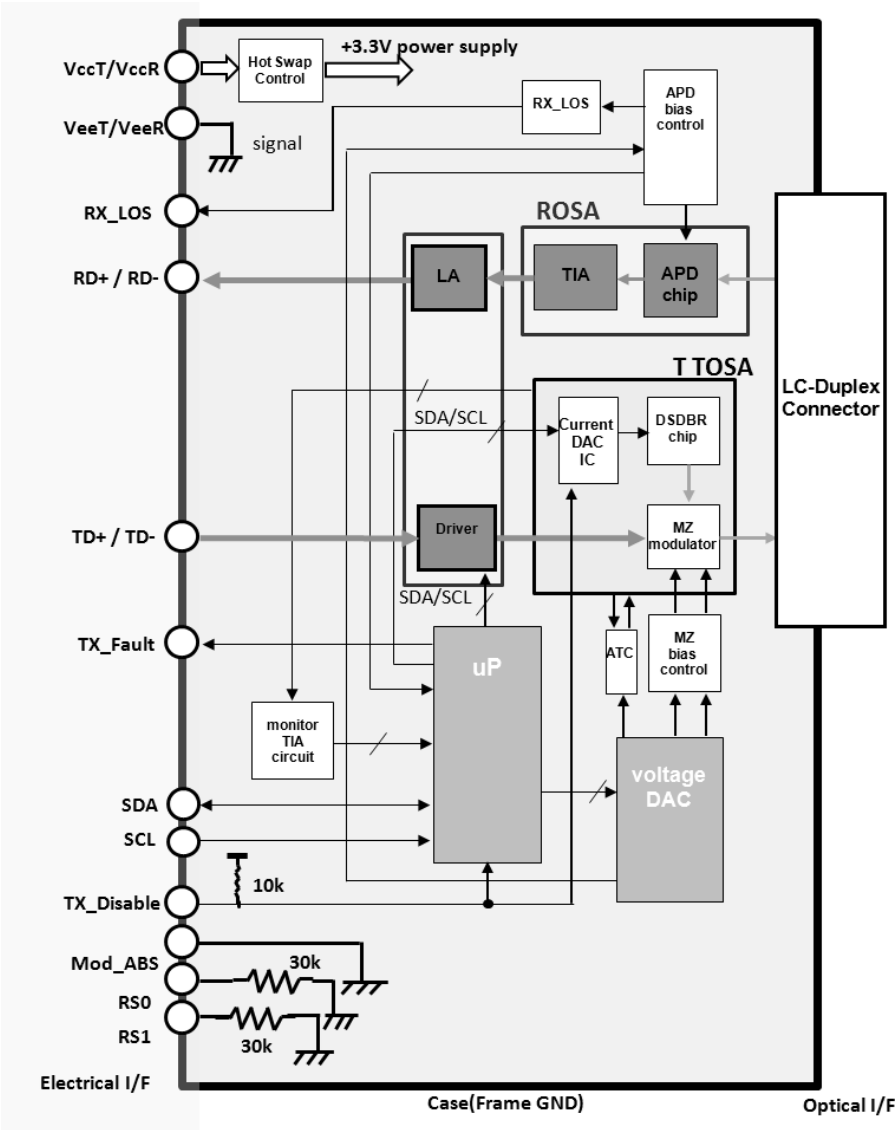


Pin-out of connector Block on Host board

## SFI Data Interface

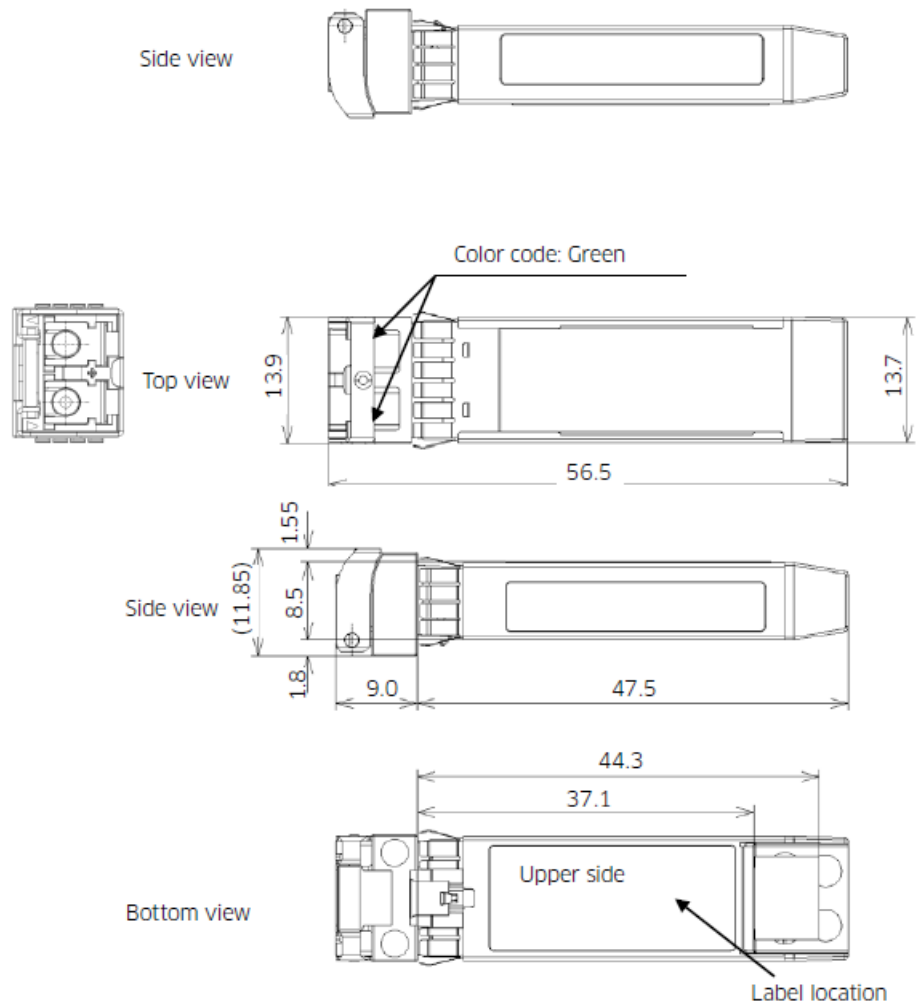


Block Diagram



## Mechanical Specifications

Comply to SFF-8432, the improved Pluggable form factor specification, with technique #2 latch. Comply to optional operational mechanical shock test in issue 2 of GR468.



# About Skylane Optics

Skylane is a leading provider of transceivers for optical communication.

We offer an extensive portfolio for the enterprise, access, datacenter and metropolitan fiber optical market as well as for smart home applications and home networks.

We cover the European, South American and North American market with a strong partner network and have offices in Belgium, Brazil, Sweden and USA.

Our offerings are characterized by high quality and performance. In combination with our strong technical support, we enable our customers to build cost optimized network solutions.

We offer an extensive range of high-quality products including transceivers (Optical and copper), Active Optical Cable (AOC), Direct Attach Cable (DAC), Mux/Demux, Coding Box.

