

### 3HE15642AA-PRO

Alcatel-Lucent Nokia® 3HE15642AA Compatible TAA Compliant 100GBase-LR1 SFP-DD Transceiver (SMF, 1310nm, 10km, DOM, CMIS 2.0, 0 to 70C, LC)

#### Features

- IEEE 100GBASE-LR Compliant
- SFP-DD MSA compliant
- 100GAUI-2 compliant – 2x 26.5625Gbaud
- Single mode Fiber
- Commercial Temperature 0 to 70 Celsius
- Duplex LC Connector
- CMIS Management Interface
- Hot Pluggable
- RoHS Compliant and Lead Free
- Excellent ESD Protection



#### Applications:

- 100GBase Ethernet

#### Product Description

This Alcatel-Lucent Nokia® 3HE15642AA compatible SFP-DD transceiver provides 100GBase-LR1 throughput up to 10km over single-mode fiber (SMF) using a wavelength of 1310nm via an LC connector. It is guaranteed to be 100% compatible with the equivalent Alcatel-Lucent Nokia® transceiver. This easy to install, hot swappable transceiver has been programmed, uniquely serialized and data-traffic and application tested to ensure that it will initialize and perform identically. 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.

Proline's 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.



## Absolute Maximum Ratings

| Parameter                   | Symbol          | Min. | Typ. | Max. | Unit | Notes   |
|-----------------------------|-----------------|------|------|------|------|---------|
| Power Supply Voltage        | V <sub>CC</sub> | 0    |      | +3.6 | V    |         |
| Storage Ambient Temperature | T <sub>S</sub>  | -40  |      | 85   | °C   |         |
| Operating Case Temperature  | T <sub>C</sub>  | 0    | 25   | 70   | °C   |         |
| Optical Receiver Input      |                 |      |      | +5.5 | dBm  | Average |

### Notes:

1. Stresses in excess of the absolute maximum ratings can cause permanent damage to the device. These are absolute stress ratings only. Functional operation of the device is not implied at these or any other conditions in excess of those given in the operational sections of the data sheet. Exposure to absolute maximum ratings will cause permanent damage and/or adversely affect device reliability.

## Electrical Characteristics

| Parameter  | Symbol/<br>Test Point | Min.             | Typ.    | Max.    | Unit | Notes         |
|--|-----------------------|------------------|---------|---------|------|---------------|
| Power Supply Voltage                               | V <sub>CC</sub>       | 3.135            | 3.3     | 3.465   | V    |               |
| Supply Voltage Noise Tolerance                     | PSNR                  |                  |         | 66      | mV   | 10 Hz –10 MHz |
| Power Consumption                                  | PD                    |                  | 3.0     | 3.5     | W    |               |
| Supply Current                                     | I <sub>CC</sub>       |                  |         | 1116.4  | mA   | Steady state  |
| <b>Transmitter (per lane)</b>                      |                       |                  |         |         |      |               |
| Signaling Rate Per Lane (Range)                    | TP4                   | -100ppm          | 26.5625 | +100ppm | GBd  | 1             |
| AC Common-Mode Output Voltage (RMS)                | TP4                   |                  |         | 17.5    | mV   | 1             |
| Differential Peak-to-Peak Output Voltage           | TP4                   |                  |         | 900     | mV   | 1             |
| Near-End ESMW (Eye Symmetry Mask Width)            | TP4                   | 0.265            |         |         | UI   | 1             |
| Near-End Eye Height, Differential                  | TP4                   | 70               |         |         | mV   | 1             |
| Far-End ESMW (Eye Symmetry Mask Width)             | TP4                   | 0.2              |         |         | UI   | 1             |
| Far-End Eye Height, Differential                   | TP4                   | 30               |         |         | mV   | 1             |
| Far-End Pre-Cursor ISI Ratio                       | TP4                   | -4.5             |         | 2.5     | %    | 1             |
| Differential Output Return Loss                    | TP4                   | Equation (83E-2) |         |         | dB   | 1, 2          |
| Common to Differential Mode Conversion Return Loss | TP4                   | Equation (83E-3) |         |         | dB   | 1, 2          |
| Differential Termination Mismatch                  | TP4                   |                  |         | 10      | %    | 1             |
| Transition Time (20% to 80%)                       | TP4                   | 9.5              |         |         | ps   | 1             |
| DC Common Mode Voltage                             | TP4                   | -350             |         | 2850    | mV   | 1             |
| <b>Receiver (per lane, at TP1)</b>                 |                       |                  |         |         |      |               |
| Signaling Rate Per Lane (Range)                    | TP1                   | -100ppm          | 26.5625 | +100ppm | GBd  |               |

|   |      |                  |  |      |    |   |
|---|------|------------------|--|------|----|---|
| Differential Pk-Pk Input Voltage Tolerance    | TP1a | 900              |  |      | mV |   |
| Differential Input Return Loss                | TP1  | Equation (83E-5) |  |      | dB | 2 |
| Differential to Common Mode Input Return Loss | TP1  | Equation (83E-6) |  |      | dB | 2 |
| Differential Termination Mismatch             | TP1  |                  |  | 10   | %  |   |
| ESMW (Eye Symmetry Mask Width)                | TP1a | 0.22             |  |      | UI |   |
| Eye Width                                     | TP1a | 0.22             |  |      | UI |   |
| Eye Height                                    | TP1a | 32               |  |      | mV |   |
| Single-Ended Input Voltage Tolerance Range    | TP1a | -0.4             |  | 3.3  | V  |   |
| DC Common Mode Voltage                        | TP1  | -350             |  | 2850 | mV |   |

**Notes:**

1. Electrical module output is squelched for loss of optical input signal.
2. IEEE 802.3-2018 Section 6.

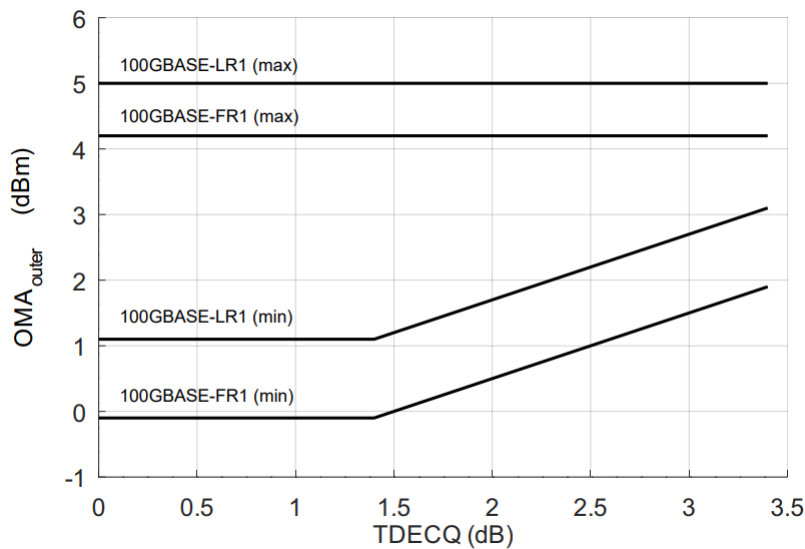
**Optical Characteristics**

| Parameter  | Symbol    | Min.          | Typ.             | Max. | Unit | Notes |
|--|-----------|---------------|------------------|------|------|-------|
| <b>Transmitter</b>   |           |               |                  |      |      |       |
| PAM4 Signaling Rate (Range)  |           |               | 53.125 ± 100 ppm |      | GBd  |       |
| Lane Wavelengths (Range)   | $\lambda$ |               | 1304.5 – 1317.5  |      | nm   |       |
| Side Mode Suppression Ratio  | SMSR      | 30            |                  |      | dB   |       |
| Average Launch Power   | Aop       | -1.9          |                  | 4.8  | dBm  | 1     |
| Average Launch Power-OFF   | POFF      |               |                  | -15  | dBm  |       |
| Extinction Ratio   | ER        | 3.5           |                  |      | dB   |       |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> )                             | OMA       |               |                  | 5    | dBm  |       |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) for TDECQ <1.4 dB           |           | 1.1           |                  |      | dBm  |       |
| Outer Optical Modulation Amplitude (OMA <sub>outer</sub> ) for 1.4 dB ≤ TDECQ ≤ 3.4 dB |           | - 0.3 + TDECQ |                  |      | dBm  |       |
| Transmitter and Dispersion Penalty Eye Closure for PAM4                                | TDECQ     |               |                  | 3.4  | dB   |       |
| Transmitter Eye Closure for PAM4 (TECQ)  |           |               |                  | 3.4  | dB   |       |
| TDECQ – TECQ   |           |               |                  | 2.5  | dB   |       |
| Over/Under-Shoot   |           |               |                  | 22   | %    |       |
| Transmitter Power Excursion  |           |               |                  | 2.8  | dBm  |       |
| Optical Return Loss Tolerance  | ORLT      |               |                  | 15.6 | dB   |       |
| Transmitter Reflectance  |           |               |                  | -26  | dB   | 2     |
| Transmitter Transition Time  |           |               |                  | 17   | ps   |       |

|   |                     |      |  |                  |       |   |
|---|---------------------|------|--|------------------|-------|---|
| <b>RIN<sub>15.5</sub> OMA</b>                               |                     |      |  | -136             | dB/Hz |   |
| <b>Receiver</b>   |                     |      |  |                  |       |   |
| <b>PAM4 Signaling Rate (Range)</b>                          |                     |      |  | 53.125 ± 100 ppm | GBd   |   |
| <b>Lane Wavelengths (Range)</b>                             | $\lambda$           |      |  | 1304.5 – 1317.5  | nm    |   |
| <b>Damage Threshold</b>                                     | P <sub>damage</sub> | 5.8  |  |                  | dBm   | 3 |
| <b>Average Receive Power</b>                                | R <sub>xAVG</sub>   | -8.2 |  | 4.8              | dBm   | 4 |
| <b>Receive Power (OMA<sub>outer</sub>)</b>                  | R <sub>xOMA</sub>   |      |  | 5                | dBm   |   |
| <b>Receiver Reflectance</b>                                 |                     |      |  | -26              | dB    |   |
| <b>Receiver Sensitivity (OMA<sub>outer</sub>)</b>           | Sen <sub>OMA</sub>  |      |  | -6.1, TECQ-7.5   | dBm   | 5 |
| <b>Stressed Receiver Sensitivity (OMA<sub>outer</sub>)</b>  | Sen <sub>OMA</sub>  |      |  | -4.1             | dBm   | 6 |
| <b>Conditions of Stressed Receiver Sensitivity (Note 7)</b> |                     |      |  |                  |       |   |
| <b>Stressed Eye Closure for PAM4 (SECQ)</b>                 |                     |      |  | 3.4              | dB    |   |

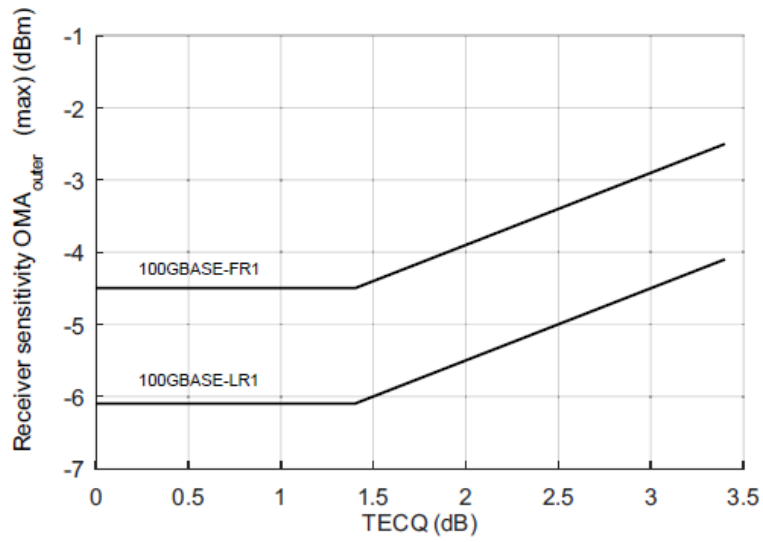
**Notes:**

1. Average launch power (min) is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance.
2. Transmitter reflectance is defined looking into the transmitter.
3. The receiver shall be able to tolerate, without damage, continuous exposure to an optical signal having this average power level.
4. Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.
5. OMA Outer:



6. Measured with conformance test signal at TP3 (see 100G Lambda MSA 100G-FR - “Technical Specification, Rev. 2.0 clause 3.11) for the BER specified in IEEE Std 802.3cd clause 140.1.1.
7. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

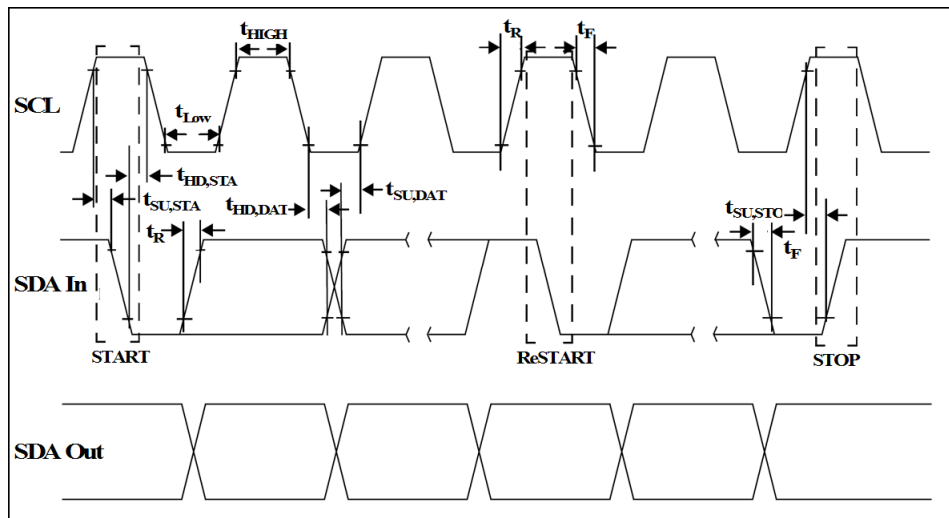
## Receiver Sensitivity



## RX\_LOS Alarm Characteristics

| Parameter   | Symbol | Min. | Typ. | Max. | Unit | Notes         |
|---|--------|------|------|------|------|---------------|
| Receiver Loss of Signal Indicator Assert Level    | RX_LOS | -15  |      | -8.5 | dBm  | Average power |
| Receiver Loss of Signal Indicator De-assert Level | RX_LOS |      |      | -8   | dBm  | Average power |
| Hysteresis  | RX_LOS | 0.5  |      |      | dB   |               |

## 2-Wire Interface Timing Diagram



## Control and Status Timing Requirements

| Parameters           | Symbol                | Min | Max  | Units | Conditions   |
|----------------------|-----------------------|-----|------|-------|--|
| MgmtInit Duration    | Max MgmtInit Duration |     | 2000 | ms    | Time from power on <sup>1</sup> , hot plug or rising edge of reset until the high to low SDA transition of the Start condition for the first acknowledged TWI transaction. |
| ResetL Assert Time   | t_reset_init          | 10  |      | μs    | Minimum pulse time on the ResetL signal to initiate a module reset.  |
| IntL Assert Time     | ton_IntL              |     | 200  | ms    | Time from occurrence of condition triggering IntL until Vout:IntL=Vol.   |
| IntL Deassert Time   | toff_IntL             |     | 500  | μs    | Time from clear on read <sup>2</sup> operation of associated flag until Vout:IntL=Voh. This includes deassert times for Rx LOS, Tx Fault and other flag bits.              |
| Rx LOS Assert Time   | ton_los               |     | 100  | ms    | Time from Rx LOS condition present to Rx LOS bit set (value = 1b) and IntL asserted.   |
| Tx Fault Assert Time | ton_Txfault           |     | 200  | ms    | Time from Tx Fault state to Tx Fault bit set (value=1b) and IntL asserted.   |
| Flag Assert Time     | ton_flag              |     | 200  | ms    | Time from occurrence of condition triggering flag to associated flag bit set (value=1b) and IntL asserted.   |
| Mask Assert Time     | ton_mask              |     | 100  | ms    | Time from mask bit set (value=1b) <sup>3</sup> until associated IntL assertion is inhibited.   |
| Mask Deassert Time   | toff_mask             |     | 100  | ms    | Time from mask bit cleared (value=0b) <sup>3</sup> until associated IntL operation resumes.  |

### Notes:

1. Power on is defined as the instant when supply voltages reach and remain at or above the minimum level specified in the Electrical Specifications table.
2. Measured from the rising edge of SDA in the stop bit of the read transaction.
3. Measured from the rising edge of SDA in the stop bit of the write transaction.
4. Rx LOS condition is defined at the optical input by the relevant standard.

## I/O Timing for Squelch & Disable

| Parameters                                     | Symbol      | Max              | Units | Conditions  |
|--|-------------|------------------|-------|---|
| Rx Squelch Assert Time                         | ton_Rxsq    | 15               | ms    | Time from loss of Rx input signal until the squelched output condition is reached.  |
| Tx Squelch Assert Time                         | ton_Txsq    | 400              | ms    | Time from loss of Tx input signal until the squelched output condition is reached.  |
| Tx Squelch De-assert Time                      | toff_Txsq   | 5<br>(Tentative) | s     | Tx squelch deassert is system and implementation dependent.   |
| Tx Disable Assert Time                         | ton_txdis   | 100              | ms    | Time from the stop condition of the Tx Disable write sequence <sup>1</sup> until optical output falls below 10% of nominal.   |
| Tx Disable Assert Time (optional fast mode)    | ton_txdisf  | 3                | ms    | Time from Tx Disable bit set (value = 1b) <sup>1</sup> until optical output falls below 10% of nominal and see notes 2 and 3. |
| Tx Disable De-assert Time                      | toff_txdis  | 400              | ms    | Time from Tx Disable bit cleared (value = 0b) <sup>1</sup> until optical output rises above 90% of nominal and see note 2.    |
| Tx Disable De-assert Time (optional fast mode) | toff_txdisf | 10               | ms    | Time from Tx Disable bit cleared (value = 0b) <sup>1</sup> until optical output rises above 90% of nominal, see note 3.       |

|   |            |   |    |  |
|---|------------|---|----|--|
| <b>Rx Output Disable Assert Time</b>    | ton_rxdis  | 100   | ms | Time from Rx Output Disable bit set (value = 1b) <sup>1</sup> until Rx output falls below 10% of nominal.                            |
| <b>Rx Output Disable De-assert Time</b> | toff_rxdis | 100   | ms | Time from Rx Output Disable bit cleared (value = 0b) <sup>1</sup> until Rx output rises above 90% of nominal.                        |
| <b>Squelch Disable Assert Time</b>      | ton_sqdis  | Not applicable (Tx/Rx Auto Squelch Disable not supported) |    | This applies to Rx and Tx Squelch and is the time from bit set (value = 0b) <sup>1</sup> until squelch functionality is disabled.    |
| <b>Squelch Disable De-assert Time</b>   | toff_sqdis | Not applicable (Tx/Rx Auto Squelch Disable not supported) |    | This applies to Rx and Tx Squelch and is the time from bit cleared (value = 0b) <sup>1</sup> until squelch functionality is enabled. |

**Notes:**

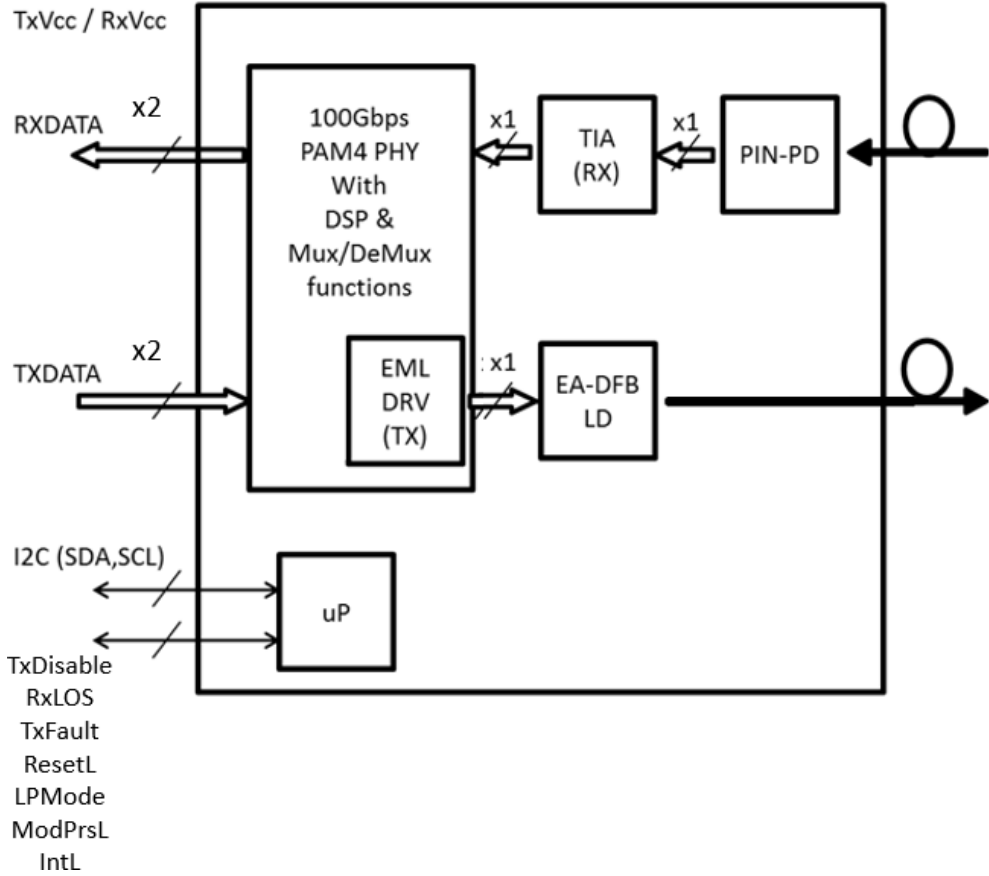
1. Measured from LOW to HIGH SDA signal transition of the STOP condition of the write transaction.
2. CMIS 4.0 and beyond the listed values are superseded by the advertised.  
DataPathTxTurnOff\_MaxDuration and DataPathTxTurnOn\_MaxDuration times in P01h.168.
3. Listed values place a limit on the DataPathTxTurnOff\_MaxDuration and DataPathTxTurnOn\_MaxDuration times (P01h.168) that can be advertised by such modules (for CMIS 4.0 and beyond).

**Maximum Power Classes**

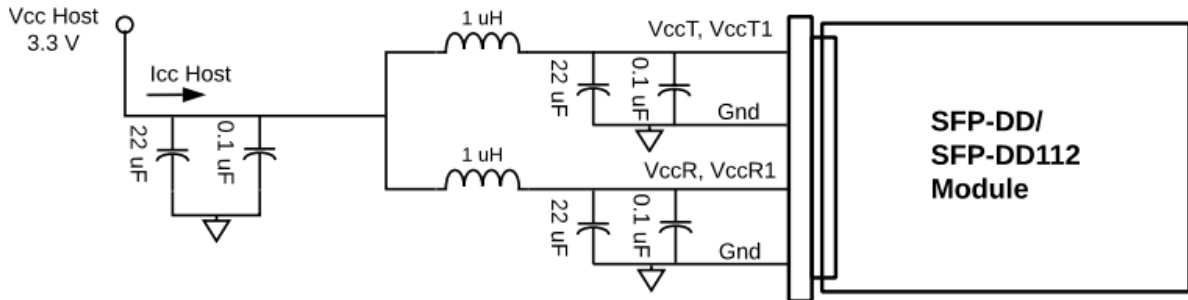
SFP56-DD modules are categorized into several power classes as listed in the table below. The power class of this module is class 4.

| Power Class | Maximum power dissipation per module (W) |
|-------------|--|
| 1           | 1.5                                      |
| 2           | 2.0                                      |
| 3           | 2.5                                      |
| 4           | 3.5                                      |
| 5           | 4.0                                      |
| 6           | 4.5                                      |
| 7           | 5.0                                      |

### Functional Block Diagram



### Recommended Host Board Power Supply Filtering Network





## Pin Descriptions

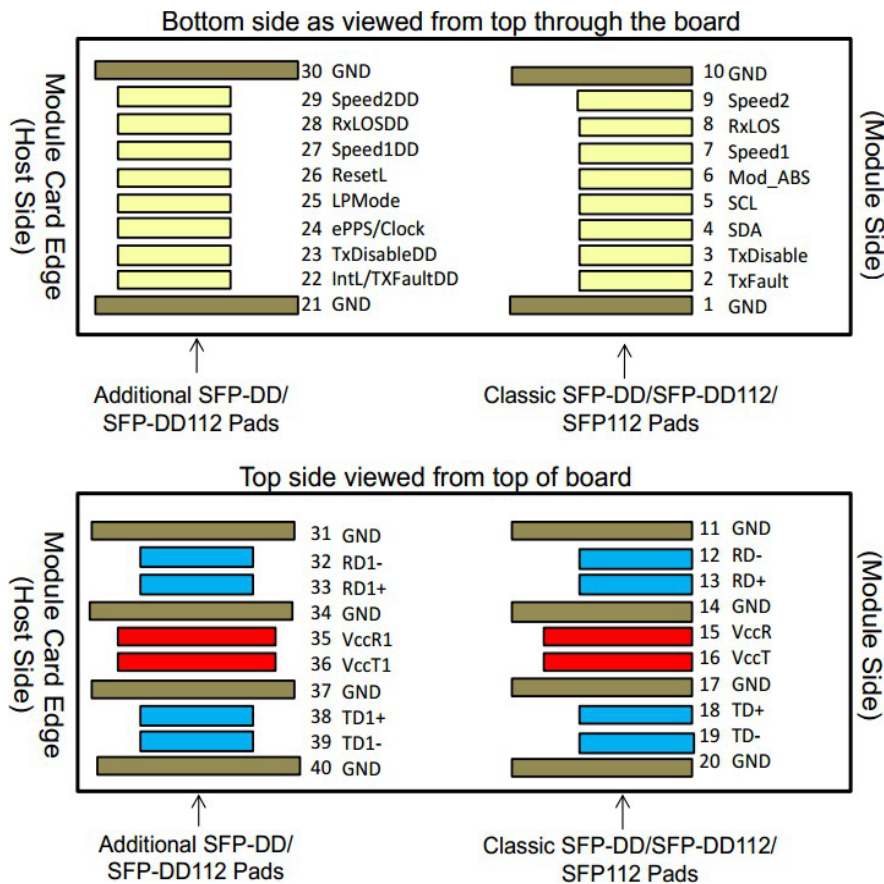
| Pin | Logic       | Symbol         | Name/Description  | Notes |
|-----|-------------|----------------|---|-------|
| 1   |             | GND            | Ground.   | 1     |
| 2   | LVTTTL-O    | TX_Fault       | Module Fault Indication: optionally configured as classic SFP Module Fault Indication via TWI as described in the SFP-DD MIS. |       |
| 3   | LVTTTL-I    | Tx_Disable     | Transmitter Disable for classic SFP channel.  |       |
| 4   | LVC MOS-I/O | SDA            | Management I/F data line.   |       |
| 5   | LVC MOS-I/O | SCL            | Management I/F clock.   |       |
| 6   | LVTTTL-O    | MOD_ABS        | Module Absent.  |       |
| 7   | LVTTTL-I    | Speed1         | Rx Rate Select for classic SFP channel.   |       |
| 8   | LVTTTL-O    | RxLOS          | Rx Loss of Signal for classic SFP channel.  |       |
| 9   | LVTTTL-I    | Speed1         | Tx Rate Select for classic SFP channel.   |       |
| 10  |             | GND            | Ground.   | 1     |
| 11  |             | GND            | Ground.   | 1     |
| 12  | CML-O       | RD0-           | Inverse Received Data Out for classic SFP+ channel.   |       |
| 13  | CML-O       | RD0+           | Received Data Out for classic SFP+ channel.   |       |
| 14  |             | GND            | Ground.   | 1     |
| 15  |             | VccR           | Receive Power.  | 2     |
| 16  |             | VccT           | Transmitter Power.  | 2     |
| 17  |             | GND            | Ground.   | 1     |
| 18  | CML-I       | TD0+           | Transmit Data In for classic SFP channel.   |       |
| 19  | CML-I       | TD0-           | Inverse Transmit Data In for classic SFP channel.   |       |
| 20  |             | GND            | Ground.   | 1     |
| 21  |             | GND            | Ground.   | 1     |
| 22  | LVTTTL-O    | IntL/TXFaultDD | Interrupt: optionally configured as TXFaultDD via TWI as described in the SFP-DD MIS.   |       |
| 23  | LVTTTL-I    | TxDisableDD    | Transmitter Disable for DD channel.   |       |
| 24  | LVTTTL-I    | ePPS/Clock     | Precision Time Protocol (PTP) reference clock input.  | 3     |
| 25  | LVTTTL-I    | LPMMode        | Low Power Mode Control.   |       |
| 26  | LVTTTL-I    | ResetL         | Module Reset.   |       |
| 27  | LVTTTL-I    | Speed1DD       | Rx Rate Select for DD channel.  |       |
| 28  | LVTTTL-O    | RxLOSDD        | Loss of Signal for DD channel.  |       |
| 29  | LVTTTL-I    | Speed2DD       | Tx Rate Select for DD channel.  |       |
| 30  |             | GND            | Ground.   | 1     |
| 31  |             | GND            | Ground.   | 1     |
| 32  | CML-O       | RD1-           | Inverse Received Data Out for DD channel.   |       |
| 33  | CML-O       | RD1+           | Received Data Out for DD channel.   |       |
| 34  |             | GND            | Ground.   | 1     |
| 35  |             | VccR1          | Receiver Power for DD channel.  | 2     |
| 36  |             | VccT1          | Transmitter Power for DD channel.   | 2     |
| 37  |             | GND            | Ground.   | 1     |

|    |       |      |  |   |
|----|-------|------|--|---|
| 38 | CML-I | TD1+ | Transmit Data In for DD channel.         |   |
| 39 | CML-I | TD2- | Inverse Transmit Data In for DD channel. |   |
| 40 |       | GND  | Ground.                                  | 1 |

**Notes:**

1. SFP-DD uses common ground (GND) for all signals and supply (power). All are common within the SFP-DD module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.
2. VccR, VccT shall be applied concurrently and VccR1, VccT1 shall be applied concurrently. Requirements defined for the host side of the Host Card Edge Connector are listed in the Maximum Power Classes table above. VccR, VccT, VccR1, VccT1 may be internally connected within the module in any combination. The connector Vcc pins are each rated for a maximum current of 1000mA.
3. The ePPS pins (if not used) may be terminated with 50Ω to the ground on the host.
4. Plug Sequence specifies the mating sequence of the host connector and module. The sequence is 0, 1A, 2A, 3A, 1B, 2B, 3B. Contact sequence A will make, then break contact with additional SFP-DD/SFP-DD112 pads. Sequence 1A, 1B will then occur simultaneously, followed by 2A, 2B, followed by 3A, 3B.

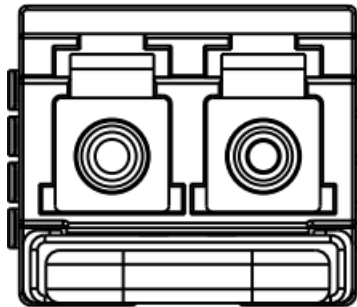
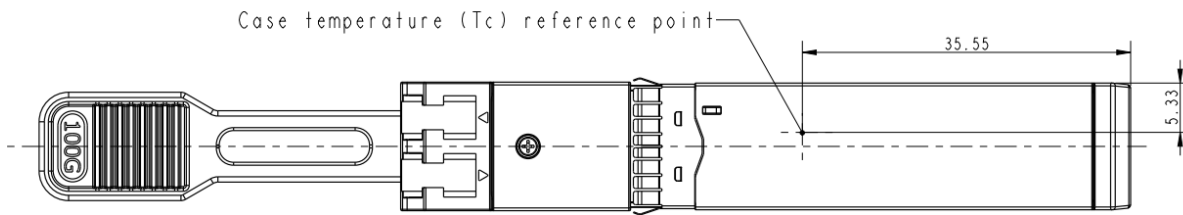
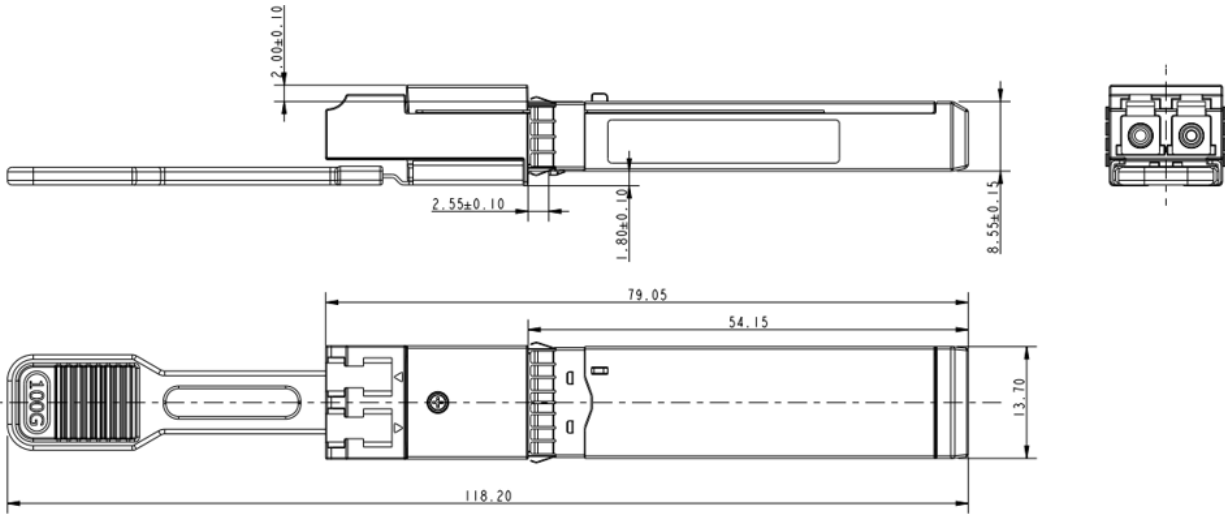
**Electrical Pin-out Details**



### Mechanical Specifications

Unit: mm

Pull tab color: Blue



Looking into the connector, transmitter on the left.

**About Us:**

Proline Options is one of North America's leading providers of transceivers and high speed cabling. With a reputation for quality, tested products that cover the connectivity spectrum, Proline Options has a solution for you regardless of the specification.

At Proline Options, every product is tested in its intended application - never batch or spec tested only. We run bandwidth, distance and IOS network tests. We have documented an impressive 0.03% failure rate over the last 10 years. To continue this rate of success we invest millions annually in our own on-site testing lab.



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