

### **3HE04821AB-OPC**

Alcatel-Lucent Nokia® 3HE04821AB Compatible TAA 100GBase-LR4 CFP Transceiver (SMF, 1310nm, 10km, LC, DOM)

#### **Features**

- CFP MSA 1.4 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:**

- 100GBase Ethernet
- OTU4 Operation
- Access and Enterprise

#### **Product Description**

This Alcatel-Lucent Nokia® 3HE04821AB compatible CFP transceiver provides 100GBase-LR4 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.

## Absolute Maximum Ratings

| Parameter                        | Symbol | Min. | Max. | Unit |
|----------------------------------|--------|------|------|------|
| Storage Temperature              | TS     | -40  | +85  | °C   |
| Power Supply Voltage             | VCC    | -0.5 | 3.6  | V    |
| Operating Case Temperature Range | Tc     | -10  | +75  | °C   |
| Relative Humidity                | Rh     | 5    | 85   | %    |

## Electrical Characteristics

| Parameter                      | Symbol   | Min. | Typ. | Max. | Unit  |         |
|--------------------------------|----------|------|------|------|-------|---------|
| Power Supply Voltage           | VCC      | 3.2  | 3.3  | 3.4  | V     |         |
| Power Supply Current           | Icc      |      | 4000 |      | mA    |         |
| Transmitter                    |          |      |      |      |       |         |
| Differential data input swing  | Vin      |      |      | 1050 | mVp-p |         |
| Input differential impedance   | Zin      | 80   | 100  | 120  | Ω     |         |
| Receiver                       |          |      |      |      |       |         |
| Differential data output swing | Vout, pp | 360  |      | 770  | mVp-p |         |
| Output differential impedance  | Zo       | 80   | 100  | 120  | Ω     |         |
| Output Rise/Fall Time          | tr/tf    | 24   |      |      | ps    | 20%~80% |

## 1.2V MDIO Interface Specifications

| Parameter          | Symbol       | Min. | Typ. | Max   | Unit | Notes |
|--------------------|--------------|------|------|-------|------|-------|
| Input Voltage      | VIH          | 0.84 |      | 1.5   | V    |       |
|                    | VIL          | -0.3 |      | 0.36  | V    |       |
| Input Leak current | IIN          | -100 |      | 100   | uA   |       |
| Output Voltage     | VOH          | 1.0  |      | 1.5   | V    |       |
|                    | VOL          | -0.3 |      | 0.2   | V    |       |
| Input Capacitance  | CI           |      |      | 10    | pF   |       |
| Input MDC Clock    | fMDC         | 0.1  |      | 4     | MHz  |       |
| MDC Clock Period   | TMDC         | 250  |      | 10000 | ns   |       |
| MDIO Hold Time     | Thold        | 10   |      |       | ns   |       |
| MDIO Setup Time    | Tsetup       | 10   |      |       | ns   |       |
| GLB_ALM            | Tglb_alm_ass |      |      | 150   | ms   |       |
|                    | Tglb_alm_dea |      |      | 150   | ms   |       |

# OTU4 4I1-9D1F Operation Optical Characteristics

| Parameter                                                   | Symbol         | Min.              | Typical | Max.    | Unit | Notes |
|-------------------------------------------------------------|----------------|-------------------|---------|---------|------|-------|
| Transmitter                                                 |                |                   |         |         |      |       |
| Signaling Speed per Lane                                    | BRAVE          |                   | 27.95   |         | Gbps |       |
| Lane_0 Center Wavelength                                    | $\lambda_{C0}$ | 1294.53           | 1295.56 | 1296.59 | nm   |       |
| Lane_1 Center Wavelength                                    | $\lambda_{C1}$ | 1299.02           | 1300.05 | 1301.09 | nm   |       |
| Lane_2 Center Wavelength                                    | $\lambda_{C2}$ | 1303.54           | 1304.58 | 1305.63 | nm   |       |
| Lane_3 Center Wavelength                                    | $\lambda_{C3}$ | 1308.09           | 1309.14 | 1310.19 | nm   |       |
| Total Average Output Power                                  | PO1            | -                 |         | 8.9     | dBm  | 1, 2  |
| Average Launch Power per Lane                               | Peach1         | -2.5              |         | 2.9     | dBm  | 2     |
| Side Mode Suppression Ratio                                 | SMSR           | 30                |         |         | dB   |       |
| Optical Return Loss Tolerance                               |                |                   |         | 20      | dB   |       |
| Extinction Ratio                                            | ER1            | 7                 |         |         | dB   | 2     |
| Transmitter eye mask definition<br>{X1, X2, X3, Y1, Y2, Y3} |                | G.959.1 Compliant |         |         |      | 2     |
| TX Disable Assert Time                                      | t_off          |                   |         | 100     | us   |       |
| Receiver                                                    |                |                   |         |         |      |       |
| Signaling Speed per Lane                                    | BRAVE          |                   | 27.95   |         | Gbps |       |
| Lane_0 Center Wavelength                                    | $\lambda_{C0}$ | 1294.53           | 1295.56 | 1296.59 | nm   |       |
| Lane_1 Center Wavelength                                    | $\lambda_{C1}$ | 1299.02           | 1300.05 | 1301.09 | nm   |       |
| Lane_2 Center Wavelength                                    | $\lambda_{C2}$ | 1303.54           | 1304.58 | 1305.63 | nm   |       |
| Lane_3 Center Wavelength                                    | $\lambda_{C3}$ | 1308.09           | 1309.14 | 1310.19 | nm   |       |
| Average Receive Power per Lane                              | Rpow1          | -8.8              |         | 4       | dBm  | 5     |
| Equivalent Sensitivity per Lane                             | Pmin1          |                   |         | -10.3   | dBm  | 7     |
| Receiver Overload per Lane                                  | Pmax           | 5.5               |         |         | dBm  |       |
| Optical Return Loss                                         | ORL            |                   |         | -26     | dB   |       |
| LOS Assert                                                  | LOSA           | -21               |         |         | dBm  |       |
| LOS De-Assert                                               | LOSD           |                   |         | -11     | dBm  |       |
| LOS Hysteresis                                              |                | 0.5               |         |         | dB   |       |

## 100GBASE-LR4 Operation Optical Characteristics

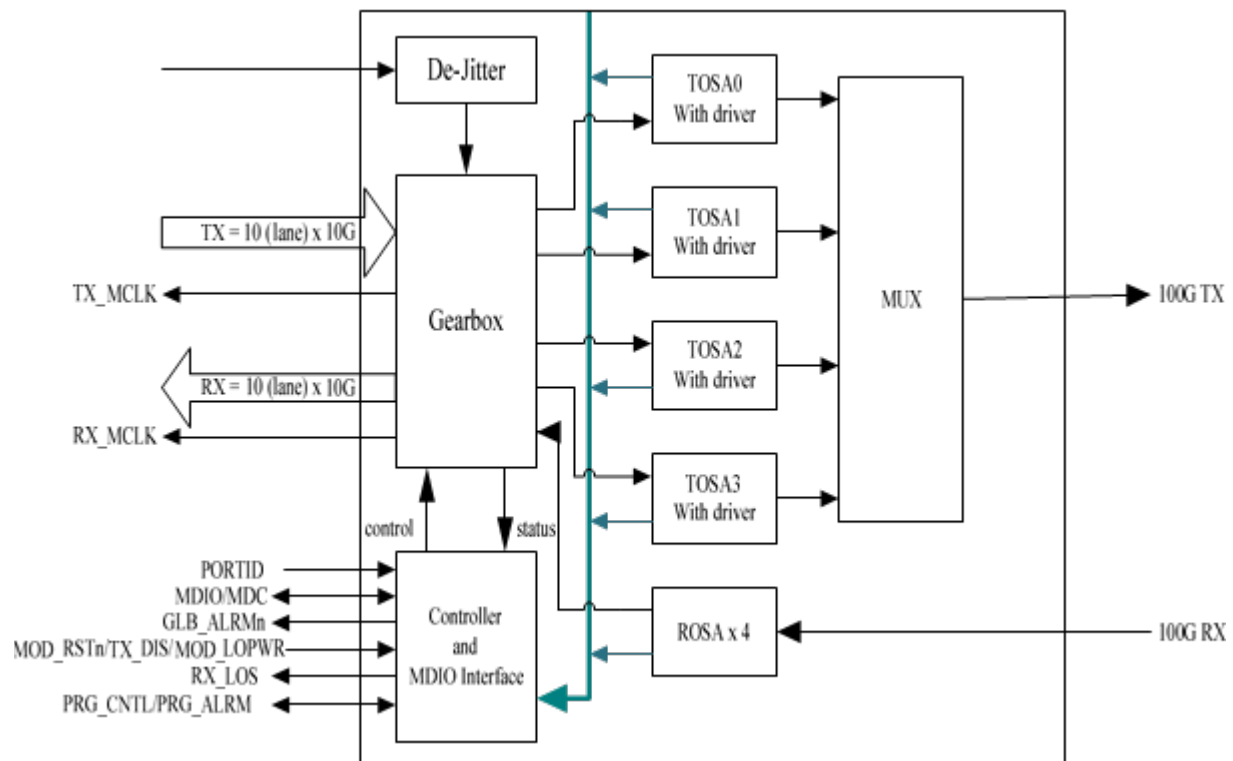
| Parameter                                                   | Symbol         | Min.                       | Typical | Max.    | Unit | Notes |
|-------------------------------------------------------------|----------------|----------------------------|---------|---------|------|-------|
| <b>Transmitter</b>                                          |                |                            |         |         |      |       |
| Signaling Speed per Lane                                    | BRAVE          |                            | 25.78   |         | Gbps |       |
| Lane_0 Center Wavelength                                    | $\lambda_{C0}$ | 1294.53                    | 1295.56 | 1296.59 | nm   |       |
| Lane_1 Center Wavelength                                    | $\lambda_{C1}$ | 1299.02                    | 1300.05 | 1301.09 | nm   |       |
| Lane_2 Center Wavelength                                    | $\lambda_{C2}$ | 1303.54                    | 1304.58 | 1305.63 | nm   |       |
| Lane_3 Center Wavelength                                    | $\lambda_{C3}$ | 1308.09                    | 1309.14 | 1310.19 | nm   |       |
| Total Average Output Power                                  | PO2            | -                          |         | 10.5    | dBm  | 1, 4  |
| Average Launch Power per Lane                               | Peach2         | -4.3                       |         | 4.5     | dBm  | 4     |
| Side Mode Suppression Ratio                                 | SMSR           | 30                         |         |         | dB   |       |
| Optical Return Loss Tolerance                               |                |                            |         | 20      | dB   |       |
| Extinction Ratio                                            | ER2            | 7                          |         |         | dB   | 4     |
| Transmitter eye mask definition<br>{X1, X2, X3, Y1, Y2, Y3} |                | IEEE802.3ba-2010 Compliant |         |         |      | 4     |
| TX Disable Assert Time                                      | t_off          |                            |         | 100     | us   |       |
| <b>Receiver</b>                                             |                |                            |         |         |      |       |
| Signaling Speed per Lane                                    | BRAVE          |                            | 25.78   |         | Gbps |       |
| Lane_0 Center Wavelength                                    | $\lambda_{C0}$ | 1294.53                    | 1295.56 | 1296.59 | nm   |       |
| Lane_1 Center Wavelength                                    | $\lambda_{C1}$ | 1299.02                    | 1300.05 | 1301.09 | nm   |       |
| Lane_2 Center Wavelength                                    | $\lambda_{C2}$ | 1303.54                    | 1304.58 | 1305.63 | nm   |       |
| Lane_3 Center Wavelength                                    | $\lambda_{C3}$ | 1308.09                    | 1309.14 | 1310.19 | nm   |       |
| Average Receive Power per Lane                              | Rpow2          | -10.6                      |         | 4.5     | dBm  | 6     |
| Receive Sensitivity (OMA) per Lane                          | Pmin2          |                            |         | -8.6    | dBm  | 8     |
| Stressed Sensitivity (OMA) per lane                         | SRS            |                            |         | -6.8    | dBm  |       |
| Receiver Overload per Lane                                  | Pmax           | 5.5                        |         |         | dBm  |       |
| Optical Return Loss                                         | ORL            |                            |         | -26     | dB   |       |
| LOS Assert                                                  | LOSA           | -21                        |         |         | dBm  |       |
| LOS De-Assert                                               | LOSD           |                            |         | -11     | dBm  |       |
| LOS Hysteresis                                              |                | 0.5                        |         |         | dB   |       |

### Notes:

1. Output is coupled into a 9/125 $\mu$ m single-mode fiber.
2. Filtered, measured with a PRBS 2<sup>31</sup>-1 test pattern @27.95Gbps
3. High speed I/O, internally AC coupled.
4. Filtered, measured with a PRBS 2<sup>31</sup>-1 test pattern @25.78Gbps
5. CFP transceiver works in OTU4 4I1-9D1F mode.
6. CFP transceiver works in 100GBASE-LR4 mode.

7. Minimum average optical power measured at BER less than  $1E-12$ , with a  $2^{31}-1$  PRBS@27.95Gbps.
8. Minimum OMA optical power measured at BER less than  $1E-12$ , with a  $2^{31}-1$  PRBS@25.78Gbps.

### Functional Description of Transceiver



### Electrical Pad Layout



## Pin Descriptions

### Part A: Bottom Row Pin Function Definition

| Pin | Name       | Function                   | Notes                                                                |
|-----|------------|----------------------------|----------------------------------------------------------------------|
| 1   | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 2   | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 3   | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 4   | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 5   | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 6   | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 7   | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 8   | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 9   | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 10  | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 11  | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 12  | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 13  | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 14  | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 15  | 3.3V       | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                      |
| 16  | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 17  | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 18  | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 19  | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 20  | 3.3V_GND   | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground     |
| 21  | VND_IO_A   | I/O                        | Module Vendor I/O, NC                                                |
| 22  | VND_IO_B   | I/O                        | Module Vendor I/O, NC                                                |
| 23  | GND        | Ground                     | Signal Ground                                                        |
| 24  | (TX_MCLKn) | Tx Monitor Clock O         | Tx Monitor Clock Output                                              |
| 25  | (TX_MCLKp) | Tx Monitor Clock O         | Tx Monitor Clock Output                                              |
| 26  | GND        | Ground                     | Signal Ground                                                        |
| 27  | VND_IO_C   | I/O                        | Module Vendor I/O, must not connect at host board                    |
| 28  | VND_IO_D   | I/O                        | Module Vendor I/O, must not connect at host board                    |
| 29  | VND_IO_E   | I/O                        | Module Vendor I/O, must not connect at host board                    |
| 30  | PRG_CNTL1  | I                          | LVCOMS                                                               |
| 31  | PRG_CNTL2  | I                          | LVCOMS                                                               |
| 32  | PRG_CNTL3  | I                          | LVCOMS                                                               |
| 33  | PRG_ALARM1 | O                          | LVCOMS                                                               |
| 34  | PRG_ALARM2 | O                          | LVCOMS                                                               |
| 35  | PRG_ALARM3 | O                          | LVCOMS                                                               |
| 36  | TX_DIS     | Transmitter Disable I      | "1" or NC = transmitter disabled,<br>"0" = transmitter enabled       |
| 37  | MOD_LOPW R | Module Low Power Mode I    | "1" or NC: module in low power (safe) mode,<br>"0": power-on enabled |
| 38  | MOD_ABS    | Module Absent O            | "1" or NC: module absent,<br>"0": module present                     |
| 39  | MOD_RSTn   | Module Reset I             | "0" resets the module,<br>"1" or NC = module enabled                 |
| 40  | RX_LOS     | Loss of Signal O           | "1": low optical signal, "0": normal condition                       |

|    |           |                            |                                                                             |
|----|-----------|----------------------------|-----------------------------------------------------------------------------|
| 41 | GLB_ALRMn | Global Alarm O             | "0": alarm condition in any MDIO Alarm register,<br>"1": no alarm condition |
| 42 | PRTADR4   | 1.2V CMOS I                | MDIO Physical Port address bit4                                             |
| 43 | PRTADR3   | 1.2V CMOS I                | MDIO Physical Port address bit3                                             |
| 44 | PRTADR2   | 1.2V CMOS I                | MDIO Physical Port address bit2                                             |
| 45 | PRTADR1   | 1.2V CMOS I                | MDIO Physical Port address bit1                                             |
| 46 | PRTADR0   | 1.2V CMOS I                | MDIO Physical Port address bit0                                             |
| 47 | MDIO      | 1.2V CMOS I/O              | Management Data I/O bi-directional data                                     |
| 48 | MDC       | 1.2V CMOS I                | Management Data Clock                                                       |
| 49 | GND       | Ground                     | Signal Ground                                                               |
| 50 | VND_IO_F  | I/O                        | Module Vendor I/O, Not Connected Internally                                 |
| 51 | VND_IO_G  | I/O                        | Module Vendor I/O, Not Connected Internally                                 |
| 52 | GND       | Ground                     | Signal Ground                                                               |
| 53 | VND_IO_H  | I/O                        | Module Vendor I/O, Not Connected Internally                                 |
| 54 | VND_IO_J  | I/O                        | Module Vendor I/O, Not Connected Internally                                 |
| 55 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 56 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 57 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 58 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 59 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 60 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 61 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 62 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 63 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 64 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 65 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 66 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 67 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 68 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 69 | 3.3V      | 3.3V Module Supply Voltage | 3.3V $\pm$ 2.5%                                                             |
| 70 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 71 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 72 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 73 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |
| 74 | 3.3V_GND  | Ground                     | 3.3V Module Supply Ground, Internally connected to Signal Ground            |

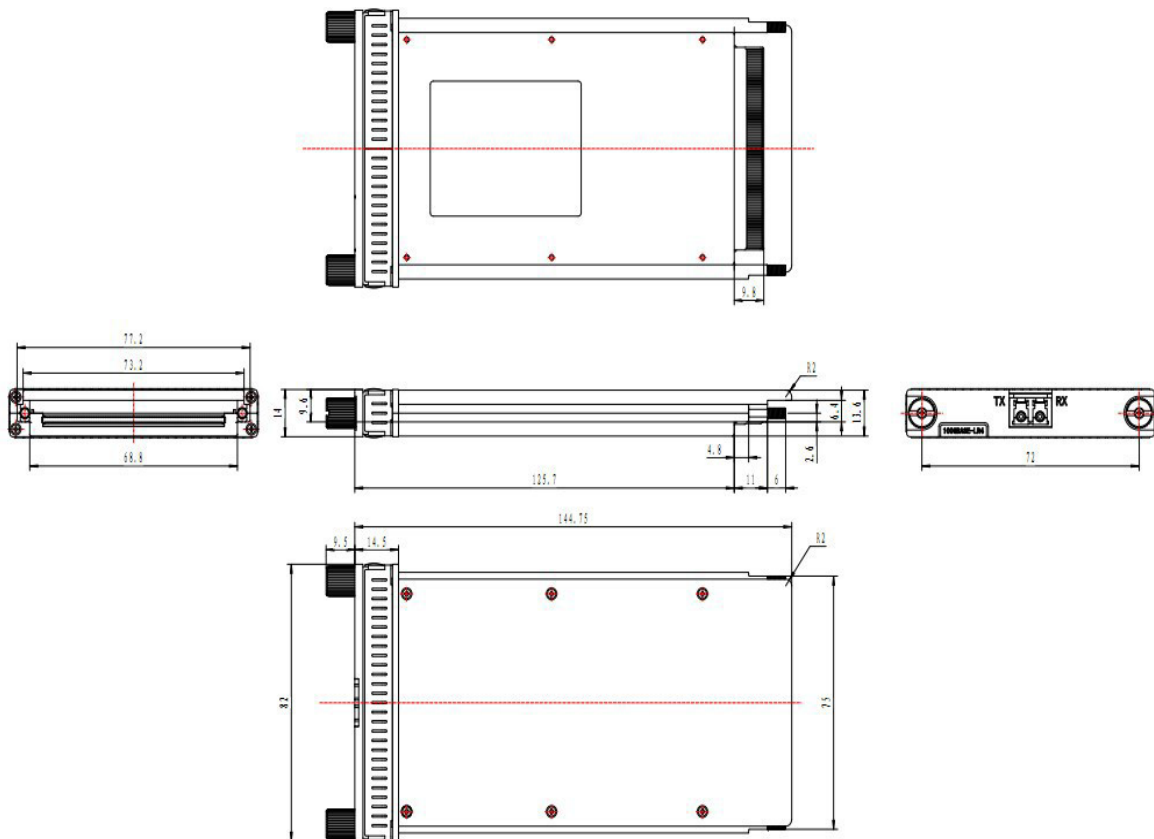
#### Part B: Top Row Pin Function Definition

| Pin | Name    | Function          | Notes                                                            |
|-----|---------|-------------------|------------------------------------------------------------------|
| 148 | GND     | Ground            | Signal Ground                                                    |
| 147 | REFCLKn | Reference Clock I | Reference Clock Input                                            |
| 146 | REFCLKp | Ground            | 3.3V Module Supply Ground, Internally connected to Signal Ground |
| 145 | GND     | Ground            | Signal Ground                                                    |
| 144 | N.C.    |                   | Not Connected Internally                                         |
| 143 | N.C.    |                   | Not Connected Internally                                         |
| 142 | GND     | Ground            | Signal Ground                                                    |
| 141 | TX9n    | Lane 9 Tx Input I |                                                                  |

|     |      |                    |                          |
|-----|------|--------------------|--------------------------|
| 140 | TX9p | Lane 9 Tx Input I  |                          |
| 139 | GND  | Ground             | Signal Ground            |
| 138 | TX8n | Lane 8 Tx Input I  | 3.3V $\pm$ 2.5%          |
| 137 | TX8p | Lane 8 Tx Input I  | 3.3V $\pm$ 2.5%          |
| 136 | GND  | Ground             | Signal Ground            |
| 135 | TX7n | Lane 7 Tx Input I  | 3.3V $\pm$ 2.5%          |
| 134 | TX7p | Lane 7 Tx Input I  | 3.3V $\pm$ 2.5%          |
| 133 | GND  | Ground             | Signal Ground            |
| 132 | TX6n | Lane 6 Tx Input I  |                          |
| 131 | TX6p | Lane 6 Tx Input I  |                          |
| 130 | GND  | Ground             | Signal Ground            |
| 129 | TX5n | Lane 5 Tx Input I  |                          |
| 128 | TX5p | Lane 5 Tx Input I  |                          |
| 127 | GND  | Ground             | Signal Ground            |
| 126 | TX4n | Lane 4 Tx Input I  |                          |
| 125 | TX4p | Lane 4 Tx Input I  |                          |
| 124 | GND  | Ground             | Signal Ground            |
| 123 | TX3n | Lane 3 Tx Input I  |                          |
| 122 | TX3p | Lane 3 Tx Input I  |                          |
| 121 | GND  | Ground             | Signal Ground            |
| 120 | TX2n | Lane 2 Tx Input I  |                          |
| 119 | TX2p | Lane 2 Tx Input I  |                          |
| 118 | GND  | Ground             | Signal Ground            |
| 117 | TX1n | Lane 1 Tx Input I  |                          |
| 116 | TX1p | Lane 1 Tx Input I  |                          |
| 115 | GND  | Ground             | Signal Ground            |
| 114 | TX0n | Lane 0 Tx Input I  |                          |
| 113 | TX0p | Lane 0 Tx Input I  |                          |
| 112 | GND  | Ground             | Signal Ground            |
| 111 | GND  | Ground             | Signal Ground            |
| 110 | N.C. |                    | Not Connected Internally |
| 109 | N.C. |                    | Not Connected Internally |
| 108 | GND  | Ground             | Signal Ground            |
| 107 | RX9n | Lane 9 Rx Output O |                          |
| 106 | RX9p | Lane 9 Rx Output O |                          |
| 105 | GND  | Ground             | Signal Ground            |
| 104 | RX8n | Lane 8 Rx Output O |                          |
| 103 | RX8p | Lane 8 Rx Output O |                          |
| 102 | GND  | Ground             | Signal Ground            |
| 101 | RX7n | Lane 7 Rx Output O |                          |
| 100 | RX7p | Lane 7 Rx Output O |                          |
| 99  | GND  | Ground             | Signal Ground            |
| 98  | RX6n | Lane 6 Rx Output O |                          |
| 97  | RX6p | Lane 6 Rx Output O |                          |
| 96  | GND  | Ground             | Signal Ground            |
| 95  | RX5n | Lane 5 Rx Output O |                          |
| 94  | RX5p | Lane 5 Rx Output O |                          |

|    |          |                    |                         |
|----|----------|--------------------|-------------------------|
| 93 | GND      | Ground             | Signal Ground           |
| 92 | RX4n     | Lane 4 Rx Output O |                         |
| 91 | RX4p     | Lane 4 Rx Output O |                         |
| 90 | GND      | Ground             | Signal Ground           |
| 89 | RX3n     | Lane 3 Rx Output O |                         |
| 88 | RX3p     | Lane 3 Rx Output O |                         |
| 87 | GND      | Ground             | Signal Ground           |
| 86 | RX2n     | Lane 2 Rx Output O |                         |
| 85 | RX2p     | Lane 2 Rx Output O |                         |
| 84 | GND      | Ground             | Signal Ground           |
| 83 | RX1n     | Lane 1 Rx Output O |                         |
| 82 | RX1p     | Lane 1 Rx Output O |                         |
| 81 | GND      | Ground             | Signal Ground           |
| 80 | RX0n     | Lane 0 Rx Output O |                         |
| 79 | RX0p     | Lane 0 Rx Output O |                         |
| 78 | GND      | Ground             | Signal Ground           |
| 77 | RX_MCLKn | Rx Monitor Clock O | Rx Monitor Clock Output |
| 76 | RX_MCLKp | Rx Monitor Clock O | Rx Monitor Clock Output |
| 75 | GND      | Ground             | Signal Ground           |

## Mechanical Specifications



Laser Emission

