

**FEATURES**

- RoHS compliant
- Compliant to SFP+ Electrical MSA SFF-8431
- Compliant with SFF-8472 MSA
- Standard LC duplex fiber-optic connector
- I<sup>2</sup>C for integrated Digital Optical Monitoring
- Power consumption < 1W

**Description**

The LCP-10G3A4EDR is a hot pluggable 10Gbps small form factor plus transceiver module integrated with the high performance 850nm VCSEL transmitter, high sensitivity PIN receiver and limiting amplifier for 10Gbps applications. It is compliant with the SFF-8431 SFP+ Electrical Multi-source Agreement (MSA) with five digital monitoring functions: Temperature, Vcc, Tx optical power, Tx laser bias current and Rx received optical power.

**Applications**

- 10G LAN switch
- 10G Ethernet switch/router
- 10G Fiber channel
- SAN applications

**Absolute Maximum Ratings**

| Parameter                  | Symbol    | Min. | Typ. | Max. | Unit |
|----------------------------|-----------|------|------|------|------|
| Storage Temperature        | $T_S$     | -40  |      | 85   | °C   |
| Supply Voltage Range @3.3V | $V_{CC3}$ | -0.5 |      | 3.6  | V    |

**Recommended Operating Conditions**

| Parameter                  | Symbol    | Min.  | Typ. | Max.  | Unit |
|----------------------------|-----------|-------|------|-------|------|
| Case Operating Temperature | $T_C$     | -5    |      | +70   | °C   |
| Supply Voltage @3.3V       | $V_{CC3}$ | 3.135 | 3.30 | 3.465 | V    |
| DC Common Mode Voltage     | $V_{CM}$  | 0     |      | 3.6   | V    |

**Low Speed Electrical Characteristics**

( $V_{CC}=3.135V$  to  $3.465V$ )

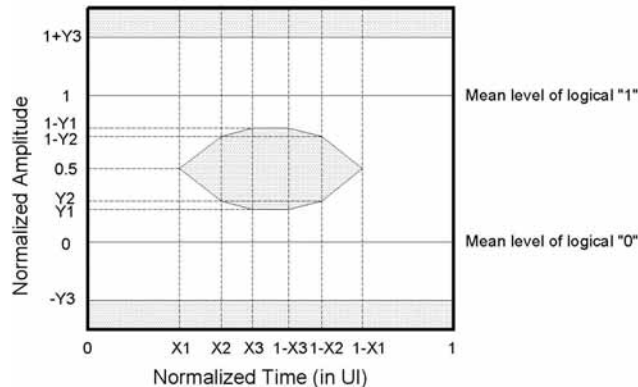
| Parameter            | Symbol   | Min.         | Typ. | Max.         | Unit | Note |
|----------------------|----------|--------------|------|--------------|------|------|
| Total Supply Current | $I_{CC}$ |              |      | 300          | mA   |      |
| Power Consumption    |          |              |      | 1            | W    |      |
| TX_Fault, RX_LOS     | $V_{OL}$ | 0            |      | 0.4          | V    |      |
|                      | $V_{OH}$ | Host_Vcc-0.5 |      | Host_Vcc+0.3 | V    |      |
| TX_Disable           | $V_{IL}$ | -0.3         |      | 0.8          | V    | 1    |
|                      | $V_{IH}$ | 2.0          |      | VccT+0.3     | V    | 1    |
| RS0, RS1             | $V_{IL}$ | -0.3         |      | 0.8          | V    | 2    |
|                      | $V_{IH}$ | 2.0          |      | VccT+0.3     | V    | 2    |

1. Shall be pulled up with 4.7k-10k ohms to VccT in the module.
2. Shall be pulled low to VeeT with a  $> 30k$  ohms resistor in the module.

**Optical Transmitter Characteristics (T<sub>C</sub> = -5°C to 70°C)**

| Parameter  | Symbol                               | Min.                                      | Typ.    | Max. | Unit  | Note |
|--|--------------------------------------|---|---------|------|-------|------|
| Data Rate  | R                                    |   | 10.3125 |      | Gb/s  |      |
| Signaling speed variation from nominal.                  |                                      |   |         | ±100 | ppm   |      |
| Average Output Power                                     | P <sub>avg</sub>                     | -5  |         | -1.8 | dBm   |      |
| Wavelength   | λ                                    | 840                                       |         | 860  | nm    |      |
| Spectral Width RMS                                       |                                      |   |         | 0.45 | nm    |      |
| Transmitter OFF Output Power                             | P <sub>off</sub>                     |   |         | -30  | dBm   |      |
| Extinction Ratio   | ER                                   | 3   |         |      |       |      |
| Optical Modulation Amplitude                             | OMA                                  | Compliant with Minimum OMA relation table |         |      | dBm   |      |
| Relative Intensity Noise                                 | RIN                                  |   |         | -128 | dB/Hz |      |
| Optical Return Loss                                      | ORL                                  |   |         | 12   | dB    |      |
| Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3} | {0.25, 0.40, 0.45, 0.25, 0.28, 0.40} |   |         |      |       |      |

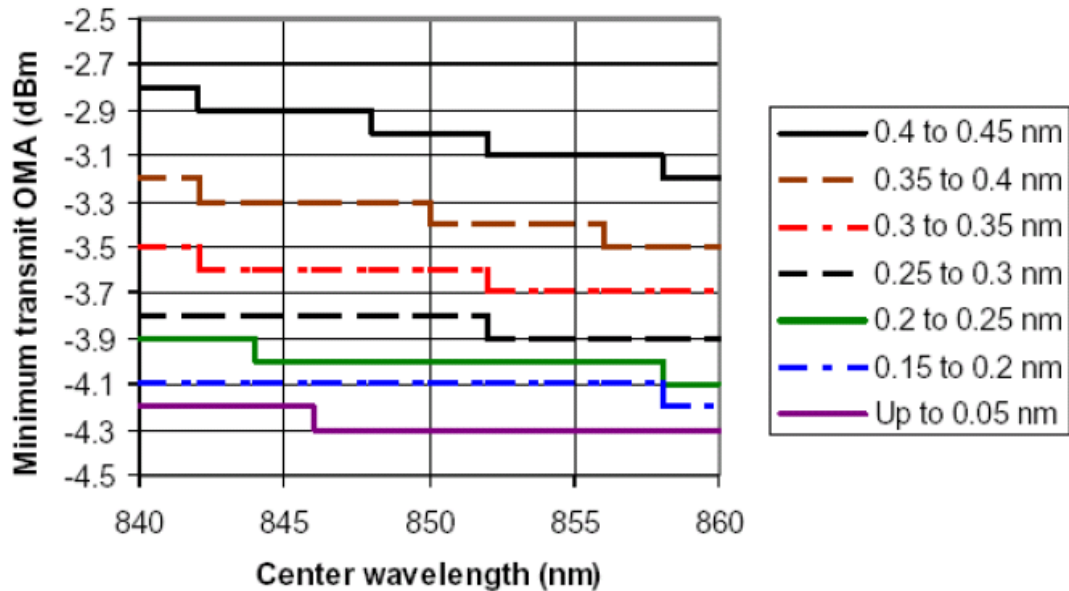
**Transmitter eye mask definition**



**Minimum optical modulation amplitude (dBm) relation table**

| Center Wavelength (nm) | RMS Spectral width (nm) |             |             |             |             |             |             |             |             |
|------------------------|-------------------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
|                        | Up to 0.05              | 0.05 to 0.1 | 0.1 to 0.15 | 0.15 to 0.2 | 0.2 to 0.25 | 0.25 to 0.3 | 0.3 to 0.35 | 0.35 to 0.4 | 0.4 to 0.45 |
| 840 to 842             | -4.2                    | -4.2        | -4.1        | -4.1        | -3.9        | -3.8        | -3.5        | -3.2        | -2.8        |
| 842 to 844             | -4.2                    | -4.2        | -4.2        | -4.1        | -3.9        | -3.8        | -3.6        | -3.3        | -2.9        |
| 844 to 846             | -4.2                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.3        | -2.9        |
| 846 to 848             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.3        | -2.9        |
| 848 to 850             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.3        | -3.0        |
| 850 to 852             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.8        | -3.6        | -3.4        | -3.0        |
| 852 to 854             | -4.3                    | -4.2        | -4.2        | -4.1        | -4.0        | -3.9        | -3.7        | -3.4        | -3.1        |
| 854 to 856             | -4.3                    | -4.3        | -4.2        | -4.1        | -4.0        | -3.9        | -3.7        | -3.4        | -3.1        |
| 856 to 858             | -4.3                    | -4.3        | -4.2        | -4.1        | -4.0        | -3.9        | -3.7        | -3.5        | -3.1        |
| 858 to 860             | -4.3                    | -4.3        | -4.2        | -4.2        | -4.1        | -3.9        | -3.7        | -3.5        | -3.2        |

Triple tradeoff curve



**Optical Receiver Characteristics (T<sub>c</sub> = -5°C to 70°C)**

| Parameter                               | Symbol                             | Min. | Typ.    | Max.  | Unit | Note |
|---|------------------------------------|------|---------|-------|------|------|
| Signaling speed (nominal)               | T <sub>s</sub>                     |      | 10.3125 |       | Gb/s |      |
| Signaling speed variation from nominal. |                                    |      |         | ±100  | ppm  |      |
| Center Wavelength                       | λ                                  | 840  |         | 860   | nm   |      |
| Overload                                | P <sub>O</sub>                     |      |         | -1    | dBm  |      |
| Receiver sensitivity in OMA             | RSO                                |      |         | -11.1 | dBm  | 1    |
| LOS De-assert                           | LOS <sub>D</sub>                   |      |         | -11   | dBm  |      |
| LOS Assert                              | LOS <sub>A</sub>                   | -27  |         |       | dBm  | 2    |
| LOS Hysteresis                          | LOS <sub>D</sub> -LOS <sub>A</sub> | 0.5  |         |       | dB   |      |
| Receiver Reflectance                    |                                    |      |         | -12   | dB   | 3    |
| Differential Output Amplitude           |                                    | 150  |         | 850   | mV   |      |
| Stressed Receive sensitivity OMA        |                                    |      |         | -7.5  | dBm  |      |

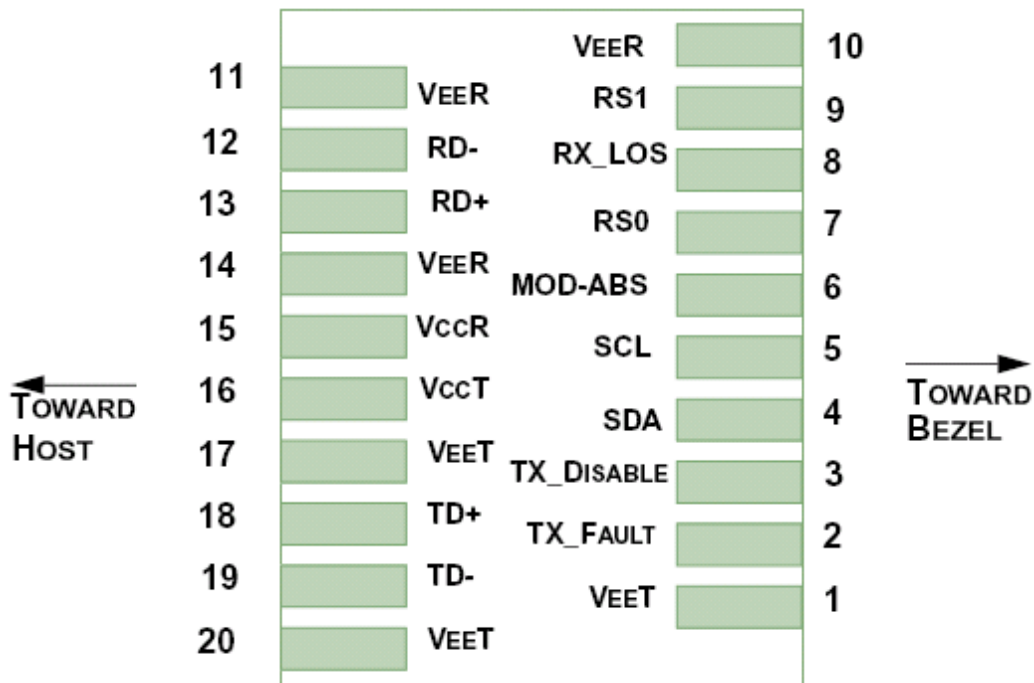
Notes:

1. Measured by reference TX with 4.75dB extinction ratio at 10<sup>-12</sup> BER
2. When LOS asserted, the data output is Low-Level (fixed)
3. When the terminal is viewed from the optical path, the reflection toward the optical path of the optical signal with a central wavelength of 840nm to 860nm transmitted to terminal.
4. Distance, shown in the "Link Length" table, are calculated for worst case fiber and transceiver characteristics based on the optical and electrical specifications shown in this document using techniques utilized in IEEE 802.3. In the nominal case, longer distance are achievable.

### Link Length

| Fiber type  | Minimum modal bandwidth @ 850nm (MHz*km) | Operating range (meters) | Note |
|-------------|--|--------------------------|------|
| 62.5 um MMF | 160                                      | 2 to 26                  | 4    |
|             | 200                                      | 2 to 33                  | 4    |
| 50 um MMF   | 400                                      | 2 to 66                  | 4    |
|             | 500                                      | 2 to 82                  | 4    |
|             | 2000                                     | 2 to 300                 | 4    |

### SFP+ Transceiver Electrical Pad Layout



**Module Electrical Pin Definition**

| Pin | Logic     | Symbol     | Name/Description   | Note |
|-----|-----------|------------|--|------|
| 1   |           | VeeT       | Module Transmitter Ground  | 1    |
| 2   | LVTTL-O   | TX_Fault   | Module Transmitter Fault   | 2    |
| 3   | LVTTL-I   | TX_Disable | Transmitter Disable; Turns off transmitter laser output                          | 3    |
| 4   | LVTTL-I/O | SDA        | 2- write Serial Interface Data Line  |      |
| 5   | LVTTL-I/O | SCL        | 2- write Serial Interface Clock  |      |
| 6   |           | MOD_ABS    | Module Absent, connected to V <sub>ee</sub> T or V <sub>ee</sub> R in the module | 4    |
| 7   | LVTTL-I   | RS0        | Not Implement  |      |
| 8   | LVTTL-O   | RX_LOS     | Receiver Loss of Signal Indication   | 2    |
| 9   | LVTTL-I   | RS1        | Not Implement  |      |
| 10  |           | VeeR       | Module Receiver Ground   | 1    |
| 11  |           | VeeR       | Module Receiver Ground   | 1    |
| 12  | CML-O     | RD-        | Receiver Inverted Data Output  |      |
| 13  | CML-O     | RD+        | Receiver Non-Inverter Data Output  |      |
| 14  |           | VeeR       | Module Receiver Ground   | 1    |
| 15  |           | VccR       | Module Receiver 3.3V Supply  |      |
| 16  |           | VccT       | Module Transmitter 3.3V Supply   |      |
| 17  |           | VeeT       | Module Transmitter Ground  | 1    |
| 18  | CML-I     | TD+        | Transmitter Non-Inverted Data Input  |      |
| 19  | CML-I     | TD-        | Transmitter Inverted Data Input  |      |
| 20  |           | VeeT       | Module Transmitter Griund  | 1    |

**Note:**

1. The module signal ground pins, VeeR and VeeT, shall be isolated from the module case.
2. This pin is an open collector/drain output pin and shall be pulled up with 4.7k-10k ohms to 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 VccT/R + 0.5V.
3. This pin is an open collector/drain input pin and shall be pulled up with 4.7k-10k ohms to VccT in the Module.
4. This pin shall be pulled up with 4.7k-10k ohms to Host\_Vcc on the host board.

## Low speed electrical control pins and 2-wire interface

In addition to the 2-wire serial interface, the SFP+ module has the following low speed pins for control and status:

- TX\_Fault
- TX\_Disable
- RS0/RS1
- MOD\_ABS
- RX\_LOS

### 1 TX\_Fault

.TX\_Fault is a module output pin that when High, indicates that the module transmitter has detected a fault condition related to laser operation or safety.

The TX\_Fault output pin is an open drain/collector and must be pulled p to the Host\_Vcc with 4.7k-10k ohms on the host board

### 2 TX\_Disable

TX\_Disable is a module input pin. When TX\_Disable is asserted High or Left open, the SFP+ module transmitter output must be turned off. The TX\_DIS pin must be pulled up to VccT in the SFP+ module..

### 3 RS0/RS1

RS0 and RS1 are module input rate select pins and are pulled low to VeeT with a > 30kΩ resistor in the module. RS0 is an input hardware pin which optionally selects the optical receive data path rate coverage for an SFP+ module. RS1 is an input hardware pin which optionally selects the optical transmit path data rate coverage for an SFP+ module. RS1 is commonly connected to VeeT or VeeR in the legacy SFP modules. The host needs to ensure that it will not be damaged if this pin is connected to VeeT or VeeR in the module.

### 4 MOD\_ABS

Mod\_ABS is pulled up to Host\_Vcc with 4.7k-10k ohms on the host board and connected to VeeT or VeeR in the SFP+ module. MOD\_ABS is then asserted “High” when the SFP+ module is physically absent from a host slot. In the SFP MSA (INF8074i) this pin had the same function but is called MOD\_DEF0.

### 5 SCL/SDA

SCL is the 2-wire interface clock and SDA is the 2-wire interface data line. SCL and SDA are pulled up to a voltage in the range of 3.14V to 3.46V on the host.

### 6 RX\_LOS

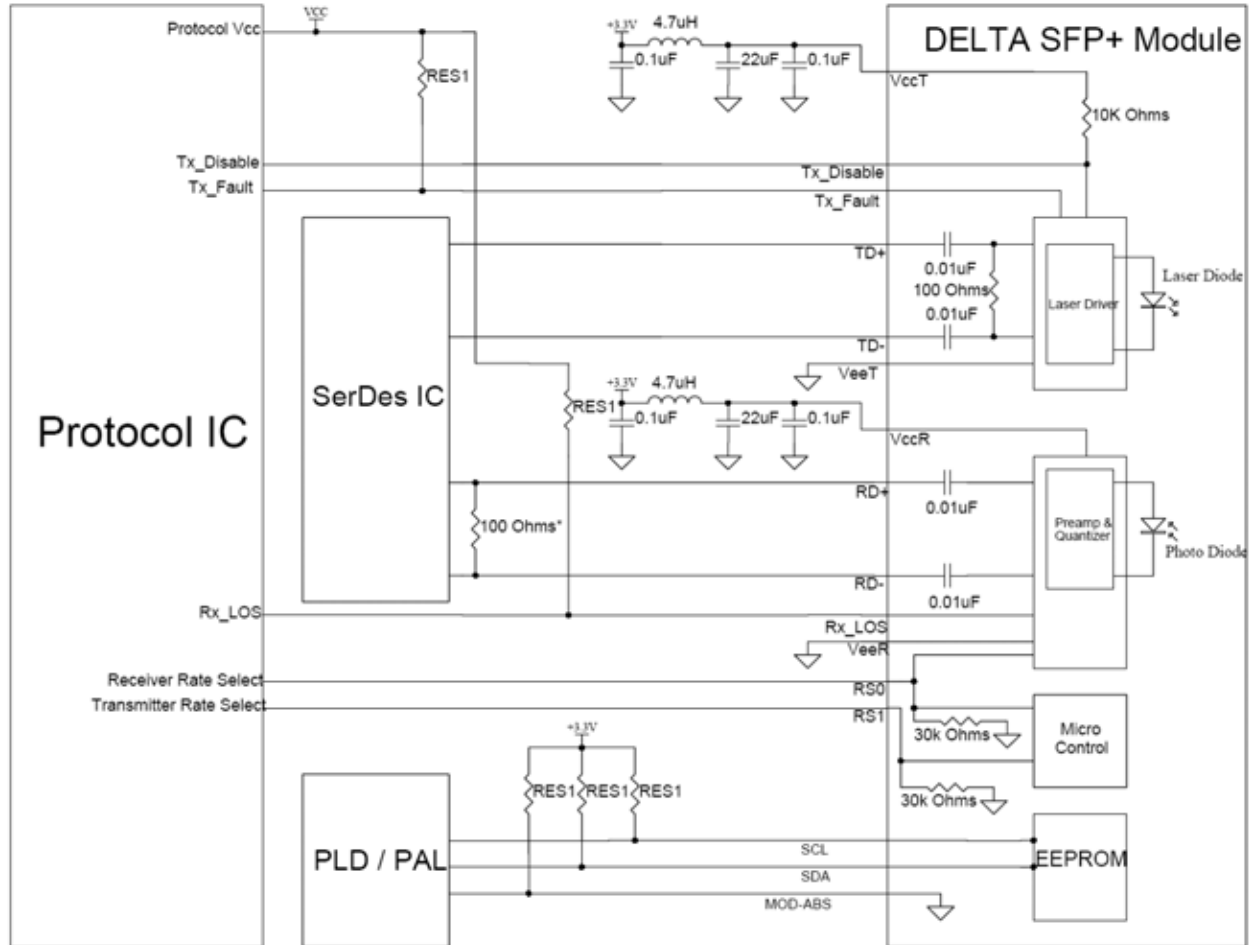
RX\_LOS when High indicated an optical signal level below that specified in the relevant standard. The RX\_LOS pin is an open drain/collector output and must be pulled up to host Vcc with a 4.7k-10k ohms on

the host board.

RX\_LOS assert min and de-assert max are defined in the relevant standard. To avoid spurious transition of RX\_LOS a minimum hysteresis of 0.5 dB is recommended.



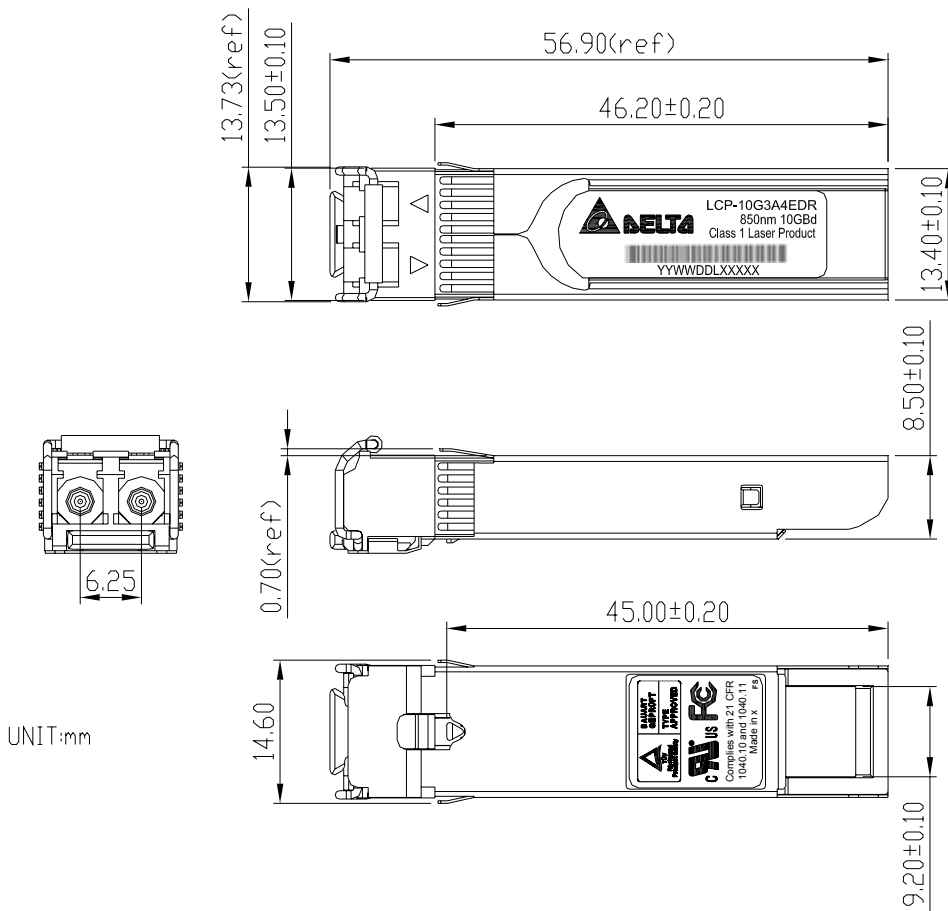
Recommend Circuit Schematic



RES1 = 4.7k TO 10k Ohms  
 \* Depends on SerDes IC used

Package Outline Drawing for Metal Housing with Bail de-latch

|                               |
|-------------------------------|
| <b>Latch Color Identifier</b> |
| Black                         |



UNIT:mm

**Timing parameters for SFP+ management**

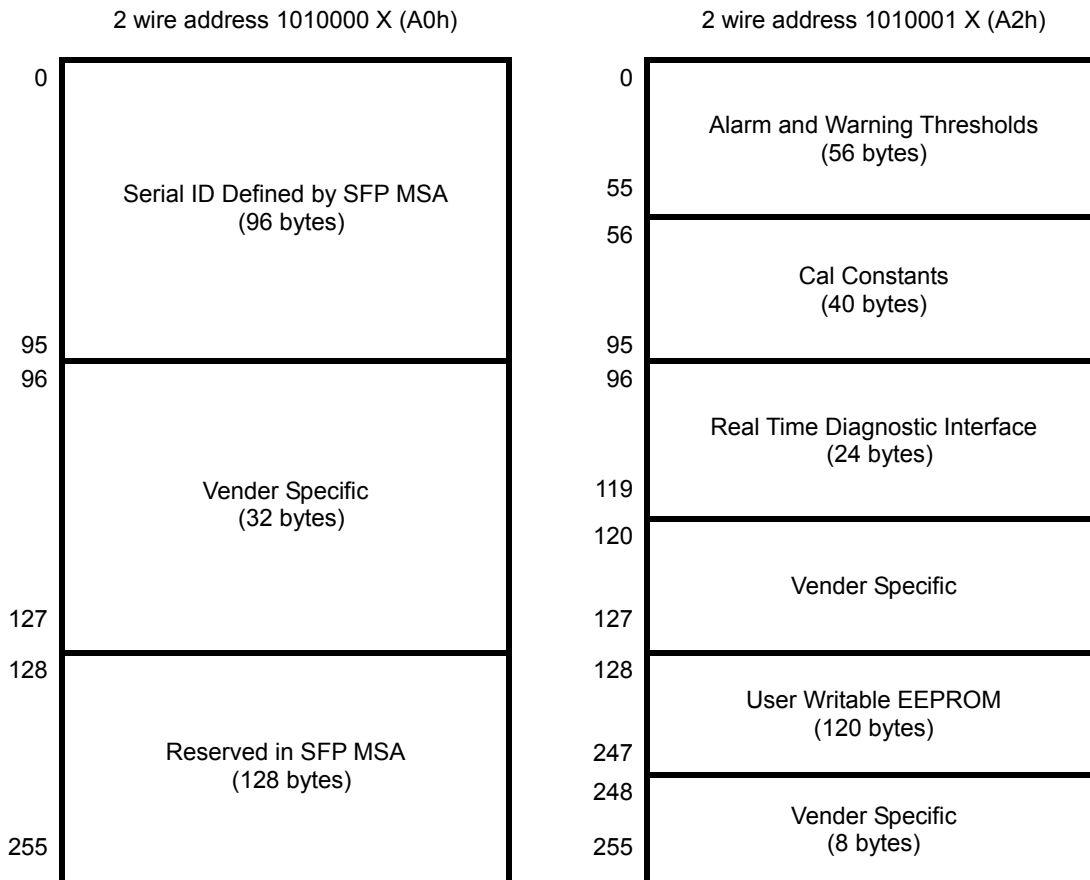
| Parameter                            | Symbol            | Min. | Max. | Unit | Note |
|--------------------------------------|-------------------|------|------|------|------|
| TX_DISABLE Assert time               | t_off             |      | 10   | μsec | 1    |
| TX_DISABLE Negate time               | t_on              |      | 2    | msec | 2    |
| Time to initialize 2-wire interphase | t_2w_start_up     |      | 300  | msec | 3    |
| Time to initialize                   | t_start_up        |      | 300  | msec | 4    |
| Time to initialize cooled module     | t_start_up_cooled |      | 90   | sec  | 4    |
| Time to Power Up to Level 2          | t_power_level2    |      | 300  | msec | 5    |
| Time to Power Down from Level 2      | T_power_down      |      | 300  | msec | 6    |
| TX_Fault assert                      | TX_Fault_on       |      | 1    | msec | 7    |
| TX_Fault assert for cooled module    | TX_Fault_on       |      | 50   | msec | 7    |
| TX_Fault Reset                       | t_reset           | 10   |      | μsec | 8    |
| Module Reset                         | t_module_reset    |      | TBD  | msec | TBD  |
| RS0, RS1 rate select timing for FC   | t_RS0_FC, RS1_FC  |      | 500  | μsec | 9    |
| RS0, RS1 rate select timing non FC   | t_RS0, t_RS1      |      | 10   | msec | 9    |
| RX_LOS assert delay                  | t_los_on          |      | 100  | μsec | 10   |
| RX_LOS negate delay                  | t_los_off         |      | 100  | μsec | 11   |

**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 negation of TX\_Disable.
- 4) From power on or TX\_Disable negated during power up, or TX\_Fault recovery, until non-cooled power level 1 part (or non-cooled power level 2 part already enabled at power level 2 for TX\_Fault recovery) is fully operational.
- 5) From falling edge of stop bit enabling power level 2 until non-cooled module is fully operational.
- 6) From falling edge of stop bit disabling power level 2 until module is within power level 1 requirements.
- 7) From Occurrence of fault to assertion of TX\_Fault.
- 8) Time TX\_Disable must be held High to reset TX\_Fault.
- 9) From assertion till stable output.
- 10) From Occurrence of loss of signal to assertion of LOS
- 11) From Occurrence of presence of signal to negation of RX\_LOS.

## Enhanced Digital Diagnostic Interface

The memory map in the following describes an extension to the memory map defined in SFP MSA. The enhanced interface uses the two wire serial bus address 1010001X(A2h) to provide diagnostic information about the module's present operating conditions.



Digital Diagnostic Memory Map Specific Data Field Descriptions

**EEPROM Serial ID Memory Contents (2-Wire Address A0h)**

| Address | Hex | ASCII | Address | Hex | ASCII  | Address | Hex | ASCII  |
|---------|-----|-------|---------|-----|--------|---------|-----|--------|
| 00      | 03  |       | 43      | 2D  | -      | 86      | DC  |        |
| 01      | 04  |       | 44      | 31  | 1      | 87      | DC  |        |
| 02      | 07  |       | 45      | 30  | 0      | 88      | DC  |        |
| 03      | 10  |       | 46      | 47  | G      | 89      | DC  |        |
| 04      | 00  |       | 47      | 33  | 3      | 90      | DC  |        |
| 05      | 00  |       | 48      | 41  | A      | 91      | DC  |        |
| 06      | 00  |       | 49      | 34  | 4      | 92      | 68  |        |
| 07      | 00  |       | 50      | 45  | E      | 93      | F0  |        |
| 08      | 00  |       | 51      | 44  | D      | 94      | 03  |        |
| 09      | 00  |       | 52      | 52  | R      | 95      | CS2 | Note 4 |
| 10      | 00  |       | 53      | 20  |        | 96      | 00  |        |
| 11      | 03  |       | 54      | 20  |        | 97      | 00  |        |
| 12      | 67  |       | 55      | 20  |        | 98      | 00  |        |
| 13      | 00  |       | 56      | 41  |        | 99      | 00  |        |
| 14      | 00  |       | 57      | 20  |        | 100     | 00  |        |
| 15      | 00  |       | 58      | 20  |        | 101     | 00  |        |
| 16      | 08  |       | 59      | 20  |        | 102     | 00  |        |
| 17      | 03  |       | 60      | 03  |        | 103     | 00  |        |
| 18      | 00  |       | 61      | 52  |        | 104     | 00  |        |
| 19      | 1E  |       | 62      | 00  |        | 105     | 00  |        |
| 20      | 44  | D     | 63      | CS1 | Note 1 | 106     | 00  |        |
| 21      | 45  | E     | 64      | 00  |        | 107     | 00  |        |
| 22      | 4C  | L     | 65      | 1A  |        | 108     | 00  |        |
| 23      | 54  | T     | 66      | 00  |        | 109     | 00  |        |
| 24      | 41  | A     | 67      | 00  |        | 110     | 00  |        |
| 25      | 20  |       | 68      | SN  | Note 2 | 111     | 00  |        |
| 26      | 20  |       | 69      | SN  |        | 112     | 00  |        |
| 27      | 20  |       | 70      | SN  |        | 113     | 00  |        |
| 28      | 20  |       | 71      | SN  |        | 114     | 00  |        |
| 29      | 20  |       | 72      | SN  |        | 115     | 00  |        |
| 30      | 20  |       | 73      | SN  |        | 116     | 00  |        |
| 31      | 20  |       | 74      | SN  |        | 117     | 00  |        |
| 32      | 20  |       | 75      | SN  |        | 118     | 00  |        |
| 33      | 20  |       | 76      | SN  |        | 119     | 00  |        |
| 34      | 20  |       | 77      | SN  |        | 120     | 00  |        |
| 35      | 20  |       | 78      | SN  |        | 121     | 00  |        |
| 36      | 00  |       | 79      | SN  |        | 122     | 00  |        |
| 37      | 00  |       | 80      | SN  |        | 123     | 00  |        |
| 38      | 00  |       | 81      | SN  |        | 124     | 00  |        |
| 39      | 00  |       | 82      | SN  |        | 125     | 00  |        |
| 40      | 4C  | L     | 83      | SN  |        | 126     | 00  |        |
| 41      | 43  | C     | 84      | DC  | Note 3 | 127     | 00  |        |
| 42      | 50  | P     | 85      | DC  |        | 128     | 00  | Note 5 |

**Notes:**

- 1) Byte 63: Check sum of bytes 0-62.
- 2) Byte 68-83: Serial number.
- 3) Byte 84-91: Date code.
- 4) Byte 95: Check sum of bytes 64-94.
- 5) Byte 128 to 255 had been set hex 00.

**Digital Diagnostic Monitoring Interface**
**Alarm and Warning Thresholds (2-Wire Address A2h)**

| Address | # Bytes | Name                              | Value (Dec.)           | Unit | Note |
|---------|---------|-----------------------------------|------------------------|------|------|
| 00-01   | 2       | Temp High Alarm                   | 85 degree Celsius      | °C   | 1    |
| 02-03   | 2       | Temp Low Alarm                    | -10 degree Celsius     |      |      |
| 04-05   | 2       | Temp High Warning                 | 80 degree Celsius      |      |      |
| 06-07   | 2       | Temp Low Warning                  | -5 degree Celsius      |      |      |
| 08-09   | 2       | Voltage High Alarm                | 3.6V                   | Volt |      |
| 10-11   | 2       | Voltage Low Alarm                 | 3.0V                   |      |      |
| 12-13   | 2       | Voltage High Warning              | 3.5V                   |      |      |
| 14-15   | 2       | Voltage Low Warning               | 3.1V                   |      |      |
| 16-17   | 2       | Bias High Alarm                   | I <sub>OP</sub> +10 mA | mA   | 2    |
| 18-19   | 2       | Bias Low Alarm                    | I <sub>OP</sub> -5 mA  |      |      |
| 20-21   | 2       | Bias High Warning                 | I <sub>OP</sub> +7 mA  |      |      |
| 22-23   | 2       | Bias Low Warning                  | I <sub>OP</sub> -3 mA  |      |      |
| 24-25   | 2       | TX Power High Alarm               | P +3dB                 | dBm  | 3    |
| 26-27   | 2       | TX Power Low Alarm                | P -3dB                 |      |      |
| 28-29   | 2       | TX Power High Warning             | P +2dB                 |      |      |
| 30-31   | 2       | TX Power Low Warning              | P -2dB                 |      |      |
| 32-33   | 2       | RX Power High Alarm               | 0dBm                   | dBm  | 4    |
| 34-35   | 2       | RX Power Low Alarm                | -13.1dBm               |      |      |
| 36-37   | 2       | RX Power High Warning             | -1dBm                  |      |      |
| 38-39   | 2       | RX Power Low Warning              | -11.1dBm               |      |      |
| 40-45   | 16      | Reversed                          |                        |      |      |
| 56-91   | 36      | External Calibration Constants    |                        |      |      |
| 92-94   | 3       | Reversed                          |                        |      |      |
| 95      | 1       | Checksum                          |                        |      | 5    |
| 96-97   | 2       | Real Time Temperature             |                        |      |      |
| 98-99   | 2       | Real Time Supply Voltage          |                        |      |      |
| 100-101 | 2       | Real Time Tx Bias Current         |                        |      |      |
| 102-103 | 2       | Real Time Tx Optical Power        |                        |      |      |
| 104-105 | 2       | Real Time Rx Received Power       |                        |      |      |
| 106-109 | 4       | Reserved                          |                        |      |      |
| 110     | 1       | Optional Status/ Control Bits     |                        |      |      |
| 111     | 1       | Reserved                          |                        |      |      |
| 112-119 | 8       | Optional Set of Alarm and Warning |                        |      |      |

**Notes:**

- 1) T<sub>C</sub>: Case Operating temperature
- 2) I<sub>OP</sub>: Operating current at room temperature. The min. setting current is 0 mA.
- 3) P: Operating optical power of transmitter at room temperature.
- 4) P<sub>O</sub>: Overload optical power of receiver  
P<sub>S</sub>: Sensitivity optical power of receiver
- 5) Byte 95 contains the low order 8bits of sum of bytes 0-94

6)

**State/ Control Bits**

| Byte | Bit | Name              | Description  |
|------|-----|-------------------|--|
| 110  | 7   | Tx Disable State  | Digital state of the Tx disable input pin            |
| 110  | 6   | Soft Tx Disable   | Read/ Write bit that allow software disable of laser |
| 110  | 5   | Reserved          |  |
| 110  | 4   | Rate Select State | Rate Select State                                    |
| 110  | 3   | Soft Rate Select  | Software Rate Select State                           |
| 110  | 2   | Tx Fault          | Digital state of the Tx fault output pin             |
| 110  | 1   | LOS               | Digital state of the LOS output pin.                 |
| 110  | 0   | Data_Ready_Bar    | NA   |

7)

**Optional Set of Alarm and Warning**

| Byte | Bit | Name                  | Description   |
|------|-----|-----------------------|---|
| 112  | 7   | Temp High Alarm       | Set when internal temperature exceeds high alarm level      |
| 112  | 6   | Temp Low Alarm        | Set when internal temperature is below low alarm level      |
| 112  | 5   | Vcc High Alarm        | Set when internal supply voltage exceeds high alarm level   |
| 112  | 4   | Vcc Low Alarm         | Set when internal supply voltage is below low alarm level   |
| 112  | 3   | Tx Bias High Alarm    | Set when Tx Bias current exceeds high alarm level           |
| 112  | 2   | Tx Bias Low Alarm     | Set when Tx Bias current is below low alarm level           |
| 112  | 1   | Tx Power High Alarm   | Set when Tx output power exceeds high alarm level           |
| 112  | 0   | Tx Power Low Alarm    | Set when Tx output power is below low alarm level           |
| 113  | 7   | Rx Power High Alarm   | Set when received power exceeds high alarm level            |
| 113  | 6   | Rx Power Low Alarm    | Set when received power is below low alarm level            |
| 113  | 5-0 | Reserved              |   |
| 116  | 7   | Temp High Warning     | Set when internal temperature exceeds high warning level    |
| 116  | 6   | Temp Low Warning      | Set when internal temperature is below low warning level    |
| 116  | 5   | Vcc High Warning      | Set when internal supply voltage exceeds high warning level |
| 116  | 4   | Vcc Low Warning       | Set when internal supply voltage is below low warning level |
| 116  | 3   | Tx Bias High Warning  | Set when Tx Bias current exceeds high warning level         |
| 116  | 2   | Tx Bias Low Warning   | Set when Tx Bias current is below low warning level         |
| 116  | 1   | Tx Power High Warning | Set when Tx output power exceeds high warning level         |
| 116  | 0   | Tx Power Low Warning  | Set when Tx output power is below low warning level         |
| 117  | 7   | Rx Power High Warning | Set when received power exceeds high warning level          |
| 117  | 6   | Rx Power Low Warning  | Set when received power is below low warning level          |
| 117  | 5-0 | Reserved              |   |

**Digital Diagnostic Monitor Accuracy**

| Parameter               | Typical Value           | Note |
|-------------------------|-------------------------|------|
| Transceiver Temperature | $\pm 3^{\circ}\text{C}$ | 1    |
| Power Supply Voltage    | $\pm 3\%$               | 2    |
| TX Bias Current         | $\pm 10\%$              |      |
| TX Optical Power        | $\pm 1.5\text{dB}$      |      |
| RX Optical Power        | $\pm 3\text{dB}$        |      |

**Notes:**

- 1) Temperature is measured internal to the transceiver
- 2) Voltage is measured internal to the transceiver

**Regulatory Compliance**

| Feature   | Test Method            | Reference   | Performance  |
|---|------------------------|---|--|
| Electromagnetic Interference (EMI)                        |                        | FCC Part15 Class B<br>EN 55022 Class B<br>(CISPR 22A) | (1) Satisfied with electrical characteristics of product spec.<br><br>(2) No physical damage |
| Radio Frequency Electromagnetic Field Immunity            |                        | IEC/EN 61000-4-3                                      |  |
| Electrostatic Discharge (ESD) to the Duplex LC Receptacle | Contact Discharge      | IEC/EN 61000-4-2                                      |  |
|   | Air Discharge          | IEC/EN 61000-4-2                                      |  |
| Electrostatic Discharge (ESD) to the Electrical Pins      | Human Body Model (HBM) | MIL-STD-883E Method 3015.7<br>EIA-JESD22-A114         |  |
|   | Machine Model (MM)     | EIA-JESD22-A115                                       |  |
| Laser Eye Safety  | FDA/CDRH               | US FDA CDRH AEL Class 1                               |  |
|   | TUV                    | IEC/EN 60825-1<br>IEC/EN 60825-2                      |  |
| Component Recognition                                     | TUV                    | IEC/EN 60950-1  |  |
|   | UL/CSA                 | UL60950   |  |