



RoHS compliant Small Form Factor Pluggable Transceiver for Fast Ethernet, ATM, SONET OC-3/SDH STM-1

FEATURES



- Compliant with SFP Transceiver MSA specification
- Compliant with Intra-office SONET OC-3 / SDH STM-1 (I-1)
- Compliant with Industry Standard RFT Electrical Connector and Cage
- Single + 3.3V Power Supply and TTL Logic Interface
- EEPROM with Serial ID Functionality
- Laser Class 1 Product which comply with the requirements of IEC 60825-1 and IEC 60825-2
- Duplex LC Connector interface

Description

The LCP-155A4HSRx series is a hot pluggable 3.3V Small-Form-Factor transceiver module designed expressly for high-speed communication applications that require rates of up to 155Mbit/sec. It is compliant with the ATM, SONET OC-3/SDH STM-1 standards, as well as the SFP Multisource Agreement (MSA) except for TX fault function is not implemented.

The LCP-155A4HSRx transceivers provide with the LC receptacle that is compatible with the industry standard LC connector. The transceiver is also compatible with industry standard RFT connector and cage.

The post-amplifier of the LCP-155A4HSRx also includes a Loss Of Signal (LOS) circuit that provides a TTL logic-high output when an unusable optical signal level is detected.

The LCP-155A4HSRx transceiver is a Class 1 eye safety product. The optical power levels, under normal operation, are at eye safe level.

Applications

- SONET OC-3/SDH STM-1
- ATM Network
- Fast Ethernet
- Switch to Switch interface
- Switched backplane applications
- File server interface

Performance

- LCP-155A4HSR (H/T) Data Link up to 2km in 62.5/125 μ m Multi-Mode Fiber.

Absolute Maximum Ratings

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|---------------------|--------|------|------|------|------|------|
| Storage Temperature | Ts | -40 | | 85 | °C | |
| Supply Voltage | VCC | 0 | | 5 | V | |

Recommended Operating Conditions

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|----------------------------|--------|-------|------|-------|------|-------------------------------------|
| Case Operating Temperature | Tc | -5 | | 70 | °C | See Ordering information for detail |
| Supply Voltage | VCC | 3.135 | | 3.465 | V | |

Electrical Characteristics

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

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|--|--------------------------------|------|------|----------------------|------|------|
| Total Supply Current | ICCT | | | 320 | mA | |
| Transmitter | | | | | | |
| Transmitter Differential Input Voltage | VDT | 0.5 | | 2.4 | V | 1 |
| Transmitter Disable Input-High | V _{DISH} | 2 | | V _{CC} +0.3 | V | |
| Transmitter Disable Input-Low | V _{DISL} | 0 | | 0.8 | V | |
| Receiver | | | | | | |
| Receiver Differential Output Voltage | VDR | 0.35 | 1.3 | 2 | V | 2 |
| Receiver LOS Load | R _{RXLOS} | 4.7 | | 10 | kΩ | 3 |
| LOS Output Voltage-Low | V _{LOSL} | 0 | | 0.8 | V | |
| LOS Output Voltage-High | V _{LOSH} | 2 | | V _{CC} +0.3 | V | |
| Output Data risetime/falltime | t _r /t _f | | | 2.2 | ns | 4 |

Notes:

1. Internally AC coupled.
2. Internally AC coupled, but requires a 100 Ohm differential termination at or internal to Serializer/Deserializer.
3. Pull up to V_{CC} on host Board
4. These are 20%~80% values

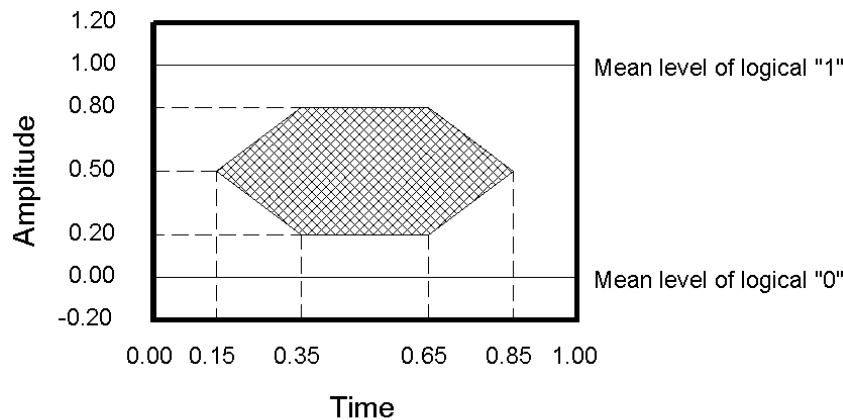
Optical Characteristics

($V_{CC}=3.135V$ to $3.465V$, Data Rate= $155Mb/sec$, PRBS= $2^{23}-1$ NRZ, $62.5/125\mu m$ MMF)

| Parameter | Symbol | Min. | Typ. | Max. | Unit | Note |
|-----------------------------|---|------|------|------|-------|------|
| Transmitter | | | | | | |
| Output Optical Power (Avg.) | P _O | -20 | | -14 | dBm | |
| Optical Extinction Ratio | ER | 9 | | | dB | |
| Center Wavelength | c | | 1310 | | nm | |
| Spectral Width (RMS) | | | | 200 | nm | |
| Optical Rise /Fall Time | t _r /t _f | | | 3 | ns | 1 |
| Duty Cycle Distortion | DCD | | | 0.6 | ns | |
| Jitter | t _J | | | 1.0 | ns | |
| Relative Intensity Noise | RIN | | | -117 | dB/Hz | |
| Output Eye | Compliant with ITU-T recommendation G.957 | | | | | |
| Receiver | | | | | | |
| Sensitivity (Avg.) | P _{IN} | | | -31 | dBm | 2 |
| Input Optical Wavelength | | | 1310 | | nm | |
| LOS-Deasserted (Avg.) | P _D | | | -31 | dBm | |
| LOS-Asserted (Avg.) | P _A | -48 | | | dBm | |
| LOS-Hysteresis | P _D -P _A | 0.5 | | | dB | |
| Overload | P _O | -14 | | | dBm | |

Notes:

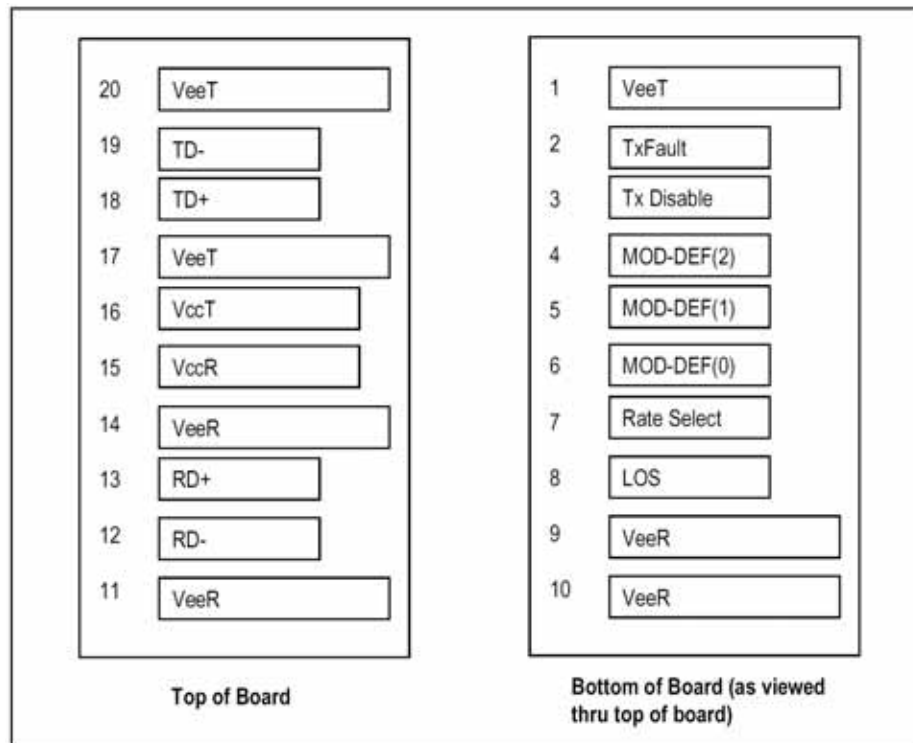
- These are unfiltered 10%~90% values
- The sensitivity is provided at a BER of 1×10^{-10} or better with an input signal consisting of 155Mb/s, $2^{23}-1$ PRBS and ER=9dB.



Optical Pulse Mask with Bessel Filter Specified in ITU-T G.957

Mask of the eye diagram for the optical transmit signal

SFP Transceiver Electrical Pad Layout



Pin Function Definitions

| Pin Num. | Name | Function | Plug Seq. | Notes |
|----------|-------------|------------------------|-----------|---|
| 1 | VeeT | Transmitter Ground | 1 | |
| 2 | TX Fault | Non connection | 3 | Note 1 |
| 3 | TX Disable | Transmitter Disable | 3 | Note 2 Module disables on high or open |
| 4 | MOD-DEF2 | Module Definition 2 | 3 | Note 3, 2 wire serial ID interface |
| 5 | MOD-DEF1 | Module Definition 1 | 3 | Note 3, 2 wire serial ID interface |
| 6 | MOD-DEF0 | Module Definition 0 | 3 | Note 3, Grounded in Module |
| 7 | Rate Select | Not Connect | 3 | Function not available |
| 8 | LOS | Loss of Signal | 3 | Note 4 |
| 9 | VeeR | Receiver Ground | 1 | Note 5 |
| 10 | VeeR | Receiver Ground | 1 | Note 5 |
| 11 | VeeR | Receiver Ground | 1 | Note 5 |
| 12 | RD- | Inv. Received Data Out | 3 | Note 6 |
| 13 | RD+ | Received Data Out | 3 | Note 7 |
| 14 | VeeR | Receiver Ground | 1 | Note 5 |
| 15 | VccR | Receiver Power | 2 | 3.3 ± 5%, Note 7 |
| 16 | VccT | Transmitter Power | 2 | 3.3 ± 5%, Note 7 |
| 17 | VeeT | Transmitter Ground | 1 | Note 5 |
| 18 | TD+ | Transmit Data In | 3 | Note 8 |
| 19 | TD- | Inv. Transmit Data In | 3 | Note 8 |
| 20 | VeeT | Transmitter Ground | 1 | Note 5 |

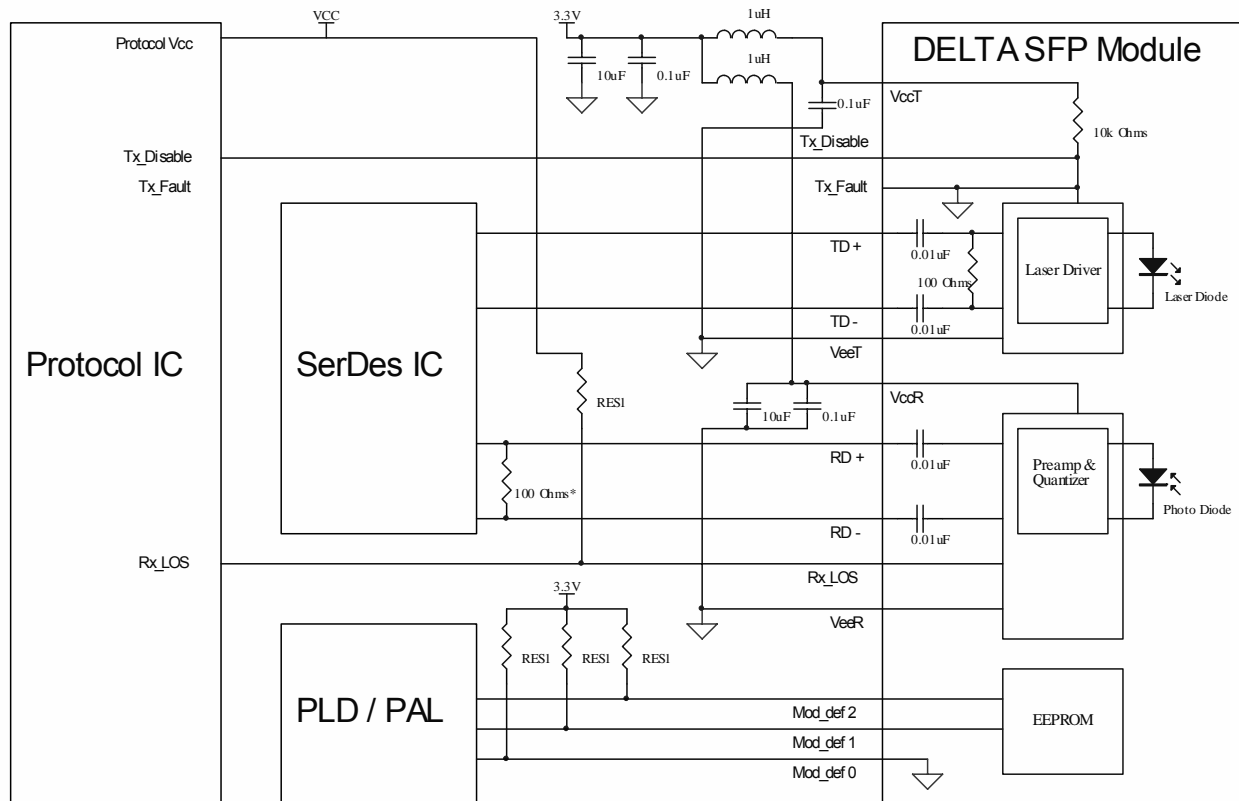
Plug Seq.: Pin engagement sequence during hot plugging.

Notes:

- 1) TX Fault is internally connected to TX ground.
- 2) TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7 – 10 K Ω resistor. Its states are:

| | |
|----------------------|----------------------|
| Low (0 – 0.8V): | Transmitter on |
| (>0.8, < 2.0V): | Undefined |
| High (2.0 – 3.465V): | Transmitter Disabled |
| Open: | Transmitter Disabled |
- 3) Mod-Def 0,1,2. These are the module definition pins. They should be pulled up with a 4.7K – 10K Ω resistor on the host board. The pull-up voltage shall be VccT or VccR (see Section IV for further details). Mod-Def 0 is grounded by the module to indicate that the module is present Mod-Def 1 is the clock line of two wire serial interface for serial ID Mod-Def 2 is the data line of two wire serial interface for serial ID
- 4) LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10K Ω resistor. Pull up voltage between 2.0V and VccT, R+0.3V. When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
- 5) VeeR and VeeT may be internally connected within the SFP module.
- 6) RD-/+ : These are the differential receiver outputs. They are AC coupled 100 Ω differential lines which should be terminated with 100 Ω (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board. The voltage swing on these lines will be between 370 and 2000 mV differential (185 – 1000 mV single ended) when properly terminated.
- 7) VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V \pm 5% at the SFP connector pin. Maximum supply current is 300 mA. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1 Ω should be used in order to maintain the required voltage at the SFP input pin with 3.3V supply voltage.
- 8) TD-/+ : These are the differential transmitter inputs. They are AC-coupled, differential lines with 100 Ω differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board. The inputs will accept differential swings of 500 – 2400 mV (250 – 1200 mV single-ended), though it is recommended that values between 500 and 1200 mV differential (250 – 600 mV single-ended) be used for best EMI performance.

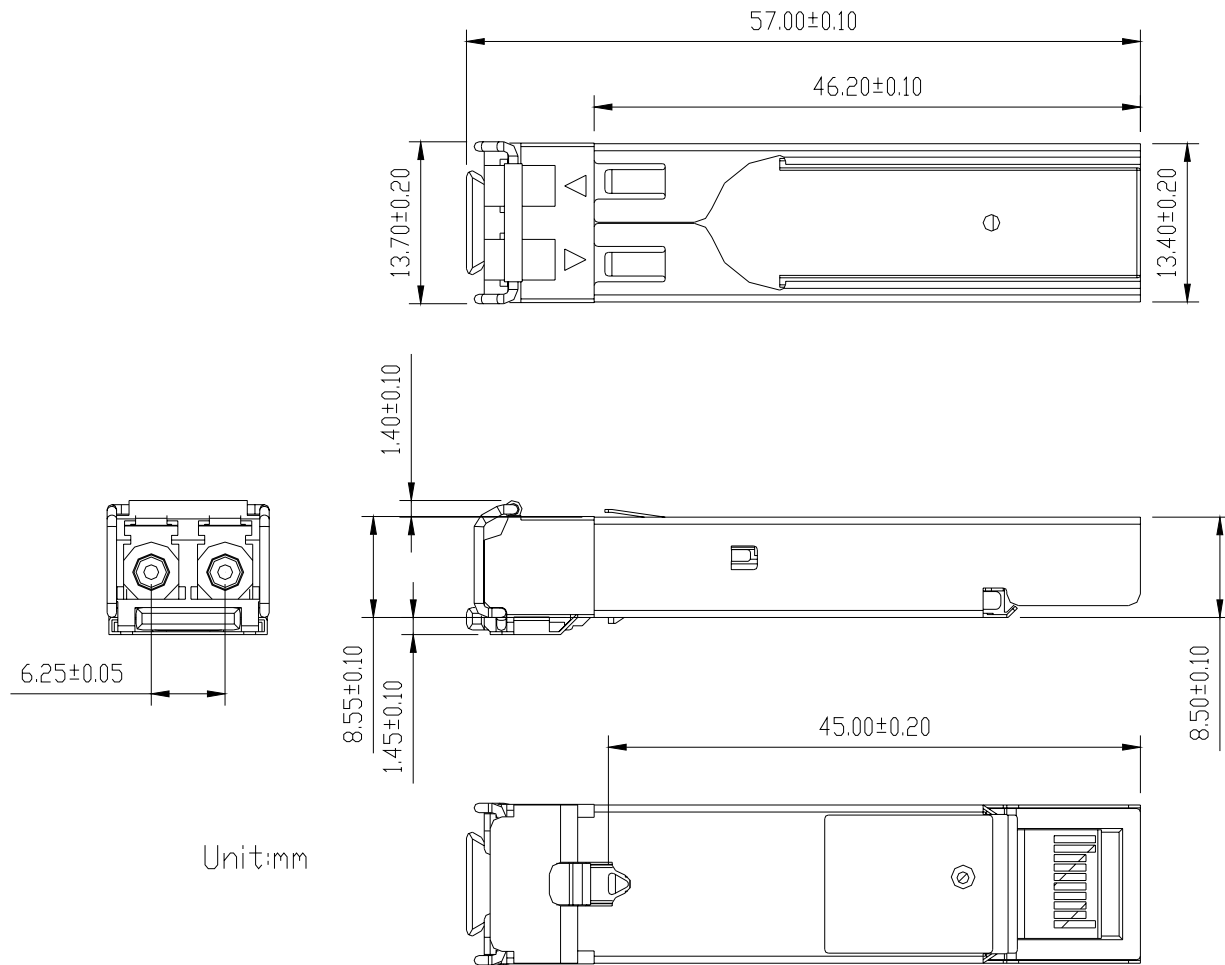
Recommend Circuit Schematic



RES1 = 4.7k to 10k Ohms

* Depends on SerDes IC used

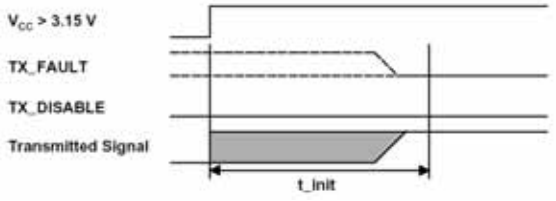
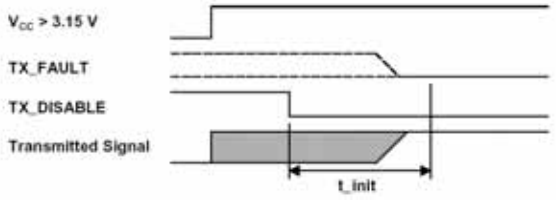
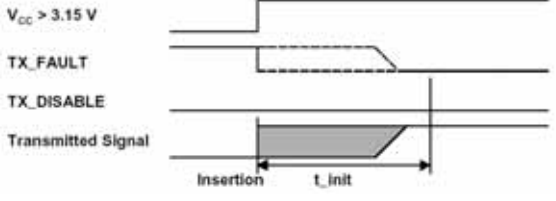
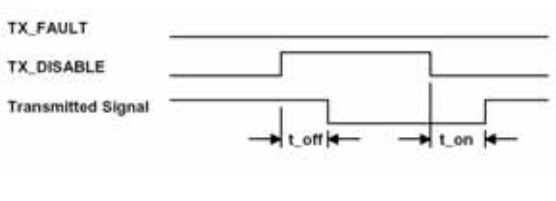
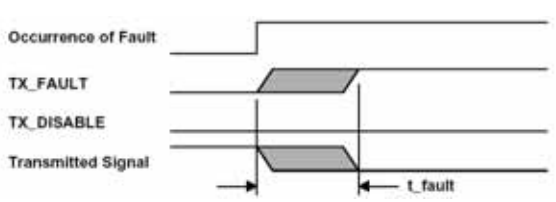
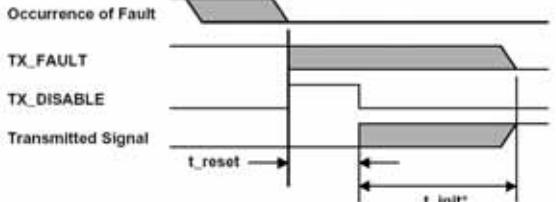
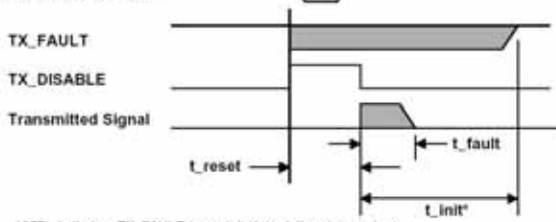
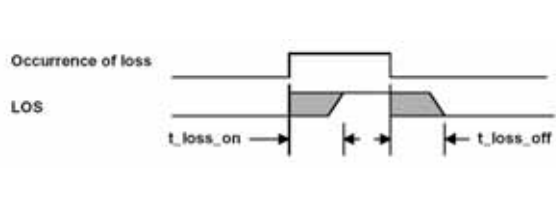
Package Outline Drawing for Metal Housing with Bail de-latch



SFP timing parameters for SFP management

| Parameter | Symbol | Min. | Max. | Unit | Unit Conditions |
|---|---------------------------|------|------|------|--|
| TX_DISABLE Assert time | t _{off} | | 10 | μsec | Time from rising edge of TX_DISABLE to when the optical output falls below 10% of nominal |
| TX_DISABLE Negate time | t _{on} | | 1 | msec | Time from falling edge of TX_DISABLE to when the modulated optical output rises above 90% of nominal |
| Time to initialize, including reset of TX_FAULT | t _{init} | | 300 | msec | From power on or negation of TX_Fault using TX Disable. |
| TX Fault Assert Time | t _{fault} | | 100 | μsec | Time from fault to TX fault on. |
| TX_DISABLE to reset | t _{rest} | 10 | | μsec | Time TX Disable must be held high to reset TX_Fault |
| LOS Assert Time | t _{loss_on} | | 100 | μsec | Time from LOS state to Rx LOS assert |
| LOS Deassert Time | t _{loss_off} | | 100 | μsec | Time from non-LOS state to Rx LOS deassert |
| Serial ID Clock Rate | f _{serial_clock} | | 100 | kHz | |

SFP timing parameters:

| | |
|---|---|
|  <p>$V_{CC} > 3.15\text{ V}$</p> <p>TX_FAULT</p> <p>TX_DISABLE</p> <p>Transmitted Signal</p> <p>t_{init}</p> |  <p>$V_{CC} > 3.15\text{ V}$</p> <p>TX_FAULT</p> <p>TX_DISABLE</p> <p>Transmitted Signal</p> <p>t_{init}</p> |
| <p>Power on initialization of SFP transceiver, TX_DISABLE negated</p> | <p>Power on initialization of SFP, TX_DISABLE asserted Initialization during hot plugging of SFP TRANSCEIVER.</p> |
|  <p>$V_{CC} > 3.15\text{ V}$</p> <p>TX_FAULT</p> <p>TX_DISABLE</p> <p>Transmitted Signal</p> <p>Insertion</p> <p>t_{init}</p> |  <p>TX_FAULT</p> <p>TX_DISABLE</p> <p>Transmitted Signal</p> <p>t_{off}</p> <p>t_{on}</p> |
| <p>Example of initialization during hot plugging, TX_DISABLE negated.</p> | <p>SFP TX_DISABLE timing during normal operation.</p> |
|  <p>Occurrence of Fault</p> <p>TX_FAULT</p> <p>TX_DISABLE</p> <p>Transmitted Signal</p> <p>t_{fault}</p> |  <p>Occurrence of Fault</p> <p>TX_FAULT</p> <p>TX_DISABLE</p> <p>Transmitted Signal</p> <p>t_{reset}</p> <p>t_{init}^*</p> <p><small>*SFP shall clear TX_FAULT in $< t_{init}$ if the failure is transient</small></p> |
| <p>Detection of transmitter safety fault condition</p> | <p>Successful recovery from transient safety fault condition</p> |
|  <p>Occurrence of Fault</p> <p>TX_FAULT</p> <p>TX_DISABLE</p> <p>Transmitted Signal</p> <p>t_{reset}</p> <p>t_{fault}</p> <p>t_{init}^*</p> <p><small>*SFP shall clear TX_FAULT in $< t_{init}$ if the failure is transient</small></p> |  <p>Occurrence of loss</p> <p>LOS</p> <p>t_{loss_on}</p> <p>t_{loss_off}</p> |
| <p>Unsuccessful recovery from safety fault condition</p> | <p>Timing of LOS detection</p> |



LCP-155A4HSRx EEPROM Serial ID Memory Contents (2-Wire Address A0h)

| Address | Hex | ASCII | Address | Hex | ASCII | Address | Hex | ASCII | Address | Hex | ASCII | Address | Hex | ASCII | Address | Hex | ASCII |
|---------|-----|-------|---------|-----|-------|---------|-----|--------|---------|-----|--------|---------|-----|-------|---------|-----|-------|
| 00 | 03 | | 25 | 20 | | 50 | 53 | S | 75 | SN | | 100 | 00 | | 125 | 00 | |
| 01 | 04 | | 26 | 20 | | 51 | 52 | R | 76 | SN | | 101 | 00 | | 126 | 00 | |
| 02 | 07 | | 27 | 20 | | 52 | 20 | | 77 | SN | | 102 | 00 | | 127 | 00 | |
| 03 | 00 | | 28 | 20 | | 53 | 20 | | 78 | SN | | 103 | 00 | | | | |
| 04 | 00 | | 29 | 20 | | 54 | 20 | | 79 | SN | | 104 | 00 | | | | |
| 05 | 01 | | 30 | 20 | | 55 | 20 | | 80 | SN | | 105 | 00 | | | | |
| 06 | 00 | | 31 | 20 | | 56 | 30 | | 81 | SN | | 106 | 00 | | | | |
| 07 | 00 | | 32 | 20 | | 57 | 30 | | 82 | SN | | 107 | 00 | | | | |
| 08 | 00 | | 33 | 20 | | 58 | 30 | | 83 | SN | | 108 | 00 | | | | |
| 09 | 00 | | 34 | 20 | | 59 | 30 | | 84 | DC | Note 3 | 109 | 00 | | | | |
| 10 | 00 | | 35 | 20 | | 60 | 05 | | 85 | DC | | 110 | 00 | | | | |
| 11 | 03 | | 36 | 00 | | 61 | 1E | | 86 | DC | | 111 | 00 | | | | |
| 12 | 02 | | 37 | 00 | | 62 | 00 | | 87 | DC | | 112 | 00 | | | | |
| 13 | 00 | | 38 | 00 | | 63 | CS1 | Note 1 | 88 | DC | | 113 | 00 | | | | |
| 14 | 00 | | 39 | 00 | | 64 | 00 | | 89 | DC | | 114 | 00 | | | | |
| 15 | 00 | | 40 | 4C | L | 65 | 1A | | 90 | DC | | 115 | 00 | | | | |
| 16 | 00 | | 41 | 43 | C | 66 | 05 | | 91 | DC | | 116 | 00 | | | | |
| 17 | C8 | | 42 | 50 | P | 67 | 05 | | 92 | 00 | | 117 | 00 | | | | |
| 18 | 00 | | 43 | 2D | - | 68 | SN | Note 2 | 93 | 00 | | 118 | 00 | | | | |
| 19 | 00 | | 44 | 31 | 1 | 69 | SN | | 94 | 00 | | 119 | 00 | | | | |
| 20 | 44 | D | 45 | 35 | 5 | 70 | SN | | 95 | CS2 | Note 4 | 120 | 00 | | | | |
| 21 | 45 | E | 46 | 35 | 5 | 71 | SN | | 96 | 00 | | 121 | 00 | | | | |
| 22 | 4C | L | 47 | 41 | A | 72 | SN | | 97 | 00 | | 122 | 00 | | | | |
| 23 | 54 | T | 48 | 34 | 4 | 73 | SN | | 98 | 00 | | 123 | 00 | | | | |
| 24 | 41 | A | 49 | 48 | H | 74 | SN | | 99 | 00 | | 124 | 00 | | | | |

Notes:

- 1) Byte 63(CS1): Check sum of bytes 0-62.
- 2) Byte 68-83 (SN): Serial number.
- 3) Byte 84-91 (DC): Date code.
- 4) Byte 95 (CS2): Check sum of bytes 64-94.
- 5) Bytes 128-255 had been set hex. 00.

Regulatory Compliance

| Feature | Reference | Performance |
|---|---|--|
| Electromagnetic Interference (EMI) | FCC Class B EN 55022 Class B (CISPR 22A) | (1) Satisfied with electrical characteristics of product spec. (2) No physical damage |
| Radio Frequency Electromagnetic Field | EN 61000-4-3 IEC 1000-4-3 | |
| Electrostatic Discharge to the Duplex LC Receptacle | EN 61000-4-2 IEC 1000-4-2 IEC 801.2 | |
| Electrostatic Discharge to the Electrical Pins | MIL-STD-883E Method 3015.7 | |
| Eye Safety | US FDA CDRH AEL Class 1 EN 60950: 2000 EN 60825-1: 1994+A11+A2 EN 60825-2: 2000 | CDRH File # 0321539-00 TUV Certificate No. R50032471 |
| Component Recognition | Underwriters Laboratories and Canadian Standards Association Joint Component Recognition for Information Technology Equipment Including Electrical Business Equipment | UL File # E239394 |

Ordering information for SFP modules

LCP-155A4HSRX₁

X₁: Temperature

Blank: -5 to +70 degree C

H: -10 to +85 degree C

T: -40 to +85 degree C

Related SFP products

- LCP-155Bxxx: 155.52Mb/s, Single mode transceiver.
- LCP-1250xxxx: 1.25Gb/s, Multimode and single mode transceiver from 500m to 10km
- LCP-2125xxxx: 2.125Gb/s, Multimode and single mode transceiver from 300m to 10km
- LCP-2488xxxx: 2.488Gb/s, multimode and single mode transceiver from 300m to 15km