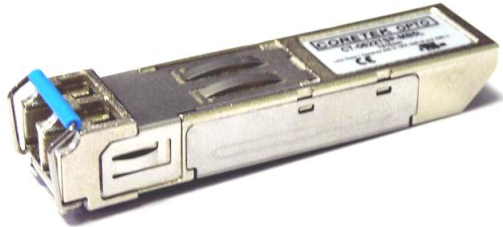
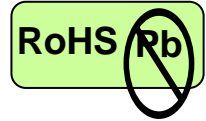


# 2 Mb/s IEEE C37.94 Single Mode Transceiver



**SFP, Duplex LC Connector, 1310 nm FP LD for Single Mode Fiber, RoHS Compliant**  
*Digital Diagnostics Functions, Extended Operating Temperature from -40 to +85°C*



## Features

- 1310 nm FP LD
- Data Rate: 2 Mb/s, NRZ
- Single +3.3 V Power Supply
- RoHS Compliant and Lead-free
- AC/AC Differential Electrical Interface
- Compliant with Multi-Source Agreement (MSA) Small Form Factor Pluggable (SFP)
- Compliant with SFF-8472 Digital Diagnostic Monitoring Interface
- Duplex LC Connector
- Compatible with IEEE C37.94 / IEC 62843 Standard

## Applications

- IEEE C37.94 / IEC 62843
- Single Mode Fiber Links
- Optical-Electrical Interface Conversion

## Description

The CT-0155TSP-MB7L-E 2M from Coretek Opto Corp. is the high performance and cost-effective module for serial optical data communication applications specified for 2 Mb/s. It operates with +3.3 V power supply. The module is intended for single mode fiber, operates at a nominal wavelength of 1310 nm and complies with Multi-Source Agreement (MSA) Small Form Factor Pluggable (SFP). Each module is integrated digital diagnostics functions via an I<sup>2</sup>C serial interface.

The module is a duplex LC connector transceiver designed to provide an IEEE C37.94 / IEC 62843 link for 2 Mb/s long reach applications. The characteristics are performed in accordance with Telcordia Specification GR-468-CORE.

## EMC

Most equipment utilizing high-speed transceivers will be required to meet the following requirements:

- 1) FCC in the United States
- 2) CENELEC EN55022 (CISPR 22) in Europe

To assist the customer in managing the overall equipment EMC performance, the transceivers have been designed to satisfy FCC class B limits and provide good immunity to radio-frequency electromagnetic fields.

## Eye Safety

This laser based single mode transceiver is a CLASS 1 LASER PRODUCT, Hazard level 1. It complies with IEC 60825-1 Ed.2: 2007-03 and FDA performance standards for laser products (21 CFR 1040.10 and 1040.11) except for deviations pursuant to Laser Notice 50, dated June 24, 2007.

# 2 Mb/s IEEE C37.94 Single Mode Transceiver



## Product Information

| Model Number         | Operating Voltage & SD Output | Distance | LD Type & Wavelength | Output Power | Sensitivity |
|----------------------|-------------------------------|----------|----------------------|--------------|-------------|
| CT-0155TSP-MB7L-E 2M | 3.3 V TTL AC/AC               | 60 km    | 1310 nm FP           | -3 ~ +2 dBm  | ≤-36 dBm    |

## ABSOLUTE MAX RATINGS

| PARAMETER           | SYMBOL          | MIN | MAX | UNIT | NOTE |
|---------------------|-----------------|-----|-----|------|------|
| Storage Temperature | T <sub>S</sub>  | -40 | 85  | °C   |      |
| Supply Voltage      | V <sub>CC</sub> | 0   | 6   | V    |      |

## OPERATING CONDITIONS

| PARAMETER                  | SYMBOL          | MIN. | TYP. | MAX. | UNIT | NOTE |
|----------------------------|-----------------|------|------|------|------|------|
| Case Operating Temperature | T <sub>C</sub>  | -40  |      | 85   | °C   |      |
| Supply Voltage             | V <sub>CC</sub> | 3.1  |      | 3.5  | V    |      |
| Data Input Voltage Swing   | V <sub>ID</sub> | 400  |      | 1600 | mV   |      |

## ELECTRICAL CHARACTERISTICS

| PARAMETER                                 | SYMBOL            | MIN                   | MAX                   | UNIT | NOTE |
|---|-------------------|-----------------------|-----------------------|------|------|
| <b>Transmitter</b>                        |                   |                       |                       |      |      |
| Transmitter Supply Current                | I <sub>CC</sub> T |                       | 200                   | mA   |      |
| Tx_Disable Input Voltage - Low            | V <sub>IL</sub>   | 0                     | 0.8                   | V    |      |
| Tx_Disable Input Voltage - High           | V <sub>IH</sub>   | 2.0                   | V <sub>CC</sub>       | V    |      |
| Tx_Fault Output Voltage - Low             | V <sub>OL</sub>   | 0                     | 0.8                   | V    |      |
| Tx_Fault Output Voltage - High            | V <sub>OH</sub>   | 2.0                   | V <sub>CC</sub>       | V    |      |
| <b>Receiver</b>                           |                   |                       |                       |      |      |
| Receiver Supply Current                   | I <sub>CC</sub> R |                       | 100                   | mA   |      |
| Receiver Data Output Differential Voltage | V <sub>OD</sub>   | 0.4                   | 1.3                   | V    |      |
| Rx_LOS Output Voltage - Low               | V <sub>OL</sub>   | 0                     | 0.8                   | V    |      |
| Rx_LOS Output Voltage - High              | V <sub>OH</sub>   | 2.0                   | V <sub>CC</sub>       | V    |      |
| MOD_DEF (1) , MOD_DEF (2) - Low           | V <sub>IL</sub>   | -0.6                  | V <sub>CC</sub> × 0.3 | V    |      |
| MOD_DEF (1) , MOD_DEF (2) - High          | V <sub>IH</sub>   | V <sub>CC</sub> × 0.7 | V <sub>CC</sub> + 0.5 | V    |      |

## TRANSMITTER ELECTRO-OPTICAL CHARACTERISTICS

| PARAMETER                     | SYMBOL         | MIN                                     | TYP. | MAX  | UNIT | NOTE |
|-------------------------------|----------------|---|------|------|------|------|
| Optical Output Power          | P <sub>o</sub> | -3                                      |      | 2    | dBm  | 1    |
| Extinction Ratio              | ER             | 12                                      |      |      | dB   | 2    |
| Center Wavelength             | λ <sub>c</sub> | 1263                                    | 1310 | 1360 | nm   |      |
| Spectral Width (RMS)          | Δλ             |   |      | 3    | nm   |      |
| Optical Rise time ( 10%-90% ) | t <sub>r</sub> |   |      | 10   | ns   |      |
| Optical Fall time ( 10%-90% ) | t <sub>f</sub> |   |      | 10   | ns   |      |
| Output Eye                    |                | Compliant with ITU recommendation G.957 |      |      |      |      |

# 2 Mb/s IEEE C37.94 Single Mode Transceiver



## RECEIVER ELECTRO-OPTICAL CHARACTERISTICS

| PARAMETER                   | SYMBOL      | MIN  | TYP. | MAX  | UNIT | NOTE |
|-----------------------------|-------------|------|------|------|------|------|
| Maximum Input Optical Power | $P_{max}$   | -3   |      |      | dBm  | 3    |
| Receiver Sensitivity        | $P_{min}$   |      |      | -36  | dBm  | 3    |
| Operating Wavelength        | $\lambda$   | 1100 |      | 1600 | nm   |      |
| Loss of Signal - Asserted   | $P_A$       | -45  |      |      | dBm  |      |
| Loss of Signal - Deasserted | $P_D$       |      |      | -35  | dBm  |      |
| Loss of Signal - Hysteresis | $P_D - P_A$ | 0.5  |      |      | dB   |      |

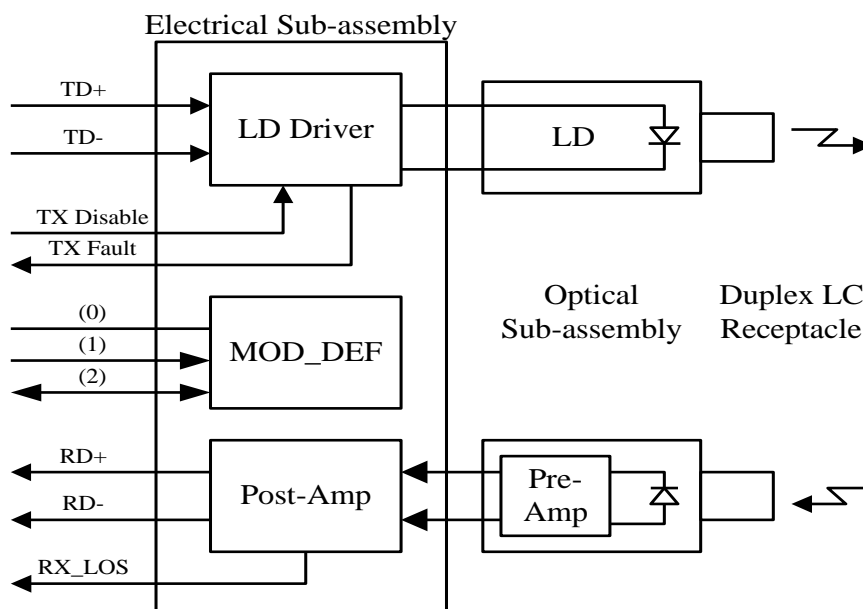
### Notes:

1. Measured average power coupled into 9/125  $\mu\text{m}$  single mode fiber.
2. Optical eye settings are adjusted at 155 Mb/s using an OC-12 Bessel Thomson filter and adjusting the crossing level between 15-20%. Final test is at 155 Mb/s using an OC-3 Bessel Thomson filter.
3. Measured with  $2^{23}-1$  PRBS at  $\text{BER} < 10^{-10}$

## TIMING CHARACTERISTICS

| PARAMETER                                       | SYMBOL          | MIN | TYP. | MAX | UNIT          | NOTE |
|---|-----------------|-----|------|-----|---------------|------|
| TX_DISABLE Assert Time                          | $t_{off}$       |     |      | 10  | $\mu\text{s}$ |      |
| TX_DISABLE Negate Time                          | $t_{on}$        |     |      | 1   | ms            |      |
| Time to initialize, include reset of TX_FAULT   | $t_{init}$      |     |      | 300 | ms            |      |
| TX_FAULT from fault to assertion                | $t_{fault}$     |     |      | 100 | $\mu\text{s}$ |      |
| TX_DISABLE time to start reset                  | $t_{reset}$     | 10  |      |     | $\mu\text{s}$ |      |
| Receiver Loss of Signal Assert Time (off to on) | $t_{A,RX\_LOS}$ |     |      | 100 | $\mu\text{s}$ |      |
| Receiver Loss of Signal Assert Time (on to off) | $t_{D,RX\_LOS}$ |     |      | 100 | $\mu\text{s}$ |      |

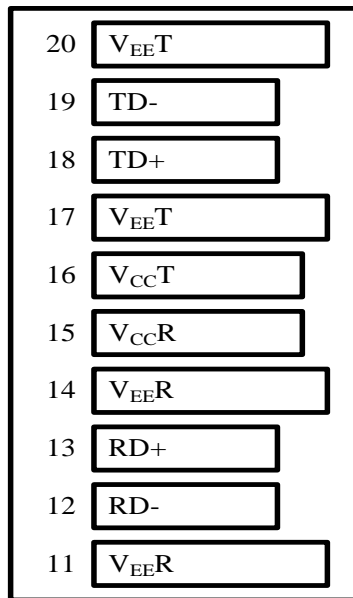
## BLOCK DIAGRAM OF TRANSCEIVER



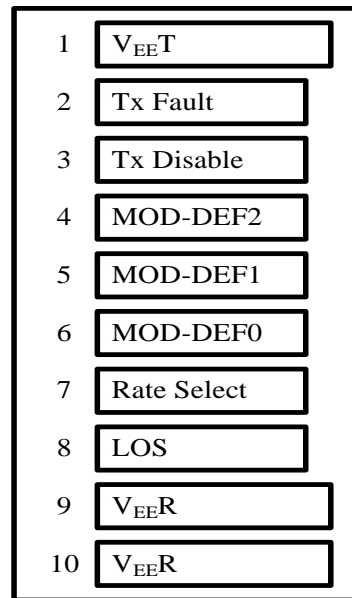
# 2 Mb/s IEEE C37.94 Single Mode Transceiver



## PIN OUT DIAGRAM OF TRANSCEIVER



Top of Board



Bottom of Board (As Viewed through Top of Board)

## PIN OUT TABLE

| Pin | Symbol      | Functional Description                                |
|-----|-------------|---|
| 1   | VeeT        | Transmitter Ground                                    |
| 2   | TX Fault    | Transmitter Fault Indication                          |
| 3   | TX Disable  | Transmitter Disable – Module disables on high or open |
| 4   | MOD-DEF(2)  | Module Definition 2 – Two wire serial ID interface    |
| 5   | MOD-DEF(1)  | Module Definition 1 – Two wire serial ID interface    |
| 6   | MOD-DEF(0)  | Module Definition 0 – Grounded in module              |
| 7   | Rate Select | Not Connected   |
| 8   | LOS         | Loss of Signal  |
| 9   | VeeR        | Receiver Ground                                       |
| 10  | VeeR        | Receiver Ground                                       |
| 11  | VeeR        | Receiver Ground                                       |
| 12  | RD-         | Inverse Received Data Out                             |
| 13  | RD+         | Received Data Out                                     |
| 14  | VeeR        | Receiver Ground                                       |
| 15  | VccR        | Receiver Power  |
| 16  | VccT        | Transmitter Power                                     |
| 17  | VeeT        | Transmitter Ground                                    |
| 18  | TD+         | Transmitter Data In                                   |
| 19  | TD-         | Inverse Transmitter Data In                           |
| 20  | VeeT        | Transmitter Ground                                    |

# 2 Mb/s IEEE C37.94 Single Mode Transceiver



## EEPROM Serial ID Memory Contents

Table 1 - EEPROM Serial ID Memory Contents (A0h)

| Addr.   | Field Size (Bytes) | Name of Field         | Hex  | Description                  |
|---------|--------------------|-----------------------|--|------------------------------|
| 00      | 1                  | Identifier            | 03   | SFP                          |
| 01      | 1                  | Ext. Identifier       | 04   | MOD4                         |
| 02      | 1                  | Connector             | 07   | LC                           |
| 03 ~ 10 | 8                  | Transceiver Codes     | 00 00 00 00 00 00 00 00                            |                              |
| 11      | 1                  | Encoding              | 03   | NRZ                          |
| 12      | 1                  | BR, Nominal           | 01   |                              |
| 13      | 1                  | Reserved              | 00   |                              |
| 14      | 1                  | Length (SMF)-km       | 3C   | 60 km                        |
| 15      | 1                  | Length (SMF)-100 m    | FF   | >25.4 km                     |
| 16      | 1                  | Length (50 μm, OM2)   | 00   | 2 km                         |
| 17      | 1                  | Length (62.5 μm, OM1) | 00   | 2 km                         |
| 18      | 1                  | Length (copper)       | 00   |                              |
| 19      | 1                  | Reserved              | 00   |                              |
| 20 ~ 35 | 16                 | Vendor Name           | 43 4F 52 45 54 45 4B 20 20 20 20<br>20 20 20 20 20 | CORETEK                      |
| 36      | 1                  | Reserved              | 00   |                              |
| 37 ~ 39 | 3                  | OUI Code              | 00 00 00   |                              |
| 40 ~ 55 | 16                 | Vendor PN             | 43 54 30 31 35 35 54 53 50 4D 42<br>37 4C 45 32 4D | CT0155TSPMB7LE2M             |
| 56 ~ 59 | 4                  | Vendor Rev            | 30 30 30 31  | 0001                         |
| 60 ~ 61 | 2                  | Wavelength            | 05 1E  | 1310 nm                      |
| 62      | 1                  | Reserved              | 00   |                              |
| 63      | 1                  | CC BASE               | XX   | Check sum                    |
| 64 ~ 65 | 2                  | Options               | 00 1A  | LOS, TX_FAULT and TX_DISABLE |
| 66      | 1                  | BR max                | 00   |                              |
| 67      | 1                  | BR min                | 00   |                              |
| 68 ~ 83 | 16                 | Vendor SN             | xxxxxxxxxxxxxxxx                                   |                              |
| 84 ~ 91 | 8                  | Date code             |  |                              |

# 2 Mb/s IEEE C37.94 Single Mode Transceiver



|          |    |                            |    |                                |
|----------|----|----------------------------|----|--------------------------------|
| 92       | 1  | Diagnostic Monitoring Type | 68 |                                |
| 93       | 1  | Enhanced Options           | 90 |                                |
| 94       | 1  | SFF-8472                   | 01 | Rev 9.3 of SFF-8472 Compliance |
| 95       | 1  | CC BASE                    | XX | Check sum                      |
| 96 ~ 127 | 32 | Vendor Specific            |    |                                |

**EEPROM**

讀取

|               |                  |
|---------------|------------------|
| Connect Type  | SFP - LC         |
| Fiber Type    | Single-mode      |
| TX Wavelength | 1310             |
| Baud Rate     |                  |
| Vendor OUI    | 00:00:00         |
| Vendor Name   | CORETEK          |
| Vendor PN     | CT0155TSPMB7LE2M |
| Vendor Rev    | 0001             |
| Vendor SN     | GF0124Q87S0001   |
| Date Code     | 171024           |

讀取

```

000~015 0 03 04 07 00 00 00 00 00 00 00 03 01 00 3C FF
016~031 1 00 00 00 00 43 4F 52 45 54 45 4B 20 20 20 20
032~047 2 20 20 20 20 00 00 00 00 43 54 30 31 35 35 54 53
048~063 3 50 4D 42 37 4C 45 32 4D 30 30 30 31 05 1E 00 8D
064~079 4 00 1A 00 00 47 46 30 31 32 34 51 38 37 53 30 30
080~095 5 30 31 20 20 31 37 31 30 32 34 20 20 68 90 01 EA
096~111 6 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
112~127 7 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
128~143 8 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
    
```

# 2 Mb/s IEEE C37.94 Single Mode Transceiver



Table 2- EEPROM Serial ID Memory Contents (A2h)

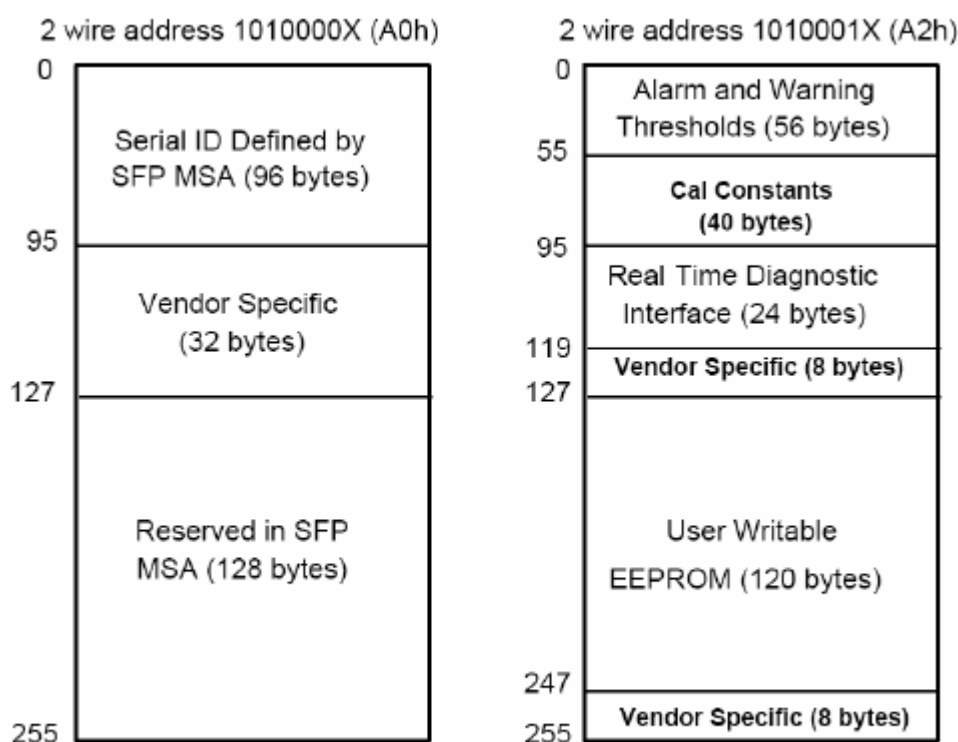
| Addr.   | Field Size (Bytes) | Name of Field                   | Hex                     | Description                                       |
|---------|--------------------|---------------------------------|-------------------------|---|
| 00 ~ 07 | 8                  | Temperature Alarm/Warning (°C)  | 6E 00 D8 00 64 00 DD 00 | Alarm_H/L : 110/-40<br>Warning_H/L : 100/-35      |
| 08 ~ 15 | 8                  | Voltage Alarm/Warning (V)       | 8C A0 75 30 88 B8 79 18 | Alarm_H/L : 3.6/3<br>Warning_H/L : 3.5/3.1        |
| 16 ~ 23 | 8                  | Bias Current Alarm/Warning (mA) | 9C 40 03 E8 88 B8 07 D0 | Alarm_H/L : 80/2<br>Warning_H/L : 70/4            |
| 24 ~ 31 | 8                  | Tx Power Alarm/Warning (dBm)    | 4D F1 0F 8D 3D E9 13 94 | Alarm_H/L : 3/-4<br>Warning_H/L : 2/-3            |
| 32 ~ 39 | 8                  | Rx Power Alarm/Warning (dBm)    | 18 A6 00 02 13 94 00 03 | Alarm_H/L : -2/-37<br>Warning_H/L : -3/-36        |
| 96 ~ 97 | 2                  | Measure Temperature             |                         | Internally measure module Temperature             |
| 98 ~ 99 | 2                  | Measure Vcc                     |                         | Internally measure supply voltage in transceiver. |
| 100~101 | 2                  | Measure TX Bias                 |                         | Internally measure TX Bias Current                |
| 102~103 | 2                  | Measure TX Power                |                         | Measure TX output power                           |
| 104~105 | 2                  | Measure RX Power                |                         | Measure RX output power                           |

## Monitoring Specification

The digital diagnostic monitoring interface also defines another 256-byte memory map in EEPROM, which makes use of the 8 bit address 1010001X (A2h). Please see Figure 1. For detail EEPROM information, please refer to the related document of SFF-8472 Rev 9.5. The monitoring specification of this product is described in Table 3.

**Figure 3.1: Digital Diagnostic Memory Map**

### Specific Data Field Descriptions



**Figure 1, EEPROM Memory Map Specific Data Field Descriptions**

**Table 3 - Monitoring Specification**

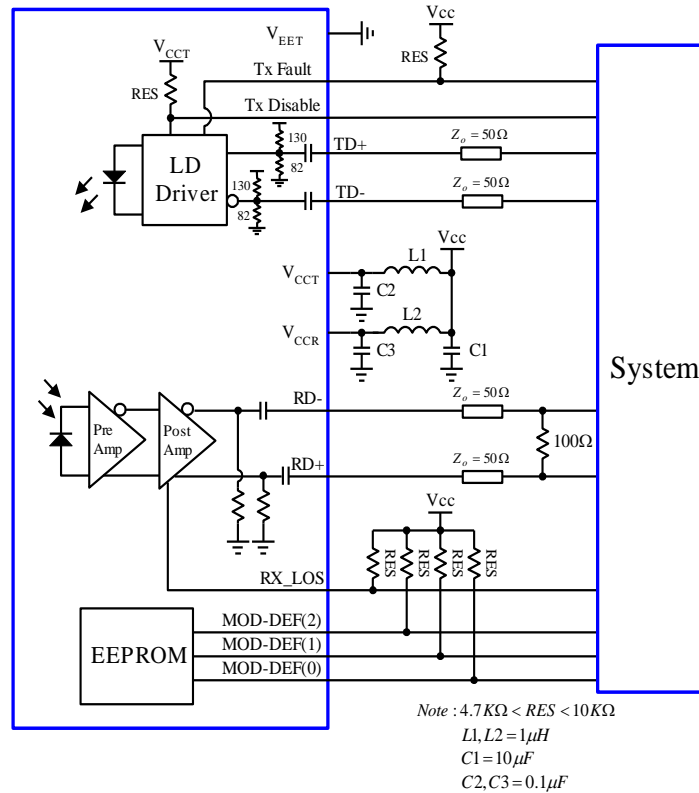
| Parameter    | Range         | Accuracy | Calibration |
|--------------|---------------|----------|-------------|
| Temperature  | -40°C to 85°C | ±3°C     | Internal    |
| Voltage      | 3.0 to 3.6 V  | ±3%      | Internal    |
| Bias Current | 0 to 70 mA    | ±10%     | Internal    |
| TX Power     | -3 to 2 dBm   | ±3 dB    | Internal    |
| RX Power     | -30 to -3 dBm | ±3 dB    | Internal    |



# 2 Mb/s IEEE C37.94 Single Mode Transceiver

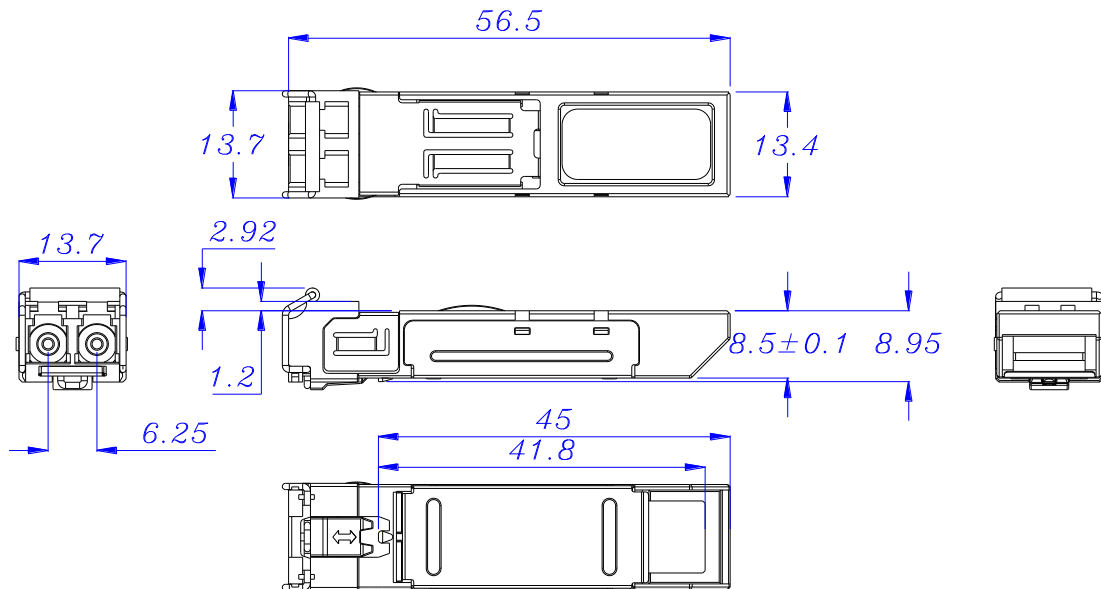


## RECOMMENDED CIRCUIT SCHEMATIC



## MECHANICAL DIMENSIONS

Units in mm



All dimensions are  $\pm 0.2\text{mm}$  unless otherwise specified.

# 2 Mb/s IEEE C37.94 Single Mode Transceiver



## REVISION HISTORY

| Formulate (Revise) Record |         |                 |
|---------------------------|---------|-----------------|
| D/M/Y                     | Version | Description     |
| 25/01/2017                | A       | Initial version |
|                           |         |                 |
|                           |         |                 |

**Claim:**

*CORETEK Opto Corp. reserves the right to make changes in the specification described hereinafter without prior notice.*