

## DATA SHEET

### MODULETEK –SFP-GE-BIDI-20KM-T1550R1310-LC-C10

1.25Gb/s SFP (Small Form Pluggable) Tx1550nm/Rx1310nm Bi-directional Transceiver

### SFP-GE-BIDI-20KM-T1550R1310-LC-C10 Overview

ModuleTek' s SFP-GE-BIDI-20KM-T1550R1310-LC-C10 SFP BIDI optical transceivers are based on Gigabit Ethernet IEEE 802.3 standard and Fiber Channel FC-PI-2 Rev7.0 and provide a quick and reliable interface for the GE/FC application. The digital diagnostics functions are available via the 2-wire serial bus specified in the SFP MSA. In addition, they comply with the Small Form Factor Pluggable Multi -Source Agreement (MSA) and SFF-8472.

### Product Features

- Up to 1.25 Gb/s bi-directional data links
- Single LC connector
- Compliant with IEEE 802.3z Gigabit Ethernet
- Compliant with SFP MSA
- Hot-pluggable SFP footprint
- 1550nm DFB laser transmitter
- Built-in digital diagnostic functions
- Up to 20km on 9/125um SMF
- Single power supply 3.3V
- RoHS Compliant
- Class 1 laser product complies with EN 60825–1
- Operating temperature range: 0°C to 70°C

### Applications

- 1.25 Gb/s Gigabit Ethernet
- 1.063 Gb/s Fiber Channel

## Ordering Information

| Part Number   | Description   | Color on Clasp |
|---|---|----------------|
| SFP-GE-BIDI-20KM-T1550R1310-LC-C10  | GE/FC, SFP-BIDI, Single LC Connector, Tx1550nm/Rx1310nm, 20KM, with DOM function. | yellow         |
| <b>For More Information:</b><br>ModuleTek Limited<br>Web: <a href="http://www.moduletek.com">www.moduletek.com</a><br>Email: <a href="mailto:sales@moduletek.com">sales@moduletek.com</a> |   |                |

## General Specifications

| Parameter             | Symbol           | Min  | Typ   | Max        | Unit | Remarks |
|-----------------------|------------------|------|-------|------------|------|---------|
| Data Rate             | DR               |      | 1.25  |            | Gb/s | 1       |
|                       | DR               |      | 1.062 |            | Gb/s | 2       |
| Bit Error Rate        | BER              |      |       | $10^{-12}$ |      |         |
| Operating Temperature | T <sub>OP</sub>  | 0    |       | 70         | °C   | 3       |
| Storage Temperature   | T <sub>STO</sub> | -40  |       | 85         | °C   | 4       |
| Supply Current        | I <sub>S</sub>   |      | 200   | 300        | mA   | 5       |
| Input Voltage         | V <sub>CC</sub>  | 3.14 | 3.3   | 3.46       | V    |         |
| Maximum Voltage       | V <sub>MAX</sub> | -0.5 |       | 4          | V    | 5       |

### Notes:

1. IEEE 802.3
2. FC-PI-2 Rev7.0
3. Case temperature
4. Ambient temperature
5. For electrical power interface

## Optical - Characteristics - Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

| Parameter                         | Symbol          | Min  | Typ  | Max  | Unit    | Remarks |
|-----------------------------------|-----------------|------|------|------|---------|---------|
| Output Optical Power              | $P_{TX}$        | -9   |      | -3   | dBm     | 1       |
| Optical Center Wavelength         | $\lambda_C$     | 1530 | 1550 | 1570 | nm      |         |
| Optical Modulation Amplitude      | OMA             | 174  |      |      | $\mu W$ | 2       |
| Extinction Ratio                  | ER              | 9    |      |      | dB      |         |
| Spectral Width (-20dB)            | $\Delta\lambda$ |      |      | 1    | nm      |         |
| Side Mode Suppression Ratio       | SMSR            | 30   |      |      |         |         |
| Optical Rise/Fall Time (20%-80%)  | $t_r/t_f$       |      | 150  | 260  | ps      |         |
| Relative Intensity Noise          | RIN             |      |      | -120 | dB/Hz   |         |
| Deterministic Jitter Contribution | DJ              |      | 30   | 60   | ps      |         |
| Total Jitter Contribution         | TJ              |      | 60   | 120  | ps      |         |

### Notes:

1. Class 1 Product
2. Equivalent extinction ratio specification for FC

## Optical- Characteristics - Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

| Parameter                        | Symbol        | Min  | Typ | Max  | Unit | Remarks |
|----------------------------------|---------------|------|-----|------|------|---------|
| Optical Receiver Power           | $P_{RX}$      |      |     | 0    | dBm  | 1       |
| Optical Center Wavelength        | $\lambda_C$   | 1260 |     | 1360 | nm   |         |
| Receiver Sensitivity @ 1.063Gb/s | $R_{X\_SEN1}$ |      |     | -23  | dBm  | 2       |
| Receiver Sensitivity @ 1.25Gb/s  | $R_{X\_SEN2}$ |      |     | -23  | dBm  | 3       |
| Optical Return Loss              | ORL           | 14   |     |      | dB   |         |
| Optical Isolation                | ISO           | 35   |     |      | dB   |         |
| LOS Assert                       | $LOS_A$       | -30  |     |      | dBm  |         |
| LOS De-Assert                    | $LOS_D$       |      |     | -23  | dBm  |         |
| LOS Hysteresis                   | $LOS_H$       | 0.5  |     |      | dB   |         |

### Notes:

1. Average
2. FC-PI-2 Rev7.0
3. IEEE 802.3

## Electrical - Characteristics - Transmitter

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

| Parameter                     | Symbol       | Min          | Typ | Max          | Unit     | Remarks |
|-------------------------------|--------------|--------------|-----|--------------|----------|---------|
| Input differential impedance  | $R_{IN}$     |              | 100 |              | $\Omega$ |         |
| Single ended data input swing | $V_{IN\_PP}$ | 250          |     | 1200         | mV       |         |
| Transmit disable voltage      | $V_D$        | $V_{CC}-1.3$ |     | $V_{CC}$     | V        |         |
| Transmit enable voltage       | $V_{EN}$     | $V_{EE}$     |     | $V_{EE}+0.8$ | V        |         |
| Transmit disable assert time  |              |              |     | 10           | $\mu S$  |         |

## Electrical - Characteristics - Receiver

$V_{CC}=3.14V$  to  $3.46V$ ,  $T_C=0^{\circ}C$  to  $70^{\circ}C$

| Parameter                            | Symbol        | Min          | Typ | Max            | Unit | Remarks |
|--------------------------------------|---------------|--------------|-----|----------------|------|---------|
| Single ended data output swing       | $V_{OUT\_PP}$ | 300          | 400 | 800            | mV   |         |
| Data output rise/fall time (20%-80%) | $T_R/T_F$     |              |     | 300            | ps   |         |
| LOS Assert                           | $V_{LOS\_A}$  | $V_{CC}-0.5$ |     | $V_{CC\_HOST}$ | V    |         |
| LOS De-Assert                        | $V_{LOS\_D}$  | $V_{EE}$     |     | $V_{EE}+0.5$   | V    |         |

## Digital Diagnostic Functions

SFP-GE-BIDI-20KM-T1550R1310-LC-C10 supports the 2-wire serial communication protocol as defined in the SFP MSA. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for SFP-GE-BIDI-20KM-T1550R1310-LC-C10 are internally calibrated by default. A micro controller unit inside the transceiver gathers the monitoring information and reports the status of transceiver.

**Transceiver Temperature**, internally measured, represented as a 16 bit signed twos complement value in increments of 1/256 degrees Celsius, Temperature accuracy is better than  $\pm 3$  degrees Celsius over specified operating temperature and voltage.

**Transceiver Supply Power**, internally measured, represented as a 16 bit unsigned integer with the voltage defined as the full 16 bit value (0 – 65535) with LSB equal to 100  $\mu$ Volt, yielding a total range of 0 to +6.55 Volts.

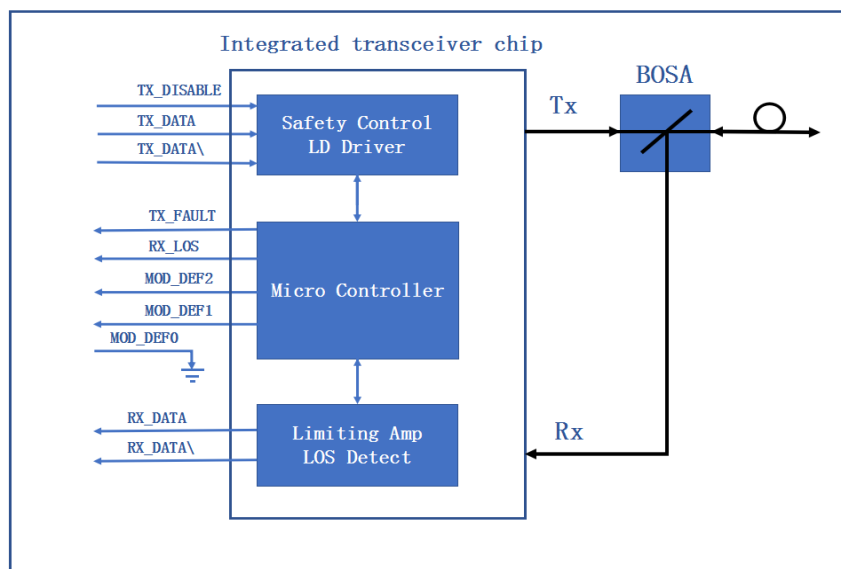
**Transceiver TX bias current**, internally measured, represented as a 16 bit unsigned integer with the current defined as the full 16 bit value (0 – 65535) with LSB equal to 2  $\mu$ A, yielding a total range of 0 to 131mA. Accuracy is better than  $\pm 10\%$  over specified operating temperature and voltage.

**Transceiver TX output power**, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit value (0– 65535) with LSB equal to 0.1  $\mu$ W. Data is assumed to be based on measurement of laser monitor photodiode current. Accuracy is better than  $\pm 3$ dB over specified temperature and voltage. Data is not valid when the transmitter is disabled.

**Transceiver RX received optical power**, internally measured, represented as a 16 bit unsigned integer with the power defined as the full 16 bit 35 value (0 – 65535) with LSB equal to 0.1  $\mu$ W. Accuracy is better than  $\pm 3$ dB over specified temperature and voltage.

| Parameter            | Symbol           | Accuracy  | Units        | Report Range |     | Unit         | Remarks |
|----------------------|------------------|-----------|--------------|--------------|-----|--------------|---------|
| Internal Calibration |                  |           |              |              |     |              |         |
| Temperature          | T <sub>MON</sub> | $\pm 3$   | $^{\circ}$ C | -40          | 95  | $^{\circ}$ C |         |
| Voltage              | V <sub>MON</sub> | $\pm 0.1$ | V            | 2.7          | 3.9 | V            |         |
| Bias Current         | I <sub>MON</sub> | $\pm 10$  | %            | 1            | 80  | mA           |         |
| Tx Power             | P <sub>MON</sub> | $\pm 3$   | dB           | -12          | 2   | dBm          |         |
| Rx Power             | P <sub>MON</sub> | $\pm 3$   | dB           | -30          | 0   | dBm          |         |

## Block-Diagram-of-Transceiver



### Transmitter Section

The DFB driver accepts differential input data and provide bias and modulation currents for driving a laser. An automatic power-control (APC) feedback loop is incorporated to maintain a constant average optical power. 1550 nm DFB in an eye safe optical subassembly (OSA) mates to the fiber cable.

### TX\_DISABLE

The TX\_DISABLE signal is high (TTL logic "1") to turn off the laser output. The laser will turn on within 1ms when TX\_DISABLE is low (TTL logic"0").

### TX\_FAULT

When the TX\_FAULT signal is high, output indicates a laser fault of some kind. Low indicates normal operation.

### Receiver Section

The receiver utilizes a PIN detector integrated with a trans-impedance preamplifier in an OSA. This OSA is connected to a Limiting Amplifier which providing post-amplification quantization, and optical signal detection. The limiting Amplifier is AC-coupled to the transimpedance amplifier, with internal 100Ω differential termination.

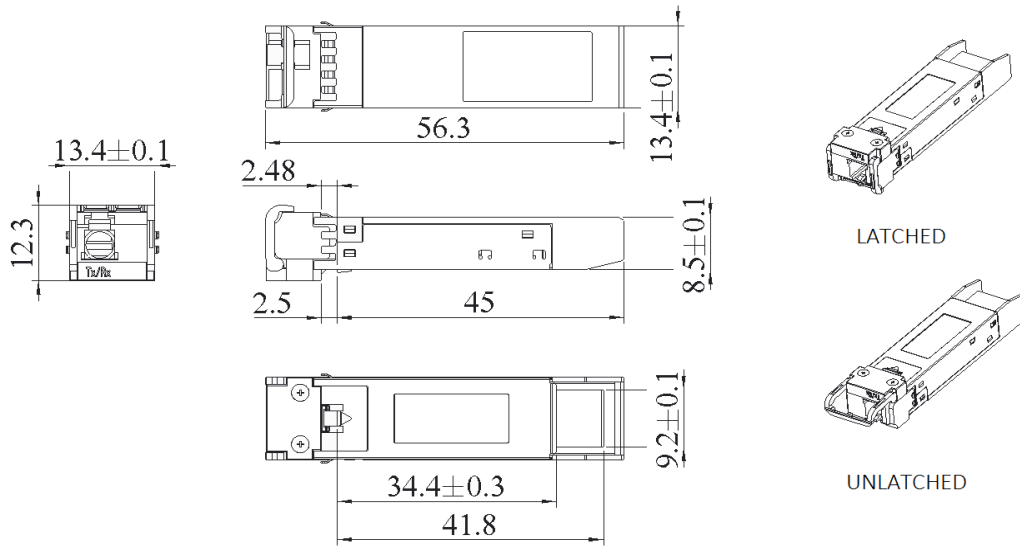
### Receive (RX\_LOS)

The RX\_LOS is high (logic "1") when there is no incoming light from the companion transceiver. This signal is normally used by the system for the diagnostic purpose. The signal is operated in TTL level.

## Controller Section

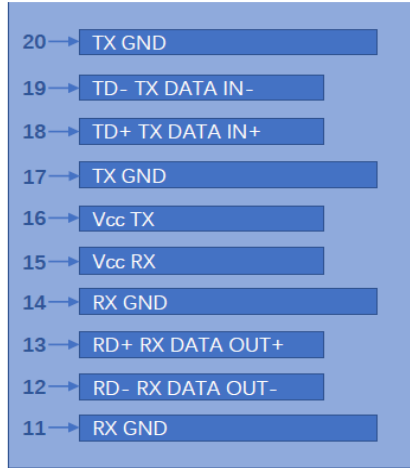
The micro controller unit monitors the operation information of LD driver and Limiting Amplifier. And report these status to the customer.

## Dimensions



ALL DIMENSIONS ARE  $\pm 0.2$ mm UNLESS OTHERWISE SPECIFIED  
UNIT: mm

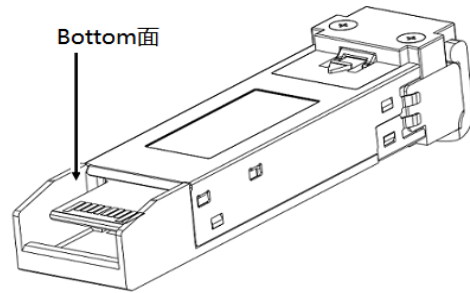
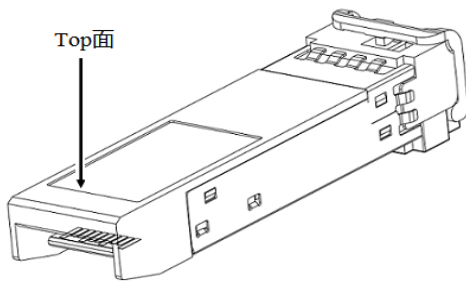
## Electrical Pad Layout



Top of Board



Bottom of Board





## Pin Assignment

| PIN # | Symbol           | Description   | Remarks |
|-------|------------------|---|---------|
| 1     | V <sub>EET</sub> | Transmitter ground (common with receiver ground)              | 1       |
| 2     | T_FAULT          | Transmitter Fault. Not supported                              |         |
| 3     | T_DIS            | Transmitter Disable. Laser output disabled on high or open    | 2       |
| 4     | MOD_DEF(2)       | Module Definition 2. Data line for serial ID                  | 3       |
| 5     | MOD_DEF(1)       | Module Definition 1. Clock line for serial ID                 | 3       |
| 6     | MOD_DEF(0)       | Module Definition 0. Grounded within the module               | 3       |
| 7     | Rate Select      | No connection required  |         |
| 8     | LOS              | Loss of Signal indication. Logic 0 indicates normal operation | 4       |
| 9     | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 10    | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 11    | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 12    | RD-              | Receiver Inverted DATA out. AC coupled                        |         |
| 13    | RD+              | Receiver Non-inverted DATA out. AC coupled                    |         |
| 14    | V <sub>EER</sub> | Receiver ground (common with transmitter ground)              | 1       |
| 15    | V <sub>CCR</sub> | Receiver power supply   |         |
| 16    | V <sub>CCT</sub> | Transmitter power supply                                      |         |
| 17    | V <sub>EET</sub> | Transmitter ground (common with receiver ground)              | 1       |
| 18    | TD+              | Transmitter Non-Inverted DATA in. AC coupled                  |         |
| 19    | TD-              | Transmitter Inverted DATA in. AC coupled                      |         |
| 20    | V <sub>EET</sub> | Transmitter ground (common with receiver ground)              | 1       |

### Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled: T<sub>DIS</sub>>2V or open, Enabled: T<sub>DIS</sub><0.8V
3. Should Be pulled up with 4.7k -10k ohm on host board to a voltage between 2V and 3.6V
4. LOS is open collector output

## References

1. IEEE standard 802.3. IEEE Standard Department, 2005.
2. Small Form Factor Pluggable (SFP) Transceiver Multi-Source Agreement (MSA), September 2000.
3. Fiber Channel Draft Physical Interface Specification (FC-PI-2 Rev7.0).
4. Digital Diagnostics Monitoring Interface for Optical Transceivers –SFF-8472.
5. Fiber Channel Physical and Signaling Interface (FC-PH/PH2/PH3).