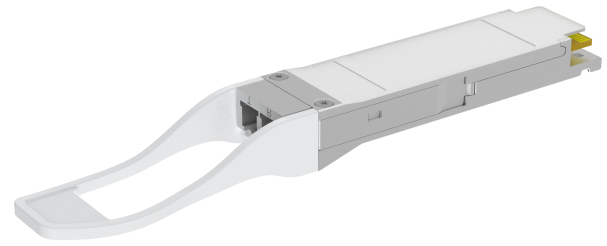


# FIBERSTAMP 100G QSFP28 ZR4 Optical Transceiver Module

## FBG-112L4K80C

### Features

- 4 channels full-duplex transceiver modules
- Transmission data rate up to 27.95Gbps per channel
- 4 X 25/28G LAN-WDM EML Integrated TOSA
- Cooling transmitter
- 4 X PIN+SOA Receivers
- Internal CDR circuits on both receiver and transmitter channels
- Power consumption < 6W
- Hot Pluggable QSFP form factor
- Up to 80km transmission on single mode fiber
- Duplex LC receptacles
- Built-in digital diagnostic functions
- Operating case temperature 0°C to +70°C
- 3.3V power supply voltage
- RoHS compliant(lead free)



### Applications

- 100GBASE-ZR4

### Description

This product is a 100Gbps transceiver module designed for optical communication applications compliant to 100GBASE-ZR4. The module converts 4 input channels of 25Gb/s electrical data to 4 channels of LAN WDM optical signals and then multiplexes them into a single channel for 100Gb/s optical transmission. Reversely on the receiver side, the module de-multiplexes a 100Gb/s optical input into 4 channels of LAN WDM optical signals and then converts them to 4 output channels of electrical data.

The central wavelengths of the 4 LAN WDM channels are 1295.56, 1300.05, 1304.58 and 1309.14 nm as members of the LAN WDM wavelength grid defined in IEEE 802.3ba. The high performance cooled LAN WDM EML transmitters and high sensitivity PIN+SOA receivers provide superior performance for 100Gigabit Ethernet applications up to 80km links.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP28 Multi-Source Agreement. It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.



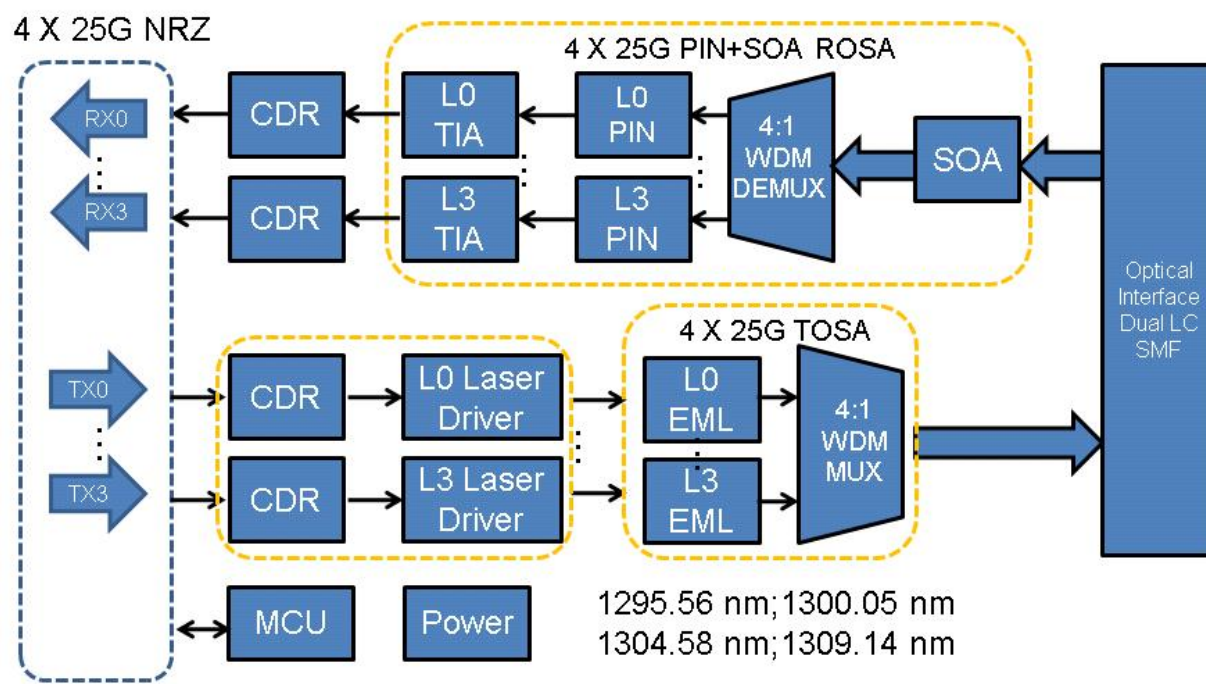


Figure1. Module Block Diagram

**Absolute Maximum Ratings**

| Parameter                  | Symbol | Min  | Max     | Unit |
|----------------------------|--------|------|---------|------|
| Supply Voltage             | Vcc    | -0.3 | 3.6     | V    |
| Input Voltage              | Vin    | -0.3 | Vcc+0.3 | V    |
| Storage Temperature        | Tst    | -20  | 85      | °C   |
| Case Operating Temperature | Top    | 0    | 70      | °C   |
| Humidity(non-condensing)   | Rh     | 5    | 85      | %    |

**Recommended Operating Conditions**

| Parameter                  | Symbol | Min  | Typical  | Max     | Unit |
|----------------------------|--------|------|----------|---------|------|
| Supply Voltage             | Vcc    | 3.13 | 3.3      | 3.47    | V    |
| Operating Case Temperature | Tca    | 0    |          | 70      | °C   |
| Data Rate Per Lane         | fd     |      | 25.78125 | 27.9525 | Gbps |
| Humidity                   | Rh     | 5    |          | 85      | %    |
| Power Dissipation          | P      |      |          | 6       | W    |
| Link Distance with G.652   | D      |      |          | 80      | km   |

**Electrical Specifications**

| Parameter                         | Symbol | Min | Typical | Max | Unit |
|-----------------------------------|--------|-----|---------|-----|------|
| Power Consumption                 | P      |     |         | 6   | W    |
| Supply Current                    | Icc    |     |         | 1.9 | A    |
| Transmitter(each Lane)            |        |     |         |     |      |
| Differential Input Voltage Swing  | Vin    |     |         | 900 | mVpp |
| Differential Input Impedance      | Zin    | 90  | 100     | 110 | Ohm  |
| Receiver(each Lane)               |        |     |         |     |      |
| Differential Output Voltage Swing | Vout   | 300 |         | 900 | mVpp |
| Differential Output Impedance     | Zout   | 90  | 100     | 110 | Ohm  |

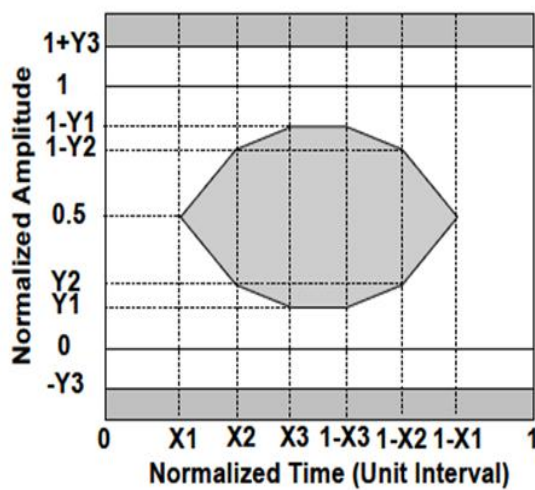
Optical Characteristics

| QSFP28 100GBASE-ER4                             |          |                                    |          |         |       |       |   |
|---|----------|------------------------------------|----------|---------|-------|-------|---|
| Parameter                                       | Symbol   | Min                                | Typical  | Max     | Unit  | Notes |   |
| Data Rate, each Lane                            | fd       |                                    | 25.78125 | 27.9525 | Gbps  |       |   |
| Lane Wavelength                                 | L0       | 1294.53                            | 1295.56  | 1296.59 | nm    |       |   |
|   | L1       | 1299.02                            | 1300.05  | 1301.09 | nm    |       |   |
|   | L2       | 1303.54                            | 1304.58  | 1305.63 | nm    |       |   |
|   | L3       | 1308.09                            | 1309.14  | 1310.19 | nm    |       |   |
| Transmitter                                     |          |                                    |          |         |       |       |   |
| SMSR  | SMSR     | 30                                 |          |         | dB    |       |   |
| Total Average Launch Power                      | PT       | -                                  |          | 12.5    | dBm   |       |   |
| Average Launch Power, each Lane                 | PAVG     | 2                                  |          | 6       | dBm   |       |   |
| Difference in launch power between any two      | Ptx,diff |                                    |          | 3.6     | dB    |       |   |
| Extinction Ratio                                | ER       | 8                                  |          |         | dB    |       |   |
| RIN200MA  | RIN      |                                    |          | -130    | dB/Hz |       |   |
| Optical Return Loss Tolerance                   | TOL      |                                    |          | 20      | dB    |       |   |
| Transmitter Reflectance                         | RT       |                                    |          | -12     | dB    |       |   |
| Eye Mask coordinates:<br>X1, X2, X3, Y1, Y2, Y3 |          | {0.25, 0.4, 0.45, 0.25, 0.28, 0.4} |          |         |       |       | 1 |
| Average Launch Power OFF Transmitter, each Lane | Poff     |                                    |          | -30     | dBm   |       |   |
| Receiver  |          |                                    |          |         |       |       |   |
| Average Receive Power, each lane(OTU4)          |          | -28                                |          | -3.5    | dBm   |       |   |
| Average Receive Power, each lane(100GE)         |          | -28                                |          | -3.5    | dBm   |       |   |
| Equivalent Sensitivity for Each lane(OTU4)      | SEN      |                                    |          | -28     | dBm   | 2     |   |
| Receiver sensitivity Average, each lane(100GbE) | SEN      |                                    |          | -28     | dBm   | 2     |   |
| LOS Assert                                      | LOSA     | -38                                |          |         | dBm   |       |   |
| LOS Deassert                                    | LOSD     |                                    |          | -29     | dBm   |       |   |
| LOS Hysteresis                                  | LOSH     | 0.5                                |          |         | dB    |       |   |

Note :

See Figure below.

Sensitivity is specified at BER@5E-5 with FEC.



### Pin Descriptions

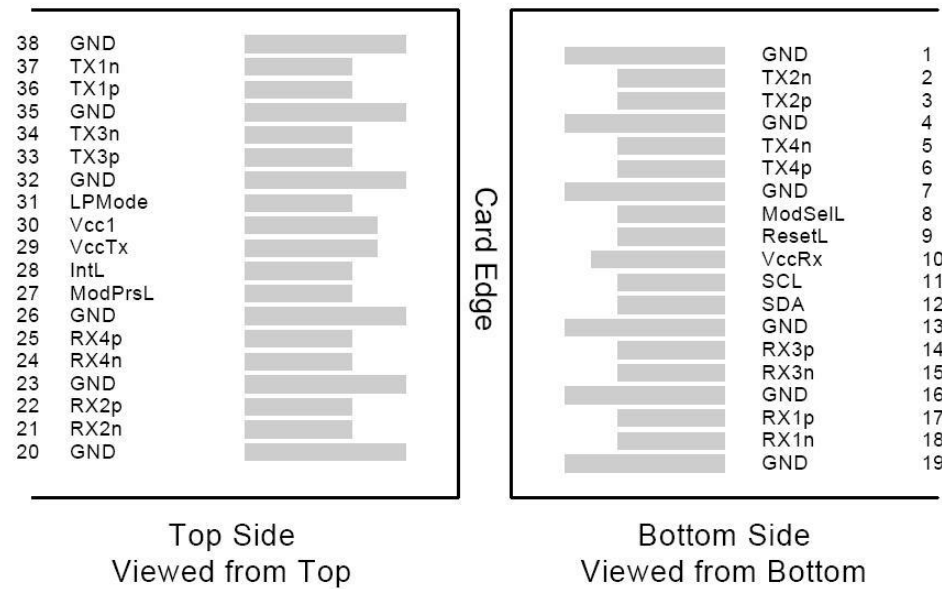
| Pin | Logic      | Symbol  | Name/Description                                    | Ref. |
|-----|------------|---------|---|------|
| 1   |            | GND     | Module Ground                                       | 1    |
| 2   | CML-I      | Tx2-    | Transmitter inverted data input                     |      |
| 3   | CML-I      | Tx2+    | Transmitter non-inverted data input                 |      |
| 4   |            | GND     | Module Ground                                       | 1    |
| 5   | CML-I      | Tx4-    | Transmitter inverted data input                     |      |
| 6   | CML-I      | Tx4+    | Transmitter non-inverted data input                 |      |
| 7   |            | GND     | Module Ground                                       | 1    |
| 8   | LVTTTL-I   | MODSEIL | Module Select                                       | 2    |
| 9   | LVTTTL-I   | ResetL  | Module Reset  | 2    |
| 10  |            | VCCRx   | +3.3v Receiver Power Supply                         |      |
| 11  | LVCMOS-I   | SCL     | 2-wire Serial interface clock                       | 2    |
| 12  | LVCMOS-I/O | SDA     | 2-wire Serial interface data                        | 2    |
| 13  |            | GND     | Module Ground                                       | 1    |
| 14  | CML-O      | RX3+    | Receiver non-inverted data output                   |      |
| 15  | CML-O      | RX3-    | Receiver inverted data output                       |      |
| 16  |            | GND     | Module Ground                                       | 1    |
| 17  | CML-O      | RX1+    | Receiver non-inverted data output                   |      |
| 18  | CML-O      | RX1-    | Receiver inverted data output                       |      |
| 19  |            | GND     | Module Ground                                       | 1    |
| 20  |            | GND     | Module Ground                                       | 1    |
| 21  | CML-O      | RX2-    | Receiver inverted data output                       |      |
| 22  | CML-O      | RX2+    | Receiver non-inverted data output                   |      |
| 23  |            | GND     | Module Ground                                       | 1    |
| 24  | CML-O      | RX4-    | Receiver inverted data output                       |      |
| 25  | CML-O      | RX4+    | Receiver non-inverted data output                   |      |
| 26  |            | GND     | Module Ground                                       | 1    |
| 27  | LVTTTL-O   | ModPrsL | Module Present, internal pulled down to GND         |      |
| 28  | LVTTTL-O   | IntL    | Interrupt output, should be pulled up on host board | 2    |
| 29  |            | VCCTx   | +3.3v Transmitter Power Supply                      |      |
| 30  |            | VCC1    | +3.3v Power Supply                                  |      |
| 31  | LVTTTL-I   | LPMode  | Low Power Mode                                      | 2    |
| 32  |            | GND     | Module Ground                                       | 1    |
| 33  | CML-I      | Tx3+    | Transmitter non-inverted data input                 |      |
| 34  | CML-I      | Tx3-    | Transmitter inverted data input                     |      |
| 35  |            | GND     | Module Ground                                       | 1    |



| Pin | Logic | Symbol | Name/Description                    | Ref. |
|-----|-------|--------|-------------------------------------|------|
| 36  | CML-I | Tx1+   | Transmitter non-inverted data input |      |
| 37  | CML-I | Tx1-   | Transmitter inverted data input     |      |
| 38  |       | GND    | Module Ground                       | 1    |

**Notes:**

1. Module circuit ground is isolated from module chassis ground within the module.
2. Open collector; should be pulled up with 4.7k – 10k ohms on host board to a voltage between 3.15V and 3.6V.



**Figure2. Electrical Pin-out Details**

**ModSelL Pin**

The ModSelL is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple QSFP modules on a single 2-wire interface bus. When the ModSelL is “High”, the module will not respond to any 2-wire interface communication from the host. ModSelL has an internal pull-up in the module.

**ResetL Pin**

Reset. LPMode\_Reset has an internal pull-up in the module. A low level on the ResetL pin for longer than the minimum pulse length ( $t_{Reset\_init}$ ) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time ( $t_{init}$ ) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset ( $t_{init}$ ) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by posting an IntL signal with the Data\_Not\_Ready bit negated. Note that on power up (including hot insertion) the module will post this completion of reset interrupt without requiring a reset.

**LPMode Pin**

FIBERSTAMP QSFP28 module operate in the low power mode (less than 1.5 W power consumption)  
This pin active high will decrease power consumption to less than 1.5W.

**ModPrsL Pin**

ModPrsL is pulled up to Vcc on the host board and grounded in the module. The ModPrsL is asserted “Low” when the module is inserted and deasserted “High” when the module is physically absent from the host connector.

**IntL Pin**

IntL is an output pin. When “Low”, it indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt by using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled up to Vcc on the host board.



### DIAGNOSTIC MONITORING INTERFACE

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

| Parameter                               | Symbol       | Min  | Max | Units | Notes                            |
|---|--------------|------|-----|-------|----------------------------------|
| Temperature monitor absolute error      | DMI_Temp     | -3   | +3  | degC  | Over operating temperature range |
| Supply voltage monitor absolute error   | DMI_VCC      | -0.1 | 0.1 | V     | Over full operating range        |
| Channel RX power monitor absolute error | DMI_RX_Ch    | -2   | 2   | dB    | 1                                |
| Channel Bias current monitor            | DMI_Ibias_Ch | -10% | 10% | mA    |                                  |
| Channel TX power monitor absolute error | DMI_TX_Ch    | -2   | 2   | dB    | 1                                |

**Notes:**

Due to measurement accuracy of different single mode fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

Digital diagnostics monitoring function is available on all FIBERSTAMP QSFP28 module. A 2-wire serial interface provides user to contact with module.

The structure of the memory is shown in Figure 3. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, such as Interrupt Flags and Monitors. Less time critical time entries, such as serial ID information and threshold settings, are available with the Page Select function.

The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a one-time-read for all data related to an interrupt situation. After an interrupt, IntL, has been asserted, the host can read out the flag field to determine the affected channel and type of flag.



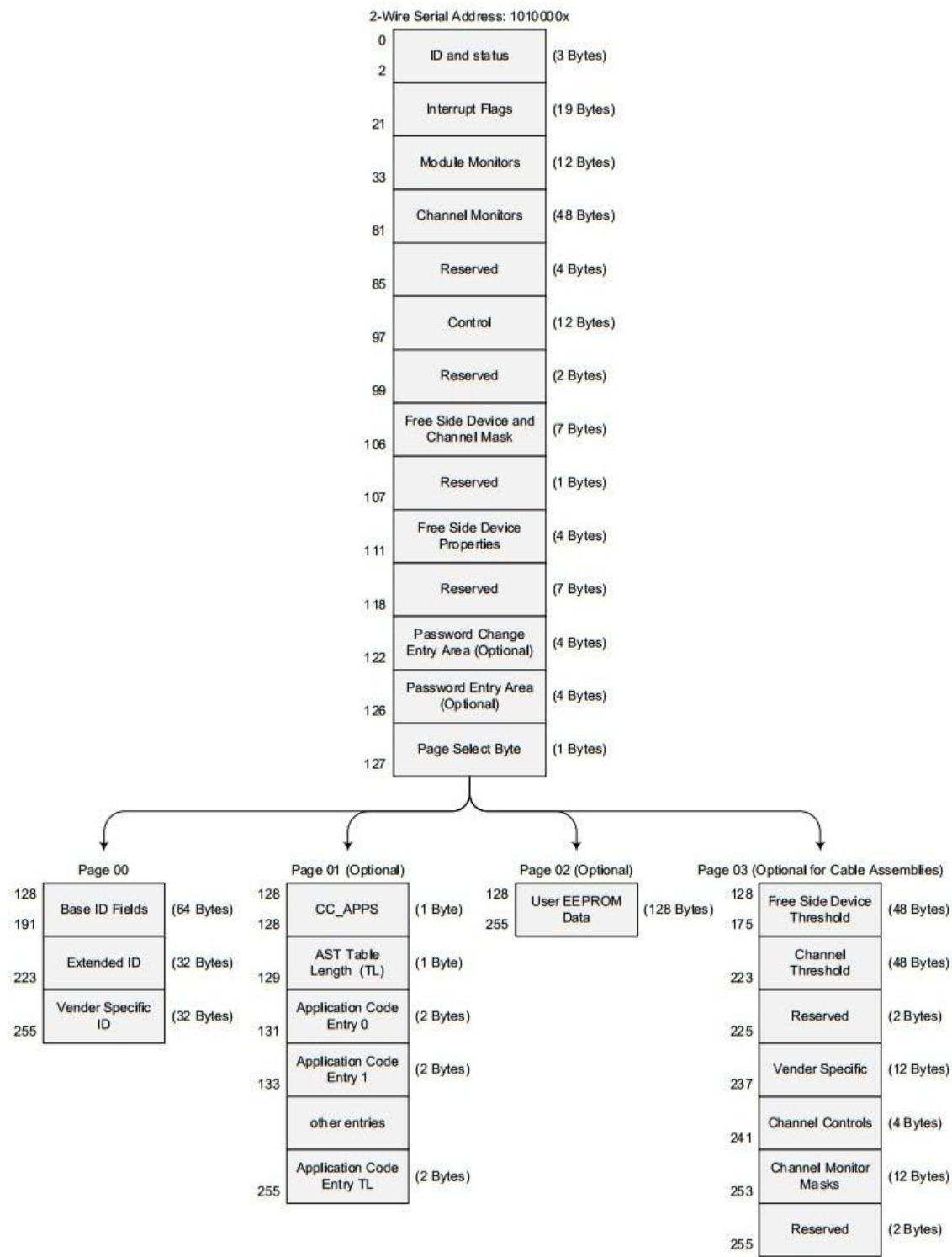


Figure3. QSFP Memory Map

| Byte Address | Description                        | Type       |
|--------------|------------------------------------|------------|
| 0            | Identifier (1 Byte)                | Read Only  |
| 1-2          | Status (2 Bytes)                   | Read Only  |
| 3-21         | Interrupt Flags (31 Bytes)         | Read Only  |
| 22-33        | Module Monitors (12 Bytes)         | Read Only  |
| 34-81        | Channel Monitors (48 Bytes)        | Read Only  |
| 82-85        | Reserved (4 Bytes)                 | Read Only  |
| 86-97        | Control (12 Bytes)                 | Read/Write |
| 98-99        | Reserved (2 Bytes)                 | Read/Write |
| 100-106      | Module and Channel Masks (7 Bytes) | Read/Write |
| 107-118      | Reserved (12 Bytes)                | Read/Write |
| 119-122      | Reserved (4 Bytes)                 | Read/Write |
| 123-126      | Reserved (4 Bytes)                 | Read/Write |
| 127          | Page Select Byte                   | Read/Write |

Figure4. Low Memory Map

| Byte Address | Description                  | Type       |
|--------------|------------------------------|------------|
| 128-175      | Module Thresholds (48 Bytes) | Read Only  |
| 176-223      | Reserved (48 Bytes)          | Read Only  |
| 224-225      | Reserved (2 Bytes)           | Read Only  |
| 226-239      | Reserved (14 Bytes)          | Read/Write |
| 240-241      | Channel Controls (2 Bytes)   | Read/Write |
| 242-253      | Reserved (12 Bytes)          | Read/Write |
| 254-255      | Reserved (2 Bytes)           | Read/Write |

Figure5. Page 03 Memory Map



| Address | Name                                    | Description  |
|---------|---|--|
| 128     | Identifier (1 Byte)                     | Identifier Type of serial transceiver  |
| 129     | Ext. Identifier (1 Byte)                | Extended identifier of serial transceiver  |
| 130     | Connector (1 Byte)                      | Code for connector type  |
| 131-138 | Transceiver (8 Bytes)                   | Code for electronic compatibility or optical compatibility   |
| 139     | Encoding (1 Byte)                       | Code for serial encoding algorithm   |
| 140     | BR, nominal (1 Byte)                    | Nominal bit rate, units of 100 Mbits/s   |
| 141     | Extended RateSelect Compliance (1 Byte) | Tags for Extended RateSelect compliance  |
| 142     | Length SMF (1 Byte)                     | Link length supported for SM fiber in km   |
| 143     | Length E-50 μm (1 Byte)                 | Link length supported for EBW 50/125 μm fiber, units of 2 m  |
| 144     | Length 50 μm (1 Byte)                   | Link length supported for 50/125 μm fiber, units of 1 m  |
| 145     | Length 62.5 μm (1 Byte)                 | Link length supported for 62.5/125μm fiber, units of 1 m   |
| 146     | Length copper (1 Byte)                  | Link length supported for copper, units of 1 m   |
| 147     | Device Tech (1 Byte)                    | Device technology  |
| 148-163 | Vendor name (16 Bytes)                  | QSFP vendor name (ASCII)   |
| 164     | Extended Transceiver (1 Byte)           | Extended Transceiver Codes for InfiniBand <sup>†</sup>   |
| 165-167 | Vendor OUI (3 Bytes)                    | QSFP vendor IEEE vendor company ID   |
| 168-183 | Vendor PN (16 Bytes)                    | Part number provided by QSFP vendor (ASCII)  |
| 184-185 | Vendor rev (2 Bytes)                    | Revision level for part number provided by vendor (ASCII)  |
| 186-187 | Wavelength (2 Bytes)                    | Nominal laser wavelength (Wavelength = value / 20 in nm)   |
| 188-189 | Wavelength Tolerance (2 Bytes)          | Guaranteed range of laser wavelength (+/- value) from Nominal wavelength (Wavelength Tol. = value / 200 in nm) |
| 190     | Max Case Temp (1 Byte)                  | Maximum Case Temperature in Degrees C  |
| 191     | CC_BASE (1 Byte)                        | Check code for Base ID fields (addresses 128-190)  |
| 192-195 | Options (4 Bytes)                       | Rate Select, TX Disable, TX Fault, LOS   |
| 196-211 | Vendor SN (16 Bytes)                    | Serial number provided by vendor (ASCII)   |
| 212-219 | Date code (8 Bytes)                     | Vendor's manufacturing date code   |
| 220     | Diagnostic Monitoring Type (1 Byte)     | Indicates which type of diagnostic monitoring is implemented   |
| 221     | Enhanced Options (1 Byte)               | Indicates which optional enhanced features are implemented   |
| 222     | Reserved (1 Byte)                       | Reserved   |
| 223     | CC_EXT                                  | Check code for the Extended ID Fields (addresses 192-222)  |
| 224-255 | Vendor Specific (32 Bytes)              | Vendor Specific EEPROM   |

Figure6. Page 00 Memory Map

Page02 is User EEPROM and its format decided by user.

The detail description of low memory and page00.page03 upper memory please see SFF-8436 document.

**Mechanical Dimensions**

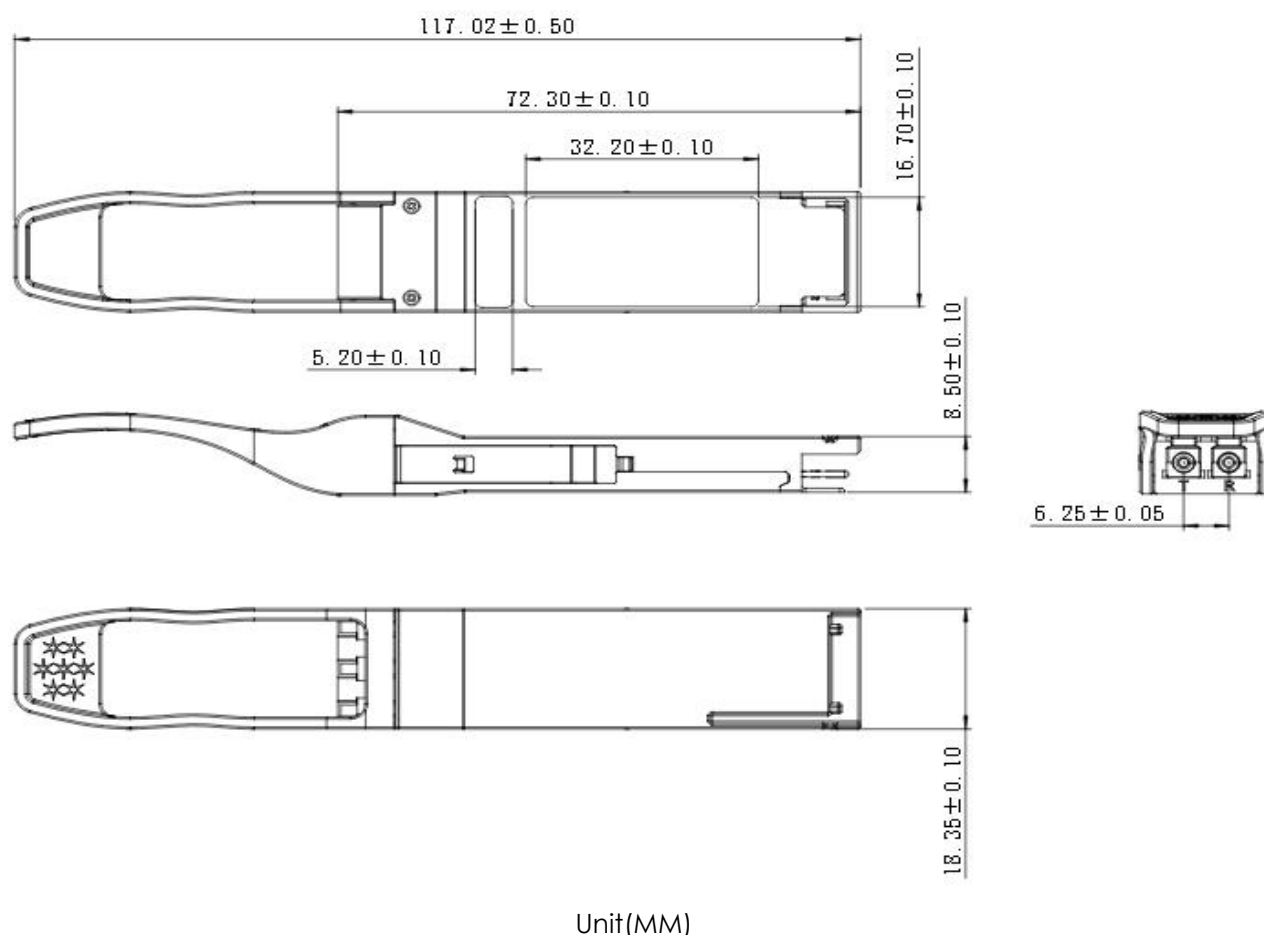


Figure7. Mechanical Specifications



### Regulatory Compliance

FIBERSTAMP FBG-112L4K80C transceivers are Class 1 Laser Products. They meet the requirements of the following standards:

| Feature                  | Standard   |
|--------------------------|--|
| Laser Safety             | IEC 60825-1:2014 (3rd Edition)<br>IEC 60825-2:2004/AMD2:2010 |
| Electrical Safety        | EN 62368-1: 2014<br>IEC 62368-1:2014                         |
| Environmental protection | Directive 2011/65/EU with amendment(EU)2015/863              |
| CE EMC                   | EN55032 : 2015<br>EN55035 : 2017                             |
| FCC                      | FCC Part 15, Subpart B<br>ANSI C63.4-2014                    |

### References

1. SFF-8436 QSFP+
2. Ethernet 100GBASE-ZR4

### CAUTION:

Use of controls or adjustment or performance of procedures other than those specified herein may result in hazardous radiation exposure.

### Ordering information

| Part Number   | Product Description                            |
|---------------|--|
| FBG-112L4K80C | 100GE,OTU4, QSFP28, 100GBASE-ZR4, LAN_WDM 80km |

### Important Notice

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