

100G-ER1-40km QSFP28 Optical Transceiver FBG-10031K40C

Features

- Compliant to 100G Lambda MSA 100G ER1-40
- Full-duplex transceiver module
- 4x25.78125Gbps NRZ electrical interface(CAUI-4)
- 106.25Gbps PAM4 based on a cooled EML TOSA transmitter
- 106.25Gbps PAM4 APD Receiver
- 4W maximum power dissipation
- Hot-pluggable QSFP28 form factor
- Maximum link length of 40km on G.652 SMF with KP-FEC
- Duplex LC receptacles
- Built-in digital diagnostic functions
- Operating case temperature range: 0 to 70°C
- Single 3.3V power supply
- RoHS compliant (lead free)



Applications

- 100G Lambda 100G ER1-40

Description

The FIBERSTAMP 100G ER1-40km QSFP28 optical transceiver, 100G QSFP28 ER1-40(FBG-10031K40C) is designed for using in 100-Gigabit Ethernet links up to 40km over Single-Mode Fiber (SMF). It is compliant with the QSFP28 MSA, 100G Lambda 100G ER1-40 and CAUI-4(no FEC)1. Digital diagnostics functions are available via the I2C interface, as specified by the QSFP28 MSA. The module incorporates 1 channel optical signal, on 1311nm center wavelength, operating at 100Gbps data rate. This module can convert 4 channels of 25Gbps (NRZ) electrical input data to 1 channel of 100Gbps (PAM4) optical signal, and also can convert 1 channel of 100Gbps (PAM4) optical signal to 4 channels of 25Gbps (NRZ) electrical output data. The electrical interface uses a 38-contact edge type connector. The optical interface uses a Duplex LC connector. The high performance cooled EML transmitter and high sensitivity PIN receiver provide superior performance for 100Gigabit Ethernet applications up to 40km links.



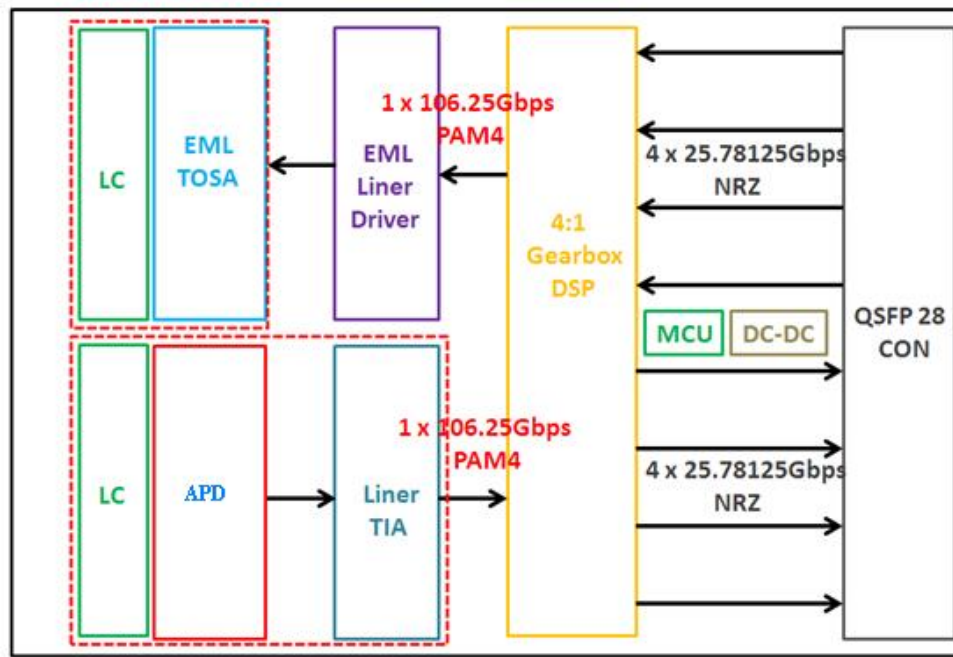


Figure 1. Module Block Diagram

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 | Ts | -20 | 85 | °C |
| Case Operating Temperature | Tc | 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 | Tc | 0 | - | 70 | °C |
| Data Rate Per Lane | fd | - | 106.25 | - | Gb/s |
| Humidity | Rh | 5 | - | 85 | % |
| Power Dissipation | Pm | - | - | 4 | W |
| Link Distance with G.652 | D | - | - | 40 | km |

Electrical Specifications

| Parameter | Symbol | Min | Typical | Max | Unit |
|--|--------|-----|---------|------|-------|
| Differential Input Impedance | Zin | 90 | 100 | 110 | ohm |
| Differential Output Impedance | Zout | 90 | 100 | 110 | ohm |
| Differential Input Voltage Amplitude1 | ΔVin | - | - | 1600 | mVp-p |
| Differential Output Voltage Amplitude2 | ΔVout | - | - | 900 | mVp-p |

Note:

1. Differential input voltage amplitude is measured between TxnP and TxnN.
2. Differential output voltage amplitude is measured between RxnP and RxnN.



Optical Characteristics

| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
|--|-------------|--------|---------|--------|------|-------|
| Transmitter | | | | | | |
| Centre Wavelength | λ_c | 1304.5 | - | 1317.5 | nm | - |
| Side-mode suppression ratio | SMSR | 30 | - | - | dB | - |
| Average launch power | Pout | 1.7 | - | 7.1 | dBm | - |
| Transmitter and dispersion eye closure(TDEC) | TDEC | - | - | 3.9 | dB | - |
| Extinction Ratio | ER | 5 | - | - | dB | - |
| Average launch power of OFF transmitter | | - | - | -30 | dB | - |
| Receiver | | | | | | |
| Centre Wavelength | λ_c | 1304.5 | - | 1317.5 | nm | - |
| Receiver Sensitivity in OMA outer | RXsen | - | - | -13.8 | dBm | 1 |
| Average receive power | Pin | -16 | - | -3.4 | dBm | - |
| Receiver Reflectance | | - | - | -26 | dB | - |
| LOS Assert | | - | -18 | - | dBm | - |
| LOS De-Assert – OMA | | - | -16 | - | dBm | - |
| LOS Hysteresis | | 0.5 | - | - | dB | - |
| Damage threshold | | | | -3 | dBm | |

Note:

1. Measured with conformance test signal at TP3 for BER = 2.4E-4 Pre-FECs

Pin Description

| Pin | Logic | Symbol | Name/Description |
|-----|-------------|---------|-------------------------------------|
| 1 | | GND | Module Ground1 |
| 2 | CML-I | Tx2- | Transmitter inverted data input |
| 3 | CML-I | Tx2+ | Transmitter non-inverted data input |
| 4 | | GND | Module Ground1 |
| 5 | CML-I | Tx4- | Transmitter inverted data input |
| 6 | CML-I | Tx4+ | Transmitter non-inverted data input |
| 7 | | GND | Module Ground1 |
| 8 | LVTTTL-I | MODSEIL | Module Select2 |
| 9 | LVTTTL-I | ResetL | Module Reset2 |
| 10 | | VCCRx | +3.3V Receiver Power Supply |
| 11 | LVC MOS-I | SCL | 2-wire Serial interface clock2 |
| 12 | LVC MOS-I/O | SDA | 2-wire Serial interface data2 |
| 13 | | GND | Module Ground1 |
| 14 | CML-O | RX3+ | Receiver non-inverted data output |

| Pin | Logic | Symbol | Name/Description |
|-----|---------|---------|--|
| 15 | CML-O | RX3- | Receiver inverted data output |
| 16 | | GND | Module Ground1 |
| 17 | CML-O | RX1+ | Receiver non-inverted data output |
| 18 | CML-O | RX1- | Receiver inverted data output |
| 19 | | GND | Module Ground1 |
| 20 | | GND | Module Ground1 |
| 21 | CML-O | RX2- | Receiver inverted data output |
| 22 | CML-O | RX2+ | Receiver non-inverted data output |
| 23 | | GND | Module Ground1 |
| 24 | CML-O | RX4- | Receiver inverted data output |
| 25 | CML-O | RX4+ | Receiver non-inverted data output |
| 26 | | GND | Module Ground1 |
| 27 | LVTTL-O | ModPrsL | Module Present, internal pulled down to GND |
| 28 | LVTTL-O | IntL | Interrupt output, should be pulled up on host board2 |
| 29 | | VCCTx | +3.3V Transmitter Power Supply |
| 30 | | VCC1 | +3.3V Power Supply |
| 31 | LVTTL-I | LPMode | Low Power Mode2 |
| 32 | | GND | Module Ground1 |
| 33 | CML-I | Tx3+ | Transmitter non-inverted data input |
| 34 | CML-I | Tx3- | Transmitter inverted data input |
| 35 | | GND | Module Ground1 |
| 36 | CML-I | Tx1+ | Transmitter non-inverted data input |
| 37 | CML-I | Tx1- | Transmitter inverted data input |
| 38 | | GND | Module Ground1 |

Note:

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

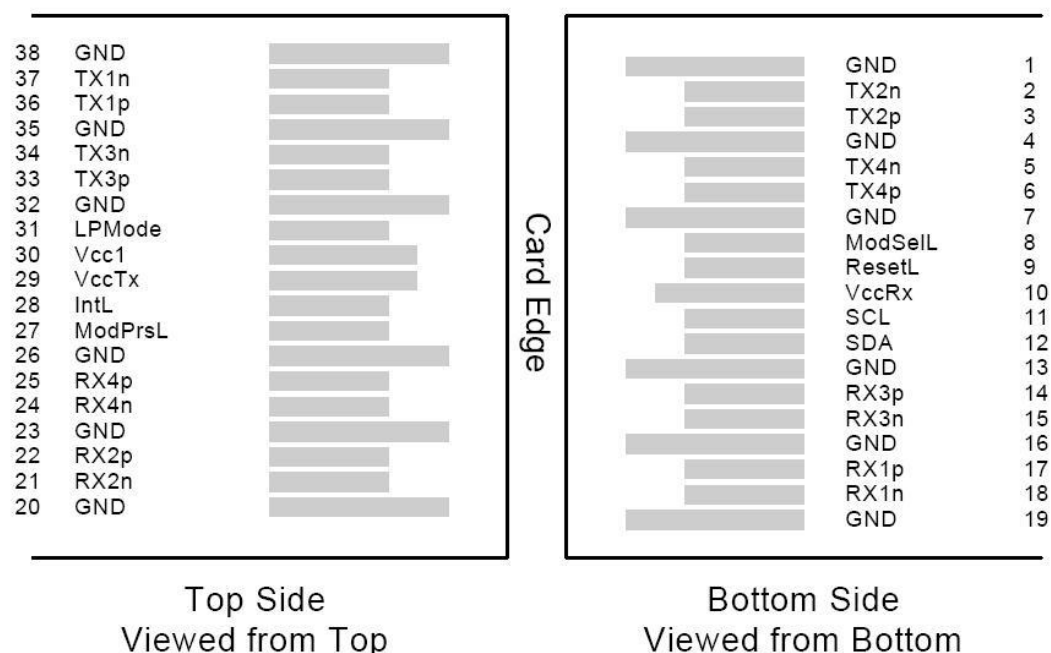


Figure 2. Electrical Pin-out Details

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 modules operate in the low power mode (less than 1.5 W power consumption). This pin active high will decrease power consumption to less than 1W.

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.

Power Supply Filtering

The host board should use the power supply filtering shown in Figure 3.

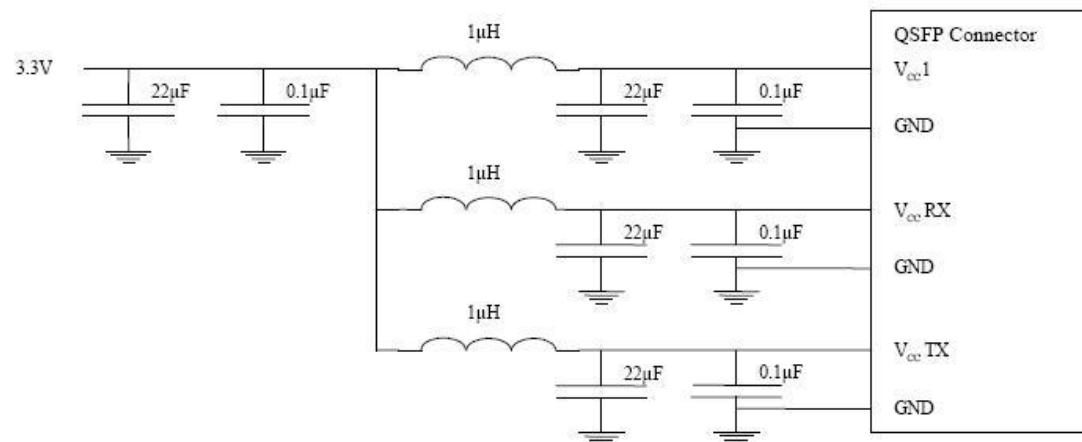


Figure 3. Host Board Power Supply Filtering



DIAGNOSTIC MONITORING INTERFACE (OPTIONAL)

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:

1. 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 transceivers. A 2-wire serial interface provides user to contact with module.

The structure of the memory is shown in Figure 4. 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.

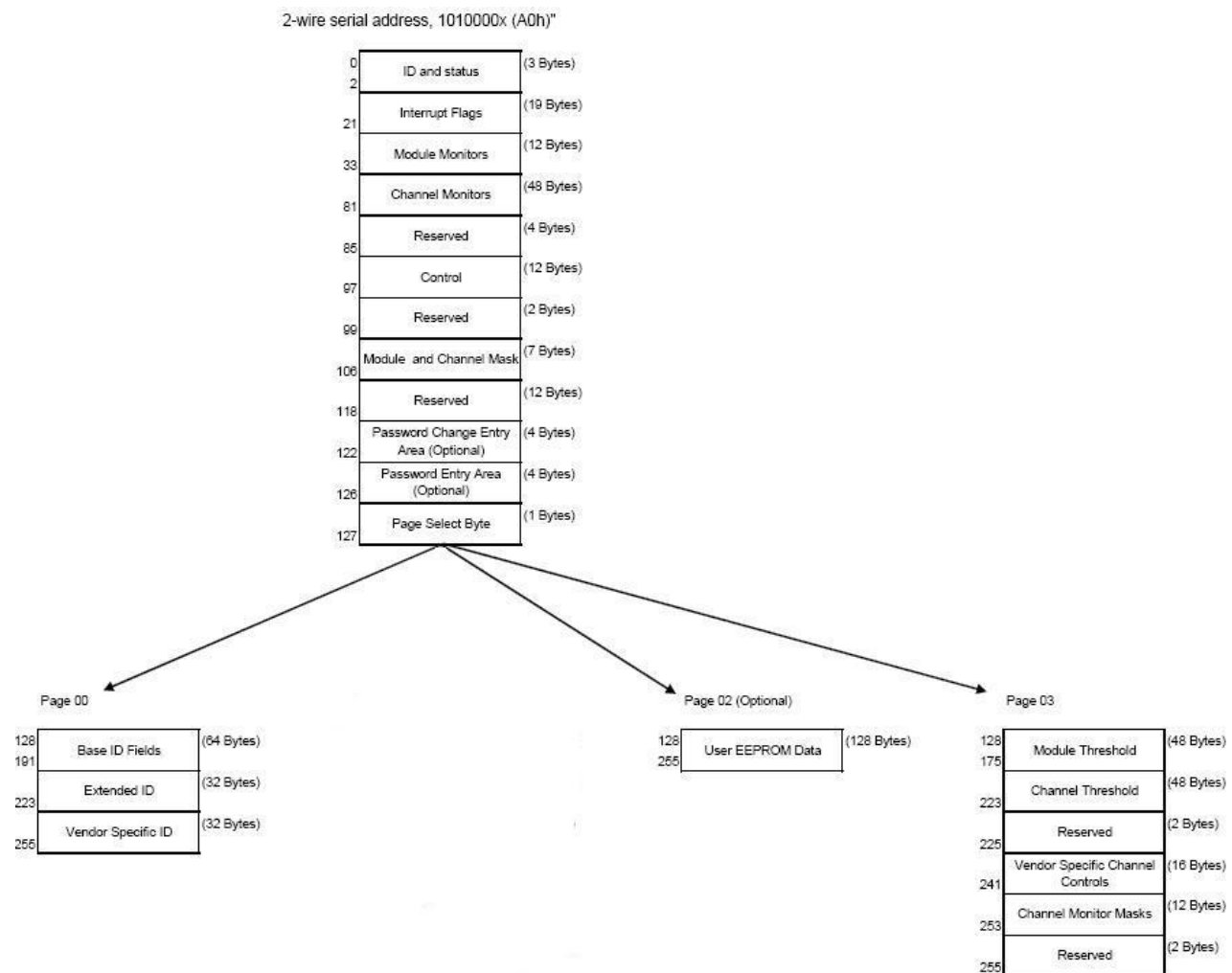


Figure 4. QSFP28 Memory Map



| 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 |

Figure 5. 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 |

Figure 6. 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 62.5/125 μm 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 [†] |
| 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 |

Figure 7. Page 00 Memory Map

Page02 is User EEPROM and its format decided by user.

The detail description of low memory and Page 00,Page 03 upper memory please see SFF-8436 document.



Mechanical Dimensions

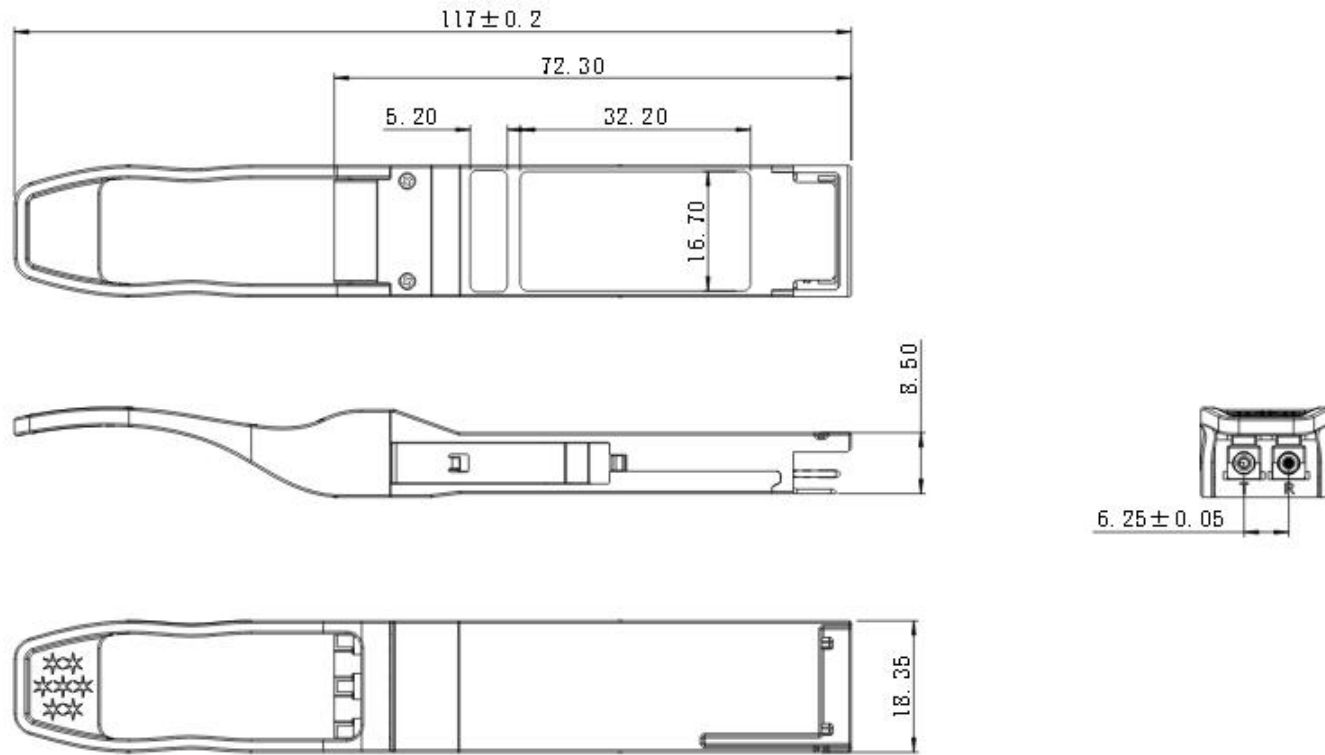


Figure 8. Mechanical Specifications

Regulatory Compliance

FIBERSTAMP FBG-10031K40C transceivers are Class 1 Laser Products. They meet the requirements of the following standards.

| Feature | Standard |
|--------------------------|--|
| Laser Safety | IEC 60825-1:2014 (3rd Edition) IEC 60825-2:2004/AMD2:2010 EN 60825-1-2014 EN 60825-2:2004+A1+A2 |
| Electrical Safety | EN 62368-1: 2014 IEC 62368-1:2014 UL 62368-1:2014 |
| Environmental protection | Directive 2011/65/EU with amendment(EU)2015/863 |
| CE EMC | EN55032: 2015 EN55035: 2017 EN61000-3-2:2014 EN61000-3-3:2013 |
| FCC | FCC Part 15, Subpart B ANSI C63.4-2014 |

References

1. QSFP28 MSA
2. SFF-8436 QSFP+
3. IEEE802.3cu 100GBASE-LR1
4. 100G Lambda MSA 100G LR1-20

Ordering Information

| Part Number | Product Description |
|---------------|--|
| FBG-10031K40C | QSFP28 ER1-40, 106.25Gb/s, 40km, EML+APD, SMF, Dual LC |

⚠️ CAUTION:

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