

Product Datasheet

FG-TRAN-QSFP+SR BIDI-C

Fortinet® Compatible 40Gbps-BX QSFP+

Duplex LC, +3.3V, BiDi, 850/900nm, MMF, 100m, 0 ~ 70°C

FEATURES

- Compliant to the 40GbE XLPI electrical specification per IEEE 802.3ba-2010
- Compliant to QSFP+ SFF-8436 Specification
- QSFP MSA compliant
- Aggregate bandwidth of > 40Gbps
- Operates at 10.3125 Gbps per electrical channel with 64b/66b encoded data
- Capable of over 100m transmission on OM3 Multimode Fiber (MMF) and 150m on OM4 MMF
- Single +3.3V power supply operating
- Built-in digital diagnostic functions
- Commercial Operating Temperature range 0 ~ 70°C
- RoHS Compliant Part
- Utilizes a standard LC duplex fiber cable allowing reuse of existing cable infrastructure

APPLICATIONS

- 40 Gigabit Ethernet interconnects
- Datacom/Telecom switch & router connections
- Data aggregation and backplane applications
- Proprietary protocol and density applications

DESCRIPTION

ATGBICS® compatible FG-TRAN-QSFP+SR BIDI-C is a Four-Channel, Pluggable, LC Duplex, Fiber-Optic QSFP+ Transceiver for 40 Gigabit Ethernet Applications. This transceiver is a high-performance module for short-range duplex data communication and interconnect applications. It integrates four electrical data lanes in each direction into transmission over a single LC duplex fiber optic cable. Each electrical lane operates at 10.3125 Gbps and conforms to the 40GE XLPI interface.

The transceiver internally multiplexes an XLPI 4x10G interface into two 20Gb/s electrical channels, transmitting and receiving each optically over one simplex LC fiber using bi-directional optics. This results in an aggregate bandwidth of 40Gbps into a duplex LC cable. This allows reuse of the installed LC duplex cabling infrastructure for 40GbE application. Link distances up to 100 m using OM3 and 150m using OM4 optical fiber are supported. These modules are designed to operate over multimode fiber systems using a nominal wavelength of 850nm on one end and 900nm on the other end. The electrical interface uses a 38 contact QSFP+ type edge connector. The optical interface uses a conventional LC duplex connector.

Product Datasheet

Transceiver Block Diagram

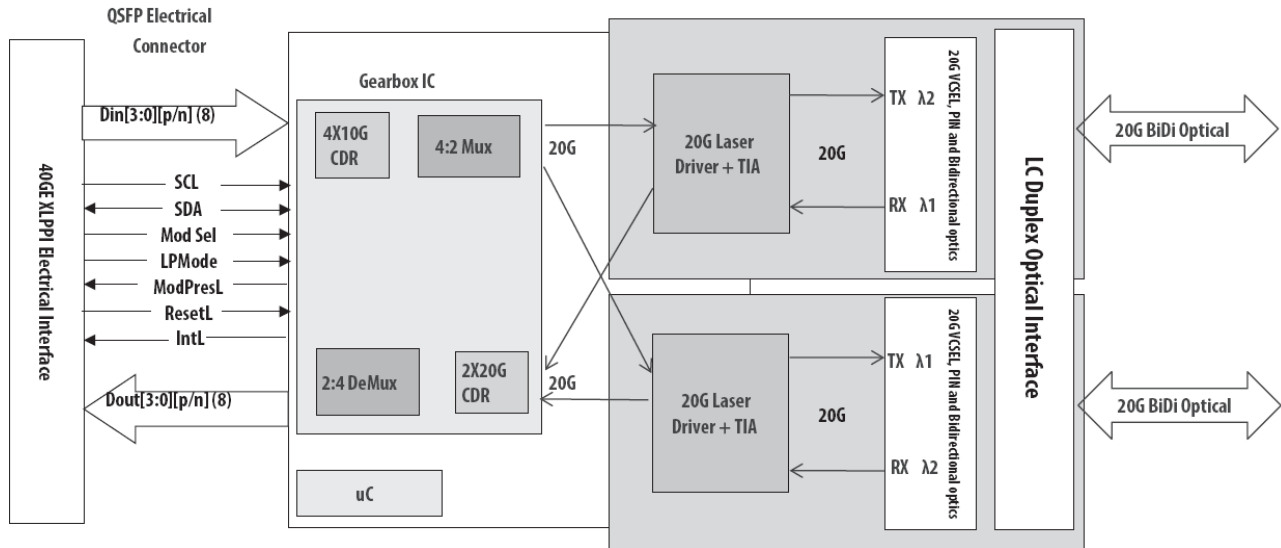


Figure 1. Transceiver Block Diagram

Absolute Maximum Ratings

| Parameter | Symbol | Min. | Typical | Max. | Unit |
|---------------------|----------------------|------|---------|------|------|
| Storage Temperature | T _s | -40 | | +85 | °C |
| Supply Voltage | V _{CC(T,R)} | -0.5 | | 4 | V |
| Relative Humidity | RH | 0 | | 85 | % |

Recommended Operating Environment

| Parameter | Symbol | Min. | Typical | Max. | Unit |
|----------------------------|----------------------|-------|---------|-------|------|
| Case operating Temperature | T _c | 0 | | +70 | °C |
| Supply Voltage | V _{CC(T,R)} | +3.13 | 3.3 | +3.47 | V |
| Supply Current | I _{CC} | | | 1000 | mA |
| Power Dissipation | PD | | | 3.5 | W |

Product Datasheet

Electrical Characteristics (TOP = 0 to 70 °C, VCC = 3.13 to 3.47 Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Note |
|---------------------------------------|--------|-----|---------|------|------|------|
| Data Rate per Channel | | - | 10.3125 | 11.2 | Gbps | |
| Power Consumption | | - | 2.5 | 3.5 | W | |
| Supply Current | Icc | | 0.75 | 1.0 | A | |
| Control I/O Voltage-High | VIH | 2.0 | | Vcc | V | |
| Control I/O Voltage-Low | VIL | 0 | | 0.7 | V | |
| Inter-Channel Skew | TSK | | | 150 | Ps | |
| RESETL Duration | | | 10 | | Us | |
| RESETL De-assert time | | | | 100 | ms | |
| Power On Time | | | | 100 | ms | |
| Transmitter | | | | | | |
| Single Ended Output Voltage Tolerance | | 0.3 | | 4 | V | 1 |
| Common mode Voltage Tolerance | | 15 | | | mV | |
| Transmit Input Diff Voltage | VI | 120 | | 1200 | mV | |
| Transmit Input Diff Impedance | ZIN | 80 | 100 | 120 | | |
| Data Dependent Input Jitter | DDJ | | | 0.1 | UI | |
| Data Input Total Jitter | TJ | | | 0.28 | UI | |
| Receiver | | | | | | |
| Single Ended Output Voltage Tolerance | | 0.3 | | 4 | V | |
| Rx Output Diff Voltage | Vo | | 600 | 800 | mV | |
| Rx Output Rise and Fall Voltage | Tr/Tf | | | 35 | ps | 1 |
| Total Jitter | TJ | | | 0.7 | UI | |
| Deterministic Jitter | DJ | | | 0.42 | UI | |

Note:

1. 20~80%

Product Datasheet

Optical Parameters (TOP = 0 to 70 °C, VCC = 3.0 to 3.6 Volts)

| Parameter | Symbol | Min | Typ | Max | Unit | Ref. |
|-----------------------------------|------------------|------|------|------|-------|------|
| Transmitter | | | | | | |
| Optical Wavelength CH1 | λ | 832 | 850 | 868 | nm | |
| Optical Wavelength CH2 | λ | 882 | 900 | 918 | nm | |
| RMS Spectral Width | Pm | | 0.5 | 0.65 | nm | |
| Average Optical Power per Channel | Pavg | -4 | -2.5 | +5.0 | dBm | |
| Laser Off Power Per Channel | Poff | | | -30 | dBm | |
| Optical Extinction Ratio | ER | 3.5 | | | dB | |
| Relative Intensity Noise | Rin | | | -128 | dB/HZ | 1 |
| Optical Return Loss Tolerance | | | | 12 | dB | |
| Receiver | | | | | | |
| Optical Center Wavelength CH1 | λ | 882 | 900 | 918 | nm | |
| Optical Center Wavelength CH2 | λ | 832 | 850 | 868 | nm | |
| Receiver Sensitivity per Channel | R | | -11 | | dBm | |
| Maximum Input Power | PMAX | +0.5 | | | dBm | |
| Receiver Reflectance | Rrx | | | -12 | dB | |
| LOS De-Assert | LOS _D | | | -14 | dBm | |
| LOS Assert | LOS _A | -30 | | | dBm | |
| LOS Hysteresis | LOS _H | 0.5 | | | dB | |

Note:

1. 12dB Reflection

Product Datasheet

Diagnostic Monitoring Interface

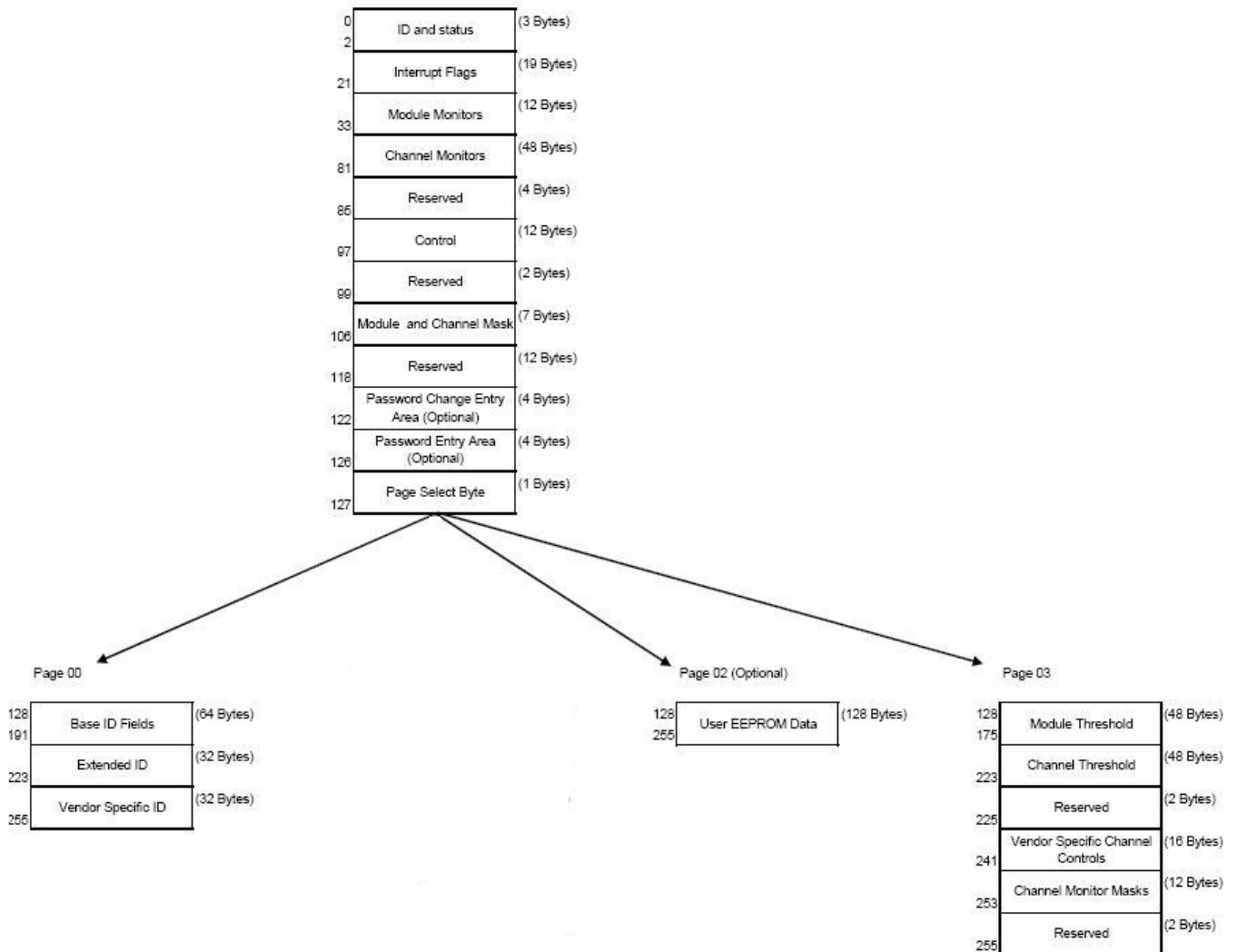
Digital diagnostics monitoring function is available on all QSFP+ SRBD. A 2-wire serial interface provides user to contact with module. The structure of the memory is shown in flowing. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space 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.

| 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 |

| 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 |

Product Datasheet

2-wire serial address, 1010000x (A0h)"



Product Datasheet

| 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 [†] |
| 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 |

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.

Product Datasheet

Timing for Soft Control and Status Functions

| Parameter | Symbol | Max | Unit | Conditions |
|---------------------------------------|--------------|------|------|--|
| Initialization Time | t_init | 2000 | ms | Time from power on ¹ , hot plug or rising edge of Reset until the module is fully functional ² |
| Reset Init Assert Time | t_reset_init | 2 | µs | A Reset is generated by a low level longer than the minimum reset pulse time present on the ResetL pin. |
| Serial Bus Hardware Ready Time | t_serial | 2000 | ms | Time from power on ¹ until module responds to data transmission over the 2-wire serial bus |
| Monitor Data Ready Time | t_data | 2000 | ms | Time from power on ¹ to data not ready, bit 0 of Byte 2, deasserted and IntL asserted |
| Reset Assert Time | t_reset | 2000 | ms | Time from rising edge on the ResetL pin until the module is fully functional ² |
| LPMMode Assert Time | ton_LPMMode | 100 | µs | Time from assertion of LPMMode (Vin:LPMMode = Vih) until module power consumption enters lower Power Level |
| IntL Assert Time | ton_IntL | 200 | ms | Time from occurrence of condition triggering IntL until Vout:IntL = Vol |
| IntL Deassert Time | toff_IntL | 500 | µs | toff_IntL 500 µs Time from clear on read ³ operation of associated flag until Vout:IntL = Voh. This includes deassert times for Rx LOS, Tx Fault and other flag bits. |
| Rx LOS Assert Time | ton_los | 100 | ms | Time from Rx LOS state to Rx LOS bit set and IntL asserted |
| Flag Assert Time | ton_flag | 200 | ms | Time from occurrence of condition triggering flag to associated flag bit set and IntL asserted |
| Mask Assert Time | ton_mask | 100 | ms | Time from mask bit set ⁴ until associated IntL assertion is inhibited |
| Mask De-assert Time | toff_mask | 100 | ms | Time from mask bit cleared ⁴ until associated IntL operation resumes |
| ModSelL Assert Time | ton_ModSelL | 100 | µs | Time from assertion of ModSelL until module responds to data transmission over the 2-wire serial bus |
| ModSelL Deassert Time | toff_ModSelL | 100 | µs | Time from deassertion of ModSelL until the module does not respond to data transmission over the 2-wire serial bus |
| Power_override or | ton_Pdown | 100 | ms | Time from P_Down bit set ⁴ until module power |

Product Datasheet

| | | | | |
|--|------------|-----|----|---|
| Power-set Assert Time | | | | consumption enters lower Power Level |
| Power over-ride or Power-set De-assert Time | toff_Pdown | 300 | ms | Time from P_Down bit cleared ⁴ until the module is fully functional ³ |

Note:

1. Power on is defined as the instant when supply voltages reach and remain at or above the minimum specified value.
2. Fully functional is defined as IntL asserted due to data not ready bit, bit 0 byte 2 de-asserted.
3. Measured from falling clock edge after stop bit of read transaction.
4. Measured from falling clock edge after stop bit of write transaction.

Pin Assignment

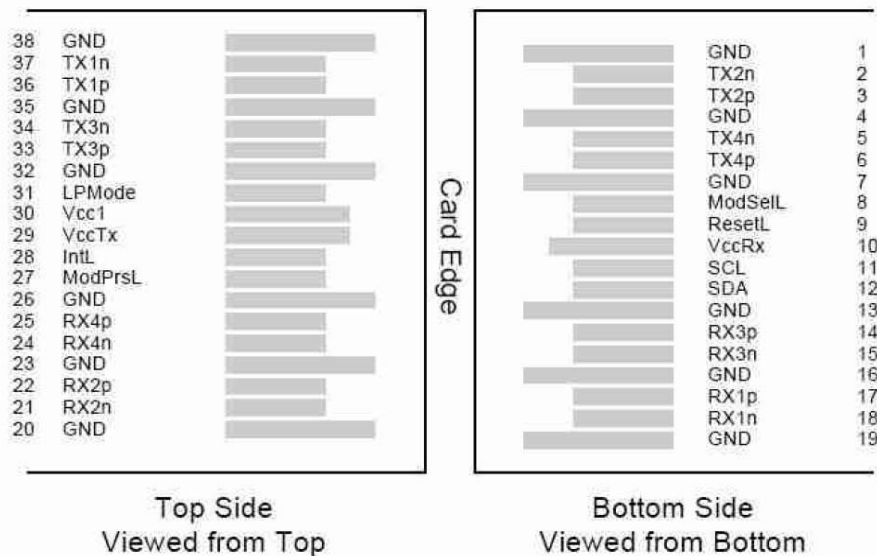


Diagram of Host Board Connector Block Pin Numbers and Name

Product Datasheet

Pin Description

| Pin | Logic | Symbol | Name/Description | Ref. |
|-----|-------------|---------|--------------------------------------|------|
| 1 | | GND | Ground | 1 |
| 2 | CML-I | Tx2n | Transmitter Inverted Data Input | |
| 3 | CML-I | Tx2p | Transmitter Non-Inverted Data output | |
| 4 | | GND | Ground | 1 |
| 5 | CML-I | Tx4n | Transmitter Inverted Data Output | |
| 6 | CML-I | Tx4p | Transmitter Non-Inverted Data Output | |
| 7 | | GND | Ground | 1 |
| 8 | LVTTL-I | ModSelL | Module Select | |
| 9 | LVTTL-I | ResetL | Module Reset | |
| 10 | | VccRx | +3.3V Power Supply Receiver | 2 |
| 11 | LVC MOS-I/O | SCL | 2-Wire Serial Interface Clock | |
| 12 | LVC MOS-I/O | SDA | 2-Wire Serial Interface Data | |
| 13 | | GND | Ground | 1 |
| 14 | CML-O | Rx3p | Receiver Inverted Data Output | |
| 15 | CML-O | Rx3n | Receiver Non-Inverted Data Output | |
| 16 | | GND | Ground | 1 |
| 17 | CML-O | Rx1p | Receiver Inverted Data Output | |
| 18 | CML-O | Rx1n | Receiver Non-Inverted Data Output | |
| 19 | | GND | Ground | 1 |
| 20 | | GND | Ground | 1 |
| 21 | CML-O | Rx2n | Receiver Inverted Data Output | |
| 22 | CML-O | Rx2p | Receiver Non-Inverted Data Output | |
| 23 | | GND | Ground | 1 |
| 24 | CML-O | Rx4n | Receiver Inverted Data Output | |
| 25 | CML-O | Rx4p | Receiver Non-Inverted Data Output | |
| 26 | | GND | Ground | 1 |
| 27 | LVTTL-O | ModPrsL | Module Present | |

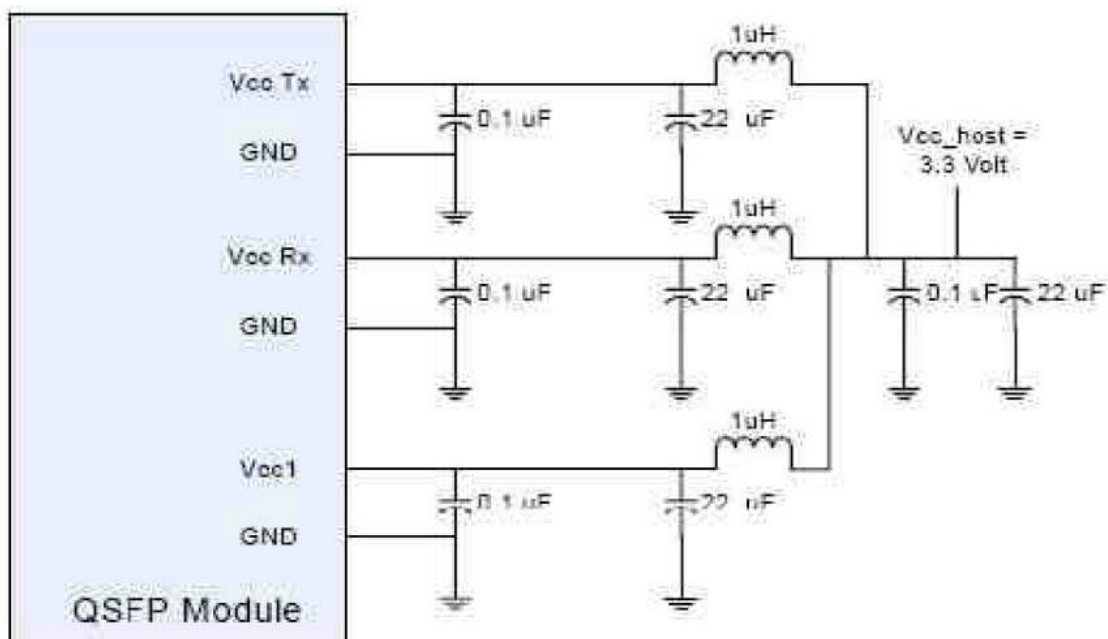
Product Datasheet

| | | | | |
|----|---------|--------|--------------------------------------|---|
| 28 | LVTTL-O | IntL | Interrupt | |
| 29 | | VccTx | +3.3V Power Supply Transmitter | 2 |
| 30 | | Vcc1 | +3.3V Power Supply | 2 |
| 31 | LVTTL-I | LPMode | Low Power Mode | |
| 32 | | GND | Ground | 1 |
| 33 | CML-I | Tx3p | Transmitter Inverted Data Output | |
| 34 | CML-I | Tx3n | Transmitter Non-Inverted Data Output | |
| 35 | | GND | Ground | 1 |
| 36 | CML-I | Tx1p | Transmitter Inverted Data Output | |
| 37 | CML-I | Tx1n | Transmitter Non-Inverted Data Output | |
| 38 | | GND | Ground | 1 |

Notes:

- GND is the symbol for single and supply (power) common for QSFP modules, all are common within the QSFP module and all module voltages are referenced to this potential otherwise noted. Connect these directly to the host board signal common ground plane. Laser output disabled on TDIS >2.0V or open, enabled on TDIS <0.8V.
- VccRx, Vcc1 and VccTx are the receiver and transmitter power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. VccRx, Vcc1 and VccTx may be internally connected within the QSFP transceiver module in any combination. The connector pins are each rated for maximum current of 500mA.

Recommended Circuit



Product Datasheet

Mechanical Dimensions

