



TOPSTAR TECHNOLOGY INDUSTRIAL CO., LIMITED

产品规格书

Product Specification Sheet

TOP-TOP-QSFP-40G-SR4

40Gbps QSFP SR4 Optical Transceiver Module



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Features

- 4 independent full-duplex channels
- Up to 11.2Gbps data rate per channel
- MTP/MPO optical connector
- QSFP MSA compliant
- Digital diagnostic capabilities
- Capable of over 100m transmission on OM3 multi-mode ribbon fiber
- CML compatible electrical I/O
- Single +3.3V power supply
- Operating case temperature: 0~70C
- XLPPPI electric interface (with 1.5W Max power)
- RoHS-6 compliant

Applications

- Rack to rack
- Data Center
- Infiniband QDR, DDR and SDR
- 40G Ethernet

1. General Description

The TOP-QSFP-40G-SR4 is a parallel 40Gbps Quad Small Form-factor Pluggable (QSFP) optical module. It provides increased port density and total system cost savings. The QSFP full-duplex optical module offers 4 independent transmit and receive channels, each capable of 10Gbps operation for an aggregate data rate of 40Gbps over 100 meters of OM3 multi-mode fiber.

An optical fiber ribbon cable with an MPO/MTP™ connector can be plugged into the QSFP module receptacle. Proper alignment is ensured by the guide pins inside the receptacle. The cable usually can not be twisted for proper channel to channel alignment. Electrical connection



is achieved through a z-pluggable 38-pin IPASS[®] connector.

The module operates by a single +3.3V power supply. LVCMOS/LVTTL global control signals, such as Module Present, Reset, Interrupt and Low Power Mode, are available with the modules. A 2-wire serial interface is available to send and receive more complex control signals, and to receive digital diagnostic information. Individual channels can be addressed and unused channels can be shut down for maximum design flexibility.

The TOP-QSFP-40G-SR4 is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference. The module offers very high functionality and feature integration, accessible via a two-wire serial interface.

2. Functional Description

The TOP-QSFP-40G-SR4 converts parallel electrical input signals into parallel optical signals, by a driven Vertical Cavity Surface Emitting Laser (VCSEL) array. The transmitter module accepts electrical input signals compatible with Common Mode Logic (CML) levels. All input data signals are differential and internally terminated. The receiver module converts parallel optical input signals via a photo detector array into parallel electrical output signals. The receiver module outputs electrical signals are also voltage compatible with Common Mode Logic (CML) levels. All data signals are differential and support a data rates up to 10 Gbps per channel. Figure 1 shows the functional block diagram of the TOP-QSFP-40G-SR4 QSFP Transceiver.

A single +3.3V power supply is required to power up the module. Both power supply pins VccTx and VccRx are internally connected and should be applied concurrently. As per MSA specifications the module offers 7 low speed hardware control pins (including the 2-wire serial interface): ModSelL, SCL, SDA, ResetL, LPMode, ModPrsL and IntL.

Module Select (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 – individual ModSelL lines for each QSFP module must be used.

Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP memory map.

The ResetL pin enables a complete module reset, returning module settings to their default state, when a low level on the ResetL pin is held for longer than the minimum pulse length.



During the execution of a reset 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 (Interrupt) signal with the Data_Not_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

Low Power Mode (LPMode) pin is used to set the maximum power consumption for the module in order to protect hosts that are not capable of cooling higher power modules, should such modules be accidentally inserted.

Module Present (ModPrsL) is a signal local to the host board which, in the absence of a module, is normally pulled up to the host Vcc. When a module is inserted into the connector, it completes the path to ground through a resistor on the host board and asserts the signal. ModPrsL then indicates a module is present by setting ModPrsL to a “Low” state.

Interrupt (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 using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board.

3. Transceiver Block Diagram

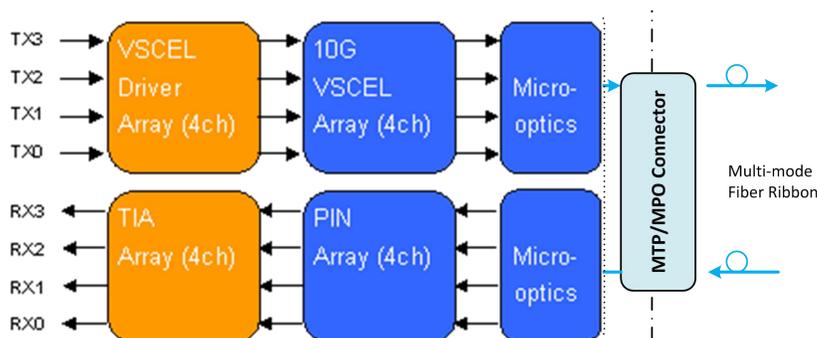


Figure 1: QSFP Transceiver Block Diagram



4. Pin Assignment and Pin Description

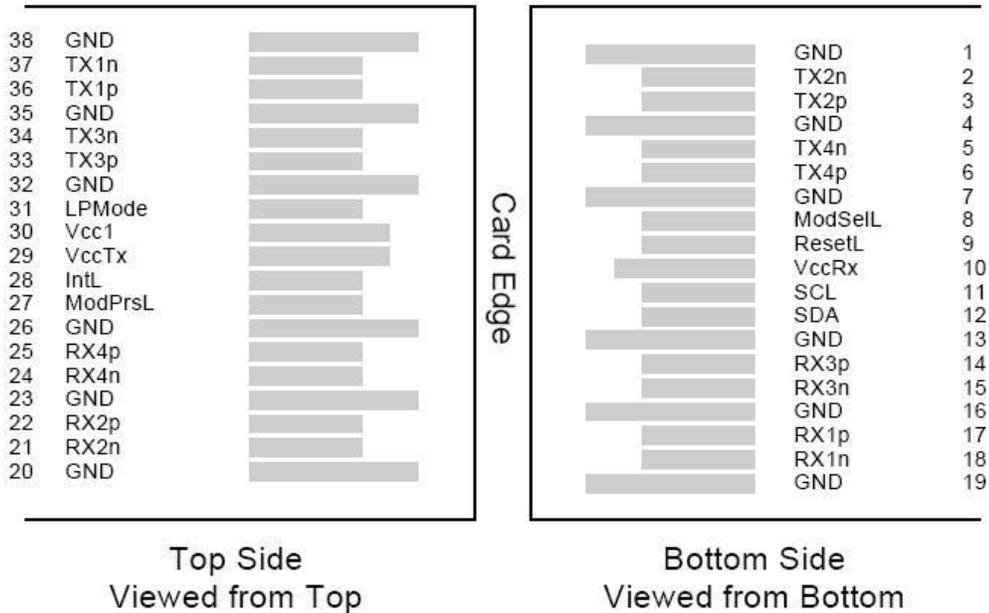


Figure 2: QSFP Transceiver Electrical Pad Layout

5. Pin Definitions

| PIN | Logic | Symbol | Name/Description | Note |
|-----|-------------|---------|--------------------------------------|------|
| 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 Input | |
| 6 | CML-I | Tx4p | Transmitter Non-Inverted Data output | |
| 7 | | GND | Ground | 1 |
| 8 | LVTLL-I | ModSelL | Module Select | |
| 9 | LVTLL-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 | |
| 14 | CML-O | Rx3p | Receiver Non-Inverted Data Output | |



| | | | | |
|----|---------|---------|-------------------------------------|---|
| 15 | CML-O | Rx3n | Receiver Inverted Data Output | |
| 16 | | GND | Ground | 1 |
| 17 | CML-O | Rx1p | Receiver Non-Inverted Data Output | |
| 18 | CML-O | Rx1n | Receiver 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 | 1 |
| 25 | CML-O | Rx4p | Receiver Non-Inverted Data Output | |
| 26 | | GND | Ground | 1 |
| 27 | LVTTL-O | ModPrsL | Module Present | |
| 28 | LVTTL-O | IntL | Interrupt | |
| 29 | | VccTx | +3.3 V Power Supply transmitter | 2 |
| 30 | | Vcc1 | +3.3 V Power Supply | 2 |
| 31 | LVTTL-I | LPMODE | Low Power Mode | |
| 32 | | GND | Ground | 1 |
| 33 | CML-I | Tx3p | Transmitter Non-Inverted Data Input | |
| 34 | CML-I | Tx3n | Transmitter Inverted Data Output | |
| 35 | | GND | Ground | 1 |
| 36 | CML-I | Tx1p | Transmitter Non-Inverted Data Input | |
| 37 | CML-I | Tx1n | Transmitter Inverted Data Output | |
| 38 | | GND | Ground | 1 |

Note:

1. GND is the symbol for signal and supply (power) common for QSFP modules. All are common within the QSFP module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.

2. 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. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.



6. Optical Interface Lanes and Assignment

Figure 3 shows the orientation of the multi-mode fiber facets of the optical connector. Table 1 provides the lane assignment.

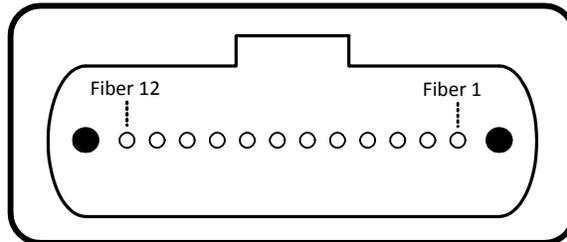


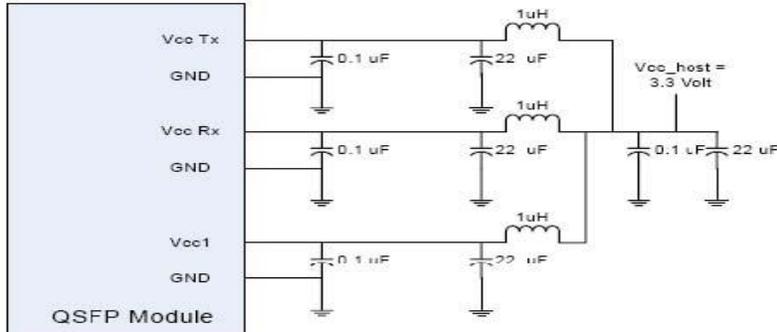
Figure 3: Outside view of the QSFP module MPO receptacle

Table1: lane assignment

| Fiber # | Lane Assignment |
|---------|-----------------|
| 1 | RX0 |
| 2 | RX1 |
| 3 | RX2 |
| 4 | RX3 |
| 5 | Not used |
| 6 | Not used |
| 7 | Not used |
| 8 | Not used |
| 9 | TX3 |
| 10 | TX2 |
| 11 | TX1 |
| 12 | TX0 |



7. Recommended Power Supply Filter



8. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

| Parameter | Symbol | Min | Max | Unit | Note |
|--|---------|------|---------|------|------|
| Storage Temperature | Tst | -20 | 85 | degC | |
| Relative Humidity (non-condensation) | RH | - | 85 | % | |
| Operating Case Temperature | Topc | 0 | 70 | degC | 1 |
| Supply Voltage | VCC | -0.5 | 3.6 | V | |
| Voltage on LVTTTL Input | Vilvttl | -0.5 | VCC+0.5 | V | |
| LVTTTL Output Current | Iolvttl | - | 15 | mA | |
| Voltage on Open Collector Output | Voco | 0 | 6 | V | |
| Receiver Input Optical Power (Average) | Mip | | 2 | dBm | 2 |

Notes:

1. Ta: -10 to 60degC with 1.5m/s airflow with an additional heat sink.
2. Pin Receiver.

9. Recommended Operating Conditions and Supply Requirements

| Parameter | Symbol | Min | Max | Unit |
|---------------------------------|--------|-----|-----|------|
| Operating Case Temperature | Topc | 0 | 70 | degC |
| Power Supply Voltage | VCC | 3.1 | 3.5 | V |
| Power Supply Current | ICC | - | 350 | mA |
| Total Power Consumption (XLPPi) | | - | 1.5 | W |



10. Optical Characteristics

| Parameter | Symbol | Min. | Typical | Max | Unit | Notes |
|---|-------------|-----------------------------------|---------|------|-------|-----------------|
| Transmitter | | | | | | |
| Center Wavelength | λ_t | 840 | 850 | 860 | nm | |
| RMS Spectral Width | Pm | - | 0.5 | 0.65 | nm | |
| Average Optical Power, each Lane | Pavg | -8 | -2.5 | +1 | dBm | |
| Optical Modulation Amplitude (OMA) | Poma | -6 | - | +3 | dBm | |
| Peak Power, each Lane | PPt | | | 4 | dBm | |
| Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane | | -7 | - | | dB | |
| TDP, each Lane | | | | 4 | dB | |
| Extinction Ratio | ER | 3 | - | - | dB | |
| Relative Intensity Noise | Rin | - | - | -128 | dB/Hz | 12dB reflection |
| Optical Return Loss Tolerance | | - | - | 12 | dB | |
| Encircled Flux | | >86% at 19um <30% at 4.5um | | | | |
| Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3} | | 0.23, 0.34, 0.43, 0.27, 0.33, 0.4 | | | | |
| Average Launch Power OFF Transmitter, each Lane | Poff | | | -30 | dBm | |



| Parameter | Symbol | Min. | Typical | Max | Unit | Notes |
|--|-------------|------|---------|------|------|-------|
| Receiver | | | | | | |
| Center Wavelength | λ_r | 830 | 850 | 860 | nm | |
| Damage Threshold | THd | 2 | | | dBm | 1 |
| Average Power at Receiver Input, each Lane | | -9.9 | | 0 | dBm | |
| Receiver Reflectance | | - | - | -12 | dB | |
| OMA, each Lane | | | | 3 | dBm | |
| Stressed Receiver Sensitivity in OMA, each Lane | | - | - | -5.4 | dBm | |
| Receiver Sensitivity per Channel | Psens | - | -13 | | dBm | |
| Peak Power, each Lane | PPr | | | 4 | dBm | |
| Receiver Jitter Tolerance Signal Level in OMA, each Lane | | | | -5.4 | dBm | |
| Los Assert | LosA | -30 | - | - | dBm | |
| Los Dessert | LosD | - | - | -14 | dBm | |
| Los Hysteresis | LosH | 0.5 | - | - | dB | |
| Overload | Pin | +1 | - | - | dBm | |



| Parameter | Symbol | Min. | Typical | Max | Unit | Notes |
|---|--------|----------|---------|-----|---------|-------|
| Receiver | | | | | | |
| Conditions of Stress Receiver Sensitivity Test ² : | | | | | | |
| Vertical Eye Closure Penalty, each Lane | | | 2 | | dB | |
| Stressed Eye J2 Jitter, each Lane | | | 0.35 | | UI | |
| Stressed Eye J9 Jitter, each Lane | | | 0.47 | | UI | |
| Conditions of Receiver Jitter Tolerance Test: | | | | | | |
| Jitter Frequency and Peak-peak Amplitude | | (75, 5) | | | KHz, UI | |
| | | (375, 1) | | | | |

Notes:

1. The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

11. DIGITAL DIAGNOSTIC FUNCTIONS

The following digital diagnostic characteristics are defined over the Recommended Operating Environment unless otherwise specified. It is compliant to SFF-8436.

| Parameter | Symbol | Min. | Max | Unit | Notes |
|---------------------------------------|----------|------|-----|------|----------------------|
| Temperature monitor absolute error | DMI_Temp | -3 | 3 | degC | Over operating temp |
| Supply voltage monitor absolute error | DMI_VCC | -0.1 | 0.1 | V | Full operating range |



| | | | | | |
|---|--------------|------|-----|----|---------|
| Channel RX power monitor absolute error | DMI_RX_Ch | -3 | 3 | dB | Ch1~Ch4 |
| Channel Bias current monitor | DMI_Ibias_Ch | -10% | 10% | mA | Ch1~Ch4 |

12. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

| Parameter | Symbol | Min. | Typical | Max | Unit | Notes |
|--|--------|---------------------------|---------|------|------|---------------------------|
| Data Rate, each Lane | | - | 10.3125 | 11.2 | Gbps | |
| Power Consumption (XLPP1) | | - | | 1.5 | 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 (XLPP1) | | | | | | |
| Single Ended Output Voltage Tolerance | | -0.3 | - | 4 | V | Referred to signal common |
| AC Common mode Voltage Tolerance (RMS) | | 15 | - | - | mV | |
| Tx Input Diff Voltage | VI | 90 | | 1600 | mV | |
| Tx Input Diff Impedance | ZIN | 80 | 100 | 120 | Ω | |
| Differential Input Return Loss | | See IEEE 802.3ba 86A.4.11 | | | dB | 10MHz-11.1GHz |
| J2 Jitter Tolerance | Jt2 | | | 0.18 | UI | |



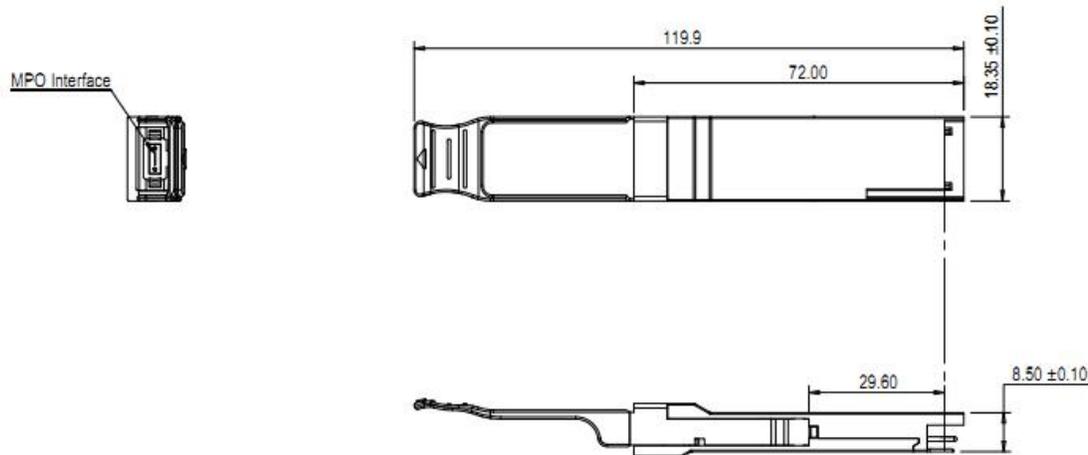
| | | | | | | |
|--|-------|----------------------------|-----|------|----------|-------------------------------|
| J9 Jitter Tolerance | Jt9 | | | 0.26 | UI | |
| Data Dependent Pulse Width Shrinkage | DDPWS | | | 0.07 | UI | |
| Eye Mask Coordinates {X1, X2 Y1, Y2} | | 0.1, 0.31 95, 350 | | | UI mV | |
| Receiver (XLPP1) | | | | | | |
| Single Ended Output Voltage Tolerance ¹ | | -0.3 | - | 4 | V | Referred to TP1 signal common |
| AC Common mode Voltage Tolerance (RMS) | | - | - | 7.5 | mV | |
| Termination Mismatch at 1MHz | | | | 5 | % | |
| Differential Output Return Loss | | See IEEE 802.3ba 86A.4.2.1 | | | dB | 10MHz-11.1GHz |
| Common-mode Output Return Loss | | See IEEE 802.3ba 86A.4.2.2 | | | dB | 10MHz-11.1GHz |
| Rx Output Diff Voltage | Vo | | 600 | 800 | mV | |
| Rx Output Rise and Fall Time | Tr/Tf | | | 35 | ps | 20% to 80% |
| J2 Jitter Tolerance | Jr2 | | | 0.46 | UI | |
| J9 Jitter Tolerance | Jr9 | | | 0.63 | UI | |
| Eye Mask Coordinates {X1, X2 Y1, Y2} | | 0.29, 0.5 150, 425 | | | UI mV | |

Notes:

1. The single ended input voltage tolerance is the allowable range of the instantaneous input signals



13. Mechanical Dimensions



14. ESD

This transceiver is specified as ESD threshold 1KV for SFI pins and 2KV for all others electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

15. Laser Safety

This is a Class 1 Laser Product according to IEC 60825-1:1993+A1:1997+A2:2001. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007)

16. Ordering Information

| Part Number | Product Description |
|------------------|--------------------------------------|
| TOP-QSFP-40G-SR4 | 40Gb/s QSFP+ SR4 Optical Transceiver |



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