# Alpha Bridge AQSFP-40G-LX4 Datasheet

## Features

- 4 CWDM lanes MUX/DEMUX design
- Up to 11.2Gb/s data rate per wavelength
- QSFP+ MSA compliant
- IEEE 802.3ba Electrical Interface
- Digital diagnostic capabilities
- Compliant with QDR/DDR Infiniband data rates
- Up to 150m transmission on OM3 multimode fiber (MMF) or 2km transmission on single mode fiber (SMF)
- Operating case temperature: 0 to 70℃
- Maximum power consumption 3.5W
- LC duplex connector

## Applications

- 40GBASE-LX4 Ethernet Links
- InfiniBand QDR and DDR & SDR interconnects
- Client-side 40G datacom connections

## Description

This product converts the 4-channel 10Gb/s electrical input data into CWDM optical signals (light), by a driven 4-wavelength Distributed Feedback Laser (DFB) array. The light is combined by the MUX parts as a 40Gb/s data, propagating out of the transmitter module from the MMF.

The receiver module accepts the 40Gb/s CWDM optical signals input, and de-multiplexes it into 4 individual 10Gb/s channels with different wavelength. Each wavelength light is collected by a discrete photo diode, and then outputted as electric data after amplified by a TIA and a post amplifier.

## Absolute Maximum Ratings

| Parameter | Symbol | Min | Max | Unit |
|---|---|---|---|---|
| Storage Temperature | Ts | -40 | 85 | °C |
| Operating Case Temperature | TOP | 0 | 70 | °C |
| Power Supply Voltage | Vcc | -0.5 | 3.6 | V |
| Relative Humidity (non-condensation) | RH | 0 | 85 | % |
| Damage Threshold, each Lane | $TH_d$ | 4.5 | | dBm |

## Recommended Operating Conditions

| Parameter | Symbol | Min | Typical | Max | Unit |
|---|---|---|---|---|---|
| Operating Case Temperature | TOP | 0 | | 70 | °C |
| Power Supply Voltage | Vcc | 3.135 | 3.3 | 3.465 | V |
| Data Rate, each Lane | | | 10.3125 | 11.2 | Gb/s |
| Control Input Voltage High | | 2 | | Vcc | V |
| Control Input Voltage Low | | 0 | | 0.8 | V |
| Link Distance with (OM3 MMF) | D_MMF | | | 150 | m |
| Link Distance (SMF) | D_SMF | | | 2 | km |

## Electrical Characteristics

| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| Power Consumption | | | | 3.5 | W | |
| Supply Current | Icc | | | 1.1 | A | |
| Transceiver Power-on Initialization Time | | | | 2000 | ms | 1 |

## Optical Characteristics

| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| Wavelength Assignment | L0 | 1264.5 | 1271 | 1277.5 | nm | |
| | L1 | 1284.5 | 1291 | 1297.5 | nm | |
| | L2 | 1304.5 | 1311 | 1317.5 | nm | |
| | L3 | 1324.5 | 1331 | 1337.5 | nm | |

## Digital Diagnostic Functions

| Parameter | Symbol | Min | Max | Unit | Notes |
|---|---|---|---|---|---|
| Temperature monitor absolute error | DMI_Temp | -3 | 3 | °C | 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 multi-mode fibers, there could be an additional +/-1 dB fluctuation, or a +/- 3 dB total accuracy.

## Transmitter Electro-optical Characteristics (each Lane)

**Vcc = 3.135 V to 3.465 V, TC = 0 □C to 70 □C**

| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| Single-ended Input Voltage Tolerance (Note 1) | | -0.3 | | 4 | V | Referred to TP1 signal common |
| AC Common Mode Input Voltage Tolerance | | 15 | | | mV | RMS |
| Differential Input Voltage Swing Threshold | | 50 | | | mVpp | LOSA Threshold |
| Differential Input Voltage Swing | Vin,pp | 190 | | 700 | mVpp | |
| Differential Input Impedance | Zin | 90 | 100 | 110 | Ohm | |
| Differential Input Return Loss | | See IEEE 802.3ba 86A.4.11 | | | dB | 10MHz- 11.1GHz |
| J2 Jitter Tolerance | Jt2 | 0.17 | | | UI | |
| J9 Jitter Tolerance | Jt9 | 0.29 | | | UI | |
| Data Dependent Pulse Width Shrinkage (DDPWS) Tolerance | | 0.07 | | | UI | |
| Eye Mask Coordinates {X1, X2, Y1, Y2} | | | 0.11, 0.31 95, 350 | | UI mV | Hit Ratio = 5x10-5 |
| Total Average Launch Power (for SMF) | PT,SMF | | | 8.3 | dBm | |
| Total Average Launch Power (for MMF) | PT,MMF | | | 9.5 | dBm | |
| Average Launch Power, each Lane (for SMF) | PAVG, SMF | -7 | | 2.3 | dBm | |
| Average Launch Power, each Lane (for MMF) | PAVG, MMF | -5 | | 3.5 | dBm | |
| OMA, each Lane (for SMF) | POMA, SMF | -6 | | 3.5 | dBm | 2 |
| OMA, each Lane (for MMF) | POMA, MMF | -4 | | 4.5 | dBm | |

| | | | | | | |
|---|---|---|---|---|---|---|
| Difference in Launch Power between any Two Lanes (OMA) | Ptx,diff | | | 6.5 | dB | |
| Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane | | -6.8 | | | dBm | |
| TDP, each Lane | TDP | | | 2.6 | dB | |
| Extinction Ratio | ER | 3.5 | | | dB | |
| Relative Intensity Noise | RIN | | | -128 | dB/Hz | 12dB reflection |
| Transmitter Reflectance | RT | | | -12 | dB | |
| Average Launch Power OFF Transmitter, each Lane | Poff | | | -30 | dBm | |
| Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3} | | {0.23,0.34,0.43,0.27,0.35, 0.4} | | | | |

Notes:

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

2. Even if the TDP < 0.8 dB, the OMA min must exceed the minimum value specified here.

### Receiver Electro-optical Characteristics (each Lane)

| Parameter | Symbol | Min | Typical | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| Single-ended Output Voltage | | -0.3 | | 4 | V | Referred to signal common |
| AC Common Mode Output Voltage | | | | 7.5 | mV | RMS |
| Differential Output Voltage Swing | Vout,pp | 300 | | 850 | mVpp | |
| Differential Output Impedance | Zout | 90 | 100 | 110 | Ohm | |
| 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 |
| Output Transition Time | | 28 | | | ps | 20% to 80% |
| J2 Jitter Output | Jo2 | | | 0.42 | UI | |
| J9 Jitter Output | Jo9 | | | 0.65 | UI | |
| Eye Mask Coordinates {X1, X2 , Y1, Y2} | | 0.29, 0.5 150, 425 | | | UI mV | Hit Ratio = 5x10-5 |
| Damage Threshold, each Lane | THd | 4.5 | | | dBm | 1 |
| Total Average Receive Power (for SMF) | | | | 8.3 | dBm | |
| Total Average Receive Power (for MMF) | | | | 9.5 | dBm | |
| Average Receive Power, each Lane (for SMF) | | -11.7 | | 2.3 | dBm | |
| Average Receive Power, each Lane (for MMF) | | -7 | | 3.5 | dBm | |
| Receiver Reflectance | $R_R$ | | | -26 | dB | |
| Receive Power (OMA), each Lane (for SMF) | | | | 3.5 | dBm | |
| Receiver Power (OMA), each Lane (for MMF) | | | | 4.5 | dBm | |
| Receiver Sensitivity (OMA), each Lane (for SMF) | SENSMF | | | -11.5 | dBm | |
| Receiver Sensitivity (OMA), each Lane (for MMF) | SENMMF | | | -10.5 | dBm | |
| Difference in Receive Power between any Two Lanes (OMA) | Prx,diff | | | 7.5 | dB | |
| LOS Assert | LOSA | -28 | | | dBm | |

| LOS Deassert | LOSD | | | -15 | dBm | |
|---|---|---|---|---|---|---|
| LOS Hysteresis | LOSH | 0.5 | | | dB | |
| Receiver Electrical 3 dB upper Cutoff Frequency, each Lane | Fc | | | 12.3 | GHz | |

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.
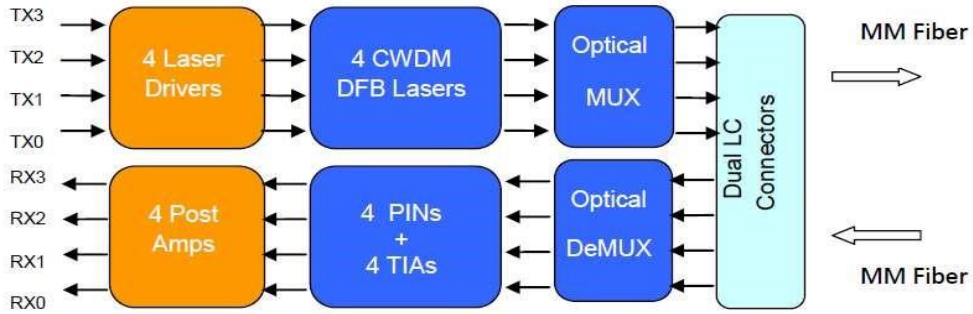
## Block Diagram of Transceiver



Figure 1. Transceiver Block Diagram for Applications over Multimode Fiber
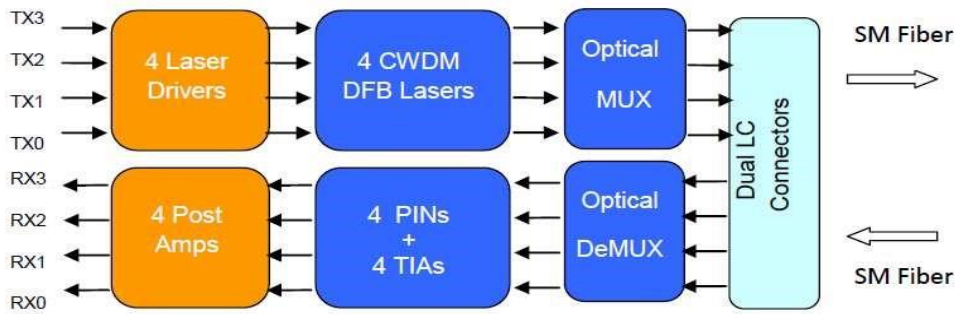


Figure 2. Transceiver Block Diagram for Applications over Single Mode Fiber
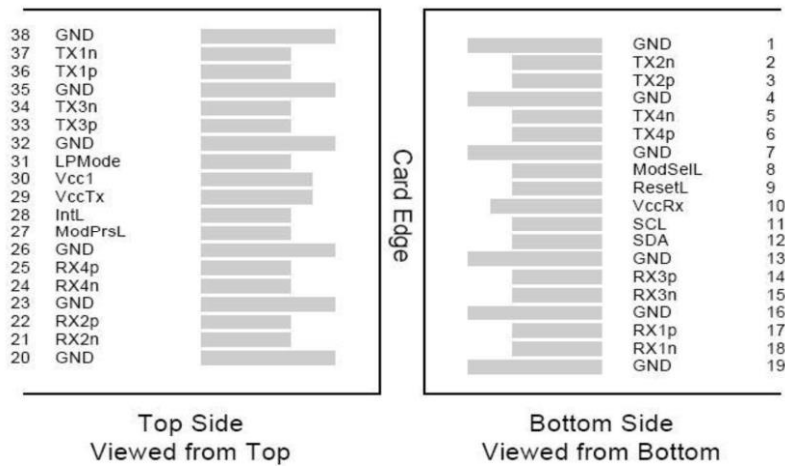
## Pin Assignment



Figure 3.  MSA compliant Connector

| 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 | LVCMOS-I/O | SCL | 2-Wire Serial Interface Clock | |
| 12 | LVCMOS-I/O | SDA | 2-Wire Serial Interface Data | |
| 13 | | GNC | 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 | +3.3V 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 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 |

**Notes:**

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 receiving and transmission power suppliers and shall be applied concurrently. 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.

## Dimensions
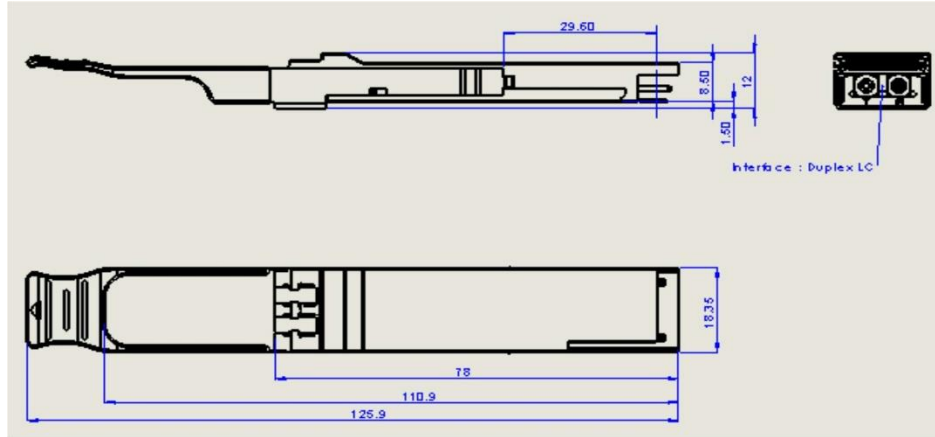


## Optical Receptacle Cleaning Recommendations

All fiber stubs inside the receptacle portions were cleaned before shipment. In the event of contamination of the optical ports, the recommended cleaning process is the use of forced nitrogen. If contamination is thought to have remained, the optical ports can be cleaned using a NTT international Cletop® stick type and HFE7100 cleaning fluid. Before the mating of patch-cord, the fiber end should be cleaned up by using Cletop® cleaning cassette.



Note: The pictures were extracted from NTT-ME website. And the Cletop® is a trademark registered by NTT-ME

## Ordering Information

| Model Number | Part Number | Voltage | Temperature |
|---|---|---|---|
| AQSFP-40G-LX4 | OPCS-X02-13-CB | 3.3V | 0°C to 70°C |