

## ProLabs – QSFP-40G-ER4-C

*40GBASE--ER4 QSFP+ SMF 1271--1331NM 30KM REACH LC DOM*

### QSFP-40G-ER4-C Overview

ProLabs QSFP--40G-ER4-C Quad Small Form Factor Pluggable (QSFP+) transceivers are compatible with the Small Form Factor Pluggable Multi--Sourcing Agreement (MSA). The QSFP+ transceivers are high performance, cost effective modules supporting 40 Gigabit Ethernet and up to 30km transmission distance with SMF.

ProLabs QSFP+ transceivers are RoHS compliant and lead--free.

### Product Features

- Compliant with 40G Ethernet IEEE802.3ba and 40GBase--ER4 standard
- Compliant with QDR/DDR Infiniband data rates
- Up to 11.2Gb/s data rate per wavelength
- 4 CWDM lands MUX/DEMUX design
- Up to 30km transmission on single mode fiber (SMF)
- Operating case temperature 0°C to 70°C
- Maximum power consumption 3.5W
- RoHS 6 compliant

### Applications

- 40Gbase--ER4 Ethernet Links
- Infiniband QDR and DDR interconnects
- Client--side 40G Telecom connections

### Absolute Maximum Ratings

| Parameter                   | Symbol | Min.  | Typ. | Max. | Unit |
|-----------------------------|--------|-------|------|------|------|
| Power Supply Voltage        | Vcc    | --0.5 |      | 3.6  | V    |
| Storage Temperature         | Tst    | --40  |      | 85   | °C   |
| Case Operating Temperature  | Top    | 0     |      | 70   | °C   |
| Humidity (non--condensing)  | Rh     | 0     |      | 95   | %    |
| Damage Threshold. Each lane |        | THd   | 3.8  |      | dBm  |

## Recommended Operating Conditions

| Parameter                  | Symbol | Min.  | Typ.    | Max.  | Unit |
|----------------------------|--------|-------|---------|-------|------|
| Supply Voltage             | Vcc    | 3.135 | 3.3     | 3.465 | V    |
| Operating Case Temperature | Tca    | 0     |         | 70    | °C   |
| Data Rate Per Lane         |        |       | 10.3125 | 11.2  | Gbps |
| Control Input Voltage High |        | 2     |         | Vcc   | V    |
| Control Input Voltage Low  |        | 0     |         | 0.8   | V    |
| Link Distance with G.652   | D      |       |         | 30    | km   |

## Electrical Characteristics

| Parameter                                    | Symbol  | Min.                  | Typ. | Max. | Unit     | Notes |
|--|---------|-----------------------|------|------|----------|-------|
| Power Consumption                            |         |                       |      | 3.5  | W        |       |
| Supply Current                               | Icc     |                       |      | 1.1  | A        |       |
| Transceiver Power-on Initialization Time     |         |                       |      | 2000 | ms       | 1     |
| Transmitter                                  |         |                       |      |      |          |       |
| Single-ended Input Voltage                   |         | -0.3                  |      | 4.0  | V        |       |
| AC Common Mode Input Voltage Tolerance       |         | 15                    |      |      | mV       |       |
| Differential Input Voltage Swing Threshold   |         | 50                    |      |      | mVpp     |       |
| Differential Input Voltage Sing              | Vin, pp | 190                   |      | 700  | mVpp     |       |
| Differential Input Impedance                 | Zin     | 90                    | 100  | 110  | Ohm      |       |
| Differential Input Return Loss               |         | IEEE 802.3ba 86A.4.11 |      |      | dB       |       |
| J2 Jitter Tolerance                          | Jt2     | 0.17                  |      |      | UI       |       |
| J9 Jitter Tolerance                          | Jt9     | 0.29                  |      |      | UI       |       |
| Data Dependent Pulse Width Shrinkage (DDPWS) |         | 0.07                  |      |      | UI       |       |
| Eye Mask Coordinates {X1, X2, Y1, Y2}        |         | 0.11,0.31<br>95, 350  |      |      | UI<br>mV |       |
| Receiver                                     |         |                       |      |      |          |       |

|   |         |                        |     |      |          |  |
|---|---------|------------------------|-----|------|----------|--|
| Single Ended Output Voltage                 |         | --0.3                  |     | 4.0  | V        |  |
| AC Common Mode Output Voltage               |         |                        |     | 7.5  | mV       |  |
| 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             |         | IEEE 802.3ba 86A.4.2.1 |     |      | dB       |  |
| Common Mode Output Return                   |         | IEEE 802.3ba 86A.4.2.2 |     |      | dB       |  |
| Output Transition Time                      |         | 28                     |     |      | ps       |  |
| J2 Jitter Output                            | Jo2     |                        |     | 0.42 | UI       |  |
| J9 Jitter Output                            | Jo9     |                        |     | 0.65 | UI       |  |
| Eye Mask Coordinates<br>{X1, X2,<br>Y1, Y2} |         | 0.29, 0.5<br>150, 420  |     |      | UI<br>mV |  |

**Note:**

1. Power--on Initialization Time is the time from when the power supply voltages reach and remain above the minimum recommended operating supply voltages to the time when the module is fully functional.
2. The single ended input voltage tolerance is the allowable range of the instantaneous input signals.

**Optical Characteristics**

| <i>Parameter</i>                              | <i>Symbol</i>    | <i>Min.</i> | <i>Typ.</i> | <i>Max.</i> | <i>Unit</i> | <i>Notes</i> |
|---|------------------|-------------|-------------|-------------|-------------|--------------|
| Wavelength Assignment                         | L0               | 12694.5     | 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          |              |
| <i>Transmitter</i>                            |                  |             |             |             |             |              |
| Side Mode Suppression Ratio                   | SMSR             | 30          |             |             | dB          |              |
| Total Average Launch Power                    | P <sub>T</sub>   |             |             | 10.5        | dBm         |              |
| Average Launch Power, each Lane               | P <sub>AVG</sub> | --3.7       |             | 4.5         | dBm         |              |
| Optical Modulation Amplitude (OMA), each Lane | P <sub>OMA</sub> | --0.7       |             | 5           | dBm         | 1            |

|  |          |     |  |     |    |  |
|--|----------|-----|--|-----|----|--|
| Difference in Launch Power between and Two Lanes     | Ptx,diff |     |  | 4.7 | dB |  |
| Launch Power in OMA minus Transmitter and Dispersion |          | 1.5 |  |     |    |  |
| TDP, each Lane                                       | TDP      |     |  | 2.6 | dB |  |
| Extinction Ratio                                     | ER       | 5.5 |  |     | dB |  |

|  |                 |                               |      |        |       |   |
|--|-----------------|-------------------------------|------|--------|-------|---|
| Relative Intensity Noise                                 | RIN             |                               |      | --128  | dB/Hz |   |
| Optical Return Loss Tolerance                            | TOL             |                               |      | 20     | dB    |   |
| Transmitter Reflectance                                  | RT              |                               |      | --12   | dB    |   |
| Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3} |                 | {0.25,0.4,0.45,0.25,0.28,0.4} |      |        |       |   |
| Average Launch Power OFF Transmitter, each               | Poff            |                               |      | --30   | dBm   |   |
| <i>Receiver</i>  |                 |                               |      |        |       |   |
| Damage Threshold, each Lane                              | TH <sub>d</sub> | 3.8                           |      |        | dBm   | 2 |
| Average Receive Power, each Lane                         |                 | --20.2                        |      | --1.5  | dBm   |   |
| Receiver Reflectance                                     | R <sub>R</sub>  |                               |      | --26   | dB    |   |
| Receiver Power (OMA), each Lane                          |                 |                               |      | --1    | dBm   |   |
| Receiver Sensitivity (OMA), each Lane                    | SEN             |                               |      | --18   | dBm   |   |
| Stressed Receiver Sensitivity (OMA), each                |                 |                               |      | --15.8 | dBm   | 3 |
| Difference in Receiver Power between and Two Lanes       | Prx,diff        |                               |      | 7      | dB    |   |
| LOS Assert   | LOSA            | --35                          |      |        | dBm   |   |
| LOS Deassert   | LOSD            |                               |      | --20   | dBm   |   |
| LOS Hysteresis   | LOSH            | 0.5                           |      |        | dB    |   |
| Receiver Electrical 3 dB upper Cutoff Frequency,         | Fc              |                               |      | 12.3   | GHz   |   |
| Conditions of Stress Receiver Sensitivity Test (Note 4)  |                 |                               |      |        |       |   |
| Vertical Eye Closure Penalty, each Lane                  |                 |                               | 2.2  |        | dB    |   |
| Stressed Eye J2 Jitter, each Lane                        |                 |                               | 0.3  |        | UI    |   |
| Stressed Eye J9 Jitter, each Lane                        |                 |                               | 0.47 |        | UI    |   |

**Note:**

1. Even if the TDP<0.8 dB, the OMA min must exceed the minimum value specified here.
2. 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.
3. Measured with conformance test signal at receiver input for BER= 1x10<sup>-12</sup>.

4. Vertical eye closure penalty and stressed eye jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

## Pin Descriptions

| Pin | Logic        | Symbol            | Name/Descriptions                    | Ref. |
|-----|--------------|-------------------|--------------------------------------|------|
| 1   |              | GND               | Module Ground                        | 1    |
| 2   | CML--        | Tx2--             | Transmitter inverted data input      |      |
| 3   | CML--        | Tx2+              | Transmitter non--inverted data input |      |
| 4   |              | GND               | Module Ground                        | 1    |
| 5   | CML--        | Tx4--             | Transmitter inverted data input      |      |
| 6   | CML--        | Tx4+              | Transmitter non--inverted data input |      |
| 7   |              | GND               | Module Ground                        | 1    |
| 8   | LVTTL--      | MODSEL            | Module Select                        | 2    |
| 9   | LVTTL--      | ResetL            | Module Reset                         | 2    |
| 10  |              | VCCR <sub>x</sub> | +3.3v Receiver Power Supply          |      |
| 11  | LVC MOS--    | SCL               | 2--wire Serial interface clock       | 2    |
| 12  | LVC MOS-- /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        |      |

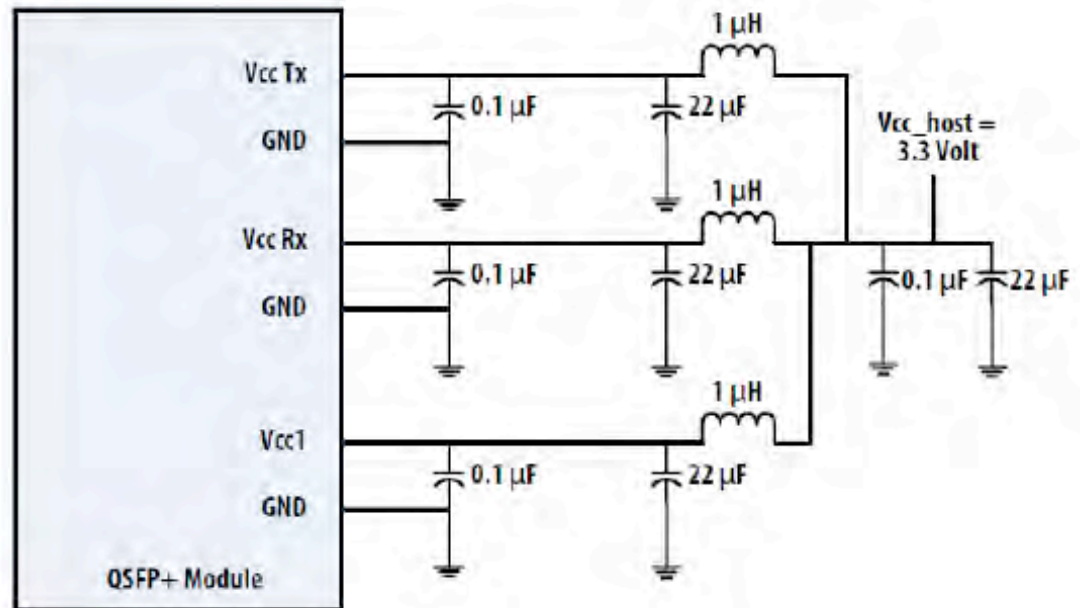
|    |          |                   |   |   |
|----|----------|-------------------|---|---|
| 25 | CML--O   | RX4+              | Receiver non--inverted data output                  |   |
| 26 |          | GND               | Module Ground                                       | 1 |
| 27 | LVTTL--O | ModPrsL           | Module Present, internal pulled down to GND         |   |
| 28 | LVTTL--O | IntL              | Interrupt output, should be pulled up on host board | 2 |
| 29 |          | VCCT <sub>x</sub> | +3.3v Transmitter Power Supply                      |   |

|    |         |        |                                      |   |
|----|---------|--------|--------------------------------------|---|
| 30 |         | VCC1   | +3.3v Power Supply                   |   |
| 31 | LVTTL-- | LPMode | Low Power Mode                       | 2 |
| 32 |         | GND    | Module Ground                        | 1 |
| 33 | CML--   | Tx3+   | Transmitter non--inverted data input |   |
| 34 | CML--   | Tx3--  | Transmitter inverted data input      |   |
| 35 |         | GND    | Module Ground                        | 1 |
| 36 | CML--   | Tx1+   | Transmitter non--inverted data input |   |
| 37 | CML--   | Tx1--  | Transmitter inverted data input      |   |
| 38 |         | GND    | Module Ground                        | 1 |

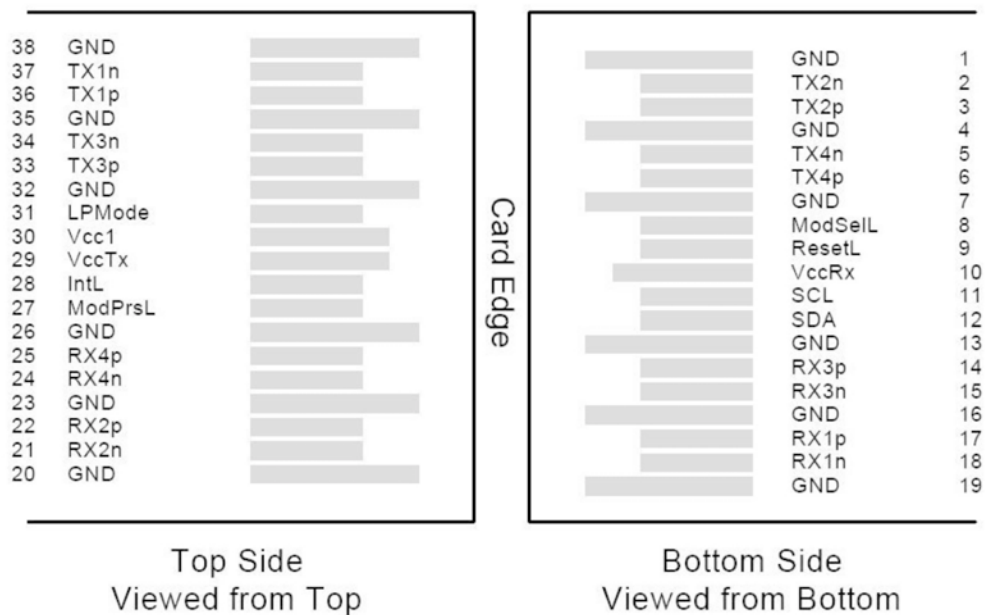
**Note:**

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 Vxx Tx are the receiving and transmission power suppliers and shall be applied concurrently. Recommend host board power supply filtering is shown in image below. VccRx, 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

## Recommended Power Supply Filter



## Electrical Pin-out Details



## Digital Diagnostic Functions

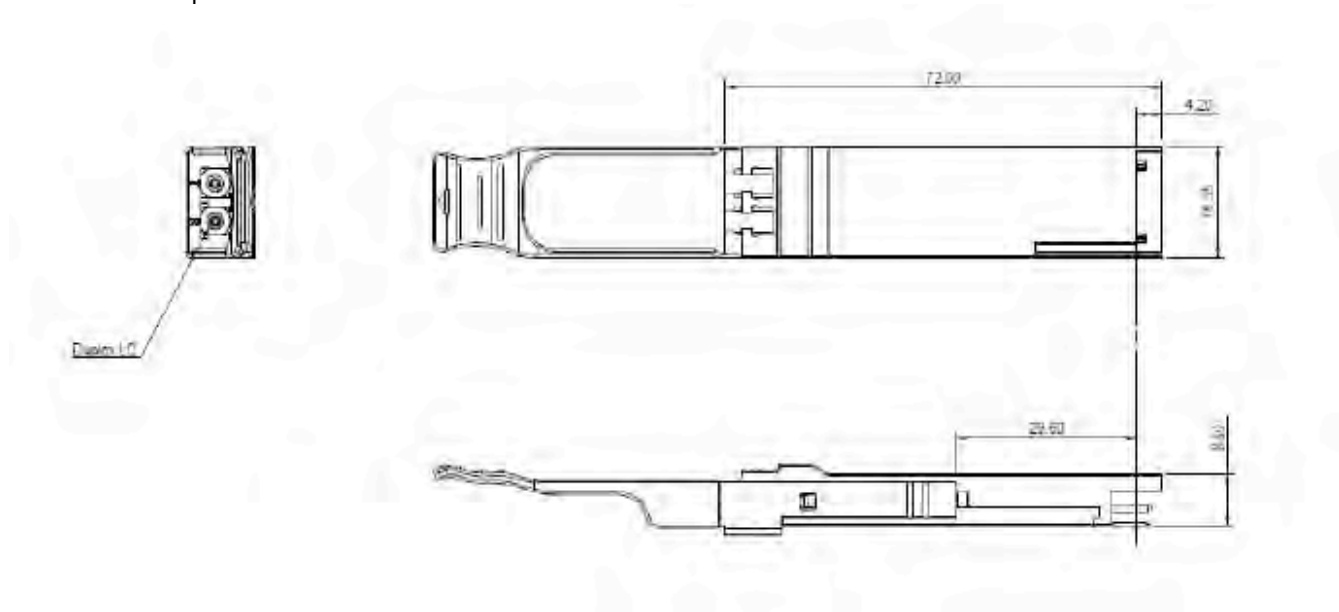
The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

| 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                                |

Note:

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

## Mechanical Specifications



### ESD

This transceiver is specified as ESD threshold 1kV for SFI pins and 2kV for all other 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.

### Laser Safety

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