

# 40GBASE-ER4 and OTU3 QSFP+ 1310nm 40km LC Transceiver for SMF

FG-TRAN-QSFP+ER-LL



## Application

- 40GBASE-ER4 40G Ethernet
- OTU3, OTU3e1, OTU3e2

## Features

- Hot Pluggable QSFP+ form factor
- Supports 39.8Gb/s to 44.6 Gb/s aggregate bit rates
- Power dissipation <3.5W
- 18.5dB link insertion loss budget
- RoHS-6 compliant
- Single 3.3V power supply
- Maximum link length of 40km on Single Mode Fiber (SMF)
- Commercial operating case temperature range: 0°C to 70°C
- Uncooled 4x10Gb/s CWDM transmitter
- XLPI electrical interface
- Duplex LC receptacles
- Built-in digital diagnostic functions, including optical power monitoring

## Description

QSFP+ transceiver modules are designed for use in 40 Gigabit Ethernet links and 4x10G OTN client interfaces over single mode fiber. They are compliant with the QSFP+ MSA , IEEE 802.3bm 40GBASE-ER4 and OTU3 requirements specified in ITU-T Recommendation G.695 as adapted to a 40km interface. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The optical transceiver is RoHS compliant per Directive 2011/65/EU.

## Product Specifications

### I.General Product Characteristics

Parameter	Value	Unit	Notes			
<b>Module Form Factor</b>	QSFP+					
<b>Number of Lanes</b>	4 Tx and 4 Rx					
<b>Maximum Aggregate Data Rate</b>	44.6	Gb/s				
<b>Maximum Data Rate per Lane</b>	11.2	Gb/s				
<b>Protocols Supported</b>	Typical applications include OTN OTU3, 40G Ethernet, Infiniband, SATA/SAS3					
<b>Electrical Interface and Pin-out</b>	38-pin edge connector		Pin-out as defined by the QSFP+ MSA			
<b>Maximum Power Consumption</b>	3.5	Watts				
<b>Management Interface</b>	Serial, I2C-based, 400 kHz maximum frequency		As defined by the QSFP+ MSA			
Data Rate Specifications	Symbol	Min	Typ.	Max	Units	Ref.
<b>Bit Rate per Lane</b>	BR	9.95		11.15	Gb/sec	1
<b>Bit Error Ratio</b>	BER			10 <sup>-12</sup>		2
<b>Link distance on SMF-28</b>	d	0.002		40	kilometers	3

#### Notes:

- Compliant with 40GBASE-ER4 and XLPP1 per IEEE 802.3bm, OTU3 C4S1-2D1 per ITU-T Rec.
- G.695 and OTU3e1/OTU3e2 per ITU-T G-Series Rec. Supplement 43. Compatible with
- 1/10 Gigabit Ethernet and 1/2/4/8/10G Fibre Channel.
- Tested with a PRBS 231-1 test pattern.
- Per 40GBASE-ER4, IEEE 802.3bm. Links longer than 30km are considered to be
- Engineered links, with losses less than the worst case specified for the fiber type.

## II. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
Maximum Supply Voltage	Vcc1, VccTx, VccRx	-0.5		3.6	V	
Storage Temperature	Ts	-40		85	° C	
Case Operating Temperature	Top	0		70	° C	
Relative Humidity	RH	0		85	%	1
Damage Threshold, per Lane	DT	3.4			dBm	

### Notes:

1. Non-condensing..

## III. Electrical Characteristics (TOP = 0 to 70°C, VCC = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
Supply Voltage	Vcc1, VccTx, VccRx	3.1		3.47	V	
Supply Current	Icc			1.13	A	
Transmit turn-on time				2000	ms	1

### Transmitter (per Lane)

Single ended input voltage tolerance	VinT	-0.3		4.0	V	
Differential data input swing	Vin,pp	120		1200	mVpp	2
Differential input threshold			50		mV	
AC common mode input voltage tolerance (RMS)		15			mV	
Differential input return loss		Per IEEE P802.3ba, Section 86A.4.1.1			dB	3
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 95, 350		UI mV	4

## Receiver (per Lane)

<b>Single-ended output voltage</b>		-0.3		4.0	V	
<b>Differential data output swing</b>	Vout,pp	0		800	mVpp	5
<b>AC common mode output voltage (RMS)</b>				7.5	mV	
<b>Termination mismatch at 1 MHz</b>				5	%	
<b>Differential output return loss</b>		Per IEEE P802.3ba,Section 86A.4.2.1			dB	3
<b>Common mode output return loss</b>		Per IEEE P802.3ba,Section 86A.4.2.2			dB	3
<b>Output transition time, 20% to 80%</b>		28			ps	
<b>J2 Jitter output</b>	Jo2			0.42	UI	
<b>J9 Jitter output</b>	Jo9			0.65	UI	
<b>Eye mask coordinates #1 {X1, X2, Y1, Y2}</b>		0.29, 0.5 150, 425			UI mV	4
<b>Power Supply Ripple Tolerance</b>	PSR	50			mVpp	

## Notes:

1. From power-on and end of any fault conditions.
2. After internal AC coupling. Self-biasing 100Ω differential input.
3. 10 MHz to 11.1 GHz range
4. Hit ratio =  $5 \times 10^{-5}$ .
5. AC coupled with 100Ω differential output impedance.

#### IV. Optical Characteristics (TOP = 0 to 70°C, VCC = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Transmitter (per Lane)</b>						
<b>Signaling Speed per Lane</b>		9.95		11.15	GBd	1
<b>Lane Center wavelengths (range)</b>			1264.5-1277.5 1284.5-1297.5 1304.5-1317.5 1324.5-1337.5		nm	
<b>Total Average LaunchPower</b>	Pout			10.5	dBm	
<b>Average Launch Power per Lane</b>	TXP <sub>x</sub>	-2.7		4.5	dBm	2
<b>Transmit OMA per Lane</b>	TxOMA	0.3		5.0	dBm	
<b>Difference in Power between any two lanes (OMA)</b>	DP <sub>x</sub>			4.7	dB	
<b>Transmitter Dispersion Penalty</b>	TDP			2.6	dB	
<b>Launch Power (OMA) minus TDP per Lane</b>	P-TDP	-0.5			dBm	
<b>Optical Extinction Ratio</b>	ER	5.5				
<b>Sidemode Suppression ratio</b>	SS <sub>Rmin</sub>	30			dB	
<b>Average launch power of OFF transmitter, per lane</b>				-30	dBm	
<b>Relative Intensity Tolerance</b>	RIN			-128	dB/Hz	3
<b>Optical Return Loss Tolerance</b>	ORL			20		
<b>Transmitter Reflectance</b>				-12	dB	
<b>Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}</b>			(0.25, 0.4, 0.45, 0.25, 0.28, 0.4)			
<b>Jitter Generation</b>			Per OTL3.4 section 4.14.1			

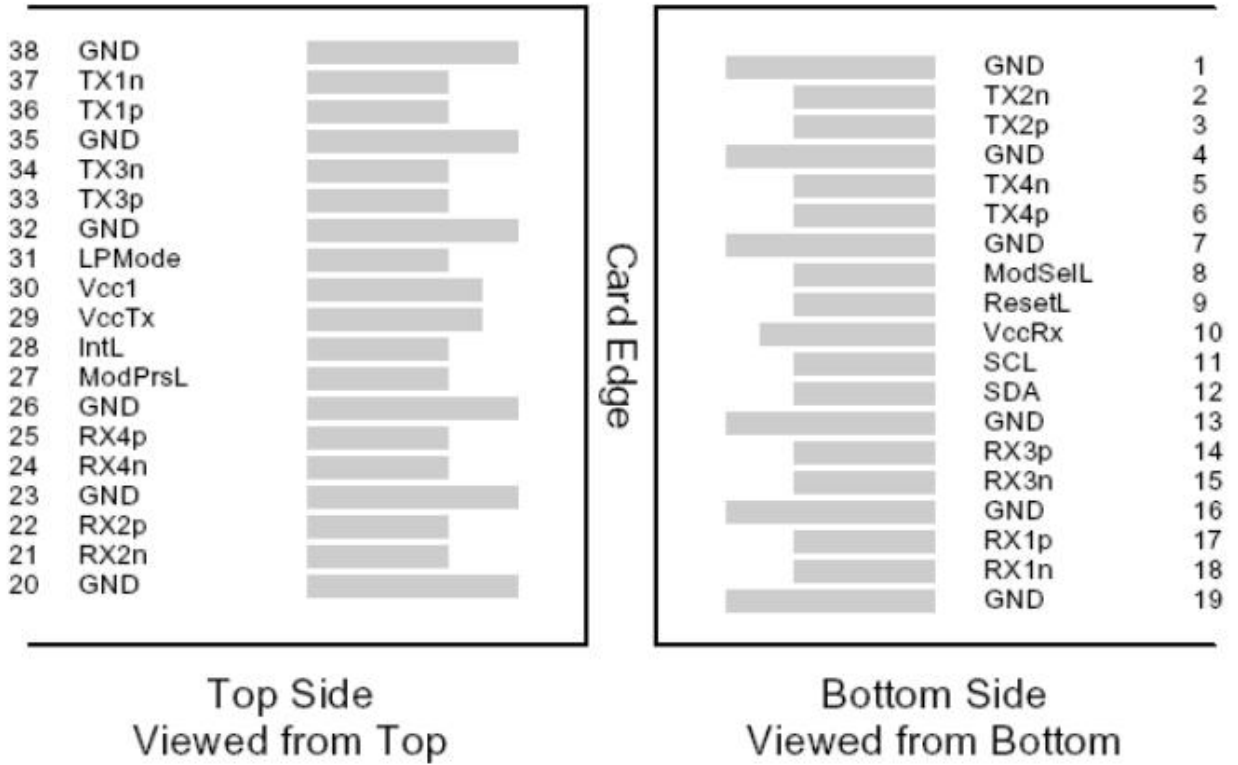
### Receiver (per Lane)

<b>Signaling Speed per Lane</b>		9.95		11.15	GBd	4
<b>Lane Center wavelengths (range)</b>			1264.5-1277.5 1284.5-1297.5 1304.5-1317.5 1324.5-1337.5		nm	
<b>Receive Power (OMA) per Lane</b>	RxOMA			-4.0	dBm	
<b>Average Receive Power per Lane</b>	RXP <sub>x</sub>	-21.2		-4.5	dBm	5
<b>Receiver Sensitivity (OMA) per Lane</b>	Rxsens			-19	dBm	
<b>Stressed Receiver</b>	SRS			-16.8	dBm	
<b>Damage Threshold per Lane</b>	P <sub>MAX</sub>			3.8	dBm	
<b>Return Loss</b>	RL			-26	dB	
<b>Jitter Tolerance</b>			Per OTL3.4, G.8251			
<b>Vertical eye closure penalty, per lane</b>				2.2		
<b>Receive electrical 3dB upper cutoff frequency, per lane</b>				12.3	GHz	
<b>LOS De-Assert</b>	LOS <sub>D</sub>			TBD	dBm	
<b>LOS Assert</b>	LOS <sub>A</sub>	TBD			dBm	
<b>LOS Hysteresis</b>			1		dB	

#### Notes:

1. Transmitter consists of 4 lasers operating at up to 11.2 Gb/s each, +/- 20ppm
2. Minimum value is informative.
3. RIN is scaled by  $10 \cdot \log(10/4)$  to maintain SNR outside of transmitter.
4. Receiver consists of 4 photodetectors operating at up to 11.15 Gb/s each, +/- 100ppm
5. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.

### V. Pin Description



**Figure 1 – QSFP+ MSA-compliant 38-pin connector**

Pin	Symbol	Name/Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	

10	Vcc Rx	+3.3 V Power supply receiver	
11	SCL	2-wire serial interface clock	
12	SDA	2-wire serial interface data	
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	Vcc Tx	+3.3 V Power supply transmitter	
30	Vcc1	+3.3 V Power Supply	
31	LPMODE	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	



34	Tx3n	Transmitter Inverted Data Input	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

**Note:**

Circuit ground is internally isolated from chassis ground.

**VI. Mechanical Specifications**

The mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

