

# 40GBASE-PLR4L QSFP+ 1310nm 1.4km MTP/MPO Transceiver for SMF

FG-TRAN-QSFP+PIR-LL



## Application

- 10GBASE-LR Lite 10G Ethernet

## Features

- Hot-pluggable QSFP+ form factor
- Maximum link length of 1.4km and 4dB insertion loss on single mode fiber (SMF)
- Built-in digital diagnostic functions, including Tx/Rx power monitoring
- Supports 4 independent streams of 10GBASE-LR Lite
- Commercial case temperature range 0° C to 70° C
- RoHS-6 compliant
- Power dissipation < 2.5W
- Single 3.3V power supply
- MPO12 receptacle
- XLPP electrical interface

## Description

QSFP+ transceiver modules are designed for use in high density 10 Gigabit Ethernet links over single mode fiber. They are compliant with the QSFP+ MSA and a Lite version of IEEE 802.3ae 10GBASE-LR/LW. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The 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>	41.2	Gb/s	
<b>Maximum Data Rate per Lane</b>	10.3125	Gb/s	
<b>Protocols Supported</b>	10G Ethernet		This module is not retimed
<b>Electrical Interface and Pin-out</b>	38-pin edge connector		Pin-out as defined by the QSFP+ MSA
<b>Maximum Power Consumption</b>	2.5	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	Unit	Ref.
<b>Bit Rate per Lane</b>	BR	9.95		10.313	Mb/sec	
<b>Bit Error Ratio</b>	BER			10 <sup>-12</sup>		1
<b>Link distance on SMF-28</b>	d			2	kilometers	2
<b>Link insertion loss on SMF-28</b>				4.0	db	2

**Notes:**

1. Tested with a PRBS 231-1 test pattern.
2. 10GBASE-LR Lite.

**II. Absolute Maximum Ratings**

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Maximum Supply Voltage</b>	V <sub>cc1</sub> , V <sub>ccTx</sub> , V <sub>ccRx</sub>	-0.5		3.6	V	
<b>Storage Temperature</b>	T <sub>s</sub>	-40		85	° C	
<b>Case Operating Temperature</b>	T <sub>op</sub>	0		70	° C	
<b>Relative Humidity</b>	RH	0		85	%	1
<b>Damage Threshold, per Lane</b>	DT	3.4			dBm	

**Note:**

Non-condensing

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

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Supply Voltage</b>	V <sub>cc1</sub> , V <sub>ccTx</sub> , V <sub>ccRx</sub>	3.1		3.47	V	
<b>Supply Current</b>	I <sub>cc</sub>			1.13	A	
<b>Transmit turn-on time</b>				2000	ms	1
<b>Transmitter (per Lane)</b>						
<b>Single ended input voltage tolerance</b>	V <sub>inT</sub>	-0.3		4.0	V	
<b>Differential data input swing</b>	V <sub>in,pp</sub>	120		1200	mV <sub>pp</sub>	2
<b>Differential input threshold</b>			50		mV	
<b>AC common mode input voltage tolerance (RMS)</b>		15			mV	
<b>Differential input return loss</b>		Per IEEE P802.3ba, Section 86A.4.1.1			dB	3
<b>J2 Jitter Tolerance</b>	J <sub>t2</sub>	0.17			UI	

### Transmitter (per Lane)

<b>J9 Jitter Tolerance</b>	Jt9	0.29			UI	
<b>Data Dependent Pulse Width Shrinkage</b>	DDPWS	0.07			UI	
<b>Eye mask colordinates {X1, X2, Y1, Y2}</b>			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	200		400	mVpp	5.6
		300		600		
		400	500	800		
		600		1200		
<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.
6. Output voltage is settable in 4 discrete steps via I2C. Default is 400–800 mV.

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

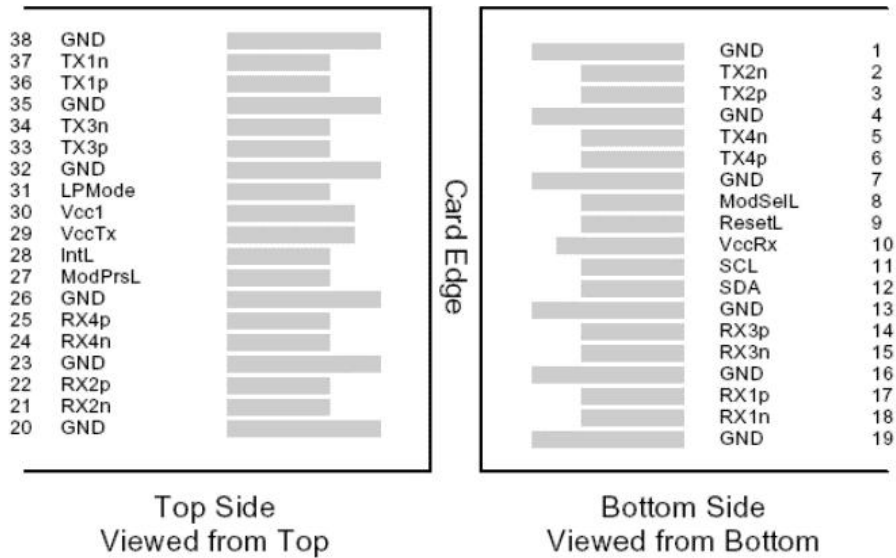
Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Transmitter</b>						
<b>Signaling Speed per Lane</b>		9.95		10.3125	GBd	1
<b>Lane center wavelength</b>	$\lambda$	1260		1355		
<b>Total Launch Power</b>	$P_{OUT}$			6.5	dBm	
<b>Transmit OMA per Lane</b>	TxOMA	-6.4		3.0	dBm	
<b>Transmitter and Dispersion Penalty</b>	TDP			6.4	dBm	
<b>Transmit OMA - TDP</b>	Tp-OMA	-8.4				
<b>Average Launch Power per Lane</b>	$TXP_x$	-9.4		0.5		2
<b>Optical Extinction Ratio</b>	ER	3.5			dB	
<b>Sidemode Suppression ratio</b>	SSR <sub>mim</sub>	30			dB	
<b>Average launch power of OFF transmitter, per lane</b>				-30	dBm	
<b>Relative Intensity Noise</b>	RIN			-128	dB/Hz	3
<b>Tx Jitter</b>	Txj			20	dB	
<b>Transmitte Reflectance</b>			Per 802.3ae requirements			
<b>Transmitter eye mask definition</b>			Per 802.3ae requirements			

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Receiver</b>						
<b>Signaling Speed per Lane</b>		9.95		10.3125	GBd	4
<b>Lane center wavelength</b>	$\lambda$	1260		1355	nm	
<b>Damage Threshold per Lane</b>	$P_{MAX}$			3.5	dBm	
<b>Average Receive Power per Lane</b>	RXPx	-14.4		0.5	dbm	5
<b>Receiver Sensitivity (OMA) per Lane</b>	Rxsens			-12.6	dBm	
<b>Stressed Receiver Sensitivity (OMA) per Lane</b>	SRS			-10.3	dBm	
<b>Return Loss</b>	$R_L$			-12	dBm	
<b>Receive electrical 3 dB upper cutoff frequency, per lane</b>				12.3	GHz	
<b>LOS De-Assert</b>	$LOS_D$			-17	dBm	
<b>LOS Assert</b>	$LOS_A$	-30			dBm	
<b>LOS Hysteresis</b>			0.5		dB	
<b>Link Power Budget</b>						
<b>Power Budget</b>		6.2			dB	
<b>Link Insertion Loss</b>		4.0			dB	6

**Notes:**

1. Transmitter consists of 4 lasers operating between 9.95 and 10.3 Gb/s each.
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 between 9.95 and 10.3 Gb/s each.
5. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.
6. Insertion loss includes 0.8 dB for fiber attenuation and 3.2 dB for connector and splice 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	21
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

**Notes:**

Circuit ground is internally isolated from chassis ground.



## VI. Mechanical Specifications

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

