

# 40GBASE-PLR4 QSFP +1310nm 10km MTP/MPO Transceiver for SMF

F5-UPG-QSFP+PLR4-LL



## Application

- 10GBASE-LR/LW 10G Ethernet
- OTU2, OTU1e, OTU2e

## Features

- Hot-pluggable QSFP+ form factor
- Supports 4 independent streams of 10G Ethernet or OTN data
- Power dissipation < 2.5W
- RoHS-6 compliant
- Commercial case temperature range 0° C to 70° C
- Single 3.3V power supply
- Maximum link length of 10km on Single Mode Fiber (SMF)
- XLPP electrical interface
- MPO12 receptacle
- Built-in digital diagnostic functions, including Tx/Rx power monitoring

## 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, IEEE 802.3ae 10GBASE-LR/LW, and OTN data rates OTU2, OTU1e, and OTU2e per the ITU. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The transceiver is RoHS compliant per Directive 2011/65/EU5.

## Product Specifications

### I.General Specifications

Parameter	Value	Unit	Notes
<b>Module Form Factor</b>	QSFP+		
<b>Maximum Aggregate Data Rate</b>	44.4	Gb/s	
<b>Maximum Data Rate per Lane</b>	11.095	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	Units	Ref.
<b>Bit Rate per Lane</b>	BR	9.95		11.10	Mb/sec	1
<b>Bit Error Ratio</b>	BER			10 <sup>-12</sup>		2
<b>Link distance on SMF-28</b>	d			10	kilometers	

**Notes:**

1. Compliant with 10GBASE-LR/LW, OTU2, OTU1e, and OTU2e and XLPP1.
2. Tested with a PRBS 2-1 test pattern.

**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	

**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.
<b>Supply Voltage</b>	Vcc1, VccTx, VccRx	3.1		3.47	V	
<b>Supply Current</b>	Icc			1.13	A	
<b>Transmit turn-on time</b>				2000	ms	1
<b>Transmitter (per Lane)</b>						
<b>Single ended input voltage tolerance</b>	VinT	-0.3		4.0	V	
<b>Differential data input swing</b>	Vin,pp	120		1200	mVpp	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>	Jt2	0.17			UI	
<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>	V <sub>out,pp</sub>	200		400	mVpp	5,6
		300		600		
		400		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 x 10E-5.
5. AC coupled with 100Ω differential output impedance.
6. Output voltage settable in four discrete ranges via I2C command.

#### 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		10.095	GBd	1
<b>Lane center wavelength</b>	$\lambda$	1290		1330		
<b>Average Launch Power per Lane</b>	TXPx	-6.0		-1.0	dBm	2
<b>Transmit OMA per Lane</b>	TxOMA	-5.2		3.0	dBm	
<b>Transmitter and Dispersion Penalty</b>	TDP			3.2	dB	
<b>Transmit OMA per lane minus TDP</b>		-6.2			m	
<b>Optical Extinction Ratio</b>	ER	6.0			dB	
<b>Sidemode Suppression ratio</b>	SSRmin	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>Transmitter Reflectance</b>				-12		
<b>Transmitter eye mask definition</b>			Per 802.3ae, G.693, and G.691			

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Receiver</b>						
<b>Signaling Speed per Lane</b>		9.95		10.095	GBd	4
<b>Lane center wavelength</b>	$\lambda$	1260		1355		
<b>Damage Threshold per Lane</b>	$P_{MAX}$			1.5	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>	$R_L$			-14	dBm	
<b>Receive electrical 3 dB upper cutoff frequency, per lane</b>				12.3	GHz	
<b>LOS De-Assert</b>	LOS <sub>D</sub>			-14	dBm	
<b>LOS Assert</b>	LOS <sub>A</sub>	-30		-17	dBm	
<b>LOS Hysteresis</b>			0.5		dB	

**Notes:**

1. Transmitter consists of 4 lasers operating between 9.95 and 11.10 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 11.10 Gb/s each.
5. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.

## V. Pin Description

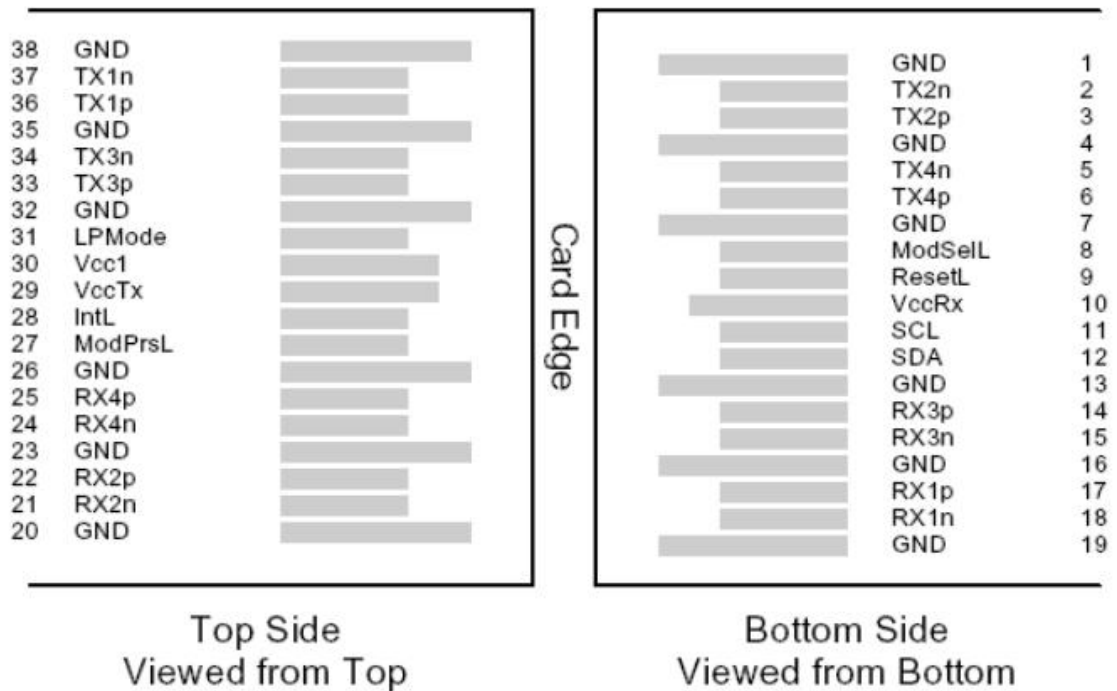


Figure 1 – QSFP+ MSA-compliant 38-pin connector

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

**Notes:**

1. Circuit ground is internally isolated from chassis ground.

**VI. Mechanical Specifications**

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

