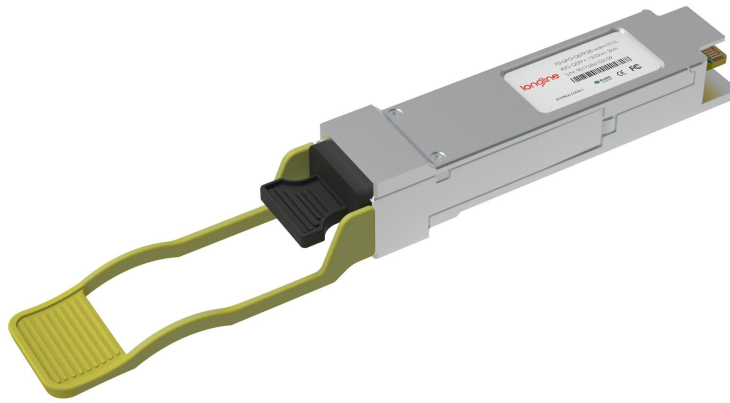


# 100GBASE-4WDM-10 QSFP28 1310nm 10km DOM Transceiver

F5-UPG-QSFP28-wdm10-LL



## Application

- Data Center
- 100G Ethernet
- 100G Campus Link
- Enterprise networking

## Features

- Compliant to QSFP28 Extended CWDM4 MSA
- Four CWDM lanes MUX/DEMUX design
- Supports 103.1Gb/s aggregate bit rate
- Up to 10km transmission on single mode fiber (SMF) with RS-FEC
- Operating case temperature: 0 to 70° C
- 4x25G electrical interface (OIF CEI-28G-VSR)
- Maximum power consumption 3.5W
- LC duplex connector
- RoHS compliant

## Description

This product is a transceiver module designed for low cost 10km optical communication applications. The module converts 4 inputs channels (ch) of 25Gb/s electrical data to 4 CWDM optical signals, and multiplexes them into a single channel for 100Gb/s optical transmission. Reversely, on the receiver side, the module optically de-multiplexes a 100Gb/s input into 4 CWDM channels signals, and converts them to 4 channel output electrical data.

The central wavelengths of the 4 CWDM channels are 1271, 1291, 1311 and 1331 nm as members of the CWDM wavelength grid defined in ITU-T G.694.2. It contains a duplex LC connector for the optical interface and a 38-pin connector for the electrical interface. To minimize the optical dispersion in the long-haul system, single-mode fiber (SMF) has to be applied in this module. Host FEC is required to support up to 10km fiber transmission.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP28 Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

## Product Specifications

### I. Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Operating Case Temperature</b>	TOP	0		70	degC	
<b>Power Supply Voltage</b>	VCC	3.135	3.3	3.465	V	
<b>Data Rate, each Lane</b>			25.78125		Gb/s	
<b>Data Rate Accuracy</b>		-100		100	ppm	
<b>Pre-FEC Bit Error Ratio</b>				5x10 <sup>-5</sup>		
<b>Post-FEC Bit Error Ratio</b>				1x10 <sup>-12</sup>		1
<b>Control Input Voltage High</b>		2		Vcc	V	
<b>Control Input Voltage Low</b>		0		0.8	V	
<b>Link Distance with G.652</b>	D	0.002		10	km	2

#### Notes:

- 1.FEC provided by host system.
- 2.FEC required on host system to support maximum distance.

## II. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Storage Temperature</b>	$T_S$	-40		85	degC	
<b>Case Operating Temperature</b>	TOP	0		70	degC	
<b>Power Supply Voltage(non-condensation)</b>	VCC	-0.5		3.6	V	
<b>Relative Humidity</b>	RH	0		85	%	
<b>Damage Threshold , each lane</b>	THd	3.5			dBm	

### Note:

1.Non-condensing.

## III. Electrical Characteristics (TOP= 0 to 70 ° C, VCC = 3.14 to 3.46 Volts)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
<b>Power Consumption</b>				3.5	W	
<b>Supply Current</b>	I <sub>cc</sub>			1.06	A	

**Transmitter**

<b>Overload Differential Voltage pk-pk</b>	TP1a	900			mV	
<b>Common Mode Voltage (Vcm)</b>	TP1	-350		2850	mV	1
<b>Differential Termination Resistance Mismatch</b>	TP1			10	%	At 1MHz
<b>Differential Return Loss (SDD11)</b>	TP1			See CEI-28G-VSR Equation 13-19	dB	
<b>Common Mode to Differential conversion and Differential to Common Mode conversion (SDC11, SCD11)</b>	TP1			See CEI-28G-VSR Equation 13-20	dB	
<b>Stressed Input Test</b>	TP1a	See CEI-28G-VSR Section 13.3.11.2.1				
<b>Common Mode to Differential conversion and Differential to Common Mode conversion (SDC11, SCD11)</b>	TP1			See CEI-28G-VSR Equation 13-20	dB	

### Receiver(each Lane)

<b>Differential Voltage, pk-pk</b>	TP4			900	mV	
<b>Common Mode Voltage (Vcm)</b>	TP4	-350		2850	mV	1
<b>Common Mode Noise, RMS</b>	TP4			17.5	mV	
<b>Differential Termination Resistance Mismatch</b>	TP4			10	%	At 1MHz
<b>Differential Return Loss (SDD22)</b>	TP4			See CEI-28G-VSR Equation 13-19	dB	
<b>Common Mode to Differential conversion and Differential to Common Mode conversion (SDC22, SCD22)</b>	TP4			See CEI-28G-VSR Equation 13-21	dB	
<b>Common Mode Return Loss (SCC22)</b>	TP4			-2	dB	2
<b>Transition Time, 20 to 80%</b>	TP4	9.5			ps	
<b>Vertical Eye Closure (VEC)</b>	TP4			5.5	dB	
<b>Eye Width at 10-15 probability (EW15)</b>	TP4	0.57			UI	
<b>Eye Height at 10-15 probability (EH15)</b>	TP4	228			mV	

#### Notes:

1. Vcm is generated by the host. Specification includes effects of ground offset voltage.
2. From 250MHz to 30GHz.

#### IV. Optical Characteristics (TOP = 0 to 70 °C, VCC = 3.14 to 3.46 V)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Wavelength Assignment</b>	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	

#### Transmitter (Tx)

<b>Side Mode Suppression Ratio</b>	SMSR	30			dB	
<b>Total Average Launch Power</b>	$P_T$			8.5	dBm	
<b>Average Launch Power, each Lane</b>	$P_{AVG}$	-6.5		2.5	dBm	
<b>Optical Modulation Amplitude (OMA), each Lane</b>	$P_{OMA}$	-4.0		2.5	dBm	1
<b>Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), each Lane</b>		-5.0			dBm	
<b>Difference in launch power between any two lanes (Average and OMA)</b>				6.0	dB	
<b>TDP, each Lane</b>	TDP			3.0	dB	
<b>Extinction Ratio</b>	ER	3.5			dB	
<b>Optical Return Loss Tolerance</b>	TOL			20	dB	
<b>Transmitter Reflectance</b>	$R_T$			-20	dB	

**Average Launch Power OFF**

-30 dBm

**Transmitter, each Lane**

<b>Transmitter Optical Eye Mask</b>		{0.31, 0.4, 0.45, 0.34, 0.38, 0.4}			2
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**Receiver (Rx)****Damage Threshold, each Lane**

THd 3.5 dBm 3

<b>Average Receive Power, each Lane</b>		-13.0	2.5	dBm	
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**Receive Power (OMA), each Lane**

2.5 dBm

<b>Receiver Sensitivity (OMA), each Lane</b>				-11.5	dBm	for BER = 5x10 <sup>-5</sup>
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**Stressed Receiver Sensitivity (OMA), each Lane**

-9.1 dBm 4

<b>Receiver Reflectance</b>	RR			-26	dB	
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**LOS Assert**

LOSA -30 dBm

<b>LOS Deassert</b>	LOSD			-15	dBm	
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**LOS Hysteresis**

LOSH 0.5 dB

**Conditions of Stress Receiver Sensitivity Test (Note 5)****Vertical eye closure penalty, each lane**

VEC 1.9 dB

<b>Stressed Eye J2 Jitter, each Lane</b>			0.33		UI	
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**Stressed Eye J4 Jitter, each Lane**

0.48 UI

<b>SRS eye mask definition { X1, X2, X3, Y1, Y2, Y3}</b>				{0.39, 0.5, 0.5, 0.39, 0.39, 0.4}		
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**Notes:**

1. Even if the TDP < 1.0 dB, the OMA min must exceed the minimum value specified here.
2. Hit ratio  $5 \times 10^{-5}$ .
3. 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.
4. Measured with conformance test signal at receiver input for BER =  $5 \times 10^{-5}$ .
5. Vertical eye closure penalty, stressed eye J2 jitter, and stressed eye J4 jitter are test conditions for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

## V. Digital Diagnostic Specifications

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

Parameter	Symbol	Min	Typ.	Max	Units	Ref.
<b>Temperature monitor absolute error</b>	DMI_Temp	-3		3	degC	Over operating temperature range
<b>Supply voltage monitor absolute error</b>	DMI_VCC	-0.1		0.1	V	Over full operating range
<b>Channel RX power monitor absolute error</b>	DMI_RX_Ch	-2		2	dB	1
<b>Channel Bias current monitor</b>	DMI_Ibias_Ch	-10%		10%	mA	
<b>Channel TX power monitor absolute error</b>	DMI_TX_Ch	-2		2	dB	1

**Note:**

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



## VI. Pin Description

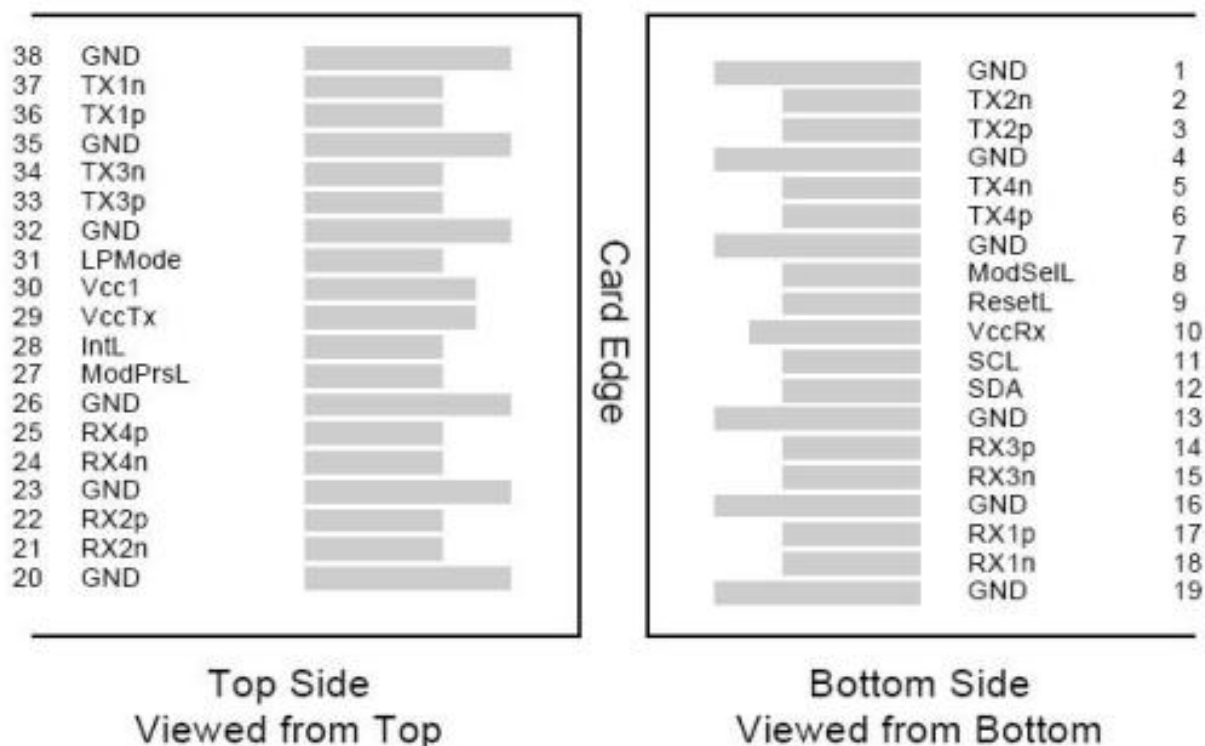
Pin	Symbol	Name/Description	Ref.
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data output	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data output	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	VccRx	+3.3V Power Supply Receiver	2
11	SCL	2-Wire Serial Interface Clock	
12	SDA	2-Wire Serial Interface Data	
13	GND	Ground	
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

Pin	Symbol	Name/Description	Ref.
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Inverted Data Output	1
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	VccTx	+3.3 V Power Supply transmitter	2
30	Vcc1	+3.3 V Power Supply	2
31	LPMode	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Output	
35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Output	
38	GND	Ground	1

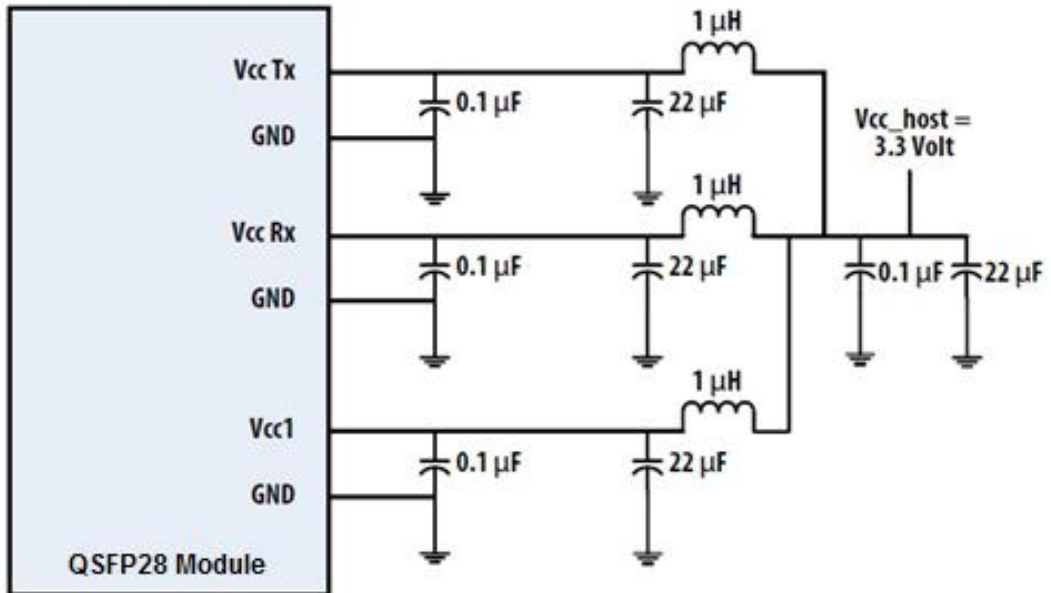
**Notes:**

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 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. Recommended host board power supply filtering is shown in Figure 3 below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.

**VII .Pin Assignment and Description**



### VIII. Recommended Power Supply Filter



### IX. Mechanical Dimensions

