

100Gb/s QSFP28 Parallel Active Optical Cable (AOC)

TF-FCxxx-N00

Product Specification

Features

- QSFP MSA compliant
- Four independent full-duplex channels
- Supports 103.1Gb/s aggregate bit rate
- Up to 100m OM4 MMF transmission
- Operating case temperature: 0 to 70°C
- 4x25G electrical interface (OIF CEI-28G-VSR)
- Single 3.3V power supply
- Maximum power consumption 2.5W each terminal
- RoHS-6 compliant



Module picture shown above is that of InnoLight standard part and is for reference.

Applications

- 100G Ether
- Infiniband EDR

Part Number Ordering Information

TF-FCxxx-N00	QSFP28 active optical cable with full real-time digital diagnostic monitoring
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where "xxx" denotes cable length in meters. Examples of cable length offered are as follows:

- | | |
|-------------------|--------------------|
| xxx = 001 for 1m | xxx = 050 for 50m |
| xxx = 005 for 5m | xxx = 075 for 75m |
| xxx = 010 for 10m | xxx = 100 for 100m |

1. General Description

This product is a high data rate parallel active optical cable (AOC), to overcome the bandwidth limitation of traditional copper cable. The AOC offers 4 independent data transmission channels and 4 data receiving channels via a multimode fiber cable, each capable of 25Gb/s operation. Consequently, an aggregate data rate of 100Gb/s over 100 meters transmission can be achieved by this product, to support the ultra-fast computing data exchange.

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

2. Functional Description

This product converts the parallel electrical input signals into parallel optical signals (light), by a driven Vertical Cavity Surface Emitting Laser (VCSEL) array. The light propagates through multimode fibers inside the fiber cable individually, and is captured by the photo diode array. The optical signals are converted into parallel electrical signals and outputted. Consequently, each terminal of the cable has 8 ports, 4 for data transmission and 4 for data receiving, to provide totally 100Gb/s data exchange. Figure 1 shows the functional block diagram of the parallel AOC.

A single +3.3V power supply is required to power up this product. Both power supply pins VccTx and VccRx are internally connected and should be applied concurrently. As per MSA specifications the module offers 7 low speed hardware control pins (including the 2-wire serial interface): ModSelL, SCL, SDA, ResetL, LPMode, ModPrsL and IntL.

Module Select (ModSelL) is an input pin. When held low by the host, this product responds to 2-wire serial communication commands. The ModSelL allows the use of this product on a single 2-wire interface bus – individual ModSelL lines must be used.

Serial Clock (SCL) and Serial Data (SDA) are required for the 2-wire serial bus communication interface and enable the host to access the QSFP memory map.

The ResetL pin enables a complete reset, returning the settings to their default state, when a low level on the ResetL pin is held for longer than the minimum pulse length. During the execution of a reset the host shall disregard all status bits until it indicates a completion of the reset interrupt. The product indicates this by posting an IntL (Interrupt) signal with the Data_Not_Ready bit negated in the memory map. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

Low Power Mode (LPMode) pin is used to set the maximum power consumption for the product in order to protect hosts that are not capable of cooling higher power modules, should such modules be accidentally inserted.

Module Present (ModPrsL) is a signal local to the host board which, in the absence of a product, is normally pulled up to the host Vcc. When the product is inserted into the connector, it completes the path to ground through a resistor on the host board and asserts the signal. ModPrsL then indicates it is present by setting ModPrsL to a “Low” state.

Interrupt (IntL) is an output pin. “Low” indicates a possible operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled to the Host Vcc voltage on the Host board.

3. AOC Block Diagram

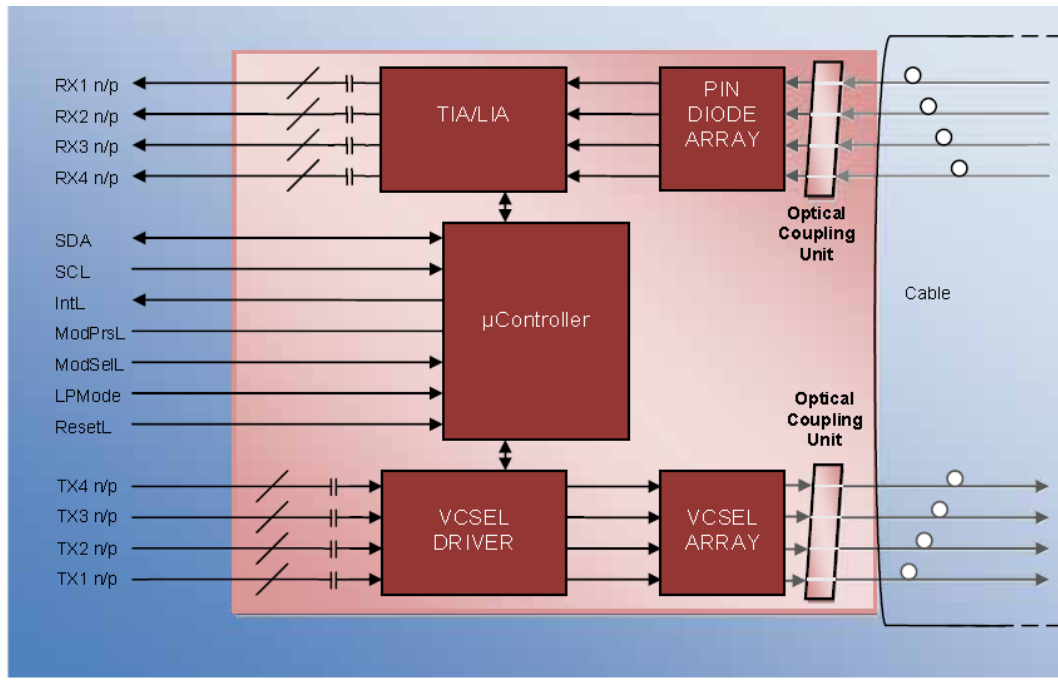


Figure 1. Block Diagram of One of the QSFP28 End Modules

4. Pin Assignment and Description

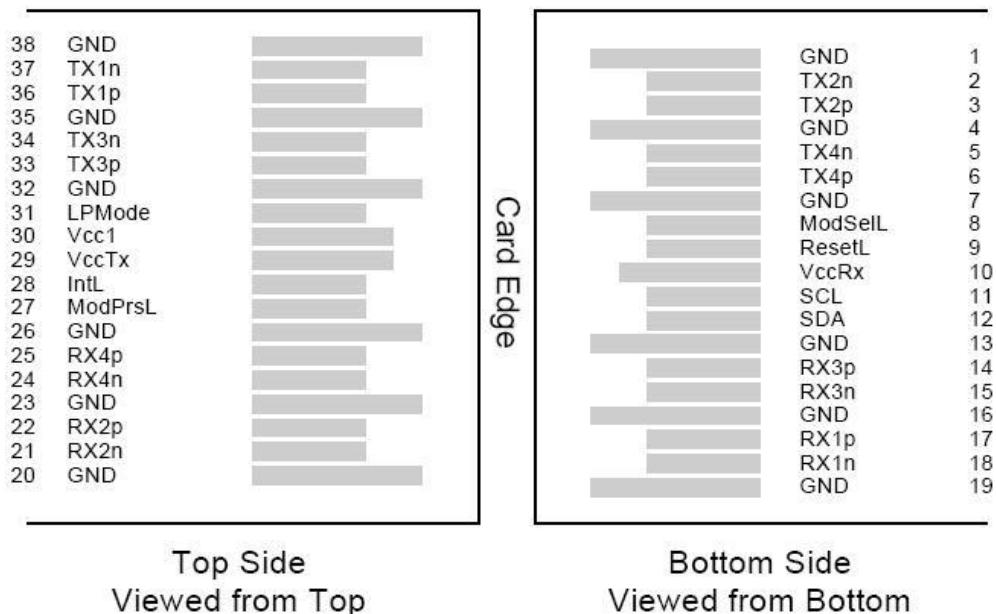


Figure 2. MSA compliant Connector

Pin Definition

PIN	Logic	Symbol	Name/Description	Notes
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	
7		GND	Ground	1
8	LVTLL-I	ModSelL	Module Select	
9	LVTLL-I	ResetL	Module Reset	
10		VccRx	+3.3V Power Supply Receiver	2
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data	
13		GND	Ground	
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	
15	CML-O	Rx3n	Receiver Inverted Data Output	
16		GND	Ground	1

17	CML-O	Rx1p	Receiver Non-Inverted Data Output	
18	CML-O	Rx1n	Receiver Inverted Data Output	
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	1
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	
28	LVTTL-O	IntL	Interrupt	
29		VccTx	+3.3 V Power Supply transmitter	2
30		Vcc1	+3.3 V Power Supply	2
31	LVTTL-I	LPMODE	Low Power Mode	
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	
34	CML-I	Tx3n	Transmitter Inverted Data Output	
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	
37	CML-I	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 1000mA.

5. Recommended Power Supply Filter

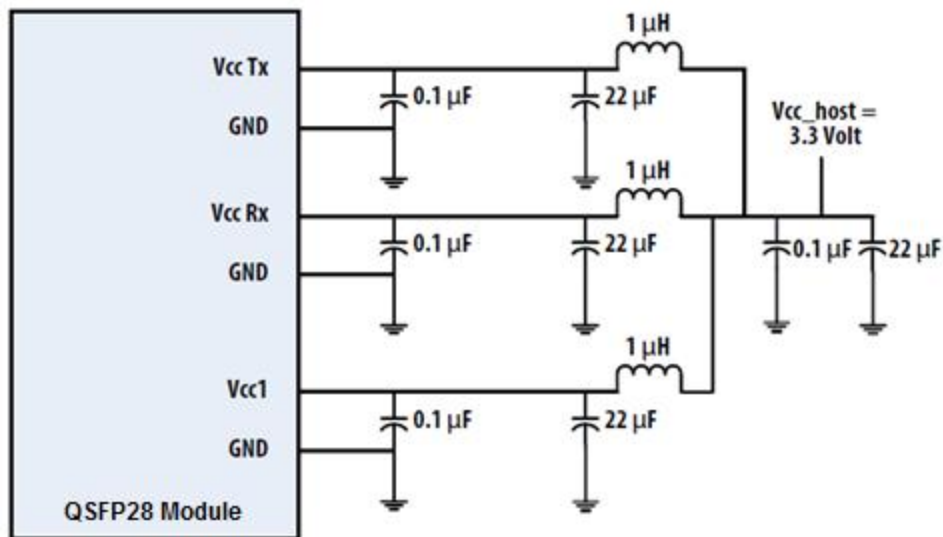


Figure 3. Recommended Power Supply Filter

6. Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min	Max	Units	Notes
Storage Temperature	T _S	-40	85	degC	
Operating Case Temperature	T _{OP}	0	70	degC	
Power Supply Voltage	V _{CC}	-0.5	3.6	V	
Relative Humidity (non-condensation)	RH	0	85	%	

7. Recommended Operating Conditions and Power Supply Requirements

Parameter	Symbol	Min	Typical	Max	Units
Operating Case Temperature	T _{OP}	0		70	degC
Power Supply Voltage	V _{CC}	3.135	3.3	3.465	V
Data Rate, each Lane			25.78125		Gb/s
Data Rate Accuracy		-100		100	ppm
Control Input Voltage High		2		V _{cc}	V
Control Input Voltage Low		0		0.8	V

8. Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating temperature and supply voltage unless otherwise specified.

Parameter	Test Point	Min	Typical	Max	Units	Notes
Power Consumption				2.5	W	1
Supply Current	Icc			757	mA	1
Transmitter (each Lane)						
Overload Differential Voltage pk-pk	TP1a	900			mV	
Common Mode Voltage (Vcm)	TP1	-350		2850	mV	2
Differential Termination Resistance Mismatch	TP1			10	%	At 1MHz
Differential Return Loss (SDD11)	TP1			See CEI-28G-VSR Equation 13-19	dB	
Common Mode to Differential conversion and Differential to Common Mode conversion (SDC11, SCD11)	TP1			See CEI-28G-VSR Equation 13-20	dB	
Stressed Input Test	TP1a	See CEI-28G-VSR Section 13.3.11.2.1				
Receiver (each Lane)						
Differential Voltage, pk-pk	TP4			900	mV	
Common Mode Voltage (Vcm)	TP4	-350		2850	mV	2
Common Mode Noise, RMS	TP4			17.5	mV	
Differential Termination Resistance Mismatch	TP4			10	%	At 1MHz
Differential Return Loss (SDD22)	TP4			See CEI-28G-VSR Equation 13-19	dB	

Common Mode to Differential conversion and Differential to Common Mode conversion (SDC22, SCD22)	TP4			See CEI-28G-VSR Equation 13-21	dB	
Common Mode Return Loss (SCC22)	TP4			-2	dB	3
Transition Time, 20 to 80%	TP4	9.5			ps	
Vertical Eye Closure (VEC)	TP4			5.5	dB	
Eye Width at 10^{-15} probability (EW15)	TP4	0.57			UI	
Eye Height at 10^{-15} probability (EH15)	TP4	228			mV	

Notes:

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

9. Mechanical Dimensions

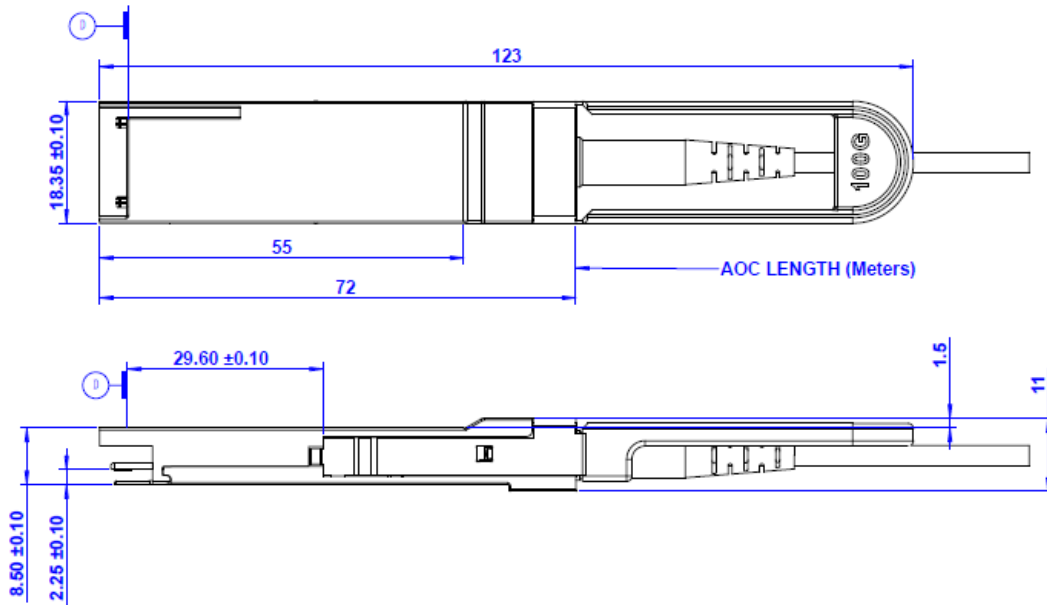


Figure 4. Mechanical Outline

10. ESD

This transceiver is specified as ESD threshold 1kV for high speed data pins and 2kV for all others 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.

11. Laser Safety

This is a Class 1 Laser Product according to EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

Caution: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Contact Information

Vitex LLC
105 Challenger Road, Suite 401 Ridgefield Park, NJ 07760 USA Ph: 201-296-0145 Email: info@vitextech.com www.vitextech.com