

## PRELIMINARY Product Specification

### 100G Quadwire® QSFP28 Active Optical Cable

#### FCBN425QB1Cxx

#### PRODUCT FEATURES

- Four-channel full-duplex active optical cable
- Multirate capability: 10 Gb/s to 28 Gb/s per channel
- QSFP28 high-density form factor
- Reliable VCSEL array technology using multimode fiber
- Round OFNP-rated cable
- Hot Pluggable
- Low power dissipation: <3.5W per cable end (<2.5W with CDRs off)
- Commercial operating case temperature range: 0°C to 70°C
- RoHS-6 Compliant



#### APPLICATIONS

- Infiniband 4xEDR, 4xFDR, 4xQDR
- 10/25/40/100G Ethernet
- 4G/8G/16G/32G Fibre Channel
- SAS3
- Proprietary HPC Interconnections

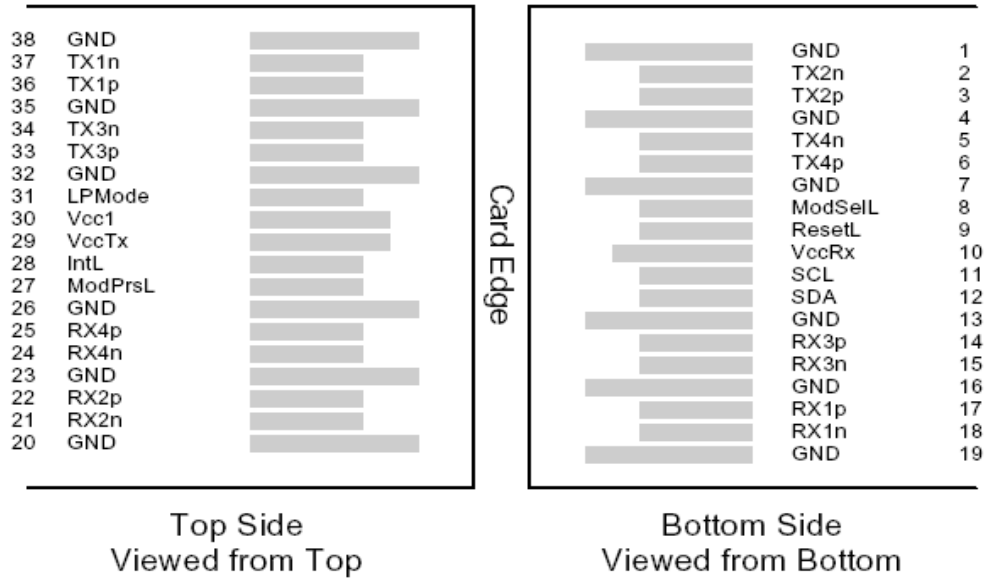
Compliant to RoHS Directive 2011/65/EU

#### PRODUCT SELECTION (Standard Lengths\*)

<b>FCBN425QB1C01</b>	1-meter cable
<b>FCBN425QB1C03</b>	3-meter cable
<b>FCBN425QB1C05</b>	5-meter cable
<b>FCBN425QB1C10</b>	10-meter cable
<b>FCBN425QB1C15</b>	15-meter cable
<b>FCBN425QB1C20</b>	20-meter cable
<b>FCBN425QB1C30</b>	30-meter cable
<b>FCBN425QB1C50</b>	50-meter cable
<b>FCBN425QB1CX0</b>	100-meter cable

\*For availability of additional cable lengths or cable types, please contact Finisar.

**I. Pin Descriptions**



**Figure 1 – QSFP28-compliant 38-pin connector (per SFF-8679)**

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.

**II. General Product Characteristics**

Parameter	Value	Unit	Notes
Module Form Factor	QSFP28		As defined by SFF-8661
Number of Lanes	4 Tx and 4 Rx		
Maximum Aggregate Data Rate	103.125	Gb/s	
Maximum Data Rate per Lane	25.78125	Gb/s	
Standard Cable Lengths	1, 3, 5, 10, 15, 20, 30, 50, 100	meters	Other lengths may be available upon request
Protocols Supported	Typical applications include InfiniBand QDR/FDR/EDR, 10/25/40G/100G Ethernet, 4/8/16/32G Fibre Channel, SAS3		
Electrical Interface and Pin-out	38-pin edge connector		Pin-out as defined by SFF-8679
Standard Optical Cable Type	Multimode round fiber cable, plenum-rated		OFNP
Maximum Power Consumption per End	3.5 (retimed Tx) 2.5 (unretimed)	Watts	Varies with output voltage swing and pre-emphasis settings
Management Interface	Serial, I2C-based, 450 kHz maximum frequency		As defined by SFF-8636

Data Rate Specifications	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate per Lane	BR	10.00000	25.781.25	28.05	Gb/sec	1
Bit Error Ratio	BER			10 <sup>-12</sup>		2

Notes:

1. Supports InfiniBand QDR/FDR/EDR, 10/25/40/100 Gigabit Ethernet and 8/16/32G Fibre Channel applications.
2. Tested with a PRBS 2<sup>31</sup>-1 test pattern.

### III. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	V <sub>cc1</sub> , V <sub>ccTx</sub> , V <sub>ccRx</sub>	-0.5		3.6	V	
Storage Temperature	T <sub>S</sub>	-40		85	°C	1
Case Operating Temperature	T <sub>OP</sub>	0		70	°C	
Relative Humidity	RH	0		85	%	2

#### Notes:

- Assumes no mechanical load force on the unit. Ensuring no mechanical load force requires a cable bend radius of >105 mm within 100 mm of either cable end module and >60 mm on the rest of the cable.
- Non-condensing.

### IV. Electrical Characteristics (T<sub>OP</sub> = 0 to 70°C, V<sub>CC</sub> = 3.3 ± 5% Volts)

NOTE: The Quadwire EDR requires an electrical connector compliant with SFF-8662 or SFF-8672 be used on the host board to guarantee its electrical interface specification. Please check with your connector supplier.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	V <sub>cc1</sub> , V <sub>ccTx</sub> , V <sub>ccRx</sub>	3.15		3.45	V	
Supply Current	I <sub>cc</sub>			TBD	mA	
Power Dissipation per cable end	P			3.5	W	1, 2
<b>Link Turn-On Time</b>						
Transmit turn-on time				2000	ms	3
<b>Transmitter (per Lane)</b>						
Single ended input voltage tolerance	V <sub>inT</sub>				V	
Differential data input swing	V <sub>in,pp</sub>				mV <sub>pp</sub>	
Differential input threshold					mV	
AC common mode input voltage tolerance (RMS)					mV	
Differential input return loss					dB	
J2 Jitter Tolerance	J <sub>t2</sub>				UI	4
J9 Jitter Tolerance	J <sub>t9</sub>				UI	4
Data Dependent Pulse Width Shrinkage	DDPWS				UI	
Eye mask coordinates {X1, X2 Y1, Y2}					UI mV	
<b>Receiver (per Lane)</b>						
Single-ended output voltage					V	
Differential data output swing	V <sub>out,pp</sub>				mV <sub>pp</sub>	
AC common mode output voltage (RMS)					mV	
Termination mismatch at 1 MHz					%	
Differential output return loss					dB	
Common mode output return loss					dB	
Output transition time, 20% to 80%					ps	
J2 Jitter output	J <sub>o2</sub>				UI	4
J9 Jitter output	J <sub>o9</sub>				UI	4
Eye mask coordinates {X1, X2 Y1, Y2}					UI mV	
Power Supply Ripple Tolerance	PSR				mV <sub>pp</sub>	

Notes:

1. Maximum total power value is specified across the full temperature and voltage range.
2. Settable in various discrete steps via the I2C interface.
3. From power-on and end of any fault conditions.
4. For jitter performance depending on CDR configuration, see below

**Jitter with TX and RX CDRs enabled**

Jitter (Measured at TP1)	Symbol	Min	Typ	Max	Unit	Ref
Total Jitter Input	iTLj pp			0.62	UI	1,2,3,5
Deterministic Jitter Input	iDLj pp			0.42	UI	1,2,3,5
J2 Jitter Tolerance	iLJ2 pp			0.5	UI	2,3,5
J9 Jitter Tolerance	iLJ9 pp			0.58	UI	2,3,5

Jitter (Measured at TP4)	Symbol	Min	Typ	Max	Unit	Ref
Total Jitter Output	oTLj pp			0.45	UI	1,3,4,5
Deterministic Jitter Output	oDLj pp			0.3	UI	1,3,4,5
J2 Jitter	oLJ2 pp			0.34	UI	3,4,5
J9 Jitter	oLJ9 pp			0.43	UI	3,4,5

Notes:

1. 28Gbps PRBS2<sup>31</sup>, BER 10<sup>-12</sup>.
2. Measured at TP1, minimum input voltage.
3. All channels are on for worst condition crosstalk.
4. Measured at TP4 with iTLj= 0.62UI, iDLj= 0.42UI at TP1, max temp.
5. These jitter values provided are for information only, they do not include the noise impact of the test O:E receiver required to measure them.

**Jitter with TX and RX CDRs in bypass**

Jitter (Measured at TP1)	Symbol	Min	Typ	Max	Unit	Ref
Total Jitter Input	iTLj pp			0.25	UI	1,2,3,5
Deterministic Jitter Input	iDLj pp			0.05	UI	1,2,3,5
Data Depended Pulse Width Shrinkage	DDPWS pp			0.01	UI	1,2,3,5
J2 Jitter Tolerance	iLJ2 pp			0.12	UI	1,2,3,5
J9 Jitter Tolerance	iLJ9 pp			0.23	UI	1,2,3,5

Jitter (Measured at TP4)	Symbol	Min	Typ	Max	Unit	Ref
Total Jitter Output	oTLj pp			0.82	UI	1,3,4,5
Deterministic Jitter Output	oDLj pp			0.42	UI	1,3,4,5
Data Depended Pulse Width Shrinkage	oLJ2 pp			0.36	UI	1,2,3,5
J2 Jitter	DDPWS			0.45	UI	1,3,4,5
J9 Jitter	oLJ2 pp			0.72	UI	3,4,5

Notes:

1. 28Gbps PRBS2<sup>31</sup>, BER 10<sup>-12</sup>.
2. Measured at TP1, minimum input voltage.
3. All channels are on for worst condition crosstalk.
4. Measured at TP4 with iTLj=.25UI, iDLj=.05UI at TP1, max temp.
5. These jitter values provided are for information only, they do not include the noise impact of the test O:E receiver required to measure them.

**Jitter with TX CDR enabled and RX CDR in bypass**

Jitter (Measured at TP1)	Symbol	Min	Typ	Max	Unit	Ref
Total Jitter Input	iTLj pp			0.62	UI	1,2,3,5
Deterministic Jitter Input	iDLj pp			0.42	UI	1,2,3,5
J2 Jitter Tolerance	iLJ2 pp			0.5	UI	2,3,5
J9 Jitter Tolerance	iLJ9 pp			0.58	UI	2,3,5

Jitter (Measured at TP4)	Symbol	Min	Typ	Max	Unit	Ref
Total Jitter Output	oTLj pp			0.82	UI	1,3,4,5
Deterministic Jitter Output	oDLj pp			0.42	UI	1,3,4,5
Data Depended Pulse Width Shrinkage	oLJ2 pp			0.36	UI	1,2,3,5
J2 Jitter	DDPWS			0.45	UI	1,3,4,5
J9 Jitter	oLJ2 pp			0.72	UI	3,4,5

Notes:

1. 28Gbps PRBS2<sup>31</sup>, BER 10<sup>-12</sup>.
2. Measured at TP1, minimum input voltage.
3. All channels are on for worst condition crosstalk.
4. Measured at TP4 with iTLj=.25UI, iDLj=.05UI at TP1, max temp.
5. These jitter values provided are for information only, they do not include the noise impact of the test O:E receiver required to measure them.

**V. Memory Map and Control Registers**

Compatible with SFF-8636. More details to be provided in a future application note.

## VI. Environmental Specifications

Finisar Quadwire EDR active optical cables have an operating temperature range from 0°C to +70°C case temperature.

Environmental Specifications	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T <sub>op</sub>	0		70	°C	
Storage Temperature	T <sub>sto</sub>	-10		70	°C	

## VII. Regulatory Compliance

Finisar Quadwire EDR active optical cables are RoHS-6 Compliant. Copies of certificates to be available at Finisar Corporation upon request.

Quadwire EDR active optical cables are Class 1 laser eye safety compliant per IEC 60825-1.

Standard fiber cable type is round-section construction, plenum-rated. Other cable types can be supported upon request.

## VIII. Mechanical Specifications

The Quadwire EDR mechanical specifications are compliant with the QSFP28 transceiver module specifications (as defined in SFF-8661), substituting the MPO12 receptacle with a fiber optics cable connecting both ends.

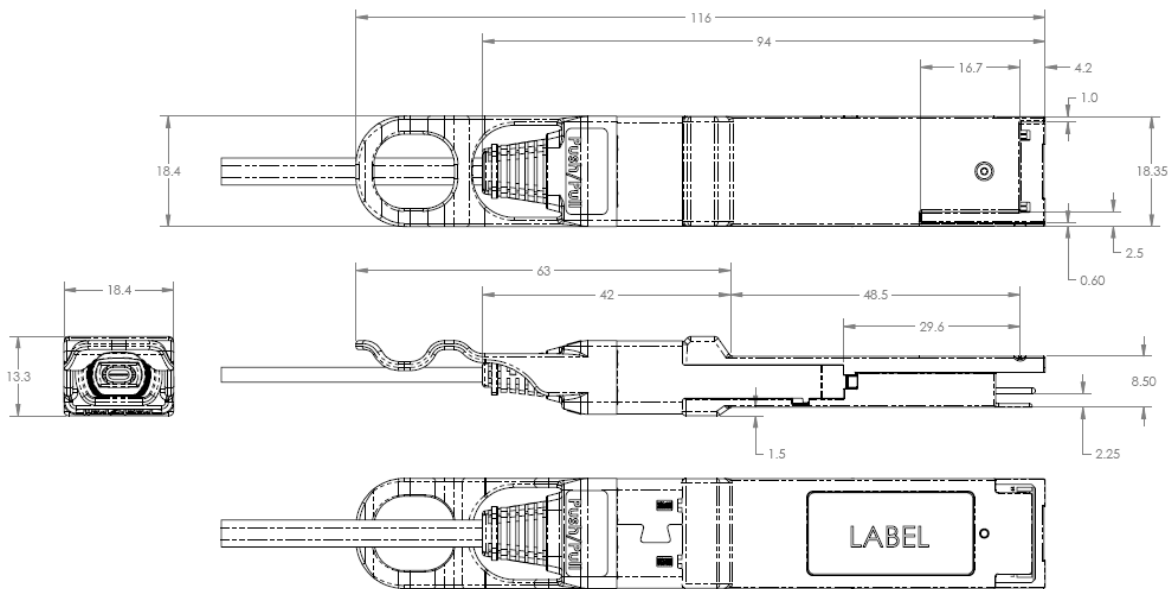


Figure 2 – Quadwire EDR mechanical drawing (Preliminary)

<b>Insertion, Extraction and Retention Forces</b>	<b>Min</b>	<b>Max</b>	<b>Units</b>	<b>Notes</b>
Cable Proof (Tensile) Test (0°)		44.0	Newtons	
Cable Proof (Tensile) Test (90°)		33.0	Newtons	
Impact		8	Cycles	1.5m drop
Flex		8.9	Newtons	
Twist		13.0	Newtons	
Module retention	90	N/A	Newtons	No damage below 90N
Host Connector Retention	180	N/A	Newtons	No damage below 180N



**IX. References**

1. InfiniBand™ Architecture Release, Vol. 2 – Physical Specifications, Rev. 1.3, November 2012.
2. SFF-8665 – QSFP+ 28Gb/s 4X Pluggable Transceiver Solution (QSFP28), Rev 1.8, May, 2013.
3. SFF-8636 – Specification for Common Management Interface, Rev 1.7, January 2014.
4. “CAUI-4” Retimed 4x25G electrical interface, to be defined by IEEE 802.3
5. CEI-28G-VSR Implementation Agreement, per OIF 2012.290.00
6. Directive 2011/65/EU of the European Council Parliament and of the Council, “on the restriction of the use of certain hazardous substances in electrical and electronic equipment.” Certain products may use one or more exemptions as allowed by the Directive.

**X. For More Information**

Finisar Corporation  
1389 Moffett Park Drive  
Sunnyvale, CA 94089-1133  
Tel. 1-408-548-1000  
Fax 1-408-541-6138  
[sales@finisar.com](mailto:sales@finisar.com)  
[www.finisar.com](http://www.finisar.com)