Product Specification

Quadwire® FDR Parallel Active Optical Cable

FCBx414QD3Cyy

PRODUCT FEATURES

- Four-channel full-duplex active optical cable
- Multirate capability: 1.06Gb/s to 14.025Gb/s per channel
- Complies with QSFP MSA high-density form factor
- Reliable VCSEL array technology using multimode fiber
- Round, plenum-rated (OFNP) and riser-rated (OFNR), low smoke zero halogen (LSZH) cables
- Hot Pluggable
- Built-in digital diagnostic functions
- Low power dissipation: <1.3W per cable end
- Commercial operating case temperature range: 0ºC to 70ºC
- RoHS-6 Compliant (lead-free)

APPLICATIONS

- Infiniband 4xFDR, 4xQDR
- 40G Ethernet
- 4G/8G/10G/14G Fibre Channel
- HPC Interconnections
- SATA/SA

PRODUCT SELECTION (Standard Lengths*)

FCBx414QD3Cyy	
x:	N = Plenum-rated (OFNP) cable jacket R = Riser-rated (OFNR) low smoke zero halogen (LSZH) cable jacket
yy*:	03 = 3m length 05 = 5m length 10 = 10m length 15 = 15m length 20 = 20m length 30 = 30m length 50 = 50m length X0 = 100m length

*Please contact Finisar for availability of additional cable lengths.

I. Pin Descriptions

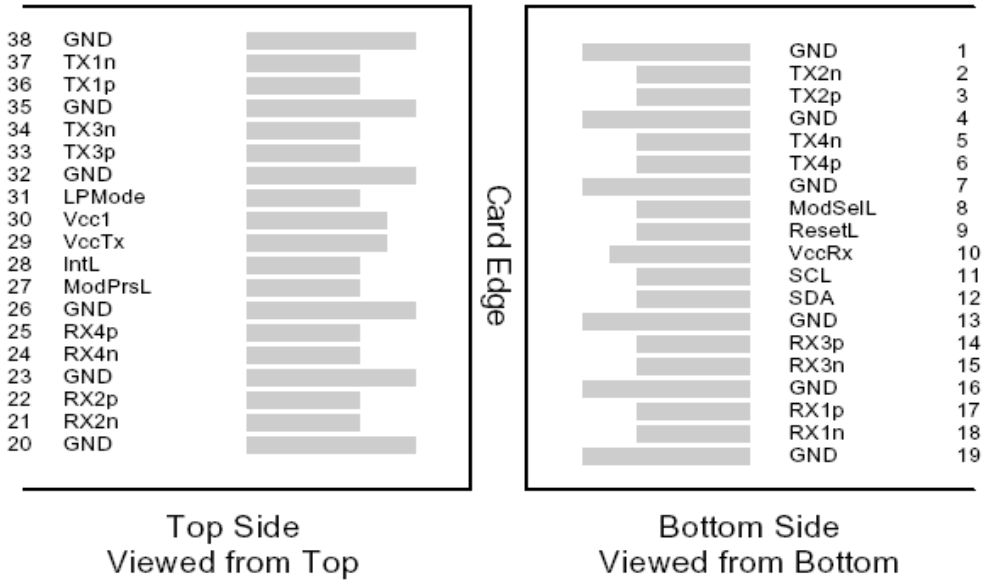

Figure 1 – QSFP MSA-compliant 38-pin connector

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.

II. General Product Characteristics

Parameter	Value	Unit	Notes
Module Form Factor	QSFP		
Number of Lanes	4 Tx and 4 Rx		
Maximum Aggregate Data Rate	56.25	Gb/s	
Maximum Data Rate per Lane	14.0625	Gb/s	
Standard Cable Lengths	3, 5, 10, 15, 20, 30, 50, 100	meters	Other lengths may be available upon request (< 300m)
Protocols Supported	Typical applications include Infiniband, Fibre Channel, 40G Ethernet, SATA/SAS3		
Electrical Interface and Pin-out	38-pin edge connector		Pin-out as defined by the QSFP MSA
Standard Optical Cable Type	Multimode ribbon fiber cable assembly, riser-rated		
Maximum Power Consumption per End	1.3	Watts	Varies with output voltage swing and pre-emphasis settings (see Figure 2)
Management Interface	Serial, I2C-based, 400 kHz maximum frequency		As defined by the QSFP MSA

Data Rate Specifications	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate per Lane	BR	1000		14062.5	Mb/sec	1
Bit Error Ratio	BER			10^{-12}		2

Notes:
1. 1/10 Gigabit Ethernet and 1/2/4/8/10/16G Fibre Channel compatible.
2. Tested with a PRBS 2^{31}-1 test pattern.

III. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	Vcc1, VccTx, VccRx	-0.5		3.6	V	
Storage Temperature	T_S	-40		85	°C	1
Case Operating Temperature	T_{OP}	0		70	°C	
Relative Humidity	RH	0		85	%	2

Notes:
1. 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.
2. Non-condensing.

IV. Electrical Characteristics (T_{OP} = 0 to 70°C, V_{CC} = 3.3 ± 5% Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc1, VccTx, VccRx	3.15		3.45	V	
Supply Current	Icc			350	mA	
Link Turn-On Time						
Transmit Turn-On Time				2000	ms	1
Transmitter (per Lane)						
Differential data input swing	Vin,pp	180		1200	mVpp	2
Differential input threshold			50		mV	
Receiver (per Lane)						
Differential data output swing	Vout,pp	0		800	mVpp	3,4
Power Supply Ripple Tolerance	PSR	50			mVpp	

Notes:
1. From power-on and end of any fault conditions.
2. AC coupled internally. Self-biasing 100Ω differential input.
3. AC coupled with 100Ω differential output impedance. See Figure 3 for output eye mask.
4. Settable in 4 discrete steps. See Figure 2 for Vo settings

V. High-Speed Electrical Characteristics per Lane

(T_{OP} = 0 to 70°C, V_{CC} = 3.3 ± 5% Volts)

Parameter –Inputs	Symbol	Conditions	Min	Typ	Max	Units	Ref.
Reference Differential Input Impedance	Z_d			100		Ω	
Termination Mismatch	ΔZ_M				5	%	1
Input AC Common Mode Voltage					25	mV (RMS)	
Differential Input Return Loss	SDD11	0.01-4.1 GHz				dB	2
		4.1 – 11.1 GHz				dB	3
Differential to Common Mode Loss	SCD11	0.01-11.1 GHz			-10	dB	
Jitter Tolerance (Total)	TJ				0.40	UI	
Jitter Tolerance (Deterministic)	DJ				0.15	UI	

Notes:
1. See SFF-8431 Rev 3.2 (SFP+) section D.15 Termination Mismatch for definition & test recommendations
2. Reflection coefficient given by equation SDD11(dB)< -12+2*SQRT(f), with f in GHz.
3. Reflection coefficient given by equation SDD11(dB)< -6.3+13Log10(f/5.5), with f in GHz.

Parameter –Outputs	Symbol	Conditions	Min	Typ	Max	Units	Ref.
Reference Differential Output Impedance	Z_d			100		Ω	
Termination Mismatch	ΔZ_M				5	%	
Output AC Common Mode Voltage					15	mV_{RMS}	
Output Rise and Fall time (20% to 80%)	t_{RH}, t_{FH}	14 Gbps	24			ps	
Differential Output Return Loss	SDD22	0.01-4.1 GHz				dB	1
		4.1 – 11.1 GHz				dB	2
Common Mode Output Return Loss	SCC22	0.01-2.5 GHz				dB	3
		2.5-11.1 GHz			-3	dB	

Notes:
1. Reflection coefficient given by equation SDD22(dB)< -12+2*SQRT(f), with f in GHz.
2. Reflection coefficient given by equation SDD22(dB)< -6.3+13Log10(f/5.5), with f in GHz.
3. Reflection coefficient given by equation SCC22(dB)< -7+1.6*f, with f in GHz.

Receiver Output Jitter Specification	Symbol	Min	Typ	Max	Units	Ref.
Deterministic Jitter	DJ_{OUT}			0.38	UI	1
Total Jitter	TJ_{OUT}			0.64	UI	1

Notes:
1. When transmitter input jitter specs are met.

Other Informational Specifications (not tested)	Symbol	Min	Typ	Max	Units	Ref.
Max Bit Rate NRZ	B			14.0625	Gb/s	
Low Frequency 3dB Cutoff	f_c	175			kHz	
Ch / Ch crosstalk				-26	dB	
Output Pre-emphasis settings (user selectable)	PE		0		mV	
			125		mV	
			175		mV	
			325		mV	
Pre-Emphasis pulse width		60		90	ps	
Digital clock to data delay				25	ns	
Digital output rise/fall times				5	ns	
Digital input / output Cap				1	pF	
Digital input logic High		2			V	
Digital input logic Low				1	V	
ESD Signal pads				500	V	HBM
ESD (other pads)				2	kV	HBM
Channel-to-channel skew				913	ps	1
Latency				1086+4990/m	ps	

Notes:
1. For cable lengths ≤ 7m. For longer cable lengths, the maximum channel-to-channel skew = 1204ps + (cable length – 8m) * 992ps.

Power (mW)		Pre-Emphasis into 100ohms (mV)			
		0	125	175	325
Vo (mV)	0	599			
	317	751	935	971	1075
	422	787	971	1007	1111
	739	883	1055	1103	1190

Figure 2 – Power Dissipation (mW, maximum) vs. Rx Output Conditions

VI. Memory Map and Control Registers

Compatible with SFF-8436.[2] Please see Finisar Application Note AN-2075: Quadwire® EEPROM Mapping[3] for details.

VII. Environmental Specifications

Finisar Quadwire® 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_{op}	0		70	°C	
Storage Temperature	T_{sto}	-40		85	°C	1

1. 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.

VIII. Regulatory Compliance

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

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

The round cable jacket is available in both plenum-rated (OFNP) and riser-rated (OFNR) low smoke zero-halogen (LSZH).

IX. Mechanical Specifications

Finisar FDR Quadwire® mechanical specifications are based on QSFP transceiver module specifications, substituting the MPO connectors with a cable connecting both ends.

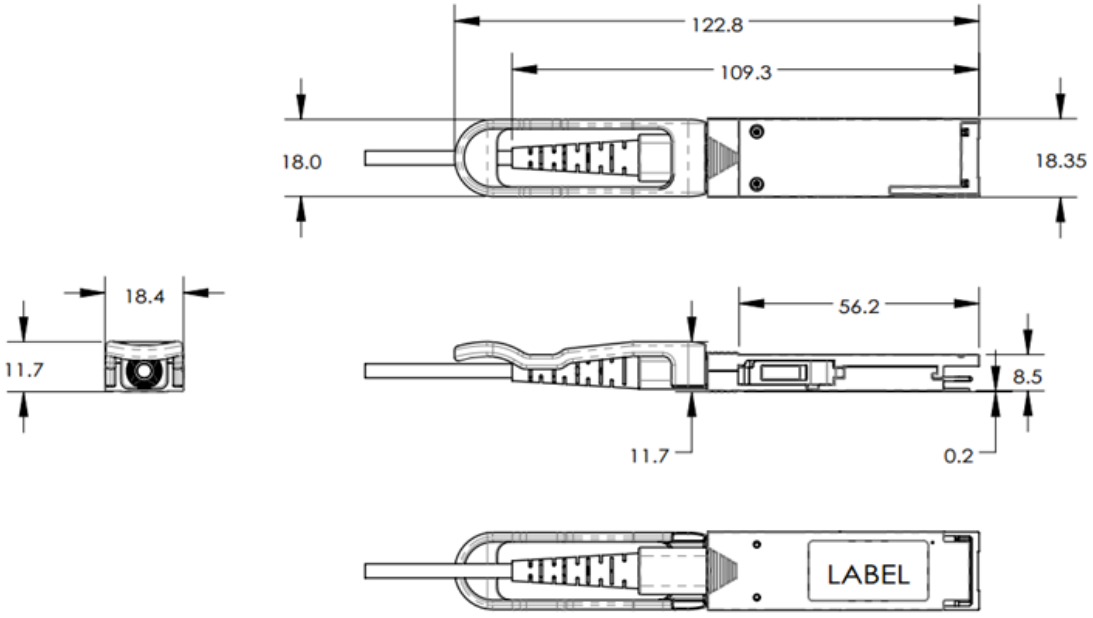

Figure 3 – Quadwire® mechanical drawing

Cable Mechanical Specifications	Min	Typical	Max	Units
Minimum bend radius	60			mm
Minimum bend radius within 100 mm of the Quadwire® module end	105			mm
Diameter	3.0	3.3	3.6	mm

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

Figure 4 – Quadwire® production-level product label

X. References

1. INF-8438i – Specification for QSFP (Quad Small Formfactor Pluggable) Transceiver, Rev 1.0, November 2006

2. SFF-8636 – Specification for QSFP+ Copper and Optical Transceiver, Rev 2.7, January, 2016

3. Application Note AN-2075: Quadwire® EEPROM Mapping, Rev E

XI. For More Information

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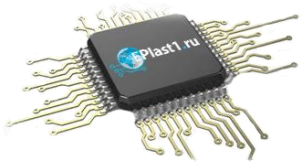

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