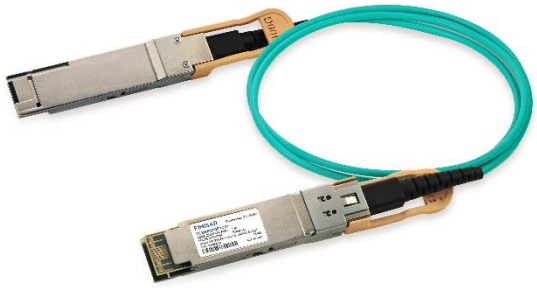
Product Specification

400G QSFP-DD Active Optical Cable
Finisar® Transceiver

FCBR850QE1Cyy
FCBN850QE1Cyy

PRODUCT FEATURES

- Hot-pluggable QSFP-DD Type 2 form factor
- Eight-channel parallel active optical cable
- Multirate capability: 50 Gb/s PAM4 or 25 Gb/s NRZ per channel
- 8x50G PAM4 retimed 400GAUI-8 electrical interface
- Reliable VCSEL array technology using multimode fiber
- Low power dissipation: <10W per cable end
- Single 3.3V power supply
- Commercial operating case temperature range: 0ºC to 70ºC
- RoHS-6 Compliant



APPLICATIONS

- 400G Ethernet

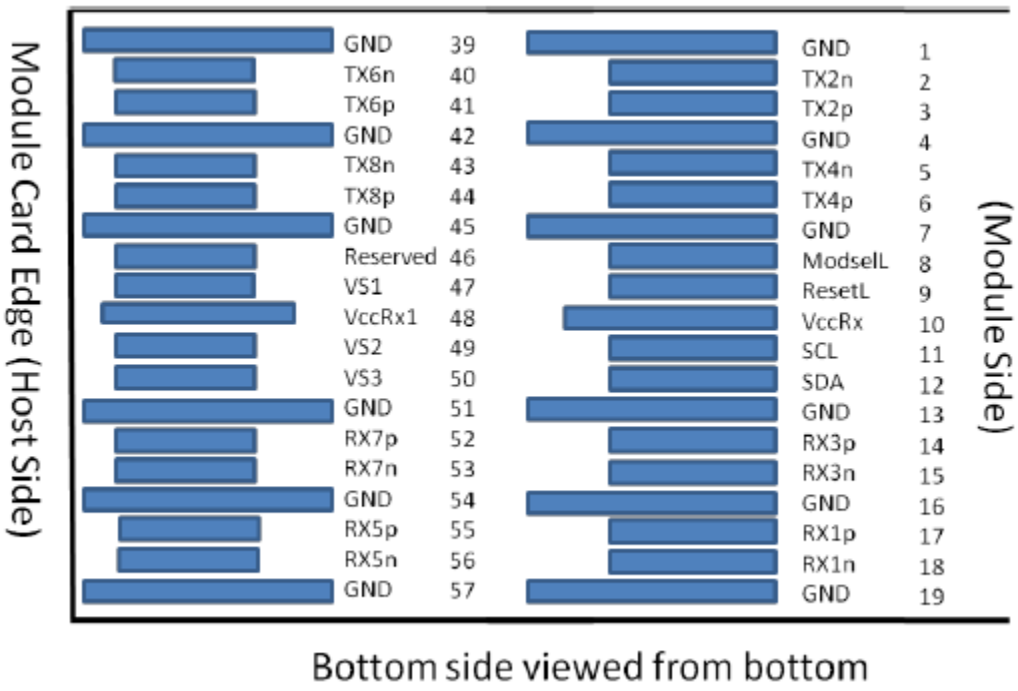
PRODUCT SELECTION (Standard Lengths*)

FCBx850QE1Cyy

x: N for OFNP cable; R for OFNR/LSZH cable
E: Ethernet datarate
C: Commercial temperature range
yy: cable length as listed below

FCBx850QE1C01	1-meter cable
FCBx850QE1C03	3-meter cable
FCBx850QE1C05	5-meter cable
FCBx850QE1C10	10-meter cable
FCBx850QE1C15	15-meter cable
FCBx850QE1C20	20-meter cable
FCBx850QE1C30	30-meter cable
FCBx850QE1C50	50-meter cable
FCBx850QE1C70	70-meter cable

I. Pin Descriptions



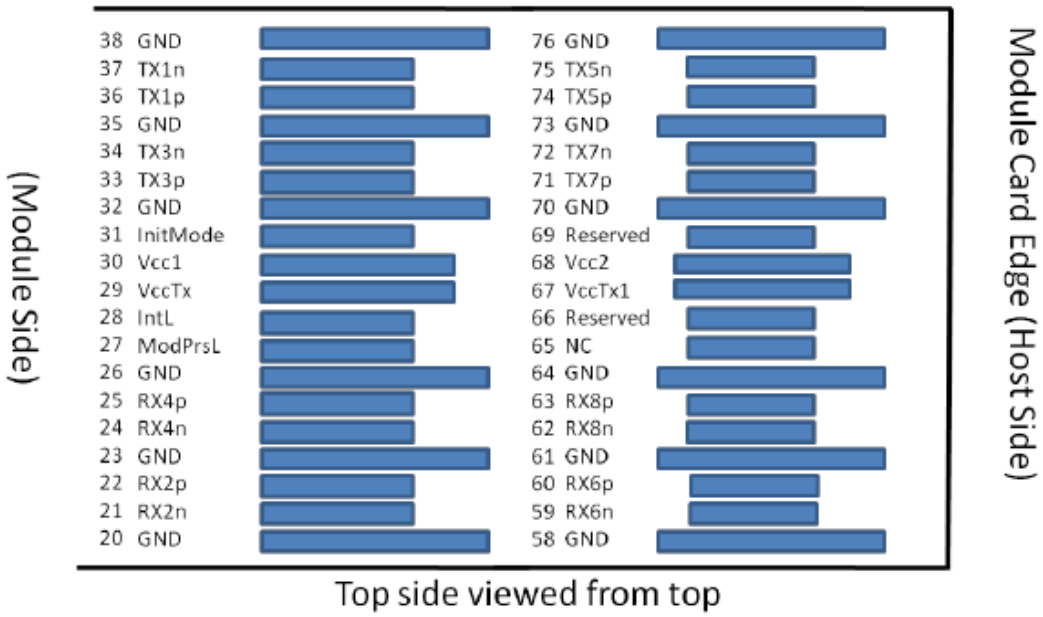


Figure 1 – QSFP-DD -compliant 76-pin connector (per QSFP-DD MSA)

Pad	Logic	Symbol	Description	Plug Sequence[4]	Notes
1		GND	Ground	1B	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3B	
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3B	
4		GND	Ground	1B	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3B	
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3B	
7		GND	Ground	1B	1
8	LVTTL-I	ModSelL	Module Select	3B	
9	LVTTL-I	ResetL	Module Reset	3B	
10		VccRx	+3.3V Power Supply Receiver	2B	2
11	LVCMOS-I/O	SCL	2-wire serial interface clock	3B	
12	LVCMOS-I/O	SDA	2-wire serial interface data	3B	
13		GND	Ground	1B	1
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3B	
15	CML-O	Rx3n	Receiver Inverted Data Output	3B	
16		GND	Ground	1B	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3B	
18	CML-O	Rx1n	Receiver Inverted Data Output	3B	
19		GND	Ground	1B	1
20		GND	Ground	1B	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3B	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3B	
23		GND	Ground	1B	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3B	
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3B	
26		GND	Ground	1B	1
27	LVTTL-O	ModPrsL	Module Present	3B	
28	LVTTL-O	IntL	Interrupt	3B	
29		VccTx	+3.3V Power supply transmitter	2B	2
30		Vcc1	+3.3V Power supply	2B	2
31	LVTTL-I	InitMode	Initialization mode; In legacy QSFP applications, the InitMode pad is called LPMODE	3B	
32		GND	Ground	1B	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3B	
34	CML-I	Tx3n	Transmitter Inverted Data Input	3B	
35		GND	Ground	1B	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3B	
37	CML-I	Tx1n	Transmitter Inverted Data Input	3B	
38		GND	Ground	1B	1
39		GND	Ground	1A	1
40	CML-I	Tx6n	Transmitter Inverted Data Input	3A	
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input	3A	
42		GND	Ground	1A	1
43	CML-I	Tx8n	Transmitter Inverted Data Input	3A	
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input	3A	
45		GND	Ground	1A	1
46		Reserved	For future use	3A	3
47		VS1	Module Vendor Specific 1	3A	3
48		VccRx1	3.3V Power Supply	2A	2
49		VS2	Module Vendor Specific 2	3A	3
50		VS3	Module Vendor Specific 3	3A	3
51		GND	Ground	1A	1
52	CML-O	Rx7p	Receiver Non-Inverted Data Output	3A	
53	CML-O	Rx7n	Receiver Inverted Data Output	3A	
54		GND	Ground	1A	1
55	CML-O	Rx5p	Receiver Non-Inverted Data Output	3A	

56	CML-O	Rx5n	Receiver Inverted Data Output	3A	
57		GND	Ground	1A	1
58		GND	Ground	1A	1
59	CML-O	Rx6n	Receiver Inverted Data Output	3A	
60	CML-O	Rx6p	Receiver Non-Inverted Data Output	3A	
61		GND	Ground	1A	1
62	CML-O	Rx8n	Receiver Inverted Data Output	3A	
63	CML-O	Rx8p	Receiver Non-Inverted Data Output	3A	
64		GND	Ground	1A	1
65		NC	No Connect	3A	3
66		Reserved	For future use	3A	3
67		VccTx1	3.3V Power Supply	2A	2
68		Vcc2	3.3V Power Supply	2A	2
69		Reserved	For Future Use	3A	3
70		GND	Ground	1A	1
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input	3A	
72	CML-I	Tx7n	Transmitter Inverted Data Input	3A	
73		GND	Ground	1A	1
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input	3A	
75	CML-I	Tx5n	Transmitter Inverted Data Input	3A	
76		GND	Ground	1A	1
Note 1: QSFP-DD uses common ground (GND)for all signals and supply (power). All are common within the QSFP-DD module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.					
Note 2: VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 shall be applied concurrently. Requirements defined for the host side of the Host Card Edge Connector are listed in Table 4. VccRx, VccRx1, Vcc1, Vcc2, VccTx and VccTx1 may be internally connected within the module in any combination. The connector Vcc pins are each rated for a maximum current of 1000 mA.					
Note 3: All Vendor Specific, Reserved and No Connect pins may be terminated with 50 ohms to ground on the host. Pad 65 (No Connect) shall be left unconnected within the module. Vendor specific and Reserved pads shall have an impedance to GND that is greater than 10 kOhms and less than 100 pF.					
Note 4: Plug Sequence specifies the mating sequence of the host connector and module. The sequence is 1A, 2A, 3A, 1B, 2B, 3B. (see Figure 2 for pad locations) Contact sequence A will make, then break contact with additional QSFP-DD pads. Sequence 1A, 1B will then occur simultaneously, followed by 2A, 2B, followed by 3A, 3B.					

II. Absolute Maximum Ratings

Module performance is not guaranteed beyond the operating range (see Section V). Exceeding the limits below may damage the transceiver module permanently.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	Vcc	-0.5		4.0	V	
Storage Temperature	T_S	-40		+85	°C	1
Case Operating Temperature	T_{OP}	0		+70	°C	
Relative Humidity	RH	15		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.

III. Electrical Characteristics (EOL, T_{OP} = 0 to +70 °C, V_{CC} = 3.135 to 3.465 Volts)

NOTE: The Active Optical Cable requires an electrical connector compliant with the QSFP-DD MSA 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	Vcc	3.135	3.3	3.465	V	
Supply Current	Icc			3.19	A	
Module total power	P			10	W	1
Transmitter						
Signaling rate per lane		26.5625± 100 ppm.			Gbd	
Differential data input voltage per lane	Vin,pp,diff	900			mV	2
Differential input return loss		Per equation (83E–5) IEEE802.3bm			dB	
Differential to common mode input return loss		Per equation (83E–6) IEEE802.3bm			dB	
Differential termination mismatch				10	%	
Module stress input test		Per 120E.3.4.1 IEEE802.3bs				3
Single-ended voltage tolerance range		-0.4		3.3	V	
DC common mode voltage		-350		2850	mV	4
Receiver						
Signaling rate per lane		26.5625± 100 ppm.			Gbd	
AC common-mode output voltage (RMS)				17.5	mV	
Differential output voltage				900	mV	
Near-end ESMW (Eye symmetry mask width)		0.265			UI	
Near-end Eye height, differential (min)		70			mV	
Far-end ESMW (Eye symmetry mask width)		0.2			UI	
Far-end Eye height, differential (min)		30			mV	
Far-end pre-cursor ISI ratio		-4.5		2.5	%	
Differential output return loss		Per equation 83E-2 IEEE802.3bm				
Common to differential mode conversion return loss		Per equation 83E-3 IEEE802.3bm				
Differential termination mismatch				10	%	
Transition time (min, 20% to 80%)		9.5			ps	
DC common mode voltage (min)		-350		2850	mV	4

Notes:

1. Maximum total power value is specified across the full temperature and voltage range.
2. With the exception to 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
3. Meets specified BER
4. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

IV. General Specifications

Parameter	Value	Unit	Notes
Module Form Factor	QSFP-DD		As defined by QSFP-DD
Number of Lanes	8 Tx and 8 Rx		
Maximum Aggregate Data Rate	425	Gb/s	
Maximum Data Rate per Lane	26.5625 ± 100 ppm	GBd	
Standard Cable Lengths	1, 3, 5, 10, 15, 20, 30, 50, 70	meters	Other lengths may be available upon request
Protocols supported	200/400G Ethernet		
Electrical Interface and Pin-out	76-pin edge connector		Pin-out as defined by QSFP-DD
Standard Optical Cable Type	Multimode round fiber cable, OM3/OM4		Two options available: OFNR and Low Smoke Zero Halogen (LSZH), or OFNP
Maximum Power Consumption per End	10 (retimed Tx)	Watts	Maximum total power value is specified across the full temperature and voltage range
Management Interface	Serial, I2C-based, 1 MHz maximum frequency		As defined in CMIS 4.0

Data Rate Specifications	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate per Lane	BR	26.5625 ± 100 ppm			GBd	1
Pre-FEC Bit Error Ratio	BER			2.4^{-4}		2

Notes:
1. Supports Ethernet
2. Tested with a PRBS 2^{31}-1 test pattern.

V. Environmental Specifications

Finisar® FCBx850QE1Cyy QSFP-DD Active Optical Cables have an operating case temperature range of 0°C to +70°C.

Parameter	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.

VI. Regulatory Compliance

The Finisar® FCBx850QE1Cyy QSFP-DD Active Optical Cables are RoHS-6 compliant. Copies of certificates are available from II-VI Incorporated upon request.

Finisar® FCBx850QE1Cyy QSFP-DD Active Optical Cables are Class 1M Laser Products. They are certified per the following standards:

Feature	Agency	Standard
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50
Laser Eye Safety	TÜV	EN 60825-1: 2007 IEC 60825-2: 2004+A1+A2

Electrical Safety	TÜV	EN 60950
Electrical Safety	UL/CSA	CLASS 3862.07 CLASS 3862.87

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

Either round-section construction LSZH, riser-rated or round-section construction, plennum-rated cable is alternative for Finisar® FCBx850QE1Cyy QSFP-DD Active Optical Cables.

VII. Memory Map

Compatible with QSFP-DD CMIS rev 4.0.

VIII. Mechanical Specifications

Finisar® FCBx850QE1Cyy QSFP-DD Active Optical Cables are compatible with the QSFP-DD Type 2 Specification for pluggable form factor modules.

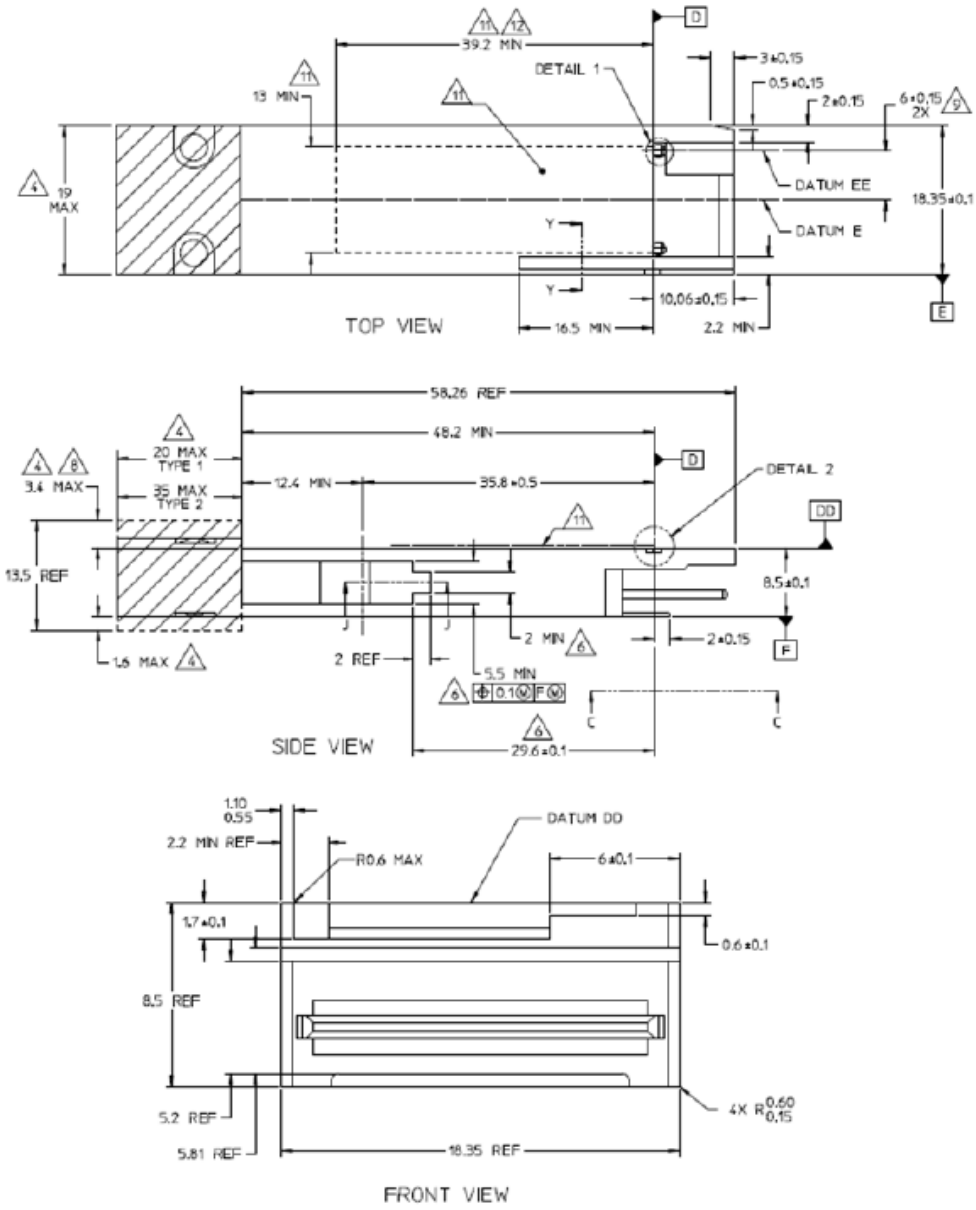


Figure 2. Module Mechanical Dimensions

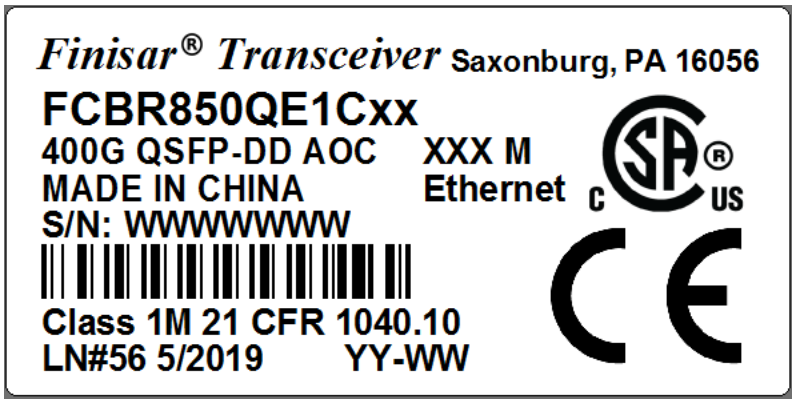


Figure 3. Product Label

IX. References

1. QSFP-DD Hardware Specification for QSFP DOUBLE DENSITY 8X PLUGGABLE TRANSCEIVER Rev 5.0

2. SFF-8665: "QSFP+ 28Gb/s 4X Pluggable Transceiver Solution (QSFP28)", Rev 1.9, June 29, 2015 and associated SFF documents referenced therein:
    i. SFF-8661
    ii. SFF-8679
    iii. SFF-8662
    iv. SFF-8663
    v. SFF-8672

3. 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" as well as Commission Delegated Directive (EU) 2015/863 amending Annex II to Directive 2011/65/EU. Certain products may use one or more exemptions as allowed by the Directive.

4. Application Note AN-2038: "II-VI Implementation of RoHS Compliant Transceivers".

5. Common Management Interface Specification (CMIS) Rev 4.0.

6. IEEE P802.3bs, 400GAUI-8 Interface.

X. For More Information

II-VI Incorporated
375 Saxonburg Boulevard
Saxonburg, PA 16056
photonics.sales@ii-vi.com
www.ii-vi.com