

Product Specification

400G QSFP-DD/QSFP Breakout Active Optical Cable

FCBN950QE2Cxx

PRODUCT FEATURES

- 400G QSFP-DD breaking out to 2x 200G QSFP56
- 16-fiber Y-shape active optical cable
- Datarate: 50 Gb/s PAM4 per lane
- Reliable VCSEL array technology using multimode fiber
- Round plenum-rated cable
- Hot Pluggable
- Low power dissipation: <8W in QSFP-DD end; <4.5W in QSFP end
- Commercial operating case temperature range: 0°C to 70°C
- RoHS-6 Compliant



APPLICATIONS

- 400G/200G Ethernet

PRODUCT SELECTION (Standard Lengths*)

FCBN950QE2Cxx

N: Plenum rated cable. R for LSZH cable as the option.
E: Ethernet datarate
C: Commercial temperature range
xx: cable length like 01,02,03..... (Unit :meters)

xx	Length (meter)	xx	Length (meter)	xx	Length (meter)	xx	Length (meter)	xx	Length (meter)	xx	Length (meter)
1	1	8	8	15	15	22	22	29	29	40	40
2	2	9	9	16	16	23	23	30	30	50	50
3	3	10	10	17	17	24	24	P5	0.5	60	60
4	4	11	11	18	18	25	25	A5	1.5	70	70
5	5	12	12	19	19	26	26	B5	2.5	80	80
6	6	13	13	20	20	27	27	C5	3.5	90	90
7	7	14	14	21	21	28	28	35	35	x0	100

*For availability of additional cable lengths or Y location, please contact Coherent

I. 400G QSFP-DD Pin Descriptions

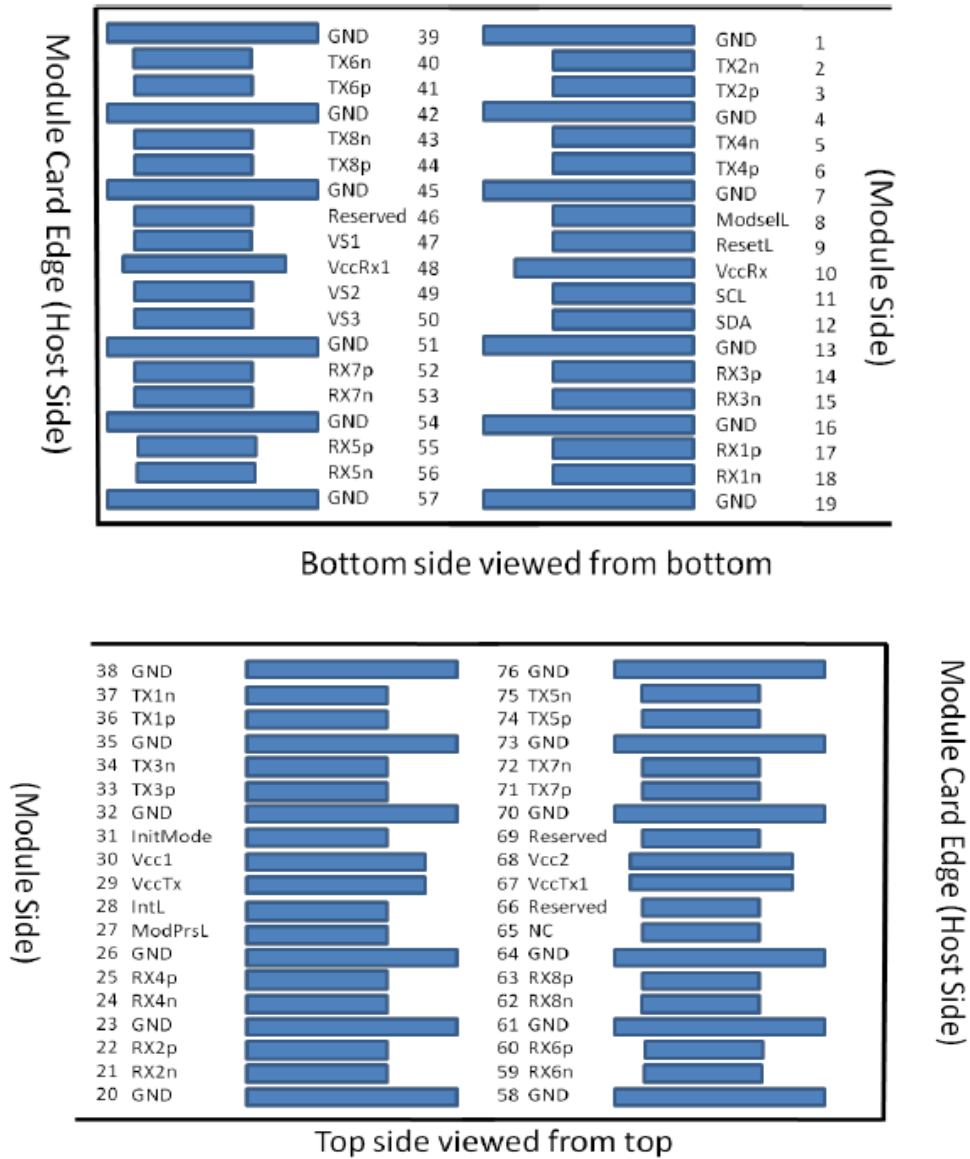


Figure 1 – QSFP-DD -compliant 76-pin connector (per QSFP-DD MSA)

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	LVCNOS-I/O	SCL	2-wire serial interface clock	3B	
12	LVCNOS-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. 200G QSFP56 Pin Descriptions

QSFP56 pin-out as being defined by QSFP MSA¹.

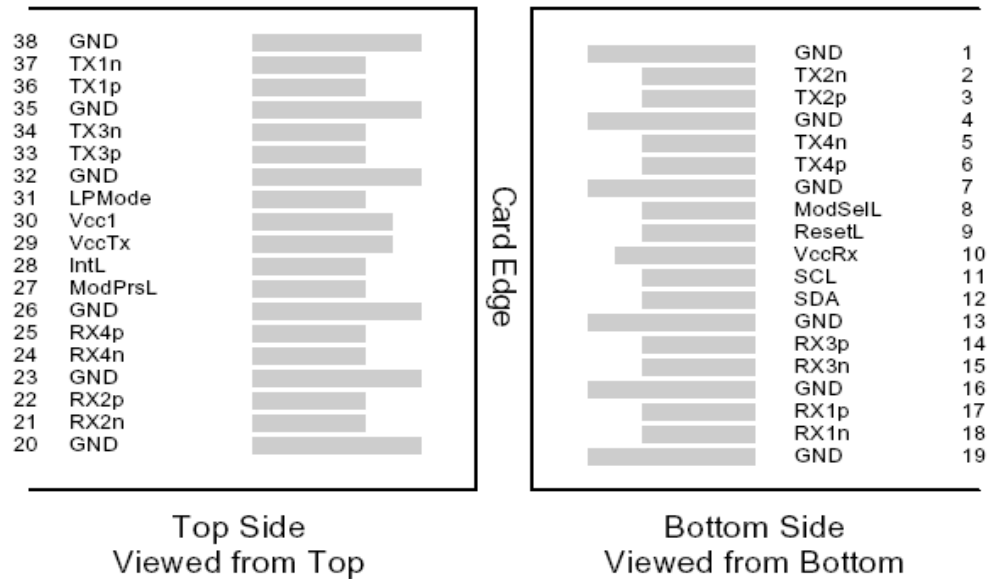


Figure 2 – QSFP-compliant 38-pin connector (per SFF-8679)

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.

III. General Product Characteristics

Parameter	Value	Unit	Notes
Module Form Factor	QSFP-DD/QSFP56		As defined by QSFP-DD/QSFP MSA
Number of Lanes	8 Tx and 8 Rx		8 lanes QSFP-DD at one of cable, breaking out to 2x 4 lane QSFP56's
Maximum Aggregate Data Rate	425	Gb/s	
Maximum Data Rate per Lane	26.5625 ± 100 ppm	GBd	
Standard Cable Lengths	5,10,15,20,25,30	meters	Other lengths may be available upon request
Protocols Supported	200G & 400G Ethernet		
Electrical Interface and Pin-out	QSFP-DD 76-pin edge and QSFP56 38-pin edge connectors		Pin-out as defined by QSFP/QSFP-DD MSA
Standard Optical Cable Type	Multimode round fiber cable, plenum-rated		OFNP round fiber cable as default. OFNR Low Smoke Zero Halogen (LSZH) also available
Maximum Power Consumption per End	QSFP-DD 8 QSFP56 4.5	Watts	Maximum total power value is specified across the full temperature and voltage range
Management Interface	Serial, I2C-based, 1MHz maximum frequency		As defined by CMIS 4.0

Data Rate Specifications	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate per Lane	BR	26.5625 ± 100 ppm			GBd	1
Bit Error Ratio	BER			2.4 ⁻⁴		2

Notes:

1. Supports InfiniBand 200/400G Ethernet.
2. Tested with a PRBS 2³¹-1 test pattern.

IV. 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 >74 mm on the rest of the cable.
2. Non-condensing.

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

NOTE: The Active Optical Cable requires an electrical connector compliant with QSFP-DD/QSFP 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	V _{cc1} , V _{ccTx} , V _{ccRx}	3.15		3.45	V	
Supply Current per cable end (QSFP-DD)	I _{cc}			2.54	A	
Supply Current per cable end (QSFP56)	I _{cc}			1.43	A	
Power Dissipation per cable end (QSFP-DD)	P			8	W	1
Power Dissipation per cable end (QSFP56)	P			4.5	W	1

Notes:

1. Maximum total power value is specified across the full temperature and voltage range.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Transmitter QSFP-DD end						
Signaling rate per lane		26.5625± 100 ppm.			Gbd	
Differential data input voltage per lane	V _{in,pp,diff}	900			mV	1
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				2
Single-ended voltage tolerance range		-0.4		3.3	V	
DC common mode voltage		-350		2850	mV	3
Receiver QSFP-DD end						
Signaling rate per lane		26.5625± 100 ppm.			Gbd	
AC common-mode output voltage (RMS)				17.5	mV	
Differential peak-to-peak 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	3

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Transmitter QSFP56 end						
Signaling rate per lane		26.5625± 100 ppm.			GBd	
Differential peak-peak input voltage tolerance	V _{in,pp,diff}	900			mV	1
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				2
Single-ended voltage tolerance range		-0.4		3.3	V	
DC common mode voltage		-350		2850	mV	3
Receiver QSFP56 end						
Signaling rate per lane		26.5625± 100 ppm.			Gbd	
AC common-mode output voltage (RMS)				17.5	mV	
Differential peak-to-peak 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		-350		2850	mV	3

Notes:

1. With the exception to 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
2. Meets specified BER
3. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

VI. Memory Map and Control Registers

The management interface and EEPROM on the QSFP-DD end is based on CMIS rev 4.0. The management interface and EEPROM on the QSFP56 end is based on SFF8636 by default, while we could also support the CMIS 4.0 based Memory Map based on customization.

VII. Environmental Specifications

Coherent 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}	-10		70	°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

Coherent FCBx950 Active Optical Cables are RoHS-6 Compliant. Copies of certificates to be available at Coherent upon request.

Coherent FCBx950 Active Optical Cables are Class 1 laser eye safety compliant per IEC 60825-1.

Feature	Agency	Standard
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040.10 and Laser Notice 56
Laser Eye Safety	UL/CSA/TÜV	IEC/EN 60825-1:2014 IEC/EN 60825-2: 2004+A1+A2
Electrical Safety	UL/CSA/TÜV	IEC/UL/EN 62368-1:2014

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

Standard fiber cable type is round-section construction OFNP, plenum-rated. Other cable types can be supported upon request such as round-section construction, riser-rated and low-smoke zero halogen.

IX. Mechanical Specifications

The mechanical specifications are compliant with the QSFP-DD and QSFP transceiver module specifications (as defined in SFF-8661 & QSFP-DD MSA). The fiber optics cable is with 16 fibers inside, which breakouts into two 8-fiber cables connecting to each QSFP56 module.

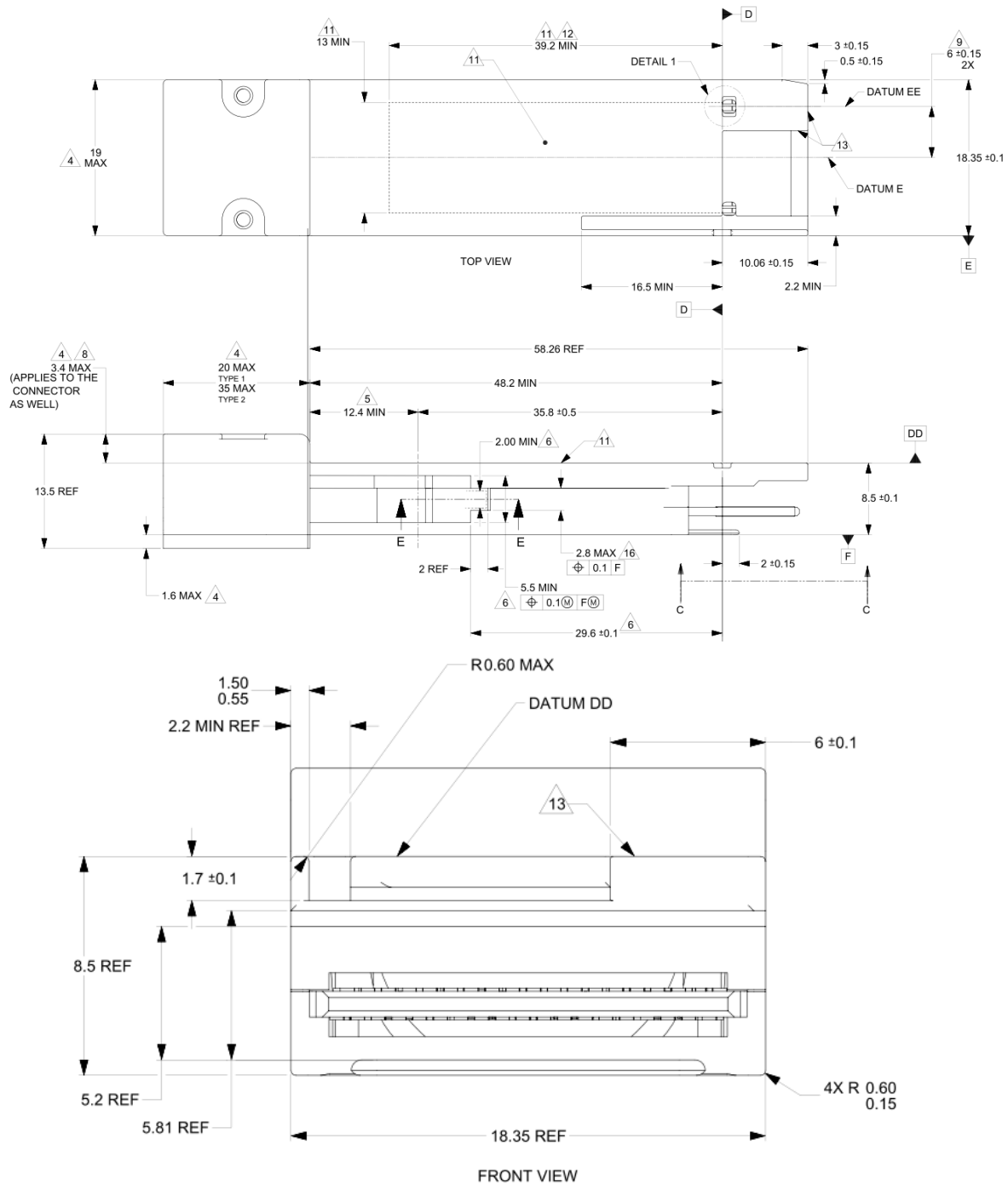
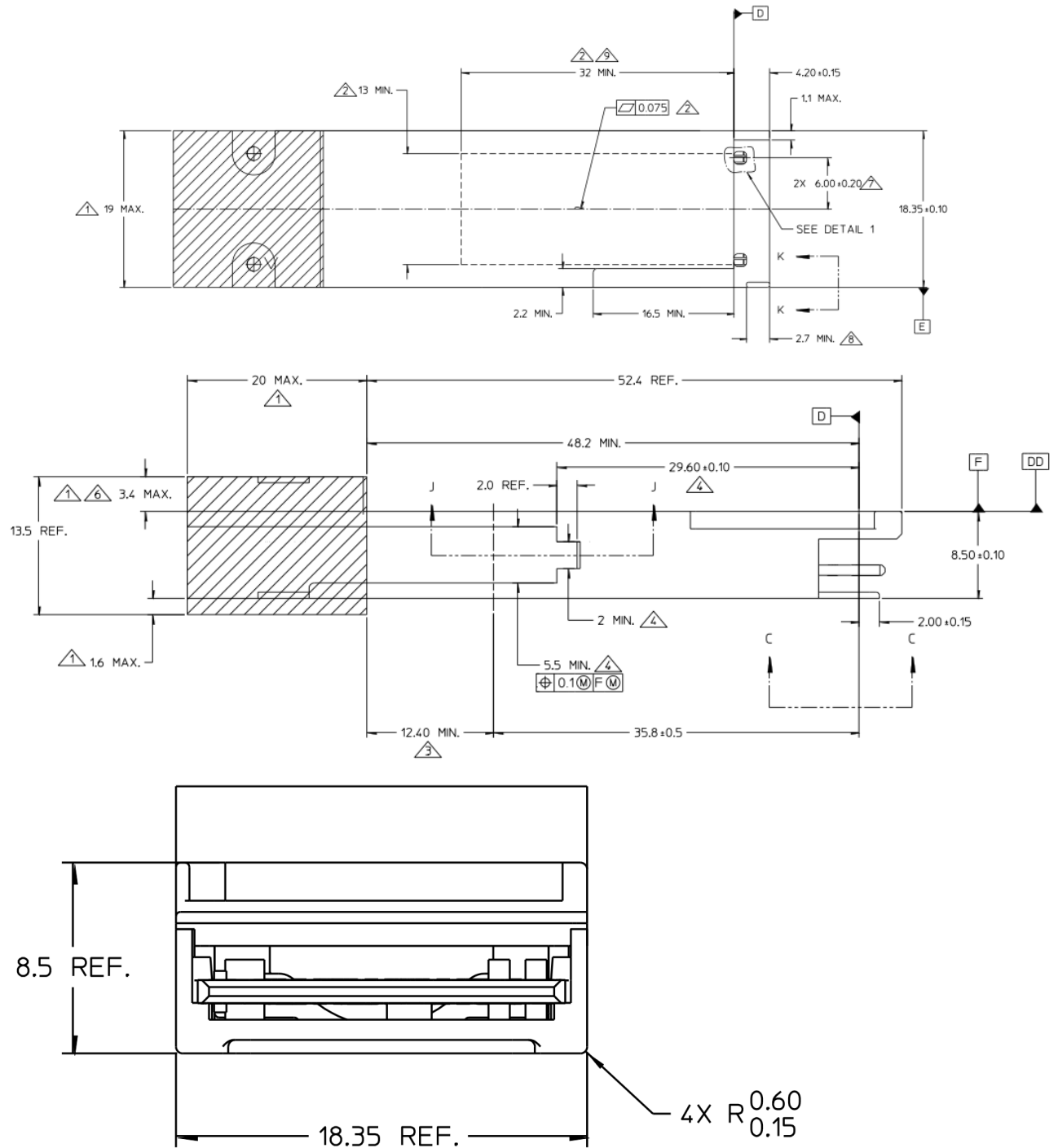


Figure 3 –QSFP-DD mechanical drawing



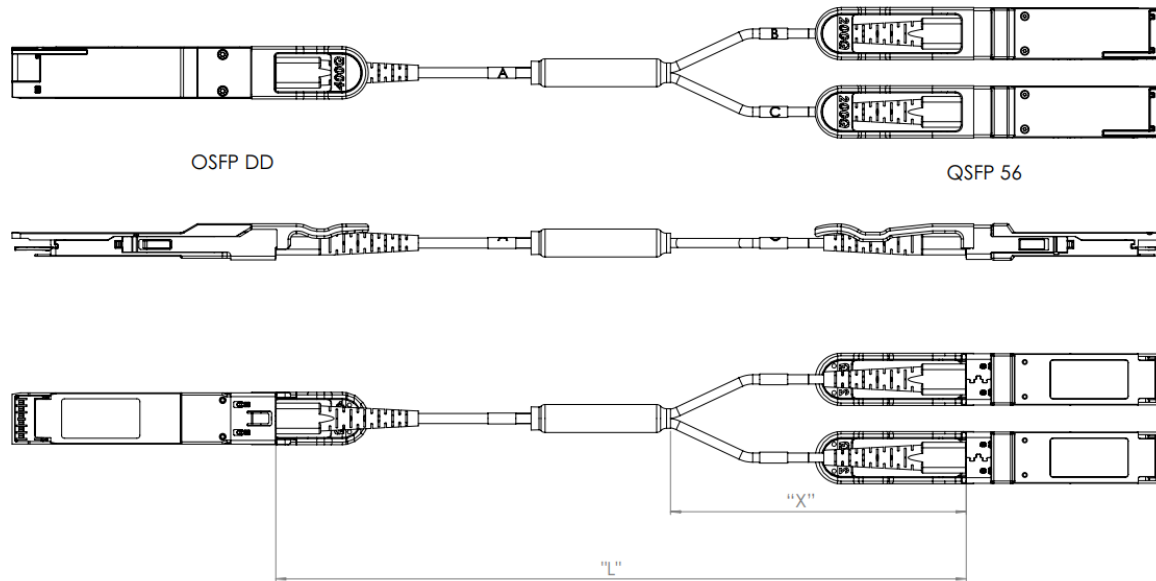


Figure 5 –The location of the Y split

"L" (M)	"X" (M)
4.0 +0.30/-0	2.67 +/-0.10
5.0 +0.30/-0	3.0 +/-0.10
6.0 +0.30/-0	3.0 +/-0.10
7.0 +0.30/-0	3.0 +/-0.10
8.0 +4%/-0	3.0 +/-0.10
10.0 +4%/-0	3.0 +/-0.10

Standard lengths*

*For availability of additional cable lengths or Y location, please contact Coherent

X. References

1. QSFP-DD Specification for QSFP DOUBLE DENSITY 8X PLUGGABLE TRANSCEIVER
2. SFF-8665 – QSFP+ 28Gb/s 4X Pluggable Transceiver Solution (QSFP28), Rev 1.8, May, 2013.
3. “400GAUI-8” Retimed 8x50G electrical interface, defined by IEEE 802.3bs
4. CEI-56G-VSR-PAM4 Implementation Agreement
5. 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.
6. QSFP-DD CMIS rev 4.0
7. IEEE P802.3bs, 200GAUI-4 and 400GAUI-8 Interface.

XI. For More Information

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