



400G QSFP56-DD SR4.2 BiDi Transceiver Hot Pluggable, BiDi MPO-12, 850 / 908nm VCSEL, MMF 150M, DDM

Part Number: FQDD-T9-C85-X1D



Overview

FQDD-T9-C85-X1D is a parallel fiber QSFP-DD(Double-Density) Bi-direction optical transceiver with MPO-12 connector for short-reach 400G data communication and interconnect applications using multi-mode fiber. The transceiver receives 8x50G Host electrical data and converts that into two groups of transmitting optical signal (4x50G 850nm and 4x50 908nm) into 8 Bi-Direction lanes. Reversely converting 8x50G receiving signals (4x50G 850nm and 4x50 908nm) from the 8 Bi-Direction lanes to 8x50G electrical data, it achieves an aggregated data rate of 400G up to MMF OM5 150m optical link.

Applications

- 400GBASE-SR4.2 Ethernet @425G
- Breakout connection to 4xSR1.2
- Infiniband HDR, EDR
- Data Centers Switch Interconnect
- Server and Storage Area Network Interconnect

Features

- Compliant with IEEE 802.3cm 400GBASE-SR4.2
- Compliant with QSFP-DD MSA
- Compliant with IEEE 802.3bs 400GAUI-8 Interface
- Dual wavelength 850/908nm VCSEL Bi-Directional optical lanes
- Optical Data Rate PAM4 2x26.5625GBd each lane
- Electrical Data Rate NRZ 8x53.125Gbps
- Built in quad Tx CDR and Rx CDR
- Support KP4 FEC at 400Gbps
- Hot Pluggable QSFP-DD 76-pin footprint
- Bidi MPO-12 connector
- 2-wire interface for management and diagnostic monitor compliant with CMIS
- Single 3.3V power supply
- Link distance 150m over OM5 fiber, 100m over OM4 fiber and 70m over MM OM3 fiber
- Operating Temperature 0~+70°C
- Maximum power consumption 12W
- RoHS compliant



Laser Safety

- This is a Class 1 Laser Product complies with 21 CFR 1040.10 and 1040.11 except for conformance with IEC 60825-1 Ed. 3., as described in Laser Notice No. 56, dated May 8, 2019.
- Caution: Use of control or adjustments or performance of procedure other than those specified herein may result in hazardous radiation exposure.

Absolute Maximum Ratings

Parameters	Symbol	Min.	Max.	Unit
Storage Temperature	T _{ST}	-40	+85	°C
Storage Relative Humidity	RH	0	85	%
Supply Voltage	V _{CC3}	-0.5	+3.6	V

Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Unit
Case Operating Temperature	T _{OP}	0	-	+70	°C
Supply Voltage	V _{CC}	+3.13	+3.3	+3.47	V
Data Rate, per Lane	DR		26.5625		GBd
Data Rate Accuracy	ΔDR	-100		+100	ppm
Bit Error Rate (NO FEC)	BER			2.4x10 ⁻⁴	
Bit Error Rate (with FEC)	BER			1x10 ⁻¹²	
Supply Current	I _{CC}			3630	mA
Power Consumption	P			12	W
Transceiver Power-on Initialization Time				2000	ms
Control Input Voltage High	V _{IH}	2.0		V _{CC}	V
Control Input Voltage Low	V _{IL}	GND		0.8	V
Control Output Voltage High	V _{OH}	2.0		V _{CC}	V
Control Output Voltage Low	V _{OL}	GND		0.8	V



Transmitter Electro-optical Characteristics

$V_{CC} = 3.13V$ to $3.47V$, $T_{OP} = 0\text{ }^{\circ}C$ to $70\text{ }^{\circ}C$

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Electrical Data Rate, per Lane (TP1)	D _{REL}		53.125		Gb/s	PAM4
Optical Data Rate, per Lane	D _{ROP}		26.5625		GBd	
Optical Wavelength, λ_1	λ_1	844	850	863	nm	1
Optical Wavelength, λ_2	λ_2	900	908	918	nm	1
Spectral Width (RMS)	$\Delta\lambda$			$\lambda_1: 0.6$ $\lambda_2: 0.65$	nm	1
Average Launch Power, per Lane	P _{AVG}	-6.5		+4	dBm	
Optical Modulation Amplitude (OMA), per Lane	P _{OMA}	-4.5		+3	dBm	2
Launch Power in OMA minus Transmitter and Dispersion Penalty (TDP), per Lane	OMA-TDP	-5.9			dBm	
TDECQ, per Lane				4.5	dB	
Optical Extinction Ratio	ER	3			dB	
RIN12 OMA	RIN _{OMA}			-128	dB/Hz	
Average Launch Power OFF, per Channel	P _{OFF}			-30	dBm	
Optical Return Loss Tolerance	ORLT			-12	dB	
Encircled Flux			$\geq 86\%$ at 19 μ m $\leq 30\%$ at 4.5 μ m			3
Differential Data Input Voltage (TP1a)	V _{IN-PP}	900			mVpp	4
Differential Termination Mismatch (TP1)				10	%	
Single-ended Voltage Tolerance Range (Min) (TP1a)		-0.4		3.3	V	
DC Common Mode Input Voltage (TP1)	CMV _{IN}	-350		2850	mA	5

Note1: Transmitter wavelength, RMS spectral width and launch power need to meet the OMA minus TDP specs to guarantee link performance.

Note2: Even if the TDECQ < 1.4 dB, the OMA_{outer} (min) must exceed this value.

Note3: If measured into type A1a.2, or type A1a.3, or type A1a.4, 50 μ m fibers in accordance with IEC 61280-1-4.

Note4: With the exception to IEEE 802.3bs 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.

Note5: DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.



Receiver Electro-optical Characteristics

$V_{CC} = 3.13V$ to $3.47V$, $T_{OP} = 0\text{ }^{\circ}C$ to $70\text{ }^{\circ}C$

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Optical Data Rate, per Lane (TP4)	DR _{OP}		26.5625		GBd	
Electrical Data Rate, per Lane	DRE _L		53.125		Gb/s	PAM4
Optical Wavelength, λ_1	λ_1	844	850	863	nm	
Optical Wavelength, λ_2	λ_2	900	908	918	nm	
Damage Threshold, per Lane	D _{TH}	+5				1
Average Receive Power, per Lane	PR _{X-AVG}	-8.5		+4	dBm	2
Receive Power (OMA), per Lane	PR _{X-OMA}			+3	dBm	
Receiver Sensitivity (OMA), per Lane	SEN _{OMA}	Max (-6.6, SECQ-8)			dBm	3
Stressed Receiver Sensitivity (OMA), per Lane	SRS _{OMA}			-3.5		4
Receiver Reflectance	R _{RX}			-12	dB	
Differential Data Output Voltage (TP4)	V _{OUT-PP}			900	mVpp	
AC Common Mode Output Voltage, RMS (TP4)				17.5	mA	
Differential Termination Mismatch (TP4)				10	%	
Transition Time, 20% to 80% (TP4)		9.5			ps	
Near-end Eye Symmetry Mask Width (ESMW) (TP4)			0.265		UI	
Near-end Eye Height, Differential (TP4)		70			mV	
Far-end Eye Symmetry Mask Width (ESMW) (TP4)			0.2		UI	
Far end Eye Height, Differential (TP4)		30			mV	
Far-end Pre-cursor ISI Ratio (TP4)		-4.5		2.5	%	
DC Common Mode Output Voltage (TP4)	CMV _{OUT}	-350		2850	mV	5

Note1: The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power.

Note2: Average receive power, each lane (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance.

Note3: Receiver sensitivity is considered a normative requirement. RX sensitivity is defined for a transmitter with a value of SECQ up to 4.5dB.

Note4: Measured with a conformance test signal at TP3 (see IEEE 802.3 Cl 150) for the BER specified. They are not characteristics of the receiver. The conditions for measuring stressed receiver sensitivity are

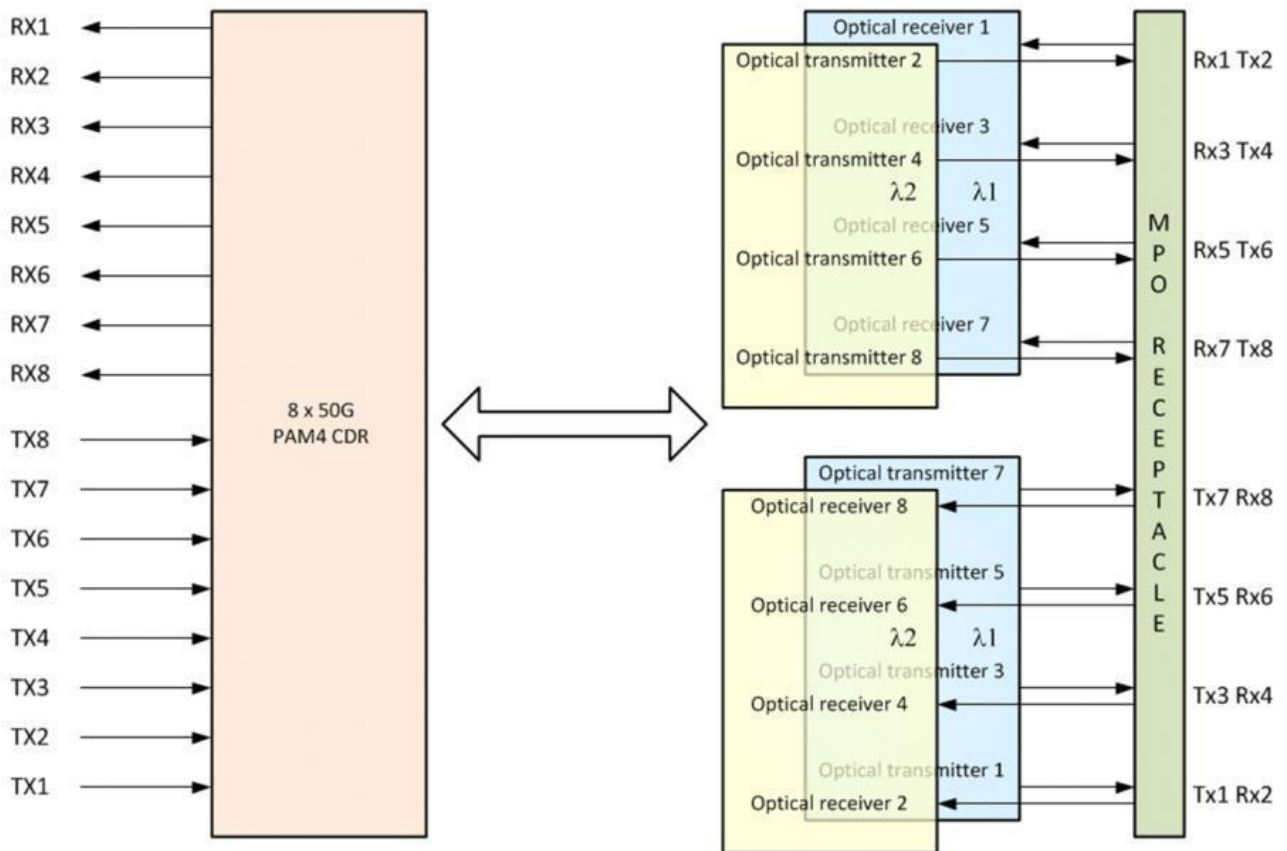


the following.

Stressed eye closure (SECQ), lane under test	4.5dB
SECQ – 10log10(Ceq) lane under test	4.5dBm
OMAouter of each aggressor lane	3.0dBm

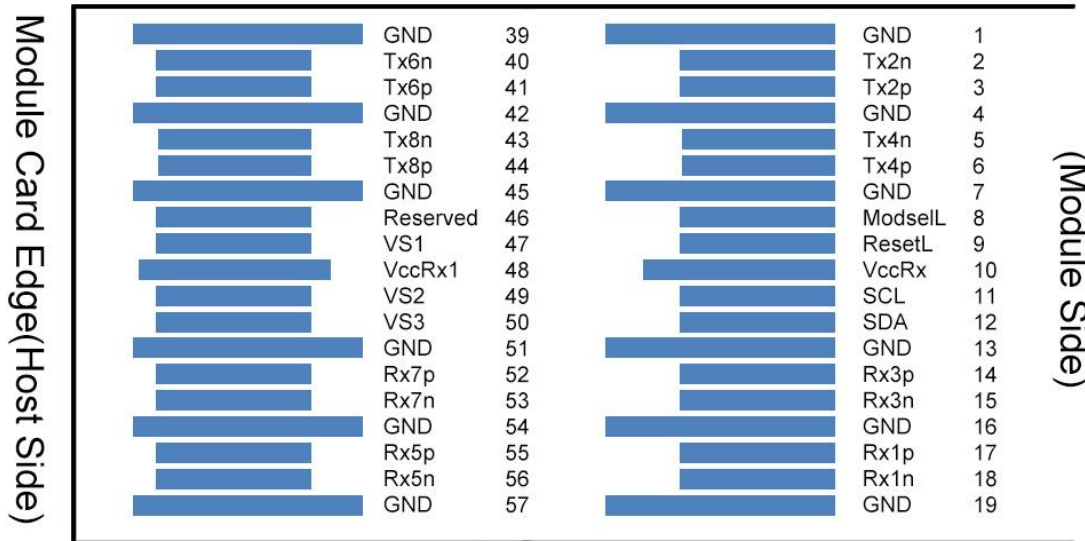
Note5: DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

Transceiver Block Diagram





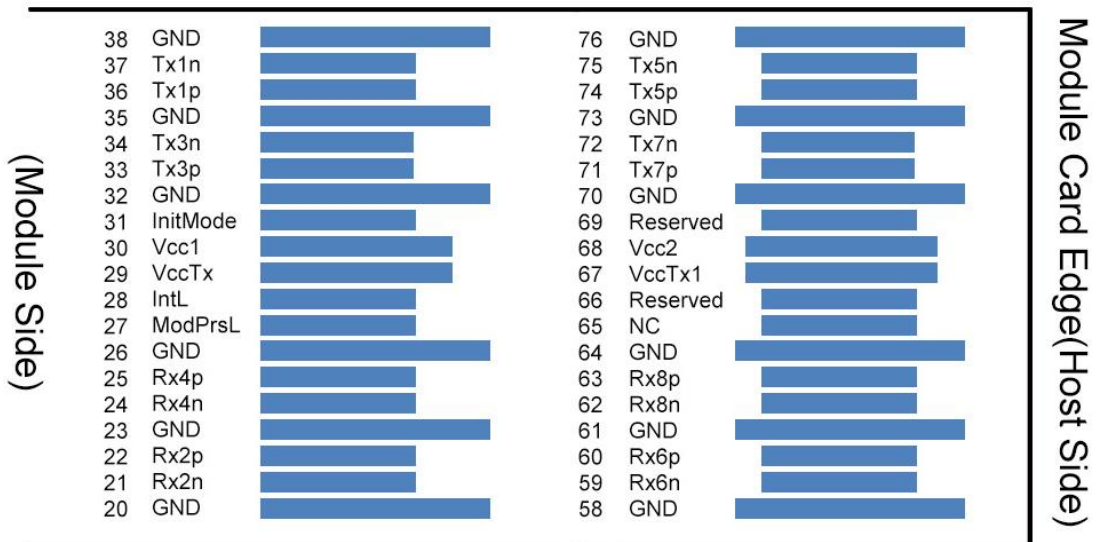
Pin Assignment



Bottom Side Viewed From Bottom

Additional
 QSFP-DD Pads

Legacy QSFP28
 Pads



Top Side Viewed From Top

Legacy QSFP28
 Pads

Additional
 QSFP-DD Pads



Pin Description

Pin	Logic	Name	Function / Description
1		GND	Module Ground
2	CML-I	Tx2n	Transmitter Inverted Data Input
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input
4		GND	Module Ground
5	CML-I	Tx4n	Transmitter Inverted Data Input
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input
7		GND	Module Ground
8	LVTLL-I	ModSelL	Module Select
9	LVTLL-I	ResetL	Module Reset
10		VccRx	+3.3V Power Supply Receiver
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data
13		GND	Module Ground
14	CML-O	Rx3p	Receiver Non-Inverted Data Output
15	CML-O	Rx3n	Receiver Inverted Data Output
16		GND	Module Ground
17	CML-O	Rx1p	Receiver Non-Inverted Data Output
18	CML-O	Rx1n	Receiver Inverted Data Output
19		GND	Module Ground
20		GND	Module Ground
21	CML-O	Rx2n	Receiver Inverted Data Output
22	CML-O	Rx2p	Receiver Non-Inverted Data Output
23		GND	Module Ground
24	CML-O	Rx4n	Receiver Inverted Data Output
25	CML-O	Rx4p	Receiver Non-Inverted Data Output
26		GND	Module Ground
27	LVTLL-O	ModPrsL	Module Present
28	LVTLL-O	IntL	Interrupt
29		VccTx	+3.3V Power Supply Transmitter
30		Vcc1	+3.3V Power Supply
31	LVTLL-I	InitMode	Initialization mode
32		GND	Module Ground

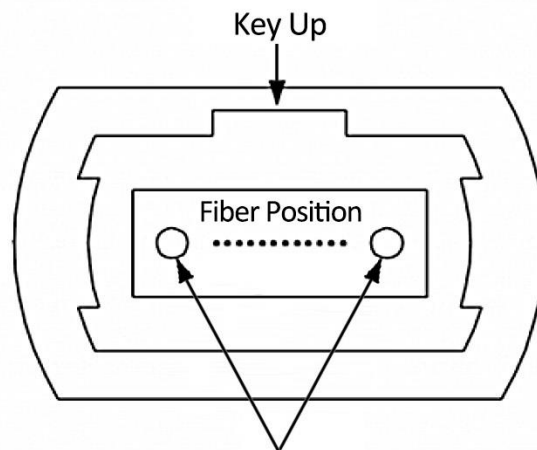


33	CML-I	Tx3p	Transmitter Non-Inverted Data Input
34	CML-I	Tx3n	Transmitter Inverted Data Input
35		GND	Module Ground
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input
37	CML-I	Tx1n	Transmitter Inverted Data Input
38		GND	Module Ground
39		GND	Module Ground
40	CML-I	Tx6n	Transmitter Inverted Data Input
41	CML-I	Tx6p	Transmitter Non-Inverted Data Input
42		GND	Module Ground
43	CML-I	Tx8n	Transmitter Inverted Data Input
44	CML-I	Tx8p	Transmitter Non-Inverted Data Input
45		GND	Module Ground
46		Reserved	For Future Use
47		VS1	Module Vendor Specific 1
48		VccRx1	+3.3V Power Supply Receiver
49		VS2	Module Vendor Specific 2
50		VS3	Module Vendor Specific 3
51		GND	Module Ground
52	CML-O	Rx7p	Receiver Non-Inverted Data Output
53	CML-O	Rx7n	Receiver Inverted Data Output
54		GND	Module Ground
55	CML-O	Rx5p	Receiver Non-Inverted Data Output
56	CML-O	Rx5n	Receiver Inverted Data Output
57		GND	Module Ground
58		GND	Module Ground
59	CML-O	Rx6n	Receiver Inverted Data Output
60	CML-O	Rx6p	Receiver Non-Inverted Data Output
61		GND	Module Ground
62	CML-O	Rx8n	Receiver Inverted Data Output
63	CML-O	Rx8p	Receiver Non-Inverted Data Output
64		GND	Module Ground
65		NC	No Connect
66		Reserved	For Future Use

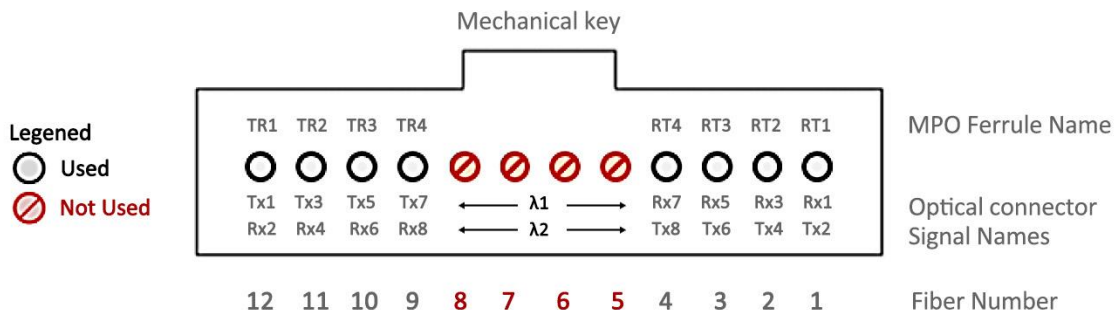


67		VccTx1	+3.3V Power Supply Transmitter
68		Vcc2	+3.3V Power Supply
69		Reserved	For Future Use
70		GND	Module Ground
71	CML-I	Tx7p	Transmitter Non-Inverted Data Input
72	CML-I	Tx7n	Transmitter Inverted Data Input
73		GND	Module Ground
74	CML-I	Tx5p	Transmitter Non-Inverted Data Input
75	CML-I	Tx5n	Transmitter Inverted Data Input
76		GND	Module Ground

Optical Interface Lanes and Assignment

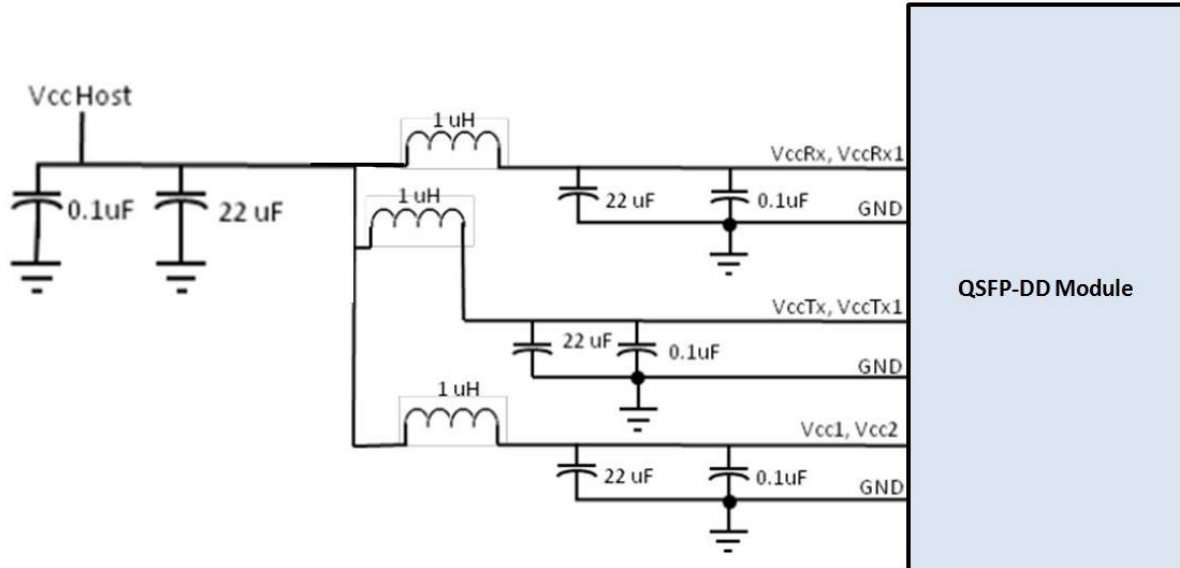


2 Aligment PIN are present
 The Central Four fibers may be physically present



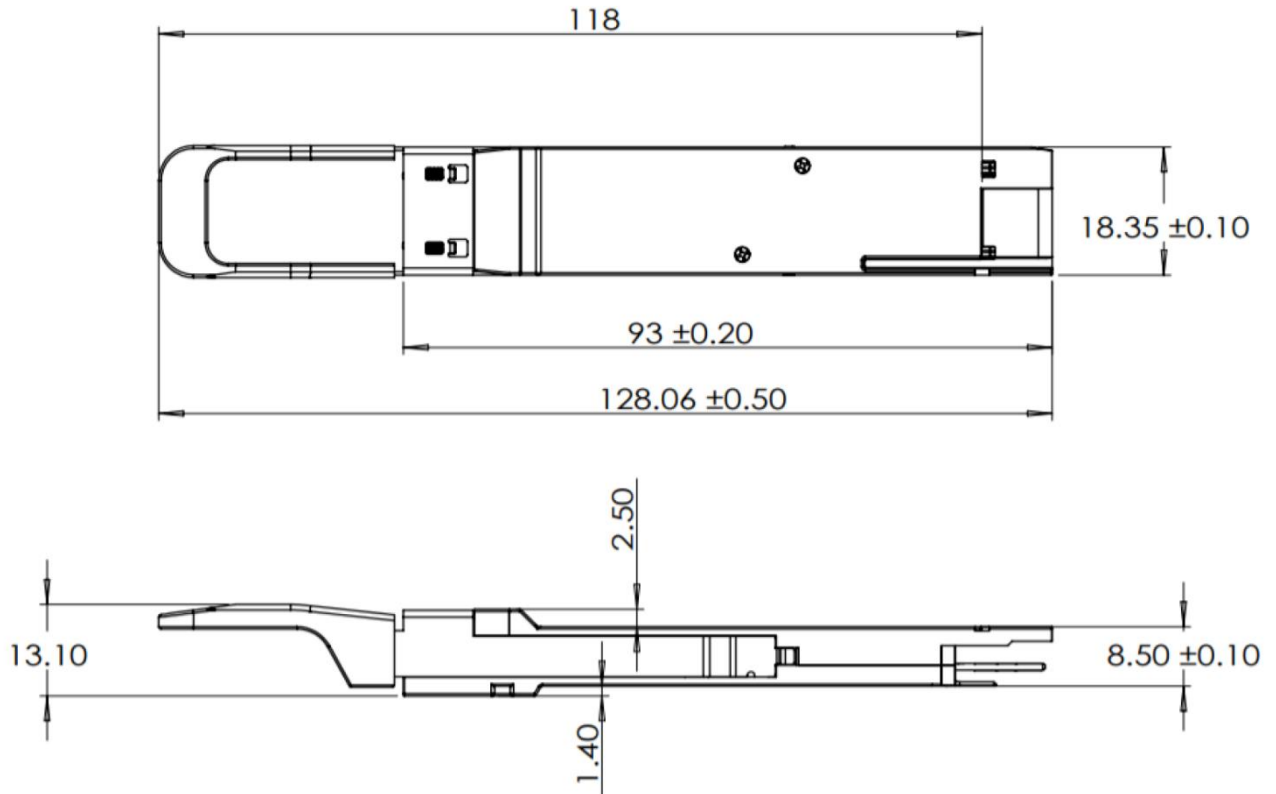


Recommended Power Supply Filter





Mechanical Dimensions



(All Dimensions are ±0.20mm Unless Otherwise Specified, Unit: mm)

Ordering Information

Part No.	Tx	Rx	Link	DDM	Temp.
FQDD-T9-C85-X1D	850nm 908nm	908nm 850nm	MM OM3 70m MM OM4 100m MM OM5 150m	Yes	0~70°C

Note: Distances are indicative only. To calculate a more precise link budget based on specific conditions in your application, please refer to the optical characteristics.