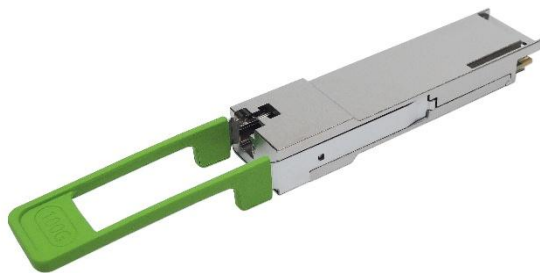




**100G QSFP28 ZR4 BiDi Transceiver**  
**Hot Pluggable, BiDi LC, SMF 80KM, DDM**  
**Tx LWDM 1295.56~1309.14nm EML / Rx 1273.55~1286.66nm, E-Temp**

**Part Number: FQ28-K8-L95-80D**



## Overview

FQ28-K8-L95-80De is a 4-Channel LWDM 1300nm QSFP28 BiDi transceiver for 100GbE applications especially in Telecom, Datacom, Data Center & Storage networks. The transmitter converts 4-Channel 25G electrical input data to four LWDM optical signals and multiplex that into aggregated 100G signal. The receiver de-multiplex the 100G signal reversely and converts that to 4-Channel 25G electrical output data. The techniques bring a compact transceiver module for an aggregate bandwidth of 100Gbps up to SMF 80km optical links in -40~+80°C Extended Temperature range.

## Applications

- 100GBASE-ZR4 Ethernet
- Infiniband QDR and DDR
- Data Centers Switch Interconnect
- Server and Storage Area Network Interconnect

## Features

- Compatible with IEEE802.3ba 100GBASE-ER4
- Compliant with SFF-8665 QSFP28 MSA
- Compliant with IEEE 802.3bm CAUI-4 Interface
- 4CH LWDM MUX / DEMUX design
- Optical Data Rate NRZ 25.78125Gbps per Lane
- Built in Tx CDR and Rx CDR
- Hot Pluggable QSFP28 footprint
- O-Band LWDM 1295.56~1309.14nm EML transmitter
- SOA + PIN receiver
- Simplex LC connector
- 2-wire interface for management and diagnostic monitor compliant with SFF-8636
- Single 3.3V power supply
- Operating Temperature -40~+80°C
- Link distance 80km over SM fiber with FEC
- Maximum Power consumption 6W
- 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 <sub>ST</sub>	-40	+85	°C
Storage Relative Humidity	RH	15	85	%
Supply Voltage	V <sub>CC</sub>	-0.5	+3.6	V

## Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Unit
Case Operating Temperature	T <sub>OP</sub>	-40	-	+80	°C
Supply Voltage	V <sub>CC</sub>	+3.13	+3.3	+3.47	V
Supply Current	I <sub>CC</sub>			1800	mA
Electrical Data Rate, per Lane (NRZ)	D <sub>RELE</sub>		25.78125		Gb/s
Optical Data Rate (PAM4)	D <sub>ROPT</sub>		53.125		GBd
Data Rate Accuracy	ΔDR	-100		+100	ppm
Bit Error Rate (Pre-FEC)	BER <sub>PRE</sub>			2.4x10 <sup>-4</sup>	
Bit Error Rate (Post-FEC)	BER <sub>POST</sub>			1x10 <sup>-12</sup>	
Power Consumption (3.3V)	P			6	W
Transceiver Power-on Initialization Time				2000	ms
Control Input Voltage High	V <sub>IH</sub>	2.0		V <sub>CC</sub>	V
Control Input Voltage Low	V <sub>IL</sub>	0		0.8	V
Fiber Link Distance (SMF)	D			80	km



## Transmitter Electro-optical Characteristics

V<sub>CC</sub> = 3.13V to 3.47V, T<sub>OP</sub> = -40 °C to +80 °C

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Data Rate, per Lane	DR		25.78125		Gb/s	
Total Average Launch Power	TP <sub>AVG</sub>	+8		+12	dBm	
Average Launch Power, per Lane	P <sub>AVG</sub>	+2		+6	dBm	
Difference in Launch Power between any two Lanes (OMA)	P <sub>TX-DIFF</sub>			3.6	dB	
Optical Wavelength, each Lane	λ <sub>L0</sub>	1294.53	1295.56	1296.59	nm	
	λ <sub>L1</sub>	1299.02	1300.05	1301.09	nm	
	λ <sub>L2</sub>	1303.54	1304.58	1305.63	nm	
	λ <sub>L3</sub>	1308.09	1309.14	1310.09	nm	
Spectral Width (-20dB)	Δλ			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Optical Extinction Ratio	ER	6			dB	
Optical Eye Mask { X1, X2, X3, Y1, Y2, Y3 }		{ 0.25, 0.4, 0.45, 0.25, 0.28, 0.4 }				1
Average Launch Power OFF, per Lane	P <sub>OFF</sub>			-30	dBm	
Relative Intensity Noise (OMA)	RIN			-130	dB/Hz	
Optical Return Loss Tolerance	ORLT			20	dB	
Transmitter Reflectance	R <sub>TX</sub>			-12	dB	
Input Differential Impedance	Z <sub>IN</sub>	90	100	110	Ω	
Differential Data Input Voltage	V <sub>IN-PP</sub>	180		1000	mVpp	

**Note1:** Hit ratio  $5 \times 10^{-5}$  hits per sample.



## Receiver Electro-optical Characteristics

V<sub>CC</sub> = 3.13V to 3.47V, T<sub>OP</sub> = -40 °C to +80 °C

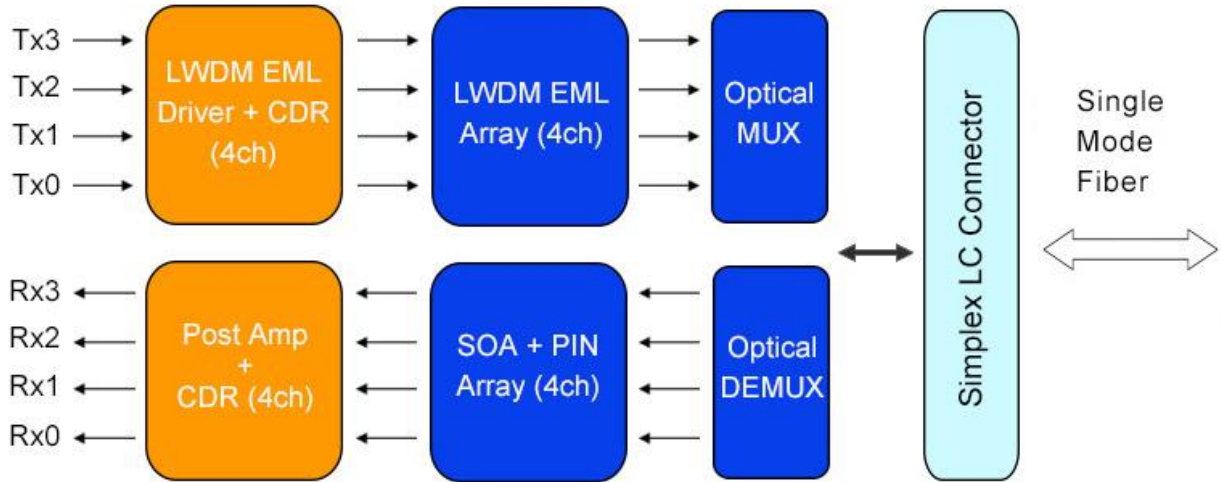
Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Data Rate, per Lane	DR		25.78125		Gb/s	
Damage Threshold, per Lane	D <sub>TH</sub>	+6.5			dBm	1
Average Receive Power, per Lane	PRX-AVG	-30		-7	dBm	
Maximum Receive Power (Saturation)	PRX-MAX	-7			dBm	
Receiver Sensitivity (AVG), per Lane	SEN <sub>AVG</sub>			-28	dBm	
Optical Wavelength, each Lane	λ <sub>L0</sub>	1272.55	1273.55	1274.54	nm	
	λ <sub>L1</sub>	1276.89	1277.89	1278.89	nm	
	λ <sub>L2</sub>	1281.25	1282.26	1283.27	nm	
	λ <sub>L3</sub>	1285.65	1286.66	1287.68	nm	
Receiver Reflectance	R <sub>RX</sub>			-26	dB	
LOS De-Assert	LOS <sub>D</sub>			-29	dBm	
LOS Assert	LOS <sub>A</sub>	-40			dBm	
LOS Hysteresis	LOS <sub>HY</sub>	0.5			dB	
Receiver Electrical 3dB upper Cutoff Frequency, each Lane	F <sub>CUT</sub>			31	GHz	
Output Differential Impedance	Z <sub>OUT</sub>	90	100	110	Ω	
Differential Data Output Voltage	V <sub>OUT-PP</sub>	350		900	mVpp	

**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.

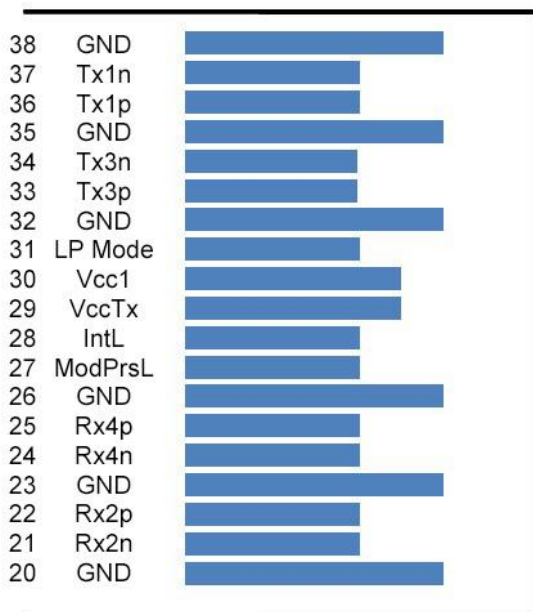
**Note2:** Measured with conformance test signal at receiver input @25.78125Gbps, ER=8.2dB, BER= 5x10<sup>-5</sup> with PRBS 2<sup>31</sup>-1 test pattern.



## Transceiver Block Diagram

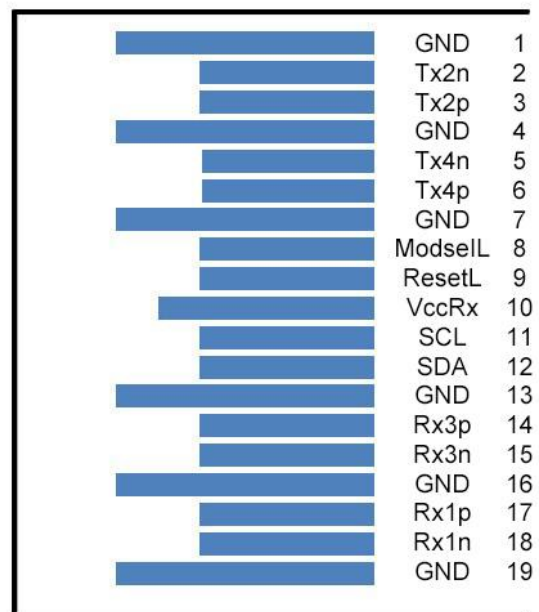


## Pin Assignment



Top Side  
Viewed From Top

Module Card Edge



Bottom Side  
Viewed From Bottom



## 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	LPMODE	Low Power Mode
32		GND	Module Ground

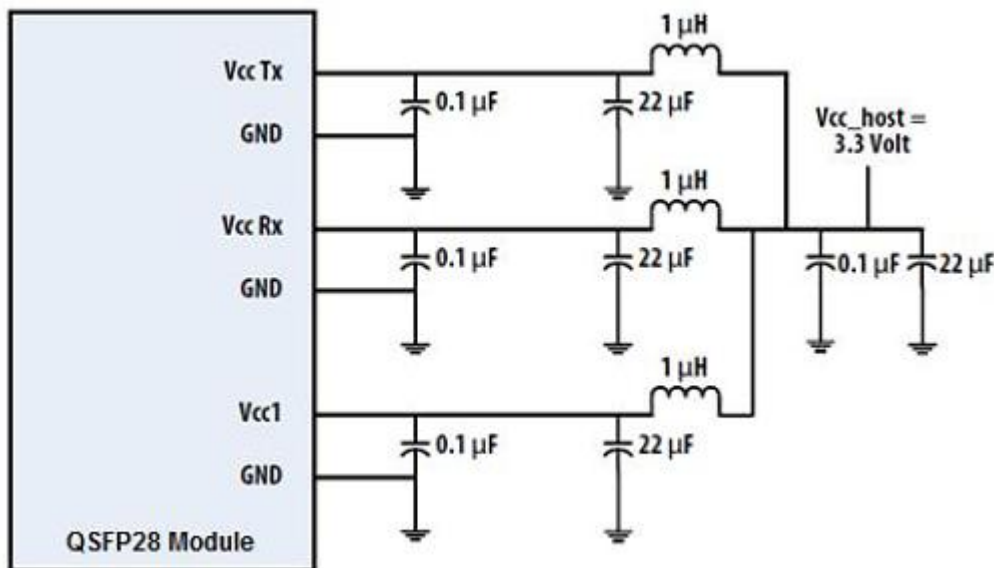


33	CML-I	Tx3p	Transmitter Non-Inverted Data Input
34	CML-I	Tx3n	Transmitter Inverted Data Input
35		GND	Module Ground
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input
37	CML-I	Tx1n	Transmitter Inverted Data Input
38		GND	Module Ground

**Note1:** GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground lane.

**Note2:** VccRx, Vcc1 and VccTx are the receiver and transmitter power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 1000mA.

### Recommended Power Supply Filter





## Digital Diagnostic Functions

As defined by the QSFP28 MSA, Ficer's QSFP28 transceivers provide digital diagnostic functions via a 2-wire serial interface, which allows real-time access to the following operating parameters:

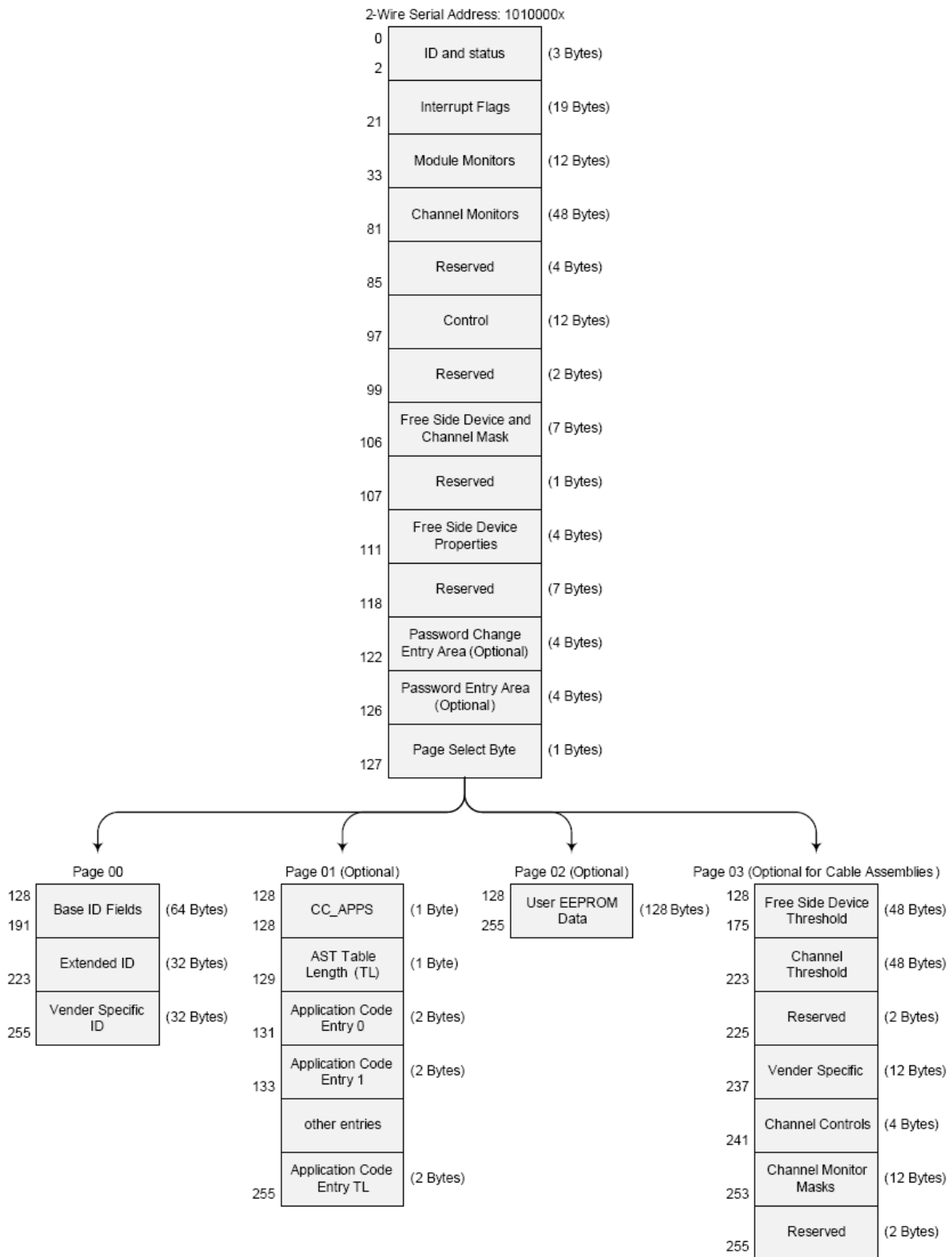
- Transceiver temperature
- Laser bias current
- Transmitted optical power
- Received optical power
- Transceiver supply voltage

It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Controller (DDC) inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the QSFP28 transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the QSFP28 transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially. The 2-wire serial interface provides sequential or random access to the 8 bit parameters, addressed from 000h to the maximum address of the memory.

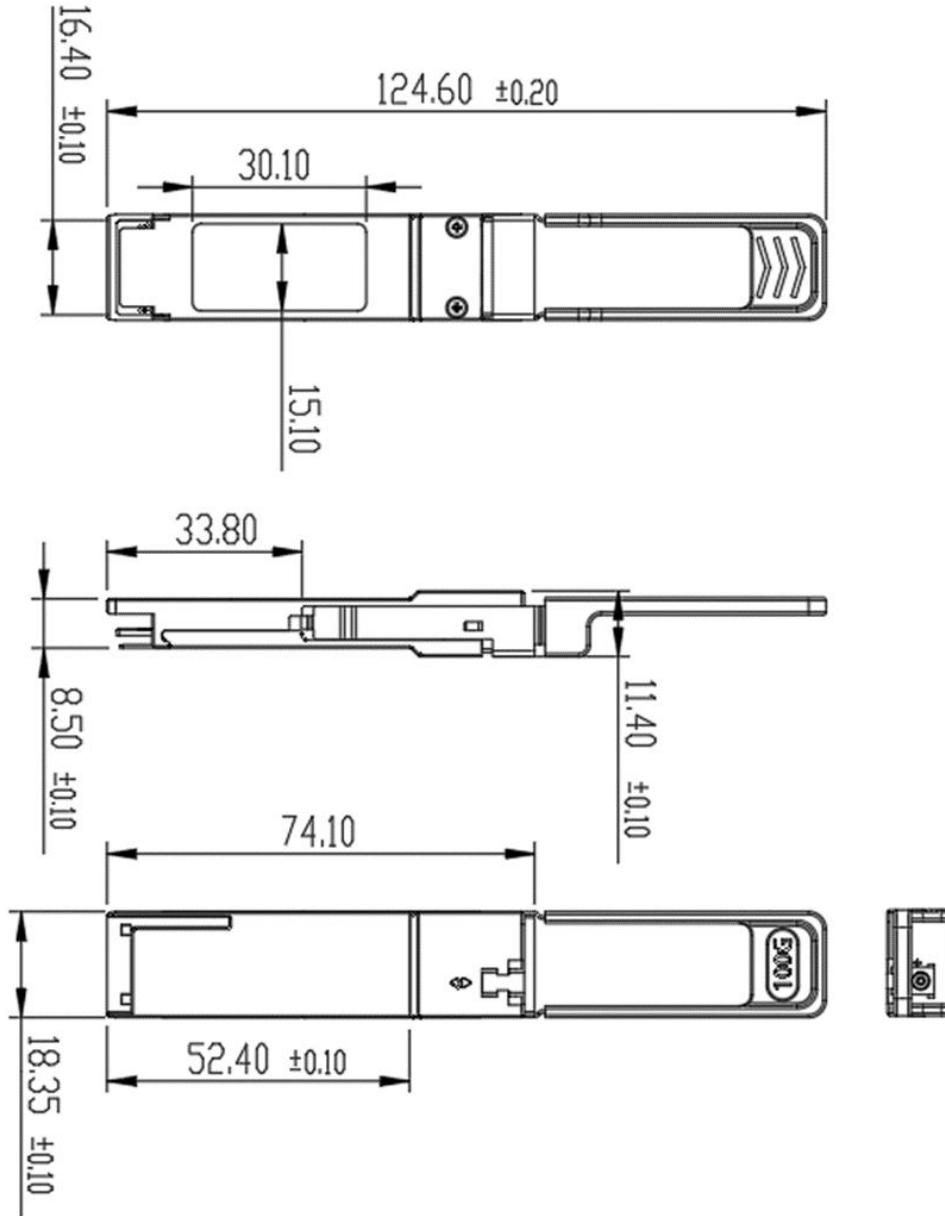
For more detailed information including memory map definitions, please see the QSFP28 MSA Specification.

## Digital Diagnostic Memory Map





## Mechanical Dimensions



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



## Ordering Information

Part No.	Tx	Rx	Link	DDM	Temp.
FQ28-K8-L95-80De (Gray Pull Tab)	1295.56nm 1300.05nm 1304.58nm 1309.14nm	1273.55nm 1277.89nm 1282.26nm 1286.66nm	SMF 80km (with FEC)	Yes	-40~+80°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.