



## 40G QSFP+ LR4 Transceiver

### Hot Pluggable, Duplex LC, CWDM DFB, SMF 20KM, DDM

**Part Number: FQFP-I7-C13-20D**



### Overview

FQFP-I7-C13-20D is a 4-Channel CWDM 1300nm QSFP+ transceiver for 40GbE and InfiniBand DDR, QDR applications especially in Data Center & Storage networks. The transmitter converts 4-Channel 10G electrical input data to four CWDM optical signals and multiplex that into one 40G signal. The receiver de-multiplex the 40G signal reversely and converts that to 4-Channel 10G electrical output data. The techniques bring a compact transceiver module for an aggregate bandwidth of 40Gbps up to SMF 20km optical links.

### Applications

- 40GBASE-LR4 Ethernet
- OTN OTU3 @43.01G, OTU3e2 @44.58G
- Data Centers Switch Interconnect
- Server and Storage Area Network Interconnect

### Features

- Compliant with IEEE802.3ba 40GBASE-LR4
- Compliant to SFF-8436 QSFP+ MSA
- Supports QDR / DDR InfiniBand
- 4CH CWDM MUX / DEMUX design
- Data Rate up to 11.2Gbps per Lane
- Hot Pluggable
- CWDM DFB transmitter
- Duplex LC connector
- 2-wire interface for management and diagnostic monitor compliant with SFF-8436, SFF-8636
- Single 3.3V power supply
- Link distance 20km over SM fiber
- Maximum Power consumption 3.5W
- 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	5	85	%
Supply Voltage	V <sub>CC</sub>	-0.5	+3.6	V

## Recommended Operating Conditions

Parameters	Symbol	Min.	Typ.	Max.	Unit
Case Operating Temp. (FQFP-I7-C13-20D)	T <sub>OP</sub>	0	-	+70	°C
Case Operating Temp. (FQFP-I7-C13-20Di)	T <sub>OP</sub>	-40	-	+85	°C
Supply Voltage	V <sub>CC</sub>	+3.13	+3.3	+3.47	V
Data Rate, per lane	DR		10.3125	11.2	Gb/s
Data Rate Accuracy	ΔDR	-100		+100	ppm
Bit Error Rate	BER			10 <sup>-12</sup>	
Supply Current	I <sub>CC</sub>			1050	mA
Power Consumption	P			3.5	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>	GND		0.7	V
Control Output Voltage High	V <sub>OH</sub>	2.0		V <sub>CC</sub>	V
Control Output Voltage Low	V <sub>OL</sub>	GND		0.7	V



## Transmitter Electro-optical Characteristics

$V_{CC} = 3.13V$  to  $3.47V$ ,  $T_{OP} = 0\text{ }^{\circ}C$  to  $70\text{ }^{\circ}C$ (FQFP-I7-C13-20D);  $T_{OP} = -40\text{ }^{\circ}C$  to  $85\text{ }^{\circ}C$ (FQFP-I7-C13-20Di)

Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Data Rate, per Lane	DR		10.3125	11.2	Gb/s	
Total Average Launch Power	$TP_{AVG}$			+8.3	dBm	
Average Launch Power, per Lane	$P_{AVG}$	-5.0		+2.3	dBm	
Optical Modulation Amplitude (OMA), per lane	$P_{OMA}$	-4.0		+2.5	dBm	1
Difference in Launch Power between any two Lanes (OMA)	$P_{TX-DIFF}$			4.0	dB	
Transmitter Dispersion Penalty, per Lane	TDP			2.3	dB	
Launch Power (OMA) minus TDP, per Lane	$P_{OMA-TDP}$	-3.8			dB	
Optical Wavelength, each Lane	$\lambda_{L0}$	1264.5	1271	1277.5	nm	
	$\lambda_{L1}$	1284.5	1291	1297.5	nm	
	$\lambda_{L2}$	1304.5	1311	1317.5	nm	
	$\lambda_{L3}$	1324.5	1331	1337.5	nm	
Spectral Width (-20dB)	$\Delta\lambda$			1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Optical Extinction Ratio	ER	3.5			dB	
Optical Eye Mask {X1, X2, X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				
Average Launch Power OFF, per Lane	$P_{OFF}$			-30	dBm	
Relative Intensity Noise (OMA)	RIN			-128	dB/Hz	
Optical Return Loss Tolerance	ORLT			20	dB	
Transmitter Reflectance	$R_{TX}$			-12	dB	
Input Differential Impedance	$Z_{IN}$	85	100	115	$\Omega$	
Differential Data Input Voltage	$V_{IN-PP}$	150		1200	mVpp	

**Note1:** Transmitter wavelength and launch power need to meet the OMA minus TDP specs to guarantee link performance.



## Receiver Electro-optical Characteristics

$V_{CC} = 3.13V$  to  $3.47V$ ,  $T_{OP} = 0\text{ }^{\circ}C$  to  $70\text{ }^{\circ}C$ (FQFP-I7-C13-20D);  $T_{OP} = -40\text{ }^{\circ}C$  to  $85\text{ }^{\circ}C$ (FQFP-I7-C13-20Di)

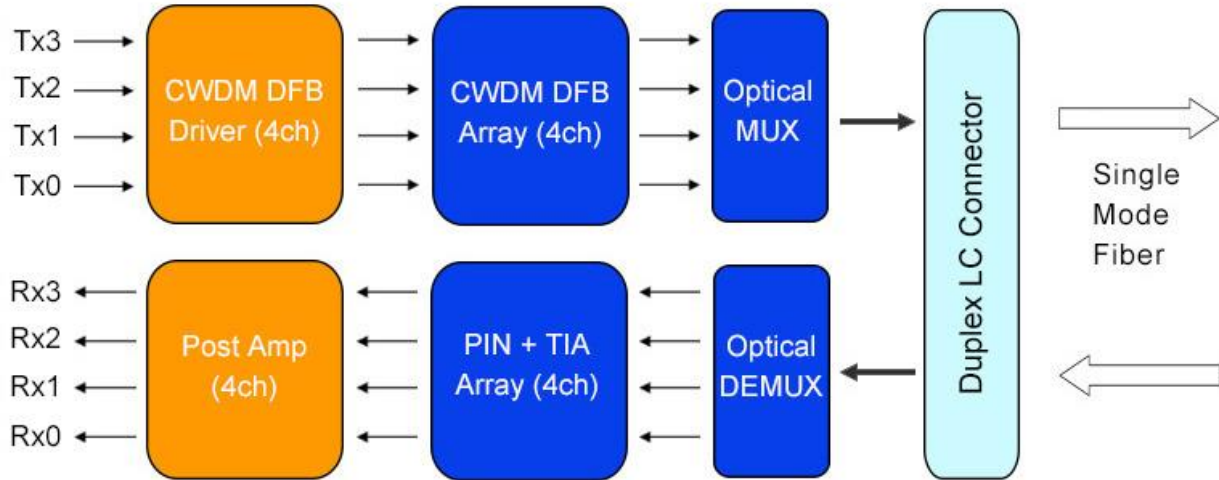
Parameters	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Data Rate, per Lane	DR		10.3125	11.2	Gb/s	
Damage Threshold, per Lane	D <sub>TH</sub>	+3.3			dBm	1
Average Receive Power, per Lane	P <sub>RX-AVG</sub>	-13.7		+2.3	dBm	
Receiver Power (OMA), per Lane	P <sub>RX-OMA</sub>			+3.5	dBm	
Receiver Sensitivity (OMA), per Lane	SEN <sub>OMA</sub>			-11.5	dBm	
Stressed Receiver Sensitivity (OMA), per Lane	SRS <sub>OMA</sub>			-9.9	dBm	2
Receiver Reflectance	R <sub>RX</sub>			-26	dB	
LOS De-Assert	LOS <sub>D</sub>			-15	dBm	
LOS Assert	LOS <sub>A</sub>	-30			dBm	
LOS Hysteresis	LOS <sub>HY</sub>	0.5			dB	
Receiver Electrical 3dB upper Cutoff Frequency, per Lane	F <sub>CUT</sub>			12.3	GHz	
Output Differential Impedance	Z <sub>OUT</sub>	85	100	115	$\Omega$	
Differential Data Output Voltage	V <sub>OUT-PP</sub>	370	600	950	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.

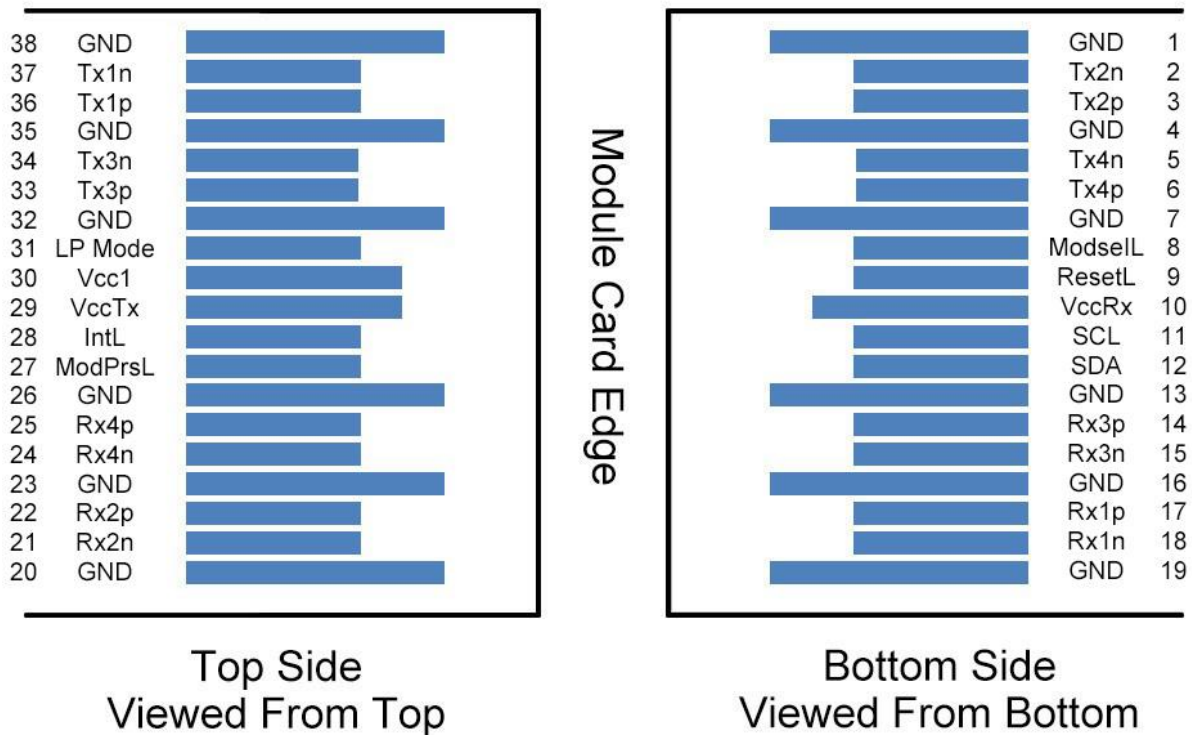
**Note2:** Measured with conformance test signal at receiver input for BER=  $1 \times 10^{-12}$ .



## Transceiver Block Diagram



## Pin Assignment





## 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

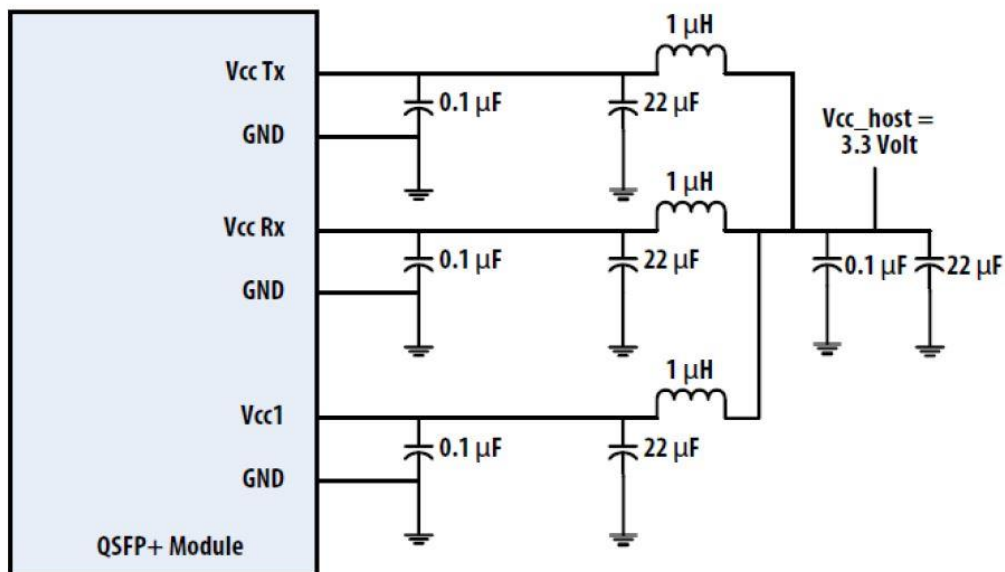


33	CML-I	Tx3p	Transmitter Non-Inverted Data Input
34	CML-I	Tx3n	Transmitter Inverted Data Input
35		GND	Module Ground
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input
37	CML-I	Tx1n	Transmitter Inverted Data Input
38		GND	Module Ground

**Note1:** GND is the symbol for signal and supply (power) common for QSFP+ modules. All are common within the QSFP+ 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 transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. VccRx, Vcc1 and VccTx may be internally connected within the QSFP+ transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.

### Recommended Power Supply Filter





## Digital Diagnostic Functions

As defined by the QSFP+ MSA, Ficer's QSFP+ 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 (4-Channel)
- Transmitted optical power (4-Channel)
- Received optical power (4-Channel)
- Transceiver supply voltage

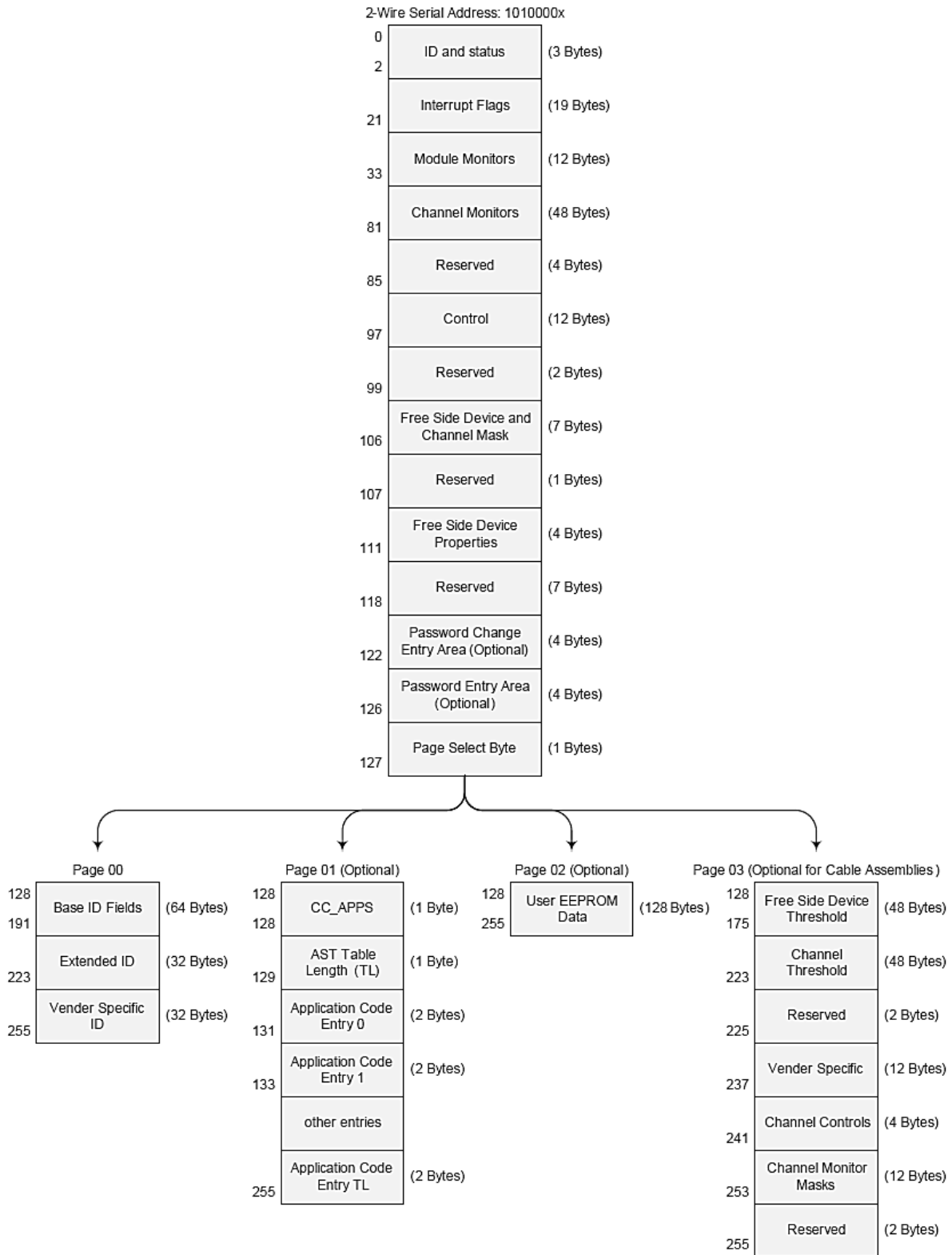
It also provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

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 QSFP+ transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the QSFP+ 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 QSFP+ MSA Specification.

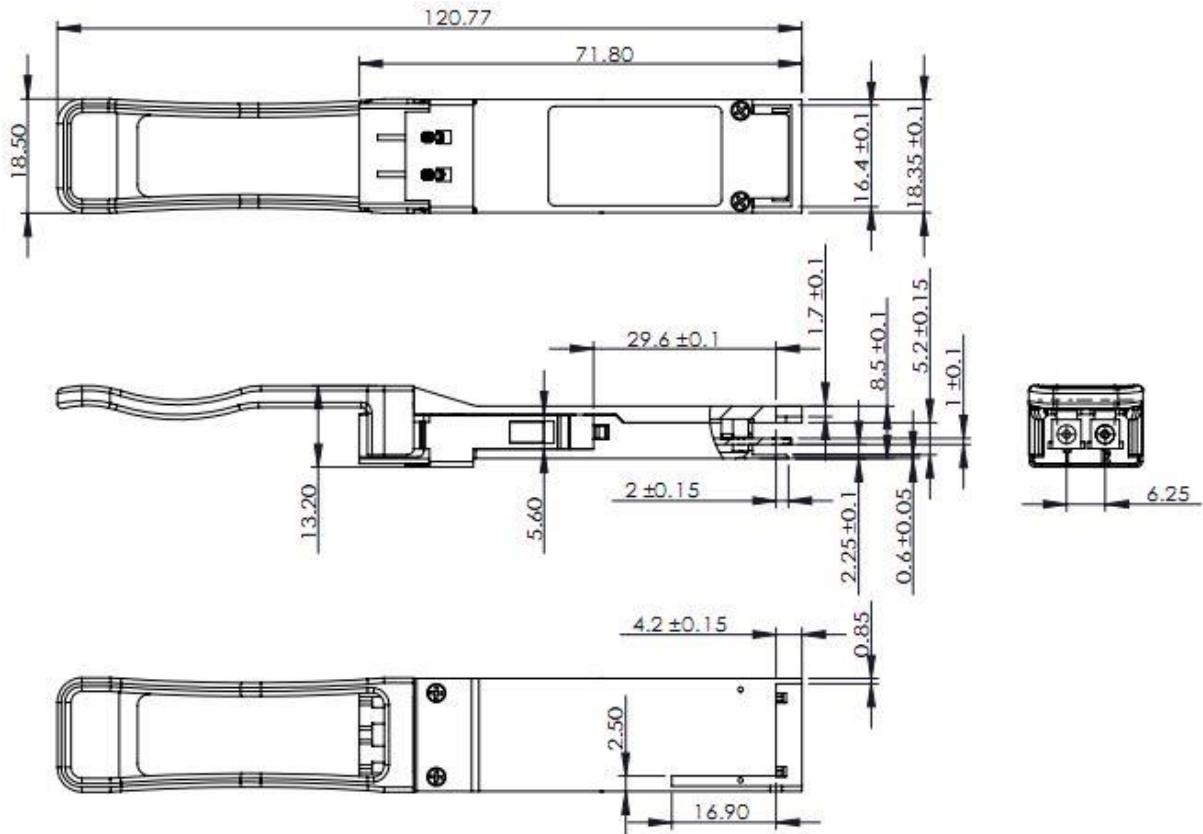
## Digital Diagnostic Memory Map







## Mechanical Dimensions



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

## Ordering Information

Part No.	Tx	Rx	Link	DDM	Temp.
FQFP-I7-C13-20D	1271nm 1291nm	1271nm 1291nm	SMF 20km	Yes	0~70°C
FQFP-I7-C13-20Di	1311nm 1331nm	1311nm 1331nm			-40~85°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.