Finisar

Product Specification

10km Multirate QSFP+ Optical Transceiver Module

FTL4C1QM1C

PRODUCT FEATURES

- Hot-pluggable QSFP+ form factor
- Supports 39.8 Gb/s to 44.6 Gb/s aggregate bit rates
- Power dissipation < 3.5W
- RoHS-6 compliant (lead-free)
- Commercial case temperature range 0°C to 70°C
- Single 3.3V power supply
- Maximum link length of 10km on Single Mode Fiber (SMF)
- Uncooled 4x10Gb/s CWDM transmitter
- XLPPI electrical interface
- Duplex LC receptacles
- Built-in digital diagnostic functions, including Tx/Rx power monitoring

APPLICATIONS

- 40GBASE-LR4 40G Ethernet
- OTN OTU3 C4S1-2D1
- OTU3e1 and OTU3e2

Finisar's FTL4C1QM1C QSFP+ transceiver modules are designed for use in 40 Gigabit Ethernet links and 4x10G OTN client interfaces over single mode fiber. They are compliant with the QSFP+ MSA[1,2] , IEEE 802.3ba 40GBASE-LR4[3] and OTU3 C4S1-2D1 requirements specified in ITU-T Recommendation G.695. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The transceiver is RoHS compliant per Directive 2011/65/EU[4] and Finisar Application Note AN-2038[5].

PRODUCT SELECTION

FTL4C1QM1C

M:	Multirate support
1:	First generation product
C:	Commercial temperature rate

I. Pin Descriptions

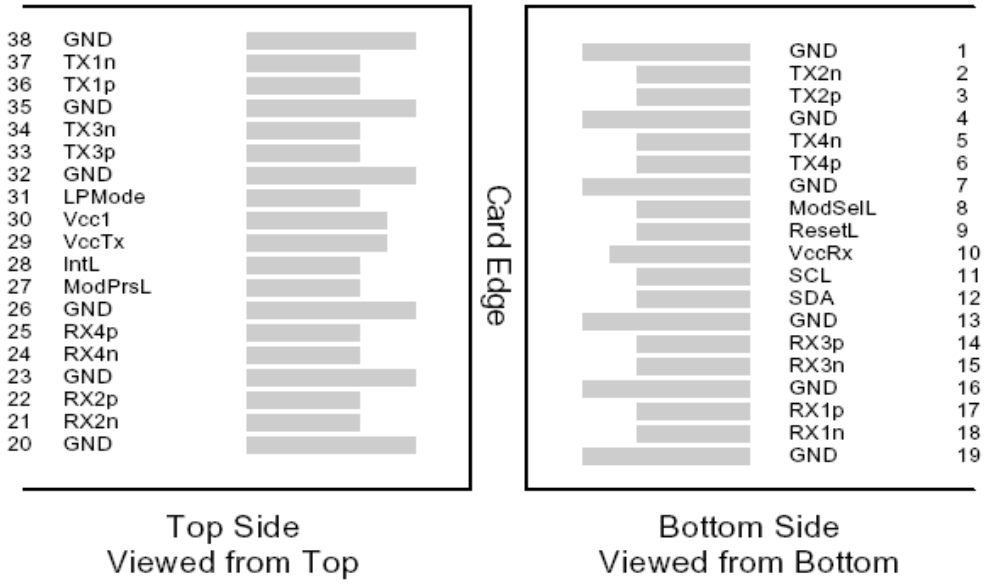

Figure 1 – QSFP+ MSA-compliant 38-pin connector

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.

II. General Product Characteristics

Parameter	Value	Unit	Notes
Module Form Factor	QSFP+		
Maximum Aggregate Data Rate	44.6	Gb/s	
Maximum Data Rate per Lane	11.2	Gb/s	
Protocols Supported	Typical applications include OTN OTU3, 40G Ethernet, Infiniband, Fibre Channel, SATA/SAS3		
Electrical Interface and Pin-out	38-pin edge connector		Pin-out as defined by the QSFP+ MSA
Maximum Power Consumption	3.5	Watts	
Management Interface	Serial, I2C-based, 400 kHz maximum frequency		As defined by the QSFP+ MSA

Data Rate Specifications	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate per Lane	BR			11,200	Mb/sec	1
Bit Error Ratio	BER			10^{-12}		2
Link distance on SMF-28	d			10	kilometers	3

Notes:
1. Compliant with 40GBASE-LR4 and XLPPI per IEEE 802.3ba, OTU3 C4S1-2D1 per ITU-T Rec. G.695 and OTU3e1/OTU3e2 per ITU-T G-Series Rec. Supplement 43. Compatible with 1/10 Gigabit Ethernet and 1/2/4/8/10G Fibre Channel.
2. Tested with a PRBS 2^{31}-1 test pattern.
3. Per 40GBASE-LR4, IEEE 802.3ba

III. 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	
Case Operating Temperature	T_{OP}	0		70	°C	
Relative Humidity	RH	0		85	%	1
Damage Threshold, per Lane	DT	3.4			dBm	

Notes:
1. Non-condensing.

IV. Electrical Characteristics (T_{OP} = 0 to 70°C, V_{CC} = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc1, VccTx, VccRx	3.1		3.47	V	
Supply Current	Icc			1.13	A	
Link turn-on time						
Transmit turn-on time				2000	ms	2
Transmitter (per Lane)						
Single ended input voltage tolerance	VinT	-0.3		4.0	V	
Differential data input swing	Vin,pp	120		1200	mVpp	3
Differential input threshold			50		mV	
AC common mode input voltage tolerance (RMS)		15			mV	
Differential input return loss		Per IEEE P802.3ba, Section 86A.4.1.1			dB	4
J2 Jitter Tolerance	Jt2	0.17			UI	
J9 Jitter Tolerance	Jt9	0.29			UI	
Data Dependent Pulse Width Shrinkage	DDPWS	0.07			UI	
Eye mask coordinates {X1, X2 Y1, Y2}		0.11, 0.31 95, 350			UI mV	5
Receiver (per Lane)						
Single-ended output voltage		-0.3		4.0	V	
Differential data output swing	Vout,pp	0		800	mVpp	6
AC common mode output voltage (RMS)				7.5	mV	
Termination mismatch at 1 MHx				5	%	
Differential output return loss		Per IEEE P802.3ba, Section 86A.4.2.1			dB	4
Common mode output return loss		Per IEEE P802.3ba, Section 86A.4.2.2			dB	4
Output transition time, 20% to 80%		28			ps	
J2 Jitter output	Jo2			0.42	UI	
J9 Jitter output	Jo9			0.65	UI	
Eye mask coordinates #1 {X1, X2 Y1, Y2}		0.29, 0.5 150, 425			UI mV	5
Power Supply Ripple Tolerance	PSR	50			mVpp	

Notes:
1. Maximum total power value is specified across the full temperature and voltage range.
2. From power-on and end of any fault conditions.
3. After internal AC coupling. Self-biasing 100Ω differential input.
4. 10 MHz to 11.1 GHz range.
5. Hit ratio = 5 x 10E-5.
6. AC coupled with 100Ω differential output impedance.

V. Optical Characteristics (T_{OP} = 0 to 70°C, V_{CC} = 3.1 to 3.47 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Transmitter						
Signaling Speed per Lane				11.2	GBd	1
Lane center wavelengths (range)		1264.5 – 1277.5 1284.5 – 1297.5 1304.5 – 1317.5 1324.5 – 1337.5			nm	
Total Average Launch Power	P_{OUT}			8.3	dBm	
Transmit OMA per Lane	TxOMA	-4.0		3.5	dBm	
Average Launch Power per Lane	TXP_x	-2.3		2.3	dBm	2
Optical Extinction Ratio	ER	4.5			dB	
Sidemode Suppression ratio	SSR_{min}	30			dB	
Average launch power of OFF transmitter, per lane				-30	dBm	
Relative Intensity Noise	RIN			-128	dB/Hz	3
Optical Return Loss Tolerance				20	dB	
Transmitter Reflectance				-12	dB	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}		{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}				
Receiver						
Signaling Speed per Lane				11.2	GBd	4
Lane center wavelengths (range)		1264.5 – 1277.5 1284.5 – 1297.5 1304.5 – 1317.5 1324.5 – 1337.5			nm	
Total Average Receive Power	P_{IN}			8.3	dBm	
Receive Power (OMA) per Lane	RxOMA			3.5	dBm	
Average Receive Power per Lane	RXP_x	-13.7		2.3	dBm	5
Receiver Sensitivity (OMA) per Lane	Rxsens			-11.5	dBm	
Stressed Receiver Sensitivity (OMA) per Lane	SRS			-9.6	dBm	
Damage Threshold per Lane	P_{MAX}			3.3	dBm	
Return Loss	RL			-26	dB	
Vertical eye closure penalty, per lane				1.9	dB	
Receive electrical 3 dB upper cutoff frequency, per lane				12.3	GHz	
LOS De-Assert	LOS_D			-15	dBm	
LOS Assert	LOS_A	-28			dBm	
LOS Hysteresis			1		dB	

Notes:
1. Transmitter consists of 4 lasers operating at up to 11.2 Gb/s each, +/- 20ppm
2. Minimum value is informative.
3. RIN is scaled by 10*log(10/4) to maintain SNR outside of transmitter.
4. Receiver consists of 4 photodetectors operating at up to 11.2 Gb/s each, +/- 100ppm
5. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.

VI. Memory Map and Control Registers

Compatible with SFF-8436 (QSFP+). Please see Finisar Application Note AN-2104[6].

VII. Environmental Specifications

Finisar FTL4C1Q transceivers 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}	-40		85	°C	

VIII. Regulatory Compliance

Finisar FTL4C1Q transceivers are RoHS-6 Compliant. Copies of certificates are available at Finisar Corporation upon request.

FTL4C1Q transceiver modules are Class 1 laser eye safety compliant per IEC 60825-1.

IX. Mechanical Specifications

The FTL4C1Q mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

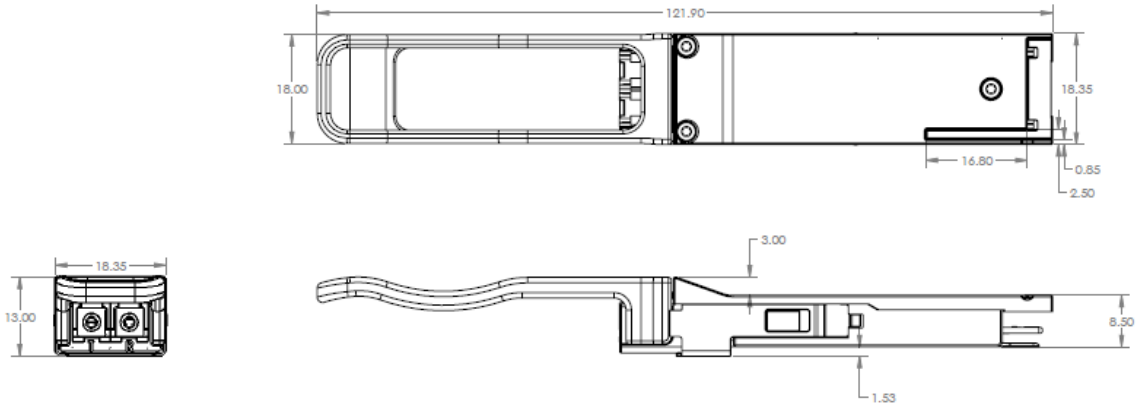

Figure 2 – FTL4C1Q mechanical drawing

Figure 3 – FTL4C1QM1C production label

X. References

1. INF-8438i – Specification for QSFP (Quad Small Formfactor Pluggable) Transceiver, Rev 1.0, November 2006.

2. SFF-8436 – Specification for QSFP+ Copper and Optical Transceiver, Rev 4.7, February 2013.

3. IEEE 802.3ba – PMD Type 40GBASE-LR4.

4. 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," June 8, 2011, which supercedes the previous RoHS Directive 2002/95/EC.

5. "Application Note AN-2038: Finisar Implementation of RoHS Compliant Transceivers", Finisar Corporation, January 21, 2005.

6. "Application Note AN-2104: QSFP+ 40G LR4 Transceiver EEPROM Mapping," Rev. A, Finisar Corporation, June, 2013.

XI. For More Information

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