

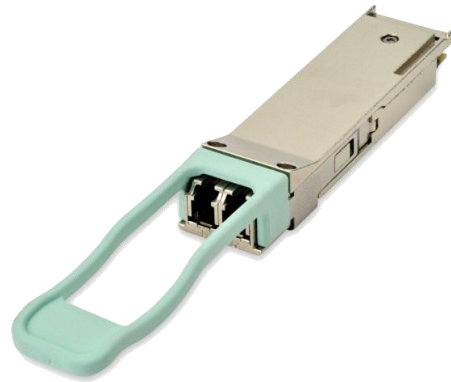
Product Specification

40GE Universal LM4 QSFP+ Optical Transceiver Module

FTL4C3QE1C

PRODUCT FEATURES

- Hot-pluggable QSFP+ form factor
- Operates over duplex multimode and single mode fiber with dual LC receptacles
- Supports 41.2 Gb/s aggregate bit rate
- Power dissipation < 3.5W
- Commercial case temperature range 0°C to 70°C
- Maximum link length of 140m on OM3, 160m on OM4, and 1km on SMF
- Uncooled 4x10Gb/s CWDM transmitter
- XLPPi electrical interface
- Built-in digital diagnostic functions, including Tx/Rx power monitoring
- RoHS-6 compliant



APPLICATION

- 40G Ethernet over MMF and SMF

Finisar's FTL4C3QE1C QSFP+ transceiver modules are designed for use in 40 Gigabit Ethernet links over duplex multimode or single mode fiber. They are compliant with the QSFP+ MSA^{1,2} and represent a multimode adaptation of IEEE 802.3ba 40GBASE-LR4³ referred to as LM4. Digital diagnostics functions are available via an I2C interface, as specified by the QSFP+ MSA. The transceiver is RoHS compliant per Directive 2011/65/EU⁴ and Finisar Application Note AN-2038⁵.

PRODUCT SELECTION

FTL4C3QE1C

C3: 1271 - 1331 nm CWDM over MMF and SMF
 E: 40G Ethernet
 1: First generation product
 C: Commercial temperature range

I. Pin Descriptions

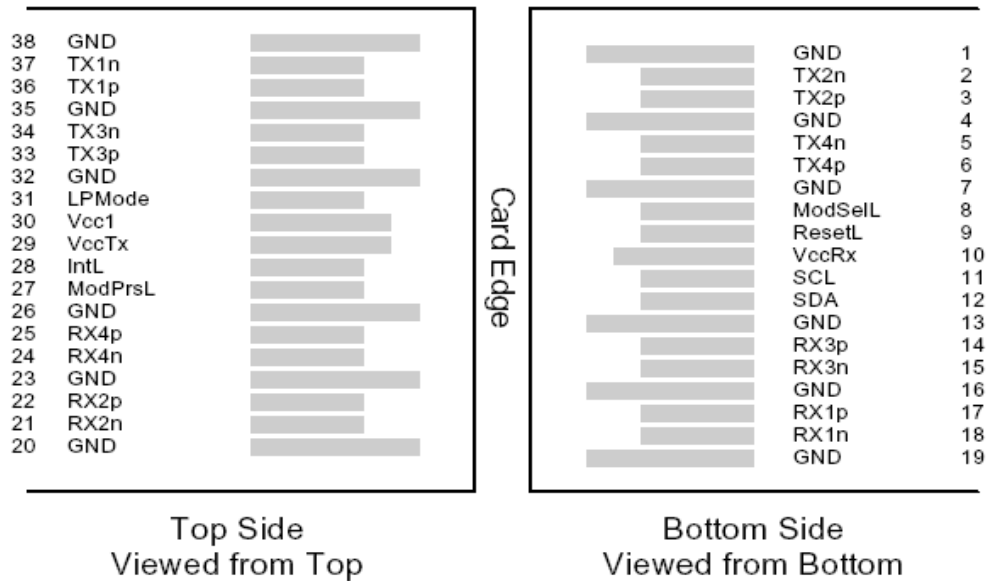


Figure 1 – QSFP+ MSA-compliant 38-pin connector

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	41.2	Gb/s	
Maximum Data Rate per Lane	10.3125	Gb/s	
Protocols Supported	40G Ethernet		
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			10,313	Mb/sec	1
Bit Error Ratio	BER			10^{-12}		2
Link distance on OM3	d			140	m	
Link distance on OM4	d			160	m	
Link distance on SMF	d			1000	m	

Notes:

1. Adapted from 40GBASE-LR4, IEEE 802.3ba
2. Tested with a PRBS $2^{31}-1$ test pattern.

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	I _{cc}			1.13	A	
Link turn-on time						
Transmit turn-on time				2000	ms	2
Transmitter (per Lane)						
Single ended input voltage tolerance	V _{inT}	-0.3		4.0	V	
Differential data input swing	V _{in,pp}	120		1200	mV _{pp}	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	J _{t2}	0.17			UI	
J9 Jitter Tolerance	J _{t9}	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	V _{out,pp}	0		800	mV _{pp}	6
AC common mode output voltage (RMS)				7.5	mV	
Termination mismatch at 1 MHz				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	J _{o2}			0.42	UI	
J9 Jitter output	J _{o9}			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			mV _{pp}	

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 = $5 \times 10E-5$.
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			10.3125		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}			10.3	dBm	
Transmit OMA per Lane, MMF	TxOMA	-3.0		4.8	dBm	
Transmit OMA per Lane, SMF		-6.0		3.5		
Average Launch Power per Lane, MMF	TXP _x	-7.0		4.3	dBm	2
Average Launch Power per Lane, SMF		-10.0		2.3		
Optical Extinction Ratio	ER	3.5			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			10.3125		GBd	4
Lane center wavelengths (range)				1264.5 – 1277.5 1284.5 – 1297.5 1304.5 – 1317.5 1324.5 – 1337.5	nm	
Receive Power (OMA) per Lane, MMF	RxOMA			4.8	dBm	
Receive Power (OMA) per Lane, SMF				3.3		
Average Receive Power per Lane, MMF	RXP _x	-10.0		4.3	dBm	5,6
Average Receive Power per Lane, SMF		-13.7		2.3		
Receiver Sensitivity (OMA) per Lane, MMF	Rxsens			-10.5	dBm	
Receiver Sensitivity (OMA) per Lane, SMF				-10.5		
Stressed Receiver Sensitivity (OMA) per Lane, MMF	SRS			-5.0	dBm	
Stressed Receiver Sensitivity (OMA) per Lane, SMF				-8.5		
Damage Threshold per Lane	P _{MAX}			5.5	dBm	

Return Loss	RL			-20	dB	
Vertical eye closure penalty, per lane				3.6	dB	
Receive electrical 3 dB upper cutoff frequency, per lane				12.3	GHz	
LOS De-Assert	LOS _D			-12	dBm	7
LOS Assert	LOS _A	-28			dBm	7
LOS Hysteresis			1		dB	

Notes:

1. Transmitter consists of 4 lasers operating at 10.3Gb/s each.
2. Minimum value is informative.
3. RIN is scaled by $10 \cdot \log(10/4)$ to maintain SNR outside of transmitter.
4. Receiver consists of 4 photodetectors operating at 10.3Gb/s each.
5. Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.
6. SMF receiver sensitivity guaranteed by design, but not measured in production.
7. LOS Assert and De-Assert values are informative and may vary between MMF and SMF uses.

VI. Memory Map and Control Registers

Compatible with SFF-8636². Please see Finisar Application Note AN-2104⁶ for memory map details.

Although this module is designed for both multimode and single mode fiber operation, the Tx and Rx power monitors are calibrated for multimode fiber. Therefore, the DDM reading should be relied upon only for multimode operation.

VII. Environmental Specifications

Finisar FTL4C3QE1C 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 FTL4C3QE1C transceivers are RoHS-6 Compliant. Copies of certificates are available at Finisar Corporation upon request.

FTL4C3QE1C transceiver modules are Class 1 laser eye safety compliant per IEC 60825-1.

IX. Mechanical Specifications

The FTL4C3QE1C mechanical specifications are compliant to the QSFP+ MSA transceiver module specifications.

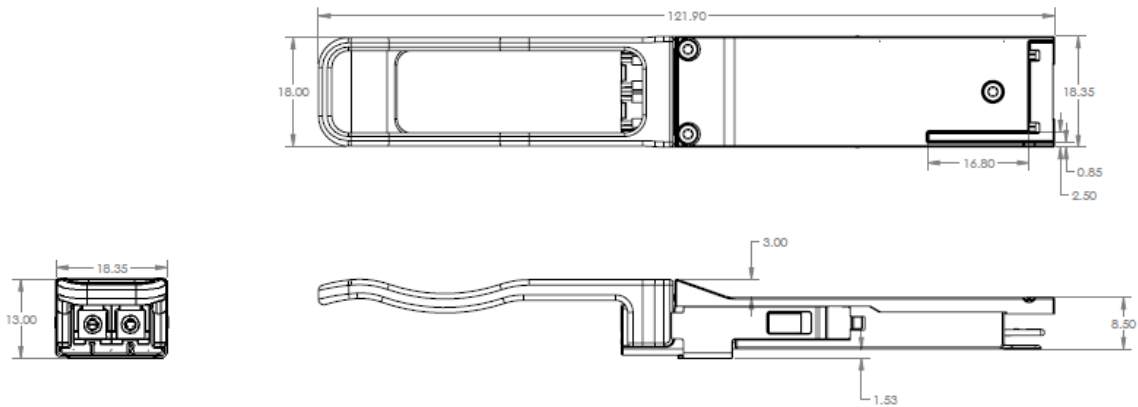


Figure 2 – FTL4C3QE1C mechanical drawing.

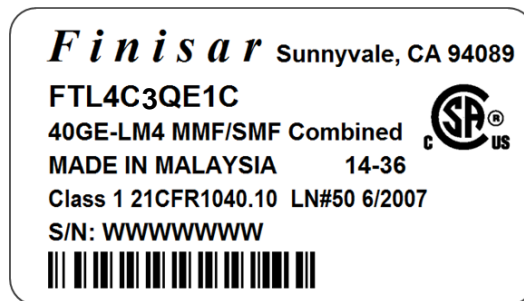


Figure 3 – FTL4C3QE1C label

X. References

1. SFF-8436 – Specification for QSFP+ Copper and Optical Transceiver, Rev 4.8, October 2013.
2. SFF-8636 – Common Management Interface, Rev. 2.3, October 2014.
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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