

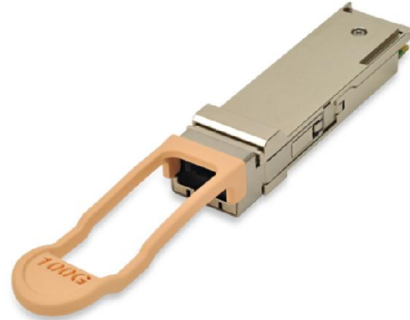
## Product Specification

### 128G Fibre Channel Parallel 100m MMF QSFP28 Optical Transceiver

#### FTLC9555FEPM

#### PRODUCT FEATURES

- Hot-pluggable QSFP28 form factor
- Supports up to 112.2Gb/s aggregate bit rates
- Power dissipation < 2.5W
- RoHS-6 compliant
- Commercial case temperature range of 0°C to 70°C
- Single 3.3V power supply
- Maximum link length of 100m on OM4 Multimode Fiber (MMF)
- 4x28Gb/s 850nm VCSEL-based transmitter
- 4x25G electrical interface
- Single MPO12 receptacle
- I2C management interface



#### APPLICATIONS

- 8/16/32/128G Fibre Channel\*

Finisar's FTLC9555FEPM 128G QSFP28 transceiver modules are designed for use in 16/32/128G Fibre Channel links over multimode fiber. They are compliant with the QSFP28 MSA<sup>1</sup>, 128GFC<sup>2</sup> and IEEE 802.3bm CAUI-4<sup>3</sup>. Digital diagnostics functions are available via the I2C interface, as specified by the QSFP28 MSA<sup>1</sup> and Finisar Application Note AN-2041<sup>4</sup>. The transceiver is RoHS-6 compliant per Directive 2011/65/EU<sup>5</sup> and Finisar Application Note AN-2038<sup>6</sup>.

**\*See section V for compliance information.**

#### PRODUCT SELECTION

### FTLC9555FEPM

- F: 128G FC maximum bit rate (112.2 Gb/s)
- E: 4x28G parallel optics
- P: Pull tab release
- M: MPO receptacle

### I. Pin Descriptions

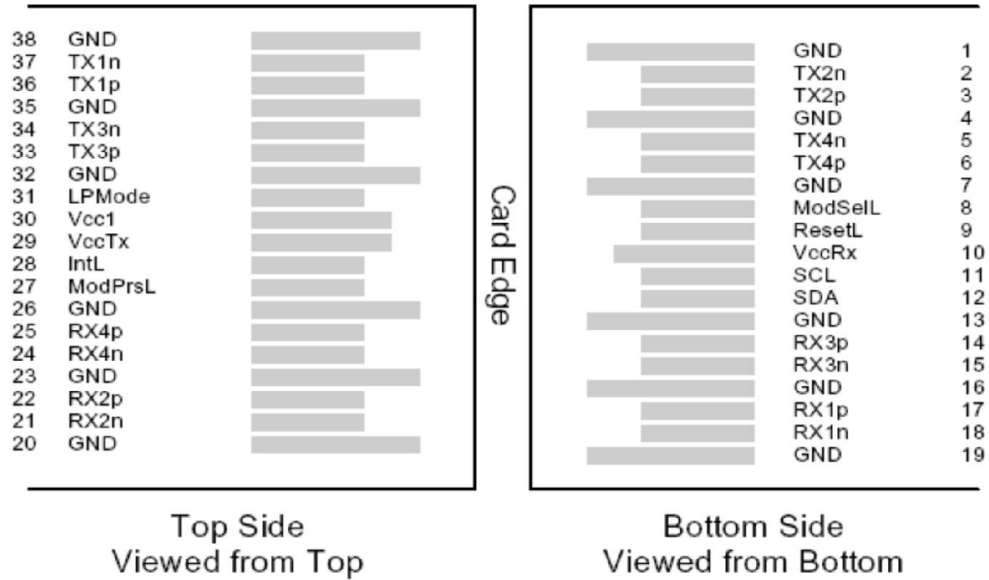


Figure 1 – QSFP28-compliant 38-pin connector (per SFF-8679)

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. Absolute Maximum Ratings

Module performance is not guaranteed beyond the operating range (see Section VI). Exceeding the limits below may damage the transceiver module permanently.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	Vcc	-0.5		4.0	V	
Storage Temperature	T <sub>S</sub>	-40		85	°C	
Case Operating Temperature	T <sub>OP</sub>	0		70	°C	1
Relative Humidity	RH	15		85	%	2
Receiver Damage Threshold, per Lane	P <sub>Rdmg</sub>	3.4			dBm	

#### Notes:

1. Can support temporary excursions of case operating temperature from -5 to -75 °C not exceeding 72 hours.
2. Non-condensing.

## III. Electrical Characteristics (EOL, T<sub>OP</sub> = 0 to 70 °C, V<sub>CC</sub> = 3.135 to 3.465 Volts)

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc	3.135		3.465	V	
Supply Current	Icc			1.5	A	
Module total power	P			2.5	W	1
<b>Transmitter</b>						
Signaling rate per lane		25.78		28.05	Gb/s	2
Differential data input voltage per lane	V <sub>in,pp,diff</sub>			900	mV	
Single-ended voltage tolerance	V <sub>in,pp</sub>	-0.35		+3.3	V	
Module stress input test		Per Section 13.3.11.2.1, OIF CEI-28G-VSR				
<b>Receiver</b>						
Signaling rate per lane		25.78		28.05	Gb/s	2
Differential data output swing	V <sub>out,pp</sub>	100		400	mVpp	3
		300		600		
		400	600	800		
		600		1200		
Eye width		0.57			UI	
Eye height, differential		228			mV	
Vertical eye closure	VEC	5.5			dB	
Transition time (20% to 80%)	t <sub>r</sub> , t <sub>f</sub>	12			ps	

**Notes:**

1. Maximum total power value is specified across the full operational temperature and voltage range when CDRs are locked or a lack of input signal results in squelch being activated. If incorrect frequencies cause the CDRs to continuously attempt to lock, maximum power dissipation may reach 3.5 W.
2.  $\pm 100\text{ppm}$
3. Output voltage is settable in 4 discrete ranges via I2C. Default range is 400 – 800 mV.

**IV. Optical Characteristics (EOL,  $T_{OP} = 0$  to  $70^{\circ}\text{C}$ ,  $V_{CC} = 3.135$  to  $3.465$  Volts)**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.			
<b>Transmitter</b>									
Signaling Speed per Lane		8.5		28.05	Gb/s	1			
Center wavelength		840		860	nm				
RMS Spectral Width	SW	128GFC per T.11			nm				
Average Launch Power per Lane	$\text{TXP}_x$							dBm	
Transmit OMA per Lane	$\text{TxOMA}$							dBm	
Difference in Power between any two lanes [OMA]	$\text{DP}_x$							dB	
Peak Power per Lane	$\text{PP}_x$							dBm	
Launch Power [OMA] minus TDP per Lane	P-TDP							dBm	
TDP per Lane	TDP							dBm	
Optical Extinction Ratio	ER							dB	
Optical Return Loss Tolerance	ORL							dB	
Encircled Flux	FLX							dBm	
Average launch power of OFF transmitter, per lane								dBm	
Relative Intensity Noise	RIN							dB/Hz	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}									
<b>Receiver</b>									
Signaling Speed per Lane		8.5		28.05	GBd	2			
Center wavelength		840		860	nm				
Damage Threshold	DT	128GFC per T.11			dBm				
Average Receive Power per Lane	$\text{RXP}_x$							dBm	
Receive Power (OMA) per Lane	$\text{RxOMA}$							dBm	
Stressed Receiver Sensitivity (OMA) per Lane	SRS							dBm	
Back to Back Receiver Sensitivity (OMA) per Lane	$\text{RxSens}$							dBm	
Peak Power, per lane	$\text{PP}_x$							dBm	
Receiver Reflectance	Rfl							dB	
Vertical eye closure penalty, per lane								dB	
Stressed eye J2 jitter, per Lane								UI	
Stressed eye J9 jitter, per Lane								UI	
OMA of each aggressor lane								dBm	
Receiver jitter tolerance [OMA], per Lane								dBm	
Rx jitter tolerance: Jitter frequency and p-p amplitude								kHz, UI	
								kHz, UI	
LOS De-Assert	$\text{LOS}_D$			-13	dBm				
LOS Assert	$\text{LOS}_A$	-30			dBm				
LOS Hysteresis		0.5	2		dB				

**Notes:**

1. Transmitter consists of 4 lasers operating at a maximum speed of 28.05Gb/s each.

- Receiver consists of 4 photodetectors operating at a maximum speed of 28.05Gb/s each.

## V. Data Rate and Reach Specifications

Finisar FTLC9555F QSFP28 Fibre Channel transceivers are compliant with 128G Fibre Channel (32GFC per lane), and compatible with 8GFC and 16GFC (per lane).

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Bit Rate (all wavelengths combined)	BR			112.2	Gb/s	1
Bit Error Ratio @28.05Gb/s	BER2			$5 \times 10^{-5}$		2
<b>Maximum Supported Distances</b>						
Fiber Type						
OM3 MMF	Lmax1			70	m	3
OM4 MMF	Lmax2			100	m	3

Notes:

- Supports 8/16/32/128G FC per T11.
- Tested with a  $2^{31} - 1$  PRBS.
- Requires FEC on the host to support maximum distance.

## VI. Environmental Specifications

Finisar FTLC9555 QSFP28 transceivers have a commercial operating case temperature range of 0°C to +70°C. They can support temporary excursions to case temperatures of -5°C and +75°C without permanent damage (see Section II).

Parameter	Symbol	Min	Typ	Max	Units	Ref.
Case Operating Temperature	T <sub>op</sub>	0		70	°C	
Storage Temperature	T <sub>sto</sub>	-40		85	°C	

## VII. Regulatory Compliance

Finisar FTLC9555 QSFP28 transceivers are Class 1 Laser Products. They are certified per the following standards:

Feature	Agency	Standard
Laser Eye Safety	FDA/CDRH	CDRH 21 CFR 1040 and Laser Notice 50
Laser Eye Safety	TÜV	EN 60825-1:2014 EN 60825-2:2004+A1+A2
Electrical Safety	TÜV	EN 60950-1:2006+A11+A1+A12+A2
Electrical Safety	UL/CSA	CAN/CSA-C22.2 No. 60950-1-07+A2:2014 ANSI/UL Std. No. 60950-1:2014

Copies of the referenced certificates will be available at Finisar upon request. Complies with FDA performance standards for laser products except for deviations pursuant to Laser Notice No. 50, dated June 24, 2007.

**CAUTION** – Use of Controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

**VIII. Digital Diagnostics Functions**

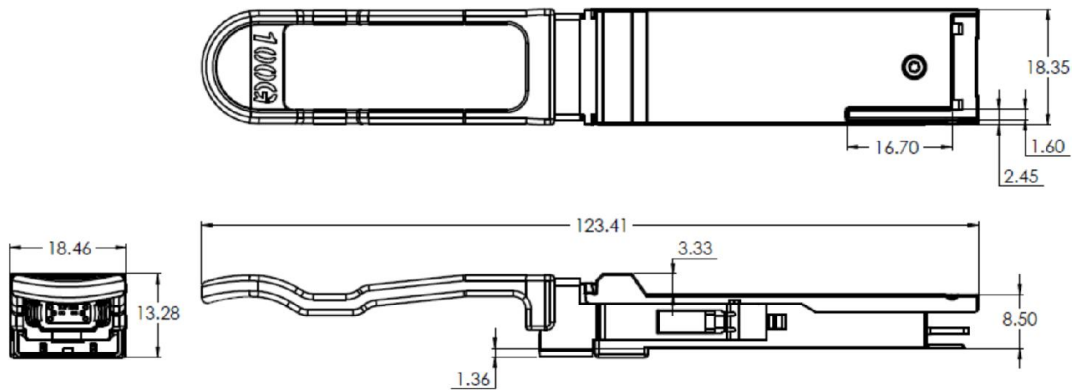
FTLC9555 QSFP28 transceivers support the I2C-based diagnostics interface specified by the QSFP28 MSA<sup>1</sup>. See Finisar Application Note AN-2041<sup>4</sup>.

**IX. Memory Contents**

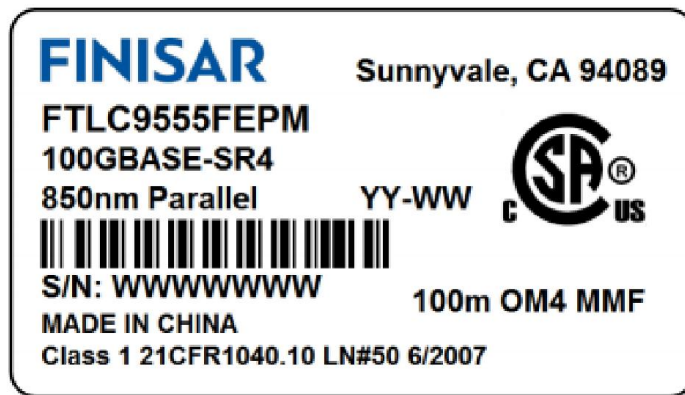
Per the QSFP28 MSA<sup>1</sup>. See Finisar Application Note AN-2041<sup>4</sup>.

**XI. Mechanical Specifications**

Finisar FTLC9555 QSFP28 transceivers are compatible with the MSA specification for QSFP28 pluggable form factor modules<sup>1</sup>.



**Figure 2. FTLC9555FEPM Mechanical Dimensions.**



**Figure 3. FTLC9555FEPM Product Label (not to scale)**

## **XII. References**

1. SFF-8665: “QSFP+ 28Gb/s 4X Pluggable Transceiver Solution (QSFP28)”, Rev 1.9, June 29, 2015 (and associated SFF documents)
  - i. SFF-8661
  - ii. SFF-8679
  - iii. SFF-8636
  - iv. SFF-8662
  - v. SFF-8663
  - vi. SFF-8672
  - vii. SFF-8683
2. 128G Fibre Channel Specification, per ANSI T.11.
3. IEEE 802.3bm CAUI-4.
4. Application Note AN-2041, Finisar Corporation.
5. Directive 2011/65/EU of the European Parliament and of the Council, “on the restriction of the use of certain hazardous substances in electrical and electronic equipment,” July 1, 2011.
6. “Application Note AN-2038: Finisar Implementation Of RoHS Compliant Transceivers”, Finisar Corporation, January 21, 2005.

### **For More Information:**

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[5803AZ](#) [TQS-Q1LH8-XCA03](#) [TQS-Q1LH8-XCA05](#) [TQS-Q1LH8-XCA10](#) [TQS-Q1LH9-2CA](#) [HFBR-1414Z](#) [HFBR-1527Z](#) [HFBR-1528Z](#)  
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