


## TSQL4-F22JE3C Optical Transceiver

Single-Mode 100GBASE-LR4 Transceiver, With Diagnostic Monitoring  
Duplex QSFP28 100G Ethernet 10Km Transceiver

### Features

- Supports 103Gbps
- I2C interface with integrated Digital Diagnostic Monitoring
- 4\*25Gbps DFB-based LAN-WDM transmitter
- PIN and TIA array on the receiver side
- 4x25G electrical interface
- Single 3.3V Power Supply and Power dissipation < 4W
- Distance up to 10km over SMF
- Duplex LC receptacles
- Operating case temperature: 0°C~+70°C
- RoHS Compliant 

### Applications

- 100GBASE-LR4 100G Ethernet

### Production Description

This product is a 100Gb/s transceiver module designed for optical communication applications compliant to 100GBASE-LR4 of the IEEE P802.3ba standard. The module converts 4 input channels of 25Gb/s electrical data to 4 channels of LAN WDM optical signals and then multiplexes them into a single channel for 100Gb/s optical transmission. Reversely on the receiver side, the module de-multiplexes a 100Gb/s optical input into 4 channels of LAN WDM optical signals and then converts them to 4 output channels of electrical data. The central wavelengths of the 4 LAN WDM channels are 1295.56, 1300.05, 1304.58 and 1309.14 nm as members of the LAN WDM wavelength grid defined in IEEE 802.3ba. The high performance cooled LAN WDM DFB transmitters and high sensitivity PIN receivers provide superior performance for 100Gigabit Ethernet applications up to 10km links and compliant to optical interface with IEEE802.3ba Clause 88 100GBASE-LR4 requirements. The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP+ Multi-Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

## Absolute Maximum Ratings

These values represent the damage threshold of the module. Stress in excess of any of the individual Absolute Maximum Ratings can cause immediate catastrophic damage to the module even if all other parameters are within Recommended Operating Conditions.

Parameters	Symbol	Min.	Max.	Unit
Power Supply Voltage	VCC	-0.5	+3.6	V
Storage Temperature	Tc	-40	+85	°C
Relative Humidity	RH	0	85	%

## Recommended Operating Environment

Parameter	Symbol	Min	Typical	Max	Unit
Power Supply Voltage	VCC	3.15	3.30	3.45	V
Operating Case Temperature	Tca	0		70	°C

## Electrical Characteristics

Parameter	Symbol	Min.	Typical	Max	Unit	Ref.
<b>Transmitter</b>						
Input differential impedance	Rin	-	100	-	Ω	1
Single-ended Input Voltage Tolerance		-0.3	-	4.0	V	
AC Common Mode Input Voltage Tolerance		15		-	mV	
Differential Input Voltage		50	-	-	mV	
Differential Input Voltage swing, per lane	Vin	190		1000	mV	
<b>Receiver</b>						
Output differential impedance	Rout		100		Ω	1
Differential Output Swing, per lane	Vout	300		900	mV	2
AC Common Mode Output Voltage Tolerance				7.5	mV	
Single-ended Output Voltage		-0.3		4.0	V	

### Notes:

[1] AC coupled.

[2] Into 100 ohm differential termination.

## Transmitter Specifications – Optical

Parameter	Symbol	Min	Typical	Max	Unit	Ref.
Bit Rate per Lane	DR	25.78125 ± 100ppm			Gb/s	1
Data Rate Variation		-100		100	ppm	
Lane_0 Center Wavelength	λ0	1294.53	1295.56	1296.59	nm	
Lane_1 Center Wavelength	λ1	1299.02	1300.05	1301.09	nm	

Information and specifications are subject to change without notice.  
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Lane_2 Center Wavelength	$\lambda_2$	1303.54	1304.58	1305.63	nm	
Lane_3 Center Wavelength	$\lambda_3$	1308.09	1309.14	1310.19	nm	
Total Average Output Power	Po			10.5	dBm	
Average Launch Power each Lane		-4.3		4.5	dBm	2,7
Optical Modulation Amplitude (OMA) each Lane	OMA	-1.3		4.5	dBm	
Difference in launch power between any two lanes (OMA)				5	dB	
Launch power in OMA minus TDP, each lane	OMA-TDP	-2.3			dBm	
Transmitter and dispersion penalty (TDP), each lane	TDP			2.2	dB	
Extinction Ratio	ER	4			dB	
Side-mode Suppression ratio	SMSR	30			dB	
Average launch power of OFF transmitter per lane	Poff			-30	dBm	
Transmitter Reflectance				-12	dB	
Optical Return Loss Tolerance	ORL			20	dB	
Transmitter eye mask definition {X1, X2, X3, Y1, Y2, Y3}	{0.25, 0.4, 0.45, 0.25, 0.28, 0.4}					3

## Receiver Specifications – Optical

Parameter	Symbol	Min	Typical	Max	Unit	Ref.
Bit Rate per Channel	DR	25.78125 $\pm$ 100ppm			Gb/s	4
Data Rate Variation		-100		100	ppm	
Lane_0 Center Wavelength	$\lambda_0$	1294.53	1295.56	1296.59	nm	
Lane_1 Center Wavelength	$\lambda_1$	1299.02	1300.05	1301.09	nm	
Lane_2 Center Wavelength	$\lambda_2$	1303.54	1304.58	1305.63	nm	
Lane_3 Center Wavelength	$\lambda_3$	1308.09	1309.14	1310.19	nm	
Average Receive Power per Lane	RXPOW	-10.6		4.5	dBm	5,7
Receive Power (OMA) per Lane				4.5	dBm	
Receive Sensitivity in OMA per Lane	Rsen			-8.6	dBm	
Stressed Receiver Sensitivity (OMA) per Lane	RXSRS			-6.8	dBm	6
Optical Return Loss	ORL			-26	dB	
LOS Assert	Lsa	-25			dBm	
LOS DE-Assert	Lda			-12	dBm	
LOS Hysteresis	Lh	0.5			dB	

### Notes:

- [1] Transmitter consists of 4 lasers operating at 25.78Gb/s each.
- [2] Minimum value is informative.
- [3] Hit ratio 5x10<sup>-5</sup>.
- [4] Receiver consists of 4 photodetectors operating at 25.78Gb/s each.
- [5] Minimum value is informative, equals min TxOMA with infinite ER and max channel insertion loss.
- [6] SRS is measured with vertical eye closure penalty of 1.8 dB max, J2 of 0.30 UI, and J9 of 0.47 UI.
- [7] Power value and power accuracy are with all channels on.

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## General Specifications

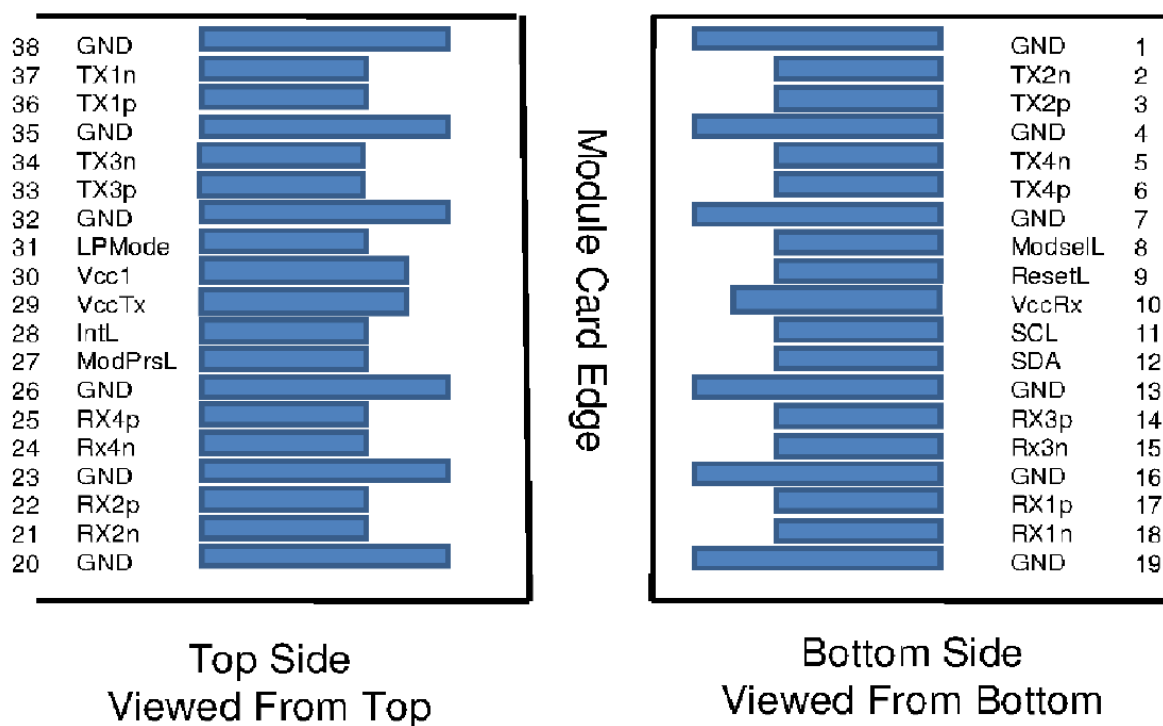
Parameter	Symbol	Min	Typical	Max	Unit	Ref.
Bit Rate (all wavelengths combined)	BR			103.1	Gb/s	1
Bit Error Ratio @25.78Gb/s	BER			10 <sup>-12</sup>		2
Maximum Supported Distances						
Fiber Type						
SMF per G.652	Lmax			10	km	

### Notes:

[1] Supports 100GBASE-LR4 per IEEE 802.3ba.

[2] Tested with a 231 – 1 PRBS.

## Qsfp28 Transceiver Electrical Pad Layout



## Pin Definition

Pin	Symbol	Name/Description
1	GND	Ground
2	Tx2n	Transmitter Inverted Data Input
3	Tx2p	Transmitter Non-Inverted Data Input
4	GND	Ground
5	Tx4n	Transmitter Inverted Data Input
6	Tx4p	Transmitter Non-Inverted Data Input
7	GND	Ground
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
14	Rx3p	Receiver Non-Inverted Data Output
15	Rx3n	Receiver Inverted Data Output
16	GND	Ground
17	Rx1p	Receiver Non-Inverted Data Output
18	Rx1n	Receiver Inverted Data Output
19	GND	Ground
20	GND	Ground
21	Rx2n	Receiver Inverted Data Output
22	Rx2p	Receiver Non-Inverted Data Output
23	GND	Ground
24	Rx4n	Receiver Inverted Data Output
25	Rx4p	Receiver Non-Inverted Data Output
26	GND	Ground
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
33	Tx3p	Transmitter Non-Inverted Data Input
34	Tx3n	Transmitter Inverted Data Input
35	GND	Ground
36	Tx1p	Transmitter Non-Inverted Data Input
37	Tx1n	Transmitter Inverted Data Input
38	GND	Ground

## Ordering Information

Part Number	Product Description
TSQL4-F22JE3C	100G QSFP28 LR4 10Km Ethernet 0°C ~ +70°C

## References

1. SFF-8636 Specification for QSFP28.
2. Ethernet 100GBASE-LR4

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