QSFP28-DTCZR

100G/OTN, QSFP28-DCO, DWDM Tunable ZR, 50/100GHZ, SMF Transceiver

Product Features

- Digital Coherent Optics module, hot-pluggable QSFP28 form factor
- IEEE 100G Ethernet (CAUI-4) or ITU-T 100G OTN (OTL4.4) compliant host interface
- 100G optical coherent interface with DP-DQPSK modulation and Staircase FEC per IEEE Std. 802.3-2022 100GBASE-ZR or ITU-T G.709.2
- Transmission reach:
  - Up to 80km unamplified (loss limited)
  - Up to 120km amplified (dispersion limited, optionally extendable to 300km)
- Full C-band tunable, 50GHz or 100GHz grid with optional FlextuneTM automatic wavelength tuning
- Power dissipation < 5.5W (C-temp) or < 6.0W (I-temp)
- Remote digital diagnostics monitoring
- Case operating temperature:
  - Commercial: 0 ~ 70°C
  - Industrial: -40 ~ +85°C

Product Applications

- 100G/OTN
- Access and aggregation networks
- Cable TV networks
- Wireless front-haul & mid-haul

Ordering Details	
Product Part Number	**Product Description**
QSFP28-DTCZR-8636	QSFP28-DCO SFF-8636, DWDM Tunable ZR, 50/100GHZ, SMF, 100G/OTN DDM
QSFP28-DTCZR-I-8636	QSFP28-DCO SFF-8636, DWDM Tunable ZR, 50/100GHZ, SMF, 100G/OTN DDM, I-Temp
QSFP28-DTCZR-CMIS	QSFP28-DCO CMIS, DWDM Tunable ZR, 50/100GHZ, SMF, 100G/OTN DDM
QSFP28-DTCZR-I-CMIS	QSFP28-DCO CMIS, DWDM Tunable ZR, 50/100GHZ, SMF, 100G/OTN DDM, I-Temp

I. Maximum Ratings

Exceeding the limits below may damage the transceiver module permanently.

Parameter	Conditions		Symbol	Min.	Typ.	Max	Units	Notes
DC Supply Voltage			Vcc	-0.3		3.6	V	
Low Speed I/O Voltages				-0.3		3.6	V	
Storage Temperature			Ts	-40		85	°C	
Case Operating Temperature	Commercial		Top	-5		75	°C	C-temp
	Industrial			-40		85		I-temp
Relative Humidity	Non-condensing		RH	5		95	%	
Rx Input Power			$P_{RX,in}$			10	dBm	
ESD Damage Threshold	Human body model (HBM)	DC pins		2000			V	
		RF pins		1000				

II. Operating Specifications

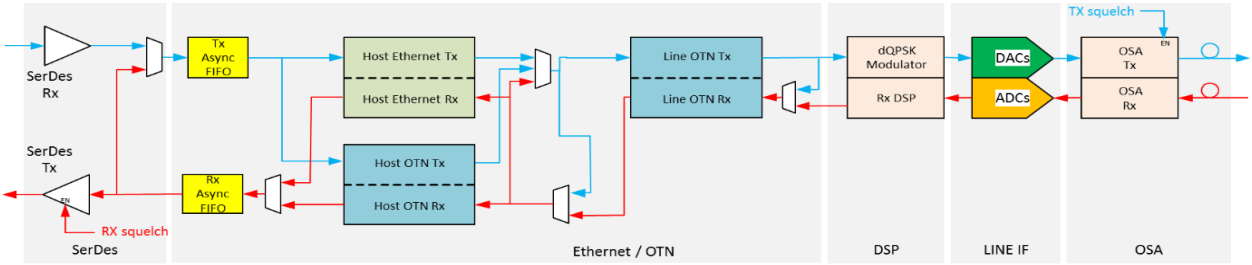
Parameter	Conditions		Symbol	Min.	Typ.	Max	Units	Notes
Storage Temperature			Ts	-40		85	°C	
Relative Humidity	Non-condensing		RH	5		85	%	
Case Operating Temperature	C-temp	Long term	Top	0		70	°C	
		Short term < 96h		-5		75		
	I-temp	Long term		-20		85		1
		Start-up		-40		85		

Notes:

1. No optical performance specifications need to be met during start-up at cold, but module will power up and respond to commands.

III. Data Path

[*High-level block diagram of QSFP28-DTCZR module data path*]



Host Interface Modes					
Host Interface ID [18]	**Host Interface Description [18]**	**Modulation**	**Forward Error Correction Code**	**Nominal Symbol Rate (GBd)**	**Supported Line Interface IDs [18]**
For QSFP28-DTCZR-8636 and QSFP28-DTCZR-CMIS (C-Temp and I-Temp versions)					
65 [8]	CAUI-4 C2M without FEC	NRV	None	25.78125	68, 192, 193
66 [8]	CAUI-4 C2M with RS(528,514) FEC	NRV	RS(528,514)	25.78125	68, 192, 193
For QSFP28-DTCZR-CMIS only (C-Temp and I-Temp versions)					
57 [9]	OTL4.4 (ITU-T G.709/ Y.1331 G.Sup58)	NRV	RS(255,239)	27.9525	192, 193

Line Interface Modes					
Line Interface ID [18]	**Line Interface Description [18]**	**Modulation**	**Forward Error Correction Code**	**Nominal Symbol Rate (GBd)**	**Supported Line Interface IDs [18]**
For QSFP28-DTCZR-8636 and QSFP28-DTCZR-CMIS (C-Temp and I-Temp versions)					
[68] 8	100GBASE-ZR (Clause 154)	DP-DQPSK	Staircase (SC)	27.9525	None
For QSFP28-DTCZR-CMIS only (C-Temp and I-Temp versions)					
192 [10]	OTU4 Long Reach	DP-DQPSK	Staircase (SC)	27.9525	None
193 [9]	OTU4 Short Reach	DP-DQPSK	RS (255, 239)	27.9525	None

Data Path Parameters							
Parameter	**Conditions**	**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Latency							
End-to-end Module Transit Delay	100G DQPSK SC line mode				17	µs	
	100G DQPSK RS line mode				3		
Delay Variation	100GE CAUI-4 host mode		-10		10	ns	1
	OTU4 OTL4.4 host mode		-6		6		

Notes:

1. Maximum delay variation for a pair of FTLC3351S3PLt modules over time, including cold restarts, when delay variation is filtered with a low-pass filter with 0.1Hz bandwidth. This is to support transparent transport of IEEE 1588-2019 Precision Time Protocol messages enabling Class C operation.

IV. Optical Characteristics

General							
Parameter	**Conditions**	**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Symbol Rate		R_{baud}		27.95		GBd	
Modulation Format				DP-DQPSK			
Channel Frequency Range	100 GHz grid	vC	191.400	193.700	196.1000	THz	
	50 GHz grid		191.350	193.700	196.100		
Channel Spacing	100 GHz grid	ΔvC		100		GHz	
	50 GHz grid			50			
Frequency Accuracy		δvC	-1.8		1.8	GHz	
Laser Intrinsic Linewidth	Calculated based on FM noise power spectral density (PSD)	LW			500	kHz	
Side-Mode Suppression Ratio	No modulation	SMSR	40			dB	
Relative Intensity Noise	Peak over 0.2GHz < f < 10GHz	RIN			-140	dB/Hz	

Transmitter							
Parameter	**Conditions**	**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Tx output power		$P_{Tx,out}$	-8		-4	dBm	
Tx output power monitor range		$P_{Tx,mon}$	-10		-2	dBm	
Tx output power monitor accuracy	Tx optical power monitor reading relative to actual Tx output power	$\delta P_{Tx,mon}$	-1.5		1.5	dB	
Tx output power during tuning or when Tx disabled		$P_{Tx,dark}$			-35	dBm	
Tx spectral excursion	ITU-T G.698.2 §7.2.3 [11]		-15		15	GHz	
Tx output power imbalance between X- and Y-polarizations		$\Delta P_{X/Y}$			1.5	dB	
Tx XY skew					6.0	ps	
Tx IQ offset					-25	dB	
Tx IQ imbalance					1.0	dB	
Tx quadrature error			-7.0		7.0	°	
Tx IQ skew					1.5	ps	
Tx error vector magnitude mask ratio	ITU-T G.698.2 §7.2.12 [11], with 24dB/0.1nm noise loading				23	%	
Tx in-band optical signal to noise ratio	Under modulation, |Δf| < 60 GHz	$OSNR_{in}$	40			dB/0.1nm	
Tx out-of-band optical signal to noise ratio	Under modulation, |Δf| > 60 GHz, excl. side mode peaks	$OSNR_{out}$	35				
Tx reflectance					-20	dB	

Receiver								
Parameter	**Conditions**		**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Rx total input power	Broadband		$P_{Rx,tot}$	-30		3	dBm	
Rx signal input power (amplified)	Full Rx OSNR tolerance		$P_{Rx,sig}$	-18		1	dBm	
	Extended range			-22		3		1
Rx OSNR tolerance	Back-to-back, $P_{Rx,sig}$ > -18dBm	100G DQPSK SC		16.5			dB/0.1nm	
		100G DQPSK RS		21.5				
CD tolerance	OSNR penalty < 0.5dB					2.4	ns/nm	
PMD tolerance	OSNR penalty < 0.5dB					10	ps	
DGD tolerance	OSNR penalty < 0.5dB					20	ps	
Tolerance to change in SOP	OSNR penalty < 0.5dB					50	krad/s	
PDL OSNR penalty	Change in principal state of polarization < 1rad/ms	1dB PDL				0.5	dB/0.1nm	
		2dB PDL				1.0		
		4dB PDL				3.0		
Rx signal input power transient amplitude	Peak excursion from steady state, transient within Rx signal input power (amplified) range, OSNR penalty < 0.5dB			-3		3	db	
Rx signal input power transient rise/fall time	Rise/fall time for the above peak excursion, OSNR penalty < 0.5dB			100			µs	
Rx signal input power (unamplified)	OSNR > 35dB/0.1nm	100G DQPSK SC		-30		1	dBm	
		100G DQPSK RS		-24		1		
Rx signal input power monitor range			$P_{Rx,mon(s)}$	-21		3	dBm	
Rx signal input power monitor accuracy			$\delta P_{Rx,mon(s)}$	-2.5		2.5	dB	
Rx total input power monitor range			$P_{Rx,mon(t)}$	-21		6	dBm	
Rx total input power monitor accuracy			$\delta P_{Rx,mon(t)}$	-2.0		2.0	dB	
Rx reflectance						-20	dB	

Notes:

1. Rx signal input power range over which performance can be guaranteed with <1dB OSNR penalty relative to Rx OSNR tolerance limit

v. Electrical Characteristics

Power & Low Speed I/O							
Parameter	**Conditions**	**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Power Supply - General							
Power supply voltages	Including ripple, droop and noise below 100kHz		3.135	3.300	3.465	V	
Host RMS noise output	10Hz - 10MHz				25	mV	
Module RMS noise output	10Hz - 10MHz				15	mV	
Module supply noise tolerance	10Hz - 10MHz, peak-to-peak	$PSNR_{mod}$			66	mV	
Module inrush	Instantaneous peak duration	T_{ip}			50	µs	
	Initialization time	T_{init}			500	ms	
Power Supply - Low Power Mode							
Power dissipation		P_{lp}			1.5	W	
Power supply current	Instantaneous peak current	$I_{CC,ip,lp}$			600	mA	
	Sustained peak current	$I_{CC,sp,lp}$			495		
	Steady state current	$I_{CC,lp}$			478		1
Power Supply - High Power Mode : QSFP28-DTCZR-8636 and QSFP28-DTCZR-CMIS (C-temp)							
Power dissipation		P_{hp}			5.5	W	
Power supply current	Instantaneous peak current	$I_{CC,ip,hp}$			2200	mA	
	Sustained peak current	$I_{CC,sp,hp}$			1815		
	Steady state current	$I_{CC,hp}$			1754		1
Power Supply - High Power Mode : QSFP28-DTCZR-I-8636 and QSFP28-DTCZR-I-CMIS (I-temp)							
Power dissipation		P_{hp}			6.0	W	
Power supply current	Instantaneous peak current	$I_{CC,ip,hp}$			2400	mA	
	Sustained peak current	$I_{CC,sp,hp}$			1980		
	Steady state current	$I_{CC,hp}$			1914		1

Power & Low Speed I/O (continued)							
Parameter	**Conditions**	**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Low speed I/O							
Clock frequency, SCL	Default	fSCL		400		kHz	
	Fast mode+			1000			
Output voltage, SCL and SDA	Output low	VOL	0.0		0.4	V	
	Output high	VOH	V_{CC}-0.5		V_{CC}+0.3		
Input voltage, SCL and SDA	Input low	VIL	-0.3		0.3×V_{CC}	V	
	Input high	VIH	0.7×V_{CC}		V_{CC}+0.5		
Capacitance for SCL and SDA I/O signal		Ci			14	pF	
Total bus capacitive load for SCL and SDA	400kHz clock rate			100		pF	2
		3.0kΩ pull-up resistor, max.		200	pF		
Input voltage / current, LPMode/TxDis, ResetL and ModSelL	Input voltage, low	VIL	-0.3		0.8	V	
	Input voltage, high	VIH	2.0		V_{CC}+0.3		
	Input current, 0V < V_{in} < V_{CC}	Iin	-365		125	µA	
Output voltage, ModPrsL and IntL/RxLOSL	Output low, I_{OL} = 2mA	VOL	0.0		0.4	V	
	Output high, 10kΩ pull-up resistor to host V_{CC}	VOH	V_{CC}-0.5		V_{CC}+0.3		

Notes:

1. The module will stay within its advertised power class for all supply voltages.
2. For 1000kHz clock rate, refer to Figure 6-4 in [2]

High Speed Data I/O (continued)							
Parameter	**Conditions**	**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Transmitter (module input) – CAUI-4							
Signaling rate per lane			Per IEEE Std 802.3 [8], Annex 83E, Table 83E–7			GBd	
Differential pk-pk input voltage tolerance						mV	
Differential input return loss						dB	
Differential to common mode input return loss						dB	
Differential termination mismatch						%	
Module stressed input test							
Single-ended voltage tolerance range						V	
DC common mode voltage						mV	
Transmitter (module input) – OTL4.4							
Overload differential voltage pk-pk			Per OIF-CEI-04.0 [14], Clause 13 CEI-28G-VSR, Table 13-2			mV	
Common mode voltage						mV	
Differential termination resistance mismatch						%	
Differential return loss						dB	
Differential mode to common mode conversion						dB	
Stressed input test							
Receiver (module input) – CAUI-4							
Signaling rate per lane			Per IEEE Std 802.3 [8], Annex 83E, Table 83E–3			GBd	
AC common-mode output voltage						mV	
Differential peak-to-peak output voltage						mV	
Eye width						UI	
Eye height, differential						mV	
Vertical eye closure						dB	
Differential output return loss						dB	
Common to differential mode conversion return loss						dB	
Differential termination mismatch						%	
Transition time						ps	
DC common mode voltage						mV	

High Speed Data I/O (continued)							
Parameter	**Conditions**	**Symbol**	**Min.**	**Typ.**	**Max**	**Units**	**Notes**
Receiver (module input) – OTL4.4							
Differential voltage, pk-pk			Per OIF-CEI-04.0 [14], Clause 13 CEI-28G-VSR, Table 13-4			mV	
Common mode voltage						mV	
Common mode noise, RMS						mV	
Differential termination resistance mismatch						%	
Differential return loss						dB	
Common mode to differential mode conversion						dB	
Common mode return loss						dB	
Transition time						ps	
Vertical eye closure						dB	
Eye width						UI	
Eye height						mV	

VI. Module Timing Characteristics

Parameter	Conditions	Symbol	Min.	Typ.	Max	Units	Notes
Tx Turn on time	Warm Start				10	s	1
	Cold Start				120	s	
Rx acquisition time	Warm Start				30	ms	
	Cold Start				120	s	
Tx/Rx channel tuning time					30	s	

Notes:

1. Assumes the Tx/Rx laser is already tuned to the correct frequency

Warranty
https://pivotaloptics.com/warranty/

Disclaimer
External physical characteristics are subject to variation. This may include, but is not limited to, external case designs, pull tab colors and/or shapes, removal latch styles or colors, and label sizes and placement. These variations do not affect the function or characteristics of the transceivers.