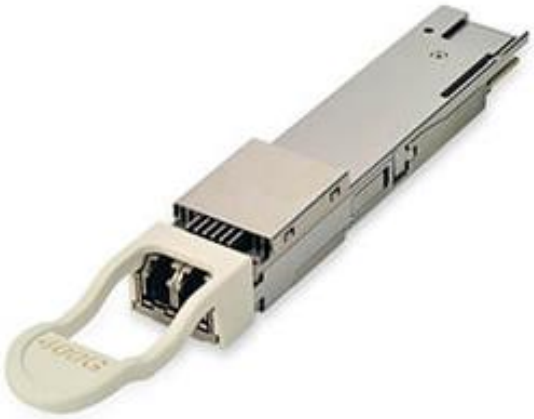
QSFP56-DD-ZR+-HP

400G Coherent DWDM, QSFP56-DD DCO, ZR (High Tx Power), OpenZR+ SMF TRANSCEIVER DUPLEX LC CONNECTOR

Product Features

- Digital Coherent Optics module, QSFP-DD form factor, Type 2A
- IEEE 400GE or n×100GE (n = 1…4) Ethernet compliant host interface
- Coherent 400G/300G/200G/100G optical interface based on OpenZR+ MSA
- High Tx output power (0dBm) and Tx OSNR for compatibility with deployed ROADM line systems
- Transmission reach > 600km at 400G, with extended reaches at lower data rates
- Full C-band tunable with flexible grid support
- Power dissipation < 22.5W
- Case operating temperature:
  - Commercial: 0 ~ 70°C



Product Applications

- Data center interconnect
- Metro / regional ROADM networks

I. Maximum Ratings

Exceeding the limits below may damage the transceiver module permanently.

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit	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			Top	-5		75	°C	
Relative Humidity	Non-condensing		RH	5		95	%	
Rx Input Power			$P_{RX,IN}$			18	dBm	
ESD damage threshold	HBM	DC pins			2000		V	
		RF pins			1000			

II. Operating Specifications

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	Notes
Storage Temperature		Ts	-40		85	°C	
Case Operating Temperature		Top			70	°C	
Relative Humidity	Non-condensing	RH	5		85	%	

III. Host and Line Interface Modules

A. Host Interface Modules

Host Interface ID	Host Interface Description	Modulation	Forward Error Correction Code	Nominal Symbol Rate (GBd)	Supported Line Interface IDs
17	400GAUI-8	PAM4	RS(544,514)	26.5625	70, 62
13	4 × 100GAUI-2	PAM4	RS(544,514)	26.5625	70, 62
13	3 × 100GAUI-2	PAM4	RS(544,514)	26.5625	71
13	2 × 100GAUI-2	PAM4	RS(544,514)	26.5625	72
13	100GAUI-2	PAM4	RS(544,514)	26.5625	73

B. Line Interface Modules

Line Interface ID	Line Interface Description	Modulation	Forward Error Correction Code	Nominal Symbol Rate (GBd)	Spectral Shaping
70	ZR400-OFEC-16QAM	16QAM	O-FEC	60.1385	None
71	ZR300-OFEC-8QAM	8QAM	O-FEC	60.1385	None
72	ZR200-OFEC-QPSK	QPSK	O-FEC	60.1385	None
73	ZR100-OFEC-QPSK	QPSK	O-FEC	30.0693	None
62	400ZR, DWDM, Amplified	16QAM	C-FEC	59.8438	None

IV. Electrical Characteristics

A. Power & Low Speed I/O

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	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	40Hz - 10MHz				25	mV	
Module RMS noise output	10Hz - 10MHz				30	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	$I_{CC,lp}$			475		
Power Supply - High Power Mode							
Power dissipation		P_{lp}			22.5	W	
Power supply current	Instantaneous peak current	$I_{CC,ip,hp}$			9.0	A	
	Sustained peak current	$I_{CC,sp,hp}$			7.5		
	Steady state current	$I_{CC,hp}$			7.2		
Low Speed I/O							
Output voltage, SCL and SDA	Output Low	V_{OL}	0.0		0.4	V	
	Output High	V_{OH}	Vcc-0.5		Vcc+0.3		
Input voltage, SCL and SDA	Input Low	V_{IL}	-0.3		0.3xVcc	V	
	Input High	V_{IH}	0.7xVcc		Vcc+0.5		
Capacitance for SCL and SDA I/O signal		Ci			14	pF	
Total bus capacitive load for SCL and SDA	400kHz clock rate, 3.0kΩ pull-up, max.	Cb			100	pF	1
	400kHz clock rate, 1.6kΩ pull-up, max.				200		

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	Notes
Input voltage / current, InitMode, ResetL and ModSelL	Input voltage, Low	V_{IL}	-0.3		0.8	V	
	Input voltage, High	V_{IH}	2.0		Vcc+0.3		
	Input current, 0V < V_{in} < V_{CC}	$\|I_{in}\|$			360	µA	
Output voltage, IntL	Output low, I_{OL} = 2mA	V_{OL}	0.0		0.4	V	
	Output high, 10kΩ pull-up resistor to host V_{CC}	V_{OH}	Vcc-0.5		Vcc+0.3		
Output voltage, ModPrsL	Output low, I_{OL} = 2mA	V_{OL}	0.0		0.4	V	2
	Output high	V_{OH}					

Notes:

1. For 1000kHz clock rate refer to Figure 6 in QSFP-DD MSA “QSFP-DD/QSFP-DD800/QSFP112 Hardware Specification for QSFP Double Density 8× and QSFP 4× Pluggable Transceivers” Revision 6.3 (July 26, 2022).
2. ModPrsL can be implemented as a short-circuit to GND on the module.

B. High Speed Data I/O

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Transmitter (module input) - 400GAUI-8, 100GAUI-2						
Signaling rate per lane		Per IEEE Std 802.3 [IEEE Computer Society “IEEE Standard for Ethernet”, IEEE Std. 802.3TM-2022], Annex 120E, Table 120E–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	

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Receiver (module output) - 400GAUI-8, 100GAUI-2						
Signaling rate per lane		Per IEEE Std 802.3 [IEEE Computer Society "IEEE Standard for Ethernet", IEEE Std. 802.3TM-2022], Annex 120E, Table 120E–3			GBd	
AC common-mode output voltage					mV	
Differential peak-to-peak output voltage					mV	
Near-end ESMW					UI	
Near-end eye height, differential					mV	
Far-end ESMW					UI	
Far-end eye height, differential					mV	
Far-end pre-cursor ISI ratio					%	
Differential output return loss					dB	
Common to differential mode conversion return loss					dB	
Differential termination mismatch					%	
Transition time					ps	
DC common mode voltage					mV	

V. Optical Characteristics

A. General

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	Notes
Symbol rate		R_{baud}	30.07		60.14	GBd	
Modulation format			16QAM, 8QAM, QPSK				
Channel frequency range		V_C	191.300		196.100	THz	
Channel spacing	Flexible grid	ΔV_C	6.25	100		GHz	
Frequency accuracy		δV_C	-1.5		1.5	GHz	
Frequency fine tune range	Fine tuning with Tx output enabled (bright tuning)	v_{adj}	-6.25		6.25	GHz	
Frequency fine tune resolution					0.10	GHz	
Laser intrinsic linewidth	Calculated based on FM noise power spectral density (PSD) measurement	LW			300	KHz	
Side-mode suppression ratio	No modulation	SMSR	40			dB	
Relative intensity noise	Peak over 0.2GHz < f < 10GHz	RIN			-140	dB/Hz	
	Average over 0.2GHz < f < 10GHz				-145		

B. Transmitter

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit	Notes
Tx output power configurable range			$P_{Tx,out}$	-6	0	1	dBm	1
Tx output power adjustment resolution						0.1	dB	
Tx output power tolerance			$\delta P_{Tx,out}$	-1.0		1.0	dB	2
Tx output power monitor range			$P_{Tx,m}$	-8		2	dBm	
Tx output power monitor accuracy			$\delta P_{Tx,m}$	-1.0		1.0	dB	3
Tx output power during tuning or when Tx disabled			$P_{Tx,dark}$			-40	dBm	
Tx output power imbalance between X- and Y-polarizations			$\Delta P_{X/Y}$			1.0	dB	
Tx XY skew						5.0	ps	
Tx IQ offset						-26	dB	
Tx IQ imbalance						0.8	dB	
Tx quadrature error				-5.0		5.0	°	
Tx IQ skew						0.75	ps	
Tx in-band optical signal to noise ratio	Under modulation, $\lvert\Delta f\rvert$ < 150 GHz		$OSNR_{in}$	40			dB/ 0.1nm	
Tx out-of-band optical signal to noise ratio	Under modulation, $\lvert\Delta f\rvert$ > 150 GHz, excluding side mode peaks	Max PTx,out	$OSNR_{out}$	40			dB/ 0.1nm	
		Min PTx,out		35				
Tx reflectance						-27	dB	

Notes:

1. Range of target Tx output power values for which other Tx specifications can be maintained.
2. Deviation from target value under closed loop control, over all operating conditions and life.
3. Tx optical output power monitor reading relative to actual Tx output power.

C. Receiver

Parameter	Conditions		Symbol	Min.	Typ.	Max.	Unit	Notes
Rx total input power			$P_{Rx,tot}$	-30		13	dBm	
Rx signal input power (amplified)	Full Rx OSNR tolerance		$P_{Rx,sig}$	-12		0	dBm	
	Extended range	ZRx00-OFEC		-18		3		1
		400ZR		-15		1		
Rx OSNR tolerance	ZR400-OFEC-16QAM			23.5			dB/ 0.1nm	
	ZR300-OFEC-8QAM			20.0				
	ZR200-OFEC-QPSK			15.0				
	ZR100-OFEC-QPSK			12.0				
	400ZR			26.0				
CD tolerance OSNR penalty < 0.5dB	ZR400-OFEC-16QAM					12.0	ns/nm	2
	ZR300-OFEC-8QAM					18.0		
	ZR200-OFEC-QPSK					24.0		
	ZR100-OFEC-QPSK					48.0		
	400ZR			-2.4		2.4		
PMD tolerance OSNR penalty < 0.5dB	ZR400-OFEC-16QAM					20	ps	2
	ZR300-OFEC-8QAM					25		
	ZR200-OFEC-QPSK					25		
	ZR100-OFEC-QPSK					30		
	400ZR					10		
Tolerance to change in SOP OSNR penalty < 0.5dB	ZR400-OFEC-16QAM					100	krad/s	2
	ZR300-OFEC-8QAM					180		
	ZR200-OFEC-QPSK					300		
	ZR100-OFEC-QPSK					600		
	400ZR					60		
Polarization dependent loss OSNR penalty	QPSK	1dB PDL				0.3	dB	
		2dB PDL				0.5		
		4dB PDL				1.5		
	8QAM, 16QAM	1dB PDL				0.5		
		2dB PDL				1.0		
		4dB PDL				2.0		

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	Notes
Rx signal input power transient amplitude	Peak excursion from steady state (within Rx signal input power range)		-7		7	dB	
Rx signal input power transient rise/fall time			0.1			ms	
Rx signal input power (unamplified) OSNR > 35dB/0.1nm	ZR400-OFEC-16QAM		-23		0	dBm	
	ZR300-OFEC-8QAM		-26		0		
	ZR200-OFEC-QPSK		-30		0		
	ZR100-OFEC-QPSK		-32		0		
	400ZR		-20		0		
Rx signal input power monitor range		$P_{Rx,m(s)}$	-22		1	dBm	
Rx signal input power monitor accuracy		$\delta P_{Rx,m(s)}$	-2.0		2.0	dB	
Rx total input power monitor range		$P_{Rx,m(t)}$	-22		3	dBm	
Rx total input power monitor accuracy	-22dBm to -18dBm	$\delta P_{Rx,m(t)}$	-2.0		2.0	dB	
	-18dBm to+3dBm		-1.5		1.5		
	+3dBm to +13dBm		-2.0		2.0		
Rx reflectance					-27	dB	

Notes:

1. Rx signal input power range over which performance can be guaranteed with <1dB OSNR penalty relative to Rx OSNR tolerance limit.
2. Rx OSNR penalty is specified for Rx signal input powers < 0dBm.

VI. Module Timing Characteristics

Parameter	Conditions	Symbol	Min.	Typ.	Max.	Unit	Notes
Optical							
Tx turn on time	Warm Start				100	ms	
	Cold Start				150	s	
Rx acquisition time	Warm Start				30	ms	
	Cold Start				150	s	
Tx/Rx channel tuning time					30	s	

VII. Ordering Information

Pivotal Part Number	Description
QSFP56-DD-ZR+-HP	QSFP56-DD DCO, 400G Coherent DWDM, High Tx Power OpenZR+ SMF, LC DDM, C-Temp

Notes:

1. Please contact sales for specific OEM Platform part numbers to fit your network.

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.