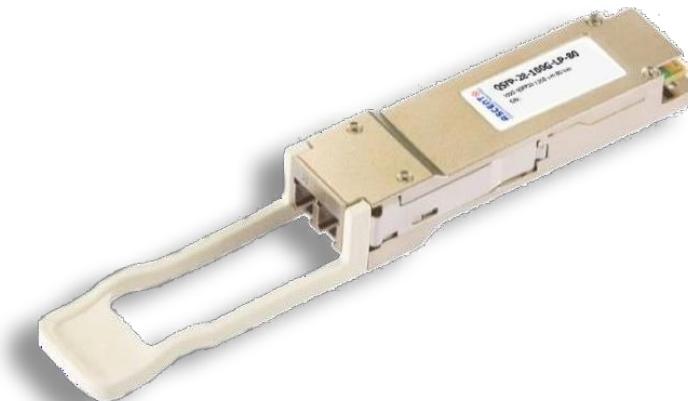


QSFP28 ZR4 100 Gb/s 80 km Transceiver

QSFP28 Series

- **Up to 103.125 Gbps data rate**
- **Up to 80 km transmission distance on SMF**
- **Tx/Rx Wavelength: 1295.56, 1300.05, 1304.58, 1309.14 nm**
- **EML-cooled LAN WDM TOSA laser**
- **27 dB optical budget**
- **Double LC connectors**
- **Supports DDM/DOM**
- **≤6.5 W power consumption**



Ascent's QSFP28-100G-LP80 is MSA compatible 100GBASE-ZR4 QSFP28 (Quad Small Form-Factor Pluggable 28) transceiver, operating over a pair of single-mode optical fibers with four independent optical communication lanes separated from each other using LAN WDM technology. It is widely deployed by Internet Service Provider (ISP) Fiber to the Home Aggregation and Backbone, Mobile Operator Core Networks and Mobile Backhaul and Data Center networking site interconnections.

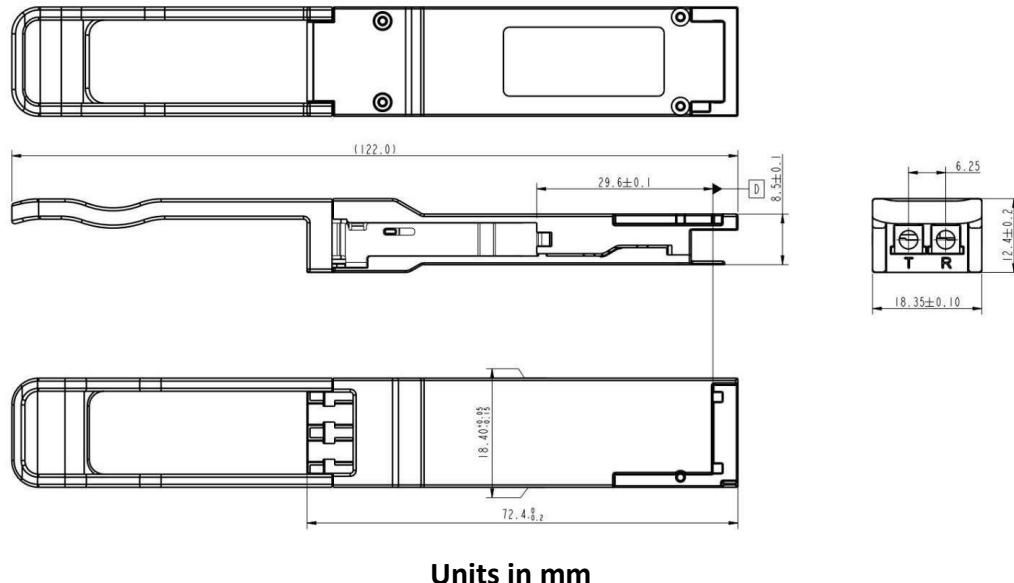
The module uses EML cooled 4x25Gb/s LAN WDM TOSA (1295.56, 1300.05, 1304.58, 1309.14nm) laser transmitters and 4x25Gb/s SOA+PIN receivers. It has a minimum guaranteed optical budget of 27 dB (with host FEC), which in most cases is enough to reach 80 km distance (with host FEC) and 40 km distance (without host FEC) using a single-mode cable.

The module supports DDM/DOM optical diagnostics, which provide diagnostic information about the present operating conditions. Additionally, the module supports a KR4 FEC (Forward Error Correction) function which will help the receiving side detect and correct bit errors and improve the overall quality of the link. QSFP28-100G-LP80 operates in a 0 °C to +70 °C temperature range and has double LC connectors connections.

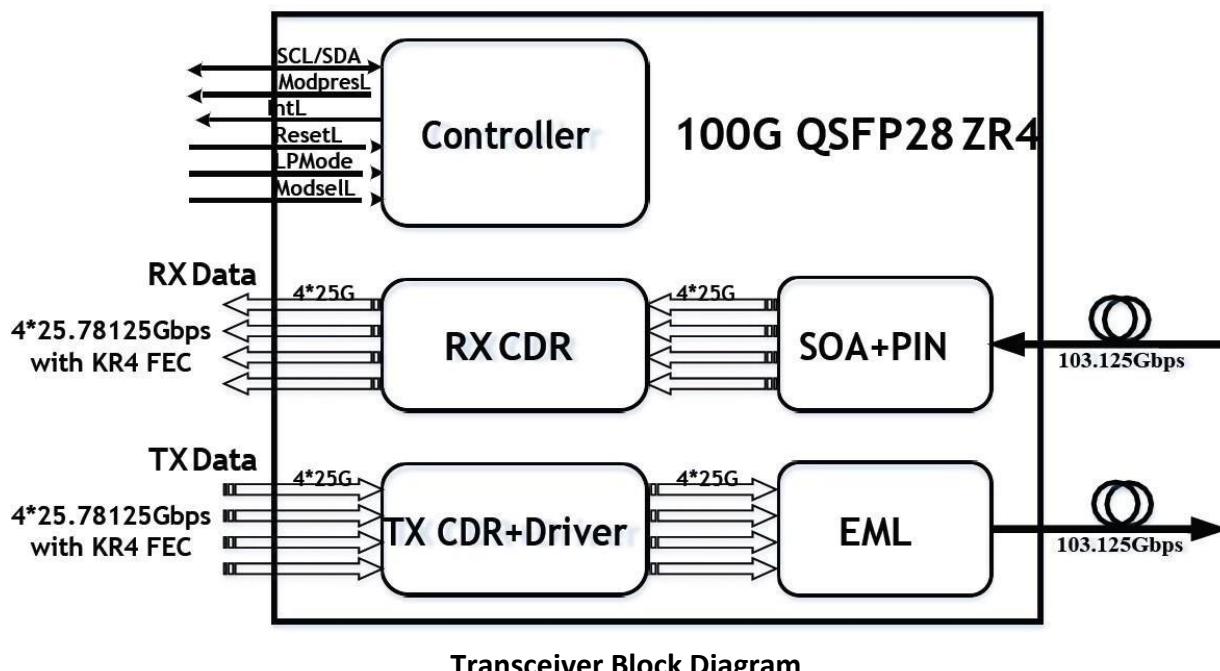
Key Features

- 100GBASE-ZR4 QSFP28
- Multi-vendor MSA compatible
- Tx/Rx Wavelength: 1295.56, 1300.05, 1304.58, 1309.14 nm
- EML-cooled LAN WDM TOSA laser
- Single-mode fiber (SMF)
- Double LC connectors
- 27 dB optical budget (with host FEC)
- Max. distance: 80 km (with host FEC), 40 km (no host FEC)
- 103.125 Gbps data rate
- FEC Forward Error Correction: KR4 FEC Supported
- Supports DDM/DOM
- ≤ 6.5 W power consumption
- 0 °C to +70 °C temperature range
- Compatible with Juniper

Outline Diagram



Transceiver Block Diagram



Transceiver Block Diagram

ModSelL:

The ModSelL is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple modules on a single 2-wire interface bus. When the ModSelL is "High", the module shall not respond to or acknowledge any 2-wire interface communication from the host. ModSelL signal input node shall be biased to the "High" state in the module. In order to avoid conflicts, the host system shall not attempt 2-wire interface communications within the ModSelL de-assert time after any modules are deselected. Similarly, the host shall wait at least for the period of the ModSelL assert time before communicating with the newly selected module. The assertion and de-asserting periods of different modules may overlap as long as the above timing requirements are met.

ResetL:

The ResetL pin shall be pulled to Vcc in the module. A low level on the ResetL pin for longer than the minimum pulse length (t_{Reset_init}) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time (t_{init}) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset (t_{init}) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by asserting "low" an IntL signal with the Data_Not_Ready bit negated. Note that on power up (including hot insertion) the module should post this completion of reset interrupt without requiring a reset.

LPMode:

The LPMode pin shall be pulled up to Vcc in the module. The pin is a hardware control used to put modules into a low power mode when high. By using the LPMode pin and a combination of the Power override, Power_set and High_Power_Class_Enable software control bits (Address A0h, byte 93 bits 0, 1, 2).

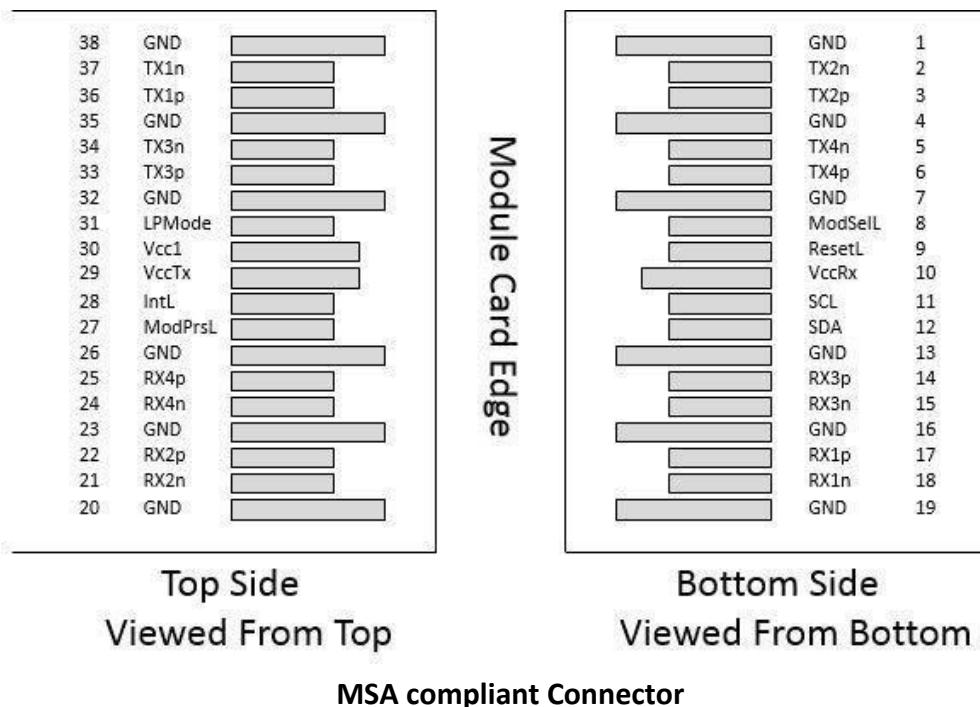
ModPrsL:

ModPrsL is pulled up to Vcc_Host on the host board and grounded in the module. The ModPrsL is asserted "Low" when inserted and de-asserted "High" when the module is physically absent from the host connector.

IntL:

IntL is an output pin. When IntL is "Low", it indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt using the 2-wire serial interface. The IntL pin is an open collector output and shall be pulled to host supply voltage on the host board. The INTL pin is deasserted "High" after completion of reset, when byte 2 bit 0 (Data Not Ready) is read with a value of '0' and the flag field is read.

Pin Assignment



Pin	Symbol	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	+3.3V 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 Non-Inverted Data Output	
25	Rx4p	Receiver Inverted Data Output	
26	GND	Ground	1
27	ModPrsL	Module Present	
28	IntL	Interrupt	
29	Vcc Tx	+3.3V Power supply transmitter	
30	Vcc1	+3.3V 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.

Specifications

Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Maximum Supply Voltage	Vcc	0		3.6	V	
Storage Temperature	Ts	-40		85	°C	
Relative Humidity	RH	5		85	%	1
Damage Threshold, each lane	THd	6.5			dBm	

Notes

1. Non-condensing

Operating Environments

Electrical and optical characteristics below are defined under this operating environment, unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Supply Voltage	Vcc	3.135	3.3	3.465	V	
Case Temperature	Top	0		70	°C	Commercial
		-40		85	°C	Industrial
Link Distance with G.652				80	k m	

Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Power Dissipation				6.5	W	
Supply Current	Icc			1.8759	A	Steady state
Transmitter						
Data Rate, each Lane			25.78125		Gbps	
Differential Voltage pk-pk	Vpp			900	mV	At 1 MHz
Common Mode Voltage	Vcm	-350		2850	mV	
Transition Time	Trise/Tfall	10			ps	20 % to 80 %
Differential Termination				10	%	
Resistance Mismatch						
Eye Width	EW15	0.46			UI	
Eye Height	EH15	95			mV	
Receiver						
Data Rate, each Lane			25.78125		Gbps	
Differential Termination				10	%	At 1 MHz
Resistance Mismatch						
Differential Output Voltage Swing	Vout, pp			900	mV	
Common Mode Noise, RMS	Vrms			17.5	mV	
Transition Time	Trise/Tfall	12			ps	20 % to 80 %
Eye Width	EW15	0.57			UI	
Eye Height	EH15	228			mV	

Optical Characteristics

100GBASE-ZR4 Operation (EOL, TOP = 0 to +70 °C, VCC = 3.135 V to 3.465 V)

Parameter	Unit	Min	Typ.	Max.	Notes
Transmitter					
Signaling Speed per Lane	Gb/s	25.78125 ± 100 ppm			
Transmit Wavelengths	nm	1294.53		1296.59	1295.56 nm
		1299.02		1301.09	1300.05 nm
		1303.54		1305.63	1304.58 nm
		1308.09		1310.19	1309.14 nm
Side-Mode Suppression Ratio (SMSR)	dB	30			
Total Launch Power (P_{total})	dBm	8.0		12.5	
Average Launch Power, each Lane (P_{each})	dBm	2.0		6.5	
Average Launch Power of OFF Transmitter, each Lane	dBm			-30	
Optical Extinction Ratio (ER)	dB	8			
RIN OMA	dB/Hz			-130	
Optical Return Loss Tolerance	dB			20	
Transmitter Reflectance	dB			-12	
Transmitter Eye Mask Definition {X1, X2, X3, Y1, Y2, Y3}			IEEE 802.3 Clause 88 100Gbase-ZR4 + KR4-FEC, {0.25, 0.4, 0.45, 0.25, 0.28, 0.4}		1
Mask Margin	%	5			
Receiver					
Signaling Speed per Lane	Gb/s	25.78125 ± 100 ppm			
Receiver Wavelengths	nm	1294.53		1296.59	
		1299.02		1301.09	
		1303.54		1305.63	
	nm	1308.09		1310.19	
Damage Threshold (R_{dam})	dBm	6.5			
Average Receiver Power, each Lane	dBm	-28		-7	
Receiver Power, each Lane (OMA)	dBm			-7	
Receiver Sensitivity, each Lane (AOP)	dBm			-28	1
Receiver Sensitivity, each Lane (OMA)	dBm			-26.4	1
Receiver 3 dB Electrical Upper Cutoff Frequency, each Lane	GHz			31	
Damage Threshold, each Lane (R_{dam})	dBm	6.5			
Receiver Reflectance	dB			-26	
LOS Assert	dBm	-40			
LOS De-assert	dBm			-29	
LOS Hysteresis	dB	0.5			

Notes

1. Sensitivity is specified at BER@5E-5 with FEC, FEC must open to guarantee 80 km transmission.

EEPROM Definitions

Lower Memory Map

Address	Type	Size	Name	Description	Value (Hex)	Remarks
0	R	1	Identifier	Identifier		
1	R	1	Status	Revision Dompliance		
2	R	1	Status	Flat_mem/ IntL/Data_Not_Ready		
3	R	1	Interrupt Flags	Latched TX/RX LOS indicator		
4	R	1		Latched TX Adaptive EQ/TX Transmitter/Laser fault indicator		
5	R	1		Latched TX/RX CDR LOL indicator		
6	R	1		Latched temperature A/W / Initialization complete flag		
7	R	1		Latched supply voltage A/W		
8	R	1		Vendor Specific		
9 to 10	R	2		Latched RX power A/W		
11 to 12	R	2		Latched TX bias A/W		
13 to 14	R	2		Latched TX power A/W		
15 to 18	R	4		Reserved		
19-21	R	2		Vendor Specific		
22-23	R	2	Device monitors	Module temperature		
24-25	R	2		Reserved		
26-27	R	2		Supply voltage		
28-29	R	2		Reserved		
30-33	R	4		Vendor Specific		
34-35	R	2	Power monitors	RX input power, channel 1		
36-37	R	2		RX input power, channel 2		
38-39	R	2		RX input power, channel 3		
40-41	R	2		RX input power, channel 4		
42-43	R	2	LD Bias Monitors	TX bias, channel 1		
44-45	R	2		TX bias, channel 2		
46-47	R	2		TX bias, channel 3		
48-49	R	2		TX bias, channel 4		
50-51	R	2	Power monitors	TX power, channel 1		
52-53	R	2		TX power, channel 2		
54-55	R	2		TX power, channel 3		
56-57	R	2		TX power, channel 4		
58-73	R	16		Reserved		
74-81	R	8		Vendor Specific		
82-85	R	4		Reserved		

Address	Type	Size	Name	Description	Value (Hex)	Remarks
86	RW	1	Control	Tx Disable		
87	RW	1		Rx_Rate_select		
88	RW	1		Tx_Rate_select		
89 to 92	RW	4		Rx_Application_Select		
93	RW	1		Power		
94 to 97	RW	4		Tx_Application_Select		
98	RW	1		TX/RX CDR_control		
99	RW	1		Reserved		
100-104	RW	4	Free Side Device and Channel Masks	Module and Channel Masks		
105	RW	1		Vendor Specific		
106	RW	1		Vendor Specific		
107	RW	1		Reserved		
108-109	R	2	Free Side Device Properties	Most significant byte of propagation delay		
110	R	1		Advanced Low Power Mode / Far Side Managed / Min Operating Voltage		
111-112	RW	2	Assigned for use by PCI Express	PCI		
113	R	1	Free Side Device Properties	End Implementation		
114-118	RW	6		Reserved		
119-122	W	4		Password Change Entry Area		
123-126	W	4		Password Entry Area		
127	RW	1		Page Select Byte		

Upper Memory Map Page 00h

Address	Type	Size	Name	Description	Value (Hex)	Remarks
128	R	1	Identifier	Identifier Type of serial Module		
129	R	1	Ext. Identifier	Extended Identifier to free side device. Includes power classes, CLEI codes, CDR capability		
130	R	1	Connector	Code for connector type		
131	R	1	Specification compliance	10/40G/100G Ethernet Compliance Codes		
132	R	1		SONET Compliance Codes		
133	R	1		SAS/SATA Compliance Codes		
134	R	1		Gigabit Ethernet Compliant Codes		
135 to 136	R	1		Fiber Channel link length/Fiber Channel Transmitter Technology		
137	R	1		Fiber Channel transmission media		
138	R	1		Fiber Channel Speed		

Address	Type	Size	Name	Description	Value (Hex)	Remarks
139	R	1	Encoding	Code for serial encoding algorithm.		
140	R	1		Nominal bit rate, units of 100Mbps. For BR>25.4G, set this to FFh and use Byte 222.		
141	R	1		QSFP+ Rate Select Version 2.		
142	R	1		Link length supported for SMF fiber in km.		
143	R	1	Length	Length (OM3 50 um)		
144	R	1		Length (OM2 50 um)		
145	R	1		Length (OM1 62.5 um)		
146	R	1		Length (OM5 50um)		
147	R	1	Device technology	Device technology		
148	R	1	Vendor name	Free side device vendor		
149	R	1				
150	R	1				
151	R	1				
152	R	1				
153	R	1				
154	R	1				
155	R	1				
156	R	1				
157	R	1				
158	R	1				
159	R	1				
160	R	1				
161	R	1				
162	R	1				
163	R	1				
164	R	1	Extended Module			
165 to 167	R	1	Vendor OUI			
168	R	1	Vendor PN	Part number provided by free side device vendor		
169	R	1				
170	R	1				
171	R	1				
172	R	1				
173	R	1				
174	R	1				
175	R	1				
176	R	1				
177	R	1				

QSFP28 100 Gbps 80km Transceiver

Address	Type	Size	Name	Description	Value (Hex)	Remarks
178	R	1				
179	R	1				
180	R	1				
181	R	1				
182	R	1				
183	R	1				
184	R	1	Vendor rev	Revision Devel for part number provided by vendor		
185	R	1				
186	R	1	Wavelength	Nominal laser wavelength (wavelength=value/20 in nm)		
187	R	1				
188	R	1	Wavelength tolerance	Guaranteed range of laser wavelength (+/- value) from nominal wavelength. (wavelength tol. = value/200 in nm)		
189	R	1				
190	R	1	Max case temp	Maximum case temperature in degrees C		
191	R	1	C_BASE	Check code for base ID fields		
192	R	1	Link codes	Extended Specification Compliance Codes		
193	R	1	Options	TX Input Equalization Auto Adaptive Capable not implemented, TX Input Equalization Fixed Programmable Settings implemented, RX Output Emphasis Fixed Programmable Settings implemented, RX Output Amplitude Fixed Programmable Settings implemented		
194	R	1		Tx CDR LOL Flag, Rx CDR LOL Flag, RX Squelch Disable, RX Output Disable, TX Squelch Disable, TX Squelch		
195	R	1		Memory page 02h implemented. Memory page 01h implemented. Active control of the select bits in the upper memory table is required to change rates, Tx_DISABLE and serial output implemented, TxFAULT signal implemented, Tx Loss of Signal implemented		
Address	Type	Size	Name	Description	Value (Hex)	Remarks
196	R	1	Vendor SN	Serial number provided by vendor		
197	R	1				
198	R	1				
199	R	1				
200	R	1				
201	R	1				

202	R	1			
203	R	1			
204	R	1			
205	R	1			
206	R	1			
207	R	1			
208	R	1			
209	R	1			
210	R	1			
211	R	1			
212	R	1	Date Code	Vendor's manufacturing date code	
213	R	1			
214	R	1			
215	R	1			
216	R	1			
217	R	1			
218	R	1			
219	R	1			
220	R	1	Diagnostic Monitoring Type	Average RX power measurement, Transmitter power measurement supported	
221	R	1	Enhanced Options	Indicates which optional enhanced features are implemented (if any) in the free side device.	
222	R	1	BR, nominal	Nominal bit rate per channel, units of 250Mbps.	
223	R	1	CC_EXT	Check Code for Address 192 to 222	

Address	Type	Size	Name	Description	Value (Hex)	Remarks
224	R	1	Vendor Specific			
225	R	1				
226	R	1				
227	R	1				
228	R	1				
229	R	1				
230	R	1				
231	R	1				
232	R	1				
233	R	1				
234	R	1				
235	R	1				
236	R	1				
237	R	1				
238	R	1				
239	R	1				
240	R	1	Vendor Specific			
241	R	1				
242	R	1	Vendor Specific			
243	R	1		Reserved		
244	R	1				
245	R	1				
246	R	1				
247	R	1				
248	R	1				
249	R	1				
250	R	1	Checksum			
251	R	1	Vendor Specific			
252	R	1				
253	R	1				
254	R	1				
255	R	1				

Digital Diagnostic Monitoring Functions

QSFP28-100G-LP80 supports the I2C-based Diagnostic Monitoring Interface (DMI) defined in document. The host can access real-time performance of transmitter and receiver optical power, temperature, supply voltage and bias current.

Performance Item	Related Bytes (A0[00] memory)	Monitor Error	Notes
Module temperature	22 to 23	±3 °C	1, 2
Module voltage	26 to 27	<3 %	2
LD Bias current	42 to 49	<10 %	2
Transmitter optical power	50 to 57	<3 dB	2
Receiver optical power	34 to 41	<3 dB	2

Notes:

1. Actual temperature test point is fixed on module case around Laser.
2. Full operating temperature range

Regulatory Compliance

Feature	Standard	Performance
Safety		
TUV	EN 60950-1 EN/IEC 60825-1:2007, Edition 2 EN/IEC 60825-1:2014, Edition 3 EN/IEC 60825-2:2004+A1:2006+A2:2010	TUV certificate
Electromagnetic Compatibility		
	EMC Directive 2014/30/EU	Class B digital device with a minimum -6dB margin to the limit when tested with a metal enclosure. Final margin may vary depending on system application, good system EMI design practice, ie: suitable metal enclosure and well-bonding, is required to achieve Class B margins at the system level. Tested frequency range: 30 MHz to 40 GHz or 5th harmonic (5 times the highest frequency), whichever is less.
	EN 55032	
	CISPR 32	
Radiated emissions	AS/NZS CISPR 32 EN 55024	
ESD		
	CISPR 24 IEC/EN 61000-4-2 EN 55024	Withstands discharges of ± 8 k V contact, ±15 k V air.
Radiated immunity		
	CISPR 24 IEC/EN 61000-4-3	Field strength of 10 V/m from 80 MHz to 6 GHz.
Restriction of Hazardous Substances		
RoHS	EU Directive 2011/65/EU (EU) 2015/863	

ESD Design

Normal ESD precautions are required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and otherwise handled in an ESD protected environment utilizing standard grounded benches, floor mats, and wriststraps.

Parameter	Threshold value	Notes
ESD Of High-Speed Pins	1 kV	Human Body Model
ESD Of Low-Speed Pins	2 kV	Human Body Model
Air Discharge During Operation	15 kV	
Direct Contact Discharges to the Case	8 kV	

Ordering Information

Product Name	Product Description
QSFP28-100G-LP80	QSFP28 Plug-in, compatible with QSFP-100G-ZR4 (with FEC), 80 km Optical Transceiver, Duplex LC, DOM
JQ28-100G-LP80	QSFP28 Plug-in, compatible with QSFP-100G-ZR4 (with FEC), 80 km Optical Transceiver, Duplex LC, DOM

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