

100 Gb/s 10km QSFP28 LR4 Transceiver

QSFP Series

- Support line rates from **103.125 Gbps**
- Transmission data rate up to **25.78 (NRZ) per channel**
- Up to **10km transmission on single mode fiber**
- Support commercial and industrial temperature
- Low power consumption
- RoHS and FCC compliant



Ascent's 100G QSFP28 LR4 is designed for 10km optical communication applications. This module contains 4-lane optical transmitter, 4-lane optical receiver and module management block including 2 wire serial interface. The optical signals are multiplexed to a single-mode fiber through an industry standard LC connector.

Ascent's 100G QSFP28 LR4 Optical Transceiver integrates receiver and transmitter path on one module. In the transmit side, four lanes of serial data streams are recovered, retimed, and passed to four laser drivers. The laser drivers control 4 × Distributed Feedback Laser (DFB) with center wavelengths of 1296 nm, 1300 nm, 1305 nm, and 1309 nm. The optical signals are multiplexed to a single-mode fiber through an industry standard LC connector. In the receive side, the four lanes of optical data streams are optically de-multiplexed by the integrated optical de-multiplexer. Each data stream is recovered by a PIN photo-detector and trans-impedance amplifier, retimed. This module features a hot-pluggable electrical interface, low power consumption and MDIO management interface.

This product is designed with form factor, optical/electrical connections, and digital diagnostic interface according to the QSFP28 Multi-Source Agreement (MSA) and compliant to IEEE 802.3bm and IEEE 802.3ba-2010.

Key Features

- Support line rates from 103.125 Gbps
- Transmission data rate up to 25.78 (NRZ) per channel
- Up to 10km transmission on single mode fiber
- High speed I/O electrical interface (CAUI-4)
- I2C interface with integrated Digital Diagnostic monitoring
- QSFP28 MSA package with duplex LC connector
- Single +3.3V power supply consumption

Commercial: <3.5W

Industrial: <5W

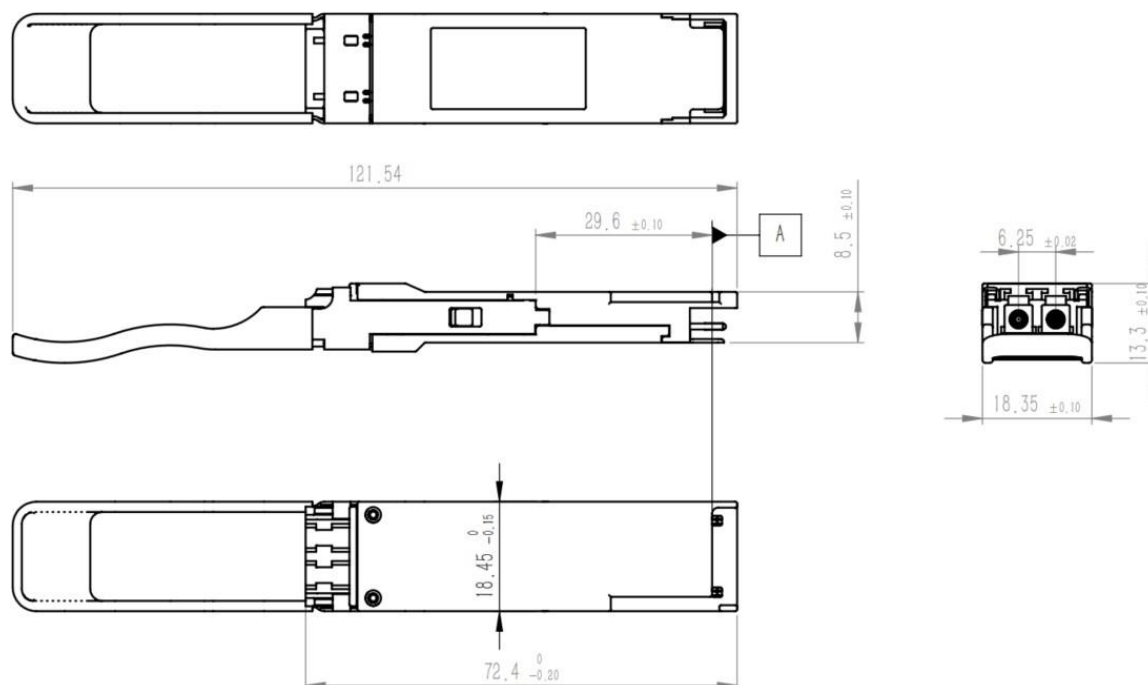
- Temperature Range:

Commercial: 0°C to +70°C

Industrial: -40°C to +85°C

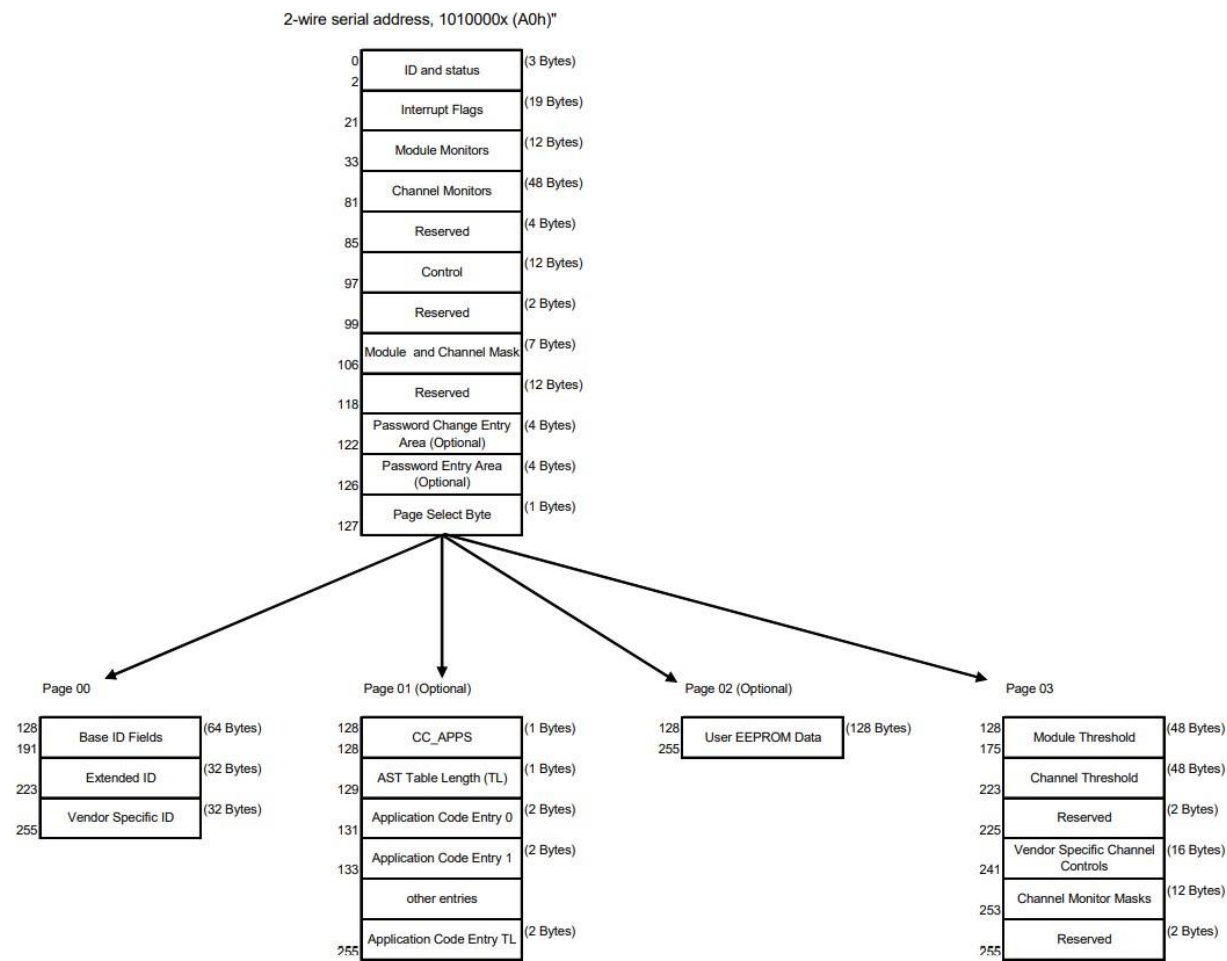
- Complies with EU Directive 2015/863/EU
- Support BER 10^{-12}

Outline Diagram

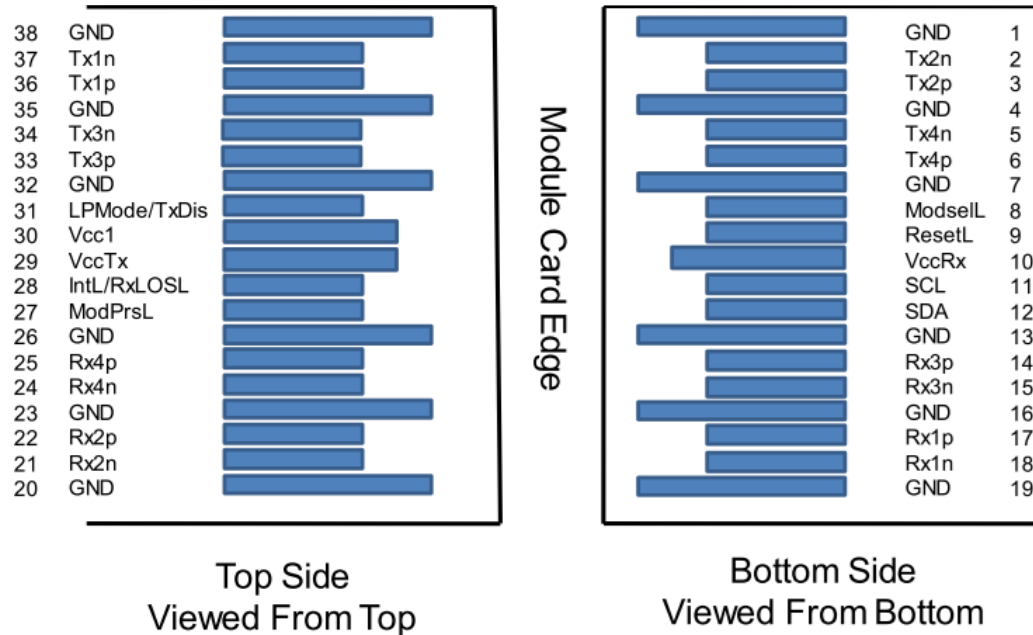


EEPROM Information

EEPROM memory map specific data field description is as below:



Pin Assignment



PIN	Logic	Symbol	Description	Plug Seq.	Notes
1		GND	Ground	1	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3	
3	CML-I	Tx2p	Transmitter Non-Inverted Data output	3	
4		GND	Ground	1	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3	
6	CML-I	Tx4p	Transmitter Non-Inverted Data output	3	
7		GND	Ground	1	1
8	LVTLL-I	ModSelL	Module Select	3	
9	LVTLL-I	ResetL	Module Reset	3	
10		VccRx	+ 3.3V Power Supply Receiver	2	2
11	LVC MOS-I/O	SCL	2-Wire Serial Interface Clock	3	
12	LVC MOS-I/O	SDA	2-Wire Serial Interface Data	3	
13		GND	Ground	1	
14	CML-O	Rx3p	Receiver Non-Inverted Data Output	3	
15	CML-O	Rx3n	Receiver Inverted Data Output	3	
16		GND	Ground	1	1
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3	
18	CML-O	Rx1n	Receiver Inverted Data Output	3	
19		GND	Ground	1	1
20		GND	Ground	1	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3	
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3	
23		GND	Ground	1	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3	1
25	CML-O	Rx4p	Receiver Non-Inverted Data Output	3	
26		GND	Ground	1	1

27	LVTTL-O	ModPrsL	Module Present	3	
28	LVTTL-O	IntL/Rx_LOS	Interrupt/Rx_LOS	3	
29		VccTx	+3.3 V Power Supply transmitter	2	2
30		Vcc1	+3.3 V Power Supply	2	2
31	LVTTL-I	LPMODE/TxDI S	Low Power Mode/Tx_Disable	3	
32		GND	Ground	1	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3	
34	CML-I	Tx3n	Transmitter Inverted Data Output	3	
35		GND	Ground	1	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3	
37	CML-I	Tx1n	Transmitter Inverted Data Output	3	
38		GND	Ground	1	1

Notes:

1. GND is the symbol for signal and supply (power) common for QSFP28 modules. All are common within the QSFP28 module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal common ground plane.
2. Vcc Rx, Vcc1 and Vcc Tx are the receiving and transmission power suppliers and shall be applied concurrently. Recommended host board power supply filtering is shown below. Vcc Rx, Vcc1 and Vcc Tx may be internally connected within the QSFP28 transceiver module in any combination. The connector pins are each rated for a maximum current of 500mA.

Digital Diagnostic Functions

ASCENT's QSFP28-100G-LP10 supports the 2-wire serial communication protocol as defined in the QSFP28 MSA, which allows real-time access to the following operating parameters:

- Transceiver temperature
- Laser bias current
- Transmitted optical power
- Received optical power
- Transceiver supply voltage

It also access and monitor module information (ex: Media type, Vendor name, Part Number, Serial Number, Wavelength, Voltage, temperature, etc), provides a sophisticated system of alarm and warning flags, which may be used to alert end-users when particular operating parameters are outside of a factory-set normal range.

The operating and diagnostics information is monitored and reported by a Digital Diagnostics Transceiver Controller inside the transceiver, which is accessed through the 2-wire serial interface. When the serial protocol is activated, the serial clock signal (SCL pin) is generated by the host. The positive edge clocks data into the QSFP28 transceiver into those segments of its memory map that are not write-protected. The negative edge clocks data from the QSFP28 transceiver. The serial data signal (SDA pin) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially. The 2-wire serial interface provides sequential or random access to the 8 bit parameters, addressed from 00h to the maximum address of the memory.

This clause defines the Memory Map for QSFP28 transceiver used for serial ID, digital monitoring and certain control functions. The interface is mandatory for all QSFP28 devices. The memory map has been changed in order to accommodate 4 optical channels and limit the required memory space. The structure of the memory is shown in below figure-QSFP28 Memory Map. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, e.g. Interrupt Flags and Monitors. Less time critical entries, e.g. serial ID information and threshold settings, are available with the Page Select function. The structure also provides address expansion by adding additional upper pages as needed. For example, in below figure upper pages 01 and 02 are optional. Upper page 01 allows implementation of Application Select Table, and upper page 02 provides user read/write space. The lower page and upper pages 00 and 03 are always implemented. The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a “one-time-read” for all data related to an interrupt situation. After an Interrupt, IntL, has been asserted, the host can read out the flag field to determine the effected channel and type of flag.

For more detailed information including memory map definitions, please see the QSFP28 MSA Specification.

Parameter	Range	Unit	Accuracy	Calibration
Temperature	-40 to +85	°C	±3°C	Internal / External
Voltage	3.0 to 3.6	V	±3%	Internal / External
Bias Current	30 to 100	mA	±10%	Internal / External
TX Power	-4.3 to 4.5	dBm	±3dB	Internal / External
RX Power	-10.6 to 4.5	dBm	±3dB	Internal / External

Note:

The transceivers provide serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA). The diagnostic information with internal calibration or external calibration all are implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

Specifications

Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T _s	-40	85	°C
Maximum Supply Voltage	V _{CC}	-0.5	3.6	V
Operating Relative Humidity	RH		85	%

Recommended Operating Conditions

Parameter	Symbol	Min.	Typ.	Max.	Unit	Note
Operating Case Temperature	Top	0		+70	°C	QSFP28-100G-LP10
		-40		+85	°C	QS28-100G-LP10A
Power Supply Voltage	V _{CC}	3.13	3.3	3.47	V	
Power Supply Current	I _{CC}	-		1.06	A	QSFP28-100G-LP10
				1.51	A	QS28-100G-LP10A
Maximum Power Consumption	P _D			3.5	W	QSFP28-100G-LP10
				5		QS28-100G-LP10A
Aggregate Bit Rate	BR _{AVE}		103.125		Gb/s	
Lane Bit Rate	BR _{LANE}		25.78125		Gbps	
Transmission Distance	TD			10	km	
Coupled Fiber	Single-mode fiber					9/125 μm SMF

Optical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Transmitter						
Signaling Speed per Lane			25.78125		Gbps	
Wavelength Assignment						
	L0	1294.53	1295.56	1296.59	nm	
Lane Wavelength	L1	1299.02	1300.05	1301.09	nm	
	L2	1303.54	1304.58	1305.63	nm	
	L3	1308.09	1309.14	1310.19	nm	
Total Average Launch Power	P _T			10.5	dBm	1
Average Launch Power per Lane,	P _{avg}	-4.3		4.5	dBm	1
OMA, Each Lane	P _{OMA}	-1.3		4.5	dB	1
Difference in Launch Power between any Two Lanes(Average and OMA) between any Two Lanes (OMA)	P _{tx, diff}			3	dB	
Average Output Power (Laser Turn off)	P _{off}			-30	dBm	
Side Mode Suppression Ratio	SMSR	30			dB	
Extinction Ratio	ER	4			dB	
RIN20OMA	RIN			-130	dB/Hz	
Optical Return Loss Tolerance	TOL			20	dB	

Parameter	Symbol	Min	Typ	Max	Unit	Note
Transmitter Reflectance	R_T			-12	dB	
Optical Eye Mask	{0.25,0.4, 0.45, 0.25, 0.28, 0.4}				%	2
Receiver						
Signaling Rate, each Lane			25.78125		Gbps	
Center Wavelength Lane 0	λ_0	1294.53	1295.56	1296.59	nm	
Center Wavelength Lane 1	λ_1	1299.02	1300.05	1301.09	nm	
Center Wavelength Lane 2	λ_2	1303.54	1304.58	1305.63	nm	
Center Wavelength Lane 3	λ_3	1308.09	1309.14	1310.19	nm	
Damage Threshold , each Lane	Pdamage	5.5			dBm	
Average Receive Power, each Lane		-10.6		4.5	dBm	
Receiver Sensitivity (OMA) per Lane	SEN			-10.6	dBm	
Los Assert	LosA	-30			dBm	
Los De-assert	LosDA			-12	dBm	
Los Hysteresis	LosH	0.5			dB	

Notes:

1. The optical power is launched into SMF.
2. Measured with a PRBS $2^{31}-1$ test pattern @25.78125, Hit ratio $\leq 5E^{-5}$.

Electrical Characteristics

Parameter	Symbol	Min	Typ	Max	Unit	Note
Transmitter (Module Input)						
Data Rate, each Lane			25.78125		Gbps	
Differential Voltage Pk-Pk	Vpp			900	mV	1
Common Mode Voltage	Vcm	-350		2850	mV	
Transition Time	Trise/Tf all	10			ps	2
Receiver (Module Output)						
Data Rate, each Lane			25.78125		Gbps	
Common Mode Noise, RMS	Vrms			17.5	mV	
Differential Output Voltage	Vout, pp			900	mV	
Wwing						
Eye Width	EW15	0.57			UI	
Eye Height	EH15	228			mV	
Differential Termination Resistance				10	%	1
Mismatch						
Transition Time	Trise/Tf all	12			ps	

Notes:

1. At 1 MHz
2. 20% to 80%

Ordering Information

Product Name	Product Description
QSFP28-100G-LP10	QSFP28 Plug-in, 100GBASE-LR4 1295, 1300, 1304, 1309nm 10km Optical Transceiver, LC, DOM
QSFP28-100G-L10A	QSFP28 Plug-in, 100GBASE-LR4 1295, 1300, 1304, 1309nm 10km Optical Transceiver, LC, DOM, -40 to +85 °C
JQ28-100G-LP10	QSFP28 Plug-in, 100GBASE-LR4 1295, 1300, 1304, 1309nm 10km Optical Transceiver, LC, DOM, Compatible with Juniper
JQ28-100G-LP10A	QSFP28 Plug-in, 100GBASE-LR4 1295, 1300, 1304, 1309nm 10km Optical Transceiver, LC, DOM, Industrial Temp -40 °C to +85 °C, Compatible with Juniper

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Ver. ACT_QSFP28-100G-LP10_Datasheet_V1g_Nov_2017