

Product Specification

103.125Gb/s LR QSFP28 1310nm 10km
Optical Transceiver

P/N: 100G-Q28-LR



Features

- Hot Pluggable QSFP28 form factor
- Operating data rate 103.125Gbps
- Single +3.3V power supply
- Duplex LC receptacles
- Max power dissipation <4.5W
- Up to 10km transmission distance on SMF
- 4 channel PIN receivers
- Built-in digital diagnostic function
- Commercial temperature range 0°C to 70°C

Compliance

- QSFP28 MSA
- Compliant with QSFP Electrical MSA SFF-8636
- Compliant with QSFP Mechanical MSA SFF-8665
- IEEE 802.3bm
- RoHS

Applications

- Switches with QSFP28 ports
- Router with QSFP28 Ports
- Server or Network Adapter Card
- Optical Transmission System
- Other devices with QSFP28 Ports

Description

The 100G-Q28-LR is a high-performance transceiver module specifically engineered for long-range optical communication applications, supporting distances of up to 10 kilometers. This module features a single-channel optical signal operating at a center wavelength of 1310nm and a data rate of 50Gbaud. On the transmitter side, the module integrates an EML Driver along with a cooled EML to ensure stable and efficient signal transmission. On the receiver side, the incoming optical signal is captured by a high-sensitivity PIN photo-diode detector.

The module employs a sophisticated DSP based gearbox to convert 4x25Gbps NRZ signals into a 1x50Gbaud PAM4 signal. Additionally, the DSP incorporates a 4-channel re-timer and a Forward Error Correction block to enhance signal integrity and reliability. The electrical interface complies with the IEEE 802.3cd standard and the QSFP28 MSA for both transmitting and receiving directions. The optical interface adheres to the IEEE 802.3cd and 100G Lambda MSA standards, utilizing a Duplex LC connector for seamless integration into existing optical networks.

With a maximum power consumption of 4.5W, the 100G-Q28-LR is designed to be energy-efficient while delivering high performance. The module is built in accordance with the QSFP28 MSA, ensuring compatibility with industry-standard form factors, optical/electrical connections, and digital diagnostic interfaces. Engineered to withstand the most demanding external operating conditions, including extreme temperatures, humidity, and EMI interference, the 100G-Q28-LR is a robust and reliable solution for high-speed, long-distance optical communication needs.

Product performance Specifications

1、Basic Product Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit
Storage Temperature	T _s	-40	-	+85	°C
Supply Voltage	V _{CC}	-0.5	-	3.6	V
Relative Humidity	RH	0	-	85	%
Operating Case Temperature	T _c	0	-	70	°C
Power Supply Voltage	V _{CC}	3.135	3.3	3.465	V
Power Supply Current	I _{CC}			1.36	A
Power Dissipation	PD	-	-	4.5	W
Data Rate	DR	-	103.125	-	Gbps
Link Distance with G.652 ₁	D	0.002		10	km

2、Product Optical and Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit
Data Rate Accuracy		-100ppm	103.125	+100ppm	GBd
Control Input Voltage High	V_{CC}	2			V
Control Input Voltage Low		0		0.8	V
Link Distance with G.652	D	0.002		10	km
Overload Differential Voltage pk-pk	TP1a	900			mV
Common Mode Voltage (V_{cm}) ₂	TP1	-350		2850	mV
Differential Termination Resistance Mismatch	TP1			10	%
Differential Return Loss (SDD11)	TP1			See CEI-28G-VSR Equation13-19	dB
Common Mode to Differential conversion and Differential to Common Mode conversion (SDC11, SCD11)	TP1			See CEI-28G-VSR Equation13-20	
Stressed Input Test	TP1a	See CEI-28G-VSR Section13.3.11.2.1			
Differential Voltage, pk-pk	TP4			900	mV
Common Mode Voltage (V_{cm})	TP4	-350		2850	mV
Common Mode Noise, RMS	TP4			17.5	mV
Differential Termination Resistance Mismatch	TP4			10	%
Differential Return Loss (SDD22)	TP4			See CEI-28G-VSR Equation13-19	dB
Common Mode to Differential conversion and Differential to Common Mode conversion (SDC22, SCD22)	TP4			See CEI-28G-VSR Equation13-21	dB
Common Mode Return Loss (SCC22)	TP4			-2	dB
Transition Time, 20 to 80%	TP4	9.5			ps
Vertical Eye Closure (VEC)	TP4			5.5	dB
Eye Width at 10-15 probability (EW15)	TP4	0.57			UI
Eye Height at 10-15 probability (EH15)	TP4	228			mV
Transmitter					
Center Wavelength	λ_t	1304.5		1317.5	nm
Side Mode Suppression Ratio	SMSR	30			dB
Average Launch Power ₃	P_{AVG}	-1.4		4.5	dBm
Outer Optical Modulation Amplitude (OMA _{outer}) ₄	P_{OMA}	0.7		4.7	dBm
Launch Power in	for ER ≥ 4.5dB	-0.7			dBm
OMA _{outer} minus TDECQ	for ER ≤ 4.5dB	-0.6			

Transmitter and Dispersion Eye Closure for PAM4 (TDECQ)	TDECQ			3.4	dB
TDECQ – 10*log10(Ceq) ₅				3.4	dB
Extinction Ratio	ER	3.5			dB
RIN15.6 OMA	RIN			-136	dB/HZ
Optical Return Loss Tolerance	TOL			15.6	dB
Transmitter Reflectance	RT			-26	dB
Transmitter Transition Time				17	ps
Average Launch Power of OFF Transmitter	Poff			-15	dBm
Optical eye mask	Compliant with IEEE std 802.3bm-2015				
Receiver					
Center Wavelength	λt	1304.5		1317.5	nm
Damage Threshold ₆	THd	5.5			dBm
Average Receive Power ₇		-7.7		4.5	dBm
Receive Power (OMA _{outer})				4.7	dBm
Receiver Sensitivity (OMA _{outer}) ₈	SEN			-7.7	dBm
Stressed Receiver Sensitivity (OMA _{outer}) ₉	SRS			-4.1	dBm
Receiver Reflectance	RR			-26	dB
LOS Assert	LOSA	-15			dBm
LOS Deassert	LOSD			-10.7	dBm
LOS Hysteresis	LOSH	0.5			dB
Eye Height at 10-15 probability (EH15)	TP4	228			mV

Note1:FEC required to be turned on to support maximum transmission distance

Note2:Vcm is generated by the host. Specification includes effects of ground offset voltage

Note3:Average launch power, each lane min is informative and not the principal indicator of signal strength. A transmitter with launch power below this value cannot be compliant; however, a value above this does not ensure compliance

Note4:Even if the TDECQ < 1.4dB for an extinction ratio of $\geq 4.5\text{dB}$ or TDECQ > 1.3dB for an extinction ratio of < 4.5dB, the OMA_{outer} (min) must exceed the minimum value specified here

Note5:Ceq is a coefficient defined in IEEE Std 802.3-2018 clause 121.8.5.3 which accounts for reference equalizer noise enhancement

Note6:Average receive power (min) is informative and not the principal indicator of signal strength. A received power below this value cannot be compliant; however, a value above this does not ensure compliance

Note7:The receiver shall be able to tolerate, without damage, continuous exposure to a modulated optical input signal having this power level on one lane. The receiver does not have to operate correctly at this input power

Note8:Receiver sensitivity (OMA_{outer}) (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB

Note9:Measured with conformance test signal at TP3 for the BER equal to 2.4×10^{-4}

Recommended Host Board Power Supply Circuit

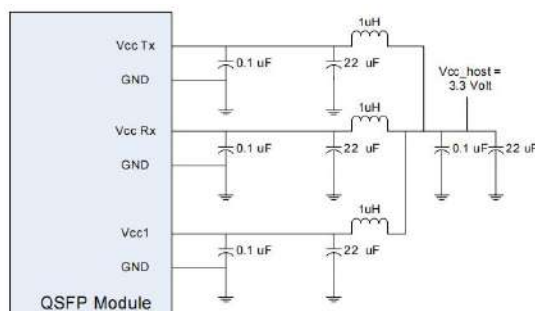


Figure 1: Recommended Host Board Power Supply Circuit

Recommended Interface Circuit

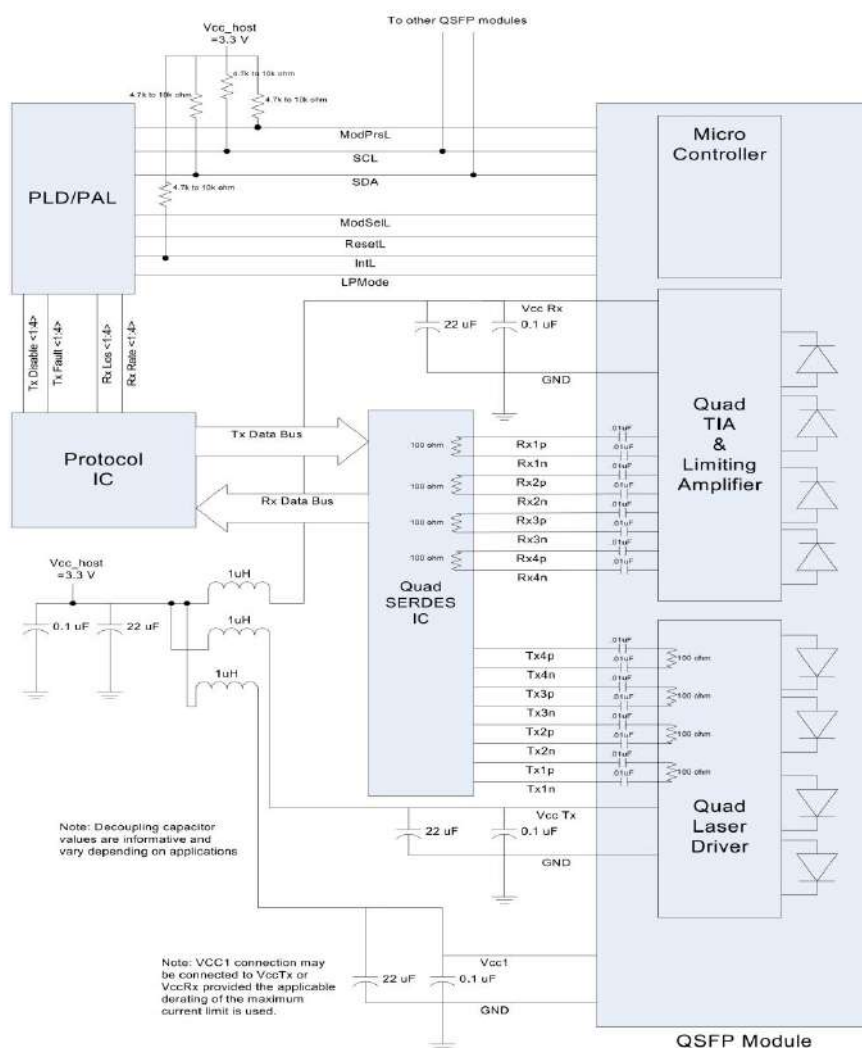


Figure2:Recommended Interface Circuit

Optical Interface

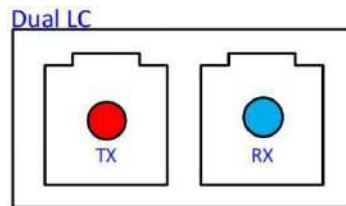


Figure3:Optical Lane Sequence

Pin-out Definition

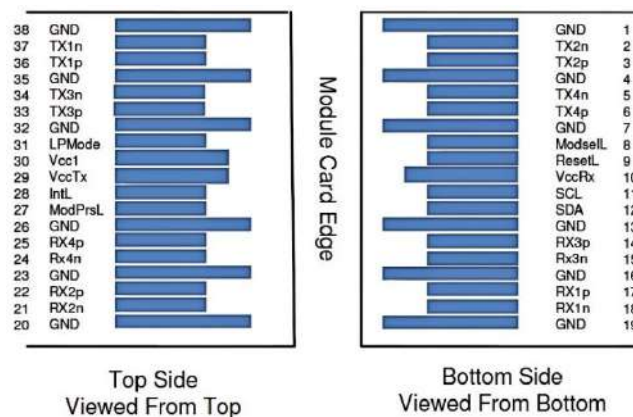


Figure4:Pin view

Pin Function Definitions

Pin	Logic	Symbol	Description	Note
1		GND	Ground	1
2	CML-I	Tx2n	Transmitter Inverted Data Input	3
3	CML-I	Tx2p	Transmitter Non-Inverted Data Input	3
4		GND	Ground	1
5	CML-I	Tx4n	Transmitter Inverted Data Input	3
6	CML-I	Tx4p	Transmitter Non-Inverted Data Input	3
7		GND	Ground	1
8	LVTTL-I	ModSelL	Module Select	4
9	LVTTL-I	ReSelL	Module Select	4
10		Vcc Rx	+3.3V Power Supply Receiver	2
11	LVC MOS-I/O	SCL	2-wire serial interface clock	4
12	LVC MOS-I/O	SDA	2-wire serial interface data	4
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
17	CML-O	Rx1p	Receiver Non-Inverted Data Output	3
18	CML-O	Rx1n	Receiver Inverted Data Output	3
19		GND	Ground	1
20		GND	Ground	1
21	CML-O	Rx2n	Receiver Inverted Data Output	3
22	CML-O	Rx2p	Receiver Non-Inverted Data Output	3
23		GND	Ground	1
24	CML-O	Rx4n	Receiver Inverted Data Output	3
25	CML-O	Rx4p	Receiver Non-Inverted Data Output Ground	3
26		GND	Ground	1
27	LVTTL-O	ModPrsL	Module Present	4
28	LVTTL-O	IntL	Interrupt	4
29		Vcc Tx	+3.3V Power supply transmitter	2
30		Vcc1	+3.3V Power supply	2
31	LVTTL-I	LPMODE	Low Power Mode	4
32		GND	Ground	1
33	CML-I	Tx3p	Transmitter Non-Inverted Data Input	3
34	CML-I	Tx3n	Transmitter Inverted Data Input	3
35		GND	Ground	1
36	CML-I	Tx1p	Transmitter Non-Inverted Data Input	3
37	CML-I	Tx1n	Transmitter Inverted Data Input	3
38		GND	Ground	1

Note1: GND is the symbol for signal and supply (power) common for the QSFP+ module. All are common within the QSFP+ module and all module voltages are referenced to this potential unless otherwise noted. Connect these directly to the host board signal-common ground plane.

Note2: Vcc Rx, Vcc1 and Vcc Tx are the receiver and transmitter power supplies and shall be applied concurrently. Requirements defined for the host side of the Host Edge Card Connector are listed in Table. Recommended host board power supply filtering is shown in Host board power supply circuit. Vcc Rx Vcc1 and Vcc Tx may be internally connected within the QSFP module in any combination. The connector pins are each rated for a maximum current of 500 mA.

Note3: High-speed signal interfaces require differential pairs (e.g. TX1+/TX1-) with tightly matched impedances (typically 100Ω).

Note4: The management and control signals are based on LVTTL level logic and are used for functions such as module selection and reset.

Monitoring Specification

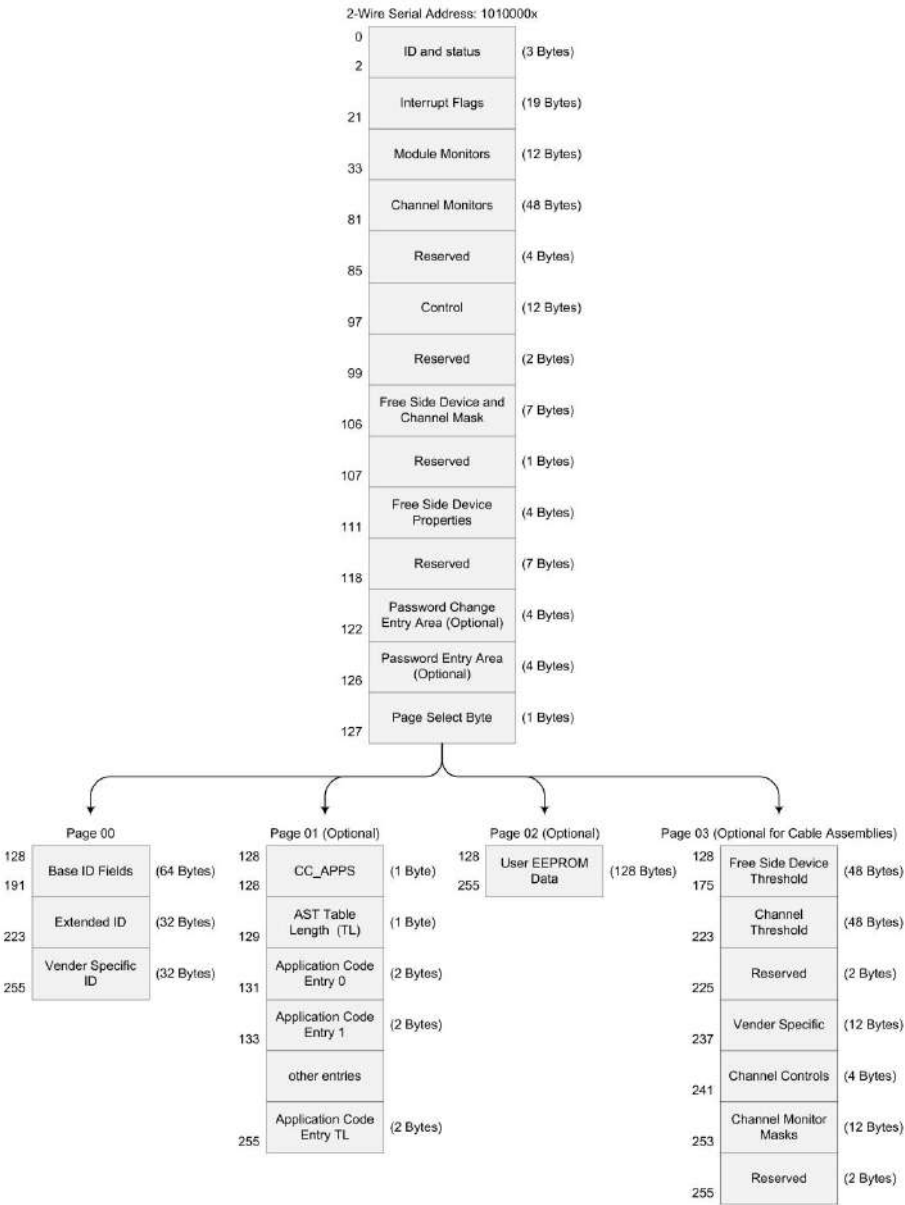


Figure5:Memory map

Memory map Table

Byte	Unit	Name	Description
Lower Page 00h			
0	1	Identifier	Type of transceiver,Page 00h Byte 0 and Page 00h Byte 128 shall contain the same parameter values.
1	1	Status	Revision Compliance
2	1	Status	Status indicators

3-21	19	Interrupt Flags	Consist of interrupt flags for LOS, Tx Fault, warnings and alarms. The non-asserted state shall be 0b.
22	1	Temperature MSB	Internally measured temperature (MSB)
23	1	Temperature LSB	Internally measured temperature (LSB)
24-25	2	Reserved	Reserved
26	1	Supply Voltage MSB	Internally measured supply voltage (MSB)
27	1	Supply Voltage LSB	Internally measured supply voltage (LSB)
28-29	2	Reserved	Reserved
30-33	4	Vendor Specific	Vendor Specific
34	1	Rx1 Power MSB	Internally measured Rx1 input power
35	1	Rx1 Power LSB	
36	1	Rx2 Power MSB	Internally measured Rx2 input power
37	1	Rx2 Power LSB	
38	1	Rx3 Power MSB	Internally measured Rx3 input power
39	1	Rx3 Power LSB	
40	1	Rx4 Power MSB	Internally measured Rx4 input power
41	1	Rx4 Power LSB	
42	1	Tx1 Bias MSB	Internally measured Tx1 bias
43	1	Tx1 Bias LSB	
44	1	Tx2 Bias MSB	Internally measured Tx2 bias
45	1	Tx2 Bias LSB	
46	1	Tx3 Bias MSB	Internally measured Tx3 bias
47	1	Tx3 Bias LSB	
48	1	Tx4 Bias MSB	Internally measured Tx4 bias
49	1	Tx4 Bias LSB	
50	1	Tx1 Power MSB	Internally measured Tx1 Power
51	1	Tx1 Power LSB	
52	1	Tx2 Power MSB	Internally measured Tx2 Power
53	1	Tx2 Power LSB	
54	1	Tx3 Power MSB	Internally measured Tx3 Power
55	1	Tx3 Power LSB	
56	1	Tx4 Power MSB	Internally measured Tx4 Power
57	1	Tx4 Power LSB	
58-65	8	Reserved	Reserved channel monitor set 4
66-73	8	Reserved	Reserved channel monitor set 5
74-81	8	Vendor Specific	Vendor Specific
82-85	4	Reserved	Reserved
86-99	14	Control	Control
100-106	7	Free Side Device and Channel Masks	Free Side Device and Channel Masks
107-110	4	Free Side Device Properties	Free Side Device Properties

111-112	2	Assigned for use by PCI Express	Used for:
			- The PCI Express External Cable Specification
			- The PCI Express OCuLink Specification
113-117	4	Free Side Device Properties	Free Side Device Properties
118	1	Reserved	Reserved
119-122	4	Password Change Entry Area	Password Change Entry Area
123-126	4	Password Entry Area	Password Entry Area
127	1	Page Select Byte	Page Select Byte
Upper Page 00h			
128	1	Identifier	Identifier Type of free side device.(See SFF-8024 Transceiver Management)
129	1	Ext. Identifier	Extended Identifier of free side device. Includes power classes, CLEI codes, CDR capability.
130	1	Connector Type	Code for media connector type. (See SFF-8024 Transceiver Management)
131-138	8	Specification Compliance	Code for electronic or optical compatibility.
139	1	Encoding	Code for serial encoding algorithm. (See SFF-8024 Transceiver Management)
140	1	Signaling rate, nominal	Nominal signaling rate, units of 100 MBd. For rate > 25.4 GBd, set this to FFh and use Byte 222.
141	1	Extended Rate Select Compliance	Tags for extended rate select compliance.
142	1	Length (SMF)	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for SMF fiber in km *. A value of 1 shall be used for reaches from 0 to 1 km.
143	1	Length (OM3 50 um)	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for EBW 50/125 um fiber (OM3), units of 2 m *
144	1	Length (OM2 50 um)	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for 50/125 um fiber (OM2), units of 1 m *
145	1	Length (OM1 62.5 um) or Copper	Link length supported at the signaling rate in byte 140 or page 00h byte 222, for 62.5/125 um fiber (OM1), units of 1 m *, or copper cable attenuation in dB at 25.78 GHz.
		Cable Attenuation	
146	1	Length (passive copper or active cable or OM4 50 um)	Length of passive or active cable assembly (units of 1 m) or link length supported at the signaling rate in byte 140 or page 00h byte 222, for OM4 50/125 um fiber (units of 2 m) as indicated by Byte 147. See 6.3.12.
147	1	Device technology	Device technology
148-163	16	Vendor name	Free side device vendor name (ASCII)
164	1	Extended Module	Extended Module codes for InfiniBand.
165-167	3	Vendor OUI	Free side device vendor IEEE company ID.
168-183	16	Vendor PN	Part number provided by free side device vendor(ASCII)
184-185	2	Vendor rev	Revision level for part number provided by the vendor(ASCII)

186-187	2	Wavelength or Copper Cable Attenuation	Nominal laser wavelength (wavelength=value/20 in nm) or copper cable attenuation in dB at 2.5 GHz (Byte 186) and 5.0 GHz (Byte 187)
188-189	2	Wavelength tolerance or Copper Cable Attenuation	The range of laser wavelength (+/- value) from nominal wavelength. (wavelength Tol. =value/200 in nm) or copper cable attenuation in dB at 7.0 GHz (Byte 188) and 12.9 GHz (Byte 189)
190	1	Max case temp	Maximum case temperature
191	1	CC_BASE	Check code for base ID fields (Bytes 128-190)
192	1	Link codes	Extended Specification Compliance Codes (See SFF-8024)
193-195	3	Options	Optional features implemented.
196-211	16	Vendor SN	Serial number provided by vendor.(ASCII)
212-219	8	Date Code	Vendor's manufacturing date code.
220	1	Diagnostic Monitoring Type	Indicates which type of diagnostic monitoring is implemented (if any) in the free side device. Bit 1,0 Reserved.
221	1	Enhanced Options	Indicates which optional enhanced features are implemented in the free side device.
222	1	CC_EXT	Check code for the Extended ID Fields (Bytes 192-222)
224-255	32	Vendor Specific	Vendor Specific EEPROM

Page 02h (Optional)

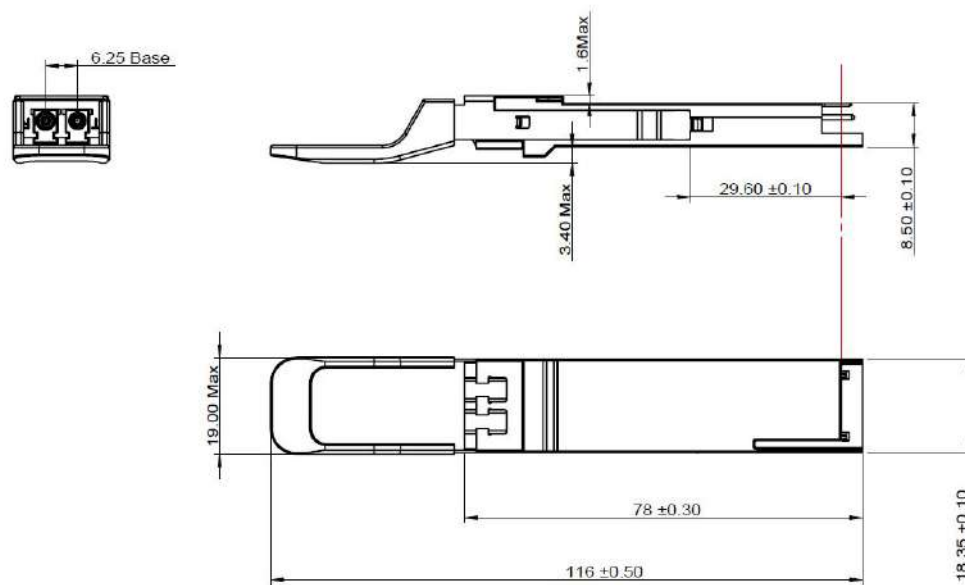
128-255	128	User EEPROM Data	
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Page 03h (Optional)

128-129	2	Temp High Alarm	MSB at lower byte address
130-131	2	Temp Low Alarm	MSB at lower byte address
132-133	2	Temp High Warning	MSB at lower byte address
134-135	2	Temp Low Warning	MSB at lower byte address
136-143	8	Reserved	Reserved
144-145	2	Vcc High Alarm	MSB at lower byte address
146-147	2	Vcc Low Alarm	MSB at lower byte address
148-149	2	Vcc High Warning	MSB at lower byte address
150-151	2	Vcc Low Warning	MSB at lower byte address
152-159	8	Reserved	Reserved
160-175	16	Vendor Specific	Vendor Specific
176-177	2	Rx Power High Alarm	MSB at lower byte address
178-179	2	Rx Power Low Alarm	MSB at lower byte address
180-181	2	Rx Power High Warning	MSB at lower byte address
182-183	2	Rx Power Low Warning	MSB at lower byte address
184-185	2	Tx Bias High Alarm	MSB at lower byte address
186-187	2	Tx Bias Low Alarm	MSB at lower byte address
188-189	2	Tx Bias High Warning	MSB at lower byte address
190-191	2	Tx Bias Low Warning	MSB at lower byte address
192-193	2	Tx Power High Alarm	MSB at lower byte address
194-195	2	Tx Power Low Alarm	MSB at lower byte address
196-197	2	Tx Power High Warning	MSB at lower byte address

198-199	2	Tx Power Low Warning	MSB at lower byte address
200-207	8	Reserved	Reserved thresholds for channel parameter set 4
208-215	8	Reserved	Reserved thresholds for channel parameter set 5
216-223	8	Vendor Specific	Vendor Specific
224	1	Tx EQ & Rx Emphasis Magnitude ID	Tx EQ & Rx Emphasis Magnitude ID
225	1	Rx output amplitude support indicators	Rx output amplitude support indicators
226-229	4	Control options advertising	Control options advertising
230-241	12	Optional Channel Controls	Optional Channel Controls
242-247	6	Channel Monitor Masks	Channel Monitor Masks
248-249	2	Reserved	Reserved channel monitor masks set 4
250-251	2	Reserved	Reserved channel monitor masks set 5
252-255	4	Reserved	Reserved

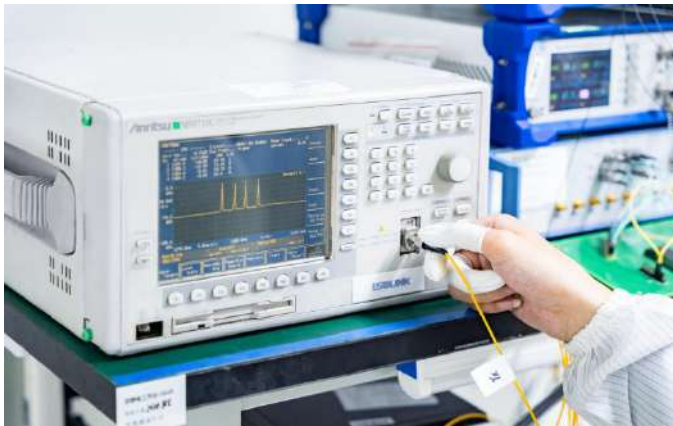
Mechanical Dimension



Test Center

1、Performance Testing

Every fiber optic transceiver is thoroughly tested by the LSOLINK Assurance Program, which is equipped with the world's most advanced analytical equipment to ensure that our transceivers meet the industry's international public protocol standards while still functioning flawlessly in your facility.



Optical Spectrum Inspection

Using the industry's leading optical spectrum analyser to check in real time that the parameters of the optical transceiver's laser comply with industry standards.

- **Peak:** Peak wavelength and peak level
- **2nd Peak:** Side-mode wavelength and level
- **Mean Wl:** Center wavelength
- **Total Power:** Total power of spectrum
- **SMSR:** Side-Mode Suppression Ratio



Optical Signal Quality Inspection

Using highly efficient sampling oscilloscopes and BERT testers, equipped with an automated test platform to accurately test the signal quality of the transceiver, test records are kept for up to 5 years to ensure the traceability of each transceiver.

- **Eye Mask Margin(NRZ)**
- **TDECQ(PAM4):**transmitter dispersion eye closure
- **OMA:** Optical modulation amplitude
- **BER:** Bit error rate
- **ER:** Extinction Ratio



Flow Pressure Test

Using multi-protocol network traffic analyser with various brands of switches to test the transceiver's ability to transmit at full speed.

- **Bandwidth:** Actual transceiver bandwidth on the port
- **Packet Loss**
- **Packet Errors:**CRC Errors/PCS Errors/Symbol Errors
- **LinkDown Counts**
- **latency**

Above is part of our test bed network equipment. For more information, Please click [download](#) for optical transceiver performance test report.

2、Quality Control

We adopt advanced quality management solutions. Each transceiver is self-inspected, including: 20x microscope inspection, 200x microscope inspection, and QC process inspection.



visual inspection



Microscopic inspection: 20X



Microscopic inspection: 200X



Reliability Verification



Optical endface inspection



OQC Inspection

3、Compatibility Testing

Each optical transceiver is tested in LSOLINK's library of compatibility test equipment to ensure perfect compatibility with multiple brands on the market.



Juniper QFX5110-48S-4C



Cisco N9K-C9318YC-EX



Cisco C9500-24Y4C



Aruba 8360-32Y4C



Huawei S6720-30L-HI-24S



Arista DCS-7060SX2-48YC6-R

Above is part of our test bed network equipment. For more information, Please click [download](#) to get the compatibility test report of each brand of optical transceiver.


Order Information

Part Number	Description
100G-Q28-SR4	100GBASE-SR4 QSFP28 100G 850nm 100m DOM MTP/MPO-12 UPC MMF Transceiver Module
100G-Q28-PSM4	100GBASE-PSM4 QSFP28 100G 1310nm 2km DOM MTP/MPO-12 APC SMF Transceiver Module
100G-Q28-CWDM4	100GBASE-CWDM4 QSFP28 100G 1310nm 2km DOM LC SMF Transceiver Module
100G-Q28-SR-BD	100GBASE-SR Bi-Directional QSFP28 850nm 100m DOM Duplex LC MMF Optical Transceiver Module
100G-Q28-SWDM4	100GBASE-SWDM4 QSFP28 100G 850nm 100m DOM LC MMF Transceiver Module
100G-Q28-LX4	100GBASE-LX4 QSFP28 100G 1310nm 100m/2km DOM LC MMF/SMF Transceiver Module
100G-Q28-LR4	100GBASE-LR4 QSFP28 100G 1310nm 10km DOM LC SMF Transceiver Module
100G-Q28-ER4	100GBASE-ER4 QSFP28 100G 1310nm 40km DOM LC SMF Transceiver Module
100G-Q28-ZR4	100GBASE-ZR4 QSFP28 100G 1310nm 80km DOM LC SMF Transceiver Module
112G-Q28-LR4	100/112GBASE-LR4 QSFP28 100G Dual Rate 1310nm 10km DOM LC SMF Transceiver Module
112G-Q28-ER4	100/112GBASE-ER4 QSFP28 100G Dual Rate 1310nm 40km DOM LC SMF Transceiver Module
100G-Q28-DR	100GBASE-DR QSFP28 100G PAM4 1310nm 500m DOM LC SMF Transceiver Module
100G-Q28-FR	100GBASE-FR QSFP28 100G PAM4 1310nm 2km DOM LC SMF Transceiver Module
100G-Q28-LR	100GBASE-LR QSFP28 100G PAM4 1310nm 10km DOM LC SMF Transceiver Module
100G-Q28-ER	100GBASE-ER QSFP28 Single Lambda 1310nm 40km DOM Duplex LC SMF Optical Transceiver Module

Further Information

 | Lighting the Path to Global Links

 **Web** | www.lsolink.com

 **Email** | For Sales@lsolink.com

Disclaimer

1. We are committed to continuous product improvement and feature upgrades, and the contents contained in this manual are subject to change without notice.
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