103.125Gb/s FR QSFP28 1310nm 2km Optical Transceiver

P/N: QSFP100G-FR-2

Features

- Hot Pluggable QSFP28 form factor
- Operating data rate 103.125Gbps
- Single +3.3V power supply
- Duplex LC receptacles
- Max power dissipation <4.0W
- Up to 2km transmission on single mode fiber
- 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 QSFP100G-FR-2 Transceiver is a high-performance optical module designed for 2-kilometer optical communication applications,compliant with the IEEE 802.3cd and 100G Lambda MSA standards. Operating on a 1310 nm center wavelength and supporting a 50 Gbaud PAM4 data rate, this module is ideal for high-speed data center interconnects, enterprise networks, and telecommunications.

The module integrates advanced technologies to ensure reliable signal transmission and reception. On the transmitter side, it combines an EML Driver and a cooled EML to generate high-quality optical signals. On the receiver side, the input optical signal is coupled to a PIN photo-diode detector for precise signal detection. A DSP-based gearbox is employed to convert 4x25Gbps NRZ signals into a 1x50Gbaud PAM4 signal, while a 4-channel re-timer and FEC block enhance signal integrity and error correction.

Designed for durability and efficiency, the QSFP100G-FR-2 complies with the QSFP28 MSA standard, featuring a compact form factor,a duplex LC connector, and a digital diagnostic interface (DDM) for real-time monitoring. With a maximum power consumption of 4.5W, it is optimized for energy efficiency and robust performance in harsh operating conditions, including extreme temperature, humidity, and EMI interference. This transceiver is a reliable solution for next-generation 100G optical networks.

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	5	-	85	%
Operating Case Temperature	T_C	0	-	70	°C
Power Supply Voltage	V_{CC}	3.135	3.3	3.465	V
Pre-FEC Bit Error Ratio			$2.4x10^{-4}$		
Post-FEC Bit Error Ratio			$1x10^{-12}$		
Data Rate	DR	-	103.125	-	Gbps
Transmission Distance	-	2	-	2000	m

Note1:FEC feature is embedded in the module, fec required to be turned on to support maximum transmission distance.

2、Product Optical and Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Power Consumption				4.5	W	
Supply Current	Icc			1.36	A	
Transmitter						
Overload Differential Voltage pk-pk	TP1a	900			mV	
Common Mode Voltage (Vcm)	TP1	-350		2850	mV	1
Differential Termination Resistance Mismatch	TP1			10	%	@ 1MHz
Differential Return Loss (SDD11)	TP1	See CEI- 28G-VSR Equation 13-19			dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC11,SCD11)	TP1	See CEI- 28G- VSR Equation 13- 20			dB	
Stressed Input Test	TP1a	See CEI- 28G-VSR Section 13.3.11.2.1			dB	
Center Wavelength	λt	1304.5		1317.5	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Average Launch Power	P_{AVG}	-2.4		4	dBm	3
Outer Optical Modulation Amplitude (OMA_{outer})	P_{OMA}	-0.2		4.2	dBm	4
Launch Power in OMA_{outer} minus TDECQ for ER ≥ 4.5dB		-1.6			dBm	
Launch Power in OMA_{outer} minus TDECQ for ER < 4.5dB		-1.5			dBm	
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ)	TDECQ			3.4	dB	
TDECQ – 10*log10(Ceq)				3.4	dB	5
Extinction Ratio	ER	3.5			dB	
$RIN_{17.1}OMA$	RIN			-136	dB/Hz	
Optical Return Loss Tolerance	T_{OL}			17.1	dB	
Transmitter Reflectance	R_T			-26	dB	
Transmitter Transition Time				17	ps	
Average Launch Power of OFF Transmitter	P_{off}			-15	dBm	
Receiver						
Differential Voltage, pk-pk	TP4			900	mV	

Differential Voltage, pk-pk	TP4	-350		2850	mV	1
Common Mode Noise, RMS	TP4			17.5	mV	
Differential Termination Resistance Mismatch	TP4			10	%	@ 1MHz
Differential Return Loss (SDD22)	TP4	See CEI- 28G-VSR Equation 13-19			dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion (SDC22,SCD22)	TP4	See CEI- 28G- VSR Equation 13- 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	
Center Wavelength	λr	1304.5		1317.5	nm	
Damage Threshold	THd	5.5			dBm	6
Average Receive Power		-6.4		4.5	dBm	7
Receive Power (OMA_{outer})				4.7	dBm	
Receiver Sensitivity (OMA_{outer})	SEN			Equation (1)	dBm	8
Stressed Receiver Sensitivity(OMA_{outer})	SRS			-2.5	dBm	9
Receiver Reflectance	RR			-26	dB	
LOS Assert	LOSA	-15			dBm	
LOS Deassert	LOSD			-9.4	dBm	
LOS Hysteresis	LOSH	0.5			dB	
Conditions of Stress Receiver Sensitivity Test (Note 10)						
Stressed Eye Closure for PAM4 (SECQ)			3.4		dB	
SECQ – 10*log10(C_{eq})				3.4	dB	

Note1: Vcm is generated by the host. Specification includes effects of ground offset voltage

Note2: From 250MHz to 30GHz.

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 ≥ 4.5dB or TDECQ < 1.3dB for an extinction ratio of < 4.5dB, the OMAouter (min) must exceed the minimum value specified here.

Note5:C_{eq} is acoefficient 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 (OMAouter) (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. It should meet Equation (1), which is illustrated in Figure.

RS = max(-4.5,SEQ - 5.9)dBm

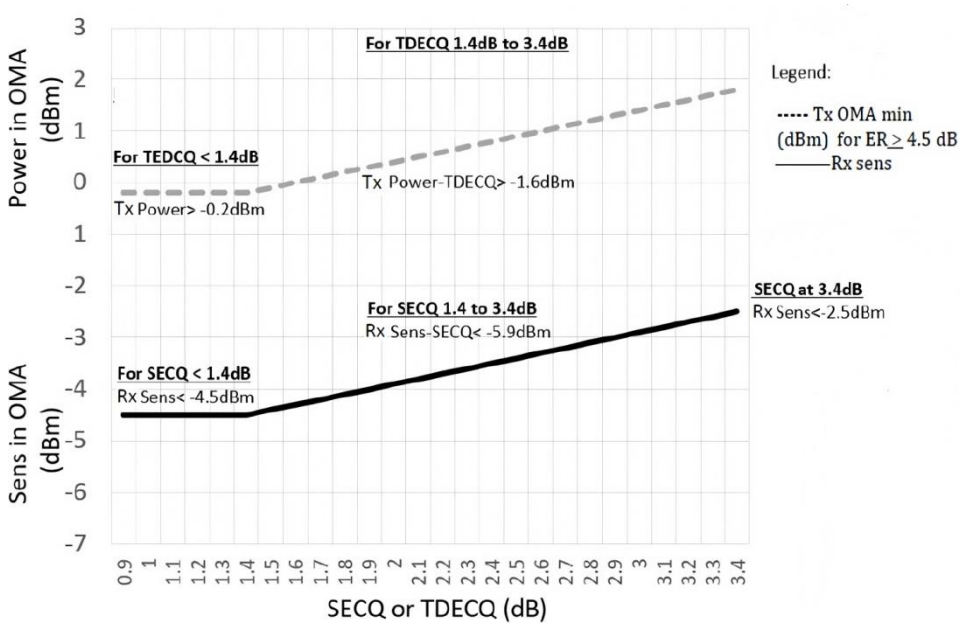
Where:

RS is the receiver sensitivity,and

SRCQ is the SECQ of the transmitter used to measure the receiver sensitivity.

Note9: Measured with conformance test signal at TP3 for the BER equal to $2.4x10^{-4}$.

Note10: These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.



Recommended Host Board Power Supply Circuit

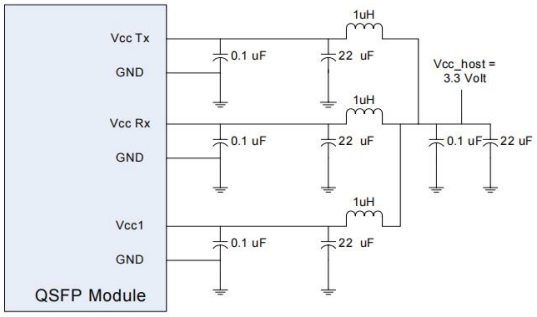


Figure 1: Recommended Host Board Power Supply Circuit

Recommended Interface Circuit

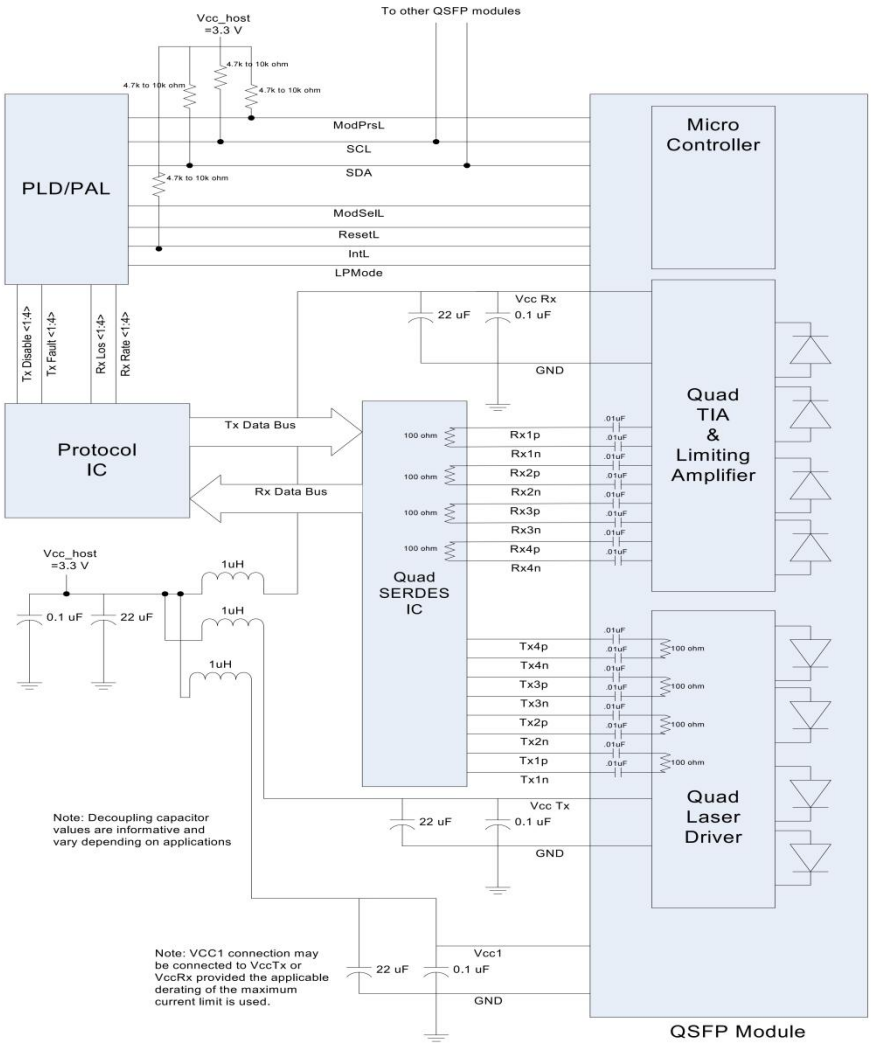


Figure2: Recommended Interface Circuit

Optical Interface

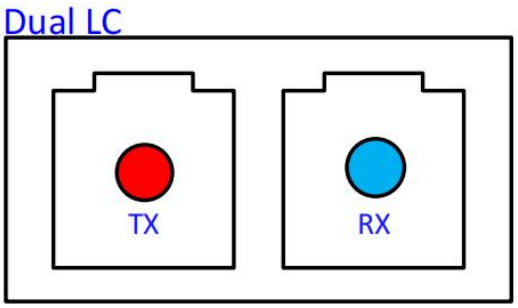


Figure3: Optical Lane Sequence

Pin-out Definition

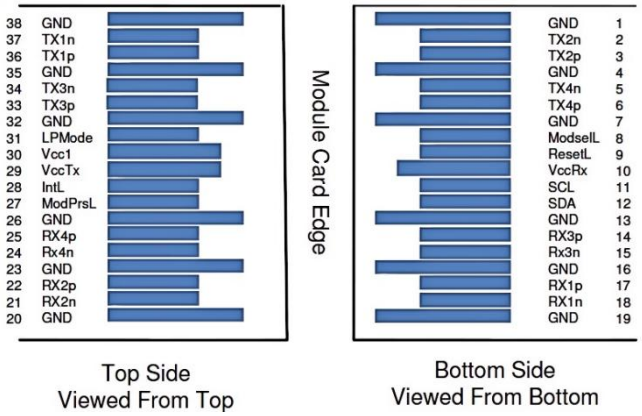


Figure4: Pin view

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	LVCMOS-I/O	SCL	2-wire serial interface clock	4
12	LVCMOS-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

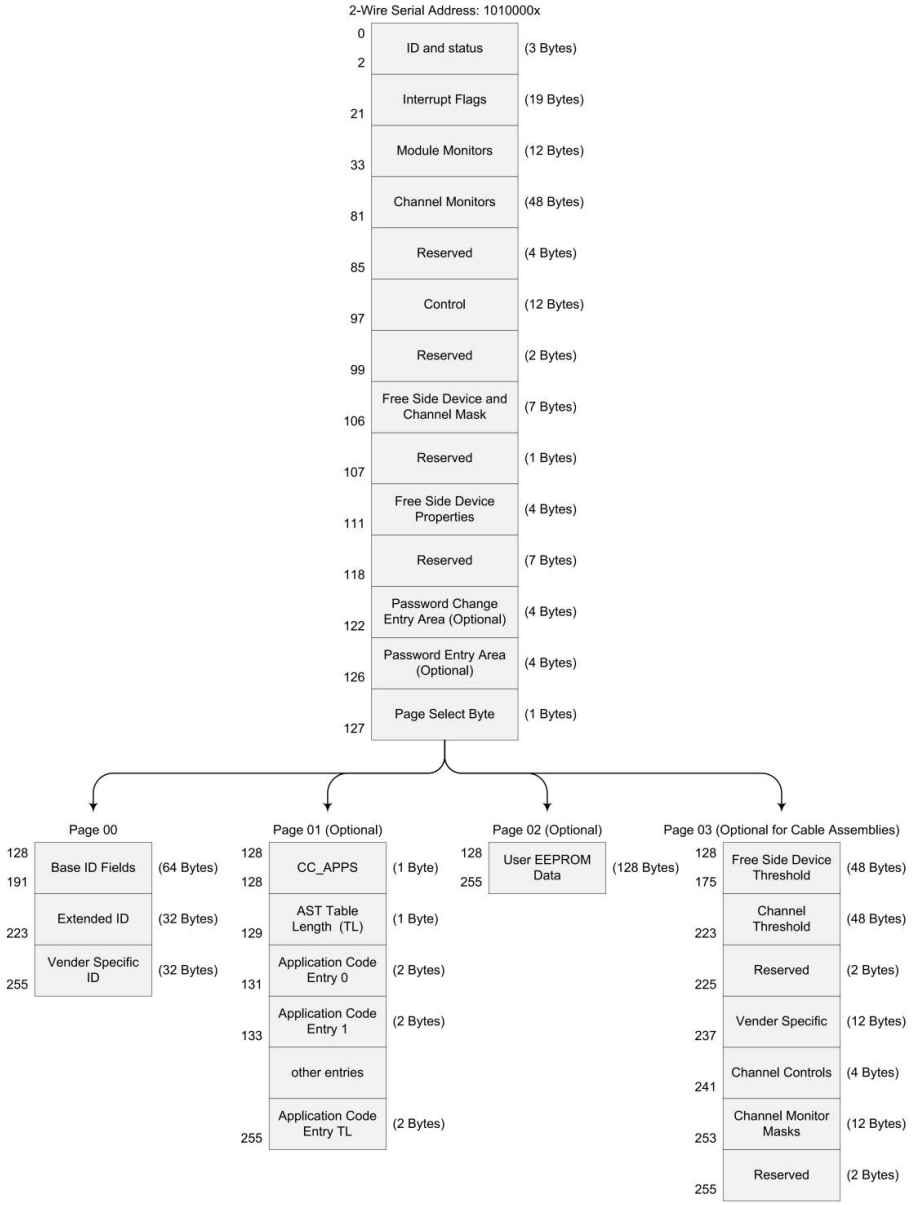


Figure5: Memory map

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

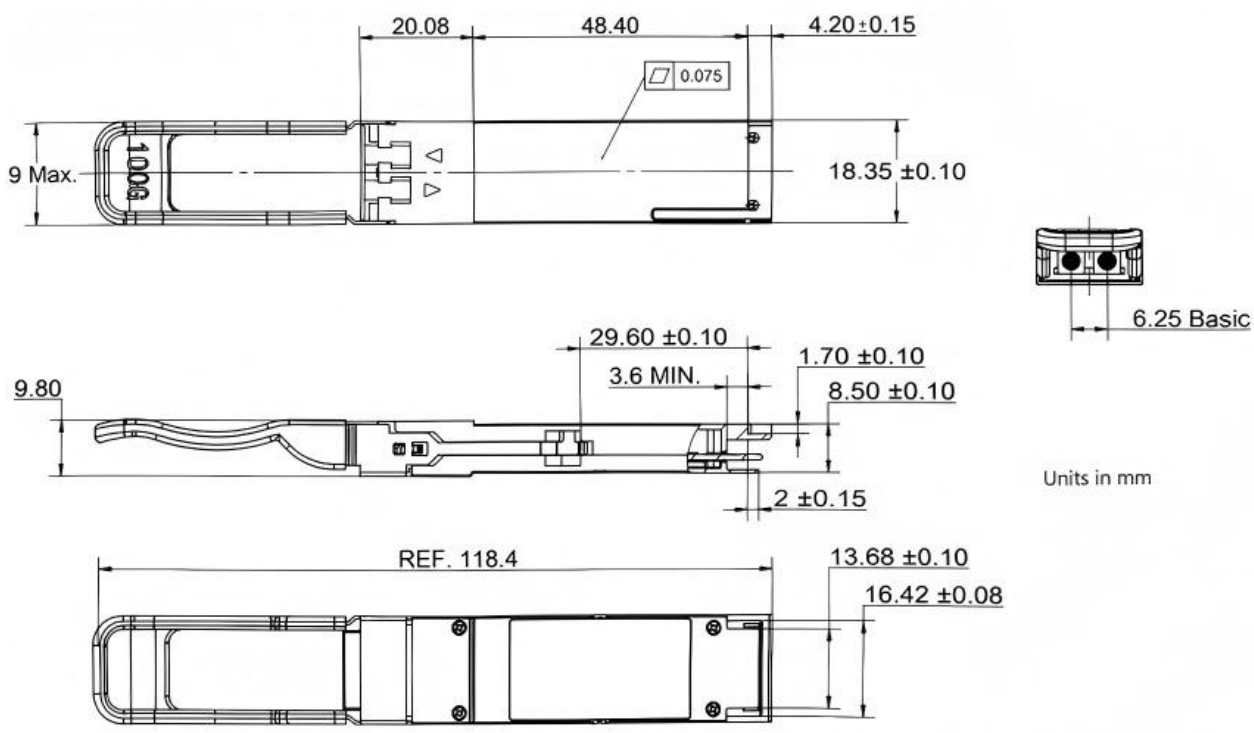
3-21	19	Interrupt Flags	Consist of interrupt flags for LOS, Tx Fault, warnings and alarms. The non-asserted state shall be 0b.
22	1	Temperature MSB	Internally measured temperature (MSB)
23	1	Temperature LSB	Internally measured temperature (LSB)
24-25	2	Reserved	Reserved
26	1	Supply Voltage MSB	Internally 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 Cable Attenuation	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.
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	
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

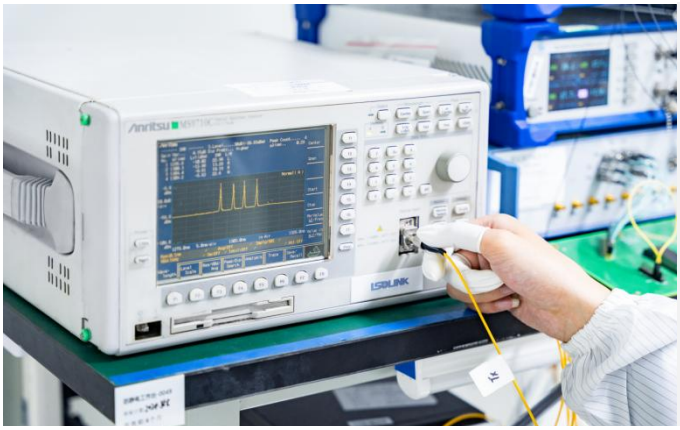
Mechanical Dimension



Test Center

1、Performance Testing

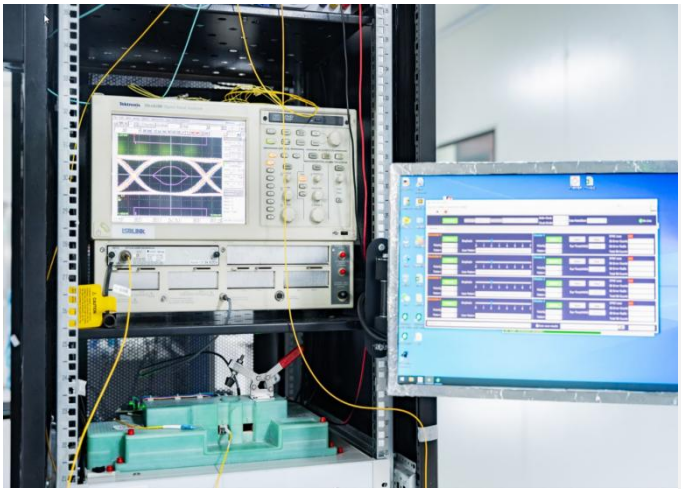
Every fiber optic transceiver is thoroughly tested by the Assurance Program, which is equipped with the world's most advanced analytical equipment to ensure that our transceivers meet the industry's international public protocol standards while still functioning flawlessly in your facility.



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 WI:** 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**

Aboveis 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

Order Information

Part Number	Description
QSFP100G-SR4-100	100GBASE-SR4 QSFP28 100G 850nm 100m DOM MTP/MPO-12 UPC MMF Transceiver Module
QSFP100G-PSM4-2	100GBASE-PSM4 QSFP28 100G 1310nm 2km DOM MTP/MPO-12 APC SMF Transceiver Module
QSFP100G-CWDM4-2	100GBASE-CWDM4 QSFP28 100G 1310nm 2km DOM LC SMF Transceiver Module
QSFP100G-SR-BD	100GBASE-SR Bi-Directional QSFP28 850nm 100m DOM Duplex LC MMF Optical Transceiver Module
QSFP100G-SWDM4	100GBASE-SWDM4 QSFP28 100G 850nm 100m DOM LC MMF Transceiver Module
QSFP100G-LX4	100GBASE-LX4 QSFP28 100G 1310nm 100m/2km DOM LC MMF/SMF Transceiver Module
QSFP100G-LR4-10	100GBASE-LR4 QSFP28 100G 1310nm 10km DOM LC SMF Transceiver Module
QSFP100G-ER4-40	100GBASE-ER4 QSFP28 100G 1310nm 40km DOM LC SMF Transceiver Module
QSFP100G-ZR4-80	100GBASE-ZR4 QSFP28 100G 1310nm 80km DOM LC SMF Transceiver Module
QSFP112G-LR4-10	100/112GBASE-LR4 QSFP28 100G Dual Rate 1310nm 10km DOM LC SMF Transceiver
QSFP112G-ER4-40	100/112GBASE-ER4 QSFP28 100G Dual Rate 1310nm 40km DOM LC SMF Transceiver Module
QSFP100G-U23-20	100GBASE-BX20 QSFP28 1280nm-TX/1310nm-RX 20km DOM Simplex LC SMF Optical Transceiver Module
QSFP100G-D32-20	100GBASE-BX20 QSFP28 1310nm-TX/1280nm-RX 20km DOM Simplex LC SMF Optical Transceiver Module
QSFP100G-DR-500	100GBASE-DR QSFP28 Single Lambda PAM4 1310nm 500m DOM LC SMF Transceive
QSFP100G-FR-2	100GBASE-FR QSFP28 Single Lambda PAM4 1310nm 2km DOM LC SMF Transceiver
QSFP100G-LR-10	100GBASE-LR QSFP28 Single Lambda PAM4 1310nm 10km DOM LC SMF Transceive
QSFP100G-ER-40	100GBASE-ER QSFP28 Single Lambda PAM4 1310nm 40km DOM Duplex LC SMF Optical Transceiver Module