

# Product Specification

103.125Gb/s QSFP28 Active Optical Cable

P/N: EDR-Q28-A



## Features

- Hot Pluggable QSFP28 form factor
- Available length range 1m~100m
- Active Optical Cable
- Operating data rate 103.125Gbps
- Single +3.3V power supply
- Max power dissipation <2.5W
- 4-Channel Full-Duplex Active Optical Cable
- 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 802.3bj
- RoHS

## Applications

- Supports 100Gb InfiniBand EDR Systems
- Fiber Channel over Ethernet
- Switches, servers, routers and HBA
- Data center cabling infrastructure
- High density connections between networking equipment

## Description

The EDR-Q28-A is an active optical cable (AOC) designed to support InfiniBand EDR 100G data transmission. Encased in a QSFP28 package, this high-performance cable offers a reliable solution for long-distance interconnections within data centers, supercomputing clusters, and high-performance computing environments. The AOC design ensures enhanced signal integrity and minimal power consumption, which is essential for maintaining low-latency communication over extended distances.

Ideal for connecting InfiniBand switches and network adapters, the EDR-Q28-A enables seamless data flow, helping to meet the demanding bandwidth requirements of modern data-intensive applications. It supports reliable, high-speed data transmission with excellent noise immunity, making it a valuable component for applications in fields such as artificial intelligence, scientific research, and large-scale cloud data centers. This AOC solution provides a cost-effective and energy-efficient method to extend the reach of InfiniBand networks while ensuring optimal performance.

## Product performance Specifications

### 1. Basic Product Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit
Absolute Maximum Ratings					
Supply voltage	$V_{CC}$	-0.3	-	3.6	V
Data input voltage		-0.3	-	3.465	V
Control input voltage	$V_I$	-0.3	-	4.0	V
Damage threshold		3.4	-	-	dBm
Storage temperature	$T_s$	-40	-	85	°C
Operational Specifications					
Supply Voltage	$V_{CC}$	3.135	-	3.465	V
Power dissipation (each end, no retiming)		1.5	-	1.8	W
Power dissipation (each end, retiming on all lanes)		2.2	-	2.5	W
Supply noise tolerance (10Hz-10MHz)		66	-	-	mVpp
Operating case temperature	$T_{OC}$	0	-	70	°C
Operating relative humidity	RH	5	-	85	%

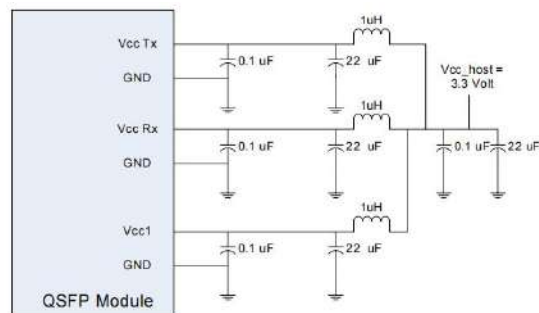
## 2. Product Optical and Electrical Characteristics

Parameter	Symbol	Min	Typ.	Max	Unit	Note
Signaling rate	SR	-100ppm	25.78125	+100ppm	GBd	
Signaling rate (without retiming)		0.3	-	25.784	GBd	
BER (Bit Error Rate)	BER	-	-	10 <sup>-15</sup>		1
Transmitter						
Differential data input swing at TP1a	Vout	See2		900	mVpp	2
Differential input return loss		Meets equation (83E–5) in IEEE 802.3bm			dB	
Receiver						
Differential data output swing at TP4		300		480	mVPP	
Differential output return loss		Meets equation (83E–5) in IEEE 802.3bm			dB	
Common Mode output return loss				-6	dB	
Output eye width (EW15)		0.57			UI	
Output eye height (EH15)		288			mV	
Output Transition time, 20 to 80%		17			ps	
Output Eye Crossing		45			%	

**Note1:** BER performance was verified with a PRBS31 test pattern in accordance with the IEEE 802.3bm specifications, as part of the product qualification.

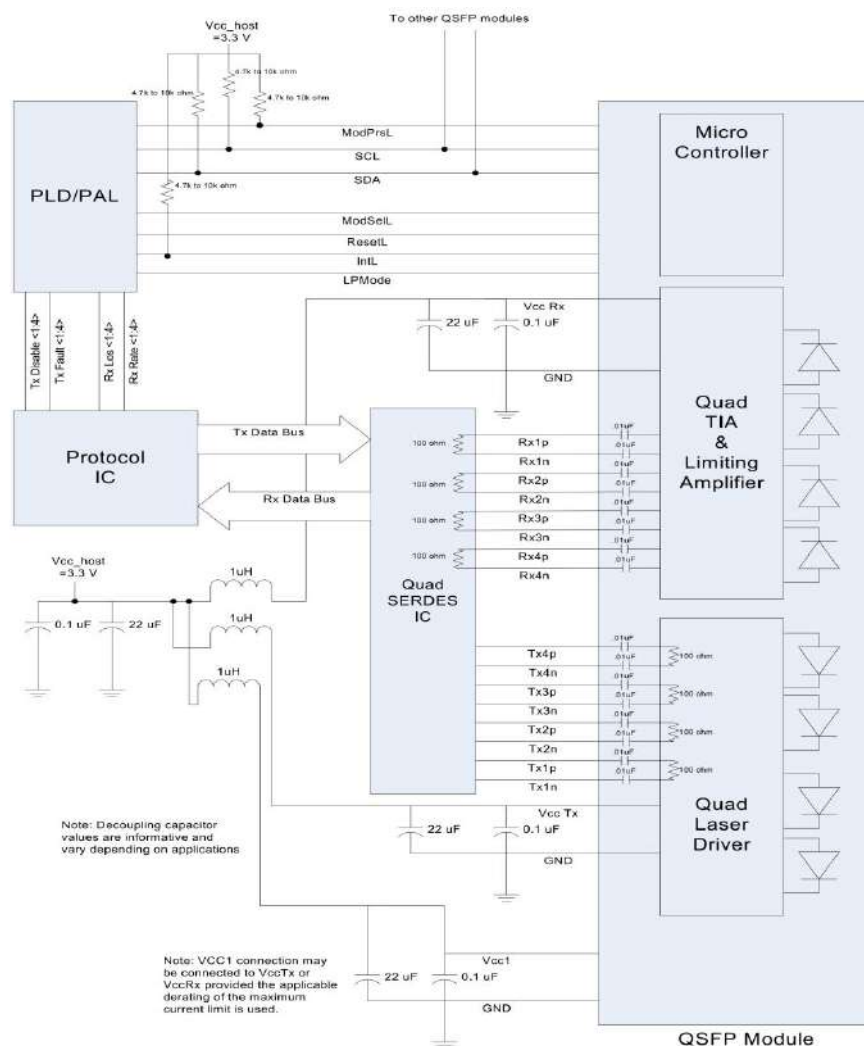
**Note2:** Requires optimization of the input equalizer

## Recommended Host Board Power Supply Circuit



**Figure 1:**Recommended Host Board Power Supply Circuit

## Recommended Interface Circuit



**Figure2:**Recommended Interface Circuit

## Pin-out Definition

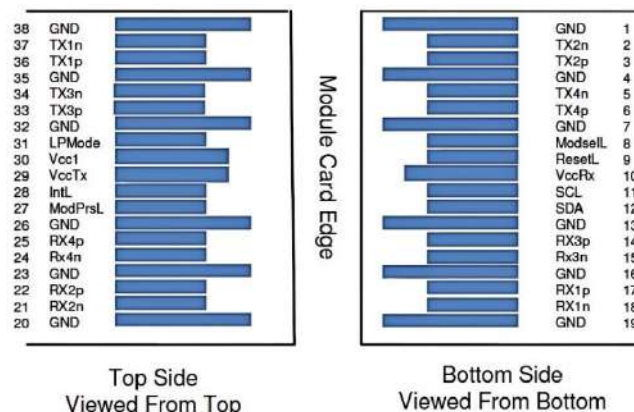


Figure3:Pin view

## 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

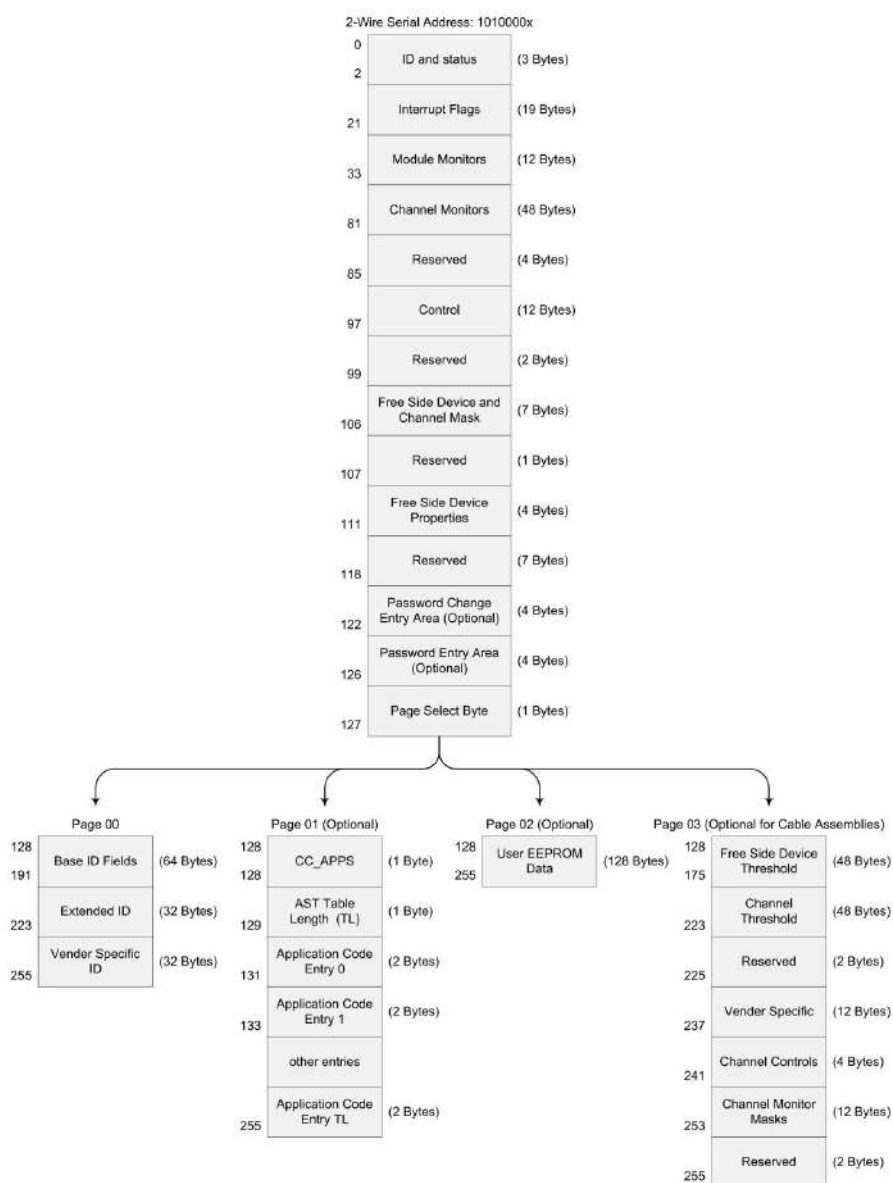


Figure4:Memory map

## 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

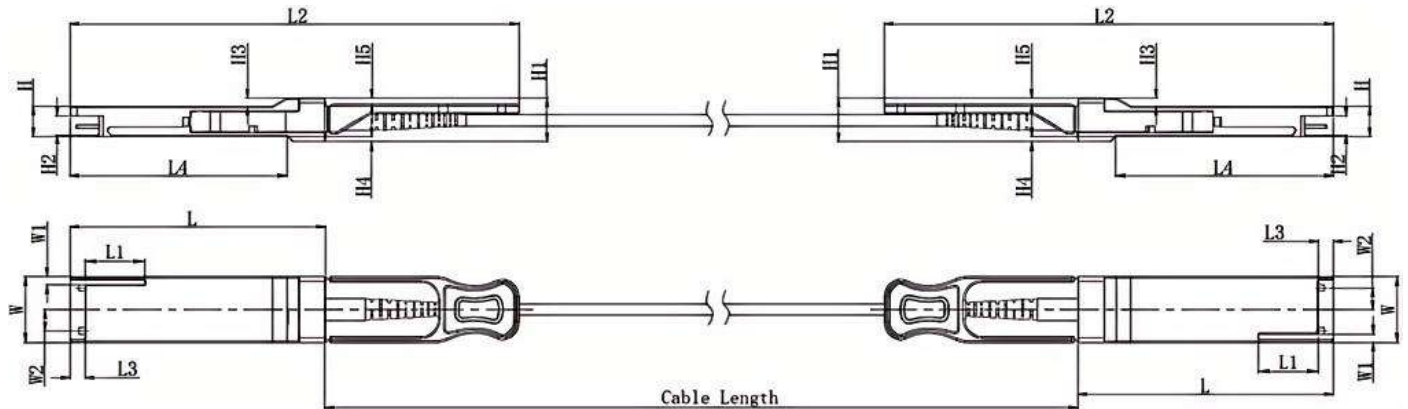
			non-asserted state shall be 0b.
22	1	Temperature MSB	Internally measured temperature (MSB)
23	1	Temperature LSB	Internally measured temperature (LSB)
24-25	2	Reserved	Reserved
26	1	Supply Voltage MSB	Internally measured supply voltage (MSB)
27	1	Supply Voltage LSB	Internally measured supply voltage (LSB)
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

## Mechanical Dimension



### Note:

- Diameter: 3mm
- Minimum bend radius:30mm
- Cable color:Orange(OM2),Aqua(OM3),Magenta(OM4)
- When  $L \leq 1\text{m}$ , the tolerance is +5cm
- When  $1\text{m} \leq L \leq 4.5\text{m}$ , the tolerance is +15cm
- When  $5\text{m} \leq L \leq 14.5\text{m}$ , the tolerance is +30cm
- When  $L \geq 15\text{m}$ , the tolerance is +2%m

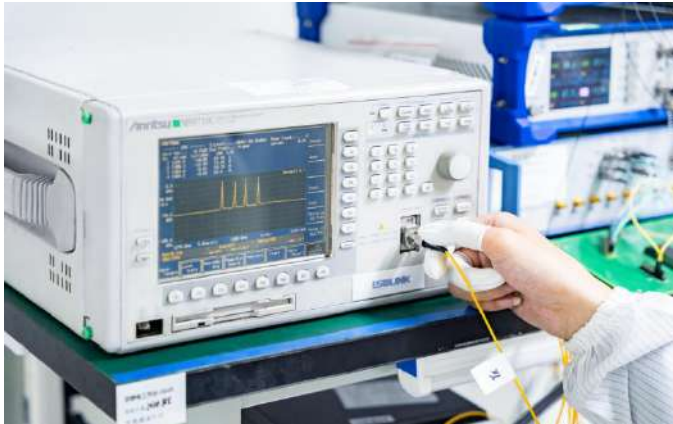
### Waring:

- The transceiver optics is supplied with a dust cover. This plug protects the transceiver optics during standard manufacturing processes by preventing contamination from air borne particles.It is recommended that the dust cover remain in the transceiver whenever an optical fiber connector is not inserted.
- Handling Precautions: This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.
- Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.

## 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


## Order Information

Part Number	Length(m)	Connector Type	Cable Type	Cable Jacket
EDR-Q28-A1	1	QSFP28 to QSFP28	Active Optical	OFNP
EDR-Q28-A3	3	QSFP28 to QSFP28	Active Optical	OFNP
EDR-Q28-A5	5	QSFP28 to QSFP28	Active Optical	OFNP
EDR-Q28-A7	7	QSFP28 to QSFP28	Active Optical	OFNP
EDR-Q28-A10	10	QSFP28 to QSFP28	Active Optical	OFNP
EDR-Q28-A15	15	QSFP28 to QSFP28	Active Optical	OFNP

## Further Information

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 **Email** | For [Sales@lsolink.com](mailto:Sales@lsolink.com)

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