GigaLight

GIGALIGHT Marketing Report

Special Issue on Featured Products

Issue 1, 2023

New Solution for 100G Short-distance Cabling

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100G QSFP28 SWDM4

4×100G PAM4 Solution

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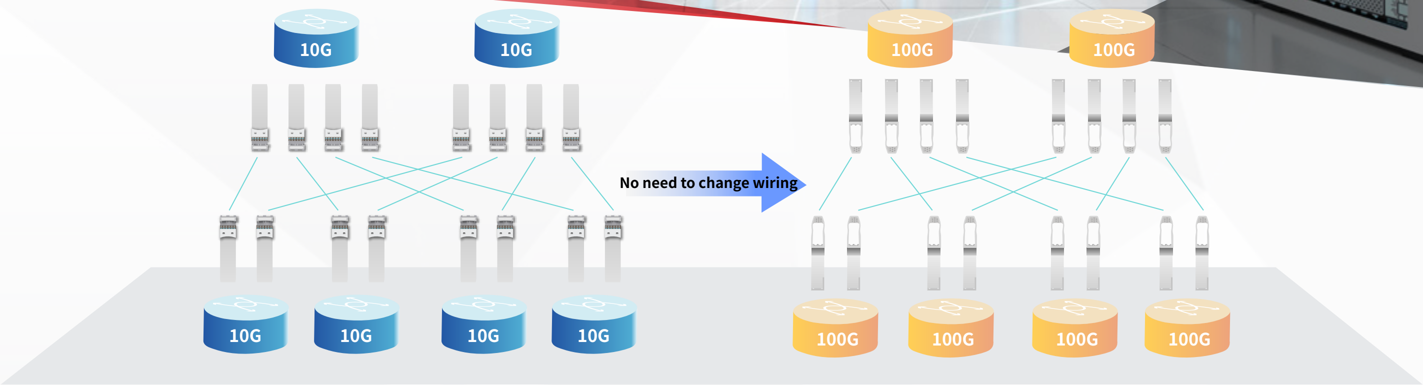
New Solution for 100G Short-distance Cabling

——Smooth upgrade, Simplified Cabling



Compared with the traditional 100G short-distance transceivers based on MPO multi-fiber cabling, the two new products adopt duplex-fiber cabling. When the network architecture is upgraded from 1G/10G to 100G, by using the duplex-fiber 100G transceivers, the deployed LC duplex cabling infrastructure can be reused and additional MPO cabling is not required, saving much cabling cost. So, that the duplex-fiber 100G transceivers come to be a new choice for data center cabling.

100G QSFP28 SR BiDi

Overview

The 100GE QSFP28 SR BiDi transceiver is compliant with SFF-8436 and SFF-8636, with built-in DSP and 4:2 Gearbox. The electrical port end adopts 4×25G NRZ modulation, while the optical port end adopts 2×50G PAM4 modulation. The uplink and downlink of each optical channel use different operating wavelengths (850nm or 910nm), and KP4 FEC is enabled by default to support the transmission distance of up to 70m (OM3 MMF) or 100m (OM4 MMF). The power consumption is less than 4W.

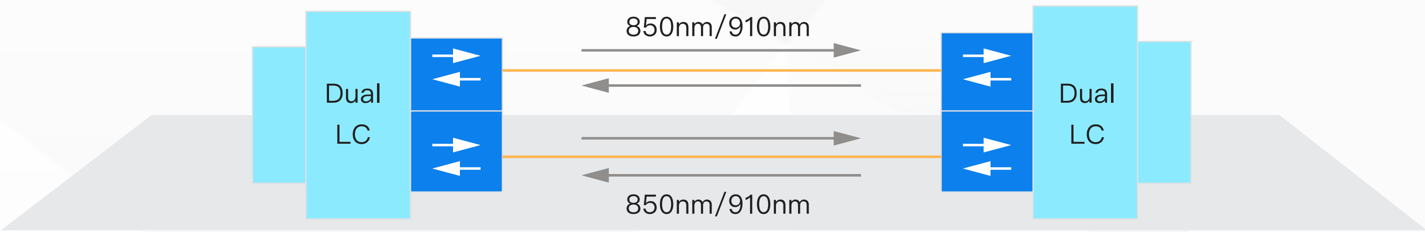
Key Parameters

Transmitter	Min.	Typ.	Max.	Unit	Note
Wavelength CH1	844	850	863	nm	–
Wavelength CH2	900	910	918	nm	–
Average launch power	-6.2	–	4	dBm	–
OMA_{outer}	-4.2	–	3	dBm	–
TDECQ	–	–	4.5	dB	–

Receiver	Min.	Typ.	Max.	Unit	Note
Wavelength CH1	844	850	863	nm	–
Wavelength CH2	900	910	918	nm	–
Average receive power	-8.2	–	4	dBm	–
Receiver Sensitivity (OMAouter)	–	–	-6.6 -3.5	dBm	1

*Measured BER=2.4E-4Pre-FEC at TP3 using one-time conformance test signal

Connection Schematic Diagram



100G QSFP28 SWDM4

Overview

The 100G QSFP28 SWDM4 transceiver is compliant with SWDM4 MSA. It adopots internal 4CH MUX/DMUX to realize the multiplexing and demultiplexing of 4-lane of 25G NRZ optical signals (850nm, 880nm, 910nm, and 940nm), transmitting on a single multi-mode fiber up to 70m (OM3), 100m (OM4), or 150m (OM5). The power consumption is less than 3.5W.

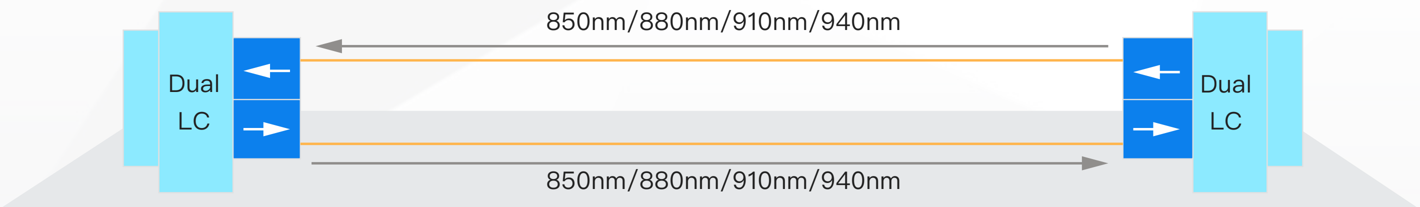
Key Parameters

Transmitter	Aisle	Min.	Typ.	Max.	Unit
Signaling rate, each lane			25.78125±100ppm		Gb/s
Lane wavelength range	Lane0	844		858	nm
	Lane1	874		888	nm
	Lane2	904		918	nm
	Lane3	934		948	nm
Modulation format			NRZ		
OMA, each lane		-5.5		3	dBm

Receiver	Aisle	Min.	Typ.	Max.	Unit
Signaling rate, each lane			25.78125±100ppm		Gb/s
Lane wavelength range	Lane0	844		858	nm
	Lane1	874		888	nm
	Lane2	904		918	nm
	Lane3	934		948	nm
Modulation format			NRZ		
Unstressed sensitivity (OMA)	Lane0			-8.2	dBm
	Lane1			-8.4	dBm
	Lane2			-8.6	dBm
	Lane3			-8.8	dBm

*@5E-5 BER with pre FEC

Connection Schematic Diagram



4x100G PAM4 Solution

——Low Cost Architecture

The optical connections inside the data center are realized by means of optical transceivers and optical fiber cables. In order to cope with the growth of data traffic and take into account more flexible expansion and upgrade and backup functions, the new generation of large-scale data centers generally adopt the leaf-spine architecture with greater internal data exchange and throughput.

Considering the cost, the data center TOR servers/switches are interconnected with medium and long-distance optical transceivers. For 400G data centers, the 400G QSFP-DD DR4 (silicon photonics), 400G QSFP-DD XDR4/PLR4 and 400G QSFP-DD FR4/LR4 transceivers are the most popular.

400G QSFP-DD DR4（Silicon Photonics）

Overview

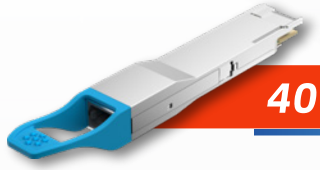
GIGALIGHT adopts silicon lens technology to achieve high-efficiency coupling of silicon photonics, making the optical coupling responsivity up to 0.8A/W under three-temperature conditions, which can overcome the adverse effects of multi-channel crosstalk on the link, and perfectly realizes the commercial production of 400G QSFP-DD DR4 silicon photonics transceivers. Thanks to the advantages of high signal quality and low mass production cost brought by silicon photonics technology, as well as the advantages of low device cost brought by single-lambda 100G PAM4 technology and parallel optical engine technology, this product has now become one of the most cost-effective data center solutions for 400G interconnection within 500m.

Key Parameters

Transmitter	Min.	Typ.	Max.	Unit	Note
Center Wavelength	1304.5		1317.5	nm	–
SMSR	30	–	––	dB	–
Average launch power, each lane	-2.9	–	4.0	dBm	–
OMAouter	-1.46	–	4.2	dBm	_
TDECQ	–		3.4	dB	

Receiver	Min.	Typ.	Max.	Unit	Note
Center Wavelength	1304.5		1317.5	nm	–
Receive Power (OMAouter), each lane			-4.4	dBm	
Average receive power, each lane	-5.9		4	dBm	–

*Measured at TP3 using compliance test signal BER=2.4E-4 Pre-FEC.



400G QSFP-DD XDR4/PLR4

Overview

400G QSFP-DD XDR4/PLR4 (EML) transceivers are upgraded versions of 400G QSFP-DD DR4. With higher sensitivity, they support longer transmission distance of up to 2km/10km @FEC symbol error≤2. Based on EML lasers and Broadcom 7nm DSP, the maximum power consumption is 10W.

Key Parameters

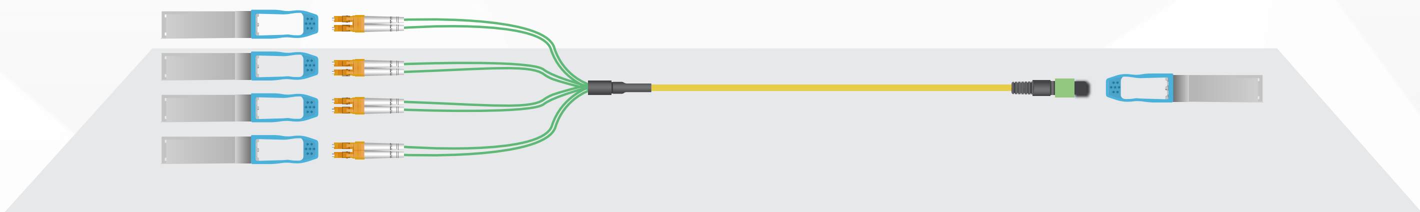
Transmitter	Min.	Typ.	Max.	Unit	Note
Center Wavelength	1304.5		1317.5	nm	–
Average launch power, each lane	–3.2	–	4.4	dBm	XDR4
Average launch power, each lane	–1.4	–	4.5	dBm	PLR4
OMA_{outer}	–0.2	–	3.7	dBm	XDR4
OMA_{outer}	0.7	–	4.7	dBm	PLR4
TDECQ			3.4	dB	

Receiver	Min.	Typ.	Max.	Unit	Note
Center Wavelength	1304.5		1317.5	nm	–
Receive Power (OMA_{outer}), each lane			–4.6	dBm	XDR4
Receive Power (OMA_{outer}), each lane			–6.1	dBm	PLR4
Average receive power, each lane	–7.2		4.4	dBm	XDR4
Average receive power, each lane	–7.7		4.5	dBm	PLR4

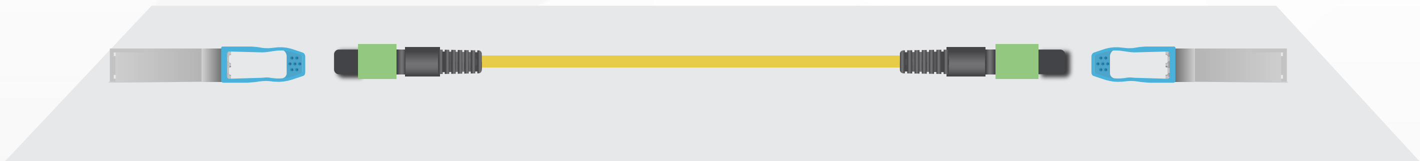
*Measured at TP3 using compliance test signal BER=2.4E–4 Pre–FEC.

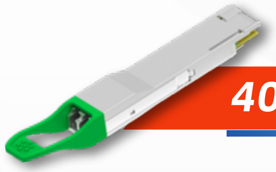
Application

Scenario 1:4x 100G QSFP28 DR1/FR1/LR1 to 400G QSFP–DD DR4/XDR4/PLR4



Scenario 2:400G QSFP–DD DR4/XDR4/PLR4 to 400G QSFP–DD DR4/XDR4/PLR4





400G QSFP-DD FR4

Overview

- Type-2 QSFP-DD form factor
- Internal integrated CWDM4 optical MUX/DeMUX and Broadcom 7nm DSP
- Up to 2km over single-mode fiber with KP4 host FEC
- Compliant with 100G Lambda MSA 400G-FR4
- Compatible with the IEEE 802.3cu 400GBASE-FR4
- Compliant with the 400GAUI-8 and CEI-56G-VSR-PAM4
- 10W maximum power consumption

Key Parameters

Parameters	Min.	Typ.	Max.	Unit	Note
Wavelengths	1264.5	1271	1277.5	nm	
	1284.5	1291	1297.5	nm	
	1304.5	1311	1317.5	nm	
	1324.5	1331	1337.5	nm	
SMSR	30	–	–	dB	
Average launch power, each lane	-3.2	–	4.4	dBm	1
OMA_{outer}	–	–	3.7	dBm	
TDECQ	–	–	3.4	dB	
Average receive power, each lane	-7.2	–	4.4	dBm	2
Receive Power (OMA_{outer}), each lane for TDECQ <1.4dB for 1.4≤TECQ≤3.4dB	–	–	-4.6 -6+TECQ	dBm	
Stressed receiver sensitivity (OMA_{outer}), each lane	–	–	-2.6	dBm	

400G QSFP-DD LR4

Overview

- Type-2 QSFP-DD form factor
- Internal integrated CWDM4 optical MUX/DeMUX
- Up to 10km over single-mode fiber with KP4 host FEC
- Compliant with 100G Lambda MSA 400G-LR4-10
- Compatible with the IEEE 802.3cu 400GBASE-LR4-6
- Compliant with the 400GAUI-8 and CEI-56G-VSR-PAM4
- 10W maximum power consumption

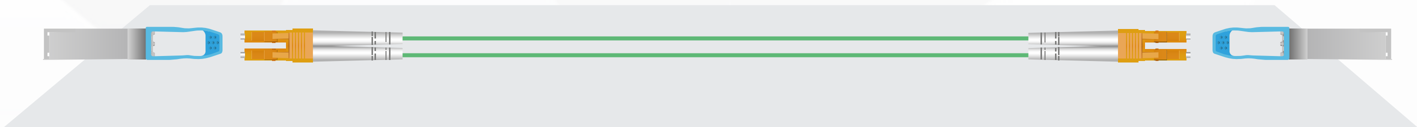
GIGALIGHT has optimized the design of the EML laser to improve the performance of the chirp and balanced the parameters such as the bias voltage, and finally realized the 10km high-performance transmission based on Single Lambda 100G PAM4.

Key Parameters

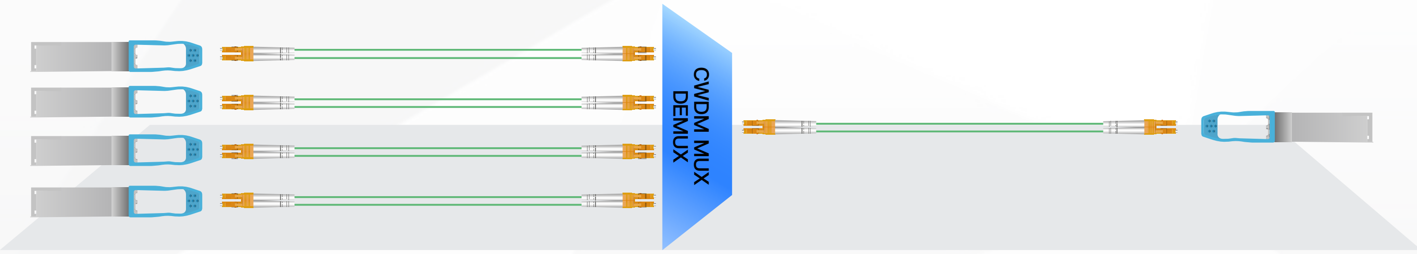
Parameters	Min.	Typ.	Max.	Unit	Note
Wavelength L0	1264.5	1271	1277.5	nm	
Wavelength L1	1284.5	1291	1297.5	nm	
Wavelength L2	1304.5	1311	1317.5	nm	
Wavelength L3	1324.5	1331	1337.5	nm	
Average launch power, each lane	-2.7	-	5.1	dBm	1
OMAouter	-	-	4.4	dBm	
OMAouter for TDECQ <1.4dB for 1.4≤TECQ≤3.4dB	0.3 -1. 1+ TDECQ				
Stressed receiver sensitivity (OMAouter), each lane	-	-	3.9	dB	
TDECQ	-	-	3.9	dB	
Average receive power, each lane	-9	-	5.1	dBm	1
OMAouter	-	-	4.4	dBm	
OMAouter for TECQ <1.4dB for 1.4≤TECQ≤3.4dB	-	-	-6.8 -8.2+TE CQ	dBm	
Stressed receiver sensitivity (OMAouter), each lane	-	-	-4.3	dBm	

Application (FR4/LR4)

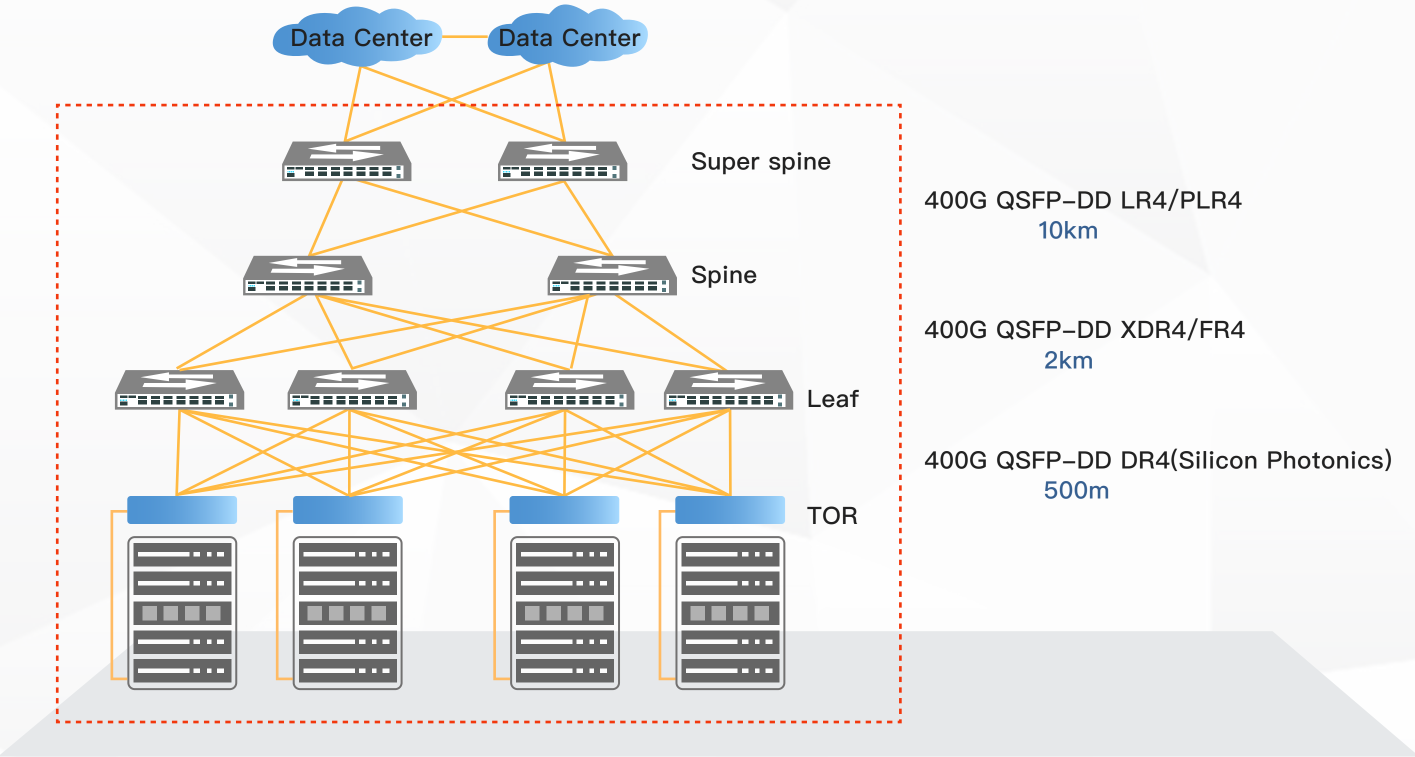
Scenario 1:400G QSFP-DD FR4/LR4 to 400G QSFP-DD FR4/LR4



Scenario 2:4x 100G QSFP28 FR1/LR1 to 400G QSFP-DD FR4/LR4



400G Data Center Architecture based on Single Lambda 100G



GIGALIGHT 400G QSFP-DD Famliy (100G PAM4 Series)

400G QSFP-DD	DR4 Silicon Photonics	XDR4	PLR4	FR4	LR4
Reach	500m	2km	10km	2km	10km
Wavelength	1310nm	1310nm	1310nm	CWDM4	CWDM4
Optical Engine	PSM4	PSM4	PSM4	CWDM4	CWDM4
Optical Interface	MPO12	MPO12	MPO12	Duplex LC	Duplex LC
Proposed Price	US$ 600.00	US$ 1100.00	US$ 1100.00	US$ 820.00	US$ 1200.00

400G Long-distance Telecom Solution

——Born for long-distance transmission applications

How Do the 400G Optical Transceivers Achieve Long-distance Transmission?

DCI and metro scenarios require ultra-long-distance transmission, and have higher requirements for the transmission performance of optical transceivers. As the rate is upgraded to 400G, the demand for 400G long-distance optical transceivers is increasing, and the industry is constantly breaking through the transmission distance of 400G optical transceivers.

Increase the Baud Rate of Optical Components

The line capacity can be increased by increasing the baud rate of optical components, but this approach is limited due to the performance bottleneck of III-V semiconductor lasers. According to the requirements of the metropolitan area network, 25Gbps optical components (DML and EML) have been applied in batches. However, at the 56Gbps level, only EML is available.

More Channels

Because the bandwidth and performance improvements of optical components are limited, multiple channels can be used in parallel to achieve 100G transmission, as shown in 4x 25G NRZ technology. The mature industry chain of 25G components can be reused to provide high-capacity solutions in advance to meet actual application needs. In the 400G era, multi-channel solutions are essential, and x4 or x8 multi-channel architecture is the most suitable, considering cost and power consumption.

Use Higher-level Modulation

When using higher-order modulation formats, spectral efficiency can be increased without increasing the signal baud rate, thereby increasing the overall bandwidth. Currently, PAM4 is the mainstream modulation method in the industry, because it can achieve a single-channel 50G transmission rate through a transmitter and receiver based on 25GBd, thereby reducing power consumption and cost per bit.

Use More Reliable Components

In the metro integrated bearer network, optical transceivers are mainly used in carrier-class scenarios. They are required to have a 10-year life cycle, be fully functional over a temperature range of 0℃ to 70℃, and be hermetically sealed to ensure their reliability. Cost reduction is becoming increasingly important for data center transceivers, driving the development of non-hermetic packaging technologies. However, such technologies still face the following challenges in carrier-grade scenarios.

- Reliability risk of laser diode (LD): non-hermetic package requires higher coating on LD end face.
- Condensation and chemical corrosion risks of thermoelectric cooler (TEC): LAN wavelength division multiplexing (LWDM) components use TECs for temperature control. As a result, some parts of the LWDM component (where the TEC is located) are cooler than the ambient temperature, there is a risk of condensation in non-sealed environments, and long-term exposure to water vapor may cause galvanic corrosion.
- Risk of optical path pollution: In the non-hermetic package and the space between the LD chip and the optical port, the non-hermetic package cannot avoid the following two problems. First, due to condensation and pollution, the optical surface power may change. Second, the glue inside the component may absorb water and results in a change in the relative position of the optical path, which also changes the optical power output.

Using High-Performance LWDM Transmitters

CWDM wavelength spacing is 20nm and does not require TEC for cooling, which greatly reduces the cost. CWDM transmitters support 2km applications and are the mainstream solution for data center solutions. Compared with CWDM, LWDM has a wavelength interval of 5nm, and has low dispersion loss and higher transmission performance. Therefore, it is the first choice for carrier-grade solutions in metropolitan area networks. Take the Single Lambda 100G solution as an example. After transmitting 10km, the dispersion window and dispersion loss (2.5dB) of CWDM are much larger than that of LWDM (1dB). In the 400G era, CWDM cannot support long-distance transmission over 10km, so LWDM transmitters will become the mainstream solution for metro integrated bearer networks.

Using High-Performance Receivers with APD

Generally, the output power of the 25G transmitter is 0dBm to 3dBm, and the sensitivity of the 25G PIN receiver is about -7dBm, which cannot meet the long-distance (40km) transmission requirements of the carrier-grade optical transceivers. Therefore, high-performance APDs are required to improve receiver sensitivity.

	Sensitivity	Receiver	Cost
400G LR8	-6.6dBm	PIN	Low
400G ER8	-16.1dBm	APD	High

GIGALIGHT 400G Long-distance Optical Transceivers

The 400G QSFP-DD LR8 and 400G QSFP-DD ER8 are 8-channel full-duplex transceivers based on the hot-pluggable QSFP-DD form fctor with a transmission rate of up to 425Gbps. Both of them adopt dual LC interface and 8CH LAN-WDM 50G PAM4 modulation.

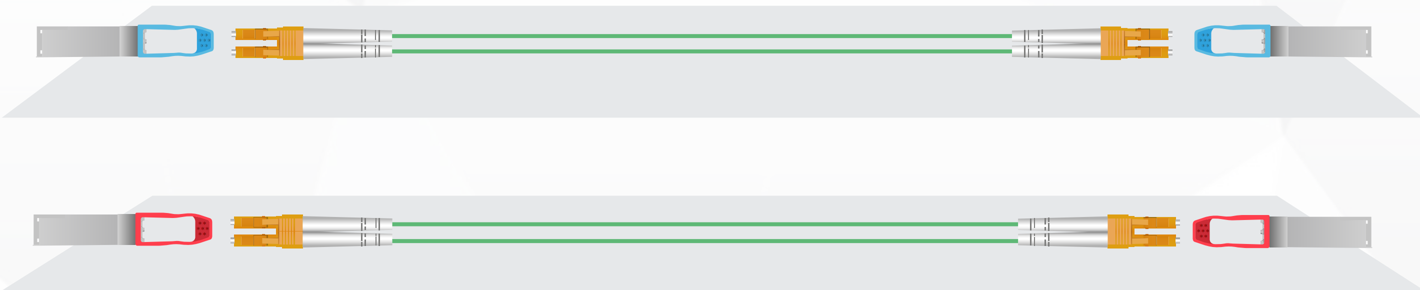
400G QSFP-DD LR8

- Compliant with QSFP-DD MSA and IEEE 802.3bs 400GBASE-LR8
- PIN receiver with RX Sen. ⩽ -7.1dBm @2E-4 BER
- Reach up to 10km with KP4 host FEC
- 12.5W maximum power consumption

400G QSFP-DD ER8

- Compliant with QSFP-DD MSA and IEEE 802.3cn 400GBASE-ER8
- High-performance APD receiver with RX Sen. ⩽ -18.6dBm @2E-4 BER
- Reach up to 40km with KP4 host FEC
- 14W maximum power consumption

Application



Introduce Coherent Technology

Limited by component performance, the 400G PAM4 solution does not support long-distance transmission over 80km. To overcome this challenge, mature coherent technologies that have been successfully deployed on long-distance transmission networks should be introduced. In addition, silicon photonics and InP integration technologies, as well as CMOS technologies, continue to evolve to support smaller coherent optical modules with lower power consumption. With the help of compact ICT/ICR and low-power 7nm oDSP, 400GE compact QSFP-DD coherent optical modules can be realized. In 2017, the OIF 400ZR project was launched, which defined the concatenated forward error correction (CFEC) mode and the low-complexity 400G-16QAM modulation mode. Both the performance and power consumption of 400ZR modules are considered to support 80-120km metropolitan area network and data center applications.

GIGALIGHT 400G Coherent Optical Modules

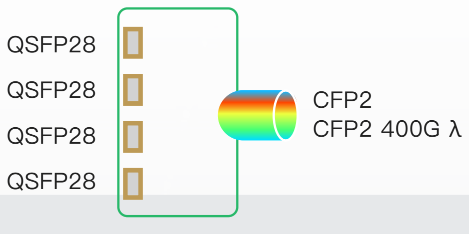
400G CFP2 DCO

- Supports n100GE, 200GE, 400GE and OTU4/OTUCn data rates up to 425Gbps
- Supports 200G PM-QPSK, 200G PM-16QAMps and 400G PM-16QAM
- Compliant with OTL4.4, FOIC1.4, CAUI-4 and FOIC1.2
- Supports near-end/far-end data loopback testing
- Supports OTN data monitoring functions

Tunable wavelength (frequency) range	DWDM：1529.16nm-1567.14nm(191.3THz-196.05THz)
Modulation	DP-QPSK@100G 50Ghz；DP-16QAM@200G 50Ghz；DP-16QAMps@200G 50Ghz；DP-QPSK@200G 75Ghz；DP-16QAM@400G 75Ghz
RX OSNR tolerance	<12dBG@100G QPSK；<20.5dB@200G DP-16QAM；<16dB@200G DP-16QAMps；<13.5dB@200G DP-OPSK；<22dB@400G DP-16QAM
Protocol	100GE、OTU4
Dispersion tolerance	±40000ps/nm@100G

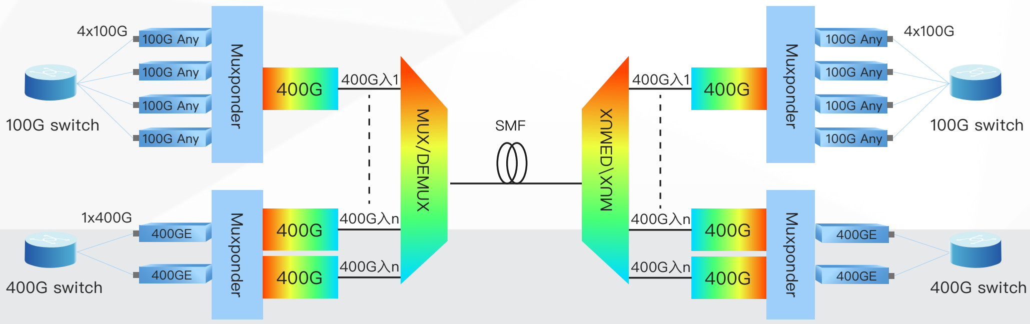
Application

*Used in DCI applications with 400G muxponder OTU card



400G DWDM point-to-point transmission

*For DCI



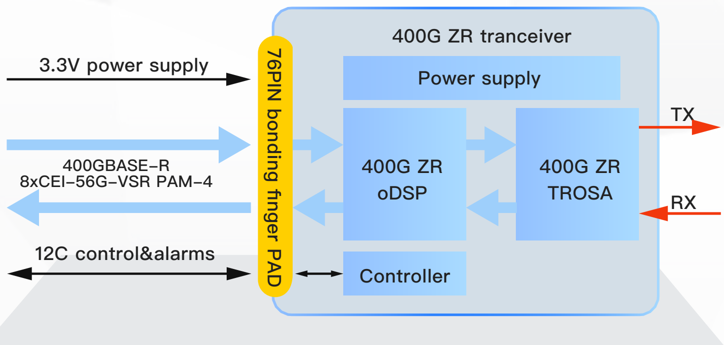
400G QSFP-DD DCO ZR

- Up to 80–120km (amplified) or 40km (non–amplified)
- Compliant with OIF–400ZR–01.0
- Built–in 7nm DSP
- 400G 16QAM modulation
- Full C–band tunable wavelength with 75GHz/100GHz channel spacing
- Flex grid 6.25Ghz adjustment step size

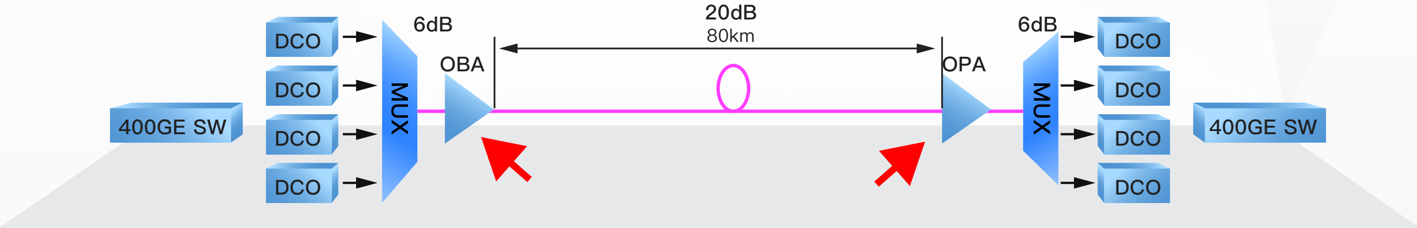
Key Parameters

Key Parameters		Value
Adjustable output optical power		–10dBm to –6dBm
Receiver sensitivity	DWDM (amplified)	> –12dBm
	Gray light link (non–amplified)	> –20dBm
OSNR (DWDM link)		26dB/0.1nm SEN –8 to –10dBm
TX OSNR		>35dBm

Module Block Diagram



Application



GigaLight

Open Optical Network Device Explorer

For any needs, please contact sales@gigalight.com. Thanks!

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