400GE QSFP-DD FR4 2km Optical Transceiver Module

GQD-SPO401-FR4C

PRODUCT FEATURES

- Compliant with 400GBASE-FR4(IEEE802.3cu)
- Compliant with IEEE 802.3bs standard: 400GAUI-8 electrical interface
- Compliant with QSFP-DD MSA HW Rev 5.1; type 2 housing with duplex LC connector
- Compliant with QSFP-DD CMIS Rev 4.0
- Maximum power consumption 10 W
- Case operating temperature 0℃ to 70℃
- Two wire serial Interface with digital diagnostic monitoring
- Complies with EU Directive 2011/65/EU (RoHS compliant)
- Class 1 Laser

APPLICATIONS

- Data Center Interconnect

DESCRIPTIONS

GQD-SPO401-FR4C is a transceiver module designed for 2km optical communication applications, and it is compliant to 100G Lambda MSA standard. This module can convert 8-channel 53.125Gb/s electrical data to 4-channel 106.25Gb/s optical signals, and multiplex them into a single channel for 425Gb/s optical transmission. Similarly, it optically de-multiplexes a 425Gb/s input into 4-channel signals, and converts them to 8-channel output electrical data on the receiver side. It has been designed to meet the harshest external operating conditions in- cluding temperature, humidity and EMI interference. The module offers very high functionality and feature integration, accessible via a two-wire serial interface.

Absolute Maximum Ratings

It has to be noted that the operation in excess of any individual absolute maximum ratings might cause permanent damage to this module.

Parameter	Symbol	Min.	Max.	Unit	Notes
Storage Temperature	Ts	-40	85	℃	
Supply Voltage	Vcc	-0.5	3.6	V	
Relative Humidity (non-condensing)	RH	5	95	%	

Data Input Voltage Differential	lVDIP-VDINl	-	1	V	
Control Input Voltage	VI	-0.3	VCC+0.5	V	
Control Output Current	IO	-20	20	mA	

Recommended Operating Conditions

Electrical and optical characteristics below are defined under this operating environment, unless otherwise specified.

Parameter	Symbol	Min.	Typ.	Max.	Unit	Notes
Operating Case Temperature	TOPR	0	-	70	℃	
Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Instantaneous peak current at hot plug	ICC_IP	-	-	4000	mA	
Sustained peak current at hot plug	ICC_SP	-	-	3300	mA	
Maximum Power Dissipation	PD	-	-	10	W	
Maximum Power Dissipation, Low Power Mode	PDLP	-	-	1.5	W	
Signalling Rate per Lane	SRL	-	53.125	-	Gbd	PAM4
Two Wire Serial Interface Clock Rate	-	-	-	400	kHz	
Module power supply noise tolerance 10 Hz - 10 MHz (ptp)	-	-	-	66	mVpp	
Rx Differential Data Output Load	-	-	100	-	Ohm	
Operating Distance	-	2	-	2000	m	

Optical Characteristics

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Transmitter						
Line wavelengths	λC0	1264.5	1271	1277.5	nm	
	λC1	1284.5	1291	1297.5	nm	
	λC2	1304.5	1311	1317.5	nm	
	λC3	1324.5	1331	1337.5	nm	
Side Mode Suppression Ratio	SMSR	30	-	-	dB	

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Average Launch Power, each lane	AOPL	-3.2	-	4.4	dBm	1
Outer Optical Modulation Amplitude (OMAouter), each lane	TOMA	-	-	3.7	dBm	
Outer Optical Modulation Amplitude (OMAouter) each lane: for TDECQ <1.4dB for 1.4≤TDECQ≤3.4dB	TOMA	-0.2 -1.6+TDECQ				
Difference in launch power between any two lanes (OMAouter)	DP	-	-	3.9	dB	
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ), each lane	TDECQ	-	-	3.4	dB	
Transmitter eye closure for PAM4(TECQ)	TECQ	-	-	3.4	dB	
| TDECQ - TECQ |	-	-	-	2.5	dB	
Over/under-shoot	-	-	-	22	%	
Transmitter power excursion	-	-	-	1.8	dBm	
Average Launch Power of OFF Transmitter, each lane	TOFF	-	-	-16	dBm	
Extinction Ratio, each lane	ER	3.5	-	-	dB	
Transmitter transition time	-	-	-	17	ps	
RIN17.1OMA	RIN	-	-	-136	dB/Hz	
Optical Return Loss Tolerance	ORL	-	-	17.1	dB	
Transmitter Reflectance	TR	-	-	-26	dB	
Receiver						
Line wavelengths	λC0	1264.5	1271	1277.5	nm	
	λC1	1284.5	1291	1297.5	nm	
	λC2	1304.5	1311	1317.5	nm	
	λC3	1324.5	1331	1337.5	nm	
Damage Threshold, each lane	AOPD	5.4	-	-	dBm	
Average Receive Power, each lane	AOPR	-7.2	-	4.4	dBm	2

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Receive Power (OMAouter), each lane	OMAR	-	-	3.7	dBm	
Difference in receive power between any two lanes (OMAouter)	DR	-	-	4.1	dB	
Receiver Reflectance	RR	-	-	-26	dB	
Receiver Sensitivity (OMAouter), each lane for TECQ <1.4dB for 1.4≤TECQ≤3.4dB	SOMA	-	-	-4.6 -6+TECQ	dBm	
Stressed Receiver Sensitivity (OMAouter), each lane	SRS	-	-	-2.6	dBm	
Conditions of stressed receiver sensitivity test						
Stressed eye closure for PAM4 (SECQ)	-	-	3.4	-	dB	
OMAouter of each aggressor lane	-	-	1.4	-	dBm	

Notes:
1. Average launch power, each lane (min) is informative and not the principal indicator of signal strength.
2. Average receive power, each lane (min) is informative and not the principal indicator of signal strength.

Electrical Specification High Speed Signal (compliant with IEEE 802.3bs 400GAUI-8)

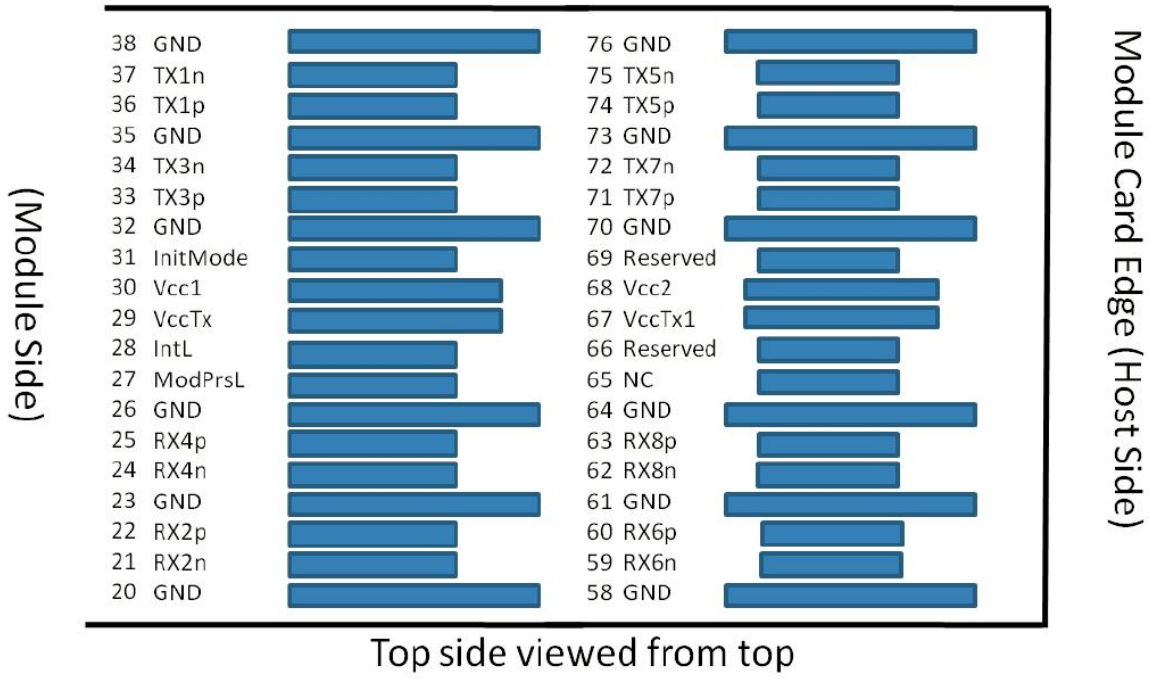
Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Receiver (Module Output)						
AC common-mode output Voltage (RMS)		-	-	17.5	mV	
Differential output Voltage		-	-	900	mV	
Near-end Eye height, differential		70	-	-	mV	
Far-end Eye height, differential		30	-	-	mV	
Far end pre-cursor ISI ratio		-4.5	-	2.5	%	
Differential Termination Mismatch		-	-	10	%	
Transition Time (min, 20% to 80%)		9.5	-	-	ps	
DC common mode Voltage		-350	-	2850	mV	
Receiver (Module Input)						
Differential pk-pk input Voltage tolerance		900	-	-	mV	
Differential termination mismatch		-	-	10	%	

Parameters	Symbol	Min.	Typ.	Max.	Unit	Notes
Single-ended voltage tolerance range		-0.4	-	3.3	V	
DC common mode Voltage		-350	-	2850	mV	

Electrical Specification Low Speed Signal (compliant with QSFP-DD HW Rev 5.1)

Parameter	Symbol	Min.	Max.	Unit
Module output SCL and SDA	VOL	0	0.4	V
Module Input SCL and SDA	VIL	-0.3	VCC*0.3	V
	VIH	VCC*0.7	VCC+0.5	V
LPMode, ResetL, ModSelL and ePPS	VIL	-0.3	0.8	V
	VIH	2	VCC+0.3	V
IntL	VOL	0	0.4	V
	VOH	VCC-0.5	VCC+0.3	V

Pin definitions of the module high speed inputs/outputs



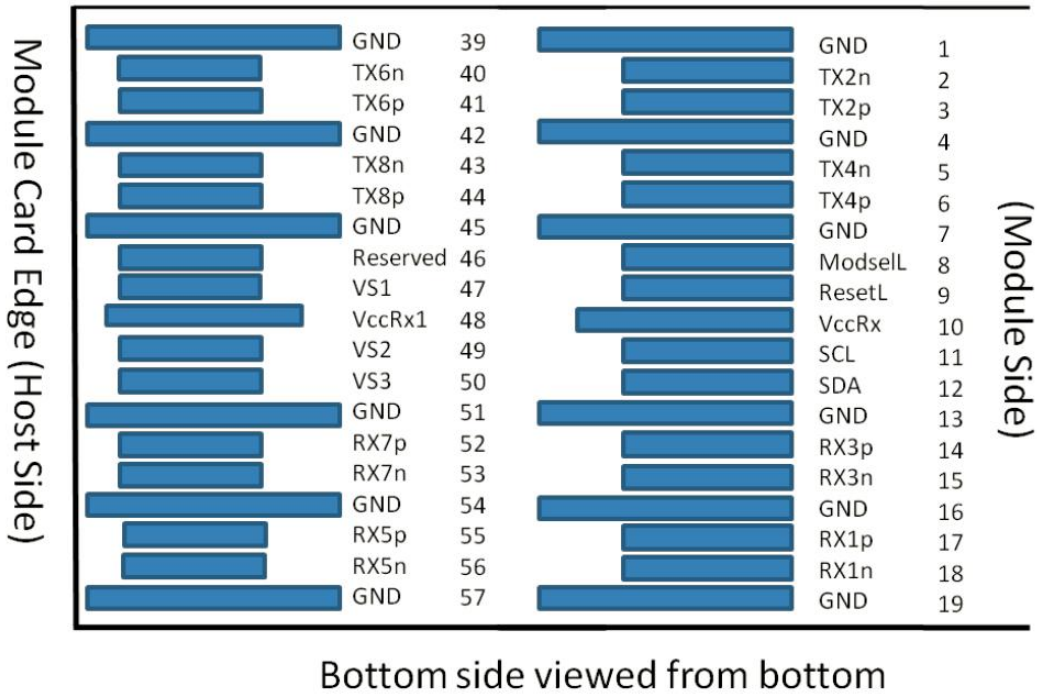


Figure 1. Pin definitions of the module high speed inputs/outputs

Module Pin Definitions

Pin #	Logic	Symbol	Definition	Pin #	Logic	Symbol	Definition
1		GND	Ground	39		GND	Ground
2	CML-I	Tx2n	Transmitter Inverted Data Input	40	CML-I	Tx6n	Transmitter Inverted Data Input
3	CML-I	Tx2p	Transmitter Non-inverted Data Input	41	CML-I	Tx6p	Transmitter Non-inverted Data Input
4		GND	Ground	42		GND	Ground
5	CML-I	Tx4n	Transmitter Inverted Data Input	43	CML-I	Tx8n	Transmitter Inverted Data Input
6	CML-I	Tx4p	Transmitter Non-inverted Data Input	44	CML-I	Tx8p	Transmitter Non-inverted Data Input
7		GND	Ground	45		GND	Ground
8	LVTTL-I	ModSelL	Module Select	46		Reserved	
9	LVTTL-I	ResetL	Module Reset	47		VS1	Module Vendor Specific 1
10		VccRx	+3.3V Power Supply Receiver	48		VccRx1	3.3V Power Supply
11	LVCMOS -I/O	SCL	2-wire serial interface clock	49		VS2	Module Vendor Specific 2
12	LVCMOS -I/O	SDA	2-wire serial interface data	50		VS3	Module Vendor Specific 3
13		GND	Ground	51		GND	Ground
14	CML-O	Rx3p	Receiver Non-inverted Data Output	52	CML-O	Rx7p	Receiver Non-inverted Data Output

Pin #	Logic	Symbol	Definition	Pin #	Logic	Symbol	Definition
15	CML-O	Rx3n	Receiver Inverted Data Output	53	CML-O	Rx7n	Receiver Inverted Data Output
16		GND	Ground	54		GND	Ground
17	CML-O	Rx1p	Receiver Non-inverted Data Output	55	CML-O	Rx5p	Receiver Non-inverted Data Output
18	CML-O	Rx1n	Receiver Inverted Data Output	56	CML-O	Rx5n	Receiver Inverted Data Output
19		GND	Ground	57		GND	Ground
20		GND	Ground	58		GND	Ground
21	CML-O	Rx2n	Receiver Inverted Data Output	59	CML-O	Rx6n	Receiver Inverted Data Output
22	CML-O	Rx2p	Receiver Non-inverted Data Output	60	CML-O	Rx6p	Receiver Non-inverted Data Output
23		GND	Ground	61		GND	Ground
24	CML-O	Rx4n	Receiver Inverted Data Output	62	CML-O	Rx8n	Receiver Inverted Data Output
25	CML-O	Rx4p	Receiver Non-inverted Data Output	63	CML-O	Rx8p	Receiver Non-inverted Data Output
26		GND	Ground	64		GND	Ground
27	LVTTL-O	ModPrsL	Module Present	65		NC	Not connected
28	LVTTL-O	IntL	Interrupt	66		Reserved	
29		VccTx	+3.3V Power Supply Transmitter	67		VccTx1	3.3V Power Supply
30		Vcc1	+3.3V Power Supply	68		Vcc2	3.3V Power Supply
31	LVTTL-I	InitMode	Initialization mode	69		Reserved	
32		GND	Ground	70		GND	Ground
33	CML-I	Tx3p	Transmitter Non-inverted Data Input	71	CML-I	Tx7p	Transmitter Non-inverted Data Input
34	CML-I	Tx3n	Transmitter Inverted Data Input	72	CML-I	Tx7n	Transmitter Inverted Data Input
35		GND	Ground	73		GND	Ground
36	CML-I	Tx1p	Transmitter Non-inverted Data Input	74	CML-I	Tx5p	Transmitter Non-inverted Data Input
37	CML-I	Tx1n	Transmitter Inverted Data Input	75	CML-I	Tx5n	Transmitter Inverted Data Input
38		GND	Ground	76		GND	Ground

Recommended QSFP-DD Host Board Schematic

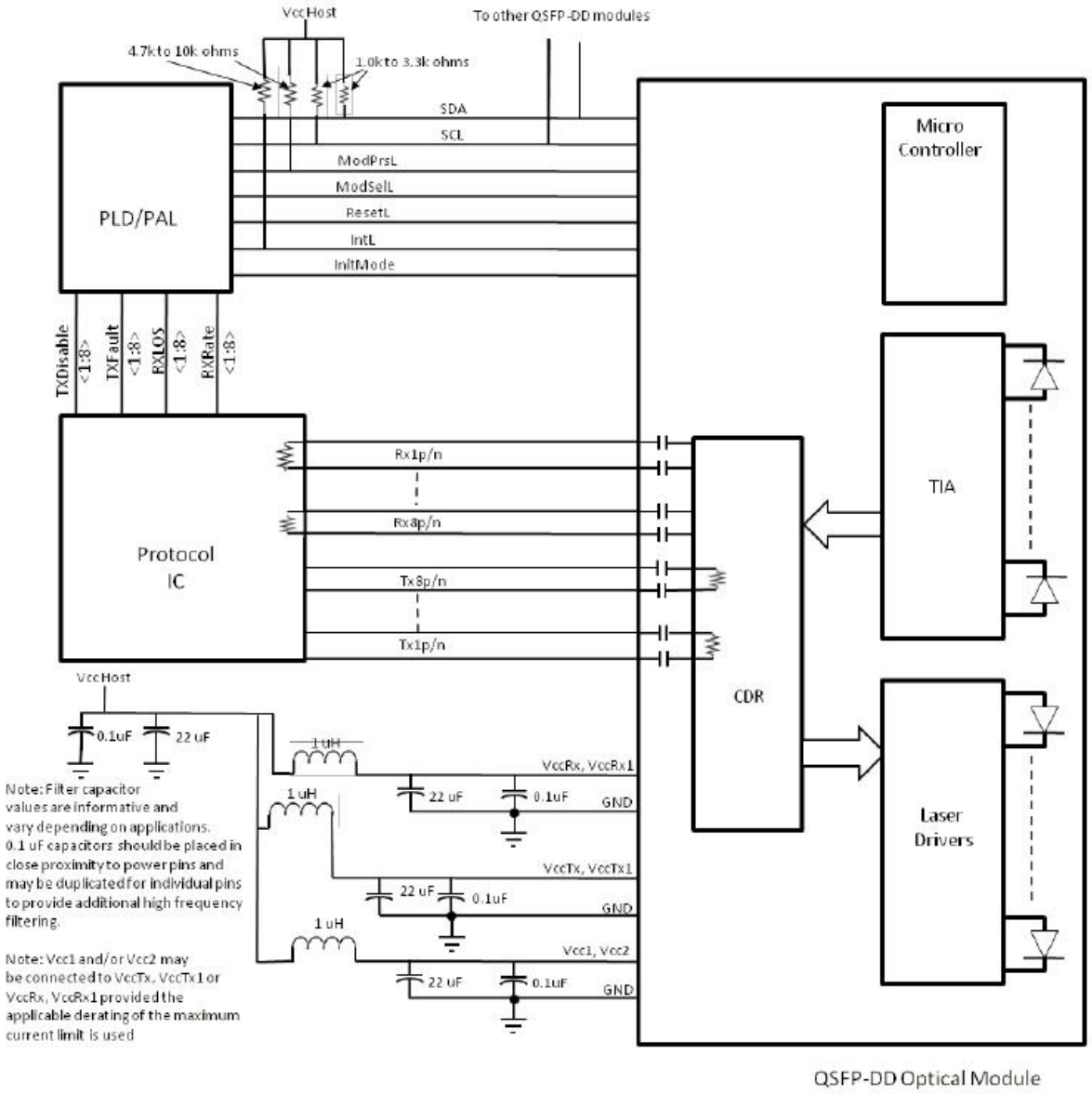


Figure 2. Recommended QSFP-DD Host Board Schematic

Timing for Soft Control and Status Functions

Parameter	Symbol	Min.	Max.	Unit	Notes
MgmtInit Duration		-	2000	ms	
ResetL Assert Time	t_reset_init	10	-	μs	
IntL Assert Time	ton_IntL	-	200	ms	
IntL Deassert Time	toff_IntL	-	500	μs	
Rx LOS Assert Time (optional fast mode)	ton_losf	-	1	ms	

Tx Fault Assert Time	ton_Txfault	-	200	ms	
Flag Assert Time	ton_flag	-	200	ms	
Mask Assert Time	ton_mask	-	100	ms	
Mask Deassert Time	toff_mask	-	100	ms	

I/O Timing for Squelch and Disable

Parameter	Symbol	Min.	Max.	Unit	Notes
Rx Squelch Assert Time	ton_Rxsq	-	150	ms	
Tx Squelch Assert Time	ton_Txsq	-	400	ms	
Tx Squelch Deassert Time	toff_Txsq	-	1.5	s	
Tx Disable Assert Time (optional fast mode)	ton_Txdisf	-	3	ms	
Tx Disable Deassert Time (optional fast mode)	toff_Txdisf	-	10	ms	
Rx Output Disable Assert Time	ton_Rxdis	-	100	ms	
Rx Output Disable Deassert Time	toff_Rxdis	-	100	ms	
Squelch Disable Assert Time	ton_sqdis	-	N/A		Note, not support
Squelch Disable Deassert Time	toff_sqdis	-	N/A		Note, not support

Digital Diagnostic Monitoring

Parameter	Range	Accuracy	Unit	Calibration
Temperature	0 to 70	±3	℃	Internal
Voltage	0 to VCC	0.1	V	Internal
Tx Bias Current (Each Lane)	0 to 100	10%	mA	Internal
Tx Output Power (Each Lane)	-3.2 to +4.4	±3	dB	Internal
Rx Receive Power (Each Lane)	-7.2 to +4.4	±3	dB	Internal

Mechanical Specifications

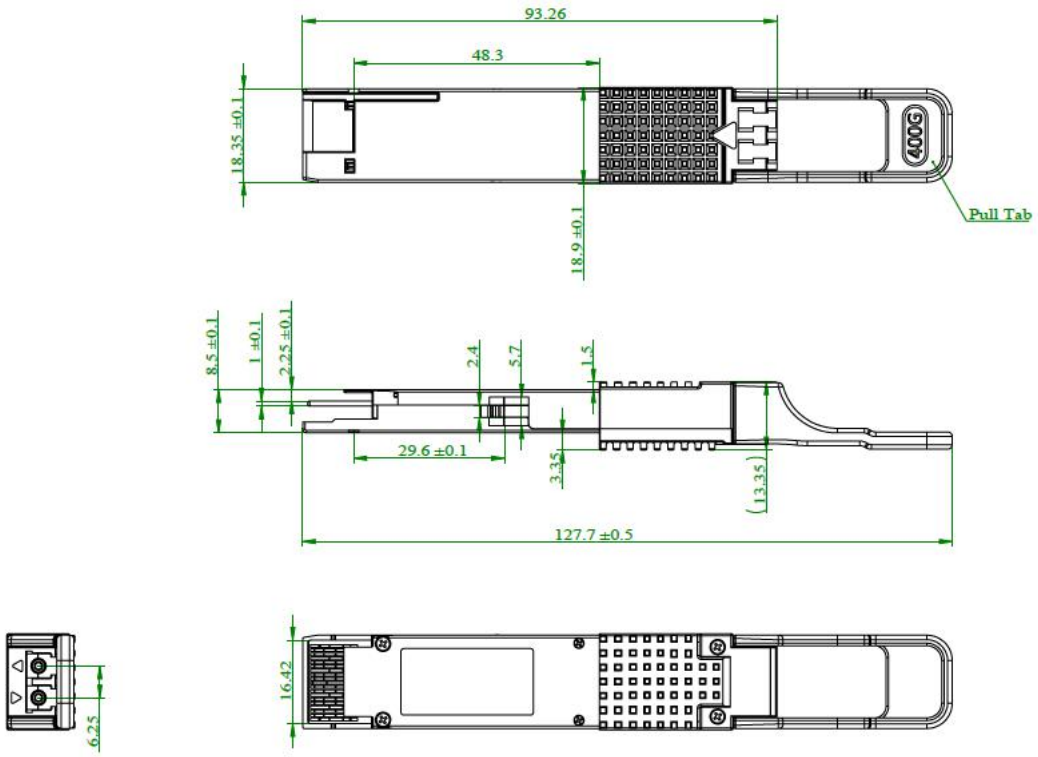


Figure 3. Mechanical Dimensions

Ordering Information

Part Number	Description
GQD-SPO401-FR4C	400GE QSFP-DD FR4

Safety Specification Desgin

Cautions

Do not look into fiber end faces without eye protection using an optical meter (such as magnifier and microscope) within 100 mm, unless you ensure that the laser output is disabled.

When operating an optical meter, observe the operation requirements.

CAUTION: Use of controls or adjustments or performance of procedures other than those specified herein may result in hazardous radiation exposure.

Important Notice

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