FluxLight
OPTICAL TRANSCEIVERS

Datasheet

QDD-400G-DR4-FL

400G, QSFP-DD, MPO-12 APC, 1310nm, SMF, 500m, COM

Quick Spec

Rate Category:	400G
Form Factor:	QSFP-DD
Interface Type:	400GBASE-DR4
Standard / Protocol:	IEEE 802.3bs 400GBASE-DR4; 400GAUI-8; QSFP-DD MSA
TX Wavelength:	1310nm
RX Wavelength:	1310nm
Cable Type:	SMF
Reach:	500m (SMF) with host FEC
DDM:	Supported
Connector Type:	MPO-12 APC
Power Consumption:	12W max
Operating Temperature:	0°C to +70°C (COM)



Overview

The FluxLight QDD-400G-DR4-FL is a hot-pluggable 400G QSFP-DD DR4 optical transceiver for 500 m links over parallel single-mode fiber. It converts eight 50 Gb/s PAM4 electrical lanes (400GAUI-8) into four parallel 100 Gb/s PAM4 optical lanes at 1310 nm, using a quad EML transmitter and a PD array with quad TIA; an integrated DSP gearbox with 8-channel retimer and FEC block converts between 26.5625 GBd and 53.125 GBd PAM4. Compliant with IEEE 802.3bs 400GBASE-DR4, it reaches up to 500 m over single-mode fiber with host FEC through an MPO-12 APC connector. The module follows the QSFP-DD MSA (Type 2), runs from a single +3.3V supply at 12 W maximum, and provides full real-time digital diagnostic monitoring.

Features

- QSFP-DD MSA compliant, hot-pluggable
- Compliant with IEEE 802.3bs 400GBASE-DR4
- 4 parallel optical lanes at 1310 nm, 53.125 GBd PAM4 (106.25 Gb/s) per lane
- 8×53.125 Gb/s electrical interface (400GAUI-8)
- Up to 500 m on single-mode fiber with host FEC
- MPO-12 APC connector
- Real-time digital diagnostic monitoring
- Single +3.3V power supply, 12 W maximum power consumption
- Operating case temperature: 0°C to +70°C (COM)
- RoHS compliant, Class 1 laser product (EN 60825-1)
- 100% compatible with and programmed for the target OEM platform
- Backed by a FluxLight lifetime warranty

Applications

- 400G Ethernet (400GBASE-DR4)
- Data center and enterprise networking

Pin Map and Description

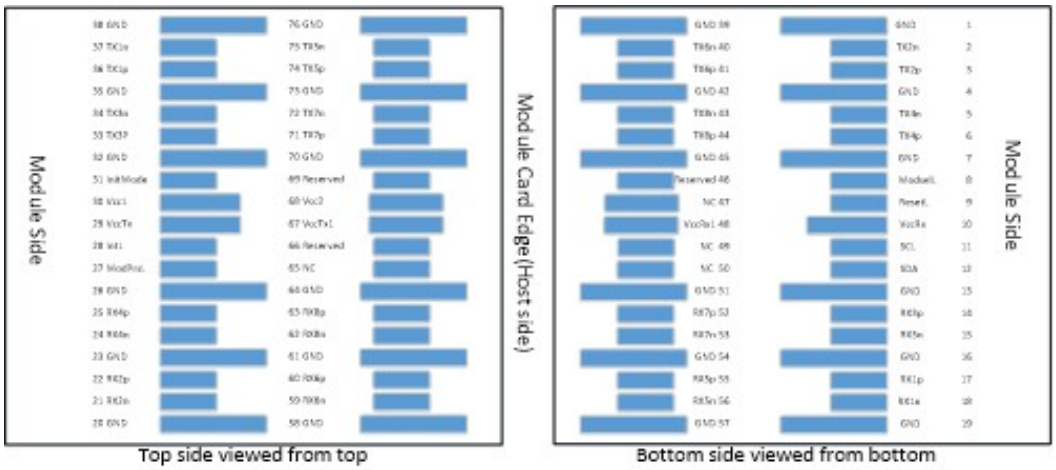
Pin	Logic	Symbol	Description
1		GND	Ground
2	CML	Tx2n	Transmitter Inverted Data Input
3	CML	Tx2p	Transmitter Non-Inverted Data Input
4		GND	Ground
5	CML	Tx4n	Transmitter Inverted Data Input
6	CML	Tx4p	Transmitter Non-Inverted Data Input
7		GND	Ground
8	LVTTL	ModSelL	Module Select
9	LVTTL	ResetL	Module Reset
10		VccRx	Receiver +3.3V DC Power Supply
11	LVCMOS	SCL	2-wire serial interface clock
12	LVCMOS	SDA	2-wire serial interface data
13		GND	Ground
14	CML	Rx3p	Receiver Non-Inverted Data Output
15	CML	Rx3n	Receiver Inverted Data Output
16		GND	Ground

Pin Map and Description (Continued)

Pin	Logic	Symbol	Description
17	CML	Rx1p	Receiver Non-Inverted Data Output
18	CML	Rx1n	Receiver Inverted Data Output
19		GND	Ground
20		GND	Ground
21	CML	Rx2n	Receiver Inverted Data Output
22	CML	Rx2p	Receiver Non-Inverted Data Output
23		GND	Ground
24	CML	Rx4n	Receiver Inverted Data Output
25	CML	Rx4p	Receiver Non-Inverted Data Output
26		GND	Ground
27	LVTTL	ModPrsL	Module Present
28	LVTTL	IntL	Interrupt
29		VccTx	Transmitter +3.3V DC Power Supply
30		Vcc1	+3.3V DC Power Supply
31	LVTTL	InitMode	Initialization Mode (called LPMode in legacy QSFP applications)
32		GND	Ground
33	CML	Tx3p	Transmitter Non-Inverted Data Input
34	CML	Tx3n	Transmitter Inverted Data Input
35		GND	Ground
36	CML	Tx1p	Transmitter Non-Inverted Data Input
37	CML	Tx1n	Transmitter Inverted Data Input
38		GND	Ground
39		GND	Ground
40	CML	Tx6n	Transmitter Inverted Data Input
41	CML	Tx6p	Transmitter Non-Inverted Data Input
42		GND	Ground
43	CML	Tx8n	Transmitter Inverted Data Input
44	CML	Tx8p	Transmitter Non-Inverted Data Input
45		GND	Ground
46		Reserved	For future use
47		VS1	Module Vendor Specific 1
48		VccRx1	+3.3V DC Power Supply
49		VS2	Module Vendor Specific 2

Pin Map and Description (Continued)

Pin	Logic	Symbol	Description
50		VS3	Module Vendor Specific 3
51		GND	Ground
52	CML	Rx7p	Receiver Non-Inverted Data Output
53	CML	Rx7n	Receiver Inverted Data Output
54		GND	Ground
55	CML	Rx5p	Receiver Non-Inverted Data Output
56	CML	Rx5n	Receiver Inverted Data Output
57		GND	Ground
58		GND	Ground
59	CML	Rx6n	Receiver Inverted Data Output
60	CML	Rx6p	Receiver Non-Inverted Data Output
61		GND	Ground
62	CML	Rx8n	Receiver Inverted Data Output
63	CML	Rx8p	Receiver Non-Inverted Data Output
64		GND	Ground
65		NC	No Connect
66		Reserved	For future use
67		VccTx1	+3.3V DC Power Supply
68		Vcc2	+3.3V DC Power Supply
69		Reserved	For future use
70		GND	Ground
71	CML	Tx7p	Transmitter Non-Inverted Data Input
72	CML	Tx7n	Transmitter Inverted Data Input
73		GND	Ground
74	CML	Tx5p	Transmitter Non-Inverted Data Input
75	CML	Tx5n	Transmitter Inverted Data Input
76		GND	Ground



Optical Port Description

The optical port is an MPO-12 APC receptacle carrying 4 transmit and 4 receive single-mode fibers. Proper alignment is ensured by the guide pins inside the receptacle; the cable should not be twisted, to keep channel-to-channel alignment.

Absolute Maximum Ratings

Operation in excess of any individual absolute maximum rating may cause permanent damage to the module.

Parameter	Symbol	Min	Max	Unit
Storage Temperature	TS	-40	85	°C
Operating Case Temperature	TOP	0	70	°C
Power Supply Voltage	VCC	-0.5	3.6	V
Relative Humidity (non-condensation)	RH	0	85	%
Damage Threshold, each Lane	THd	5		dBm

Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	TOP	0		70	°C	
Power Supply Voltage	VCC	3.135	3.3	3.465	V	
Data Rate, each Lane			26.5625		GBd	PAM4
Data Rate Accuracy		-100		100	ppm	
Pre-FEC Bit Error Ratio				2.4×10^{-4}		
Post-FEC Bit Error Ratio				1×10^{-12}		1
Link Distance (SMF)	D	2		500	m	2

1. FEC provided by host system.
2. FEC required on host system to support maximum distance.

Electrical Characteristics

The following electrical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Test Point	Min	Typical	Max	Unit	Notes
Power Consumption				12	W	
Supply Current	Icc			3.64	A	
Transmitter (each Lane)						
Signaling Rate, each Lane	TP1	26.5625 ± 100 ppm			GBd	
Differential pk-pk Input Voltage Tolerance	TP1a	900			mVpp	1
Differential Termination Mismatch	TP1			10	%	
Differential Input Return Loss	TP1	IEEE 802.3-2015 Equation (83E-5)			dB	
Differential to Common Mode Input Return Loss	TP1	IEEE 802.3-2015 Equation (83E-6)			dB	
Module Stressed Input Test	TP1a	See IEEE 802.3bs 120E.3.4.1				2
Single-ended Voltage Tolerance Range	TP1a	-0.4		3.3	V	
DC Common Mode Input Voltage	TP1	-350		2850	mV	3
Receiver (each Lane)						
Signaling Rate, each Lane	TP4	26.5625 ± 100 ppm			GBd	
Differential Peak-to-Peak Output Voltage	TP4			900	mVpp	
AC Common Mode Output Voltage, RMS	TP4			17.5	mV	
Differential Termination Mismatch	TP4			10	%	
Differential Output Return Loss	TP4	IEEE 802.3-2015 Equation (83E-2)			dB	
Common to Differential Mode Conversion Return Loss	TP4	IEEE 802.3-2015 Equation (83E-3)			dB	
Transition Time, 20% to 80%	TP4	9.5			ps	
Near-end Eye Symmetry Mask Width (ESMW)	TP4		0.265		UI	
Near-end Eye Height, Differential	TP4	70			mV	
Far-end Eye Symmetry Mask Width (ESMW)	TP4		0.2		UI	
Far-end Eye Height, Differential	TP4	30			mV	
Far-end Pre-cursor ISI Ratio	TP4	-4.5		2.5	%	
Common Mode Output Voltage (Vcm)	TP4	-350		2850	mV	3

1. With the exception to IEEE 802.3bs 120E.3.1.2 that the pattern is PRBS31Q or scrambled idle.
2. Meets BER specified in IEEE 802.3bs 120E.1.1.
3. DC common mode voltage generated by the host. Specification includes effects of ground offset voltage.

Optical Characteristics

The following optical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Center Wavelength	λc	1304.5	1310	1317.5	nm	
Transmitter						
Data Rate, each Lane		53.125 ± 100 ppm			GBd	
Modulation Format		PAM4				
Side-mode Suppression Ratio	SMSR	30			dB	
Average Launch Power, each Lane	PAVG	-2.9		4	dBm	1
Outer Optical Modulation Amplitude (OMAouter), each Lane	POMA	-0.8		4.2	dBm	2
Launch Power in OMAouter minus TDECQ, each Lane, for ER ≥ 5 dB		-2.2			dBm	
Launch Power in OMAouter minus TDECQ, each Lane, for ER < 5 dB		-1.9			dBm	
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ), each Lane	TDECQ			3.4	dB	
TDECQ – 10·log10(Ceq), each Lane				3.4	dB	3
Extinction Ratio	ER	3.5			dB	
RIN21.4OMA	RIN			-136	dB/Hz	
Optical Return Loss Tolerance	TOL			21.4	dB	
Transmitter Reflectance	TR			-26	dB	
Transmitter Transition Time				17	ps	
Average Launch Power of OFF Transmitter, each Lane	Poff			-15	dBm	
Receiver						
Data Rate, each Lane		53.125 ± 100 ppm			GBd	
Modulation Format		PAM4				
Damage Threshold, each Lane	THd	5			dBm	5
Average Receive Power, each Lane		-5.9		4	dBm	4
Receive Power (OMAouter), each Lane				4.2	dBm	
Receiver Sensitivity (OMAouter), each Lane	SEN			max(−3.9, SECQ − 5.3)	dBm	6
Stressed Receiver Sensitivity (OMAouter), each Lane	SRS			-1.9	dBm	7
Receiver Reflectance	RR			-26	dB	
LOS Assert	LOSA	-15			dBm	
LOS De-assert	LOSD			-8.9	dBm	
LOS Hysteresis	LOSH	0.5			dB	

Optical Characteristics (Continued)

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Stressed Conditions for Stressed Receiver Sensitivity						8
Stressed Eye Closure for PAM4 (SECQ), Lane under Test			3.4		dB	
SECQ – 10·log10(Ceq), Lane under Test				3.4	dB	
OMAouter of each Aggressor Lane			4.2		dBm	

1. 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.
2. Even if the TDECQ < 1.4 dB for an extinction ratio of ≥ 5 dB, or TDECQ < 1.1 dB for an extinction ratio of < 5 dB, the OMAouter (min) must exceed the minimum value specified here.
3. Ceq is a coefficient defined in IEEE Std 802.3-2018 clause 121.8.5.3 which accounts for reference equalizer noise enhancement.
4. Average receive power, each lane (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.
5. 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.
6. Receiver sensitivity (OMAouter), each lane (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB, where SECQ is the SECQ of the transmitter used to measure the receiver sensitivity.
7. Measured with conformance test signal at TP3 for a BER of 2.4×10^{-4}.
8. These test conditions are for measuring stressed receiver sensitivity. They are not characteristics of the receiver.

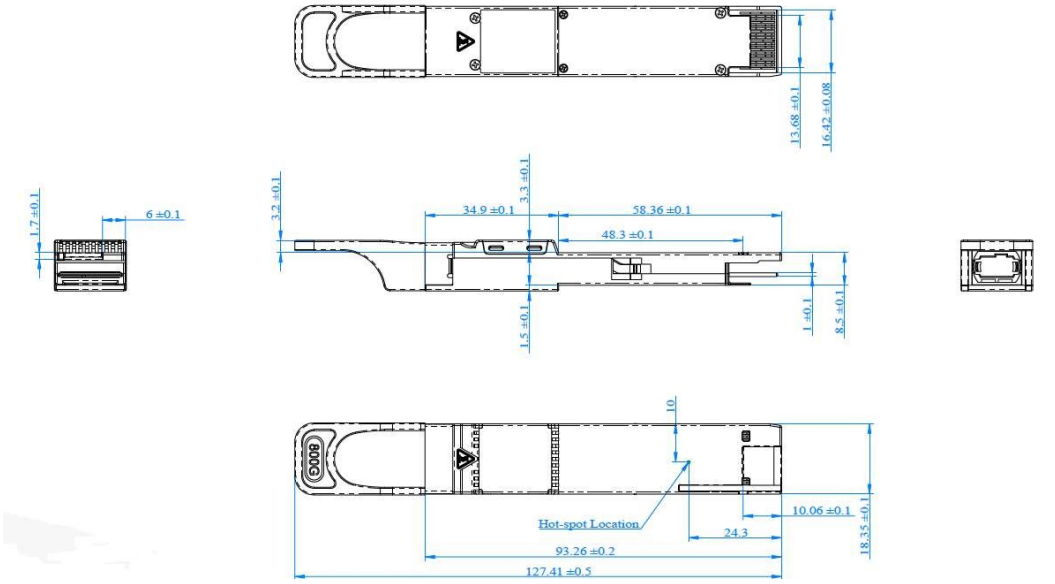
Digital Diagnostic Functions

The following digital diagnostic characteristics are defined over the normal operating conditions unless otherwise specified.

Parameter	Symbol	Min	Max	Unit	Notes
Temperature monitor absolute error	DMI_Temp	-3	3	°C	Over operating temperature range
Supply voltage monitor absolute error	DMI_VCC	-0.1	0.1	V	Over full operating range
Channel RX power monitor absolute error	DMI_RX_Ch	-2	2	dB	1
Channel bias current monitor absolute error	DMI_Ibias_Ch	-10	10	%	
Channel TX power monitor absolute error	DMI_TX_Ch	-2	2	dB	1

1. Due to measurement accuracy of different single-mode fibers, there could be an additional ±1 dB fluctuation, or a ±3 dB total accuracy.

Mechanical Drawing



Units: mm

ESD

This transceiver is specified as ESD threshold 1kV for high-speed data pins and 2kV for all other electrical input pins, tested per MIL-STD-883, Method 3015.4 /JESD22-A114-A (HBM). However, normal ESD precautions are still required during the handling of this module. This transceiver is shipped in ESD protective packaging. It should be removed from the packaging and handled only in an ESD protected environment.

Laser Safety

This is a Class 1 Laser Product according to EN 60825-1:2014. This product complies with 21 CFR 1040.10 and 1040.11 except for deviations pursuant to Laser Notice No. 50, dated (June 24, 2007).

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