Specification for

50G PAM4 QSFP28 LR BIDI Optical Transceiver

Model number: YQ56-Pxx10

Revision History

Revision	Initials	Date	Description
1	EA	03/28/2020	Initial specification release
2			
3			
4			
5			

Table of Contents

1. GENERAL DESCRIPTION

The 50G PAM4 QSFP28 module offers customers 50Gbps electrical interface compliant with CEI-28G-VSR standard for LAUI-2 with 2X25Gbps high speed CML signal and 50Gbps PAM4 optical interface compliant with IEEE802.3 cd standard, up to 10km reach on single mode fiber for 50GBASE-LR requirement.

1.1 Overview

The 50G PAM4 QSFP28 module is a 50Gbps transceiver module for single fiber bi-directional optical communication applications compliant to 50G LR requirement. The module converts 2 inputs channels of 25Gbps electrical data to single PAM4 optical signals for 50Gbps optical transmission. Reversely on the receiver side, the module receives 50Gbps PAM4 optical signals and then converts them to electrical data for 2 output channels.
The central wavelength of the optical channel is 1271nm or 1331nm defined in IEEE 802.3 cd. For SMF applications, the transceiver module has an operating range up to 10km SMF with nominal bit rate of 26.5625 G baud/s.
The 50G PAM4 QSFP28 module is designed with QSFP28 form factor, optical/electrical connection and I2C interface according to the SFF series standard.

1.2 General features of this module

- Single fiber bi-directional optical communication application
- Hot-pluggable QSFP28 form factor
- Supports 50GBASE-LR (26.5625 G baud/s PAM4)
- 25G DFB-Based linear transmitter
- 25G PIN linear receivers
- Power consumption < 3.5W
- Commercial case temperature: 0°C to 70°C
- Maximum 10km link distance on SMF with KP4 FEC
- Diagnostic features through I2C interface per SFF 8636 standard
- Providing real-time monitoring of
  Transmitted optical power
  Received optical power
  Laser bias current
  Module temperature
  Supply Voltage
- Industry-standard LC connector
- IEC 60825-1 Class 1/CDRH Class 1 laser eye safe
- Compliance with Restriction on Hazardous Substances (RoHS)

1.3 Module block diagram

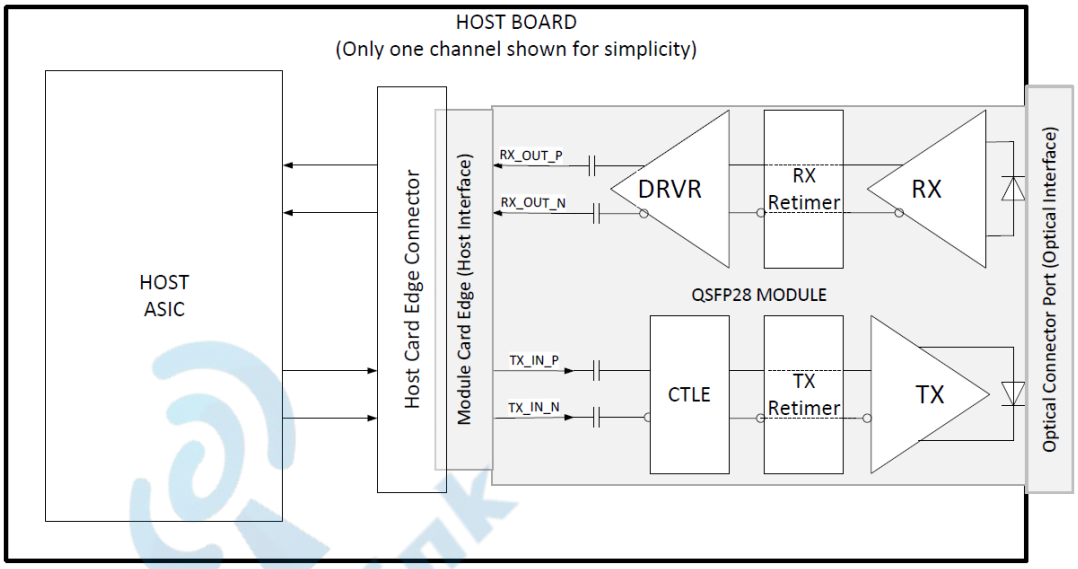

Figure 1: Functional Block Diagram

2. FUNCTIONAL DESCRIPTION

The 50G PAM4 QSFP28 module contains a simplex Straight LC connector for optical interface and a 38 pins connector for the electrical interface. The chart in section 3 shows the functional block diagram of the 50G PAM4 QSFP28 module transceiver.

2.1 Transmitter Operation

The 50G PAM4 QSFP28 module receives 2 channels of 25Gbps NRZ electrical data, which are processed by gearbox chip that reshapes and reduces the jitter of each electrical signal and multiplex into single 50Gbps PAM4 electrical signal. Subsequently, a linear DFB laser driver IC converts electrical signals to 50Gbps PAM4 optical signal with single 25G 1271nm or 1331nm DFB.

2.2 Receiver Operation

The receiver section receivers the input of 50Gbps PAM4 optical signal, converted to 50Gbps electrical signal by one linear 25G PIN/TIA. The electrical signal is feed to gearbox IC which provides reshapes and retimes function, then de-multiplex into 2 channels of 25Gbps NRZ electrical signal.

2.3 I2C Interface

The 50G PAM4 QSFP28 module supports alarm, control and monitor functions via hardware pins and via an I2C bus. Upon module initialization, these functions are available. QSFP28 I2C electrical interface consists of 2 wires including clock (SCL) and data (SDA) signals.

Pin #	Symbol	Description	I/O	Logic	“H”	“L”
11	SCL	2-Wire Serial Interface Clock	I/O	3.3V LVCMOS		
12	SDA	2-Wire Serial Interface Data	I/O	3.3V LVCMOS		

Table 1: I2C Interface Pins

3. ORDER INFORMATION

Part No.	Bit Rate	Laser (nm)	Distance	Fiber type	Connector	Temperature
YQ56-P2710	50Gbps	1271	10km	SMF	LC	C
YQ56-P3310	50Gbps	1331	10km	SMF	LC	C

Table 2: Order Information

4. IDENTIFICATION OF PINOUT ASSIGNMENT

The QSFP28 connector has 38 pins which are arranged in Top and Bottom rows. The detailed description of the Bottom row ranges from pin 1 to pin 19 and pin 20 to pin 38 are shown in Table 2 and Table 3 below. The pin orientation is shown below in Figure 2.

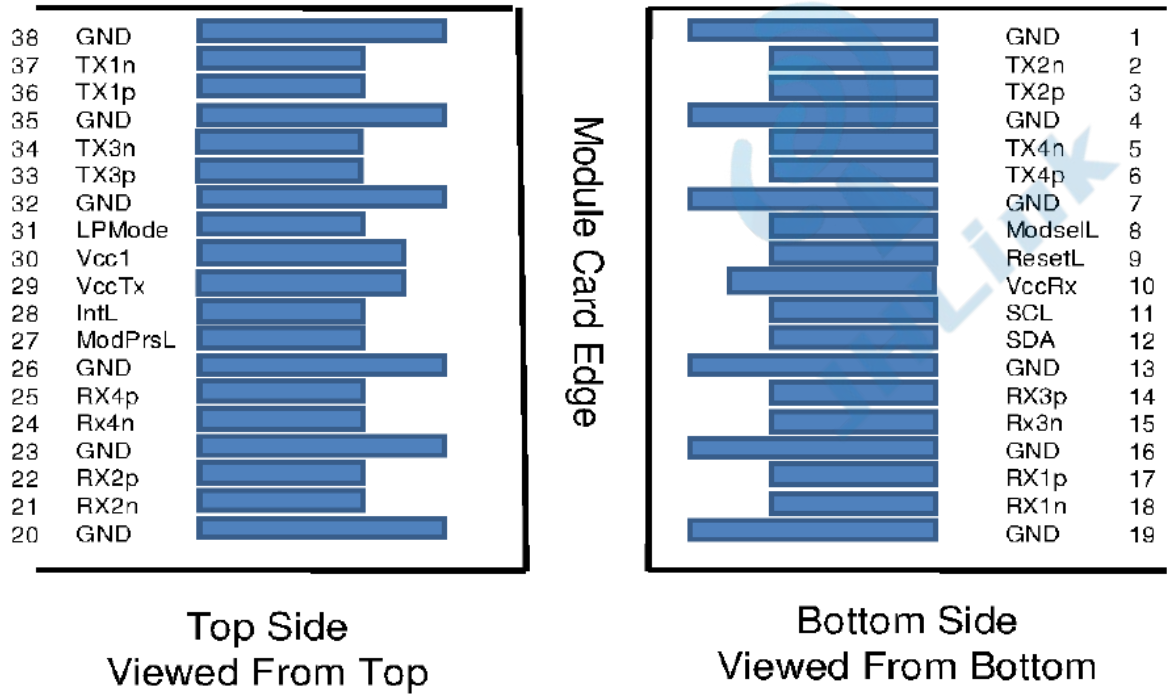

Figure 2: Pad orientation and layout

4.1 Bottom row pins description

The following table gives a short description of each electrical pin from pin 1 through pin 19 on bottom side.

PIN #	NAME	I/O	Logic	Description
1	GND			Ground
2	Tx2n	I	CML	CH2 transmitter inverted data input
3	Tx2p	I	CML	CH2 transmitter Non-inverted data input
4	GND			Ground
5	N.C.			
6	N.C.			
7	GND			Ground
8	ModSelL	I	LVTTL	Module select
9	ResetL	I	LVTTL	Module reset
10	VCC			+3.3V Module power supply
11	SCL	I/O	3.3V LVCMOS	2-Wire Serial Interface Clock
12	SDA	I/O	3.3V LVCMOS	2-Wire Serial Interface Data
13	GND			Ground
14	N.C.			
15	N.C.			
16	GND			Ground
17	Rx1p	O	CML	CH1 receiver non-inverted data output
18	Rx1n	O	CML	CH1 receiver inverted data output
19	GND			Ground

Table 2: Description of the Bottom row ranges from pin 1 through pin 19

4.2 Top row pins description

The following table gives a short description of each electrical pin from pin 20 through 38 on top side.

PIN #	NAME	I/O	Logic	Description
20	GND			Ground
21	Rx2n	O	CML	CH2 receiver inverted data output
22	Rx2p	O	CML	CH2 receiver Non-inverted data output
23	GND			Ground
24	N.C.			
25	N.C.			
26	GND			Ground
27	ModPrsL	O	LVTTL	Module present
28	IntL	O	LVTTL	Interrupt
29	VCC			+3.3V Module power supply
30	VCC			+3.3V Module power supply
31	LPMode	I	LVTTL	Low power mode
32	GND			Ground
33	N.C.			
34	N.C.			
35	GND			Ground
36	Tx1p	I	CML	CH1 transmitter non-inverted data input
37	Tx1n	I	CML	CH1 transmitter inverted data input
38	GND			Ground

Table 3: Description of the top row ranges from pin 20 through pin 38

5. ABSOLUTE MAXIMUM RATINGS

5.1 Environmental

Parameter	Symbol	Min	Max	Unit	Note
Storage and Transportation Temperature	T_s	-40	+85	˚C	
Relative Humidity	RH	5	+95	%	1
Operating Case Temperature	T_{op}	0	70	˚C	

Table 4: Max. environmental ratings

Note:
1. Non-condensing.

5.2 Electrical

Parameter	Symbol	Min	Max	Unit	Note
+3.3V Power Supply Voltage	VCC3	-0.5	+3.6	V	
Input LVTTL Control		0	VCC	V	
LVTTL output DC current		0	20	mA	
ESD	V_ESD		500	V	1

Table 5: Max. electrical ratings

Note:
1. Human body model per JEDEC JESD22-A114-B.

5.3 Optical

Parameter	Symbol	Min	Max	Unit	Note
Input Optical Power of RX, per Lane	P_{in}		4.2	dBm	

Table 6: Max. optical rating

6. RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Max	Unit	Note
Relative Humidity	RH	5	+85	%	1
Operating Case Temperature	T_{opc}	0	70	˚C	
Power Supply Voltage	VCC	3.14	3.45	V	

Table 7: Recommended operating conditions

Note:
1. Non-condensing.

7. OPTICAL CHARACTERISTICS

Unless otherwise stated the following parameters and performances are over the full range of operating conditions defined in section 5, over the full wavelength range. The typical values are referenced to case temperature of +35 C, nominal power supply, beginning of life.

Parameter	Symbol	Min.	Typ.	Max.	Units	Ref.
Transmitter						
Signaling speed per lane			26.5625		GBd/s	
Data rate variation		-100		+100	ppm	
Modulation format			PAM4			
Lane center wavelength	xx = 27	1264.5	1271	1277.5	nm	
	xx = 33	1324.5	1331	1337.5	nm	
Side mode suppression ratio (SMSR)	SMSRmin	30			dB	
Average launch power	Pave	-4.5		4.2	dBm	
Optical modulation amplitude	Poma	-1.5		4	dBm	
Launch power in OMA minus TDECQ		-2.9			dBm	
Transmitter and dispersion eye closure for PAM4	TDECQ	-	-	3.2	dB	1
Average launch power of OFF transmitter, each lane	Poff			-16	dBm	
Optical extinction ratio	ER	3.5			dB	
Transmitter reflectance	TXRef			-26	dB	
Optical return loss tolerance	ORLT			15.6	dB	
Relative intensity noise	RIN			-132	dB/Hz	
Receiver						
Signaling speed per lane			26.5625		GBd/s	
Data rate variation		-100		+100	ppm	
Modulation format			PAM4			
Lane center wavelength	xx = 27	1324.5	1331	1337.5	nm	
	xx = 33	1264.5	1271	1277.5	nm	
Receiver sensitivity (OMAouter)	Sens			-8.4	dBm	1
Overload receiver power	Povl	4.2			dBm	1
Receiver reflectance	RXref			-26	dB	
Stressed sensitivity (OMA)				-6.6	dBm	
Conditions of stressed receiver sensitivity test:						
Stressed eye closure for PAM4 (SECQ)				3.2	dB	
Links						
Power budget				8.7	dB	
Operating distance				10	km	
Discrete reflectance				– 26	dB	

Table 8: Optical characteristics of 50G LR BIDI application

Note:

1. 2.4E-4 BER, PRBS15;

8. MECHANICAL CHARACTERISTICS

8.1 Module outline drawing

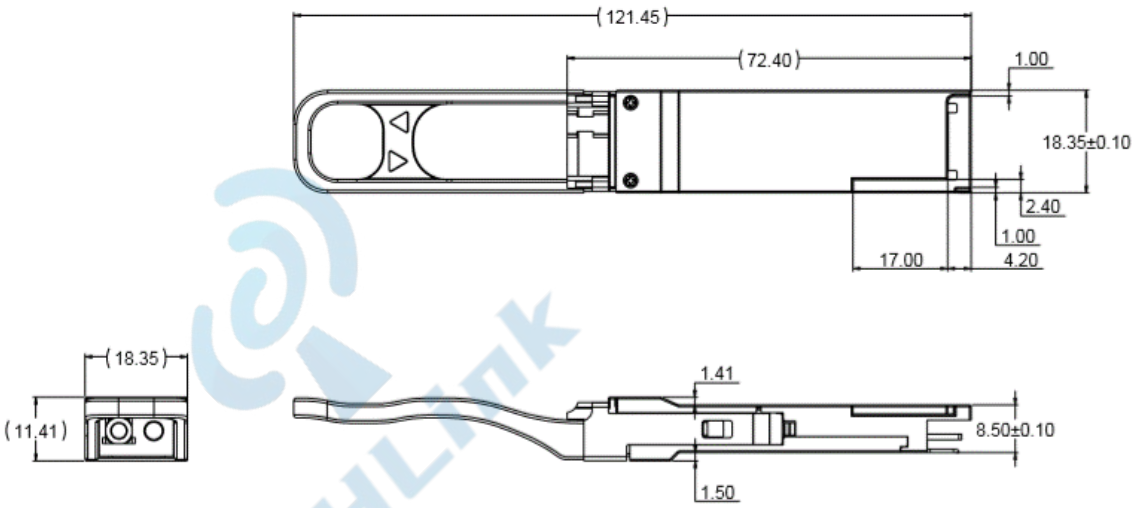

Figure 3: Mechanical outline drawing

8.2 Identification Label

Label locate on bottom side of QSFP28 module, position and style are as figure 4 below. 1-D barcode on label is code 139 type. Label size is 50X40mm, color white.

8.3 Package box

Package box are Anti-electrostatic material, color black, with ESD label sealed. Each package contains 10pcs QSFP28 module.

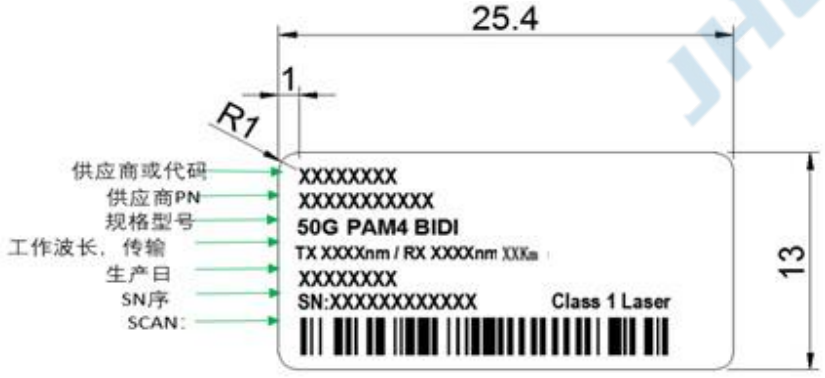

Figure 4: Identification label

9. REGULATORY AND RELIABILITY SPECTIFICATIONS.

9.1 Laser Safety

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

9.2 ESD

This transceiver electrical input pins ESD failure threshold meet classification Class1. ESD tested per MIL-STD-883, Method 3015.4 /JESD22-A114-B (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.

9.3 Electromagnetic Emission

The module is designed to comply with Class A electromagnetic emission according to GR-1089-CORE Sections 3.2.1.1 and 3.2.1.3.

9.4 Flammability

The module is designed to comply with GR-63 section 4.2.3 for fire resistance.

9.5 RoHS

The module complies with Directive 2015/863/EU on the restriction on the use of certain hazardous substances in electrical and electronic equipment.

9.6 Reliability

The module is designed to comply with GR-468 for general reliability. Target FIT < 3500 with 60% confidence level at 55 degree operating case temperature.