

## PRODUCT FEATURES

- QSFP28 MSA compliant
- 4x25Gb/s electrical interface
- Supports 103.125Gb/s aggregate bit rate
- Up to 500m transmission on single mode fiber
- LC duplex connector
- Commercial case temperature: 0 °C to 70 °C
- Single 3.3V power supply
- Maximum power consumption 4 Watts

## APPLICATIONS

- 100G Ethernet
- Data Center Interconnect

## COMPLIANCE

- QSFP28 MSA
- SFF-8665
- RoHS 2.0

## Ordering information

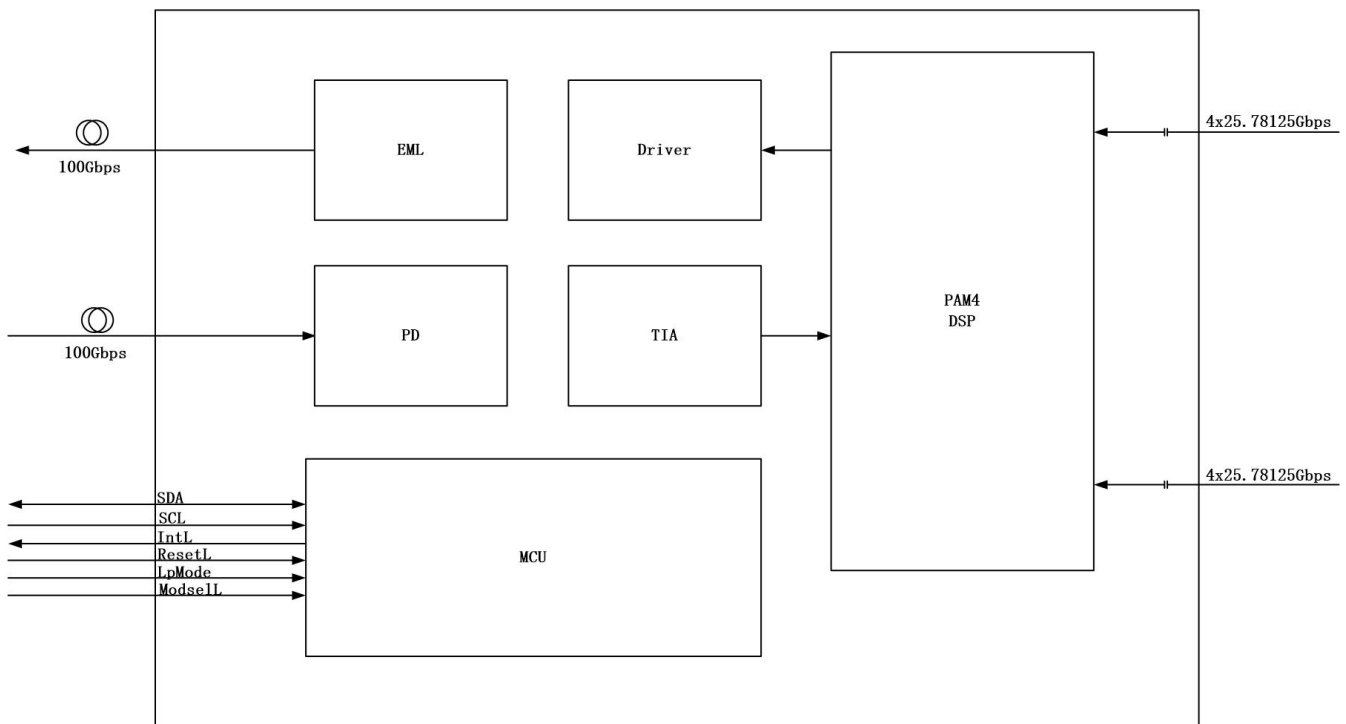
Part Number	Data Rate(Gb/s)	Media	Wavelength(nm)	Operating distance(m)	Temperature(°C)
IP-CALS50E31C1	103.125	SMF	1310	500	0~70

## PRODUCT DESCRIPTION

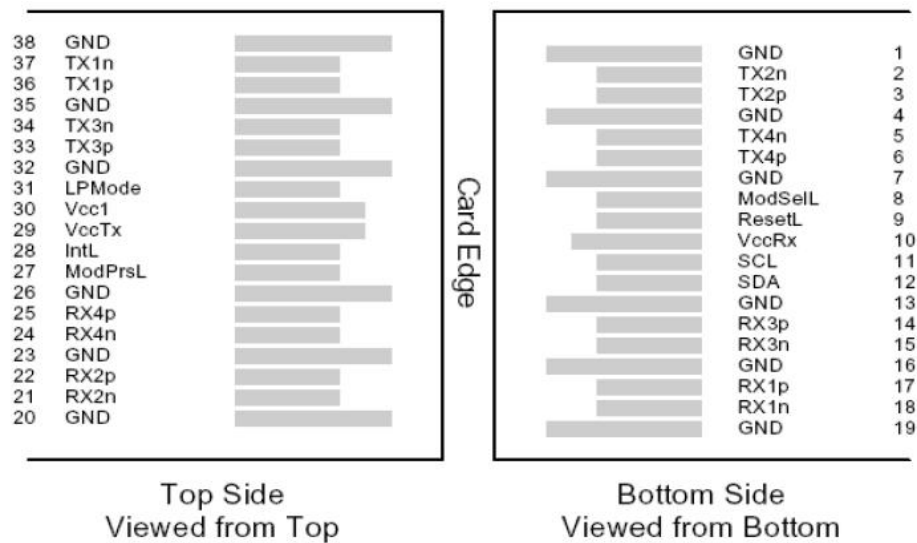
IP-CALS50E31C1 is designed for 500m optical communication applications. The module incorporates one channel optical signal, on 1310nm center wavelength, operating at 50Gbaud data rate. The transmitter path incorporates an EML Driver and a cooled EML together. On the receiver path, the input optical signal is coupled to a Pin photodiode detector. A DSP based gearbox is used to convert 4x25Gbps NRZ signals to 1x50Gbaud PAM4 signal. Also a 4-channel retimer and FEC block are integrated in this DSP. The electrical interface is compliant with IEEE 802.3cd and QSFP28 MSA in the transmitting and receiving directions, and optical interface is compliant to IEEE 802.3cd and 100G Lambda MSA with Duplex LC connector. The module has a maximum power consumption of 4W.

The product is designed with form factor, optical/electrical connection and digital diagnostic interface according to the QSFP28 Multi- Source Agreement (MSA). It has been designed to meet the harshest external operating conditions including temperature, humidity and EMI interference.

## 1. Block Diagram



## 2. Pin Diagram



QSFP28 38pin connector (SFF 8665)

### 3. Pin Descriptions

Pin	Symbol	Name/Description	Notes
1	GND	Ground	1
2	Tx2n	Transmitter Inverted Data Input	
3	Tx2p	Transmitter Non-Inverted Data Input	
4	GND	Ground	1
5	Tx4n	Transmitter Inverted Data Input	
6	Tx4p	Transmitter Non-Inverted Data Input	
7	GND	Ground	1
8	ModSelL	Module Select	
9	ResetL	Module Reset	
10	Vcc Rx	+3.3V Power supply receiver	
11	SCL	2-wire serial interface clock	
12	SDA	2-wire serial interface data	
13	GND	Ground	1
14	Rx3p	Receiver Non-Inverted Data Output	
15	Rx3n	Receiver Inverted Data Output	
16	GND	Ground	1
17	Rx1p	Receiver Non-Inverted Data Output	
18	Rx1n	Receiver Inverted Data Output	
19	GND	Ground	1
20	GND	Ground	1
21	Rx2n	Receiver Inverted Data Output	
22	Rx2p	Receiver Non-Inverted Data Output	
23	GND	Ground	1
24	Rx4n	Receiver Inverted Data Output	
25	Rx4p	Receiver Non-Inverted Data Output	
26	GND	Ground	1
27	ModPrSL	Module Present	
28	IntL	Interrupt	
29	Vcc Tx	+3.3V Power supply transmitter	
30	Vcc1	+3.3V Power supply	
31	LPMODE	Low Power Mode	
32	GND	Ground	1
33	Tx3p	Transmitter Non-Inverted Data Input	
34	Tx3n	Transmitter Inverted Data Input	

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35	GND	Ground	1
36	Tx1p	Transmitter Non-Inverted Data Input	
37	Tx1n	Transmitter Inverted Data Input	
38	GND	Ground	1

Note:

1. Circuit ground is internally isolated from chassis ground.

#### 4. 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	Typical	Max	Unit	Note
Maximum Supply Voltage	$V_{cc}$	0		3.6	V	
Storage Temperature	$T_s$	-40		85	°C	
Relative Humidity	RH	0		85	%	

#### 5. Recommended Operating Conditions

Parameter	Symbol	Min	Typical	Max	Unit	Note
Operating Case Temperature	$T_{case}$	0		70	°C	
Supply Voltage	$V_{cc}$	3.135	3.3	3.465	V	
Relative Humidity	RH	5		85	%	
Data Rate (Optical)	DRO		53.125		GBd	
Data Rate (Electrical)	DRE		4*25.78125		Gbps	
Link Distance				500	m	

#### 6. Electrical Characteristics

**100G-DR1 Operation (EOL, TOP = 0 ~ 70°C,  $V_{cc}$  = 3.135 to 3.465 V)**

Parameter	Symbol	Min	Typical	Max	Unit	Note
Power Dissipation				4	W	
Supply Current	$I_{cc}$			1.15	A	
<b>Transmitter</b>						
Data Rate, each lane			25.78125		Gbps	
Differential Voltage pk-pk	$V_{pp}$	350			mV	
Input differential impedance	$R_{in}$		100		Ohm	
Differential Termination Resistance Mismatch				10	%	
<b>Receiver</b>						
Data Rate, each lane			25.78125		Gbps	
Output differential impedance	$R_{out}$		100		Ohm	
Differential Termination Resistance Mismatch				10	%	
Differential output voltage	$V_{out, pp}$		400		mV	

#### 7. Optical Characteristics

**100G-DR1 Operation (EOL, TOP = 0 ~ 70°C,  $V_{cc}$  = 3.135 to 3.465 V)**

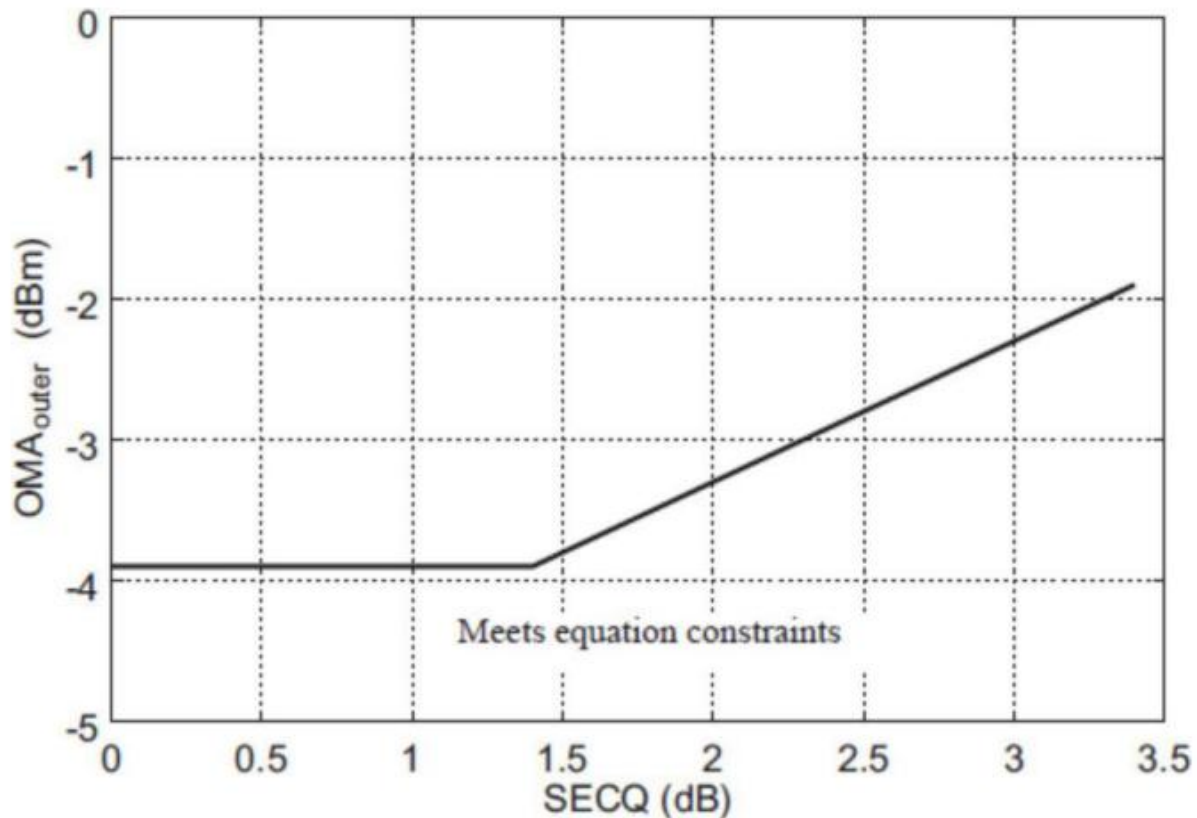
Parameters	Symbol	Min	Typical	Max	Unit	Notes
<b>Transmitter</b>						
PAM4 Signaling rate	BR		53.125 ± 100 ppm		GBd	

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Transmit wavelength	$\lambda_c$	1304.5		1317.5	nm	
Side-Mode Suppression Ratio	SMSR	30			dB	
Average launch power	$P_{out}$	-2.9		4	dBm	1
Optical Modulation Amplitude (OMA)	$P_{OMA}$	-0.8		4.2	dBm	2
Transmitter and Dispersion Eye Closure for PAM4 (TDECQ)	TDECQ			3.4	dB	
Launch power OFF				-15	dBm	
Extinction Ratio (ER)	ER	3.5			dB	
<b>Receiver</b>						
PAM4 Signaling rate	BR	53.125 $\pm$ 100 ppm			GBd	
Receive wavelength	$\lambda_c$	1304.5		1317.5	nm	
Damage threshold		5.5			dBm	
Average receive power		-5.9		4	dBm	
Receive power ( $OMA_{outer}$ )				4.2	dBm	
Receiver Sensitivity ( $OMA_{outer}$ )	SEN			Equation (1)	dBm	3
Stressed Receiver Sensitivity ( $OMA_{outer}$ )	SRS			-2.5	dBm	4
Receiver reflectance				-26	dB	
LOS Assert		-15			dBm	
LOS De-Assert				-8.9	dBm	
LOS Hysteresis		0.5		6	dB	

Notes:

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 < 1.4dB for an extinction ratio of  $\geq 4.5$ dB or TDECQ < 1.3dB for an extinction ratio of < 4.5dB, the  $OMA_{outer}$  (min) must exceed the minimum value specified here.
3. Receiver sensitivity ( $OMA_{outer}$ ) (max) is informative and is defined for a transmitter with a value of SECQ up to 3.4 dB. It should meet Equation (1), which is illustrated in Figure 1.  
 $RS = \max(-3.9, SECQ - 5.3) \text{ dBm}$   
Where: RS is the receiver sensitivity, and SECQ is the SECQ of the transmitter used to measure the receiver sensitivity.
4. Measured with conformance test signal at TP3 for the BER equal to  $2.4 \times 10^{-4}$ .



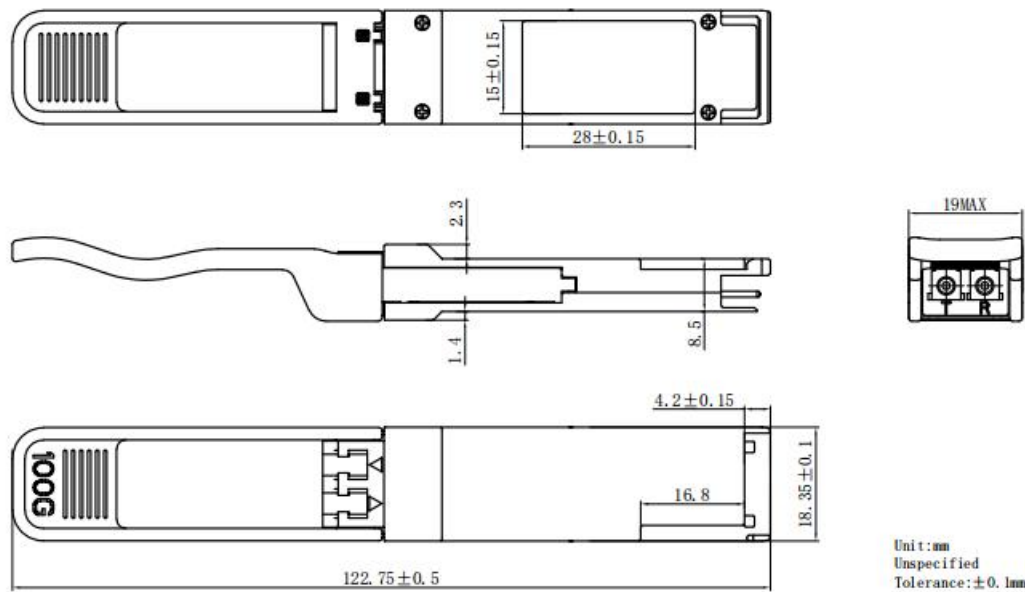
**Figure 1 – Illustration of Receiver Sensitivity Mask for 100G-DR**

## 8. Digital Diagnostic Monitoring Functions

IP-CALS50E31C1 support the I2C-based Diagnostic Monitoring Interface (DMI) defined in document SFF-8665. The host can access real-time performance of transmitter and receiver optical power, temperature, supply voltage and bias current.

Parameter	Accuracy	Unit
Case Temperature	±3	°C
Supply Voltage	±3%	V
Tx Bias Current	±10%	mA
Tx Optical Power	±3	dB
Rx Optical Power	±3	dB

## 9. Mechanical Specifications



## IP-CALS50E31C1

### 10.Regulatory Compliance

Feature	Reference	Performance
EMC	EN61000-3	Compatible with standards
Electrostatic Discharge (ESD)	IEC/EN 61000-4-2	Compatible with standards
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN 55022 Class B (CISPR 22A)	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10, 1040.11 IEC/EN 60825-1, EC/EN 60825-2	Class 1 laser product
Component Recognition	IEC/EN 60950, L 60950	Compatible with standards
RoHS	2011/65/EU	Compatible with standards

### 11. Contact Information

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### 12. Revision History

Version No.	Date	Description
1.0	Mar. 4, 2022	Preliminary datasheet
1.1	Jun.30, 2024	Update contact information.

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