



# SPECIFICATION

SPEC. NO: SPEC-QSFP28 to 4xSFP28 REV: A1

PRODUCT NAME: 100G QSFP28 to 4x25G SFP28 Fan-out  
AOC

PRODUCT NO: PA0QS1XXX-SD-R

立讯精密工业股份有限公司

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## PRODUCT FEATURES

- Four-channel full-duplex active optical cable from QSFP28 to four SFP28
- Supports 25.78125Gb/s per channel
- Low Power Dissipation, Max 1.8W on QSFP28 end, Max. 0.8W on SFP28 end.
- Operating Case Temperature: 0°C~70°C
- GR-468: Reliability Qualification
- ROHS-6: Environment Safety
- QSFP28 form factor compliance to
  - SFF-8679 electrical interface
  - SFF-8661 Pluggable Module
  - SFF-8636 Management Interface
  - IEEE 802.3bm: Physical Layer Specifications and Management Parameters
- SFP28 form factor compliance to
  - SFF-8419 Electrical interface
  - SFF-8472 Management Interface
  - SFF-8432 Pluggable Module
  - IEEE 802.3by: Physical Layer Specifications and Management Parameters



## APPLICATIONS

- Ethernet for 4x25G
- InfiniBand EDR

## ORDERING INFORMATION

Part Number	Form Factor	Data Rate	Media	Distance <sup>①</sup> (m)	Wavelength (nm)	Voltage (V)	Temperature (°C)
PA0QS1301-SD-R	Fan-out AOC	100G/25Gbps	MMF OM3	3	850	3.3	0/+70
PA0QS1401-SD-R	Fan-out AOC	100G/25Gbps	MMF OM3	5	850	3.3	0/+70
PA0QS1501-SD-R	Fan-out AOC	100G/25Gbps	MMF OM3	7	850	3.3	0/+70
PA0QS1601-SD-R	Fan-out AOC	100G/25Gbps	MMF OM3	10	850	3.3	0/+70
PA0QS1701-SD-R	Fan-out AOC	100G/25Gbps	MMF OM3	15	850	3.3	0/+70
PA0QS1801-SD-R	Fan-out AOC	100G/25Gbps	MMF OM3	20	850	3.3	0/+70

① Cable length can be customized upon customer's request.

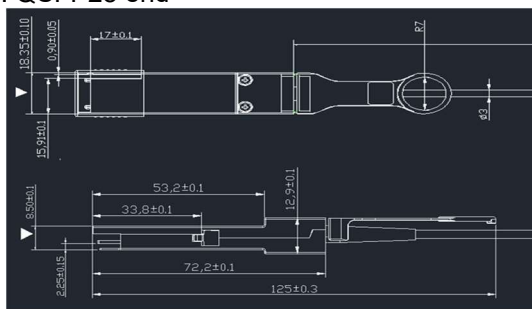
## GENERAL PRODUCT CHARACTERISTICS

Parameter	Value	Unit	Comments
Module Form Factor	QSFP28 and SFP28		Module Form Factor
Number of Lanes	4 TX and 4 RX		
Maximum Aggregate Data Rate	103.125	Gb/s	
Maximum Data Rate per Lane	25.78125	Gb/s	
Standard Cable Lengths	3, 5, 7, 10, 15, 20	meters	Other lengths may be available upon request
Protocols Supported	InfiniBand, Ethernet		
Electrical Interface and Pin-out	38-pin edge connector (QSFP28) and 20-pin edge connector (SFP28)		Pin-out as defined by SFF-8679 & SFF-8419
Standard Optical Cable Type	Multimode OM3(≤70m) Multimode OM4(<100m)		
Maximum Power Consumption per End	1.8 (QSFP28) and 0.8 (SFP)	Watts	Varies with output voltage swing and pre-emphasis settings
Management Interface	Serial, I2C-based, 400 kHz maximum frequency		As defined by SFF-8636
BER	<10 <sup>-12</sup>		PRBS:31,input signal swing 800mV differential

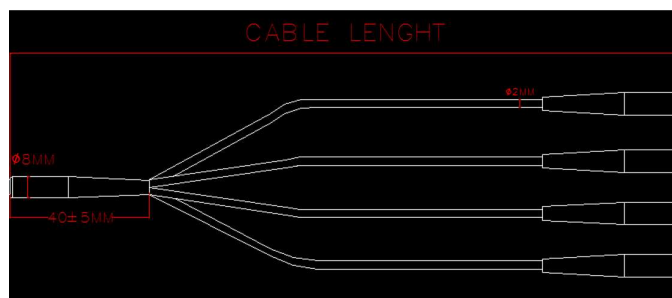
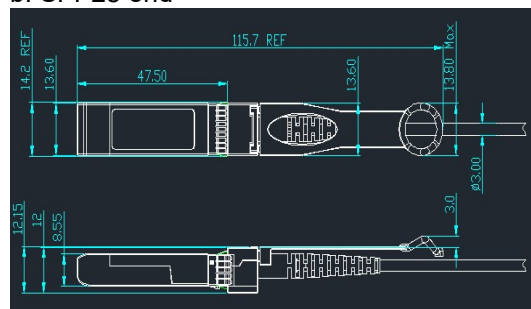
## MECHANICAL SPECIFICATION

Product shall be of design, construction and physical dimensions specified on applicable product drawing.

a. QSFP28 end



b. SFP28 end



The force specification for AOC is in the list below:

Parameter	Min.	Max.	Unit.	Comments.
Module Insertion		40 (QSFP) 18 (SFP)	Newton	
Module Extraction		30 (QSFP) 12.5 (SFP)	Newton	
Module Retention	90 (QSFP) 90 (SFP)	170 (SFP)	Newton	
Insertion and removal cycles	50		Cycle	
Cable outer Diameter	2.9	3.0	mm	
Cable Jacket Material	LSZH			

## ABSOLUTE MAXIMUM PARAMETERS

Exceeding the limits below may damage the active optical cable permanently.

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Ref.
Maximum Supply Voltage	V <sub>cc</sub>	-0.5		3.6	V	
Storage Temperature	T <sub>sto</sub>	-40		85	°C	
Case Operating Temperature	T <sub>op</sub>	0		70	°C	
Relative Humidity	RH	0		85	%	①

① No-condensing.

## PARAMETERS

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Ref.
Supply Voltage	V <sub>cc</sub>	3.14		3.46	V	
Power Consumption	P <sub>Con</sub>			1.8 (QSFP28) 0.8 (SFP28)	W	
Bit Rate	BR		25.78125		Gb/s	①
Bit Error Ratio	BER			10 <sup>-12</sup>		②
Center wavelength	λ <sub>c</sub>	840		860	nm	③
Management Interface		Serial, I2C-based, maximum frequency 400 kHz				④
Logic Input Voltage High	V <sub>ih</sub>	2		V <sub>cc</sub> +0.3	V	
Logic Input Voltage Low	V <sub>il</sub>	-0.3		0.8	V	

① Single lane

② PRBS= 2<sup>31</sup>-1 @ 25.78125Gb/s

③ As defined by IEEE Std. 802.3bm – 2015

④ As defined by SFF-8636

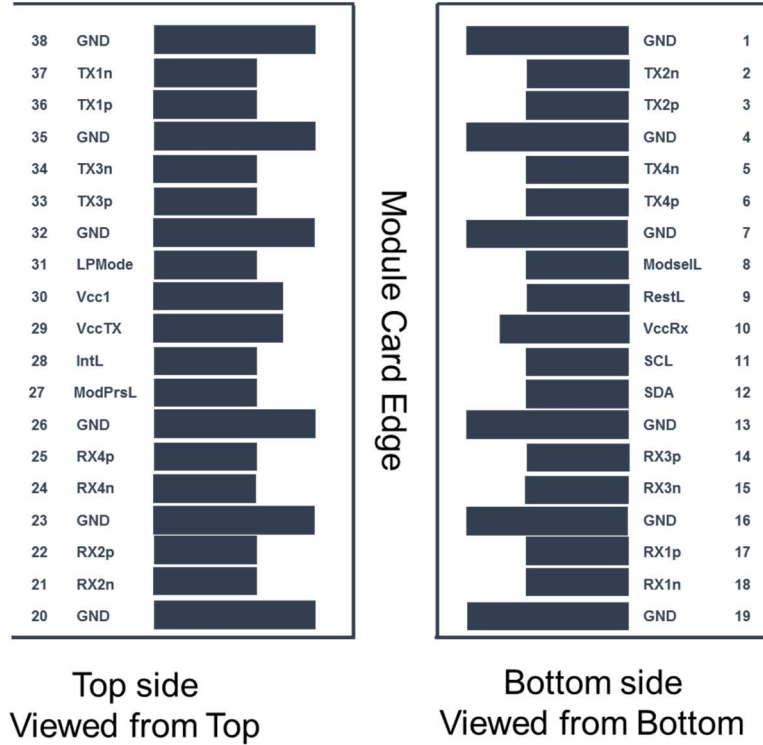
## Electrical Characteristics

Parameter	Symbol	Min.	Typ.	Max.	Unit.	Ref.
Transceiver Power Supply Current	$I_{cc}$			600 (QSFP28) 230 (SFP28)	mA	
Transceiver Power On Initialization Time	$T_{init}$			2000	ms	
Transceiver Electrical Specifications (Per Lane)						
Differential Data Input Voltage Peak to Peak Swing	$V_{in,pp}$			900	mV	
Common Mode Noise RMS				17.5	mV	
Differential Input Return Loss	SDD22	Per OIF CEI-28G-VSR and CAUI-4 Requirements			dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion	SDD22 SCD22				dB	
Common Mode Return Loss	SCC22				dB	
Transition Time, 20% to 80%	$T_r, T_f$	10			ps	
Common Mode Voltage	$V_{cm}$	-0.3		2.8	V	
Eye Width @ 1E-15 Probability	EW15	0.46			UI	
Eye Height @ 1E-15 Probability	EH15	94			mv	
Receiver Electrical Specifications (Per Lane)						
Differential Data Output Voltage Peak to Peak Swing	$V_{opp}$	300		900	mV	
Differential Output Impedance	$Z_{os}$	90	100	110	Ohms	
Common Mode Voltage	$V_{cm}$	-0.35		2.85	V	
Common Mode Noise RMS				17.5	mV	
Differential Output Return Loss	SDD22	Per OIF CEI-28G-VSR and CAUI-4 Requirements			dB	
Common Mode to Differential Conversion and Differential to Common Mode Conversion	SDD22 SCD22					
Common Mode Return Loss	SCC22			-2	dB	
Transition Time, 20% to 80%	$T_r, T_f$	10			ps	
Vertical Eye Closure	VEC			5.5	dB	A
Eye Width @ 1E-15 Probability	EW15	0.57			UI	
Eye Height @ 1E-15 Probability	EH15	228			mV	

## PIN DESCRIPTIONS

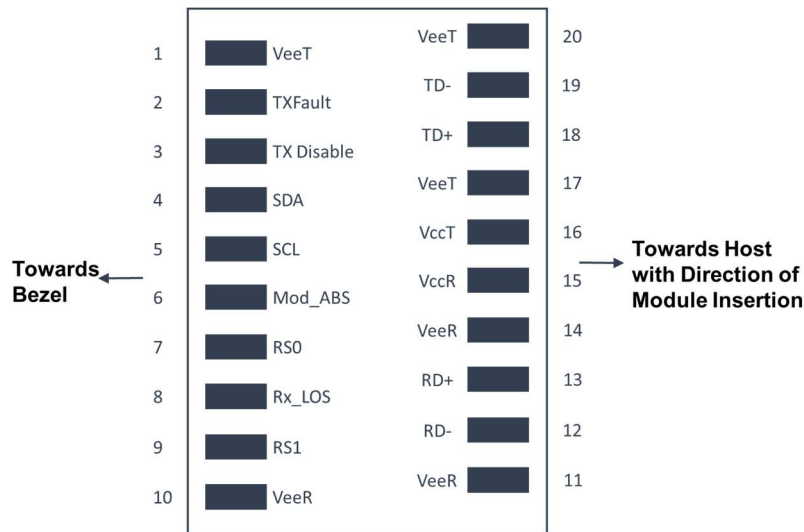
### a. QSFP28 end

PIN	Symbol	Description	Ref.
1	GND	Ground	
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	②
9	ResetL	Module Reset	②
10	V <sub>cc</sub> RX	+3.3V Receiver Power Supply Receiver	
11	SCL	2-wire Serial Interface Clock	②
12	SDA	2-wire Serial Interface Data	②
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, internal pulled down to GND	
28	IntL	Interrupt output, should be pulled up on host board	
29	V <sub>cc</sub> TX	+3.3V Transmitter Power Supply	
30	V <sub>cc</sub> 1	+3.3V Power Supply	
31	LPM <sub>ode</sub>	Low Power Mode	②
32	GND	Ground	
33	TX3p	Transmitter Non-Inverted Data Input	
34	TX3n	Transmitter Inverted Data Input	
35	GND	Ground	
36	TX1p	Transmitter Non-Inverted Data Input	
37	TX1n	Transmitter Inverted Data Input	
38	GND	Ground	①



### b. SFP28 end

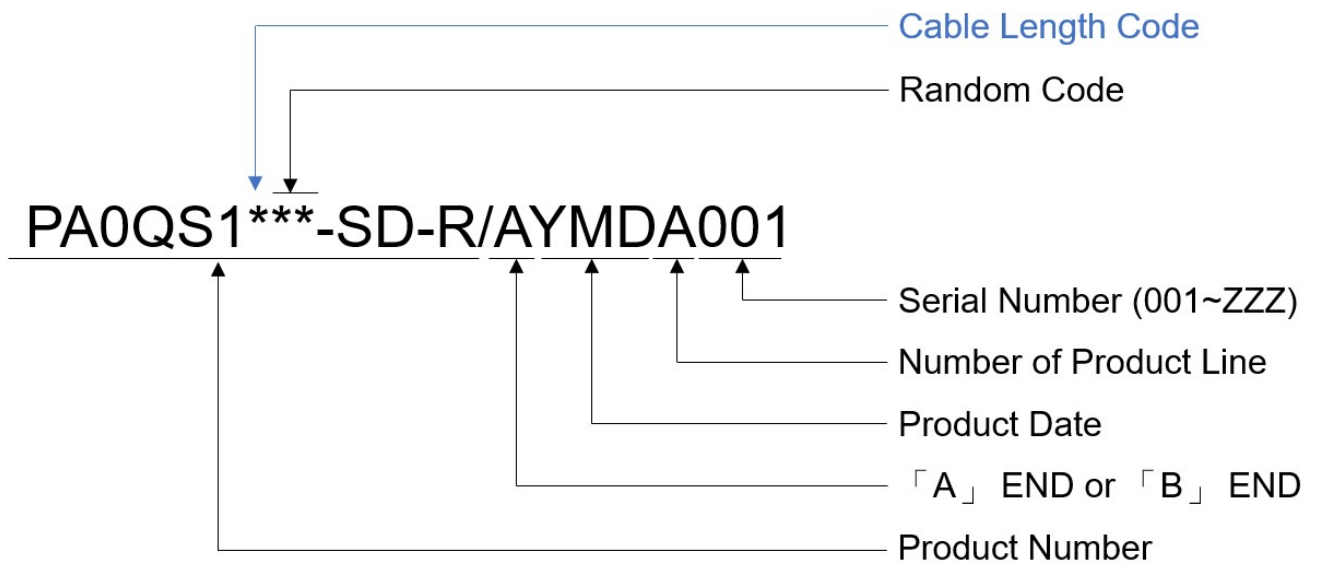
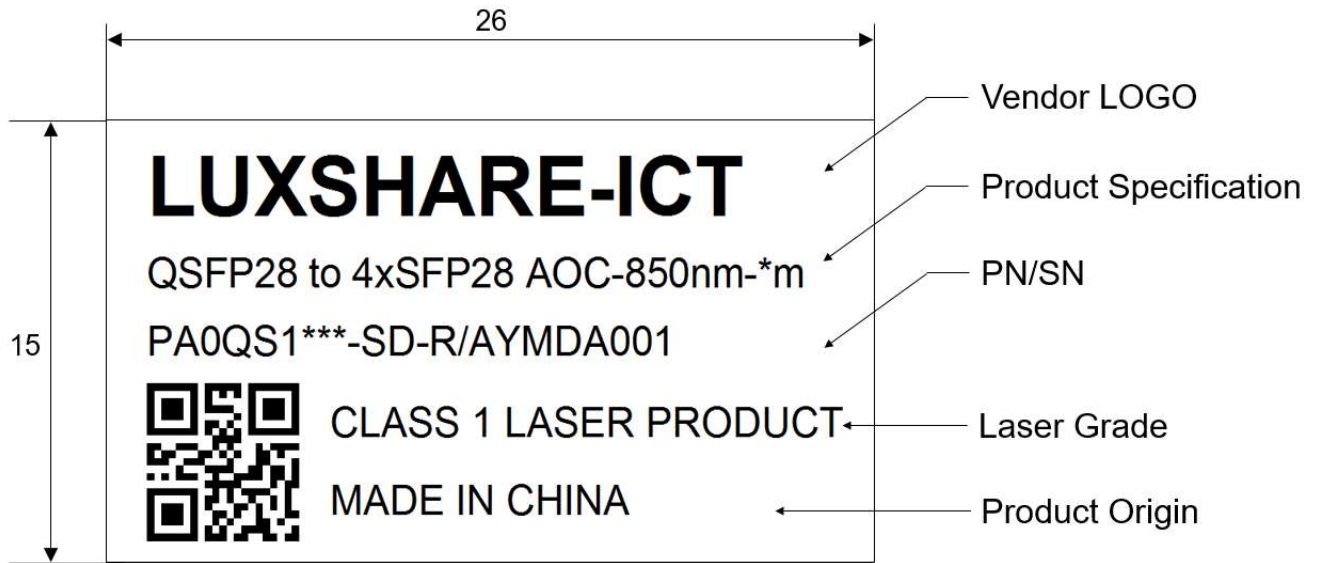
PIN	Symbol	Description	Ref.
1	Veet	Module Transmitter Ground	①
2	TX_Fault	Module Transmitter Fault	②
3	TX_Disable	Transmitter Disable, turns off the laser output	
4	SDA	2-wire Serial Interface Data Lane	
5	SCL	2-wire Serial Interface Clock	
6	Mod_ABS	Module Absent, connected To VeeT or VeeR in the module	
7	RS0	Rate Select 0, optionally controls SFP+ module Receiver	
8	RX_LOS	Receiver Loss of Signal Indication	
9	RS1	Rate Select 1, optionally controls SFP+ module transmitter	
10	VeeR	module receiver ground	①
11	VeeR	module receiver ground	①
12	RD-	Receiver inverted Data Output	
13	RD+	Receiver Non-inverted Data Output	
14	VeeR	Module Receiver ground	①
15	VccR	Module Receiver 3.3V Supply	
16	VccT	Module Transmitter 3.3V Supply	
17	VeeT	Module Transmitter Ground	①
18	TD+	Transmitter Non-inverted Data Input	
19	TD-	Transmitter Inverted Data Input	
20	VeeT	Module Transmitter Ground	①



- ① GND is the symbol for signal and supply (power) common for the module. All are common within the module and all module voltages are reference to this potential unless otherwise noted. Module circuit ground is isolated from module chassis ground within the module.
- ② Open collector, should be pulled up with 4.7~10K ohms on the host board to a voltage between 3.15V and 3.6V.



## MODULE LABEL DIAGRAM

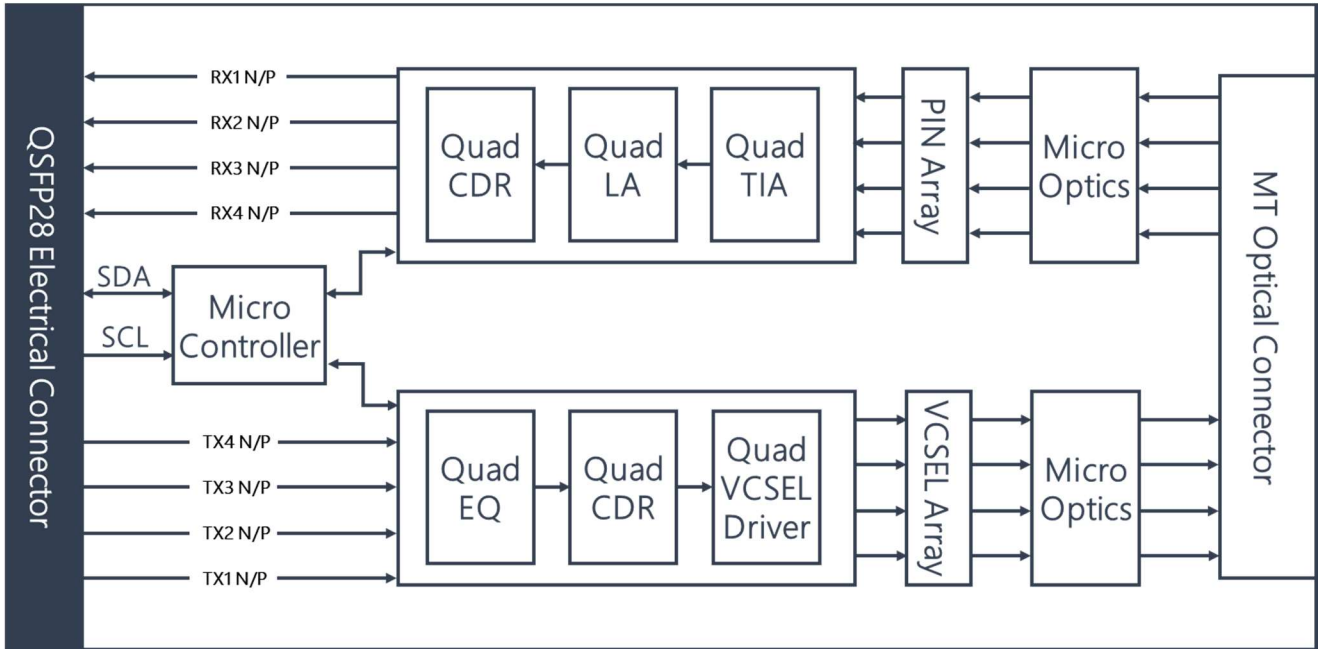


Cable Length Code	Cable Length	Unit
1	(0,1]	M
2	(1,2]	M
3	(2,3]	M
4	(3,5]	M
5	(5,7]	M
6	(7,10]	M
7	(1,15]	M
8	(15,20]	M
9	(20,100]	M

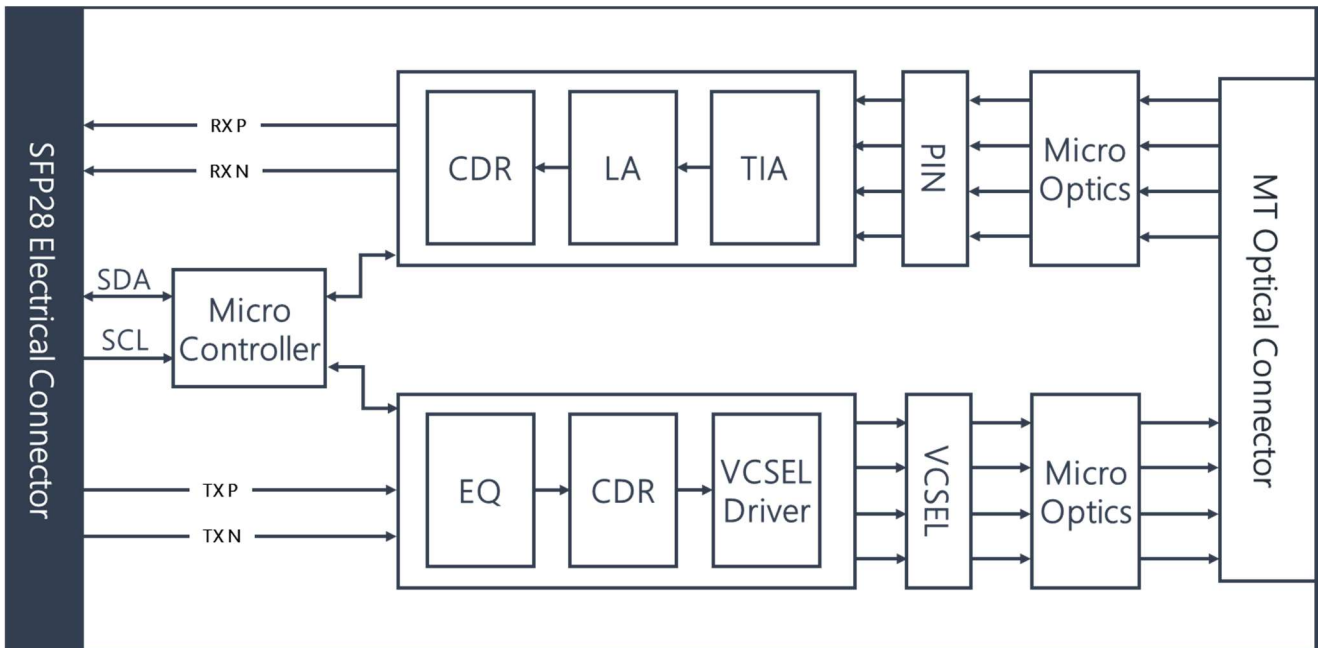
① The Random Codes are generated by the PLM system.

## RECOMMENDED HOST BOARD SCHEMATIC

### a. QSFP28 end



### b. SFP28 end



## MEMORY MAP (compliant SFF-8636)

### a. QSFP28 end

2-Wire Serial Address 1010000x	
Lower Page 00h	
0	Identifier
1 - 2	Status
3 - 2 1	Interrupt Flags
22-23	Free Side Device Monitors
34-81	Channel Monitors
82-85	Reserved
86-98	Control
99	Reserved
1 0 0 - 1 0 4	Hardware Interrupt Pin Masks
1 0 5 - 1 0 6	Vendor Specific
107	Reserved
1 0 8 - 1 1 0	Free Side Device Properties
1 1 1 - 1 1 2	Assigned for use by PCI Express
113	Free Side Device Properties
1 1 4 - 1 1 8	Reserved
1 1 9 - 1 2 2	Password Change Entry Area (Optional)
1 2 3 - 1 2 6	Password Entry Area (Optional)
127	Page Select Byte

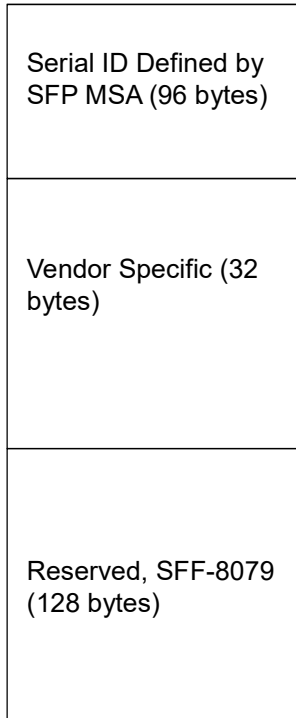


Upper Page 00h	Optional Page 01h	Optional Page 02h	Optional Page 03h	
128 Identifier	128 CC_APPS	128-255 User EEPROM data	128-175 Free Side Device Thresholds	
129-191 Base ID Fields	129 AST Table Length (TL)		176-223 Channel Thresholds	
	130-131 Application Code Entry 0			224 TX EQ & RX Emphasis Magnitude ID
	132-133 Application Code Entry 1			225 RX output amplitude indicators
192-223 Extended ID	134-253 other entries	226-241 Channel Monitor Masks		
224-255 Vendor Specific ID	254-255 Application Code Entry TL	252-255 Reserved		

## MEMORY MAP (compliant SFF-8472)

### b. SFP28 end

2wire address 1010000x (A0h)



2wire address 1010001x (A2h)

