

## Applications

- IEEE 802.3bm 100GBASE SR4 and 40GBASE SR4/128G Fiber Channel
- Infiniband FDR/EDR

## Features

- Four-channel full-duplex active optical cable
- Multirate capability: 10 Gb/s and 25 Gb/s per channel
- QSFP28 high-density form factor
- Reliable VCSEL array technology using multimode fiber
- Hot Pluggable
- power dissipation: <3.5W per cable end
- Commercial operating case temperature range: 0°C to 70°C
- UL certification optional cables



## Ordering Information

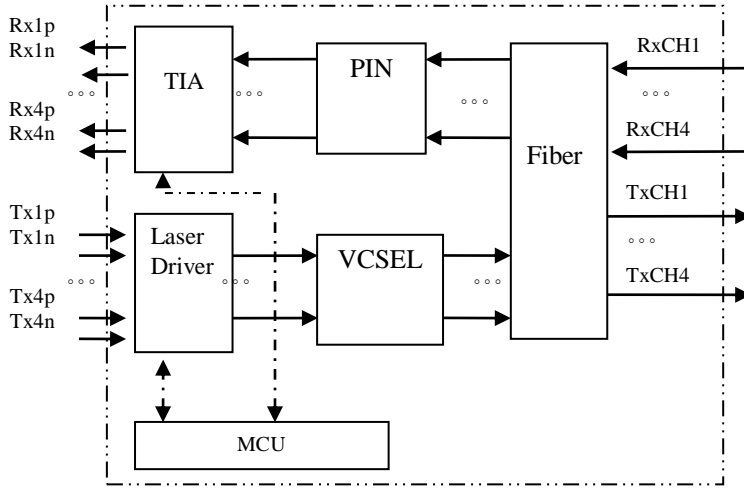
PN	Cable Information
QSFP28-100G-AOC#XXX	OM3 MMF without UL Certification( $xxx \leq 70$ meter)
	OM4 MMF without UL Certification( $70 < xxx \leq 100$ meter)
QSFP28-100G-AOCU#XXX	OM3 MMF with UL Certification( $xxx \leq 70$ meter)
	OM4 MMF with UL Certification( $70 < xxx \leq 100$ meter)

### QSFP28 Active Optical Cable Transceiver

- #001: 1-meter cable
- #003: 3-meter cable
- #005: 5-meter cable
- #010: 10-meter cable
- #015: 15-meter cable
- #020: 20-meter cable
- #030: 30-meter cable



#050: 50-meter cable  
 #100: 100-meter cable



Module Block Diagram

**Pin Descriptions**

38	GND
37	TX1n
36	TX1p
35	GND
34	TX3n
33	TX3p
32	GND
31	LPMode
30	Vcc1
29	VccTx
28	IntL
27	ModPrsL
26	GND
25	RX4p
24	RX4n
23	GND
22	RX2p
21	RX2n
20	GND

Card Edge

GND	1
TX2n	2
TX2p	3
GND	4
TX4n	5
TX4p	6
GND	7
ModSelL	8
ResetL	9
VccRx	10
SCL	11
SDA	12
GND	13
RX3p	14
RX3n	15
GND	16
RX1p	17
RX1n	18
GND	19

Top Side  
Viewed from Top

Bottom Side  
Viewed from Bottom

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

**Absolute Maximum Ratings**

Form Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Maximum Supply Voltage	Vcc1, VccTx, VccRx	-0.5		3.6	V	
Storage Temperature	T <sub>S</sub>	-20		85	°C	1
Case Operating Temperature	T <sub>OP</sub>	0		70	°C	
Relative Humidity	RH	0		85	%	2

Notes:

1. Assumes no mechanical load force on the unit. Ensuring no mechanical load force requires a cable bend radius of >105 mm within 100 mm of either cable end module and >60 mm on the rest of the cable.
2. Non-condensing.

**Recommended Operating Conditions**

Form Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc	3.13	3.3	3.47	V	
Operating Case temperature	Tca	0		70	°C	
Data Rate Per Lane	fd		25.78125		Gbps	
Humidity	Rh	5		85	%	
Fiber Bend Radius	Rb	3			cm	

**Electrical Characteristics(EOL, T<sub>OP</sub> = 0 to 70° C, V<sub>CC</sub> = 3.135 to 3.465 Volts)**

NOTE: The EDR module requires an electrical connector compliant with SFF-8662 or SFF-8672 be used on the host board to guarantee its electrical interface specification. Please check with your connector supplier.

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Supply Voltage	Vcc1, VccTx, VccRx	3.15		3.45	V	
Supply Current	Icc			1010	mA	
Module total power	P			3.5	W	1,2
<b>Input electrical specifications (per Lane)</b>						
Differential Voltage pk-pk				900	mV	
Differential Termination Resistance Mismatch				10	%	
Transition Time, 20 to 80%	Tr, Tf	10			ps	
<b>Output electrical specifications (per Lane)</b>						
Differential Voltage pk-pk				900	mV	
Differential Termination Resistance Mismatch				10	%	
Transition Time, 20 to 80%	Tr, Tf	9.5			ps	
Bit Error Rate	BER			E-12		3

## Notes:

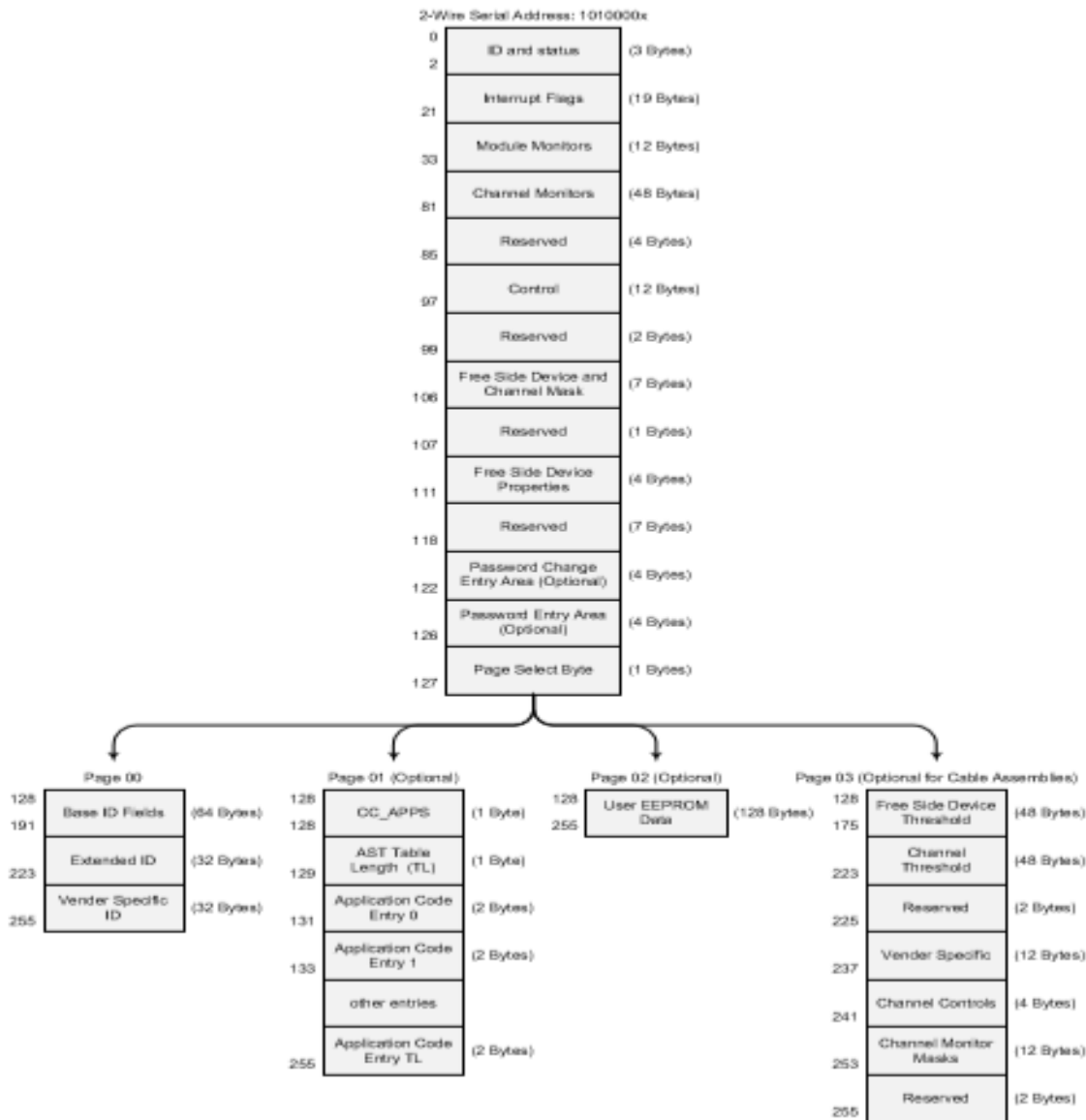
1. Maximum total power value is specified across the full temperature and voltage range.
2. Settable in various discrete steps via the I2C interface.
3. BER= $10^{-12}$ ; PRBS [2<sup>31</sup>-1@25.78125Gbps](#)

**QSFP28 Memory Map**

This subclause defines the Memory Map for QSFP28 Module used for serial ID, digital monitoring and certain control functions. The interface is mandatory for all QSFP28 devices. The interface has been designed largely after the XFP MSA as defined in INF8077i Rev.4.0. The memory map has been changed in order to accommodate 4 optical channels and limit the required memory space. The single address approach is used as found in XFP. Paging is used in order to enable time critical interactions between host and Module.

The structure of the memory is shown in following. The memory space is arranged into a lower, single page, address space of 128 bytes and multiple upper address space pages. This structure permits timely access to addresses in the lower page, e.g. Interrupt Flags and Monitors. Less time critical entries, e.g. serial ID information and threshold settings, are available with the Page Select function. The structure also provides address expansion by adding additional upper pages as needed. For example, in Figure 30 upper pages 01 and 02 are optional. Upper page 01 allows implementation of Application Select Table, and upper page 02 provides user read/write space. The lower page and upper page 00 are always implemented. Page 03 is required if byte 2, bit 2 in the lower page is low. See Table 39 for details regarding declaration of optional upper pages 01 and 02.

The interface address used is A0xh and is mainly used for time critical data like interrupt handling in order to enable a “one-time-read” for all data related to an interrupt situation. After an Interrupt, IntL, has been asserted, the host can read out the flag field to determine the effected channel and type of flag.





Address	Description	Type	Passive Copper, Active Copper, Active Optical	Optical Module
0	Identifier (1 Byte)	Read-Only	R	R
1-2	Status (2 Bytes)	Read-Only	See Table 18	
3-21	Interrupt Flags (19 Bytes)	Read-Only	See Tables 19-21	
22-33	Module Monitors (12 Bytes)	Read-Only	See Table 22	
34-81	Channel Monitors (48 Bytes)	Read-Only	See Table 23	
82-85	Reserved (4 Bytes)	Read-Only	Reserved	
86-97	Control (12 Bytes)	Read/Write	See Table 24	
98-99	Reserved (2 Bytes)	Read/Write	Reserved	
100-106	Module and Channel Masks (7 Bytes)	Read/Write	See Table 25	
107-118	Reserved (12 Bytes)	Read/Write	Reserved	
119-122	Password Change Entry Area (optional) (4 Bytes)	Read/Write	O	O
123-126	Password Entry Area (optional) 4 Bytes	Read/Write	O	O
127	Page Select Byte	Read/Write	R	R

Address	Size (Bytes)	Name	Description of Base ID Field	Passive Copper, Active Copper, Active Optical	Optical Module
<b>Base ID fields</b>					
128	1	Identifier	Identifier Type of serial Module	R	R
129	1	Ext. Identifier	Extended Identifier of Serial Module	R	R
130	1	Connector	Code for connector type	R	R
131-138	8	Specification compliance	Code for electronic compatibility or optical compatibility	R	R
139	1	Encoding	Code for serial encoding algorithm	R	R
140	1	BR, nominal	Nominal bit rate, units of 100 Mbits/s	R	R
141	1	Extended rateselect Compliance	Tags for extended rate select compliance	R	R
142	1	Length (SMF)	Link length supported for SMF fiber in km (note 1)	R	R
143	1	Length (OM3 50 um)	Link length supported for EBW 50/125 um fiber (OM3), units of 2m (note 1)	R	R
144	1	Length (OM2 50 um)	Link length supported for 50/125 um fiber (OM2), units of 1m (note 1)	R	R



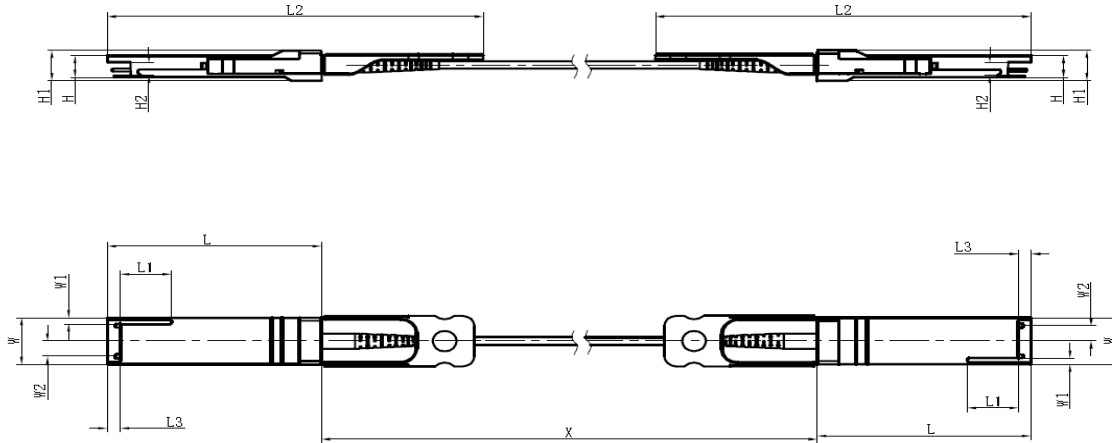
145	1	Length(OM1 62.5 um)	Link length supported for 62.5/125 um fiber (OM1), units of 1m (note 1)	R	R
146	1	Length (Copper)	Link length of copper or active cable, units of 1 m (note 1)Link length supported for 50/125 um fiber (OM4), units of 2 m) when Byte 147 declares 850 nm VCSEL as defined in Table 37	R	R
147	1	Device tech	Device technology	R	R
148-163	16	Vendor name	QSFP+ vendor name(ASCII)	R	R
164	1	Extended Module	Extended Module codes for InfiniBand	R	R
165-167	3	Vendor OUI	QSFP+ vendor IEEE company ID	R	R
168-183	16	Vendor PN	Part number provided by QSFP+ vendor(ASCII)	R	R
184-185	2	Vendor rev	Revision level for part number provided by vendor(ASCII)	R	R
186-187	2	Wave length or Copper cable Attenuation	Nominal laser wavelength (wavelength=value/20 in nm) or copper cable attenuation in dB at 2.5GHz (Adrs 186) and 5.0GHz (Adrs 187)	R	R
188-189	2	Wavelength tolerance	Guaranteed range of laser wavelength(+/- value) from nominal wavelength.(wavelength Tol.=value/200 in nm)	R	R
190	1	Max case temp.	Maximum case temperature in degrees C	R	R
191	1	CC_BASE	Check code for base ID fields (addresses 128-190)	R	R
<b>Extended ID fields</b>					
192-195	4	Options	Rate Select, TX Disable, TX Fault, LOS, Warning indicators for: Temperature, VCC, RX power, TX Bias	R	R
196-211	16	Vendor SN	Serial number provided by vendor (ASCII)	R	R
212-219	8	Date Code	Vendor's manufacturing date code	R	R
220	1	Diagnostic Monitoring Type	Indicates which types of diagnostic monitoring are implemented (if any) in the Module. Bit 1,0 Reserved	R	R
221	1	Enhanced Options	Indicates which optional enhanced features are implemented in the Module.	R	R
222	1	Reserved			
223	1	CC_EXT	Check code for the Extended ID Fields (addresses 192-222)	R	R
<b>Vendor Specific ID Fields</b>					
224-255	32	Vendor Specific EEPROM			





### Mechanical Design Diagram (mm)

The EDR module mechanical specifications are compliant with the QSFP28 transceiver module specifications (as defined in SFF-8661), substituting the MPO12 receptacle with a fiber optics cable connecting both ends.



Unit: mm

	L	L1	L2	L3	W	W1	W2	H	H1	H2
MAX	72.2	—	122	4.35	18.45	—	6.2	8.6	12.0	5.35
Typical	72.0	—	—	4.20	18.35	—	—	8.5	11.8	5.2
MIN	68.8	16.5	118	4.05	18.25	2.2	5.8	8.4	11.6	5.05

Cable Length (Unit: m)	Tolerant (Unit: cm)
<1.0	+5/-0
1.0~4.5	+15/-0
5.0~14.5	+30/-0
≥15.0	+2%/-0