

QSFP+ Active Multimode Fiber Optic Cables

Optical Transceivers

Overview

ARIA QSFP+ Active Multimode Fiber Optic Cables are a high performance, low power consumption, long reach interconnect solution supporting 40G Ethernet, fiber channel and PCIe.

This product is compliant with the QSFP MSA and IEEE P802.3ba 40GBASE-SR4 standards.

These cables are an assembly of 4 full-duplex lanes, where each lane is capable of transmitting data at rates up to 10Gb/s, providing an aggregated rate of 40Gb/s.



Features

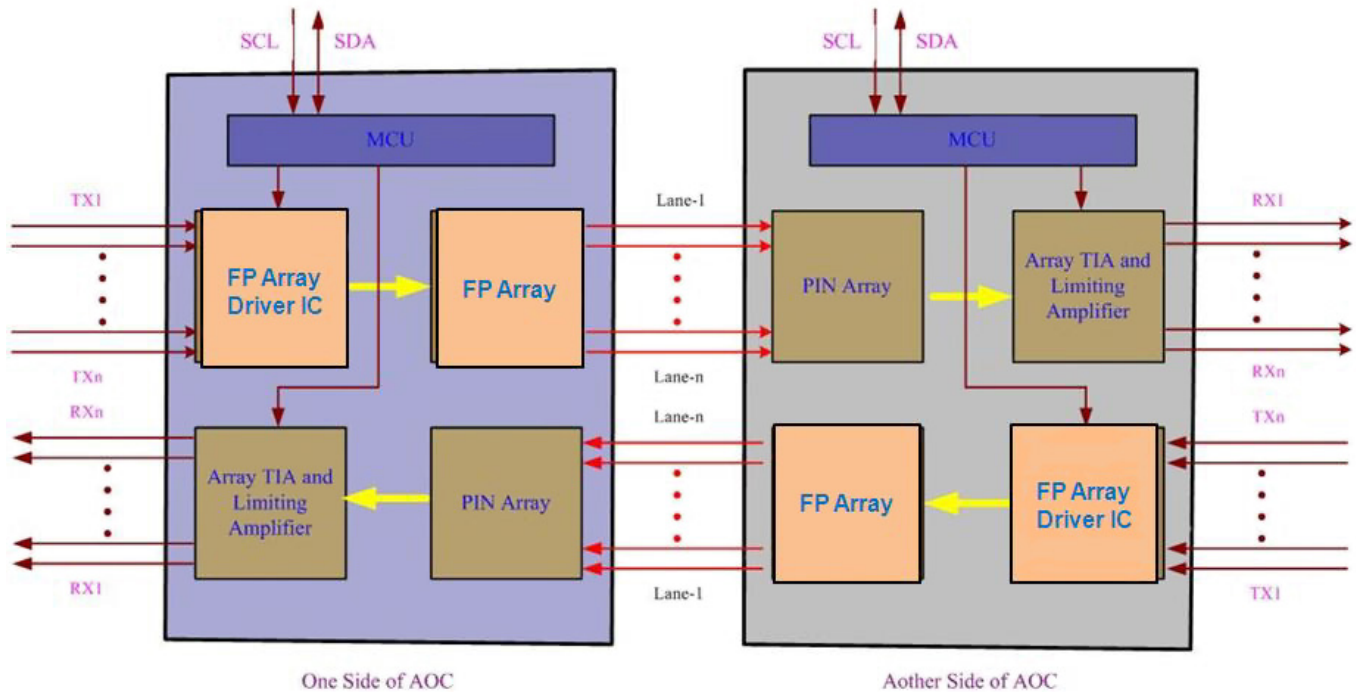
- Full duplex 4 channel 850nm parallel active optical cable
- Transmission data rate up to 10.3Gbit/s per channel
- SFF-8436 QSFP+ compliant
- Hot pluggable electrical interface
- Differential AC-coupled high speed data interface
- 4 channels 850nm VCSEL array
- 4 channels PIN photo detector array
- Maximum link length of 300m on OM3 Multimode Fiber (MMF) and 400m on OM4 MMF
- Low power consumption <1.5W
- Operating case temperature 0°C to +70°C
- 3.3V power supply voltage
- RoHS 6 compliant



Applications

- Infiniband transmission at 4ch SDR, DDR and QDR
- 40GBASE-SR4 40G Ethernet
- Data Centers

Figure1. Module Block Diagram



Absolute Maximum Ratings

Parameter	Symbol	Minimum	Maximum	Unit
Supply Voltage	V_{cc}	-0.3	3.6	V
Input Voltage	V_{in}	-0.3	$V_{cc} + 0.3$	V
Storage Temperature	T_{st}	-20	85	°C
Case Operating Temperature	T_{op}	0	70	°C
Humidity (non-condensing)	R_h	5	95	%

Recommended Operating Conditions

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Supply Voltage	V_{cc}	3.13	3.3	3.47	V
Case Operating Temperature	T_{ca}	0	N/A	70	°C
Data Rate Per Lane	f_d	2.5	N/A	10.3	Gbps
Humidity (non-condensing)	R_h	5	N/A	85	%
Power Dissipation	P_m	N/A	N/A	1.5	W
Fiber Bend Radius	R_b	3	N/A	N/A	cm

Specifications

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Differential input impedance	Zin	90	100	110	ohm
Differential Output impedance	Zout	90	100	110	ohm
Differential input voltage	ΔV_{in}	300	N/A	1100	mVp-p
Differential output voltage	ΔV_{out}	500	N/A	800	mVp-p
Skew	Sw	N/A	N/A	300	ps
Bit Error Rate	BR	N/A	N/A	E-12	N/A
Input Logic Level High	V _{IH}	2.0	N/A	VCC	V
Input Logic Level Low	V _{IL}	0	N/A	0.8	V
Output Logic Level High	V _{OH}	VCC-0.5	N/A	VCC	V
Output Logic Level Low	V _{OL}	0	N/A	0.4	V

Note:

1. BER=10⁻¹²; PRBS 2³¹-1@10.3125Gbps.
2. Differential input voltage amplitude is measured between Txnp and TxnN.
3. Differential output voltage amplitude is measured between RxNp and RxnN.

Transmitter Optical Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Center Wavelength	λ_c	840	850	860	nm
RMS spectral width	$\Delta\lambda$	N/A	N/A	0.65	nm
Average launch power, each lane	P _{out}	-7.5	N/A	2.5	dBm
Difference in launch power between any two lanes (OMA)	N/A	N/A	N/A	4	dB
Extinction Ratio	ER	3	N/A	N/A	dB
Peak power, each lane	N/A	N/A	N/A	4	dBm
Transmitter and dispersion penalty (TDP), each lane	TDP	N/A	N/A	3.5	dB
Average launch power of OFF transmitter, each lane	N/A	N/A	N/A	-30	dB
Eye Mask coordinates: X1, X2, X3, Y1, Y2, Y3	Specification Values: 0.23, 0.34, 0.43, 0.27, 0.35, 0.4 (Hit Ratio = 5x10 ⁻⁵)				

Receiver Optical Characteristics

Parameter	Symbol	Minimum	Typical	Maximum	Unit
Center Wavelength	λ_c	840	850	860	nm
Stressed receiver sensitivity in OMA, each lane*	N/A	N/A	N/A	-5.4	dBm
Maximum Average power at receiver input, each lane	N/A	N/A	N/A	2.4	dBm
Receiver Reflectance	N/A	N/A	N/A	-12	dB
Peak power, each lane	N/A	N/A	N/A	4	dBm
LOS Assert	N/A	-30	N/A	N/A	dBm
LOS De-Assert – OMA	N/A	N/A	N/A	-7.5	dBm
LOS Hysteresis	N/A	0.5	N/A	N/A	dB

*Measured with conformance test signal at TP3 for BER = 10e-12

Pin Descriptions

Pin	Logic	Symbol	Name/Description
1*	N/A	GND	Module Ground
2	CML-I	Tx2-	Transmitter inverted data input
3	CML-I	Tx2+	Transmitter non-inverted data input
4*	N/A	GND	Module Ground
5	CML-I	Tx4-	Transmitter inverted data input
6	CML-I	Tx4+	Transmitter non-inverted data input
7*	N/A	GND	Module Ground
8**	LVTTL-I	MODSEIL	Module Select
9**	LVTTL-I	ResetL	Module Reset
10	N/A	VCCR _x	+3.3v Receiver Power Supply
11**	LVC MOS-I	SCL	2-wire Serial interface clock
12**	LVC MOS-I/O	SDA	2-wire Serial interface data
13*	N/A	GND	Module Ground
14	CML-O	RX3+	Receiver non-inverted data output
15	CML-O	RX3-	Receiver inverted data output
16*	N/A	GND	Module Ground
17	CML-O	RX1+	Receiver non-inverted data output
18	CML-O	RX1-	Receiver inverted data output

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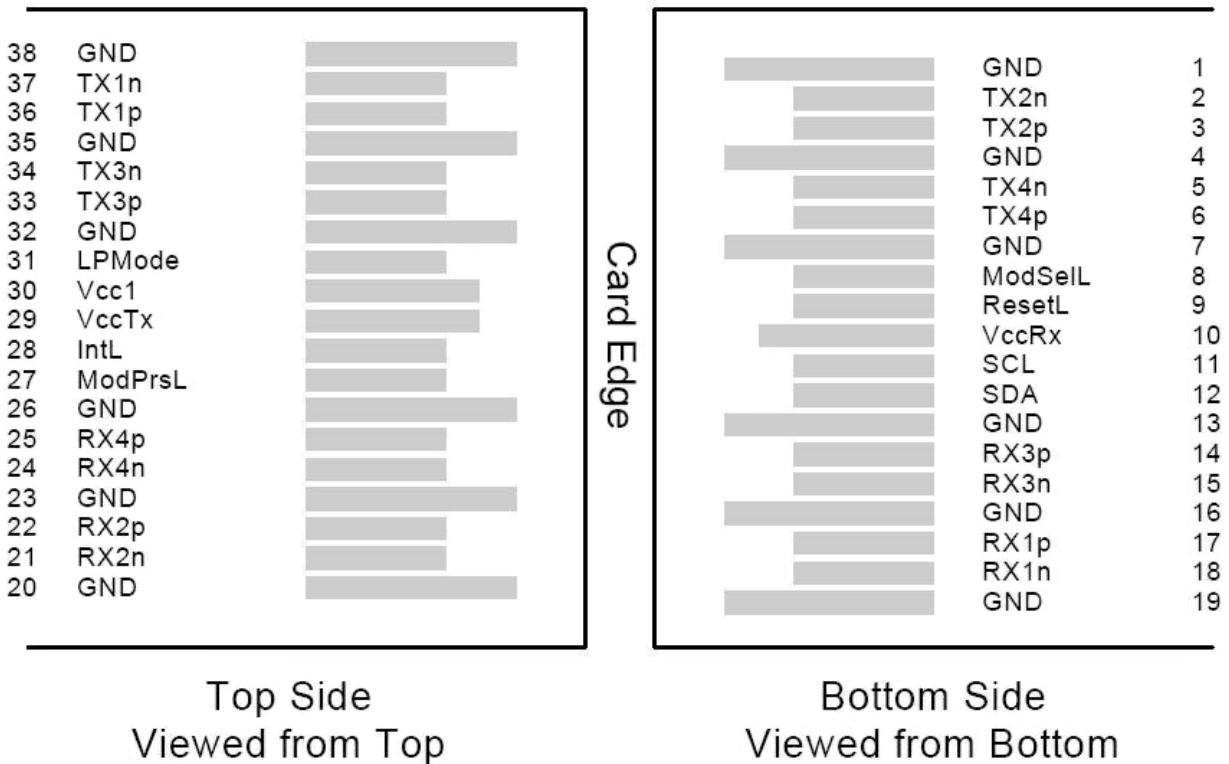
Pin Descriptions (Continued)

Pin	Logic	Symbol	Name/Description
19*	N/A	GND	Module Ground
20*	N/A	GND	Module Ground
21	CML-O	RX2-	Receiver inverted data output
22	CML-O	RX2+	Receiver non-inverted data output
23*	N/A	GND	Module Ground
24	CML-O	RX4-	Receiver inverted data output
25	CML-O	RX4+	Receiver non-inverted data output
26*	N/A	GND	Module Ground
27	LVTTL-O	ModPrsL	Module Present, internal pulled down to GND
28**	LVTTL-O	IntL	Interrupt output, should be pulled up on host board
29	N/A	VCCTx	+3.3v Transmitter Power Supply
30	N/A	VCC1	+3.3v Power Supply
31**	LVTTL-I	LPMode	Low Power Mode
32*	N/A	GND	Module Ground
33	CML-I	Tx3+	Transmitter non-inverted data input
34	CML-I	Tx3-	Transmitter inverted data input
35*	N/A	GND	Module Ground
36	CML-I	Tx1+	Transmitter non-inverted data input
37	CML-I	Tx1-	Transmitter inverted data input
38*	N/A	GND	Module Ground

*Module circuit ground is isolated from the module chassis ground within the module.

**Open collector; should be pulled up with 4.7k – 10k ohms on host board to a voltage between 3.15V and 3.6V.

Figure 2. Electrical Pin-out Details



ModSelL Pin

The ModSelL is an input pin. When held low by the host, the module responds to 2-wire serial communication commands. The ModSelL allows the use of multiple QSFP modules on a single 2-wire interface bus. When the ModSelL is “High”, the module will not respond to any 2-wire interface communication from the host. ModSelL has an internal pull-up in the module.

ResetL Pin

Reset. LPMODE_Reset has an internal pull-up in the module. A low level on the ResetL pin for longer than the minimum pulse length (t_{Reset_init}) initiates a complete module reset, returning all user module settings to their default state. Module Reset Assert Time (t_{init}) starts on the rising edge after the low level on the ResetL pin is released. During the execution of a reset (t_{init}) the host shall disregard all status bits until the module indicates a completion of the reset interrupt. The module indicates this by posting an IntL signal with the Data_Not_Ready bit negated. Note that on power up (including hot insertion) the module will post this completion of reset interrupt without requiring a reset.

LPMODE Pin

ARIA QSFP AOC operates in the low power mode (less than 1.5 W power consumption) This pin active high will decrease power consumption to less than 1W.

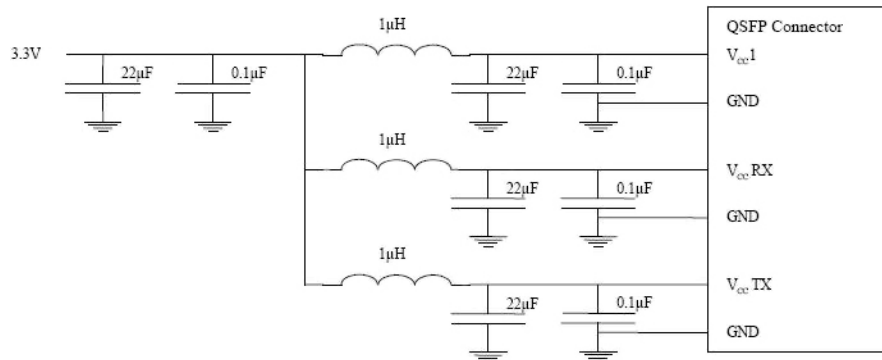
ModPrsL Pin

ModPrsL is pulled up to Vcc on the host board and grounded in the module. The ModPrsL is asserted “Low” when the module is inserted and deasserted “High” when the module is physically absent from the host connector.

IntL Pin

IntL is an output pin. When “Low”, it indicates a possible module operational fault or a status critical to the host system. The host identifies the source of the interrupt by using the 2-wire serial interface. The IntL pin is an open collector output and must be pulled up to Vcc on the host board.

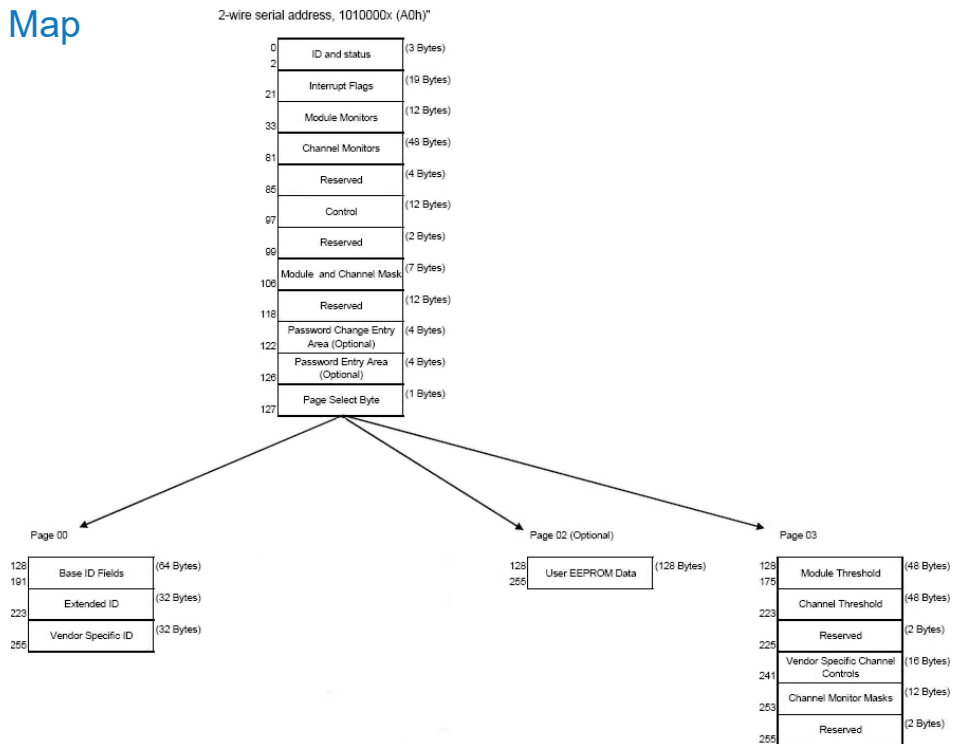
Figure 3. Host Board Power Supply Filtering



Diagnostic Monitoring Interface

A digital diagnostics monitoring function is available on all ARIA QSFP PSM AOCs. A 2-wire serial interface provides user to contact with module. The structure of the memory is shown in Figure 4. 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, such as Interrupt Flags and Monitors. Less time critical time entries, such as serial ID information and threshold settings, are available with the Page Select function. 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 affected channel and type of flag.

Figure 4. QSFP Memory Map



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Low Memory Map

Byte Address	Description	Type
0	Identifier (1 Byte)	Read Only
1-2	Status (2 Bytes)	Read Only
3-21	Interrupt Flags (31 Bytes)	Read Only
22-33	Module Monitors (48 Bytes)	Read Only
34-81	Channel Monitors (48 Bytes)	Read Only
82-85	Reserved (4 Bytes)	Read Only
86-97	Control (12 Bytes)	Read/Write
98-99	Reserved (2 Bytes)	Read/Write
100-106	Module and Channel Masks (7 Bytes)	Read/Write
107-118	Reserved (12 Bytes)	Read/Write
119-122	Reserved (4 Bytes)	Read/Write
123-126	Reserved (4 Bytes)	Read/Write
127	Page Select Byte	Read/Write

Page 03 Memory Map

Byte Address	Description	Type
128-175	Module Thresholds (48 Bytes)	Read Only
176-223	Reserved (48 Bytes)	Read Only
224-225	Reserved (2 Bytes)	Read Only
226-239	Reserved (14 Bytes)	Read/Write
240-241	Channel Controls (2 Bytes)	Read/Write
242-253	Reserved (12 Bytes)	Read/Write
254-255	Reserved (2 Bytes)	Read/Write

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Page 00 Memory Map

Address	Name	Description
128	Identifier (1 Byte)	Identifier type of serial transceiver
129	Ext. Identifier (1 Byte)	Extended identifier of serial transceiver
130	Connector (1 Byte)	Code for connector type
131-138	Transceiver (8 Bytes)	Code for electronic compatibility or optical compatibility
139	Encoding (1 Byte)	Code for serial generating algorithm
140	BR, nominal (1 Byte)	Nominal bit rate, units of 100 Mb/s
141	Extended RateSelect Compliance (1 Byte)	Tags for Extended RateSelect compliance
142	Length SMF (1 Byte)	Link length supported for SM fiber in km
143	Length E-50 μ m (1 Byte)	Link length supported for EBW 50/125 μ m fiber, units of 2 m
144	Length 50 μ m (1 Byte)	Link length supported for 50/125 μ m fiber, units of 1 m
145	Length 62.5 μ m (1 Byte)	Link length supported for 62.5/125 μ m fiber, units of 1 m
146	Length copper (1 Byte)	Link length supported for copper, units of 1 m
147	Device Tech (1 Byte)	Device technology
148-163	Vendor Name (16 Bytes)	QSFP vendor name (ASCII)
164	Extended Transceiver (1 Byte)	Extended transceiver codes for InfiniBand
165-167	Vendor OUI (3 Bytes)	QSFP vendor IEEE vendor company ID
168-183	Vendor PN (16 Bytes)	Part number provided by QSFP vendor (ASCII)
184-185	Vendor rev (2 Bytes)	Revision level for part number provided by vendor (ASCII)
186-187	Wavelength (2 Bytes)	Nominal laser wavelength (Wavelength = value / 20 in nm)
188-189	Wavelength Tolerance (2 Bytes)	Guaranteed range of laser wavelength (+/- value) from nominal wavelength (wavelength tolerance = value / 200 in nm)
190	Max Case Temp (1 Byte)	Maximum case temperature in degrees C
191	CC_BASE (1 Byte)	Check code for Base ID fields (addresses 128-190)
192-195	Options (4 Bytes)	Rate Select, TX Disable, TX Fault, LOS
196-211	Vendor SN (16 Bytes)	Serial number provided by vendor (ASCII)
212-219	Date Code (8 Bytes)	Vendor's manufacturing date code
220	Diagnostic Monitoring Type (1 Byte)	Indicates which type of diagnostic monitoring is implemented
221	Enhanced Options (1 Byte)	Indicates which optional enhanced features are implemented
222	Reserved (1 Byte)	Reserved
223	CC_EXT	Check code for the Extended ID fields (addresses 192-222)
224-255	Vendor Specific (32 Bytes)	Vendor specific EEPROM

Page02 is User EEPROM and its format is decided by the user. For a detailed description of low memory and page00. page03 upper memory please see the SFF-8436 document.

Timing for Soft Control and Status Functions

Parameter	Symbol	Max	Unit	Conditions
Initialization Time	t_init	2000	ms	Time from power on*, hot plug or rising edge of Reset until the module is fully functional**
Reset Init Assert Time	t_reset_init	2	µs	A Reset is generated by a low level longer than the minimum reset pulse time present on the ResetL pin.
Serial Bus Hardware Ready Time	t_serial	2000	ms	Time from power on* until module responds to data transmission over the 2-wire serial bus
Monitor Data Ready Time	t_data	2000	ms	Time from power on* to data not ready, bit 0 of Byte 2, deasserted and IntL asserted
Reset Assert Time	t_reset	2000	ms	Time from rising edge on the ResetL pin until the module is fully functional**
LPMode Assert Time	ton_LPMode	100	µs	Time from assertion of LPMode (Vin:LPMode = Vih) until module power consumption enters lower Power Level
IntL Assert Time	ton_IntL	200	ms	Time from occurrence of condition triggering IntL until Vout:IntL = Vol
IntL Deassert Time	toff_IntL	500	µs	Time from clear on read**** operation of associated flag until Vout:IntL = Voh. This includes deassert times for Rx LOS, Tx Fault and other flag bits.
Rx LOS Assert Time	ton_los	100	ms	Time from Rx LOS state to Rx LOS bit set and IntL asserted
Tx Fault Assert Time	ton_Txfault	200	ms	Time from Tx Fault state to Tx Fault bit set and IntL asserted
Flag Assert Time	ton_flag	200	ms	Time from occurrence of condition triggering flag to associated flag bit set and IntL asserted
Mask Assert Time	ton_mask	100	ms	Time from mask bit set**** until associated IntL assertion is inhibited
Mask Deassert Time	toff_mask	100	ms	Time from mask bit cleared**** until associated IntL operation resumes
ModSelL Assert Time	ton_ModSelL	100	µs	Time from assertion of ModSelL until module responds to data transmission over the 2-wire serial bus
ModSelL Deassert Time	toff_ModSelL	100	µs	Time from deassertion of ModSelL until the module does not respond to data transmission over the 2-wire serial bus
Power_over-ride or Power-set Assert Time	ton_Pdown	100	ms	Time from P_Down bit set**** until module power consumption enters lower Power Level
Power_over-ride or Power-set Deassert Time	toff_Pdown	300	ms	Time from P_Down bit cleared**** until the module is fully functional

*Power on is defined as the instant when supply voltages reach and remain at or above the minimum specified value.

**Fully functional is defined as IntL asserted due to data not ready bit, bit 0 byte 2 deasserted.

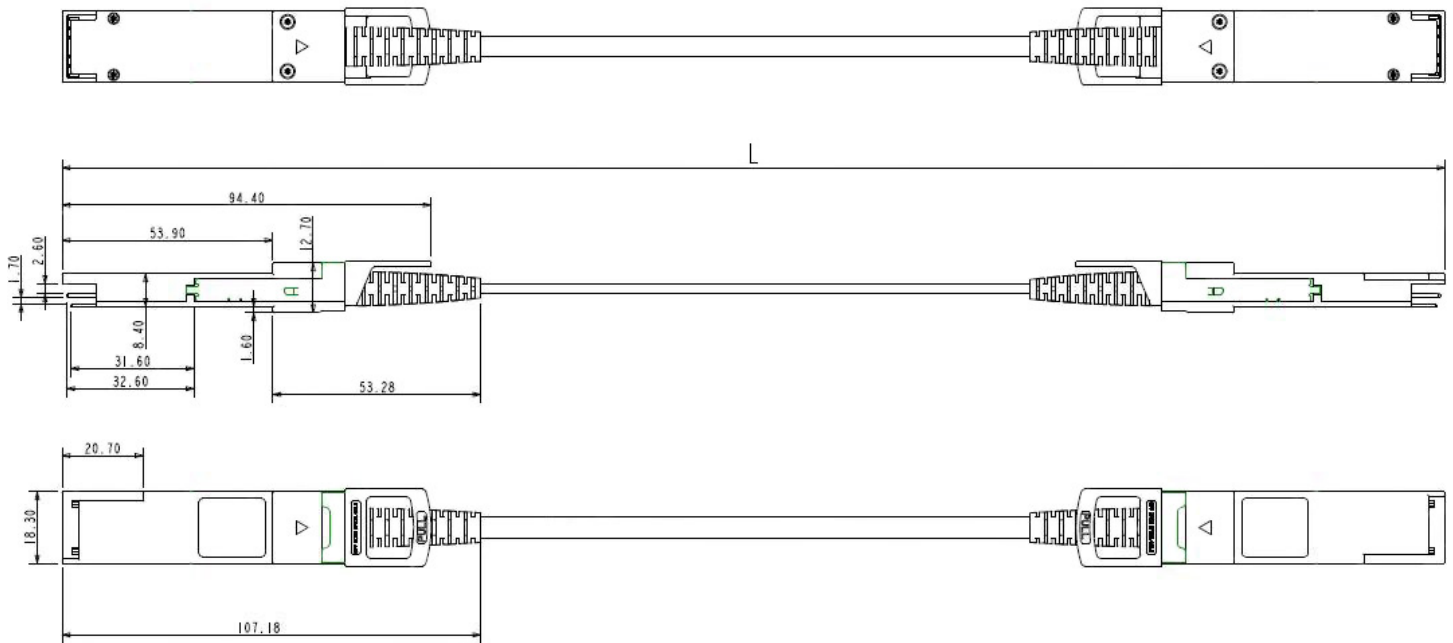
***Measured from falling clock edge after stop bit of read transaction.

****Measured from falling clock edge after stop bit of write transaction.

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Dimensions



Ordering information

Part Number	Product Description
ATQS-MDO400-003C	40Gb/s QSFP AOC up to 300m with 3 meter OM3 multimode fiber cable length
ATQS-MDO400-005C	40Gb/s QSFP AOC up to 300m with 5 meter OM3 multimode fiber cable length
ATQS-MDO400-010C	40Gb/s QSFP AOC up to 300m with 10 meter OM3 multimode fiber cable length
ATQS-MDO400-020C	40Gb/s QSFP AOC up to 300m with 20 meter OM3 multimode fiber cable length
ATQS-MDO400-050C	40Gb/s QSFP AOC up to 300m with 50 meter OM3 multimode fiber cable length
ATQS-MDO400-300C	40Gb/s QSFP AOC up to 300m with 300 meter OM3 multimode fiber cable length