

## Product Data Sheet

### **3M™ Active Optical Cable (AOC) Assemblies for CX4 and QSFP+ Applications**



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## Table of Contents

1.0	DESCRIPTION.....	2
2.0	AOC BLOCK DIAGRAM.....	2
3.0	CONNECTOR PIN ASSIGNMENT .....	3
3.1	Type Sense (TSense) .....	3
3.2	Output Disable (ODIS).....	3
3.3	Fault.....	4
4.0	LED INDICATOR SUMMARY .....	4
5.0	ABSOLUTE MAXIMUM RATING .....	4
6.0	RECOMMENDED OPERATING CONDITIONS.....	4
6.1	Type Sense (TSense) .....	4
6.2	Output Disable (ODIS).....	4
6.3	Fault.....	4
7.0	EQUIPMENT CHARACTERISTICS.....	5
7.1	Transmitter and Receiver Electrical Characteristics .....	5
7.2	Optical Characteristics.....	5
7.3	Link Performance.....	5
8.0	TESTING.....	6
8.1	Standards and Regulatory Documents .....	6
8.2	Functional Performance Criteria.....	6
8.3	Mechanical Dimensions.....	7
9.0	ORDERING INFORMATION .....	8

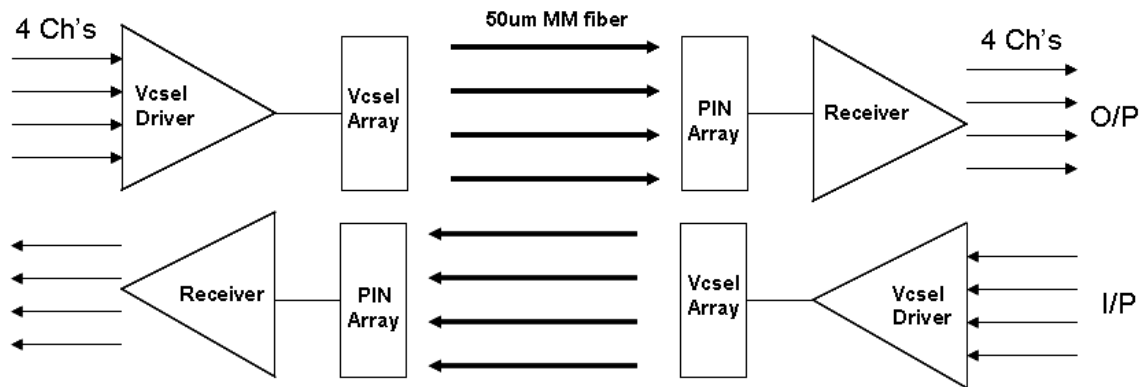
## 1.0 Description

3M's new CX4-QSFP+ hybrid active optical cable assembly provides up to 5 Gbps per channel transmission over 100 meters of multimode fiber for high-performance computing and other ultra high-throughput networking environments. The AOC transmits four parallel channels each operating up to 5Gbps. Using industry leading Vcsel technology and an advanced new light-engine design, the 3M AOC provides exceptional cost/performance value.

### Features

- Low-power
- Four channels each operating up to 5Gbps
- Fiber link up to 100m
- Reliable 850nm Vcsel technology
- 0 to +70 degree Celsius operating temperature range
- Hot pluggable
- Bend insensitive fiber

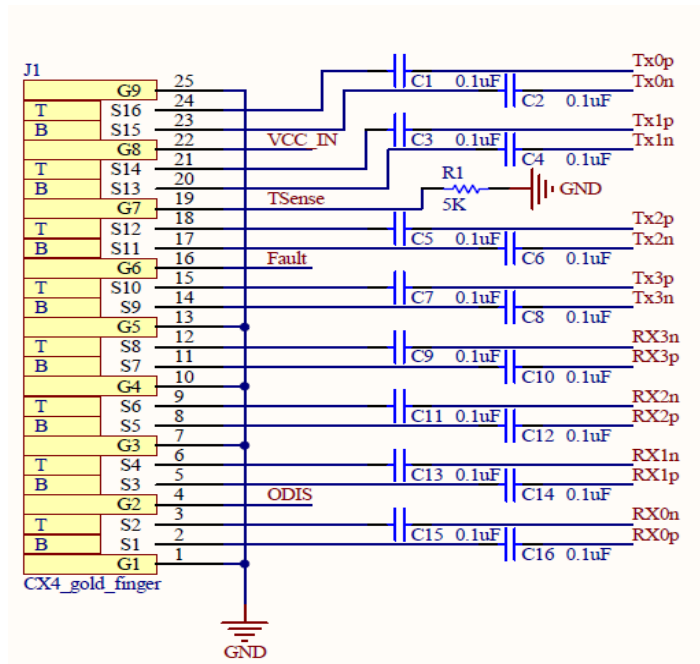
## 2.0 AOC block diagram



This document summarizes the product performance specifications for the 3M Active Optical Cable Assembly for CX4 Applications. In the event of performance data conflicts between this specification and any document listed below, this specification supersedes those documents.

### 3.0 Connector Pin Assignment

In an active optical version of the CX4-QSFP+ cable assembly, certain ground pins are repurposed to provide power and other control signaling. A CX4-QSFP+ hybrid active optical module requires a 3.3Volt power supply at each end. On the CX4 side, this voltage supply is provided through pin G8 which is normally a ground pin in an equivalent copper cable. It is used to provide electrical power to the opto-electronics inside the module. The host uses G7, Type\_Sense (labeled 'TSense' in the diagram below), to detect whether the module is an active or passive variety. If the host detects a ground it automatically assumes the module is passive variety and thus requires no electrical power. The 5K-Ohm resistor allows the host to develop the appropriate voltage across a voltage comparator circuit to detect that the module is active version and then automatically supplies power to pin G8.



#### 3.1 Type Sense (TSense)

The Type\_Sense pin on the module connector is an input pin. It is connected to a 5K-Ohm resistor connected to ground. The host system uses this line to detect whether this is an active optical module and thus provides power via the voltage input pin G8.

#### 3.2 Output Disable (ODIS)

The ODIS line is an input line to the module; it is used by the host system to switch OFF all the lasers. To turn ON all the lasers the ODIS line must be kept low by the host system. The lasers turn OFF as soon as the ODIS line is taken high. The module provides an internal 5K-Ohm pull-up resistor to Vcc\_In.

### 3.3 Fault

In normal operation, the CX4 module is able to respond to various fault conditions and signal them via the LEDs and the Fault line on the CX4 connector. The following conditions are recognized:

- RX loss-of-signal. If the Receiver IC detects loss-of-signal on one or more channels then the module will turn ON the Red LED and pull the fault line low to ground. When the fault is cleared, the Red LED will turn OFF and the fault line will be pulled low to ground.
- TX fault: If the transmitter detects a transmit fault (laser short or open circuit) it will alternately flashes the Red and Green LEDs and pulls the fault line low. The module must then be power cycled to continue.

**Note: If no fault has occurred then the module will release the Fault line (open-collector output). The host system is required to supply the recommended 5K-Ohm pull-up resistor to this output line.**

### 4.0 LED Indicator Summary

Green LED	Red LED	Fault line	Description
off	off	low	Power has not been applied or module is starting up and has not yet initialized.
on	off	low	Module is operating normally.
on	on	Open-collector	Receiver has detected loss of signal on one of more channels
flashing	flashing	Open-collector	Alternate flashing of Red and Green LEDs means a laser short or open circuit has been detected.

### 5.0 Absolute Maximum Rating

Parameters	Min	Typ	Max	Units
Storage temperature	-40		+80	Deg. Celsius
Relative humidity	5		85	%
Supply voltage	3.10		3.65	V
Operating case temperature	0		+70	Deg. Celsius

**Note: if product is exposed to conditions beyond the levels indicated, the reliability of the product is likely to be negatively affected.**

### 6.0 Recommended Operating Conditions

Parameter	Min	Typ	Max	Units
Supply voltage, Vcc	3.15	3.3	3.57	V
Power dissipation		730		mW
Operating case temperature	0		+70	Deg. Celsius
Differential impedance input/output		100		Ohm
Transmitter differential input voltage	120		1200	mV
Receiver differential output voltage, peak-to-peak		317		mV
Differential input and output impedance		100		Ohm
Signaling rate/channel, NRZ			5.00	Gbps

## 7.0 Equipment Characteristics

### 7.1 Transmitter and Receiver Electrical Characteristics

Parameters	Min	Typ	Max	Units
Transmitter differential input voltage, peak-to-peak	120		1200	mV
Receiver differential output voltage, peak-to-peak		317		mV
Peak-to-peak jitter at receiver output		36		ps
Receiver rise time, 20 -80%			75	ps
Link bit error rate (BER)		<10E-12		Bit

### 7.2 Optical Characteristics

Parameters	Min	Typ	Max	Units
Optical power coupled into 50um fiber		0.9		dBm
Optical wavelength	840	850	860	nm
Spectral bandwidth			0.65	nm

### 7.3 Mechanical Characteristics

Parameters	Min	Typ	Max	Units
Cable Installation Tension			90	N
Cable Operating Tension			31	N
Operating Cable Bend Radius	3			cm
Installation Cable Bend Radius	6			cm
Cable Outer Diameter	2.85	3.0	3.15	mm

### 7.4 Link Performance

3M CX4-QSFP+ AOC uses advance OM2+ multimode fiber with overfilled modal bandwidth of >700Mhz.Km and effective modal bandwidth of >950MHz.km at wavelength of 850nm. This allows excellent link performance up to 100 meter for InfiniBand SDR and DDR rates.

## 8.0 Testing

### 8.1 Standards and Regulatory Documents

The CX4-QSFP+ AOC has been designed and tested in accordance with the following specifications, reliability and regulatory requirements:

- Optical interface conforms to InfiniBand Architecture Specification Volume 2, Release 1.2.1
- Product tested according to Telcordia GR-468-CORE Generic Reliability Assurance Requirements for Optoelectronics Devices
- Compliant to Restriction on Hazardous Substances (RoHS) per EU requirements (ROHS directive 2002/95/EC)
- Class 1M Eye safe per IEC 60825-1/CDRH
- Conforms to UL 94 –V0 rating
- Meets FCC Class B and CE Emissions and Immunity requirements
- EN61000-4-2 (15KV air discharge during operation, and 8KV direct contact discharges to the case), Human Body Model per JEDEC JESD22-A114-B, Human Body Model JEDEC JESD22-A114-B

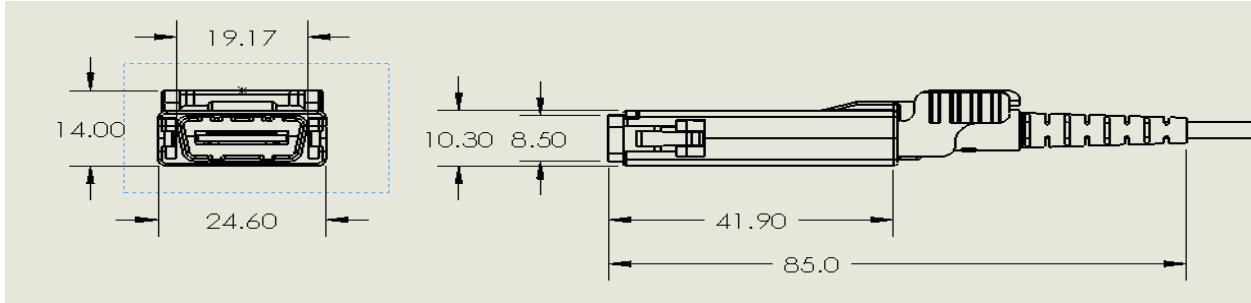
### 8.2 Functional Performance Criteria

The product was tested in accordance with various EIA and MIL-STDs as specified below. Sample sizes were selected in accordance with individual test criteria. Unless otherwise specified, all values and limits are typical of those obtained by qualification testing of the subject product.

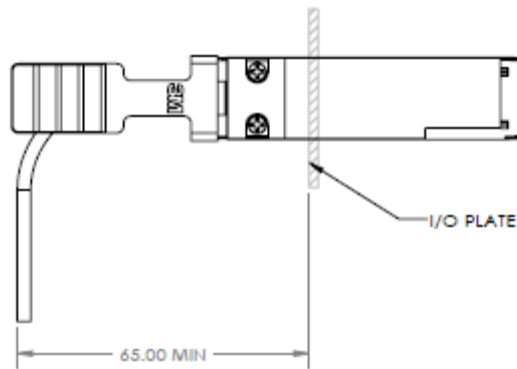
	Test	Reference	Results
1	High Temperature Operating Life	Section 5.18 (GR-468-CORE)	Pass
2	Biased Damp Heat	MIL-STD-202 Method 103	Pass
3	Temperature Cycling	MIL-STD-883 Method 1010	Pass
4	Biased Cyclic Moisture Resistance	MIL-STD-883 Method 1004	Pass
5	Thermal Shock	MIL-STD-883 Method 1011.9	Pass
6a	Mechanical Shock (MS)	MIL-STD-883 Method 2002B	Pass
6b	Mechanical Vibration (MV)	MIL-STD-883 Method 2007	Pass
7a	ESD - HBM	JESD22-A114-B	Pass
7b	ESD air discharge	EN61000-4-2	Pass
7c	ESD Contact discharge	EN61000-4-2	Pass
8a	Durability	EIA-364-09C	Pass
9a	Insertion Force	EIA/ECA-36413D	Pass
9b	Withdrawal Force	EIA/ECA-36413D	Pass
9c	Retention Force	TIA-455-6-B, FOTP 6	Pass
9d	Off-axis load capability	EIA-364-38B	Pass
10	Impact test	TIA-455-2C, FOTP-2	Pass

### 8.3 Mechanical Dimensions

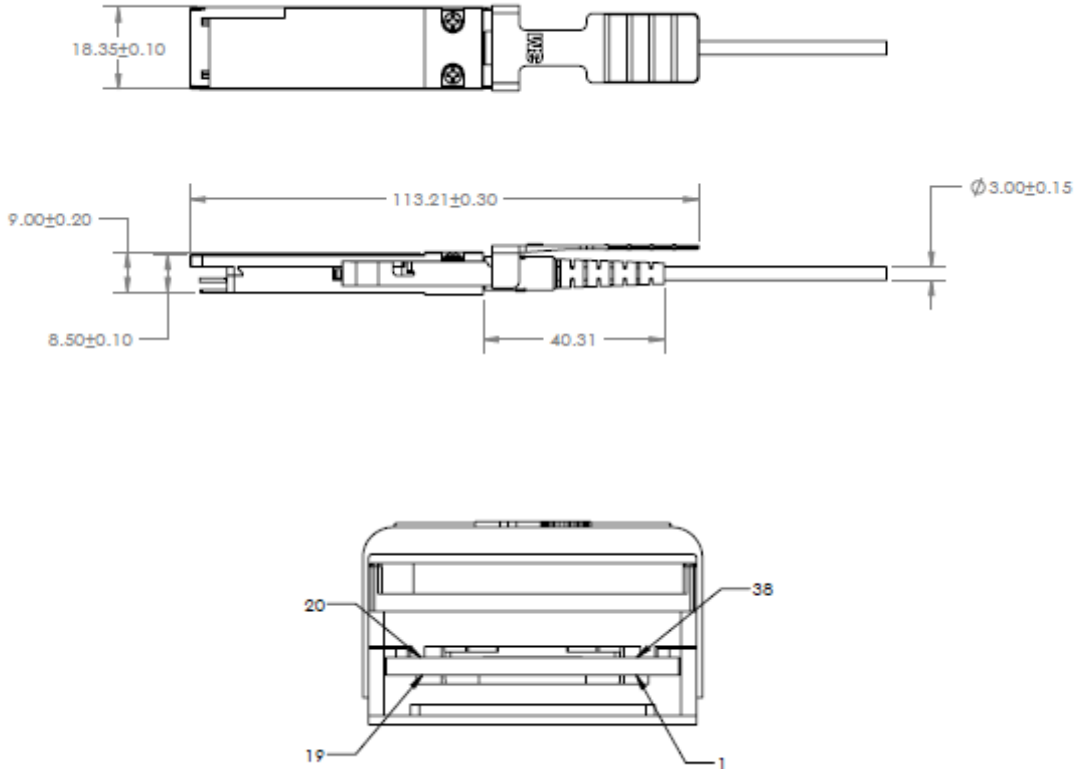
#### **CX4 Interface:**



#### **QSFP+ Interface:**







### 9.0 Ordering Information

6A24-B04X1-XXX.0-0

- |     |  Standard lengths:
- |     |     1m increments from 2m to 30m,35m,40m,45m,50m,60m,70m,80m ,90m,100m
- |     |
- |     |  Cable Type:
- |     |     2=Plenum
- |     |     4=Low Smoke Zero Halogen (LSZH)

Refer to 3M Drawing 78-5100-2554-3 for more information.

"RoHS Compliant 2002/95/EC" means that the product or part ("Product") does not contain any of the substances in excess of the maximum concentration values in EU Directive 2002/95/EC, as amended by Commission Decision 2005/618/EC, unless the substance is in an application that is exempt under EU RoHS. This information represents 3M's knowledge and belief, which may be based in whole or in part on information provided by third party suppliers to 3M.

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