

Product Data Sheet

3M™ Active Optical Cable (AOC) Assemblies for SFP+ Applications



3M Electronic Solutions Division

6801 River Place Blvd.
Austin, TX 78726-9000
www.3Mconnectors.com



Table of Contents

1.0	DESCRIPTION	2
2.0	OVERVIEW OF PRODUCT	2
3.0	ABSOLUTE MAXIMUM RATING.....	2
4.0	ELECTRICAL CHARACTERISTICS	4
5.0	LOW-SPEED ELECTRICAL CONTROL LINE DESCRIPTION.....	4
5.1	Transmitter Fault (Tx Fault).....	4
5.2	Transmitter Disable (Tx Disable).....	4
5.3	RS0/RS1 (not supported).....	4
5.4	MOD ABS (MOD DEFO).....	4
5.5	SCL/SDA.....	4
5.6	Receiver Los of Signal (Rx LOS)	4
6.0	MECHANICAL CHARACTERISTICS	4
6.1	Link Performance.....	4
6.2	Standard and Regulatory Documents	4
6.3	Pin Description of Module Edge Connector.....	5
6.4	Mechanical Dimensions	6
6.5	Laser Safety Warnings	6
6.6	SFP+ Memory Map	7

1.0 Description

3M's Active Optical Cable (AOC) Assembly for SFP+ Applications is designed for 10 Gbps Ethernet equipment, providing high-speed transmission up to 100 meters of multimode fiber and enabling high port density and ease of handling of similar copper cables. The AOC transmits a single channel operating up to 10.5 Gbps, using industry leading VCSEL technology and an advanced new light-engine design. The 3M AOC provides exceptional cost/performance value.

Features

- Low power 240mW typical
- 1 channel operating up to 10.5 Gbps
- Fiber link up to 100 meters
- Reliable 850 nm VCSEL technology
- 0 to +70 degree Celsius operating temperature range
- Hot pluggable
- Bend insensitive fiber
- Full set of diagnostic features
- 3.3 V power supply only
- Supports SFF-8431 Specifications for Enhanced Small Form Factor Pluggable Module SFP+
- Supports Fiber Channel Physical Interface – 5 (FC-PI-5) Specification

This document summarizes the product performance specifications for the 3M AOC for SFP+. In the event of performance data conflicts between this specification and any document listed below, this specification supersedes those documents.

2.0 Overview of Product

Parameters	Value	Comments
Number of data lanes	1 VCSEL Transmitter and 1 Receiver per module	
Data rate per channel	Up to 10.5 Gbps	
Electrical interface and pin-out	20-pin edge connector	
Pin description	Per SFF-8431 rev4.1	
Management interface	I2C, serial, timing per SFF-8472	
Length of AOC	1 to 100	Meters, using Advance OM2+ MM fiber
BER	$<10^{-12}$	Tested with PRB 2 ³¹ -1 test pattern
Power supply	3.3 VDC	

3.0 Absolute Maximum Rating

Parameters	Min	Typ	Max	Units
Storage temperature	-20		+85	Deg. Celsius
Relative humidity (non-condensing)	5		85	%
Supply voltage	-0.3		+3.6	V
Transmitter single-ended input voltage			1400	mVpp
Operating case temperature	0		+70	Deg. Celsius

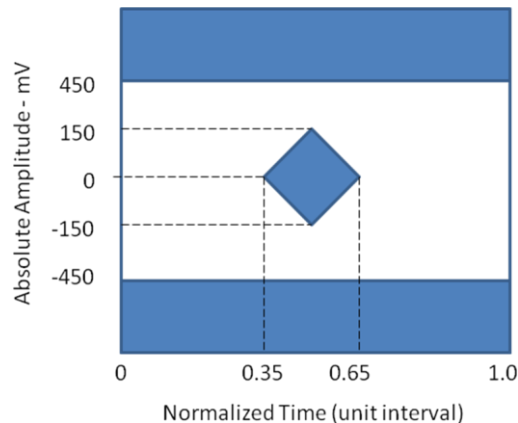
Note: if product is exposed to conditions beyond the levels indicated, the performance and reliability of the product is likely to be negatively affected.

4.0 Electrical Characteristics

Parameter	Min	Typ	Max	Units
Supply voltage, VccTx, VccRx	3.13	3.3	3.47	VDC
Supply Current, Icc		60		mA
Module power consumption, P		198		mW
Power Supply Noise Tolerance			200	mVpp
Operating case temperature	0		+70	Degree Celsius
Active cable input electrical characteristics per lane				
Single-ended input voltage	-0.3		4.0	V
Signaling rate/channel, NRZ	2.5		10.5	Gb/s
DDJ –data dependent jitter	0.10			UI(p-p)
JT1- total jitter			0.28	UI(p-p)
DDPWS –pulse width shrinkage jitter	0.055			UI
SCD ₁₁ - reflected differential to common mode conversion			-10	dB (0.01 to 1.1Ghz)
SDD ₁₁ – differential input return loss	See note 1			
Eye mask coordinates {X1, X2, Y1, Y2}	0.12, 0.33, 95, 350			UI mV (note 2)
Active cable output electrical characteristics per lane				
Single-ended output voltage tolerance	-0.3		4	V
AC common mode output voltage			7.5	mVrms
JD1- deterministic Jitter			0.42	UI
JT1- total Jitter			0.70	UI
Output rise and fall times	28			ps (20 to 80%)
SDD ₂₂ – differential output return loss	See note 1			
Eye mask coordinates {X1, Y1, Y2}	0.35, 150, 425			UI mV (note 2)
Link bit error rate (BER)		<10E-12		bit

Notes: 1. SDD_{11/22} differential input and output return loss is defined as:
 { $-12+2 \text{ SQRT}(f)$, $1 \leq f < 4.1$, $-6.3+13\log(f/5.5)$, $4.1 \leq f \leq 11.1\text{Ghz}$ }
 f is frequency in Ghz

2. Receiver output Eye mask is measured with a hit ratio of 5E-5 with a 100 Ohm load.



Receiver Electrical output Eye Mask definition

5.0 Low-Speed Electrical Control Line Description

5.1 Transmitter Fault (Tx Fault)

This is an output line (open collector or open drain and connected to 4.7K to 10K Ohm resistor in the host) and is taken high when there is a fault detected by the Vcsel driver IC (i.e. short-cct or open in the Vcsel). If no fault is detected this line is held low. Tx_Fault is latched high when there is a fault detected, and is cleared by toggling the Tx-Disable input or power cycling the AOC module.

5.2 Transmitter Disable (Tx_Disable)

This is an input line to the module allowing the host to disable the Vcsel driver, switching off the transmitter.

The line is pulled high with a pull-up resistor inside the module. When this pin is asserted low or grounded the Vcsel driver operates normally

5.3 RS0/RS1 (not supported)

These are optional input lines to the module to allow the host to select the rate of the module.

5.4 MOD_ABS (MOD_DEFO)

This line is used to detect the absence or presence of the module by the host. This line is connected to a ground inside the module. The host may pull this line up to Vcc with a resistor and asserted high to detect the absence of the module.

5.5 SCL/SDA

A complete memory map is support via the I2C interface.

5.6 Receiver Loss of Signal (Rx_LOS)

This line represents the receiver signal strength detection signal and is an output line. When the optical signal strength falls below a certain threshold, the module asserts this line high.

6.0 Mechanical Characteristics

Parameters	Min	Typ	Max	Units
Cable Installation Tension			98	N
Cable Operating Tension			31	N
Operating Cable Bend Radius	3			cm

6.1 Link Performance

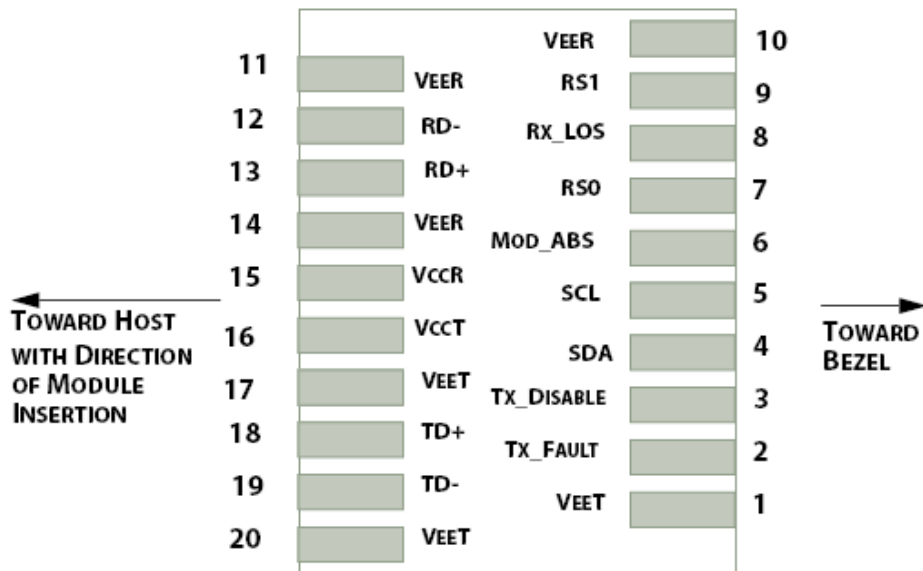
3M AOC for SFP+ uses advance OM2+ multimode fiber with overfilled modal bandwidth of >700 Mhz.Km and effective modal bandwidth of >950 MHz.km at wavelength of 850 nm. This allows link performance up to 100 meter 10 Gbps Ethernet operation.

6.2 Standard and regulatory documents

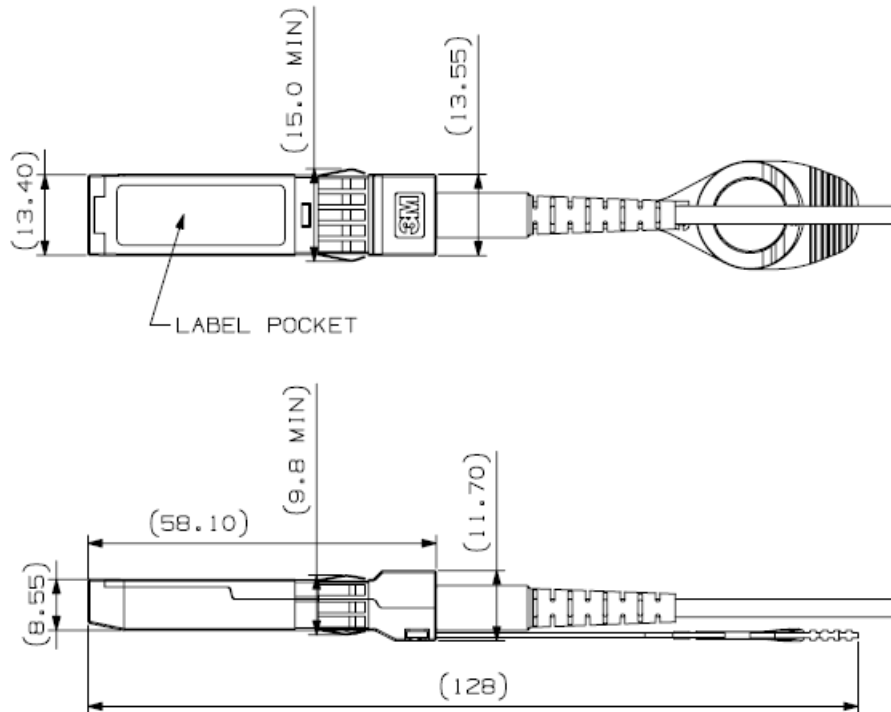
The 3M AOC for SFP+ has been designed and tested to support the following physical interface reliability and regulatory specifications SFF-8431 Enhanced Small Form Factor Pluggable Module SFP+

- Fiber Channel Physical Interface – 5 (FC-P1-5)
- Telcordia GR-468-CORE Generic Reliability Assurance Requirements for Optoelectronics Devices
- Restriction on Hazardous Substances (RoHS) per EU requirements (ROHS directive 2011/65/EU)
- Class 1 Eye safe per IEC 60825-1 (this means that if the cable is cut accidentally, the viewing of fiber ends is eye safe under normal “unaided” conditions. However, is unsafe if viewed with magnifying optics)
- 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

6.3 Pin description of module edge connector



6.4 Mechanical dimensions



Refer to 3M Drawing 78-5100-2572-5 for more information.

6.5 Laser safety warning

**INVISIBLE LASER RADIATION
CLASS 1M LASER PRODUCT
DO NOT VIEW THE END OF OPTICAL FIBER WITH OPTICAL INSTRUMENTS AS THIS MAY
RESULT IN HAZARDOUS RADIATION EXPOSURE (i.e. FIBER OPTIC VIEWERS, HAND-HELD
MAGNIFIERS OR BINOCULARS OR OTHER DIRECT IMAGING DEVICES)**

6.6 SFP+ Memory Map

Data Address	Byte Size	Name of field	Description
0	1	Identifier	hex 03, the specifies the SFP+ module
1	1	Ext identifier	hex 04, SFP function is defined by 2-wire interface ID only
2	1	Connector type	hex 00, unknown or unspecified
3	1	10G Ethernet compliance code	hex 10, 10Gbase-SR
4	1	SONET Compliance code	hex 00, OC-48, short reach
5	1	SONET Compliance code	hex 00, OC-3, short reach
6	1	Ethernet Compliance code	hex 00, 1000Base-SX
7	1	FC link length & FC technology	bit 7 and bit 2 are 1, hex 44, short distance(S), shortwave laser
8	1	SFP+ cable technology	hex 00, unallocated
9	1	FC transmission media	hex 04, multimode, 50um (M5, M5E)
10	1	FC channel speed	
11	1	Encoding	hex 06, 64B/66B
12	1	BR, nominal	hex 67, 10.3Gbit/s
13	1	Rate identifier	hex 00, unspecified
14	1	length (SMF, km)	hex 00, no single-mode fiber
15	1	length (SMF, km)	hex 00, no single-mode fiber
16	1	length (50um)	hex 64, 100m supported
17	1	length (62.5um)	hex 00, 0m supported
18	1	length (cable)	hex 00, copper cable not supported
19	1	length (OM3)	hex 00, OM3 not supported
20-35	16	Vendor name (ASCII)	"3M Company Inc'
36	1	Transceiver	hex 00, unallocated
37-39	3	Vendor OUI	hex 08, hex 00, hex 21 ("08-00-21" -3M OUI)
40-55	16	Vendor PN (ASCII)	"6A-11-A121-XXX.X")
56-59	4	Vendor rev (ASCII)	Revision level
60-61	2	Wavelength	hex 03, hex 52 ('850' nm)
62	1	unallocated	
63	1	CC-Base	Checksum for bytes 0 to 62
64	1	Options	hex 00, power class 1
65	1	Options	Not specified
66	1	BR, max	hex 00, unspecified
67	1	BR, min	hex 00, unspecified
68-83	16	Vendor SN (ASCII)	Serial number of module
84-85	2	Date code (ASCII)	Lower order digit for year (2012="12")
86-87	2	Date code (ASCII)	Digits of month ("04"-April)
88-89	2	Date code (ASCII)	Day of month (01-31)
90-91	2	Vendor specific (ASCII)	Vendor specific lot code

92	1	Diagnostic Monitoring Type	Digital diagnostics
93	1	Enhanced Options	
94	1	SFF-8472 Compliance	hex 05, Complies with revision 11.0 of SFF-8472
95	1	CC_EXT	Checksum for bytes 64-94
96-127	32	Vendor specific	hex 00 all fields, unless there is Vendor specific EEPROM information
128-255	128	Reserved	hex 00 all fields, reserved for SFF-8079

"RoHS 2011/65/EU" means that the product or part does not contain any of the substances in excess of the maximum concentration values ("MCVs") in EU RoHS Directive 2011/65/EU. The MCVs are by weight in homogeneous materials. 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.

In the event any product is proven not to conform with 3M's Regulatory Information Appendix, then 3M's entire liability and Buyer's exclusive remedy will be in accordance with the Warranty stated below.

Unless otherwise noted, reference to industry specifications are intended to indicate substantial compliance to the material elements of the specification. Such references should not be construed as a guarantee of compliance to all requirements in a given specification.

3M is a trademark of 3M Company.

Important Notice

All statements, technical information, and recommendations related to 3M's products are based on information believed to be reliable, but the accuracy or completeness is not guaranteed. Before using this product, you must evaluate it and determine if it is suitable for your intended application. You assume all risks and liability associated with such use. Any statements related to the product which are not contained in 3M's current publications, or any contrary statements contained on your purchase order shall have no force or effect unless expressly agreed upon, in writing, by an authorized officer of 3M.

Warranty; Limited Remedy; Limited Liability.

This product will be free from defects in material and manufacture for a period of 2 years from the time of purchase. 3M MAKES NO OTHER WARRANTIES INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. If this product is defective within the warranty period stated above, your exclusive remedy shall be, at 3M's option, to replace or repair the 3M product or refund the purchase price of the 3M product. Except where prohibited by law, 3M will not be liable for any indirect, special, incidental or consequential loss or damage arising from this 3M product, regardless of the legal theory asserted.