

DATA SHEET

MODULETEK: AOC-SFP28-SFP28-aaa.aaM-D0D0C

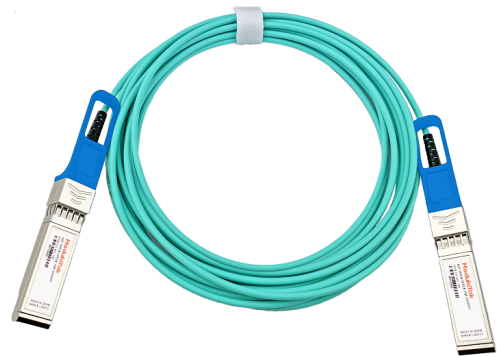
25.78Gb/s SFP28 Active Optical Cable

AOC-SFP28-SFP28-aaa.aaM-D0D0C Overview

ModuleTek's AOC-SFP28-SFP28-aaa.aaM-D0D0C SFP28 active optical cables are based on 25G Ethernet IEEE 802.3 standard. They are compliant with FC-PI-6, SFF-8402, SFF-8419, SFF-8432 and SFF-8472, providing a fast and reliable interface for 25G Ethernet applications. The product implements the digital diagnostics required by the SFF-8472 via a 2-wire serial bus.

Product Features

- Operating data rate support 25.2Gbps to 28.1Gbps
- Compliant with IEEE 802.3
- Compliant with FC-PI-6
- Compliant with SFF-8402
- Compliant with SFF-8419
- Compliant with SFF-8432
- Compliant with SFF-8472
- Hot-pluggable SFP+ footprint
- 850nm VCSEL laser transmitter and PIN receiver
- Built-in digital diagnostic functions
- Up to 100m in length
- RoHS6 Compliant
- Single power supply 3.3V
- Low power consumption (module working power <0.5W@Single-end)
- Operating temperature range: 0°C to70°C(case temperature)



Applications

- 25G Ethernet Data Center Intra-Rack and Inter-Rack links

Ordering Information

Part Number	Product ID	Description	Color on Clasp
AOC-SFP28-SFP28-aaa.aaM-D0D0C	M496801	25G SFP28 Active Optical Cable, Length 0.5~100 meters	Blue
Notes: 1.Product ID is the abbreviated order number of our company's product standard model 2.Model AOC-SFP28-SFP28-aaa.aaM-D0D0C, where aaa.aaM refers to the length of the AOC cable			
For More Information: ModuleTek Limited Web: www.moduletek.com Email: sales@moduletek.com			

General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR		25.78		Gb/s	1
Bit Error Rate	BER			5×10^{-5}		2
Operating Temperature	T _C	0		70	°C	3
Storage Temperature	T _{STO}	-40		85	°C	4
Supply Current	I _{CC}		145	290	mA	5
Input Voltage	V _{CC}	3.15	3.3	3.46	V	
Maximum Voltage	V _{MAX}	-0.5		4	V	5
Product Weight	G		54.0		g/PCS	6
Fiber Optical Cable Weight	G		7.5		g/M	7

Notes:

- IEEE 802.3
- Measured with data rate at 25.78Gbps, PRBS 2³¹-1
- Case temperature
- Ambient temperature
- For electrical power interface
- The weight of AOC-SFP28-SFP28-1M-D0D0C
- The weight of fiber optical cable per unit length

Electrical – Characteristics – Transmitter

$V_{CC}=3.15V$ to $3.46V$, $T_C=0^{\circ}C$ to $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	R_{IN}		100		Ω	
Differential data input swing	V_{IN_PP}	180		1600	mV	
Transmit Disable Voltage	V_D	2		V_{CC}	V	
Transmit Enable Voltage	V_{EN}	V_{EE}		$V_{EE}+0.8$	V	

Electrical – Characteristics – Receiver

$V_{CC}=3.15V$ to $3.46V$, $T_C=0^{\circ}C$ to $70^{\circ}C$

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential data output swing	V_{OUT_PP}	370	600	850	mV	
LOS Fault	V_{LOS_A}	2		V_{CC_HOST}	V	
LOS Normal	V_{LOS_D}	V_{EE}		$V_{EE}+0.8$	V	

Digital Diagnostic Functions

AOC-SFP28-SFP28-aaa.aaM-D0D0C supports the 2-wire serial communication protocol as defined in SFF-8472. Digital diagnostic information is accessible over the 2-wire interface at the address 0xA2. Digital diagnostics for AOC-SFP28-SFP28-aaa.aaM-D0D0C are internally calibrated by default. The internal micro control unit accesses the device operating parameters in real time, Such as transceiver temperature, laser bias current, transmitted optical power, received optical power and transceiver supply voltage. The module implements the alarm function of the SFF-8472, alerts the user when a particular operating parameter exceeds the factory-set normal range.

Digital Diagnostic Threshold Range				
Parameter	High Alarm(HEX)	High Warning(HEX)	Low Warning(HEX)	Low Alarm(HEX)
Temperature($^{\circ}C$)	80(0x5500)	70(0x4600)	0(0x0000)	-10(0xF600)
Voltage(V)	3.63(0x8DCC)	3.46(0x8728)	3.13(0x7A44)	2.97(0x7404)
Bias Current(mA)	9(0x1194)	8(0x0FA0)	4(0x07D0)	2(0x03E8)
Tx Power(dBm)	5(0x7B86)	3(0x4DF0)	-9(0x04EB)	-11(0x031B)
Rx Power(dBm)	5(0x7B86)	3(0x4DF0)	-15(0x013D)	-17(0x00C8)

A0、A2 Write Protection

Security Level 1 Password		
Password Entry ADDR	Size	Vaules(HEX)
Page A2, 7BH-7EH	4	00 00 00 00

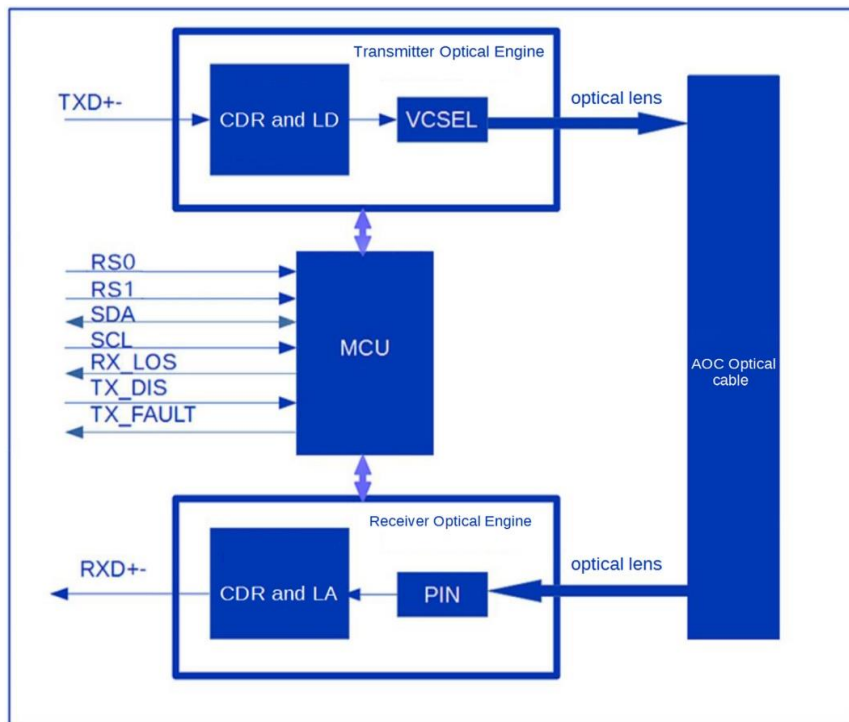
MODULETEK's AOC-SFP28-SFP28-aaa.aaM-D0D0C has the A0/A2 write protection function. The user can enter the security level 1 working state and write the contents of Table 00 and Table 01 of the device address A0H and A2H of the module. The method to enter the working state of security level 1 is to write the security level 1 password in order in the 7BH-7EH registers of A2h of the module. After entering security level 1, the user can directly write to the contents of the A0H device address, or modify the contents of the A2H 7F table selection register to write to the contents of Table 00 or Table 01. This version of the module does not support users to modify the password of security level 1. If you need to modify the security level 1 password, you must notify our company to modify it before shipping.

IIC Memory Map(Page A0 HEX, Unlisted Fields are Blank/Empty)

IIC ADDR	Size	Name	Description	Vaules(HEX)
0	1	Identifier	SFP	03
1	1	Ext. Identifier	Ext. Identifier	04
2	1	Connector	Optical Pigtail	0B
3-10	8	Transceiver	25G Base SR	00 00 00 00 00 00 00 00
11	1	Encoding	Code for high speed serial encoding 64B/66B	06
12	1	BR,Nominal	Nominal Bit Rate 25.78Gbps	FF
13	1	Rate Identifier	Type of rate select functionality	00
14	1	Length(9um)-km	Link Length in Thousands of Meters/SMF=NA	00
15	1	Length(9um)- 100m	Link Length in Hundreds of Meters/SMF=NA	00
16	1	Length(50um)- 10m	50-micron MMF Link Length=NA	00
17	1	Length(62.5um)- 10m	62.5-micron MMF Link Length=NA	00
18	1	Length(OM4)- 10m	150m Link Length in OM4 MMF	According to the needs of customers

19	1	Length(OM3)-10m	70m Link Length in OM3 MMF	According to the needs of customers
20-35	16	Vendor name	MODULETEK	ASCII Format
36	1	Transceiver	Code for electronic or optical compatibility	00
37-39	3	Vendor OUI	SFP Vendor IEEE Company ID	00 00 00
40-55	16	Vendor PN	The Part number in the Ordering Information	ASCII Format
56-59	4	Vendor rev	Programmed by Factory	Programmed by Factory
60-61	2	Wavelength	Laser Wavelength=850nm	03 52
62	1	Reserved	Reserved	00
63	1	CC_BASE	Check sum of bytes 0-62	Programmed by Factory
64-65	2	Transceiver Options	1.Internal CDR 2.RX_LOS 3.TX_Fault 4.TX_DIS	08 1A
66	1	BR,max	Upper bit rate margin	00
67	1	BR,min	Lower bit rate margin	00
68-83	16	Vendor SN	Vendor SN	Programmed by Factory
84-91	8	Date code	Year,Month,Day	Programmed by Factory
92	1	Diagnostic Monitoring Type	Internally Calibrated Received power measurement type-Average Power	68
93	1	Enhanced Options	1.Optional Alarm/Warning Flags Implemented 2.Soft TX_DIS Monitor and Control 3.Soft RX_LOS Monitor 4.Soft TX_Fault Monitor	FA
94	1	SFF-8472 Compliance	Indicates which revision of SFF8472 the transceiver complies with	08
95	1	CC_BASE	Check sum of bytes 64-94	Programmed by Factory
96-127	32	Vendor Specific	Vendor Specific EEPROM	Programmed by Factory
128-255	128	Reserved	Vendor Specific	Programmed by Factory

Block-Diagram-of-Transceiver



Functions Description

MODULETEK’s AOC-SFP28-SFP28-aaa.aaM-D0D0C module is manufactured using the advanced COB (Chip on Board) process, which consists of a microcontroller, a transmitter optical engine and a receiver optical engine. The module has built-in clock and data recovery functions. The default fixed operation is in the 25.2Gbps-28.1Gbps rate range. If you need other speed range versions or dual rate range versions, you can contact us for special customization.

The transmitter optical engine includes a transmitter clock data recovery circuit (CDR) and a laser driver circuit (LD), a VCSEL laser, and a detection photodiode (MPD). The high-speed differential electrical signal output by the host is sent to the laser driver for amplification by CDR recovery shaping, driving the VCSEL laser to generate an optical signal, and the optical signal is coupled to the optical fiber through the optical lens. The light engine integrates a photodiode for detection for output optical power detection, and the laser driver uses an automatic optical power control loop to ensure the stability of the transmitted optical power.

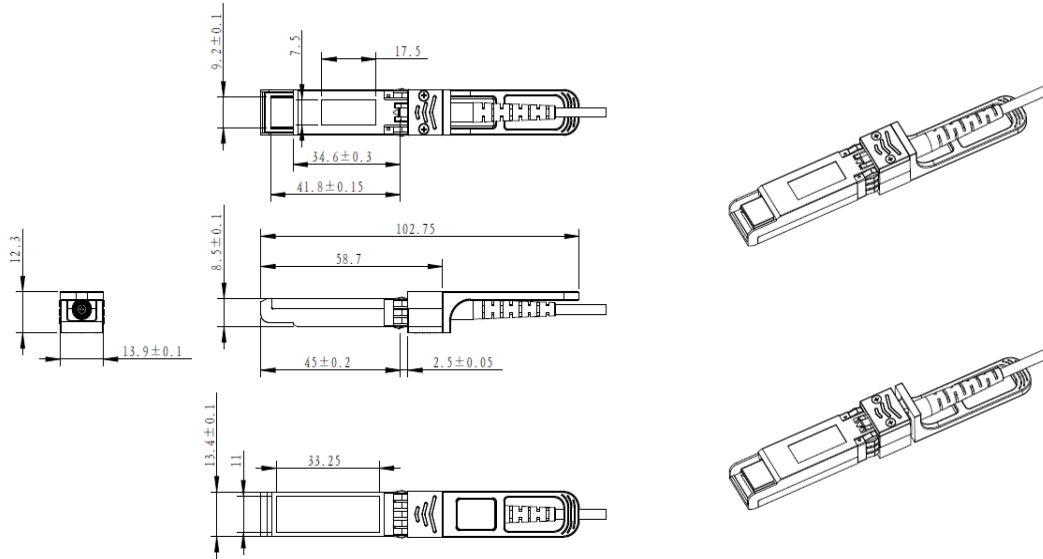
The receiving end light engine includes a photodiode (PIN), a signal amplifier (TIA/LA) and a receiving end clock data recovery circuit (CDR). The optical signal in the optical fiber is coupled to the receiving photodiode (PIN) through the optical lens to be converted into The photo-generated current, the photo-generated current signal is amplified by the amplifier, sent to the CDR circuit and recovered from the clock and data signals, and finally output to the host as a high-speed differential signal.

The microcontroller communicates with the host via a 2-wire serial communication interface, providing module control, status reporting and monitoring functions (DOM). This product complies with the SFF-8472 standard.

Optical Cable Details

Parameter	Min	Typ	Max	Unit	Remarks
Jacket Material		LSZH			
Jacket Color		Aqua Green			We can provide according to the needs of customers
Flammability Rating		OFN			We can provide according to the needs of customers
Outer Diameter	2.8	3.0	3.2	mm	
Tensile Load(Short Term)			200	N	
Tensile Load(Long Term)			100	N	
Crush Resistance	10			N/mm	IEC 60794-1-21
Impact Resistance	0.5			N.m	IEC 60794-1-21
Flexing	300			Cycles	IEC 60794-1-21
Twist Bend					IEC 60794-1-21
Cable to SFP+ Plug Connection			90	N	
Bend Radius(Short Term)	25			mm	
Bend Radius(Long Term)	30			mm	

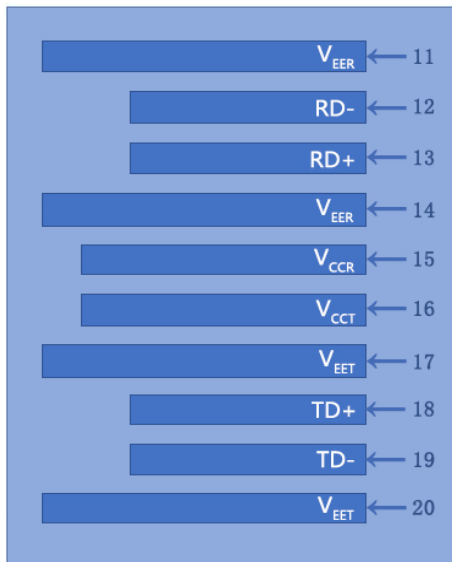
Dimensions



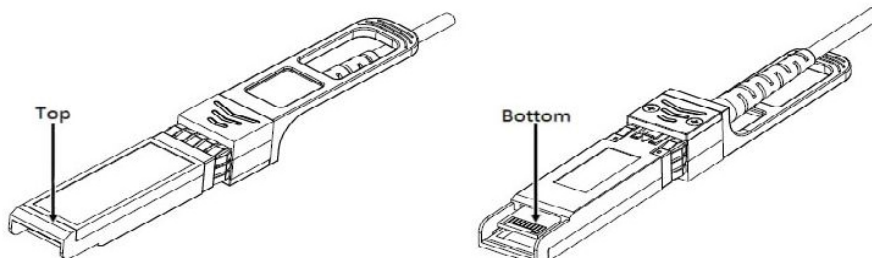
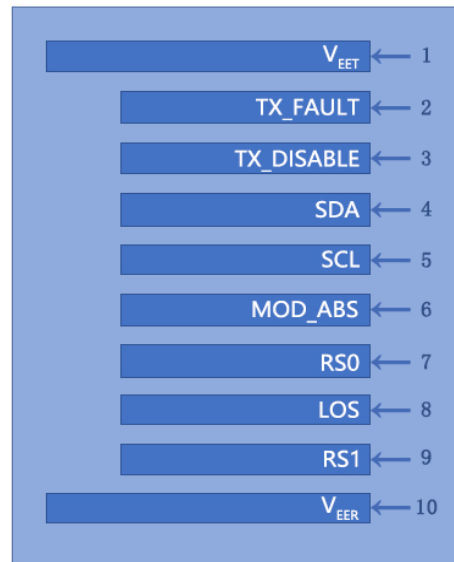
ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

Electrical Pad Layout

Top View Of Board



Bottom View Of Board



Pin Assignment

PIN #	Symbol	Description	Remarks
1	V _{EET}	Transmitter ground (common with receiver ground)	1
2	TX_FAULT	Transmitter Fault	
3	TX_DISABLE	Transmitter Disable. Laser output disabled on high or open	2
4	SDA	2-wire Serial Interface Data Line	3
5	SCL	2-wire Serial Interface Clock Line	3
6	MOD_ABS	Module Absent. Grounded within the module	3
7	RS0	No connection required	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	4
9	RS1	No connection required	1
10	V _{EER}	Receiver ground (common with transmitter ground)	1
11	V _{EER}	Receiver ground (common with transmitter ground)	1
12	RD-	Receiver Inverted DATA out. AC coupled	
13	RD+	Receiver Non-inverted DATA out. AC coupled	
14	V _{EER}	Receiver ground (common with transmitter ground)	1
15	V _{CCR}	Receiver power supply	
16	V _{CCT}	Transmitter power supply	
17	V _{EET}	Transmitter ground (common with receiver ground)	1
18	TD+	Transmitter Non-Inverted DATA in. AC coupled	
19	TD-	Transmitter Inverted DATA in. AC coupled	
20	V _{EET}	Transmitter ground (common with receiver ground)	1

Notes:

1. Circuit ground is isolated from chassis ground
2. Disabled: T_{DIS}>2V or open, Enabled: T_{DIS}<0.8V
3. Should Be pulled up with 4.7k –10k ohm on host board to a voltage between 2V and 3.6V
4. LOS is open collector output

References

1. IEEE standard 802.3. IEEE Standard Department, 2018
2. FIBRE CHANNEL Physical Interface-6(FC-PI-6).Rev3.10 October 25, 2013
3. SFF-8402 SFP+ 1X28 Gb/s Pluggable Transceiver Solution(SFP28).Rev1.1 September 13, 2014
4. SFF-8419 SFP+ Power and Low Speed Interface.Rev1.3 June 11, 2015
5. SFF-8432 SFP+ Module and Cage.Rev5.2a November 30, 2018
6. SFF-8472 Management Interface for SFP+.Rev12.3. July 29, 2018