10G SFP+ Active Optical Cable (AOC)

Application

- 10 Gigabit Ethernet (10GbE)
- 1x InfiniBand QDR, DDR, SDR
- 1/2/4/8G Fibre Channel (1/2/4/8G FC)
- Cost effective 10G SFP+ link solution
- System cascade applications
- System Internal data link solution
- Proprietary high speed, high density data transmission
- Switch and router high speed backplane interconnect
- High performance computing, server and data storage

Features

- Support up to 10 Gb/s bi-directional operation
- 850nm VCSEL transmitter, PIN photo-detector receiver, up to 300m on OM3 MMF
- Cable type: Active Optical Cable
- Available lengths (in meters): 1, 2, 3, 4, 5....
- Hot-pluggable SFP+ cable ends
- Commercial temperature range(COM): 0 to 70° C
- Low power consumption: less than 1.0 W per end
- Bend insensitive fiber
- Single 3.3V power supply
- All-metal housing for superior EMI performance
- I2C standard management interface
- Electrical interface compliant to SFF-8431
- Compliant to industrial standard SFP MSA

Description

FS.COM SFP+ Active Optical Cable (AOC) assemblies use active circuits to support longer distances than standard Passive or Active SFP+ Copper Cables. They are designed for high speed, short range data link via optical fiber wire. SFP+ AOC cables provide high performance Enhanced Small Form Factor Pluggable (SFP+) interface and it is a cost effective solution for Data Center/ storage and all short range data application.

These Active Optical Cable (AOC) can be used as an alternative solution to SFP+ passive and active copper cables, while providing improved signal integrity, longer distances, superior electromagnetic immunity and better bit error rate performance.

Products Specifications

I. Absolute Maximum Ratings

*Exceeding the limits below may damage the active optical cable permanently.

Parameter	Symbol	Min	Typical	Max	Unit	Notes
Operating Case Temperature	Tc	0	25	70	° C	
Ambient Humidity	H_A	5		85	%	1
+3.3V Supply Voltage	V_{CC3}	3.135	3.3	3.465	V	
+3.3V Supply Current	I_{VCC3}			300	mA	
Total Power Dissipation	P_D			1	W	

Input Control Voltage- High	ViH	2		Vcc+0.3	V	2
Input Control Voltage - Low	ViL	-0.3		0.8	V	2
Digital Output Voltage- High	VoH	2		Vcc+0.3		3
Digital Output Voltage- Low	VoL	0		0.8		3
Clock Rate-I2C				400	kHz	4

Notes:

1. Non-condensing.
2. For all control input pins: TX_DISABLE.
3. For all status output pins: RX_LOS, TX_FAULT.
4. For management interface.

II. SFP+ AOC Specifications

Parameter	Value	Units	Notes
Module Form Factor	SFP+		Supports SFF8431/SFF8432/SFF8472
Data rate per lane	From 1 to 10.3125	Gbps	No retimer or CDR devices embedded in the module. Allows operation at data-rates below 10.3125 Gbps
Protocols	1x InfiniBand QDR, DDR, SDR, 10G Gigabit Ethernet, Fibre Channel		Ethernet, Fibre Channel, InfiniBand, Other Protocols, and Proprietary Data-rates as well
Bit Error Rate Performance	1.00E-15		
Management Interface	Two-Wire Serial		Memory Map access Page A0h only per SFF-8472 Revision 11.0
Laser Output Power	Class 1		EN 60825-1 2007, EN 60825-2 A2 2010
Power consumption per end	275	mW	Nominal Power
Mechanical Specification			Mechanical specifications per SFF Committee SFF-8432 Improved Pluggable Formfactor “IPF” Can be installed in any INF-8074 or SFF-8431/2 compliant Small Form Pluggable (SFP) port
Electrical Interface	20	pins	SFF Committee SFF 8431 Specifications for Enhanced 8.5 and 10 Gigabit Small Form Factor Pluggable Module “SFP+”

III. Optical Characteristics

The following optical characteristics are defined over the Recommended Operating Environment unless otherwise specified.

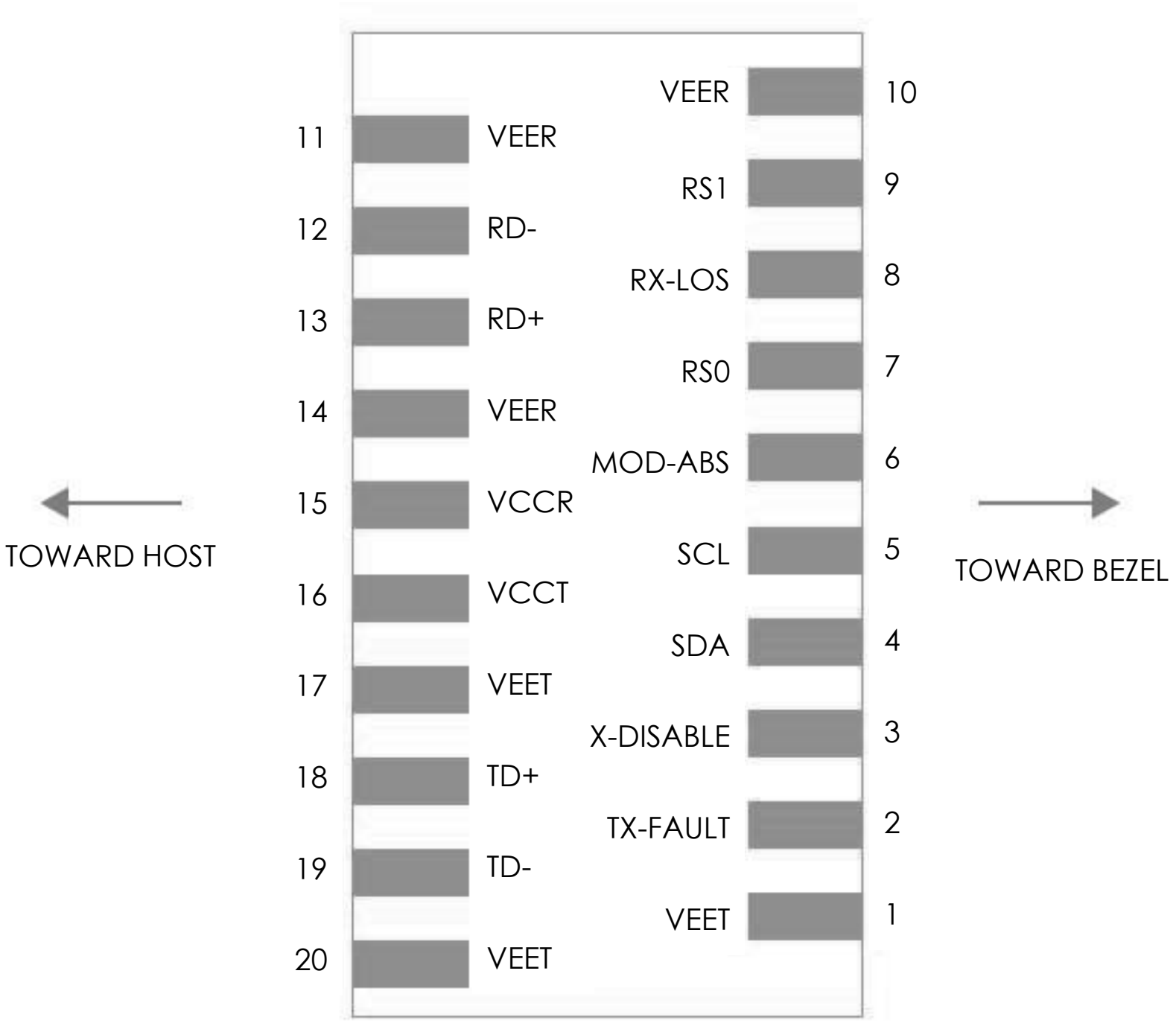
Parameter	Symbol	Min.	Typical	Max	Unit	Notes
Transmitter						
Center Wavelength	λt	840	850	860	nm	
RMS spettral width	Pm			Note 1	nm	
Average Optical Power	Pavg	-6.5		-1	dBm	Note 2
Extinction Ratio	ER	3.5			dB	Note 3
Transmitter Dispersion Penalty	TDP			3.9	dB	
Relative Intensity Noise	Rin			-128	dB/Hz	12dB reflection
Optical Return Loss Tolerance				12	dB	
Receiver						
Center Wavelength	λr	840	850	860	nm	
Receiver Sensitivity	Psens			-11.1	dBm	Note 4
Stressed Sensitivity in OMA				-7.5	dBm	Note 4
Los function	Los	-30		-12	dBm	
Overload	Pin			-1	dBm	Note 4
Receiver Reflectance				-12	dB	

Notes:

1. Trade-offs are available between spectral width, center wavelength and minimum OMA, as shown in the table.
2. The optical power is launched into MMF.
3. Measured with a PRBS 2^{31}-1 test pattern @10.3125Gbps.
4. Measured with a PRBS 2^{31}-1 test pattern @10.3125Gbps, BER$\leqslant 10^{-12}$.

IV. Pin Description

SFP+ Transceiver Electrical Pad Layout



Pin	Logic	Symbol	Name/Description	Notes
1		VeeT	Module Transmitter Ground	1
2	LVTTL-O	TX_Fault	Module Transmitter Fault	2
3	LVTTL-I	TX_Disable	Transmitter Disable; Turns off transmitter laser output	3

4	LVTTL-I/O	SDA	2- write Serial Interface Data Line	
5	LVTTL-I/O	SCL	2- write Serial Interface Clock	
6		MOD_ABS	Module Absent, connected to VeeT or VeeR in the module	4
7	LVTTL-I	RS0	Not Implement	
8	LVTTL-O	RX_LOS	Receiver Loss of Signal Indication	2
9	LVTTL-I	RS1	Not Implement	
10		VeeR	Module Receiver Ground	1
11		VeeR	Module Receiver Ground	1
12	CML-O	RD-	Receiver Inverted Data Output	
13	CML-O	RD+	Receiver Non-Inverter Data Output	
14		VeeR	Module Receiver Ground	1
15		VccR	Module Receiver 3.3V Supply	
16		VccT	Module Transmitter 3.3V Supply	
17		VeeT	Module Transmitter Ground	1
18	CML-I	TD+	Transmitter Non-Inverted Data Input	
19	CML-I	TD-	Transmitter Inverted Data Input	
20		VeeT	Module Transmitter Ground	1

Notes:

1. The module signal ground pins, VeeR and VeeT, shall be isolated from the module case.
2. This pin is an open collector/drain output pin and shall be pulled up with 4.7kΩ-10kΩ to Host_Vcc on the host board. Pull ups can be connected to multiple power supplies, however the host board design shall ensure that no module pin has voltage exceeding module VccT/R + 0.5V.
3. This pin is an open collector/drain input pin and shall be pulled up with 4.7kΩ-10kΩ to VccT in the Module.
4. This pin shall be pulled up with 4.7kΩ-10kΩ to Host_Vcc on the host board.

V. Low Speed Electrical Hardware Pins

In addition to the 2-wire serial interface, the SFP+ module has the following low speed pins for control and status:

(1) TX_Fault

TX_Fault is a module output pin that when High, indicates that the module transmitter has detected a fault condition related to laser operation or safety. The TX_Fault output pin is an open drain/collector and must be pulled up to the Host_Vcc with 4.7k-10k ohms on the host board.

(2) TX_Disable

TX_Disable is a module input pin. When TX_Disable is asserted High or Left open, the SFP+ module transmitter output must be turned off. The TX_DIS pin must be pulled up to VccT in the SFP+ module.

(3) RS0/RS1

RS0 and RS1 are module input rate select pins and are pulled low to VeeT with a > 30kΩ resistor in the module. RS0 is an input hardware pin which optionally selects the optical receive data path rate coverage for an SFP+ module. RS1 is an input hardware pin which optionally selects the optical transmit path data rate coverage for an SFP+ module.

(4) MOD_ABS

Mod_ABS is pulled up to Host_Vcc with 4.7kΩ-10kΩ on the host board and connected to VeeT or VeeR in the SFP+ module. MOD_ABS is then asserted "High" when the SFP+ module is physically absent from a host slot. In the SFP MSA (INF8074i) this pin had the same function but is called MOD_DEF0.

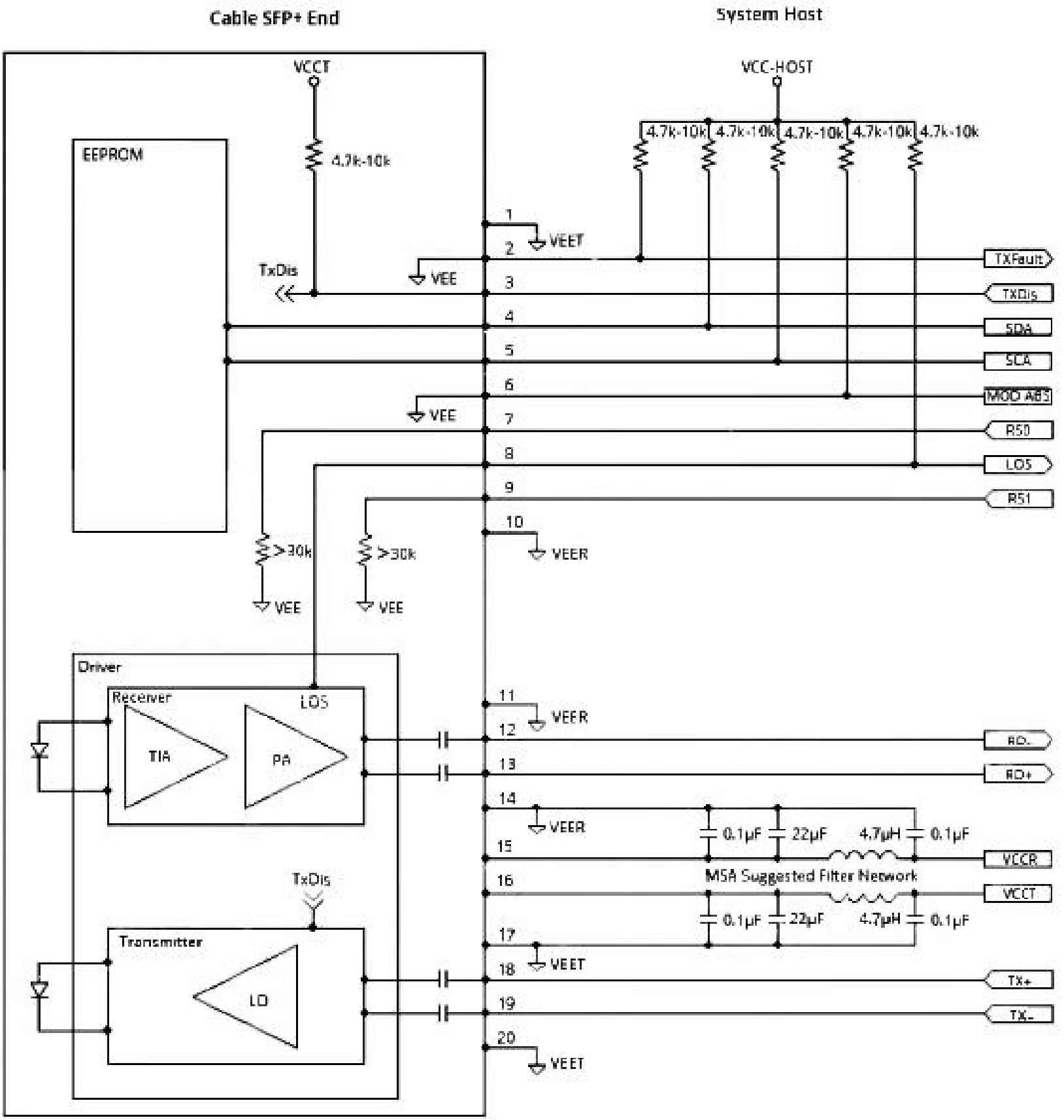
(5) SCL/SDA

SCL is the 2-wire interface clock and SDA is the 2-wire interface data line. SCL and SDA are pulled up to a voltage in the range of 3.14V to 3.46V on the host.

(6) RX_LOS

RX_LOS when High indicated an optical signal level below that specified in the relevant standard. The RX_LOS pin is an open drain/collector output and must be pulled up to host Vcc with a 4.7kΩ-10kΩ on the host board. RX_LOS assert min and de-assert max are defined in the relevant standard.

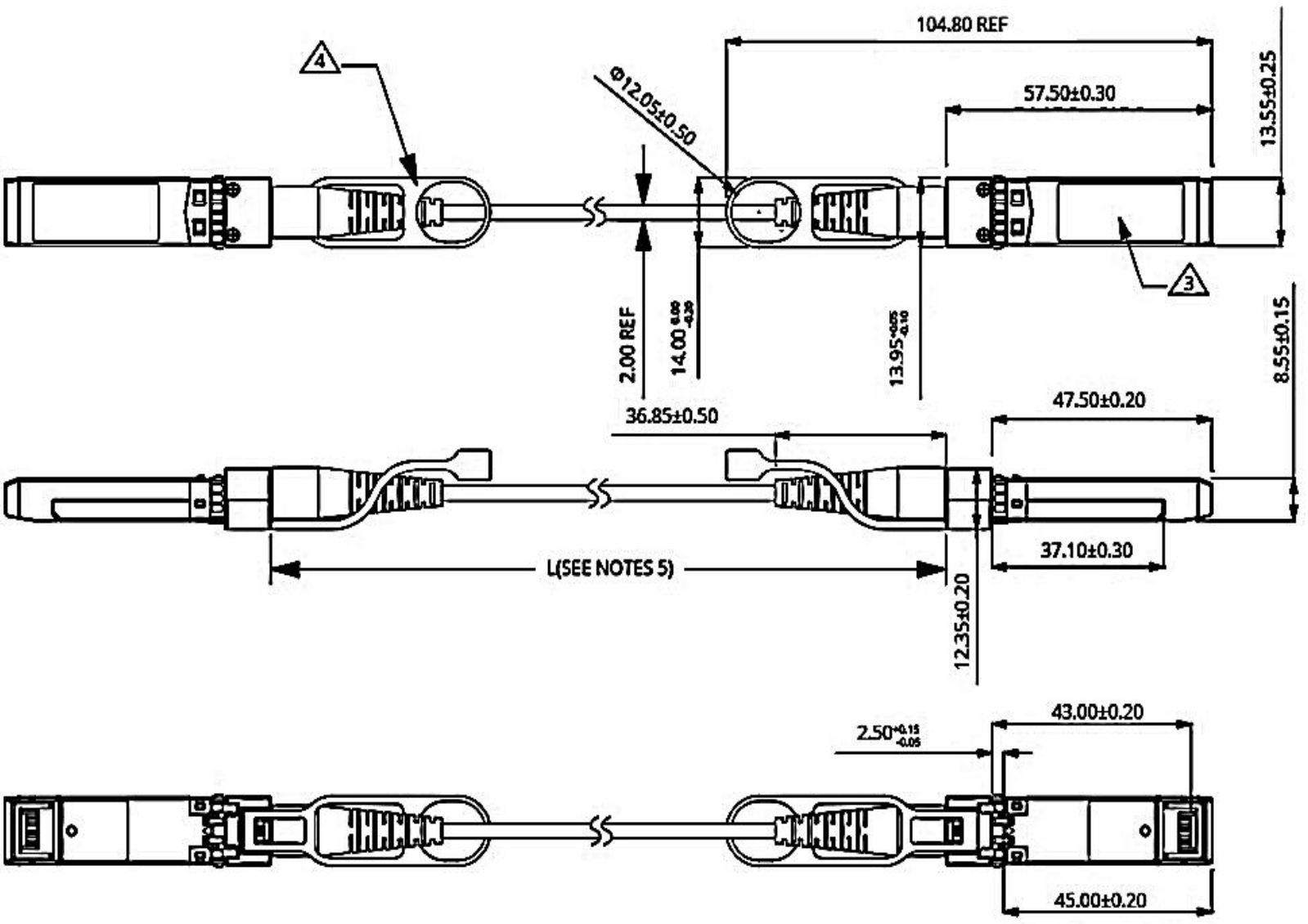
VI. Host - Active optical cable end Interface Block Diagram



VII. Mechanical Specification

Parameter	Symbol	Min.	Type	Max	Units
AOC cable length (L <=5m)	L	L-0.06	L	L+0.06	M
AOC cable length (L > 5m)	L	L-(1.1%*L)	L	L+(1.1%*L)	M
Module Retention		90		170	N
Module Insertion		0		18	N
Module Extraction		0		12.5	N
Cable Pull Strength – Apply Load at 0°		44			N
Cable Pull Strength – Apply Load at 90°		33			N
Clearance Out of IO Bezel		75			mm
Cable Bending Radius		30			mm
Insertion / Removal Cycles		50			cycles

VIII. Mechanical Outline Dimensionsimensions



L	TOLERANCE
L ≤ 5M	±5CM
L > 5M	±1%

Notes:

1. Unit: mm
2. Tolerance: φ0.1mm if not shown
3. Label specification
4. Latch color: black
5. Tolerance of cable length

IX. Installation

Caution: Follow accepted ESD practices when handling SFP+ connectors to prevent damage to the internal components within the connector. ESD (electrostatic discharge) is the sudden flow of electricity between two objects at different voltage potentials caused by contact. The basis of any ESD protection strategy is to ground or bring all elements in the ESD protected area to the same potential. An ESD wrist strap should be used for everything in the ESD protected area including personnel, tools, cabinets and components.

A. Installing SFP+ Modules

Follow these steps to install a FS.COM SFP+ cable assembly:
Step 1. Remove the protective ESD cap from the connector.
Step 2. Slide the SFP+ cable end into the slot until it locks into position (see figure 1).

There is an audible click when the connector is properly seated.

Figure 1. Installing an SFP+ Module

Figure 2. Disconnecting Latch Mechanism

Figure 3. Removing Modules

Caution : The latching mechanism locks the SFP+ connector into place when cables are connected. Do not pull on the cable in an attempt to remove the SFP+ connector.

B. Removing SFP+ Modules

Follow these steps to remove a FS.COM SFP+ cable assembly:
Step 1. Pull on the SFP+ latch pull lanyard. See figure 2.
Step 2. Grasp the SFP+ connector on both sides and remove it from the system. See figure 3.
Step 3. If possible, replace the ESD protective cap or put the SFP+ into an ESD protected bag.

Test Center

Only when quality and 100% compatibility is verified and proved do our modules enter the market. This depends on FS.COM's test center which is supported by a variety of mainstream original brand switches and professional staff. We are proud of this test center and believe all of these devices worth the investments, because it brings the best to our customers.

The original switches could be found nowhere but at FS.COM's test center, eg: Juniper MX960 & EX 4300 series, Cisco Nexus 9396PX & Cisco ASR 9000 Series, HP 5900 Series & HP 5406R ZL2 V3(J9996A), Arista 7050S-64, Brocade ICX7750-26Q & ICX6610-48, Avaya VSP 7000 MDA 2, etc.

Cisco ASR 9000 Series(A9K-MPA-1X40GE)

ARISTA 7050S-64(DCS-7050S-64)

Juniper MX960

Brocade ICX 7750-26Q

Extreme Networks X670V VIM-40G4X

Mellanox M3601Q

Dell N4032F

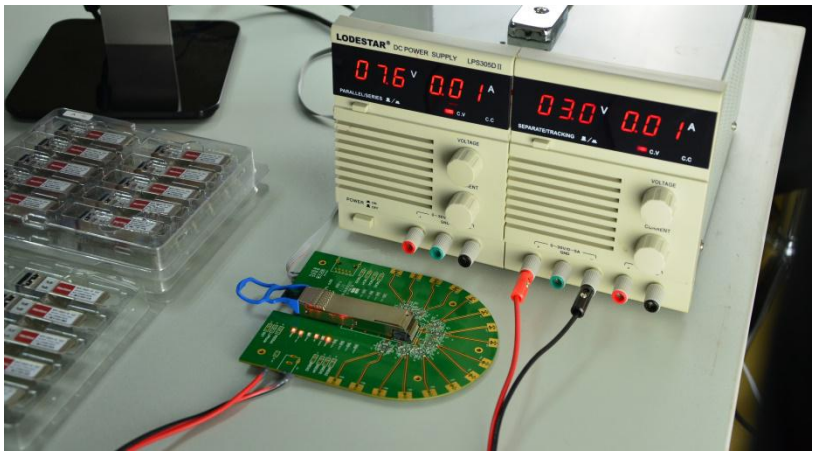
HP 5406R ZL2 V3(J9996A)

AVAYA 7024XLS(7002QQ-MDA)

Test Assured Program

FS.COM truly understands the value of compatibility and interoperability to each optics. Every module FS.COM provides must run through programming and an extensive series of platform diagnostic tests to prove its performance and compatibility. In our test center, we care of every detail from staff to facilities—professionally trained staff, advanced test facilities and comprehensive original-brand switches, to ensure our customers to receive the optics with superior quality.

Our smart data system allows effective product management and quality control according to the unique serial number, properly tracing the order, shipment and every part.



Our in-house coding facility programs all of our parts to standard OEM specs for compatibility on all major vendors and systems such as Cisco, Juniper, Brocade, HP, Dell, Arista and so on.

With a comprehensive line of original-brand switches, we can recreate an environment and test each optics in practical application to ensure quality and distance.

The last test assured step to ensure our products to be shipped with perfect package.

Order Information

Part Number	Data Rate	Length	Connector Type	Cable Type	Temp. Range	Cable Jacket
SFP-10G-AOC-1	Up to 10.5G	1m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-1.5	Up to 10.5G	1.5m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-2	Up to 10.5G	2m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-2.5	Up to 10.5G	2.5m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-3	Up to 10.5G	3m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-3.5	Up to 10.5G	3.5m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-5	Up to 10.5G	5m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-7	Up to 10.5G	7m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-10	Up to 10.5G	10m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-15	Up to 10.5G	15m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-20	Up to 10.5G	20m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-25	Up to 10.5G	25m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP
SFP-10G-AOC-30	Up to 10.5G	30m	SFP+ to SFP+	AOC Cable	0-70℃	OFNP

Notes:

1. Every cable is individually tested on corresponding equipment, walks through the testing challenges and 100% compatible with Cisco, Arista, Juniper, Dell, Brocade and other brands.
2. Customized 10GBASE SFP+ AOC are available in various lengths.

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