10G SFP+ Active Optical Cable

OTS-10G-AOC-XX

Features

- ◎ Supports 10Gb/s serial optical interface
- ◎ Maximum link length of 300m on OM3 MMF or 400m on OM4 MMF
- ◎ 850nm VCSEL laser and PIN receiver
- ◎ Hot-pluggable SFP+ footprint
- ◎ SFI high speed electrical interface
- ◎ Built-in digital diagnostic functions
- ◎ Single +3.3V power supply
- ◎ Power consumption less than 0.75 W
- ◎ Operating case temperature: -5~+70°C
- ◎ SFP+ MSA package with AOC connector

Applications

- ◎ 10GBASE-SR/SW 10G Ethernet
- ◎ 10.3125 Gb/s single lane 40GE SR4
- ◎ Other optical links

Standard

- ◎ Compliant with SFF-8472 and SFP+ MSA
- ◎ Compliant to SFF-8431 and SFF-8432
- ◎ Compliant with IEEE 802.3ae 10GBASE-SR/SW
- ◎ Compliant with FCC 47 CFR Part 15, Class B
- ◎ Compliant with Telcordia GR-468-CORE
- ◎ RoHS Compliant

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Table 1. Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge(ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class 1(>1000V for SFI pins, >2000V for other pins.)
Electrostatic Discharge (ESD) to the Duplex LC Receptacle	IEC 61000-4-2 GR-1089-CORE	Compatible with standards
Electromagnetic nterference (EMI)	FCC Part 15 Class B EN55022 Class B (CISPR 22B) VCCI Class B	Compatible with standards
Immunity	IEC 61000-4-3	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11	Compatible with Class I laser product
RoHS	2002/95/EC 4.1&4.2 2011/65/EU	Compatible with standards

Product Description

The SFP+ transceivers are high performance, cost effective modules supporting data rate of 10Gbps and Maximum link length of 300m on OM3 MMF or 400m on OM4 MMF.

The transceiver consists of three sections: a Un-cooled 850nm VCSEL laser transmitter, a PIN photodiode integrated with a trans-impedance preamplifier (TIA) and MCU control unit. All modules satisfy class I laser safety requirements.

The transceivers are compatible with SFP Multi-Source Agreement and SFF-8472 digital diagnostics functions.

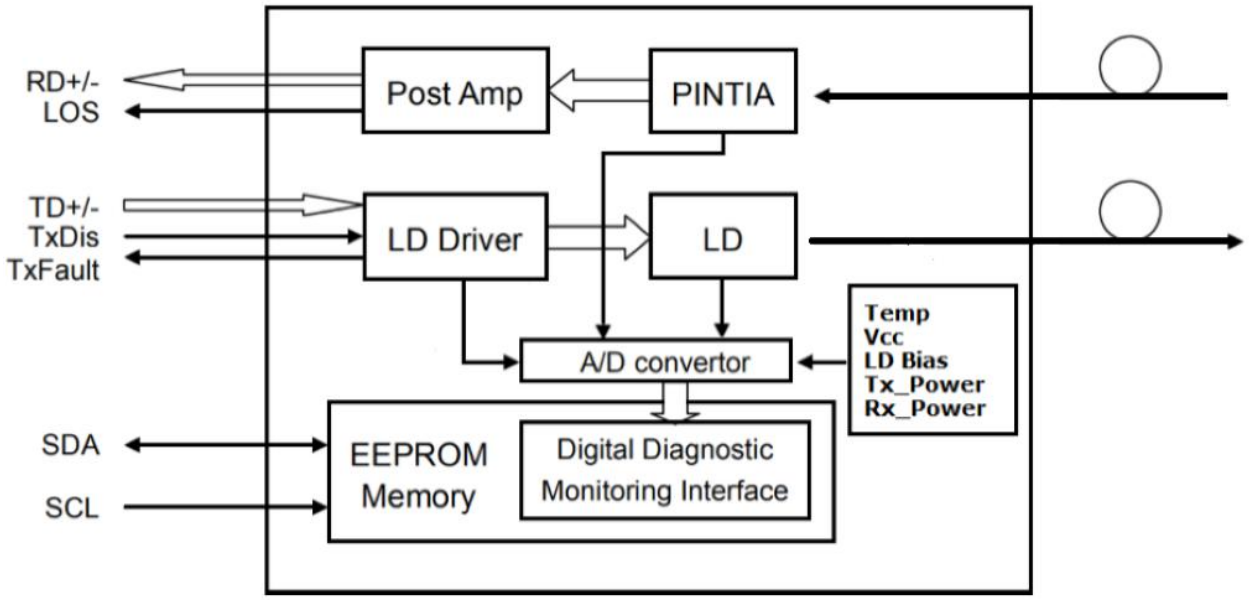

Figure 1.Transceiver functional Block Diagram

Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings

(Exceeding the limits below may damage the transceiver module permanently)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Maximum Supply Voltage	Vcc	-0.5	-	+4.0	V	
Storage Temperature	Ts	-40	-	+85	℃	
Case Operating Temperature	TA	-10	-	+75	℃	
Relative Humidity	RH	5	-	85	%	1

Notes:

1. Non-condensing.

Recommend Operation Environment

Table 3. Recommend Operation Environment

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Data Rate	BR	-	10.3125	-	Gbps	
Power Supply Voltage	Vcc	3.13	3.3	3.47	V	
Power Supply Current	Icc	-	-	220	mA	
Power Dissipation	PD	-	-	0.75	W	
Case Operating Temperature	TA	-5	-	+70	℃	

Transmission Distance	T_D	-	-	300	m	1

Notes:

1. Measured with ITU-T G.651 OM3 MMF

Electricalptical Characteristics

Table 4. Electrical Characteristics(T_{OP} = -5 to +70 °C, V_{CC} = 3.13 to 3.47 V)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Transmitter						
Differential Data Input Amplitude	$V_{IN,P-P}$	180	-	700	mVpp	1
Input Differential Impedance	Z_{IN}	90	100	110	Ω	
Transmitter Fault Output-High	V_{OH}	2.4	-	V_{CC}	V	
Transmitter Fault Output-Low	V_{OL}	-0.3	-	0.4	V	
Transmitter Disable Voltage- High	V_{IH}	2.0	-	V_{CC}	V	
Transmitter Disable Voltage- low	V_{IL}	0	-	0.8	V	
Receiver						
Differential output voltage swing	$V_{OUT,P-P}$	300	-	850	mVpp	1
Output Differential Impedance	Z_{OUT}	90	100	110	Ω	
LOS Output Voltage-High	V_{LOSH}	2.0	-	V_{CC}	V	3
LOS Output Voltage-Low	V_{LOSL}	-	-	0.8	V	3

Notes:

1. CML input/output, internally AC-coupled and terminated.

Optical Characteristics

Table 5. Optical Characteristics(T_{OP} = -5 to +70 °C, V_{CC} = 3.13 to 3.47 V)

Parameter	Symbol	Min	Typ	Max	Unit	Notes
Transmitter						
Optical Center Wavelength	λc	840	850	860	nm	
Data Rate	BR	-	10.3125	-	Gbps	
Average Output Power	P_O	-6.5	-	-1.0	dBm	
Optical Extinction Ratio	ER	3.0	-	-	dB	
RMS Spectral Width	σ	-	-	0.6	nm	
Transmitter and Dispersion Penalty	TDP	-	-	3.9	dB	
Average Launch power of Tx OFF	P_{OFF}	-	-	-30	dBm	
Optical Eye Mask	Compliant with IEEE 802.3ae-2005 and ITU-T G.691					
Receiver						
Center Wavelength Range	λc	840	850	860	nm	

Data Rate	BR	-	10.3125	-	Gbps	
Receiver Sensitivity	R_{SEN}	-	-	-11.1	dBm	1
Stressed Receiver Sensitivity (OMA)	R_{SENS}	-	-	-7.5	dBm	
Maximum Input Power	P_{MAX}	0	-	-	dB	1
LOS Assert	LOS_A	-28	-	-	dBm	
LOS De-Assert	LOS_D	-	-	-12	dBm	
LOS Hysteresis	LOS_H	0.5	-	5	dB	
Receiver Reflectance	R_R	-	-	-12	dB	

Notes:

1. Measured with worst ER=3.0dB, RPBS 2^31-1 test pattern @10.3125Gbps BER=<10^-12.

Table 6. Timing and Electrical

Parameter	Symbol	Min	Typ	Max	Unit
Tx Disable Negate Time	t_on	-	-	1	ms
Tx Disable Assert Time	t_off	-	-	10	µs
Time To Initialize, including Reset of Tx Fault	t_init	-	-	300	ms
Tx Fault Assert Time	t_fault	-	-	100	µs
Tx Fault To Reset	t_reset	10	-	-	µs
LOS Assert Time	t_loss_on	-	-	100	µs
LOS De-assert Time	t_loss_off	-	-	100	µs
Serial ID Clock Rate	f_serial_clock	-	-	400	KHz
SDA, SCL, MOD_ABS High Level	V_H	2	-	V_{CC}	V
SDA, SCL, MOD_ABS Low Level	V_L	-	-	0.8	V

Pin Assignment

Table 7. Pin Descriptions

Pin	Symbol	Name/Description	Notes
1	VEET	Module Transmitter Ground	
2	Tx_Fault	Module Transmitter Fault	1
3	Tx_Disable	Transmitter Disable, Turns off transmitter laser output	2
4	SDA	2 wire serial interface data input/output (SDA)	1
5	SCL	2 wire serial interface clock input (SCL)	1
6	MOD_ABS	Module Absent, connected to VeeT or VeeR in the module	1
7	RS0	Receiver Rate Select	
8	Rx_LOS	Loss of Signal indication, Logic 0 indicates normal operation	3
9	RS1	Transmitter Rate Select, Not Used for this product	
10	VEER	Module Receiver Ground	
11	VEER	Module Receiver Ground	
12	RD-	Receiver Inverted Data Output, AC Coupled	4
13	RD+	Receiver Non-Inverted Data Output, AC Coupled	4
14	VEER	Module Receiver Ground	
15	VCCR	Module Receiver 3.3 V Supply	
16	VCCT	Module Transmitter 3.3 V Supply	
17	VEET	Module Transmitter Ground	
18	TD+	Transmitter Non-Inverted Data Input, AC Coupled	5
19	TD-	Transmitter Inverted Data Input, AC Coupled	5
20	VEET	Module Transmitter Ground	

Notes:

1. Open collector/drain output, which should be pulled up with a 4.7kΩ to 10kΩ resistor on the host board if intended for use. Pull up voltage should be between 2.0V to 3.6V. A high output indicates
   a transmitter fault caused by either the TX bias current or the TX output power exceeding the preset alarm thresholds. A low output indicates normal operation. In the low state, the output is pulled to <0.8V.
2. Laser output disabled on Tx_Disable >2.0V or open, enabled on Tx_Disable <0.8V.
3. LOS is open collector output. Should be pulled up with 4.7kΩ to 10kΩ on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.
4. RD-/+: These are the differential receiver outputs. They are internally AC-coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES.
5. TD-/+: These are the differential transmitter inputs. They are internally AC-coupled, differential lines with 100Ω differential termination inside the module.

Pin Assignment (continued)

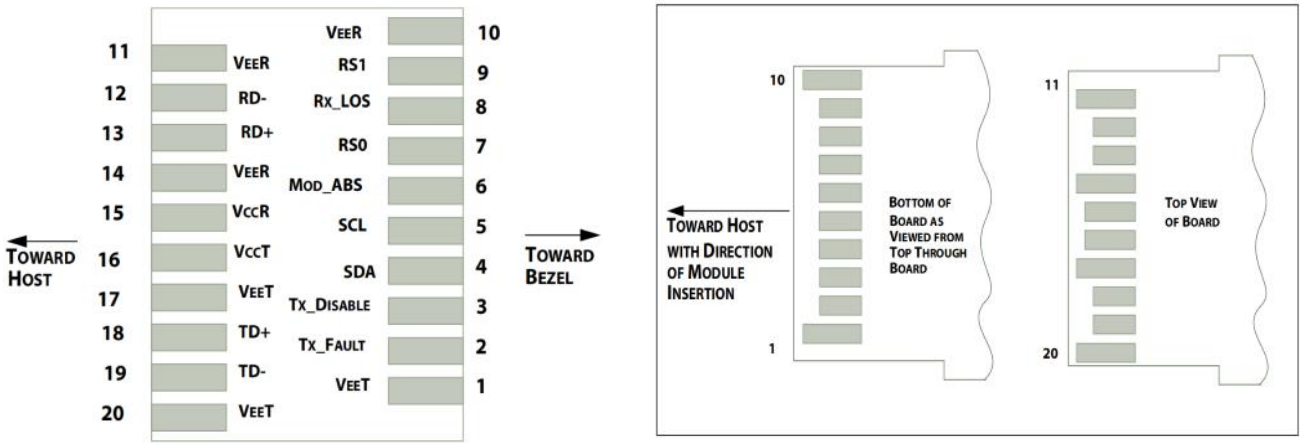

Figure 2. Host PCB SFP+ pad assignment top view and Names.

Digital Diagnostic Memory Map

The transceivers provide serial ID memory contents and diagnostic information about the present operating conditions by the 2-wire serial interface (SCL, SDA).

The diagnostic information with internal calibration or external calibration all are implemented, including received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring.

The digital diagnostic memory map specific data field defines as following.

Table 8. Digital Diagnostic Memory Map (Specific Data Field Descriptions)

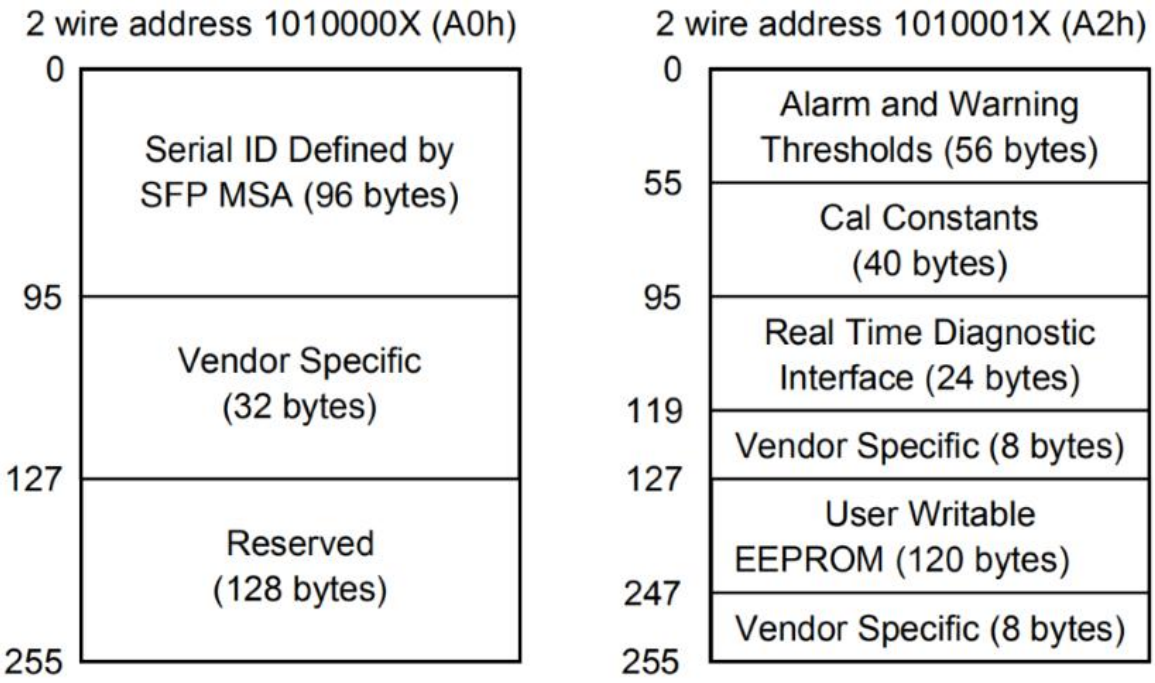

Table 9. Digital Diagnostic Monitor Characteristics

Parameter	Calibration	Range	Accuracy	Unit
Transceiver Internal Temperature	Internal	-5 to +70°C	±3.0	°C
Vcc3 Internal Supply Voltage	Internal	3.0 to 3.6V	±3.0	%
Laser Bias Current	Internal	0 to 20mA	±10	%
Tx Output Power	Internal	-7.5 to -1dBm	±3.0	dBm
Rx Input Power	Internal	-15.0 to 0dBm	±3.0	dBm

Recommended Circuit

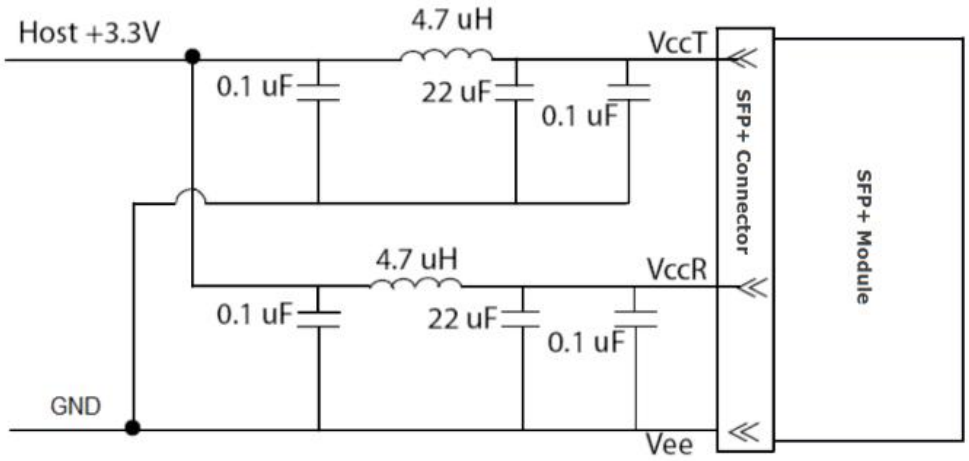

Figure 3, Recommended Host Board Power Supply Circuit

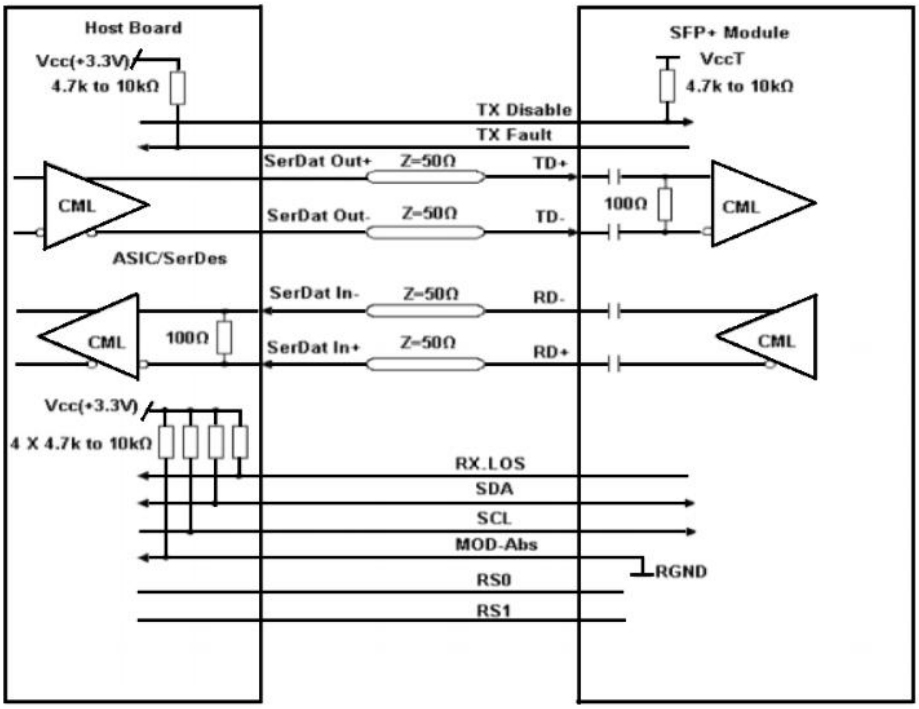

Figure 4, Recommended Interface Circuit

Mechanical Dimensions

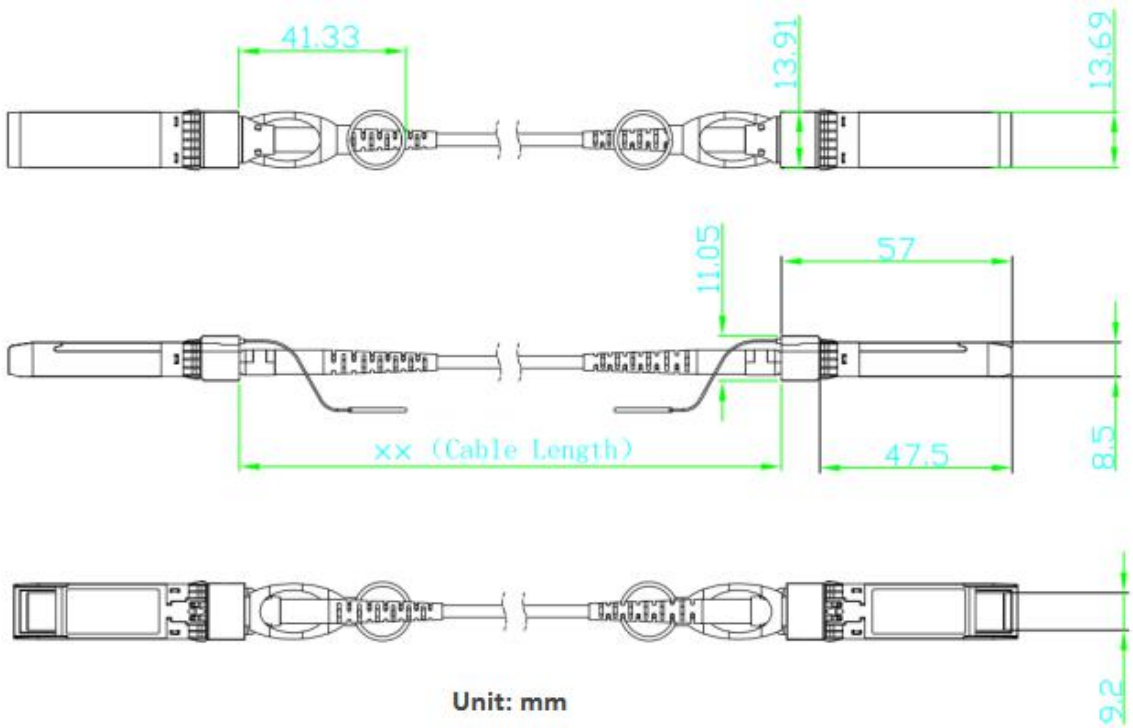

Figure 5, Mechanical Dimensions

Ordering information

Table 10. Ordering information

Part Number	Product Description
OTS-10G-AOC-03	850nm VCSEL, 10.3125Gbps, AOC 3m, OM3 MMF, -5°C ~ +70°C
OTS-10G-AOC-10	850nm VCSEL, 10.3125Gbps, AOC 10m, OM3 MMF, -5°C ~ +70°C
OTS-10G-AOC-50	850nm VCSEL, 10.3125Gbps, AOC 50m, OM3 MMF, -5°C ~ +70°C
OTS-10G-AOC-100	850nm VCSEL, 10.3125Gbps, AOC 100m, OM3 MMF, -5°C ~ +70°C
OTS-10G-AOC-300	850nm VCSEL, 10.3125Gbps, AOC 300m, OM3 MMF, -5°C ~ +70°C

Warnings

Handling Precautions: This device is susceptible to damage as a result of electrostatic discharge (ESD). A static free environment is highly recommended. Follow guidelines according to proper ESD procedures.

Laser Safety: Radiation emitted by laser devices can be dangerous to human eyes. Avoid eye exposure to direct or indirect radiation.