

## **10GBASE-IR SFP+ 1310nm 2km DDM Transceiver**

### **P/N: AE-SFP+-IR**

#### **Features**

- Operating data rate up to 11.3Gbps
- 1310nm FP-LD Transmitter
- Distance up to 2km
- Single 3.3V Power supply and TTL Logic Interface
- Duplex LC Connector Interface
- Hot Pluggable
- Power Dissipation < 1.0W
- Compliant with MSA SFP+ Specification SFF-8431
- Compliant with IEEE 802.3ae 10GBASE-LR/LW
- Operating Case Temperature Standard: 0°C~+70°C Industrial: -40°C~+85°C

#### **Applications**

- 10GBASE-LR at 10.31Gbps
- 10GBASE-LW at 9.95Gbps
- OBSAI rates 6.144 Gb/s, 3.072 Gb/s,  
1.536 Gb/s, 0.768Gb/s
- CPRI rates 10.138Gb/s ,9.830 Gb/s,7.373Gb/s, 6.144 Gb/s, 4.915  
Gb/s, 2.458 Gb/s, 1.229 Gb/s, 0.614Gb/s

## Product Description

The AE-SFP+-IR series single mode transceiver is small form factor pluggable module for serial optical data communications such as IEEE 802.3ae 10GBASE-LR/LW. It is with the SFP+ 20-pin connector to allow hot plug capability.

This module is designed for single mode fiber and operates at a nominal wavelength of 1310 nm. The transmitter section uses a 1310nm multiple quantum well FP laser and is a class 1 laser compliant according to International Safety Standard IEC-60825.

The receiver section uses an integrated InGaAs detector preamplifier (IDP) mounted in an optical header and a limiting post-amplifier IC.

## I. Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	T <sub>s</sub>	-40	+85	°C
Supply Voltage	V <sub>cc</sub>	-0.5	3.6	V
Input Voltage	V <sub>in</sub>	-0.5	V <sub>cc</sub>	V
Output Current	I <sub>o</sub>	-	50	mA

*Note2: Exceeding any one of these values may destroy the device permanently.*

## II. Recommended Operating Conditions

Parameter	Symbol	Min.	Typical	Max.	Unit
Operating Case Temperature	T <sub>c</sub>	EOLP-1396-02	0	+70	°C
		EOLP-1396-02-I	-40	+85	
Power Supply Voltage	V <sub>cc</sub>	3.15	3.3	3.45	V
Power Supply Current	I <sub>cc</sub>			300	mA
Surge Current	I <sub>Surge</sub>			+30	mA
Baud Rate		0.6		11.3	Gbps

## III. Performance Specifications – Electrical

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
Transmitter						
CML Inputs(Differential)	V <sub>in</sub>	150		1200	mVpp	AC coupled inputs
Input AC Common Mode Voltage		0		25	mV	RMS
Input Impedance (Differential)	Z <sub>in</sub>	85	100	115	ohm	R <sub>in</sub> > 100 kohms @ DC
Differential Input S-parameter	S <sub>DD11</sub>	-	-	-10	dB	

Differential to Common Mode Conversion	S <sub>CD11</sub>	-		-10	dB	
Tx_DISABLE Input Voltage – High		2		3.45	V	
Tx_DISABLE Input Voltage – Low		0		0.8	V	
Tx_FAULT Output Voltage – High		2		V <sub>cc</sub> +0.3	V	I <sub>o</sub> = 400µA; Host V <sub>cc</sub>
Tx_FAULT Output Voltage – Low		0		0.5	V	I <sub>o</sub> = -4.0mA
Receiver						
CML Outputs (Differential)	V <sub>out</sub>	350		700	mV <sub>pp</sub>	AC coupled outputs
Output AC Common Mode Voltage		0		15	mV	RMS
Output Impedance (Differential)	Z <sub>out</sub>	90	100	110	ohm	
Differential Output S-parameter	S <sub>D22</sub>	-	-	-10	dB	
Rx_LOS Output Voltage – High		2		V <sub>cc</sub> +0.3	V	I <sub>o</sub> = 400µA; Host V <sub>cc</sub>
Rx_LOS Output Voltage – Low		0		0.8	V	I <sub>o</sub> = -4.0mA
MOD_DEF ( 0:2 )	VoH	2.5			V	With Serial ID
	VoL	0		0.5	V	

#### IV. Performance Specifications – Optical

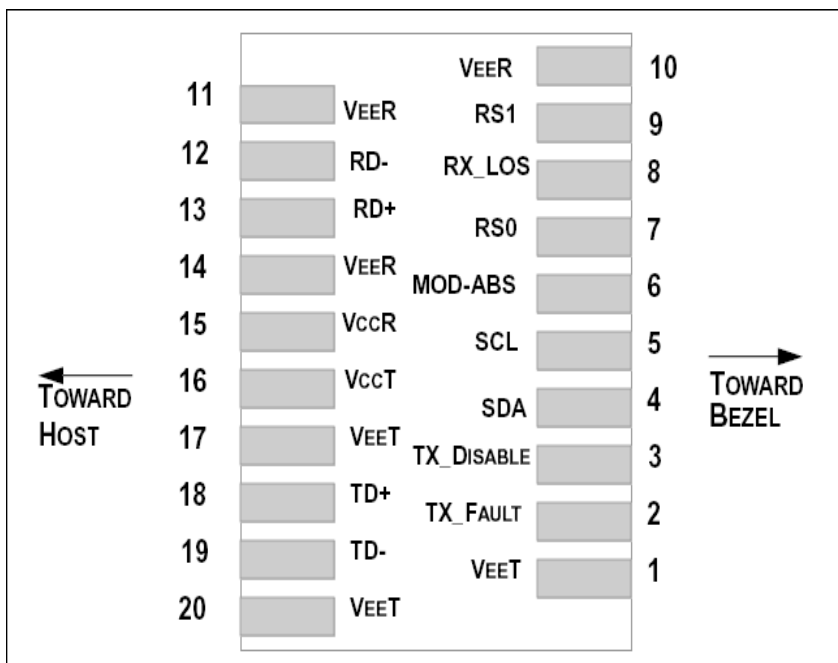
Parameter	Symbol	Min.	Typical	Max.	Unit
9µm Core Diameter SMF			2		Km
Data Rate		0.6		11.3	Gbps
Transmitter					
Centre Wavelength	λ <sub>C</sub>	1270	1310	1355	nm
Spectral Width (RMS)	Δλ			3	nm
Average Output Power*note3	P <sub>out</sub>	-6		-1	dBm
Extinction Ratio	ER	3.5			dB
Average Power of OFF Transmitter	P <sub>off</sub>			-30	dBm
Transmitter Dispersion Penalty	TDP			3.2	dB
TX Disable Assert Time	t <sub>off</sub>	-	-	10	us

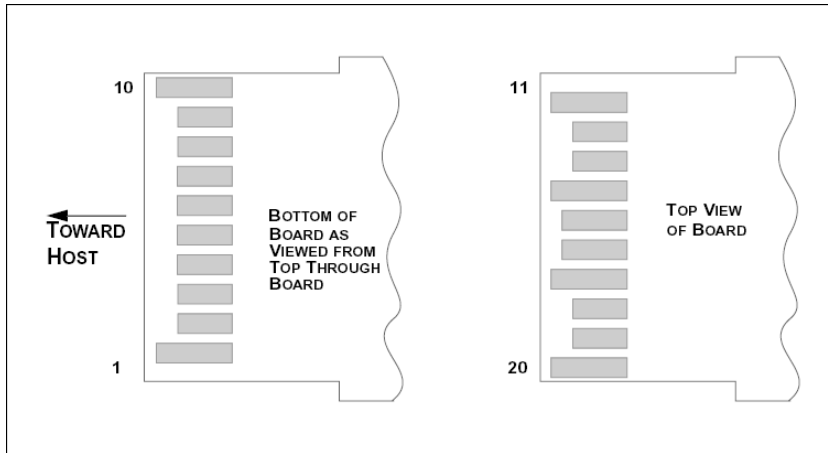
TX_DISABLE Negate Time	t_on	-	-	1	ms
TX_BISABLE time to start reset	t_reset	10	-	-	us
Time to initialize, include reset of TX_FAULT	t_init	-	-	300	ms
TX_FAULT from fault to assertion	t_fault	-	-	100	us
Total Jitter	TJ	-	-	0.28	UI(p-p)
Data Dependant Jitter	DDJ	-	-	0.1	UI(p-p)
Uncorrelated Jitter	UJ	-	-	0.023	RMS
Receiver					
Centre Wavelength	$\lambda$	1260		1565	nm
Sensitivity*note4	P <sub>min</sub>			-14.4	dBm
Receiver Overload	P <sub>max</sub>	0.5			dBm
Optical Return Loss	ORL			-12	dB
LOS De-Assert	LOS <sub>D</sub>			-16	dBm
LOS Assert	LOS <sub>A</sub>	-28			dBm

Note3: Output is coupled into a 9/125um SMF.

Note4: Minimum average optical power measured at the BER less than 1E-12, back to back. The measure pattern is PRBS 231-1.

## V. SFP+ Transceiver Electrical Pad Layout





## VI. Pin Function Definitions

Pin Num.	Name	FUNCTION	PlugSeq.	Notes
1	VeeT	Transmitter Ground	1	Note 5
2	TX Fault	Transmitter Fault Indication	3	Note 1
3	TX Disable	Transmitter Disable	3	Note 2, Module disables on high or open
4	SDA	Module Definition 2	3	2-wire Serial Interface Data Line.
5	SCL	Module Definition 1	3	2-wire Serial Interface Clock.
6	MOD-ABS	Module Definition 0	3	Note 3
7	RS0	RX Rate Select (LVTTTL).	3	No Function Implement
8	LOS	Loss of Signal	3	Note 4
9	RS1	TX Rate Select (LVTTTL).	1	No Function Implement
10	VeeR	Receiver Ground	1	Note 5
11	VeeR	Receiver Ground	1	Note 5
12	RD-	Inv. Received Data Out	3	Note 6
13	RD+	Received Data Out	3	Note 7
14	VeeR	Receiver Ground	1	Note 5
15	VccR	Receiver Power	2	3.3V ± 5%, Note 7
16	VccT	Transmitter Power	2	3.3V ± 5%, Note 7
17	VeeT	Transmitter Ground	1	Note 5
18	TD+	Transmit Data In	3	Note 8
19	TD-	Inv. Transmit Data In	3	Note 8
20	VeeT	Transmitter Ground	1	Note 5

**Notes:**

1. TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor on the host board. Pull up voltage between 2.0V and  $V_{ccT/R}+0.3V$ . When high, output indicates a laser fault of some kind. Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
  2. TX disable is an input that is used to shut down the transmitter optical output. It is pulled up within the module with a 4.7K – 10 KΩ resistor. Its states are:
    3. Low (0 – 0.8V): Transmitter on (>0.8, < 2.0V): Undefined
    4. High (2.0 – 3.465V): Transmitter Disabled Open: Transmitter Disabled
    5. Module Absent, connected to VeeT or VeeR in the module.
  6. LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10KΩ resistor. Pull up voltage between 2.0V and  $V_{ccT/R}+0.3V$ . When high, this output indicates the received optical power is below the worst-case receiver sensitivity (as defined by the standard in use). Low indicates normal operation. In the low state, the output will be pulled to < 0.8V.
  7. The module signal ground contacts, VeeR and VeeT, should be isolated from the module case.
  8. RD-/+: These are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board.
  9. VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V ±5%, at the SFP+ connector pin. Maximum supply current is 300mA. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP+ input pin with 3.3V supply voltage. When the recommended supply-filtering network is used, hot plugging of the SFP+ transceiver module will result in an inrush current of no more than 30mA greater than the steady state value. VccR and VccT may be internally connected within the SFP+ transceiver module.
- TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100Ω differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board.

**VII. Ordering information**

Part Number	Product Description
AE-SFP+-IR	SFP+, 10Gbps, 1310nm, SMF, 10KM, DDM, LC connector, 0 °C ~ 70 °C