10 Gigabit DWDM 80km SFP+ Transceiver

Overview

Axiom's AC-E-SFPPD80-xxxx-yy SFP+ optical transceivers are based on 10G Ethernet and SFF-8431 standard,providing a fast and reliable interface for 10G DWDM applications. The product implements digital diagnostics via a 2-wire serial bus ,compliant with the SFF-8472 standard.

Product Features

- Up to 11.3 Gb/s bi-directional data links
- Compliant with 10GBASE-ZR
- Compliant with 10G FC 1200-SM-LL-L
- Compliant with SFF-8431
- Hot-pluggable SFP+ footprint
- Temperature-stabilized EML laser in DWDM wavelength and Receiver with APD
- Duplex LC connector
- Built-in digital diagnostic functions
- Up to 80km on SMF
- Single power supply 3.3V
- Low power consumption (Module work consumption <1.5W)
- RoHS Compliant
- Operating temperature range: 0°C to 70°C

Applications

- 10G Ethernet
- 10G SONET/SDH
- 4x, 8x and 10x Fibre Channel
- OTN G.709 OUT 1e/2/2e FEC bit rates
- CPRI option 2 through 8

Ordering Information

Part Number	Description	Color on Clasp
AC-E-SFPPD80-xxxx-yy	10 GBASE-DWDM SFP+, DWDM-C Band (ITU 100GHz Grid), 80km over SMF. DOM	Green

Product Selection

Part Number	Description	ITU Channel
AC-E-SFPPD80-6305-yy	10GBASE-DWDM SFP+ Transceiver 1563.05nm	18
AC-E-SFPPD80-6223-yy	10GBASE-DWDM SFP+ Transceiver 1562.23nm	19
AC-E-SFPPD80-6142-yy	10GBASE-DWDM SFP+ Transceiver 1561.42nm	20
AC-E-SFPPD80-6061-yy	10GBASE-DWDM SFP+ Transceiver 1560.61nm	21
AC-E-SFPPD80-5979-yy	10GBASE-DWDM SFP+ Transceiver 1559.79nm	22
AC-E-SFPPD80-5898-yy	10GBASE-DWDM SFP+ Transceiver 1558.98nm	23
AC-E-SFPPD80-5817-yy	10GBASE-DWDM SFP+ Transceiver 1558.17nm	24
AC-E-SFPPD80-5736-yy	10GBASE-DWDM SFP+ Transceiver 1557.36nm	25
AC-E-SFPPD80-5655-yy	10GBASE-DWDM SFP+ Transceiver 1556.55nm	26
AC-E-SFPPD80-5575-yy	10GBASE-DWDM SFP+ Transceiver 1555.75nm	27
AC-E-SFPPD80-5494-yy	10GBASE-DWDM SFP+ Transceiver 1554.94nm	28
AC-E-SFPPD80-5413-yy	10GBASE-DWDM SFP+ Transceiver 1554.13nm	29
AC-E-SFPPD80-5333-yy	10GBASE-DWDM SFP+ Transceiver 1553.33nm	30
AC-E-SFPPD80-5252-yy	10GBASE-DWDM SFP+ Transceiver 1552.52nm	31
AC-E-SFPPD80-5172-yy	10GBASE-DWDM SFP+ Transceiver 1551.72nm	32
AC-E-SFPPD80-5092-yy	10GBASE-DWDM SFP+ Transceiver 1550.92nm	33
AC-E-SFPPD80-5012-yy	10GBASE-DWDM SFP+ Transceiver 1550.12nm	34
AC-E-SFPPD80-4932-yy	10GBASE-DWDM SFP+ Transceiver 1549.32nm	35
AC-E-SFPPD80-4851-yy	10GBASE-DWDM SFP+ Transceiver 1548.51nm	36
AC-E-SFPPD80-4772-yy	10GBASE-DWDM SFP+ Transceiver 1547.72nm	37
AC-E-SFPPD80-4692-yy	10GBASE-DWDM SFP+ Transceiver 1546.92nm	38
AC-E-SFPPD80-4612-yy	10GBASE-DWDM SFP+ Transceiver 1546.12nm	39
AC-E-SFPPD80-4532-yy	10GBASE-DWDM SFP+ Transceiver 1545.32nm	40
AC-E-SFPPD80-4453-yy	10GBASE-DWDM SFP+ Transceiver 1544.53nm	41
AC-E-SFPPD80-4373-yy	10GBASE-DWDM SFP+ Transceiver 1543.73nm	42
AC-E-SFPPD80-4294-yy	10GBASE-DWDM SFP+ Transceiver 1542.94nm	43
AC-E-SFPPD80-4214-yy	10GBASE-DWDM SFP+ Transceiver 1542.14nm	44

AC-E-SFPPD80-4135-yy	10GBASE-DWDM SFP+ Transceiver 1541.35nm	45
AC-E-SFPPD80-4056-yy	10GBASE-DWDM SFP+ Transceiver 1540.56nm	46
AC-E-SFPPD80-3977-yy	10GBASE-DWDM SFP+ Transceiver 1539.77nm	47
AC-E-SFPPD80-3898-yy	10GBASE-DWDM SFP+ Transceiver 1538.98nm	48
AC-E-SFPPD80-3819-yy	10GBASE-DWDM SFP+ Transceiver 1538.19nm	49
AC-E-SFPPD80-3740-yy	10GBASE-DWDM SFP+ Transceiver 1537.4nm	50
AC-E-SFPPD80-3661-yy	10GBASE-DWDM SFP+ Transceiver 1536.61nm	51
AC-E-SFPPD80-3582-yy	10GBASE-DWDM SFP+ Transceiver 1535.82nm	52
AC-E-SFPPD80-3504-yy	10GBASE-DWDM SFP+ Transceiver 1535.04nm	53
AC-E-SFPPD80-3425-yy	10GBASE-DWDM SFP+ Transceiver 1534.25nm	54
AC-E-SFPPD80-3347-yy	10GBASE-DWDM SFP+ Transceiver 1533.47nm	55
AC-E-SFPPD80-3268-yy	10GBASE-DWDM SFP+ Transceiver 1532.68nm	56
AC-E-SFPPD80-3190-yy	10GBASE-DWDM SFP+ Transceiver 1531.9nm	57
AC-E-SFPPD80-3112-yy	10GBASE-DWDM SFP+ Transceiver 1531.12nm	58
AC-E-SFPPD80-3033-yy	10GBASE-DWDM SFP+ Transceiver 1530.33nm	59
AC-E-SFPPD80-2955-yy	10GBASE-DWDM SFP+ Transceiver 1529.55nm	60
AC-E-SFPPD80-2877-yy	10GBASE-DWDM SFP+ Transceiver 1528.77nm	61

General Specifications

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR	1.2	10.3125	11.3	Gb/s	1
Bit Error Rate	BER			10^{-12}		
Operating Temperature	T_C	0		70	°C	2
Storage Temperature	T_{STO}	-40		85	°C	3
Supply Current	I_{CC}		450	500	mA	4
Input Voltage	V_{CC}	3.14	3.3	3.46	V	
Maximum Voltage	V_{MAX}	0.5		4	V	4

Notes:
1. IEEE 802.3ae
2. Case temperature
3. Ambient temperature
4. For electrical power interface

Link Distances

Data Rate	Fiber Type	Distance Range (km)
1.2–11.3 Gb/s	9/125um SMF	80

Optical – Characteristics – Transmitter

V_{CC}=3.14V to 3.46V, T_C=0˚C to 70˚C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Output Optical Power	P_{TX}	0		4	dBm	1
Optical Center Wavelength	λ_C	λ_C-0.1	λ_C	λ_C+0.1		2
Extinction Ratio	ER	9			dB	
Spectral Width (-20dB)	Δλ			0.6	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Relative Intensity Noise	RIN			-128	dB/Hz	
Transmitter Dispersion Penalty	TDP			3.2	dB	
Launch Power of OFF Transmitter	P_{OUT_OFF}			-30	dBm	1

Notes:
1. Average
2. λ = specified ITU Grid wavelength

Optical – Characteristics – Receiver

V_{CC}=3.14V to 3.46V,T_C=0˚C to 70˚C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Optical Center Wavelength	λ_C	1260		1620	nm	
Average Receive Power	P_{RX}	-24		-7	dBm	
Receiver Sensitivity @10.3Gb/s	R_{X_SEN1}			-24	dBm	1
Receiver Reflectance	TR_{RX}			-27	dB	
LOS Assert	LOS_A	-35			dBm	
LOS De-Assert	LOS_D			-27	dBm	
LOS Hysteresis	LOS_H	0.5			dB	

Notes:
1. Measured with the PRBS 2^{31} -1 test mode,BER< 10^{-12} ;

Electrical – Characteristics – Transmitter

V_{CC}=3.14V to 3.46V,T_C=0˚C to 70˚C

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input differential impedance	R_{IN}		100		Ω	
Differential data input swing	V_{IN_PP}	300		850	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}=3.14V to 3.46V,T_C=0˚C to 70˚C

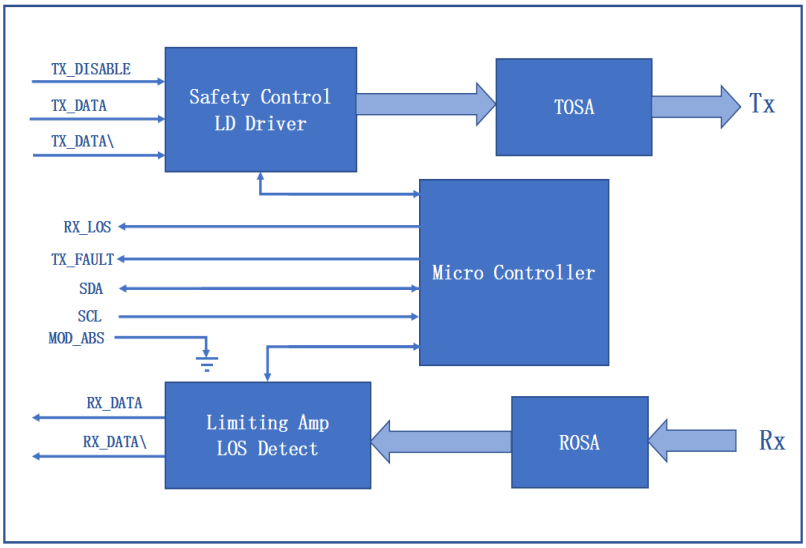
Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential data output swing	V_{OUT_PP}	300		850	mV	
Data output rise time/fall time (20%-80%)	t_r/t_f	28			ps	
LOS Fault	V_{LOS_A}	2		V_{CC_HOST}	V	
LOS Normal	V_{LOS_D}	V_{EE}		V_{EE}+0.5	V	

Digital Diagnostic Functions

AC-E-SFPPD80-xxxx-yy 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 AC-E-SFPPD80-xxxx-yy 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**	**High Warning**	**Low Warning**	**Low Alarm**	**Remarks**
Temperature (C)	75	70	0	-5	
Voltage (V)	3.63	3.46	3.13	2.97	
Bias Current (mA)	100	95	20	15	
Tx Power (uw)	3014.2	2511.8	1000	800	
Rx Power (uw)	251.7	188.8	2.9	1.9	

Block-Diagram-of-Transceiver



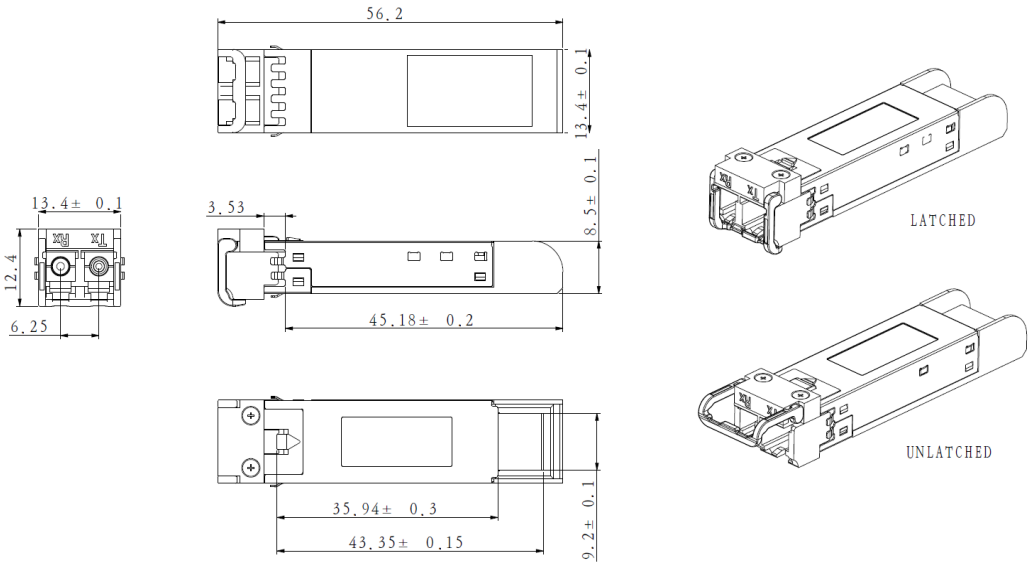
Functions Description

The transmitter consists of a laser driver chip and a TOSA (light-emitting component). The TOSA includes a DFB laser, an electroabsorption modulator (EAM), a TEC, and a backlight diode. Unlike DML, EML TOSA uses external modulation. When the transmission rate of the system is high, the transmission distance is not only limited by the attenuation of the optical fiber, but also by the dispersion of the optical fiber, and the dispersion of the optical communication system is related to the modulation spectral width. The directly modulated laser has a large dispersion cost, and has spectral broadening, frequency chirp, and short transmission distance, so the external modulation method is adopted in the medium-long-distance transmission at a rate of 10 Gb/s. TEC (Thermo Electric Cooler) Controls the temperature of the laser tube. When a temperature is set, the TOSA temperature of the module will remain unchanged through the control of the TEC. The wavelength of the module laser tube is related to the temperature of the laser tube. The module wavelength can be set by setting the TOSA temperature.When stable, the module has excellent wavelength stability. The electrical signal enters the optical module from the serial electrical interface and is then input to the laser driver chip. The laser driver chip supplies the bias current and the modulation current to the laser. The laser driver chip simultaneously uses an automatic optical power control (APC) feedback loop to maintain a constant average optical power of the laser output. The purpose is to eliminate the change of the output optical signal due to temperature changes and aging of the light source device. When the transmitter enable pin (TX_Disable) is high (TTL logic “1”), the laser output is turned off. When TX_Disable is low (TTL logic “0”), the laser will turn on within 1ms. When the transmitter fault signal (TX_Fault) is reported as high, indicates a transmitter failure caused by the transmitter’s bias current or transmitted optical power or laser tube temperature exceeding a preset alarm threshold. Low indicates normal operation.

The receiver consists of a ROSA (light-receiving component) and a limiting amplifier chip, ROSA includes a APD photodetector and a transimpedance amplifier chip. The ROSA detects the incident optical signal, converts the optical signal into an electrical signal, and outputs the electrical signal to the

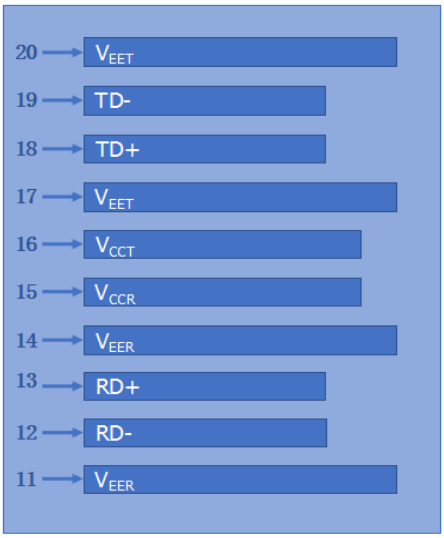
limiting amplifier. The electrical signal is further amplified by the limiting amplifier, then outputs a fixedamplitude electrical signal to the host. When the amplitude of the electrical signal received from the incident light conversion of the opposite optical transceiver module is lower than the set threshold, the module reports that the received signal is lost, the RX_LOS pin is high (logic “1”),which can be used to diagnose whether the physical signal is normal.The signal is operated in TTL level.The micro-processor inside the module monitors the module’s operating voltage, temperature, transmitted optical power, received optical power, and laser bias current value in real time. The host acquires this information over a 2-wire serial bus.

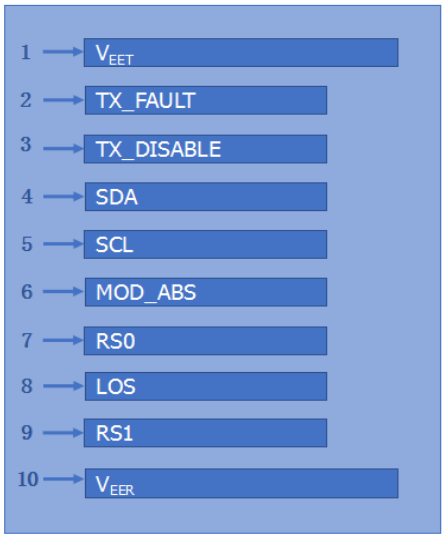
Dimensions



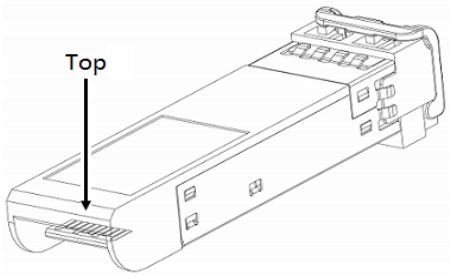
ALL DIMENSIONS ARE ±0.2mm UNLESS OTHERWISE SPECIFIED
UNIT: mm

Electrical Pad Layout

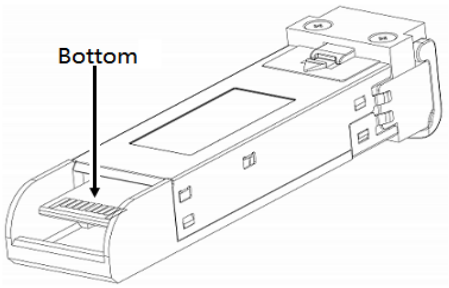




Top of Board



Bottom 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 Date Line	3
5	SCL	2-wire Serial Interface Clock Line	3
6	MOD_ABS	Module Absent. Grounded within the module	3
7	RS0	Rate Select 0	
8	LOS	Loss of Signal indication. Logic 0 indicates normal operation	4
9	RS1	Rate Select 1	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} > 2Vor 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 3.46V
4.LOS is open collector output

References

1.IEEE standard 802.3ae. IEEE Standard Department,2005.
2. Enhanced 8.5 and 10 Gigabit Small Form Factor Pluggable Module " SFP+" SFF-8431.
3. Digital Diagnostics Monitoring Interface for Optical Transceivers –SFF-8472.