

Dual-Rate 1000BASE-LX and 10GBASE-LR SFP+ 1310nm 10km Optical Transceiver

Features

- Hot pluggable SFP+ footprint
- Supports 9.95 to 10.5 Gb/s bit rates
- Power dissipation $\leq 1.2W$
- RoHS-6 compliant (lead free)
- Commercial temperature range 0°C to 70°C
- Single +3.3V Power Supply
- Maximum link length of 10km
- Uncooled 1310nm DFB laser
- Receiver limiting electrical interface
- Duplex LC connector
- Built in digital diagnostic functions

Applications

- 1000BASE LX 1G Ethernet
- 10GBASE LR/LW 10G Ethernet

Compliance

- SFF-8431
- IEEE 802.3-2005 10GBASE-LR/LW
- 1000BASE-LX

Description

The SFP-1/10G-LR transceivers are designed for use in 1-Gigabit and 10-Gigabit Ethernet links up to 10km over single mode fiber. They are compliant with SFF-8431, IEEE 802.3-2005 10GBASE-LR/LW and 1000BASE-LX.

Digital diagnostics functions are available via a 2-wire serial interface. This product is for applications specifically designed for 10G SFP+ ports and 1G/10G SFP+ ports and not native 1G SFP ports. This is a "limiting module", i.e., it employs a limiting receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer's recommended settings for inter operating the host- board EDC PHY with a limiting receiver SFP+ module. The optical transceivers are compliant per the RoHS Directive 2011/65/EU.

General Specifications

Table1-General Specifications						
Parameter	Symbol	Min.	Typical	Max.	Unit	Ref.
Bit Rate (RS0 = LOW)	BR		1.25		Gb/s	1
Bit Error Ratio (RS0 = HIGH)	BER	9.95	10.3		Gb/s	2
Max. Supported Link Length	Lmax		10		km	

Notes:

[1] 1000BASE-LX. Tested with a 27- 1 PRBS. See Section I, Note 5 for RS0 conditions for 1.25Gb/s operation.

[2] 10GBASE-LR/LW. Tested with a 231-1 PRBS. See Section I, Note 5 for RS0 conditions for 10.3Gb/s operation.

Absolute Maximum Ratings

Table2-Absolute Maximum Ratings						
Parameter	Symbol	Min.	Typical	Max.	Unit	Ref.
Maximum Supply Voltage	Vcc	-0.5		4.0	V	
Storage Temperature	Ts	-40		85	°C	
Case Operating Temperature	TOP	0		70	°C	
Relative Humidity	RH	0		85	%	1

Note:

[1] Non-condensing.

Electrical Characteristics (TOP= 0 to 70 °C, VCC = 3.14 to 3.46 Volts)

Table3-Electrical Characteristics						
Parameter	Symbol	Min.	Typical	Max.	Unit	Ref.
Supply Voltage	Vcc	3.14	3.30	3.46	V	
Supply Current	Icc		200	285	mA	
Transmitter						
Input differential impedance	Rin		100		Ω	1
Differential data input swing	Vin pp	180		700	mV	

Transmit Disable Voltage	V _D	2		V _{CC}	V	
Transmit Enable Voltage	V _{EN}	V _{EE}		V _{EE} +0.8	V	
Receiver						
Differential data output swing	V _{out pp}	300		850	mV	2,6
Output rise time and fall time	T _r T _f	20			ps	3
LOS asserted	V _{LOS} fault	2		V _{CC} HOST	V	4
LOS de-asserted	V _{LOS} norm	V _{EE}		V _{EE} +0.8	V	4
Power Supply Noise Tolerance	V _{CC} T/V _{CC} R	Per SFF-8431 Rev 4.1			mVpp	

Notes:

[1] Connected directly to TX data input pins. AC coupling from pins into laser driver IC.

[2] Into 100Ω differential termination.

[3] 20 – 80 % . Measured with Module Compliance Test Board and OMA test pattern. Use of four 1's and four 0's in sequence in the PRBS⁹ is an acceptable alternative.

[4] LOS is an open collector output. Should be pulled up with 4.7kΩ – 10kΩ on the host board. Normal operation is logic 0; loss of signal is logic 1.

[5] The transceiver is a "limiting module", i.e., it employs a limiting receiver. Host board designers using an EDC PHY IC should follow the IC manufacturer's recommended settings for inter operating the host-board EDC PHY with a limiting receiver SFP+ module.

Optical Characteristics for RS0=HIGH (10G Operation)(TOP =0 to 70°C, VCC3 = 3.14 to 3.46 Volts)

Table4-Optical Characteristics for RS0=HIGH

Parameter	Symbol	Min.	Typical	Max.	Unit	Ref.
Transmitter						
Optical Modulation Amplitude (OMA)	P _{OMA}	-5.2		+0.5	dBm	1
Average Launch Power	P _{AVE}	-8.2		1355	dBm	
Optical Wavelength	λ	1260			nm	
Side-Mode Suppression Ratio	SMSR	30			dB	
Optical Extinction Ratio	ER	3.5			dB	
Transmitter and Dispersion Penalty	TDP			3.2	dB	
Average Launch power of OFF transmitter	P _{OFF}			-30	dBm	

Optical Characteristics (TOP =0 to 70°C, VCC = 3.14 to 3.46 Volts)

Table5-Optical Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	Note
Transmitter(Tx)						
Average Launch Power	P _{AVE}	-8.2		0.5	dBm	1
Optical Wavelength	λ	1260		1355	nm	

Rise-Fall Time	Trise Tfal			0.26	ns	2
RMS Spectral Width	$\Delta \lambda_{rms}$			4	nm	
Optical Extinction Ratio	ER	9			dB	
Average Launch power of OFF transmitter	P _{OFF}			-30	dB	
Tx Jitter	T _{xj}	Per IEEE 802.3ae requirements				
Relative Intensity Noise	RIN			-120	dB/Hz	
Receiver(Rx)						
Receiver Sensitivity	R _{SENS}	1260		-19	dBm	3
Stressed Receiver Sensitivity	SRS			-14.4	dBm	4
Average Receive Power	P _{AVE}			-3	dBm	
Optical Center Wavelength	λ_c	1260		1660	nm	
Return Loss	R _{rx}	12			dB	
Receive electrical 3dB upper cutoff frequency			1500		dBm	
LOS De-Assert	LOS _D		-17		dBm	
LOS Assert	LOS _A	-30			dBm	
LOS Hysteresis		0.5			dB	

Notes:

- [1] Average power figures are informative only, per IEEE 802.3-2005.
- [2] Valid between 1260 and 1355 nm. Measured with worst ER; BER<10⁻¹²; 231 -1 PRBS.
- [3] Valid between 1260 and 1355 nm. Per IEEE 802.3-2005.

Digital Diagnostic Specifications

The transceiver can be used in host systems that require either internally or externally calibrated digital diagnostics.

Table6-Digital Diagnostic Specifications

Parameter	Symbol	Min.	Typical	Max.	Units	Ref.
Accuracy						
Internally measured transceiver temperature	$\Delta DD_{Temperature}$			3	°C	
Internally measured transceiver supply voltage	$\Delta DD_{Voltage}$			3	%	
Measured TX bias current	ΔDD_{Bias}			10	%	1
Measured TX output power	$\Delta DD_{Tx Power}$			2	dB	
Measured RX received average optical power	$\Delta DD_{Rx Power}$			2	dB	
Dynamic Range for Rated Accuracy						
Internally measured transceiver temperature	DD _{Temperature}	-5		70	°C	
Internally measured transceiver supply voltage	DD _{Voltage}	3.1		3.5	V	

Measured TX bias current	DDBias	0		tbd	mA	
Measured TX output power	DDTx Power	-8.2		+0.5	dBm	
Measured RX received average optical power	DDRx Power	-14.2		+0.5	dBm	
Max Reporting Range						
Internally measured transceiver temperature	DDTemperature	-40		125	°C	
Internally measured transceiver supply voltage	DDVoltage	2.8		4.0	V	
Measured TX bias current	DDBias	0		20	mA	
Measured TX output power	DDTx Power	-10		+2	dBm	
Measured RX received average optical power	DDRx Power	-22		+2	dBm	
Accuracy						
Internally measured transceiver temperature	DDTemperature	-5		70	°C	
Internally measured transceiver supply voltage	DDVoltage	2.8		4.0	V	
Measured TX bias current	DDBias	0		20	mA	
Measured TX output power	DDTx Power	-10		+2	dBm	
Measured RX received average optical power	DDRx Power	-22		+2	dBm	

Note:

[1] Accuracy of Measured Tx Bias Current is 10% of the actual Bias Current from the laser driver to the laser.

Pin Function Definitions

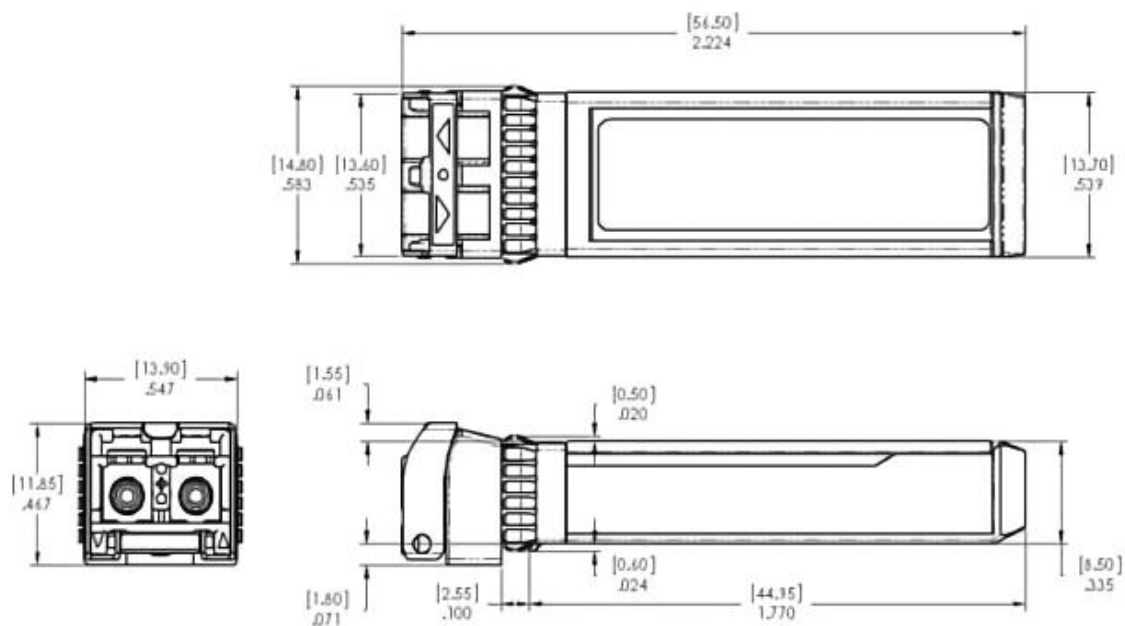
Table7-Pin Description			
PIN	Symbol	Name/Description	Ref.
1	VeeT	Transmitter Ground	1
2	TFault	Transmitter Fault	2
3	TDis	Transmitter Disable. Laser output disabled on high or open.	3
4	SDA	2-wire Serial Interface Data Line	2
5	SCL	2-wire Serial Interface Clock Line	2
6	MOD-ABS	Module Absent. Grounded within the module	2
7	RS0	Rate Select 0.	4
8	RX-LOS	Loss of Signal indication. Logic 0 indicates normal operation.	5
9	RS1	Rate Select 1.	4
10	VeeR	Receiver Ground	1
11	VeeR	Receiver Ground	1
12	RD-	Receiver Inverted DATA out. AC Coupled.	

13	RD+	Receiver Non-inverted DATA out. AC Coupled.	
14	VeeR	Receiver Ground	1
15	VccR	Receiver Power Supply	
16	VccT	Transmitter Power Supply	
17	VeeT	Transmitter Ground	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	VeeT	Transmitter Ground	1

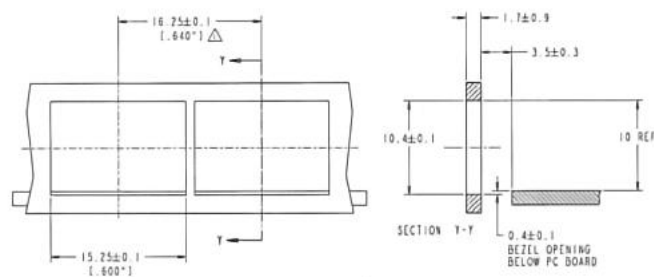
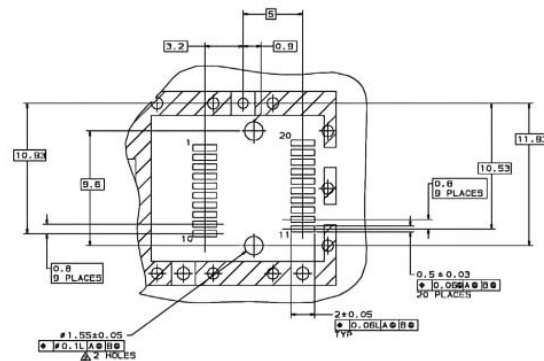
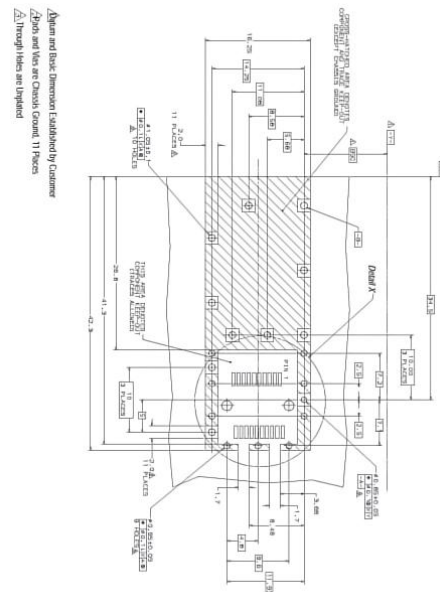
Notes:

- [1] Circuit ground is internally isolated from chassis ground.
- [2] TFAULT is an open collector/drain output, which should be pulled up with a 4.7k -10k Ohms resistor on the host board if intended for use. Pull up voltage should be between 2.0V to Vcc + 0.3V. 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 $\leq 0.8V$.
- [3] Laser output disabled on TDIS > 2.0V or open, enabled on TDIS < 0.8V.
- [4] Internally pulled down per SFF-8431 Rev 2.0. See Sec. X for the logic table to use for the internal CDRs locking modes.
- [5] LOS is open collector output. Should be pulled up with 4.7k Ω -10k Ω on host board to a voltage between 2.0V and 3.6V. Logic 0 indicates normal operation; logic 1 indicates loss of signal.

Mechanical Specifications



PCB Layout and Bezel Recommendations



- NOTES:
- MINIMUM PITCH ILLUSTRATED, ENGLISH DIMENSIONS ARE FOR REFERENCE ONLY
 - NOT RECOMMENDED FOR PCI EXPANSION CARD APPLICATIONS

Further Information:

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