

# 10GBASE-LR SFP+ 1310nm 10km Industrial DOM Transceiver

10G-SFPP-LR-I-LL



## Application

- 10GBASE-LR/LW 10G Ethernet
- 8G/10GFC
- CPRI rates 2.4576 Gb/s, 4.9152Gb/s, 6.144Gb/s, 9.8304 Gb/s

## Features

- Hot-pluggable SFP+ footprint
- Supports 9.95 to 10.52Gb/s bit rates
- Power dissipation < 1W
- RoHS-6 compliant (lead-free)
- Industrial temperature range : -40°C to 85°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

## Description

The 10G LR 10Gigabit 1310nm DFB Transceiver is designed to transmit and receive serial optical data links up from 2.1 Gb/s to 10.52 Gb/s data rate over 10km singlemode fiber. The Transceiver is compliant with SFF-8432, 10GFC, FC-PI-4, IEEE802.3ae and applicable portions of SFF-8431. Digital diagnostics functions are available via a 2-wire serial interface, as specified in SFF-8472.

## Product Specifications

### I. General Specifications

Data Rate Specifications	Symbol	Min	Typ.	Max	Units	Ref.
<b>Bit Rate</b>	BR	2.1		10.52	Gb/s	1
<b>Bit Error Ratio</b>	BER			10 <sup>-12</sup>		2
<b>Max. Supported Link Length</b>	L MAX			40	km	1

#### Notes:

1. 10GBASE-LR, 10GBASE-LW, 1200-SM-LL-L 10GFC.
2. Tested with a 2<sup>31</sup> – 1 PRBS.

## II. Absolute Maximum Ratings

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
Maximum Supply Voltage	V <sub>CC</sub>	-0.5		4.0	V	
Storage Temperature	T <sub>S</sub>	-40		85	°C	
Case Operating Temperature	T <sub>OP</sub>	-40		85	°C	
Relative Humidity	RH	0		85	%	1
Receiver Optical Damage Threshold	RxDamage	5			dBm	

**Note:**

Non-condensing.

## III. Electrical Characteristics (TOP = -40 to 85 °C, VCC = 3.14 to 3.46 V)

Parameter	Symbol	Min	Typ.	Max	Unit	Ref.
Supply Voltage	V <sub>CC</sub>	3.14	3.30	3.46	V	
Supply Current	I <sub>CC</sub>		200	285	mA	
<b>Transmitter</b>						
Input differential impedance	R <sub>in</sub>	80	100	120	Ω	1
Differential data input swing	V <sub>in,pp</sub>	180		700	mV <sub>pp</sub>	
Transmit Disable Voltage	V <sub>D</sub>	2		V <sub>OCHOST</sub>	V	
Transmit Enable Voltage	V <sub>EN</sub>	V <sub>EE</sub>		V <sub>EE</sub> +0.8	V	
Transmit Fault Assert Voltage	V <sub>FA</sub>	22		V <sub>OCHOST</sub>	V	
Transmit Fault De-Assert Voltage	V <sub>FDA</sub>	V <sub>EE</sub>		V <sub>EE</sub> +0.4	V	

## Receiver

Differential data output swing	$V_{OD}$	450	600	850	mVp-p
Output rise time and fall time	$T_r, T_f$	25			ps
LOS Fault	$V_{LOSFT}$	2		$V_{CCHOST}$	V
LOS Normal	$V_{LOSNR}$	$V_{EE}$		$V_{EE}+0.8$	V

## Notes:

1. Connected directly to TX data input pins. AC coupling from pins into laser driver IC.
2. Into 100 differential termination.
3. 20 – 80%. Measured with Module Compliance Test Board and OMA test pattern. Use of four 1' s and four 0' s sequence in the PRBS 9 is an acceptable alternative.
4. LOS is an open collector output. Should be pulled up with 4.7k – 10k 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 interoperating the host-board EDC PHY with a limiting receiver SFP+ module.

#### IV. Optical Characteristics (TOP = -40 to 85 °C, VCC = 3.14 to 3.46 V)

Parameter	Symbol	Min	Typ.	Max	Unit	Note
<b>Transmitter</b>						
Optical Modulation Amplitude (OMA)	$P_{OMA}$	-5.2			dBm	
Average Launch Power	$P_{AVE}$	-8.2		+0.5	dBm	1
Optical Wavelength	$\lambda$	1260		1360	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 when Tx is OFF	$P_{OFF}$			-35	dBm	
Relative Intensity Noise	RIN			-128	dB/Hz	
<b>Receiver</b>						
Receiver Sensitivity (OMA) @ 10.3Gb/S	$R_{SENS1}$			-12.6	dBm	2
Receiver Sensitivity (OMA) @ 10.3Gb/s	$R_{SENS2}$			-10.3	dBm	3
Average Receive Power	$P_{AVE}$	-14.2		+0.5	dBm	
Optical Center Wavelength	$\lambda_C$	1260		1610	nm	
Receiver Reflectance	$R_{RX}$			-12	dB	

LOS De-Assert	LOS De-Assert	$LOS_D$	-17				dBm
LOS Assert	LOS Assert	$LOS_A$	-30				dBm

**Notes:**

- Sensitivity for 10G PRBS 231-1 and BER better than or equal to  $10E-12$
- The stressed sensitivity value in the table are for system level BER measurements which include the effects of CDR circuit.

**V. Digital Diagnostic Specifications**

10GBASE-LR SFP+ transceivers can be used in host systems that require either internally or externally calibrated digital diagnostics.

Parameter	Symbol	Min	Typ.	Max	Units	Ref.
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**Accuracy**

Internally measured transceiver temperature	$\Delta DD_{Temperature}$			3	°C	
Internally measured transceiver supply voltage	$\Delta DD_{Voltage}$			3	%	
Measured TX bias current	$\Delta DD_{Bias}$			10	%	1
Measured TX output power	$\Delta DD_{Tx-Power}$			2	dB	
Measured RX received average optical power	$\Delta DD_{Rx-Powe}$			2	dB	

### Dynamic Range for Rated Accuracy

Internally measured transceiver temperature	DDTemperature	-40	85	°C
Internally measured transceiver temperature	DDVoltage	3.1	3.5	V
Measured TX bias current	DDBias	10	90	mA
Measured TX output power	DDTx-Power	-8.2	+0.5	dBm
Measured RX received average optical power	DDRx-Powe	-14.2	+0.5	dBm

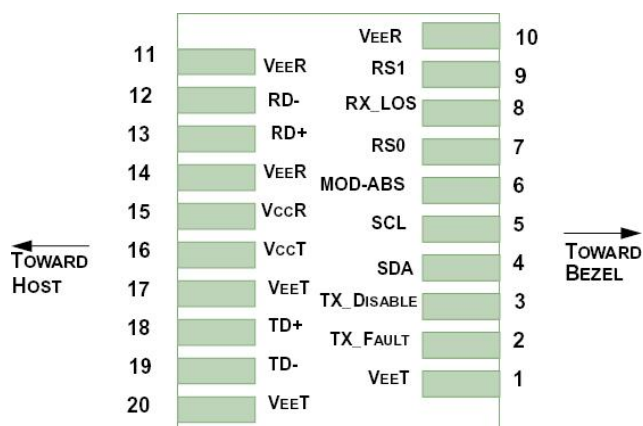
### Max Reporting Range

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

#### Notes:

Accuracy of measured Tx bias current is 10% of the actual bias current from the laser driver to the laser.

## VI. Pin Description

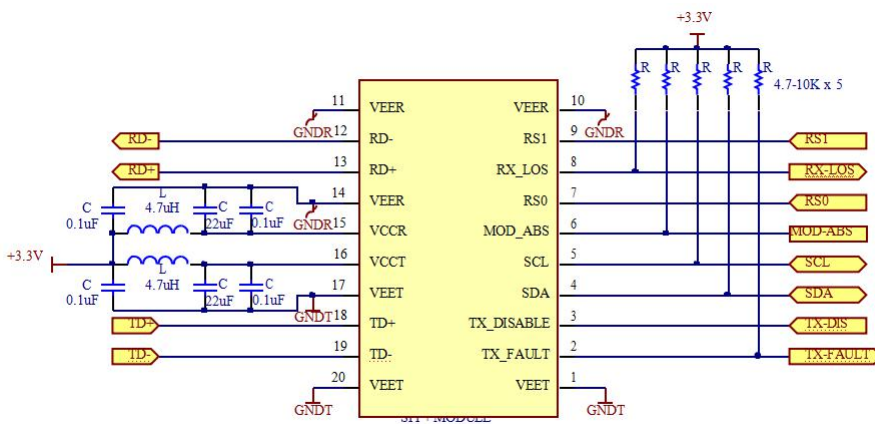


Pin	Symbol	Name/Description	Ref.
1	VEET	Transmitter Ground	1
2	T <sub>FAULT</sub>	Transmitter Fault	2
3	T <sub>DIS</sub>	Transmitter Disable. Laser output disabled on high or open.	3
4	SDA	2-wire Serial Interface Data Line	2
5	SCL	2-wire Serial Interface Clock Line	2
6	MOD_ABS	Module Absent. Grounded 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	V <sub>CCR</sub>	Receiver Power Supply	
16	V <sub>CCT</sub>	Transmitter Power Supply	
17	V <sub>EET</sub>	Transmitter Ground	1
18	TD+	Transmitter Non-Inverted DATA in. AC Coupled.	
19	TD-	Transmitter Inverted DATA in. AC Coupled.	
20	V <sub>EET</sub>	Transmitter Ground	1

### VII. Typical Application Circuit



### VIII. Mechanical Specifications

