



**OP-SFP<sup>+</sup>-LP-10**  
10.3Gbps SFP<sup>+</sup> Transceiver

## Product Description

The OP-SFP+-LP-10 series single-mode transceivers are SFP+ module for bi-directional serial optical data communications such as 10GBASE-SR and 10GBASE-SW.

It is with the SFP+ 20-pin connector to allow hot plug capability. Digital diagnostic functions are available via an I2C. This module is designed for multi-mode fiber and operates at a nominal wavelength of 1310 nm.

The transmitter section uses a 1310 nm multiple quantum well DFB laser and is a class1 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.

## Features

- Operating data rate up to 10.3Gbps
- 1310 nm DFB-LD Transmitter
- Distance up to 10Km
- Single 3.3V Power supply and TTL Logic Interface
- Duplex LC Connector Interface
- Hot Pluggable
- Operating Case Temperature Standard: 0° c~+70° c
- Compliant with MSA SFP+ Specification
- Digital diagnostic monitor interface

## Applications

- 10G Ethernet at 10.3125Gbps
- Compatible with SFF-8472

## Regulatory Compliance

Feature	Standard	Performance
Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.7	Class1(>500 V) Isolation with the case
Electromagnetic Interference (EMI)	FCC Part 15 ClassB	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN (IEC) 60825-1,2	Compatible with Class I laser product. Compatible with TÜV standards
Component Recognition	UL and CUL	Compatible with UL standards
Green Products	RoHS	RoHS6

## Absolute Maximum Ratings

Parameter	Symbol	Min.	Max.	Unit
Storage Temperature	TS	-40	+85	°C
Supply Voltage	VCC	-0.5	3.6	V

## Recommended Operating Conditions

Parameter	Symbol		Min.	Typical	Max.	Unit
Operating Case Temperature	T <sub>A</sub>	OP-SFP+-LP-10	0		+70	°C
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				10.3125	10.5	GBaud

## Performance Specifications - Electrical

Parameter	Symbol	Min.	Typ.	Max	Unit	Notes
<b>TRANSMITTER</b>						
CML Inputs(Differential)	V <sub>in</sub>	150		1200	mVp	AC coupled inputs
Input Impedance (Differential)	Z <sub>in</sub>	85	100	115	ohms	R <sub>in</sub> > 100 kohms @ DC
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

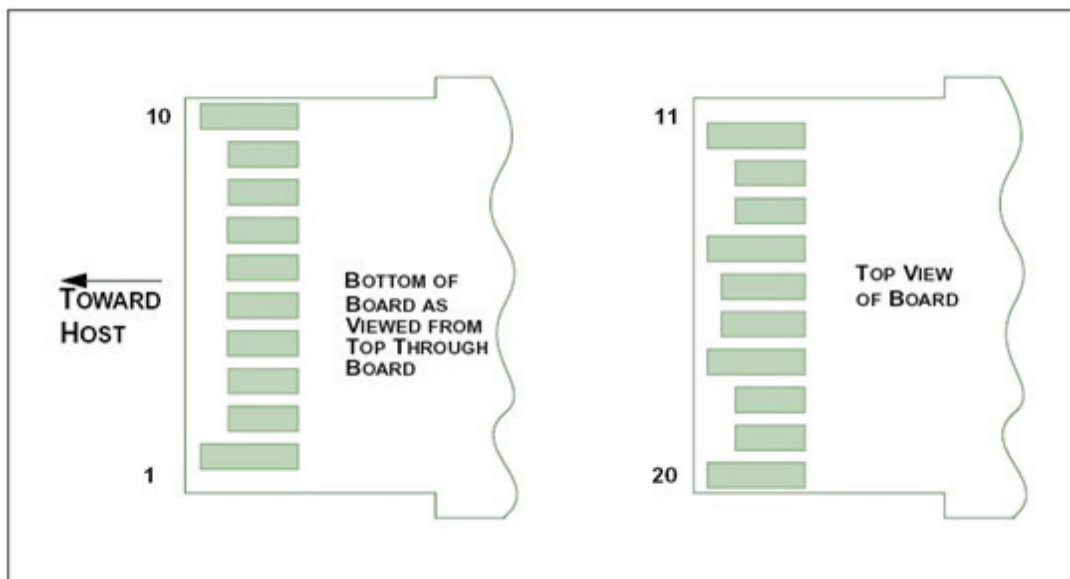
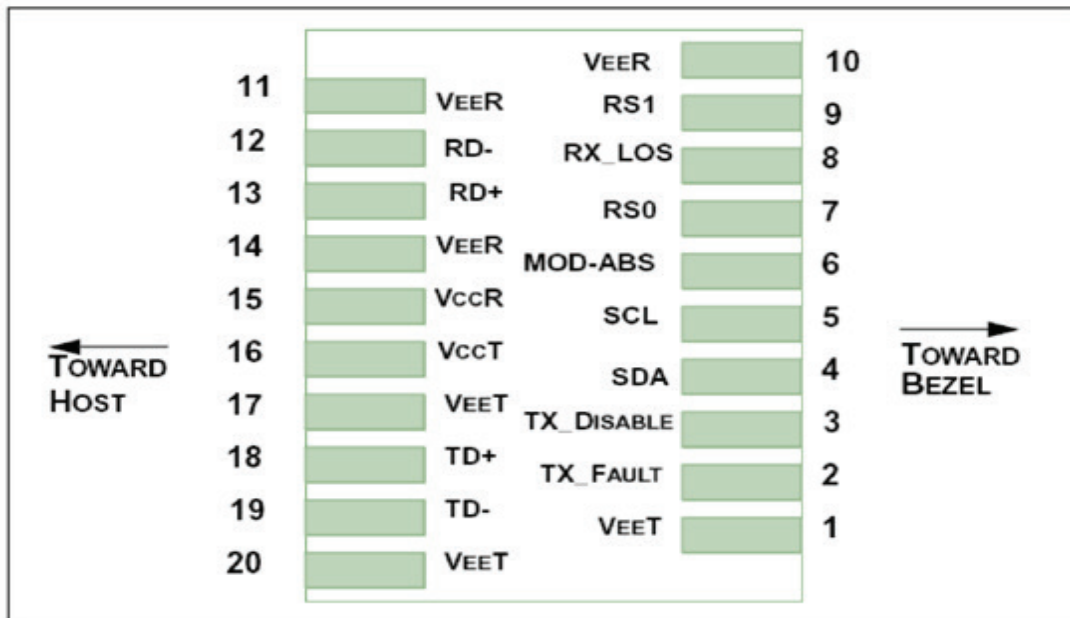
RECEIVER						
CML Outputs (Differential)	Vout	350		700	mVpp	AC coupled outputs
Output Impedance (Differential)	Zout	85	100	115	ohms	
Rx_LOS Output Voltage - High	2			Vcc+0.3	V	Io = 400µA; Host Vcc
Rx_LOS Output Voltage - Low		0		0.8	V	Io = -4.0mA
MOD_DEF ( 0:2 )	VoH	2.5		V		With Serial ID
	VoL	0		0.5 V		

## Optical and Electrical Characteristics

Parameter	Symbol	Min.	Typical	Max.	Unit	
9µm Core Diameter SMF			10		Km	
Data Rate			10.3		Gbps	
Transmitter						
Centre Wavelength	$\lambda_c$	1270	1310	1355	nm	
Spectral Width (-20dB)	$\sigma$			1	nm	
Average Output Power	P <sub>out</sub>	-8		+0.5	dBm	
Extinction Ratio	ER	3.5			dB	
Average Power of OFF Transmitter				-30	dBm	
Side Mode Suppression Ratio	SMSR	30			dB	
Input Differential Impedance	Z <sub>IN</sub>	90	100	110	Ω	
TX Disable	Disable		2.0		Vcc+0.3	V
	Enable		0		0.8	
TX_Fault	Fault		2.0		Vcc+0.3	V
	Normal		0		0.8	
TX_Disable Assert Time	t <sub>off</sub>			10	µs	

Receiver						
Centre Wavelength	$\lambda_c$	1260		1565	nm	
Receiver Sensitivity	PIN			-12.6	dBm	
Output Differential Impedance	$P_{IN}$	90	100	110	$\Omega$	
Receiver Overload	$P_{MAX}$	0.5			dBm	
Optical Return Loss	ORL			-12	dB	
LOS De-Assert	$LOS_D$			-15	dBm	
LOS Assert	$LOS_A$	-25			dBm	
LOS	High		2.0		$V_{CC}+0.3$	V
	Low		0		0.8	

### SFP+ Transceiver Electrical Pad Layout



## Pin Function Definitions

Pin No.	Name	FUNCTION	Plug Seq.	Notes
1	VeeT	Transmitter Ground	1	
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	Note 3, Data line for Serial ID.
5	SCL	Module Definition 1	3	Note 3, Clock line for Serial ID.
6	MOD-ABS	Module Definition 0	3	Note 3
7	RS0	RX Rate Select (LVTTTL).	3	This pin has an internal 30k pull down to ground. A signal on this pin will not affect module performance.
8	LOS	Loss of Signal	3	Note 4
9	RS1	TX Rate Select (LVTTTL).	1	This pin has an internal 30k pull down to ground. A signal on this pin will not affect module performance.
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	3.3 ± 5%, Note 7
16	VccT	Transmitter Power	2	3.3 ± 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:

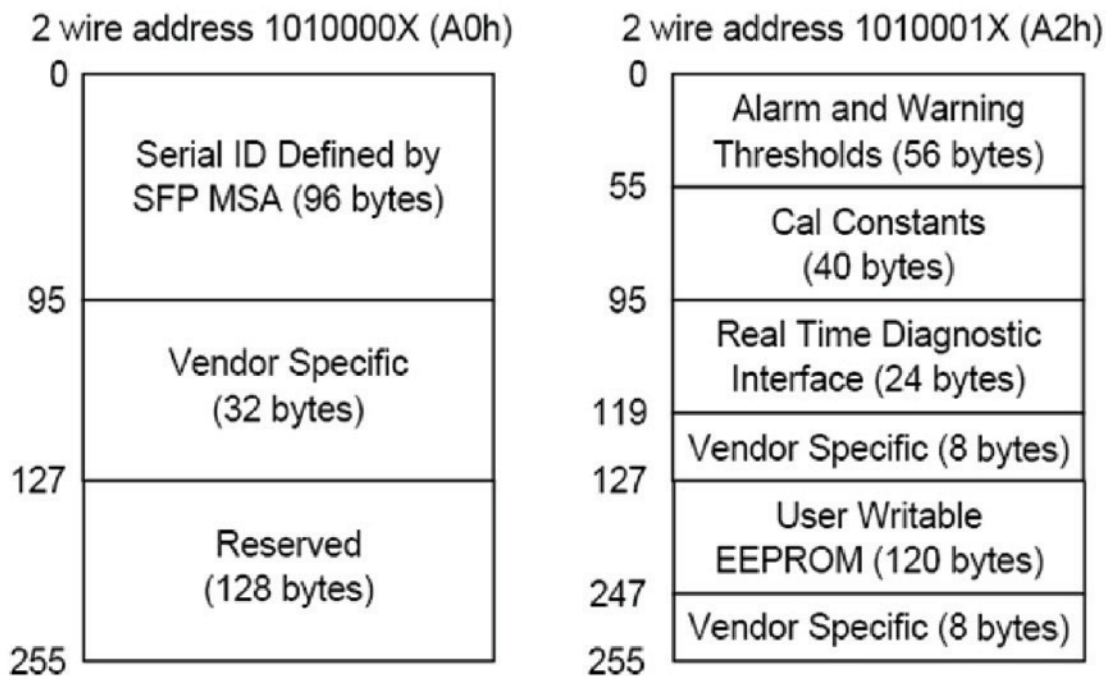
- 1) TX Fault is an open collector/drain output, which should be pulled up with a 4.7K – 10K $\Omega$  resistor on the host board. Pull up voltage between 2.0V and VccT, R+0.3V. When high, output indicates a laser fault of some kind. Low indicates normal operation.  
In the low state, the output will 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 4.7 – 10 K  $\Omega$  resistor. Its states are:  
Low (0 – 0.8V): Transmitter on  
(>0.8, < 2.0V): Undefined  
High (2.0 – 3.465V): Transmitter Disabled  
Open: Transmitter Disabled
- 3) Modulation Absent, connected to VEET or VEER in the module.
- 4) LOS (Loss of Signal) is an open collector/drain output, which should be pulled up with a 4.7K – 10K $\Omega$  resistor. Pull up voltage between 2.0V and VccT, 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.
- 5) VeeR and VeeT may be internally connected within the SFP<sup>+</sup> module.
- 6) RD-/+: These are the differential receiver outputs. They are AC coupled 100 $\Omega$  differential lines which should be terminated with 100 $\Omega$  (differential) at the user SERDES. The AC coupling is done inside the module and is thus not required on the host board. The voltage swing on these lines will be between 370 and 2000 mV differential (185 – 1000 mV single ended) when properly terminated.
- 7) VccR and VccT are the receiver and transmitter power supplies. They are defined as 3.3V  $\pm$ 5% at the SFP<sup>+</sup> connector pin. Maximum supply current is 300mA. Recommended host board power supply filtering is shown below. Inductors with DC resistance of less than 1 ohm should be used in order to maintain the required voltage at the SFP<sup>+</sup> input pin with 3.3V supply voltage. When the recommended supply-filtering network is used, hot plugging of the SFP<sup>+</sup> 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<sup>+</sup> transceiver module.
- 8) TD-/+: These are the differential transmitter inputs. They are AC-coupled, differential lines with 100 $\Omega$  differential termination inside the module. The AC coupling is done inside the module and is thus not required on the host board. The inputs will accept differential swings of 500 – 2400 mV (250 – 1200mV single-ended), though it is recommended that values between 500 and 1200 mV differential (250 – 600mV single-ended) be used for best EMI performance.



## EEPROM

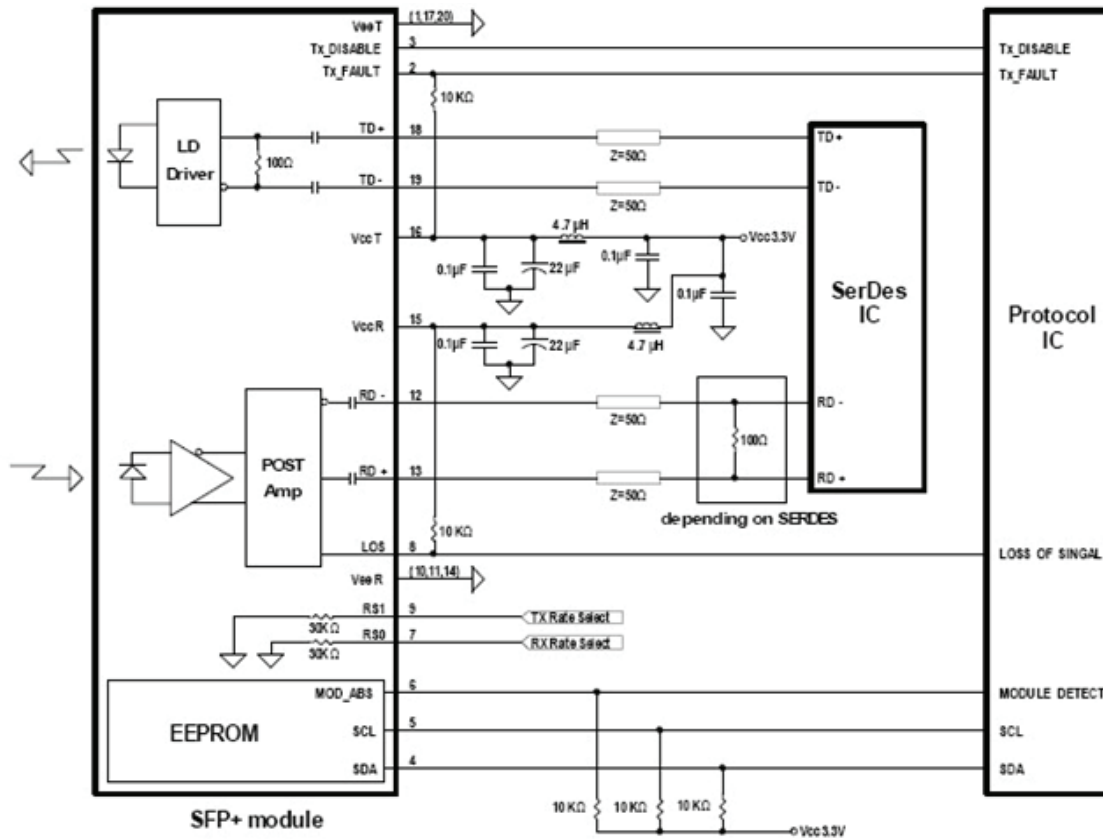
The serial interface uses the 2-wire serial CMOS EEPROM protocol defined for the ATMEL AT24C02/04 family of components. When the serial protocol is activated, the host generates the serial clock signal (SCL). The positive edge clocks data into those segments of the EEPROM that are not write protected within the SFP+ transceiver. The negative edge clocks data from the SFP+ transceiver. The serial data signal (SDA) is bi-directional for serial data transfer. The host uses SDA in conjunction with SCL to mark the start and end of serial protocol activation. The memories are organized as a series of 8-bit data words that can be addressed individually or sequentially.

The Module provides diagnostic information about the present operating conditions. The transceiver generates this diagnostic data by digitization of internal analog signals. Calibration and alarm/warning threshold data is written during device manufacture. Received power monitoring, transmitted power monitoring, bias current monitoring, supply voltage monitoring and temperature monitoring all are implemented. The diagnostic data are raw A/D values and must be converted to real world units using calibration constants stored in EEPROM locations 56 – 95 at wire serial bus address A2h. The digital diagnostic memory map specific data field define as following .For detail EEPROM information, please refer to the related document of SFF 8472 Rev 10.2 .

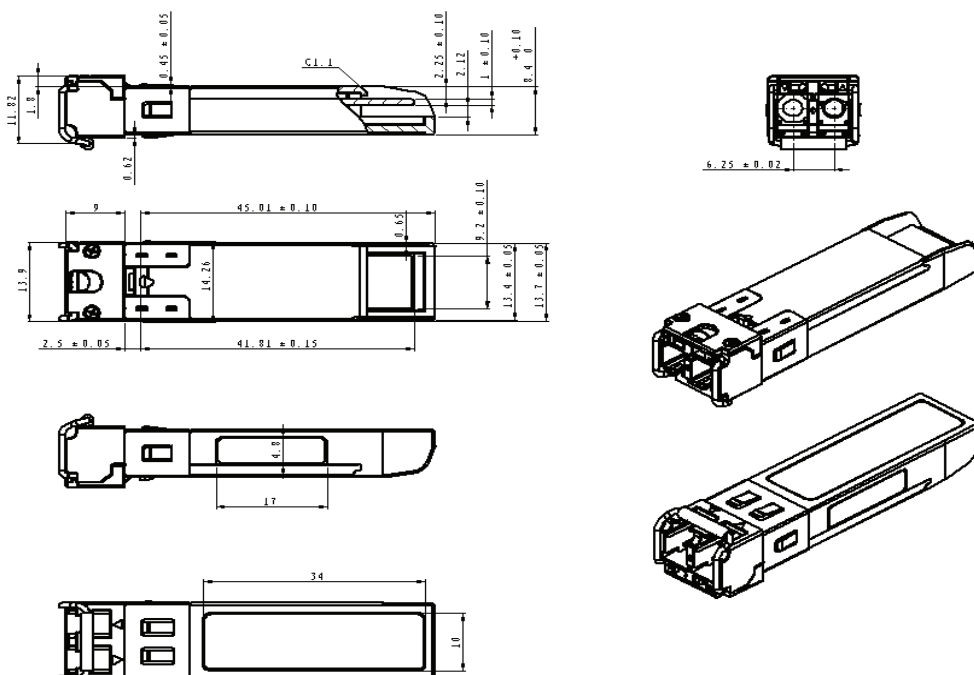




## Recommend Circuit Schematic



## Mechanical Specifications



## Ordering information

Part No.	Data Rate	Laser	Fibre Type	Distance	Optical Interface	DDMI
OP-SFP+-LP-10	10.3Gbps	1310nm DFB	SMF	10Km	LC	YES

\*I--- Industrial operating temperature

\*D--- DDMI

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