SO-SFP-10G-ZR-DWDM-I

SFP+, 10GBase-ZR, Multirate 9.95-11.1 Gbps, C Tunable, DWDM, C-Band, 50GHz, 22dB, 80km, ind. temp.

OVERVIEW

The SO-SFP-10G-ZR-DWDM-I Tunable SFP+ Optical Transceiver is a full duplex, integrated fiber optic transceiver that provides a high-speed serial link at 9.95 to 11.3 Gbps signaling rates. The transceiver supports the enhanced small form factor pluggable module (SFP+) specification SFF-8431 Rev. 4.1 for the electrical interface, SFF-8432 Rev. 5.0 for the mechanical interface, SFF-8690 Rev. 1.4 for the tunability interface, and SFF-8472 Rev. 11.3 for the management interface. The transceiver complies with IEEE 802.3-2012 clause 52 and it supports 10GBase-ZR/ZW (Ethernet), 10G Fibre Channel (FC), and corresponding forward error correction (FEC) rates. It supports Telcordia GR-253-CORE OC-192 LR-2 and ITU-T G.959.1 P1L1-2D2 data rates. On the transmit side, the serial data stream is passed from the electrical connector to a modulator driver. The modulator driver biases and modulates a C-band cooled tunable transmitter, enabling data transmission over up to 80 km of single-mode fiber through an industry-standard LC connector. On the receive side, the 10G optical data stream is recovered from an avalanche photodetector (APD) through a trans-impedance amplifier to the electrical connector. This module features a hot-pluggable SFI-compliant linear electrical interface

PRODUCT FEATURES

- SFF-8431 MSA Revision 4.1 compliant
- SFF-8690 MSA Revision 1.4 compliant
- Full C-band tunable laser source
- 50 GHz ITU channel spacing
- 80 km reach
- Operating temperature range of −40 to +85°C
- RoHS 6/6 compliant
- Limiting SFI AC-coupled electrical output interface
- Supports digital diagnostic monitoring
- Maximum power dissipation of 1.8 W

ORDERING INFORMATION

Part Number	Description
SO-SFP-10G-ZR-DWDM-I	SFP+, 10GBase-ZR, Multirate 9.95-11.1 Gbps, C Tunable, DWDM, C-Band, 50GHz, 22dB, 80km, ind. temp.

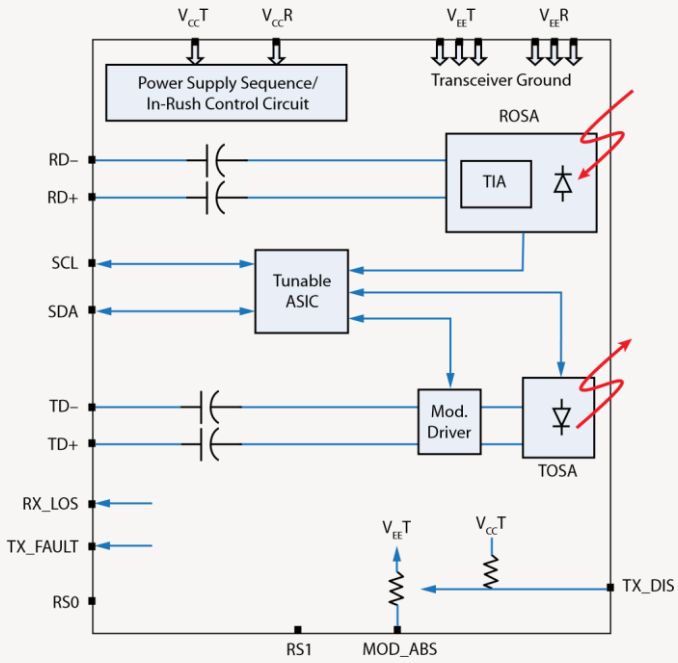
APPLICATIONS

- 10GBASE-X
- Wide area networks (WAN)
- Storage area networks (SAN)

- Ethernet switches and applications

FUNCTIONAL DESCRIPTION

The tunable SFP+ optical transceiver is a full duplex serial electric, serial optical device with both transmit and receive functions contained in a single module that provides a high-speed serial link at 9.95 to 11.3 Gbps signaling rates. The transceiver supports the Enhanced Small Form Factor Pluggable Module SFP+ specification SFF-8431 Rev. 4.1 for the electrical interface, SFF-8690 Rev 1.4 for the tunability interface, SFF-8432 Rev. 5.0 for the mechanical interface, and SFF-8472 Rev. 11.3 for the management interface. Figure below shows a block diagram.



The transceiver has several low-speed interface connections. These connections include: transmitter fault (Tx_Fault), transmitter disable (Tx_Disable), module absent (Mod_ABS), receive loss of signal (Rx_LOS), and a 2-wire serial interface clock (SCL) and data (SDA). Rate select (RS0 and RS1) is not used in this product. The transceiver supports the SFI electrical interface. The electrical interface is based on a high-speed, low-voltage logic AC-coupled linear interface with a 100 Ω nominal differential impedance.

TRANSMITTER

The transmitter path converts serial NRZ electrical data from 9.95 to 11.3 Gbps line rates to a standard compliant optical signal. Inside the module, the differential signal is coupled into the modulator driver which transforms the small swing voltage to an output modulation that drives a cooled InP Integrated Laser Mach-Zehnder (ILMZ) modulator. The optical signal is engineered to meet the 10 Gigabit Ethernet, 10G FC, and corresponding FEC-rates and DWDM specifications at ITU grids with 50 GHz channel spacing. Closed-loop control of the transmitted laser power and modulation swing over temperature and voltage variations are provided. The laser is coupled to a single-mode optical fiber through an industry-standard LC optical connector.
The transmitter performance is specified from -5 to +85°C. For lower temperatures, -40°C to -5°C, the modules heat up to above -5°C in about 1 minute.

RECEIVER

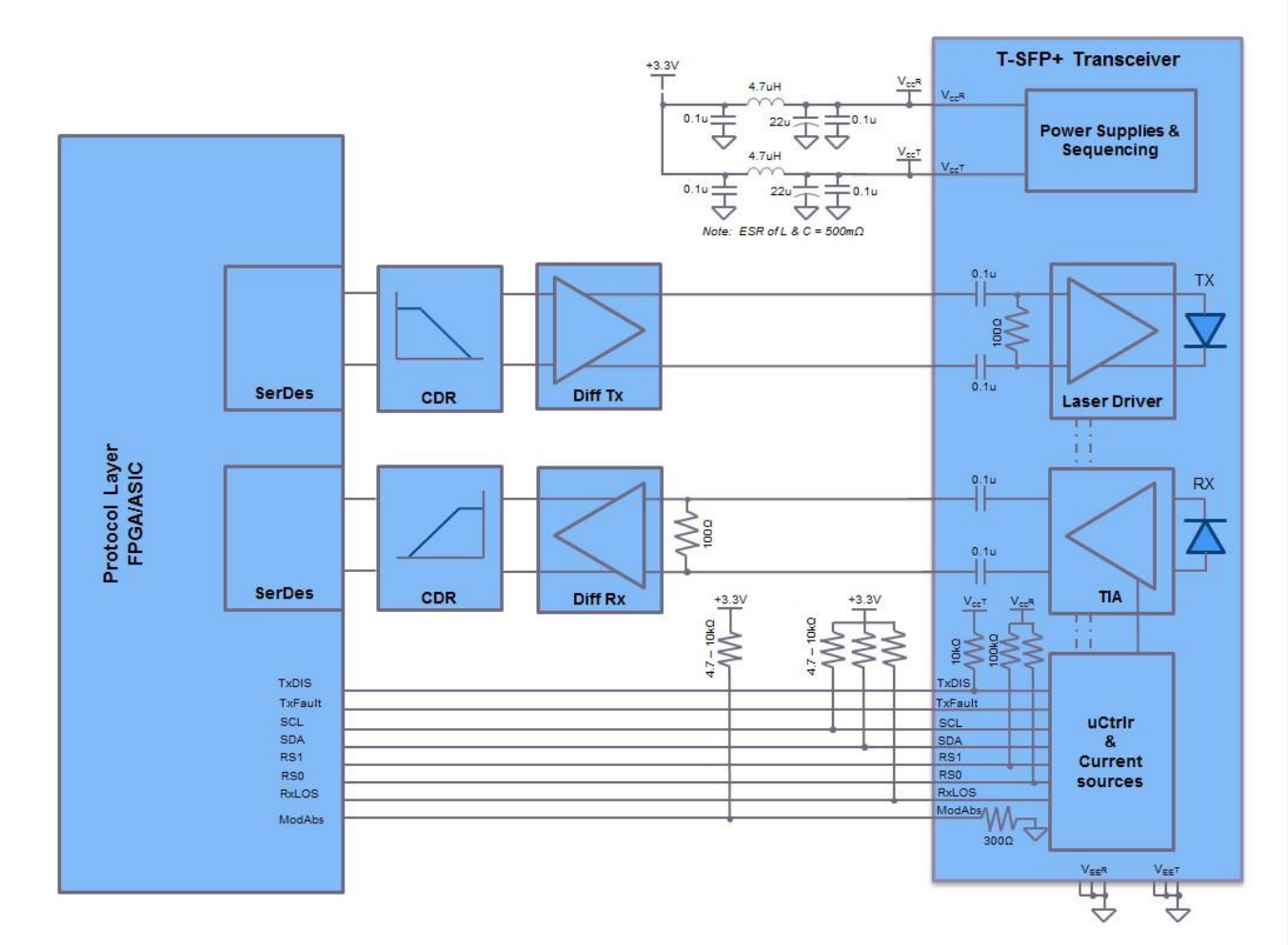
The receiver converts incoming DC-balanced serial NRZ 9.95 to 11.3 Gbps line rate optical data into serial SFI electrical data. Light is coupled to an APD from single-mode optical fiber through an industry-standard LC optical connector. The electrical current from the APD is converted to voltage in a limiting trans-impedance amplifier. The amplified signal is output directly on the RD+ and RD− pins as a 100 Ω CML signal.

LOW-SPEED SIGNALLING

Low-speed signalling is based on low-voltage TTL (LVTTL) operating at a nominal voltage of 3.3 V. Hosts should use a pull-up resistor connected to VCC 3.3 V on the 2-wire interface SCL, SDA, and all low-speed outputs.

APPLICATION SCHEMATICS

Tunable SFP+ modules are hot pluggable and active connections are powered by individual power connections for the transmitter (VCCT) and the receiver (VCCR). Multiple modules can share a single 3.3 V power supply with individual filtering for each VCCT and VCCR. The host shall generate an effective weighted integrated spectrum RMS noise of less than 25 mV in the 10 Hz to 10 MHz frequency range. Detailed power supply specifications are given in SFF-8431 Rev. 4.1 Section 2.8. Figure 2 shows a typical application schematic.



GENERAL SPECIFICATIONS

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Data Rate	DR	0.6		11.3	Gbps	
Bit Error Rate	BER			10^{-12}		
Operating Temperature	T_{OP}	-40		+85	℃	Industrial temperature range - case
Operating Relative Humidity				85	%	
Storage Temperature	T_{STO}	-40		85	℃	Ambient temperature
Supply Current (instantaneously)	I_{Rush}			600	mA	
Supply Current (sustained)	I_S			500	mA	
Power dissipation				1.8	W	
Input Voltage	V_{CC}	3.135	3.3	3.465	V	
Maximum Voltage	V_{MAX}	-0.3		4.0	V	For electrical power interface

ELECTRICAL CHARACTERISTICS – HIGH-SPEED SIGNAL INTERFACE (CML)

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Differential Input Impedance	R_{IN}	85	100	115	Ω	
Differential data input swing	V_{IN_PP}	250		1000	mVpp	Internally AC coupled
Differential Output Impedance	R_{OUT}	85	100	115	Ω	
Differential data output swing	V_{OUT_PP}	350		700	mVpp	Internally AC coupled

ELECTRICAL CHARACTERISTICS – LOW-SPEED SIGNAL INTERFACE (LVTTL)

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Input High Voltage		2.0		V_{CC}+0.3	V	TX-DIS, TX-FAULT
Input Low Voltage		GND		0.8	V	
Output High Voltage		2.4		V_{CC}	V	RX-LOS
Output Low Voltage		GND		0.5	V	

OPTICAL CHARACTERISTICS – TRANSMITTER

Parameter		Symbol	Min	Typ	Max	Unit	Remarks
Average Optical Power		P_{TX}	-1		+3	dBm	coupled into 9/125um SMF
Extinction ratio		Er	9.0			dB	
Wavelength range		λ_r	1528.38		1568.77	nm	ITU-Grid 50GHz
Frequency range		f_r	191.1		196.15	THz	ITU-Grid 50GHz
Frequency center spacing				50		GHz	
Frequency stability (BOL)			f_c-1.5		f_c+1.5	GHz	
Frequency stability (EOL)			f_c-2.5		f_c+2.5	GHz	
Channel tuning time					50	msec	Any channel to any channel
Side Mode Suppression Ratio		SMSR	35			dB	
Spectral width					200	pm	@-20dB, 0.01 nm RBW
Jitter generation	4MHz to 80MHz				0.1	$UI_{[p-p]}$	
	20kHz to 80MHz				0.3	$UI_{[p-p]}$	
Relative Intensity noise		RIN			-130	dB/Hz	

Return loss	24	dBm

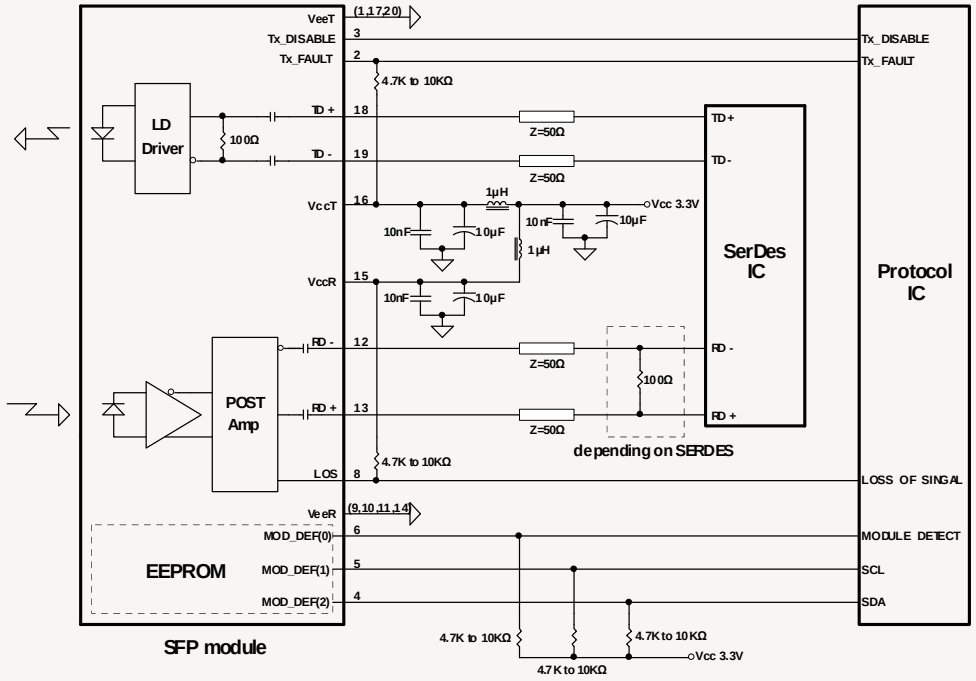
OPTICAL CHARACTERISTICS – RECEIVER

Parameter	Symbol	Min	Typ	Max	Unit	Remarks
Receiver Overload	P_{MAX}	-7			dBm	
Optical Return Loss	*ORL*			-27	dB	
Loss of Signal-Asserted	P_{LOS_A}	-33.5			dBm	
Loss of Signal-Deasserted	P_{LOS_D}			-26	dBm	
Loss hysteresis		0.5		4	dB	

Data-rate [Gbps]	BER	RX Sensitivity 0 ps/nm [max]	RX Sensitivity -400 to +1450 ps/nm [max]	Unit
9.95, 10.3, 10.5	1E-12	-23	-21	dBm
10.709	1E-4	-27	-25	dBm
11.1	1E-4	-27	-25	dBm
11.3	1E-4	-26.5	-24	dBm

Data-rate [Gbps]	BER	Dispersion ps/nm	RX Power Range		OSNR [dB]
			Min	Max	
9.95, 10.3, 10.5	1E-12	0	-18	-7	24
9.95, 10.3, 10.5	1E-12	-400 to +1450	-18	-7	26
10.709	1E-4	0	-18	-7	16
10.709	1E-4	-400 to +1450	-18	-7	19
11.1	1E-4	0	-18	-7	17
11.1	1E-4	-400 to +1450	-18	-7	20

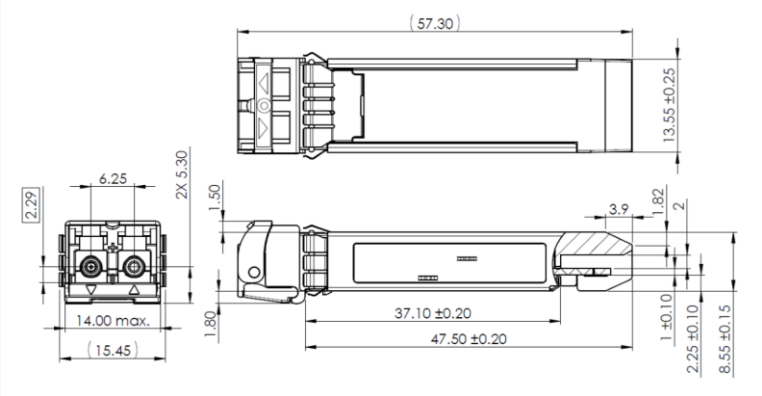
FUNCTIONAL DIAGRAM OF TRANSCEIVER

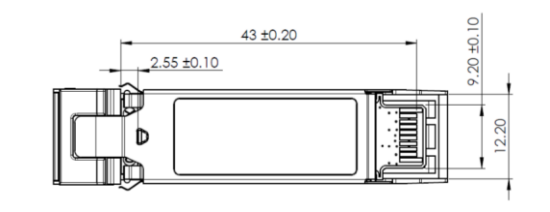


PIN ASSIGNMENT ACCORDING TO MSA

PIN	Signal Name	Description	PIN	Signal Name	Description
1	$V_{EE}T$	Transmitter Signal Ground	11	$V_{EE}R$	Receiver Signal Ground
2	TX_Fault	Transmitter Fault Indication. Logic “1” Output = Laser Fault. Logic “0” Output = Normal Operation	12	RD-	Inverse Receiver Data Out
3	TX_Disable	Logic “1” Input (or no connection) = Laser off, Logic “0” = Laser on.	13	RD+	Receiver Data Out
4	SDA	Modulation Definition 2 – Two wires serial ID Interface	14	$V_{EE}R$	Receiver Signal Ground
5	SDL	Modulation Definition 1 – Two wires serial ID Interface	15	$V_{CC}R$	Receiver Power – 3.3V±5%
6	MOD-ABS	Modulation Definition 0 – Ground in Module	16	$V_{CC}T$	Transmitter Power – 3.3V±5%
7	RS0	RX Rate Select (LVTTL). This pin has an internal 30k pulldown to ground. A signal on this pin will not affect module performance.	17	$V_{EE}T$	Transmitter Signal Ground
8	RX_LOS	Loss of Signal Out (OC).	18	TD+	Transmitter Data In
9	RS1	TX Rate Select (LVTTL). This pin has an internal 30k pulldown to ground. A signal on this pin will not affect module performance.	19	TD-	Inverse Transmitter Data In
10	$V_{EE}R$	Receiver Signal Ground	20	$V_{EE}T$	Transmitter Signal Ground

MECHANICAL DIMENSIONS





COMPLIANCE

- IEEE 802.3-2012 clause 52 standard
- 10G FC standard
- SFF-8431 Rev 4.1
- SFF-8432 Rev 5.0
- SFF-8472 Rev 11.3
- SFF-8690 Rev 1.4
- Class 1 laser safety
- Tested in accordance with Telcordia GR-468
- RoHS6/6