



The LTD1395 SONET/SDH LC duplex SFP transceiver is intended for intermediate reach service up to 20 km in 2.488 Gb/s 1310 nm single mode high-speed telecommunications equipment where low-cost, extraordinary performance and reliability are essential. It consumes low power, operates from a 3.3 volt DC power supply and is offered in the commercial, extended and industrial temperature ranges. The industry standard 2x10 small form pluggable (SFP) package is fabricated with a rugged die cast metal housing and cage assembly. The low jitter and low bit error rate optical assemblies features a 1310 nm DFB laser transmitter and PIN/TIA receiver. It incorporates the SFP MSA LVTTTL Loss of Signal (Rx_LOS), Tx Fault (Tx_FAULT) and Tx Disable (Tx_DIS) monitor and control functions. The differential LVPECL Tx DATA input is AC coupled and terminated. The differential LVPECL Rx DATA output is AC coupled. The device is Class I laser safety compliant.



APPLICATIONS

- 2488 Mb/s SONET/SDH telecom equipment
- Rack to rack system interconnects
- Metro / Access Networks
- Switch to switch interfaces
- Hub interconnects
- Bus extenders
- Channel extenders
- Host adapter interconnects
- Mass storage system interconnects
- Telecom switches
- Router interconnects

FEATURES

- LC Duplex optical interface
- 20 km reach
- 2488 Mb/s data rate
- +3.3 V power supply
- Low DC power consumption
- 2x10 SFP MSA compliant package
- Bail or pull latch option
- Hot swappable
- High performance 1310 nm DFB laser
- High sensitivity PIN/TIA optical receiver:
- Single mode operation
- BER < 1X10⁻¹⁰ (2²³- 1 NRZ PRBS)
- Operating Temperature Range:
 - Commercial: 0 to 70°C
 - Extended: -10 to 80°C
 - Industrial: -40 to 85°C
- Receiver Electrical Interface
- Loss of Signal (Rx LOS), LVTTTL
- Rx DATA AC coupled (LVPECL)
- Transmitter Electrical Interface
- Tx Disable (Tx_DIS), LVTTTL
- Tx Fault (Tx_FAULT), LVTTTL
- Tx DATA AC coupled and terminated (LVPECL)
- RoHS compliant ordering option
- FDA Class 1 Laser

HOW TO ORDER

Part Number	Latch Option (X)		Temperature Option (Y)		RoHS Option (Z)	
LTD1395 XYZ	B	Bail	C	0 to 70 °C	R	RoHS compliance
	P	Pull	E	-10 to 80 °C		
			H	-40 to 85 °C		

Note 1: The Bail and Pull Latches are compatible with the dimensions defined by the SFP MSA

Note 2: The RoHS option must be specified at the time of order



ABSOLUTE MAXIMUM RATINGS - EXCEEDING THESE RATINGS MAY CAUSE IRREVERSIBLE DAMAGE TO THE DEVICE

Parameter	Symbol	Minimum	Maximum	Units
Storage Temperature	T _{stg}	-40	+85	°C
Relative Humidity - Storage	RH _s	0	95	%
Relative Humidity - Operating	RH _o	0	85	%
DC Supply Voltage	V _{CC}	0	3.6	V
Soldering Temperature	T _{slid}	0	260	°C
Soldering Time Duration	t _{slid}	0	10	seconds
Tx DATA	V _{in}	0	V _{CC} + 0.5	V

OPTICAL AND ELECTRICAL SIGNAL - ABSOLUTE MAXIMUM RATINGS

Signal / Data Input Voltage (Tx_DATA)	V _{IN PK-PK}	-	2.4	V
Serial Clock (SCL) Clock Signal (Standard Mode)	I _{CLOCK}	100	-	kHz
Serial Clock (SCL) Clock Signal (Fast Mode)	I _{CLOCK}	-	400	kHz
Rx Optical Input Power	P _{IN-MAX}		3	dBm

LOGIC STATES - ABSOLUTE MAXIMUM RATINGS

Tx_DISABLE Logic HIGH State	Tx_DIS	-	V _{CC} +0.5	V
Tx_FAULT Logic HIGH State	Tx_FAULT	-	V _{CC} +0.5	V
Rx_LOS Logic HIGH State	Rx_LOS	-	V _{CC} +0.5	V
Serial Data (SDA) MOD-DEF2	MOD_DEF2	-	V _{CC} +0.5	V

RECOMMENDED OPERATING CONDITIONS

Parameter	Symbol	Min	Typ	Max	Units	Notes
Ambient Operating Temperature	T _{amb}	0	25	+70	°C	Temperature Range = C
		-10	25	+80	°C	Temperature Range = E
		-40	25	+85	°C	Temperature Range = H
DC Supply Voltage	V _{CC}	3.14	3.30	3.46	Volts	
Module Supply Current	I _{IN}	-	200	250	mA	
Power Dissipation	P _D	-	660	875	mW	



TRANSMITTER LOGIC

Parameter	Function	Logic State	Logic Type	Min	Max	Units
Tx_DIS and Tx_FAULT	DISABLE	HIGH	LVTTL	2.4	V _{CC} +0.3	V
Tx_DIS and Tx_FAULT	ENABLE	LOW	LVTTL	0	0.8	V
Tx_DIS	Assert Time	-	LVTTL	-	10	µs

RECEIVER LOGIC

Parameter	Function	Logic State	Logic Type	Min	Max	Units
Rx_LOS	LOSS OF SIGNAL	HIGH	LVTTL	2.4	V _{CC} +0.3	V
Rx_LOS	NORMAL	LOW	LVTTL	0	0.8	V

I²C Serial ID Logic

Parameter	Function	Logic State	Logic Type	Min	Max	Units
MOD_DEF 0	Digital Ground	Ground	N/A	0	0	V
MOD_DEF 1	Clock Signal	HIGH	LVTTL	2.4	V _{CC} +0.3	V
		LOW	LVTTL	0	0.8	V
MOD_DEF 2	Serial Data	HIGH	LVTTL	2.4	V _{CC} +0.3	V
		LOW	LVTTL	0	0.8	V

TRANSMITTER ELECTRO-OPTICAL CHARACTERISTICS

Parameter	Symbol	LTD1395			Units	Notes
		Min	Typ	Max		
Laser Type		1310 nm DFB				
Optical Output Power	P _o	-0.5	-	5	dBm	Average Optical Output
Center Wavelength	λ	1270	1310	1360	nm	
Spectral Line Width @ -20dB	Δλ	-	-	1	nm	
Side Mode Suppression Ratio	SMSR	30			dB	
Extinction Ratio	ER	8.2	-	-	dB	
Optical Rise and Fall Time	t _r , t _f	-	150	160	ps	20% - 80%
Relative Intensity Noise	RIN	-	-	-120	dB/Hz	
Output Eye		ITU-T G.957 Compliant				
Tx Differential Input Impedance	Z _{in}	-	100	-	Ohms	
Tx Differential Input Voltage	V _{IN}	400	-	2400	mV p-p	LVPECL Tx DATA (Note 1)

Note 1: Internally AC coupled and terminated



RECEIVER ELECTRO-OPTICAL CHARACTERISTICS

Parameter	Symbol	LTD1395			Units	Notes
		Min	Typ	Max		
Receiver Type		PIN / TIA				
Receiver Optical Sensitivity	P _{IN}	-	-	-20.5	dBm	Average Received Power (Note 1)
Receiver Optical Overload	P _{OL}	0	-	-	dBm	
Center Wavelength	λ	1260	1310	1360	nm	
Rx Upper 3 dB Cutoff Frequency	f _c	-	-	2500	MHz	
Signal Loss - Assert	P _{SLA}	-31	-	-21	dBm	
Signal Loss - Deassert	P _{SLD}	-30.5	-	-20.5	dBm	
Signal Loss - Hysteresis	P _H	0.5	2	5	dB	
Data Output Rise / Fall Time	t _r / t _f		100	-	ps	20 - 80 %
Rx Differential Load Impedance	Z _{LOAD}	-	100	-	Ohms	
Rx Differential Output Voltage	V _{OUT}	400	-	1400	mV p-p	LVPECL Rx DATA (Note 2)
Note 1: Average received power where the BER = 10 ⁻¹⁰ , measured with a 2 ²³ -1 NRZ test pattern						
Note 2: Internally AC coupled and terminated						

REGULATORY INFORMATION

Eye Safety

The transceiver is a Class 1 eye-safe device according to FDA 21CFR1040.10 and IEC 60825-1.

Electromagnetic Interference (EMI), Immunity and Product Safety

The transceiver is ESD safe (electrical pins) when tested according to MIL-STD-883, Method 3015.7 and ESD safe (optical connector) when tested according to IEC 61000-4-2. The device is immune to strong RF fields when tested in accordance with IEC 61000-4-3. The device complies with (US) FCC, Part 15; (Europe) CENELEC EN 55022;

(Canada) Class B (CISPR22A); and (Japan) VCCI Class 1. The device has been designed to conform to product safety requirements including UL1950, CSA 22.2, and IEC 60950-1, and has been designed to meet the flammability requirements of UL94.

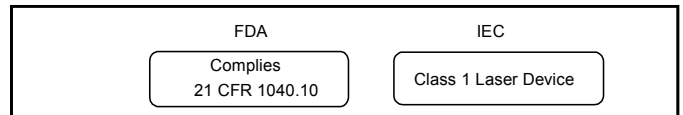
Notice

The factory has made all adjustments to this device prior to shipment. No adjustments or modifications to the device are required or permitted. Any adjustment, modification or tampering of the device voids the product warranty. The US Food and Drug Administration may consider that any adjustment or modification to this device is an act of manufacturing and therefore will require that the device be recertified in accordance with 21 CFR 1040.10.

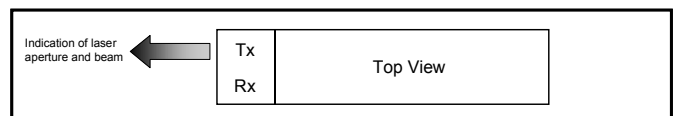
LASER RADIATION INFORMATION

Wavelength	1310 nm
FDA Total Pout: 7 mm aperture at 20 cm distance	< 195 microwatts
IEC Total Pout: 7 mm aperture at 10 cm distance	< 15,600 microwatts
Beam Divergence	17.25°

REQUIRED LABEL



LASER EMISSION





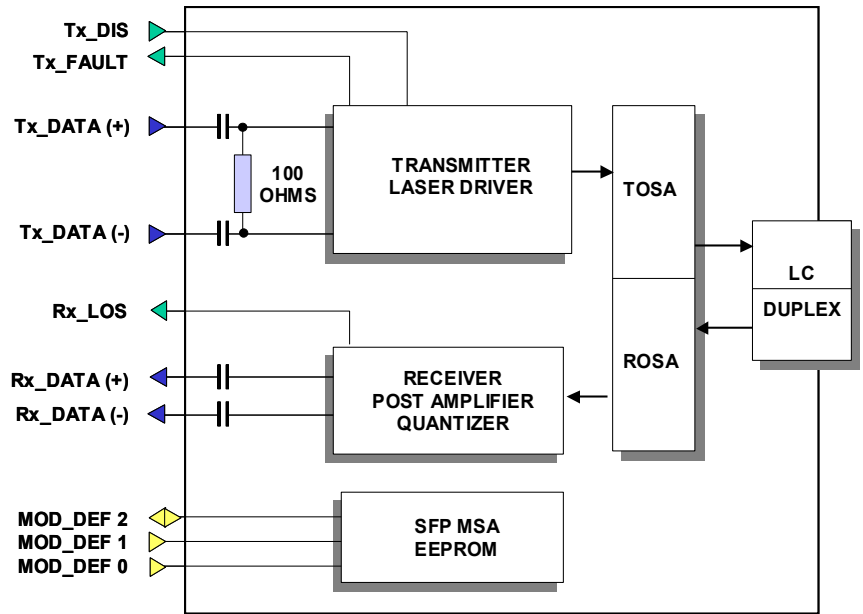
TRANSCEIVER BLOCK DIAGRAM

Transmitter Section

The transmitter section consists of a high reliability 1310 nm DFB laser diode (LD) with back facet monitor photo detector (PD) in an eye safe optical sub-assembly (TOSA), which is mated to the Tx port of the fiber optic LC duplex receptacle. A driver IC converts LVPECL differential input data signals into an analog current source that drives the LD. The transmitter is provided with the Tx_Disable and Tx_FAULT control and monitoring functions.

Receiver Section

The receiver section consists of a high-speed In-GaAs PIN photodiode (PD) and transimpedance preamplifier mounted in an optical subassembly (ROSA), which is mated to the Rx port of the fiber optic LC duplex receptacle. The output of the PD drives the post-amplification, quantizing, and optical signal detection circuits. The receiver is provided with the Rx_LOS (Loss of Signal) monitoring function.



TRANSCEIVER MONITOR AND CONTROL FUNCTIONS

Rx Signal Loss (Rx_LOS) Description

The Rx_LOS (Loss of Signal) is an open collector LVTTTL monitor port. It switches state based on the received optical input signal level that passes through the photo detector (PD), post amplifier and quantizer. If the received signal is above the Rx threshold, then Rx_LOS is set LOW indicating normal operation. If the received signal is below the Rx threshold, then Rx_LOS is set HIGH indicating a possible broken fiber, unplugged connector or low Tx signal from the host. The Rx_LOS pin requires an external 4.7k to 10k Ohm pull-up resistor.

Tx Disable (Tx_DIS) Description

The Tx_DIS (Transmit Disable) is an open collector LVTTTL control port that is controlled by a logic signal on the host (system) printed

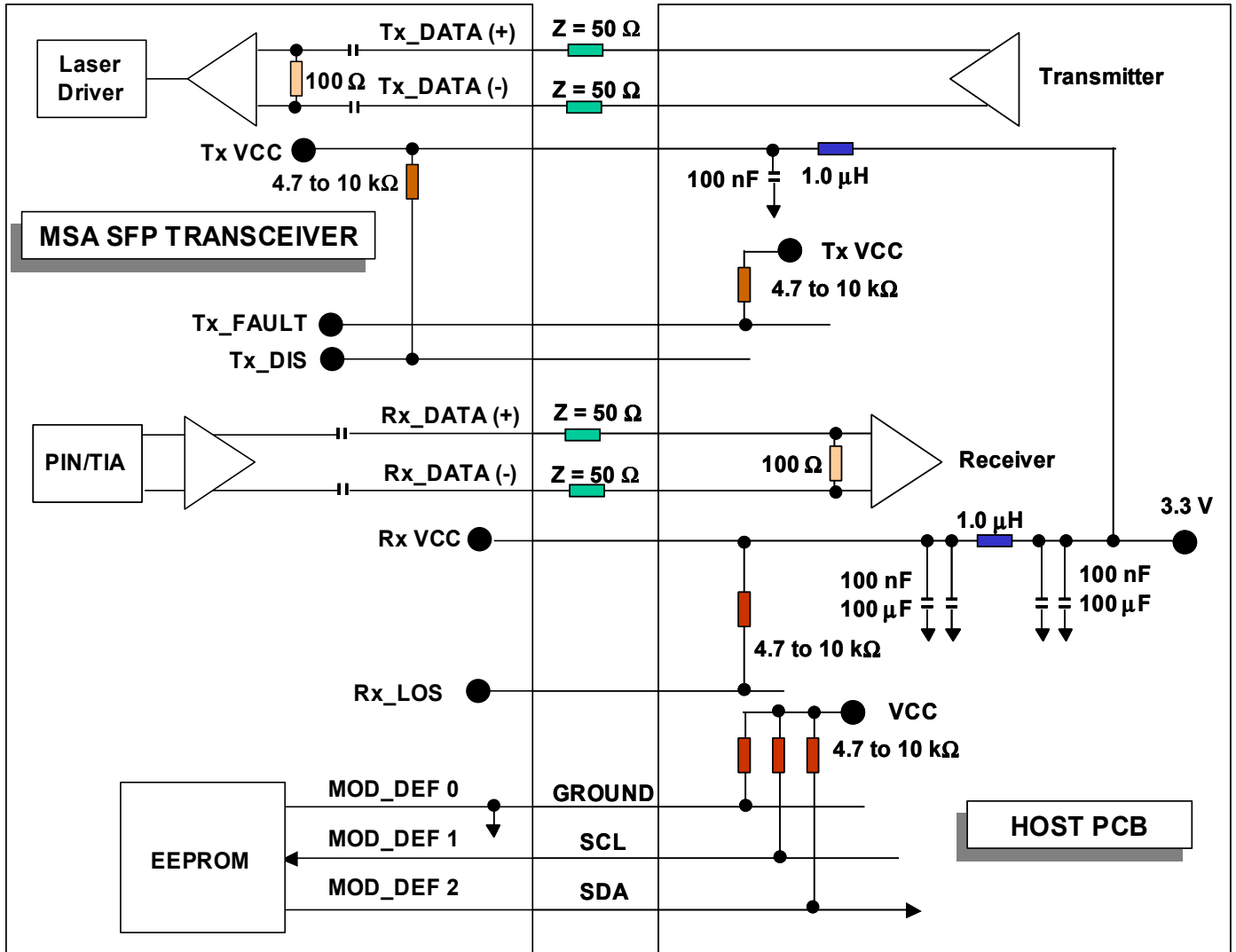
circuit board. If the system is ready to send data then the Tx_DIS line is set LOW to enable the laser driver and the laser transmitter. If the system is not ready to send data, then the Tx_DIS line is set HIGH to disable the transmitter.

Tx Fault (Tx_FAULT) Description

The Tx_FAULT (Transmit Fault) is an open collector LVTTTL monitor port. It switches states based on the condition of the laser driver and the laser including the end of life condition of the laser. If the parameters of the laser driver and laser are within specifications then the Tx_FAULT is set LOW indicating normal transceiver operation. If a fault occurs, including excess optical output power then Tx_FAULT is set HIGH which disables the transmitter. The Tx_FAULT can be reset to normal operation by toggling Tx_DIS or switching the power supply. The Tx_FAULT pin requires an external 4.7k to 10k Ohm pull-up resistor.

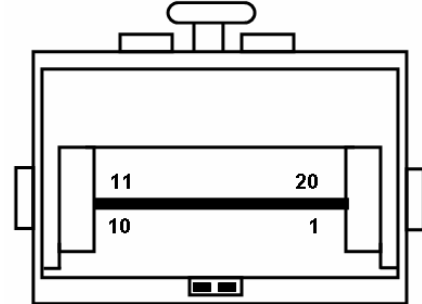
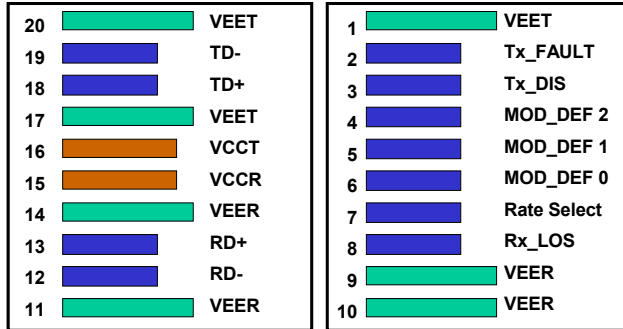


ELECTRICAL INTERFACE





PIN ASSIGNMENT



Transceiver Electrical Pad Layout
Top View Bottom View

Transceiver Pin Locations

SFP PIN ASSIGNMENT

Pin	Symbol	Logic Type	Description	Notes
1	V _{EET}	N/A	Transmitter Ground	
2	Tx_FAULT	LVTTL	Transmitter Fault, LOW = Normal Operation, HIGH = Fault Indication	Note 1
3	Tx_DIS	LVTTL	Transmit Disable, LOW = Normal Operation, HIGH = Disables Module	Note 1
4	MOD_DEF 2	LVTTL	Module Definition 2 - Two-Wire Interface - Serial Data	Note 1
5	MOD_DEF 1	LVTTL	Module Definition 1 - Two-Wire Interface - Clock Signal	Note 1
6	MOD_DEF 0	LVTTL	Module Definition 0 - Two-Wire Interface Digital Ground	
7	Rate Select	N/A	Not Connected	
8	Rx_LOS	LVTTL	Receiver Loss of Signal, LOW = Normal Operation, HIGH = Loss of Signal	Note 1
9	V _{EER}	N/A	Receiver Ground	
10	V _{EER}	N/A	Receiver Ground	
11	V _{EER}	N/A	Receiver Ground	
12	RD-	LVPECL	Rx_Data Output (Inverted)	Note 2
13	RD+	LCPECL	Rx_Data Output (Non Inverted)	Note 2
14	V _{EER}	N/A	Receiver Ground	
15	V _{CCR}	N/A	Receiver DC Power	3.3 V +/- 5%
16	V _{CCT}	N/A	Transmitter DC Power	3.3 V +/- 5%
17	V _{EET}	N/A	Transmitter Ground	
18	TD+	LVPECL	Tx_Data Input (Non Inverted)	Note 3
19	TD-	LVPECL	Tx_Data Input (Inverted)	Note 3
20	V _{EET}	N/A	Transmitter Ground	

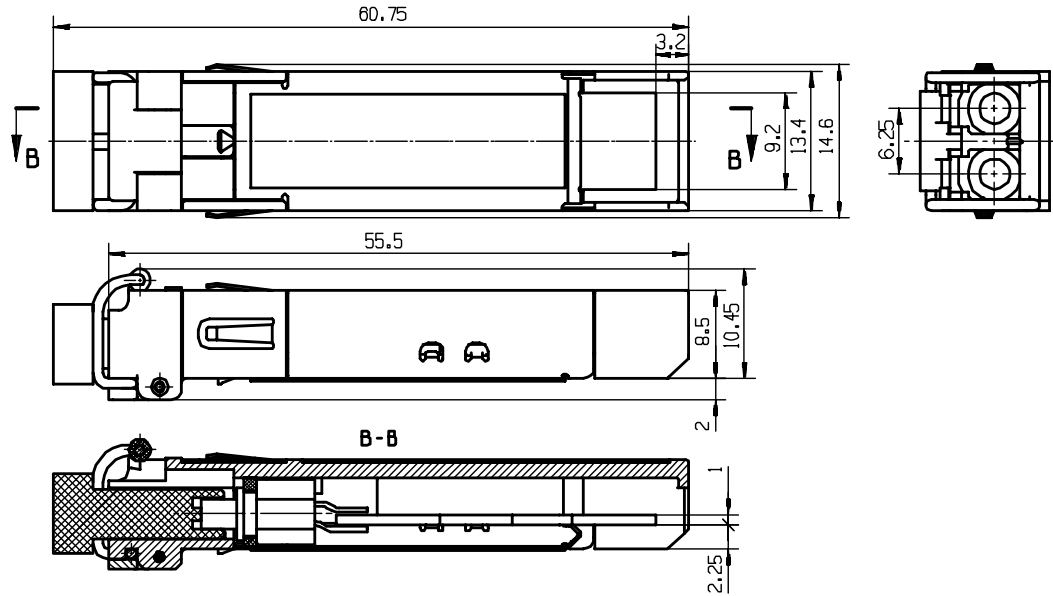
Note 1 The uncommitted Tx_Fault, Rx_LOS, MOD_DEF 1 and MOD_DEF 2 LVTTL monitor and control pins each require a pull up resistor of 4.7k to 10k Ohms.

Note 2 The 100 Ohm differential Rx Data output is internally AC coupled and must be terminated with 100 Ohms at the differential user interface.

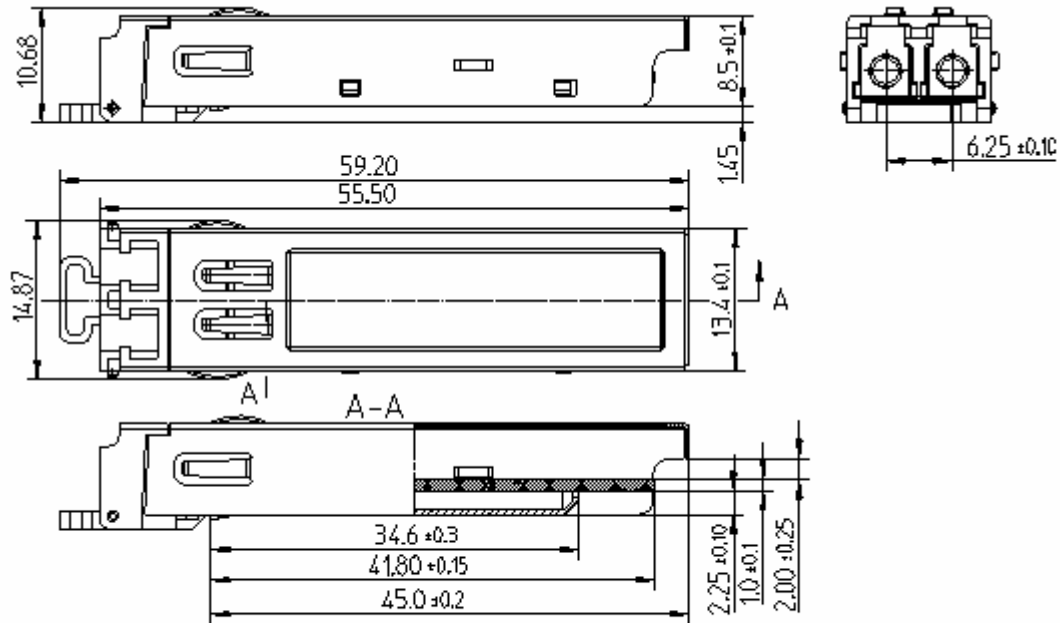
Note 3 The 100 Ohm differential Tx Data input is internally AC coupled and terminated.



SFP DUPLEX TRANSCEIVER MECHANICAL DIMENSIONS (BAIL LATCH OPTION)



SFP DUPLEX TRANSCEIVER MECHANICAL DIMENSIONS (PULL LATCH OPTION)



Dimensions are in millimeters
Dimension tolerance is ± 0.1mm unless otherwise specified



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