Features

- Hot pluggable
- 10Gb/s serial optical interface
- 850nm high-speed VCSEL and PIN receiver
- SFP+ MSA package with duplex LC connector
- 2-wire interface for management and diagnostic monitor
- SFI High Speed Electrical Interface
- Very low EMI and excellent ESD protection
- +3.3V single power supply
- Power consumption less than 0.8W
- Operating case temperature: 0~+70°C

Applications

- ✧ 10G Base-SR/SW
- ✧ 10GE Storage, 8G Fiber Channel
- ✧ 10G Ethernet

Standard

- ✧ Compliant to SFP+ SFF-8431 and SFF-8432
- ✧ Compliant with SFF-8472 Rev 10.2
- ✧ Compliant with IEEE 802.3ae 10GBASE-SR and 10GBASE-SW
- ✧ RoHS Compliant

Description

HSFP10-3831 is a very compact 10Gb/s optical transceiver module for serial optical communication applications, supporting data-rate of 10.3125Gbps (10GBASE-SR) or 9.953Gbps (10GBASE-SW), and transmission distance up to 300m on 50μm MMF (2000MHz.km).

Fiber type	Minimum modal bandwidth @ 850 nm (MHz•km)	Operatingra nge (meters)
62.5um MMF	160	2 to 26
	200	2 to 33
50um MMF	400	2 to 66
	500	2 to 82
	2000	2 to 300

SFP+ SR Operating Range for each Optical Fiber Type

The transceiver consists of two sections: The high performance 850nm VCSEL transmitter and high sensitivity PIN integrated with a TIA. Receiver.

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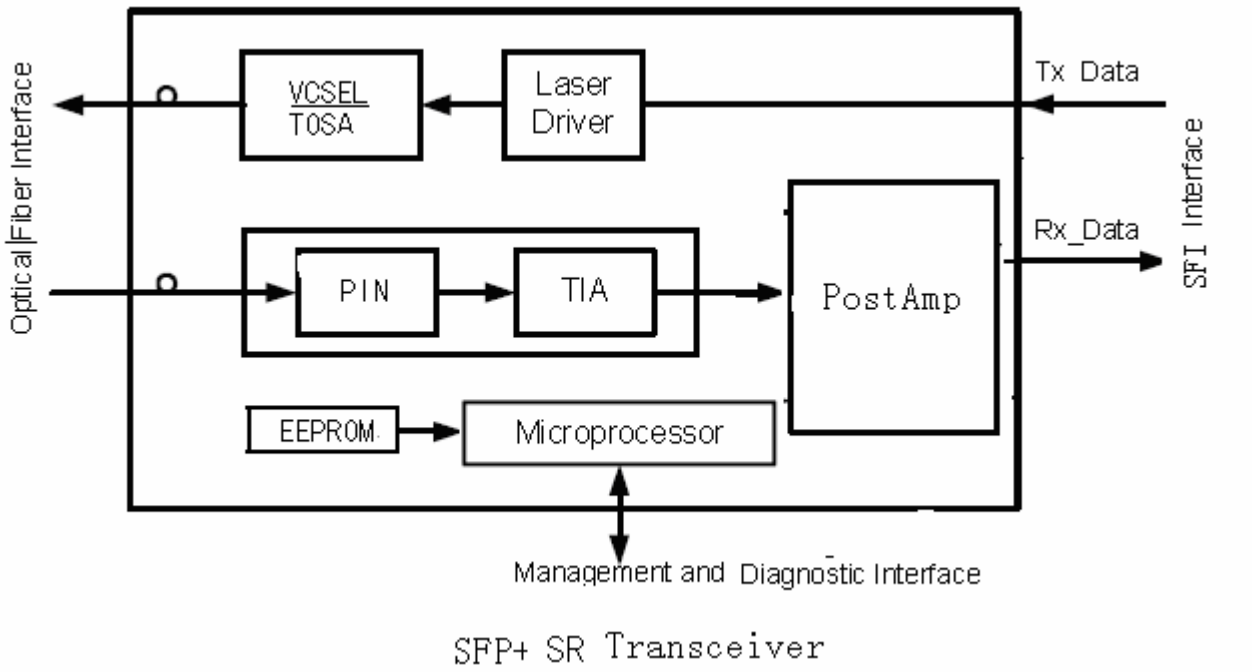
A block diagram of the HSFP10-3831 SFP+ optical transceiver is shown below



SFP+ SR Transceiver

- **Absolute Maximum Ratings**

Parameter	Symbol	Min	Max	Unit
Storage Temperature	T_{ST}	-40	+85	℃
Supply Voltage	V_{CC3}	0	+3.6	V
Relative Humidity	RH	5	85	%

- **Recommend Operation Environment:**

Parameter	Symbol	Min	Typ	Max	Unit
Date Rate			10.3125		Gb/s
Supply Voltage	V_{CC}	+3.14	3.3	+3.47	V
Supply Current	I_{CC}		180	200	mA
Power Dissipation	PD			0.8	W
Operating Temperature	T_{OP}	-5	25	+75	℃

- **Transmitter Operating Characteristic-Optical, Electrical**

Parameter	Symbol	Min	Typ	Max	Unit	Ref.
Side Mode Suppression Ratio	SMSR	30	-		dBm	
Average launch power of OFF transmitter	Poff		-	-30	dBm	

Extinction Ratio		ER	3.5		-	dB	1
Transmitter Dispersion Penalty		TDP	-	-	3.9	dB	
Operating Data Rate		S		10.3125		Gbps	
Centre Wavelength		λC	840	850	860	nm	
Spectrum Band Width (RMS)		σ			0.45	nm	
Average Optical Power		Pavg	-7.3	-	-1	dBm	
Optical Eye Mask		Compliant with IEEE 802.3ae					
Input Differential Impedance		ZIN	90	100	110	Ω	
TX Disable	Disable		2.0		Vcc+0.3	V	
	Enable		0		0.8	V	
TX Fault	Fault		2.0		Vcc+0.3	V	
	Normal		0		0.8	V	
Data Dependent Input Jitter		DDJ			0.08	UI	
Data Input Total Jitter		TJ			0.25	UI	

- **Receiver Operating Characteristic-Optical, Electrical**

Parameter		Symbol	Min	Typ	Max	Unit	Ref.
Center Wavelength		λr		850		nm	
Average receiver power		PIN			-11.1	dBm	2
Receiver Overload		PMAX	-1.0			dBm	2
Los Assert		LosA	-30		-	dBm	
Los Dessert		LosD			-12	dBm	
Los Hysteresis		LosH	0.5	2.5	5	dB	
Receiver Reflectance					-12	dB	1
Output Differential Impedance		PIN	90	100	110	Ω	
LOS	High		2.0		Vcc+0.3	V	
	Low		0		0.8		
Rx Output Rise and Fall Time		Tr/Tf	30			ps	20% to 80%
Total Output Jitter		TJ			0.7	UI	
Data Dependent Output Jitter		DJ			0.42	UI	

Notes:

Note 1、 Measured at 10.3125b/s with PRBS 2^{31} – 1 NRZ test pattern.

Note 2、Under the ER worst case, measured at 10.3125 Gb/s with PRBS 2^{31} – 1 NRZ test pattern for BER < $1x10^{-12}$

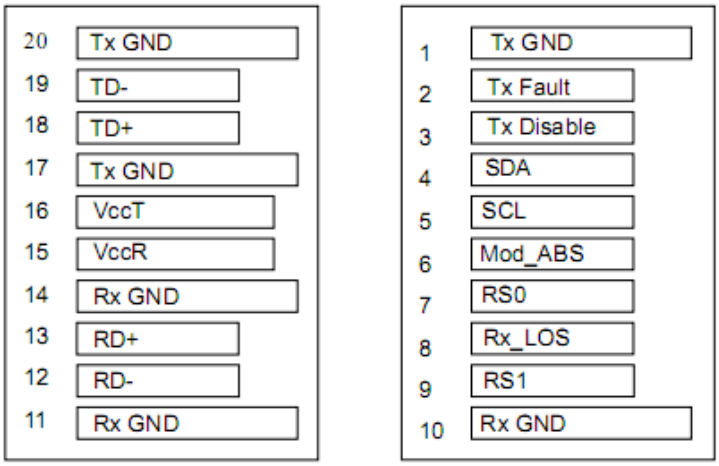
- **Control and Status I/O Timing Characteristics**

Parameter	Symbol	Min	Max	Unit	Ref.
TX Disable Assert Time	t_off		10	μs	1
TX Disable Negate Time	t_on		1	ms	2
Time to initialize including reset of TX_Fault	t_init		300	ms	3
TX Fault Assert Time	t_fault		100	μs	4
TX Disable to reset	t_reset	10		μs	5
LOS Assert Time	t_loss_on		100	μs	6
LOS Deassert Time	t_loss_off		100	μs	7
Rate-Select Change Time	t_ratesel		10	μs	8
Serial ID Clock Rate	f_serial_clock		400	kHz	

Notes:
[1] Time from rising edge of TX Disable to when the optical output falls below 10% of nominal
[2] Time from falling edge of TX Disable to when the modulated optical output rises above 90% of nominal
[3] From power on or negation of TX Fault using TX Disable
[4] Time from fault to TX fault on
[5] Time TX Disable must be held high to reset TX_fault
[6] Time from LOS state to RX LOS assert
[7] Time from non-LOS state to RX LOS deassert.
[8] Time from rising or falling edge of Rate Select input until receiver bandwidth is in conformance with appropriate specification

Pin Assignment

Diagram of Host Board Connector Block Pin Numbers and Name



Top of Board **Bottom of Board**

Pin Assignment

Parameter	Logic	Symbol	Name/Description	Note
1		VeeT	Module Transmitter Ground	1
2	LVTTL-O	TX_Fault	Module Transmitter Fault	2
3	LVTTL-I	TX_Disable	Transmitter Disable; Turns off transmitter laser output	3
4	LVTTL-I/O	SDA	2-wire Serial Interface Data Line	
5	LVTTL-I/O	SCL	2-wire Serial Interface Clock	
6		MOD_ABS	Module Absent, connected to VeeT or VeeR in the module	4
7	LVTTL-I	RS0	Receiver Rate Select，Not used	
8	LVTTL-O	RX_LOS	Receiver Loss of Signal Indication Active High	2
9	LVTTL-I	RS1	Transmitter Rate Select，Not used	
10		VeeR	Module Receiver Ground	1
11		VeeR	Module Receiver Ground	1
12	CML-O	RD-	Receiver Inverted Data Output	
13	CML-O	RD+	Receiver Non-Inverted Data Output	
14		VeeR	Module Receiver Ground	1
15		VccR	Module Receiver 3.3 V Supply	
16		VccT	Module Transmitter 3.3 V Supply	
17		VeeT	Module Transmitter Ground	1
18	CML-I	TD+	Transmitter Non-Inverted Data Input	
19	CML-I	TD-	Transmitter Inverted Data Input	
20		VeeT	Module Transmitter Ground	1

Notes:
[1] The module signal ground pins, VeeR and VeeT, shall be isolated from the module case.
[2] This pin is an open collector/drain output pin and shall be pulled up with 4.7k-10kohms to Host_Vcc on the host board. Pull ups can be connected to multiple power supplies, however the host board design shall ensure that no module pin has voltage exceeding module VccT/R + 0.5 V.
[3] This pin is an open collector/drain input pin and shall be pulled up with 4.7k-10kohms to VccT in the module.

[4] This pin shall be pulled up with 4.7k-10kohms to Host_Vcc on the host board.

SFP Module EEPROM Information and Management

The SFP+ modules implement the 2-wire serial communication protocol as defined in the SFP -8472. The serial ID information of the SFP+ modules and Digital Diagnostic Monitor parameters can be accessed through the I2C interface at address A0h and A2h. The memory is mapped in Table 1. Detailed ID information (A0h) is listed in Table 2. And the DDM specification at address A2h. For more details of the memory map and byte definitions, please refer to the SFF-8472, "Digital Diagnostic Monitoring Interface for Optical Transceivers".

Table 1. Digital Diagnostic Memory Map (Specific Data Field Descriptions)

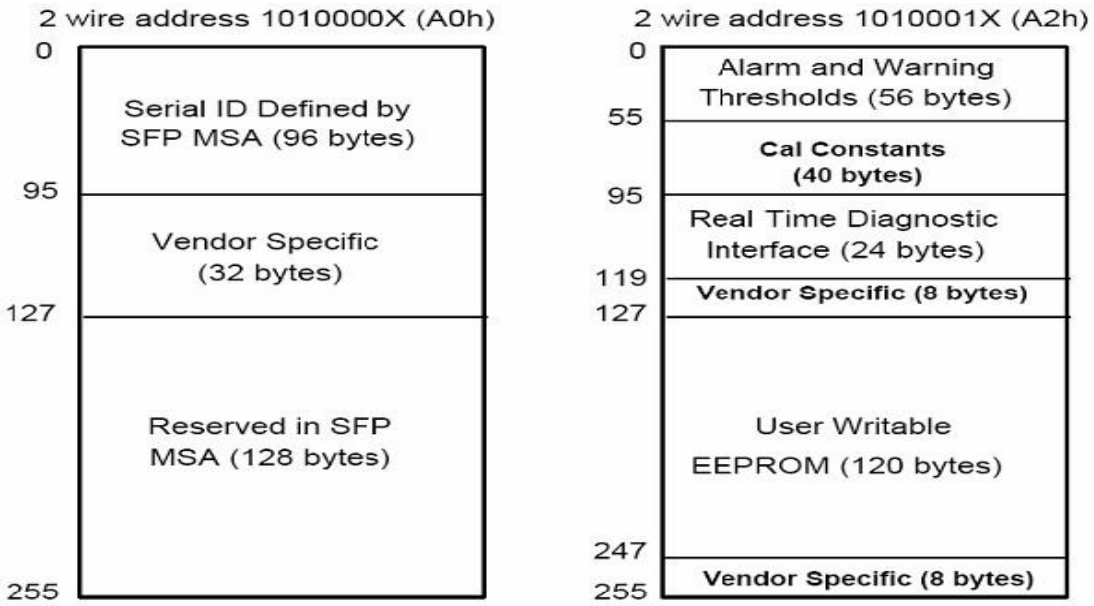


Table 2 - EEPROM Serial ID Memory Contents (**A0h**)

Data Address	Length (Byte)	Name of Length	Description and Contents
Base ID Fields			
0	1	Identifier	Type of Serial transceiver (03h=SFP)
1	1	Reserved	Extended identifier of type serial transceiver (04h)
2	1	Connector	Code of optical connector type (07=LC)
3-10	8	Transceiver	
11	1	Encoding	64B/66B (06h)
12	1	BR,Nominal	Nominal baud rate, unit of 100Mbps （67h）
13-14	2	Reserved	(0000h)
15	1	Length(9um)	Link length supported for 9/125um fiber, units of 100m
16	1	Length(50um)	Link length supported for 50/125um fiber, units of 10m
17	1	Length(62.5um)	Link length supported for 62.5/125um fiber, units of 10m
18	1	Length(Copper)	Link length supported for copper, units of meters
19	1	Reserved	

20-35	16	Vendor Name	SFP vendor name: Hi-Optel ECI
36	1	Reserved	
37-39	3	Vendor OUI	SFP transceiver vendor OUI ID
40-55	16	Vendor PN	Part Number: "HSFP10xxxxECI" (ASCII)
56-59	4	Vendor rev	Revision level for part number
60-62	3	Reserved	
63	1	CCID	Least significant byte of sum of data in address 0-62
Extended ID Fields			
64-65	2	Option	Indicates which optical SFP signals are implemented (001Ah = LOS, TX_FAULT, TX_DISABLE all supported)
66	1	BR, max	Upper bit rate margin, units of %
67	1	BR, min	Lower bit rate margin, units of %
68-83	16	Vendor SN	Serial number (ASCII)
84-91	8	Date code	Hi-Optel's Manufacturing date code
92	1	Diagnostic type	
93	1	Enhanced option	
94	1	SFF-8472	
95	1	CCEX	Check code for the extended ID Fields (addresses 64 to 94)
Vendor Specific ID Fields			
96-127	32	Readable	Hi-Optel specific date, read only
128-255	128	Reserved	Reserved for SFF-8079

Table 2 - EEPROM Serial ID Memory Contents (**A2h**)

Address	Bytes	Name	Description
00-01	2	Temp High Alarm	MSB at low address
02-03	2	Temp Low Alarm	MSB at low address
04-05	2	Temp High Warning	MSB at low address
06-07	2	Temp Low Warning	MSB at low address
08-09	2	Voltage High Alarm	MSB at low address
10-11	2	Voltage Low Alarm	MSB at low address
12-13	2	Voltage High Warning	MSB at low address
14-15	2	Voltage Low Warning	MSB at low address
16-17	2	Bias High Alarm	MSB at low address
18-19	2	Bias Low Alarm	MSB at low address
20-21	2	Bias High Warning	MSB at low address
22-23	2	Bias Low Warning	MSB at low address
24-25	2	TX Power High Alarm	MSB at low address
26-27	2	TX Power Low Alarm	MSB at low address
28-29	2	TX Power High Warning	MSB at low address
30-31	2	TX Power Low Warning	MSB at low address
32-33	2	RX Power High Alarm	MSB at low address

34-35	2	RX Power Low Alarm	MSB at low address
36-37	2	RX Power High Warning	MSB at low address
38-39	2	RX Power Low Warning	MSB at low address
40-55	16	Reserved	Reserved for future monitored quantities

Address	#Bytes	Name	Description
56-59	4	Rx_PWR(4)	Single precision floating point calibration data - Rx optical power. Bit 7 of byte 56 is MSB. Bit 0 of byte 59 is LSB.
60-63	4	Rx_PWR(3)	Single precision floating point calibration data - Rx optical power. Bit 7 of byte 60 is MSB. Bit 0 of byte 63 is LSB.
64-67	4	Rx_PWR(2)	Single precision floating point calibration data - Rx optical power. Bit 7 of byte 64 is MSB, bit 0 of byte 67 is LSB.
68-71	4	Rx_PWR(1)	Single precision floating point calibration data - Rx optical power. Bit 7 of byte 68 is MSB, bit 0 of byte 71 is LSB.
72-75	4	Rx_PWR(0)	Single precision floating point calibration data - Rx optical power. Bit 7 of byte 72 is MSB, bit 0 of byte 75 is LSB.
76-77	2	Tx_I(Slope)	Fixed decimal (unsigned) calibration data, laser bias current. Bit 7 of byte 76 is MSB, bit 0 of byte 77 is LSB.
78-79	2	Tx_I(Offset)	Fixed decimal (signed two's complement) calibration data, laser bias current. Bit 7 of byte 78 is MSB, bit 0 of byte 79 is LSB
80-81	2	Tx_PWR(Slope)	Fixed decimal (unsigned) calibration data, transmittercoupled output power. Bit 7 of byte 80 is MSB, bit 0 of byte81 is LSB.
82-83	2	Tx_PWR(Offset)	Fixed decimal (signed two's complement) calibration data, transmitter coupled output power. Bit 7 of byte 82 is MSB, bit 0 of byte 83 is LSB.
84-85	2	T(Slope)	Fixed decimal (unsigned) calibration data, internal module temperature. Bit 7 of byte 84 is MSB, bit 0 of byte 85 is LSB.
86-87	2	T(Offset)	Fixed decimal (signed two's complement) calibration data, internal module temperature. Bit 7 of byte 86 is MSB, bit 0 of byte 87 is LSB.
88-89	2	V(Slope)	Fixed decimal (unsigned) calibration data, internal module supply voltage. Bit 7 of byte 88 is MSB, bit 0 of byte 89 is LSB.
90-91	2	V(Offset)	Fixed decimal (signed two's complement) calibration data, internal module supply voltage. Bit 7 of byte 90 is MSB. Bit 0 of byte 91 is LSB.
92-95	4	Reserved	Reserved

Byte	Bit	Name	Description
Converted analog values. Calibrated 16 bit data			
96	All	Temperature MSB	Internally measured module temperature.
97	All	Temperature LSB	
98	All	Vcc MSB	Internally measured supply voltage in transceiver.
99	All	Vcc LSB	
100	All	TX Bias MSB	Internally measured TX Bias Current.
101	All	TX Bias LSB	
102	All	TX Power MSB	Measured TX output power.
103	All	TX Power LSB	
104	All	RX Power MSB	Measured RX input power.
105	All	RX Power LSB	
106	All	Reserved MSB	Reserved for 1st future definition of digitized analog input
107	All	Reserved LSB	Reserved for 1st future definition of digitized analog input
108	All	Reserved MSB	Reserved for 2nd future definition of digitized analog input
109	All	Reserved LSB	Reserved for 2nd future definition of digitized analog input
Optional Status/Control Bits			
110	7	TX Disable State	Digital state of the TX Disable Input Pin. Not supported.
110	6	Soft TX Disable	Read/write bit that allows software disable of laser. Not supported.
110	5	Reserved	
110	4	RX Rate Select State	Digital state of the SFP RX Rate Select Input Pin. Not supported.
110	3	Soft RX Rate Select	Read/write bit that allows software RX rate select.
			Not supported.
110	2	TX Fault	Digital state of the TX Fault Output Pin.
110	1	LOS	Digital state of the LOS Output Pin.
110	0	Data Ready	Indicates transceiver has achieved power up and data is ready
111	7-0	Reserved	Reserved.

Byte	Bit	Name	Description
Reserved Optional Alarm and Warning Flag Bits			
112	7	Temp High Alarm	Set when internal temperature exceeds high alarm level.
112	6	Temp Low Alarm	Set when internal temperature is below low alarm level.
112	5	Vcc High Alarm	Set when internal supply voltage exceeds high alarm level.
112	4	Vcc Low Alarm	Set when internal supply voltage is below low alarm level.
112	3	TX Bias High Alarm	Set when TX Bias current exceeds high alarm level.

112	2	TX Bias Low Alarm	Set when TX Bias current is below low alarm level.
112	1	TX Power High Alarm	Set when TX output power exceeds high alarm level.
112	0	TX Power Low Alarm	Set when TX output power is below low alarm level.
113	7	RX Power High Alarm	Set when Received Power exceeds high alarm level.
113	6	RX Power Low Alarm	Set when Received Power is below low alarm level.
113	5	Reserved Alarm	
113	4	Reserved Alarm	
113	3	Reserved Alarm	
113	2	Reserved Alarm	
113	1	Reserved Alarm	
113	0	Reserved Alarm	
114	All	Reserved	
115	All	Reserved	
116	7	Temp High Warning	Set when internal temperature exceeds high warning level.
116	6	Temp Low Warning	Set when internal temperature is below low warning level.
116	5	Vcc High Warning	Set when internal supply voltage exceeds high warning level.
116	4	Vcc Low Warning	Set when internal supply voltage is below low warning level.
116	3	TX Bias High Warning	Set when TX Bias current exceeds high warning level.
116	2	TX Bias Low Warning	Set when TX Bias current is below low warning level.
116	1	TX Power High Warning	Set when TX output power exceeds high warning level.
116	0	TX Power Low Warning	Set when TX output power is below low warning level.
117	7	RX Power High Warning	Set when Received Power exceeds high warning level.
117	6	RX Power Low Warning	Set when Received Power is below low warning level.
117	5	Reserved Warning	
117	4	Reserved Warning	
117	3	Reserved Warning	
117	2	Reserved Warning	
117	1	Reserved Warning	
117	0	Reserved Warning	
118	All	Reserved	
119	All	Reserved	

Digital Diagnostic Monitor Characteristics

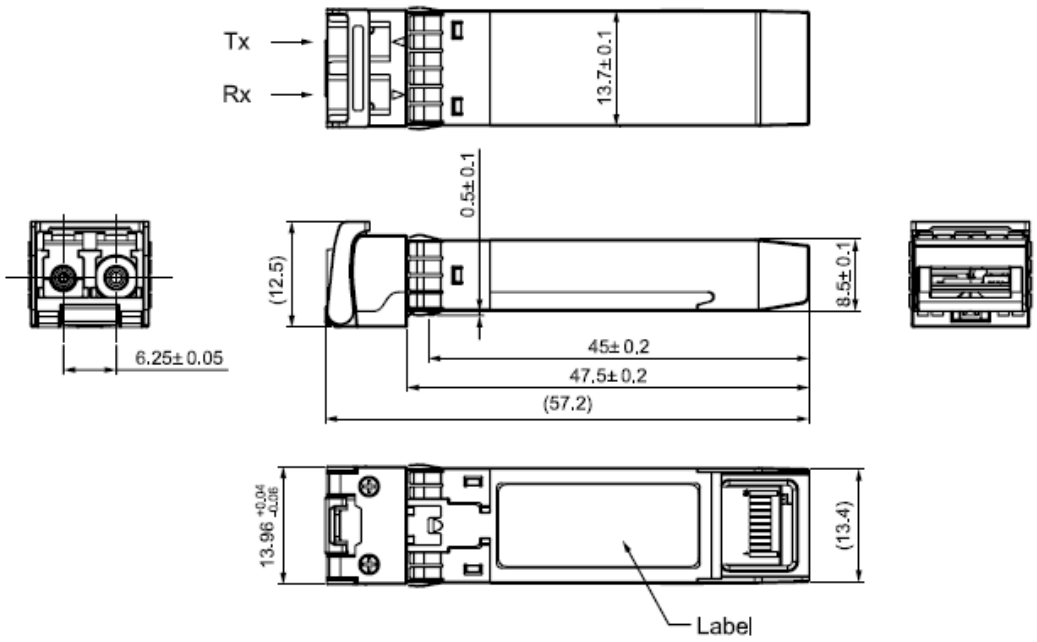
Parameter	Symbol	Min.	Max	Unit
Temperature monitor absolute error	DMI_Temp	-3	3	°C
Laser power monitor absolute error	DMI_TX	-3	3	dBm
RX power monitor absolute error	DMI_RX	-3	3	dBm
Supply voltage monitor absolute error	DMI_VCC	-0.17	0.17	V
Bias current monitor	DMI_Ibias	-10%	10%	mA

DDM Range and Accuracy

Tx DDM（dBm）		Rx DDM（dBm）		DDM Accuracy
High	Low	High	Low	
+0	-9.5	+1.0	-13	<3 dB

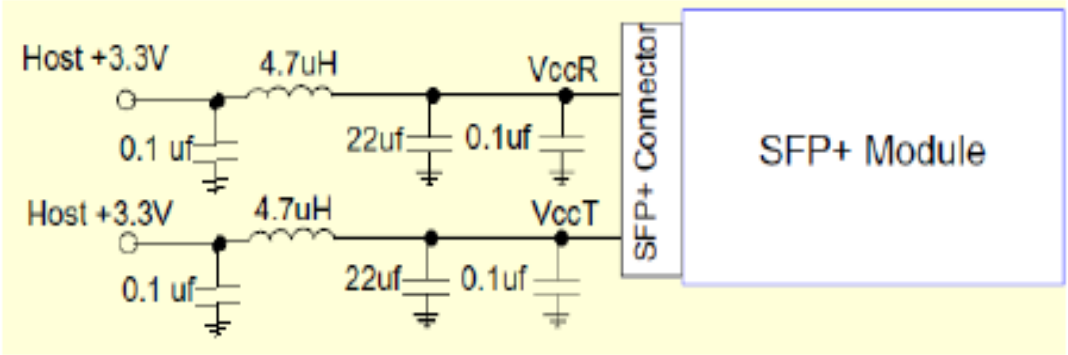
Mechanical Dimensions

Comply to SFF-8432 rev. 5.1 Improved Pluggable formfactor specification.

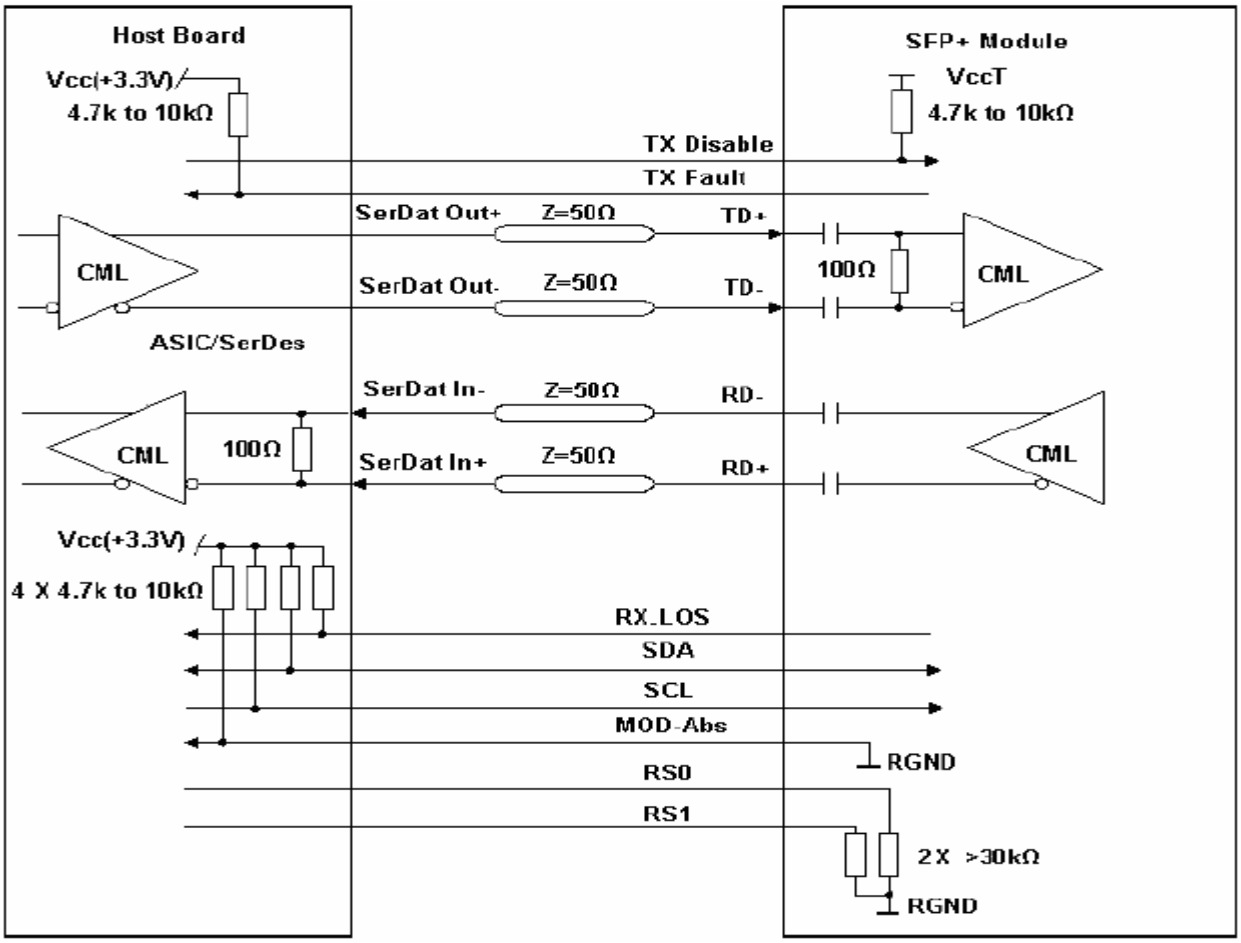


10G SFP+ Transcelver
(Unlt: mm Vlew:)

Recommended Circuit



Recommended Host Board Power Supply Circuit



Recommended High-speed Interface Circuit

Regulatory Compliance

The HSFP10-383X complies with international Electromagnetic Compatibility and international safety requirements and standards (see details in Table following).

Electrostatic Discharge (ESD) to the Electrical Pins	MIL-STD-883E Method 3015.4	Class 1(>2000 V)
Electromagnetic Interference (EMI)	FCC Part 15 Class B EN55022 Class B (CISPR 22B) VCCI Class B	Compatible with standards
Laser Eye Safety	FDA 21CFR 1040.10 and 1040.11 EN60950, EN (IEC) 60825-1,2	Compatible with Class 1 laser product.

Ordering information

HSFP10–□□□□□□□

Transmission Distance
0：Ultra Long Reach
1：Long Reach
2：Intermediate
3：Short Reach

Wavelength
3: 1310nm
5: 1550nm
8: 850nm
C: CWDM
D: DWDM

LD Type
1: FP-LD/ PIN-TIA
2: DFB-LD / PIN-TIA
3: VCSEL/ PIN-TIA
4: EML / PIN-TIA
5: EML / APD

Customer Specific Code

Channel Code
01~08：
CWDM 1310 range
(1270nm~1450nm)
09~16：
CWDM 1550 range
(1470nm~1610nm)
17~61：
DWDM 1310 range
(191.7~196.1THz)
(1563.86nm~1528.77nm)

Operation Temperature
1：0 ~ +70 °C
2：-10 ~ +85 °C
3：-40 ~ +85 °C