SFP-1FX

SFP BIDI 155Mb/s 40km Transceiver with DDMI

Hot Pluggable, 1550nm TX / 1310nm RX with SC Receptacle

- **Features:**

- Data-rate of 155Mbps operation
- 1550nm DFB Laser Transmitter and 1310nm PIN-TIA Receiver
- SFP Multi-source Package Simplex SC Connector
- Up to 40km on SMF
- Hot-Pluggable Capability with SFP form factor
- Single +3.3V Power Supply
- Operating Case Temperature: Industrial -40℃~+85℃
- Compliant with Specifications for IEEE802.3
- Eye Safety Designed to Meet Laser Class1
- Compliant with SFP MSA Specification
- Compliant with SFF-8472

- **Applications:**

- Gigabit Ethernet
- Fiber Channel
- Other optical links

SFP-1FX -- transceiver is small form factor pluggable module for serial optical data communications. It's compatible with SFP Multi- Sourcing Agreement (MSA). It's RoHS compliant and lead-free per Directive 2002/95/EC. The digital diagnostics functions are compliant with SFF-8472, which are available via the 2-wire serial bus specified in the SFP MSA.

- **Order Information:**

Part No.	Bit Rate (Mbps)	Wavelength(nm)	Distance [note2]	DDMI	Connector	Temp [note1]
SFP-1FX	155	TX1550nm/RX1310nm	40km	YES	SC	-40℃~+85℃

Notes:

1. Case Temperature.
2. Maximum Supported Distances.

- **Absolute Maximum Ratings:**

Parameter	Symbol	Min.	Typ	Max.	Unit
Maximum Supply Voltage	Vcc	-0.5	-	4.0	V
Storage Temperature	TS	-40	-	85	℃
Operating Humidity	-	5	-	95	%

- **Recommended Operating Environment:**

Parameter	Symbol	Min.	Typ	Max.	Unit
Power Supply Voltage	Vcc	3.13	3.30	3.47	V
Power Supply Current	Icc	-	-	300	mA
Surge current	Isurge	-	-	30	mA
Case Operating Temperature	Top	-40		85	°C
Data Rate	DR	-	155	-	Mbps

- **Transmitter Electrical Characteristics:**

Parameter	Symbol	Min.	Typ	Max.	Unit
CML Inputs(Differential)	Vin	150		1200	mVpp
Input AC Common Mode Voltage		0		25	mV
Input Impedance(Differential)	Zin	85	100	115	ohm
Differential Input S-parameter	$S_{DD}11$	-	-	-10	dB
Differential to Common Mode Conversion	$S_{CD}11$	-	-	-10	dB
TX Disable Input Voltage High		2		3.45	V
TX Disable Input Voltage Low		0		0.8	V
TX Fault Output Voltage High		2		Vcc+0.3	V
TX Disable Input Voltage High		0		0.5	V

- **Receiver Electrical Characteristics:**

Parameter	Symbol	Min.	Typ	Max.	Unit
CML Outputs(Differential)	Vout	350		700	mVpp
Output AC Common Mode Voltage		0		15	mV
Output Impedance(Differential)	Zout	90	100	110	ohm
Differential Output S-parameter	S_D22	-	-	-10	dB
RX LOS Output Voltage High		2		Vcc+0.3	V
RX LOS Output Voltage Low		0		0.8	V
MOD_DEF(0:2) Voltage High	VoH	2.5			V
MOD_DEF(0:2) Voltage High	VoL	0		0.5	V

- **Transmitter Optical Characteristics:**

Parameter	Symbol	Min.	Typ	Max.	Unit
Center Wavelength	λc	1530	1550	1570	nm
Spectral Width (-20dB)	σ	-	-	1	nm
Side Mode Suppression Ratio	SMSR	30	-	-	dB
Average Output Power	Po	-5	-	0	dBm
Extinction Ratio	ER	9	-	-	dB
Average Launch power of OFF TX	Poff	-	-	-30	dBm
Transmitter Dispersion Penalty	TDP	-	-	3.2	dB

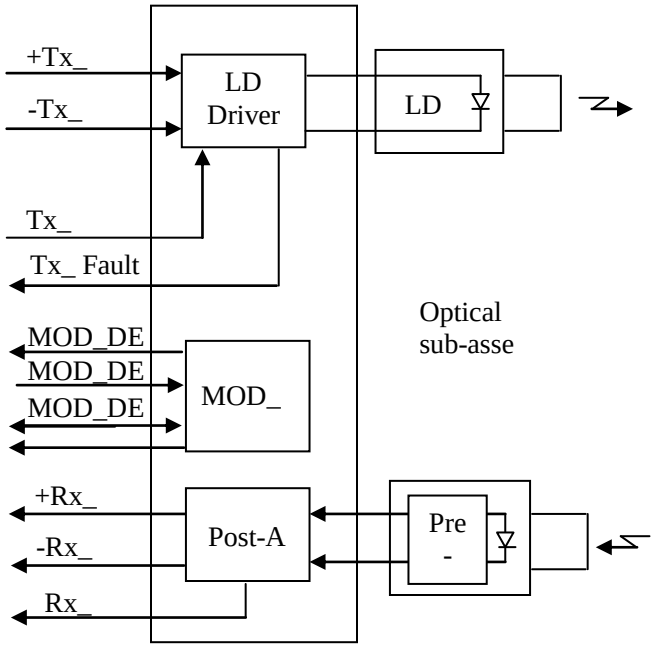
- **Receiver Optical Characteristics:**

Parameter	Symbol	Min.	Typ	Max.	Unit
Operating Wavelength	λc	1260	1310	1360	nm
Receive Sensitivity(Note 1)	Pmin	-	-	-34	dBm
Maximum Input Power(Note 1)	PMAX	-3	-	-	dBm
LOS Assert	LOSA	-45	-	-	dBm
LOS De-assert	LOSD	-	-	-35	dBm
LOS Hysteresis	-	0.5	-	4	dB

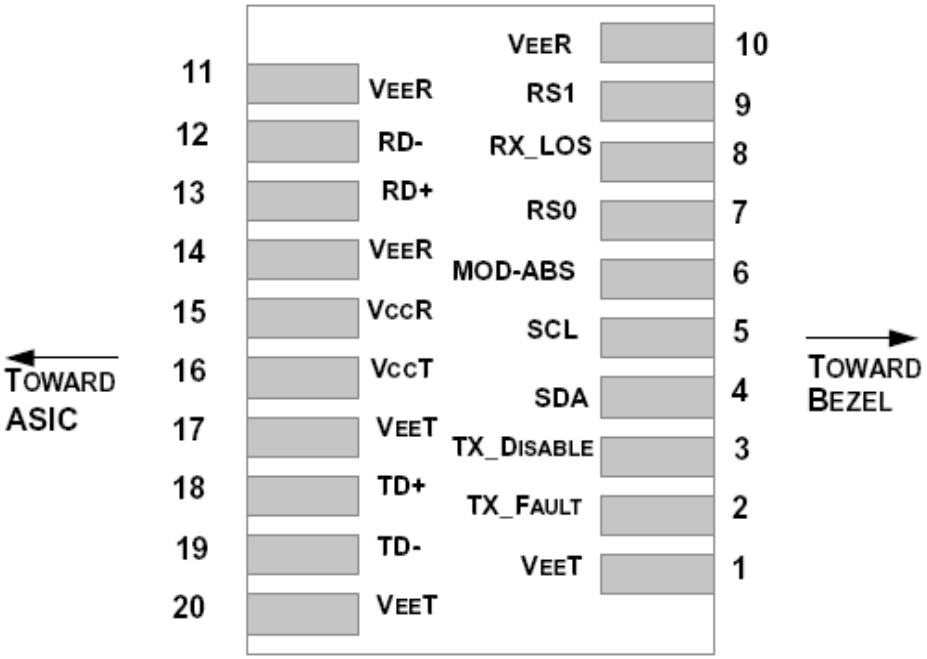
Note:

1. Measured with a PRBS2^{23}-1 test pattern @155Mbps, BER≤ 1x10 -10

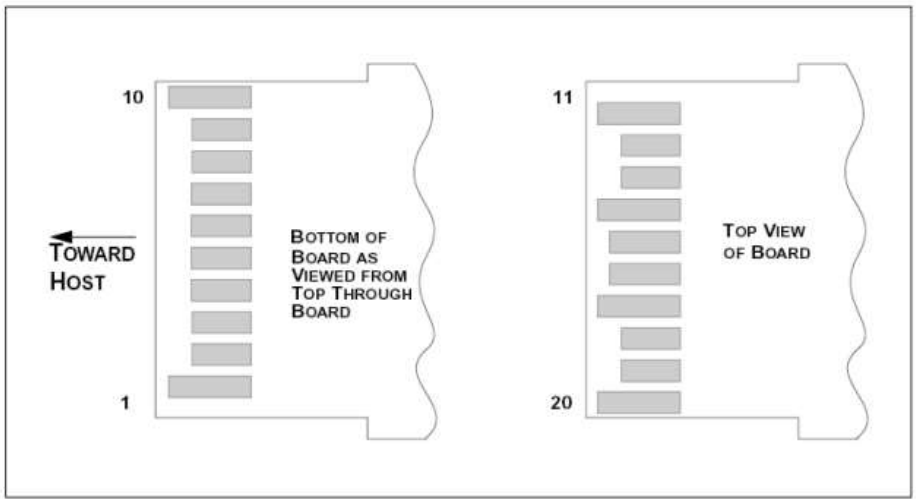
- **Block Diagram of Transceiver:**



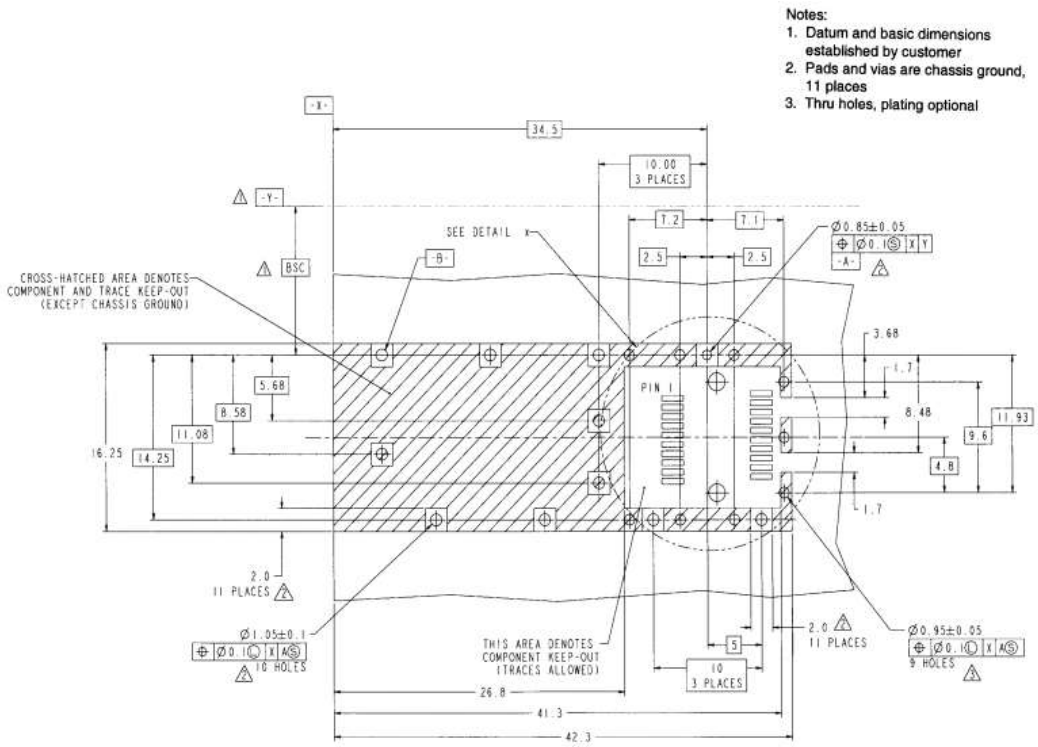
- **Pin Assignment:**



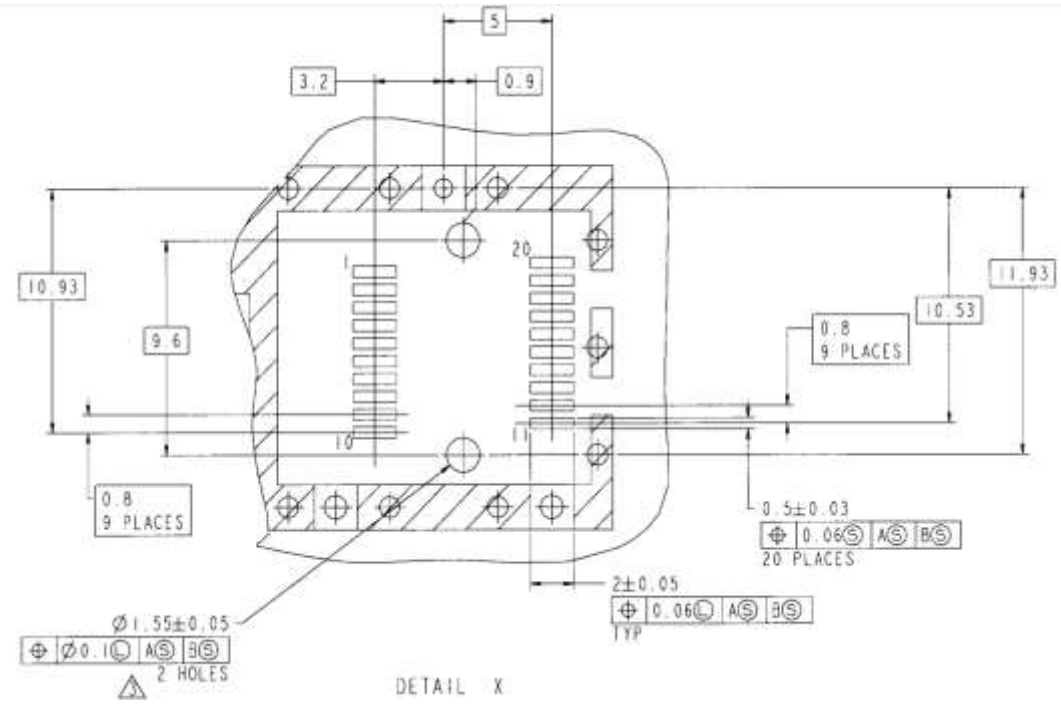
Pin out of Connector Block on Host Board



Pin out of Module Connector



SFP Host Board Mechanical Layout



SFP Host Board Mechanical Layout(Cout.)

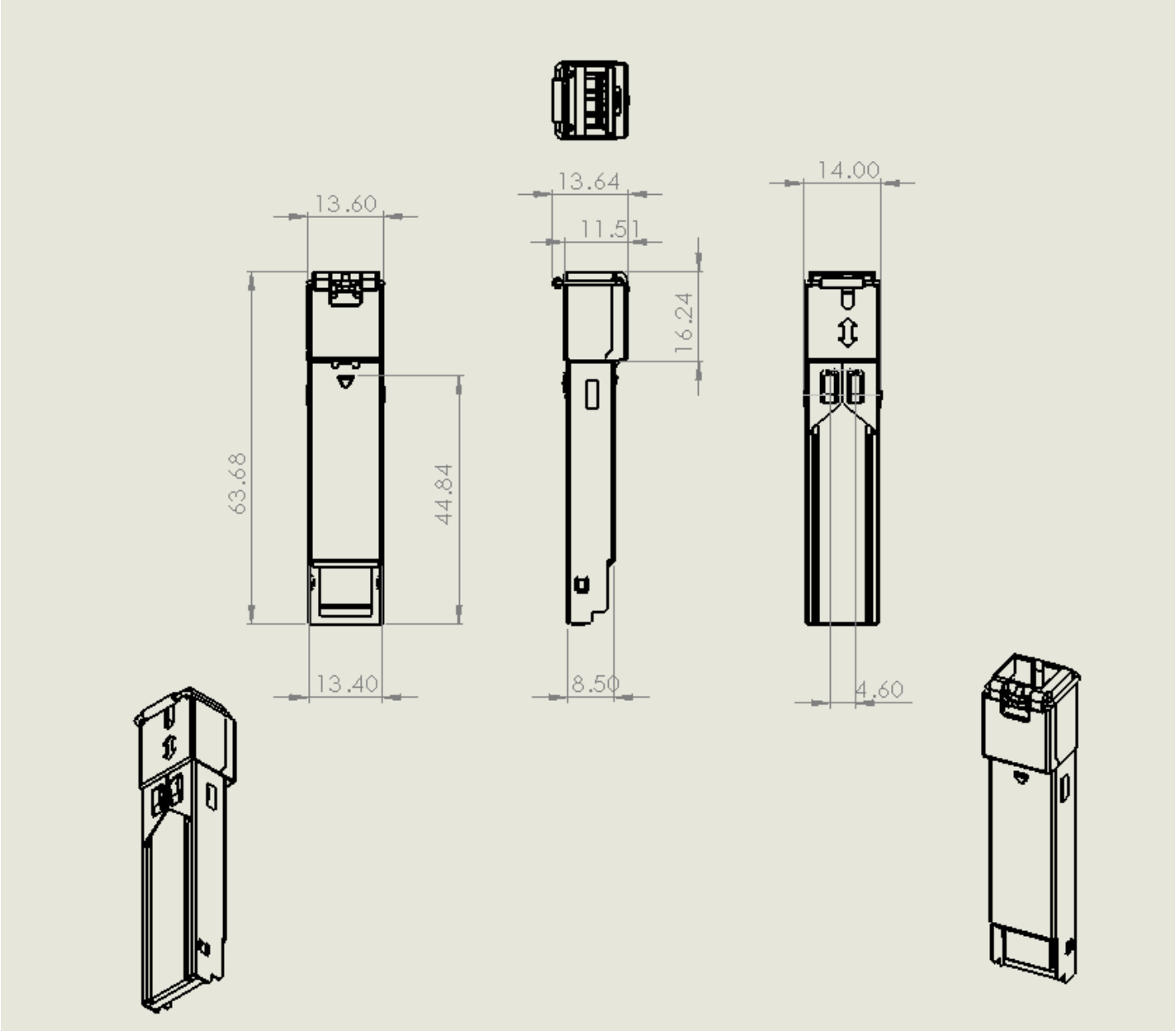
- **Pin Description:**

Pin	Symbol	Name/Description	Notes
1	VEET	Module Transmitter Ground	1
2	TX_FAULT	Module Transmitter Fault	2
3	TX_DISABLE	Transmitter Disable; Turns off transmitter laser output	3
4	SDA	2-Wire Serial Interface Data Line (MOD-DEF2)	2
5	SCL	2-Wire Serial Interface Clock (MOD-DEF1)	2
6	MOD_ABS	Module Absent, connected to VEET or VEER in the module	4
7	RS0	Rate Select 0, optionally controls SFP+ module receiver as the following when HIGH input Bit Rate>4.25 Gbps and when LOW input Bit Rate ≤4.25 Gbps.	5
8	RX_LOS	Receiver Loss of Signal Indication (in FC designated as RX_LOS, in SONET designated as LOS, and in Ethernet designated as NOT Signal Detect)	2
9	RS1	Rate Select 1, optionally controls SFP+ module transmitter as the following when HIGH input Bit Rate>4.25 Gbps and when LOW input Bit Rate ≤4.25 Gbps.	5
10	VEER	Module Receiver Ground	1
11	VEER	Module Receiver Ground	1
12	RD-	Receiver Inverted Data Output	
13	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	TD+	Transmitter Non-Inverted Data Input	
19	TD-	Transmitter Inverted Data Input	
20	VEET	Module Transmitter Ground	1

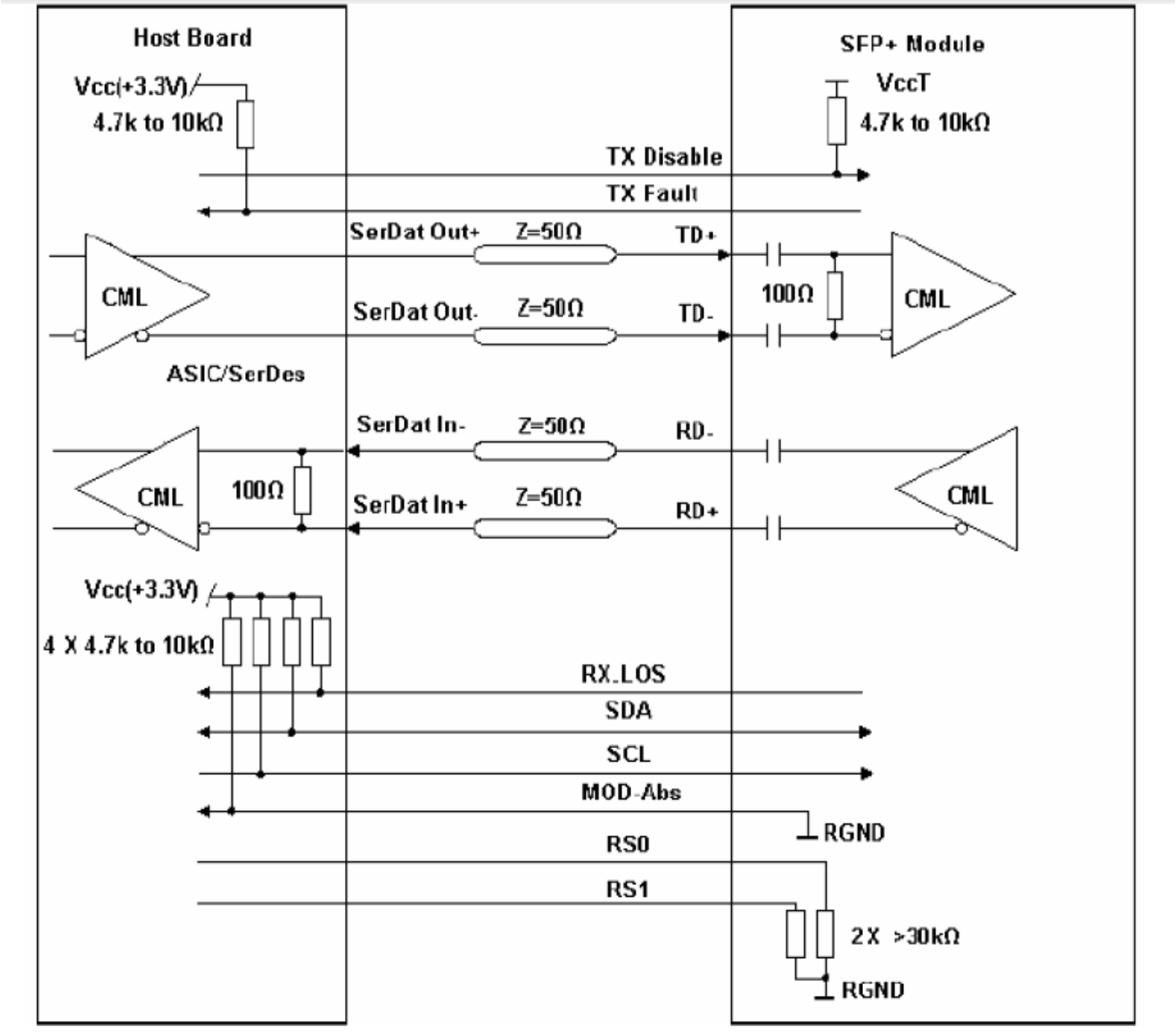
Notes:

1. Module circuit ground is isolated from module chassis ground within the module.
2. Should be pulled up with 4.7 kΩ to 10 kΩ ohms on host board to a voltage between 3.15Vand 3.6V.
3. Tx_Disable is an input contact with a 4.7 kΩ to 10 kΩ pullup to VccT inside the module.
4. Mod_ABS is connected to VeeT or VeeR in the SFP module. The host may pull this contact up to Vcc_Host with a resistor in the range 4.7 kΩ to10 kΩ.Mod_ABS is asserted “High” when the SFP module is physically absent from a host slot.
5. RS0 and RS1 are module inputs and are pulled low to VeeT with > 30 kΩ resistors in the module.

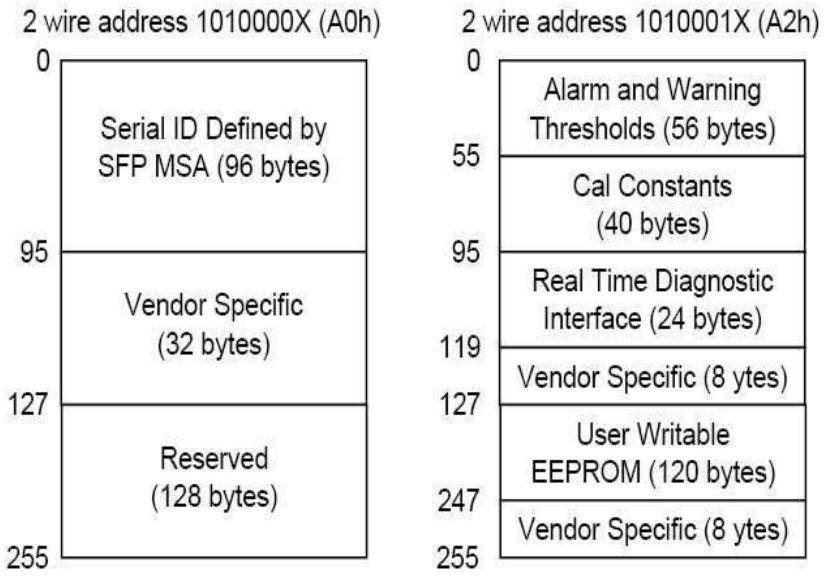
- **Mechanical Dimensions:**



- **Recommended Circuit:**



- **Digital Diagnostic Functions:**



Transceiver supports the 2-wire serial communication protocol as defined in SFP MSA: in which defines a 256-byte memory map in EEPROM at 8 bit address 1010000X (A0h). The digital diagnostic monitoring interface be assigned with 8 bit address 1010001X (A2h)

Additionally, transceivers provide a unique digital diagnostic monitoring interface (DDMI), which allows real-time access to product operating parameters such as transceiver supply voltage, transceiver temperature, transmitted optical power, laser bias current and received optical power. It also defines alarm and warning threshold, which alerts end-users when particular operating parameters are outside of factory setting.

When the serial protocol is activated, the serial clock signal (SCL, Mod Def 1) is generated by the host. The positive edge clocks data into those segments of the EEPROM that are not write-protected. The negative edge clocks data from the SFP transceiver. The serial data signal (SDA, Mod Def 2) 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.

Digital diagnostics for the transceiver are internally calibrated by default: Calibration and alarm/warning threshold data is written during device manufacturing.

- **Digital Diagnostic Specifications:**

The following digital diagnostic characteristics are defined over the recommended operating environment unless otherwise specified. It is compliant to SFF-8472 Rev10.2 with internal calibration mode.

Monitor accuracy					
Parameter	**Min**	**Typ**	**Max**	**Units**	**Ref**
Internally measured transceiver temperature			±3	ºC	
Internally measured transceiver supply voltage			±3	%	
Measured TX bias current			±10	%	
Measured TX output power			±3	dB	
Measured RX received average optical power			±3	dB	

- **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
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: Kyland
36	1	Reserved	
37-39	3	Vendor OUI	SFP transceiver vendor OUI ID
40-55	16	Vendor PN	Part Number: “IFSFP-xxxxxx” (ASCII)
56-59	4	Vendor rev	Revision level for part number
60-61	2	Wavelength	Laser wavelength
62	1	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	Manufacturing date code
92-94	3	Reserved	
95	1	CCEX	Check code for the extended ID Fields (addresses 64 to 94)
Vendor Specific ID Fields			
96-127	32	Readable	Specific date, read only

- **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	

Byte	# Byte	Name	Description
120-127	8	Vendor Specific	00h.
128-255	128		Writable Memory

- **Notice:**

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