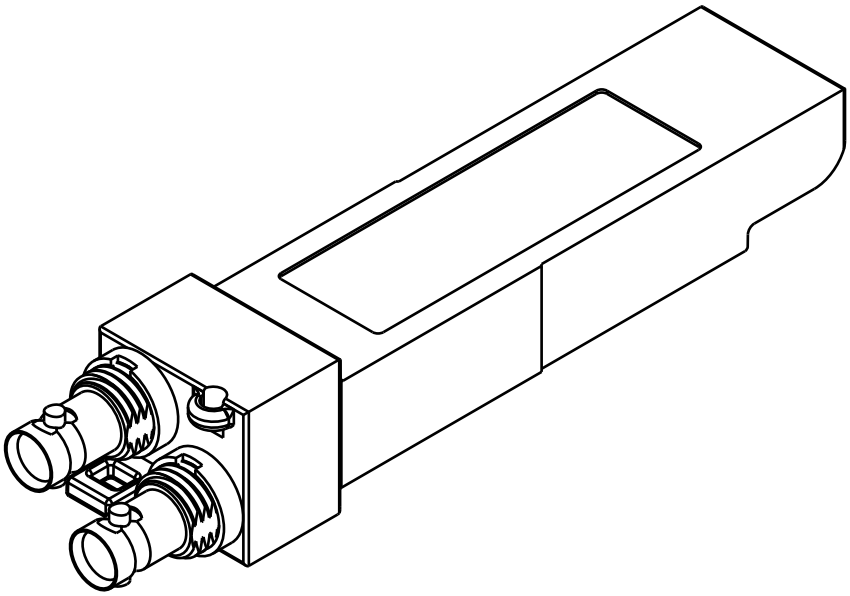

fiberplex TECHNOLOGIES, LLC

USER MANUAL

3Gbps SDI SFP Coaxial Transceiver
SFP-BHDVXC-0000-R / SFP-BHDVXC-0000-L

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Warning for Your Protection

1. Read these instructions.

2. Keep these instructions.

3. Heed all warnings.

4. Follow all instructions.

5. Do not use this apparatus near water.

6. Clean only with a dry cloth.

7. Do not block any of the ventilation openings. Install in accordance with the manufacturer's instructions.

8. Do not install near any heat sources such as radiators, heat registers, stoves, or other apparatus (including amplifiers) that produce heat.

9. Do not defeat the safety purpose of the polarized or grounding-type plug. A polarized plug has two blades with one wider than the other. A grounding type plug has two blades and a third grounding prong. The wide blade or the third prong is provided for your safety. If the provided plug does not fit into your outlet, consult an electrician for replacement of the obsolete outlet.

10. Protect the power cord from being walked on or pinched, particularly at plugs, convenience receptacles, and the point where they exit from the apparatus.

11. Only use attachments/accessories specified by the manufacturer.

12. Use only with the cart, stand, tripod, bracket, or table specified by the manufacturer, or sold with the apparatus. When a cart is used, use caution when moving the cart/apparatus combination to avoid injury from tip-over.

13. Unplug this apparatus during lightning storms or when unused for long periods of time.

14. Refer all servicing to qualified service personnel. Servicing is required when the apparatus has been damaged in any way, such as power-supply cord or plug is damaged, liquid has been spilled or objects have fallen into the apparatus, the apparatus has been exposed to rain or moisture, does not operate normally, or has been dropped.

The apparatus shall not be exposed to dripping or splashing. No objects filled with liquids, such as vases, shall be placed on the apparatus.

"WARNING: To reduce the risk of fire or electric shock, do not expose this apparatus to rain or moisture."

General Installation Instructions

Please consider these general instructions in addition to any product-specific instructions in the "Installation" chapter of this manual.

Unpacking

Check the equipment for any transport damage. If the unit is mechanically damaged, if liquids have been spilled or if objects have fallen into the unit, it must not be connected to the AC power outlet, or it must be immediately disconnected by unplugging the power cable. Repair must only be performed by trained personnel in accordance with the applicable regulations.

Installation Site

Install the unit in a place where the following conditions are met:

- The temperature and the relative humidity of the operating environment must be within the specified limits during operation of the unit. Values specified are applicable to the air inlets of the unit.
- Condensation may not be present during operation. If the unit is installed in a location subject to large variations of ambient temperature (e.g. in an OB-van), appropriate precautions must be taken.
- Unobstructed airflow is essential for proper operation. Ventilation openings of the unit are a functional part of the design and must not be obstructed in any way during operation (e.g. - by objects placed upon them, placement of the unit on a soft surface, or improper installation of the unit within a rack or piece of furniture).
- The unit must not be unduly exposed to external heat sources (direct sunlight, spot lights).

Ambient Temperature

Units and systems by FiberPlex are generally designed for an ambient temperature range (i.e. temperature of the incoming air) of 5 °C to 40 °C (41 °F to 104 °F). When rack mounting the units, the following facts must be considered:

- The permissible ambient temperature range for operation of the semiconductor components is 0 °C to +70 °C (32 °F to 158 °F) (commercial temperature range for operation).
- The airflow through the installation must allow exhaust air to remain cooler than 70 °C (158 °F) at all times.
- Average temperature increase of the cooling air shall be about 20 °C (68 °F), allowing for an additional maximum 10 °C increase at the hottest components.

If the cooling function of the installation must be monitored (e.g. for fan failure or illumination with spot lamps), the exhaust air temperature must be measured directly above the modules at several places within the enclosure.

Grounding and Power Supply

Grounding of units with mains supply (Class I equipment) is performed via the protective earth (PE) conductor integrated in three-pin Phoenix™ connector. Units with battery operation (< 60 V, Class III equipment) must be earthed separately. Grounding the unit is one of the measures for protection against electrical shock hazard (dangerous body currents). Hazardous voltage may not only be caused by defective power supply insulation, but may also be introduced by the connected audio or control cables.

This equipment may require the use of a different line cord, attachment plug, or both, depending on the available power source at installation. If the attachment plug needs to be changed, refer servicing to qualified personnel.

Warranty, Service and Terms and Conditions of Sale

For information about Warranty or Service information, please see our published 'Terms and Conditions of Sale'. This document is available on fiberplex.com or can be obtained by requesting it from clients@fiberplex.com or calling 301.604.0100.

Disposal

Disposal of Packing Materials

The packing materials have been selected with environmental and disposal issues in mind. All packing material can be recycled. Recycling packing saves raw materials and reduces the volume of waste. If you need to dispose of the transport packing materials, recycling is encouraged.

Disposal of Used Equipment

Used equipment contains valuable raw materials as well as substances that must be disposed of professionally. Please dispose of used equipment via an authorized specialist dealer or via the public waste disposal system, ensuring any material that can be recycled has been. Please take care that your used equipment cannot be abused. After having disconnected your used equipment from the mains supply, make sure that the mains connector and the mains cable are made useless.

Disclaimer

The information in this document has been carefully checked and is believed to be accurate at the time of publication. However, no liability is assumed by FiberPlex for inaccuracies, errors, or omissions, nor for loss or damage resulting either directly or indirectly from use of the information contained herein.

Notice

Introduction

The SFP-BHDVXC-0000-L is an electrical SFP Transceiver module with optional reclockers (SFP-BHDVXC-0000-R) designed to transmit and receive SDI signals up to 2.97Gbps over 75Ω coaxial cables via HD-BNC connectors. Cable driver slew rate is automatically configured in order to achieve compliance to SMPTE 424M/ SMPTE 292M and SMPTE 259M. Equalizer features DC restoration to compensate for the DC content of SMPTE pathological test patterns. On the SFP-BHDVXC-0000-R, the reclocker procures optimal input & output jitter performance by suppressing accumulated jitter.

The SFP-BHDVXC provides module identification information and diagnostic monitoring through a 2 wire serial interface. It is also hot- pluggable solution for in field system upgrade and maintenance. The SFP-BHDVXC is interchangeable with others MSA pinout optical video SFP improving product flexibility. The module is SMPTE compliant resulting in quick time-to- market and reduced development effort and cost. The SFP-BHDVXC is Pb-free and RoHS compliant.

Key Features

- SMPTE 424M, SMPTE 292M, and SMPTE 259M compliant
- HD-BNC 75Ω connectors
- Equalizes Belden 1694A cable up to: 140m at 2.97Gb/s, 200m at 1.485Gb/s and 400m at 270Mb/s
- Integrated Reclocker and Cable Driver
- Supports DVB-ASI at 270Mb/s
- Supports video pathological patterns for SD- SDI, HD-SDI and 3G-SDI
- Hot-pluggable
- Control via serial interface including:
    - Output slew rate (SD or HD/3G)
    - Input signal detection (RX_LOS)
    - Voltage & Temperature Monitoring
    - Module Information
    - Reclocker Rate & Lock Monitoring
    - Bypass Reclocker stage
    - Autosleep feature on Rx channel
- Low Power Consumption - typical 1216mW
- Single Supply +3.3V
- Pb-free and RoHS compliant
- Operating temperature range: -40°C to 80°C
- 58.5mm x 13.4mm x 8.6mm SFP Package
- Ganged Cages & Stacked Cages mounting supported

Theory of Operation

The SFP-BHDVXC Transceiver is a Small Form Factor Pluggable (SFP) module with coaxial interface. HD-BNC connectors are used to interface the module with 75Ω coaxial cables.

The SFP-BHDVXC Transceiver will drive the differential TD± inputs to its TX coaxial output if TX_DIS input is low and Soft Tx_Disable is low (Status/Control register bit6).

The slew rate of the SFP-BHDVXC-0000-L output is configurable through the SERIAL CONFIG INTERFACE via Soft Rate_Select and shall be configured based on the transmitted signal standard to ensure compliancy with SMPTE specification. At power up, the default configured slew rate is compliant with HD/3G-SDI signal. Because the default slew rate is for HD-SDI & 3G-SDI, the host should detect if the module gets swapped via MOD_DEF0. If module is replaced or hot swapped while driving an SD-SDI signal, the new module will have the wrong slew rate and it will require reconfiguration. The slew rate of the SDI outputs of the SFP-BHDVXC-0000-R is automatically configured by the reclocker and is compliant with SMPTE specification.

The SFP-BHDVXC Transceiver automatically equalized the received signal (RX) for the cable loss and retimes (reclocker version only) serial digital video data conforming to the SMPTE 424M, 292M and 259M. Without a valid signal detected, the LOS output is active (open-drain).

The SFP-BHDVXC Transceiver module has a serial interface through which an EEPROM containing the SERIAL IDENTIFICATION can be read. Through the same serial interface, diagnostic monitoring is provided via the SERIAL CONFIG INTERFACE giving the opportunity to read the temperature, the supply voltage, the LOS status and all reclocker features.

Getting Started

Initial Inspection

Immediately upon receipt, inspect the shipping container for damage. The container should be retained until the shipment has been checked for completeness and the equipment has been checked mechanically and electrically. If the shipment is incomplete, if there is mechanical damage, or if the unit fails to operate notify FiberPlex and make the shipping materials available for the carrier's inspection.

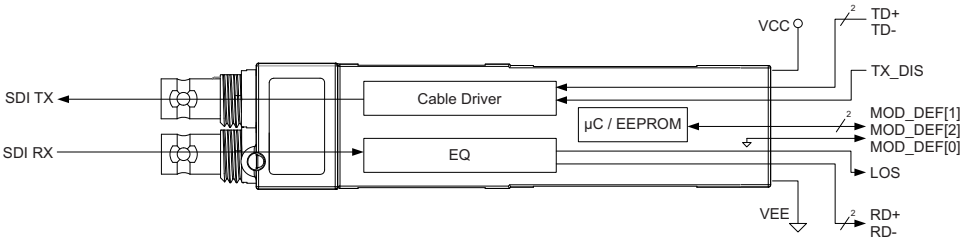


Figure 1: High Level Block Diagram - SFP-BHDVXC-0000-L (standard)

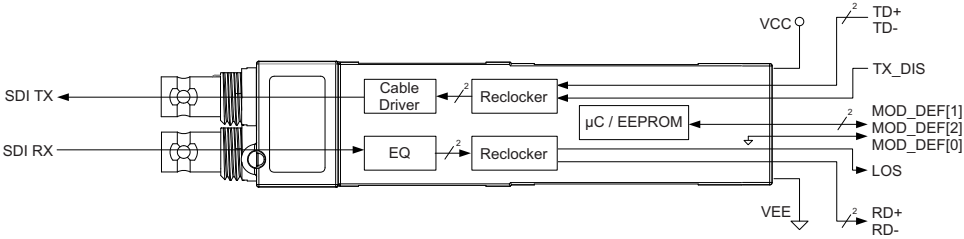


Figure 2: High Level Block Diagram - SFP-BHDVXC-0000-R (with reclocker)

Host Connector Pin Configuration

Figure below shows the pin names and numbering for the connector block on the host board. The diagram is in the same relative orientation as the host board layout. The pin functions are described in Table 1 with accompanying notes. To minimized EMI emission, the signals to the 20-pin connector should be shut off when the module is removed.

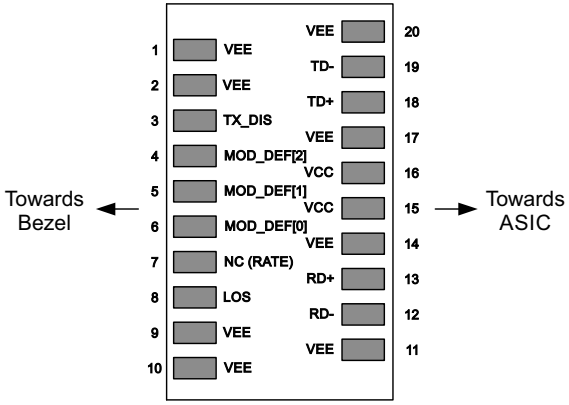


Figure 3: Host Connector Pin Configuration

SFP Electrical Pad Layout

The SFP Transceiver contains a printed circuit board that mates with the SFP electrical host connector. The pads are designed for a sequenced mating:

First mate – ground contacts

Second mate – power contacts

Third mate – signal contacts

The design of the mating portion of the SFP Transceiver printed circuit board is illustrated in Figure 4.

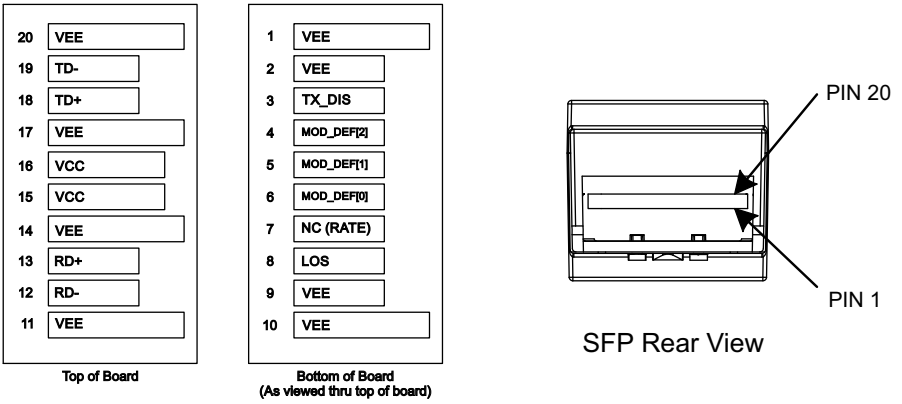


Figure 4: SFP Electrical Pad Layout

Table 1: SFP Pin Description

Pin	Name	Function	Notes
1	VEE	Ground	
2	VEE	Ground	TX_FAULT never asserted by this module
3	TX_DIS	Transmitter Disable	TX_DIS is an active high input that is used to shut down the transmitter electrical output. It is internally pulled up with a 4.7kΩ to 10kΩ resistor. (The output may be disabled by registry even if TX_DIS='0') High/Open = Transmitter Disabled Low = Transmitter Enabled
4	MOD_DEF[2]	Module Definition 2	Defined as Serial Data (SDA). Must be pulled up to VCC (4.7k-10kΩ) on the host board (open drain).
5	MOD_DEF[1]	Module Definition 1	Defined as Serial Clock (SCL). Must be pulled up to VCC (4.7k-10kΩ) on the host board (open drain).
6	MOD_DEF[0]	Module Definition 0	Grounded by the module to indicate that the module is present.
7	NC (RATE)	Not Connected	Floating; not internally connected
8	LOS	Loss of signal	LOS is an active high open-drain output that returns the loss of a valid SDI input by the receiver equalizer. High = No carrier detected Low = Carrier detected
9	VEE	Ground	
10	VEE	Ground	
11	VEE	Ground	
12	RD-	Inv. Received Data Out	RD± are the differential receiver outputs. They are AC coupled 100Ω differential lines which should be terminated with 100Ω differential at the user SERDES/ASIC. The voltage swing on these lines will be between 620mV and 880mV differential when properly terminated.
13	RD+	Received Data Out	
14	VEE	Ground	
15	VCC	+3.3V Supply	Defined as 3.3V±5% ate the SFP connector pin. Recommended host board power filtering is shown in figure 5.2. When the recommended supply filtering network is used, hot plugging of module will result in an inrush current of no more than 30mA greater than the steady state value.
16	VCC	+3.3V Supply	
17	VEE	Ground	
18	TD+	Transmit Data In	TD± are the differential inputs of the transmitter. They are AC coupled differential lines with 100Ω 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 swing of 200mV to 1600mV.
19	TD-	Inv. Transmit Data In	
20	VEE	Ground	

General Instructions for Inserting and Removing SFP Modules

Handling Warnings

SFP Modules are static sensitive. To prevent damage from electrostatic discharge (ESD), it is recommended to attach an ESD preventative wrist strap to your wrist and to a bare metal surface when you install or remove an SFP Module.

Disconnect all optical or copper cables from SFP Modules prior to installing or removing the SFP Module. Failure to do so could result in damage to the cable, cable connector or the SFP Module itself. Removing and inserting an SFP Module can shorten its useful life, so you should not remove and insert SFP Modules any more often than is absolutely necessary.

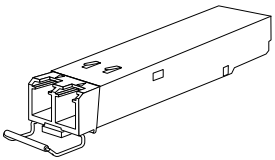
Protect optical SFP modules by inserting clean dust covers into them after the cables are removed. Be sure to clean the optic surfaces of the fiber cables before you plug them back into the optical ports of another SFP module. Avoid getting dust and other contaminants into the optical ports of your SFP modules, because the optics will not work correctly when obstructed with dust.

Identify the Latch Type of the SFP Module

SFP Modules have various latching mechanisms to secure them into the SFP Cage of a device. The FiberPlex WDM can support a host of manufacturers and brands of SFP Modules so the user may encounter any number of different latches. Some of these are described below.

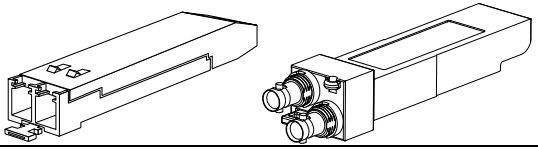
Bail Clasp

The bail clasp SFP module has a clasp that you use to remove or install the SFP module.



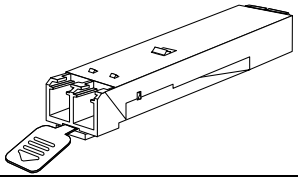
Actuator Button

The actuator button SFP module includes a button that you push in order to remove the SFP module from a port. This button can either lift 'Up' or press 'In' to release the SFP Module depending on the manufacturer.



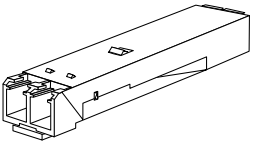
Mylar Tab

The Mylar tab SFP module has a tab that you pull to remove the module from a port.

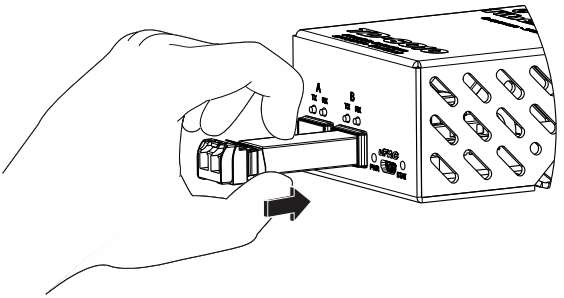


Slide Tab

The slide tab SFP module has a tab underneath the front of the SFP module that you use to disengage the module from a port.

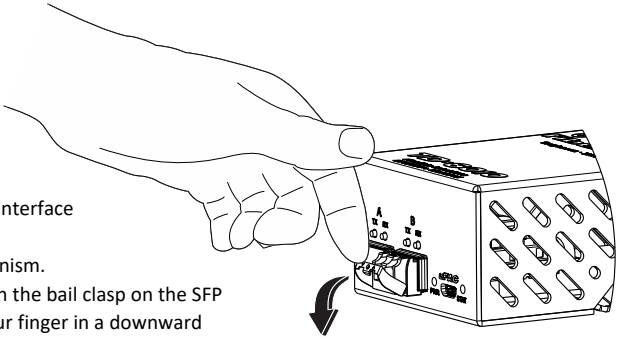


Inserting a Module

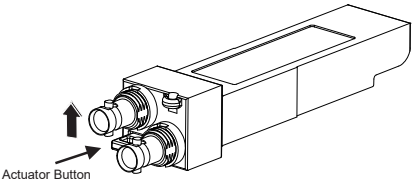


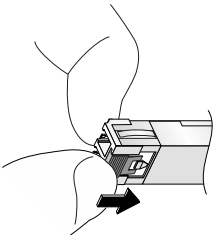
1) Attach an ESD-preventative wrist or ankle strap, following its instructions for use.
2) Disconnect and remove all interface cables from SFP Module.
3) If the SFP Module has a Bail Clasp , close the Bail Clasp before inserting the SFP Module.
4) With the gold finger connector on the bottom and the label on the top, line up the SFP Module with the empty cage and slide it in making sure that it is completely inserted and seated in the cage.

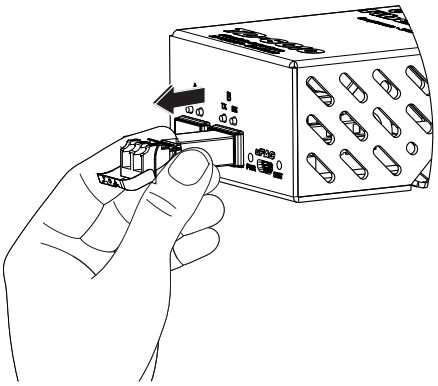
Removing a Module



1) Attach an ESD-preventative wrist or ankle strap, following its instructions for use.
2) Disconnect and remove all interface cables from SFP Module.
3) Release the latching mechanism.
    - Bail Clasp – Open the bail clasp on the SFP Module with your finger in a downward direction.
    - Actuator Button – Gently press the actuator up (or in) while pulling the body of the SFP Module to release the SFP Module from the cage.
    - Mylar Tab – Pull the tab gently in a straight outward motion until it disengages from the port. Make sure the tab is not twisted when pulling as it may become disconnected from the SFP Module.
    - Slide Tab - With your thumb, push the slide tab on the bottom front of the SFP module in the direction of the equipment to disengage the module from the line card port. If you pull on the SFP module without disengaging the tab, you can damage the SFP module.







4) Grasp the SFP Module between your thumb and index finger and carefully remove it from the port
5) Place the SFP Module on an antistatic mat, or immediately place it in a static shielding bag or container

Serial Identification (EEPROM)

The SFP 2-wire serial interface (MOD_DEF1/MOD_DEF2) provides access to the identification information describing SFP capabilities, interfaces, and associated information. The serial interface uses the 2-wire serial EEPROM protocol defined for the ATMEL AT24C02 family component. The memory is organized as a series of 8-bit data words that can be addressed individually or sequentially. The content of the SERIAL IDENTIFICATION (serial ID) device is write-protected. The 2-wire serial bus address 1010000X (A0h) is used for serial ID access.

The table below defines the information structures that are obtained from the SFP Transceiver via the serial ID.

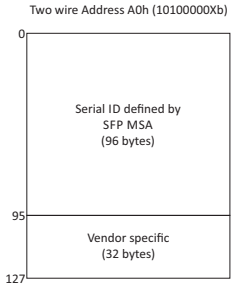


Figure 5 EEPROM memory mapping

Table 2: Serial Identification Registers

Addr	Registry Name	Registry Description	Value
BASE ID FIELDS			
0	Identifier	Type of serial transceiver *Vendor specific – Video transceiver MSA*	80h
1	Ext. Identifier	Extended type of serial transceiver *SFP function is defined by serial ID only*	04h
2	Connector	Connector type *Vendor specific - HD-BNC*	82h
3	Transceiver	Electronic or optical compatibility *SMPTE 259M, 344M, 292M, 424M*	82h
4	Reserved	MSA do not specify any SMPTE standard code	00h
5			00h
6			00h
7			00h
8			00h
9			00h
10			00h
11	Encoding	*Code for serial encoding algorithm* *Unallocated - NRZI*	07h
12	BR, Nominal	Nominal bit rate, units of 100Mbps *3Gbps*	1Eh
13	Reserved	Reserved	00h
14	Reserved	Reserved	00h
15		*Fiber Not Supported*	00h
16			00h
17			00h
18	Length (Copper)	Length supported (cooper) in m *255m (Vary with bit rate)*	FFh
19	Reserved	Reserved	00h
20		Vendor name SFP transceiver vendor name (ASCII)	46h
21		*"FIBERPLEX"*	49h
22			42h
23			45h
24			52h
25			50h
26			4Ch
27			45h
28			58h
29			20h
30			20h
31			20h
32			20h
33			20h

Addr	Registry Name	Registry Description	Value
34			20h
35			20h
36	Reserved	Reserved	00h
37	Vendor OUI	SFP vendor IEEE company ID	00h
38			00h
39			00h
40	Vendor PN	Part number (ASCII)	53h
41		"SFP-BHDVXC"	46h
42			50h
43			2Dh
44			42h
45			48h
46			44h
47			56h
48			58h
49			43h
50			20h
51			20h
52			20h
53			20h
54			20h
55			20h
56-59	Vendor rev	Revision level for part number (ASCII)	XXh …
60-62	Reserved	Reserved	00h
63	CC_BASE	checksum (8lsb result) (add. 0-62)	XXh
EXTENDED ID FIELDS			
64	Options	optional SFP signals are implemented	00h
65		*Tx_Disable implemented*	12h
		LOS implemented	
66	BR, max	Upper bit rate margin, unit of %	00h
67	BR, min	Lower bit rate margin, unit of %	00h
68-83	Vendor SN	Serial number (ASCII)	XXh …
84-91	Date code	Vendor's manufacturing date code	XXh …
92	Diagnostic Monitoring	Diagnostic Monitoring	60h
		Digital Diagnostic monitoring implemented Internally calibrated	
93	Enhanced Options	Enhanced Options	50h
		Soft Tx_DIsable control	
		Soft RX_LOS monitoring	
94	SFF-8472 Compliance	SFF-8472 Compliance	00h
		Digital diagnostic functionality undefined	
95	CC_EXT	Checksum (add. 64-94)	XXh
VENDOR SPECIFIC ID FIELDS			
96†	Vendor Specific	Advanced Enhanced Options	01h
		EQ Autosleep Control	
96‡	Vendor Specific	Advanced Enhanced Options 1 (TX Channel)	0Eh
		Bit3: Reclocker Rate Monitoring	
		Bit2: Reclocker Bypass Control	
		Bit1: Reclocker Lock Monitoring	
97‡	Vendor Specific	Advanced Enhanced Options 2 (RX Channel)	07h
		Bit2: Reclocker Bypass Control	
		Bit1: Reclocker Lock Monitoring	
		Bit0: EQ Autosleep Control	
98-127	Vendor Specific	Vendor Specific	XXh …

Notes:

1. The values with XXh are determined during manufacturing
2. Addresses 68-83 specify the Vendor Serial Number
3. Addresses 84-91 specify the Manufacturing Date Code (YYMMDD: YY=Year, MM=Month, DD=Day)
4. Address 63 contains the checksum for byte 0-62
5. Address 95 contains the checksum for byte 64-94

†: Standard Only ‡: Reclcocker Only

Serial Configuration Interface

The SFP 2-wire serial interface (MOD_DEF1/MOD_DEF2) provides also digital diagnostic monitoring via the SERIAL CONFIG INTERFACE. The serial interface uses the 2-wire serial EEPROM protocol defined for the ATMEL AT24C02 family component. The memory is organized as a series of 8-bit data words that can be addressed individually or sequentially. The 2-wire serial bus address 1010001X (A2h) is used for SERIAL CONFIG INTERFACE access.

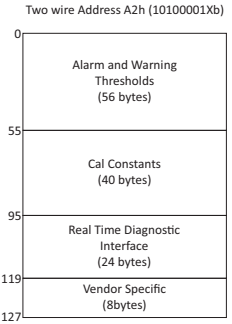


Figure 6 Serial Config Interface Memory Mapping

The table below defines the information structures that are obtained from the SFP Transceiver via the SERIAL CONFIG INTERFACE.

Table 3: Serial Configuration Interface Registers

Addr	Field Name	Registry Name	Description	Default Value (hex)	Default Value (dec)
0	Alarm & Warning Thresholds	Temp High Alarm (MSB)	Internal Temperature High Alarm Threshold	55h	+85°C
1		Temp High Alarm (LSB)		00h	
2		Temp Low Alarm (MSB)	Internal Temperature Low Alarm Threshold	D8h	-40°C
3		Temp Low Alarm (LSB)		00h	
4		Temp High Warning (MSB)	Internal Temperature High Warning Threshold	50h	+80°C
5		Temp High Warning (LSB)		00h	
6		Temp Low Warning (MSB)	Internal Temperature Low Warning Threshold	DDh	-35°C
7		Temp Low Warning (LSB)		00h	
8		Voltage High Alarm (MSB)	Internal Voltage High Alarm Threshold	8Ch	+3.6V
9		Voltage High Alarm (LSB)		A0h	
10		Voltage Low Alarm (MSB)	Internal Voltage Low Alarm Threshold	75h	+3.0V
11		Voltage Low Alarm (LSB)		30h	
12		Voltage High Warning (MSB)	Internal Voltage High Warning Threshold	87h	+3.47V
13		Voltage High Warning (LSB)		8Ch	
14		Voltage Low Warning (MSB)	Internal Voltage Low Warning Threshold	7Ah	+3.14V
15		Voltage Low Warning (LSB)		A8h	
16-39		NA	Not Applicable	XXh..	
40-55	Unallocated	Unallocated	Reserved	XXh...	
56-91	Ext Cal Constant	NA	Not Applicable	XXh..	
92-94	Unallocated	Unallocated	Reserved	XXh...	
95	CC_DMI	Checksum	Checksum	XXh	
96	Diagnostics	Temperature (MSB)	Measured Internal Temperature	XXh	°C
97		Temperature (LSB)		XXh	

Addr	Field Name	Registry Name	Description	Default Value (hex)	Default Value (dec)
98		Vcc (MSB)	Measured Internal Voltage	XXh	V
99		Vcc (LSB)		XXh	
100-105		NA	Not Applicable	XXh...	
106-109	Unallocated	Unallocated	Reserved	XXh...	
110	Status/Control	Status/Control	See below for bit definition	XXh	

MSB LSB

b7	b6	b5	b4	b3	b2	b1	b0
r	r/w	r	r	r	r	r	r
TX_DIS State TX_DIS input pin state can be read via this bit	Soft Tx_Disable Select 1=Force Disable TX 0=Use TX_DIS pin (default)	NA	NA	Soft Rate_Select 1=HD/3G Slew Rate (default) 0=SD Slew Rate	NA	LOS 1=No Input Detect 0=Input Detect	Data_Ready State 1=Power up 0=Data ready
'X'	**'0'**	**'0'**	**'0'**	**'0'**	**'0'**	**'X'**	**'X'**

111	Reserved	Reserved	Reserved	XXh	
112	Alarm Flags	Alarm Flags	See below for bit definition	XXh	

MSB LSB

b7	b6	b5	b4	b3	b2	b1	b0
r	r/w	r	r	r	r	r	r
Temp High Alarm 1=Alarm Active 0=Alarm Inactive	Temp Low Alarm 1=Alarm Active 0=Alarm Inactive	Vcc High Alarm 1=Alarm Active 0=Alarm Inactive	Vcc Low Alarm 1=Alarm Active 0=Alarm Inactive	NA	NA	NA	NA
'X'	**'X'**	**'X'**	**'X'**	**'0'**	**'0'**	**'0'**	**'0'**

114-115	Unallocated	Unallocated	Reserved	XXh...	
116	Warning Flags	Warning Flags	See below for bit definition	XXh	

MSB LSB

b7	b6	b5	b4	b3	b2	b1	b0
r	r/w	r	r	r	r	r	r
Temp High Warning 1= Warning Active 0= Warning Inactive	Temp Low Warning 1= Warning Active 0= Warning Inactive	Vcc High Warning 1= Warning Active 0=Alarm Inactive	Vcc Low Warning 1= Warning Active 0= Warning Inactive	NA	NA	NA	NA
'X'	**'X'**	**'X'**	**'X'**	**'0'**	**'0'**	**'0'**	**'0'**

117		Not Applicable	Not Applicable	XXh	
118	Ext	Ext Status/Control	Not Applicable	XXh	
119	Status/Control	Unallocated	Reserved	XXh	
120	Vendor Specific	Advanced Status/Control 1 TX Channel	See below for bit definition	XXh	

MSB LSB

b7	b6	b5	b4	b3	b2	b1	b0
r	r/w	r	r	r	r	r	r
NA	NA	NA	NA	Reclocker Rate‡ 1=HD/3G 0=SD	Reclocker Bypass‡ 1=Bypass 0=Auto-Bypass (default)	Reclocker Lock‡ 1=Lock Detect 0=Not Lock	Autosleep[3] 1=Enable Autosleep (default) 0=Disable Autosleep
'0'	**'0'**	**'0'**	**'0'**	**'X'**	**'0'**	**'X'**	**'1'**

Addr	Field Name	Registry Name	Description	Default Value (hex)	Default Value (dec)
			• **Reclocker Rate:** Indicates whether the reclocker is processing SD or HD/3G data rates. • **Reclocker Bypass:** When the Bypass bit set to '1', it forces the device to output the data without reclocking it. If the Bypass bit is set to '0', the device automatically bypasses the reclocking function when the device is an unlocked condition or the detected rate is a rate which the device does not support. Note that when the Bypass input is set to '1', Lock detect will remain low. • **Reclocker Lock:** When the Lock bit egal '1', it indicates that data is being received and the PLL is locked. Note that when the Bypass bit is set to '1', Lock detect will remain '0'.		
121-123	Vendor Specific	Vendor Specific	Reserved	XXh...	
124‡	Vendor Specific	Advanced Status/Control 2 RX Channel	See below for bit definition	XXh	

MSB LSB

b7	b6	b5	b4	b3	b2	b1	b0
r	r/w	r	r	r	r	r	r
NA	NA	NA	NA	NA	Reclocker Bypass 1=Bypass 0=Auto-Bypass (default)	Reclocker Lock 1=Lock Detect 0=Not Lock	Autosleep[3] 1=Enable Autosleep (default) 0=Disable A utosleep
'0'	**'0'**	**'0'**	**'0'**	**'0'**	**'0'**	**'X'**	**'1'**

- **Reclocker Bypass:** When the Bypass bit set to '1', it forces the device to output the data without reclocking it. If the Bypass bit is set to '0', the device automatically bypasses the reclocking function when the device is an unlocked condition or the detected rate is a rate which the device does not support. Note that when the Bypass input is set to '1', Lock detect will remain low.
- **Reclocker Lock:** When the Lock bit egal '1', it indicates that data is being received and the PLL is locked. Note that when the Bypass bit is set to '1', Lock detect will remain '0'.
- **Autosleep:** If the Autosleep bit is set to '1', the SFP equalizer goes into a power save mode when no signal is detected. The equalizer power on again once an input is detected. The Autosleep functionality can be turned off by setting Autosleep bit to '0'.

122-127	Vendor Specific	Vendor Specific	Reserved	XXh...	

Notes:

1. The values with XXh are either determined during manufacturing or depend on SFP state
2. Address 95 contains the checksum for byte 64-94
3. Autosleep enables\disables the Save Mode

†: Standard Only ‡: Reclcocker Only

Measurements are calibrated over operating temperature and voltage and should be interpreted as defined below. Alarm and warning threshold values should be interpreted in the same manner as real time 16 bit data.

Internally measured temperature

The temperature is represented as a 16 bit signed two's complement value in increments of 1/256°C, yielding a total range of -128°C to +128°C. The measured range is limited to the operating recommended conditions. To convert a 16 bit digital value in Celsius, take directly the 16-bit value and divide it by 256°C. If the result is greater or equal to 128, subtract 256 from the result.

Table 4: Temperature conversion examples

16-bit value		Temperature
MSB	LSB	
4Bh	00h	+75°C
4Bh	80h	+75.5°C
DDh	00h	-35°C
DCh	80h	-35.5°C

Internally measured supply voltage

The voltage is represented as a 16 bit unsigned integer with the voltage defined as the full 16 bit value (0 – 65535) with LSB equal to 100 µVolt, yielding a total range of 0 to +6.55 Volts. The measured range is limited to the operating recommended conditions. To convert a 16 bit digital value in Volt, take directly the 16-bit value and multiply it by 100 µVolt.

Table 5: Voltage conversion examples

16-bit value		Supply Voltage
MSB	LSB	
80h	E8h	+3.3V
7Eh	F4h	+3.25V

Alarms and Warnings

An Alarm or a Warning flag is set if the measured temperature or voltage exceed the corresponding Alarm or Warning threshold value.

Other Considerations

Video Optimization

The Society of Motion Picture and Television Engineers, or SMPTE, is a leader in the development of standards for film, television, and other video. The Serial Digital Interface or SDI, was standardized by SMPTE for broadcast quality digital video transmission. Other standards evolved from this original standard, defining Enhanced, High-definition (HD), 3G-SDI (1080p) and Ultra High-definition (UHD), or 4K video (2160p).

To help ensure error-free transmission, the standards include a data scrambler / descrambler to create a high density of transitions in the serial data, making it easier for the receiver to maintain timing. Where an encoding method such as 8B-10B ensures a minimal sequential run of all ones or zeros, it does so at the cost of a 25% increase in bandwidth requirements. The scrambler / descrambler method does not require this, but as a result there are certain combinations of scrambler state and the next data bits to be scrambled that result in a sequence of up to twenty consecutive ones or zeros. These sequences are referred to as pathological conditions, and are present in specific shades of pink or grey.

These pathological conditions may create errors in transmission through typical AC coupled optics, or any other AC coupled interface. Video Enhanced or SMPTE Compliant optics are designed to accept these pathological conditions, allowing the longer sequences of ones or zeros to pass without error.

SFP MSA Compliance

The SFP Multi-Source Agreement (MSA) is an agreement that was drafted among competing manufacturers of SFP optical modules. The SFF Committee was formed to oversee the creation and maintenance of these agreements including the SFP MSA designated as INF-8074i. This agreement describes a mutually agreed upon standard for the form and function of SFP modules. However, not all SFPs produced are MSA compliant. The MSA provides for a transceiver (TX/RX) pinout. Other industries such as broadcast had the need for dual TX and dual RX SFP for unidirectional applications such as video. Naturally, a non-MSA standard was introduced allocating pinout assignments for dual output and dual input I/O configurations. In addition, the some of the internal serial communication pins were reassigned.

Table 6: Pinout Comparison Chart

PIN	Transceiver (MSA)	Transceiver (Non-MSA)	Dual TX (Non-MSA)	Dual RX (Non-MSA)
1	VEE	VEE	VEE	VEE
2	TX_FAULT [VEE]	VEE	NC	Rx2-
3	TX_DIS	NC	NC	Rx2+
4	MOD_DEF(2) - SDA	VEE	VEE	VEE
5	MOD_DEF(1) - SCL	SCL	SCL	SCL
6	MOD_DEF(0) – PRESENCE [VEE]	SDA	SDA	SDA
7	Rate [NC]	VEE	VEE	VEE
8	LOS	RX1_LOS	Tx2+	NC
9	VEE	NC	Tx2-	NC
10	VEE	NC	Tx2_DIS	NC
11	VEE	VEE	VEE	VEE
12	RD-	Rx1-	NC	Rx1-
13	RD+	Rx1+	NC	Rx1+
14	VEE	VEE	VEE	VEE
15	VCC	VCC	VCC	VCC
16	VCC	VCC	VCC	VCC
17	VEE	VEE	VEE	VEE
18	TD+	Tx1+	Tx1+	NC
19	TD-	Tx1-	Tx1-	NC
20	VEE	Tx1_DIS	Tx1_DIS	NC

Recommended Circuit Schematic

Host Board Recommended Circuit Schematic

Next figure shows an example of a complete SFP host board schematic with connections to SerDes/ASIC and protocol ICs.

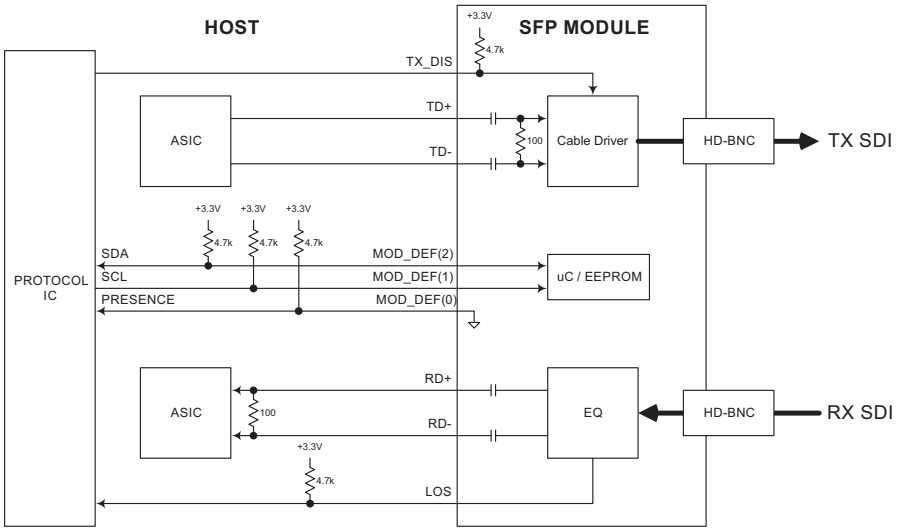


Figure 7: Host Circuit

Host Board Recommended Power Supply

Figure 8 shows the recommended power supply filtering network.

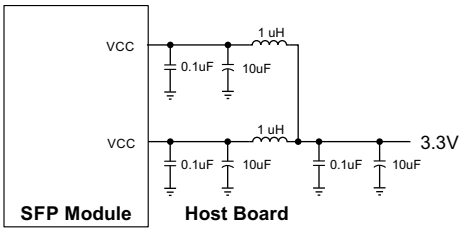


Figure 8: Host Power Supply

PCB Layout Recommendation

Standard board layout practices such as connections to Vcc and GND planes with vias, use of short and equal-length differential signal traces are recommended.

RD± shall be routed as 100Ω differential controlled impedance traces.

TD± shall be routed as 100Ω differential controlled impedance traces.

For cage & host connector layout, please refer to manufacturer documentation.

Specifications

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings		Symbol	Min	Typ	Max	Unit
Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.						
Absolute Maximum	Voltage Range	V_{CC_MAX}	0	3.3	3.6	VDC
Environmental	Storage Temperature	T_s	-40	-	+85	°C
	Operating Temperature	T_{C_MAX}	-40	-	+80	°C
	Operating Relative Humidity (non condensing)		5	-	95	%
	ESD Rating		-	-	1	kV HBM
Recommended Operating Conditions		**Symbol**	**Min**	**Typ**	**Max**	**Unit**
Unless otherwise specified, all specifications are valid under these conditions: VCC = 3.3V ±5%, TC = -40°C to +80°C. Specifications are guaranteed by design and characterization.						
Recommended Operating Conditions	Supply Voltage	V_{CC}	3.13	3.3	3.465	VDC
	Operating Case Temperature	T_C	-40	-	+80	°C
	Serial Data Rate SD (SMPTE 259M, C)	BR_{SD}	-	270	-	Mbps
	Serial Data Rate HD (SMPTE 292M)	BR_{HD}	-	1483, 1485	-	Mbps
	Serial Data Rate 3G SMPTE (424M)	BR_{3G}	-	2967, 2970	-	Mbps
DC characteristics	Power Supply Current[1] (RX1 <140m)	I_{CC}	-	348	402	mA
	Power Supply Current[1] (RX1 >140m)	I_{CC}	-	368	427	mA
	Power Supply Current[2] (Save Mode)	$I_{CC\ (Save\ Mode)}$	-	288	331	mA
	Total Power Consumption[1] (RX1 >140m)	P_D	-	1216	1410	mW
	1. All power consumption characterised at 25°C 2. Save Mode is activated when Autosleep register is set HIGH and no input is detected on RX Channel					
Digital I/O Characteristics - Logic		**Symbol**	**Min**	**Typ**	**Max**	**Unit**
TX_DIS (Input)	Input Voltage Low	V_{IL}	-	-	0.8	V
	Input Voltage High	V_{IH}	2.0	-	-	V
	Rpull-up	R_{PU}	4.7	-	10	kΩ
LOS (Output)	Output Voltage Low (I_{OL}=10µA)	V_{OL}	-	-	0.1	V
	Output Voltage Low (I_{OL}=8.5µA)		-	-	0.6	V
MOD_DEF2 (Output)	Output Voltage Low (I_{OL}=10µA)	V_{OL}	-	-	0.1	V
	Output Voltage Low (I_{OL}=8.5µA)		-	-	0.6	V
MOD_DEF1 & MOD_DEF2 (Input)[1]	Input Voltage Low	V_{IL}	-	-	0.8	V
	Input Voltage High	V_{IH}	2.0	-	-	V
	1. MOD_DEF1 (SCL) & MOD_DEF2 (SDA) must be pulled up to V_{CC} with a 4.7k-10kΩ on the host board					
Digital I/O Characteristics - Data		**Symbol**	**Min**	**Typ**	**Max**	**Unit**
RD± (Output)[1]	Single-ended Voltage Swing[3]	$V_{O\ P-P}$	310	375	440	mVP-P
	Differential Voltage Swing[3]	$V_{ODIFF\ P-P}$	620	750	880	mVP-P
	Differential Impedance[3]	Z_{ODIFF}	90	100	110	Ω
	Rise Time, Fall Time[3] (20% - 80%)	t_r, t_f	-	90	130	ps
	Serial Data Output Jitter[4, 5, 6]	t_{JIT-SD}	-	0.01	0.03	UI
		t_{JIT-HD}	-	0.03	0.04	UI
		t_{JIT-3G}	-	0.06	0.08	UI
	Reclocker Loop Bandwidth (270 Mbps, <0.1dB Peaking)	$BW_{LOOP-SD}$	-	275	-	KHz
	(1485 Mbps, <0.1dB Peaking)	$BW_{LOOP-HD}$	-	1.5	-	MHz
	(2970 Mbps, <0.1dB Peaking)	$BW_{LOOP-3G}$	-	2.75	-	MHz
	Reclocker Acquisition Time[7]	T_{ACQ}	-	-	15	ms
TD± (Input)[2]	Differential Voltage Swing	V_{IDIFF}	200	-	1600	mVP-P
	Differential Impedance	Z_{IN}	90	100	110	Ω
	Input Rise Time / Fall Time (270 Mbps)	t_r, t_f	-	-	1500	ps
	(1485 Mbps)	t_r, t_f	-	-	270	ps
	(2970 Mbps)	t_r, t_f	-	-	135	ps
	Serial Input Jitter Tolerance (A_1 -Timing Jitter – RP184-1996) (A_2 - Alignment Jitter - RP184-1996)	$TOL_{JIT-SD-A1}$	>6	-	-	UI_{P-P}
		$TOL_{JIT-SD-A2}$	>0.6	-	-	UI_{P-P}
		$TOL_{JIT-HD-A1}$	>6	-	-	UI_{P-P}
		$TOL_{JIT-HD-A2}$	>0.6	-	-	UI_{P-P}
		$TOL_{JIT-3G-A1}$	>6	-	-	UI_{P-P}
		$TOL_{JIT-3G-A2}$	>0.6	-	-	UI_{P-P}
	Reclocker Loop Bandwidth (270 Mbps, <0.1dB Peaking)	$BW_{LOOP-SD}$	-	275	-	KHz
	(1485 Mbps, <0.1dB Peaking)	$BW_{LOOP-HD}$	-	1.5	-	MHz
	(2970 Mbps, <0.1dB Peaking)	$BW_{LOOP-3G}$	-	2.75	-	MHz
	Reclocker Acquisition Time[7]	T_{ACQ}	-	-	15	ms

	1. RD± Outputs are AC-coupled inside the module 2. TD± Inputs are AC-coupled inside the module 3. 100Ω Load condition 4. SD-SDI signal, PRBS210-1, Reclock input = 31psp-p 5. HD-SDI signal, PRBS210-1, Reclock input = 24psp-p 6. 3G-SDI signal, PRBS210-1, Reclock input = 22psp-p 7. Measured from first SDI transition until Lock Detect (LD) is enable by Reclocker					
SDI Characteristics		**Symbol**	**Min**	**Typ**	**Max**	**Unit**
SDI RX (Input)	Input Voltage Swing	V_{SDI}	720	800	950	mV_{P-P}
	Input Return Loss (Bandwidth 0-1.5GHz)	$IRL_{0-1.5G}$	15	18	-	dB
	(Bandwidth 1.5-3GHz)	$IRL_{1.5-3G}$	10	13	-	dB
	Jitter SD-SDI (0-350m Belden 1694A)		-	-	0.2	UI
	(350-400m Belden 1694A)		-	0.2	-	UI
	Jitter HD-SDI (0-170m Belden 1694A)		-	-	0.25	UI
	(170-200m Belden 1694A)		-	0.3	-	UI
	Jitter 3G-SDI (0-110m Belden 1694A)		-	-	0.3	UI
	(110-140m Belden 1694A)		-	0.35	-	UI
	Cable Length (Belden 1694A) SD-SDI		-	350	400	m
	HD-SDI		-	170	200	m
	3G-SDI		-	110	140	m
SDI TX (Output)	Output Voltage Swing (75Ω Load)	V_{SDO}	720	800	880	mV
	Output Return Loss (Bandwidth 0-1.5GHz)	$ORL_{0-1.5G}$	15	27	-	dB
	(Bandwidth 1.5-3GHz)	$ORL_{1.5-3G}$	10	13	-	dB
	Output Jitter SD-SDI[1]	t_{jit-SD}	-	0.014	-	UI_{P-P}
	HD-SDI[2]	t_{jit-HD}	-	0.057	-	UI_{P-P}
	3G-SDI[3]	t_{jit-3G}	-	0.119	-	UI_{P-P}
	Rise/Fall Time (80%-20%) Rate_Select = 0 (SD-SDI)	t_{r-SD}, t_{f-SD}	400	-	800	ps
	Rate_Select = 1 (HD/3G-SDI)	tr_{-HD}, t_{f-HD}	-	90	135	ps
	Mismatched in Rise/Fall Rate_Select = 0 (SD-SDI)		-	-	50	ps
	Rate_Select = 1 (HD/3G-SDI)		-	-	30	ps
	Duty Cycle Distortion Rate_Select = 0 (SD-SDI)		-	100	-	ps
	Rate_Select = 1 (HD-SDI)		-	30	-	ps
	Rate_Select = 1 (3G-SDI)		-	27	-	ps
	Overshoot Rate_Select = 0 (SD-SDI)		-	-	8	%
	Rate_Select = 1 (HD/3G-SDI)		-	-	10	%
	1. SD-SDI signal, PRBS210-1, Reclock input = 31psp-p 2. HD-SDI signal, PRBS210-1, Reclock input = 24psp-p 3. 3G-SDI signal, PRBS210-1, Reclock input = 22psp-p					
Timing Characteristics		**Symbol**	**Min**	**Typ**	**Max**	**Unit**
MOD_DEF1 (Input)	Clock Rate1		-	-	400	kHz
	1. If host does not support clock stretching, MOD_DEF1 (SCL) clock rate should be set to 100kHz maximum.					

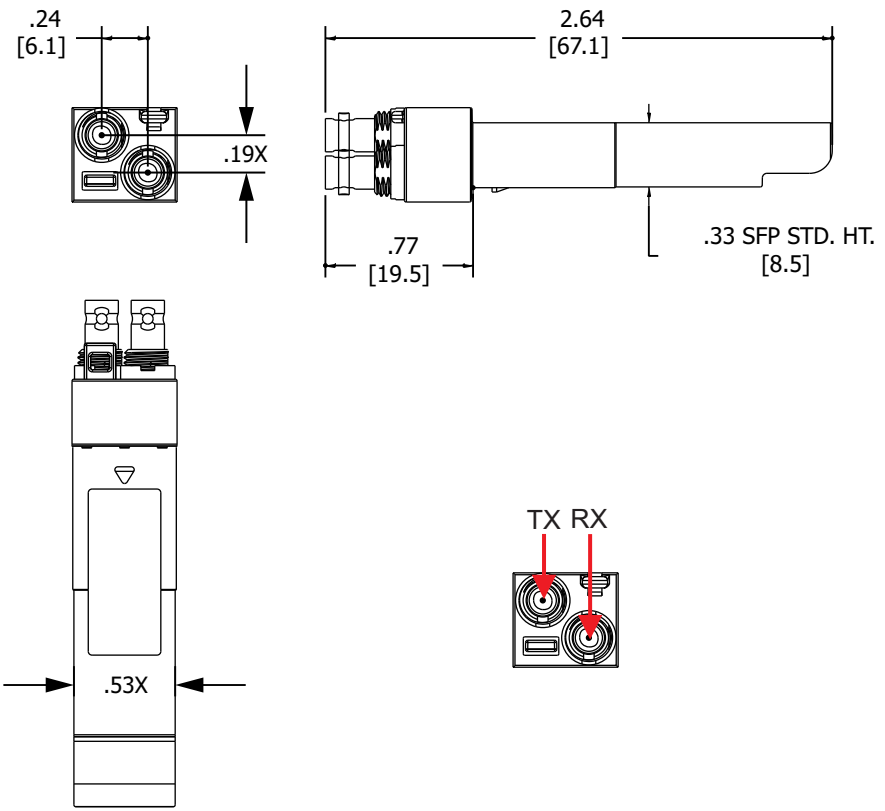


Figure 9 SFP-BHDVXC Dimensions

Mechanical Features

This section provides a brief list of the SFP-BHDVXC mechanical features.

Item	Description
Connector Type	HD-BNC (75Ω)
Plug Diameter	Up to 7.8mm external HD-BNC plug diameter (Standard)
Ganged Cages	Ganged cages mounting supported
Stacked Cages	Stacked cages mounting supported
Mechanical release	Simple pull up mechanical release system to disengage the module from his cage

References

INF-8074i Rev1.0 SFP (Small Form Factor Pluggable) Transceiver

SFF-8472 Rev10.4 Diagnostic Monitoring Interface for Optical Transceivers

SMPTE 259M-2008 SDTV Digital Signal/Data – Serial Digital Interface

SMPTE 292M-2008 1.5 Gb/s Signal / Data Serial Interface

SMPTE 424M-2006 3 Gb/s Signal/Data Serial Interface

fiberplex TECHNOLOGIES, LLC
18040-412 Guilford Rd. • Annapolis Junction, MD 20701
fiberplex.com • clients@fiberplex.com • 301.604.0100