

Ultrix

SFP Modules Guide

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 - offer the best product quality and support
2. Make Cool Practical Technology
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Ross has become well known for the Ross Video Code of Ethics. It guides our interactions and empowers our employees. I hope you enjoy reading it below.

If anything at all with your Ross experience does not live up to your expectations be sure to reach out to us at solutions@rossvideo.com.



David Ross
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Ross Video Code of Ethics

Any company is the sum total of the people that make things happen. At Ross, our employees are a special group. Our employees truly care about doing a great job and delivering a high quality customer experience every day. This code of ethics hangs on the wall of all Ross Video locations to guide our behavior:

1. We will always act in our customers' best interest.
2. We will do our best to understand our customers' requirements.
3. We will not ship crap.
4. We will be great to work with.
5. We will do something extra for our customers, as an apology, when something big goes wrong and it's our fault.
6. We will keep our promises.
7. We will treat the competition with respect.
8. We will cooperate with and help other friendly companies.
9. We will go above and beyond in times of crisis. *If there's no one to authorize the required action in times of company or customer crisis - do what you know in your heart is right. (You may rent helicopters if necessary.)*

Ultrix · SFP Modules Guide

- Ross Part Number: **2101DR-008-06**
- Release Date: December 14, 2017.

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Patents

Patent numbers US 7,034,886; US 7,508,455; US 7,602,446; US 7,802,802 B2; US 7,834,886; US 7,914,332; US 8,307,284; US 8,407,374 B2; US 8,499,019 B2; US 8,519,949 B2; US 8,743,292 B2; GB 2,419,119 B; GB 2,447,380 B; and other patents pending.

Notice

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Statement of Compliance

This product has been determined to be compliant with the applicable standards, regulations, and directives for the countries where the product is marketed.

Compliance documentation, such as certification or Declaration of Compliance for the product is available upon request by contacting techsupport@rossvideo.com. Please include the product; model number identifiers and serial number and country that compliance information is needed in request.

EMC Notices

United States of America - FCC Part 15

This equipment has been tested and found to comply with the limits for a class A Digital device, pursuant to part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a Commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canada

This Class A device complies with Canadian ICES-003 and part 15 of the FCC Rules.

Cet appareil numérique de la classe "A" est conforme à la norme NMB-003 du Canada.

Notice — *Changes or modifications to this equipment not expressly approved by Ross Video Ltd. could void the user's authority to operate this equipment.*

European Union

This equipment is in compliance with the essential requirements and other relevant provisions established under regulation (EC) No 765/2008 and Decision No 768/2008/EC referred to as the “New Legislative Framework”.



Warning — *This equipment is compliant with Class A of CISPR 32. In a residential environment this equipment may cause radio interference.*

Australia/New Zealand

This equipment is in compliance with the provisions established under the Radiocommunications Act 1992 and Radiocommunications Labeling (Electromagnetic Compatibility) Notice 2008.

Korea

This equipment is in compliance with the provisions established under the Radio Waves Act.

Class A equipment (Broadcasting and communications service for business use).

This device is a business-use (Class A) EMC-compliant device. The seller and user are advised to be aware of this fact. This device is intended for use in areas outside home.

Type of Equipment	User's Guide
A급 기기 (업무용 방송통신기자재)	이 기기는 업무용(A급) 전자파적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.
Class A Equipment (Industrial Broadcasting & Communication Equipment)	This equipment is Industrial (Class A) electromagnetic wave suitability equipment and seller or user should take notice of it, and this equipment is to be used in the places except for home.

International

This equipment has been tested under the requirements of CISPR 22:2008 or CISPR 32:2015 and found to comply with the limits for a Class A Digital device.

Notice — *This is a Class A product. In domestic environments, this product may cause radio interference, in which case the user may have to take adequate measures.*

Warranty and Repair Policy

The product is backed by a comprehensive one-year warranty on all components.

Notice — *Changes or modifications to this equipment not expressly approved by Ross Video Ltd. could void the user's authority to operate this equipment.*

If an item becomes defective within the warranty period Ross will repair or replace the defective item, as determined solely by Ross.

Warranty repairs will be conducted at Ross, with all shipping FOB Ross dock. If repairs are conducted at the customer site, reasonable out-of-pocket charges will apply. At the discretion of Ross, and on a temporary loan basis, plug in circuit boards or other replacement parts may be supplied free of charge while defective items undergo repair. Return packing, shipping, and special handling costs are the responsibility of the customer.

This warranty is void if products are subjected to misuse, neglect, accident, improper installation or application, or unauthorized modification.

In no event shall Ross Video Limited be liable for direct, indirect, special, incidental, or consequential damages (including loss of profit). Implied warranties, including that of merchantability and fitness for a particular purpose, are expressly limited to the duration of this warranty.

This warranty is TRANSFERABLE to subsequent owners, subject to Ross' notification of change of ownership.

Environmental Information

The equipment may contain hazardous substances that could impact health and the environment.

To avoid the potential release of those substances into the environment and to diminish the need for the extraction of natural resources, Ross Video encourages you to use the appropriate take-back systems. These systems will reuse or recycle most of the materials from your end-of-life equipment in an environmentally friendly and health conscious manner.

The crossed-out wheeled bin symbol invites you to use these systems.



If you need more information on the collection, reuse, and recycling systems, please contact your local or regional waste administration. You can also contact Ross Video for more information on the environmental performances of our products.

This appliance may contain a Coin type battery which should not be treated as household waste.

To ensure that the battery will be treated properly use the appropriate take-back systems in your area. These systems will reuse or recycle most of the materials from your end-of-life equipment in an environmentally friendly and health conscious manner.

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Contents

Introduction	11
Related Publications	11
Documentation Conventions	11
Block Diagram Conventions	11
Referenced Guides	11
Important Instructions	11
Contacting Technical Support	11
 Getting Started	 13
Before You Begin	13
Installation Overview	13
 SFP-HDM-OUT	 15
Features	15
Simplified Block Diagram	15
Supported Video Formats	16
Functional Overview	16
Video	16
Audio	16
Module Installation	17
Technical Specifications	17
Absolute Maximum Ratings	17
Recommended Operating Conditions	17
HDMI TX Characteristics	17
Mechanical Specifications	18
 SFP-HDM-IN	 19
Features	19
Simplified Block Diagram	19
Format Resolution Details	20
Functional Overview	20
Audio Support	20
SDI Video Output	20
Module Installation	21
Technical Specifications	21
Absolute Maximum Ratings	21
Recommended Operating Conditions	21
HDMI Input Characteristics	21
Mechanical Specifications	22
 SFP-ANA-IO	 23
Features	23
Simplified Block Diagram	23
Functional Overview	24
Receive Channel	24
Transmit Channel	24
Module Installation	24
Technical Specifications	24
Absolute Maximum Ratings	24

Recommended Operating Conditions	24
Composite Receive Channel Specifications	25
Composite Transmit Specifications	25
Mechanical Specifications	26
Mechanical Features	26
Physical Channel Position	26
SFP-MADI-COAX	27
Features	27
Simplified Block Diagram	27
Functional Description	27
Module Installation	27
Technical Specifications	27
Absolute Maximum Ratings	27
Recommended Operating Conditions	28
MADI Receive Characteristics	28
MADI Transmit Characteristics	28
Mechanical Specifications	29
Mechanical Features	29
Physical Channel Position	29
SFP-FIBER-3G,SFP-MADI-1310SM	31
Features	31
Simplified Block Diagram	31
Technical Specifications	31
Absolute Maximum Ratings	31
Optical Performance Specifications	32
Mechanical Specifications	33
Physical Channel Position	33
SFP-HDB-IO-3G	35
Features	35
Simplified Block Diagram	35
Module Installation	35
Technical Specifications	36
Absolute Maximum Ratings	36
Recommended Operating Conditions	36
SDI Receive Characteristics	36
SDI Transmit Characteristics	37
Mechanical Features	37
Physical Channel Position	38
SFP-HDB-IN-12G	39
Features	39
Simplified Block Diagram	39
Functional Description	39
Module Installation	39
Technical Specifications	40
Absolute Maximum Ratings	40
Recommended Operating Conditions	40
SDI Receive Characteristics	40
Mechanical Specifications	41
Physical Channel Position	41

SFP-HDB-OUT-12G	43
Features	43
Simplified Block Diagram	43
Functional Description	43
Module Installation	43
Technical Specifications	44
Absolute Maximum Ratings	44
Recommended Operating Conditions	44
SDI Input Characteristics	45
SDI Output Characteristics	45
Mechanical Specifications	45
Physical Channel Position	46
 SFP-MADI-850MM	 47
Features	47
Simplified Block Diagram	47
Technical Specifications	47
Absolute Maximum Ratings	47
Transmitter Performance Characteristics	48
Receiver Performance Characteristics	48
Mechanical Specifications	49
Physical Channel Position	49
 SFP-MADI-1300MM	 51
Features	51
Simplified Block Diagram	51
Technical Specifications	51
Absolute Maximum Ratings	51
Recommended Operating Conditions	52
Transmitter Optical Characteristics	52
Receiver Optical and Electrical Characteristics	52
Mechanical Specifications	53
Physical Channel Position	53
Configuring the SFP-MADI-1300MM in the Ultrix Database	53

Introduction

This addendum is for installers of the Ross Video Ultrix router. It provides additional information on the Small Form Pluggable (SFP) modules that can be installed in the **AUX** ports of the router.

If you have questions, please contact us at the numbers listed in the section “**Contacting Technical Support**” on page 11. Our technical staff is always available for consultation, training, or service.

Related Publications

It is recommended to consult the following Ross documentation before installing your SFP module for the Ultrix router:

- *Ultrix Quick Start Guide*, Ross Part Number: 2101DR-002
- *Ultrix Installation Guide*, Ross Part Number: 2101DR-003
- *Ultrix User Guide*, Ross Part Number: 2101DR-004

Documentation Conventions

Special text formats are used in this guide to identify parts of the user interface, text that a user must enter, or a sequence of menus and sub-menus that must be followed to reach a particular command.

Block Diagram Conventions

The block diagrams reference “AUX IN” and “AUX OUT”. These terms refer to the auxiliary inputs and outputs of the Ultrix router respectively.

Referenced Guides

Italic text is used to identify the titles of referenced guides, manuals, or documents. For example:

For more information, refer to the section “**Assigning an IP Address**” in the *Ultrix User Guide*.

Important Instructions

Star icons are used to identify important instructions or features. For example:

- ★ When the Ultrix router cannot connect to the network, a **Message** dialog opens to report the connection problem.

Contacting Technical Support

At Ross Video, we take pride in the quality of our products, but if problems occur, help is as close as the nearest telephone.

Our 24-hour Hot Line service ensures you have access to technical expertise around the clock. After-sales service and technical support is provided directly by Ross Video personnel. During business hours (Eastern Time), technical support personnel are available by telephone. After hours and on weekends, a direct emergency technical support phone line is available. If the technical support person who is on call does not answer this line immediately, a voice message can be left and the call will be returned shortly. This team of highly trained staff is available to react to any problem and to do whatever is necessary to ensure customer satisfaction.

- **Technical Support:** (+1) 613-652-4886
- **After Hours Emergency:** (+1) 613-349-0006
- **E-mail:** techsupport@rossvideo.com
- **Website:** <http://www.rossvideo.com>

Getting Started

This section provides a general overview of how to install an SFP module into an AUX port on the rear panel of the Ultrix router. Refer to the documentation that accompanied your SFP module for installation details.

★ Ross Video Ultrix routers support only Ross Video branded SFP modules. SFP modules from other vendors may yield unpredictable results.

Before You Begin

Throughout this manual, please heed the following cautionary note:



ESD Susceptibility — *Static discharge can cause serious damage to sensitive semiconductor devices. Avoid handling circuit boards in high static environments such as carpeted areas and when synthetic fiber clothing is worn. Always exercise proper grounding precautions when working on circuit boards and related equipment.*

Installation Overview

This section provides a general overview of how to install an SFP module into an AUX port on the rear panel of the Ultrix router.

For More Information on...

- installing an SFP module, refer to the documentation that accompanied your SFP module.

To install an SFP module in an AUX port



Caution — *Do not remove the dust caps from the AUX port until you are ready to install the SFP Module.*

1. Remove the dust cap from the **AUX** port on the Ultrix rear panel as follows:
 - a. Locate the **AUX** port you wish to install the SFP module into.
 - b. Grasp the cap between your thumb and forefinger and gently press on the sides.
 - c. Pull the cap towards you and away from the port.
 - d. Store the dust cap for later use.
2. Locate the markings on the SFP Module chassis that identify the orientation for installing. These markings may include Tx/Rx icons, or arrows that indicate the direction.



Caution — *Do not install the SFP-FIBER-3G or SFP-MADI-FIBER modules with fiber-optic cables attached. Doing so can damage the cables, the cable connector, the SFP Module or all three.*

3. Align the SFP Module in front of the empty **AUX** port.
4. Insert the SFP Module into the **AUX** port, ensuring it is seated home and the latch is engaged.



Caution — *Do not remove the dust caps from the SFP Module until you are ready to connect the cables.*

SFP-HDM-OUT

The SFP-HDM-OUT is an electrical SFP Transmitter module designed to convert SDI signals to an HDMI/DVI output without scaling artifacts. A copy of the reclocked SD/HD/3G-SDI source is loopback to the router. Up to 8 channel of audio are supported and embedded in the HDMI signal.

Features

- SMPTE 424M, SMPTE 292M, SMPTE 259M, SMPTE 425A (Mapping 1), and SMPTE 425B (372M Mapping)
- SDI Reclocked loopback to router connector
- Supported formats: 525/625, 720p/1080i (50/ 59.94/60Hz), 1080p (23.98/24/25/29.97/30/50/ 59.94/60Hz)
- HDMI Output:
 - › 24bit (3x8bit), BW=150MHz
 - › RGB 4:4:4, YCbCr 4:2:2, YCbCr 4:4:4
 - › DVI 1.0 Mode
 - › RGB Range (Full/SMPTE)
 - › Up to 8 channel audio embedding (PCM)
- HDMI 1.4 type D connector
- Hot-pluggable
- Low Power Consumption - typical 1032mW
- Single Supply +3.3V
- Operating temperature range: -20°C to 80°C
- SFP package size: 64.1mm x 13.4mm x 8.6mm

Simplified Block Diagram

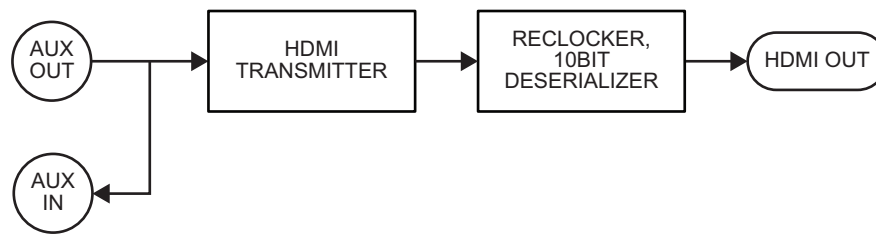


Figure 3.1 SFP-HDM-OUT — High Level Block Diagram

Supported Video Formats

For 3G-SDI source, the module supports SMPTE 425-A and SMPTE 425-B. For Level B, only the Dual Link mapping (372M) is supported. **Table 3.1** list all supported SDI input formats.

Table 3.1 Support Formats

Format		CEA-861 VIC Code
SD-SDI	720x480i @ 60/59.94Hz	6
	720x576i @ 50Hz	21
HD-SDI	1280x720p @ 60/59.94Hz	4
	1280x720p @ 50Hz	19
	1920x1080i @ 60/59.94Hz	5
	1920x1080i @ 50Hz	20
	1920x1080p @ 30/29.97Hz	34
	1920x1080p @ 25Hz	33
	1920x1080p @ 24/23.98Hz	32
3G-SDI	1920x1080p @ 60/59.94Hz	16
	1920x1080p @ 50Hz	31

Functional Overview

The SFP-HDM-OUT 3G-SDI to HDMI converter output displays the native resolution without introducing any scaling artifacts. The SDI input format is automatically detected and converted by the module to CEA-861 format to respect HDMI video format timing specifications. The HDMI output provides a 150MHz bandwidth with 24bit of resolution, enabling the direct mapping of SDI source up to 1080p at 60Hz. An integrated color space converter combined with a 4:2:2 to 4:4:4 interpolation up-conversions give the flexibility to convert the YCbCr source to RGB with a limited or full range to support DVI display. Output format can be configured to YCbCr 4:2:2, YCrCr 4:4:4, or RGB 4:4:4 in HDMI mode. By default, the module output format is YCbCr 4:2:2 in HDMI mode.

Up to 8 PCM audio channels from 2 selected groups can be de-embedded from the SDI source and mapped over the HDMI. Select audio channel status information is also extracted and available via registry.

Video

The video output format will be formatted as per sink EDID information (either HDMI or DVI mode). The video output format can be forced to YCbCr 4:2:2, YCbCr 4:4:4 or RGB 4:4:4 via registry.

As DVI only supports RGB, color space conversion and up-conversion (4:2:2 to 4:4:4) will be applied. No de-interlacing is performed by the module, only a progressive SDI source can be monitored in DVI mode with an HDMI bandwidth limitation of 150MHz.

Audio

SDI de-embedded audio is re-embedded in the HDMI stream. If DVI mode is selected, no audio is embedded on the TMDS interface.

No down-mix is performed by the module, only channel mapping.

The HDMI audio automatically use 24bit resolution in HD. In SD, the resolution is 20bit by default and automatically set to 24bit based on the detection of audio extended data packet.

Module Installation

The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design. The module housing makes initial contact with the router board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD).

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 3.2 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	-20°C	+80°C	Measured on the top side of the module in the center
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	Non-condensing
ESD Rating		8kV	IEC61000-4-2 level 4

Recommended Operating Conditions

Table 3.3 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.13V	3.3V	3.465V	
Operating Case Temperature	-20°C		+80°C	
SDI Serial Data Rate	270Mbps		2970Mbps	270/1485/2970Mbps

HDMI TX Characteristics

Table 3.4 HDMI TX Characteristics — Output

Parameter	Min.	Typical	Max.	Notes
TMDS Output Clock Freq.	20MHz		150MHz	
TMDS Output Clock Duty Cycle	48%		52%	
TMDS Differential Swing	800mV	1000mV	1200mV	
TMDS Rise/Fall Time	75ps	175ps		
Maximum Output Current (5V)	55mA			
Output Voltage (5V)	4.8V	5.05V	5.3V	

Mechanical Specifications

Note that specifications are subject to change without notice.

Table 3.5 provides a brief list of the SFP-HDM-OUT mechanical features.

Table 3.5 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HDMI 1.4 Type D
Plug Mechanical Retention	Custom Design to enable cable mechanical retention
Mechanical release	Simple pull up mechanical release system to disengage the module from its cage

SFP-HDM-IN

The SFP-HDM-IN is an electrical SFP Receiver module designed to convert an HDMI input (High Definition Multimedia Interface®) to an SDI format. Up to 4 channels of audio are supported.

Features

- SMPTE 259M, SMPTE 292M, SMPTE 344M, and SMPTE 424M compliant
- SDI Reclocked output to router auxiliary input
- Supported output formats in YCbCr 4:2:2: 525i/625i, 720p/1080i (50/ 59.94/60Hz), 1080p (50/59.94/60Hz)
- Supported audio embedded: 4 channels, AES1 group 1, L-PCM, 48KHz
- HDMI Input:
 - › 24bit (3x8bit)
 - › RGB 4:4:4, YCbCr 4:2:2, YCbCr 4:4:4
 - › BW=165MHz
 - › DVI 1.0 Mode (Only video resolution)
 - › RGB Range (Full/SMPTE)
- HDMI 1.4 type D connector
- Hot-pluggable
- Low Power Consumption: typical 1353mW
- Single Supply +3.3V
- Operating temperature range: 0°C to 70°C
- SFP package size: 64.1mm x 13.4mm x 8.6mm

Simplified Block Diagram

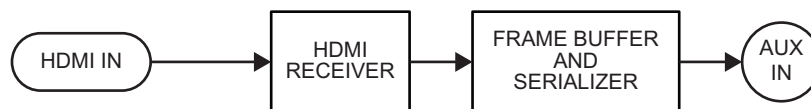


Figure 4.1 High Level Block Diagram

Format Resolution Details

Table 4.1 lists the formats supported by the SFP-HDM-IN.

Table 4.1 Supported Formats

HDMI Input Format		CEA-861 VIC Code
Standard Definition	720 (1440) x 480i 59.94/60Hz	6, 7
	720 (1440) x 576i 50Hz	21, 22
High Definition	1920 x 1080i 50/59.94/60Hz	5, 20
	1280 x 720p 50/59.94/60Hz	4, 19
3G (1080p)	1920 x 1080p 50/59.94/60Hz	16, 31
Graphic ^a	640 x 480 50/59.94/60/75Hz	
	720 x 480 50/59.94/60/75Hz	
	720 x 576 50/59.94/60/75Hz	
	800 x 600 50/59.94/60/75Hz	
	1024 x 768 50/59.94/60/75Hz	
	1152 x 864 50/59.94/60/75Hz	
	1280 x 768 50/59.94/60/75Hz	
	1280 x 800 50/59.94/60/75Hz	
	1280 x 960 50/59.94/60/75Hz	
	1280 x 1024 50/59.94/60/75Hz	
	1366 x 768 50/59.94/60/75Hz	
	1400 x 1050 50/59.94/60Hz	

a. All formats in progressive mode, HDMI/DVI.

Functional Overview

- Cold boot time can take up to 8 seconds.
- When no HDMI signal is present or the HDMI signal is invalid, the default is to output a 100% color bar and LOS signal is asserted.
- Hot-plug detect circuit is toggled upon SFP power up when the HDMI cable is already present and when a cable is inserted while the SFP is already powered up.
- EDID is readable only after initial SFP power up. Stays available afterward until HDMI cable is disconnected.

Audio Support

- Four audio input channels available.
- Audio input sampling frequency supported: 32KHz, 44.1KHz, and 48KHz.
- Two audio output channels available, always mapped to AES1 Group 1.

SDI Video Output

- Defaults to same format and rate as the HDMI input, when possible.
- When the HDMI input is invalid, a 100% color bar is outputted.

Module Installation

The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design. The module housing makes initial contact with the router board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD).

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 4.2 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	0°C	+70°C	Measured on the top side of the module in the center
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	Non-condensing
ESD Rating		8kV	IEC61000-4-2 level 4 (HDMI Connector)

Recommended Operating Conditions

Table 4.3 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.13V	3.3V	3.465V	
Operating Case Temperature	0°C		+70°C	
SDI Serial Data Rate	270Mbps		2970Mbps	270/1485/2970Mbps

HDMI Input Characteristics

Table 4.4 HDMI Input Characteristics

Parameter	Min.	Typical	Max.	Notes
TMDS Clock Frequency	20MHz		165MHz	
TMDS Clock Duty Cycle	45%	50%		
TMDS Ended Amplitude	75mV		700mV	
Intra-pair Differential Input Skew	0.4t _{BIT}			
Channel-to-Channel Differential Input Skew	0.6t _{PIXEL}			

Mechanical Specifications

Note that specifications are subject to change without notice.

Table 4.5 provides a brief list of the SFP-HDM-IN mechanical features.

Table 4.5 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HDMI 1.4 Type D
Plug Mechanical Retention	Custom Design to enable cable mechanical retention
Mechanical Release	Simple pull up mechanical release system to disengage the module from its cage

SFP-ANA-IO

The SFP-ANA-IO is an electrical SFP Encoder/Decoder (Transceiver) module designed to encode/decode video composite signals over 75Ω coaxial cables via HD-BNCs. On the receive (Rx) channel, the module decodes NTSC/PAL composite input and converts it to an SD-SDI signal. On the transmit (Tx) channel, the module encodes the SD-SDI signal to NTSC/PAL composite.

Features

- SMPTE 259M-C compliant
- HD-BNC 75Ω connectors
- Supported Composite Standards:
 - › NTSC M, NTSC J, NTSC 4.43
 - › PAL B/G/H/I/D, PAL M, PAL N, PAL 60
- Input Channel:
 - › 10bit Composite to SD-SDI video decoder
 - › 4x oversampling (54MHz)
 - › Test Pattern generation
- Output Channel:
 - › 10bit SD-SDI to Composite video encoder
 - › Up to 16x oversampling (216MHz)
 - › Multiple Chroma and Luma filters
 - › Test Pattern generation
- Hot-pluggable
- Power Consumption: typical 1100mW
- Single Supply +3.3V
- Operating temperature range: 0°C to 65°C
- SFP package size: 58.5mm x 13.4mm x 8.6mm

Simplified Block Diagram

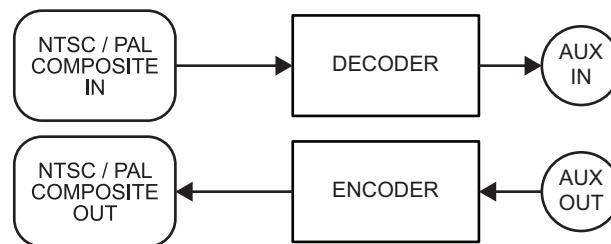


Figure 5.1 SFP-ANA-IO — High Level Block Diagram

Functional Overview

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

Receive Channel

The Receive (Rx) channel converts a NTSC/PAL video composite input signal to SD-SDI. The video decoder has a 10bit analog-to-digital video converter (ADC) sampling at 54MHz. With 4x oversampling, it features a DC restore circuit with offset correction and automatic gain control (AGC) to accurately optimize the full-scale range of the ADC. The input also has a multi-line adaptive (5-lines) comb filter to minimize the cross-chrominance and cross-luminance artifacts.

Transmit Channel

The Transmit (TX) channel converts an SD-SDI digital video signal to NTSC/PAL video composite output. The transmit path of the module has a Deserializer and a composite video encoder with a high speed 10bits Digital-to-Analog video converter (DAC) that can oversample up to 216MHz.

Module Installation

The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design. The module housing makes initial contact with the router board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD).

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 5.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	0°C	+65°C	Measured on the top side of the module in the center
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	Non-condensing
ESD Rating		500V	HBM

Recommended Operating Conditions

Table 5.2 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.13V	3.3V	3.465V	
Operating Case Temperature	0°C		+65°C	
Serial Data Rate		270Mbps		

Composite Receive Channel Specifications

Table 5.3 Composite RX Input Specifications

Parameter	Min.	Typical	Max.	Notes
Input Return Loss	25dB			
Input Voltage Range	270mVp-p	500mVp-p	830mVp-p	
Cutoff Frequency (3dB)		13MHz		
Passband Flatness		0.25dB		
Stopband Cutoff		53MHz		
Stopband Attenuation		36dB		
Full-Scale Conversion Range		670mVp-p	830mVp-p	
		270mVp-p	330mVp-p	
AGC Gain Step Size		0.167V/V		
Differential Nonlinearity		±0.5LSB		
Integral Nonlinearity		±1LSB		
Signal-to-Noise Ratio		58.8dB		
Differential Phase		1.0°		
Differential Gain		1%		
2T Pulse Response		0.4%		
2T Bar Response		0.2%		
2T Pulse to Bar Rating		0.2%		
Group Delay Distortion		±1ns		100kHz < f < 5MHz
Chroma Bandwidth		1MHz		
Luma Bandwidth		5.5MHz		
Luma Nonlinearity		1%		5-step staircase
Luma Line Time Distortion		0.5%		
Luma Field Time Distortion		0.1%		
Lock time		3 Frames		
Horizontal Line Time Static Variation	-5%		+5%	
Maximum Horizontal Line Time Jitter			160ns	

Composite Transmit Specifications

Table 5.4 Composite TX (Output) Specifications

Parameter	Min.	Typical	Max.	Notes
Output Voltage	0mV		1400mV	
Full-drive Output Current	31.5mA	33.5mA	37mA	
Output Return Loss	25dB			

Table 5.4 Composite TX (Output) Specifications

Parameter	Min.	Typical	Max.	Notes
Analog Output Delay		6ns		
Resolution		10Bits		
Luminance Nonlinearity		±0.5%		
Differential Gain		0.5%		NTSC
Differential Phase		0.6°		NTSC
SNR Ratio		58dB		Luma ramp
		75dB		Flat field full bandwidth

Mechanical Specifications

Note that specifications are subject to change without notice.

Mechanical Features

Table 5.5 provides a brief list of the SFP-ANA-IO mechanical features.

Table 5.5 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HD-BNC 75Ω
Plug Diameter	Up to 7.8mm external HD-BNC plug diameter (standard)
Mechanical Release	Simple pull up mechanical release system to disengage the module from its cage

Physical Channel Position

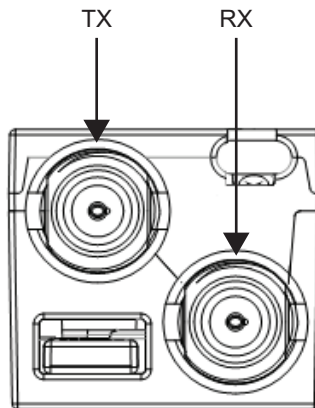


Figure 5.2 SFP Package Outline, Front View — Channel Position

SFP-MADI-COAX

The SFP-MADI-COAX is an electrical SFP Transceiver module designed to transmit and receive MADI signals of 125Mbps over 75Ω coaxial cables via HD-BNC connectors.

Features

- AES10-2008 compliant
- HD-BNC 75Ω connectors
- Equalizes Belden 1694A cable up to 300m
- Integrated Tx Cable Driver with output impedance of 75Ω ±2Ω
- Hot-pluggable
- Low Power Consumption - typical 427mW
- Single Supply +3.3V
- Operating temperature range: -40°C to 80°C
- SFP package size: 58.5mm x 13.4mm x 8.6mm

Simplified Block Diagram

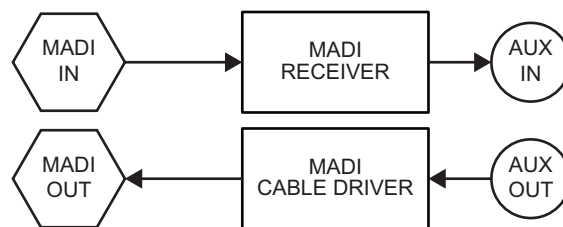


Figure 6.1 SFP-MADI-COAX — High Level Block Diagram

Functional Description

The SFP-MADI-COAX 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-MADI-COAX transceiver contains both a cable driver for transmission of the MADI signal, and an automatic cable equalizer of reception of a MADI signal.

Module Installation

The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design. The module housing makes initial contact with the router board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD).

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 6.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	-40°C	+80°C	Measured on the top side of the module
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	Non-condensing
ESD Rating		1kV	HBM

Recommended Operating Conditions

Table 6.2 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.13V	3.3V	3.465V	
Operating Case Temperature	-40°C		+80°C	
Serial Data Rate		125Mbps		

MADI Receive Characteristics

Table 6.3 MADI Receive Specifications

Parameter	Min.	Typical	Max.	Notes
Input Voltage Swing	150mVp-p		950mVp-p	
Input Return Loss	30dB			Bandwidth up to 150MHz
Input Impedance	73Ω	75Ω	77Ω	Bandwidth up to 150MHz
Cable Length (Belden 1694A)		300m		MADI

MADI Transmit Characteristics

Table 6.4 MADI Transmit Specifications

Parameter	Min.	Typical	Max.	Notes
Output Voltage Swing	300mV		600mV	75Ω load
Output Return Loss	25dB			Bandwidth up to 150MHz
Output Impedance	73Ω	75Ω	77Ω	Bandwidth up to 150MHz
Additive Jitter		15psp-p		
Rise/Fall Time (80-20%)	1		3ns	75Ω load
Mismatched in Rise-Fall Time			0.5ns	75Ω load, measured at average amplitude point

Mechanical Specifications

Note that specifications are subject to change without notice.

Mechanical Features

Table 6.5 provides a brief list of the SFP-MADI-COAX mechanical features.

Table 6.5 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HD-BNC (75Ω)
Plug Diameter	Up to 7.8mm external HD-BNC plug diameter (standard)
Mechanical release	Simple pull up mechanical release system to disengage the module from its cage

Physical Channel Position

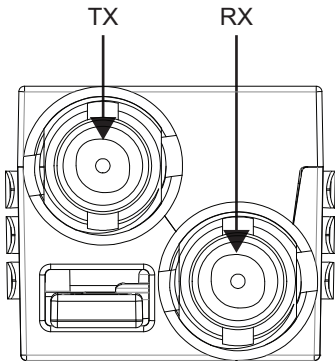


Figure 6.2 SFP Package Outline, Front View — Channel Position

SFP-FIBER-3G,SFP-MADI-1310SM

The SFP-FIBER-3G is an optical transceiver module engineered for exceptional performance in the presence of SDI pathological patterns. The transceiver features best-in-class optical receiver sensitivity for SMPTE 259M, SMPTE 344M, SMPTE 292M and SMPTE 424M serial rates, thus providing superior optical link budget and robustness.

The SFP-FIBER-3G contains a PIN photo diode receiver and a 1310nm Fabry-Pérot laser transmitter designed to provide error-free transmission of signals from 50Mbps to 3Gbps over single mode fiber (9/125). It is also hot-pluggable.

The SFP-MADI-1310SM includes the same features as the SFP-FIBER-3G, but also transmits and receives MADI signals.

Features

- SMPTE 297-2006 compatible
- Best-in-class optical receiver sensitivity: -22dBm (over all supported video rates with pathological data)
- Robust error free transmission of signals from 50Mbps to 3Gbps with up to 30km single-mode fiber
- Supports video pathological patterns for SD-SDI, HD-SDI and 3G-SDI
- Hot-pluggable
- Laser disable pin
- Single +3.3V power supply
- Operating temperature range: -25°C to 85°C
- SFP package size: 56.5mm x 13.4mm x 8.6mm

Simplified Block Diagram

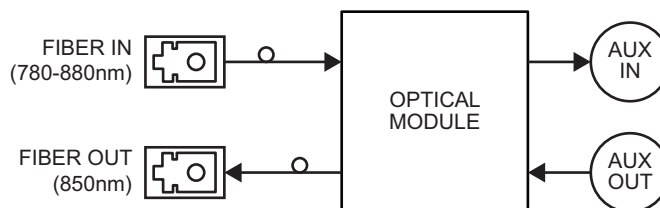


Figure 7.1 SFP-FIBER-3G, SFP-MADI-1310SM — High Level Block Diagram

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 7.1 Absolute Maximum Ratings

Parameter	Value
Supply Voltage	4V
Operating Case Temperature	-25°C to 85°C

Table 7.1 Absolute Maximum Ratings

Parameter	Value
Storage Temperature	-40°C to 85°C
Operating Relative Humidity	±1kV HBM
ESD Rating	5%-95% RH

Optical Performance Specifications

Table 7.2 Optical Performance Specifications — Transmitter

Parameter	Min.	Typical	Max.	Notes
Wavelength	1280nm	1310nm	1340nm	Measured at 25°C
Spectral Line Width (RMS)		1.5nm	3nm	
Average Optical Output Power	-5dBm	-2dBm	0dBm	
Extinction Ratio	7dB			
Optical Signal Intrinsic Jitter	2.97Gbps, 1.485Gbps 270Mbps PRBS	30ps	60ps	
	2.97Gbps SMPTE 424M Pathological	50ps	70ps	
	1.485Gbps SMPTE 292M Pathological	60ps	100ps	
	270Mbps SMPTE 259M Pathological	110ps	180ps	
Optical Signal Rise Time (20-80%) 2.97Gbps SMPTE 424M			135ps	
Optical Signal Fall Time (20-80%) 2.97Gbps SMPTE 424M			135ps	
Laser Power Monitoring Accuracy	-2dB		+2dB	

Table 7.3 Optical Performance Specifications — Receiver

Parameter	Min.	Typical	Max.	Notes
Wavelength	1260nm		1620nm	
Sensitivity (ER=7dB)		-25dBm	-22dBm	The sensitivity and the overload specifications refer to the input power levels for BER=1E-12 against PRBS and pathological pattern at SMPTE 259M, 292M, and 424M rates.
Overload	0dBm			
Loss of Signal Asserted ^a	-31dBm			
Loss of Signal De-asserted ^a			-23dBm	
Loss of Signal Optical Hysteresis ^a	0.5dB			
Maximum Back Reflection			-27dB	
Input Power Monitoring Accuracy	-2dB		2dB	

a. Condition: 2.97Gbps PRBS, ER=7dB

Mechanical Specifications

Note that specifications are subject to change without notice.

Physical Channel Position

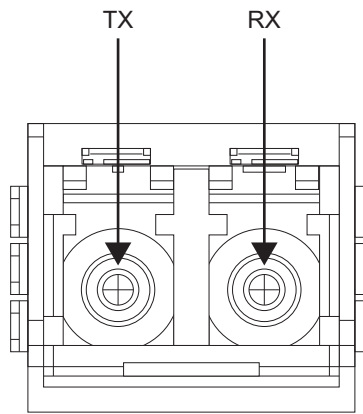


Figure 7.2 SFP Package Outline, Front View — Channel Position

SFP-HDB-IO-3G

The SFP-HDB-IO-3G is an electrical SFP Transceiver module designed to transmit and receive SDI signals up to 2.97Gbps over 75Ω coaxial cables over 75Ω HD-BNC connectors. Cable driver provides two selectable slew rates 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. The Auto-sleep feature automatically enables the equalizer power Save Mode when no input signal is detected.

Features

- SMPTE 424M, SMPTE 292M, and SMPTE 259M compliant
- HD-BNC 75Ω connectors
- Equalizes Belden 1694A cable up to: 140m at 2.97Gbps, 200m at 1.485Gbps, and 400m at 270Mbps
- Integrated Tx Cable Driver
- Supports DVB-ASI at 270Mbps
- Supports video pathological patterns for SD-SDI, HD-SDI, and 3G-SDI
- Hot-pluggable
- Low power consumption - typical 485mW
- Single Supply +3.3V
- SFP package size: 58.5mm x 13.4mm x 8.6mm SFP Package

Simplified Block Diagram

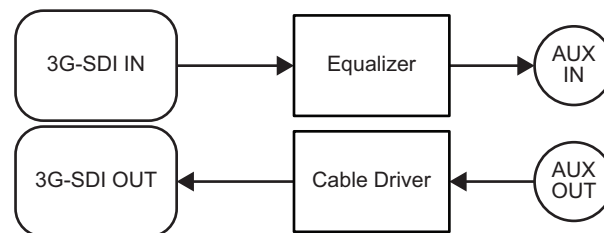


Figure 8.1 SFP-HDB-IO-3G — High Level Block Diagram

Module Installation

The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design. The module housing makes initial contact with the router board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD). The SFP-HDB-IO-3G is compatible with ESD levels specified in **IEC 61000-4-2**. In normal handling, manipulation and operation, ESD is of concern in two circumstances:

- During handling of the transceiver prior to insertion into an SFP+ /SFP compliant cage. To protect the device, please use normal ESD precautions. These include use of grounded wrist straps, work-benches and ESD floor.
- Static discharges to the exterior of the host equipment chassis after installation.

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 8.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	-40°C	+80°C	Measured on the top side of the module in the center
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	Non-condensing
ESD Rating		1kV	HBM

Recommended Operating Conditions

Table 8.2 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.13V	3.3V	3.465V	
Operating Case Temperature	-40°C		+80°C	
Serial Data Rate Minimum		125Mbps		270/360/1485/2970Mbps
Serial Data Rate Maximum			2970Mbps	270/360/1485/2970Mbps

SDI Receive Characteristics

Table 8.3 SDI RX Characteristics

Parameter		Min.	Typical	Max.	Notes
Input Voltage Swing		720Mvp-p	800Mvp-p	950Mvp-p	
Input Return Loss		15dB	18dB		Bandwidth 0-1.5GHz
		10dB	13dB		Bandwidth 1.5-3GHz
Jitter	SD-SDI			0.2UI	Cable length: 0-400m
			0.07UI		
	HD-SDI			0.25UI	Cable length:0-140m
			0.08UI		
	3G-SDI			0.3UI	Cable length:0-120m
			0.18UI		
Cable Length (1694A)	SD-SDI		350m		
	HD-SDI		140m		
	3G-SDI		120m		

SDI Transmit Characteristics

Table 8.4 SDI TX Characteristics

Parameter		Min.	Typical	Max.	Notes
Output Voltage Swing		720mV	800mV	880mV	75Ω load
Output Return Loss		15dB	27dB		Bandwidth 0-1.5GHz
		10dB	13dB		Bandwidth 1.5-3GHz
Additive Jitter	SD-SDI		15ps p-p		
	HD-SDI		18ps p-p		
	3G-SDI		20ps p-p		
Rise/Fall Time (80%-20%)	SD-SDI	400ps		800ps	
	HD/3G-SDI		90ps	135ps	
Mismatched in Rise/Fall Time	SD-SDI			50ps	
	HD/3G-SDI			30ps	
Duty Cycle Distortion	SD-SDI		100ps		
	HD-SDI		30ps		
	3G-SDI		27ps		
Overshoot	SD-SDI			8%	
	HD/3G-SDI			10%	

Mechanical Features

Note that specifications are subject to change without notice.

Table 8.5 provides a brief list of the SFP-HDB-IO-3G mechanical features.

Table 8.5 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HD-BNC 75Ω
Plug Diameter	Up to 7.8mm external HD-BNC plug diameter (standard)
Mechanical Release	Simple pull up mechanical release system to disengage the module from its cage

Physical Channel Position

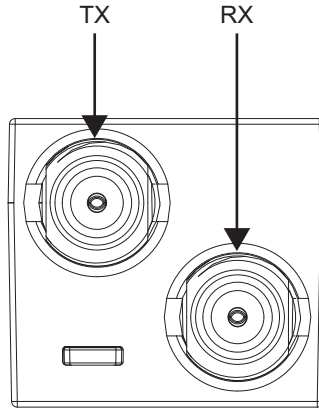


Figure 8.2 SFP Package Outline, Front View — Channel Position

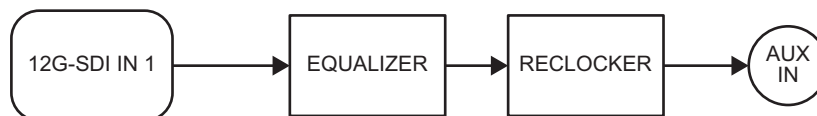
SFP-HDB-IN-12G

The SFP-HDB-IN-12G is an electrical SFP Receiver with Reclocker module designed to receive SDI signal up to 11.88Gbps over 75Ω coaxial cables via a HD-BNC connector. The Equalizer features DC restoration to compensate for the DC content of SMPTE pathological test patterns. By suppressing accumulated jitter, each Reclocker procures predictable cable length on every system.

Features

- SMPTE 2082, SMPTE 2081, SMPTE 424, SMPTE 292, and SMPTE 259 compliant
- HD-BNC 75Ω connectors
- Equalizes Belden 1694A cable up to: 45m at 11.88Gbps, 75m at 5.94Gbps, 135m at 2.97Gbps, 180m at 1.485Gbps and 400m at 270Mbps
- Supports DVB-ASI at 270Mbps
- Supports video pathological patterns for 12G-SDI, 6G-SDI, 3G-SDI, HD-SDI and SD-SDI
- Hot-pluggable
- Low Power Consumption - typical 1100mW
- Single Supply +3.3V
- Operating temperature range: -40°C to 85°C
- SFP package size: 58.5mm x 13.4mm x 8.6mm

Simplified Block Diagram



*Note only one BNC is active with the SFP-HDB-IN-12G.

Figure 9.1 SFP-HDB-IN-12G — High Level Block Diagram

Functional Description

The SFP-HDB-IN-12G Receiver with Reclocker is a video SFP module with coaxial interface. The HD-BNC connectors are used to interface the module with the 75Ω coaxial cables.

The SFP-HDB-IN-12G Receiver with Reclocker automatically equalizes the received signal for the cable loss and re-times serial digital video data conforming to the SMPTE 2082, 2081, 424, 292, and 259 standards.

Module Installation

The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design. The module housing makes initial contact with the router board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD). The SFP-HDB-IN-12G is compatible with ESD levels specified in *IEC 61000-4-2*. In normal handling, manipulation and operation, ESD is of concern in two circumstances:

- During handling of the transceiver prior to insertion into an SFP+ /SFP compliant cage. To protect the device, please use normal ESD precautions. These include use of grounded wrist straps, work-benches and ESD floor.
- Static discharges to the exterior of the host equipment chassis after installation.

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 9.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	-40°C	+85°C	Measured on the top side of the module in the center.
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	Non-condensing

Recommended Operating Conditions

Table 9.2 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.13V	3.3V	3.465V	
Supply Noise Tolerance ^a			66mV	Including ripple, pk-pk
Operating Case Temperature	-40°C		+85°C	
Serial Data Rate SD		270Mbps		SMPTE 259-C
Serial Data Rate HD		1483Mbps, 1485Mbps		SMPTE 292
Serial Data Rate 3G		2967Mbps, 2970Mbps		SMPTE 424
Serial Data Rate 6G		5934Mbps, 5940Mbps		SMPTE 2081
Serial Data Rate 12G		11868Mbps, 11880Mbps		SMPTE 2082

a. Noise from 10Hz to 10Mhz as specified in SFF-8431.

SDI Receive Characteristics

Table 9.3 SDI RX Characteristics

Parameter		Min.	Typical	Max.	Notes
Input Voltage Swing		720mVp-p	800mVp-p	950mVp-p	
Input Return Loss		-15dB			Bandwidth 0-1.5GHz
		-10dB			Bandwidth 1.5-3GHz
		-7dB			Bandwidth 3-6GHz
		-4dB			Bandwidth 6-12GHz
Input Jitter Tolerance ^a	SD-SDI	0.2UI			
	HD-SDI	1UI	10UI		
	3G-SDI	2UI	10UI		

Table 9.3 SDI RX Characteristics

Parameter		Min.	Typical	Max.	Notes
Input Jitter Tolerance ^a	6G-SDI	2UI	12UI		
	12G-SDI	2UI	24UI		
Cable Length ^{ab}	SD-SDI			400m	
	HD-SDI			180m	
	3G-SDI			135m	
	6G-SDI			75m	
	12G-SDI			45m	

- a. Using Belden 1694A cable.
- b. Measured at room temperature.

Mechanical Specifications

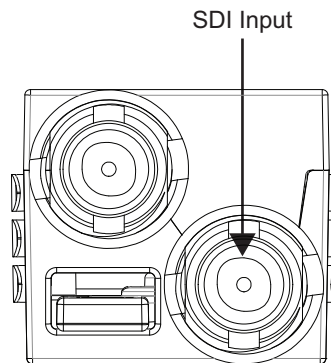
Note that specifications are subject to change without notice.

Table 9.4 provides a brief list of the SFP-HDB-IN-12G mechanical features.

Table 9.4 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HD-BNC 75Ω
Plug Diameter	Up to 7.8mm external HD-BNC plug diameter (standard)
Mechanical Release	Simple pull up mechanical release system to disengage the module from its cage

Physical Channel Position

**Figure 9.2 SFP Package Outline, Front View — Channel Position**

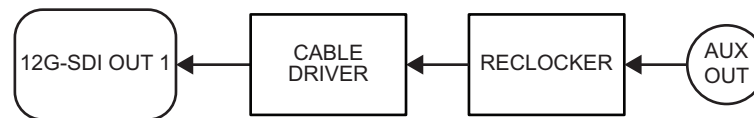
SFP-HDB-OUT-12G

The SFP-HDB-OUT-12G is an electrical SFP Transmitter with Reclocker module designed to transmit reclocked SDI signals up to 11.88Gbps over 75Ω coaxial cables via a HD-BNC. Cable driver slew rates are automatically configured in order to achieve compliance to SMPTE 2081, SMPTE 2082, SMPTE 424, SMPTE 292 and SMPTE 259.

Features

- SMPTE 2082, SMPTE 2081, SMPTE 424, SMPTE 292, and SMPTE 259 compliant
- HD-BNC 75Ω connectors
- Integrated Reclocker and Cable Driver
- Supports DVB-ASI at 270Mbps
- Supports video pathological patterns for 12G-SDI, 6G-SDI, 3G-SDI, HD-SDI and SD-SDI
- Hot-pluggable
- Power Consumption - typical 820mW
- Single Supply +3.3V
- Operating temperature range: -40°C to 85°C
- SFP package size: 58.5mm x 13.4mm x 8.6mm

Simplified Block Diagram



*Note the SFP-HDB-OUT-12G supplies only one 12G output.

Figure 10.1 High Level Block Diagram

Functional Description

The SFP-HDB-OUT-12G is a 12G-SDI Transmitter with Reclocker SFP module with a coaxial interface. The HD-BNC connector is used to interface the module with 75Ω coaxial cables.

The slew rate of the SDI output is automatically configured by the reclocker and is compliant with SMPTE specification.

Module Installation

The module is simply inserted, small end first, under manual pressure. Controlled hot plugging is ensured by design. The module housing makes initial contact with the router board EMI shield, mitigating potential damage due to Electrostatic Discharge (ESD). The SFP-HDB-OUT-12G is compatible with ESD levels specified in *IEC 61000-4-2*. In normal handling, manipulation and operation, ESD is of concern in two circumstances:

- During handling of the transceiver prior to insertion into an SFP+/SFP compliant cage. To protect the device, please use normal ESD precautions. These include use of grounded wrist straps, work-benches and ESD floor.
- Static discharges to the exterior of the host equipment chassis after installation.

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 10.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	-40°C	+85°C	Measured on the top side of the module in the center.
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	Non-condensing

Recommended Operating Conditions

Table 10.2 Recommended Operating Conditions

Parameter		Min.	Typical	Max.	Notes
Supply Voltage		3.13V	3.3V	3.465V	
Supply Noise Tolerance ^a				66mV	Including ripple, pk-pk
Operating Case Temperature		-40°C		+85°C	
Serial Data Rates	SD		270Mbps		
	HD		1483Mbps, 1485Mbps		
	3G		2967Mbps, 2970Mbps		
	6G		5934Mbps, 5940Mbps		
	12G		11868Mbps, 11880Mbps		

a. Noise from 10Hz to 10Mhz as specified in SFF-8431.

SDI Input Characteristics

Table 10.3 SDI Input Characteristics

Parameter		Min.	Typical	Max.	Notes
Differential Voltage Swing		600mVp-p		1600mVp-p	
Input Rise/Fall Time	270Mbps			1500ps	
	1485Mbps			270ps	
	2970Mbps			135ps	
	5940Mbps			80ps	
	11880Mbps			45ps	

SDI Output Characteristics

Table 10.4 SDI Output Characteristics

Parameter		Min.	Typical	Max.	Notes
Output Voltage Swing		720mV	800mV	880mV	75Ω load
Output Return Loss		-15dB	-24dB		Bandwidth 0-1.5GHz
		-10dB	-15dB		Bandwidth 1.5-3GHz
		-7dB	-8.3dB		Bandwidth 3-6GHz
		-4dB	-7.8dB		Bandwidth 6-12GHz
Output Jitter	SD-SDI		0.08UIp-p		Reclock input = 31ps
	HD-SDI		0.11UIp-p		Reclock input = 24ps
	3G-SDI		0.21UIp-p		Reclock input = 22ps
Rise/Fall Time (20-80%)	SD-SDI	400ps		800ps	
	HD/12G-SDI		33ps	45ps	
Mismatched in Rise/Fall Time	SD-SDI			50ps	
	HD/12G-SDI			18ps	
Overshoot	SD-SDI			8%	
	HD/12G-SDI			10%	

Mechanical Specifications

Note that specifications are subject to change without notice.

Table 10.5 provides a brief list of the SFP-HDB-OUT-12G mechanical features.

Table 10.5 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HD-BNC 75Ω
Plug Diameter	Up to 7.8mm external HD-BNC plug diameter (standard)
Mechanical Release	Simple pull up mechanical release system to disengage the module from its cage

Physical Channel Position

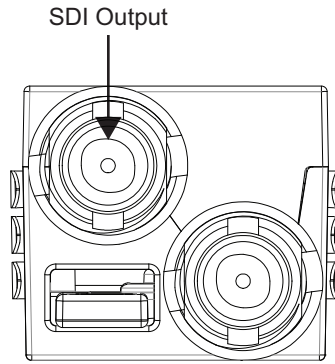


Figure 10.2 SFP Package Outline, Front View — Channel Position

SFP-MADI-850MM

The SFP-MADI-850MM is an optical transceiver module designed to transmit and receive electrical and optical serial digital signals as defined in SMPTE 297-2006 and AES10.

A highly-reliable 850nm wavelength Vertical Cavity Surface Emitting Laser (VCSEL) is used in the transmitter. The transceivers satisfy Class I Laser Safety requirements in accordance with the U.S. FDA/CDRH and international IEC-60825 standards.

Features

- SMPTE 297-2006 compliant
- Suitable for AES10 transmission and receiving
- Best-in-class optical receiver sensitivity: -22dBm (over all supported video rates with pathological data)
- Robust error free transmission of signals from 50Mbps to 3Gbps with up to 500m (50μm multi-mode fiber)
- Supports video pathological patterns for SD-SDI, HD-SDI and 3G-SDI
- Hot-pluggable
- Operating temperature range from -5°C to +70°C

Simplified Block Diagram

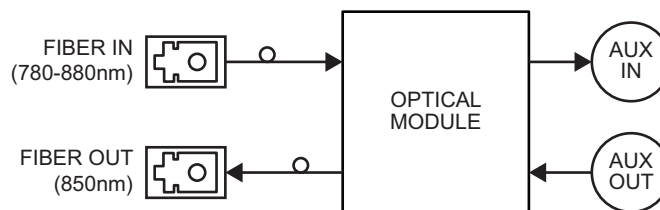


Figure 11.1 High Level Block Diagram

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 11.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	-0.5V	4V	
Case Operating Temperature	-5°C	70°C	Measured on the top side of the module at the front center vent hole of the cage
Storage Temperature	-40°C	+85°C	
Relative Humidity	5%	95%	Non-condensing

Transmitter Performance Characteristics

Table 11.2 Transmitter Specifications

Parameter		Min.	Typical	Max.	Notes
Data Rate		0.05Gbps		3Gbps	
Center Wavelength		830nm	850nm	860nm	
Spectral Width				1nm	
Average Optical Output Power		-8dBm		-3dBm	
Extinction Ratio		6dB			
Relative Intensity Noise			110dB/Hz	-118dB/Hz	
Optical Signal Rise Time (20%-80%) ^a	SMPTE 424M 2.97Gbps			165ps	
	SMPTE 292M 1Gbps			270ps	
	SMPTE 344M 540Mbps			800ps	
	SMPTE 259M 143Mbps			1500ps	
Laser Power Monitoring Accuracy		-2dB		+2dB	

a. Rise/fall times are measured unfiltered.

Receiver Performance Characteristics

Table 11.3 Receiver Specifications

Parameter		Min.	Typical	Max.	Notes
Data Rate		0.05Gbps		3Gbps	
Center Wavelength		780nm		880nm	
Sensitivity ^a	SMPTE 259M, SMPTE 344M, PRBS 2 ²³ -1			-15dBm	
	SMPTE 292M Pathological, SMPTE 424M Pathological			-13dBm	
Overload		0dBm			
LOS Thresholds ^b	Increasing Light Input			-18dBm	
	Decreasing Light Input	-28dBm			
LOS Hysteresis		1dB		6dB	
Input Power Monitoring Accuracy		-2dB		+2dB	

a. Specified at a BER of 10⁻¹².

b. Specified with a PRBS of 2.97Gbps signal, ER=7dB.

Mechanical Specifications

Note that specifications are subject to change without notice.

Physical Channel Position

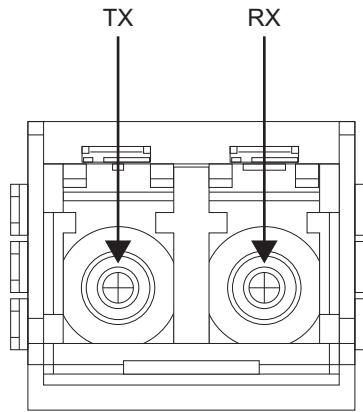


Figure 11.2 SFP Package Outline, Front View — Channel Position

SFP-MADI-1300MM

The SFP-MADI-1300MM is a small form-factor pluggable LC transceiver for use with 50/125 and 60/125 multi-mode fiber. The SFP-MADI-1300MM will provide a 1300 nanometer MADI interface to Ross Ultrix routing systems.

Features

- Industry SFP package
- LC duplex connector interface
- Suitable for AES10 transmission and receiving
- Operates with 50/125 μ m and 60/125 μ m multi-mode fiber
- Hot-pluggable
- Operating temperature range from -5°C to +70°C

Simplified Block Diagram

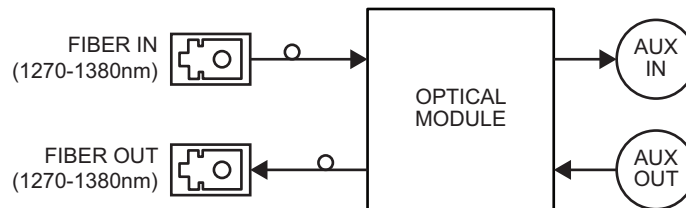


Figure 12.1 High Level Block Diagram

Technical Specifications

Note that specifications are subject to change without notice.

Absolute Maximum Ratings

Exceeding any of these ratings may permanently damage the module. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Table 12.1 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	-0.5V	3.63V	
Storage Temperature	-40°C	+100°C	

Recommended Operating Conditions

All the data in this specification refers to the operating conditions above and over lifetime unless otherwise stated.

Table 12.2 Recommended Operating Conditions

Parameter	Min.	Max.	Notes
Supply Voltage	3.0V	3.6V	
Case Operating Temperature	-40°C	+85°C	

Transmitter Optical Characteristics

Table 12.3 Transmitter Optical Characteristics

Parameter	Min.	Typical	Max.	Notes
Center Wavelength	1270nm	1308nm	1380nm	
Spectral Width - FWHM		147nm		
Optical Output Power	62.5/125µm	-20.0dBm	-17.0dBm	-14.0dBm
	50/125µm	-23.5dBm	-20.0dBm	-14.0dBm
Extinction Ratio	10dB			
Optical Rise Time (10%-90%)	0.6ns	1.0ns	3.0ns	
Optical Fall Time (10%-90%)	0.6ns	1.0ns	3.0ns	

Receiver Optical and Electrical Characteristics

Table 12.4 Receiver Optical and Electrical Characteristics

Parameter	Min.	Typical	Max.	Notes
Optical Input Power	-31.0dBm		-14.0dBm	
Operating Wavelength	1270nm		1380nm	
Duty Cycle Distortion Contributed by the Receiver			0.4ns	
Data Dependent Jitter Contributed by the Receiver			1.0ns	
Random Jitter Contributed by the Receiver		0.1ns	2.14ns	
		0.1ns	1.91ns	
Systematic Jitter Contributed by the Receiver OC-3		0.16ns	1.2ns	
LOS - De-asserted			-32.0dBm	
LOS - Asserted	-45dBm			
LOS - Hysteresis	0.5dB	1.8dB		

Mechanical Specifications

Note that specifications are subject to change without notice.

Physical Channel Position

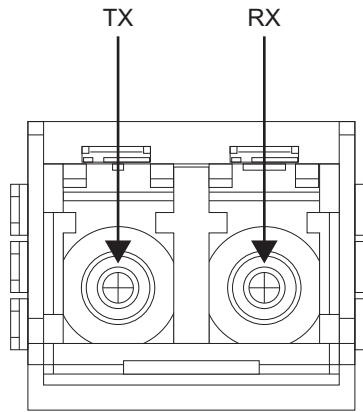


Figure 12.2 SFP Package Outline, Front View — Channel Position

Configuring the SFP-MADI-1300MM in the Ultrix Database

The Ultrix router does not automatically detect when an AUX port is populated with an SFP-MADI-1300MM module. You must manually enable the port and assign an SFP module type using the options in the **Frame Configuration** interface.

★ Ensure the SFP module is physically installed into the SFP port of the Ultrix rear panel. Refer to the section “**Installation Overview**” on page 13.

To configure an SFP-MADI-1300MM module installed in an AUX port

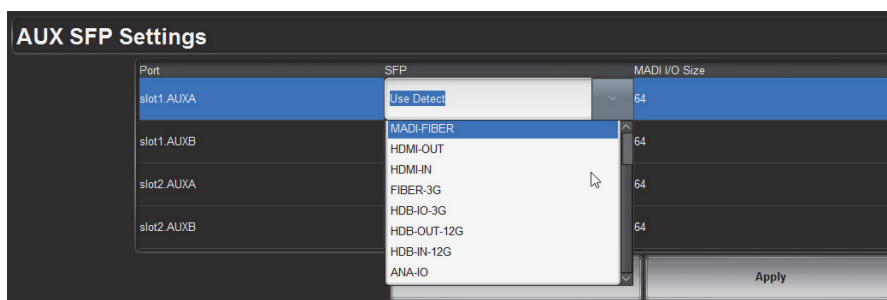
1. Expand the **Devices** node.
2. Expand the **Controllers + Matrices** node.
3. Double-click the node for your Ultrix router.

The **Device Configuration** interface opens with the **Frame Configuration** interface selected.

4. Click **AUX SFP Settings**.

The **AUX SFP Settings** table displays.

5. Locate the row for the AUX port you want to configure.
6. Use the **SFP** menu to select **MADI-FIBER**.



7. Use the **MADI I/O Size** menu to specify the number of MADI channels the AUX port will support.
8. Click **Apply** to save your changes.

