



SFP Modules Guide

Thank You for Choosing Ross

You've made a great choice. We expect you will be very happy with your purchase of Ross Technology.

Our mission is to:

1. Provide a Superior Customer Experience
 - offer the best product quality and support
2. Make Cool Practical Technology
 - develop great products that customers love

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
CEO, Ross Video
dross@rossvideo.com

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-008-14**
- Revision: 2
- Release Date: July 25, 2024.

The information contained in this Guide is subject to change without notice or obligation.

Copyright

©2024 Ross Video Limited, Ross®, and any related marks are trademarks or registered trademarks of Ross Video Limited. All other trademarks are the property of their respective companies. PATENTS ISSUED and PENDING. All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, mechanical, photocopying, recording or otherwise, without the prior written permission of Ross Video. While every precaution has been taken in the preparation of this document, Ross Video assumes no responsibility for errors or omissions. Neither is any liability assumed for damages resulting from the use of the information contained herein.

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

The material in this manual is furnished for informational use only. It is subject to change without notice and should not be construed as commitment by Ross Video Limited. Ross Video Limited assumes no responsibility or liability for errors or inaccuracies that may appear in this manual.

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.

Company Address



Ross Video Limited

8 John Street
Iroquois, Ontario
Canada, K0E 1K0

Ross Video Incorporated

P.O. Box 880
Ogdensburg, New York
USA 13669-0880

General Business Office: (+1) 613 • 652 • 4886

Fax: (+1) 613 • 652 • 4425

Technical Support: (+1) 613 • 652 • 4886

After Hours Emergency: (+1) 613 • 349 • 0006

E-mail (Technical Support): techsupport@rossvideo.com

E-mail (General Information): solutions@rossvideo.com

Website: <http://www.rossvideo.com>

Contents

Introduction	11
Related Publications	11
Documentation Conventions	11
Contacting Technical Support	11
Getting Started	13
Before You Begin	13
Installation Overview	13
Configuring the SFP Options	15
Before You Begin	15
Configuring an SFP Module	15
SFP-HDM-OUT	17
Features	17
Simplified Block Diagram	17
Supported Video Formats	17
Functional Overview	18
Video	18
Audio	18
Module Installation	18
Technical Specifications	18
Absolute Maximum Ratings	18
Recommended Operating Conditions	19
HDMI TX Characteristics	19
Mechanical Specifications	19
SFP-HDM-OUT-12G	21
Features	21
Simplified Block Diagram	21
Module Installation	21
Technical Specifications	21
Absolute Maximum Ratings	21
Recommended Operating Conditions	22
Mechanical Specifications	22
SFP-HDM-IN	23
Features	23
Simplified Block Diagram	23
Format Resolution Details	23
Functional Overview	24
Audio Support	24
SDI Video Output	24
Module Installation	25
Technical Specifications	25
Absolute Maximum Ratings	25
Recommended Operating Conditions	25
HDMI Input Characteristics	25
Mechanical Specifications	26

SFP-HDM-IN-12G	27
Features	27
Simplified Block Diagram	27
Format Resolution Details	27
Functional Overview	27
Audio Support	28
SDI Video Output	28
Module Installation	28
Technical Specifications	28
Absolute Maximum Ratings	28
Recommended Operating Conditions	28
Mechanical Specifications	29
 SFP-ANA-IO	 31
Features	31
Simplified Block Diagram	31
Functional Overview	32
Receive Channel	32
Transmit Channel	32
Module Installation	32
Technical Specifications	32
Absolute Maximum Ratings	32
Recommended Operating Conditions	32
Composite Receive Channel Specifications	33
Composite Transmit Specifications	34
Mechanical Specifications	34
Mechanical Features	34
Physical Channel Position	34
 SFP-MADI-COAX	 35
Features	35
Simplified Block Diagram	35
Functional Description	35
Module Installation	35
Technical Specifications	35
Absolute Maximum Ratings	35
Recommended Operating Conditions	36
MADI Receive Characteristics	36
MADI Transmit Characteristics	36
Mechanical Specifications	37
Mechanical Features	37
Physical Channel Position	37
 SFP-FIBER-3G,SFP-MADI-1310SM	 39
Features	39
Simplified Block Diagram	39
Technical Specifications	39
Absolute Maximum Ratings	39
Optical Performance Specifications	40
Mechanical Specifications	41
Physical Channel Position	41
 SFP-FIBER-12G	 43
Features	43
Simplified Block Diagram	43

Technical Specifications	43
Absolute Maximum Ratings	43
Recommended Operating Environment and Electrical Ratings	44
Optical Specifications	44
Electrical Specifications	44
Physical Channel Position	45
SFP-FIBER-12G-xx	47
Features	47
Simplified Block Diagram	47
Overview	47
Technical Specifications	48
Absolute Maximum Ratings	48
Recommended Operating Environment and Electrical Ratings	48
Optical Specifications	48
Physical Channel Position	49
SFP-HDB-IO-3G	51
Features	51
Simplified Block Diagram	51
Module Installation	51
Technical Specifications	52
Absolute Maximum Ratings	52
Recommended Operating Conditions	52
SDI Receive Characteristics	52
SDI Transmit Characteristics	53
Mechanical Features	53
Physical Channel Position	54
SFP-HDB-IO-12G	55
Features	55
Simplified Block Diagram	55
Module Installation	55
Technical Specifications	55
DC Specifications	55
Recommended Operating Conditions	56
SDI Receive Characteristics	56
SDI Transmit Characteristics	57
Mechanical Features	57
Physical Channel Position	58
SFP-MADI-850MM	59
Features	59
Simplified Block Diagram	59
Technical Specifications	59
Absolute Maximum Ratings	59
Transmitter Performance Characteristics	60
Receiver Performance Characteristics	60
Mechanical Specifications	61
Physical Channel Position	61
SFP-MADI-1300MM	63
Features	63
Simplified Block Diagram	63
Technical Specifications	63

Absolute Maximum Ratings	63
Recommended Operating Conditions	63
Transmitter Optical Characteristics	64
Receiver Optical and Electrical Characteristics	64
Mechanical Specifications	65
Physical Channel Position	65
 End-of-Life Modules	 67

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, contact us at the numbers listed in “**Contacting Technical Support**”. 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 “**Assigning an IP Address**” in the ***Ultrix User Guide***.

Important Instructions

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

- ★ Ensure that you are using the latest version of the DashBoard client software.

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.*

Configuring the SFP Options

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

Before You Begin

Ensure the following steps are completed before configuring the options for an SFP module:

- Ensure the SFP module is physically installed into the SFP port of the Ultrix rear panel. Refer to **"Installation Overview"**.
- Ensure that the Ultrix router is running software version 4.0 or higher. Refer to the ***Ultrix Installation Guide*** for information on verifying the software version and upgrade instructions.

Configuring an SFP Module

This section is applicable to all SFP module types that the Ultrix supports.

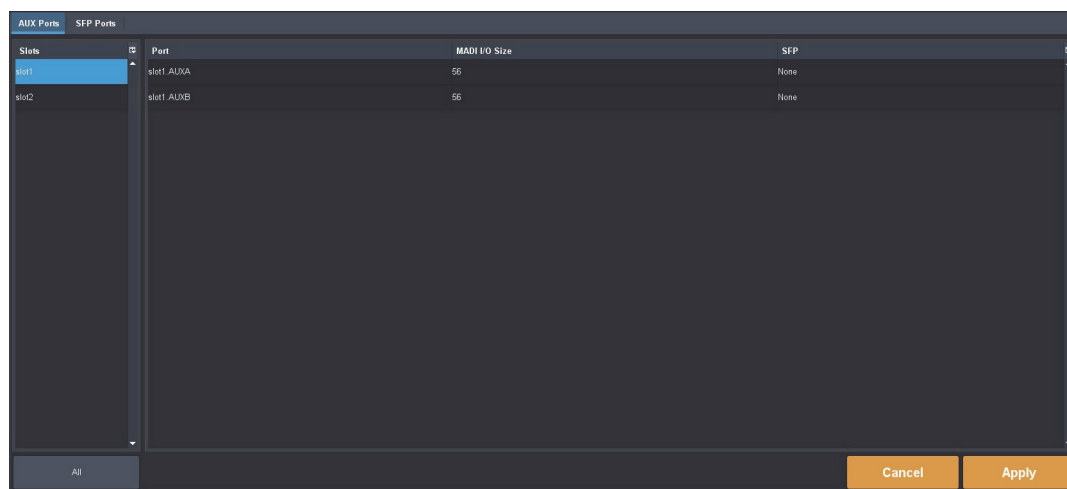
To configure an SFP module installed in an AUX port

1. Locate the Ultrix in the Tree View of DashBoard.
2. Expand the Ultrix node to display a list of sub-nodes in the Tree View.
Each sub-node is an Ultrix interface.
3. Expand the **Devices** node.
4. Expand the **Controllers + Matrices** node.
5. Double-click the node for your Ultrix router.

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

6. Select the **SFP Configuration** tab.
7. Select the tab appropriate to the port location you wish to configure.

In the example below, the user selected the **AUX Ports** tab.



8. From the **Slots** table on the left, select the router slot the SFP module is installed in.
9. In the table of the tab, locate the row for the specific port you wish to configure.

10. Use the **SFP** menu to select an option matching the type of SFP installed.
11. If MADI is selected as the SFP Type, use the **MADI I/O Size** menu to specify the number of MADI channels the AUX port will support.
12. Click **Apply** to save your changes.

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.

★ The SFP-HDM-OUT is no longer available from Ross Video.

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
 - › 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

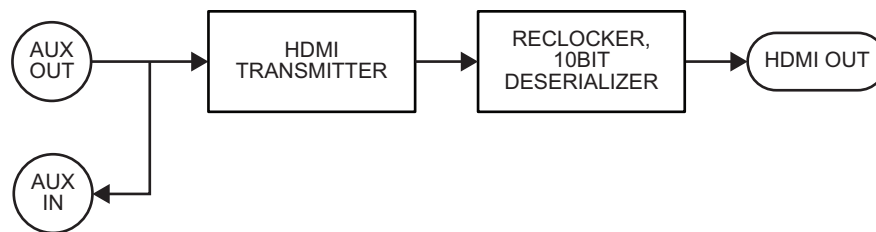


Figure 1 SFP-HDM-OUT — High Level Block Diagram

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 1** list all supported SDI input formats.

Table 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.

Video

The video output format is set to YCbCr 4:2:2.

Audio

Up to 8 channels of audio may be embedded in the HDMI stream.

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

Table 5 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HDMI 1.4 Type D

Table 5 Technical Specifications — Mechanical Features

Parameter	Specifications
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-OUT-12G

The SFP-HDM-OUT-12G is an HD/3G/6G/12G-SDI to HDMI 2.0 converter, able to transmit one SDI signal via an HDMI Type D connector.

Features

- SMPTE 2082, SMPTE 2081, SMPTE 424, SMPTE 292, and HDMI 2.0 compliant
- Supports video pathological patterns for HD-SDI and 3G-SDI
- HDMI type D connector
- Hot-pluggable
- Operating temperature range: -20°C to 85°C

Simplified Block Diagram

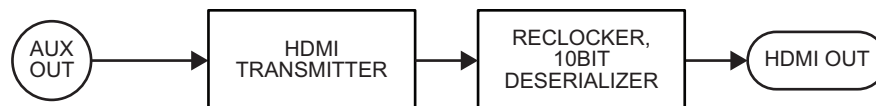


Figure 2 SFP-HDM-OUT-12G — High Level Block Diagram

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).

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 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	-20°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
ESD Rating		1kV	HBM

Recommended Operating Conditions

Table 7 Recommended Operating Conditions

Parameter		Min.	Typical	Max.	Notes
Supply Voltage		3.135V	3.3V	3.465V	
Operating Case Temperature		-20°C		+85°C	Measured on the top side of the module in the center
SDI Serial Data Rate	HD		1483Mbps, 1485Mbps		ST292
	3G		2967Mbps, 2970Mbps		ST424
	UHD		5934Mbps, 5940Mbps, 11868Mbps, 11880Mbps		ST2081, ST2082

Mechanical Specifications

Note that specifications are subject to change without notice.

Table 8 provides a brief list of the SFP-HDM-OUT-12G mechanical features.

Table 8 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HDMI Type D HDMI 2.0 compliant
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.

★ The SFP-HDM-IN is no longer available from Ross Video.

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)
 - › BW=165MHz
 - › DVI 1.0 Mode (Only video resolution)
- 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

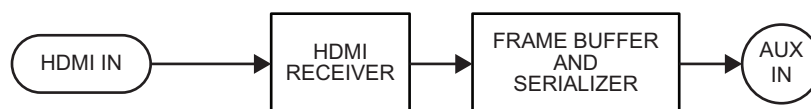


Figure 3 High Level Block Diagram

Format Resolution Details

Table 9 lists the formats supported by the SFP-HDM-IN.

Table 9 Supported Formats

	HDMI Input Format	CEA-861 VIC Code
SD	480i 59.94/60Hz	6, 7
	576i 50Hz	21, 22
HD	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

Table 9 Supported Formats

	HDMI Input Format	CEA-861 VIC Code
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 10 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 11 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 12 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 13 provides a brief list of the SFP-HDM-IN mechanical features.

Table 13 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-12G

The SFP-HDM-IN-12G is an electrical SFP Receiver module designed to convert an HDMI 2.0 input (High Definition Multimedia Interface®) to an 12G-SDI format.

Features

- SMPTE 2082, SMPTE 2081, SMPTE 424, SMPTE 292, and HDMI 2.0 compliant
- SDI Reclocked output to router auxiliary input
- Supported audio embedded: 8 channels, ch1-4 (SDI Groups 1, 3), ch5-8 (SDI Groups 2, 4)
- HDMI Input: 4:2:2 YCbCr 10bit
- HDMI 2.0 type D connector
- Hot-pluggable
- Operating temperature range: -20°C to 85°C

Simplified Block Diagram

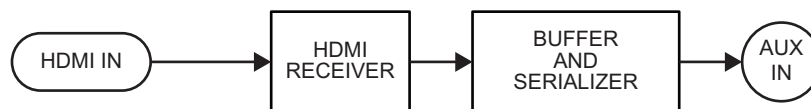


Figure 4 High Level Block Diagram

Format Resolution Details

Table 14 lists the formats supported by the SFP-HDM-IN-12G.

Table 14 Supported Formats

	HDMI Input Format	CEA-861 VIC Code
HD	1920x1080i 50/59.94/60Hz	5, 20
	1280x720p 50/59.94/60Hz	4, 19
3G	1920x1080p 50/59.94/60Hz	16, 31
6G	3840x2160p 25/29.97/30Hz	94, 95
12G	3840x2160p 50/60Hz	106, 107

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 15 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Supply Voltage	0V	3.6V	
Operating Case Temperature	-20°C	+85°C	
Storage Temperature	-40°C	+85°C	
Operating Relative Humidity	5%	95%	non-condensing
ESD Rating		1kV	

Recommended Operating Conditions

Table 16 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.135V	3.3V	3.465V	
Operating Case Temperature	-20°C		+85°C	
SDI Serial Data Rate				
HD	1483Mbps		1485Mbps	ST292
3G	2967Mbps		2970Mbps	ST424
UHD	5934Mbps	5940Mbps	11868Mbps 11880Mbps	ST2081, ST2082

Mechanical Specifications

Note that specifications are subject to change without notice.

Table 17 provides a brief list of the SFP-HDM-IN-12G mechanical features.

Table 17 Technical Specifications — Mechanical Features

Parameter	Specifications
Connector Type	HDMI Type D HDMI 2.0 compliant
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

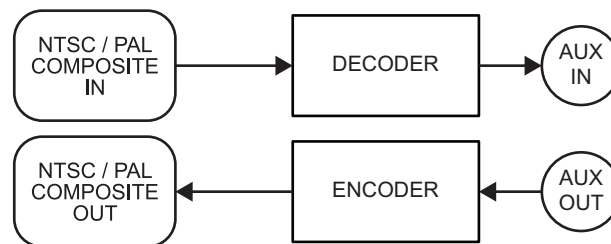


Figure 5 SFP-ANA-IO — High Level Block Diagram

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 De-serializer 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 18 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 19 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Supply Voltage	3.13V	3.3V	3.465V	

Table 19 Recommended Operating Conditions

Parameter	Min.	Typical	Max.	Notes
Operating Case Temperature	0°C		+65°C	
Serial Data Rate		270Mbps		

Composite Receive Channel Specifications

Table 20 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 21 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			
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 22 provides a brief list of the SFP-ANA-IO mechanical features.

Table 22 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

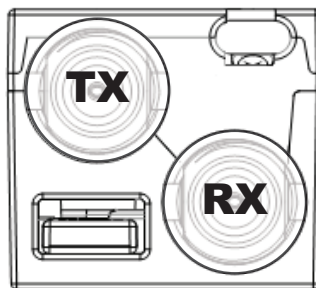


Figure 6 SFP Package Outline, Front View — Channel Position

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 $75\Omega \pm 2\Omega$
- 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

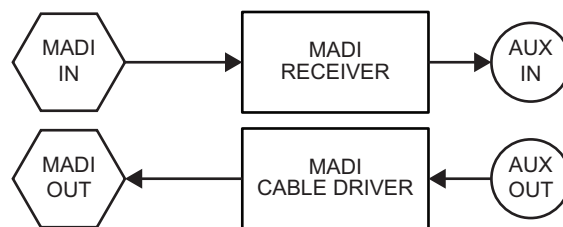


Figure 7 SFP-MADI-COAX — High Level Block Diagram

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 23 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 24 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 25 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 26 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 27 provides a brief list of the SFP-MADI-COAX mechanical features.

Table 27 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

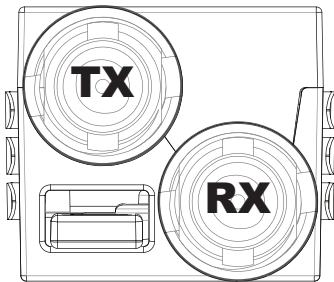


Figure 8 SFP Package Outline, Front View — Channel Position

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

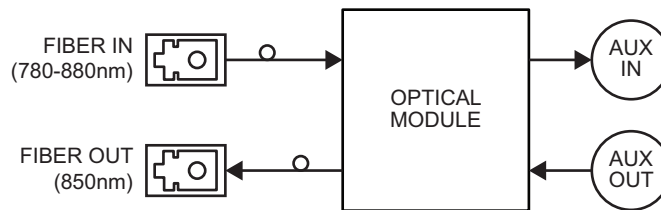


Figure 9 SFP-FIBER-3G, SFP-MADI-1310SM — High Level Block Diagram

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 28 Absolute Maximum Ratings

Parameter	Value
Supply Voltage	4V
Operating Case Temperature	-25°C to 85°C
Storage Temperature	-40°C to 85°C
Operating Relative Humidity	±1kV HBM
ESD Rating	5%-95% RH

Optical Performance Specifications

Table 29 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 30 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	

Table 30 Optical Performance Specifications — Receiver

Parameter	Min.	Typical	Max.	Notes
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

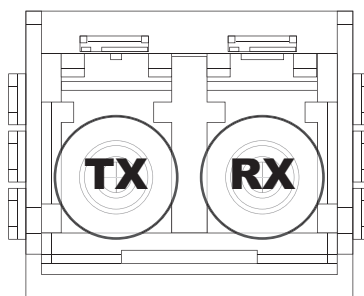


Figure 10 SFP Package Outline, Front View — Channel Position

SFP-FIBER-12G

The SFP-FIBER-12G is an optical transceiver module that supports data rates up to 12Gbps for single fiber communications.

Features

- SMPTE 297-2006 compatible for SD-SDI, HD-SDI, 3G-SDI, 6G-SDI, and 12G-SDI
- Compliant with SFP MSA (Small Form-Factor Pluggable Transceiver Multi-Source Agreement) and SFS-8472
- 1310 DFB laser diode with CML logic interface
- Duplex LC receptacle
- Up to 20km on 9/125μm SMF
- Single 3.3V power supply
- Operating temperature range: 0°C to 70°C
- SFP package size: 56.5mm x 13.4mm x 8.6mm

Simplified Block Diagram

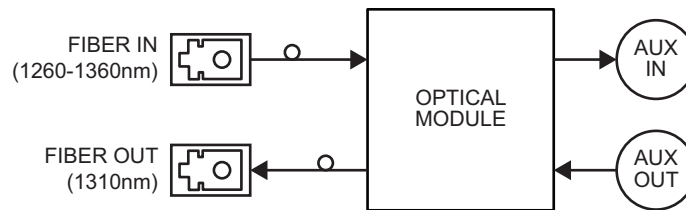


Figure 11 SFP-FIBER-12G — High Level Block Diagram

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 31 Absolute Maximum Ratings

Parameter	Min.	Max.
Supply Voltage	0V	+3.8V
Storage Temperature	-40°C	+85°C
Relative Humidity	5%	95%

Recommended Operating Environment and Electrical Ratings

Table 32 Recommended Ratings

Parameter	Min.	Typical	Max.
Supply Voltage	+3.2V	+3.3V	+3.4V
Supply Current	-	-	300mA
Operating Case Temperature	0°C		+70°C
Data Rate	270Mbps		11.88Gbps

Optical Specifications

Table 33 Optical Specifications — Transmitter

Parameter	Min.	Typical	Max.	Notes
Ambient Operating Temperature	Ta=+25±5°C C, VCC = 3.3±0.2V			
Data Rate			11.88Gbps	
Output Center Wavelength	1260nm	1310nm	1360nm	
Output Spectral Width (-20dB)			1nm	
Average Optical Output Power	-6dBm		0dBm	The optical power is launched into 9/125µm SMF
Extinction Ratio	7dB			
Optic Output Eye: Compliant with IEEE 802.3ba				With a PRBS 223-1 test pattern @ 11.88Gbps

Table 34 Optical Specifications — Receiver

Parameter	Min.	Typical	Max.	Notes
Receiver Sensitivity			-13dBm	With a PRBS 223-1 test pattern @ 11.88Gbps
Maximum Input Power	-3dBm			
Operation Center Wavelength	1260nm		1360nm	
Loss of Signal	Assert	-25dBm		@ 12Gbps
	De-assert	-15dBm		@ 12Gbps
LOS Hysteresis	0.5dB			

Electrical Specifications

Table 35 Electrical Specifications — Transceiver

Parameter	Min.	Typical	Max.	Notes
Ambient Operating Temperature	Ta=+25±5° C, VCC = 3.3±0.2V			

Table 35 Electrical Specifications — Transceiver

Parameter		Min.	Typical	Max.	Notes
Supply Voltage		3.2V	3.3V	3.4V	
Supply Current				300mA	I _{cc} =I _{TX} +I _{RX}

Table 36 Electrical Specifications — Transmitter

Parameter		Min.	Typical	Max.	Notes
Differential Input Voltage		100mV _{p-p}		800mV _{p-p}	
TX_Disable	Normal Operation	-0.3V		0.8V	
	Laser Disable	2.0V		VCC+0.3V	

Table 37 Electrical Specifications — Receiver

Parameter		Min.	Typical	Max.	Notes
Differential Output Voltage		400mV _{p-p}		900mV _{p-p}	
Rx_LOS	Fault	2.0V		V _{cc} V	
	Normal	0V		0.8V	

Physical Channel Position

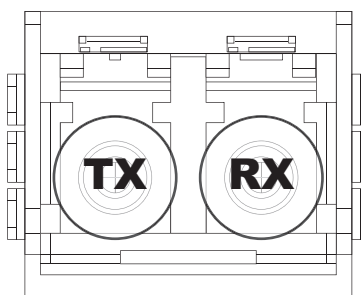


Figure 12 SFP Package Outline, Front View — Channel Position

SFP-FIBER-12G-xx

Each SFP-FIBER-12G-xx is an optical transceiver module that supports SDI data rates from SD up to 12Gbps. Sixteen channels of CWDM wavelengths are available for multiplexing multiple optical signals over one single-mode fiber.

Features

- SMPTE 297-2006 compatible for SD-SDI, HD-SDI, 3G-SDI, 6G-SDI, and 12G-SDI
- CWDM DFB Lasers
- 16 wavelengths available from 1270nm to 1610nm
- Duplex LC receptacle
- Up to 10km on 9/25µm SMF (1270nm-1450nm, contingent on link budget)
- Up to 15km on 9/25µm SMF (1470nm-1610nm, contingent on link budget)

Simplified Block Diagram

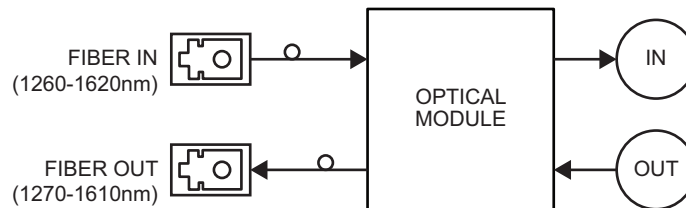


Figure 13 SFP-FIBER-12G-xx — High Level Block Diagram

Overview

The SFP-FIBER-12G-xx models are available in 16 CWDM wavelengths, where "xx" denotes the specific wavelength as outlined in **Table 38**.

Table 38 Filter Wavelengths

Model	xx	Wavelength
SFP-FIBER-12G-27	27	1270nm
SFP-FIBER-12G-29	29	1290nm
SFP-FIBER-12G-31	31	1310nm
SFP-FIBER-12G-33	33	1330nm
SFP-FIBER-12G-35	35	1350nm
SFP-FIBER-12G-37	37	1370nm
SFP-FIBER-12G-43	43	1430nm
SFP-FIBER-12G-45	45	1450nm
SFP-FIBER-12G-47	47	1470nm
SFP-FIBER-12G-49	49	1490nm
SFP-FIBER-12G-51	51	1510nm
SFP-FIBER-12G-53	53	1530nm

Table 38 Filter Wavelengths

Model	xx	Wavelength
SFP-FIBER-12G-55	55	1550nm
SFP-FIBER-12G-57	57	1570nm
SFP-FIBER-12G-59	59	1590nm
SFP-FIBER-12G-61	61	1610nm

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 39 Absolute Maximum Ratings

Parameter	Min.	Max.
Supply Voltage	0V	+5.5V
Storage Temperature	-40°C	+85°C

Recommended Operating Environment and Electrical Ratings

Table 40 Recommended Ratings

Parameter	Min.	Typical	Max.
Supply Voltage	+3.1V	+3.3V	+3.5V
Supply Current		300mA	400mA
Operating Case Temperature	0°C		+70°C
Data Rate	270Mbps		11.88Gbps

Optical Specifications

Table 41 Optical Specifications — Transmitter

Parameter	Min.	Typical	Max.	Notes
Ambient Operating Temperature	Ta=+25±5°C C, VCC = 3.3±0.2V			
Data Rate	270Mbps		11.88Gbps	
Output Center Wavelength ^a	$\lambda - 10\text{nm}$	λnm	$\lambda + 10\text{nm}$	
Output Spectral Width (-20dB)			1nm	
Average Optical Output Power	-2dBm		+3dBm	The optical power is launched into 9/125μm SMF
Linear Extinction Ratio	3.5dB			

- a. λ = CWDM Wavelength: 1270, 1290, 1310, 1330, 1350, 1370, 1430, 1450, 1470, 1490, 1510, 1530, 1550, 1570, 1590, 1610

Table 42 Optical Specifications — Receiver

Parameter		Min.	Typical	Max.	Notes
Receiver Sensitivity	11.88Gbps			-10dBm	With a pathological pattern; BER<10 ⁻¹²
	6Gbps			-10dBm	
	2.97Gbps			-14dBm	
	1.485Mbps			-14dBm	
Maximum Input Power		-2dBm			
Operation Center Wavelength		1260nm		1620nm	
Loss of Signal	Assert		-30dBm		
	De-assert		-10dBm		
LOS Hysteresis		0.5dB	2dB		

Physical Channel Position

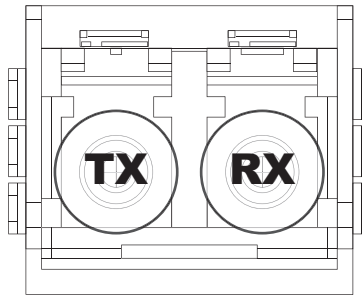


Figure 14 SFP Package Outline, Front View — Channel Position

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: 120m at 2.97Gbps, 140m 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

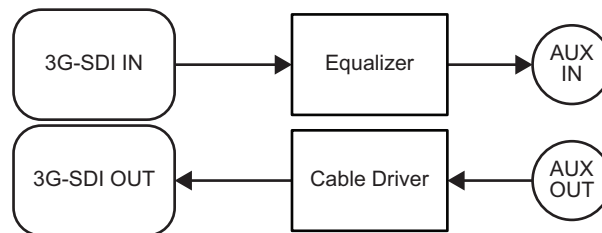


Figure 15 SFP-HDB-IO-3G — High Level Block Diagram

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 43 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 44 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		270/360/1485/2970M bps
Serial Data Rate Maximum			2970Mbps	270/360/1485/2970M bps

SDI Receive Characteristics

Table 45 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		

Table 45 SDI RX Characteristics

Parameter		Min.	Typical	Max.	Notes
Cable Length (1694A)	SD-SDI		400m		
	HD-SDI		140m		
	3G-SDI		120m		

SDI Transmit Characteristics

Table 46 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 47 provides a brief list of the SFP-HDB-IO-3G mechanical features.

Table 47 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

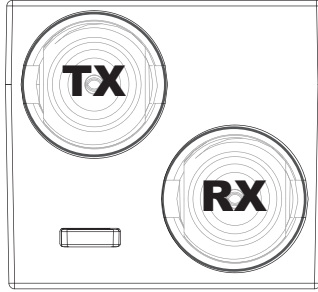


Figure 16 SFP Package Outline, Front View — Channel Position

SFP-HDB-IO-12G

The SFP-HDB-IO-12G is an electrical SFP Transceiver module designed to transmit and receive one SDI signal up to 11.88Gbps (UHD12) over 75Ω coaxial cables.

Features

- SMPTE 2081, SMPTE 2082, SMPTE 424, SMPTE 292, and SMPTE 259 compliant
- HD-BNC 75Ω connectors
- Supports video pathological patterns for SD-SDI, HDSDI, 3G-SDI, 6G-SDI, and 12G-SDI
- Hot-pluggable

Simplified Block Diagram

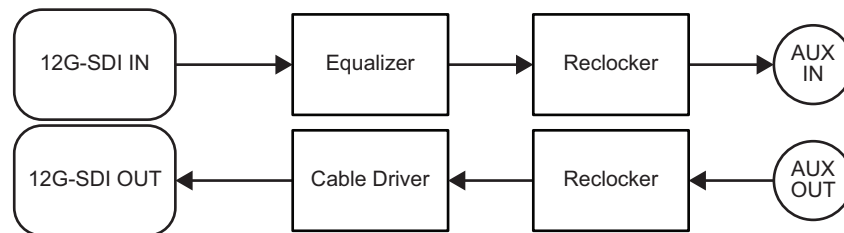


Figure 17 SFP-HDB-IO-12G — High Level Block Diagram

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-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.

DC Specifications

Table 48 DC Specifications

Parameter	Typical	Max.	Notes
Power Supply Current	250mA	303mA	All power consumption characterized at 25C, V _{CC} = 3.3V
Total Power Consumption	825mW	1000mW	

Recommended Operating Conditions

Table 49 Recommended Operating Conditions

Parameter		Min.	Typical	Max.	Notes
Supply Voltage		3.135	3.3	3.465	
Operating Case Temperature		-40°C		+85°C	Measured on the top side of the module in the center
Serial Data Rate	SD-SDI		270Mbps		ST259
	HD-SDI		1483Mbps, 1485Mbps		ST292
	3G-SDI		2967Mbps, 2970Mbps		ST424
	12G-SDI		11868Mbps, 11880Mbps		ST2081, ST2082

SDI Receive Characteristics

Table 50 SDI RX Characteristics

Parameter		Min.	Typical	Max.	Notes
Input Voltage Swing		150mVp-p		425mVp-p	
Input Return Loss	0-1.5Ghz	15dB	16.5dB		
	1.5-3Ghz	10dB	12.5dB		
	3-6Ghz	7dB	11.5dB		
	0-1.5Ghz	4dB	6dB		
Jitter	SD-SDI		0.11UIp-p		250m
	HD-SDI		0.10UIp-p		155m
	3G-SDI		0.10UIp-p		130m
	6G-SDI		0.10UIp-p		65m
	12G-SDI		0.14UIp-p		40m
Cable Length					
Belden 1694A	SD-SDI		250m		
	HD-SDI		155m		
	3G-SDI		130m		
	6G-SDI		65m		
	12G-SDI		40m		
Belden 4794R	12G-SDI		60m		
Canare 16AE	12G-SDI		65m		

SDI Transmit Characteristics

Table 51 SDI TX Characteristics

Parameter		Min.	Typical	Max.	Notes
Output Voltage Swing		720mVp-p	800mVp-p	880mVp-p	
Output Return Loss	0-1.5Ghz	15dB	16.5dB		
	1.5-3Ghz	10dB	12.5dB		
	3-6Ghz	7dB	11.5dB		
	6-12Ghz	4dB	6dB		
Rise/Fall Time (80%-20%)	SD-SDI	390ps	550ps	1500ps	
	HD-SDI		60ps	270ps	
	3G-SDI		59ps	135ps	
	6G-SDI		36ps	80ps	
	12G-SDI		34ps	45ps	
Mismatched in Rise/Fall Time	SD-SDI		72ps	150ps	
	HD-SDI		0.8ps	12ps	
	3G-SDI		0.8ps	12ps	
	6G-SDI		2.7ps	12ps	
	12G-SDI		3ps	18ps	
Overshoot		5%			

Mechanical Features

Note that specifications are subject to change without notice.

Table 52 provides a brief list of the SFP-HDB-IO-12G mechanical features.

Table 52 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

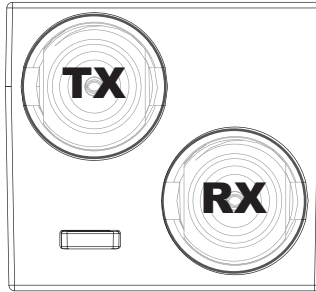


Figure 18 SFP Package Outline, Front View — Channel Position

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.

★ The SFP-MADI-850MM is no longer available from Ross Video.

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

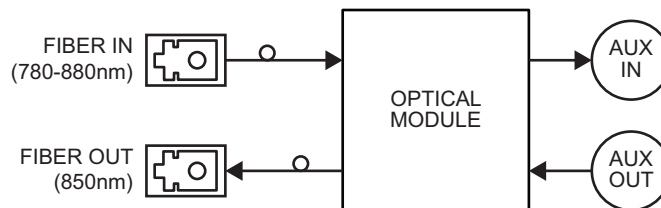


Figure 19 High Level Block Diagram

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 53 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

Table 53 Absolute Maximum Ratings

Parameter	Min.	Max.	Notes
Storage Temperature	-40°C	+85°C	
Relative Humidity	5%	95%	Non-condensing

Transmitter Performance Characteristics

Table 54 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 55 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			

Table 55 Receiver Specifications

Parameter		Min.	Typical	Max.	Notes
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

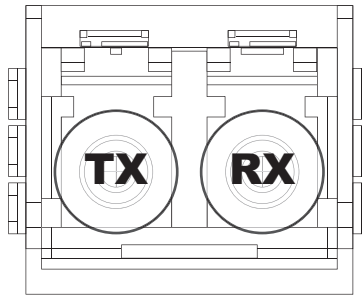


Figure 20 SFP Package Outline, Front View — Channel Position

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 50/125µm and 60/125µm multi-mode fiber
- Hot-pluggable

Simplified Block Diagram

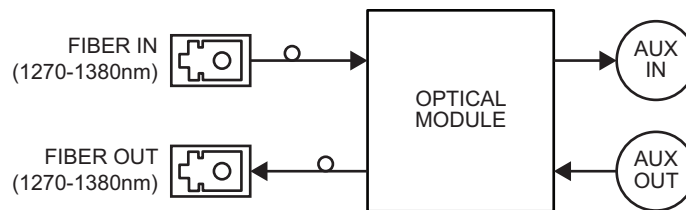


Figure 21 High Level Block Diagram

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 56 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 57 Recommended Operating Conditions

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

Transmitter Optical Characteristics

Table 58 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 59 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

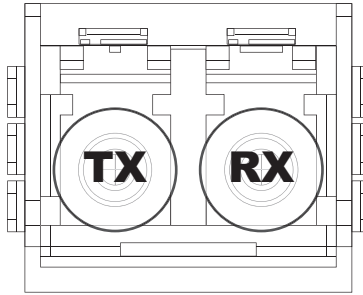


Figure 22 SFP Package Outline, Front View — Channel Position

End-of-Life Modules

This chapter lists the SFP modules that are no longer available from Ross Video:

- SFP-ANA-IO
- SFP-HDB-IN-12G
- SFP-HDB-OUT-12G
- SFP-HDM-OUT
- SFP-HDM-IN
- SFP-MADI-850MM

