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NEO® XHD

XHD-3903
HDTV Conversion Platform

Installation and Operation Manual

Edition E
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XHD-3903

HDTV Conversion Platform

Installation and Operation Manual

Edition E
April 2010

Copyrights

Warranty Information

The Limited Warranty Policy provides a complete description of your warranty coverage, limitations, and exclusions, as well as procedures for obtaining warranty service. To view the complete warranty, visit our website.

This publication is provided “as is” without warranty of any kind, either express or implied, including, but not limited to, the implied warranties of merchantability, fitness for a particular purpose, or non-infringement.

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Chapter 3: Audio and Video Configuration

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Preface

Manual Information

Purpose

This manual details the features, installation, operation, maintenance, and specifications of the NEO XHD-3903 HDTV conversion platform.

Audience

This manual is written for engineers, technicians, and operators responsible for the installation, setup, maintenance, and operation of the XHD-3903 HDTV conversion platform.

Revision History

Table P-1. Revision History of Manual

Edition	Date	Revision History
1st preliminary	October 2007	Product improvements
2nd preliminary	February 2008	Product improvements
A	March 2008	Product improvements
B	August 2008	Addition of fast-switching and 3G HD-SDI
C	December 2008	Addition of Neural audio products, BrandNet, and logo capabilities
D	July 2009	Additional Neural audio products, Dolby decoder, and second frame sync
E	April 2010	ARC and GPI improvements; additional Dolby options

Writing Conventions

To enhance your understanding, the authors of this manual have adhered to the following text conventions:

Table P-2. Writing Conventions

Term or Convention	Description
Bold	Indicates dialog boxes, property sheets, fields, buttons, check boxes, list boxes, combo boxes, menus, submenus, windows, lists, and selection names
Italics	Indicates E-mail addresses, the names of books or publications, and the first instances of new terms and specialized words that need emphasis
CAPS	Indicates a specific key on the keyboard, such as ENTER, TAB, CTRL, ALT, or DELETE
`Code`	Indicates variables or command-line entries, such as a DOS entry or something you type into a field
>	Indicates the direction of navigation through a hierarchy of menus and windows
hyperlink	Indicates a jump to another location within the electronic document or elsewhere
Internet address	Indicates a jump to a Web site or URL
Note	Indicates important information that helps to avoid and troubleshoot problems

Unpacking/Shipping Information

Unpacking a Product

This product was carefully inspected, tested, and calibrated before shipment to ensure years of stable and trouble-free service.

1. Check equipment for any visible damage that may have occurred during transit.
2. Confirm that you have received all items listed on the packing list.
3. Contact your dealer if any item on the packing list is missing.
4. Contact the carrier if any item is damaged.
5. Remove all packaging material from the product and its associated components before you install the unit.

Keep at least one set of original packaging, in the event that you need to return a product for servicing.

Product Servicing

Except for firmware upgrades, NEO modules are not designed for field service. All hardware upgrades, modifications, or repairs require you to return your module to the Customer Service center.

Returning a Product

In the unlikely event that your product fails to operate properly, please contact Customer Service to obtain a Return Authorization (RA) number, then send the unit back for servicing.

Keep at least one set of original packaging in the event that a product needs to be returned for service. If the original package is not available, you can supply your own packaging as long as it meets the following criteria:

- The packaging must be able to withstand the product's weight.
- The product must be held rigid within the packaging.
- There must be at least 2 in. (5 cm) of space between the product and the container.
- The corners of the product must be protected.

Ship products back to us for servicing prepaid and, if possible, in the original packaging material. If the product is still within the warranty period, we will return the product prepaid after servicing.

Standards

Product compliance and safety standards for this module are contained in the *NEO Safety Instructions and Precautions Manual* (contained in the *FR-3901, FR-3903, and FR-3923 Mounting Frames Installation and Operation Manual*.

Restriction on Hazardous Substances (RoHS) Compliance

Directive 2002/95/EC—commonly known as the *European Union (EU) Restriction on Hazardous Substances (RoHS)*—sets limits on the use of certain substances found in electrical and electronic equipment. The intent of this legislation is to reduce the amount of hazardous chemicals that may leach out of landfill sites or otherwise contaminate the environment during end-of-life recycling. The Directive took effect on July 1, 2006, and it refers to the following hazardous substances:

- Lead (Pb)
- Mercury (Hg)
- Cadmium (Cd)
- Hexavalent Chromium (Cr-V1)
- Polybrominated Biphenyls (PBB)
- Polybrominated Diphenyl Ethers (PBDE)

According to this EU Directive, all products sold in the European Union are fully RoHS-compliant and "lead-free." (See our website for more information.) Spare parts supplied for the repair and upgrade of equipment sold before July 1, 2006 are exempt from the legislation. Equipment that complies with the EU directive is marked with a RoHS-compliant emblem, as shown in Figure 1.

Figure P-1. RoHS Compliance Emblem

Waste from Electrical and Electronic Equipment (WEEE) Compliance

The *European Union (EU) Directive 2002/96/EC on Waste from Electrical and Electronic Equipment (WEEE)* deals with the collection, treatment, recovery, and recycling of electrical and electronic waste products. The objective of the WEEE Directive is to assign the responsibility for the disposal of associated hazardous waste to either the producers or users of these products. Effective August 13, 2005, producers or users are required to recycle electrical and electronic equipment at end of its useful life, and may not dispose of the equipment in landfills or by using other unapproved methods. (Some EU member states may have different deadlines.)

In accordance with this EU Directive, companies selling electric or electronic devices in the EU will affix labels indicating that such products must be properly recycled. (See our website for more information.) Contact your local sales representative for information on returning these products for recycling. Equipment that complies with the EU directive is marked with a WEEE-compliant emblem, as shown in Figure 2.

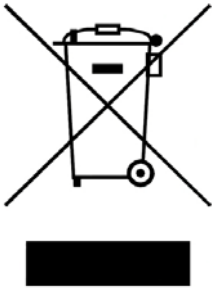


Figure P-2. WEEE Compliance Emblem

Safety

Carefully review all safety precautions to avoid injury and prevent damage to this product or any products connected to it. You will find a complete list of safety precautions in the *NEO Safety Instructions and Precautions Manual*. Only qualified personnel should perform service procedures.

Safety Terms and Symbols in This Manual

WARNING
Statements identifying conditions or practices that may result in personal injury or loss of life. High voltage is present.

CAUTION
Statements identifying conditions or practices that can result in damage to the equipment or other property.

Chapter 1

Introduction

Overview

The XHD-3903 platform offers broadcast-quality HD/SD-SDI upconversion, crossconversion, and downconversion with aspect ratio conversion (ARC), and closed-captioning support.

This chapter covers the following topics:

For information about NEO frames, see the *FR-3901, FR-3903, and FR-3923 Installation and Operation Manual*. The frame manual includes information about these items:

- General information about module unpacking, installation, removal, navigation, configuration, and setup
- Card-edge screen savers
- State recovery parameters
- Fan, resource, and alarm interconnect modules
- Power supplies
- Servicing instructions

Product Description

The XHD-3903 platform offers a wide range of different HDTV conversion capabilities (up, cross, down, and ARC) in AES and non-AES versions, along with many specialty options (including I-Wings, DVB teletext closed captioning, and 3 Gb/sec processing).

You can control XHD-3903 modules at the card edge with on-screen display, and by using CCS-enabled control panels and software applications such as CCS Navigator™.

The different versions are named as follows:

- XHD-3903-A (non-AES SD-SDI ARC)
- XHD-3903-D (non-AES downconversion)
- XHD-3903-UC (non-AES up- and crossconversion)
- XHD-3903-UCD (non-AES up-, cross-, and downconversion)
- XHD-3903-A-AES (SD-SDI ARC with AES)
- XHD-3903-D-AES (downconversion with AES)
- XHD-3903-UC-AES (up- and crossconversion with AES)
- XHD-3903-UCDAES (up-, cross-, and downconversion with AES)

Main Features

The following list includes the main features of the XHD-3903 platform:

- Available 3.0 Gb/sec, 1080p, 50/59.94 processing option
- Motion-adaptive de-interlacing up/cross/down conversion
- Support for wide range of HDTV formats
- Internally-generated external ARC key channel
- Auto-detectable/user-selectable input/output standards and formats
- Error monitoring on all SDI inputs and AES inputs
- Analog composite genlock input with support for tri- and bi-level sync, and user-selectable internal 75Ω load termination
- Switchable external or backplane genlock inputs
- GPI inputs for triggering ARC changes; GPI outputs for signalling when ARC changes occur
- DARS input

- Dedicated SD/HD-SDI output carrying the same program signal with embedded audio; one additional SD/HD-SDI output carrying either the same program signal or the same key signal (user-selectable)
- Automatic reconfiguration between standard conversion modes based on input standard changes
- Audio tracking and delay capabilities
- 10-bit motion-adaptive video de-interlacing with edge interpolation
- User-selectable detail enhancement settings (edge sharpening/ softening)
- EIA-608, EIA-708 closed captioning transcoding capability
- Color-space conversion between SD and HD
- User-configurable aspect ratio conversion (H/V size, H/V position) for picture resizing, with selectable internally-generated color ARC backgrounds
- Automatic 2:2/3:2 pull-down detection and handling
- Ancillary data (ANC) processing
- Adjustable vertical blanking size in fields 1 and 2; transfer and transcoding of closed captioning information between formats
- DVB subtitling software text option, providing ITU-R BT-653-3 compliance (Systems A, B, C, D World System Teletext)
- Enhanced VI, WSS, and AFD decoding, processing, and encoding capabilities
- 24-bit audio processing
- Embedded audio processing (demultiplexing from SDI, delay/sync, sample rate conversion, quiet switching, and re-multiplexing into SDI)
- Transparent handling of embedded compressed audio with fixed delay
- Available eight-channel AES audio support
- Support for compressed and linear PCM in the same audio group
- Audio sync/delay
- Support for four groups (sixteen channels) of embedded audio
- Balanced or unbalanced AES input and output (XHD-3903 AES versions)

- Eight AES input channels (XHD-3903 AES versions)
- Available eight-channel AES audio support (XHD-3903 AES versions)
- Eight AES processed output channels (XHD-3903 AES versions)
- Loss-of-video freeze
- Built-in SD- and HD-SDI test generator containing 75% color bars, cross hatch pattern, frequency sweep (luma and chroma), white, black, and safe area generator (SAG)
- Key output of picture or non-picture area
- On-screen display of module parameters (see page 97 for details)
- Fast-switching capability for HD-SDI master control and production switching
- DTS Neural and Dolby advanced audio processing options
- 3 Gb/s Level A and Level B (dual link SMPTE372) support (data and audio embed/de-embed is fixed on link A)
- Frame sync output on SDI 2
- Audio metadata embedding and de-embedding
- Audio metadata serial port receiving and transmitting
- Serial port AFD control
- Fully configurable AFD/VI/WSS embedding on AFD loss

Front Modules

Figure 1-1 illustrates the position of the LEDs and card-edge controls on an XHD-3903-FM front module.

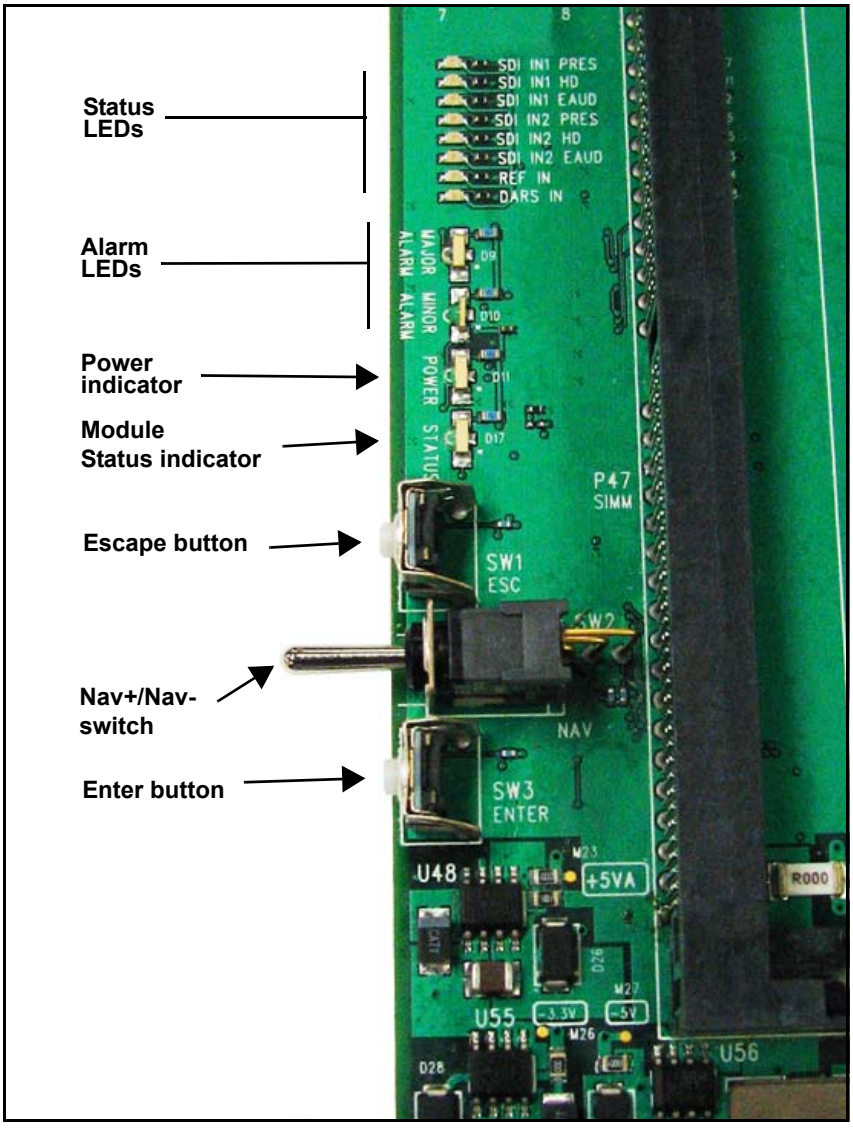


Figure 1-1. Card-Edge Controls on XHD-3903 Front Modules

Back Modules

Non-AES versions of the XHD-3903 use a single-slot back module (Figure 1-2 below); AES versions use a dual-slot back module (Figure 1-3). AES versions of the XHD-3903 front module cannot be inserted into a single slot. However, the dual-slot back module can be used for both front modules.

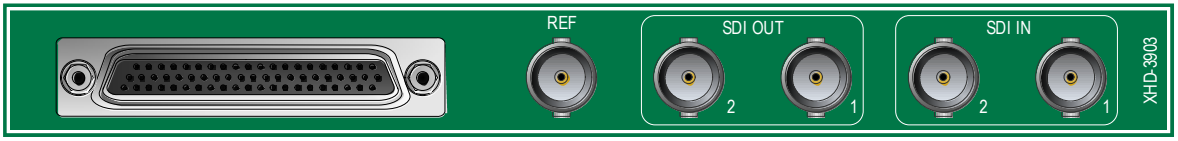


Figure 1-2. Non-AES XHD-3903-BM-1 Back Module

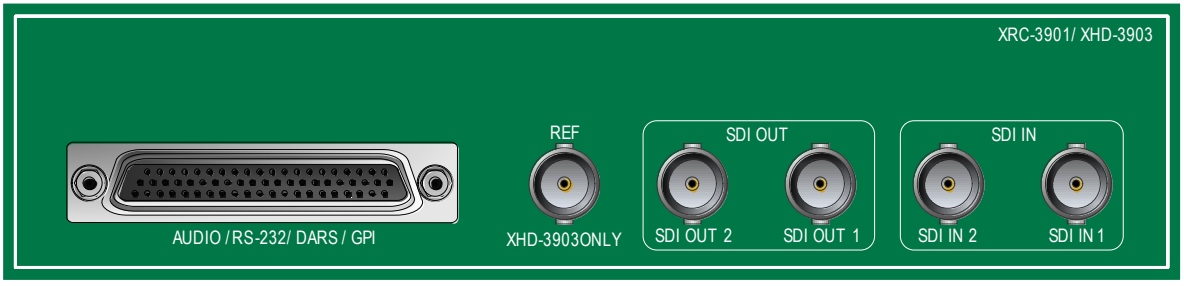


Figure 1-3. AES XHD-3903-BM-2 Back Module

Figure 1-4 and Table 1-1 on page 7 show the pinouts of the back module DB-62 connector.

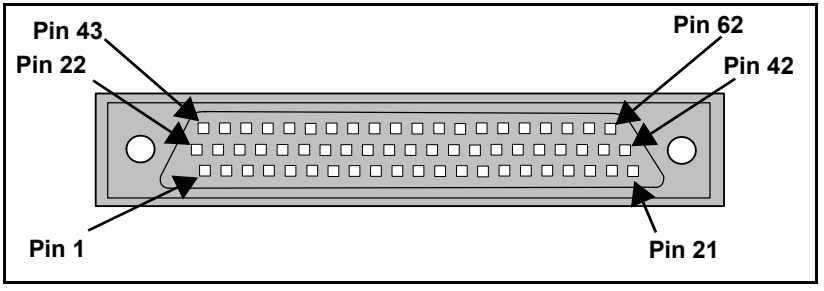


Figure 1-4. Back Module DB-62 Pinouts

Table 1-1. Back Module DB-62 Pinouts

Pin Number	Description	Pin Number	Description
1	GPI In 4	32	DARS In Ground
2	GPI In 3	33	AES 8 In Ground
3	GPI In 2	34	AES 7 In Ground
4	GPI In 1	35	AES 5 In Ground
5	AES 5 Out +	36	AES 6 In -
6	AES 5 Out -	37	AES 3 In Ground
7	AES 3 Out +	38	AES 4 In -
8	AES 3 Out -	39	AES 2 In Ground
9	AES 1 Out +	40	AES 1 In Ground
10	AES 1 Out -	41	RS-422 Rx + (RS-232 Rx)
11	DARS In -	42	RS-422 Tx - (RS-232 Tx)
12	AES 8 In -	43	GPI Out 4
13	AES 7 In -	44	GPI Out 3
14	AES 5 In -	45	BNC In
15	AES 6 In Ground	46	AES 8 Out -
16	AES 3 In -	47	AES 7 Out -
17	AES 4 In Ground	48	AES 6 Out -
18	AES 2 In -	49	AES 4 Out -
19	AES 1 In -	50	AES 2 Out -
20	RS-422 Rx -	51	Aux Tx - (Aux Tx)
21	RS-422 Tx +	52	Aux Rx -
22	GPI Out 2	53	DARS In +
23	GPI Out 1	54	AES 8 In +
24	BNC In Ground	55	AES 7 In +
25	AES 8 Out +	56	AES 5 In +
26	AES 7 Out +	57	AES 6 In +
27	AES 6 Out +	58	AES 3 In +
28	AES 4 Out +	59	AES 4 In +
29	AES 2 Out +	60	AES 2 In +
30	Aux Tx +	61	AES 1 In +
31	Aux Rx + (Aux Rx)	62	Ground

Breakout Cables

One of the following breakout cables is standard with each XHD-3903 module:

- Non-AES cable (Figure 1-6 on page 10)
- Unbalanced 8-channel AES* cable (XHD39OPTCAB-C) (Figure 1-7 on page 11)

The following breakout cable is available as an option:

- Balanced 8-channel AES* cable (XHD39OPTCAB-B) for discrete audio versions of the module (Figure 1-8 on page 12)

Figure 1-5 on page 9 shows the numbering of the pins on the breakout cable DB-9 connectors.

Table 1-2 on page 9 lists the connector pinouts of the three DB-9 connectors in each breakout cable.

CAUTION

To prevent breakage of the back module, you must support a balanced breakout cable. Do not allow the weight of the cable to rest on the back module.

The XHD-3903-UG-AESC upgrade kit makes it possible for you to upgrade an existing single-slot non-AES XHD-3903 module to a double-slot AES-compatible module. See page 34 for details.

*or 16-channel mono

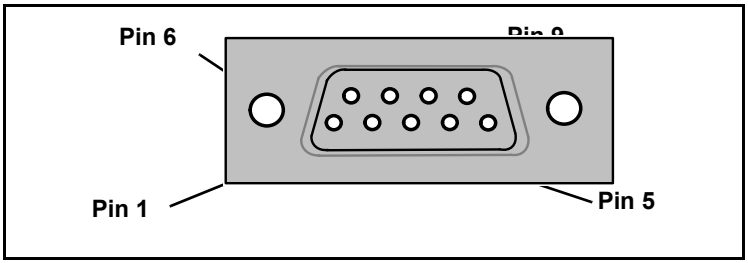


Figure 1-5. Breakout Cable DB-9 Pin Numbering

Table 1-2. DB-9 Pinouts

DB-9 Connector	Pin Number	Function
• Auxiliary data (for audio metadata) • RS-232/RS-422 (for serial control)	2	Tx - (Tx)
	3	Rx + (Rx)
	7	Tx +
	8	Rx -
	Metal body	Ground
GPI in/out	1	In 1
	2	In 2
	4	In 3
	5	In 4
	6	Out 1
	7	Out 2
	8	Out 3
	9	Out 4
	Metal body	Ground

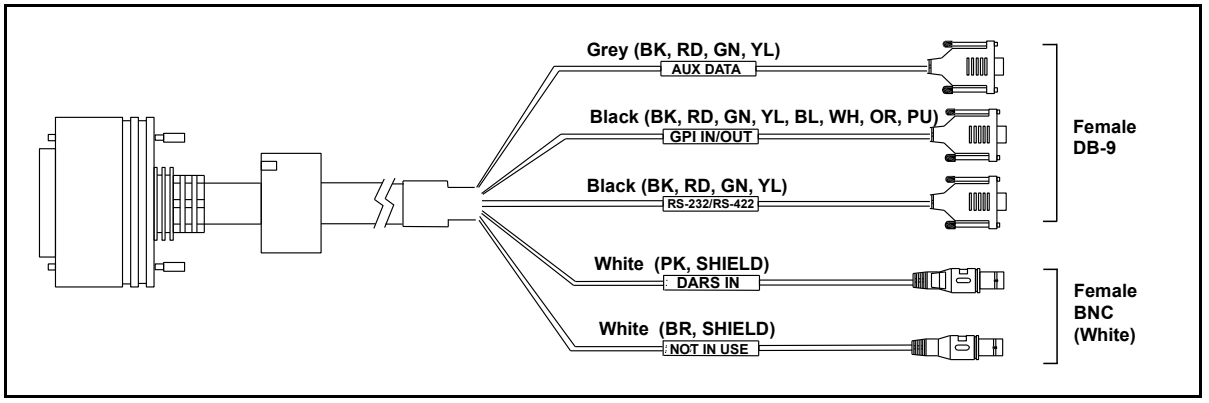


Figure 1-6. Non-AES Breakout Cable

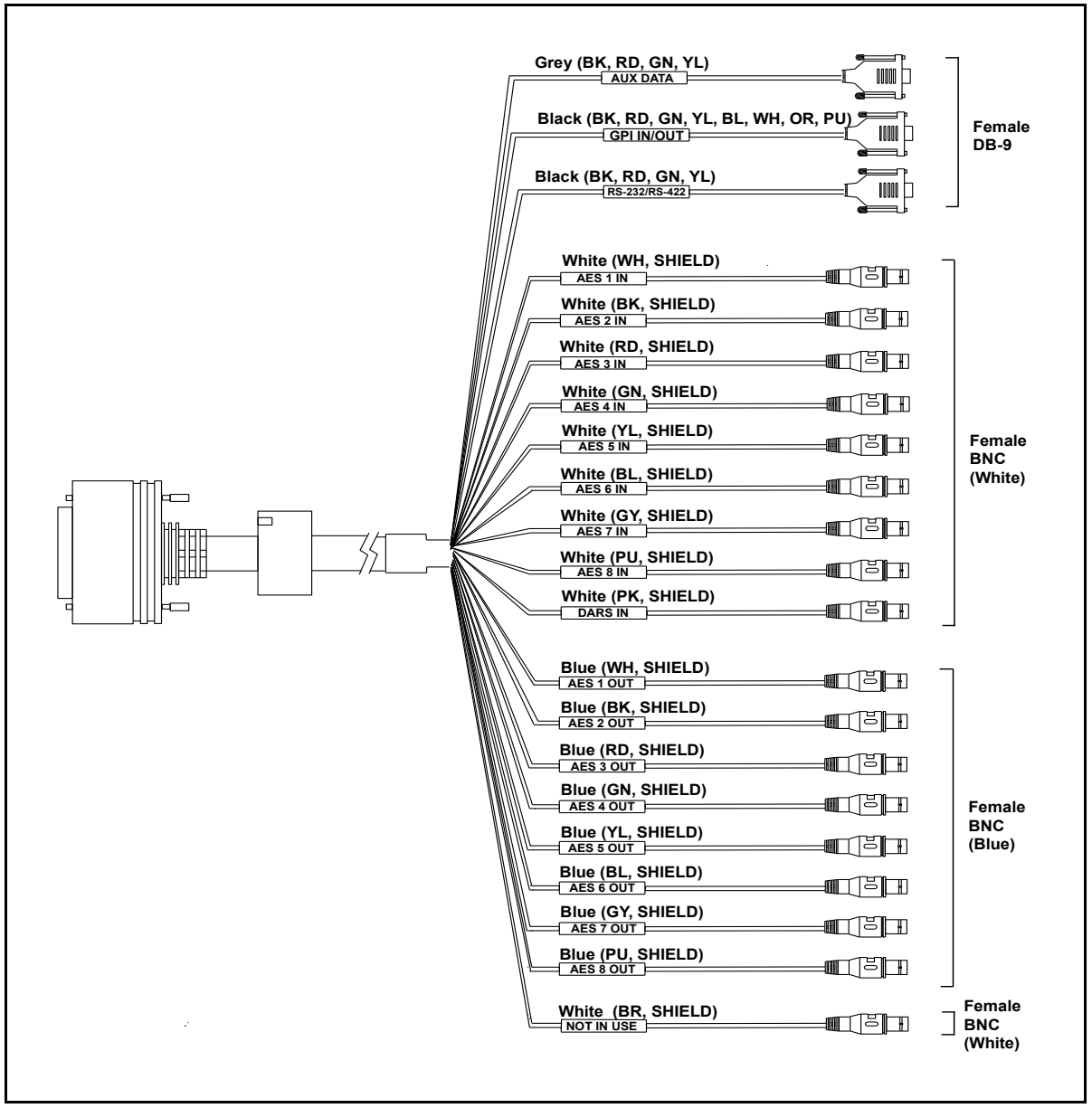


Figure 1-7. Unbalanced AES Breakout Cable (XHD39OPTCAB-C)

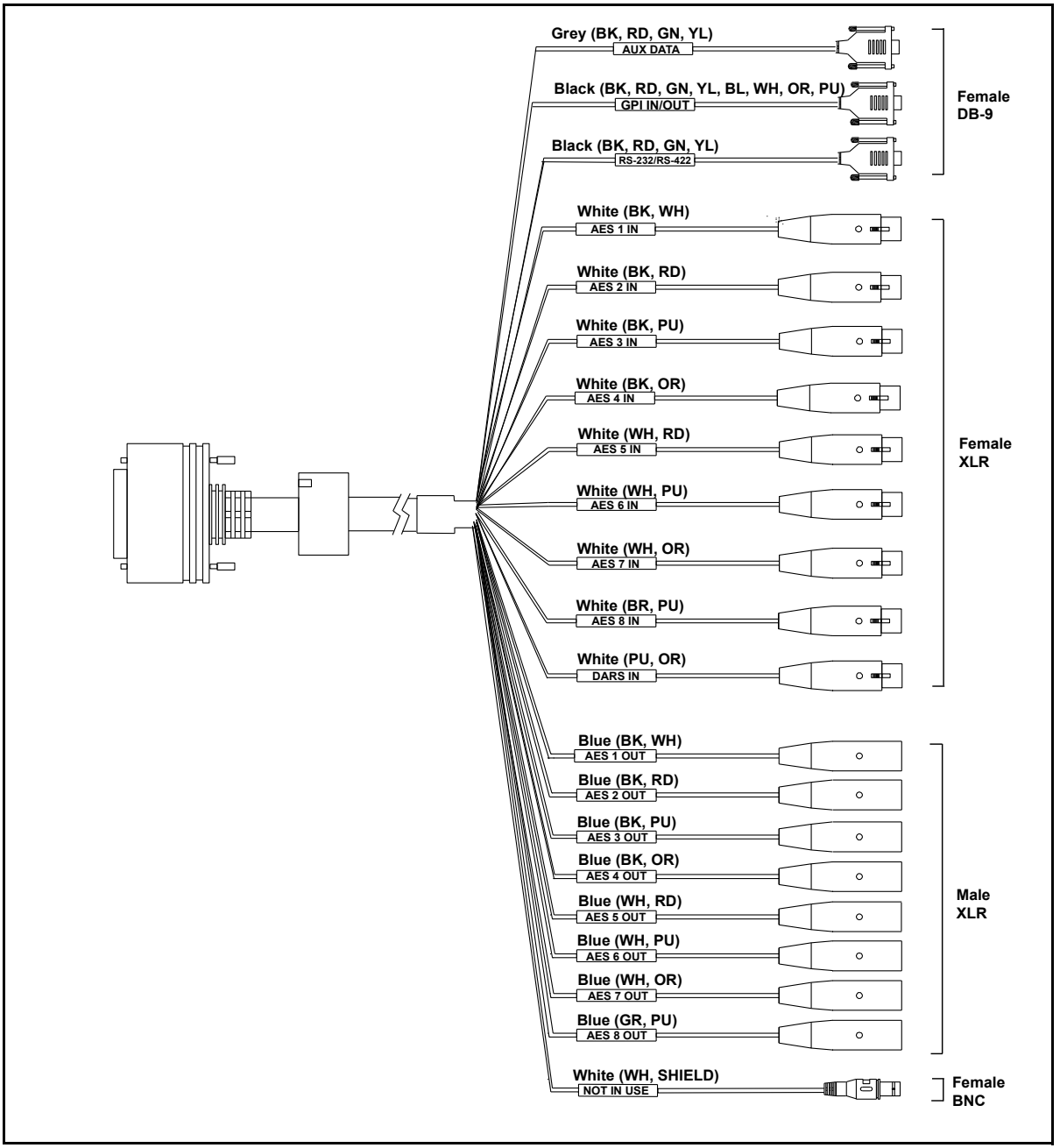


Figure 1-8. Balanced AES Breakout Cable (XHD39OPTCAB-B)

Signal Flow

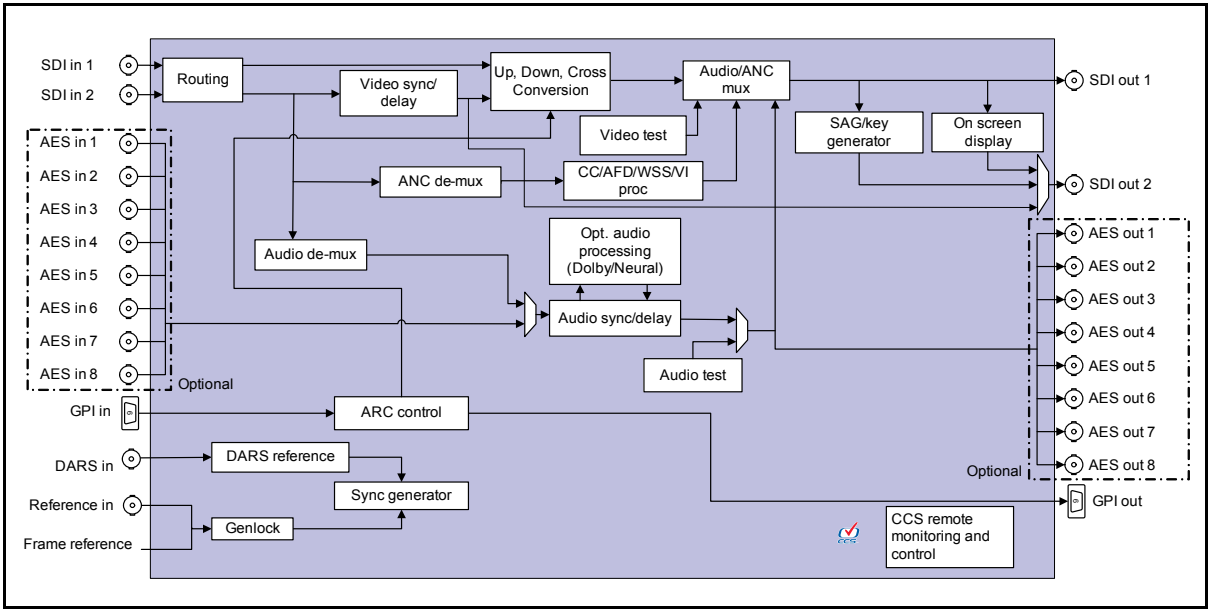


Figure 1-9. Signal Flow

Applications

XHD-3903 conversion modules are suitable for the following applications:

- Final conversion to a high- or standard-definition output, regardless of input format
- Bridging between high-definition and standard-definition installations in a mixed signal facility
- Bridging between 720p and 1080p high-definition installations
- Transitioning small market broadcasters requiring high-quality conversion
- Ingestion of high-definition or standard-definition signal into a facility running either video standard
- Insertion of external content into the sidebars of a converted 4:3 SDI signal, using the optional I-Wings content insertion feature

In all applications, the XHD-3903 is configured in a routing mode (page 15) an I-Wings mode (page 15), or a fast-switching mode (page 16).

Routing Mode

The most common application for the XHD-3903 is the routing mode, in which the incoming signal is converted up, down, across, or in ARC. In the event of a loss of video, only the actively routed signal will trigger an LOV event, and only one of the two SDI inputs is alarmed. This mode is activated when either **SDI 1** or **SDI 2** is selected in the **Primary Video Source** parameter (**Video > Output > Primary Video Source**).

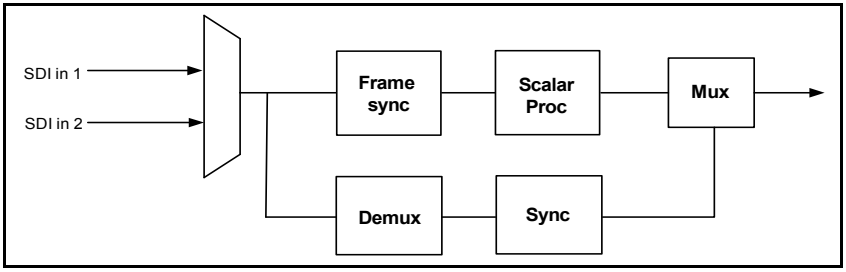


Figure 1-10. Routing Mode

I-Wings Mode

The I-Wings mode displays video or graphics on the two "wings" on either side of an SDI signal located within a larger aspect ratio signal.

In the I-Wings mode, a loss of either SDI input will trigger an alarm. In addition, if video is lost on the SDI 2 input, an LOV black signal is automatically activated on that input. This mode is activated when you select **SDI 1-IW** in the **Primary Video Source** parameter (**Video > Output > Primary Video Source**).

For more information about I-Wings, see page 63.

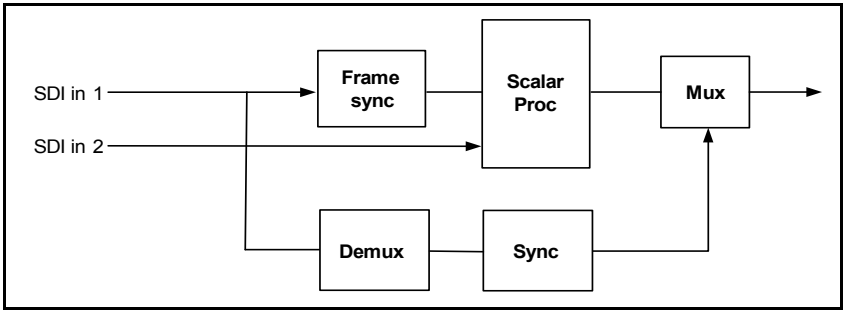


Figure 1-11. I-Wings Mode

Fast-Switching Mode

When an XHD-3903 module is used to provide HD-SDI sources to a switcher, you can set the module to one of the fast switching options in the **Primary Video Source** parameter. In the fast-switching mode, (see Figure 1-12) the module upconverts between SD-SDI and HD-SDI inputs in as little as eight frames. To achieve this response time, each XHD-3903's input standard must be fixed ahead of time, and the SD/HD sources must have the same frame rate.

For more information about this feature, see page 65.

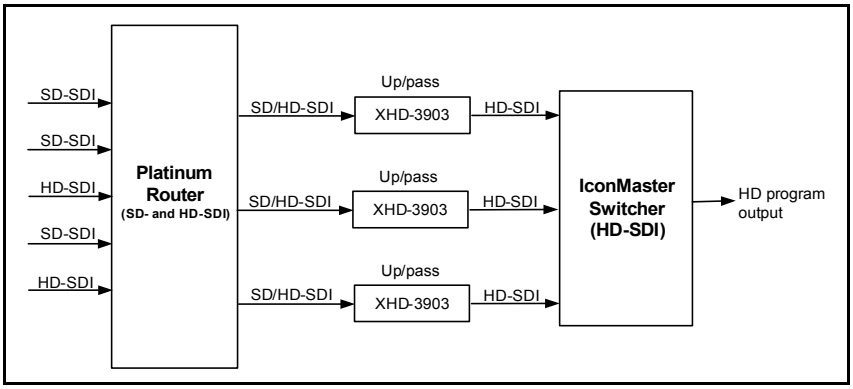


Figure 1-12. Fast-Switching Mode

Level A and Level B 3 Gb/s

There are two methods for organizing video, audio, data, and metadata for a 3 Gb/s serial digital signal: Level A and Level B.

Level A follows the same data organization as 1080i and 720p 1.5 Gb.s serial digital signals. The video is carried in two streams: Stream A and Stream B. *Stream A* contains the luminance information with its VANC (Vertical Ancillary data space) and HANC (Horizontal Ancillary data space) and *Stream B* contains the Cb/Cr color difference signals with its VANC and HANC.

Since the inception of digital television in the early '90s, broadcasters have used the YCbCr color space. The sampling structure is 4:2:2 where the luminance (4) is sampled twice as often as the color difference (2:2). A 10-bit digital word is used when sampling the signal. The only difference is that 1080i and 720p take up 1.5 Gb/s when in the serial digital domain; 1080p takes up 3 Gb/s in the serial digital domain because it has twice the data (it is progressive, not interlaced).

Figure 1-13 shows the two stream data organization for 3 Gb/s 1080p Level A.

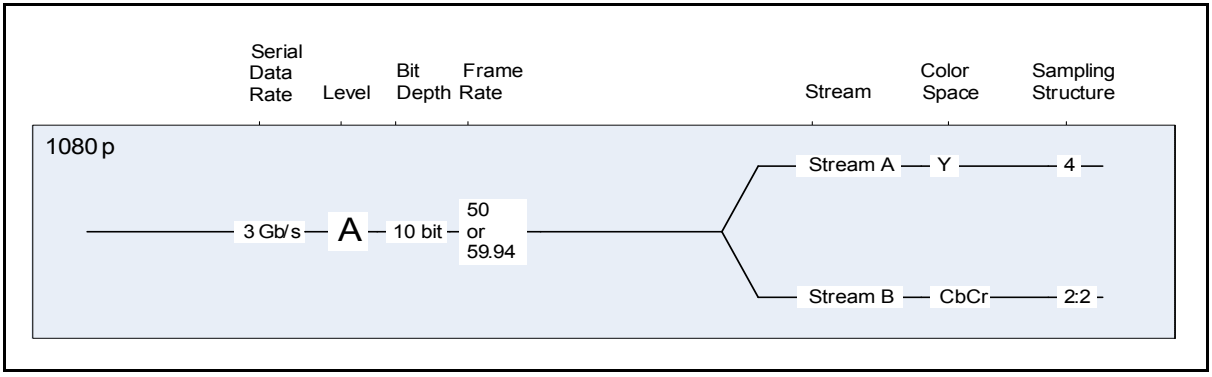


Figure 1-13. 3 Gb/s 1080p Level A

Level B supports the SMPTE 372M Dual Link standard (2 x 1.5 Gb/s) over one 3 Gb/s serial digital connection. Dual Link has been used in production for many years for many video formats. Link A is formatted in a similar way to 1.5 Gb/s (with streams A and B). Link B adds formatting that is similar to the Level A signal, creating a total of four streams in a Dual Link Level B signal, each with its own VANC and HANC. The XHD-3903 currently supports the YCbCr, 4:2:2 10-bit standard.

Figure 1-14 shows the dual link data organization for 3 Gb/s 1080p Level B.

NOTE

When the output is 3 Gb/s Dual Link, the embedded line numbers for closed captioning and AFD will reference the picture standard. For example, the output and embedding on *line 20* refer to Link A *line 10*.

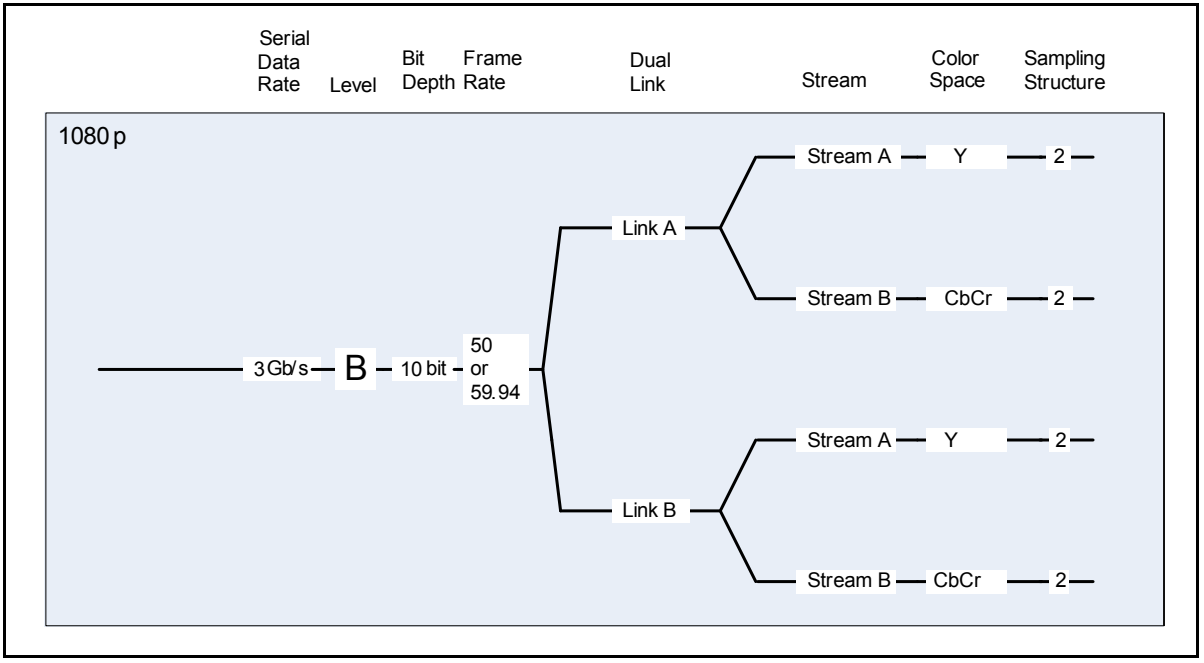


Figure 1-14. 3 Gb/s 1080p Level B

Chapter 2

Installation

Overview

Installation, navigation, configuration, and setup information is included in the *NEO FR-3901, FR-3903, and FR-3923 Mounting Frames Installation and Operation Manual*. See our website for this and other related documents.

In this chapter, you will find information on the following topics:

CAUTION

Before installation, please read the *NEO Safety Instructions and Precautions Manual*. This document contains important information about the safe installation and operation of NEO products.

Checking the Packing List

The XHD-3903 packages include these items:

- One XHD-3903-FM front module, with pre-entered license keys
- One XHD-3903-BM-1 single-height non-AES back module, or one XHD-3903-BM-2 double-height AES back module
- One non-AES breakout cable or one AES breakout cable
- One (optional) XHD39OPTCAB-B balanced AES breakout cable
- One *XHD-3903 HDTV Conversion Platform Installation and Operation Manual* per order

NOTE

ARC conversion is included with most versions. XHD-3903-A and XHD-3903-A-AES modules include an SD-SDI ARC license.

Installing XHD-3903 Modules

To configure XHD-3903 modules for use, you must first ensure that the module jumpers are properly set (see page 21 for details). After jumpers are set, you can install XHD-3903 modules into your frame using the standard procedures described in the *NEO FR-3901, FR-3903, and FR-3923 Mounting Frames Installation and Operation Manual*.

AES and 3G upgrades require special installation procedures. See the information on page 24 and page 25.

Removing XHD-3903 Modules

These modules require no specialized removal procedures, and they are both hot-swappable and hot-pluggable. See page 99 for special information about DejaView on XHD-3903 modules. For general information about removing NEO modules, see your *NEO FR-3901, FR-3903, and FR-3923 Mounting Frames Installation and Operation Manual*.

Setting Jumpers

Figure 2-1 shows the placement and settings of the jumpers for AES, DARS, and video reference on the XHD-3903 front module. The AES and DARS jumpers will have different balanced or unbalanced settings, depending upon which breakout cable you use. On each jumper, pin **1** is identified by a white triangle.

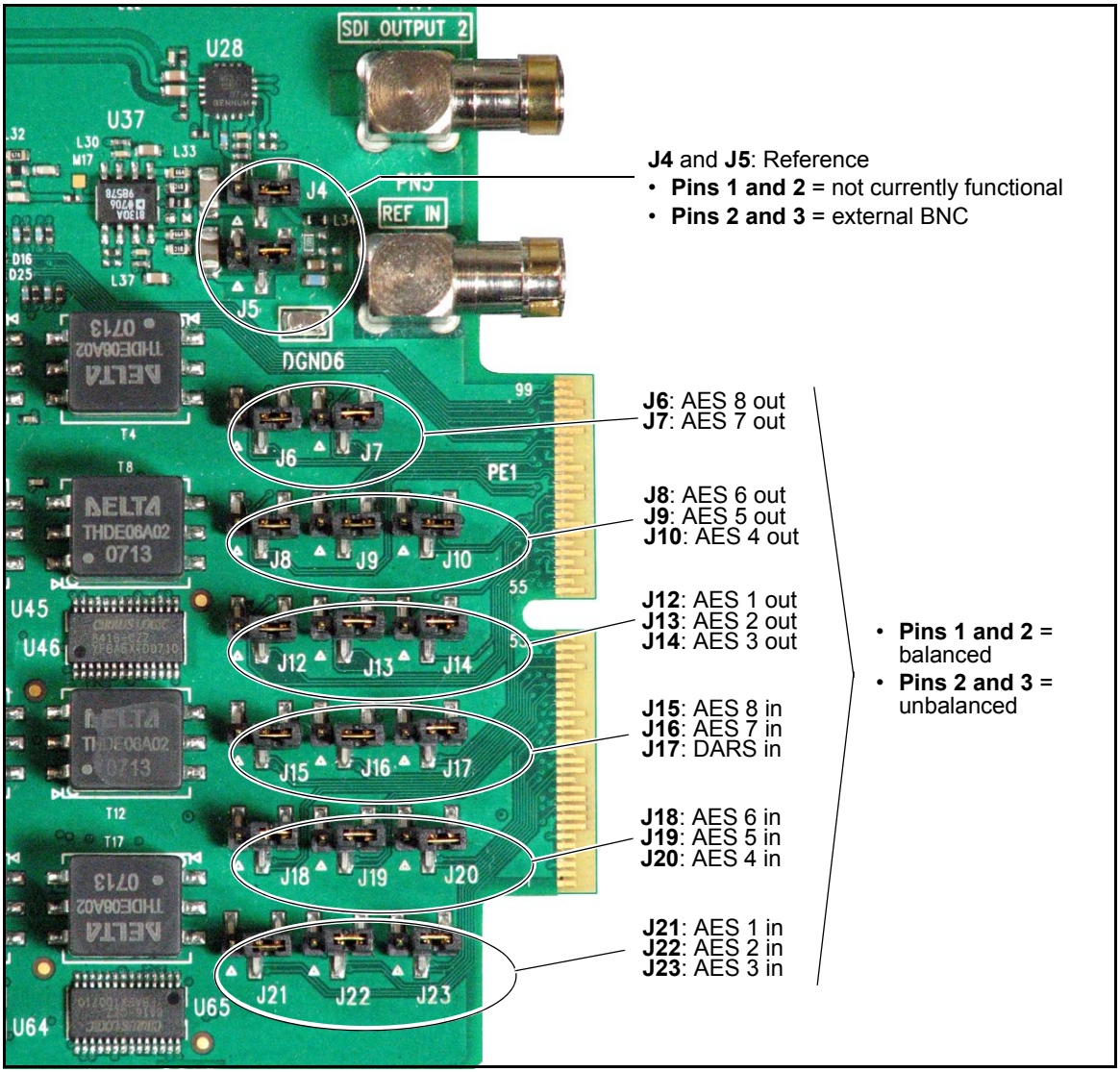


Figure 2-1. XHD-3903 AES, DARS, and Reference Jumpers

Powering Up a Module

The XHD-3903 powering-up sequence is slightly different than it is for other NEO modules. To power up the XHD-3903, follow these steps:

Video Settings

1. If you need on-screen display of the module's parameters, do either of the following:
   - Hold down the **Escape** button for five seconds
   - In CCS, select **Video > Output > Other > On Screen Display >** (toggle **Off/On**).

   The on-screen display appears in the **SDI 2** output.
2. Select the frame rate of the output video by following **Video > Output > Global Frame Rate**.
   - **Auto, 25/50 Hz** detects the input frame rate and offers a corresponding output, but in the event of no signal, outputs a 25/50 signal.
   - **Auto, 29/59 Hz** (default) detects the input frame rate and offers a corresponding output, but in the event of no signal, outputs a 29/59 signal.
   - **25/50** always outputs a 25/50 signal, but when an incompatible input signal is detected, the input signal is treated as loss-of-video.
   - **29/59** always outputs a 29/59 signal, but when an incompatible input signal is detected, the input signal is treated as loss-of-video.

NOTE

Auto-detection is not available in the fast-switching mode.

3. Set the output signal standard in the **Output Video Standard Select** parameter (**Video > Output > Output Video Standard Select**).
4. Connect the input video signal to the **SDI In 1** and/or **SDI In 2** connection on the back module.
5. Select your source option in the **Primary Video Source** parameter (**Video > Output**).

6. If you are using frame synchronization, connect a reference signal to the **REF** input connector on the back module.
7. In the **Reference Source** parameter **(Reference > Reference Source**), select **External Sync**.

Audio Settings

1. Select **Balanced** or **Unbalanced** AES input (**Audio > Input > AES Balanced/Unbalanced Select**).
2. In the input **Routing** parameter (**Audio > Input > Routing**), select AES or embedded audio for SRCs 1 to 16.
3. In the output **Routing** parameter (**Audio > Output > Routing**), set SRCs 1 to 16 to embedded (**Mux Group**) or AES outputs.
4. Set the audio reference by selecting **Reference > DARS Source**.

   The default **Auto** setting gives priority to video sync over DARS. If you wish to use DARS as your reference source, you must select **DARS** instead of **Auto**.

Upgrading License Keys

By purchasing a software license key option, you can upgrade your XHD-3903 to a number of different capabilities. (HD/SD-SDI ARC is included in most of the converters; "-A" and "-A-AES" versions provide SD-SDI ARC.)

To upgrade a single-slot non-AES module to 3G HD-SDI capability, you must first install the XHD39OPT-DH upgrade kit (supplied free of charge) before activating the license key. See page 34 for details.

To upgrade a single-slot non-AES module to AES capability, you must purchase and install the XHD3903-UG-AESC hardware upgrade kit.

NOTE

If you have an existing **Rev 2** double-slot XHD-3903 module, you must select **Dual Slot** in **Other > Module Type Set** when activating the license key. See *"3G HD-SDI Settings" on page 78* for details.

Table 2-1 on page 25 shows all of the available software key options. In the parameter list, see **Other > License Key** and **Other > License Key Status**.

When you order a new license key, Harris Sales staff will ask you to provide the serial number of the module. Follow **Other > Serial Number** to obtain this information. Do not use any numbers found on stickers on the module itself.

Installing Advanced Audio License Keys

Follow these steps to install an advanced audio license key (Dolby or DTS Neural):

1. Enter the license key in the **Other > License Key** field, and then press `Enter` on your keyboard.
2. Wait 30 seconds for the change to take effect.
3. Reboot the module by removing it from the frame or by starting the reboot procedure in CCS Navigator.

   The module may take a moment before it is enabled for use.
4. Confirm the license key type by rolling over the **Other > Options** field.

Table 2-1. Software Key Options

New Module Type	Current Module Type	Upgrade Keys Needed
XHD-3903-UCD and XHD-3903-UCDAES Up-, Cross-, and Downconverter	XHD-3903-A and XHD-3903-A-AES SD-SDI Aspect Ratio Converter	X3903-A-UG-UCD
	XHD-3903-D and XHD-3903-D-AES Downconverter	X3903-D-UG-UCD
	XHD-3903-UC and XHD-3903-UC-AES Upconverter and Crossconverter	X3903-UC-UG-UCD
Internal Wings (-IW) for XHD-3903-A, -D, -UC, -UCD and XHD-3903-A-AES, -D-AES, -UC-AES, -UCDAES	XHD-3903-A, -D, -UC, -UCD and XHD-3903-A-AES, -D-AES, -UC-AES, -UCDAES	XHD3903-OPT-IW
DVB Teletext Closed Captioning (in 625-SDI Conversion) for XHD-3903-A, -D, -UC, -UCD and XHD-3903-A-AES, -D-AES, -UC-AES, -UCDAES	XHD-3903-A, -D, -UC, -UCD and XHD-3903-A-AES, -D-AES, -UC-AES, -UCDAES	XHD3903-OPT-TT
Single-channel 3 Gb/sec processing for XHD-3903-A, -D, -UC, and -UCD* * This feature requires the XHD39OPT-DH hardware kit, available at no charge. Single-slot modules must be upgraded to a double-height back module with the hardware kit before the software keys are applied.	XHD-3903-D Downconverter	XHD39OPT-D-3G**
	XHD-3903-UC Upconverter and Crossconverter	XHD39OPT-UC-3G**
	XHD-3903-UCD Up-, Cross-, and Downconverter	XHD39OPT-UCD-3G**
Single-channel 3 Gb/sec processing for XHD-3903-A-AES, -D-AES, -UC-AES, -UCDAES	XHD-3903-D-AES Downconverter	XHD39OPT-D-3G
	XHD-3903-UC-AES Upconverter and Crossconverter	XHD39OPT-UC-3G
	XHD-3903-UCDAES Up-, Cross-, and Downconverter	XHD39OPT-UCD-3G
Integrated Graphics Storage and Playout for XHD-3903-A, -D, -UC, -UCD XHD-3903-A-AES, -D-AES, -UC-AES, -UCDAES	XHD-3903-A, -D, -UC, -UCD or XHD-3903-A-AES, -D-AES, -UC-AES, -UCDAES All Converters	XHD3903-OPT-GFX

Table 2-1. Software Key Options *(Continued)*

New Module Type	Current Module Type	Upgrade Keys Needed
BrandNet capability	Any XHD-3903 module	XHD3903-OPT-BN
DTS Neural Surround™ DownMix DTV 5.1 Transport Solution, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)	Any AES-enabled XHD-3903 module	XHD39OPT-DM
DTS Neural Surround™ DownMix DTV 5.1 Transport Solution with NLC Neural Loudness Control, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-DM-LC
DTS Neural Loudness Control for 2.0 or 5.1 Program Audio, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-LC
DTS Neural Loudness Control for 2.0 and 5.1 (separate programs), plug-in for NEO XHD-3903 (AES input/ output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-LC-6+2
DTS Neural Loudness Control for 4 x 2.0 Program Audio, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-LC-8
DTS Neural Loudness Control for 5.1 Program Audio with Neural DTS-Surround™ Downmix output, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-LC+DM
DTS Neural Surround™ 5.1 and rendered stereo content transitioning for DTV 5.1 Production, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-MM
DTS Neural Surround™ 5.1 and rendered stereo content transitioning for DTV 5.1 Production with NLC Neural Loudness Control, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-MM-LC
DTS Neural Surround™ UpMix DTV 5.1 Production Solution, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD39OPT-UM

Table 2-1. Software Key Options *(Continued)*

New Module Type	Current Module Type	Upgrade Keys Needed
DTS Neural Surround™ UpMix DTV 5.1 Production Solution with NLC Neural Loudness Control, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)	Any AES-enabled XHD-3903 module	XHD39OPT-UM-LC
Dolby E and AC-3 Decoder Option Hardware and Software Key (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD3903OPT-D1
Dolby E Integrated Encoder Hardware and Software Key (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD3903OPT-D2
Dolby Digital (AC-3) Integrated Encoder Hardware and Software Key (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)		XHD3903OPT-D3
Second channel SD/HD frame sync (no HD Up/Down/ Cross conversion)		XHD39OPT-2FS

**Must be ordered with the free XHD39OPT-DH Double-Height hardware kit

Upgrading Module Software using CCS 4.1 (or later)

NOTE

Starting with CCS version 3.5, Pilot and CoPilot are no longer offered as separate programs. A free trial version of CCS Navigator is packaged with each new XHD-3903 order; after the trial period, the program retains the upgrading capability of the former CoPilot program.

To monitor and control XHD-3903 modules using CCS Navigator, you must first upgrade your NEO frame resource module software to version 4.0 or higher. In addition, firmware upgrades to the XHD-3903 module require the use of Navigator 4.2 or higher.

XHD-3903 modules with Neural audio options have a slightly different behavior during and after a software upgrade. See page 34 for details.

Overview

Software upgrading is a routine procedure that you must perform to install newer versions of software on XHD-3903 modules. CCS Navigator software application is required for this procedure. Use care to ensure that you upload the correct files to the intended module.

In the unlikely event that the upgrade fails, the module may not respond to controls and will appear to be non-functional. In that event, follow the procedures described in “Correcting a Failed Upgrading Procedure” on page 31.

Before beginning the upgrading procedure, ensure that you have written down the IP address of your module. To do this, select the Build mode in CCS software. Right-click on the module, select **Properties**, and then click **Device**. The IP address appears in the second **Device ID** field.

Upgrading Procedure

The upgrading procedure will take approximately 10 minutes. Follow these steps to upgrade the software:

1. Download the most recent upgrade package for your module from our website.
2. Set your CCS Pilot or Navigator software to the Build mode (CoPilot only functions in Build mode).
3. If the affected module has not been discovered, perform the **Discovery** operation, as described in your CCS software application manual or online help, and then save the results.
4. From the **Tools** menu, select **Software Upgrade**.

   The **Software Upgrade** window opens or is brought to the foreground (see Figure 2-2).

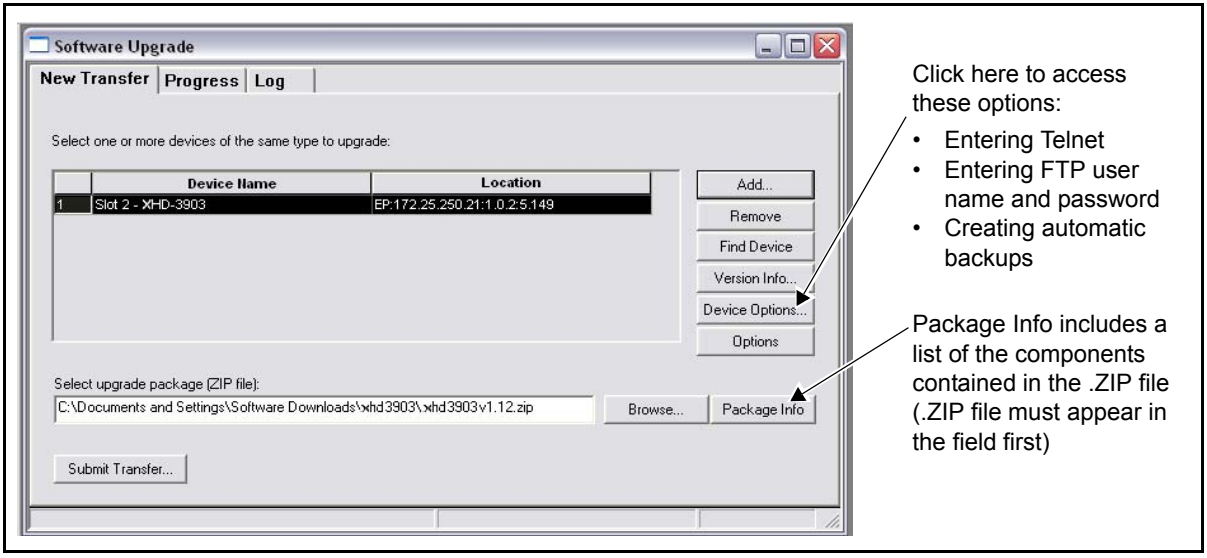


Figure 2-2. Software Upgrade Tool's New Transfer Tab

5. On the **New Transfer** tab, click **Add**.

   The **Device Selection** dialog opens.
6. Select one or more devices, and then click **OK** to close the **Add Device** dialog box.

   Here is some additional information:

- You can only add one unit from each IP address. Since all items in a frame have the same IP address, you cannot upgrade multiple modules in the same frame at the same time.
- The selected devices appear in the table on the **New Transfer** tab of the **Software Upgrade** window. This table lists devices that are to receive the same upgrade package.
- You can highlight the position of each device in the Navigation pane by clicking **Find Device**.
- The **Version Info** and **Device Options...** buttons currently are not supported by the XHD-3903.

7. In the **Software Upgrade** window, press **Browse...** to select the software upgrade package (ZIP file) that you want to upload to the module.

   A standard **Windows File Selection** dialog box opens.

8. Choose the upgrade ZIP file on a local or network drive, and then click **Open**.

   The selected file's path name is displayed beside the **Browse…** button.

9. Click **Submit Transfer...**

   A dialog box opens, requesting confirmation that you want to proceed with the request. If you have multiple devices selected, multiple transfer tasks are submitted—one per device.

   The extraction process on the ZIP file is handled as part of the upgrade process. You do not need to extract the files yourself.

   Although the file name disappears from the screen, the transfer is now underway. You may close the **Software Upgrade** window, continue with other tasks, or switch to the **Progress** tab to view the status of the transfers. The transfer may take several moments.

NOTE

Closing the **Software Upgrade** window does not affect any of the transfer processes that may be running in the background. If you try to log off or exit the CCS software while a transfer is underway, a notification window will alert you that processes are still active and will ask if you want to terminate these processes.

10. Click on the **Log** tab and look at the **Transfer Status** column to ensure that all files have correctly updated.

    The module is automatically rebooted after the upgrade procedure.

CAUTION

After the transfer is complete, the module reboots and upgrades itself for approximately five minutes. Do not interrupt this event. When the module is ready, the card-edge Status LEDs lights green, and in CCS Navigator, the status is **Network Active**.

11. To confirm the correct software version was installed, right-click the module in the Navigation pane, select **Configuration**, then **Version**, and then **Software**.

Correcting a Failed Upgrading Procedure

Software upgrades may fail in the event of network interruptions, power failures, or if too much data is uploaded to the XHD-3903 module.

The failure can be corrected by re-installing the software while in a fail-safe mode, as described in the following pages. Use care to ensure that you upload the correct files to the intended module.

Two general steps are involved in correcting a failed upgrade. These steps are found in the following sections:

1. "Setting the Module to Fail-Safe Loader Mode" (below)
2. "Upgrading the Software in the Boot Folder in Fail-Safe Mode" on page 32

Setting the Module to Fail-Safe Loader Mode

Follow these steps to set the module to the fail-safe loader mode:

1. Remove the affected module from the NEO frame.

2. Press the **Nav** switch down while simultaneously pressing the **Escape** button.

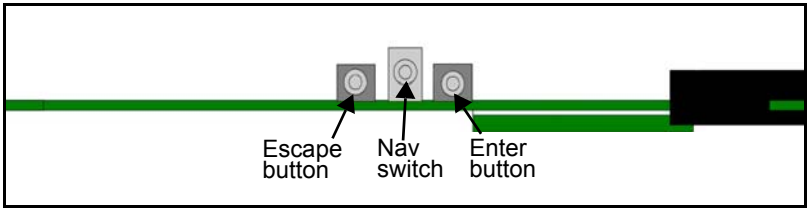


Figure 2-3. Buttons on a Typical Card Edge

3. While still pressing the button and the navigation switch, reinsert the module into the frame and hold for approximately three seconds until the **Status** LED begins "chasing."

   If your device has been discovered, you can continue upgrading your device's software, starting with step 4 on page 29. If the device has not been discovered, continue with the procedure described below.

Upgrading the Software in the Boot Folder in Fail-Safe Mode

This is the second stage of the failed upgrading procedure. To successfully complete this upgrade, you must follow these steps in the exact sequence described:

1. Enter Build mode in CCS Pilot or Navigator.
2. In the Navigation pane, drag or copy-and-paste the module's device icon from the **Catalog** folder into your NEO frame.
3. Right-click the device icon, and then select **Properties**.
4. On the **Device** tab of the **Navigation Properties** box, enter the IP address of the frame that holds the module (see below).

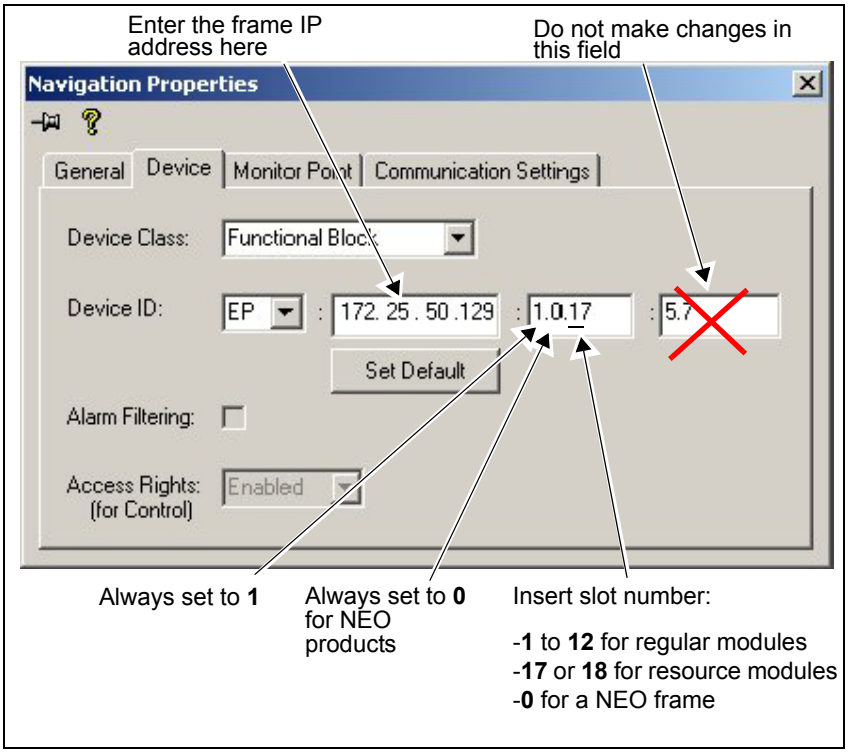


Figure 2-4. Navigation Properties Box

5. In the third field, enter

   `1.0.[slotnumber]`

   (For example, 1.0.5 would refer to the module in *slot 5* of the frame.)

NOTE

Ensure you do not make changes in the *last* field (located above and to the right of the **Set Default** button.) The value for the XHD-3903 module will be **5.154**.

6. Close the window, and continue upgrading your device's software, starting with step 4 on page 29.

Upgrading Modules with DTS Neural Audio

With a Neural audio submodule installed, the XHD-3903 behaves slightly differently during software upgrades.

After the usual CCS upgrade, additional components must be upgraded as well. During this time, two or four lit LEDs at the card edge scroll left and right across the module. This may take two minutes. When the LEDs have finished cycling, and the Status LED is green, the upgrade is complete.

When the module is in failsafe mode, three LEDs scroll left and right across the module.

The XHD-3903 module must be turned off and re-powered to apply the changes from the upgrade.

AES and 3G Upgrade Kits

The XHD3903-UG-AESC optional upgrade kit makes it possible for you to upgrade an existing single-slot non-AES module to a double-slot AES-compatible module.

The XHD39OPT-DH upgrade kit (available free of charge) makes it possible to upgrade a single-slot non-AES module to 3G HD-SDI capability when you purchase a 3G license key. This hardware kit must be installed before you activate the license key.

The upgrade packages include the following items:

- Unbalanced AES breakout cable (XHD3903-UG-AESC only)
- Double-slot back module
- Power connector assembly with mounting screws
- Standoff with mounting screw

Installation Procedure

Follow these steps to install the upgrade kit:

1. Remove the XHD-3903 front module, back module, and breakout cable from the NEO frame.
2. Replace the existing single-slot back module with the new double-slot AES version.

3. If applicable, connect and tighten the new unbalanced AES breakout cable (XHD39OPTCAB-C), or the optional balanced AES breakout cable (XHD39OPTCAB-B).

   The *balanced* breakout cable requires extra support. See page 36 for details.

4. Attach the power connector assembly to the XHD-3903 front module by gently tightening the two mounting screws from underneath the module (Figure 2-5).

5. Mount the 1-inch (2.5 cm) metal standoff in the left corner of the module by gently tightening the supplied screw from underneath the module.

   This standoff prevents the accidental insertion of a module into the upper slot.

6. Reinsert the modified front module into the frame.

7. Install the software license key (XHD39OPT-DH only).

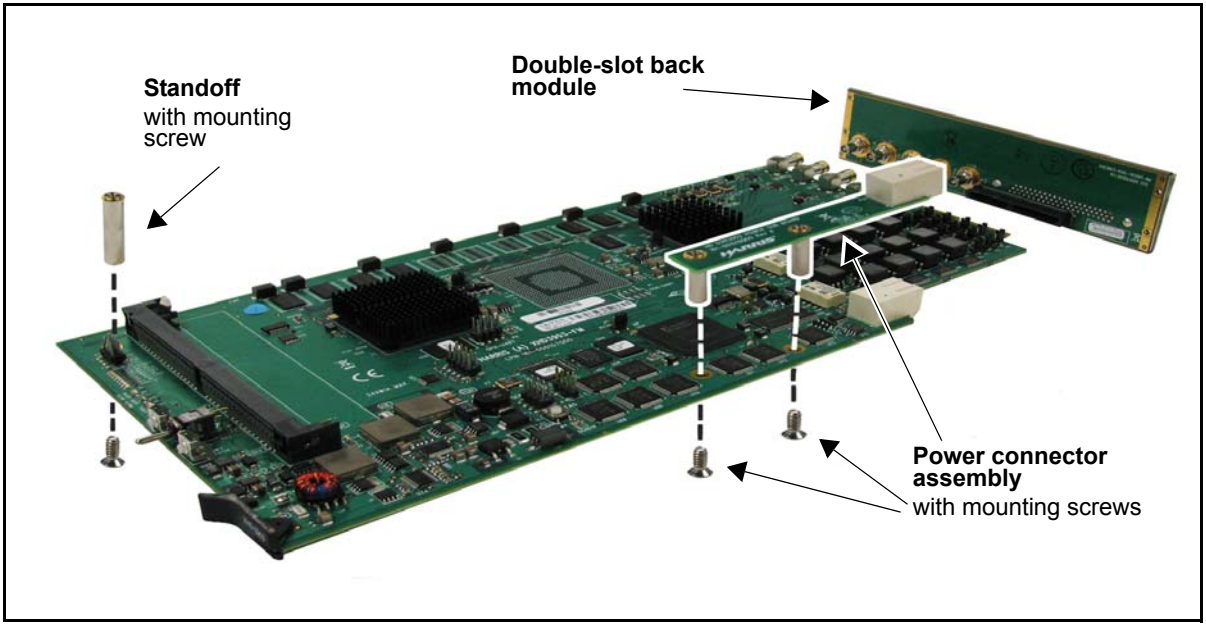


Figure 2-5. Installation of the Upgrade Kit

Balanced Breakout Cable Support

When using the balanced AES breakout cable, you must provide support to prevent damage to the back module. The FR-3901-RSB (1RU) and FR-3923-RSB (3RU) cable support bars are available for this purpose (Figure 2-6). Instructions for installing the support bar are found in the *NEO FR-3901, FR-3903, and FR-3923 Installation and Operation Manual*.

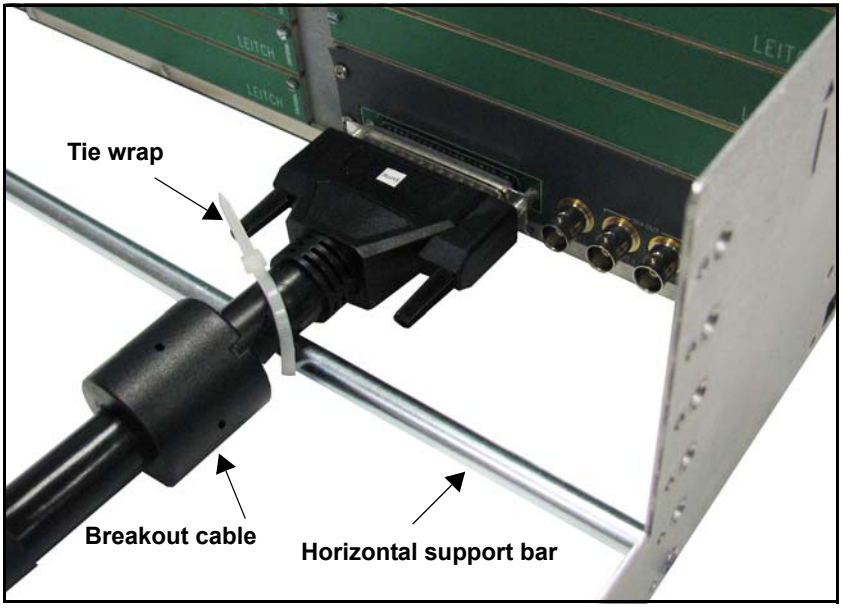


Figure 2-6. Balanced Breakout Cable Support (3RU Version Shown)

Advanced Audio Processing

The XHD-3903 offers a wide variety of DTS Neural and Dolby audio processing options. These options make it possible to offer advanced audio processing for high-definition and surround sound programming using 5.1 and stereo sources.

To install one of the advanced audio options, your XHD-3903 module must be configured for AES capability. This may require the installation of the XHD3903-UG-AESC upgrade kit. See page 115 for complete information about DTS Neural and Dolby audio options.

NOTE

Only one DTS Neural Audio option or one Dolby option can be installed on an XHD-3903 at any given time.

BrandNet

BrandNet is an ABC (USA) Network protocol used for the carriage of triggers in the VANC of an HDTV signal. The XHD3903-OPT-BN softkey option makes it possible for the XHD-3903 to preserve the BrandNet SDR (Single Data Rate) Satmatte and DDR (Double Data Rate) Sal Matte data during up-, cross-, and downconversion. The XHD3903-OPT-BN option also passes MasterKey legacy triggers for HDTV.

The **BrandNet DID**, **BrandNet SDID,** and read-only **BrandNet Present** parameters are found in the **Input** > **De-Embed** path. The output signal is enabled using the **BrandNet Embed** parameter (**Output > Embedder**). BrandNet is supported only in 525 and 720p/59.94 formats.

Graphics Storage and Playout

When you order the XHD3903-OPT-GFX Integrated Graphics Storage and Playout option with the XHD-3903, two additional hardware items are enclosed:

- 1 GB microSD memory card and SD-to-microSD adapter
- MicroSD-to-USB adapter

The microSD memory card and adapter kit make it possible to transport graphics from your PC to any XHD-3903 module (these items must be provided by the customer when the option is ordered separately).

Use the LogoCreator software provided on the *IconTools* CD-ROM to position and convert your on-air graphics files to the mg2 format. Then transfer the files from your PC's USB port to the microSD card—using the adapter kit provided—and insert the microSD card into the socket located on the underside of your XHD-3903 module (see Figure 3).

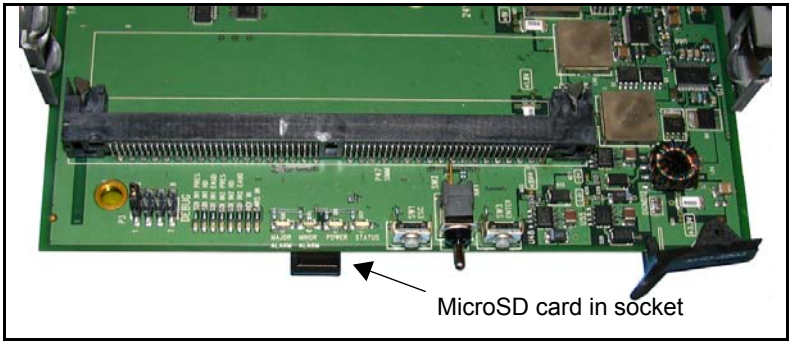


Figure 3. Inserting the MicroSD Card

The XHD3903-OPT-GFX software license key must be installed on the XHD-3903 module to download your graphics files. See "Integrated Graphics Storage and Playout" on page 87 for more information about converting graphics files using LogoCreator.

Chapter 3

Audio and Video Configuration

Overview

This chapter describes the audio and video configuration options that can be changed in the course of normal operation.

The following topics are found in this chapter:

Audio Configuration

All XHD-3903 modules process embedded audio. The input embedded audio from SDI 1 is demultiplexed (de-embedded) and synchronized to the video, delayed to match the video processing delay, processed, and then remultiplexed (re-embedded) into HD- and SD-SDI video output. Up to four groups of audio can be embedded into the video stream.

The AES versions of the XHD-3903 can process both embedded audio and discrete AES audio. Unlike embedded audio, discrete AES audio flows independently from the video stream. This audio is synchronized to the video, delayed to match the video processing delay, processed, and then multiplexed into HD- and SD-SDI output. The audio can also be output as a discrete AES signal.

Audio Controls

XHD-3903 modules can route audio from one of several sources to the outgoing SDI (up to 8 channel pairs can be embedded) and/or AES outputs (1 channel pair each).

The non-AES XHD-3903 modules support embedded audio. These modules are capable of demultiplexing up to four groups of embedded audio from the primary video SDI stream, and embedding up to four groups into the output SDI stream. The discrete AES versions additionally provide eight AES inputs (each balanced or coax) and eight AES outputs (each balanced or coax). XHD-3903 modules can select up to eight channel pairs of audio without AES, and an additional eight pairs of channels with AES.

The **Demux Group Present** and **Demux Channel Pairs Present** parameters (**Audio > Input > Status > Demux Group Present** and **Demux Channel Pairs Present**) indicate which groups and channel pairs have audio present in the video inputs.

The **AES Present** parameter indicates whether AES audio is detected.

See page 43 for more information about audio status parameters.

Audio Routing

Input

To manually configure the audio inputs, you will need to select options in the **Audio > Input > Routing** section. Set your options in the **SRC1** to **SRC8 Input Select** parameters (for non-AES modules), or the **SRC1** to **SRC16 Input Select** parameters (for AES modules).

The default settings for non-AES inputs follow this pattern:

- SRC1 Input Select = SDI 1 Group 1 Channel 1/2
- SRC2 Input Select = SDI 1 Group 1 Channel 3/4
- SRC3 Input Select = SDI 1 Group 2 Channel 1/2
- SRC4 Input Select = SDI 1 Group 2 Channel 3/4, etc.

The default settings for AES inputs follow this pattern:

- SRC9 Input Select = AES1a/1b
- SRC10 Input Select = AES2a/2b
- SRC11 Input Select = AES3a/3b
- SRC12 Input Select = AES4a/4b, etc.

Output

To manually configure the output of the audio, select **Enable** in **Mux Group 1 Enable** to **Mux Group 4 Enable.** (This is found at **Audio > Output > Embedder > Mux Group 1 Enable** to **Mux Group 4 Enable.**)

Next, set your options in the **Routing** section **(Audio > Output > Routing > Mux Group *x* Channel *x*)**.

The default audio routing settings follow this pattern:

- Mux Group 1 Channel 1 = SRC 1A
- Mux Group 1 Channel 2 = SRC 1B
- Mux Group 2 Channel 1 = SRC 2A
- Mux Group 2 Channel 2 = SRC 2B, etc.

In addition to selecting audio sources from the video groups, four custom tone generators are available, as well as **Mute** and **SMPTE RP155** and **EBU R68** tones. To set the four custom tones, follow the path to **Audio > Other > Tones > Tone Generators 1** to **4 Level**.

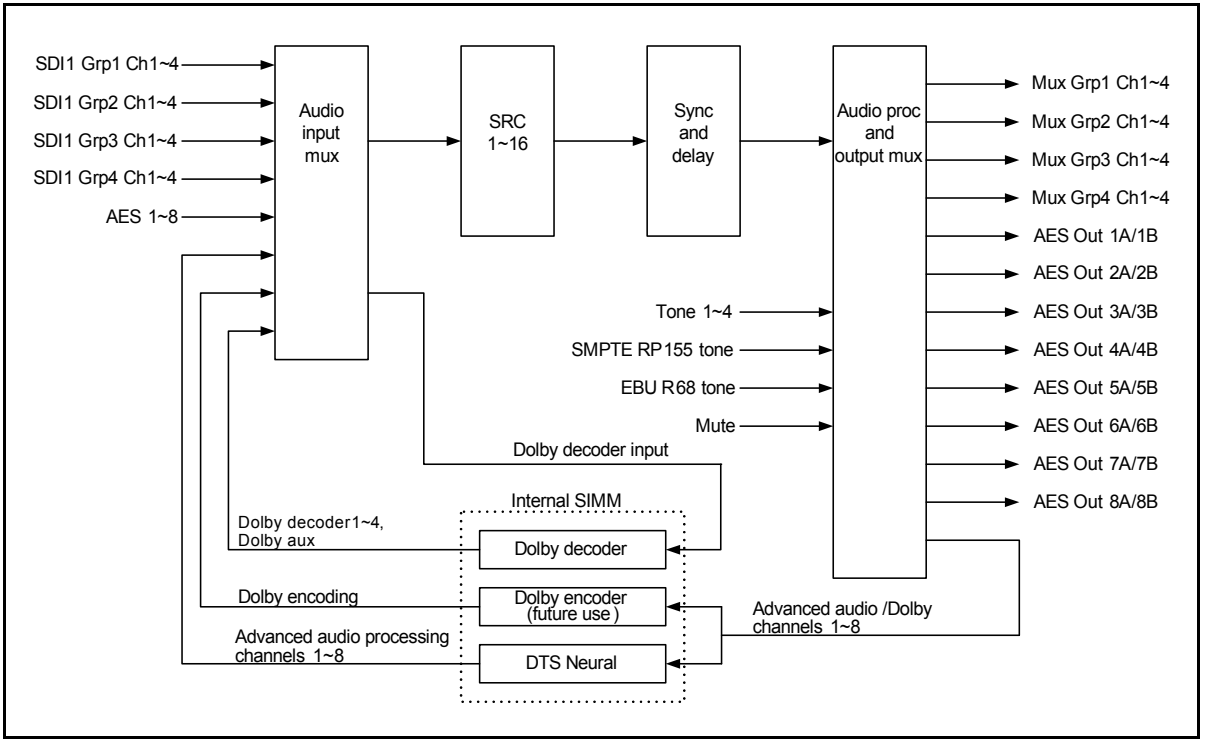


Figure 3-1. Audio Routing

Audio Proc Amp

Gain, bypass, and delay controls are available for the left and right side of each of the processed audio channels.

You can individually adjust the gain and delay of the left and right sides of each channel using the control parameters in the **Gain** and **Delay** sections (**Audio > Processing > Gain** or **Delay**).

The audio can contain non-PCM audio data (in other words, it is indicated by **bit 1** of channel status bits being set for **Non-Audio** instead of **Audio** as shown on page 112). In this case, the sample rate converter must be bypassed to ensure audio integrity. You must individually indicate which sample rate converter or gain to bypass using the **SRCx Gain/Bypass** parameters (**Audio > Input > Bypass > SRC*x* Gain/Bypass**). Select **Manual** in the **SRC/Gain Bypass Mode** to enable these individual controls.

If you set **SRC/Gain Bypass Mode** to **Auto**, the audio will be monitored, and if non-PCM audio data is detected, the sample rate converter for that side of the channel will be bypassed.

In addition to the mute controls that control audio pairs individually, a **Master Mute** control mutes all of the audio channel pairs (**Audio > Processing > Gain > Master Mute**). Also, if the audio source for either side of a given audio channel does not have any incoming audio, the signal will be automatically muted.

Dolby and DTS Neural Audio Processing

For configuration information about Dolby and DTS Neural audio options, see page 115.

Audio Status Parameters

The read-only **Demux Group Present** parameter (in **Audio > Input > Status**) indicates which groups are present in the video input (see Figure 3-2). The "=" indicates no audio is detected for a particular group, while the letter **P** indicates the presence of audio. For example, "= P= =" means the XHD-3903 detects audio in Group 2, but no audio is detected in the other three groups.

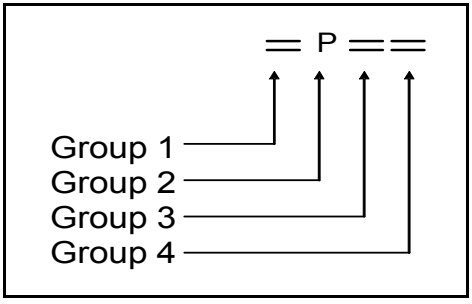


Figure 3-2. Demux Group Present and Demux Group Error

The **Demux Group Error** parameter (also in the **Audio > Input > Status** path) displays errors in the same way. In a string of "=" signs, the letter **E** indicates an error for that audio group.

Demux Channel Pair Present displays the eight channel pairs, with the letter **P** indicating audio presence (see Figure 3-3).

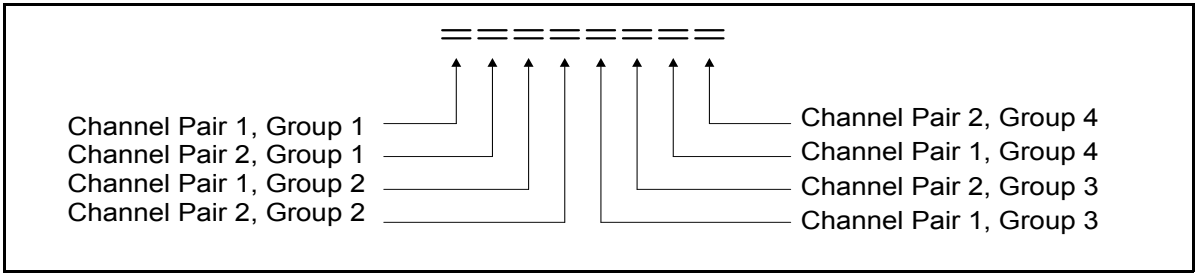


Figure 3-3. Demux Channel Pair Present/Type, and AES Present

Demux Channel Pair Type displays the eight channel pairs, with the letter **A** indicating PCM audio, and the letter **D** indicating non-PCM (data). In **AES Present**, the letter **P** indicates the presence of AES. In **AES Channel Pair Type**, **A** = PCM; **D** = non-PCM (data).

Audio V-Fade

To enable a smooth de-embedded audio V-fade transition while switching between same-standard video sources, set the **Audio V-Fade** parameter to **Enable**.

To have "glitch-free" audio output when you use the audio processing module, or when the user delay is set to different values for different channels, you can adjust the **V-Fade Mute Time**, **V-Fade Time,** and **HD Inter-Group Phase** parameters.

When the **V-Fade Mute** time is changed to less than 0.2 seconds, or the fade time is changed to less than 0.5 seconds, the **HD Inter-Group Phase** must be disabled to avoid an output audio glitch.

DARS Sources

The **DARS Source** parameter (**Reference> DARS Source**) aligns the AES output signal with one of the following options:

- **Auto**

  When set to this option, the module automatically selects the method for aligning with the AES output signal. **DARS Present** and **DARS Locked** parameters provide feedback.

- **Video** (external reference signal)

  The X/Z preamble of the output AES signal aligns with the reference signal as per AES11-1997 and RP 168-2002.

- **DARS**

  The Z preamble of the output AES signal aligns with the Z preamble of DARS.

- **Off** (nothing)

Aspect Ratio Processing

The XHD-3903 offers a highly configurable and comprehensive feature set for processing aspect ratio codes and determining ARC settings. The key benefits are that ARC control and AFD/WSS/VI code insertion control can track, but can also operate independently from each other. In addition, user-defined mapping makes it possible to have complete control over what ARC and code is inserted for any given input of AFD, WSS, or VI code.

Enhanced Aspect Ratio Conversion Control

GPI triggers can modify the aspect ratio conversion control for each mode of operation separately. In other words, you can change the ARC for upconversion without affecting the ARC for down- or crossconversion. For example, if the XHD-3903 is in upconversion mode, the GPI can only change the upconversion ARC setting. This capability makes it possible to control the ARC control for any mode, regardless of which mode is currently active.

A user-selectable ARC setting is provided in the event that AFD, WSS, or VI code disappears. For example, if upconversion is set to follow AFD, but the AFD data isn't available, the user can choose which ARC to implement in its place.

Enhanced AFD/WSS/VI Insertion

GPI triggers can affect the insertion mode and insert specific codes for AFD, WSS, and VI. Each control is separate and independent from the other.

Enhanced Monitoring

GPI outputs on the XHD-3903 can perform the following:

- Monitor for specific input AFD, WSS, and VI codes
- Separately monitor the ARC setting for each conversion mode
- Report the current AFD, WSS, or VI insertion mode in use for a particular type of conversion

Enhanced User ARC Settings

Each user setting includes default AFD, WSS and VI code associated with it. A **Live View** mode makes it possible to see custom ARC adjustments in real time.

Custom Code Map

With the custom code map, you have the ability to precisely specify the ARC setting and code insertion for each input AFD, WSS, and VI code, including reserved codes. You can override only the code insertion, the ARC setting, or both. In addition, you can override specific AFD, WSS, or VI codes and leave the remainder as default.

The map can be used to create custom **AFD In** to **AFD Out** mappings, as well as custom translation from any incoming AFD, WSS, and VI to insert any AFD, WSS, and VI code.

GPI triggers make it possible to switch between standard mapping and custom mapping for each conversion mode separately.

Conversion Mode

Depending on the current input/output video standard setting, the XHD-3903 will be placed in an up-, down-, cross-, or SD-ARC conversion mode. Most of the arcing settings are set per conversion mode. To see the immediate results of ARC settings, the related mode selection must be set to match the current conversion mode. If the mode selection is set to **Current**, the ARC control will always take effect immediately. The conversion mode settings are found in these paths:

- **Video > Processing >ARC > ARC Control > Mode**
- **Video > Processing > ARC > AFD-VI-WSS Insertion > Mode**
- **Video > Processing > ARC > AFD-VI-WSS Custom Mapping > Mode**
- **Other > GPI Input > Event Mode**
- **Other > GPI Output > Event Mode**

The current operating mode is shown in the **ARC Mode Feedback** parameter at **Video > Processing > ARC > Status.**

Aspect Ratio Conversion

For the module output, you can select either a standard ARC setting, or one of your own customized preset ARC settings. There are five customized preset ARC settings for each conversion mode. All settings are maintained separately for each conversion mode.

Selecting a Standard Aspect Ratio

To select a standard aspect ratio for the output image, set ARC Control (found at **Video > Processing > ARC > ARC Control**) to one of the following selections:

- Anamorphic
- 4:3 Pillar Box
- 14:9 Pillar Box
- 16:9 Cut
- 4:3->21:9 Ltr
- 16:9 Letter Box
- 14:9 Letter Box
- 4:3 Cut
- 16:9->21:9 Ltr
- PixelTrue

Pixel True performs no scaling to the input video. Instead, each input pixel is mapped directly to one output pixel. You can use this preset to transport an SD picture embedded inside an HD stream.

Selecting a Custom Aspect Ratio

To select a pre-defined custom aspect ratio for the output image, use one of the options found at **Other > GPI Input > ARC Control**:

- **Custom Up ARC1** to **Custom Up ARC5**
- **Custom Down ARC1** to **Custom Down ARC5**
- **Custom Cross ARC1** to **Custom Cross ARC5**
- **Custom SD ARC1** to **Custom SD ARC5**

Only five options are exposed at one time, based on the mode selected.

Selecting Aspect Ratio Control Following AFD, VI, WSS

An XHD-3903 module can automatically change the aspect ratio, based on the incoming AFD, WSS, or VI control codes. Set the **ARC Control** parameter to one of the following selections (some options are not available, depending upon the selected conversion mode):

- AFD
- AFD - ALTR
- AFD - Custom Map
- VI
- VI - ALTR
- VI - Custom Map
- WSS
- WSS - ALTR
- WSS - Custom Map

The **AFD**, **WSS**, and **VI** selections follow standard ARC recommendations. For instance, selecting **AFD** causes the module to set the ARC setting according to the incoming AFD code, **-ALTR** selections use the alternate ARC method, and **Custom Map** follows the user defined ARC settings for each individual code. See "Active Format Description" on page 51 for more details about custom mapping.

Setting a Custom Aspect Ratio

You can scale and pan the output image to any size and location by using the various parameters of the custom aspect ratio settings. These parameters include: **Horizontal Offset, Vertical Offset, Horizontal Scale, Vertical Scale, Crop Left, Crop Right, Crop Top,** and **Crop Bottom**. These parameters can be individually modified, or batch-modified by recalling a standard aspect ratio or a pre-defined custom aspect ratio.

Setting **Live Edit View** to **On** will actually make the custom aspect ratio settings take effect immediately on the output. This is useful when trying to visually align the various parameters.

Custom aspect ratios are configured by choosing a custom aspect ratio name from **Save ARC**s selections.

All of the related controls can be found at **Video > Processing > ARC > Custom ARC.**

Overscan Mode

The overscan mode is similar to a zoom mode. When enabled, it discards a specified number of lines and columns of pixels around the borders of the input image active picture region before processing.

For example, the active picture region for 525 standard starts on line 20 and ends at line 263 on field 1. Therefore, an overscan setting of one line implies that upconversion starts at line 22 and ends at line 261. In addition to the two discarded lines, the first and last pixel of each remaining line in the active picture region are discarded.

The overscan mode prevents data embedded in the active picture region (usually line 21), such as closed captioning, from being converted.

To enable the overscan mode, scroll to the **Overscan Up, Overscan Down, Overscan Cross,** or **Overscan SD-ARC (Video > Processing > ARC**), and then select the number of rows and columns for cropping.

Using the overscan control you can also discard picture ramp-up and ramp-down regions commonly present in material digitized from analog video sources.

If you are using an XHD-3903 with a downstream keyer, and the keyed image appears with a dark border around it, the border is caused by this shaping of the incoming video frame. Use the **Overscan Up, Overscan Down, Overscan Cross,** or **Overscan SD-ARC** parameters to minimize this border effect.

Active Format Description

Active Format Description (AFD) transmits data in the VANC portion of the SDI signal, enabling both 4:3 and 16:9 television monitors to optimally present video with preset ARC and safe area information. Without AFD, converted video may appear distorted or "cut off" when it appears on different monitors. The XHD-3903 can encode or decode AFD; it can also encode or decode earlier Video Index (VI) and Wide Screen Signalling (WSS) formats.

In addition, the XHD-3903 provides the ability to automatically embed AFD in the event of the loss of an embedded input signal (**Video > Output > Embedder > AFD Control**).

You can control the AFD features using both software parameters and serial connectors found on breakout cables. For more information about serial control, see page 66.

AFD/ARC Alignment

When you use AFD to select your aspect ratio, the XHD-3903 ensures that the AFD codes and associated image will remain in sync. For example, during a hotswitch, the new ARC will only be applied to the new image. There are a few cases which could cause AFD/ARC misalignment:

- The ARC applied is reducing the image vertically such that the new image is less than 60% of the original image.
- The output standard is set to either 1080p/23.98 or 1080p/29.97.

Figure 3-4 shows two comparisons of a signal that is encoded with AFD and without AFD.

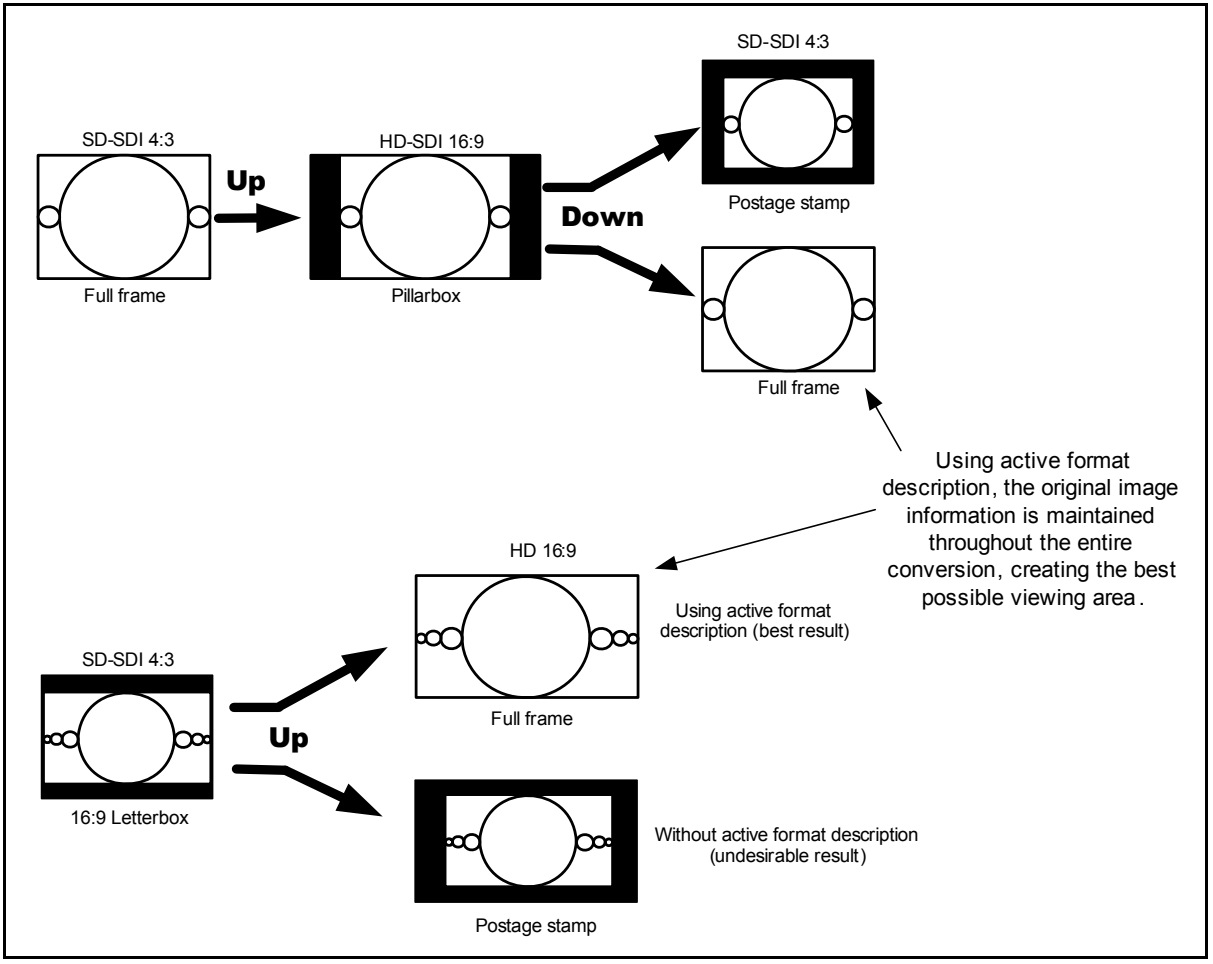


Figure 3-4. AFD/Non-AFD Comparisons

Figure 3-5 shows different applications of AFD insertion and decoding.

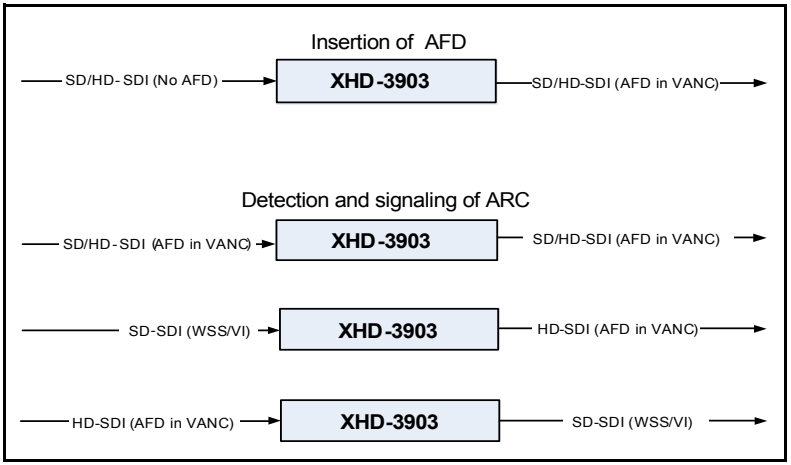


Figure 3-5. AFD Block Diagram

The AFD feature of the XHD-3903 includes nine possible SD-SDI configurations and eight possible configurations in HD-SDI. Figure 3-7 on page 57 describes the SD-SDI AFD configurations; Figure 3-8 on page 58 describes the HD-SDI AFD configurations.

AFD, VI, and WSS Detection

AFD, VI, and WSS data that is embedded in the incoming video can be detected by the XHD-3903, and read from the following parameters found in the **Video > Processing > ARC > Status** path:

- AFD Present
- VI Scan Present
- VI AFD Present
- WSS Present

AFD, VI and WSS Code Insertion

AFD, VI and WSS data can be passed from input to output, or it can be generated manually or automatically by the XHD-3903 module. This function is controlled by the **AFD Insert**, **VI Insert**, and **WSS Insert** parameters located in the **Video > Processing > ARC > AFD-VI-WSS Insertion** path. Table 3-1 lists the function of each of the available options (some options are not available in all conversion modes).

You can also remove WSS from the input video stream. To do this, follow: **Video > Input > De-embedder > Input WSS Remove.**

Table 3-1. AFD, VI and WSS Code Insertion

Option	Details
Pass	The incoming AFD, VI or WSS code is inserted unmodified. (This option is only supported in SD-ARC and crossconversion modes. In up- or downconversion modes, the **Pass** option is equivalent to a loss of code, even when an input code is present. When a loss of code occurs, the module will insert your selection from the **AFD Pass on Loss**, **VI Pass on Loss**, or **WSS Pass on Loss** parameters.)
Remove	No code is generated by the module. The original input code is removed, except for the following: • WSS in line 23 • All codes in proc bypass mode.
Auto	The module generates code automatically and inserts it. The code can be generated in one of the following scenarios: • A standard or custom aspect ratio is selected, and the corresponding AFD, VI, or WSS code is inserted. • The **ARC Control** parameter is set to **AFD, AFD-ALTR, VI, VI-ALTR, WSS**, or **WSS-ALTR**, and the generated output code is based on input code according to the alternate implementations of the standard. • The **ARC Control** parameter is set to **AFD-Custom Map, VI-Custom Map** or **WSS - Custom Map**, and the output code is generated from the custom map settings.
• Custom AFD Map • Custom VI Map • Custom WSS Map	The output code is generated according to the custom map table.
(code list)	The actual code selected is inserted

AFD, VI, WSS Based Aspect Ratio Control

When you set the **ARC Control** parameter to follow the aspect ratio codes (**AFD, AFD-ALTR, AFD-Custom Map, VI, VI-ALTR, VI-Custom Map, WSS, WSS-ALTR,** and **WSS-Custom Map**), the aspect ratio control is based on input AFD, VI, or WSS code. **AFD-Custom Map, VI-Custom Map,** and **WSS-Custom Map** make it possible for you to perform automatic aspect ratio conversions based on the custom defined mapping table. The other options set the ARC to an existing standard. When the input code is missing, the ARC behavior is defined by **Loss of AFD ARC**, **Loss of VI ARC** or **Loss of WSS ARC.** Only one of these options is be enabled at any one time.

Though they are not widely used, some AFD, VI or WSS codes recommend cropping part of the image. When this type of cropping is enabled, the module will take longer to change ARC modes. To create faster ARC transitions, you can disable the cropping using the **AFD Crop Enable** parameter (**Video > Processing > ARC > ARC Control**).

When the ARC is based on AFD, VI, or WSS, and the output standard is SD-SDI, you must set the output aspect ratio (either 4:3 or 16:9) to ensure that the correct mapping table is used. (Follow **Video > Processing > ARC > ARC Control > SD Out Aspect Ratio**.)

AFD, VI, WSS Custom Mapping Configuration

Using the controls in **Video > Processing > ARC > AFD-VI-WSS Custom Map**, you can define a special mapping table other than the one specified by a standard. Given any input AFD, VI or WSS code, you can define the aspect ratio behavior and output AFD, VI and WSS code independently.

Advanced Controls

The de-embedding line controls for VI and WSS are at **Video > Input > De-embedder**. The embedding line number controls for AFD, VI, and WSS are at **Video > Output > Embedder**.

If you are using VI according to the SMPTE Proposed RP-186+ standard as of January 11, 2007, you must ensure you have enabled the standard by following this path: **Video > Output > Embedder > SD Out VI with AFD** (default setting is **Yes**).

At this time, Bar Data and Pan-Scan for VI and AFD are not supported.

AFD Descriptions

In the following pages, Figures 3-7 to 3-12 show the different AFD code descriptions. Comparable WSS and VI templates are included in the SD-SDI descriptions.

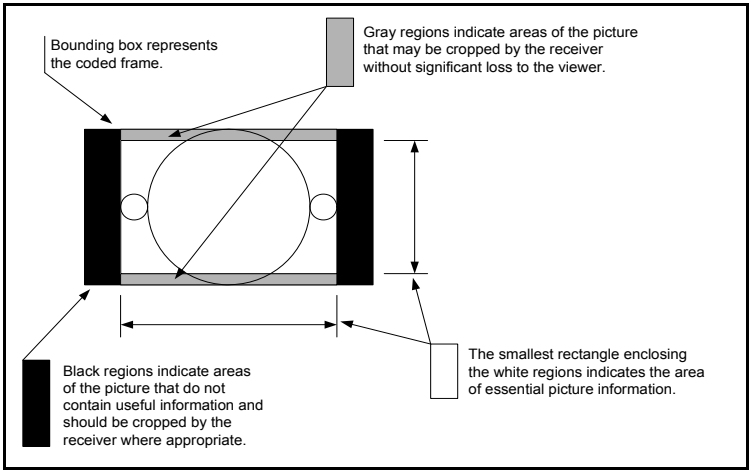


Figure 3-6. Explanation of AFD Diagrams

AFD 4:3 code and description

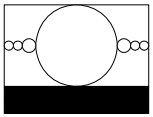
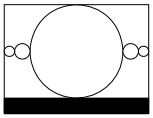
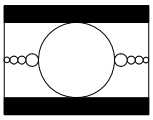
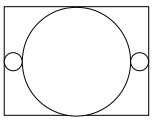
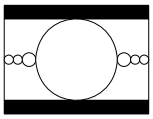
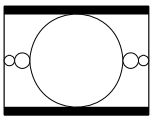
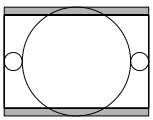
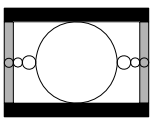
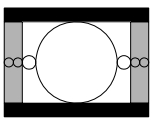
WSS name	AFD and VI Select parameter options	Illustration in a 4:3 coded frame	Description
100 16:9 Top	(4:3) 0010 16:9 Top		Image with a 16:9 aspect ratio as letterbox at the top of a 4:3 coded frame
010 14:9 Top	(4:3) 0011 14:9 Top		Image with a 14:9 aspect ratio as letterbox at the top of a 4:3 coded frame
101 GT 16:9	(4:3) 0100 GT 16:9		Image with aspect ratio greater than 16:9 as a vertically centered letterbox in a 4:3 coded frame
000 4:3 Full	(4:3) 1000 4:3 Full		Image is full frame, with an aspect ratio that is the same as the 4:3 coded frame
011 16:9 CNTR	(4:3) 1010 16:9 L		Image with a 16:9 aspect ratio as a vertically centered letterbox in a 4:3 coded frame
001 14:9 CNTR	(4:3) 1011 14:9 L		Image with 14:9 aspect ratio as a vertically centered letterbox in a 4:3 coded frame
110 4:3 A 14:9	(4:3) 1101 4:3 A 14:9		Image with a 4:3 aspect ratio and with an alternative 14:9 center in a 4:3 coded frame
Not applicable	(4:3) 1110 16:9 LA 14:9		Image with a 16:9 aspect ratio and with an alternative 14:9 center as a vertically centered letterbox in a 4:3 coded frame
Not applicable	(4:3) 1111 16:9 LA 4:3		Image with a 16:9 aspect ratio and with an alternative 4:3 center as a vertically centered letterbox in a 4:3 coded frame

Figure 3-7. 4:3 AFD Descriptions

AFD 16:9 code and description

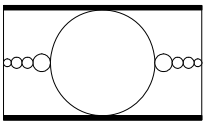
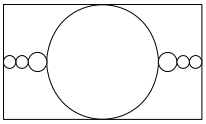
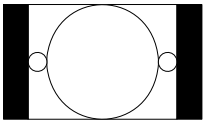
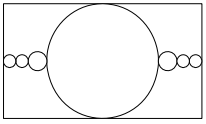
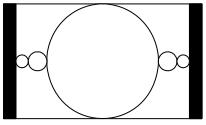
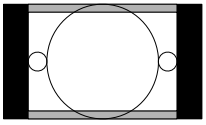
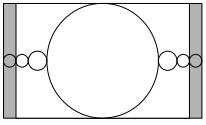
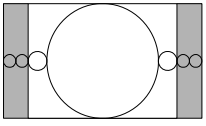
WSS name	AFD and VI Select parameter options	Illustration in a 16:9 coded frame	Description
Not applicable	(16:9) 0100 GT 16:9		Image with aspect ratio greater than 16:9 as a vertically centered letterbox in a 16:9 coded frame
111 Anamorphic	(16:9) 1000 16:9 Full		Image is full frame, with an aspect ratio that is the same as the 16:9 coded frame
Not applicable	(16:9) 1001 4:3 P		Image with a 4:3 aspect ratio as a horizontally centered pillarbox image in a 16:9 coded frame
Not applicable	(16:9) 1010 16:9 Prtctd		Image is full frame, with a 16:9 aspect ratio and with all image areas protected
Not applicable	(16:9) 1011 14:9 P		Image with a 14:9 aspect ratio as a horizontally centered pillarbox image in a 16:9 coded frame
Not applicable	(16:9) 1101 4:3 P A 14:9		Image with a 4:3 aspect ratio and with an alternative 14:9 center as a horizontally centered pillarbox image in a 16:9 coded frame
Not applicable	(16:9) 1110 16:9 A 14:9		Image with a 16:9 aspect ratio and with an alternative 14:9 center in a 16:9 coded frame
Not applicable	(16:9) 1111 16:9 A 4:3		Image with a 16:9 aspect ratio and with an alternative 4:3 center in a 16:9 coded frame

Figure 3-8. 16:9 AFD Descriptions

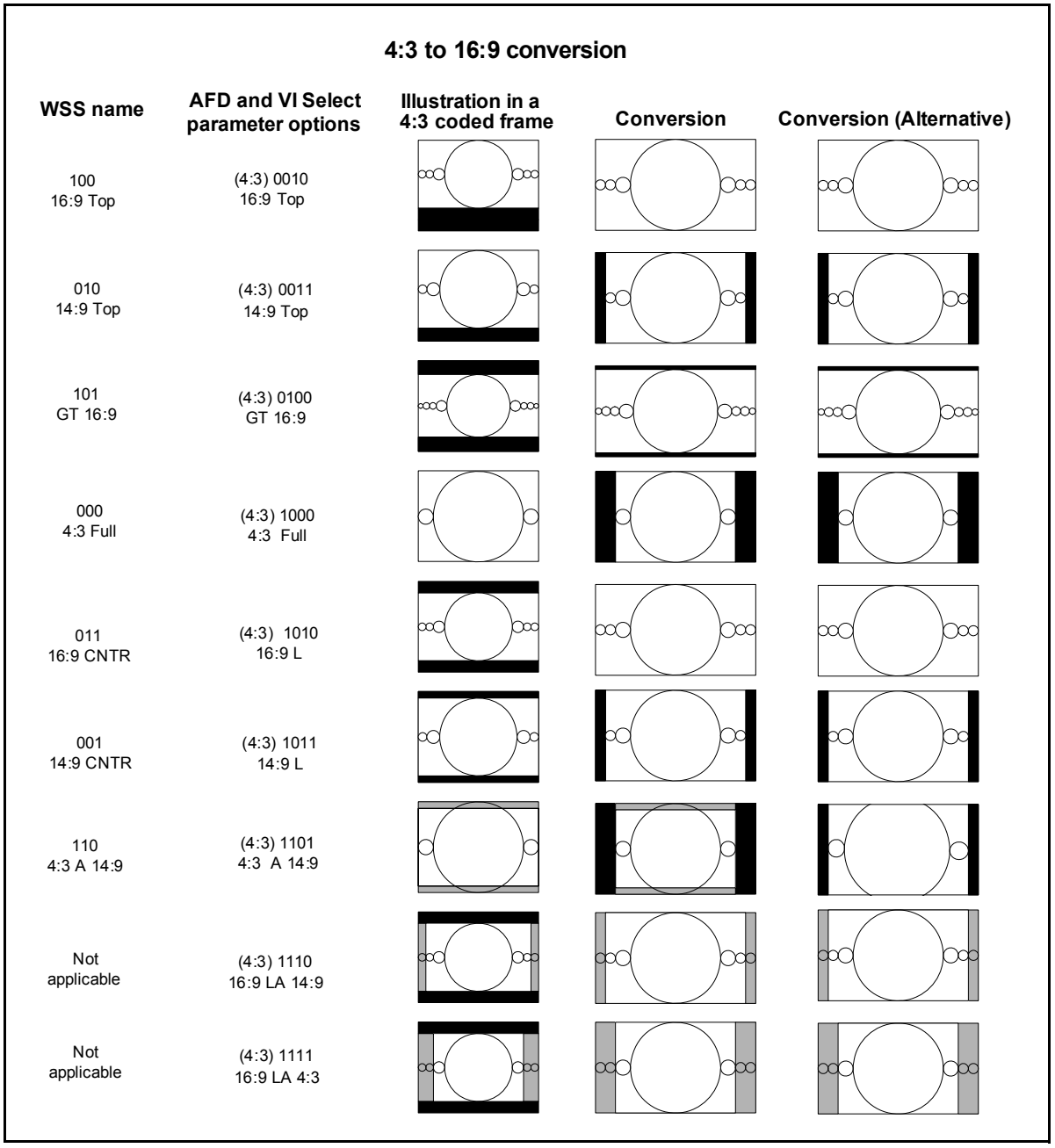


Figure 3-9. 4:3 to 16:9 Conversion

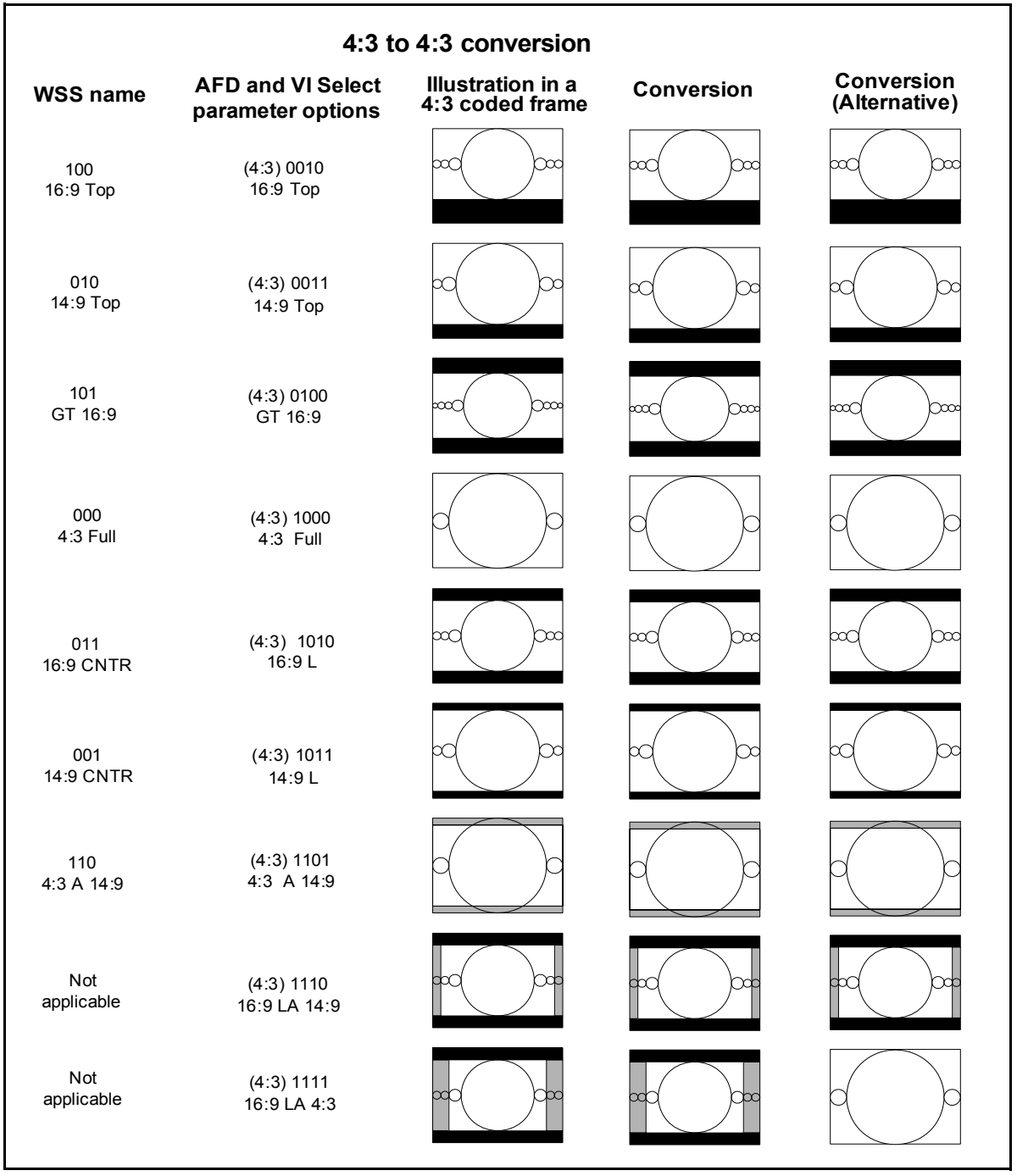


Figure 3-10. 4:3 to 4:3 Conversion

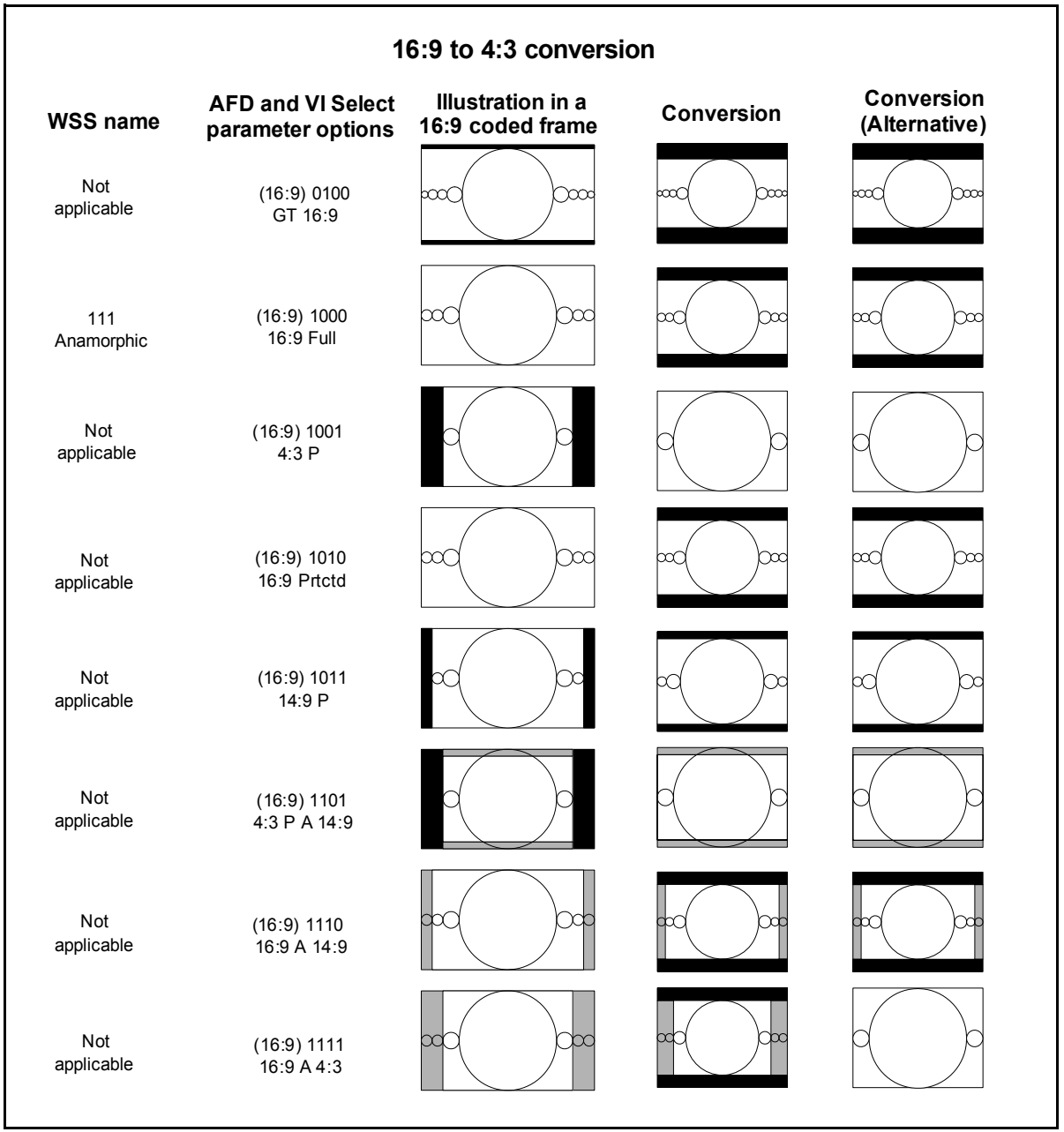


Figure 3-11. 16:9 to 4:3 Conversion

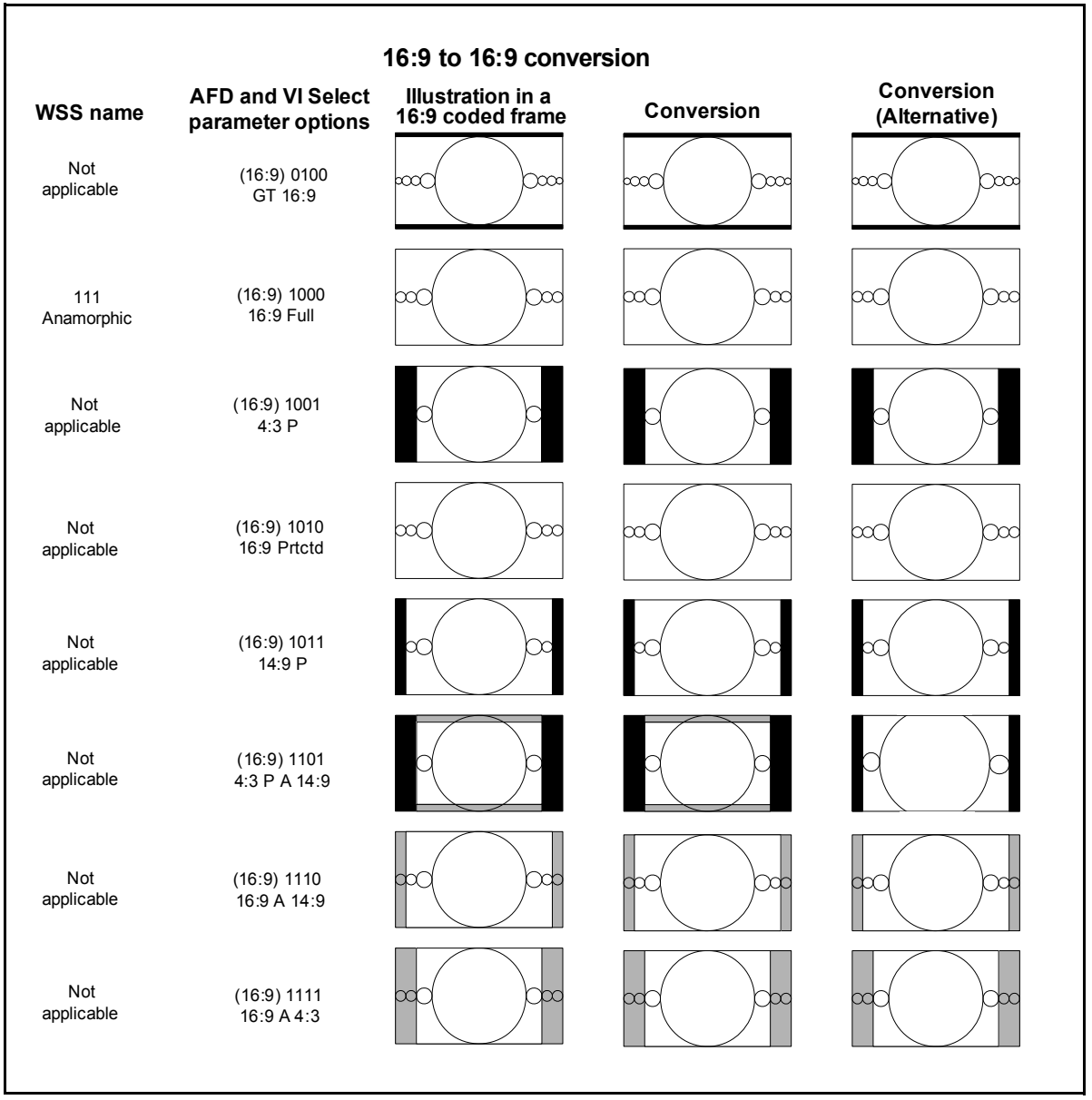


Figure 3-12. 16:9 to 16:9 Conversion

I-Wings Integrated Sidebar Content Insertion

I-Wings integrated content insertion is a software key option that makes it possible to key HD- or SD-SDI content into the sidebar portion of the output image raster using the module's internal keyer. This option is useful, for example, in applications where upconversion of SD-SDI 4:3 content is being performed, and insertion of additional content is required in the 16:9 upconverted image raster's sidebars. (See Figure 3-13 on page 64.)

To set up the I-Wings feature, follow these steps:

1. Ensure that SDI 1 and SDI 2 inputs have compatible frame rates.

   An **SDI 1 Standard Mismatch** or **SDI 2 Standard Mismatch** alarm is activated if the two inputs are not compatible. In that event, the module automatically generates a black background, replacing the SDI 2 input until a valid input is received.

2. Set the ARC parameters as required, found in this path: **Video > Processing > ARC**.

   I-Wings will only appear in the background area. Therefore, ARC settings that are anamorphic will block I-Wings from appearing.

3. Select **SDI 1-IW** in the **Primary Video Source** parameter (**Video > Output > Primary Video Source**).

ARC-adjusted 4:3 program

Anamorphic 16:9 sidebar content

Program output with I-Wings sidebar content

Figure 3-13. Creating the I- Wings Effect

Fast-Switching Capability

When XHD-3903 modules are used to provide HD-SDI sources to a switcher, you can set the module to one of the fast switching options in the **Primary Video Source** parameter. (Fast switching is available when you have purchased "–UC" or "-UCD" capability for your XHD-3903 module.)

In the fast-switching mode, the module transitions between SD-SDI and HD-SDI inputs in eight frames or less, providing ready access to converted HD signals for the switcher. (See Table 3-2 on page 66 for a list of equivalent times in milliseconds.)

To achieve this response time, each XHD-3903's HD-SDI input standard must be fixed ahead of time. The module will accept one SD standard and a frame rate-compatible HD standard. The input auto-detection feature does not operate in this mode.

Follow these steps to configure the fast-switching mode:

1. In the **Primary Video Source** parameter (**Video > Output)**, select either **SDI1-FAST-SW 25/50** or **SDI1-FAST-SW 29/59**.
2. Select the correct input standard in **Fast Switch Standard** (**Video > Output**)
3. Set the **Input Frame Delay** (**Video > Processing > Synchronizer**).

   The time transition between input standard changes is shown in Table 3-2 on page 66 when the **Input Frame Delay** is set to **0**. Increasing the **Input Frame Delay** results in a longer transition time. The value set in this parameter is added to the eight frames that result from the default setting of **0.**
4. Connect an external reference to the module.

   The module defaults to **External Reference.**

When the XHD-3903 is operating in the fast-switching mode, 720p and 1080i input standards are offered (the related SD-SDI standards are implicit). If the module receives a standard that has not been selected, it treats the signal as invalid, and the module reverts to its loss-of-video setting (**Video > Output > Primary LOV Mode**). In this condition, the **SDI1 Std Mismatch** parameter reports an **Unknown/invalid** response and activates a major alarm.

In fast-switching mode, the **Background Color** defaults to **Black;** other colors are disabled.

Aspect ratio settings for the HD-SDI output are preconfigured for the HD-SDI switcher standard. Information about setting the ARC output begins on page 46.

Table 3-2. Minimum Transition Delay

Output Format	Transition Time (Milliseconds)
525	266.9
720p/59	200.2
1080i/59	266.9
1080p/29	266.9
1080p/23.98	333.6
1080p/59	200.2
625	320
720p/50	240
1080i/50	320
1080p/25	320
1080p/50	240

Serial Control Information

To communicate using serial control, use a hyperterminal application, ensuring you have enabled the echo function. (Version 1.14 firmware must be installed on the XHD-3903 module). Either of the standard breakout cables shipped with the XHD-3903 will provide the DB-9 pinouts. Because each facility uses different configurations, connecting cables are not provided with the XHD-3903 package.

NOTE

Serial control on the XHD-3903 does not support non-printing characters; control keys such as **Backspace** will not function.

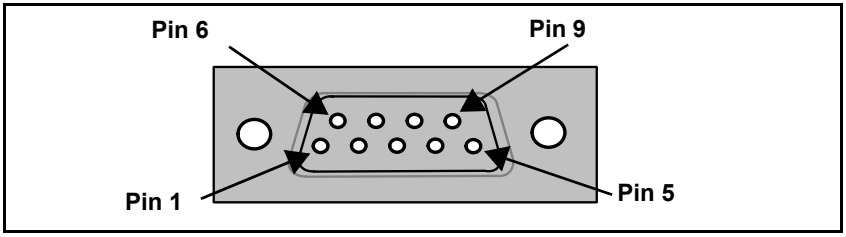


Figure 3-14. Breakout Cable DB-9 Pin Numbering

Table 3-3. DB-9 Pinouts

DB-9 Connector	Pin Number	Function
RS-232	2	Tx - (Tx)
	3	Rx + (Rx)
	7	Tx +
	8	Rx -
	Metal body	Ground

Table 3-4. Serial Port Specifications

Item	Specification
Supported Standard	RS-232
Baud rate	115200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

Table 3-5. Serial Control Commands

Command	Comments
init	The first command; must be executed before any other control command can be used. Upon successful execution, the XHD-3903 sends out a **Connection established** message.
release	Releases the connection established by **init** command; upon successful execution, the XHD-3903 sends out **Connection closed** message.
setafdmode	Controls the output AFD code. This command should be called as **setafdmode bbbb**, where **b** is either **0** or **1**, and **bbbb** in combination should represent a valid AFD code. **Note:** This control result will be reflected on the CCS control parameters **AFD Control** and **AFD Select**. **AFD Control** is set to **Insert Custom**, and **AFD Select** is set to the code of **bbbb**. The output selected for the insertion is indicated by **z**.
getafdmode	*Gets* the current output AFD code. This command should be called as **setafdmode**. The card will return current AFD code in **bbbb** format if it is inserting some AFD code; it will reply **Not inserting AFD code** if it is not inserting any code.
boardstatus	Depending on the module status, the XHD-3903 will reply with one of the following: • Major and Minor alarm on • Major alarm on • Minor alarm on • Good
help	Prints out all the supported commands through this port.

Table 3-5. Serial Control Commands *(Continued)*

Command	Comments
enumset [CCS Param - ID],[Enum Index]	Sets an enumeration parameter on the XHD-3903. **Arguments** • **CCS Param - ID** is the parameter ID specified in the *XHD-3903 Parameter List*, supplied with this document • **Enum Index** is the enumeration index value for the parameter specified in the *XHD-3903 Parameter List*. **Return Value** • **ok** - Parameter set command successfully sent • **error** - Parameter set command failed to send **Example** Here is a sample parameter definition from the *XHD-3903 Parameter List:* *ARC Preset DOWN [CCS-P Parameter ID = 357]* Description: Selects a preset ARC configuration. Navigation Path:/ Video/Processing/ARC Type: enumeration Access: read/write Default: 0 Enum Values: 0="Anamorphic" ,1="4:3 Pillar Box" ,2="14:9 Pillar Box" ,3="16:9 Cut" ,4="4:3->21:9 Ltr" ,5="16:9 Letter Box" ,6="14:9 Letter Box" ,7="4:3 Cut" ,8="16:9->21:9 Ltr" ,9="PixelTrue" ,10="Preset 1" ,11="Preset 2" ,12="Preset 3" ,13="Preset 4" ,14="Preset 5" ,15="Preset 6" ,16="Preset 7" ,17="Preset 8" ,18="Preset 9" ,19="Preset 10" ,20="AFD" ,21="AFD - ALTR" ,22="VI" ,23="VI - ALTR" ,24="WSS" ,25="WSS - ALTR" ,26="Custom" To set the above parameter to **Anamorphic** using the **enumset** serial command, the following command can be issued: **enumset 357,0** A return value of **ok** is then returned upon the successful execution of the above command.

Table 3-5. Serial Control Commands *(Continued)*

Command	Comments
intset [CCS Param - ID],[Integer value]	Sets an integer parameter on the XHD-3903. **Arguments** • **CCS Param - ID** is the parameter ID specified in the *XHD-3903 Parameter List*, supplied with this document • **Integer value** is the integer value specified in the *XHD-3903 Parameter List's* **Valid Range** (supplied with this document), and does not take precision into account. This number value can be preceded by a '**-**' to indicate a negative number. **Return Value** • **ok** - Parameter set command successfully send. • **error** - Parameter set command failed to send. **Example** Here is a sample parameter definition from the *XHD-3903 Parameter List:* *Horz. Offset [CCS-P Parameter ID = 274]* Description: Sets the ARC horizontal offset. Navigation Path:/ Video/Processing/ARC Type: integer Access: read/write Valid Range:- 800 to 800 with units of **%** and precision of 1 decimal places Default: 0 To set the above parameter to **-25.5%** using the **intset** serial command, the following command can be issued: **intset 274,-255** A return value of **ok** is then returned upon the successful execution of the above command.

Table 3-5. Serial Control Commands *(Continued)*

Command	Comments
strset [CCS Param - ID],[String value]	Sets a string parameter on the XHD-3903. **Arguments** • **CCS Param - ID** is the parameter ID specified in the *XHD-3903 Parameter List*, supplied with this document • **String value** is an ASCII character string value of the parameter. The character string must be preceded and terminated by a **""** character. **String value** can not exceed 64 characters. **Return Value** • **ok** - Parameter set command successfully send. • **error** - Parameter set command failed to send. **Example** Here is a sample parameter definition from the *XHD-3903 Parameter List:* *File Path Select [CCS-P Parameter ID = 440]* Description: Selects the logo image to load. Navigation Path:/ Video/Processing/Logo Type: string Access: read/write Default: To set the above parameter to **logo1.mg2** using the **strset** serial command, the following command can be issued: **strset 440, "logo1.mg2"** A return value of **ok** is then returned upon the successful execution of the above command.

Closed Captioning and DVB Teletext Captioning

Although North America has dedicated standards for closed captioning of video (EIA-608 and 708), many countries in Europe and elsewhere have not yet adopted formal standards. For these countries, closed captioning is part of the DVB Teletext System as described in ITU-R BT-653-3. These specifications define all Teletext Systems (Systems A, B, C, D) used in the world and are also known as the World System Teletext (WST). A Teletext system is made of several pages of various data information and CC data is described in one these pages. System B is used in Australia, the UK, and Germany, among other countries.

Australian closed captions are inserted on line 21/334 in analog PAL broadcast signals, as per the ITU-R BT-653-3. When analog PAL is produced or converted to SDTV (625 digital), a digitized version of the closed captioning appears on line 21/334 (in the same way line 21 on NTSC signals is digitized and appears on the line 21 of SD-SDI signals). The ITU-R BT-653-3 document proposed by Free TV Australia indicates how to carry this CC data into the VANC area of SD-and HD-SDI signals by use of the SMPTE 334M VANC embedding protocol. For digital broadcasting, Australia intends to use the ETSI EN 300 472 standard that specifies the conveyance of ITU-R System B Teletext in DVB bit streams.

Setting Closed Captioning and Teletext

To make changes to the default CC and Teletext settings, use the **Closed Captioning/Teletext Embed** and **Closed Captioning/Teletext Embed Line** parameters from the path **Video > Output > Embedder** path. To verify the presence of the embedded CC, use the **Input Closed Captioning/Teletext Present** parameter (**Video > Input > De-embedder** path).

The DVB Teletext feature is available when you purchase the **XHD3903-OPT-TT** software key option. See page 24 for more information.

Generic VANC Data Passing

The XHD-3903 can pass user-defined VANC packets. These VANC data packets are identified by their DID/SDID. Controls for **Data DID, Data SDID, Data Pass**, and **Data Embed Field** are located at **Video > Output > Embedder**. Currently, the XHD-3903 supports one unique combination of DID/SDID packets to pass from HD-SDI standard input to HD-SDI standard output

Examples

- To pass NBC Namedropper, make the following settings:
  - **Data DID** to **52**
  - **Data SDID** to **0F**
  - **Data Pass** to **Pass**
  - **Data Embed Field** to **1st Field**
  - **Data Embed Line** to **11**
- To pass CBS Lidia data, make the following settings:
  - **Data DID** to **54**
  - **Data SDID** to **22**
  - **Data Pass** to **Pass**
  - **Data Embed Field** to **1st Field**
  - **Data Embed Line** to **9**

GPI Inputs and Outputs

The XHD-3903 module provides four GPI inputs and four GPI outputs for automation. These are open collector style inputs with approximately 10 KΩ pull-ups to +5V. This means that you can use *contact closure-to-ground* switches to control these GPI inputs.

The GPI input actions are controlled by parameters in **Video > Other > GPI Input**.

GPI inputs make it possible to control the ARC being used for a particular conversion mode, as well as the AFD, WSS or VI code to be inserted. The read-only **GPI Input Status** parameter provides current information. All GPI events occur in the order they are triggered and will override older events.

The GPI output actions are controlled in the **Video > Other > GPI Output** path.

GPI outputs can reflect the state of the current ARC being used, or can be triggered on a specific input AFD, WSS or VI code.

The current GPI output active status can be read from the **GPO Output Status** parameter.

Custom GPI Events

The Custom GPI feature on the XHD-3903 makes it possible for you to configure GPIs so that certain combinations of GPI input levels can change a parameter to a specific value. The GPI output state can be determined by changes to certain parameter values.

To set up custom GPIs, the related GPI event selections have to be set to **Custom GPI** at:

Other > GPI Input > Event

Other > GPI Output > Event

In addition, you must write a custom GPI script and enter it into the follow parameters:

Other > Custom GPI > Custom Input Script

Other > Custom GPI > Custom Output Script

NOTE

When you select a Custom GPI input or output, the **GPI Trigger** control is disabled for that specific GPI. Also, the **GPI Input Status** and **GPI Output Status** parameters will not report the portion of the the field that represents custom GPIs.

Writing the Custom GPI Script

GPI input scripts and GPI output scripts are created from several statements. Each statement consists of one condition and several assignments:

IF [condition] **THEN** [assignment] [assignment] ...

In each statement, if the condition is satisfied, the assignments will take effect. A condition is created from one or more comparisons.

In a GPI *input* script, the comparison could be either **GPI*x* == 0** or **GPI*x* == 1**, where ***x*** is in the range of [0, number of GPI inputs - 1], and **0** represents low and **1** represents high.

In a GPI *output* script, the comparison is in the format of **PARAM[*x*]==*y***, where ***x*** is the ID of a device parameter and ***y*** is a value for that parameter.

The script can include any of the following comparisons:

- == equal
- > greater than
- < less than
- >= greater or equal than
- <= less than or equal than
- != not equal

Comparisons can be **AND**ed together using **&&**, and then can be **OR**ed together using **||** to form a condition. The **AND** operation always has precedence over the **OR** operation when **AND** and **OR** both exist in a condition.

GPI Input and Output Examples

The following GPI input script condition

GPI2==1 || GPI0==0 && GPI1==1 || GPI0==1

should be interpreted as

GPI2==1 || (GPI0==0 && GPI1==1) || GPI0==1

And the following GPI output script condition

PARAM[400]==5 || PARAM[400]==3 || PARAM[400] >= 8 && PARAM[400] <= 12

should be interpreted as

PARAM[400]==5 || PARAM[400]==3 || (PARAM[400] >= 8 && PARAM[400] <= 12)

The assignment is always done using the **=** symbol

In a GPI input script, an assignment is written as **PARAM[*x*]=*y***, where ***x*** is the ID of a device parameter and ***y*** is a value for that parameter.

In a GPI output script, an assignment is written as **GPO*x*==0** or **GPO*y*==1**, where ***x*** and ***y*** is in the range [0, number of GPI outputs -1] and **0** represents low and **1** represents high.

GPI In Example

IF GPI0==0 && GPI1==0 THEN PARAM[755]=2

IF GPI0==0 && GPI1==1 THEN PARAM[755]=3

IF GPI0==1 && GPI1==0 THEN PARAM[755]=10

IF GPI0==1 && GPI1==1 THEN PARAM[755]=19

In the above example, if the level of GPI input **0** and GPI input **1** match an entry in the following table, the parameter with **755** as its ID will be assigned to the corresponding value:

Table 3-6. GPI Input Parameter Example

GPI Input 0	GPI Input 1	Value of Parameter with ID of 755
Low	Low	2
Low	High	3
High	Low	10
High	High	19

GPI Output Example

IF PARAM[754]==2 THEN GPO0=0 GPO1=1

IF PARAM[754]==3 THEN GPO0=1 GPO1=0

IF PARAM[754]==7 THEN GPO0=1 GPO1=1

IF PARAM[754]<2 || PARAM[754] > 3 && PARAM[754]<7 THEN GPO0=0 GPO1=0

In the above example, if the parameter with 754 as its ID has a current value that matches one of the entries in the following table, the levels of GPI output **0** and GPI output **1** level will be assigned to the corresponding values:

Table 3-7. GPI Output Parameter Example

Value of Parameter with ID of 754	GPI Output 0	GPI Output 1
0	Low	Low
1	Low	Low
2	Low	High
3	High	Low
4	Low	Low
5	Low	Low
6	Low	Low
7	High	High

The maximum length of a script is 500 characters.

Video Keying

The video keying feature is activated by following **Video > Output > Config > Video Keying**. When enabled, the key image appears on the SDI 2 output. The **On Screen Display** feature (**Video > Output > Config > On Screen Display)** also appears on the SDI 2 output when it is enabled.

3G HD-SDI Settings

If your module is a **Rev 2** version, you must select **Dual Slot** in **Other > Module Type Set** to activate the 3G capability. To confirm your version, check the module identification number as shown in Figure 3-15. If your module is **Rev (2)**, you will need to select the **Dual Slot** option.

When you changing the **Module Type Set** parameter to **Dual Slot**, you must wait 30 seconds, and then re-power the module.

CAUTION

If your module is Rev **A**, do *not* change the **Module Type Set** parameter. If your module is Rev **2**, do not change **Module Type Set** to **Dual Slot** if the card does not have an AES or 3 G upgrade kit installed. The module may be damaged if you do not follow these steps.

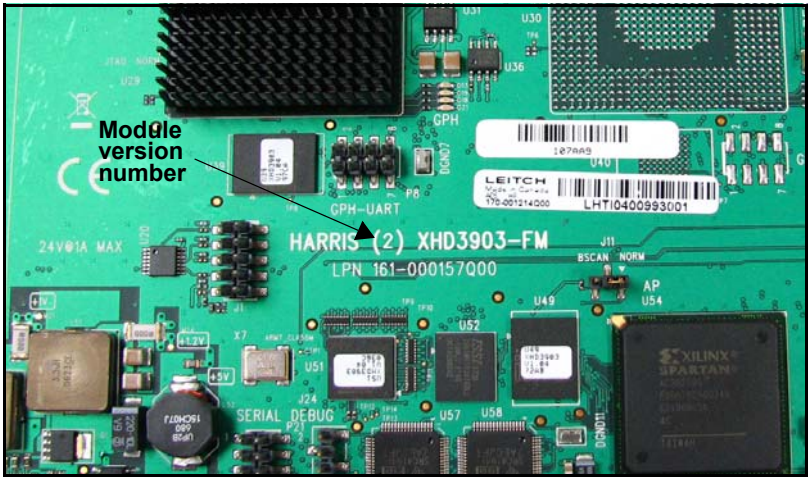


Figure 3-15. Module Version Number

Chapter 4

Operation

Overview

Installation, navigation, configuration, and setup information is included in the *NEO FR-3901, FR-3903, and FR-3923 Mounting Frames Installation and Operation Manual*. You can access this and other related documents by visiting our website.

This chapter describes how to operate the XHD-3903 modules using card-edge controls and CCS-enabled devices and software.

NOTE

To monitor and control XHD-3903 modules using CCS Navigator, you must first upgrade your NEO frame resource module software to version 4.0 or higher. In addition, firmware upgrades to the XHD-3903 module require the use of Navigator 4.2.

The following topics are found in this chapter:

Selecting the Conversion Mode

Each module of the XHD-3903 series includes the same core feature set, including closed captioning transcoding, and transparent handling of four groups of embedded audio. Table 4-1 lists the input and output standards of the different XHD-3903 variations.

Table 4-1. Conversion Modes

Converters	Input	Output
XHD-3903-A Standard Definition Aspect Ratio Converter	SD-SDI • 525i • 625i	SD-SDI • 525i (from 525i) • 625i (from 625i)
XHD-3903-D Downconverter	HD-SDI • 1080i • 720p • 1080p • 1080psf	SD-SDI • 525i • 625i
XHD-3903-UC Up- and Crossconverter	SD-SDI • 525i • 625i HD-SDI • 1080i • 720p • 1080p • 1080psf	HD-SDI • 1080i • 720p • 1080p
XHD-3903-UCD, Up-, Cross-, and Downconverter	SD-SDI • 525i • 625i HD-SDI • 1080i • 720p • 1080p • 1080psf	SD-SDI • 525i • 625i HD-SDI • 1080i • 720p • 1080p

Cross-Functional Parameter Changes

Each different conversion mode enables, disables, or changes the options that are available in the parameter lists. In some cases, the range of certain numeric values will be smaller, for example, between the upconversion and crossconversion modes. In other cases, some options will not be functional, or previously unavailable options will become visible. These changes reflect the different specifications of the various SD and HD-SDI standards, and are not indications of flaws in the control interface.

Operation Notes

CAUTION

Failure to observe these Operation Notes will result in accidental changes to the module's parameter settings.

When using the XHD-3903 modules, observe the following operation notes:

- If you change parameters within 16 seconds after the XHD-3903 module starts up, your changes will not be saved. Parameter changes that you make *after* this 16-second delay will be saved if the module loses power. You must restart the module to restore these saved settings.
- Although the effect of a parameter change may appear to be immediate, the module requires 20 seconds to save the latest change. If another change is made during these 20 seconds, the first parameter change and the second parameter change will not be saved until 20 seconds after the second parameter change. There is no limit to the number of changes that can be made within 20 seconds of each other. However, none of these changes will be saved until 20 seconds after the last parameter change.
- XHD-3903 modules have two SDI outputs. The SDI 1 output always carries program output. You can configure the SDI 2 output to carry either the same signal as the SD1 output (with or without an output key signal for downstream keying and on-screen display of parameters) or a frame sync signal. Depending on the configuration and availability of the input signals, the output video timing can be derived from input video, timing reference input, or it can be free-running within the tolerance allowed by the applicable standards.
- Changes in some parameters will cause additional changes in other parameters, or lock them out entirely. See "Cross-Functional Parameter Changes" on page 81 for more information.

Video Synchronization and Delay

The XHD-3903 modules provide conversion between HD- and/or SD-SDI standards. During conversion, there is a certain amount of delay added to the primary SDI input signal in the main video processing path. The amount of delay to the primary signal is dependent upon the type of processing applied to it.

In the routing mode, the selected SDI input signal is frame-synchronized to the genlock reference (see page 15). A user delay control is available to compensate for other external processes. The user delay interface provides a delay range between 0 to 8 frames in one-frame increments.

When the I-Wings feature is in use, the SDI 2 signal does not enter the frame synchronizer (see page 15). Therefore, the user delay interface is not available for the SDI 2 input. However, this signal *is* synchronized to the genlock reference inside the scalar, and thus, upstream synchronization of the SDI 2 signal is not required.

Additionally, an external DARS reference input (AES interface) provides audio timing synchronization when the module embeds the audio streams into the SDI program output.

Video Frame Synchronizer

Primary Frame Sync

The video frame synchronizer (frame sync) on the primary SDI input provides synchronization using the **Reference Source** parameter (**Reference > Reference Source**). The default option in this parameter is the **External Reference** sync mode. SDI input timing is provided by the **Delay** option.

When the **External Reference** option is selected, the frame synchronizer automatically detects and locks to the genlock reference signal for video timing alignment. The frame synchronizer either drops or repeats video frames to achieve synchronization.

The XHD3903 module supports the following reference signals:

- NTSC/PAL-M, TLS1080i/59, and TLS1080p/29
- PAL-B, TLS1080i/50, and TLS1080p/25
- 720p59 (when the module's output is 1080p59, 1080p59 Level B, or 720p59)

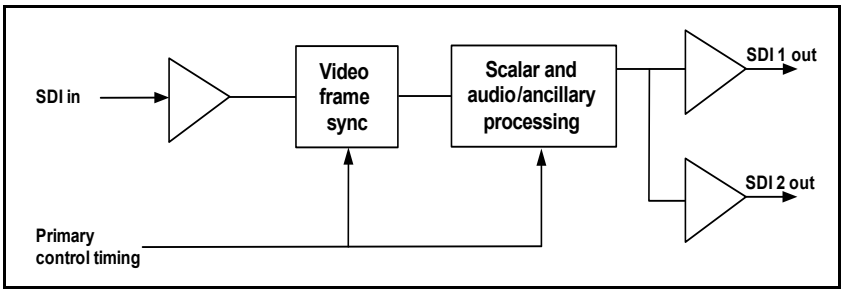


Figure 4-1. SDI 2 Scalar Output

Secondary Frame Sync

When the XHD39OPT-2FS softkey is installed, frame sync can be output to the SDI 2 connector. To enable the frame sync on SDI 2, select **Video > Output > Embedder > SDI Source > FS**. This enables the horizontal and vertical phase adjustments that are found at: **Video > Processing > Sync**. Secondary timing control does not affect SDI 1 output timing. The secondary frame sync only provides a Level A output, even if the input is Level B.

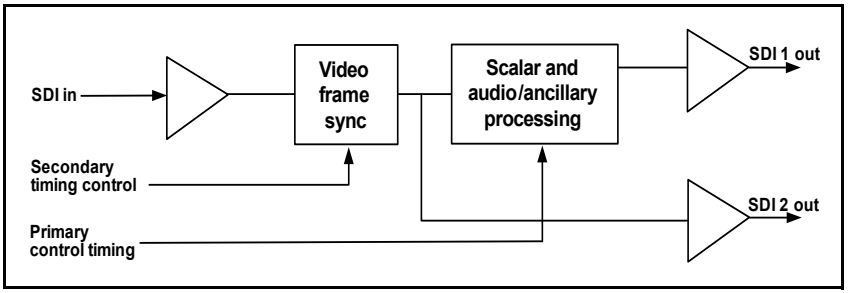


Figure 4-2. SDI 2 Frame Sync Output

Delays

The total propagation delay is the result of adding frame sync, SD user frame delay, the SD-ARC scalar value, and the SD user output delay.

The values shown in Table 4-2 and Table 4-3 represent the scalar only. These are also the delay values through the entire product if the following conditions are true:

- The module is in **Delay** mode (**Reference > Reference Source)**.

- The **Output Vertical Phase** and **Output Horizontal Phase** controls (**Video > Processing > Synchronizer**) are set to **0**.
- The **Input Frame Delay** (**Video > Processing > Synchronizer**) is set to **0** (maximum setting = 12 frames).

Using the *sync* mode (**Reference > Reference Source > Free Run** or **External Ref)** adds 0 to 1 frame to the delay.

Also see page 124 for information about propagation delays involving Neural audio options.

Table 4-2. Minimum Propagation Delays, 59.94 Hz

	Output (ms)					
Input	**525**	**720p/59.94**	**1080i/59.94**	**1080p/23.98**	**1080p/29.97**	**1080p/59.94**
525	33.4	33.4	33.4	33.4	33.4	33.4
720p/59.94	16.7	16.7	16.7	0	0	16.7
1080i/59.94	33.4	33.4	33.4	16.7	16.7	33.4
1080psf/23.98	41	41	41	41	41	41
1080p/23.98	41	41	41	41	41	41
1080p/29.97	33.4	33.4	33.4	33.4	33.4	33.4
1080p/59.94	16.7	16.7	16.7	16.7	16.7	16.7

Table 4-3. Minimum Propagation Delays, 50 Hz

	Output (ms)				
Input	**625**	**720p/50**	**1080i/50**	**1080p/25**	**1080p/50**
625	40	40	40	40	40
720p/50	20	20	20	0	20
1080i/50	40	40	40	20	40
1080p/25	40	40	40	40	40
1080p/50	20	20	20	20	20

Audio Synchronization and Delay

Audio is synchronized to video by applying the same frame sync delay and converter delay to the audio associated with the given video path.

By changing the **Input/Output Delay SRC *x*** parameter (**Audio > Other > I/O Delay Config > Input/Output Delay SRC x)**, you can turn on or off the frame sync and processing delay. This triggers the audio to resynchronize with the video. (The two options are **FS and Converter Delay** and **None**.) When enabled, the audio synchronization will *not* occur immediately. Approximately 10 seconds per frame of delay are needed in order to prevent any audio "glitch."

You can add additional delay using the **Delay 1 to 32 (Channels 1 to 16 Left and Right)** parameters, found in the **Audio > Processing > Delay** path.

This processing delay is always applied *in addition* to the audio synchronization and will cause an audio glitch to occur when the processing delay changes.

Integrated Graphics Storage and Playout

The optional XHD3903-OPT-GFX logo generator and inserter provides on-demand insertion of pre-defined static SD-SDI and HD-SDI logo images.

Logos used by the XHD-3903 must be created or saved in the .mg2 file format, and initially stored on a micro-SD card that is inserted into the slot located at the card edge of the module. (LogoCreator software is provided as a utility to convert existing files to .mg2). The process is similar to the loading of logos into an X75, with a few exceptions:

- The XHD-3903 uses a microSD card* instead of an SD card.
- The files must be loaded onto the card directly at your PC workstation.

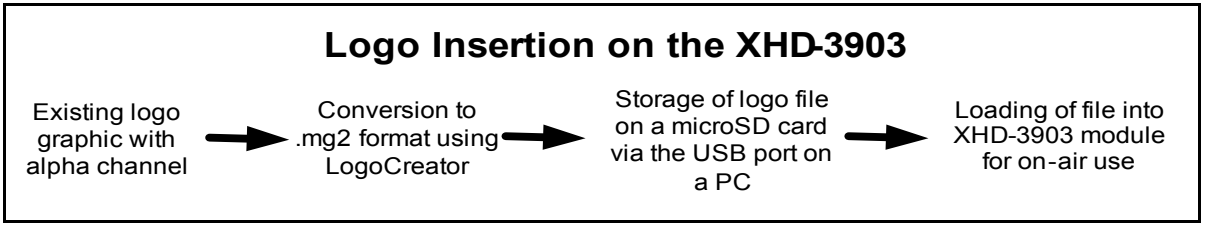


Figure 4-3. Progression of Logo to On-Air Signal

The files that you use as logos must be selected according to the video output standard set on the XHD-3903 (**Video > Output > Output Video Std Select**). When the output standard changes on the module, the XHD-3903 automatically loads files that use the selected output standard.

* SanDisk 512 MB and 1 GB microSD cards are supported.

Basic Steps to Installing Logo Files

If you are starting with existing graphics files, these basic steps are described in the following pages:

1. Install the LogoCreator conversion software from the *IconTools 3.0* CD-ROM.
2. Convert the logos to an .mg2 format.
3. Transfer the files to the microSD card via CCS Pilot/Navigator, or directly from the PC.
4. Set the parameters and load the logo files using CCS Navigator.
5. Set your GPI parameters (optional).

Step 1: Install LogoCreator Software

All logos used by the XHD-3903 must either be generated as .mg2 files or converted to that format. A version of LogoCreator (located on the *IconTools 3.0* CD-ROM) is provided with the manual for this purpose.

For best results, LogoCreator requires a PC with the following system specifications:

- Intel Pentium III processor at 500 MHz or faster
- 512 MB or more of physical memory (RAM)
- Microsoft® Windows® XP or Windows 2000

If a version of LogoCreator already exists on the PC, ensure that you first uninstall the program and restart the computer. Then proceed with the steps below:

1. Close all other software applications running on the PC and then insert the IconTools CD-ROM into the computer's CD-ROM tray.
2. Using Windows Explorer, browse to the CD-ROM contents, and then double-click the **LogoCreator** folder.
3. Double-click **Setup.exe**.
4. When the **IconTools 3 Setup** box appears, click **Next**, and then follow the on-screen installation instructions.

Step 2: Convert Files to the .mg2 Format

Using LogoCreator, you need a source image file for the fill portion of your logo, and a source image file for the key portion. The fill is the picture or image you want to overlay onto the program output. The key is the cutout or shape of the desired logo, which may or may not be the same shape as the fill. Using LogoCreator, you will set the fill and key images to the same size (resolution) as the standard of the XHD-3903 output. LogoCreator infers the key from the alpha channel in a targa (.tga) file.

After you save the logo, the logo displays in your LogoCreator workspace. To save your logo files using LogoCreator, follow these steps:

1. In LogoCreator, open the **Logo Set-Up** dialog box (Figure 4-4 below).

   When you first open LogoCreator, the **Logo Set-Up** dialog box opens automatically. If the **Logo Set-Up** dialog box is closed, select **File > New** to open the dialog box.

Figure 4-4. LogoCreator Setup Dialog Box

NOTE

If you click the **Open** button directly in the **Logo Set-Up** box, the program will only launch files with a .mg2 prefix. If you attempt to open a file with any other prefix, the program will generate error messages.

2. Click the **Logo** button to open the Static Logo dialog box.
3. Use the **Logo ID** box to assign the logo to a specific slot on your IconLogo system.
4. Enter a name for the logo in the **Name** box.
5. Click the **Open** button below the **Logo Image Preview** window.

   The **Open** dialog box displays.
6. Select your existing logo file and click the **Open** button to open the logo in the **Static Logo** dialog box.

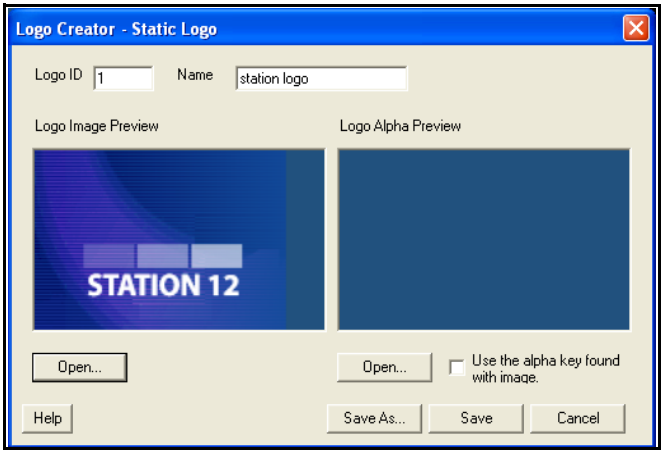


Figure 4-5. Static Logo Dialog Box

   - A preview of the composited logo displays in the **Logo Image Preview** area.
   - A preview of the image alpha displays in the **Logo Alpha Preview** area if the file contains alpha.
7. Select a file to use as the alpha channel for your logo.

   You must select a file before you can save the logo.
   - To use the original image's alpha channel, select the **Use the alpha key found with image** checkbox.
   - To use a different image for the alpha channel, clear the **Use the alpha key found with image** checkbox, and then click the **Open** button to select a new file for your alpha channel.

NOTE

An alpha channel is an 8-bit layer in a graphics file format that is used for expressing translucency (transparency). Typically, you define the alpha channel on a per-object basis. Different parts of an object will have different levels of transparency depending on how much background you want to show through.

8. Click the **Save** button in the **Static Logo** dialog box.

   The **Save Logo File** dialog box opens where you can save your logo as a .mg2 file. Once you save the logo as a .mg2 file, the logo displays in the LogoCreator workspace.

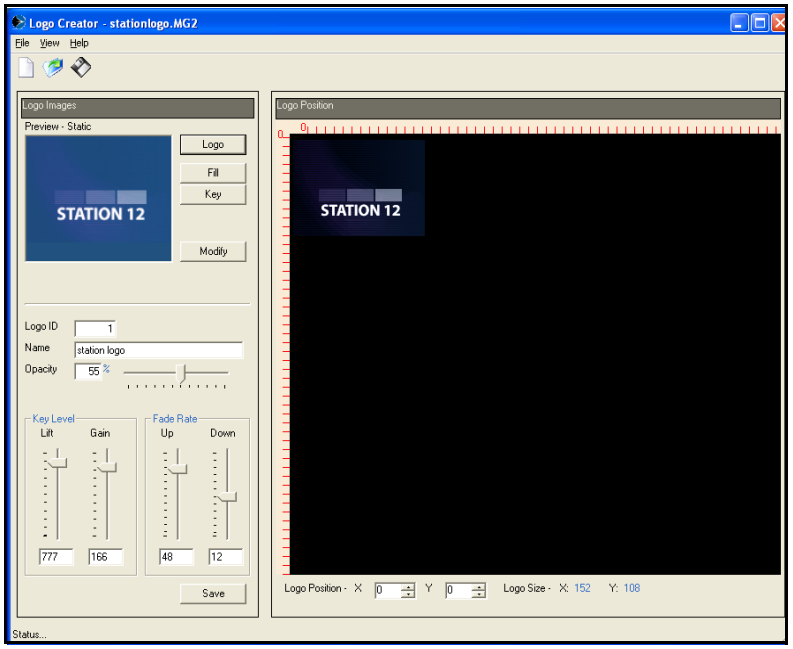


Figure 4-6. LogoCreator Work Space

Once you create an .mg2 logo you can open the file in LogoCreator, set the logo position, and modify specific logo attributes. LogoCreator also makes it possible to adjust the noise and strength of the key signal and apply fade on/off transitions to the logo.

Opening and Previewing an Existing .mg2 Logo

To make position, opacity, or key level changes to the .mg2 logo, follow these steps:

1. In LogoCreator, select **File > Open** to open the **Open Logo File** dialog box, or if the **Open Logo File** dialog box has already launched, click **Open**.
2. Using the **Open Logo File** dialog box, find and select your .mg2 logo file.
3. Click the **Open** button.

   The .mg2 logo displays in the LogoCreator workspace (Figure 4-7).

   In the upper left corner (Figure 4-8), you can preview the changes you make using the **Fill**, **Opacity**, and **Logo Position** options. (Other functions shown in the window are not be supported on the XHD-3903.)

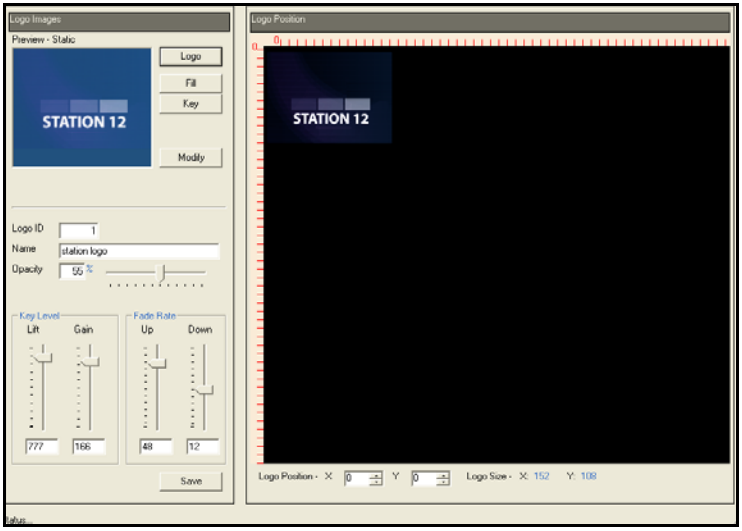


Figure 4-7. Opening a Logo

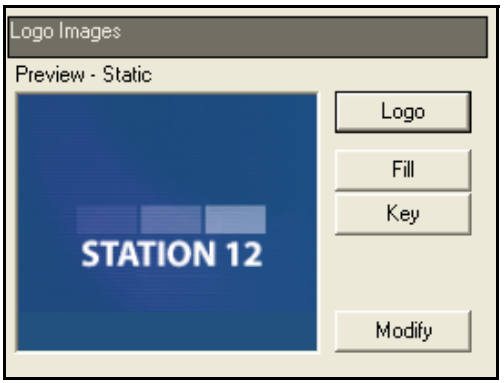


Figure 4-8. Preview Pane

Modifying the Position, Opacity, and Key Level

Using the **Modify** button, you can adjust the logo attributes you defined when you created the logo.

1. Click the **Modify** button to open the **Logo** dialog box, where you defined the logo attributes.
2. Use the options to adjust the logo properties.
3. Click **Save** to save the changes and return to the LogoCreator workspace.

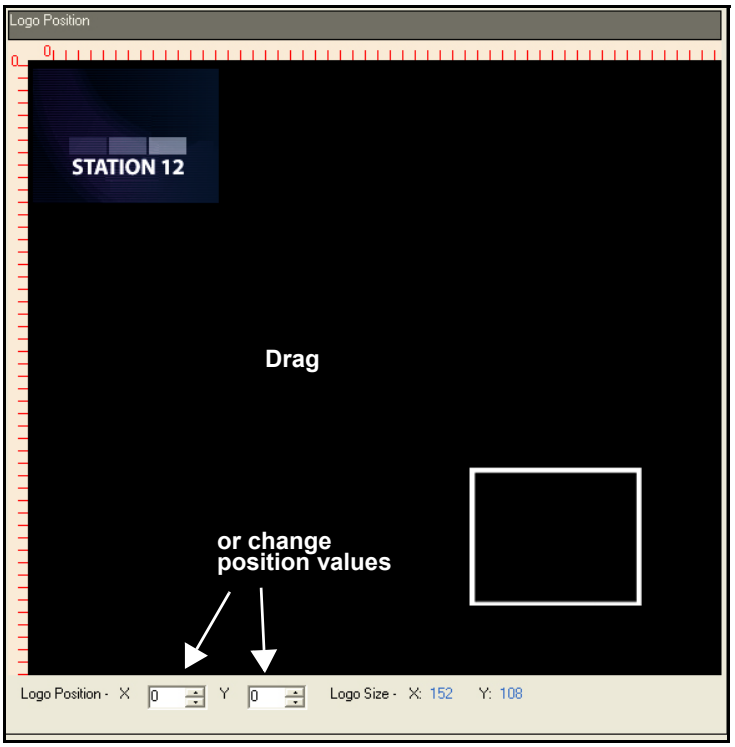


Figure 4-9. Positioning a Logo

To position your logo, either drag the logo to a new position, or use the **Logo Position X** and **Logo Position Y** boxes below the workspace to place your logo in an exact position. You can enter positive or negative values. The **X** value moves the logo horizontally and the **Y** value moves the logo vertically by the set number of pixels.

NOTE

The **Logo Position** feature works differently on the XHD-3903 than it does on the X75. Using the XHD-3903, the X and Y values that you enter or drag (Figure 4-9) will appear in the **X Position** and **Y Position** parameters in CCS Navigator (see page 96).

The **Opacity** sets the overall transparency level for the composited logo. Use either the **Opacity** field or slider to adjust the logo transparency. **100%** sets the logo as completely opaque. **0**% sets the logo as completely transparent.

Step 3: Transfer the Logos to the MicroSD Card

When your logos have been created or converted to the .mg2 format, they can be saved on the microSD card. The XHD-3903 references files on the MicroSD card using the DOS 8.3 short filename convention. Longer filenames may be accessed by entering the alternate 8.3 filename. To avoid any confusion, it is preferable to limit all filenames to the 8.3 format, with a maximum of 8 characters before the .mg2 extension.

In addition, all files must be located within the **logos** folder on the microSD card. Figure 4-10 shows the location of the microSD socket.

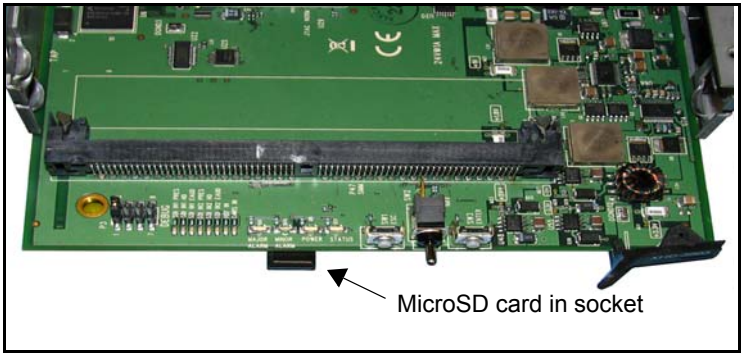


Figure 4-10. Inserting the MicroSD Card

Step 4: Set the Parameters and Load the Logo Files

Using the XHD-3903, you can preset a logo filename and its settings for each output standard. The preset logo will automatically load when the corresponding output standard is selected and becomes active (**Video > Output > Output Video Standard Select**). You must correctly set the **Config Select** parameter (**Video > Processing > Logo**) to edit the logo preset configuration for a specific output standard.

If you have selected a logo that matches the output standard and the logo is available for use, the **Load Status** parameter will read **Loaded**. Click **Enable** to activate the logo, or program the logo to be activated by GPI settings (see below).

Otherwise, all of the settings that control and monitor the logos are found at **Video > Processing > Logo**.

Table 4-4 lists some typical loading times for various sizes of logos.

Table 4-4. Typical SD Card-to-XHD-3903 Logo Loading Times

Content	Format	Approximate Load Time from MicroSD Card to XHD-3903
Bug logo, 1/16 screen	720p	10 seconds
Detailed 500 kB image, 1/4 screen	720p	30 seconds
Full screen, 8 Mb	1080p	5 minutes

Step 5: Make the GPI Settings (Optional)

As a final step, you may need to set triggers to activate your logos. The GPI inputs are internally pulled HIGH.

In the event that a file has not correctly loaded into the XHD-3903, or it has been given the wrong name, Navigator will display an **Image Not Found** major alarm. This alarm will clear itself when the problem is resolved.

Navigating the Parameter List

For a complete list of the XHD-3903 parameters, see the separate *XHD-3903 Parameter List* that accompanies this manual.

You can control these parameters in CCS-enabled software and hardware devices, and via card-edge controls while viewing the *on-screen display* feature (encoded in the SDI output 2 signal). To enable or disable this feature, change the **On-Screen Display** parameter in the **Video > Output > Config** path. (The default setting is **On.**) At the card-edge, you can enable this feature by holding down the **Escape** button for five seconds.

Navigating the Parameter List at the Card Edge

To navigate, and then view or change a parameter from the Tree View using card-edge controls, follow these steps:

1. Using CCS-enabled software, enable the **On Screen Display** parameter.
2. Open the front panel of the NEO frame.
3. Press the **Enter** button.

   The first two items in the Level One list will appear.
4. Click **Nav-** (down) on the **Nav-/Nav+** switch to view more items in the Level One list.
5. Select the desired item in the Level One list, and then press **Enter**.

   This leads you to the Level Two list.
6. Repeat steps 4 and 5 to view more items in Levels Two, Three, and Four.
7. If the parameter is selectable, slide the bar to the desired parameter using the **Nav+/Nav-**switch, or select the desired item in the Level Four list, and then press **Enter**.

   Once the Level Four parameter is set or viewed, you can leave the parameter in its current state, or return to the banner. To return to the XHD-3903 banner, repeatedly press the **Escape** button.

   Close the front panel again after you have completed the procedure to prevent the frame from overheating.

Alarms

The following table lists the alarms for the XHD-3903 modules. You can enable or disable these settings (default setting is **Disabled**), but you cannot change the level of the alarms.

Table 4-5. Default XHD-3903 Alarms

Alarm Name	Alarm Level	Meaning
SDI 1 Standard Mismatch	Major	The selected and detected primary video signals at the SDI 1 input are mismatched.
SDI2 Standard Mismatch	Major	The selected and detected primary video signals at the SDI 2 input are mismatched.
SDI 1 Loss of Video	Major	The module detects a loss of video at the SDI 1 input.
SDI 2 Loss of Video	Major	The module detects a loss of video at the SDI 2 input.
Reference is Invalid	Major	The reference input is either not valid or not supported.
DARS Not Locked	Major	The system timing is not locked to the DARS signal.
Scalar Bypass Active	Minor	The bypass mode is enabled.
Logo File Input/ Output Error	Minor	The logo file is not found, not supported, or is corrupted.
Master Mute On	Major	The master audio mute is enabled.
PCM VBit Mute On	Minor	The PCM outputs are automatically muted when the V bit is set.
Teletext Parity Error	Minor	The teletext input has a parity error.
Teletext Frame Error	Minor	The teletext input has a frame error.
Dolby Reference Mismatch	Major	The Dolby signal feeding the decoder is set at a different rate than the video reference.
Loss of AFD	Major	The incoming AFD signal is disrupted.

Unique State Recovery Behavior

DejaView state recovery of parameters operates differently on the XHD-3903 than it does with other NEO products. Unlike most other NEO modules, the XHD-3903 does not use a card-edge display. Thus, the module does not prompt you to activate DejaView.

Instead, when an a XHD-3903 is inserted in its slot, it is assumed that the module will keep its own settings, and it will *not* download DejaView values from the resource module. After five minutes, the XHD-3903 module's values will automatically transfer *to the resource module.*

However, if you insert the XHD-3903 module with the **Escape** button pressed during bootup, LEDs **D1**-**D8** will all flash on, and then off, during which time the DejaView settings are transferred from the resource module to the new XHD-3903 module. If you remove the resource module after DejaView has occurred, and then replace it with another resource module, no DejaView activity will occur.

LEDs and Module Indicators

Each XHD-3903 module has eight card-edge LEDs and four module indicators.

The module indicators include **Major Alarm** and **Minor Alarm**. These alarms alert users to failures or impending failures within the module. They are also found in the following locations:

- As red or yellow LEDs on the 3901AIC Alarm Interconnect Module or the 3901RES-E Resource Module (visible via light pipes through the frame's front panel)
- In external systems connected to the alarm contact closures at the back of the NEO frames
- On CCS-enabled software and hardware devices

Card-Edge Locations

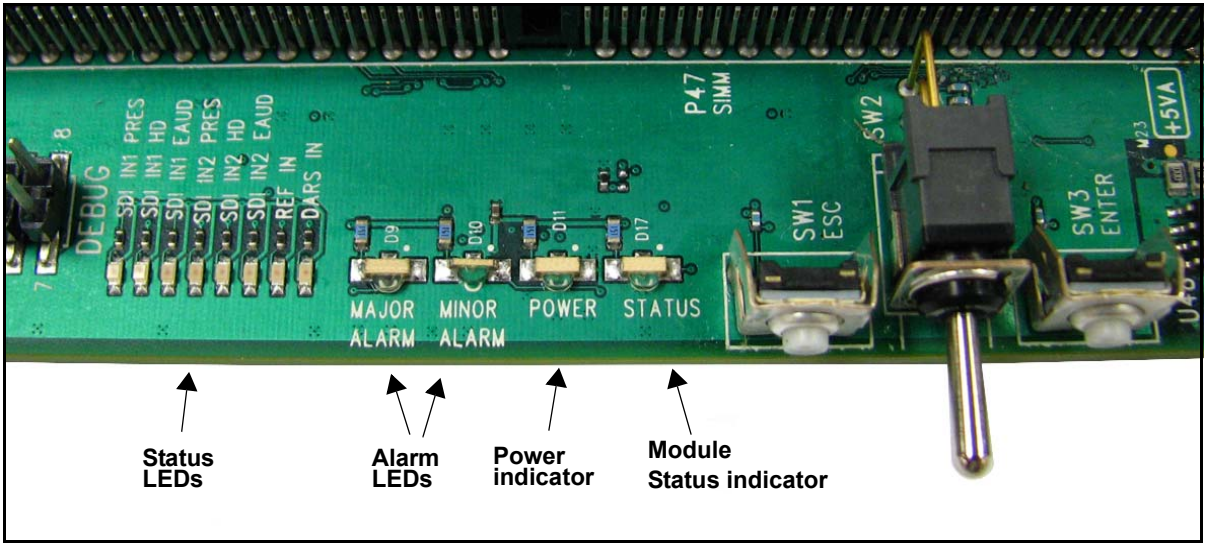


Figure 4-11. Card-Edge LEDs and Module Indicators

LED Descriptions

See Figure 4-11 on page 100 for the location of the card-edge LEDs described in Table 4-6.

Table 4-6. Color and Meaning of Card-Edge LEDs

LED	Color	Meaning (When Lit)
SDI In 1 Present	Green	The module detects the presence of an SDI signal in SDI input 1.
SDI In 1 HD	Green	The module detects the presence of an HD-SDI signal in SDI input 1 (SD-SDI input is indicated if the SDI In 1 Present LED is lit while the SDI In 1 HD LED is not lit).
SDI In 1 EAUD	Green	The module detects the presence of embedded audio in SDI input 1.
SDI In 2 Present	Green	The module detects the presence of an SDI signal in SDI input 2.
SDI In 2 HD	Green	The module detects the presence of an HD-SDI signal in SDI input 2 (SD-SDI input is indicated if the SDI In 1 Present LED is lit while the SDI In 1 HD LED is not lit).
SDI In 2 EAUD	Green	The module detects the presence of embedded audio in SDI input 2.
Ref In	Green	The module is locked to an external reference signal.
DARS In	Green	The module detects DARS input. (If the LED flashes, DARS input is present but not locked; if the LED is lit but not flashing, the DARS input is present and locked.)

Module Indicator Descriptions

See Figure 4-11 on page 100 for the location of the module indicators described in Table 4-7.

Table 4-7. Color Meaning of Module Indicators

Module Indicator	Color	Meaning (When Lit)
Major Alarm (see Table 4-5 on page 98 for details)	Red	The module detects one or more of the following problems: • Mismatch between the selected and detected primary video signal • Mismatch between the selected and detected secondary video signal • Loss of SDI 1 input video • Loss of SDI 2 input video • Loss of locked reference • Loss of DARS reference • Master audio muted
Minor Alarm (see Table 4-5 on page 98 for details)	Yellow	The module detects one or more of the following problems: • PCM VBit Mute is enabled. • Parity error in thee teletext signal • Frame error in the teletext signal
Power	Green	The module is receiving power.
Module Status	Green	The module is configured, loaded, and operational.

Chapter 5

Specifications

Overview

The tables in this chapter list the following specifications for the XHD-3903 modules:

Some of the connectors described in this chapter are found on the breakout cables supplied for the back module.

Specifications and designs are subject to change without notice.

Inputs

SD-SDI Video (270 Mb/sec)

Table 5-1. SD-SDI Video (270M) Specifications

Item	Specification
Standard	SMPTE 259M-C, 270 Mbps, 525/625 component
Connector	BNC (IEC 169-8)
Impedance	75Ω
Return loss	>18 dB from 5 MHz to 270 MHz
Equalization	>23 dB Belden 8281 cable

HD-SDI Video (1.5 Gb/sec)

Table 5-2. HD-SDI Video (1.5 G) Specifications

Item	Specification
Standard	SMPTE292M, 1080i/59.94, 1080i/50, 720p/59.94, 720p/50, 1080p/23.98, 720p/23.98
Connector	BNC (IEC169-8)
Impedance	75Ω
Return loss	>18 dB (typical) from 5 MHz to 1485 MHz
Equalization	• Adaptive cable equalization for up to 492 ft (150 m), typical, of Belden 1694A coaxial cable (Hardware Version A*) • Adaptive cable equalization for up to 656 ft (200 m) typical, of Belden 1694A co-axial cable (Hardware Version B or later*) * See **Parameters > Other** to obtain hardware information about your model

HD-SDI Video (3 Gb/sec)

Table 5-3. HD-SDI Video (3 G) Specifications

Item	Specification
Standard	SMPTE 424M, SMPTE 372M (4:2:2 10-bit)
Connector	BNC (IEC 169-8)
Impedance	75Ω
Return loss	• >15 dB, typical, from 5 MHz to 1485 MHz • >10 dB, typical, from 1485MHz to 2970MHz
Equalization	• Adaptive cable equalization for up to 164 ft (50m) , typical, of Belden 1694A coaxial cable (Hardware Revision A*) • Adaptive cable equalization for up to 427 ft (130 m), typical, of Belden 1694A co-axial cable (Hardware Revision B* or later) * See **Parameters > Other** to obtain hardware information about your model

AES/DARS (Balanced)

Table 5-4. AES/DARS (Balanced) Specifications

Item	Specification
Number of inputs	8 + DARS
Standard	AES3
Connector	XLR
Sensitivity	<200 mV pk-to-pk (100 mV pk-to-pk typical)
Impedance	110 ±20% (0.1 MHz to 6 MHz)
Common mode rejection	0 V to 7 V (0 kHz to 20 kHz)
Input audio rate	16 kHz to 96 kHz

AES/DARS (Unbalanced)

Table 5-5. AES/DARS (Unbalanced) Specifications

Item	Specification
Number of inputs	8 + DARS
Standard	AES3, SMPTE276M
Connector	BNC (IEC169-8)
Sensitivity	<100 mV pk-to-pk (50 mV pk-to-pk typical)
Impedance	75Ω
Return loss	<-25 dB, 0.1 MHz to 6 MHz (<-35 dB typical)
Input audio rate	16 kHz to 96 kHz

Genlock

Table 5-6. Genlock Specifications

Item	Specification
Connector	BNC (IEC169-8)
Return loss	• >40 dB (typical) to 6 MHz • >35 dB (typical) to 30 MHz

Input level	• 1 V pk-to-pk, -5.0 dB to + 6.0 dB for NTSC/ PAL-B
	• 1 V pk-to-pk, -3.5 dB to + 6.0 dB for tri-level sync
	  • 1080i: 59.94/50
	  • 1080p: 29.97/25
	  • 720p: 59.94 *

Signal type	• NTSC/PAL-B analog composite
	• ±300 mV Tri-level sync
	  • 1080i: 59.94/50
	  • 1080p: 29.97/25
	  • 720p: 59.94 *

* 720p/59.94 reference is accepted only at 720p/59.94, 1080p/59.94, or 1080p/59.94 Level B output

Outputs

SD-SDI Video (270 Mb/sec)

Table 5-7. SD-SDI Video (270M) Specifications

Item	Specification
Standard	SMPTE 259M-C, 270Mbps, 525/625 component
Quantization	10 bits
Connector	BNC (IEC 169-8)
Impedance	75Ω
Return loss	18 dB (typical) from 5 MHz to 270 MHz
Signal level	800 mV ±10%
D.C. offset	0.0 V ±0.5 V
Rise and fall time	400 ps to 1500 ps (20% to 80%)
Overshoot	<10% of amplitude
Jitter	Timing: <0.2 UI; alignment: <0.2 UI

HD-SDI Video (1.5 Gb/sec)

Table 5-8. HD-SDI Video (1.5) Specifications

Item	Specification
Standard	SMPTE292M
Quantization	10 bits
Connector	BNC (IEC 169-8)
Impedance	75Ω
Return loss	18 dB (typical) from 5 MHz to 1485 MHz
Signal level	800 mV ±10%
D.C. offset	0.0 V ±0.5 V
Rise and fall time	<270 ps
Overshoot	<10% of amplitude
Jitter	Timing: <1 UI; alignment: <0.2 UI

HD-SDI Video (3 Gb/sec)

Table 5-9. HD-SDI Video (3 G) Specifications

Item	Specification
Standard	SMPTE 424M, SMPTE 372M (4:2:2 10-bit)
Quantization	10 bits
Connector	BNC (IEC 169-8)
Impedance	75Ω
Return loss	• 12 dB (typical) from 5 MHz to 1485 MHz • 12 dB (typical) from 1485 MHz to 2970 MHz
Signal level	800 mV ±10%
D.C. offset	0.0 V ± 0.5 V
Rise and fall time	<135 ps (20/80), no differ by more than 50 ps
Overshoot	<10% of amplitude
Jitter	• Timing jitter: 2 UI • Alignment jitter: 0.3 UI

AES (Balanced)

Table 5-10. AES/DARS (Balanced) Specifications

Item	Specification
Number of outputs	8
Standard	AES3
Connector	XLR
Impedance	110 ±20% (0.1 MHz to 6 MHz)
Jitter	<±4 ns, peak value
DC offset	0.0 ±50 mV
Rise/fall time	5 ns to 30 ns (10% to 90%) (10 ns typical)

AES (Unbalanced)

Table 5-11. AES/DARS (Unbalanced) Specifications

Item	Specification
Number of outputs	8
Standard	AES3, SMPTE276M
Connector	BNC (IEC169-8)
Impedance	75Ω
Return loss	<-25 dB, 0.1 MHz to 6 MHz (<-35 dB typical)
Jitter	<±4 ns, peak value
DC offset	0.0 ± 50 mV
Rise/fall time	30 ns to 44 ns (10% to 90%) (33 ns typical)

Propagation Delays

See page 83 for detailed propagation delay information.

Miscellaneous

RS-232/RS-422/485

Table 5-12. RS-232/RS-422/485 Specifications

Item	Specification
Electrical	Differential balanced
Standard	Electrical specification EIA-232C
Connector	• DB-9 • 232/422/485 switchable • 422/485 termination can be selected

Power Consumption

Table 5-13. Power Consumption Specifications

Item	Specification
Maximum power consumption	• 24 W for non-AES version • 26 W for AES version
Power supply	24 V

GPI Input/Output

Table 5-14. GPI Input/Output Specifications

Item	Specification
GPI inputs	• Number: 4 • Internally pulled HIGH • External contact closure to ground to trigger
GPI outputs	• Number: 4 • TTL compatible • 5 mA drive
Connector	DB-9

Appendix A

Audio Bit Manipulation

Overview

This appendix contains information on the manipulation of bits that occur when using the XHD-3903 modules.

RX Key: N = not recognized, Y = recognized, S = recognized and stored or passed through or both

TX Key: N = not transmitted, Y = transmitted

Channel Status Bits

Table A-1. C-Bit Manipulation

Byte	Bit	Function	RX	TX	Remarks
0	0	[0] Consumer use [1] Professional use	N Y	N Y	Set to [1]
0	1	[0] Normal Audio Mode (linear PCM) [1] Non-audio (non-PCM)	S S	Y Y	Passed unmodified
0	2 to 4	[000] Not indicated [100] No emphasis [110] 50/15 µs [111] CCITT J.17	S S S S	Y Y Y Y	Passed unmodified
0	5	[0] Locked [1] Unlocked	N N	Y N	Set to [0]
0	6 to 7	[00] Not indicated [01] 48 kHz [10] 44.1 kHz [11] 32 kHz	Y Y Y Y	N Y N N	Set to [01]
1	0 to 3	[0000] Not indicated [0001] Two channel [0010] Mono [0011] Prim/sec [0100] Stereo [0101] to [1111] Undefined	N N N N N N	Y N N N N N	Set to [0000]
1	4 to 7	[0000] Not indicated [0001] 192 bit block [0010] AES18 (HDLC) [0011] User defined [0100] to [1111] Undefined	N N N N N	Y Y Y Y Y	Set to [0000]
2	0 to 2	[000] Not indicated [001] Audio data [010] Co-ordination signal [011] to [111] Undefined	N N N N	N Y N N	Set to [001]

Table A-1. C-Bit Manipulation *(Continued)*

Byte	Bit	Function	RX	TX	Remarks
2	3 to 5	[000] Not indicated [001] Max length - 1 [010] Max length - 2 [011] Max length - 3 [100] Max length - 4 [101] Max length [110] to [111] Undefined	N N N N N N N	N N N N N Y N	Set to [101]
2	6 to 7	Reserved	N	Y	Set to [0]
3	0 to 7	Reserved	N	Y	Set to [0]
4	0 to 1	[00] Not a reference [01] Grade 1 reference [10] Grade 2 reference [11] Undefined	N N N N	Y N N N	Set to [00]
4	2	Reserved	N	Y	Set to [0]
4	3 to 6	[0000] Not indicated [1000] 24 kHz [0100] 96 kHz [1100] 192 kHz [1100] 22.05 kHz [0101] 88.2 kHz [1101] 176.4 kHz [1111] User defined	N N N N N N N N	Y N N N N N N N	Set to [0000]
4	7	[0] Sample frequency not scaled [1] Sample frequency scaled by 1/1.001	N N	Y N	Set to [0]
5	0 to 7	Reserved	N	Y	Set to [0]
6 to 9	0 to 7	Alphanumeric channel origin data	S	Y	Passed unmodified
10 to 13	0 to 7	Alphanumeric channel destination data	S	Y	Passed unmodified
14 to 17	0 to 7	Local sample address code	S	Y	Passed unmodified
18 to 21	0 to 7	Time-of-day sample address code	S	Y	Passed unmodified
22	0 to 3	Reserved	N	Y	Set to 0
22	4	Bytes 0 to 5 reliability flag	S	Y	Passed unmodified
22	5	Bytes 6 to 13 reliability flag	S	Y	Passed unmodified

Table A-1. C-Bit Manipulation *(Continued)*

Byte	Bit	Function	RX	TX	Remarks
22	6	Bytes 14 to 17 reliability flag	S	Y	Passed unmodified
22	7	Bytes 18 to 21 reliability flag	S	Y	Passed unmodified
23	0 to 7	CRC	Y	Y	Calculated on output

Validity and User Bits

Table A-2. V-Bit and U-Bit Manipulation

Bit Manipulation	RX	TX	Remarks
Validity (V) bit	S	Y	Passed unmodified
User (U) bit	S	Y	Passed unmodified

Miscellaneous Data

Table A-3. Miscellaneous Data

Item	RX Specification	TX Specification
Audio sampling frequency	32 to 108 kHz	48 kHz
Audio sampling word length	16 to 24 bits	24 bits

Appendix B

Advanced Audio Packages

Overview

This chapter describes the different advanced audio option packages that are available with the XHD-3903. The following topics are covered:

Dolby and DTS Neural Audio Licenses

The XHD-3903 offers a wide variety of Dolby and DTS Neural audio processing options, either as separate licenses, or in different combinations (Dolby-2 and Dolby-3 options require version 4.0.4 firmware on the frame's resource module).

These options make it possible to offer advanced audio processing for high-definition and surround sound programming using 5.1 and stereo sources.

To install one of these audio options, your XHD-3903 module must be configured for AES capability. This may require the installation of the XHD3903-UG-AESC upgrade kit.

Figure B-1 shows how DTS Neural and Dolby audio processing is integrated into the XHD-3903 signal flow. Table B-1 on page 117 lists the different audio license keys available.

NOTE

Only one Dolby or DTS Neural license may be purchased for each XHD-3903 module.

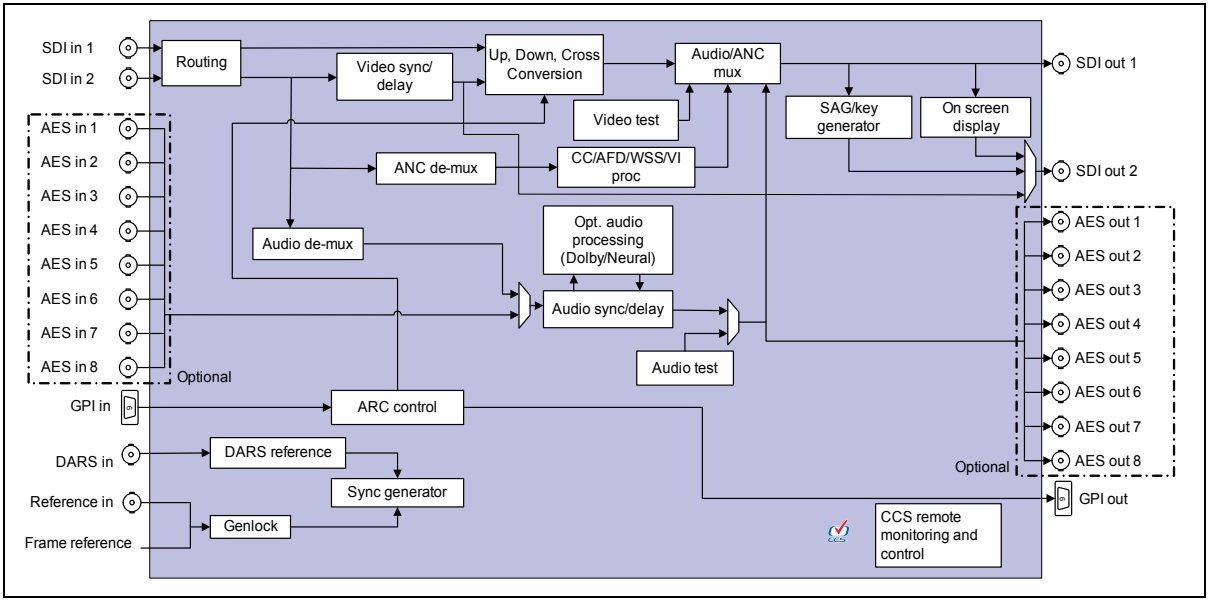


Figure B-1. XHD-3903 Signal Flow with Neural Audio

Table B-1. Neural Audio License Keys

Part Number	Capability
XHD3903OPT-D1	Dolby E and AC-3 Decoder Option Hardware and Software key (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD3903OPT-D2	Dolby E Integrated Encoder Hardware and Software Key (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD3903OPT-D3	Dolby Digital (AC-3) Integrated Encoder Hardware and Software Key (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-DM	DTS Neural Surround™ DownMix DTV 5.1 Transport Solution, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-DM-LC	DTS Neural Surround™ DownMix DTV 5.1 Transport Solution with NLC Neural Loudness Control, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-LC	DTS Neural Loudness Control for 2.0 or 5.1 Program Audio, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-LC-6+2	DTS Neural Loudness Control for 2.0 and 5.1 (separate programs), plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-LC-8	DTS Neural Loudness Control for 4 x 2.0 Program Audio, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-LC+DM	DTS Neural Loudness Control for 5.1 Program Audio with Neural DTS-Surround™ Downmix output, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-MM	DTS Neural Surround™ 5.1 and rendered stereo content transitioning for DTV 5.1 Production, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-MM-LC	DTS Neural Surround™ 5.1 and rendered stereo content transitioning for DTV 5.1 Production with NLC Neural Loudness Control, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-UM	DTS Neural Surround™ UpMix DTV 5.1 Production Solution, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)
XHD39OPT-UM-LC	DTS Neural Surround™ UpMix DTV 5.1 Production Solution with NLC Neural Loudness Control, plug-in for NEO XHD-3903 (AES input/output version required; for field upgrade, order XHD3903-UG-AESC)

Block Diagrams

Dolby

Figure B-2 shows how Dolby is used in a typical XHD-3903 application. Dolby E or Dolby Digital (AC-3) decoding takes place at ingest for voice-over.

NOTE

Only one Dolby or DTS Neural license may be purchased for each XHD-3903 module.

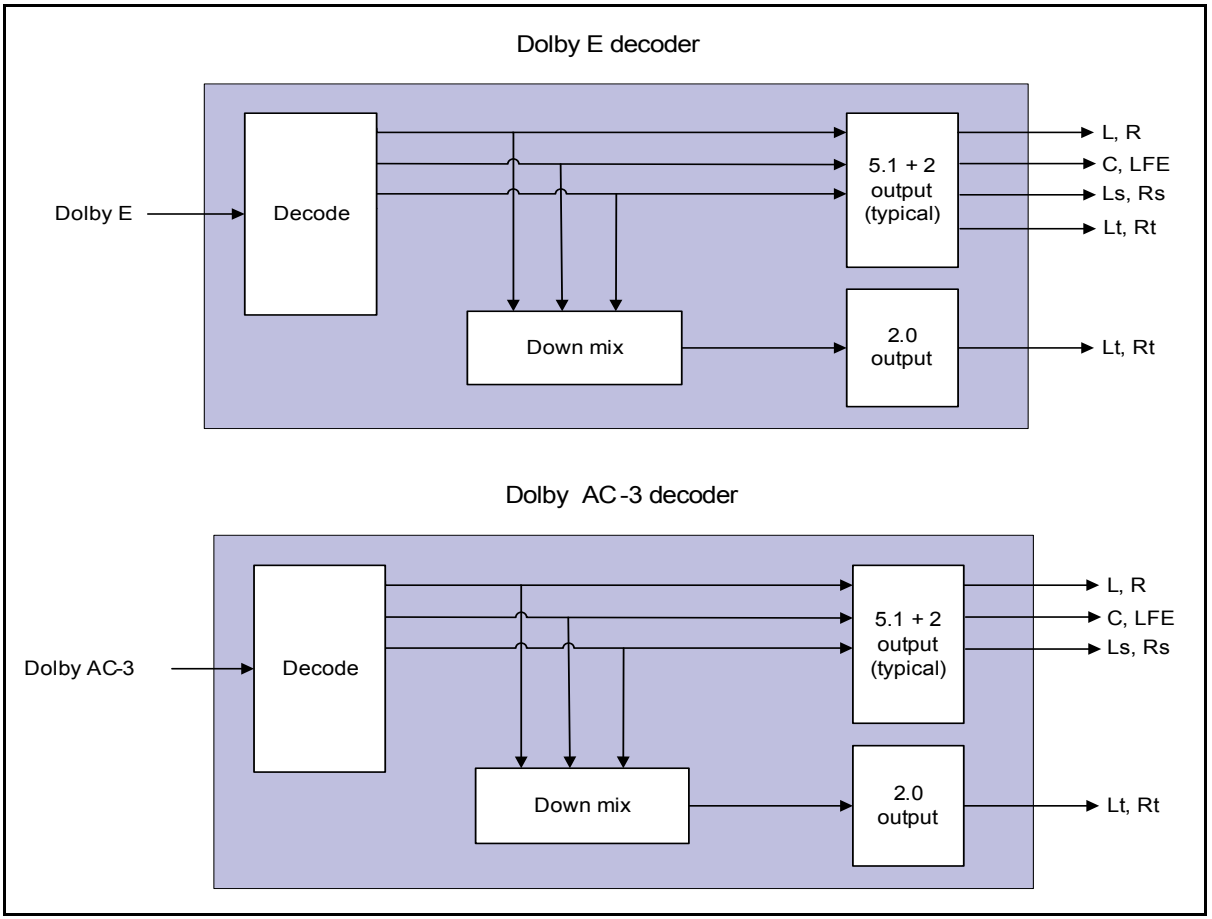


Figure B-2. Dolby Block Diagrams

DTS Neural

The block diagrams shown in Figure B-3 to Figure B-5 illustrate the uses of the different DTS Neural audio license key options.

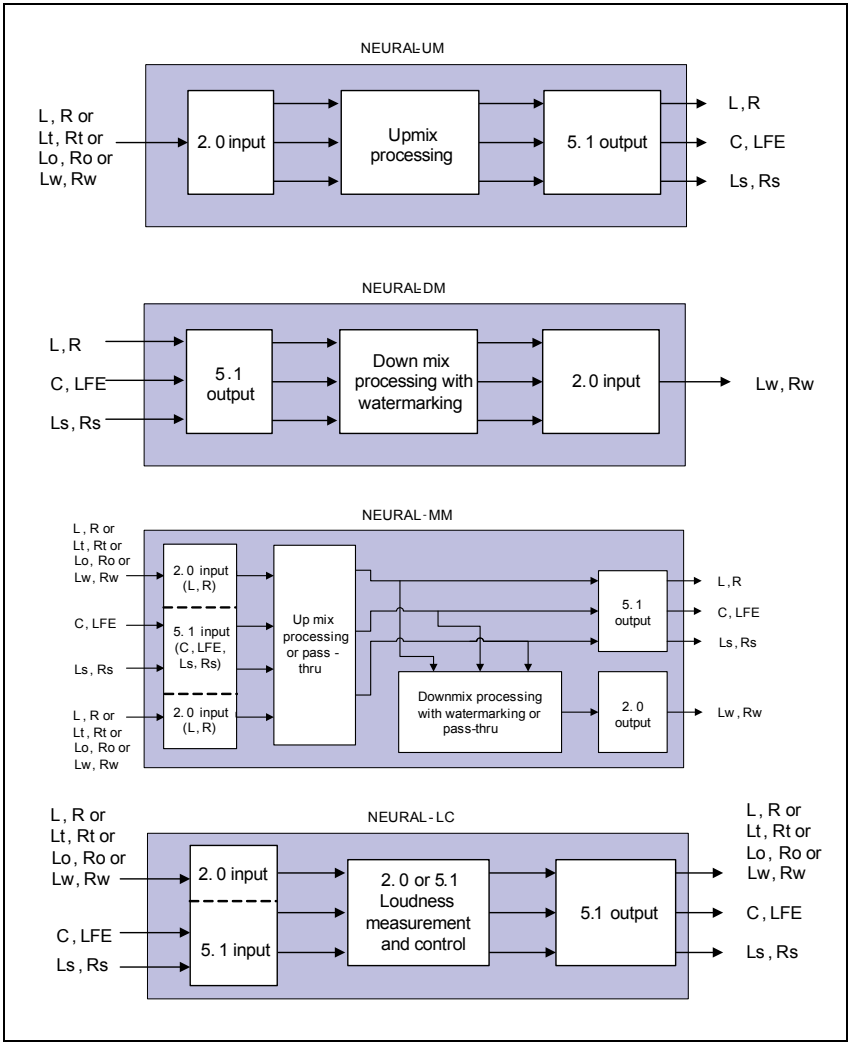


Figure B-3. DTS Neural Audio Option Block Diagrams (1)

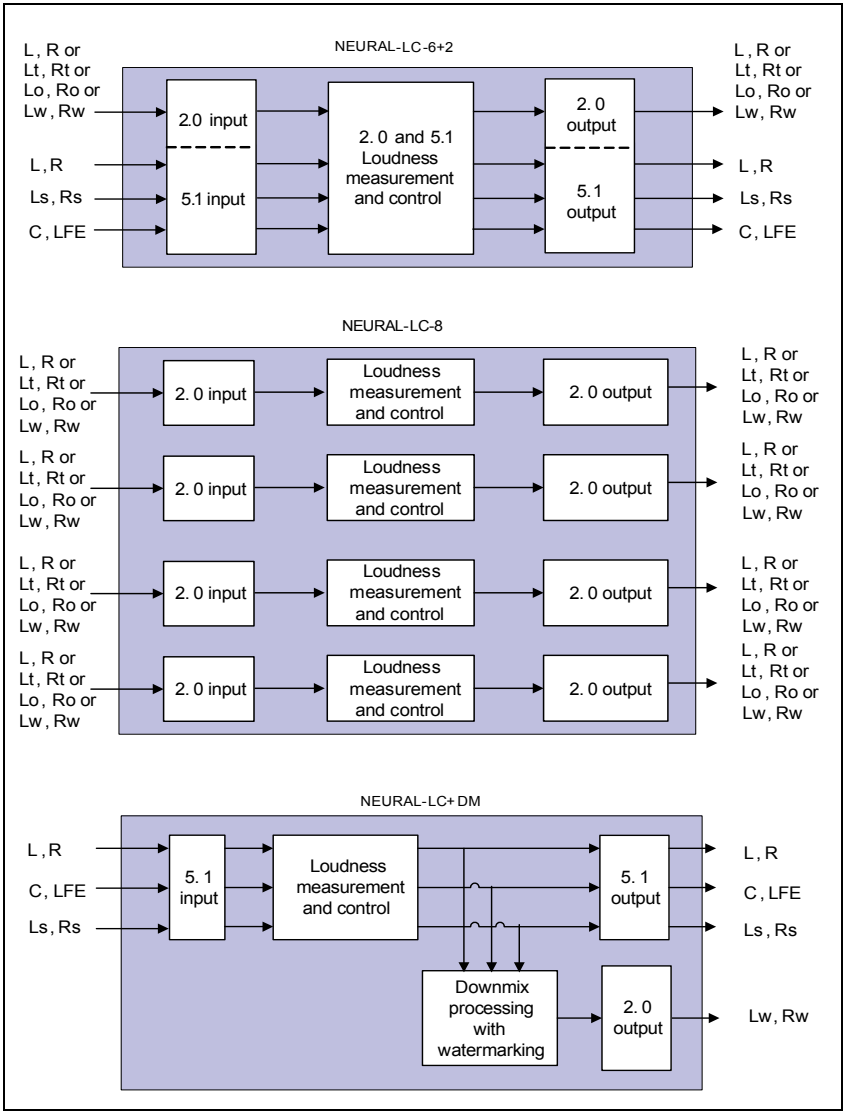


Figure B-4. DTS Neural Audio Option Block Diagrams (2)

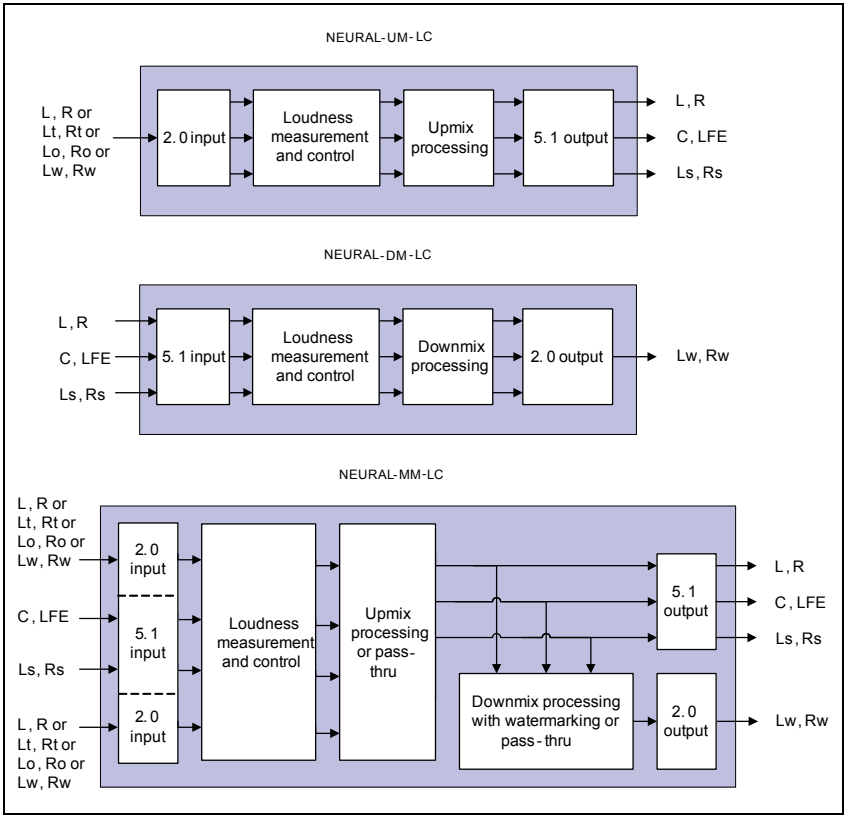


Figure B-5. DTS Neural Audio Option Block Diagrams (3)

Hardware and Software Installation

The Dolby and DTS Neural packages consist of two parts:

- Hardware submodule
- Software keycode to enable the submodule

Follow these steps to install the hardware:

1. Remove the XHD-3903 module from its frame.
2. Gently insert the connector side of the submodule into the Dolby/ DTS Neural socket of the XHD-3903 module (see Figure B-6).

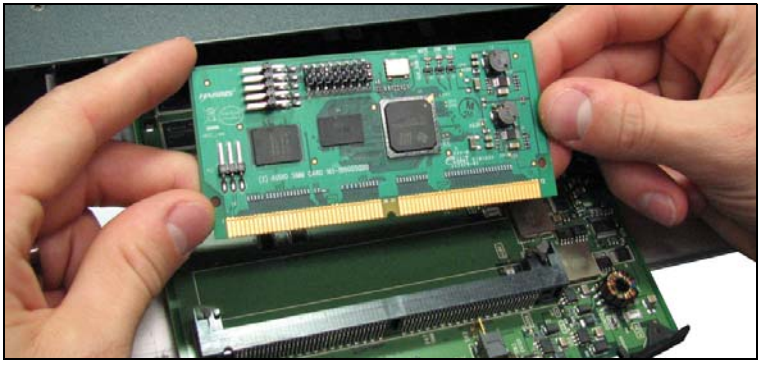


Figure B-6. Inserting Submodule into Socket

3. Press the submodule edges down slowly until it locks into place (see Figure B-7 and Figure B-8).

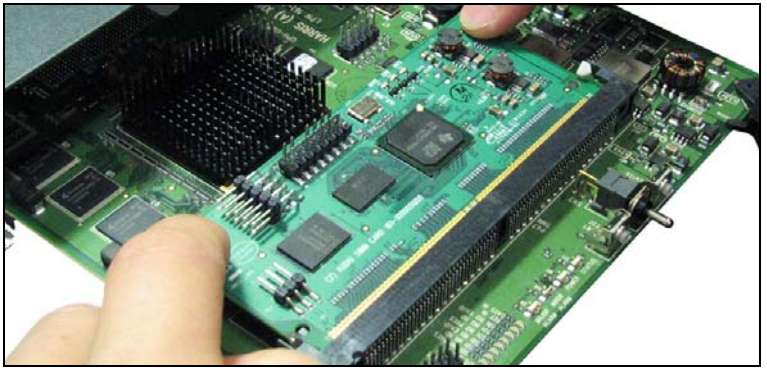


Figure B-7. Submodule Installed

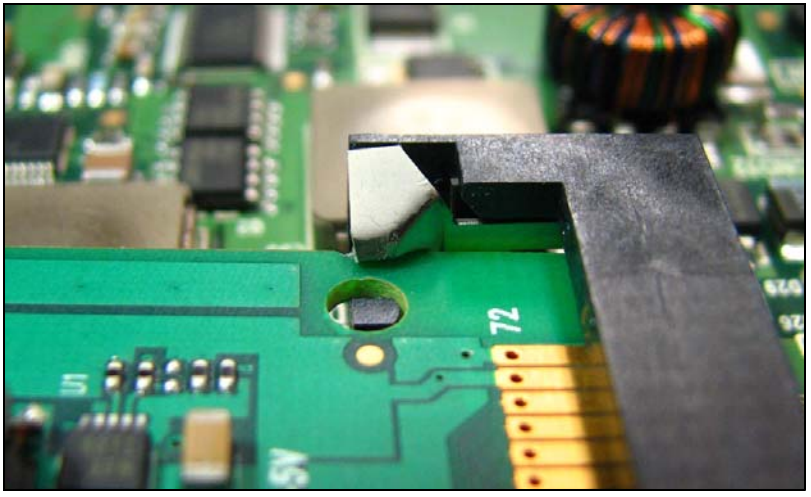


Figure B-8. Submodule Locked in Place

4. Reinsert and power up the XHD-3903 module.

Follow these steps to install an advanced audio license key:

1. Enter the license key number in the **Other > License Key** field, and then press `Enter` on your keyboard.
2. Wait 30 seconds for the change to take effect.
3. Reboot the module by removing it from the frame or by starting the reboot procedure in CCS Navigator.

   The module may take a moment before it is enabled for use.
4. Confirm the license key type by rolling over the **Other > Options** field.

NOTE

An XHD-3903 with a DTS Neural module installed will display different LEDs during software upgrades. See page 34 for details.

Dolby Audio Metadata

When the Dolby decoder option is in use, you can source audio metadata from the external serial port, SDI demux, or from the Dolby decoder. The audio metadata can then be embedded in the output video.

To select the source of the metadata, use the **Ameta Source** parameter (**Audio > Output > Embedder**). The **Ameta Present** parameter indicates when the metadata is detected.

When you apply external metadata to the XHD-3903, the metadata properties persist even after you remove the external metadata from the module. Performing a **Factory Default** of the user settings *does not* clear the metadata properties that were received when external metadata was present. After you remove the external metadata, you must restart the module to clear the metadata properties.

For general information about the use of audio metadata in professional video applications, visit the Dolby Web site at www.dolby.com.

Audio Delay with Advanced Audio Modules

When a Dolby or DTS Neural advanced audio module is enabled, an additional system delay is applied automatically to all other audio routing, ensuring all audio outputs are aligned (the automatic delay is the same as the processing delay of non-Dolby/Neural audio).

However, there is only one delay applied per audio input source. Therefore, if the input source is routed through the advanced audio module and then that source is concurrently routed to an output, the two outputs will be misaligned.

The advanced audio feature also includes **Audio Latency** and **Video Latency** parameters. *Audio latency* is the total audio latency through the system, and does not include any additional user delay. *Video latency* refers to the total video latency through the system from the input to the output. If the two values do not match (possibly because an advanced audio processing module is adding audio delay), select **Track Audio** to add a one-time minimum number of input frames of delay to synchronize the video and audio.

If the **Input Frame Delay** is later modified, you can trigger the **Track Audio** parameter to add back the minimum number of frames to the **Input Frame Delay** parameter to compensate for these delays. (Both parameters are in **Video > Processing > Synchronizer: Ch1**). If there is no Neural module installed, the **Track Audio** control is always disabled (and audio should always be aligned).

DTS Neural Audio Parameters

Each DTS Neural module has its own specific parameters:

- The XHD39OPT-UM✚ and XHD39OPT-UM✚LC✚ include the UpMix parameters listed in Table on page 127.
- The XHD39OPT-DM✚, XHD39OPT-DM✚LC✚, and XHD39OPT-LC✚DM✚ include the DownMix parameters listed in Table B-3 on page 130.
- The XHD39OPT-MM✚ and XHD39OPT-MM✚LC✚ include the MultiMerge parameters listed in Table B-4 on page 132.
- The XHD39OPT-LC✚6✚2✚, XHD39OPT-LC✚8✚, XHD39OPT-LC✚DM✚, XHD39OPT-UM✚LC✚, XHD39OPT-DM✚LC✚, and XHD39OPT-MM✚LC✚ include the Loudness Control parameters listed in Table B-6 on page 137.

General Steps for Routing DTS Neural Audio

Follow these general steps when configuring DTS Neural products:

1. Determine the input sources for the DTS Neural module (either AES or demuxed audio).
2. Route the inputs intended for DTS Neural processing to a set of SRCs (sample rate convertors) by following **Audio > Input > Routing > SRC*x* Input Select**.

   (SRCs **1** to **4** will be used, each being fed a stereo pair.)
3. Route the designated input SRCs to DTS Neural module inputs by following **Audio > Input > Routing > AdvAudio/Dlby Ch1-8**.

   These parameters assign the output of the SRCs that you selected in step 2. The output of these SRCs will then feed the DTS Neural module inputs.
4. Route the DTS Neural audio outputs to the SRC by assigning each output of the DTS Neural processing to the input of an SRC, under **Audio > Input > Routing >** (unused **SRCx Input Select** > **AvAudProcCh*x/y***).
5. Route the designated output SRCs (sample rate convertors) to system outputs by following **Audio > Output > Routing**, selecting the output SRCs from step 4 to feed either a mux channel or AES output.

DTS Neural Audio UpMix

Overview

The DTS Neural Surround UpMix renders any two channel audio source (stereo, matrix encoded stereo, LtRt, or DTS Neural Surround LwRw) as surround sound. The DTS Neural Surround UpMix can simultaneously position individual elements within the surround field, creating high levels of image stability and granularity.

The UpMix technology avoids taking “artistic license” with content by placing audio exactly where it would be heard in a professional LEDE (Live End Dead End) listening environment. For example, mono or pan-pot stereo will image in front of the listener, whereas stereo containing depth information will surround the listener.

You can use the DTS Neural Surround UpMix as a stand-alone unit to monitor stereo production, or you can use it in tandem with the DTS Neural Surround DownMix as a complete 5.1 transport solution.

Figure B-9 below shows an UpMix taking a two-channel audio source (stereo, matrix encoded stereo, LtRt or DTS Neural Surround LwRw) and rendering a 5.1 multi-channel mix.

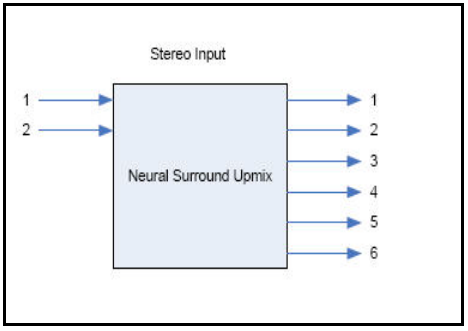


Figure B-9. UpMix Block Diagram

Parameters

Table B-2. DTS Neural Audio UpMix Parameters

Processing > Neural > Upmix		
Parameter Name	**Function**	**Options**
Output Config	Controls the output channel configuration generated by the Upmix.	• 2.1 • 3.1 • 4.1 • **5.1**
Output Bias	Controls the soundstage depth of the upmix. (Values near -1.0 indicate that the soundstage image will be biased toward the surround channels; values near 1.0 indicate that the soundstage image will be biased toward the front channels)	-1.00 to 1.00 (**0**)
Upmix LFE Mute	Mutes the LFE channel output from the upmix	• Yes • **No**
LFE Up Cutoff	Controls the cutoff frequency of the low pass filter applied to the LFE channel before output	60 Hz to 140 Hz (**80** Hz)
Limiter Enable	Enables a limiter on the surround output from the upmix	• No • **Yes**
Limiter Threshold	Sets the upper threshold of the limiter applied to the output	-20 dBFS to **0** dBFS

DTS Neural Audio DownMix

Overview

The DTS Neural Surround DownMix enables 5.1 surround sound to be transported through any stereo infrastructure. The downmix process is based upon the principle that both natural stereo and 5.1 content are two-dimensional; both contain width and depth spatial attributes.

The DTS Neural Surround DownMix can represent six channels of discreet audio sources in a stereo downmix by transforming the sources into pure intensity and coherence encoding. By correcting overlaps of the signal sources in intensity, time, coherence, polarity, and phase before the six channels are combined, the DTS Neural Surround DownMix accounts for the problems suffered in traditional matrix encode systems—such as comb filtering, spatial location distortion, etc.

The proprietary Neural Audio “watermark process” faithfully reproduces surround information when it is rendered by the DTS Neural Surround UpMix or any LtRt system. In brief, the DTS Neural Surround DownMix produces a stereo downmix that accurately represents the original content whether monitored in mono, stereo, matrix or DTS Neural 5.1 Surround Sound.

Figure B-10 below shows a DownMix taking a multi-channel audio source. The downmix creates two-channel audio source using the Neural Audio approach of embedding a watermark signal within the stereo audio signal patch. The watermark signal contains spatial and steering positioning information. The resulting stereo audio signal is also known as LwRw.

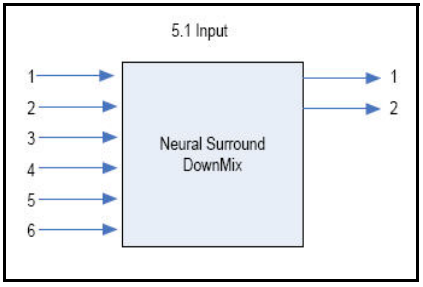


Figure B-10. DownMix Block Diagram

Parameters

Table B-3. DTS Neural Audio DownMix Parameters

Processing > Neural > Downmix		
Parameter Name	**Function**	**Options**
LFE Down Filter En	Enables a low pass filter to the LFE input to the downmix	• No • **Yes**
LFE Down Cutoff	Sets the cutoff frequency of the low pass filter applied to the LFE input	60 Hz to 140 Hz (**80** Hz)
Limiter Enable	Enables a limiter on the stereo output of the downmix Note: 6 (5.1) channels of audio can naturally represent more total energy than 2 (stereo) channels of audio. Because of this, content downmixed from 5.1 to stereo will often have higher energy than any of the 5.1 channels individually. You can enable the limiter to protect content from digital 0 clipping and adjust the desired threshold.	• No • **Yes**
Limiter Threshold	Sets the upper threshold of the limiter applied to the output	-20 dBFS to **0** dBFS

DTS Neural Audio MultiMerge

Overview

The DTS Neural Surround MultiMerge enables broadcasters to transition from stereo to 5.1 surround sound, providing viewers with a 24/7 surround sound experience. With MultiMerge inline, 5.1 original content is passed unaffected to the viewer while original stereo content is upmixed to a 5.1 surround sound image. This provides the viewer with a consistent surround experience.

The transition between 5.1 and stereo occurs seamlessly without the need of operator intervention. By offering a 24/7 5.1 signal, AC3 metadata does not transition between 2/0 and 3/2 mode. This prevents audio clicks, pops, and dropouts. The process also avoids taking "artistic license" with content by placing audio exactly where it would be heard in a professional LEDE (Live End Dead End) listening environment. For example, mono or pan-pot stereo will image in front of the listener, whereas stereo containing depth information, or LtRt encoding, will surround the listener.

You can use the MultiMerge in combination with the DTS Neural Surround DownMix device to pass 5.1 through stereo-only facilities and therefore eliminate the need for costly master control upgrades.

Figure B-11 shows how the MultiMerge takes a two-channel audio source (stereo, matrix encoded stereo, LtRt or DTS Neural Surround LwRw) and render a 5.1 multi-channel mix; in combination with taking original multi-channel content and creating a stereo downmixed signal, depending on the input configuration and content source used.

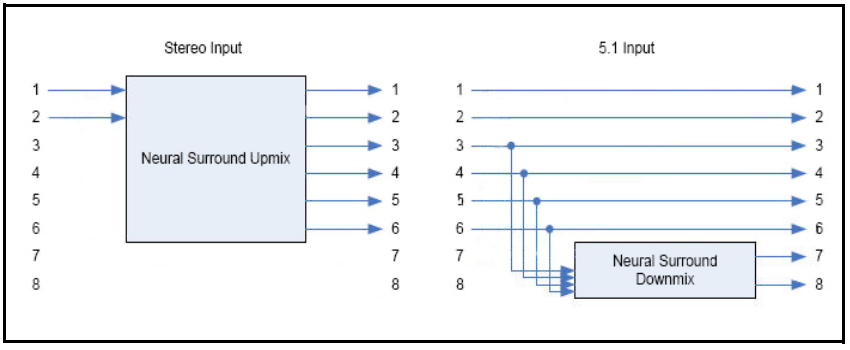


Figure B-11. MultiMerge Block Diagram

Parameters

Table B-4. DTS Neural Audio MultiMerge Parameters

Processing > Neural > Multimerge		
Parameter Name	**Function**	**Options**
Input Selection Mode	Selects the input selection mode (See Table B-5 on page 133 for descriptions of these options.)	• **Mix** • Multi • Stereo • Aux • Multi Detect • Stereo Detect • Aux Detect • Multi Aux Stereo
Multimerge Mode	Controls the mode of the MultiMerge algorithm	• **Auto** • Pass Through • Up Mix
Detect Threshold	Controls the noise floor level for the detection while in Auto mode.	80 dBFS to -50 dBFS (**-60** dBFS)
Input Crossfade Time	Determines the transition time from one source to another	50 ms to 750 ms (**200** ms)
MM Crossfade Time	Controls the length of the audio crossfade used on the outputs when switching between Upmix and Passthrough modes automatically	50 ms to 750 ms (**200** ms)
Upmix LFE Mute	Mutes the LFE channel output from the upmix	• Yes • **No**
LFE Up Cutoff	Controls the cutoff frequency of the low pass filter applied to the LFE channel before output	60 Hz to 140 Hz (80 Hz)
LFE Down Filter En	Enables a low pass filter to the LFE input to the downmix	• No • **Yes**
LFE Down Cutoff	Sets the cutoff frequency of the low pass filter applied to the LFE input	60 Hz to 140 Hz (80 Hz)
Surround Limiter En	Enables a limiter on the surround output from the multimerge	• No • **Yes**

Table B-4. DTS Neural Audio MultiMerge Parameters *(Continued)*

Parameter Name	Function	Options
Surround Threshold	Sets the upper threshold of the limiter applied to the surround output	-20 dBFS to **0** dBFS
Stereo Limiter en	Enables a limiter on the stereo output of the multimerge	• No • **Yes**
Stereo Threshold	Sets the upper threshold of the limiter applied to the stereo output	-20 dBFS to **0** dBFS

Table B-5. Input Selection Mode Option Descriptions

Option	Notes
Mix	• This option sums the Aux input to the L/R of the 5.1 input. • The AES1, AES2, AES3 inputs are 5.1 (L/R, C/LFE, Ls/Rs) in. • The AES4 input is 2.0 in (L/R) in. • The AES1 output is a sum of AES 1 and AES 4 (AES1L + AES4L, AES1R + AES4R). • The AES2 output is C/LFE. • The AES3 output is LsRs.
Multi	• This option only sources audio from the 5.1 input. • Inputs are AES1 (L/R), AES2 (C/LFE), AES3 (Ls/Rs). • Outputs are AES1 (L/R), AES2 (C/LFE), AES3 (Ls/Rs). • AES4 is not used
Stereo	• Audio is sourced from only the L/R pair, while simultaneously muting the C/LFE and Ls/Rs pairs of the 5.1 input (used in situations where there is information on the other inputs that you would want to ignore). • Input is AES1 (L/R) • Output is AES1 (L/R) • AES2, AES3, AES4 are not used
Aux	• This option only sources audio from the Aux input. • Input is AES4 (L/R). • Output is AES4 (L/R). • AES1, AES2, AES3 is not used

Table B-5. Input Selection Mode Option Descriptions *(Continued)*

<table>
<tr><th>Option</th><th>Notes</th></tr>
<tr><td>Multi Direct</td><td>• If audio is present on the 5.1 input, the Aux input is overridden.
• Inputs are 2.0 on AES1 (L/R) or 5.1 on AES1 (L/R), AES2 (C/LFE), AES3 (Ls/Rs) or 2.0 on AES4 (L/R).
• Outputs are 5.1 on AES1 (L/R), AES2 (C/LFE), AES3 (Ls/Rs) and 2.0 on AES4 (L/R)</td></tr>
<tr><td>Stereo Detect</td><td>If audio is present on the L/R pair of the 5.1 input, the Aux input is overridden. Information on the C/LFE and Ls/Rs pairs of the 5.1 input is ignored.</td></tr>
<tr><td>Aux Detect</td><td>• If audio is present on the Aux input, the 5.1 input is overridden.
• This is an EAS application mode.
• Inputs are 5.1 on AES1 (L/R), AES2 (C/LFE), AES3 (Ls/Rs), and EAS input on AES4 (L/R).
• Output is 5.1 on AES1 (L/R), AES2 (C/LFE), AES3 (Ls/Rs).
• When EAS appears on AES4 input, the output becomes EAS output on AES1 (L/R).</td></tr>
<tr><td>Multi Aux Stereo</td><td>• If audio is present on the 5.1 input, the Aux input is overridden.
• If only L/R is present on the 5.1 input and audio is present on the Aux, the L/R is overridden.
• If there is no audio present on C/LFE, Ls/Rs, or Aux inputs, source from L/R.

<table>
<tr><th></th><th>MultiMerge Input</th><th>Scenario 1 (5.1)</th><th>Scenario 2 (Lt/Rt)</th><th>Scenario 3</th></tr>
<tr><td>AES 1</td><td>L/R</td><td>Yes</td><td>Yes (foreign language)</td><td>Yes (foreign language)</td></tr>
<tr><td>AES 2</td><td>C/LFE</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>AES 3</td><td>LS/RS</td><td>Yes</td><td>No</td><td>No</td></tr>
<tr><td>AES 4</td><td>Aux</td><td>No</td><td>Yes (desired language)</td><td>No</td></tr>
</table>
• If 5.1 is present, take 5.1.
• If there is no 5.1 or stereo available on either L/R or AUX, take AUX.
• If stereo is only available on L/R, take L/R.</td></tr>
</table>

DTS Neural Loudness Control

Overview

DTS Neural Loudness Control is a loudness leveling device that uses advanced psycho-acoustic and signal processing techniques to accurately detect and regulate the perceived loudness of stereo and 5.1 sources. Using this feature, you can regulate audio without creating the perception of being “squished” or compressed.

One of the important aspects of loudness control is *frequency compensation*. Loudness studies dating back to Fletcher /Munson in the 1930s found that the human ear is more sensitive to different frequencies at different loudness levels. The **Frequency Compensation** parameter preserves the same perceptual frequency balance as the input signal, while correcting the loudness to match a desired **Target Level.**

For example, with **Frequency Compensation** enabled at a medium level, signals that fall below the **Target Level** setting have more gain added to middle frequencies than higher or lower frequencies. This preserves the original spectral balance. Conversely, signals that fall above the **Target Level** setting will have middle frequencies attenuated more than higher or lower frequencies. Because the **Frequency Compensation** parameter applies less gain to high and low frequencies, high or low frequency noise does not become over-emphasized.

The DTS Neural Loudness Control processing library is written in standard floating point ANSI C code, with a simple and straightforward API (application programming interface). The processing operates on separate mono buffers of floating point multichannel sources. In other words, a frame of audio samples for each channel L, R, C, LFE, Ls, and Rs is passed to the loudness control process. The loudness control engine outputs a frame of processed audio samples for each of the 5.1 output channels L, R, C, LFE, Ls, and Rs.

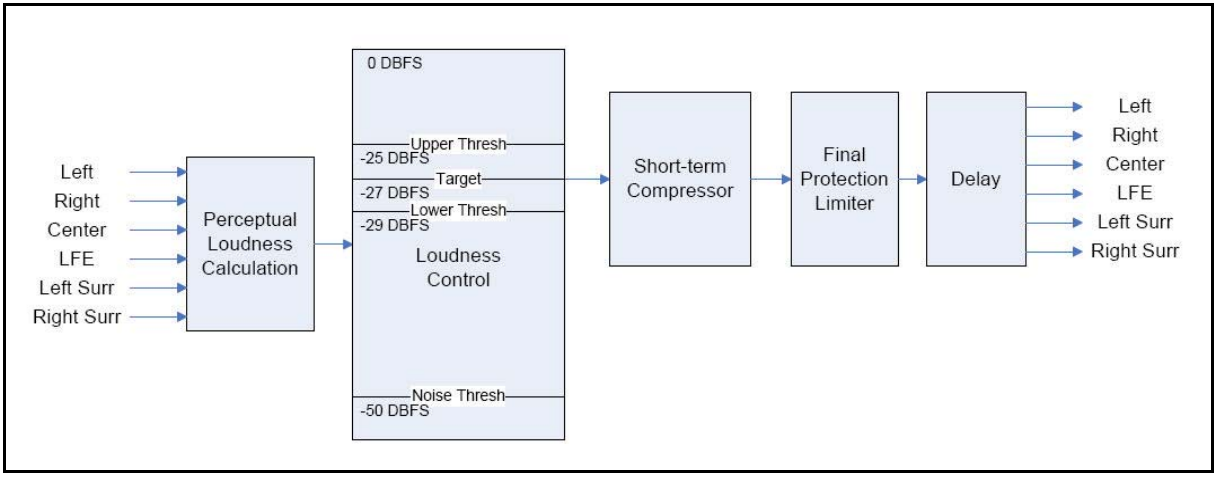


Figure B-12. Loudness Control Block Diagram

Parameters

Table B-6 on page 137 lists the parameters for the various DTS Neural Loudness Control options.

NOTE

Group 1 parameters in the XHD39OPT-LC✚6✚2✚ modules are repeated again for Group 2. In XHD39OPT-LC✚8✚ modules, these parameters appear for Groups 1, 2, 3, and 4.

Table B-6. DTS Neural Audio Loudness Control Parameters

Processing > Neural > Loudness Control		
Parameter Name	**Function**	**Options**
Preset Select	Selects a loudness control preset	• **(select preset)** • Mild • Medium • Aggressive
Processing > Neural > Loudness Control > Group 1 **Processing > Neural > Loudness Control > Group 2 (XHD39OPT-LC+6+2+ and XHD39OPT-LC+8+ only)** **Processing > Neural > Loudness Control > Group 3 (XHD39OPT-LC+8+ only)** **Processing > Neural > Loudness Control > Group 4 (XHD39OPT-LC+8+ only)**		
Bypass	Loudness Control bypass	• **LC1 enable** • LC1 bypass
Target Level	Loudness Control Target Level	-31 dBFS to -1 dBFS (**-27** dBFS)
LC Ratio	Loudness Control Ratio	0.00 to 1.00 (**0.95**)
Upper Threshold	Loudness Control Upper Threshold	0 dB to 12 dB (**0 dB**)
Lower Threshold	Loudness Control lower threshold	-12 dB to 0 dB (**0 dB**)
Freeze Window	Loudness Control freeze window	0.0 to 6.0 (**1.0**)
Noise Floor	Loudness Control Noise Floor	-60 dBFS to -40 dBFS (**-50** dBFS)
Attack Time	Loudness Control Attack Time	0 ms to 120 ms (**20** ms)
Release Time	Loudness Control Release Time	40 ms to 200 ms (**120** ms)
Freq Compensation	Sets the reference level relative to the loudness shaping	• Off • **Low** • Medium • High
Parameter Name	**Function**	**Options**
Compressor Threshold	Sets the threshold at which short term peaks are accepted	0 dB to 12 dB (**5 dB**
Compressor Ratio	Loudness Control Compressor Ratio	0.0 to 1.0 (**0.4**)
Output Limiter En	Loudness Control Output Limiter Enable	• No • **Yes**
Output Limiter Threshold	Loudness Control Output Limiter Threshold	-20 dBFS to **0** dBFS

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