grass valley

A **BELDEN** BRAND

HCO-3901

3G/HD/SD/ASI Change Over
with optional Clean Switch and ALC

Guide to Installation and Operation

M981-9900-127

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- EN 55022 Class A radiated and conducted emissions
- ENV 50204 Radiated EMF Immunity – RF 900 MHz Pulsed
- EN 61000-3-2 Harmonic current emission limits
- EN 61000-3-3 Voltage fluctuations and flicker limitations
- EN 61000-4-2 Electrostatic discharge immunity
- EN 61000-4-3 Radiated electromagnetic field immunity – radio frequencies
- EN 61000-4-4 Electrical fast transient immunity
- EN 61000-4-5 Surge transient immunity
- EN 61000-4-6 Conducted disturbances immunity
- EN 61000-4-11 Voltage-dips, short-interruption and voltage variation immunity

Table of Contents

1 HCO-3901 3G/HD/SD/ASI Change Over with Clean Switch and ALC

1.1 Introduction

The HCO-3901 from Grass Valley, a Belden Brand, is a 3x1 3G/HD/SD/ASI change-over which support 16 channels of embedded audio and metadata. The module can perform a video and audio "Clean and Silent Switch" between sources using the CS option (not available with ASI signals). In the event of a power failure, the PGM signal is protected by relays fitted on the rear module, maintaining the integrity of the selected signal at the output. Those protection relays are fully controllable via GPI. With the addition of the HCO- 3901-3DRP-R-EX rear panel, the HCO now supports paired outputs for 3G/HD/SD SDI (single outputs only for ASI).

Input selection can be performed automatically or manually.

- In automatic mode, the card will perform input selection between IN 1 and IN 2 based on internal signal analysis with alarm parameters, and the status of the inputs.

- In manual mode, any three sources can be selected:
  - from the Densité controller
  - using the iControl software
  - or simply by using a GPI input (3DRP rear only).

A GPI input can be triggered by an automation system or any simple GPI control panel.

The GPI outputs allow tallies to give status of the selected source.

The HCO-3901 provides up to eight 3G/HD/SD SDI video outputs (depending on the rear panel in use). The preview outputs are user selectable to follow the main program output, video inputs IN 1, IN 2 or IN 3.

The HCO-3901 generates audio/video fingerprints for input 1 and input 2. In combination with other cards streaming fingerprints for the same signals, an optional module in iControl can measure and report lip sync errors through the entire chain of a broadcast facility.

Grass Valley's automatic loudness control (ALC) option can eliminate objectionable loudness variations between programs and commercials (not available with ASI signals).

The module provides streaming video and audio level metering so an operator can remotely and effectively monitor the signal path using Grass Valley's iControl facility monitoring and control system.

The HCO-3901 is a 3 RU card and is available with a one or two slot rear module. Up to 20 modules can fit in a 3 RU Densité frame with a 1-slot rear module (or 19 with REF-1801).

1.2 Features

- Two Primary inputs: IN 1 & IN 2 plus one Secondary: IN 3
- Four Outputs: One Main Program plus three previews
- Eight outputs (with EX rear): paired outputs for Main Program and each of the three previews (single outputs only for ASI)
- Supports 3G, HD (1080i50/59.94, 720p50/59.94) and SD (525, 625) or ASI input and output
- Electronic switching with relay backup (on rear module) maintains selected input with power loss for Primary inputs IN 1 and IN 2
- Automatic mode using internal signal analysis with alarm parameters for IN 1 and IN 2
- Manual change-over by local frame controller, iControl, iControl Solo or GPI (3DRP rear) for 3 inputs

- Alarm reporting to iControl facility monitoring and control system
- Compatible with iControl end-to-end A/V fingerprint analyzer for lip sync error detection and measurement (not available with ASI signals)
- GPI in and out (IN 1, IN 2, IN 3, auto, bypass)
- Optional clean switch function (video and 16 channels of audio) for IN 1 and IN 2 (not available with ASI signals)
- Optional on-board automatic loudness control by Grass Valley (not available with ASI signals)
- Reference input with passive loop through (3DRP rear only)
- Two line timing window with CS option (not available with ASI signals)
- Thumbnail and audio level meter streaming for IN 1, IN 2 and PGM OUT (not available with ASI signals)
- Loudness compliant to EBU R128-2014, ATSC A/85:2013 (FCC CALM compliant) and ARIB TR-B32 (ITU-R BS.1770-3)
- HCO-3901-X4RP Adapter for 4 x HCO-3901 (Quad-Link 3G-A) - (hardware option)

1.3 Block Diagram

The following block diagrams show the functionality of the HCO-3901 and its associated rear panels.
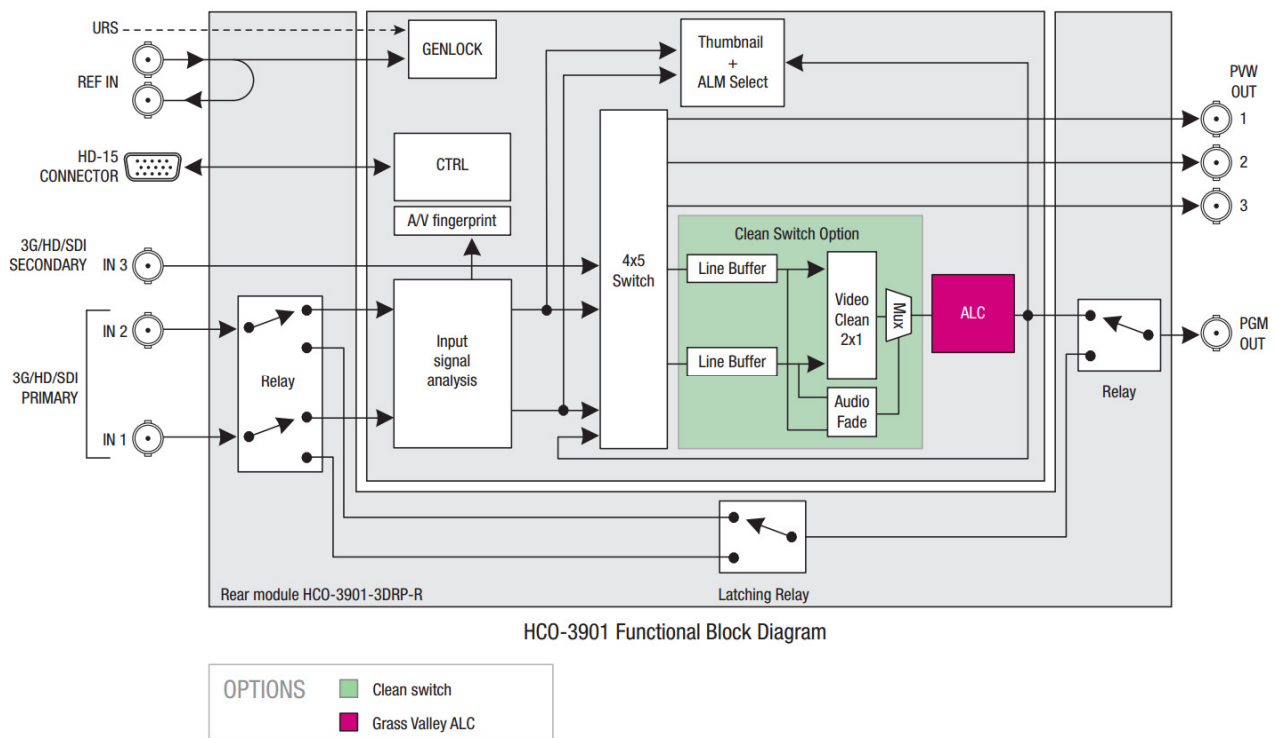
Figure 1-1 *Functional Block Diagram - HCO-3901 (shown with the HCO-3901-3DRP-R rear panel)*
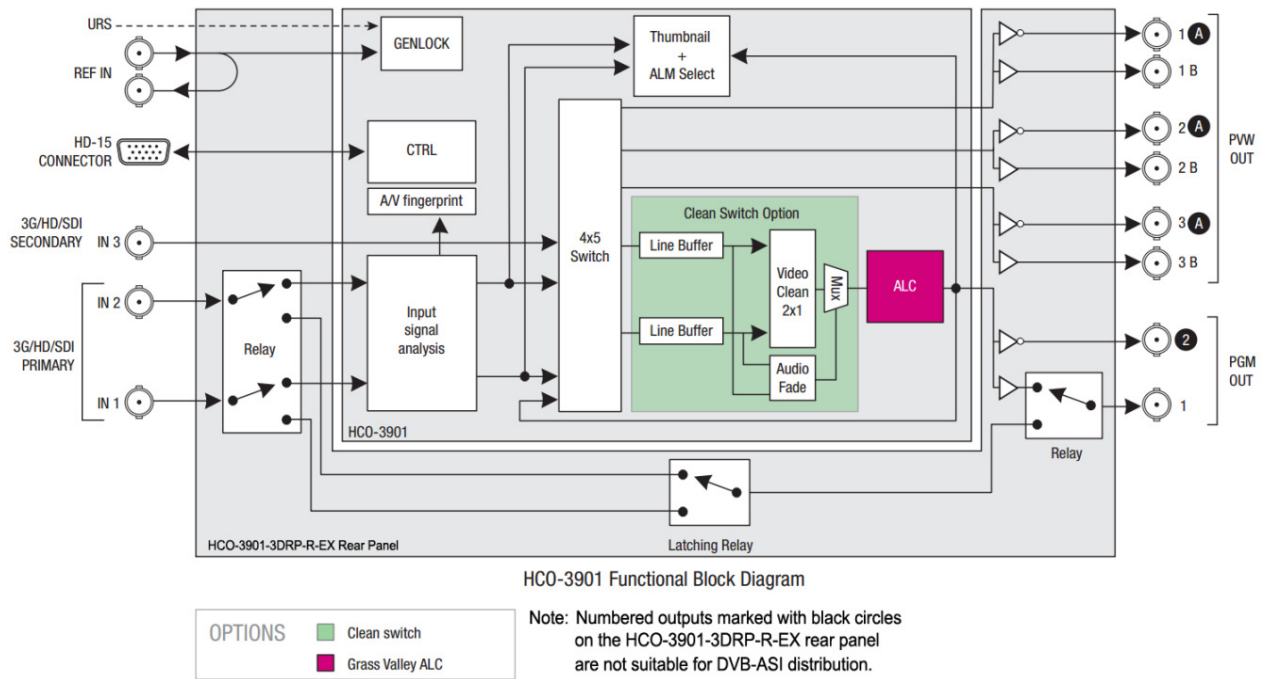
Figure 1-2 *Functional block diagram - HCO-3901 (shown with the HCO-3901-3DRP-R-EX rear panel)*

1.4   Front Card-edge Interface

The front card-edge of the HCO-3901 incorporates two elements:

- Status LED (see section 3.2)
- Select Button (see section 3.3)

An additional connector is present, intended for future use.

Figure 1-3 *Front card-edge layout*

1.5   Option: HCO-3901-X4RP Adapter for 4 x HCO-3901 (Quad-Link 3G-A)

1.5.1   Introduction

This hardware option is intended to be used with four HCO-3901 cards sharing a Quad-Link 3G-A SDI video signal.

This option allows the switching of the four cards to be synchronized.

If the CleanSwitch options are activated on the four HCO-3901 and the timing requirements are met, the switching between inputs 1 and 2 will be glitchless.
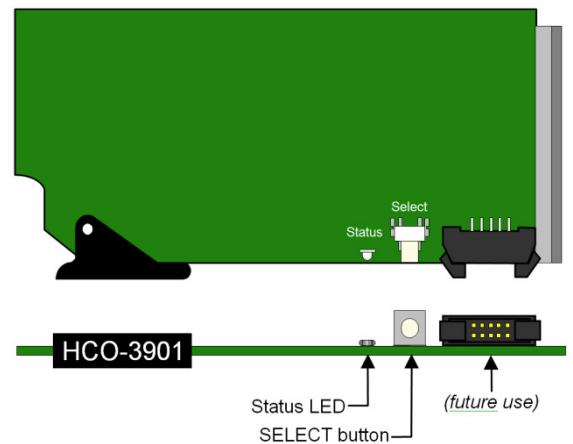
This option requires an external +5 V DC supply (6 W power) and HCO-3901 firmware version 1.2.6 or later for compatibility.

- The external supply must be connected through the HD-Sub15 connector on the HCO-3901-X4RP panel.

A single remote Control Panel (user-supplied), incorporating 5 switches and 5 LEDs, allows the four cards to be switched together from a remote keyboard, but this is not mandatory. An HD-Sub15 connector is provided on the adapter panel to support this remote control. See ANNEX 2 for circuit details.

1.5.2 HCO-3901-X4RP Features

The switching information can come from any one of the four HCO-3901 cards, triggered in several possible ways:

- Through the Densité control panel,
- Via the iControl interface,
- A detected error flagged as a Level 1 alarm.

The three other cards will share the same input selection and the same mode:

- Input: IN1, IN2 or IN3.
- Mode: AUTO or BYPASS.

Switching of all four cards together can also be triggered from the optional (user-supplied) external remote control. Five selections are offered:

- Input: IN1, IN2 or IN3.
- Mode: AUTO or BYPASS

The four cards should use the HCO-3901-3DRP-R rear panels.

- Note: it is possible to use the HCO-3901-3DRP-R-EX rear with the following restriction: the two connectors "IN3" input and "PREVIEW 3 B" output will be masked and unusable.

2 Installation

2.1 Installation in the Densité frame

The HCO-3901 and its associated rear connector rear panel must be mounted in a Densité-3 or Densité-3+ series frame, or in a GV Node.

- It is not necessary to switch off the frame's power when installing or removing the card.
- With a double-width rear panel installed, the HCO-3901 must be installed in the right-most of the two slots covered by the panel in order to mate with the panel's connectors.
- If it is placed in the wrong slot, the front panel LED will flash red. Move the card to other slot for correct operation. No damage will result to the card should this occur.

See the manual for your Densité frame for detailed instructions on installing cards and their associated rear panels.

2.2 Rear Connector Panels

There are three rear panels available for the HCO-3901. The table summarizes their features, and their layouts are shown in the figure below.

HCO-3901-3DRP-R-EX				
HCO-3901-3DRP-R				
HCO-3901-3SRP-R				
Single-slot-width panel		♦		
Double-slot-width panel			♦	♦
Bypass Relay		♦	♦	♦
CONNECTORS		**BNC**	**BNC**	**DIN**
Ref IN		♦	♦	♦
Ref IN loop out			♦	♦
GPI I/O			♦	♦
3G/HD/SD IN	1 and 2	♦	♦	♦
	3		♦	♦
3G/HD/SD OUT	PGM 1	♦	♦	♦
	PGM 2 (phase inverted)			♦
	PVW 1A (phase inverted)			♦
	PVW 1 (1B on –EX rear)	♦	♦	♦
	PVW 2A (phase inverted)			♦
	PVW 2 (2B on –EX rear)		♦	♦
	PVW 3A (phase inverted)			♦
	PVW 3 (3B on –EX rear)		♦	♦
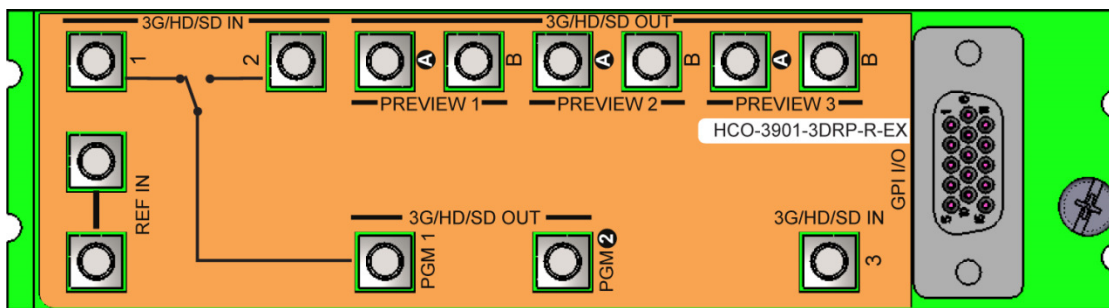
HCO-3901-3DRP-R-EX – Double-width Densité-3 rear with bypass relay and DIN connectors. This rear features extra PGM and PWV outputs. ***Outputs designated by a black circle are phase-inverted and not suitable for ASI.***
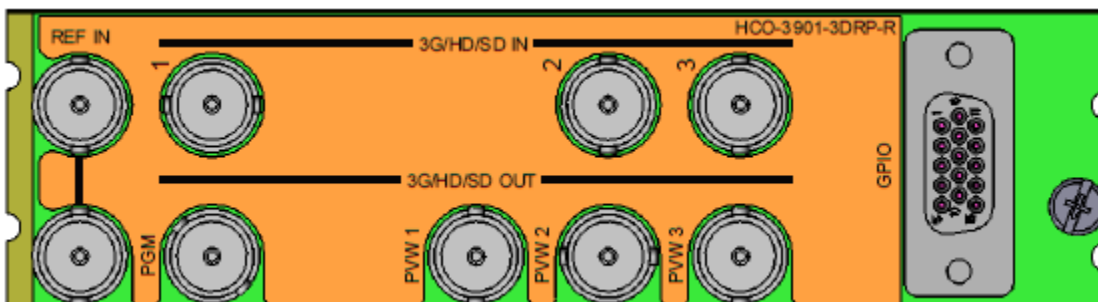
HCO-3901-3DRP-R – double-width Densité-3 rear with bypass relay and BNC connectors.

HCO-3901-3SRP-R – Single-width Densité-3 rear with bypass relay. The lower connector count is suitable for situations where the third input, multiple preview outputs and GPI interface are not required, saving a frame slot for another card.

Figure 2-1 *HCO-3901 Rear Panels*

The rear panel connections are as follows:

3G/HD/SD IN – serial digital 3G/HD/SD input

Connect up to three serial digital video signals, conforming to the SMPTE 292M standard for HD input signals, SMPTE 259M standard for SD input signals or SMPTE-425M for 3Gbps signals (level A only; level B will be flagged as an input error), to the BNCs labeled **3G/HD/SD SDI IN**. DVB-ASI per EN 50083-9 is also supported. The HCO-3901 will automatically switch to the detected line format.

OUT – serial digital video outputs

The HCO-3901 provides up to eight 3G/HD/SD SDI video outputs (depending on the rear panel in use), labeled **PGM** (program) and **PVW1, PVW2** and **PVW3** (preview). The SDI video signals conform to the SMPTE 292M, SMPTE 259M-C and SMPTE 425M standards.

DVB-ASI per EN 50083-9 is also supported. *Note: The phase-inverted outputs on the –EX rear panel (indicated by white lettering in a black circle) are not suitable for DVB-ASI distribution.*

REF IN – Studio reference input

For external synchronization, connect a black studio reference signal to the BNC labeled **REF IN**. *NB: The REF IN loop-through, when provided, must be terminated if not used.*

The reference input must conform to SMPTE 170M/SMPTE 318M/ITU 624-4/BUT 470-6 for standard definition signals and SMPTE 274M / SMPTE 296M for high definition signals and is used to phase the HD/SD SDI outputs to the studio. A reference mismatch may occur if there is a difference between the input video format's frame rate and the reference format's frame rate. When a mismatch occurs, an input error will be flagged and the card-edge Status LED will turn red to indicate the mismatch. The table shows the supported reference signals with respect to the input signals:

Supported input signals	Reference
525 (SMPTE-259M-C)	NTSC (SMPTE-170M)
625 (SMPTE-259M-C)	PAL (ITU 624-4)
1080i50 (SMPTE-274M)	1080i50, PAL
1080i59.94 (SMPTE-274M)	1080i59.94, NTSC
720p50 (SMPTE-296M)	720p50, PAL
720p59.94 (SMPTE-296M)	720p59.94, NTSC
3G Lvl A 50/60	NTSC, PAL
ASI (EN50083-9)	-------

GPI connector (3DRP rears only)

The double-width rear panels of the HCO-3901 include a GPI interface that allows control of the switch process. When constructing and using an external GPI box, be aware of the following:

1. The HCO-3901 card monitors the external power supply voltage on the GPI input. If the voltage is less than approximately 4V, an alarm will be raised.
2. GPI IN 1 and GPI IN 2 should NOT be activated at the same time – DAMAGE TO THE RELAY MAY RESULT.
3. GPI inputs trigger on a momentary pulse. To be recognized without ambiguity, a GPI trigger pulse should have a duration of at least 40 ms.
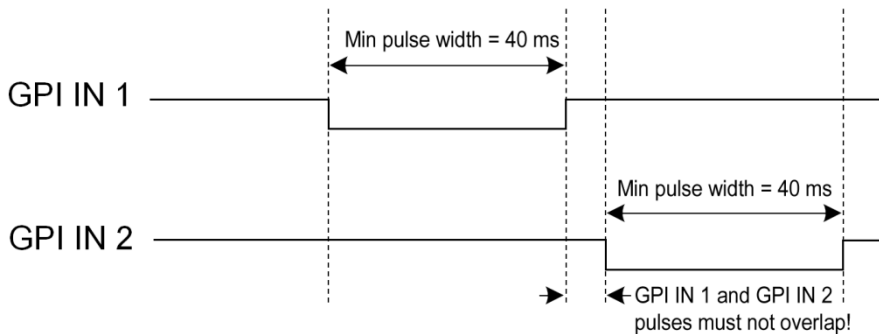
Figure 2-2 GPI input trigger pulse timing

The GPIO interface is implemented on an HD-15 connector. The pinout is as follows:

GPI Label	Pin #
GPI-IN-1	4
GPI-IN-2	9
GPI-IN-3	3
GPI-BYPASS-IN	6
GPI-AUTO-IN	10
GPI-OUT-1	1
GPI-OUT-2	7
GPI-OUT-3	2
GPI-BYPASS-OUT	11
GPI-AUTO-OUT	5
GPI-PWR-IN	15
GND	8,12,13,14

Note: *Users may find it convenient to purchase Grass Valley's NSH-15M HD15-to-terminal-block adapter, which provides easy access to the GPI-I/O pins.*

Using the GPI interface

- Trigger the GPI-IN-1, GPI-IN-2 or GPI-IN-3 pin to select that input.
- Trigger the AUTO-IN or BYPASS-IN pin to select that mode
- Read the GPI-OUT-1, GPI-OUT-2 and GPI-OUT-3 pins to identify which output is selected ("0" indicates selection)
- Read the AUTO-OUT and BYPASS-OUT pins to determine whether either of these modes is in operation ("0" indicates selection).

Note: When a GPI INPUT is triggered while the card is operating in auto mode, the card switches to the input selected by the GPI. It may switch to manual mode, or remain in auto mode, depending on the setting in the Switch / Config Auto panel (see page 16). It is possible to select the input via GPI even when the HCO-3901 is in bypass mode.

When GPI-IN-3 is triggered the card will switch to Manual mode and will have to be placed back in AUTO mode by the user if desired. When the user configures AUTO mode again, the card will select IN1 by default unless the user has previously selected IN2 manually.

2.3   HCO-3901-X4RP

2.3.1   Installation

This option should be used with HCO-3901-3DRP-R rear panels. The four HCO-3901 cards must be placed side by side in the frame.

- The HCO-3901-X4RP needs an external +5 V DC supply to function.
- It can be used with or without a user-supplied external control panel.
- The external power supply and the external control panel (if implemented) are connected via the HD-15 connector on the panel.
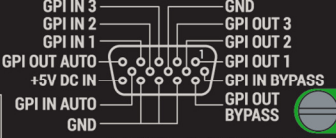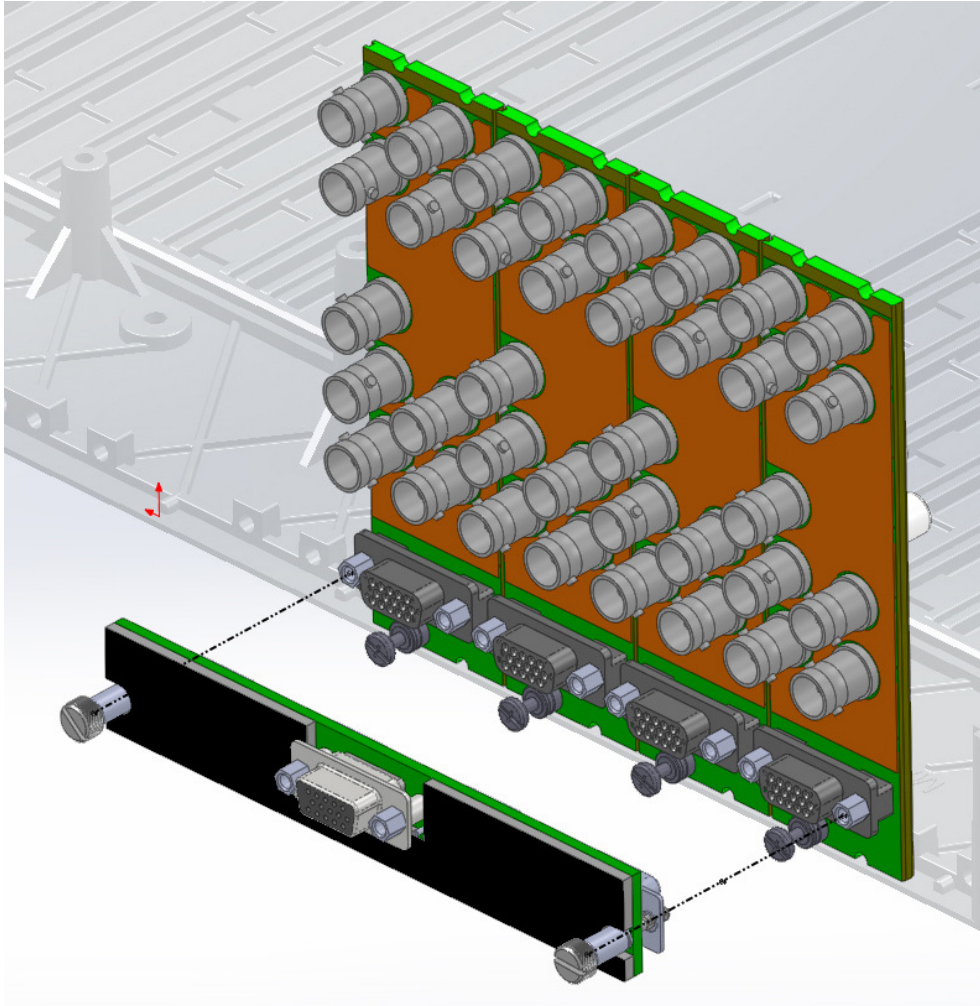
To install the HCO-3901-X4RP adapter

1. Loosen the rear module mounting screws at the bottom of the four adjacent HCO-3901 rear panels enough to allow some movement.
2. Position the HCO-3901-X4RP against the HD-15 connectors on the four rear panels, and push it firmly to seat the connectors.
3. Tighten the rear module mounting screws.
4. Tighten the two thumbscrews on the HCO-3901-X4RP assembly.
5. Connect an HD-15 connector carrying the external 5V supply, and also the optional external control panel interface (if implemented) to the socket on the HCO-3901-X4RP assembly. The pinout is shown on the assembly, and matches the pinout of the GPI connectors on the HCO-3901 rear panels.

A suggested schematic for an external control panel is shown in Annex 2 at the end of this document.

2.3.2 Utilisation

The HCO-3901-X4RP allows the four HCO-3901 cards to switch simultaneously between inputs (IN1, IN2 or IN3) and modes (AUTO or BYPASS). The option uses the GPI interfaces on the four HCO-3901 rear panels to implement the synchronized switching feature.

- If one of the cards switches, the GPI output status is read by the other cards and triggers them to switch as well.
- Pushing a button on the optional remote control panel activates the GPI inputs on all four cards, switching them simultaneously.

  The pin configuration and functionality of the GPI connector on the X4RP assembly is exactly the same as the GPI interface on an HCO-3901 rear panel.

See the technical specifications for GPI interface requirements.

Note:

It is recommended that the four HCO-3901 cards be placed in the same operating configuration to start, to ensure that there are no unexpected situations that will confuse the logical operation of the system. Note that the cards have no means to detect the presence of the X4RP.

Warning:

DO NOT USE the HCO-3901 cards in AUTO, "SWITCH AND RETURN" mode associated with the "STAY IN AUTO MODE" selection for "GPI control event". In case of a failure not affecting the four SDI signals, this will lead to a permanent switching between IN1 and IN2.

3 Operation

3.1 Control options

The HCO-3901 can be controlled in different ways:

- The local control panel and its push-buttons can be used to move through a menu of parameters and to adjust parameter values (see section 3.3).

- Grass Valley's iControl system can be used to access the card's operating parameters from a remote computer, using a convenient graphical user interface (GUI). (see section 3.4)

3.2 Card-Edge Status LED

The status monitor LED is located on the front card-edge of the HCO-3901, and is visible through the front access door of the DENSITÉ-3 frame. This multi-color LED indicates the status of the HCO-3901 by color, and by flashing/steady illumination.

The chart shows how the various error conditions that can be flagged on the HCO-3901 affect the LED status.
- If a cell is gray, the error condition cannot cause the LED to assume that status
- If more than one LED status is possible for a particular error condition, the status is configurable.
  See Section 3.4.14 for details.
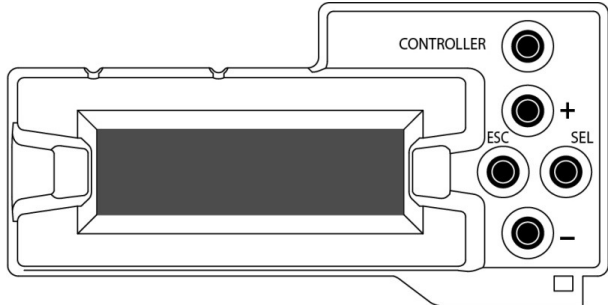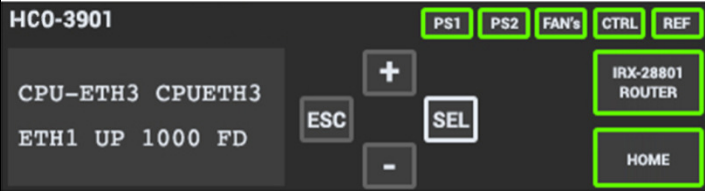- The factory default status is shown by a ✪

The LED will always show the most severe detected error status that it is configured to display, and in the chart error severity increases from left to right, with green representing no error/disabled, and flashing red the most severe error.

Error Condition	LED Status			
	Green	Yellow	Red	Flashing Red
No errors	✪			
Backup Input			✪	
Reference Presence			✪	
Bypass Mode			✪	
Video error			✪	
Expected video format error			✪	
Input timing out of range			✪	
Reference mismatch			✪	
Black detection			✪	
Freeze detection			✪	
Audio presence group			✪	
Audio silence channel			✪	
Rear presence error				✪
Card Fan				✪

If the LED is Flashing Yellow, it means that the card is selected for local control using the Densité frame's control panel. See Section 3.3 for details.

3.3 Local control using the Densité frame control panel

There are two types of local control panel:

Panel type	Frame models	Appearance
Physical	Densité-2, Densité-3, Densité-3+FR1,	
Touch screen	Densité 3+FR4, GV Node	

The local control panel is fastened to the front of the controller card.
- The physical panel is accessed by opening the front door of the frame.
- The touch screen panel is accessed through an aperture in the frame door.

The panel consists of a display capable of displaying two lines of text, each 16 characters in length, and four pushbuttons. The functionality of the pushbuttons is as follows:

[+] [−]   Used for menu navigation and value modification

[SEL]   Gives access to the next menu level. When a parameter value is shown, pushing this button once enables modification of the value using the [+] and [−] buttons; a second push confirms the new value

[ESC]   Cancels the effect of parameter value changes that have not been confirmed; pushing [ESC] causes the parameter to revert to its former value.

Pushing [ESC] moves the user back up to the previous menu level. At the main menu, [ESC] does *not* exit the menu system. To exit, re-push the [SEL] button for the card being controlled.

If no controls are operated for 30 seconds, the controller reverts to its normal standby status, and the selected card's STATUS reverts to its normal operating mode.

To assign the local control panel to the HCO-3901:
- Physical Panel: Push the SELECT button on the HCO-3901 card edge (see Section 1.4).
- Touch-screen panel: In the home screen, touch the virtual button corresponding to this HCO-3901.

The STATUS LED on the HCO-3901 flashes yellow, and the touch-screen status shows yellow for the IPG-3901.

Use the control panel buttons to navigate through the menu, as described above.
The complete menu structure is shown in <u>ANNEX – HCO-3901 User Interface</u>, beginning on page 44.

3.4 Remote control using iControl

The operation of the HCO-3901 may be controlled using Grass Valley's iControl system.

- This manual describes the control panels associated with the HCO-3901 and their use.
- Please consult the iControl User's Guide for information about setting up and operating iControl.

In iControl Navigator or iControl Websites, double-click on the HCO-3901 icon to open the control panel.

3.4.1 The iControl graphic interface window

The basic window structure for the HCO-3901 is shown in figure 3.2. The window identification line gives the card type (*HCO-3901*) and the slot number where the card installed in its Densité frame.
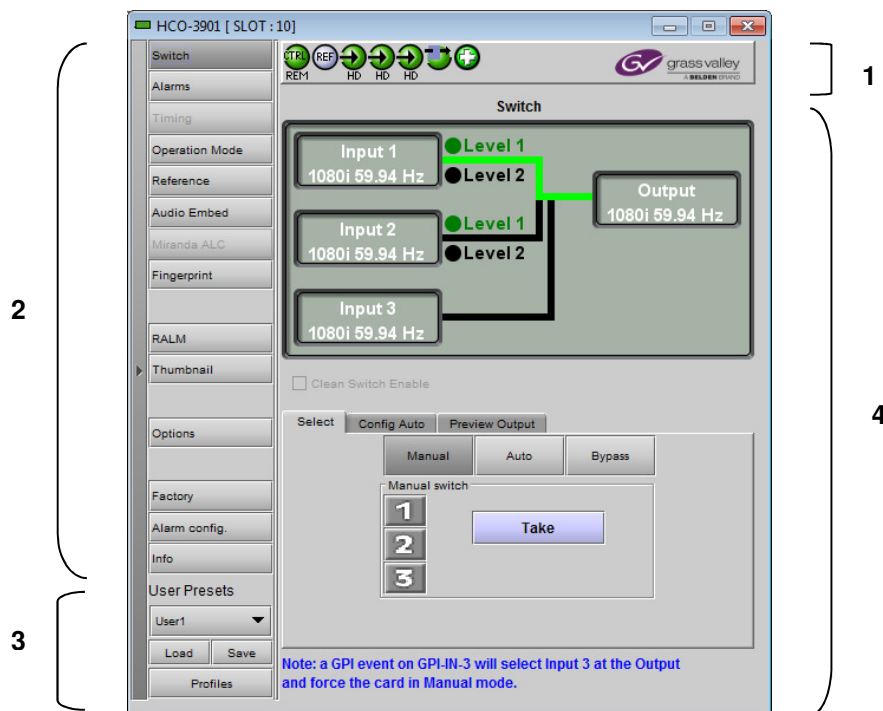
Figure 3.2 *HCO-3901 iControl graphic interface window*

There are four main sections in the window itself, identified in figure 3.2:

1. The Status Icon area shows a series of seven icons that report the status of some card parameters. Figure 3.3 shows the various forms that may appear; their meaning is described below.

   Icon 1 – Control status
   - A: Green - Remote Control via iControl
   - B: Yellow - Local control using the menu

   Icon 2 – Reference status
   - A: Green - Locked to external reference
   - B: Red - Reference is missing
   - C: Grey - No reference
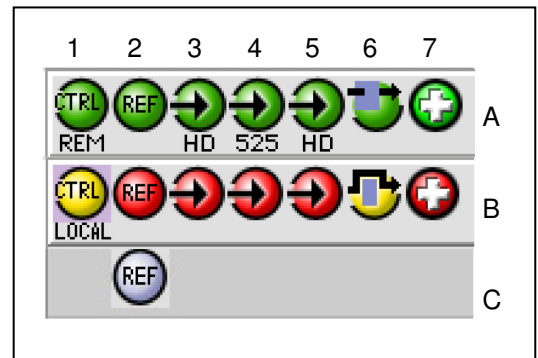
Figure 3.3 *Status Icons*

Icon 3 – Input 1 status
- • A: Green - Status OK; format shown
- • B: Red – Error

Icon 4 – Input 2 status
- • A: Green - Status OK
- • B: Red - Error

Icon 5 – Input 3 status
- • A: Green - Status OK
- • B: Red - Error

Icon 6 – Bypass Status
- • A: Bypass not active – switch operational
- • B: Bypass activated

Icon 7 – Card Heath status
- • A: Green - Fan OK and GPI Power OK
- • B: Red - Fan error or GPI Power Error

When an icon shows an error state, a message describing the error will appear beneath the icons. If there is more than one error, they will cycle through the display.
- • The icon whose status or error message is shown is highlighted with a mauve background
- • Move the cursor over an icon to display its status message. Error message cycling will resume when the cursor is no longer over an icon

2. The left-hand side of the panel contains a series of buttons that control the contents of the main window (section 4). Click on one to access the indicated controls. The selected button is highlighted (darker) and the main panel heading matched the button name.

3. At the bottom are the controls for the User presets.

4. This section contains the main operating controls and displays for managing the HCO-3901's feature set. The contents are selected by clicking a button on the left-hand side of the screen.

The left side of the window, containing sections 2 and 3, can be hidden or revealed by clicking the arrow icon at the center of the left side border.

Each of the panels associated with the groups accessed from the buttons in Section 2, and shown in Section 4, is described individually in the following sections.

3.4.2 The *Switch* panel

The HCO-3901 has three modes of switch operation, selected from the Select tab in the Switch control panel.

Clean switching in any of these modes is enabled by selecting the **Clean Switch Enable** checkbox.
This activates the Timing panel, where the clean switch timing requirements can be set up. See section 3.4.4

NOTE – Input 3 is a secondary input, and has limitations:
- • *It is not included in the AUTO switch mode and the associated alarm-setting functionality.*
- • *Clean switches are not supported.*
- • *It does not generate thumbnails or fingerprints.*
- • *It is not selectable for audio level metering (RALM) or ALC.*

The graphic at the top of the panel identifies the input that is currently selected, and indicates the validity of all 3 inputs by the color of their icons.

1. **Manual switch**

   Manually switches the HCO-3901 output between the three possible sources: input 1, input 2 or input 3.

   • Click the Manual button. The three possible sources are shown on the left. The graphic on the page shows which input is currently active.

   • Click the Manual Switch button for a different source. The selection shows green, and the Take button is activated, appearing red.

   • A countdown (from 10 seconds) underneath the Take button shows how long the Take button will remain active before it times out.

   • Click the Take button while it is active to switch the HCO-3901 output over to the other source.
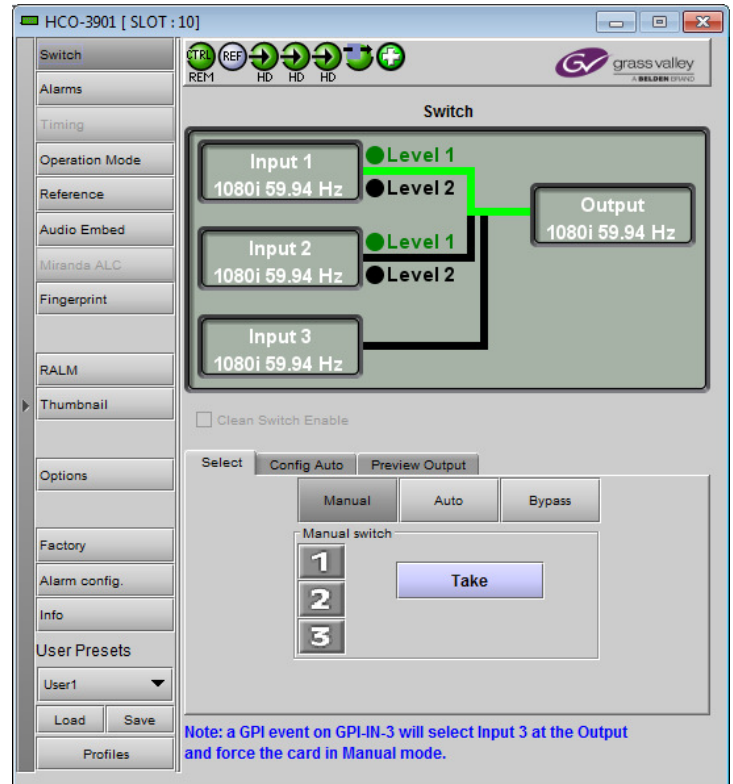

Figure 3.4 *Switch panel*

2. **Auto switch**

   Auto switch uses Alarms based on the status of the selected input to determine whether the other input should be selected.

   • Click the Auto mode button in the *Select* tab to activate the Auto mode.

   • NOTE – AUTO mode is only available for inputs 1 and 2. If you select AUTO mode while input 3 is active, you will be warned that if you proceed, the input selection will automatically fall over to Input 1
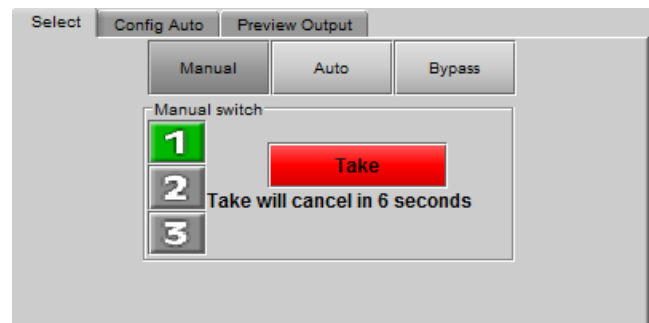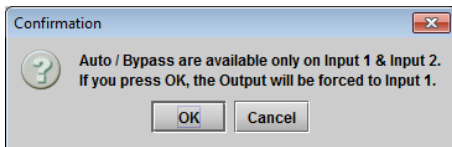

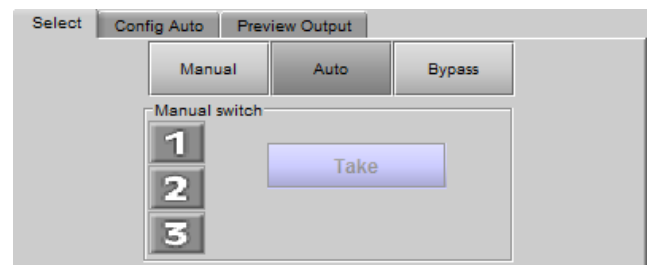**Figure 3.5** *Manual Switch controls*

Figure 3.6 *Auto Mode*

In addition, if you select Input 3 using GPI-IN-3 while in Auto mode, you will force the selection of input 3, and the card will revert to Manual mode.
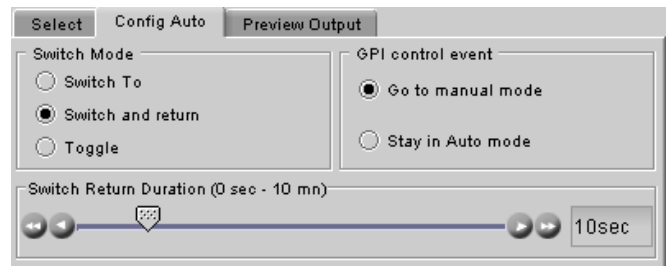
Auto mode operation:

- If Input 1 fails with an alarm level of higher priority than input 2, the HCO-3901 will automatically switch over to Input 2

- If the Switch Mode has been set to *Switch and Return* (see below), the HCO-3901 can automatically switch back to Input 1 if it has a lower alarm priority than input 2.

- If the Switch Mode has been set to *Switch To* (see below), the HCO-3901 will not switch back to Input 1 even if it has a lower alarm priority.

- **NOTE:** for certain errors, the switch-over is delayed by 0.5 second beyond the selected duration because it often happens that the same signal is feeding both inputs, possibly offset by a frame or two. The delay ensures that the alternate feed is indeed error-free before switching to it. The errors affected are:
  - o Video error (when detection duration is 1 second or more)
  - o Black detect
  - o Freeze detect (when detection duration is 1 second or more)
  - o Audio silence detect

Select the *Config Auto* tab to select the Auto Mode functionality:

In the *Switch Mode* box, select:

- o *Switch To:* switches to the input #2 (if it is valid) when the alarm conditions trigger a switch

- o *Switch and Return:* switches to input #2 (if is valid) when the alarm conditions trigger a switch, and then switches back after a predetermined interval, counted from the time the original input returns to a valid state. Use the slider at the bottom of the tab to set the interval (0 to 59 seconds, 1 to 10 minutes).

Figure 3.7   *Configure the Auto Switch Mode*

- o *Toggle:* switches to the other input (if it is valid) when the alarm conditions trigger a switch. It will stay on that input until an alarm condition appears for that input in which case it will switch to the other input again (if it is valid).

In the *GPI Control Event* box, select whether the HCO-3901 will change to manual mode, or remain in auto mode, when a switch is triggered from a GPI while the HCO-3901 is in auto mode.

Warning:

When using four HCO-3901 cards sharing a Quad-Link 3G-A SDI video signal, in conjunction with the HCO-3901-X4RP hardware option:

DO NOT USE the HCO-3901 cards in AUTO, "SWITCH AND RETURN" mode associated with the "STAY IN AUTO MODE" selection for "GPI control event". In case of a failure not affecting the four SDI signals, this will lead to a permanent switching between IN1 and IN2.

3. Bypass

Bypass triggers relays located on the rear panel to connect the inputs directly to the outputs. When the HCO-3901 is in Bypass:

- The currently selected input (IN 1 or IN2) is connected to PGM OUT
- IN 3 is not protected by the bypass relays, and cannot appear on PGM OUT
- The PVW (preview) outputs are disabled
- There is no video / audio / metadata analysis

The bypassed HCO-3901 card is electrically disconnected from the Densité signal system, and can be removed from the frame with no discontinuity in the signal path.

NOTE: *Grass Valley recommends that you set the HCO-3901 in BYPASS before removing it from the Densité frame to ensure no disruption in the signal when the card is removed and reinserted.*

The Operating Mode can also be selected using the Menu from the local control panel (see Section 3.3), and via the GPI interface on the rear connector panel (see Section 2.2)
Preview Output tab

Use this tab to select the source for the three preview outputs.

- Auto   Selects the Preview output based on the current program output:

Program	Preview
Input 1	Input 2
Input 2	Input 1
Input 3	Input 3

- Input 1   Rear panel input 1
- Input 2   Rear panel input 2
- Input 3   Rear panel input 3
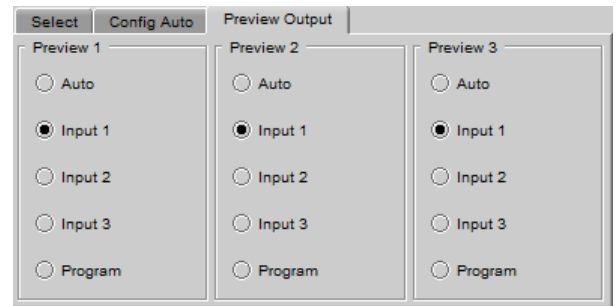- Program: The same as the Program output

Figure 3.8 *Preview output source selection*

3.4.3   The *Alarms* panel

The HCO-3901 continuously monitors the condition and status of the input signals it is processing. The information is used to decide whether the input must be switched in Auto mode. It is also used to flag the status of the card in the iControl system.

Note that, because Auto mode involves only inputs 1 and 2, input 3 is not considered in the alarm process, and does not appear in this panel.

In general:

- A number of parameter values are continuously tested against user-defined thresholds or for presence/absence.
- Each parameter test is assigned a Level, to determine the extent to which it contributes to the changeover decision.

Many alarms can be enabled or disabled using the *Enable* checkbox in their control panel (see below).
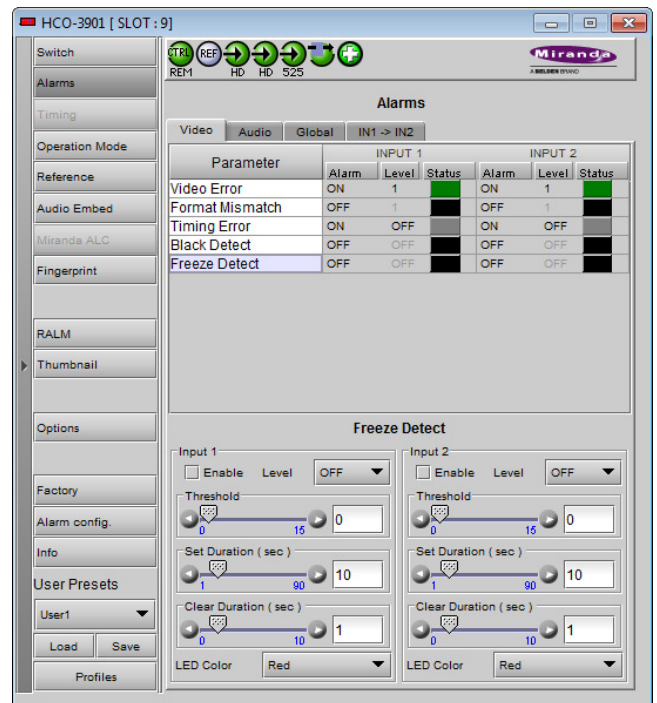
An alarm that is enabled:

Figure 3.9 *Alarms panel*

- Contributes to the switch decision process based on its LEVEL.
- Is reflected in the device status as reported to iControl (LEVEL has no bearing on this)

Each alarm is assigned a LEVEL that determines its contribution to the switch decision process. Possible levels are:
- 1 – highest significance
- 2 – lower significance
- OFF – not used in the switch decision process

Some alarms are arbitrarily assigned as Level 1 and cannot be changed by the user (e.g. Video Error is always a Level 1 alarm). Their Enable checkbox is ticked, and greyed-out.

Other alarms have a pulldown in their control panel that allows the user to set the level.

The HCO-3901 uses the most significant alarm detected for an input as the alarm level for that input, and then uses the truth table shown here to decide whether to switch from input 1 to input 2 and back.

The Alarms section of the iControl panel gives access to all alarm-related settings.

- The Video and Audio tabs show lists of the parameters for which alarms exist, and show the current settings for each, for both inputs.

INPUT 1 Alarm level 1	INPUT 1 Alarm level 2	INPUT 2 Alarm level 1	INPUT 2 Alarm level 2	OUTPUT: SELECT INPUT #
○	○	x	x	1
○	●	○	○	2
○	●	○	●	1 or last
○	●	●	x	1
●	x	○	○	2
●	x	○	●	2
●	x	●	x	1 or last

● = Alarm at this level
○ = No Alarm at this level
x = Don't care

- Click on one to select it, and the control panel for adjusting that parameter appears at the bottom of the screen.

Video – Video Error alarm

This error is always ENABLED and the level set to 1, 2 or OFF. The factory default value is level 1.

Use the slider to set the duration for which the error must continuously exist before the alarm is flagged. The nominal range of durations is 0 to 5 seconds. When durations ≥1 sec are selected, there is an additional 0.5 seconds intrinsic to the error detection algorithm that will prevent switching when there are nearly-coincident errors at the two inputs.

In AUTO MODE, if switching is not desired when input 1 changes video format, set the Duration to at least 0.5 seconds

The LED color is not configurable.

NOTE: This is the only error that can be triggered in the ASI operating mode. All other errors will be disabled.
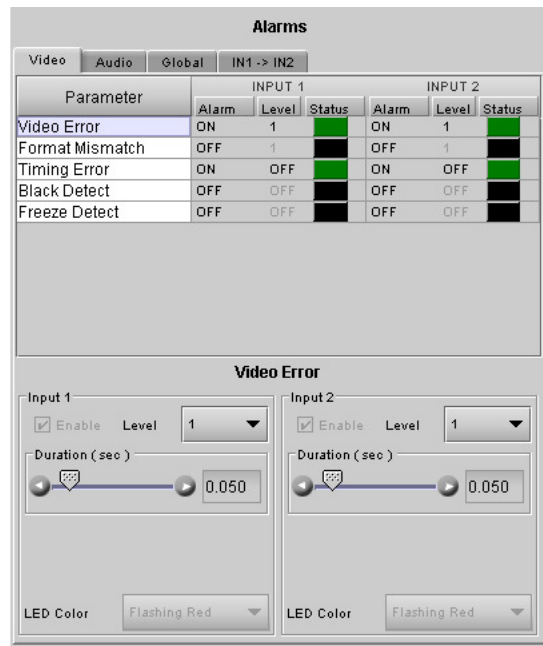
Figure 3.10 *Video Error alarm configuration*

Video – Format Mismatch

The user sets an expected format for each input using the pulldown in the control panel. The HCO-3901 compares this with the actual format detected at the input, and flags an error if they do not match, after a 0.5 second delay.

Formats listed in the pulldown are:
- 525
- 625
- 1080i 59.94 Hz
- 1080i 50 Hz
- 1080p 59/50
- 720p 59.94 Hz
- 720p 50 Hz
- SD
- HD

This error can be Enabled using the checkbox, and the level set to 1, 2 or OFF.

Use the *LED Color* pulldown to choose the color that will be displayed by the status LED on the card edge when a Format Mismatch error is detected. Choices are:

- Green, Yellow, Red, Flashing Red

Figure 3.11   *Format Mismatch alarm config*

Video – Timing Error

This error is generated if the timing offset between the output signal and the video input is greater than 2 lines.

- This alarm is always enabled, but is not a switch condition for either of the inputs.

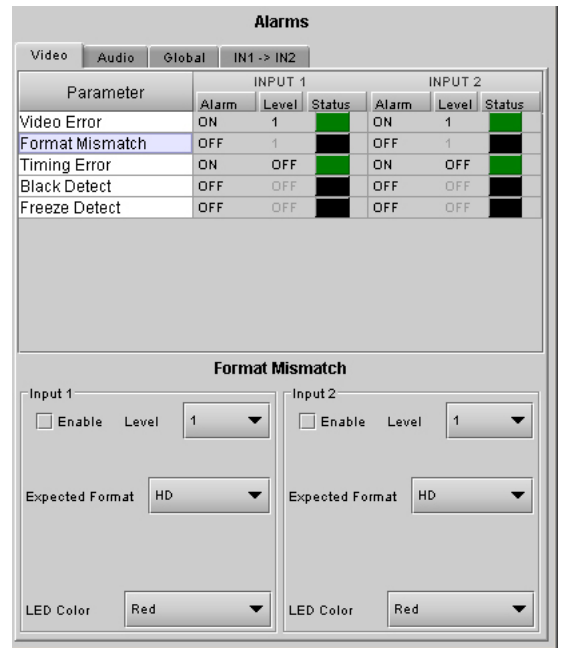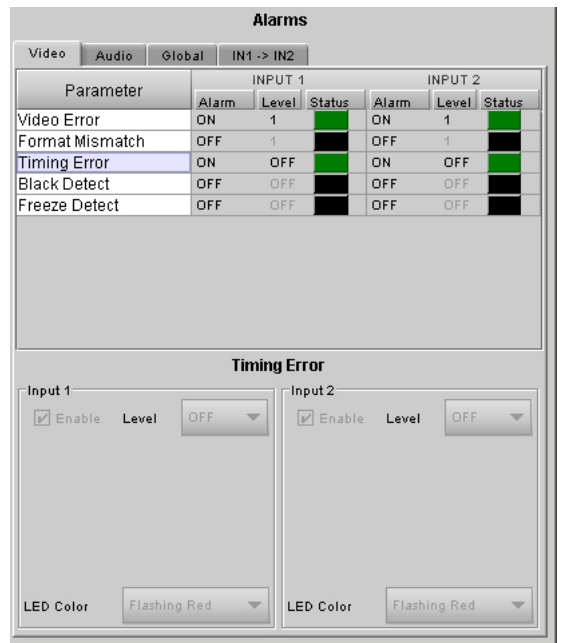The LED color is not configurable for this alarm.

Figure 3.12   *Timing Error alarm Config.*

Video – Black Detect

This error detects the presence of a continuous black signal for a period of time; the error is flagged only when the time duration criterion has been satisfied.

This error can be Enabled using the checkbox, and the level set to 1, 2 or OFF.

The user sets the detection parameters for this error using two sliders:

- Threshold (mV) – sets the signal level below which Black will be considered to have been detected.

- Set Duration (sec) – sets the time interval over which Black must be continuously detected before the error is flagged. An additional delay of 0.5 sec is included to prevent switching when there are nearly-coincident errors at the two inputs.

- Clear Duration (sec) – sets the time interval during which a non-black signal must be continuously detected before a previously-flagged Black error will be cleared.

Use the *LED Color* pulldown to choose the color that will be displayed by the status LED on the card edge when a Black Detect error is detected. Choices are:

- Green, Yellow, Red, Flashing Red

Figure 3.13 *Black Detect alarm Config.*

Note that if a Video Error is detected on the backup input (i.e. input 2), a switch over to that input will be inhibited until the Input 2 Set Duration has expired, and then will only succeed if input 2 is no longer in error.

Video – Freeze Detect

This error detects the presence of a signal freeze (i.e. no change in content) for a period of time; the error is flagged only when the time duration criterion has been satisfied.

This error can be Enabled using the checkbox, and the level set to 1, 2 or OFF.

The user sets the detection parameters for this error using two sliders:

- Threshold – sets a sensitivity level for detection that will allow minor level changes due to noise, but will detect a lack of change in the picture content. The value (in the range 0 to 15) is arbitrary, and may need to be set by trial and error depending on the signal characteristics.

    A higher threshold value will be more tolerant to video noise than a lower value and the card may not be able to detect the freeze in presence of changing pixels. If you want to detect a pure digital video freeze, you can use the value zero. Otherwise, the threshold should be increased until a consistent freeze is detected.
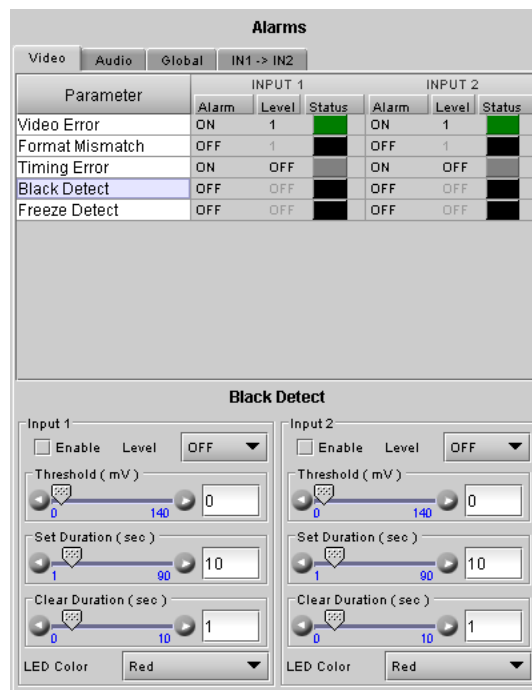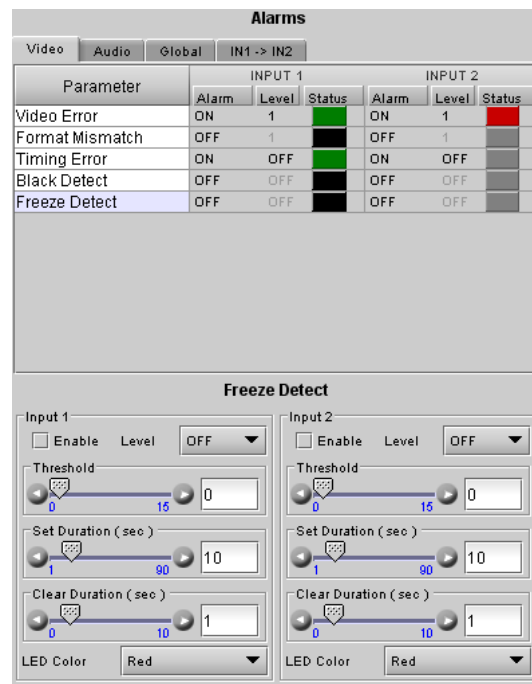
Figure 3.14 *Freeze Detect alarm Config.*

- Set Duration (sec) – sets the time interval over which a freeze must be continuously detected before the error is flagged. The nominal range of durations is 1 to 90 seconds. There is an additional 0.5 seconds intrinsic to the error detection algorithm that will prevent switching when there are nearly-coincident errors at the two inputs.

- Clear Duration (sec) – sets the time interval during which an active signal must be continuously detected before a previously-flagged Freeze error will be cleared.

Use the *LED Color* pulldown to choose the color that will be displayed by the status LED on the card edge when a Freeze Detect error is detected. Choices are:

- Green, Yellow, Red, Flashing Red

Note that if a Video Error is detected on the backup input (i.e. input 2), a switch over to that input will be inhibited until the Input 2 SET Duration has expired, and then will only succeed if input 2 is no longer in error.

Audio – Audio Grp 1 (same for Grp.2, 3, 4)

This error detects the absence of audio in the named group.

This error can be Enabled using the checkbox, and the level set to 1, 2 or OFF.

The user sets the detection parameter for this error using the slider:

- Duration (sec) – sets the time interval over which loss of audio must be continuously detected before the error is flagged

Use the *LED Color* pulldown to choose the color that will be displayed by the status LED on the card edge when an Audio Grp error is detected. Choices are:

- Green, Yellow, Red, Flashing Red

Figure 3.15 *Audio Grp alarm config.*

Audio – Silence CH1 (same for CH2-16)

This error flags the continuous absence of sound level in the specified audio channel for a specified duration.

NB *– this error applies only to PCM audio*

This error can be Enabled using the checkbox, and the level set to 1, 2 or OFF.

The user sets the detection parameters for this error using two sliders:

- Threshold (dB) – sets the signal level below which silence will be considered to have been detected.

- Duration (sec) – sets the time interval over which silence must be continuously detected before the error is flagged. An additional delay of 0.5 sec is included to prevent switching when there are nearly-coincident errors at the two inputs.
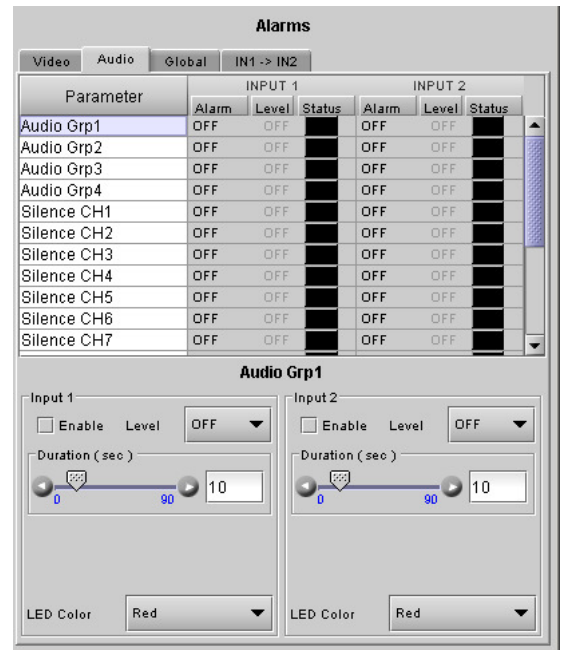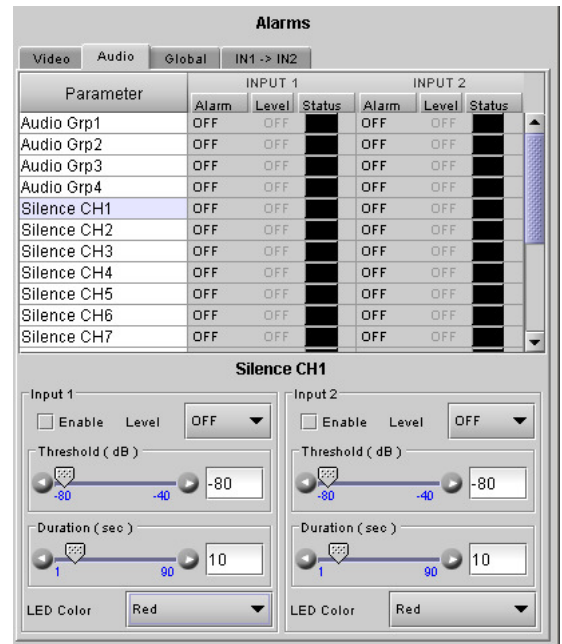

Figure 3.16 *Silence CH alarm configuration*

Use the *LED Color* pulldown to choose the color that will be displayed by the status LED on the card edge when a Silence CH error is detected. Choices are:
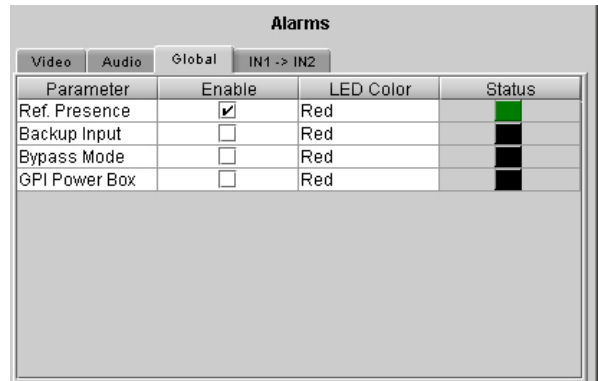
- Green, Yellow, Red, Flashing Red

Global alarms

The parameters found under the Global tab do not have individual control panels.

These alarms DO NOT CONTRIBUTE to the switch decision process, but are included in the card status.

Four parameters are included in the Global Alarms list:

- Ref Presence – checks for the presence of a reference signal on the rear panel connector.
- Backup input – when Red, indicates the selection of the Backup Input (input 2) while in AUTO MODE only.
- Bypass Mode – indicates whether the HCO-3901 is in *Bypass* mode.

Figure 3.17 *Global alarms*

- GPI Power Box – detects whether a GPI box is supplying power to the GPI connector on the rear panel. Displays an error when the alarm is enabled and no power is detected.

Each parameter has two configurable features:

- *Enable* – click in the *Enable* check box to include the alarm in the card status
- *LED Color* - click on the color name in the LED Color column and a pulldown will appear offering the choice of Green, Yellow, Red or Flashing Red. The current status is shown by the colored icon in the right-hand column

In1->In2

Click the checkbox to force all alarm parameters for input 2 to match those set for input 1.

- When this is selected, only one set of alarm parameters is displayed for both inputs.
- When the checkbox is deselected, the alarm parameters for input 2 revert to their previous values, i.e. as they were before the checkbox was selected.

**Figure 3.18** *IN1→ IN2 alarm configuration*

3.4.4   The *Timing* panel

*NOTE: this panel is only available when the **Clean Switch Enable** checkbox is selected in the Switch panel (see section 3.4.2).*

The PGM output timing, with respect to a detected reference, is programmable from -2 to +2 video lines with programmable increments at -2, -1, -½, 0, +½, +1, or +2 lines.

In order for no output timing errors to occur, the input source must be synchronized (phased) to within a pre-defined window. The size of this window will always remain the same length for a given format, but the start and end of the window is a function of the user-programmed output timing. The size of the window is [2 lines less 12.3µs] for SD sources and [2 lines less 4.5µs] for HD sources. The following examples illustrate this concept.

- Example (a) shows the supported input timing window for a user-programmed output timing of +1 line. In order for the HCO-3901 to guarantee no output timing errors, the input signal must be phased to within -1 line of the reference signal and +1 line – 12.3µs (SD) of the reference signal.

- Example (b) shows the supported input timing window for a user-programmed output timing of +½ line. In order for the HCO-3901 to guarantee no output timing errors, the input signal must be phased to within   -1½ line of the reference signal and +½ line – 12.3µs (SD) of the reference signal.

Notice for both examples, that the size of the supported input range is 2 lines – 12.3µs (SD) and 2 lines – 4.5µs (HD).
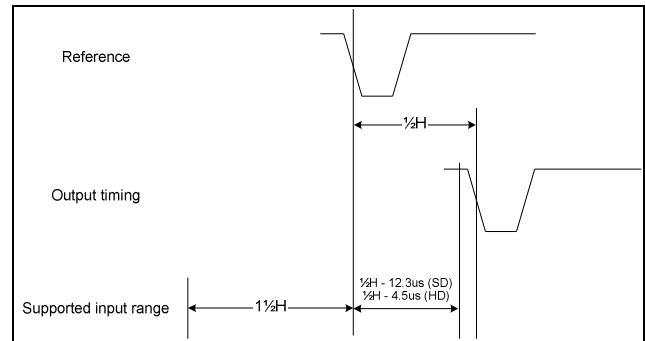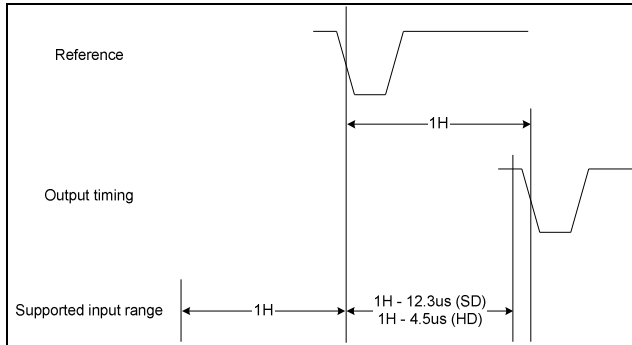
(a) Output timing = +1H

(b) Output timing = +1/2H

Figure 3.19 *Output timing examples*

The graphic and the text at the top of the panel show the timing of the two inputs with respect to the reference. Input timing measurements are shown above (Input 1) and below (Input 2) the user-programmed output timing (shown in blue and set using the pulldown below the graphic). If the measured input timing respects the supported input window, this measurement will remain green. If not, the measurement will turn red.

Output Timing

Use the *Vertical* pulldown to offset the output from the reference by a number of video lines.
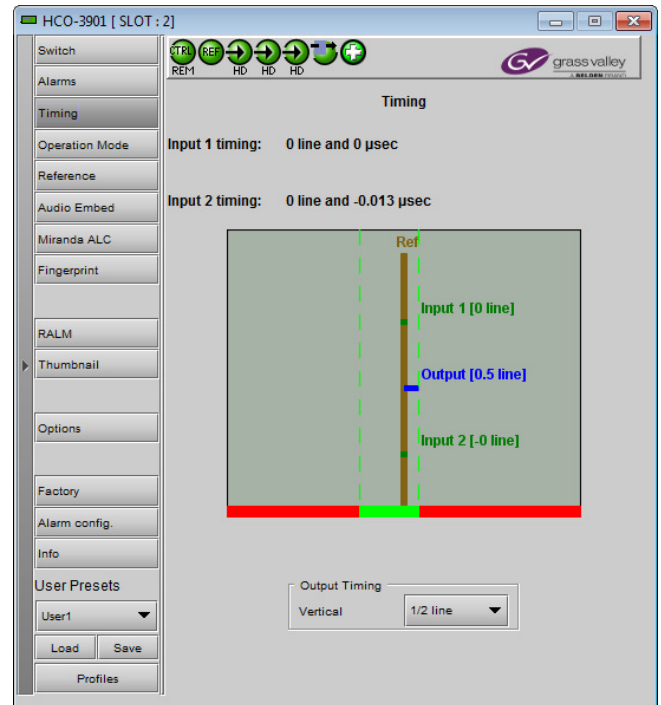
Figure 3.20 *Timing panel*

3.4.5   The *Operation Mode* panel

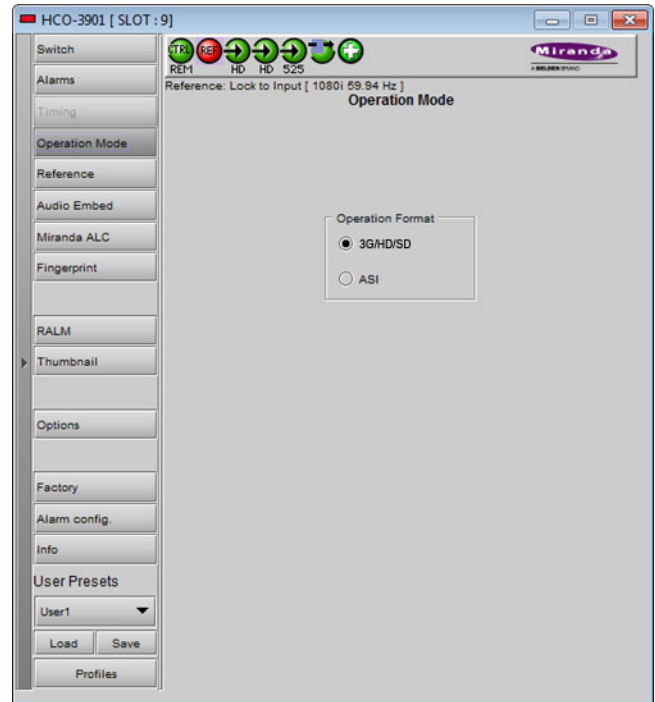Use the radio buttons in the Operation Format box to choose whether this HCO-3901 will operate using 3G/HD/SD, or ASI.

Figure 3.21   *Operation Mode Panel*
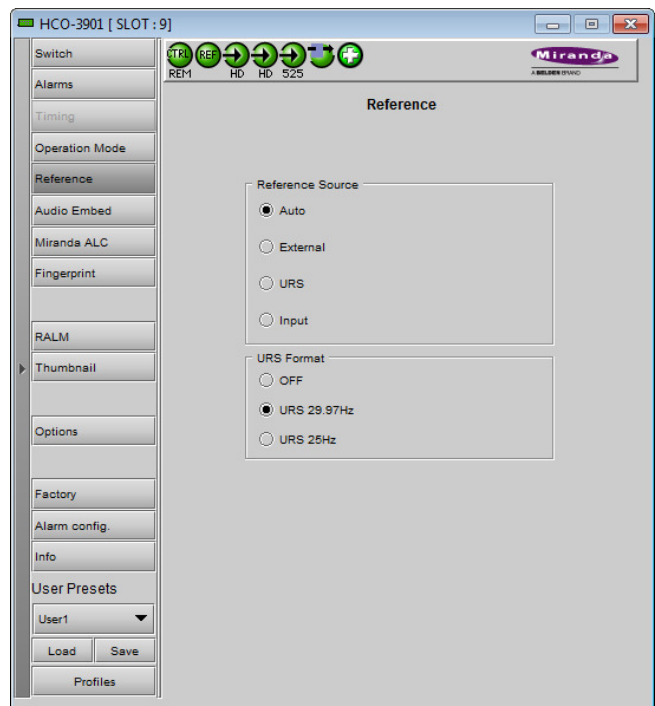
3.4.6   The *Reference* panel

The HCO-3901 output signals should always be genlocked to some reference source. The genlock source is selected in the Reference control panel. Use the radio buttons in the Reference Source area to select from the following options:

- Auto – this mode selects the first source detected in this order of priority:
  o Reference input
  o URS
  o Selected Input signal
- External – selects the signal connected to the rear-panel REF IN connector
- URS (Universal Reference Signal) – selects the internal reference from the backplane
- Input – uses the currently-selected input signal.

URS Format – use the radio buttons in the URS Format area to select whether the URS is OFF, 29.97 Hz or 25 Hz.

The genlock is used to assure a switch during the vertical interval of the genlock source.

See the Timing panel (section 3.4.4) for a display of the measured timing between the outputs and the reference, and to set the output timing.

Figure 3.22   *Reference Panel*

Note that when the ALC option is active but clean switch is not active (either the option has not been purchased, or is available but not activated), the reference source is forced to the selected input. The user can select a different reference here, but that selection will only become active when clean switch is activated. In this case, a warning message will appear in the panel.

3.4.7 The *Audio Embed* panel

SD Audio Embed Input 1 & SD Audio Embed Input 2
Use the pulldown to select the number of audio bits to be embedded at the output from these inputs.

Audio is processed in the HCO-3901 according to the following rules:

1. Supported serial formats include
   - SMPTE-299,
   - SMPTE-272M-C (Embedded audio)

2. When switching PCM audio, a fade-out / fade-in is performed on a few samples to avoid audio glitches.

3. When switching Dolby-E and AC-3 audio, no fade-out / fade-in is performed. For Dolby-E, the channel switches on the video switching line (i.e. between 2 packets).

4. Audio embedding is 20 or 24 bits (only for SD inputs).

5. 16 channels per input are supported

6. Note: These controls are disabled when clean switch is disabled and the ALC option is not enabled. In this case, the HCO-3901 acts as an intelligent 2x1 router.
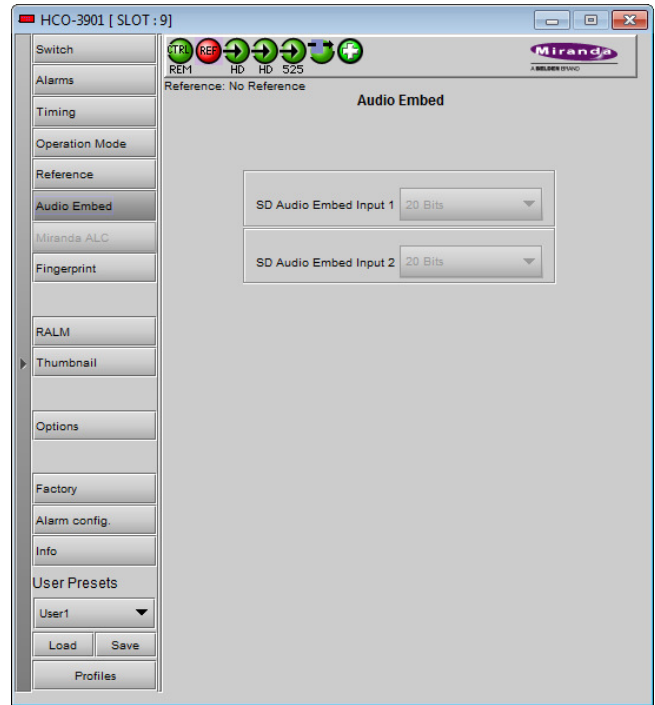

Figure 3.23 *Audio Embed panel*

3.4.8 The *ALC* panel

Minimizing loudness differences between segments in a playout channel is an important issue in a world where multiple programs originating in different formats from different sources must be integrated seamlessly. The Automatic Loudness Control (ALC) option is the solution to this need. It uses Grass Valley's proprietary *wideband* ALC algorithm.

- Identified as HCO-3901-OPT-ALC-X, where X can be 2, 6, 8 or 16 input channels. The table shows the ALC models available :

Model	Description	Output Channel Config.	
		PGM 1 & 2	**PGM 3-8**
HCO-3901-OPT-ALC-2	2-Channel ALC, up to 2 programs	Up to 2.0	N/A
HCO-3901-OPT-ALC-6	6-Channel ALC, up to 8 programs	Up to 5.1	Up to 5.1
HCO-3901-OPT-ALC-8	8-Channel ALC, up to 8 programs	Up to 7.1	Up to 7.1
HCO-3901-OPT-ALC-16	16-Channel ALC, up to 8 programs	Up to 7.1	Up to 7.1

Depending on the model, different channel configurations are possible as listed in the table above. The 2-channel ALC supports only two independent programs (either one 2.0 program, or 2 mono programs). All other ALC models supports up to 8 independent programs (mono channel, 2.0 channels, 3.0 channels, 4.0 channels, 5.1 channels and 7.1 channels).

Note: The ALC works with PCM audio. If non-PCM audio like Dolby-E or AC-3 is fed to the module, it will be ignored and all the program channels will be bypassed to prevent interference with the other PCM audio channel

3.4.8.1   Config tab

Channels per program
Pull-downs are available to select the number of channels per program. Depending on the ALC model, you may have different possible selections, from 1 to 8 channels per program.

Input channels selection
An input shuffler allows any combination of the available channels to be used as inputs to each ALC program.

Note: An input channel cannot be assigned to more than one (1) program.

Global Config - Mode
This pull-down selects the type of filtering that is applied to the audio content of all programs:
- EBU R128
- A85 ITU-R BS.1770
- ARIB TR-B32

Enable Loudness Monitoring turns ON the ALC input and output loudness monitoring for all programs.

3.4.8.2   PGM1-8 tabs

Loudness monitoring
When turned ON, the loudness meters display the program input loudness (before ALC processing), the dynamic correction applied by the ALC, the ALC limiter correction, and the program output loudness (after ALC processing).

The input and output loudness are given in **dBFS** or **LKFS**, depending on the selected ALC filter (dB without filtering, LKFS for ITU-R BS.1770 filtering). Loudness meters are integrated over a 10 second period using a "sliding-window", which is equivalent to the *Short-term* mode in Dolby's LM100 loudness meter.

Dynamic and limiter corrections are always given in dB. Each correction meter is integrated over a period of 250 milliseconds.

ALC Presets
Three factory presets for the ALC are available to cover most broadcast applications.

- *Factory Light –* The ALC applies low dynamic range compression on the audio program content. The overall response time is relatively slow, which reduces the ALC

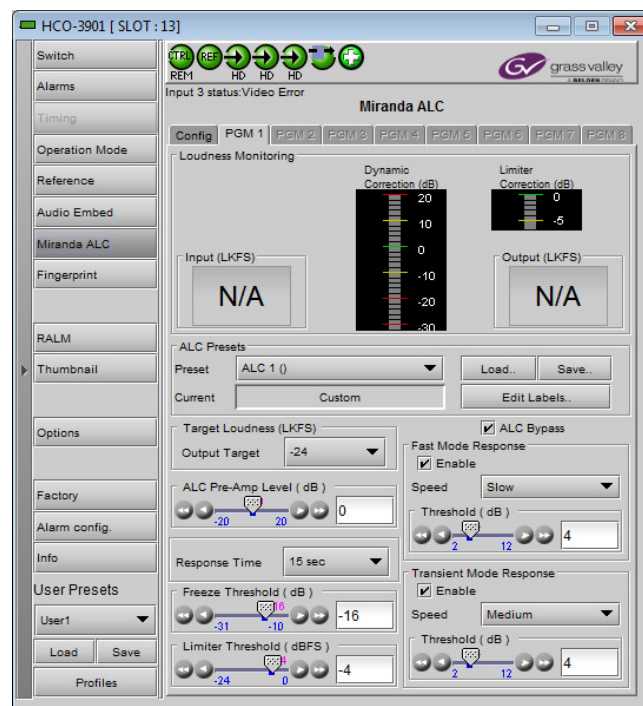**Figure 3.24** *ALC – Config tab*

Figure 3.25 *ALC – PGM1 to PGM8 tab*

ability to tightly follow the target output loudness. Using this preset, the program content will sound a little more dense, while keeping most of the original program dynamic range.

- *Factory Standard* **–** The ALC applies moderate dynamic range compression on the audio program content. The overall response time is also moderate, which allows the ALC to follow the target output loudness quite well. This preset is well-suited for most types of audio content. It is the factory preset loaded when loading the card default parameters.

- *Factory Heavy* **–** The ALC applies high dynamic range compression on the audio program content. The overall response time is relatively fast, which improves the ALC ability to tightly follow the target output loudness. Using this preset, the program output content will sound much more dense, less dynamic.

Five user presets are also available to save and load custom configurations of the ALC. These presets are labeled ALC 1 to 5 but the user can edit the preset names via the "Edit Labels" button.

We *STRONGLY* recommend starting with the ALC factory preset (Light, Standard, Heavy) that is closest to the desired objective, then fine tuning it to reach the desired goal. This will minimize the troubles that will likely be encountered as many adjustments interact.

ALC Bypass
Checking this box bypasses the ALC processing, and the input channels pass through to the output unaltered.

Target Loudness
Sets the target output loudness. This value sets the *average* output loudness, which means that due to the program dynamics, the output loudness will move around the selected target. With the ALC filter set to *None*, the target output loudness ranges from -10 dBFS to -31 dBFS. With the ALC filter set to ITU-R BS.1770, the target output loudness ranges from -10 LKFS to -31 LKFS.
Here's the time-domain response of the ALC:
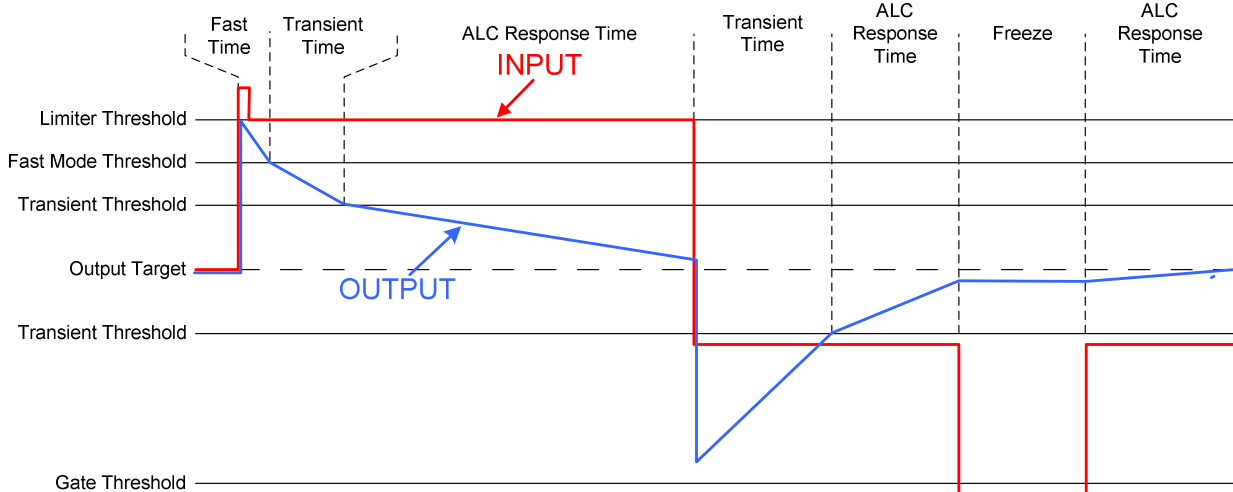
ALC Pre-Amp Level
A pre-amp stage is available in front of the ALC to compensate for programs having an input loudness out of the ALC tracking range (very low or very high input loudness). The pre-amp level ranges from -20 dB to + 20 dB, in steps of 1 dB.

Fast Mode Response
The *Fast Mode Response* is optional and is enabled by checking the **Enable** box.

The ALC *Fast Mode Response* kicks in whenever the input loudness goes over the **Fast Mode Threshold** and loudness is reduced, in a few milliseconds. The **Fast Mode Threshold** is given in dB with respect to the target loudness and ranges from 2 to 12 dB, in dB steps.

Transient Mode Response
The *Transient Mode Response* is optional and is enabled by checking the **Enable** box.

The ALC *Transient Mode Response* kicks in whenever the input loudness goes over or under the **Transient Mode Threshold**. The **Transient Mode Threshold** is symmetric with respect to the target loudness and ranges from 2 to 12 dB, in dB steps. When the input loudness is over the **Transient Mode Threshold** , loudness is reduced following the rate set by the **Speed** pull-down. When the input loudness is under the **Transient Mode Threshold**, loudness is increased, again following the **Speed** pull-down, which ranges from Slow (up to 15 seconds) to Fast (up to 4 seconds).

Response Time
Outside of the *Fast* and *Transient* modes ranges, the ALC performs loudness correction slowly, following the **Response Time**. Response time values are : 5 sec, 10 sec, 15 sec, 20 sec, 30 sec, 45 sec, 1 min, 5 min, 10 min, 15 min, 20 min.

Gate Threshold
The **Gate Threshold** sets the threshold under which the ALC will stop to increase loudness. This avoids quiet portions of programs (and noise) to be boosted unintentionally. If the input program loudness is under the **Gate Threshold** for more than 30 seconds, the ALC will smoothly return to 0 dB of loudness correction.

Limiter Threshold
The **Limiter Threshold** will limit the output loudness under the selected threshold. This avoids loud portions of programs to be clipped unintentionally. If the input program loudness is over the **Limiter Threshold**, the ALC will reduce the loudness very quickly, in 1 millisecond.

3.4.9   The *Fingerprint* panel

Fingerprinting technology on this card functions in conjunction with iControl.

- ***iControl 5.0 and higher is required.***

HCO-3901 streaming is ON by default, but the management of the stream is handled in iControl, and there is no local control of the process at this card control panel, except to select the window, and to turn streaming OFF if there are problems with the stream or the network.

- Use the pulldown at the top of the panel to turn Fingerprint Streaming ON or OFF

> See the iControl Version 5.00 User's Guide (Grass Valley document 226-99M00-284) for a description of Fingerprint management in iControl.
>
> See Chapter 9, "Fingerprint Comparison and Analysis".

Individual fingerprints are generated for Input 1, Input 2 and PGM out. Use the tabs in the panel to select one of these.

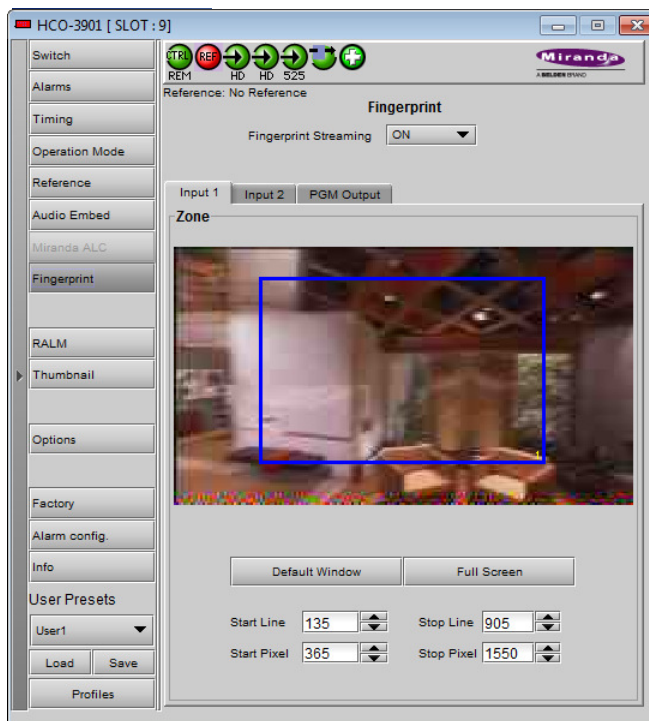**Note: Fingerprint generation is disabled when input 3 is selected.**

Figure 3.26 *Fingerprint panel – Input 1 or Input 2*

Note: The windows for Inputs 1 and 2 can be adjusted independently. The PGM Output window settings follow those of the selected input, and are shown in the tab but cannot be adjusted there.

Zone

Select the area of the image within which fingerprint data will be calculated and streamed.

- The selected area is shown as a blue outline on the control panel window, superimposed over a thumbnail of the video.
- The thumbnail is only available when the Input Control box is selected in the Thumbnail panel.

Default Window – a factory default is specified which is applied consistently to all Grass Valley fingerprinting devices. It places the window in the central "action area" of the image, generally avoiding letterboxes and static graphics that are usually found in the periphery of the image.

Full Screen – opens the window to include the complete video image.

Start/Stop Line & Pixel – allows the user to create a custom window in response to particular or unusual image content.
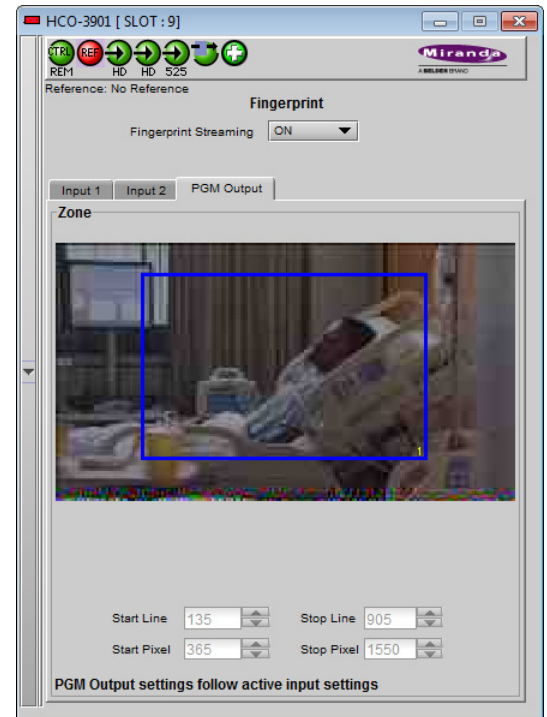
- The custom window can be placed anywhere within the picture.
- Type the value into the data box and Enter, or use the scroll arrows to change the value

Use a mouse to resize – you may also use your mouse to move and resize the window. Click within the blue frame and it will turn yellow and display control handles. Mouse over a handle until the cursor switches to an arrow icon, and then drag the handle to resize the window. When you are not over a handle, the 4-arrow cursor allows you to drag the window to a new location

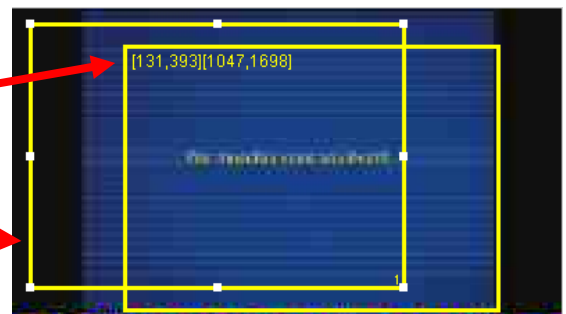**Figure 3.27** *Fingerprint panel – PGM output*

- While you are resizing with the mouse, the start and stop line and pixel are shown in the top left of the frame area, in this format:

  [start line, start pixel][stop line, stop pixel]

- The original position of the frame remains visible, so the amount of change can easily be seen

In operation:

- Use the fingerprints from Inputs 1 and 2 for comparison with fingerprints from upstream sources
- Use the fingerprint from the output for comparison with fingerprints from downstream devices.

3.4.10 The *RALM* panel

The Remote Audio Level Meter (RALM) panel displays audio level meters that can be assigned to audio arriving at both inputs of the HCO-3901.

Use the checkboxes in the RALM Remote Control section at the bottom of the panel to select the audio to be displayed on the meters.

The display window is divided into two sections of two meter-pairs each.

- The left-hand section displays the audio associated with the first group selected using the checkboxes in the RALM Remote Control section of the panel (as indicated in the label above the meters)

- The right-hand section displays the audio associated with the second group selected using the checkboxes in the RALM Remote Control section of the panel (as indicated in the label above the meters)

Figure 3.28 *RALM Panel*

You may select any of the eight AES available in inputs 1 and 2; there is no need to select one from input 1 and one from input 2.

- A maximum of four AES can be selected at any time
- You must deselect one of the inputs before you can select another one to replace it.

Once the groups are selected, use the controls in the RALM Connections tab to turn individual meter-pairs on and off.

Speed – select the meter response from the pull-down list, options are [fast, medium, slow]

RALM Connections tab

Use the radio buttons to turn the meter display ON (RALM) or OFF for the indicated channels. The meter appears directly above the controls.

Reset Counter: click this button to reset the overload counter on the ALM display to zero. See the next section for instructions on setting up the overload counter.

Figure 3.29 *RALM Connections tab*

Meter Ballistics Config tab

Type – select a type of meter from the pull-down list

The meter is divided into three zones, and the dividing points and color of each zone are individually configurable in this tab.
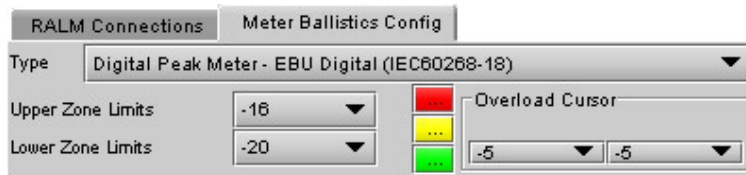

Figure 3.30 *Meter Ballistics Config tab*

Upper Zone Limits – select the crossover level between the upper and middle zones of the meter (the range of values shown in the pull-down list depends on the type of meter selected)

Lower Zone Limits – select the crossover level between the middle and lower zones of the meter (the range of values shown in the pull-down list depends on the type of meter selected)

Color samples – the three samples show the current selected color for the upper, middle and lower zones of the meter.

- Click on the color sample of a zone to open a color selection panel to choose a different color for that zone

Overload Cursor – The overload cursor appears on the meter as an arrowhead in the meter scale. The two pulldown boxes set the position of the overload cursor on the left and right meters. If the audio level on that channel goes above the cursor, the Overload Counter at the top of the meter is incremented.

The *Overload Counter* shows a running count of the number of overloads detected. The Overload level is shown by a marker beside the meter, and its position can be set under the *Meter Ballistics Config* tab

The *Phasemeter* (located at the bottom of the RALM meter display) is a small meter that represents the phase correlation factor between the two channels of a pair.
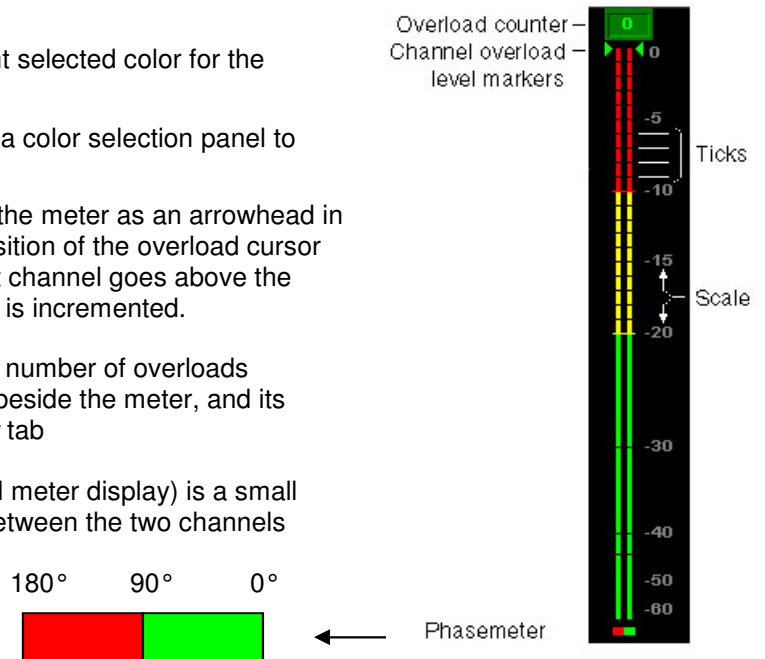

Figure 3.31 *RALM meter details*

3.4.11 The *Thumbnail* panel

The thumbnail area displays thumbnail images for the inputs and outputs selected in the Player area.

Player – Click the checkboxes to select which thumbnails will be displayed. Only those whose Control checkbox has been selected will be available.

- Input 1
- Input 2
- Program output
- Preview output (use the *Previews Select* pulldown at the bottom of the panel to select which of the three preview outputs will be displayed)

  Note that Input 3 is not available for selection, and no thumbnails are generated for it.

If only one is selected it will appear full screen, otherwise those selected will appear in a grid as shown in the figure.

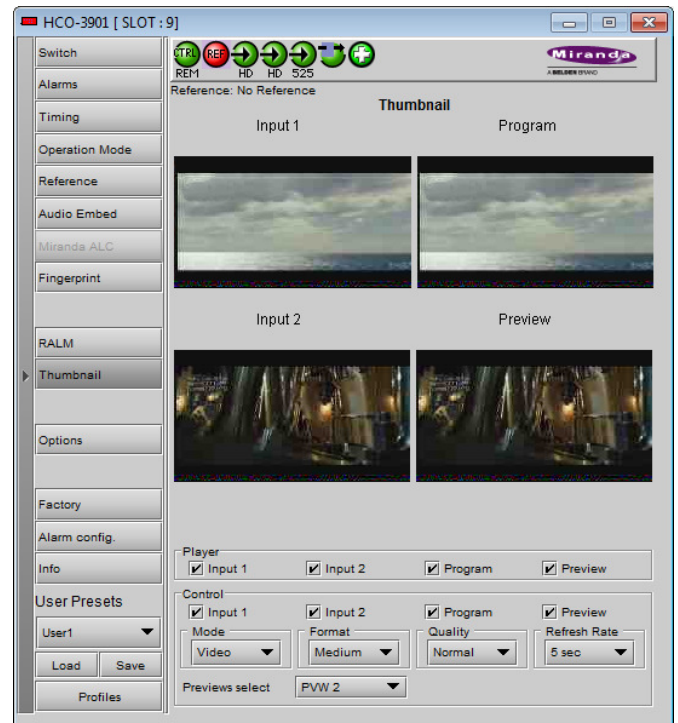*Control* – Click the checkboxes to apply the Mode, Format, Quality and Refresh Rate settings to the these thumbnails.

Figure 3.32 *Thumbnail Panel*

Mode – select between Video mode and Test mode. Use Video mode for normal operation.

Format – choose the thumbnail size:
- small, medium, large

Quality – choose the quality of the displayed image
- Poor, Normal, HiQ

Refresh Rate – select the desired refresh rate from the pull-down box. The choices are:

[Fast, 1 sec, 2 sec, …, 9 sec, 10 sec.]

Previews Select – choose which of the three available Preview outputs will be displayed when *Player – Preview* is selected.

3.4.12 The *Options* panel

Two options are available for the HCO-3901:
- Clean Switch Option   (HCO-3901-OPT-CS)
- ALC Option   (HCO-3901-OPT-ALC-X)

To activate each of these options, you must:
- Obtain a license key from Grass Valley.
- Type the license key in the *Enter Key* box.
- Click on ENABLE OPTION to enable the option's features.

Clean Switch Option – allows the HCO-3901 to make a glitch-free switch between its two primary inputs IN 1 and IN 2 under certain circumstances (*note – IN 3 is not part of the clean switch process*):

1. The two inputs MUST have the same format.

2. An external reference or URS is required to run the CSO. In this mode, the reference presence is always reported, regardless of the user's setting.

3. The CSO allows us to do a clean video switch between two synchronized sources. For timing requirements between the video sources and the reference source, refer to the Genlock section. Switching is executed on the proper vertical blanking interval video line according to the format of the reference source. (refer to SMPTE RP 168-2002: Switching point for synchronous video switching) .

Supported input signals	Reference
525 (SMPTE-259M-C)	NTSC (SMPTE-170M)
625 (SMPTE-259M-C)	PAL (ITU 624-4)
1080i50 (SMPTE-274M)	1080i50, PAL
1080i59.94 (SMPTE-274M)	1080i59.94, NTSC
720p50 (SMPTE-296M)	720p50, PAL
720p59.94 (SMPTE-296M)	720p59.94, NTSC
3G Lvl A 50/60	NTSC, PAL
ASI (EN50083-9)	-------

4. The switch is free of any glitches, assuming the switch is not due to loss of video or CRC errors and format or reference mismatch are detected.

5. During a switch, the CSO performs a fade out/fade in audio switch on 200 samples to prevent any pops or clicks (only applicable to PCM audio)

6. The following parameters and functions are not supported without the CSO.
   - Timing measurements.
   - Output timing adjustment.
   - Glitch-free switching.

- Reclocked outputs.

7. If there are no errors on input 1 but a reference mismatch is detected on input 2, the CSO keeps working.

The Options panel gives some information about obtaining the Clean Switch option, and provides a data entry box "Enter Key" where the activation key supplied when the option is purchased can be entered.

- Enter the Key in the data box, and click the *Enable Option* button to activate the Clean Switch feature.

Figure 3.33   *Options Panel – Clean Switch Option*

ALC – This option enables the Automatic Loudness Control feature of the HCO-3901.

Note that this option is available for 2, 6, 8 or 16 channels. A separate license key is required for each of these, and the data window below the *Enter key* data box will indicate which is currently enabled, e.g.:

HCO-3901-OPT-ALC-8 for the 8 channel option

If the currently-enabled option is 2, 6, or 8 channels, the *Enter key* data box will be available to upgrade to a greater number of channels.

Figure 3.34 *Options panel – ALC option*

3.4.13 The *Factory* panel

The HCO-3901 maintains a "Factory Default" alignment in its memory, to which it can be restored at any time.

- Click the *Load Factory* button to restore the card to its Factory default alignment.

Figure 3.35 *Factory Panel*

3.4.14 The *Alarm Config* panel

This panel allows the alarm reporting of the HCO-3901 to be configured. The panel opens in a new window when the button is clicked, and can be resized if needed.

The panel is organized in columns.

Status/Name
This contains an expandable tree listing all the alarms reported by this HCO-3901 card.

- Each alarm name includes an icon that shows its current status

- Some alarms may be text-only and the alarm status is shown in the name and not by a status icon, e.g.
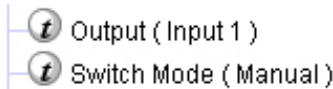
The **Overall alarm** and **GSM contribution** columns contain pulldown lists that allow the level of contribution of each individual alarm to the alarm named in the column heading to be set.

➢ Click on the alarm icon to see the available levels; then click on one to select it

Figure 3.36 *Alarm Configuration Panel*

- ***Overall Alarm***
  This column allows configuration of the contribution of each individual alarm to the Overall Alarm associated with this card. The Overall Alarm is shown in the upper left corner of the iControl panel, and also appears at the bottom of the Status/Name column.

- ***GSM Contribution***
  This column allows configuration of the contribution of each individual alarm to the GSM Alarm Status associated with this card. GSM is a dynamic register of all iControl system alarms, and is also an alarm provider for external applications. The possible values for this contribution are related to the Overall alarm contribution:
  - If the Overall alarm contribution is selected as Disabled, the GSM alarm contribution can be set to any available value
  - If the Overall alarm contribution is selected as any level other than disabled, the GSM contribution is forced to follow the Overall Alarm.
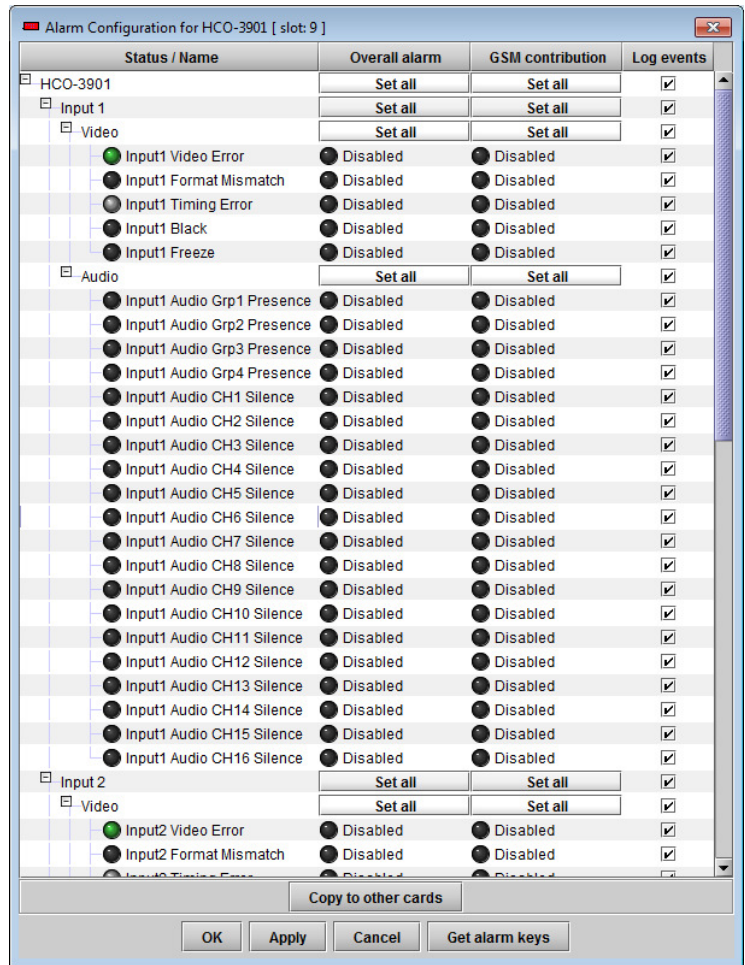
<div style="border:1px solid">

Levels associated with these alarms:

The pulldown lists may contain some or all of the following options:

⚫ Disabled	The alarm makes no contribution (black icon)
🟡 Minor	The alarm is of minor importance (yellow icon)
🟠 Major	The alarm is of major importance (orange icon)
🔴 Critical	The alarm is of critical importance (red icon)
🟠 Passthrough	The alarm exists but has no effect (used for text and composite alarms)

Shortcut: if you click in one of the Set All boxes beside a section heading, you will open a pulldown that lets you assign a level to all alarms in that section of the column simultaneously.

</div>

Log Events

iControl maintains a log of alarm events associated with the card. The log is useful for troubleshooting and identifying event sequences. Click in the checkbox to enable logging of alarm events for each individual alarm.

At the bottom of the window are several other controls:

Copy to other cards

Click this button to open a panel that allows the alarm configuration set for this card to be copied into another HCO-3901 card.

- Select one or more destination cards from the list in the window by clicking in the checkboxes, or all of them by clicking in the *All* checkbox

- Note that when you do a Copy Profile for this card (see Sect. 3.4.17), the alarm configuration is copied along with all the other settings.
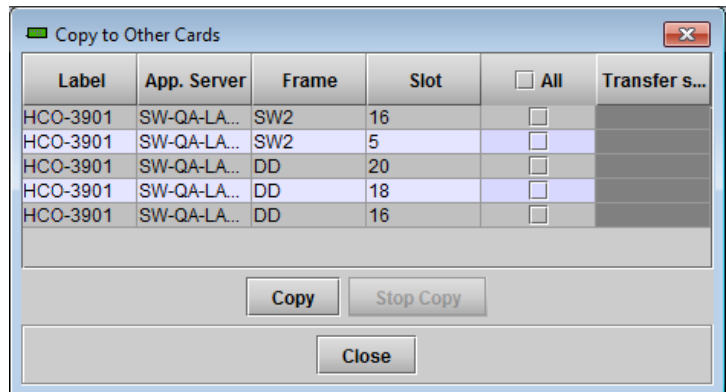
**Figure 3.37** *Copy to other cards*

Get alarm keys

Click this button to open a save dialog where you can save a file containing a list of all alarms on this card and their current values, along with an Alarm Key for each. The alarm keys are useful for system integration and troubleshooting.

- The file is saved in .csv format

OK, Apply, Cancel

- *OK* accepts the settings and closes the window once the card confirms that there are no errors.

- *Apply* accepts the settings, but leaves the window open

- *Cancel* closes the window without applying any changes, and leaves the previous settings intact.
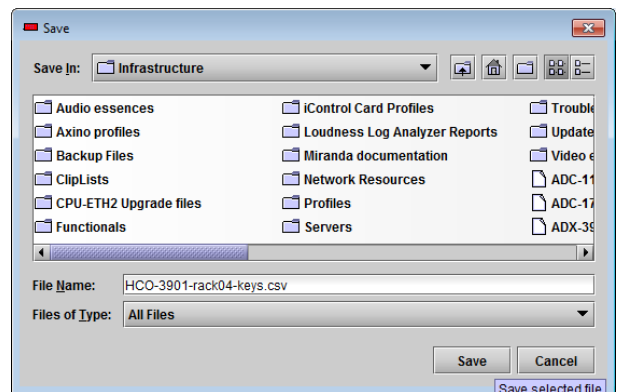
Figure 3.38 *Get alarm keys save dialogue*

3.4.15 The *Info* panel

When the HCO-3901 is included in an iControl environment, certain information about the card should be available to the iControl system. The user can enter labels and comments that will make this card easy to identify in a complex setup. This information is entered via the Info control panel. This panel also shows other information about the card.

Rear Type: Identifies the type of rear panel that is installed.

Label: type the label identifies this HCO-3901 when it appears in iControl applications

Short Label   type the short-form label that iControl uses in some cases (8 characters)

Source ID   type a descriptive name for this HCO-3901

Comments: type any desired text

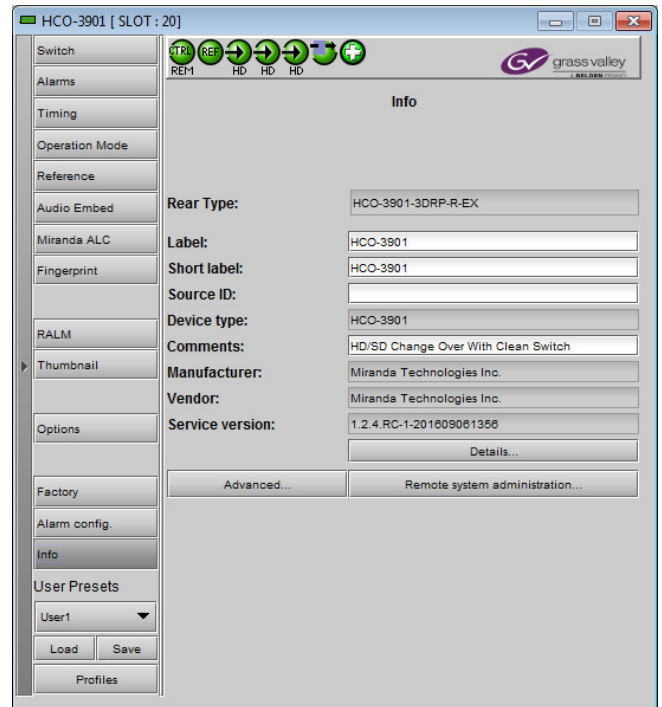The remaining data boxes show manufacturing information about this card.

Figure 3.39 *Info Panel*

- Details…: Reports the Firmware version, service version, and panel version for this card
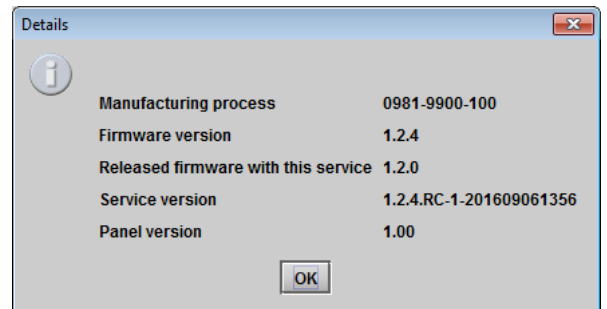
Figure 3.40 *Details window*

- Advanced…: Shows the LongID for this card. The LongID is the address of this HCO-3901 in the iControl network.
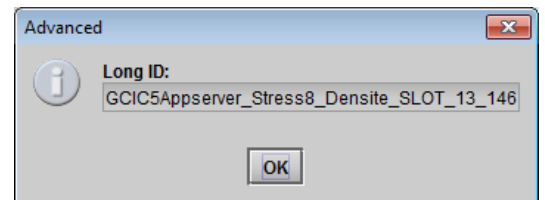
Figure 3.41 *Advanced window*

- Remote System Administration – opens the Joining Locators data box, which lists remote lookup services to which this HCO-3901 is registered.

    Add: Force the iControl service for this HCO-3901 to register itself on a user-specified Jini lookup service, using the following syntax:

    jini://<ip_address>

    where <ip_address> is the ip address of the server running the lookup service

    Enter the address in the Input data box. e.g.
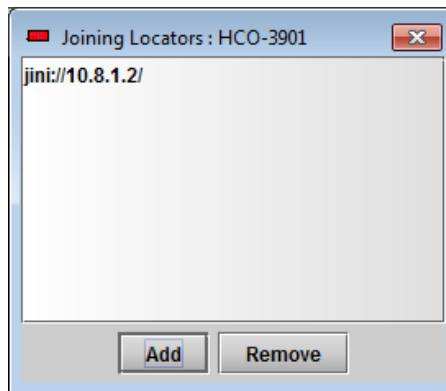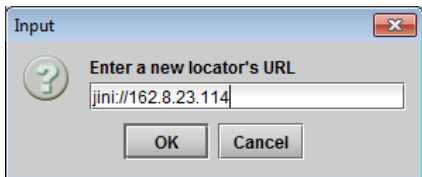
Figure 3.42 *Joining Locators window*

Remove: select one of the services listed in the window by clicking on it, and click *Remove* and then *Yes* to delete it from the window.
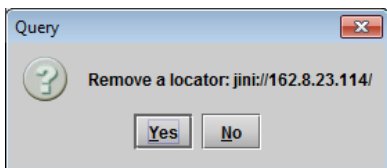
3.4.16 User Presets

The User Preset controls allow the user to save and recover all configuration settings on the card.

Select any one of the five presets using the pulldown list. The name of the currently-selected User Preset is shown on the on the pulldown icon (e.g. *User1*, *User2*,… *User5*)

- Click *Load* to load the contents of the selected User Preset into the HCO-3901. All parameter settings and values will be replaced by the contents of the selected User Preset.

- Click *Save* to store the current parameter settings and values from the HCO-3901 into the selected User Preset. The existing contents of the preset will be overwritten.
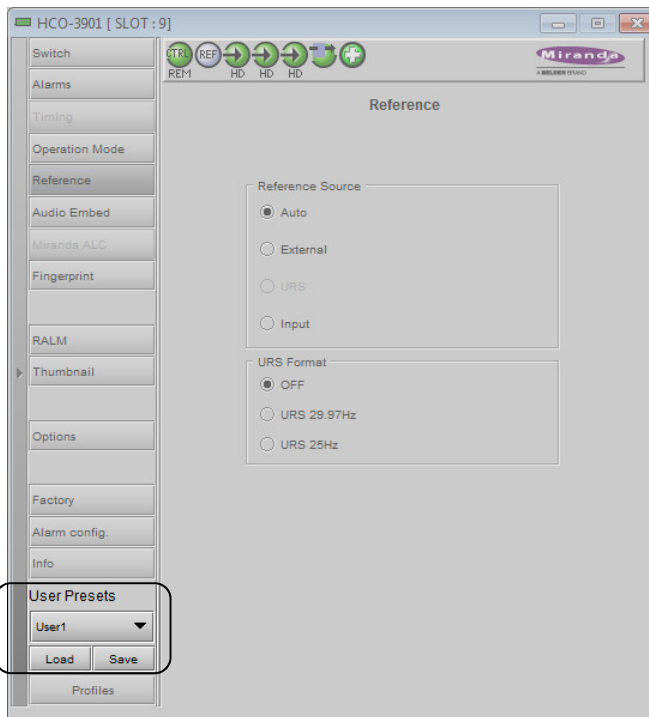
Figure 3.43 *User Presets*

3.4.17 Profiles

This section provides the option to save and recover the entire card configuration (including user presets if desired) on an external disk, or to copy it to another HCO-3901 card.

Click on the *Profiles* button at the bottom left corner of the control panel to open the Profile Copy window.
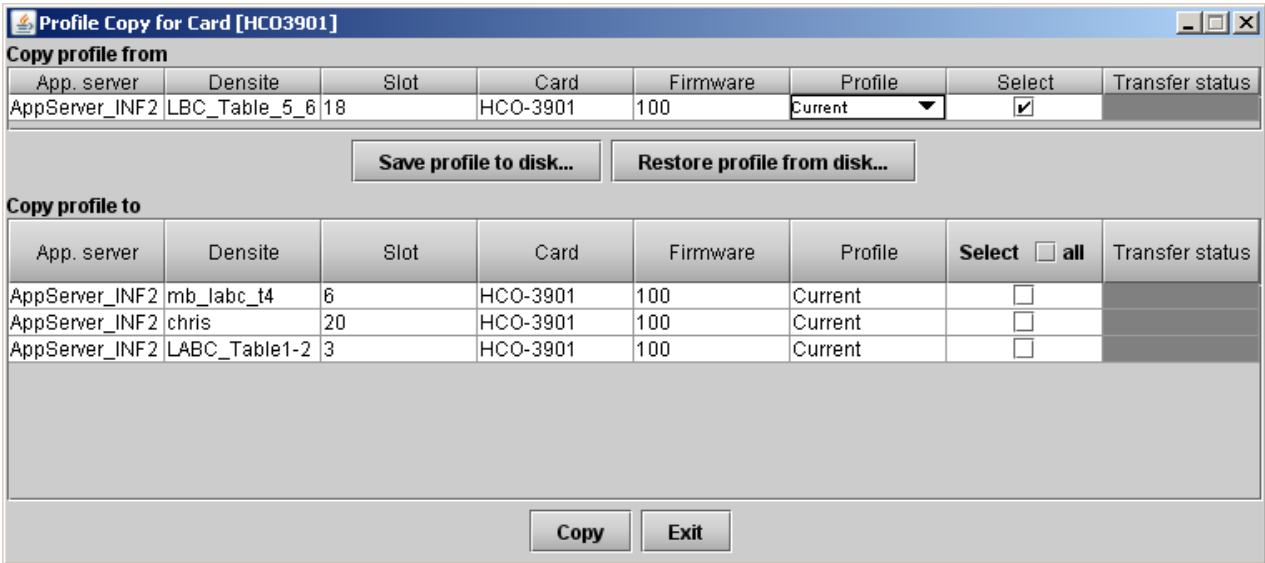
Figure 3.44 *Profile copy window*

***Copy Profile From*:**

This line shows this HCO-3901 card, and identifies it by App server, Densité frame and slot number, card type and firmware version.

The *Profile* column has a pulldown that allows you to select which profiles you will work with, and gives these choices:

- Current, User1, User2, User3, User4, User5

The *Select* column includes a checkbox, preselected as checked, to confirm that you want to work with the current card.

Figure 3.45 *Select Profile to copy*

Save Profile to Disk…

Click this button to open a Save dialog allowing you to specify a file name and location to which the selected profiles for this card will be saved.

Hint - It is a good idea to create a folder for these files, because they are not explicitly identified as HCO-3901 profiles, and will be difficult to find and identify if not clearly named and conveniently located.

- Click the save button once the name and location have been identified in the Save box

- If the file is saved correctly, the Transfer Status box on the right of the *Copy profile from* line will indicate *Succeeded* against a green background

- If the file was not saved for some reason, the Transfer Status box to the right of the *Copy profile from* line will indicate *Failed* against a red background

Figure 3.46   *Save profile dialog*

Restore profile from disk…
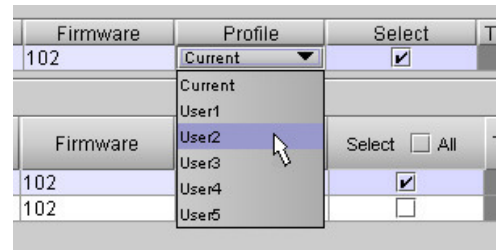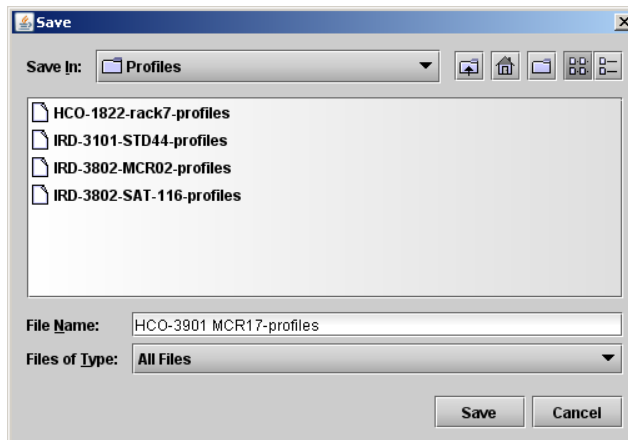
Click this button to open an *Open* dialog box within which you can locate and select a valid HCO-3901 profile file.

- Click Open to read the contents of the file and to reconfigure this HCO-3901's profiles according to its contents

- While the reconfiguration is in progress, the Transfer Status box on the right of the *Copy profile from* line will indicate *Working* against a yellow background

- When the reconfiguration is complete, the Transfer Status box on the right of the *Copy profile from* line will indicate *Succeeded* against a green background

Note: There is no need to select a profile using the Profile pulldown (e.g. current, User1, etc.) when restoring a profile from disk. The profile selection is stored within the file.
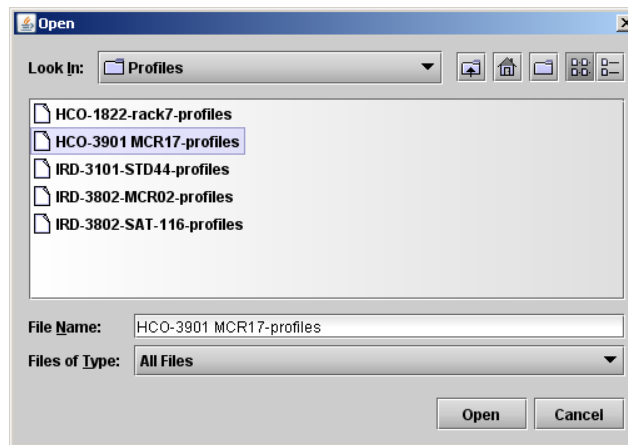
Figure 3.47   *Open a profile file to restore profiles*

Copy profile to section

This line shows other HCO-3901 cards that are available on the iControl network, each identified by App server, Densité frame and slot number, card type and firmware version.

The *Profile* column shows the same information as is shown for the current card in the Copy profile from line, i.e.
- Current, User1, User2, User3, User4, User5

The *Select* column includes a checkbox to identify which HCO-3901 cards you wish to copy profiles into from the current card.
- For convenience, a *Select all* checkbox is provided in the column header

Click *Copy* to copy the selected profiles from this card into the selected other HCO-3901 cards

- While the profile copy operation is in progress, the Transfer Status box on the right of the *Copy profile to* line will indicate *Working* against a yellow background

- When the profile copy operation is complete, the Transfer Status box on the right of the *Copy profile to* line will indicate *Succeeded* against a green background

4   Specifications

Video inputs (3)

SIGNAL	SD: SMPTE 259M-C (270 Mbps), HD: SMPTE 292M (1.485, 1.485/1.001 Gbps), 3G: SMPTE 425 (2.970, 2.970/1.001 Gbps) Level A only. DVB-ASI : EN 50083-9
SUPPORTED FORMATS	SD: SMPTE 125M: 480i59.94 SD: EBU: 576i50 HD: SMPTE 274M: 1080i59.94, 1080i50 HD: SMPTE 296M: 720p59.94, 720p50 3G: SMPTE 425 level A (mapping 1):1080p59.94, 1080p50 Quad-Link 3G Level A, 2SI, SQ, 1080p59.94, 1080p50: only with 4x HCO-3901 & 1x HCO-3901-X4RP
CABLE LENGTH	350m Belden 8281 at 270 Mbps 130m Belden 1694A at 1.485 Gbps 90m Belden 1694A at 2.970 Gbps
CABLE LENGTH In relay bypass[1]	220m Belden 8281 at 270 Mbps 70m Belden 1694A at 1.485 Gbps 60m Belden 1694A at 2.970 Gbps
RETURN LOSS	> 10 dB up to 1.5 GHz (IN1, IN2)[2] > 8 dB up to 3 GHz (IN1, IN2)[2] > 15 dB up to 1.5 GHz (IN3) > 10 dB up to 3 GHz (IN3)

[1] Total input/output maximum cable length
[2] Input protected by relay

Video outputs (4)

SIGNAL	SD: SMPTE 259-C (270 Mbps) HD: SMPTE 292M (1.485, 1.485/1.001 Gbps) 3G: SMPTE 425 (2.970, 2.970/1.001 Gbps) DVB-ASI : EN 50083-9
SUPPORTED FORMATS	SD: 480i59.94, 576i50 HD: SMPTE 274M: 1080i59.94, 1080i50 HD: SMPTE 296M: 720p59.94, 720p50 3G: SMPTE 425 level A (mapping 1):1080p59.94, 1080p50 Quad-Link 3G Level A, 2SI, SQ, 1080p59.94, 1080p50: only with 4x HCO-3901 & 1x HCO-3901-X4RP
RETURN LOSS[3]	PGM out: >15 dB up to 270 MHz >12 dB up to 1.5 GHz > 7 dB up to 3 GHz

PVW out: > 15 dB up to 270 MHz
> 15 dB up to 1.5 GHz
> 10 dB up to 3 GHz

[3] PGM output protected by relay

JITTER SD/HD <0.2UI (alignment jitter)
3G <0.3UI (alignment jitter)

Reference input

SIGNAL (1) SMPTE 170M/SMPTE 318M/ITU 624-4/BUT 470-6 or composite sync
SMPTE 274M / SMPTE 296M Tri-level sync
RETURN LOSS >35 dB up to 5.75 MHz

GPI (10) – without HCO-3901-X4RP

Connector HD-15, opto-isolated, common ground
GPI IN (5) Contact closure to ground
GPI OUT (5) Open collector
- External pull-up voltage: +3.3 V to +24 V
- Maximum current: 15 mA
External GPI power +5V DC nominal, 1.5 W

GPI (10) – with HCO-3901-X4RP

Connector D-SUB HD15, female on rear panel
External power +5V DC nominal, 6W
GPI IN (5) Contact closure to ground
GPI OUT (5) Open collector
- External pull-up voltage: +3.3 V to +24 V
- Maximum current: 50 mA

Video Processing Performance

SIGNAL PATH: 10 bits
LATENCY 0.4 ns without CS option and without ALC option
Maximum of 2 lines with CS option or ALC option

Audio Processing Performance

QUANTIZATION: 20-24 bits
SAMPLING: 48 KHz, synchronous
NUMBER OF CHANNELS: 16, 4 Groups
AUDIO LATENCY 0.4 ns without CS option and without ALC option
- Add 1 ms if CS option is enabled.
- Add 1 ms if ALC option is enabled

POWER 10 W

5 Contact Us

Grass Valley Technical Support

For technical assistance, contact our international support center, at
1-800-547-8949 (US and Canada) or +1 530 478 4148.

To obtain a local phone number for the support center nearest you, please consult the *Contact Us* section of Grass Valley's website (www.grassvalley.com).

An online form for e-mail contact is also available from the website.

Corporate Head Office
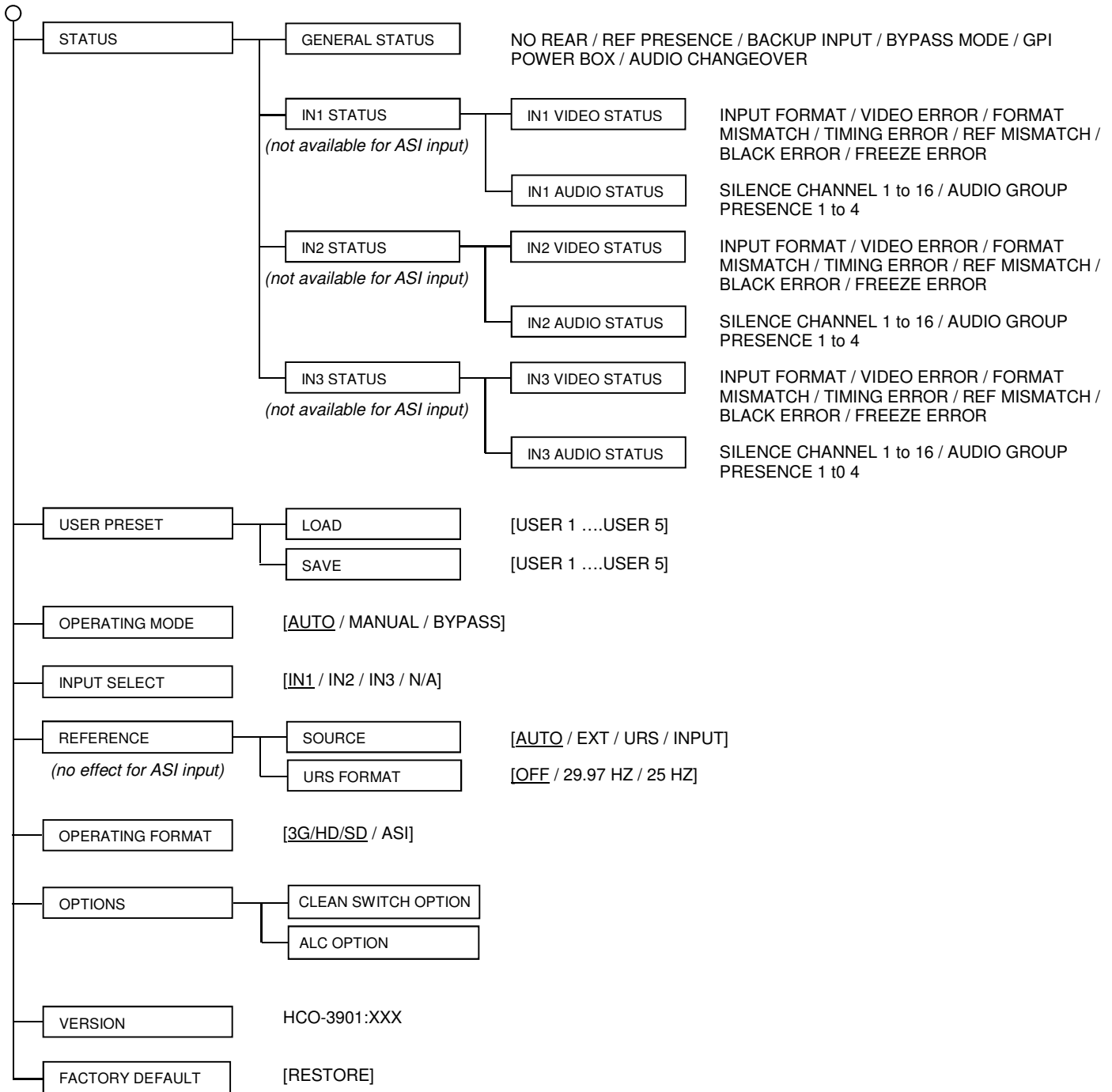
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ANNEX 1 – HCO-3901 User Interface

STATUS
- **GENERAL STATUS** → NO REAR / REF PRESENCE / BACKUP INPUT / BYPASS MODE / GPI POWER BOX / AUDIO CHANGEOVER
- **IN1 STATUS** *(not available for ASI input)*
  - **IN1 VIDEO STATUS** → INPUT FORMAT / VIDEO ERROR / FORMAT MISMATCH / TIMING ERROR / REF MISMATCH / BLACK ERROR / FREEZE ERROR
  - **IN1 AUDIO STATUS** → SILENCE CHANNEL 1 to 16 / AUDIO GROUP PRESENCE 1 to 4
- **IN2 STATUS** *(not available for ASI input)*
  - **IN2 VIDEO STATUS** → INPUT FORMAT / VIDEO ERROR / FORMAT MISMATCH / TIMING ERROR / REF MISMATCH / BLACK ERROR / FREEZE ERROR
  - **IN2 AUDIO STATUS** → SILENCE CHANNEL 1 to 16 / AUDIO GROUP PRESENCE 1 to 4
- **IN3 STATUS** *(not available for ASI input)*
  - **IN3 VIDEO STATUS** → INPUT FORMAT / VIDEO ERROR / FORMAT MISMATCH / TIMING ERROR / REF MISMATCH / BLACK ERROR / FREEZE ERROR
  - **IN3 AUDIO STATUS** → SILENCE CHANNEL 1 to 16 / AUDIO GROUP PRESENCE 1 t0 4

USER PRESET
- **LOAD** → [USER 1 ....USER 5]
- **SAVE** → [USER 1 ....USER 5]

OPERATING MODE → [AUTO / MANUAL / BYPASS]

INPUT SELECT → [IN1 / IN2 / IN3 / N/A]

REFERENCE *(no effect for ASI input)*
- **SOURCE** → [AUTO / EXT / URS / INPUT]
- **URS FORMAT** → [OFF / 29.97 HZ / 25 HZ]

OPERATING FORMAT → [3G/HD/SD / ASI]

OPTIONS
- **CLEAN SWITCH OPTION**
- **ALC OPTION**

VERSION → HCO-3901:XXX

FACTORY DEFAULT → [RESTORE]

Sets all parameters shown above to their underlined default values.

ANNEX 2 – Remote Control Panel for HCO-3901-X4RP Quad-Link Adapter