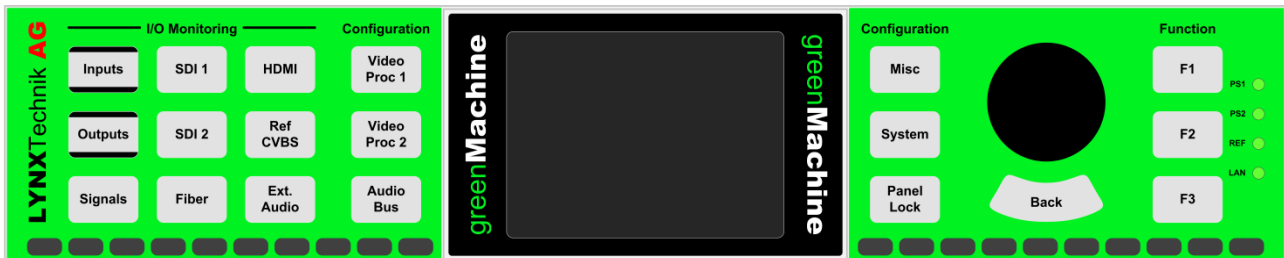# greenMachine®

Reference Manual

greenMachine
callisto

3G/HD/SD Dual Channel SDI Frame Synchronizer with Image and Audio Processing

Revision 1.5 – August 2016

LYNXTechnik AG®
Broadcast Television Equipment

This Manual Supports Device Revisions:	
callisto Revision	751

Table of Contents

Product Description

The greenMachine callisto is the Swiss army knife for professional broadcast productions. At its core the module is a dual channel video processing module with frame synchronizing and high quality up/down/cross conversion. In addition to the video capability, the module includes an internal audio bus with audio processing as well as synchronizing functionality.

The greenMachine callisto offers a multitude of different video and audio in- and output connections. Together with the two high quality up/down/cross converters the callisto is the ideal solution for long list of applications.

The greenMachine products are standalone processing modules with an intuitive control interface with an LCD display for the graphical menu as well as video input or output monitoring.

In addition the greenMachine products can be fully integrated into the LYNX APPolo Control System adding the long list of APPolo feature such as flexGUI, AutoControl, CustomControl and many more.

Product Overview
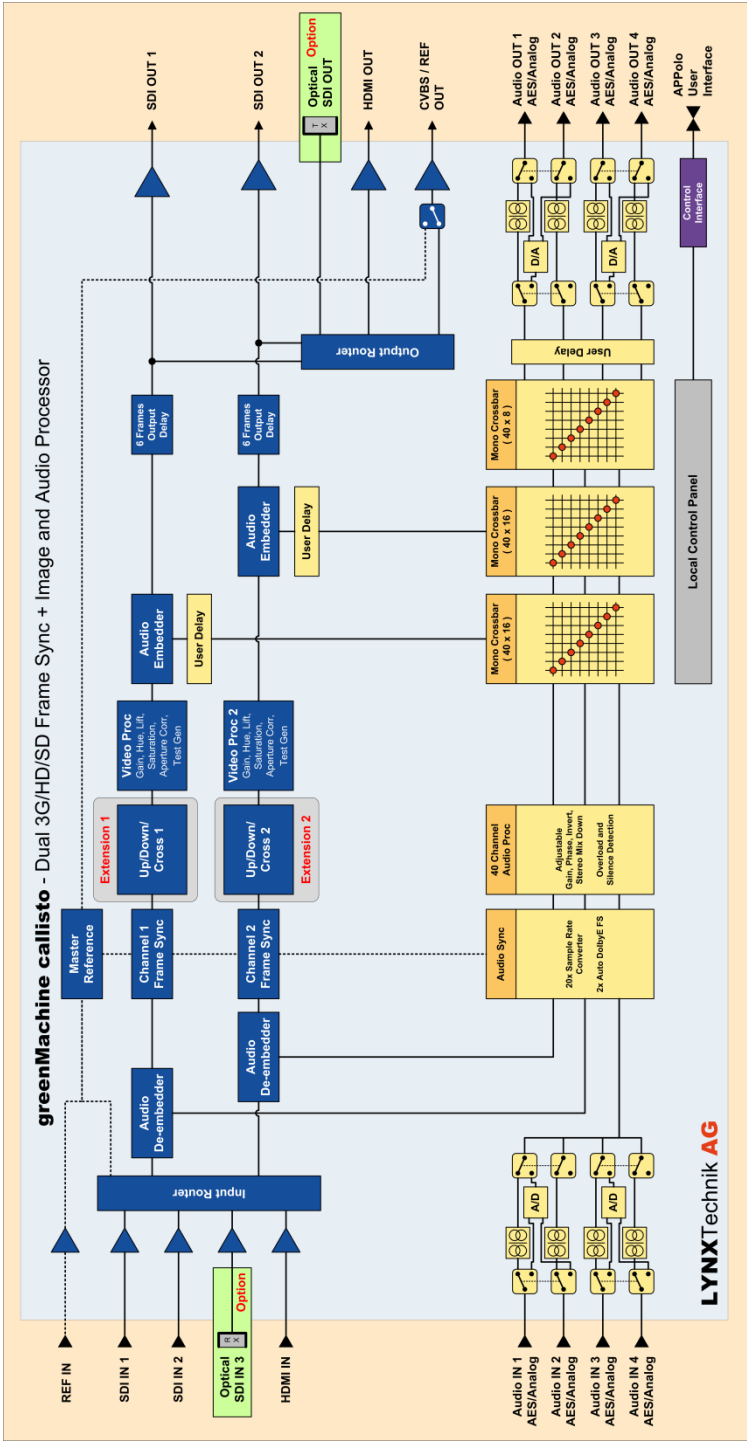
Functional Diagram

Image 1: greenMachine callisto - Functional Diagram

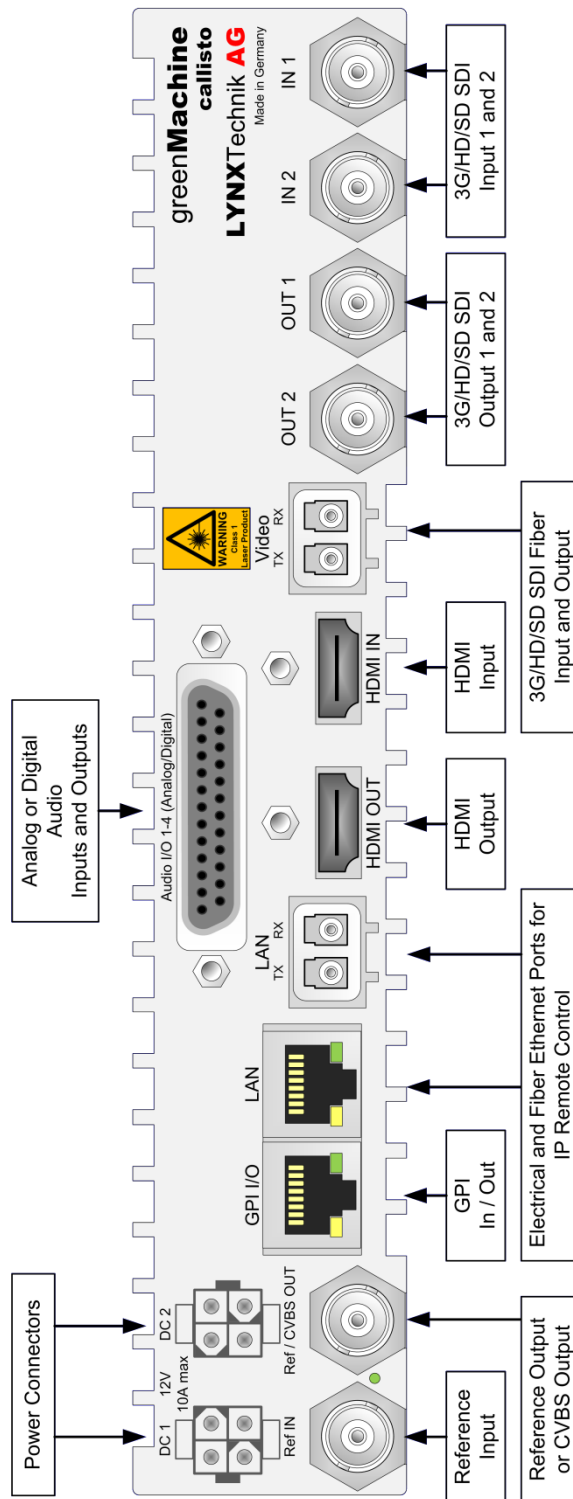# Rear Connection Panel Overview

Image 2: greenMachine callisto - Backpanel

Control Panel Overview
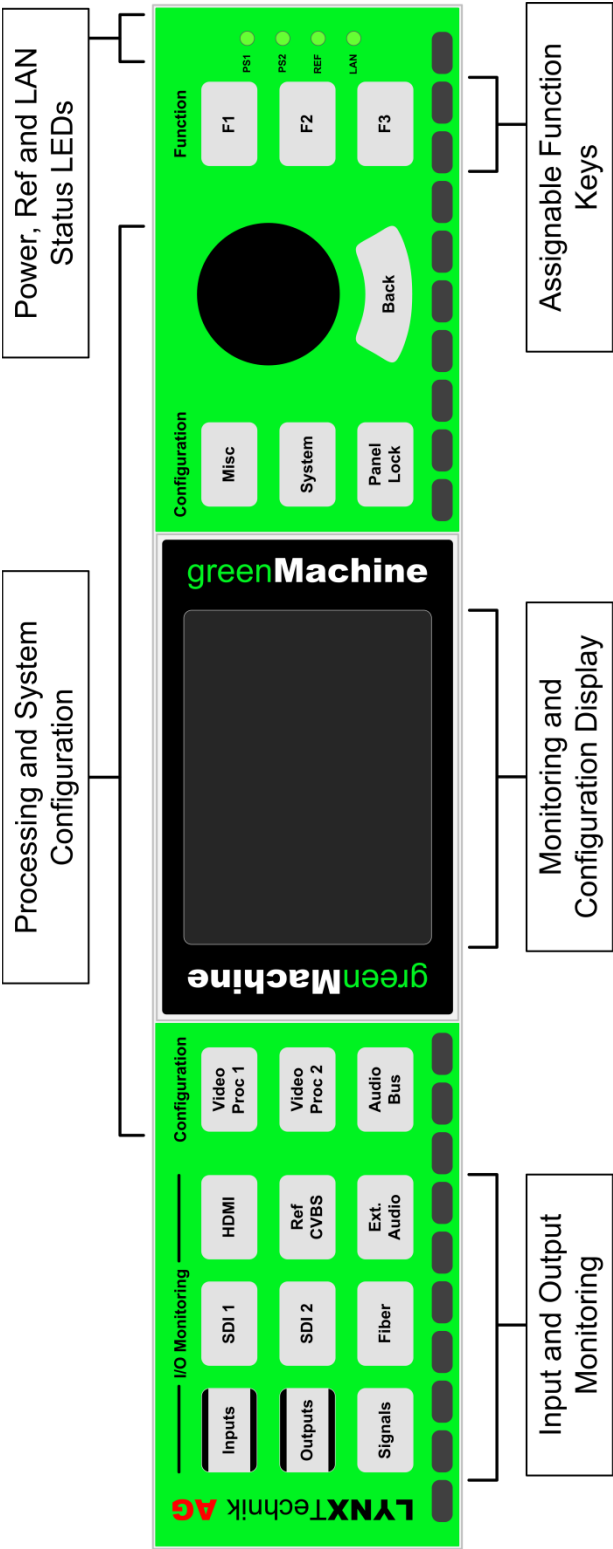
Image 3: greenMachine callisto - Front Control Panel

Control Panel Description

The front control panel allows the complete configuration of the module in addition to detailed monitoring features of the input and output signals. The following chapters will outline the functionalities.

I/O Monitoring

The nine push buttons located on the left hand side of the control panel in conjunction with the local display provide everything that is required for a detailed input and/or output signal monitoring.

"Signals" Button

Pressing the "Signals" button located on the bottom left of the control panel will result in an input and output signals overview being shown in the display. The "Signals" button will be illuminated white to indicate that it is selected.
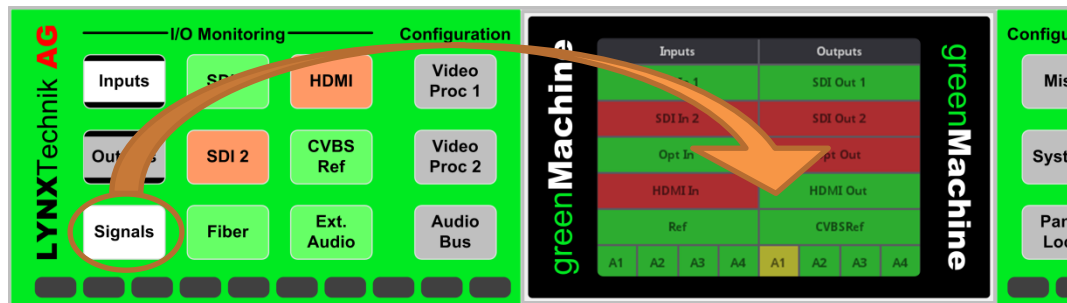
Image 4: "Signals" - Monitoring of all Input and Output Signals

Pressing the "Signals" button a second time will show the left hand side of a signal flow overview of the module including the status indication of the video and reference inputs and outputs. Pressing the "Signals" button another time will pan to the right hand side of this flow diagram.

When either the left or right hand side of the diagram is shown in the display, the rotary push encoder can be used to pan between the left and right side.

Pressing the "Signals" button when the display shows the right hand side of the flow diagram, will switch back to the signals overview page.
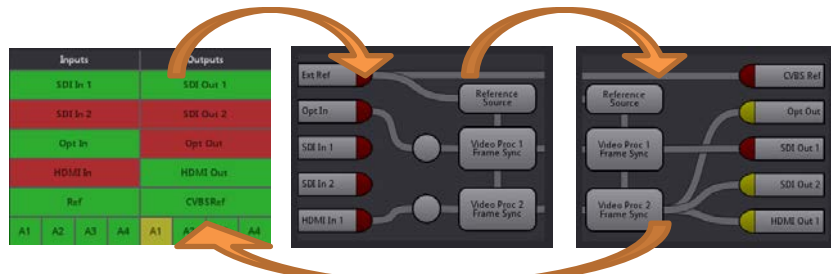
Image 5: "Signals" Display Navigation

"Inputs" Button

Pressing the "Inputs" button will result in two things happening:
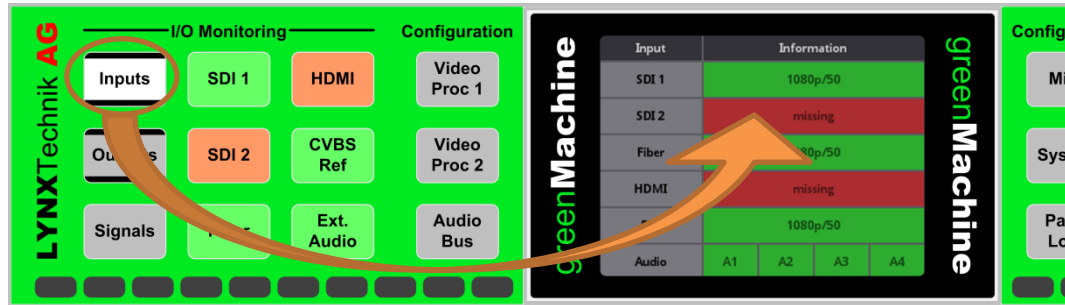
Image 6: "Inputs" – Monitoring Overview

1. The display will show more detailed information for all the input signals.

2. The signal buttons (e.g. SDI 1, SDI 2, Fiber, HDMI, etc.) now will be illuminated with colors according to the input signals. The "Inputs" button itself will be illuminated white to indicate that it is selected. This button status indication will remain unless the "Outputs" button is pressed.
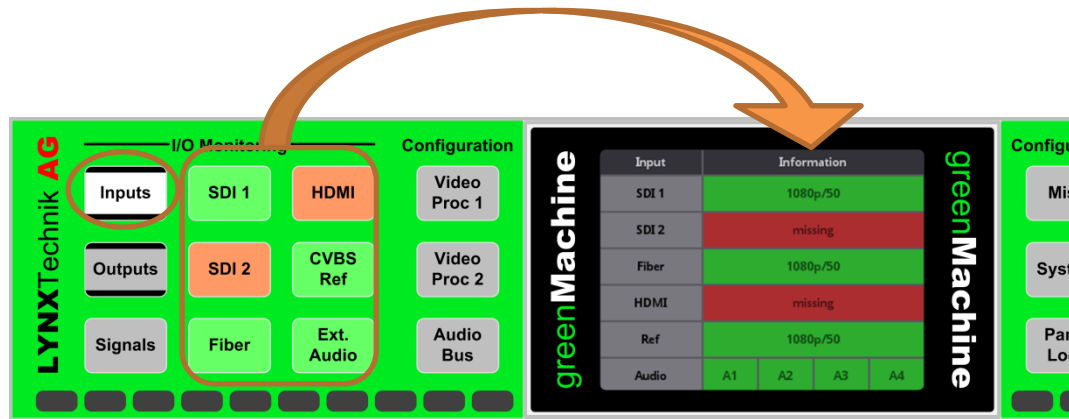
Image 7: Correlation of button illumination and Signal Status

Detailed Signal Information

To get detailed information for a specific input signal simply press the signal button (e.g. SDI 1) when in "Inputs" mode. The chosen signal button will be illuminated more brightly than the other ones to indicate that it is selected.
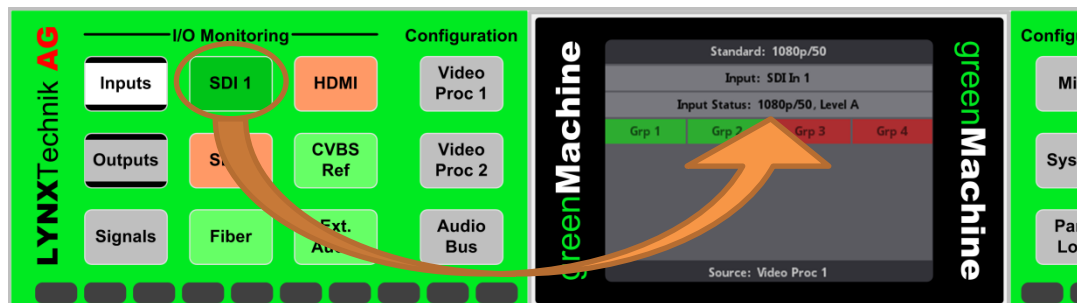
Image 8: Detailed Input Monitoring

The detected input standard of the selected input will be shown at the top of the display. The bottom of the display will list which internal video processor the signal is assigned to (none, Video Proc 1 and/or Video Proc 2).

Pressing the same signal button repeatedly will toggle between different pages with more information. The following example will show the information pages for the SDI inputs.
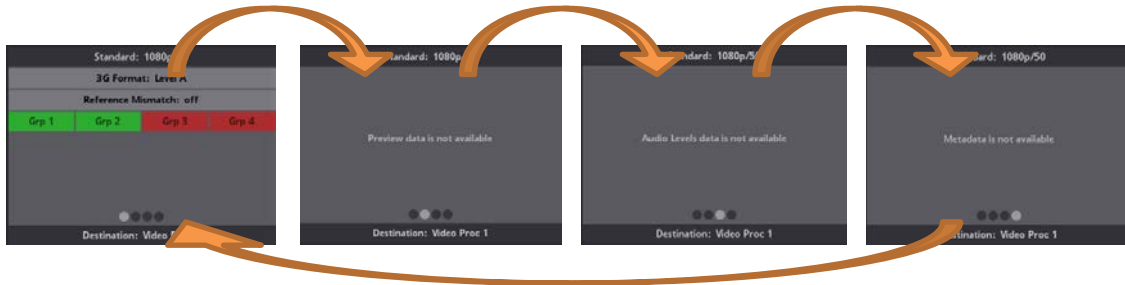
Image 9: Detailed Signal Information Pages

1. **Signal Status Overview**
   Depending on the type of input (i.e. electrical SDI or Fiber) this page will show details about the input format, available audio, optical input budget or similar.

2. **Preview**
   The display will show a preview image of the selected input that is assigned to one of the video processors. This feature is only available for the input signal(s) assigned to one of the processors.

3. **Audio Level Meters**
   The display will show audio level meters of the selected input that is assigned to one of the video processors. This feature is only available for the input signal(s) assigned to one of the processors.
   (This feature will be available in one of the next version)

4. **Meta Data Information**
   The display will show the detected meta data information of the selected input that is assigned to one of the video processors. This feature is only available for the input signal(s) assigned to one of the processors.

"Outputs" Button

The "Outputs" button works exactly the same way as the "Inputs" button with the difference being that the monitoring is based on the output signals instead of the input signals.

- The display will show an overview of all the output signals after pressing the "Outputs" button.

- The signal buttons (e.g. SDI 1, SDI 2, Fiber, HDMI, etc.) will be illuminated with colors according to the output signals.

- Pressing a signal button when in output mode will show the Detailed Signal Information in the same way as in input mode (i.e. pressing the signal button repeatedly will toggle between different information pages – *preview and audio level meters will be available in one of the next versions*).

Processing Configuration

The three buttons to the left of the display as well as the top button on the right of the display access the four processing configuration menus in the display.

Image 10: Configuration Controls

Together with the rotary push encoder and the back button these four configuration menus are all that is required to configure the processing of the callisto greenMachine.

Processing Configuration Menus

The processing configuration menus are generally grouped as shown in the functional diagram below (Image 11). Settings that logically can't be associated to any of these three categories can be found in the "Misc" menu (e.g. storing/loading presets)
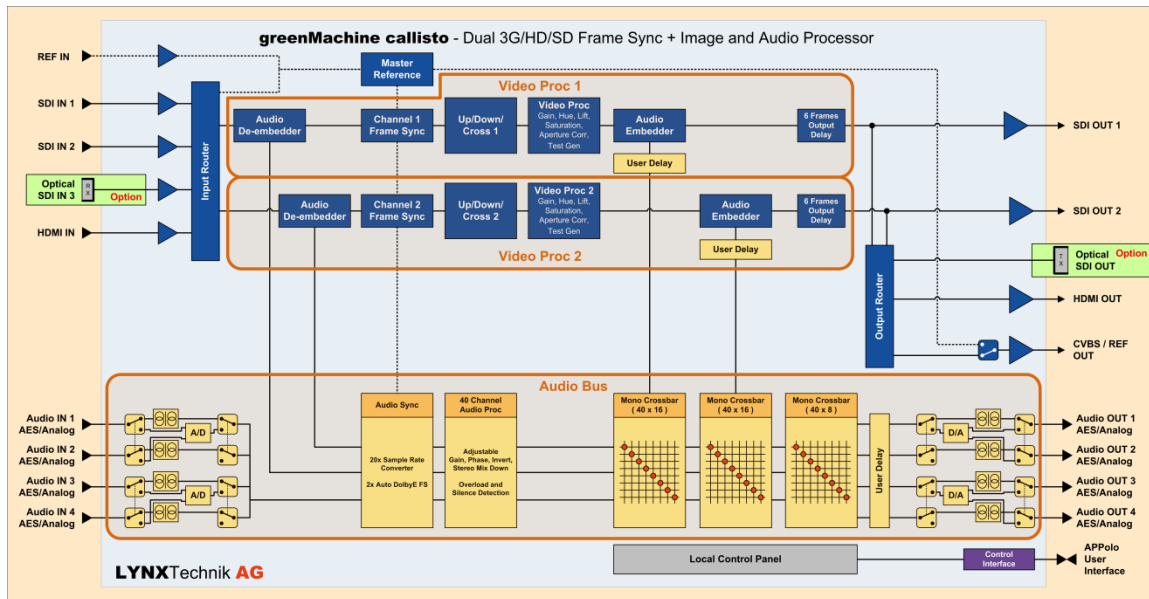
Image 11: Processing Overview

The structure and usage of the configuration menus works as follows.

Image 12: Active Menu Items

The areas on the left and right side of the display show the active menu items. Turning the rotary push encoder will navigate between these different menu items. The inverted menu item (i.e. dark gray with white text) is the currently selected one. It's possible that there are more than six menu items. In this case there will be more pages available. These are indicated by the circles at the bottom of the center part of the menu. The pale gray circle indicates which page is currently selected. To change pages, simply continue turning the rotary encoder beyond the last icon (next page) or the first icon (previous page).

There are two different shapes for the menu items. The square boxes are menus containing at least one additional menu level. When selected the middle part of the display will show a preview of what settings and/or menus are available within this menu (Image 13). Pressing the encoder will enter the selected menu. Pressing the "Back" button below the encoder will return to the lower menu level.

Image 13: Preview of Menu Content

The hexagon shaped items are parameters. When one of these menu items is selected, the middle area of the display will show the type of parameter and the current setting (Image 14).

Image 14: Parameter Preview

To edit the parameter press the encoder. When in edit mode, turn the encoder. To exit the edit mode, press either the encoder or the "Back" button.

System Settings

The "System" menu contains all setting and monitoring possibilities that are not related to the processing.

IP Settings

This menu provides all settings required for the IP configuration of the greenMachine.

- Set IP Mode
  Choose between "Static" IP settings or "DHCP"

- Set IP Address
  This menu allows the reading (DHCP mode) and setting of the IP address if the "IP Mode" is set to "Static". To adjust the IP address, press the encoder and the first block of three digits can be set by turning the encoder. Press the encoder to confirm the first block and to edit the second. Repeat this procedure until you have set all four three digit blocks of the IP address (Image 15).
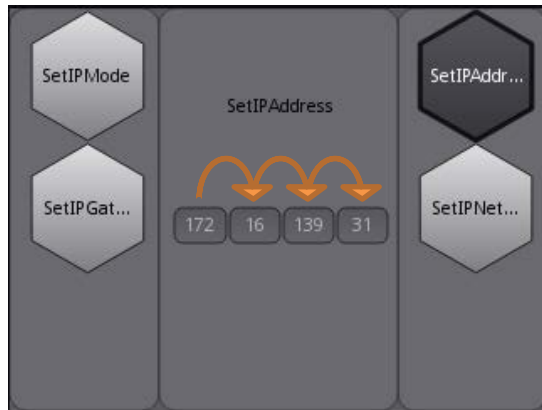
Image 15: IP Setting Adjustment

After confirming the four IP address block, a "Confirmation Request" will be shown in the display. Confirm to finalize the IP address settings or press "Cancel" and the IP address will not be adjusted. Pressing the "Back" button at any time while editing the IP address will exit the edit mode and the IP address will not be adjusted.

- Set Gateway
  This menu allows the adjustment of the IP Gateway if the "IP Mode" is set to "Static".

- Set Network Mask
  This menu allows the adjustment of the IP Network Mask if the "IP Mode" is set to "Static".

Panel Configuration

- Brightness
  This menu allows the adjustment of the brightness of the display and button illumination.

- Timeout
  When turned on, the panel will go into a snooze mode after the selected timeout. The panel will turn on again if any of the controls are adjusted.

F-Key Assign

This menu provides the possibility to assign stored presets (to store presets, press the "Misc" menu button and enter the Preset menu) to the three F-Keys on the far right of the control panel (Image 16).
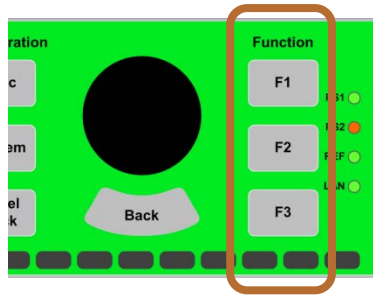
Image 16: Function Keys

Once a Preset has been assigned to an F-Key, pressing this function button will load the previously assigned preset after accepting the confirmation request.

Reset

There are two types of reset available:

- Reset Module
  Using this reset will only set the processing relevant parameters back to factory default. In other words all parameters that can be configured via the Video Proc 1/2, "Audio Bus" and "Misc" menus.
  Note: The stored presets won't be affected by the reset.

- Reset Controller
  This reset will set all system settings back to factory default excluding the IP settings.

Health Parameters

This menu provides health monitoring parameters for the greenMachine. If one of these parameters should be within a warning or critical level, the "System" menu button will be illuminated according to the alarm state and in addition the parameter in question on the display menu will have a colored frame.
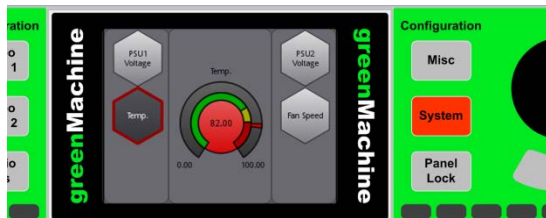
Image 17

Panel Lock

The "Panel Lock" button at the bottom right of the display activates or de-activated the panel lock. To lock or to unlock, press and hold the button for 3 seconds.

When in lock mode, the "Panel Lock" button will be illuminated red and the configuration buttons will be dimmed. However, the I/O Monitoring functionality will still available.

PSU, LAN and Ref LEDs

The four LEDs located on the far right of the control panel provide a simple status monitoring of the power supplies, LED activity and reference input.

- PSU 1/2
  If a power supply is connected the LED will be green. If not, the LED will be red.

- LAN
  This LED will indicate if a LAN connection is established.

- REF
  This LED is a simple monitoring of the reference input.

    o Green: Valid reference detected

    o Yellow: Reference to video mismatch

    o Red: No valid reference detected

IP Remote Control

The greenMachine can be used as a stand-alone module but at the same time it is fully integrated into the LYNX APPolo Control System and in addition can be remote controlled and/or monitored via the LYNX IP remote control protocol or SNMP.

APPolo Control GUI

To connect the greenMachine to the APPolo Control GUI (9.0.0 or higher), make sure that the module and the PC running the software are in the same IP range (see IP Settings for more details).

Start the APPolo Control software and open the "Connection Manager" from the "Tools" menu. Select the "Network Connections Editor" tab. This editor will list the detected the detected greenMachine modules in the right column. To connect them to the APPolo GUI, simply drag and drop this greenMachine entry from the right column onto the "My Computer" entry in the left column.
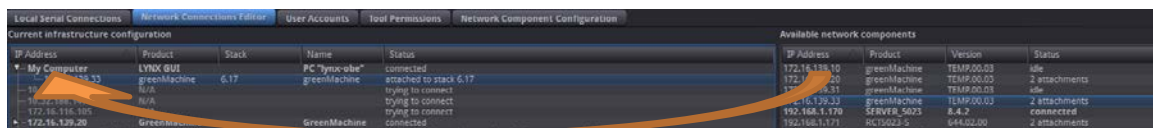
Image 18: Connecting the greenMachine callisto to the APPolo Control Software

Once this is done, you can select the "Main Control" from the Tools menu to control and monitor the greenMachine.

The device tree on the left hand side will show two entries (Image 19).
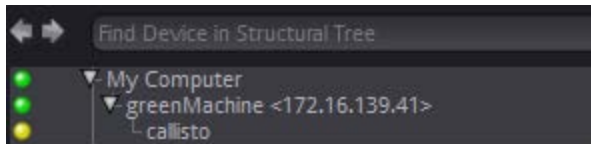
Image 19: callisto in the Device Tree
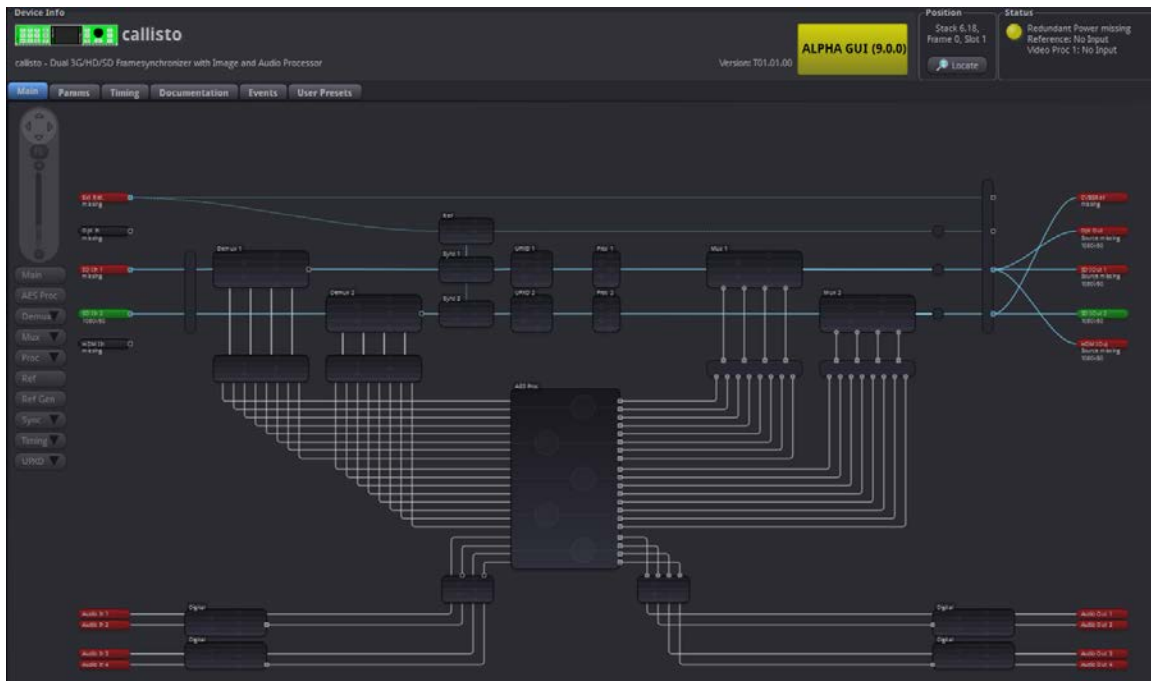
Image 20: The greenMachine callisto flexGUI view

If you select the "greenMachine <IP-Address>" entry you will access the system settings of the greenMachine.

Selecting the "callisto" will show the processing flexGUI of the greenMachine (Image 20).

For an introduction video of the flexGUI, please visit our homepage http://www.lynx-technik.com/en/products/appolo-control/).

Feature Description

The greenMachine callisto is a high performance 3G/HD/SD dual channel frame synchronizer with full embedded and external audio support. For each frame synchronizer channel an optional high quality Up/Down/Cross converter extension is available. Each converter extension can convert between the different supported input and output standards in addition to freely cropping and sizing the video images.

Two electrical 3G/HD/SD SDI inputs and outputs are available on the greenMachine callisto. In addition to this it has an HDMI input and output as well as an optional fiber in and output.

A Sub-D 25 connector provides 4 audio input and output connections that can be configured for either analog or digital audio.

Supported SDI I/O Formats

The module has two multi-format serial digital inputs with automatic input detection. The module will detect the following input standards and configure the input stage automatically for operation in the connected format. The supported SDI output standards are identical to the input standards.

| SDTV Formats	HDTV Formats
525 / 59.94Hz	1080i / 50Hz
625 / 50Hz	1080i / 59.94Hz
	1080i / 60Hz
	1080p / 23.98Hz
	1080p / 24Hz
	1080p / 25Hz
	1080p / 29.97Hz
	1080p / 30Hz
	1080psf / 23.98Hz
3GBit/s Formats Level A	1080psf / 24Hz
1080p / 50Hz	1080psf / 25Hz
1080p / 59.94Hz	720p / 23.98Hz
1080p / 60Hz	720p / 24Hz
	720p / 25Hz
	720p / 29.97Hz
3GBit/s Formats Level B Dual Link	720p / 30Hz
1080p / 50Hz	720p / 50Hz
1080p / 59.94Hz	720p / 59.94Hz
1080p / 60Hz	720p / 60Hz

As the synchronizer uses a single studio reference input both input signals should be the same input frequency range (odd or even frame rate) as the reference for normal operation.

The output format frequency (or frame rate) is determined by the connected reference signal and the output will remain fixed to this reference regardless of the connected input signals.

Supported HDMI Input Formats

The module has an HDMI input with automatic input detection. The module will detect the following input standards and configure the input stage automatically for operation in the connected format. The supported HDMI output standards are identical to the input standards.

SDTV Formats	HDTV Formats
525 / 59.94Hz	1080i / 50Hz
625 / 50Hz	1080i / 59.94Hz
	1080i / 60Hz
3GBit/s Formats	1080p / 23.98Hz
1080p / 50Hz	1080p / 24Hz
1080p / 59.94Hz	1080p / 25Hz
1080p / 60Hz	1080p / 29.97Hz
	1080p / 30Hz
	720p / 23.98Hz
	720p / 24Hz
	720p / 25Hz
	720p / 29.97Hz
	720p / 30Hz
	720p / 50Hz
	720p / 59.94Hz
	720p / 60Hz

As the synchronizer uses a single studio reference input both input signals should be the same input frequency range (odd or even frame rate) as the reference for normal operation.

The output format frequency (or frame rate) is determined by the connected reference signal and the output will remain fixed to this reference regardless of the connected input signals.

Supported Reference Input Formats

The module has a very flexible input reference stage which facilitates the use of either SDTV analog bi-phase sync (i.e. black burst) or HDTV analog tri-level sync. The reference input is "cross lock" compatible so an SDTV reference can be used to frequency lock HDTV signals (and vice versa). The connected reference is auto detected and the synchronizer automatically configures the outputs to the frame rate of the connected reference signal.

SDTV Analog Bi-Level Sync	HDTV Analog Tri-Level Sync
525 / 59.94Hz	1080i / 50Hz
625 / 50Hz	1080i / 59.94Hz
	1080i / 60Hz
HDTV Analog Tri-Level Sync	1080p / 23.98Hz
720p / 23.98Hz	1080p / 24Hz
720p / 24Hz	1080p / 25Hz
720p / 25Hz	1080p / 29.97Hz
720p / 29.97Hz	1080p / 30Hz
720p / 30Hz	1080psf / 23.98Hz
720p / 50Hz	1080psf / 24Hz
720p / 59.94Hz	1080psf / 25Hz
720p / 60Hz	

Frame Synchronization

The algorithms used for frame synchronization are extremely robust and very tolerant of poor input signals. The Synchronizer uses "Flywheel" functionality. This allows the module to recover from any missing sync pulses on the input signal(s) by predicting where they should be and then re-inserting them.

If no converters are active, the frame synchronizer passes the video in the connected input format.

Reference Source

The frame synchronizers can be referenced by the external reference input or either one of the video processing paths. The reference source is a global setting i.e. both frame synchronizers use the same reference source and can't be set individually.

If the reference source is set to external reference and no external reference is connected, the frame synchronizer is in free run mode.

TRS Error Behavior

In addition to synchronizing the video signal(s) to the reference source the frame synchronizers can also detect TRS errors of the video signal. The frame synchronizers can individually be configured to either ignore the TRS error or to freeze on TRS error. The freeze behavior is determined by the freeze mode setting.

Freeze Mode

The Freeze Mode determines the behavior of the individual frame synchronizers when set to "Freeze on TRS" and detecting a TRS error on the processed video signal. Possible selections are:

- Freeze Field 1
  Only Field 1 will be frozen and output. This only applies for interlaced standards. For progressive standards the frame synchronizer will automatically freeze frame.

- Freeze Field 2
  Only Field 2 will be frozen and output. This only applies for interlaced standards. For progressive standards the frame synchronizer will automatically freeze frame.

- Freeze Frame
  The frame synchronizer will freeze the frame on TRS error.

- Test Pattern
  When detecting a TRS error the frame synchronizer will output a test pattern. The test pattern is identical to the one selected for the test pattern generator.
  This setting is ideal to identify TRS errors on the video signal.

Output if no Input

This setting determines the behavior of the frame synchronizer if the processed video input signal is lost. Three possible selections are available.

- Freeze (outputs the last frame)

- Black (outputs a black signal)

- Test Pattern (outputs the selected test pattern)

Audio Synchronization and Processing

The greenMachine callisto will deembed the complete audio payload of the two processed video paths. In other words a maximum of 16 AES streams (i.e. 32 mono channels).

Audio Content Detection

Each one of the deembedded AES streams goes through an audio content detection stage. This content detection stage will determine if the AES stream is a PCM audio, DolbyE stream or any other data stream (e.g. AC3). A consequence of the content detection is the behavior of the following audio synchronization and processing. If either a DolbyE or data stream is detected, the audio synchronization and processing is automatically deactivated for these streams.

By default the content detection is set to automatic. However, it is possible to force the content detection to any of the three possible settings (i.e. PCM, DolbyE or Data). It is recommended to have the content detection set to automatic.

Audio Synchronization

For each incoming AES stream, the greenMachine callisto has a sample rate converter (SRC). Their reference is locked to the frame synchronizers.

The sample rate converters can individually be deactivated. If a DolbyE or Data stream is detected by the audio content detection (or if it is force set to any of these settings), the sample rate converters are automatically deactivated.

Audio Processing

Each audio path has its individual mono processing stage. The following processing is available:

- Gain
  Adjusts the audio level (-66,3dB to +18dB)

- Mute
  Mutes the audio channel

- Invert
  Phase inverts the audio

- Test
  Inserts a 1kHz test tone

- Add L/R
  This is a mono mix-down functionality (a+b)/2. The left channel has the "add R" button which will add the right to the left channel. The right channel has the "add L" button which adds the left to the right channel.

Audio Routing

The greenMachine callisto comes with a powerful routing capability enabling the audio coming from the processing stage to be routed to any output. The integrated router is mono based.

External Audio

The greenMachine callisto has a female Sub-D 25 connector for external audio interfacing. It has four input connections and four output connections. The connections can be configured for digital or analog audio.

Sub-D 25 Pinning

| Pin Number	Connection	Pin Number	Connection
1	Audio Output 4 +	14	Audio Output 4 -
2	Audio Output 4 GND	15	Audio Output 3 +
3	Audio Output 3 -	16	Audio Output 3 GND
4	Audio Output 2 +	17	Audio Output 2 -
5	Audio Output 2 GND	18	Audio Output 1 +
6	Audio Output 1 -	19	Audio Output 1 GND
7	Audio Input 4 +	20	Audio Input 4 -
8	Audio Input 4 GND	21	Audio Input 3 +
9	Audio Input 3 -	22	Audio Input 3 GND
10	Audio Input 2 +	23	Audio Input 2 -
11	Audio Input 2 GND	24	Audio Input 1 +
12	Audio Input 1 -	25	Audio Input 1 GND
13	n.c.		
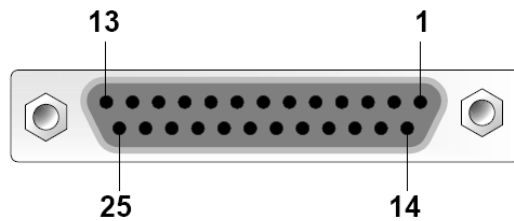
Image 21: Sub-D 25 Female Connector

Analog Digital Configuration

The audio inputs and outputs can be configured as analog or digital interfaces. When configured as analog interfaces, a maximum of 4 analog audio inputs/channels and 4 analog audio outputs/channels are available.

When configured as digital interfaces, a maximum of 4 AES inputs (8 audio channels) and 4 AES outputs (8 audio channels) are available.

Synchronization and Processing

When set to digital, the synchronization and audio processing is identical to the audio being deemedded from the video processing paths.

When set to analog, the full scale level adjustments are added to the inputs and outputs and the sample rate converters on the input side are redundant as the AD converters automatically are linked to the reference of the frame synchronizers.

Up/Down/Cross Converter

The greenMachine callisto has two broadcast high quality up/down/cross converter extensions.

- Ext_XC1_Callisto
  Up/Down/Cross Converter for video processing path 1.

- Ext_XC2_Callisto
  Up/Down/Cross Converter for video processing path 2.

These extensions are purchasable options. If you have purchased the options prior to delivery, the extensions will be activated. If you have purchased them after delivery, you will receive an activation key per extension and per module (linked to the serial number of the module).

In order to activate the extensions, the greenMachine needs to be connected to the APPolo Control Software. Select the greenMachine in question in the device tree. Now select the "Extensions" tab of the greenMachine. Enter the activation key and then press the "Activate" button.

The features and controls of both Up/Down/Cross converters are identical.

Input Control Mode

The aspect ratio conversion mode can either be configured manually (default), automatically controlled by the supported standard format description indications: AFD, WSS or VI

For the manual aspect ratio conversion mode, see Conversion Mode chapter.

Input Image Aspect Ratio

For SDTV input signaly, the source aspect ratio can be set to 4:3 or 16:9. This setting can be derived from AFD, WSS or VI, see above.

Output Image Format

The Output Image Format determines the video standard to which the converter converts the input image.

For SDTV output formats the aspect ratio is also part of the selection. This setting influences the aspect ratio conversion mode (Conversion Mode).

Conversion Mode

The conversion mode determines how the converter handles the conversion between different aspect ratios. Possible selections are:

- Pillarbox 4:3 / Letterbox 16:9

- Center Cut

- 14:9 Conversion

- Stretch to Fill

- Custom

The Custom setting allows the individual adjustment of the horizontal and vertical input image cropping as well as the horizontal and vertical output image sizing. The Conversion Mode automatically switches to "Custom" when the input cropping or output sizing is adjusted (Input Cropping/Output Sizing).

Format Description Insertion

The converter can insert AFD, WSS and/or VI format description. When the insertion is activated, the modules will automatically determine the correct format description code derived from the converter settings.

Input Cropping

The controls of the input cropping enable the input image to be cropped. Four controls are available:

- Horizontal Size
- Vertical Size
- Horizontal Start Position
- Vertical Start Position

The cropped image is scaled to the size of the output image which can be adjusted and positioned with the output sizing and positioning controls.

Output Sizing

The controls of the output sizing enable the size and position of the output image to be adjusted. Four controls are available:

- Horizontal Size
- Vertical Size
- Horizontal Start Position
- Vertical Start Position

Video Processing

Each Video processing path has its individual output processing stage.

Video Adjustments

Four settings are available for video adjustments:

- Gain
- Saturation
- Black
- Hue

Default settings are 0%.

Aperture Correction

Horizontal aperture correction is provided for each video proc channel, which can be used to sharpen or soften the video signal. (This is sometimes required for down converted video signals as the filtering process rolls off the high frequency very slightly). If adjusted in the positive direction this will increase sharpness, if adjusted in the negative direction this will soften the image.

H/V Blanking

The horizontal and/or vertical blanking interval can be blanked.

This setting is only available if the Up/Down/Cross converter extensions are not activated.

Test Pattern

Each video Processor path has its individual test pattern generator. Three controls are available:

- Test Pattern Enable
  This control switches the test pattern on or off

- Test Pattern Select
  This control determines the test pattern that is to be output

- Test Pattern Standard
  With this control the video standard of the test pattern generator can be determined.
  By default it is set to follow the last video input standard.

H-Flip

With the H-Flip control the image can be horizontally mirrored.

3G Output Format

The 3G output format selecting determines if the 3G output signal is a Level A or Level B Dual Link. By default this configuration is set to "Auto" which would result in the 3G format being the same as the input. It's also possible to force the output to either format i.e. if a 3G signal is output.

Timing

The greenMachine callisto will automatically add processing compensation delay for the video and audio to be aligned at the output. In addition to this, up to 30 frames of manual delay can be added to each video processing output (15 frames for Level B DL) as well as AES based audio delay (up to 1,3s).

The external audio outputs can also be manually delayed on an AES base and/or tracked to either one of the video processing output (i.e. adding the automatic processing compensation of the respective video proc output to the audio output).

Technical Support

If you have any questions or require support please contact your local distributor for further assistance.

Technical support is also available from our website:

http://support.lynx-technik.com/support/home

Please do not return products to LYNX without an RMA. Please contact your authorized dealer or reseller for more details.

More detailed product information and product updates may be available on our web site:

www.lynx-technik.com

Contact Information

Please contact your local distributor; this is your local and fastest method for obtaining support and sales information.

LYNX Technik can be contacted directly using the information below.

Address	LYNX Technik AG
	Brunnenweg 3
	D-64331 Weiterstadt
	Germany
Website	www.lynx-technik.com
E-Mail	info@lynx-technik.com

LYNX Technik manufactures a complete range of high quality modular products for broadcast and Professional markets, please contact your local representative or visit our web site for more product information.

LYNXTechnik **AG**
Broadcast Television Equipment