Hitomi MatchBox xFrame

Operation Manual

Version 1.11.7

Contents

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2. Safety Information

AVOIDING PERSONAL INJURY

This instrument is designed for use by qualified personnel only. The chassis does not contain any user serviceable parts. Units should be returned to Hitomi Ltd or a registered agent for servicing. The Operator should NOT open the unit; the Hitomi warranty will be void if the unit has been opened. The unit is not sealed against fluid infiltration: do not spill any liquid onto the unit or its power supply.

POWER SUPPLY

Make sure that the unit is connected to the correct power supply voltage. A power supply unit is provided with your MatchBox xFrame unit which may be connected to an AC power source ranging from 100 to 240VAC at 50-60Hz.

Only the Hitomi supplied power adaptor should be used with the unit. Do not use a damaged power cables with the unit as it may cause a shock or fire hazard.

ENVIRONMENT AND OPERATING TEMPERATURE

The MatchBox unit is specified to operate between 0 and 40 °C; operating outside this range may present a fire hazard or failure of the unit.

WHEN NOT IN USE

Disconnect the unit from the power supply and AC power source when not in use.

MAINTENANCE

Wipe the case gently with a lightly dampened cloth with a neutral cleaning agent. Do not let any fluid enter the unit when cleaning and ensure the unit is off with power supply removed.

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3. Introduction

MatchBox is a precision audio video alignment system along with video and audio line identification functionality and full video test pattern generator. Control and monitoring are facilitated via an Ethernet based web interface.

The xFrame chassis may be populated with a number of hot-pluggable modules, configured as either generators or analysers.

The Generator is a full test pattern generator with on screen text identification overlay, sophisticated tone and audio identification generator with temporal marker in video.

The Analyser accepts a test signal from a MatchBox Generator and provides diagnostic information regarding the link in between. The combination of Generator and Analyser allows measurement of several essential line-up parameters including audio timing with respect to video, measurement of timing between individual audio channels (coherence), end to end video transmission and processing delays (latency), audio alignment level and source ID.

Precise inter-stem audio timing is extremely important when dealing with 5.1 surround sound because in all likelihood this will at some point be down-mixed, at which point any misalignment will cause significant distortion due to the comb-filtering effects of mixing and audio signal with a delayed version of itself. This effect becomes significant even with mistiming much less than one sample. For this reason, the MatchBox solution measures to a precision of 0.01 samples giving complete confidence that all is timed up.

MatchBox 4K has additional support for Quad-link based 4K (UHD test signal generation and analysis), providing all standard features plus the ability to check alignment of the four individual links with respect to each other and reference.

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4. MatchBox Modular Ecosystem

Several modules and sub-modules are available for the xFrame chassis. Generators and analysers are both based on a core video platform module with the option of an audio companion module providing extended audio functionality including AES, Analogue audio I/O and Dolby E decoding.

4.1. Video Processor

The video processor card can either be licensed as a Generator or Analyser. Additional licences are available for Glass, Latency and 4K support, as well as Dolby E tone generation. Embedded audio operation is included as standard on the video card and rear.

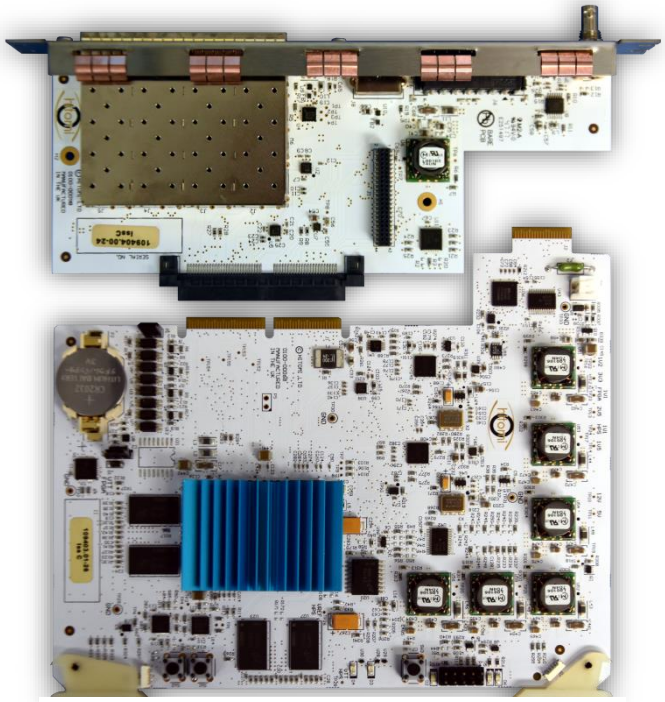

Figure 4-1 Video Processor Card & Rear Interface Module

4.1.1. Rear Interface Module

The rear interface module for the video processor card (MatchBox Generator or Analyser) provides SDI and bi/tri-level sync connections. Video rear interfaces are available in two variants:

- SD/HD/3G & 4k Video interfaces via SFPs.
    - This hardware can support Quad link UHD standards.
- SD/HD/3G/12G Video interfaces via dedicated HDBNCs.
    - This hardware supports all the standards of the SFP variant plus 12G single link UHD.

The interfaces provided by each variant are described below.

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4.1.2. Serial Digital Video Interfaces

The video processing module has eight SDI interfaces on its rear module. Ports numbered 1-4 (highlighted in blue) are inputs. Ports numbered 5-8 (highlighted in orange) are outputs.

Generator Rears provide 2 to 4 SDI outputs depending on the options purchased. Analyser Rears provide 2 to 4 inputs also depending on the options purchased.

4.1.2.1. SFP Rears

This is the rear provided by default for SD/HD/3G and 4k systems. SFP modules are used for the video interfaces allowing SDI coax, fibre, or other SFP based video interface. Ports numbered 1-4 are inputs so can only accept receiver modules, allowing up to 4 SDI inputs. Ports numbered 5-8 are outputs so can only accept transmitter modules.

The system only supports non-MSA SFP types. While in most cases customer purchased non-MSA SFPs will work correctly, Hitomi Ltd does not warrant the functionality or cover by warranty any damage caused using SFPs not provided by Hitomi or one of their registered dealers.

SFPs fitted to the system can be monitored under the **System** page, where the type of SFP fitted, the connected video format and SFP temperature can be viewed as described in section 6.1.4.

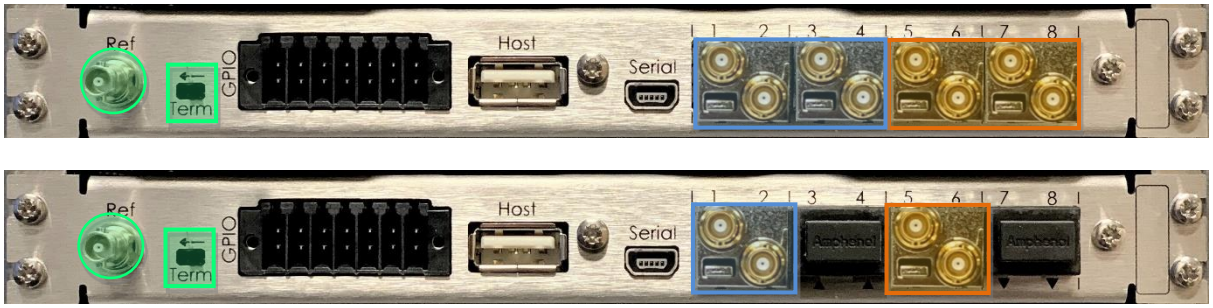

Figure 4-2 MatchBox Analyser SFP Rears, SD/HD/3G/4k followed by SD/HD/3G

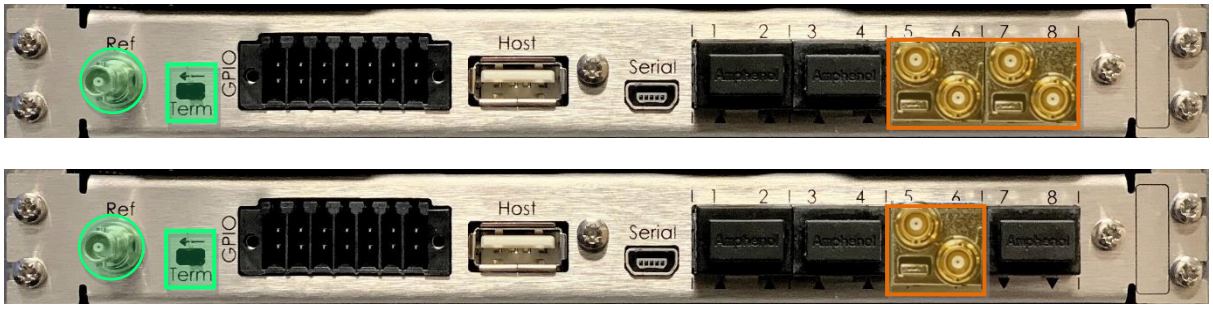

Figure 4-3 MatchBox Generator SFP Rears, SD/HD/3G/4k followed by SD/HD/3G

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4.1.2.2. HDBNC Rears (12G)

Units shipped with 12G interfaces will be provided with the 12G HDBNC rear option. The HDBNC rears offer the same video I/O capability as the SFP rears with 4 inputs and 4 outputs but with physical HDBNC connectors in place of the SFP cages.

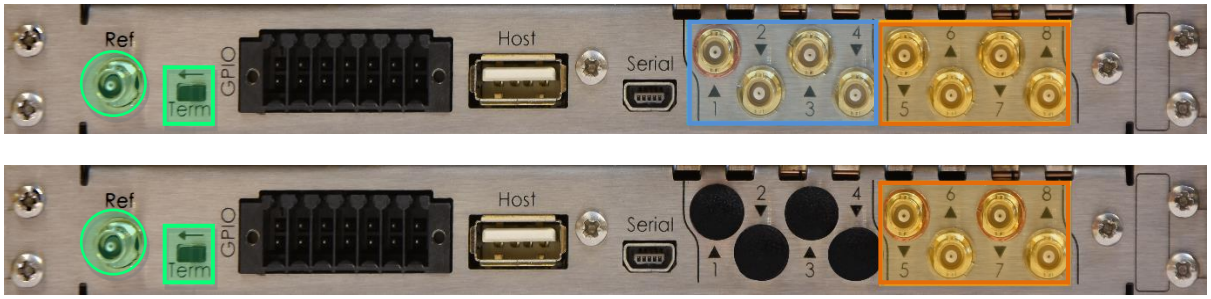

Figure 4-4 MatchBox 12G Rears, Analyser SD/HD/3G/4k/12G Rear followed by Generator SD/HD/3G/4k/12G Rear

4.1.2.3. SD/HD/3G & 4k Operation

The basic operation of cards with SFP transmitters fitted in positions 5-8 is to transmit exact copies of the SDI stream on all available outputs. Cards licenced for 4K operation are capable of outputting 2SI or SQD UHD from the four outputs. Generator cards licenced for 4K operation (including IdentBox) can also output 4 independently configured SD/HD/3G SDI streams from each of these four outputs with unique test patterns, Logos, and video idents.

Analysers licenced for quad-input or 4K operation can have 4 inputs, whereas SD/HD/3G systems can only allow two inputs. For systems able to accept only 2 inputs these can be any of the 4. For SFP rears the system will accept the first two ports for which the SFP functions as an input device starting with number 1.

4.1.2.4. 12G Serial Digital Video Interfaces

Generator cards licenced for 4K operation fitted with a 12G capable rear can output 12G single link video from output 5 and duplicated on output 7. They can optionally output quad link 4K as described above. Analyser cards licenced for 4K operation fitted with a 12G capable rear can only output quad link 4K video as described above. These Analysers can also take a 12G input on input 1 and optionally a quad link input on inputs 1-4 as described above.

4.1.3. Card Bi/Tri-level Sync Input

An analogue bi or tri-level sync signal can be connected to the module via the HD-BNC connected highlighted in green in Figure 4-2, Figure 4-3 and Figure 4-4.

Generators can either take the reference from this input OR the xFrame common reference (please refer to the xFrame handbook for information on the xFrame shared reference). Analysers can use both references concurrently to analyse SDI / reference timing.

The card reference should be terminated either by sliding the ‘term’ switch on the rear in the direction of the arrow OR using an external 75Ω termination.

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4.1.4. Serial Interface

The mini-USB connecter on the rear is a virtual COM port which uses an FTDI chip to connect a terminal to the unit for diagnostic purposes. **This is not intended for customer use**.

The serial port operating parameters are shown below:

Parameter	
Baud Rate	115200
Data Bits	8
Stop Bits	1
Parity	None
Flow Control	XON/XOFF

4.1.5. GPIO / Host Interfaces

These ports are reserved for future use.

4.1.6. Standard Video I/O configurations

As standard units are shipped with the HD-BNC SFPs or dedicated HDBNC interfaces described in the table below unless specified differently at the time of ordering.

Module Type	**Licence Option**	**Fitted as standard**
Generator	Standard SD/HD/3G	1x Dual Tx HDBNC SFP
	4K	2x Dual Tx HDBNC SFP
	4K+12G (no SFPs)	4x Dedicated HDBNC Outputs Two of which are 12G capable
Analyser	Standard SD/HD/3G	1x Dual Tx HDBNC SFP 1x Dual Rx HDBNC SFP
	Quad Input	2x Dual Rx HDBNC SFP 1x Dual Tx HDBNC SFP
	4K	2x Dual Rx HDBNC SFP 2x Dual Tx HDBNC SFP
	4K+12G (no SFPs)	4x Dedicated HDBNC Inputs One of which is 12G capable 4x Dedicated HDBNC Outputs None of which are 12G capable

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4.2. Audio Processor

The audio processor companion card facilitates extra audio functionality and I/O. This module requires a video processor card and sub-module(s) to operate. The card has three sub-module locations. Locations 1 & 2 can carry an IO sub-module enabling AES or Analogue audio interfaces. Location 0 can accept a Dolby E decoder module.

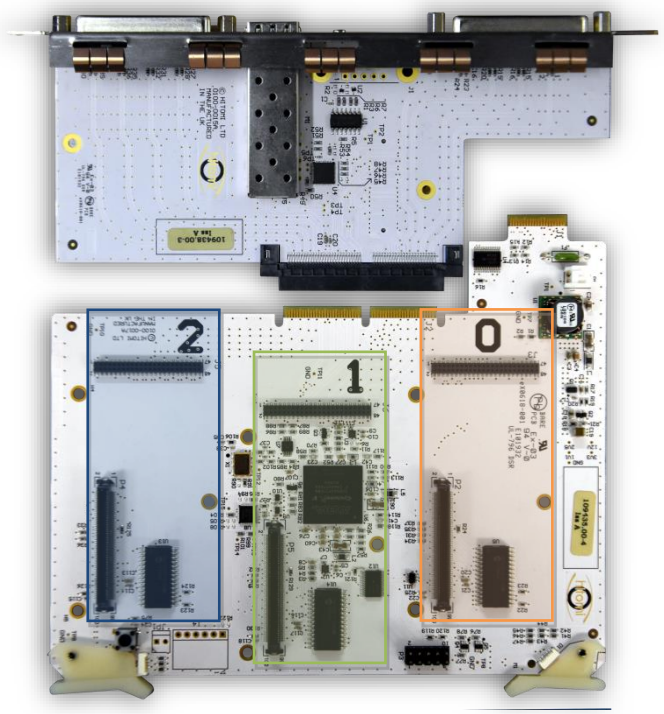

Figure 4-5 Audio Processor, Rear & Sub-module locations

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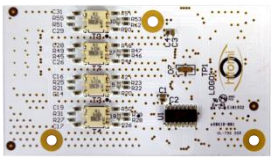
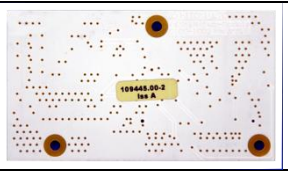
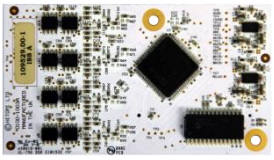
4.2.1. Audio Submodules

There are currently four available sub-modules as described in the table below:

	Sub-module Type	Description	Location Compatibility		
			0	1	2
	AES Output	The AES output sub-module provides 8x balanced AES outputs to a **Generator** through a 25-way D-Sub connector on the audio rear.	✗	✓	✓
	AES Input	The AES input sub-module provides 8x balanced AES inputs to an **Analyser** through 25-way D-Sub connector on the audio rear.	✗	✓	✗
	Analogue Output	The Analogue output sub-module provides 8x balanced Analogue outputs to a **Generator** through 25-way D-Sub connector on the audio rear.	✗	✓	✓
	CAT1100 Dolby E Decoder	The Dolby CAT1100 module provides Dolby E decode functionality to the **Analyser**.	✓	✗	✗

4.2.2. Audio Companion Rear Interface Module

The audio companion rear interface provides the I/O for audio options fitted to the system through two 25-way D-Sub connectors. The MADI interface is not supported at this time.

4.2.3. D-Sub Audio Connectors

Two 25-way D-Sub connectors are provided on the audio companion rear interface module. These allow breakout of either AES or Analogue audio from the AES or Analogue audio sub-modules fitted to the audio companion module.

The connectors are numbered the same as the audio sub-modules to which they are connected i.e. the connector marked 'Audio Option 1' interfaces to sub-module 1 and 'Audio Option 2' to sub-module 2.

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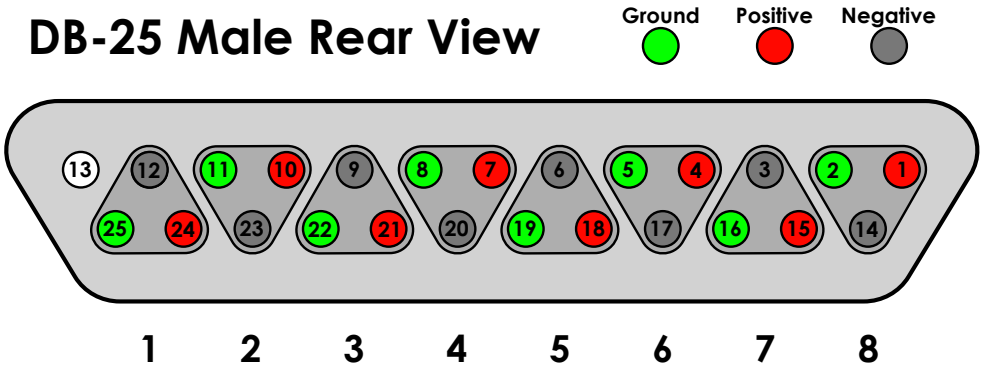
4.2.4. D-Sub Pinouts

AES/Analogue input or output options connect via a 25-way D-sub connecter on the rear. The connector on the rear of the unit is a female so will require a male connector on the breakout cable.

The AES/Analogue interfaces are balanced and have the pin out shown below. The view is from the rear of the male connector.



4.2.5. Fitting Audio Companion Rear Interface Module

The audio companion rear is physically coupled to the video module rear. There are electrical connections between the audio and video rears as well as two pillars between the rears to physically join the two rears. The combined rear should be inserted into the xFrame as a pair and fixed in with 8 M2.5x6 screws.

4.2.6. Assembling Audio/Video rear

If the audio module has been supplied separately from the video rear, it will be necessary to remove the video rear from the frame prior to coupling the two rear modules together. The audio module should be placed on top of the video rear ensuring the connectors on the two modules mate correctly and in alignment. The audio rear is supplied with two screws which should be used to fix the pillars fixed to the audio rear to the video rear.

The combined rear should be inserted into the xFrame as a pair and fixed in with 8 M2.5x6 screws.

4.2.7. ** Care-point when removing audio rear interface module **

When removing either the video or audio rear, if the audio rear is fitted it is important to note that both MUST be removed at the same time. All 8 screws which hold the rear pair into the xFrame must be removed. Trying to remove one module without the other will cause damage.

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5. Web Interface

5.1. Overview

To access the web interface, enter the IP address of the module to be controlled into a web-browser on the same network. For instructions setting up the networking see section 6.1. To navigate through the web interface, use the buttons at the bottom of the web pages. Back and home buttons appear at the bottom left of the control page. Control settings are stored in non-volatile memory so will be restored after a power cycle.

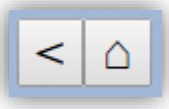
The unit can be controlled via several browsers at the same time with control changes tallying back to all browsers controlling the device.

MatchBox is tested against the latest versions of Chrome, FireFox and IE running under Windows along with Safari on iPad.

Please note that the browser 'back button' is not currently supported.

5.1.1. Navigating

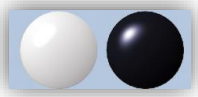
The web control surface is navigated using the buttons at the bottom of the web page to switch between menus.



Some pages operate as a hierarchy; when in lower levels of the menu hierarchy there are two extra buttons on the control strip at the bottom:

The 'angle bracket' symbol returns to the previous page, and the 'home' shaped button returns to the home screen.

5.1.2. Heart Beat



The web interface has a heartbeat indicator in the bottom right of the web page as shown below:

The stones alternate in colour when the web interface is in communication with the unit. If the network connection is lost the animation will stop.

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6. General Video Processor Control

Control which is common to both Generator and Analyser is described in this section. This includes network configuration, SFP status and general health monitoring.

6.1. Network configuration

The xFrame chassis has a single 1GigE Ethernet port on the rear which is connected via a switch on the control module to each individual slot. Each 'intelligent' module runs its own web server for control and has its own IP address. The IP addresses are configured on the processing module.

xFrame controllers above version 0.107 store the IP address for each slot and ensure they are consistent; so, the IP addresses remain with the frame. The slot's IP address is assigned to any processing module plugged into that slot. IP addresses can be reset to defaults using the instructions on the xFrame front panel; see the inside of the front panel or the xFrame handbook for more details.

XFrame controllers at or below version 0.107 allow the IP address to be kept on the processing module only. IP addresses cannot be reset via the front panel.

The xFrame is shipped with default static IP addresses for each slot. The default addresses are 192.168.1.10**x** where **x** represents the slot number between 1 and 4. Slots are numbered left to right bottom to top. Please see the xFrame handbook for more detail on IP address allocation within xFrame.

Once configured, the unit can support either address acquisition through DHCP or a static IP address.

To configure the network for your set up follow the steps below:

1. Connect the PC you are using to set up MatchBox the xFrame using a standard Ethernet cable (this assumes your PC Ethernet port supports auto-crossover if not a cross-over RJ45 cable may be used or connect via an Ethernet switch).

2. Set the IP address of the setup PC to a free address in the 192.168.1.x range

   e.g. IPv4 address: 192.168.1.1, Subnet mask: 255.255.255.0

3. Open a web browser on the PC and enter the IP address of the module you wish to set up 192.168.1.10**x** into the address bar. You should see the home page of the MatchBox hardware with that IP address.

4. Click the **System** button at the bottom of the page, then click the **Network Settings** button at the bottom of the page where the network configuration can be set up.

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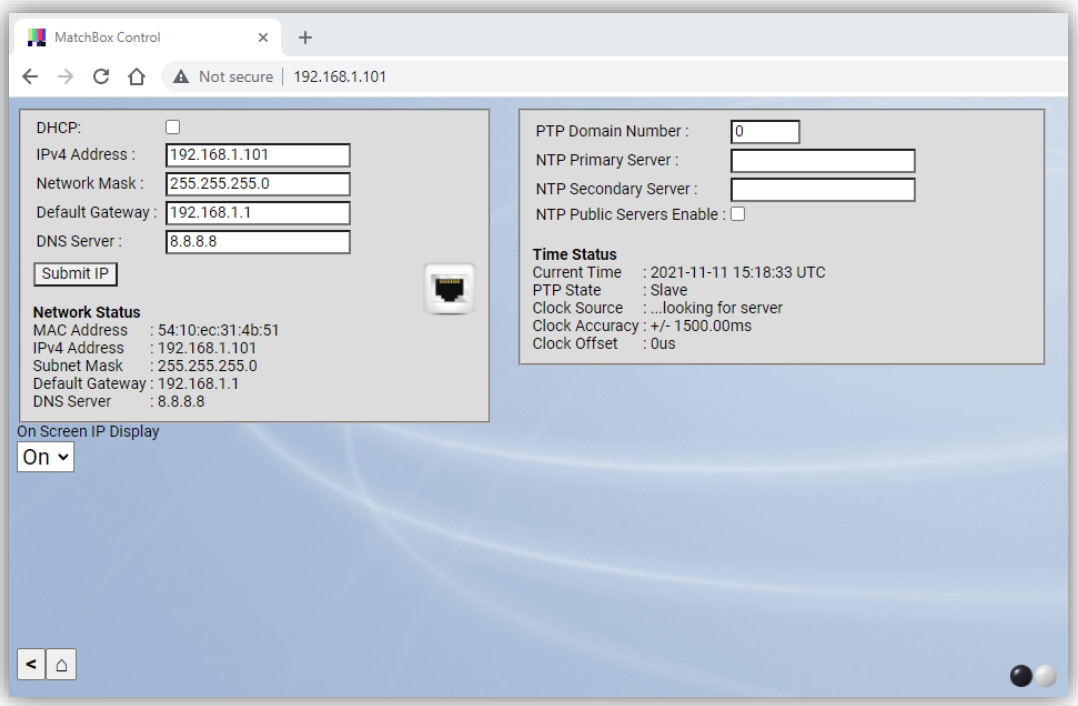
6.1.1. Network and Time Settings Page



To set the unit up as a DHCP device:

*Check the DCHP checkbox on the Network Setup control.

* Click the Submit IP button.

* Confirm that you want to change network settings by clicking OK.

To set the unit up with a static IP:

* Enter the static IP address, subnet mask and default gateway provided by your network administrator.

* Click the Submit IP button.

* Confirm that you want to change network settings by clicking OK.

Repeat for any other video modules in the frame.

Note:
After reassigning the network settings, the unit will no longer be controllable until a connection is made with the new network settings for the MatchBox.

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6.1.2. Time Status

The time settings are used when measuring latencies of transmission from a Glass or generator source to the MatchBox analyser.

For most accurate results, the best common time source available should be used for all involved equipment. In this configuration, any offsets in the time source are cancelled out and only variability in the routing to the time source will affect the accuracy of the measurement.

The MatchBox module will attempt to locate a PTP time source but, if it does not locate one, the best NTP source it can find is used and the MatchBox will consider becoming a PTP master. When multiple MatchBox modules are available, they may all attempt to become PTP masters if no dedicated master is available. Each module can be configured to prevent it becoming a PTP master to allow more control over the network.

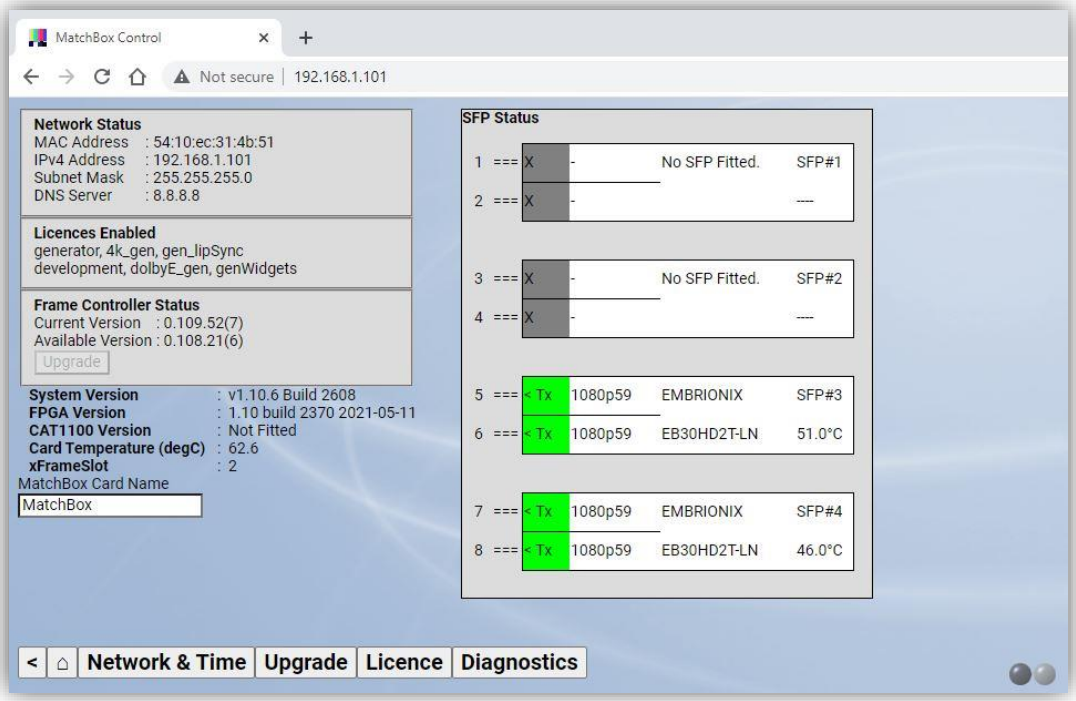
6.1.3. On Screen IP display

The MatchBox unit can overlay the IP address and subnet mask of the unit over SDI video outputs. To enable or disable the on-screen overlay of IP settings, use the ***On-Screen IP Display*** control which can be found in the **Network Settings** page.

The On-Screen IP Display control defaults to '*On*' and will also automatically be set to '*On*' when there is a change to the IP settings.

6.1.4. System Page

The **System** page shows various status from the system and has sub-pages to which facilitate upgrading, licensing and network setup.



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6.1.5. Network Status

The top left shows the current network configuration (MAC address, IP address, Subnet Mask and DNS Server). You can change the network configuration under the **Network Settings** page.

6.1.6. Controller Version

This reflects the current software version running on the frame controller which is the small card installed in the centre of the xFrame.

A new upgrade package for a module may be accompanied by a new version of the controller software. The controller software is upgraded automatically during the module upgrade process. Where different module versions have been installed in an xFrame, the controller version may not match the version supplied with the module. Controller software versions are designed to be backward compatible.

If a newer version of controller software is available, an update can be manually requested by pressing the button in the Frame Controller Status area.

6.1.7. System Version

This reflects the current software release running on the system. The system software may be upgraded under the **Upgrade** page.

6.1.8. FPGA Version

The released version of the firmware used in the FPGA. Multiple upgrade package releases could include the same FPGA version.

6.1.9. CAT1100 Version

Analysers which have an audio companion card fitted with the Dolby E decode feature will show this status which reflects the software revision installed on the Dolby decoder module. The software for the module is distributed with the MatchBox upgrade package.

6.1.10. Card Temperature

This reflects the module temperature.

6.1.11. xFrame Slot

There are four slots able to accept modules in the xFrame; these are numbered 1-4 starting on the bottom left (looking from the front) numbered left to right then from bottom to top. This status indicates which slot the video processing module is plugged into.

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6.2. System Upgrade

Periodically new software releases are issued with new features and bug fixes. Upgrades can be applied through the web interface.

The latest software can be downloaded from the Hitomi website support section; https://www.hitomi-broadcast.tv/Support. You must register on the website to access this area.

Generators and Analysers require updating independently, however the same upgrade file can be used for all system types.

The upgrade process will work with most web browsers although Chrome is recommended.

6.2.1. Upgrading through the Web GUI

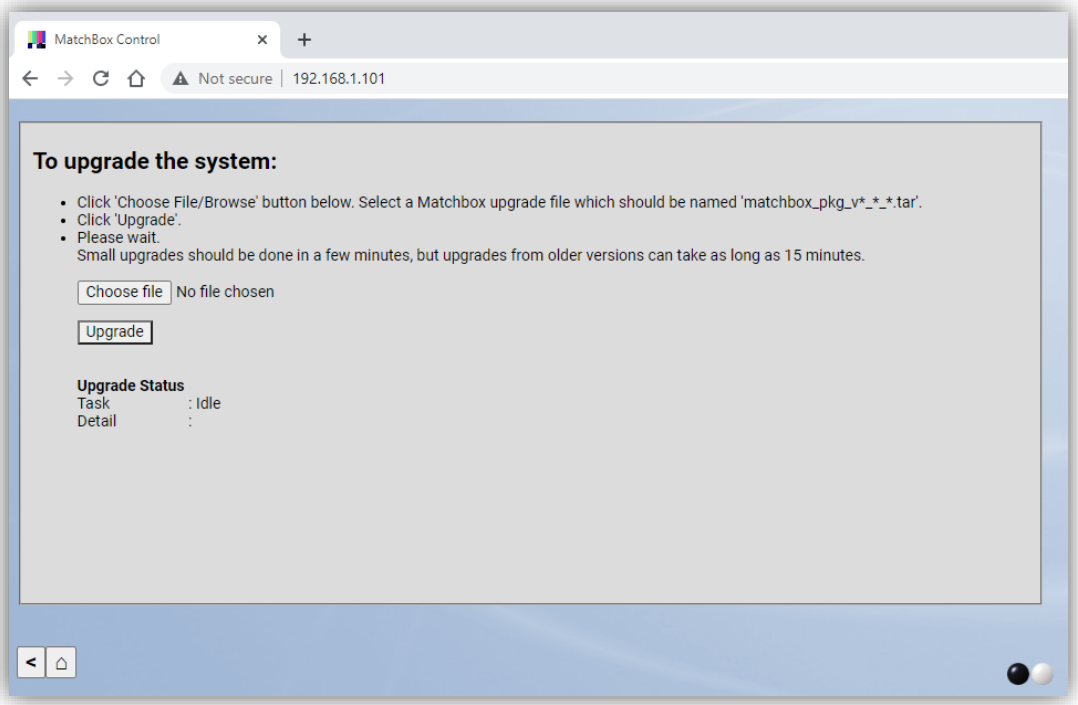
Step 1

The software is usually distributed as a .zip file, extract the *'matchbox_pkg_v**X**_**Y**_**Z**u.tar'* file onto a drive on the computer you are using to upgrade the MatchBox.

*An upgrade file would usually have a name of the form: 'matchbox_pkg_v**X**_**Y**_**Z**u.tar' where X_Y_Z represents the version number of the release e.g. 'matchbox_pkg_v1_4_9u.tar'* for V1.4.9.

Step 2

Navigate to the **System->Upgrade** page on the Analyser or Generator web interface.



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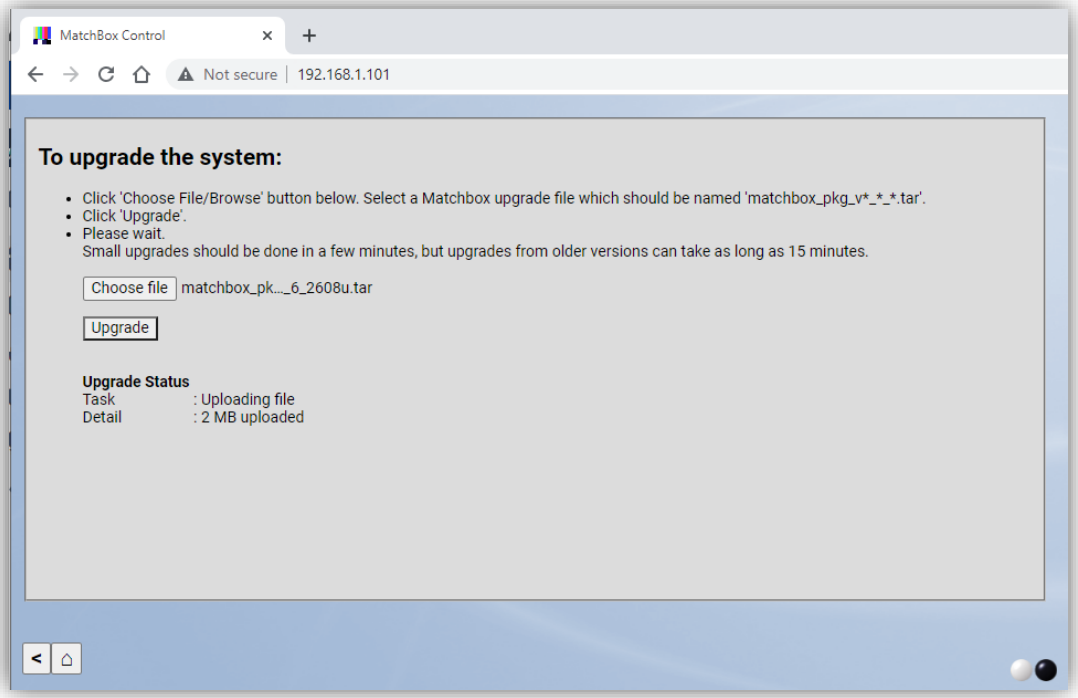
Step 3

Click the 'Choose File' button and navigate to where you have put the .tar upgrade file.

Step 4

After selecting the upgrade file click the 'Upgrade' button. The web browser will report progress through the upgrade process as shown below. The upgrade process takes around 5 minutes during which the system will reboot.

If the unit is in sight the LEDs on the front panel relating to the Generator or Analyser being upgraded will go white, then purple as the boot process progresses (V1.47 onward).



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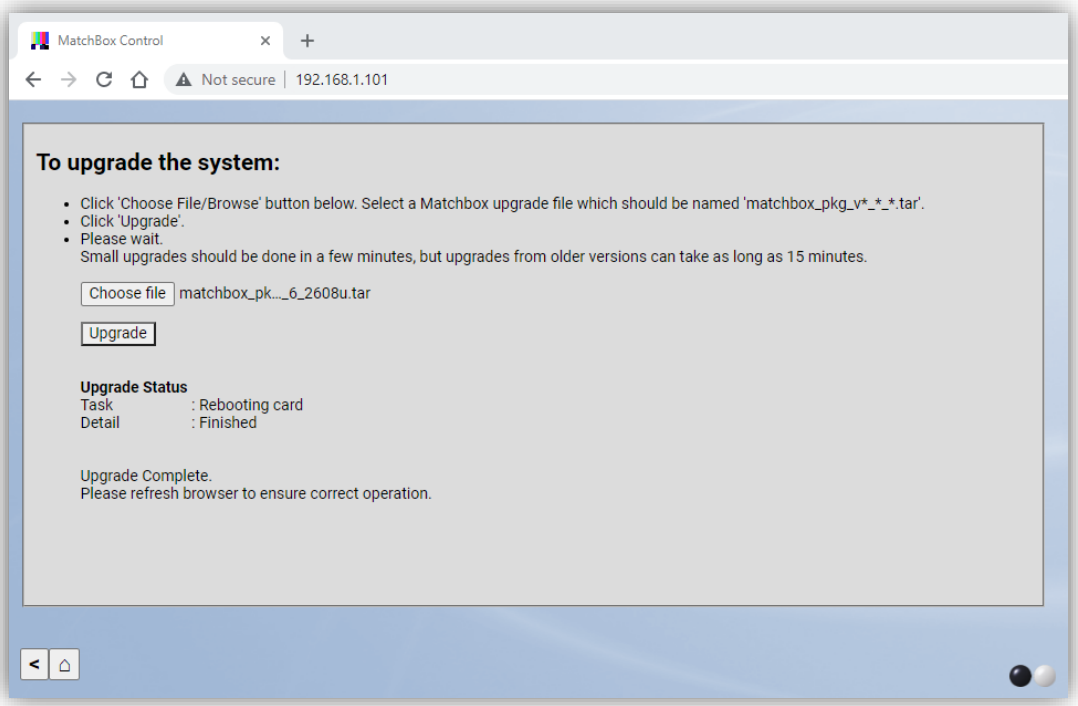
Step 5

Once the system reports *'Upgrade Complete.'*, refresh the web-browser.

**** Do not power down the system during the upgrade process. ****



6.2.2. Possible issues during upgrade

6.2.2.1. The upgrade never reported 'Upgrade Complete'.

If for any reason the web page loses connection through the process progress information can be lost however this should not affect the application of the upgrade. This can happen due to you network infrastructure disconnecting the unit as it reboots or unexpected behaviour of some web browsers.

If more than 10 minutes has elapsed since the upgrade started and the browser has reported *'Upgrading...'* but not reported *'Upgrade Complete.'* as shown above, then upgrade will have almost certainly completed but connection may well have been lost. Try refreshing the web browser and navigate to the **System** page and check that the expected revision is shown. It should now be safe to power down the system if required.

6.2.2.2. I navigated away from the Upgrade page while the upgrade was in progress.

If you have navigated away from the **Upgrade** page during the procedure, the upgrade should continue in the background. Leave the system for 10 minutes to ensure it has completed before powering down the system.

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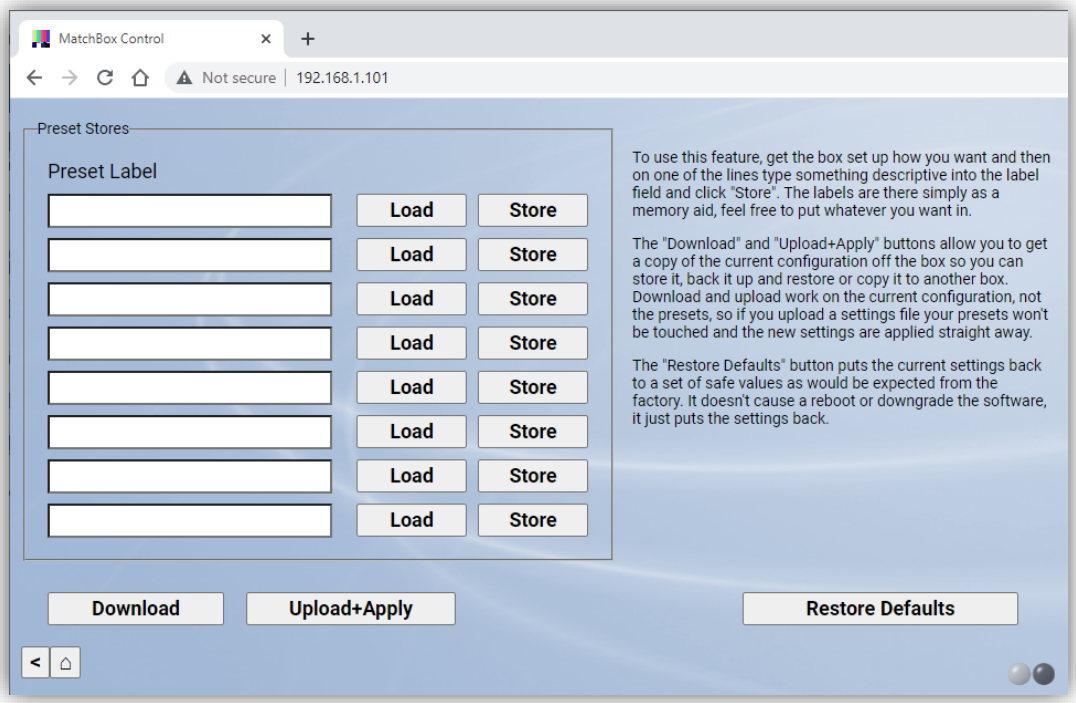
6.2.2.3. *The system was powered down during an upgrade.*

If power has been lost during an upgrade, it is possible that the system may be in an unpredictable state although it is most likely that the system will still boot. If the system does still boot, then repeat the upgrade procedure to ensure the system is in a known state.

In the unlikely event that the system will no longer correctly boot, please contact Hitomi for support.

6.3. Pre-sets

The current module configuration can be saved as a pre-set. The module can store Eight pre-sets which can be recalled at any time. A meaningful label can be associated with the pre-set store. In addition to storing and loading pre-sets stored on the module; module configuration files can be downloaded and uploaded from any PC. The ability to revert to Factory Settings is always available. Loading pre-sets and recalling Factory Settings will not affect the module's network configuration or licenced options.



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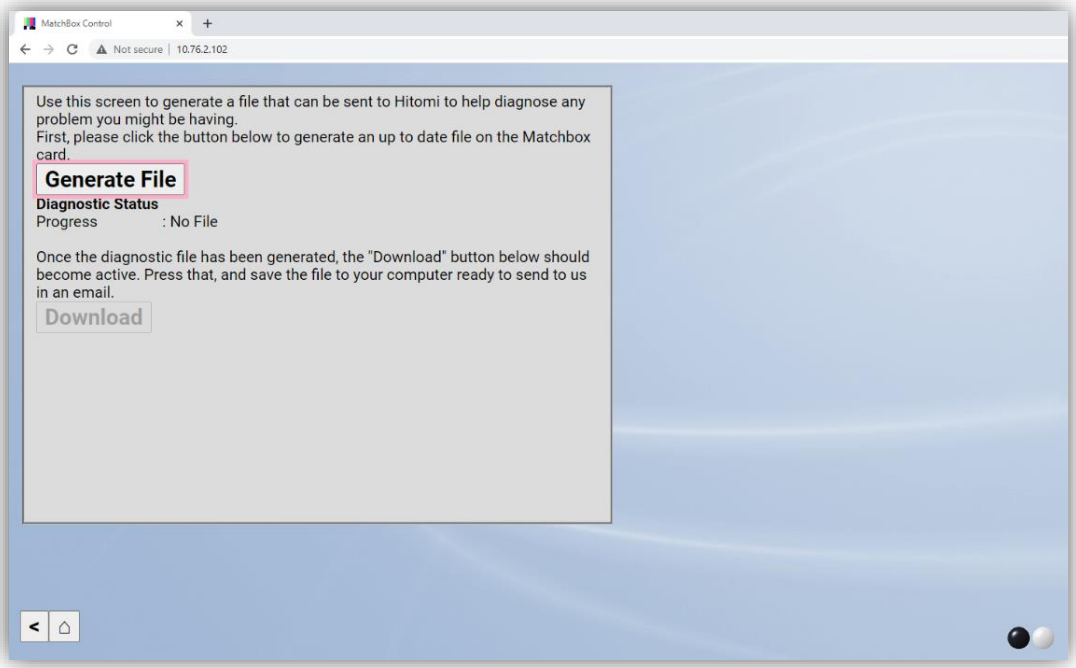
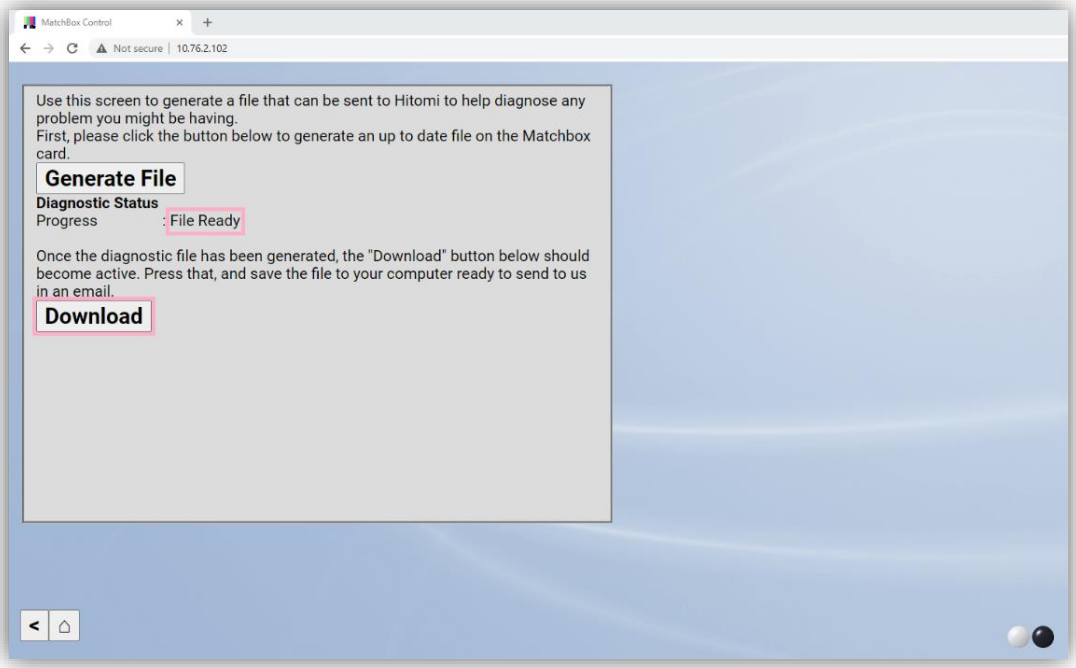
6.4. Diagnostics

In the rare circumstance that a MatchBox unit behaves unexpectedly, the Diagnostics page allows system logs to be downloaded from the unit which can be sent to Hitomi for analysis to help diagnose the issue.

To create a log file, first click the ‘Generate File’ button. Once the ‘Progress’ indication changes to ‘File Ready’ click the ‘Download’ button. A file named ‘diags.tgz’ will be downloaded, which can be shared with Hitomi as part of a support request.





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7. Generator

The MatchBox generator is a fully fledged test pattern generator with genlocking facility capable of generating a wide range of SD/HD/3G/(optional) 4K formats. The Generator has addition features to allow audio video timing measurement along with an audio tone and voice identification generator.

A variety of test patterns can be generated, all of which may be used as the background to audio video timing measurement.

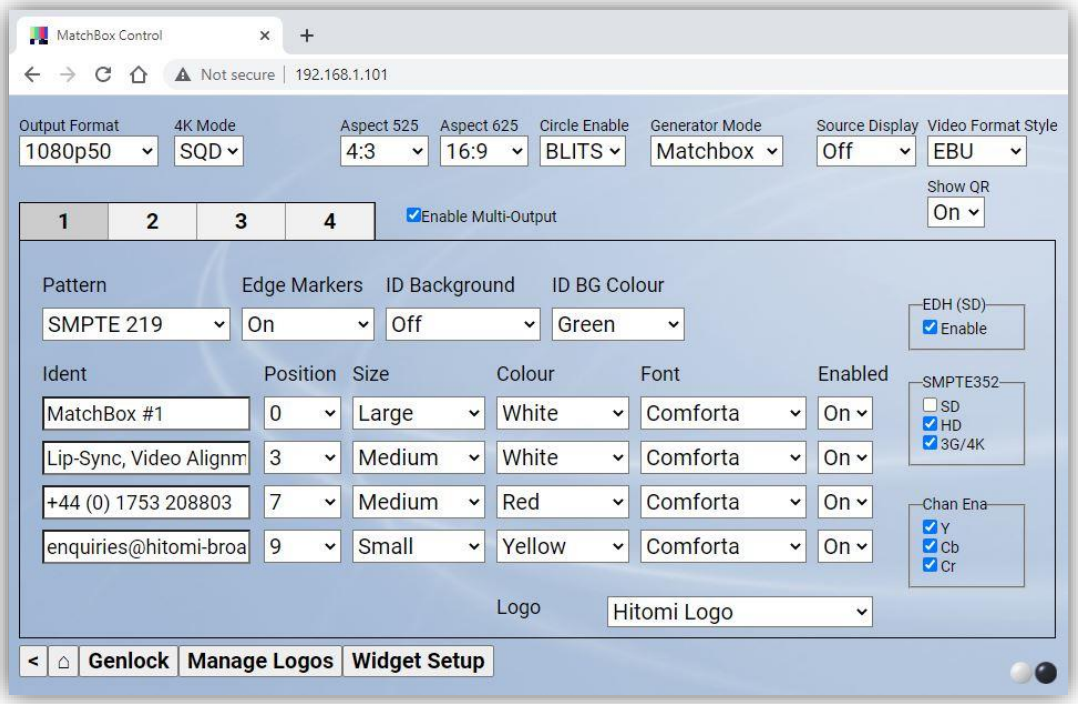
The audio generator can generate GLITS or BLITS tones along with continuous tone.

GLITS may be used to measure AV timing and is compatible with MatchBox or Vistek/Pro-Bel VALID and VALID8 readers.

BLITS is a 5.1 surround tone sequence that can only be read by MatchBox Analysers and allows alignment of 5.1 systems including precise inter-stem timing alignment to sub sample precision.

7.1. Video Page

Controls relating to the generator video output can be found in the **Video** page such as output format, output pattern and metadata controls.



Cards licenced with 4K/Quad have tabbed settings for each of the four outputs; titled 1 to 4. Allowing each output to be set uniquely. Checking the '**Enable Multi-Output**' checkbox enables the unique outputs, otherwise the four outputs are copies of the first tab. Systems without 4K licences will only have access to the first tab, with tabs 2, 3 and 4 greyed out.

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7.1.1. Output Format

The output format can be selected using the ***Output Format*** dropdown.

7.1.2. 4K Mode

MatchBox 4K units can generate 2SI and SQD quad-link test signals. When fitted with a 12G capable rear they can also generate 12G SDI. To enable this feature, select the format used for the links (e.g. 2160p50) and then select the 'SQD', '2SI' or '12G' setting from the '4K Mode' dropdown. Only 2160p formats can be used as a 4K carrier.

This control is only available on MatchBox Generators with licensed for 4K operation.

7.1.3. Test Patterns

The output test pattern can be selected using the ***Pattern*** dropdown. Text idents and other overlaid features are unaffected by changing the pattern. The pattern is affected by the ***Chan Ena*** control.

7.1.4. Channel Enable

The pattern is affected by the ***Chan Ena*** control which can be used to turn off the individual colour channels (Y, CB, or Cr) independently; for instance a luminance only sweep can be generated by selecting one of the sweep patterns in the ***Pattern*** dropdown and turning off the Cb and Cr channels using the ***Chan Ena*** checkboxes.

7.1.5. Edge Markers

In order to check whether pixels at the edge of picture, and top and bottom lines are all passed correctly through a video path, MatchBox can add castellated edge markers. These markers are alternating black and white pulses around the image perimeter.

This can be especially useful when testing quad-link paths. In the case of quadrant based quad link, each quadrant will have edge markers. These should meet up correctly when the quadrants are put back together.

Edge markers can be turned On/Off through the ***Edge Markers*** dropdown.

Below are shown edge markers in SD/HD/3G/4K-2SI (left) and Quadrant based 4K (right).

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7.1.6. SD Aspect Ratio Controls

The ***Aspect 525*** and ***Aspect 625*** dropdowns control the aspect ratio of the generator when a standard definition output format is selected. These controls effect elements of the output test pattern which are aspect ratio sensitive, predominantly the aspect ratio of the circle which will be rendered as a precise circle when observed at the correct aspect ratio.

7.1.7. Circle

The ***Circle Enable*** dropdown can be used to configure or turn off the animated circle on the output test pattern. It has different options depending on the Mode of operation:

Mode	MatchBox	IdentBox
Off – No Circle present on outputs	✓	✓
BLITS – Animated circle centred on output frames tracking BLITS tone sequence	✓	✗
GLITS – Animated circle centred on output frames tracking GLITS tone sequence	✓	✗
Blank - Animated circle centred on output frames showing basic comet rotation	✓	✗
Bounce – Small circle bouncing around output frames to add motion to the output for visual indication of freeze frame faults	✗	✓

7.1.8. Source Display

The output of the generator can optionally display the source format and audio alignment level (e.g. 1080p50 -18dBFS). To burn in the source format and audio alignment level set this control to 'On'.

7.1.9. Video Format Style

EBU and SMPTE define different styling for video formats. MatchBox can use either to display the source format on screen. As an example, European interlaced 1080-line HD would be referred to as 1080i/25 by EBU standards or 1080i50 by SMPTE.

7.1.10. Show QR

Enabling the QR code display on the generator will allow end to end latency measurements for the video channel to be gathered on a suitably licensed analyser. The QR code is currently not available on the IdentBox.

7.1.11. EDH

The ***EDH(SD)*** checkbox enables or disables SMPTE RP165 EDH packet insertion for standard definition outputs.

7.1.12. SMPTE 352 Payload ID

The ***SMPTE352*** checkboxes are used to enable SMPTE 352 payload ID packets on the generator output. These can be independently enabled for SD, HD and 3G outputs. The packets are mandatory for 3G signals however may be turned off, but this could cause issues with downstream equipment.

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7.1.13. Logo

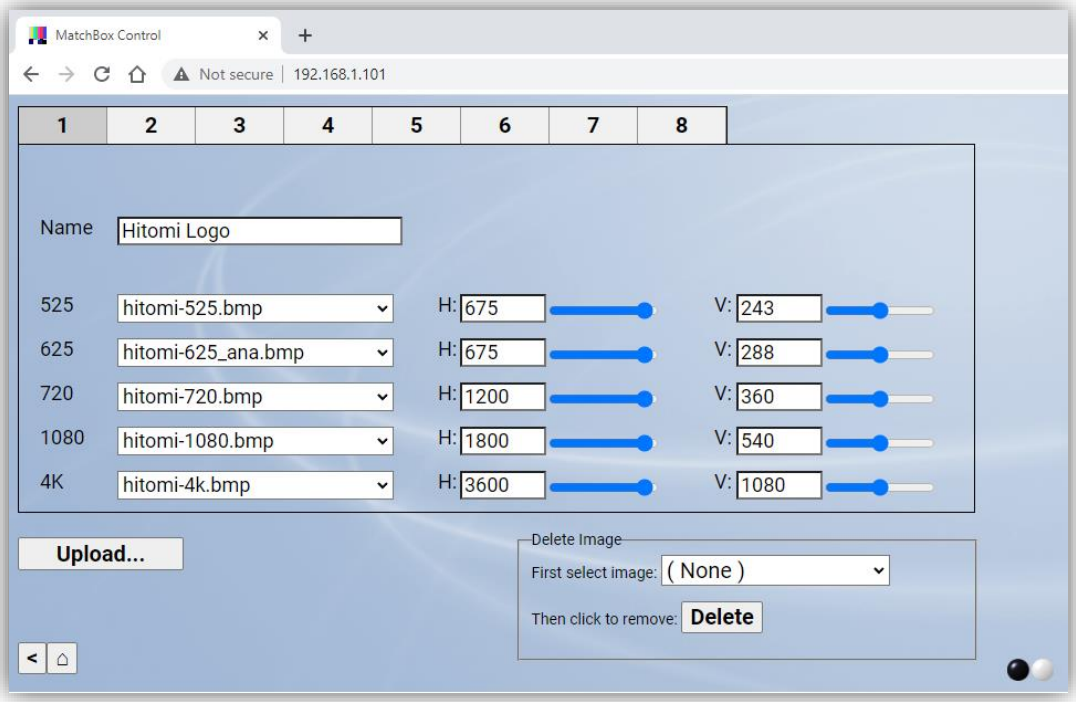
Each video output can be assigned a logo from one of the eight logo stores. The logo will be displayed on the modules video output in the position for the current output format set in the Logo Upload Submenu.

7.1.14. Manage Logos Submenu

Eight logo stores can be configured on the module. Each store holds logo images and position settings for each of the five different video line formats; 525, 625, 720, 1080 & 4k. The module will automatically apply the settings for the current output format. This allows the user to design logos specifically for the colour space, resolution and aspect ratio of the different line formats. Logo positioning is controlled via the horizontal (H) and vertical (V) sliders. These controls set the centre position of the logo in pixels.

Clicking on 'Upload' will open a file browser to select a logo file to upload. Once uploaded the logo will be available for selection in the dropdown list.

Bitmap logo images can be uploaded in ARGB32 pixel format only.



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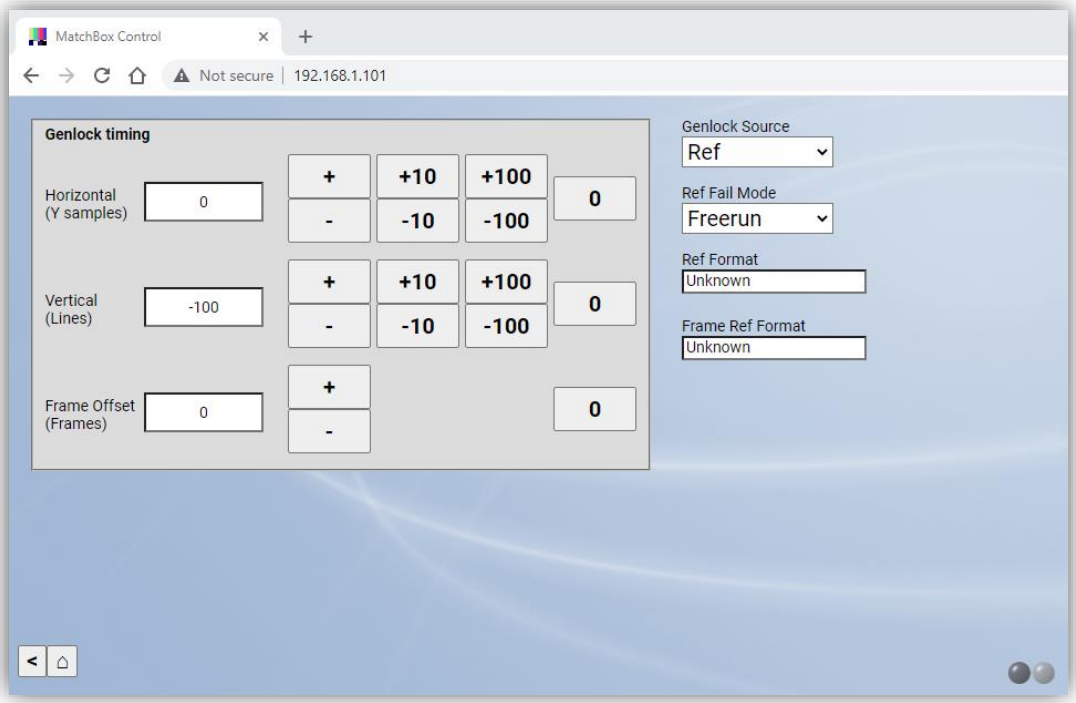
7.1.15. Genlock Submenu



The generator may be locked to a black and burst reference, or one of the SDI inputs. If the selected reference fails, the system will lock to the source selected in the ***Ref Fail Mode*** dropdown which has the same options as the ***Genlock Source*** control.

The reference source can be selected with the ***Genlock Source*** control which has the following options:

Genlock Source	Generator clock system behaviour.
FreeRun	Free runs, ignoring any applied references.
Ref	Locks to the bi/tri-level sync reference input of the module if it is of a compatible format.
Ref (Frame)	Locks to the xFrame common bi/tri-level sync reference input of the module if it is of a compatible format.
SDI	Locks to the selected SDI input.
SDI Passthrough	Locks to the selected SDI input with timing fixed such that timing is aligned with the input video if it is passed through the generator.

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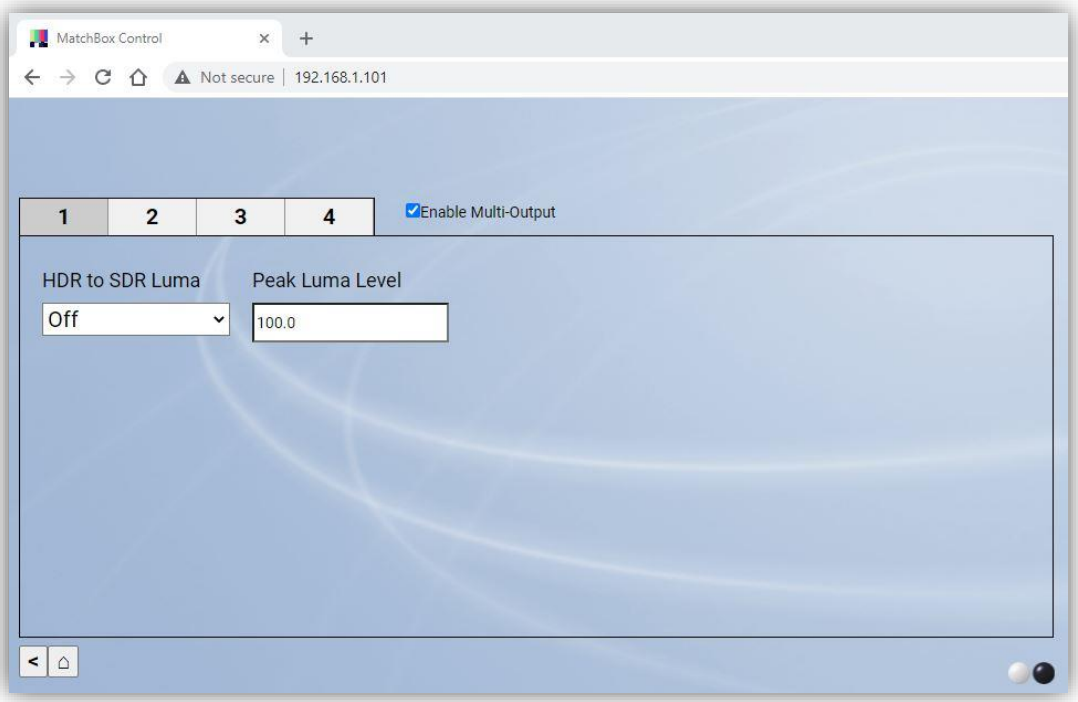
7.1.16. Widget Setup

The HDR luma setting can be mapped to SDR values using a control on this page. In addition, the peak luma level can be configured.

All settings are configured per-output.



7.1.16.1. Timing Offsets

Timing relative to the reference can be adjusted with the Genlock Timing control where the timing can be adjusted in line and pixel steps. The offsets can be directly entered in the text box or can be adjusted in steps of 1, 10 or 100 lines of pixels. The frame offset control is used when an interlaced reference signal is supplied but a progressive signal is being generated to ensure audio frames are synchronised to the correct field.

Timing offsets are stored uniquely for each output video format so separate settings can be made for different formats used in house.

7.1.16.2. Ref Format

The format of the current reference signal applied to the unit is displayed on the Genlock web page. The unit can accept SD bi-level syncs (525/625) or HD 1080i tri-level syncs (1080i50/59/60). Progressive bi-level syncs are not recommended.

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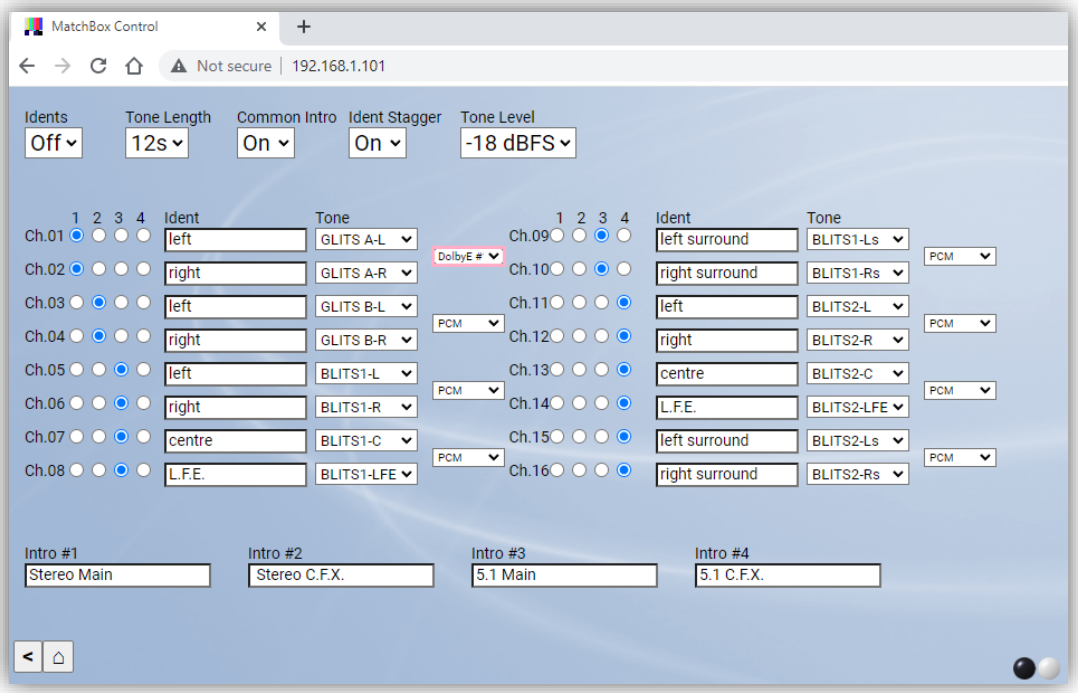
7.2. Audio Page

The **Audio** page contains all controls relating to the generator audio outputs.



7.2.1. Audio Tones

MatchBox can generate two types of tone sequence based on GLITS or BLITS.

7.2.2. GLITS

GLITS is a stereo tone sequence with tone on both legs with leg identifying breaks, one in the left leg and two in the right. GLITS tones are available in 8 different frequencies allowing identification of 16 individual channels.

GLITS tones are compatible with the Vistek VALID and VALID8 systems.

7.2.3. BLITS

The BLITS tone sequence is intended for use to identify 5.1 surround sound audio groups and therefore comprises 6 different tone sequences. The initial part of the sequence has an individual tone burst on each audio stem, followed by a 1kHz identifying sequence only on Left and Right stems closing with a constant tone on all stems.

MatchBox generates two variants of the BLITS sequence (referred to as BLITS1 and BLITS2). BLITS1 conforms to the EBU specification with regard to tone frequencies with the final burst on all stems being 2kHz, whereas BLITS2 has a 1.5kHz burst at the end so that two separate 5.1 groups can be identified.

Both BLITS variants slightly deviate from the EBU recommendation in that they have been truncated to 12 seconds rather than the specified 13.1 seconds in order to play out concurrently with 3 cycles of GLITS tone.

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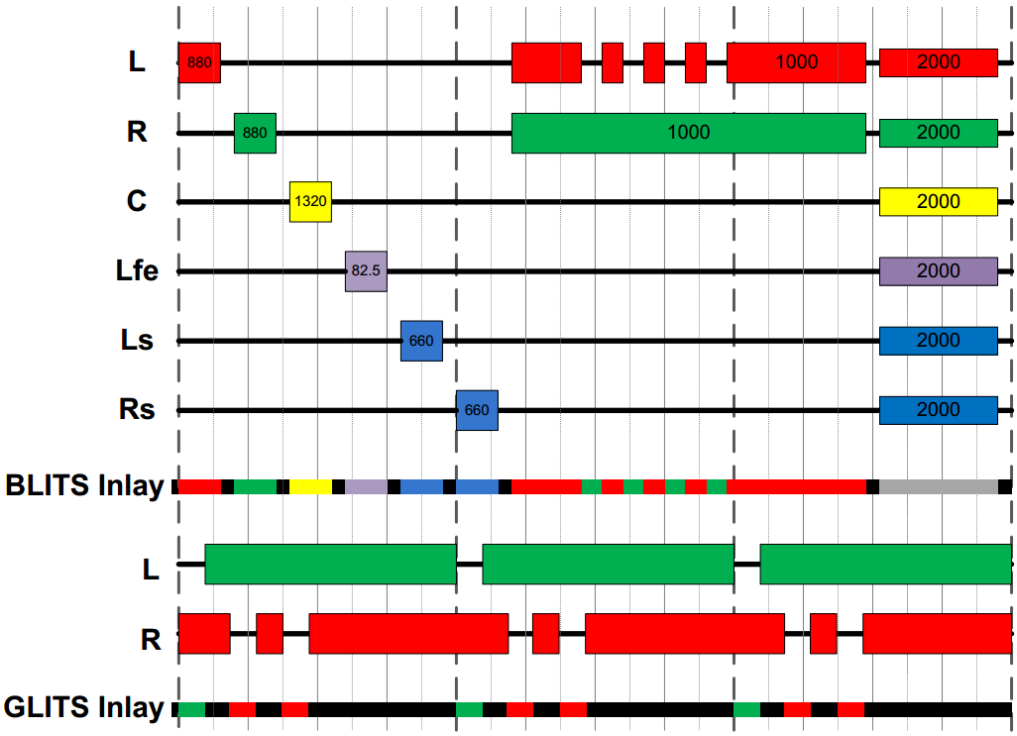
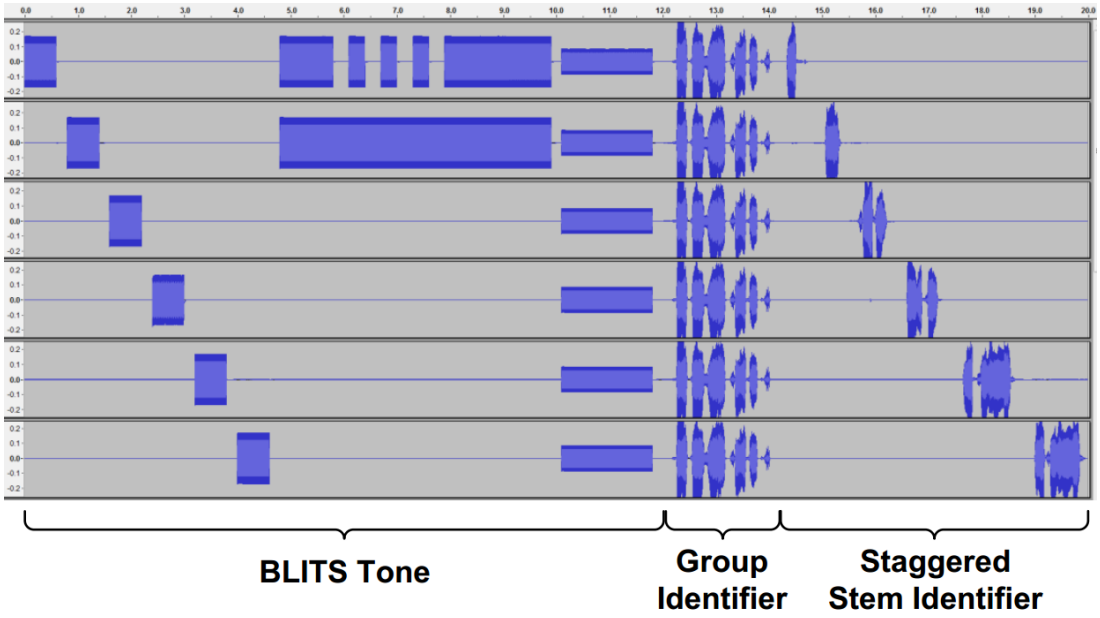


Figure 7-1 - BLITS / GLITS Tone Sequences

7.2.4. Audio Identifiers

Voice synthesised audio stem identifiers can be added to the audio output of the generator. Audio identifiers can be set up to have a group identifier which is common to a selectable group of channels and output simultaneously on all channels in the group. This is followed by individual stem identifiers which may be set to be staggered in time so that each can be heard individually.



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7.2.5. Common Intro & Identifier groups

A common voice identifier can be played out on all channels in a channel group. Logically grouping audio channels in this way allows a common identifier to be played simultaneously on all the channels in that logical group. It might be desirable to logically group channels if they belong together for some reason, for example in the same 5.1 surround program. After the common introduction identifier, the individual channel idents are played.

Ident groups can be selected in the audio page on the generator control page. Each audio channel has 4 radio buttons to select its ident group which are numbered 1-4. The numbering corresponds to the Intro#1/2/3/4 text boxes which allow intro ident text to be entered for each group.

Group audio identifiers will only be played out if the ***Idents*** control is set to on AND the ***Common Intro*** control is set to on.

7.2.6. Ident stagger

Channel identifiers would usually be set to unique text for each stem in a group e.g. 'left', 'right', 'centre', etc. Playing all identifiers concurrently can make it very hard to hear which stem is which when they are all played concurrently; with this in mind a stagger feature has been included which allows all channel identifiers within a group to be played out one after the other. This does not affect the group identifiers which will still be played out concurrently.

To enable identifier staggering, turn on ***Ident Stagger*** in the **Audio** page.

7.2.7. Dolby E

MatchBox generators fitted with the Dolby E option can generate an encoded Dolby E stream on any of the audio output pairs.

7.2.8. Enabling Dolby E outputs

The encoded streams are encoded as a 5.1+2 Dolby E transport with the 5.1 audio containing BLITS tones and the +2 pair containing GLITS tones.

If Dolby Encoding is licenced, the Audio page has an extra drop-down for each audio pair as shown below highlighted in pink.

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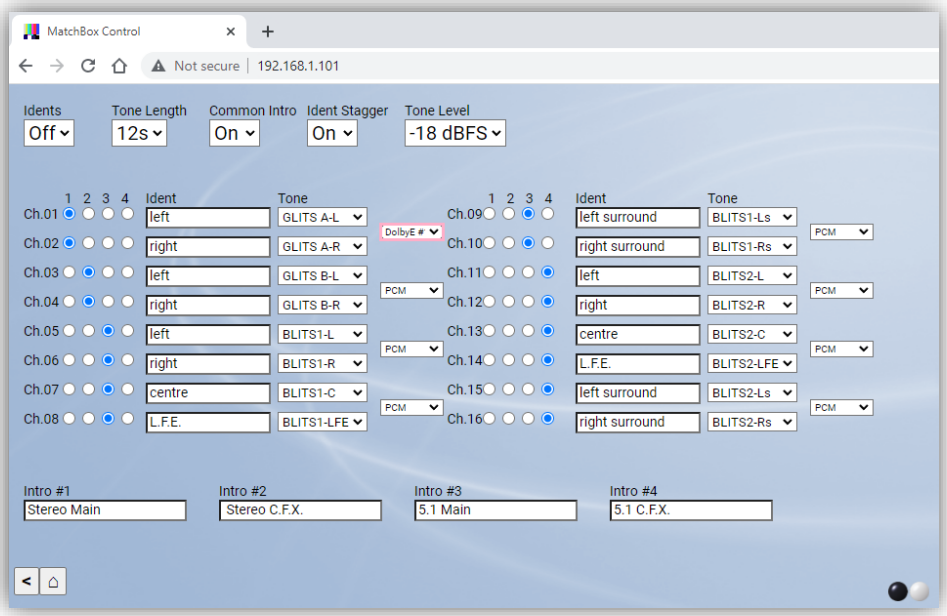

This dropdown has 3 options: **PCM**, **DolbyE #1** and **DolbyE #2**.

When set to PCM the channel pair will output PCM audio as selected in the 'Tone' selection immediately to the left.

When set to either **DolbyE #1** and **DolbyE #2** the Tone selection will be overridden, and a Dolby E stream played out instead. The mapping of the tones in the Dolby E stream is shown below:

5.1+2 channel		DolbyE #1	DolbyE #2
5.1	Left	BLITS1-L	BLITS2-L
	Right	BLITS1-R	BLITS2-R
	Centre	BLITS1-C	BLITS2-C
	LFE	BLITS1-LFE	BLITS2-LFE
	Left Surround	BLITS1-Ls	BLITS2-Ls
	Right Surround	BLITS1-Rs	BLITS2-Rs
+2	Left	GLITS A-L	GLITS B-L
	Right	GLITS A-R	GLITS B-R

7.2.9. Audio Idents and Dolby E

Audio Idents have limited support when playing out Dolby E. While Audio Idents can be inserted in Dolby E play out mode, they will be inserted as a PCM sequence on the AES pair packed in between tone encoded as Dolby E. Decoders should automatically switch from decode mode to pass-through allowing the idents through however on the decoder output it is likely these will only be heard on the Left and Right outputs.

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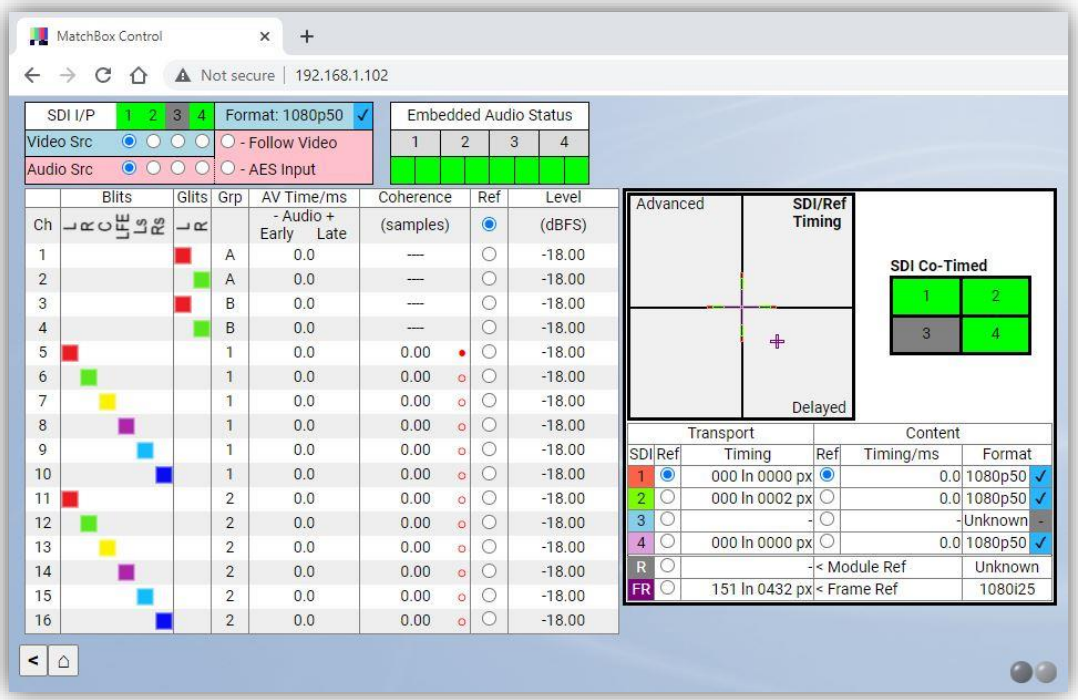
8. Analyser

The MatchBox Analyser is used to analyse the test pattern and audio generated by a MatchBox generator, providing amongst other measurements: AV timing, audio level, stem coherence measurement and source identification.

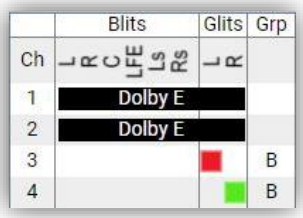
Measurements can be accessed through either the web interface or via on screen overlays on the processed output of a MatchBox Analyser.

8.1. Analyser Page

Analyser measurements can be accessed through the **Analyser** page on the web control for the Analyser. Values are updated at an interval of once per second. The individual measurements are detailed in section 8.3.



Where Dolby E channels are being received but not decoded, the channels will not display measurements but will be identified by a banner message.



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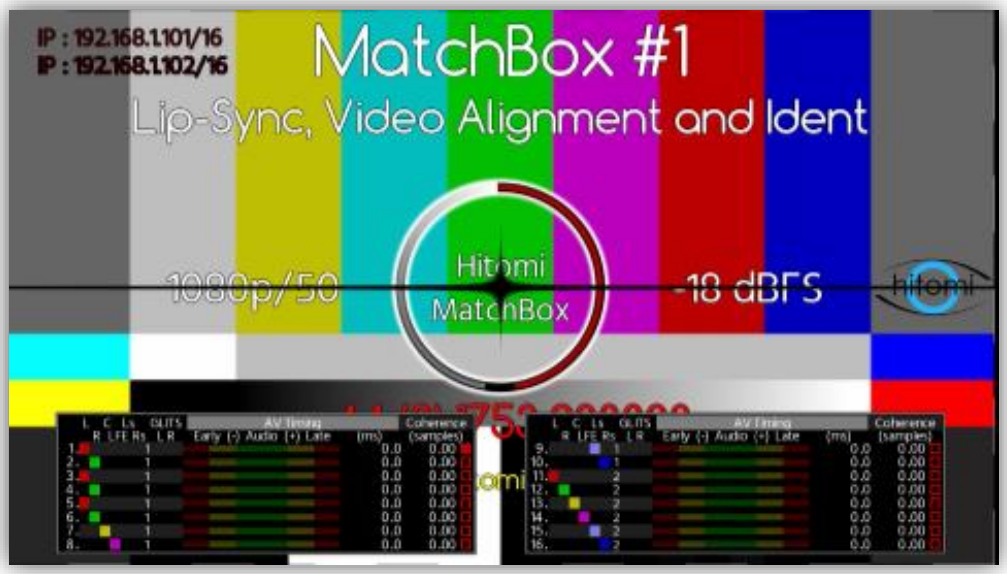
8.2. Analyser Settings Page

8.2.1. Burnt in On Screen Displays (OSD)

As well as providing measurements over the web interface, MatchBox has the capability to overlay (burn-in) measurements over the incoming video.

The on-screen displays are always burnt into all outputs of the Analyser when the 'OSD Mode' control in the analyser 'Settings' menu is 'On. The on-screen display can be forced 'Off' or left in 'Auto' which will only show the OSD when a MatchBox test signal input is detected.

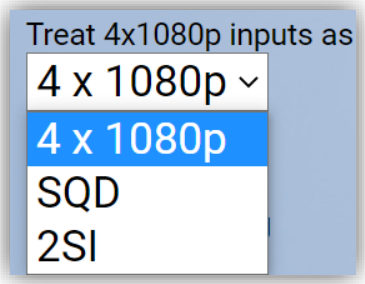
Additionally, the 'OSD Video Timing' control is used to include the display of latency figures on the OSD, when licensed.



8.2.2. Dealing with Quad-link inputs

When licenced appropriately the Analyser can accept four SDI inputs. Determining between 4 discrete 1080p inputs or Quadlink/2SI modes is not an automatic process so ***this must be manually set as the same as the expected input format***.

To configure the quad link format, use the ***'Treat 4x1080p inputs as***' control under the **Settings** page. This has options of 4 x 1080p/SQD/2SI. This control is only applicable when the four inputs are 1080p. The pixel format of the output OSD will follow this setting also.



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8.2.3. Video Source for On Screen Display

When operating in non-4K formats, MatchBox measurements are keyed over one of the available input channels to the unit. The input selected as the source depends upon the Video source setting in the source selector control on the **Analyser** page of the web interface described in 8.3.1.

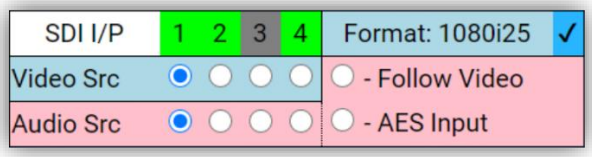
The unit may take a few seconds to lock to a new source during which time some picture disturbances may occur.

If the selected input is not present the SDI output of the unit will display ** INPUT FAIL ** on the SDI outputs. The SDI format will be preserved when the input fails.

When operating on a 4K input, the on-screen display will either be overlaid over the full 4K picture OR one of the four quadrants dependent upon the setting of the ***'Treat 4x1080p input as***' control under the **Settings** page.

8.3. Control / Measurements

8.3.1. Source Selector (For AV Timing measurements)



The MatchBox Analyser can analyse audio and video from any of its available SDI inputs, including measuring audio from one input against video from another.

In the top left of the analyser page is the source selector for the AV Timing pane. In the **Blue** area of the box there are radio buttons to select which video input into the unit is being used as the reference for AV timing measurement.

The **Pink** area contains radio buttons which select the audio source used for measurement. The two or four radio buttons in the SDI I/P area select de-embedded audio from each of the SDI inputs. Alternatively, if the AES input option has been purchased then the AES Input may be selected as a source. For easy switching between video sources in situations where the audio should always be from its own video, the 'Follow Video' radio button can be selected.

Above the source radio buttons are the SDI I/P headings relating to SDI inputs 1-4. The numbers are coloured to indicate the status of the respective input. Input indications will be missing for inputs that are not configured for use or SFP transmitters have been fitted where receivers are expected.

SDI Input heading light		Indication meaning
Illuminated Green	1	The input port is available through the fitted SFP and a recognised signal is connected.
Dark Grey	2	The input port is available through the fitted SFP but has NOT got a recognised signal connected.

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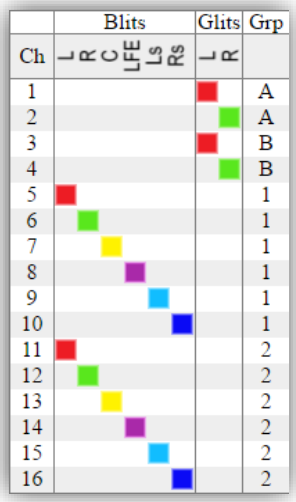
Video timing detection indicator

To the top right of the source selector there is an indicator which displays a tick if video timing on the selected channel has been locked onto for measurement.

This appears as a tick on a coloured background indicating whether the detected video originates from a MatchBox or the Glass App, Blue representing MatchBox and Magenta representing Glass. The indicator relates to the selected video channel and operates in the same way as the indicators on the Video Timing Panel (see section 8.3.8) on the analyser page which show the same information but for all input channels.

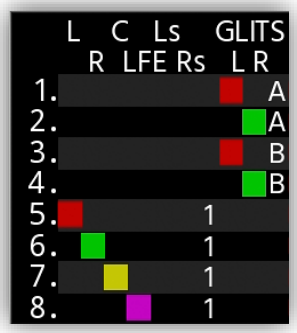
8.3.2. Channel Identity (BLITS, GLITS & Glass)

Receiving a MatchBox / VALID Signal



On the left-hand side of both web interface and on screen displays there are columns marked BLITS and GLITS with sub-headings of L, R, C, LFE, Ls and Rs for BLITS and L & R for GLITS. Below the heading are an array of lights which will be illuminated if that tone sequence had been identified on the respective audio channel (marked in the 'Ch' column). Channels 1-4 come from embedded group 1 and channels 5-8 from group 2 etc.

The colours of the lights correspond to the channel (Red for Left, Green for Right, etc..) giving an easier visual cue of the channel source without referencing the heading.

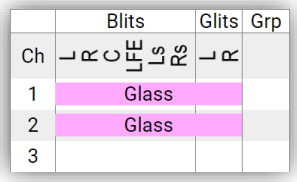


Both GLITS and BLITS12 tone have variants with altered frequencies to identify different groups which are identified in the ***Grp*** column. GLITS groups are identified alphabetically (A-H), and BLITS numerically (1-2).

If the signal has been downmixed before the Analyser, several of the lights may come on for the same channel, indicating which channels are present in the mix.

Receiving a Glass Signal (Glass licenced systems)

Audio received from a device running the Glass app will be indicated by a magenta bar against the audio input channel instead of the coloured lights used to indicate audio stems from a MatchBox or VALID system.



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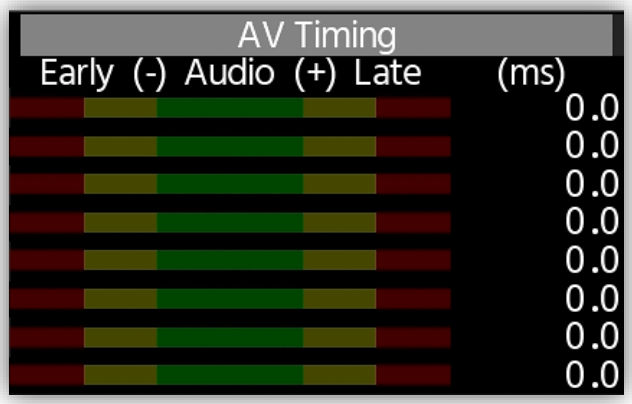
The same bars are used to indicate licence status to the operator. For example, if Glass audio is received but a Glass licence is not installed, the bar will be red and the words 'No Licence' are displayed in place of 'Glass'.

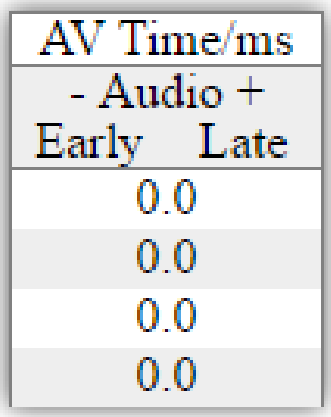
8.3.3. Inversions

If any channel has had its polarity inverted, this is indicated on the channel identification panel as a down arrow in the channel identity box for that channel.

8.3.4. AV Timing

Audio/Video timing is indicated in the ***AV Timing*** column and is measured in milliseconds. A negative value indicated that the audio is early with respect to video, with positive values indicating it is late. AV timing measurements have a range of +/- 6 seconds to a precision of 0.1ms when a MatchBox





generator is used as the source with BLITS tones (+/- 2s for GLITS tones). It should be noted that if MatchBox is reading a signal from a VALID8 generator the accuracy is slightly lower than a MatchBox generator with offset in the order of +/- 0.5ms and when reading Glass the precision is limited to +/- 1ms.

8.3.5. Coherence

The MatchBox Analyser can analyse BLITS tones generated by a MatchBox generator and provide a measurement of the relative delay of the individual stems of the 5.1. This is measured in 48KHz samples to a resolution of 0.01 samples.

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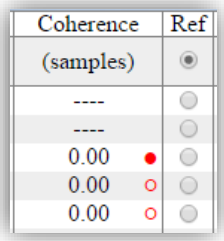
Note that GLITS and Glass audio sources are not compatible with the Coherence measurement so no values will be displayed.

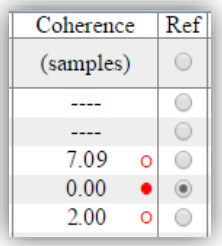
The coherence measurement is performed on the 2kHz/1.5kHz section of the BLITS tone (depending on group) and will not be measurable if the 2kHz/1.5kHz tone section has been filtered out for example in a low bandwidth LFE channel.

8.3.6. Coherence Reference Channel

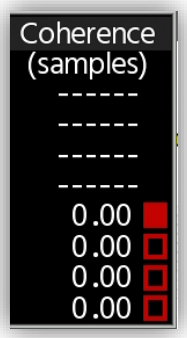


Coherence is a relative measurement i.e. it is a measurement of one audio channel relative to another therefore a reference channel must be chosen. By default, MatchBox uses the first measurable channel as the reference (which will always read 0.00).

If another channel would be preferable as the reference, this may be selected by using the ***Ref*** radio buttons on the **Analyser** page. If that channel has audio suitable for coherence measurement found on it, it will be selected as the reference for coherence measurement.

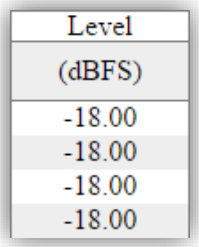


Whether the reference channel is automatically selected or selected via the ***Ref*** radio buttons, and indication of the reference will be shown to the right of the coherence value as a filled circle. Channels which are being measured relative to the reference will be marked with an empty circle.



When viewing coherence data via the On-Screen Display, the reference channel for the measurement is the same as that selected on the web interface. The reference channel is shown in a similar fashion to the web interface but with a filled square to the right.

8.3.7. Level Measurement



Audio levels are measured using the stem identification section of the BLITS tone which is usually aligned at -18dBFS or -20dBFS.

It should be noted that the frequency of the BLITS tone differs from stem to stem, so level measurements will be only accurate at the specific frequency of that tone; this measurement may not be meaningful if the frequency response is not flat across the frequency range of interest.

Tone levels are measured using an interpolation algorithm to determine the true peak of the audio tone rather than the highest sample value observed.

The audio levels are currently only available on the web interface.

Note that Glass audio sources are not compatible with this level measurement and therefore no value is displayed.

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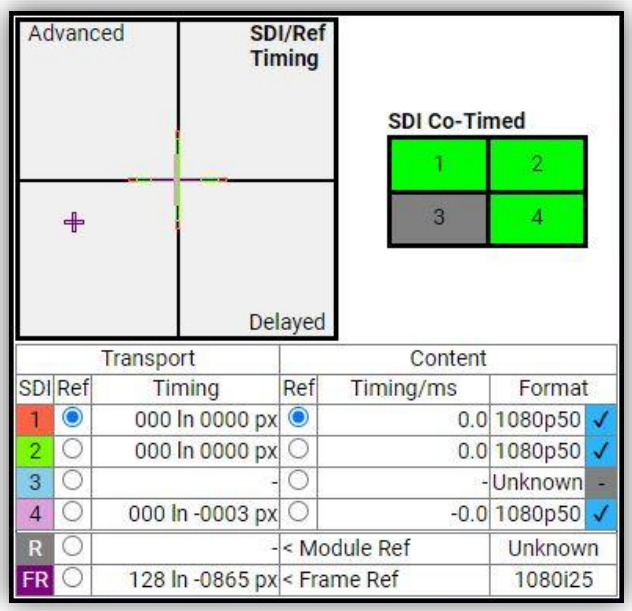
8.3.8. Video Timing Analyser



	Transport			Content		
SDI	Ref	Timing	Ref	Timing/ms	Format	
1	◉	000 ln 0000 px	◉	0.0	1080p50	✓
2	○	000 ln 0000 px	○	0.0	1080p50	✓
3	○	-	○	-	Unknown	-
4	○	000 ln -0003 px	○	-0.0	1080p50	✓
R	○	-	< Module Ref		Unknown	
FR	○	128 ln -0865 px	< Frame Ref		1080i25	

As well as measuring AV timing, MatchBox can also measure the relative timing of its inputs against each other and the video references. It is capable of measuring the video timing of its inputs when there is a difference in their timing of a fraction of a millisecond or several frames.

To the right-hand side of the Analyser page is the video timing pane. The pane has a table of figures split into two halves: 'Transport Timing' and 'Content Timing'. Transport Timing is the literal timing of the SDI transport vs another SDI or the references. 'Content Timing' is the relative time of the content, i.e. the picture itself and has a range of +/-2 seconds. This is especially important where the feeds are part of a quad-link signal and all links must have data from the same frame.

Format	
1080i25	✓
1080p50	✓
Unknown	-
1080i25	✓

To the very right of the table there are indicators which illuminate if the analyser has detected video timing. These appear as a tick marks on a coloured background indicating whether the detected video originates from a MatchBox or the Glass App, Blue representing MatchBox and Magenta representing Glass.

8.3.9. Transport Timing

	Transport			Content		
SDI	Ref	Timing	Ref	Timing	Format	
1	◉	000 ln 0000 px	◉	0.0 ms	1080i25	✓
2	○	003 ln 0678 px	○	40.1 ms	1080p50	✓
3	○	-	○	-	Unknown	-
4	○	000 ln 0000 px	○	40.0 ms	1080i25	✓
R	○	-	< Module Ref		Unknown	
FR	○	050 ln 0528 px	< Frame Ref		1080i25	

Transport timing shows the relative timing of the SDI transport in lines and pixels up to +/-0.5 frames relative to either the analogue references or one of its other video inputs. The measurements are in

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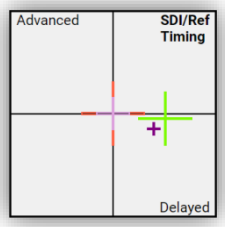
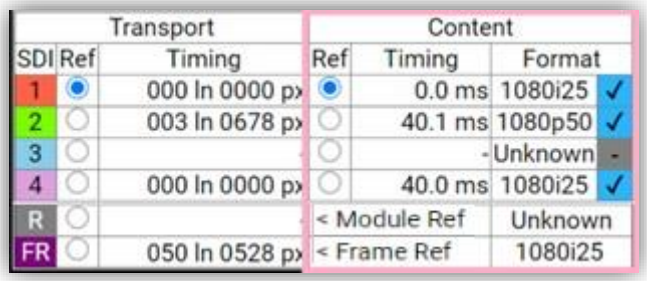
lines and pixels of the SDI being measured, so if two SDI inputs of different formats are compared to each other, each will be measured in lines and pixels of its own format. The reference for the transport timing measurement can be selected with the 'Ref' radio buttons to the left of the column.



The XY plot above graphically displays the transport timing, with the selected reference channel centred. Each input channel including the reference has a different coloured cross correlating to the colour of the SDI channel number on the left of the timing table. A cross to the right of centre indicates that the channel is delayed horizontally from the selected reference, a cross below the line indicates that it is delayed vertically. Crosses in the upper half or left half are advanced horizontally/ vertically.

8.3.10. Content Timing



Content timing is the measurement of the relative timing of the video data being carried by the SDI transport on two or more separate inputs. For instance, if video is being delivered via two paths from the same generator, one of which has an extra frame of delay compared to the other this would read 20ms (in a 50P format) whereas the Transport Timing control will read 0 lines / 0 pixels. The content timing measurement has a range of +/- 2 seconds. The source for content timing measurement can be either a MatchBox generator or a device running the Glass app (when licenced). When a QR coded source is used the Analyser recognises inputs from a common source and will only display content timing results for sources common to the selected reference source.

Like transport timing the channel to use as a reference for this measurement can be selected in Ref column radio buttons associated with the measurements. It is not possible to measure content timing relative to the analogue reference input.

8.3.11. Latency Measurements

When the latency feature is enabled, the content timing display will contain an extra reference select radio control to select latency. When enabled, this will change the measured timing from video/audio relative timing to the absolute timing of the video transmission from the source to the analyser when monitoring a Glass app or a matchbox generator with the QR code enabled.

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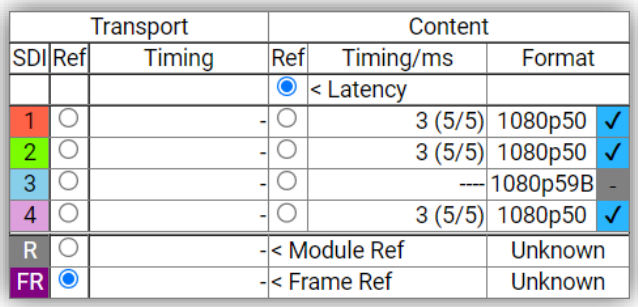
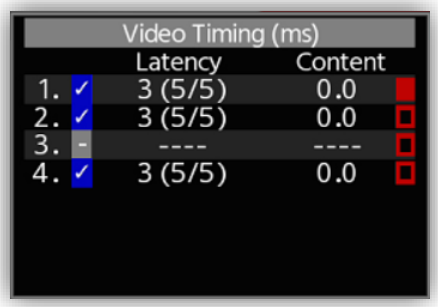


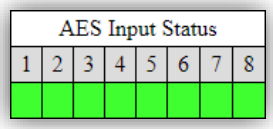


The accuracy of this measurement will depend on the synchronisation of the clock reference at either end of the path. The matchbox Generator and Analyser time sources can be set in the 'system'->'network and time' pages. A time reference source can be configured in the Glass app settings. For optimum accuracy, a generator and analyser will use PTP references, either from an external PTP source or from the analyser. The next best configuration would be for both ends to use the same NTP server. The time reference for the Glass app should be a WIFI accessible NTP reference if possible. Poorer reference sources are likely to introduce more jitter into the resulting measurements as well as reducing confidence in the measurement displayed.

The 'Quality' reading will indicate the confidence in the results based on the clock source accuracies. With 5/5 being the best quality. As the quality figure drops, the latency figure, while still likely to be correct, may be susceptible to variations from network or clock sources.

8.3.12. Audio Status

The top centre of the Analyser page shows the Audio Status. The status displayed will reflect the status of the audio source selected in the Source Selector (see 8.3.1).



The **AES Input Status** display indicates the presence; **Green**, or absence; **Grey**, of each of the 8 AES inputs. This status is only available if the hardware supports the physical AES inputs.

The **Embedded Audio Status** display indicates which embedded audio is present on the video channel selected by the pink radio buttons in the Source Selector. There are 8 coloured indicators in the status display, one for each AES pair in the 4 groups.

The **Embedded Audio Status** and **AES Input Status** displays will highlight channels that are receiving Dolby E audio streams.

To maintain audio coherence of the embedded audio it is important that all the AES pairs are embedded with the same embedding pattern within the SDI stream. If they are not embedded with the same pattern, a receiving de-embedder may not be able to correctly align the AES streams and

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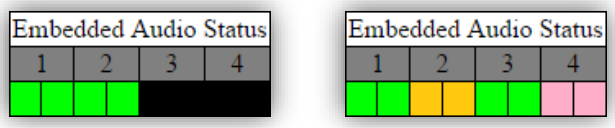
may cause an audio coherence error. The Embedded Audio Status display will indicate if each AES pair is embedded with the same pattern.

Each of the 8 lights will be **Black** if there is no AES present. If there is an AES stream present, the light will illuminate. If all present AES pairs are embedded with the same pattern within the ancillary space, the Status lights will all be **Green**. If differing patterns are present, the AES pairs with differing patterns will be illuminated **Orange**. If there are more than 2 different embedding patterns, several different colours are used.

Common reasons for groups having different patterns is the groups being embedded by different embedders, or by equipment not designed to keep groups coherent.



Above are two examples of different scenarios. On the left-hand side, the selected audio source has 4 AES pairs present on embedding groups 1 & 2. On the right-hand side all 4 audio groups are present (8 AES pairs in total). Groups 1 & 3 are embedded with the same pattern in ancillary data space. The different colours for Channels 2 & 4 indicate that they have different embedding patterns to each other as well as to the other common channels.

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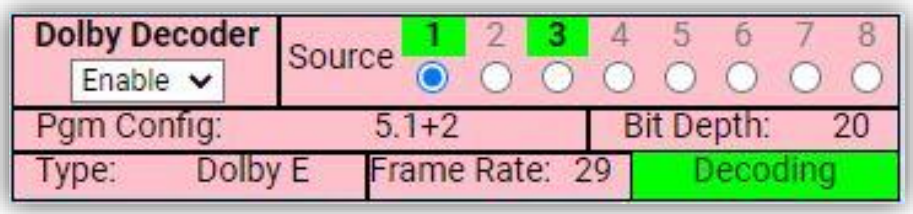
8.3.13. Dolby Decoder

Optionally the Analyser can have a Dolby E decoder fitted to the system. If fitted the Dolby Decoder menu will appear on the analyser page.



Channels that are receiving a Dolby E stream will be highlighted in green. This is informative only and does not affect the ability to select channels that may be receiving non-Dolby streams.

8.3.13.1. Source selection

The Dolby decoder can decode Dolby E from any of the 8 input pairs. The radio buttons in the 'Source' box select channels numbered as pairs (1 corresponding to channels 1&2, 8 corresponding to 14&15 of the de-embedded audio).

8.3.13.2. Enabling the decoder

The decoder can be enabled and disabled using the drop-down in the 'Dolby Decoder' box. When set to 'Bypass' the decoder is disabled and the unit measures PCM audio in the same way as it does when the decoder is not fitted. When set to 'Enable' the analyser takes its source from the decoder rather than the selected PCM inputs.

If there is no Dolby E present on the selected AES pair the Dolby decoder will pass through the selected PCM and display 'PCM' in the 'Type' box and 'Bypassed' in the bottom right of the control. In this case the analyser will simply measure the selected pair. It should be noted that whichever pair is selected will always be measured on channels 1&2 of the analyser irrespective of the originating AES pair.

When a Dolby stream is present the control will display the word 'Decoding' highlighted in Green as seen above.

8.3.13.3. Meta-data display

The Dolby decoder control provides basic meta-data from the selected stream (irrespective of whether the decoder is bypassed or not.

This provides the frame rate of the Dolby E stream, the Program Config (e.g. 5.1+2), the bit depth of the stream and the stream type.

8.3.13.4. Decoder delay compensation.

The delay through the decode process is compensated for internally so the AV timing measured is as on the input. This is equivalent to the video being delayed, compensating for the decoder delay. This is the typical setup expected for any decoder in the programme chain.

This leaves the operator with no need for consideration of the decoder delay with the aligned reading form the analyser being 0.0ms.

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8.3.13.5. Precision of Dolby E measurement.

Due to the encode/decode process there may be some variance in the AV timing measurement which leads to a slightly reduced precision of +/- 1.5ms. A small variation in the level measurement may also be observed but only in the order of +/-0.05dBFS.

The LFE channel is low-pass filtered in the encode process which causes it to be slightly delayed and missing the high frequency burst used for coherence measurement. This means that coherence measurement is not available for the LFE channel when using Dolby E (although given the low bandwidth of the channel this measurement would be of little relevance).

8.4. MatchBox Glass & Latency

8.4.1. Overview

In conjunction with the Glass iOS app, a MatchBox Analyser can analyse AV timing from the camera and mic. By simply holding an iOS device running the Glass app in front of the camera with mic held near the device, AV sync may be precisely measured by an analyser receiving the signal.

The Video latency (time of flight) can also be measured from the iOS Glass source (if licenced) and from a MatchBox Generator.

8.4.2. Licensing

Applying Activation Code

Licences for Glass and Latency operate in a slightly different way other licenced features that use a licence file. They employ an “Activation Key” which is a simple character string.

Upon purchase of one of these licences, an activation code will be issued to the unit administrator. The activation code is applied through the web GUI in the System->Licence page.

Paste the activation code into the next spare text box in ‘Edit Licence Features’, press tab or select some free space on the web page, then click Apply. A pop up confirmation box will appear, click OK.

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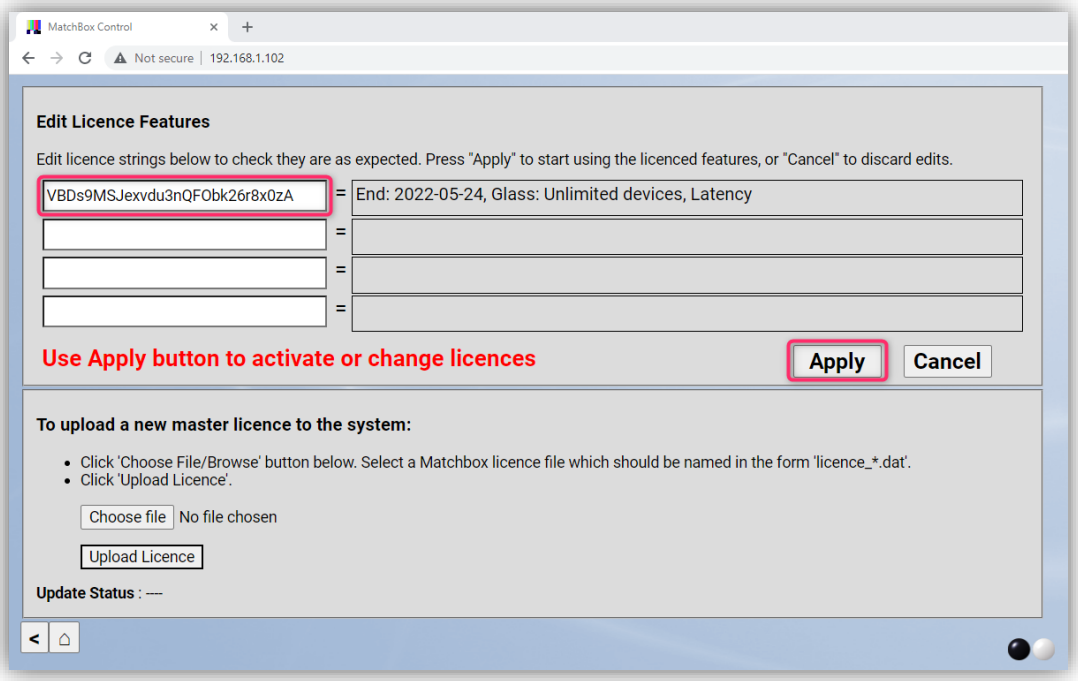

Glass Licence usage limit levels

There two levels of Glass licence, ‘unlimited’ and ‘limited.’ ‘unlimited’ licences may be used with an unlimited number of individual iOS devices. A ‘limited’ licence only allows a restricted number of individual iOS devices to be analysed in any 24 hour period. The 24 hour device limit for a standard ‘Limited’ licence is 5 devices.

Operation of Glass licencing limits

A licence device seat is booked out when a new iOS device is presented to the one of the analyser’s inputs and the analyser has scanned its QR code. The number of available seats will be reduced by 1.

From the instant of first use, the seat is booked out for a period of 24 hours. Once 24 hours have elapsed from the first use, the device seat is made available again for use with new devices. The 24 hours applies only to the time from first use of the device, for instance a device has been used many times over several days, the seat will have become transferrable as soon as the first 24 hours have elapsed, so, if that device could no longer be used (e.g. lost / out of battery / broken) another device can immediately book out the same seat (and a new 24 hour period will start).

The number of device seats currently available and the expiry date of the licence is shown under the System->Licence page on the web GUI.

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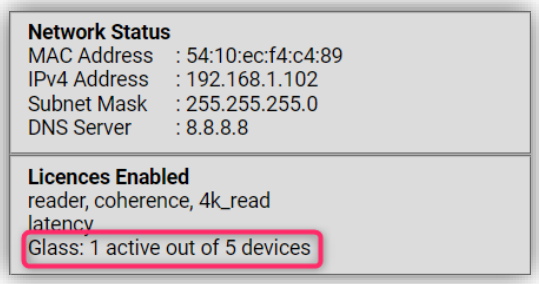
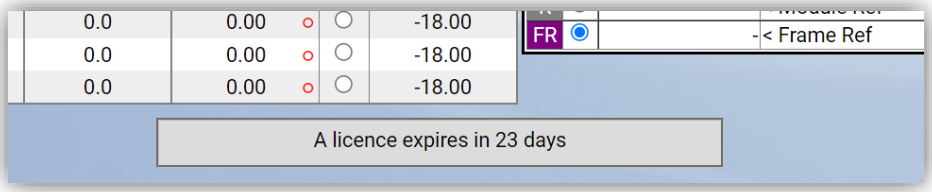


8.4.3. Glass & Latency Subscription Licences

Use of Latency and Glass is made available via a Subscription licence. These are valid for a specific time period. This can be for the duration of an event or on an annual subscription. The analyser will no longer have the licenced feature after the expiry date.

The subscription expiry date is shown on the licence web interface page (see screen shot in 8.4.2). When there are fewer than 30 days left on the licence a banner will appear on the Analyser web interface page.



The legacy licensing model based on annual Maintenance subscriptions is no longer available[1].

[1] Annual maintenance supported the ongoing addition of new iOS devices to the supported list. Once a maintenance licence expired, new iOS device models released after that date would not be recognised. Support for new devices is now bundled into the subscription model.

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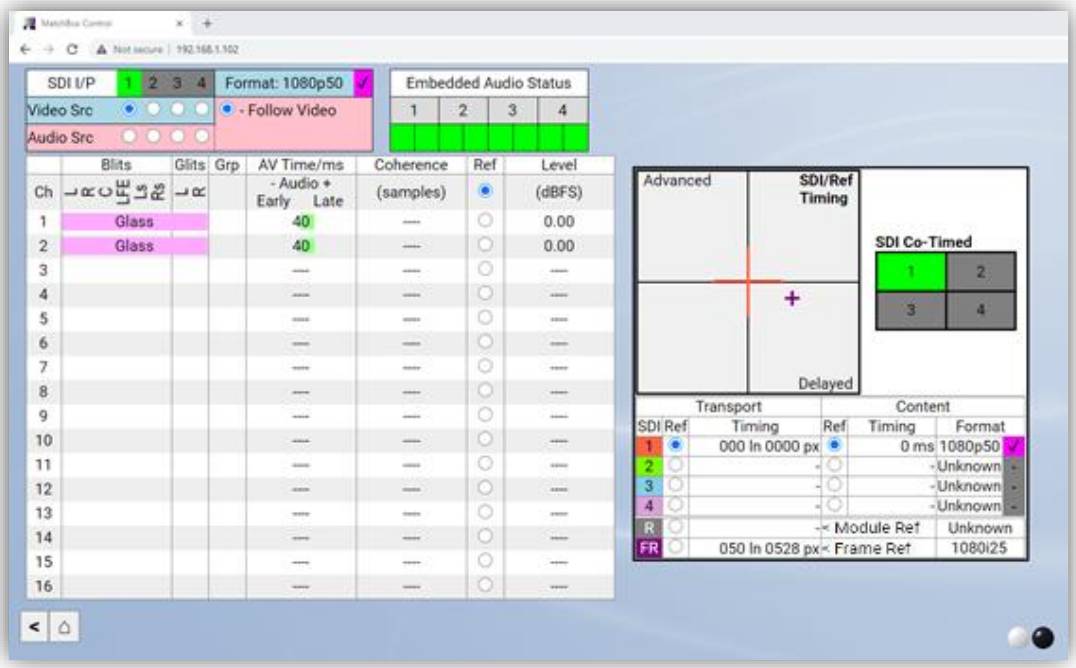
8.4.4. Measuring AV Sync

Glass AV Timing measurements are displayed in the same way as the measurements from a MatchBox Generator. Audio is measured independently on each input channel as with a MatchBox source, but with a Magenta bar in the BLITS/GLITS columns of the display indicating the audio detection. Below are captures of the GUI and OSD with Glass audio detected on audio input channels 1&2 measured against SDI input 1.



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8.4.5. Measuring Camera to Camera Timing

Relative timing differences between up to 4 (depending on licence) cameras may be measured by framing the same iOS device running Glass in shot of all the cameras at the same time. The relative timing measurements can be made in the same way as with either a MatchBox or VALID signal (See section 8.3.10) by reading the 'Content' timing measurements. These are provided in the bottom right of the Analyser page of the web interface.

8.4.6. Glass Latency Measurement

When licensed at the analyser, the iOS glass app can be used to measure latency from the glass display device to the analyser.

Selecting 'Latency' as the reference source in the content readings display will switch to absolute instead of relative timing of the content which provides the latency measurement.

Latency measurements can only be as accurate as the time sources used. A good NTP source will define a worst case accuracy of 10's of milliseconds but will be far more accurate than this in reality. See 8.3.11 for further details.

Transport			Content			
SDI	Ref	Timing	Ref	Timing/ms	Format	
			◉	< Latency		
1	◉	000 ln 0000 px	○	62 (5/5)	1080p50	✓
2	○	000 ln 0000 px	○	62 (5/5)	1080p50	✓
3	○	000 ln 0001 px	○	62 (5/5)	1080p50	✓
4	○	000 ln 0001 px	○	62 (5/5)	1080p50	✓
R	○	-	< Module Ref		Unknown	
FR	○	-	< Frame Ref		Unknown	

8.4.7. Glass Detection Indication

The Analyser provides independent indication of Glass audio and Video reception.

	Blits						Glits		Grp
Ch	L	R	C	LFE	Ls	Rs	L	R	
1	Glass								
2	Glass								
3									

The magenta indication in the Blits/Glits audio channels is confirmation that Glass audio has been detected on these audio inputs.

SDI I/P	1	2	3	4	Format: 1080p50	✓
Video Src	◉	○	○	○	◉ - Follow Video	
Audio Src	○	○	○	○		

To the right of the input video standard indication, a magenta cell with a tick indicates the Analyser has detected a video source containing a Glass test signal.

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8.4.8. Glass Hints and Tips

While the detection of the Glass signal is designed to be robust, adhering to some basic guidelines will ensure reliable detection every time.

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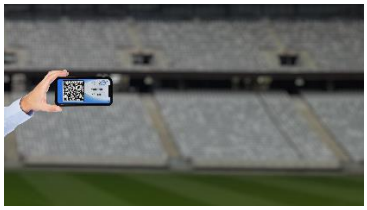
8.4.8.1. Video Framing

	✓	*Ideal framing* The ideal framing for HD video formats is for the Glass app to occupy 30% to 50% of picture height. This is a rough guideline and Glass should work over a much larger range. As a guideline, the QR code should be clearly visible with easily discernible black and white pattern.
	✗	*The screen should be in focus* The analyser needs to be able to decode the QR code on the iOS device screen, if this is out of focus the analyser may struggle to read it.
	✗	*The whole device screen should be visible* The analyser needs to be able to see all four corners of the screen. There is little benefit in the device filling the whole screen and being zoomed right in makes it hard to keep the whole screen in shot.
	✗	*Too far away* We recommend the device screen should occupy between 30% and 50% of picture height for HD/4K formats though the system will function over a wider range.
	✗	*Keep an eye on brightness* Glass works across a wide range of contrast situations. In darker settings the device screen can appear very bright; clipping the whites, this should be avoided. Do turn down the brightness of the device or, adjust the camera aperture, or ND filter. Avoid using the shutter time to adjust the brightness as this will change the measurement.
	✗	*Hold the device horizontal.* The device should be held level in shot in most cases in landscape. For a few iPad devices the device must be held in portrait, this will be clearly indicated by the orientation of the app on the device screen. By default, Glass will alert the user if the device is held in the wrong orientation. It is also important that the device is held level in shot. To help the orientation a haptic response will also be issued from the device if it is inadvertently tilted by more than 15°. This functionality can be disabled in the app settings for situations where the camera is deliberately not level.

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	✗	*The whole screen should be visible.* Avoid fingers or other obstructions in front of the screen.
	✗	*The screen should be free of large reflections* The analyser needs to be able to decode the QR code on the iOS device screen, if this has significant reflections on it the analyser may struggle to read it.

8.4.8.2. Audio Levels

The Analyser's Glass audio detection is quite sensitive and adaptive to the ambient noise in the environment. As a general guide, the audio signal from the Glass app should be audible above the ambient noise.

It is usually not required to have the device volume turned right up unless in a particularly noisy environment.

Having the audio level too high can stop measurements working if the audio clips or if the audio level is affected by compressors or loudness control.

8.4.8.3. Echoes

Echoey environments can cause some issues with audio detection. Most issues caused by echoes are when the microphone is further away from the phone than a wall or hard object causing the echo to have nearly as much, or potentially more, sound energy than the sound from the Glass app directly.

As a guide, keep the microphone closer to the device running the Glass app than the nearest wall or hard surface. This is not an issue if the device is very close to the hard surface for instance propping the device on a table or the ground, or mounting it on a wall which should work without problem as the echo will be almost coherent with the sound from the device.

A bad scenario might be placing the device on a tripod 50cm from a concrete wall with the mic 50cm from the device. This situation could be fixed by moving the mic much closer to the iOS device or by moving the device away from or right against the wall.

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9. Specification

Video

SDI	SD / HD / 3G level A (SMPTE 259M/292M/424M)	
	Limited 3G level B input only support[2]	
	4K Quad-link (SQD)	(*MatchBox 4K only*)
Supported Formats	SD 525/625	
	HD 720P(23/24/25/29/30/50/59/60) 1080I(25/29/30) 1080P(23/24/25/29/30)	
	3G Level A - 1080P (50/59/60)	
	3G Level B - 1080P (50/59/60) as an input only[2]	
	4K 2160P (50/59/60) SQD / 2SI quad-link	(MatchBox 4K only)
Inputs	2 x Optical **or** 2x HD-BNC 75ohm **or** 2xHDMI	(HD units)
	or 1x Quad-link (SQD)	(*MatchBox 4K only*)
	or 1x 12G 2160P (50/59/60)	(12G Option Only)
Outputs	4 x Optical SD/HD/3G **or** HD-BNC 75ohm **or** 2xHDMI	
	or 1x Quad-link (SQD/2SI)	(*MatchBox 4K only*)
	or 4x SD/HD/3G	(*MatchBox 4K / Quad option only*)
	or 2x 12G 2160P (50/59/60)	(12G Option Only)
Output Jitter	SD-SDI <0.2 UI (10Hz) / <0.2 UI (1KHz),	
	3G/HD-SDI <1.0 UI (10Hz) / <0.2 UI (100KHz)	
Genlock	Bi-Level / Tri-Level Analogue HD-BNC 75ohm	
	or SDI input	

Measurement (Analyser)

A/V Delay/Latency	+/- 0.1ms (MatchBox as source)[3]
	+/- 1ms (Glass as source)
Coherence	+/- 0.01 x 48KHz sample[4]*
Video Timing	+/- 1 video sample (precision)
	+/- 20 video samples (accuracy relative to reference)

Audio

Embedded audio	HD-24bit synchronous 48kHz SMPTE 299M
	SD-20bit synchronous 48kHz SMPTE 272M
AES	Balanced AES3 IEC 60958 (8 pairs via DB-25 connector)
Analogue	Balanced 0dBu tones +/- 0.2dBu

[2] Level B Analyser inputs are output as interlaced, measurement functionality works as normal

[3] latency accuracy will depend on the source of the timing references at each end of the path

[4] coherence accuracy is dependent upon integrity of signal path.

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