Hitomi MatchBox 1RU

Operation Manual

Version 1.4.9

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1. DISCLAIMER

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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 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.

Contents

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3. Introduction

MatchBox 1RU is a precision audio video alignment system along with video and audio line identification functionality and full video TPG. Control and monitoring is facilitated via an Ethernet based web interface.

The 1RU chassis may be populated with a number of factory fitted modules, configured as either generators or readers.

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 reader accepts a test signal from a MatchBox generator and provides diagnostic information regarding the link in between. The combination of generator and reader allows measurement of several essential line-up parameters including audio timing with respect to video, measurement of timing between individual audio channels (coherence), 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, luckily the MatchBox solution measures to a precision of 0.01 samples giving complete assurance that all is timed up.

MatchBox 4K has additional support for Quadlink 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. Quickstart

4.1. Box contents

1x Hitomi chassis

2x 12V Power supplies

SFPs and tails as ordered and specified in the dispatch note.

By default generators ship with 1x dual Tx copper SFP with HD-BNC, and readers Bidirectional SFPs.

4.2. Powering the unit

The MatchBox chassis has dual redundant 12V power inputs, one located either side of the unit on the rear. Power is provided through 4 pin XLR connections.

The unit may be powered through one or both power inputs.

The unit must be powered by supplies capable of providing at least 5A at 12V dc.

4.3. Network connection

The MatchBox chassis can contain one or two hardware sets (which will have been configured as generators or readers before shipping), each of which has an RJ45 Ethernet connection.

Units are shipped with default static IP addresses. The default IP addresses for the fitted units are 192.168.1.58 and 192.168.1.59 for the left and right units (looking from the front). When there is only one populated module, in will be located on the left hand side with the IP address 192.168.1.58.

The unit can support either address acquisition through DHCP or a static IP address.

To set up the correct network set up for your network, follow the steps below:

1. Connect the PC you are using to set up MatchBox the right hand RJ45 socket (looking from the rear) using an 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 192.168.1.58 into the address bar. You should see the home page of the right hand MatchBox hardware.

4. Click the **System** tab at the bottom of the page, then click the **Network Settings** tab at the bottom of the page.

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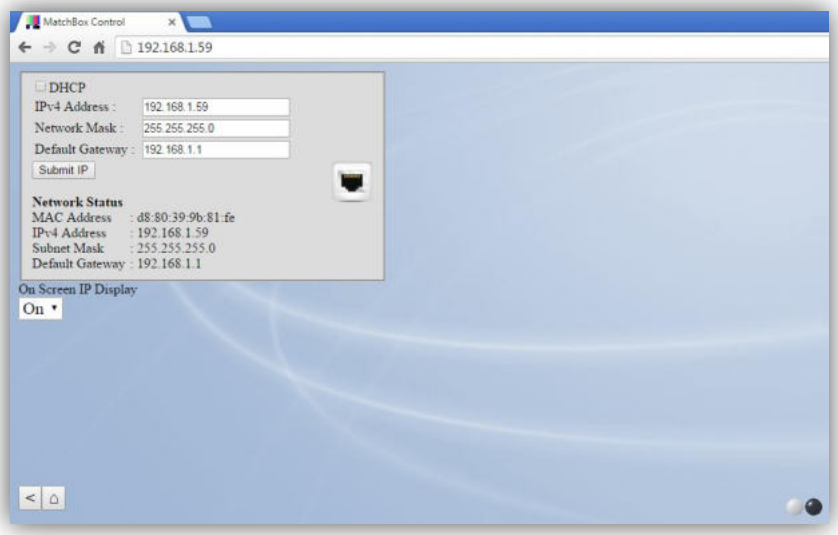
5. You should now see the screen shown below. Here you can set up the unit's network configuration.



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.

6. If a second hardware set is fitted, connect the PC to the left hand Ethernet connection using an standard Ethernet cable (this assumes your PC Ethernet port supports auto-crossover) and repeat steps 3-5, making sure to use a different static IP address if not using DHCP.

Note:

After reassigning the network settings the unit will no longer be controllable until connected to either a DHCP server (if set to DHCP) or connected to a network on the newly assigned subnet.

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4.3.1. On Screen IP display

The MatchBox unit can overlay the IP settings 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** tab.

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.

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5. Connectivity

Various rear connections are shown on the diagram below, others left for future use have been omitted. The frame may be fitted with either 1 or 2 hardware modules marked 'Primary' and 'Secondary' on the diagram below. If only one module is fitted, it will be in the 'Primary' location.

Both modules are essentially the same, only the primary in the diagram has been annotated.

5.1.1. Power

There are two power inlets on the left and right of the unit. These are dual redundant, each supplying power to both modules.

5.1.2. SFP Ports

Video interfaces to the unit are achieved through SFP modules which can provide SD/HD or 3G connectivity through HDBC, DIN1.0/2.3, fibre or HDMI.

Each module has 2 SFP cages each. The SFP connections are marked 1,2,3&4 on the rear. Direction is partly dependent on what SFPs are fitted and partly by hardware support for receive channels.

Both HD and 4K units all 4 SDI channels are available as outputs however on HD units only SDI channels 1 & 3 are available as inputs, unlike the 4K system where all channels are available as inputs (required for 4K quad-link).

The unit will be shipped fitted with SFPs as requested at the time of purchase. If unspecified HD units ships with a dual HD-BNC transmitter for a generator or an SFP with single receive and single transmit channel if it is a reader whereas 4K units ship with 2 dual transmitters on generators and 2 dual receivers.

The user may fit their own non-MSA SFPs to the system however Hitomi Ltd does not warrant their functionality or support the use of SFP not supplied by Hitomi or their distributors for use with this product.

5.1.3. Ethernet

Both modules within the frame have their own Ethernet connections thorugh RJ45 connections on the rear. These support 10/100/1000Mbps.

5.1.4. Reference Input

Generators may be locked to an external reference through the HD-BNC connection on the rear marked 'Analogue Reference on the rear diagram. There is an optional 75R termination which can be enabled via the termination switch adjacent to the reference input.

Each module has its own reference input.

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5.2. Power

The frame has dual redundant 12V power supply inlets through 4 pin XLR connectors. Power supplies are hot-pluggable. Each supply should be capable of delivering 60W. The pin-out is shown below.

Pin No.	
1	+12V
2	N/C
3	N/C
4	Ground

Power inlets are dual redundant and hot swappable.

5.3. SFP IO

Each hardware set fitted to the frame has two SFP cages. Each cage can be fitted with either a dual transmitter SFP, a bidirectional SFP (one receive, one transmitter) or, in the case of 4K enabled readers, dual receivers. The unit has been tested with fibre, copper and HDMI SFPs.

The following SFPs have been tested with the system. It should be noted that only non-MSA SFPs can be fitted in the frame.

The following SFPs have been tested with the system, others may work but are not guaranteed to function correctly.

SFPs fitted to the system can be monitored under the **System** tab, where the type of SFP fitted, the connected video format and SFP temperature can be viewed as shown below.

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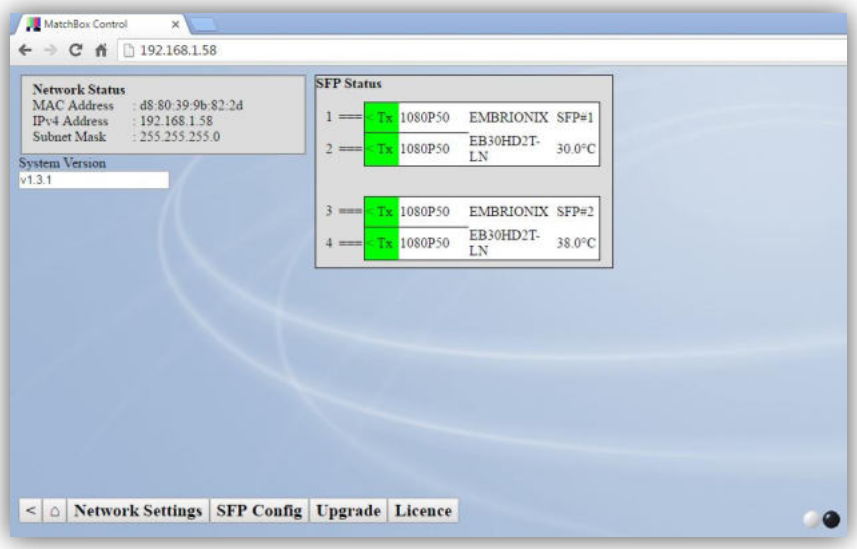
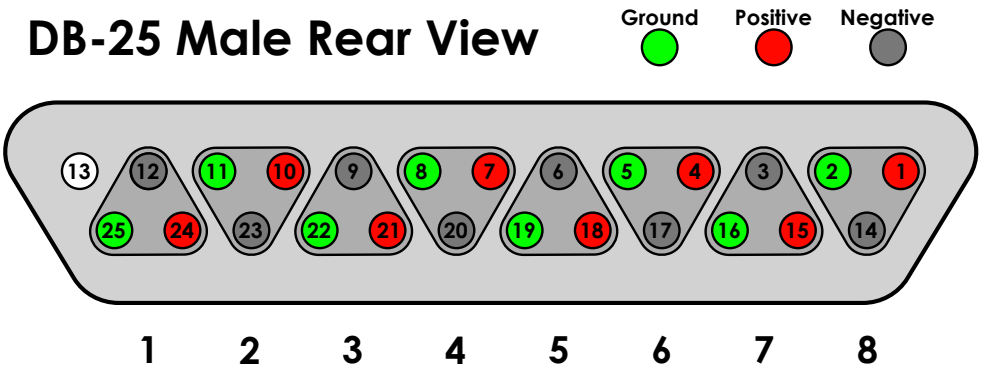


5.4. AES Interfaces

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

The AES is unbalanced and has the pin out shown below. The view is from the rear of the male connector.



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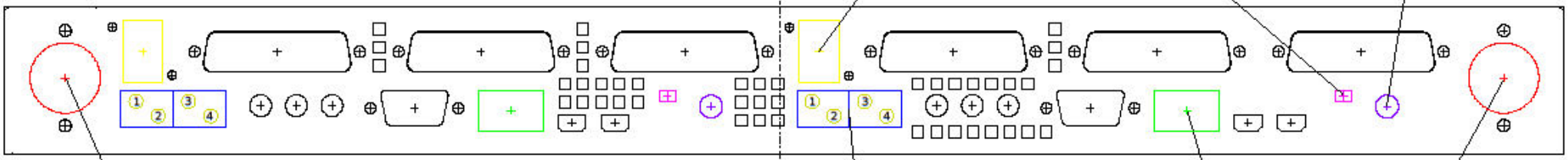
MatchBox 1RU Rear Panel

Secondary Module

Primary Module



GPIO Via 6-pin screw terminal Weidmuller Connector

75R Termination switch

HD-BNC Analogue Ref

12V Power - 4pin XLR*

Dual SFP Cage
1 - 4 available as SDI Tx
1 & 3 available as SDI Rx

Electrical / Optical / HDMI

Ethernet via RJ45

12V Power - 4pin XLR*

* Power supplies are dual redundant & hot swappable.

Power supplies should be rated for at least 50W for a fully populated frame, or 30W for a half populated frame.

Unmmarked connectors are reserved for future use.

6. Web Interface

6.1. 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 4.3. The menu system is navigated through the menu tabs at the bottom of the web page. 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.

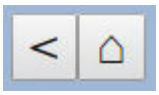
MatchBox is tested against the latest versions of Chrome, FireFox and IE running under Windows along with Safari on iPad.

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

6.1.1. Navigating

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

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



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

6.1.2. Heart Beat

The web interface has a heart beat 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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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. Test patterns have 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 line-up.

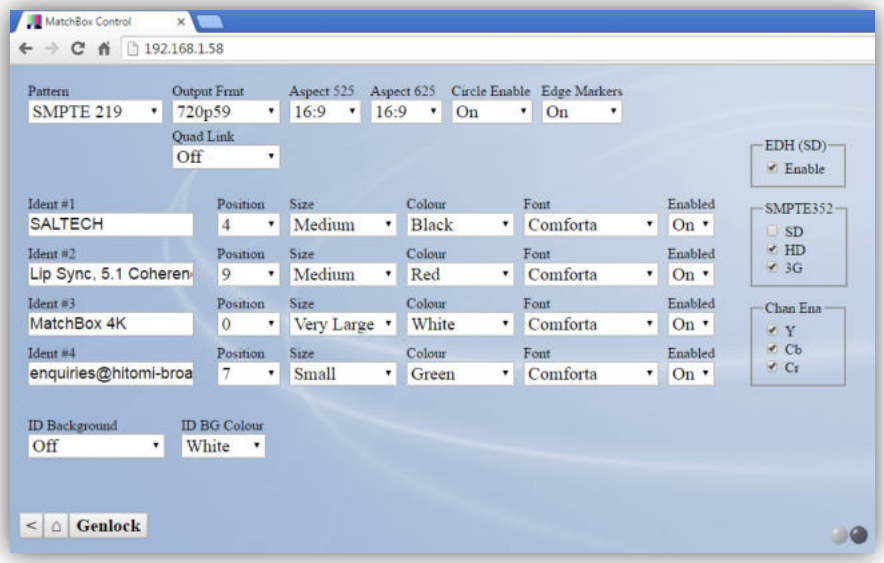
The audio generator can generate GLITS or BLITS tones along with continuous tone.

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 which can be read only by MatchBox readers, but allows alignment of 5.1 systems including precise inter-stem timing alignment to sub sample precision.

7.1. Video Tab

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



7.1.1. Output Format

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

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7.1.2. Quad-Link

MatchBox 4K units can generate quadrant based quad-link test signals. To enable this feature select the format used for the links (e.g. 1080p50 for 2160p50 quad-link) and then select the 'Quadrant' setting from the ***Quad Link*** dropdown. Any format can be used as a quad-link carrier although in most cases 1080p50/59/60 would be typical.

This control is only available with MatchBox 4K units Generators.

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 (left) and Quadrant based 4K (right).

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.

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7.1.7. Circle

The ***Circle Enable*** dropdown can be used to turn off the animated circle on the output test pattern. It has two options : On/Off.

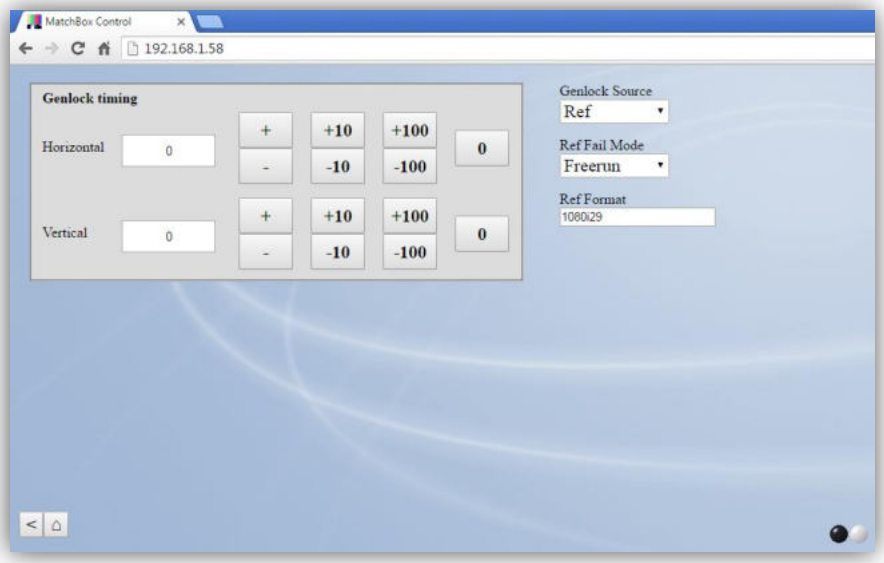
7.1.8. EDH

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

7.1.9. 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.

7.1.10. Genlock Submenu



The generator may be locked to a black and burst reference, or one of the SDI inputs. 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 analogue black and burst reference input 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.

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.

7.1.10.1. 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. For rapid stepping through the delays there are buttons o step in steps of 1, 10 or 100 lines or pixels.

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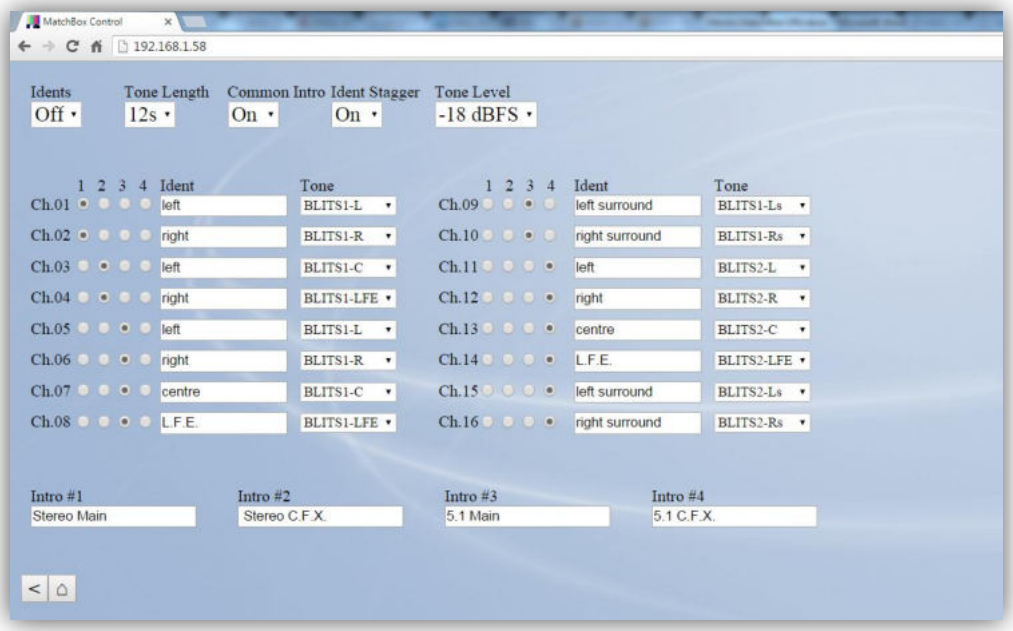
Timing offsets are stored uniquely for each output video format so separate settings can be made for different formats used in house.

7.1.10.2. 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.

7.2. Audio Tab

The **Audio** tab 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.

7.2.1.1. 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.

7.2.1.2. 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.

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MatchBox generates 2 variants of BLITS (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 BLITS tone.

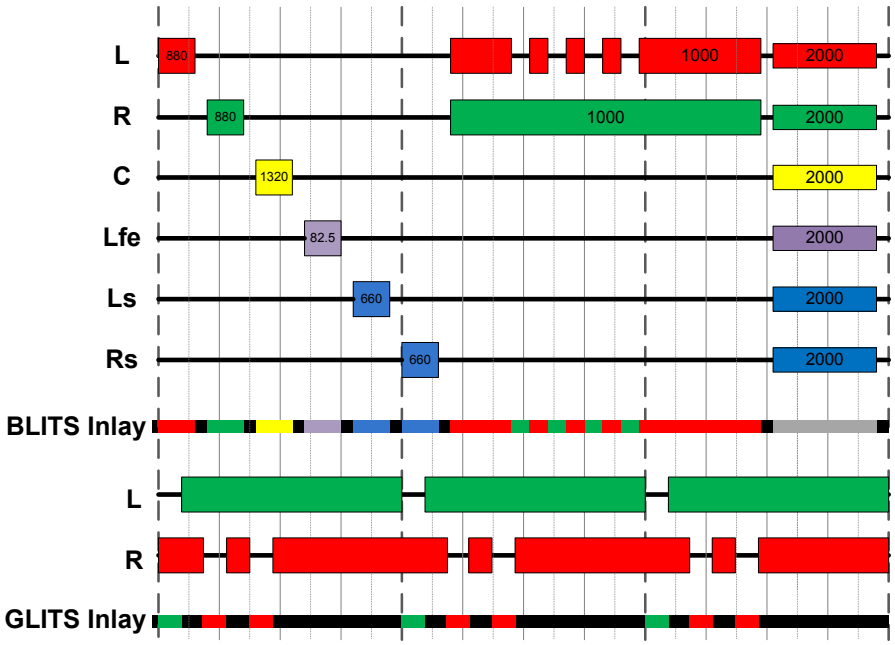

Figure 7-1 - BLITS / GLITS Tone Sequences

7.2.2. 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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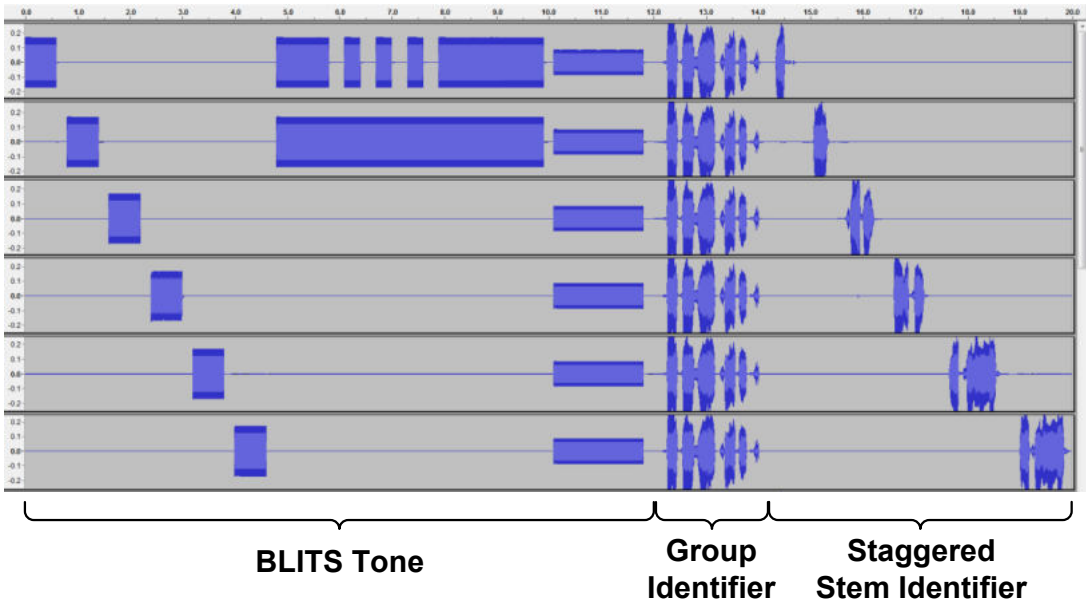

7.2.3. Common Intro & Identifier groups

A common voice identifier can be played out on all channels in a channel group. A channel group can be used for a group of channels which belong to the same audio for example belong to the same 5.1 surround.

Intro text is synthesised and played out on all audio channels in the group concurrently, before individual channel idents.

Ident groups can be selected in the audio tab 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.

7.2.4. 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 if 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** tab.

7.2.5. Dolby E

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

7.2.5.1. 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.

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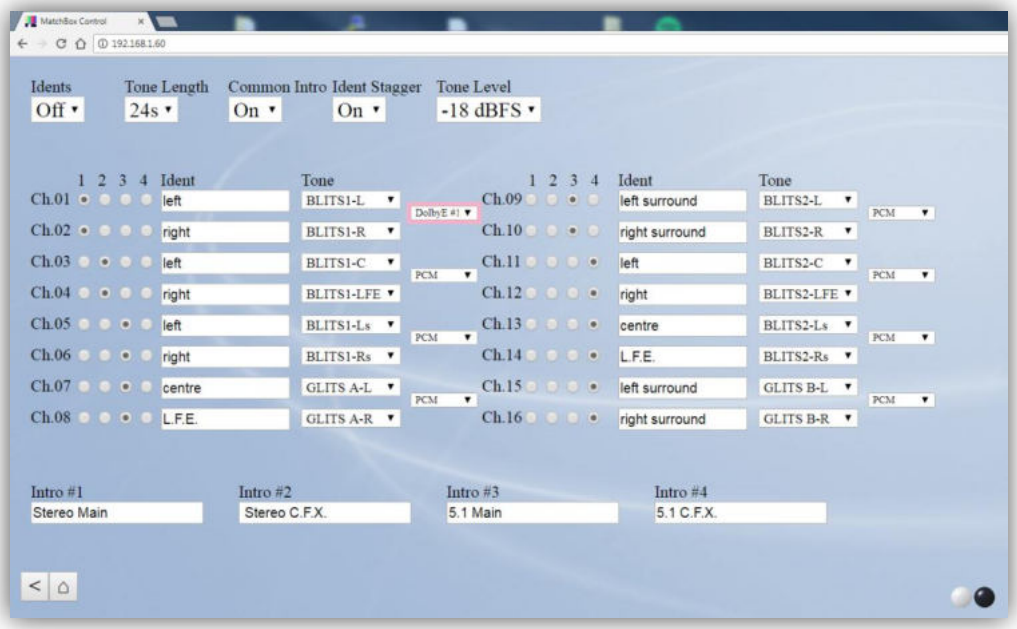
When fitted the Audio tab has an extra drop-down for each audio pair as shown below highlighted in pink.



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

7.2.5.2. Audio Idents and Dolby E

Audio Idents are 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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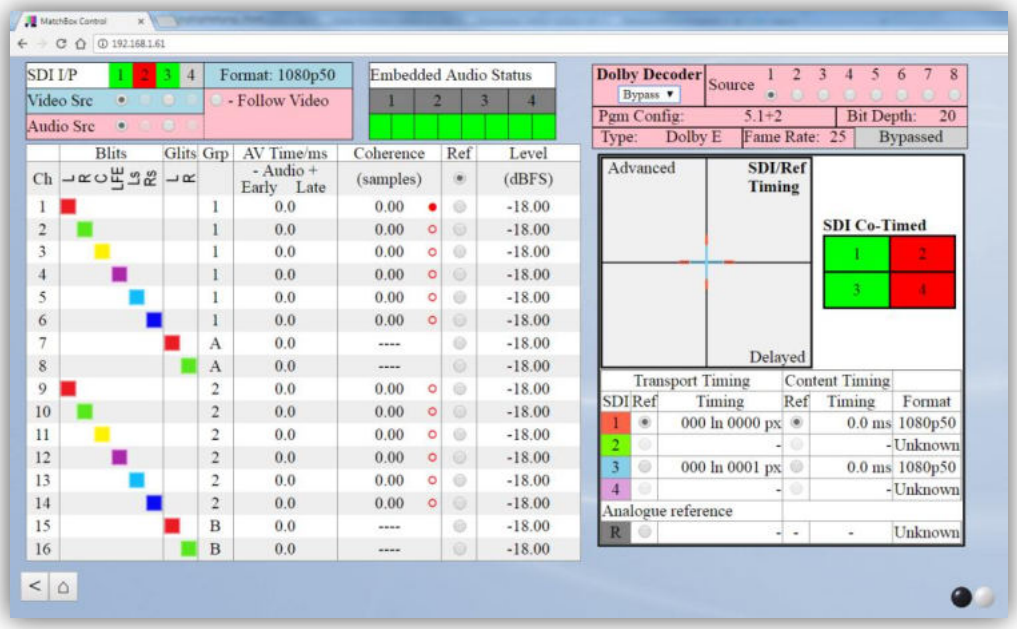
8. Reader

The MatchBox reader 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 reader.

8.1. Analyser Web View

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



8.2. Analyser Burnt in On Screen Displays

8.2.1. Overview

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 reader.

MatchBox 4K on screen displays are not available when the analyser is to be connected to a quad-link input signal due to IO limitations (all available SFP ports are used as inputs).

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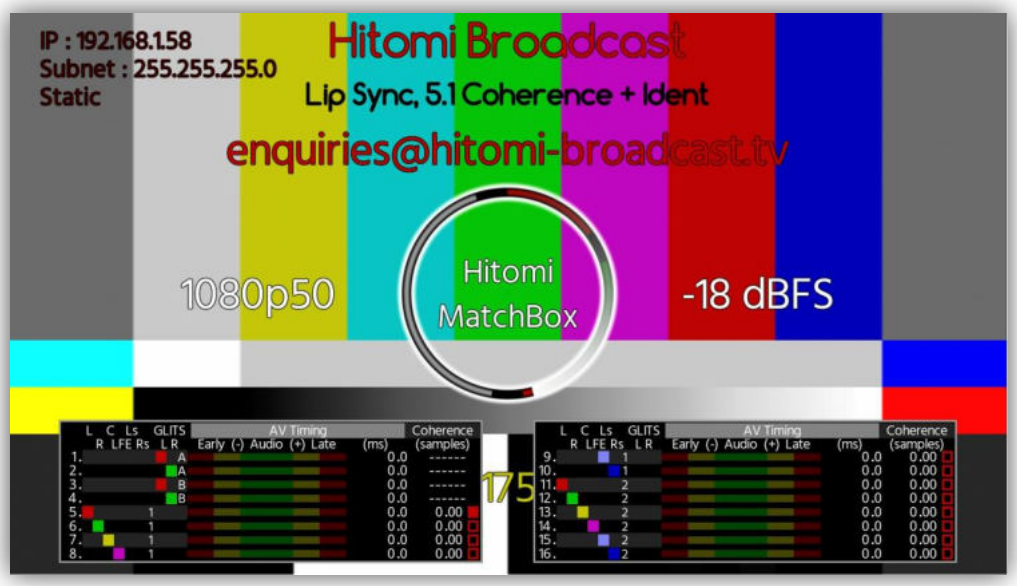


8.2.2. Video Source for On Screen Display

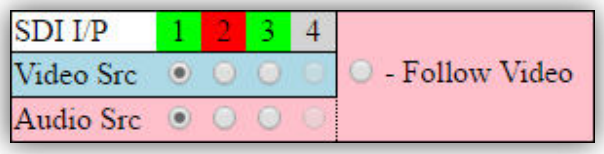
MatchBox measurements are keyed over one of the available input channels to the unit. The particular channel. The input selected as the source depends upon the Video source setting in the source selector control on the **Analyser** page of the web interface described in 8.3.1.

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.

8.3. Control / Measurements

8.3.1. Source Selector (For AV Timing measurements)



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

In the top left of the analyser page can be found 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 selects which video channel audio is being de-embedded for measurement. 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 dependent on the status of the respective input.

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SDI Input heading light		Indication meaning
Illuminated Green	1	The input port is available through the fitted SFP and has a recognised signal is connected.
Illuminated Red	2	The input port is available through the fitted SFP and has NOT got a recognised signal is connected.
Grey	4	There is no SFP fitted or the fitted SFP does not support this port as an input.

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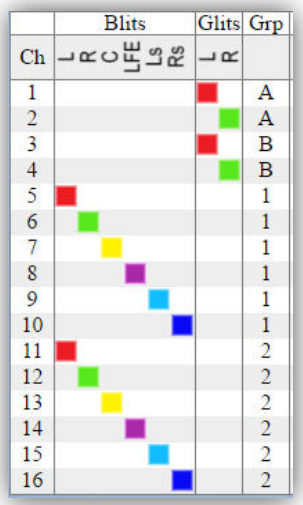
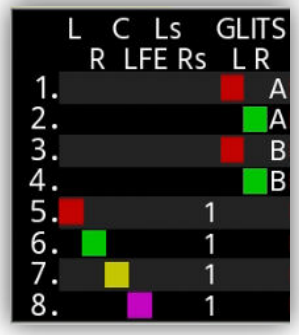
8.3.2. Channel Identity



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 coming from embedded group 1, 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).

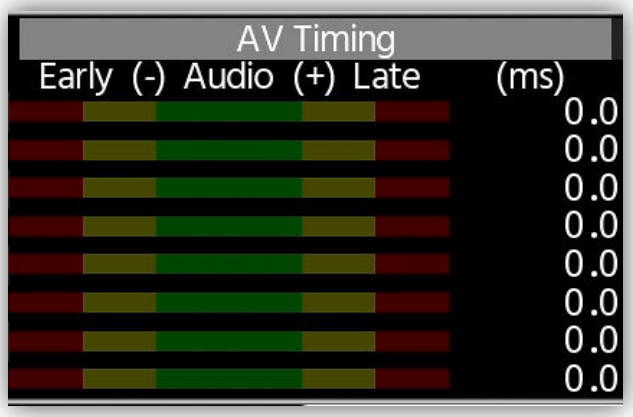
If the signal has been down-mixed before the reader, several of the lights may come on for the same channel, indicating which channels are present in the mix.

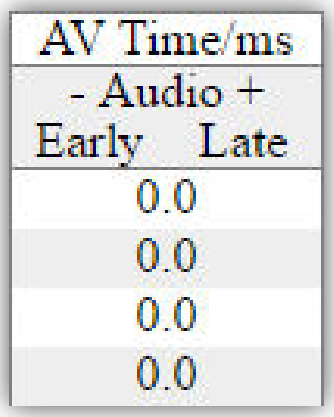
8.3.3. Inversions

If any channel has had its polarity inverted. An inversion 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 +/- 2 seconds to a precision of 0.1ms. It should





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be noted that if MatchBox is reading a signal from a VALID8 generator the accuracy is slightly lower than a MatchBox generator with ststis offset in the order of +/- 0.5ms.

8.3.5. Coherence

The MatchBox reader 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.

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.

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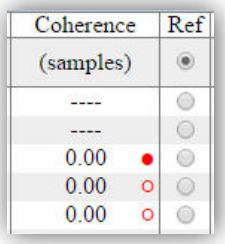
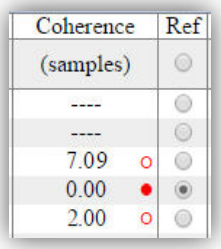
8.3.6. Coherence Reference Channel

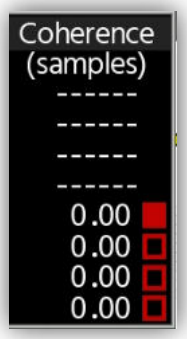


Coherence is a relative measurement i.e. it is a measurement of one audio channel relative to another therefore a reference channel must be chosen. By default MatchBox uses the first measurable channel as the reference (which will always read 0.00). The red dot to the right of the coherence reading

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

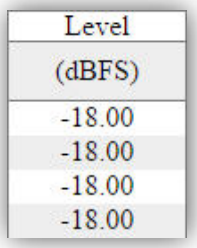


Whether the reference channel is automatically selected or selected via the ***Ref*** radio buttons, and indication of the reference will be shown to the right of the coherence value as a filled circle. Channels which are being measured relative to the reference will be marked with an empty circle. When viewing coherence measurements on the on screen overlays, this is represented by a filled or empty square to the right of the coherence measurement.



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.

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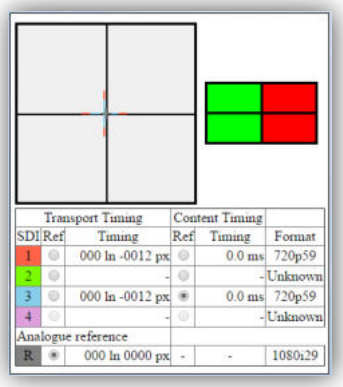
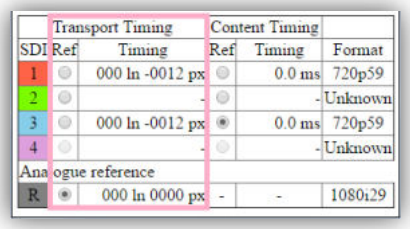
8.3.8. Video Timing Analyser



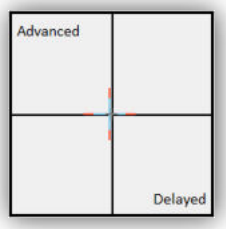
As well as measuring AV timing MatchBox can also measure the relative timing of its inputs against each other and the video reference. It can also measure video timing of its inputs when there is a difference in their timing of more than 1 frame, for instance when one of the paths from generator to reader has several frames more delay than the other.

To the right hand side of the Analyser page is the video timing pane, which 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 reference, whereas Content Timing is the relative time of the content, i.e. the picture itself and has a range of +/-2 seconds so that extra frames of delay in one path can be seen. This is especially important where the feeds are part of a quad-link signal and all links must have data from the same frame.

8.3.8.1. Transport Timing



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



In the XY plot above this is graphically displayed, 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.

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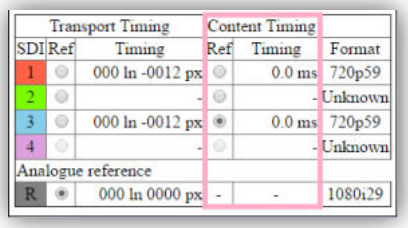
8.3.8.2. Content Timing

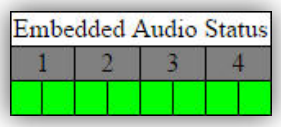


	Transport Timing		Content Timing		
SDI	Ref	Timing	Ref	Timing	Format
1	○	000 ln -0012 px	○	0.0 ms	720p59
2	○	-	○	-	Unknown
3	○	000 ln -0012 px	◉	0.0 ms	720p59
4	○	-	○	-	Unknown
Analogue reference					
R	◉	000 ln 0000 px	-	-	1080i29

Content timing is the measurement of the relative timing of the video data being carried by the SDI transport on two separate inputs. For instance if video is coming down two paths from the same generator, one 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.

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.

8.3.9. Embedded Audio Status



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 lights in the status display, one for each AES pair in the in the 4 groups.

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 an 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**. I however differing patterns, the AES pairs with a differing pattern will be illuminated **Orange**, if there are more than 2 different embedding patterns then several different colours are used.*

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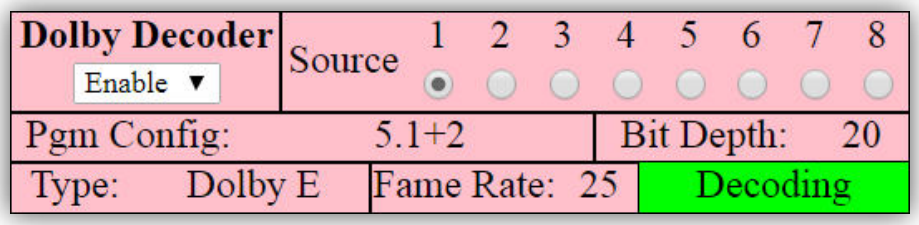
A common reason for groups having different pattern would be the groups being embedded by different embedder, or by equipment not designed to keep groups coherent.

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 exactly the same pattern in ancillary data space; channels 2 & 4 have a different embedding pattern, not only that they are showing different colours indicating that they have different embedding patterns to each other.

8.3.10. 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 tab.



8.3.10.1. 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).

8.3.10.2. 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 as when the decoder is not fitter. 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 PCM pair that is selected displaying '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.

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8.3.10.3. 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 give the 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.

8.3.10.4. 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 to compensate for the decoder delay as would be expected in a 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 0.0 ms.

8.3.10.5. Precision of Dolby E measurement.

Due to the encode/decode process there may be some tolerance of the AV timing measurement has 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).

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9. 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 (www.hitomi-broadcast.tv) and can be found in the 'Support' section. You will have to 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.

**** Important note ****

Versions of software prior to V1.4.7 limited the size of the upgrade file which the system could upload as a security precaution. Software upgrades from V1.4.7 onwards exceed this limit. In order to upgrade from a version older than V1.4.7 to a newer version requires a patch to be applied. Please see section 9.2 for instructions on applying this patch.

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9.1. 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** tab on the Analyser or Generator web interface.

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 take 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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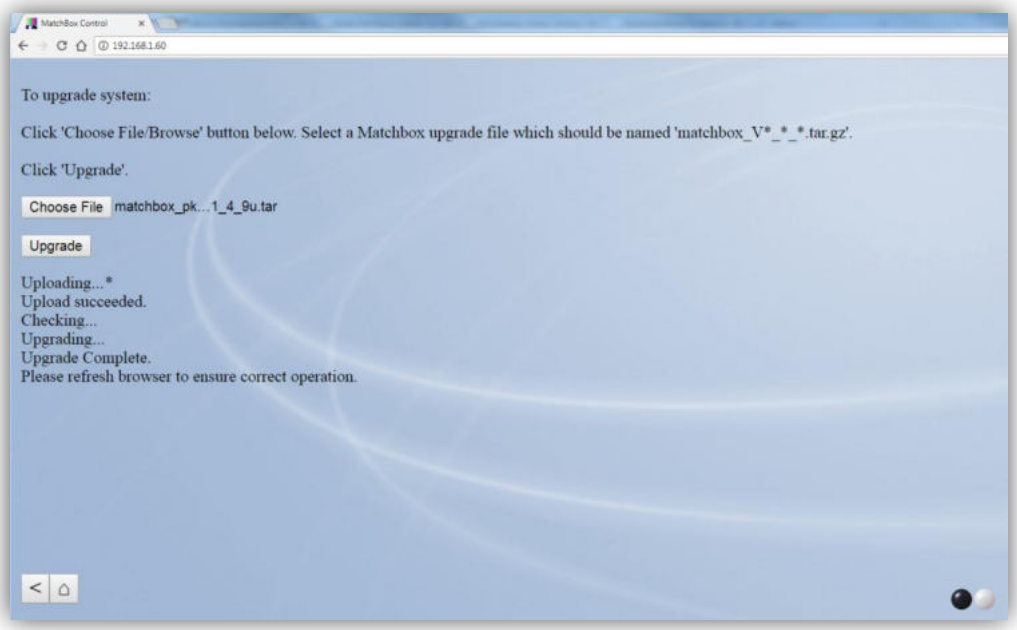

Step 5

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

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

9.2. Upgrading systems older than V1.4.7

Versions of software prior to V1.4.7 limited the size of the upgrade file which the system could upload as a security precaution. Software upgrades from V1.4.7 onwards exceed this limit. In order to upgrade from a version older than 1.4.7 to a newer version will requires a patch to be uploaded. Please see section 9.2 for instructions on applying this patch.

Applying the patch to allow for larger upgrade files is done in the same way as a normal upgrade. The patch file is called *'matchbox_pkg_v0_0_0u.tar'*. This patch may be applied to any installation prior to V1.4.7. Applying this patch should take around 2 minutes and is done in exactly the same way as a normal upgrade although in this case only the software responsible for upgrading is replaced.

After applying the patch the version reported by the system will report as V99.99.99.

Once the patch is applied the normal upgrade procedure may be followed with the desired version of software.

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9.3. Possible issues during upgrade

9.3.1. 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.

In the event that 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** tab and check that the expected revision is shown. It should now be safe to power down the system if required.

9.3.2. I navigated away from the Upgrade tab while the upgrade was in progress.

If you have navigated away from the **Upgrade** tab 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.

9.3.3. The system got 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 us for support.

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10. Specification

Video

SDI	SD / HD / 3G level A (SMPTE 259M/292M/424M)	
	4K Quad-link (SQD)	(*MatchBox 4K only*)
Suppported 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)	
	4K 2160P (50/59/60) SQD 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 4x SD/HD/3G	(*MatchBox 4K / Quad option only*)
Outputs	4 x Optical SD/HD/3G **or** HD-BNC 75ohm **or** 2xHDMI	
	or 1x Quad-link (SQD)	(*MatchBox 4K 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	+/- 0.1ms
Coherence	+/- 0.01 x 48KHz sample*
Video Timing	+/- 1 video sample (precision)
	+/- 20 video samples (accuracy relative to refrence)

* dependent upon integrity of signal path.

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)

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