USER MANUAL

Vision SYSTEM

M-SAFIRE

IP/SDI chroma keyer

Crystal Vision

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Contents

1 Introduction

M-SAFIRE is a 3G/HD/SD-SDI chroma keying software app that runs on the MARBLE media processor – purpose-built GPU/CPU hardware that fits in the Vision frame. It has 3 inputs that can be assigned to foreground, background, and key/mask to allow for chroma keying for a variety of applications including VR/AR, news, weather, sports applications, and many more.

Like all MARBLE-V1 video processing software apps, the M-SAFIRE can be used with IP (ST 2022 or ST 2110 video), with SDI or with both IP and SDI at the same time (thereby providing gateway functionality).

M-SAFIRE:

- Chroma keyer for adding an externally produced background to a green/blue screen foreground
- Third input can be used as a key or mask signal to force either foreground or background to inflow signal parameters
- Full spill suppression controls to eliminate any areas of green/blue screen spill on foreground objects
- Backdrop lighting control allows for quadrant-based suppression controls
- Shadow density control to emphasize or de-emphasize natural shadows cast from foreground objects on the backdrop
- Edge shrink control to soften and clean foreground keyed edges
- Unwanted Chroma Key removal tools allowing for rejection of key in unwanted areas
- Foreground re-spill RGB controls
- Full colour corrector
- Two quad-view multiview outputs with zoom are very useful for setting up chroma keys. One shows output video, output key, keyed foreground and keyed background, while the other shows output video, output key, key source and suppressed foreground
- Mixer for fading chroma key up or down
- Internal foreground/background crop with softness
- Ten frame adjustable video input delay per input, in one frame increments

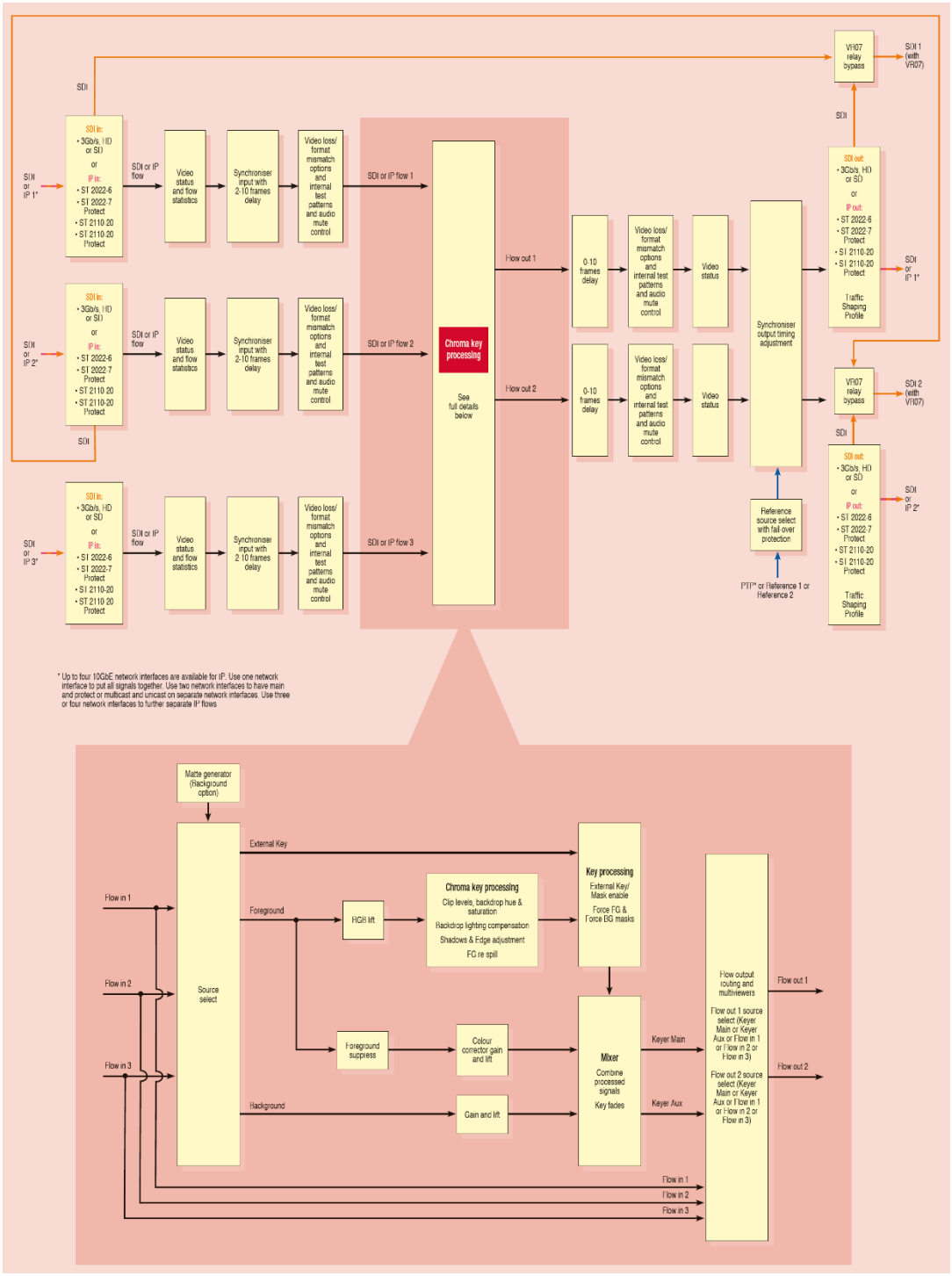
Common MARBLE-V1 feature set:

- Supports SMPTE ST 2022-6 and ST 2022-7 protocols and video within ST 2110 (supporting ST 2110-10, -20 and -21 standards)
- 10GbE SFP+ connectivity supporting 1310nm single-mode long range and 850nm multi-mode short range fibre
- Input and output present, black and frozen monitoring
- Input video and network error detection
- IP inputs tolerant of any input packet distribution
- Instant clean switching between input flows, whatever their timing

- IP flow monitoring including packet loss, duplicated packets and packet delay variation
- Internal test patterns
- Sub frame output timing adjustment locked to chosen reference source
- Ten frame adjustable video output delay per output, in one frame increments
- Choice of multiple timing sources with fail-over: PTP and two analogue Black and Burst or tri-level syncs references via Vision frame
- Support for unicast and multicast transmission
- Full range of VLAN support
- Supports IGMP V1, V2 and V3
- Supports 31 video standards
- Flexible remote control and monitoring using frame integrated control panel, VisionPanel remote control panel, ASCII and JSON protocols, SNMP and the web browser-based VisionWeb Control
- Dual slot card allowing 10 cards in Vision 3 frame

2 Block Diagram

M-SAFIRE



3 Hardware Installation

The potentiometers on the card are factory set and should not be adjusted. There are no user-selectable links.

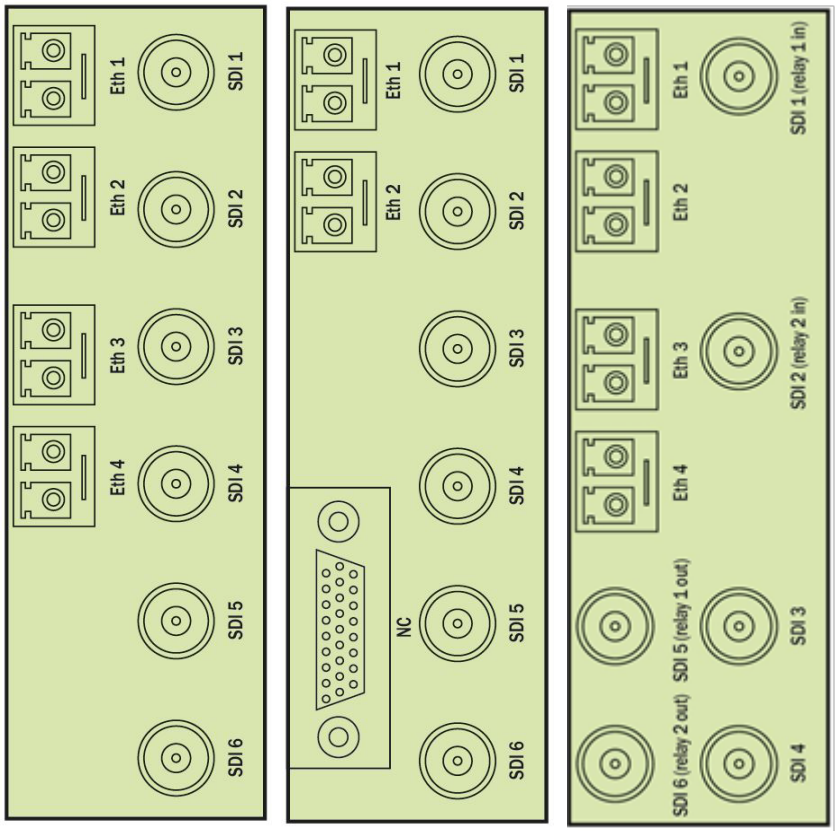
The app-based MARBLE-V1 cards are intended for use only in the Crystal Vision 'Vision' frame range and not in older style frames such as 'Indigo'.

Insert the card by pushing the white handle on the card edge, being careful to ensure the card is inside the guide rails. Remove it by pulling the metal hook. Do not force the card if resistance is met as the card may not be correctly aligned with the rear connectors.

Ensure that the Vision frame has the correct rear module fitted. Only the VR04, VR06 and VR07 rear modules offer the correct input/output functionality for the M-SAFIRE app.

The cards and rear modules can be inserted and removed without powering down the frame.

3.1 Rear module signal IO



VR04 *VR06* *VR07*

SDI 1: SDI Flow In 1

SDI 2: SDI Flow In 2

SDI 3: SDI Flow In 3

SDI 4: No Connection

SDI 5: SDI Flow Out 1

SDI 6: SDI Flow Out 2

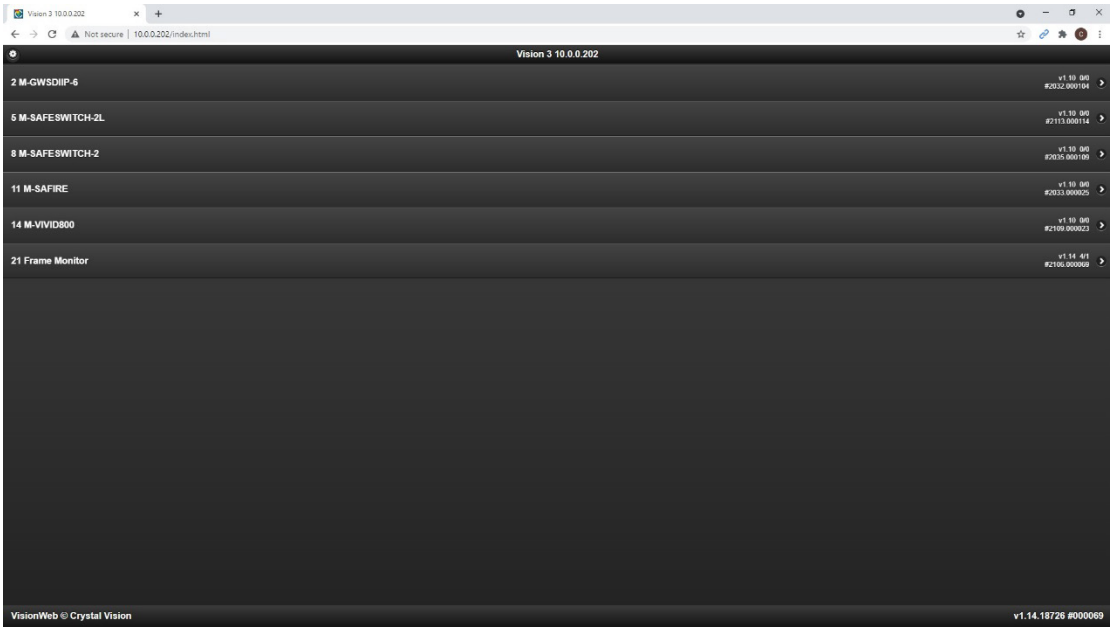
Eth 1 to 4: 10GbE video over IP I/O

D-Type on VR06: No connection

VR07 SDI relay bypass protection, in the event of power or card malfunction: SDI 1 to 5, SDI 2 to 6

4 Input/Output Configuration

VisionWeb web browser control software is recommended for the configuration of the MARBLE-V1 software apps. This is achieved by entering the IP address of the frame into a web browser (10.0.0.201 on Ethernet port 1 of the frame by default). See the Vision 3 frame manual for more information on VisionWeb and frame configuration and operation.



Example 'VisionWeb' homepage

4.1 Configuring the Ethernet Interfaces

MARBLE-V1 ST 2022 and ST 2110 video over IP flows are received and transmitted using the VR04/VR06/VR07 10GbE network interface connections. VR06 provides two network interfaces while the VR04 and VR07 provide four. A typical usage case is to use Eth 1 interface for the 'primary' IP traffic and Eth 2 for the 'protect'. The additional Eth 3 and 4 interfaces on the VR04 and VR07 allow input flows to be separated from output flows.

Within each Ethernet interface there are six virtual interfaces. These are useful for software apps which process six individual IP flows, such as the IP gateways, as each flow can be assigned to its own unique IP address. For the M-SAFIRE app fewer connections will require configuration. If using SDI I/O with an analogue reference no virtual interfaces will need configuring.

If using IP I/O main and protect protocols, typically five virtual interfaces across two physical interfaces will require configuration. For example:

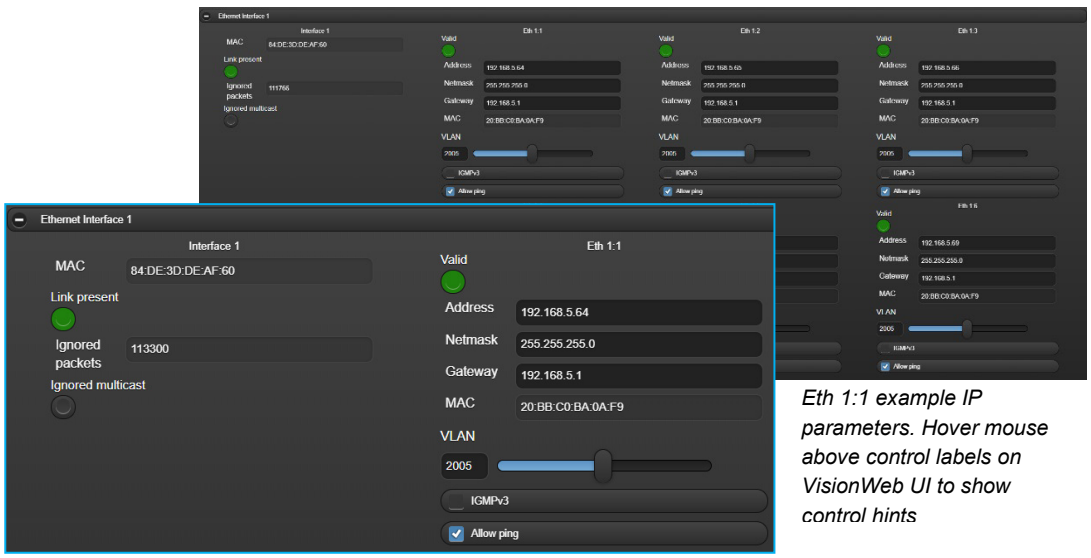
IP Inputs

Eth 1:1 Primary IP Input 1	Eth 2:1 Protect IP Input 1
Eth 1:2 Primary IP Input 2	Eth 2:2 Protect IP Input 2
Eth 1:3 Primary IP Input 3	Eth 2:3 Protect IP Input 3

IP Outputs

Eth 1:4 Primary IP Output 1	Eth 2:4 Protect IP Output 1
Eth 1:5 Primary IP Output 2	Eth 2:5 Protect IP Output 2

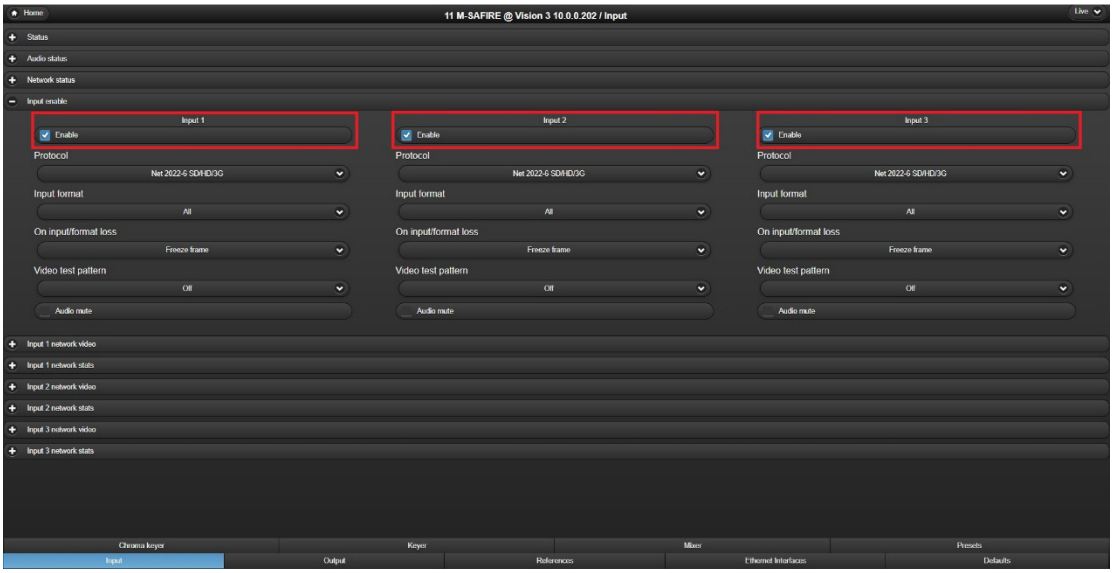
Alternatively, if using the VR04 or VR07, the IP Flow Outputs can be separated onto Eth 3 and 4.



Eth 1:1 example IP parameters. Hover mouse above control labels on VisionWeb UI to show control hints

4.2 Enabling Inputs and Outputs

By default, M-SAFIRE inputs and outputs are disabled. Use the input enable and output enable menu to enable appropriate signal flows.

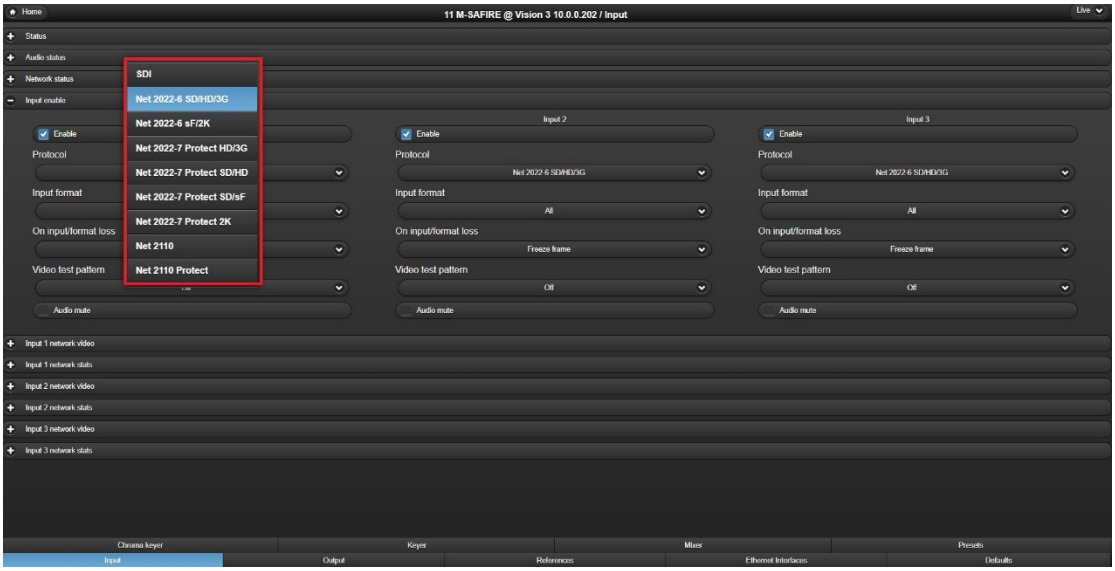


M-SAFIRE Input enable

4.3 Select Flow Protocol

M-SAFIRE supports SDI and uncompressed video over IP protocols ST 2022 and ST 2110-20. It is possible to mix protocols between input and outputs. For example, an ST 2022 input can be output as SDI on Output 1 and ST 2110 on Output 2.

Once the appropriate inputs and outputs have been enabled, the required Protocol can be selected using the drop-down menus within the Input and Output enable menus. The protocol type will need selecting for each input and output that is enabled.

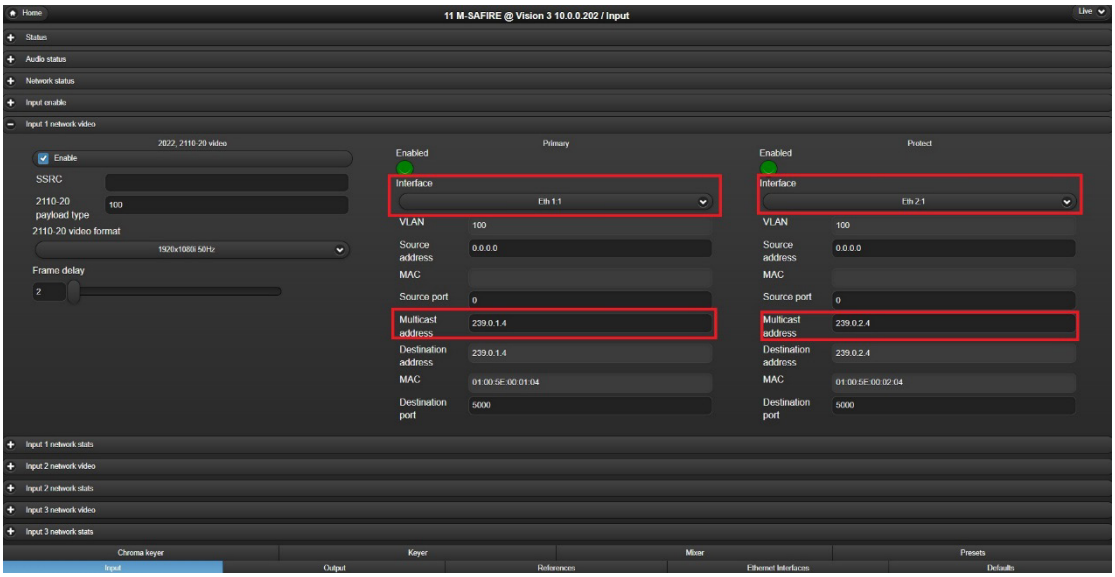


M-SAFIRE Input enable protocol selection

4.4 Receiving an IP Flow

M-SAFIRE receives ST 2022 or ST 2110-20 video over IP flows using the 10GbE network interfaces on the VR04/VR06/VR07 Vision frame rear connector. Typically, Eth 1 is used for receiving and transmitting the ‘primary’ IP flows, with Eth 2 being used for the ‘protect’ in -7 protect applications.

The following example shows the Input 1 Network Video tab configured to receive Input 1 using SMPTE ST 2110-20 Protect. When selecting ST 2110-20 Protect it is necessary to configure both the ‘Network In’ and ‘Protect Network In’.



M-SAFIRE Input 1 network video

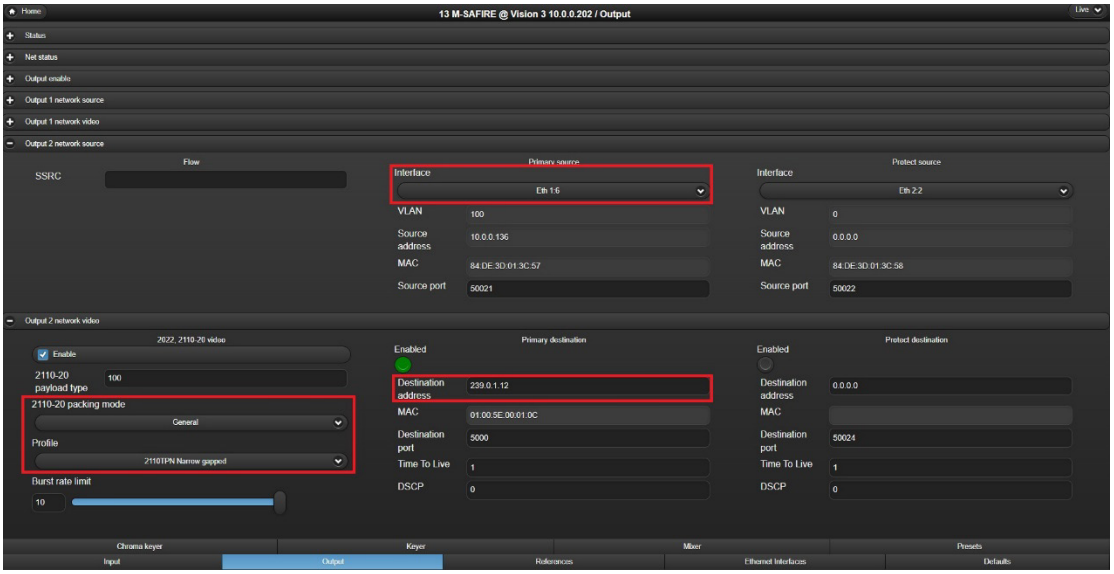
The controls highlighted in the above configuration show the input of the M-SAFIRE set to receive the ‘main’ flow packets on Ethernet Interface 1:1 and ‘protect’ packets of the ST 2110-20 Protect protocol on 2:1. In this example multicast IP addresses are in use.

To successfully receive a flow, all IP parameters must agree with those of the transmitter. If receiving ST 2110, the 2110 payload type and 2110 format will need to match the transmitter, as well as proper SSRC if used.

4.5 Transmitting an IP Flow

M-SAFIRE transmits ST 2022 or ST 2110-20 video over IP flows using the 10GbE network interfaces on the VR04/VR06/VR07 Vision frame rear connector.

The following example shows an M-SAFIRE configured to transmit Output 2 using ST 2110-20 GPM Protect protocol.



M-SAFIRE Output 2 network source and video menus

The controls highlighted in the above configuration show the Output 2 configuration for a main flow of ST 2110 video. In this example, multicast destination addresses are being used for the main. If required, this could be replaced by single point unicast addresses.

Ports and Time To Live (TTL) should be configured as per the network switch requirements.

If required a valid SSRC (Synchronisation source identifier) can be entered, otherwise left blank or set to 0 will accept all.

When transmitting ST 2110 the required payload type value should be set. The value for payload type is arbitrary and decided by the user. For example, value 100 could be used to indicate 1920x1080i 50Hz content and value 101 used to indicate 625i 50Hz content.

5 Status

5.1 Input Video and Audio Status

Input video and audio status

Video Status

Present LED: Green when input is present, otherwise off

Time present: Length of time input has been present

Format: Read only text showing video format e.g. 1920x1080i 50Hz

Video black LED: Yellow if input is full frame black, otherwise off

Video frozen LED: Yellow if input is frozen, otherwise off

Video error LED: Red if CRC errors detected at input, otherwise off

Network error LED: Red if lost or duplicate packets are detected on primary or protect network input

Audio Status

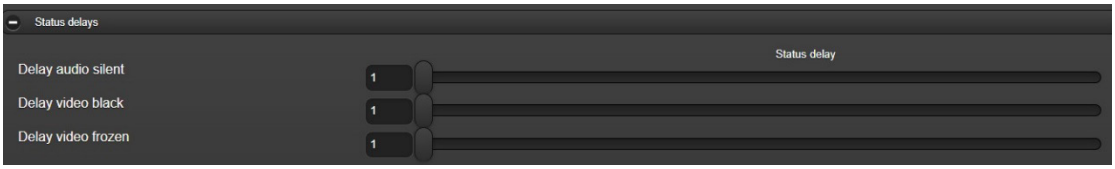
Audio group and channel LED: Green when audio groups or individual channels are present, otherwise off

Audio silent LED: Yellow if audio is present but silent for a given channel

The equivalent output status is also provided for present, format, video black and video frozen.

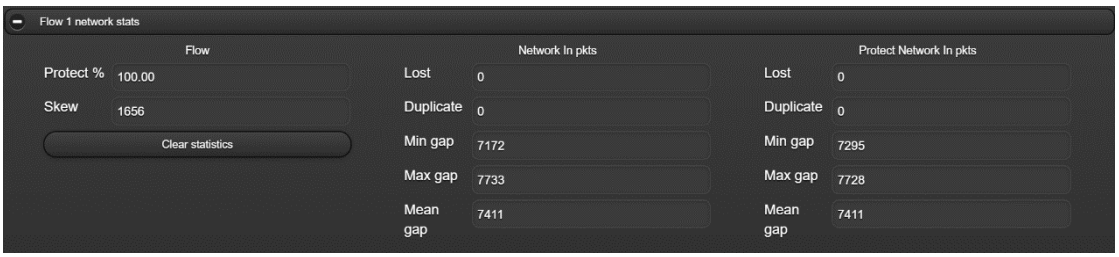
Status Delay

Black and Frozen video as well as audio silent can be prevented from triggering until a user selectable delayed period between 1 to 120 seconds has expired. These controls are located on the ‘Defaults’ tab.



Status delay

5.2 Network Statistics



IP input network statistics

Flow Statistics

Protect %: Percentage of packets used from the ‘protected’ network input

Skew: Difference in packet arrival. –ve indicates protect packets are arriving first

Network In/Protect Network In pkts

Lost: Number of lost packets

Duplicate: Number of duplicate packets

Min gap: Minimum gap between packets (nSec)

Max gap: Maximum gap between packets (nSec)

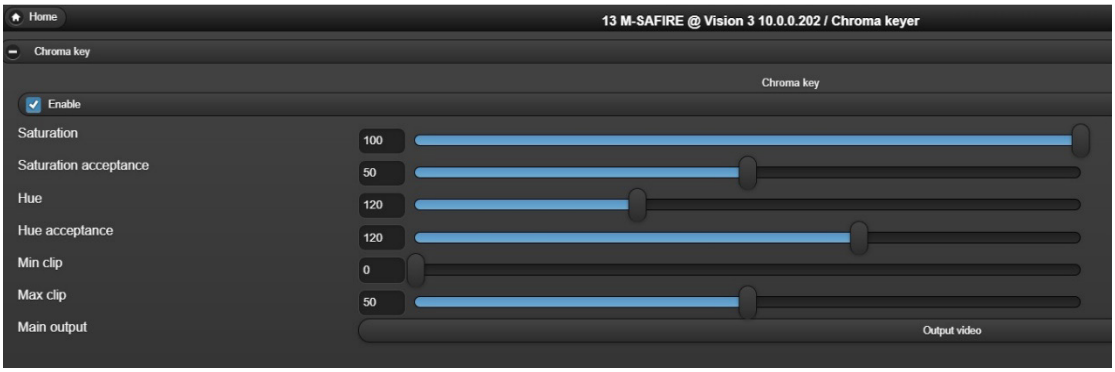
Mean gap: Mean gap between packets of a frame (nSec)

6 Chroma Keyer

The Chroma Keyer menu is used to set up all the chroma keyer functions. These functions are described here, including a suggested set of steps to optimise these controls.

6.1 Chroma key

This is the main control menu for creating the chroma key. M-SAFIRE produces very clean, precise chroma keys. M-SAFIRE allows the user to set both the colour and saturation range of the area to be suppressed and background inserted.



Chroma key

Enable: Enables/disables chroma key processing, *default=Enable*

Saturation: Range 0-100, sets the saturation level of the foreground backdrop area to create the key. This will normally be the first control adjusted, *default=100, Note: This default level will show none or very little final composite, the intent is to lower this control first to establish the level for the key to occur*

Saturation acceptance: Range 0-100, sets a range of saturation that will be used to create the final key, *default=50*

Hue: Range 0-360, sets the colour to be used in the foreground to create the key signal. A value of 120 is good starting point for green screen backgrounds, 240 for blue. Fine adjustment for full suppression, *default=120*

Hue acceptance: Range 0-180, sets the range of colours that the Hue colour will use to create the key signal. Setting this value too low will result in lack of full suppression, too high a value will cause unwanted transparencies in foreground objects, *default=120*

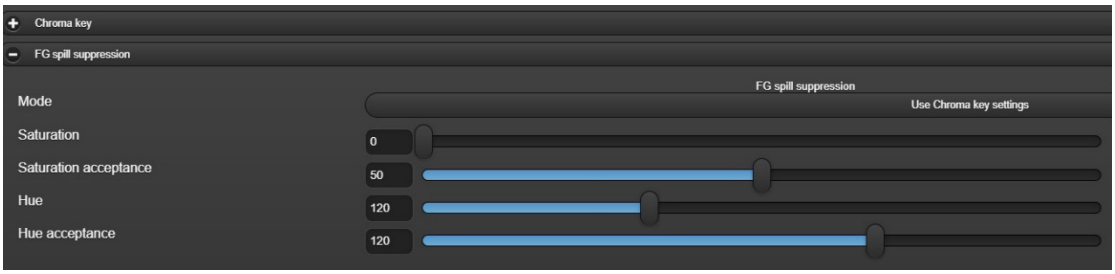
Min clip: Range 0-100. Increasing the min clip value will force lower key levels to zero, whilst the max clip level is unaffected. This is mainly used when small amounts of key level remain in foreground object areas causing breakthrough of the new background, *default=0*

Max clip: Range 0-100. Reducing the max clip level value will force variations in key level to full key value by amplifying and clipping. Use this control to compensate for uneven chroma key backdrop illumination to fully suppress the background area. This control does not affect min clip levels, *default=100*

Main output: Sets the source for the main output. A good tool during setup of the system, sources are *Output video, Output key, Output key inverted, Foreground source, Suppressed foreground, Background source, External key source, Keyed foreground, Keyed background, Video/Key,Src/SuppressFG quad split* and *Video/Key,Keyed FG/BG quad split*

6.2 FG Spill suppression

The spill suppression menu assists in removing any areas where colour spill from the backdrop on foreground objects are causing unwanted keying of the background or backdrop colour tints on foreground objects.



FG Spill suppression

Mode: *Use Chroma key settings* utilises the same settings set in the chroma key menu to set all the parameters of spill suppression. *Enabled* activates the settings set in this menu, *default=Use Chroma key settings*

Saturation: Range 0-100, sets the saturation level of spill suppression processing, *default=0*

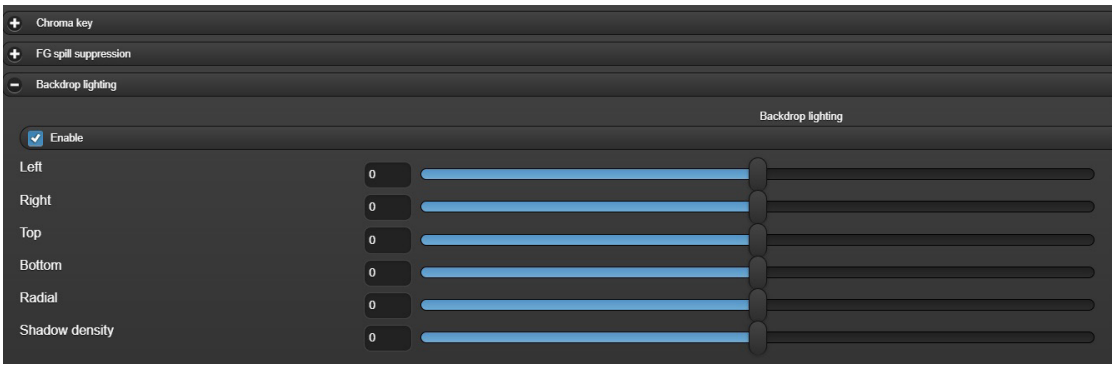
Saturation acceptance: Range 0-100, sets the range of saturation level for spill suppression, *default=50*

Hue: Range 0-360, sets the colour for spill suppression enabled processing, *default=120*

Hue acceptance: Range 0-180, sets the range of colours controlled by the hue spill suppression processing, *default=120*

6.3 Backdrop lighting

Backdrop lighting allows for quadrant gain control to assist in poorly lit or variably lit backdrops. This menu also contains the shadow density control for enhancing or rejecting natural occurring shadows on the backdrop.



Backdrop lighting

Enable: Enables/disables all controls in this menu, *default=off*

Left: Quadrant gain control for left side of image, adjust for even key, *default=0*

Right: Quadrant gain control for right side of image, adjust for even key, *default=0*

Top: Quadrant gain control for top side of image, adjust for even key, *default=0*

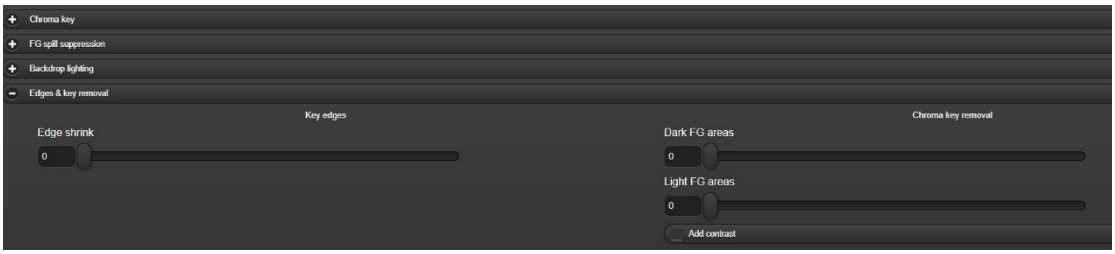
Bottom: Quadrant gain control for bottom edge of image, *default=0*

Radial: Overall lighting spotlight control, increasing lowers overall gain, decreasing increases gain, *default=0*

Shadow density: Range -100 to 100, control will enhance or reject natural shadows from foreground objects on backdrop, increasing enhances shadows, decreasing rejects shadows, *default=0*

6.4 Edges and key removal

This menu contains the Edge shrink control for softening and cleaning up edges on foreground objects. Chroma key removal controls can attenuate the created key signals in areas of foreground in dark and light luminance levels.



Edges & key removal

Edge shrink: Range 0-100, increasing value reduces created key while simultaneously softening the edge, *default=0*

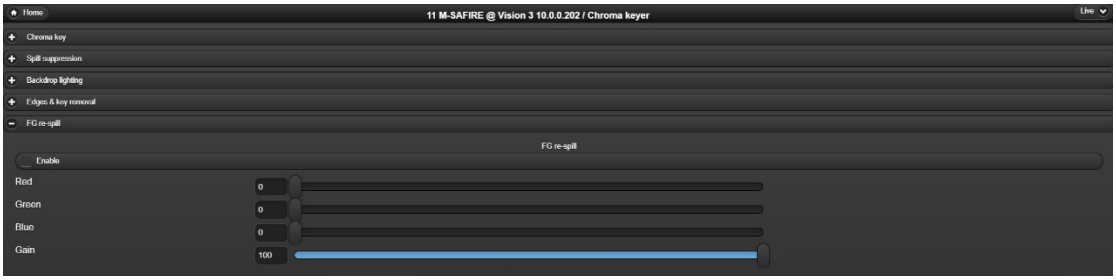
Dark FG areas: Range 0-100, increasing will help to remove spill areas by forcing BG on low luminance areas in the foreground that are suffering from unwanted background keying, *default=0*

Light FG areas: Range 0-100, increasing will help to remove spill areas by forcing BG on high luminance areas in the foreground that are suffering from unwanted background keying, *default=0*

Add contrast: Enable to add additional contrast into the areas forced by dark and light FG areas controls. By adding additional contrast those areas are further forced to background and filled, *default=disabled*

6.5 FG re-spill

Re-spill can be used to colour any areas of remaining foreground spill to make them look more natural. Normally, the colour of re-spill would be used to replicate if the background colours were being reflected onto foreground objects.



FG re-spill

Enable: Enables/disables FG re-spill, *default=disabled*

Red: Range 0-100, percentage of red in re-spill colour, *default=0*

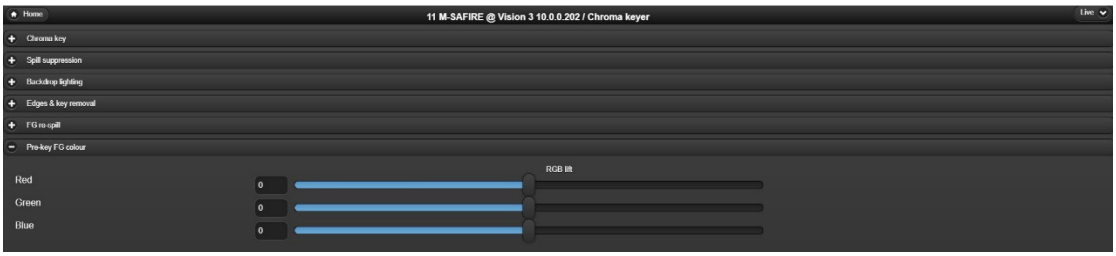
Green: Range 0-100, percentage of green in re-spill colour, *default=0*

Blue: Range 0-100, percentage of blue in re-spill colour, *default=0*

Gain: Range 0-100, amount of re-spill applied to composited image, *default=100*

6.6 Pre-key FG colour

This menu allows for correction to RGB lift of the foreground image before keying. These controls can be used to compensate for any colour loss from high levels of spill suppression.



Pre-key FG colour

Red: Range -20 to 20, adjusts the pre-key red component lift of the FG signal, *default=0*

Green: Range -20 to 20, adjusts the pre-key green component lift of the FG signal, *default=0*

Blue: Range -20 to 20, adjusts the pre-key blue component lift of the FG signal, *default=0*

6.7 Post-key FG colour

RGB lift and gain colour correction of the FG after keying.

Post-key FG colour

Red gain: Range 80-120%, adjusts the red gain of FG after keying, *default=100*

Green gain: Range 80-120%, adjusts the green gain of FG after keying, *default=100*

Blue gain: Range 80-120%, adjusts the blue gain of FG after keying, *default=100*

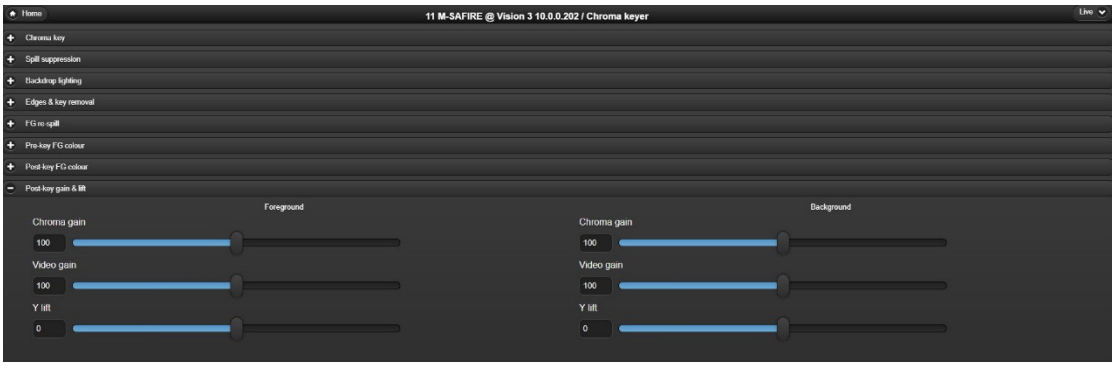
Red lift: Range -20 to 20%, adjusts the red lift of FG after keying, *default=0*

Green lift: Range -20 to 20%, adjusts the green lift of FG after keying, *default=0*

Blue lift: Range -20 to 20%, adjusts the blue lift of FG after keying, *default=0*

6.8 Post-key gain & lift

Adjusts the keyed foreground and background signals to achieve a more realistic composite.



Post key gain & lift menu

Foreground chroma gain: Range 80-120%, adjusts foreground chroma gain post-key, *default=100*

Foreground video gain: Range 80-120%, adjusts foreground video gain post-key, *default=100*

Foreground Y lift: Range -20 to 20%, adjusts foreground Y lift post-key, *default=0*

Background chroma gain: Range 80-120%, adjusts background chroma gain post-key, *default=100*

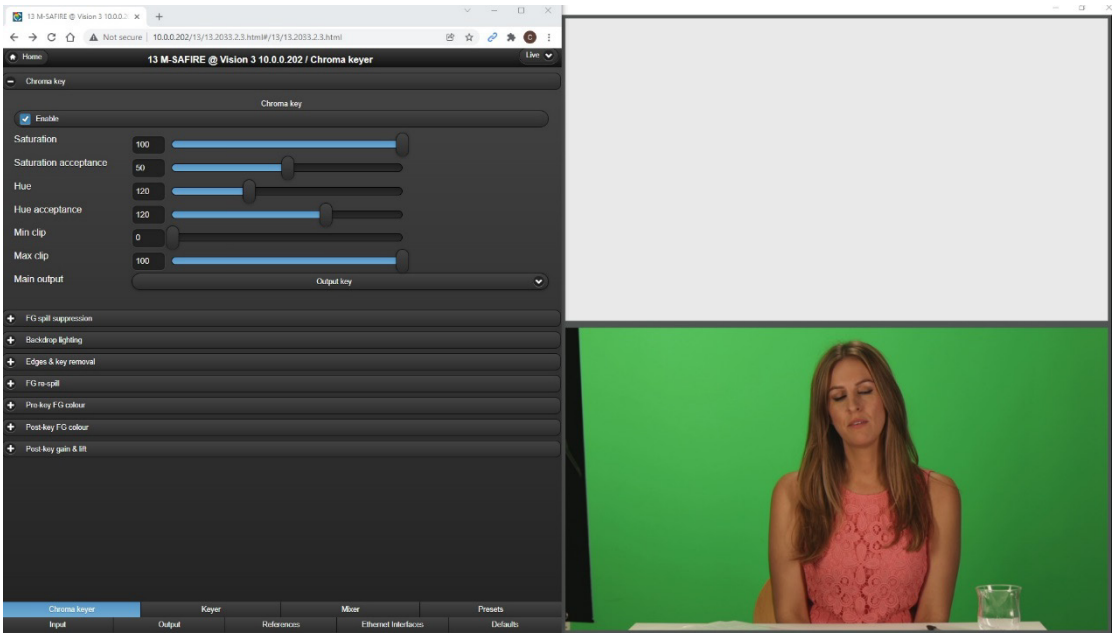
Background video gain: Range 80-120%, adjusts background video gain post-key, *default=100*

Background Y lift: Range -20 to 20%, adjusts background Y lift post-key, *default=0*

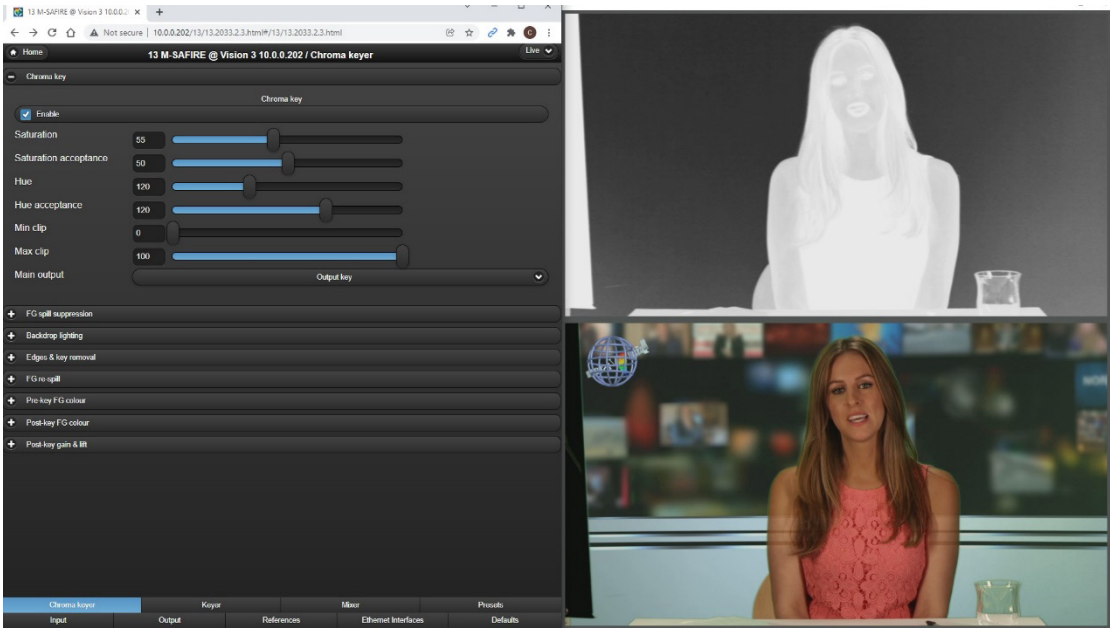
6.9 Example of set-up

The following is an example setup utilising the main controls needed to get a good key. Section 6.10 will go further into some examples of more fine controls and their uses.

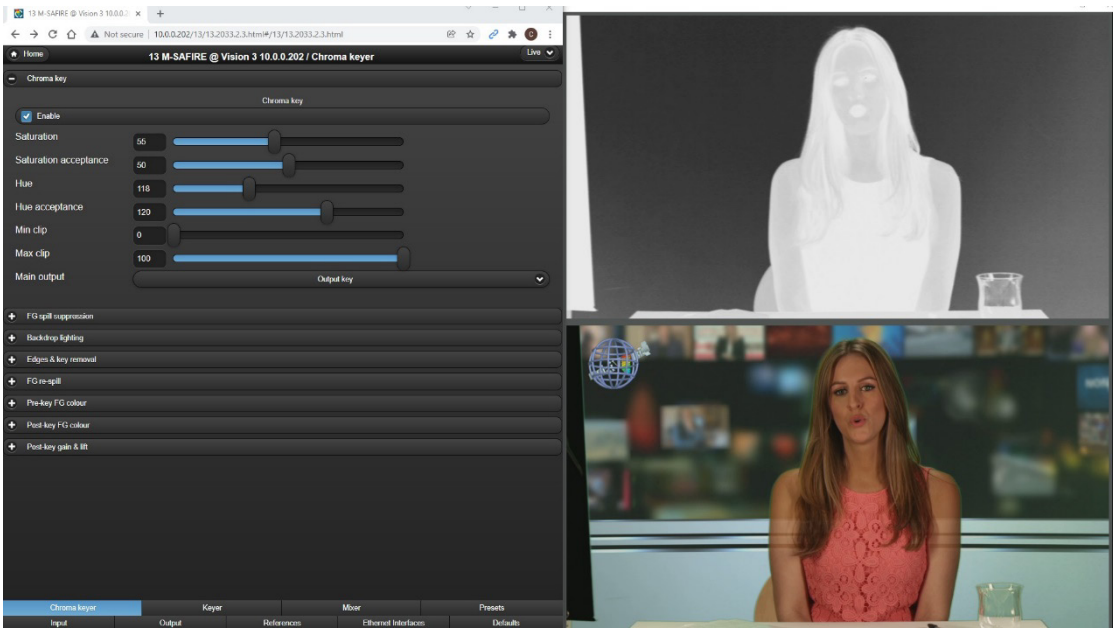
With all controls at default, we are monitoring both main and aux outputs. This is a typical procedure when there is access to two monitors. In the event of a single monitor setup, you could monitor one of the two available quad split multiview outputs.



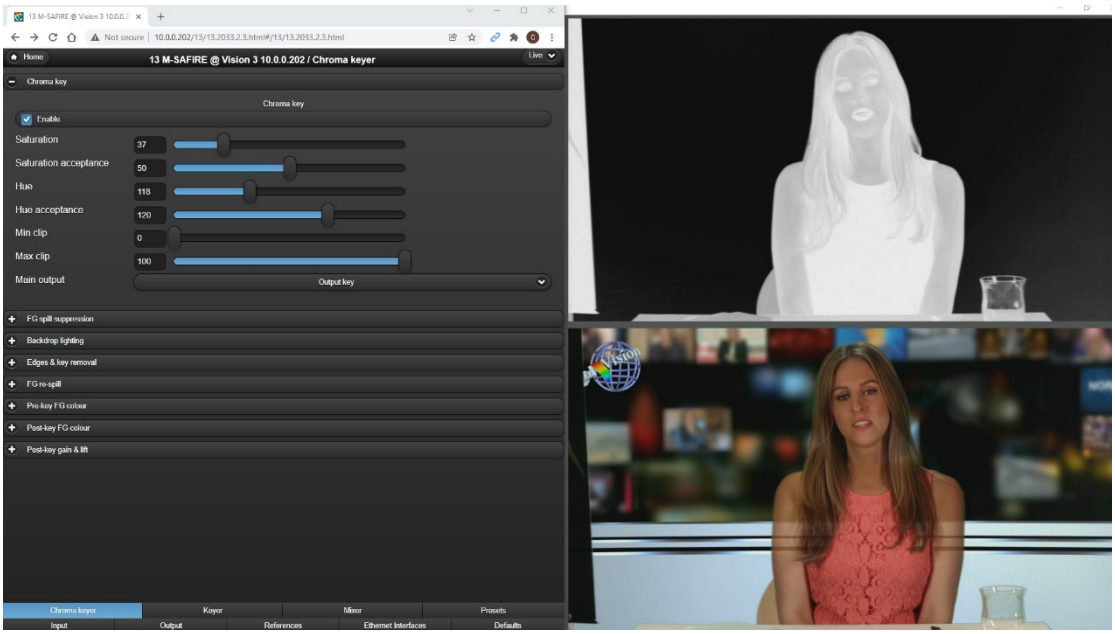
The top output is the Main Out set to Output key, the bottom is the Aux Out showing the output video. In the chroma key menu, beginning the setup, lower the *saturation* control to about 55. The backdrop suppression will begin.



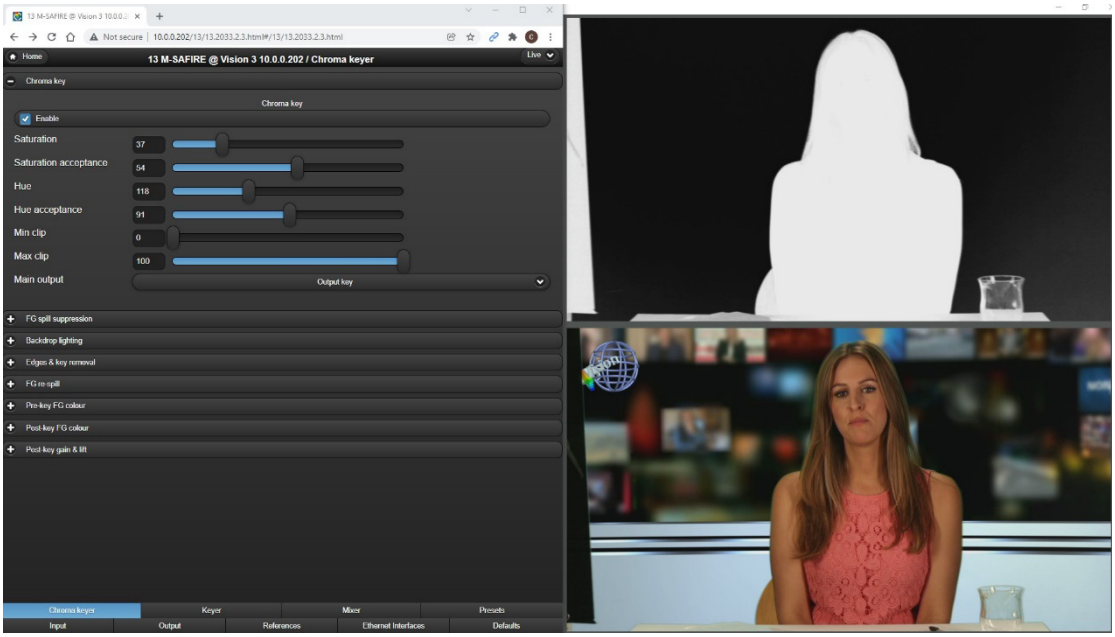
Before final adjustment of *saturation*, set the *hue* control. This video is using a green screen backdrop. The default *hue* setting of 120 will be close. Watching the output key, slowly adjust the hue control to the point that provides the most suppression to the backdrop – meaning turning the backdrop as black as possible. *Note: It may be necessary to set saturation a little higher or lower to be able to see the hue changes.*



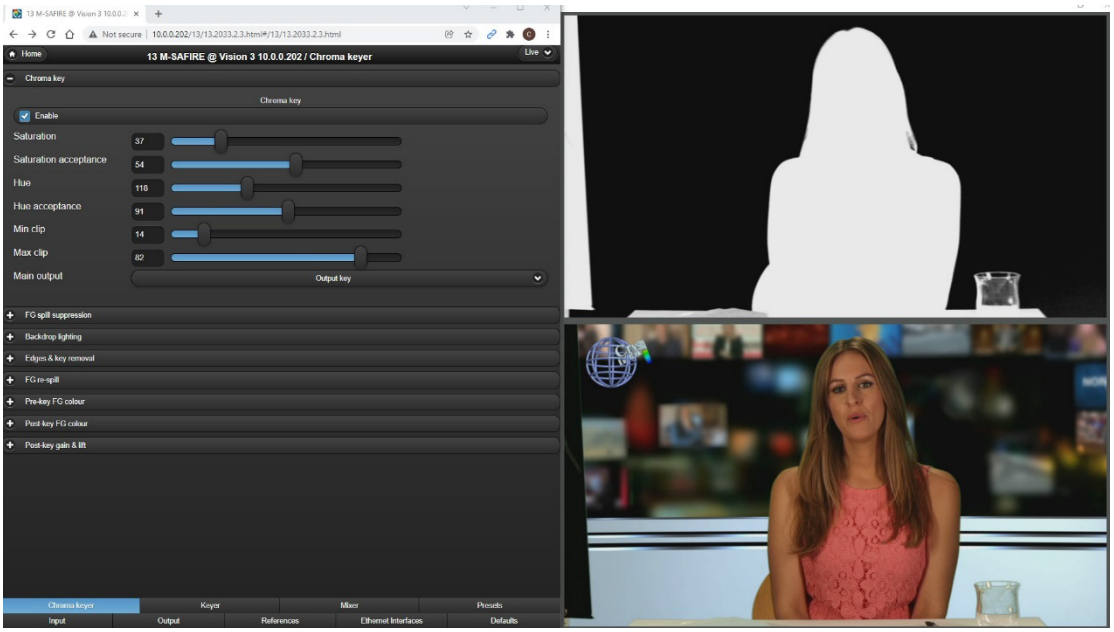
Now fully adjust the *saturation* control. Adjust the control for maximum backdrop suppression while monitoring the output key. There will be a point that the backdrop luminance begins to brighten again. Find the sweet spot in the middle of this transition with the most backdrop suppression.



Next adjust *saturation acceptance* and *hue acceptance* for minimum transparency of the foreground and maximum suppression of the backdrop.



Next adjust the clip controls. *Min clip* will be adjusted upward to clean any remaining transparencies in the FG key signal. All foreground objects in the key signal should be represented as full luminance white. *Max clip* will be adjusted downward to fully suppress and force the full backdrop to black while viewing the output key signal.

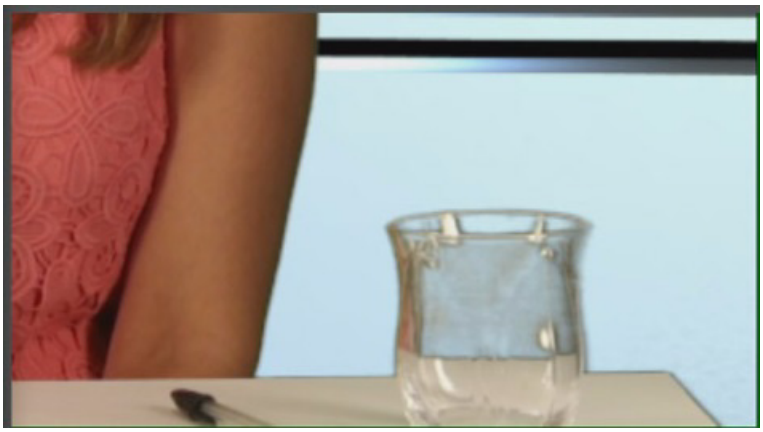


The next section will discuss some further fine-tuning adjustments that can be made to this composite, as well as a few other sample images.

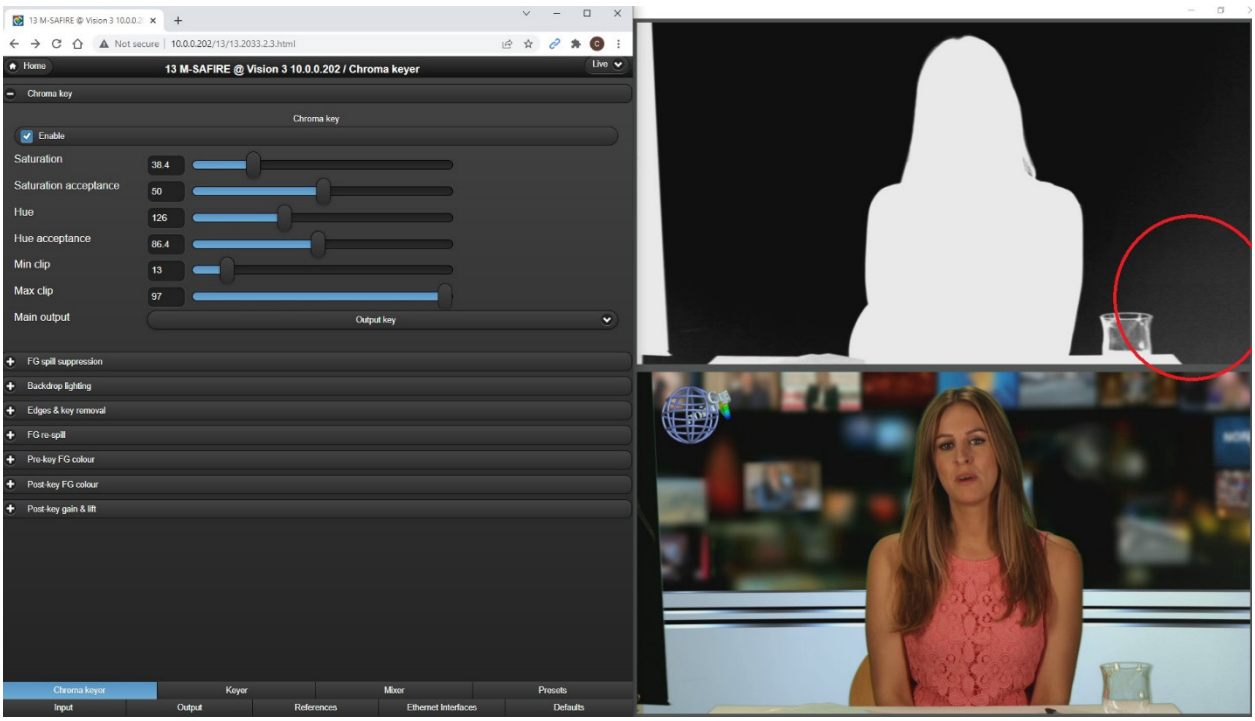
6.10 Further examples of controls

The glass in the image used before has both spill reflecting on the glass as well as the green backdrop showing through. These types of objects will many times need additional spill removal using the *spill suppression* menu. Here, the quad split view zoom feature is used to zoom in on this area of concern.

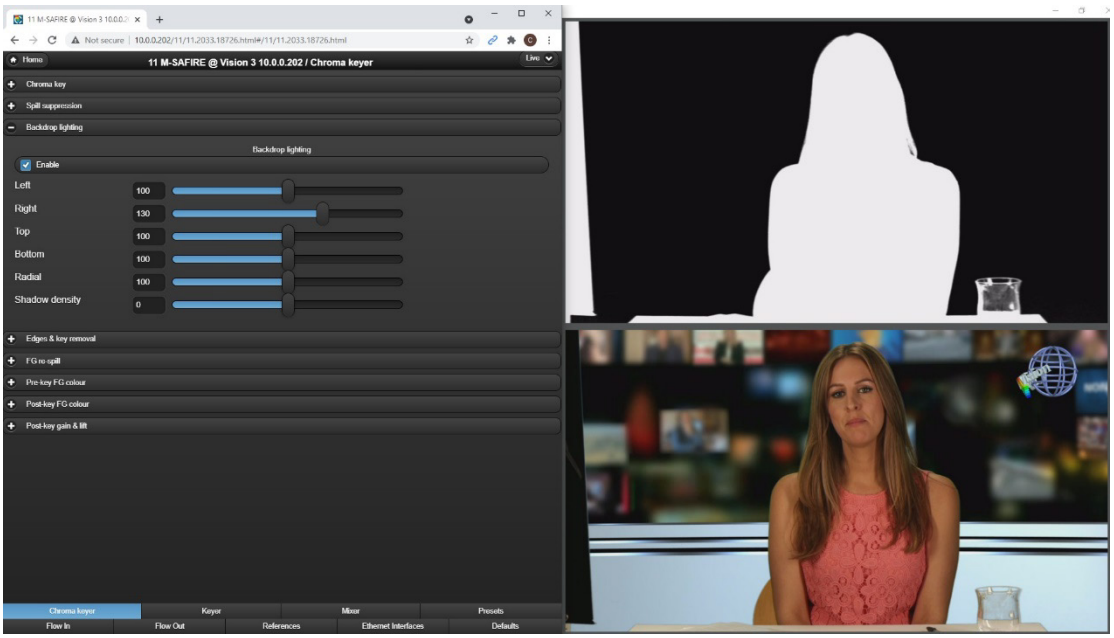
In most cases the default setting for the spill suppression menu, *Use chroma key settings,* will give great results without further adjustment. In this case *Enabled* has been selected and all controls have been adjusted while focusing on the area of concern, in this case, the glass.



If the backdrop is unevenly lit, dark areas and brighter areas occur. In this earlier example image, the area of issue is marked with a red circle. Earlier, we fully suppressed this by lowering the *Max Clip* control. If we go back into the Chroma Key Menu and raise the max clip, it exposes the issue of an unevenly lit backdrop. An uneven lighting condition such as this is a great use of our quadrant gain controls, *Backdrop lighting.*

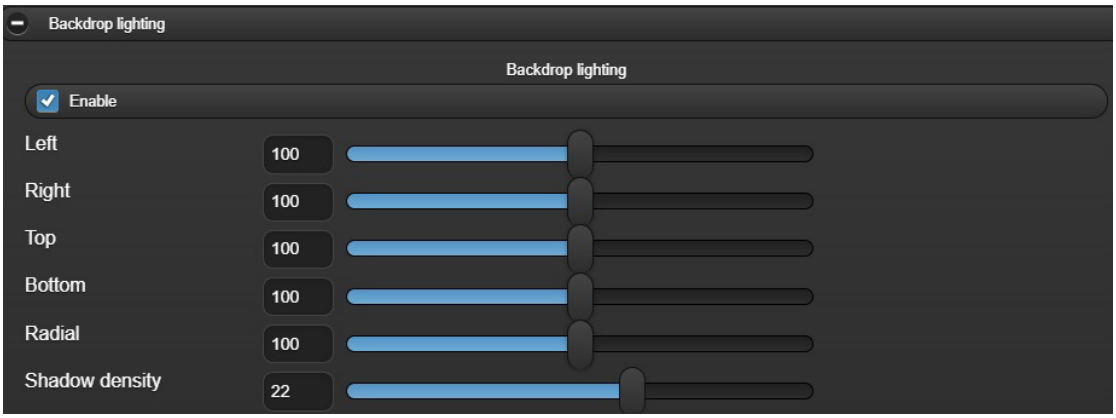


The menu is *Enabled,* and the right quadrant control is increased adding additional suppression to just the right edge of the image. The other directional controls as well as the *Radial* control can be used to add suppression into just the areas needed.

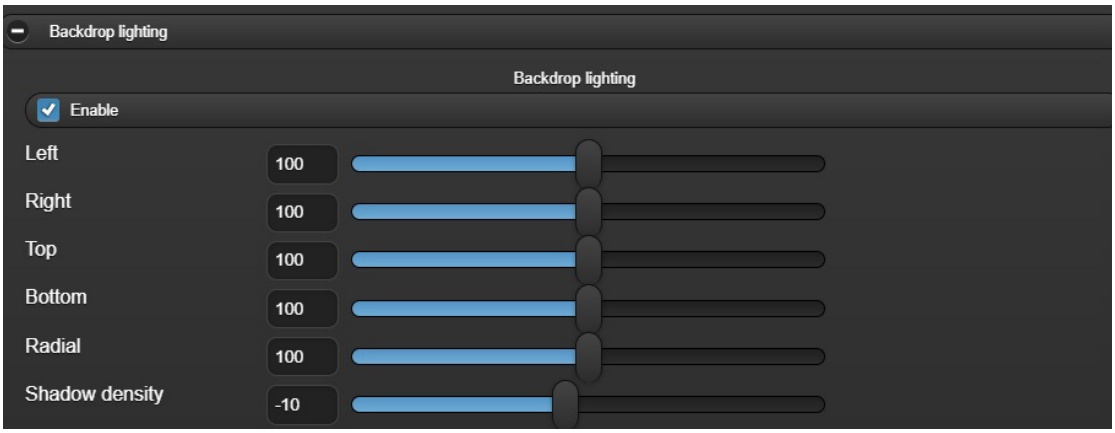


Naturally occurring shadows from foreground objects onto the backdrop can be manipulated. Here's a composite zoom where our presenter's arm is casting a shadow on the backdrop.

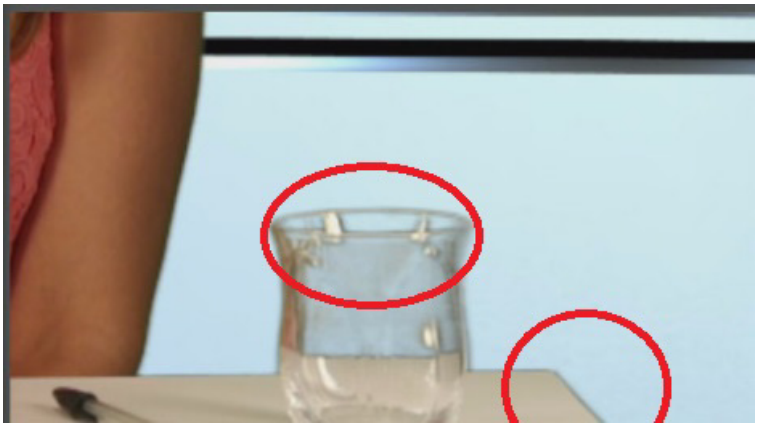
Using *Shadow Density,* you can enhance or reject these shadows. Increasing the control will enhance the shadow.



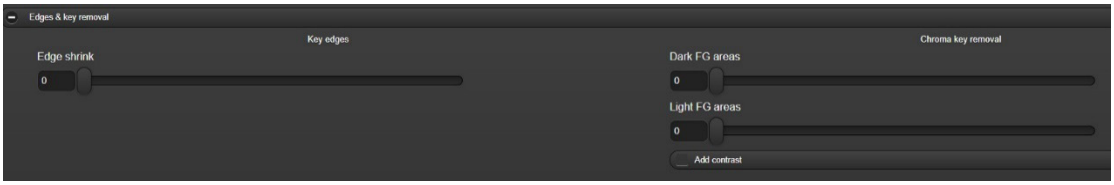
Decreasing this control will reject these shadows.



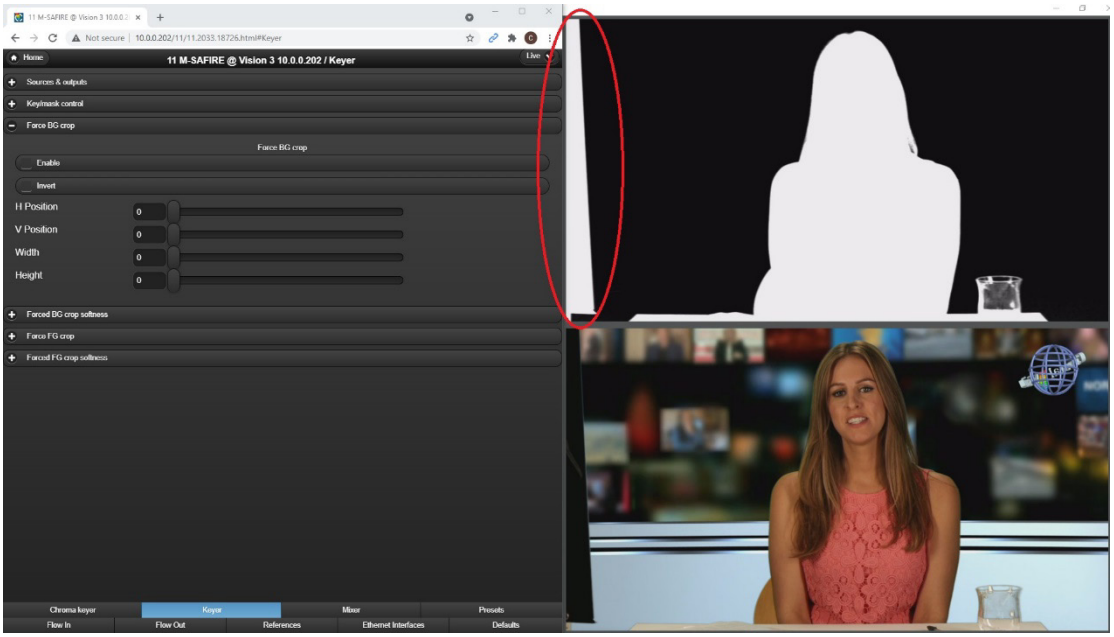
More natural and softer edges can be achieved by using our *Edge shrink* control. In this example utilising zoom, a slightly incorrect suppression setting has caused a hard edge on the table and the edges of the glass.



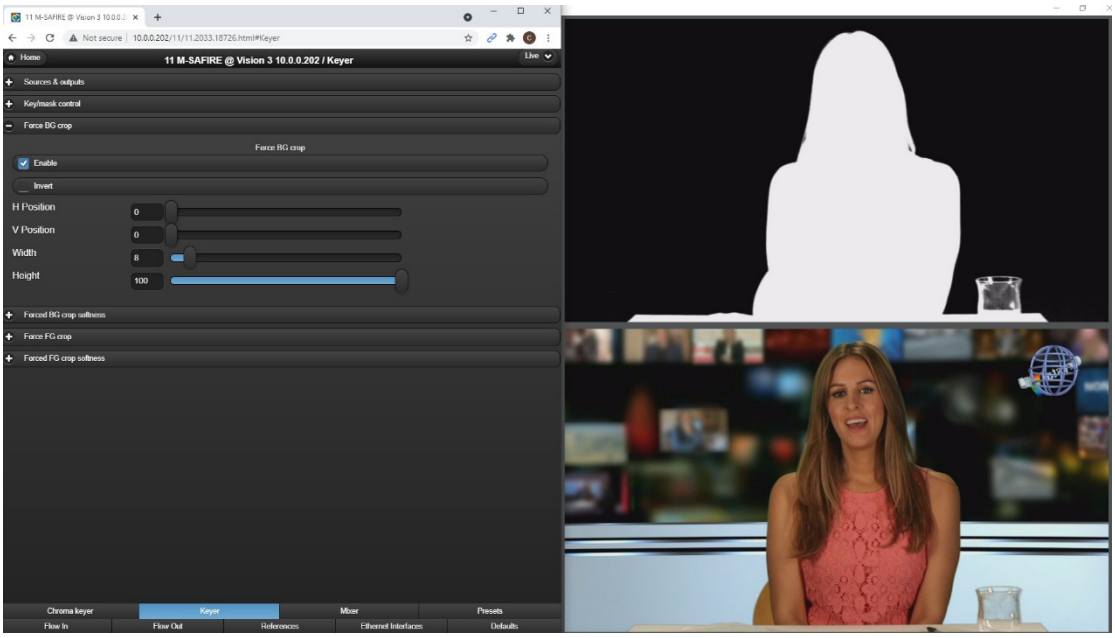
Increasing the *Edge shrink* control in the edges and key removal menu will reduce the edge size while simultaneously softening or feathering the edge.



The left side of this sample image has a torn and missing backdrop.



This can be easily removed utilizing the *Force BG crop* control in the *Keyer* menu.



Further adjustment tools are available to resolve most real-world issues. These are just a few examples of the use of specialised fine tune controls to create clean, crisp chroma key images.

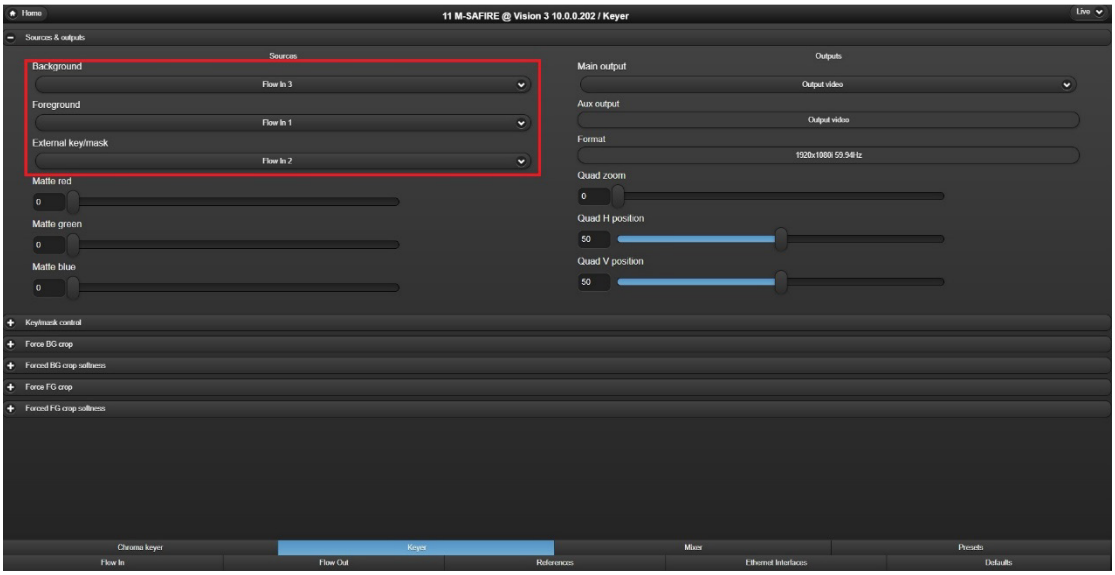
7 Keyer and Mixer

The M-SAFIRE Keyer menu is used to set sources for the chroma keyer as well as controls for the external key/mask. These controls can be used to force foreground or background objects into your final composite key. The mixer menu allows for fade up or down of the keyer.

7.1 Keyer

Source & outputs

Select which of the flow inputs are to be used for foreground, background, and key/mask for the M-SAFIRE chroma key. Background can also be set to internal matte, with the matte colour configurable using the matte RGB sliders.

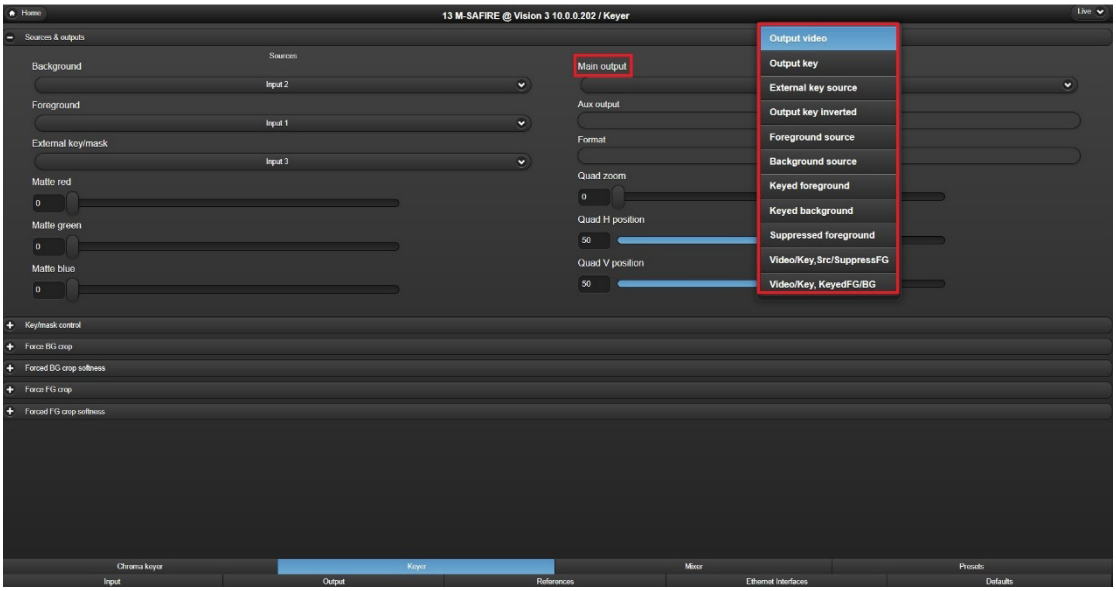


Keyer source selection

Keyer Outputs

The M-SAFIRE keyer processing provides both a ‘Main’ and ‘Aux’ output. The Aux output is fixed to display the final processed output from the keyer. The Main output, however, can be routed to display the source signal or keyed signals at various stages of the key processing.

To aid setup, there are two quad split outputs showing four signals composited onto one video screen. These can be accessed by selecting 'Video/Key, Keyed FG/BG' or ‘Video/Key, Source/Suppressed FG”. The quad zoom and position controls provide the ability to zoom into each quad for close inspection of the adjustments to the key across the picture.

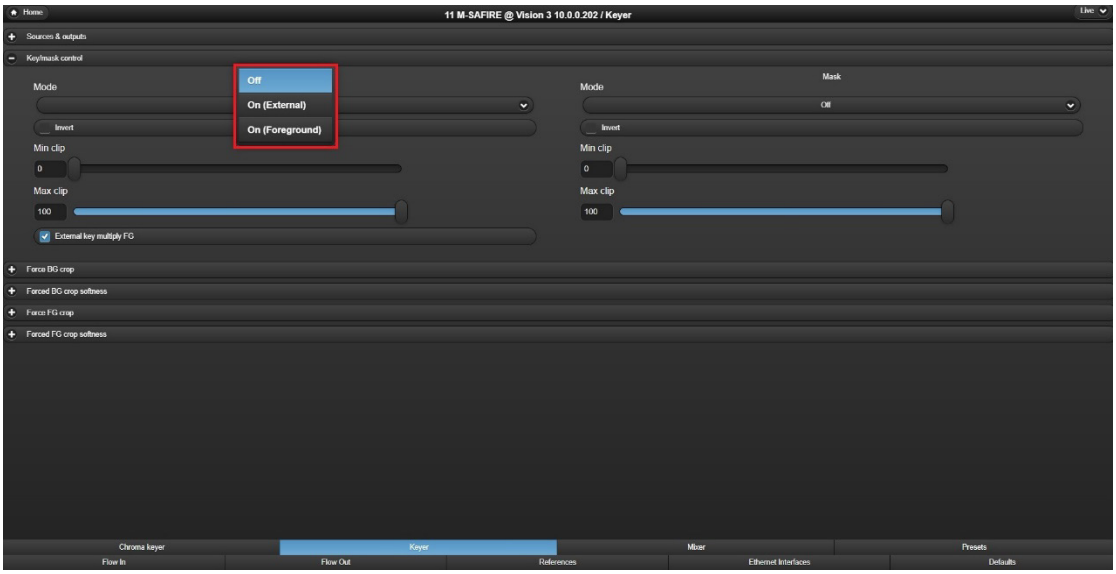


Main output signal processing selection

Key/mask control

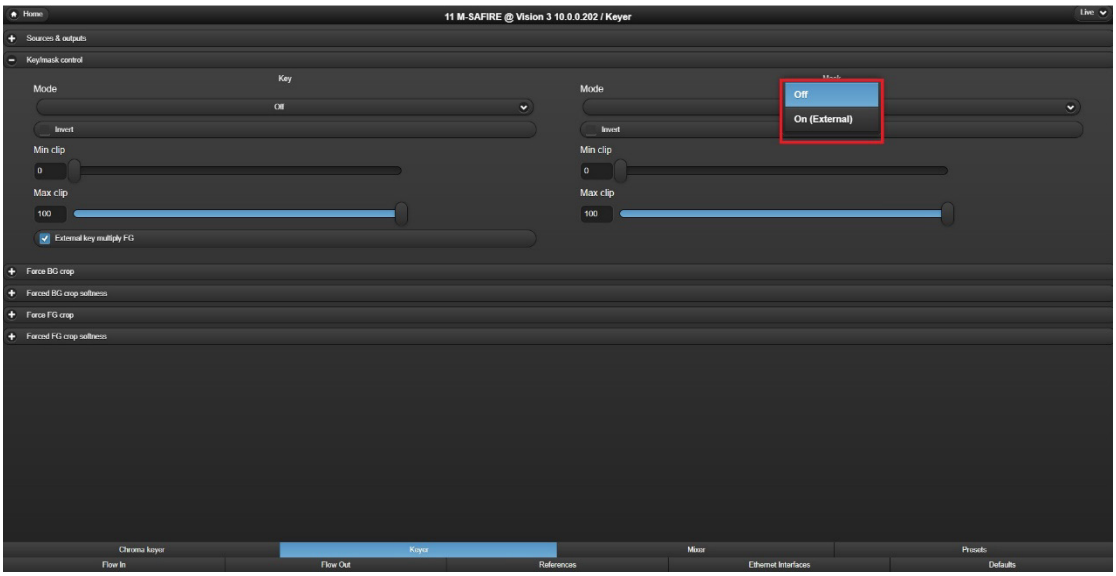
Use the Key/mask control menu to force either foreground objects or background into your composite chroma key based on the key/mask selected flow.

In Key mode, objects in the foreground will be forced and not subject to the chroma key suppression. An example of use would be a monitor in the foreground camera shot of a sports event. The green field would normally be subject to the chroma key and the unwanted background source would be added to the monitor. A key signal for the foreground object, the monitor, would result in the foreground video being forced into the composite image, thus the video on the monitor looking correct in the final composite.



M-SAFIRE key mode selection

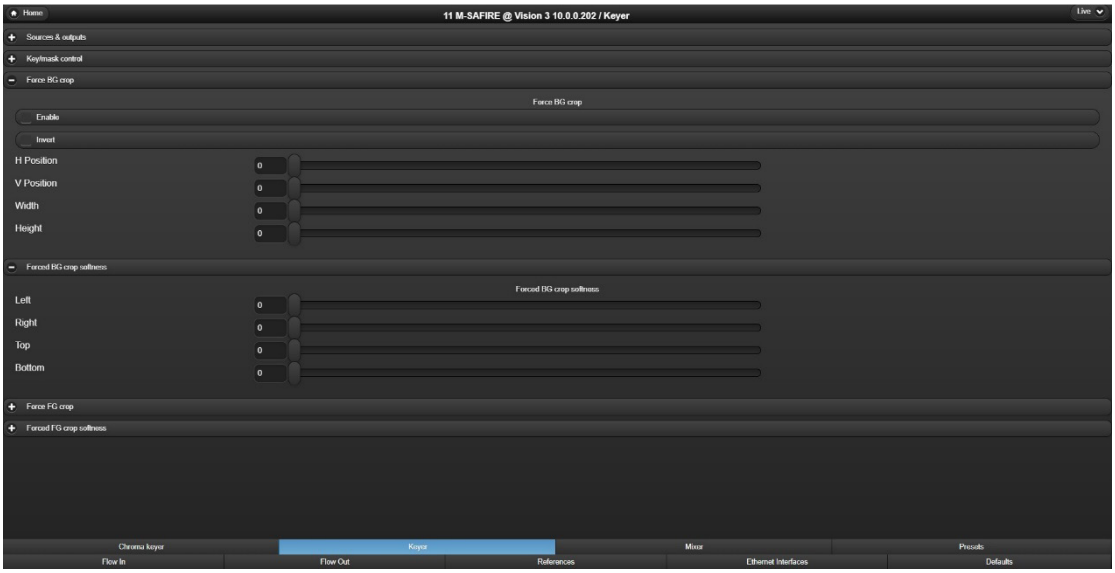
In mask mode, objects in the background will be forced based upon the source selected as the key/mask. A use example would be an area of the green screen that is missing or as an input garbage matte. The mask signal will allow for the background to fill that area.



M-SAFIRE mask mode selection

Internal forced foreground and background sources

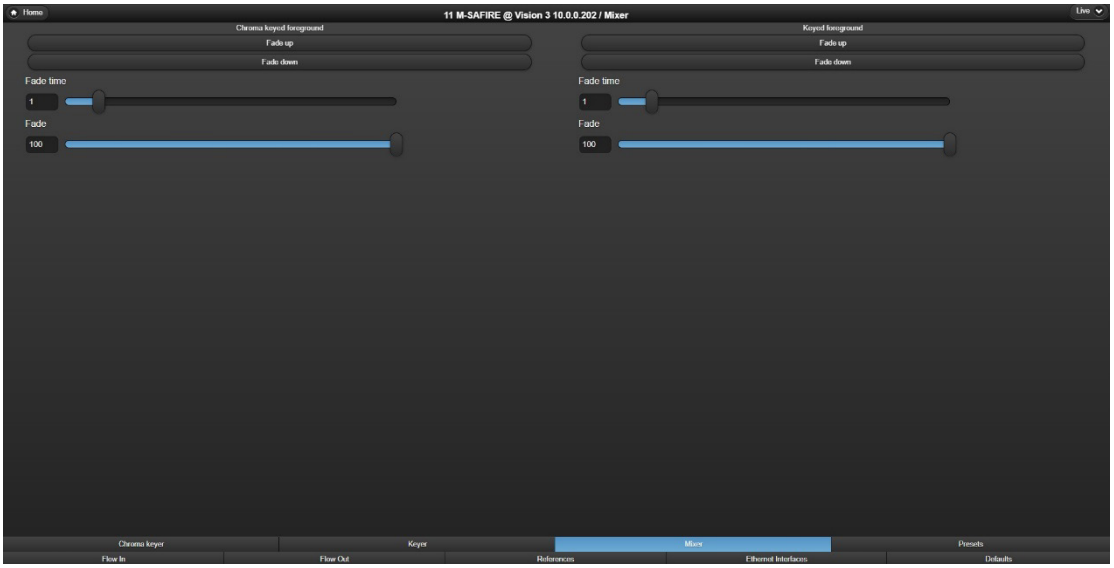
In addition to the external key/mask modes, M-SAFIRE has internal forced foreground and background crops with softness controls. Using the Force BG and Force FG controls it is possible to force areas of the foreground or background input sources. Use the crop controls to determine the size and position of the forced area. Use the softness controls to apply a soft edge to the forced area.



Force BG crop and softness controls

7.2 Mixer

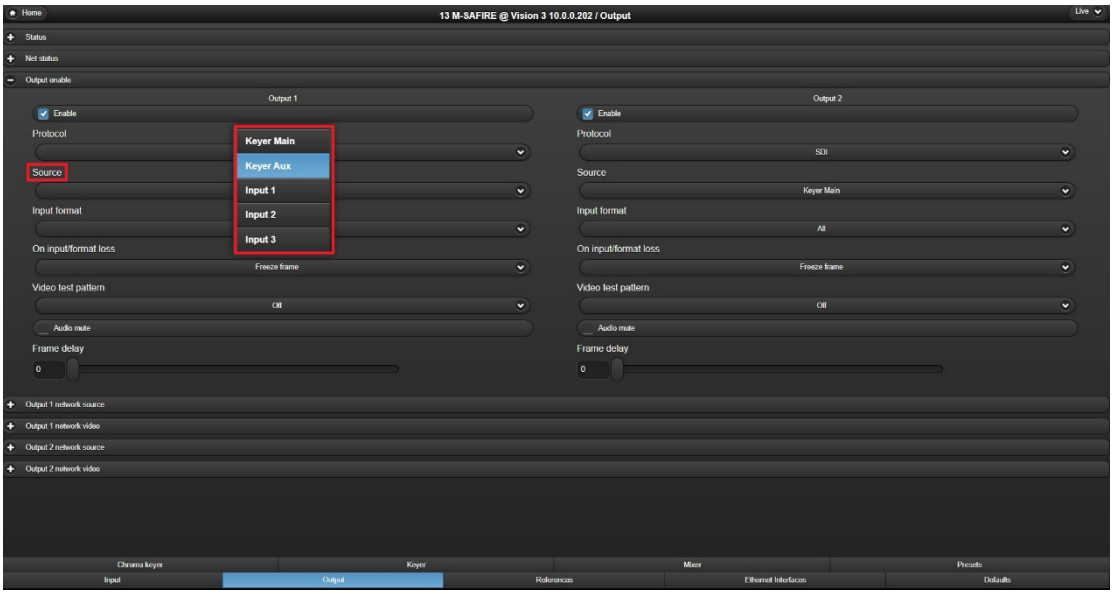
The chroma keyed foreground and keyed foreground have individual mixer controls. These mixers can be faded up and down using the fade buttons on the Mixer control tab. Fade time from 0 to 10 seconds can be set.



M-SAFIRE mixer controls

7.3 Output Routing

Outputs 1 and 2 can be independently routed to be Keyer Main, Keyer Aux, or any of the inputs. Keyer Main content is selected in the Keyer sources & outputs menu.



M-SAFIRE output source selection

8 References and Output Timing

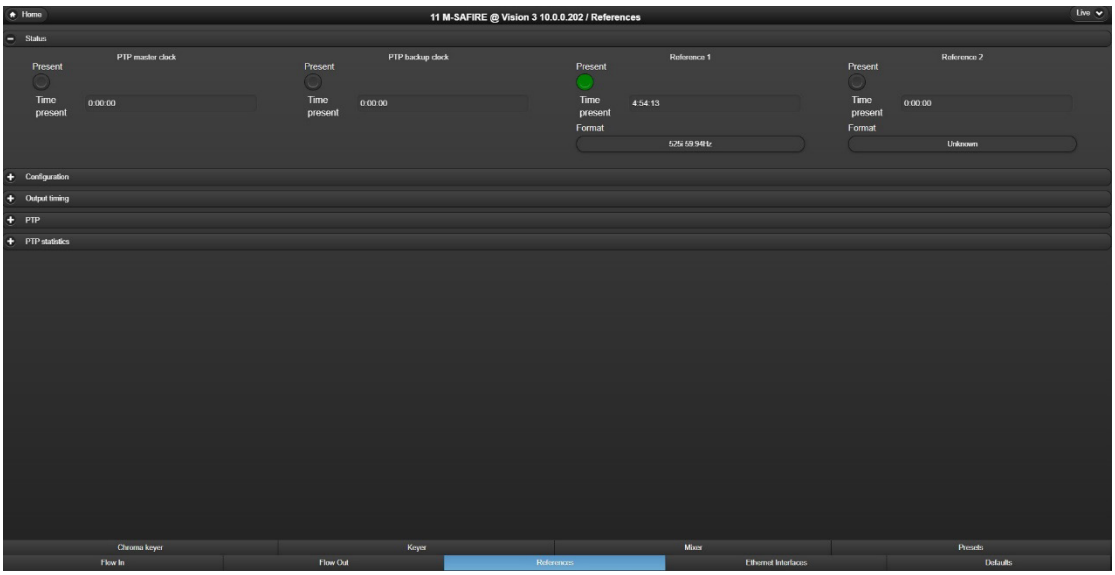
8.1 References

The M-SAFIRE flow output can be locked to a PTP clock, an analogue tri-level or Black & Burst sync or the SDI input if present and selected as the input protocol. If the chosen reference sources are absent at power up, the outputs will freerun to an internally generated clock.

Both outputs are locked to the same reference clock. It is not possible to lock different outputs to different clocks.

Inputs are not required to be the same frame rate as the chosen reference. It is possible, for example, to input 59.94Hz video locked to a 50Hz reference. However, frames will be dropped and repeated as necessary when cross-locking frame rates to maintain a valid output.

Status



Reference status

Reference & PTP clock Present LEDs: Green when present, otherwise off

Time present: Length of time input has been present

Reference 1 & 2 Format: Read only text showing reference format e.g. 525i 59.94Hz

Reference configuration

Reference Configuration

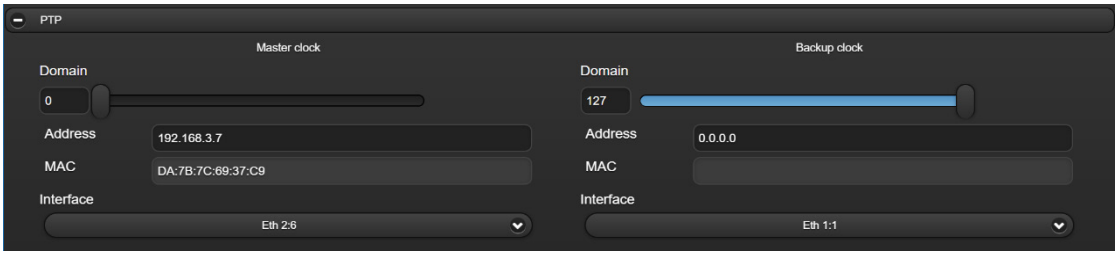
Reference source: Select priority order of reference source. Will automatically fail-over to next source in list if priority source missing

Auto relock enable: Automatically relocks to priority reference source upon its return

Active source: Read only text showing which reference source is in use

Force relock: Returns to priority reference source if auto relock is not enabled

PTP Configuration



PTP Configuration

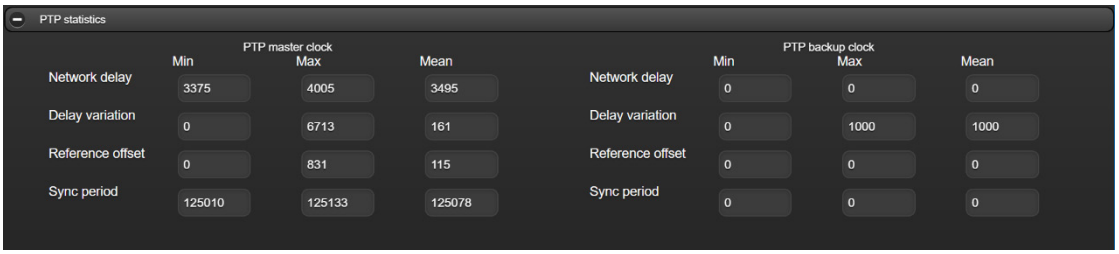
Domain: Domain number of the PTP clock

Address: Source IP address of the master and backup PTP clocks

MAC: Read only text showing the MAC address of the PTP clocks

Interface: Ethernet interface chosen to receive the PTP clock. The interface chosen must be configured for the same IP range and as the PTP clock

PTP Statistics



PTP statistics

Network delay: Calculated delay between MARBLE-V1 card and the master PTP clock. Expected to be small if network switch is PTP-aware, otherwise will reflect number of switches between MARBLE-V1 card and the master PTP source

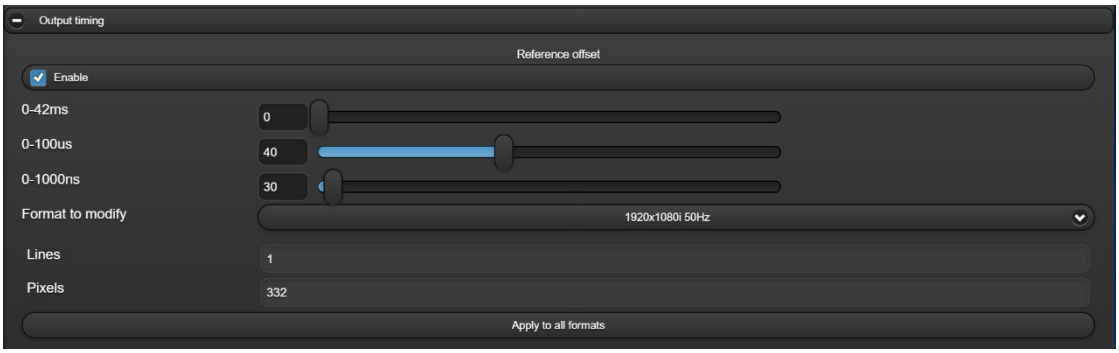
Delay variation: Indicates system noise and how accurately MARBLE-V1 can lock. For example, to lock within 500ns, the delay variation should be less than 500ns

Reference offset: Offset between MARBLE-V1 card and master PTP clock. Expected to be less than 500ns

Sync Period: How often the PTP sync packets are seen. Indicates whether the master PTP clock is configured correctly, e.g. 8 packets a second, and whether there are any packets missing which could indicate a network issue

8.2 Output timing

The output timing controls adjust the offset delay of all outputs relative to the chosen reference source. All outputs are locked to the same reference source, it is not possible to offset each output individually. However, the offset can be set per video format, allowing for example, different output timing for HD and SD signals. If the input to chosen reference timing is close enough to fall below the card's minimum processing delay, a one frame delay will be applied. The output timing controls are sub-frame time based (ms and us). Status is provided for the equivalent lines and pixels delay.



Output timing

Output Timing

Enable: Select to enable the output timing controls. Minimum possible delay applied when deselected

Time adjustment sliders: Sub-frame adjustment of output timing relative to reference source

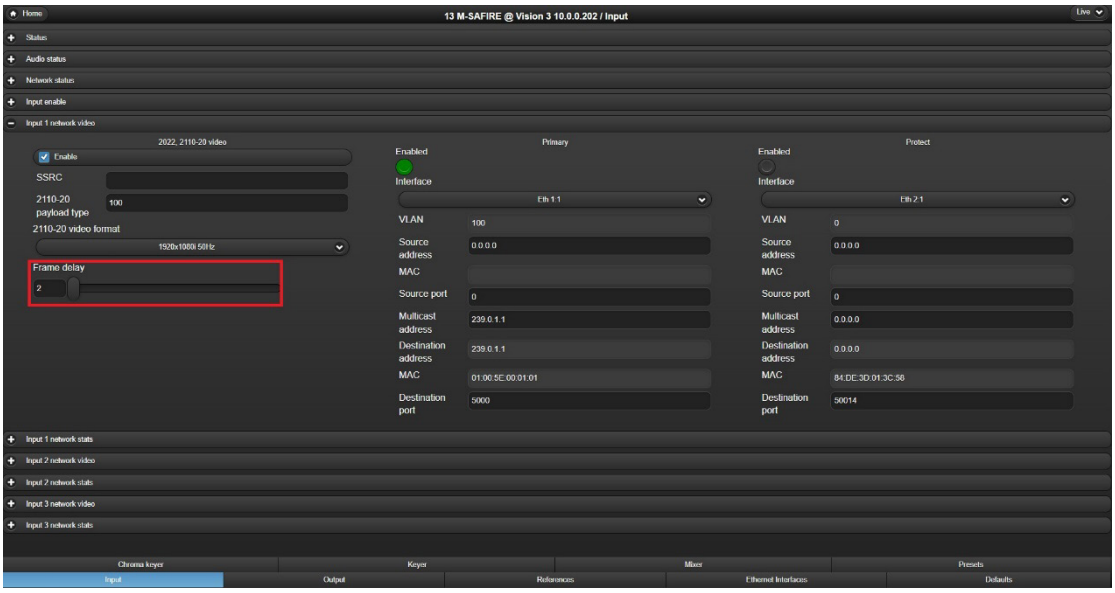
Format to modify: Independently adjust output timing for each video format

Apply to all formats: Select to apply the output timing adjustment to all video formats

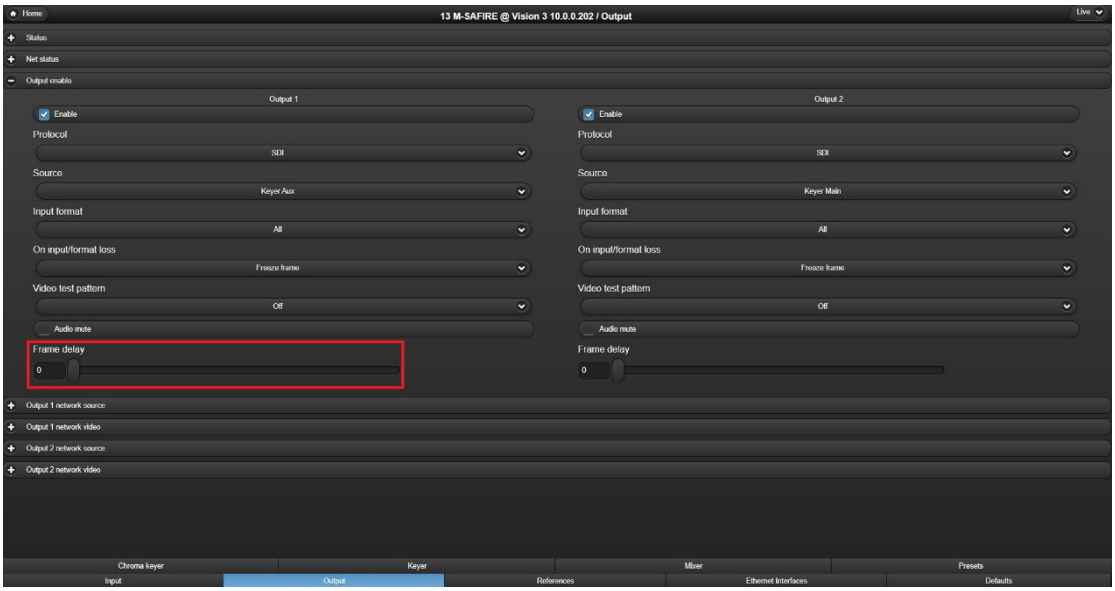
Lines/Pixel: Read only status of the output timing in equivalent lines and pixels

8.3 Frame delay

Up to ten frames of delay adjustable in one frame steps can be applied to each input and output flow. The minimum processing delay through M-SAFIRE is two frames, therefore the input flow frame delays cannot be set lower than this value.



Input 1 network video frame delay



Output enable frame delay

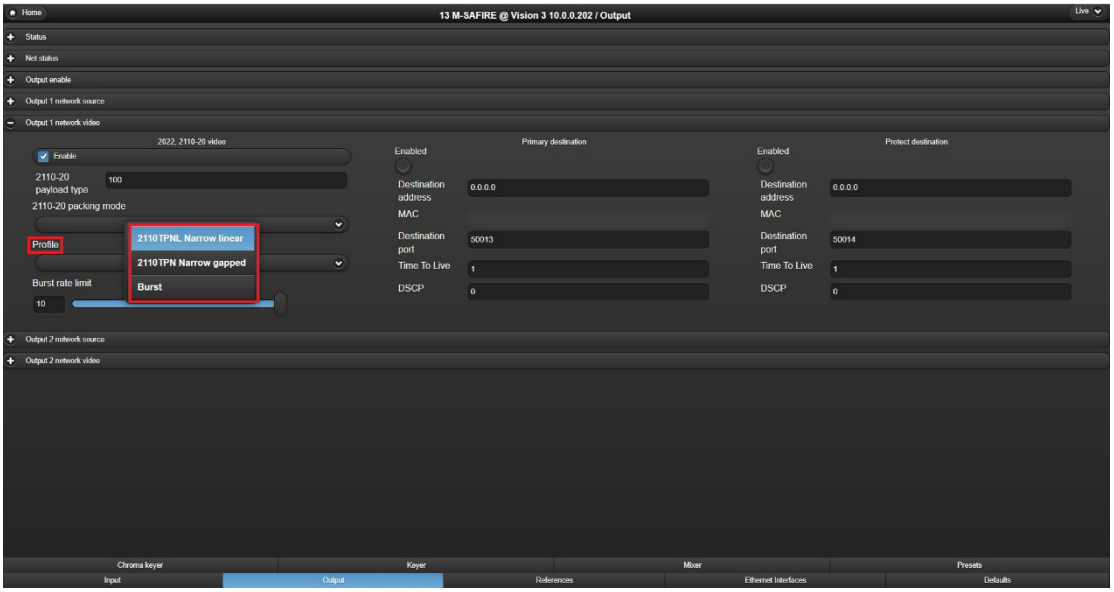
9 Traffic Shaping Profile

9.1 Traffic Shaping Profiles

SMPTE ST 2022 transmits using a narrow linear profile, with all packets evenly spaced throughout the duration of each entire traditional corresponding SDI video frame.

SMPTE ST 2110-20 supports both narrow linear (TPNL) and narrow gapped (TPN) transmission. As per SMPTE ST 2022 transmission, TPNL transmits the packets evenly spaced throughout the duration of each entire video frame but starting one line after the first Start-of-Frame (SOF) VANC period. TPN, however, does not transmit packets during the VBI or VANC period of the traditional corresponding SDI video frame.

For both SMPTE ST 2022 and ST 2110-20 protocols it is possible to ‘burst’ the packets out as fast as possible, using the ‘Burst rate limit’ control to determine the maximum bandwidth the burst traffic will limit to.



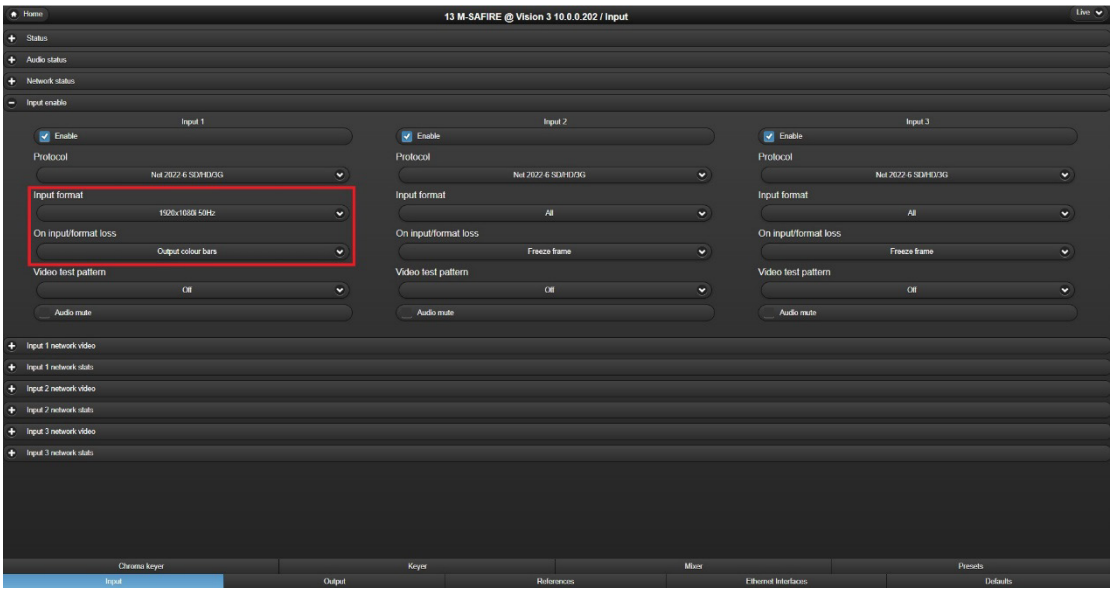
Output 1 network video profile selection

10 Input Format, Input Loss and Test Pattern Options

10.1 Input Format and On Loss of Input

All apps provide an Input Format control. If set to ‘All’, any input format present is deemed valid. If set to a single format, any input format present which does not match the selected format is deemed invalid, upon which the ‘On input/format loss’ function is triggered.

In the example below, if the source input format is not 1920x1080i 50Hz, the output will be replaced with colour bars.



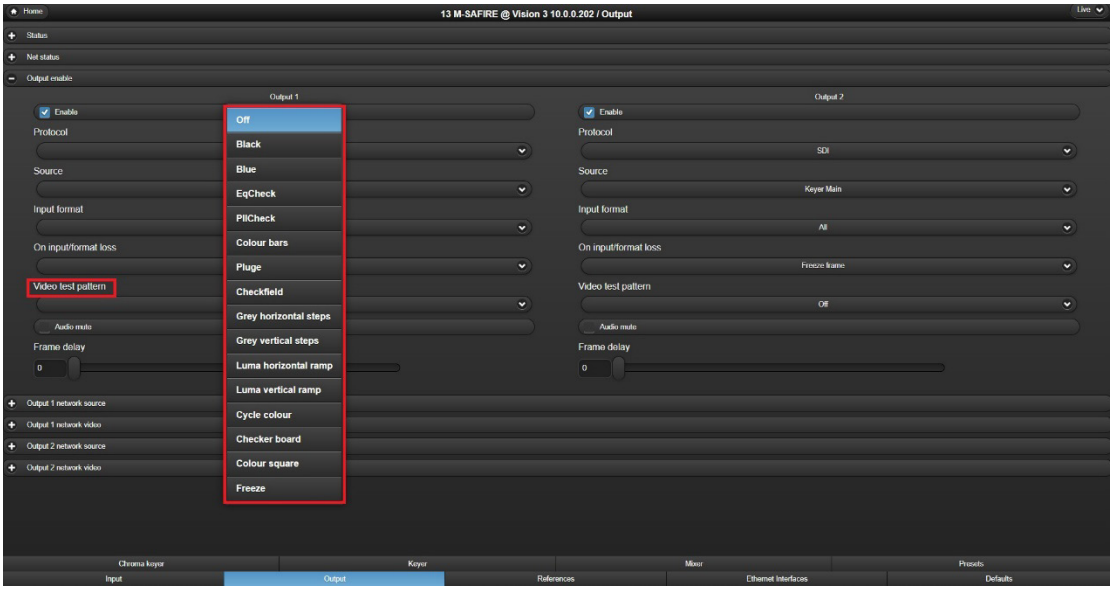
Input enable format and on loss options

Apps which combine multiple input flows to produce an output, such as picture-in-picture and keying apps, feature ‘On input/format loss’ functions at both the input and output stage. Enabling at the input stage provides protection prior to the the app specific video processing block. For example, if Input 1 is the background source for M-SAFIRE, this could be replaced with colour bars if the signal is lost or the incorrect format.

If the inputs are set to ‘No output’ upon input/format loss, this could result in no output from the app specific video processing block. Should this occur the output input/format loss options can be used to provide an output failover option e.g. colour bars.

10.2 Internal Test Patterns

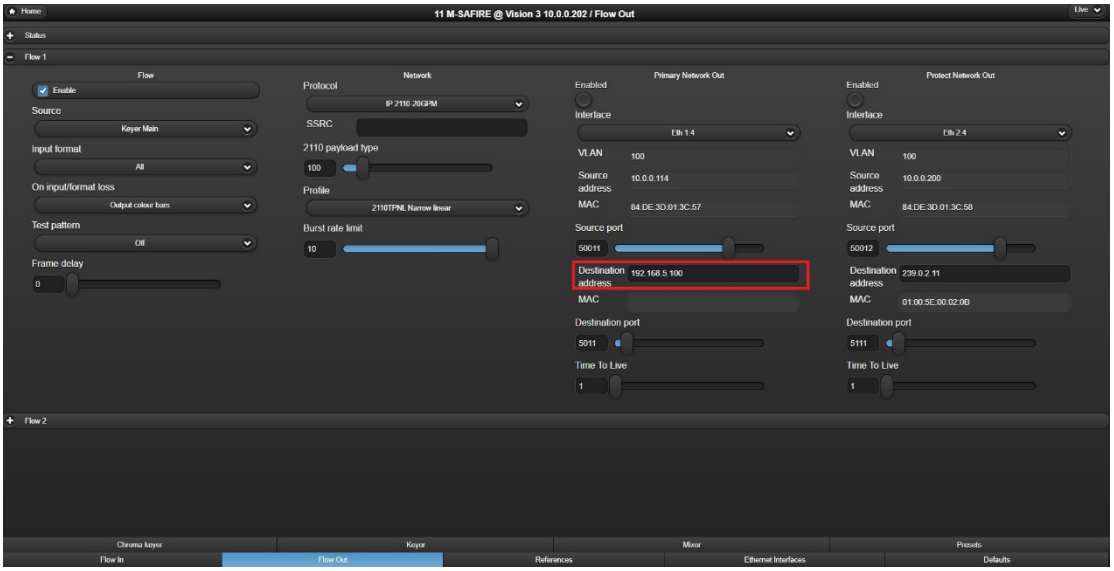
The following internal test patterns are provided for all inputs and outputs which, when enabled, replace the video content with the selected test pattern.



Output enable test pattern selection

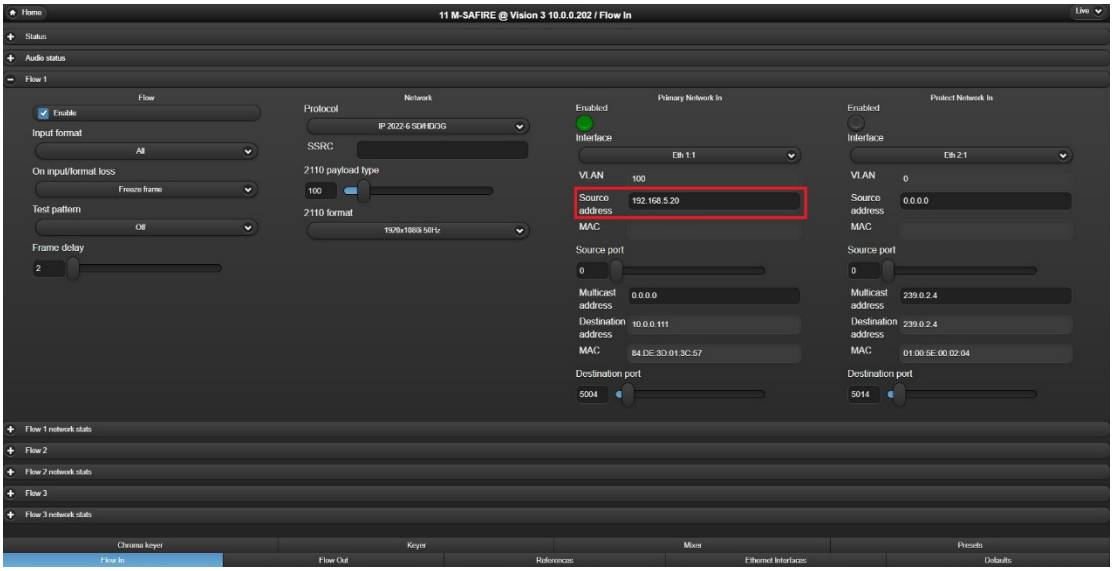
11 Unicast Flow Configuration

To transmit a unicast flow, the Flow Out ‘Destination address’ should be the IP address of the downstream Ethernet Interface you want to transmit to. The example below shows that rather than transmitting using a multicast address, interface 1:4 on the M-SAFIRE is now set to transmit the flow to a downstream device with IP address 192.168.5.100.



Unicast IP Address transmit

When receiving a unicast flow, the input ‘Multicast address’ should be set to 0.0.0.0. The input ‘Source address’ can be one of two options. If set to 0.0.0.0 it will accept any source transmitting to its virtual interface IP address. This is acceptable if it is known only one device at a time will be transmitting to it. Alternatively the ‘Source address’ can be limited to only receive from one IP address, as shown in the example below, where the source address is limited to only receiving traffic from a device with IP Address 192.168.5.20.



Unicast IP Address receive

12 Basic Trouble Shooting

12.1 No input or output signals present

- Confirm using GUI status LEDs whether the problem is input or output related
- Check SDI and fibre cabling
- Check that inputs are enabled (off by default)
- Check that outputs are enabled (off by default)
- Check correct flow protocol has been selected
- Check flow parameters (protocol type, IP address, VLANs, ports etc.) are configured correctly
- Check Ethernet Interface IP parameters are configured correctly
- Check Ethernet Interface link present LED is illuminated on GUI
- Check network switch ports are configured for trunk mode and not access mode (access mode sends untagged packets which MARBLE-V1 will ignore)

12.2 Errors in the IP flow's video content

- Check the 'Ignored packets' count on the Ethernet Interfaces tab of GUI is incrementing in no more than values of 10s. Incrementing in values of 100s indicates a network flooding problem
- Check the 'Ignored multicast' LED on the Ethernet Interfaces tab of GUI is not illuminated. If illuminated, this indicates multicast packets are being flooded to the card's Ethernet Interface port, a likely cause of which is incorrectly configured IGMP on the network switch
- Check flow in network status for lost or duplicate packets. Check maximum gap is less than 12000ns (0.012us). Larger gaps could indicate bursts in the IP packets

12.3 IP flows keep stopping after a few minutes

- Check IGMP is enabled and correctly configured on the network switch

13 Specification

M-SAFIRE APP RUNNING ON MARBLE-V1 MEDIA PROCESSOR

MECHANICAL

'Double slot' Vision card 96mm x 303mm (96mm x 325mm including finger pull)
Weight: 355g
Power consumption: 25 Watts, plus 1 Watt for each SFP+ fitted to MARBLE-V1

INPUT AND OUTPUTS

Inputs can be IP and/or SDI
Outputs can be IP and/or SDI
Five BNCs for SDI and up to four fibre SFP+ 10GbE IP network interfaces. Choice of fibre modules: either 850nm multi-mode (for up to 300m) or 1310nm single-mode (for up to 10km)
Inputs and outputs can be mixture of ST 2022 and ST 2110. Video can be passed between ST 2022 and ST 2110, although audio and any other non-video data will be lost
IP only, SDI to IP and IP to SDI applications require at least one SFP+ transceiver option, up to a maximum of four. Use one SFP+ to put all signals together, use two SFP+ to have main and protect or multicast and unicast on separate network interfaces and use three or four SFP+ to further separate flows
Uses VR04, VR06 or VR07 frame rear modules. VR04 or VR07 must be used when more than two SFP+ are fitted

SDI VIDEO INPUTS

(NB. Some or all of the inputs can be IP instead)
Up to three 3Gb/s or HD or SD SDI inputs
270Mb/s or 1.5Gb/s or 3Gb/s serial compliant to SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A
3Gb/s cable equalisation up to 100m using Belden 1694A. HD cable equalisation up to 140m with Belden 1694A or equivalent (approx. 100m with Belden 8281). SD cable equalisation >250m Belden 8281 or equivalent

IP FLOW INPUTS

(NB. Some or all of the inputs can be SDI instead)
Up to three 3Gb/s or HD or SD video over IP inputs
Packet distribution is not important as variable input buffer will compensate for any timing irregularities. Any traffic shaping option from ST 2110-21 can be used, or packets can come from a device which does not meet the shaping requirement of ST 2110-21
A protect input for SMPTE ST 2022-7 seamless protection switching or the equivalent protect input in ST 2110-20 can come from any of the 10GbE IP network interfaces. This protects the stream from lost packets by creating two streams of the same data using different routing to the destination. Flow analyser handles the analysis and reconstruction of the protected stream. Any IP input can come from any of the 10GbE IP network interfaces and can either be multicast or unicast

SDI VIDEO OUTPUTS

(NB. Some or all of the outputs can be IP instead)
Up to two 3Gb/s or HD or SD SDI outputs
270Mb/s or 1.5Gb/s or 3Gb/s serial compliant to SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A

IP FLOW OUTPUTS

(NB. Some or all of the outputs can be SDI instead)
Up to two 3Gb/s or HD or SD video over IP outputs
Any of the 10GbE IP network interfaces can be used to provide a protected output for SMPTE ST 2022-7 or ST 2110 seamless protection switching, which protects the stream from lost packets by creating two streams of the same data using different routing to the destination
Alternatively it is possible to have a unicast on some network interfaces and a multicast on others

RELAY BYPASS PROTECTION (SDI ONLY)

The VR07 frame rear module provides dual relay bypass protection when M-SAFIRE is used with both SDI inputs and SDI outputs
The relay bypass protection protects the video output on frame power failure or if the MARBLE-V1 card loses power or is removed
An electromechanical relay switch on the VR07 needs power to hold the switch in one state and will revert to the other state (card bypass) on loss of power. It prevents signal loss by mechanically connecting an SDI input to an SDI output: SDI In 1 is connected to SDI Out 1 and SDI In 2 is connected to SDI Out 2
NB. Use of the VR07 requires issue 5 or later of MARBLE-V1

VIDEO FORMATS SUPPORTED

The video formats supported are 625i, 525i, 720p50, 720p59.94, 720p60, 1080i50, 1080i59.94, 1080i60, 1080p23.98, 1080p24, 1080p25, 1080p29.97, 1080p30, 1080p50, 1080p59.94, 1080p60, 1080PsF23.98, 1080PsF24, 1080PsF25, 1080PsF29.97, 1080PsF30, 2048x1080p23.98*, 2048x1080p24*, 2048x1080p25*, 2048x1080p29.97*, 2048x1080p30*, 2048x1080PsF23.98*, 2048x1080PsF24*, 2048x1080PsF25*, 2048x1080PsF29.97*, 2048x1080PsF30* (*= YUV 4:2:2 10 bit)

IP PROTOCOLS

Protocols supported on network interfaces: SMPTE ST 2022-6, SMPTE ST 2022-7, SMPTE ST 2110-20 (uncompressed video), SMPTE ST 2110-10 (system architecture and synchronisation), SMPTE ST 2110-21 (traffic shaping), IGMPv3, ARP, ICMP ping, IPv4, IEEE802.1q, VLAN, IEEE802.3-2012 (10G Ethernet), LLDP
Packing options of the ST 2110 output are selectable per flow between BPM and GPM (Block Packing Mode or General Packing Mode)
Packet shaping and distribution (compulsory in ST 2110 and optional in ST 2022) is selectable per flow between TPNL and TPN (narrow linear or narrow gapped packet distribution). There is also a mode for burst packet distribution with a control for the burst rate limit. This is for connecting between Crystal Vision and other compatible devices that allow for a reduced transmission delay
SMPTE ST 2022-7 and ST 2110 flow protection facilitates the dual stream output

KEYER SOURCES AND OUTPUTS

Background source can be set to Flow in 1 or Flow in 2 or Flow in 3 or Matte
Foreground source can be set to Flow in 1 or Flow in 2 or Flow in 3
External key/mask source can be set to Flow in 1 or Flow in 2 or Flow in 3
Keyer Aux Output shows processed Output video only
Keyer Main Output can be set to show processed Output video, Output key, External key source, Output key inverted, Foreground source, Background source, Keyed foreground, Keyed background, Suppressed Foreground, Output video/Output key/External key source/Suppressed foreground quad split or Output video/Output key/Keyed foreground/Keyed background quad split
The quad split options are useful for checking details during configuration and allow close inspection of the adjustments to the key across the picture. Controls are Quad zoom (0-100%), Quad H position and Quad V position. The single set of controls are applied to all four quads. Zoom of 0% shows the entire images in the quads and zoom of 100% expands a single pixel to fill each quad. When the image is expanded, the position controls define the area of the image to be displayed

INTERNAL MATTE GENERATOR

The keyer background source can be replaced with a colour produced by an internal matte generator

CHROMA KEY ADJUSTMENTS

The Chroma key menu is used to set up the chroma keyer functions
M-SAFIRE allows the user to set both the colour and saturation range of the area to be suppressed and background inserted
Enable: Enables/disables chroma key processing
Saturation: Sets the saturation level of the foreground area to create the key. Range is 0-100
Saturation acceptance: Sets a range of saturation that will be used to create the final key and can be used to fine-tune adjustments. Range is 0-100
Hue: Sets the colour in the foreground to be used to create the key signal. Range is 0-360
Hue acceptance: Sets the range of colours that the Hue colour will use to create the key signal and can be used to fine-tune adjustments. Range is 0-180
Min clip: Increase to force lower key levels to zero for when small amounts of key level remain in foreground object areas causing breakthrough of the new background. Range is 0-100. Does not affect Max clip levels
Max clip: Reduce the Max clip level value to force variations in key level to full key value by amplifying and clipping. Range is 0-100. Does not affect Min clip levels
Main output: The source for the Main output can also be selected from the Chroma key menu (see KEYER SOURCES AND OUTPUTS for full details)

FOREGROUND SPILL SUPPRESSION

The FG spill suppression menu assists in removing any areas where colour spill from the backdrop on foreground objects is causing unwanted keying of the background or is causing backdrop colour tints on foreground objects
Mode: Use Chroma key settings (default) uses the same settings from the Chroma key menu to set all the spill suppression parameters. Enabled activates the Saturation, Saturation acceptance, Hue and Hue acceptance settings set in the Spill suppression menu

BACKDROP LIGHTING AND SHADOW PROCESSING

The Backdrop lighting control provides quadrant gain control to assist in poorly lit or variably lit backdrops

Enable: Enables/disables all controls in this menu

There are four quadrant gain controls – Left, Right, Top and Bottom – which can be adjusted to produce an even key in the left, right, top and bottom areas of the image

Radial is an overall lighting spotlight control. Increasing lowers overall gain, decreasing increases overall gain

The Backdrop lighting menu also contains the Shadow density control for enhancing or rejecting natural occurring shadows on the backdrop. Range -100 to 100. Increasing enhances shadows, decreasing rejects shadows

EDGES AND KEY REMOVAL

Edge shrink control is used for softening and cleaning up edges on foreground objects. Range is 0-100. Increasing value reduces created key while simultaneously softening the edge

Chroma key removal controls can attenuate the created key signals in areas of foreground in dark and light luminance levels. 'Dark FG areas' control (range 0-100) is available for low luminance objects in the foreground that are suffering from unwanted background keying. 'Light FG areas' control (range 0-100) is available for high luminance objects in the foreground that are suffering from unwanted background keying. Enable the 'Add contrast' control to add additional contrast into the areas forced by Dark and Light FG areas controls

FOREGROUND RE-SPILL

Foreground re-spill can be used to throw a new spill colour back on to the suppressed foreground in situations requiring a false spill effect for a more natural composite picture

Percentages (0-100%) of red, green and blue in re-spill colour can be set, while Gain setting controls amount of re-spill applied to composited image

COLOUR CORRECTION

Pre-key FG colour allows correction to the RGB lift of the foreground signal before keying. These red, green and blue controls (each with a range of -20 to 20) can be used to compensate for any colour loss from high levels of spill suppression

Post-key FG colour allows correction to the RGB lift and gain colour correction of the foreground signal after keying. Controls are Red gain (range 80-120%), Green gain (range 80-120%), Blue gain (range 80-120%), Red lift (range -20 to 20%), Green lift (range -20 to 20%) and Blue lift (range -20 to 20%)

Post-key gain & lift adjusts the keyed foreground and background signals to achieve a more realistic composite. Controls are Foreground chroma gain (range 80-120%), Foreground video gain (range 80-120%,), Foreground Y lift (range -20 to 20%), Background chroma gain (range 80-120%,), Background video gain (range 80-120%) and Background Y lift (range -20 to 20%)

KEY AND MASK CONTROL

The Key/mask control menu is used to force either foreground objects or background into the composite chroma key

In Key mode, objects in the foreground will be forced using the key signal luminance and will not be subject to the chroma key suppression. 'On (External)' uses the external key input to

generate the key. ‘On (Foreground)’ uses the luminance in the foreground input to generate the key
When Mask mode is set to 'On (External)', objects in the background will be forced based upon the luminance of the external source selected as the key/mask
The key and mask can be inverted
Key processing is multiplicative by default. For additive keying, untick the External key multiply FG box
The Min Clip and Max Clip controls can be used to increase or reduce transparency in the key or mask

INTERNAL MASKS

Two internal masks can be turned on or off to force areas of foreground and background
The masks can be inverted and adjusted in position and size
Edge softness controls prevent hard edge on mask, with each edge individually selectable
The internal masks are independent of the external mask and can be used at the same time if required

MIXER

Chroma keyed foreground and keyed foreground can be faded up or down as a timed transition, with fade time set from 0-10 seconds
Fade level can be manually adjusted between 0% and 100%

ROUTING

The keyer processing block provides a Keyer Main and Keyer Aux output. The aux output shows the final result of the keyer processing (output video), whereas the main output can show different stages of processing (see KEYER SOURCES AND OUTPUTS section)
The flow output routing allows selection between Keyer Main and Keyer Aux for each of the two flow outputs. For example, Flow Out 1 could be set to Keyer Aux and therefore display the final output video of the keyer processing, whereas setting Flow Out 2 to Keyer Main allows this output to be used to preview different stages of the keyer processing. Additionally the Flow Out routing can be set to any of the three input flows

VIDEO LOSS CONTROLS

The video loss/format mismatch controls – available at both the input and output stages – allow the user to select what will happen to a flow in the event that the video is lost or the video format does not match the specified format. The user can specify to freeze the last good frame or show a black or blue screen or 100% colour bars (with or without an initial delay of three seconds). No output can also be selected. This is independently adjustable on each flow

TEST PATTERNS

The test pattern controls allow the user to override an input and force the output flow to output a test pattern including Colour Bars, Blue, Black, EqCheck, PllCheck, Pluge, Checkfield, Grey Horizontal Steps, Grey Vertical Steps, Luma Horizontal Ramp, Luma Vertical Ramp, Cycle Colour or Checker Board, or to freeze the picture. This is independently adjustable on each flow

AUDIO MUTE CONTROL

The input audio mute control allows you to control whether the audio from the SDI or ST 2022 input is passed through when a test pattern is enabled

SYNCHRONISER AND TIMING ADJUSTMENTS

Video sources are synchronised to common reference timing source

Choice of timing options:

- PTP (SMPTE ST 2059-2) master and backup, via 10GbE IP network interface
- Two tri-level syncs or analogue Black and Burst references (Reference 1 and Reference 2), connected via the Vision 3 frame
- SDI video input, where available (defaults to SDI 1)

Chosen reference is the global reference source for all inputs and outputs

There are up to ten options for the reference selection, selectable via VisionWeb. The hierarchy runs from left to right – should the timing source at the top of the list become missing or invalid, the app will move down the list until it finds a valid timing reference source. When used with IP inputs, the SDI reference option is not applicable and therefore the reference will move to the next valid timing source:

- PTP>Ref1>Ref2>Hold
- PTP>Ref1>Hold
- PTP>Ref2>Ref1>Hold
- PTP>Ref2>Hold
- PTP>Hold
- PTP>Ref1>Ref2>SDI>Hold
- PTP>Ref1>SDI>Hold
- PTP>Ref2>Ref1>SDI>Hold
- PTP>Ref2>SDI>Hold
- PTP>SDI>Hold

(“PTP” means PTP Master>PTP Backup. “SDI” means SDI1>SDI2>SDI3>SDI4>SDI5 >SDI6, dependent on number of SDI available. “Hold” means it will hold the timing of the last good reference)

When using video reference, video inputs can be different formats but only inputs with the same frame rate as reference video will be locked to that reference. Input signals of same frame rate as reference will be locked together and locked to external reference. Inputs with a differing frame rate will be locked and maintain timing with no drift, but their sync point will be undefined (all same frame rate signals will, however, be locked to each other)

When using PTP reference, input sources of different format and/or frame rate will all be correctly locked to the PTP reference

PTP timing reference should be used when there is a ST 2110-20 output to ensure the RTP timestamp is related to the time of day. However without a PTP reference, a valid ST 2110-20 signal will still be generated using a free running RTP timestamp

When Auto relock enable is selected, the card will automatically relock when a lost reference is restored. Selecting Force lock (with Auto relock disabled) will force the synchroniser to relock after a reference is restored, and can be activated at a non-critical time to avoid video disturbance

Minimum flow input delay is two frames which equates to the minimum processing delay. Eight additional frames of flow input video delay (adjustable in one frame steps) allows delay compensation between the input sources

Output timing can be fully adjusted with respect to the reference using three time-based controls: 0 - 42ms adjustable in 0.1ms steps, 0 - 100us adjustable in 1us steps and 0 - 1us adjustable in 5ns steps. Sub frame timing alignment to chosen reference is global to all outputs
Ten frames of flow output video delay (adjustable in one frame steps) allows compensation for any big system delays. This delay can be configured individually for each SDI output or IP output flow

ANCILLARY DATA
All ancillary data (including audio and locked Dolby E) is passed from SDI or ST 2022 input to SDI or ST 2022 output. When ST 2110 input or output is selected, all ancillary data is discarded

LED INDICATION OF:
Power okay

PRESETS
The current app settings can be saved in one of 16 locations to be recalled as required

SIGNAL MONITORING
Comprehensive SDI, IP and PTP monitoring information is available and can be used to generate SNMP traps
Checks can be performed on the following video and audio parameters:

- Video present and time present
- Video format
- Video black
- Video frozen
- Video error
- Audio group 1 present
- Audio group 2 present
- Audio group 3 present
- Audio group 4 present
- Audio present on group 1 channel 1
- Audio present on group 1 channel 2
- Audio present on group 1 channel 3
- Audio present on group 1 channel 4
- Audio present on group 2 channel 5
- Audio present on group 2 channel 6
- Audio present on group 2 channel 7
- Audio present on group 2 channel 8
- Audio present on group 3 channel 9
- Audio present on group 3 channel 10
- Audio present on group 3 channel 11
- Audio present on group 3 channel 12
- Audio present on group 4 channel 13
- Audio present on group 4 channel 14
- Audio present on group 4 channel 15
- Audio present on group 4 channel 16

- Silence group 1 channel 1
- Silence group 1 channel 2
- Silence group 1 channel 3
- Silence group 1 channel 4
- Silence group 2 channel 5
- Silence group 2 channel 6
- Silence group 2 channel 7
- Silence group 2 channel 8
- Silence group 3 channel 9
- Silence group 3 channel 10
- Silence group 3 channel 11
- Silence group 3 channel 12
- Silence group 4 channel 13
- Silence group 4 channel 14
- Silence group 4 channel 15
- Silence group 4 channel 16

Black or frozen video will be indicated by an amber LED. This alert can be delayed by 1-120 seconds to prevent false warnings during brief video pauses

The audio silence alert is triggered at an audio level of -93dbFS and can be delayed by 1-120 seconds to prevent false warnings during quiet audio periods

The following IP parameters are monitored for input flows:

- Network error
- Packet loss
- Duplicated packets
- Packet delay variation. Shown as the skew (difference in time of packet arrival) between the main and protected input, and also as the min and max nano second gap between the packets on each input

The Ethernet interfaces are monitored for:

- Count of packets ignored by the app (general network traffic non-media packets, which do not require processing by the app). Jumps in 100 step increments indicate network traffic flood
- Ignored multicast packets. LED indicates multicast traffic not requested by the app is present on the Ethernet Interface, indicating incorrectly configured IGMP at the network switch

References are monitored for:

- Reference 1 and 2 present and time present
- Reference 1 and 2 format
- PTP master and backup clock present and time present
- PTP statistics – network delay, delay variation, reference offset and sync period

REMOTE CONTROL

Software:

VisionWeb Control is available via the web server on the frame and allows control and monitoring using a standard web browser on a computer, tablet or phone

SNMP monitoring and control available as standard

Control using ASCII and JSON protocols

Hardware:

Control from integrated control panel on Vision 3 frame

Control from VisionPanel 3U remote panel

SBB-4 smart button box connects to the frame via Ethernet and provides four programmable LCD switches (which are configured for each order). The SBB-4 uses information from VisionWeb for settings. Uses Power over Ethernet so must be used with PoE enabled switch