USER MANUAL

Vision SYSTEM

M-SAFESWITCH-2

and

M-SAFESWITCH-2L

IP/SDI dual channel 2 x 1 fail-safe routing switches

Crystal Vision

Crystal Vision Ltd., Lion Technology Park, Station Road East, Whittlesford, Cambridge, CB22 4WL, England.
Tel: +44(0) 1223 497049 sales@crystalvision.tv www.crystalvision.tv

Contents

Revision 1	Added new features: 60 frames additional Source B delay, switch tolerance and third output.	27/01/21
Revision 2	Updated block diagram and specs to clarify only two inputs available when used with 3Gb/s.	19/02/21
Revision 3	Added M-SAFESWITCH-2L version. Added VR07 relay bypass.	13/04/21
Revision 4	User interface screen shots updated to align with V2.3 MARBLE-V1 and V1.19 Vision 3 software releases. Added new audio switching, audio monitoring and audio mute features. Added new preset features. Updated use of flow terminology.	21/07/22

1 Introduction

M-SAFESWITCH-2 and M-SAFESWITCH-2L are 3G/HD/SD-SDI intelligent dual clean switch software apps that run on the MARBLE-V1 media processor – purpose-built GPU/CPU hardware that fits in the Vision frame. Featuring two independent 2x1 switches, source A to B switching can be triggered automatically based upon user configurable input fault conditions, or manually – useful for planned maintenance on the primary programme channel.

Like all MARBLE-V1 video processing software apps, the M-SAFESWITCH-2 and M-SAFESWITCH-2L 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).

The M-SAFESWITCH-2 and M-SAFESWITCH-2L will be referred to collectively as M-SAFESWITCH-2/2L throughout this manual.

M-SAFESWITCH-2:

- Dual 2x1 clean switch for 3G/HD/SD SDI or IP video
- Switch from source A to B automatically based upon user configurable input fault conditions, or manually
- Four video inputs for input source selection to each switch
- Three video outputs (two SDI or IP, one IP only) routable to the output from each switch or direct to inputs for monitoring
- Monitor and switch upon input not present, input format error, video black, video frozen, video error, network error, audio channels missing, audio channels silent
- Latch the switch to source B, or automatically return to A after the source has been free from error for a user adjustable delay time
- Ten frames adjustable video input delay per input, in one frame increments
- Additional Source B frame delay of up to 60 frames to compensate for systems where Source A is subjected to a long delay e.g. arrival from a graphics system

M-SAFESWITCH-2L:

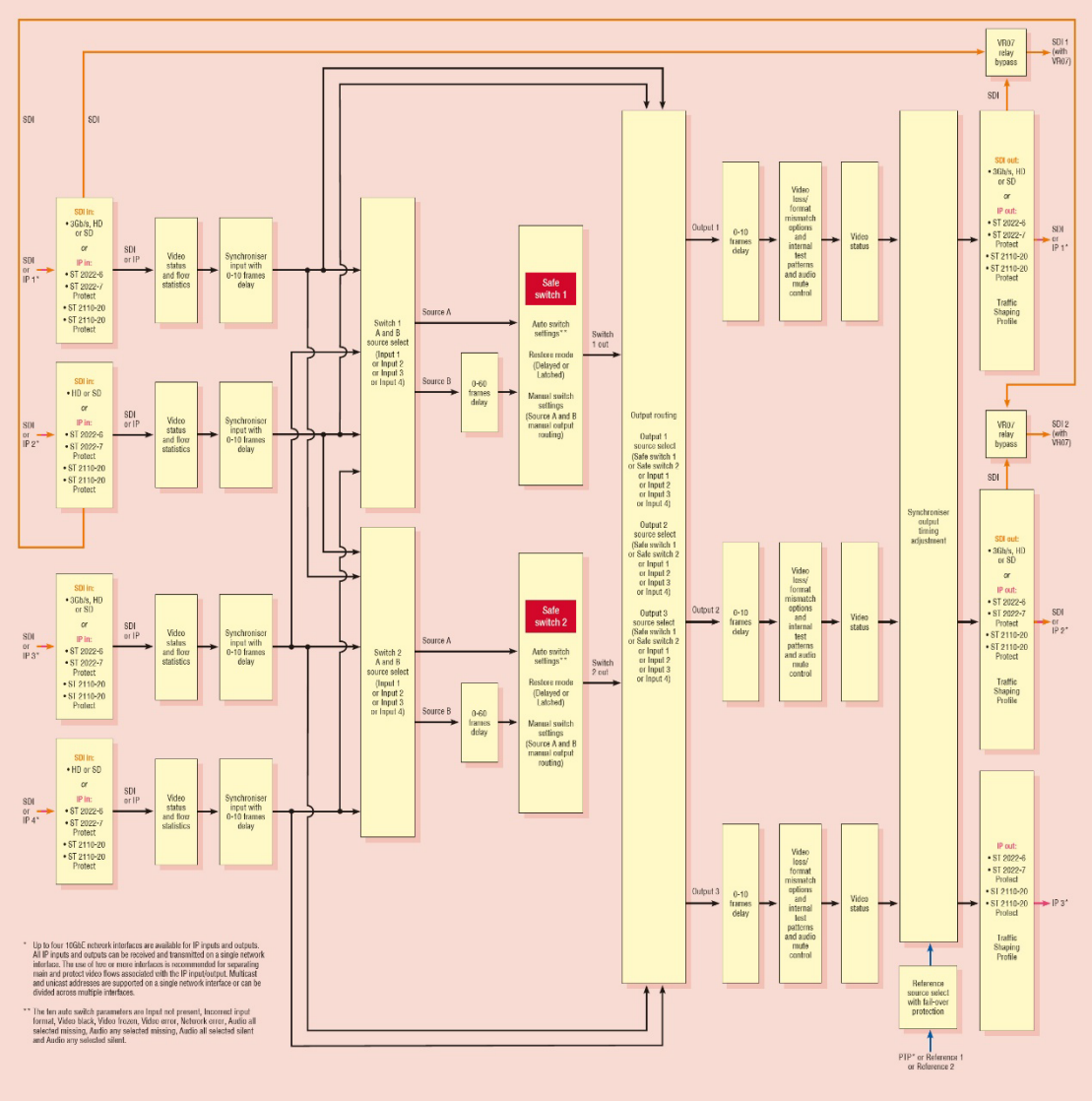
- As above but with RGB legalisers on each output
- When enabled, legalisers clip RGB to be within the limits specified by the EBU R 103 recommendation
- Choice of clipping mode: Constant Hue, Desaturation or simple Hard / Medium / Soft clip

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
- Input audio group monitoring
- 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-SAFESWITCH-2



N.B. M-SAFESWITCH-2L as above but with the addition of RGB legalisers on each of the outputs

3 Hardware Installation

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

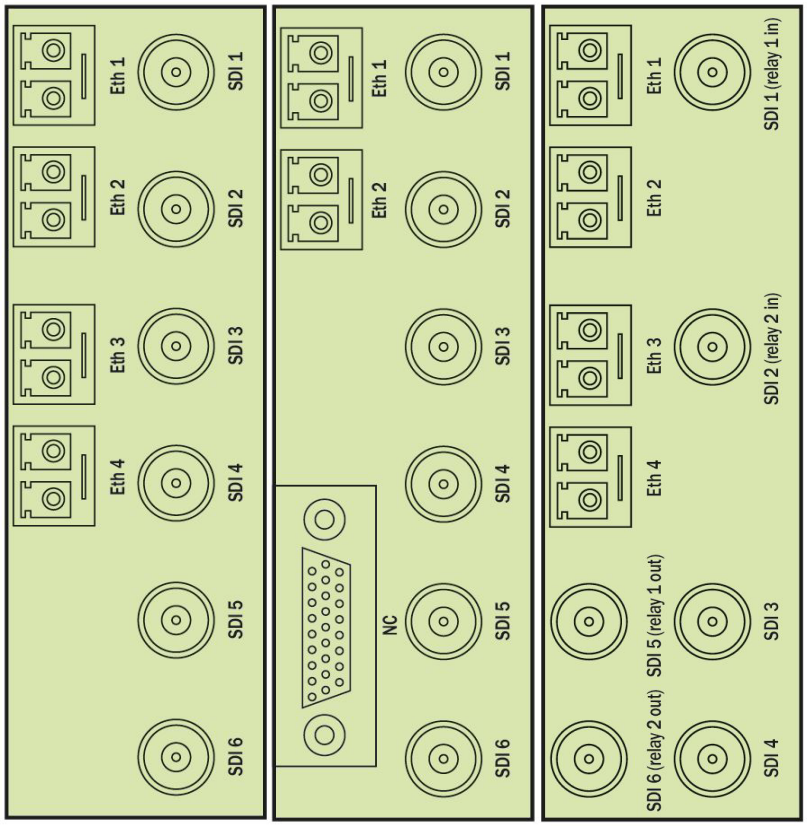
The app based MARBLE-V1 cards are intended for use only in the Crystal Vision 'Vision' frame range and not in older style frames such as 'Indigo'.

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-SAFESWITCH-2/2L apps.

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 In 1

SDI 2: SDI In 2

SDI 3: SDI In 3

SDI 4: SDI In 4

SDI 5: SDI Out 1

SDI 6: SDI Out 2

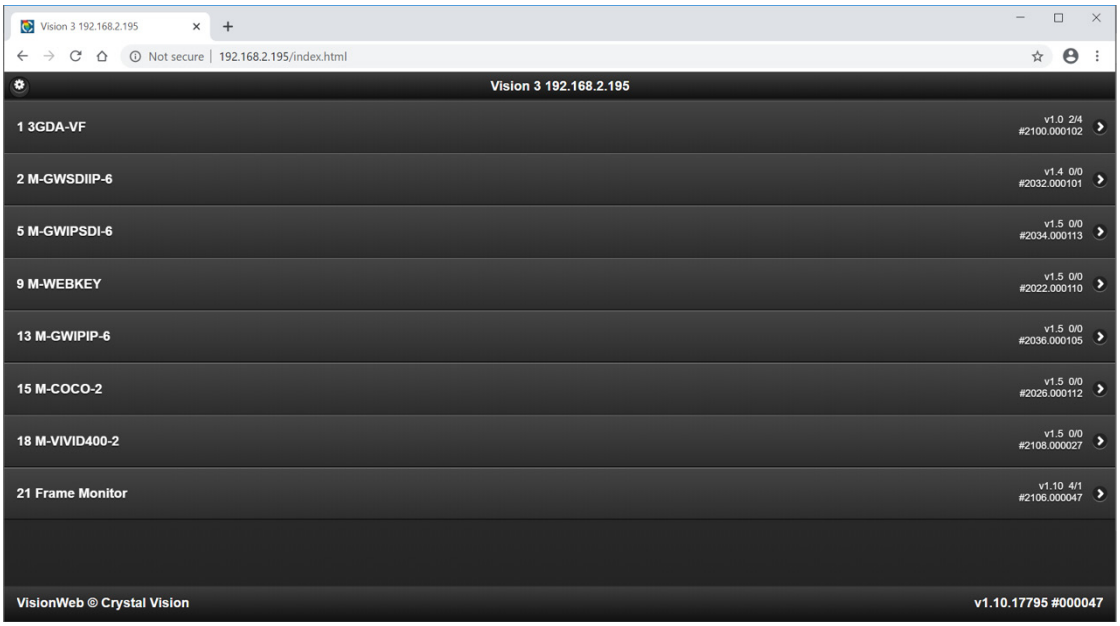
Eth 1 to 4: 10GbE video over IP I/O

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 I/O 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. It is, however, possible to use the same virtual interface for all input and output flows. If using SDI I/O with an analogue reference no virtual interfaces will need configuring.

In a fully IP environment, the following example shows how the M-SAFESWITCH-2/2L primary and protect input and output flows could be assigned to individual virtual interfaces. As previously mentioned, it is also possible to assign all flows to the same interface.

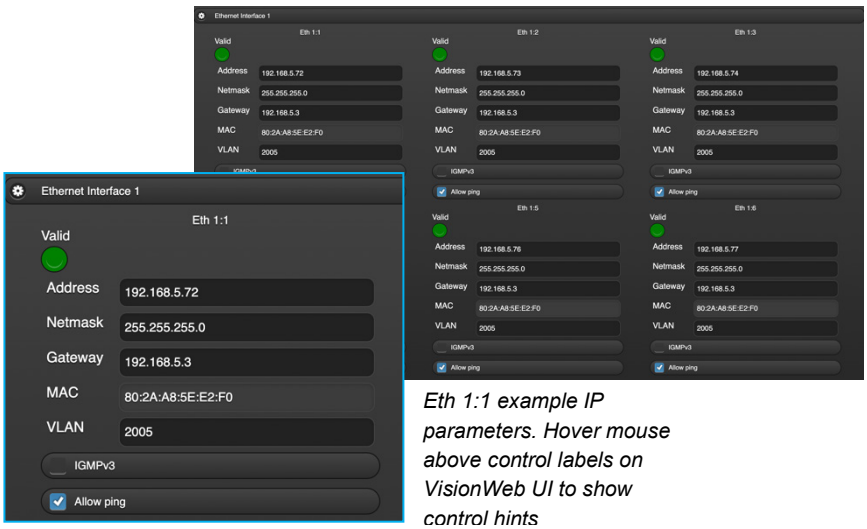
Flow Inputs

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
Eth 1:4 Primary IP Input 4	Eth 2:4 Protect IP Input 4

Flow Outputs

Eth 1:5 Primary IP Output 1	Eth 2:5 Protect IP Output 1
Eth 1:6 Primary IP Output 2	Eth 2:6 Protect IP Output 2
Eth 1:6 Primary IP Output 3	Eth 2:6 Protect IP Output 3

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

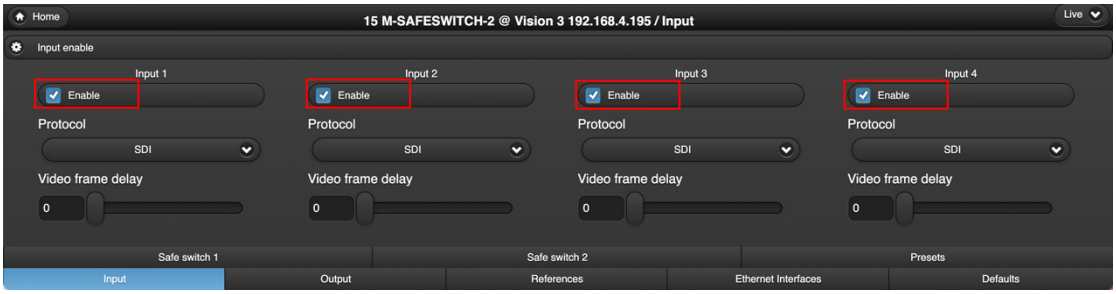


Eth 1:1 example IP parameters. Hover mouse above control labels on VisionWeb UI to show control hints

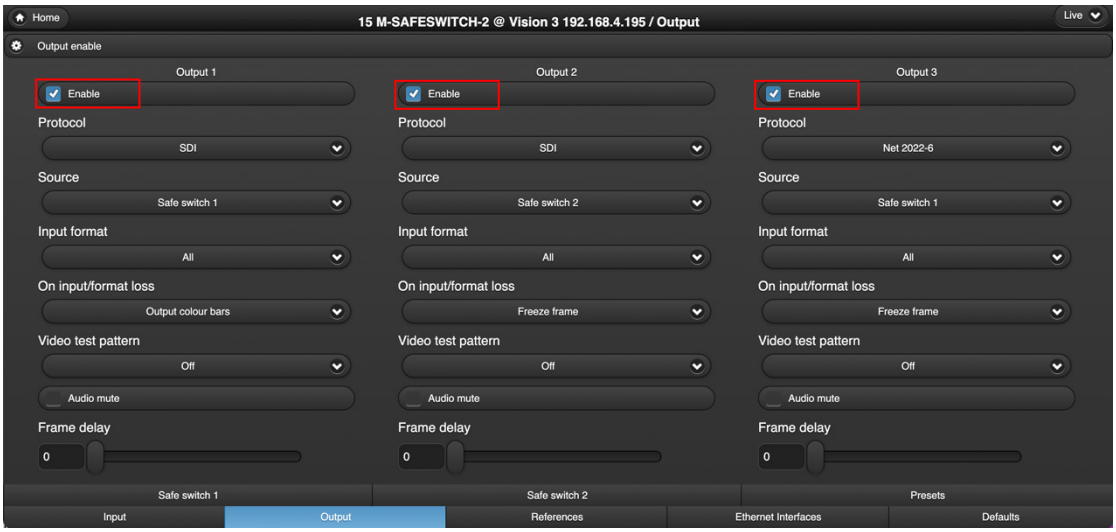
4.2 Enabling Inputs & Outputs

By default M-SAFESWITCH-2/2L inputs and outputs are disabled. Use the Enable control within the Input and Output menus to enable them.

To prevent exceeding the network interface and processing bandwidth, 3G video inputs are supported on inputs 1 and 3 only.



M-SAFESWITCH-2 Input Enable

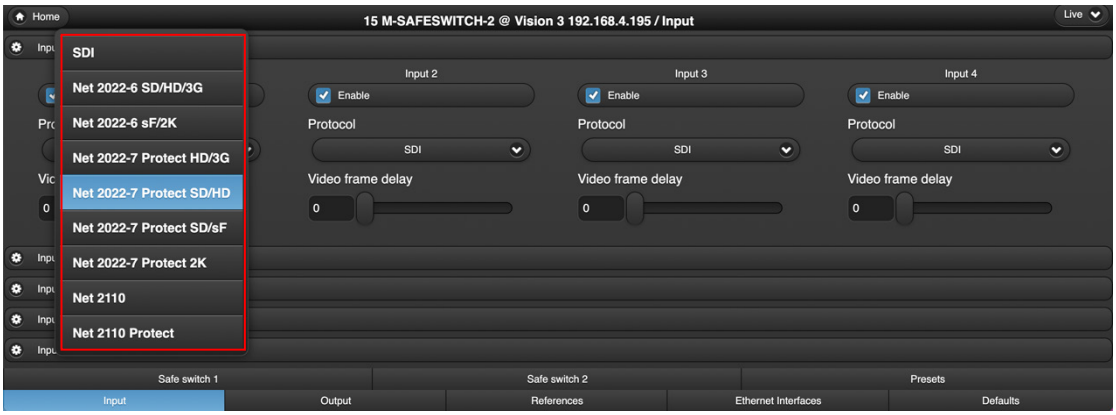


M-SAFESWITCH-2 Output Enable

4.3 Select I/O Protocol

M-SAFESWITCH-2/2L 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 inputs and outputs have been enabled, the required Protocol can be selected using the drop down menus within the Input and Output control tabs. The protocol type will need selecting for each input and output.



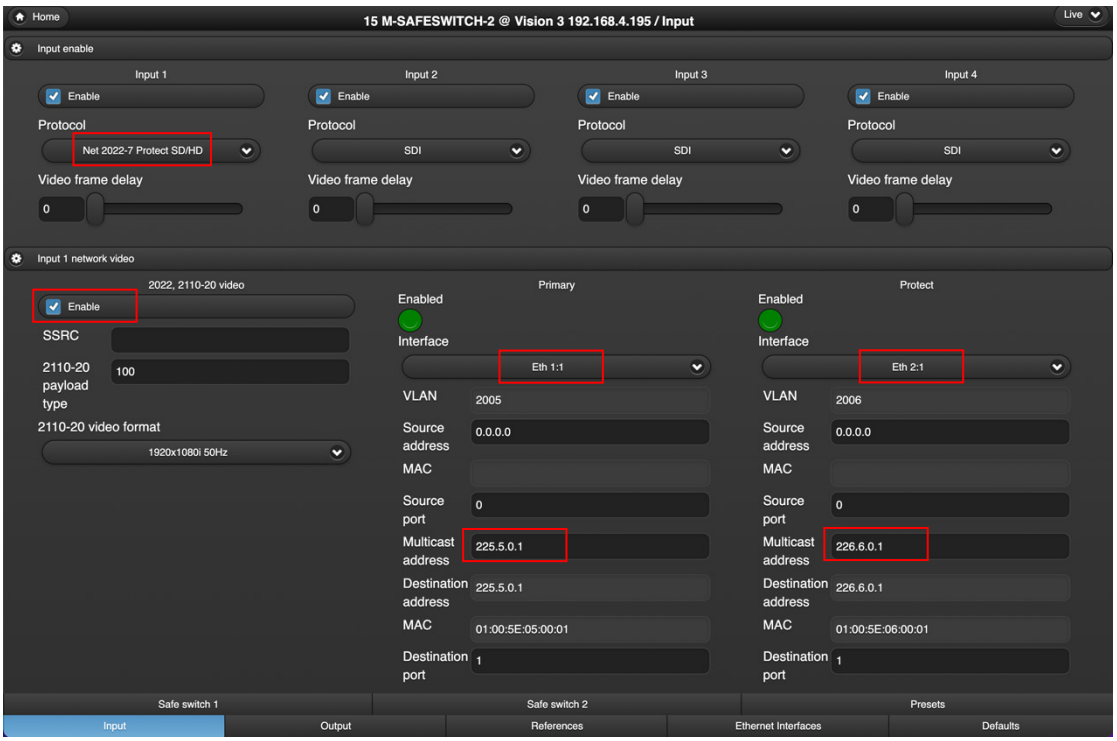
M-SAFESWITCH-2 Input Protocol Selection

IP output flow transmission supports both Block Packing Mode (BPM) and General Packing Mode (GPM) for ST 2110-20 encapsulation. BPM, which packs multiple (up to 7) 180 byte blocks into an RTP payload, is a restricted subset of GPM, and GPM is the more general case.

4.4 Receiving an IP Flow

M-SAFESWITCH-2/2L 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 an M-SAFESWITCH-2/2L configured to receive Input 1 using SMPTE ST 2022-7 protocol. When selecting ST 2022-7 it is necessary to configure both the 'Network In' and 'Protect Network In'.



M-SAFESWITCH-2 Input 1 IP Flow In

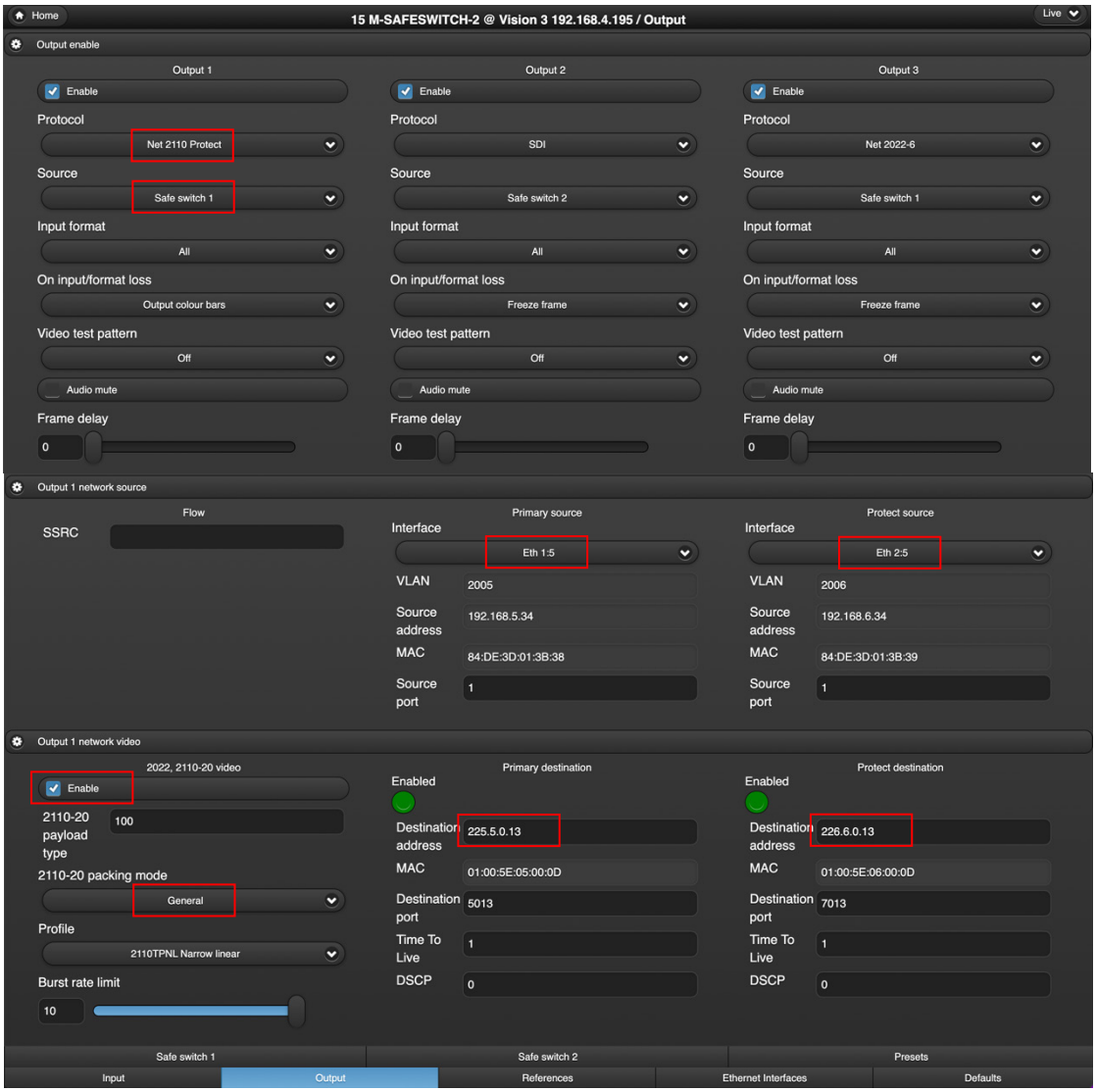
The controls highlighted in the above configuration show Input 1 of the M-SAFESWITCH-2/2L set to receive the 'main' flow packets on Ethernet Interface 1:1 and 'protect' packets of the ST 2022-7 protocol on 2:1. In this example multicast IP addresses are in use.

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.

4.5 Transmitting an IP Flow

M-SAFESWITCH-2/2L 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. 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 an M-SAFESWITCH-2 configured to transmit Output 1 using ST 2110-20 GPM Protect protocol. When selecting a protect protocol it is necessary to configure both the ‘Network Out’ and ‘Protect Network Out’.



M-SAFESWITCH-2 Output 1 IP Flow Out

The controls highlighted in the above configuration show Output 1 of the M-SAFESWITCH-2 routing the Safe switch 1 processing block to Ethernet Interface 1:5 and 2:5 using ST 2110-20 GPM Protect protocol. In this example multicast destination addresses are being used for the main and protected flows which, if required, could be replaced by single point unicast addresses.

VLANs, 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 status

Input video status

Video Status

Enabled LED: Green when input is enabled, otherwise off

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

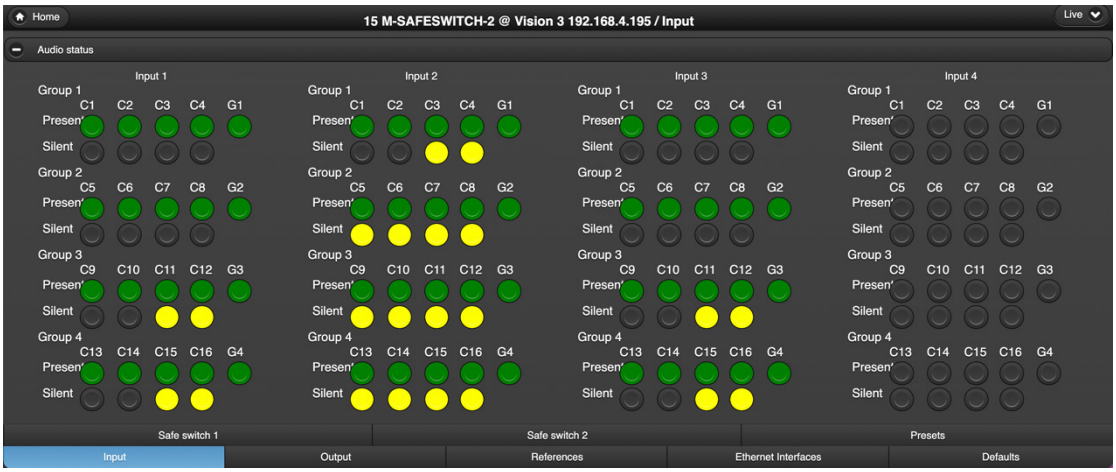
Video frozen LED: Yellow if input is frozen, otherwise off

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

Ancillary data error LED: Red if ANC data errors detected at input, otherwise off

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

5.2 Input Audio status



Input audio status

Audio Status

Audio Group 1 to 4 present LED: Green when audio groups present, otherwise off

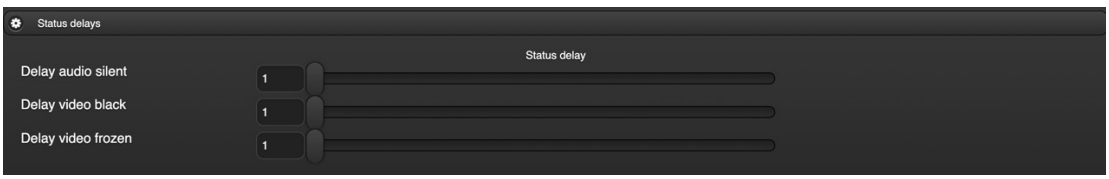
Audio Channel 1 to 16 present LED: Green when audio channels present, otherwise off

Audio Group 1 to 16 silent LED: Yellow when audio channels silent (-93dBFS trigger point), otherwise off

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

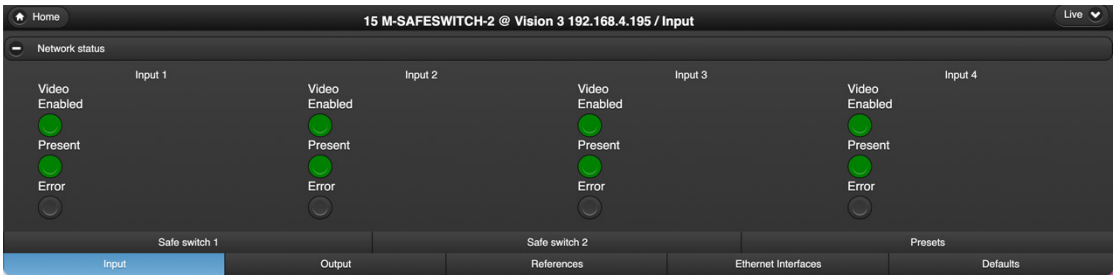
5.3 Status Delay

Audio silent, video black and video frozen status can be prevented from triggering until a user selectable delayed period between 1 to 120 seconds has expired. These controls are located within the ‘Defaults’ tab and are also duplicated on each of the ‘Safe Switch’ tabs.



Status delay

5.4 Network Status & Statistics

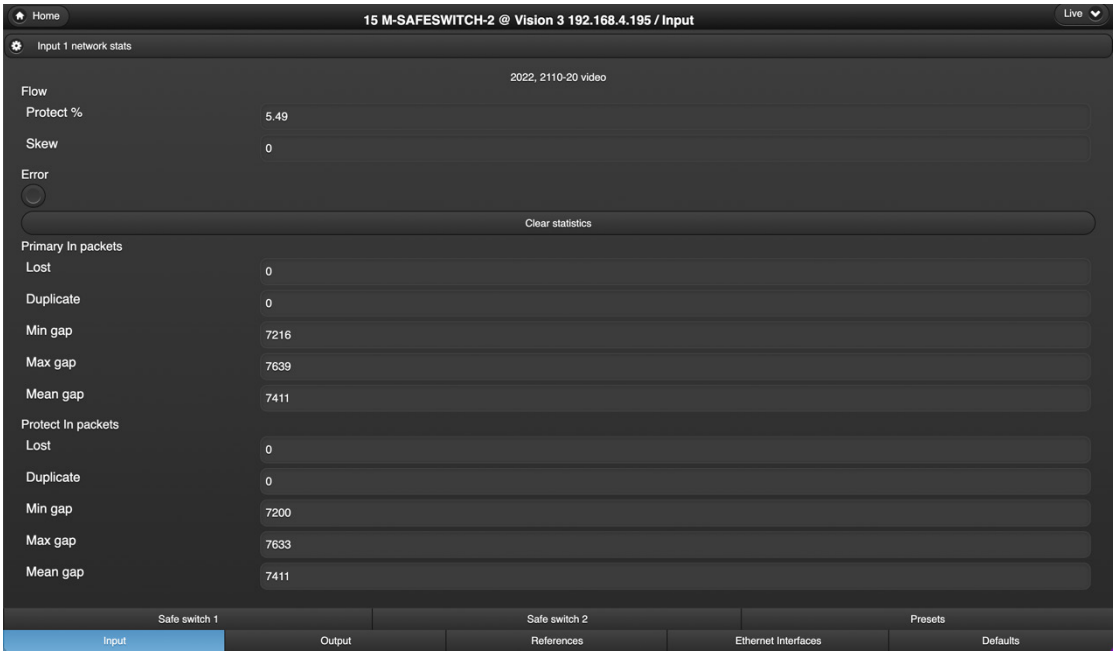


Input network status

Enabled LED: Green when input is enabled, otherwise off

Present LED: Green when input is present, otherwise off

Error LED: Red if lost or duplicate packets detected at input, otherwise off



Input 1 flow 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)

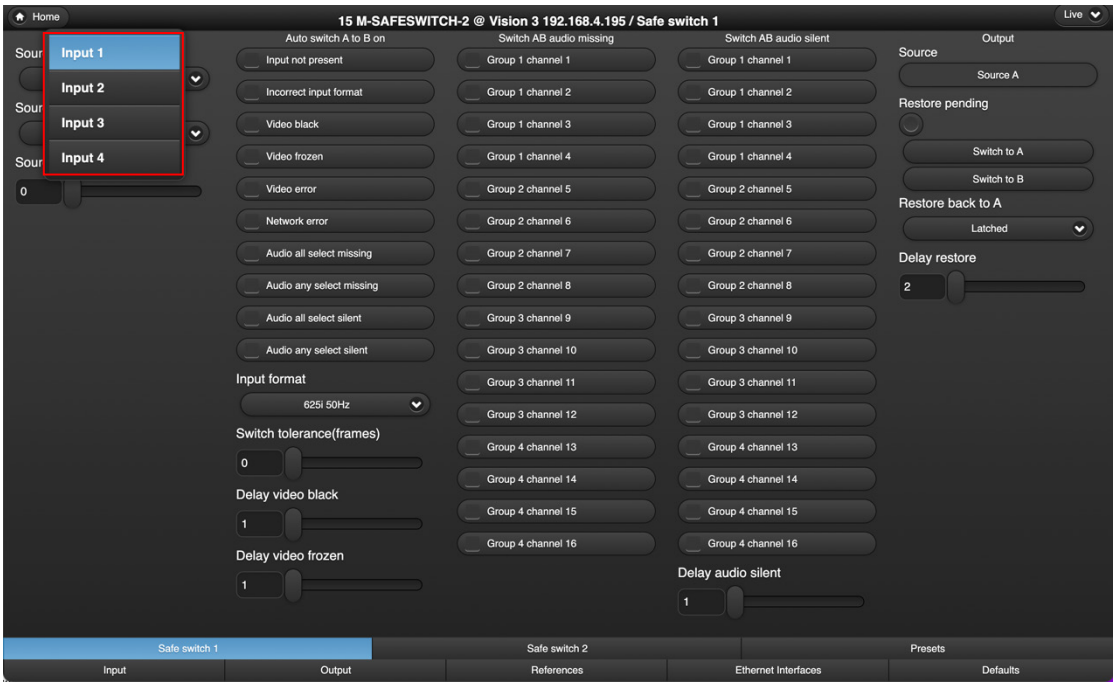
Mean gap: Mean gap between packets of a frame (nSec)

6 Safe Switch Processing

M-SAFESWITCH-2/2L features dual independent 2x1 switches. Source A to B switching can be triggered automatically based upon user configurable input fault conditions, or manually – useful for planned maintenance on the primary programme channel.

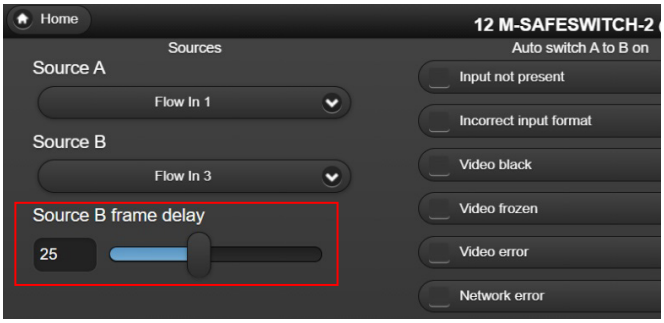
6.1 A and B Sources

Within the Safe Switch control tabs, select the inputs to be used for Source A and B for each switch. To prevent exceeding the network interface and processing bandwidth, 3G video inputs are supported on inputs 1 and 3 only. For this reason default pairing is Input 1 and 3 for Safe Switch 1 in order to provide full 3G I/O for this switch.



Switch Source selection

In addition to the up to 10 frames input flow delay adjustment, up to 60 frames of delay can be applied to Source B, allowing input timing alignment should Source A be subjected to lengthy delays e.g. arrival from a graphics system.

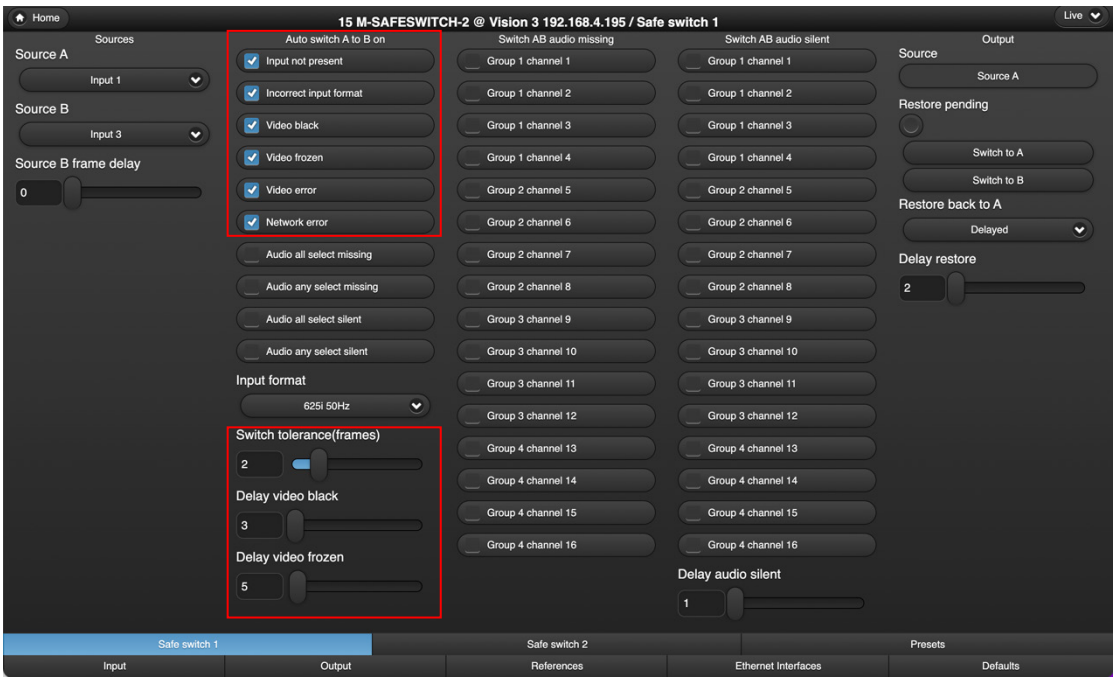


Source B frame delay

6.2 Auto Switch Configuration

Video & Network errors

An auto switch to Source B will occur if any of the video or network fault conditions shown within the ‘Auto switch A to B’ control group are selected and true.



Auto switch configuration – video and network errors

If ‘Incorrect input format’ is selected as an auto switch condition, an auto switch will occur if the input format does not match the format selected in the ‘Input format’ drop down menu.

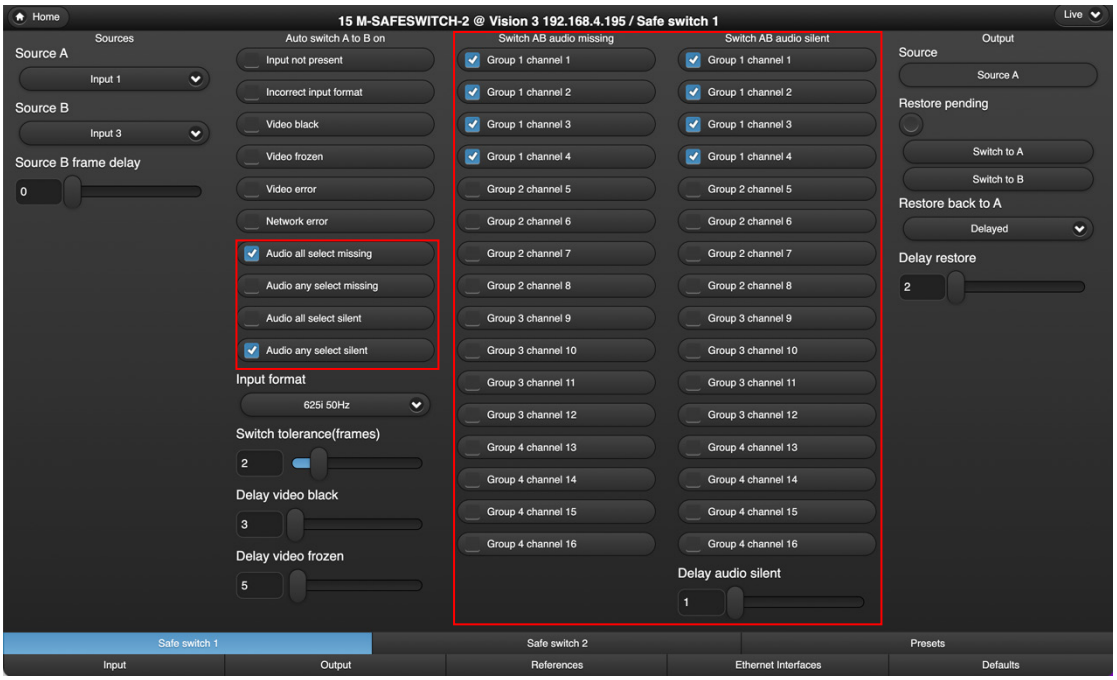
The ‘Delay video black & frozen’ controls allow video to be black and frozen for the set amount of time before triggering the switch. This is adjustable between 1 and 120 seconds and is a global setting which applies to both to switch 1 and 2.

Black is detected when all pixels are black. A single non-black pixel resets the detection delay period. Frozen is detected by splitting each video frame into a grid of image tiles where the sum of pixel values within each tile is computed and compared against the previous frame. If the difference between sums is greater than the in-built frozen detection threshold, the image is detected as not frozen and resets the detection delay period. This allows frozen video to be detected even in the presence of noise or ‘bad’ pixels.

‘Switch tolerance’ allows the errors conditions to exist for up to 10 frames before triggering the auto switch and black/frozen delay timer.

The switch to Source B will occur regardless of whether or not the flow assigned to Source B contains errors. It is therefore recommended that all inputs are continuously monitored for errors, using SNMP for example.

Audio errors



Auto switch configuration – audio errors

If ‘Audio all select missing’ is enabled an auto switch to source B will occur if **all** of the selected audio channels are missing on source A. If ‘Audio any select missing’ is enabled, it will switch if **any** of the selected audio channels are missing. The same functionality applies to the audio silent options.

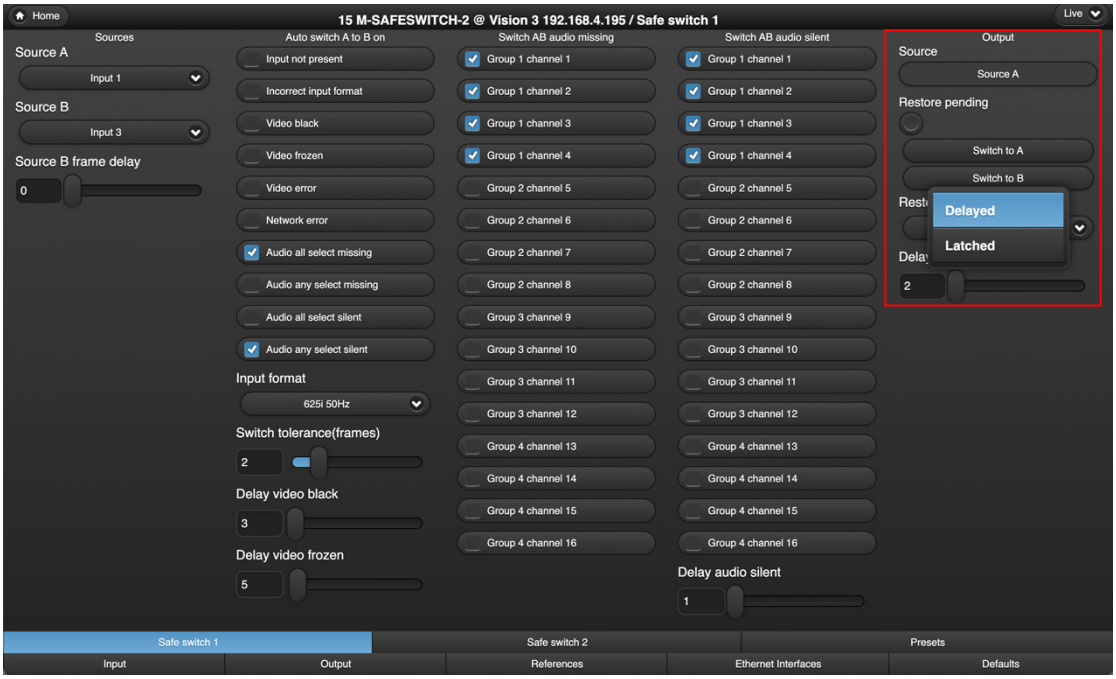
The ‘Delay audio silent’ control allows audio to be silent for the set amount of time before triggering the switch. This is adjustable between 1 and 120 seconds and is a global setting which applies to both to switch 1 and 2.

6.3 Switching Modes

When the Restore to A mode is set to 'Delayed', the switch will automatically return to Source A once it has been clear of the monitored faults for the time set on the Restore delay slider, with the time programmable between two and 60 seconds. The 'Restore pending' LED illuminates to signal that switch is preparing to return to Source A.

When the Restore to A mode is set to 'Latched', the switch will stay switched to Source B until the user manually restores it to Source A.

The ‘Switch to A and B’ controls will manually switch the output source routing to Source A or B. If 'Delayed' restore mode is set, the switch will still automatically return to Source A after manually selecting Source B. To remain with Source B, 'Latched' mode should be selected.

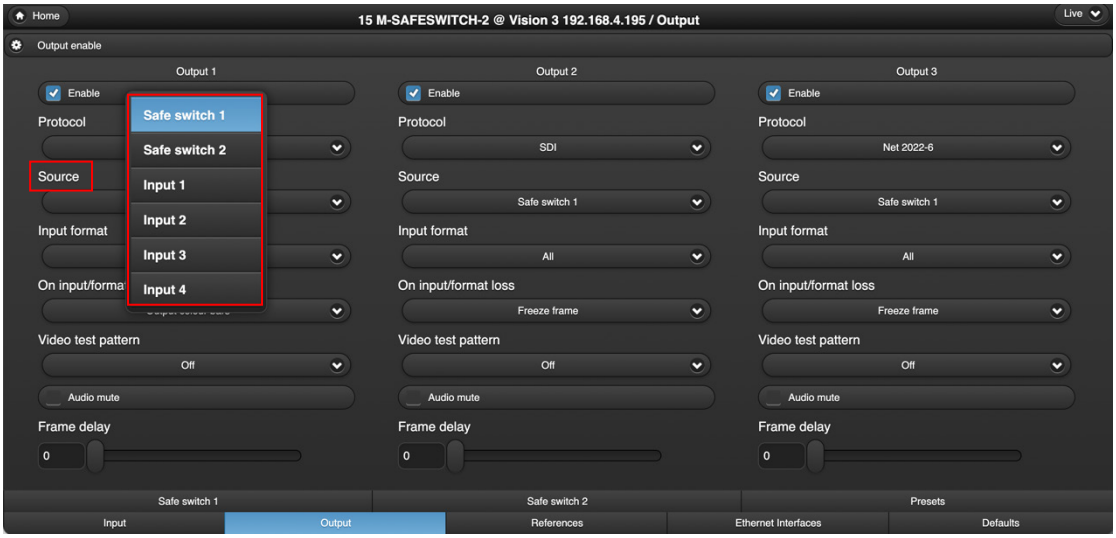


Switching modes

6.4 Output Routing

M-SAFESWITCH-2/2L features dual independent 2x1 switches. There are three outputs. Outputs 1 and 2 out can be configured to be either IP or SDI. Output 3 is IP only.

By default outputs 1 and 3 route to the processing from Switch 1. Output 2 routes to Switch 2. All outputs can be routed to the same switch or directly to any of the inputs, using the source routing controls in the Output control tab.

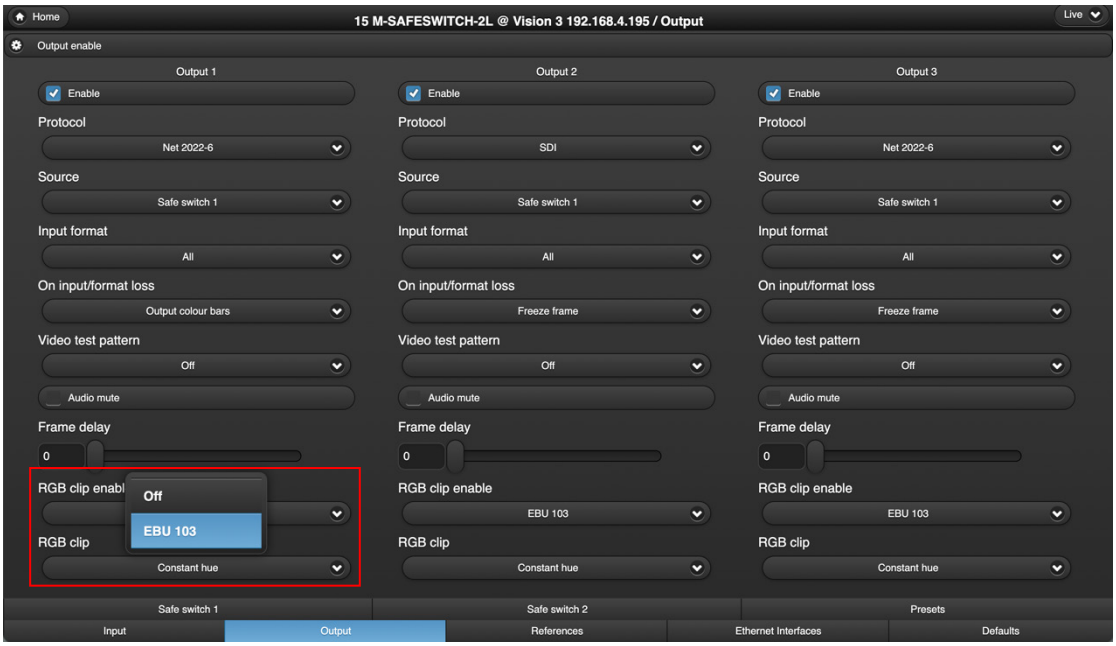


Output Routing

7 Output Legalising (M-SAFESWITCH-2L only)

The M-SAFESWITCH-2L version is equipped with RGB legalisers for each of the outputs. If enabled, any illegal RGB signals will be clipped to be within the limits as given by the EBU R 103 recommendation.

Legalising is enabled on an output by setting RGB clip enable to ‘EBU 103’.



Output Legalising

The RGB clip can be set to Hard, Medium, Soft, Desaturation or Constant hue mode. Hard, medium and soft are all sloped controls with a hard, medium or soft filter added. Desaturation mode legalises by means of desaturating all components equally to apply clipping without significant changes to hue. Constant hue mode transforms RGB to Hue Saturation Intensity colour space and reduces saturation without changing hue.

8 References and Output Timing

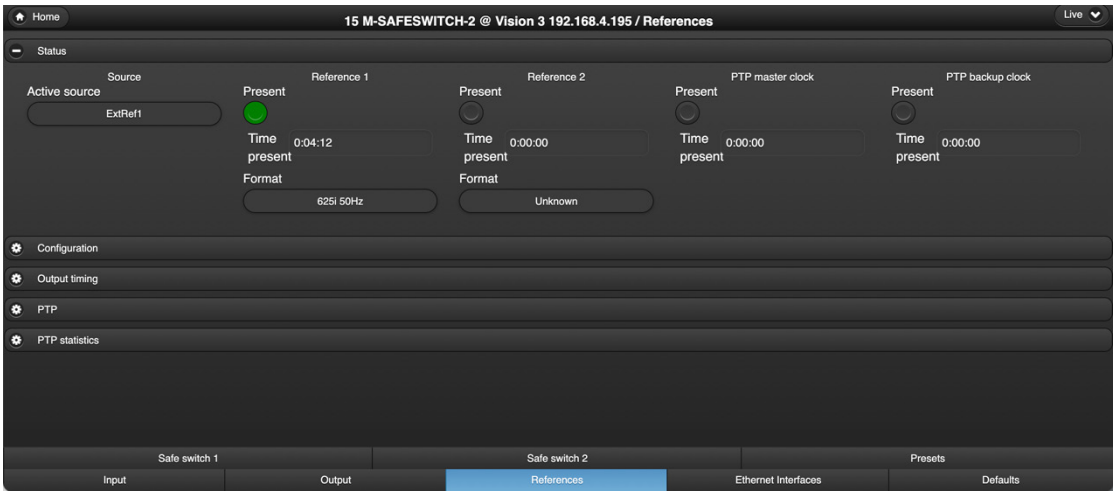
8.1 References

The M-SAFESWITCH-2/2L outputs 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 flow in 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 in order to maintain a valid output.

Status



Reference Status

Active source: Reference source outputs are locked to

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. 625i 50Hz

Reference configuration

Reference Configuration

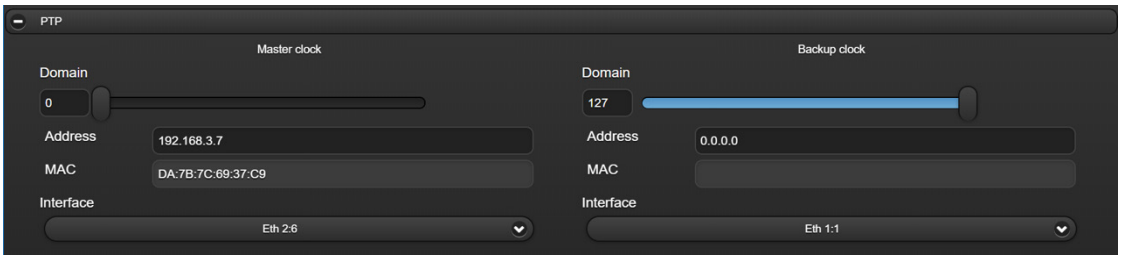
Reference source: Select priority order of reference source. Will automatically fail-over to next source in list if priority source missing

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

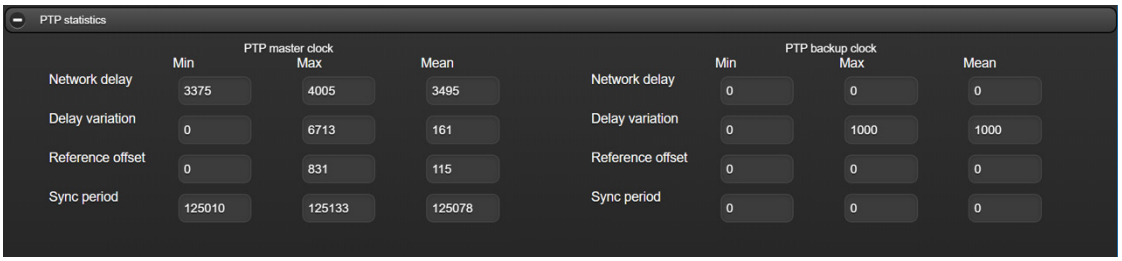
Domain: Domain number of the PTP clock

Address: 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

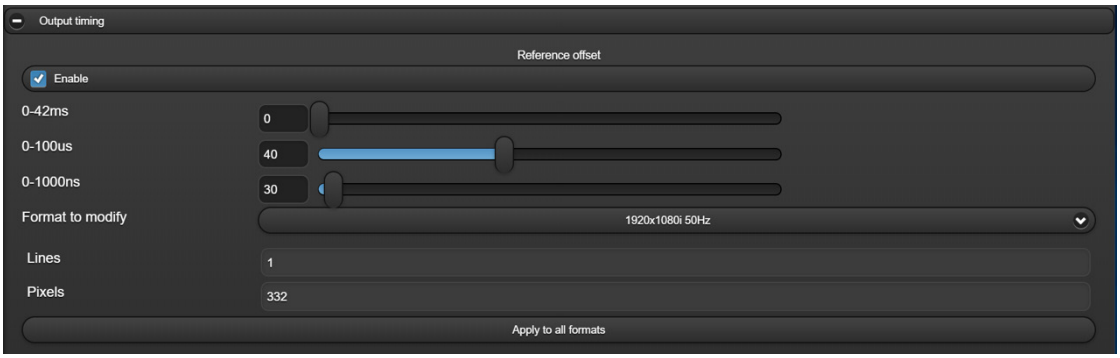
Delay variation: Indicates system noise and how accurately MARBLE-V1 can lock. For example, to lock within 500ns, the delay variation should be less than 500ns

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

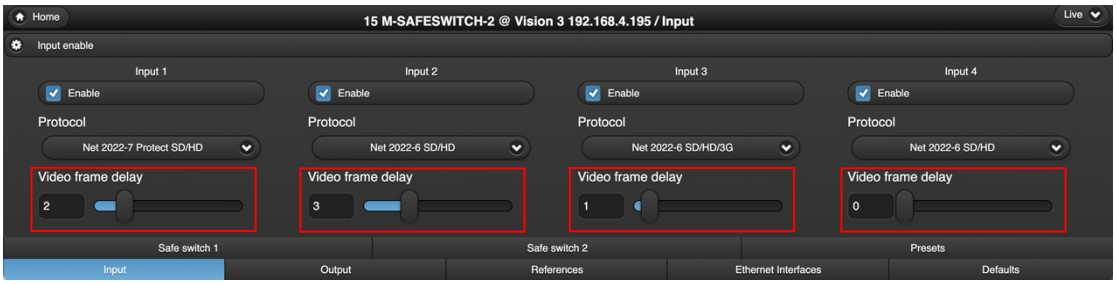
Format to modify: Independently adjust output timing for each video format

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

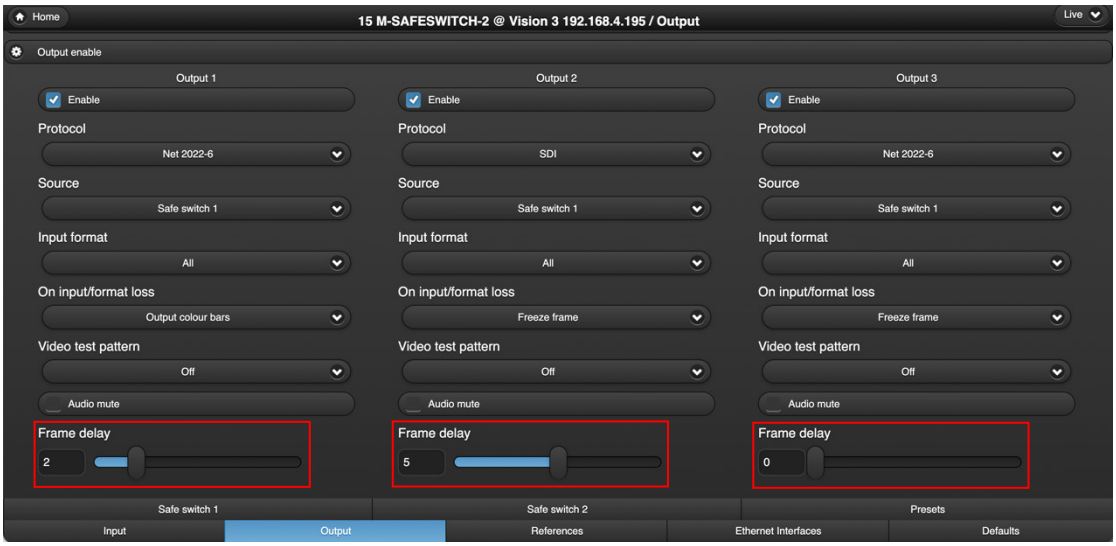
Lines/Pixel: Read only status of the output timing in equivalent lines and pixels

8.3 Frame delay

Up to ten frames of delay adjustable in one frame steps can be applied to the input and each output.



Input Frame Delay



Output Frame Delay

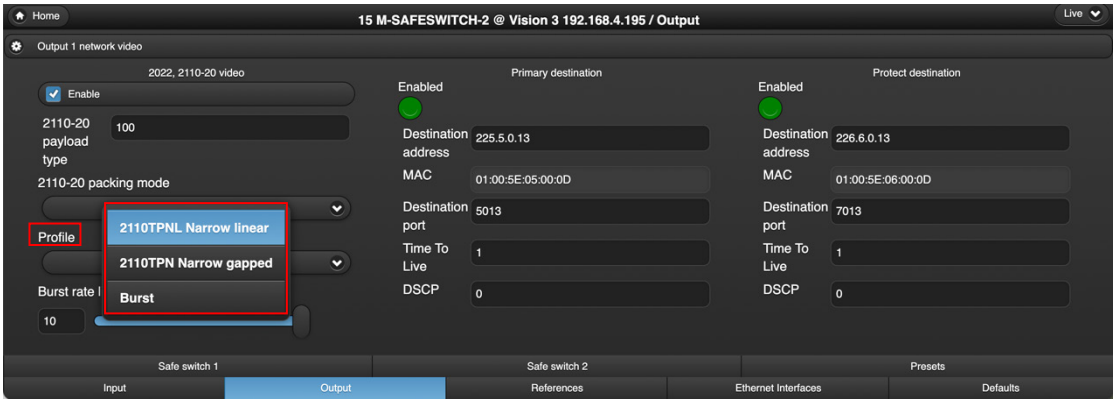
9 Traffic Shaping Profile

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.



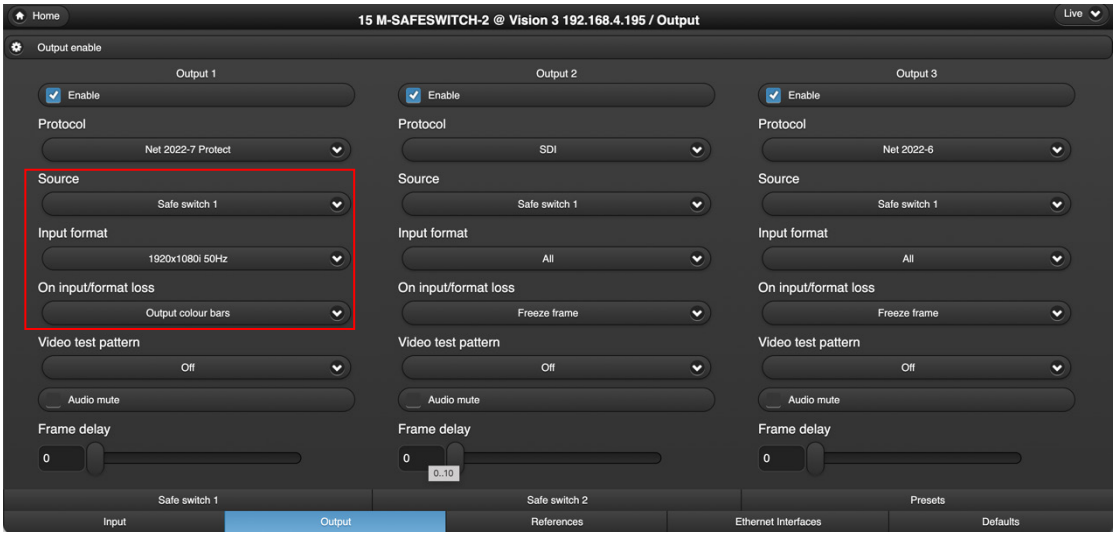
Traffic Shaping Profile

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.

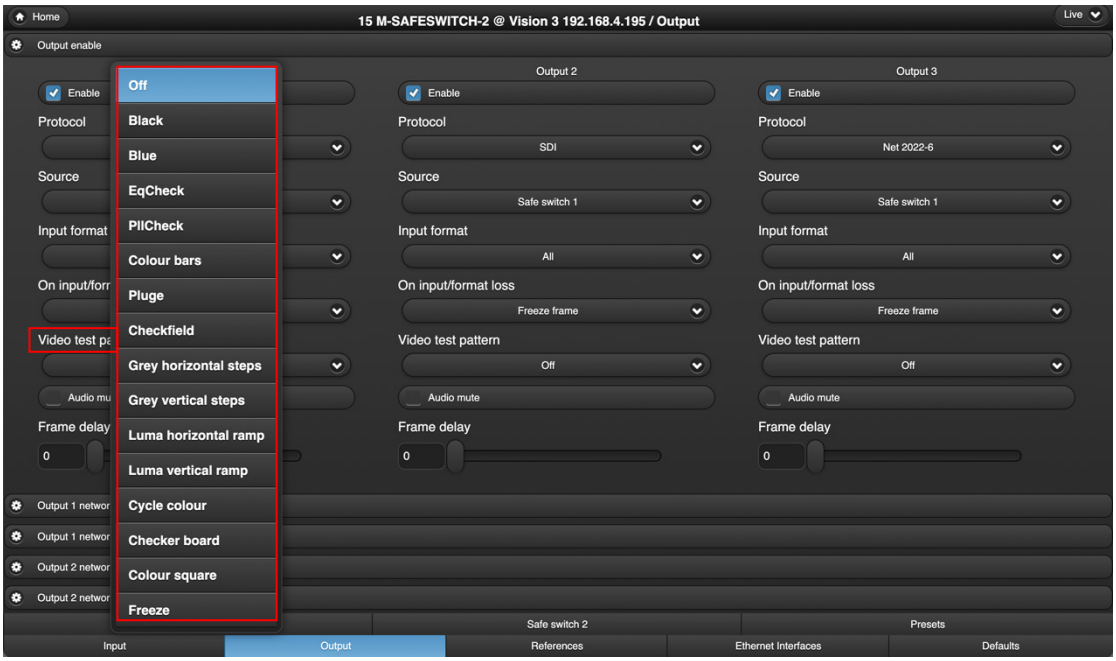
In the example below, if the source input format is not 1920x1080i 50Hz, the output will be replaced with colour bars.



Input Format and On Loss Options

10.2 Internal Test Patterns

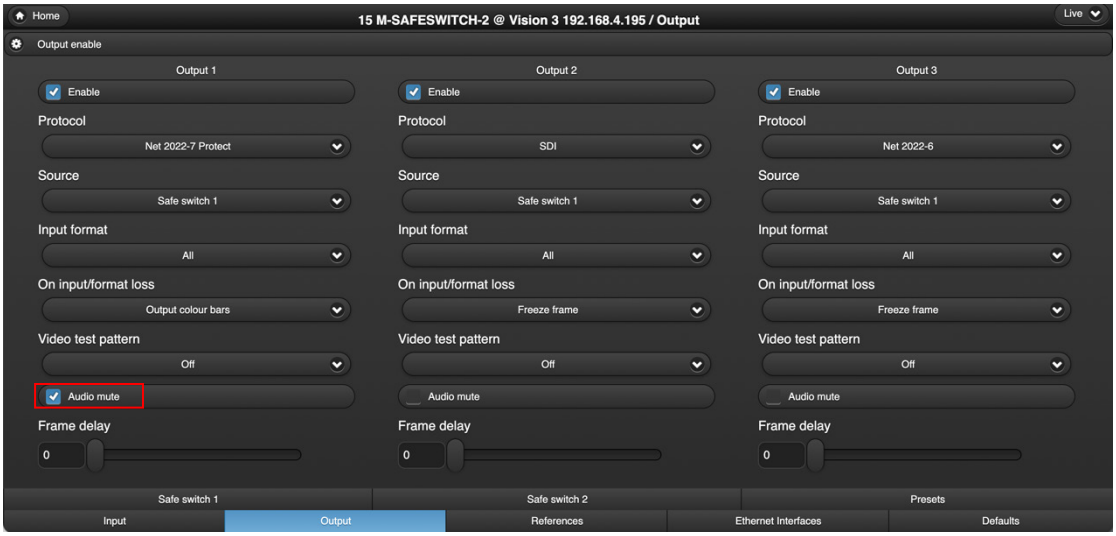
The following internal test patterns are provided which, when enabled, replace the outgoing video content with the selected test pattern.



Internal Test Pattern options

10.3 Audio mute

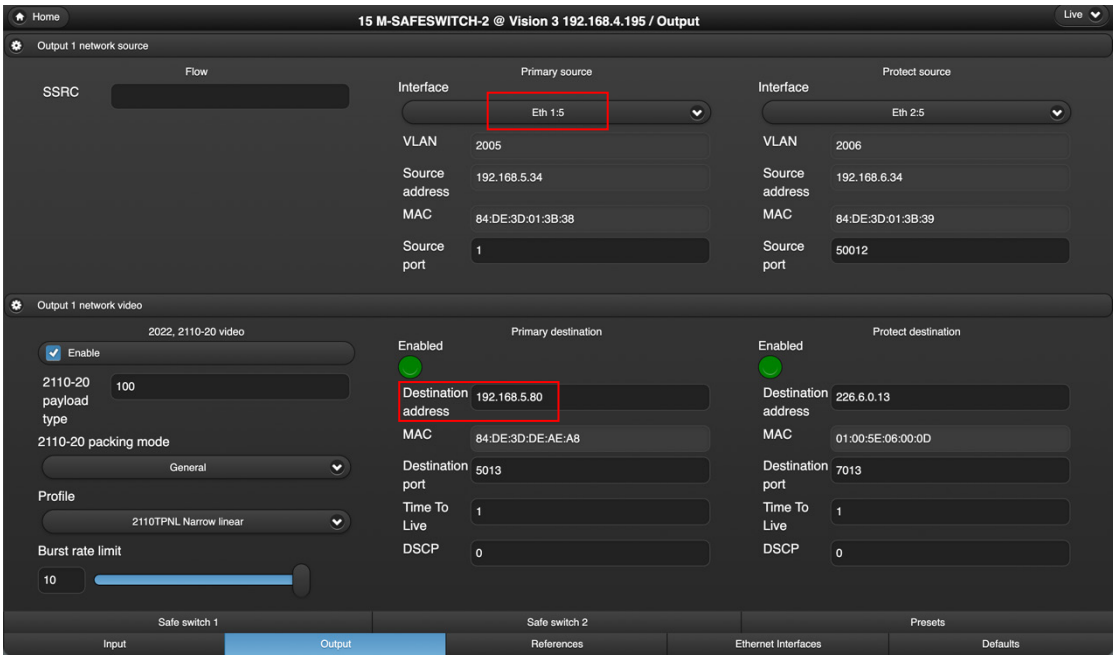
Embedded audio present in SDI or ST 2022 inputs will be passed through to the outputs. Use the Audio mute controls to mute embedded audio present on the output.



Audio mute

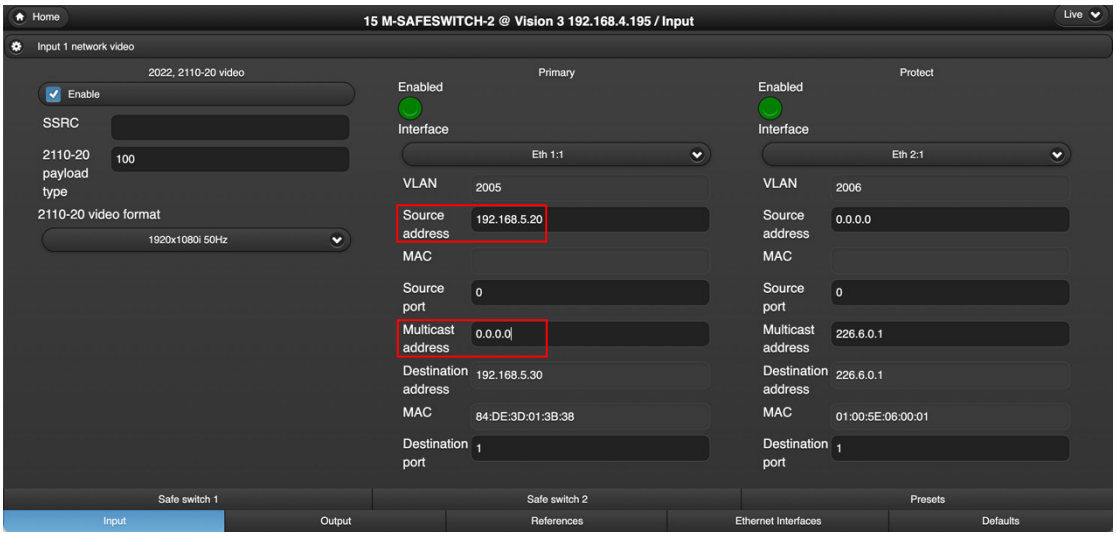
11 Unicast Flow Configuration

To transmit a unicast flow, the output flow ‘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 1:5 on the M-SAFESWITCH-2 is now set to transmit the flow to a downstream device with IP address 192.168.5.80.



Unicast IP Address transmit

When receiving a unicast flow, the input flow ‘Multicast address’ should be set to 0.0.0.0. The input flow ‘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 192.168.5.56.



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 inputs are enabled (off by default)
- Check outputs are enabled (off by default)
- Check correct I/O protocol has been selected
- Check IP 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 input flow 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-SAFESWITCH-2/2L APPS 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

INPUTS AND OUTPUTS

Inputs can be IP and/or SDI
Outputs can be IP and/or SDI
Six 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. All IP inputs and outputs can be received and transmitted on a single network interface. The use of two or more interfaces is recommended for separating main and protect video flows associated with the IP input/output. Multicast and unicast addresses are supported on a single network interface or can be divided across multiple interfaces
SDI only applications do not require any SFP+
Uses VR04 or VR06 frame rear modules. VR04 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 two 3Gb/s SDI inputs or four HD or SD SDI inputs. If the input is 3Gb/s then Input 1 and Input 3 should be used
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 INPUTS

(NB. Some or all of the inputs can be SDI instead)
Up to two 3Gb/s video over IP inputs or four HD or SD video over IP inputs. If the input is 3Gb/s then Input 1 and Input 3 should be used
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 video flow from lost packets by creating two streams of the same data using different routing to the destination. IP packet analyser handles the analysis and reconstruction of the protected

video flow. 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 (NB. Two 3Gb/s outputs available when both are routed to the switch with 3Gb/s inputs)
270Mb/s or 1.5Gb/s or 3Gb/s serial compliant to SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A

IP OUTPUTS

(NB. Up to two of the outputs can be SDI instead)
Up to three 3Gb/s or HD or SD video over IP outputs (NB. Three 3Gb/s video over IP outputs available when all are routed to the switch with 3Gb/s inputs)
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

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 2110-20 video flow are selectable per IP output between BPM and GPM (Block Packing Mode or General Packing Mode)
Packet shaping and distribution of the video flow (compulsory in ST 2110 and optional in ST 2022) is selectable per IP output 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 video flow protection facilitates the dual stream output

MANUAL AND AUTOMATIC SWITCHING

M-SAFESWITCH-2 provides two 2 x 1 clean switches
These can be switched either manually (using the Switch to A and Switch to B buttons) or automatically
In auto mode M-SAFESWITCH-2 will always want to be on its primary input (Source A), only switching to secondary input B if there are user-defined faults on the primary input. It is

possible to select from ten different parameters to automatically trigger the switch (see AUTO SWITCH PARAMETERS)
After switching away from a faulty input, M-SAFESWITCH-2 can be set to switch back automatically or by user intervention
When the Restore to A mode is set to "Delayed", M-SAFESWITCH-2 will automatically return to Source A once it has been clear of the monitored faults for the time set on the Restore delay slider, with the time programmable between two and 60 seconds
When the Restore to A mode is set to "Latched", M-SAFESWITCH-2 will stay switched to Source B until the user manually restores it to Source A
The framestore synchroniser in each input stream will ensure that both inputs to the switch are correctly timed to the reference so that there is no disruption during a switch
M-SAFESWITCH-2 can cope with signal path delays of ten frames between the inputs. Additional delay of up to 60 frames can be applied to Source B of each switch, should the Source A delay be greater than the ten frames adjustment provided at the input stage

AUTO SWITCH PARAMETERS

M-SAFESWITCH-2 performs checks on the following ten parameters which can trigger an automatic switch, with the user able to select a number of parameters in any combination. Different parameters can be chosen for each switch. Switch tolerance can be applied which allows the error to exist for up to ten frames before the auto switch will occur

- Input not present
- Incorrect input format
- Video black
- Video frozen
- Video error
- Network error
- Audio all selected missing
- Audio any selected missing
- Audio all selected silent
- Audio any selected silent

In addition to the ten frames switch tolerance, detection delay can be applied to the video black and video frozen auto switch parameters which allows the picture to remain black or frozen between 1 and 120 seconds before the auto switch will occur. Black and frozen delays can be individually set, but each is common to both switches
Black is detected when all pixels are black – a single non-black pixel resets the detection delay period
Frozen is detected by splitting each video frame into a grid of image tiles where the sum of pixel values within each tile is computed and compared against the previous frame. If the difference between sums is greater than the in-built frozen detection threshold, the image is detected as not frozen and this resets the detection delay period. This allows frozen video to be detected even in the presence of noise or ‘bad’ pixels
The four audio parameters are applicable to SDI and ST 2022. Individual audio channels can be selected and a switch can be triggered if any or all of the audio channels are missing or are silent. In addition to the ten frames switch tolerance, detection delay can be applied to the audio silence switch parameters which allows the audio to remain silent between 1 and 120 seconds before the auto switch will occur

LEGALISING (M-SAFESWITCH-2L ONLY)

Each channel has its own legaliser with RGB clipping. The RGB Enable control can be set to "Off" (disables RGB clip functions) or to "EBU 103" (any illegal RGB signals will be clipped to be within the limits as given by the EBU R 103 recommendation)

The RGB clip can be set to hard, medium, soft, desaturation or constant hue mode

To avoid affecting hue, two modes are available: desaturation and constant hue. With desaturation mode, clip applied to one channel will cause a proportional reduction to the other channels. With constant hue mode, RGB is transformed into saturation intensity colour space and saturation is then reduced

Hard, medium and soft are sloped controls with a hard, medium or soft filter added

ROUTING

The two clean switches can each select between the four inputs for their Source A and Source B

The default setting – which gives a dual channel 2 x 1 safe switch – is Switch 1 to Output 1 and Output 3 and Switch 2 to Output 2. The default inputs to Switch 1 are Input 1 and Input 3. The default inputs to Switch 2 are Input 2 and Input 4

It is also possible to configure the product to give two or three outputs of Switch 1 or Switch 2 instead, if required. (NB. Third output only available in IP)

VIDEO LOSS CONTROLS

The video loss/format mismatch controls allow the user to select what will happen to an output in the event that the input 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 output

TEST PATTERNS

The test pattern controls allow the user to override an input and force the output 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, Checker Board or Colour Square, or to freeze the picture. This is independently adjustable on each output

AUDIO MUTE CONTROL

The output audio mute control allows the user to mute the audio embedded within any of the SDI or ST 2022 outputs

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, depending 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

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 input video delay (adjustable in one frame steps) allows delay compensation between the two input sources to each switch

Additional 60 frames of delay (adjustable in one frame steps) is available to further delay Source B on each switch. This is useful for input timing alignment when there are long Source A delays, such as those created by a graphics system

Ten frames of output video delay (adjustable in one frame steps) allows compensation for any big system delays

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
App settings and Input/Output configuration settings can be stored and recalled independently

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