# USER MANUAL

Indigo SYSTEM

CoolFlow

# Safire 3 Xpress

## 3G/HD/SD real-time chroma keyer

Crystal Vision

| R1.1 | Updated VisionPanel button names and function | 23/10/15 |
| R1.2 | Clarified GPI section. | 03/08/16 |
| R1.3 | Updated VisionPanel button operation and images to reflect changes made in V1.6 VisionPanel, V5.7 Indigo and V1.9 Safire 3 Xpress software. | 28/07/17 |
| R1.4 | Corrected "Max Clip set to zero" typo on page 50 – changed to Min Clip. | 22/12/17 |
| R1.7 | Added note about removal of card edge control in 2019. | 15/01/21 |

# 1 Introduction

Safire 3 Xpress is a modular real-time chroma keyer for 3Gb/s, HD and SD sources. Ideal for weather, news bureaus and other single static camera 3Gb/s, HD or SD live applications that use simple backgrounds but require high quality chroma keying combined with easy control. The main features are as follows:

- **Use with any source** – works with 3Gb/s, HD and SD.

- **Supports the following video standards:** 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).

- **Key on any colour** – select any key colour including grass.

- **Auto setup** – cursor based auto setup produces optimal chroma key result.

- **Correct timing errors automatically** – each input has a frame synchroniser timed to an external reference or selected input.

- **Internal mask generator** – to overrule the chroma keyer to force areas to be foreground or background. Use to prevent unwanted keying from reflective objects or to force keying if the backdrop is too small or damaged.

- **External key input** – use Safire 3 Xpress as a linear keyer to key graphics into a video source, or use as a chroma key mask.

- **Fade keys** – fade keys up and down with an auto-transition or manually.

- **Fade to Black** – fade main output to black with an auto-transition or manually.

- **Two video outputs** – independent Main and Aux outputs feature routable sources to display all inputs and outputs.

- **Control** of Safire 3 Xpress is most easily achieved by the VisionPanel or VisionWeb Control PC interface software. Control can additionally be from SNMP. Board edge control was also available prior to 2019.

- **GPI control** of configuration set-ups and key fade.

- **Supports the following rear module connectors:** RM50, RM73.

- **Compatible** with Crystal Vision standard frames available in 2U, 1U and desk top box.

- **Passes all ancillary data** from chosen video input.

## Block Diagram
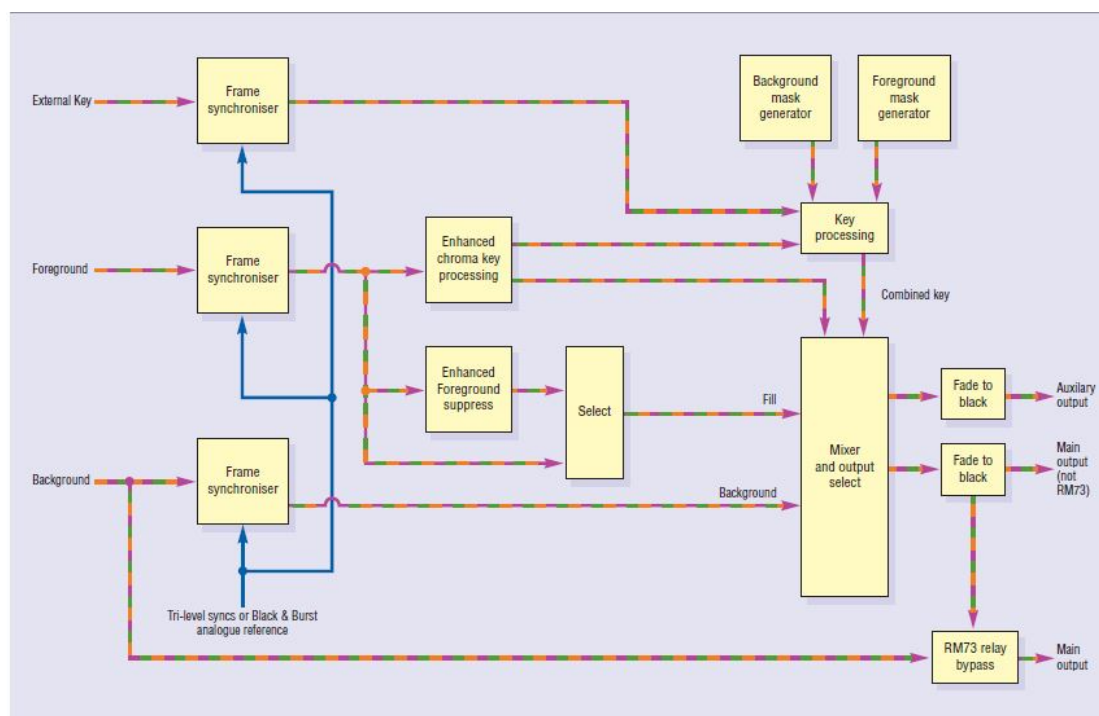


Safire 3 Xpress block diagram

### Block Diagram Description

The Foreground (FG), Background (BG) and External Key video inputs are firstly frame synchronised and timed to an external analogue Black and Burst or tri-level syncs reference, or to one of the other inputs.

The FG signal is then passed to the FG suppression block where, in Suppress Foreground mode, all colours in the FG acceptance window are de-saturated to shades of grey and any colour exactly the same as the FG hue colour will be suppressed to black. Luminance is subtracted from the suppressed signal to ensure that all the coloured backdrop area is black. In Multiply Foreground mode the suppression block is bypassed.

A key is derived from the chroma key processing block which is maximum for FG colours exactly the same as the Chroma Key Colour hue. All other colours within the Chroma Key Colour acceptance window will produce varying amounts of key from maximum in the centre to zero at the edges. The clipped chroma key is combined with other keys and masks to produce a single key which is used to cut a hole in the Background video – and in Multiply Foreground mode only, the inverse key cuts a hole in the FG signal as well.

The FG and BG signal are mixed with their video fills before being added together to make the final composite output.

# 2 Hardware installation

## Board configuration
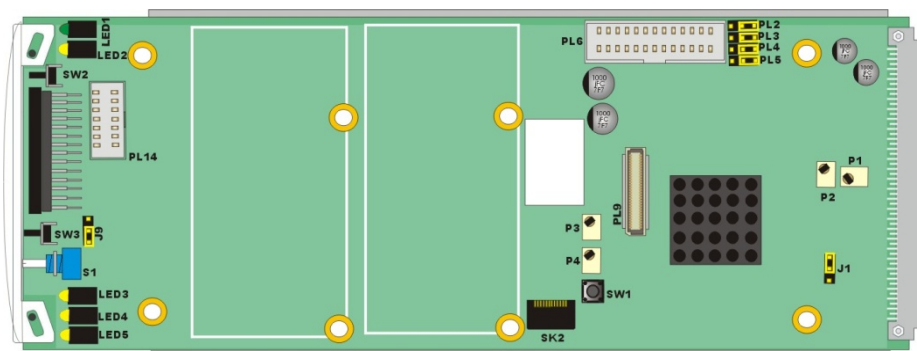


Safire 3 Xpress main board top-side

## Link Configuration

There are four user-settable links on the Safire 3 Xpress. These are PL2-5, all other links should be left in the position shown in the above picture. PL2-5 set whether the board's GPI inputs are used as GPIs or as an extra serial I/O port.

| Link | Towards front of board or Up | Towards the rear of board or Down |
|------|------------------------------|-----------------------------------|
| J1 | Sync input unterminated. | Sync input terminated by 75 ohms |
| J9 | Debug mode – forces board's IP address to be 10.0.0.201 | Normal mode (factory set, do not alter) |
| PL2 | GPI 1 Input = RS422 Rx+ | GPI 1 Input = GPI 1 |
| PL3 | GPI 2 Input = RS422 Rx- | GPI 2 Input = GPI 2 |
| PL4 | GPI 3 Input = RS422 Tx+ | GPI 3 Input = GPI 3 |
| PL5 | GPI 4 Input = RS422 Tx- | GPI 4 Input = GPI 4 |



| Front Edge LEDs | | |
|-----------------|---|---|
| PSU | HD | SD |
| On if power supply OK | On if reference signal is HD format | On if reference signal is SD format |

# 3 Rear Modules

The 2U Indigo 2 frame will house up to 12 single height modules and dual power supplies. The 1U Indigo 1 frame will house six single height modules and a single or dual power supply. The Indigo DT desk top boxes have a built-in power supply and will house up to two single height modules. All modules can be plugged in and removed while the frame is powered without damage.

> **Note:** *For details of fitting rear connectors please refer to the appropriate frame manual.*

Safire 3 Xpress can support the following rear modules: RM50, RM73.

## Rear module connections with RM50

The RM50 being a single height module will allow maximum packing density with the maximum number of inputs and outputs available.

| RM50 rear module connector | Description |
|---|---|
|  FG IN   SAFIRE 3   KEY IN   ZLA00541   SYNC IN   RM50   BG IN   MAIN OUT   AUX OUT | **RM50**<br>• 12 per Indigo 2 frame<br>• Six per Indigo 1 frame<br>• Two per Indigo DT<br>• All frame slots can be used |

### BNC connections

| BNC | I/O assignment |
|---|---|
| **FG IN** | 3G/High Definition/Standard Definition serial digital input |
| **KEY IN** | 3G/High Definition/Standard Definition serial digital input |
| **SYNC IN** | Analogue Black & Burst or tri-level syncs reference for video synchroniser |
| **BG IN** | 3G/High Definition/Standard Definition serial digital input |
| **MAIN OUT** | 3G/High Definition/Standard Definition serial digital output |
| **AUX OUT** | 3G/High Definition/Standard Definition serial digital output |

# Rear module connections with RM73

The RM73 being a single height module will allow maximum packing density with the maximum number of outputs available. This module features relay bypass protection, automatically switching the main output to BG IN in the event of power failure.
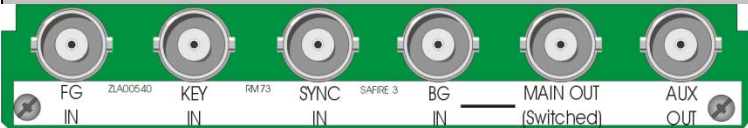
| RM73 rear module connector | Description |
|---|---|
|  | **RM73**<br>• 12 per Indigo 2 frame<br>• Six per Indigo 1 frame<br>• Two per Indigo DT<br>• All frame slots can be used |

**BNC connections**

| BNC | I/O assignment |
|---|---|
| **FG IN** | 3G/High Definition/Standard Definition serial digital input |
| **KEY IN** | 3G/High Definition/Standard Definition serial digital input |
| **SYNC IN** | Analogue Black & Burst or tri-level syncs reference for video synchroniser |
| **BG IN** | 3G/High Definition/Standard Definition serial digital input |
| **MAIN OUT (SWITCHED)** | 3G/High Definition/Standard Definition serial digital output |
| **AUX OUT** | 3G/High Definition/Standard Definition serial digital output |

# 4 General Purpose Interface

## Introduction

Each frame slot has up to six connections 'a-f' for GPI control and monitoring. These connections are available at the rear of the frame on the 26-way D-Type remote connectors.

Safire 3 Xpress has six GPI inputs. Five recall one of five presets (by binary selection) and the sixth is used to trigger an auto transition of the Key Fade (see Engineering menu control description).

Each General Purpose Interface (GPI) input is fitted with a 10kΩ resistor connected to the internal +5V and in the following table, this equates to logic 'H'. With the GPI preset recall lines set to 'level' mode and no connections (logic 'HHHHH'), preset 1 will be selected. With the GPI preset recall lines set to 'pulse' mode, the GPI will be activated whenever a bit is pulled low but no change to the preset selection will occur when all bits return to logic 'HHHHH'. Note that preset 32 is not accessible in pulse mode.

*Note: Because the GPI inputs are sampled in the vertical interval it is recommended that in 'pulse' mode, the GPI should be asserted at least 2mS before the start of vertical sync to ensure stability and held active for at least 40mS.*

See *Engineering***Error! Reference source not found.** section in this manual for details of inverting the GPI preset logic.

Each General Purpose output has a 270Ω resistor in series with its output. This allows for an external LED to be driven, connected to a DC voltage of +5V.

## Preset recall by GPI

The GPI inputs can be programmed to automatically recall a previously saved preset configuration by initiating either a permanent change of level of the five preset lines or a pulse change according to the settings in the Engineering menu. Active high or low can be set in the same menu.

| GPI | | | Low (<1V) | High (+5V) |
|-----|-----|------------------------|-----------|-----------|
| **1** | 'a' | **Recall preset bit 1** | | |
| **2** | 'b' | **Recall preset bit 2** | | |
| **3** | 'c' | **Recall preset bit 4** | See following table for user preset selection | |
| **4** | 'd' | **Recall preset bit 8** | | |
| **5** | 'e' | **Recall preset bit 16** | | |
| **6** | 'f' | **Fade Key Autotrans** | Trigger Autotrans (see GPI Fade Keys Setup) | |

*Table showing the six GPI functions*

| GPI | Bit 16 | Bit 8 | Bit 4 | Bit 2 | Bit 1 |
|-----|--------|-------|-------|-------|-------|
| **Preset** | | | | | |
| 1 | H | H | H | H | H |
| 2 | H | H | H | H | L |
| 3 | H | H | H | L | H |
| 4 | H | H | H | L | L |
| 5 | H | H | L | H | H |
| 6 | H | H | L | H | L |
| 7 | H | H | L | L | H |
| 8 | H | H | L | L | L |
| 9 | H | L | H | H | H |
| 10 | H | L | H | H | L |
| 11 | H | L | H | L | H |
| 12 | H | L | H | L | L |
| 13 | H | L | L | H | H |
| 14 | H | L | L | H | L |
| 15 | H | L | L | L | H |
| 16 | H | L | L | L | L |
| 17 | L | H | H | H | H |
| 18 | L | H | H | H | L |
| 19 | L | H | H | L | H |
| 20 | L | H | H | L | L |
| 21 | L | H | L | H | H |
| 22 | L | H | L | H | L |
| 23 | L | H | L | L | H |
| 24 | L | H | L | L | L |
| 25 | L | L | H | H | H |
| 26 | L | L | H | H | L |
| 27 | L | L | H | L | H |
| 28 | L | L | H | L | L |
| 29 | L | L | L | H | H |
| 30 | L | L | L | H | L |
| 31 | L | L | L | L | H |
| 32 | L | L | L | L | L |

*Binary coding of GPI inputs to recall preset configurations in level mode*

| GPI | Bit 16 | Bit 8 | Bit 4 | Bit 2 | Bit 1 |
|-----|--------|-------|-------|-------|-------|
| **Preset** | | | | | |
| No change | — | — | — | — | — |
| 1 | — | — | — | — | ⎍ |
| 2 | — | — | — | ⎍ | — |
| 3 | — | — | — | ⎍ | ⎍ |
| 4 | — | — | ⎍ | — | — |
| 5 | — | — | ⎍ | — | ⎍ |
| 6 | — | — | ⎍ | ⎍ | — |
| 7 | — | — | ⎍ | ⎍ | ⎍ |
| 8 | — | ⎍ | — | — | — |
| 9 | — | ⎍ | — | — | ⎍ |
| 10 | — | ⎍ | — | ⎍ | — |
| 11 | — | ⎍ | — | ⎍ | ⎍ |

| | | | | | |
|---|---|---|---|---|---|
| 12 | pulse | pulse | line | line | line |
| 13 | line | pulse | pulse | line | pulse |
| 14 | line | pulse | pulse | pulse | line |
| 15 | line | pulse | pulse | pulse | pulse |
| 16 | pulse | line | line | line | line |
| 17 | pulse | line | line | line | pulse |
| 18 | pulse | line | line | pulse | line |
| 19 | pulse | line | line | pulse | pulse |
| 20 | pulse | line | pulse | line | line |
| 21 | pulse | line | pulse | line | pulse |
| 22 | pulse | line | pulse | pulse | line |
| 23 | pulse | line | pulse | pulse | pulse |
| 24 | pulse | pulse | line | line | line |
| 25 | pulse | pulse | line | line | pulse |
| 26 | pulse | pulse | line | pulse | line |
| 27 | pulse | pulse | line | pulse | pulse |
| 28 | pulse | pulse | pulse | line | line |
| 29 | pulse | pulse | pulse | line | pulse |
| 30 | pulse | pulse | pulse | pulse | line |
| 31 | pulse | pulse | pulse | pulse | pulse |
| 32 | Not accessible in pulse mode | | | | |

*Binary coding of GPI inputs to recall preset configurations in pulse mode*

## Indigo DT desk top box GPI connections

GPI lines 'a' to 'f' of each card connect to two rear remote connectors as follows:

| Slot no. | 'a' pin | 'b' pin | 'c' pin | 'd' pin | 'e' pin | 'f' pin |
|---|---|---|---|---|---|---|
| 1 | 8 (1) | 9 (1) | 18 (1) | 26 (1) | 19 (2) | 20 (2) |
| 2 | 7 (1) | 16 (1) | 17 (1) | 25 (1) | 10 (2) | 11 (2) |

*Table shows pin number (remote number)*

*Note:*     *Remote 1: 26-way high-density D-Type female socket. Frame ground is pin 2 and +5V @500mA is pin 1.*
*Remote 2: 26-way high-density D-Type male plugs and frame ground is pin 6 and +5V @500mA is pin 15.*
*Note: The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-2 to approximately 1A.*

## 1U frame GPI connections

GPI lines 'a' to 'f' of each card connect to two rear remote connectors as follows:

| Slot no. | 'a' pin | 'b' pin | 'c' pin | 'd' pin | 'e' pin | 'f' pin |
|----------|---------|---------|---------|---------|---------|---------|
| **1** | 8 (1) | 9 (1) | 18 (1) | 26 (1) | 19 (2) | 20 (2) |
| **2** | 7 (1) | 16 (1) | 17 (1) | 25 (1) | 10 (2) | 11 (2) |
| **3** | 5 (1) | 6 (1) | 15 (1) | 24 (1) | 1 (2) | 2 (2) |
| **4** | 4 (1) | 14 (1) | 13 (1) | 23 (1) | 3 (2) | 4 (2) |
| **5** | 3 (1) | 12 (1) | 22 (1) | 21 (1) | 12 (2) | 13 (2) |
| **6** | 10 (1) | 11 (1) | 19 (1) | 20 (1) | 21 (2) | 22 (2) |

*Table shows pin number (remote number)*

**Note:**     *Remote 1: 26-way high-density D-Type female socket. Frame ground is pin 2 and +5V @500mA is pin 1.*
*Remote 2: 26-way high-density D-Type male plugs and frame ground is pin 6 and +5V @500mA is pin 15.*
*Note: The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-2 to approximately 1A.*

## 2U frame GPI connections

GPI lines 'a' to 'f' of each card connect to two of four rear remote connectors as follows:

| Slot no. | 'a' pin | 'b' pin | 'c' pin | 'd' pin | 'e' pin | 'f' pin |
|----------|---------|---------|---------|---------|---------|---------|
| **1** | 8 (1) | 9 (1) | 18 (1) | 26 (1) | 19 (2) | 20 (2) |
| **2** | 7 (1) | 16 (1) | 17 (1) | 25 (1) | 10 (2) | 11 (2) |
| **3** | 8 (3) | 9 (3) | 18 (3) | 26 (3) | 19 (4) | 20 (4) |
| **4** | 7 (3) | 16 (3) | 17 (3) | 25 (3) | 10 (4) | 11 (4) |
| **5** | 5 (1) | 6 (1) | 15 (1) | 24 (1) | 1 (2) | 2 (2) |
| **6** | 4 (1) | 14 (1) | 13 (1) | 23 (1) | 3 (2) | 4 (2) |
| **7** | 5 (3) | 6 (3) | 15 (3) | 24 (3) | 1 (4) | 2 (4) |
| **8** | 4 (3) | 14 (3) | 13 (3) | 23 (3) | 3 (4) | 4 (4) |
| **9** | 3 (1) | 12 (1) | 22 (1) | 21 (1) | 12 (2) | 13 (2) |
| **10** | 10 (1) | 11 (1) | 19 (1) | 20 (1) | 21 (2) | 22 (2) |
| **11** | 3 (3) | 12 (3) | 22 (3) | 21 (3) | 12 (4) | 13 (4) |
| **12** | 10 (3) | 11 (3) | 19 (3) | 20 (3) | 21 (4) | 22 (4) |

*Table shows pin number (remote number)*

**Note**:     *Remote 1 and Remote 3 are 26-way high-density D-Type female sockets. Frame ground is pin 2 and +5V @500mA is pin 1 in each case.*
*Remote 2 and Remote 4 are 26-way high-density D-Type male plugs and frame ground is pin 6 in each case and +5V @500mA is pin 15 on Remote 2.*
*Note: The +5V output is protected by self-resetting thermal fuses, which limit the total output current available from Remotes 1-4 to approximately 1A.*

# 5 VisionPanel

## Introduction

VisionPanel is a stylish 3U control panel for the hands-on control of up to 16 frames containing Crystal Vision products including the Safire 3 and Safire 3 Xpress chroma keyers. Multiple VisionPanels can be installed – allowing any device to be controlled from a number of locations. It can also be used alongside the VisionWeb web browser control for simultaneous operation of systems. VisionPanel features eight hard buttons that have the following function:

| Button | Function |
|---|---|
| C 1/5 | **Select Channel 1 as the device to control or Channel 5 if the 'Shift' button is held down.** |
| C 2/6 | **Select Channel 2 as the device to control or Channel 6 if the 'Shift' button is held down.** |
| C 3/7 | **Select Channel 3 as the device to control or Channel 7 if the 'Shift' button is held down.** |
| C 4/8 | **Select Channel 4 as the device to control or Channel 8 if the 'Shift' button is held down.** |
| Shift | **Hold down to select alternate function. Hold down for fine knob adjustment.** |
| Presets Outputs/ CKey Enable | **Jump directly into the 'Presets & Outputs' menu or enable/disable chroma key if the 'Shift' button is held down.** |
| GainSpill/ Key Status | **Jump directly into the 'Gain & Spill' menu or into the 'Key Status' menu if 'Shift' is held down.** |
| Back/Home | **Go back a menu level, or jump to the 'Home' menu if the 'Shift' button is held down, where all the top level menu options are available.** |
| Knob click | **Press down on the knob to default the value of the slider being adjusted.** |

Crystal Vision cards can be assigned to one of eight channels by using the card management menu (see below). The four buttons on the left of VisionPanel in conjunction with the 'Shift' button ( top right) allow you to select which one of eight devices you want to control but should your system contain more than eight devices, you can easily select additional ones to control using the 'Cards List' menu (see below) on the touch screen.

Soft buttons on the touch screen are used in conjunction with physical knobs to access the various intuitive setup menus, which allow the key processing, masks and engineering settings to be configured with ease. Fades can be implemented using one of these soft buttons or by using a GPI.

VisionPanel is designed to operate the Safire 3 Xpress over Ethernet using standard CAT5 cables. Just plug the panel into your Ethernet network to connect to the Safire 3 Xpress chroma keyers set up on that network.

## Panel Overview
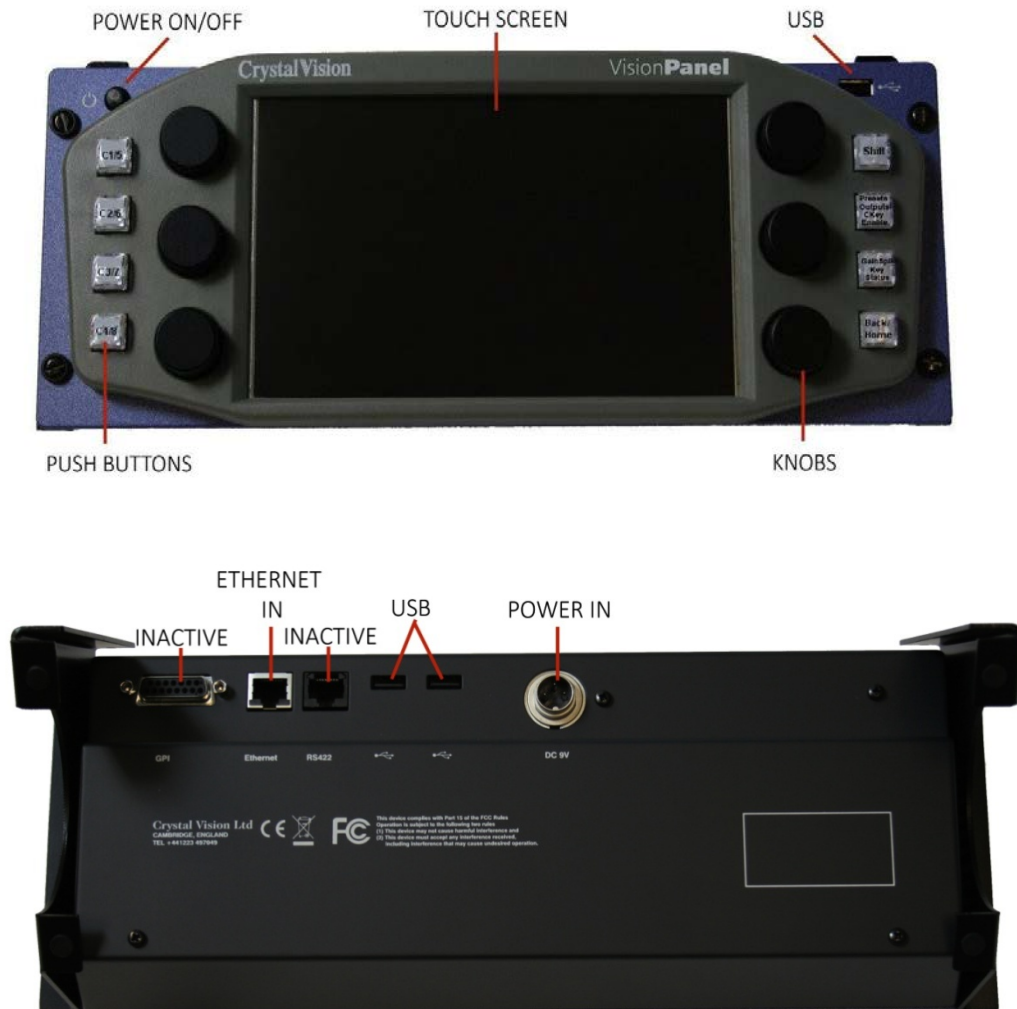




## Mounting

VisionPanel can be mounted on a desk, inside a desk or in a 19" rack using the supplied mounting ears.

The desk stand brackets can be mounted in two orientations as shown below. The panel is shipped with the brackets pre-fitted to the shallower orientation. To change to the steep orientation undo the four fixing screws and reverse the

brackets so the left hand bracket is fitted to the right and vice versa.



## Connecting

VisionPanel requires an Ethernet link to the Crystal Vision frame housing the Safire 3 Xpress chroma keyer. The Crystal Vision frame must therefore be Ethernet capable such as the Indigo 2SE/2AE or equivalent 1U or desk top models. See the frame specific manuals for details on how to assign an IP address to the frame.

Connect VisionPanel to the same network as the Crystal Vision frame using a standard CAT5 network cable. Direct connections from the panel to the frame are also supported and do not require a crossover cable.

Screw the supplied 9V External PSU onto the power connector on the rear of the VisionPanel.

VisionPanel Connections
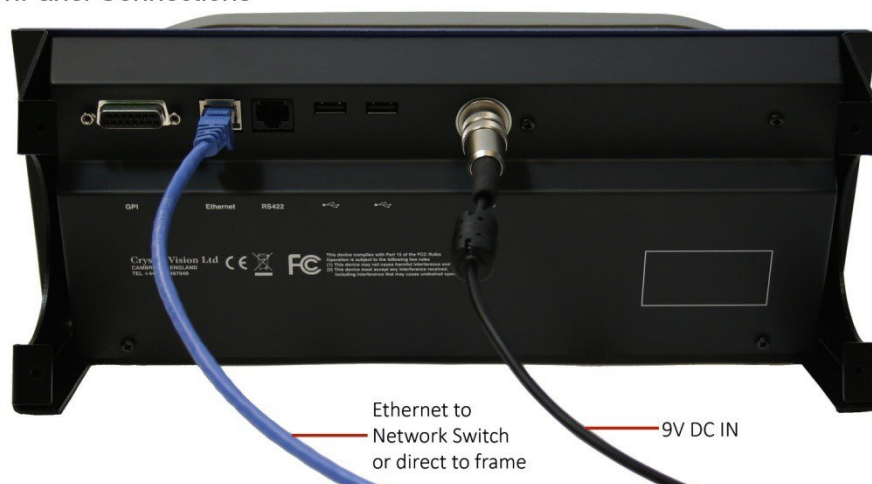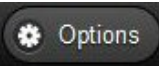
## Setting Up

When first powering VisionPanel you will need to set the panel's network settings.

The procedure is as follows:

1. Turn VisionPanel on using the power button on the front of the control panel. The screen will display the 'Card List' menu which will eventually be filled by the names and locations of detected cards:
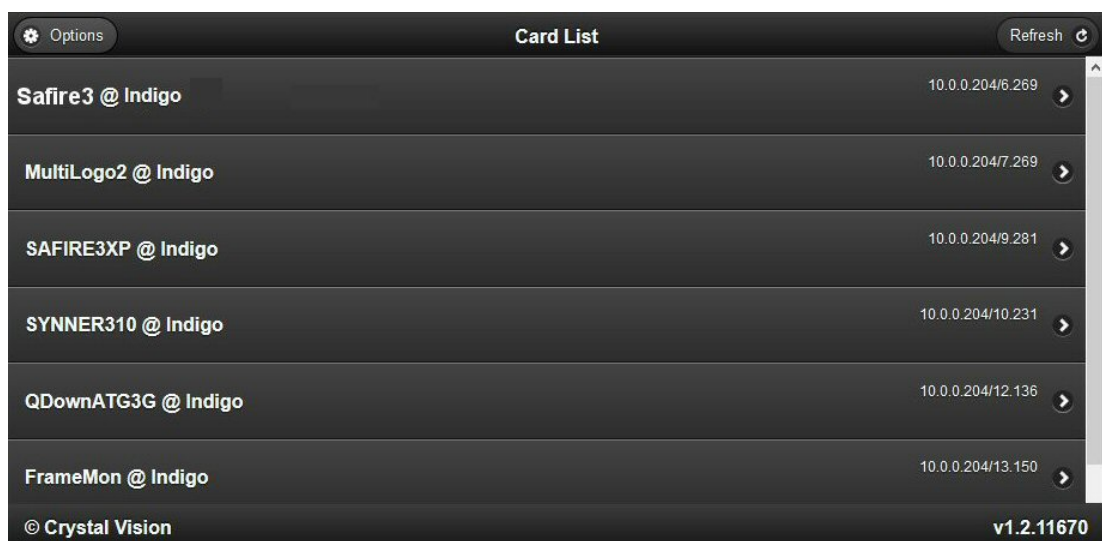


*Example of Card List display showing a number of Crystal Vision cards*

2.  Press the "Options" button at the top left of the touch screen and the 'Network Settings' menu will be displayed:
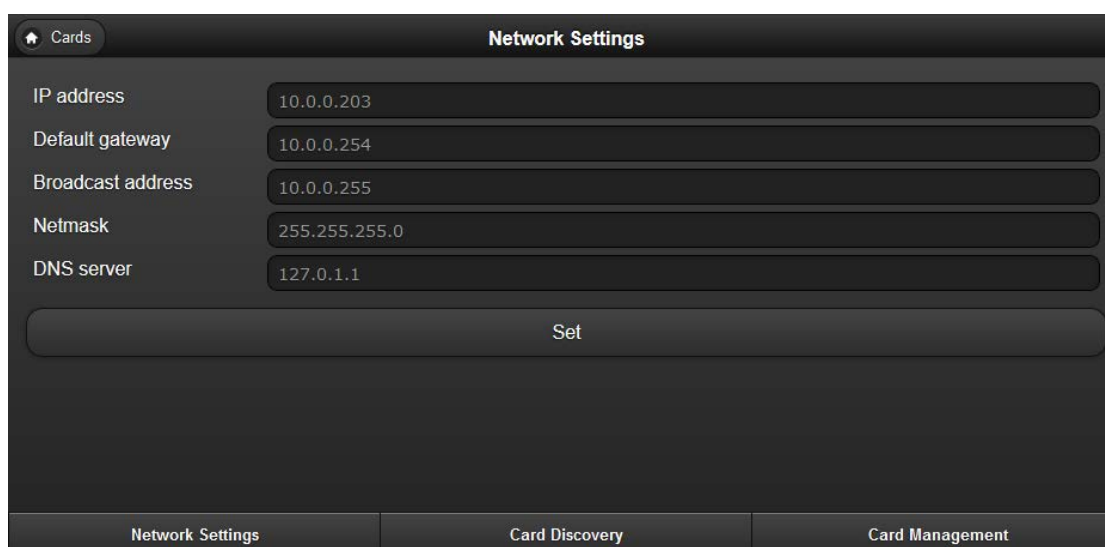


*Example of Network Settings display*

3. Using the pop-up on screen keyboard, enter the following address fields in 'dot-decimal' notation:

**IP Address** – the panel's IP Address.

**Default Gateway** – the address of any device that must be addressed in order to access devices within external networks, usually the router's IP address.

**Netmask address** – this selects the range of network addresses that are checked when identifying devices within a network. For instance a Netmask of 255.255.255.0 will only test the first 24 bits of IP addresses. So a panel with an IP address of 10.0.0.203 and with the netmask above will consider all devices with an IP address of 10.0.0.xx as part of the same network.

**Broadcast address** – the address that a packet uses to broadcast to the whole network and is usually the IP address of the panel but with all bits that are zero in the netmask set to 1. So the broadcast address in the above example would be 10.0.0.255.

**DNS Server** – this is the address of a server that translates domain names and IP addresses.

*Note: The Broadcast address and DNS server information is not currently used so can be left at the default values.*

4.    Press 'Set' when all the fields have been entered.

5.    Press the 'Card Discovery' tab to enter IP addresses of the frames you want to scan:



*Example of 'Card Discovery' display*

6.    Enter the IP addresses and port number 80 (e.g. 10.0.0.201:80) of all the frames you wish to control, up to a maximum of 16 frames. Press 'Add' to include an IP address or 'Delete' to remove it.

7.    Press 'Discover' to make the panel search the IP addresses in the list and create a new list of cards (the old card list will be deleted).

8.    Select 'Card Management' to assign different cards to the hard Channel Select buttons on the panel (CH1 to CH8) by using the 'Move Up' buttons below. It also allows you to delete cards you don't want to show on the VisionPanel. You cannot rename cards on VisionPanel. However you can rename cards using VisionWeb (V5.1 or later) and this name will then propagate to the VisionPanel.
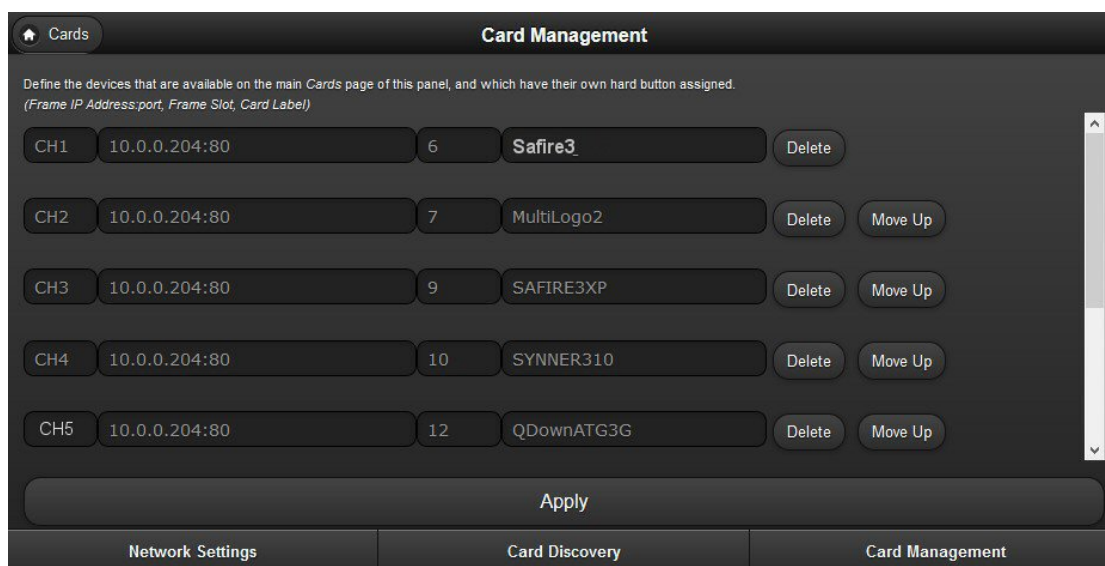
*Example of 'Card Management' display*

9.      Returning to the 'Cards' menu by pressing 'Cards' at the top left hand corner should now display a list of all the cards in all the frames detected by card discovery, except those cards specifically excluded by card management.

10.     Selecting any Safire 3 Xpress will display the card's home page:
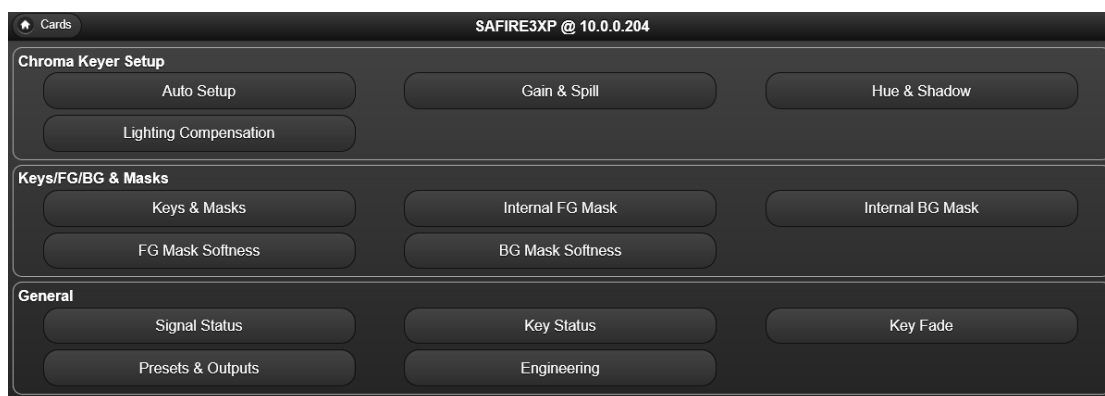


*Safire 3 Xpress home page*

The Safire 3 Xpress home page is split into three panels: Chroma Keyer Setup, Keys/FG/BG & Masks and General. Within each panel are a number of buttons, each one reveals a number of controls. These controls are documented in the 'Controls' section of this handbook.

## Operation

**Left hand side panel buttons**

Use the push buttons on the left hand side of the VisionPanel to quickly select which Safire 3 Xpress chroma keyer is to be controlled.

For systems containing more than eight keyers the touch screen 'Cards List' menu can be used for accessing additional channels

**Right hand side panel buttons (V1.6 software and later)**

Use the push buttons on the right hand side for the following actions:

Shift – Hold down to select the alternate function.

Presets Outputs/CKey Enable – jump directly into the 'Presets & Outputs' menu or enable/disable the chroma key if the 'Shift' button is held down.

GainSpill/Key Status – jump directly into the 'Gain & Spill' menu or into the 'Key Status' menu if the 'Shift' button is held down.

Back/Home – return the touch screen to the previous menu, or if 'Shift' is held down, quickly return the touch screen to the keyer's 'Home' menu.

**Knobs**
**(V1.6 software and later)**

The six knobs allow easy adjustment of the touch screen slider controls.

For fine adjustment hold down the 'Shift' button and turn the knob.

To default the value of the slider being adjusted, press down on the knob.

# 6 VisionWeb Control

## Introduction

VisionWeb Control is the web interface for controlling Crystal Vision boards. Just by connecting the Indigo frame containing Safire 3 Xpress to a PC via an Ethernet connector, and browsing to the IP address of the frame, a similar page to below will be displayed, showing all the controllable boards fitted in the frame:



By selecting Safire 3 Xpress the board's home page will be displayed:



All of Safire 3 Xpress's controls are accessible from here. Click on each tab to reveal more controls. All controls are documented in the 'Controls Descriptions' section of this handbook.

## Connecting

Connect the Indigo frame to the PC via an Ethernet cable. Some older PCs may require a crossover cable. Enter the IP address of the frame into the browser to reveal the home page. Indigo frames have a default IP address of 10.0.0.201. See the relevant frame user manual for more information on VisionWeb Control and setting up of the frame IP address and connecting to a computer.

## Menu Tree

The basic menu structure for VisionPanel and VisionWeb access is identical and consists of the following groups and sub-groups:

Chroma
Key
Setup
- Auto Setup
  - Sample Setup
    - Grab
  - Show Sample
    - Show sample on Main
    - Show sample on Aux
    - Freeze Input
  - Sample Position
    - Reset Sample
    - Horizontal
    - Vertical
  - Auto Settings
    - Reset Chroma Keyer
- Gain and Spill
  - Chroma Key
    - Min Clip
    - Max Clip
    - Acceptance
  - Foreground
    - Suppression
    - Acceptance
  - Chroma Key Control
    - Enable
    - Suppress Foreground
    - Multiply Foreground
    - Invert
- Hue and Shadow
  - Hue and Shadow
    - Shadow Density
    - Key Hue
    - Suppression Hue
    - Key Shrink
    - Background Saturation
- Lighting Compensation
  - Lighting Compensation
    - Enable
    - Aspect Ratio
    - Left
    - Right
    - Top
    - Bottom
    - Radial
    - Blue
- Output Signal
  - Outputs
    - Main
    - Aux
- Keys & Masks

Keys
FG/BG &
Masks

External Key Control

- Enable
- Multiply
- Invert
- Min Clip
- Max Clip

External Mask Control

- Enable
- Multiply
- Invert
- Min Clip
- Max Clip

Self Key Control

- Enable
- Multiply
- Invert
- Min Clip
- Max Clip

Internal FG
Mask

FG Mask Control

- Enable
- Invert

FG Mask Window

- Left
- Right
- Top
- Bottom

Internal BG
Mask

BG Mask Control

- Enable
- Invert

BG Mask Window

- Left
- Right
- Top
- Bottom
- Background

FG Mask
Softness

FG Softness

- Left
- Right
- Top
- Bottom

BG Mask
Softness

BG Softness

- Left
- Right
- Top
- Bottom

Signal Status

FG Input

- Standard
- Input Present
- Input Black
- Input Frozen
- Input ATC Present

General

BG Input

Key Status
- Key Input
  - Standard
  - Input Present
  - Input Black
  - Input Frozen
  - Input ATC Present
- Reference Input
  - Standard
  - Input Present
  - Input Black
  - Input Frozen
  - Input ATC Present
- Output
  - Standard
  - Input Present
- Chroma Key
  - Standard
- Self Key
  - Enabled
  - Faded Down
- External Key
  - Enabled
  - Faded Down
- Masks Enabled
  - Enabled
  - Faded Down
  - External
  - FG
  - BG

Key Fade
- Fade Keys
  - Autotrans
  - Fades Up
  - Fades Down
  - Fade Time
  - Fade
- Fade to Black
  - Autotrans
  - Fades Up
  - Fades Down
  - Fade Time
  - Fade

Presets
- Presets
  - Store
  - Preset Select
  - Recall

Delay & Timing
- Genlock
  - Source
  - Reference
- Output Delay
  - Pixel Timing
  - Line Timing

Engineering
- Output

```
                              ┌─────────────┐ Format
                              │             │ Ancillary Data
                              │             │ Invert Output Key
                              │ GPI Preset Recall
                              ├─────────────┤ Enable
                              │             │ GPI Active level
                              │             │ GPI Trigger
                              │ GPI Fade Keys
                              ├─────────────┤ Enable
                              │             │ GPI Active level
                              │             │ GPI Trigger
                              │ Progressive Frames
                              ├─────────────┤ Lock Frames to ATC
                              │             │ Swap FG Input
                              │             │ Swap BG Input
                              │             │ Swap Key Input
                              │             │ Swap Output Frames
                              │ Reset
                              └─────────────┤ Defaults
                                            │ Erase Presets
```

The above menu structure is the means to access the various Safire 3 Xpress controls and status. A more detailed description is in section – 'Control Descriptions'.

# 7 Control Descriptions

The controls of Safire 3 Xpress are accessible from VisionPanel, the VisionWeb Control software or the board edge. *Board edge control was removed from the Safire 3 Xpress in 2019 and therefore the card edge control information is only relevant for older versions of the product.*

The screen grabs of controls used in this manual are from VisionPanel but are similar to VisionWeb Control with a few minor differences. The path to locate controls via VisionWeb Control or board edge follows similar logic. For instance, in the VisionPanel display, an 'Input Frozen' indicator is accessed via the '**General**' panel, '**Signal Status**' tab and '**FG Input**' group where it can also be found in VisionWeb Control. To find the same control using the card edge follow the path **General->Signal Status->FG Input** to the **Input Frozen** indicator.

VisionWeb GUI controls are located in a number of tabs each containing panels which mostly contain the controls. Some controls are LEDs that are used to show status, others are check boxes, buttons or sliders which change various Safire 3 Xpress settings. (*Note: Slider controls in VisionWeb Control, once selected, can be moved by the keyboard up and down arrow keys to give finer control than possible with a mouse.*)

The description of the tabs are in the order shown in the GUI i.e.

**AUTO SETUP, GAIN & SPILL, HUE & SHADOW, LIGHTING COMPENSATION, OUTPUT SIGNAL, KEYS & MASKS, INTERNAL FG MASK, INTERNAL BG MASK, FG MASK SOFTNESS, BG MASK SOFTNESS, SIGNAL STATUS, KEY STATUS, KEY FADE, PRESETS, DELAY & TIMING, ENGINEERING.**
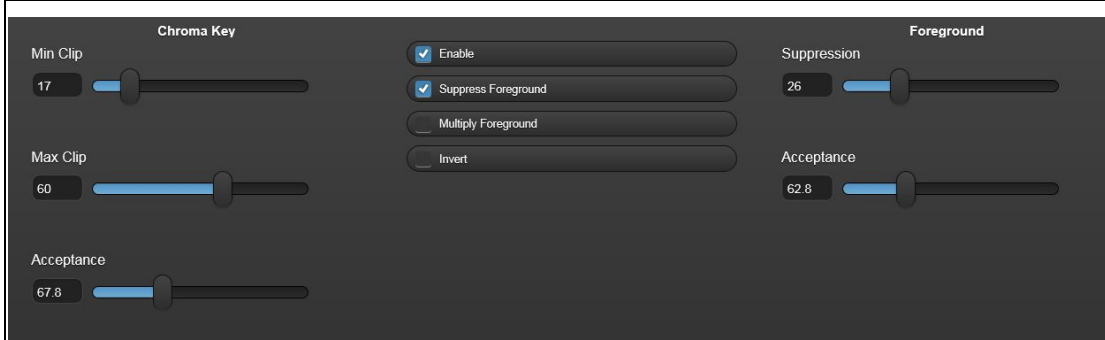
Each tab is shown with a screen grab and description of each control's function:

| Auto Setup | | |
|---|---|---|
| **Set up chroma key auto-sampling. Select the position of the sample and grab to create a composite image.** | | |
|  | | |
| **Auto Settings** | **Reset Chroma Keyer** | Return Safire 3 Xpress to its calibrated settings. |

| Sample Setup | Grab | Set up Safire 3 Xpress using sample taken from the backdrop area. The following parameters are automatically adjusted: Max Clip, Key Hue, Suppression Hue, Foreground Suppression and Background Saturation. |
|---|---|---|
| Show Sample | Show Sample on Main | Select this to display the sample position as a small rectangle on the Main output. |
| | Show Sample on Aux | Select this to display the sample position as a small rectangle on the Aux output. |
| | Freeze Input | Select this to freeze the FG input signal. This is useful to enable accurate positioning of the backdrop sample when the subject is moving. |
| Sample Position | Horizontal/Vertical | Adjust the sample's position horizontally and vertically to the desired location. |
| | Reset Sample | Return sample position to its default location. |

## Gain & Spill

Manual adjustment of chroma key controls including key clip and gain. Control key and FG suppression acceptance angles, and FG suppression gain. Set up chroma key suppression modes.

| | | |
|---|---|---|
| **Chroma Key** | **Min Clip** | Adjust the offset of the key signal that will cut a hole in the new Background video signal. Increasing the min clip value will force lower key levels to zero. This is mainly used when small amounts of key level remain in foreground object areas causing breakthrough of the new background. Any increase in min clip value will have to be compensated for by reducing the max clip value to restore the key in other areas. Note that shadows and scuffs appear as high to mid level key values and that increasing the min clip setting and reducing the max clip setting will tend to accentuate these. The effect of this control is best observed by monitoring the Output Key. The default level for this control is 0. |
| | **Max Clip** | Adjust the gain of the key signal that will cut a hole in the new Background video signal. 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. Adjusting this control is a compromise between removing key variations and retaining key edge detail. The effect of this control is best observed by monitoring the Output Key. The default level for this control is 50. |
| | **Acceptance** | Adjust this control to change the range of colours about the hue colour (acceptance angle) used by the new Background key circuitry. Monitor the output key and with the min and max clip controls set to default values, adjust this control to give the best overall key. Note: It may help to invert the key output in the Engineering menu so that full key level is peak white and no key is black. Setting the acceptance value too small may result in an uneven key in the chroma key backdrop area. Too large a value may cause keying in foreground areas resulting in the new background breaking through to the foreground. |
| **Chroma Key Control** | **Enable** | Select this to enable chroma key operation on the foreground. |
| | **Suppress Foreground** | Select this to enable FG suppression. This is usually always selected if 'Multiply Foreground' is NOT selected. If 'Multiply Foreground' IS selected then deselecting this option can sometimes give better results if FG suppression has altered foreground colours. |

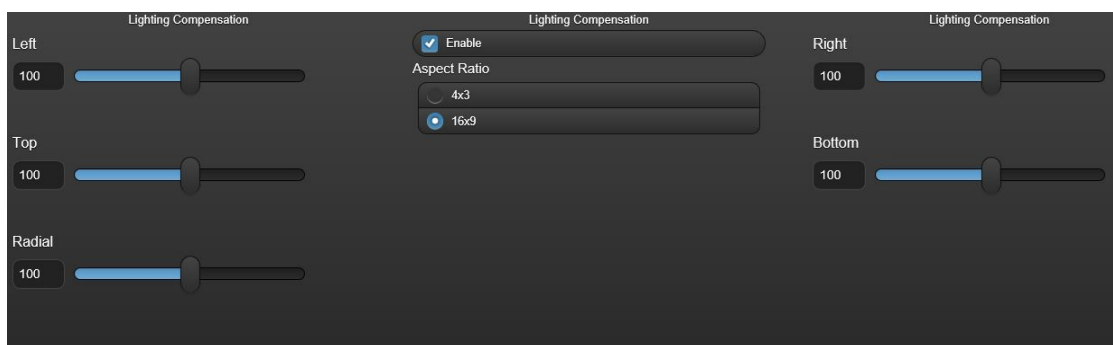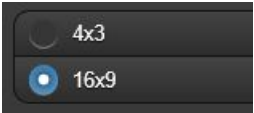| | | |
|---|---|---|
| | **Multiply Foreground** | Select this to multiply the Foreground by the inverse of the new Background key. If de-selected, the FG is added to the keyed background. With good lighting and a high quality chroma key backdrop it is usually better to not select 'Multiply Foreground' as FG Suppression and non-multiply mode give better results particularly with fine detail such as hair. However sometimes it is not possible to fully suppress all backdrop detail from the FG picture and that can show in the final composite. In this case multiply mode will cut out the backdrop entirely, but at the expense of fine detail. The different modes should be tried to see what gives the best result. |
| | **Invert** | In Multiply Foreground mode this control will invert the generated key – thereby swapping the FG and BG pictures in the final composite. |
| **Foreground** | **Suppression** | Adjust this control to set the suppressed backdrop area to black. Monitor the keyed FG signal and set the control to the minimum level necessary to give a solid black in the chroma key backdrop area. This control is best adjusted after the hue and acceptance controls have been set and – because because of their interactive nature – the min and max clip controls set to their default values. Note that when the suppressed FG signal and keyed Background signal are added together to form a final composite, any luminance in the FG backdrop area will be added to the new background. This can sometimes be compensated for with BG lift reduction in the BG Match sub menu of the Colour Adjust tab, but every attempt should be made to achieve as close to black as possible. Over-suppressing will distort edges possibly causing a black halo around FG objects. |
| | **Acceptance** | Adjust this control to change the range of colours about the hue colour (acceptance window) suppressed by the Foreground suppression circuitry. Monitor the Keyed FG signal and adjust this control to entirely suppress the chroma key backdrop colour. If the acceptance angle is set too small, then due to variations in backdrop colour, a colour tint may remain in places. If the angle is set too large then unwanted suppression may occur on foreground objects. Adjust the hue control as well to get the best compromise if there are large variations in backdrop colour. This control is best adjusted with the suppression control set mid-way to see the effect most clearly. |

## Hue & Shadow

Manually set the chroma key colour, compensate for under-saturated backdrop colour and fine-tweak the balance between FG suppression window.



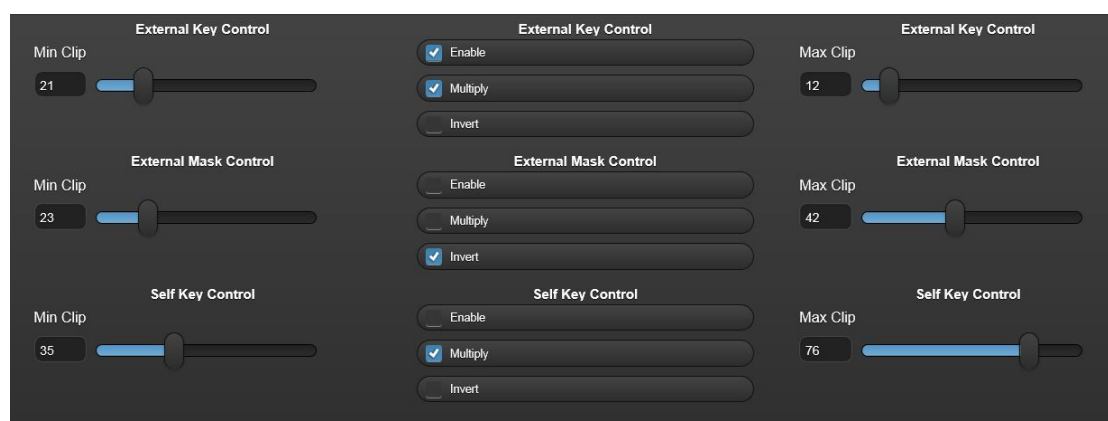| Hue & Shadow | Shadow Density | This control changes the appearance of shadows. Increasing the value of this control will make shadows appear more prominent and decreasing less prominent. |
|---|---|---|
| | Key Hue | Set the colour that will be used by the new Background key circuitry. Monitor the output key, and with the acceptance control set to 90 degrees, and the min and max clip controls set to default values, adjust the control to give the best overall key. Note: it may help to invert the key output in the Engineering menu so that full key level is peak white and no key is black. Note also: this control rarely needs adjusting after auto setup. |
| | Suppression Hue | Set the colour that will be used by the Foreground suppression circuitry. Monitor the Keyed FG signal and adjust this control to suppress the chroma key backdrop colour. Note that often there is a variation in backdrop colour caused by lighting etc. so adjust this control to give the best suppression in the most noticeable areas. This control is best adjusted with the suppression control set mid-way and the acceptance control set to 90 degrees to see the effect most clearly. Note also: this control rarely needs adjusting after auto setup. |
| | Key Shrink | Adjust the shape of the key. If a black line appears around foreground objects when the new background is added, adjust the key shrink control to help compensate for this. |

| | | |
|---|---|---|
| | **Background Saturation** | This control helps compensate for a poorly saturated camera output in FG backdrop areas. Ideally, a well lit backdrop would produce a 100% saturated colour output from the camera - but this is rarely the case. While monitoring the output key and with max clip set to 100, adjust this control to provide an even and low noise key in the backdrop area. The max clip control can then be adjusted to amplify the key to full level. This control is automatically set by quick setup. |

## Lighting Compensation

**Compensate for a poorly lit backdrop.**



| | |
|---|---|
| **Left/Top/Right/Bottom** | These controls help compensate for uneven backdrop lighting. By monitoring the output key and adjusting the lighting compensation controls it is possible to minimise the effects of lighting edge fade. With max clip set to 100, adjust the position controls to provide as even a key distribution in the backdrop area as possible. These controls are automatically set if 'auto lighting' is selected in quick setup. |
| **Radial** | The lighting distribution of a spotlight is a bright centre that fades away to the edges in a circular pattern. The Background key produced when a spotlight is used to illuminate a chroma key backdrop will reflect that lighting distribution. Increasing key gain (max clip) will help compensate for that but at the expense of fine detail. By monitoring the output key and adjusting the lighting compensation controls it is possible to minimise the effects of lighting edge fade. With max clip set to 100, adjust the radial control to provide as even a key distribution in the backdrop area as possible. These controls are automatically set if 'auto lighting' is selected in quick setup. |

| Aspect Ratio | ○ 4x3 <br> ● 16x9 | Select the aspect ratio of the radial lighting compensation to match the image. |
|---|---|---|

## Keys & Masks

**Set clip and gain levels for the External Key, External Mask and Self Key. Enable all keys, set key operation to Multiply and enable key inversion.**



| External Key Control | Min Clip | Use this control to clip all key signals below the threshold set by the control – i.e. if the control is set to 20 then all key levels up to 20% of max will be removed. |
|---|---|---|
|  | Max Clip | Use this control to amplify and clip all key signals above the threshold set by the control – i.e. if the control is set to 80, then all key levels above 80% of max will be clipped and amplified to full scale. |
|  | Enable | Select to enable the External Key signal as a key. The BG picture is keyed and filled with the FG source. Use this control to key a caption into the Background video and fill with matte, black or video. This key augments the chroma key and self key in its active areas. In chroma key mode this key will force the FG video to mask chroma keying in unwanted regions. The external key combines with the self key to extend the size of the key. |

| | | |
|---|---|---|
| | **Multiply** | Select to key the FG signal before adding to the keyed BG signal. Select if the FG signal is not black outside of the caption fill area. |
| | **Invert** | Select to invert the clipped key. |
| **External Mask Control** | **Enable** | Select to enable the external key signal as a mask. The mask signal disables the self key and chroma key in its active areas. If the chroma key is enabled the mask will force the final composite to Background and this can be used to compensate for missing backdrop areas or to promote an area of Background to the front of the composite. |
| | **Multiply** | Multiply mode is the normal way of using the external mask; the suppressed FG signal is keyed with the mask prior to adding to the BG. In non-multiply mode the FG signal is not keyed and added to the BG signal. |
| | **All other controls** | As External Key. |
| **Self Key Control** | **Enable** | Select to use the luminance of the FG signal as a key. The BG is keyed and filled with the FG source. Use this control to key a caption derived from the FG video into the Background video and fill with a matte, black or video. Usually chroma key mode would be disabled if self key mode is enabled. |
| | **Multiply** | Select to key the FG signal before adding to the keyed BG signal. Select if the FG signal is not black outside of the caption fill area. |
| | **All other controls** | As External Key. |

| Internal FG Mask | | |
|---|---|---|
| **Enable and set rectangle size for internal FG mask.** | | |



| | |
|---|---|
| **Left/Top/Right/Bottom** | Use these controls to position the mask rectangle. |

| | |
|---|---|
| **Enable** | Select this control to enable the FG mask. This user-positionable mask will override the chroma key in its active area to force the BG signal. Use this mask if the chroma key backdrop is too small or damaged, or badly lit at the edges. |
| **Invert** | Select this control to invert the mask. |

## Internal BG Mask

### Enable and set rectangle size for internal BG mask.



| | |
|---|---|
| **Left/Top/Right/Bottom** | Use these controls to position the mask rectangle. |
| **Enable** | Select this control to enable the BG mask. This user-positionable mask will override the chroma key in its active area to force FG video. Use this mask to disable the chroma key in FG non-backdrop areas containing the key colour, or reflective objects. Note that the BG mask does not override FG suppression, only the BG key. |
| **Invert** | Select this control to invert the mask. |

## FG Mask Softness

### Set the amount of softness for each edge of the FG mask rectangle.

| FG Softness | Left/Top/Right/Bottom | Use these controls to soften the four edges of the mask to make the mask less noticeable. The internal masks can be configured and positioned as a rectangular wipe and added softness can be used as an artistic effect. |
|---|---|---|

## BG Mask Softness

**Set the amount of softness for each edge of the BG mask rectangle.**



| BG Softness | Left/Top/Right/Bottom | Use these controls to soften the four edges of the mask to make the mask less noticeable. The internal masks can be configured and positioned as a rectangular wipe and added softness can be used as an artistic effect. |
|---|---|---|

## Signal Status

**Monitor the status of all inputs and outputs.**

| | | |
|---|---|---|
| **FG / BG / Key Input** | **Standard** | **Shows input video standard i.e "1920x1080/50i" or "missing" if none detected.** |
| | **Input Present** | **Lights green if input video present.** |
| | **Input Black** | **Lights yellow if input video at black level.** |
| | **Input Frozen** | **Lights yellow if input video frozen.** |
| | **Input ATC Present** | **Lights green if audio timecode is detected.** |
| **Reference Input** | **Standard** | **Shows input video reference standard i.e "1080/50i" or "missing" if none detected.** |
| | **Input Present** | **Lights green if reference video present.** |
| **Output** | **Standard** | **Shows output video standard i.e "1920x1080/50i".** |
| | **Input Freeze Enabled** | **Lights yellow if FG input freeze selected in 'Auto Setup'.** |
| | **Output Faded to Black** | **Lights yellow if output faded to black in 'Key Fade'.** |

## Key Status

**Monitor the status of Chroma Key, External Key, Self Key and External Mask.**



| | | |
|---|---|---|
| **Chroma/Self/External Key** | **Enabled** | **Lights yellow if key is enabled.** |
| | **Faded Down** | **Lights yellow if key is faded down.** |

| | | |
|---|---|---|
| **Masks Enabled** | **External** | Lights yellow if External mask enabled in 'Keys & Mask'. |
| | **FG** | Lights yellow if FG mask enabled in 'Internal FG Mask'. |
| | **BG** | Lights yellow if BG mask enabled in 'Internal BG Mask'. |

## Key Fade

**Fade all keys up and down – fade outputs to and from black.**
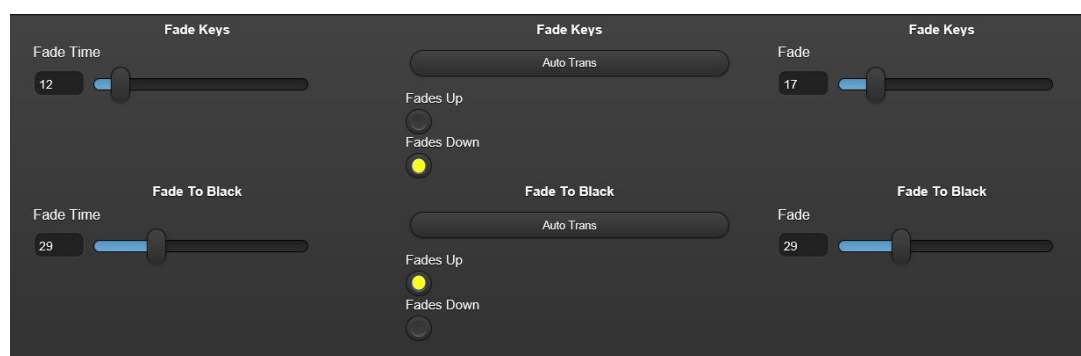


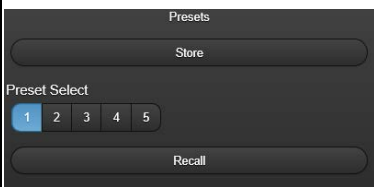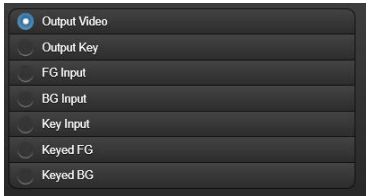| | | |
|---|---|---|
| **Fade Keys** | **Fade Time** | Use this control to set an autotrans fade time of 0-100 seconds. |
| | **Fade** | Use this control to manually fade keys up and down. |
| | **Auto Trans** | Use this control to automatically fade enabled keys up and down at the rate set by the Fade Time control. In chroma key mode the FG image will be faded up and down but masks are unaffected. External and self key will fade up and down. |
| | **Fades Up/Down** | These indicate which direction the autotrans operation will take. |
| **Fade to Black** | **Fade Time** | Use this control to set an autotrans fade time of 0-100 seconds. |
| | **Fade** | Use this control to manually fade outputs to and from black. |

| | Auto Trans | Use this control to automatically fade main and aux outputs to and from black at the rate set by the Fade Time control. |
| | Fades Up/Down | These indicate which direction the autotrans operation will take. |

## Presets & Outputs

**Select which preset memories to save to or recall from. Select output signal for Main and Aux video outputs.**



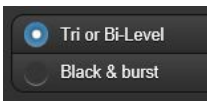| Store | Store Safire 3 settings as one of 5 presets. |
|---|---|
| **Preset Select** |  Select preset number 1-5 to store or recall. |
| **Recall** | Recall one of 5 previously stored settings. |

| | |
|---|---|
| **Main/Aux Outputs** | Select which signals are routed to the Main and Aux video outputs:<br><br>**Output video**: the composite chroma keyed result.<br><br>**Output key**: the key signal, as a monochrome image, produced by the combination of the chroma keyer, other keys and masks.<br><br>**FG input**: the Foreground video input.<br><br>**BG input**: the Background video input.<br><br>**Key input**: the external key input signal.<br><br>**Keyed FG**: the suppressed Foreground image after chroma keying. This signal is useful for fine adjustment of the various controls to optimise the removal of the key colour from the subject.<br><br>**Keyed BG**: the Background signal after keying. This signal is useful in fine adjusting the key gain and other controls. |

## Engineering - Delay & Timing

Select genlock source, output timing with respect to reference and video delays for all inputs.
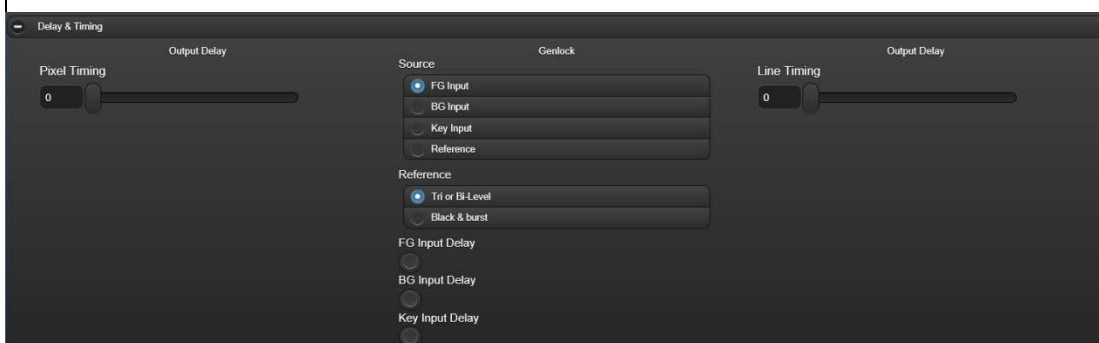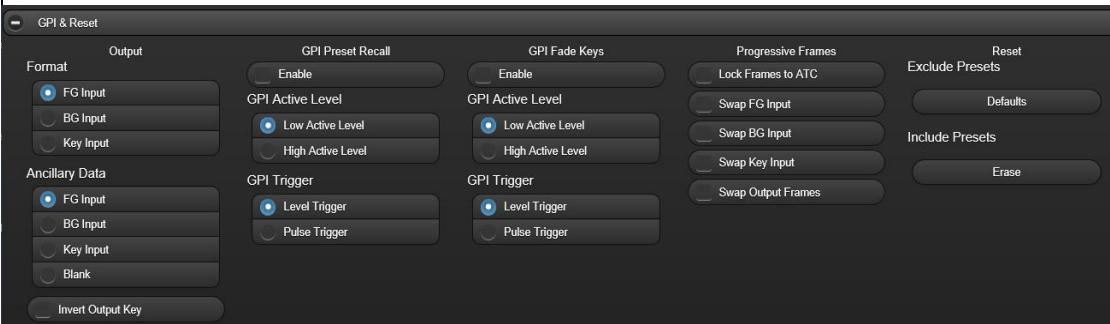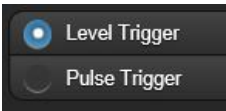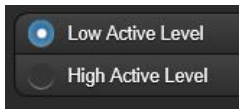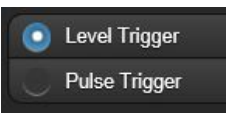
| | | |
|---|---|---|
| **Output Delay** | **Pixel Timing** | Delay output video horizontally by 0 to 2640 pixels with respect to reference. (See note below.) |
| | **Line Timing** | Delay output video vertically by 0 to 1125 lines with respect to reference. See note above for max delay. *Note: the total Pixel + Line delay can not exceed one frame for any output standard. E.g. 720 lines is the maximum delay for 720p standard.* |

| Genlock | Source |  | Select which input Safire 3 Xpress will use as its reference source. |
| | Reference |  | Select whether the external analogue reference input is Tri-Level or Black & Burst. No reference needs to be applied unless 'Reference' is selected as the genlock source. |
| | Foreground, Background, Key - Input Delay | Indicates whether the output signal is more than one whole frame delayed with respect to each input. | |

## Engineering – GPI & Reset

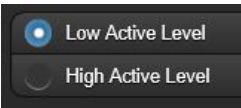**Control Engineering functions such as Ancillary data, GPI preset recall, GPI fade keys, swap field sequences and reset Safire 3 Xpress.**



| Output | Format |  | Select which input video should be used as the format for the video output. |

| | | | |
|---|---|---|---|
| | **Ancillary Data** | FG Input<br>BG Input<br>Key Input<br>Blank | Select which video input is the source of output ancillary data, or blank it. |
| | **Invert Output Key** | | Select this to invert the output key. Use this to match the key polarity with other equipment or for monitoring purposes to make the key more visible. |
| **GPI Preset Recall** | **Enable** | | Select to enable recall of presets by GPI. Presets 1-32 can be selected from the binary coding of the external GPI inputs. |
| | **GPI Active Level** | Low Active Level<br>High Active Level | Select low or high level as the active level for the GPI. |
| | **GPI Trigger** | Level Trigger<br>Pulse Trigger | Select whether GPI recall should be triggered by a change in level or a pulse. |
| **GPI Fade Keys** | **Enable** | | Select to enable fading of keys by GPI. |
| | **GPI Active Level** | Low Active Level<br>High Active Level | Select low or high level as the active level for the GPI. |
| | **GPI Trigger** | Level Trigger<br>Pulse Trigger | Select whether GPI triggering should be triggered by a permanent change in level or a transition. |
| **Progressive Frames** | **Lock Frames to ATC** | | Lock the HD progressive video output to Ancillary Timecode. |
| | **Swap FG/BG/Key Input** | | Swap field sequence of the selected progressive video input. |
| | **Swap Output frames** | | Swap field sequence of the progressive video output. |

| Reset | Defaults | Select to restore Safire 3 Xpress to default conditions without erasing stored presets. |
|---|---|---|
| | Erase Presets | Select to restore Safire 3 Xpress to default conditions AND erase stored presets. |

# 8 Using Safire 3 Xpress

In this section, when we refer to 'FG' and 'BG' we are referring to the FG and BG input video signals. FG is the signal with objects placed in front of a coloured backdrop. BG is the signal that will replace the coloured backdrop in the final composite. Whereas, to avoid confusion, 'foreground' and 'backdrop' refers to parts of the FG image.

Here is an example of a FG image:



The model is sitting in front of a green backdrop. The backdrop can be of any uniform colour provided the foreground objects don't contain exactly the same colour. The backdrop must be well and uniformly lit and the foreground objects placed at least 2m in front to reduce colour tinting from backdrop reflections (see section Chroma Key Tips).

The BG image will appear behind the foreground objects in place of the backdrop. Here is an example of a BG picture:

With *Suppress Foreground* in the Gain & Spill menu selected, the chosen hue set by the *Suppression Hue* control in the Hue & Shadow menu is subtracted from the FG signal to replace the backdrop colour with black:



Above, the green backdrop has been replaced by black and other foreground colours remain largely unaffected. A similar process is used to create a 'key' to cut a hole in the BG signal. In this case the *Key Hue* control in the Hue & Shadow menu sets the key colour:
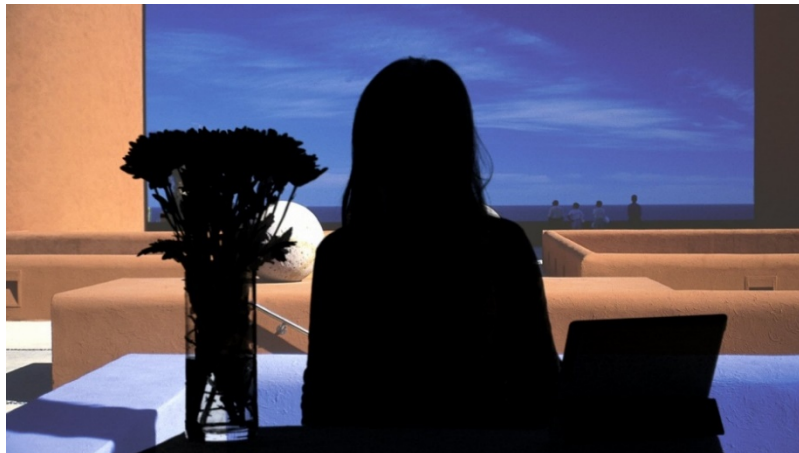


The two images are then added together to create a high-quality composite:

If **Multiply Foreground** is selected, the FG signal is keyed before adding to the keyed BG. Normally this is left de-selected but can be used if it otherwise proves impossible to create a realistic effect. In this mode, 'Suppress Foreground' can still be selected to suppress any colour tinting on foreground objects.

***Selecting 'Suppress Foreground' and de-selecting 'Multiply Foreground' helps retain fine foreground detail and generally gives the most realistic results with a well-lit backdrop.***

Safire 3 Xpress is capable of producing a very realistic composite chroma key image, but to get the best results, attention must be paid to the lighting and quality of the coloured backdrop, the lighting of the foreground objects and colour and reflectivity of foreground objects. If all of the above have been considered, then the Auto Setup feature of Safire 3 Xpress will give excellent results.

# Auto Setup

For most well lit scenes, **Auto Setup** provides an acceptable chroma keyed result. Not all of Safire 3 Xpress's controls are adjusted automatically so some knowledge of the other controls is essential. Each control is explained in detail in the 'Controls' section but the following brief explanation with pictorial examples will help aid understanding.

Auto Setup works by using a sample taken from the backdrop area to automatically adjust most of Safire 3 Xpress's settings to achieve the best result by taking into account variations in illumination and saturation. Auto Setup allows the position of the sample to be adjusted and it also offers the option of freezing the FG input video to make positioning the sample easier.



In the above example, the sample can be seen as a small white rectangle by the model's head.

The **Grab Sample** control in the Auto Setup menu automatically produced the following composite image:

Here we can see a realistic result; notice that hair detail and glass transparency has been retained. Not all FG images are as well lit as the above example and it may be necessary to fine tune Safire 3 Xpress's settings after Auto Setup.

## Foreground Suppression

Safire 3 Xpress works by suppressing the colours of foreground objects within a range of hues set by a combination of the *Suppression Hue* control in the Hue & Shadow menu and the Foreground *Acceptance* control in the Gain & Spill menu. Foreground colours that are exactly the same as the selected hue are suppressed to black and other colours close to that are suppressed to varying shades of grey. The Foreground *Suppression* control in the Gain & Spill menu adjusts the result to provide an even black backdrop – this control is set automatically by Auto Setup. The following picture shows the Keyed FG output where all the backdrop area has been suppressed to black prior to adding to the keyed BG signal.



If we manually adjust the Foreground *Suppression* control away from ideal to show a grey backdrop, it shows more clearly the effects of colour suppression. In the next picture you can see residual green backdrop colour around the model's hair – this is because the Foreground *Acceptance* control, which adjusts the range of colours that are suppressed, has been set at too small a value.

This control is set automatically by Auto Setup but may need adjusting for best results. In the next picture the Foreground *Acceptance* control has been set at too large a value and has noticeably changed the colour of the leaves of the flowers in the vase.



Adjustment of the Foreground *Acceptance* control is a compromise between removing residual backdrop colour and leaving wanted foreground colours unaffected.

Another example in the picture below shows the model wearing a top of similar colour to the blue backdrop:

Auto Setup produces the following result:
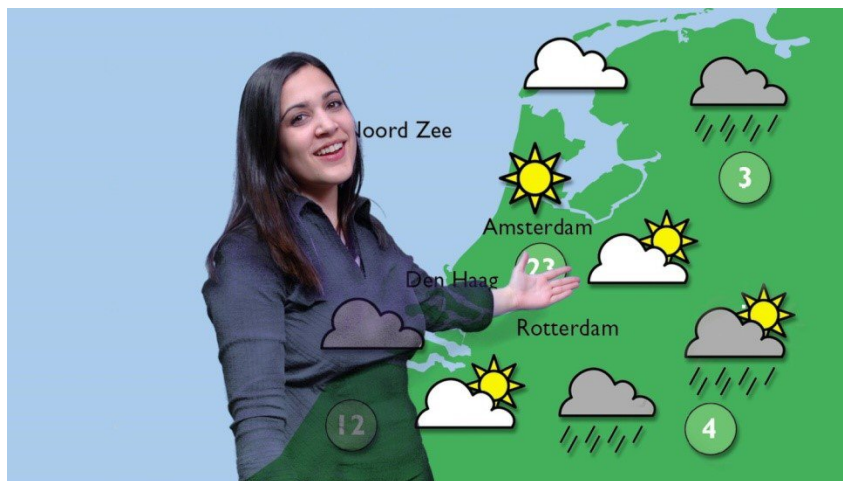


Some key remains, which causes the BG signal to be visible on foreground areas – but adjusting the *Min Clip* control resolves this:



Notice how the model's top now appears purple as suppression has removed some blue from it, but this can be improved by minimising the Foreground *Acceptance* control:

This an area where *Multiply Foreground* mode can sometimes be advantageous. De-selecting *Suppress Foreground* ensures that there can be no colour change to foreground objects of similar colour to the backdrop.

## Background Key

The key that cuts the hole in the new BG is derived from *Key Hue* in the Hue & Shadow menu and Chroma Key *Acceptance* in the Gain & Spill menu, and modified by the Chroma Key controls, *Min Clip* and *Max Clip*. The *Key Hue* and *Acceptance* controls are independent of those that produce Foreground suppression and are automatically set by Auto Setup, but may need adjusting.

The following picture is the Output Key signal produced by Auto Setup. This is the level of quality of key to aim for - solid blacks and whites with no noise and fine detail retained.



In the Gain & Spill menu, the *Min Clip* and *Max Clip* controls are used to clip the key at its minimum and maximum levels. Both these controls are set automatically by Auto Setup but may need adjusting. *Min Clip* is mainly used to reduce any small amounts of key level in foreground object areas causing breakthrough of the BG picture. Increasing the *Min Clip* value will force lower key levels to zero. Shadows can also be accentuated by raising *Min Clip*.

*Max Clip* is used to increase the overall gain of the key signal, removing variations to give an even result. The following picture is the Output Key with Max Clip set to a low value – although there are no variations in key in backdrop areas, fine hair detail has been lost. Set *Max Clip* to as high a value as possible.



Low values of *Max Clip* also change the shape of the key causing edges to be more noticeable in the composite output.

# Fine Controls

To illustrate the more advanced Safire 3 Xpress features it is necessary to use a more challenging FG signal. The backdrop is unevenly lit and has shadows and reflections that may or may not be wanted. The model is also wearing a shiny black jacket that tends to reflect and cause an unwanted key.



Auto Setup produces a key with signs of breakthrough in the black jacket and skirt. The reflective floor is also producing a key. The Key Output in the picture below shows unwanted keying in the model's jacket:

To illustrate the importance of good lighting and backdrop quality, in the following picture the *Max Clip* value has been deliberately raised above the Auto Setup value to show the raw key signal:



The variations in backdrop illumination can clearly be seen, as can scuff marks on the floor. Should Auto Setup fail to produce a satisfactory result, these imperfections can be minimised by manually adjusting the key gain controls:

With *Min Clip* set to zero and *Max Clip* set to 40, adjust the *Background Saturation* control in the Hue & Shadow menu to give as best a 'noise' free key signal possible – aim for consistent greys.

Now adjust *Min Clip* sparingly to remove any residual key noise.

Then adjust the *Max Clip* control to get the best key output. The following picture shows the improved Key Output after the above process:

Notice that the floor reflections still remain in the key signal. Increasing key gain by reducing the *Max Clip* value will certainly remove the keying in the floor area but at the expense of key quality. Increasing the *Min Clip* value will have the opposite effect by emphasising low key levels. The following picture shows just that:



The key on the floor area has been exaggerated. This can be useful when shadows need to be emphasised, but not in this case. The Hue & Shadow control *Shadow Density* changes the density of the key signal in shadow areas to enhance or reduce shadows:

The final composite shows a realistic scene with shadows removed and some fine hair detail remaining:



Even better results can be obtained with careful lighting and non-reflecting and unmarked backdrop surfaces.

## Lighting Compensation

The light output from a studio light often fades towards the edges which results in a non-uniform key signal requiring more key gain to even it out. The Lighting Compensation controls boost the key at the edges, or radially.

# Keys and Masks

See section 'Key Signals' for more information on how keys and masks combine.

In addition to the chroma keyer, Safire 3 Xpress can generate an internal linear self key derived from the luminance of the FG signal. This can be used to key a caption into the BG video and fill with FG video. In the picture below the Crystal Vision logo signal is the FG input and is self keyed into the BG signal using the FG signal as both key and fill. *(Note: The model in front of the green backdrop is the BG signal in this setup.)*

The Self Key*, Max Clip* and *Min Clip* controls are adjusted to give the best result.

## External Key

The *External Key* input can be used as a linear key to cut a hole into the BG signal. Logos often have two separately generated components – a key and a fill. To create the picture below, the model in front of the green backdrop is the BG signal, the logo key signal is fed to the External Key input and the logo fill signal to the FG input:



The External Key can also be used as a FG force signal during chroma keying to prevent unwanted keying on foreground objects. In the example below, the chroma keyer has been set to key off the pitch colour in Multiply Foreground mode. The logo signal here is both the External Key input and BG signal. The logo needs to appear as though it is painted onto the pitch with players apparently able to walk over it, and it is possible to combine the chroma key and External Key to limit chroma keying to the External Key area only:

Because, in this case, the key and fill signals are the same signal, the External Key signal *Inversion* control needs selecting to disable chroma keying in the non-logo key areas by forcing the FG signal (See Section – Key Signals). Below is the Key Output:
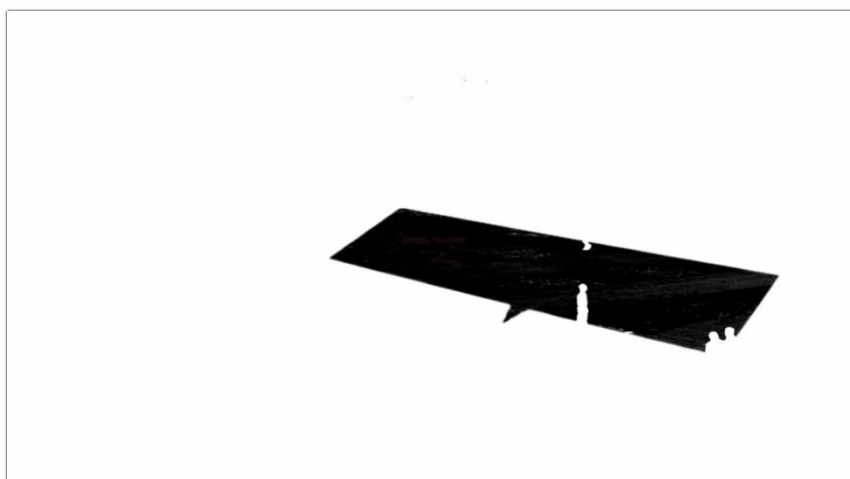


The white outline of players and spectators produced by the chroma key can be seen, but note that there is no other chroma keying outside of the logo key area. The External Key can also be used to prevent unwanted keying on foreground objects during normal studio chroma key operation. For example, if the foreground contained an object of exactly the same colour as the backdrop, or a highly reflective object was causing unwanted keying, then a well placed key could be input to prevent this.

## External Mask

During chroma keying, the ***External Mask*** combines with the chroma key to force the BG signal. In the following example, a BG signal is chroma keyed behind the model as before but an External Key input signal that matches some parts of the BG signal is enabled as an External Mask:

BG signal.
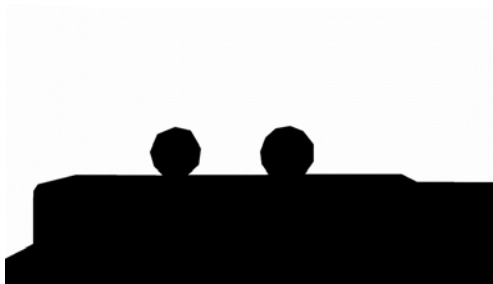


External Key signal as External Mask.

The External Mask signal combines with the key produced by the chroma keyer, as can be seen in the following Key Output:



The result is that part of the BG signal now appears to be in front of the FG image:

This technique is commonly used to promote architectural features such as pillars from the background to the foreground so actors appear to be walking behind them.

## Internal Masks

Safire 3 Xpress has two independent internal rectangular mask generators to remove unwanted foreground keying and to force keying in areas where the backdrop is too small or badly illuminated. These masks can be re-sized, inverted or not and moved to the ideal position. The following are examples of where FG and BG mask generators could be useful:



In this example the backdrop is torn either side and features a discoloured patch.

Without the *FG Mask* the tears are clearly visible. The patch can be keyed out by widening the FG Acceptance window and adjusting the key controls:

With the FG Mask the left hand side and some of the right hand side tears are removed by correct positioning of the FG Mask rectangle:



As part of the right hand side tear is within the wanted foreground image area it cannot be totally masked without losing some part of the foreground. To remove this entirely would require an external key signal set up as a mask. The second example shows the FG model wearing a badge of identical colour to the backdrop. Normally this would cause an unavoidable key.



After chroma keying the BG image can be seen in the badge:

Using the *BG Mask* controls, a rectangle can be placed over the badge to disable keying in that area. Note that FG suppression would still be acting, so the chroma keyer must be set to Multiply Foreground mode to retain the original colour:

# 9 Key Signals

All the keys in Safire 3 Xpress combine to form a single key which is used to cut a hole in the BG picture. The keys combine as a logical 'OR' such that high level (white) areas take priority. All keys can be individually inverted from VisionPanel or other control options.

The following is a pictorial description of key polarities for common Safire 3 Xpress key operations. The **White** (high level key) is the part of the key signal that will show the FG picture and **Black** (low level key) the BG picture.
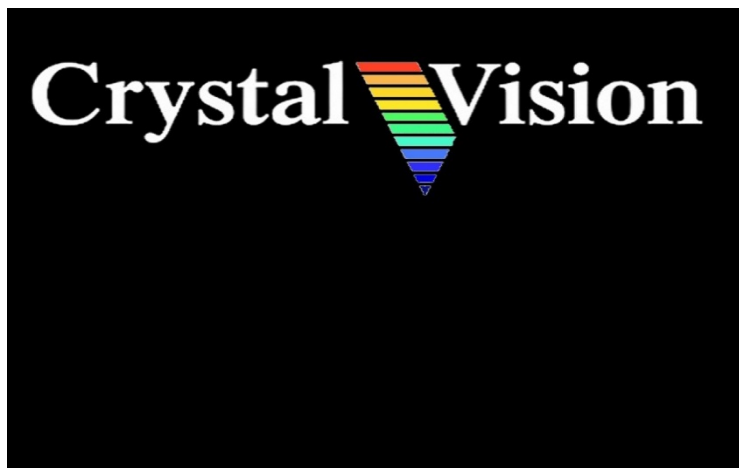
## Chroma key

Generated by Safire 3 Xpress to cut a hole in the BG signal. The white areas will show the selected FG source, usually the suppressed or keyed FG picture:



## Self Key

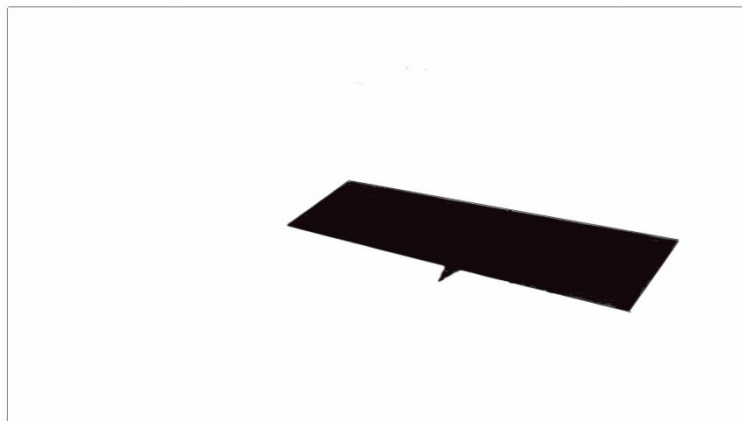To cut a caption derived from the FG signal into the BG and fill with same FG video.
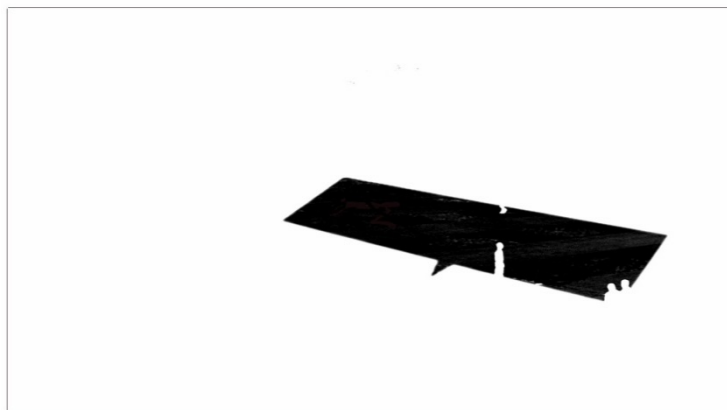
## External Key

To cut a caption using the external key input into the BG signal and fill with FG video.



To force the FG picture to override the chroma key:



This key shape would limit chroma keying to the black area only and force the FG picture to stay unaffected in the white areas.

## External Mask

The External Key input when used as an External Mask combines with the other keys as a logical 'AND' such that black areas take priority.

To force the BG picture to override the chroma key using the external key input as a mask:
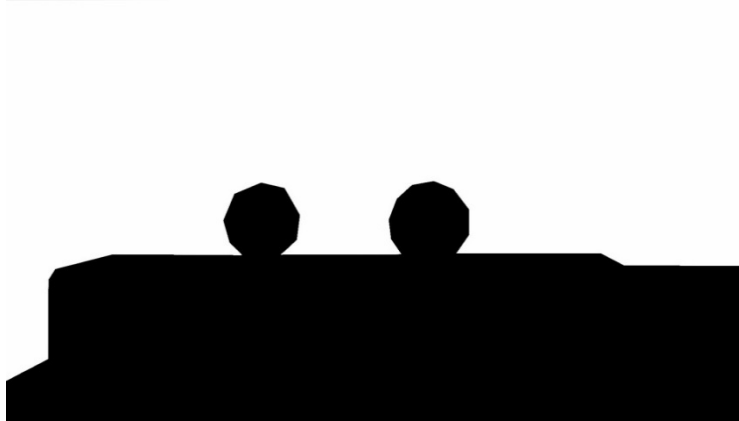


The mask signal above combines with the chroma key to force the composite to BG in the black areas:



Or to override the chroma key in areas where the backdrop is missing, damaged or poorly lit – typically the edges:

# 10 Chroma Key Tips

## Lighting

Proper set lighting is essential for realistic chroma keying and can help to minimise the amount of time required to set up Safire 3 Xpress.

The coloured backdrop must be as evenly illuminated as possible over its entire useable surface. Variations in lighting cause chroma key level variations which require extra key gain to remove. As key gain is increased, the shape of the key edges change making the composite result less realistic. Lighting Compensation controls can help minimise the effects of uneven lighting.

Wherever possible use the same type of lighting on the backdrop – all tungsten, all LED etc. Try to avoid mixing light types as they have different colour temperatures and will produce a variable key signal.

The lighting on the backdrop should be diffused and as low level as possible to minimise spill – that is the reflection of the backdrop colour onto the foreground – but bright enough to produce a low-noise camera output. Ideally, the backdrop lighting should have roughly the same incident light level as the subject's key light.

## Subject Placement

To minimise spill, the foreground subjects should be as far away as possible from the backdrop, at least 2m. This may not be possible with weather maps, for example, but some lighting techniques can minimise the effect of spill: up or down lighting the vulnerable areas with white light can help, as can using a gel of a complementary colour – i.e. a magenta gel when using a green backdrop.

## Background

The backdrop itself should be of a consistent quality: scuff marks, patches etc. also require increased key gain. Use an internal or external mask signal to force the composite to BG in difficult areas.

The backdrop should be of a non-reflective nature as should the floor surface. It is very difficult to avoid keying on foreground reflections from a shiny floor.

## Clothing

The colour of foreground objects should be chosen to be dissimilar, wherever possible, to the backdrop colour. Narrowing the acceptance angle to avoid keying on foreground objects makes it harder to achieve a good key on variations in backdrop colour.

## Reflective Foreground Objects

Any Foreground object that is reflective may reflect some of the backdrop colour causing unwanted keying. Use the internal BG mask or external key to prevent keying on glass table tops etc. unless wanted, but consider that natural reflections often mirror image the reflected scene.

# 11 Troubleshooting

## Card edge monitoring

The front edge of the card provides useful power rail monitoring and input status.



*Safire 3 Xpress front edge view*

See **Card Edge Controls** for explanation of card edge LEDs.

The card edge LEDs and 10-digit display may be used in conjunction with status information from any connected remote status panel display or from VisionWeb if available.

*Board edge control was removed from Safire 3 Xpress in 2019. Therefore the card edge control information is only relevant for older versions of the product.*

## Basic fault finding guide

**The Power OK LEDs are not illuminated**

> Check that the frame PSU is functioning – refer to the appropriate frame manual for detailed information

**There is no video output**

> Check that a valid SDI input is present and that any cabling is intact

**The video output exhibits jitter**

> Check that the input SDI stability is within normal limits

**The card no longer responds to front panel control**

> Check that the card is seated correctly and that the Power OK LEDs are lit
> Check any active control panel cabling
> Check if the control panel can control another card in the same rack
> If necessary reset the card

**Resetting the card**

> If required, the card may be reset by removing the card from the rack and then re-inserting it
> It is safe to re-insert the card whilst the rack is powered. Any previous configuration will be retained, use a factory reset to erase any configurations stored in the card

# 12 Specification

## Safire 3 Xpress

**General**

| | |
|---|---|
| Dimensions | 100mm x 266mm module with DIN 41612 connector. |
| Weight | 200g. |
| Power consumption | 11.9 Watts. |

**Inputs**

| | |
|---|---|
| Video | HD or SD SDI 270 Mb/s to 2.970 Gb/s serial digital compliant to EBU 3267-E, SMPTE 259M, SMPTE 292M and SMPTE 424M. |
| | Cable Equalisation: |
| | 3G (2.970Gb/s) – 80 metres, Belden 1694A or equivalent. |
| | HD (1.485Gb/s) – 140 metres, Belden 1694A or equivalent. |
| | SD (270Mb/s) >250 metres, Belden 8281A or equivalent. |
| | Automatic de-embedding to SMPTE 272M or SMPTE 299M. |
| Video standards supported | 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). |
| | Input format auto selected. |
| Delay through board | Minimum processing delay of 10us @ 3G, 18us @ HD and 85us @ SD. Maximum processing delay as above + 1 frame. |

**Outputs**

| | |
|---|---|
| Video | Serial output: 270Mb/s to 2.970Gb/s serial compliant to EBU 3267-E, SMPTE 259M, SMPTE 292M and SMPTE 424M. |
| | Output follows the input format. |
| | Audio is embedded to SMPTE 272M or SMPTE 299M. |

**Rear Module I/O**

| | |
|---|---|
| RM50 | Three serial video inputs, one analogue sync input. Two BNC video outputs. |

RM73    Three serial video inputs, one analogue sync input. Two BNC video outputs – Main Output relay bypassed in the event of power failure.

**Status monitoring**

LEDs    Front of card edge LED indicators to indicate:
        PSU rails present.
        SDI input HD/SD.

**GPI inputs**

Number and type:    6 x GPI inputs. For recall of five presets and trigger of auto key transition.
                    Active pull to ground, pulled up to +5V through 10 kohm.
                    Pulse mode GPI to be asserted for min. of 40mS and at least 2mS before vertical interval.

**GPI outputs**

Number and type:    None.

**Input fail output**

Type:    Dark Blue.

**Control**

Remote:    Control from VisionWeb Control web browser software.
           Control from VisionPanel 3U touch screen control panel.
           SNMP control and monitoring via frame CPU and Ethernet connection.

## VisionPanel

**General**

Dimensions:    3U touch screen. 344mm wide, 133.5mm high (3U), 44mm deep (rear connector to mounting plate); 65mm deep (rear connector to display bezel). Weight 1.64kg without stand; 1.97kg with stand.

**Control**

Connectors:    RJ45 Ethernet connection.
               USB2 x 2
               DC power connector.

**Power**    9v dc external mains power supply, 100-240Vac.50/60Hz 1A.