Crystal Vision

SAFIRE HD 2

HD/SD chroma keyer

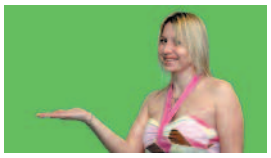
Safire HD 2 produces exceptional digital linear chroma keying for the creation of realistic virtual images, making it ideal for any live HD or SD chroma keying or virtual set production – news, weather, sports programming, chat shows, current affairs, game shows, election broadcasts or drama.

Well known for being the easiest chroma keyer to set up and operate, many side-by-side evaluations have been won on this ease of use. Safire HD 2 also has features you won't find anywhere else – whether it's the special processing to perfect that picture or the unequalled features for sports graphics. It will save you rack space too. This 100mm x 266mm board forms part of a modular system resulting in easy integration with any of Crystal Vision's interface products.

It's no surprise then that Safire HD 2 is used by broadcasters and sports graphics providers across the world.

WHAT IS CHROMA KEYING?

Chroma keying is used to combine a virtual object (Background) with a real image (Foreground) by replacing a real colour (usually blue or green) with a virtual input.



Foreground

Suppressed Foreground

Background

Composite picture

In a typical chroma key the Foreground subject is shot against a well lit uniformly coloured backdrop. A Suppressed Foreground signal is produced in which the backdrop colour is removed and this signal is used to create a key to remove an area from the Background video that is identical in size to the Foreground subject. The Suppressed Foreground is inserted into the backdrop 'hole', then masks can be added to remove unwanted Foreground or Background and any fine-tuning can be applied.

SETTING UP IS EASY!

It's so easy (and quick) to set up a chroma key using the Safire HD 2. It can be auto-configured with the help of a cursor which is used to point at a representative area of the backdrop colour, and this will set all variables and be suitable for most applications. For those that need it, a full range of fine tuning tools are available. A flexible output bus allows the main and auxiliary outputs to monitor each stage of the keying process, allowing you to look at the various internal signals individually and make any changes.

KEY ON ANY COLOUR

While blue and green are the traditional chroma keying colours, Safire HD 2 gives you the flexibility to key on any colour just by selecting it with a cursor. Best results are obtained from intense colours (with high chrominance) that do not occur in the Foreground subject. Safire HD 2 has been used in many sports applications where keying has been required on the normal playing surface.

WORK WITH TRANSPARENT AND REFLECTIVE OBJECTS

Linear chroma keying avoids the hard switch associated with non-linear keying and allows areas of the final picture to be a mixture of both Foreground and Background, permitting the use of transparent and reflective objects (such as spectacles, a glass of water and smoke) and resulting in more convincing edges. Safire HD 2 features both additive and multiplicative keying to suit all types of situations. Additive keying relies on careful attention to the lighting of both backdrops and Foreground objects, but is recommended for shadows and transparent objects.

FILLING IN AND FADING OUT

The fill video may be selected from any one of three video sources: Foreground input, Suppressed Foreground or a single colour from a matte generator. Sophisticated downstream processing of the combined picture is available, allowing fades to the Foreground or Background and a final fade to black.The keyed signal may also be amplified, offset or inverted.

By using the cursor-based auto setup you can quickly produce a usable chroma key which is suitable for most applications. Where conditions are more challenging, a range of tools are available to fine-tune your chroma key...

OVERRULING THE CHROMA KEYING: INTERNAL MASKS AND EXTERNAL KEY

Safire HD 2 offers two internal rectangular masks (Foreground and Background) and an External Key which can be combined with the chroma key for additional effects.

These masks can be used to overrule the keying process. It's not always possible to have a perfect backdrop for your chroma key. Instead you can be faced with imperfections such as uneven lighting or cables running across the set. No problem. These unwanted areas of the Foreground can easily be removed by forcing the Background with a Foreground mask. Similarly *wanted* areas of the Foreground can be forced with a Background mask. Used either together or independently, the Background and Foreground masks can be turned on or off, inverted, and adjusted in position and size.

Then there's the flexible External Key. This should be used when a customised non-rectangular or moving shape is required and can force areas to be either Foreground or Background under the control of a key generated by a graphics system. Force Background allows an External Key to override a chroma key and force part of the Background to appear in front of the subject in the area of the supplied External Key. A typical application in a virtual studio is to allow the presenter to go behind a virtual pillar or desk. The External Key can also be extensively used for sports graphics applications.

IMPROVING THE PICTURE

A comprehensive range of fine-tuning controls can be used to produce very realistic edges and shadows with a minimum of residual colour spill.

Enhance the colour sensitivity of the chroma key using the Hue, Acceptance Angle and Suppression Angle controls to determine the range of colours to be suppressed in the Foreground and reduce colour spill around the subject.

Improve the chroma key luminance by using the Max Clip, Min Clip, Y Suppression, Y Correction, Shadow Min and Shadow Enhance controls to produce a solid key. Safire HD 2 benefits from enhanced chroma key gain to help deal with low light situations.

The sophisticated shadow processing using the Shadow Min and Shadow Enhance tools allows the intensity of shadows to be precisely adjusted which also helps to create that realistic final effect. Safire HD 2 allows operators to set up their chroma key first and then adjust their shadow enhancement separately with an increased sensitivity of control – making it even easier to get clean and natural-looking shadows.

Safire HD 2 also includes a useful feature called Key Shrink. The realism of a chroma key is largely determined by how the keyer handles the boundary surrounding the Foreground image. As a result of the processing involved in extracting a key signal from the Foreground chrominance, there is a tendency for the key to 'spread', leaving a dark line at the edges of non-keyed Foreground objects such as a presenter. Key Shrink corrects this problem by allowing the operator to move the edges of the key signal by the required fraction of a pixel, eliminating the dark band around Foreground objects.

DEALING WITH DIFFICULT COLOURS: SELECTABLE COLOUR SUPPRESSION

Selectable Colour Suppression is a powerful and unique feature which is designed to allow more tolerance to 'difficult colours' in the Foreground.

The combined output from a chroma keyer is made up from the Background input and the Suppressed Foreground, from which the backdrop colour has been removed to ensure it is not visible in the final output. Colour spill can be caused by light reflected from the backdrop on to the person, and this is not exactly the same colour as the backdrop but instead a combination of the backdrop and the reflective Foreground object colours. The traditional approach to reduce this colour spill, therefore, is to suppress a wider range of colours than the range of colours we select as being our backdrop colour (defined by the Acceptance Angle), and for most situations this works really well.

However, there are some challenging situations which require a more powerful capability. You have a colour that you need to remove but you do not want to key on it. Using Selectable Colour Suppression the colour suppression selection can be uncoupled from the chroma key selection, allowing you to select the colours you want to suppress separately from the chroma key colours and so deal with colours which are a long way outside the Acceptance Angle. The result? You can keep the Acceptance Angle narrow to ensure you do not key on any unwanted colours (such as clothing), and at the same time take care of false colours that might arise due to colour spill. Selectable Colour Suppression means you don't have to compromise between the two settings but can instead choose the ideal value for each and get the best result possible.

Crystal Vision's HD chroma keyer in action... Sportvision's High Definition Virtual Advertising Technology as used in Major League Baseball's 2006 World Championship Series. Photo courtesy of Fox Sports.

LINEAR KEYING

Owning Safire HD 2 brings the further benefit of giving you a product that can double as an extremely flexible linear keyer, for those occasions when you need this functionality.

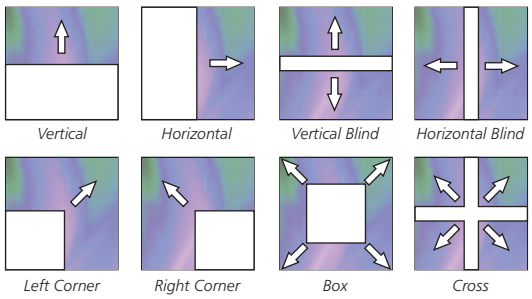
When used in this way, captions, logos, scoreboards and other graphics can be keyed over an HD or SD video source. There are two ways of generating the key. The external key mode uses the luminance of a key signal to cut a hole in the Background programme, while in self-key mode the luminance of the Foreground graphic is used to generate the key – useful if you don't want to use a dedicated key input. Fill video is then inserted into the hole, usually the Foreground signal or a colour produced by the internal matte generator. The ability to select either additive or multiplicative linear keying allows you to choose a method to suit the graphics you're working with, while the internal masks can be used to overrule the key signal and force areas of the picture to Foreground or Background. You can mix between the Foreground and Background inputs, fade the key in and out (either manually or as a timed transition), and fade to black on the main output. You can also amplify, offset or invert the key signal.

MIX AND WIPE

For applications where you're not using the chroma key functionality, Safire HD 2 can be used as a basic two input mixer.

It can perform a mix or wipe between two video sources, or between one video source and a colour produced by the internal matte generator. The mix control combines two signals by performing an alpha blend, where as the front image becomes transparent you see more of the other image through it – until the first image disappears completely. The internal wipe pattern generator features a number of simple wipes: horizontal, vertical, horizontal blind, vertical blind, left corner, right corner, cross and box. Using the Safire Controller, the mix or wipe can be controlled manually with the T-Bar or by setting an auto-transition triggered from the EFFECT button.

Available wipe patterns



THE BEST CHROMA KEYER FOR SPORTS GRAPHICS

Safire HD 2 is used to high acclaim across a whole range of sports and in a diverse range of applications from keying logos on a pitch to virtual advertising. Features such as Selectable Colour Suppression are ideal for sports graphics applications, where team clothing can sometimes be similar to the chroma key colour.

It's the flexibility of the External Key that makes Safire HD 2 ideal for inserting graphics on to sporting surfaces during live events. The result is three unique and very special features: Force Foreground, Force FB and Luma Keying.

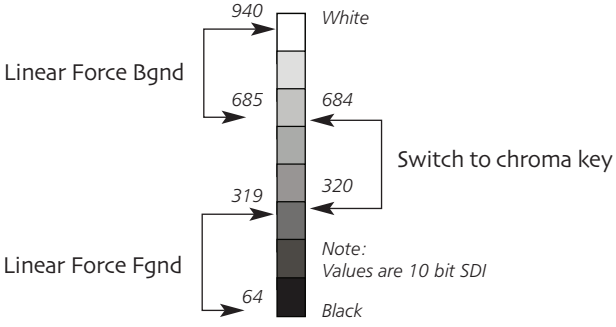
FORCE FOREGROUND

With Force Foreground the External Key is used to restrict the chroma keying to the area that contains the sports graphics by forcing Foreground everywhere else in the picture.

A typical application might be sports where players on grass are keyed over a sponsor's logo which is made to appear as if painted on the grass. The grab cursor is placed on the green grass and the resulting chroma key removes the green and replaces it with the Background. Outside of the graphics area the Foreground is forced to allow the grass to appear in the composite output. Both the final key and External Key are automatically inverted to allow the graphic to be controlled by fade operations.

FORCE FB

Force FB is an inspired feature that uses the different levels of a single External Key input to force Foreground and Background in different areas of a picture, allowing a chroma keyed subject to move in front of a selected Background object while at the same time displaying a graphic keyed over the Foreground.



There are three luminance levels in the External Key and each level applies a different effect. The black in the External Key forces full Foreground, while the white forces full Background. Chroma keying is restricted to the grey area in the External Key, with the shade of grey determining the intensity of the effect – the darker the shade the more dominant the Foreground becomes (Linear Force Foreground), while the paler the shade the more dominant the Background becomes (Linear Force Background).

Background

Foreground

External Key

Composite picture using different levels

Using Force FB a single chroma keyer could be used to chroma key a logo on to a pitch behind the players and linear key a scoreboard in front of the crowd at the same time.

LUMA KEYING

Safire HD 2 also includes special features for keying graphics on to snow or ice for winter sports programming – otherwise known as Luma Keying.

In this self-key mode Safire HD 2 will key on the Foreground luminance instead of the colour, with the key extracted from the Foreground on the basis of brightness. When keying on black or white you can set the level above which the key will be full amplitude (using Max Clip) and below which the key will be zero (using Min Clip). Keying on grey provides a very selective self-key that only places the Foreground subject in front of the Background when the Foreground subject has a specific luminance value. The key generated from the luminance can be combined with an External Key and also with the internal masks, making this type of keying as flexible as chroma keying.

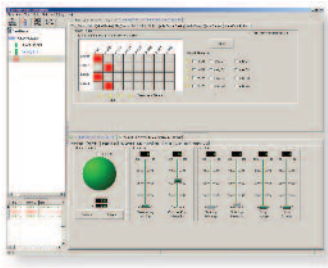
The setting up of the Luminance Key is particularly easy. The Self-Key selection allows you to view the Luma Key on its own, unencumbered by other elements such as masks, making it easy to continually tweak the settings as the light changes.

CONTROL YOUR CHROMA KEYER

Safire Controller remote control panel

How would you choose to operate Safire HD 2 – control panel or PC software?

Those that select the first option will discover that the Safire Controller is a pleasure to operate. Not only does it look good, this stylish 2U dedicated control panel is also instinctively easy-to-use, with the physical controls making it ideal for live use. It's easy to perform adjustments thanks to the large, clear display which provides extensive information on one screen, including a full set of selections for most controls. There's no need to navigate through layers of menus – all the menus can be reached by a single button press. The main keying functions are all available on quick access keys, while direct function buttons allow extremely easy T-bar transitions of the 'live use' fades, allowing fades to Foreground, Background, External Key and black. LEDs indicate the state of the main keyer settings and are independent of the current menu. The control panel allows a complete set up to be easily transferred from one board to another – allowing you to use a second chroma keyer as a preview keyer, and then move the settings to the main keyer when ready. One Safire Controller can operate up to seven chroma keyers.



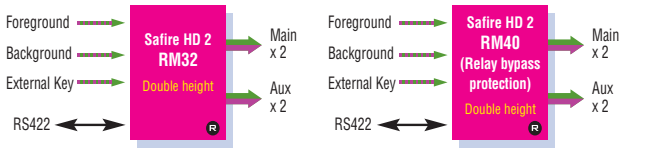
Statesman PC Control System

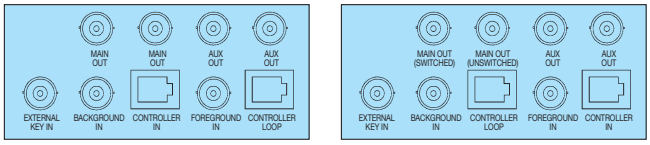
Alternatively use your PC. The Windows-based Statesman PC software can be used both to monitor the current state of Safire HD 2 – either by examining control values and virtual LED settings or by setting alarms – and for real-time control. Safire HD 2 has a specially designed GUI, with sliders, dials, trackerballs, buttons, checkboxes and radio buttons allowing easy selection of options with a simple click of the mouse. Control your Safire HD 2 from anywhere – Statesman will plug into your Ethernet network using industry standard CAT5 cables. All features are available on Statesman (including the recall of up to 40 presets) and PC control is ideal for those who do not expect to adjust the chroma keyer live on air.

Both the Safire Controller and Statesman allow recall of setups from GPIs. In addition the Safire Controller has a GPI input which can be used to choose which chroma keyer is being controlled. Instant memory recall of setups by GPI allows switching between cameras with their own individual settings and makes Safire HD 2 ideal for live use.

FRAMES AND REAR MODULES

Indigo 2AE 2U frame



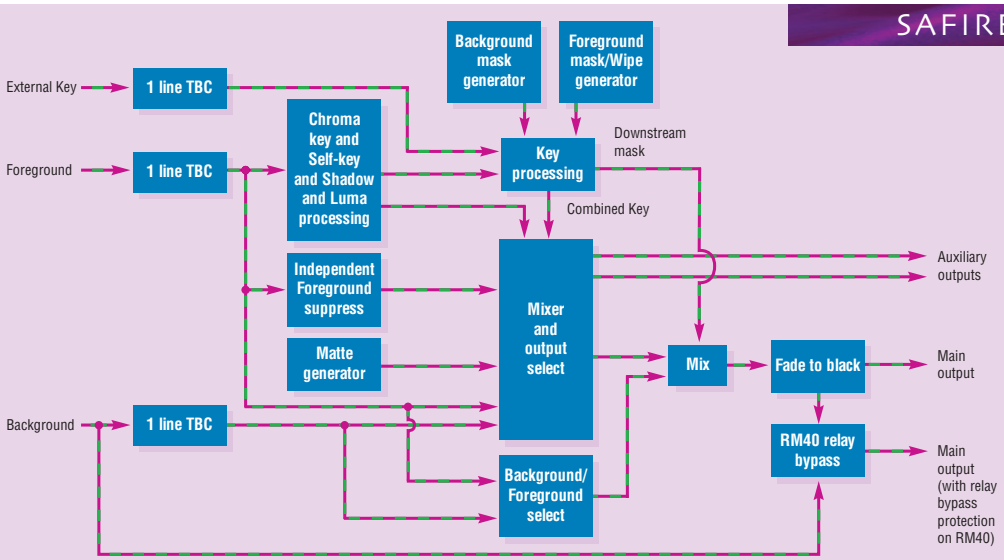


RM32 RM40

Safire HD 2 is housed in Crystal Vision's standard frames, which are available in three different sizes (2U, 1U and desk top box) to suit all applications – large or small.

The Foreground, Background and External Key inputs and two main and two auxiliary outputs are accessed by using the two slot high RM32 rear module, which includes an RJ45 connector for easy wiring of the Safire Controller as a bonus. Thanks to the inclusion of an electromechanical relay switch, the RM40 rear module can provide relay bypass protection of the Background on power failure or board malfunction or removal – most useful for virtual studio applications such as weather. Relay bypass prevents signal loss by mechanically connecting the Background input to main output 1 whenever the supply to the rear module is interrupted. In the unlikely event of failure, it's a way of maintaining programme output while maintenance is completed.

SAFIRE HD 2



SPECIFICATION

MECHANICAL
'Double decker' module 266mm x 100mm (uses two frame slots)
Weight: 300g
Power consumption: 14 Watts

VIDEO INPUTS
Three HD or SD inputs (Foreground, Background and Key)
270Mb/s or 1.5Gb/s serial compliant to EBU 3267-E, SMPTE 259 and SMPTE 292-1
The video formats supported are: 625, 525, 1035i59.94, 1035i60, 720p50, 720p59.94, 720p60, 1080i50, 1080i59.94, 1080i60, 1080PsF23.98, 1080PsF24, 1080p23.98, 1080p24, 1080p25, 1080p29.97 and 1080p30
All inputs must be same format
Reference timing can be selected to come from Foreground, Background or Key input
Delay through board: 8us to 64us max
Max input buffer length one line (selectable)

VIDEO OUTPUTS
Two main outputs and two auxiliary outputs accessed by using RM32 and RM40 rear modules.
Relay bypass protection of Background with RM40
270Mbit to 1.485Gbit compliant to EBU 3267-E, SMPTE 259 and SMPTE 292-1
Outputs follow inputs format
Both main and auxiliary outputs can be used to show Main Output, Suppressed Foreground, Foreground Input, Background Input, Chroma Key, Processed Key, Self-Key or Matte Generator

CHROMA KEY
Cursor-based auto setup will set all variables and be suitable for most applications. Fine improvements can be made by adjusting the following:

- Hue
  Colour for chroma key
- Acceptance Angle
  Range of hue to generate key
- Max Clip and Min Clip
  Set chroma level for full chroma key and zero chroma key
- Y Correction
  Luminance alteration of keying to remove key spill
- Suppression Angle
  Range of hue to completely suppress in Foreground
- Y Suppression
  Amount of luminance to be suppressed in coloured keying area of Foreground
- Shadow Enhance
  Fine adjustment of shadow effect
- Selectable Colour Suppression
  Separate Hue and Suppression Angle controls are available for the Suppressed Foreground
- Key Shrink
  On/Off. Key shrink reduces the size of the chroma key by a fraction of a clock. Reduces the possibility of a black line round the presenter in some lighting conditions

Use additive keying to get best results for shadows and transparent objects. (Relies on a good, well-lit backdrop.)
Chroma key can be inverted or turned off leaving the External Key and Background/Foreground masks. When chroma keying is switched off keying can be from Foreground luminance level (See Luminance Key)

Downstream processing:

- Keyed Background is combined with Foreground or Suppressed Foreground
- Fade to Foreground or Background, followed by a fade to black (fade to black on main outputs only)

EXTERNAL KEY
External Key and two internal masks (Background and Foreground) can be combined with the chroma key for additional effects. Controls here include:

- External Key: On/Off, Invert, Max Clip and Min Clip
- Background and Foreground masks: On/Off, Invert, Window Adjust (horizontal and vertical position, horizontal and vertical size)
- Key Fade function, to fade Foreground or Background in and out

LUMINANCE KEY (SELF-KEY)
Self-key is available from Foreground input
Adjustable Key Max, Key Min and Inversion or grey level and range
Internal colour matte generator can be used as fill for keying (also available with chroma key)

MIX AND WIPE
Foreground and Background can be mixed or wiped
Wipes include: horizontal, vertical, horizontal blind, vertical blind, left corner, right corner, box and cross

ANCILLARY DATA/EMBEDDED AUDIO
Ancillary data and embedded audio is taken from the selected timing reference

GPI INPUT LEVELS
Active: pull to ground, pulled up to +5V through 1 kohm

GPI INPUTS
Five GPI inputs
Can be used to fade to black, fade external key up and down, fade chroma key up and down, mix between Foreground and Background inputs and recall one of four presets

Four GPI connections are reserved for RS422 connection to the Safire Controller

REMOTE CONTROL
RS422/485
19200 baud, 8 bits, 1 stop no parity
Safire Controller 2U control panel operates up to seven Safire HD 2 modules
Statesman software allows control from any PC on a network. Up to 40 presets can be recalled from Statesman
SNMP monitoring and control available as a frame option
No board edge or active front panel control

ORDERING INFORMATION

Safire HD 2	HD/SD real-time chroma keyer
Indigo 2AE	2U frame with active front panel featuring Statesman CPU and integrated control panel for up to 12 Crystal Vision modules
Indigo 2SE	2U frame with active front panel featuring Statesman CPU for up to 12 Crystal Vision modules
Indigo 1AE	1U frame with active front panel featuring Statesman CPU and integrated control panel for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1AE-DP
Indigo 1SE	1U frame with active front panel featuring Statesman CPU for up to six Crystal Vision modules. Power supply redundancy available with Indigo 1SE-DP
Indigo DT	Desk top box with passive front panel for up to two Crystal Vision modules
Indigo DTSE	Desk top box with active front panel featuring Statesman CPU for up to two Crystal Vision modules
RM32	Two slot frame rear module. Allows six Safire HD 2 in 2U, three in 1U and one in desk top box. Gives access to the Foreground, Background and External Key inputs, two main outputs and two auxiliary outputs. Includes RJ45 connector for wiring to Safire Controller
RM40	Two slot frame rear module. Allows six Safire HD 2 in 2U, three in 1U and one in desk top box. Provides relay bypass protection of the Background. Gives access to the Foreground, Background and External Key inputs, two main outputs and two auxiliary outputs. Includes RJ45 connector for wiring to Safire Controller
Safire Controller	2U remote control panel for up to seven Safire HD 2 modules
Statesman	PC Control System
SNMP	SNMP monitoring and control

Performance and features are subject to change. Figures given are typical measured values. SAFIREHD21013

Crystal Vision

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