LKEY 3

3G/HD/SD linear keyer

Crystal Vision

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Contents

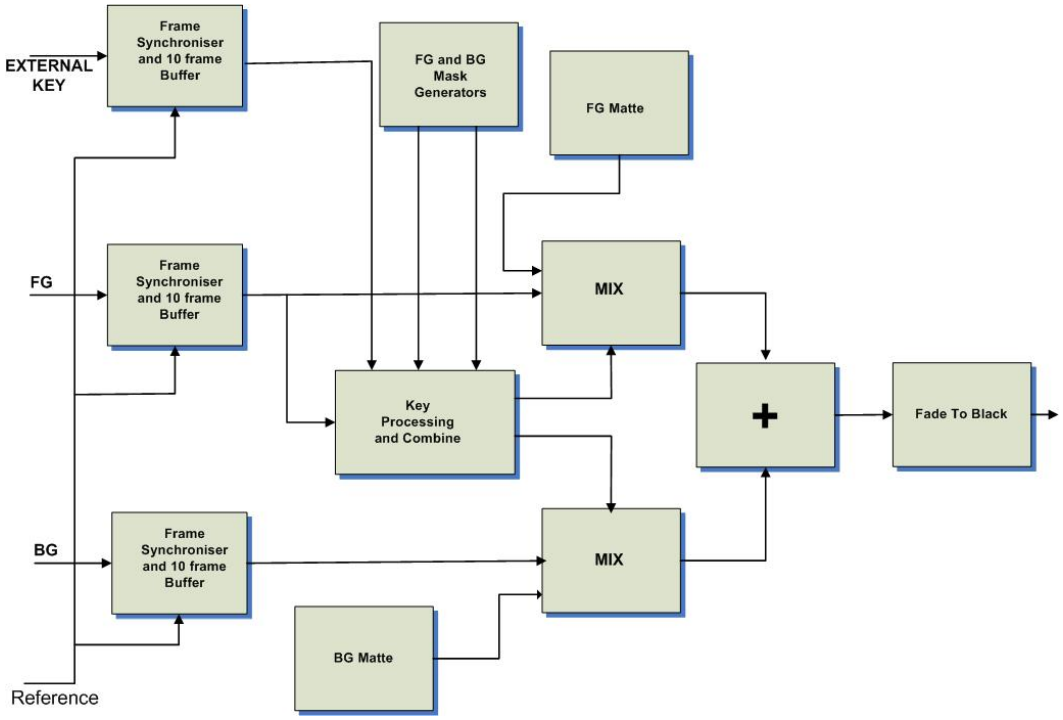
Rev 1.2	Replaced Statesman control with VisionWeb details. Deleted references to 4U frames.	09/12/14
Rev 1.3	Clarified GPI info. Added GPI Fade to Black info.	02/08/16
Rev 1.4	Added note about removal of card edge control in 2019.	12/01/21

1 Introduction

LKEY 3 is a modular linear keyer for adding graphics to 3Gb/s, HD and SD sources. The main features are as follows:

- **Use with any source** – works with 3Gb/s, HD and SD.
- **Supports the following video standards:** 625, 525, 720p50, 720p59.94, 1080i 50, 1080i 59.94, 1080p 50, 1080p 59.94.
- **Offset the graphic generator's delay** – up to ten frames of video delay for each input.
- **Correct timing errors automatically** – each input has a frame synchroniser timed to an external reference or selected input.
- **Internal mask generators** – to overrule the keyer to force areas to be foreground or background.
- **Internal Self key** – use LKEY 3 to derive a key from the luminance of the FG video input and fill with the same FG video, black or a colour matte.
- **External key input** – use LKEY 3 as a linear keyer to key graphics into a video source, or use as a mask.
- **Internal FG matte generator** – for use as a fill for Self key or External Key.
- **Internal BG matte generator** – for use as a background colour.
- **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 LKEY 3 is most easily achieved by Crystal Vision's VisionWeb web browser software. Control can additionally be from an active front panel on the frame, remote control panel or 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 timecode, AFD and subtitling information.

Block Diagram



LKEY 3 simplified block diagram

Block Diagram Description

The foreground (FG), background (BG) and External Key video inputs are firstly frame synchronised then individually delayed by up to ten frames in one frame steps. The frame synchroniser can be locked to an external analogue Black and Burst or tri-level sync reference, or one of the three video inputs.

There are two keying options available: External Key mode uses the luminance of a key input signal to cut a hole in the BG video; Self key mode uses the luminance of the FG signal itself to derive a key to cut a hole in the BG video – useful if no dedicated key input is available. Both key options can be used simultaneously.

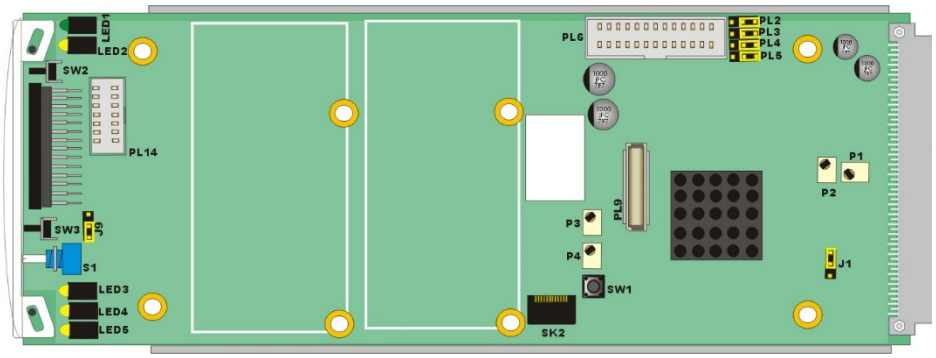
The External Key signal passes through the Key Processing and Combine block where it is shaped and combined with other keys. If Self key mode is enabled, a key is derived from the luminance of the FG signal which is shaped and combined with the other key.

In Self Key mode, the Key Processing block uses the FG input to derive a key signal that is processed by clip and gain controls. The External Key input is similarly processed and combined with the Self Key and modified by the internal Mask Generators to produce a key that will shape the BG input. The FG video input is shaped by the inverse of those keys and masks set to operate in ‘Multiply’ mode - otherwise the FG signal is unmodified.

The FG and BG signal are mixed with their selected video, matte or black fills before being added together to make the final output.The output video then passes through the fade to black block.

2 Hardware installation

Board configuration

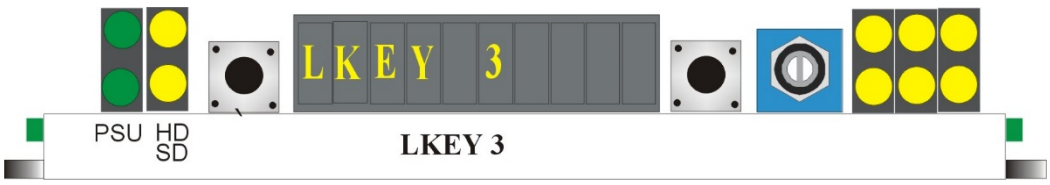


LKEY 3 main board top-side

Link Configuration

There are four user-settable links on the LKEY 3. 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		JTAG bypassed (factory set, do not alter)
J9	Debug mode	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	GPI4 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 and signal I/O

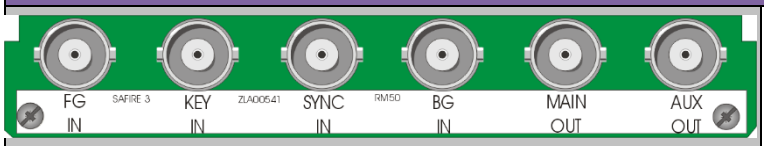
The 2U Indigo 2 frame will house up to 12 single height modules and dual power supplies. The 1U Indigo 1 frame will house six single height modules and a single or dual power supply. The Indigo DT desk top boxes have a built-in power supply and will house up to two single height modules. All modules 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.*

LKEY 3 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.

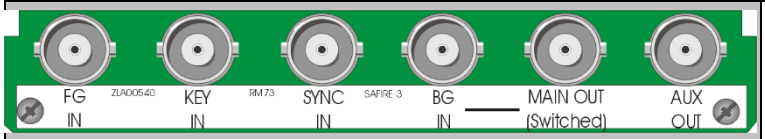
RM50 rear module connector	Description
	**RM50** • 12 per Indigo 2 frame • Six per Indigo 1 frame • Two per Indigo DT • All frame slots can be used

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 sync 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 rear 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** • 12 per Indigo 2 frame • Six per Indigo 1 frame • Two per Indigo DT • 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 sync 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.

LKEY 3 has six GPI inputs. Four of which recall one of 16 presets and the fifth and sixth are used to trigger an auto transition of the Key Fade and Fade-to-Black (see *Presets, Resets & GPI/Os*. 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 ‘HHHH’), 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 ‘HHHH’. Note that preset 16 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 *Presets, Resets & GPI/Os* in this manual for details of inverting the GPI preset logic.

Each General Purpose Interface 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.

The GPI inputs can be programmed to automatically recall a previously saved preset configuration. The 16 user preset configurations are selected using binary notation. Presets 17-40 are only accessible via VisionWeb or VisionPanel.

GPI			Low (<1V)	High (+5V)
1	**‘a’**	**Recall preset bit 1**	See following table for user preset control	
2	**‘b’**	**Recall preset bit 2**		
3	**‘c’**	**Recall preset bit 4**		
4	**‘d’**	**Recall preset bit 8**		
5	**‘e’**	**Key Fade Autotrans**	Trigger a key fade, see *GPI Fade Enable*	
6	**‘f’**	**Fade to Black Autotrans**	Trigger a fade-to-black, see *GPI Black Enable*	

Table showing the six GPI functions

GPI	Bit 8	Bit 4	Bit 2	Bit 1
Preset				
1	H	H	H	H
2	H	H	H	L
3	H	H	L	H
4	H	H	L	L
5	H	L	H	H
6	H	L	H	L
7	H	L	L	H

8	H	L	L	L
9	L	H	H	H
10	L	H	H	L
11	L	H	L	H
12	L	H	L	L
13	L	L	H	H
14	L	L	H	L
15	L	L	L	H
16	L	L	L	L

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

GPI Preset	Bit 8	Bit 4	Bit 2	Bit 1
No change	‾‾‾	‾‾‾	‾‾‾	‾‾‾
1	‾‾‾	‾‾‾	‾‾‾	‾|_|‾
2	‾‾‾	‾‾‾	‾|_|‾	‾‾‾
3	‾‾‾	‾‾‾	‾|_|‾	‾|_|‾
4	‾‾‾	‾|_|‾	‾‾‾	‾‾‾
5	‾‾‾	‾|_|‾	‾‾‾	‾|_|‾
6	‾‾‾	‾|_|‾	‾|_|‾	‾‾‾
7	‾‾‾	‾|_|‾	‾|_|‾	‾|_|‾
8	‾|_|‾	‾‾‾	‾‾‾	‾‾‾
9	‾|_|‾	‾‾‾	‾‾‾	‾|_|‾
10	‾|_|‾	‾‾‾	‾|_|‾	‾‾‾
11	‾|_|‾	‾‾‾	‾|_|‾	‾|_|‾
12	‾|_|‾	‾|_|‾	‾‾‾	‾‾‾
13	‾|_|‾	‾|_|‾	‾‾‾	‾|_|‾
14	‾|_|‾	‾|_|‾	‾|_|‾	‾‾‾
15	‾|_|‾	‾|_|‾	‾|_|‾	‾|_|‾

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 Control and Status monitoring

LKEY 3 controls and status can be accessed from card edge controls but most easily by VisionWeb web browser software, or rack front panel controls.

Board edge control was removed from the LKEY 3 in 2019. Therefore the card edge control information detailed here is only relevant for older versions of the product.

Card edge controls

LKEY 3 board edge

Card edge buttons

The two tactile push button switches allow the operator to navigate within the menu structure.

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Button	Function	Normal state Up, Action Down
^	Up Menu	Push to jump up a menu level or cancel a selection.
ENTER	Select/Action	Push to select a menu and to action and confirm a change.

Card edge rotary control

The board edge rotary encoder is used to navigate through the menu categories and adjust parameter values.

Control	Function
SCROLL/ ADJ	Rotate SCROLL/ADJ to identify a menu category. In combination with the ENTER button select and ADJUST to change the current level or select a further option.

Note: *The rotary control can access menus and parameter values by clockwise or anti-clockwise rotation.*

Navigating card edge menus

To access the card edge menu system proceed as follows:

- Press the up-arrow [^] until a top menu category is reached

- Rotate the SCROLL/ADJ control until the desired menu category is found
- Press ENTER to enter the sub-menus of that category
- Rotate SCROLL/ADJ to select a sub-menu
- Press ENTER to select the desired function. Selection will be indicated by the text being displayed in ***italic*** text
- Rotate ADJUST to make the desired change to the selected parameter. The display changes to ***italics*** to indicate that a change has been made and requires confirmation
- When required push ENTER to action the change. The display will return to normal non-italic text.
- Use the up-arrow [^] and SCROLL/ADJ control to navigate to further menus

Using the front control panel

At power up, the LEDs of all eight control panel keys will illuminate briefly. Once the panel has completed its power up and configuration sequence the panel will enter its status mode and display the current software version and frame IP address.

'Status' menu showing current software version and IP address

Selecting an LKEY 3

To continue with control panel operation or configuration, press the 'Device' key once. The control panel will display the name of the card that first responds to the polling request together with its location number. The location number consists of the frame number plus the card position in the frame. Rotate the Shaft control to poll through the available cards. Use the F2 soft key to toggle between the card's serial number and issue number with modification level.

'Device' menu showing LKEY 3 in slot 1.01

In the example above, the card displayed is located in the first frame in slot number 1.

When the desired card is selected press the ENTER key to access that card's HOME menu.

The LKEY 3 home menu

Rotate the shaft control to scroll through the menu structure and press ENTER to select the sub-menus. Press HOME at any time to return to the home menu.

LKEY 3 Video Status sub-menu

Press ENTER to select the 'Signal Status' menu or SCROLL to display other sub-menus. See description of menu structure below for list of sub-menus.

Control Panel keys overview

The functions assigned to the control panel keys are:

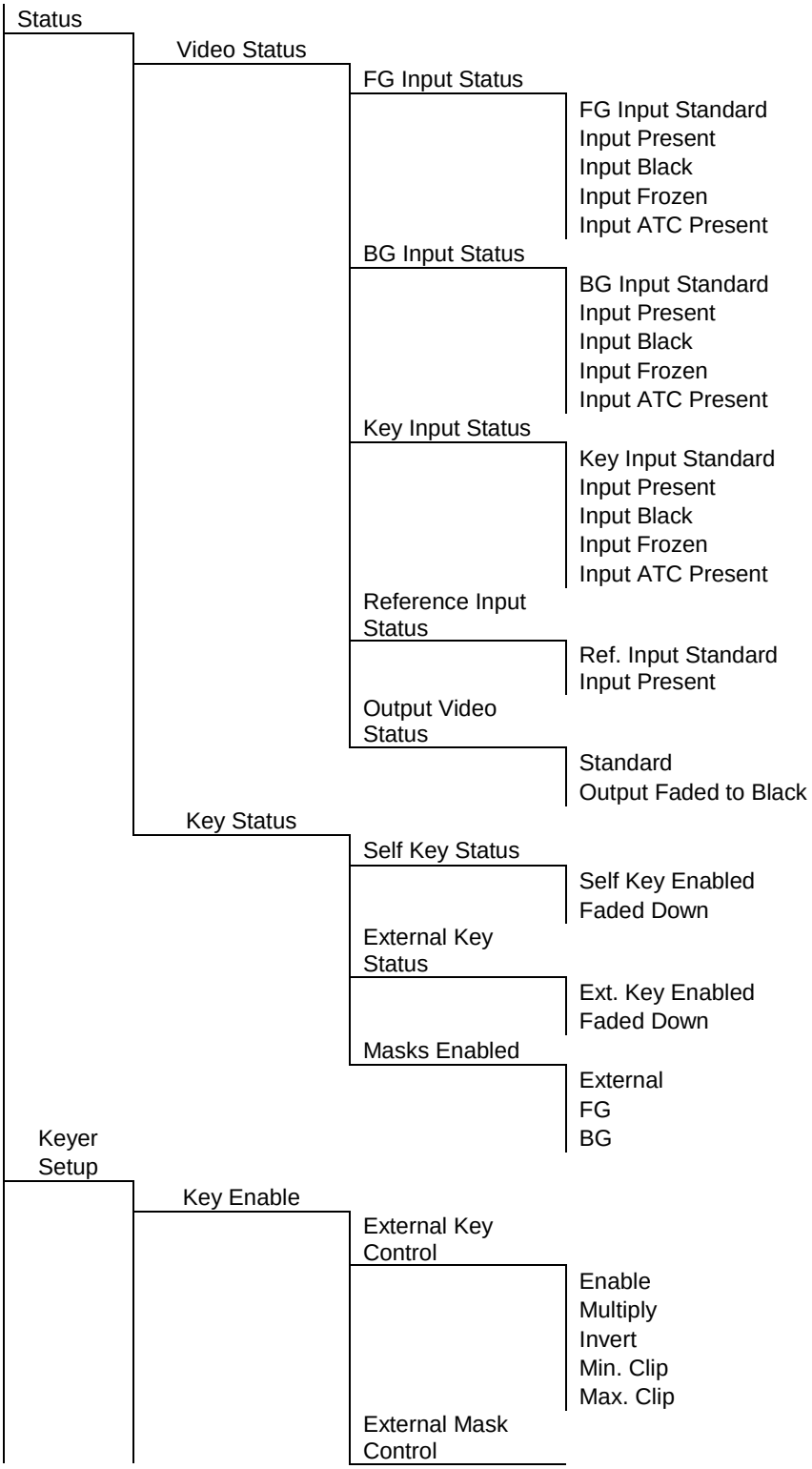
- DEVICE – enters 'device' menu to select a card or show available cards.
- ASTERISK (*) – selects 'network configuration' menu.
- F1 to F4 - soft keys not currently used by LKEY 3.
- HOME – returns to top of LKEY 3 menu structure.
- ENTER – accept current selection.
- Up arrow – used to move up through the menu structure.
- Rotary control – shaft encoder used to select sub-menus or variable data.

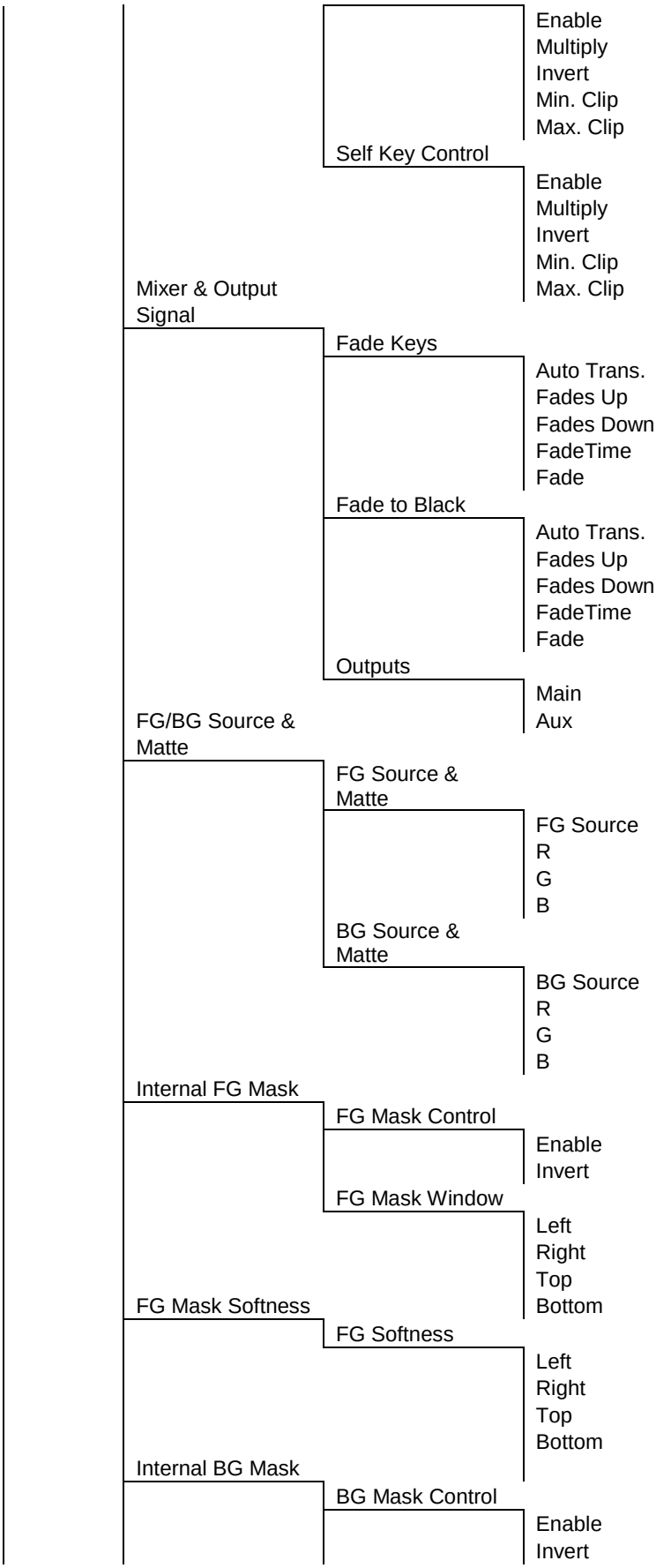
Updating the display

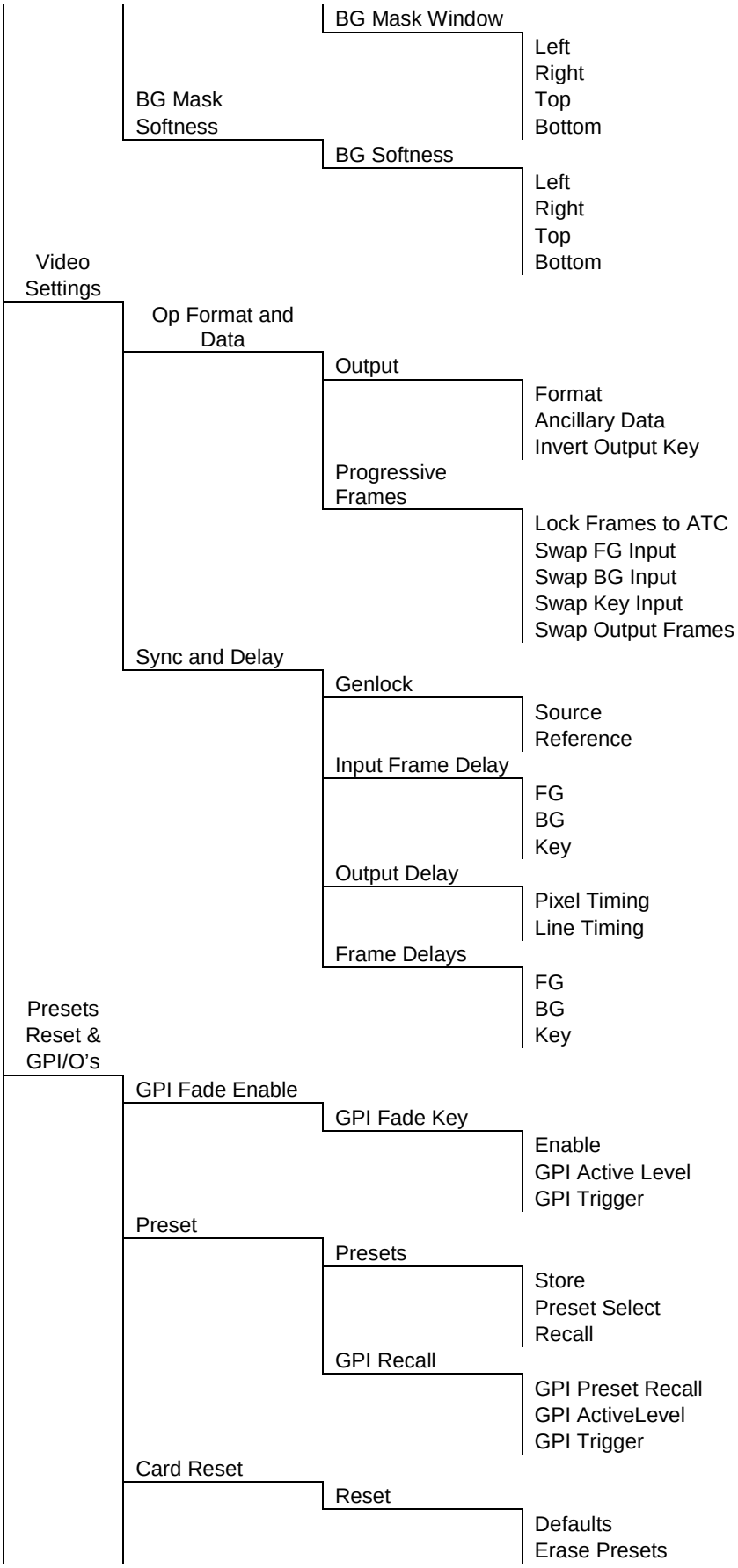
The values displayed on an active front panel are only updated when an adjustment is made and when changing menu level. If necessary, use the upward arrow to leave and then re-enter a menu to update the display.

Menu Tree

The basic menu structure for card edge, front panel access and VisionWeb is identical and consists of the following menus and sub-menus.




Enable
Multiply
Invert
Min. Clip
Max. Clip
Self Key Control
Enable
Multiply
Invert
Min. Clip
Max. Clip
Mixer & Output Signal
Fade Keys
Auto Trans.
Fades Up
Fades Down
FadeTime
Fade
Fade to Black
Auto Trans.
Fades Up
Fades Down
FadeTime
Fade
Outputs
Main
Aux
FG/BG Source & Matte
FG Source & Matte
FG Source
R
G
B
BG Source & Matte
BG Source
R
G
B
Internal FG Mask
FG Mask Control
Enable
Invert
FG Mask Window
Left
Right
Top
Bottom
FG Mask Softness
FG Softness
Left
Right
Top
Bottom
Internal BG Mask
BG Mask Control
Enable
Invert


Video Settings
BG Mask Softness
BG Mask Window
Left
Right
Top
Bottom
BG Softness
Left
Right
Top
Bottom
Op Format and Data
Output
Format
Ancillary Data
Invert Output Key
Progressive Frames
Lock Frames to ATC
Swap FG Input
Swap BG Input
Swap Key Input
Swap Output Frames
Sync and Delay
Genlock
Source
Reference
Input Frame Delay
FG
BG
Key
Output Delay
Pixel Timing
Line Timing
Frame Delays
FG
BG
Key
Presets Reset & GPI/O's
GPI Fade Enable
GPI Fade Key
Enable
GPI Active Level
GPI Trigger
Preset
Presets
Store
Preset Select
Recall
GPI Recall
GPI Preset Recall
GPI ActiveLevel
GPI Trigger
Card Reset
Reset
Defaults
Erase Presets

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

Controlling cards via VisionWeb

Crystal Vision cards use an XML file to create a control database that is used by the card's front-edge controller, the Indigo frame front panel controller and VisionWeb software. VisionWeb software offers a full range of controls with slider controls etc. similar to that available with the older Statesman PC software.

Accessing the Indigo Home page with a PC browser via the Ethernet connector of an Ethernet-enabled frame will display a list of the cards fitted. (See Frame Manual for more details.)

Indigo home page

The example above shows an LKEY 3 card fitted in slot one and the frame's power supply and status monitor in slots 13 and 14. Clicking on the LKEY 3 card will bring up the card's home page, for example:

LKEY 3 Status Page

6 Control Descriptions

The controls of LKEY 3 are accessible from Crystal Vision's VisionWeb software, the front panel or the board edge. The description of controls used in this manual is based on VisionWeb but the path to locate controls via the front panel or board edge follows the same logic. For instance, in the VisionWeb GUI, an 'Input Frozen' control is located in the '**FG Input Status'** group of the **'Video Status'** sub-menu of the '**Status'** menu. To find the same control using the card edge or front panel follow the path **Status ->Video Status->FG Input Status** to the **Input Frozen** control.

VisionWeb GUI controls are accessed by menus at the bottom of the page which, when selected, offer sub-menus containing a number of controls. Some controls are simulated LEDs that are used to show status, others are check boxes, buttons or sliders which change various LKEY 3 settings.

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

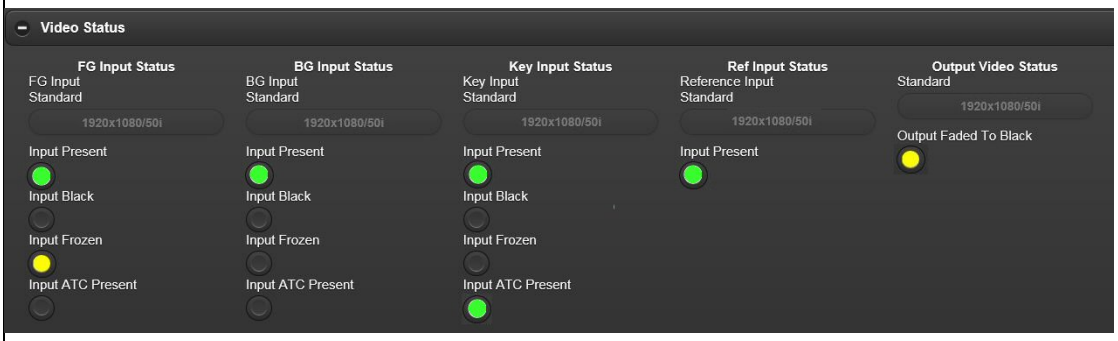
VIDEO STATUS, KEY STATUS, KEY ENABLE, MIXER & OUTPUT SIGNAL, FG/BG SOURCE & MATTE, INTERNAL FG MASK, FG MASK SOFTNESS, INTERNAL BG MASK, BG MASK SOFTNESS, OP FORMAT AND DATA, SYNC AND DELAY, GPI FADE ENABLE, GPI BLACK ENABLE, PRESET, CARD RESET.

Each menu is shown with a screen grab and description of each control's function. Some menus and some controls are specific to specific models only, in this case the model number(s) are indicated.

Status Menu

Video Status

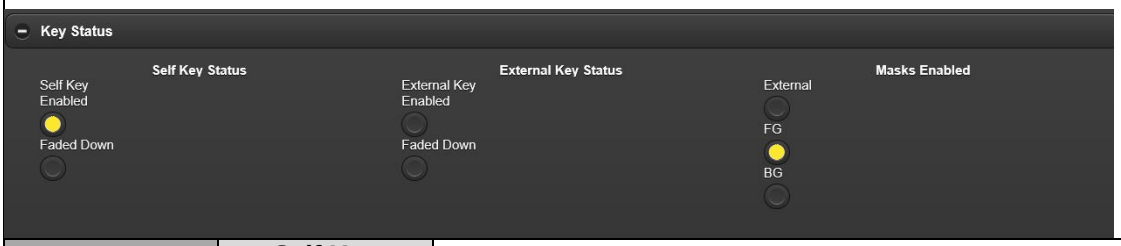
Display presence, standard and status of input and output video signals.



FG/BG/KEY Input Status	**FG/BG/KEY Input Standard**	**The Input video standard is shown. i.e. *Missing, 625/50,1920x1080/50i etc.***
	Input Present	**On if input video present.**
	Input Black	**On if input video at constant black level.**
	Input Frozen	**On if input video frozen (Still frame).**
	Input ATC Present	**On when ancillary timecode is present in input video.**
Reference Input Status	**Reference Input Standard**	**Displays reference video standard e.g. 1080/50i.**
	Input Present	**On when valid Black and Burst or tri-level video input present.**
Output Video Status	**Standard**	**Displays standard of video outputs i.e *625/50,1920x1080/50i etc.***
	Output Faded to Black	**On if main output faded to black.**

Key Status

Display status of Self Key, External Key and masks.

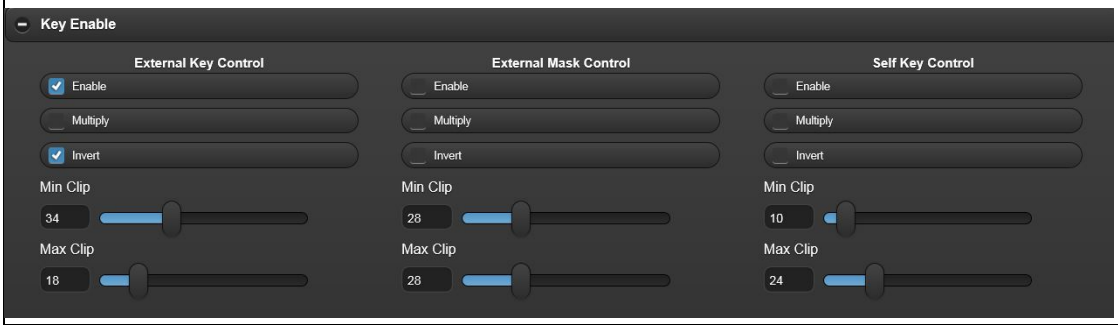


Self Key Status	**Self Key Enabled**	**On if the Self Keyer is enabled in 'Keyer Setup' menu.**
	Faded Down	**On if keys are faded down from the 'Mixer and Output Signal' menu.**
External Key Status	**External Key Enabled**	**On if the External Key is enabled in 'Keyer Setup' menu.**
	Faded Down	**On if keys are faded down from the 'Mixer and Output Signal' menu.**
Masks Enabled	**External**	**On if the external mask is enabled in the 'Keyer Setup' menu.**
	FG	**On if the FG mask is enabled in the 'Internal FG Mask' menu.**
	BG	**On if the BG mask is enabled in the 'Internal FG Mask' menu.**

Keyer Setup Menu

Key Enable

Enable and configure Self Key, External Key and masks.

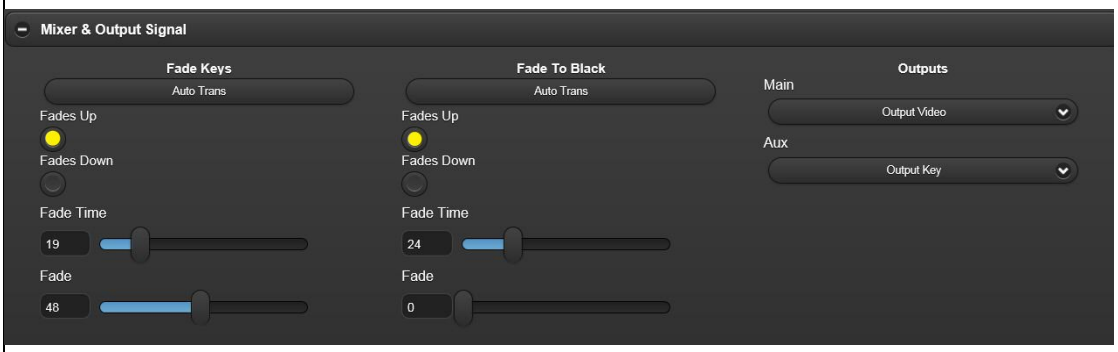


External Key Control	**Enable**	**Select to enable the External Key signal as a key. The BG picture is keyed and filled with the selected FG source. Use this control to key a caption into the background video and fill with matte, black or video. The external key combines with the self key to extend the overall size of the key. (See section Keys and Masks.)**
	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 active key area.**
	Invert	**Select to invert the clipped key.**
	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 80, then all key levels above 80% of max will be clipped and amplified to full scale.**
External Mask Control	**Enable**	**Select to enable the external key signal as a mask. The mask signal disables other keys in its active areas forcing BG video (see section Keys and Masks for more information).**
	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 before adding to the BG signal.**
	Invert	**Select to invert the clipped mask.**
	Min Clip	**As 'Min Clip' for External Key above.**
	Max Clip	**As 'Max Clip' for External Key above.**
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.**

	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 active key area.**
	Invert	**Select to invert the clipped key.**
	Min Clip	**As 'Min Clip' for External Key above.**
	Max Clip	**As 'Max Clip' for External Key above.**

Mixer and Output Signal

Fade keys, fade output to black and select output video.

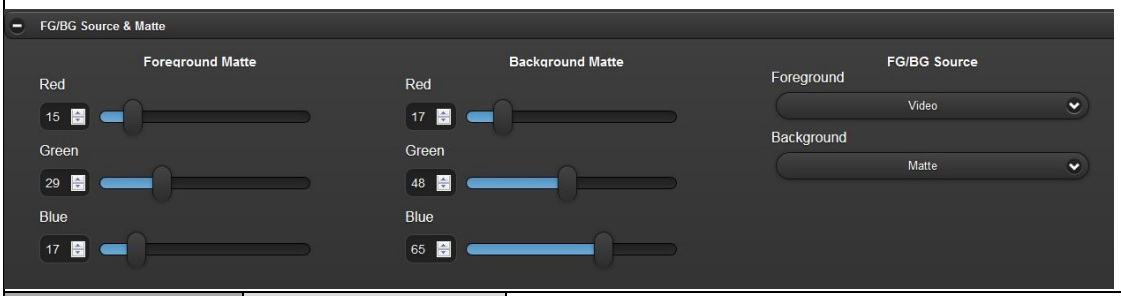


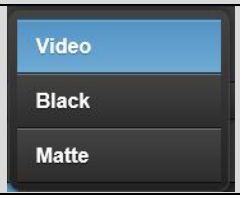
Fade Keys	**Auto Trans**	**Use this control to automatically fade enabled keys up and down at the rate set by the Fade Time control. Masks are unaffected.**
	Fades Up/Down	**These indicate which direction the autotrans operation will take.**
	Fade Time	**Use this control to set an autotrans fade time of 0-100 seconds.**
	Fade	**Use this control to manually fade keys up and down.**
Fade to Black	**Auto Trans**	**Use this control to start an automatic fade to black transition of the video output at a rate set by the Fade Time control.**
	Fades Up/Down	**These indicate which direction the autotrans operation will take.**
	Fade Time	**Use this control to set an autotrans fade time of 0-100 seconds.**
	Fade	**Use this control to manually fade to/from black.**

Outputs: Main/Aux		**Select which signal is routed to the Main or Aux output:** **Output video - the final keyed image.** **Output key - the key signal, as a monochrome image, produced by the combination of the Self key, External Key and masks.** **FG input - the foreground video input.** **BG input - the background video input.** **Key input - the External Key input signal as a monochrome image.** **FG Matte - display the matte colour set by the 'FG/BG Source & Matte' RGB controls. *Note: BG matte can only be set up via Output Video monitoring.***

FG/BG Source & Matte

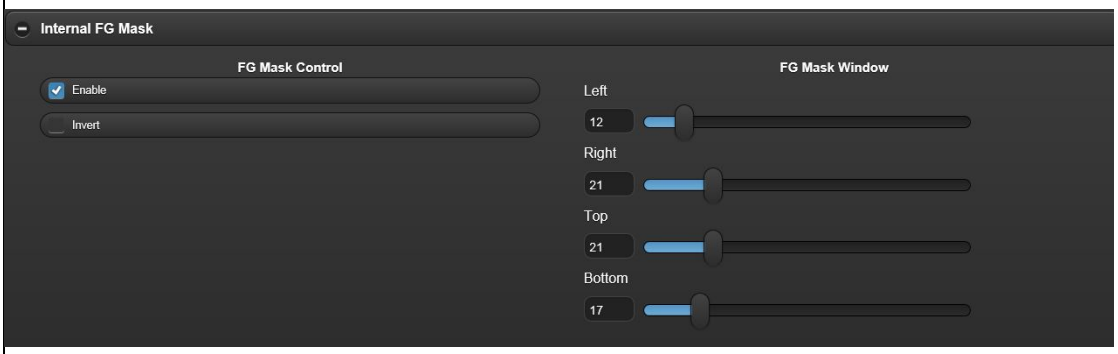
Select key fill source and BG source. Set up FG and BG colour mattes.



FG Source		**Use these controls to select the source of the FG signal used to fill the hole cut in the BG video by either self-key or external key. Select either FG video, black or the FG colour matte. (See section Keys and Masks for more detail.)**
BG Source		**Use these controls to select the source of background video. Select either BG video, black or the BG colour matte. (See section Keys and Masks for more detail.)**
Red/Green/Blue	**Use these controls to set the colour of the FG and BG mattes. The FG matte will be used as the key fill when 'Matte' is selected as the FG Source. Selecting 'Matte' as the BG source will display the BG colour matte as the BG picture.**	

Internal FG Mask

Enable, position and invert the FG mask.



FG Mask Control	**Enable**	**Select this control to enable the FG mask. This user-positionable mask will override the other keys in its active area to force the BG signal. Use this mask to select only part of a key. (See section Keys and Masks.)**
	Invert	**Select this control to invert the mask.**
FG Mask Window	**Left/ Right / Top / Bottom**	**Use these controls to position the mask rectangle.**

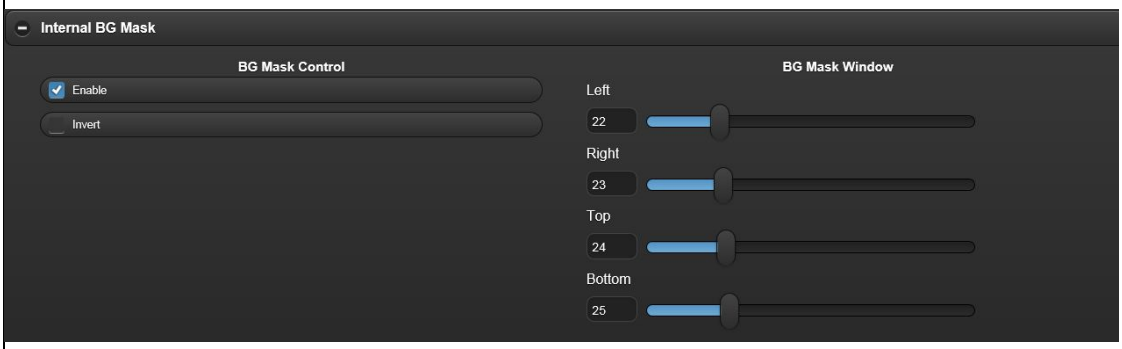
FG Mask Softness

Adjust the softness of the FG mask rectangle.

FG Softness	**Left/ Right / Top / Bottom**	**Use these controls to soften the four edges of the mask to make the mask less noticeable.**

Internal BG Mask

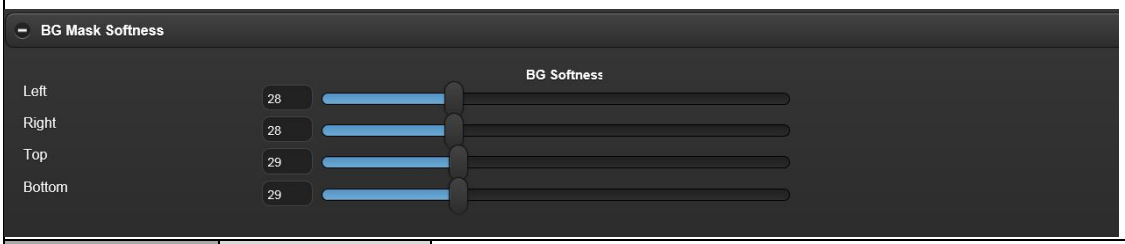
Enable, position and invert the BG mask.



BG Mask Control	**Enable**	**Select this control to enable the BG mask. This user-positionable mask will override the other keys in its active area to force FG video. Use this mask to extend the key size by forcing FG video. (See section Keys and Masks.)**
	Invert	**Select this control to invert the mask.**
BG Mask Window	**Left/ Right / Top / Bottom**	**Use these controls to position the mask rectangle.**

BG Mask Softness

Adjust the softness of the BG mask rectangle.

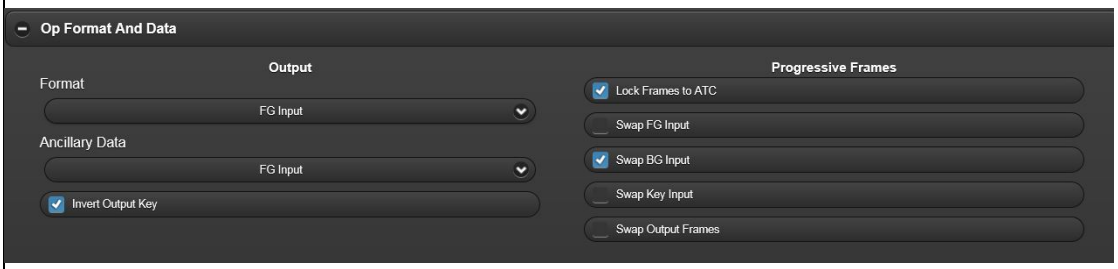


BG Softness	**Left/ Right / Top / Bottom**	**Use these controls to soften the four edges of the mask to make the mask less noticeable.**

Video Settings

Op Format and Data

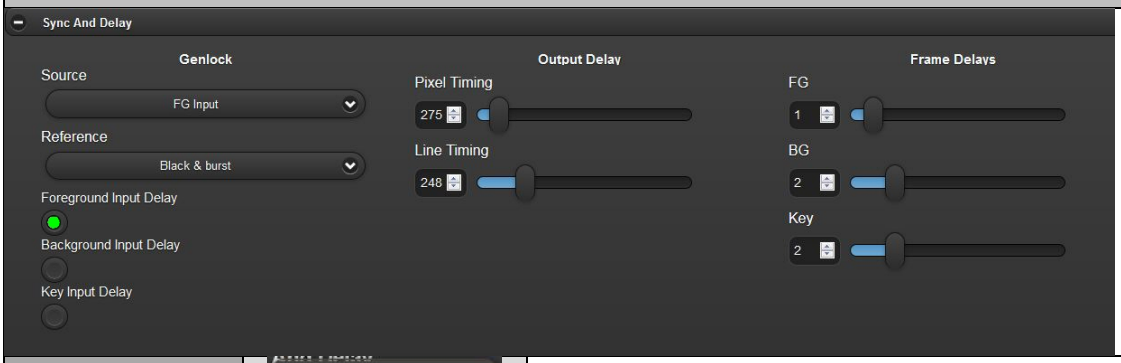
Select options for the video output format.

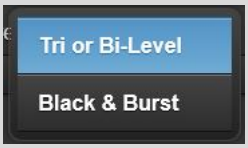


Format		**Select which input video format should be used for the video output.**
Ancillary Data		**Select which video input is the source of output ancillary data or Blank ancillary data output.**
Invert Output Key	**Select this to invert the output key. Use this feature to match the key polarity with other equipment or for monitoring purposes to make the key more visible.**	
Lock Frames to ATC	**Lock the HD progressive video output to Ancillary Timecode.**	
Swap FG/BG or Key Input	**Swap field sequence of the selected progressive video input.**	
Swap Output Frames	**Swap field sequence of the progressive video output.**	

Sync and Delay

Select genlock source and delay input video signals.

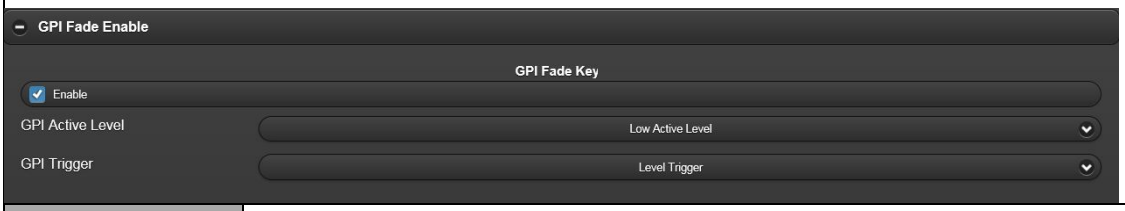


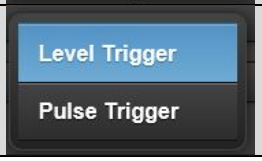
Source		**Select which source LKEY 3 will use as its reference.**
Reference		**Select whether the external analogue reference input is Tri-Level or Black & Burst. No reference need be applied unless 'Reference' is selected as the genlock source.**
Input Frame Delay FG/BG/Key	**The LEDs indicate whether the output signal is more than one whole frame delayed with respect to each input.**	
Pixel Timing	**Delay output video horizontally by 0 to 2750 pixels with respect to reference. (See note below.)**	
Line Timing	**Delay the output video vertically by 0 to 1125 lines with respect to selected reference. See note below 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.***	
Frame Delays FG/BG/Key	**These controls delay the selected video by up to ten frames at the LKEY 3's inputs.**	

Presets, Resets & GPI/Os

GPI Fade Enable

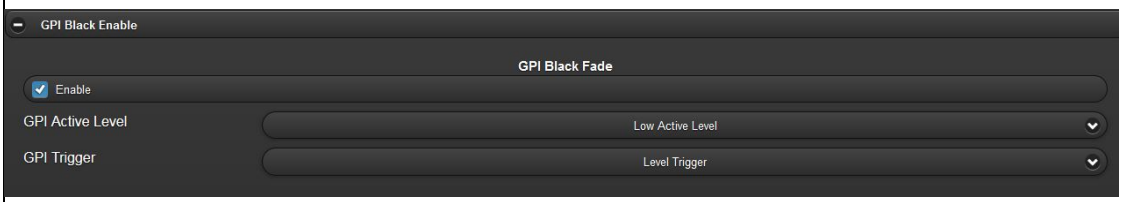
Enable and select triggering options for GPI fade.

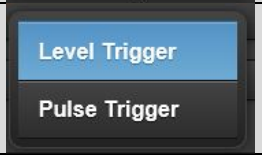


Enable		**Select to enable fading of keys by GPI.**
GPI Active Level		**Select low or high level as the active level for the GPI.**
GPI Trigger		**Select whether GPI triggering should be triggered by a permanent change in level or a transition.**

GPI Black Enable

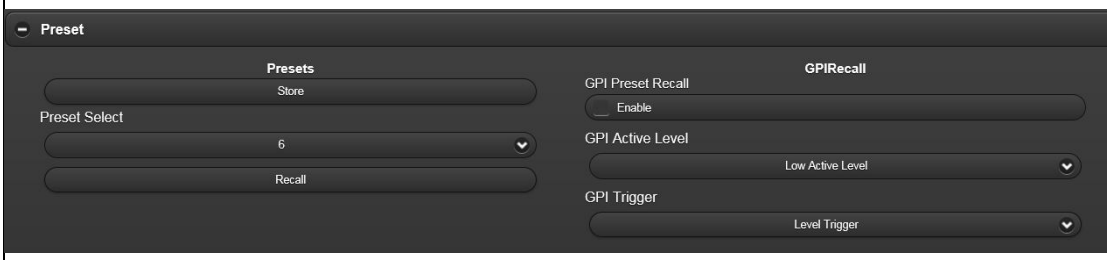
Enable and select triggering options for GPI fade to black.

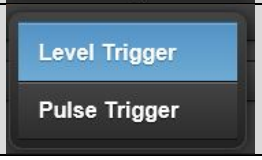


Enable		**Select to enable fading to black by GPI.**
GPI Active Level		**Select low or high level as the active level for the GPI.**
GPI Trigger		**Select whether GPI triggering should be triggered by a permanent change in level or a transition.**

Preset

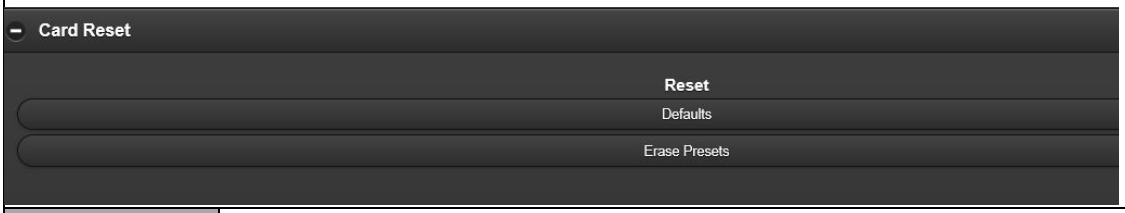
Store and recall presets, enable and set options for recall by GPI.



Store	**Store LKEY 3 settings as one of 40 presets.**
Preset Select	 **Select preset number 1-40 to store or recall.**
Recall	**Recall one of 40 previously stored setups.**
GPI Preset Recall	**Select to enable recall of presets by GPI. Presets 1-16 can be selected from the binary coding of the external GPI inputs *(see General Purpose Interface).***
GPI Active Level	 **Select low or high level as the active level for the GPI signals.**
GPI Trigger	 **Select whether GPI recall should be triggered by a change in level or a pulse.**

Card Reset

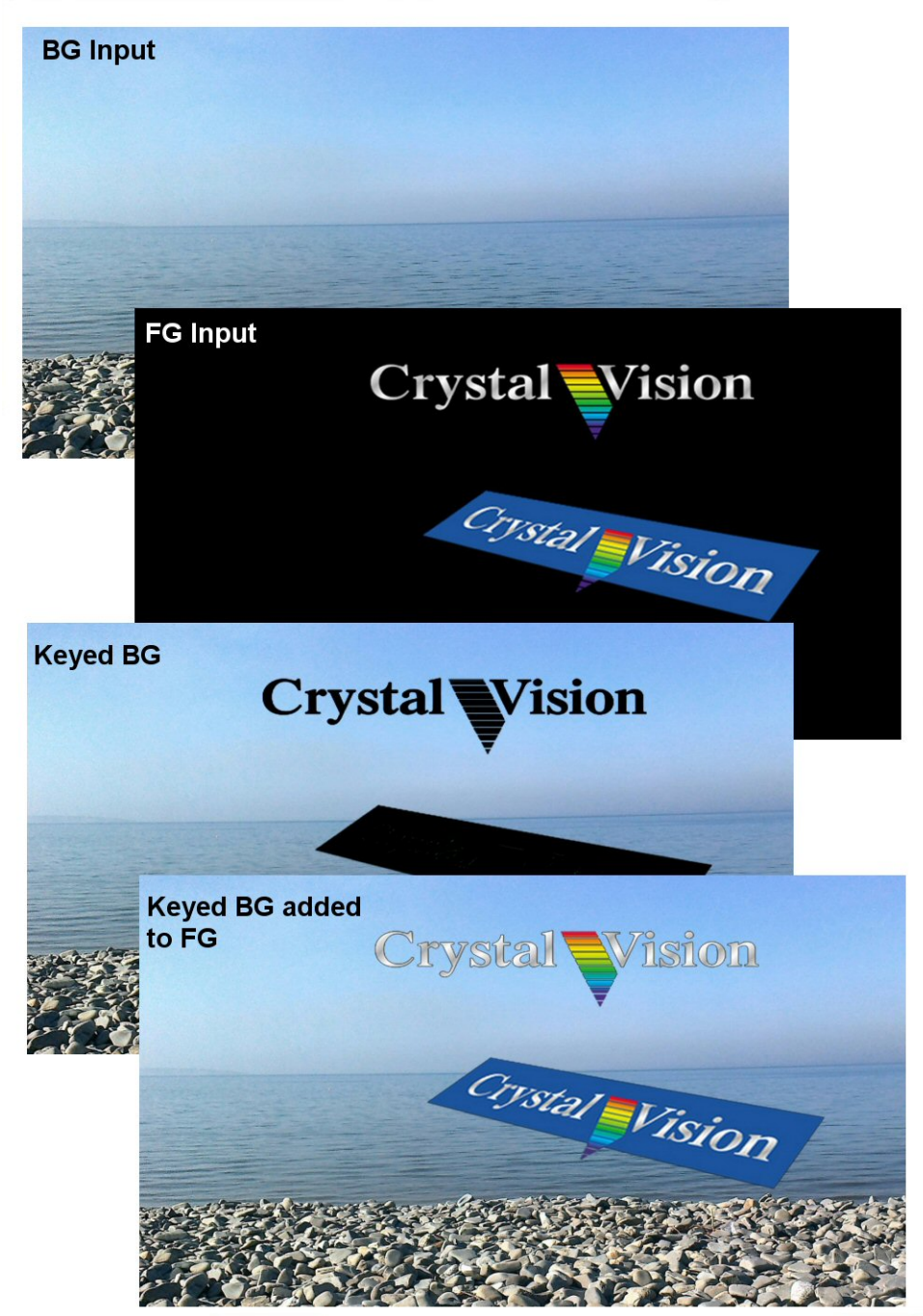
Reset LKEY 3 to default values with or without erasing preset memories.



Defaults	**Select to restore LKEY 3 to default conditions without erasing stored presets.**
Erase Presets	**Select to restore LKEY 3 to default conditions AND erase stored presets.**

7 Keys and Masks

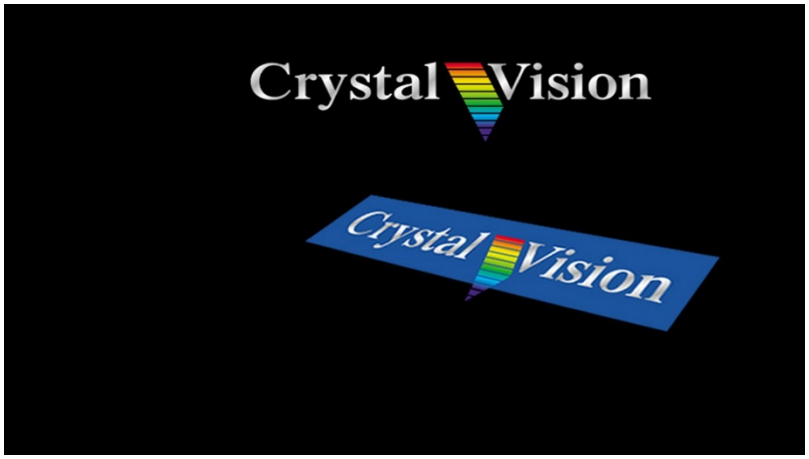
LKEY 3 works by using either an internally generated self key or an external key to cut a hole in the BG picture which is filled with either FG video, a colour matte or black. The BG picture can be either BG input video, black or a colour matte.



LKEY 3 Keying Process showing the keyed BG filled with FG video

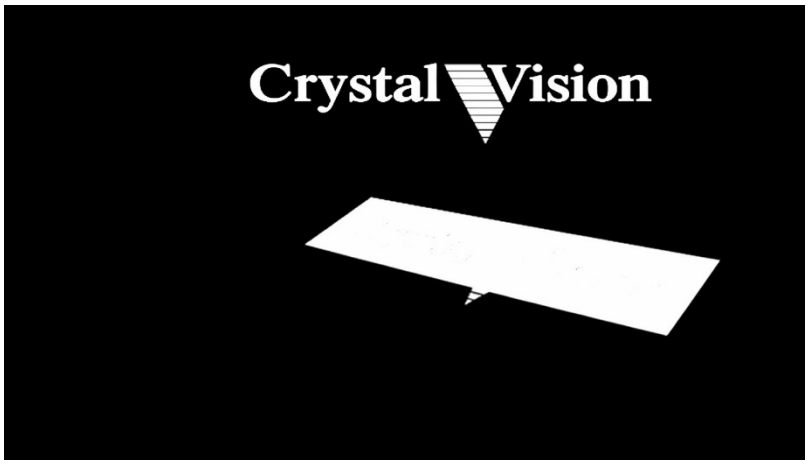
Self Key

The internal linear self key is derived from the luminance of the FG signal. In the example below, the key is generated from, and filled by, the Crystal Vision logo FG signal:



FG Input showing Crystal Vision logos to be self keyed

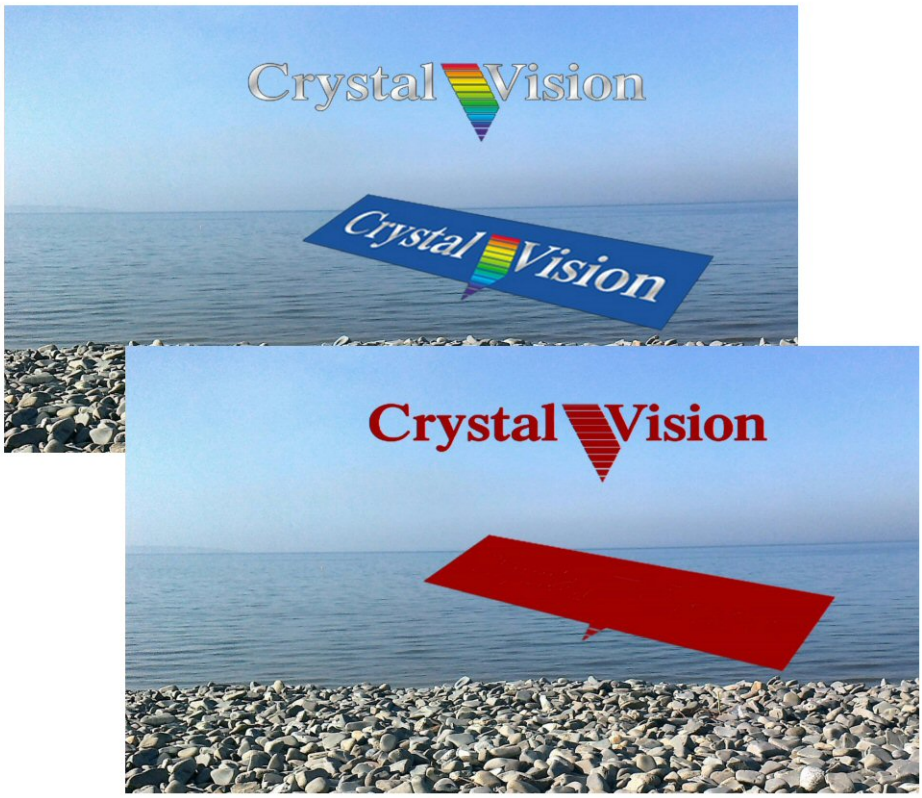
The Self Key ***Max Clip*** and ***Min Clip*** controls are adjusted to give the best result. The actual key produced after clip and gain can be seen by viewing the Key Output signal. This can be a good way to adjust the key Max and Min Clip controls:



Key Output showing clipped key produced by self keying

Because the FG signal is black in non-keyed areas there is no possibility of unwanted FG signal being visible when added to the keyed BG. If that was not the case then selecting '**Multiply'** in Self Key Control would force the FG signal to be keyed as well. *Note: It is generally not good practice to key a signal with a key derived from itself as this leads to out of band components causing possible visible artifacts due to aliasing.*

The '**FG Source'** control selects which signal is added to the keyed BG and can be either FG video, Matte or Black. The two pictures below show FG video and Matte as the FG Source:



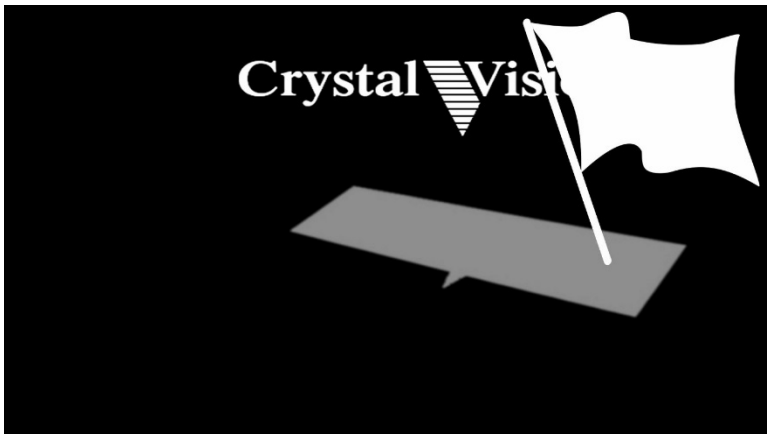
Result of Self Keying using FG Video and Matte as the FG Source

Self keying is not always successful if the FG signal (the key source) contains low luminance values requiring high key gains to produce a good key signal. In most cases it would be better to use an external key signal connected to the Key Input and a separate fill signal connected to the FG input.

External Key

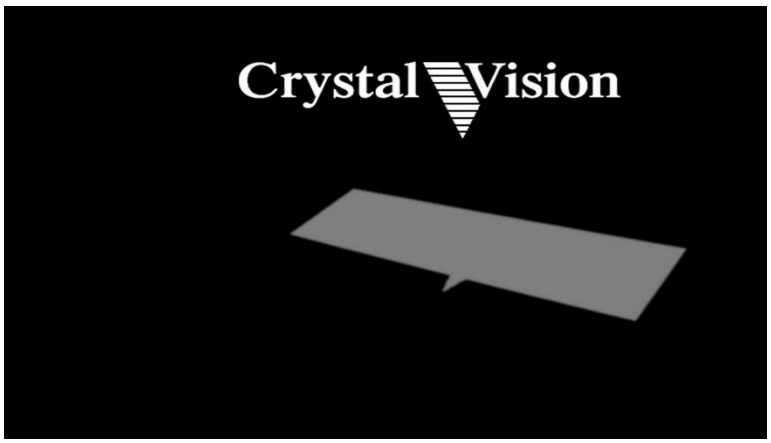
The ***External Key*** input can also be used as a linear key to cut a hole into the BG signal in addition to the self key, but in this case the FG signal is used as a fill only and not to create the key. Usually these signals are specially generated to produce the best possible results with shaped edges to minimise visible artifacts and with black fill in non-key areas so keyed BG and non-keyed FG can be simply added together.

The Self key and External Key in LKEY 3 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 VisionWeb or control panel. In the Key Output picture below, both the External Key and Self key modes are selected and the key produced by self keying the FG flag image can be seen to combine with the External Key logo signal. The fill for the combined key shape can be FG video, black or matte.



Key Output showing a self keyed 'flag' image combining with the external Crystal Vision logo key

An advantage of using an external key is that parts of the key can have varied video levels and so produce a controlled semi-transparent key in different areas. In the following example, the External Key signal has two distinct levels:



Key Input signal showing grey mid-level key area

Using the same FG logo signal as the previous Self key example, produces – with minimal key gain – a semi-transparent key on the lower logo.

Main Output showing semi-transparent keying on the lower logo

External Mask

A ‘mask’ is a key signal that modifies other key signals to mask the visibility of either the FG or BG signal. In its active area, a FG mask will prevent the FG signal being visible and a BG mask will prevent the BG signal from being visible. The active areas for all masks are low-level (black). All masks (including internal masks) can be individually inverted by VisionWeb or control panel.

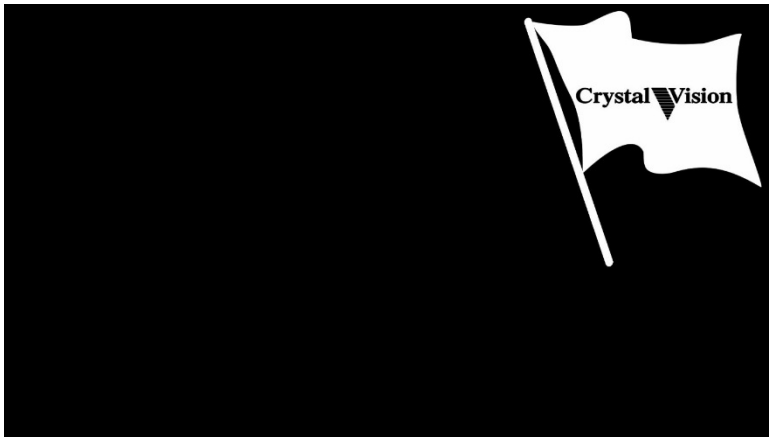
The External Key Input can be selected to be used as a FG mask signal by selecting the External Mask Control ‘**Enable’** option. In the following example, the first picture shows the result of a red flag on a black background being self keyed into the BG picture. In the second picture, a Crystal Vision logo key is connected to the External Key input with the External Mask enabled. Here the Crystal Vision logo is modifying the self key to reveal the BG picture in its active area.

Flag FG picture self keyed into BG

Crystal Vision logo masking the FG of the self key area

The Key Outputs for the two examples above show clearly the effect of the External Mask:

Key Output of self keyed flag



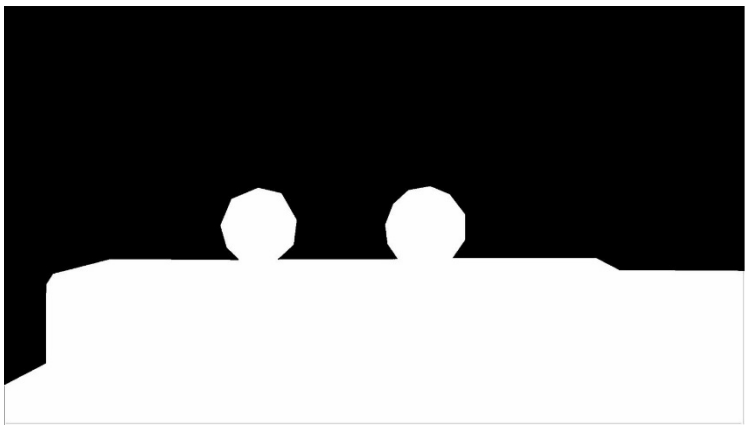
Key Output of self keyed flag with external mask

FG and BG Masks

LKEY 3 has two independent, internally generated rectangular masks that override the keys to mask either the FG video or the BG video. In the following picture, by placing the rectangular FG Mask over the lower of the two logos from the self key example, only the upper keyed logo remains:

Masking a key with the internal rectangular FG mask

In the following more complicated example, an External Key input is keying FG into the lower part of the BG video. The FG image is identical to the background behind the model, so the result is to make the model appear to be sitting behind the active key area of the FG picture:



External Key input

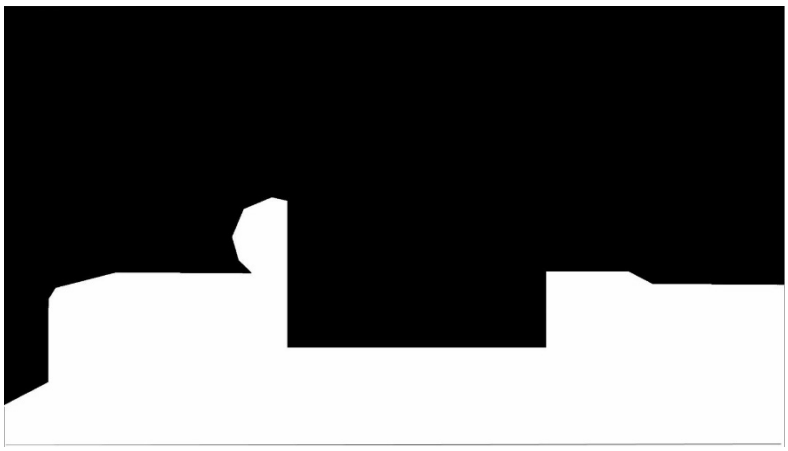
FG picture (identical to scene behind model)

Output Video showing model apparently sitting behind part of the FG picture

The following picture shows the FG mask rectangle overriding the external key to limit the FG visibility to reveal more of the BG picture:

Output Video showing effect of internal FG mask rectangle

The Key Output below shows how the FG Mask rectangle has modified the External key to reveal more BG:

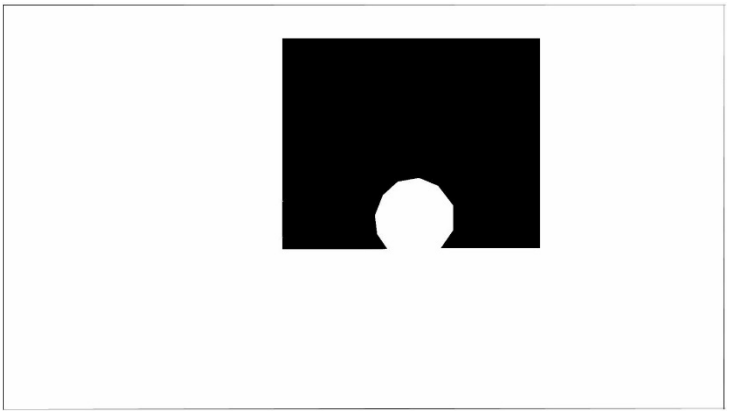


Key Output showing FG mask rectangle overriding External Key

The next picture shows an inverted BG mask rectangle modifying the external key to limit the BG visibility, to reveal more of the unkeyed FG video:

Output Video showing the effect of the internal BG mask rectangle

The Key Output picture below shows how the inverted BG Mask rectangle has modified the External Key to reveal more of the FG picture:



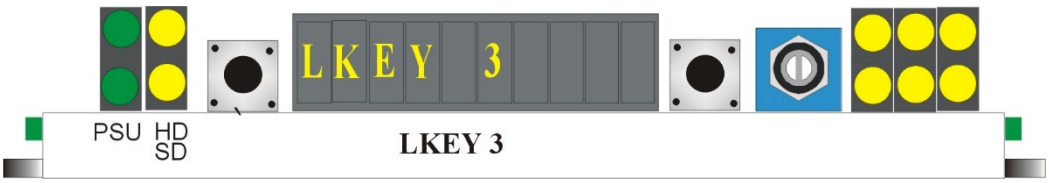
Either mask can also be used on its own as a rectangular key shape, as in this picture, with **Video** as the FG source (note the soft edges set by '**Mask Softness'** controls):

Or with **Matte** as the FG source:

8 Troubleshooting

Card edge monitoring

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



LKEY 3 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 LKEY 3 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.

9 Specification

General

Dimensions	100mm x 266mm module with DIN 41612 connector.
Weight	200g.
Power consumption	LKEY 3 - 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 259, SMPTE 292-1 and SMPTE 424/425-A. 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	1080p 50/59.94, 1080i 50/59.94, 720p 50/59.94, 625, 525. Input format auto selected.
Delay through board	Selectable ten frame video delay on all inputs can be used to compensate for delays in graphic generators.

Outputs

Video	Serial output: 270Mb/s to 2.970Gb/s serial compliant to EBU 3267-E, SMPTE 259, SMPTE 292-1 and SMPTE 424/425-A. Output follows the input format. Audio is embedded to SMPTE 272M or SMPTE 299M.

Rear Module I/O

RM50	Two BNC video outputs.
RM73	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 16 presets and trigger of auto key transition and fade to black.

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 frame active front panel and remote panel.
VisionWeb Control is available via the web server on the frame and allows operation using a standard web browser on a PC or tablet.
Statesman Lite allows control from any PC on a network.
SNMP control and monitoring via frame CPU and Ethernet connection.

10 Appendix 1

Statesman

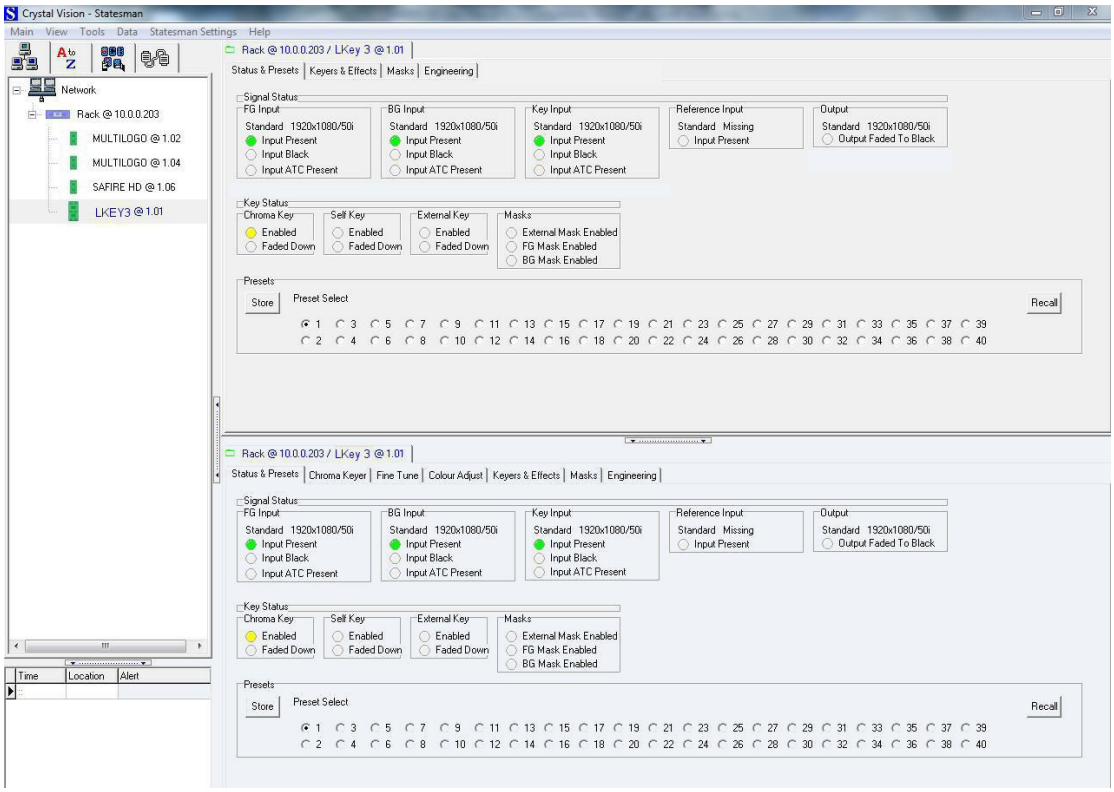
In July 2014, Statesman control of **LKEY 3** *was superseded by VisionWeb control. Statesman is no longer supported after this date, but information for existing users is included in this appendix. The following is an extract from a previous version of the manual:*

The Crystal Vision Statesman PC control software is designed to control a range of Crystal Vision modules via Ethernet control from a PC. Statesman provides a user friendly means of configuring and operating Crystal Vision modules with the benefit of “see-at-a-glance” status monitoring.

The main Statesman application communicates with each module in a frame through a Statesman-capable front panel CPU or full active control panel. Either of these must be fitted to the frame to allow Statesman control.

Statesman operation

The initial view will show an Explorer style view of the connected frames and modules. Double clicking on a module will enable the display of the main application menus.



The two large control panes shown in the upper and lower halves of the window may display different menus for the same card, or controls for different cards. Click on the horizontal button-bar between the two panes to close the lower pane or drag the button to vary the size of the panes.

Control Descriptions

The controls of LKEY 3 are accessible from the front panel, the board edge or from Crystal Vision's Statesman software. The description of controls used in this manual is based on Statesman but the path to locate controls via the front panel or board edge follows the same logic. For instance, in the Statesman GUI, an 'Input Frozen' control is located in the '**FG Input'** panel in the **'Signal Status'** group of the '**Status & Presets'** tab. To find the same control using the card edge or front panel follow the path **Status & Presets->Signal Status->FG Input** to the **Input Frozen** control.

Statesman 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 LKEY 3 settings. (*Note: Slider controls, once highlighted, can be moved by the keyboard up and down arrow keys to give finer control than possible with a mouse.*)

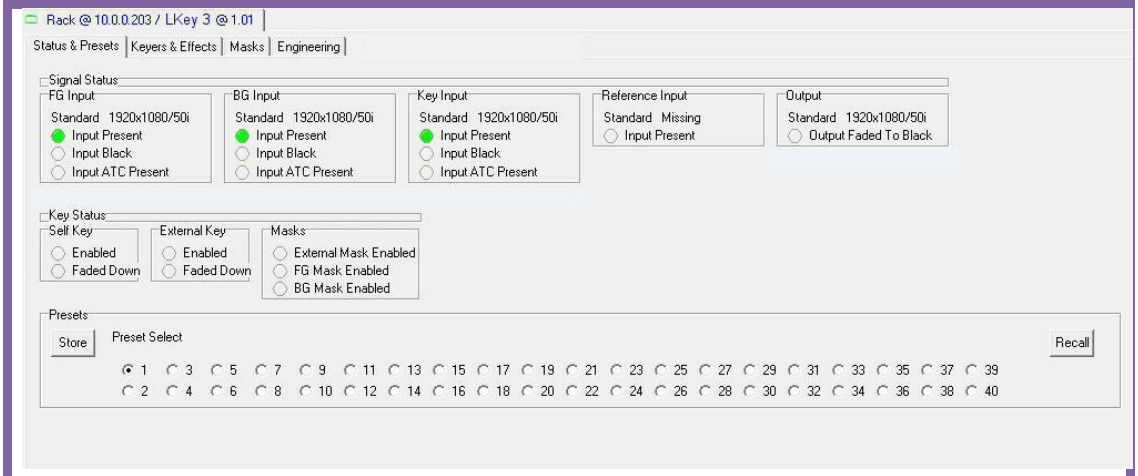
The description of the tabs are in the order shown in the GUI i.e.

STATUS & PRESETS, KEYERS & EFFECTS, MASKS, ENGINEERING.

Each tab is shown with a screen grab and description of each control's function:

Status & Presets

The board status is shown using a mixture of simulated LEDs and text information. As a general rule a green LED shows a good condition such as input present. An amber LED will give a warning as with video black or video frozen. If a LED turns red this is a fault condition. A greyed LED will indicate an absence such as non-alarm or non-warning status.



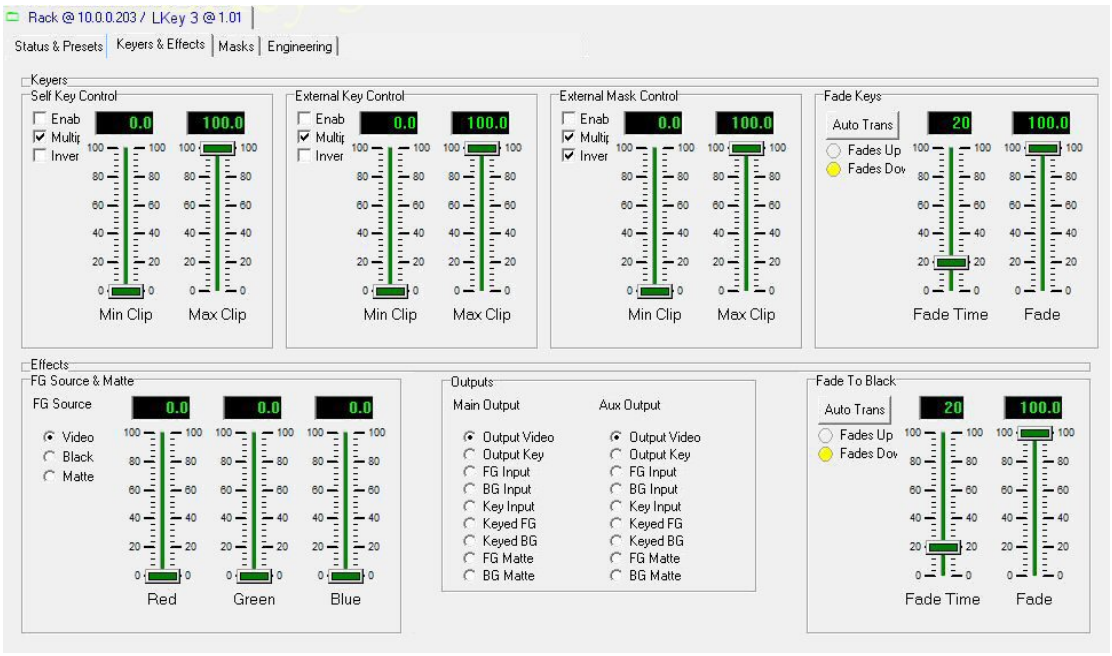
Signal Status		
FG/BG/Key Input	Standard	Displays input video standard e.g. 1920x1080/50i.
	Input Present	On when video input present.
	Input Black	On when input video is black level.
	Input ATC Present	On when ancillary timecode is present in input video.
Reference Input	Standard	Displays reference video standard e.g. 1080/50i.
	Input Present	On when reference video present.
Output	Standard	Displays output video standard e.g. 1920x1080/50i.
	Output Faded to Black	On if main output faded to black.

Key Status		
Self Key	Enabled	On when Self Key is enabled. See Keyers & Effects tab->Self Key Control.
	Faded Down	On when Self Key is enabled and faded down. See Keyers & Effects tab ->Fade Keys.
External Key	Enabled	On when External Key is enabled. See Keyers & Effects tab-> External Key Control.
	Faded Down	On when External Key is enabled and faded down. See Keyers & Effects tab->Fade Keys.
Masks	External Mask Enabled	On when External Mask is enabled. See Keyers & Effects tab->External Mask Control.
	FG Mask Enabled	On when FG Mask is enabled. See Masks tab->FG Mask Control.
	BG Mask Enabled	On when BG Mask is enabled. See Masks tab->BG Mask Control.

Presets	
Store	Store LKEY 3 settings as one of 40 presets.
Preset Select	Select preset to store or recall.
Recall	Recall one of 40 previously stored settings.

Keyers & Effects

Enable and adjust self key. Set up external key input as key and mask. Fade keys in and out, automatically and manually. Select source for FG fill and and adjust FG matte colour. Fade output to and from black.



Keyers		
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.**
	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 active key area.**
	Invert	**Select to invert the clipped key.**
	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. Monitor the keyed FG to adjust this control.**
	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 80, then all key levels above 80% of max will be clipped and amplified to full scale. Monitor the keyed FG to adjust this control.**

Keyers (contd.)		
External Key Control	Enable	Select to enable the External Key signal as a key. The BG picture is keyed and filled with the selected FG source. Use this control to key a caption into the background video and fill with matte, black or video. The external key combines with the self key to extend the overall size of the key. (See section Keys and Masks.)
	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 active key area.
	Invert	Select to invert the clipped key.
	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 80, then all key levels above 80% of max will be clipped and amplified to full scale.
External Mask Control	Enable	Select to enable the external key signal as a mask. The mask signal disables other keys in its active areas forcing BG video (see section Keys and Masks for more information).
	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 before adding to the BG signal.
	Invert	Select to invert the clipped mask.
	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 80, then all key levels above 80% of max will be clipped and amplified to full scale.
Fade Keys	Auto Trans	Use this control to automatically fade enabled keys up and down at the rate set by the Fade Time control. Masks are unaffected.
	Fades Up/Down	These indicate which direction the autotrans operation will take.
	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.

Effects		
FG Source and Matte	FG Source	Use these controls to select the FG fill. Select either FG video, black or the colour matte. (See section Keys and Masks for more detail.)
	Red/Green/Blue	Set the FG colour matte using these controls.
Outputs	Main/Aux Output	Select which signal is routed to the Main or Aux output: Output video - the final keyed image. Output key - the key signal, as a monochrome image, produced by the combination of the self key, External Key and masks. FG input - the foreground video input. BG input - the background video input. Key input - the External Key input signal as a monochrome image. Keyed FG - the foreground image after keying. This signal is useful for fine adjustment of the key controls to optimise the key. Keyed BG - the background signal after keying. This signal is useful in fine adjusting the key gain and other controls. FG Matte - display the matte colour set by the keyers and effects/FG source and matte controls. BG Matte - display the matte colour set by the keyers and effects/BG source and matte controls.
Fade to Black	Autotrans	Use this control to start an automatic fade to black transition of the video output at a rate set by the Fade Time control.
	Fades Up/Down	These indicate which direction the autotrans operation will take.
	Fade Time	Use this control to set an autotrans fade time of 0-100 seconds.
	Fade	Use this control to manually fade to/from black.

Masks

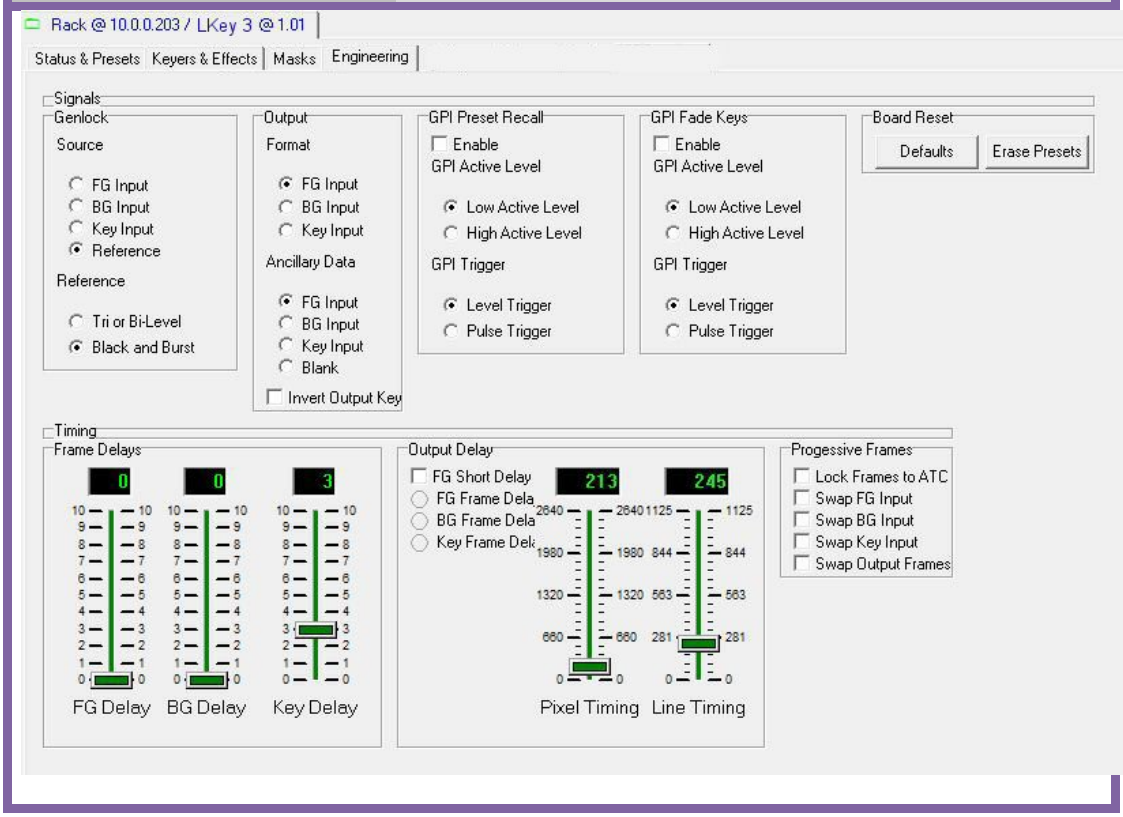
The FG and BG masks are used to override the self key or external key to either force the BG image or disable it in unwanted areas. The mask edges can be softened to make them less visible.

FG Mask		
FG Mask Control	**Enable**	**Select this control to enable the FG mask. This user-positionable mask will override the other keys in its active area to force the BG signal. Use this mask to select only part of a key. (See section Keys and Masks.)**
	Invert	**Select this control to invert the mask.**
FG Mask Window	**Left/Right/Top/Bottom**	**Use these controls to position the mask rectangle.**
FG Mask Softness	**Left/Right/Top/Bottom**	**Use these controls to soften the four edges of the mask to make the mask less noticeable.**

BG Mask		
BG Mask Control	Enable	Select this control to enable the BG mask. This user-positionable mask will override the other keys in its active area to force FG video. Use this mask to extend the key size by forcing FG video. (See section Keys and Masks)
	Invert	Select this control to invert the mask.
BG Mask Window	Left/Right/Top/Bottom	Use these controls to position the mask rectangle.
BG Mask Softness	Left/Right/Top/Bottom	Use these controls to soften the four edges of the mask to make the mask less noticeable.

Engineering

Control engineering functions such as genlock, timing and board reset.



Signals		
Genlock	Source	Select which source LKEY 3 will use as its reference.
	Reference	Select whether the external analogue reference input is Tri-Level or Black & Burst. No reference need be applied unless 'Reference' is selected as the genlock source.
Output	Format	Select which input video format should be used for the video output.
	Ancillary Data	Select which video input is the source of output ancillary data.
	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	Select low or high level as the active level for the GPI signals.
	GPI 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	Select low or high level as the active level for the GPI.
	GPI Trigger	Select whether GPI triggering should be triggered by a permanent change in level or a transition.
Board Reset	Defaults	Select to restore LKEY 3 to default conditions without erasing stored presets.
	Erase Presets	Select to restore LKEY 3 to default conditions AND erase stored presets.

Timing		
Frame Delays	FG/BG/Key Delay	These controls delay the selected video by up to ten frames at the LKEY 3's inputs.
Output Delay	FG Short Delay	Should be set as default.
	FG/BG/Key Frame Delay	Indicates whether the output signal is more than one whole frame delayed with respect to each input.
	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 selected 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.*

Timing (contd.)		
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.