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VIDEO SWITCHER

VIDEO PRODUCTION CENTER

Concepts Manual

www.grassvalley.com

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JUNE 2012

KEMA Quality

CERTIFICATE

Certificate Number: 510040.001

The Quality System of:

Grass Valley USA, LLC and its Grass Valley Affiliates

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Including its implementation, meets the requirements of the standard:

ISO 9001:2008

Scope:
The design, manufacture and support of video and audio hardware and software products and related systems.

This Certificate is valid until: June 14, 2012
This Certificate is valid as of: December 23, 2010
Certified for the first time: June 14, 2000

H. Pierre Sallé
President
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Grass Valley Web Site

The www.grassvalley.com web site offers the following:

Online User Documentation — Current versions of product catalogs, brochures, data sheets, ordering guides, planning guides, manuals, and release notes in .pdf format can be downloaded.

FAQ Database — Solutions to problems and troubleshooting efforts can be found by searching our Frequently Asked Questions (FAQ) database.

Software Downloads — Download software updates, drivers, and patches.

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END-OF-LIFE PRODUCT RECYCLING NOTICE

Grass Valley's innovation and excellence in product design also extends to the programs we've established to manage the recycling of our products. Grass Valley has developed a comprehensive end-of-life product take back program for recycle or disposal of end-of-life products. Our program meets the requirements of the European Union's WEEE Directive, the United States Environmental Protection Agency, and U.S. state and local agencies.

Grass Valley's end-of-life product take back program assures proper disposal by use of Best Available Technology. This program accepts any Grass Valley branded equipment. Upon request, a Certificate of Recycling or a Certificate of Destruction, depending on the ultimate disposition of the product, can be sent to the requester.

Grass Valley will be responsible for all costs associated with recycling and disposal, including freight. However, you are responsible for the removal of the equipment from your facility and packing the equipment to make it ready for pickup.

For further information on the Grass Valley product take back system please contact Grass Valley at + 800 80 80 20 20 or +33 1 48 25 20 20 from most other countries. In the U.S. and Canada please call 800-547-8949, and ask to be connected to the EH&S Department. Additional information concerning the program can be found at: www.grassvalley.com/about/environmental-policy

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Contents

Concepts

Introduction

In general, any video switcher receives multiple video inputs, performs signal processing on selected input signals, and then outputs the processed video. Efficient real time switcher operation is essential for live production, and can save valuable time in post production environments as well. Several innovative concepts are employed in a Grass Valley switcher system to enhance its operational speed and flexibility. Understanding these concepts, as well as basic switcher fundamentals, will help you take full advantage of the exceptional power of the system.

Grass Valley has developed several video switcher systems over the years (including the Kalypso, Kayenne, and Karrera models) and continues to create cutting edge products that extend each successive system's capabilities. Each Grass Valley switcher system consists of a Video Processor frame, which contains the electronic circuitry that performs the actual video signal routing and manipulation, and a Control Surface consisting of one or more control panels and menu interfaces, which send commands to the Video Processor Frame that direct its activity.

The term Video Production Center has been applied to recent Grass Valley products to indicate they do much more than just switch video. Integrated Digital Picture Manipulation (DPM), external device control, and integrated Image Stores are just a few of the enhancements Grass Valley offers. But certain core functionalities are shared by all recent Grass Valley switcher systems. This manual describes many of these fundamental capabilities.

System Configuration Overview

Every Grass Valley switcher system is designed for operational flexibility, and can be configured to fit various applications. Different systems can have different capabilities, or the same system can be re-configured to have different capabilities at different times. Each Grass Valley switcher system has also been designed to support multiple users on the same system, but remains suitable for use by a single operator. For these reasons, it is important for you to have a basic understanding of how the system is configured.

The way a Grass Valley switcher system is wired into your facility affects the system's capabilities. For example, the number and types of sources physically connected to the system obviously determines what video the system can handle. However, because the system inputs and outputs can be configured, once video cables are physically connected they need not be moved. Configuration settings also control many other capabilities that affect the Grass Valley switcher system behavior.

System configuration information is divided into three areas, to simplify and increase the speed of reconfiguring the system. The basic areas of system configuration are:

- Engineering Setups (settings established by the engineer in charge that affect the entire system, which never need to be changed by operators),
- Suite Preferences (settings for a suite that affect all the operators working in that suite, that are designed to suit a particular show or production style and ensure a consistent working environment), and
- Panel (or User) Preferences (settings that give the operator the ability to customize his individual work surface to meet his personal preferences).

All system configuration settings are non-volatile. Disk save and load operations are available that allow users to store configuration information on removable media for easy transport and for use as backup copies.

Engineering Setups

Engineering Setups control how the Grass Valley switcher system's major components behave and interact, and how the system interacts with the rest of the facility. Engineering Setups are not likely to change on a daily basis and so are grouped separately from the Suite and Panel Preferences. Facility maintenance personnel or the engineer in charge of a production truck generally manages Engineering Setups.

Engineering Setups information includes:

- Acquired Resources,
- Network IP addresses,
- Source definition,
- Output assignment (identifying which output connectors are Program, which are Preview, etc.),
- External device interfaces (DDRs, VTRs, DPM, Router, etc.),
- Control surface and suite definitions, and
- Various other system functions.

Suite Preferences

A Grass Valley switcher system suite corresponds to a control room, where there is a grouping of one or more control surfaces. Suite Preferences define how all the control surfaces associated with a suite behave when they control the system. Some parameters (for example, safe title displays) must be identical to all switcher system users involved in a session. Suite Preferences can substantially change system behavior, not just a user's view of the system. Suite Preferences are intended for day-to-day or session-to-session changes in system operating behavior and so are open for modification by operators.

The Resource Sharing feature makes it possible to configure a Grass Valley switcher system with two suites, corresponding to two different work environments. Each suite can be operated with its own Suite Preferences settings.

Suite Preferences include:

- Resource Allocation
- Source patching
- Safe title, preview behavior, etc.,
- Default Keyframe (initial settings for many other user controls), and
- Various other suite preferences.

Panel Preferences

Panel Preferences allow users to customize a Grass Valley switcher system control surface to suit their personal operational style. Panel Preferences apply to only one control surface, and only affect the behavior of the panel controls available to a single operator. Panel Preferences do not change system capabilities.

The Resource Sharing feature makes it possible to configure each of the two two suites with two different control surfaces. Each control surface can run its own Panel Preferences settings.

Panel Preferences include:

- Source to button mapping (described later in this section),
- Aux bus delegation button mapping,
- Panel color scheme,
- Source color,
- Macro and E-MEM start number, and
- DPOP prefs.

Signal Routing

Inputs and Sources

Incoming video signals are connected to the Grass Valley switcher system via connectors on inputs located at the back of the Video Processor frame. Some devices (for example, a camera providing serial digital output) may provide a video signal that can be received on a single connector. However, other devices may output multiple signals. For example, a character generator usually provides a signal with two components (commonly called *video* and *key*). Some incoming signals may also originate from devices the system can control (Router, DPM, DDR).

Note Although the character generator utilizes two inputs, it should be defined as only a single Video/Key source (CGx). It is not required to source define or button map the character generator's Key signal.

For a Grass Valley switcher system, the term *source* refers to all the video signals and other attributes associated with a device. This is a fundamental concept. The system is based on sources, not input signals or crosspoints. Each source can be given a descriptive name, but has an ID number for absolute identification. The system uses ID numbers, not source names or input connectors, to identify each source. Defining each source is an important aspect of the system.

Source Definition

When a Grass Valley switcher system is first configured, all sources are defined so the incoming signals from each device can be used effectively. This is usually done by engineering personnel, not operators, and once set these definitions are not changed. A source definition data file tells the system how many signals a source has (video only, or video and key), which physical inputs to route whenever a particular source is selected, the default processing of the source's key signal (if present), and what external devices (if any) are associated with that source. Tally is another important attribute of a source. On-air tally relays are related to sources, not physical inputs or source select buttons. The source definition process includes assigning a name to each source. Once sources are defined, they are mapped to specific source selection buttons. The user is then able to select the source by pressing its button, and the system automatically manages all the necessary signals, performs any default processing, and enables any additional control capabilities associated with that source.

Source definition data is stored as a part of Engineering Setups. Only one set of source definition data can be active on a system at a time.

Source to Button Mapping

Source to button mapping makes it possible to organize sources on Grass Valley switcher Control Panels in a preferred order. For example, cameras can be placed on the left side or the right side of the button row, whichever is preferred. Source mapping is distinct from source definition, as source mapping only involves the location of sources on the Control Panel and does not affect any capabilities defined for the sources. Note that E-MEM effects store the source IDs, not the source select buttons, so remapping or unmapping of sources will not change the appearance of recalled effects. On the system, button mapping for each Control Panel bank and Local Aux Panel can be different.

Source Naming

Names can be given to sources. A Grass Valley switcher system actually supports different source naming schemes, with associated IDs, to accommodate different needs.

Engineering ID – An unchanging numeric value associated with a source. This value is used to unambiguously identify each source from an engineering perspective, regardless of how it may have been named. On-air tally uses Engineering IDs so the proper device always receives tally.

Engineering Name – An editable name that can be associated with a source, intended for use by facility engineers to ease source identification. An Engineering name may that of a particular hard wired device (Cam 1), or it may indicate a patch bay location or a router source or destination. Naming sources in this manner can help engineers configure and re-configure their facility wiring.

Logical ID – An unchanging numeric value associated with a source used in a production environment. E-MEMs, source selection, macros, and source rules all use Logical IDs.

Alternative Names – Alternative editable names that can also be associated with a Logical ID. Generally alternative names are short to make larger characters appear in the system Displays.

Source Patching

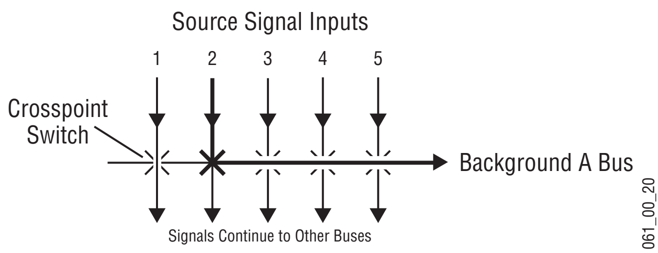
A Grass Valley switcher system allows logical sources to be associated with different engineering sources. A source patch table is used to map Logical IDs to Engineering IDs. This table acts like a patch bay. It then becomes possible to use effects in different environments. For example, effects created in one production truck equipped with one set of devices can be used in a different truck with different devices by modifying the source patch table.

Source Patching associates all attributes of a defined source's tally and attributes if included, for example: key signal, external device settings, and router destination settings.

Buses and Crosspoints

A *bus* is technically defined as a signal path where one of several available inputs can be selected to feed a single output. A *crosspoint* is an electronic switch that allows a signal to pass when the switch is closed. On video switchers, a bus can be constructed containing a series of crosspoints, which permits selecting which one of several incoming signals will be sent out the bus. In Figure 1, source 2 has been selected on the background A bus. This signal can now be called *background* video and is available for further processing.

Figure 1. Buses with Crosspoints

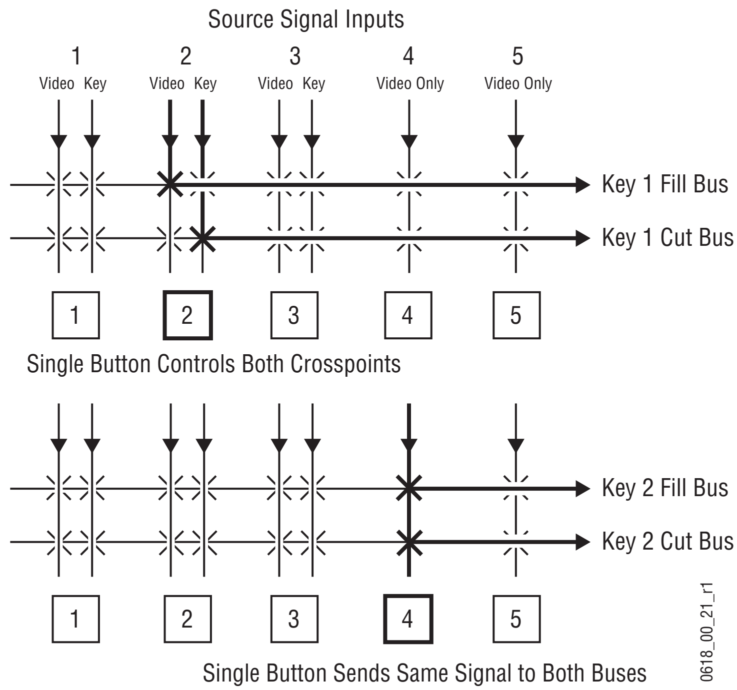


Buttons on a Control Panel can be used to control the switching of crosspoints. The buttons are usually arranged horizontally, making it easy to imagine the available signals coming in from the top, and the single bus output signal going out the right side.

In earlier generation switchers, the terms *crosspoint button* and *crosspoint bus* have been used in reference to Control Panel source selection. For a Grass Valley switcher system, the terms *source button* and *source bus* will be used. These terms better reflect a system operating philosophy that is based on sources rather than crosspoints. The system does not directly associate a source select button with a physical crosspoint. The association goes first through source to button mapping, then through source definition to find the physical inputs.

On a Grass Valley switcher system, a single source button can control crosspoints on different buses simultaneously. For example, during keying on an ME, both the video and key signals of a source can be selected with a single button press. In this case two different crosspoints on separate buses (key fill bus and key cut bus) are actually switched when the button is pressed. In the upper part of Figure 2, the *video* component of source 2 in the figure has been selected on the key fill bus and becomes the *key fill* signal for subsequent keying. The key component of source 2 selected on the key cut bus becomes the *key cut* signal for keying. The lower part of Figure 2 shows how the same source (source 4) can be selected for both the key fill and key cut signals.

Figure 2. Multiple Crosspoint Control

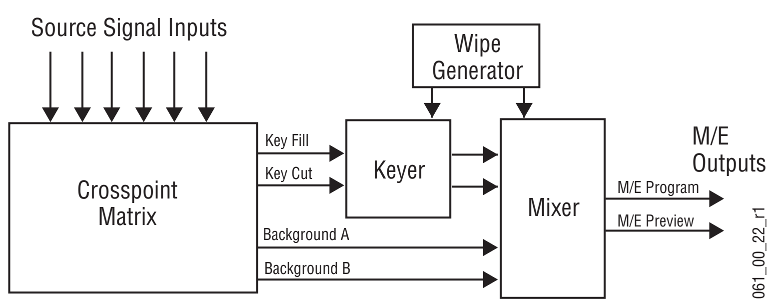


Mix/Effects (ME)

An ME is a subsystem of a video production switcher that can create a composite of two or more pictures. An ME includes multiple source selection buses and provides transition (mix and wipe) and keying capabilities on the selected signals.

A simple basic ME used in a typical switcher will be used as an example in the following discussion. A video production switcher ME has added capabilities, but the basic principles described here will apply.

Figure 3. Simplified Mix Effects (ME) Subsystem



The basic ME shown in Figure 3 has an A and a B background bus. These buses select the background video signals sent to the output of the ME. Generally the source on the background A bus is the current background output, and the source on the background B bus is the background video that will be used next. During most transitions, portions of both backgrounds are output simultaneously. The keyers in the ME allow the inclusion of additional material over the background. Wipe generators also exist, which create patterns used by the mixer for wipe transitions, or used by the keyers to modify the signals it sends the mixer. See *Transitions* on page 17 and *Keying* on page 21 for more information. The processed signal in an ME is then sent to an ME output, typically program or preview.

Each ME actually is able to produce up to six outputs (Program A, Preview A, Program B, C, D, and Preview 2 that is shared by the three additional program outputs). These additional outputs allow great flexibility in configuring a system for special purposes.

Logical Assignments of MEs

A Grass Valley switcher system can have multiple MEs. For example, a Kayenne 4.5-ME Grass Valley Video Production Center has five (ME 1, ME 2, ME 3, ME 4 and PGM PST). A 4.5-ME Kayenne frame consists of four full ME cards, A, B, C, and D and the standard Half ME (ME 50). Any frame ME can be assigned to the logical MEs by using the Eng Setup, Acquire Resources menu. ME 50 could be assigned as ME 2 or later assigned as PGM/PST on a show-by-show basis. Any of the frame's MEs can be assigned to one of the five logical MEs.

Re-Entry

Switchers with multiple MEs generally have re-entry capabilities. Re-entry permits the switcher to select the output of one ME for use as an input source to another ME. The signals are routed internally.

A Grass Valley switcher system supports ME re-entry in any order. For example, an output of ME 2 can be sent to ME 1, and an output of ME 1 can be sent to ME 3. Infinite looping re-entry (for example, ME 1 sent to ME 2 and ME 2 sent back to ME 1) is allowed but should only be done carefully.

Utility Buses

Besides the standard A and B background buses, each ME also accepts Utility 1 and Utility 2 inputs. Utility buses can be used to select signals for special purposes, and have no relation to the background buses. For example, a video signal selected on a Utility bus can be used to fill a keyed Borderline border, to feed a custom pattern into a wipe generator, or create a custom border wash pattern. When the ME is in DoubleTake, Split ME mode, the Utility Buses contribute to the secondary mixer of that ME allowing for independent ME transitions.

Outputs

Video production switchers generate several different video outputs (Program, Preview, etc.). A final program output from PGM PST is typically sent to the Master Control/Transmission for broadcast and/or to servers or VTRs for recording. Individual ME program and preview outputs and an additional switched preview output are sent to monitors in the control room. These outputs may also be routed elsewhere in the facility. Aux Bus outputs may also be used for studio display systems, ISO feeds, and complex clean feeds.

Output Mapping

Unlike earlier generation switchers, all Grass Valley switcher system outputs are configurable. There are no dedicated output connectors. Any signal can be assigned to any output connector, which provides flexibility and control of the number of fixed and up to 46 Aux bus outputs the system will have. A fixed output is always the same, while an Aux bus's output can change depending on what source has been selected on that bus. Once the fixed system outputs have been assigned, all the remaining outputs can be assigned for use with Aux Buses. When the system is configured, the outgoing signals are assigned to connectors on output modules located at the back of the Video Processor frame.

The most important difference between a fixed output and Aux bus is that an operator has control over an aux bus but a fixed output always provides the same signal. Aux bus outputs also support YUV color correction and optionally RGB color correction with E-MEM and macro control. If an output is assigned to a fixed output, any color correction settings are bypassed and the output is set back to unity default.

Aux Buses

Aux Buses can be used to select and route sources to specific destinations. For example, a source selected on an Aux bus can be sent to an ISO recorder for instant replay. This can be done directly by the Technical Director while he switches the program. Remote Aux Panels can be used to give different operators control over one or more Aux Buses.

On a Grass Valley switcher system, each Remote Aux Bus panel can have its own source to button mapping. Source name displays on a Local Aux Panel show what source is currently available for each button. Aux Buses can also be configured in pairs, to send matching key cut and key fill signals to external devices, Remote Aux Panel IP Address, Logical Aux settings, and Button Mapping are exclusively saved with the Eng Setup file.

Point Of Use

A Grass Valley switcher system can share some resources for use at different locations. The location where a resource is being used is called a *point of use*. Different types of resources are shared differently.

Floating resources (like DPMs) move between points of use, and the parameters controlling these resources are considered part of the point of use. These resources are used at only one point of use at a time. When the resource floats to the new location, its behavior changes. For example, a DPM can be set for 0.25 Z rotation (parameter) on ME 1 Key 2 (point of use). That same DPM can then be assigned to ME 2 Key 3 and set to a Z rotation of 0.0. When the DPM is reassigned back to ME 1 Key 2, the 0.25 Z rotation parameter will be restored.

Other Grass Valley switcher system resources behave differently. For example, wipe pattern generator resources can be used for an ME wipe transition, as a preset pattern, as a mask, or at other points of use. It is also possible to assign the output of the same wipe pattern generator to different points of use at the same time. For efficient operation, the system has divided the parameters controlling wipe pattern generators and related utility bus functions into two categories*; shared generator parameters* and *point of use parameters*. The set of parameters for the shared generator are used by all points of use, so changing one of these parameters will affect all locations where that wipe pattern generator is being used at that time. Separate sets of point of use parameters, however, are maintained for each system point of use (same as DPMs described above). These settings are used only by each individual point of use, so changing them will not affect any other point of use. For example, a wipe shape (box, circle, etc.) is a generator parameter, but the softness of the shape's edges is a point of use parameter. If the same wipe generator is used by both an ME wipe transition and a preset pattern, adjusting softness at one point of use will not affect the other's softness settings. However, changing the pattern shape affects both locations.

Transitions

A transition is a change from one image to another. A Grass Valley switcher system supports three basic types of transitions:

- Cut
- Mix
- Wipe

A transition can be applied to the entire picture, or to only the background or keyed elements of the picture, and can include multiple elements. See *Current and Next Stack* on page 20 for information on transitions involving more than one element.

Cut

A *cut* is an instantaneous switch from one image to another (between successive video fields or frames). The simplest type is a *hot cut*, accomplished by selecting a different source on a bus feeding an ME output. This only changes that bus's contribution to the output, and does not change what elements may be involved in the output (the same buses are involved).

The system also provides cut transitions, where the elements involved in a composite can be changed instantaneously. Different buses can be included or excluded, causing changes in the resulting composite image. Background cut transitions on an ME are first selected on the Background B bus to allow previewing the upcoming picture before it is cut on-air.

Mix

A *mix* is a transition from one picture to another where the new picture fades in as the existing picture fades out. During a standard mix transition a superimposition of both pictures, each at a lower intensity, is visible.

A Grass Valley switcher system allows mixing from one background to another and to mix up to six separate keys on or off over a background. Background and key mixes can be done separately or simultaneously.

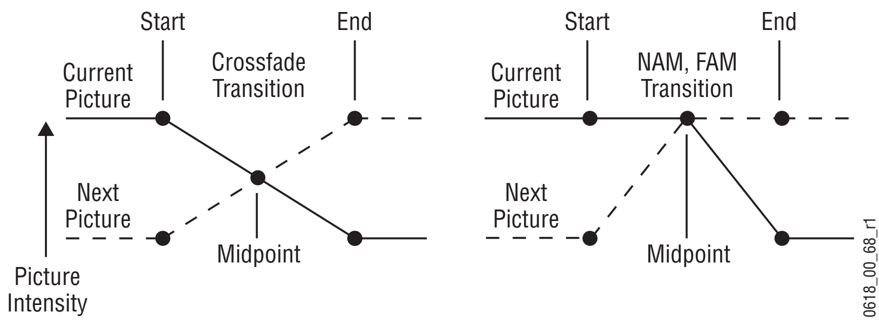
Mix Through Video

A Mix Through Video transition is a special mix transition that incorporates a third intermediate video source. This type of transition can mix from one video source, through a matte or Utility bus video source, to the final video source, all as one transition.

Non-Additive Mix, Full Additive Mix

Non Additive Mix (NAM) and Full Additive Mix (FAM) are special mix transitions that a Grass Valley switcher system supports besides normal crossfade transitions. Picture elements in NAM and FAM transitions are composited differently through the time of the transition(Figure 4).

Figure 4. Normal, NAM and FAM Mixes



NAM transitions pass only the brightest regions of each picture to the output. During the first half of a NAM transition the original picture retains its original intensity while the next picture mixes to full intensity. Brighter areas in the new picture replace any corresponding darker areas of the previous picture. During the second half of a NAM transition the previous picture mixes out of the darker areas of the new picture. FAM transitions also first fade a new picture to full intensity and then fade the old picture out, but both full intensity pictures are mixed together to the output during the transition. The resulting signal is clipped at white level to prevent generating illegal video.

Wipe

A *wipe* is a transition from one picture to another in which the edge of a shape moves across the screen, revealing the new picture. Wipe transitions can be applied to backgrounds, to keys, or to both simultaneously. A wipe transition shape can be selected from a variety of patterns, and these patterns can be adjusted in several ways (position, aspect ratios, edge attributes, etc.). It is also possible to combine wipes (Pattern Mix) to create extremely complicated wipe transition shapes. Utility bus video signals can also be used to generate a custom pattern for a wipe transition or other purposes.

Other Wipe Pattern Generator Uses

Wipe pattern generator circuitry can be used for purposes that do not involve transitions. These pattern generators can also be used for Preset Pattern, Masking, and Matte Washes.

Preset Black

Preset Black is a special type of transition, where the picture transitions to black, and then transitions out of black to the new picture. Preset Black is really two transitions, one to and one from black, and so requires two operator commands to complete. Preset Black can be used with any transition type (cut, mix, or wipe). The entire picture goes to black, even if all the transition elements involved in the picture were not selected.

Transition Rate

Cut transitions are instantaneous, but mix and wipe transitions have durations. Transition durations can be set in advance to a specific transition rate, and be initiated by pressing a button the Control Panel. It is also possible to manually control transitions using a lever arm.

On a Grass Valley switcher system, one transition rate can be assigned to the main transition of each ME. This type of transition can be controlled by that ME's lever arm. Each of the keyers on each ME can also be assigned its own transition rate.

Flip Flop Background Buses

At the completion of a transition, the background buses swap their source selections (flip flop). This makes the upper bus always act as the on-air bus, and the lower bus act as a preset bus. The operator can reliably setup the next source on the lower bus without disturbing the source selected on the on-air upper bus.

For example, if a transition begins with source 1 on Background A and goes to source 2 on Background B, as soon at the transition to source 2 completes, source 2 will be taken to the Background A bus (without disturbing the output of that ME). The source 1 selection will also be immediately taken to the Background B bus.

Look Ahead Preview

If a preview monitor is configured for Look Ahead Preview mode, the end result of the upcoming transition can be viewed on that monitor. This lets the operator know in advance what will occur for that next transition. The mode you select for each preview monitor depends on the number of monitors available and the individual requirements of the facility.

Current and Next Stack

A Grass Valley switcher system uses a current and next stack approach for transitions that involve multiple elements. The current stack is the current ME output including any keys that are on. The next stack is defined by the current stack and whatever next transition elements have been selected. Look ahead preview always displays the next stack. Next transition elements affecting stacks are Keys 1 - 6, background, and key priority.

Grass Valley switcher system transitions always occur from the current stack to the next stack. For example, if the current stack has Key 1 over Background A, and the next stack specifies Key 2 over Background B, a mix transition will occur between the composites (Key 1 over A to Key 2 over B). This is different from mixing Key 1 off, Key 2 on, and mixing between A and B at the same time, which would cause the keys to go transparent over their background during the transition. Opacity is retained throughout the transition, so midway through this example Key 1 remains fully keyed over Background A, and Key 2 is fully keyed over Background B. The transition occurs between these two fully keyed composites.

Key Priority and Transitions

Keyers on a Grass Valley switcher system MEs can be assigned priorities. This determines the layering of the keys. The highest priority key appears on top, while keyers with lower priority may be partially or fully hidden behind those with higher key priorities. The backgrounds always have the lowest priority. Changes in key priority can be included as a part of a transition. Like any other transition, the current stack will transition to the key priority of the next stack. For example, suppose the current stack has Keys 1, 2, and 3 in that key priority order over Background A, and the next stack specifies key priority order 3, 2, 1. A mix transition will occur between the 1, 2, 3 composite order to the 3, 2, 1 composite order. All three keys will remain fully keyed over the background, and will mix to their new key priority order.

Keying

Keying inserts part of one picture into another to create a composite picture. Keying involves three signals:

- background,
- key cut, used to specify where to cut a hole in the background, and
- key fill, used to fill the hole in the background. The fill can be an incoming video signal or it can be an internally generated matte.

A separate key cut input signal is not necessarily required for keying. For example, a self key (also called a video key) uses the same input signal for both key cut and key fill.

The Grass Valley switcher system supports the following types of keys:

- Linear Key (fixed and adjustable)
- Luminance Key
- Preset Pattern
- Chroma Key (option)

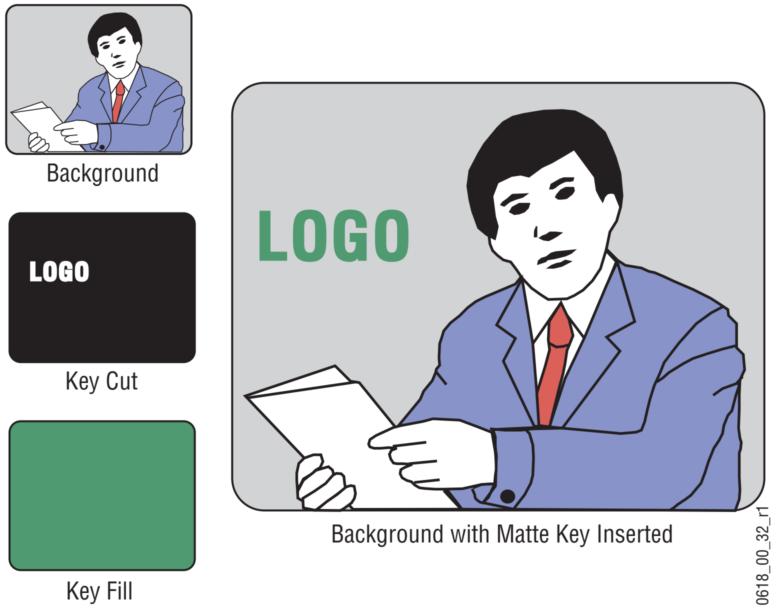
The system also supports self keys and split keys.

Matte Fill Key Example

One of the earliest keying techniques was to use an art card and camera to perform a luminance key with a matte fill. This type of key is a good example for explaining basic keying principles because three separate and independent incoming signals are used.

To insert a green logo into background video, the logo can be printed in white on black paper and a camera can be focused on it. The signal from the camera can be selected as the key cut signal and green matte video can be selected as the key fill signal sent to the keyer. The key cut signal is then adjusted (clipped) to ignore the black paper and use only the white logo shape to cut a hole in the background video. The keyer then shapes the key fill to precisely match the logo-shaped hole cut in the background and fills it with green matte video. This creates a green logo inserted into the background (Figure 5). Because luminance values of the key cut signal are used to cut the hole in the background this is called a luminance key.

Figure 5. Matte Fill Luminance Keying Example



In this keying discussion illustrations rather than actual screen images are used for simplicity, and because the printing process has difficulty capturing the subtleties of soft key edges.

Shaping Video

In the matte key example above, the key fill signal was a full raster color that did not match the shape of the key cut signal. This key fill signal is accurately called *non-shaped* video, but may also be referred to as *unshaped* video since both signal types are processed identically during keying.

Some external devices (e.g., character generators) provide a key cut signal and an already processed companion key fill signal. A key fill signal that correctly matches the key cut signal is called *shaped* video. During keying, properly shaped key fill video can be summed with a background signal (with a hole cut) and achieve the desired result. When the shaping is performed by the source device, the Grass Valley switcher system can use a standard clip and gain setting defined during system configuration to create the key cut control signal, and so relieve the operator of having to adjust clip and gain manually.

If a key fill does not match the hole in the background (like in the matte key example above), the key fill needs to be shaped by the switcher. By multiplying the key fill signal with the key control signal the unwanted areas of the fill can be made black, shaping the video to match the hole before it is summed with the background. Key fill video must be shaped using the key cut signal actually used to create the hole in the background. Video shaped with a different key cut signal will not key correctly.

A Grass Valley switcher system, as well as some external devices like DPMs, can also divide a shaped video signal by its own key signal. The result is called *unshaped* video. For optimum image quality, shaping and unshaping operations should be minimized. In general, devices should be installed and configured in a manner that prevents them from having to unshape incoming video just to reshape it again afterwards.

Specifying whether source signals are shaped or unshaped is part of the system configuration process (source definition). Properly shaped video is an important aspect of keying. See *Properly and Improperly Shaped Video* on page 34 for more information.

Note that an unshaped signal viewed directly will show harsh edge artifacts due to dividing by a small number. This is normal and expected. Keying this signal will clean up its appearance.

Key Control Signal Adjustment

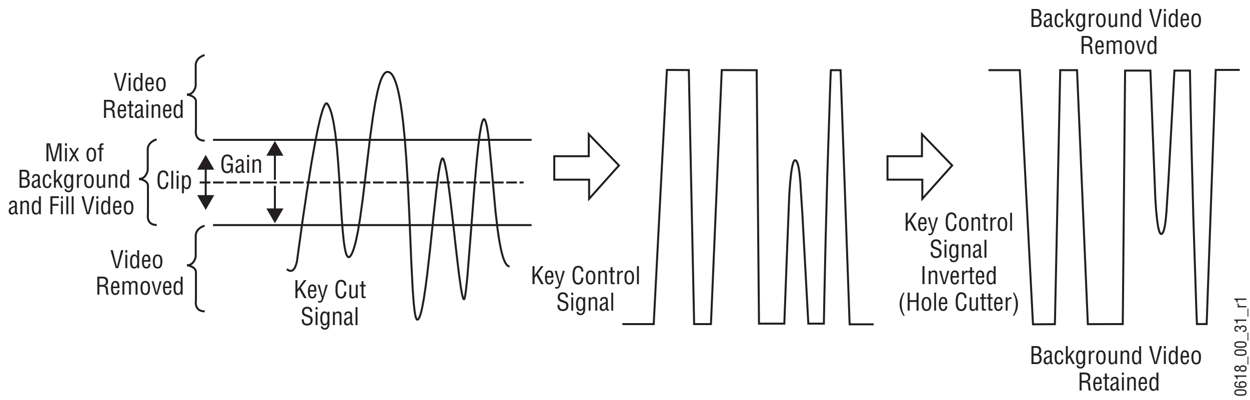
During keying, the selected key cut signal can be converted into a key control signal. It is the key control signal that actually cuts the hole in the background video. Adjusting the key control signal (Clip and Gain) is essential in the keying process. The art of setting up a good key is to use just enough Gain to suppress any imperfections in the incoming key signals. Setting Gain too high can cause ragged key edges.

A Grass Valley switcher system provides two methods for adjusting the key control signal, Clip and Gain, and Clip Hi and Clip Lo. Note that the same basic keying process is controlled by either of these methods.

Clip and Gain

The Clip and Gain operation selects a threshold of the selected key cut video that will be used to cut the hole in the background video. Clip controls the threshold, and Gain controls the softness of the key edges and any translucent areas. High portions of the key cut signal specifies what video is retained, and low portions determine what video is removed. Intermediate levels specify a soft blend of the background and fill video (Figure 6).

Figure 6. Key Clip, Gain, and Key Control Signal

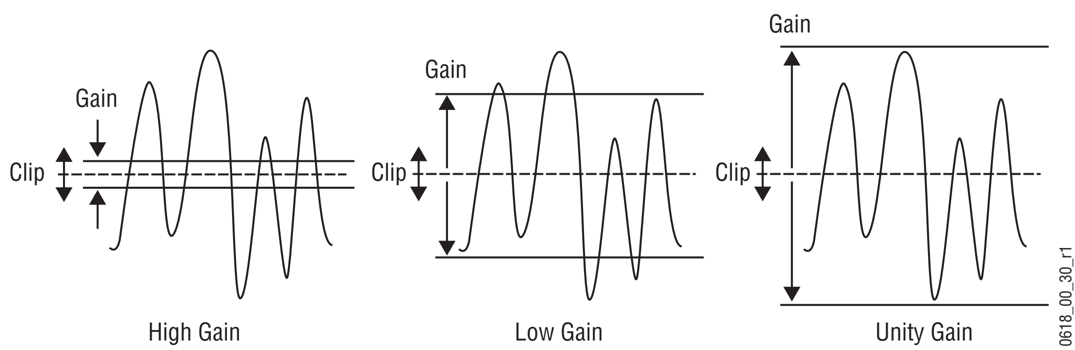


Clip and Gain control is appropriate for high gain keys (see below), to easily adjust where the relatively hard transition from background to fill occurs. In this mode, changing the Clip control moves the threshold up and down without affecting Gain, which is adjusted separately with its own Gain control.

High Gain, Low Gain, and Unity Gain

A high gain key has a narrow range, creating harder key edges. A low gain key has a wider range, creating softer key edges. Linear keys typically use minimal gain (also called unity gain) to completely preserve the soft edges of the keys (Figure 7). Note that the system also supports keys that go below unity gain.

Figure 7. Keying Gain Values

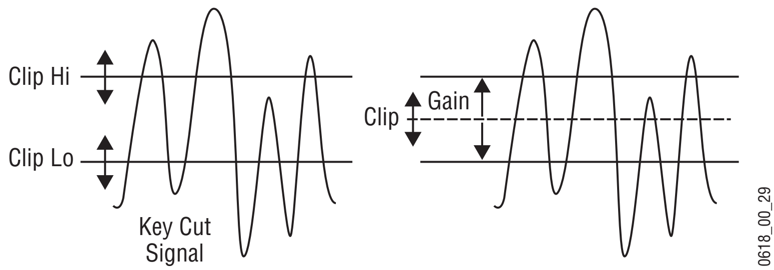


On a Grass Valley switcher system, Gain has a percentage value. A Gain value of 50% requires a luminance change of 50% of the distance between black and white to produce a keying signal ranging from transparent to opaque. A gain value of 100% (unity gain) uses the entire range between black and white for this transparent to opaque transition. A gain value of 0% produces the hard key edges (a high gain key).

Clip Hi and Clip Lo

A Grass Valley switcher system also supports a Clip Hi and Clip Lo mechanism. With Clip Hi and Clip Lo, two thresholds are established. The upper threshold specifies at what point video will be completely removed from the background, and the lower threshold determines at what point background video will be retained completely intact (Figure 8).

Figure 8. Key Hi, Clip Lo vs. Clip and Gain



In this mode, Gain changes when either control is adjusted. The difference between the upper and lower keying thresholds is equivalent to gain:

Clip Hi = Clip + Gain/2

Clip Lo = Clip – Gain/2

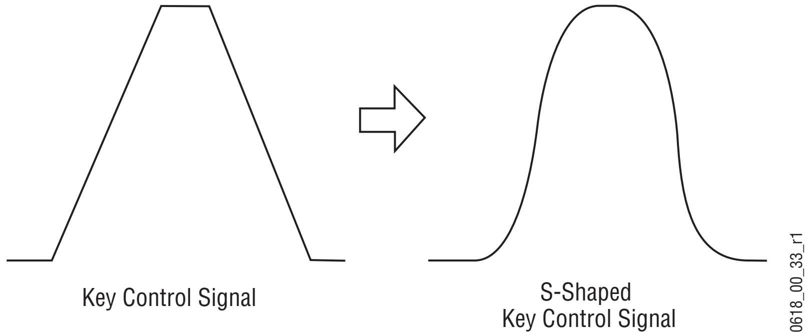
Clip Hi and Lo control is more appropriate for low gain keys, to allow independent control of the two thresholds. For example, when adjusting a linear key the operator wants to control where the fill becomes opaque (Clip Hi) and where the fill becomes transparent (Clip Low). In Clip Hi/Lo mode adjusting the point of opacity does not change the point of transparency, and vice versa.

Clip, Gain, Clip Hi and Clip Low adjustments always interact. Changing one always results in changes to two other values. Changing Clip Hi or Clip Low changes both Clip and Gain, not just Gain.

S-Shaped Key Signals

On a Grass Valley switcher system, an S-shaping function is applied to the edges of luminance keys. S-shaping smooths the sharp corners of a luminance key control signal, which helps prevent banding artifacts. S-shaping a signal minimally affects the key edges, and does not move key thresholds or affect the overall gain of the key (Figure 9).

Figure 9. S-Shaped Luminance Key Control Signal



S-shaping is generally not applied to linear keys because the external device usually applies an S-shaping function when it generates the key cut and key fill signals. S-shaping should not be applied twice.

Additional Keying Controls

The following additional controls are available for keying.

Key Invert

Keys can be inverted, causing holes to be cut in the background where a normal key retains the background, and vice versa. Key invert makes the white areas of the key cut signal produce transparency, and the black areas produce opacity, the opposite of a standard key.

Borderline

The Borderline feature generates borders around keys. The key signal is delayed and/or enlarged, and the extra bordering space can be filled with matte or video. Borderline can be adjusted in size, and in horizontal and vertical placement.Variations on Borderline include Shadow, Extrude, and Outline.

Masking

Masking defines areas that are protected from keying (Inhibit Mask) or always key (Force Mask). The shape of the mask can originate from a wipe pattern generator or by a selected mask signal (typically a key fill signal delivered via one of the Utility buses).

Opacity

The opacity of a key can be adjusted. When opacity is reduced below 100% some background video is allowed to show through areas where it is normally excluded. Key opacity is an adjustment to the overall intensity of the key, and is separate from Clip and Gain controls. Note that a common mistake is to set opacity to zero and forget that adjustment was made, which can cause confusion later when that key is selected but not visible.

Key Positioning

Key positioning allows slight adjustment of the horizontal position of the key cut signal relative to the key fill signal. This is useful if the timing of the two signals at the switcher inputs are not matched properly. This is generally only a problem if the cut or fill follow analog paths from source to switcher or if the source has video/key timing adjustments which have been set to compensate for other delays within the facility.

Key Size

Key size allows the key cut signal to be narrowed slightly. This can greatly enhance self keys and chroma keys that have been reshaped.

Coring

Coring helps reduce video noise in Chroma keys. Coring is used when a key fill signal has noise in areas that are supposed to be transparent. When noise exists in these areas it can appear in the background portion of the keyed composite. Coring replaces the noisy black areas outside the shaped fill with clean black before it is summed, eliminating the noise.

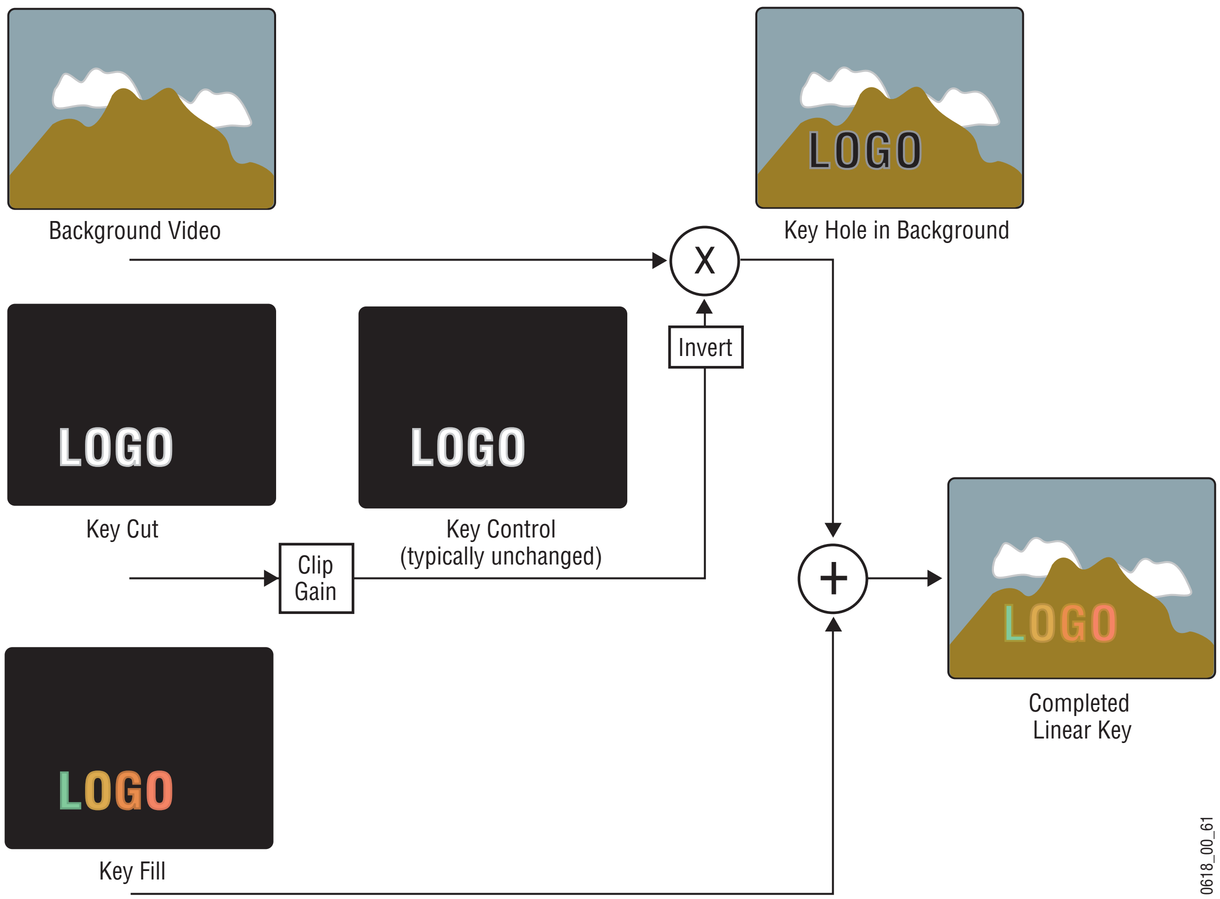
Show Key

Although the key control signal is not directly visible in the final video output, this signal can be previewed as a black and white image using the Show Key function. White areas of a show key indicate areas of complete opacity, black indicate complete transparency, and gray areas indicate translucent areas of the key. The whiter the show key signal, the more opaque the key will be. This key preview signal reflects all the adjustments that have been made to the key control signal.

Linear Key

A linear key typically uses separate key cut and key fill input signals that are intended to be used for linear keying. The key cut and key fill are usually anti-aliased (soft edged) shaped signals created by a character generator or graphics system. There may also be translucent areas intended to allow some background to show through the key (watermarks). The level of the key cut signal determines where and how deeply the hole will be cut into the background. The intended soft edge and translucency of the key can then be faithfully reproduced (Figure 10).

Figure 10. Linear Keying



Note The soft edges in the illustrations in this part of the manual are simulated. The key edges are actually gradients, which allows these edges to blend smoothly with the background.

Fixed and Adjustable Linear Keys

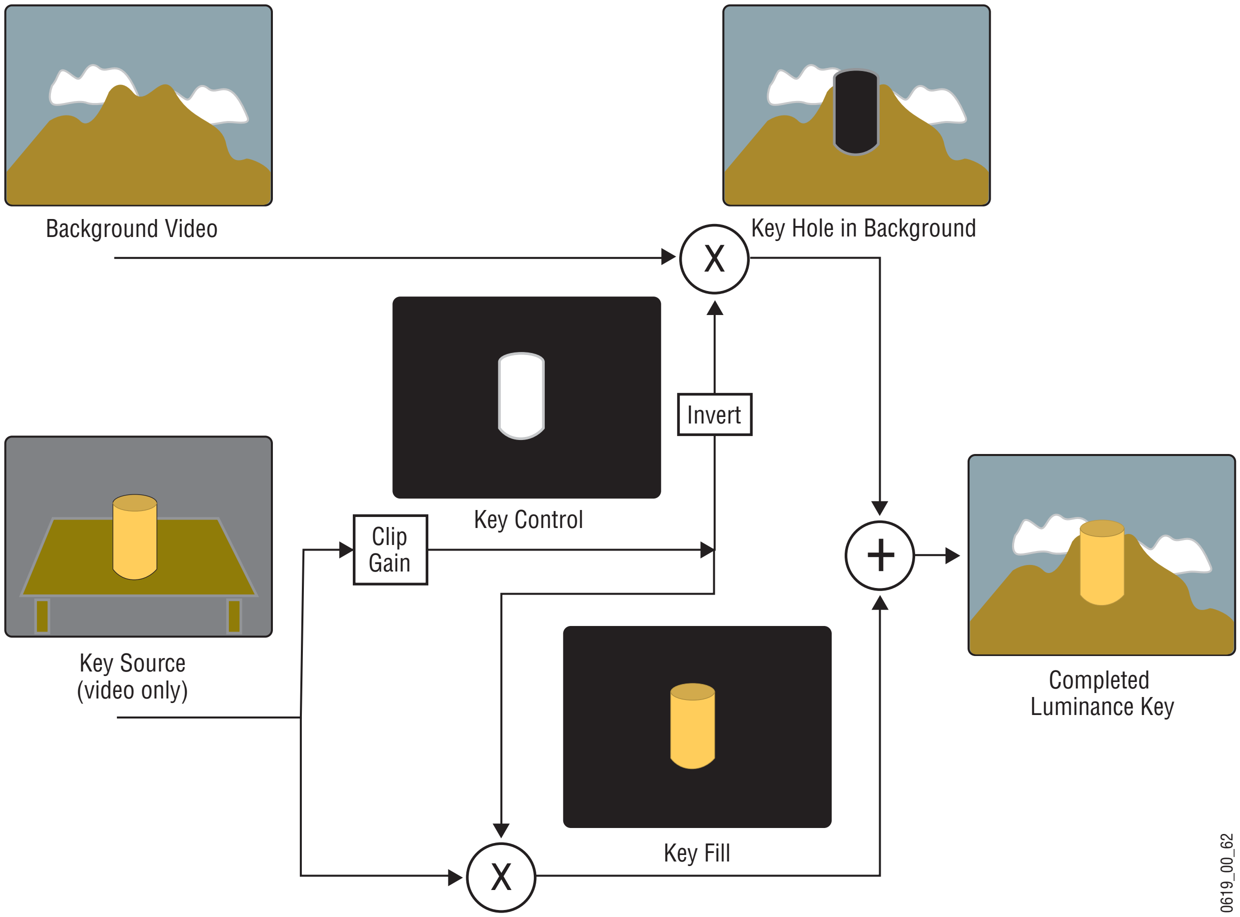
A Grass Valley switcher system supports both fixed and adjustable linear keys. A fixed linear key uses clip and gain values defined in system configuration to create the key cut signal. Typically these values are Clip 50% and unity Gain (equivalent to Clip Hi 100%, Clip Lo 0%). Once fixed linear key values are defined, these sources can be used easily without the operator having to set up the key every time it is used.

An adjustable linear key provides the operator limited control over Clip and Gain (or Clip Hi/Lo) values. This lets the operator fine tune the settings if the normal fixed linear values are not producing a good enough key.

Luminance Key and Self Key

A luminance key uses the luminance of an incoming source to specify where to cut the hole in the background. The earlier example of a matte fill key is a type of luminance key. Luminance keying is typically done on sources that do not have an accompanying key cut signal, like a video camera. The key cut signal must be generated from the incoming video signal, using clip and gain controls. When only one source is used for both key cut and key fill, the key is called a Self key or Video key. The same key source signal is multiplied by the key cut signal to create the key fill, and then the signals are summed (Figure 11).

Figure 11. Luminance Keying (Self Key)

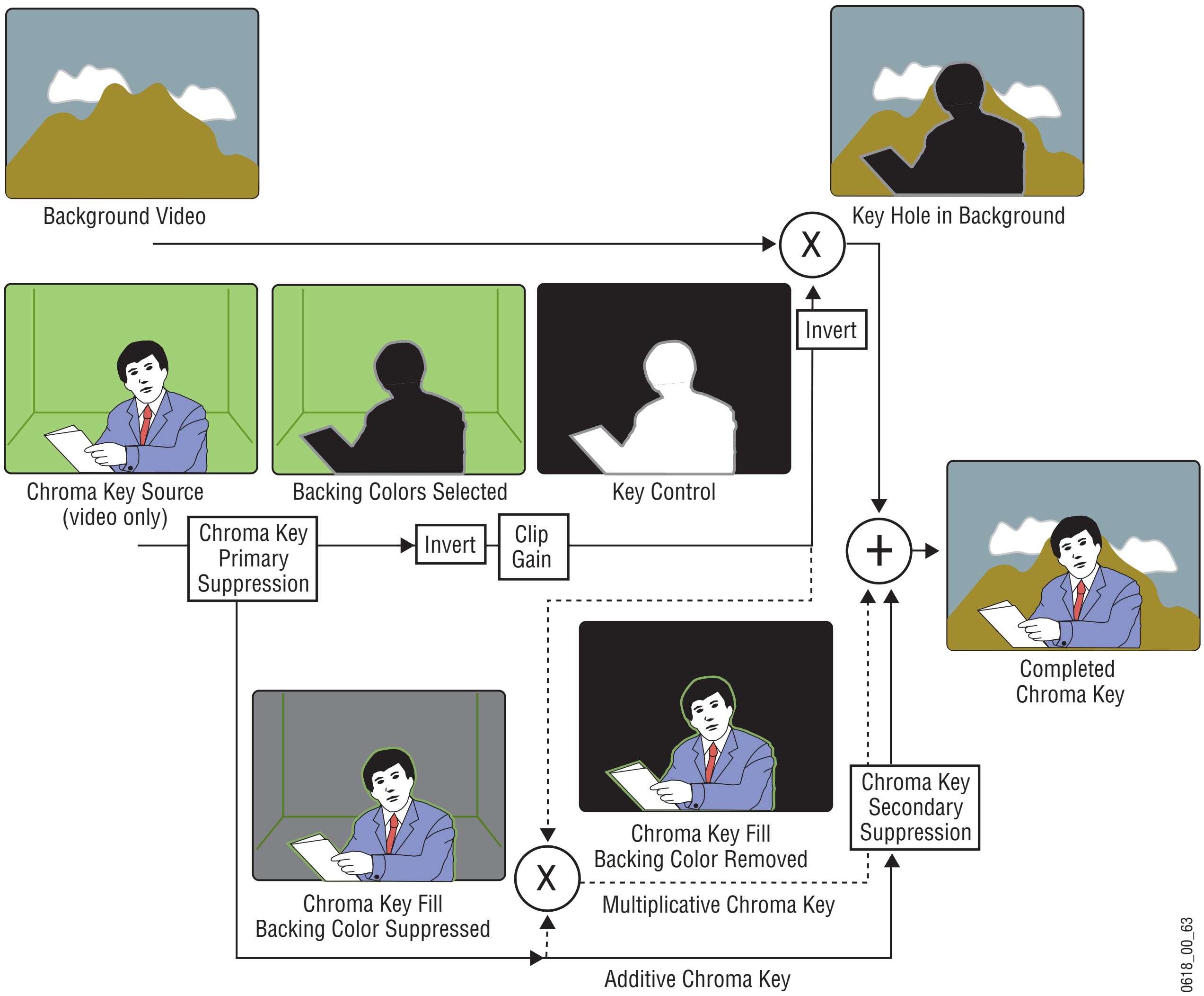


Clip and Gain (or Clip Hi/Lo) controls for luminance keys offer wide adjustment ranges. An S-shaping function is also applied to the edges of luminance keys.

Chroma Key

A chroma key is a key that detects color (rather than luminance) in a video image and replaces it with a new background. For example, a reporter may be in a studio sitting in front of a backdrop with a blue or green backing color, and the new background can be a mountain scene. The completed chroma key contains the mountain scene replacing the backing color, creating the illusion that the reporter is sitting in front of the mountain (Figure 12).

Figure 12. Chroma Key (Additive or Multiplicative)



The terms foreground and background are often a source of confusion when used for chroma keys. Foreground refers to the people or objects in a chroma key scene that are in front of the colored backdrop. Background refers to the scene that will replace the backing color (same as a linear or luminance key) in the final picture. Background does *not* refer to the backdrop of the foreground scene.

Chroma keys are performed by suppressing the backing color in the foreground scene, cutting a hole in the background, and then combining the two processed signals. When conditions are ideal, complete suppression of the backing color is possible and the hole cut in the background will match the suppressed foreground, permitting these two signals to be added successfully. This is called an additive chroma key (used when the system Foreground Reshaping feature is off). When conditions do not permit adequate backing color suppression, the foreground with its backing color suppressed can be multiplied by the keying signal to prevent contaminating areas of the background outside the keyed area. This is called a multiplicative chroma key (used when the system Foreground Reshaping feature is on). Setting up a successful chroma key setup involves many more adjustments than other keys. No amount of adjustment, however, can overcome problems caused by an improperly set up studio chroma key scene.

Primary and Secondary Color Suppression

As described above, chroma key primary color suppression replaces the old backing color with black before replacing it with the new background video. It usually has a very low selectivity and therefore suppresses a wide range of colors. The goal is to suppress as much of the backing color as possible without affecting foreground regions.

Secondary suppression is essentially a second chroma keyer that can be used to deal with areas where the backing color passes through some translucent portion of the foreground object, like smoke or liquid. This also includes hair since fine detail often mixes with the backing color. The goal of secondary suppression is to restore the natural color of the foreground object. In general, medium to high selectivity values will be used.

Primary and secondary suppression adjustments are used to select the hue to be replaced and for adjusting the luminance and chrominance levels in the areas of the picture where suppression is applied.

Flare Suppression

Flare suppression can be used to compensate for backing color reflected onto foreground objects, or for lens flare (backing color reflections within the camera lens). In these cases, the foreground object will take on a slight greenish or bluish tint. Flare suppression subtracts a slight amount of the primary suppression color from the foreground.

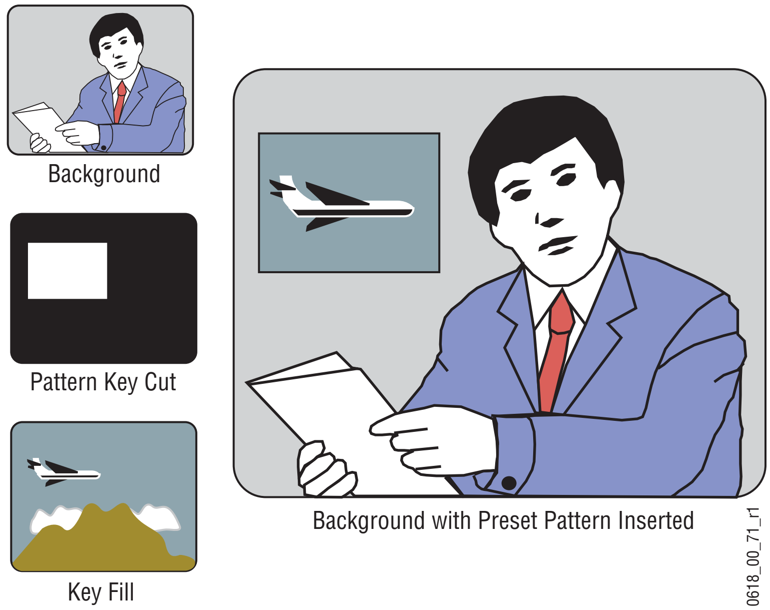
Chroma Key Shadow Generator

A shadow generator that can be used to include shadows that fall on the backing area of the scene in the background. Shadow offset, range, and density controls are also available that offer control over the placement and appearance of the added shadow.

Preset Pattern

A preset pattern uses a wipe pattern generator, rather than an incoming key cut signal to define the hole cut in the background (Figure 13). Key clip and gain controls are not available for a preset pattern, but controls over the location, size, border, opacity, and edge softness are available.

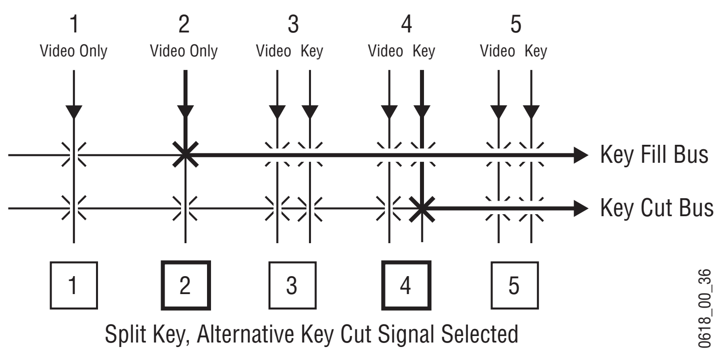
Figure 13. Preset Pattern



Split Key

A split key uses an alternative key cut signal for keying. A split key is performed by selecting the desired key fill signal, then selecting an alternative signal to be used as the key cut (Figure 14).

Figure 14. Split Key



Note that if the key fill video has been shaped by an external device, this previously shaped video will not match the different key cut signal selected for the split key. Split keys normally treat the fill as unshaped since by definition a split key uses a fill that is not related to the cut. The system gives the operator the ability to override this assumption for use when a cut and fill are brought into the switcher from two separate sources, such as a pair of DDRs producing related video and key signals.

Properly and Improperly Shaped Video

The following illustrations show the results of using correctly and incorrectly shaped video. In these examples, the video fill comes from a DPM that provides both a key signal and a fill video signal (a linear key). The DPM's key signal, fill video that has been set as a shaped output, and fill video set as unshaped is shown in Figure 15.

Figure 15. Video and Key Signals from DPM

DPM Key Signal | DPM Shaped Key Fill | DPM Unshaped Key Fill

When the shaping is configured properly (using either shaped or unshaped key fill) the desired output is the result (Figure 16).

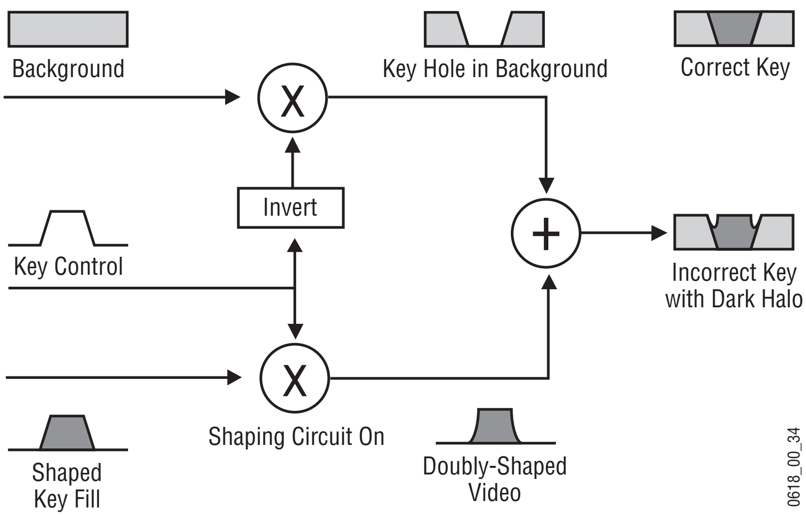
Figure 16. Correctly Shaped DPM Key Example

When the DPM provides a shaped video output but the key is processed as though it were unshaped, the shaped video does not completely fill the key hole in the background so a dark halo appears around the key (Figure 17).

Figure 17. Incorrect Key with Dark Halo

In this case the shaped input is incorrectly shaped again, sometimes called a double-multiply (Figure 18).

Figure 18. Incorrect Keying with Shaped Input

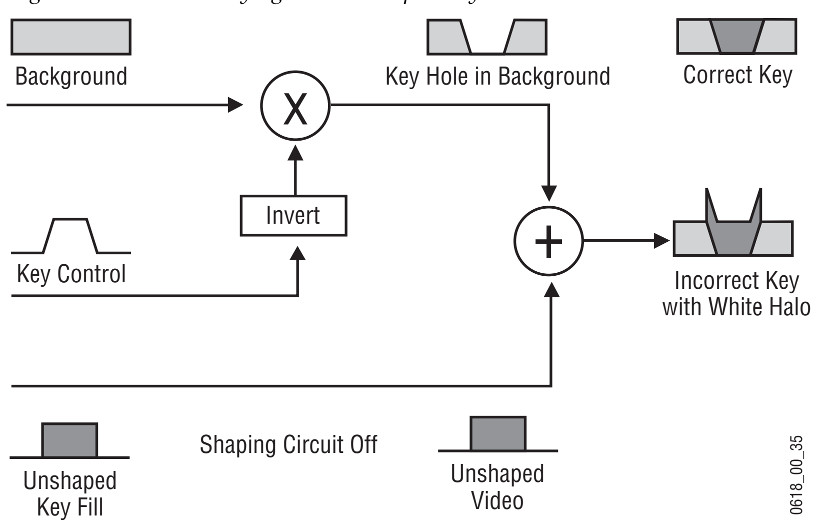


When the DPM provides an unshaped video output but the key is processed as though it were shaped, excessive luminance occurs where the key fill video and key hole edges overlap, producing a white halo around the key (Figure 19).

Figure 19. Incorrect Key With White Halo

In this case the unshaped video fails to be shaped at all (Figure 20)

Figure 20. Incorrect Keying with Unshaped Key Fill



Recognizing the appearance of improperly shaped video helps you know how to correct the problem should it occur.

E-MEM (Effects Memory)

Grass Valley developed the E-MEM (Effects Memory) system to provide a way of storing effects for later use. An effect defines parameter settings that determine how the selected video sources are processed. An E-MEM effect is *learned* into an effect *register*, and can then be *recalled* at a later time with a single button press. Effects can be edited after they have been learned, and effect data can also be saved to and loaded from disk.

Work Buffer

The *work buffer* is a fundamental aspect of system operation. The work buffer contains the current state of the system, specifying the sources selected and the video processing applied to those sources. The work buffer tracks all the system parameters, including those that do not have controls delegated. As the operator delegates and alters Control Panel and menu settings, the associated parameters in the work buffer change. If any altered work buffer parameters affect the video outputs of the switcher, the appearance of these outputs will change accordingly.

Keyframe

A single set of processing control settings can be called a *keyframe*. A keyframe defines the state of all or a portion of the switcher. Keyframes are stored in E-MEM effect registers. Two types of information are associated with a keyframe:

- On/off settings, including source selections, and
- Parameter settings.

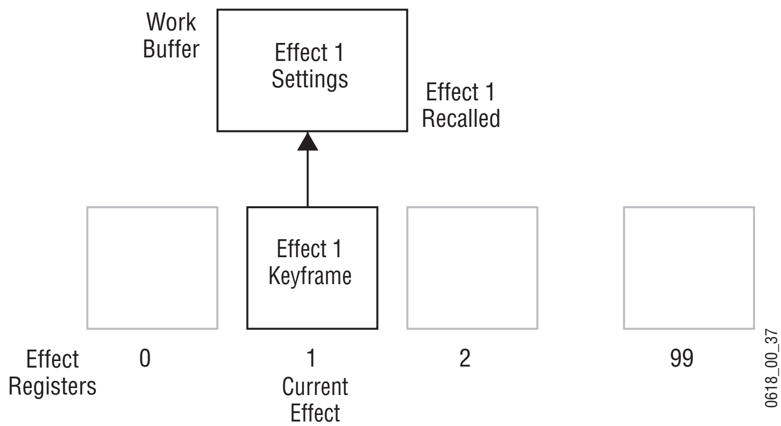
For example, an effect can consist of a keyframe specifying source 1 on ME-1's background A bus, source 2 on its background B bus, a horizontal wipe transition type, and a border. These are button settings, as they can be turned on and off. The border could be thick and colored red. These are parameter settings because a range of continuous values are available.

Effect Register, Work Buffer, and Current Effect

For clarity, the following description uses single keyframe effects. Multiple keyframe effects are discussed later (see page 39).

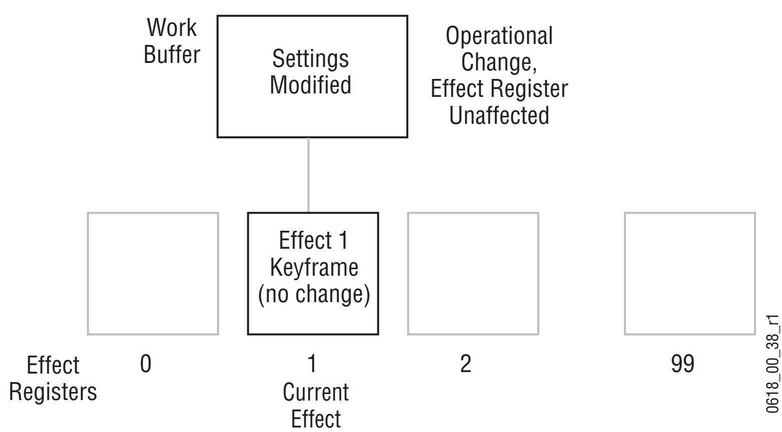
A Grass Valley switcher system has 1000 E-MEM registers (numbered 0 - 999) able to store operational settings for immediate recall. Effect register data must be applied to the work buffer before these settings can affect the system. When an effect register is recalled, keyframe data is loaded into the work buffer, and that register number becomes the *current effect* (Figure 21). The current effect is an important concept, as it defines a relationship between the effect registers and the work buffer. Only a current effect can be run or edited.

Figure 21. Work Buffer and Current Effect



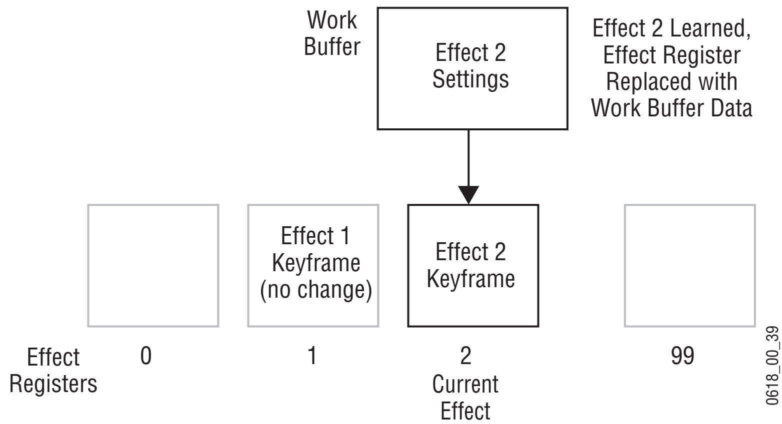
The work buffer actually holds a copy of some of the effect register information. When an operator changes a control setting manually, the work buffer settings change but the effect register data itself remains unaltered (Figure 22).

Figure 22. Work Buffer Operational Change



When an effect is learned, the current operational settings in the work buffer are loaded into the specified effect register, overwriting any information that was in that register. If a register different from the current effect is learned, the information is loaded into it and that register becomes the current effect. In this case the original effect register will not be altered, and can be instantly recalled to return the system to its earlier state (Figure 23).

Figure 23. Learn Operation Changes Effect Register



Effect registers can be saved to disk and reloaded and recalled for use at a later time.

Banks and Registers

A Grass Valley switcher system's Local E-MEM and Master E-MEMs are optimized for rapid recall of effects during live production. The system's 1000 effect registers can be thought of as being organized into pages (numbered 0 (0-99) and 100-900) and banks (numbered 0 to 9), with each bank containing ten registers (also numbered 0 to 9). For example:

- register 46 means page 0, bank 4, register 6 or
- register 226 means Page 200, bank 2, register 6.

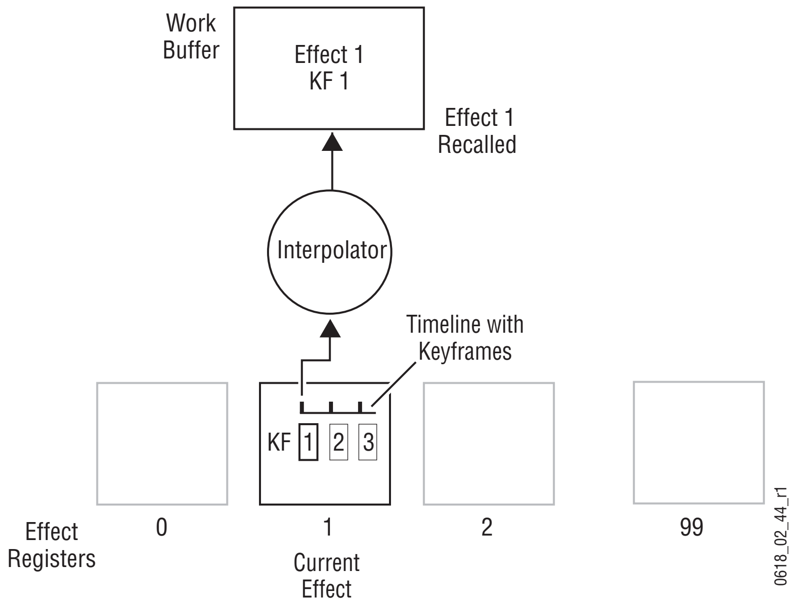
This organization is for user convenience, to allow immediate single button effect recall from ten different registers, and for clearing, copying, and saving to and from disk banks of registers with a single operation.

Multiple Keyframes and Timelines

A *timeline* is an arrangement of keyframes in linear time order. A multiple keyframe effect contains a series of two or more keyframes on a timeline. Each keyframe has a position on the timeline, specifying its location in time in the effect. The timespan from one keyframe to the next keyframe can be considered that keyframe's *duration*. The sum of these durations generally determine the total duration in time of the effect.

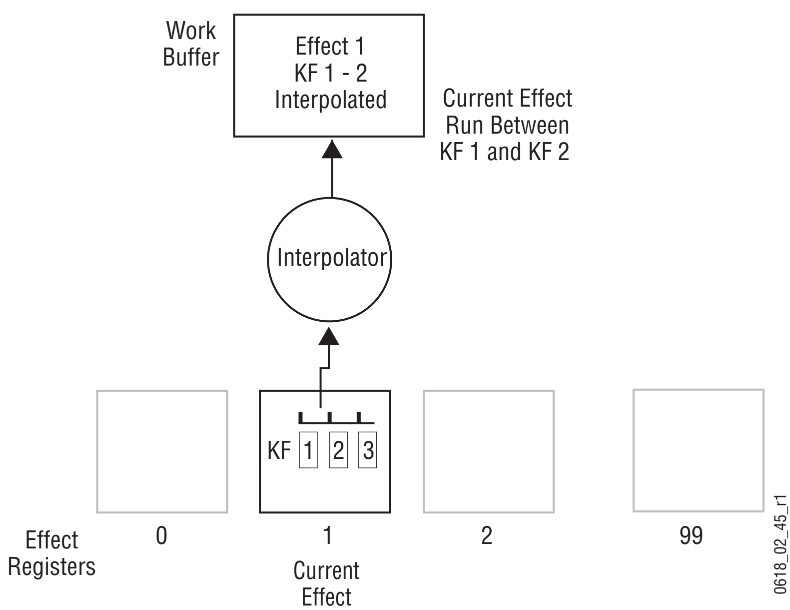
When a multiple keyframe effect is recalled from an E-MEM register, only its first keyframe is loaded into the work buffer (Figure 24). This is exactly the same as the recall of a single keyframe effect.

Figure 24. Keyframe Effect



The only difference between a single and multiple keyframe effect is a multiple keyframe effect can be run after it has been recalled. Running an effect changes the state of the system from keyframe to keyframe. During the effect run the values between the keyframes are usually interpolated (Figure 25).

Figure 25. Keyframe Effect Run



The interpolated work buffer values created during the effect run do not exist in the effect register. Instead, *path* information saved in the effect determines the type of interpolation to be used between each pair of keyframes.

As each keyframe location is encountered on the timeline, the work buffer values at that moment in time will exactly match those specified by that keyframe in the effect register. Note that this is very similar to an effects dissolve and effects sequence of multiple registers, but keyframing uses only one register and also offers path control.

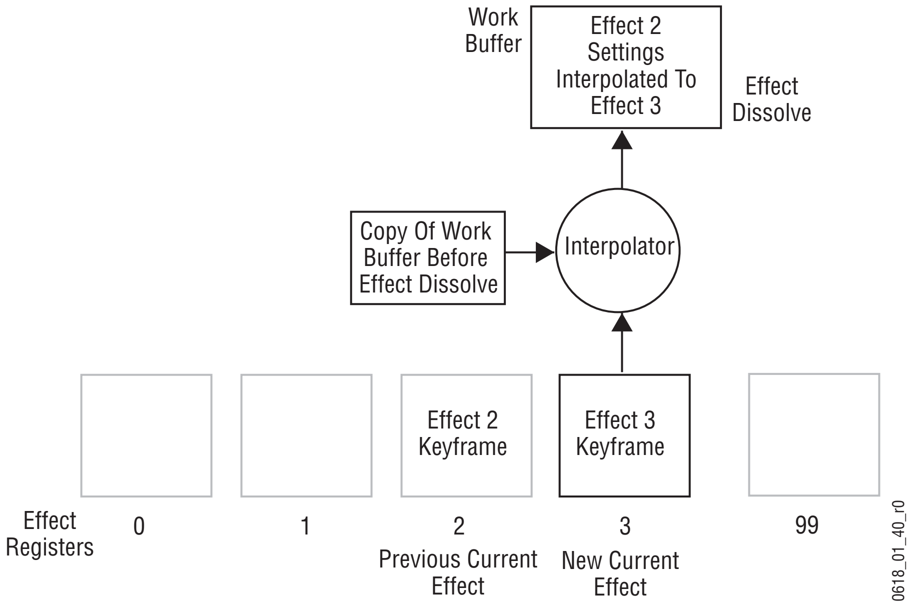
A keyframe in an effect can be changed by applying work buffer values back to the current effect register (Modify). The new values can modify an existing keyframe, or they can be inserted between keyframes (called *inserting on the path*). It is also possible to Learn, rather than Modify, an existing effect. However, the Learn operation overwrites all existing keyframes in the effect with one new set of work buffer values. A single keyframe effect is the result, and all the other keyframes in that effect are lost.

Effect Dissolve

Effect dissolve produces a smooth transition from the current state of the work buffer to the state defined in a recalled register. Effect dissolve first takes to the source and other button settings specified as a starting point in the effect register. The parameter settings in the work buffer then smoothly change so they match the settings of the recalled effect register. Effect dissolve can also simultaneously perform a transition to the specified ending sources at a specified duration. An interpolator is used to smoothly change the parameters settings involved in an effect dissolve. Before performing an effect dissolve, source and other button settings in the work buffer should be compatible with those in the effect dissolve register. This prevents an abrupt change when the new button settings are taken, and so permits smooth transitions between sources. One way this can be accomplished is by using two different, but complimentary, effect registers.

For example, if register 2 contains compatible button settings, it can be recalled into the work buffer. If an effect dissolve is then performed to register 3, the transition occurs and the parameters from register 2 in the work buffer are interpolated to those of register 3. Register 3 becomes the new current effect (Figure 26).

Figure 26. Effect Dissolve

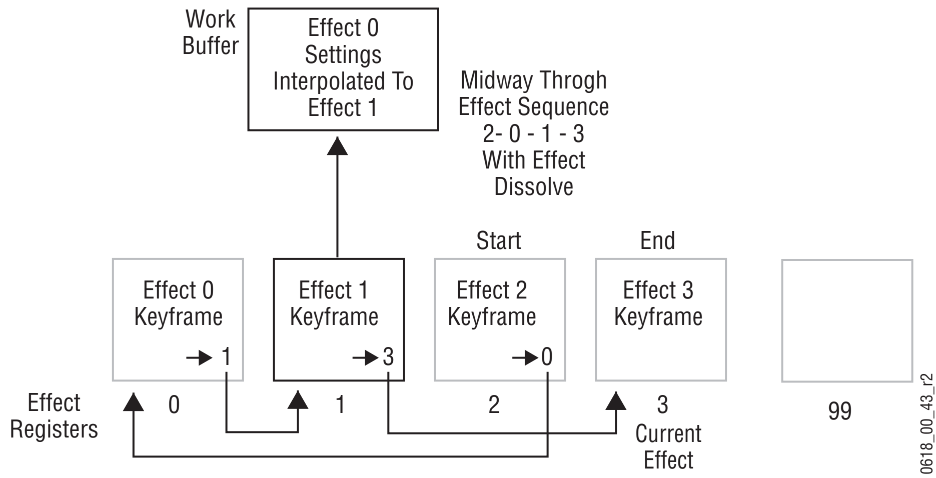


Note that the effect dissolve does not occur directly between two registers, and the transition aspect is handled separately from the interpolated parameter values. If work buffer parameter settings are changed before an effect dissolve, the current modified work buffer values (but not the source and button settings) will be smoothly interpolated to the new register values.

Effect Sequence

Effect sequence allows the operator to chain a set of specified effect registers together. Recalling the first register can initiate a sequential recall of all the registers in the sequence. As each register is recalled, its settings will be applied to the work buffer and the appearance of the system's output signals will change if they are affected. Delays can be programmed that determine when the next register in the sequence will be recalled. Effect dissolves can also occur as each register is recalled, though this is not required (Figure 27).

Figure 27. Effects Sequence



In the above example, recalling effect 2 as a sequence will proceed from register 2 to register 0 to register 1 to register 3. A sequence can begin from any of the effect registers in the sequence. For example, in the above example if register 0 is recalled, the sequence will proceed from register 0 to register 1 to register 3.

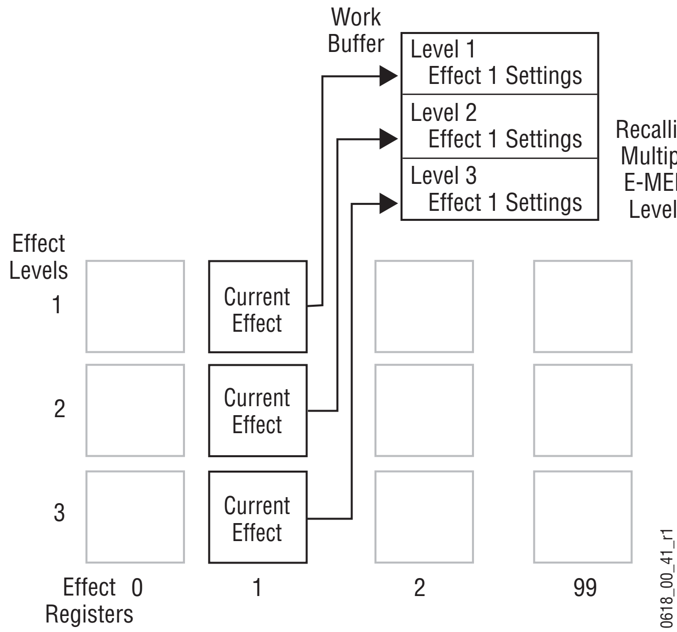
Effect dissolves can occur within a sequence. The interpolator described earlier is used to smoothly change to the next register in the sequence.

E-MEM Levels

The E-MEM system is divided into functional areas, called *levels*. Each effect level corresponds to a specific set of system operational controls, or to an individual interface to an external device. Effect levels are used to allow the operator to store and recall settings for specific system control areas without disturbing settings for other control areas. For example, on a 4-ME Grass Valley switcher system each ME has its own level. Each level also has its own set of effect registers. The settings for ME 1 can be recalled without changing the settings for ME 2, ME 3, or PGM PST. The work buffer is actually divided into sections that correspond to each effect level.

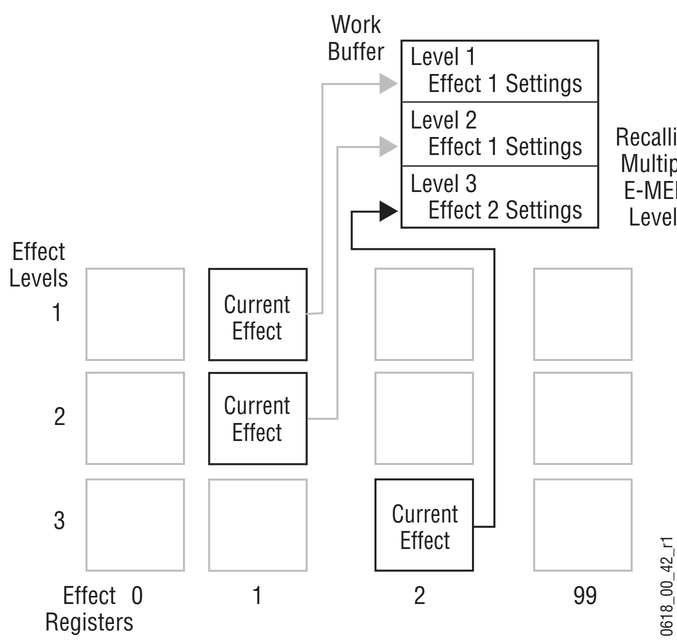
The earlier E-MEM discussion was simplified to explain basic concepts. Actually, register learn and recall operations and work buffer modifications apply to each level of an effect, though multiple levels of an effect can be changed simultaneously. Settings for each level's E-MEM register is applied to the corresponding level of the work buffer (Figure 28).

Figure 28. E-MEM Levels



If only one effect level is selected for a recall, the resulting change is only applied to its level in the work buffer. The other levels of the work buffer remain unaltered. Note that this makes is possible to have current effects from different registers, also called a *skewed effect* (Figure 29).

Figure 29. Single Level Recall

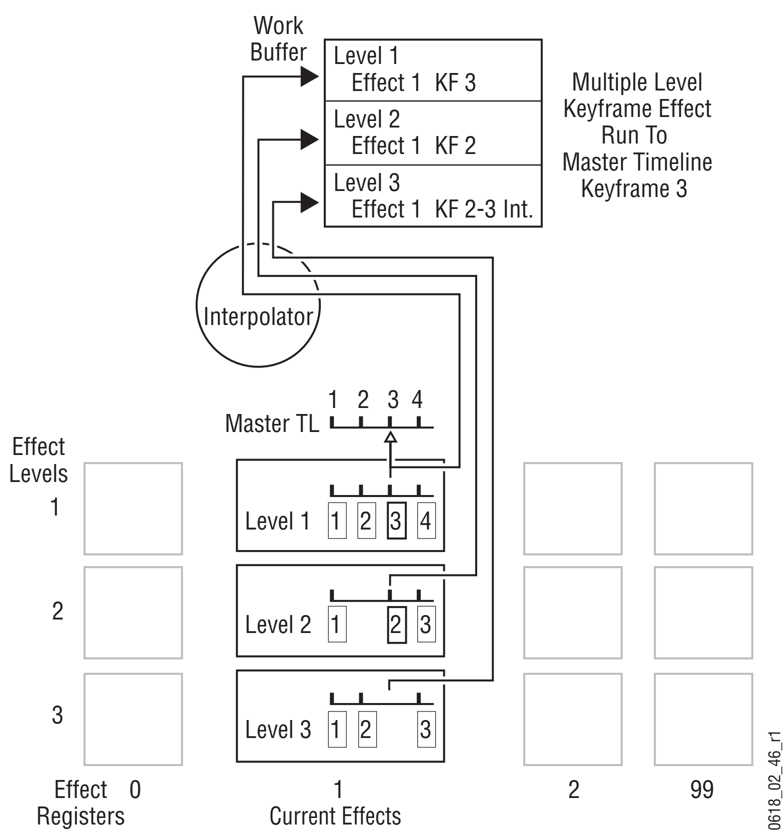


Master Timeline and Multiple Level Keyframe Effects

A *master timeline* exists to coordinate the activity of the individual level timelines. The master timeline contains a master timeline keyframe at every point in time where a keyframe exists on any of the level timelines. Keyframes from the levels are projected to the master timeline. If more than one level has a keyframe at a particular time, only one keyframe is projected to the master timeline. The master timeline keyframe can be considered a representation of the sum total of all the parameters in all the timelines that have keyframes at that point in time. However, the master timeline and its keyframes are an organizational tool only. Master timeline keyframes are not saved to a register or to the work buffer. The master timeline is constructed in real time, depending on what levels are in use by the effect.

When a multiple level keyframe effect is run, each level generally runs simultaneously, guided by the location of a *time cursor* on the master timeline. The time cursor represents the *current time* of the effect. As the time cursor moves, the work buffer is updated with the changing parameters. Figure 30 shows an effect with its time cursor located on master timeline keyframe 3.

Figure 30. Keyframe Effect and Master Timeline



An *edit cursor* is also available, which can be used during effect editing. Usually the time and edit cursors are superimposed on one another and move as one. When separated, editing actions occur at the edit cursor location.

Number of E-MEM Levels and Sublevels

A Grass Valley switcher E-MEM system has up to 31 levels, including an independent secondary level (Split Mode with the DoubleTake option). A secondary E-MEM level is attached to another level. This peer relationship is one directional. The Secondary level is controlled by the level to which it is attached, but not vice versa.

The E-MEM system also has several sublevels. E-MEM sublevels can be assigned to an E-MEM level, which provides flexibility in configuring the E-MEM system to control desired portions of the switcher and related devices.

Each Aux bus, Image Store output, GPI output, PBus device, External Device, etc. is a sublevel. The associations of sublevels to levels is completely flexible. Any sublevel can be assigned to any level. For example, a DDR or PBus device can be mapped to an ME level. This can be useful if, for example, a specific ME is always used for a replay effect. The external device playing back the animation, an Image Store output and possibly other sublevels can all be assigned to that ME's Primary level and the Local E-MEM will control the entire effect. Sublevels can also be disconnected from E-MEM control by assigning them to no level.

Each ME also has sublevels for each keyer, each wipe generator, each keyer's DPM parameters, etc. Unlike other sublevels, all ME sublevels are always mapped to either the ME primary level or the ME secondary level, based on the DoubleTake ME partition information. The ME partition boundary information is itself a special sublevel, but contains no key frames since changing the ME partition within an effect is not possible.

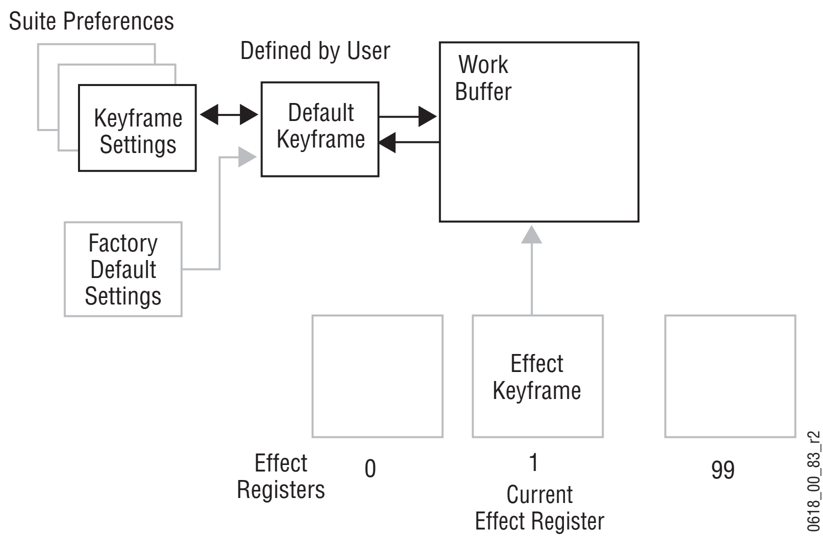
Auto Recall and Effect Levels

A Grass Valley switcher system has an Auto Recall feature. This feature makes a recalled effect automatically enable all the levels (and associated sublevels) that were involved in that effect when the effect was learned. This is a useful feature, since is can be difficult to remember all the levels involved in every learned effect, and time is required to manually enable levels before recall. The Auto Recall feature is on by default, but can be turned off to permit manual level enabling.

Default Keyframe

An important E-MEM concept is the Default Keyframe. A Default Keyframe is a standard collection of effect settings. When the work buffer is cleared, the initial settings it receives will be those defined as the Default Keyframe. The Default Keyframe does not alter effect registers and does not change current source selections or panel delegations, which should only be changed directly by the operator (Figure 31).

Figure 31. Default Keyframe



The operator can define exactly what these default settings should be (Suite Preference), and these settings can be stored and reused to meet varying requirements. A separate set of factory default settings also exist that cannot be changed, but may be loaded to the Default Keyframe and then to the work buffer, typically for system test and initial system installation.

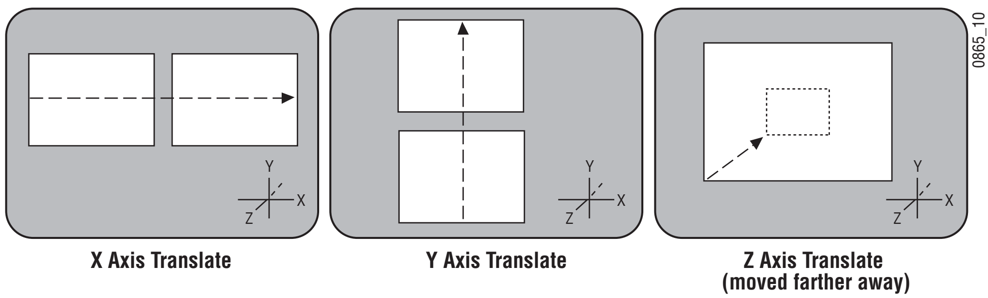
3-D Digital Effects Concepts

The Grass Valley switcher Digital Picture Manipulator (DPM) option provides 3-D planar image translation and transformation from within the system. Image translation has special basic concepts and terminology you should understand in order to get the most out of using the option.

Translation and Transformation

Translation is a subset of transformation, and involves picture movement along the X, Y, and Z axis. The picture is simply relocated to a different place and does not change in actual size or shape (*Picture Translation* on page 48).

Figure 32. Picture Translation

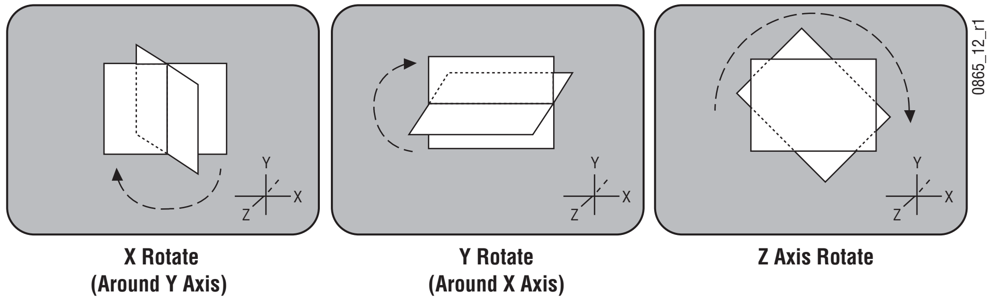


Transformation includes translation, and also includes these other functions:

Size — Enlargement and reduction of the picture area while it remains in the same plane in 3-D space. This is different from picture translation in the Z axis, where the picture retains its original size, but appears smaller when moved away, and larger when moved closer.

Rotate — Picture rotation about the reference axis in the X, Y, and Z dimensions (Figure 33). Rotate is limited to ± one half revolution, and will always take the shortest path to the new position. Rotate uses Quaternian math to calculate the move with increased accuracy. Multiple rotations are performed with the Spin function.

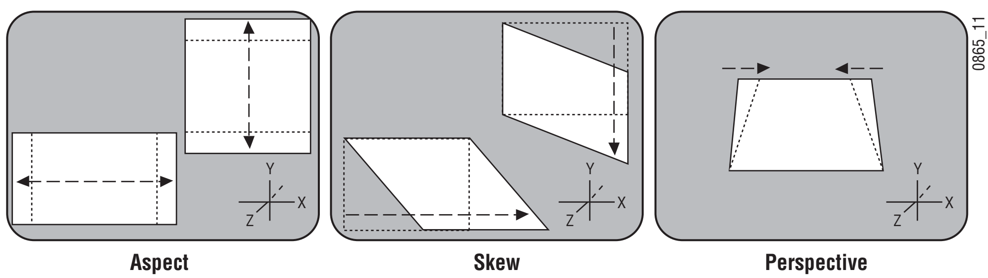
Figure 33. Rotate



Spin — Supports multiple rotations about the reference axis in the X, Y, and Z directions. Spin supports fractional values, and is similar to Rotate when the move is less than ±. one half revolution. Spin uses Euler math to calculate the move, which is not quite as precise as Quaternian, but permits multiple rotations. Spin applies transform values in Z, X, Y order, so editing effects in this axis order provides the best control of the effect.

Note Following broadcast conventions, moving the Joystick forward or back along the Joystick's Y axis rotates the top of the picture forward or back (a rotation about the X reference axis). Similarly, moving the Joystick left or right along the Joystick's X axis rotates the side picture left or right (a rotation about the Y reference axis).

Figure 34. Aspect, Skew, Perspective



Aspect — Scaling the X or Y components of the picture. X axis changes affect horizontal size, Y axis changes affect vertical size (Figure 34). Z axis changes affect both X and Y dimensions, and is the same as Size.

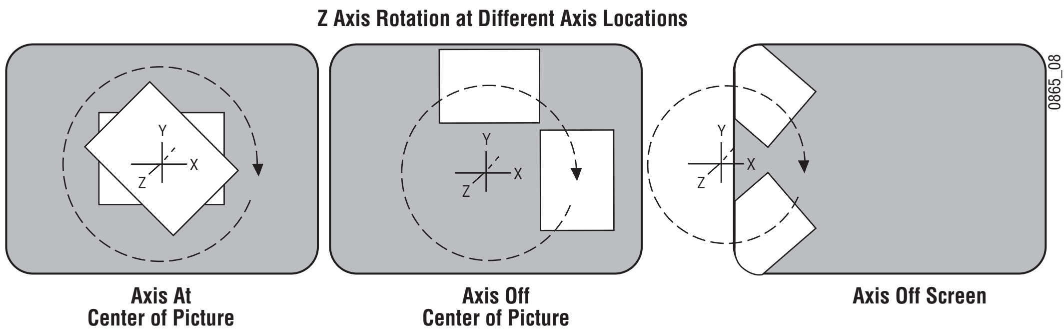
Skew — Slanting the picture in the X (horizontal) and Y (vertical) directions (Figure 34).

Perspective — Changing the viewer's apparent viewpoint of a picture. This only applies when a picture is tilted so part of it is farther from the viewer. The farther portion appears smaller than the closer portion, and the amount of perspective controls how much smaller the distant part is (Figure 34). Multi-channel perspective is discussed later in this section.

Axis Location

The axis location of the channel determines the center point of translations, spins, and rotations for that channel. You can move the axis to a new location to change the behavior of that channel. The axis location can be within or outside the screen area (Figure 35).

Figure 35. Frame of Reference Axis Locations



Source and Target Space

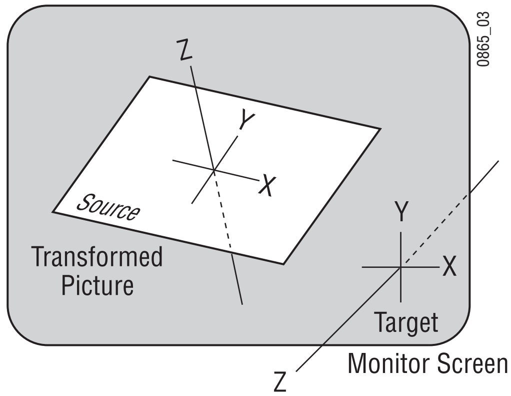
The Grass Valley switcher DPM feature uses source and target space frames of reference.

- Source space for a control channel uses that channel's coordinate system for reference.
- Target space for a channel uses the next higher level's coordinate system for reference.

Being able to use both source and target space can help make effects editing easier. One frame of reference may offer a simple and easy to understand context for a picture transform, while in another frame of reference the same transform may be difficult to understand and control. DPM effects can also employ both source and target space directed transforms simultaneously, which can create complex and beautiful effects.

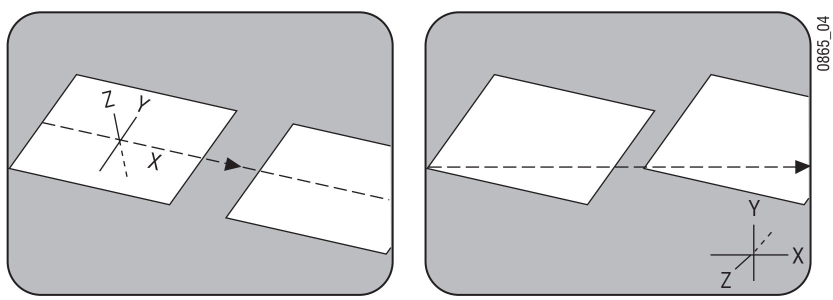
The simplest example for source and target space concerns a channel that has been rotated while the global channel remains unchanged (Figure 36).

Figure 36. Source and Target Space



In this example the source space for the channel is referenced to the picture itself (tilted back at an angle) while the target space is referenced to the monitor screen (straight). X axis translations will move this picture differently, depending on whether source or target space is being used (Figure 37).

Figure 37. Source and Target Space Translation



If the channel is controlled by a global channel, and the global channel itself has been rotated, an X axis translation will depend on whether the channel itself or the global channel is being manipulated, and whether source or target space is being used (Figure 38 and Figure 39). Note that the target translate of the channel is the same as a source translate of the global channel.

Figure 38. Channel Translate with Global Rotated

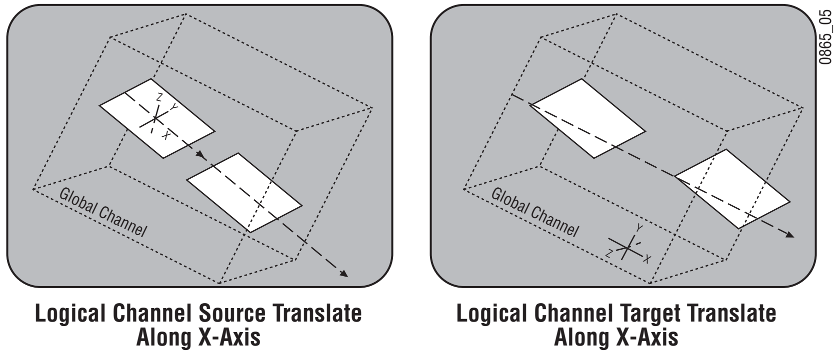
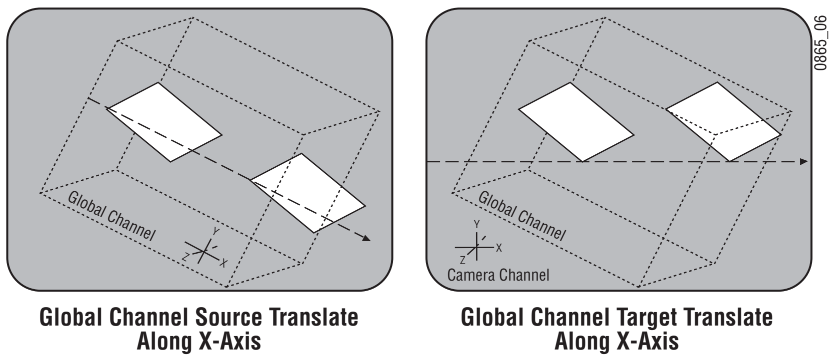


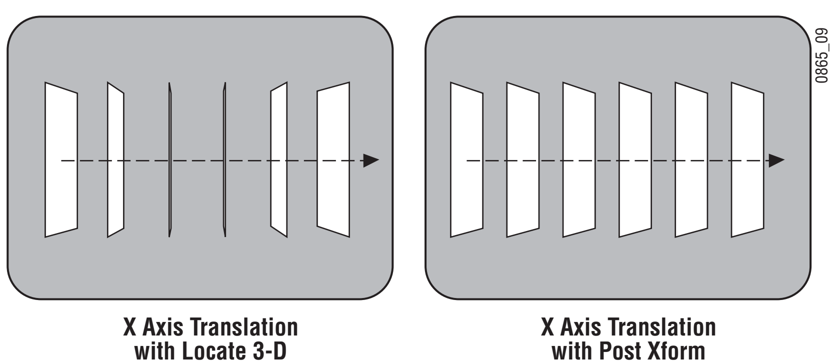
Figure 39. Global Channel Translate with Global Rotated



Post Transform Space

Post transform (**Post Xform**) is a special transform function that only affects size and location operations. It does not change the perspective of the image (Figure 40). This can be used as a convenient method to quickly project pictures onto new locations of the screen. For example, if an image has the right perspective but is partially off screen, it can be brought back on screen without changing the perspective.

Figure 40. Post Transform Translation



All post transform functions are made relative to the monitor screen frame of reference. For example, a positive X post transform always moves to the right side of the screen.

Front and Back, Near and Far

Pictures manipulated by a Grass Valley switcher DPM have front and back sides, each of which is revealed in turn as the picture spins or rotates. After a picture has been translated it can be difficult to determine which side was originally on the front and which was originally on the back. This distinction can be important when, for example, different sources are being selected for different sides of an effect.

The system uses a "Near" and "Far" convention to ease system operation. Near is always the side of the picture that is visible (facing toward the viewer), and Far is the hidden side of the picture (facing away from the viewer). The current Near side can be either the front side or the back side of the picture, depending on orientation. For example, to change the source on the visible image, just change the Near side. To change the source on the hidden side, change the Far side. You don't need to know whether the image being changed is actually the front or back side.

Transform Numbering Systems

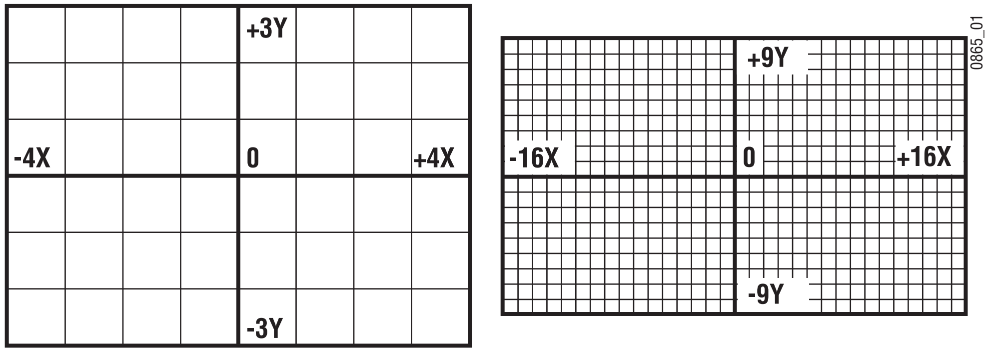
The Grass Valley switcher DPM uses the following numbering systems to precisely define picture locations, picture size, and picture rotation and spin.

Screen Coordinates

The DPM accommodates two different aspect ratios, 4 x 3 and 16 x 9. In 4 x 3 mode, the screen is six units high and eight units wide. In 16 x 9 mode, the screen is 18 units high and 32 units wide. The numbering system begins in the center of the screen, and has the standard horizontal X axis and the vertical Y axis (Figure 41). For simplicity, examples in this manual use the 4 x 3 aspect ratio.

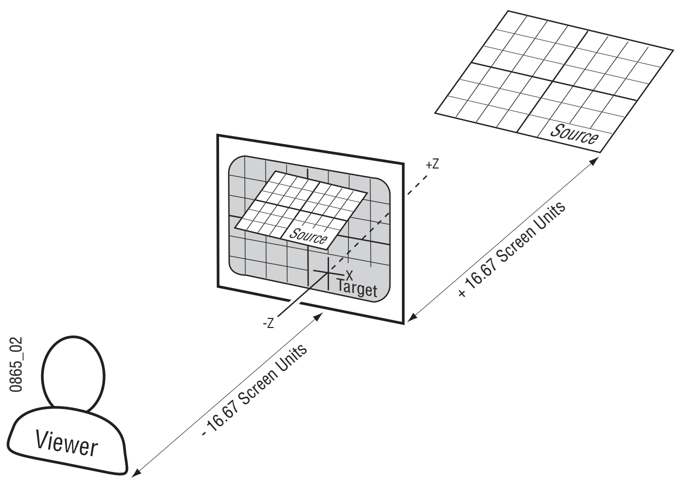
These coordinates can be used for monitor screen locations (channel target space with default global channel), or they can be applied to picture locations (channel source space).

Figure 41. Screen Coordinates



Screen units are also used to define Z axis dimension depth in 3-D space. Positive Z axis values are back behind the picture, and negative values are in front of the picture (Figure 42).

Figure 42. Viewer Location in 3-D Space



For perspective calculations the factory default viewpoint places the viewer -16.67 screen units from the monitor screen surface (4 x 3 aspect ratio). In this case, moving a full screen image 16.67 screen units back behind the screen makes the picture appear half its normal size to the viewer.

Size

Picture size is defined relative to picture screen units. A size of 0.50 indicates a picture is one-half its full size.

Rotation

Rotation is measured fractionally with respect to 360°. A value of 0.25 indicates a rotation of 90 degrees; 0.50 indicates 180 degrees (maximum rotation). Rotation values can be positive or negative, which determines the direction of rotation.

Spin

Spins are measured in number of 360° rotations (up to 999). Fractional spin values are also supported. A single axis 0.50 spin is the same as a single axis 0.50 rotation. Spin values can be positive or negative, which determines the direction of spin.

Skew

Skew supports values of ±999, though extreme values will probably rarely be used.

Aspect

Aspect values are in percentage of the original size, with 1.0 = 100%, 0.5 = 50%, etc.

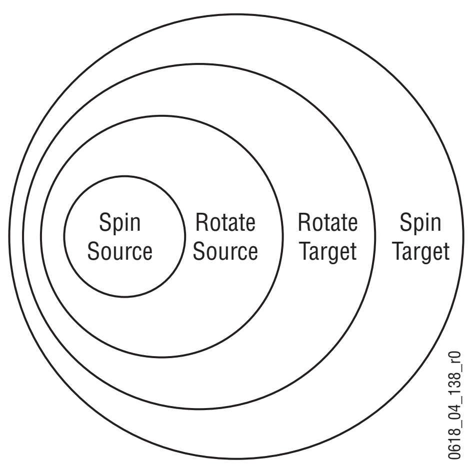
Perspective

Perspective supports values from 0-100, with 0.06 as the default.

Spin and Rotation Relationship

It is possible to use both Spin and Rotation at the same time in an effect. When both are used, the transforms are nested so that the values of one transform are applied after the previous transform values have been calculated. This nesting provides increased control of the effect dynamics. Source and Target space also affects the transform nesting order Figure 43.

Figure 43. Spin and Rotate Transform Nesting



Path Control

Paths

Keyframes specify parameter values at specific times in an effect. Most of the duration of an effect, however, occurs between these keyframes. The system interpolates parameter values between keyframes (inbetweening). The trajectory, or path, a manipulated picture travels between keyframes is determined by how these in between values are interpolated. The system offers you several path controls (Figure 44):

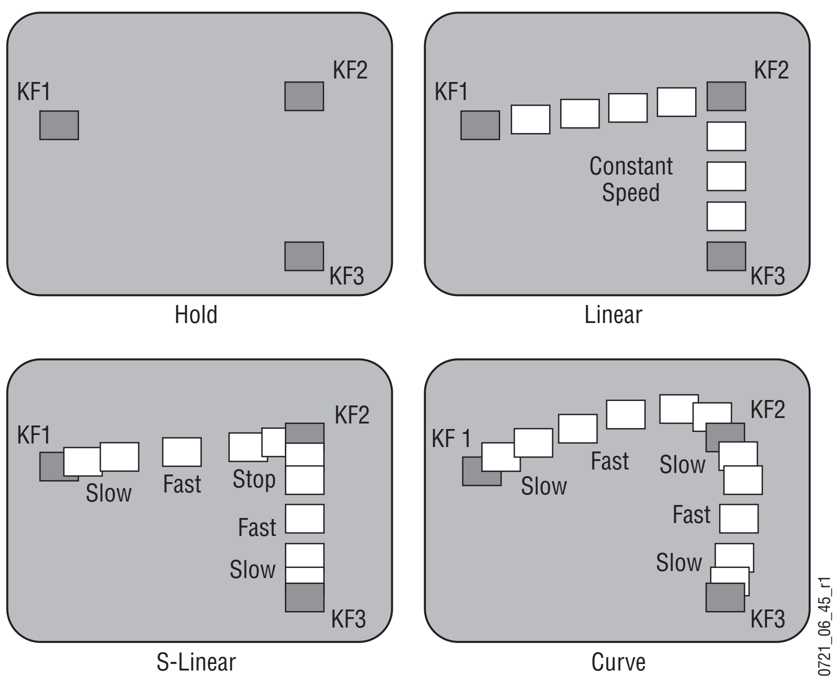
HOLD — No interpolation. Keyframes hold their values for their durations, then change all at once for the next keyframe.

LINEAR — Applies a linear interpolation between keyframes; no acceleration or deceleration is applied. Movement is mechanical with a constant velocity.

S-LINEAR — Applies a linear or straight line motion between keyframes, with acceleration and deceleration applied at the beginning and end of each keyframe.At each S-Linear keyframe the motion is stopped for two fields.

CURVE — This selection causes a rounded path through the keyframe. Paths are user adjustable with path modifiers (tension, continuity, and bias) described below.

Figure 44. Path Types



The path concept can also be applied to functions that do not move a picture across the screen, like matte hue changes. For these functions, the rate of change of the parameter follows the same path types above. For example, an S-Linear hue rotation will accelerate and decelerate the speed of the hue change at the beginning and end of the keyframe.

Tension, Continuity, and Bias Controls

When the **CURVE** parameter is selected, additional fine-tuning path controls become available:

TENSION — Controls the length of the tension vector. At a setting of 0.0, this imaginary line extends an equal distance into and out of the keyframe, and the path through the middle keyframe is curved.

CONTINUITY — Determines the angle of the path into and out of the keyframe.

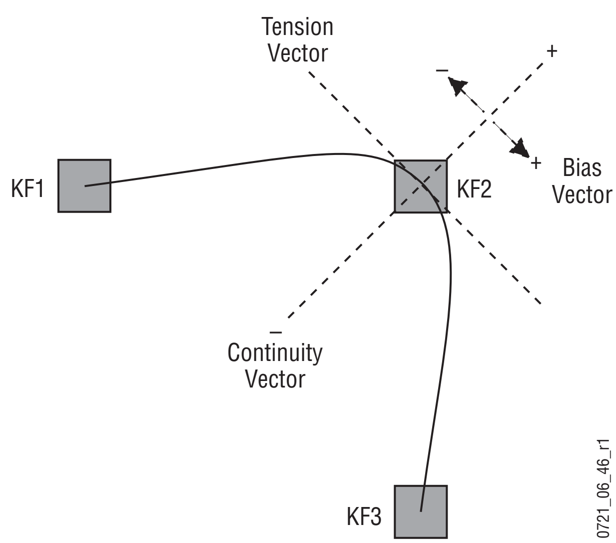
BIAS — Determines whether the path will be pulled towards the previous or the following keyframe.

In the following examples, a physical path is shown between three keyframes. The first keyframe (KF1) is the upper left square; the last keyframe (KF3) is the lower right square. The adjustments in these examples are applied to the middle keyframe only (KF2).

Path Vectors

With respect to the path between keyframes, each keyframe is made up of three vector parameters as shown below. The soft knob controls act on these vector parameters to adjust the path into (entry) and out of (exit) the keyframe. The path through KF2 is parallel to an imaginary line drawn between KF1 and KF3 (Figure 45).

Figure 45. Path Vectors



Vector Values

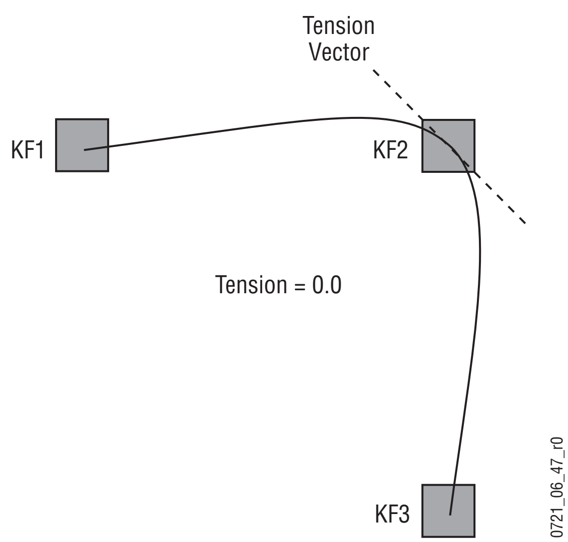
Path vector setting values of ± 1.0 are available, same as the Grass Valley Kaleidoscope DPM.

Tension Control

In the example below, the keyframes comprise a right angle, so the **TENSION** control operates on a 45° line drawn through the keyframe. This line is referred to as the Tension Vector and is parallel to a line drawn between adjacent keyframes (Figure 46).

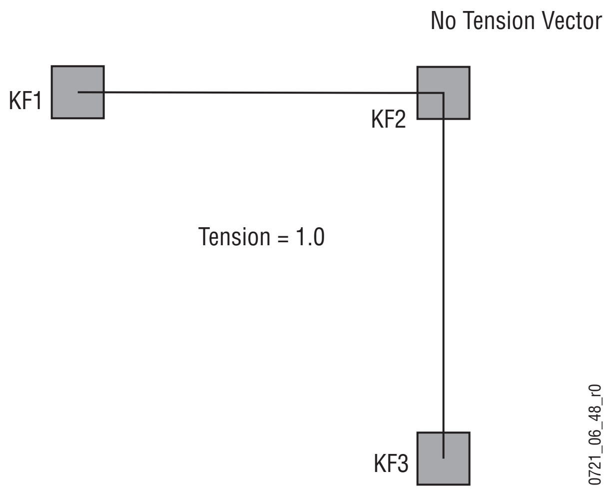
The **TENSION** soft knob controls the length of the tension vector. The length of the tension vector is inversely proportional to its parameter value. For example, at a Tension setting of 0 (zero), this imaginary line extends an equal distance into and out of the keyframe, and the path through the middle keyframe is curved. The unmodified KF2 is said to have a correction value of 0.0.

Figure 46. Tension Control Setting Zero



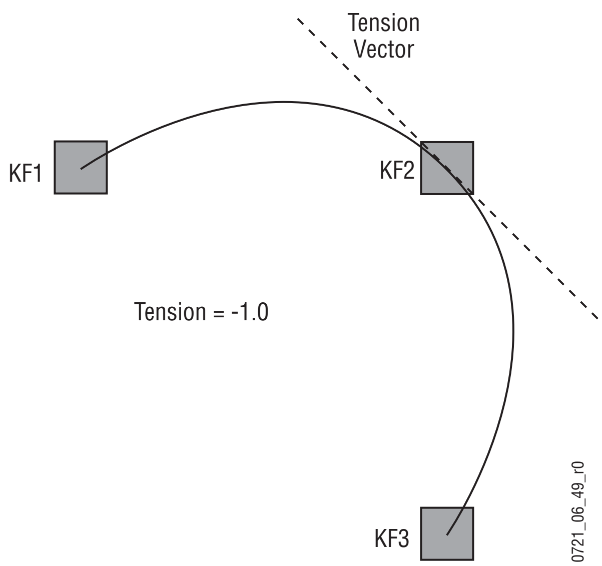
In the example below, the **TENSION** control is increased to 1.0, so that the Tension vector is shortened to non-existence through KF2 (Figure 47). The path enters and leaves the middle keyframe in a straight line as it takes on an S-Linear motion; decelerating as it enters the middle keyframe and accelerating as it leaves.

Figure 47. Tension Control Setting 1.0



In the example below, the **TENSION** control has been set to -1.0. This lengthens the Tension vector, causing the path through the middle key-frame to be longer and broader (Figure 48). The longer path will appear to make the image speed up through KF2 as it travels from KF1 to KF3.

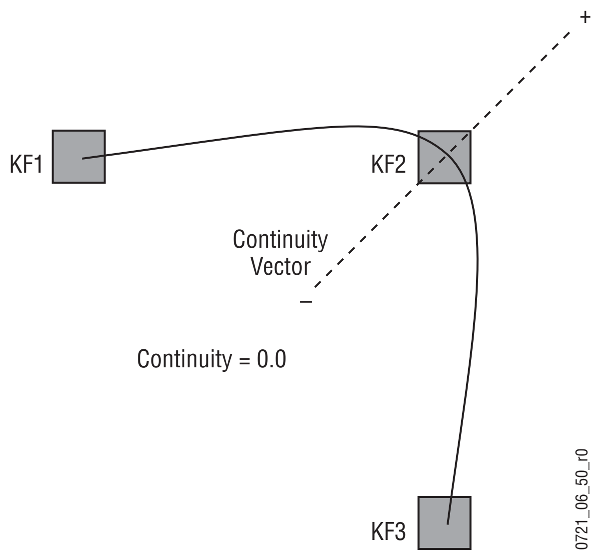
Figure 48. Tension Control Setting -1.0



Continuity Control

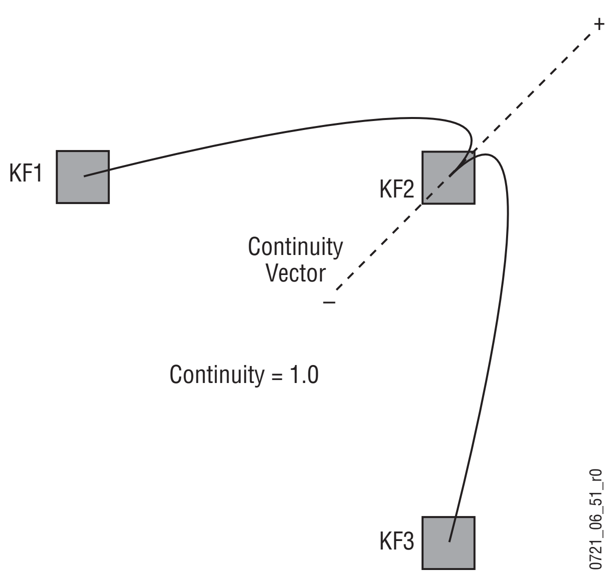
The continuity adjustment determines the angle of the path into and out of the keyframe. It is represented by a vector 90 degrees to the tension vector (Figure 49). The unmodified path shown is identical to the unmodified path of the other controls.

Figure 49. Continuity Control Setting Zero



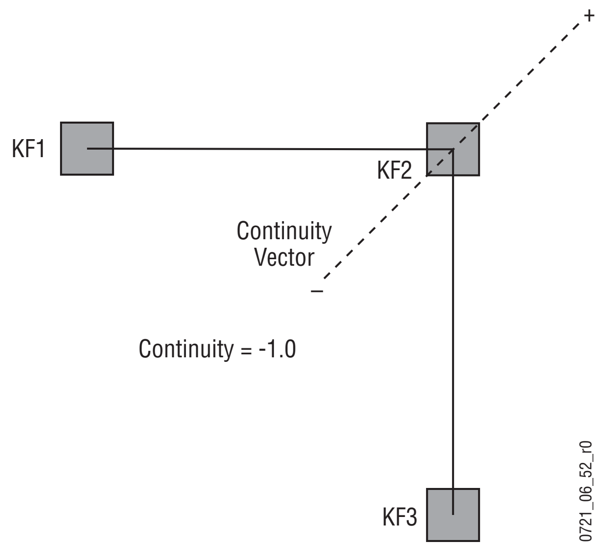
With continuity set to 1.0, the entry path through the keyframe is pulled positively along the continuity vector. The effect of 1.0 continuity is that of motion dropping into and then out of the keyframe, similar to a bouncing ball (Figure 49).

Figure 50. Continuity Control Setting 1.0



With continuity set to -1.0, the paths between the keyframes become straight lines, accelerating into the keyframe and decelerating as it leaves the keyframe (Figure 51).

Figure 51. Continuity Control Setting -1.0

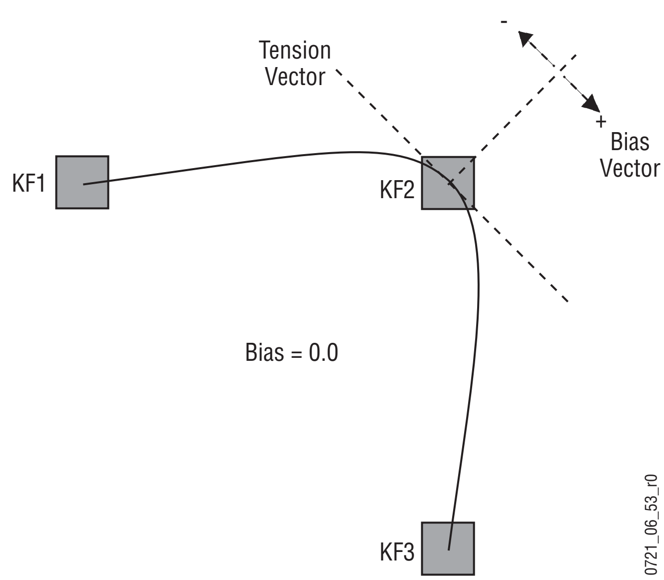


Bias Control

The **BIAS** control determines whether the path will be pulled towards the previous or the following keyframe. With extreme settings, all of the biasing will occur either before or after KF2. With bias set to 0 (zero), the curve through the keyframe is gentle as shown in Figure 52.

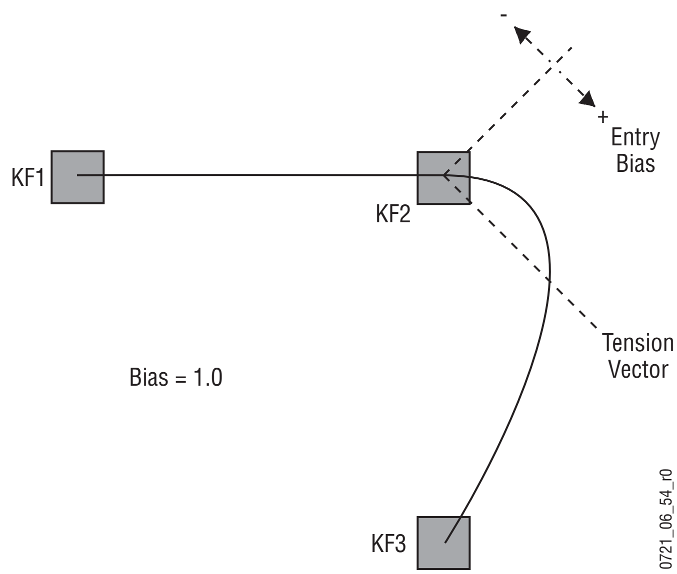
Note A Tension vector must be present for Bias control to be available.

Figure 52. Bias Control Setting Zero



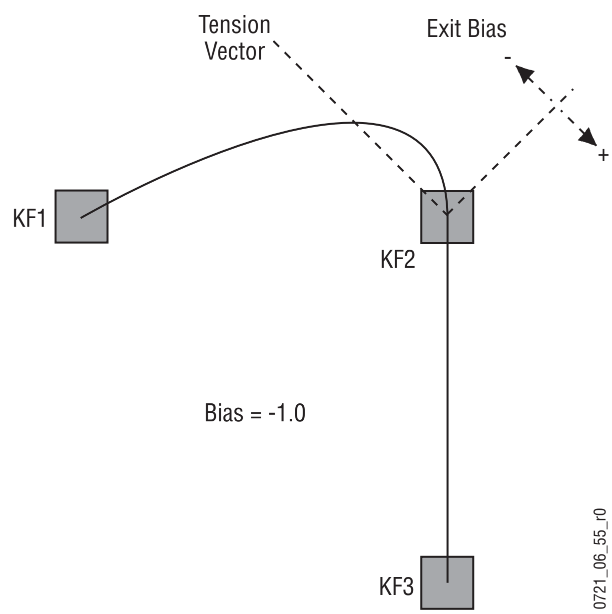
With the bias set to 1.0, the path is pulled towards the following keyframe. Entry into and exit from the keyframe is a straight line from the previous keyframe, and the path of the effect travels completely through KF2 before turning towards KF3 (Figure 53).

Figure 53. Bias Control Setting 1.0



With the bias set to -1.0, the path is pulled towards the previous keyframe. Entry into and exit from the keyframe is a straight line to the following keyframe (Figure 54).

Figure 54. Bias Control Setting -1.0



Index

T

U

V

W