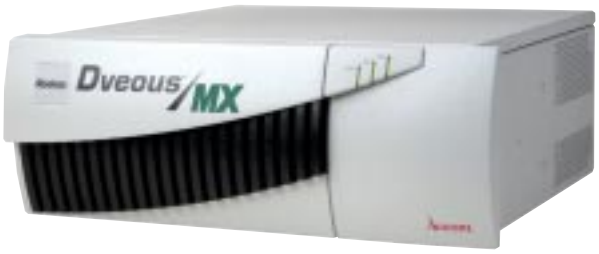
Quick Contents

Section 3: Transforms



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Overview

The Dveous/MX digital effects system is used to manipulate video images, giving the appearance of motion in three-dimensional (3D) space. To achieve this, Dveous/MX can rotate the image and, as it rotates, maintain optically correct perspective. The processing preserves the geometric precision of 3D space on the two-dimensional (2D) plane of a television screen. The video being manipulated is called the *source image*.

Note: Depending on your input and channel configurations, a channel can process a video signal, a key signal or a drop shadow. This section uses the word *image* generically to indicate the channel's source (video, key, or shadow).

Dveous/MX has four separate sets of 3D controls. It helps to visualize them by thinking of each set as applying to a 2D plane. The controls move the 2D plane in 3D space. The four 3D control sets are as follows, in processing order from upstream to downstream (first to last):

- The Local Source plane, which moves in local source space and contains the source image and any 2D pre-transform modifications.
- The Local Target plane, which moves in Local Target space and contains the entire Local Source plane.
- The Global Source plane, which moves in Global Source space and contains the entire Local Target plane.
- The Global Target plane, which moves in Global Target space and contains the entire Global Source plane.

See page the illustration on 3-3 for the hierarchy of planes. This left to right ordering of planes shows the upstream (left) to downstream (right of anything upstream) effect of one source plane on another. Any manipulation of a plane affects that plane and the ones upstream of it, while all planes downstream are not affected.

When first building effects and manipulating planes, it is a good idea to start in the Local Source space so that you can always have a true source plane to work with. As you get more familiar with the interaction of planes and create more complex effects (cubes, for example), you will sometimes start in Target space.

Axis Point

Each plane has a horizontal (or H) axis, a vertical (or V) axis, and a perpendicular (or Z) axis around which the plane can rotate. The intersection of these axes is a single point known as the axis *point*, or simply *axis*. You can view this axis point by pressing the **CURSOR** button in the Graphics area of the Control Panel. This button enables cursors in the video output that indicate the current location of the axes for the active channels. See the discussion later in this section for more details on the axis cursors.

Using a plane's *Locate* control to position it in its space also moves its axis settings to maintain their relationship to the plane. Rotating the plane does not appear to force rotations on its axis settings, but more on this later.

Transform Groups

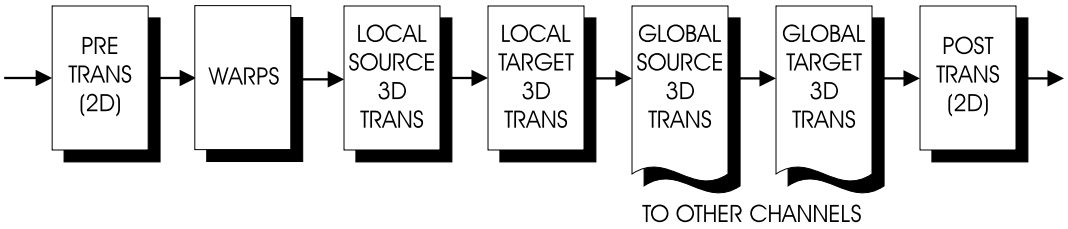
3D Transforms

Each set of 3D controls are identical in operation and power. The only thing that differentiates them is the order in which they are allowed to transform the image. The names of the 3D transform sets could just as easily been "First," "Second," "Third," and "Fourth." The two global 3D transforms ("Third" and "Fourth"), however, are special in that they apply to all Dveous/MX channels.

2D Transforms, Pre and Post

There are also ***Pre*** transform and ***Post*** transform 2D controls. The ***Pre*** controls change the H and V position and the size of the source image on the local source plane, without moving the source plane in 3D space. The ***Post*** controls change the H and V position and the size of the entire transformed image (i.e., the global target plane) on the screen, without moving the global target plane in 3D space.

The illustration below shows the upstream/downstream hierarchy of the transform groups. A detailed description of each the transforms appears later in this section, "Parameter Hierarchy Detail."



3D Transform Interaction Examples

Note: Dveous/MX is a mathematical processor that is based on the numbering system being used, i.e. 1 x .75, 4 x 3, 16 x 9. The following examples are based on SD mode (1 x .75) aspect ratios. The exact numbers being used will differ with the different aspect ratios. For instance to move an image half-way across the screen in a 1 x .75 aspect ratio would require an H loc value of .5. Whereas in the HD mode (16 x 9) the value would be 8.

For the following examples, first press **2D TRANS** to bring up its menu. Toggle the ***Position*** softkey to *Post*. Set the **Zoom** parameter softknob to reduce the image on the monitor so that you see more of the of 3D spaces. A **Zoom** value of 0.3000 works well.

Now, press **3D TRANS** to access the Local 3-D Trans menu. Controls in this menu manipulate the Local Source and Target planes. To perform a locate, rotate or axis locate in Source space, use the function softkey for that transform and then toggle to *Source*; To perform the transform in Target space, toggle the function softkey to *Target*.

Set the ***Locate*** function to *Source*. You are ready to move the location of the image on the Local Source plane. Use Local Source V locate (**V loc**) to move the image up a little. This location shift moves the Local Source plane (and its axes) independent of the other three planes (and their axes). To illustrate this, use the Local Source Z rotate (**Z rot**) to spin the image. It spins around its own center. Now use Local Target Z rotate to spin the image (toggle ***Locate*** to *Target*, then adjust **Z rot**). The Local Target plane spins on its center, which no longer matches the image's center because you have moved it with Source Locate.

In the above example, it would make no difference whether we used Local Target Z rotate, Global Source Z rotate, or Global Target Z rotate; the results would appear the same, since they are all downstream of the Local Source space.

Let's look at another example: First, press **CLEAR** + ***Locate*** to re-center the image. Now, use Local Target V locate (**V loc**) to move the image toward the top of the screen (instead of Local Source V locate used before). When you rotate the image, there is no apparent difference between Local Source Z rotate and Local Target Z rotate: they both spin the image about its own center. Using Global Z Rotates, however, spin about the center of the screen, since you have not moved the Global planes.

Here is another example of plane interaction: Start with a centered image (all locate values set to 0.0000). Set Local Source Z rotate (**Z rot**) to 0.1250 (45 degrees). Now use Local Source H locate (**H loc**) to move the image left and right. The image moves along a horizontal line straight across the screen. Using any other locate H controls gives the same results. As mentioned earlier, rotating a plane does not appear to affect its axes.

Now set the Local Source Z rotate back to 0.0000, and set the Local Target Z rotate to 0.1250. The Local Target and both Global H Locates still move the image straight across the screen. Using Local Source H Locate, however, moves the image diagonally, showing that the Local Source plane's Locate directions have indeed rotated.

The preceding example shows that rotating a plane does not affect its own Locate direction, but does affect the Locate directions of all upstream transform groups. So, rotating the Local Source plane affects only the 2D Adjust/PreTrans directions. Similarly, rotating the Local Target plane only affects the transform groups upstream of it (Local Source plane and 2D Adjust PreTrans). Since the Global Source and Target planes are downstream of the Local Target plane, they are not affected by anything you do with the Target plane.

Rotate Hierarchy

The previous examples showed that there is a hierarchy, or priority, of 3D controls. Using functions further down the list affects the controls above them. Furthermore, in the case of the Rotate function, you must take this hierarchy into account even within a single set of 3D controls.

For this example, you must tilt the image back vertically using ***Rotate/Source*** V locate (**V loc**), put the horizontal axis on the left image edge using ***Axis/Position/Source*** H locate ***(*****H loc**), and horizontally rotate the image (as if opening the cover of a book) using ***Rotate/Source*** H locate (**H loc**). Using Local Source 3D, the effect does not look like you would expect. This attempt fails because it does not take into account the Rotate control hierarchy: first Z, then V, finally H. To rotate a plane's axes, you must rotate the plane further down in the hierarchy. See the illustrations below.

When you rotate a plane around its Z (perpendicular) axis, none of the plane's three rotation axes are affected. However, when you rotate a plane vertically (around its H axis), you also rotate the Z axis vertically, but the H and V axes remain unaffected.

Finally, when you rotate a plane horizontally (around its V axis), you rotate both the Z and H axes horizontally as well, still leaving the V axis unaffected. This transformation is graphically demonstrated in the Preview output when the cursors are turned on: you can see that a Z Rotate does not move the axis cursor at all; a V Rotate tilts the Z axis only; and an H Rotate pivots both the Z and H axes. Note that the V axis remains vertical at all times.

Let's return to the “book cover” example. This time, however, use ***Rotate/Target*** **V** to lay back the top of the image. The resulting image is the correct book cover effect: the Rotate parameter for each 3D space is using its own internal hierarchy: first Z rotate, then V Rotate and, finally, H Rotate.

Note that using Rotate/Target H to open the cover would have failed exactly as it did when using Source H and V Rotates in the previous case. In the first "book cover" example, the problem was that the Source H Rotate was pivoting around the still-vertical axis.

You can use Source and Target Z rotates to spin an image about opposing corners. This effect looks better with a square image, so instead of using ***2D Adjust/ Post Trans*** **Zoom** to reduce the image, enter 0.5000 in both **Aspect H** and **Aspect V** parameter softknobs. Start with an image that has no rotates or locates, and set the Local Target Z rotate to 0.1250 (45 degrees).

The local target vertical rotate still rotates the image about axes that are straight across and straight up and down. Set ***Rotate/Target*** **H** and **V** to 0.0000. Applying a Local Source V rotate shows that the local source plane's axes are Z rotated: the image rotates on H and V axes that are diagonal to the screen.

Now enter a Local Source Z rotate of -0.1250 (45 degrees in the opposite direction). This rotate reorients the image to straight up and down, but Local Source H and V axes are still diagonal to the image, causing it to spin about its corners. Again, the reason for this transform is Target Z rotate occurs downstream, rotating the Local Source plane and all three of its rotational axes.

2D Parameter Overview

Press **2D TRANS** in the Channel Menu buttons to bring up the Local 2D Transforms menu. There are two sets of 2D position and size controls: ***Pre*** transform 2D, which comes upstream of (before) the 3D transforms, and ***Post*** transform 2D, which comes downstream of (after) the 3D transforms.

The ***Pre*** transform 2D controls include position and skew, as well as a true image size control. The size control also has aspect controls, letting you independently size the image horizontally and vertically.

2D Pre/Position and Aspect

The 2D ***Pre/Position*** controls actually move the image on the Local Source plane. It is important to note this for two reasons: ***Pre/Position*** moves the image off the axis of rotation for all four 3D transforms (since the image moves, but each plane's axes do not), and Source plane rotations directly affect the path the image takes when moved with ***Pre/Position.***

For the following examples, it is helpful to use 2D ***Post*** **Zoom** to reduce the image on the monitor and let you see more of the 3D spaces. A **Zoom** value of 0.3000 works well.

With the H and V ***Pre/Position*** set to 0.0000, the Local Source rotates (and all other rotates) spin the image on axes that intersect in the middle of the image. Use the ***Pre/Position*** **H** control to move the image left so that it touches the edge of the screen. Now try the H and Z rotates. They all act on the axes' intersection, which has not moved. Think of the 3D transforms as acting on where the image use to be: their view of 3D space has not changed.

Now rotate the image H and Z about 45 degrees. Using the ***Pre/Position*** **H** control causes the image to slide along the rotated Source plane.

Using the 2D ***Pre*** **Size** softknob actually changes the image size. Using Z locate does not actually resize the image; it appears larger or smaller because it moves closer or further away. If you set a rotate axis on the left edge of the image, then change its size with 2D ***Pre*** **Size** or **Aspect**, the axis is no longer on the image edge.

2D Post/Position

The 2D ***Post/Position*** controls let you position the output of the 3D transforms on the monitor. They do not affect the 3D look of a rotated image. These controls are very useful for offsetting or sizing a solid or other object that you created with the 3D controls. The **Zoom** control does not actually change the image's size; it acts more like a zoom lens on a camera. Zooming out (making the image smaller) widens the field of view; zooming in reduces it. The actual image you are looking at is unaffected. As opposed to the 2D ***Pre*** transform controls, the ***Post*** transform controls do not affect the 3D axis settings or rotate functions.

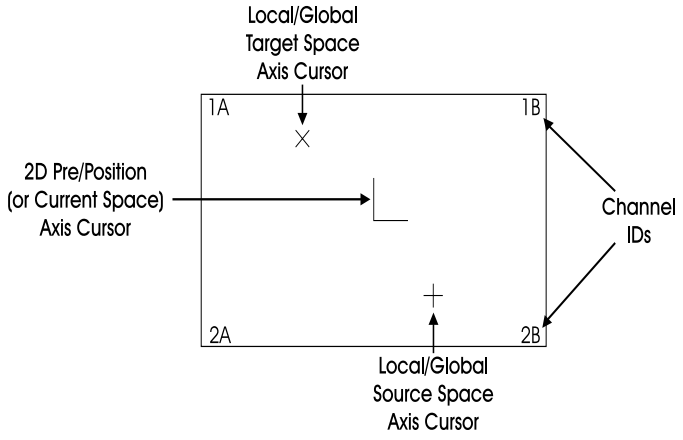
Axis Cursors

Pressing the **CURSOR** button to light its LED enables on-screen graphics to help you keep track of the channels and the locations of the Source and Target axes and the center of the source image. The channel IDs (1A, 1B, 2A, 2B) appear in the corners of the channel's image, as shown in the diagram below. Each channel, including Global, has its own set of cursors.

There are four axis cursors:

The L shaped cursor (2D Post and 3D) – In the 2D Pre Trans menu, it shows the center of the original source image. Once the image is rotated either horizontally or vertically, the third (Z axis) leg of the cursor appears (see illustration opposite page). In 3D space, the L cursor shows the center of rotation for either the Target or Source space, depending which is active.

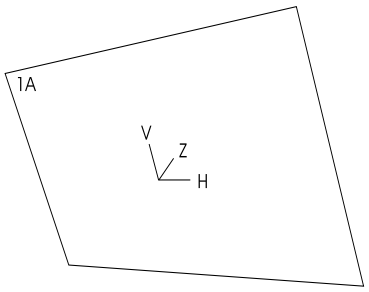
The L cursor (2D Post Trans) - indicates the center of the post trans image.



NOTE: This diagram shows all four channel IDs, but only one channel's axis cursors.

The X shaped cursor - indicates the axis for the Local Target space when Source is active.

The + shaped cursor - indicates the axis for the Local Source space when Target is active.



A rotated image that shows the third cursor axis. Axis labels are noted here for reference, and do not appear on the output.

Note that the only time all three cursors for a given channel appear on the screen at the same time is in the 2D Trans menu. In the 3D menus, L is always present, but only X or + appear with it.

The cursors and channel IDs only appear for the currently active channel(s). Since this can mean as many as 20 cursors on the screen at once, each channel has its own color for identification:

- Channel 1A: white
- Channel 1B: black
- Channel 2A: green
- Channel 2B: red
- Global Channel: grey (no channel ID)

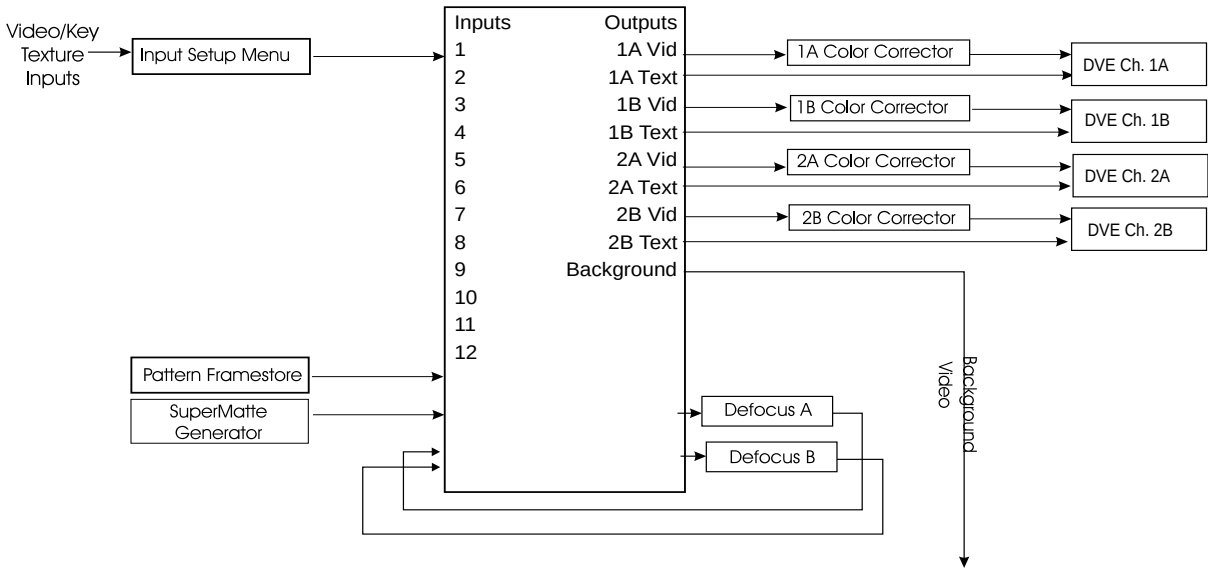
Note that the ID and cursor displays remain when you leave the 3D Trans menu. Also, running an effect automatically disables the **CURSOR** button, so the displays do not appear on the output.

Parameter Hierarchy Detail

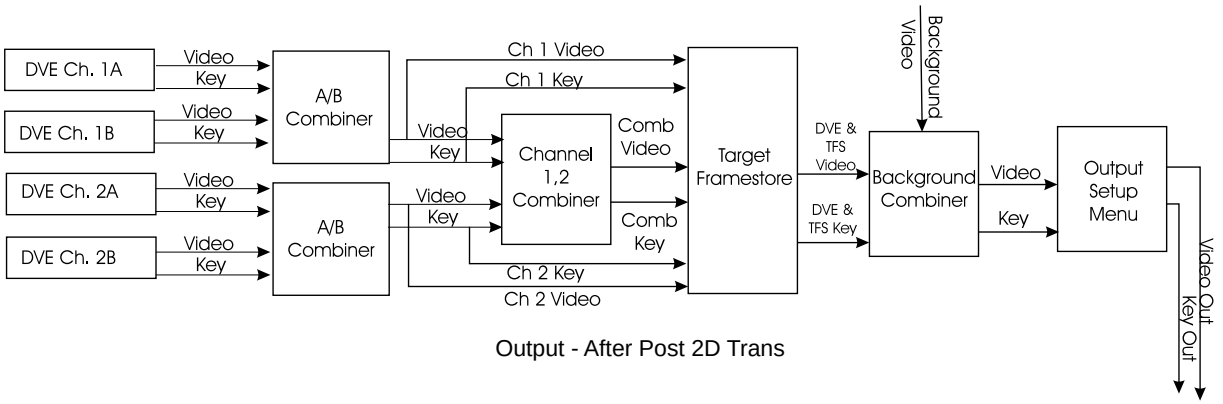
An effects system has many parameters (numeric values) and flags (switches) that alter the input video image. Dveous/MX offers many advanced features to let you create unique effects. While this power means virtually limitless possibilities, the array of controls can be daunting; therefore, it is important that you understand the image processing path and how the controls interact before you can expect to master Dveous/MX. This section describes the hierarchy of the system parameters.

The key to building effects is to design them from the most upstream parameter down (see illustration earlier). Note that although you can alter parameters at any point in the hierarchy, changing a parameter in the middle of the hierarchy reorients all upstream parameters and interacts with parameters downstream from it. Although in most effects this hierarchy is not important, you must consider it when building complex 3D tracking moves.

The following pages list the six transform groups (Pre 2D Trans, 3D Local Source, 3D Local Target, 3D Global Source, 3D Global Target, Post 2D Trans) in upstream to downstream order. Within each transform group, the hierarchy of parameters and flags is also ordered in upstream to downstream order. The menu for each parameter appears in parentheses. The following illustrations show the signal path through Dveous/MX.



Input - Before Pre 2D Trans



Output - After Post 2D Trans

Pre Trans 2D Parameters

The Source Image

The source image is, by default, a full raster image (either 1 x .75 or 16 x 9). It is placed in the center of the Source plane unless you move it with the ***Pre/Position*** controls.

Defocus (Defocus)

The wide range Defocus feature lets you select up to two video sources to be defocused or softened. It affects the source image before it is sent to the DVE channel inputs. There are independent controls for vertical and horizontal softening, and for the luminance or chrominance parts of the image.

Color Corrector (Color Crctr and Color Modify)

The ReTouch Color Corrector feature lets you work in either RGB or YUV space before it is sent to the DVE channel inputs.

Near/Far (Input)

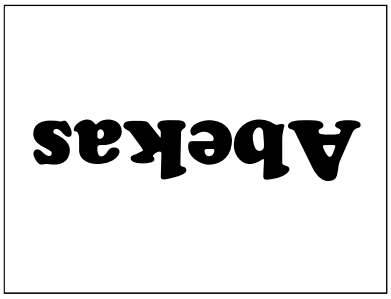
The Near/Far flags select the video input source for the two sides of the source image. Any image manipulations apply simultaneously to the near and far source images.

Freeze (Input)

You can freeze the input video by setting flags to freeze a field or frame of video. Because ***Freeze*** is downstream of the near/far video switch, selecting a freeze causes the near video to appear frozen on both sides of the plane.

Invert (Input)

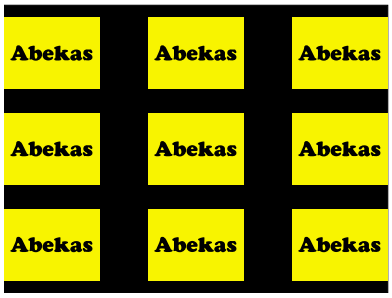
Inverts the input video for the near or far side of the DVE. You can invert horizontally, vertically or both. You can also select different settings for the near and far sides. Use Invert to reorient a source after rotating it.



Mosaic (Multi)

The Mosaic mode reduces the input video's resolution and breaks it into blocks. You can control the horizontal and vertical size of the blocks.

Multipic (Multi)



Multipic covers the Source plane with multiple copies of the source image. You can adjust the distance between the copies. The current border color fills the gaps between the copies.

You must uncrop the source image in order to see the multiple copies. Also, Multipic works differently with Video+Key and Video/Key+Shadow modes.

Border (Border/Crop)

Border crop lets you add a border inside the source image. Set the border width and move the border "window" with the joystick. A separate softkey lets you set the border color.

You can also adjust the width for each side independently, and set the border softness.

You can see that borders are downstream of crops when you apply a border to a cropped image. Border is only active in Video+Video mode, or Video/Key+Shadow, when the key is set to white.

Crop (Border/Crop)

Crop masks the size and shape of the key signal, so it gives the appearance that the source image is being cropped. By default, the system provides a key crop that is coincident with the video format in use (1 x .75 or 16 x 9).

In Dveous/MX's numbering system and in SD mode, the left edge of the raster is -.5000. the right is +.5000, the top is +.3750 and the bottom is -.3750. In the HD mode, the left edge of the raster is –8.0000, right is +8.0000, top is +4.5000, and bottom is –4.5000 screen units. Note that you can set the crops inside the image to mask part of it. In Video+Video mode, you can set the crops outside the image to reveal the border color and multipics (if enabled). In Video+Video mode, both A and B crops are active; in Video+Key and Video/Key+Shadow, only A crop is active.

Light Source (Image)

You can add lighting effects, such as spots, floods and bars, to effect for added realism. Light Source controls include position, color and rotation. When adjusting Position in Screen mode, however, Light Source effect on the image moves downstream. See later in this section under Light Source (Position).

Skew (2D Trans)

Skew distorts the image by letting you control the corner angles. A normal image has 90 degree corners. The default skew value is 0.0000. You can think of skew as a type of rotation: a value of 0.2500 brings two adjacent corners one quarter of the way around the rectangle, where they meet the other corners and form a single (invisible) line. You can skew the image horizontally, vertically, or both.

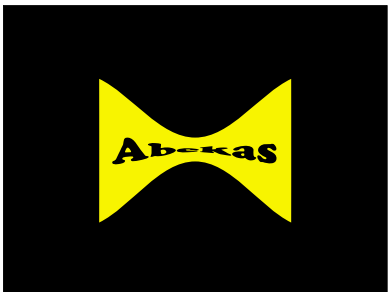
Pre/Position Size (2D Trans)

These controls adjust the image's size and position upstream of the 3D transforms. Repositioning the source image with Pre moves only the source image, not the Source plane or its axis of rotation.

Aspect (2D Trans)

Aspect lets you individually control the source image's horizontal and vertical size, making it other than the selected SD or HD format. This control resizes the image while keeping its center point at the center of the source plane.

Warp (Warp)

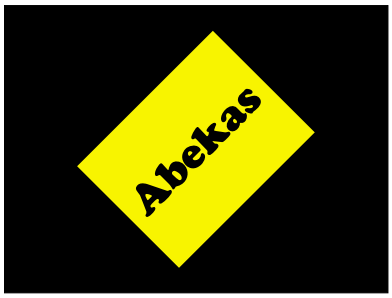


Warp controls let you distort the image. In actuality, Dveous/MX applies the warp shape to the Source plane and slides the image over that warp, thereby creating a distorted look.

To slide an image through a warp, you must go upstream to ***Pre/Position***. Moving a warped image, such as moving a circular shape around the screen, involves using one of the locate or ***Post/Position*** controls.

Local Source 3D Trans

Source Rotate (3D Trans)



Source Rotate rotates the Source plane in this order: Z, V, then H. As the image rotates, it has true perspective, with the angles and sizes needed to give the appearance of rotation in 3D space.

When the plane rotates past an edge-on point, the back image on the Source plane becomes visible. When you rotate the plane, you rotate the plane's numerical framework as well. For example, if you rotate the plane 180 degrees, then try to move the image with ***Pre/Position***, a left position entry moves the image right. With a slight rotation applied to the plane, moving the image with ***Pre/Position*** H or V (depending on the rotation) slides the image closer to or further from you.

Source Axis (3D Trans)

Source Axis lets you move the axes of rotation on the Source plane. By default (normal), the three axes (H, V, and Z) intersect at the center of the Source plane.

You can change the horizontal and vertical values to move the pivot point for the image. The Z axis is normally on the surface of the plane, relative to the H and V axes, but you can move it in front of or behind the plane. If you move the Z axis, you can make the image rotate toward or away from you in a barrel roll, or orbit.

Axis compensation
When you reposition the axis, Dveous/MX automatically corrects Locate values for you. The compensatory values ensure the image stays still while you reposition the axis. However, you can choose to turn off this automatic feature with Axis Mode in the Personality menu. Axis Mode is *On* by default. Turning it *Off* defeats the automatic correction to Locate.

Source Locate (3D Trans)

Source Locate moves the Source plane in 3D space. You can locate the plane horizontally, vertically, and on the Z axis (toward or away from you, giving the impression of a size change). The effect of moving the image in space is that it maintains the viewing perspective as it moves.

If you rotate the image horizontally, then change the **H Loc** value, the image's angles change to maintain the perspective while the image moves. That is, the image edge that is closer appears to move further and faster than the image edge that is further away.

Moving the image away in space always seems to move the image toward the center of screen. This perspective is consistent with the rules of three dimensions: the further away you get, the more you see around the focal object.

Local Target 3D Trans

The Target parameters are a second set of 3D controls. In the analogy of multiple effects systems, the processed output of the Source 3D system feeds the Target 3D system. The numbering system is identical to the Source 3D parameters. You can use Target controls as additional tools to create complete rotations and hierarchical motion paths.

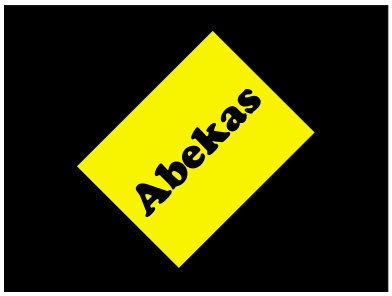
Rotation is an obvious application for additional 3D controls. If you use just one set of rotational parameters, you must use the predetermined order of plane rotation (Z, V, then H).

An identical set of rotations in Target lets you achieve a different order of plane rotation, such as Z, H, then V. This uses the Target vertical rotation, which is downstream from the Source vertical or horizontal rotation.

Target parameters also let you reposition a previously moved or rotated image, leaving Source 3D controls available to manipulate the image at a different location in space while maintaining correct perspective.

Target Rotate (3D Trans)

Target Rotate takes the three-dimensionally manipulated Source plane and rotates it about the second set of Z, V, and H axes, in that order.



Target Axis (3D Trans)

Target axis lets you move the rotation axes. By default (normal position), the three axes (H, V, and Z) intersect at the same place as the Source axes: the center of the Source plane.

You can change the horizontal and vertical values to move the pivot point for the image.

A simple application of Target axes, used with Source axes, is setting an axis of rotation on either side of the image. This setting lets you rotate the image off either edge without having to create an extra keyframe to move the axis.

Target Locate (Local 3D)

Target Locate moves the plane in 3D space. You can move the plane horizontally, vertically, and on the Z axis (toward or away from you, giving the impression of a size change). The effect of moving the image in space is that it maintains the perspective as it moves. If you use Target **H Rot**, then change the Target **H Loc** value, the image's angles change to maintain perspective as the image moves. That is, the image edge that is closer appears to move further and faster than the image edge that is further away.

Moving the image away in space always seems to move the image toward the center of screen. This is consistent with the rules of three dimensions: the further away you get, the more you see around the focal object. If you combine Target and Source parameters, note that applying a Target **H Rot**, then a Source locate, as described previously, results in the same apparent "slide" seen when moving a rotated image with 2D ***Pre/ Position***.

Global Source and Global Target

The Global Source and Target controls are a another set of 3D parameters that are downstream from, yet operate much like, their Local counterparts.

In the analogy of multiple effects systems, the processed output of the Local 3D system feeds the Global Source/Target 3D system. The numbering system is identical that in Local 3D parameters.

A primary function of globals is to move and rotate solids such as cubes and slabs, but you can also use these controls with single channel effects as well.

Light Source (Screen)

All Light Source parameters affect the image upstream, except for when adjusting *Position* in *Screen* mode. Here, when you move the image with ***Post/Position***, the light sources move with it.

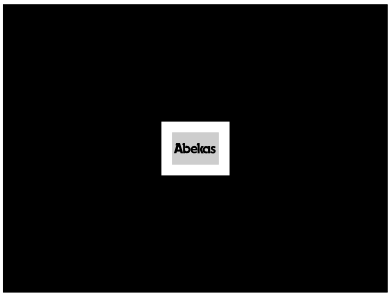
Post 2D Parameters

Perspective (2D Trans)

Perspective exaggerates or reduces the amount of perspective on the processed image to adjust the look of rotated planes. The default value is .3000 for SD mode and 0.0188 for HD mode.

Post/Position Zoom (2D Trans)

In the multiple effects system analogy, you can consider ***Post/Position* Zoom** as a simple 2D image mover that gets its input from the global effects system.



Post/Position* Zoom** is the last level of controls in the system. Use it after building an effect to position the image on the screen. Because ***Post/Position is the final image manipulator, you can also use it to bring an image that is well off screen back into view.