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ADO

OPERATOR'S GUIDE

AMPEX

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SECTION 1
INTRODUCTION

1-1 INTRODUCTION

This manual provides operating information for the Ampex Digital Optics (ADO) system. You may use the information in this guide for first-time operation, or as a reference after you have used the system for a while.

The material in this section describes ADO's real-time digital effects capability and how this capability is used to create high-quality video images with true three-dimensional characteristics. Multi-image effects are created in real time by the optional ADO concentrator.

1-2 WHAT ADO DOES

Following is a description of ADO's image processing capability. Some of the capabilities require optional equipment; where this is the case, it is noted in the description. A typical ADO system configuration is shown in Figure 1-1.

1-3 Digital Image Processing

ADO processes images by converting the analog video input signal to digital form and storing the resulting digital information. Each picture element (pixel) is mapped, in the form of a matrix, into what is termed *source* space. The source image is transformed in the desired way by calculating the location of pixels in what is termed *target* space. The transformation is done with precise mathematical formulas applied by distributed microprocessor circuits.

To preserve picture quality when images are compressed or expanded, digital interpolation and extrapolation circuits fill in or remove pixels from the original image.

There are many advantages gained by using digital processing. Because all image transformation is done digitally, noise, phase shift, and other undesirable picture effects are virtually eliminated. Digital processing circuits also provide smooth image motion, allowing images to be moved slowly or rapidly without jerkiness. Thus ADO's high-quality video output ensures that broadcast standards are met without exception.

1-4 Real-Time Image Transformation

Image transformation is done in real time, allowing live sources (e.g., from a camera) to be used as well as moving images from a videotape recorder. The output from a real-time graphics system such as a character generator can be processed while in crawl, reveal, or flash modes.

Spectacular effects such as rotating cubes with different moving images on each face are created as easily as is a single, static image. With the optional ADO Concentrator, separate images can be mixed to provide multichannel effects in real time.

Freeze mode captures a single frame from an incoming video signal. This image can then be processed in any way the user requires. A control-panel pushbutton allows the operator to choose manually a frame from an incoming video source. A programmable freeze flag freezes an image while an effect is running.

1-5 Image Transformation Capabilities

Images are transformed in three ways:

1. Aspect ratio can be changed, and image size can be modified before rotation and three-dimensional transformation.
2. Images can be compressed, expanded, and positioned after rotation and three-dimensional transformation.
3. Using optional rotation capability, images can be rotated and transformed in three-dimensional space.

Image transformation capabilities include:

- Image compression: From normal size to vanishing.
- Image expansion: From normal size to 32,767 x normal size.
- Image positioning: Images can be positioned anywhere in target space; includes positioning along X, Y, and Z axes.
- Off-axis moves: Using AXIS SELECT 3D, X, Y, and Z axes can be moved away from the normal center of target space (the video monitor screen).
- Rotation: Images can be rotated around all three axes, either in normal center position or in shifted position. Rotation gives the effect of an image spinning, tumbling, or flipping.

1-6 Three-Dimensional Effects

ADO creates three-dimensional effects by combining perspective with rotation and three-dimensional positioning to give the effect of viewing an image at a distance or from above, below, or from the side. Perspective capability is a system option.

ADO also creates three-dimensional solids by combining two or more images from two or more separate signal systems. A production switcher or the optional ADO Concentrator accessory must be used to achieve an effect containing solids.

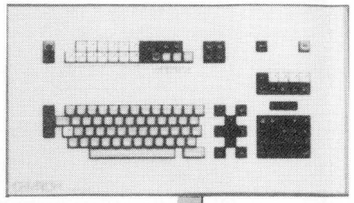
1-7 Global Control

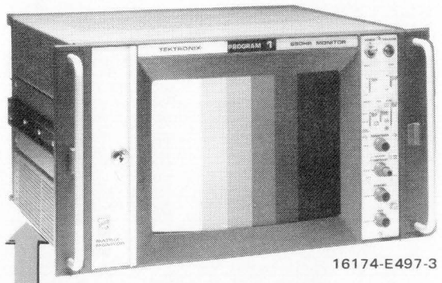
Global mode allows the user to control parameters simultaneously. This control allows simultaneous rotation and translation to give the effect of a spinning or tumbling image moving toward or away from the viewer.

16265-20

ESS-3 STILL STORE

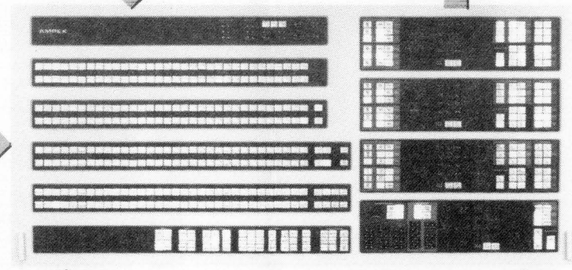
CHYRON CHARACTER GENERATOR





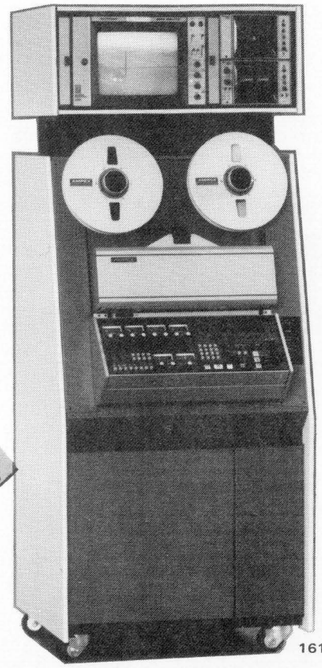
16174-E497-3

VIDEO MONITOR



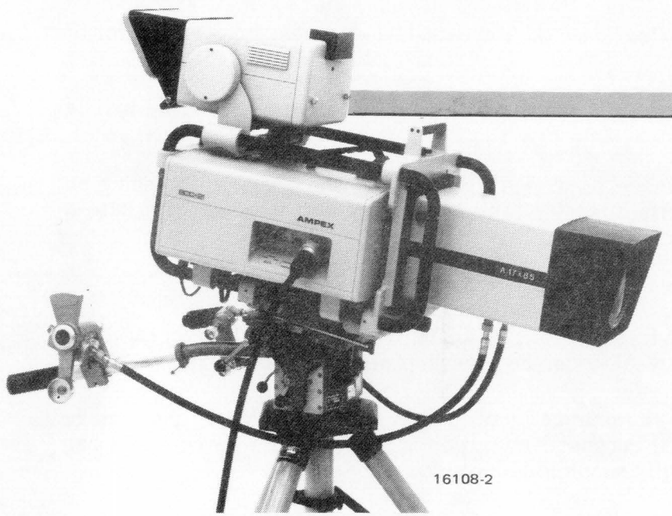
16271-8

AVC PRODUCTION SWITCHER



16134-23

VPR-3 VIDEO PRODUCTION RECORDER



16108-2

BCC-21 BROADCAST COLOR CAMERA

15887-2

ACE EDITING SYSTEM

16249-5

ADO DIGITAL OPTICS

Figure 1-1.
Typical ADO System Configuration

Another possibility for global parameter control is combined X, Z rotation in which an image is rotated around the Z axis while maintaining edges parallel to the Y axis.

1-8 Motion

By programming keyframes you can create the effect of motion. Effects such as a spinning object moving toward the viewer are created by using size, position, and rotation functions simultaneously.

Motion can be smooth or linear depending on the user's requirement. Pauses can be programmed in effect sequences to give the effect of motion stopping.

Or, each keyframe can have a variable duration programmed by the user, in one-frame increments.

1-9 Image Modification

Images can be modified using one of ADO's video modification capabilities as follows:

- Mosaic mode converts an image into rectangles. Extent of mosaic area and size of rectangles are user-programmed. An external key signal can be used to define an area for mosaic conversion, using the general-purpose key option.
- Solarization and posterization modes create high-contrast images. Extent of effect is programmed.
- Blur mode softens the edges of graphics such as those produced by a title generator.
- Light source/shadow mode creates a light source which appears to shine on the image, modifying its intensity. This mode may also be used to create a shadow of the image.

1-10 Key Channel

The system's key output provides a means of keying through a production switcher so that the image processed by ADO can be superimposed over a background.

Normal key output is a luminance key signal which follows any image transformation. If the General Purpose Key option is installed, the key channel can be used to process an externally supplied video signal.

A color background generator creates color borders after the image created by the system has been keyed over a background.

Key edge softness can be controlled by the user.

1-11 Effect Control

An effect is built from a series of keyframes, each of which specifies image transformation parameters (see paragraph 2-9). As keyframes are assembled to form an effect, the user modifies parameters as required. Existing keyframes, stored in control unit local memory, can be modified or deleted, and new keyframes can be inserted. By using run mode, the effect can be viewed and then trimmed as required.

With the optional disk drive installed, effects can be stored on a disk and then recalled for editing or running.

1-12 Effect Storage

Each 5-1/4-in. floppy disk stores up to 54 single-channel effects of up to 25 keyframes each or up to 11 multichannel effects of up to 25 keyframes each. Effects and disks can be given titles up to 15 characters for easy identification.

1-13 WHAT THE CONCENTRATOR DOES

The optional ADO Concentrator creates multichannel effects. Under control of one user, the Concentrator accepts images in digital form from one or more ADO signal systems. The images are then combined digitally and transferred to a signal system for reconstruction into a composite video signal.

Two independent effects can be produced simultaneously. The ability of the concentrator to control processing automatically and its ability to synchronize video channels used improves the quality of effects. Because the concentrator uses digital processing techniques, the user can program image priorities--which image is seen in front of another--for multi-image effects such as three-dimensional solids. In addition, the user can control image transparency, allowing channels to be superimposed. The transparency of each channel can also be programmed to change automatically at selected points in an effect. The system tolerates errors in horizontal phasing without image quality being affected. Because timing errors between video channels are eliminated, combined effects produced by the concentrator are aligned perfectly. The concentrator also produces soft edge keying when provided with a soft edge key signal from an ADO signal system.

1-14 SYSTEM INTEGRATION

An integrated system can consist of up to four signal systems controlled by up to eight control panels. One control panel can acquire up to four signal systems for multichannel effects. The ADO Concentrator can be acquired and controlled by any one or two of the control panels in an integrated system.

An integrated system can be reconfigured at any time by issuing commands from control panels. Signal systems can be acquired or released, and the concentrator can also be acquired or released.

1-15 CONTENTS OF THIS GUIDE

Note

Operating information contained in this guide pertains to ADO operating software, version 5. If subsequent software changes which affect system operation occur, these changes will be described in a change package which supplements this guide. This change package should be referred to before operating the system.

This guide is an operating manual for the ADO system operator, and can be used for instruction or as a reference during editing sessions. It is divided into four sections:

Section 1 provides preliminary information an operator should know before using the system.

Section 2 describes operator controls and system menus. This section also discusses the XYZ axis system used to describe image location. A paragraph on scale factors lists each image modification parameter and lists the factors pertaining to the parameter.

Section 3 gives step-by-step operating procedures for simple and complex effects. This section also discusses mosaic and posterization/solarization, using shadow mode, and using the key channel. Procedures for adjusting engineering parameters in setup mode are described at the end of the section.

1-16 RELATED PUBLICATIONS

The following publications should be referred to, as applicable, when using this guide:

- ADO Service Manual, catalog no. 1809550-03
- ADO Parts Lists and Schematics Manual, catalog no. 1809621-01.

SECTION 2
OPERATOR CONTROLS AND SYSTEM MENUS

2-1 DEFINITIONS AND CONVENTIONS

Throughout this manual, we refer to X, Y, and Z *axes*, movement with respect to the axes, and rotation around the axes.

In addition, we refer to *source* space and *target* space. Image size, location, and rotation parameters are chosen with respect to axes in source or target space.

2-2 Axis Definition

In both source and target space, axes are aligned in the same way. The X axis is horizontal, extending out on both sides from the picture monitor screen. The Y axis is vertical, extending up and down from the picture monitor screen. The Z axis is perpendicular to the X and Y axes, extending toward and away from the screen. See Figure 2-1.

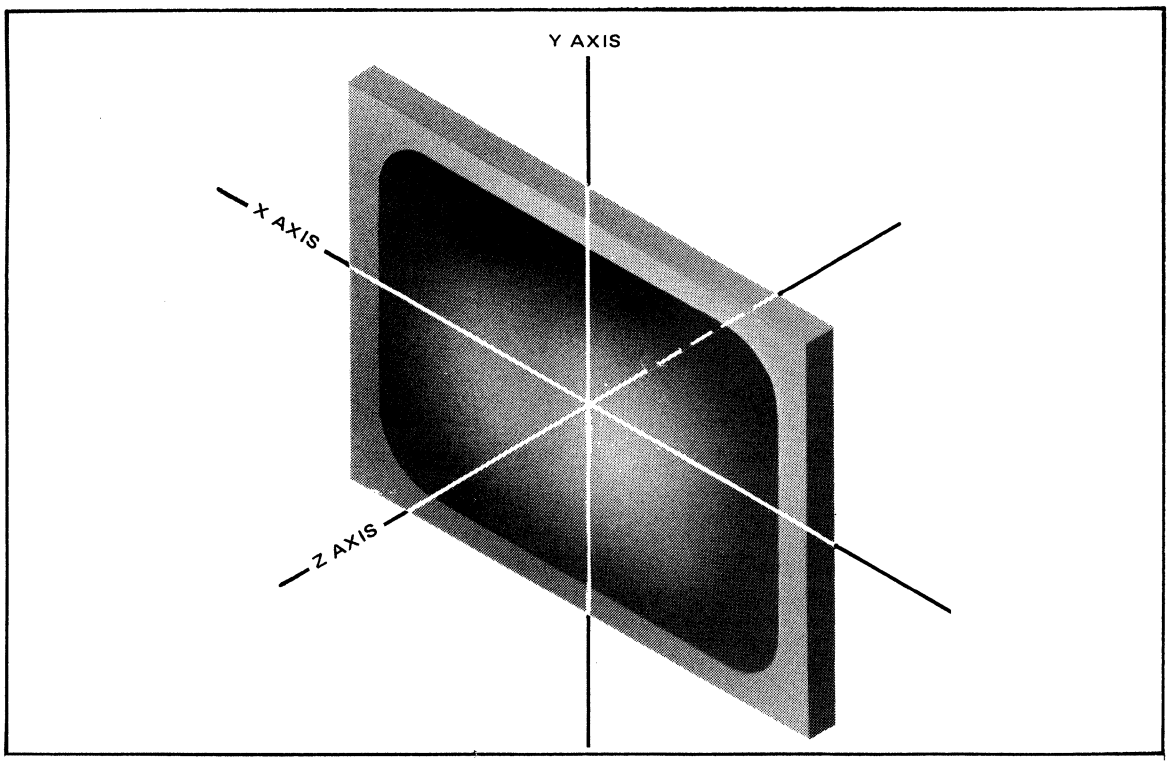


Figure 2-1. Axis Definition

2-3 Scale Factors

Position and size factors are based on a picture monitor screen which has a 4:3 aspect ratio.

- *Vertical (Y) Dimension:* 6 units; +3 and -3 units from screen center.
- *Horizontal (X) Dimension:* 8 units; +4 and -4 units from screen center.
- *Perpendicular (Z) Dimension:* An indeterminate number of units toward and away from the viewer. Positive values of Z are out of the screen, toward the viewer. Negative values of Z are into the screen, away from the viewer. Higher positive Z values appear to enlarge the image; higher negative values appear to reduce the image.
- *Rotation Values:* 1.0 is equal to 360 degree rotation. Values are programmed with 0.0001 unit resolution, corresponding to 0.036 degree increments.
- *Size Values:* 1.0 is full image size—0.5 is half size, etc.
- *Skew:* Changes image geometry so that parallel edges are slanted. A skew value of 1.0 gives an unskewed image: negative values skew image to left, positive values to right.
- *Post-Y Values:* 1.0 is equal to 360 degree rotation. Values are programmed with 0.0001 unit resolution, corresponding to 0.036 degree increments.
- *Perspective Factors:* For perspective approximating the field of view of the human eye (46 degrees), the value is 0.06. This is the value assigned by the system at power-up. A perspective value of 0.06 corresponds to a viewing distance of 16.67 units. Perspective values are programmed from 0 (viewing distance infinitely far from the screen and not having a high degree of perspective) to 10 (viewing distance 0.1 units from the screen and having a high degree of perspective).
- *Border Width:* Programs width of colored border around an image. Values can be set from 0 (no border) to 3.0 (no image).
- *Border Color Values:* Programs three sets of values--saturation, luminance, and hue. Saturation values range from 0 to 100%. Luminance values range from 0 to 100% (-6.6 to +106.1 IRE units). Border hue can be programmed in 1 degree increments from 0 degrees (cyan) to 180 degrees (purple) and back to cyan at 359 degrees.
- *Crop Left/Top and Right/Bottom:* System-assigned values are -4, 3, 4, and -3, corresponding to the uncropped edges of the 8 x 6 unit image as measured from screen center. Values lower than ±4 and ±3 crop the image from full screen areas, approaching zero image size.
- *Source Aspect/Size:* Changes image size and aspect ratio in source space. Rightward joystick movement (or X values greater than +1) expands the image horizontally. Leftward joystick movement (or X values less than +1) compresses the image horizontally. When X has a value of zero the image is infinitesimally small. Further leftward joystick movement (or negative X values) again expands the image horizontally but as a mirror image. An X value of -1 regains original image size, but the image is reversed.

Upward joystick movement (or Y values greater than +1) expands the image vertically. When Y has a value of zero, the image is infinitesimally small. Further downward joystick movement (or negative Y values) again expands the image horizontally, but as a mirror image. A Y value of -1 regains original image size, but the image is reversed.

Aspect ratio values of 1 are assigned by the system when power is turned on. Both X and Y values range from 1.0000 (normal aspect ratio) to ±32,000 (highly compressed or expanded).

Counterclockwise joystick knob rotation (or Z values less than 1) reduces image size. A Z value of 1.0000 is assigned by the system when power is turned on. Size values range from 1.0000 (normal size) to 0 (vanishing).

Clockwise joystick knob rotation (or Z values greater than 1) increases image size. Size values range from 1.0000 (normal size) to 32,000 (extremely large).

- *Target Position/Size:* Changes image size and scale factors in target space. Leftward joystick movement (or negative X values) moves the image to the left. An X value of -4 moves the center of the image to the extreme left of the screen. Rightward joystick movement (or positive X values) moves the image to the right. An X value of +4 moves the image to the extreme right of the screen.

  Upward joystick deflection (or positive Y values) moves the image up. A Y value of +3 moves the center of the image to the top of the screen. Downward joystick deflection (or negative Y values) moves the image down. A Y value of -3 moves the center of the image to the bottom of the screen.

  Counterclockwise joystick knob rotation (or Z values less than 1) reduces image size. A Z value of 1.0000 is assigned by the system when power is turned on. Size values range from 1.0000 (normal size) to 0 (vanishing).

  Clockwise joystick knob rotation (or Z values greater than 1) increases image size. Size values range from 1.0000 (normal size) to 32,000 (extremely large).

- *Axis Select 3D:* Moves image away from the intersection of source space axes. When the system is turned on, X, Y, and Z axes are located at the center of target space (values are 0, 0, 0).

  Leftward joystick movement (or negative X values) moves the image to the left of the axis of rotation. Rightward joystick movement (or positive X values) moves the image to the right of the axis of rotation.

  Upward joystick movement (or positive Y values) moves the image up from the axis of rotation. Downward joystick movement (or negative X values) moves the image down from the axis of rotation.

  Clockwise joystick knob rotation (or positive Z values) moves the image further from the viewer and away from the axis of rotation (apparently into the screen). Counterclockwise joystick knob rotation (or negative Z values) moves the image toward the viewer and toward the axis of rotation (apparently out of the screen).

- *Rotate 3D:* Rotates the image around each of the *source* space axes at a location determined by previous *axis select* parameters. Left and right joystick movements rotate the image around the *Y axis.* A value of 1.0000 is one complete rotation; a value of 0.5 is 180 degrees, etc.

  Up and down joystick movements rotate the image around the *X axis.* A value of 1.0000 is one complete rotation; a value of 0.5 is 180 degrees, etc.

  Clockwise joystick knob rotation (or positive Z values) rotates the image clockwise around the Z axis. A value of 1.0000 is one complete rotation; a value of 0.5 is 180 degrees, etc.

  Counterclockwise joystick knob rotation (or negative Z values) rotates the image counterclockwise around the Z axis. A value of -1.0000 is one complete rotation; a value of -0.5 is 180 degrees, etc.

- *Locate 3D:* Moves the image and the axis of rotation with respect to the viewer—as if the object were on a platform which can be raised, lowered, moved from side to side, or moved toward and away from the viewer. Leftward joystick movement (or negative X values) moves the image to the left. A value of -4 moves the center of the image to the extreme left of the screen.

  Rightward joystick movement (or positive X values) moves the image to the right. A value of +4 moves the center of the image to the extreme right of the screen.

  Upward joystick movement (or positive Y values) moves the center of the image up. A value of +3 moves the center of the image to the top of the screen.

  Downward joystick movement (or negative Y values) moves the center of the image down. A value of -3 moves the center of the image to the bottom of the screen.

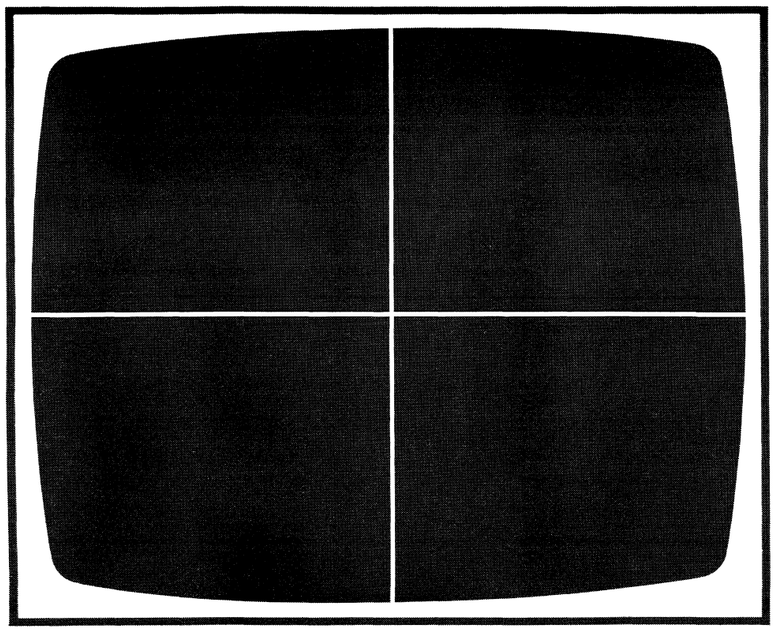
  Clockwise joystick knob rotation (or positive Z values) moves the image away from the viewer (apparently into the screen). Counterclockwise joystick knob rotation (or negative Z values) moves the image toward the viewer (apparently out of the screen).

2-4 Source Space

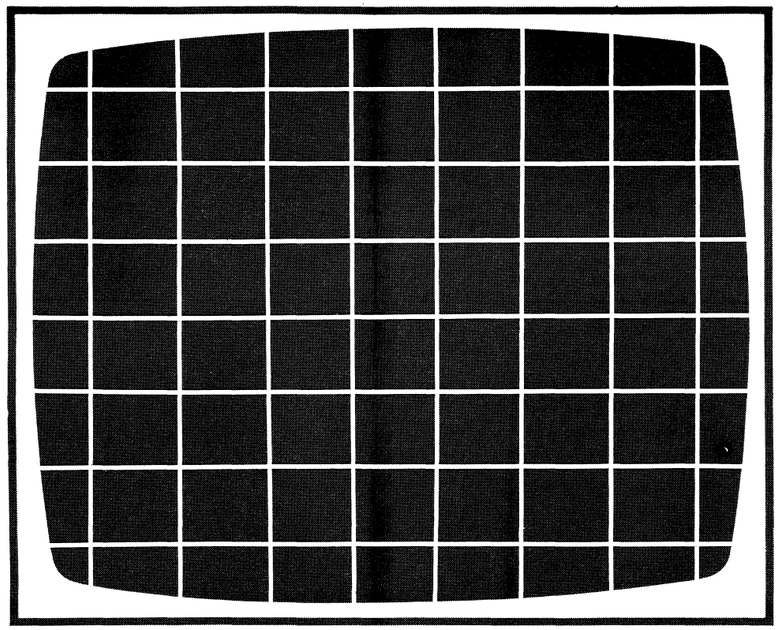
ADO processes images in three stages. The first stage performs source aspect/size, crop, border, and skew functions. The second stage performs three-dimensional functions such as axis select, locate 3D, rotate, and perspective. The third stage performs position and size functions. Stage one operates in *source* space. These functions are then translated into *target* space (stage 3).

2-5 Grids

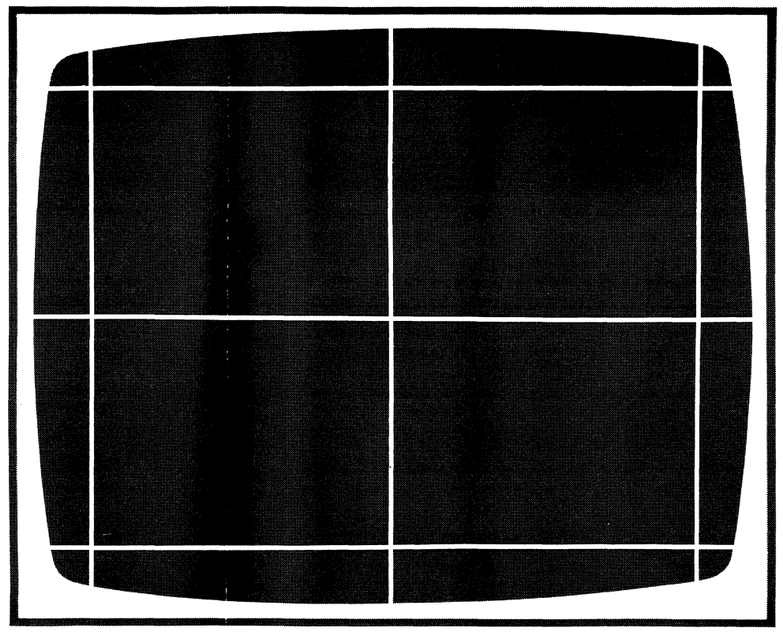
Grids provide the user with precise location references. Two kinds of grid are provided: a single, cross-hair grid in source space and a multiple grid in target space. In addition, a safe area display can be selected. See Figure 2-2.



SOURCE GRID



TARGET GRID



SAFE AREA

Figure 2-2.
Grids and Safe Area

The source grid is a single cross-hair centered on the image. This grid moves with the image in source space.

The target grid is a crosshatch with operator-controllable spacing and position. This grid, unlike the source grid, stays in place and does not change as the image is rotated or translated.

The safe area function displays a rectangle on the normally overscanned TV monitor, outlining the picture area that appears on the standard underscanned receiver. This shows the operator just how much of her effect is really visible to the television viewer.

2-6 Noise Reduction

The noise reduction function filters out low-level noise in the luminance signal, tending to produce "snow" in the output video. An intrinsically noisy signal is not noticeably improved by noise reduction, but a good signal is made better.

2-7 Motion

Motion is defined as any image movement, whether size change, location, or rotation. ADO provides three motion types: smooth, linear, and hold. A different motion type can be programmed for each of the three axes, as follows:

- *Smooth* motion moves or rotates an image from one position to the next smoothly, with acceleration and deceleration, attempting to take the smoothest path between keyframes.
- *Linear* motion moves or rotates the image at constant speed from one position to the next. The image moves at a linear rate determined by keyframe duration.
- *Hold* mode moves or rotates an image abruptly from one position to the next, remaining at each point for the keyframe duration.
- *Break* function programs an end to smooth motion at each keyframe where a break has been programmed. This suppresses overshoot in motion of the effect.

2-8 Keyframe Terminology and Definitions

A keyframe is one complete set of image modification and transformation parameters, including size, rotation, skew, perspective, and border width/color. Each keyframe is programmed independently by the operator and may include different motion types and image modification parameters such as mosaic and freeze. Keyframe duration specifies the length of time between the current keyframe and the next keyframe.

Keyframes are assembled into effects—integrated series of image transformations. Individual effects can be stored on disk and then recalled to run the effect. Any or all keyframe parameters can be edited at any time.

Keyframe flags are conditions which affect such things as image mirrors, image source, cube mode, freeze, or global. Flags can be set, for example, to change to mosaic mode or to switch sources partway through an effect.

2-9 Keyframe Parameters

Each keyframe has parameters which may or may not change during an effect. The primary parameters are:

- Source aspect and size
- Target position and size
- Axis select 3-D
- Rotate 3-D
- Locate 3-D
- Skew, post-Y rotation, and perspective
- Border width
- Border color
- Crop top and left
- Crop bottom and right

Secondary keyframe parameters, designated as keyframe flags, are:

- Freeze on or off
- Source A or B or A/B
- A mirror—none, X, Y, or X and Y
- B mirror—none, X, Y, or X and Y
- Global on or off
- Interlace—frame, field, auto 1 or auto 2
- Cube on or off (auto cube mode available with multichannel software only)
- Y blur on or off

Keyframe flags are explained in detail in paragraph 3-16.

In addition to keyframe parameters and flags listed previously, input video parameters such as solarization and mosaic can be programmed for each keyframe. Input video parameters include:

- Chroma and luminance mapping for solarization and posterization
- Vertical and horizontal mosaic block size
- Window location and size for mosaic, solarization, and posterization functions

Input video keyframe flags include:

- Mosaic on/off, all over image, inside window, or outside window.
- Solarization on/off, all over image, inside window, or outside window.
- Mosaic window rectangular, set by key, set by luminance level, or set by combination of rectangular shape and key shape.
- Solarization window rectangular, set by key, set by luminance level, or set by combination of rectangular shape and key shape.
- Mosaic chroma in X axis, Y axis, both X and Y axes, or neither axis.

The key signal is also controlled by keyframe flags which include:

- Softness
- Blur
- General-purpose key option on/off, B channel, or A channel
- General-purpose key inversion
- General-purpose key gain

2-10 Source Selection

The same or different image source can be chosen for each keyframe by setting the source flag. Different sources can be chosen for front and back of a rotating image. Selection is automatic in A/B or B/A source modes.

2-11 Mirror Mode

Mirror flags are set to reverse images when they are rotated. An X mirror flag reverses the image horizontally; a Y mirror flag reverses the image vertically. An X,Y flag reverses images in both directions. Different mirror flags can be set for both sources.

2-12 Global Mode

In global mode, operations can be performed on two or more channels simultaneously. For example, two channels which have been positioned to form two faces of a cube can be rotated together.

Different operations for the same channel can also be combined using global mode. For example, to rotate a picture around the Z-axis while maintaining picture edges parallel to X and Y axes requires global control of both locate and rotate functions.

2-13 Auto Cube Mode

This mode uses ADO's precise geometric properties to construct opposite faces of a rotating cube or any other three-dimensional solid having parallel faces. It should be noted that constructing a solid other than a cube may require calculating keyframe parameters with a programmable scientific calculator. Refer to the Appendix, *Construction of Solids Using ADO Multichannel Software*, by Ampex Corporation, included at the end of this guide. By using A/B auto mode, different

images can appear on opposite cube faces. By combining global, A/B auto, and auto cube modes, six different images can appear on all six faces of a moving cube.

2-14 Single-Channel/Multichannel Operation

Software is available either for single-channel or multichannel operation. When the multichannel option is installed, one control panel controls one, two, three, or four signal-system channels. Each signal system is a single channel, with two video inputs, two identical, buffered video outputs, a separate key output, and a reference black video input. Each video image is generated by a separate signal-system channel, and the multichannel option allows up to four signal-system channels to be controlled by a single control unit. All channels may be controlled simultaneously, using global mode.

Alternatively, from one to eight control units can be connected to the four signal systems. The four channels can be controlled by any four of the eight control units, or by fewer than four if any control unit is in multichannel operating mode.

2-15 KEYBOARD

The keyboard (see Figure 2-3) and associated joystick are the primary operator controls. All keyframe parameters are set using function keys, soft keys, and either numeric entry keypad or joystick. The following paragraphs describe each keyboard function.

2-16 Mode Select Keys

The following group of keys selects operating mode:

- SET-UP key selects setup mode. This mode includes engineering parameter adjustment (see paragraph 3-41) and disk formatting.
- PROG key selects program mode, used to specify keyframe parameters and create effects.
- RUN key selects run mode and enables ◄—, STOP, and —► keys. Effects are run or previewed in this mode.
- FREEZE key freezes and stores an image from incoming video. This mode allows the image to be transformed or modified as a still. Pressing FREEZE a second time unfreezes the image.

2-17 MORE Key

This key is used to select soft key menus in setup, program, and run modes. Pressing the key brings up new menus in sequence.

2-18 Run Mode Keys

The ◄— and —► keys control direction in which the effect runs. The STOP key stops the effect at any point while the effect is running. These keys are also used to scroll keyframes in program mode.

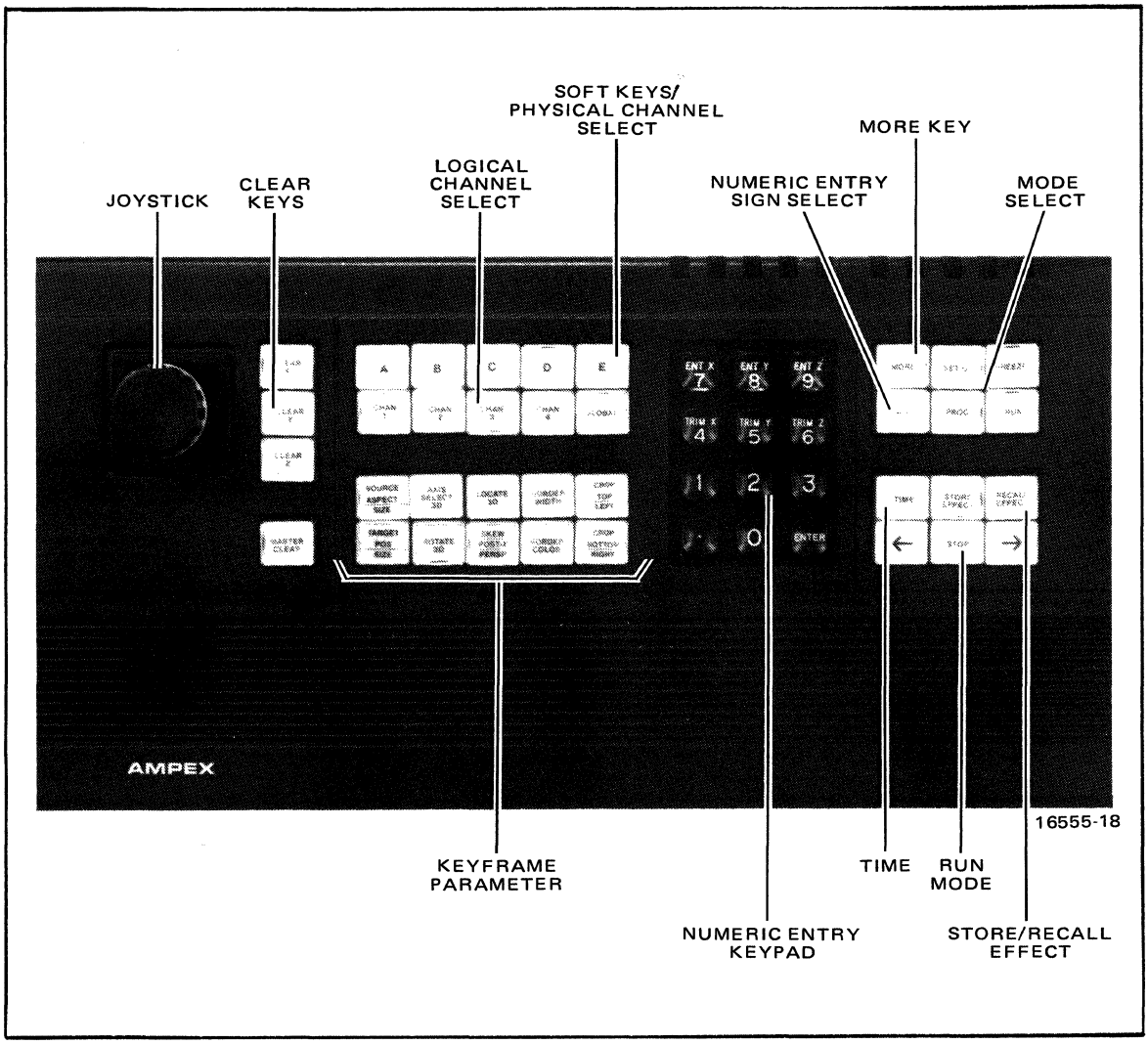


Figure 2-3. Keyboard

2-19 Logical Channel Select Keys

These keys select which channel is being programmed. The GLOBAL key selects global mode to control two or more channels simultaneously. Channel select keys are used in communications mode to acquire a signal system for control. In single channel systems, channel select keys give access to four different effects for storage or recall.

2-20 Soft Keys/Physical Channel Select Keys

Soft keys select operating modes, keyframe parameters, or other soft key menus. In addition, these keys select a physical signal system in communications mode.

2-21 Keyframe Parameter Keys

These 10 keys select keyframe parameters for modification in program mode.

2-22 Clear Keys

These four keys clear values entered for X, Y, and Z portions of the parameter selected currently.

- The CLEAR X key, in all keyframe parameters except ROTATE 3D, clears X value currently displayed to the system-assigned value (0.0).

  For ROTATE 3D parameter only, when pressed once, clears X axis to the nearest 90° point. When pressed again, clears axis to system-assigned value (0.0).

- The CLEAR Y key, in all keyframe parameters except ROTATE 3D, clears Y value currently displayed to the system-assigned value (0.0).

  For ROTATE 3D parameter only, when pressed once, clears Y axis to the nearest 90° point. When pressed again, clears axis to system-assigned value (0.0).

- The CLEAR Z key, for all keyframe parameters except ROTATE 3D, clears Z value currently displayed to the system-assigned value (0.0).

  For ROTATE 3D parameter only, when pressed once, clears Z axis to the nearest 90° point. When pressed again, clears axis to system-assigned value (0.0).

  The MASTER CLEAR key, when pushed once, clears all movement parameters programmed for the keyframe; when pushed twice, clears all keyframe parameters.

2-23 Store/Recall Effect Keys

These keys provide access to the disk drive so that new or modified effects can be stored or effects previously stored can be recalled. When either key is pressed, "Enter effect number:" appears at the bottom of the screen to prompt the operator to enter a number from the keypad. Store/recall effect keys are also used to store and recall setup parameters in setup mode.

2-24 Numeric Entry Keypad

This keypad is used to enter numeric values for keyframe parameters, set time duration values, enter and recall effects, and assign values to setup parameters. The 7, 8, and 9 keys also select X, Y, or Z values for entry. The 4, 5, and 6 keys also select X, Y or Z values for trimming. Parameters are trimmed by pressing the appropriate trim key and entering a value to be added to or subtracted from the original value. The trim value is added or subtracted when the ENTER key is pressed.

2-25 Numeric Entry Sign Select Key

This key changes the sign of the value entered on the numeric keypad from positive to negative. This function is not enabled in time entry.

2-26 TIME Key

Keyframe or effect duration is set by pressing the TIME key and then entering a value in seconds and frames from the keypad.

2-27 Soft Keys

Keys A through E are soft keys, so designated because their function changes with each mode. Soft key functions and menus are described in paragraph 2-37.

2-28 JOYSTICK

The joystick gives the operator manual control over keyframe and setup parameters and control over effect run mode.

In general, rightward joystick movement increases X values and leftward movement decreases X values. Upward joystick movement increases Y values and downward movement decreases Y values. Clockwise joystick knob rotation increases Z values; counterclockwise rotation decreases Z values.

In rotation, position, and size parameters the image moves in the same direction as the joystick.

Note

By contrast, left-right (X axis) joystick movement produces image rotation around the Y axis. Up-down (Y axis) joystick movement produces image rotation around the X axis. Similarly, X and Y numeric keypad entries produce Y and X axis rotation.

2-29 MENUS

Each screen display is termed a menu because it allows the operator to choose a mode or select a keyframe parameter for modification.

The following paragraphs describe each menu and point out features which are used to inform the operator of system operating conditions and modes in use.

2-30 Communications Mode Menu

This menu, shown in Figure 2-4, comes on the screen when the system is first turned on. The option matrix at the right of the display shows which options are installed in each signal system available to the operator. A *Y* means that the option is installed; an *N* means that the option is not installed. The options shown are:

- *IVP:* Input video processing option which gives mosaic and solarization capability.
- *GPKey:* The general-purpose key option which processes externally supplied key signals.
- *Opt 3* and *Opt 4* are future options.
- *Persp:* The perspective option, which gives an image three-dimensional qualities.
- *Rotat:* The image rotation option.

The routing matrix at the right of the menu displays the current status of each signal system in the system relative to each control unit. Refer to Figure 2-4.

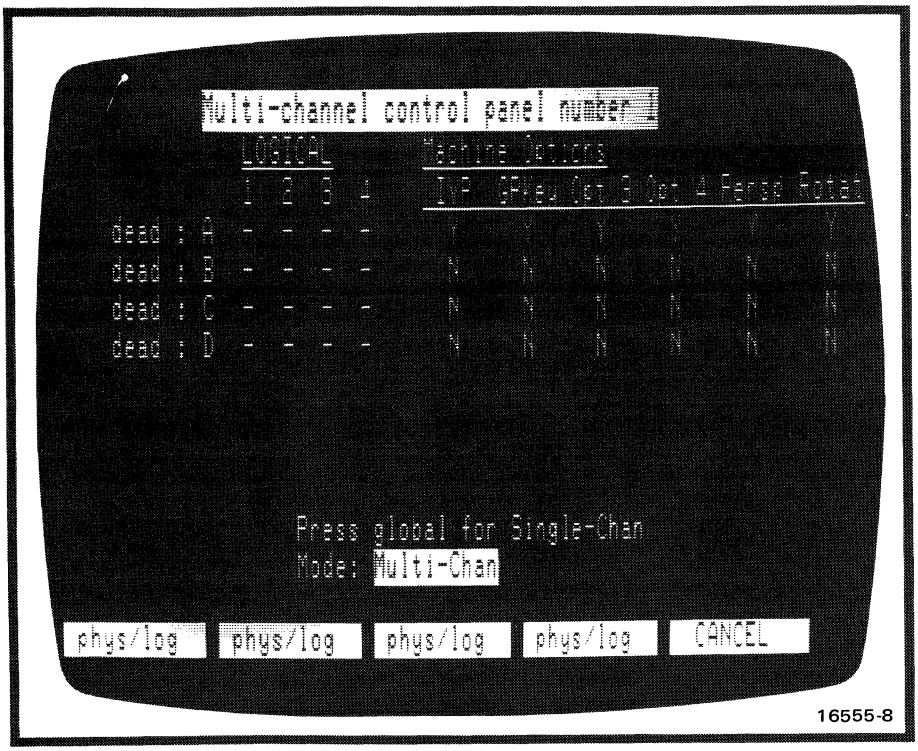


Figure 2-4. Communications Mode Menu

Each signal system can be in one of four states, listed at the left of the routing matrix: *free*, *acquired*, *busy N*, or *dead*.

- In *free* state, the physical signal system is available, and is not in use by any control unit. The corresponding horizontal row in the routing matrix contains four dashes.
- In *acquired* state, the physical signal system is under control of the control unit used to acquire the system. The corresponding horizontal row contains an X in the vertical column corresponding to the logical assignment of the signal system, and three dashes in the other columns.
- In *busy N* state, the physical signal system has been taken over by some other control unit, identified by N which is a number from 0 to 7. Each control unit has a number established by the setting of three internal switches.
- In *dead* state, either that physical signal system has its power turned off or the communication line to it from the control unit is not operating.

2-31 Set-Up Mode Menu

This menu, shown in Figure 2-5, shows engineering parameters used to adjust the system's video input and output circuits for nonstandard signal input timing or levels. The top line of the display shows the operating software version and date.

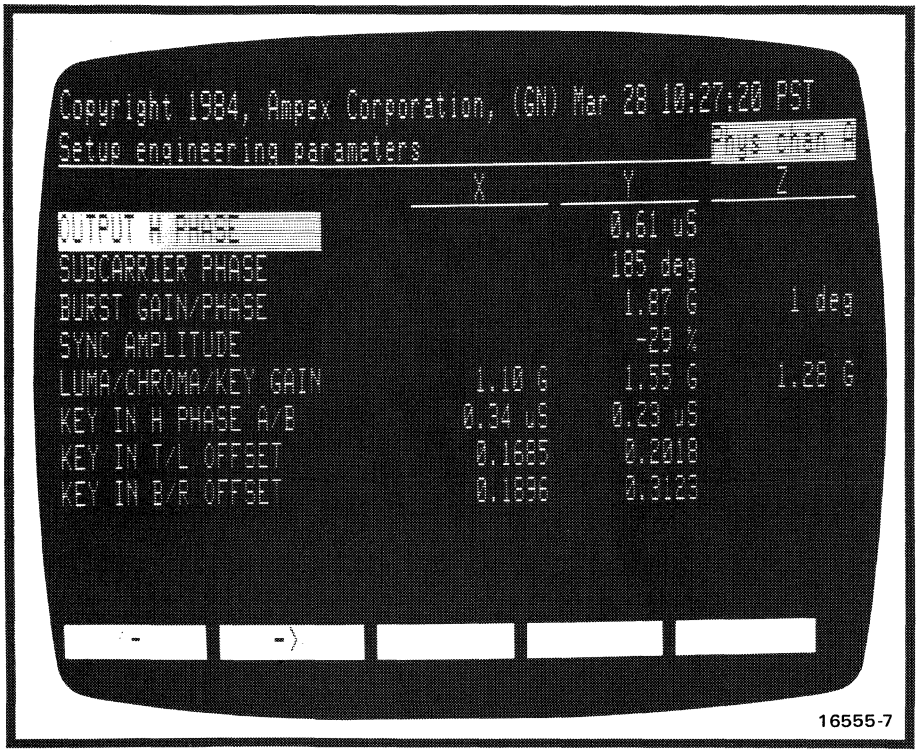


Figure 2-5. Setup Mode Menu

The physical channel (signal system) for which adjustment parameters are effective is shown at the upper right of the display.

The main body of the setup mode menu shows the parameters listed in Table 2-1 below.

Table 2-1. Setup Parameters

Setup Parameter	Function	Approximate Range	System-Assigned Value
OUTPUT H PHASE	Adjusts horizontal timing with respect to input video. In auto H-phase mode, adjusts horizontal timing with respect to reference.	±2 µs	0.00 µs
SUBCARRIER PHASE	Adjusts subcarrier phase of output video with respect to reference.	0°–360°	0°

(Continued next page)

Table 2-1. Setup Parameters (Continued)

Setup Parameter	Function	Approximate Range	System-Assigned Value
BURST GAIN	Adjusts burst amplitude; 1.00 is equal to 40 IRE units.	0–2.00	1.00
BURST PHASE	Adjusts burst phase with respect to reference video; adjusts burst phase quadrature 0°–360° in PAL systems.	0°–360°	0° NTSC 90° PAL
SYNC AMPLITUDE	Adjusts sync amplitude in percentage of peak white amplitude.	0–113%	-40%
LUMA GAIN	Adjusts level of input signal before digitizing circuits; used to normalize nonstandard input levels.	0.71–1.28	1.00
CHROMA GAIN	Adjusts level of input signal before digitizing circuits; used to normalize nonstandard input levels.	0.71–1.28	1.00
KEY GAIN	Adjusts level of key input signal in key processing circuits.	0.71–1.28	1.00
KEY IN H PHASE A/B	Adjusts horizontal phase of key signal with respect to output video.	±7.99 µs (X and Y)	0.00 µs
KEY IN TL OFFSET	Adjusts internal key generation timing to trim edges. Offset is in screen units (8 horizontally and 6 vertically). Offset is with respect to 50% levels of key output waveshape.	0–.9999 (X and Y)	0.1000 X 0.1000 Y
KEY IN BR OFFSET	Adjusts internal key generation timing edges. Offset is in screen units (8 horizontally and 6 vertically). Offset is with respect to 50% levels of key output waveshape. This is a source adjustment.	0–.9999 (X and Y)	0.1000 X 0.1000 Y
align stick	Soft key selects joystick alignment mode. Line on top row of display shows actual X, Y, and Z values for joystick position together with maximum and minimum values since **align stick** was pressed.		

2-32 Program Menu

This menu is the starting point for keyframe parameter entry and effect construction. The program menu comes in two versions: *show one* and *show many*. The *show one* version is illustrated in Figure 2-6. This version displays all parameters for one keyframe. The *show many* version displays one parameter for all keyframes. See Figure 2-7.

2-33 Show One Display

The *show one* display provides complete keyframe parameter information, including keyframe duration, source, cube, mirror, and freeze flags.

The top two lines of the display show:

- *Effect number:* The number assigned to an effect which has been recalled from a disk.
- *Keyframe:* Identifies keyframe for which parameters are displayed.
- *TIME* display: Shows keyframe beginning time in seconds and frames.
- *DURAT* display: Shows keyframe duration in seconds and frames.
- *SOURCE* display: Shows video source for keyframe: A, B, A/B auto, or B/A auto.

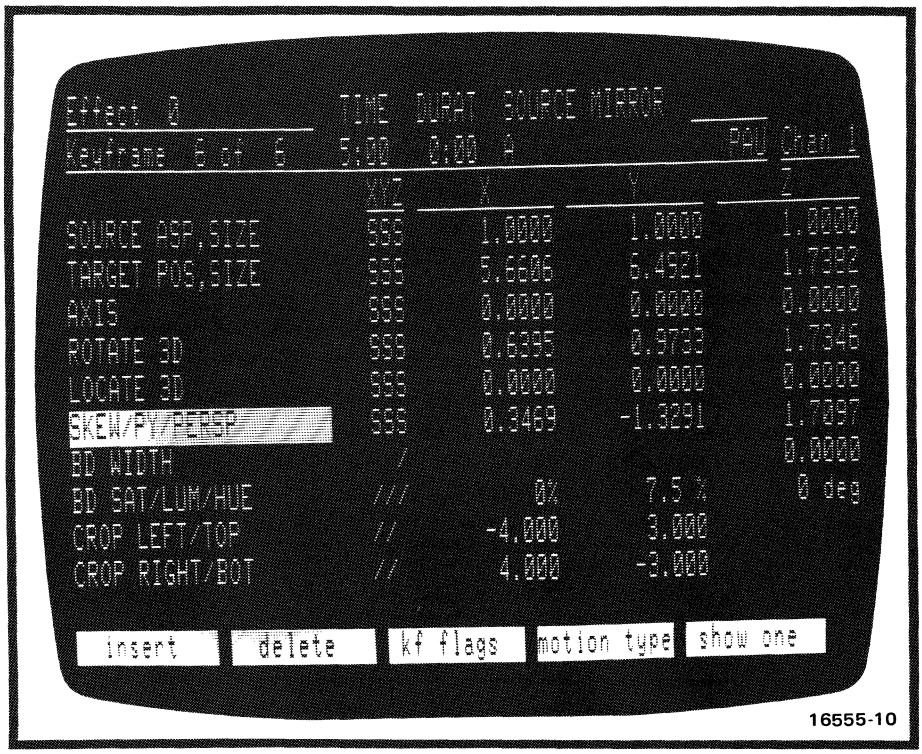


Figure 2-6. Program Menu—Show One Version

- *MIRROR:* Shows mirror flags: Ax, Ay, Axy, Bx, By, or Bxy.
- *CUB:* Indicates that auto cube mode is enabled.
- *NOG:* Indicates that global mode is disabled (no global).
- *FRZ:* Shows that the freeze flag is set for this keyframe.
- *Channel* display: Shows which logical channel is being programmed.

The main body of the display shows keyframe parameters. Image transformation parameters are listed in the column at the left of the display. Values assigned to each parameter are shown in the center of the display.

- The column labeled *XYZ* shows motion type selected for size, location, and rotation parameters. An S indicates smooth motion, a / indicates linear motion, and a — indicates hold. Reverse video around the motion symbol indicates a break is set.

2-34 Show Many Display

This display shows one parameter for all keyframes. Many, but not all, of the items displayed on the *show one* display are included in the *show many* display.

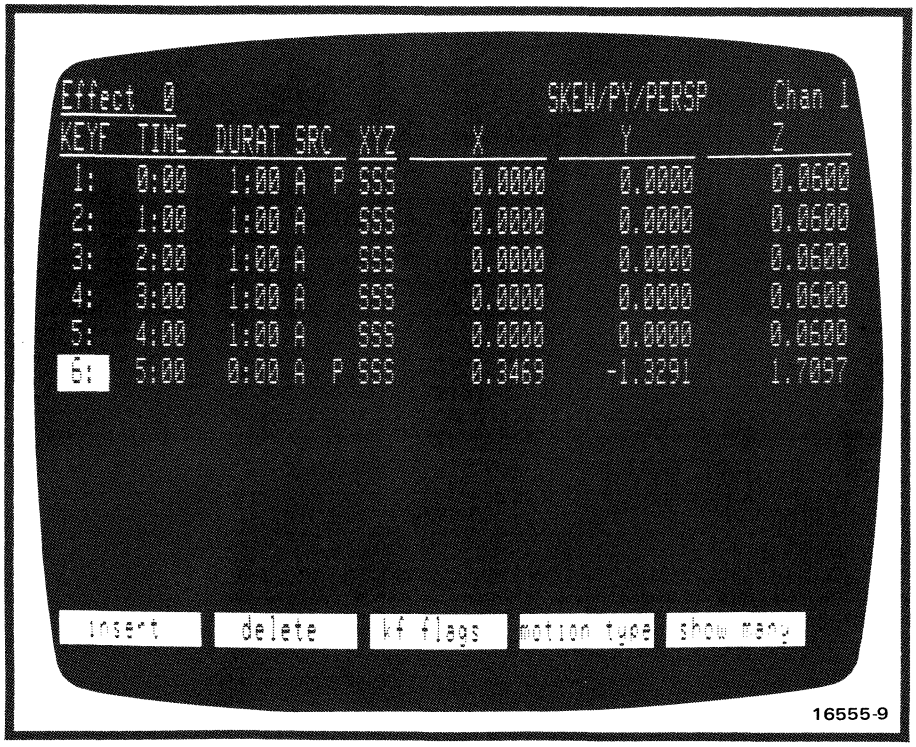


Figure 2-7. Program Menu—Show Many Version

The top line of the display lists effect number, transformation parameter (TARGET POS, SIZE in Figure 2-7), and channel selected. The second display line shows:

- *KEYF:* The keyframe number. Reverse video block indicates keyframe is enabled for entry from keypad or for modification by joystick movement. Use ◄—— and ——► keys to scroll display.
- *TIME:* Indicates time at which keyframe starts in effect.
- *DURAT:* Indicates keyframe duration.
- *SRC:* Shows image source; A, B, A/B auto, or B/A auto. An F indicates that a freeze flag is set.
- *XYZ:* Shows motion type selected for size, location, and rotation parameters. An S indicates smooth motion, a / indicates linear motion, and a —indicates hold. Reverse video around the motion symbol indicates a break is set.

2-35 Global Mode Menu

Pressing GLOBAL in program mode brings up the global menu shown in Figure 2-8. This menu is similar to the program menu shown in Figure 2-6, but only three parameters are used: global axis (axis select 3D), global rotate 3D, and global locate 3D. The global menu is used to set keyframe parameters for global effects. Soft key menus are the same as those described in paragraph 2-39.

2-36 Run Mode Menu

This menu, shown in Figure 2-9, is used when running or editing effects. The display shows run mode parameters such as effect starting time, ending time, and length.

The lines at the top of the display show times at which pauses are set.

The next line of the display identifies the effect to be run by showing effect number and name assigned.

Physical channels currently in use are shown in the next line of the display.

Multi-Channel and *single-channel*, shown in reverse video, indicate which mode of operation is in use.

The two lines at the bottom of the display show effect start time, end time, and length. These values can be modified at any time before or after the effect is run.

The effect status display in the lower portion of the menu gives a visual indication of effect timing. The line of dots represents effect length. The asterisk represents the current position on the effect time line. The letter X represents pauses programmed.

A time display above the line of dots shows the current position, in seconds and frames, on the effect time line. A line of arrows extending to the left and right of the time display indicates run direction and speed. In run mode, joystick movement

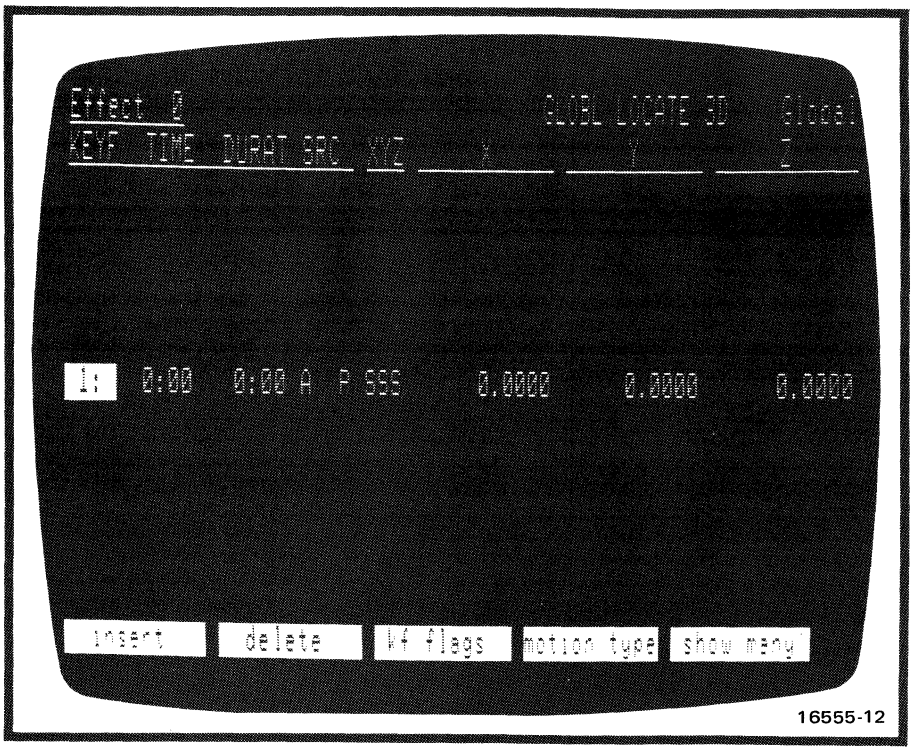


Figure 2-8. Global Mode Menu

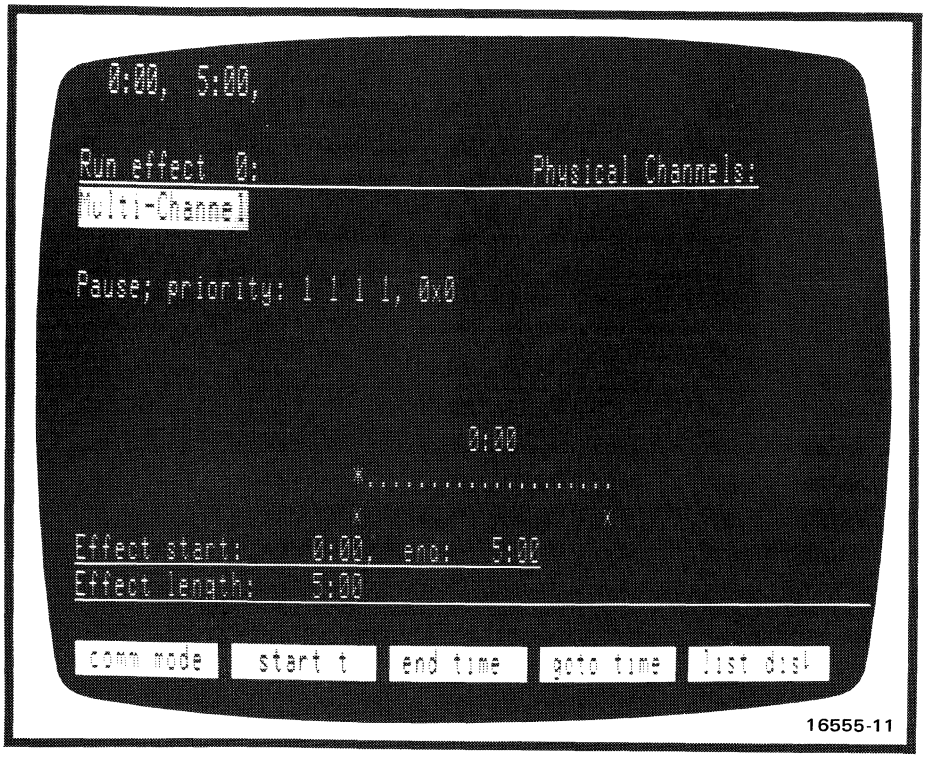


Figure 2-9. Run Mode Menu

in the Y direction runs the effect forward or in reverse. The greater the movement from center, the faster the effect runs. Near center, the effect runs at 2 to 3 frames/second. At the extremes of joystick movement, the effect runs at approximately 30 frames/second. The length of the line of arrows indicates run speed.

2-37 Soft Key Menus

Subsidiary soft key menus are associated with the menus described in previous paragraphs. Soft key functions appear at the bottom of the menu display and correspond to keys A through E on the keyboard.

Note

In descriptions of soft keys and soft key menus, soft keys are printed in boldface. Other keys on the keyboard are ALL CAPITALS.

All soft keys have repeat function. When key is held down for more than 2 seconds, the function repeats. This continues as long as the key is held down.

2-38 Setup Mode Soft Keys

Setup mode has three soft key menus, reached by pressing MORE key. The first menu consists of:

- ← and →keys select the setup parameter for adjustment. The selected parameter is highlighted with reverse video.

A second menu is reached by pressing MORE:

- **comm mode** soft key selects communications mode, described in paragraph 2-30.
- **align stick** brings up joystick alignment display, used to adjust joystick A/D converter. Refer to Table 2-1.
- **disk stat** brings up disk test display.

Pressing MORE again brings up the third soft key menu, consisting of:

- **format disk** is used to format new disks for use in storing effects.
- **disk store** is used to store setup parameters on a disk. STORE EFFECT key is used to store setup parameters in the control unit's internal non-volatile memory.
- **list disk** brings up directory of effects stored on a disk. See Figure 2-10. The directory shows effect number in the first column, effect length in the second column, and effect name, if any, in the third column. The next five columns list the number of keyframes stored in on-line memory for channels 1 through 4 and global. The column at far right lists keyframes using the ADO Concentrator.

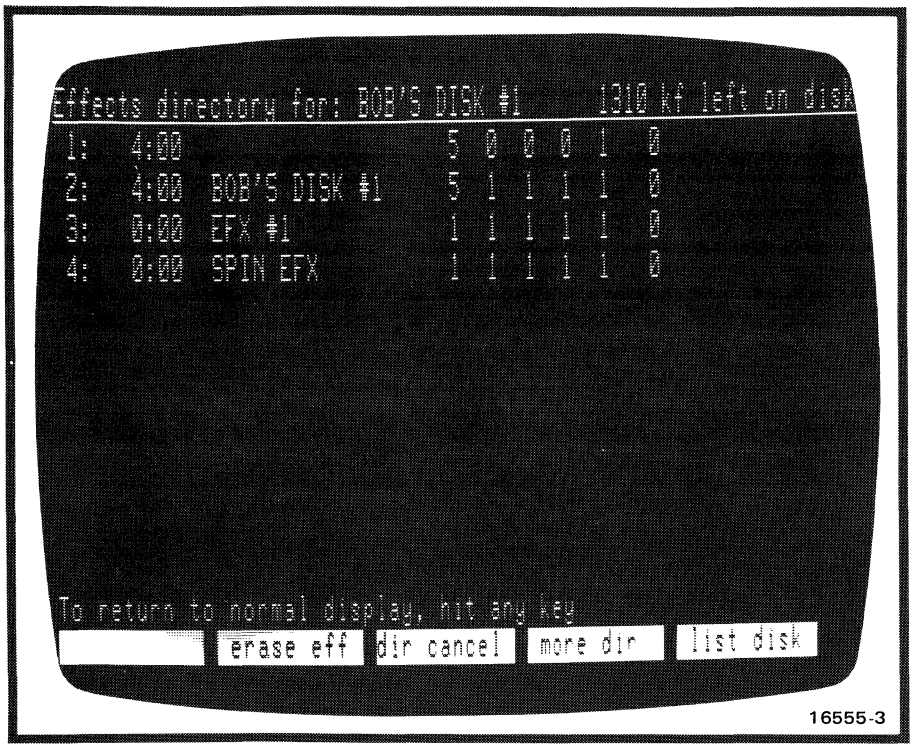


Figure 2-10. List Disk Menu

2-39 Program Mode Soft Keys

The initial soft key menu, which appears after PROG key is pressed, shows the following:

- **insert** duplicates the current keyframe, placing the duplicate immediately after the current keyframe. The keyframe just inserted becomes the current keyframe.
- **delete** removes the current keyframe from the effect.
- **keyf flags** brings up the keyframe flags menu (see Figure 2-11) and a soft key menu consisting of:

  ← and → keys select which keyframe is to be modified.

  change selects new value for flag in selected keyframe.

  all changes flag in all keyframes.

- **motion type** brings up the motion type soft key menu, consisting of:

  set enters motion type chosen with other soft keys on the motion type menu.

  all keyf sets motion type for all keyframes in effect. Pressing **all keyf** soft key changes key display to **this keyf**, which sets motion type for this keyframe only.

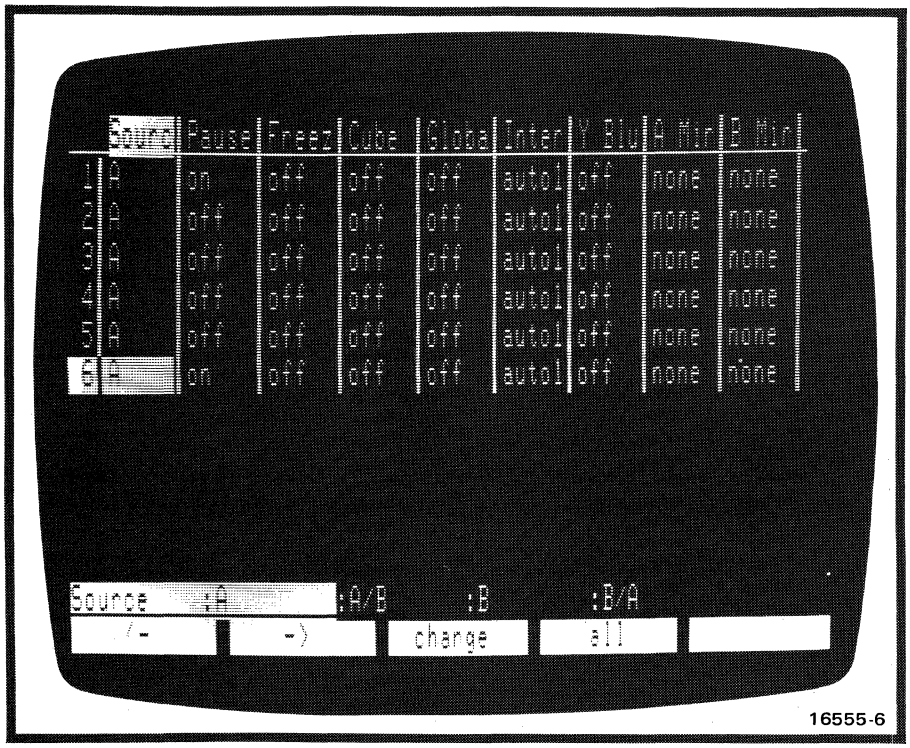


Figure 2-11. Keyframe Flags Menu

all numbers sets motion type for X, Y, and Z axes in all keyframe parameters. Pressing **all numbers** soft key brings up **X,Y,Z** soft key which sets motion type for all three axes in the selected keyframe. Pressing this key again brings up **X**, **Y**, and **Z** soft keys in turn. These keys set motion type for X, Y, and Z axes individually.

smooth selects smooth motion between keyframes; pressing this soft key again brings up **linear**, which gives abrupt motion between keyframes. Pressing this key again brings up **hold**, which pauses the effect briefly at each keyframe.

no break selects motion without breaks at keyframes. Pressing **no break** brings up **break** soft key, which selects movement breaks at each keyframe.

- **show one** indicates that show one display is on the screen. Press **show one** to bring up **show many** soft key and display. Refer to paragraphs 2-33 and 2-34.

Pressing MORE brings up a second soft key menu consisting of

- **save→mem** stores the current keyframe in memory (but not on the disk). Pressing this key writes over any keyframe stored previously. Keyframe data is lost when power is turned off at the control panel.
- **get←mem** recalls keyframe stored in memory previously, writing it into the current keyframe.
- **grid, nr** brings up the grid and noise reduction soft key menu.

grid pos brings up channel grids menu (see Figure 2-12) to allow setting grid position.

grid space brings up the channel grids menu; if menu is on screen, enables grid spacing for entry of spacing value.

no grids disables grid functions. Pressing **no grids** brings up **source grids** for grid in source space. Pressing **source grids** brings up **target grid** for grids in target space. Pressing **target grid** brings up **safe area** for rectangle outlining picture area available for effects.

no id, disables source channel identification on video monitor. Pressing **no id** brings up **id,** which enables function.

more grid brings up a subsidiary menu consisting of:

NR selects noise reduction to reduce noise visible in image. Pressing **NR** brings up **no NR** to disable noise reduction function.

white selects white grid lines. Pressing **white** brings up **invert,** which provides inverted video grid lines for easier viewing in images with large amounts of white space.

- **enter name** brings up menu shown in Figure 2-13. Use this menu to assign names to disks before formatting or to effects before storing them on a disk.

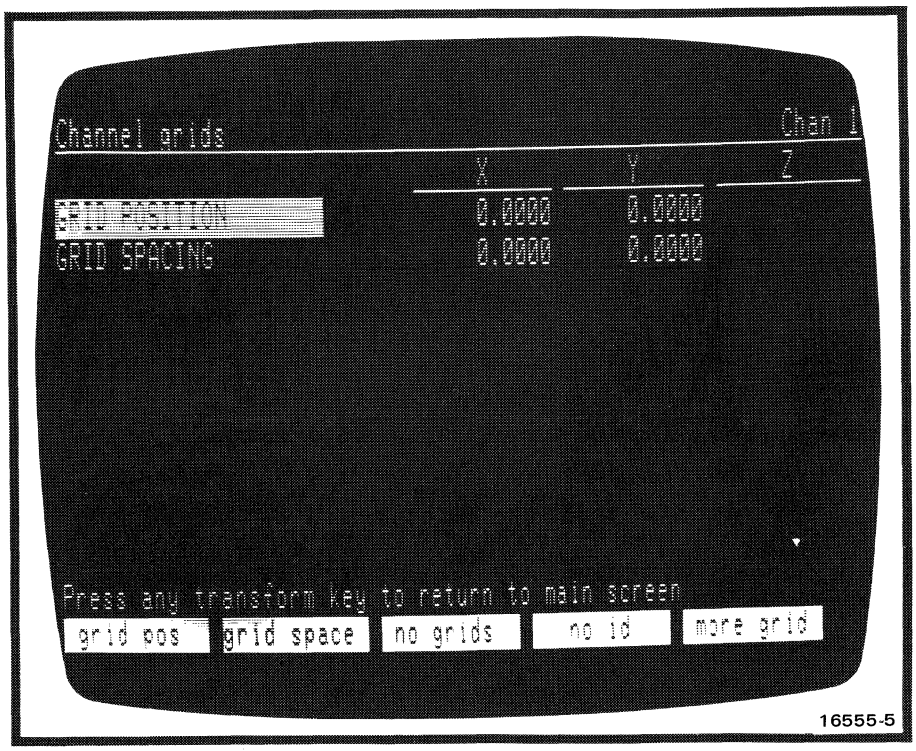


Figure 2-12. Channel Grids Menu

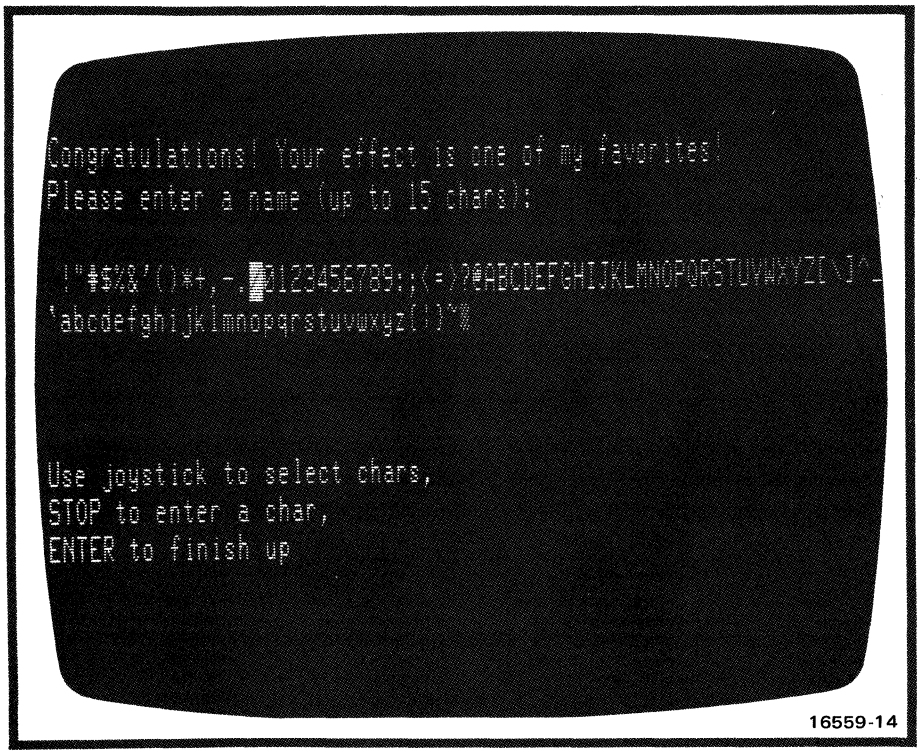


Figure 2-13. Enter Name Menu

- **delete all** deletes all keyframes in the effect under assembly on the current channel. Pressing **delete all** again deletes all keyframes on all channels.

Pressing MORE brings up a third soft key menu:

- **iv parms** brings up input video parameters display (see Figure 2-14) and a soft key menu consisting of:

  ← and → select mosaic and solarization parameters. Refer to paragraphs 3-38 and 3-39 for a complete description of these functions.

- **motion type** brings up the motion type soft key menu, consisting of:

  set enters motion type chosen with other soft keys on the motion type menu.

  all keyf sets motion type for all keyframes in effect. Pressing **all keyf** soft key changes key display to **this keyf**, which sets motion type for this keyframe only.

  all numbers sets motion type for X, Y, and Z axes in all keyframe parameters. Pressing **all numbers** soft key brings up **X,Y,Z** soft key which sets motion type for all three axes in the selected keyframe. Pressing this key again brings up **X**, **Y**, and **Z** soft keys in turn. These keys set motion type for X, Y, and Z axes individually.

  smooth soft key is not operational in input video parameters mode; pressing this soft key brings up **linear**, which gives abrupt motion between keyframes.

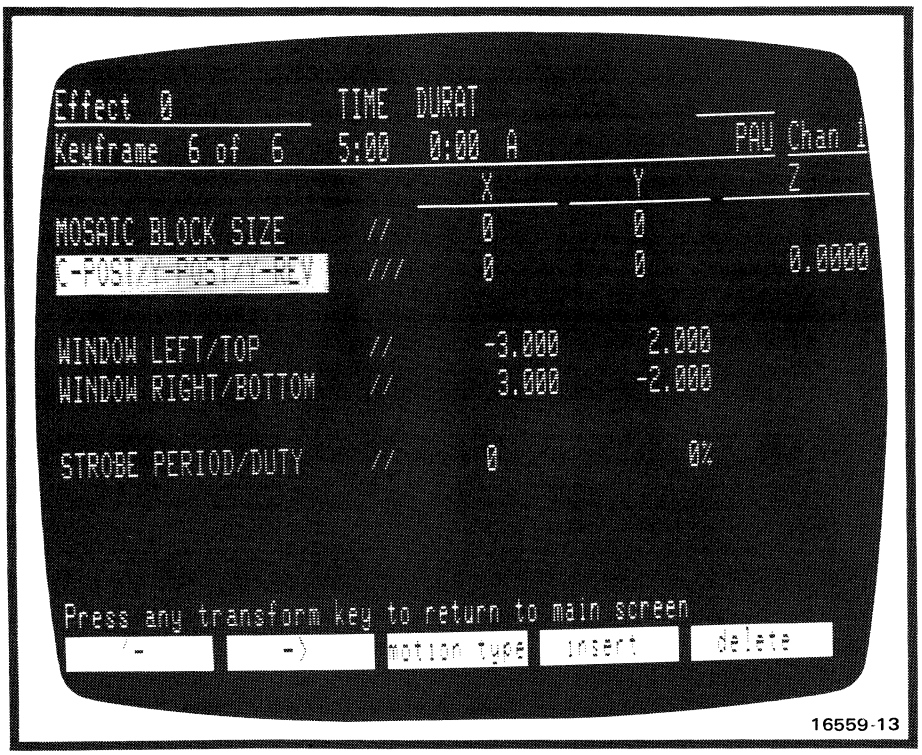


Figure 2-14. Input Video Parameters Menu

Pressing this key again brings up **hold,** which pauses the effect briefly at each keyframe transition.

no break selects motion without breaks at keyframe transitions. Pressing **no break** brings up **break** soft key, which selects breaks at each keyframe transition.

- **insert** duplicates the current keyframe, placing the duplicate immediately after the current keyframe. The keyframe just inserted becomes the current keyframe.
- **delete** removes the current keyframe from the effect.
- **iv flags** brings up input video flags menu (see Figure 2-15) and a soft key menu consisting of:

  ← and → keys select the flag parameter for change. The selected parameter is highlighted with reverse video.

  change selects new value for flag in selected keyframe.

  all changes flag in all keyframes.

- **key control** brings up key control display (see Figure 2-16) and a soft key menu consisting of:

  ← and → keys select the key parameter for change. The selected parameter is highlighted with reverse video.

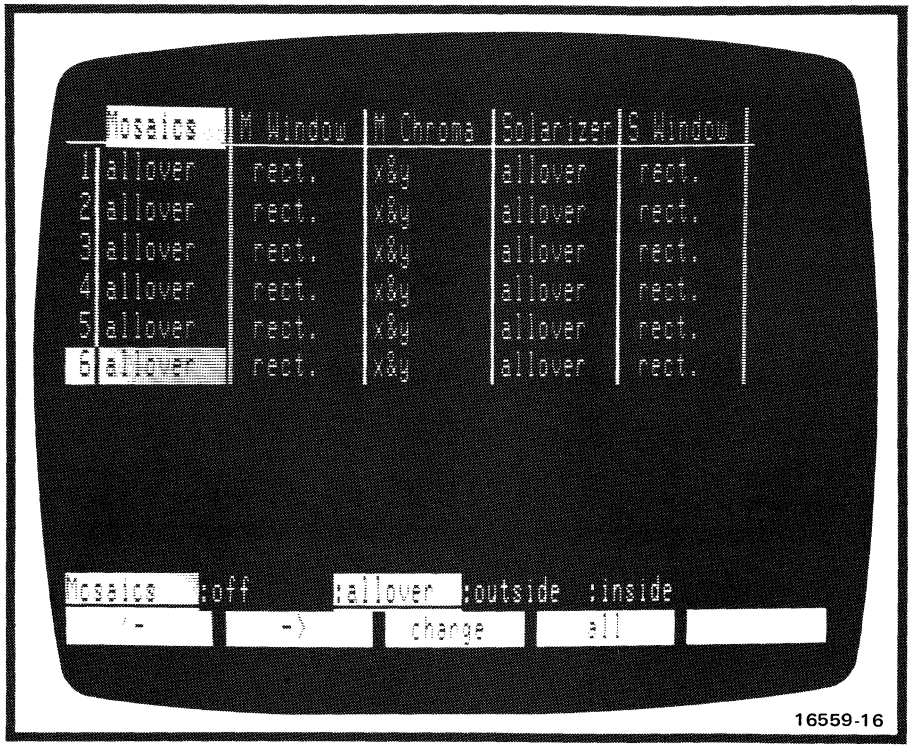


Figure 2-15. Input Video Flags Menu

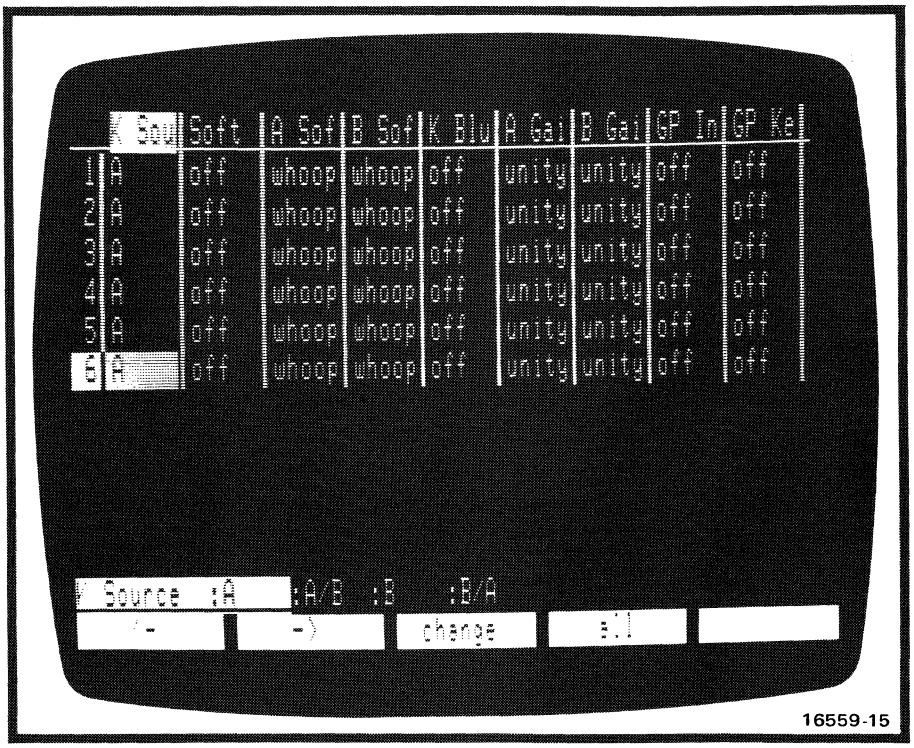


Figure 2-16. Key Control Display

change selects new value for flag in selected keyframe.

all changes flag in all keyframes.

Pressing MORE brings up the fourth and last soft key menu, consisting of:

- **comm mode** soft key selects communications mode, described in paragraph 2-30.
- **erase eff** deletes an effect from the disk. See paragraph 3-33.
- **list disk** brings up directory of effects stored on a disk.

Key control functions are described in paragraph 3-41.

2-40 Run Mode Soft Keys

Pressing RUN brings up the first run mode soft key menu, showing:

- **comm mode** soft key selects communications mode, described in paragraph 2-30.
- **start t** allows an effect start time to be changed temporarily from the 0:00 value set by the system at the first keyframe in an effect. When **start t** is pressed, the effect start value on the display flashes. Entering a value from the keypad moves the effect position asterisk to the new start point and places a dot underneath the effect time line. (Refer to Figure 2-9.) The effect moves to the keyframe corresponding to the new time, as well.
- **end time** allows an effect end time to be changed temporarily from the value set for the last keyframe in an effect. When **end time** is pressed, the effect end value on the display flashes. Entering a value from the keypad moves the effect position asterisk to the new end point and places a dot underneath the effect time line. The effect moves to the keyframe corresponding to the new time, as well.
- **goto time** allows the operator to move to any point on the effect time line. When **goto time** is pressed, "enter goto time:" appears on the display. Entering a time value in seconds and frames moves the effect position asterisk to the selected time. The image also changes to its new position in the effect. A warning message appears if the value chosen is beyond effect start or end (temporary values included).
- **list disk** brings up directory of effects stored on a disk.

Pressing MORE brings up a second soft key menu, showing:

- **add pause** inserts a pause. Use **goto time** or the joystick to move to the point required and press **add pause** to insert the pause.
- **del pause** deletes pauses on the effect time line. Either pauses programmed originally or those inserted temporarily can be deleted.
- **priority** sets image priority for multichannel effects using the ADO Concentrator.
- **go next** moves the effect to the next pause or priority event on the effect time line. The image also changes to its new position in the effect.

2-41 MENU ROAD MAP

Figure 2-17 is a graphic presentation of soft key menus, showing how each menu can be reached from any other menu.

2-42 FLOPPY DISKS

The system uses 5-1/4-in., single-sided, double-density, soft-sectored floppy disks to store effects. Disks must be inserted with write protect notch up and with read/write access slot toward the drive. See Figure 2-18.

Each disk supplied with the system has a write protect notch which prevents data from being overwritten accidentally. To protect data on the disk, a tape strip (supplied) must be placed over the notch. Remove tape strip to enable the disk for data recording.

2-43 Disk Handling and Storage

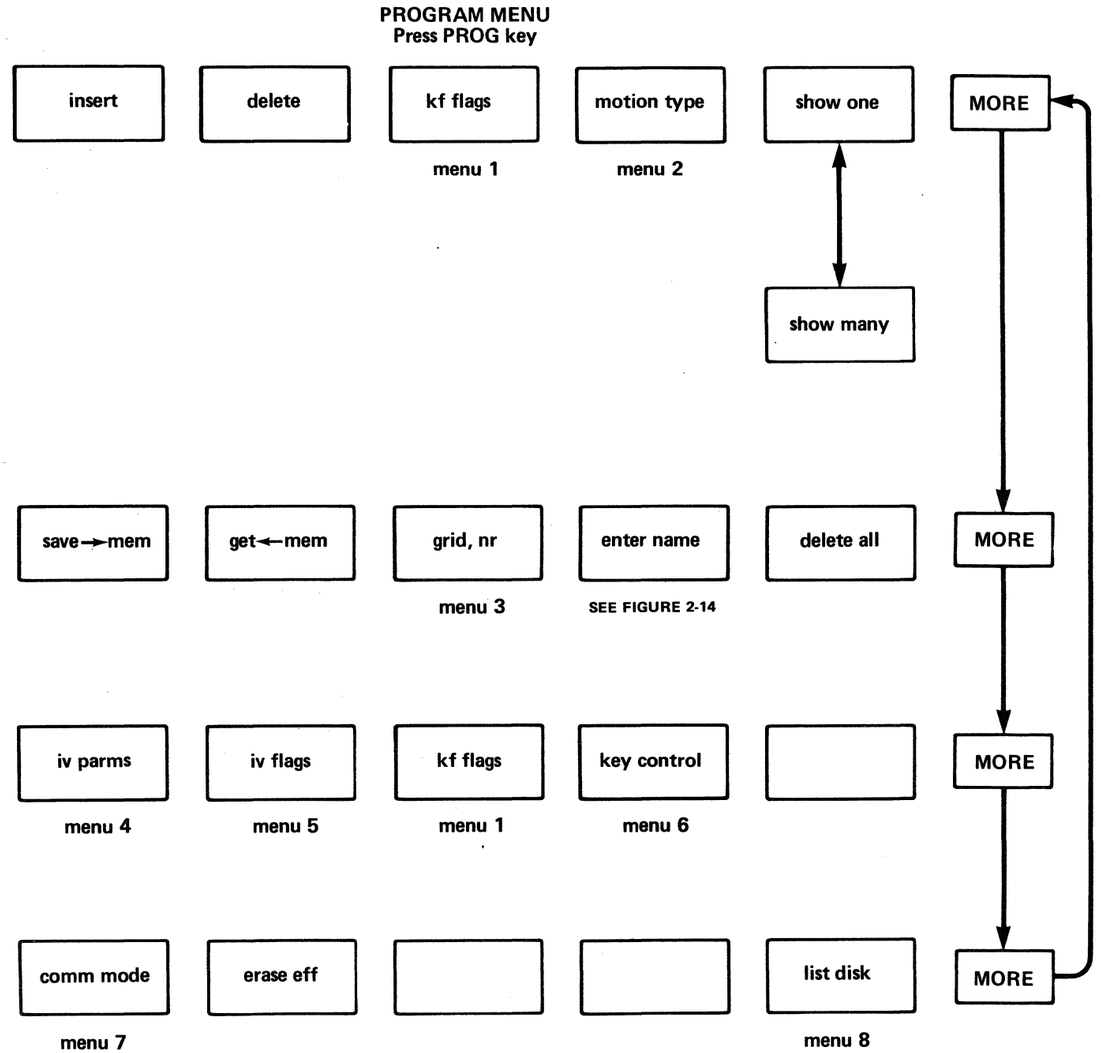
Disks are critical to storing and recalling effects. Disks must be handled and stored properly to ensure that their contents are not damaged or destroyed. Be sure to follow the precautions below. Also see Figure 2-19.

- Do not touch disk surface; hold disk only by edges or labels. Fingerprints or dust may cause errors.
- Do not turn disk drive power on or off with disks inserted; you may destroy data on the disk.
- Do not use alcohol, Freon, or thinners to clean disk.
- Do not use magnets or magnetized objects near disk. Magnetic fields erase or distort data on the disk.
- Do not bend or fold disk.
- Do not place heavy objects on disk.
- Do not use rubber bands or paper clips on disk.
- Do not write on disk label with pencil or ballpoint pen; use felt tip pen only.
- Do not use erasers on disk.
- Do not apply labels on top of other labels.
- Keep disk in protective envelope when not in use.
- Disks not in use should be stored vertically in a dust-free, covered container.
- Do not expose disk to sunlight or excessive heat.
- Operating environment:

  Temperature: 10° C to 50° C (50° F to 122° F)

  Wet Bulb Temperature: Less than 29° C (84° F)

  Relative Humidity: 20% to 80%



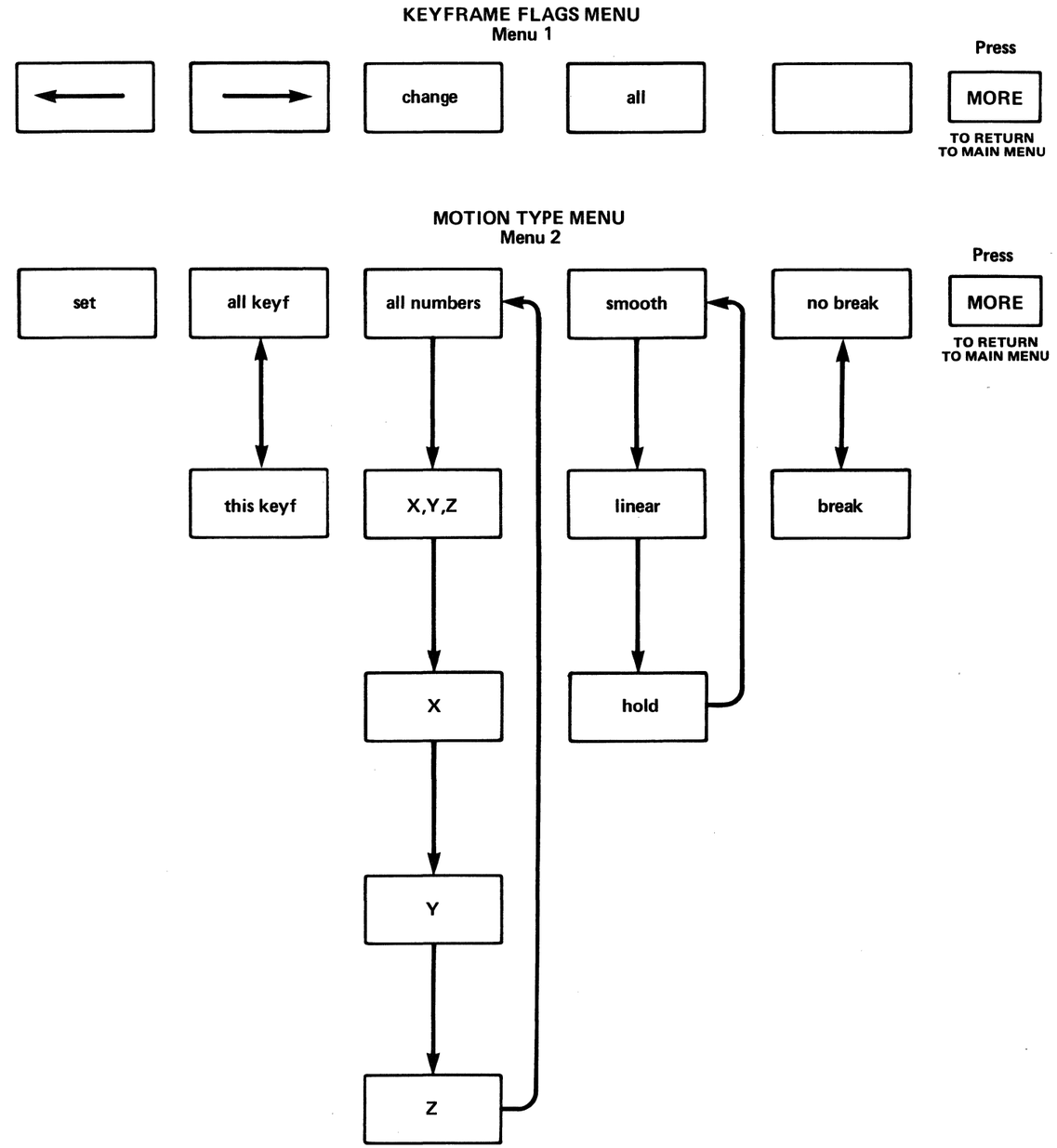
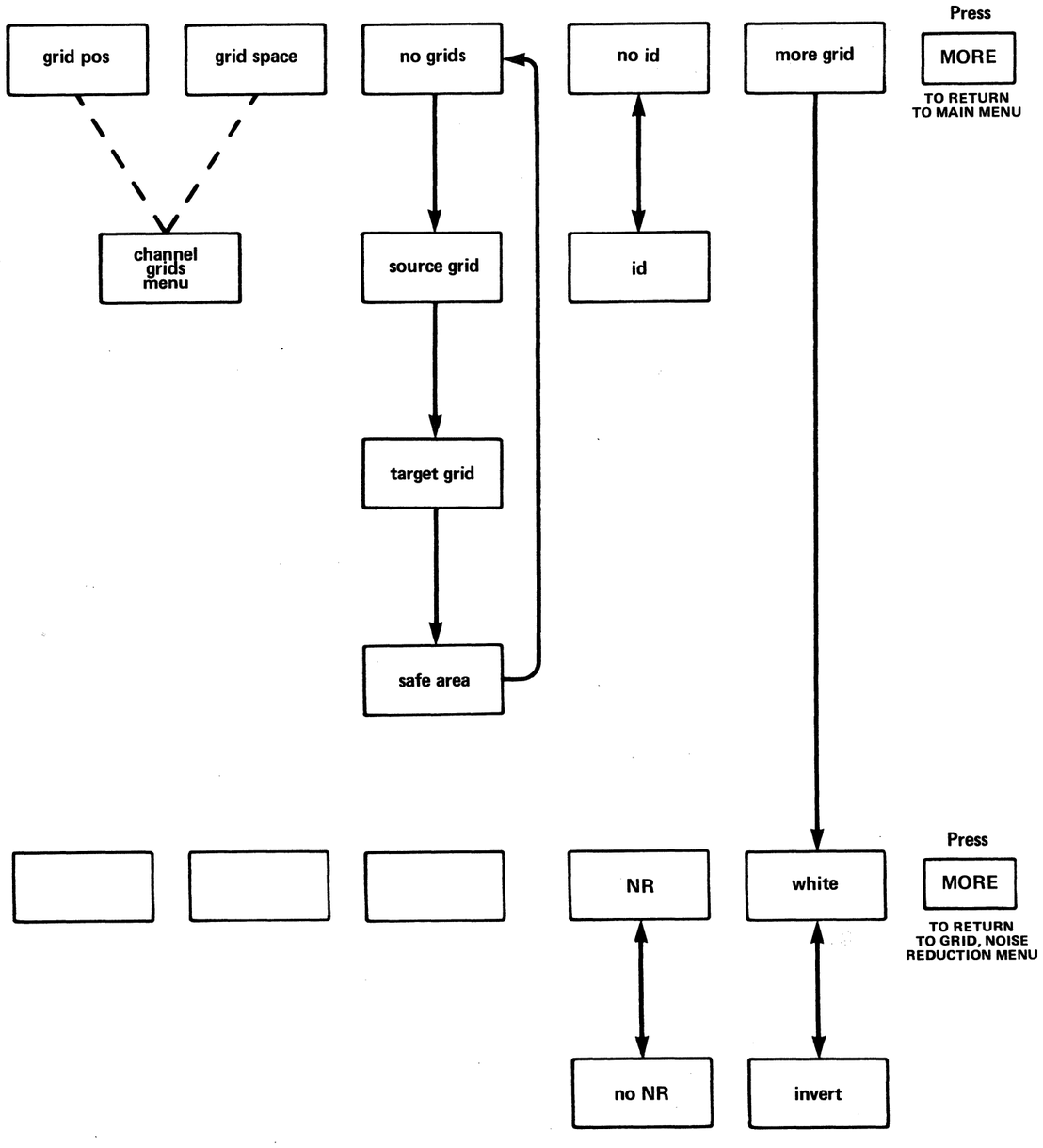
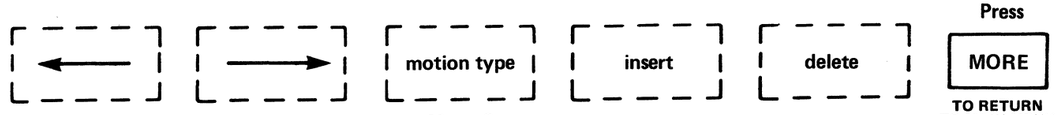


Figure 2-17.
Menu Road Map (1 of 3)

GRID, NOISE REDUCTION MENU
Menu 3

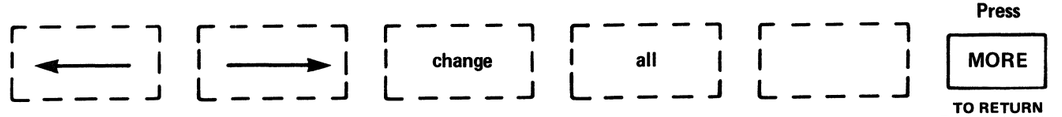


INPUT VIDEO PARAMETERS MENU
Menu 4

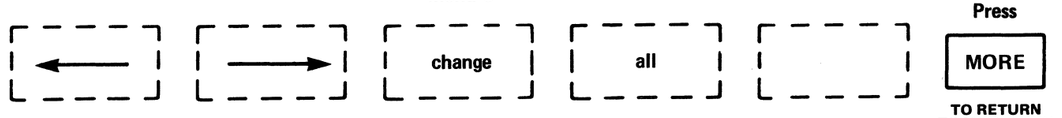


Menu 2

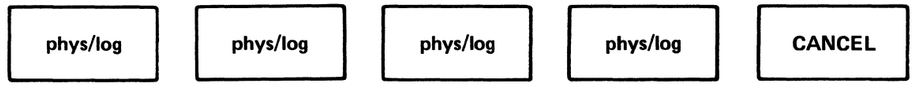
INPUT VIDEO FLAGS MENU
Menu 5



KEY CONTROL MENU
Menu 6



COMMUNICATIONS MODE MENU
Menu 7



LIST DISK MENU
Menu 8

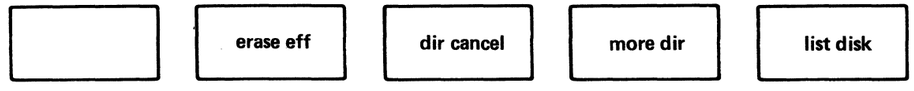
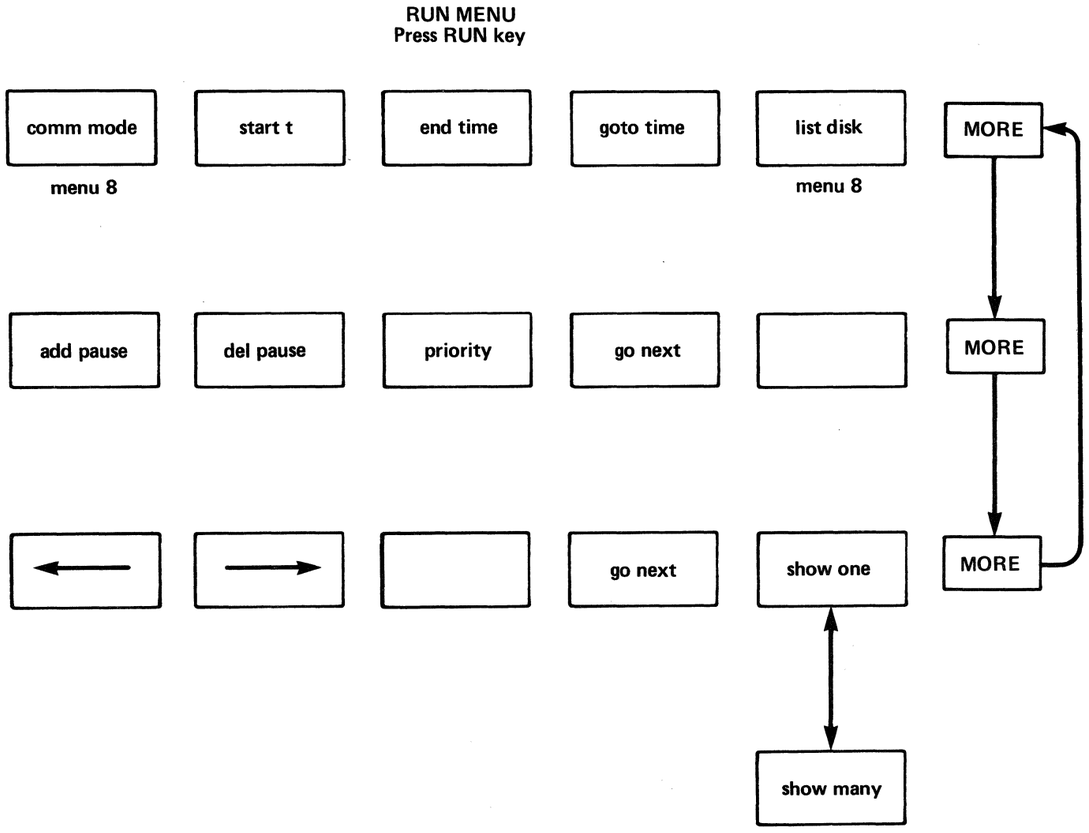


Figure 2-17.
Menu Road Map (2 of 3)



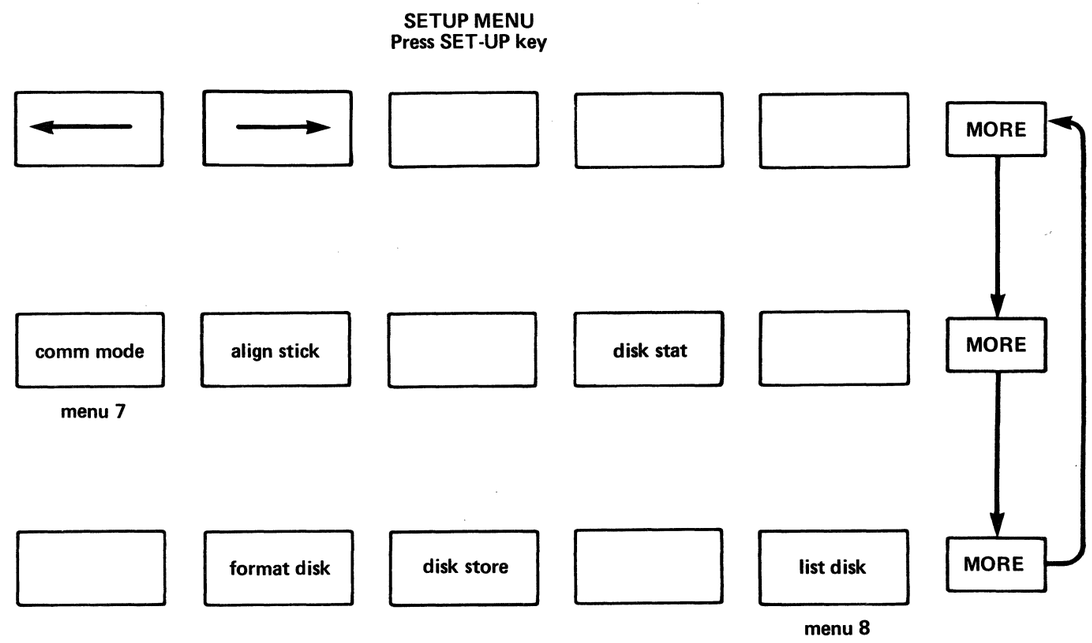


Figure 2-17.
Menu Road Map (3 of 3)

- Storage environment:
  Temperature: 4° C to 53° C (40° F to 127° F)
  Relative Humidity: 8% to 80%
- Transit environment (stored in a protective box):
  Temperature: -40° C to 53° C (-40° F to 127° F)
  Relative Humidity: 8% to 90%

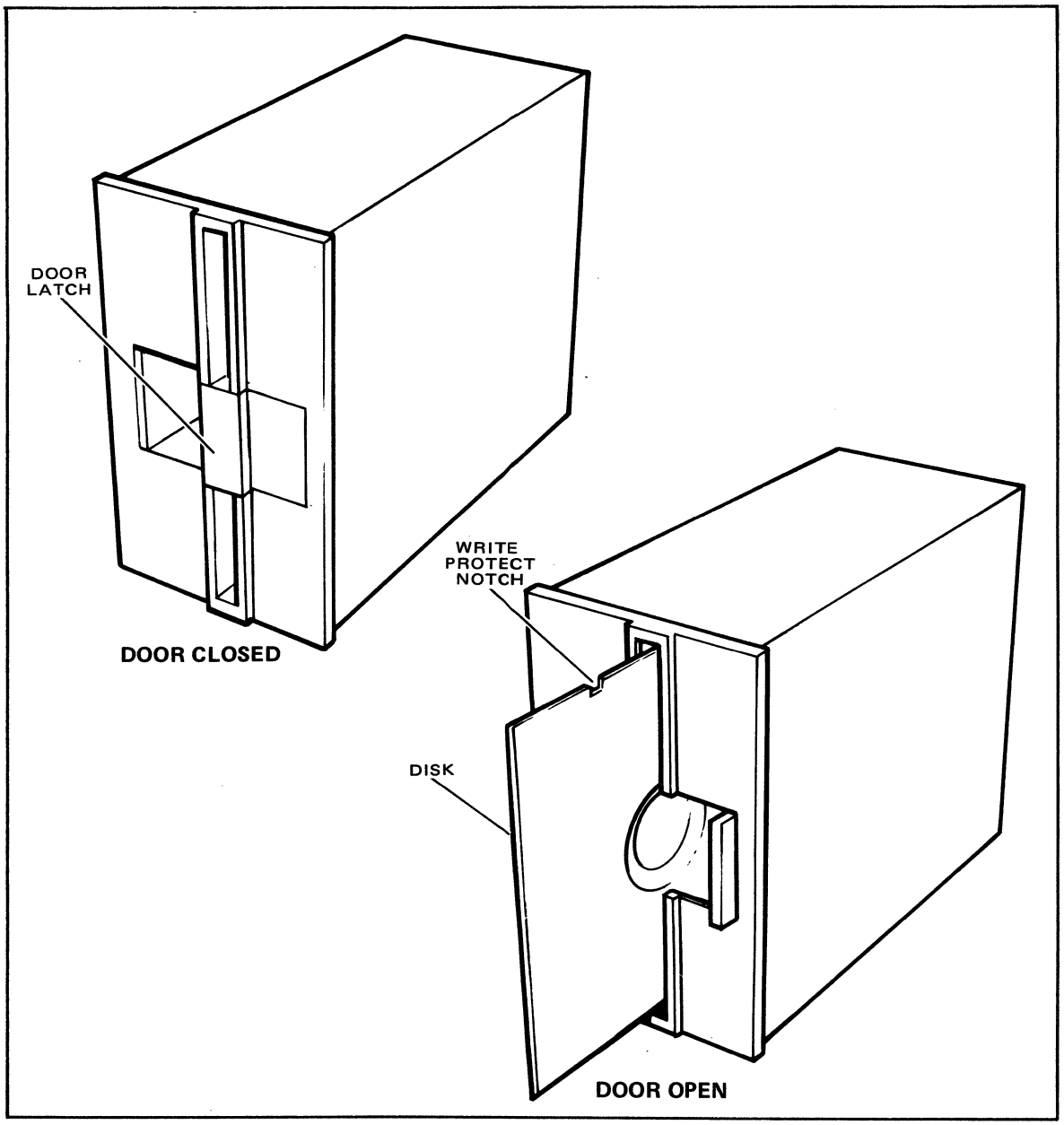


Figure 2-18. Inserting Disk in Disk Drive

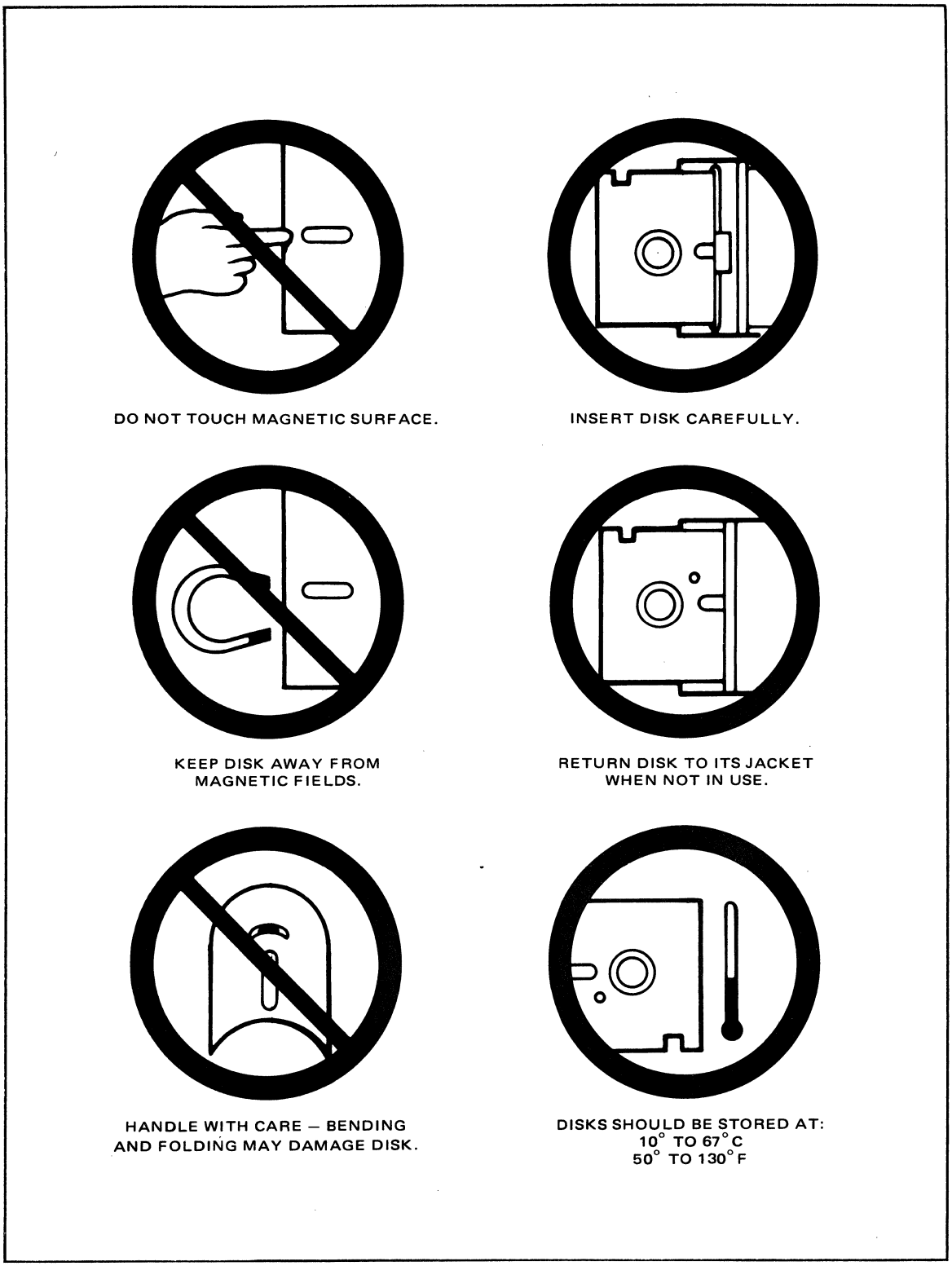


Figure 2-19. Disk Handling and Storage

2-44 Formatting Disks

Every new disk must be formatted before it can be used. Old disks containing effects that are no longer needed can also be reformatted, if the disks are not damaged.

CAUTION

BEFORE REFORMATTING AN OLD DISK, BE SURE ITS EFFECTS ARE NO LONGER NEEDED. REFORMATTING DESTROYS ALL DATA RECORDED PREVIOUSLY.

Use the procedure below to format or reformat a disk and assign a name to the disk. If you don't wish to name the disk, skip steps 2 and 3.

STEP 1 Put disk in drive with read-write slot toward drive and write protect notch up.

STEP 2 From program menu, press MORE and then **enter name** soft key. A menu with instructions and two rows of alphanumeric characters appears on the screen. Refer to Figure 2-13.

STEP 3 Use the joystick or the ← and → keys to move the cursor horizontally from one character to another. To reach lower row of display, go beyond left- or right-most character with joystick or ← and → keys. Press STOP to enter each character in the name as you spell it out. The space character is at the far left of the top line of characters (it shows as a space in the line). The character chosen appears at the top line on the screen. When the entire name has been spelled out, press ENTER to enter the disk name in a temporary name register.

STEP 4 Press SET-UP twice. The first soft key menu appears at the bottom of the screen.

STEP 5 Press MORE twice. A soft key menu with **format disk** at the left appears at the bottom of the display.

STEP 6 Press **format disk** soft key. A warning message, **"Hit format again to re-format: effects will be lost"**, appears. Press **format disk** soft key again; formatting begins automatically and continues for about 20 seconds. During this time the red indicator on the disk drive comes on. When formatting is completed, the red indicator on the disk drive goes out.

STEP 7 If more disks are to be formatted, remove the newly formatted disk from the drive, put in the next disk, and press **format disk** soft key. If formatting is finished, press PROG to return to the program menu.

SECTION 3
OPERATING PROCEDURES

3-1 INTRODUCTION

This section outlines procedures for creating, editing, and running effects. The first portion of this section describes initial turn-on and signal system acquisition. The second section describes basic effects-positioning, rotating, and moving images. The third portion gives typical procedures for using ADO's advanced effect capability—multichannel effects, three-dimensional solids, mosaic, posterization, and keys. The last portion describes engineering setup adjustments.

3-2 GETTING STARTED

Before turning on the system, be sure that all power and signal cables are connected properly. Turn on power to all signal systems, any Hub Box accessories, the ADO Concentrator, if installed, and all control panels. Figure 3-1 shows the location of power switches in all units, as well as the location of the control unit CRT display brightness control.

3-3 ACQUIRING A SIGNAL SYSTEM

The system comes up in communications mode at turn-on. This mode permits any logical (programmed) channel to acquire any physical (signal-system) channel. From communications mode, press PROG to reach the main program menu, and then MORE once or twice to reach subsidiary program menus. In communications mode, a menu containing a routing matrix appears on the display. This matrix displays the current status of each signal system in the system relative to each control unit. See Figure 3-2.

Each signal system can be in one of four states, listed at the left of the routing matrix: *free, acquired, busy N, or dead.*

- In *free* state, the physical signal system is available, and is not in use by any control unit. The corresponding horizontal row in the routing matrix contains four dashes.
- In *acquired* state, the physical signal system is under control of the control unit used to acquire the system. The corresponding horizontal row contains an X in the vertical column corresponding to the logical assignment of the signal system, and three dashes in the other columns.
- In *busy N* state, the physical signal system has been taken over by some other control unit, identified by N which is a number from 0 to 7. Each control unit has a number established by the setting of three internal switches.

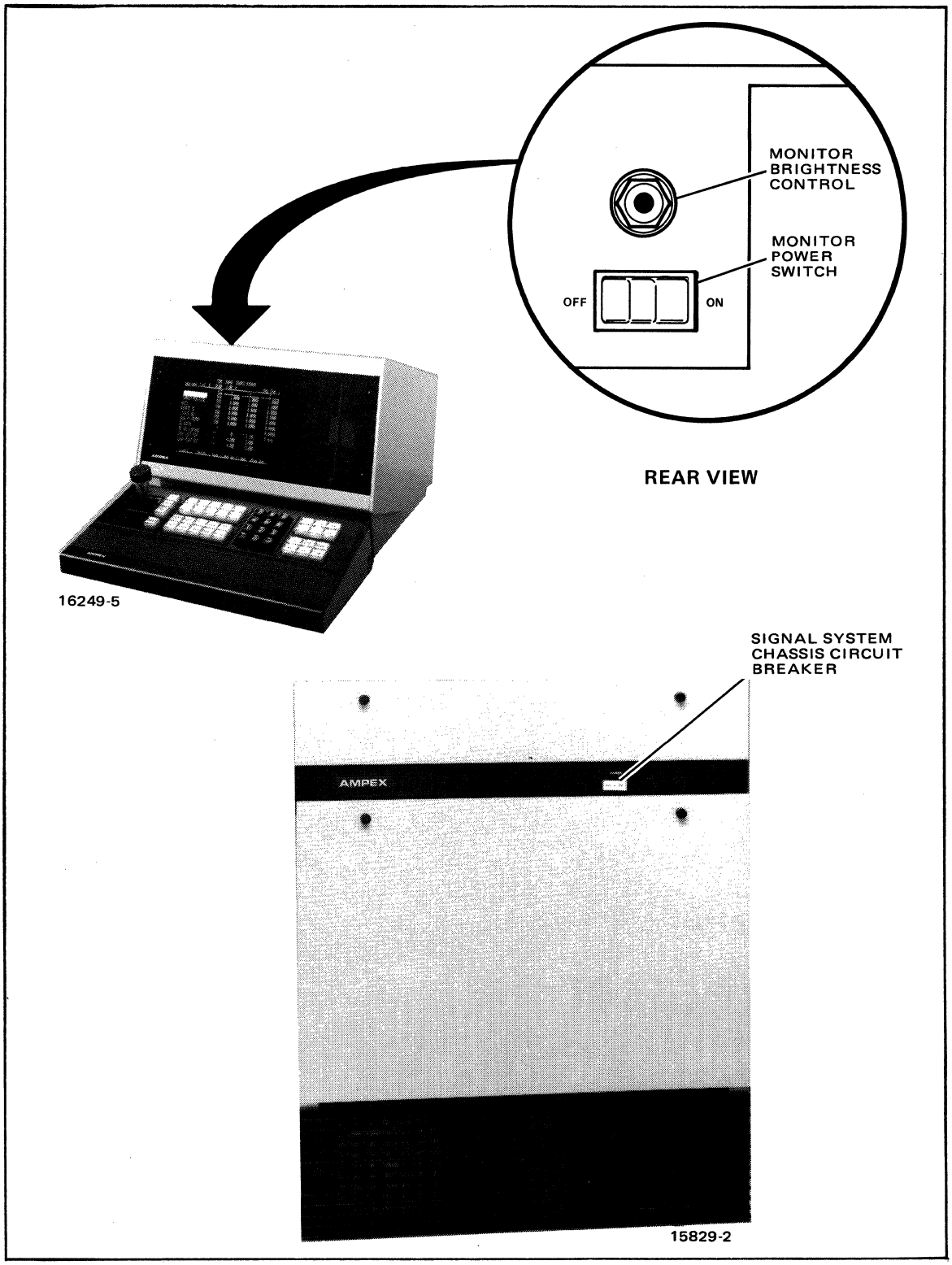


Figure 3-1. Power Switch Locations

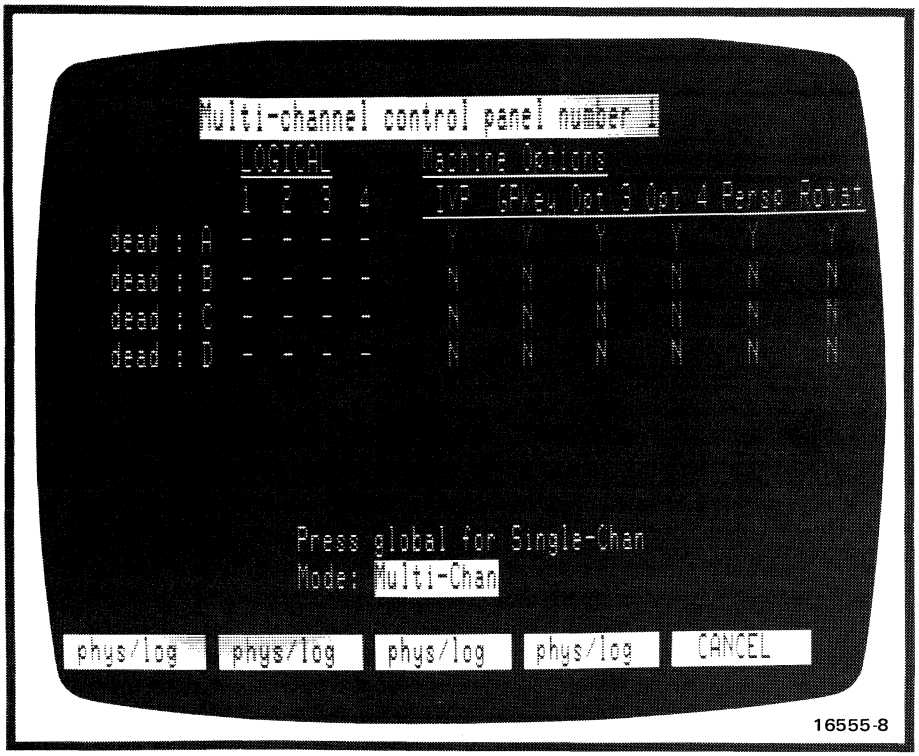


Figure 3-2. Communications Mode Display

- In *dead* state, either that physical signal system has its power turned off or the communication line to it from the control unit is not operating.

To acquire one or more signal systems for control:

STEP 1 Enter communications mode and verify from the matrix that the desired signal system or systems are free.

STEP 2 Press the soft key whose letter corresponds to the desired physical signal system. The corresponding row in the matrix begins blinking.

STEP 3 Select the logical channel (the channel programmed for the effect) by pressing the CHANNEL key whose number corresponds to the channel to be used. An X appears at the intersection of the selected row and column, and the new state appears on the routing matrix, showing *acquired* for the physical channel just acquired. All other control units show *busy N* for the channel.

STEP 4 Repeat steps 1--3 for additional signal systems if required.

To redesignate a signal system or channel choice, press **cancel** soft key or press the chosen row or column key. To release an acquired channel, press the corresponding channel key.

By pressing the GLOBAL key in communications mode, you can switch between single-channel and multichannel modes. If you have a single-channel system, you do not have multichannel control; auto-cube and multiple control panel modes are not available. All menu displays indicate single-channel capability only.

If you operate in multichannel mode, then you may have only one multichannel effect in memory at one time. If you operate in single-channel mode, then your control panel may have up to four single-channel effects in memory at one time. These four effects are accessed by pressing channel keys A through D. Other differences between single- and multichannel modes are discussed in paragraph 3-30 of this guide.

3-4 BASIC EFFECTS

The following paragraphs describe simple effects such as making horizontal, vertical, and diagonal moves, reducing images in size, and rotating images around one axis. In later paragraphs we describe how to combine keyframes, edit effects, and create multichannel effects.

3-5 Positioning Images

These procedures demonstrate horizontal (X-axis) and vertical (Y-axis) movement.

3-6 Horizontal Movement

This procedure demonstrates horizontal image movement.

STEP 1 Acquire a signal system as described in paragraph 3-3.

STEP 2 Press PROG key and then SOURCE ASPECT/SIZE key.

STEP 3 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 4 Press TARGET POS/SIZE key.

STEP 5 Press ENT X key. Note that X value on display flashes. Press 4 and then ENTER keys to move image to right side of picture monitor.

STEP 6 Press **insert** soft key.

STEP 7 Press ENT X, +/-, 4, and then ENTER keys to move image to left side of picture monitor.

STEP 8 Press ← key to change menu display to keyframe 1.

STEP 9 Press TIME key. Note that keyframe duration (DURAT) value flashes. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 10 Press RUN to bring up run mode menu.

STEP 11 Press ⟶ key. The image on the monitor should move from right to left, taking 5 seconds to cross the screen.

3-7 Vertical Movement

This procedure demonstrates vertical image movement.

STEP 1 Press PROG key and then SOURCE ASPECT/SIZE key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 5 Press TARGET POS/SIZE key.

STEP 6 Press ENT Y key. Note that Y value on display flashes. Press 3 and then ENTER keys to move image to top of picture monitor.

STEP 7 Press **insert** soft key.

STEP 8 Press ENT Y, +/-, 3 and then ENTER keys to move image to bottom of picture monitor.

STEP 9 Press ⟵ key to change display to keyframe 1.

STEP 10 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 11 Press RUN to bring up run mode menu.

STEP 12 Press ⟶ key. The image on the monitor should move from top to bottom, taking 5 seconds to cross the screen.

3-8 Diagonal Movement

This procedure combines vertical and horizontal movement to demonstrate diagonal image movement.

STEP 1 Press PROG key and then SOURCE ASPECT/SIZE key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 5 Press TARGET POS/SIZE key.

STEP 6 Press ENT Y key. Press 3 and then ENTER keys to move image to top of picture monitor.

STEP 7 Press ENT X key. Press 4 and then ENTER to move image to right side of monitor.

STEP 8 Press **insert** soft key.

STEP 9 Press ENT Y, +/-, 3 and then ENTER keys to move image to bottom of picture monitor.

STEP 10 Press ENT X, +/-, 4 and then ENTER keys to move image to left side of monitor.

STEP 11 Press ← key to change menu display to keyframe 1.

STEP 12 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 13 Press RUN to bring up run mode menu.

STEP 14 Press → key. The image on the monitor should move diagonally from top right to bottom left, taking 5 seconds to cross the screen.

3-9 Zooming Images

This procedure demonstrates apparent movement of an image from a distance toward the viewer.

STEP 1 Press PROG key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press LOCATE 3D key.

STEP 5 Press ENT Z key. Press . (decimal point), 1, and then ENTER keys to move image to a distance away from the viewer.

STEP 6 Press **insert** soft key to add a keyframe.

STEP 7 Press ENT CLEAR Z key to move image to normal viewing distance.

STEP 8 Press **show one** soft key.

STEP 9 Press ← key to change menu display to keyframe 1.

STEP 10 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 11 Press RUN to bring up run mode menu.

STEP 12 Press → key. The image on the monitor should appear to move from a distance toward the viewer, taking 5 seconds to make the move.

3-10 Combining Diagonal Movement and Zooming

This procedure combines diagonal movement and zooming to give the effect of an image crossing the screen and moving from a distance to the foreground.

STEP 1 Press PROG key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 5 Press TARGET POS/SIZE key.

STEP 6 Press ENT Y key. Press 3 and then ENTER keys to move image to top of picture monitor.

STEP 7 Press ENT X key. Press 4 and then ENTER to move image to right side of monitor.

STEP 8 Press LOCATE 3D key.

STEP 9 Press ENT Z key. Press 5, 0, and then ENTER keys to move image to a distance away from the viewer.

STEP 10 Press **insert** soft key.

STEP 11 Press ENT Y, +/-, 3 and then ENTER keys to move image to bottom of picture monitor.

STEP 12 Press ENT X, +/-, 4 and then ENTER keys to move image to left side of monitor.

STEP 13 Press CLEAR Z key to move image to normal viewing distance.

STEP 14 Press ← key to change menu display to keyframe 1.

STEP 15 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 16 Press RUN to bring up run mode menu.

STEP 17 Press ⟶ key. The image on the monitor should move diagonally from top right to bottom left and zoom toward the viewer, taking 5 seconds to cross the screen.

3-11 Rotating Images

The following procedures demonstrate image rotation.

3-12 Y-Axis Rotation

This procedure demonstrates Y-axis rotation. Note that rotation around the Y axis is done by changing X values or by moving the joystick left or right.

STEP 1 Press PROG key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 5 Press ROTATE 3D key.

STEP 6 Press **insert** soft key.

STEP 7 Press ENT X key. Press 3 and then ENTER keys to rotate image three complete revolutions.

STEP 8 Press⟵ key to change menu display to keyframe 1.

STEP 9 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 10 Press RUN to bring up run mode menu.

STEP 11 Press ⟶ key. The image on the monitor should rotate, taking 5 seconds to complete three complete revolutions.

STEP 12 Return to program mode by pressing PROG key.

STEP 13 Use ⟶ key to go to keyframe 2.

STEP 14 Press SKEW/POST-Y/PERSP key.

STEP 15 Enter a Y value of 1 from the keypad.

STEP 16 Return to run mode and run effect again. Note that image rotates around both X and Y axes simultaneously.

3-13 X-Axis Rotation

This procedure demonstrates X-axis rotation. Note that rotation around the X axis is done by changing Y values or by moving the joystick up or down.

STEP 1 Press PROG key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 5 Press ROTATE 3D key.

STEP 6 Press **insert** soft key.

STEP 7 Press ENT Y key. Press 3 and then ENTER keys to rotate image three complete revolutions.

STEP 8 Press ← key to change menu display to keyframe 1.

STEP 9 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 10 Press RUN to bring up run mode menu.

STEP 11 Press → key. The image on the monitor should rotate, taking 5 seconds to make three revolutions.

3-14 Z-Axis Rotation

This procedure demonstrates rotation around the Z-axis, giving the appearance of a spinning image.

STEP 1 Press PROG key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 4 Press MORE key three times to bring up initial soft key menu.

STEP 5 Press ROTATE 3D key.

STEP 6 Press **insert** soft key.

STEP 7 Press ENT Z key. Press 3 and then ENTER keys to rotate image three complete revolutions.

STEP 8 Press ← key to change menu display to keyframe 1.

STEP 9 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 10 Press RUN to bring up run mode menu.

STEP 11 Press → key. The image on the monitor should rotate, taking 5 seconds to make three revolutions.

3-15 Rotation with Horizontal Movement

This procedure demonstrates combined image rotation and horizontal movement.

STEP 1 Press PROG key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 5 Press TARGET POS/SIZE key.

STEP 6 Press ENT X key. Press 4 and then ENTER keys to move image to right side of picture monitor.

STEP 7 Press **insert** soft key.

STEP 8 Press ENT X, +/-, 4 and then ENTER keys to move image to left side of monitor.

STEP 9 Press ROTATE 3D key.

STEP 10 Press ENT Z, 3, and ENTER keys to rotate image three complete revolutions.

STEP 11 Press ← key to change menu display to keyframe 1.

STEP 12 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 13 Press RUN to bring up run mode menu.

STEP 14 Press ⟶ key. The image on the monitor should rotate and move from right to left, taking 5 seconds to cross the screen.

3-16 Rotation with Axis Shifted

This procedure shifts the axis of rotation to give the effect of an image rotating, as a page of a book being turned.

STEP 1 Press PROG key.

STEP 2 Press MORE key and then **delete all** soft key to clear previous keyframes.

STEP 3 Press MORE key three times to bring up initial soft key menu.

STEP 4 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 5 Press AXIS SELECT 3D key.

STEP 6 Press ENT X key. Press +/-, 3, and then ENTER keys to shift X axis to left of picture monitor.

STEP 7 Press **insert** soft key.

STEP 8 Press ROTATE 3D key.

STEP 9 Press ENT X, 3, and ENTER keys to rotate image three complete revolutions.

STEP 10 Press ⟵ key to change menu display to keyframe 1.

STEP 11 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 12 Press RUN to bring up run mode menu.

STEP 13 Press ⟶ key. The image on the monitor should rotate around the displaced Y axis, appearing as a page of a book being turned. Three complete revolutions should take 5 seconds.

3-17 KEYFRAME FLAGS

The examples given previously used only two keyframes—beginning and end—to define an effect. In practice, an effect usually consists of many keyframes. Although keyframes are usually related, entirely different transformations can be programmed for each keyframe. For example, in one keyframe an image can zoom in from the background. In the next keyframe the image can rotate. In the next keyframe the image can be switched to another video source, and in a final keyframe the image can be frozen.

The following procedures demonstrate the use of keyframe flags.

3-18 Setting a Source Flag

This procedure demonstrates how to program an effect which moves an image from right to left, changing image sources at midscreen.

STEP 1 Acquire a signal system as described in paragraph 3-3.

STEP 2 Press PROG key and then SOURCE ASPECT/SIZE key.

STEP 3 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 4 Press TARGET POS/SIZE key.

STEP 5 Press ENT X key. Press 4 and then ENTER keys to move image to right side of picture monitor.

STEP 6 Press **insert** soft key.

STEP 7 Press CLEAR X key to set X value to 0 (center screen).

STEP 8 Press **insert** soft key.

STEP 9 Press ENT X, +/-, 4, and then ENTER keys to move image to left side of picture monitor.

STEP 10 Press ← key to change menu display to keyframe 2.

STEP 11 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 12 Press ← key to change menu display to keyframe 1.

STEP 13 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 14 Press → key to change menu display to keyframe 2.

STEP 15 Press **kf flags** soft key. This brings up the keyframe flags menu.

STEP 16 Press → key to change menu display to keyframe 3.

STEP 17 Use change key to set source flag to B video source.

STEP 18 Press RUN to bring up run mode menu.

STEP 19 Press → key. The image on the monitor should move from right to left, changing images at center screen.

3-19 Setting a Freeze Flag

This procedure is similar to setting a source flag, but sets a freeze flag at midscreen to freeze the incoming video image. You will need a source which includes moving images to see the effects of freezing the image.

STEP 1 Acquire a signal system as described in paragraph 3-3.

STEP 2 Press PROG key and then SOURCE ASPECT/SIZE key.

STEP 3 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 4 Press TARGET POS/SIZE key.

STEP 5 Press ENT X key. Press 4 and then ENTER keys to move image to right side of picture monitor.

STEP 6 Press **insert** soft key.

STEP 7 Press CLEAR X key to set X value to 0 (center screen).

STEP 8 Press **insert** soft key.

STEP 9 Press ← key to change menu display to keyframe 2.

STEP 10 Press ENT X, +/-, 4, and then ENTER keys to move image to left side of picture monitor.

STEP 11 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 12 Press → key to change menu display to keyframe 1.

STEP 13 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

STEP 14 Press **kf flags** soft key. This brings up the keyframe flags menu.

STEP 15 Use → key to move highlight to Freez column.

STEP 16 Use **change** key to set freeze flag on.

STEP 17 Use → key to change menu display to keyframe 3.

STEP 18 Use **change** key to set freeze flag on.

Note

***FRZ* appears in the *show one* display for the keyframe where a freeze flag is set; an F appears in the *show many* display.**

STEP 19 Press RUN to bring up run mode menu.

STEP 20 Press ⟶ key. The image on the monitor should move from right to left, freezing the image at center screen.

3-20 Other Keyframe Flags

Other keyframe flags can be set in the same way as freeze and source flags. These flags include:

- *A mir* sets mirror mode for source A:

  —*none* disables mirror mode

  —*X* sets mirror mode for X axis

  —*Y* sets mirror mode for Y axis

  —*X,Y* sets mirror mode for both axes.

- *B mir* sets mirror mode for source B.
- *Globa* disables global mode beginning at the keyframe where the flag is set. *NOG* appears in the *show one* display in keyframes where the global disable flag is set, disabling global control on that channel.
- *Inter* sets interlace mode at the keyframe where the flag is set.

  Auto 1. In this mode the system looks at the last four fields on a pixel-by-pixel basis. If any object in the picture is moving rapidly, the system uses only the most recent field in image transformation. If no object is moving, the system computes a value for the corresponding pixels from all four fields.

  Frame. The system uses only the most recent frame in image transformation. This mode is useful for cleaning up the edges of graphics from a camera. When freezing a rapidly moving object in frame mode, the object appears to flicker because of its different positions in the two fields in the frame.

  Field. The system uses only the most recent field in image transformation. Each line of the other field is synthesized as the average of the two nearest lines. The result is a picture very close to the original full-frame picture, but with slightly reduced vertical resolution, and with no flicker in a rapidly moving object.

  Auto 2. This mode is the same as auto 1 but with a higher threshold of motion as the basis of a decision to use one field or four.

The interlace mode can be changed after freezing the picture to find the optimum mode for a particular effect.

- *Cube* enables auto cube mode beginning at the keyframe where the flag is set. *CUB* appears in the *show one* display for a keyframe where auto cube mode is enabled.
- *Y blur* reduces luminance resolution, giving the effect of a lens out of focus.

3-21 RUNNING AN EFFECT

Run mode gives the operator flexibility in previewing and trimming effects before committing the effect to final form. Effects can be run forward or backward and stopped at any point for keyframe parameter adjustment. Effect length can be trimmed to suit the operator's requirements. Using program mode, keyframes can be edited to include changes made during run mode.

The following procedures demonstrate use of run mode features.

3-22 Setting Up an Initial Effect

STEP 1 Acquire a signal system as described in paragraph 3-3.

STEP 2 Press PROG key and then SOURCE ASPECT/SIZE key.

STEP 3 Press ENT Z, . (decimal point), 5, and then ENTER keys to reduce image to one-half original size.

STEP 4 Press TARGET POS/SIZE key.

STEP 5 Press ENT X key. Press 4 and then ENTER keys to move image to right side of picture monitor.

STEP 6 Press **insert** soft key.

STEP 7 Press ENT X, +/-, 4, and then ENTER keys to move image to left side of picture monitor.

STEP 8 Press ← key to change menu display to keyframe 1.

STEP 9 Press TIME key. Press 5 and then ENTER to set keyframe duration to 5 seconds.

3-23 Running the Effect

STEP 1 Press RUN to bring up run mode menu.

STEP 2 Move the joystick upward. The effect begins to run at a speed determined by joystick position—the further from center, the faster the effect runs. Move the joystick downward and the effect runs backward. At joystick center position the effect stops running. If the joystick is held near center position, the effect can be run in one-frame increments.

3-24 Adding and Deleting Pauses

STEP 1 Press MORE key to bring up the next soft key menu.

STEP 2 Use the joystick to move the effect to some arbitrary point on the time line. Press **add pause.** Note that an X denoting a pause appears underneath the time line. Run the effect using the ⟶ key. The effect pauses at the newly-added pause.

STEP 3 With the effect stopped at the new pause, press **del pause** key. This removes the pause set previously.

3-25 Changing Start and End Times

STEP 1 Press **start t** soft key. The effect start value flashes.

STEP 2 Press 2 and then ENTER to change start time to 2:00 seconds. Note that a dot appears below the time line at the 2 second point.

STEP 3 Press **end time** soft key. The effect end value flashes.

STEP 4 Press 4 and then ENTER to change end time to 4:00 seconds. Note that a dot appears below the time line at the 4-second point.

STEP 5 Press ⟶ key. The effect now runs between 2- and 4-second start and end times.

3-26 Changing Effect Length

STEP 1 Use start and end time soft keys to return times to original 0:00 and 5:00 second values.

STEP 2 Press TIME key. Effect length value flashes.

STEP 3 Press 3 and ENTER keys. Time line shortens to 3 seconds.

STEP 4 Press ⟶ key. Effect runs as before, but with 3-second duration.

3-27 Moving to a Specified Time in an Effect

This procedure demonstrates how to move to a specified time in an effect.

STEP 1 Press **goto time** soft key. "Enter goto time:" appears in the lower portion of the run mode display.

STEP 2 Key in a time in seconds and press ENTER. The effect moves to the time specified.

3-28 EDITING EFFECTS

You can edit keyframes at any time during the process of assembling an effect. You can also build keyframes one parameter at a time by going back through each

keyframe and adding new parameters. You can use either the numeric keypad or the joystick to change values. For example, to build an effect combining horizontal movement, rotation, and zoom, start with horizontal movement, then go back and add rotation, and finally add zoom.

The procedure below illustrates keyframe editing.

STEP 1 Clear any previous keyframes by pressing **delete all** soft key in program mode.

STEP 2 Press SOURCE ASPECT/SIZE key and enter a Z value of .4.

STEP 3 Set up horizontal movement by pressing TARGET POS/SIZE and entering an X value of 4 for the first keyframe, and an X value of -4 for the second and last keyframe.

STEP 4 Go to keyframe 2 and press ROTATE 3D. Enter a Y value of 2 for keyframe 2.

STEP 5 Return to keyframe 1 and press TARGET POS/SIZE key. Enter a Z value of .1.

STEP 6 Go to keyframe 2 and enter a Z value of 2.

STEP 7 Go to run mode and run the effect. The image should appear to make two complete revolutions while moving from right to left and zooming in from the background.

STEP 8 Return to program mode and press TARGET POS/SIZE.

STEP 9 Return to keyframe 1 and use joystick to move image to top of screen.

STEP 10 Move to keyframe 2 and use joystick to move image to bottom of screen.

STEP 11 Go to run mode and run the effect. The image should move diagonally while rotating and zooming from the background.

3-29 NAMING EFFECTS

You can use name entry mode to assign a name to each effect as the effect is stored on a disk. Use the following procedure:

STEP 1 From program menu, press MORE and then **enter name** soft key. A menu with instructions and two rows of alphanumeric characters appears on the screen. Refer to Figure 2-13.

STEP 2 Use the joystick or the ← and → keys to move the cursor horizontally from one character to another. To reach lower row of display, go beyond left- or right-most character with joystick or ← and → keys. Press STOP to enter each character in the name as you spell it out. The space

character is at the far left of the top line of characters (it shows as a blank space in the line). The character chosen appears at the top line on the screen. When the entire name has been spelled out, press ENTER to enter the disk name in a temporary name register.

3-30 STORING AND RECALLING EFFECTS

Effects can be stored in two ways: on a disk or in on-line memory. Up to four effects can be stored in on-line memory using the four CHAN (channel) keys. Each disk stores up to 1360 keyframes, or 54 single-channel effects of 25 keyframes each. Effects stored in on-line memory are lost if power is turned off at the control panel. Effects stored on a disk are reasonably permanent.

3-31 Storing and Recalling Effects from On-Line Memory (Single-Channel Mode Only)

This procedure illustrates use of on-line memory.

STEP 1 Press CHAN 1 key and set up an effect several keyframes long.

STEP 2 Press CHAN 2, CHAN 3, and CHAN 4 keys in sequence, setting up effects for each channel.

STEP 3 Recall effects by pressing the channel key used to set up the effect originally.

3-32 Storing and Recalling Effects from a Disk

This procedure demonstrates use of a disk for effect storage and recall.

Note

This procedure stores keyframes from all four channels as well as keyframes on the global channel.

STEP 1 Set up effects on any or all channels.

STEP 2 If you wish to assign a name to the effect, use the procedure given in paragraph 3-29

STEP 3 Press STORE EFFECT key. "Enter effect number:" appears in the lower portion of the display.

STEP 4 Enter an effect number from 1 to 60 from the keypad.

STEP 5 Press ENTER. The disk drive indicator comes on for a few seconds and then goes off. At the same time, "Enter effect number:" disappears to indicate that the effect has been recorded on the disk.

STEP 6 To recall an effect stored previously, press RECALL EFFECT. "Enter effect number:" appears in the lower portion of the display.

STEP 7 Enter an effect number from 1 to 60 from the keypad.

STEP 8 Press ENTER. The disk drive indicator comes on for a few seconds and then goes off. At the same time, "Enter effect number:" disappears to indicate that the effect has been recalled from the disk. Run and program mode displays show keyframe parameters for the effect which was recalled.

Note

If the effect number duplicates an effect already on the disk, the system indicates that the effect exists. Press ENTER again to overwrite the existing effect.

An effect can be recalled, edited, and then stored again under the same effect name and number by following steps 3 through 5 of this procedure.

3-33 Erasing Effects from a Disk

Single effects can be erased from a disk by using the **erase eff** soft key in the program menu. To erase an effect:

STEP 1 Press **erase eff** soft key. "Enter erase effect number:" appears at the bottom of the display.

STEP 2 Enter the number of the effect you want to delete from the keypad. Press enter. The effect has now been deleted from the disk.

3-34 INSERTING AND DELETING KEYFRAMES

Keyframes can be inserted or deleted at any time during effect construction. To insert a keyframe, move to the keyframe before the point where a new keyframe is to be inserted. Press **insert**. The keyframe which you selected has now been duplicated. You may now modify the new keyframe for the parameters required.

3-35 ADVANCED EFFECTS

So far we have demonstrated effects using simple movement and rotation. The following paragraphs outline other capabilities which can be used in constructing effects.

3-36 Off-Axis Rotation

The previous rotation examples used axes positioned in the plane of the picture monitor screen. The procedure following illustrates rotation around the Y axis, displaced 2 units away from its normal position.

STEP 1 Press SOURCE ASPECT/SIZE key. Enter a Z value of .5 to reduce image to one-half original size.

STEP 2 Press AXIS SELECT 3D key.

STEP 3 Enter a Z value of -2.

STEP 4 Press ROTATE 3D key.

STEP 5 Move the joystick to the right; the image rotates around the displaced Y axis, appearing to move around the surface of a cylinder with 2 units radius.

3-37 Rotation with Perspective

When images are moved from the normal X-Y plane using LOCATE 3D, the image is affected by perspective. The amount of perspective can be changed from the system-assigned value of .06. This change results in the image appearing to be viewed through lenses of differing focal lengths. That is, for each perspective value, the effect will be more or less pronounced. The following procedure demonstrates the use of three-dimensional location, perspective, and rotation.

STEP 1 Press LOCATE 3D key.

STEP 2 Enter a Z value of 10 from the keypad.

STEP 3 Press ROTATE 3D. Rotate the image and note apparent perspective.

STEP 4 Press SKEW/POST-Y/PERSP key.

STEP 5 Enter a Z value of .4 from the keypad.

STEP 6 Press ROTATE 3D key.

STEP 7 Use the joystick to rotate the image around the Y axis. Note that the image appears to have more perspective and seems to be further away. This is because the system has created the effect of viewing the image through a wide-angle lens.

STEP 8 Press LOCATE 3D key and move the image closer to and further away from the screen. Note that the control seems more sensitive due to perspective changes.

3-38 Creating Mosaic Effects

Mosaic mode is used to create effects in which the image appears to be composed of colored tiles. Input video flags and input video parameters menus allow the operator to select mosaic/solarization area in the image and to select mosaic block size and solarization/posterization modification parameters. Pressing the **iv flags** soft key brings up the input video flags menu which has the following flag selections.

- Mosaics selects mosaic area

  —off disables mosaic function
  —allover selects mosaic over entire image area
  —outside selects mosaic outside area defined by window source (see M Window flag description)
  —inside selects mosaic inside area defined by window source

- M Window selects mosaic window source

  —rect selects rectangular window area defined by window left/top and window right/bottom values in input video parameters menu
  —ext key selects window area determined by external key source
  —luma selects window area determined by external luminance key source
  —rct&key selects window area determined by a combination of internal and external sources

- M Chroma selects axis for mosaic chroma function

  —x & y selects mosaic in both vertical and horizontal axes
  —x selects mosaic in horizontal axis only
  —y selects mosaic in vertical axis only
  —none disables mosaic chroma function

- Solarizer selects area for solarization

  —off disables solarization function
  —allover selects solarization over entire image area
  —outside selects solarization outside area defined by window source
  —inside selects solarization inside area defined by window source

- S window selects solarization window source

  —rect selects rectangular window area defined by window left/top and window right/bottom values in input video parameters menu
  —ext key selects window area determined by external key source
  —luma selects window area determined by external luminance key source
  —rct&key selects window area determined by a combination of internal and external sources.

The following procedure demonstrates mosaic mode:

STEP 1 Capture a signal system and select a video input which provides an image with a range of colors and brightness.

STEP 2 From program mode, press MORE until the input video parameters soft key menu appears in the display.

STEP 3 Press **iv parms** soft key to bring up mosaic mode menu.

STEP 4 Press ← soft key to highlight *MOSAIC BLOCK SIZE* on display.

STEP 5 Move joystick to right and upward to increase size of mosaic blocks.

STEP 6 Press MORE key and then **iv flags** soft key.

STEP 7 Press → key to select *MOSAICS*.

STEP 8 Press **change** soft key to highlight *inside* on menu.

STEP 9 Press MORE key and then **iv parms** soft key.

STEP 10 Use → soft key to highlight *WINDOW LEFT/TOP* in display.

STEP 11 Use joystick to increase X and Y values and reduce image area converted to mosaic.

STEP 12 Highlight *WINDOW RIGHT/BOTTOM* and use joystick to reduce size of mosaic area. If you return to input video flags menu and set flag to *outside*, then only area outside window is converted to mosaic.

3-39 Creating Solarized and Posterized Effects

Images are given solarized (high contrast) or posterized (high contrast with color highlights) characteristics using solarizer flag and chroma/luminance mapping parameters. The following procedure illustrates solarization and posterization mode.

STEP 1 Capture a signal system and select a video input which provides an image with a range of colors and brightness.

STEP 2 From program mode, press MORE until the input video parameters soft key menu appears in the display.

STEP 3 Press **iv parms** soft key.

STEP 4 With C-POST/Y-POST/Y-REV highlighted, move joystick to the right to vary C-POST (chroma posterization) value. Note color changes in image.

STEP 5 Move joystick up to vary Y-POST (luminance posterization) value. Note contrast change.

STEP 6 Rotate joystick clockwise and counterclockwise to vary Y-REV (luminance reversal) value. Note image change from positive to reverse video.

3-40 Creating Colored Borders

Under operator control, the system creates color background for effects. The following procedure illustrates color background effects.

STEP 1 Acquire a signal system and switch in a video source.

STEP 2 In program mode, press BORDER COLOR key.

STEP 3 Enter an X value of 80 from the keypad to set saturation to 80%.

STEP 4 Enter a Y value of 20 from the keypad to set luminance value to 20%.

STEP 5 Press BORDER WIDTH key.

STEP 6 Rotate joystick knob to increase border width to some convenient size.

STEP 7 Press BORDER COLOR key. Rotate joystick knob clockwise to change border color.

3-41 Using the Key Channel

The key control menu allows the operator to control key input and source space parameters. The following paragraphs describe key control parameters.

- K Sou (key source) sets the source for the key signal:

  —A selects A signal input only
  —A/B selects A and B inputs automatically, as in A/B auto source keyframe flag
  —B selects B signal input only
  —B/A selects B and A signal inputs automatically, as in B/A auto source keyframe flag

- Soft (Edge Softness) sets soft edges for key output:

  —off disables key softness mode
  —A sets softness for A key signal
  —B sets softness for B key signal
  —AB sets softness for both key signals

- A Sof (A channel edge softness level) sets softness levels for A signal:

  —0 through 7 set softness level from hardest to softest; whoopee sets sawtooth edge waveform which gives a highlight at the edge.

- B Sof (B channel edge softness level) sets softness levels for B signal:

  —0 through 7 set softness level from hardest to softest; whoopee sets sawtooth edge waveform which gives a highlight at the edge.

- K Blur (key blur) is similar to Y blur keyframe flag; reduces key signal bandwidth to soften edge of graphics used as key signal.

  —off disables blur function
  —A sets blur mode for A key signal
  —B sets blur mode for B key signal
  —AB sets blur mode for both key signals

- GP Ke (General-Purpose Key) sets mode for optional general-purpose key channel:

—off disables function
—A enables the key from the A input
—B enables the key from the input
—AB enables the key from both inputs

- GP In (General-Purpose Key inversion) sets inversion mode for optional general-purpose key channel to accommodate signals from units providing a black key hole.

  —off disables function
  —A invert reverses sense of A input
  —B invert reverses sense of B input
  —AB invert reverses sense of both inputs

- A gai (A channel gain) sets gain of optional general-purpose key input to reduce noise or to increase signal level to eliminate background feedthrough:

  —unity sets gain to one
  —+1 increases gain one unit
  —+2 increases gain two units
  —max sets gain to maximum

- B gai (B channel gain) sets gain of optional general-purpose key input to reduce noise or to increase signal level to eliminate background feedthrough:

  —unity sets gain to one
  —+1 increases gain one unit
  —+2 increases gain two units
  —max sets gain to maximum

3-42 ENGINEERING SETUP MODE

The following procedures adjust setup parameters to match studio conditions.

Note

Adjustment of setup parameters should be done by qualified engineers using proper test equipment.

3-43 Adjusting Luma/Chroma Gain

This procedure adjusts luminance and chrominance gain through the ADO system to unity.

STEP 1 Loop color bar signal through to waveform monitor channel A input.

STEP 2 Connect color bar input to ADO signal system.

STEP 3 Connect ADO output to switcher input. Connect switcher output to waveform monitor channel B input.

STEP 4 Set waveform monitor for A-B display.

STEP 5 Using LUMA/CHROMA/KEY GAIN and SUBCARRIER PHASE modes, move joystick to adjust gain and phase so that display on waveform monitor is zero (a straight line).

3-44 Adjusting Output Horizontal Phase

This procedure adjusts ADO output horizontal sync phase to match house reference sync.

STEP 1 Connect a waveform monitor to the switcher output.

STEP 2 Connect house reference to switcher input.

STEP 3 Switch reference to waveform monitor input.

STEP 4 Note position of negative-going edge of reference sync waveform on monitor.

STEP 5 Switch ADO output to waveform monitor input.

STEP 6 Highlight OUTPUT H PHASE on setup menu and use joystick to adjust ADO output so that negative-going edge of sync matches position of reference sync on waveform monitor.

3-45 Adjusting Subcarrier Phase

This procedure adjusts ADO output subcarrier phase to match house reference sync.

STEP 1 Connect a vectorscope to the switcher output.

STEP 2 Connect house reference to switcher input.

STEP 3 Switch reference to vectorscope input.

STEP 4 Adjust vectorscope phase so that burst vector lies on horizontal graticule reference line.

STEP 5 Switch ADO output to waveform monitor input.

STEP 6 Highlight SUBCARRIER PHASE on setup menu and use joystick to adjust ADO output so that burst vector is aligned on reference line.

3-46 Adjusting Burst Gain/Phase (NTSC Systems Only)

Ampex does not recommend making this adjustment in the field.

3-47 Adjusting Sync Amplitude

Ampex does not recommend making this adjustment in the field.

3-48 Key Gain (General-Purpose Key Option Only)

This procedure adjusts key gain.

STEP 1 Connect signal input and enable general-purpose key mode.

STEP 2 Highlight LUMA/CHROMA/KEY GAIN on setup menu and use joystick to adjust key output to 100 IRE units maximum, with a 100 IRE unit input signal.

3-49 Adjusting Key In H Phase (General-Purpose Key Option Only)

This procedure adjusts key input phasing to match switcher key phasing.

STEP 1 Connect signal to key input and enable general-purpose key function.

STEP 2 Use ADO key output to key switcher video.

STEP 3 Look at keyhole edges on picture monitor.

STEP 4 Highlight KEY IN H PHASE A/B on setup menu. Use joystick to adjust phase so that window and key video edges are aligned.

STEP 5 Rotate image 180 degrees around the Z axis. Edges should still be aligned. If not, there is a timing problem downstream from the ADO system which must be corrected.

3-50 Adjusting Key In Offset

Use this adjustment mode to change size of rectangular key output waveform.

STEP 1 Observe ADO key output on picture monitor.

STEP 2 Highlight KEY IN T/L OFFSET or KEY IN B/R OFFSET. Use joystick to adjust key matte size as required.

3-51 Storing Setup Parameters

Setup parameters can be stored in two ways: in non-volatile internal memory, or on a disk. When stored in memory, the parameters are recalled each time the system is turned on after shutdown. When parameters are stored on a disk, they must be recalled from the disk each time they are needed. Use the following procedures to store parameters:

3-52 Storing Setup Parameters in Memory

STEP 1 Adjust parameters as required.

STEP 2 Press STORE EFFECT key. The message, "Hit store again to permanently save engineering parameters" appears at the top of the screen.

STEP 3 Press STORE EFFECT again to save parameters.

3-53 Saving Setup Parameters on a Disk

STEP 1 With a disk inserted in the disk drive, press MORE twice to bring up the disk storage soft key menu.

STEP 2 Press **disk store** soft key.

STEP 3 Press STORE EFFECT soft key. The message, "Hit store again to permanently save engineering parameters" appears at the top of the screen. Press STORE EFFECT again. The message, "Enter effect number" appears at the bottom of the screen.

Note

To avoid confusion with effects stored on the disk, give the setup parameter to be stored a unique number, such as 33, 44, etc. If the number you enter is the same as an existing effect on the disk, a warning message appears. If the setup parameter number is the same as a setup stored on the disk previously, "Setup effect—hit 'enter' to overwrite" appears on the screen. If you wish to overwrite the existing setup parameters, press ENTER. If not, press STOP and then repeat steps 3 and 4 of this procedure.

STEP 4 Enter a number from the keypad.

STEP 5 To recall parameters from the disk, press DISK STORE and then RECALL EFFECT. Then enter the setup parameter effect number from the keypad.

3-54 AUTOMATIC HORIZONTAL PHASE CORRECTION (AUTO H-PHASE)

Auto H-phase mode locks output video horizontal sync to house reference horizontal sync, despite variations in input video timing. Correction operates over an input video timing range of 2 microseconds with respect to output video. The correction circuit requires five to seven fields to stabilize timing after an input video timing change. Auto H-phase mode is useful if video sources have timing differences due to their position in the video distribution system, such as upstream or downstream from the switcher. If horizontal phase has been adjusted during setup, the adjustment should be reset so that the timing difference is zero before enabling auto H-phase mode. Otherwise, the correction circuit may not be able to lock input signal timing. Once the system is in auto H-phase mode, the horizontal phase setup control adjusts output video timing with respect to reference video.

Note

A and B input signals must be synchronized with each other for proper operation; auto H-phase mode corrects input/reference timing differences.

The user can choose either manual or automatic H-phase with a switch inside the signal system chassis. This switch is section 8 of S2 on the High Level Controller

PWA. When the switch is ON, auto H-phase is disabled (manual H-phase is enabled); when the switch is OFF, auto H-phase is enabled. The High Level Controller PWA is at the farthest right (slot no. 27) in the signal system chassis (see Table 4-3 in the *ADO Service Manual,* Catalog No. 1809550-03). Turn off power and remove the High Level Controller PWA from its slot. Two switches are mounted on this PWA, both near the edge connector at the back of the board. S2 is the one nearer the corner. Section 8 is marked on the switch, as are the ON and OFF positions.

3-55 HIGH LEVEL CONTROLLER/CONTROL PROCESSOR SWITCH SETTINGS

Both High Level Controller and Control Processor PWAs have switches which control operating parameters. Tables 3-1, 3-2, and 3-3 list switches and settings for various functions.

Table 3-1. Control Processor PWA Switch 1S

Switch Section	Function			
1	Not used			
2	ON: PAL OFF: NTSC			
3 through 5	Control Panel ID (see below)			
	ID No.	**Section**		
		3	4	5
	0	ON	ON	ON
	1	OFF	ON	ON
	2	ON	OFF	ON
	3	OFF	OFF	ON
	4	ON	ON	OFF
	5	OFF	ON	OFF
	6	ON	OFF	OFF
	7	OFF	OFF	OFF
6 through 8	Not used			

Table 3-2. High Level Controller PWA Switch S1

Switch Section	Function	Switch Section	Function
1	Not used	5	Not used
2	Not used	6	Not used
3	ON: rotation OFF: no rotation	7	Not used
4	ON: perspective OFF: no perspective	8	Not used

Table 3-3. High Level Controller PWA Switch S2

Switch Section	Function	Switch Section	Function
1	Maintenance Port Baud Rate ON: 9600 baud OFF: 2400 baud	5	High Level Controller Auto-Release ON: no auto-release OFF: auto-release*
2	Not used	6	ON: NTSC OFF: PAL
3	Not used	7	ON: no concentrator** OFF: concentrator
4	Not used	8	ON: no auto H-phase OFF: auto H-phase

* When auto-release function is enabled, the high level controller releases from the control unit which acquired it, if communication between controller and control unit has failed.

** If a concentrator is not installed in the system, this switch section must be set to the ON position to allow normal setup mode.

APPENDIX

CONSTRUCTION OF SOLIDS USING ADO MULTICHANNEL SOFTWARE

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ABSTRACT

With the introduction of multichannel software it has become possible to construct a certain class of three dimensional solids. This paper gives a systematic way to construct a general member of this family and program some unique effects.

1. GENERAL SOLID DEFINITION AND INITIAL ORIENTATION

In general the solid has six degrees of freedom, three angles and three linear dimensions:

$$\Theta_1, \Theta_2, \Theta_3 \qquad h_1, h_2, h_3$$

See Figure A-1.

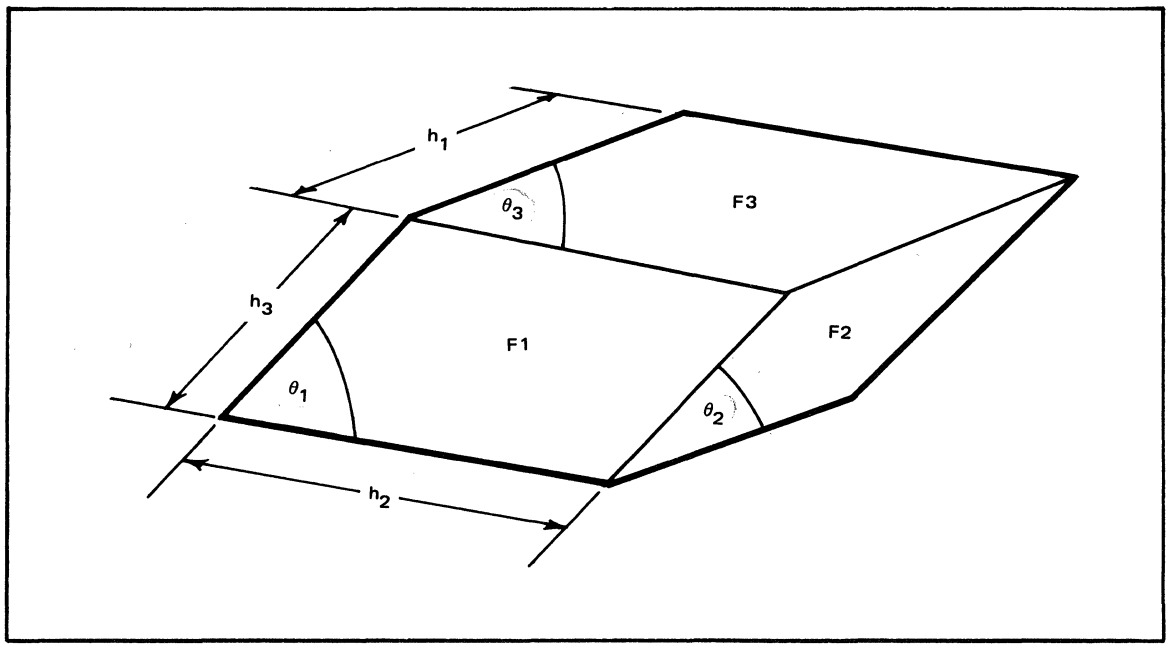

Figure A-1. Solid Definition

We define the three visible faces as F1, F2, F3, and their opposing hidden faces as HF1, HF2, and HF3. Each face is a parallelogram and opposing faces are alike and separated in space by a simple 3-D translation. This relationship between two opposing faces allows ADO's auto cube mode to generate the optical effect of a closed solid object.

For any two opposing faces there will be a plane midway between the two and parallel to both. There will be three such planes and these will intersect at a point called the center of solid. This point is denoted by C in Figure A-2.

Initially the solid is oriented so that:

- C is at the system origin.
- F3 is parallel to the XZ plane.
- The line of intersection of F1 and F3 is parallel to the X axis.

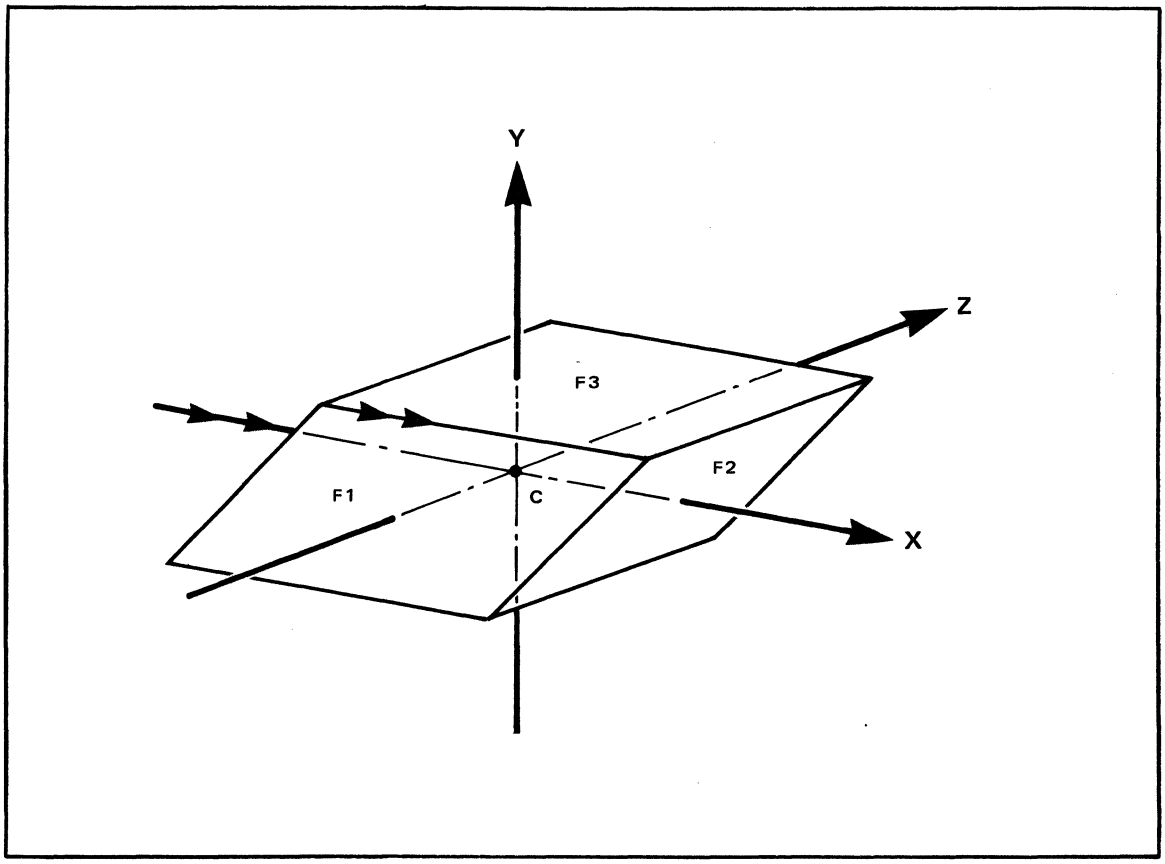

Figure A-2. Initial Orientation

2. PARAMETER FORMULAS

The following mathematical formulas are given for the general case. Only parameter values that change are given. The first step is to generate appropriate

dimensions for each face. See Figure A-3. To produce the dimensions indicated in this figure, one or several of the following parameters should be used:

- LT and BR crops
- Aspect
- Source size

The following two angles should be calculated, to be used in the various formulas. Note that all angles are in degrees.

$$\varphi_1 = \cos^{-1}\left\{\left[\frac{\cos\Theta_1}{\sin\Theta_1}\right]\left[\frac{\cos\Theta_2}{\cos\Theta_1 \sin\Theta_3} - \frac{1}{\tan\Theta_3}\right]\right\}$$

$$\varphi_2 = \cos^{-1}\left\{\left[\frac{\cos\Theta_2}{\sin\Theta_2}\right]\left[\frac{\cos\Theta_1}{\cos\Theta_2 \sin\Theta_3} - \frac{1}{\tan\Theta_3}\right]\right\}$$

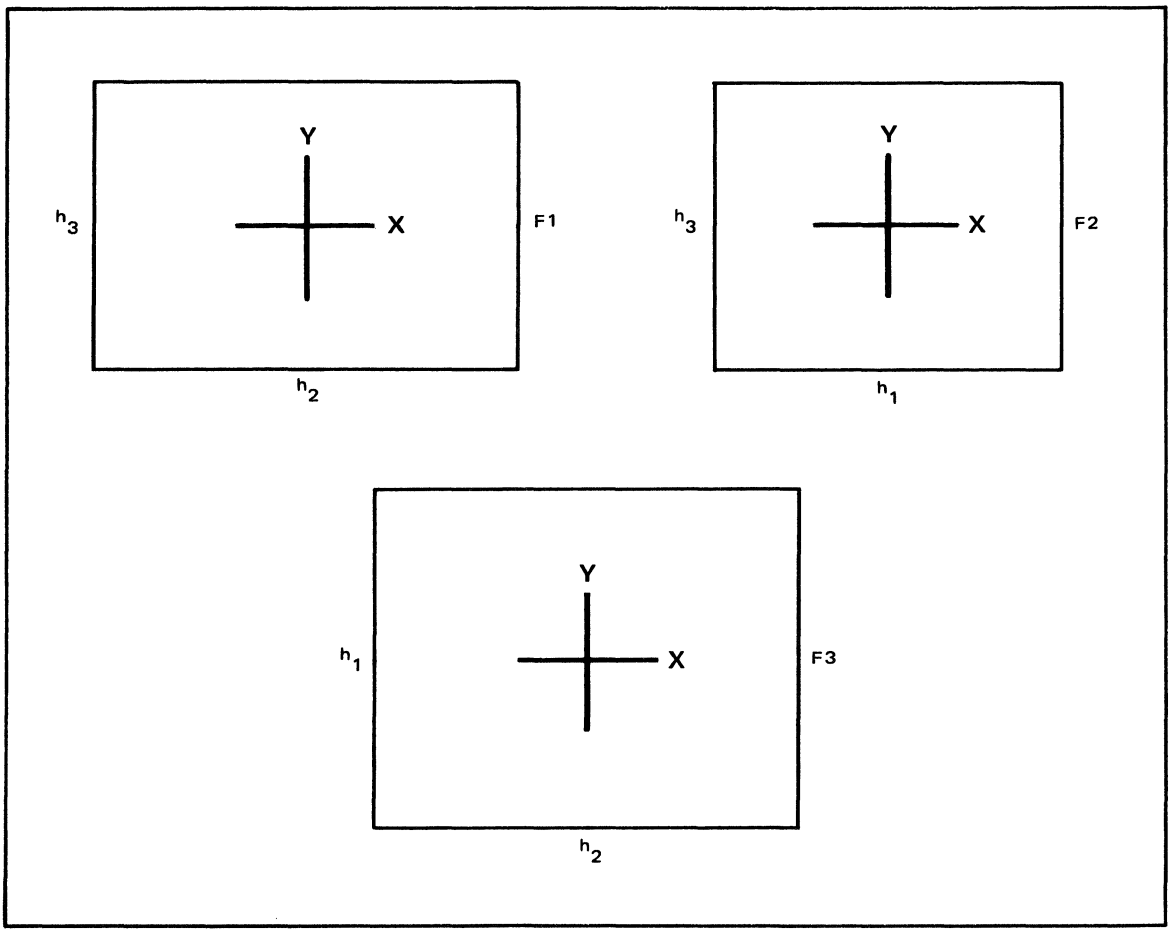

Figure A-3. Facial Dimensions

2-1. Face 1 Parameters

$$\text{skew} = \left[\frac{90 - \Theta_1}{360}\right]$$

$$\text{X-axis} = + \frac{h_1}{2}\left[\frac{\sin\Theta_3 \cos\varphi_1}{\tan\Theta_1} - \cos\Theta_3\right]$$

$$\text{Y-axis} = - \frac{h_1}{2}\left[\frac{\sin\Theta_3 \cos\varphi_1}{\sin\Theta_1}\right]$$

$$\text{Z-axis} = - \frac{h_1}{2}\left[\sin\Theta_3 \sin\varphi_1\right]$$

$$\text{Y-rotate} = \left[\frac{90 - \varphi_1}{360}\right]$$

2-2. Face 2 Parameters

$$\text{skew} = \left[\frac{90 - \Theta_2}{360}\right]$$

$$\text{X-axis} = - \frac{h_2}{2}\left[\frac{\sin\Theta_3 \cos\varphi_2}{\tan\Theta_2} - \cos\Theta_3\right]$$

$$\text{Y-axis} = \frac{h_2}{2}\left[\frac{\sin\Theta_3 \cos\varphi_2}{\sin\Theta_2}\right]$$

$$\text{Z-axis} = - \frac{h_2}{2}\left[\sin\Theta_3 \sin\varphi_2\right]$$

$$\text{X-rotate} = \left[\frac{\Theta_3}{360}\right]$$

$$\text{Y-rotate} = - \left[\frac{90 - \varphi_2}{360}\right]$$

2-3. Face 3 Parameters

$$\text{skew} = \left[\frac{90 - \Theta_3}{360}\right]$$

$$\text{X-axis} = \frac{h_3}{2}\cos\Theta_1\left[1 - \frac{\cos\varphi_1 \tan\Theta_1}{\tan\Theta_3}\right]$$

$$\text{Y-axis} = \frac{h_3}{2}\left[\frac{\cos\Theta_1}{\sin\Theta_3}\right]\left[\frac{\cos\Theta_2}{\cos\Theta_1 \sin\Theta_3} - \frac{1}{\tan\Theta_3}\right]$$

$$\text{Z-axis} = - \frac{h_3}{2}\sin\Theta_1 \sin\varphi_1$$

$$\text{Y-rotate} = 0.25$$

3. ADDITIONAL FORMULAS

Having used the above parameters to construct the solid, there are additional numerical values useful in producing various effects.

- The perpendicular distance between the faces F3 and HF3,

  $$d = h_3 \sin\Theta_2 \sin\varphi_2$$

- The coordinates of the point P shown in Figure A-4 are a, b, c where:

$$a = \frac{1}{2}\left[h_3 \cos\Theta_1 + h_2 + h_1 \cos\Theta_3\right] \qquad b = \frac{1}{2}\left[h_3 \sin\Theta_2 \sin\varphi_2\right]$$

$$c = \frac{1}{2}\left\{ h_3 \cos\Theta_1 \left[\frac{\cos\Theta_2}{\cos\Theta_1 \sin\Theta_3} - \frac{1}{\tan\Theta_3}\right] + h_1 \sin\Theta_3 \right\}$$

  The point P' has coordinates -a,-b,-c.

- The distance between the point P and the center of solid, C. See Figure A-4.

$$D = \sqrt{a^2 + b^2 + c^2}$$

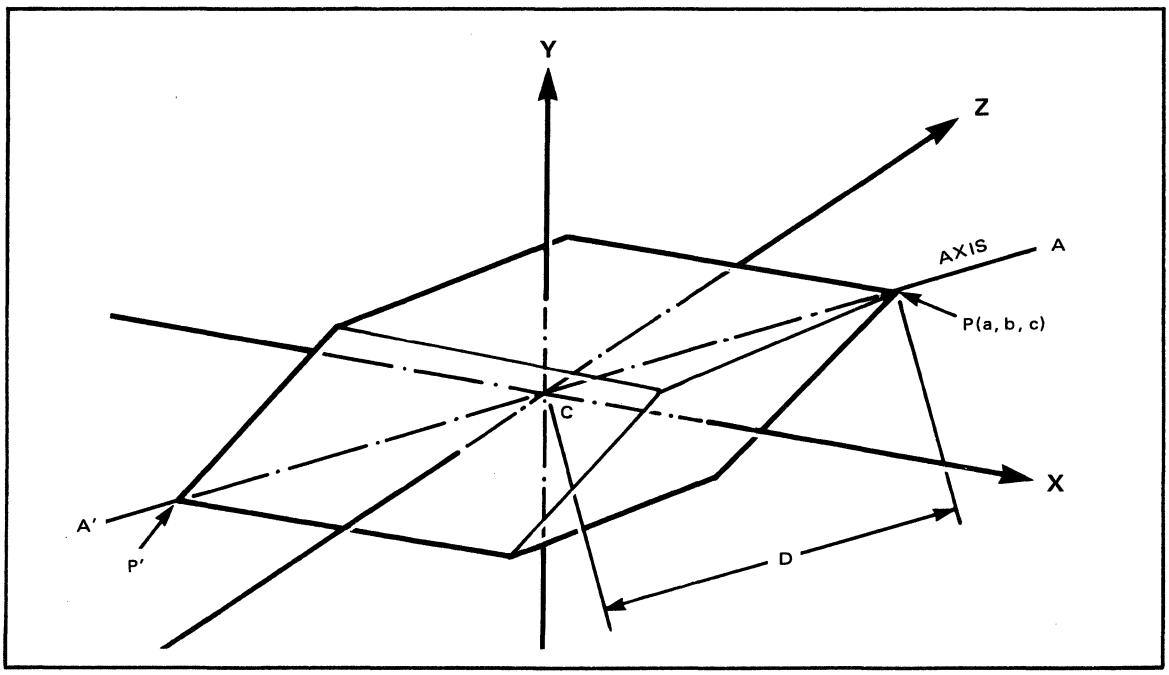

Figure A-4. Axis

4. USEFUL ORIENTATION CHANGES AND EFFECTS

In Figure A-4 the line AA' is called the axis of the solid and it will pass through points P, P' and C.

It is convenient to change the orientation of the solid so its axis is coincident with the system Z-axis. See Figure A-5. The first step is to increment each local X-rotate so that AA' lies in the YZ plane, then increment each local post-X-rotate so that AA' becomes coincident with the system z-axis.

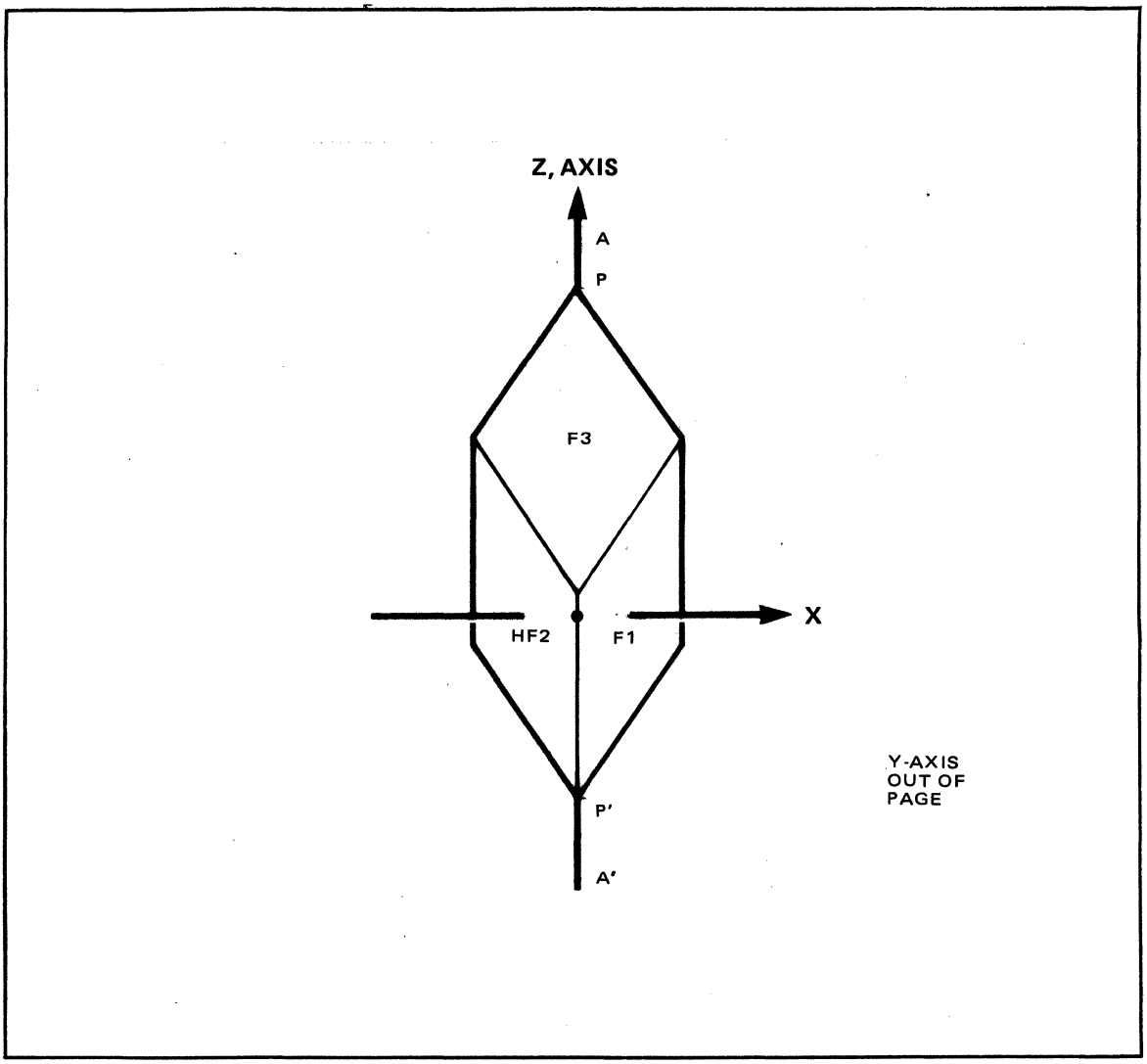

Figure A-5. Z-Axis Coincidence

By doing this we can use the global Z-rotate as a spin control and the global X- and Y-rotates to incline the solid's axis to any inclination in 3-D space. This is possible because the order in which the global rotations are done is z, y, and x. We define:

ω = Local X-rotate increment. ν = Local post X-rotate increment.

where,

$$\omega = \left\{ 0.25 - \left[\frac{\tan^{-1} \frac{c}{a}}{360} \right] \right\} \qquad \nu = \left\{ \frac{\tan^{-1} \left\{ \frac{b}{a} \cos \left[\tan^{-1} \frac{c}{a} \right] \right\}}{360} \right\}$$

With these additions to the local parameters, the global rotates can be used to orient the solid as shown in Figure A-6.

From this position we can change the global Z-axis to the value D. This will have the effect of translating point P' to the system origin. That is, the solid will appear to have pivoted at the system origin about point P'. By programming suitable values for the global X and Y rotates, the multichannel software will produce a spinning solid which will precess about the Y-axis. See Figure A-7.

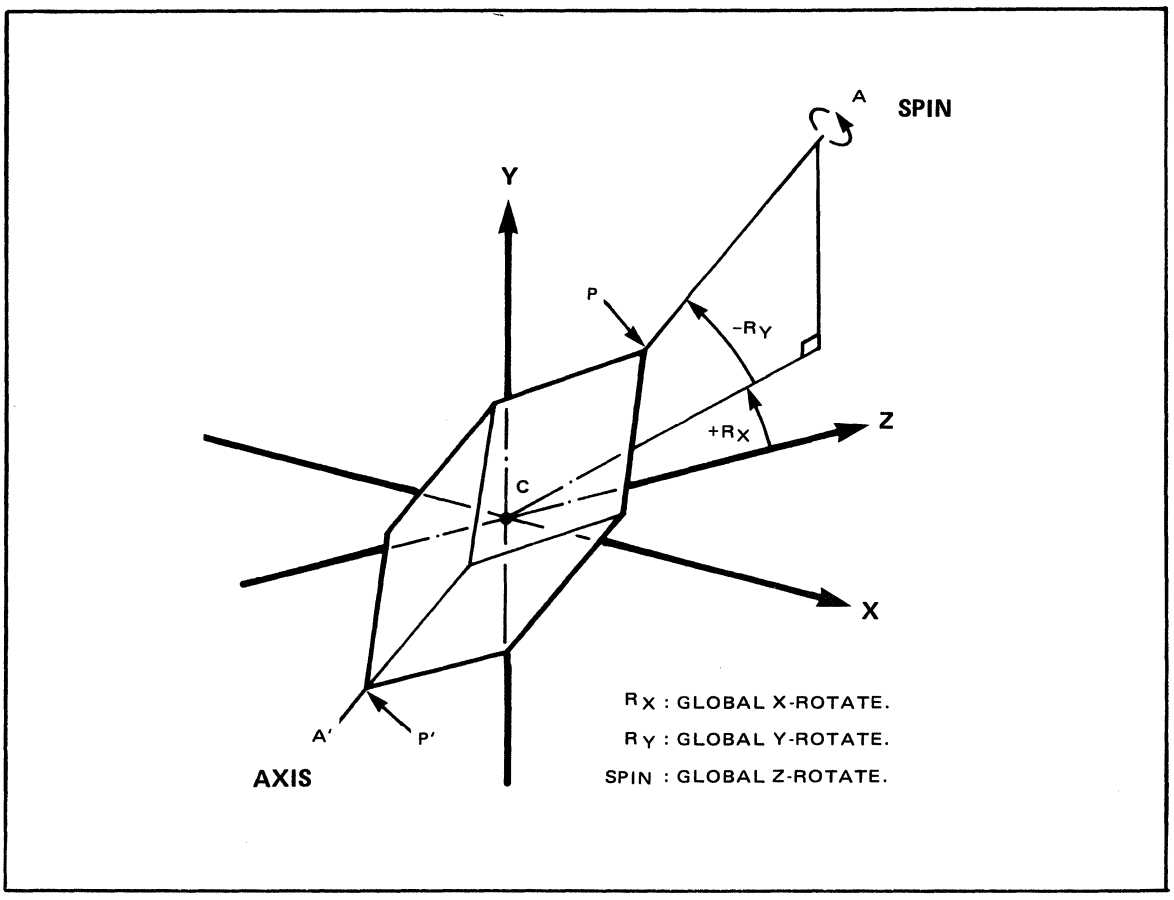

Figure A-6. Global Rotation

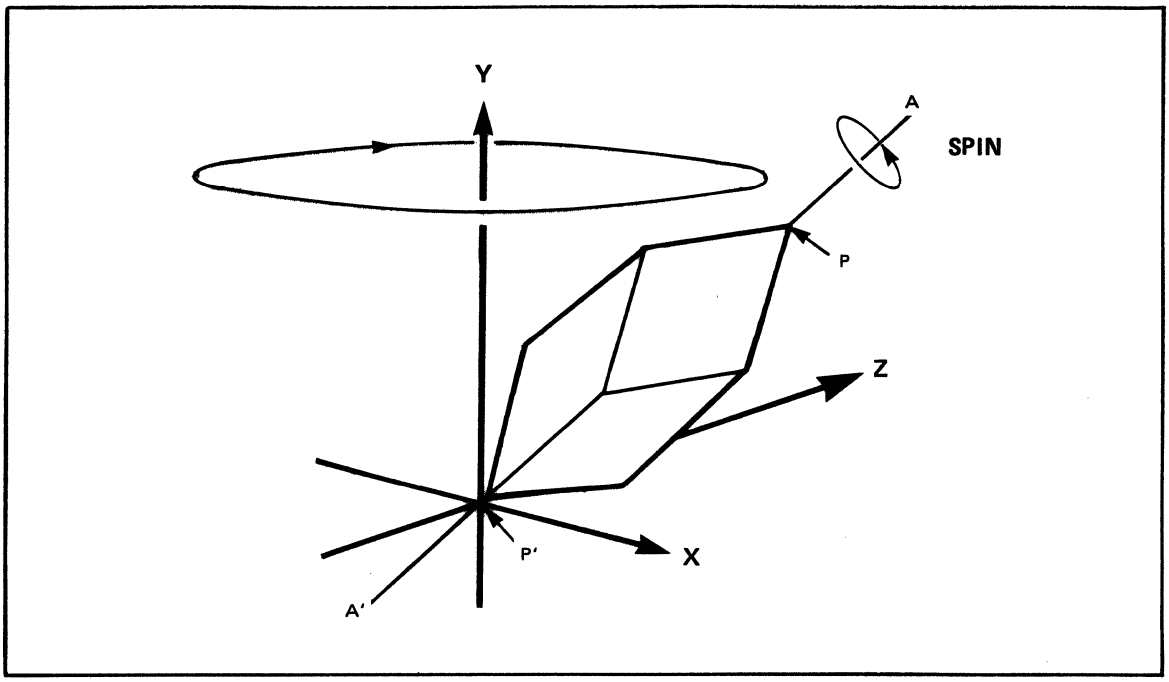

Figure A-7. Precession

5. SPECIFIC EXAMPLE

It is anticipated that in order to make the generation of such solids a fast and error-free exercise, the operator will use a small programmable calculator or computer. As a means of program verification, a table of known good data for a particular solid is given.

Define Solid

Θ_1	40	degrees	h_1	8	units
Θ_2	30	degrees	h_2	4	units
Θ_3	50	degrees	h_3	6	units

Generate solid as in Figure A-3.

Face	F1	F2	F3
Skew	0.1389	0.1667	0.1111
X-axis	0.1998	-0.1650	1.0704
Y-axis	-3.6172	1.6750	1.9101
Z-axis	-1.9958	-1.2829	-1.2561
X-rotate	0.0000	0.1389	0.0000
Y-rotate	0.1371	-0.0920	0.2500

Orient solid with axis coincident with Z axis as in Figure A-5.

X-Rotate	0.1573	0.2962	0.1573
Post-X	0.0241	0.0241	0.0241

This corresponds to:

$\omega = 0.1573$
$\nu = 0.0241$

Pivot P' at the origin.

Globals	
Z-Axis	8.3224
XYZ-Rotates	to suit

This global parameter listing will move P' to be coincident with the system origin. The relevant numerical value used is: D = 8.3224

Note

Use global Z-locate to move the solid so that it can be fully viewed. Parameters to change facial dimensions are not given.

6. LIMITATIONS

The previous mathematical approach should be used with the following two limitations.

- The solid that you try to construct must be physically possible. As a general rule, "the sum of the two lessor angles should be greater than or equal to the largest." For the previous example:

  $30 + 40 > 50$

  When the equality holds, the solid formed has six sides but no volume.

- Problems occur at angles of 0° and 90°, resulting in equations that have division by zero. Ideally we should take a limit, but the easiest solution is to use 89.99999999 for 90 and 0.00000001 for 0.

7. TRANSITIONS BETWEEN SOLIDS

Using ADO's splines it is possible to change from one general solid to another. This has the restriction that any angle must not change more than about 10° between keyframes. If this is not done, some breakup of the solid will be seen. This restriction can be greatly relaxed depending on the amount of movement of the solid. For example, any breakup in a solid that is spinning will be disguised by the spinning motion itself.

8. DEGENERATE SOLIDS

The case of the solid being reduced to having no volume is an example of a degenerate solid. Another example is when the solid reduces to a single line when all angles are zero. Both cases may prove useful start and/or end points for a particular effect.

9. OTHER EFFECTS

Two other interesting effects which may be of use are:

- The principle of conservation of angular momentum can be implemented using transitions between two solids. See Figure A-8. This has the same visual effect as an ice-skater; i.e., when skater's arms are pulled in, rotational speed increases.

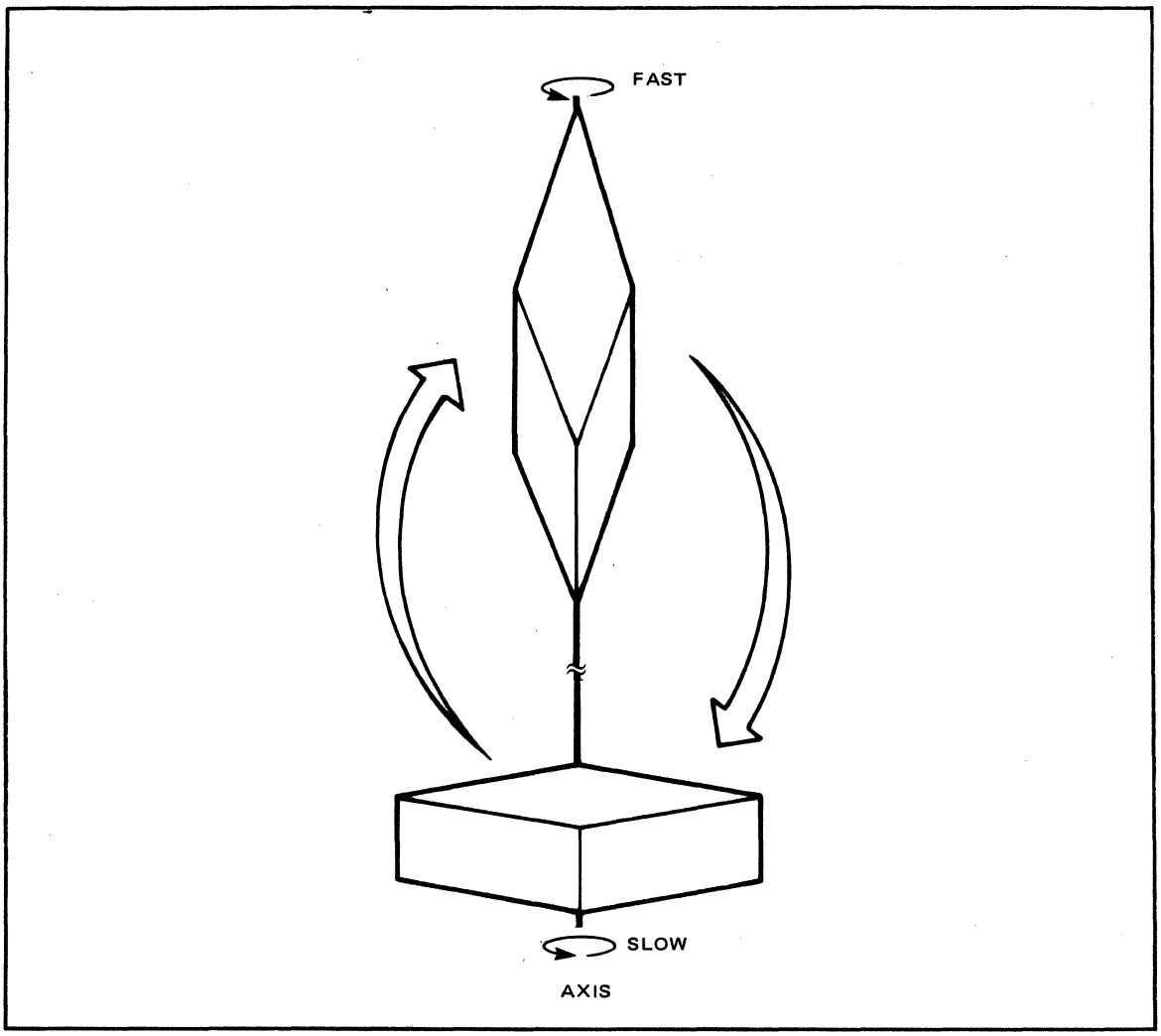

Figure A-8. Ice Skater

- By using the solid pivoted about P', it is possible to make the solid act as a simple pendulum, gradually coming to rest from some start position. See Figure A-9.

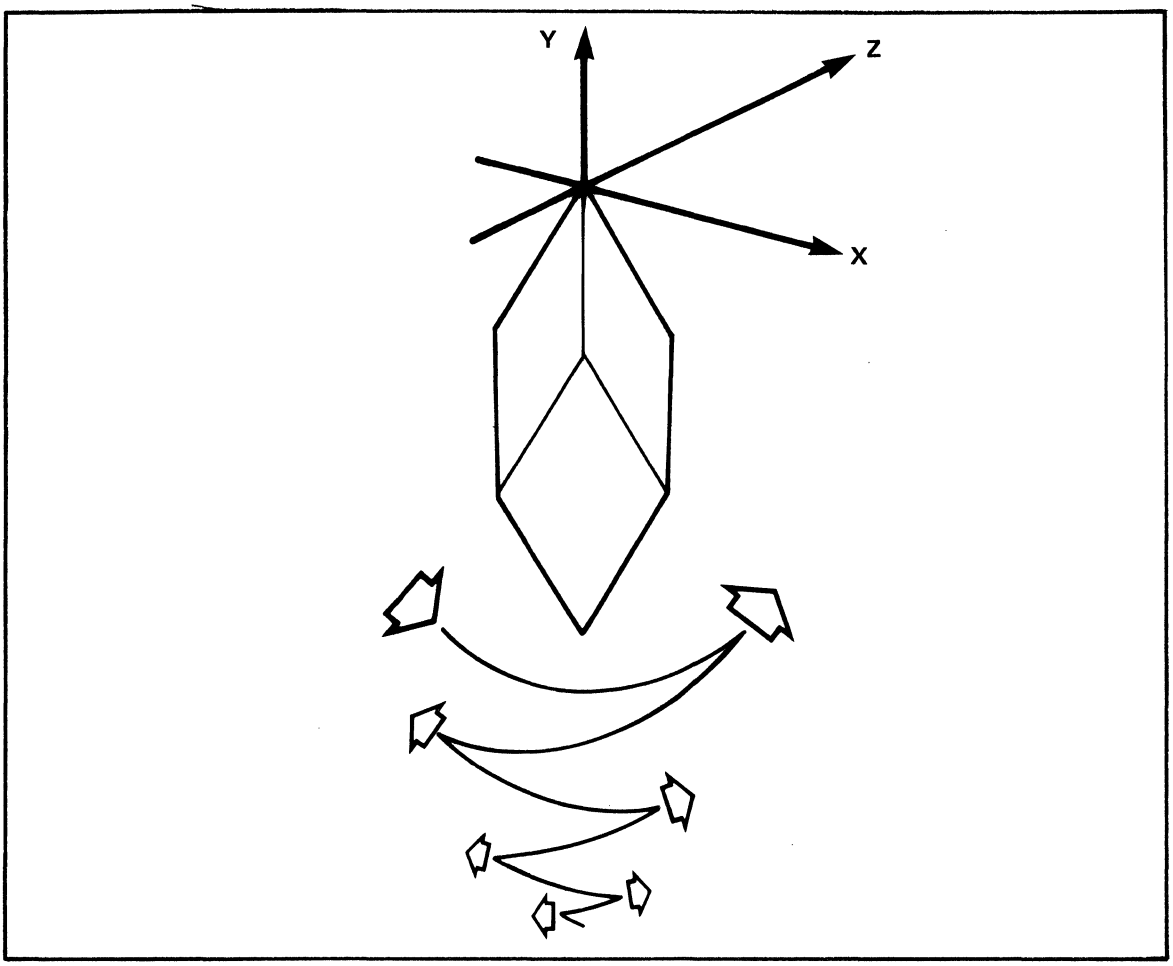

Figure A-9. Pendulum

10. RECTANGULAR SOLIDS AND CUBES

The rectangular solids are a particular sub-class of the general family the has just been described. The cube is a member of this sub-class. All rectangular solids have the following property:

$$\Theta_1 = \Theta_2 = \Theta_3 = 90.$$

Further, the cube has the additional property of:

$$h_1 = h_2 = h_3 = S \text{.....some constant}$$

The following parameter listing will generate a general rectangular solid. See Figure A-10. Only parameter values that change are given. Using one or several of the following parameters, the dimensions shown in Figure A-3 should be produced.

- LT and BR crops
- Aspect
- Source size

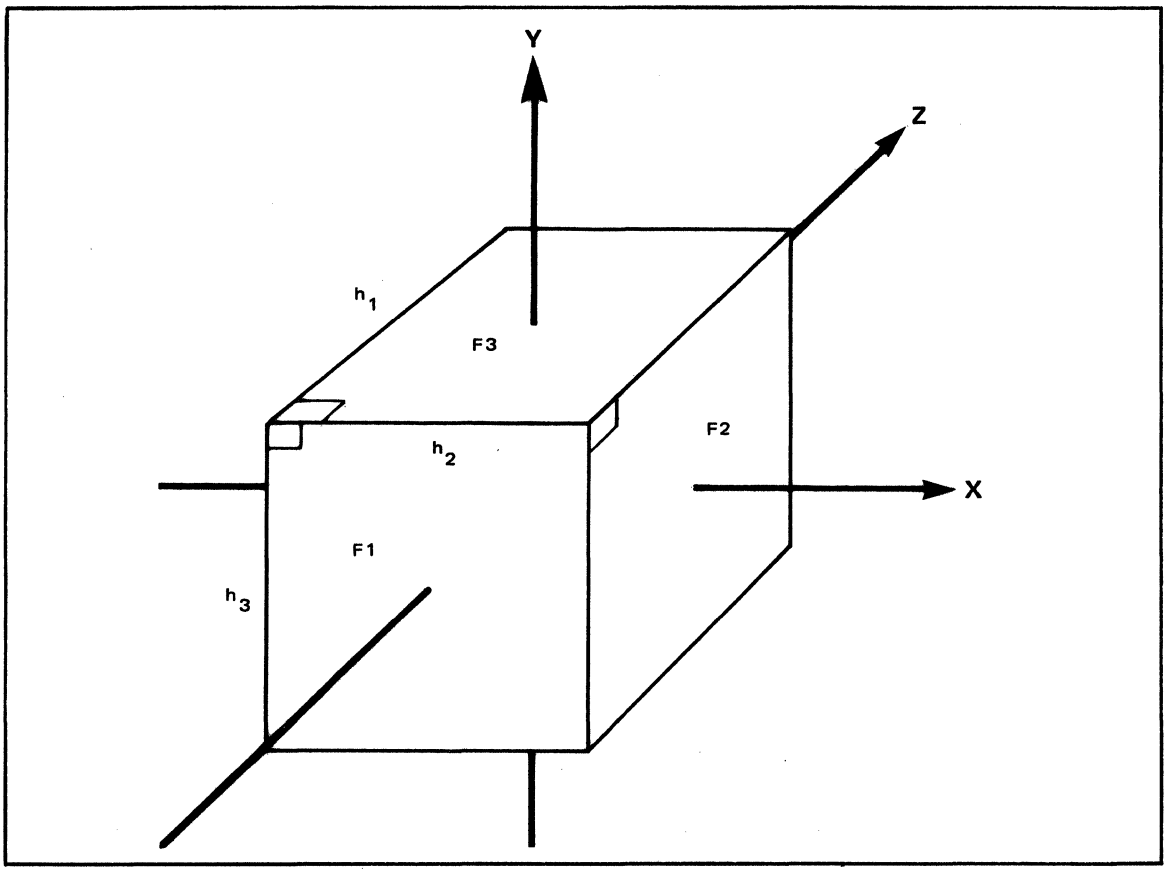

Figure A-10. Rectangular Solid

10-1 Face 1 Parameters

$$\text{Z-axis} = -\frac{h_1}{2}$$

10-2 Face 2 Parameters

$$\text{Z-axis} = -\frac{h_2}{2} \qquad \text{X-rotate} = 0.25$$

10-3 Face 3 Parameters

$$\text{Z-axis} = -\frac{h_3}{2}$$

Y-rotate = 0.25

11. EXAMPLE: THE CUBE

The following table will generate a cube with sides of six-unit length; i.e., S = 6

Face	F1	F2	F3
L-Crop	-3.0000	-3.0000	-3.0000
R-Crop	3.0000	3.0000	3.0000
Z-Axis	-3.0000	-3.0000	-3.0000
X-Rotate	0.0000	0.2500	0.0000
Y-Rotate	0.0000	0.0000	0.2500

- Left and right crops are used to set the facial dimensions.
- Use global Z-locate to move the cube so it can be fully viewed.

12. PROGRAM LISTING FOR THE HEWLETT-PACKARD HP-41C/41CV PROGRAMMABLE CALCULATOR

The following is a list of a program that does the calculations in paragraph 2 of this paper. This listing is for the HP-41 calculator and it adheres to the format used by Hewlett-Packard in their manuals distributed with the HP-41. The program can be adapted for other programmable calculators without trouble.

The HP-41C requires at least one memory module to accommodate the program. Parameters to enter into the CPP are computed and displayed for each of the three faces of the solid. The single digit suffix on a variable name (e.g. YROT2, ZAXS3) indicates which face is being referred to.

Table A-1. Main Program

Listing		Comments
01	LBL ^{T} SOLID	Program Name
02	^{T} ANG1	Prompt for angle 1
03	PROMPT	
04	STO 00	Save angle 1
05	^{T} ANG2	Prompt for angle 2
06	PROMPT	

(Continued next page)

Table A-1. Main Program (Continued)

Listing		Comments
07	STO 01	Save angle 2
08	^{T} ANG3	Prompt for angle 3
09	PROMPT	
10	STO 02	Save angle 3
11	^{T} DIM1	Prompt for dimension 1
12	PROMPT	
13	STO 03	Save dimension 1
14	^{T} DIM2	Prompt for dimension 2
15	PROMPT	
16	STO 04	Save dimension 2
17	^{T} DIM3	Prompt for dimension 3
18	PROMPT	
19	STO 05	Save dimension 3
20	0	Setup pointers for φ_1
21	STO 11	
22	STO 14	
23	1	
24	STO 12	
25	2	
26	STO 13	
27	XEQ ^{T} PHI	Calculate φ_1
28	ACOS	
29	STO 06	Save φ_1 for latter use
30	XEQ ^{T} SKEW	Calculate skew of face 1
31	^{T} SKEW1	Print answer
32	XEQ ^{T} DIS	Display answer
33	6	Setup pointers for x axis of face 1
34	STO 12	
35	3	

(Continued next page)

Table A-1. Main Program (Continued)

Listing		Comments
36	STO 14	
37	XEQ ^{T} XAXIS	Calculate x axis of face 1
38	^{T} XAXS1	
39	XEQ ^{T} DIS	Display answer
40	XEQ ^{T} YAXIS	Calculate y axis of face 1
41	^{T} YAXS1	
42	CHS	
43	XEQ ^{T} DIS	Display answer
44	XEQ ^{T} ZAXIS	Calculate z axis of face 1
45	^{T} ZAXS1	Display answer
46	XEQ ^{T} DIS	
47	6	Setup pointers for y rotation of face 1
48	STO 11	
49	XEQ ^{T} SKEW	Calculate y rotation
50	^{T} YROT1	Display answer
51	XEQ ^{T} DIS	
52	1	Setup parameters for φ_2
53	STO 11	
54	STO 14	
55	0	
56	STO 12	
57	XEQ ^{T} PHI	Calculate φ_2
58	ACOS	
59	STO 07	Save φ_2 for later
60	XEQ ^{T} SKEW	Calculate skew for face 2
61	^{T} SKEW2	Display answer
62	7	Setup pointers for x axis of face 2
63	STO 12	

(Continued next page)

Table A-1. Main Program (Continued)

Listing		Comments
64	4	
65	STO 14	
66	XEQ ᵀ XAXIS	Calculate x axis for face 2
67	CHS	
68	ᵀ XAXS2	Display 2
69	XEQ ᵀ DIS	
70	XEQ ᵀ YAXIS	Calculate y axis for face 2
71	ᵀ YAXS2	Display answer
72	XEQ ᵀ DIS	
73	XEQ ᵀ ZAXIS	Calculate z axis for face 2
74	ᵀ ZAXS2	Display answer
75	XEQ ᵀ DIS	
76	RCL 02	Calculate x rotation for face 2
77	360	
78	/	
79	ᵀ XROT2	Display answer
80	XEQ ᵀ DIS	
81	7	Setup pointers for y rotation of face 2
82	STO 11	
83	XEQ ᵀ SKEW	Calculate y rotation for face 2
84	CHS	
85	ᵀ YROT2	Display answer
86	XEQ ᵀ DIS	
87	2	Setup pointers for skew of face 3
88	STO 11	
89	XEQ ᵀ SKEW	Calculate skew for face 3
90	ᵀ SKEW3	Display answer
91	1	Calculate x axis of face 3

(Continued next page)

Table A-1. Main Program (Continued)

Listing		Comments
92	RCL 00	
93	TAN	
94	RCL 06	
95	COS	
96	*	
97	RCL 02	
98	TAN	
99	/	
100	-	
101	RCL 00	
102	COS	
103	*	
104	RCL 05	
105	*	
106	2	
107	/	
108	^{T} XAXS3	Display answer
109	XEQ ^{T} DIS	
110	0	Setup pointers for y axis of face 3
111	STO 11	
112	1	
113	STO 12	
114	2	
115	STO 14	
116	XEQ ^{T} PHI	Calculate y axis for face 3
117	RCL 05	
118	*	
119	2	
120	/	

(Continued next page)

Table A-1. Main Program (Continued)

Listing		Comments
121	ᵀ YAXS3	Display answer
122	0	Setup pointers for z axis of face 3
123	STO 12	
124	6	
125	STO 13	
126	5	
127	STO 14	
128	XEQ ZAXIS	Calculate z axis for face 3
129	ᵀ ZAXS3	Display answer
130	.25	
131	ᵀ YROT3	Display y rotation for face 3
132	XEQ ᵀ DIS	
133	END	

Table A-2. Subroutine DIS

Listing		Comments
01	LBL ᵀ DIS	This routine displays the answers
02	10000	Round off to four decimal places
03	*	
04	INT	
05	10000	
06	/	
07	ARCL X	Append X register into the Alpha register
08	PROMPT	Display answer
09	END	

Table A-3. Subroutine PHI

Listing		Comments
01	LBL ^{T} PHI	This subroutine does the equation:
02	RCL IND 12	$\frac{\cos\vartheta_a}{\sin\vartheta_d}\left[\frac{\cos\vartheta_b}{\cos\vartheta_a \sin\vartheta_c} - \frac{1}{\tan\vartheta_c}\right]$
03	COS	
04	RCL IND 11	
05	COS	Where:
06	/	
07	RCL IND 13	ϑ_a is pointed to by register 11
08	SIN	ϑ_b is pointed to by register 12
09	/	ϑ_c is pointed to by register 13
10	RCL IND 13	ϑ_d is pointed to by register 14
11	TAN	
12	1/X	
13	-	
14	RCL IND 11	
15	COS	
16	RCL IND 14	
17	SIN	
18	/	
19	*	
20	END	

Table A-4. Subroutine Skew

Listing		Comments
01	LBL ^{T} SKEW	This subroutine does the equation:
02	90	$\frac{90 - \vartheta_a}{360}$
03	RCL IND 11	
04	-	
05	360	
07	/	Where:
08	END	
		ϑ_a is pointed to by register 11

Table A-5. Subroutine X-Axis

Listing		Comments
01	LBL ^{T} XAXIS	This subroutine does the equation:
02	RCL IND 13	$\frac{h_d}{2} \frac{\sin\vartheta_c \cos\vartheta_b}{\tan\vartheta_a} - \cos\vartheta_c$
03	SIN	
04	RCL IND 12	
05	COS	
06	*	
07	RCL IND 11	
08	TAN	Where:
09	/	
10	RCL IND 13	ϑ_a is pointed to by register 11
11	COS	ϑ_b is pointed to by register 12
12	-	ϑ_c is pointed to by register 13
13	RCL IND 14	ϑ_d is pointed to by register 14
14	*	
15	2	
16	/	
17	END	

Table A-6. Subroutine Y-Axis

Listing		Comments
01	LBL ^{T} YAXIS	This subroutine does the equation:
02	RCL IND 13	
03	SIN	$\frac{h_d}{2} \frac{\sin\vartheta_c \cos\vartheta_b}{\sin\vartheta_a}$
04	RCL IND 12	
05	COS	
06	*	
07	RCL IND 11	
08	SIN	
09	/	Where:
10	RCL IND 14	
11	*	ϑ_a is pointed to by register 11
12	2	ϑ_b is pointed to by register 12
13	/	ϑ_c is pointed to by register 13
14	END	h_d is pointed to by register 14

Table A-7. Subroutine Z-Axis

Listing		Comments
01	LBL"ZAXIS	This subroutine does the equation:
02	RCL IND 13	
03	SIN	$\frac{h_d}{2} \sin\vartheta_c \sin\vartheta_b$
04	RCL IND 12	
05	SIN	
06	*	
07	RCL IND 14	Where:
08	*	
09	2	ϑ_b is pointed to by register 12
10	/	ϑ_c is pointed to by register 13
11	CHS	h_a is pointed to by register 14
12	END	

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