Kuper Controls

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HARDWARE INSTALLATION

Make certain the computer is turned off. Remove the computer's cover. The Kuper Card may be plugged into any available bus slot, including VL and PCI slots. In some cases you may need to rearrange the positions of pre-existing cards in order to accommodate the Kuper Card. Verify that the Card is not pressing down on any RAM chips, wire connectors, or similar obstructions when it is fully seated. It is okay for the bottom of the Card rests on unused portions of the same row of bus connectors. If possible, locate the Card so it is not directly over the large brown CPU chip, so as not to obstruct air circulation over the CPU.
We recommend that you route the "JP4 Encoder" ribbon cable to an I/O opening on the solder side (the side without chips) of the Card. If you don't plan to use any encoders (joysticks), you may simply remove the JP4 cable. If your computer's case has punch-out DB25 openings, route the "JP5 RTMC Logic" ribbon cable to one of these openings; otherwise bring out the RTMC Logic ribbon cable through an I/O slot using the supplied "L" bracket adapter. The DB37 "JP1 Axes 1 - 16" cable brings out the step and direction pulses, and is best located on the "chip" side of the Card. Refer to the drawings on the last few pages of the Kuper Manual for pin assignments.
The RTMC48 Card has two connectors mounted on the end of the Card, one on top of the other. The larger DB25 connector is for the Jogbox. Connect the Jogbox using the supplied cable. The smaller DB15 "Accessory" connector handles connections to external cameras, timecode, video & camera sync, relay operated devices, and flash sync. For more information on the Accessory connector, refer to the drawing "DB15 Accessory Connector" in the last few pages of the Kuper Manual. For your initial testing, note that the Kuper Software will run without any connections to the DB15 Accessory connector, without any motors connected, and even without the Jogbox plugged in.

SOFTWARE INSTALLATION

You only have to go through these software installation steps one time. Once the computer is closed and running, place the supplied Software Disc in the 3.5 inch floppy drive. Make a new hard disc directory, and copy all the files from the floppy disc to the new directory. Assuming the 3.5 inch floppy is drive "A:", a typical sequence would be: (what you type is shown in bold type)

`C:>md kuper` *{press the Enter key)* `C:>cd kuper` *{press the Enter key}* `C:\KUPER>copy a:*.* /v` *{press the Enter key}*

If your 3.5 inch drive is drive "B:", the last line above would be

`C:\KUPER>copy b:*.* /v` *{press the Enter key}*

It will take a few moments for the files to copy from the floppy disc to the hard disc. After the disc activity stops, start the Kuper Software by typing:

C:\KUPER>rtmcl30 *{press the Enter key}*

It takes a few seconds for the program to load and run. You should see the familiar Control Panel Screen within no more than 10 seconds. If not, please call Kuper at 310-414-0701.

EVERYDAY USAGE

After the computer has finished its bootup sequence, change to the Kuper directory, and run the RTMC130.EXE program:

`C:>cd kuper` *{press the Enter key}* `C:\KUPER>rtmcl30` *{press the Enter key}*

When you are done, use the "QUIT" command on the main Control Panel Screen to leave the Kuper Software and return to the "C:" prompt. While it is technically acceptable to simply turn off the computer while still in the Kuper Software, the more rigorous use of the "QUIT" command offers some protection against accidentally losing an unsaved move or "AxisSetup" configuration. If you are running the Kuper Software from a "Stacked" or "DoubleSpaced" hard disc, we strongly recommend that you turn off the computer power only when the "C:" prompt is displayed.

Please note that while it is possible to launch the Kuper Software from within Windows, we discourage you from doing so. Windows can exact a heavy performance and resource penalty on DOS programs launched from it, and is certainly of no benefit to such programs.

IF THE JOGBOX DOESN'T WORK

The cable leading from the Jogbox should connect to the female DB25 connector mounted on the Kuper Card and available at the back of the computer. Note that the Printer Port and RTMC Logic connectors are also female DB25 connectors. Plugging the Jogbox into the a Printer Port or the RTMC Logic connector will not cause any damage, but only the Kuper Card connector will work.

INSTALLATION PROBLEMS

There are certain rare circumstances which can prevent the Kuper Software from running correctly. If the Control Panel Screen does not appear, please check to see if the mouse is plugged in, and then bring the telephone as near to the running computer as possible and give us a call at 310-414-0701. If you are "DOS aware" you might want to run down this list first:

* The mouse driver is not properly installed, or not loaded, or the mouse is not plugged in.
* There may be a network card, "bus mouse" card, MIDI card, or other type of card installed in the computer which uses the same interrupt line (#5) and address range (300 to 3 IF hex) as the default Kuper Card settings. Please call us before changing any jumpers.
* On systems with less than 8 megabytes of RAM, the DOS "smartdrv.exe" program is using too much memory, and should be removed from the bootup files.
* The "device=c:\dos\himem.sys" statement is missing from the "config.sys" file.
* The video card is not a VGA type.

* If you are using QEMM it may be hogging too much memory. QEMM is of no benefit to the Kuper Software, and should be removed from config.sys.
* EMM386 causes problems on certain types of motherboards, and should be removed from the bootup files.
* A very small number of motherboards will not work correctly with our normal 32 bit DOS extender software. Call us to obtain an alternative DOS extender at no charge.
* There is a conflicting device driver or TSR program loaded into memory.
* The BIOS Setup configuration is too quirky.
* The CPU is a -SX, -SL, or other type without a math co-processor chip.
* You are trying to run the Kuper Software from outside of its directory. You can only run the Kuper Software from within its own directory, even if the Kuper directory is in the path statement.

The above problems are the exception, and the Kuper Software runs well on almost all systems with no modifications to autoexec.bat or config.sys, or to the BIOS Setup configuration. Under normal circumstances the only really worthwhile modification is simply to remove the "smartdrv.exe" statement from the autoexec.bat file — this typically results in several thousand more frames of move length being available.

"AUTOEXEC.BAT" FILE FOR DEDICATED MOTION CONTROL

prompt pg c:\mouse\mouse

"CONFIG.SYS" FILE FOR DEDICATED MOTION CONTROL

device=c:\dos\himem.sys device=c:\dos\setver.exe

If you plan to also run Microsoft Windows programs on your computer, you will probably want to leave your autoexec.bat and config.sys files unmodified. The above Spartan bootup files are intended for systems dedicated to motion control, and will give the maximum possible system resources to the Kuper System. The Kuper Software is written in 32 bit protected mode, and does not benefit from the fidgeting typical autoexec and config files go through in order to accommodate 16 bit programs in the limited first megabyte of memory. The Kuper Software can directly access all the memory in the computer (up to 32 megabytes) and simply does not require the assistance of QEMM, EMM386, "LoadHigh", "UMB", and the like, all of which were designed to overcome the fundamental memory access limitations of 16 bit programs.

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RTMC16 TO RTMC48 UPGRADE INSTALLATION

Remove the RTMC16 card, leaving the ENCODER SIGNALS and RTMC LOGIC ribbon cables with the computer. Look at jumper JP5 on the RTMC 16 card near the bus connector. If RTMC 16 JP5 is connected center pin to top pin, adjust RTMC48 jumpers JP6, JP7, and JP8 to connect the center pin to the pin to your left. If RTMC 16 JP5 is connected center to bottom, adjust RTMC48 jumpers JP6, JP7, and JP8 center to your right. Before installing the RTMC48 card, locate connectors JP4 and JP5 near the top of the RTMC48 card, since it is not possible to see the white letters when the card is in the computer. Insert the RTMC48 card into any bus slot inside the computer. Attach the ENCODER SIGNALS ribbon cable to jumper JP4 on the RTMC48 card. Attach the RTMC LOGIC connector to jumper JP5 on the RTMC48 card. Be sure the two ribbon cable connectors are properly oriented to the pins, and not shifted one pin up/down or left/right. The red side of both ribbon cables should be oriented towards the front (operator side) of the computer, the same as they were with the RTMC 16 card.

Remove the old Jogbox cable with the three way split at one end. Install the supplied new Jogbox cable between the DB25 connectors on the RTMC48 card and the Jogbox.

Note that with the RTMC48 Card the Black Box is not required in order to use the Jogbox. With the RTMC 16 Card, the Black Box was required to supply power to the Jogbox. With the RTMC48 Card, the Jogbox plugs directly into the Card through a single pin to pin cable.

If want to use a Black Box in conjunction with the RTMC48 card, you must make a minor modification to the Black Box. If you do not make the modification the encoder in your Jogbox will not operate correctly, but no damage will occur. Open the Black Box. Remove chips U3 and U4. Bend up pin 9 on both chips*, and replace the chips so the bent up pins no longer make contact with the sockets. Close the Black Box. This disables encoder #16 on the Black Box. Encoder #16 is the encoder inside the Jogbox, and feeds through the new Jogbox cable directly to the RTMC48 card.

All RTMC48 connector pinouts are the same as for RTMC 16. The step and direction signals come out through the DBS 7 connector on the supplied ribbon cable/L-bracket.

Please call if you need assistance. 310-414-0701.

*To locate pin 9 on U3 and U4, position the Black Box so the letters "74LS244" on the chips read in the normal left to right orientation. Just below "74LS244" is a row of 10 pins. Pin 9 is ninth in from your left, or the second pin in from your right. Don't worry, nothing bad will happen if you pick the wrong pin. If the encoder in the Jogbox works correctly, you got the right pin. When you put U3 and U4 back in their sockets, check Ul and U2 for the proper chip orientation ~ the letters should have the same orientation for all chips. U3 and U4 are interchangeable, so you don't need to keep track of which is which.

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"RTMC130B" BETA TEST UPDATE

November 23, 1993 **SOFTWARE**

Automatic hardware camera and focus homing capabilities have been added. Contact Kuper for more information.

In the "Options" command, the new "Emergency Stop %" parameter box sets how aggressive emergency stops will be — if 100% is selected, emergency stops ramp down at the assigned "Slew Deceleration" parameter assigned with the "AxisSetup" command; if 50% is selected, emergency stops occur in 1/2 the "Slew Deceleration" times. The parameter applies to all axes.

The same physical copy of the RTMC130B software can now be used for both RTMC48 and RTMC16 Cards. In order to use RTMC130B with an RTMC16 Card, there must be a file located in the Kuper directory named "RTMC16" with no extension. The file can contain anything ~ the simple presence of the file signals the software to configure itself for the RTMC16 card. It may be convenient to simply copy the small "RTMC.ENV" to "RTMC16" (at the DOS prompt, type "copy rtmc.env rtmcl6" and press the Enter key). Note that the RTMC16 file must NOT be present on the directory when an RTMC48 is being used.

The Virtual Axes have been considerably improved since the previous version. Problems with "chirps" when entering or leaving Virtual Axes have been corrected. For this version only, the virtual axes will be automatically turned off whenever you load a move or load a new axis setup file. Assuming the newly loaded axis parameters are correct for the hardware, just turn the Virtual Axes on again with the Jogbox "JOG32 + JOYSTAXIS" key combination or with the Mode Set menu item.

The new "pd" (Pull Down) command is primarily intended to setup parameters relating to camera operation, but is also playing temporary host to one or more other new parameters which will ultimately migrate to other menus. The "Kuper Encoder Handles" checkbox tells the system if the new Kuper Encoder Handles Box is installed, which allows the handles operator to change joystick sensitivity, smoothing, and some other related parameters directly from the joysticks via a small keypad. As of this date, clicking the Encoder Handles Options without the hardware device actually installed can lock up the software. Contact Kuper for more information.

Exposure and synthetic shutter angle accuracy have been finely calibrated over all the various shooting modes. Exposure accuracy is now better than one percent, comparing any shooting mode to any other. Synthetic shutter angles are also accurate to better than 1/2 percent. Please be sure to use the "pd" command or the "UtilFiles: 4Perf / SPerf' menu item to program the correct physical shutter angle for your camera.

It is now possible to set absolute position Software Limits with the "Hardset: Set Position Limits" menu item. When enabled, the absolute position limits are active at all times. This differs from "Joystick Limits" which are only active when an axis is under joystick control.

Some New **Two Letter Commands:**
em Exponent Moves. Creates simple move curves with exponential inflections.
ct Compensated Trucks. Creates a move curve such that the percentage change in field of view over any given time interval remains constant. Use for "Cosmic Zooms" or to maintain the same apparent rate of motion when cutting between trucks on images of different sizes. For this effect to work properly, the track "0.000" position should place the center of the lens inside the plane of the subject — use "AxisSetup:Homeposition" to place the track home position safely in front of the subject.
br Build Ramps. Force an existing move curve to decrease to zero velocity starting with the first frame number parameter and reaching 0 velocity by the second frame number parameter. Selecting the numerical order of the frame number parameters causes the effect to work either forwards or backwards from the starting frame number. Often useful after "AddHolds" (ah).
ie Impose Eases. Superimposes an casein, easeout over an existing move curve. Same effect as the "Redistrib" command, without having to create a parameter file. Input a "0" parameter to prevent eases at either end of the move. Rearranges the move timing in the course of adding the eases, so it may sometimes be desirable to use the sequence "ah" (AddHolds) and "br" (Build Ramps) to preserve all the timing qualities of the original move, at the expense of adding move length.
ps Pull Set. Create a series of keyframes at regular frame intervals. Pulls the keyframe positions from the existing move curve. Quick method for making keyframe moves out of joystick moves.
ds Delete Set. Delete all the keyframes with a range of keyframe numbers.
ec Extend Curve. Extends the existing move curve starting with the given frame number. The acceleration or deceleration of the original curve is extrapolated into the newly created curve. Can create a strongly inflected curve if invoked at a frame number with high acceleration. Works both forward and backward.
el Extend Linear. Extends the existing move curve by maintaining the existing velocity at the starting frame, with 0 acceleration. Works forward and backward.
rq Reload Quit conditions. The operator can elect to reload any or all of the following conditions as they were when the Kuper Software was last exited using the Quit menu item: Axis positions, AxisSetup information, and/or the move data in memory. Protects you from forgetting to save important data, but only if you always exit the software through the "Quit" command.
bl Intended to BLend together discontinuities over a specified range in the move. This is really just the mouse oriented SmoothPart command restated in command line format.

HARDWARE

Several clients have experienced trouble when using an Arriflex BL motor as the source for the synchronization input on the RTMC48 Card. The typical problem is that the camera shuts down after only a few seconds of operation. The cause of the problem is that the shutter pulse driver chip in the camera motor electronics has very low line drive capability, and goes into shutdown when loaded even by the relatively modest current requirements of the RTMC48 pin 4 "Shutter Pulse In" signal. To correct this problem, you can either replace R6 on the RTMC48 with a 1000 ohm 1/4 watt resistor, or place a 1000 ohm resistor in series with the pin 4 sync input, inside the connector. We have supplied RTMC48 Cards with a 1000 ohm resistor at R6 for the last several weeks. If you are not certain about your card, locate R6 at the upper right corner of the card, and check that the color bands are BROWN BLACK RED GOLD -- if not, please replace R6 or contact Kuper. This change does not seem to interfere with other camera sync pulses such as Fries and Panavision.

The sensitivity of the RTMC48 Card timecode input was originally set for professional level sources such as timecode generators, address track outputs, and other equipment with strong output signals. However, this original preset level is marginal for low level outputs such as stereo cassette decks and other consumer grade devices. **If you are having trouble getting good timecode response, we recommend changing RIO to 5 600 ohms (GREEN BLUE RED GOLD), and the unmarked resistor just below D3 to 1 000 000 ohms (BROWN BLACK GREEN GOLD).** This increases the sensitivity into the consumer equipment range, and so far has not caused problems with higher level sources. All recent RTMC48 Cards have this modification when shipped.

If you wish, Kuper will make any of the above modifications free of charge. Please contact us for further information.

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December 6, 1994

NEW **JOGBOX KEY COMBINATIONS**

The labels on the Jogbox command keys name the basic function of each key. It is possible to access several functions beyond the basic functions by pressing Jogbox keys in special combinations and sequences.

Send an axis to a specific absolute position.

* Press and hold JOGS2, tap GOTO HOME POSN, release all keys.
* In response to the "GOTOPOSN" prompt, enter a motor position and press ENTER
* SELECT AXES to go to the position (normally only one) and press ENTER

Initialize one or more axes to a non-zero motor position.

* Tap SET HOME POSN and observe the "AXES TO JOGZERO" prompt.
* SELECT AXES to initialize to the same non-zero motor position (normally only one axis), **then tap the 15+ key instead of the ENTER key.**
* In response to the "NEW POSN" prompt, enter the new position, and tap ENTER.
* Don't confuse this with "Automatically calibrate the pulses per unit for axes" as described below.

Automatically calibrate the pulses per unit for axes.

* Use the SET HOME POSN command to set the motor positions for the axis / axes to calibrate to 0.000.
* Jog or joystick the axis to a known, non-zero position such as 100 inches, 90 degrees, etc. Move the axis to the actual physical position, ignoring the yet uncalibrated numbers displayed on the Jogbox.

» Tap SET HOME POSN

* SELECT AXES the axes to calibrate (normally only one), **then tap the 15- key instead of the ENTER key.**
* In response to the "CALIBRAT" prompt, enter the desired motor position to correspond to the current motor position. Tap ENTER to complete. The Pulses Per Unit will automatically be adjusted. Use UtilFiles:Save Default Setup to make the changes permanent.
* Don't confuse this with "Initialize one or more axes to a non-zero motor position", above.

Set the axis slewing speed (especially useful for Virtual axes).

* Place the axis on the jogbox joystick by pressing the JOYST AXIS key, and then tapping the axis select key ^t the top of the Jogbox.
* Make sure the axis is in velocity mode. Tap the POSN/VELO key once if the axis is in position mode.

» Turn the joystick knob until the axis is running at the desired slewing speed.

* Press the 16* key. As long as the 16f key is pressed, the axis slewing speed will be displayed on the Jogbox display. When the 16* key is released, the axis will automatically slow to a stop, and the speed at the time you released the 164 key will be recorded in the

AxisSetup "Slew Speed in PPS" parameter. Use UtilFiles:Save Default Setup to make the changes permanent.

Hold open the camera shutter for X framing.

* Tap WIND CAMERA.
* Press and hold down the 15- key to open the shutter.
* Release the 15- to close the shutter.

Automatically wind 16 frames.

» Tap WIND CAMERA

* Tap the 16+ key. The camera winds at either 1/8 or 1/2 second, depending on which of the next two special key combinations was last used.

Wind one frame at 1/8 second.

* Tap WIND CAMERA
* Tap the 15+key.

Wind one frame at 1/2 **second.**

'* Tap WIND CAMERA

* Tap the 16- key.

Place the camera movement in Vista Vision loading position.

* Tap WIND CAMERA
* Tap and release the 14+ to move to loading position. » Tap any key to rephase the movement.

Adjust the move data to make the move data for a particular move frame number match the current axes positions.

* Move the axes to the desired position.
* Press and hold JOG32, tap SET HOME POSN, release all keys.
* In response to the "MAKETHIS" prompt, enter the move frame number to equal the current axes position, tap ENTER.
* SELECT AXES to modify, tap ENTER.

Enter Browsing Mode from the Jogbox.

* Press and hold JOG32, tap LIST KEYS, release all keys.
* In response to the "BROWZ FR#" prompt, enter the move frame number at which to start browsing, tap ENTER
* SELECT AXES to actually browse, tap ENTER
* The selected axes immediately move to the selected frame number position. **TO CANCEL AND STOP THE AXES, press any of the command keys at the bottom of the Jogbox.**
* Once the axes reach their positions, use the Joystick knob like a tape deck shuttle.
* Tap the POSN/VELO key to change between position and velocity browsing responses.
* To stop browsing, tap EMER STOP or press JOG32 and LIST KEYS together.

Turn automatic nodal point correction on and off from the Jogbox.
* Press and hold JOG32, tap STOP/CANCEL, release all keys.
» The real axes immediately start to move to the corresponding Virtual Axes positions.
TO CANCEL AND STOP THE AXES, press any of the command keys at the bottom of the Jogbox.
* To turn off the virtual axes, press JOG32 and STOP/CANCEL together.

Jog axes above axis 16.
* Press and hold JOG32, tap JOYST AXIS, release all keys.
* The jog keys "shift up" 16 axes (i.e. the 1- /1+ keys actually jog axis 17) and the display announces which axes will be jogged.
* Repeat the JOG32 + JOYST AXIS combination to toggle through various groups of axes.

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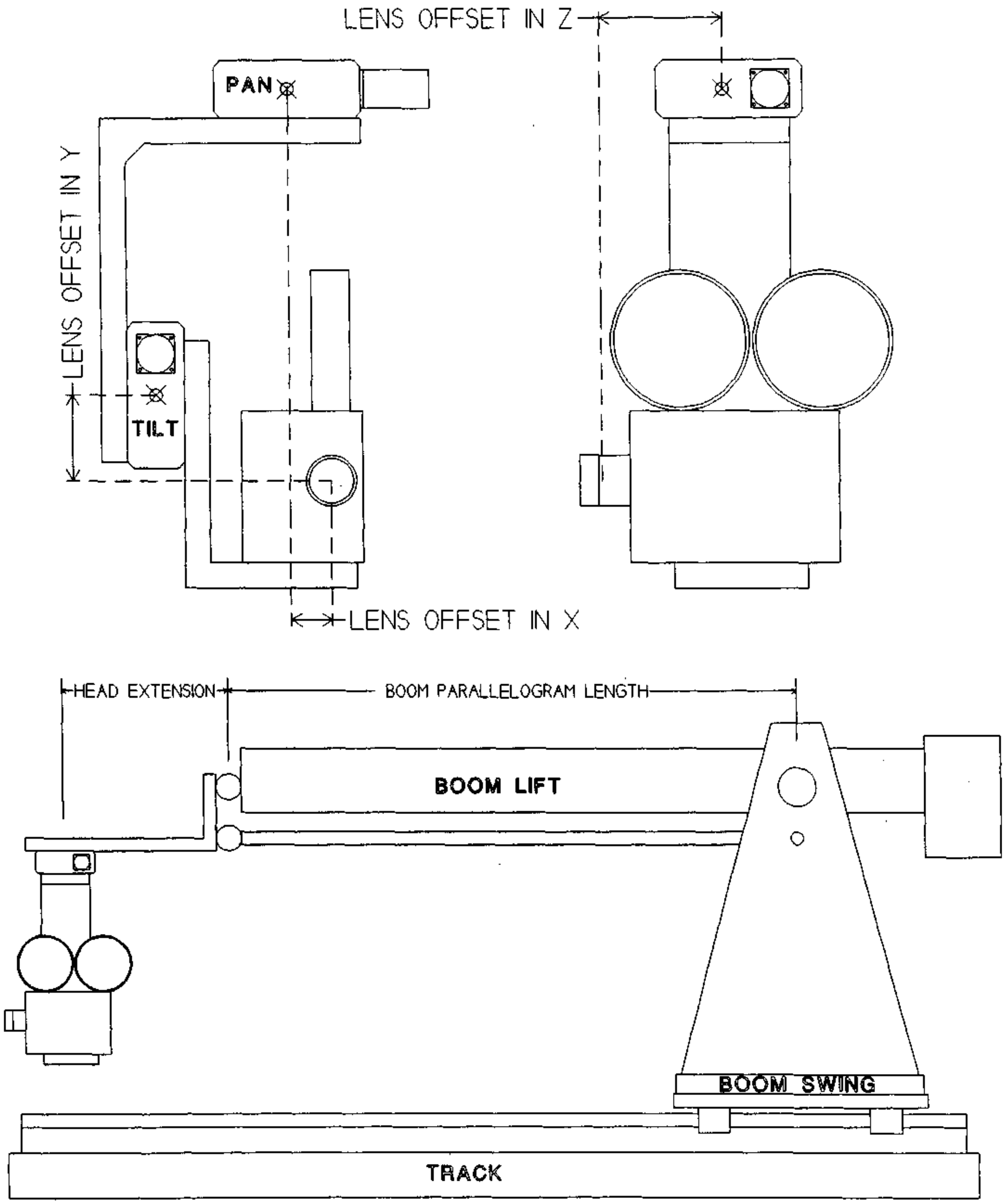

LENS OFFSET IN Z
PAN
LENS OFFSET IN Y
TILT
LENS OFFSET IN X
HEAD EXTENSION
BOOM PARALLELOGRAM LENGTH
BOOM LIFT
BOOM SWING
TRACK

January 3, 1994

The Virtual Axis System is operating very reliably as of this date, but is still under active development. The version of the software you are using may present slightly different prompts than shown in the illustrations. The terms "Virtual" and "Synthetic" are used here interchangeably to refer to the same thing, although in the future they will refer to distinctly different functions.

CALIBRATING THE VIRTUAL AXES

Before the Virtual Axes can be used, you must calibrate the real Pan, Tilt, Roll, Boom Swing, and Boom Lift axes in degrees of rotation, Track, and NS and EW (if present) in linear units such as inches or centimeters. The following mathematical sign conventions must be used. All directions are referenced to an operator looking through the camera viewfinder from behind the camera.

Pan: Panning to the right is in the + direction.

Tilt: Tilting up is in the + direction.

Roll: Rolling so the top of the image moves right is in the + direction.

Boom Lift: Moving the camera up is in the + direction.

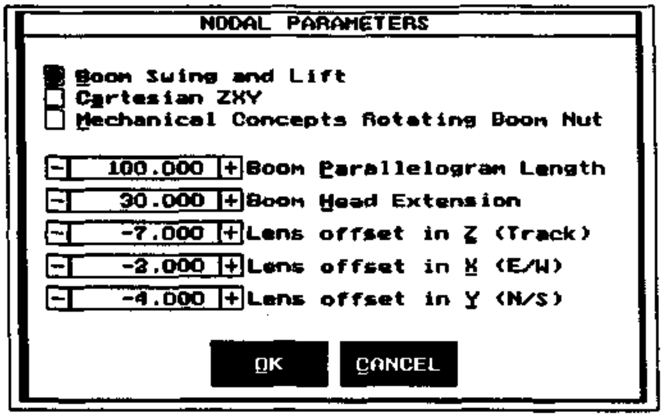
Boom Swing: Swinging to the operator's right is in the + direction.

Track moving forward is in the - direction. EW: Moving to the right is in the + direction. NS: Moving up is in the + direction.

Use the Jogbox or the MouseJog command to verify that the directions and units are correct.

From the Control Panel Screen, click on the "HardSet/Setup Nodal Parameters" command. Referring to the attached track camera diagram, make careful measurements of the various parameters, and enter them in the appropriate boxes. The more accurate your measurements, the better the Virtual Axes will operate. "Z" is track axis, "X" is the East/West axis, and "Y" is the vertical North/South axis. "Lens Offset in X" and "Lens Offset in Z" are referenced to the center of the Pan rotator, and "Lens Offset in Y" is referenced to the center of the Tilt rotator. All the offsets are linear measurements, in the same units used to calibrate the track axis.

In the "Nodal Parameters" illustration, the numbers shown approximate the track camera diagram. In the diagram, the lens is below the center of the tilt rotator, so its "Lens Offset in Y" is negative; if the lens were above the center of the tilt rotator, the number would be positive. Likewise, the lens is offset in X to the operator's left, so its "Lens Offset is X" is negative. The optical center of the Camera lens is about 7 units in front the of center of the Pan rotator, so its offset is -7.000 units -- remember that forward on the track is the negative direction, so since the lens is offset 7 units in the negative direction along the track axis, the offset is negative. If your system has the lens mechanically centered on the all the rotations, the three offsets would be "0.000".


NODAL PARAMETERS
Boom Swing and Lift
Cartesian ZXY
Mechanical Concepts Rotating Boom Nut
100.000 Boom Parallelogram Length
30.000 Boom Head Extension
-7.000 Lens offset in Z (Track)
-2.000 Lens offset in X (E/W)
-4.000 Lens offset in Y (N/S)
OK
CANCEL

"Boom Parallelogram Length" is the distance between the two swivel points of the Boom Lift axis. "Head Extension" is the distance between the Boom Parallelogram attachment point, and the center of the Pan rotator. "Head Extension" may be 0.000 if the Pan rotator is exactly centered below the Parallelogram attachment point. Note that Boom Parallelogram Length and Head Extension are both positive (actually, Absolute Value) numbers, even though they are measured along the track axis ~ life is not always consistent — but just remember the "Lens Offset in Z" must still be negative if it extends in front of the center of the Pan rotator.

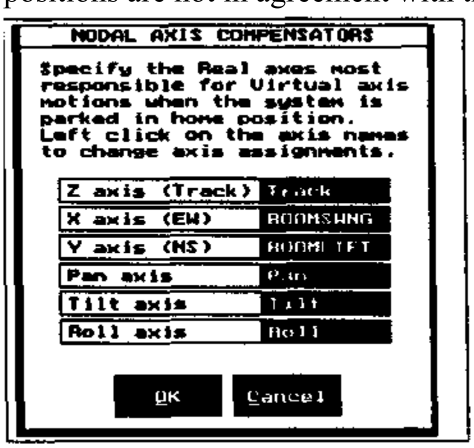
You must also tell the software which real axes will be involved in the process of compensating for the desire Virtual axis motions. Click on "HardSet/Setup Nodal Comp Axes", and fill in the appropriate axes by clicking on the axis names.

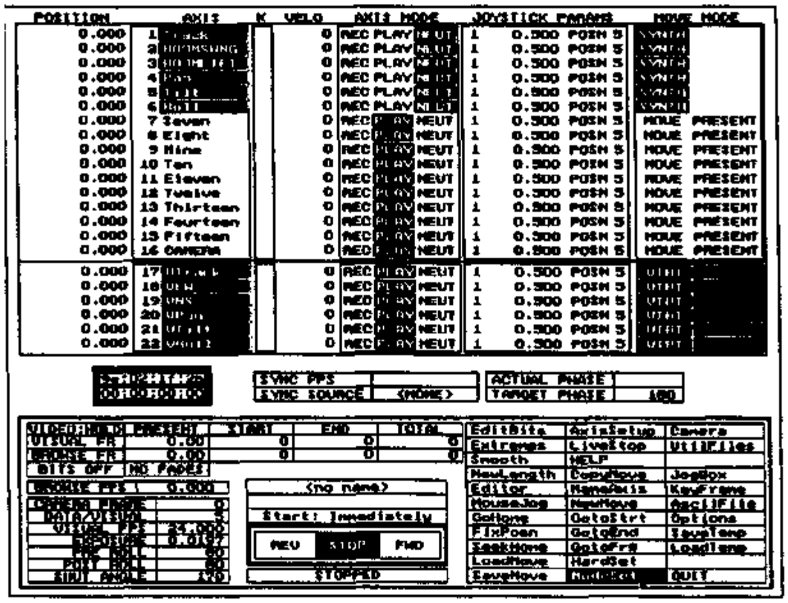
After your calibrations are completed, use the "UtilFiles" command to save the information on disc. If you click on "Save Default Setup", the information will be there the next time you boot up; if you use "Save Named Setup", you must specifically reload the information with the "UtilFiles/Load Named Setup" each time you boot up.

Before turning on the Virtual Axes, the "0.000" position for Pan, Tilt, Boom Lift, Boom Swing, and Track must all be as shown in the attached diagram. The Boom arm is level and parallel to the track. Tilt is level. Pan is looking straight ahead, parallel to the track. A line drawn between the center of the Boom Swing and Pan rotators would be parallel to the track. Jog all the real axes to the proper positions, and zero their motor counts with the "SET HOME POSITION" key on the Jogbox, or from the Control Panel Screen.

Also make sure that the Virtual Axes positions are all set to 0.000. The Virtual Axes positions can be set by left-clicking on the position number with the mouse, or through the MouseJog command. The Virtual Axes are listed just below the Real Axes, and are named VTrack, VEW (East/West), VNS (North/South), VPan, VTilt, and VRoll in the illustration. Note that the while the Real axes may be listed and Patch Motor'd in any order, the Virtual Axes functions are "hard-wired" in the order listed in the illustration, even though you can ReName them to anything. That is to say, the first Virtual Axes will always function as Virtual Track, the second Virtual as Virtual East / West, etc., no matter what their names are.

For safety, we had you position all the real and Virtual axes at their 0.000 positions before turning on the Virtual Axes. This is not strictly necessary, but if the real axes positions are not in agreement with the current Virtual Axes





POSITION
AXIS
K
VELO
AXIS MODE
JOYSTICK PARAMS
MOVE MODE
7 Seven
8 Eight
9 Nine
10 Ten
11 Eleven
12 Twelve
13 Thirteen
14 Fourteen
15 Fifteen
16 CAMERA
REC PLAY NEUT
0.500 POSN 5
MOVE PRESENT
SYNC FPS
SYNC SOURCE
<NONE>
ACTUAL PHASE
TARGET PHASE
180
PRESENT
START
END
TOTAL
VISUAL FR
BROWSE FR
BITS OFF
NO FADES
BROWSE FPS
CAMERA FRAME
DATA/VISUAL
VISUAL FPS
24.000
EXPOSURE
PRE ROLL
POST ROLL
SHUT ANGLE
170
<no name>
Start: Immediately
REV
STOP
FWD
STOPPED
EditBits
AxisSetup
Camera
Extremes
LiveStop
UtilFiles
Smooth
HELP
NewLength
CopyMove
JogBox
Editor
NameAxis
KeyFrame
MouseJog
NewMove
AsciiFile
GoHome
GotoStrt
Options
FixPosn
GotoEnd
SaveTemp
SeekHome
GotoFr#
LoadTemp
LoadMove
HardSet
SaveMove
QUIT

positions, the real axes will first move to the equivalent Virtual Axes positions, before taking up their Virtual functions.
Now turn on the Virtual Axes by tapping once on the Jogbox "JOG32" key to wake up the Jogbox, and then hold down "JOG32" and tap "STOP/CANCEL" once, and then release all keys. You can also use "ModeSet/Start Synthetic Axes" from the Control Panel Screen. If the real axes are not in the equivalent Virtual Axes positions, the real axes will slew to the equivalent Virtual Axis positions while "Going to Virtual" is displayed. In this example, the real axes should not move since we previously zero'd both real and virtual axes. If the real axes do move, "GOING TO VIRTUAL" will be displayed, during which time you can instantly cancel the Virtual mode and stop all the axes by tapping any of the lower 16 keys on the Jogbox.
Assuming you successfully entered Virtual Mode, the Control Panel Screen will arrange itself as show in the illustration above. On the Jogbox The first 6 pairs of + and - keys on the Jogbox will control the six Virtual Axes, while the next 10 pairs will control the corresponding real axes.

1-+ Virtual Track
2-+ Virtual EW
3-+ Virtual NS
4-+ Virtual Pan
5-+ Virtual Tilt
6-+ Virtual Roll
7-+ Real axis 7
8-+ Real axis 8 etc.

Try jogging Virtual NS with 34- key. The Boom should rise, while the real Track Axis moves slowly forward to keep the lens moving perfectly vertically. Jog Virtual EW with the 24- key. The Boom should swing to the right, the real Track move forward, and the real Pan backpan to move the lens on a linear EW track, constantly point forward. Jog Virtual Pan (4-+) and Virtual Tilt (5-4-) and observe that the lens swivels on center, while the real axes magically adjust themselves. Jogging the axes from 7-4- on up will simply jog the equivalent real axes.
If something seems wrong, turn off the Virtual Axes by holding down "JOG32" and tapping "STOP/CANCEL". Alternate use of this combination toggles the Virtual Axes on and off. You can also use "ModeSet/Stop Synthetic Axes". Check all your units calibrations. The most typical error is an axis with the wrong direction sense (ie. the axis moves in the wrong direction).
Assuming all is well, put Pan on the Joystick by tapping "JOYST AXIS" and then tapping the "4" key on the top row. Tap the "POSN/VELO" until the screen reads "POSITION" and gently move the Joystick knob. You may need to change the joystick smoothing with "JOYST SMUTH" key, or the sensitivity with the "JOYST GAIN" key. In general, the Virtual Axes can be treated exactly like the real axes. Trying Mouse Jogging the virtuals, use the "gm"~command, etc. From the Jogbox, jog the Virtual EW axis to about -30 degrees, and "MEMO DOUBL KEY" for keyframe 0.00. When the Virtuals are on, they "take over" the first 6 pairs of -4- keys from the real axes. Press the number "2" to take a keyframe for only the Virtual EW axis. Note that when you press the "2" key to "SELECT AXES" for keyframing, the axis letter "G" is displayed (if you have a sixteen axis system) instead of "2". For a sixteen axis system the SELECT

numbers for the Virtual Axes will display as GFflJKL for the jog keys 1 through 6, and the equivalent Virtual Axis name will be displayed as long as you hold down any of the 1 to 6 keys. Now Move Virtual EW to about 4-30.0 degrees, "MEMO DOUBL KEY" for frame 600, for only the Virtual EW axis. Press the "FITALL" key and fit only Virtual

EW, key # 2. Use "RUN REV" to run the move in reverse back to frame 0.00. Note than even though you took keyframes only on the Virtual EW axis, most of the real axes run automatically to maintain a perfectly linear EW path. This is one of the great advantages of the Virtual Axis systems ~ move making is greatly simplified. Imagine what a difference this could make with a long snorkel lens.

Do not attempt to directly run any of the compensating real axes while the Virtual Axes are running. Of course, you can still use the non-compensating real axes as before, you only need to avoid the real axes which do the nodal compensating. If you need to record a joystick move, put the Virtual Axes on REC, not the compensating real axes. Take keyframes on the Virtuals, not on the compensators. Most especially, do not try to zero out or change the motor position counts on the compensating real axes while the Virtuals are on — this "pulls the rug out" from under the Virtual System and can lead to dramatic crashes. If you need to re-zero the real axes, first turn off the Virtual Axes with the "JOG32" and "STOP/CANCEL" key combination, after which the real axes again become available from the first six pairs of jog-+ keys. Once the real axes are set to their proper 0.000 positions, re-engage the Virtuals by pressing "JOG32" and tapping "STOP/CANCEL". Note that if the positions for any of the Virtual Axes are not 0.000, some or all of the compensating real axes will immediately start to move to the equivalent Virtual Axis positions. If this happens, you can stop the compensators by tapping any of the lower 16 Jogbox keys, or pressing the emergency stop key. Usually, you would just let the compensating real axes move to the equivalent Virtual Positions, where they will automatically switch into Virtual mode. For most people, the least stressful entry into the Virtual mode occurs when all the compensating real axes and all the Virtual Axes are at position 0.000 when the Virtual are turned on ~ this prevents any motor movement.

The two-letter "vr" (Virtual to Real) command converts the move in the Virtual Axes channels to the equivalent move in the real axes channels. This lets you make a move on the Virtual Axes, turn the Virtual Axes off, and create the equivalent move on the real axes channels. Sometimes you have to "cheat" the move away from the strict Virtual Axes positions in order to maneuver into a tight space, avoid grazing a model, or some such pragmatic purpose. With the "vr" command, you can work out most of the move with Virtual Axes, then finish up programming with the real axes.

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USING THE KUPER SYSTEM AS A MOTION DIGITIZER DEVICE
This is a brief description of how to use the Kuper Motion Control System as a digitizing device for a computer graphic system. The Kuper system can receive information from quadrature encoders attached to devices such as pan/tilt heads, etc., and transfer the position information in real time over a serial communication device, at rates up to 115,200 baud. The position data is transmitted in a compact sixteen byte format. The first four bytes comprise a synchronization header, which is always the byte sequence of:
1,0,0,0
The remaining 12 bytes are organized as 6, sixteen bit words. The positions are derived from the first 6 axes listed on the Kuper Control Panel Screen, and may be used to encode any six encoder inputs. By one user's conventions, a possible set of assignments is:
Z (track) axis position, where 32768 = home position X (E/W) axis position, where 32768 = home position Y (N/S) axis position, where 32768 = home position Pan axis positions, where 23041 = home position Tilt axis positions, where 23041 = home position Field of View, with a range of 1 to 768
By the present conventions, the maximum allowable value of the fourth and fifth axes (Pan and Tilt) is 46080, after which the value rolls around to 0. The first three axes (Z, X, Y) use the full 16 bit value range of 0..65535.
The sixteen byte data packets are sent at a rate N packets per seconds, where "N" is the number in the VISUAL FPS box at screen lower right.
Kuper will be happy to make modifications to this format to suit your local conventions. Please call 310-414-0701 if you wish to have a modified format, larger number of active encoders (up to 16), etc.
CALIBRATION:
The "AxisSetup" command in the grey menu area can be used to change the number of units per degree. After clicking "AxisSetup", click on any axis name. Change the "Pulses Per Unit" to equal the number units per degree. For our current format, the "Pulses Per Unit" for rotational axes should be 128.
In the "Joystick Params" area of the Kuper Control Panel Screen, there are four parameters which you must adjust. From left to right:
*	1. Click left and right mousekeys on the joystick number to control which joystick is connected to the axis. Joystick numbers 1 to 16 correspond to the sixteen joystick inputs shown on the drawing named "Pinouts for Black Box Encoder Connectors" at the back of the large "RTMC16 Manual". Any joystick may be assigned to any axis, but for your purposes be careful not to assign the same joystick to more than one axis.
*	2. The josytick gain number (number with three decimals) controls the electronic gear ratio between the encoder and the axis. Adjust the number by clicking with the left mouse

key. Select a number which makes a given amount of encoder movement produce the correct axis position number, ie. 30 degrees of physical pan movement produces the number "30.000" next to the pan axis name. Use negative numbers to reverse the direction sense.

» 3. Click the "POSN/VELO" box so "POSN" is displayed. This is the correct joystick response type for your application.

* 4. The number at far right is a "smoothing factor" which gives an effect like fluid head damping. Click the LEFT or RIGHT mouse keys until this number is "0". Any number besides 0 will introduce time lag.

Use "UtilFiles" and then "Save Default Setup" to save these various parameters and settings on disc for automatic loading the next time you boot up.

NOTE: in order for an axis to respond to its encoder (and for the data to be sent over the serial port), two conditions must be met:

* 1. The axis name must be highlighted (YELLOW). Click with the LEFT mouse key to highlight/unhighlight the axis name.

* 2. Either the REC or NEUT box to the right of the axis name must be highlighted. Click REC or NEUT with the LEFT mouse key to highlight.

In the "HardSet: Setup Serial Port" dialogue box, the "Low byte first" and "High byte first" parameters control whether the 16 bit data values are sent with the low 8 bits or high 8 bits first (Intel format vs. Motorola format).

TO START SERIAL COMMUNICATIONS:

Click on "HardSet" in the grey menu area at screen lower right. Click on "Setup Serial Port" in the submenu. Fill in the blanks in the dialogue box. Click "Start" to start sending. To stop sending, click STOP on the above dialogue box. Be sure not to select the COM port used by your mouse.

The X, Y, Z, PAN, TILT, and FOV axes listed on the screen correspond to the 6 data axes in the communication format. The first six axes listed on the screen are always sent in order from top to bottom. Use the "NameAxis" command in the grey menu area to change the names to your liking.

The best way to check things out without encoders:

Turn on serial communications using the above procedure. Click "MousJog" in the grey menu area. Place the mouse arrow on the PAN (or any other) axis name. Click the LEFT and RIGHT mouse keys to jog the axis. Click "QuitJog" at screen right center to leave MousJog.

NEW **ANIMATION TRICKS**

Feb. 8, 1994

This version of RTMC130 rev B contains a change in the Animation Setup Screen functions which allows many new tricks of great use to animators. Specifically, entering an exposure time of "0.000" now prevents the camera from winding for that frame. Previously, a time 0.000 entry caused the camera to wind capped or shutter-closed. Some of the possibilities include:

MOVING AXES OUT OF THE WAY FOR THE ANIMATOR. It is sometimes desirable to move the camera away from the model to give the animator some elbow room. Also, some shots require motorized set elements to move out of the way between exposures. The "Index" scheme provides a method.

Procede generally as described in the two exposure-line RACKOVER scheme below, with the following modifications: the axis "mode box" under the axis name will be "I" for the first (non-shooting) exposure, and either "B" (go-motion) or "S" (still) for for the second exposure. This causes the axis to assume an out-of-the-way indexed position for the #1 non-shooting exposure step, and back into the move position for the actual exposure line *#2.* Since the first exposure is "indexing", you must create a special "indexing" keyframe with a frame number of 1.00 and a position equal to the desired out-of-the-way position. Since you will already have some other keyframes in the list, be careful not to disturb the move by using any of the curvefit or other move generating commands after you create the indexing key frame. It is assumed that all move modification will be completed by the time you reach the shooting point, so the presence of a "odd ball" key frame at frame 1.00 should be of no consequence ~ unless you accidentally curvefit the move. Be careful about this.

GENERATING A STROBE SIGNAL ON EACH ANIMATION FRAME. In continuous shooting modes with the RTMC48 Card, the flash strobe outlet can be programmed to generate a once-per-frame strobe signal with the "fs" command. For the RTMC16 Card, and for single frame work in general, a strobe can be generated as follows. It is necessary to program two exposures in the animation setup screen. Use one of the RTMC Logic bits 0 to 4 as the strobe signal source. Refer to the back of the RTMC 16 manual for pinouts. Note that these signals are TTL, 5 volts. Verify that the device to triggered can operate safely from such signals. In the Animation Setup Screen, click in two exposures with the "+ -" box. Set the exposure time for the second exposure to 0.000, which will prevent the camera from rolling. Set the polarity for the trigger bit to opposite polarity for the two exposures, by clicking in the appropriate "bit box" in the "Triggers" column. You may need to experiment with the polarity sequence, delay time, etc. for best results, depending on the requirements of the device being triggered.

CAUSING THE CAMERA TO RACKOVER BETWEEN FRAMES. This assumes that the rackover is motorized. Set the pulses per unit for the rackover axis so that 1.000 unit of travel moves the axis over its range of travel. The shooting position should be 0.000, the viewing position 1.000. To simply rack over when not shooting, use the "gm" command, "gm rackover 0" moves the camera to the shooting postion, "gm rackover 1" moves the camera to the viewing

position. This assumes the axis is named "Rackover" -- you can also use the axis number instead of the name. The axis name must be highlighted in order for the axis to move.
To setup the rackover function for stop motion, enter the stop motion setup screen. Click the "+" side of the "+-" box to display two "exposure lines" on the screen. Click on the mode select box at screen top center until it displays "INDEX". Click in the two axis mode boxes just below the name of the rackover axis so both boxes display "I" for in both exposures.
The next step is to tell the indexing rackover axis where it should be for each of the two exposures. This information is carried in the list of keyframes. For the rackover trick, keyframe frame number 1.00 contains the index position for exposure 1, keyframe frame number 2.00 contains the index position for exposure 2, etc. This also works for any axis designated "I" on the animation setup screen. To create the keyframes, enter the graph move editor by clicking on the "Editor" menu box. Use PickAxes to select the rackover axis. To create the keyframes you can use the "EditKeys" command, or just type in the following two-letter command:
in 1 1 2 0
Don't do any curve fitting. For any exposure where an axis is a Index axis, the software only looks at the keyframes and ignores the move data. The above keyframes place the index axis at position 1.000 (racked over in this case) for exposure number 1, and at position 0.000 for exposure number 2.
Finally, back in the animation setup screen, enter an exposure of "0.000" for the first exposure line, and the normal exposure for the second exposure line. Designate the other axes as "B" for go-motion, "S" for normal stop motion, or even "I" for other indexing axes. The "Switch" option should be selected for both exposure lines.
When you click FWD, the camera will rack into viewing position (if the axis name is highlighted). When the animator is ready to shoot, he presses the switch again, and the camera will rack back into shooting position, and once more wait for the switch. The next switch press will expose the frame. Immediately after the exposure, the camera will once again rack into viewing position for another cycle.

HARDWARE INSTALLATION, December '94

Make certain the computer is turned off. Remove the computer's cover. The Kuper Card may be plugged into any available bus slot, including VL and PCI slots. In some cases you may need to rearrange the positions of pre-existing cards in order to accommodate the Kuper Card. Verify that the Card is not pressing down on any RAM chips, wire connectors, or similar obstructions when it is fully seated. It is okay for the bottom of the Card rests on unused portions of the same row of bus connectors. If possible, locate the Card so it is not directly over the large brown CPU chip, so as not to obstruct air circulation over the CPU. We recommend that you route the " JP4 Encoder" ribbon cable to an I/O opening on the solder side (the side without chips) of the Card. If you don't plan to use any encoders (joysticks), you may simply remove the JP4 cable. If your computer's case has punch-out DB25 openings, route the "JP5 RTMC Logic" ribbon cable to one of these openings; otherwise bring out the RTMC Logic ribbon cable through an I/O slot using the supplied "L" bracket adapter. The DB37 "JP1 Axes 1-16" cable brings out the step and direction pulses, and is best located on the "chip" side of the Card. Refer to the drawings on the last few pages of the Kuper Manual for pin assignments.

The RTMC48 Card has two connectors mounted on the end of the Card, one on top of the other. The larger DB25 connector is for the Jogbox. Connect the Jogbox using the supplied cable. The smaller DB15 "Accessory" connector handles connections to external cameras, timecode, video & camera sync, relay operated devices, and flash sync. For more information on the Accessory connector, refer to the drawing "DB15 Accessory Connector" in the last few pages of the Kuper Manual. For your initial testing, note that the Kuper Software will run without any connections to the DB15 Accessory connector, without any motors connected, and even without the Jogbox plugged in.

SOFTWARE INSTALLATION

You only have to go through these software installation steps one time. Once the computer is closed and running, place the supplied Software Disc in the 3.5 inch floppy drive. Make a new hard disc directory, and copy all the files from the floppy disc to the new directory. Assuming the 3.5 inch floppy is drive "A:", a typical sequence would be: (what you type is shown in bold type)

`C:>md kuper` *{press the Enter key)* `C:>cd kuper` *{press the Enter key]* `C:\KUPER>copy a:*.* /v` *{press the Enter key}*

If your 3.5 inch drive is drive "B:", the last line above would be

`C:\KUPER>copy b:*.* /v` *{press the Enter key}*

It will take a few moments for the files to copy from the floppy disc to the hard disc. After the disc activity stops, start the Kuper Software by typing:

`C:\KUPER>rtmcl30` *{press the Enter key}*

It takes a few seconds for the program to load and run. You should see the familiar Control Panel Screen within no more than 10 seconds. If not, please call Kuper at 310-414-0701.

EVERYDAY USAGE

After the computer has finished its bootup sequence, change to the Kuper directory, and run the RTMC130.EXE program:

`C:>cd kuper` *{press the Enter key}* `C:\KUPER>rtmcl30` *{press the Enter key}*

When you are done, use the "QUIT" command on the main Control Panel Screen to leave the Kuper Software and return to the "C:" prompt. While it is technically acceptable to simply turn off the computer while still in the Kuper Software, the more rigorous use of the "QUIT" command offers some protection against accidentally losing an unsaved move or "AxisSetup" configuration. If you are running the Kuper Software from a "Stacked" or "DoubleSpaced" hard disc, we strongly recommend that you turn off the computer power only when the "C:" prompt is displayed.

Please note that while it is possible to launch the Kuper Software from within Windows, we discourage you from doing so. Windows can exact a heavy performance and resource penalty on DOS programs launched from it, and is certainly of no benefit to such programs.

IF THE JOGBOX DOESN'T WORK

The cable leading from the Jogbox should connect to the female DB25 connector mounted on the Kuper Card and available at the back of the computer. Note that the Printer Port and RTMC Logic connectors are also female DB25 connectors. Plugging the Jogbox into the a Printer Port or the RTMC Logic connector will not cause any damage, but only the Kuper Card connector will work.

INSTALLATION PROBLEMS

There are certain rare circumstances which can prevent the Kuper Software from running correctly. If the Control Panel Screen does not appear, please check to see if the mouse is plugged in, and then bring the telephone as near to the running computer as possible and give us a call at 310-414-0701. If you are "DOS aware" you might want to run down this list first:

* The mouse driver is not properly installed, or not loaded, or the mouse is not plugged in.
* There may be a network card, "bus mouse" card, MIDI card, or other type of card installed in the computer which uses the same interrupt line (#5) and address range (300 to 3 IF hex) as the default Kuper Card settings. Please call us before changing any jumpers.
* On systems with less than 8 megabytes of RAM, the DOS "smartdrv.exe" program is using too much memory, and should be removed from the bootup files.
* The "device=c:\dos\himem.sys" statement is missing from the "config.sys" file.
* The video card is not a VGA type.

* If you are using QEMM it may be hogging too much memory. QEMM is of no benefit to the Kuper Software, and should be removed from config.sys.
* EMM386 causes problems on certain types of motherboards, and should be removed from the bootup files.
* A very small number of motherboards will not work correctly with our normal 32 bit DOS extender software. Call us to obtain an alternative DOS extender at no charge.
* There is a conflicting device driver or TSR program loaded into memory.
* The BIOS Setup configuration is too quirky.
* The CPU is a -SX, -SL, or other type without a math co-processor chip.
* You are trying to run the Kuper Software from outside of its directory. You can only run the Kuper Software from within its own directory, even if the Kuper directory is in the path statement.

The above problems are the exception, and the Kuper Software runs well on almost all systems with no modifications to autoexec.bat or config.sys, or to the BIOS Setup configuration. Under normal circumstances the only really worthwhile modification is simply to remove the "smartdrv.exe" statement from the autoexec.bat file ~ this typically results in several thousand more frames of move length being available.

"AUTOEXEC.BAT" FILE FOR DEDICATED MOTION CONTROL

prompt pg c:\mouse\mouse

"CONFIG.SYS" FILE FOR DEDICATED MOTION CONTROL

device=c:\dos\himem. sys device=c:\dos\setver.exe

If you plan to also run Microsoft Windows programs on your computer, you will probably want to leave your autoexec.bat and config.sys files unmodified. The above Spartan bootup files are intended for systems dedicated to motion control, and will give the maximum possible system resources to the Kuper System. The Kuper Software is written in 32 bit protected mode, and does not benefit from the fidgeting typical autoexec and config files go through in order to accommodate 16 bit programs in the limited first megabyte of memory. The Kuper Software can directly access all the memory in the computer (up to 32 megabytes) and simply does not require the assistance of QEMM, EMM386, "LoadHigh", "UMB", and the like, all of which were designed to overcome the fundamental memory access limitations of 16 bit programs.

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RTMC16 TO RTMC48 UPGRADE INSTALLATION

Remove the RTMC16 card, leaving the ENCODER SIGNALS and RTMC LOGIC ribbon cables with the computer. Look at jumper JP5 on the RTMC 16 card near the bus connector. If RTMC 16 JP5 is connected center pin to top pin, adjust RTMC48 jumpers JP6, JP7, and JP8 to connect the center pin to the pin to your left. If RTMC 16 JP5 is connected center to bottom, adjust RTMC48 jumpers JP6, JP7, and JP8 center to your right. Before installing the RTMC48 card, locate connectors JP4 and JP5 near the top of the RTMC48 card, since it is not possible to see the white letters when the card is in the computer. Insert the RTMC48 card into any bus slot inside the computer. Attach the ENCODER SIGNALS ribbon cable to jumper JP4 on the RTMC48 card. Attach the RTMC LOGIC connector to jumper JP5 on the RTMC48 card. Be sure the two ribbon cable connectors are properly oriented to the pins, and not shifted one pin up/down or left/right. The red side of both ribbon cables should be oriented towards the front (operator side) of the computer, the same as they were with the RTMC 16 card.

Remove the old Jogbox cable with the three way split at one end. Install the supplied new Jogbox cable between the DB25 connectors on the RTMC48 card and the Jogbox.

Note that with the RTMC48 Card the Black Box is not required in order to use the Jogbox. With the RTMC 16 Card, the Black Box was required to supply power to the Jogbox. With the RTMC48 Card, the Jogbox plugs directly into the Card through a single pin to pin cable.

If want to use a Black Box in conjunction with the RTMC48 card, you must make a minor modification to the Black Box. If you do not make the modification the encoder in your Jogbox will not operate correctly, but no damage will occur. Open the Black Box. Remove chips U3 and U4. Bend up pin 9 on both chips*, and replace the chips so the bent up pins no longer make contact with the sockets. Close the Black Box. This disables encoder #16 on the Black Box. Encoder #16 is the encoder inside the Jogbox, and feeds through the new Jogbox cable directly to the RTMC48 card.

All RTMC48 connector pinouts are the same as for RTMC 16. The step and direction signals come out through the DB37 connector on the supplied ribbon cable/L-bracket. Please call if you need assistance. 310-414-0701.

*To locate pin 9 on U3 and U4, position the Black Box so the letters "74LS244" on the chips read in the normal left to right orientation. Just below "74LS244" is a row of 10 pins. Pin 9 is ninth in from your left, or the second pin in from your right. Don't worry, nothing bad will happen if you pick the wrong pin. If the encoder in the Jogbox works correctly, you got the right pin. When you put U3 and U4 back in their sockets, check Ul and U2 for the proper chip orientation — the letters should have the same orientation for all chips. U3 and U4 are interchangeable, so you don't need to keep track of which is which.

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"RTMC130B" BETA TEST UPDATE
November 23, 1993 **SOFTWARE**
Automatic hardware camera and focus homing capabilities have been added. Contact Kuper for more information.
In the "Options" command, the new "Emergency Stop %" parameter box sets how aggressive emergency stops will be ~ if 100% is selected, emergency stops ramp down at the assigned "Slew Deceleration" parameter assigned with the "AxisSetup" command; if 50% is selected, emergency stops occur in 1/2 the "Slew Deceleration" times. The parameter applies to all axes.
The same physical copy of the RTMC130B software can now be used for both RTMC48 and RTMC16 Cards. In order to use RTMC130B with an RTMC16 Card, there must be a file located in the Kuper directory named "RTMC16" with no extension. The file can contain anything ~ the simple presence of the file signals the software to configure itself for the RTMC16 card. It may be convenient to simply copy the small "RTMC.ENV" to "RTMC16" (at the DOS prompt, type "copy rtmc.env rtmcl6" and press the Enter key). Note that the RTMC16 file must NOT be present on the directory when an RTMC48 is being used.
The Virtual Axes have been considerably improved since the previous version. Problems with "chirps" when entering or leaving Virtual Axes have been corrected. For this version only, the virtual axes will be automatically turned off whenever you load a move or load a new axis setup file. Assuming the newly loaded axis parameters are correct for the hardware, just turn the Virtual Axes on again with the Jogbox "JOG32 + JOYSTAXIS" key combination or with the ModeSet menu item.
The new "pd" (Pull Down) command is primarily intended to setup parameters relating to camera operation, but is also playing temporary host to one or more other new parameters which will ultimately migrate to other menus. The "Kuper Encoder Handles" checkbox tells the system if the new Kuper Encoder Handles Box is installed, which allows the handles operator to change joystick sensitivity, smoothing, and some other related parameters directly from the joysticks via a small keypad. As of this date, clicking the Encoder Handles Options without the hardware device actually installed can lock up the software. Contact Kuper for more information.
Exposure and synthetic shutter angle accuracy have been finely calibrated over all the various shooting modes. Exposure accuracy is now better than one percent, comparing any shooting mode to any other. Synthetic shutter angles are also accurate to better than 1/2 percent. Please be sure to use the "pd" command or the "UtilFiles: 4Perf / SPerf' menu item to program the correct physical shutter angle for your camera.
It is now possible to set absolute position Software Limits with the "Hardset: Set Position Limits" menu item. When enabled, the absolute position limits are active at all times. This differs from "Joystick Limits" which are only active when an axis is under joystick control.

Some New **Two Letter Commands:**
em Exponent Moves. Creates simple move curves with exponential inflections.
ct Compensated Trucks. Creates a move curve such that the percentage change in field of view over any given time interval remains constant. Use for "Cosmic Zooms" or to maintain the same apparent rate of motion when cutting between trucks on images of different sizes. For this effect to work properly, the track "0.000" position should place the center of the lens inside the plane of the subject — use "AxisSetup:Homeposition" to place the track home position safely in front of the subject.
br Build Ramps. Force an existing move curve to decrease to zero velocity starting with the first frame number parameter and reaching 0 velocity by the second frame number parameter. Selecting the numerical order of the frame number parameters causes the effect to work either forwards or backwards from the starting frame number. Often useful after "AddHolds" (ah).
ie Impose Eases. Superimposes an casein, easeout over an existing move curve. Same effect as the "Redistrib" command, without having to create a parameter file. Input a "0" parameter to prevent eases at either end of the move. Rearranges the move timing in the course of adding the eases, so it may sometimes be desirable to use the sequence "ah" (AddHolds) and "br" (Build Ramps) to preserve all the timing qualities of the original move, at the expense of adding move length.
ps Pull Set. Create a series of keyframes at regular frame intervals. Pulls the keyframe positions from the existing move curve. Quick method for making keyframe moves out of joystick moves.
ds Delete Set. Delete all the keyframes with a range of keyframe numbers.
ec Extend Curve. Extends the existing move curve starting with the given frame number. The acceleration or deceleration of the original curve is extrapolated into the newly created curve. Can create a strongly inflected curve if invoked at a frame number with high acceleration. Works both forward and backward.
el Extend Linear. Extends the existing move curve by maintaining the existing velocity at the starting frame, with 0 acceleration. Works forward and backward.
rq Reload Quit conditions. The operator can elect to reload any or all of the following conditions as they were when the Kuper Software was last exited using the Quit menu item: Axis positions, AxisSetup information, and/or the move data in memory. Protects you from forgetting to save important data, but only if you always exit the software through the "Quit" command.
bl Intended to BLend together discontinuities over a specified range in the move. This is really just the mouse oriented SmoothPart command restated in command line format.
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HARDWARE

Several clients have experienced trouble when using an Arriflex BL motor as the source for the synchronization input on the RTMC48 Card. The typical problem is that the camera shuts down after only a few seconds of operation. The cause of the problem is that the shutter pulse driver chip in the camera motor electronics has very low line drive capability, and goes into shutdown when loaded even by the relatively modest current requirements of the RTMC48 pin 4 "Shutter Pulse In" signal. To correct this problem, you can either replace R6 on the RTMC48 with a 1000 ohm 1/4 watt resistor, or place a 1000 ohm resistor in series with the pin 4 sync input, inside the connector. We have supplied RTMC48 Cards with a 1000 ohm resistor at R6 for the last several weeks. If you are not certain about your card, locate R6 at the upper right corner of the card, and check that the color bands are BROWN BLACK RED GOLD -- if not, please replace R6 or contact Kuper. This change does not seem to interfere with other camera sync pulses such as Fries and Panavision.

The sensitivity of the RTMC48 Card timecode input was originally set for professional level sources such as timecode generators, address track outputs, and other equipment with strong output signals. However, this original preset level is marginal for low level outputs such as stereo cassette decks and other consumer grade devices. **If you are having trouble getting good timecode response, we recommend changing RIO to 5 600 ohms (GREEN BLUE RED GOLD), and the unmarked resistor just below D3 to 1 000 000 ohms (BROWN BLACK GREEN GOLD).** This increases the sensitivity into the consumer equipment range, and so far has not caused problems with higher level sources. All recent RTMC48 Cards have this modification when shipped.

If you wish, Kuper will make any of the above modifications free of charge. Please contact us for further information.

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December 6, 1994

NEW **JOGBOX KEY COMBINATIONS**

The labels on the Jogbox command keys name the basic function of each key. It is possible to access several functions beyond the basic functions by pressing Jogbox keys in special combinations and sequences.

Send an axis to a specific absolute position.

* Press and hold JOG32, tap GOTO HOME POSN, release all keys.
* In response to the "GOTOPOSN" prompt, enter a motor position and press ENTER
* SELECT AXES to go to the position (normally only one) and press ENTER

Initialize one or more axes to a non-zero motor position.

* Tap SET HOME POSN and observe the "AXES TO JOGZERO" prompt.
* SELECT AXES to initialize to the same non-zero motor position (normally only one axis), **then tap the 15+ key instead of the ENTER key.**
* In response to the "NEW POSN" prompt, enter the new position, and tap ENTER.
* Don't confuse this with "Automatically calibrate the pulses per unit for axes" as described below.

Automatically calibrate the pulses per unit for axes.

* Use the SET HOME POSN command to set the motor positions for the axis / axes to calibrate to 0.000.
* Jog or joystick the axis to a known, non-zero position such as 100 inches, 90 degrees, etc. Move the axis to the actual physical position, ignoring the yet uncalibrated numbers displayed on the Jogbox.
* Tap SET HOME POSN
* SELECT AXES the axes to calibrate (normally only one), **then tap the 15- key instead of the ENTER key.**
* In response to the "CALIBRAT" prompt, enter the desired motor position to correspond to the current motor position. Tap ENTER to complete. The Pulses Per Unit will automatically be adjusted. Use UtilFiles:Save Default Setup to make the changes permanent.
* Don't confuse this with "Initialize one or more axes to a non-zero motor position", above.

Set the axis slewing speed (especially useful for Virtual axes).

* Place the axis on the jogbox joystick by pressing the JOYST AXIS key, and then tapping the axis select icey at the top of the Jogbox.
* Make sure the axis is in velocity mode. Tap the POSN/VELO key once if the axis is in position mode.
* Turn the joystick knob until the axis is running at the desired slewing speed.
* Press the 16t key. As long as the 16* key is pressed, the axis slewing speed will be displayed on the Jogbox display. When the 16* key is released, the axis will automatically slow to a stop, and the speed at the time you released the 16* key will be recorded in the

AxisSetup "Slew Speed in PPS" parameter. Use UtilFiles:Save Default Setup to make the changes permanent.

Hold open the camera shutter for X framing.

» Tap WIND CAMERA.

* Press and hold down the 15- key to open the shutter.
* Release the 15- to close the shutter.

Automatically wind 16 frames.

* Tap WIND CAMERA
* Tap the 16+ key. The camera winds at either 1/8 or 1/2 second, depending on which of the next two special key combinations was last used.

Wind one frame at 1/8 second.

* Tap WIND CAMERA
* Tap the 15+ key.

Wind one frame at 1/2 **second.**

» Tap WIND CAMERA

* Tap the 16-key.

Place the camera movement in Vista Vision loading position.

* Tap WIND CAMERA
* Tap and release the 14+ to move to loading position.
* Tap any key to rephase the movement.

Adjust the move data to make the move data for a particular move frame number match the current axes positions.

* Move the axes to the desired position.
* Press and hold JOG32, tap SET HOME POSN, release all keys.
* In response to the "MAKETHIS" prompt, enter the move frame number to equal the current axes position, tap ENTER.
* SELECT AXES to modify, tap ENTER.

Enter Browsing Mode from the Jogbox.

* Press and hold JOG32, tap LIST KEYS, release all keys.
* In response to the "BROWZ FR#" prompt, enter the move frame number at which to start browsing, tap ENTER
* SELECT AXES to actually browse, tap ENTER
* The selected axes immediately move to the selected frame number position. **TO CANCEL AND STOP THE AXES, press any of the command keys at the bottom of the Jogbox.**
* Once the axes reach their positions, use the Joystick knob like a tape deck shuttle.
* Tap the POSN/VELO key to change between position and velocity browsing responses.
* To stop browsing, tap EMER STOP or press JOG32 and LIST KEYS together.

Turn automatic nodal point correction on and off from the Jogbox.
* Press and hold JOG32, tap STOP/CANCEL, release all keys.
* The real axes immediately start to move to the corresponding Virtual Axes positions.
TO CANCEL AND STOP THE AXES, press any of the command keys at the bottom of the Jogbox.
* To turn off the virtual axes, press JOG32 and STOP/CANCEL together.
Jog axes above axis 16.
* Press and hold JOG32, tap JOYST AXIS, release all keys.
* The jog keys "shift up" 16 axes (i.e. the 1- /1+ keys actually jog axis 17) and the display announces which axes will be jogged.
* Repeat the JOG32 + JOYST AXIS combination to toggle through various groups of axes.

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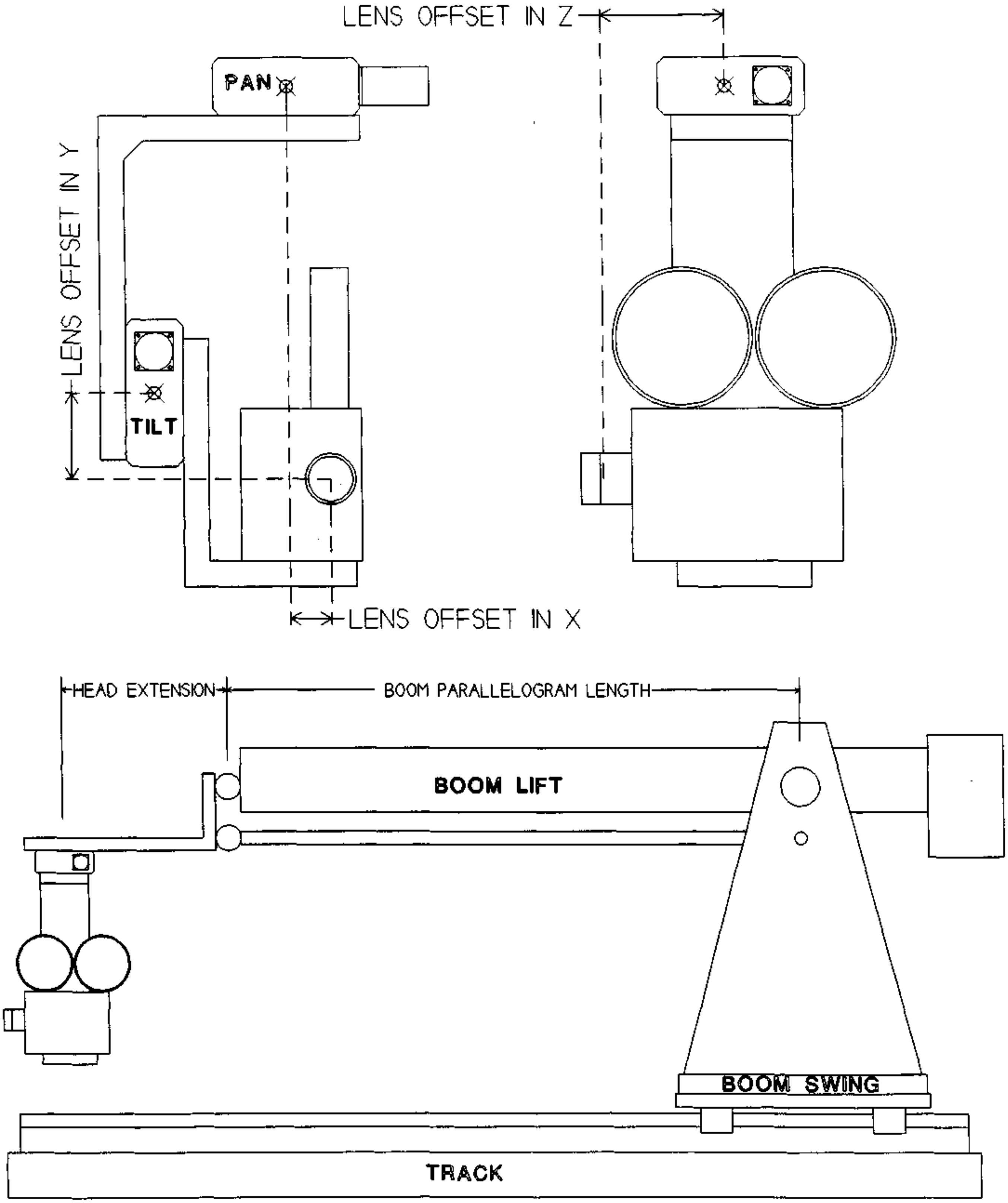

LENS OFFSET IN Z
PAN
LENS OFFSET IN Y
TILT
LENS OFFSET IN X
HEAD EXTENSION
BOOM PARALLELOGRAM LENGTH
BOOM LIFT
BOOM SWING
TRACK

Januarys, 1994

The Virtual Axis System is operating very reliably as of this date, but is still under active development. The version of the software you are using may present slightly different prompts than shown in the illustrations. The terms "Virtual" and "Synthetic" are used here interchangeably to refer to the same thing, although in the future they will refer to distinctly different functions.

CALIBRATING THE VIRTUAL AXES

Before the Virtual Axes can be used, you must calibrate the real Pan, Tilt, Roll, Boom Swing, and Boom Lift axes in degrees of rotation, Track, and NS and EW (if present) in linear units such as inches or centimeters. The following mathematical sign conventions must be used. All directions are referenced to an operator looking through the camera viewfinder from behind the camera.

Pan: Panning to the right is in the + direction.

Tilt: Tilting up is in the + direction.

Roll: Rolling so the top of the image moves right is in the + direction.

Boom Lift: Moving the camera up is in the + direction.

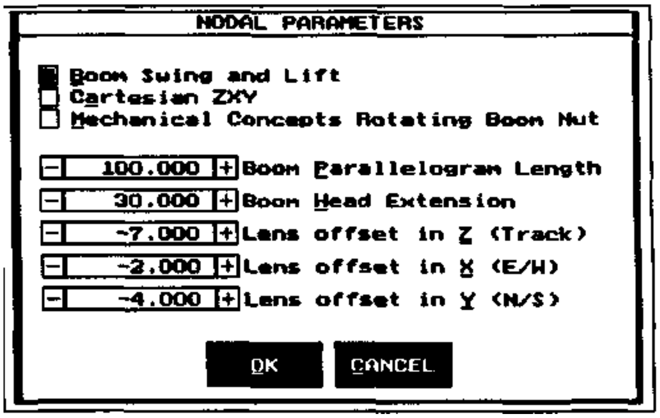
Boom Swing: Swinging to the operator's right is in the + direction.

Track moving forward is in the - direction. EW: Moving to the right is in the + direction. NS: Moving up is in the + direction.

Use the Jogbox or the MouseJog command to verify that the directions and units are correct.

From the Control Panel Screen, click on the "HardSet/Setup Nodal Parameters" command. Referring to the attached track camera diagram, make careful measurements of the various parameters, and enter them in the appropriate boxes. The more accurate your measurements, the better the Virtual Axes will operate. "Z" is track axis, "X" is the East/West axis, and "Y" is the vertical North/South axis. "Lens Offset in X" and "Lens Offset in Z" are referenced to the center of the Pan rotator, and "Lens Offset in Y" is referenced to the center of the Tilt rotator. All the offsets are linear measurements, in the same units used to calibrate the track axis.

In the "Nodal Parameters" illustration, the numbers shown approximate the track camera diagram. In the diagram, the lens is below the center of the tilt rotator, so its "Lens Offset in Y" is negative; if the lens were above the center of the tilt rotator, the number would be positive. Likewise, the lens is offset in X to the operator's left, so its "Lens Offset is X" is negative. The optical center of the Camera lens is about 7 units in front the of center of the Pan rotator, so its offset is -7.000 units — remember that forward on the track is the negative direction, so since the lens is offset 7 units in the negative direction along the track axis, the offset is negative. If your system has the lens mechanically centered on the all the rotations, the three offsets would be "0.000".


NODAL PARAMETERS
Boom Swing and Lift
Cartesian ZXY
Mechanical Concepts Rotating Boom Nut
100.000 Boom Parallelogram Length
30.000 Boom Head Extension
-7.000 Lens offset in Z (Track)
-2.000 Lens offset in X (E/W)
-4.000 Lens offset in Y (N/S)
OK
CANCEL

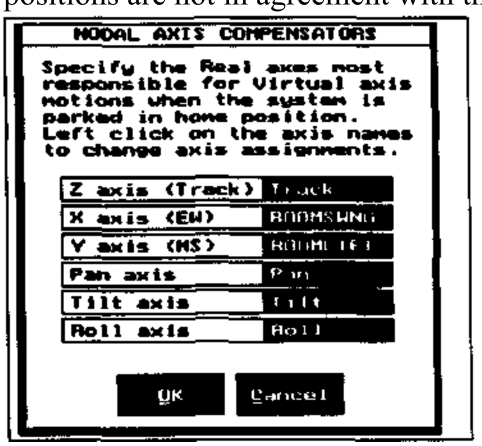
"Boom Parallelogram Length" is the distance between the two swivel points of the Boom Lift axis. "Head Extension" is the distance between the Boom Parallelogram attachment point, and the center of the Pan rotator. "Head Extension" may be 0.000 if the Pan rotator is exactly centered below the Parallelogram attachment point. Note that Boom Parallelogram Length and Head Extension are both positive (actually, Absolute Value) numbers, even though they are measured along the track axis — life is not always consistent ~ but just remember the "Lens Offset in Z" must still be negative if it extends in front of the center of the Pan rotator.

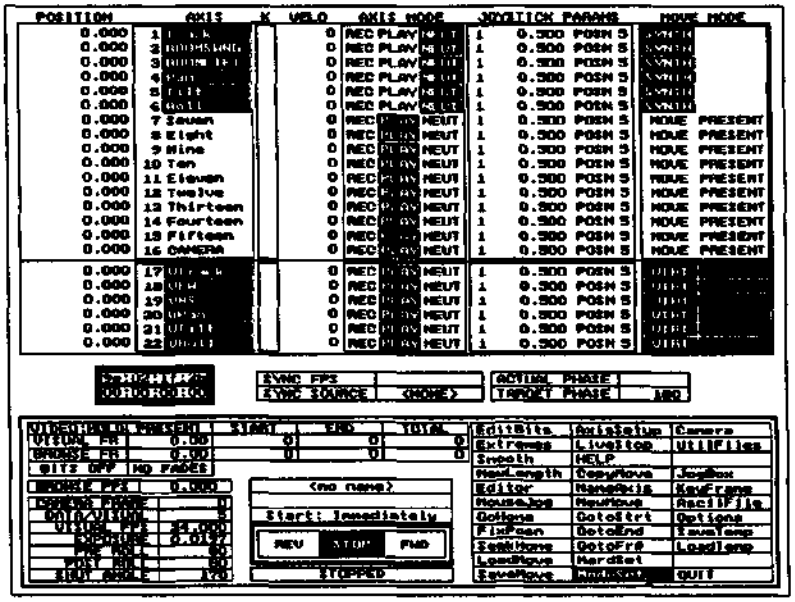
You must also tell the software which real axes will be involved in the process of compensating for the desire Virtual axis motions. Click on "HardSet/Setup Nodal Comp Axes", and fill in the appropriate axes by clicking on the axis names.

After your calibrations are completed, use the "UtilFiles" command to save the information on disc. If you click on "Save Default Setup", the information will be there the next time you boot up; if you use "Save Named Setup", you must specifically reload the information with the "UtilFiles/Load Named Setup" each time you boot up.

Before turning on the Virtual Axes, the "0.000" position for Pan, Tilt, Boom Lift, Boom Swing, and Track must all be as shown in the attached diagram. The Boom arm is level and parallel to the track. Tilt is level. Pan is looking straight ahead, parallel to the track. A line drawn between the center of the Boom Swing and Pan rotators would be parallel to the track. Jog all the real axes to the proper positions, and zero their motor counts with the "SET HOME POSITION" key on the Jogbox, or from the Control Panel Screen. Also make sure that the Virtual Axes positions are all set to 0.000. The Virtual Axes positions can be set by left-clicking on the position number with the mouse, or through the MouseJog command. The Virtual Axes are listed just below the Real Axes, and are named VTrack, VEW (East/West), VNS (North/South), VPan, VTilt, and VRoll in the illustration. Note that the while the Real axes may be listed and Patch Motor'd in any order, the Virtual Axes functions are "hard-wired" in the order listed in the illustration, even though you can ReName them to anything. That is to say, the first Virtual Axes will always function as Virtual Track, the second Virtual as Virtual East / West, etc., no matter what their names are.

For safety, we had you position all the real and Virtual axes at their 0.000 positions before turning on the Virtual Axes. This is not strictly necessary, but if the real axes positions are not in agreement with the current Virtual Axes




POSITION
AXIS
K
VELO
AXIS MODE
JOYSTICK PARAMS
MOVE MODE
7 Seven
8 Eight
9 Nine
10 Ten
11 Eleven
12 Twelve
13 Thirteen
14 Fourteen
15 Fifteen
16 CAMERA
REC PLAY NEUT
POSN 5
MOVE PRESENT
SYNC FPS
SYNC SOURCE
<NONE>
ACTUAL PHASE
TARGET PHASE
180
VIDEO:HOLD
PRESENT
START
END
TOTAL
VISUAL FR
BROWSE FR
BITS OFF
NO FADES
BROWSE FPS
CAMERA FRAME
DATA/VISUAL
VISUAL FPS
EXPOSURE
PRE ROLL
POST ROLL
SHUT ANGLE
<no name>
Start: Immediately
REV
STOP
FWD
STOPPED
EditBits
AxisSetup
Camera
Extremes
LiveStop
UtilFiles
Smooth
HELP
NewLength
CopyMove
JogBox
Editor
NameAxis
KeyFrame
MouseJog
NewMove
AsciiFile
GoHome
GotoStrt
Options
FixPosn
GotoEnd
SaveTemp
SeekHome
GotoFr#
LoadTemp
LoadMove
HardSet
SaveMove
QUIT

positions, the real axes will first move to the equivalent Virtual Axes positions, before taking up their Virtual functions.
Now turn on the Virtual Axes by tapping once on the Jogbox "JOGS2" key to wake up the Jogbox, and then hold down "JOG32" and tap "STOP/CANCEL" once, and then release all keys. You can also use "ModeSet/Start Synthetic Axes" from the Control Panel Screen. If the real axes are not in the equivalent Virtual Axes positions, the real axes will slew to the equivalent Virtual Axis positions while "Going to Virtual" is displayed. In this example, the real axes should not move since we previously zero'd both real and virtual axes. If the real axes do move, "GOING TO VIRTUAL" will be displayed, during which time you can instantly cancel the Virtual mode and stop all the axes by tapping any of the lower 16 keys on the Jogbox.
Assuming you successfully entered Virtual Mode, the Control Panel Screen will arrange itself as show in the illustration above. On the Jogbox The first 6 pairs of+ and - keys on the Jogbox will control the six Virtual Axes, while the next 10 pairs will control the corresponding real axes.

1-+	Virtual Track
2-+	Virtual EW
3-+	Virtual NS
4-+	Virtual Pan
5-+	Virtual Tilt
6-+	Virtual Roll
7-+	Real axis 7
8-+	Real axis 8 etc.

Try jogging Virtual NS with 3+ key. The Boom should rise, while the real Track Axis moves slowly forward to keep the lens moving perfectly vertically. Jog Virtual EW with the 2+ key. The Boom should swing to the right, the real Track move forward, and the real Pan backpan to move the lens on a linear EW track, constantly point forward. Jog Virtual Pan (4-+) and Virtual Tilt (5-+) and observe that the lens swivels on center, while the real axes magically adjust themselves. Jogging the axes from 7-+ on up will simply jog the equivalent real axes.
If something seems wrong, turn off the Virtual Axes by holding down "JOG32" and tapping "STOP/CANCEL". Alternate use of this combination toggles the Virtual Axes on and off. You can also use "ModeSet/Stop Synthetic Axes". Check all your units calibrations. The most typical error is an axis with the wrong direction sense (ie. the axis moves in the wrong direction).
Assuming all is well, put Pan on the Joystick by tapping "JOYST AXIS" and then tapping the "4" key on the top row. Tap the "POSN/VELO" until the screen reads "POSITION" and gently move the Joystick knob. You may need to change the joystick smoothing with "JOYST SMUTH" key, or the sensitivity with the "JOYST GAIN" key.
In general, the Virtual Axes can be treated exactly like the real axes. Trying MouseJogging the virtuals, use the "gm"-command, etc. From the Jogbox, jog the Virtual EW axis to about -30 degrees, and "MEMO DOUBL KEY" for keyframe 0.00. When the Virtuals are on, they "take over" the first 6 pairs of -+ keys from the real axes. Press the number "2" to take a keyframe for only the Virtual EW axis. Note that when you press the "2" key to "SELECT AXES" for keyframing, the axis letter "G" is displayed (if you have a sixteen axis system) instead of "2". For a sixteen axis system the SELECT

numbers for the Virtual Axes will display as GHIJKL for the jog keys 1 through 6, and the equivalent Virtual Axis name will be displayed as long as you hold down any of the 1 to 6 keys. Now Move Virtual EW to about +30.0 degrees, "MEMO DOUBL KEY" for frame 600, for only the Virtual EW axis. Press the "FITALL" key and fit only Virtual

EW, key # 2. Use "RUN REV" to run the move in reverse back to frame 0.00. Note than even though you took keyframes only on the Virtual EW axis, most of the real axes run automatically to maintain a perfectly linear EW path. This is one of the great advantages of the Virtual Axis systems — move making is greatly simplified. Imagine what a difference this could make with a long snorkel lens.

Do not attempt to directly run any of the compensating real axes while the Virtual Axes are running. Of course, you can still use the non-compensating real axes as before, you only need to avoid the real axes which do the nodal compensating. If you need to record a joystick move, put the Virtual Axes on REC, not the compensating real axes. Take keyframes on the Virtuals, not on the compensators. Most especially, do not try to zero out or change the motor position counts on the compensating real axes while the Virtuals are on ~ this "pulls the rug out" from under the Virtual System and can lead to dramatic crashes. If you need to re-zero the real axes, first turn off the Virtual Axes with the "JOG32" and "STOP/CANCEL" key combination, after which the real axes again become available from the first six pairs of jog-+ keys. Once the real axes are set to their proper 0.000 positions, re-engage the Virtuals by pressing "JOG32" and tapping "STOP/CANCEL". Note that if the positions for any of the Virtual Axes are not 0.000, some or all of the compensating real axes will immediately start to move to the equivalent Virtual Axis positions. If this happens, you can stop the compensators by tapping any of the lower 16 Jogbox keys, or pressing the emergency stop key. Usually, you would just let the compensating real axes move to the equivalent Virtual Positions, where they will automatically switch into Virtual mode. For most people, the least stressful entry into the Virtual mode occurs when all the compensating real axes and all the Virtual Axes are at position 0.000 when the Virtual are turned on ~ this prevents any motor movement.

The two-letter "vr" (Virtual to Real) command converts the move in the Virtual Axes channels to the equivalent move in the real axes channels. This lets you make a move on the Virtual Axes, turn the Virtual Axes off, and create the equivalent move on the real axes channels. Sometimes you have to "cheat" the move away from the strict Virtual Axes positions in order to maneuver into a tight space, avoid grazing a model, or some such pragmatic purpose. With the "vr" command, you can work out most of the move with Virtual Axes, then finish up programming with the real axes.

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USING THE KUPER SYSTEM AS A MOTION DIGITIZER DEVICE
This is a brief description of how to use the Kuper Motion Control System as a digitizing device for a computer graphic system. The Kuper system can receive information from quadrature encoders attached to devices such as pan/tilt heads, etc., and transfer the position information in real time over a serial communication device, at rates up to 115,200 baud. The position data is transmitted in a compact sixteen byte format. The first four bytes comprise a synchronization header, which is always the byte sequence of: 1,0,0,0
The remaining 12 bytes are organized as 6, sixteen bit words. The positions are derived from the first 6 axes listed on the Kuper Control Panel Screen, and may be used to encode any six encoder inputs. By one user's conventions, a possible set of assignments is: Z (track) axis position, where 32768 = home position X (E/W) axis position, where 32768 = home position Y (N/S) axis position, where 32768 = home position Pan axis positions, where 23041 = home position Tilt axis positions, where 23041 = home position Field of View, with a range of 1 to 768
By the present conventions, the maximum allowable value of the fourth and fifth axes (Pan and Tilt) is 46080, after which the value rolls around to 0. The first three axes (Z, X, Y) use the full 16 bit value range of 0..65535.
The sixteen byte data packets are sent at a rate N packets per seconds, where "N" is the number in the VISUAL FPS box at screen lower right.
Kuper will be happy to make modifications to this format to suit your local conventions. Please call 310-414-0701 if you wish to have a modified format, larger number of active encoders (up to 16), etc.
CALIBRATION:
The "AxisSetup" command in the grey menu area can be used to change the number of units per degree. After clicking "AxisSetup", click on any axis name. Change the "Pulses Per Unit" to equal the number units per degree. For our current format, the "Pulses Per Unit" for rotational axes should be 128.
In the "Joystick Params" area of the Kuper Control Panel Screen, there are four parameters which you must adjust. From left to right:
* 1. Click left and right mousekeys on the joystick number to control which joystick is connected to the axis. Joystick numbers 1 to 16 correspond to the sixteen joystick inputs shown on the drawing named "Pinouts for Black Box Encoder Connectors" at the back of the large "RTMC16 Manual". Any joystick may be assigned to any axis, but for your purposes be careful not to assign the same joystick to more than one axis.
» 2. The josytick gain number (number with three decimals) controls the electronic gear ratio between the encoder and the axis. Adjust the number by clicking with the left mouse

key. Select a number which makes a given amount of encoder movement produce the correct axis position number, ie. 30 degrees of physical pan movement produces the number "30.000" next to the pan axis name. Use negative numbers to reverse the direction sense.

* 3. Click the "POSN/VELO" box so "POSN" is displayed. This is the correct joystick response type for your application.

* 4. The number at far right is a "smoothing factor" which gives an effect like fluid head damping. Click the LEFT or RIGHT mouse keys until this number is "0". Any number besides 0 will introduce time lag.

Use "UtilFiles" and then "Save Default Setup" to save these various parameters and settings on disc for automatic loading the next time you boot up.

NOTE: in order for an axis to respond to its encoder (and for the data to be sent over the serial port), two conditions must be met:

* 1. The axis name must be highlighted (YELLOW). Click with the LEFT mouse key to highlight/unhighlight the axis name.

* 2. Either the PvEC or NEUT box to the right of the axis name must be highlighted. Click REC or NEUT with the LEFT mouse key to highlight.

In the "HardSet: Setup Serial Port" dialogue box, the "Low byte first" and "High byte first" parameters control whether the 16 bit data values are sent with the low 8 bits or high 8 bits first (Intel format vs. Motorola format).

TO START SERIAL COMMUNICATIONS.

Click on "HardSet" in the grey menu area at screen lower right. Click on "Setup Serial Port" in the submenu. Fill in the blanks in the dialogue box. Click "Start" to start sending. To stop sending, click STOP on the above dialogue box. Be sure not to select the COM port used by your mouse.

The X, Y, Z, PAN, TILT, and FOV axes listed on the screen correspond to the 6 data axes in the communication format. The first six axes listed on the screen are always sent in order from top to bottom. Use the "NameAxis" command in the grey menu area to change the names to your liking.

The best way to check things out without encoders:

Turn on serial communications using the above procedure. Click "MousJog" in the grey menu area. Place the mouse arrow on the PAN (or any other) axis name. Click the LEFT and RIGHT mouse keys to jog the axis. Click "QuitJog" at screen right center to leave MousJog.

NEW **ANIMATION TRICKS**
Feb. 8, 1994
This version of RTMC130 rev B contains a change in the Animation Setup Screen functions which allows many new tricks of great use to animators. Specifically, entering an exposure time of "0.000" now prevents the camera from winding for that frame. Previously, a time 0.000 entry caused the camera to wind capped or shutter-closed. Some of the possibilities include:
MOVING AXES OUT OF THE WAY FOR THE ANIMATOR It is sometimes desirable to move the camera away from the model to give the animator some elbow room. Also, some shots require motorized set elements to move out of the way between exposures. The "Index" scheme provides a method.
Precede generally as described in the two exposure-line RACKOVER scheme below, with the following modifications: the axis "mode box" under the axis name will be "I" for the first (non-shooting) exposure, and either "B" (go-motion) or "S" (still) for for the second exposure. This causes the axis to assume an out-of-the-way indexed position for the #1 non-shooting exposure step, and back into the move position for the actual exposure line #2. Since the first exposure is "indexing", you must create a special "indexing" keyframe with a frame number of 1.00 and a position equal to the desired out-of-the-way position. Since you will already have some other keyframes in the list, be careful not to disturb the move by using any of the curvefit or other move generating commands after you create the indexing key frame. It is assumed that all move modification will be completed by the time you reach the shooting point, so the presence of a "odd ball" key frame at frame 1.00 should be of no consequence ~ unless you accidentally curvefit the move. Be careful about this.
GENERATING A STROBE SIGNAL ON EACH ANIMATION FRAME. In continuous shooting modes with the RTMC48 Card, the flash strobe outlet can be programmed to generate a once-per-frame strobe signal with the "fs" command. For the RTMC16 Card, and for single frame work in general, a strobe can be generated as follows. It is necessary to program two exposures in the animation setup screen. Use one of the RTMC Logic bits 0 to 4 as the strobe signal source. Refer to the back of the RTMC 16 manual for pinouts. Note that these signals are TTL, 5 volts. Verify that the device to triggered can operate safely from such signals. In the Animation Setup Screen, click in two exposures with the "+ -" box. Set the exposure time for the second exposure to 0.000, which will prevent the camera from rolling. Set the polarity for the trigger bit to opposite polarity for the two exposures, by clicking in the appropriate "bit box" in the "Triggers" column. You may need to experiment with the polarity sequence, delay time, etc. for best results, depending on the requirements of the device being triggered.
CAUSING THE CAMERA TO RACKOVER BETWEEN FRAMES. This assumes that the rackover is motorized. Set the pulses per unit for the rackover axis so that 1.000 unit of travel moves the axis over its range of travel. The shooting position should be 0.000, the viewing position 1.000. To simply rack over when not shooting, use the "gm" command, "gm rackover 0" moves the camera to the shooting postion, "gm rackover 1" moves the camera to the viewing

position. This assumes the axis is named "Rackover" — you can also use the axis number instead of the name. The axis name must be highlighted in order for the axis to move.
To setup the rackover function for stop motion, enter the stop motion setup screen. Click the "+" side of the "+-" box to display two "exposure lines" on the screen. Click on the mode select box at screen top center until it displays "INDEX". Click in the two axis mode boxes just below the name of the rackover axis so both boxes display "I" for in both exposures.
The next step is to tell the indexing rackover axis where it should be for each of the two exposures. This information is carried in the list of keyframes. For the rackover trick, keyframe frame number 1.00 contains the index position for exposure 1, keyframe frame number 2.00 contains the index position for exposure 2, etc. This also works for any axis designated "I" on the animation setup screen. To create the keyframes, enter the graph move editor by clicking on the "Editor" menu box. Use PickAxes to select the rackover axis. To create the keyframes you can use the "EditKeys" command, or just type in the following two-letter command:
in 1 1 2 0
Don't do any curve fitting. For any exposure where an axis is a Index axis, the software only looks at the keyframes and ignores the move data. The above keyframes place the index axis at position 1.000 (racked over in this case) for exposure number 1, and at position 0.000 for exposure number 2.
Finally, back in the animation setup screen, enter an exposure of "0.000" for the first exposure line, and the normal exposure for the second exposure line. Designate the other axes as "B" for go-motion, "S" for normal stop motion, or even "I" for other indexing axes. The "Switch" option should be selected for both exposure lines.
When you click FWD, the camera will rack into viewing position (if the axis name is highlighted). When the animator is ready to shoot, he presses the switch again, and the camera will rack back into shooting position, and once more wait for the switch. The next switch press will expose the frame. Immediately after the exposure, the camera will once again rack into viewing position for another cycle.

Dec. 13, 1993

RC SERVO SETUP SCREEN PROCEDURES, PRELIMINARY VERSION

The KRJ130 RC Setup Screen sets motor travel limits, and how each axis relates to its joystick. It also a good way to quickly check joystick activity, and to determine if all the joysticks are operating correctly. You will use the RC Setup at least once for each new controlled device, and thereafter whenever you change a motor configuration or replace a potentiometer.

The setup procedure is usually done in the following order:

1. Set the axis home position. This is the motor shaft "neutral" position, which equals position "0.000" on the screen display. Ideally the servo's home position will be very close to the center of its total travel range.
2. Set the axis travel limits. You should always do this early in the setup process, since both RC servos and puppets can be easily damaged by crashing them into either internal or external physical limits.
3. Assign which joystick controls what axis.
4. Tell the computer where each joystick's "neutral" position is. This is the joystick position which corresponds to the motor home position. For spring loaded controls, this is the "hands off' position.
5. Set the sensitivity and direction sense of each joystick, so a given amount of joystick movement produces the desired amount and direction of axis movement.

Detailed instructions for all these steps begin on the next page. You can do most of these steps in any order you wish, but for your initial experiments we recommend you stick to the above sequence.

To enter the RCSetup screen, click the SetupRC menu item in the grey menu area at screen lower left. After the axes are set up to your liking, click the QUIT box at screen lower right to return to the main Control Panel Screen. **Use the UTILFILES : SAVE DEFAULT SETUP command to save your setup on disc,** so it will automatically boot up the next time you run the Kuper software.

SOME TECHNICAL BACKGROUND ON RC SERVO MOTORS

RC Servos are controlled by "PWM" (Pulse Width Modulation) signals. The Kuper card generates PWM signals at its DB37 output connector. PWM signals are said to have a "pulse width". By sending different pulse widths, the RC Servo assumes different positions. For most servos, a pulse width of 1.5 milliseconds puts the motor in the center of it possible movement range. A millisecond is 1/1000 of a second. Reducing the pulse width to 1.0 milliseconds moves most servos about 30 degrees away from home in one direction, while increasing the pulse width to 2.0 milliseconds moves he servo about 30 degrees away from home in the opposite direction. Most manufacturers recommend limiting the motor travel to +- 30 degrees from the ideal, 1.5 millisecond home position, which is in fact more travel than the typical puppet axis uses. However, most RC servos will respond to pulse widths in the range of 0.2 to 3.0 milliseconds, moving +- 90 degrees or slightly more from the center position. The risk with such large movements is that at some point you will grind up against the internal hard limits of the motor.

Grinding an RC servo motor against its hard limits for more than a short period of time will cause permanent damage.

MOTOR POSITION DISPLAY CONVENTIONS

Since it's so important not to crash into the limits of travel, the KRJ130 software bases its display of motor position on the actual pulse width reaching the motor. This helps the operator understand how much of the available range of motion is actually being used, and how much is still available.

When you first boot up the KRJ130 software, the position display for all motors is at "0.000" and the KRJ32 card is sending a "textbook" 1.5 millisecond pulse to every motor, which should place all motors at their perfect center of travel. The "0.000" on the position display shows that the motor is 0.000 milliseconds away from the ideal 1.5 millisecond pulse width. If you move an axis to position 0.500, you are now 0.500 milliseconds away from the ideal 1.5 millisecond home position — that is, the motor is receiving a 2.0 millisecond pulse-width and is close to one of its recommended travel limits. If you move an axis to position -0.500, you are -0.500 away from the 1.5 millisecond home position, and the pulse width is 1.0 millisecond. If possible, always try to rig your axes so you don't have to move any axis to a screen position outside of its "normal" -0.500 to +0.500 operating range.

As described in the next paragraph, there is a complication to this scheme which can be introduced if you elect to assign an axis home position which is not equal to an exact 1.5 millisecond home position.

For the following discussions, it is assumed that you are in the RC Setup Screen, which is reached by clicking the "Setup RC" command box at the lower right of the main Control Panel Screen.

1. SETTING THE AXIS HOME POSITION

Each puppet axis has special "home position" or "neutral position" which results in a generally neutral, relaxed looking puppet position. For eyes, this may be looking forward. For a mouth, perhaps home has the lips just barely parted. In the most ideal situation, this puppet axis neutral position will be achieved when the RC servo motor is at its exact midrange (1.5 millisecond) position. This makes available the same amount of motor travel range in either direction. When an axis is in its neutral position, the axis position displayed on the screen is "0.000".

In actual practice, it's hard to rig a puppet axis neutral position to coincide with the ideal motor neutral position. Sometimes the desired puppet neutral position is also near one of the practical limits of the desired travel range (the puppet's lower lip will seldom travel much above the barely parted position). Sometimes the motor is simply too "buried" to reach for adjustments. At any rate, it is often expedient to assign an "electronic" motor home position that is different than the ideal motor center of travel.

Place the mouse arrow on one of the axis names at screen upper left. While the arrow is on the name, tap either the right or left mouse keys. Note that the position display just to the left of the axis name changes as the motor moves.

Jog an axis to the desired "home" or "neutral" position. At screen upper right, locate the "AXHOME" column. Make a mental note of the current motor position as shown in the POSITION column just to the left of the axis name. Place the mouse arrow on the AXHOME number which corresponds to the axis you just jogged, and tap the

RIGHT mouse key. Two

things happen: the POSITION number for the axis is immediately transferred into the AXHOME entry for the axis, and the POSITION count for the axis changes to 0.000, without moving the axis from its current position. The former motor position becomes the new home position. The number in the AXHOME column is just a reminder of how far away the axis is from the ideal home position. AXHOME Numbers outside the range of+- 0.500 indicate a problem axis where the servo may be dangerously close to one of its internal travel limits. You should definitely consider re-rigging any axis requiring a home position outside this range.

Clicking each of the three mouse keys inside the AXHOME column gives a different result.

RIGHT KEY copies the current motor position into the AXMODE column, and resets the POSITION count to 0.000. This is the most common method.

LEFT KEY calls up the Calculator Entry Device. You can literally type a specific number into the Calculator using the number keys on the computer keyboard, or by mouse clicking keys on the Calculator. To enter the number, press Enter on the computer keyboard, or click the Calculator screen with the left mouse key.

MIDDLE KEY resets the AXHOME position to 0.000.

The Kuper software has several different commands (such as GoHome on the main Control Panel Screen) which quickly send all the axes to their home or neutral positions. Also, when the Kuper software first boots up it moves all the axes to the "electronic" neutral position, based on the numbers entered in the AXHOME column.

2. SETTING AXIS TRAVEL LIMITS

Place the mouse arrow on an axis name, and left/right click the mouse keys to jog the axis to one of the travel limits. Locate the two AXIS LIMITS columns at screen upper center. Click the RIGHT mouse key on the number in either one of the two AXIS LIMITS columns. The current motor position will be copied into the column. Now mousejog the axis to the opposite travel limit, and click the RIGHT mouse key on the other of the two AXIS LIMITS columns. Again, the current motor position is automatically copied into the column. The software may swap the values so the more positive one is on the left, without changing the values.

Now locate the LIMS (LIMITS) column at screen center top. The values in this column can be either OFF or ON, and turn software travel limits off and on. Click in this column so the limits display for axis shows ON. Try jogging the axis outside the limits and notice that you can't. Clicking the LIMITS to OFF lets you move the axis outside the AXIS LIMITS.

3. ASSIGNING JOYSTICKS TO AXES

Locate the "#" column near screen top center. The numbers in the column show which joystick is assigned to each axis. Joysticks are numbered 1 to 32. To change joystick assignments, place the arrow on the number, and left or right click to toggle up and down through the possible joystick selections.

Just to left of the "#" column is the JOYPOS column, which always shows the current position for the selected joystick. The joystick position is shown in raw "joystick units", which range in value from about 40 to 550. These numbers don't directly relate to axis positions, but are simply a measure of joystick activity. The JOYPOS column is especially helpful when you are trying to sort out which joystick "#" goes to each physical joystick. If no joystick is hooked up for a given joystick number, the number in the JOYPOS column will be "0", but may occasionally flicker in response to environmental noise. This is normal.

4. ASSIGNING THE JOYSTICK'S CENTER POSITION

One by one, place each joystick in its center position. This is the joystick position you want to be equal to a motor's "0.000" position. Locate the JCTR column at screen upper left. Click the RIGHT mouse key in the this column, for the specific axis. The current JOYPOS number is copied in the column. From then on, the corresponding axis will be at home position whenever the JOYPOS number equals the JCTR for that axis.

The JCTR number is sensitive to the following mouse clicks:

RIGHT KEY immediately copies the current JOYPOS position.

LEFT KEY lets you enter a specific JOYPOS number using the Calculator device.

Note that the JCTR position actually belongs to the axis, and not to the joystick. You can easily change the joystick assigned to each axis by clicking in the "#" column. The number in the JCTR is a "raw joystick position number", and no matter what joystick is assigned to an axis, the JCTR number stays the same. Also, if one joystick number is assigned to multiple axes, the different positions for that joystick may be required to bring each axis to its home position, depending on the specific JCTR number for each axis.

5. CONTROLLING JOYSTICK SENSITIVITY AND DIRECTION

As a safety measure, first make sure the LIM column (LIMITS) entry for each axis you plan to joystick is set to ON. To enable an axis to be controlled by its joystick, first place the joystick in an approximately centered position, and then click in the JOY column for the axis. The values in the JOY column toggle between ON and OFF. When "ON" is displayed in the JOY column, the axis is immediately placed under the control of the joystick. Carefully move the joystick, being careful not to move the motor against its limits. If nothing happens, make sure you have the right joystick assigned to the axis in the "#" column.

The JSENS (Joystick Sensitivity) column controls how sensitive each axis is to its joystick. Bigger numbers give more axis movement for a given amount of joystick movement. To change the sensitivity, LEFT click on the number in the JSENS, and enter a different sensitivity on the Calculator device. If you want to reverse the direction sense between joystick and axis, click the MIDDLE key on the JSENS number, which changes the mathematical sign between + and -.

Note that as with the JCTR number, the joystick sensitivity and direction parameters belong to the axis, and not the joystick. This makes it possible to simultaneously use one joystick to control several different axes, with a different amount of sensitivity, direction sense, and home position for each axis.

Dec. 2, 1994
The enclosed update to KRJ130.EXE contains numerous additions and corrections, including the following:

* There is a new looped "breathing cycle" which operates automatically in the background, relieving the animator of having to specifically program blinks, breathing, body twitches, etc.
* It is possible to break down the move into sections, where each section is started in sequence with a switch closure. In conjunction with the breathing cycle function, this greatly facilitates the ability of a puppet to interact in situations such as dialogue with an actor.
* The MergeFile command is corrected, and greatly improved. It is now possible to visually select which axis in the input file will load into which axis on the screen.

BREATHING CYCLES

A breathing cycle is a loop of action which is automatically added into the puppet motion whenever the operator has highlighted the "axis number box" just to the left of the axis name. The loop is entirely independent of the move currently loaded into memory, and is applied whenever the axis number box is highlighted, regardless of whether the axis is in PLAY, NEUT, or REC, whether or not the frame count is advancing, and whether or not the axis name is highlighted.

To create a loop, first make the loop as a normal move of any length up to 15 seconds duration. Proceed exactly as you would with a normal move, except use the DrawFree menu item (or some other method) to make sure that the first and last frames have roughly the same position, in order to insure a smooth loop transition. Now use the "ib" (Initialize Breath) command, answering " 1" to the warning prompt. The "ib" command copies the move into a special memory area outside of the move memory, at which point the loop becomes entirely independent of the move file. You can erase the move used to create the loop with the "NewMove" command, but the loop itself will remain memory resident until the computer is turned off, or a second invocation of "ib" is used to overwrite the previous loop with a new loop.

Highlight or un-highlight the number box to the left of the axis name to turn looping on and off on an axis by axis basis. Clicking the MIDDLE mouse key anywhere in the axis number column will simultaneously turn off the loop function for all axes.

Note that the loop action does not itself record when the axis is being recorded in REC mode, even though the loop action is being manifested at the time of recording. In most cases, it is probably best to record the puppet motion with the loop turned off, and then turn the loop on for playback only.

There is no specific command to load or save loop files. When you create a loop, always save the move used to create the loop as a normal move file. To load a loop, first load the original move file used to create the loop, and then use the "ib" command to transfer the move to the special loop memory area. Remember that the loop will persist through any number of NewMoves, move edits, etc.

SECTIONING MOVES

It is possible to start and stop a move file with a switch closure. This is especially useful when engaging a puppet in dialogue which a human actor, where the actor's timing is not completely predictable from take to take.

First, you must indicate all the start and stop points with the "EditBits" command. Bits #1 and #2 are used to indicate the start and stop points for each sequence. Highlight one frame of bit #1 (the top one on the staves) to indicate each starting point, and one frame of bit #2 to indicate the corresponding stop point.

Click the "START:..." box so that "START: Shoot Switch" is displayed. Set the VISUAL:PRESENT to some point in the move where you want to pick up the dialogue (this will typically be frame 00:00:00). Now start things rolling with the "sn" (SequeNce) command, rather than by clicking on the FWD box. The software will search the EditBits program until it finds the first highlighted bit #1, and que that frame into "START" box, and then place the frame number of the next occurrence of bit #2 into the "END" box. The FWD box will automatically light, and the first sequence will start to play when the shoot switch is pressed. After the first sequence is completed, the software will automatically que up the next bit #1 "START" and bit #2 "END" framecounts, and once again wait for the shoot switch to be pressed. And so on for as many bit #1 and bit #2 combinations have been set. Click STOP to cancel out of the sequence cycle.

The new breath loop capability will prove very useful in this sort of application, since it will keep the puppet from freezing up between passes, while waiting for the shoot switch to be pressed.

The KRJ32 Card does not have a dedicated switch input. A shoot switch occurrences can always be simulated by mouse-clicking on the "WAITING FOR SWITCH" box on the screen, or you can implement a physical shoot switch using a parallel port or commercial parallel card.

In the case of an actual hardware shoot switch, you must tell the software the address, bit number, and polarity of the switch by creating a special file in the Kuper directory. The name of the file must be "switch" with no extension. The file must contain three entries, separated by spaces:

(port address in hexadecimal) (which bit on the port) (what polarity to look for)

* The port address must be a hexadecimal number in the range of 200 to 3ff.
* The bit number must be in the range of 0 to 7, depending on which bit the switch is connected to.
* The polarity must be either 0 or 1. Most switches will require a 0 for this entry.

Connecting a switch through a parallel port can be less than straightforward due to inconsistencies in parallel port design. Please feel free to call Kuper for help in this matter: 310-414-0701.

USING THE KUPER ENCODER HANDLES:

The Kuper Encoder Handles greatly simplify the interaction between the computer operator and the handle operator during live action shooting. The handles operator can directly modify sensitivity and smoothing, set travel limits, and enable / disable the encoders under his control without the aid of the computer operator.

The computer operator must set certain initial operating parameters. The two encoders in the handles are numbers 9 and 10. The computer operator must pre-assign these encoder numbers to the axes to be controlled by the handles. This is done by right and left clicking on the Encoder numbers at the left of the "Joystick Params" area of the control panel screen. Also, the computer operator should set the sensitivity and smoothing parameters to reasonable initial values for the axes being controlled. The axes should usually be placed in "POSN" rather than "VELO" mode. In the Options command (visible on the control panel screen), the encoders can be set to either automatically be disconnected from the handles (that is, placed in PLAY) mode at the end of each recording pass, or left active (in RECord mode). Finally, the keypad on the handles is "enabled" by invoking the "pd" command, and selecting the appropriate dialogue item. Note the encoders in the handles can be used as encoders 9 and 10 at any time, under the direct control of the computer operator ~ the "pd" command selection goes the additional step of allowing the handles operator to directly control the encoder parameters with the keypad.

The keypad on the handles box is organized so that the left two vertical columns control pan, and the right two vertical columns control tilt. The same functions are duplicated in each of the pairs of columns. In practice, the handle operator can do the following at any time:

Enable the axis by tapping the ON button. This automatically puts the axis under the control of its handle. On the control panel screen, the axis is enabled and placed in RECord.

Disable the axis by tapping the OFF button. The handles can no longer control the axis, and on the control panel screen the axis is disabled and placed in PLAY.

Change the sensitivity by tapping the LESS SENS or MORE SENS buttons.

Increase or decrease the smoothing between the handle and the axis by tapping the LESS SMTH or MORE SMTH buttons. There are seven levels of smoothing, ranging from almost none to very heavy. Clicking more than seven times in the same direction has no effect.

Reverse the direction sense of the axis by tapping the REVERSE button. **Set travel limits for an axis:**

If the limits are already on, tap the LIMIT OFF button.

Move the axis to the first limit, and tap the LIMIT ONE button.

Move the axis the second limit, and tap the LIMIT TWO button. Tapping this button also automatically turns the limit watching function on.

GENERAL CAUTIONS:

Whenever an axis is enabled (name highlighted) and in RECord mode, as when an axis is under encoder control, the axis motion will be recorded whenever the move is played either forward or reverse. Be careful not to accidentally record over the move data. It is easy to do this when running a just recorded move back to the start position with the REV button.

June 29, 1993 **IMPORTANT NOTICE:**
The disc contains an updated version of RTMC130, which corrects various user reported bugs, and offers an improved synclock capability. We recommend that you install all the files on the new disc in a new hard disc directory. There is a change in the file format, which may prevent you from loading moves or "default setup" (axes.set) files generated by previous versions. If you attempt to use your present "axes.set" default setup file, your computer may lock up before reaching the main screen. If this happens, remove your old axes.set file from the hard disc directory, and use the axes.set supplied on the new disc.
USING THE RTMC48 TARGET PHASE FEATURE (RTMC48 Card Only):
The Target Phase establishes the sync angle between an external camera, timecode, or video source and the motion control move. There are two primary reasons for varying the Target Phase:
» Removing the video roll bar from video screens.
» Phasing a sound speed camera to match the phase angle conventions of a stepper camera motor controlled directly by the motion control system.
Use the "sa" or "tp" command to vary the target phase angle. You can do this even while a move is running, which is especially helpful to move a video sync bar out of frame.
To phase a sound speed camera to match stepper motor camera phase conventions:
Make about a three inch cardboard disc. Cut out a roughly 10 degree slot in the disc. Mount the disc on a pulley (glue or tape), and then on a stepper motor. Make a home position mark on the motor frame so the disc slot can be consistently aligned to the stepper motor. Using the AxisSetup command, set the pulses per unit of the slot stepping motor to equal the number of pulses required to rotate the slot motor once. Make about a 3000 frame move on the slot motor axis, so the motor rotates once per frame ("in 0 0 3000 3000", and then "fa"). Jog the slot motor so the slot is at the home position mark, and zero the motor count. Connect the sound speed camera to the DB15 sync input, and start the camera (make the sure the VISUAL FPS is the same as the camera FPS) and wait for the SYNCLOCK bar on the Control Panel screen to light. Look at the camera movement through the spinning slot disc, such that you are looking through the slot at a position 180 degrees away from the home mark on the motor frame. The slot acts as a strobe to freeze the movement. While the move is running, use the "sa" command to adjust the phase angle such that the movement is frozen centered on the "frame pinned" position (use values between 0 and 360). Experiment with "sa" parameters until you find the two angles at which the pins are just barely inserted,-and then just starting to withdraw, and average the two. The average of the two extremes of pin insertion will your "working TARGET PHASE". Make a note of the angle. If phased in this manner, sound speed passes shot with a normal camera motor will exactly match later go-motion, stop-motion, and continuous passes shot with a stepper motor.
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SOME NEW **RTMC130 COMMANDS:**

np Nodal Parameters: boomlength lens offset if z axis lens offset in x axis lens offset in y axis

offsets are relative distances center of pan. -z is in front of camera -x is to the left, looking through lens -y is below the pan axis

na Nodal Axes. Specify physical axes to accomplish nodal corrections.

ad Add axes together. AXIS_A = AXIS_B + AXIS_C

su Subtract axes. AXIS_A = AXIS_B - AXIS_C

mu Multiply axes. AXIS_A = AXIS_B * AXIS_C

dv Divide axes. AXIS_A = AXIS_B / AXIS_C

ra Radian Arctangent. AXIS_A = ARCTAN(AXIS_B)

da Degree Arctangent. AXIS_A = ARCTAN(AXIS_B)

sq SQuare root. AXIS_A = SQRT(AXIS_B)

co COsine, degree mode. AXIS_A = COS(AXIS_B)

si Sine, degree mode. AXIS_A = SIN(AXIS_B)

at Axis Tracking in y / x only, degrees. AXIS_A = ARCTAN(AXIS_B / AXIS_C) Works for all quadrants.

pt Point Tracking. Construct a Pan and Tilt move to always point at a point in space specified by Z Y X offsets from system zero position. Axes can be real or virtual.

PAN = axis to receive pan data

TILT = axis to receive tilt data

TRACK = preprogrammed Z axis

EW = preprogrammed X axis

NS —preprogrammed Y axis

Offset_Track = target point Z offset from system home position

Offset_EW = target point X offset from system home position

Offset_NS = target point Y offset from system home position

gv Go Virtual. Make real axes go to equivalent position for current Virtual Axes positions. Requires no parameters.

gn Go Nodal to specified virtual Y X Z Pan Tilt Roll, must enter six parameters.

dt Dolly Type. Specify dolly as boom or Cartesian.
cp Convert to Position. Takes the data in the position (POS:) graph, treats the data as velocity, and adds up each file entry to create a new "position" move. Allows velocity profile moves to be created using keyframe techniques only available in the position graph mode. Use "cv" (Convert to Position) to undo.
cv Convert to Velocity. The data in the position graph is replaced by the frame by frame difference, or velocity. Use the cp (Convert to velocity) command to undo.
ot Offset To new position. The user may supply between one and three parameters:
Parameter 1: Distance to offset, always required.
Parameter 2: (optional) the frame number to offset to the new position.
If not supplied, frame 0.00 is assumed.
Parameter 3: A list of one or more axes to offset. If no list is supplied, only the selected (name highlighted) axis will be affected.
example: "ot 45 100 pan" offsets frame 100 of the pan axis move to 45 degrees.
ro ROtate axes. Rotates the move on any two axes oriented at 90 degrees to each other by a specified angle. The axes may be real or virtual. Three paramters are required:
Parameter 1: The "0 degree" axis, relative to which the move will be rotated. This is often the main track axis.
Parameter 2: An axis at 90 degrees to the "0 degree" axis.
Parameter 3: The specified angle of rotation, in degrees.
uk Update Keyframes from move data. Some commands and operations may pull the move data away from the established keyframes. This commands makes the keyframes jump to the current move positions for the corresponding keyframe number. A list of several axes may be supplied. In no list is supplied, only the selected (name highlighted) axis will be affected.
cr Create Rotation. Fills in rotation data for a given axis, based on the resulting motion vector of the velocities of 2 "xy" axes which establish the direction of travel. Three parameters are required. The xy axes may be real or virtual.
Parameter 1: The axis to fill in, typicall model yaw or model pitch.
Parameter 2: The "xy" axis parallel to the model "0.00" orientation.
Parameter 3: The other "xy" axis, at 90 degrees to model "0.00"
example: "cr ModelYaw Track EW" fills in the move data on the modelyaw axis to keep the model pointed in the direction of motion imparted by the movement of the track and ew axes.

vr Virtual axis data to Real axis data. Fills the real axis move data files with the equivalent of the Virtual axis move data. Useful to edit "virtual" axis moves in their "real" axis format.
za Zero all Axes. Sets to motor positions for all real and virtual axes to 0.000.
op One Pulse. Send out 1 pulse in the positive direction, followed by 1 pulse in the negative direction. Use to wakeup Centent drivers.
pc Phase Check. Moves a single specified axis +- as much as 1/2 rotation from its current position, so that the motor shaft only is at its "home position" even though the axis may be physically far away from the actual "0.000" home position. If the motor shaft home marks line up the same as at the 0.000 position, it is fairly safe to assume that the axis has not lost or gained pulses since setting the home position.
The format is:
pc (number of pulse per motor shaft turn) axis Assuming that the driver for the Track axis is set to 5000 pulses per motor shaft turn:
pc 5000 track
Would move the motor shaft for the track motor +- 1/2 turn to achieve the corresponding "0 phase".
It is imperative that the pulses parameter be the actual raw number of pulses per motor shaft turn, and not the Pulses per Unit as set with the AxisSetup command. If the pulses per motor turn is wrong, the axis may move considerably more than 1/2 turn from its present position.
As soon as the motor achieves its "0 phase", a dialogue box appears. If you click "OK" or press the keyboard Enter key, the motor will automatically go back to its original position. If you click outside the "OK" box, the motor will remain at its 0 phase position. Please do not use "pc" between the time you click "FWD" or "REV" to start a move pass and the actual start of the move. To check phase before running a move, click the "GotoStart" box or type in the "gs" (Goto Start) command. When the motors stop at their preroll start positions, use "pc" to check individual axes.
gs GotoStart. Same as clicking the "GotoStart" box.
ge GotoEnd. Same as clicking the "GotoEnd" box.
vp Visual Present. Used to change the Visual .Present box from the keyboard.
vs Visual Start. Change the Visual:Start box from the keyboard.
ve Visual End. Change the Visual:End box from the keyboard.
vt Visual Total. Change the Visual:Total box from the keyboard.

ml Move Length. Change the system's concept of how many frames are in the move, "ml" simply chops off the move at a new frame count. Do not confuse with "nl" (NewLength) which contracts or expands the move over a different number of frames.
sa Sync Angle. Changes the Target Phase angle. Same as clicking the TARGET PHASE box. The sync angle can be changed while the move is running. Any angle between 0 and 360 is valid.
tp Target Phase. Synonymous with the "sa" command.
be Backlash Compensate. Takes out the backlash in all highlighted axes. Format is: be (number of units)
"be 4" moves all highlighted axes first 4 units away from the direction of the move, and then 4 units back in the direction of the move. In practice, first type "gs" or click GotoStart to position all axes at their preroll start positions. Then type "be 4" to correct the backlash at that position. Please do not use "be" between clicking "FWD" or "REV" and starting the move.
At this time, "be" only is only valid for moves which run in the "FWD" (forward) direction.
nb Number of Editbits Bits. Sets whether the number of bits visible on the EditBits programming staves is 8 or 16. If 16 is selected, the top 8 bits will come out on the port complimentary to the EditBits port specified using the setrtmc.exe program. If LPT1 (port 278 hexadecimal) is specified via setrtmc.exe, then the low 8 bits will come out on port 278, while the hi 8 bits will come out of LPT2 (port 378 hexadecimal), and vice versa. For RTMC16 systems, nb must ordinarily be equal to 8, in order to prevent conflicts with the Jogbox's use of one of the LPT ports; there is no such restriction for the RTMC48 Jogbox scheme.
fi File Init. For a specified frame number in the move file, modify the motor position counts of the selected axes to match the move file positions for the specified frame number. Use of this command will usually result in a modified home position. The motors stay in the current position, but the computer's perception of where the motors are is altered to equal the move file positions.
fb FileBrowsing. Initiate move browsing controlled from a parametric FPS file. A prompt box appears. The position numbers on the FPS AXIS control the fps at which each frame number will be shot. On the EXPOSURE COMPENSATION AXIS, the position data is interpreted as the motor position for a shutter or iris control motors, while the frame number is interpreted as the FPS; if the position for frame 4 is 3.567, then the exposure compensation axis will position itself at 3.567 when the move is running at 4 fps. The EXPOSURE COMPENSATION AXIS should have valid move data up through a frame number equal to the largest position data entry on the FPS AXIS.
xy Display an elevation graph of 3 selected axes. Press the enter key once to draw the graphs at 24 FPS. Press any key to leave the graph.
nu List out the move position NUmbers. nv List out the move data in terms of Velocity.
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NEW JOGBOX COMMAND:
The Jogbox "MakeThis" command provides a way to offset the move data on one or more axes to match the present motor position(s) for the axes. Jog one or more axes to a new position, press and HOLD DOWN the "Jog32" key, and tap the "Set Home Position" key. Release all keys. The Jogbox prompts for frame number, and to select a group of axes to offset.

change during sync. Whenever the SYNC LOCK is displayed, the actual motion control FPS is the FPS displayed in the SOURCE FPS box. When sync lock is broken (the incoming signal moves outside the range of+- 0.5 fps away from the VISUAL FPS speed and NO SYNC is displayed), the motion control slowly drifts back to the VISUAL FPS speed over about 2 seconds. When a signal in sync lock range starts arriving, the motion control changes to the sync lock FPS and phase over about 1/2 second. If the VISUAL FPS speed is set at or close to the FPS of the sync lock source, several seconds of temporarily broken sync lock may safely pass before camera and motion control are sufficiently out of phase to make matching a correctly phased pass difficult. (For average moves, "seriously out of phase" means a camera out of phase difference of more than 45 degrees on different passes of the same move. For very violent moves, as little as 15 degrees. For very slow, even moves, 180 or more degrees of error may not matter.)
On the RTMC48 card only, the VISUAL FPS can be directly changed by clicking with the left mouse key. Any FPS can be selected, provided "DATA/VISUAL" times "VISUAL FPS" does not exceed 160.0.
The old DATA FPS parameter has been replaced by an EXPOSURE parameter. For the
RTMC48 card, you can change the move speed by clicking either on the VISUAL FPS or EXPOSURE parameter ~ changes to either parameter are reflected in the other. For the RTMC16 card, only the VISUAL FPS parameter can be directly changed in pre-determined steps by left or right clicking, although the EXPOSURE parameters always reports the correct equivalent exposure.
The red TIMECODE WINDOW is active whenever timecode is arriving, whether or not timecode is selected as the sync source. The top window shows the arriving timecode, while the bottom window is the "timecode trigger" number. Whenever the "Start:" box displays "Start: TCode Trigger" the motion control will wait for the timecode in the bottom window to occur before starting a record or playback pass. Use the new "tt" command to program the timecode trigger number. Always enter four numbers (hours minutes seconds frame) separated by SPACES, not colons or commas. Note that is not necessary for the SYNC SOURCE to be TIMECODE to trigger to timecode. In a typical live action situation, the SYNC SOURCE will normally be the film or video camera, with the "Start: TCode Trigger" option set. **In almost every case where a normal video or sound speed film camera is being used, the sync should be to the camera, not to any accompanying timecode.** In practice, if both a sound speed film or video camera and timecode are being used, always sync to the camera and trigger from the timecode This assures perfect repeats in cases where the timecode and camera are not synchronized outside the motion control ~ sound is much less registration critical than the image.
Note that the "Start: External Camera" option is obsolete for the RTMC48 Card, and should not be used.
In cases where you want to sync lock (rather than just trigger) to timecode, the timecode should be of top quality. The best sources are a hardware timecode generator, or the "address track" of a professional deck running a first or second generation tape. Timecode from a consumer VHS audio track or other low level, "AGC" affected source is often not acceptable. The output level of the timecode source should be as high as possible. We have tested TCODE 24, 25, 30, and 60, both drop and non-drop. It not necessary to specify drop or non-drop in the RTMC130 Software. If you must use a

timecode source with unusually high or low output levels, some components on the RTMC48 card can be changed to compensate ~ contact Kuper Controls. For most stereo cassette decks, the best results will be had if you change resistor RIO to 5.6K, and the resistor just under D3 to 1 megohm. In any case, record and playback timecode in the -6 to 0 db range (just below the red line).

The distribution disc contains the latest version of a program named "SMPTE.EXE" which can be used to generate longitudinal timecode through your computer's printer port.
This is useful for pre-striping audio tapes with timecode. The current version allows timecode to be generated at any FPS and any frame modulus (24, 25, etc.). If you have an older version of SMPTE.EXE which does not prompt for FPS, please contact Kuper Controls for an update.
The ACTUAL PHASE box shows the phase relationship between the external sync source and the motion control. The TARGET PHASE box lets you program the desired sync up angle. **The TARGET SYNC value can be changed during a running move, useful to position the sync bar off a photographed video screen (assuming the RTMC48 is synchronized to the video source).** Target phase can be changed by clicking on the numeric box, or by using the "sa" (sync angle) or "tp" (target phase) commands.
The Options command now allows you to select between frame number display in raw frames or in timecode format. Also, you can select timecode format 24, 25, or 30 for the display of your frame numbers. Changing any of these parameters does not alter the move in any way, except for the protocol of frame number display. Note that the "tf" (Timecode/Frames) command is a shortcut switch between timecode and frames. For your own sanity, it's important that the timecode format (24, 25, or 30) you select with Options matches the format of the incoming timecode. When you have selected to display your frame numbers in timecode format, the frame numbers are displayed in a short form MINUTES:SECONDS:FRAMES format. Whenever you type in a frame number in timecode format, it must be in a slightly nonstandard format. If you wish to enter 1 minute, 2 seconds, 3 frames, you would enter 010203. Note that there are no colons or spaces between the minute, second, and frame fields. To enter 0 minutes, 0 seconds, 0 frames, you would enter 000000. It is always necessary to enter 6 digits, even is some or all of them are O's. The one exception is the special "tt" TimeCode Trigger command, where you always enter 4 digits (hours minutes seconds frames), separated by spaces. If you are triggering or syncing to an external timecode device, you must first use the Options command to select the format of the incoming timecode. It is not necessary to distinguish between drop and non-drop timecodes, but if you have a choice, specify non-drop.
A new MOVE BROWSING function is implemented. Press and hold JOG32, and tap LIST KEYS. Enter a starting BROWSE FR #, and select the axes to browse in the normal way. The Jogbox joystick knob is the browsing control, which works like the shuttle control knob on an editing deck. Frame number and FPS are displayed on the Jogbox screen. Browsing always starts off in POSITION mode. Click the POSN/VELO key on the Jogbox to switch to VELOCITY mode. Position mode is best for looking at a small section of the move, while VELOCITY mode is preferred for perusing large portions of the move. Whenever VELOCITY or POSITION is displayed on the Jogbox, the browsing FPS is 0.00. This helps locate the VELOCITY deadband. When in VELOCITY mode, about two turns of the joystick knob equals 24 FPS. When in POSITION mode, one turn per second equals about 24 FPS. To stop browsing, press EMERGENCY STOP, or enter JOG32 + LIST KEY FRAMES a second time. Browsing does not stay within VISUAL:START and VISUAL:END, but can go anywhere between frame 0 and the

VISUAL:TOTAL, so be careful when browsing moves with position restrictions. Be careful when starting to browse in a section of the move with no motion — watch the Jogbox FPS and frame number display carefully to make sure you don't slam into the start of motion with an excessive FPS.

In AxiSetup, motor performance settings are easier to understand. Motor speed in now specified in Pulses Per Second, and Slew Acceleration and Slew Decelerations are specified in seconds. As a starting point for most microstepping drivers, try 20,000 Pulses Per Second, Slew Acceleration = 2.5 seconds, and Slew Deceleration = 1.5 seconds. The practical limit for acceleration or deceleration is 30 seconds. In general, the deceleration time can be shorter than the acceleration time.

The MousJog command has a PatchMotors function. Up until now, the first axis in the axis name list always had to come out on the first driver, etc. PatchMot lets you assign any driver to any axis in the list. When PatchMot is invoked, the POSITIONS display to the left of the axis name is temporarily changed to a DRIVER NUMBER display. To match up a specific driver to a specific axis name, place the mouse cursor on one of the listed driver numbers, and hold down the left key. As long as the key is held down, you can slide the driver number box up and down. Simply drop off the driver box number next to the desired axis name by releasing the left mouse key. To help sort things out during this process, you can mousejog any axis by clicking the left or right mouse keys on the axis name. Use the UtilFiles:Save Default Setup or UtilFiles:Save Named Setup menu items to save the new patch on disc. All this opens up new horizons for confusion. If in the future an axis seems to be dead, give the PatchMot list a quick check.

The dblS connector on the RTMC48 Card has synchronization outputs for external flash devices. Pin 14 is the emitter (ground) of a NPN optoisolator. Pin 7 is the collector ("positive" side). The transistor is turned on once per frame. Use the "fs" (flash setup) command to program a delay from shutter closed, and flash signal duration, "fs 19.7 .5" gives a delay of 19.7 milliseconds from shutter closed, and a flash signal duration of 0.5 milliseconds. This is the nominal "centered on frame" combination for 25.000 FPS. For 24 FPS, "fs 20.6 .5". For 30 FPS, "fs 16.4 .5". Parameter resolution is 0.1 milliseconds. For calibration, remove the lens so you can see the shutter. If you are using a stepper motor camera, make sure the home position is set to shutter closed, same distance either way to shutter open. Run the camera and check to see that the flashes are falling on film, and that the edges of the shutter blades are not in frame. Experiment with the first "fs" parameter (delay from shutter closed) until you find two values which separately catch both opening and closing edges of the shutter blades in frame. Average the two values to arrive at a working value. This assures maximum shutter blade clearance. If the shutter does not fire, the second "fs" value (signal duration) may be too short. For details on how to hook up to your flash system, please contact Kuper Controls.

You can also use the flash signal to test camera syncing and phasing. On the DB15 connector, temporarily attach a wire from pin 14 to 1. With a short two wire cable, attach the positive side (long wire) of an ultra bright LED (such as Radio Shack 276-087 "Super-Bright LED") to pin 5, and the negative side to pin 7. Place a small high contrast mark on the camera inching knob. Type in "fs 20 1.0" and run a move. Hold the LED close to the inching knob. If the room is dark enough, the strobe effect will freeze the mark in its shutter open phase. After you do this test, remember to remove the pin 14 to pin 1 connection, to avoid connecting the flash and computer grounds in the future. Note that if the LED strobe seems awfully dark, you may need to change resistor R8 on the RTMC48 from 2.2k (RED RED RED) to 330 ohms (ORANGE ORANGE BROWN). To save the considerable trouble of pulling R8, you can leave the 2.2k resistor in place and just tack solder a 330 ohm resistor to the two R8 pads on the back of the board. R8 serves no special purpose other than as a hedge against the possible future need for a pull-up resistor for the flash or cap outputs. The original 2.2k value of R8 in no way affects system performance. All RTMC48 cards delivered after March 6, 1993 have a 330 ohm resistor at R8.

In the Graphic Move Editor, the keyframe numbers now always default to visible. If you don't want to always display the keyframe numbers, use the "vk" (visual keyframes) command to toggle visible keyframes on and off

THE INFORMATION FROM HERE ON WAS ORIGINALLY SUPPLIED WITH RTMC120

The maximum number of keyframes is increased to 255, from the previous 63.
The Calculator device is greatly improved. Keyboard input is much smoother, with no blank first character.
The MouseJog command now resembles a sort of "software Jogbox." Several useful commands are now immediately available without having to leave the MouseJog screen. The vertical stack of"%" boxes is used to individually set axis jogging speeds as a percentage of the normal "Slew Speed in PPI" speed. The left and right mouse keys are used to increase or decrease the percentage speed.
The AxisSetup command has a new "Home Position" parameter. The home position can now be a non "0.000" position, such as "12.000" for an animation stand. AxisSetup does not yet accept keyboard input, other than through the Calculator device.
It is possible to change the Jogbox motor speeds anytime by pressing and holding down the JOG32 key and then tapping either RUN FWD or RUN REV while JOG32 is held down. The display shows a relative jogging speed in % values. RUN FWD increases the relative speed, while RUN REV decreases the relative speed. Remember to hold down the JOG32 key. Speeds from 1 to 400% of the normal motor slewing speeds are available.
A set of about 80 two letter commands are implemented, most of which can be accessed at any time. When letters are typed at the keyboard, a narrow window pops up to display the typed input and to display prompt information. The automatic prompt message tells you what kind of additional parameters are required for each command. The "Esc" key can be used to cancel the command and remove the window. Here are some two-letter command examples:
delOO
will delete key frame number 100 from the hilited axis. However,
de 100 TRACK EW ROLL
Will delete keyframe 100 from the track, ew, and roll axes. This is typical of several commands which can accept a variable number of axes. For all commands which accept "axis lists," you can also add a single letter to specify a group of axes. For instance.
de 100 V
Will delete keyframe 100 from all the axes whose graphs are visible on the Graphic Move Editor
Screen. V stands for "visible axes."
delOON
Will delete keyframe 100 from all the axes NOT visible on the Graphic Move Editor Screen. *N'
stands for "non-visible axes."
de 100 *
Will delete keyframe 100 from all axes which have a key frame for 100.
uu
Unlocks the graph scale for the hilited axis only.
uuV
Unlocks the graph scale for all axes visible on the Graphic Move Editor Screen.

pp ROLL
Displays the graph for the axis named "ROLL" in Position Mode.
w v
Displays all the visible graphs in Velocity Mode.
gm TRACK -10.5 PAN 20
The Track axis moves to position -10.500, the Pan axis to position 20.000.
we
Brings up the Wedging Screen, without going through the Camera command.
wr 100 .05 c
Winds the camera and Relative distance of 100 frames from the starting point, with an exposure
of 0.05 seconds, Capped.
wa 0.125
Winds the camera to roll frame number 0, at an exposure of 0.125 seconds, uncapped.
The 'in[1] command (INsert Keyframes) does not accept axis lists. It is primarily intended for use on the Graphic Move Editor Screen. Keyframes are always inserted into the axis with the hilited name. Here is a typical sequence:
hiPANBARl
or
ch PANBAR1
Hilites the 'Panbarl[1] axis on the Graphic Move Editor Screen.
in 0 -50 100 80.25 200 90
Creates the following keyframes on the "Panbarl" axis:

Frame #	Position
0	-50.000
100	80.250
200	90.000

For keyboard oriented keyframing, the Control Panel Screen, the 'kf (KeyFrame) command is preferable to the 'in[1] command. A typical sequence.
k-*
Turn off the "K" keyframe enable boxes for all axes.
k+ Track Pan Tilt
Turn on the "K" keyframe enable boxes for Track, Pan, and Tilt. Only axes with hilited "K" boxes will receive keyframes in response to the "kf[l] command.
kf
Brings up the Keyframe entry calculator. Type in the desired keyframe, and press the Enter key. Keyframes are entered for all the axes with hilited "K" boxes. The keyframe position is the current motor position.
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Next to the Jogbox, the best keyframing technique is to use the MouseJog command. This command now contains a wide range of sub-menu commands applicable to keyframe move generation.
Even if you have several keyframes, the actual move is not in-betweened until you use one of the "fx" commands"
fa PAN TILT
In-betweens the keyframes on the Pan and Tilt axes, using standard cubic splines.
frV
In-betweens the keyframes for all the axes visible on the Graphic Move Editor Screen, using the "FitRough" technique.
fe
In-between all the keyframes on only the Hilited axis on the Graphic Move Editor Screen.
fp 100 200 TRACK PAN TILT
In-betweens only the keyframes with frames numbers between 100 and 200, on the Track, Pan, and Tilt axes. TP' always uses standard cubic splines.
To create keyframe eases, use the 'dd' command. DoDouble creates a second keyframe adjacent to an existing keyframe in such a way as to create an ease. Suppose you have keyframes at frame 0.00 and frame 100.00 on one or more axes. After in-between the keyframes with one of the 'fx' commands, the result move will be linear, with a constant velocity. To create an ease-in at the start of the move:
ddOV
Will a new keyframe adjacent to keyframe 0.00, on all the axes visible on the Move Editor Screen. The positions for both keyframes will be the same, thus creating an ease-in from zero velocity. You must now use one of the 'fx[1] commands to in-between the new changed set of keyframes. Only one keyframe number can be "doubled" per use of the dd command.
Some commands require fairly complicated parameter lists:
ks 48 120 60168v
For all axes visible on the Graphic Move Editor Screen (the V), with keyframes between 48 and 120, proportionally spread those keyframes to occupy the frame numbers between 60 and 168.
ks 48 120 60 168 PAN
Would do the same, but only to the Pan axis.
There is a single level undo command. When you use this command, the previous step is displayed on the graph. If you keep Undoing, the screen toggles between the latest change and the previous change.
un
undoes one step on the hilited axis. Type 'un' again to "Undo the Undo."
un TRACK
Undoes one step on the track axis, even if it is not the hilited axis.
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unv
Undoes one step on all the axes with graphs visible on the screen.
In the old Camera Box (click on the Camera menu item, or type 'ca'), you can type the first letter of the parameter you want to change.
t to program a new target (Destination) frame.
r to program the number of frames to wind.
e to program the running speed in exposure time.
f to program the running speed in FPS.
w to access the Wedge Box. (Use the 'WE' command for direct access to wedging.)
c to cap / uncap.
s to start.
qto quit.
The Wedging Box supports full, 1/2, 1/3, and 1/4 stop increments. The new "EXP X" box sets how many successive exposures will be made for each exposure. From the keyboard,
1 to 4 changes the f-stop increment.
e sets the number of frames shot at each exposure time.
p sets the number of passes through the list
r reverse the order of the exposures.
s toggles between the various "shoot-switch" variations.
0 starts the pass.
c cancels the screen.
t and F toggle between wedging in time units or fps units.
Use the '+' and '-' keys to select exposure values. Press the spacebar to select (hilite) or deselect (unhilite) exposures. The Wedging Box is directly accessible through the 'we' command.
The "EditKeys" screen also accepts keyboard input.
f adds a frame number offset to the hilited keyframes.
f adds a position offset to the hilited keyframes.
d deletes the hilited keyframes.
m allows more keyframes to be input.
c leaves the screen without applying any of the changes.
1 edits the "left" or "frame number" parameter on the keyframe pointed to by the marker box. Equivalent to clicking the middle mouse key on the frame number.
r edits the "right" or "position" parameter on the keyframe pointed to by the marker box. Equivalent to clicking the middle mouse key on the position number.
The '+' and '-' keys move a marker box from keyframe to keyframe. Press the spacebar to select (hilite) or deselect (unhilite) keyframes. The EditKeys screen is directly accessible through the 'ek' or 'li[1] commands.
"RP4" users will have to slightly adjust their keyboard rhythm. Almost none of the Kuper 2 letter commands are "hair trigger" -- you must almost always press the Enter key after the command. Many of the Kuper commands use different letter combinations for similar functions. Also, the
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sense of "parking on an axis" is less pronounced. The command structure is designed so that it is easy to work on several axes at once in the Graphic Move Editor. For instance:
pu 100
Creates a new keyframe number 100.0 from the hilited axis, with the current move position as the keyframe position.
pu 100 v
Creates a new keyframe 100, but for all the axes visible on the screen, not just the hilited axis.
There is also a prototype "motion roto" capability available from the Jogbox, which is still in need of some fine-tuning. Once the Jogbox is activated, press and hold "JOG32" and then tap "WIND CAMERA" to enter the roto mode. Follow the prompts. Press the JOG32:WIND CAMERA again to exit roto mode. In roto mode:
* RUN FWD and RUN REV automatically wind the camera from frame to frame.
* MEMO KEY FRAME automatically memorizes a key frame to go with the frame in the gate. The key frame number is automatically supplied based on the film frame.

All the other Jogbox keys work as before. You can use either the joystick or the jog keys to adjust motor positions. The JOG32:RUN REV or RUN FWD combination can be used to adjust overall motor speed. Axes specified as PLAYBACK AXES will only start to play back after you have used the FIT ALL command.
Always use the Jogbox FIT ALL command to in-between roto'd key frames. The keyframes are taken at xxx.5 intervals — there is always a .5 in each roto'd keyframe number, to center the roto'd position on the motion blur. When you use FIT ALL from the Jogbox, the software automatically inserts xxx.O keyframes just before and just after the last roto'd keyframes. This gives the motion a velocity at those positions.
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PROVISIONAL SUMMARY OF TWO LETTER COMMANDS
mm Move Motors a specified distance from their present position.
gm Go Motors to a specified position.
gz Go to Zero position.
gh Go to Home position.
im Initialize Motor count to a specific position.
wr Wind the camera a specified number of frames,
wa Wind the camera to a specified frame count,
ca Access the Camera control box.
we Access the Wedging box.
mb Initiate Move Browsing from the computer keyboard. Always uses the Jogbox encoder (number 16).
fd Start the move running in the forward direction, from MOVE:PRESENT.
rv Start the move running in the reverse direction, from MOVE:PRESENT.
sp Stop the move.
pf Position axes at a specified frame. Resets MOVE:PRESENT. Use to reset starting
position for FD and RV
pb Position axes at center of Blur for the specified frame. Resets MOVE:PRESENT.
en Enable axes,
di Disable axes.
re Set specified axes to RECord mode,
pi Set specified axes to PLAY mode,
ne Set specified axes to NEUTral mode.
ea Encoder Assignment. Assign encoders to specific axes.
es Set Encoder Sensitivity setting.
ev Toggle encoder into Velocity response mode.
ep Toggle encoder into Position response mode.
ef Set encoder smoothing factor.
k+ Turn on "keyframe enable" boxes,
k- Turn off "keyframe enable" boxes.
kf Memorize a key frame for all axes with hilited "keyframe enable" boxes.
li List keyframes for the specified axis,
ek Edit Keyframes. Same as li.
iv Convert move positions into rounded off Integer Values. Useful for skip framing
schemes on projector axes. Use with OF to offset motor phase for stop-open or stop-closed.
1m Load Move file,
sm Save Move file.
It Load Temporary move file.
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st Save Temporary move file.
ed Enter the Graphic Move Editor Screen.
qe Quit the Graphic Move Editor Screen.
w Display graphs in velocity mode.
pp Display graphs is position mode.
uu Unlocks the graph scale so the graph fills the entire frame.
cc Cleans up specified graphs.
cu Cleans Up all the displayed graphs.
hi HIlite (select) a specific axis for editing.
kg Remove specified graphs from the screen, without affecting the move data.
zo Zoom in to the graph.
za Zoom to show the full frame count on all graphs.
sf Same Frames. Make the left and right graph frame number settings for all axes match the settings for the Hilited axis.
sk Show Keyframes. List out keyframes numbers on all visible graphs.
vk Visual Keyframes. Turns automatic graph keyframe numbers on and off.
fa Fit the specified axes with standard curve fit.
fe Fit the specified axes with "FitEasy" curve fit.
fr Fit the specified axes with "FitRough" curve fit.
fp Fit Part of the keyframe list,
re Same as FA.
nl Change the number of frames in the move, keeping original path of motion,
et Display extreme velocities and positions for each axis.
km Move a specified range of keyframes in the "frame number" axis,
ko Move a specified range of keyframes in the "position" axis.
pu Create a new keyframe by pulling out an existing move position from the move data.
mt Make This. Make the current motor positions the move position for a specified move frame. All move data is offset.
dd create a double keyframe at the specified keyframe number. One keyframe must all ready exist at the specified frame number.
ks Keyframe Spread. Spread out all the keyframes in the specified range to occupy a different range.
ka Keyframe Align. Specify a keyframe number and a list of axes. Move the closest keyframe on each specified axis to match the specified key frame number.
sh SmootH the move data .
du Duplicate a key frame, new frame number but same position.
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on Old to New. Move an existing keyframe number to a new frame number, same
position.
nm New Move. Clear out the move data,
cm Clear Move. Same as NM.
un UNdo one editing step,
uo Turn UNdo on and off.
rs Repeat Section. Repeat a section of the move data one or more times,
cd Copy one axis to another.
sc Scale the move data by a factor. A factor of 0.5 reduces the distance travelled by 1/2.
Use with OF to offset the move starting position.
of OFfset the move position data by a specified amount.
mp Offset the move position data so a specified frame achieves a specified position.
fl FLip the move data so the start and end are reversed.
ah Add Hold positions to the beginning and end of the move. Specify "0" if no hold is
desired for one end of the move. Negative holds chop of frames.
tt Select a timcode trigger point. Enter hours minutes seconds frames separated by
spaces.
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RTMC120 REVISION "A" SUPPLEMENT

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NEW **CURVE FITTING COMMANDS**

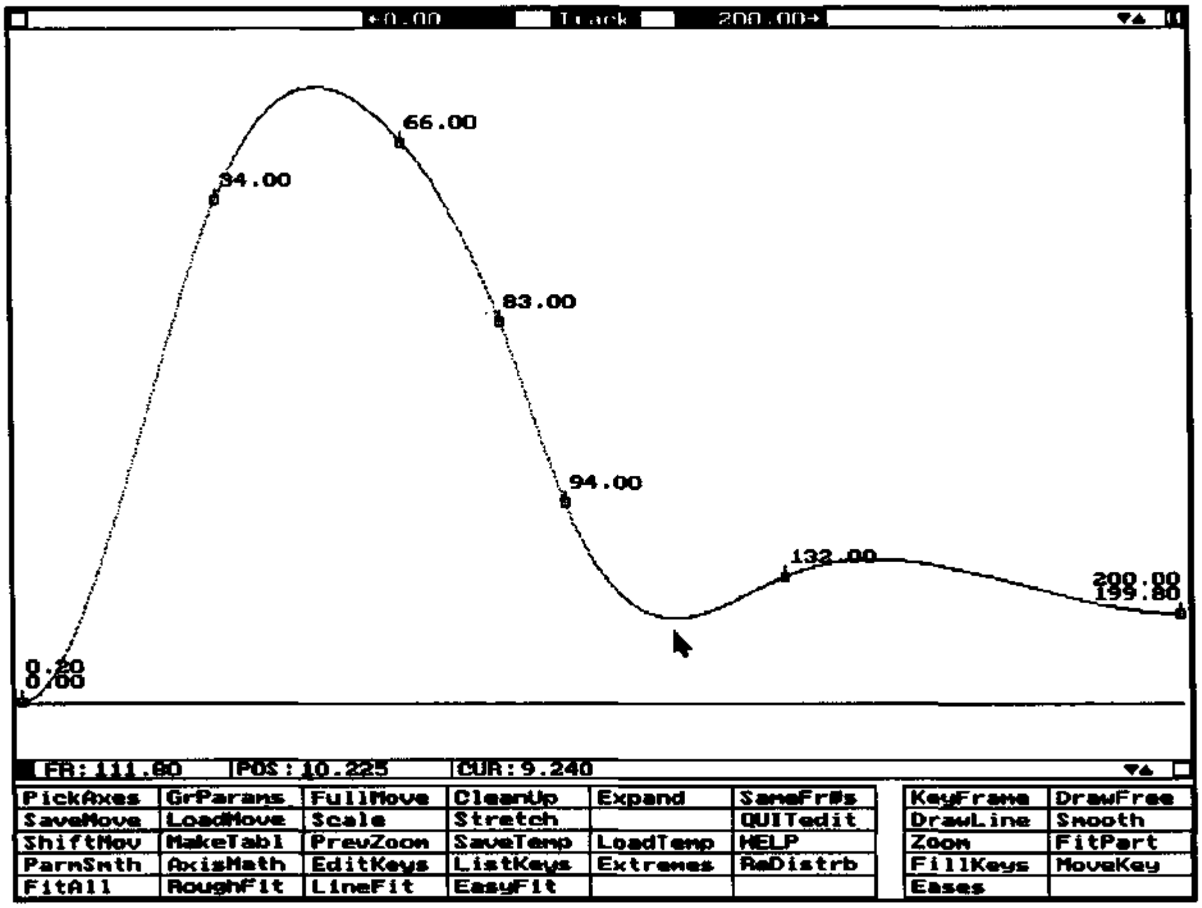
The illustration below shows several key frames in-betweened with the "FitAll" command. Typical of the pure Cubic Splines, the move exhibits "overshoots" between several key frames, such as between 34 and 66. In certain circumstances, the overshoots can be quite extreme. Previously, it was almost always necessary for the operator to use the Graphic Move Editor to edit "raw" key frame moves to control overshoots and otherwise get an acceptable move.

We have added three new curve fit types: RoughFit, LineFit, and EasyFit. LineFit simply connects all key frames with straight lines and is not directly useful for normal move generation. **Both RoughFit and EasyFit almost always produce good "first try" moves with no further intervention from the operator.**

Figure 1 Key frames in-between with the "FitAll" command.

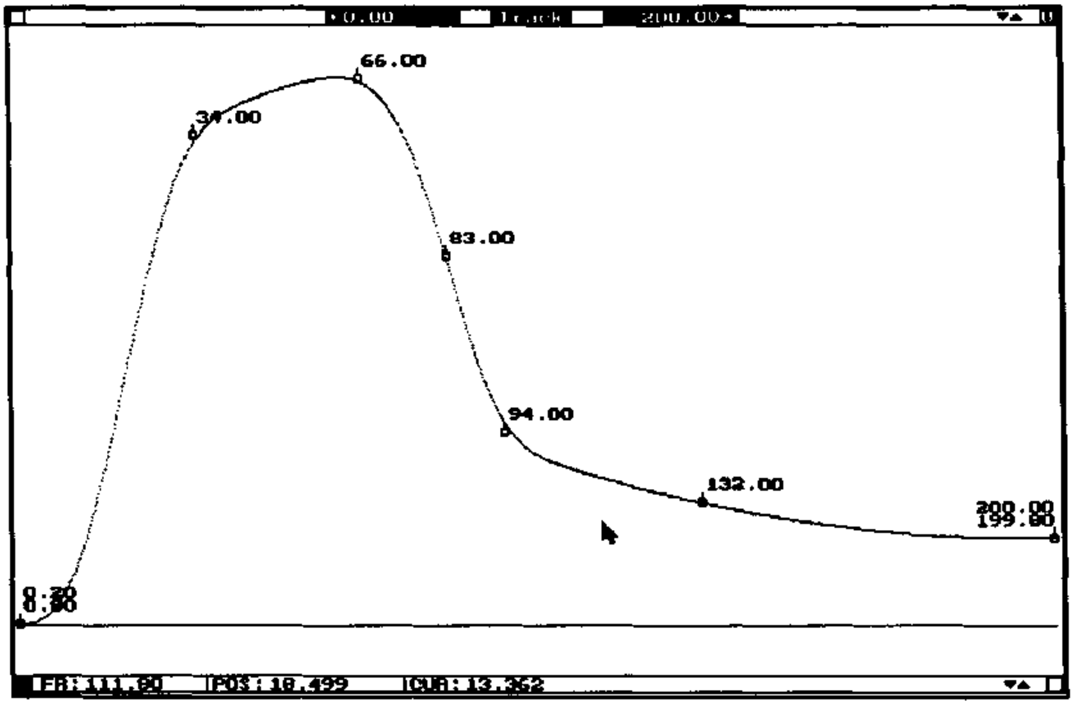
The following illustrations show how RoughFit and EasyFit deal with the set of key frames shown above. The most obvious difference is that **EasyFit passes exactly through each key frame, while RoughFit only comes close to the key frames** (but still exactly hits the first and last key frames).

The qualitative differences are more apparent on the velocity graphs. The RoughFit velocity graph is very rounded. Such rounded velocity graphs mean that the accelerations change slowly over time. The EasyFit velocity graphs shows sharp angles, characteristic of rapid changes in acceleration. The velocity-to-velocity transitions are still gradual, but the sharp corners show where the acceleration changes abruptly. Both the RoughFit and EasyFit moves appear smooth when actually run, but the EasyFit move shows more dynamic changes in acceleration. **RoughFit has a somewhat smoothed "fluid head" feel, while EasyFit has a looser "straight head" feel.** RoughFit sacrifices exactly hitting


←0.00
Track
200.00→
66.00
34.00
83.00
94.00
132.00
200.00
199.80
0.20
0.00
FR: 111.80
POS: 10.225
CUR: 9.240
PickAxes
GrParams
FullMove
CleanUp
Expand
SameFr#s
KeyFrame
DrawFree
SaveMove
LoadMove
Scale
Stretch
QUITedit
DrawLine
Smooth
ShiftMov
MakeTabl
PrevZoom
SaveTemp
LoadTemp
HELP
Zoom
FitPart
ParmSmth
AxisMath
EditKeys
ListKeys
Extremes
RmDistrb
FillKeys
MoveKey
FitAll
RoughFit
LineFit
EasyFit
Eases

the key frames in order to get the smooth acceleration transitions— in everyday practice, this should not be a problem.
IMPORTANT NOTE: when the software first boots up, the default type of curve-fit is RoughFit. To select other types of curve fit, click one of the various types of curve-fit at the bottom of the menu area. The Graphic Move Editor remembers the last type of curve-fit used, and will apply that type of curve-fit when the "hold middle key, click left key" trick is used to initiate a curve-fit when using the "KeyFrame" command in the Graphic Move Editor. During the actual curve-fit calculations, the mouse cursor will change to an "F[1] for FitAll, an "E" for EasyFit, or an "R" for RoughFit.
To select the default type of curve-fit for the Jogbox "FIT ALL" key, use the "Options" command in the menu area at the lower right of the Control Panel Screen. The third dialogue box sets the Jogbox curve-fit type. The Jogbox curve-fit type is saved with setup files saved with the "UtilFiles" command.
As with the FitAll command, RoughFit and EasyFit will work best if you keep the key-frames fairly well separated
If you are in doubt about which type of curve-fit to use, use RoughFit. This is especially recommended for beginners.

Figure 3 RoughFit sacrifices exactly hitting the keyframes to produce extremely smooth acceleration changes.
Figure 4 Rounded RoughFit velocity graph shows smooth transitions between velocities. Changes in acceleration are gradual.



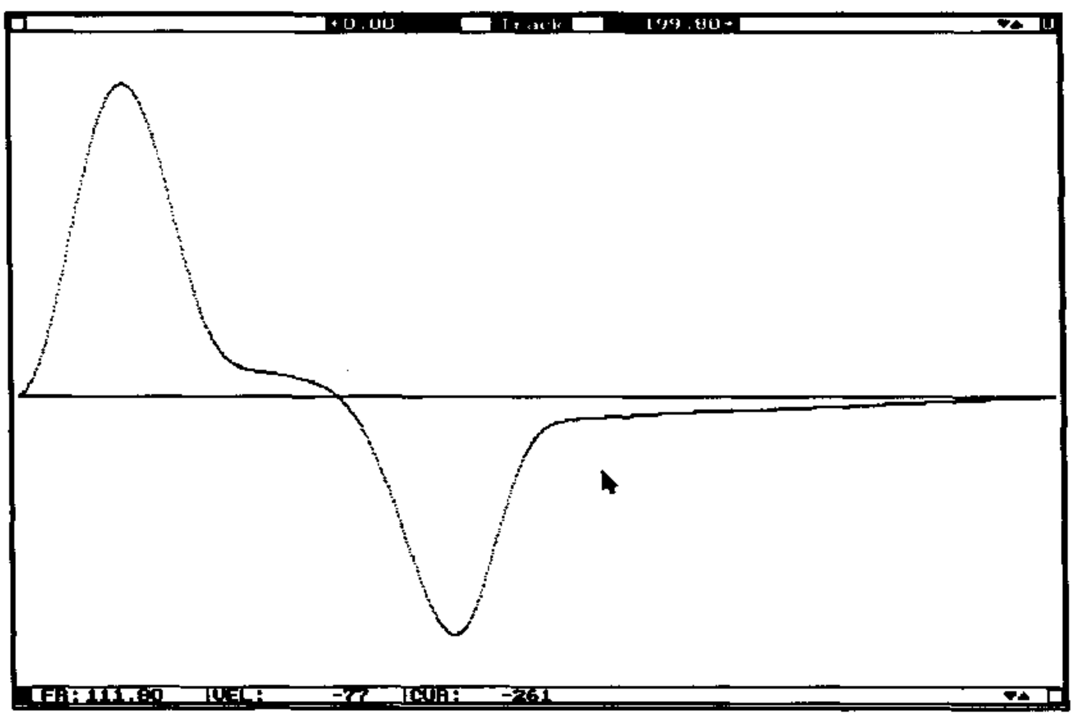
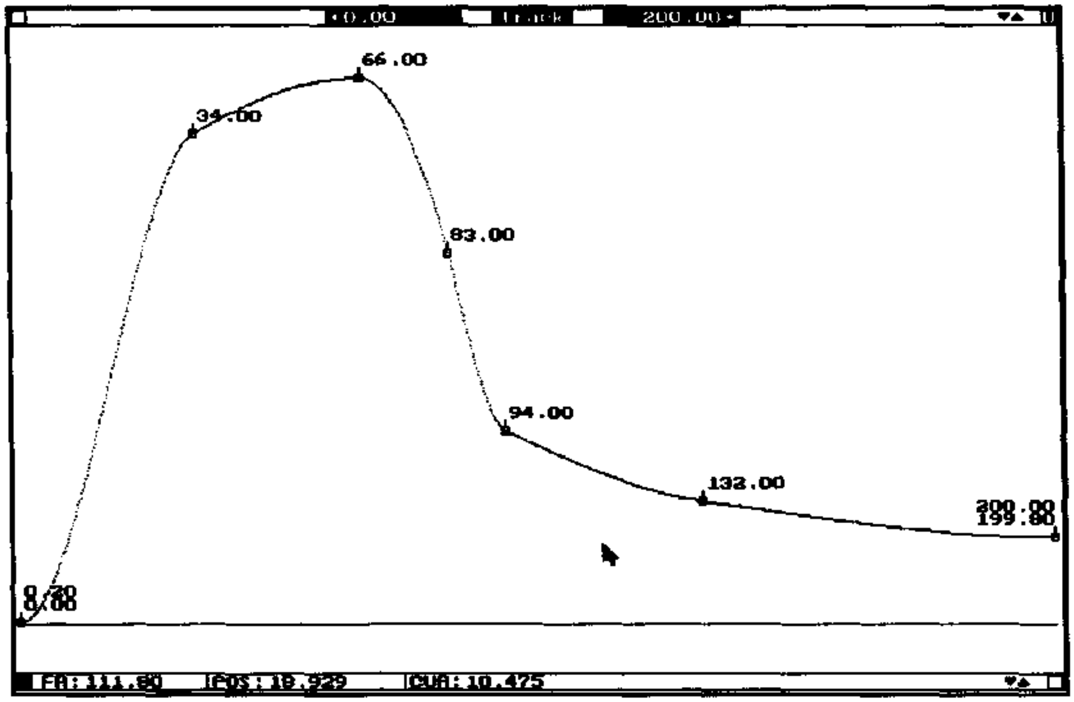


Figure 5 EasyFit passes exactly through the key frames.
Figure 6 EasyFit velocity graph showing sudden changes in acceleration.



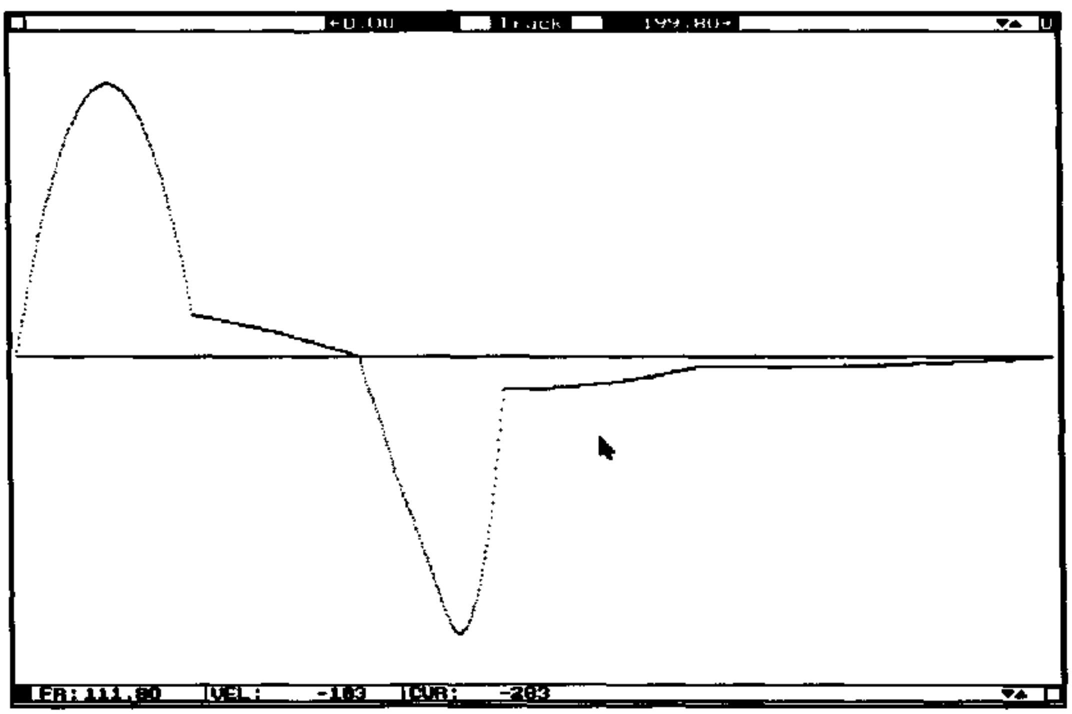
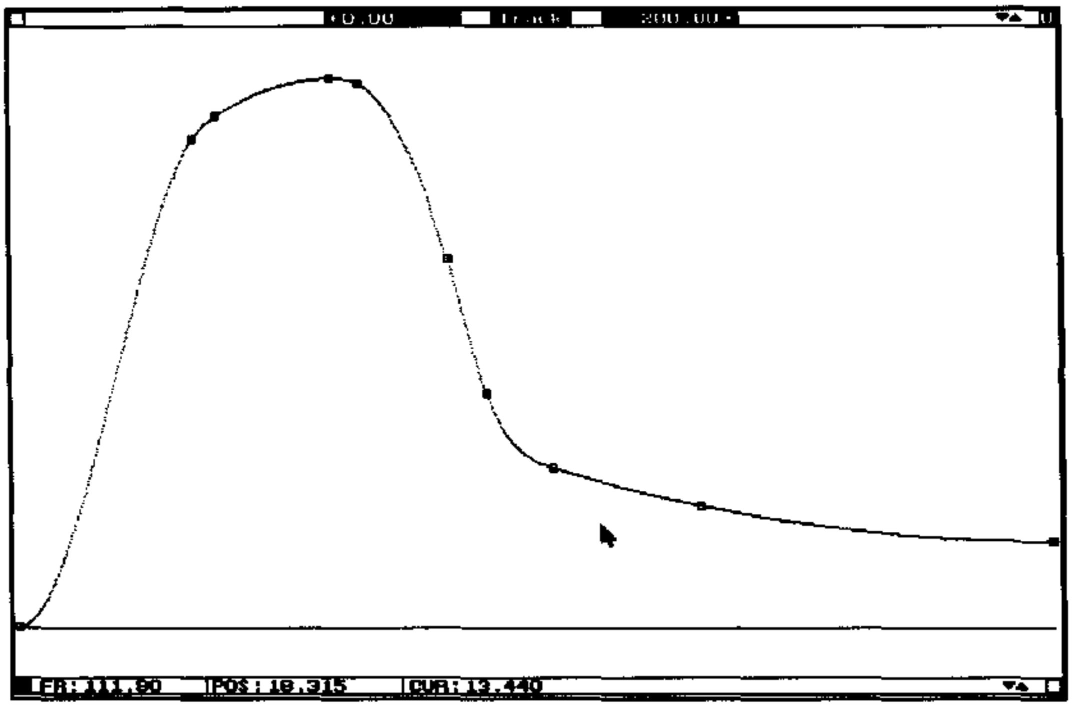
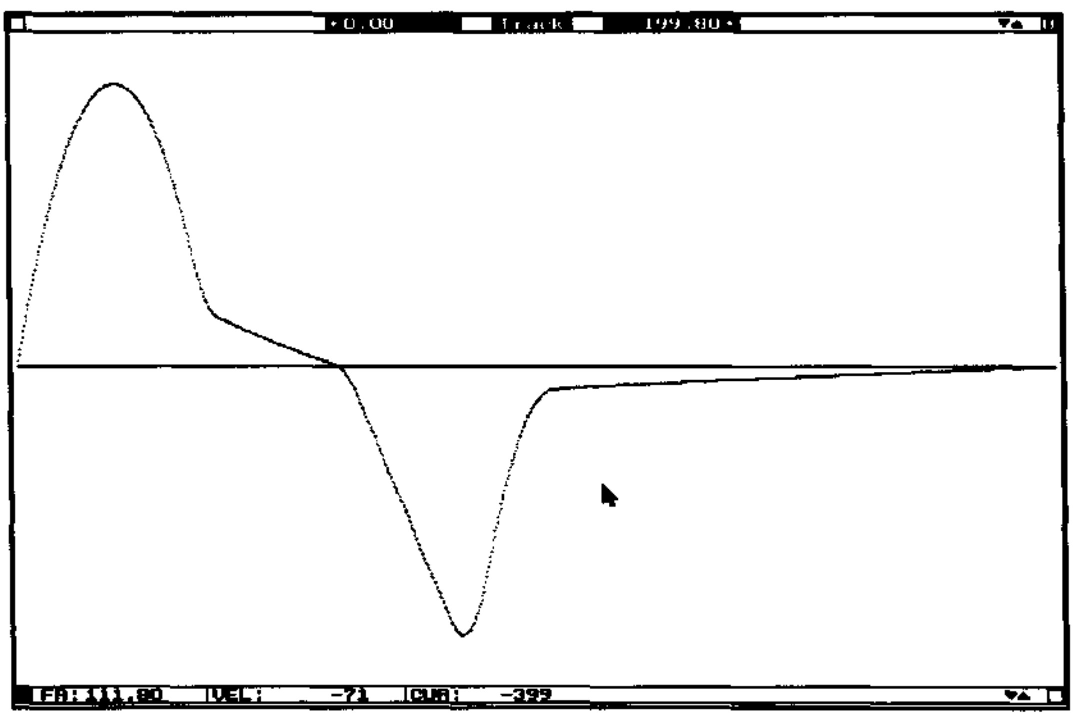


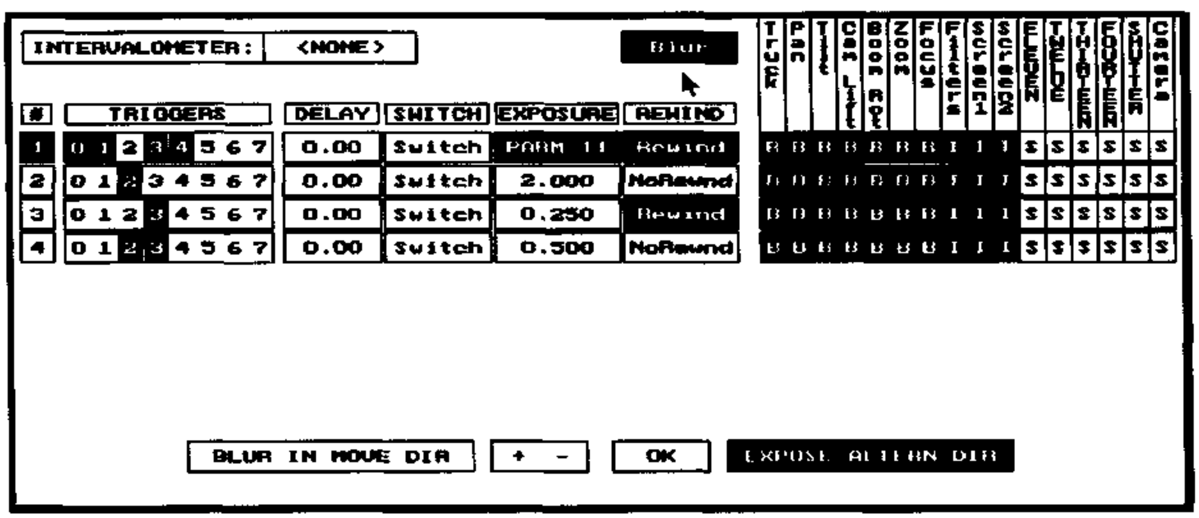
Figure 7 Here is FitAll curve-fit move, with additional key frames added to control overshoots.
Figure 8 Velocity graph of the above modified FitAll move shows velocity



transitions similar to the RoughFit command.



ANIMATION
The above illustration shows the Animation Setup Screen. This screen comes up by clicking the exposure time at screen lower left, or clicking the multiple-exposure bar just above the REV-STOP -FWD control.
Up to 8 exposures may be made for each move position. In the illustration there will be a total of 4 exposures, made on 2 successive film frames.
For each exposure, each axis may be programmed with a "motion type" of STILL, BLUR, or INDEX. BLUR produces the same sort of motion blur as occurs during normal cinematography. STILL simply moves the axis to the correct position for the frame number. INDEX moves the axis to a different position for each exposure, and is useful for controlling filter wheels, frontlight / backlight screens, and other motorized devices which must assume different positions for one or more of the multiple exposures.
The area to the upper right lists all the axis names. Just below, the small boxes containing "B" or "I" or "S" control whether each axis will BLUR, INDEX, or STILL for each exposure. To change the motion mode, click the box just above the REWIND box. Clicking toggles the box between BLUR, INDEX, and STILL. In the illustration, the box displays BLUR- clicking individual motion mode boxes just below the axis names will put the axis into "B" or BLUR mode. Whenever a motion mode box is clicked, it changes to the mode shown just above REWIND. To program the "I" (for INDEX) axes, click the box until it reads INDEX, and then clicked all the exposure boxes below the axis names. Hold down the left mouse key to paint over several axes in a single stroke.
For BLUR and STILL modes, the axes go to their move positions. For INDEX mode, the axes move to the position in a special list. For convenience, the list of INDEX positions is the keyframe list for the INDEX axis. Suppose there is a motorized filter wheel with 4 filter positions. The filter wheel is mounted directly on the motor shaft of the "Filters" axis. For filter #1 the motor position is 0.0, for filter #2, the-position is 0.250, etc.- The-operator wants filter #1 for the first exposure, filter #2 for the second exposure, etc. He creates the following list of keyframes for the filter wheel axis:
1.00 2.00 3.00 4.00
0.000 0.250 0.500 0.750



The list can be created using the MouseJog and KeyFrame commands, the Jogbox, or the EditKeys command. For INDEX axes, the keyframe number is the exposure number, and the keyframe position in the position for the exposure. To program the positions with the MouseJog command, jog the filter wheel so the first filter is in place, and then take a keyframe for frame 1.0. (Be sure the "K" box to the right of the axis name is highlighted.) Then jog filter #2 into position, and take a keyframe for frame #2.0. You do not take a keyframe for frame 0.0, since the exposures on the Exposure Setup Screen are listed starting with frame 1, not frame 0. It is not necessary to use Fit All or any other curve-fit technique. The computer only looks at the keyframes for INDEX axes, not at the move.
The TRIGGERS are used to turn lights and other electrical devices on and off. The triggers "come out" through output lines on the RTMC LOGIC connector. See the "Simple Accessory Scheme" drawing at the end of the RTMC16 Manual for more information on connecting lights. The TRIGGERS are programmed by clicking individual boxes highlighted for "on," and not highlighted for "off." If you highlight the "#" box to the left of the triggers, the triggers for that exposure will be automatically output as you adjust them. This gives you a way to test lighting setups, etc, without actually running the move.
DELAY sets a pause time between turning on the programmed triggers and checking for the shoot switch. DELAY is typically used to program settling times and delays to allow switched lights to reach color temperature, but may also be used as a simple, linear intervalometer mechanism.
SWITCH selects whether or not the particular exposure will wait for the shoot switch. If the "NoSwch" option is set, the exposure is made without waiting for the switch, as soon as the DELAY time is up.
EXPOSURE sets the exposure time. The exposure can be either a constant exposure the same for all frames, or obtained from a list of exposures which can change for each frame in the move. If you click this box with the left mouse key, the Calculator appears to get the specified constant exposure. If you click with right mouse key, a list of axes appears. Select an axis containing a sequence of exposures as its move data. The move positions for the selected axis will be interpreted as a series of exposure times. The exposure axis should be one of the FARM axes, such as FARM 11. Note that although INDEX axes get their positions from the key frame list, EXPOSURE gets the exposure from the move data.
If REWIND is programmed, the camera will cap and rewind after making the exposure; if "NoRwnd" is set, the camera simply advances to the next film frame.
Towards the bottom of the Exposure Setup Screen, the"+ -" box increases or decreases the number of multiple exposures per frame. Click on the "+" side of the box to add exposures, and on the "-" side of the box to delete exposures. The minimum number of exposures is 1, the maximum is 8.
When there is more than one exposure per any film frame (as programmed with REWIND box), it is possible to specify whether the camera and axes will expose and blur in the same direction for each frame, or in alternate directions. At bottom left, a box displays "BLUR IN MOVE DIR." If you click this box, it toggles between "BLUR IN MOVE DIR" and "BLUR IN ALTERNATE DIR." If BLUR IN ALTERNATE DIR is selected, the BLUR axes will move in the normal move direction on the first frame, and then in the opposite direction on the next frame, and so on. Otherwise the axes will slew

back to their original position for the next multiple exposure. The box displaying "EXPOSE IN ALTERNATE DIR" does the same for the camera. In general, if you plan to make more than 2 exposures on each film frame, there is some advantage to using the ALTERNATE DIRECTION option for axes and camera, since overall axis and/or camera motion will be minimized.
Click to "OK" box to leave the Exposure Setup Screen.
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For backwinds during multiple exposures, the Software always turns the capping shutter bit "On." If you don't have a solenoid type capping shutter, but one of the axes is labelled "SHUTTER" (in any combination of upper or lower case), the shutter axis will automatically close for backwinds. The convention for shutter operation is that the "0.000" position count is always shutter fully open, and "1.000" is always shutter fully closed.

If you have a "Shutter" axis, and are shooting in "STILL" mode, the shutter will close down for exposures shorter than "StopMo Base Exposure" programmed with the "CamSetup" command. If you don't have a "Shutter" axis, the camera motor will attempt to wind faster for short exposures, and you must be careful not to program exposures that will cause the motor to stall. For exposures longer than twice the "StopMo Base Exposure", the camera motor will "whip-open," pause, and "whip-closed."

In the illustration the INTERVALOMETER axis is specified as "<NONE>" which means the intervalometer function is turned off. Any axis can be selected as the intervalometer axis by clicking on the box now containing <NONE>. Usually, one of the FARM axes is selected. The intervalometer axis should be programmed in exposure times relative to the start of the shot, in minutes. If the last frame in the intervalometer "move" file has a position of 10.00, the last film frame will be exposed 10.00 minutes after the first frame. The first frame should always have a "position" of 0.000. The "time progression" on the intervalometer axis can be non-linear. For instance, suppose we wish to shoot an intervalometer shot of a cake baking. The cake may take 60 minutes to bake, but will only start to brown during the last 10 minutes. The intervalometer file might be programmed with a curve, so that exposures are spaced far apart at the start, but gradually get much closer together for the last few minutes of browning. This way most of the frames will be exposed during browning part of the baking cycle, making the browning seem to occur over most of the shot.

Note that BLUR mode axis and camera pre and post rolls are significantly different for RTMC120 than for previous versions. Previously, the axes would "back up" to get a running start at the specific frame interval to be photographed. Starting with RTMC120, the pre and post rolls occur entirely within the move increment, and the axes never back up or overshoot. The pre rolls are designed to be completed just before shutter open, and the post rolls to start just after shutter closed. On the plus side, this saves time, prevents extra motion, and maintains the same backlash as occurs during a continuously running shot. On the minus side, the shortest possible exposure is somewhat longer than before, due to the shorter pre rolls.

CALIBRATING NON-LINEAR SHUTTERS

Most camera angle control shutters do not respond in a linear manner. The number of pulses required to move the shutter from 0 to 10 degrees may be much greater than the amount to go from 160 to 170. This problem is most extreme on cameras such as 2709's. To get good cross dissolves, it is essential to somehow compensate. When it boots up, RTMC120 looks for a special file named "shutter.cal" which must be in the same directory as the RTMC120 program. If it finds the file, the file is automatically loaded. "Shutter.cal" contains shutter calibration information for the particular camera being used.

To create a custom "shutter.cal" file for your camera:

1. Set the pulses per unit for your shutter axis so that shutter position "0.000" is fully open, and "1.000" is fully closed. See the manual for more information.
2. Using the mouse or Jogbox, jog the shutter from fully open to fully closed, stopping at 10 degree intervals to write down the shutter angle and position. Read the shutter angle from the mechanical shutter angle indicator on the camera, and the position from the Control Panel Screen or Jogbox.
3. Use a text editor or the DOS "copy con" command to create a file called "shutter.cal". The file must be in pure ascii format. Save the file on the same directory as the RTMC120 program.

Here is an example of a typical shutter.cal file. Note that the table must go from the fully open angle to the fully closed angle. The first entry must equal the widest available shutter angle (fully open, 170 degree angle, position 0.000), and the last entry must be for shutter fully closed, position 1.000. There must be an entry for each 10 degree shutter interval. This table is hypothetical, and does not represent any actual camera:

```
170 0.000
160 0.077
150 0.147
140 0.205
130 0.254
120 0.297
110 0.334
100 0.368
90  0.402
80  0.437
70  0.475
```

60	0.518
50	0.569
40	0.630
30	0.702
20	0.788
10	0.889
0	1.000

To check your table for accuracy, use the Graphic Move Editor "EditKeys" command to type in the above table as keyframe/position pairs, ie. key frame 170, position 0.000, etc. Use "FitAll" to connect the key frames. Any "bad" data points will be very apparent on the graph. Make modifications to the "key frames" to produce a smooth curve, and copy the corrected data for use in your "shutter.cal" file.

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AUTOMATIC WEDGING

To activate automatic wedging, click the "Camera" command and then click the "WEDGE" box.

The two figures to the right show the automatic wedging screens. The top screen uses exposure time as a basis for wedging while the bottom screen uses FPS. To switch between exposure-time / EPS wedging, click the mouse at the top of the screen. Clicking the "WEDGE TIME" box toggles the screen between "WEDGE FPS" and "WEDGE TIME."

Each screen offers a preset series of exposures/FPS. Use all three mouse keys to select a set of exposures:

LEFT MOUSE KEY selects/deselects individual exposures.

MIDDLE MOUSE KEY deselects all the exposures in the list at and including the clicked exposure.

RIGHT MOUSE KEY selects alternate exposures in the list at and below the clicked exposure.

On the "WEDGE TIME" screen, a full stop sequence is selected between 0.125 and 1.000 seconds. To set up this sequence, the operator could simply click the four desired exposure boxes. In this example, the operator actually first clicked the middle mouse key on the 0.063 exposure, which cleared all the exposures. He then clicked the right mouse key on 0.125, which selected alternate exposures (ie. full f stop equivalent changes) all the way down to 64.000 seconds. He finally clicked the middle mouse key on 2.000, which cleared the 2.000 through 64.000 second exposures.

The "PASSES" box sets how many times the sequence will be repeated, in this case 4 times. Click on the number to change the number of passes.

Just below PASSES, a box toggles between "WAIT FOR SWITCH" and "IGNORE SWITCH" on alternate clicks. If WAIT FOR SWITCH is selected, the software will wait for the shoot switch to be pressed for each exposure. In this mode, the left mouse key will also function as a single frame shoot switch, regardless of where the mouse cursor is placed. If IGNORE SWITCH is selected, the exposures will proceed in order regardless of the shoot switch or mouse. It is possible to toggle between WAIT FOR SWITCH and IGNORE SWITCH while the wedge is running, however the box will toggle only between exposures, so you must "lean" on the mouse until the current exposure is done.

"OK" starts the wedge sequence. "CANCEL" stops the wedging sequence. CANCEL is only recognized between exposures, so you must "lean" on the mouse during a long exposure.

When wedging in the "WEDGE FPS" mode, the software calculates the actual exposure time based on the "SHUTTER ANGLE" displayed at the lower left of the Control Panel Screen. If the specified angle is a simulated shutter angle greater than the actual physical angle of the shutter, the exposure will be proportionately longer than for the actual physical shutter angle. Whenever a

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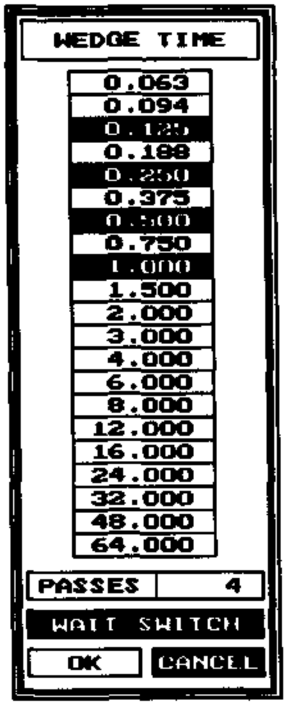
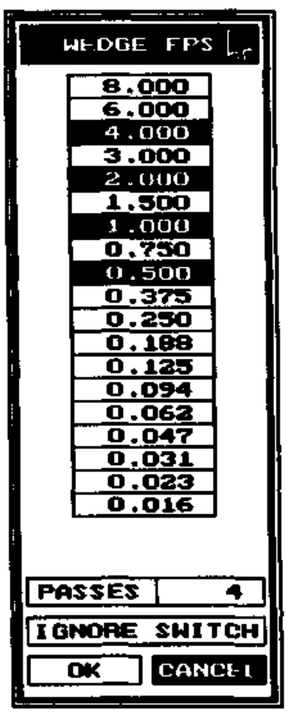

WEDGE TIME
0.063
0.094
0.125
0.188
0.250
0.375
0.500
0.750
1.000
1.500
2.000
3.000
4.000
6.000
8.000
12.000
16.000
24.000
32.000
48.000
64.000
PASSES
4
WAIT SWITCH
OK
CANCEL


WEDGE FPS
8.000
6.000
4.000
3.000
2.000
1.500
1.000
0.750
0.500
0.375
0.250
0.188
0.125
0.094
0.062
0.047
0.031
0.023
0.016
PASSES
4
IGNORE SWITCH
OK
CANCEL

simulated shutter angle is selected, a reminder box appears prior to starting the pass. In the example to the right, the box reminds the operator that a synthetic SHUTTER ANGLE of 210 degrees is selected on the control panel screen. Click OK to continue with the exposure adjusted for an effective 210 degree shutter angle. Click ASSUME 170 to wedge at the actual 170 physical shutter angle.

Click QUIT to exit without wedging. No compensation is made for synthetic shutter angles when wedging in the "WEDGE TIME" mode.

Wedging exposures longer than about twice the default animation exposure time will be made using the "whip-open, wait, whip-closed" method. The exposure will be exactly equivalent to the continuously running live action exposure, provided that "StopMo Slew Accel" is 8 or more for 2000 step drivers or 20 or more for 5000 step drivers, and the "StopMo Slew Decel" is 2 or less for all types of drivers. Accel and Decel numbers outside this range may cause the ramps to extend into the shutter open phase, giving longer exposures than intended. StopMo Slew Accel and StopMo Slew Decel can be adjusted by clicking the "AxiSetup" command, and then clicking the Camera axis name. Note that the shortest exposure available in "WEDGE TIME" is 0.063 seconds, and the fastest "WEDGE FPS" exposure is equivalent to 8 FPS. For shorter exposures than these it is very likely that the camera will stall during the ultra fast ramps required for single frame exposures.

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JOYSTICK LIMITS

Many kinds of axes such as zoom lenses and focus rings have very short travel and hard stops at either end of the travel. Hitting the stops many cause the motor to loose position, or even cause damage to the axis. Joystick control of such axes can be very difficult, since the operator must be very careful not to hit the hard stops.

RTMC120 introduces "Joystick Limits" to solve this problem. By setting appropriate position limits, axes can be prevented from exceeding certain limit positions while under joystick control. The illustration above shows the setup screen for the AxiSetup command. Three new parameters are added at the bottom of the dialogue box.

+ Joystick Limit sets the "positive direction" limit for axis travel, in this case position 1.000. - **Joystick Limit** sets the "negative direction" limit, in this case position -1.000.

Check Joystick Limits turns limit checking on and off.

Note that the range enclosed by + and - limits must include home position, which is 0.000. In the illustration the range goes from 1.000 to -1.000, which includes 0.000. 55.124 and 0.000, or 0.000 and -77.804 would also be acceptable.

However, -5.000 and -10.000 would not be acceptable, since 0.000 is outside of that range. A warning message is displayed if the limits are incorrectly set.

Rather than exceeding a limit position while under joystick control, the axis will stop at the limit. If joystick smoothing is set to 0, the stop will be immediate. If joystick smoothing is set between 1 and 8, the stop will decelerate smoothly to 0 velocity, stopping exactly on the limit. The greater the amount of joystick smoothing, the gentler the stop. This very useful feature makes it possible to rush up to the limits with no fear of losing position due to a too-fast stop.

If an axis with "Check Joystick Limits" set to YES is enabled and placed in REC or NEUT while the axis is outside its limits, a prompt appears offering several ways to correct the "out of limits" situation. In practice, this will rarely happen except in situations where the limits settings are no longer applicable.

NOTE THAT THIS LIMIT SCHEME ONLY APPLIES TO AXES WHILE THEY ARE BEING GUIDED BY A JOYSTICK OR THE MOUSE IN JOYSTICK MODE. It does apply when axes are running a move, slewing to position, or being jogged with the Jogbox "JOG32" keys. The Jogbox encoder will observe the limits. Use the Extremes command to check the extremes of axis movement in the move data file.

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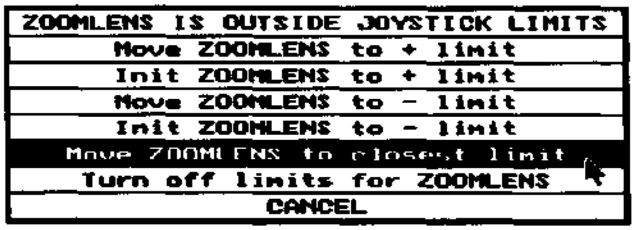
Parameters for ZOOMLENS		RANGE
Slew Speed in PPI	100	1 to 2047
Slew Acceleration	3	1 to 20
Slew Deceleration	6	1 to 8
Pulses per Unit	8420	no limit
Powerdown Polarity	0	1 or 0
Powdown delay (seconds)	0.0	0.000 to 500.000
VELO Joystick Deadband	50	0 to 16000
+ Joystick Limit	1.000	no limit
- Joystick Limit	-1.000	no limit
Check Joystick Limits	YES	YES or NO

OK CANCEL


OK


ZOOMLENS IS OUTSIDE JOYSTICK LIMITS
Move ZOOMLENS to + limit
Init ZOOMLENS to + limit
Move ZOOMLENS to - limit
Init ZOOMLENS to - limit
Move ZOOMLENS to closest limit
Turn off limits for ZOOMLENS
CANCEL

There are many uses for the limits feature. In general, any time an axis has predictable start and stop positions, limits can be used to pre-program the extreme positions of movement. Suppose an object must be photographed tightly framed through a telephoto lens while it falls from 10 story building. The tilt speed at impact will be quite high, and there is a very good chance of tilting considerably past the impact point. By pre-programming the impact point as a limit, the tilt is guaranteed to not overshoot the mark. Limits can be used to prevent panning or tilting off a tight set, especially useful in cases where it's necessary to pan or tilt briskly to the absolute limit of the set. Remember that the limit position stops can be "softened" by increasing the smoothing on the joystick.
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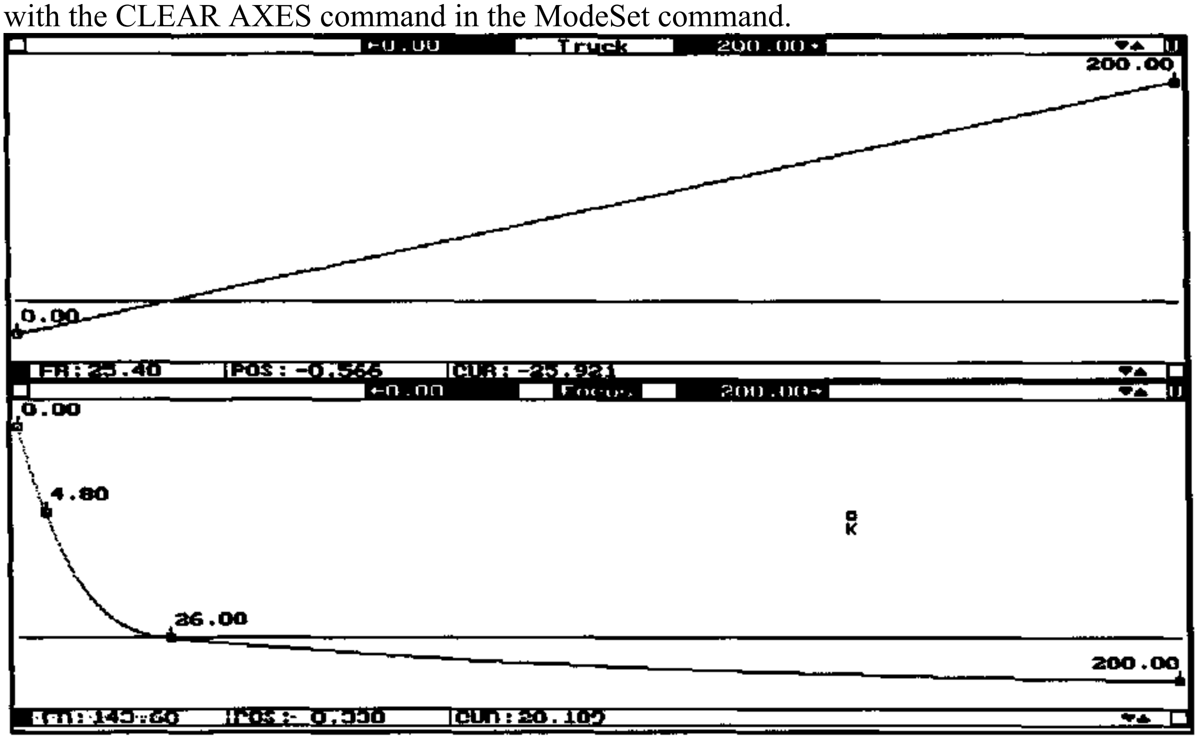
TABLE AXES

RTMC120 has a table axis function. A typical table axis application is automatic follow focus. As the truck axis moves, the focus axis changes position to maintain focus. The focus axis "looks up" its position for any given truck position from a special "table file" move. To determine what part of the table file to look up, the focus axis first checks the position of the truck relative to the total possible truck movement, then looks up a proportionate position from the focus axis table file. The position of the truck dictates which part of the table file the focus should use to determine its position, while the contents of the table file determine the actual position for the focus axis to assume.

The following illustrations show how to set up a simple follow focus table file, and how to activate, save, and clear the focus table file. Although this example shows only one slave axis assigned to the master axis, it is possible to have any number of slave axes assigned to a single master axis, or multiple master axes with one or more slave axes each. The only limitation is that no slave axis may have more than one master axis at the same time.

The "table file" is not the same as the move data file. It is created once as a move data file, and then saved on the disc using the "SAVE TABLE FILE" menu item in the UtilFiles command. The only time the table file appears as a move data file is when the operator first creates the table file using normal move generation techniques. Once created, the table file is loaded before use, and will stay loaded until specifically removed with the CLEAR AXES command in the ModeSet command.



The illustration above shows the move data used to create the table file in this example, procedure is:

The

1. Create a linear, two point curve fit move on the "master axis." The move can be any length, but we recommend 200 frames for almost all table axis applications- at 5 DATA/VISUAL frames this will result in a table that is 1000 elements long. In this case

the Truck axis will be the master axis. The master axis move must be completely linear, and

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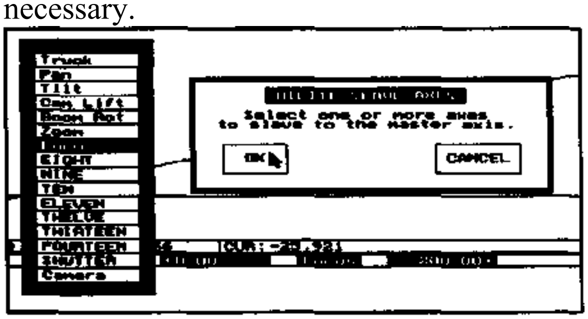
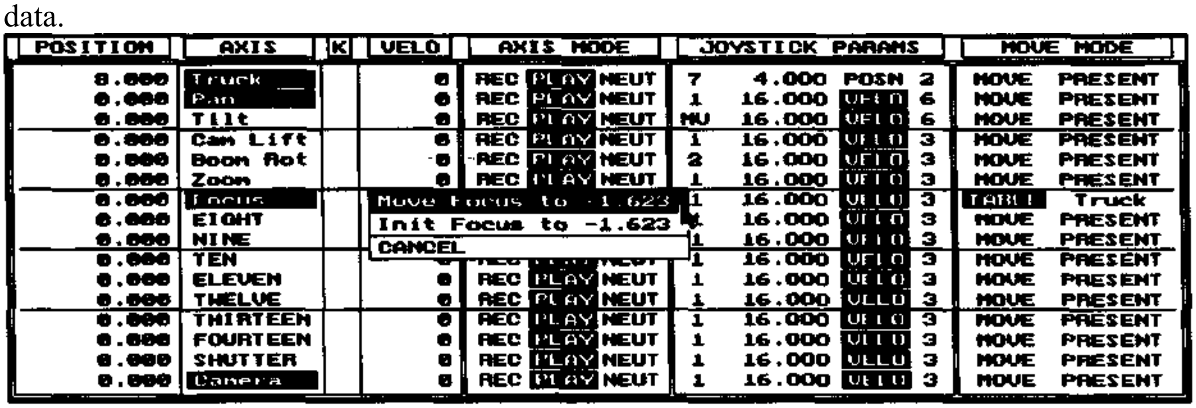
there must be exactly two key frames, one for the start of the truck move, and one for the end. Use the "FitAll" command to in-between the key frames. The two key frames should represent the absolute maximum possible limits on the master axis travel, since the slave axes will not respond when the master axis is outside these limits. There is no restriction on starting and ending positions for the master axis, and the move may pass between positive and negative positions.
2. Create a slave axis move which relates the desired slave axis motion to the linear master axis move. The slave axis move can be any shape, without restriction. When the master axis and the slave axis are played back together, focus should be maintained throughout the entire master axis move.
In the example, the slave axis move was created using key frame techniques. Using "GotoFr#" with the mouse, or "GOTO FRAME NUMBER" with the jogbox, the operator positioned the master axis at several positions along its linear move, jogged the focus axis into focus, and took a key frame for the focus axis only. After "inbetweening" with a curve fit function, He then used "GotoFr#" with the mouse or "GOTO FRAME NUMBER" from the jogbox to send both axes to various frame numbers in the move, checking focus and taking additional key frames and amending existing key frames as necessary.



Once the focus move works correctly for all track positions, activate the table axis. Click "MakeTabl" in the Graphic Move Editor menu. Using the dialogue boxes, select Truck as the Master axis, and Focus as the Slave axis.
After clicking "OK" on the Slave axis dialogue box, the software reports the amount of memory used to store the table. 4032 bytes were required in this case, which is typical of a 200 frame long table when DATA/VISUAL is set to 5. The table is actually 1000 elements long: 5 * 200 = 1000. There are 4 bytes per element, plus 32 bytes of overhead data.



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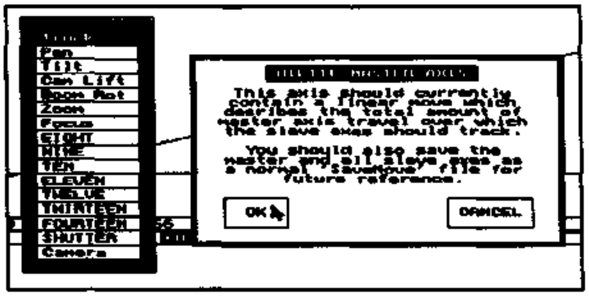

Pan
Tilt
Cam Lift
Zoom
Focus
EIGHT
TEN
ELEVEN
TWELVE
THIRTEEN
FOURTEEN
SHUTTER
Camera
This axis should currently
contain a linear move which
describes the total amount of
master axis travel over which
the slave axes should track.
You should also save the
master and all slave axes as
a normal "SaveMove" file for
future reference.
OK
CANCEL


MEMORY USED: 4032
OK

The above illustration shows the Control Panel Screen just after using MakeTabl. The "MOVE MODE" for the Focus axis is changed from "MOVE" to "TABLE." Just to the right, "Truck" is the master axis for Focus. Focus is placed in NEUT, and is initially disabled (axis name unhighlighted). The operator has just clicked the Focus axis name to enable the axis. Note that the Truck axis position is 8.000. The software detects that the present 0.000 position of Focus does not match the correct table file position. The prompt box just to the right of the axis name gives the operator three options. The axis can MOVE to the correct position, or it can be INITialized to the correct position without moving, or the operator can CANCEL and leave the Focus axis disabled. If either MOVE or INIT is selected, the Focus axis will start up in Table mode. Whenever the Track (master) axis moves for any reason, the Focus axis will adjust itself according to the table file.

Try jogging the master axis with the mouse of Jogbox, and watch the Focus axis automatically adjust. The two moves used to create the table file are no longer needed. We strongly recommend that you save the moves as a normal move file, such as FOCUS.MOV, but this is not required.

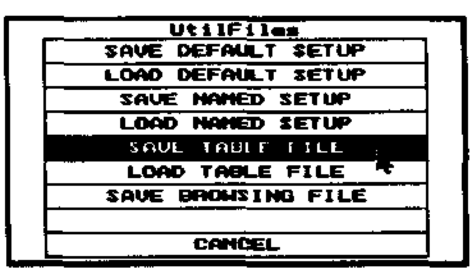
The table file is now in memory, but will disappear as soon as you leave the RTMCxxx program. There are three ways to save the table file for future use:

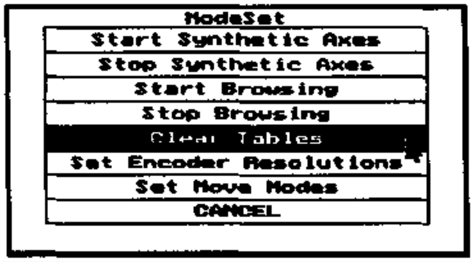
1. Save the file on disc using the "SAVE TABLE FILE" menu item in the UtilFiles command. Assign a file name with 8 or fewer letters, and be sure to include an extension of ".tab". All the current table files will be saved. To reload the table files later, use the "LOAD TABLE FILE" command.
2. Select either "SAVE DEFAULT SETUP" or "SAVE NAMED SETUP" to save an overall setup file. The Focus table will be included with all the other axis setup data. If you select "SAVE DEFAULT SETUP" the Focus table file will automatically load when the RTMCxxx software boots up.
3. If you save a move file with an active table file, the table file will come back with the move data.

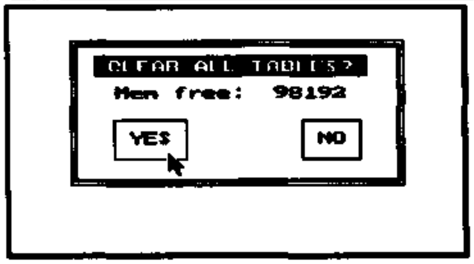
In all three of the above cases, the table axes will come up unhighlighted after loading. Enable one table axis at a time by highlighting its name, and selecting MOVE... INIT... or CANCEL.

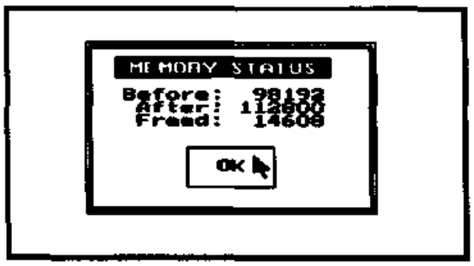
To shut down table axes, click the ModeSet command on the Control panel screen. The dialogue box reports the present amount of "scrap" memory available. Select "CLEAR ALL TABLES". The next dialogue box reports the amount of available memory. Select "YES" to clear the tables. The last dialogue box reports the amount of memory freed up.

17



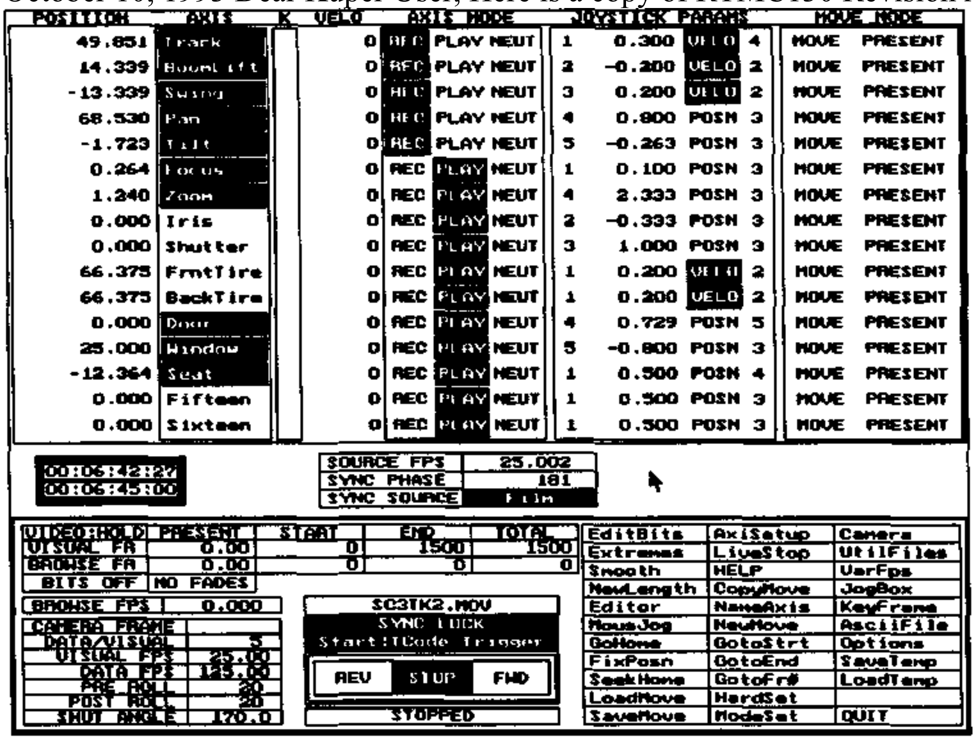

ModeSet
Start Synthetic Axes
Stop Synthetic Axes
Start Browsing
Stop Browsing
Clear Tables
Set Encoder Resolutions
Set Move Modes
CANCEL


CLEAR ALL TABLES?
Mem free: 98192
YES
NO


MEMORY STATUS
Before: 98192
After: 112800
Freed: 14608
OK

KUPER CONTROLS

October 10, 1993 Dear Kuper User, Here is a copy of RTMC130 Revision A.



When used with the RTMC48 Card, the RTMC130 Revision A Software supports hardware sync lock to standard sound speed film cameras, NTSC or PAL composite video, and SMPTE timecode. Refer to the last page of these sheets for hookup information. No electronic adapters are required, other than pin to pin cable connections. INSTALLATION: Make a new K130 directory and copy all the files from the distribution disc to the new directory. Always run RTMC130.EXE from the K130 directory. **RTMC130 move and setup files are NOT compatible with those from RTMC121 or earlier versions.** This applies to both move files and setup files. For this reason, be sure to install RTMC130 in its own directory. Do NOT copy your old RTMC121 AXES.SET file to the new directory. IfRTMC130 crashes on bootup, it is almost certainly a result of an old AXES.SET file present in the RTMC130 directory.
If you need to import moves from an older software version, use the ASCIIFILES format which is still backward compatible. From the old version of the software used to originally save the move, load the move file. Change DATA/VISUAL to " 1", and save an ascii file with the "Centered on Shutter Closed" option. Load RTMC 130, temporarily change DATA/VISUAL to

"1", and load the ascii file (you must have the same set of axis name assignments as in the old move). Then change DATA/VISUAL to the value in effect when the original move was generated. Changing DATA/VISUAL to "1" makes sure all the data is transferred in the exact original format, without invoking the automatic "NewLength" function which AsciiFiles normally uses when DATA/VISUAL is set to anything except one.

RTMC130 can use all the available memory on the computer, up to 32 megabytes. It is no longer necessary to use QEMM, although other programs on your computer may require

QEMM. RTMC130 stores move data in a format with much higher resolution than the old format (float rather than 16 bit int). This means twice the memory is required to store the same amount of move data as compared to previous versions. For this reason, **you may want to remove SMARTDRV.SYS from your config.sys file, which will free up several thousand more move frames.** The removal of SMARTDRV is especially recommended for systems with four or fewer megabytes of RAM. We now recommend eight megabytes of RAM as the standard amount. If you find yourself cramped with four megabytes, you will find that going to eight megs will triple or quadruple the available move length. The cost of expanding from four to eight megabytes is about $190.00, the cost of four additional 1 megabyte simms. The new storage format removes some serious limitations of the old format.

There are several sync related boxes in the middle of the control panel screen. To sync to an external device:

* Click the LEFT mouse key on the VISUAL FPS number. Enter the FPS of the expected incoming signal (ie. 29.970 for NTSC, 25.000 for PAL, 24.000 for theatrical film, etc.). The FPS you enter must be within +-0.5 FPS of the actual external signal.
* Click the SYNC SOURCE box through <NONE>, VIDEO, FILM, and TIMECODE until you reach the proper one.
* Whenever VIDEO, FILM, or TIMECODE is selected, the SOURCE FPS box will display the FPS of the external signal.
* A box just above REV STOP FWD will display SYNC LOCK whenever the system is sync locked to the external signal. However, remember that sync cannot be achieved unless VISUAL FPS is within +-0.5 FPS of the external sync signal.

Whenever SYNC LOCK is displayed, all move record and playback passes will be synchronized with the external sync source. When an external sync signal is not present, the motion control will run at the normal VISUAL FPS. If you are syncing to a film camera or other intermittent sync source, make sure SYNC LOCK is lighted before starting a record or playback pass. Beyond checking for the SYNC LOCK indication before starting a pass, no special syncing procedures are necessary. Live action crews can be your friends again.

If you experience difficulty achieving sync:

» Make sure the VISUAL FPS is set within +-0.5 FPS of the sync source.
* Make sure the sync source is running at the FPS you think it is. Sound speed motors may have been modified to run at 25.000, 29.970, or 30.000 FPS when the switch is at 24 FPS.

In sync lock situations, the motion control actually slaves to the SYNC **FPS. The number displayed in the VISUAL FPS box represents the "idealized" center speed,**

and will not

Once a table file is created, it no longer depends on the move files used to create the table file. From the time "MakeTabl" is used from the Graphic Move Editor screen, the original move data is no longer necessary. Even if NewMove was used to erase the move file, the table file would be remain and still function. The table file is completely independent after using MakeTabl.

A slave axes remains active as long as the axis name is highlighted, the axis in REC or NEUT, and the MOVE MODE is "Table." A slave axis will stop if you unhighlight the axis name, or place the axis in PLAY. As long as CLEAR TABLES has not been used, the slave axis will "come back to life" when the Axis name is re-highlighted and the axis is in REC or NEUT. The only way to completely shut down a slave axis is to use CLEAR TABLES (in the ModeSet command), or load a new table file which does not have table file data for the axis in question, or leave the RTMCxxx program.

If a slave axis is in REC during a move pass, the position data for the axis will be recorded in the move data file. If a slave axis is in NEUT during a move pass, the position data will not be recorded. In either case the axis will accurately track its master axis. By placing the axis in REC during a move pass, the move data is recorded and the axis can be later used either in "table" or "normal" mode. Note that recording the motion of a slave axis in no way affects the table file, since the table file is completely independent of the move file as soon as "MakeTabl" is used to create the table file in the first place.

The ability to record the motion of a slave axis opens up many other possibilities. A complicated pan, tilt, move can be "blocked in" as table files slaved to Track or even to a non-motorized "ghost" master axis. During the shot, only the master axis is controlled with a single encoder while pan, tilt, zoom track along their pre-programmed table files. Slave axes can even back up along their table files if the master axis encoder is reversed. If pan, tilt, zoom are in REC, their motions will be recorded during the move pass. Later on, the slave axes can be "cleared" using ModeSet/CLEAR TABLES, and used as normal move data files containing the data recorded while they were in Slave mode.

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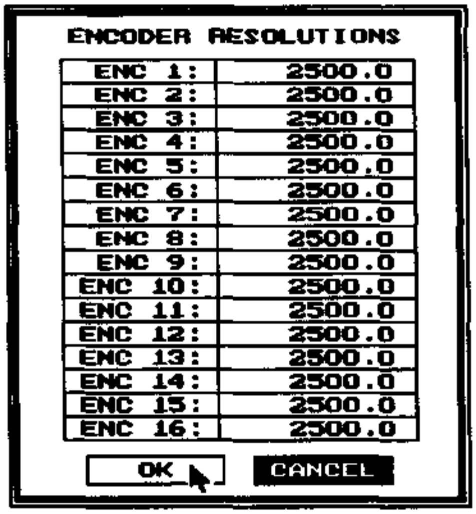
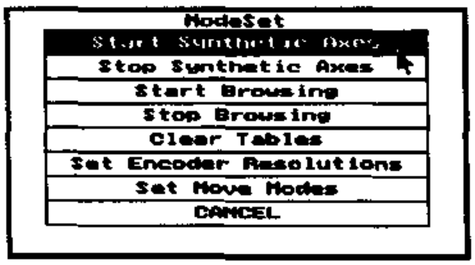
SYNTHETIC AXES

RTMC120 has a rudimentary synthetic axis feature. There are six axes listed in a special area near the center of the screen. At present, only the VELOCITY, HEADING, and CLIMB axes are functional. The "hardwired" synthetic feature models an aircraft. The VELOCITY is a general speed control. HEADING and CLIMB are directional controls point the direction of movement. In practice the operator steers the X, Y, and Z axes with HEADING and CLIMB, while controlling the overall rate of speed with VELOCITY. The VELOCITY encoder might have a lever attached to model a throttle quadrant, while HEADING and CLIMB might be attached together in a straight-head fashion.
The sensitivity of the VELOCITY axis is set to 1.000, which means that one turn of the velocity encoder (encoder 1 in this example) will create an overall speed of one unit per second. The sensitivity of the HEADING and CLIMB encoders is also set to 1.000, which means that one turn of either encoder will result in a direction change of 360 degrees. Any sensitivity may be specified, including negative sensitivities to reverse the encoder direction sense. Smoothing also operates in the normal way. If the axis movement is jerky, increase the smoothing factors. The VELOCITY axis must be in VELO response mode, and HEADING and CLIMB must be in POSN response mode. In order for the encoder numbers to work as stated above, the software must know the correct encoder resolutions. This is done by clicking the ModeSet command, and then clicking "SET ENCODER RESOLUTIONS". The numbers entered for encoder resolution should be the "raw" encoder resolution printed on the encoder case, such as 2500 for most circuit electronically increases the raw resolution by a factor
To start the synthetic axes, click the "ModeSet" command, and then click "START SYNTHETIC AXES" in the submenu. The synthetic axes will come alive with the velocity at 0.000 and in its deadband. Carefully advance the encoder assigned to the VELOCITY axis while steering with the HEADING and CLIMB encoders. The MOVE MODE of the first three axes automatically changes to SYNTH.
BEI encoders. Note that the RTMC16 of 4.
The synthetic axis function "works on" the first three physical axes, which are treated as X (forward/reverse), Y (left/right) and Z (up/down). It is important to have the correct "Pulses Per Unit" set for these axes, as set with the AxiSetup command. When the axes are in SYNTH mode, the encoder settings have no effect. It is possible to record the move data on the X, Y, Z axes if they are placed in REC mode.
19

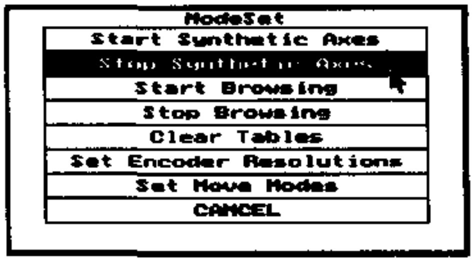

ENCODER RESOLUTIONS
ENC 1: 2500.0
ENC 2: 2500.0
ENC 3: 2500.0
ENC 4: 2500.0
ENC 5: 2500.0
ENC 6: 2500.0
ENC 7: 2500.0
ENC 8: 2500.0
ENC 9: 2500.0
ENC 10: 2500.0
ENC 11: 2500.0
ENC 12: 2500.0
ENC 13: 2500.0
ENC 14: 2500.0
ENC 15: 2500.0
ENC 16: 2500.0
OK
CANCEL


ModeSet
Start Synthetic Axes
Stop Synthetic Axes
Start Browsing
Stop Browsing
Clear Tables
Set Encoder Resolutions
Set Move Modes
CANCEL

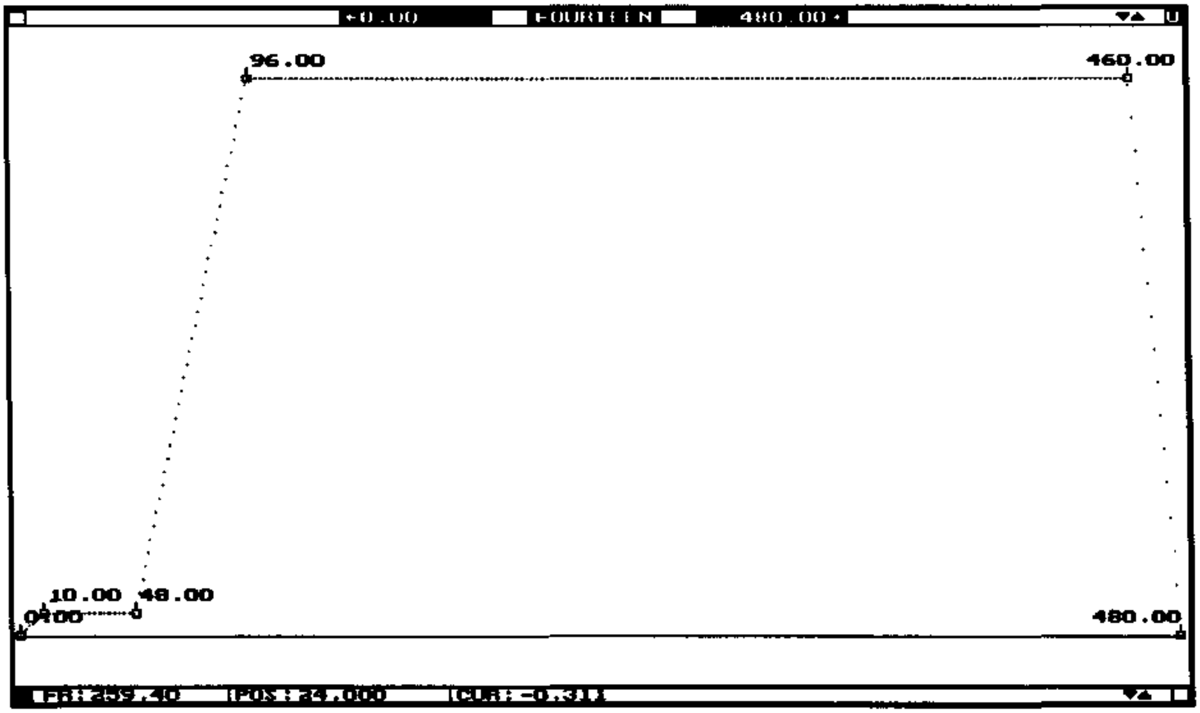

X AXIS
Y AXIS
Z AXIS
REC PLAY
REC PLAY
REC PLAY
20.000
16.000
16.000
VELO
SYNTH
SYNTH
SYNTH

The SYNTH axes will stay activated at all times until they are turned off by clicking the ModeSet command and then clicking STOP SYNTHETIC AXES from the submenu. While the axes are active, they may be placed in either REC or NEUT. If the axes are in REC during a move pass, their move data will be recorded and may be used for later playback while the axes are not in SYNTH mode.

20

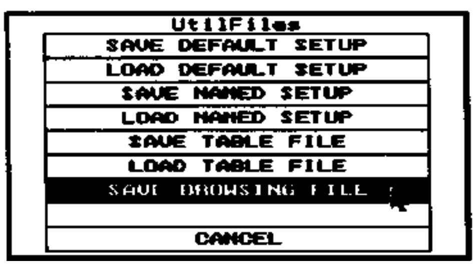


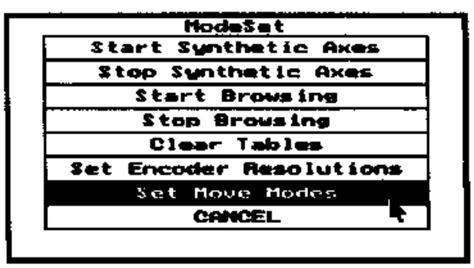
BROWSING
In the RTMCxxx Software, Browsing means being able to move freely forward and backward through move data at varying speeds. The move data used for browsing is not the "normal" move data. The browsing move file is saved on the hard disc prior to use, and when browsing occurs the motion data is pulled from the hard disc browsing file. This means that browsing can occur entirely independent of move record/playback. During normal move record/playback, the motion of the browsing axes can be recorded if desired.
There are two ways of guiding a browsing move. The operator can use a joystick encoder to guide the browsing axes much the same way as a video editor uses the editing joystick to browse through a tape at various speeds, or the browsing can be guided from an "FPS" axis generated with the Graphic Move Editor.
GUIDING THE BROWSING MOVE WITH AN "FPS AXIS"
In RTMC120, the FPS axis is axis 14. This is the 14th axis from the top of the axis list. While browsing, move data on this axis is interpreted as FPS rather than as positions. If the data on axis 14 for frame 100.00 is 1.000, the move will be photographed at 1.000 FPS on that frame.
The illustration above shows axis Fourteen set up as an FPS control axis. The move is constructed from the key frames shown to the right. The intent is to have the move shoot at 1.000 FPS up to frame 48, then accelerate to 24.000 fps between frames 48.00 and 96.00, hold at 24.000 fps until frame 460.00, and then decelerate to 1.000 FPS. Note that the operator has built in a short ramp up between 0.100 and
1.000 fps between frames 0.00 and 10.00, and a quick ramp down between frames 460.00 and 480.00.
This is necessary in the current version of RTMC120, since browsing from an FPS file is the only
RTMC function which does not automatically create pre and post rolls. The key frames were typed
in using the EditKeys command in the Graphic Move Editor, and in-betweened using the LineFit
21

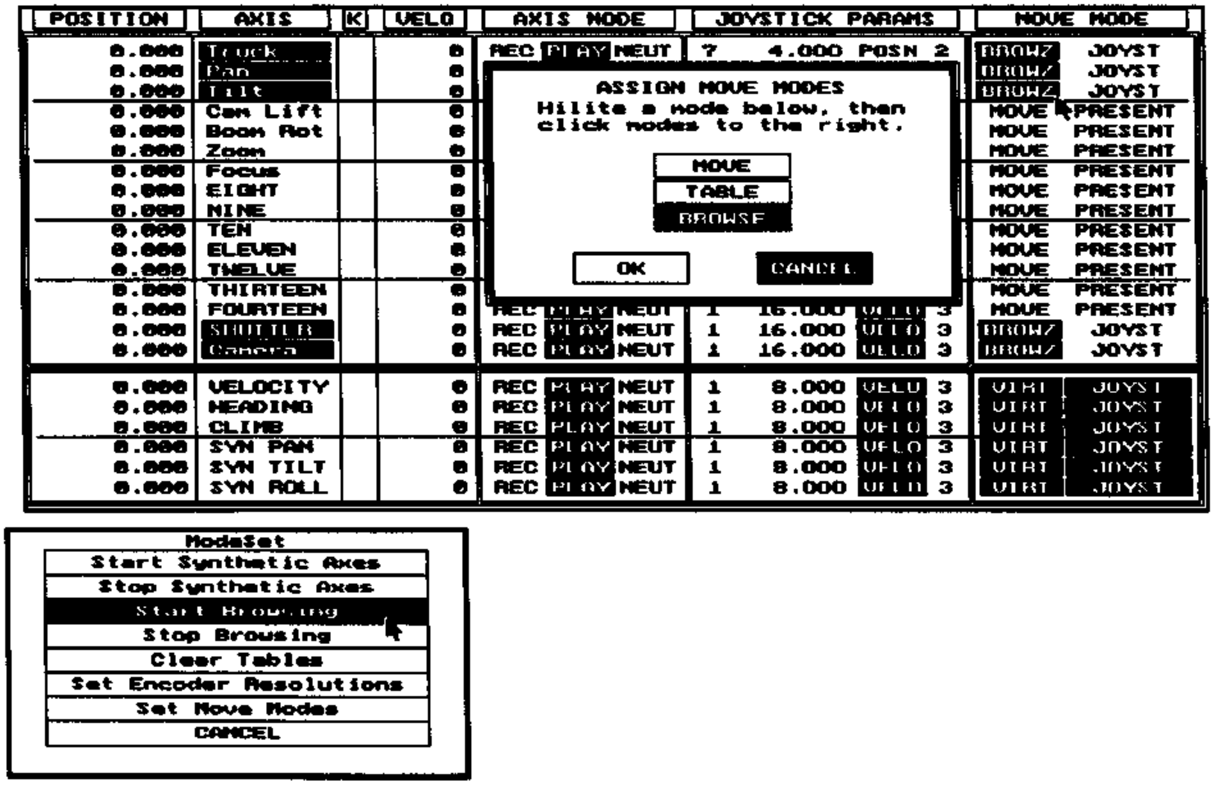


0.00:	0.100
10.00:	1.000
48.00:	1.000
96.00:	24.000
460.00:	24.000
480.00:	0.100

command. LineFit and Eases are the preferred methods of in-betweening the FPS axis. Note that smooth transitions are not necessary for the FPS axis, as long as all the position move segments are connected.
In practice, the browsing move is first created as a normal move file of any convenient length. Then the axis 14 FPS data is added if the move is to guided by that axis rather than by an encoder. The axis 14 file is not needed if the browsing is to be guided by an encoder. Then the special browsing file is saved using the "SAVE BROWSING FILE" menu item in the UtilFiles command.
Once the browsing file is saved, the original move data is no
longer necessary. However, we recommend that you always save the move data used to create the
browsing file as a normal move file for future reference.
The data for all the axes is saved in the browsing file. Before running the browsing file, the operator must select which axes are to actually browse. Click the ModeSet command. Click "Set Move Mode" at the bottom of the sub menu. A dialogue box appears as illustrated below. Click on "BROWSE" in the new dialogue box, and click the MOVE MODE column to the right for all axes which are to BROWZ. Click "OK" after the BROWZ axes are selected.
To activate the browsing axes, click ModeSet, and "Start Browsing" from the submenu. Another dialogue box appears, asking whether to guide the browsing from the Axis 14 FPS axis, or from the-encoder-assigned to the camera axis. Since we want to guide browsing from the Axis 14 data, click "FROM AXIS 14 MOVE". The browsing axes will immediately move to their start positions, and the browsing move will start.
22






POSITION
AXIS
K
VELO
AXIS MODE
JOYSTICK PARAMS
MOVE MODE
Truck
Pan
Tilt
Cam Lift
Boom Rot
Zoom
Focus
EIGHT
NINE
TEN
ELEVEN
TWELVE
THIRTEEN
FOURTEEN
SHUTTER
Camera
VELOCITY
HEADING
CLIMB
SYN PAN
SYN TILT
SYN ROLL
REC PLAY NEUT
ASSIGN MOVE MODES
Hilite a mode below, then
click modes to the right.
MOVE
TABLE
BROWSE
OK
CANCEL
BROWZ JOYST
MOVE PRESENT
VIRT JOYST
ModeSet
Start Synthetic Axes
Stop Synthetic Axes
Start Browsing
Stop Browsing
Clear Tables
Set Encoder Resolutions
Set Move Modes
CANCEL

GUIDING THE BROWSING MOVE FROM AN ENCODER

If "FROM CAMERA ENCODER" is selected instead of "FROM AXIS 14 MOVE", the encoder assigned to the camera axis will serve as the browsing control. The encoder may be in either VELO or POSN mode, depending on the type of response desired. The sensitivity and smoothing factors may be adjusted. The smoothest response is available in VELO mode. If POSN mode is selected, the smoothing factor should be 4.000 or more. As the encoder shaft is turned, the operator may browse back and forth through the move data.

Regardless of whether the browsing move is being guided by the axis 14 data or the encoder assigned to the camera axis, the effective browsing FPS and frame number will be displayed on the Control Panel Screen and on the Jogbox display.

To turn off browsing, click ModeSet and Select "STOP BROWSING". It is also possible to stop browsing by clicking the "BROWSE FILE:" box displayed just above the menu area. If "Browmove.brw" is highlighted, browsing is activated.

THINGS TO REMEMBER ABOUT BROWSING

The browsing information is retrieved from the hard disc in real time, while the browse move is running. In order to use the UtilFiles, LoadMove, SaveMove, LoadTemp, SaveTemp, or any other command which accesses the disc drive, you must first turn off browsing. A typical hard disc with a 28 millisecond response time should be adequate for speeds up to at least 48 FPS. If you have an unusually slow hard disc, you may be limited to a lower speed. If your hard disc is "fragmented" from long use, or is nearly full, you should consider using a disc optimizer such as available in Central Point Software's "PC Tools" and similar disc management programs.

Any browse axis in REC mode during move record/playback will have its motion recorded in the normal move file.

In this version of RTMCxxx, automatic shutter control is only available when the browsing move is being guided by the axis 14 FPS file. Remember that axis 14 is "hard-wired" as the browsing control axis. The axis 14 file must be saved along with the master browsing move, by clicking UtilFiles/SAVE BROWSING MOVE. Since the only way to edit a browsing file is to edit the normal move data used to create the browsing file and then create a new browsing file, be sure to save the browsing move as a normal SaveMove file.

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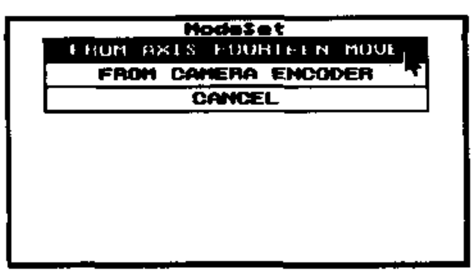
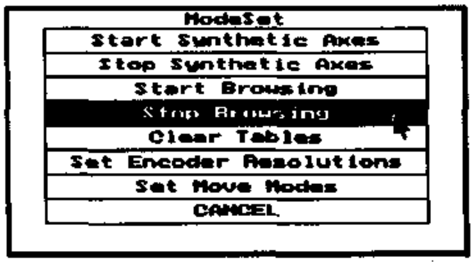
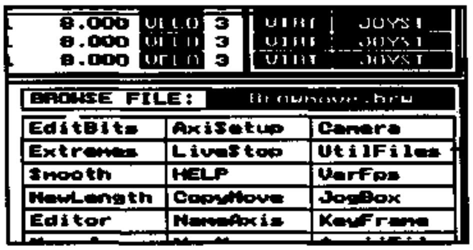
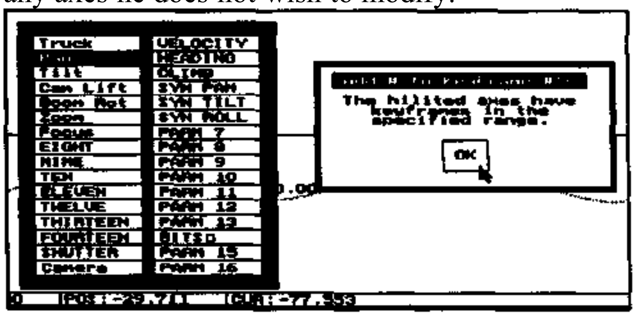


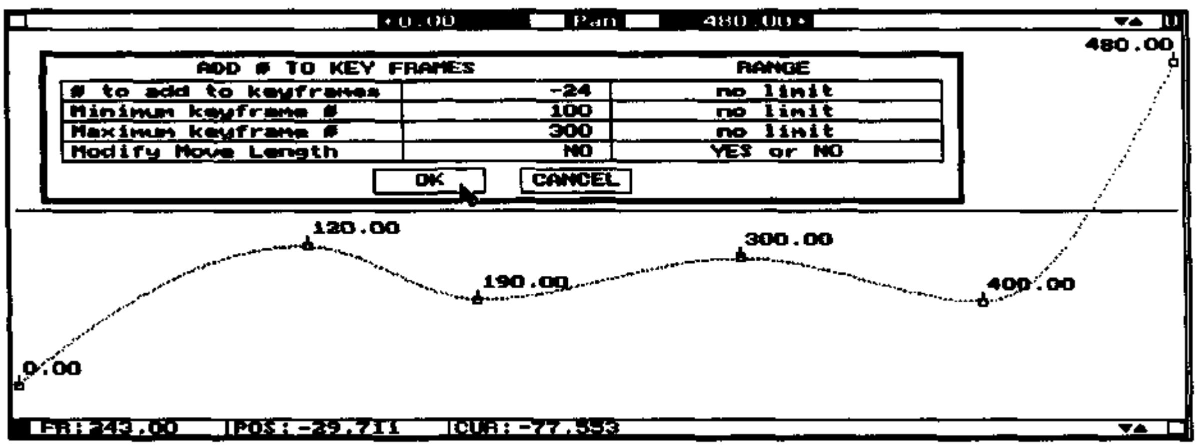

ModeSet
Start Synthetic Axes
Stop Synthetic Axes
Start Browsing
Stop Browsing
Clear Tables
Set Encoder Resolutions
Set Move Modes
CANCEL

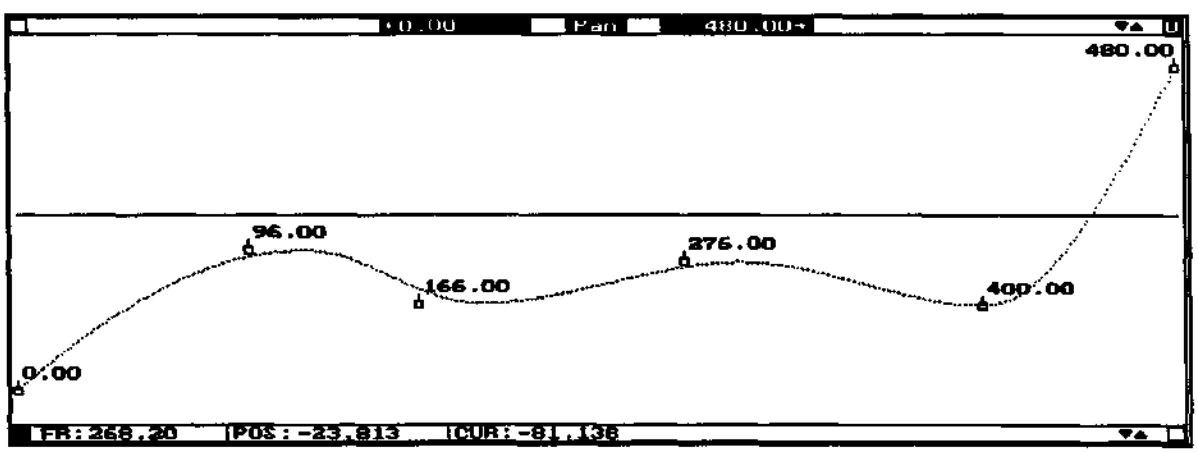

8.000 VELO 3 VIRT JOYST
8.000 VELO 3 VIRT JOYST
8.000 VELO 3 VIRT JOYST
BROWSE FILE:
EditBits
AxiSetup
Camera
Extremes
LiveStop
UtilFiles
Smooth
HELP
VarFps
NewLength
CopyMove
JogBox
Editor
NameAxis
KeyFrame

command: **AddtoKeys** where: Graphic Move Editor
purpose: Shift specified subsets of key frames left or right along the frame number axis, affects multiple axes at the same time.
The above illustration shows a typical curve fit move and the dialogue box which appears just after clicking the AddtoKeys command. The operator wants to shift key frames 120, 190, and 300 to a position 24 frames earlier. Based on the dialogue box entries, 24 frames will be subtracted from all the key frames with a value between 100 and 300. Adding "-24" frames is the same as subtracting +24 frames.
After clicking "OK" the software checks the keyframes for all the axes. In this case it found keyframes between 100 and 300 only on the Pan axis. If more than one axis has key frames in the specified range, the axis names will be highlighted, and the operator can unhighlight any axes he does not wish to modify.



24





The last illustration shows the results. Key frames 120, 190, and 300 have been shifted down to frames 96, 166, and 276. All keyframes outside the 100 to 300 range are unmodified. It is now necessary to use one of the curvefit commands to inbetween the newly repositioned key frames; RoughFit was used in this example.

The "Modify Move Length" option only applies if the shift will move an existing key frame past the present end of the move. If "Last Key Fr #" was specified as 400 instead of 300, the previous key frame for frame 400 would be shifted up to 424. If "Modify Move Length" is "NO" the original key frame 400 would be lost, although a new "place holder" key frame would be created at 400.00 at the previous position for frame 376. If "Modify Move Length" is "YES" the move length would be increased to 424. This is not the same as using the "NewLength" command which expands or contracts the whole move. "Modify Move Length" simply attaches extra frames at the end of the existing move.

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Command: **ModeSet**
where: Control Panel Screen
purpose: Assigns special operating modes to axes.
START SYNTHETIC AXES and STOP SYNTHETIC AXES are described in the "SYNTHETIC AXES" section of this document.
START BROWSING and STOP BROWSING are described in the "BROWSING" section of this document.
CLEAR TABLES deactivates all the currently active table files, clears the tables from memory, and returns table axes to their normal function. See the "TABLE AXES" section of this document.
SET ENCODER RESOLUTIONS tells the software the resolution of each of the 16 possible joystick encoders. See the "SYNTHETIC AXES" section of this document.
SET MOVE MODES tells the software which axes should enter browsing mode. See the "BROWSING" section of this document.
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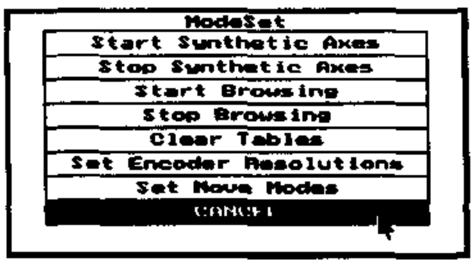
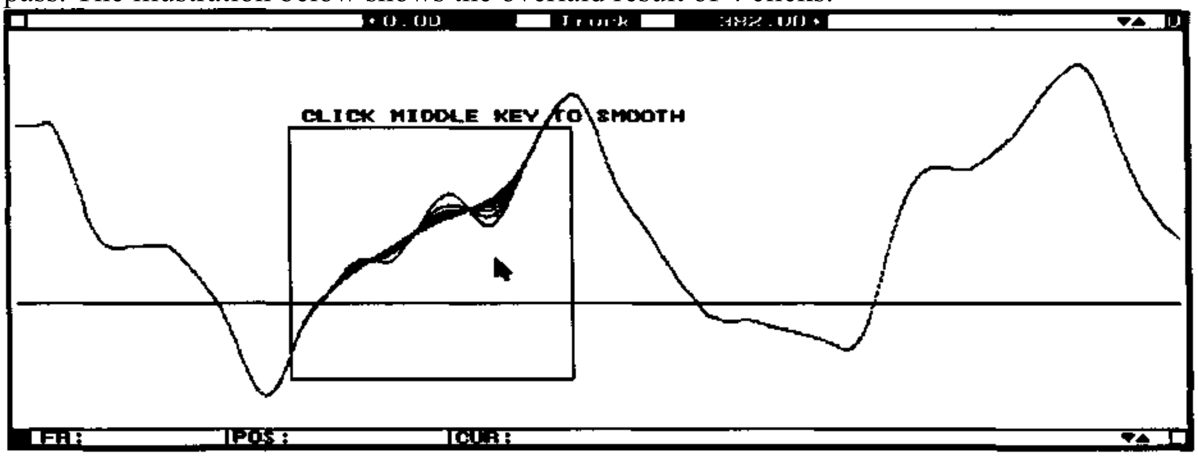
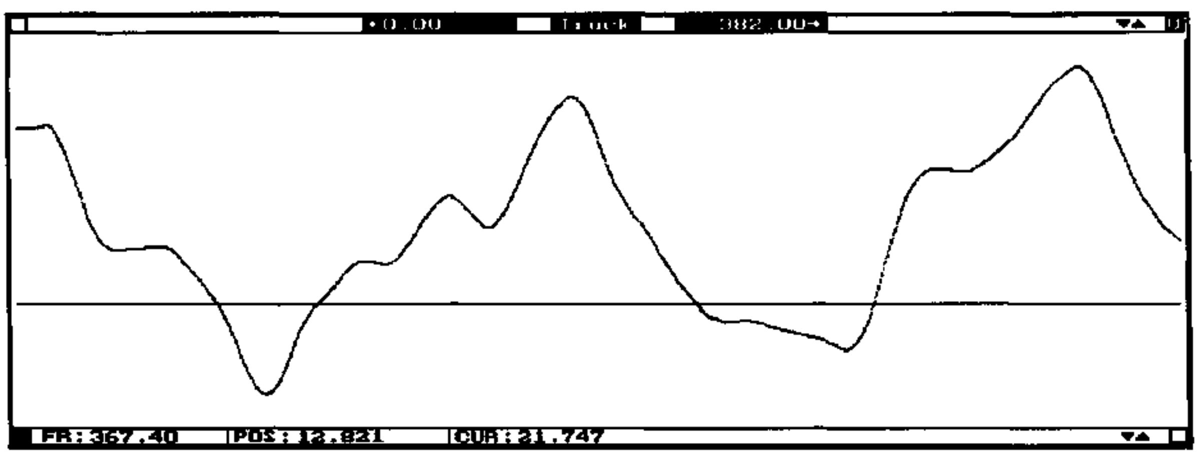
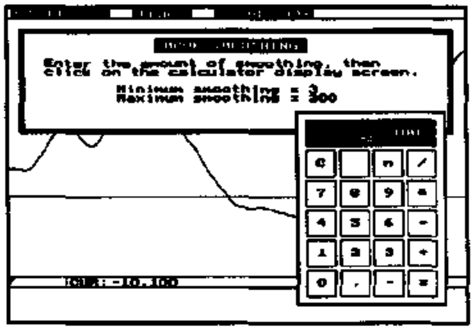


command: **SmthPart**
where: Graphic Move Editor
purpose: Smooth only a portion of move.
In the above position graph, there are some undesirable changes in direction around frame 150. After clicking "SmthPart" the normal Calculator appears to request the desired amount of smoothing. 100 is selected in this example, since a major change in the move is desired. The cursor changes to the "Sp" shape. Frame the desired area to smooth using the normal technique: hold down the left mouse key to stretch out the lower left corner of the frame, and hold down both left and right keys to reposition the entire frame. Once the desired area is framed, release all mouse keys.
Click the middle mouse key any number of times. Each click produces one smoothing pass. The illustration below shows the overlaid result of 4 clicks.



27




Enter the amount of smoothing, then
click on the calculator display screen.
Minimum smoothing = 3
Maximum smoothing = 300

Click the right mouse key to remove the smoothing frame and return to the "Sp" cursor. The effectiveness of the smoothing eases-in from the left side of the smoothing frame, and eases-out to the right side, with the maximum effect in the middle of the frame. You may want to frame the area to smooth rather loosely. However, in the special case where one side of the smoothing frame is butted up against frame 0.00 or the end of the move, the full smoothing effect will extend all the way to the butted frame. This provides a way to avoid smoothing out eases: if the smoothing frame does not cover the start or end of an ease, the ease will remain largely unmodified. Placing the smoothing frame on frames 0.00 and 100.00 of a 100 frame eased move will produce a much different effect than placing the smoothing frame on frames 1.00 and 99.00, which is the best way to protect eases from smoothing.
It is possible to use SmthPart with the graph in either position or velocity modes.
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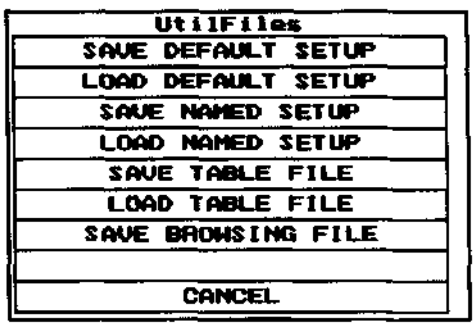
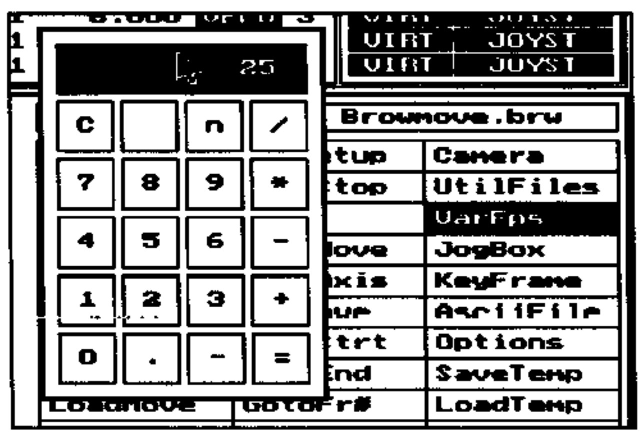
Command: **UtilFiles**
where: Control Panel Screen
purpose: replaces old SaveSetup command. Saves and loads motor performance files.
The first four entries save load user changeable settings in the RTMC120 Software. This includes Control Panel Screen settings, AxiSetup command motor performance settings, Options command settings, animation setups, and any table files which may be in operation.
If SAVE DEFAULT SETUP is used, the current settings will be automatically reloaded when the RTMCxxx Software boots up. LOAD DEFAULT SETUP can also be used to specifically reload the default settings at any time. ALWAYS ADD A FILE EXTENSION OF ".SET[1] WHEN NAMING A SETUP FILE, IE. "MYSETUP.SET[1].
SAVE NAMED SETUP saves the current settings in a user named file which can be later reloaded with LOAD NAMED SETUP command.
SAVE and LOAD TABLE FILE save only the table file information for any table axes currently operating. See the "TABLE AXES" section of this document for more information. Note that the four "SETUP" menu items also save table file information, in addition to the setup information. ALWAYS USE AN EXTENSION OF ".TAB" WHEN SAVING A TABLE FILE, IE. "TABFILE1.TAB".
SAVE BROWSING FILE saves the current move data in browsing file format. This step is necessary before using the browsing function described elsewhere in this document.
29



command: **VarFps**
where: Control Panel Screen
purpose: play back the move data at any FPS.
VarFps can play back the move at any FPS. After clicking the command, the calculator screen appears and the operator enters in an FPS number. The playback speed is accurate to approximately +- 0.0001 FPS. As soon as the number is entered, all highlighted axes move to the first frame in the move, and start playback. VarFps always starts from the first move frame, regardless of the number in the PRESENT box.
This is command is for playback only. It is not possible to record move data, although various axes may be tracking joysticks in the NEUT mode, and TABLE files may be operating.
The amount of axis and camera pre roll is proportionate to the "Live Act PRE ROLL" number for the camera, as specified when the "Camera" axis is selected from the "AxiSetup" command. Number between 100 and 240 are suitable for live action speeds.
Because VarFps runs the move from the hard disc, it is not possible for Browsing to be active during a VarFps pass, since Browsing also uses the hard disc. The maximum available FPS is dependent on the type of hard disc being used. With a typical 28ms access time disc, the top FPS will be somewhere around 48 FPS. If your disc is nearly full or has been used for a long time, it may help to use an "unfragmenter" program such as the Disc Optimize program which comes with Central Point Software's "PcTools." Watch the disc drive access light during playback- if the access light is "on" much more than "off you are approaching the maximum possible FPS.
30



command: **LIST KEY FRAMES**
where: Jogbox
purpose: Display and manipulate key frames from the Jogbox display screen.
Starting with RTMC120, LIST KEY FRAMES can be used to edit the key frames for only a single axis at a time, or the key frames for all the axes which contain key frames. After pressing this key, the Jogbox display prompts the operator to select an axis. The operator can either select a single axis by pressing one of the "1" to "F" keys at the top of the Jogbox, or he can select "ALL AXES" by pressing that key.
If a single axis is selected, the Jogbox display shows only a single key frame at a time, with frame number on the top line and position on the bottom line. If ALL AXES are selected, the top line on the Jogbox display shows the key frame number, while the bottom line displays how many axes have a key frame for that number. Whether or not a single axis or ALL AXES is selected, the special LIST KEY FRAMES commands below will function the same, except that for the ALL AXES mode the SELECT KEY FRAMES prompt will appear for the GOTO FRAME NUMBER, ENTER (delete key frame), and MEMO DOUBL KEY commands to select which axes should be acted upon.
The operator uses various other keys on the Jogbox to browse through the keyframe list, delete key frames, and send the axis to the motor position for specific key frames. The key frames are displayed one at a time. The following Jogbox keys have special functions ONLY while the LIST KEY FRAMES command is active:
RUN FWD moves the next key frame into the display. **RUN REV** moves the previous key frame into the display.
GOTO FRAME NUMBER causes the axis to immediately start moving to the position for the key frame shown on the Jogbox display.
ENTER deletes the key frame shown on the display.
MEMO DOUBL KEY creates a double key frame, one frame number removed from the key frame number originally displayed in the window. The position for the newly created double key frame will be the position for the original key frame, rather than the current motor position. This allows for creating double key frames (for purposes of suppressing overshoots, forcing eases, etc.) without having to first reposition the motor at the desired key frame position. The newly created key frame will always be one frame less the original key frame, except when the original key frame number is "0.0". In the "0.0" case the new key frame will be one frame more than the original.
To exit the LIST KEY FRAME mode,-press STOP/CANCEL or some other command key besides the five shown above.
The idea of special case functions for the above keys takes a little getting used to. Make a strong mental note whenever you enter the LIST KEY FRAME command that the GOTO FRAME NUMBER and ENTER (delete function) keys are potentially dangerous, and you must specifically press some Jogbox key besides the five listed above to exit the LIST KEY FRAME command and restore the normal functions of the five special keys.
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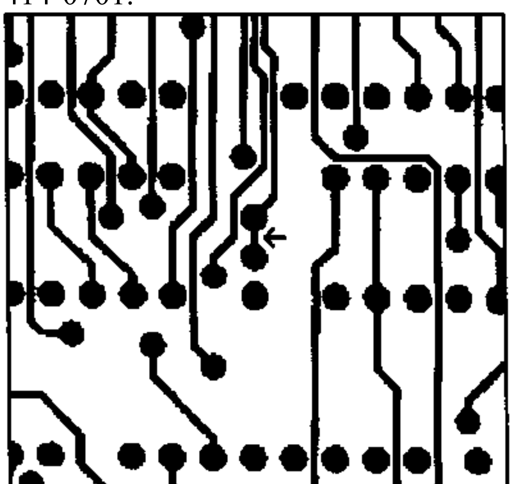
Increasing the RTMC16 Card's Maximum Pulses Per Second

As supplied from the factory, the RTMC16 circuit card has a maximum pulses-per-second of 122760. This allows a maximum "Slew Speed in PPI" of 1023. Micro-stepping drivers with resolutions of more than 2000 pulses-per-turn will benefit from a higher maximum pulses-per-second. We recommend this modification if you are using CNO-162 drivers, or other high performance micro-stepping drivers with resolutions greater than 2000 pulses per turn. This modification increases the maximum "Slew Speed in PPI" to 2047.

IMPORTANT NOTE: This modification will decrease the width of the step pulses for all 16 axes from 4 microseconds to 2 microseconds. This is acceptable for most microstepping drivers such as the Centent CNO-162. However, most CNO-142 and a some older CNO-143 drivers will not work correctly with a pulse width of less than 4 microseconds. **If you have a mix of CNO-142 or CNO-143 and CNO-162 drivers, you may need to keep the original 4 microsecond pulse width to accommodate the older drivers.** Call Kuper Controls if you are in doubt about making this modification: 310-414-0701.



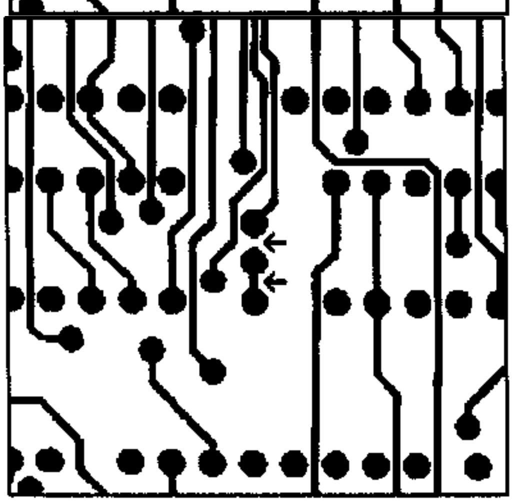


Figure 48 JP2 before modification.

Figure 49 JP2 after modification.

It is possible to increase the maximum pulses-per-second to 245640 by modifying JP2 on the RTMC16 card. JP2 is a set of three vertical holes located between U67 and U68. See

Figure 2 on the previous page. **Figures 3 and 4 show JP2 as seen from the back (solder side) of the RTMC16 circuit card.**
Figure 3 shows the original condition of JP2. There is a pre-wired trace between the top and middle holes of JP2.
Use an Xacto knife or razor blade to cut the existing connection. Make several very shallow cuts on the trace, and then pry it up with the cutting edge. Solder a wire between the middle and bottom holes of JP2, as shown in Figure 4. This completes the modification.
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RTMC16 MANUAL

version 119

Kuper Controls

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QUICK START

Other parts of the RTMC16 Manual provide detailed installation information. Here is a simplified "quick start" procedure:

1. Plug the RTMC16 Card into any available slot. If you plan to use encoders or the Jogbox, the bus connector on the chip side of the RTMC16 Card should be empty.
2. Run the "Encoder Signals" cable to the IBM I/O opening next to the RTMC16 Card. Connect the ribbon cable leading from the Black Box (or Black Box Card) to the grey plastic connector. Orient the arrow upwards. If the Encoder Signals cable is not all ready installed on the circuit card connector, check carefully that the connector is centered on the pins before pressing it in. The red stripe should be near the "RP4" and "C8" markings on the circuit card.
3. Run the "RTMC Logic" cable to any DB25 cutout at the back of the computer, and mount it with the supplied screws and nuts. If your computer doesn't have a DB25 cutout, use the supplied "L" mounting bracket to bring the connector out through an IBM I/O opening. Be sure the connector is centered on the pins. The red stripe should be near the "HI" marking on the circuit card.
4. If you don't have a Jogbox, go on to step 5. If your computer does not have an LPT2 port, install the supplied LPT2 card in any slot. If you all ready have an LPT2 port installed (which is unusual), just put the supplied card aside. Hook up the Jogbox "PAR.PORT" connector to the LPT2 card. Connect the Jogbox "RTMC LOGIC" connector to the "RTMC Logic" DB25 cable connector you just installed in step 3. The "BLACK BOX B" connector goes to the Black Box DB37 connector to your left. Plug in the Black Box AC cord. If you want to use the LPT1 port for the "PAR.PORT" connector, you must run the "setrtmc.exe" program, as described in the "Jogbox/Joystick Installation" section of this Manual.
5. Copy all the files on either the Monochrome or Color version distribution disc to your hard disc. All the programs on the distribution disc must reside on the same directory. If you don't have a hard disc, copy all the files to another floppy which will be your "working disc." The two software versions are identical, except that the Monochrome version uses a strict black/white color convention for the display.
6. The mouse driver supplied by the mouse manufacturer must be loaded prior to running the RTMC Software. This typically involves copying the mouse manufacturer's "mouse.com" program to your boot-up disc, and typing "mouse" before starting the RTMC119 program. DO NOT RUN THE MOUSE MANUFACTURERS INSTALL PROGRAM-JUST COPY MOUSE.COM ONTO YOUR BOOTUP DRIVE. Logitech and other mouse manufacturers' install programs copy useless, memory wasting programs onto your bootup disc and autoexec.bat file which take up memory and may interfere with the proper realtime operation of the Kuper Software. If you find "Logimenu" or "Click" statements in your autoexec.bat file, please remove them. Consult the mouse manufacturer's manual for more information. If you modify AUTOEXEC.BAT or CONFIG.SYS to automate loading the mouse driver, reboot the computer to get the changes to take effect.
7. Install Quarterdeck's "QEMM-386" program on your bootup disc. Run the "Install" program located on the QEMM-386 distribution disk, and accept all the default configuration options as presented by the install program.

8. Type "RTMC119" from the dos command line. Try using the Software, as described in the "Software Familiarization" section of this Manual.

9. If the software "locks up" or otherwise seems to malfunction, there are probably address or interrupt line conflicts. If this is the case, turn off the computer, and refer to the detailed installation procedures in the "Card Installation" and "Software Setup" sections of this Manual. If

the computer crashes with only the words "PLAY" and/or "NEUT" visible, the interrupt line is almost certainly incorrect.

If the messages "EMS failure" or "Not enough memory--" are displayed, QEMM-386 may not be installed properly, or there may not be enough memory available for the program to run. See the section titled "Problems with Microsoft Windows and Logitech TSR's" listed in the table of contents.

It is not necessary to have motors or encoders connected to exercise the Software. The Software will not function unless the RTMC16 Card is in the computer.

The Jogbox/Joystick will not function unless the Black Box is plugged in and turned on.

As well as operating in its dedicated joystick mode, the joystick/encoder in the Jogbox comes out as encoder 16, and may be used as a normal encoder from the Control Panel Screen.

Pinouts for the step-and-direction and encoder signals are available in the "Technical Drawing" section of the manual.

The "Simple Accessory Scheme" drawing shows how to add a "shoot switch" and other external controls. These are not necessary to run the Software.

Starting with the "Software Familiarization" section of this manual, there are several pages of basic orientation and introductory exercises which help give the basic "feel" of the system. Each command is explained in detail in the "Command Definition" section. We recommend you that you read the command definitions for the KeyFrame, DrawFree, DrawLine, Scale, ListKeys, and EditKeys commands fairly soon.

The "Using the Jogbox" section will get you started with that device, and be sure to look over the "Jogbox Definitions" section, especially for information on the very useful "LIST KEY FRAME" Jogbox key.

The Index at the back of this Manual is a very good way to find specific information.

CARD INSTALLATION
Under some circumstances, various jumpers on the RTMC16 Card may have to be changed, although chances are the card will work fine the way the card comes from the factory.
When you receive it, the card is set for address 300 (hexadecimal) and interrupt line 5. If any other card in your system is using the same address or interrupt line, your will have to change the address or interrupt of the either the RTMC16 Card or the conflicting card. If the RTMC Software locks up the first time you use it, or seems to operate erratically, there is probably an address or interrupt line conflict. If you have a "Bus Mouse" card in the system, check to see if it is using interrupt line 5, and try to change it to another interrupt line. Consult the mouse manufacturer's manual for details. **If you change jumpers JP3 or JP4, you must run the "setrtmc.exe" program,** which in turn modifies the "rtmc.env" file, which is checked by the RTMC Software to determine which address and interrupt line to use.
If you need to adjust jumper sets JP3 or JP4, or jumpers or switches on any other boards, we strongly suggest you make simple drawings of the original settings. The problems which arise out of "jumper bingo" are often due to not being able to remember the original settings.
The card uses one IBM hardware interrupt line and eight sequential I/O addresses. Jumper set JP3 is used to set the interrupt line, and jumper set and JP4 sets the address. Each set of jumpers is organized as pairs of two, one member of the pair on top of the other. The black plastic blocks are used to "bridge" the pairs. Bridges are placed on JP3 and JP4 to set the card's interrupt line and address. Make a note of which interrupt line and address you select. The card comes initially set for interrupt line 5 and address 300h.
JP3 selects hardware interrupt lines 2 through 7. From your left to right, the jumpers are for lines 2 through 7. Only one bridge should be in position on JP3 at any time. Place only one bridge according to the following rules:
If you DON'T have a LPT2: port, or you are using LPT2 for the jogbox: bridge pair 5 If you DON'T have a COM2: port, bridge pair 3 If you DON'T have a COM1: port, bridge pair 4 If you DON'T have a LPT1: port, bridge pair 7
(SPECIAL NOTE: NEVER BRIDGE PAIR 2 OR PAIR 6)
Remember, just one of the above! If you're not sure what lines your computer is using, try placing the bridge on pair 5. If you are using LPT2: for the Jogbox/Joystick "PAR.PORT", remove the interrupt jumper from the LPT2: card. See the computer manual for details on how to do this. **If you have a "bus" mouse, the interrupt line used by the mouse card is a likely source of trouble, since it will be using one the above interrupts. Check the mouse manual and jumper settings to make sure the mouse card is not using the same interrupt line as the RTMC16 Card.** Having the mouse and RTMC16 Card on the same interrupt line is the single greatest cause of installation problems. If you have two COM ports and a bus mouse card and a second printer port (LPT2), you may need to disable the COM2 or LPT2 interrupt line in order to use the RTMC16 card on one of those interrupt lines-check the documentation which came with your computer for details on disabling interrupt lines. Depending on the electronic design of the conflicting card, in some circumstances

the RTMC16 card can "share" the COM2 or LPT2 interrupt line without having to hardware disable the COM2 or LPT2 interrupt.
JP4 selects the board address. From your left to right, the jumpers are for address lines A3 to A9. Placing a bridge over the pair interprets the line as '0' while leaving the bridge off interprets the line as T. Finding an acceptable address may take some experimentation, since there is no real standard for addresses used by certain kinds of IBM expansion cards. If you don't have many cards in the computer, chances are the factory setting of 300h will work just fine. The following addresses are presented in "most likely to work" order:

A3	A4	A5	A6	A7	A8	A9	ADDRESS
on	on	on	on	on	off	off	300
on	on	off	on	on	off	off	320
off	on	off	on	on	off	off	328
on	off	off	on	on	off	off	330
on	on	on	off	on	off	off	340
on	on	on	on	off	on	off	280
on	on	off	on	off	on	off	2AO
off	on	on	on	on	off	off	308
on	off	on	on	on	off	off	310
off	off	on	on	on	off	off	318

There is a special disc file named "RTMC.ENV" which is on the same disc as the RTMCxxx Software. Every time it boots up, the RTMCxxx program refers the RTMC.ENV file for information about board address, interrupt line, and other things. Whenever you change the address or interrupt line, the RTMC.ENV file must be updated. The best way to change the RTMC.ENV file is with the SETRTMC.EXE program on the distribution disc. The SETRTMC program lets you specify board address, interrupt vector, type of video card, etc., and then creates a new RTMC.ENV file. Check the technical drawings "RTMC16 PULSE OUTPUT CONNECTOR" and "RTMC ENCODER INTERFACE CONNECTOR" for details on hooking up motor drivers and encoders. You will also need the driver and encoder manufacturers' manuals. The drawing "SIMPLE ACCESSORY SCHEME" shows how to hook up various switches, triggers, and a frame marker light.
Place the card in any available slot. Use the locking screw to secure the card in place. Route any nearby flat cables away from the Card as much as possible to give the card cooling air space.
If you are using a Black Box Encoder Interface, install the "Encoder Signals" flat cable bracket in IBM I/O opening on the chip side of the RTMC16 card-this slot will probably have to be empty. The other end of the cable goes to connector "H2" on the RTMC16 card. BEFORE PRESSING THE FLAT CABLE CONNECTOR ONTO THE PINS,

CHECK VERY CAREFULLY THAT

THE CONNECTOR IS EXACTLY CENTERED ON THE PINS, AND NOT SHIFTED ONE OR MORE PINS LEFT OR RIGHT, OR UP OR DOWN. The red stripe on the ribbon cable should be near the "C8" and "RP4" markings on the circuit card. Install the external flat cable between the bracket and the Black Box connector "C", which is the plastic connector below the two DB37 connectors.

Install the RTMC Logic Connector leading from "HI" on the RTMC16 Card to an open DB25 cutout on the back of your computer. If you your computer doesn't have a DB25 cut-out, use the included DB25 mounting bracket to bring the DB25 Logic Connector out through an IBM I/O opening. Be sure the circuit card connector is centered on the pins. The red stripe on the ribbon cable should be near the "HI" marking on the circuit card.

Here is a Basic program which reads the computer's interrupt control circuitry in an attempt to find out what interrupt lines are currently in use. This may be helpful if you can't find manuals for other cards installed in the computer, or if you are experiencing difficulties which you think are interrupt related. The output of this program must be taken somewhat skeptically, since interrupt using cards usually disable their interrupt when they are not in use. In particular, be sure to briefly use some mouse-using application (such as a paint program) before testing with this program, in order to get the mouse interrupt switched on and "visible."

```
10 DEFINT X,N,I
20 X = INP(&H21)
30 PRINT "Unused Interrupts"
40 N = 1
50 FOR I = 0 TO 7
60 IF ((X AND N) <> 0) THEN PRINT "LINE";I,"VECTOR ";CHR$(I + 63)
70 N = N * 2
80 NEXT
```

The "Manifest" program supplied with QEMM-386 also provides information about interrupts and other cards installed in the system.

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JOGBOX/JOYSTICK INSTALLATION

To install the Joystick, you must plug in 4 connectors, and run the "setrtmc.exe" program to modify your "rtmc.env" file to reflect the address of the parallel printer port used for the "PAR. PORT' connector described below.

CABLE INSTALLATION:

The Joystick cable uses "DB" series logic connectors. The screws serve only to keep the connector from falling off, and it is only necessary to tighten the screws just slightly snug. Avoid over tightening.

One end of the Joystick cable has three connectors; this is the computer end. Connect the other end of the cable to the Joystick.

The computer end of the cable is attached as follows:

The large 37 **pin connector** goes to the Black Box "Connector B." As you look at the Black Box, this is the 37 pin connector to your left, which normally handles encoders 9 through 16. The encoder in the Joystick uses the input for Encoder 16.

If you are all ready using other encoders in the 9 to 16 range, resolder the 4 Joystick wires to the same pins on the existing 37 pin connector. Be sure to get the same wire to the same pin, since the two lower wires are the power supply lines for the Joystick, and reversing these wires can cause damage. The black wire with the white stripe goes to pin 34 (ground), and the red wire with the white stripe goes to pin 35 (+5 volts). The other two wires go to pin 15 (green wire with white stripe) and pin 16 (blue wire with white stripe).

The 25 **pin connector labelled "PAR. PORT** goes to an IBM compatible parallel port. This is typically LPT2:, although LPT1: can also be used. Also, any 8 bit output port may be used, provided the wires are hooked up with proper DO through D7 progression; see the attached drawing for pinouts.

The 25 **pin connector labelled "RTMC LOGIC"** has three wires which mate to the DB25 connector and ribbon cable leading to "HI" on the RTMC16 Card.

We supply the Jogbox "RTMC LOGIC" lines all ready connected to a DB25 connector for your convenience in testing the Joystick. In actual use, these 3 wires share the same connector used for the marker light, shoot switch, trigger relays, etc. You may want get the Joystick working with the supplied connector, and then switch the wires over to the normal connector. When the Joystick checks out, remove the 3 wires from the supplied connector and attach them to the exact same pins on the existing connector.

Attach the **SPADE LUG** to any convenient screw on the back of the computer. One of the screws that attaches the cover is a good choice. This is the grounding wire for the cable shield.

MODIFYING THE RTMC.ENV FILE:
The "rtmc.env" file must be modified to reflect the address of the parallel printer port connected to the "PAR. PORT' connector. The "setrtmc.exe" program provides a convenient way of making modifications to the "rtmc.env" file. Although early versions of the RTMC Manual recommend modifying rtmc.env with a text editor, we have found that certain text editors corrupt the file. Always use setrtmc.exe instead.
Copy the "setrtmc.exe" program to the same directory as your "RTMCxxx.exe" and "rtmc.env" files.
Start the program by typing "setrtmc" at the DOS prompt. A menu is shown which lets you change any of the parameters in the "rtmc.env" file. Item #5 shows the address of the output port for the Joystick. This will probably be either 278, 378, or 3bc. The numbers are shown in hexadecimal format.

Printer port	Address
LPT1:	378
LPT2:	278

Rarely, the address for LPT1: may be 3bc, mainly in cases where the printer port is located on the video card.
If the address shown does not match the address for the printer port you are using, select item number 5, and enter the new address.
If you are using a "generic" parallel port, such as on an industrial control card, type the address of the port in hexadecimal format.
When the correct address is shown, exit with the "QUIT[1] menu item. When the program asks you whether or not to save the changes, type "y" or "Y".
Now boot up RTMCxxx. As soon as the Control Panel Screen appears, click on the "JogBox" menu item at screen lower right. The Jogbox should display "Jogbox On". If the display is blank, or contains garbage, quit RTMCxxx and check the connector installation. If the connectors are correct, try a different port address. If you are not familiar with the IBM pc, do not try addresses except 278, 378, or 3bc, since certain addresses (such as the hard disc address) are "dangerous" if used by mistake.
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SOFTWARE SETUP

Be sure to make copies of your original discs. Use the copies as your working discs, and put the originals safely away. The RTMCxxx program and all the other files on the distribution disc should be copied to your hard disc. The Software may also be run from floppies. There are no copy protection schemes in the Software. However, RTMCxxx Software will not function unless the RTMC16 Card is plugged into the computer's bus, and the selected address and interrupt lines are correct.

The current version of the Software must be run under DOS versions 3.1 to 3.3. Dos 4.x and Microsoft Windows may interfere with the real time operation of the RTMC Software. If you have Windows installed on your computer, do not run Windows between the time you boot up and the time you run RTMCxxx. Always enter the RTMCxxx program from the DOS command line, and never through Windows.

To run properly, the Software needs to have all the files on the distribution disc present on the same directory as the RTMCxxx program. The help menu system will not work unless there is a copy of "HELP.ASC" on the same directory. If the Software does not detect the "RTMC.ENV" file, it will prompt the operator to create one.

The RTMC Software needs to have the mouse manufacturer's software driver loaded before running. The mouse manufacturer's manual explains how to do this. Typically the statement 'mouse' or 'msmouse' or something similar is added to the autoexec.bat file, or something like 'device=mouse.sys' is added to the config.sys file. In any case, either the mouse manufacturer's "mouse.com" or "mouse.sys" file must be present on the computer's boot-up disc, and properly installed in memory before running the RTMC Program.

MOST MOUSE MANUFACTURERS SUPPLY AN "INSTALL" PROGRAM--WE STRONGLY RECOMMEND YOU DO NOT USE THE MANUFACTURER'S INSTALLATION PROGRAM, BUT RATHER SIMPLY COPY THE MOUSE.COM PROGRAM ONTO YOUR BOOTUP DIRECTORY, AND INCLUDE THE STATEMENT "MOUSE" AS A LINE IN YOUR AUTOEXEC.BAT FILE. The install programs tend to copy "DOS-shell" and other types of TSR programs onto your bootup disc, and modify autoexec.bat and config.sys to automatically load these programs, resulting in wasted memory and possible interference with the realtime functions of the RTMC Software. If you wish to use mouse related programs such as Logitech's Logimenu, Click, or PopDos programs, see the section of this manual titled "Problems with Windows and Logitech TSR's" for information on how to use QuarterDecks's Optimize program to place such programs out of the say of RTMCxxx.

The Logitech C9 mouse driver supports a "ballistic response" feature which varies the mouse resolution according to how fast the mouse is being moved. This subtly changes the way the mouse feels when being used as a joystick. You might want to experiment with turning this feature on and off. To turn the "ballistic response" on, type "MOUSE BON" from the dos command line; type "MOUSE BOFF" to switch off. "BON" or "BOFF" can be added at the end of the "mouse" line in your autoexec.bat or config.sys file.

Quarterdeck's "QEMM-386" EMS memory manager program must be loaded before running the RTMC Software. Simply run the "install" program provided with the QEMM Software, and accept

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the default setup parameters. The install program need only be run one time. Other EMS memory manager programs may also be used, provided they are truly "386 specific." Memory manager programs claimed to be "286 compatible" will probably be much too slow, and will lead to problems.
To check for proper installation of QEMM-386, type "QEMM" from the DOS command line. If QEMM-386 is correctly installed, a screen full of data should list out; otherwise an error message will be displayed.
There must be at least 560k of free memory available before running RTMCxxx. Run the DOS "chkdsk.com" program to check the amount of available. If less than 560K of memory are free, the error messages "EMS failure" or "Not Enough Memory" may be displayed. See the section of this manual titled "Problems with Microsoft Windows and certain Logitech Programs", listed in the table of contents.
The RTMC Software is unusual in that it is a "real time" application, with two programs running side by side simultaneously. Certain TSR programs, such as "pop-up" desktop accessories, print-spoolers, and "shell" programs such as "DesqView" may seriously interfere with the proper operation of the RTMC Software, by preventing the RTMC16 Software from communicating with the RTMC16 Card for overly long periods of time. For your initial experimentation with the RTMC16 Card, it is best to disable any such competing programs.
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PROBLEMS RELATED TO MICROSOFT WINDOWS AND LOGITECH TSR'S
Making custom Autoexec.bat and Config.sys files for Windows and RTMC:
The presence of Microsoft Windows on the computer often causes problems, even when Windows has not been run since booting up the computer. The problem is that during the Windows installation process, changes are made to autoexec.bat and config.sys files which reduce the total amount of memory available to the RTMC Software, even when Windows is not run.
Remember that if you make changes to autoexec.bat or config.sys, you must reboot the computer for the changes to take effect. The computer only looks at autoexec and config when it boots up, or is reset with either the reset switch or the "Alt-Ctrl-Del" key combination.
The DOS program "chkdsk.com" reports the amount of memory available. "Chkdsk.com" is usually located in the "DOS" directory on the hard disc, or it can be copied from the DOS distribution disc. Type "chkdsk" from the DOS command line. Several lines of information are displayed. The last line reports the amount of free memory. If less than about 560k are free, as reported by "chkdsk", you will have to make two separate sets of autoexec.bat and config.sys files. One set will be your "normal" set containing Windows setup information; the other will be a "lean and mean" set designed to free up as much memory as possible for use by large DOS programs such as RTMCxxx.
The following instructions assume that "mouse.com" is located in your bootup directory, and that you have run the "install" program supplied with the QEMM-386 Software.
First, make copies of your existing autoexec.bat and config.sys files. Be sure you are in the "bootup" directory. From the DOS command line, type:
COPY AUTOEXEC.BAT AUTOEXEC.W COPY CONFIG.SYS CONFIG.W
Make sure "1 file copied" is displayed after pressing "Enter" at the end of each of the above lines. DO THE ABOVE STEP ONLY ONE TIME-ITS PURPOSE IS TO PRESERVE YOUR ORIGINAL AUTOEXEC.BAT AND CONFIG.SYS FILES WHICH CONFIGURE YOUR COMPUTER FOR RUNNING WINDOWS. IF YOU NEED TO REPEAT ANY OF THE FOLLOWING STEPS, SKIP THE ABOVE. For extra safety, it's a good idea to copy your original autoexec.bat and config.sys files to a floppy disc as well.
Now type:
COPY CON AUTOEXEC.MC
and press "Enter". This invokes DOS's "mini" text editor. The cursor will position itself to the extreme left of the screen. Type in the following, carefully checking each line before pressing the "Enter" key:
PATH QEMM; MOUSE.COM PROMPT PG
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And press the "F6" key. The letter characters " ~ Z" will appear. Press the "Enter" key. Make sure the message "1 file copied" is displayed.
Type:
COPY CON CONFIG.MC And press enter. The cursor should go to screen extreme left.
Type:
DEVICE=\QEMM\QEMM386.SYS HANDLES=80 NOVIDEOFILL RAM ROM
FILES=20
BUFFERS=20
Now press the "F6" key and press "Enter". Make sure the message "1 file copied" is displayed.
Now make two batch files to modify autoexec.bat and config.sys according to whether you want to run Windows or motion control. Type:
COPY CON MC.BAT And press "Enter". Type:
COPY AUTOEXEC.MC AUTOEXEC.BAT COPY CONFIG.MC CONFIG.SYS
Press the "F6" key and then "Enter". Make sure "1 file copied" is displayed.
Type:
COPY CON W.BAT
And press "Enter". Type:
COPY AUTOEXEC.W AUTOEXEC.BAT COPY CONFIG.W CONFIG.SYS
Press the "F6" key and then "Enter". Make sure "1 file copied" is displayed. This completes the batch setups. From now on, just after booting the computer:
If you want to run Windows, type "W" and press "Enter". If you want to run RTMCxxx, type "MC" and press "Enter".
In either case, autoexec.bat and config.sys will be automatically modified. The disc activity will continue or a few seconds. **After the two files are copied, re-boot the computer to allow the newly modified autoexec and config files to take effect.** After this second reboot, you may run the
appropriate programs.
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Placing Logitech Click, Logimenu, and PopDos programs out of the way RTMCxxx:
Logitech and most other mouse manufacturers supply utility programs along with their basic mouse drivers. The problem with these utility programs is that they take up memory which large programs such as RTMCxxx need to run correctly. The Logimenu, Click, and PopDos programs supplied on the Logitech distribution discs are examples of such utility programs. The only program required by the RTMCxxx Software is the "Mouse.com" program; the other mouse related programs are of no advantage to RTMCxxx, and may in fact cause problems.

The Logitech install program normally places the bootup commands for Logimenu, Click, and PopDos in a separate file named "Gomouse.bat". Under normal circumstances, the operator would type "Gomouse" after the computer bootup; if "Gomouse" is not typed, the memory hungry Logimenu, Click, and PopDos programs are not loaded. However, if "Gomouse.bat" is included in your Autoexec.bat file, the utility programs will be automatically loaded every time the computer is booted. We suggest that you make certain that none of the following commands in you Autoexec.bat file:

Gomouse Logimenu Click PopDos

Please remove any such commands from your Autoexec.bat file, and place them in a separate "Gomouse.bat" file. Only type "Gomouse" when you are NOT going to run the RTMC Software.

Optionally, it is possible to place Logimenu, Click, and/or PopDos statements in the Autoexec.bat file, and then run the "Optimize" program located in the QEMM directory. Optimize attempts to place utility TSR programs out of main RAM area, and typically frees up a considerable amount of memory. If running "Chkdsk.com" (located in the DOS directory and on the DOS distribution disc) reports more than about 580k of memory free after the optimization, you may keep the programs in your Autoexec.bat file; otherwise you should use the separate "Gomouse.bat" file method.

Note that "Optimize" will only optimize Logimenu, Click, and PopDos if those specific named are located in autoexec.bat. Any "Gomouse" statement must be removed from autoexec.bat before running Optimize.

UNDER NO CIRCUMSTANCE SHOULD THE RTMCXXX PROGRAM BE ENTERED THROUGH THE "POPDOS" MENU SCREEN. RTMCXXX SHOULD ONLY BE INVOKED FROM THE NORMAL DOS COMMAND LINE.

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HARDWARE REQUIREMENTS

The RTMC Software requires a three button mouse. We have used Logitech "C7" and "C9" mice successfully. Either a "bus mouse" or a "serial" mouse may be used, with a "serial" mouse preferred. If you have two COM ports, use a serial mouse on one of the ports, otherwise use a bus mouse. If you have bus mouse, the mouse circuit card will probably be set for the default interrupt line used by the RTMC card (line 5), in which case you must change the interrupt line for either the mouse or the RTMC16 Card. Note that the Microsoft Mouse is a two button mouse, and is not acceptable.

The Software requires a minimum of a 16 megahertz 386SX Computer. The faster the computer, the better, since the RTMC Program uses graphics extensively, and the Graphic Move Editor is very math intensive. Computers up through 33 megahertz 486's are acceptable.

Two megabytes of memory are required, consisting of the normal 1 megabyte of "base" memory, and one megabyte of "extended" memory.

An 80387 math co-processor is highly recommended, although not required by the current version of the Software. For persons planning to use the Graphic Move Editor more than occasionally, the co-processor is virtually a necessity, since it speeds up the Editor by a very large factor, as much as 50 times. Future versions of the Software may require a math co-processor. Note that 486 computers come with a built-in math co-processor; a separate 80387 is not needed.

Use a VGA video card with a monochrome or color monitor, although 640x350 and 640x480 EGA cards are also acceptable. Hercules and CGA cards are not acceptable. Future releases of the Software may not support EGA 640x350. In experimenting with various video cards, we found that cards with 16 bit buses are considerably faster than cards with 8 bit buses, and well worth a few extra dollars. Future versions of the RTMC16 system will support more than 16 axes, for which a 16 color, 800x600, VESA compatible "Super VGA" resolution will be required. Many current VGA cards and monitors support "SuperVGA" mode, but check with the salesman before buying just to be sure. Verify that the card is VESA compatible, since many older 800x600 cards are not. We use a Headland (formerly Video 7) VGA1024i card and NEC Multisync 3D monitor in our development system.

If you wish to save moves on a floppy disc, the disc should have at least a 1 megabyte capacity, to accommodate the longest possible move recorded on the maximum number of axes. A 720k or 360k drive should suffice for saving most typical moves.

A hard disc is recommended, but not required for the current version of the RTMC Software.

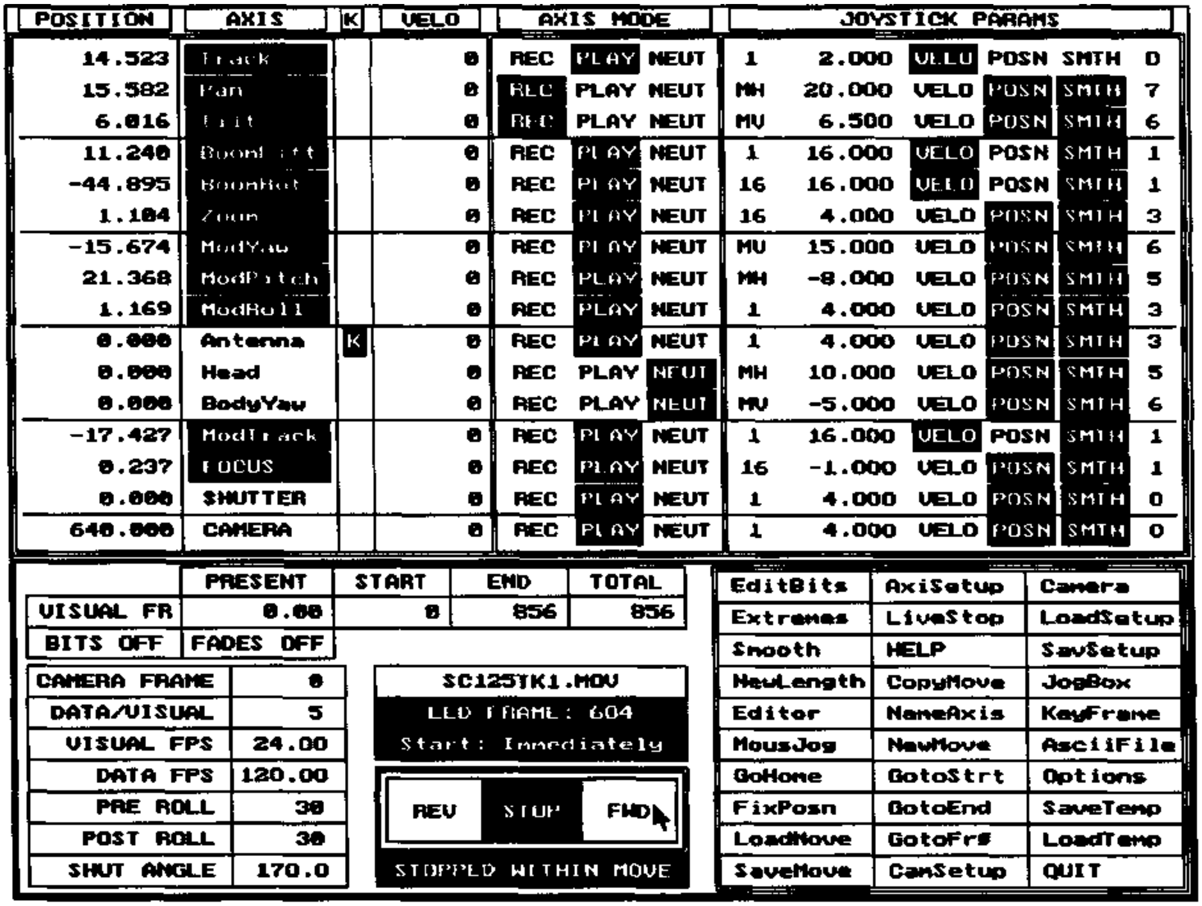
An external RESET button is desirable, since it will serve as a crash stop for the axes in the event of a computer crash.

SOFTWARE FAMILIARIZATION

First things first: there are two emergency stop keys--the " ~" key on the computer keyboard and the "EMER STOP" key on the Jogbox. Pressing either key will produce a rapid, controlled stop any time the axes are moving.

Check the disc directory for the exact name of the program. The name will be "RTMC" followed by some numbers indicating the exact version.

To load the Software, switch to the disc and directory containing the Software, type the Software name, and press the 'Enter' key. Press the 'Enter' key again to pass the title screen.



The Control Panel Screen is basically a large array of buttons. Buttons are pressed by clicking with the mouse.

Click on the "MousJog" button in the menu area at the lower right hand corner of the screen. A prompt message appears explaining how to use the command. Try jogging a few axes by placing the cursor on an axis name, and pressing the right or left keys. Notice the positions change on the screen. Hold down the middle mouse key in combination with the left or right keys to inch the axis. Press the "OK" button in the prompt when you're done. Another prompt message appears. Just press the "OK" button again.

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If the axes run too fast while jogging, click on the "AxiSetup" command, and change the "Slew Speed in PPI" parameter to a much smaller value; click on the existing value in the center column to change it. See "AxiSetup defined" in the index for an explanation of how to change other motor performance characteristics.

Press the "GoHome" button. Check the various options, then send the axes you just jogged back to their home positions. Home position is considered to be "0.000". To start several axes at one, just hold down the left mouse key and drag the arrow over the names of the axes.

Typical prompt for a Control Panel function.

Move the mouse up to the column of axis names. Click the left mouse key on the name at the top of the column. The highlight means that the axis is "selected." Click again to "deselect" the axis. Hold down the left key and run the mouse up and down the column, watching the highlights toggle back and forth. Highlight several names, and then click the middle mouse key; all the names go deselected. Click the right mouse key to select only a single axis, while deselecting all the others.

Move the mouse over to the "AXIS MODE" columns. Click on "REV "PLAY" and "NEUT." Run the mouse up and down the columns with the left mouse key pressed. Put some axes on "REC" and then click anywhere in the "REC" column with the right mouse key, noting that all the "REC" axes change over to "PLAY."

The "JOYSTICK PARAMS" column controls how the joysticks relate to the axes. The number at the left side of this area controls which joystick is assigned to the axis. Click with the left key to increase the number, with the right key to decrease the number. "MH" and "MV" stand for mouse horizontal movement and mouse vertical movement, which are treated as two separate joysticks. The number just to the right is how sensitive the joystick will be. Click on this number, and observe the appearance of the Data Entry Calculator. Enter a number on the calculator by poking with the mouse or using the keyboard numeric entry keys (the NumLock must be on to use the keyboard). Click on the calculator screen when you are done.

"VELO" and "POSN" are the two types of joystick response available, Velocity and Position.

"SMTH" turns simulated fluid-head smoothing on and off. The number to the right of "SMTH" sets the amount of smoothing. Left key increases, right key decreases. Larger numbers produce a more fluid-like joystick response.

Whenever the Software wants you to input a number, the Data Entry Calculator will appear on screen. You can enter the numbers by clicking the mouse on the calculator keys, or using the numeric pad on the computer keyboard, in which case the "NumLock" LED must be lighted. To enter the number on the Calculator, click on the calculator screen, or press "Enter" if you are using the numeric keypad. The "C" button clears the display to "0". The "n" button makes the displayed number negative.

Data Entry Calculator

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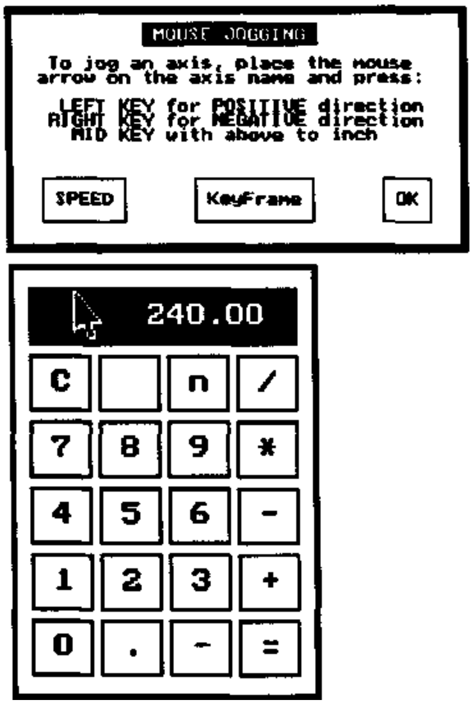
MOUSE JOGGING
To jog an axis, place the mouse arrow on the axis name and press:
LEFT KEY for POSITIVE direction
RIGHT KEY for NEGATIVE direction
MID KEY with above to inch
SPEED
KeyFrame
OK
240.00
C
n
/
7
8
9
*
4
5
6
-
1
2
3
+
0
.
=

INTRODUCTORY EXERCISE:

Click the "Start:" box above the "REV STOP FWD" control until "Start: Immediately" is displayed.

Enable two axes by highlighting their names. Do not select Camera or Shutter if those names are visible. Go over to the joystick number column and toggle the numbers with the right or left mouse keys until one axis is assigned to "MV" and the other to "MH." Highlight "POSN" and "SMTH". Adjust the amount of smoothing (over at the extreme right) to 7; click on the number with the left or right mouse keys to increase or decrease the amount of smoothing. Now highlight "REC" for both of the selected axes.

Place the mouse somewhere in the "VELO" column and press the middle mouse-key. As long as the middle key is pressed, the axes should track the mouse. Release the middle key to restore normal mouse operation. Try adjusting the sensitivity higher and lower. For very high sensitivities, you may need to increase the amount of smoothing. If the axis lurches or feels clumsy, try more smoothing; if the response seems too mushy, decrease the smoothing. Whenever you adjust any of the joystick parameters, the axis will change from "REC" to "PLAY." To joystick an axis, you will have to put the axis back on "REC" or "NEUT"; you can't joystick any axes set to "PLAY", or axes which are not "enabled" (name highlighted).

This prompt is displayed over the menu area whenever the mouse is being used as a joystick.

Make sure the "CAMERA" axis is disabled (disabled = not highlighted, enabled = highlighted-click the axis name to adjust the highlight). Start joysticking the axes again with the middle mouse key. While holding down the middle key, tap the right key. The Data Frame and Visual Frame numbers will start to advance, indicating that a move is being recorded. After a few hundred frames, release the middle key to stop recording. The axes will automatically change from "REC" to "PLAY." If the "CAMERA" axis were enabled, the camera motor would have run.

Move the mouse down to the "REV" box at screen lower center. Tap once to start an immediate playback of the move you just recorded. Tap "STOP" to halt the playback at any time. Practice toggling back and forth between "REV" "STOP" and "FWD." Assign some other axes to "REC" while keeping the ones you just recorded on "PLAY." Remember to select "MV" or "MH" for the joysticks, and use plenty of smoothing to compensate for the very low resolution of the mouse. Remember to change joystick parameters before putting the axis on "REC." The "START:" box just above the "REV STOP FWD" display should read "START: IMMEDIATELY"--if it says something different, click on in until it display "START: IMMEDIATELY"--see "STARTING THE MOVE" in the index for more information.

Once you've recorded a few axes, click the left mouse key on the "DATA FPS" number at screen lower left. The left key decreases this number, the right key increases. Notice how the "VISUAL FPS" changes in proportion. Run the move at a few different speeds. Click on the "NewLength" command to change the overall number of frames in the move, while keeping the original shape of the move. Click on the move length number to change it. This

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MOUSE SERVING AS JOYSTICK
LEFT KEY = REV Button
RIGHT KEY = FWD Button
Releasing the MID KEY
returns mouse to normal
function and stops
Record/Playback.

command is very useful when you are trying to make a joystick move to a specific frame count. As you initially record the move, just concentrate on getting the gesture of the move correct, without worrying about the number of frames. When the move has the right path, use "NewLength" to get the desired number of frames.
"PRE ROLL" and "POST ROLL" control how much "runup" the axes will take to reach speed. Try a few different numbers between 0 and 200 and watch the results. "0" produces no PRE or POST ROLLS, while "200" produces the maximum amount. The effects of the ramps will be most apparent when you stop and start the move in sections where the axes are running fast. Very low numbers may result in stalls; very large numbers may produce unnecessarily long ramps. We recommend using the same number for both pre and post roll, since this allows toggling back and forth between "REV" and "FWD" without any repositioning. The "Options" command sets whether PRE and POST rolls are "minimized" with decreasing FPS, or stay the same at all FPS. If the pre rolls seems to drag on excessively at slower FPS, check the "Options" command.
Any axis which is named "CAMERA", with any combination of upper or lower case letters, will function as a camera. If no "camera" axis is listed, create one by using the "NameAxis" menu item at screen lower right-just type in the name "Camera" on any axis, and it will become a specialized camera motor axis. The "CamSetup" menu item controls various aspects of the camera, such as amount of rampup, top speed, and whether or not the camera is allowed to shoot in reverse during live action shooting. Run the move with the camera enabled (name highlighted) and on "PLAY."
The "VISUAL FR" box shows information about length of move, what part of the move is currently being played or recorded, and lets the operator limit record and playback to specific parts of the move. Set "START" and "END" to a narrow section within the move and note how the move will not run outside these limits.
The "HELP" menu item provides information about specific items on the screen. Click on this item to enter the "help" mode. Whenever the help prompt is displayed, you can click on specific screen items to get more information. For example, try clicking anywhere in the "JOYSTICK PARAMS" area just above the help prompt box to get more information about joystick operation.
"AxiSetup" lets you change the performance limits and characteristics for each axis. See "AxiSetup defined" in the index for information on what the various parameters mean. After you change any of these parameters, test out the result by jogging the axis some distance with the "MousJog" command, and then sending the axis back home. Experiment until you find a combination of acceleration, deceleration, and top speed which gives comfortable performance without danger of stalling. The axis settings are saved to disc along with the move data whenever you save a move file.
"SaveSetup" saves the present joystick and motor performance settings on the disc. The file used is always "AXES.SET". This file is loaded automatically when the RTMC Software boots up. "LoadSetup" specifically loads this same file at any time. Whenever a move is loaded, the motor and joystick settings in effect at the time the move was saved will be reloaded. "LoadSetup" provides a method of over-writing the settings saved with the move with more current settings.
The "Options" command sets two important system parameters-whether or not RECord axes automatically switch to PLAYback at the end of a recording pass, and how the camera and axis pre-

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rolls will behave at different shooting FPS speeds. See "Options Defined" for more information on this important command.
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MISCELLANEOUS USEFUL INFORMATION

Mouse Tricks. Two useful functions are available on the control panel which relate to motor positions. The operator places the mouse cursor on the motor position count just to the left of the axis name, and presses either the left or right mouse keys:

Left mouse key: the Software prompts for a new motor count. The operator enters a new position on the Calculator, and clicks on the Calculator screen. The motor count is changed to reflect the new position. Note that the motor does not move-the software just has a new notion of where the motor is. Click outside the Calculator screen to cancel.

Right mouse key: the Software prompts for a destination. The operator enters a destination, and the motor starts moving to the destination as soon as the Calculator screen in clicked. Click outside the Calculator screen to cancel.

Stopping moving axes with the mouse key. Click on the axis name of any moving axis. The axis will ramp to stop. In some cases, it is possible for an axis to move without the name being highlighted, in which case you will first have to highlight and then unhighlight the name-basically, just a double mouse click on the name. Click the Middle mouse key anywhere in the column of axis names, and all moving axes will stop.

To quickly change the amount of smoothing applied when using the Editor's Smooth command, click the Middle mouse key, and enter a new smoothing amount on the Calculator. This does not cause a smoothing pass, just a change in the amount of smoothing. Clicks on the Left mouse key cause smoothing, one pass per click.

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THE GRAPHIC MOVE EDITOR

Make a move on one or more axes as described above. Click on the "Editor" menu item to switch over to the Graphic Move Editor. The white blocks at the left of the axis names means the axis is presently enabled on the Control Panel Screen. Highlight the names of the axes you want to see displayed-click on one or two axes which have moves recorded. Click on "OK" when you have made your selections.

There are several menu items at the bottom of the screen. Above, axis moves are displayed, each in its own frame. Each axis frame carries several controls. The small boxes at the upper left and lower right are used to change the size and location of the frame. Click and hold the left key on the box at frame lower right. The corner of the frame can be resized as long as the left key is pressed. While holding the left key, press also the right key. The frame can now be dragged to a new position without resizing. The box at the upper left has similar functions.

The "Lock scale" control is at frame upper right. If an~"L" is displayed, the vertical scale of the graph will remain locked at the present scale. If a "U" is displayed, the vertical scale is Un-locked, and the scale of the graph will adjust to tightly frame the move data. If you know you have data, but nothing shows on the graph, the graph may be "locked" to a vertical scale outside the move. Just click on the "L" to tightly frame the move data.

The two pairs of arrows at top and bottom right are used to squeeze and unsqueeze the graph within the frame. They provide more or less headroom

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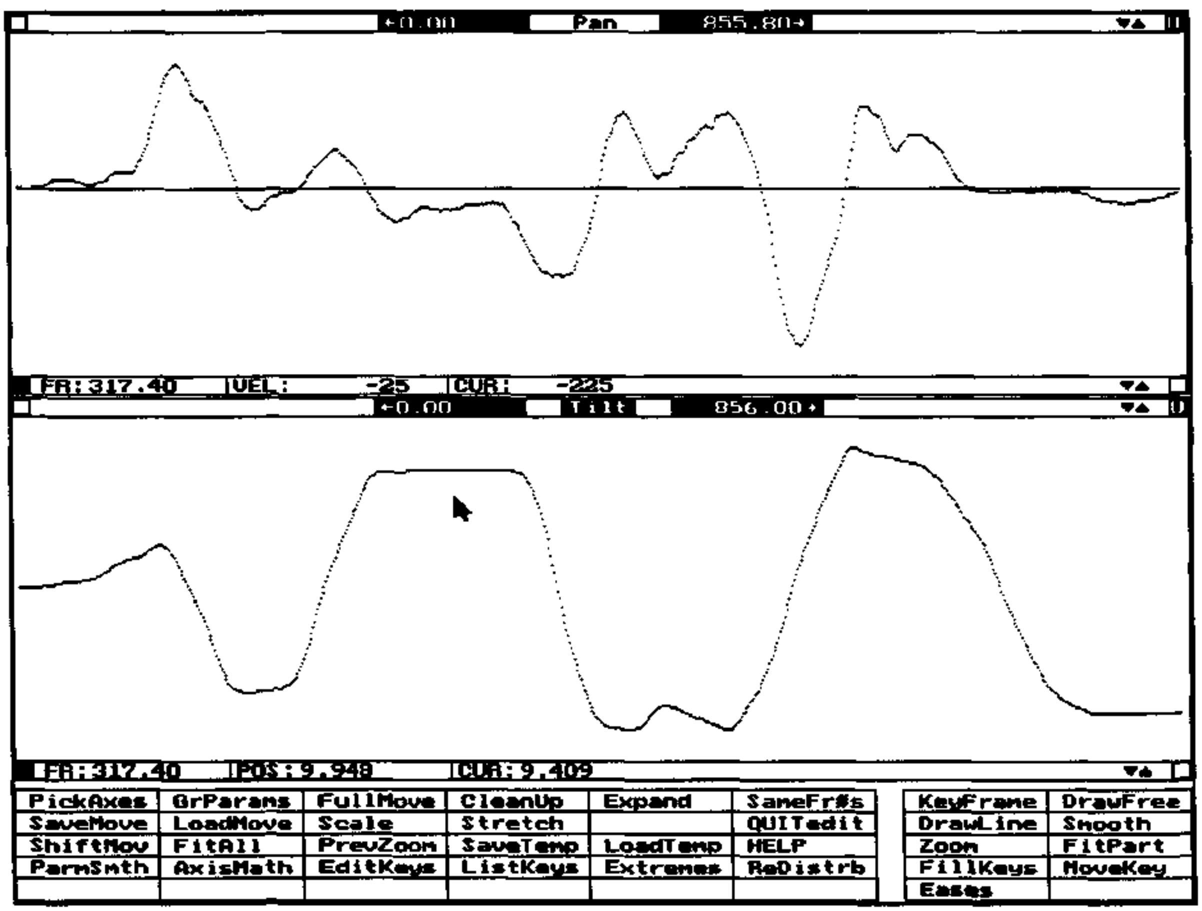

and footroom for the curve. Note that the "L" and arrows affect only how the graph is displayed; they have no effect on the actual move.
The axis name is at the top of the graph. A tap on the name causes the graph to re-draw. Clicking and holding on the name allows the frame to be repositioned on the screen. Immediately to the left and right of the axis name are "Pan Left" and "Pan Right" boxes. Clicking on either of these causes the screen to pan left or right, whenever less than the whole move is displayed. Further to the left and right are notations about what part of the move is displayed. Each of these two numbers may be changed up or down by clicking on either the left side of the rectangle to reduce the number, or on the right to increase the number..
Another method of zooming in on the move is the "Zoom" menu item at the bottom of the screen. The lower right hand corner of the zoom cursor may be expanded or shrunk by pressing and holding the left mouse key. Releasing the key causes the zoom to take place. If you hold down the left key and then press the right mouse key, the entire zoom window may be moved. Releasing the right key returns you to dragging just the lower right corner. Practice this a few times. Information about the left and right sides of the zoom box are displayed at frame lower left. If you loose track of where you are, click on "FullMove" at the bottom of the screen to restore the graph to showing the whole move.
At the lower left of the frame, there is a readout showing what frame the cursor is pointing at, what that frame's move velocity is, and what the velocity position of the mouse cursor is. If you click on the "VEL:" box, the screen changes over to display the curve in terms of positions, and "POS:" is displayed. Position ("POS:") makes it easy to evaluate things like distance travelled and specific positions for each frame. Velocity ("VEL:") graphs accentuate things like speed, acceleration, and smoothness.
Click the "PickAxes" command to change the set of axes graphed. Highlight the desired axis names on the displayed list of axes, and then click "OK" in the dialogue box.
The box at frame lower left is used to remove the graph from the screen. Move data is not affected; the graph is simply not displayed. Use "PickAxes" command to bring the graph back, or select a new group of axes for display.
When more than one axis is displayed, shift from working on one axis to another by clicking once on the frame border of the new axis. You may also click anywhere within the graph, but using the frame border is sometimes less confusing. The name of the axis you are working on is highlighted. Use the "Expand" menu item to expand the graph of the axis you are working on to fill the entire screen; click on expand again to restore the previous screen condition.
"CleanUp" draws all the displayed axes to the same size. "SameFr#s" zooms all the displayed graphs to match the left and right frame numbers of the axis you are working on.
"PrevZoom" restores the zoom to the section of the graph displayed before the last time you changed the zoom. This is a good way to flip back and forth between two different sections of the same move.
The "Help" menu gives more information about the various menu items.
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"DrawFree" lets you draw move curves free hand. The cursor draws whenever the left key is pressed. You can only draw from left to right. Curves may be drawn either in velocity or position mode. If you draw in position mode, you must always "Smooth" the move data heavily to compensate for the relatively low resolution of the screen. Both drawing functions work best when the graph fills as much of the screen as possible, and no more than a few hundred frames are displayed. In practice, zoom the screen in to the start of the move, with about 200 frames displayed. Draw up to the right hand side of the screen, and then use the "PanRight" box (just to the right of the axis name) to pan to the next part of the move.
"DrawLine" is used to draw series of straight lines. You may only draw from left to right. After clicking on the command name, start clicking on the left part of the graph. Each time you click, a line is drawn from the previous clicked point. When you're finished clicking, move the cursor outside the axis frame and wait for the redraw. "DrawLine" is most useful in the velocity mode, and is one way to create ease-in, linear, ease-out moves and moves with constant velocities. Use "Scale" or "Stretch" to adjust the distance travelled, and to assign the start position.
"KeyFrame" creates key frames on the graph, and may only be used when the graph is in position mode (with "POS:" displayed at frame lower left). Key frames are shown as small squares on the graph. Each click of the left key creates a key frame at whatever frame and position the cursor is pointing. Each click of the middle key creates a key frame at the cursor's frame position, but exactly on the position of any pre-existing move data for that frame. Each click of the right key deletes the key frame nearest to the mouse cursor. Holding down the middle key, and then tapping the right key will create a double key frame at the key frame nearest to the cursor. Double key frames are useful for preventing over-shoots, and for forcing ease-ins and ease-outs. See "KeyFrame defined" in the index for important key framing hints.
One you have "stacked up" two or more key frames, use the "FitAll" or "FitPart" commands to in-between the move data. "FitAll" always connects all the key frames. "FitPart" connects only selected sequences of key frames. The cursor for "FitPart" works the same as the cursor for "Zoom." Holding the left key lets you drag the lower right part of the key frame window. If you also hold down the right key, the entire key frame window can be moved around the screen. Frame the key frame squares you want to in-between, and release all the keys. Only the left and right sides of the "FitAll" key frame box apply, the top and bottom are not meaningful for selecting key frames to in-between. Whenever the KeyFrame "[]K" cursor is displayed, a "FitAll" can be also be initiated by holding down the middle mouse key, and then tapping the left mouse key. Be sure to hold down the middle key until you tap the left, otherwise the normal middle key function of erasing the nearest key frame will occur.
"ListKeys" labels each key frame box with its corresponding frame number. If the graph is displayed in Velocity mode, vertical lines are drawn at each key frame position to help locate the part of the velocity graph affected by the key frame.
"EditKeys" produces a numeric listing of all the key frames for the selected (name highlighted) axis, along with a menu of options. The operator highlights certain key frames or groups of key frames by clicking with the mouse, and then selects one of the possible options. It is also possible to directly
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type over old key frame data with new data, or type in entirely new key frames. See "EditKeys defined" in the Index for more information on this very useful command.
The "LoadMove" and "SaveMove" commands produce a listing of all the files on the last disc drive on which you saved move data. Use the "More" and "Back" boxes to page through the file names if they fill more than one screen. Click on the box at screen upper left to change from disc to disc
or to a different directory. You can enter a file name into the "NAME:____" line either by clicking
on a listed file name, or clicking directly on the "NAME:____" line and typing in a move name.
When you are done, click on the "LOAD" or "SAVE" box. The Software does as much "disc safety" checking as possible, and warns you about overwriting all ready saved move names, trying to write to full or damaged discs, etc.
"AxisMath" provides a way to add axes together. Clever use of this command can give the effect of having more axes than are physically available—see "AxisMath" defined in the Index for some examples.
"Smooth" evens out the move data. With the graph is "VEL:" (velocity) mode, try drawing some very rough, jagged curves on the screen with "DrawFree", and then experiment with different amounts of smoothing. Multiple passes with a small amount of smoothing produces different results than a single pass with a large amount of smoothing. Whenever the "Sm" cursor is displayed, each click of the left key causes one smoothing pass. To change the amount of smoothing, click the "Smooth" command again, or click the middle mouse key anytime the "Sm" cursor is displayed. The hour-glass symbol appears while the smoothing is taking place. The effects of smoothing are most visible when the graph is displayed as velocities, as indicated by the "VEL:" at frame lower left.
"ParmSmth" makes it possible to smooth only selected sections of the move data. This command requires the use of a "parameter" or "control" axis, which is treated as a list of percentage numbers which control how "deep" the smoothing will be on a frame by frame basis. See "ParmSmth defined" in the Index.
"RediStrb" rearranges the times at which various points of the move are reached, without changing the path of the move. Consider the move path to be a curved wire, and the various move position along the wire as beads—RediStrb lets you rearrange the beads, without bending the wire. The timing changes, but not the route. RediStrb uses a "control" or "parameter" axis to specify how the timing should be redistributed. See "RediStrb defined" in the Index for examples.
The "Eases" command connects pairs of key frames with simple "ease-in / constant-velocity / ease-out" curves. Click the middle mouse key to set the number of frames of ease. Click between two key frames with the left and/or right mouse keys to create eases. The left mouse key creates an ease-in / constant-velocity segment. The right mouse key creates a constant-velocity / ease-out segment. To create a full ease-in / constant-velocity / ease-out section, click and hold the left key, tap the right key, and release both keys. See "Ease, defined" in the Index for more information and limitations to this command.
Use the "Quit" menu item to return to the Control Panel Screen.
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FADES AND DISSOLVES

The "Fade" control is just below the "PRESENT[1] frame box at screen lower left. To program fades and dissolves, click on this box. The screen which appears allows the operator to specify "START[1] and "END" frames, "TYPE" of fade curve, and whether the fade/dissolve is in the "IN" or "OUT[1] direction. The empty box to the left of each fade line enables or disables the particular fade/dissolve. In the following discussions we will use "fades" to mean both fades and dissolves.

In practice, the operator pre-programs several fades in advance, selects which fades should be involved in a particular pass by highlighting the empty box to the left of each line, and then clicks the "OK" box. If any fades are activated (highlighted), the "Fade" box displays "Fades On" and the two adjacent boxes adjust to show the first and last frames where exposures are taking place. If the operator does not want any fades, he clicks the "NO FADES" response box.

Fades may be used in any shooting mode, including live action. Of course, the physical shutter must be motorized. The Software actually builds a move on the "Shutter" axis which accomplishes the fade. The shape of the "shutter" move is based on what combination of fades are selected when the operator clicks the "OK" box. The shutter move can be viewed with the Graphic Move Editor. The convention is that a position of "1.000" corresponds to shutter fully closed, and "0.000" corresponds to shutter fully open. View the fade graphs in "POS:" (position) mode, and with the graph unlocked

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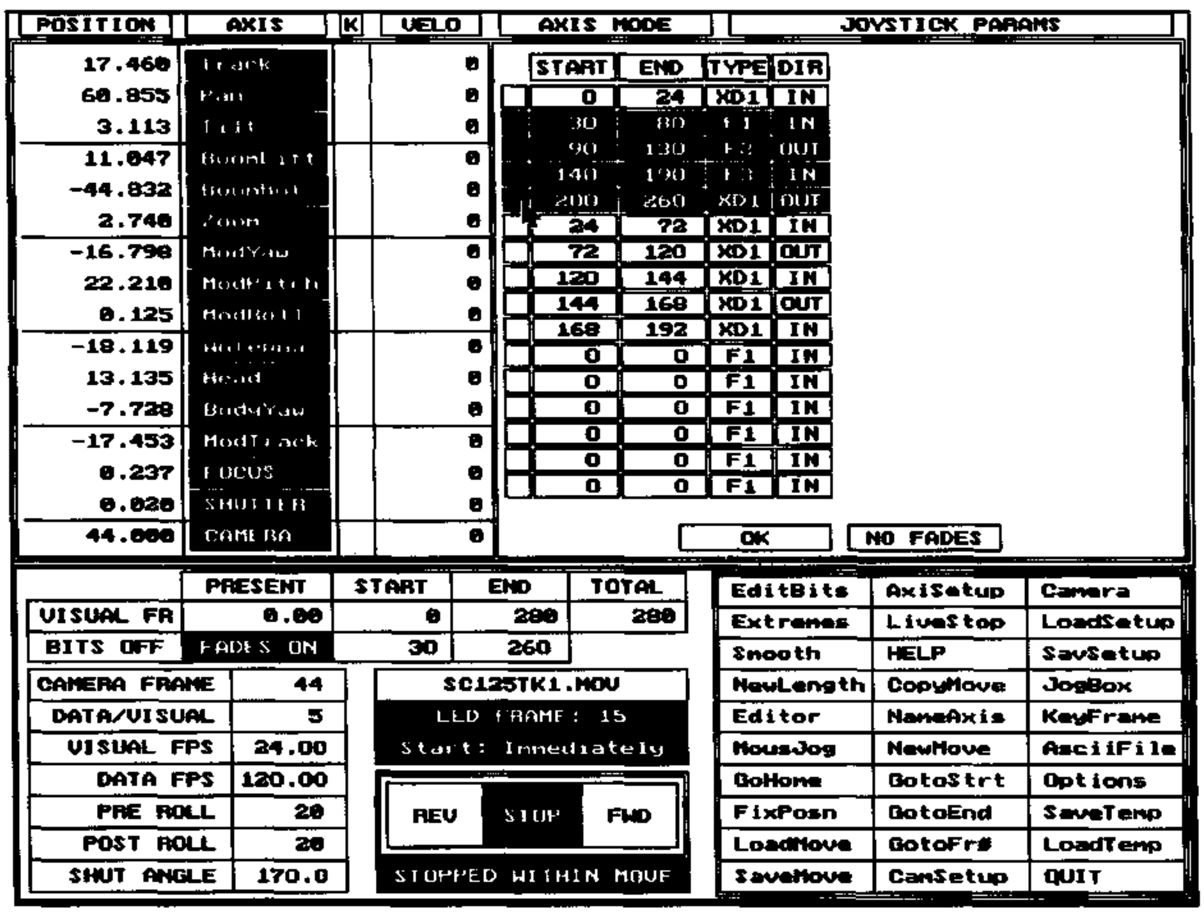

(click on the "L" at frame upper right). On the graph, the "closed" position is at the top, and the "open" position is at the bottom.

To program fades, click on the "START[1] and "END" numbers, and use the Calculator to enter new frame numbers. Use the left and right mouse keys to click through the list of available fade curves in the "TYPE" column. Clicking in the "DIR" column toggles the fade direction between "IN" and "OUT[1]. Click in the empty box to the left of the "START[1] frame number to enable/disable a particular fade. Click the middle mouse key anywhere in the enable/disable column to disable all fades. It is up to the operator to make sure that the particular set of the highlighted fades does not overlap.

The example screen shows several pre-programmed fades. On this pass, the operator wants to shoot the four highlighted fades. After clicking on the "OK" box, the Software builds the shutter move shown above. Remember that "closed" is at the top, and "open" at the bottom. From left to right, the four fade curves graphed are Fl, F2, F3, and XD1.

Fl is linear.

F2 slightly favors brighter exposures. **Use F2 for normal fades.**

F3 strongly favors brighter exposures.

XD1 is designed to produce clean, subtle cross-dissolves with constant film density.

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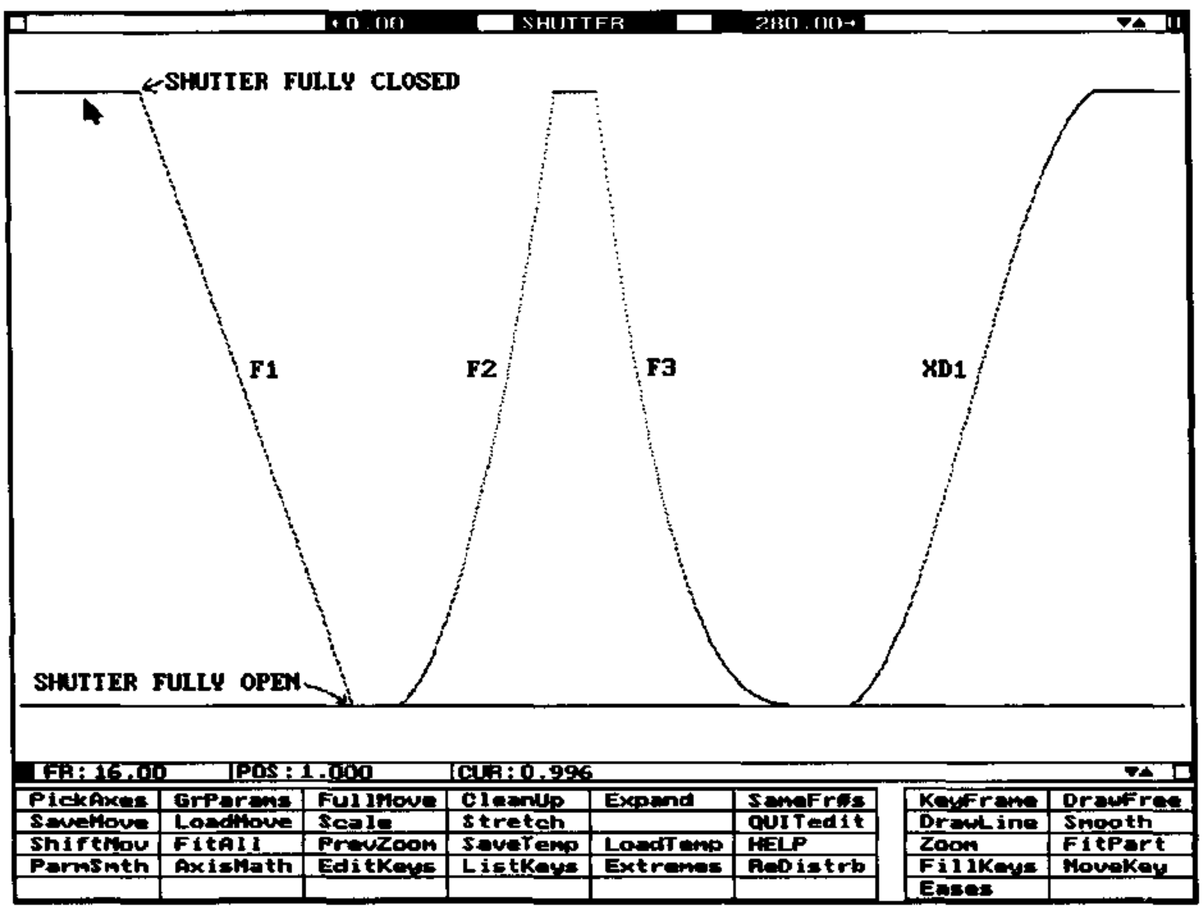

Whenever any fades are selected, the Fade box displays "FADES ON" and the two adjacent boxes display the first and last frames which receive exposures for the selected fades. Click on these two boxes to transfer their numbers up into the "VISUAL FR" "START[1] and "END" boxes.

It is also possible to create fade "moves" using normal editing techniques on the Shutter axis. In order to do this, you must first create at least one "dummy" fade using the fade setup screen—this forces the Shutter axis to follow the fade move, instead of just staying open. The fade box must display "FADES ON". Then make a move on the Shutter axis, being careful to stay within the range of move positions "1.000" to "0.000". Remember that your fade move will be lost the next time you program a fade with the fade setup screen.

The illustration to the right shows a different set of the fades selected. This is a series of "rolling" cross-dissolves. After clicking the "OK" box, the Software builds a shutter move which accomplishes the series dissolves, and which completely replaces the previous shutter move.

The next illustration shows how to quickly set up the complementary cross dissolve pass. After shooting the first series of cross-dissolves, the operator clicks on the Fade box one more time, holds down the left mouse key, and drags the cursor down the "DIR" column. This toggles all the "IN" directions to "OUT[1], and all the "OUT[1] directions to "IN".

A series of cross dissolves selected from the fade setup list.

The "Shutter" axis automatically has its pre and post rolls disabled, since most shutter mechanisms "hard-stop" at their extreme positions. Mechanically, it is best to use a small motor (M061 size or smaller) to prevent potential damage to the shutter mechanism.

The gear ratio between the shutter motor and the shutter should be such that only 1 to 4 motor revolutions are required for full shutter travel~the lack or pre roll may cause motor stalls with higher ratios. Use the "AxiSetup" command to the set the "Pulses Per Unit" to the amount of pulses required to move from fully open to fully closed. If "Pulses Per Unit" is set properly, the shutter position display will read "0.000" when the shutter is fully open, and "1.000" when it is fully closed. If there is backlash in the shutter mechanism, the "Pulses Per Unit" should be set high enough to make sure the shutter is closed with the worst-case backlash in effect.

The complementary series of cross-dissolves programmed by dragging the mouse over the "DIR" column with the left mouse key pressed.

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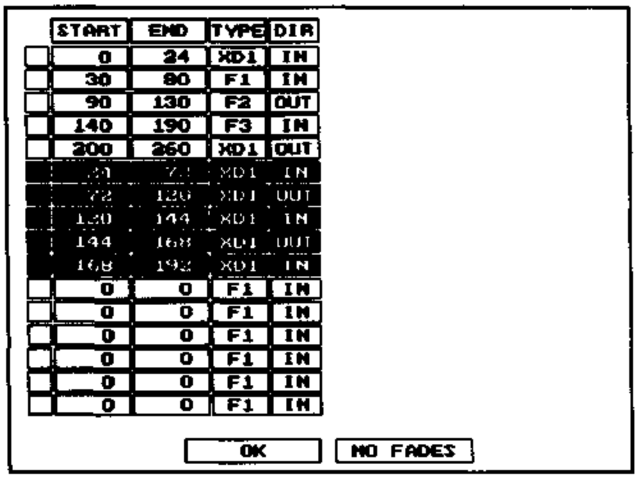
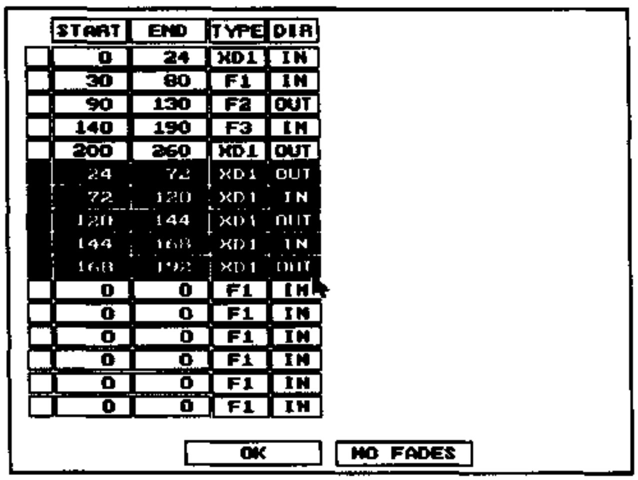


	START	END	TYPE	DIR
	0	24	XD1	IN
	30	80	F1	IN
	90	130	F2	OUT
	140	190	F3	IN
	200	260	XD1	OUT
	24	72	XD1	IN
	72	120	XD1	OUT
	120	144	XD1	IN
	144	168	XD1	OUT
	168	192	XD1	IN
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN



	START	END	TYPE	DIR
	0	24	XD1	IN
	30	80	F1	IN
	90	130	F2	OUT
	140	190	F3	IN
	200	260	XD1	OUT
	24	72	XD1	OUT
	72	120	XD1	IN
	120	144	XD1	OUT
	144	168	XD1	IN
	168	192	XD1	OUT
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN
	0	0	F1	IN

STARTING THE MOVE
In older versions of the RTMC Software, the move would start as soon as the operator clicked the "REV" or "FWD" boxes, or clicked the left of right mousekeys when the mouse was acting as a joystick. It is now possible to specify three distinct events to actually start move playback:
1. **Start: Immediately,** the old default.
2. **Start: Shoot Switch,** when the Shoot Switch is pressed.
3. **Start: External Camera,** in sync with a sound speed camera motor.

The box just above the "REV STOP FWD" control is used to set which option is in effect-toggle through the three options by clicking with the mouse. Note that the "KeyFrame" control which previously occupied this box has been moved into the menu area at screen lower right.
"Start: Immediate" simply starts the move as soon as all the axes are in position.
"Start: Shoot Switch" waits for all the axes to arrive at their starting positions, and then waits for the Shoot Switch to be pressed. You can override the wait by mouse-clicking the Start box.
"Start: External Camera" starts the move when the computer detects synchronization signals coming from a sound speed camera motor. The software waits for at least 24 consecutive "once per frame" synchronization signals within a user specified speed tolerance, and then starts the move. The LED marker light marks the first frame of the move. See "CamSetup defined" in the Index for information regarding setting the speed regulation tolerance for sound speed camera motors.
To escape from "Start: External Camera" before camera sync is achieved, press the "Esc" key on the computer keyboard.
The synchronization signals from the external camera must be "TIL" or "open-collector" conditioned, and between 1 and 6 milliseconds in length. Either signal polarity is acceptable. Connect signal ground to pin 1 or 14 of the RTMC Logic Connector, and the sync line to pin 15. **DO NOT ATTEMPT TO MAKE ANY CONNECTION BETWEEN A CAMERA MOTOR AND YOUR COMPUTER UNLESS YOU ARE VERY SURE OF WHAT YOU ARE DOING,** since virtually all cameras use voltages dangerous to computers. The "TECHNICAL DRAWINGS" section at the rear of this manual contains a schematic for a simple interface circuit that works with both Panavision and Fries sound speed camera motors. If you use a Fries motor, make sure it is crystal sync at the speed you plan to use, since most of these motors are preset to be crystal sync only at one specific speed, such as 24,25, or 30 fps--all other speeds are "analog" and are not steady enough for accurate synchronization.
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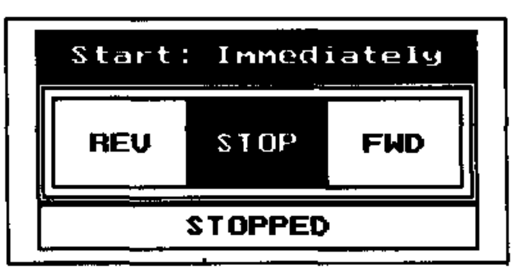

SYNCHRONIZING MULTIPLE PASSES

When moves are started in "Immediate" or "Shoot Switch" modes, some important information is displayed just above the "Start:" box. The number of frames the camera will pre roll, and the camera frame number which receives the "LED marker light" are shown. A typical display may read "CAM PRE: 14 LED:927" which means that the camera will pre roll 14 frames before reaching speed, and the camera frame which records the first actual frame in the move (and which receives the LED marker light image) will be frame number 927. The camera frame number refers to the "long term" roll count just to the left of the "Camera" name in the list of axes, rather than the short term "CAMERA FRAME" number at screen lower left.

The "LED:" frame number provides an absolute identification of the first frame of the move on each pass, regardless of the camera pre roll or FPS. The "LED:" frame number is updated whenever the "REV" or "FWD" controls are clicked. In order to get a reading without actually committing to a move pass, click the "Start:" box until it reads "Start: Shoot Switch", and be sure the shoot switch is not engaged. Click "FWD" or "REV" to update the "LED:" frame display, and then click "STOP" to cancel. **If the announced "LED:" frame number is not as desired, simply wind a proportionate number of camera frames. For instance, if you want camera frame 80 to be the first move frame, and "LED: 82" is displayed, use the camera command to wind the camera negative two frames relative from its present frame.**

With the "Options" command ramping option set to "REDUCED", the number of frames of camera pre roll will reduce with decreasing FPS. Regardless of FPS, "LED:" will always correctly identify the camera frame which corresponds to the first frame of move. It will be necessary to wind the camera to different starting frames when the FPS is not the same for all passes. The "Options, defined" in the Index. When one or more passes are very slow, the small effort of winding the camera to a different starting frame for each pass may easily be worth the effort for time saved over very long "SAME" length ramp ups.

To DX animation passes onto live action passes, simply position the camera at one frame before the "LED:" frame number before beginning the animation pass. If the display reads "CAM PRE:14 LED:927" for the live action pass, wind the camera to frame 926 (927 - 1) before starting the animation pass. The convention is: "on frame 926, ready to shoot frame 927."

Remember that the "LED:" frame number refers to the "total roll count" as displayed just to the left of the Camera axis name. Since each pass announces a new "LED:" frame number and overwrites the previous number, it is important to write down the frame numbers when multiple passes need to be located on the roll. Likewise, it's important to punch or otherwise physically mark the first frame on the roll. In practice, load the punched frame into the gate, and set the frame count to "0.000". This provides a way to correlate the location of multiple "LED:" frames later on. The most direct way to set the camera framecount is to click the left mouse key on the actual camera position number, and enter "0" on the calculator.

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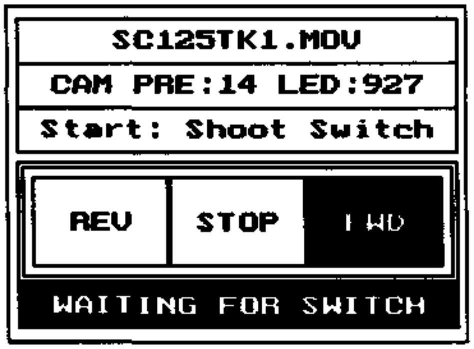
SC125TK1.MOV
CAM PRE:14 LED:927
Start: Shoot Switch
REV
STOP
FWD
WAITING FOR SWITCH

INTERPRETING MOVE GRAPHS

Move graphs can be displayed in terms of either position or velocity. In either case the left-right direction is always frame number, and the up-down direction is always either position or velocity. Frame numbers increase from left to right. As the eye scans from left to right along increasing frame numbers, the viewer can determine what the move is doing at any particular frame number by examining what the move curve is doing on the up-down direction.

The two illustrations on the next page show the same move. In the top graph, the vertical (up-down) direction is displayed in terms of velocities, or speeds. The bottom graph shows the same move in terms of a series of positions on the vertical direction. Both graphs describe the same motion. In the top graph, we see how velocity (speed) changes on a frame by frame basis; in the bottom graph we see how far the axis has moved.

The graphs have some things in common:

1. Frame numbers increase from left to right.
2. Each graph has a horizontal (left-right) "zero" line. For the velocity graph, the zero line shows where the velocity (speed) is zero; for the position graph, the zero line shows where position "0.00" (home) is located.

The move starts at the left. The move increases in velocity up until position "A". The increase in speed can be plainly seen on the velocity graph-as the speed increases the graph curve pulls away from the zero velocity line; on each successive frame the velocity is a little higher. On the position graph, the section from the start of the move to "A" shows the characteristic curved shape associated with changes in speed on a position graph.

From "A" to "B" the velocity is essentially constant. The velocity stays about the same from frame to frame, instead of increasing as during the first part of the move. When the velocity graph curve is horizontal, the speed is constant. The position graph shows a straight line for this section of the move, since the frame to frame change in position is about the same~a rising or falling straight line on a position graph indicates an area of relatively constant speed.

In the area from "B" to "C" the velocity graph moves back down to zero velocity; as the velocity curve approaches the zero velocity line, the speed decreases. On the position graph, the graph line bends back to horizontal in this section, reflecting the decreasing speed. At position "C" the velocity is briefly zero~the velocity is at or close to zero where the graph line crosses the zero velocity line. At "C" the position graph goes horizontal, since there is almost no frame by frame change in position in this area. This is also the extreme position for the move graph, since the velocities have changed over from positive to negative at the point where the velocity graph goes below the zero velocity line.

As the velocity graph picks up "negative direction" speed from "C" to "D", the position graph turns around and heads back towards the starting position. In the brief section of constant velocity around "D", the position graph again assumes the straight line shape characteristic of a constant velocity. From "D" to the end, the move eases out as the velocity graph approaches the zero velocity line, and the position graph assumes the characteristic rounded shape associated with changes in speed.

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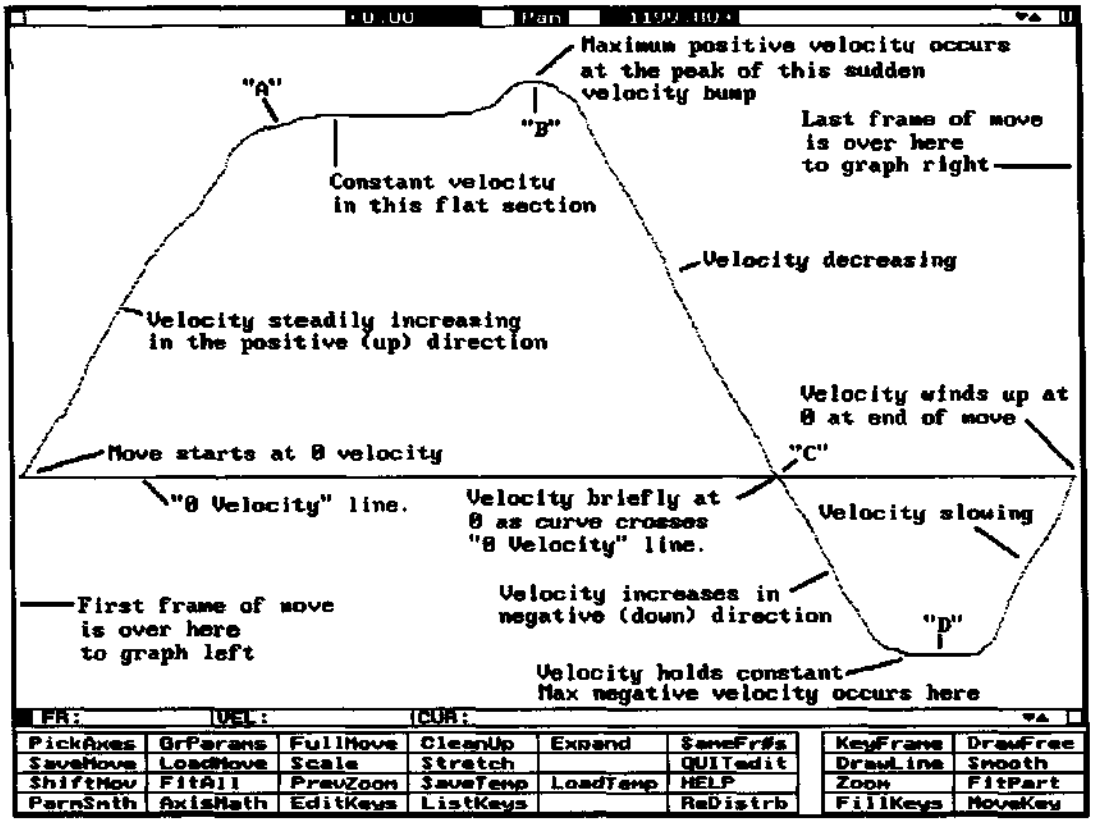
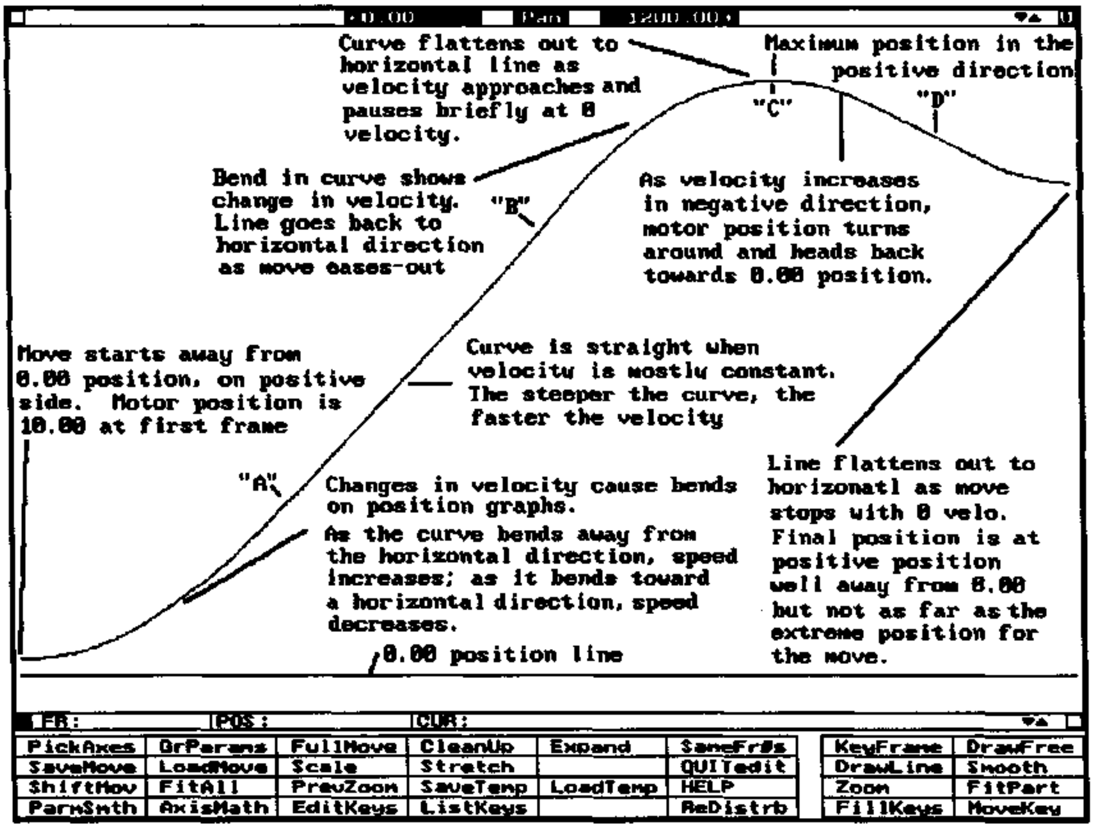

Pan
Maximum positive velocity occurs
at the peak of this sudden
velocity bump
"A"
"B"
Last frame of move
is over here
to graph right
Constant velocity
in this flat section
Velocity decreasing
Velocity steadily increasing
in the positive (up) direction
Velocity winds up at
0 at end of move
Move starts at 0 velocity
"C"
"0 Velocity" line.
Velocity briefly at
0 as curve crosses
"0 Velocity" line.
Velocity slowing
First frame of move
is over here
to graph left
Velocity increases in
negative (down) direction
"D"
Velocity holds constant
Max negative velocity occurs here
FR:
VEL:
CUR:
PickAxes
GrParams
FullMove
CleanUp
Expand
SameFr#s
KeyFrame
DrawFree
SaveMove
LoadMove
Scale
Stretch
QUITedit
DrawLine
Smooth
ShiftMov
FitAll
PrevZoom
SaveTemp
LoadTemp
HELP
Zoom
FitPart
ParmSmth
AxisMath
EditKeys
ListKeys
ReDistrb
FillKeys
MoveKey


Curve flattens out to horizontal line as velocity approaches and pauses briefly at 0 velocity.
Maximum position in the positive direction
"C"
"D"
Bend in curve shows change in velocity. Line goes back to horizontal direction as move eases-out
"B"
As velocity increases in negative direction, motor position turns around and heads back towards 0.00 position.
Move starts away from 0.00 position, on positive side. Motor position is 10.00 at first frame
Curve is straight when velocity is mostly constant. The steeper the curve, the faster the velocity
"A"
Changes in velocity cause bends on position graphs.
As the curve bends away from the horizontal direction, speed increases; as it bends toward a horizontal direction, speed decreases.
Line flattens out to horizonatl as move stops with 0 velo. Final position is at positive position well away from 0.00 but not as far as the extreme position for the move.
0.00 position line
FR:
POS:
CUR:
PickAxes
GrParams
FullMove
CleanUp
Expand
SameFr#s
KeyFrame
DrawFree
SaveMove
LoadMove
Scale
Stretch
QUITedit
DrawLine
Smooth
ShiftMov
FitAll
PrevZoom
SaveTemp
LoadTemp
HELP
Zoom
FitPart
ParmSmth
AxisMath
EditKeys
ListKeys
ReDistrb
FillKeys
MoveKey

General observations about velocity and position graphs: VELOCITY GRAPHS:
--The further the graph line is away from the zero velocity line, the faster the move is going.
--When the graph line is tilted up or down, the move is either accelerating or decelerating. The steeper the line, the faster the change in speed. Areas of ease-in and ease-out always show this characteristic tilted-line shape.
-When the graph line is horizontal, the speed stays constant.
—When the graph line is above the zero velocity line, the axis is moving in the positive direction; when the line is below the zero velocity line, the axis is moving in the negative direction.
-When the graph line is on the zero velocity line, the velocity is zero, and there is no motion.
—Velocity graphs make it very easy to see small changes in speed, which are almost impossible to read on position graphs. Notice how the sudden increase and decrease in velocity around "B" is very pronounced on the velocity graph, but not at all noticeable on the position graph. Velocity graphs are very useful for evaluating things like roughness, turbulence, and other subtleties of motion.
POSITION GRAPHS:
—The steeper the line, the faster the move is going.
—When the line is curving, speed is changing. If the curve is changing from shallow to steep, the move is easing-in to higher speed; if the curve is changing from steep to shallow, the move is easing-out to slower speeds.
-When the line is horizontal, there is no motion.
—When the line is straight, the motion is at a constant velocity.
—Position graphs are most useful to show how the position of the axis changes over the course of the move. In the example, we can easily see how the axis moved away from its starting position, slowed down at a turn around point, and came back a short distance in the direction of the starting point. While this could also be inferred from the velocity graph in this rather simple move; it's harder to do this with more complex moves. By moving the mouse cursor left and right in the position graph, it is possible to directly read exact positions for each frame, which is not possible with the velocity graph. However, position graphs are very poor for evaluating move smoothness.
In summary: use velocity graphs to evaluate smoothness, rate of acceleration and deceleration, peak speeds, and other things which relate to changes in speed. Use position graphs to evaluate where the move goes.
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USING THE JOGBOX/JOYSTICK

Here is an introduction to the Jogbox/Joystick. The "Jogbox Definitions" section of this Manual provides expanded information for each Jogbox key.

Activate the Joystick by clicking the "JogBox" menu item at the lower right corner of the Control Panel Screen. Under most circumstances, it is also possible to activate the Jogbox by pressing the "JOG32" key on the Jogbox.

The "EMER STOP" jogbox key is the general purpose emergency stop, like hitting the " ~" key on the computer keyboard.

Press the "JOG32/INCH" key on the Jogbox, to your left and 4 up from the bottom. Observe the "JOG32-+" prompt on the display. The top 32 Jogbox keys have a section labelled "5-", "5+", etc. Press "1+" and watch the position for the first axis change. Press "1-" to jog the axis in the opposite direction. When jogging, the axes use the top speed and acceleration set using the "AxiSetup" command.

Try jogging several axes at once—any number of axes can be jogged at the same time. The Jogbox displays the name and current position of the **last** axis jogged. If you are jogging several axes at once, you can control which axis name and position are displayed by briefly releasing and pressing one of the two jog keys for the desired axis—this makes it the "last" axis jogged.

To "inch" the axes a pulse at a time, hold down the "JOG32/INCH" key at the same time as the Jogging keys.

After you have jogged several axes away from their "0.000" position, press the "GOTO HOME POSN" button. The "SELECT AXES" prompt appears on the display, indicating the Software wants you to specify which axes to return to position "0.000".

To select axes, press various of the first 16 keys, labelled "1" to "16F[1] to correspond to each of the 16 axes. "1" through "0" correspond to axes 1 to 10 (0 = 10), and "11A" through "16F[1] correspond to axes 11 to 16. The "A" through "F[1] letters are attached to the last 6 axis numbers, since these axes show up as "A" through "P on the Jogbox display as you use the AXIS SELECT menu. The display will show which axes are selected-alternate presses on each button selects and de-selects the axis. As long as the button is pressed, the axis name is displayed. **The axes with their numbers displayed when you press the ENTER key are the selected axes.**

Select several axes, then press the "ENTER" key. The axes will immediately start moving to "0.000". Note that you don't have to wait for the axes to arrive before using other Joystick functions, such as starting another group of axes on their way home, or jogging other axes.

Many of the Joystick buttons use the same "SELECT AXES" technique as the "GOTO HOME POSN" button. Whenever "SELECT AXES" appears, use the first 16 keys to alternately select and de-select the various axes. All the axes with their numbers displayed when you press the "ENTER" button will be affected. Remember that axes 11 to 16 show up as "A" through "F[1] on the AXES SELECT display.

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Whenever the Software asks you to select axes, the "ALL AXES" key will select all the axes except camera and shutter. If you want to also select camera or shutter, just press their select keys.
"SET HOME POSN" sets the axis position count to "0.000", making the present motor position the "HOME" position. The "SELECT AXES" menu lets you choose which axes to set to "0.000".
"GOTO FRAME NUMBER" sends the selected axes to a particular frame number in the move.
"MEMO KEY FRAME" memorizes the positions of all the selected axes as a key frame. The "KEY FR:" prompt expects you input a frame number for the key frame. The keys at the top of the Joystick serve several duties-sometimes they are "axis select" buttons, sometimes jogging keys, and in this case they are numeric input keys. Use the first ten keys to input the key frame number. The decimal point is the "11 A" key; notice the "." at the bottom of that key. The "12B" key serves as the "minus" key; notice the "-" at the bottom of the key (however, no negative key frame numbers, please). When the number shows correctly on the display, press the "ENTER" key. The "STOP/CANCEL" key at bottom left serves as a "Clear Entry" key.
"MEMO DOUBL KEY" works the same as "MEMO KEY FRAME" except that a second key frame is automatically created next to the specified key frame. Both key frames have the same position, but are one data frame number apart. Double key frames force the move to zero velocity at that point-they are useful for creating eases, and when you want to make sure the move will not go past the key frame position at a turn-around point. See "KeyFrame defined" in the Index for more information on key framing techniques.
"FIT ALL" works the same as the Graphic Move Editor "FitAll" command-all the existing key frames are in-betweened for all the selected axes. This command may also be used to create ease-in / constant-velocity / ease-out moves between the first and last key frames memorized for each axis. If you press the "ENTER" key after selecting the axes, all the key frames will be connected with curve-fit. If you press the "FIT ALL" key again after selecting axes, further prompts will appear which allow you to enter the number of frames of ease-in and ease-out. See "FIT ALL, defined" in the Index for more information on this command, and "EASES, defined" for more information on creating eased moves.
"LIST KEY FRAMES" lets you display the key frame list on the jogbox, send axes to key frame positions, and delete key frames. While this key is active, other keys on the Jogbox have special temporary functions: "RUN REV" and "RUN FWD" step backward and forward through the key frame list (only one key frame can be displayed at a time on the Jogbox display), "GOTO FR#:" immediately sends the axis to the position for the key frame, pressing the "ENTER" key deletes the displayed key frame, and pressing "DOUBL KEY" creates a double key frame next to the displayed key frame. Please check "LIST KEY FRAMES, defined" in the Index for more information.
"GRAPH AXES" displays the move curves for the selected axes on the graph. If you wish, you can pick up the mouse and edit the moves in the normal way. While the graph is displayed, pressing the "POSN/VELO" key on the Jogbox will toggle the graph between position and velocity display modes.
"WIND CAMERA" rolls the camera. If the Live Action screen is displayed, the next prompt will be for FPS; if the Stop-Motion screen is displayed, the next prompt will be

for exposure time. You
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can either type in a new FPS or exposure, or simply press the "ENTER" key to start the camera rolling. You don't have to wait for the camera to stop rolling to use other Joystick functions.

"OPEN/CLOSE SHUTTER" opens and closes the capping shutter on alternate presses. If you have an axis named "SHUTTER", the motorized shutter will open and close as well.

"STOP'Y'RUN REV", and "RUN FWD" are similar to the "REV STOP FWD" controls on the Control Panel Screen. Pressing "RUN REV or "RUN FWD" briefly displays the "AXES TO PLAYBACK" prompt, followed by the "SELECT AXES" prompt. If you are happy with the existing set of playback axes, just click the key a second time, or press "ENTER"-if any selected axes are away from their "on the move curve" position, they will slew to the proper move data position, and the move will start. A "double click" on either "RUN REV" or "RUN FWD" will cause an immediate reverse or forward direction playback/record pass, essentially by clicking past the "SELECT AXES" prompt with the default selection. If any non-playback axis is responding to the joystick when you use "RUN FWD" or "RUN REV", that axis will have its motion recorded as move data.

"JOYST AXIS" lets you use the built in encoder to joystick one axis at a time. Press "JOYST AXIS" and then one of the top 16 "axis select" keys. The name of the axis and its position count are displayed. Press the axis select key a second time to toggle the display over to display axis velocity and position, instead of name and position.

After pressing the "JOYST AXIS" key, you can switch from joysticking one axis to the next by pressing various "axis select" keys. If you use any other command, you will have to press the "JOYST AXIS" again to be able to switch from axis to axis. As long as it's responding to the joystick, the axis is put on "REC", and will have its motion recorded if you use the "RUN REV" or "RUN FWD" command.

"POSN/VELO" toggles the joystick back and forth between position and velocity response modes.

"JOYST GAIN" controls now sensitive the joystick is. Pressing this key displays the present setting on the screen, which you may change. Note that there are really two separate sets of joystick gains-one for position mode and one for velocity mode. The number that is displayed (and optionally changed) is the gain for the particular mode in effect. For large gains, you may also need to increase the smoothing, to avoid "slamming" the axes.

"JOYST SMUTH" sets the amount of smoothing. Valid numbers are 0 to 8, for no smoothing through heavy smoothing. Again, there are two separate numbers, one for position mode and one for velocity mode.

The gain and smoothing set from the Jogbox only apply when the axis is being driven by the encoder in the Jogbox, and the Jogbox is activated. These gains and smoothing settings are separate from the gains and smoothing factors displayed on the Control Panel Screen, and only apply when the Jogbox is activated.

To record joystick moves one axis at a time, put the desired axis "on the joystick" with "JOYST AXIS" and press the "RUN FWD" or "RUN REV" keys. Be sure the joystick axis is not listed as selected when the "AXES TO PLAYBACK" prompt appears, since this will take precedence over joysticking. If you "pick up" new recorded sections in the middle of an old move, be sure to use the

Graphic Move Editor to check for discontinuities. Depending on how the Control Panel "Options" command is set, the joystick may automatically leave joystick mode at the end of any move playback pass, and always whenever "GOTO HOME POSN" or any other axis-moving command is applied to the joystick axis.
Changes you make to joystick smoothing, gain, etc are saved on disc along with the move, or by using the "SaveSetup" command on the Control Panel Screen.
In general, it is not necessary for the axes to be stationary when switching from joysticking to "GOTO HOME POSN", or between any of the motor moving functions. If you want to joystick an axis presently moving on its way to home position, just press "JOYST AXIS" and then press the axis select key for that axis. The axis will first slow to a stop, and then "pick up" the joystick. Whenever you ask an axis to move for any reason, the axis will first slow to a stop, and then start again in response to the most recent motion request. When you enter the "JOG32" function, any axis all ready in motion will stay in motion until you first press its jog key, at which time it will come to a stop and then respond to the jog key.
To leave the Joystick, click the left mouse key, or press the spacebar on the computer terminal.
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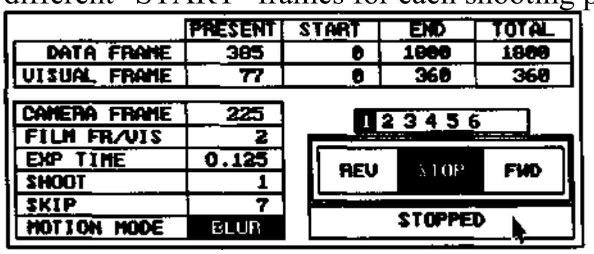
ANIMATION

To enter animation mode, click on the "LiveStop" menu item at screen lower right. The only difference between the "Live Action" and "Animation" screens is that the display at the lower left
corner of the screen is slightly different, and the "Multiple Exposure Bar" appears instead of the "KeyFrame" bar. To leave the animation screen, click on "LiveStop" one more time. Do this a few times until you can readily recognize whether you are in the Animation or Live Action screen.

Animation is defined here as shooting a move one frame at a time. This may be done with the axes in a "MOTION MODE" of "STILL" or "BLUR." BLUR produces the same sort of motion blur as occurs during normal cinematography.

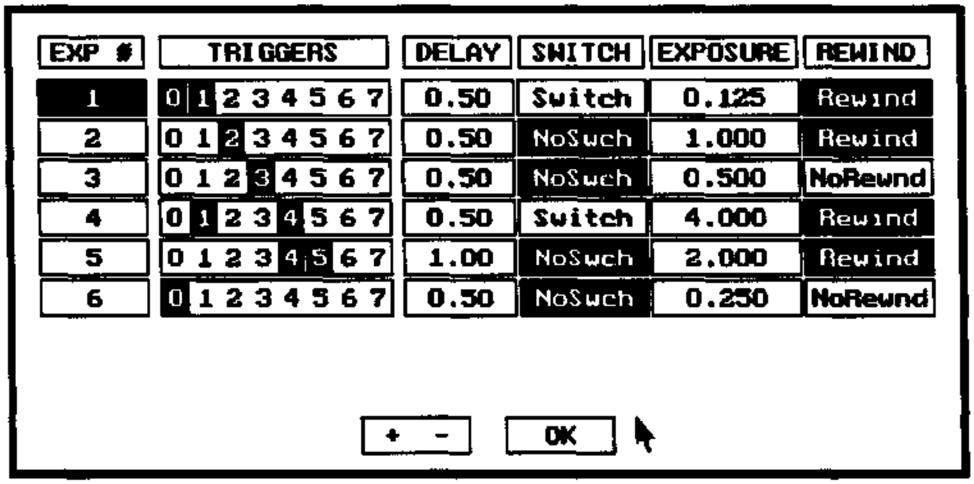
The operator may select how many frames to "SHOOT' and how many frames to "SKIP" by clicking on these menu items. The shoot-skip passes are staggered by selecting different "START" frames for each shooting pass.



Clicking on "EXP TIME" or on the "multiple exposure bar" just above the "REV STOP FWD" control produces an elaborate prompt box which allows complicated sequences of multiple exposures, backwinds, and trigger bits to be programmed for each move position. This allows considerable flexibility when setting up front-light/back-light shots, or when compositing multiple exposures during a single stop motion pass through the move.

The trigger bits are programmed by clicking them highlighted for "on," and not highlighted for "off." If you highlight the "EXP #" box to the left of the triggers, the triggers for that exposure will be automatically output as you adjust them. This gives you a way to test lighting setups, etc, without actually running the move.

All the items displayed in the Multiple Exposure Prompt Box can be changed by clicking on the item. "DELAY" sets a pause time between turning on the programmed triggers (lights) and checking for the shoot switch. If the "NoSwch" option is set, the exposure is made without waiting for the switch.


EXP #
TRIGGERS
DELAY
SWITCH
EXPOSURE
REWIND
1
0 1 2 3 4 5 6 7
0.50
Switch
0.125
Rewind
2
0 1 2 3 4 5 6 7
0.50
NoSwch
1.000
Rewind
3
0 1 2 3 4 5 6 7
0.50
NoSwch
0.500
NoRewnd
4
0 1 2 3 4 5 6 7
0.50
Switch
4.000
Rewind
5
0 1 2 3 4 5 6 7
1.00
NoSwch
2.000
Rewind
6
0 1 2 3 4 5 6 7
0.50
NoSwch
0.250
NoRewnd
+ -
OK

If "REWIND" is programmed, the camera will cap and rewind after making the exposure; if "NoRwnd" is set, the camera simply advances to the next film frame.
If you only want one exposure per move position, only program one exposure. Use the " + -" box to add or delete exposures.
For backwinds during multiple exposures, the Software always turns the capping shutter bit "On." If you don't have a solenoid type capping shutter, but one of the axes is labelled "SHUTTER" (in any combination of upper or lower case), the shutter axis will automatically close for backwinds. The convention for shutter operation is that the "0" pulse count position is always shutter fully open, and the "Pulses Per Unit" set using the "AxiSetup" is always the position for shutter fully closed.
If you have a "Shutter" axis, and are shooting in "STILL" mode, the shutter will close down for exposures shorter than "StopMo Base Exposure" programmed with the "CamSetup" command. If you don't have a "Shutter" axis, the camera motor will attempt to wind faster for short exposures, and you must be careful not to program exposures that will cause the motor to stall. For exposures longer than the "StopMo Base Exposure", the camera motor will "whip-open," pause, and "whip-closed."
In general, the operator is free to access anything on the screen anytime during a shooting pass, including the Multiple Exposure setup, camera winding, or even changing the "PRESENT[1] frame number.
We recommend using LiveStop to toggle to the Live Action screen for all joystick move recording activities.
For best result with BLUR mode shooting, it is important to set the camera and axis pre rolls so as to produce a reasonable amount of ramp up. **The amount of camera pre roll is controlled by the "Blur PRE ROLL" setting in the CamSetup command.** The bigger the number, the greater the number of degrees the camera will pre roll. If the number is too big, the camera may pre roll back into the previous film frame; if the number is too small, the camera may accelerate too rapidly and stall. The effect of the number also diminishes with decreasing exposures, so before you experiment to find a satisfactory Blur PRE ROLL number, set the exposure time to the fastest exposure you plan to use-all slower exposures will produce proportionately fewer degrees of pre roll for the same Blur PRE ROLL number. Settings between 10 and 4 are typical. "0" completely eliminates camera pre roll. If you have a capping shutter, the "Cap PRE & POST rolls" parameter in the "CamSetup" command sets whether or not the capping shutter will automatically cap PRE and POST rolls in Live Action and BLUR shooting modes.
The amount all the motion control axes (except the camera) pre roll is determined by the PRE ROLL setting towards the lower left of the Live Action screen.
Typically, settings which work well for live action shooting also work well for BLUR shooting. It is slightly inconvenient that this number is not visible from the stop-motion screen. If you need to shorten or lengthen the amount the axes pre roll in BLUR mode, click "LiveStop" to temporarily shift over to the Live Action Screen, adjust PRE ROLL, and click LiveStop again to return to the Stop-Motion Screen. Settings between 20 and 100 are typical. "0" completely eliminates all axis pre roll.
See the "LiveStop defined" in the index for more information.
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COMMAND DEFINITIONS
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command: **AsciiFile**
where: Control Panel Screen
purpose: to save and load move data files in a "text" format which can be used by programmers to transfer move data to other motion-control and graphic systems. Clicking this commands causes the screen to clear, and the following menu appears. Click on either the "SAVE ASCII FILE'V'LOAD ASCII FILE", or "CANCEL" option. After clicking either the "SAVE" or "LOAD" option, the procedure is similar to the "SaveMove" and "LoadMove" commands.

SAVE ASCII FILE

The "SAVE ASCII FILE" function creates a data file in text format. The first line contains the names of the axes the operator selected to save. All subsequent lines are move positions. Each vertical data column represents an individual axis, in the order shown on the first line. All lines are terminated by carriage-retura/line-feed combination. Here is an example of a "SaveAscii" file for the pan and tilt axes:

Axes = Pan, Tilt

-0.0432	6.1465
-0.5813	5.0420
-0.9722	3.9010
-1.2263	2.7390
-1.3478	1.5735
-1.3233	0.4220
-1.1663	-0.7090
-0.9008	-1.7975
-0.5122	-2.8295

Note that the first line of move data corresponds to the LED "marker frame."
In addition to the familiar "SaveMove" prompts, "SAVE ASCII FILE" produces one additional prompt box:
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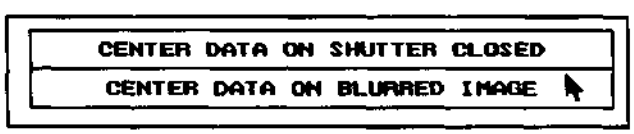

"SaveAscii" saves only one position per camera frame, regardless of the user's "DATA/VISUAL" setting. The prompt box shown above selects whether the data is to correspond to the axis positions when the camera's shutter is fully closed, or when the shutter is fully open. When data is to be transferred to a graphic system, use the "Center on Blurred Image" response, since this will produce the best match between photographed and graphic image~the graphic image will be centered on the image blur of the "live" photography. "Center Data of Shutter Closed" may be desirable when transferring data to other motion control systems.

LOAD ASCII FILE

The "LOAD ASCII RLE" option reads text format move data files. The input file must satisfy at least two requirements: there must be an "Axes = " line which states which axes are represented by the data columns, and there must be move data. Optionally, there may be one or more "comment" lines containing text, such as instructions to operators, etc. All lines must be terminated with "carriage return, line feed" characters, hexadecimal "OD OA". No line may exceed 510 characters in length.

The "Axes = " line tells the software which axes should receive the move data. In this example: Axes = Pan,Tilt,Zoom

the software will load the first three data columns into Pan, Tilt, and Zoom axes, in that order. Up to 32 axes may be named. "Axes" and "=" must be separated by a space, as must "=" and the first axis name. Axis names must be separated by a ",". The "A" must be the first character on the line. The "Axes = " list can state axis names in any order relative to the order of the axis names on the Control Panel Screen. The "Axes = " list must precede all move data in the file. All the axis names in the "Axes = " list must be present by name on the Control Panel Screen, or an error message will result and the data will not be loaded. If this occurs, use the "NameAxis" function to rename axes on the Control Panel Screen to match the names in the "Axes = " list, or text edit the move file to match the axis names.

Data lines are in the same format shown for the "SAVE ASCII FILE" command. The only characters allowed are spaces (hex 20), tabs (hex 09), "-", ".", and the digits 0 to 9. Each column must be separated from the next by at least one space. The data is assumed to be in positions. Units are in screen units, so it is essential that the "AxisSetup" command's "Pulses per Unit" number is set to match the units assumed by the software which generates the move file. There must be one vertical data column for each axis listed in the "Axes = " line. **To insure smooth velocity transitions during real time move playback, it is essential to have 4 or more decimal places in the position data.** The number of decimal places should be selected to resolve the motor position down to a single pulse.

Any line which does not begin with "Axes = " or satisfy the requirements of a "data line" as described above, will be printed on the screen during the move load, but otherwise ignored by the software. This provides a way of embedding instructions to operators, comments, etc. in the data file. The operator should always check that any such displayed lines are in fact messages, rather than a move data line with a "typo."

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Data files are always assumed to contain one data line per Visual Frame. Since the RTMCxxx software normally stores more than one velocity change (usually 5) per Visual Frame, the software automatically interpolates the required number of move storage elements, depending on the setting of "DATA/VISUAL" when the data is loaded. This process is transparent to the operator. We recommend you use the normal "DATA/VISUAL" setting of "5".

It is possible to edit data files using any text editor which can read and write "ASCII" or "DOS" format text files. Axis names may be changed, comments added, or actual motion data edited. Just be careful not to erase any data lines or insert accidental characters in the motion data. The "TurboC" editor is suitable. If you use WordPerfect, save the data in DOS format with the "ctrl-F5,l,l" keystroke sequence.

WE RECOMMEND THAT "ASCIIFILE" ONLY BE USED FOR THE PURPOSE OF TRANSFERRING MOVE DATA TO AND FROM OTHER SYSTEMS. DO NOT USE THIS FUNCTION FOR NORMAL MOVE STORAGE, SINCE SOME MINOR MOTION SUBTLETY IS LOST WHEN "SAVEASCII" CONVERTS THE HIGH RESOLUTION RTMC MOTION DATA TO ONE-POSITION-PER-VISUAL-FRAME FORMAT.

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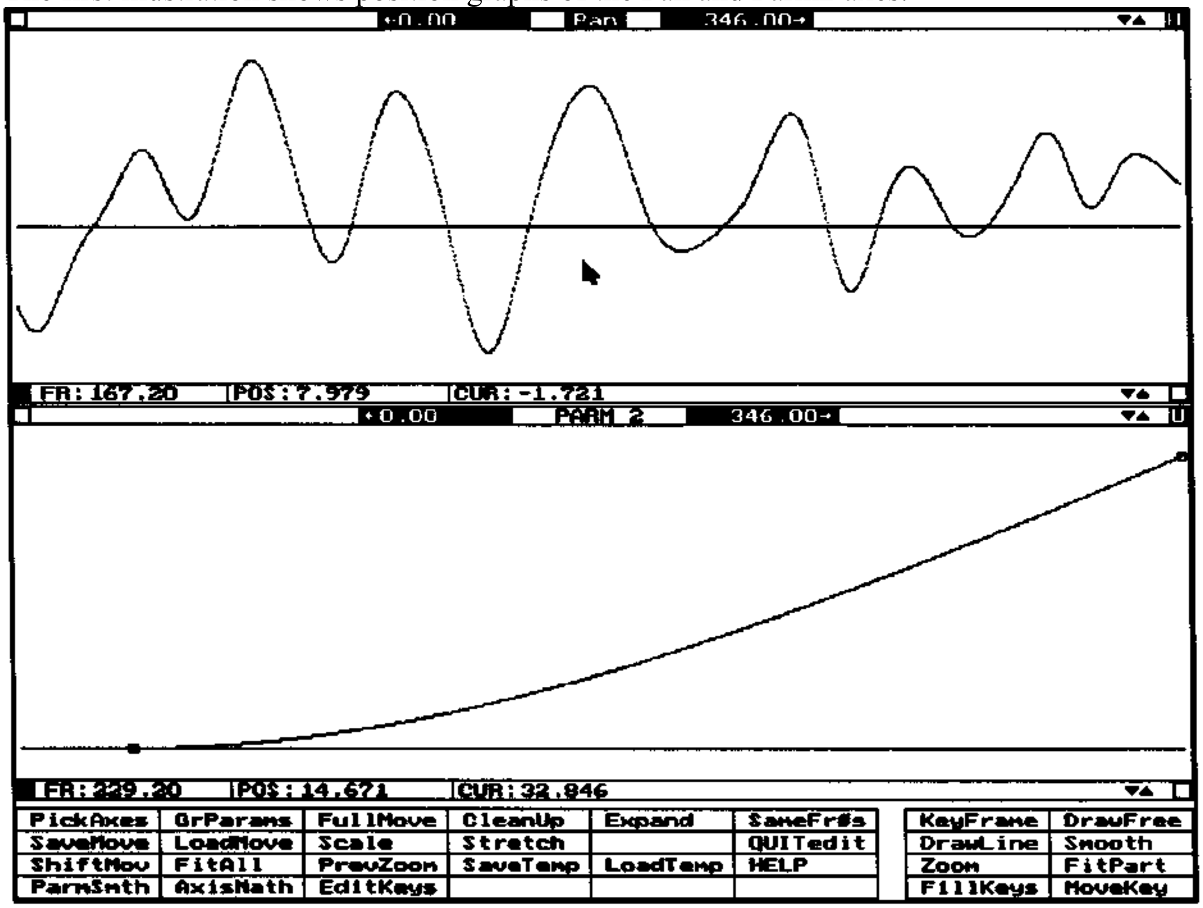
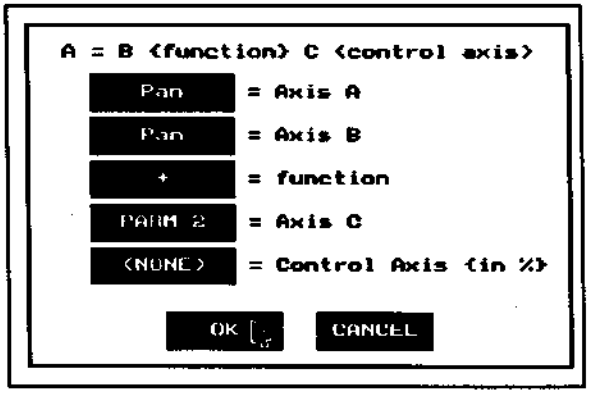
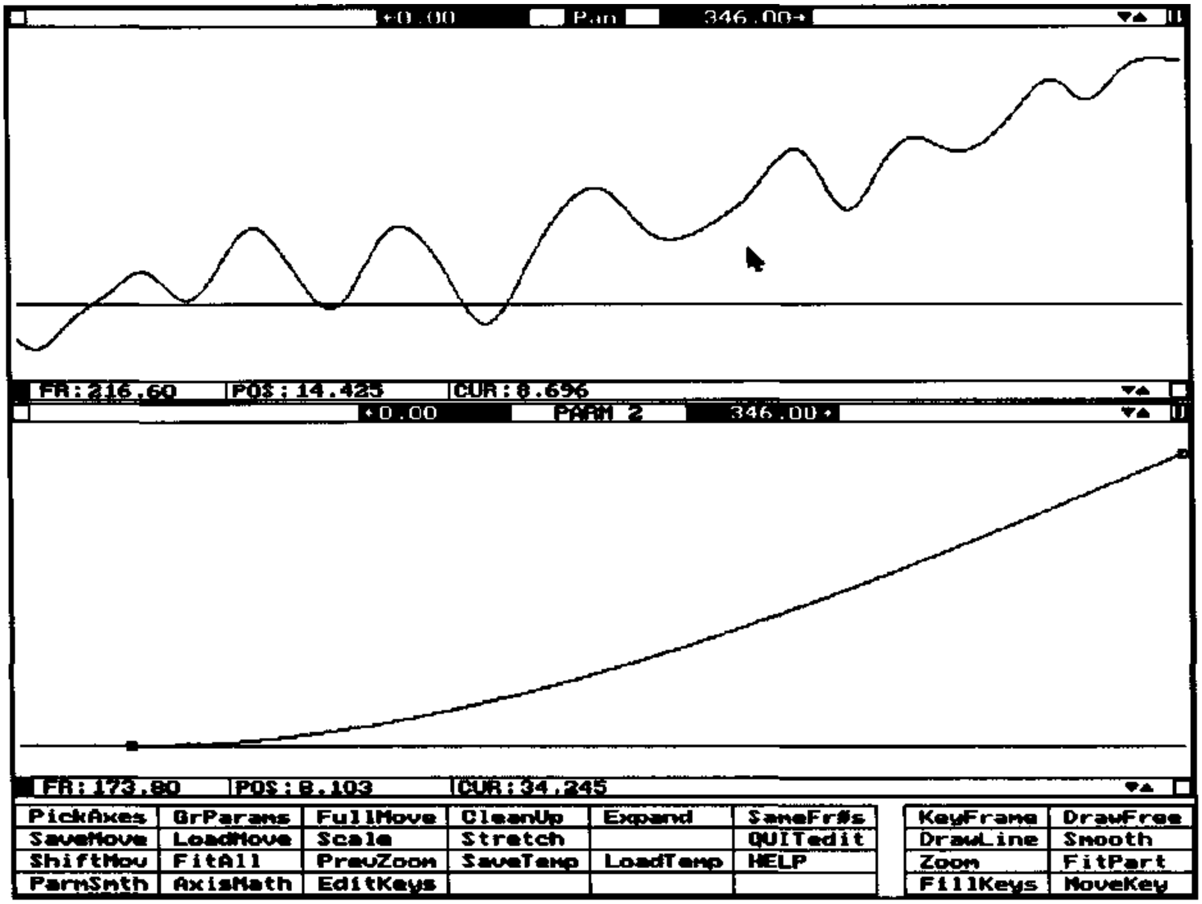
command: **AxisMath**
where: Graphic Move Editor
purpose: Add axes together, with optional control axis.
The first illustration shows position graphs of the Pan and Parm2 axes.



The next illustration shows the dialogue box which appears when the AxisMath command is selected. The setup shown will cause the Parm2 axis motion to be added into the Pan axis motion. The axis names can be changed by clicking on the boxes. The mathematical function selected is"+"; to select other functions click on the box. "<None>" is selected as the control axis. If an actual axis name were selected for the control axis, that axis would control how "effective" the function would be on a frame by frame basis. The control axis should be programmed in position mode, with the position
45


A = B <function> C <control axis>
Pan
= Axis A
Pan
= Axis B
+
= function
PARM 2
= Axis C
(NONE)
= Control Axis (in %)
OK
CANCEL

numbers considered to be in percentage units. See the ParmSmth command for more information on using the control axis. With <None> selected for the control axis, the add will be 100% effective at each frame.



The effect of the "+" function is shown above. Note that the Pan axis is now a combination of the original back-and-forth motion plus the upward motion of the Parm2 axis. Parm2 is not changed.

Since Parm2 started its move at 0.0 (as shown by the horizontal 0.0 position line), the starting point of the Pan axis is unchanged; if Parm2 started its move at some position besides 0.0, that starting position would have been added into the Pan move, changing the Pan starting position. For this reason it is sometimes desirable to use the Scale command to offset the start of the move to "add-in" before using the AxisMath command; set the Scale command "Scaling Factor" to 1.00, the "Visual Pivot Frame" to 0.0, and the "Pivot Position" to 0.0. Scale can also be used to offset the start of the axis "added-into" after the fact.

Clever "addition" tricks can simulate axes which do not physically exist. Suppose the moves shown were part of a shot where the camera point of view starts out on an airplane "bumping" through turbulence. As the shot progresses, the camera pans back to a point behind the plane. In this example, the original "back-and-forth" Pan move (and similar Tilt move) was intended to simulate the rising and falling of an aircraft resulting from turbulence. To build the move, the operator first simply framed the model and concentrated on the "turbulence" motion without worrying about the "visual" pan and tilt~the original Pan and Tilt moves were only the "turbulence" components of the

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overall move. The rising of the Parm2 move curve is the camera motion pan. When added together, the new Pan move both "bumps" the airplane and pans the airplane forward. The effect is virtually the same as the Parm2 axis were a physical track axis oriented to carry the airplane out of frame.

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Command: **AxiSetup** Screen: Control Panel Screen
Purpose: Give the Software information that is specific to each individual axis, such as motor performance limits.
The illustration above shows the prompt for the "AxiSetup" menu item on the Control Panel Screen. The first three items control how the motor performs when it is simply slewing from position to position, such as when the motor is going to home position, to the starting position in preparation for running a move, etc. These have no effect on how the motors perform during move playback or recording passes.
The parameter values shown in the illustration are typical. To change parameters, click on the number in the middle column, enter the new number on the Calculator, and then click on the Calculator screen.
If you want to keep the changes you make to the "AxiSetup" parameters, you can save them on disc by using the "SaveSetup" command after you change the parameters. The Software will remember the new parameters the next time it boots up.
Slew Speed in PPI controls the maximum speed the motor will attain while slewing. The higher the number, the faster the top speed.
The pulses per second can be determined by multiplying this number by 120. The "100" in this example, when multiplied by 120, shows the motor will reach 12000 pulses per second.
"PPI" means "Pulses Per Interrupt." Interrupts occur at 120 per second.
This number does not affect how fast the motor is allowed to go while recording or playing back real time moves.
Slew Acceleration sets how fast the motor will speed up to reach its top speed. The bigger the number, the faster the acceleration. If this number is too large, the motor may not be able to accelerate without stalling, just like a car will stall if you try to accelerate from a stop in 4th gear. Small numbers give more gradual accelerations, which in turn allows for much higher top speeds. Typical values are between 1 and 3.
The number of seconds the motor will take to reach its top speed equals:
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Parameters for Track		RANGE
Slew Speed in PPI	100	1 to 2047
Slew Acceleration	1	1 to 10
Slew Deceleration	6	1 to 8
Pulses per Unit	2000.000	no limit
Disable Polarity	0	1 or 0
Dis. delay (seconds)	0.0	0.000 to 500.000
VELO Joystick Deadband	500	0 to 16000

OK CANCEL

(Slew Speed in PPI / Slew Acceleration) / 120

Slew Deceleration sets how quickly the motor will slow down to a stop as it approaches its destination. The bigger the number, the longer the deceleration time. Numbers between 3 and 6 are typical. If the axis lurches as it slows down, the deceleration may be too fast; try a larger number to give a longer, gentler deceleration.

Pulses Per Unit sets how many pulses are needed to go one "position number." The axis positions are shown on the Control Panel Screen and the Graphic Move Editor screen. Suppose your track must travel 4000 pulses to move one inch. If you enter "4000" as the Pulses Per Unit, the position shown on the screen will change by "1.000" for each inch the track moves. You may select any type of unit you want: inches, degrees, millimeters, etc. Just measure how many pulses are needed to go the unit distance.

The best way to determine the number of pulses required is to temporarily set Pulses Per Unit to "1000." This will cause the display to read out directly in pulses. Just ignore the decimal point; if the display reads "0.456," you have moved 456 pulses.

The next two parameters let the operator control automatic power down for those systems which have the necessary hardware for this feature. Some motor drivers have a hardware input line which is used to set the motor to a "low power standby" mode when it is not being used.

Disable Polarity sets whether the control line must be "0" or "1" to activate the lower power mode.

Disable delay (seconds) sets how long the axis must remain idle before the Software puts it into lower power mode. The time selected depends on the type of driver, the motor load, and many other primarily mechanical factors about the particular hardware being controlled. Times between 1 and 10 seconds are typical.

VELO Joystick Deadband applies only when the axis is being joysticked in velocity mode. This is the number of encoder pulses around the zero velocity joystick position which will produce a true zero velocity--in short, a "dead" range of joystick knob positions. The larger then number, the wider the deadband. For the Jogbox's 10000 pulse per turn encoder, a value of 500 gives a deadband which is 18 degrees wide: 18 = 360 * 500 /10000.

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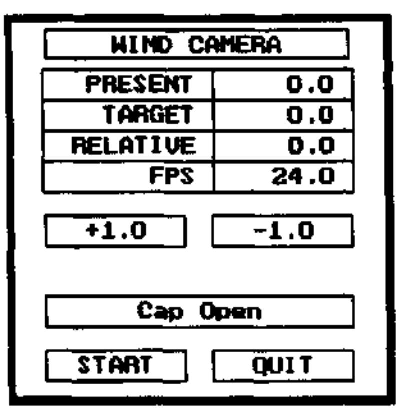
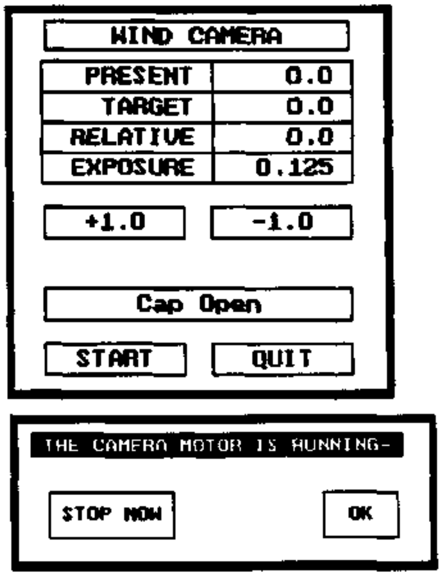
command: **Camera**
where: Control Panel Screen
purpose: wind film through the camera.
The camera command prompt box provides a convenient way to wind the axes assigned to camera functions. The "Present" camera frame is shown at the top of the prompt box. The frame can be changed by clicking in the frame box.
"Target" and "Relative" provide two different ways of specifying how many frames to wind; you would ordinarily change one or the other. Target is the frame number to which you want the camera to roll. "Relative" is how many frames the camera should roll.
"+1.0" and "-1.0" provide a quick way of winding one frame; these boxes do not cause the camera to wind immediately, but simply adjust the "Target" box so the camera will wind one frame when the "Start" button is pressed.
"Cap Open" toggles between "Cap Open" and "Cap Closed" with alternate clicks. This causes the capping shutter to open and close, and if a shutter axis is assigned (ie, some axis is named "Shutter" and enabled), the shutter will also open or close. If you run the camera "Cap Closed", the shutter and or capping shutter will not automatically open when the camera stops winding, but will open before the next shooting pass.
The Stop-motion/Go-motion version operates the same, except the camera speeds are specified as exposures times.
Camera prompt, Live Action version specifies camera speed in FPS.
Unlike shooting commands, the Camera command will cause the camera motor to wind even if the Camera axis name is not highlighted (enabled).
Stop-motion Camera command specifies camera speed as exposure time.
Once the camera starts to wind, you are free to go and do other
things, including running moves, provided the "Camera" axis name is not highlighted. If you attempt to run a move while the camera is winding, and the camera axis is enabled, the camera will first stop, and then the move pass will begin.
To stop the camera from winding, click on the Camera command. Whenever you try to use the Camera command while the camera is all ready running, a prompt appears which allows you to either stop the camera, or let it continue on as before.
50




WIND CAMERA
PRESENT 0.0
TARGET 0.0
RELATIVE 0.0
EXPOSURE 0.125
+1.0
-1.0
Cap Open
START
QUIT
THE CAMERA MOTOR IS RUNNING-
STOP NOW
OK

command: **Cam Setup** where: Control Panel Screen
purpose: Gives the Software information about how the axis assigned to camera functions should operate.
The above illustration shows the prompt for the "CamSetup" menu item. This is similar to the "AxiSetup" menu item, but contains extra parameters needed to fully control how the camera is to operate. **The parameter values shown above represent typical values.**
The camera motor must behave differently for Live Action and Stop Motion photography. For this reason, some of the parameters only relate to Live Action, while others only relate to Stop Motion. The main difference is that the camera needs extended slewing ramps and long pre-rolls to reach Live Action camera speed, while only short, precise ramps and pre-rolls are needed to reach the relatively slow camera speeds needed for Stop Motion work. Live action ramps extend over many frames, just as with a normal Live Action motor; Stop Motion ramps must occur in the 90 degrees of rotation before and the shutter is exposes the film.
Click on the numbers in the middle column to change them. Click on the Calculator screen to enter the number.
Present Camera Frame is simply the present frame count, just as you would read from a mechanical frame counter.
Pulses Per Camera Frame is the number of pulses required to advance the film one frame. This is usually the number of pulses per turn of the motor. Early RTMC Software versions required that this number be positive only; current versions will accept positive or negative numbers, as required to achieve the proper camera direction sense.
LiveAct FWD Only. If "ON" the camera will only roll when the move is played back in the forward direction. If "OFF[1] the camera will roll when the move is played back either in the forward or
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Camera Parameters		RANGE
Present Cam Frame	0.0	no limit
Pulses/Cam Frame	2000	-5000 to 5000
LiveAct FWD Only	ON	ON or OFF
LiveAct PRE ROLL	120	0 to 240
LiveAct Slew Accel	2	1 to 10
LiveAct Slew Decel	6	1 to 8
Blur PRE ROLL	8	0 to 20
StopMo Slew Accel	8	1 to 10
StopMo Slew Decel	2	1 to 8
StopMo Base Expos.	0.125	0.001 to 600.000
Actual shutter angle	170.0	85.000 to 240.000
2 Pull VistaVision	OFF	ON or OFF
Extrn cam tol (usec)	400	0 to 2000
Cap PRE & POST rolls	NO	YES or NO

OK CANCEL

reverse direction. This is normally kept "ON" to prevent massive film jams on cameras with belt driven takeups. This parameter does not affect Stop Motion and BLUR shooting modes, which always allow bidirectional camera operation.

LiveAct PRE ROLL controls how much time the camera will take to reach full speed when shooting "real time" passes, responding to the "FWD" and "REV" buttons on the Control Panel. The larger the number, the longer the ramps and the higher the real time speed the camera can reach. The number is a measure of how many "time periods" the acceleration will take. Since there are 120 time periods per second, a "LiveAct PRE ROLL" of 120 will take exactly one second to reach speed. This parameter does not affect Stop Motion or BLUR shooting, or camera slewing. To determine the exact number of frames the camera will pre roll, click the "Start:" box to "Shoot Switch" and then click "FWD"; the box just above REV STOP FWD will display the number of camera pre roll frames. Instead of starting the move, just click STOP.

LiveAct Slew Accel controls how fast the camera accelerates when it responds to the winding requests from the "Camera" menu item on the Control Panel. This is not the same as "LiveAct PRE ROLL," which controls how much pre-roll the camera takes when shooting Live Action passes; "LiveAct Slew Accel" simply controls how the camera will ramp when the operator uses the "Camera" menu item to wind some film when the Live Action Screen is displayed. Small numbers produce long ramps; big numbers produce fast ramps. This parameter is identical to the "Slew Acceleration" parameter in the "AxiSetup" command.

LiveAct Slew Decel controls the amount of camera deceleration during non real time camera rolls, as above. Small numbers produce rapid decelerations; large values give slow decelerations.

Blur PRE ROLL sets how much ramp up the camera motor will take when shooting stop-motion BLUR mode, which produces motion blur. The camera always backs up a partial frame when shooting Go-motion exposures. This number should be selected to produce about 20 or 30 degrees of pre-roll. If this number is too big, the camera will open the shutter on the previous frame. This number is relative to the exposure-the faster the exposure, the more pre roll for any given Blur PRE ROLL number. **Before experimenting to find a good working number, set the exposure to the shortest exposure you plan to use, since this will produce the maximum number of degrees of pre roll.** For longer exposures, the amount of pre roll automatically reduces, since slower camera speeds require less pre roll.

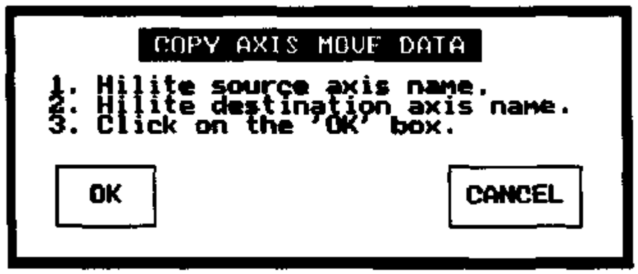
StopMo Slew Accel controls how fast the camera accelerates when shooting STILL mode stop-motion. Small number produce longer accelerations. The acceleration should be set to be fairly abrupt, so that the camera reaches speed in the 1/4 camera turn before the camera reaches steady speed. Typical number are between 5 and 10. We recommend 8 as a typical value. If this number is too big (favoring fast accelerations) the camera may stall or chronically looses pulses~if this occurs try a smaller number for a gentler acceleration.

StopMo Slew Decel control the camera ramps when shooting normal Stop Motion. Larger numbers produce more gradual deceleration. Select a number so the camera just starts to decelerate as the shutter closes at the end of the exposure. Try 2 to 4. If the camera stops too abruptly or looses pulses, try a larger number.

StopMo Base Exposure sets the default exposure for Stop Motion and Blur shooting. This is the shortest exposure that will be possible when shooting Stop-Motion. **Also, this is the speed the camera will wind when it winds with the shutter closed, as when backwinding for multiple exposures per frame when shooting stop-motion passes.** This number may also be changed from the Animation Screen. The advantage of changing the Base Exposure here is that the number will be saved when you use the "SaveSetup" command.
Actual shutter angle should be set to actual angle of the mechanical shutter in the camera. This is typically equal to 170 degrees for Mitchell and other common cameras. The Software uses this information when calculating exposures and simulating larger shutter angles. For double pull down Vista Vision cameras, enter the number of degrees for the exposing pull down only, which is typically 170 degrees for Oxberry cameras.
2 Pull VistaVision turns double pull down Vista Vision camera response on and off. If OFF the camera operates as an ordinary single-pulldown camera. If ON the camera pulls down twice for each exposure: the first pulldown is capped, and the second pull down is uncapped. The camera MUST have a capping shutter to operate in double pulldown mode.
Extern cam tol (usec) means "External camera tolerance." It applies only when the move start is to be synchronized to an external Panavision or Fries sound speed motor. It has no meaning for cameras operated with a stepping motor. This parameter sets how steady the sound speed camera motor must be before the RTMC Software will commit to a move pass. When a typical sound speed camera motor starts, the speed oscillates up and down for a few seconds before settling down to the exact speed. Setting the "Extern camera tolerance" to a tight value of about 400 microseconds (usec) assures that the camera will have settled down before the move pass. If the move does not start within a few seconds, try a larger, more forgiving value; the larger the value, the loser the speed regulation requirement and the faster sync will be established. Values greater than about 1000 suggest the camera motor may be in bad shape, or may not be truly crystal sync at the particular speed being used. Electrical noise may also be a problem; be sure your interface circuit is correctly built. The schematic for the camera interface circuit is in technical drawing section at the back of this manual.
In practice, select the smallest "Extern cam tol" which allows the move to start within a few seconds of starting the camera. Cameras in good condition require a value of about 400. For values over 1000, assume that their are problems with either the interface or the camera motor.
Cap PRE & POST Rolls controls whether or not the capping shutter will cap the camera rampup and ramp down during Live Action and BLUR photography. If this parameter is set to "YES" there will be a great deal of capping shutter activity during frame by frame BLUR photography. If the BLUR camera pre roll is not enough to back up the shutter into the previously exposed frame, you may want to set this parameter to "NO" for BLUR shooting. For fast Live Action shooting, certain capping shutter designs may not be fast enough to avoid covering all or part of the first frame of the move, which may result in losing the "marker light" frame.

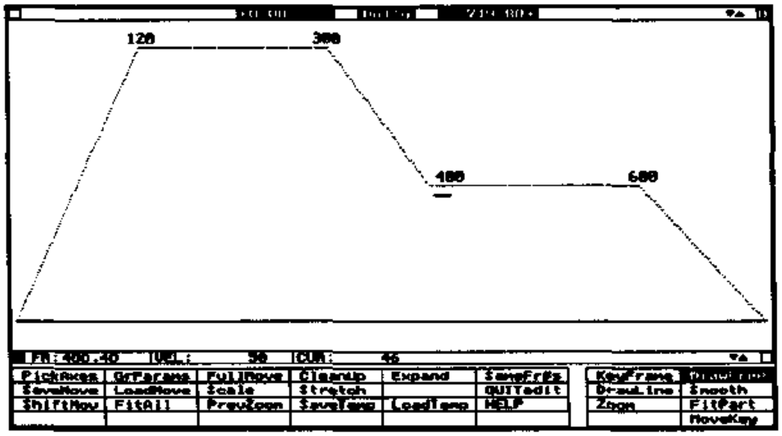
command: **CleanUp**
where: Graphic Move Editor screen.
purpose: divides the available screen display area evenly between all the displayed axes. All the axes will be drawn at exactly the same size.
EXAMPLE:
Several axis graphs are displayed on the screen at different sizes, and perhaps some space is left blank because of removing axes from the screen (by clicking the "un-display" box at frame lower right). The operator wants to do an axis by axis check with all the axes at the same scale. He clicks on the CleanUp command to draw every displayed axis at the same scale. A further step would be to click the SameFr# command so that the same range of frames is displayed on every graph.
54

command: **CopyMove**
where: Control Panel Screen
purpose: copy moves from one axis to another.
CopyMove completely replaces the move on the destination channel.
CopyMove offers a quick way to erase the move data on an axis, by simply copying an unprogrammed axis onto the axis you wish to erase.
55



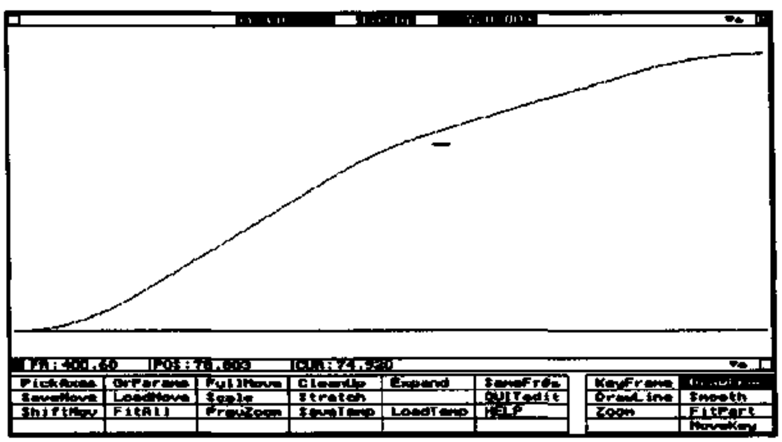
command: **DrawFree**
where: Graphic Move Editor
purpose: draw free hand move curves on the Move Editor Screen.
After clicking this command, the cursor assumes the "pencil" shape whenever it is inside the graph of the selected (name highlighted) axis.
To draw, position the cursor inside the graph, hold down the LEFT mouse key, and move the cursor left to right. Note that drawing only works left to right, and not the other way.
When you are finished drawing, release the mouse key. The graph will redraw.
You can make as many drawing passes as you like within the graph.
It is best to have the graph as large as possible on the screen when drawing. If several axes are displayed, use the Expand command to make the graph of the selected axis fill the entire screen. The GrParams command can be used to set the limits for top and bottom velocities displayed on the graph. Make your "first approximation" sketch with the full move (use the FullMove command) displayed, then click on the left side of the frame number to the right of the axis name to "zoom in" on the first part of the move. Go over the magnified section of the curve one more time to clean it up, then pan to the next part of the curve by clicking on the "pan right" box just to the right of the axis name.
DrawFree may be used with the graph displayed in either position or velocity mode, although drawing in velocity mode usually produces the best results. If you draw on a position graph, you will have to use the Smooth command to even out the "jaggies" which result from the low resolution of the display and mouse. When smoothing graphs drawn in position mode, it is best to display the graph in velocities to judge how much smoothing is necessary. An unsmoothed, hand drawn position curve looks remarkably rough when first viewed in velocity mode; a few smoothing passes begin to make sense out of the curve. Try 3 or 4 passes with a smoothing factor of about 50. Curves drawn in velocity mode usually require little or no smoothing.
Pay special attention to the first and last few frames in the move, since it is easy to miss these when using DrawFree. Take a quick look at these parts of the move using the Zoom command, or clicking on the frame numbers to the left and right of the axis name.
When drawing with the graph displayed in velocity mode, it is usually difficult to predict the distance travelled. In cases where the distance travelled is important, use either the Scale and Stretch commands to set the exact distance and starting point for the move.
These commands do not affect the shape of the velocity curve, but do alter the overall magnitude of the velocities to get the correct distance.
See the DrawLine command.
56

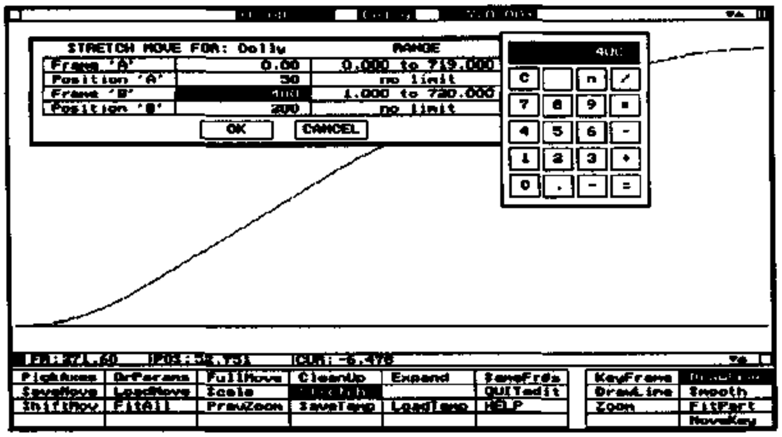
command: **DrawLine**
where: Graphic Move Editor
purpose: draw straight line segments on the Move Editor Screen.
DrawFree draws straight line segments on the move graphs. It is useful for creating "velocity contour" moves, which are moves expressed in terms of acceleration and speed at different points in the move. So called "ease-in, constant-velocity, ease-out" moves are this type of move.
Be sure the move graph is displayed as velocities, as indicated by "VEL:" being visible at graph lower left. If "POS:" is shown, the graph is in position mode; click on "POS:" to switch over to velocity mode. After clicking on the DrawLine command, move the cursor into the move graph area. Click the LEFT mouse key at the starting point for the first line segment. Move the cursor to a new point to the right of the previous point, and click again. A straight line is drawn between the two point. Continue clicking line end-points, each time moving further to the right. Use the frame number and cursor position read-outs at frame lower left as you select the points.
In the first illustration the move has the following contour: it eases-in from frame 0, accelerates up to frame 120, holds a constant speed up to frame 300, decelerates to about half that speed by frame 400, maintains a constant speed until frame 600, then decelerates to a stop by frame 720. The frame numbers shown do not appear on the actual graph. The operator selected velocities by watching the "CUR:" display at frame lower left, which displays the present velocity pointed at by the cursor
The readout at frame lower left shows that the pencil shaped cursor is pointing to frame 400.40, that the move velocity for that is frame is 50 (as is the entire linear move section to the right), and that the cursor just below the move is pointing to a velocity of 46. The straight horizontal line below the move graph is the "0 velocity" line. Since the entire graph is above the 0 velocity line, all the velocities are in the positive direction; if the move graph dipped below the 0 velocity line, the velocities would be in the negative direction.
The next illustration shows the same move drawn as a position graph. The operator clicked on the "VEL:", which switched the graph over to positions, or "POS:". The graph is shown as a sequence of positions, rather than as a sequence of velocities. The horizontal line is "0 position" instead of "0 velocity."
By examining the display at graph lower left, the operators sees the cursor is positioned at frame 400.60. The position for the frame is 78.803. The cursors is "pointing" at a position of 74.920.
57

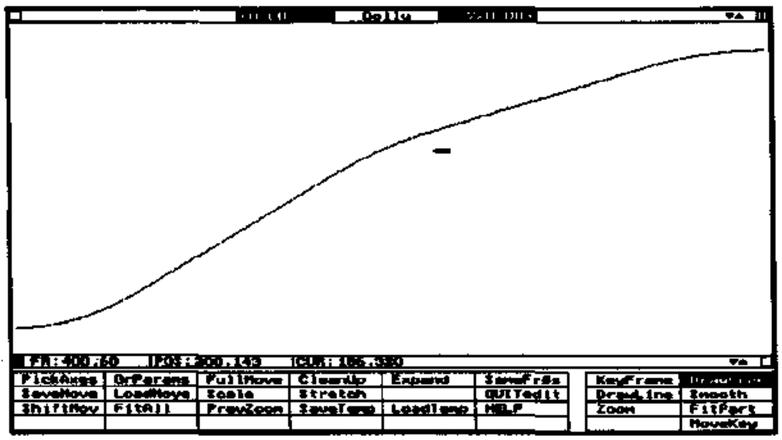


120
300
400
600
FR:400.40
VEL: 50
CUR: 46
PickAxes
GrParams
FullMove
CleanUp
Expand
SaveFrRs
SaveMove
LoadMove
Scale
Stretch
QUITedit
ShiftMov
FitAll
PrevZoom
SaveTemp
LoadTemp
HELP
KeyFrame
DrawLine
Smooth
Zoom
FitPart
MoveKey

The move also starts at position 0.0, a indicated by the curve touching the zero position line at the left side of the graph. The operator wants the move to start at a position of 50.000, and be at a position of 200.000 at frame 400. He clicks the Stretch command, and fills in the position "A" and "B" frame numbers and positions accordingly. As soon as he clicks "OK", the move data gets stretched to the new specifications for those frames and positions.
The last figure shows the results of the Stretch. Frame 400.000 is now exactly at a position of 200.00, and frame 0.00 is not exactly at a position of 50.000, which puts the horizontal "zero position" line off the bottom of the graph. To read various positions in the move, the cursor can be moved left and right, allowing the operator to read various "FR:" and "POS:" combinations at frame lower right.
Same move data displayed as positions.
Using the Stretch command to assign specific positions for two frames in the move.
When the operator drew the original "velocity contour" graph, he didn't pay too much attention to the exact velocities he selected, since he knew he would be using the Stretch command to set the exact positions of the move. He was careful to draw the second linear section at half the value of the first linear section, since this was an important move specification for the particular move. Beyond that, he simply concentrated on getting the shape
of the velocity contour correct, rather than worrying about the actual distance that would be aSS1gned pOSltlons,
The move "Stretched" to accommodate the newly
58




STRETCH MOVE FOR: Dolly
RANGE
Frame 'A'
0.00
0.000 to 719.000
Position 'A'
50
no limit
Frame 'B'
1.000 to 720.000
Position 'B'
200
no limit
OK
CANCEL
PickAxes
DrParams
FullMove
CleanUp
Expand
SaveFrms
SaveMove
LoadMove
Scale
QUITedit
ShiftMov
FitAll
PrevZoom
SaveTemp
LoadTemp
HELP
KeyFrame
DrawLine
Smooth
Zoom
FitPart
MoveKey


Dolly
PickAxes
DrParams
FullMove
CleanUp
Expand
SaveFrms
SaveMove
LoadMove
Scale
Stretch
QUITedit
ShiftMov
FitAll
PrevZoom
SaveTemp
LoadTemp
HELP
KeyFrame
DrawLine
Smooth
Zoom
FitPart
MoveKey

covered. The Stretch command adjusted the final, actual velocities to cover the required distance; even though the distance covered is mow different than after drawing the original contour, the velocity contour retains the same shape.
DrawLine was used to create the curves in these examples. Slightly more "live-action natural" moves can be generated by drawing similar curves using the free handed DrawFree command.

The "Eases" command may be used to automatically create velocity profiles between selected key frames.

59

command: **Eases**
where: Graphic Move Editor Screen.
purpose: create "ease-in / constant-velocity / ease-out" moves between previously memorized key frame positions.

The Eases command produces classic eased moves. The operator specifies the number of frames of ease-in and ease-out, and the Software builds a move. The section of the move between the eases is constant speed.

Creating an eased move involves two steps:

1. The operator creates two or more key frames. The keyframes mark start and end positions for the move, and may also include some intermediate turn-around points. Keyframes are created by using the Control Panel "MousJog" or "KeyFrame" commands, the Graphic Move Editor "KeyFrame" or "EditKeys" commands, or the Jogbox.
2. The operator enters the Graphic Move Editor Screen, clicks the "Eases" command, and uses the mouse cursor and various mouse keys to actually create the eased move. Cursor position is used to select keyframes, and mouse keys control the size and types of ease:

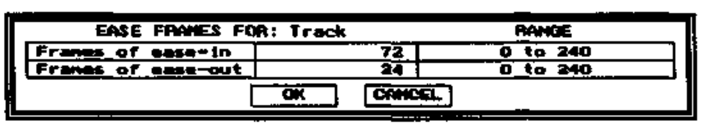
LEFT key creates an ease-in / constant-velocity move between the two keyframes surrounding the cursor.

RIGHT key creates a constant-velocity / ease-out move between the two keyframes surrounding the cursor.

MIDDLE key produces a dialogue box which allows the operator to enter the number of frames of ease-in and ease-out associated with the left and right mouse keys. To change either number, click the number with the left mouse key. The values entered remain the default values until the next time they are specifically changed. This key does not create eases, it just sets the length of eases created with the left and right mouse keys.

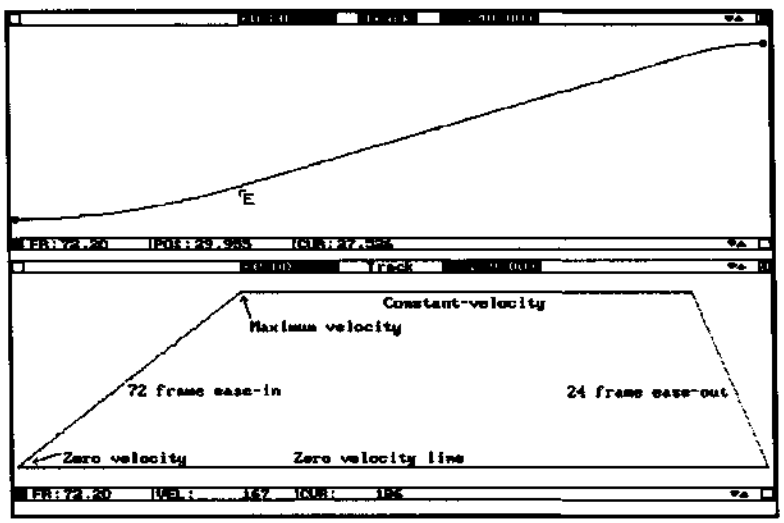
To create an ease-in / constant-velocity / ease-out move: —position the cursor between two key frames, -press and HOLD the LEFT mouse key. -tap the RIGHT mouse key, then release both keys.

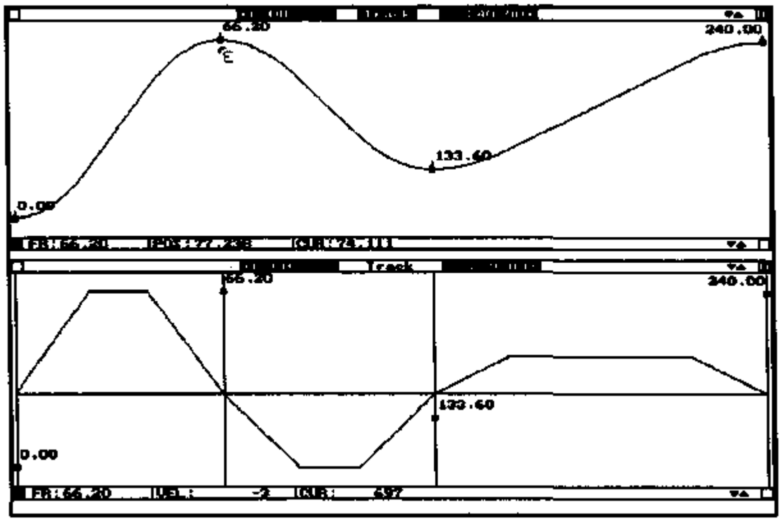
60



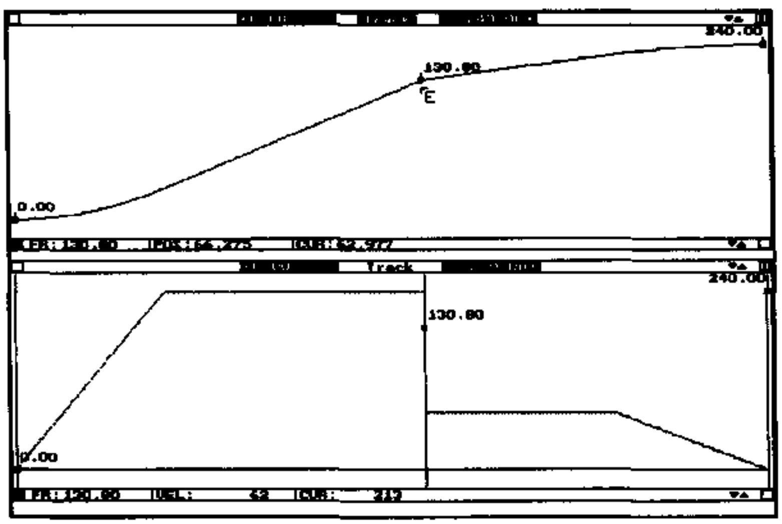
Each time you create eases between keyframes, any previous eases between those keyframes are wiped out. It is not possible to first create a left key ease-in / constant-velocity connect between key frames, and then come back later and round out the section with a right key ease-out; the only possible approach to create an ease-in / constant-velocity / ease-out section is to press and hold the left key while tapping the right.
The above illustration shows position (top) and velocity (bottom) graphs of a single move created with the "Eases" command. The position graph displays the characteristic smooth curves of the 72 frame ease-in and 24 frame ease-out. The same move displayed as a velocity graph shows the characteristic velocity profile of an eased move; the horizontal line at the bottom is the "0" velocity line, and the linear acceleration, constant velocity, and linear deceleration sections are very apparent.
Intermediate keyframes may be taken between the starting and ending key frames to mark "turnaround" points. In the above example, the operator clicked between each successive pair of key frames with the "hold left key, tap right key" combination to build the three separate ease-in / constant-velocity / ease-out section which make up the move. This technique works fine when each key frame marks a distinct change in direction, but there is a problem with eased moves when more than two key frames trend in the same direction.

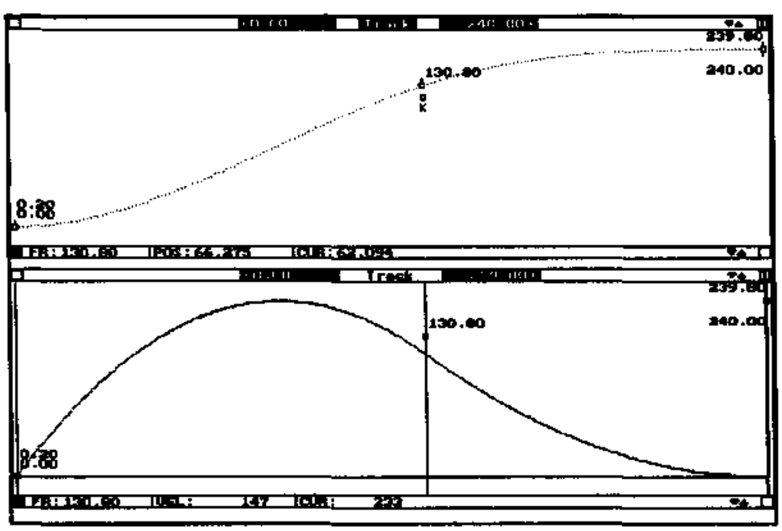
61




66.20
240.00
133.60
0.00
66.20
240.00
133.60
0.00

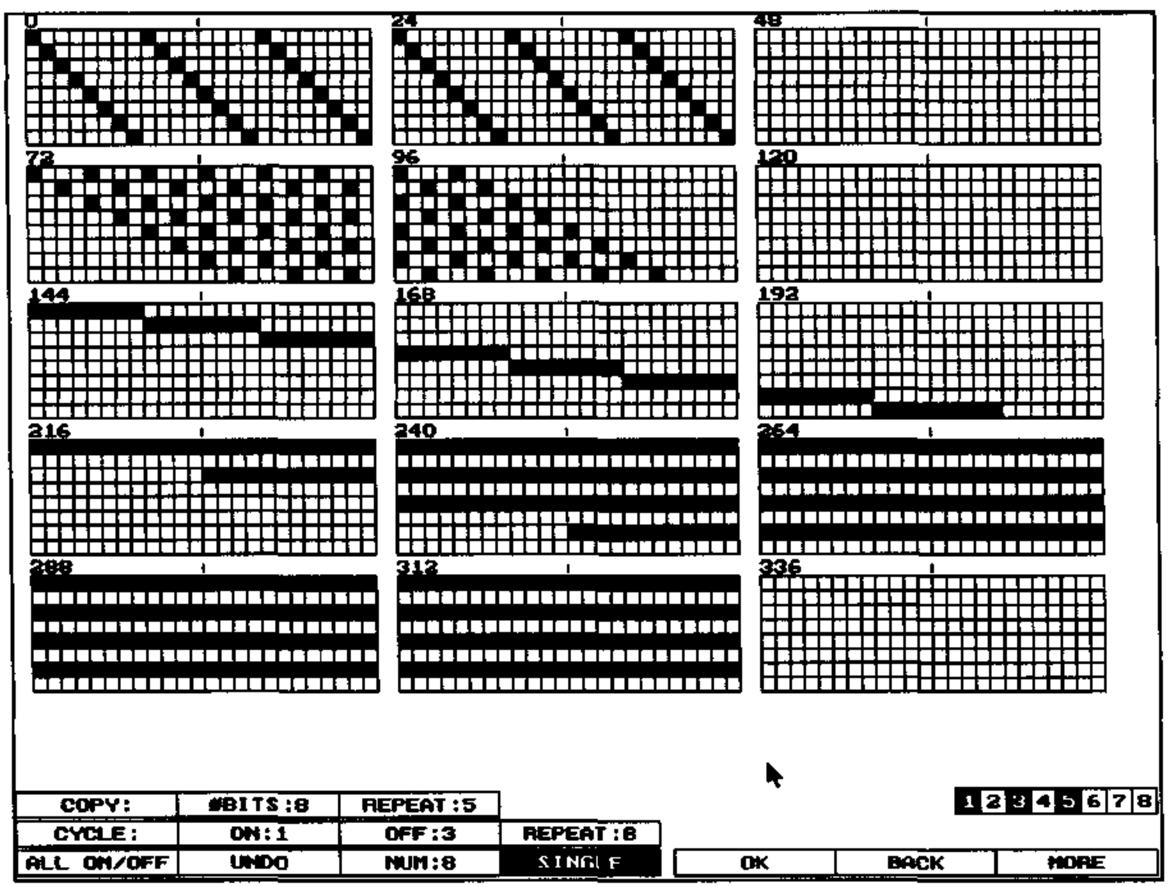
The next illustration shows an attempt to connect three keyframes with eases. The middle key frame does not mark a turn-around point, but rather a point along a general trend in direction. The operator clicked between the first two key frames with the left key, which created an ease-in / constant-velocity section. He then clicked between the last two keyframes with the right key, creating the constant-velocity / ease-out section. The sudden bend apparent in the position graph (top) and the equivalent large velocity discontinuity in the velocity graph (bottom) are unacceptable; the motor would probably stall at that point in the move.
This is a case where curve fit moves are more appropriate. The illustration below shows the same set of keyframes connected with the "FitAll" command. The operator first used the mouse to create double key frames at the first at last key frame positions, to force the ease-in / ease-out at the beginning and end of the move.
In general, eased moves are of somewhat limited usefulness. Baseline track moves, animatics, and shots requiring only very simple moves are good candidates, but it is very difficult to build up complex moves only with eases, especially if one or more axes place the camera significantly off its nodal point. Eased moves also tend to have a rather "robotic" look, which is generally inappropriate
62





for when trying to mimic a live action feel. We recommend that you first consider joystick or curve fit moves for most applications.
63

command: **EditBits**
where: Control Panel Screen
purpose: program a parallel output port to control on/off devices such as lights.
The illustrations shows the Bit Programming Screen. The bits are programmed in a way similar to scoring music. The "staves" show the move in one second intervals. At the upper left of each stave is the beginning frame count for that stave. The bits are stacked up vertically, bit 1 and the top and bit 8 at the bottom. Horizontally, each stave has 1 second worth of frames.
Down at screen lower right, there are eight boxes labelled "1" to "8". These boxes are used to manually turn various bits on and off. Highlighted bits 1, 3, and 5 are turned on. These bits are color-coded the same as the bits on the staves. For the "1 to 8" boxes:
LEFT mouse key turns the bit on.
RIGHT mouse key turns the bit off.
MIDDLE mouse key reverses the on-off sense of the bit.
If a relay is off when a bit is highlighted, click once with the middle mouse key.
64

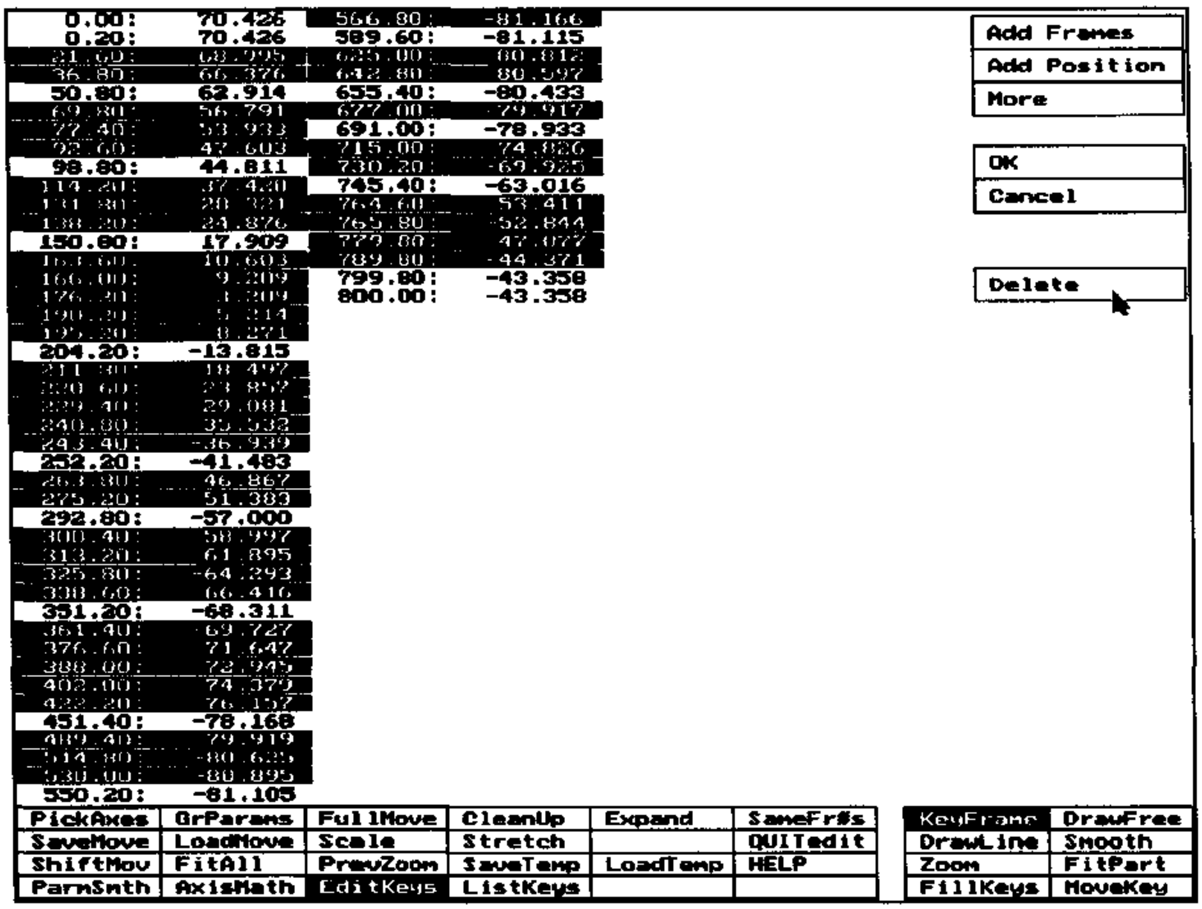


Several commands are available at the bottom of the screen.
SINGLE toggles individual bits on and off. Left key turns on, right key turns off. To program or erase multiple bits, hold down the left or right keys and drag the mouse.
NUM: turns bits on and off in consecutive groups. When the NUM: box is clicked the Calculator appears-enter the number of consecutive bits which should turn on or off. In this example, the operator entered the number "8". The sequence starting at frame 144 was programmed this way. The operator clicked bit 1 at frame 144, bit 2 at frame 152, bit 3 at frame 160, etc. Each time eight bits in a row were programmed on. Click with the left key to turn bits on, right key to turn bits off.
ALL ON/OFF turns all the bits **at and after** the cursor position on or off (left key or right key), all the way to the end of the move. In the illustration, the operator clicked bit 1 at frame 216, bit 3 at frame 224, etc. Initially, the bits were turned on all the way to the end of the move-in this case the operator then held down the right mouse key, positioned the cursor on bit 1 of frame 336, and then dragged the mouse downward across all the bits. This resulted in all the bits being programmed off from frame 316 to the end of the move.
CYCLE: is used to set up repetitive cycles. There are three parameters to the right: "ON:", "OFF:", and "REPEAT:". The parameters set how many bits on, how many off, and how many times the pattern repeats. To actually create the pattern, position the cursor at the starting frame and click. In the example, the operator programmed 1 bit "ON:", 3 bits "OFF:", and 8 repeats, and highlighted the "CYCLE:" box. He clicked bit 1 at frame 72, which created 8 repeats of 1 on, 3 off, starting at that frame. He then clicked bit 2 at frame 74, etc. The right key may be used to erase cycles. If you want the cycle to repeat until the end of the move, enter a very large "REPEAT:" value, such as 9999; the repeat will not go past the end of move.
COPY: duplicates a pattern 1 or more times. Two parameters are used: "#BITS:" sets how many consecutive bits should be duplicated, and "REPEAT" controls how many times the number of "BITS:" should be duplicated. The section from frame 0 through frame 47 was created with this command. First, the operator clicked the "SINGLE" command, and then one-by-one clicked in the first eight frames, starting with bit 1 and frame 0. He then programmed "#BITS:" to 8, "REPEAT:" to 5, and highlighted the "COPY:" box. Placing the cursor on bit 1 of frame 0, he held down the left key and dragged the mouse downward across all eight bits. As the mouse crossed each new bit, the eight bits to the right were duplicated 5 times. If you want copies to be made all the way to the end of the move, enter a very large "REPEAT:" value, such as 9999; the repeats will stop at the end of the move.
UNDO undoes anything which occurred previous to the last time either mouse key was released. If you make a mistake, be sure to use "UNDO" immediately.
MORE advances the displayed data to the next part of the move. **BACK** backs up the displayed data to the previous part of the move. **OK** returns to the Control Panel Screen.
65

In order for the bits to playback, the "BITS ON / BITS OFF' just under "VISUAL FR" must be clicked to "BITS ON". This box is a master enable/disable for bit playback.
The bits are "saved" on a special parameter axis named "BITS". If you want to save the bit data with the move, be sure to highlight this axis name when using "SaveMove". It is also possible to do a limited amount of move editing on this axis, using the Graphic Move Editor. Try using the "DrawFree" command to sketch in some move data on this axis, and then check the result with the "EditBits" command. This is one way to create random data on the bit axis. Several commands such as "Smooth" do not work with the bit axis.
Before the bits can actually be used to control solid state relays, etc., you must run the new "setrtmc.exe" program to assign the address of the hardware bit port you want to use. Setrtmc.exe should be located in the same directory as the RTMCxxx program. Typically the bit port used would be LPT1, your normal printer port at address 378 hexadecimal, although any parallel port may be used. Item #6 programs the port address, and whether "LO" or "HI" should result in the relay being on. If you want to disable the bit output, program an address of "0". When you have entered the correct address and polarity settings, use item #7 to save a new RTMC.ENV file. The pinouts for the LPT1 port connector is:
A DB25P connector is required. For most high quality solid state relays, you can directly connect the bit line to the "+" input on the relay, and ground to the "-" or "GND" input. Be sure the bit signals do not come in contact with the power lines on the other side of the relay. This is a good job for a professional technician, since mistakes can bring AC into your computer with disastrous results.
66

BIT	DB25 PIN
1	2
2	3
3	4
4	5
5	6
6	7
7	8
8	9
GND	18-25

command: **EditKeys**
where: Graphic Move Editor
purpose: allow key frames to be listed and edited in purely numeric form.
The above illustration shows the screen just after clicking the EditKeys command. To the left, the keyframes are listed by Visual Frame number and position. The same key frames show up as squares on the graph screen. Several command boxes are listed to the right. The key frames are from the "Selected" axis, with the highlighted name.
In practice, the operator highlights keyframes by clicking on them with the with left mouse key, and then clicks on a command. The command selected will only affect the highlighted key frames.
In the above illustration, most of the key frames are highlighted. The operator is trying to simplify the key frame "stack" by eliminating all the key frames closer than roughly 50 frames apart. The double key frames at frames 0.00 and
67



0.00:	70.426
0.20:	70.426
50.80:	62.914
98.80:	44.811
150.80:	17.909
204.20:	-13.815
252.20:	-41.483
292.80:	-57.000
351.20:	-68.311
451.40:	-78.168
550.20:	-81.105
589.60:	-81.115
655.40:	-80.433
691.00:	-78.933
745.40:	-63.016
799.80:	-43.358
800.00:	-43.358

800.00 force an ease-in and ease-out, and are retained so as not to loose the eases. As soon as the "Delete" menu item is clicked, all the highlighted key frames are eliminated, as shown to the right.
The illustration to the right shows the key frame list after using the "Add Frames" command. The Calculator appeared and the operator typed in "48." The highlighted key frames had 48.00 frames added to their frame numbers, which caused that part of the move to be shifted forward in time by 48 frames-the non-highlighted key frames were not affected. This is a useful alternative to the ShiftMov command for moves made exclusively with key frames.
It is possible to add negative numbers to the key frames, which has the effect of moving key frames to the left on the graph. Note that if the keyframe goes below 0.0 as a result of adding a negative number, the key frame will disappear.
"Add Position" operates the same as "Add Frames" except that the entered number is added to the positions of the highlighted key frames.
Individual key frames may be edited directly by clicking with the middle mouse key. Clicking with the middle mouse key causes a text cursor to appear, and the operator types in new key frame information. If the frame number is clicked, just the frame number is edited; if the position is clicked, just the position is edited; if the area between the frame number and position is clicked, both frame number and position may be edited-separate frame number and position with a space.
Note that the key frames shown on the ListKey screen are edited on a "scratchpad" that is independent of the actual key frames. The actual key frames are not changed until you click on the "OK" box. If you click on the "Cancel" box instead, none of the "scratchpad" changes will take effect, and the key frames will be as they were before clicking the ListKey command.
The "More" command is used to type in more key frames. A highlighted box appears after the last listed key frame. The operator types in a key frame number and position, and presses the keyboard "Enter" key. The frame number and position should be separated by a space. If only the key frame number is entered, followed the "Enter" key, the software will automatically insert the current move position for the frame as the key frame position. Key frames may be entered in any order, and do not have to be in "increasing frame number" sequence. If you want to see your typed key frames sorted into the list in order, exit the EditKeys command with the "OK" box, and immediately click the ListKeys command again. Be careful not to exit with "Cancel" box, or the typed key frames will be lost. To finish entering key frames, press the "Enter" key without typing a key frame.
Remember that after changing the key frames, you need to use either the FitAll or FitPart commands to conform the move to the key frames.
68

48.00:	70.426
48.20:	70.426
98.80:	62.914
146.80:	44.811
198.80:	17.909
252.20:	13.815
300.20:	-41.483
340.80:	-57.000
399.20:	-68.311
451.40:	-78.168
550.20:	-81.105
589.60:	-81.115
655.40:	-80.433
691.00:	-78.933
745.40:	-63.016
799.80:	-43.358
800.00:	-43.358

command: **Editor**
where: Control Panel Screen.
purpose: entry way from the Control Panel Screen into the Graphic Move Editor screen.
69

command: **Expand**
where: Graphic Move Editor Screen
purpose: Causes the selected axis to fill the entire screen. If the selected axis is all ready filling the entire screen, it returns to its previous place among several displayed axes. The selected axis is considered to be the single axis with its name highlighted.
EXAMPLE:
Several axes are displayed on the move editor screen. The operator wants to make a fine adjustment one of the axes. If the axis is not selected (name highlighted), he clicks inside of the axis frame to select the axis. Clicking on Expand causes the axis to fill the whole screen, making it possible to do fine editing adjustments with commands such as DrawFree, KeyFrame, etc. When the changes are make, he clicks Expand again to restore the selected axis to its previous place among all the displayed axes.
70

command: **Extremes**

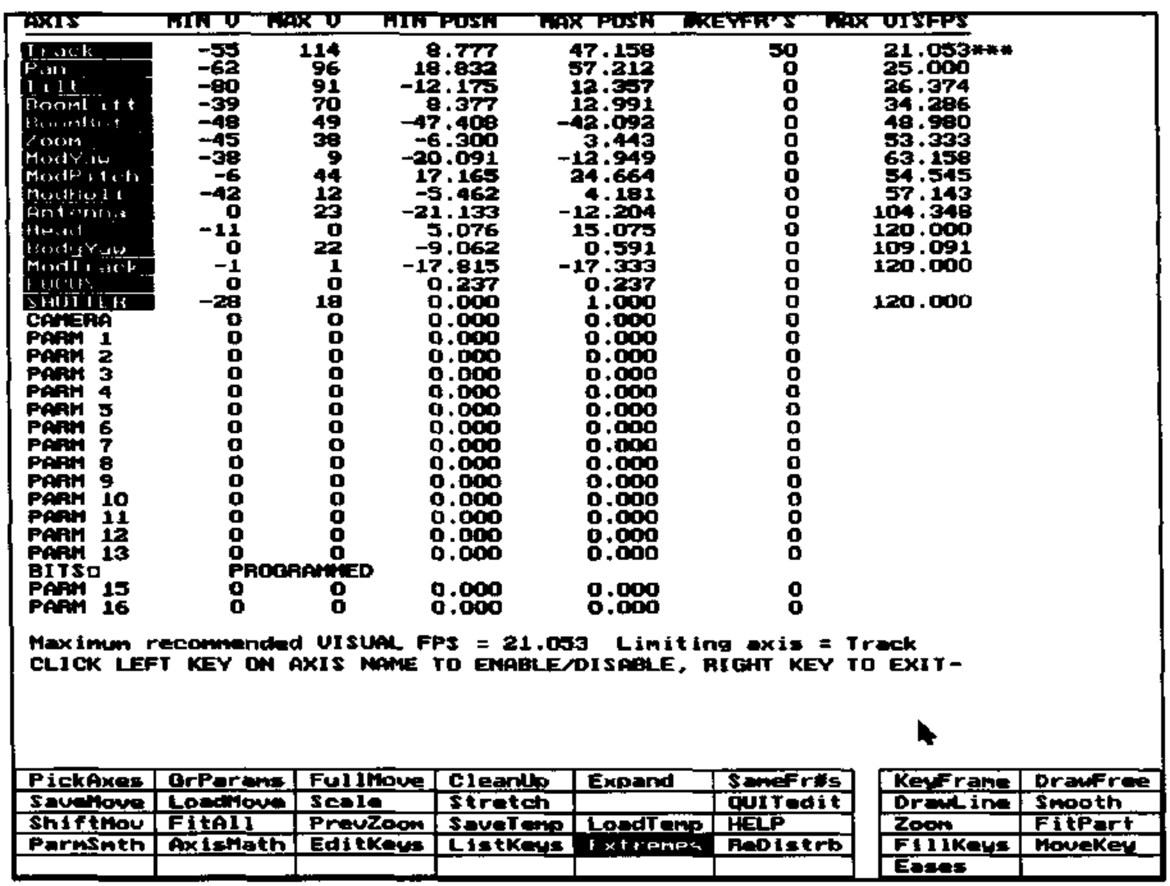
where: Control Panel Screen and Graphic Move Editor Screen purpose: Display a quick synopsis of the move data on all the axes.

The screen displays minimum and maximum velocities, and minimum and maximum positions for each axis.

#KEYFR's shows how many key frame are present on each axis.

MAX VISFPS is calculated by comparing the "Slew Speed in PPI" set with AxiSetup command to the largest velocity in the move data. A separate number is listed for each axis, based on an axis by axis analysis of the move data. Note that the Track axis has a maximum recommended FPS of 21.053, due to large increments in the move. The "***" marks this speed as being below the present "VISUAL FPS" setting on the control panel screen. MAX VISFPS is a recommendation only~the Software will not enforce this value. The operator must exercise some judgement in these matters; if the limiting velocity is reached after a long rampup section there may be no problem, but if the limiting velocity has little or no rampup, the axis may stall. The axis with the most limiting FPS is listed at the bottom of the screen. Axes without any movement do not have a MAX VISFPS number listed.

71



AXIS	MIN V	MAX V	MIN POSN	MAX POSN	#KEYFR'S	MAX VISFPS
Track	-55	114	8.777	47.158	50	21.053***
Pan	-62	96	18.832	57.212	0	25.000
Tilt	-80	91	-12.175	12.357	0	26.374
BoomLift	-39	70	8.377	12.991	0	34.286
BoomRot	-48	49	-47.408	-42.092	0	48.980
Zoom	-45	38	-6.300	3.443	0	53.333
ModYaw	-38	9	-20.091	-12.949	0	63.158
ModPitch	-6	44	17.165	24.664	0	54.545
ModRoll	-42	12	-5.462	4.181	0	57.143
Antenna	0	23	-21.133	-12.204	0	104.348
Head	-11	0	5.076	15.075	0	120.000
BodyYaw	0	22	-9.062	0.591	0	109.091
ModTrack	-1	1	-17.815	-17.333	0	120.000
FOCUS	0	0	0.237	0.237	0	
SHUTTER	-28	18	0.000	1.000	0	120.000
CAMERA	0	0	0.000	0.000	0	
PARM 1	0	0	0.000	0.000	0	
PARM 2	0	0	0.000	0.000	0	
PARM 3	0	0	0.000	0.000	0	
PARM 4	0	0	0.000	0.000	0	
PARM 5	0	0	0.000	0.000	0	
PARM 6	0	0	0.000	0.000	0	
PARM 7	0	0	0.000	0.000	0	
PARM 8	0	0	0.000	0.000	0	
PARM 9	0	0	0.000	0.000	0	
PARM 10	0	0	0.000	0.000	0	
PARM 11	0	0	0.000	0.000	0	
PARM 12	0	0	0.000	0.000	0	
PARM 13	0	0	0.000	0.000	0	
BITS□	PROGRAMMED					
PARM 15	0	0	0.000	0.000	0	
PARM 16	0	0	0.000	0.000	0	

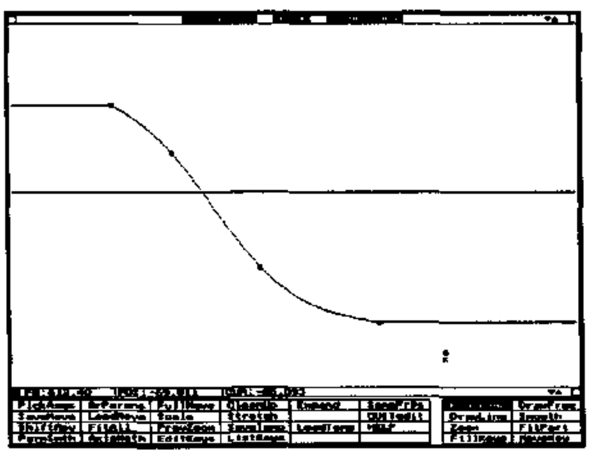
Maximum recommended VISUAL FPS = 21.053 Limiting axis = Track

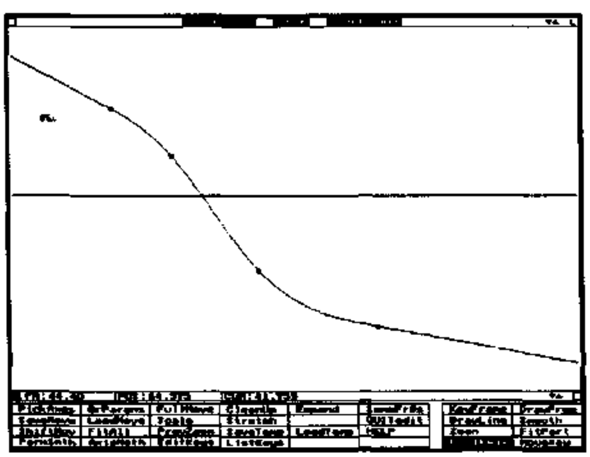
CLICK LEFT KEY ON AXIS NAME TO ENABLE/DISABLE, RIGHT KEY TO EXIT-

PickAxes	GrParams	FullMove	CleanUp	Expand	SameFr#s	KeyFrame	DrawFree
SaveMove	LoadMove	Scale	Stretch		QUITedit	DrawLine	Smooth
ShiftMov	FitAll	PrevZoom	SaveTemp	LoadTemp	HELP	Zoom	FitPart
ParmSmth	AxisMath	EditKeys	ListKeys	Extremes	ReDistrb	FillKeys	MoveKey
						Eases	

The dedicated "Bits" channel is special case, and is only reported to be "Programmed" or "Not programmed" depending of whether or not any bits are programmed.
Initially, any axis which is highlighted on the Control Panel Screen is highlighted on the "Extremes" screen. You can highlight / unhighlight axis names directly on the "Extremes" screen by clicking the name; when you return to the Control Panel Screen, these axis names will be enabled and set to PLAY. This provides a convenient way of making sure that all axes with move data are enabled. "Parameter" axes can not be highlighted.
To exit this screen, click the right mouse key.
72

command: **FillKeys**
where: Graphic Move Editor
purpose: add holds to key frame moves in front of the first key frame and after the last key frame.
The left and right mouse keys are used to add either static holds or velocity extensions in the areas before the first key frame and after the last key frame.
To use the command, place the cursor anywhere in front of the first key frame, or after the last key frame, and click the left or right mouse keys:
LEFT builds a zero velocity hold in the area clicked.
RIGHT extends the move at the velocity at the nearest key frame.
If you click the right key, the move will only actually be extended if the velocity at the nearest key frame is not 0. An extension at 0 velocity is the same as a hold.
The above illustrations show the same move before and after velocity extensions were added. The operator clicked the right mouse key in the area just after the last key frame and just before the first key frame. Both ends of the move now blend into the velocity at the nearest key frame, rather than starting and stopping at a substantial velocity.
73

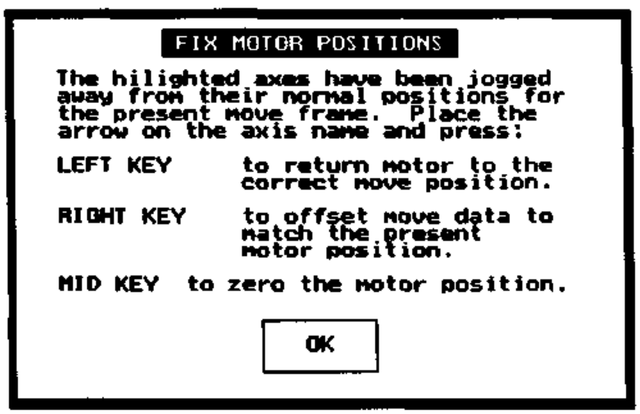




command: **FitAll**
where: Graphic Move Editor
purpose: in-between all the key frames for the selected (name highlighted) axis.
The key frames are not in-betweened until the FitAll command is used. FitAll always in-betweens all the key frames. The variant FitPart command can be used to in-between only selected sets of key frames.
There is short cut method to force a FitAll to occur, which is only available when the KeyFrame command box at screen lower right is highlighted, and the cursor is displayed as "[]K": Press and hold down the MIDDLE mouse key, and then tap the LEFT mouse key. Be sure to hold down the MIDDLE key until you tap the LEFT key, otherwise the normal middle key function of erasing the nearest key frame will occur.
74

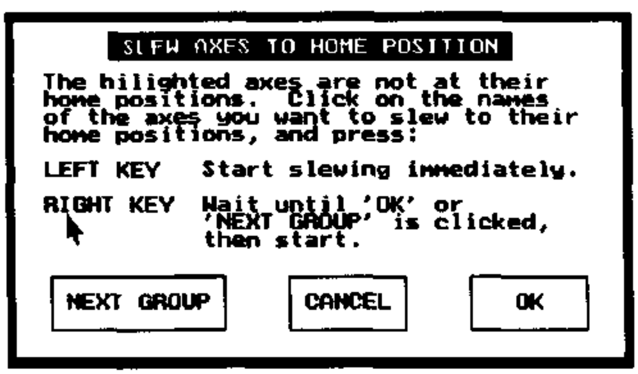
command: **FitPart**
where: Graphic Move Editor screen
purpose: do a curve-fit in-between only between certain key frames, rather than through all the key frames, as with the FitAll command.
The FitPart command uses a box to frame the key frames to be in-betweened. The cursor changes to a box shape, similar to the Zoom command cursor.
The LEFT mouse key expands and contracts the lower right corner of the box. When the LEFT key is released the in-betweening takes place. There must be at least two key frames within the FitPart frame.
While holding down the LEFT mouse key, the entire box cam be moved by also pressing the RIGHT mouse key. Remember, as soon as the LEFT key is released, the in-betweening takes place, although you may press and release the RIGHT key as often as you like.
The top and bottom of the FitPart framing box have no real meaning; any key frames located inside of the left and right hand sides of the box will be in-betweened regardless of whether they are inside of the top and bottom frame lines.
The frame numbers for the positions of the left and right hand sides of the box are displayed at frame lower left.
75

command: **FixPosn**
where: Control Panel Screen
purpose: axis position management.
There are several actions which can moves axes off the path of the move. These include the MousJog command, using the Jogbox, editing the move data so the move no longer reflects the present motor position, etc. Under normal circumstances, the Software will always insist on returning the axes to their proper positions before running the move, without any special intervention by the operator. FixPosn provides a way of doing this in a very deliberate manner, and is especially useful when the motion control rig is surrounded by lights and other objects which might get knocked down if the axes where to indiscriminately head to the proper move position.
The "normal position for the present move frame" is the position presently listed in the "PRESENT" box towards the lower left of the Control Panel Screen.
To start axes heading towards the "normal positions" click on the axis names with the LEFT mouse key. Each axis will start as soon as its name is clicked.
As an alternative to returning the motor to the move position, you can literally shift the move position to match the present motor position, by clicking the axis name with the RIGHT mouse key. This simply offsets the entire move data for that axis, so that the position for the PRESENT frame matches the current motor position.
Use the MIDDLE mouse key to set the axis motor position to "0.0".
76

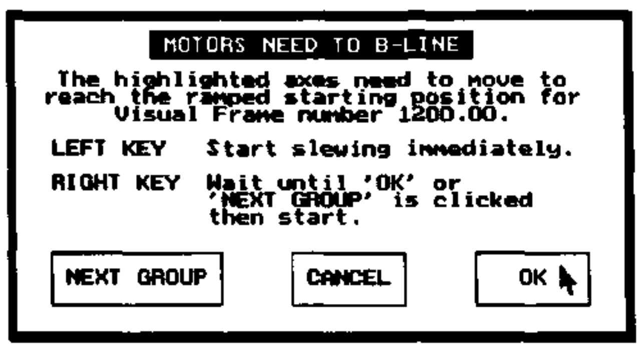


command: **FullMove**
where: Graphic Move Editor Screen
purpose: draw the move graph so that the entire move is displayed on the screen.
Only the selected (name highlighted) axis is affected.
If you want to display the full move for all the graphed axes, first use this command to display the entire move for the selected axis, and then use the SameFr# to cause all the graphed axes to display the same left and right frame numbers as the selected axis.
77

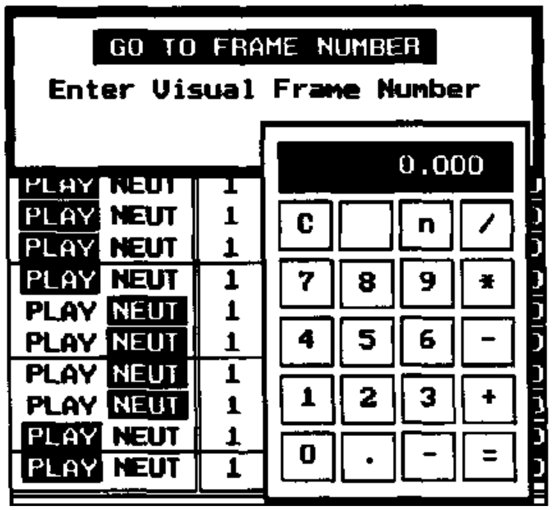
command: **GoHome**
where: Control Panel Screen
Purpose: to send motors to their home position. Home position is always assumed to be position "0.0".
Axes may be sent home to position "0.0" either singly or in groups. The simplest thing to do is to hold down the left mouse key while dragging the cursor over the names of all the axes you want to return home. Whenever an axis name is touched while the left key is pressed, the axis will start moving immediately.
I some cases, obstacles around the camera system will make it necessary to start the axes running in a particular sequence. You can start axes moving in small groups by clicking the names with the right mouse key. The right key doesn't cause the axis to start moving, but changes the highlight around the axis name to indicate it is "selected" to return home. Alternate clicks with the right key select and un-select the axis.   When the "NEXT GROUP" box is clicked, all the selected axes will start homewards simultaneously as a group. As soon as one group starts moving, you can start selecting the next group.
78



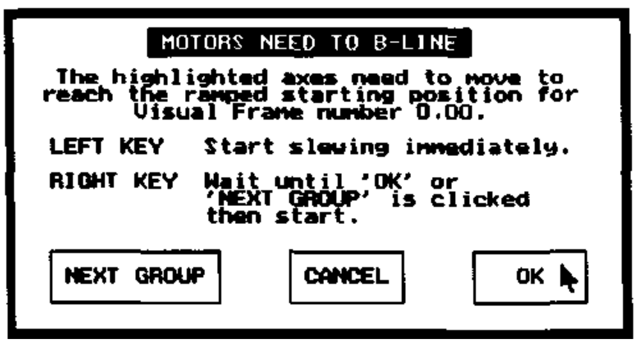
command: **GotoEnd** where: Control Panel Screen
purpose: send all the axes to the frame number shown in the Control Panel "END" box, in preparation for a live action playback in the reverse direction.
The position is not the exact position for the data, but takes into account the amount of "PRE ROLL" displayed at screen lower left.
Use the GotoFr# command to send the axes to exact frame positions, without adding in the PREROLL distance.
Only the axes with highlighted names will respond. EXAMPLE:
The operator wants to play the move in reverse. He wants the move to start the instant he hits the "REV" button, without having to wait for the axes to go to the starting position. He uses the GotoEnd command to move all the axes to the starting position, PREROLL included. Since the axes don't have to do any positioning when the REV button is hit, the move start immediately.
79



command: **GotoFr#**
where: Control Panel Screen
purpose: position the axes at a specific frame number within the move.
The axes go to the exact position for the specified frame number.
This command does not take into account PRE ROLL or POST ROLL; it goes directly to the visual center of the photographed "blur image" for the specified frame.
80



command: **GotoStrt**
where: Control Panel Screen
purpose: send all the axes to the frame number shown in the Control Panel "START[1] box, in preparation for a live action playback in the forward direction.
The position is not the exact position for the data, but takes into account the amount of "PRE ROLL" displayed at screen lower left.
Use the GotoFr# command to send the axes to exact frame positions, without adding in the PREROLL distance.
Only the axes with highlighted names will respond.
EXAMPLE:
The operator wants to play the move in the forward direction. He wants the move to start the instant he hits the "FWD" button, without having to wait for the axes to go to the starting position. He uses the GotoStrt command to move all the axes to the starting position, PREROLL included. Since the axes don't have to do any positioning when the FWD button is hit, the move starts immediately.
81



command: **GrParams** where: Graphic Move Editor
purpose: Set the limits for the top and bottom positions visible on graph of the selected axis. Also, change the upper limit for the length of the move.
Just as the left and right limits of the graph are specified by the frame number surrounding the graph name at the top of each axes graph, the top and bottom "field of view" of the graph is specified using the GrParams command. On the graph, the left and right limits are expressed in terms of frames; the vertical limits are specified as position or velocity, depending on whether the graph is displayed in position (POS:) mode or velocity (VEL:) mode.
This command only affects the selected (name highlighted) axis.
This command is most useful when you are making moves from scratch. Set the maximum velocities or positions to "fit in" the kind of move you plan to make, and then do key-framing, drawing, etc. Any or all of the parameters may be changed to get the desired framing. Practically speaking, only the Velocity or Position parameters would be initially set, since as soon as the first approximation move is made, the graph can be "Unlocked" ("U" visible in the upper right hand corner) to automatically frame further move changes.
"Visual Fr's in Move" simply sets how long the operator wants the move to be. It doesn't stretch or contract the shape of the move; it just cuts the move off at the specified frame number. Unlike the first four parameters, this affects all the axes. If you increase this number, be sure to check the graphs of all the axes to make their moves do not "slam" to a stop at the previous maximum move frame.
82

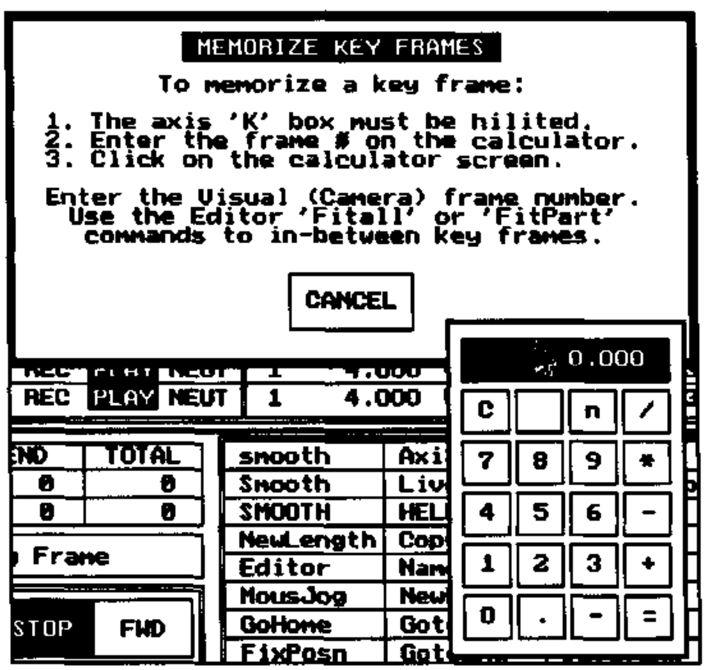
GRAPH SETTINGS FOR AXIS Dolly		RANGE
Max Position	100.000	no limit
Min Position	-100.000	no limit
Max Pos Velocity	255	-2048 to 2047
Max Neg Velocity	-255	-2048 to 2047
Visual Fr's in Move	720.00	1.000 to 3160.000

OK CANCEL

command: **HELP**
where: Control Panel and Graphic Move Editor screens
purpose: to provide on-screen explanations about each command.
From the Graphic Move Editor, first click on "HELP" and then on the name of command you would like to see explained.
From the Control Panel Screen, you can also click on specific areas of the screen to get help information; for instance, "REV STOP FWD", Frame Number, axis name, and other blocks all produce help explanations.
83

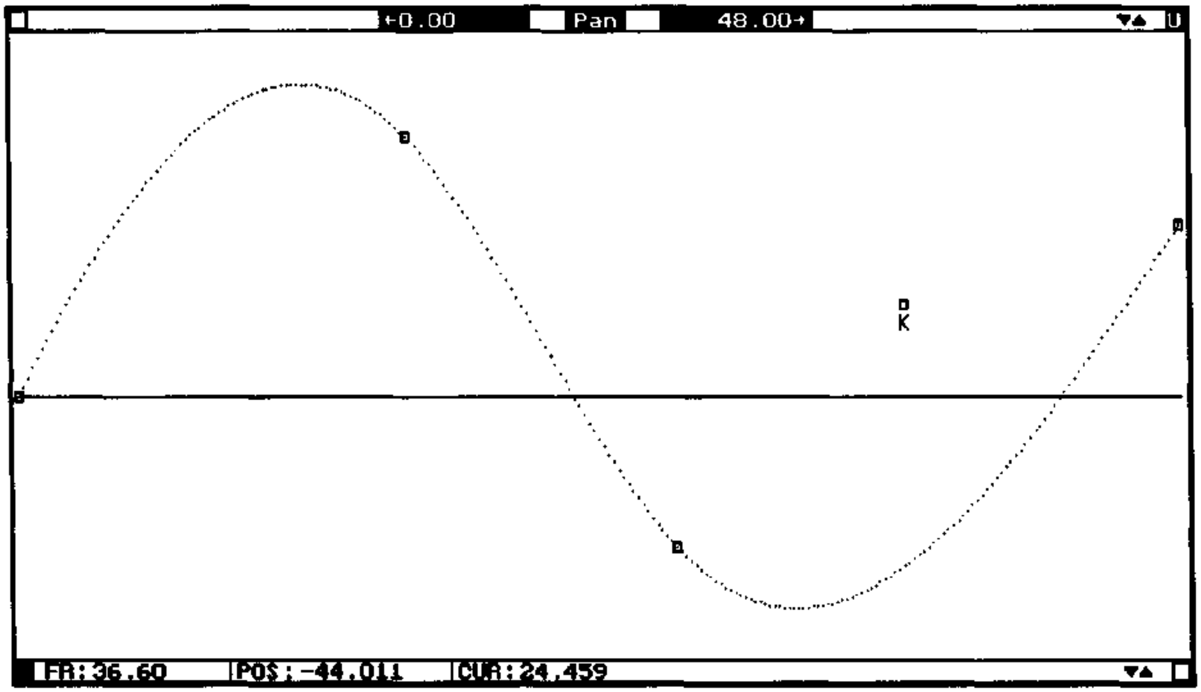
command: **JogBox**
where: Control Panel screen
purpose: activate the Jogbox.
See "Using the Jogbox/Joystick" in the index.
To exit the Jogbox command, click the mouse or tap the spacebar.
84

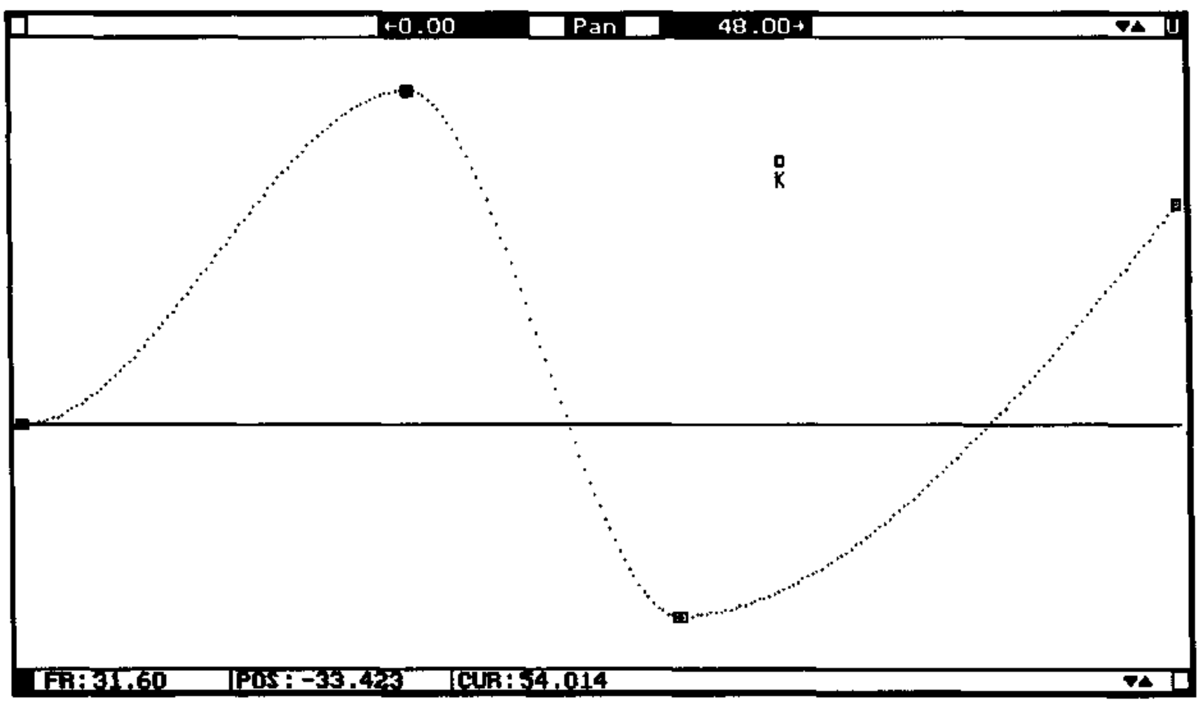
command: **KeyFrame**
where: Control Panel and Graphic Move Editor screens
purpose: memorize key frames.
Key Frames are points along the move. Each key frame has two parts: a position, and a frame number for the position. When there are two or more key frames, the Graphic Move Editor FitAll or FitPart commands are used to in-between the key frames.
Key frames show up as squares on Graphic Move Editor position graphs. They are only visible when the graph is displayed in position mode, with "POS:" visible at the lower right section of the graph.
Control Panel Version:
Key frames may be recorded at any time. The position recorded is always the present motor position; the key frame number is entered using the screen shown in the illustration. Note that only those axes with their "K" box highlighted will have a key frame recorded. The "K" box is located just to your right of the axis name, and is highlighted by clicking with the mouse.
Note that the MousJog command has a special "KeyFrame" prompt located inside of its prompt box; use this special box to record keyframes when you are "MousJogging." Use the "KeyFrame" box in the Control Panel menu area at any other time.
Graphic Move Editor Version:
Key frames may only be created when the graph is displayed in position mode, with "POS:" displayed at graph lower left.
When the KeyFrame command is clicked, the cursor changes to the "[]K" shape.
Key frames are created, moved and edited by clicking with the mouse. All three mouse keys have specific functions, as well as combinations of mouse keys.
85



The "single key" mouse functions are:
LEFT: create a key frame exactly at the position of the cursor position, as shown in the "CUR:" box at graph lower left.
MIDDLE: create a key frame exactly on any existing move curve, at the frame number shown in the "FR:" at graph lower left. The vertical position of the cursor does not matter, and the cursor will "jump" onto the curve before memorizing the key frame.
RIGHT: Delete the key frame nearest to the cursor. Be careful, since each subsequent press will delete the nearest key frame, until finally all the key frames are deleted.
Combinations of mouse keys perform additional functions:
Press and hold the MIDDLE key, and then tap the LEFT key: to force an immediate FitAll in-between of all the key frames, Be sure to hold on to the middle key until you tap the left key, otherwise the normal middle function of deleting the nearest key frame will take place.
Press and hold the MIDDLE key, and then tap the RIGHT key: to create a double key frame at the nearest existing key frame. Once again, hold down the middle key until you tap the right key. The newly created key frame will be at exactly the same position as the existing key frame, but just one frame away in the direction of the cursor. Such pairs of key frames are very useful for preventing over-shoots, and forcing eases.
Making good key frame moves requires experience and practice. The main problem with key framing is the tendency of the curve to "over-shoot" and go past key frame positions which you would like be the extreme limits of motion.
The most useful tool for preventing over-shoots is the double key frame technique described above. The two graph illustrations show "before and after" use of double key framing to prevent over-shoots at two extreme position in a move, and to force an ease out from the first key frame.
The first graph shows a move made up of 4 key frames. The ^{n}[]K" cursor shape reminds us that the Key Frame command is selected. The small squares on the graph mark the actual key frames. They were in-betweened using the FitAll command (or optionally "chording" the middle and left mouse keys). The move starts at speed from the first key frame, overshoots the second and third key frames, and stops at speed at the fourth key frame.
The second graph shows the result of "double keying" the first three key frames, as indicated by the boxes right next to each other. The "middle then right key" chord was used, after first bringing the cursor near the key frames to be doubled. The move now eases in from the first key frame, and respects the next two turn-around points. The non-eased stop at the last key frame remains, but could be changed into an ease out with another double key frame at that point.
Note that the effect of new key frames does not take place until you use FitAll command, FitPart command, or use the "middle then left key" chord while within the Key Frame command.

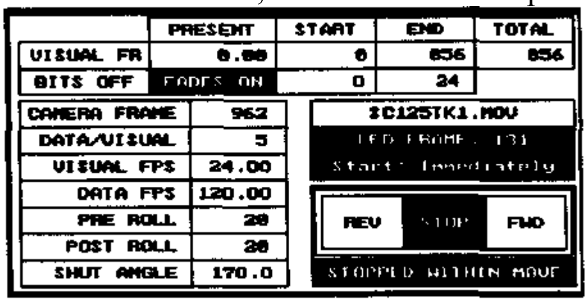
Move made by in-betweening four key frames, shown as squares. Notice the overshoots at the two middle key frames.
Move after adding "double key frames" to the first three original key frames. The m ove now eases in, and doesn't overshoot the middle key frames.
87





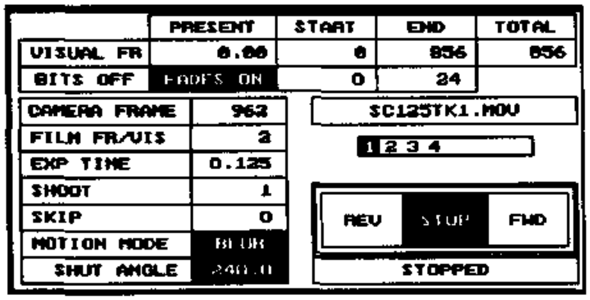
command: **ListKeys**
where: Graphic Move Editor screen
purpose: display the frame number for each key frame near the key frame boxes on the graph.
ListKeys displays the corresponding key frame number near each key frame box. This is a very transient command, since the frame numbers will be erased whenever the graph is redrawn due to a resize or shift between position and velocity modes.
88

command: **LiveStop** where: Control Panel screen
Clicking on this command toggles the lower part of the screen back and forth between the live action and animation versions of the Control Panel Screen. The two versions look almost the same, and share most of the same functions. The difference is at the lower left corner of the screen, which has different parameters for the two screen types.



Specialized Live Action section of the Control Panel Screen.
Specialized Animation section of the Control Panel Screen.

The live action version displays parameters primarily important to live action work.
DATA/VISUAL sets how many velocity changes will be recorded for each VISUAL (or camera) frame. The example shows "5", which is the recommended value for most purposes. This means that the axis speed changes velocity 5 times for each photographed frame in the move. Also, five separate velocity values are recorded in memory for each frame. Although values as small as 1 may be used, 5 provides excellent smoothness and allows for faster accelerations than lower values.
VISUAL FPS is the film frames per second. "DATA FPS" is how fast the recorded velocity changes are played back. VISUAL FPS is always equal to the DATA FPS divided by DATA/VISUAL
To change the DATA/VISUAL value, click on the number, and type in a new value on the calculator pad which appears (enter the new number by clicking on the calculator screen). DATA FPS and VISUAL FPS change in preset steps by clicking with the mouse: the LEFT key decreases, the RIGHT key increases. DATA FPS and VISUAL FPS always change together, and maintain the same proportion to each other for any given DATA/VISUAL value.
PRE ROLL and POST ROLL control how much motor ramp up and ramp down occur during live action shooting passes. The larger the number, the more extended the ramps. The number is actually a measure to time; the number of seconds taken by the PRE or POST ROLL is equal to the number divided by 120, or 1/6 second for a value of 20. The axes back off just the right distance to wind up at the correct move position at the end of the PRE ROLL and pass up the actual last move position by an amount proportionate to the POST ROLL If you don't want PRE or POST ROLLS, set the values to 0 (and watch out for motor stalls).
SHUT ANGLE shows the effective shutter angle. If the number is not highlighted, the shutter angle is equal to the actual shutter angle of the camera. If the number is highlighted, the Software will
89


PRESENT
START
END
TOTAL
VISUAL FR
0.00
0
856
856
BITS OFF
FADES ON
0
24
CAMERA FRAME
963
FILM FR/VIS
2
EXP TIME
0.125
SHOOT
1
SKIP
0
MOTION MODE
BLUR
SHUT ANGLE
240.0
SC125TK1.MOV
1 2 3 4
REV
STOP
FWD
STOPPED

simulate shutter angles wider than the actual shutter by making "whip-around" camera exposures. Click the number with the left mouse key to increase simulated shutter angles, and with the right mouse to decrease simulated shutter angles. Click with the middle key to set the shutter angle to normal.

The specialized section of the Animation Control Panel screen contains **animation-related parameters.**

FILM FR/VIS reports how many separate film frames will be photographed for each position in the move. Complex sequences of exposures can be set up for each move position, up to 8 separate frames may be exposed for each position. In this example a total of 2 film frames will be exposed, possible due to a front-light/back-light exposure setup. Just above the "REV STOP FWD" control, we see that 2 exposures are planned, and highlighted exposure #\ is next up. See the "ANIMATION" section in this manual for more information on this subject.

EXPOSURE TIME is simply the next exposure time for the next exposure. Click on this number to enter the exposure set up prompt.

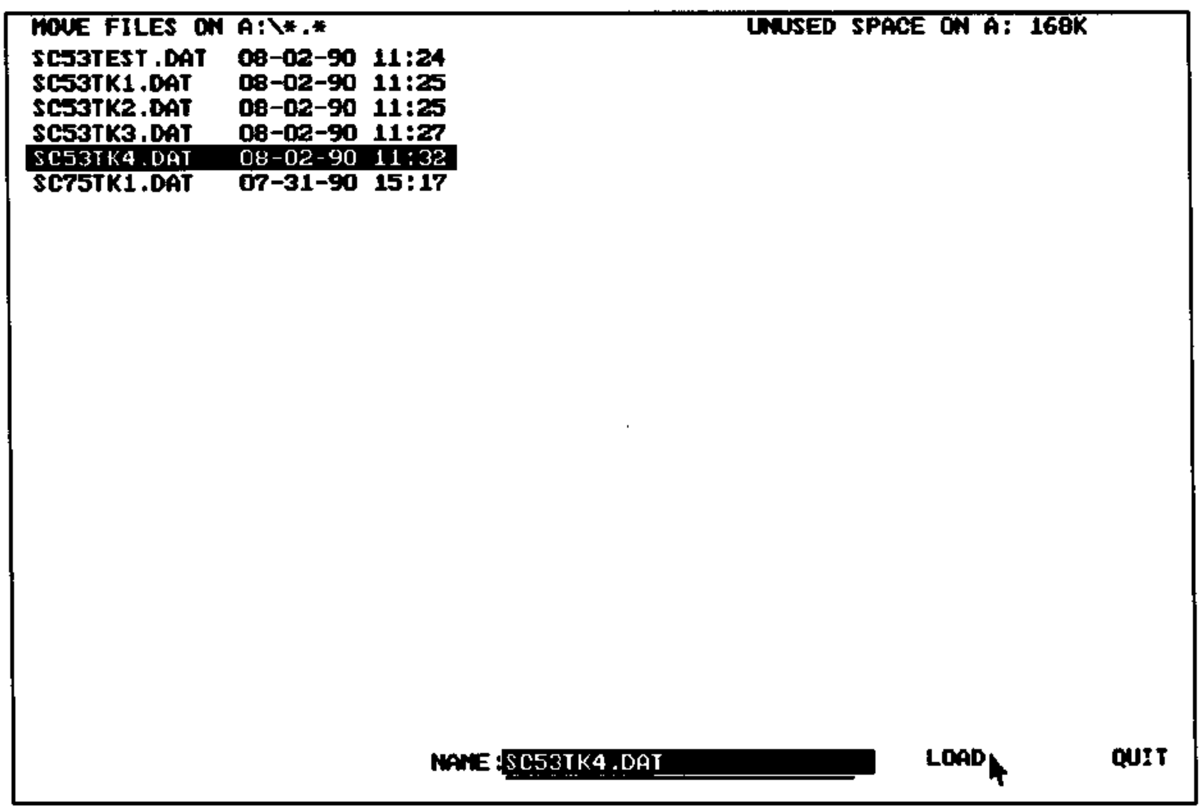
SHOOT and SKIP allow for shooting cycles. In this example, we are shooting a 24 frame cycle: we will SHOOT 1 frame, and then SKIP 23. That starting frame for the cycle may be staggered by starting each pass on a different PRESENT or START frame.

MOTION MODE may be clicked between BLUR and STILL, depending on whether the operator wants "go-motion" (BLUR) or old fashioned "no-motion" (STILL) exposures.

As in the Live Action version of this screen **SHUT ANGLE** sets the simulated shutter angle, and is changed by click various mouse keys.

90

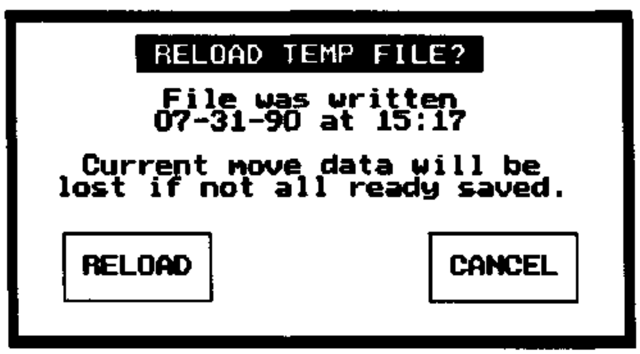
command: **LoadMove**
where: Control Panel and Graphic Move Editor screens
purpose: load moves into memory from the disc drive.
The illustration shows the prompt screen. At the upper left we see that disc "A:" will be used. To the right, the amount of storage space available is shown. To change to another disc drive or directory, click on the "MOVE FILES ON A:" line, and select a different drive or directory from the menu that appears. The Software always remembers the last drive on which a move was saved, and will keep that setting until you change it.
Just below that, the names of all the files on disc "A:" are listed.   At screen bottom, the "NAME:____" area is used to enter the move name. There are two ways to enter a name: click on
the "NAME:____" area and type in a move name, or click on one of the move names in the list at
screen upper left. In this example, the move name was selected by clicking on a name in the list, which caused the name to appear on the "NAME:____" line.
Click "LOAD" when the name is correct. Not just the move data will be reloaded, but also the entire Control Panel setup in effect when the move was saved, to include joystick setups, AxiSetup parameters, etc. If you want to over-ride these new settings with more current settings, use the LoadSetup command to retrieve the settings last saved with SaveSetup.
91



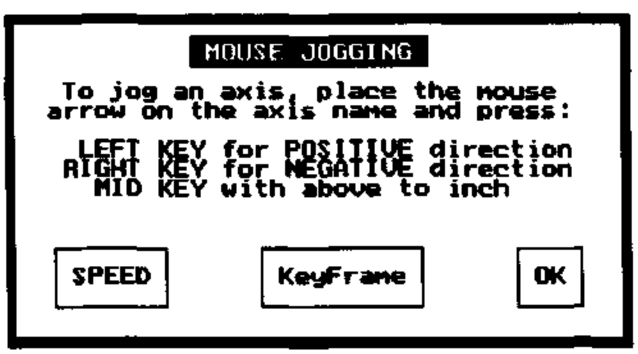
Merging Moves.
The LoadMove command does not automatically erase the previous move from memory. Any axis in a newly loaded move will over write the previous move data for the same axis. However, any preexisting move data on axes not saved in the newly loaded move file will remain as before. For this reason, **use the "New-Move" command just before "LoadMove" when you want to completely replace an old move with a new move.**
When you deliberately merge two moves together, always view the graphs to check for discontinuities in the move, which is a serious problem when the two moves are of different frame counts. The "FillKeys" command provides one possible way of extending "short" move files.
After loading a move file, the "Extremes" command provides a convenient way of characterizing which axes contain move data, what the extreme positions are, etc. If you click the axis names on the "Extremes" screen, the same axes will be enabled and on PLAY when you return to the Control Panel Screen.
92

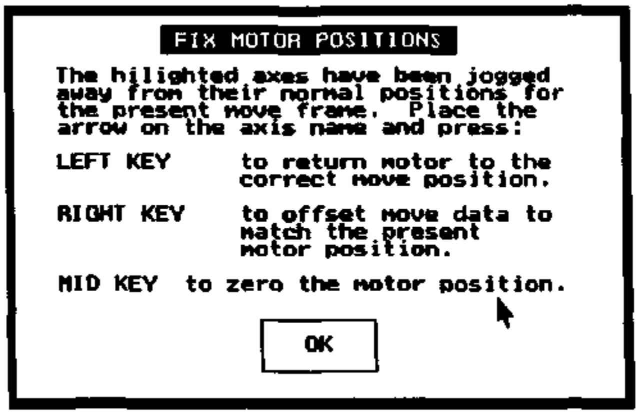
command: **LoadSetup** where: Control Panel Screen
purpose: reload the motor performance settings saved in the "Axes.set" file with the SaveSetup command.
Each time the Software boots up, the information that was saved in the "Axes.set" file is loaded. LoadSetup provides a way of reloading at any time.
When a move is loaded using the LoadMove command, the motor and joystick parameters in effect when the move was saved will be reloaded. LoadSetup provides a method of over-writing this old information with more recent settings.
93

command: **LoadTemp**
where: Control Panel and Graphic Move Editor screens
purpose: reload the special "temporary" move data file, which was saved with the SaveTemp command.
The move data saved with the last use of the SaveTemp command is reloaded into memory.
The date and time the last SaveTemp file was saved is displayed.
CAUTION: the existing move will be overwritten, and lost unless it was saved permanently on disc with the long-term SaveMove command.
LoadTemp only reloads the last file written with SaveTemp; it cannot be used to load normal move data files saved with SaveMove.
EXAMPLE:
The operator has a successful move, but wants to make one small change, just to see if it works out. He uses the SaveTemp command to rapidly save the existing move in the "temporary" file, then tries out the change. If the change isn't for the better, he uses the LoadTemp to quickly restore the last version of the move.
94



command: **Mousjog**
where: Control Panel Screen
function: Jogs motors using the left and right mouse keys as negative and positive direction keys.
Place the mouse arrow on the axis name and press the left mouse key to jog the axis in the negative direction, and the right mouse key to jog the axis in the positive direction.
The axes will accelerate according to the "Slew Accel" factor shown in the AxiSetup command. Their will reach their normal slewing speed, as set type "SlewPPI" factor in the AxiSetup command.
The axes may be "inched" a single pulse at a time by holding down the middle mouse key while either the left of right keys are pressed.
The "SPEED" box causes the axis to jog at about 1/3 its normal speed. When you click on the "SPEED" box, the last axis that was jogged will run at the reduced speed; no other axes will be affected.
The "KeyFrame" box provides a convenient method for taking key frames while jogging. Click on the box to produce the keyframe entry screen, type in the key frame number, and click on the calculator screen. A keyframe will be created for each axis which has its "K" box highlighted. The position for the key frame will be the current motor position. To highlight the "K" box, just click in the "K" column to the right of the axis names.
After the "OK" box is clicked, another menu appears which allows you to "reconcile" your jogging activity. Just click on the "OK" box if you don't want to use any of the selections.
To return axes to their exact move position for the "PRESENT[1] frame number, as shown in the "PRESENT[1] box, click on the axis name with the left mouse key. You can drag the mouse with the left key pressed to start multiple axes on their way.
The middle mouse key sets the motor position
to "0.0" on one axis at a time.   For safety, dragging does not work for this key; you must click
individually on each axis name.
The right mouse key shifts the move data so that the present motor position will become the
95




FIX MOTOR POSITIONS
The hilighted axes have been jogged away from their normal positions for the present move frame. Place the arrow on the axis name and press:
LEFT KEY to return motor to the correct move position.
RIGHT KEY to offset move data to match the present motor position.
MID KEY to zero the motor position.
OK

new position for the frame number shown in the "PRESENT" box. The shape of the move data is not changed in any way; the move is simply shifted over to match the new motor position.

EXAMPLE 1:

You want to set motor home positions. Click on the MousJog menu item. One by one, place the cursor on the names of the axes you want to jog, and press the left or right mouse keys to jog. Use the middle mouse key in combination with the left and right keys to "inch" the axes into their home positions. Click the "OK" box, which causes the "FIX MOTOR POSITIONS" prompt to appear. One by one, place the mouse cursor on the names of the axes you want to set to home position, and tap the middle mouse key. The position will be set to "0.0." Note that you must tap individually on each axis; the mouse can't be "dragged" for this function.

EXAMPLE 2:

You have an approved move. For some reason, the model has to be moved 12" further down the track, which throws off a critical close-up at frame 300. Use the "REV STOP FWD" control to run the move up to the critical area around frame 300. Click on MousJog and jog the track so the framing is correct. Click "OK" to bring up the "FIX MOTOR POSITIONS" screen. Click the right mouse key on the TRACK name. The move data will be automatically adjusted to accommodate the new position.

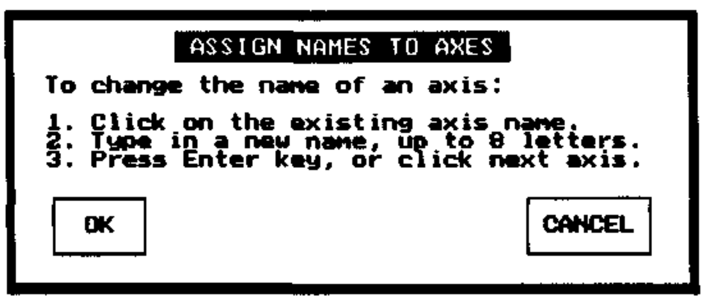
Note that although actually running the move up to frame 300 is a nice touch, it would have sufficed to simply click on the "PRESENT[1] box, enter "300", jog the track to the correct new position, and then click the right mouse key from the "FIX..." prompt. Even though this would result in several other axes being "off move," the axes would return to their correct "PRESENT" position before starting the next move run.

Alternate solution: use the Scale or Stretch commands in the Graphic Move Editor.

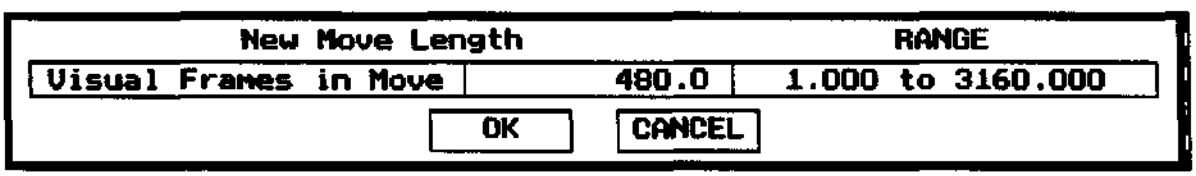
%

command: **MoveKeys**
where: Graphic Move Editor screen
purpose: move individual or groups of key frames to new positions on the graph.
This new version of MoveKeys is significantly different than the previous version. It accomplishes visually what the EditKeys command accomplishes numerically, and is a good alternative to the ShiftMov command for moves made exclusively out of key frames.
This is a "two part" command. The operator first selects one or more key frames using the framing device, which operates the same as the Zoom and FitPart framing device. As soon as all the mouse keys are released, the selected key frames are highlighted green, and the individual mouse keys may then be used to move the key frames around the screen.
While the key frames are highlighted green the mouse keys have the following functions:
LEFT slides the selected key frames strictly left and right along the frame number axis; the positions are not changed. The current frame number of the left-most key frame can be read as the "FR:" number on the window data box at graph lower left.
MIDDLE slides the selected key frames strictly up and down along the position axis; the original key frame numbers are not changed. The current position of the left-most key frame is shown on the "POS:" display at graph lower left.
RIGHT locks the key frames in their new position. The color returns to orange.
If the cursor goes outside the graph before clicking the right mouse key, the key frames will snap back to their original positions. This provides an escape mechanism. Unless you want to cancel the changes, be careful not to accidentally move the cursor outside the graph until you click the right mouse key.
Remember to use FitPart or FitAll after moving the key frames to conform the move to the new key frame positions.
After moving key frames, it is often necessary to do some minor tweaking of individual key frames to restore the same general sense of the move that existed before the shift, since changing the relative positions of moved and non-moved key frames sometimes changes the "tension" of the curve and introduces dips and wiggles which weren't originally present. It is usually best to check both the position and velocity graphs before and after moving key frames.
97

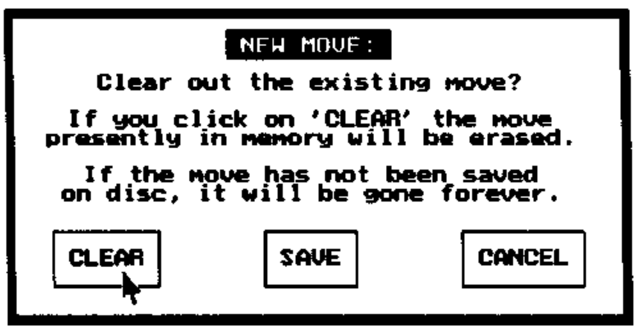
command: **NameAxis**
where: Control Panel Screen
purpose: allows the operator to change the axis names.
Click on the name of the axis. The axis name goes blank, and a cursor appears. Type in the new axis name, which must be 8 or fewer letters in length. When the new name is correct, either press "Enter" on the computer keyboard, or click the mouse on the next axis name you want to change; either way the new name is "entered" into the screen.
Use the SaveSetup command to make the change permanent. This causes the new name to stored in the "AXES.SET" file, which is automatically loaded whenever the software is booted up.
Note that there are two "special" names: "Camera" and "Shutter". If either of these names is the axis name, the axis will have special, automatic camera or shutter functions, and will not be usable as a normal motion control channel. "CAMerA" and "sHuTtEr" can be spelled with any combination of upper or lower case letters, but should have no extra letters or spaces included. If you don't want a camera or shutter axis, simply don't name any axis camera or shutter.
98

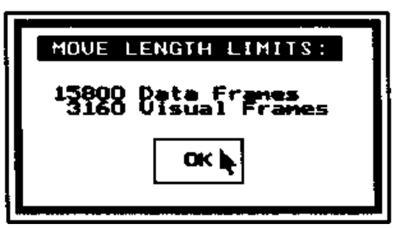


COMMAND: **NewLength**
WHERE: Control Panel Screen
FUNCTION: Change the number of frames in the move, without changing the shape of the move.
Don't confuse this with the Scale and Stretch commands in the Editor. Scale and Stretch change the distance travelled; NewLength spreads the move over a different number of frames.
To enter a new length for the move, click on the number in the center of the prompt box, in this case 480.00.
EXAMPLE 1:
You have a move that you like, but the action is just a little too fast. Use NewLength to increase the number of frames over which the action occurs.
EXAMPLE 2:
You have to make a joystick move that is exactly 480 frames long. Even after many takes, you keep coming up just over or just under the 480 frame mark. Also, watching the frame count makes it hard to watch the move. Solution: don't worry about the exact frame count as you record, just concentrate on getting the path of the move right. When you've got the move looking the way you want, use NewLength to adjust it to the exact 480 frame length.
99

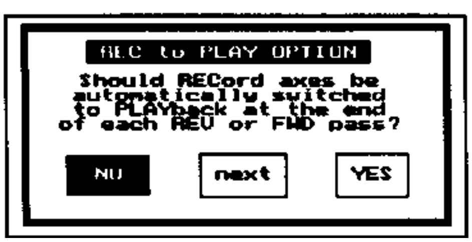


COMMAND: **NewMove**
WHERE: Control Panel Screen
FUNCTION: Erase the move that is presently in memory. Unless the move data has been saved on disc using the SaveMove command, it will be lost forever.
This command never affects moves saved on the disc; only the move in memory is erased.
The motor positions, Joystick setups, camera frame count, and most other parameters you can modify remain as they were. The length of move is set to zero, and all the move data is set to "0" velocity. The TOTAL move length is set to zero, as are the PRESENT, START, and END frame numbers.
After clicking "CLEAR", a prompt box appears announcing the maximum possible move length, based on the memory present in the computer. The maximum available move length is also displayed when the Software first boots up. Click "OK" to continue.
EXAMPLE:
You have just finished making a move, and have used the SaveMove command the save the move data on the floppy disc. You want to start working on the next move.
Use NewMove to erase the old move from memory in preparation for starting work on the next move.
100





command: **Options**
where: Control Panel Screen
purpose: Sets how the system will respond at the end of a recording pass, and whether or not the automatic PRE ROLL function will expose the same number of pre roll frames for all FPS speeds.
This command presents two response boxes in sequence. The operator may select a new option from each response box, or just go on to the next option selection by clicking the "Next" response box.
The first option controls how RECord axes will act at the end of a recording pass.
If "NO" is selected, all axes which are set to RECord will stay in record mode at the end of a move pass. If "YES" is selected, all RECord axes will automatically switch over the PLAYback axes and the end of a move. Note that RECord axes only have their motion recorded while the move is running in response to clicking "REV" or "FWD" on the Control Panel or Jogbox—all other times the axes simply track the joysticks without recording.
The first option controls the behavior of RECord passes at the end of a recording pass.
"NO" is a good option when it is anticipated that several takes will be recorded in fairly rapid succession, without
playing back each move before going on to the next. The encoders stay "live" in this mode, allowing the joystick operators to rapidly reset positions for the next take while the operator saves the move to disc. This makes the process more familiar to joystick operators without motion control experience, since the joysticks don't "go away." Be careful about using "REV" to rewind PLAYback axes to their starting position, since the RECord axes will over-write the last move. One possible "end of take" procedure for this mode is:
1. The computer operator sends all the pre-recorded PLAYback axes back to their start position with the "GotoStrt" command.
2. The joystick operators drive the RECord axes back to the start position.
3. While the axes are repositioning, the computer operator saves the move to disc.
Note that all the RECord axes can be instantly shifted to PLAYback by clicking with the right mouse key anywhere in the AXIS MODE "REC" column.
The "YES" option is useful when there will normally be a playback pass immediately after the move is recorded. As soon as the move stops, all RECord axes flip over to PLAYback. This also minimizes the danger of inadvertently overwriting the move if "REV" is used to rewind the move back to the starting frame. This is the default setting.
101



Regardless of the setting of this option, RECord axes which are using the mouse as a joystick will always switch from RECord to PLAYback at the end of the pass, since the mouse must be available for its normal pointing duties when the pass ends.

The next option controls whether or not the camera will pre roll the exact same number of frames for all FPS speeds. There are two options: "Same" and "Reduced". The "Same" option causes the camera to pre roll the same number of frames at all shooting speeds. The slower the FPS, the longer the time the camera will require to pre roll—if the camera pre rolled 30 frames at 24 FPS, it will pre roll 30 frames at 1 FPS, or any other speed. **Select the "Same" option if you are DX'ing in-camera at varying FPS speeds, since you will simply have to position the camera motor at the same film frame before each pass.**

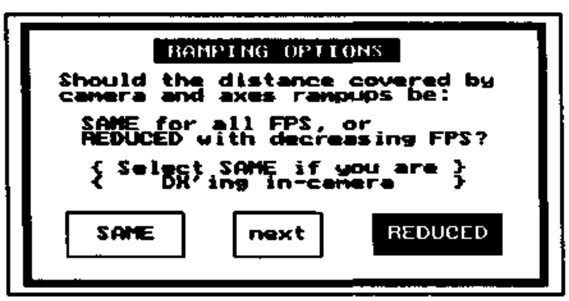
The second option controls whether or not the camera pre roll stays the same for varying FPS speeds.

The "Reduced" option automatically scales down the amount of pre roll in proportion to the shooting FPS. While the camera might require 30 or more frames of pre roll to reach 24 FPS, only a fraction of a frame is needed to reach 1 FPS. This saves much time when shooting slow FPS passes, but it makes it difficult to DX in-camera, since the number of pre roll camera frames decreases with FPS. **If you are shooting individual passes at different speeds for later composite on a printer, the "Reduced" option is a good way to go.** The drawback for this option is that it's hard to predict which film frame is the first move frame-always use the frame marker LED when using this option to mark the first move frame.

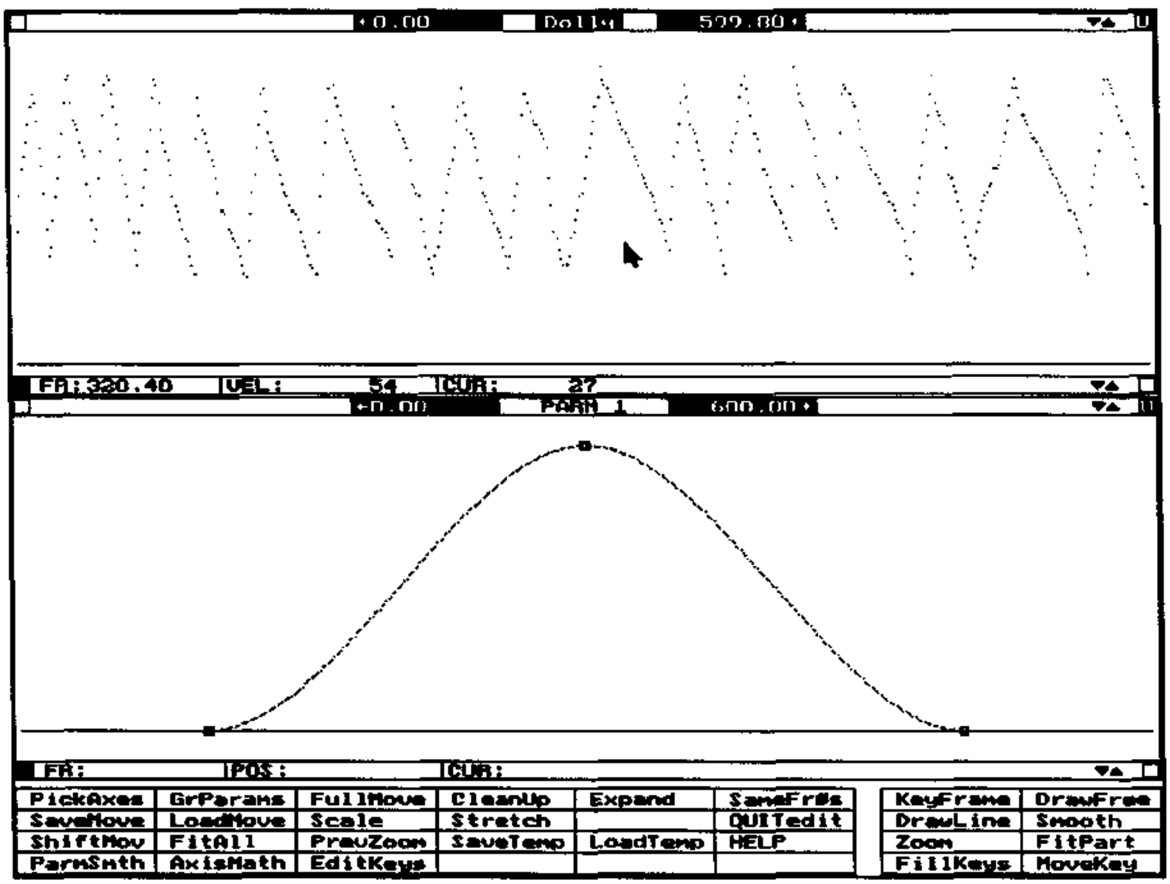
Note that if you plan to shoot only at relatively slow FPS speeds, a good compromise is to use the "CamSetup" command and assign the camera a very low "Liveact PRE ROLL" value, such as 10. Then use the "Options" command to select the "Same" camera pre roll option. This will produce reasonably short camera pre rolls, that are always the same number of frames regardless of FPS speed. Select a "Liveact PRE ROLL" large enough to accommodate the fastest pass without motor stalls. Remember to reset "LiveAct PRE ROLL" to a relatively large number before shooting 24 FPS passes.

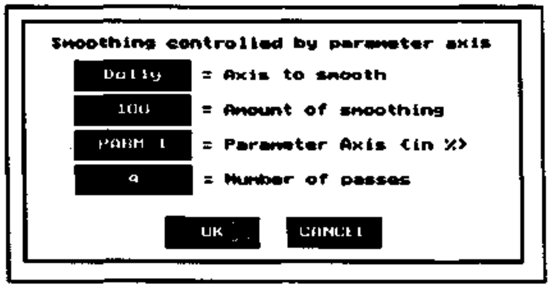
Another option for slow FPS shooting is simply to disable the camera pre roll entirely, by setting "Liveact PRE ROLL" to 0. This will limit the camera to at most 2 or 3 FPS.

102

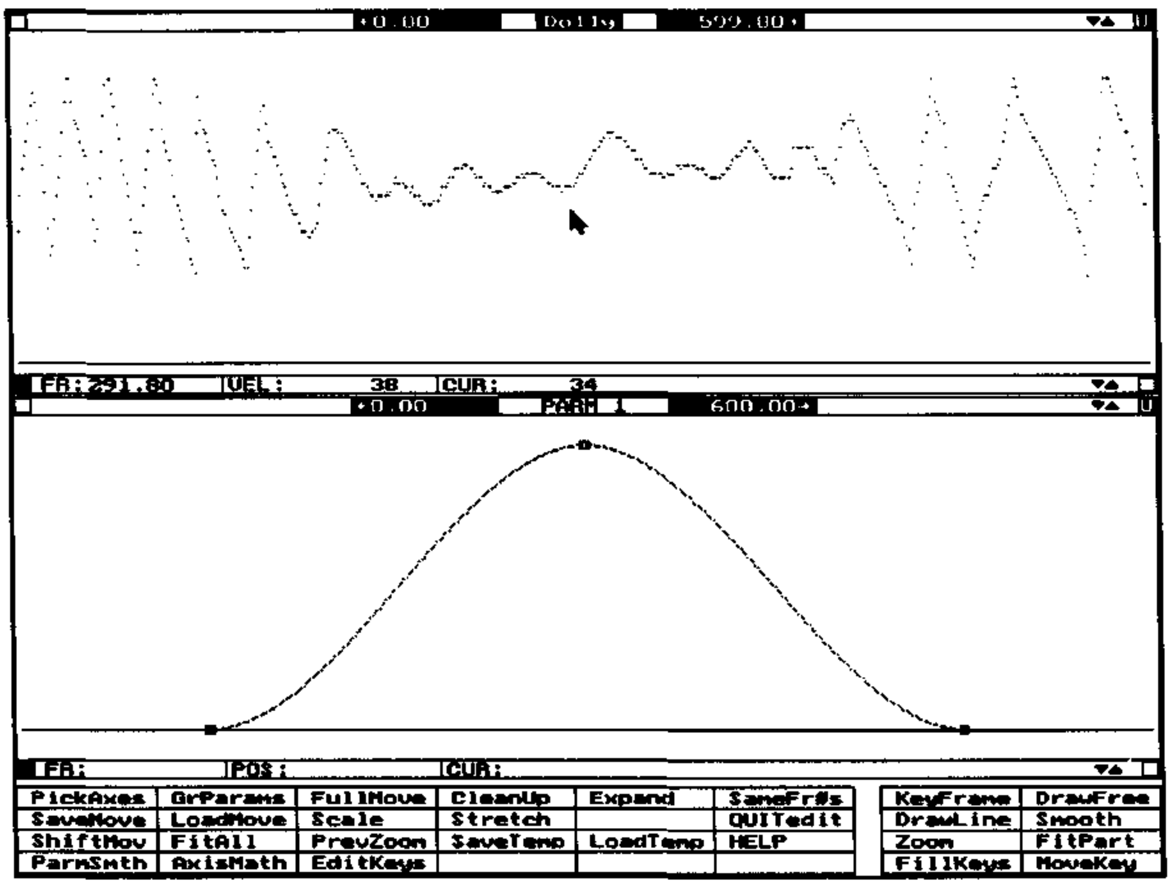


command: **ParmSmth**
where: Graphic Move Editor
purpose: Smooth only selected sections of the move data, as controlled by a parameter axis.
The first illustration shows two axes. The top axis is displayed in velocity mode, and shows a very rough move. The bottom axis is a key frame move displayed in position mode. The bottom axis starts out at "0.0" position, increases up to a position of "100.00" at the peak, and then returns to "0.0" for the last part of the move.
The bottom axis (Parml) is set up to control which part of the top axis (Dolly) will be smoothed. Where Parml is at 100.00, the effect of the smoothing will be strongest (100.00%); where it is at 0.0, there will be no smoothing (0.0%).
The next illustration shows the dialogue box which appears after clicking the ParmSmth command. The box is used to select which axis to receive the effects of smoothing, how much smoothing will be applied (this is the same as the normal Smooth command
103

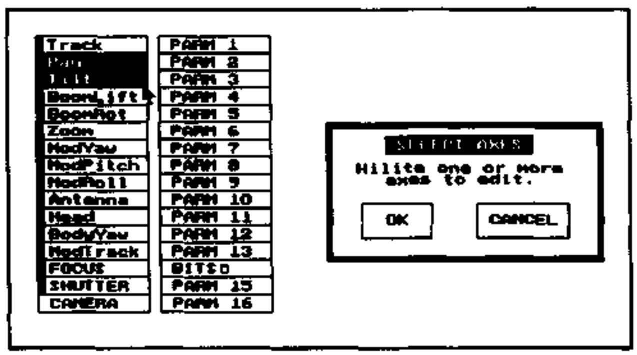



Smoothing controlled by parameter axis
Dolly = Axis to smooth
100 = Amount of smoothing
PARM 1 = Parameter Axis (in %)
9 = Number of passes
OK
CANCEL

parameter), which axis will act as the control channel, and how many passes will be made. Any of these selections can be changed by clicking on them with the mouse.
The next figure shows the effect of the smoothing. Notice how the effect eases-in and eases-out in proportion to the Parml control axis. Where Parml is near 100 (100.0%) the effect is very strong; where Parml is at 0.0, there is no effect. Parml is not changed.
The list of axes which appears when you select the Parameter Axis also includes "<NONE>". If you select <NONE>, the amount of smoothing will be 100% for the entire move. This would be equivalent to the Smooth command, with the added advantage that you can automate multiple passes with the "Number of passes" parameter.
For convenience, we recommend you first "select" the axis you want to smooth before clicking the ParmSmth command. This is done by clicking somewhere in the graph or on the frame of the axis you want to smooth, which causes the name to he highlighted. The dialogue box always defaults to the "selected" axis to be the "Axis to smooth."
Be sure to carefully read the name of the "Axis to smooth" before clicking "OK", to avoid accidentally smoothing the wrong axis. The most common error here is to smooth the control axis, instead of the desired axis.
104



command: **PickAxes**
where: Graphic Move Editor Screen
purpose: lets the operator select which axes to display on the Graphic Move Editor Screen.
The names of all the axes are displayed. The operator clicks the names of the axes he would like displayed, and then clicks the "OK" button.
The names of all the axes that are currently being displayed come up all ready highlighted.
The short bar to the left of the name indicates that the axis is selected on the Control Panel Screen, but not yet displayed as a Move Editor graph.
105

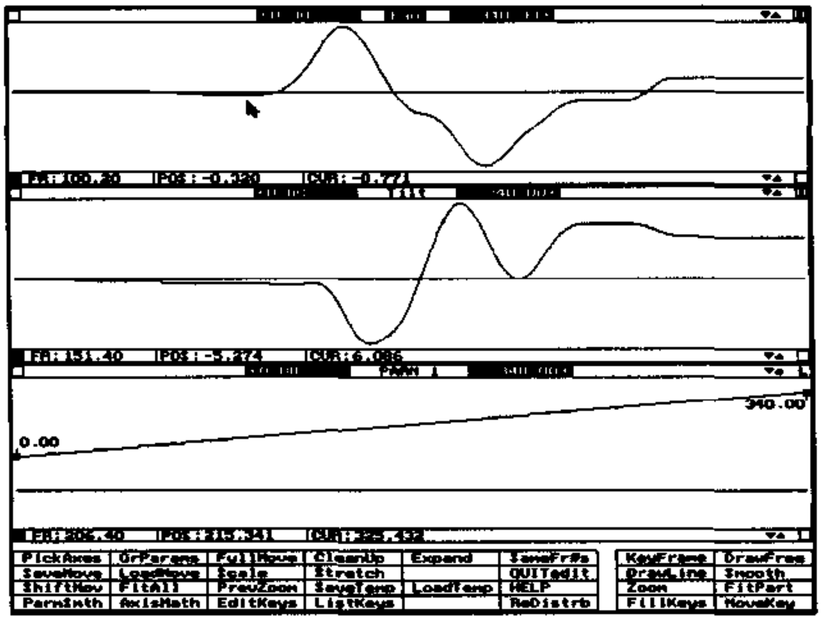


command: **PrevZoom**
where: Graphic Move Editor Screen
purpose: redraws the graph of the selected (name highlighted) axis as it was before the last time the operator zoomed in or out on the move.
EXAMPLE:
The operator is working on a curve fit move. There are two key frames placed close together in one part of the move. Each time the key frames are changed, the whole move is affected. It is necessary to be zoomed in on the two key frames to make fine adjustments, but the operator also needs to view the entire move after each use of the FitAll command.
The operator first uses the FullMove command to display the entire move. He then uses the Zoom command to zoom tightly on the two critical key frames. Each time he clicks the PrevZoom command, the graph toggles between these two views.
106

command: **QUIT**
where: Control Panel Screen
purpose: leave the RTMC16 Software program and return to DOS.
107

command: **QUITedit**
where: Graphic Move Editor Screen
purpose: leave the Move Editor and return to the control panel screen.
This command does not take you out of the RTMC Software, as does the Control Panel QUIT command: if just take you back to the Control Panel Screen.
The next time you enter the Graphic Move Editor, it will take up with the same axes displayed as when you left.
108

command: **RediStrb**
where: Graphic Move Editor
purpose: rearrange the times at which various parts of the move are reached, without changing the path of the move.
The illustration to the right shows a Pan and Tilt move. The action takes place towards the center of move, and the operator wants to eliminate most of the inactive sections at the start and end, and expand the active section to occupy the entire 340 frame length of the move.
The mouse cursor is pointing to about frame 100.00, which is where the action starts. Over to the right, the action stops at about frame 290.00. The operator determined the start and stop frame numbers by simply moving the mouse cursor back and forth on the graph and reading the frame number display at the lower left of each axis graph.
Original move with the desirable action concentrated toward the center of the move.
The Parml axis graph at the bottom shows a "control move" set up to tell the Software how to redistribute the active parts of the Pan and Tilt over the entire move. The Parml move was set up using key frames. The operator made Parml the "selected" axis (name highlighted) and then used the EditKeys command to enter a list of key frames. It would also be possible to create the Parml key frames graphically with the mouse, but the operator wanted "perfect" precision for this particular case.
O.oo:
34O.DO:
100.ooo
290.000
The Parml key frames are listed to the left. Key frame 0.00 has a "position" of 100.000; key frame 340.00 has a "position" of
Key frames used to create 290.000. After using the FitAll command in-between the key the control axis frames, the list of "positions" on the Parml axis extends from
100.00 to 290.00. Running the mouse cursor left and right in the Parml graph would show that the position for frame 0.00 is 100.000, and so on until the position for frame 340.00 is 290.000.
The central idea behind the RediStrb command is that the Software refers to a control axis as a list of "new" and "old" positions. In this example, Parml is set up as the control axis. The "frame numbers" are interpreted as the "new" positions; the "positions" are interpreted as the "old" frame
109


Tilt
0.00
340.00
PickAxes
OrParams
FullMove
CleanUp
Expand
SaveFr#s
KeyFrame
DrawFree
SaveMove
LoadMove
Scale
Stretch
QUITedit
DrawLine
Smooth
ShiftMov
FitAll
PrevZoom
SaveTemp
LoadTemp
HELP
Zoom
FitPart
ParmSnth
AxisMath
EditKeys
ListKeys
ReDistrb
FillKeys
MoveKey

numbers. Since Parml "frame number" 0.00 has a "position" of 100.000, the "new" position for frame 0.00 will be the "old" position for frame number 100.000. Since Parml frame number 340.00 has a "position" of 290.000, the "new position" for frame number 340.00 will be the "old" position for frame number 290.00. The net result is that the old part of the move from frames 100.00 to 290.00 is now expanded to cover the entire frame 0.00 to 340.00 range.

The result of this use of the RediStrb command is shown to the right. The command prompted the operator for the name of the Control Axis (Parml), and then asked for a list of axes to be modified. The active section of the move is now expanded to fill the entire move. The path of the action is unchanged, but since the action is spread out over more frames, the motion is slower.

This is fairly simple use of RediStrb. Since the Parml axis contained a linear move, the events of the original move still have the same relative "timewise" relationship, except that the overall action is now equally slower at all places in the move. The next example shows how a non-linear control axis can be used to re-arrange the timing relationships within an existing move-all while keeping the same move path through space.

The first illustration on the next page shows a symmetrical move. The small squares represent the positions of the key frames used to create the move. The operator wants to slow down the events at the start of the move, and is willing to let the extra time spent at the start of the move be taken-up towards the end of the move.

The center part of the is now redistributed to fill the entire move, as regulated by the Parml control axis.

Key frames used to create the non-linear control axis.

The key frames used to create the non-linear control numbers on Parml are shown to the left. The first and last key frames have the same "new" and "old" numbers, which preserves the original starting and ending positions. The middle key frame makes the control axis non-linear; the "new" position for frame 191.4 will be the "old" position for frame 144.928. This will drag the old position for frame 144.9 out to be the new position from frame 191.40. Since all the other "new" frames in the control axis have non-matching "old" positions, the entire move timing will be dragged forward in time (with the exception of 0.00 and 400.00, where the new and old positions match). The two illustrations on the next sheet show the move graphs before and after applying the RediStrb command.

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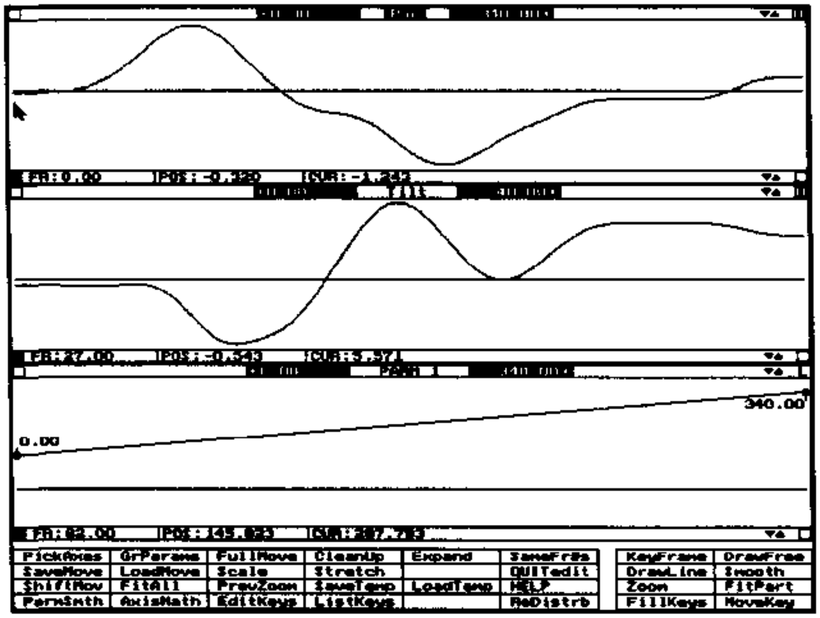
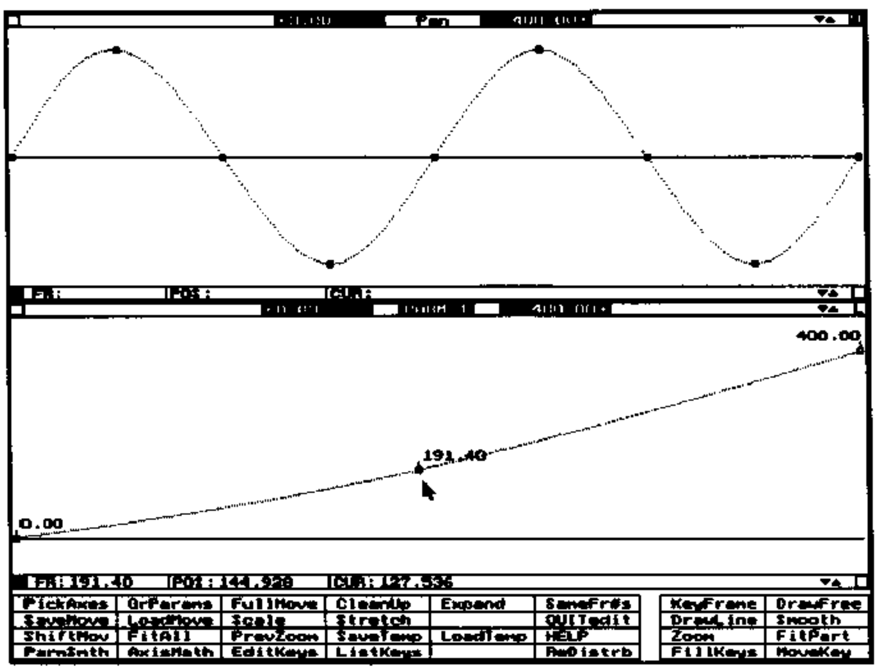
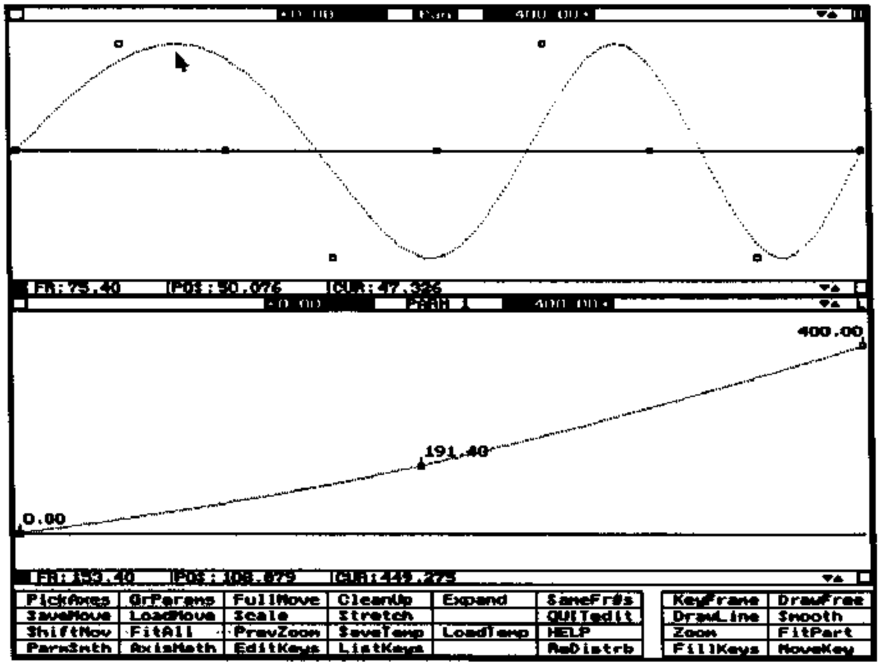


0.00:	0.000
191.40:	144.928
400.00:	400.000

Notice the key frames are not affected by the RediStrb command. In the lower illustration, the mouse cursor is pointing at the peak shifted away from its original key frame. **Since the key frames remain as before, the FitAll command could be used to restore the original move, and serves as an "undo" for shifted key frame moves. Joystick moves may be redistributed the same way as key frame moves. Shifted joystick moves cannot be restored with the FitAll command -always be sure to save the original joystick move to disc before using the RediStrb command.**
Symmetrical key frame move before applying the non-linear control axis data on Parml.
In both the examples present here, the control axis "position" numbers (the "old" frame numbers) advance forward in time. It is also possible to have the control axis numbers move back and forth in time, or have any shape at all. **The only constraint of the "old" numbers on the control axis is that they must remain equal to or above 0.00, and smaller than or equal to the biggest frame in the original move-that is, the control axis "old" numbers must be constrained to frame numbers inside the original move.**
Result of applying the non-linear control axis Parml to a symmetrical move. Notice how the move data has shifted away from the original key frames, which are not modified.
Ill





400.00
191.40
0.00
PickAxes
GrParams
FullMove
CleanUp
Expand
SameFr#s
SaveMove
LoadMove
Scale
Stretch
QUITedit
ShiftMov
FitAll
PrevZoom
SaveTemp
LoadTemp
HELP
ParmSmth
AxisMath
EditKeys
ListKeys
ReDistrb
KeyFrame
DrawFree
DrawLine
Smooth
Zoom
FitPart
FillKeys
MoveKey

command: **SameFr#s**
where: Graphic Move Editor screen
purpose: redraws all the displayed graphs with the same left and right frames numbers as the selected graph (name highlighted).
If you want all the axes to be redrawn to show a specific part of the move, first adjust the left and right frames for the selected axis (using the Zoom command or clicking on the frame numbers to the left and right of the axis name), and then click on SameFr#s; all the graphs will be redrawn to match the selected axis.
112

command: **SaveMove**
where: Control Panel and Graphic Move Editor screen
function: save the move in memory on the disc.
Do not confuse SaveMove with SaveTemp. SaveTemp is for very short term move storage, and the last SaveTemp move file gets over-written with each use. SaveMove is for long term move storage.
The illustration shows the prompt screen. At the upper left we see that disc "A:" will be used. To the right, the amount of storage space available is shown. To change to another disc drive or directory, click on the "MOVE FILES ON A:" line, and select a different drive or directory from the menu that appears. The Software always remembers the last drive on which a move was saved, and will keep that setting until you change it.
Just below that, the names of all the files on disc "A:" are listed. At screen bottom, the "NAME:____" area is used to enter the move name. There are two ways to enter a name: click on
the "NAME:____" area and type in a move name, or click on one of the move names in the list at
screen upper left, which will copy the name to the "NAME:____" line.
When you click on "SAVE" you will be prompted for which axes to save. Highlight the names of the axes you want to save by clicking on the name, then press "OK". Be sure to highlight all the axes which have moves!
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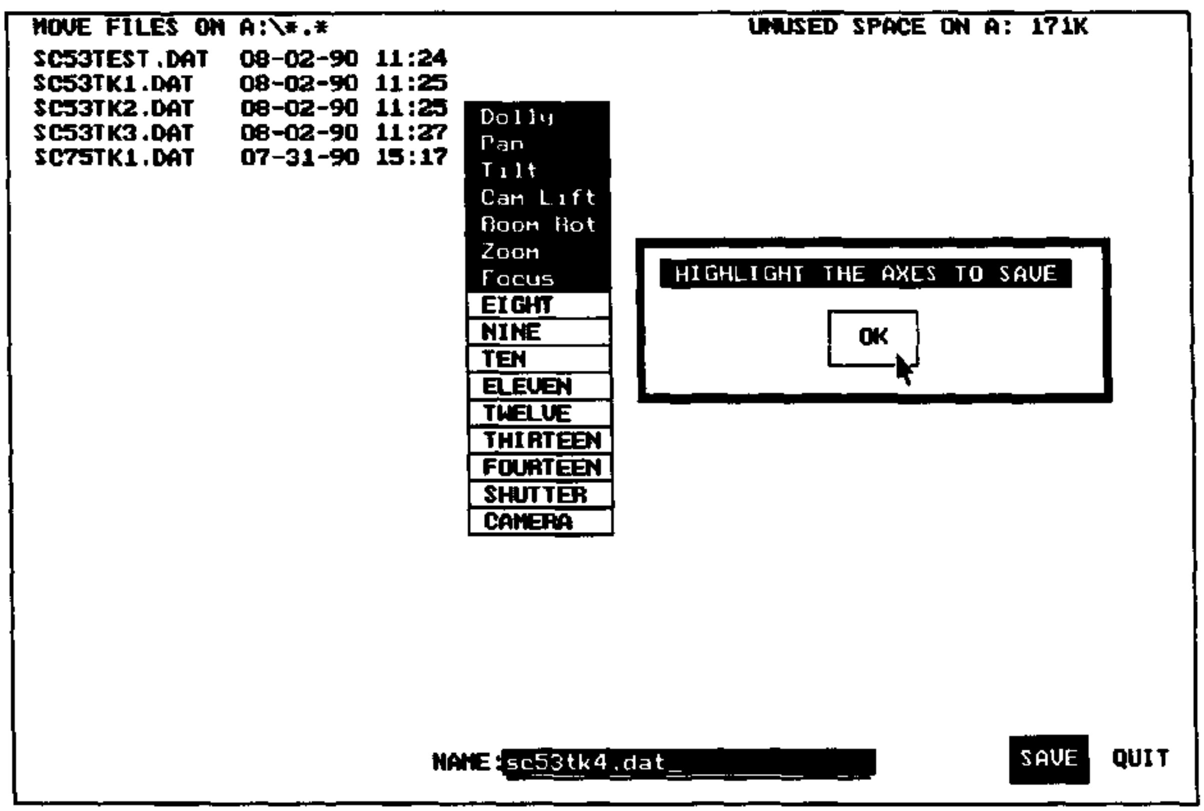
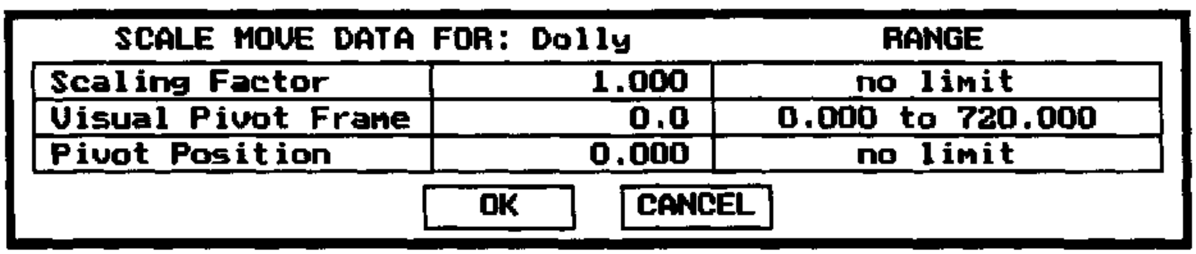


If there is some problem saving the move, such as full disc or defective drive, error messages will appear. If the disc is full, put another formatted disc in the drive. Discs must be formatted with the DOS "Format" command before they can be used for move storage. If you don't have a formatted disc available, you can over-write the name of a previous move, provided you no longer need the old move.
Be sure to always have a good supply of formatted discs ready for move storage. If you are using 5 1/4" discs, make sure the write protect tab is NOT in place. If you are using 3 1/2" discs, make sure the write protect "slider" is closed, so you can't see through the hole; if the hole is open, the disc is write-protected.
114

command: **SaveSetup**
where: Control Panel Screen
purpose: store the present user-changeable Control Panel setup on disc.
All the changes made with AxiSetup, CamSetup, joystick settings and assignments, etc are saved in the "Axes.set" file. The contents of the previous file are over-written by the new data.
The information saved using this command will be reloaded the next time the Software boots up. It may be specifically loaded at any time by using the LoadTemp command.
115

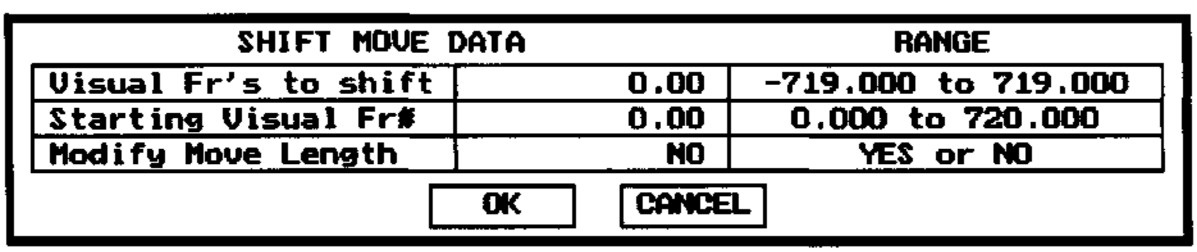
command: **SaveTemp**
where: Control Panel and Graphic Move Editor screens
purpose: rapidly save the current version of the move in memory to a special temporary file.
SaveTemp operates several times faster than the normal SaveMove command.
CAUTION: every time the SaveTemp command is used, the last move that was saved with this move is erased. Do not rely on this command for long term move storage, for which you should use the SaveMove command. SaveTemp is strictly for very short term move storage.
SaveTemp is intended to let you save the present
state of the move when you are going to try some modification which may or may succeed. It
provides a quick way or restoring the pre-trial version.
The temporary move saved with SaveTemp is reloaded with the LoadTemp command.
EXAMPLE:
You are working on a move in the Move Editor. You want to try using DrawFree to "rough up" the move on one of the axes, but you think it might take several tries to get it right. Use the SaveTemp command to quickly save the "un-roughed" move, and then use the DrawFree command. If you don't like the result, just use LoadTemp to quickly restore the original version.
Alternate solution: use the slower SaveMove command to save the move in a non-volatile "permanent" move file. Use the LoadMove command to restore the move.
116

COMMAND: **Scale**
WHERE: Graphic Move Editor
FUNCTION: Increase or decrease the overall distance an axis travels. Do not confuse Scale with NewLength; NewLength changes the number of frames in the move; Scale changes how far the axis travels.
The Scale prompt asks you for three parameters:
Scaling Factor Pivot Frame Pivot Position
You may change any or all of the parameters.
Scaling Factor controls how much the distance travelled is expanded or contracted. A Scaling Factor of 1.0 would leave the move unchanged. A Scaling Factor of 2.0 would make the move travel twice the original distance. A Scaling Factor of -1.0 would cause the move to travel the original distance, but in the opposite direction.
Pivot Frame and Pivot Position allow you to "peel up" the move and "paste it down" at a new position. Suppose the original Pivot Frame is 0.0, and the Pivot Position is -10.00. That means that the position for frame 0.0 is at -10.00 units. If you change Pivot Position to 5.00, the new position for frame 0.0 would be 5.00 units.
EXAMPLE 1:
You have a track axis movement that is working well, but you want the track to go just a little further than it now does. Solution: use Scale and select a Scale Factor slightly larger than 1.0. You could try 1.05, to make the axis go 5% further. If the axis now goes too far, try trimming the distance travelled with a Scale Factor less than 1.0, say 0.97.
EXAMPLE 2:
You want the axis to start its move at a new position. Solution: use Scale, and set the Pivot Frame to 0.0, and Pivot Position to the desired new starting position.
Alternate solution: you could also use MousJog to do this visually.
117



EXAMPLE 3:
You have a move that was originally shot Live Action with track, camera pan, and camera tilt axes involved. You now want to duplicate the same move while photographing a model built to a scale of 1 inch equals 1 foot. Solution: Scale the track move with a Scaling Factor of 0.085, which is the decimal for 1/12. However, do not scale the pan and tilt, since only "linear" axes like track, E/W, and N/S need to be scaled. Rotational axes like pan and tilt are independent of model scale.
EXAMPLE 4:
You have an axis controlling a model searchlight. At a position of exactly 90.00, the light produces a strong flare in the camera lens. You want the flare to occur exactly at frame 240.0. The rest of the searchlight move is not critical. Solution: Use Scale, selecting a Pivot Frame of 240.0, and a Pivot Position of 90.00.
Alternate solution: You could also use MousJog to do this visually.
Stretch could also be used, which would provide a convenient way of lining up multiple light hits.
SEE ALSO:
MousJog
FixPosn
Stretch
118

COMMAND: **ShiftMov** WHERE: Graphic Move Editor
FUNCTION: Plug in some extra frames somewhere in the move. This is typically used to add some hold frames at the beginning or end of an existing move, or to open up a section in the middle of a move. Shift is often used in conjunction with other move editing commands.
Shift asks for three parameters:
Visual Frames to Shift Start Visual Frame Number Modify Move Length
Visual Frames to Shift sets how many frames will be "plugged in" to the move. If this number is negative, the frames will be removed from the move.
Start Visual Frame sets the frame number where the new frames will be placed or removed.
Modify Move Length is a "Yes/No" parameter. Suppose you have specified a Visual Frames to Shift of 48. If "Modify Move Length" is Yes, the overall length of the move will be increased by 48 frames to allow room for the new frames without losing the last part of the move; if No, the overall length of the move will remain the same, and the original last 48 frames of the move will slide off the end of the move.
Do confuse "Modify Move Length" with the NewLength command. NewLength spreads the overall shape of the move over a different number of frames; "Modify Move Length" just adds or deletes frames at the end of the move to compensate for frames added or deleted from the move.
EXAMPLE 1:
You have a live action move. You want to use the entire move starting with the existing frame 0.0. There is not enough time to get the slate out of the scene before the action starts. Solution: add 48 frames at the head of the move. As soon as you see the frame number start advancing, call "speed" and have the slate holder clack and yank the slate, which should take less than 48 frames. Specify 48 Visual Frames to Shift, 0.0 as the Start Visual Frame Number, and Modify Move Length "Yes" to prevent losing move frames at the end of the move.
119



SHIFT MOVE DATA		RANGE
Visual Fr's to shift	0.00	-719.000 to 719.000
Starting Visual Fr#	0.00	0.000 to 720.000
Modify Move Length	NO	YES or NO

OK CANCEL

COMMAND: Smooth
WHERE: Control Panel Screen and Graphic Move Editor Screen.
FUNCTION: To even out the move data, so that sudden changes in speed are "rounded out." The motion is literally made smoother.
The resulting effect is the same as if the move were recorded with the joystick "SMTH" function highlighted, and the amount of joystick smoothing set to something besides 0. The difference is that the "Smooth" functions have their effect after the move is recorded, rather than during the recording pass.
CAUTION: The smoothing functions smooth the move data after the original move is recorded. If you are recording the original motion recording pass on film, as in a Live Action situation, you must not do any "after the fact" smoothing of the move data, since subsequent smoothed passes will not exactly match the "non-smoothed" original pass. If you need to have smoothing in Live Action situations, use encoder smoothing: highlight the "SMTH" on the Control Panel Screen, and select a smoothing factor greater than 0. This will smooth the move data as it comes in from the encoders and before reaching the motors, rather than after the recording is done.
You can visualize the affect of smoothing as a sanding block being dragged along the move curve. The large peaks and valleys which indicate sudden changes in velocity get sanded off, while all ready smooth parts of the move are not much changed.
Don't go overboard on smoothing. The more you smooth a joystick move, the more it will look like a pure curve-fit move. Distinguish between situations where you just want to take a little roughness out of the move (one or two passes of the "Light" smoothing) from situations where you need a very fluid looking motion (several passes of "Heavy" smoothing). Some smoothing is recommended for most position mode joystick moves recorded at slow settings.
If you want to smooth just one small portion of a move, use the "ParmSmth" command. Alternatively, Zoom into that part of the move in VEL: mode, and use DrawFree to draw a smooth curve over the original non-smooth section. This confines the "smoothing" to that portion only, without smoothing the whole move. Draw the curve to pass through the average center of the un-smoothed peaks and valleys.
The effects of smoothing are most apparent when the graph is displayed in VEL: (velocity) mode, and not very apparent at all in POS: (position) mode. You should always use the VEL: graph when judging the need for and results of smoothing.
The Control Panel and the Graphic Move Editor have slightly different versions of the smoothing function.

CONTROL PANEL VERSION:

You can produce multiple smoothing passes by clicking multiple times on the axis names. Each click of the left mouse key adds one smoothing pass; each click of the right mouse key removes one
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smoothing pass. The advancing highlight over the axis name shows the relative number of smoothing passes.
After "clicking in" the number of passes, click either the "Light" or "Heavy" box in the dialogue box. The smoothing does not actually take place until one of these boxes is clicked. "Light" has a width of 10, while "Heavy" has a width of 60.
GRAPHIC MOVE EDITOR VERSION:
Click the left mouse key on the "Smooth" menu item. When the mouse cursor moves into the graph area, it will change to the "SM" shape, and the Calculator will appear.
Enter the amount of smoothing as a number between 3 and 200. 3 produces a very minimal effect; 200 has a very strong effect. Numbers around 10 to 60 give the most useful results for smoothing normal joystick moves. Click on the Calculator screen to enter the number.
Whenever the "SM" cursor is displayed, each click of the left mouse key produces one smoothing pass. The "hourglass" is displayed while the moving pass is taking place.
To change the amount of smoothing, just click on SMOOTH again, or click the Middle mouse key. The Calculator will appear again when the cursor enters the graph area.
The "Amount of Smoothing" is actually specified in Data Frames. Since there are normally 120 Data Frames per Second during 24 FPS Live Action Shooting, an "Amount of Smoothing" equal to 120 would give a "sanding block" 1 second wide; events which occurred faster than 1 second would tend to be sanded down much more than events that lasted longer than 1 second.
EXERCISE:
The effect created by smoothing with several small "Amounts of Smoothing" is different than the effect of one large "Amount of Smoothing."
Use the DrawFree command to draw some ragged move curves, and then experiment with various numbers of smoothing passes and "Amounts of Smoothing." Draw and view the curves with the graph in VEL: mode.
Note that the changes which result from smoothing are much more apparent when the graph is displayed as velocities (VEL: mode) than when displayed as positions (POS: mode).
121

command: **Stretch**
where: Graphic Move Editor
purpose: expand or contract the distance travelled by the move, so that two specified separate frame number have specific positions.
See the "DrawFree" command description for a detailed application of Stretch.
Any or all of the parameters may be changed. The numbers originally displayed are for the present first and last frames in the move.
Note that for the present version of the Software, the two specified positions can not be the same position.
122

STRETCH MOVE FOR: Dolly		RANGE
Frame 'A'	0.00	0.000 to 719.000
Position 'A'	0.000	no limit
Frame 'B'	720.00	1.000 to 720.000
Position 'B'	56.000	no limit

OK CANCEL

command: **Zoom**
where: Graphic Move Editor Screen
purpose: zoom in on the move data, by selecting new left and right frame limits for the displayed data.
The size and position of the "zoom box" is controlled by the left and right mouse keys. Hold down the left mouse key to expand and contract the lower right corner of the box. To reposition the entire box, hold down both the left and right mouse keys.
The frame positions of the left and right sides of the zoom box are displayed at graph-frame lower left.
As soon as the left mouse key is released, the graph zooms in on the zoom box. To restore the graph of the entire move, click on the FullMove command. Use the PrevZoom command to toggle between the present and previous views.
Another method of zooming is to click on the frame numbers displayed to the left and right of the axis name. Clicking on the left side of each number decreases the number; clicking on the right side increases. Click on the empty spaces between the frame numbers and the axis names to pan the graph left and right.
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JOGBOX DEFINITIONS

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command: **ALL AXES**
where: Jogbox
purpose: shortcut to select all available axes in response the Jogbox "SELECT AXES" prompt.
Whenever the "SELECT AXES" prompt appears, you are expected to use the "1" through "F keys at the top of the Jogbox to select which axes should respond to the command.
Whenever the "SELECT AXES" prompt appears, "ALL AXES" provides a shortcut to select all the axes, except the Camera and Shutter axes. If you want to include the Camera and Shutter axes, just toggle the corresponding select keys.
126

command: **EMER STOP**
where: Jogbox
purpose: cause all moving axes to stop at once.
All the axes come to a rapid, controlled stop. If a real time move is recording or playing, the move stops at the current frame number. The axes do not lose their correct position count.
This is the Jogbox equivalent of pressing the " ~" key, which is the computer keyboard emergency stop.
EMER STOP is active at all times, even when the Jogbox is not "turned on" with the Jogbox command.
127

command: **FIT ALL**
where: Jogbox
purpose: create the in-between positions for all the key frames on a selected set of axes. The prompt "AXES TO CURVEFIT" appears briefly on the Jogbox display, followed by the "SELECT AXES" prompt. The operator selects one or more axes to in-between by pressing the "1" to "F[1] keys, until the "numbers" of all axes to be in-betweened are displayed. There must be at least two keyframes memorized on each of the specified axes.
Two types of in-betweening are available, depending on the next Jogbox key pressed:
If the operator presses the "ENTER" key, all the key frames will be connected using cubic spline curvefit techniques.
If the operator presses the "FIT ALL" key once more (instead of "ENTER"), the Jogbox will prompt for "EASE-IN" and "EASE-OUT[1] frames. The operator may either enter new values, or simply accept the displayed defaults, and press "ENTER". To eliminate either ease, enter "0" for the number of frames. The software will create ease-in / linear / ease-out moves on all the specified axes. For this type of in-betweening, the eases will occur only between the first and last key frames in the memorized key frame list; all intermediate key frames will be ignored. To construct more complex eased moves, use the "Eases" command on the Graphic Move Editor Screen.
Press the "STOP/CANCEL" key instead of the "ENTER" or "FIT ALL" keys to quit with no in-between.
FIT ALL always in-betweens all the key frames for each selected axis.
If the first key frame is not frame 0.0, a hold is automatically built in between frame 0.0 and the first key frame. If the last key frame is not at the end of the move, an automatic hold is built between the last key frame and the end of the move. In such cases, if you plan to use "spline" in-betweens, it is usually a good idea to make the first and last key frames "double key frames" to force the moves to ease in from 0 velocity at the start of motion, and ease out to 0 velocity at the end of motion; use the "MEMO DOUBLE KEY" command to create double key frames from the Jogbox, or the "middle key down, tap right key" mouse key combination from the Graphic Move Editor "KeyFrame" command.
If you "eased" in-betweens, be sure to have at least a few ease-in and ease-out frames.
128

command: **GOTO FRAME NUMBER**
where: Jogbox
purpose: send a selected group of axes to their move positions for a specific frame in the move.
The prompt "GOTO FR#:" appears, along with a default frame number. To change the frame number, the operator enters a new frame number with the number keys at the top of the Jogbox keyboard. After pressing "ENTER" the prompt "AXES FOR xxxxx" appears, with "xxxxx" being the previously entered frame number. The operator uses the "1" to "F[1] keys to select which axes should respond. The selected axes start to move as soon as "ENTER" is pressed.
Press the "STOP/CANCEL" key instead of "ENTER" to quit with no axes moving.
The "RUN REV and "RUN FWD" real time motion playback/record commands always use the last frame number input with "GOTO FRAME NUMBER" as the starting frame for the next move playback/record pass. If you want real time move playback/record to start at a particular frame, first send the axes to the desired frame with "GOTO FRAME NUMBER."
The "MEMO KEY FRAME" and "MEMO DOUBL" commands use the last frame number input with "GOTO FRAME NUMBER" as the default for the next key frame number.
129

command: **GOTO HOME POSN**
where: Jogbox
purpose: send a selected group of axes to their "0.0" position.
The Jogbox display briefly displays "AXES TO GO HOME," and then the "SELECT AXES" prompt appears. The operator selects one or more axes with the "1" to "F[1] keys, and then presses the Jogbox "ENTER" key. The selected axes immediately start towards position "0.0."
Press the "STOP/CANCEL" key instead of the "ENTER" to escape with no axis movement.
Using "GOTO HOME POSN" causes the first frame for move playback/record to be set to frame 0.0. If you use "RUN FWD" after "GOTO HOME POSN" the axes will first move to their starting positions for frame 0.0. "RUN REV" produces no result after "GOTO HOME POSN" since the move is all ready at the first frame number.
130

command: GRAPH AXES
where: Jogbox
purpose: display move graphs on the monitor.
After pressing this command key, select one or more axes to display using the "1" to "F keys at the top of the Jogbox keypad. Press enter to display the graphs on the screen.
Whenever the graphs are displayed from the Jogbox, the graphs come up in position mode, and with the key frame numbers showing next to the key frame boxes.
To return to using the Jogbox, press any command key on the Jogbox. It is also possible to perform mouse move-editing in the normal manner, and then return to the Jogbox. **If the mouse is moved between the time the graphs are displayed and you want to use the Jogbox again, it will sometimes be necessary to leave the graph by clicking the "QuitEdit" move editor command; if the Jogbox does not re-activate by pressing a command key, you will have to mouse-click "QuitEdit."**
While the graph is displayed, the "POSN/VELO" key on the Jogbox will toggle the graph between position and velocity display modes.
131

command: **JOG32**
where: Jogbox
purpose: Jog axes either direction, depending on which of the top 32 "Jogging" keys are pressed.
The top 32 keys on the Jogbox are grouped as pairs for purposes of jogging. The keys have labels such as "1-" and "1+" at the top. The numbers refer to an axis number, and the "+" or "-" to the direction sense for the key. Just press the key for axis number and direction you want to jog.
If the axes accelerate too fast, use the "AxisSetup" command on the control panel screen, and set the "Slew Acceleration" number to a smaller value. If acceleration is too slow, try a higher number. If the top speed is too high or too low, change "Slew Speed in PPI" to a lower or higher number.
To inch the axes, hold down the "JOG32" key while you are jogging-this results in a very low top speed. This is useful for nudging axes into their exact home positions, prior to using the "SET HOME POSITION" command.
If some axes are all ready moving in response to another command when you use "JOG32", the axes will continue in their original mode, until you press a jog key for a moving axis-the axis then slows down to zero velocity, cancels the previous mode, and "picks up" the JOG32 mode. This provides a way to jog unprogrammed axes out the way during early record/playback passes in the move building process, before all the axes are programmed. Also, this is a handy way to stop only certain axes when a group of axes starts moving together, such as in response to a "GOTO HOME POSN" command.
132

command: **JOYST AXIS**
where: Jogbox
purpose: select which axis the Joystick on the Jogbox will control.
The prompt "SELECT JOY AXIS" appears. Select one axis by pressing one of the "1" through "F keys at the top of the Jogbox. As soon as the key is pressed, the corresponding axis starts tracking the Joystick on the Jogbox.
Initially, the axis name and position are displayed. When the next command is invoked from the Jogbox, the display stops showing the axis name and position and shifts over to servicing the new command-however, the axis keeps responding to the joystick. If you want to go back to viewing the joystick axis name and position, simply press the "JOYST AXIS" and the axis key once again. Whenever the Jogbox display is tracking the joystick, the display can be toggled back and forth between displaying name_and_position or velocity_and_position by pressing the axis select key; alternate presses toggle between the two display modes.
To shift from joysticking one axis to another:
-If the current joystick axis name and position are displayed, just click on one of the 16 "axis select" keys. This is a very quick way to switch between several axes.
-If you have used some other command besides "JOYST AXIS" since last selecting a joystick axis, press "JOYST AXIS" again, and then the select key for the new axis.
In either case, the Joystick knob will immediately start controlling the new axis, while the previous joystick axis automatically slows to a stop.
Each axis has its own unique response settings. When a new joystick axis is selected, its settings may be considerably different than the previous axis. Use the "JOYST GAIN" key to control the sensitivity, "JOYST SMUTH" to control the smoothing, and "POSN/VELO" to switch between position and velocity response modes. All these commands only affect the current operating joystick axis. Use the "SaveSetup" command on the Control Panel Screen to make changed settings the bootup default settings
VELO (velocity) mode is sometimes a little disturbing to newcomers because the axis "keeps moving" after the joystick is released. To stop the axis, turn the joystick "speed dial" back to "0", or simply press the "POSN/VELO" key once more to toggle the joystick over to POSN (position) response mode—position mode joysticks only cause axis motion when the joystick moves. Use the "AxiSetup" command on the Control Panel Screen to set the width of the VELO deadband. The wider the deadband, the easier it is to set the motor to "0" velocity.
Selecting an axis to joystick automatically puts the axis into "REC" mode-whenever the move is played back with the Jogbox "RUN FWD" or "RUN REV" keys, the joystick axis will have its motion recorded- if you don't want this to happen, select the joystick axis as a playback axis, which will take the axis "off the joystick.
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Depending on how the Control Panel Screen "Options" command is setup, at the end of any move pass ("RUN FWD" or "RUN REV), the joystick axis will either shift over to PLAYback and disengage from the joystick, or remain in RECord mode and still responsive to the joystick.
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command: **JOYST GAIN**
where: Jogbox
purpose: set the sensitivity of the present joystick axis.
The Jogbox displays "GAIN: x.xx" where "x.xx" is the present setting for the joystick gain, or sensitivity. Use the first ten Jogbox keys to enter a new number, and press "ENTER."
Bigger numbers increase the sensitivity. "8.00" would produce twice the amount of motor movement for the same joystick motion as would "4.00."
If you want to change the direction sense of the Joystick, enter a negative number. "4.00" and "-4.00" will produce the same amount of motor motion, except in opposite directions.
When you are entering numbers into the Jogbox, the "11 A" key acts as the "." key, and "12B" acts as the "-"; markings at the bottom of these two keys reflect these functions.
The greater the sensitivity, the more likely the axis is to lurch as a result of sudden Joystick movements. If lurching becomes a problem, use the "JOYST SMUTH" command to increase the amount of joystick smoothing.
Since the Joystick can be operating in either Position of Velocity mode (as set with the POSN/VELO Jogbox key), there are really two separate "JOYST GAIN" numbers for each axis. When you change "JOYST GAIN" you only change the gain for the mode in which the Joystick is presently operating.
Any changes you make with this command are saved to disc by the "SaveSetup" command on the Control Panel Screen. If you don't use "SaveSetup", your changes will be lost when you leave the RTMCxxx program.
If the Joystick gain is set to zero, the axis will not move.
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command: **JOYST SMUTH**
where: Jogbox
purpose: set how much smoothing will be applied to the present joystick axis.
The Jogbox displays "SM<0..8>: x", where "0...8" is the acceptable range of settings, and "x" is the present setting. Use the first ten Jogbox keys to enter a new number, and press "ENTER."
"0" turns off all smoothing, and "8" produces the maximum amount of smoothing.
Decimal numbers have no effect.
If the Joystick response is too "mushy," try a smaller smoothing number. If the axis lurches, try a larger smoothing number. Usually, it is best to select the smallest amount of smoothing which produces lurch-free axis response.
Since the Joystick can be operating in either Position of Velocity mode (as set with the POSN/VELO Jogbox key), there are really two separate "JOYST SMUTH" numbers for each axis. When you change "JOYST SMUTH" you only change the smoothing for the mode in which the Joystick is presently operating.
Any changes you make with this command are saved to disc by the "SaveSetup" command on the Control Panel Screen. If you don't use "SaveSetup", your changes will be lost when you leave the RTMCxxx program.

command: **LIST KEY FRAMES**
where: Jogbox
purpose: shows the key frame numbers and positions for a single axis on the Jogbox display screen.
After pressing this key, the Jogbox display prompts the operator to select a single axis. The operator selects a single axis by pressing one of the "1" to "P keys at the top of the Jogbox. These keys correspond to axes 1 to 16.
As soon as the axis is selected, the operator uses various other keys on the Jogbox to browse through the keyframe list, delete key frames, and send the axis to the motor position for specific key frames. The key frames are displayed one at a time, with frame number on top and position below. The following Jogbox keys have special functions ONLY while the LIST KEY FRAMES command is active:
RUN FWD moves the next key frame into the display. **RUN REV** moves the previous key frame into the display.
GOTO FRAME NUMBER causes the axis to immediately start moving to the position for the key frame shown on the Jogbox display.
ENTER deletes the key frame shown on the display.
MEMO DOUBL KEY creates a double key frame, one frame number removed from the key frame number originally displayed in the window. The position for the newly created double key frame will be the position for the original key frame, rather than the current motor position. This allows for creating double key frames (for purposes of suppressing overshoots, forcing eases, etc.) without having to first reposition the motor at the desired key frame position. The newly created key frame will always be one frame less the original key frame, except when the original key frame number is "0.0". In the "0.0" case the new key frame will be one frame more than the original.
To exit the LIST KEY FRAME mode, press STOP/CANCEL or some other command key besides the five shown above.
The idea of special case functions for the above keys takes a little getting used to. Make a strong mental note whenever you enter the LIST KEY FRAME command that the GOTO FRAME NUMBER and ENTER keys are potentially dangerous, and you must specifically press some Jogbox key besides the five listed above to exit the LIST KEY FRAME command and restore the normal functions of the five special keys.
To go from axis to axis, press LIST KEY FRAMES again at any time, and select the next axis as described above.
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command: MEMO DOUBLE KEY
where: Jogbox
purpose: memorize a double key frame from the Jogbox.
This command is the same as the MEMO KEY FRAME command, except that two key frames are memorized, instead of one. **The operator specifies only one frame number- the Software automatically creates a second, adjacent key frame. Both of the key frames are at the same motor position; the frame number for the automatic second key frame is 1 Data Frame away from the specified frame.** If you input "100.0" in response to the Jogbox "FRAME #:" prompt, key frames for both frames 100.00 and 99.80 will be added to the list of key frames, and both key frames will have the same position. Unless the FRAME # is 0.0, the second key frame will always be 1 Data Frame (usually 0.20 Camera or Visual Frames) less than the specified FRAME #. If the frame specified is 0.0, the automatic second key frame will be 1 Data Frame ahead, or frame 0.20 when there are 5 data frames per visual frame.
Double key frames at the same motor position and 1 frame number apart force the move to 0.0 velocity at the key frame. This makes double key frames useful for forcing eases, or preventing overshoots. **Take double key frames whenever you want to force an ease-in or ease-out, and whenever the key frame is intended to be a "don't exceed" extreme position in the move.**
The KeyFrame command definition in the RTMC16 Manual gives additional information and illustrations regarding key frame techniques.
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command: **MEMO KEY FRAME**
where: Jogbox
purpose: place a new key frame into the list of key frames for a selected group of axes. The Jogbox display prompts for "KEY FR:" and displays a default key frame number. The operator either accepts the default, or enters a new key frame number using the first ten Jogbox keys, and presses the "ENTER" key. "AXES TO KEYFRAME" is briefly displayed, followed by the "SELECT AXES" prompt. Using the "1" to "F[1] keys, the operator selects which axes will have the new key frame added to their lists of key frames. Pressing "ENTER" again causes the new key frame to actually be memorized. The position for the new key frame is the present motor position.
The default key frame number is either the last key frame number entered, or the last frame number specified with the "GOTO FRAME NUMBER" command, which ever is more recent.
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command: **OPEN/CLOSE SHUTTER**
where: Jogbox
purpose: open and close the capping shutter and motorized angle shutter.
Alternate presses of this key open and close the capping shutter (if one is hooked up) and the motorized angle control shutter (if there is one). There must be either an electronic capping shutter and/or motorized shutter angle axis for this command to have any meaning. If either one is present, this command effectively covers or uncovers the film for exposure purposes.
This command is intended for use in conjunction with the Jogbox "WIND CAMRA" key. Regardless of the state in which the "capping shutter" is left when you leave the Jogbox, the film will automatically be "uncovered" before any shooting pass takes place.
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command: **POSN/VELO**
where: Jogbox
purpose: switch the active joystick axis between position and velocity response modes.
Each time you press this key, the Joystick response for the present joystick channel flip-flops between position and velocity mode. The new response mode is displayed as long as the key is pressed.
Any changes you make with this command are saved to disc by the "SaveSetup" command on the Control Panel Screen. If you don't use "SaveSetup", your changes will be lost when you leave the RTMCxxx program.
In the special case where a move graph is displayed on the screen as a result of using the "GRAPH AXES" command, pressing POSN/VELO will toggle the graph between position and velocity display modes.
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command: **RUN FWD**
where: Jogbox
purpose: start real time record/playback forward through the frame numbers.
The Jogbox display prompts for "AXES TO PLAYBACK". The operator uses the "1" through "F keys to select which axes should playback. Press "ENTER" and the move starts immediately. Any axis which is set to "REC" and not selected as a Playback axis, will have its motion data recorded during this pass. Whenever you are joysticking an axis as a result of using the "JOYST AXIS" key, the joystick axis is set to "REC." The result is that any axis which is responding the Jogbox joystick will have its motion recorded each time the operator uses "RUN FWD" or "RUN REV."
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command: **RUN REV**
where: Jogbox
purpose: start real time record/playback backwards through the frame numbers.
SEE "RUN FWD" on previous page.
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command: **SET HOME POSITION**
where: Jogbox
purpose: reset the displayed motor position count to "0.0"
The Jogbox display briefly displays "AXES TO ZERO" followed by the "SELECT AXES" prompt. The operator uses the "1" to "P keys to select the group of axes which will have their motor position counts set to "0.0." Pressing the "ENTER" causes the motor position counts for the selected axes to be zeroed.
Press the "STOP/CANCEL" key to quit without changing any position counts.
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command: **WIND CAMERA**
where: Jogbox
purpose: roll the axis assigned to camera motor functions.
The prompt "NUM FRS:" appears on the Jogbox display. Enter the number of frames you want to wind, and press the "ENTER" key. Note that the "12B" Jogbox key is the "-" key.
If the Live Action screen is active, the prompt "FPS" appears; if the Stop-Motion screen is active, the prompt "EXP TIME" appears. In either case, the last FPS or exposure time you entered is displayed as the default value. Either enter a new frames per second or exposure, or simply accept the displayed value. Press "ENTER" to start the camera rolling, or "STOP/CANCEL" to quit with no camera activity.
Use "EMER STOP" to stop the camera on an emergency basis. Note that all other running axes will also stop.
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PROBLEMS AND SOLUTIONS

THE MOTORS RUN TOO FAST OR TOO SLOW-

Use the "AxiSetup" menu item to control the motor top speed. The "Top Speed in PPI" parameter controls how fast each motor goes when just slewing to position. The number shown in the middle box is the current setting. Click on the number to change it. The bigger the number, the faster the motor goes. This number has no effect on how fast the axis runs when playing back or recording a move. The actual speed in pulses-per-second is equal to "Top Speed in PPI" times 120.

THE MOTORS RAMP UP TOO FAST OR TOO SLOW-

The "AxiSetup" "Acceleration" number controls how fast the axis accelerates. The bigger the number, the faster the axis accelerates. Use "CamSetup" to modify the camera axis acceleration.

THE MOTORS RAMP DOWN TOO FAST OR TOO SLOW-

The "AxiSetup" "Deceleration" number controls how fast the axis decelerates. Bigger numbers give longer decelerations. Use "CamSetup" to modify the camera axis deceleration.

THE CAMERA MOTOR STALLS BEFORE IT REACHES SPEED WHEN SHOOTING LIVE ACTION MOVES-

The "CamSetup" menu item controls several parameters relating to the use of one of one of the axes as a camera motor. The "LiveAct PRE ROLL" number sets how long the camera will take to reach speed. In general, the longer the motor takes to ramp up to speed, the faster it can go. The number is how many time periods the camera motor will use to reach speed. Since there are 120 time periods per second, if the "LiveAct PRE ROLL" is 120, the camera will take 1 second to reach speed. Whenever the "LiveAct PRE ROLL" number is greater than the axis PRE ROLL (located Control Panel Screen lower left), the camera will start rolling before the axes.

Check to see if the SHUT ANGLE box is highlighted. If highlighted, the camera motor will try to make "whip-around" simulated shutter angle exposures which will not work correctly above just a few FPS. Click the SHUT ANGLE number with the middle mouse key to set it back to normal.

To determine the exact number of frames that will be used during the camera pre roll, click the "Start:" box until it reads "Shoot Switch", enable the camera, and then click "FWD". The box just above REV-STOP-FWD will display the number of pre roll frames. Click STOP to cancel.

WHEN I USE THE "CAMERA" MENU **ITEM TO ROLL FRAMES, THE CAMERA ACCELERATES AND DECELERATES TOO FAST OR TOO SLOW, OR THE RAMPS ARE TOO LONG OR TOO SHORT-**

See "CamSetup, defined" in the Index for information on setting camera ramping.

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WHEN I CLICK ON THE "DATA FPS" NUMBER, THE NUMBER WILL ONLY DECREASE. HOW DO I GET THE NUMBER TO INCREASE-DATA FPS is decreased by each click of the left mouse key, and increased by each click of the right mouse key. Click with the middle mouse to set the "normal" FPS.

HOW DO I CHANGE THE "VISUAL FPS" SETTING-

Click with the left mouse key to decrease, and with the right mouse key to increase. The DATA/VISUAL setting on the Control Panel Screen impacts the range of settings available. The following list shows some available for various DATA/VISUAL settings. The VISUAL FPS settings of 24 and 30 with a DATA/VISUAL of 1 were obtained by "clicking down" the DATA FPS number with the left mouse key.

VISUAL FPS	DATA FPS	DATA / VISUAL
24	120	5
30	120	4
60	120	2
120	120	1
24	24	1
30	30	1

We do not recommend using a DATA/VISUAL lower than 2 when shooting live action. Although low DATA/VISUAL numbers use up less memory for the same length of move, they don't produce the tight feel, high acceleration capability, and high top end speeds given by large DATA/VISUAL numbers.

I WANT **TO KEEP THE CAMERA FROM ROLLING BACKWARDS WHEN I RUN MOVES IN REVERSE-**

Turn the "CamSetup" "LiveAct FWD Only" parameter "ON." The camera will only run when the move is played/recorded in the forward direction. This applies only to Live Action shooting; stop-motion and BLUR exposures may always be run in either directions.

THE CAMERA MOTOR WON'T RUN-

The camera motor will only run when it's enabled (name highlighted) and in "PLAY." Click on the name to adjust the highlight to bright, and click on "PLAY." An exception to this is the "CAMERA" menu item, which allows the camera to be rolled regardless of whether it's enabled or not. If the "LiveAct FWD Only" item in the "CamSetup" menu is set to "ON", the camera will only wind during forward running record/playback passes. The axis name "CAMERA" must be spelled correctly on

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the screen, with no extra letters or spaces, and of course the driver and motor must be hooked up correctly and turned on.

I DON'T WANT **THE AXES TO PRE ROLL OR POST ROLL-**

Set the PRE ROLL and POST ROLL numbers at screen lower left to 0. Look out for motor stalls! **I DON'T WANT THE CAMERA TO PRE ROLL OR POST ROLL-** Click on the "CamSetup" menu item. To prevent camera pre rolls when shooting live action, set the "LiveAct PRE ROLL" number to 0. To prevent camera pre rolls when shooting STILL or BLUR (stop-motion or go-motion), set the "Blur PRE ROLL" to 0. Don't expect the camera to be able to run more than about 2 Visual FPS without PRE and POST rolls.

I WANT **TO COMPOSITE SEVERAL PASSES IN-CAMERA, BUT THE CAMERA PRE ROLLS A DIFFERENT NUMBER OF FRAMES WITH DIFFERENT FPS SPEEDS-**

Use the "Options" command to set the "RAMPING OPTION" to "SAME". This assures that the camera will pre roll the exact same number of frames, regardless of shooting speed. Just wind the camera to the same frame number before each pass, and go. If you don't plan to shoot much faster than about 2 FPS, another solution is to simply disable the camera ramps, as described above.

If you select the "REDUCED" option the pre rolls will be proportionately shorter with slower FPS settings, but the number of pre roll camera frames will decrease as well. You can use the information box just above REV-STOP-FWD boxes to predict the exact number of camera pre roll frames.

AT THE BOTTOM LEFT OF THE STOP-MOTION SCREEN, THERE'S A MENU **ITEM WHICH TOGGLES BACK AND FORTH BETWEEN "STILL" AND "BLUR." WHAT'S THE DIFFERENCE-**

"BLUR" is the same as go-motion. The axes and camera move through one frame of motion each time you press the shoot button. "BLUR" passes have the same motion blur characteristics as passes shot in continuous motion, and cut in well with live action scenes. "STILL" passes are shot in the traditional "nothing moving" stop motion style, and have a noticeably different quality than a live action shot. Shots photographed in "STILL" mode look very crisp and are sometimes preferred for commercial work.

WHEN SHOOTING "BLUR" GO-MOTION, THE CAMERA PRE ROLLS SO MUCH IT OPENS THE SHUTTER ON THE PREVIOUS FRAME-

The "CamSetup" "Blur PRE ROLL" parameter sets how much the camera pre rolls when shooting go-motion. The larger the number, the more the pre-roll. "Blur PRE ROLL" numbers between 5 and 15 are appropriate for most work at exposures of 0.25 seconds or shorter; the exact number chosen depends on the resolution of the camera motor driver, and your own preferences. Pick a number which gives about 20 or 30 degrees of pre roll for your fastest exposure. The faster the exposure, the more pre roll any given number will produce. A '0' pre roll number will completely eliminate any pre-roll. If you need to have large amounts of camera pre roll for shooting very short exposures, enable to capping shutter to cap the pre and post roll by setting the "Cap PRE & POST

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rolls" parameter in the "CamSetup" command to "YES". You must have a physical capping shutter to use this option~the motorized angle shutter is not applicable in this mode.
The "Blur PRE ROLL" number applies only to the camera axis; the pre and post rolls for the normal axes are relative to the PRE ROLL and POST ROLL numbers set on the Live Action screen. If the motion axes pre roll too much for your tastes, lower the PRE ROLL and POST ROLL numbers on the live action screen, but leave enough headroom for the fastest frames in the move.
THE AMOUNT OF PRE ROLL AND POST ROLL SEEMS TO VARY WITH THE EXPOSURE WHEN SHOOTING GO-MOTION, AND WITH THE FPS WHEN SHOOTING LIVE ACTION-
This is normal; the faster the exposure or FPS, the more the pre-roll and post-roll for any given number assigned to these parameters. The "Options" command can be used to make pre and post rolls the same for all speeds, at the expense of creating sluggish ramps a slower FPS speeds.
I CAN CHANGE SLEWING SPEEDS, CAMERA PRE ROLL, ETC, BUT THESE SETTINGS ARE GONE WHENEVER I RE-BOOT. HOW CAN I MAKE MY CHANGES PERMANENT-
You can save the current joystick, motor performance, pre/post roll, fps and other settings by using the "SaveSetup" menu item. This saves all the information in the file called "AXES.SET". The setup in effect the last time you used "SaveSetup" will be reloaded each time the Software is re-booted. Use "LoadSetup" to reload the "AXES.SET" parameters anytime, except when the axes are running.
HOW DO I KNOW WHICH CAMERA FRAME RECORDS THE FIRST FRAME OF THE SHOT WHEN I'M SHOOTING LIVE ACTION? THE PRE ROLL MAKES THIS HARD TO FIGURE-
The number of frames the camera will pre roll frames is always consistent for the same FPS setting, and is proportionate to the "LiveAct PRE ROLL" parameter set with the "CamSetup" command. The number of camera pre roll frames is displayed just above the REV-STOP-FWD box whenever the FWD or REV boxes are clicked. To determine the actual number of frames, click the "Start:" box to "Shoot Switch" and click FWD. The number of frames will be displayed, as well as the camera frame number which will record the first frame of the move. Click STOP to cancel.
The "SIMPLE ACCESSORY SCHEME" drawing in the back of this manual shows how to wire up a high intensity LED to mark the first frame of move record/playback. The LED will fire for exactly one film frame on the first frame of move playback after the PRE ROLL. The LED can be concealed somewhere in the camera's view, or wired to the slate (the LED becomes the "Speed" call). This provides a very unambiguous sync mark. When the move is run, the camera frame number which actually receives the LED exposure is displayed just above REV-STOP-FWD.
LED's with an intensity of 2000 mcd or more can be easily seen even in bright sunlight. Radio Shack part number 276-087, "Super Bright LED," is a good choice.
See "Options, defined" in the Index, and "Synchronizing Multiple Passes" in the table of contents for more information.
WHEN SHOOTING LIVE ACTION, THE CAMERA MOTOR ROLLS FORWARD A PARTIAL FRAME BEFORE STARTING ITS ACCELERATION TO SPEED-

This is normal; the camera is adjusting its starting phase so that it will be in perfect phase when it hits speed. If you wish to cap this adjustment and the rest of the camera pre roll, set the "Cap PRE & POST rolls" parameter in the "CamSetup" command to "YES".

HOW DO I GET AN **AXIS TO ACT LIKE A CAMERA MOTOR-**

Use the NameAxis menu item to name the axis "CAMERA". Any combination of upper or lower case letter will do, as long as "cAMerA" is spelled correctly without any extra letters or spaces.

MUST I HAVE A CAMERA AXIS-

No. Just don't name any axis "Camera".

DO I REALLY NEED A CAPPING SHUTTER-

Strictly speaking, no. A capping shutter is handy during rewinds, but you can also just remember to rackover or cover the lens. If you plan to do multiple exposures per frame when working with stop-motion or go-motion, either a capping shutter or motorized angle shutter are essential.

WHAT ABOUT A MOTORIZED ANGLE-CONTROL SHUTTER-

If you name an axis "SHUTTER" in any combination of upper or lower case letters, that axis will act as a dedicated shutter control. The shutter will close when backwinding during multiple Animation exposures per frame, or whenever backwinding "CAPPED" when using the "CAMERA" menu item. In stop-motion, the shutter will close down for exposures shorter than the "StopMo Base Exposure" set with the "CamSetup" menu item. The distance the axis will travel to reach "Shutter Closed" is the number assigned to "Pulses Per Increment" in the "AxiSetup" menu item. Shutter open is assumed to be position 0.0.

HOW DO I GET THE SYSTEM TO MAKE MULTIPLE EXPOSURES PER FRAME AND MAKE FRONT-LIGHT/BACK-LIGHT EXPOSURES-

To control lighting bits used for multiple exposure animation shooting, click on either the exposure time or the multiple-exposure bar just above the "REV STOP FWD" control. An elaborate menu will appear which allows considerable control over sequential exposures, settling times, backwinds, output triggers, and pauses for the shoot switch. The "4- -" at the bottom of the screen adds or deletes exposures. The "TRIGGERS" are the bits used to control lights which must change for each of the individual exposures. These triggers bits come out through the RTMC Logic Connector.

The bits programmed with the "EditBits" are used to control things like beacon lights on the model and other on/off devices in the set. These are played back in sequence while the move is running. See "EditBits, defined" in the Index for more information.

HOW DO I GET THE TRIGGER OUTPUTS TO TURN LIGHTS, ETC, ON AND OFF-

Use the "EditBits" commands. Look up "EditBits, defined" in the Index for more information.

I AM A CONFUSED ABOUT YOUR MOVE FRAME NUMBERING SCHEME, AND I NOTICE THAT WHEN TOGGLING BACK AND FORTH BETWEEN "VEL:" AND "POS:" IN THE GRAPHIC MOVE EDITOR, "POS:" ALWAYS SHOWS THE MOVE AS ONE FRAME LONGER THAN "VEL:"-

The frame numbering scheme we use is a compromise which arises out the fact that the System has to reconcile live action, stop-motion, and go-motion passes on the same move. Consider a move which is to be photographed on three film frames. If we photograph the move in motion, exposure one will record the motion between points a and b, exposure two between points b and c, exposure three between points c and d. The move has three "vectors" or "velocities": a to b, b to c, and c to d. But it also has four "points": a, b, c, and d.

The convention we use is: we photograph the "vectors" between points. To get three vectors, we wind up with four points. Vectors are the same as velocities shown when the graph is in "VEL:" (velocity) mode. Points are the same as the positions shown in "POS:" mode. You always need one more position (point) than the number of velocities.

HOW DO I CHANGE WHICH DISC THE MOVES GET SAVED ON-

Click on the box at the upper left corner of the "SaveMove" or "LoadMove" screens. A series of prompts will guide you through shifting to a different disc or directory. To make the change permanent, just save or load a move on the new disc. The Software always remembers the last disc and directory a move was saved on or loaded from, and defaults to that disc and directory even after re-booting the Software.

HOW DO I GET THE SOFTWARE TO USE EMS MEMORY-

The Software automatically checks for EMS memory when it boots up. You must run the "install" program which comes with QEMM-386 or whatever EMS memory manager you are using.

SOME NUMBERS AND LETTERS APPEAR AT SCREEN UPPER LEFT WHENEVER THE SOFTWARE BOOTS UP. WHAT DO THEY MEAN-

From left to right: the default move disc and directory, the base address of the RTMC16 Card in hexadecimal, and the interrupt vector used by the card.

CAN I USE THE MOUSE AS A SHOOT SWITCH-

When shooting STILL or BLUR exposures, click the mouse on the "Status Message" box just below the "REV STOP FWD" control. Be careful to click directly on the box, since clicking the nearby "REV STOP FWD" keys can cause a lot of confusion. Generally, we discourage the use of the mouse as a shoot switch—a nice mechanical switch is very easy to hook up, as shown in the "Simple Accessory Scheme" drawing in the "TECHNICAL DRAWINGS" section of this Manual.

HOW DO I ADD A SETTLING TIME BEFORE STOP-MOTION EXPOSURES-

Click on the exposure time or the multiple-exposure bar just above the "REV STOP FWD" control. Set the "DELAY" time to any value you want.

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I CAN TAKE KEY FRAMES FROM THE CONTROL PANEL SCREEN, BUT THEY AREN'T VISIBLE WHEN I ENTER THE GRAPHIC MOVE EDITOR-
Key frames are only visible when the graph is displayed in position mode. If you see the word "VEL:" at the lower left of the graph frame, the move is displayed in velocity mode. Click on the word "VEL:" to shift the graph over to position or "POS:" mode. The key frames show up as little red squares. If you still can't see any key frames, the key frames may be off the graph. Click of "FitAll" to in-between the key frames, and then click on the "L" at frame upper right to unlock the vertical scale of the graph.
WHEN I SHOOT MULTIPLE-EXPOSURE-PER-FRAME STOP MOTION, THE CAMERA MOTOR RUNS TOO FAST WHEN THE CAMERA REWINDS WITH THE SHUTTER CLOSED-
When the shutter is closed, the camera rewinds at the "StopMo Base Exposure", which is set with the "CamSetup" command. The longer the "StopMo Base Exposure" the slower the camera will wind. Note that "StopMo Base Exposure" is also the shortest exposure that is possible without closing the shutter to a smaller angle~if you don't have a shutter, this will effectively be the shortest possible stop motion exposure.
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TECHNICAL DRAWINGS
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<blank>
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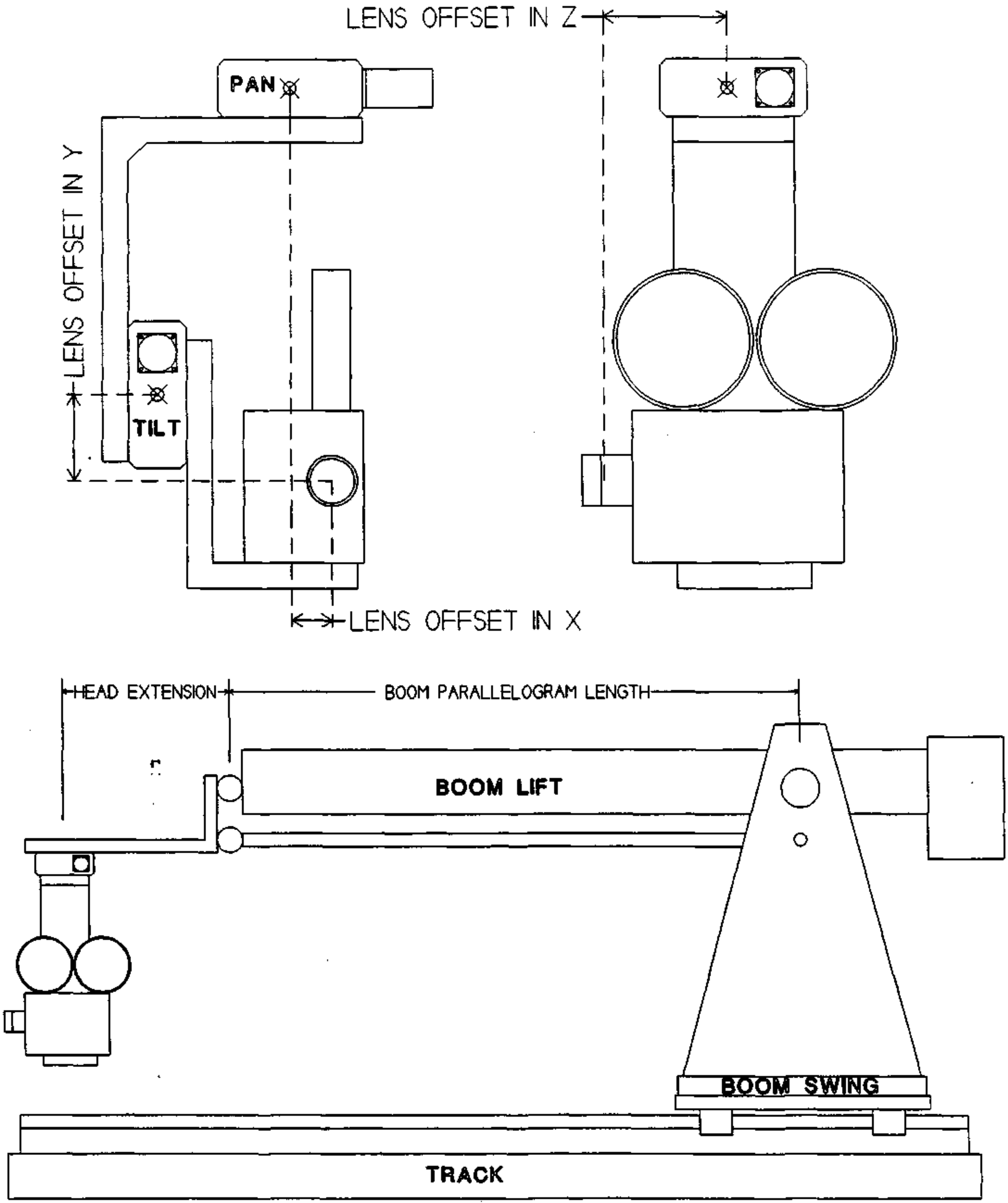
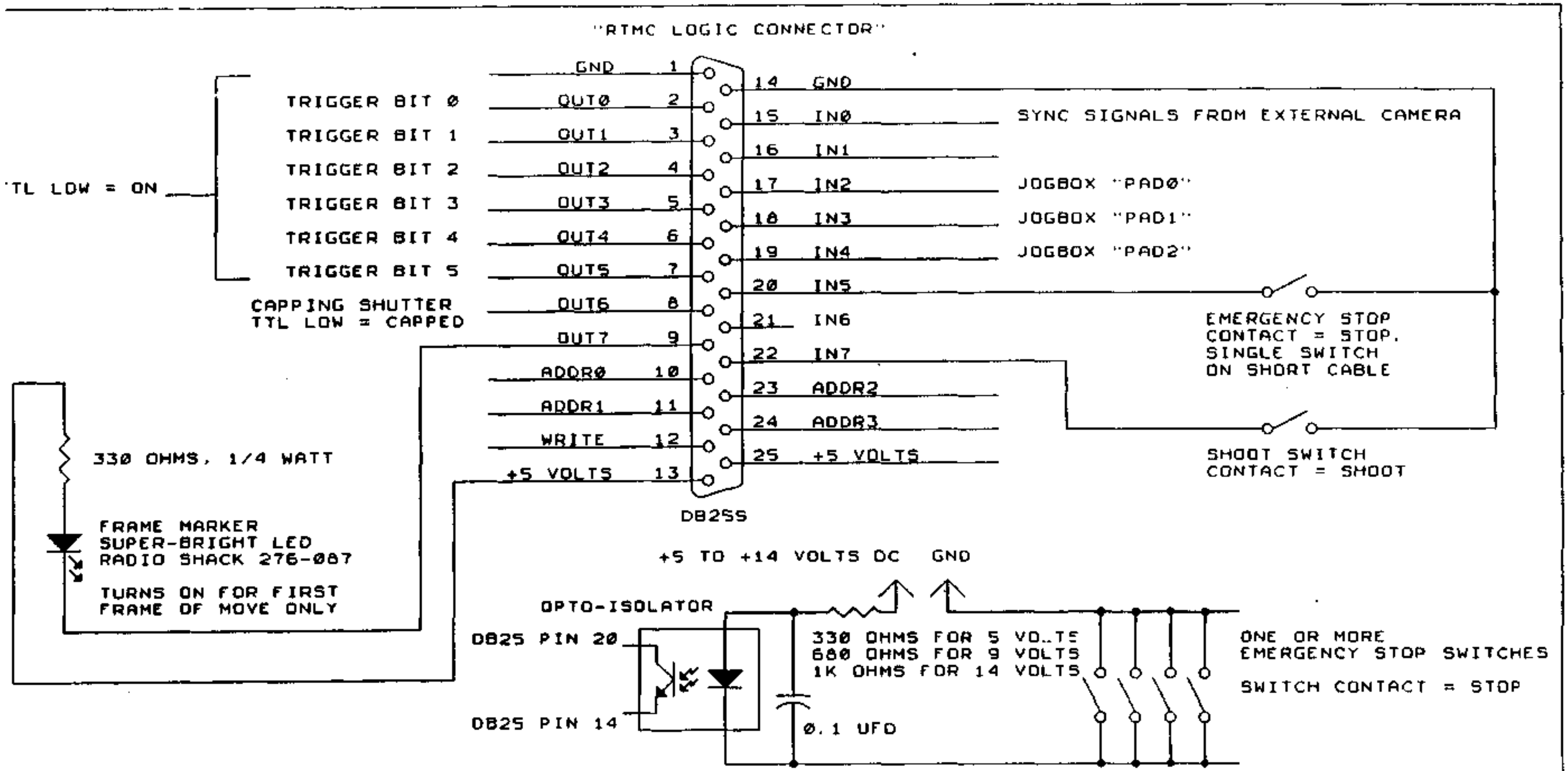

LENS OFFSET IN Z
PAN
LENS OFFSET IN Y
TILT
LENS OFFSET IN X
HEAD EXTENSION
BOOM PARALLELOGRAM LENGTH
BOOM LIFT
BOOM SWING
TRACK



USE THIS SCHEME IF YOU WANT TO USE SEVERAL EMERGENCY STOP SWITCHES. ALMOST ANY OPTO ISOLATOR WILL DO, ALTHOUGH DARLINGTON TYPES MAY BE TOO NOISE SENSITIVE .
DO NOT USE THE COMPUTER POWER SUPPLY TO POWER THIS CIRCUIT!

S IS THE "RTMC LOGIC CONNECTOR"

DB25S CONNECTOR IS CONNECTED RTMC16 CARD "H1"
A 25 WIRE FLAT CABLE. PIN 26 OF H1 IS IGNORED.
1 OF H1 (THE PIN NEAREST THE "H1" LEGEND ON THE BOARD)
CONNECTED TO PIN 1 OF THE DB25S CONNECTOR.

CAMERA HOME AND EMERGENCY STOP CIRCUITS ARE NOT REQUIRED

SIGNALS ARE TTL LEVEL. BE CAREFUL NOT TO LET THESE SIGNALS
E IN CONTACT WITH EXTERNAL VOLTAGES OR METALLIC OBJECTS .

SHOWN, THE EMERGENCY SWITCH CIRCUIT IS INTENDED FOR USE
H A SINGLE SWITCH ON A SHORT CABLE.

COMPLEX EMERGENCY STOP CIRCUITS, USE AN OPTO-ISOLATOR TO
TECT THE COMPUTER FROM DANGEROUS EXTERNAL VOLTAGES AND
CTRICAL NOISE.

ALL THE ACCESSORIES SHOWN ARE OPTIONAL, ALTHOUGH THE SHOOT SWITCH IS ESSENTIAL FOR ANIMATION.

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Title	SIMPLE ACCESSORY SCHEME	
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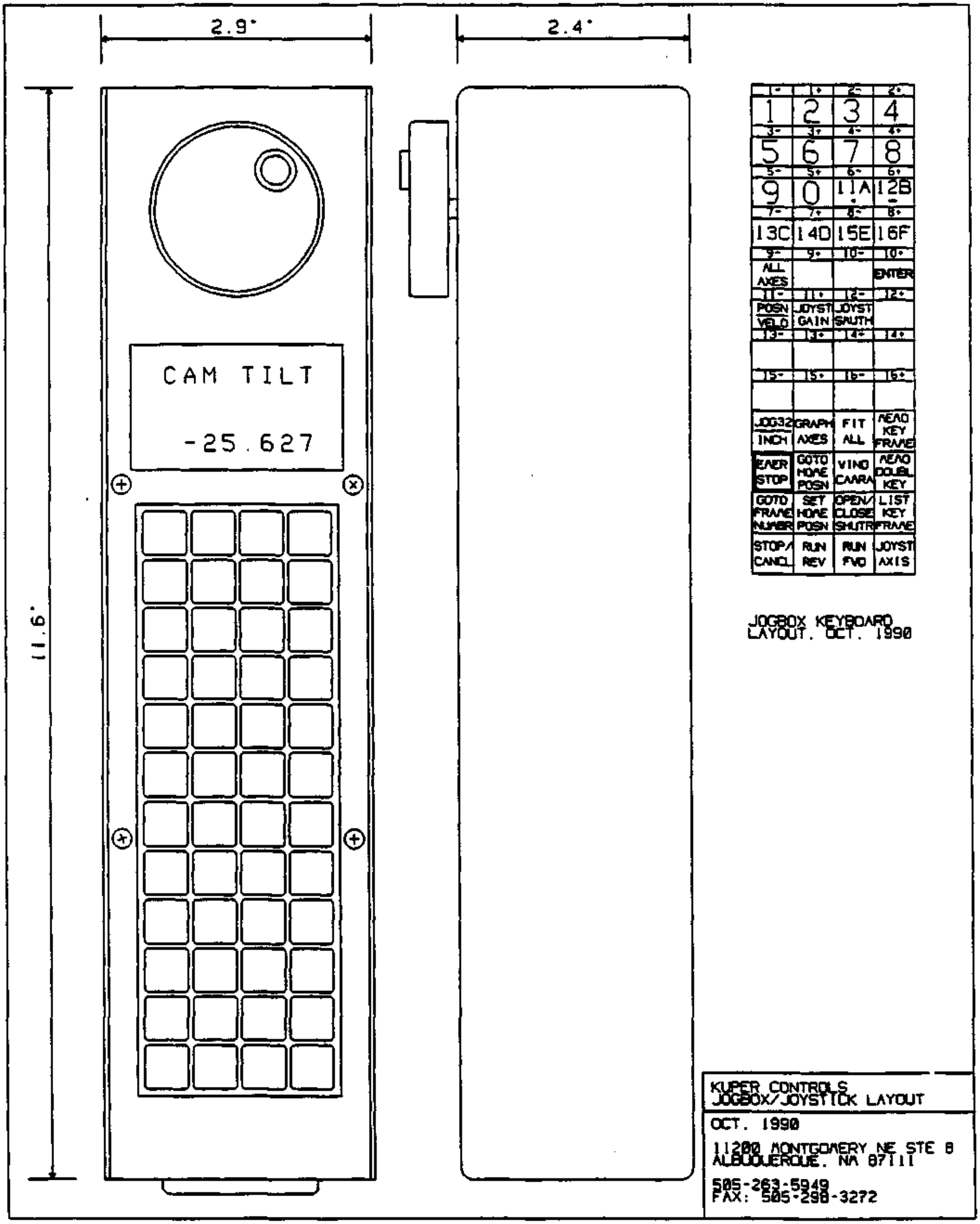
2.9"
2.4"
11.6"
CAM TILT
-25.627
1- 1+ 2- 2+
1 2 3 4
3- 3+ 4- 4+
5 6 7 8
5- 5+ 6- 6+
9 0 11A 12B
7- 7+ 8- 8+
13C 14D 15E 16F
9- 9+ 10- 10+
ALL AXES
ENTER
11- 11+ 12- 12+
POSN VELO
JOYST GAIN
JOYST SMUTH
13- 13+ 14- 14+
15- 15+ 16- 16+
JOG32 INCH
GRAPH AXES
FIT ALL
READ KEY FRAME
EMER STOP
GOTO HOME POSN
VIND CAMRA
READ DOUBL KEY
GOTO FRAME NUMBR
SET HOME POSN
OPEN/ CLOSE SHUTR
LIST KEY FRAME
STOP/ CANCL
RUN REV
RUN FWD
JOYST AXIS
JOGBOX KEYBOARD LAYOUT, OCT. 1990
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JOGBOX/JOYSTICK LAYOUT
OCT. 1990
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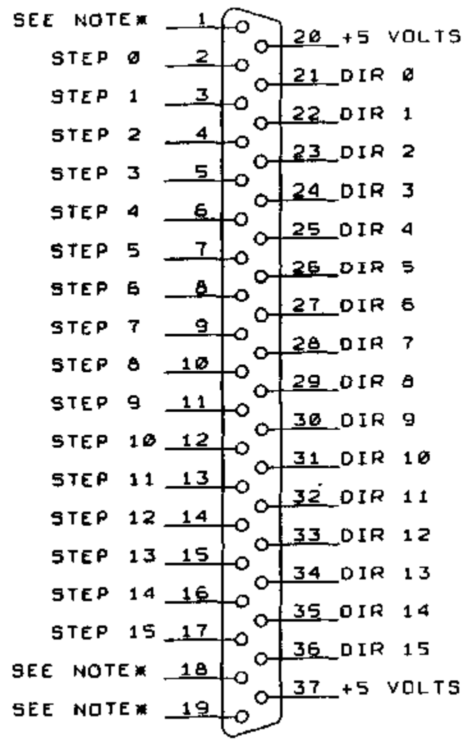
STEP AND DIRECTION CONNECTORS AS SEEN
FROM THE REAR OF THE COMPUTER.

CONNECTORS ARE DB37S



ON THE RTMC48 CARD, 40 PIN HEADERS
BRING OUT THE STEP AND DIRECTION
SIGNALS TO DB37S CONNECTORS IN
I/O SLOTS ON THE BACK OF THE COMPUTER.

HEADER ASSIGNMENTS ON THE RTMC48 CARD:

JP1 = AXES 1 TO 16 (0 TO 15)
JP2 = AXES 17 TO 32 (16 TO 31)
JP3 = AXES 33 TO 48 (32 TO 47)

FOR EACH GROUP OF 16 AXES,
*PINS 1, 18, AND 19 MAY BE SET TO PROVIDE
EITHER +5 VOLTS OR GROUND BY ADJUSTING JUMPERS
JP6, 7, AND 8 ON THE RTMC48 CARD. IN EACH CASE:

GND = CENTER TO YOUR LEFT (PINS 1 AND 2)
+5VOLTS = CENTER TO YOUR RIGHT (PINS 2 AND 3)

JP6 = AXES 1 TO 16 (0 to 15)
JP7 = AXES 17 TO 32 (16 to 31)
JP8 = AXES 33 TO 48 (32 to 47)

ALL SIGNAL OUTPUTS ARE OPEN-COLLECTOR TTL.

THE VOLTAGES AVAILABLE ON PINS 1, 18, 19, 20 AND 37
AND ARE INTENDED TO BE USED TO DRIVE OPTO-ISOLATED
INPUTS TO STEPPING MOTOR DRIVERS. THESE VOLTAGES
ARE THE COMPUTER BUS SUPPLY VOLTAGES. USE GREAT
CARE WHEN MAKING EXTERNAL CONNECTIONS. EXTERNAL
CIRCUITRY OTHER THAN OPTO-ISOLATED DRIVER INPUTS
USING THESE VOLTAGES SHOULD BE LIMITED TO 300 MILLIAMPS.

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TIMECODE IN AND TIMECODE COMMON ACCEPT ALL LONGITUDINAL TIMECODE FORMATS.
TIMECODE SHOULD BE OF GOOD QUALITY AND HAVE A HIGH SIGNAL LEVEL.

IN ORDER TO MAINTAIN GOOD TIMECODE SYNC, THE SOURCE SHOULD BE A TIMECODE GENERATOR OR THE "ADDRESS TRACK" ON A PROFESSIONAL TAPE DECK.

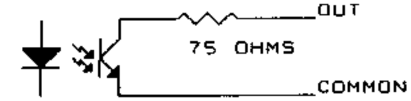
INPUT IMPEDANCE IS > 5000 OHMS.

VIDEO IN AND VIDEO COMMON CONNECT DIRECTLY TO NTSC OR PAL COMPOSITE VIDEO. A "SYNC ONLY" SOURCE IS ALSO ACCEPTABLE.

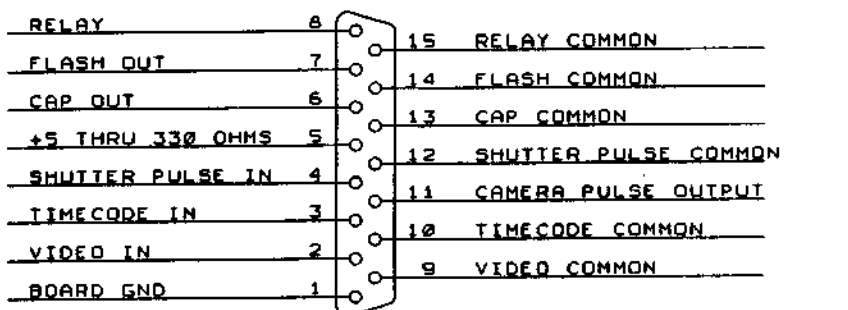
INPUT IMPEDANCE IS 75 OHMS.

RELAY AND RELAY COMMON ARE THE UNPOLARIZED CONTACTS ON A MECHANICAL RELAY. ABSOLUTE MAXIMUM RATING IS 100 VOLTS DC, 500 MILLIAMPERES.

TYPICAL OF CAP AND FLASH OUTPUTS



ABSOLUTE MAXIMUM RATING:
40 VOLTS, 200 MILLIAMPERES



DB15P ON KUPER CARD I/O CONNECTOR

SYNC CONNECTIONS FOR SOUND SPEED CAMERA MOTORS:
ALL CONNECTIONS ARE PIN-TO-PIN, NO SIGNAL CONDITIONING IS REQUIRED
INPUT IMPEDANCE IS 2000 OHMS

	PANAVISION	ARRI "B"	ARRI 535	FRIES
SHUTTER PULSE IN	PIN 9	PIN 2	PIN 7	PIN E
SHUTTER PULSE COMMON	PIN 8	PIN 9	PIN 4	PIN C

PANAVISION CONNECTOR: FFA 2S310CNAC62
SOURCE: LEMO, TEL 800-444-LEMO, 707-578-8811

ARRIFLEX "B" CONNECTOR: "FISCHER 11 PIN"
ARRIFLEX 535 CONNECTOR: "FISCHER 9 PIN" P/N S104A055-130
STRAIN REFLIEF CLAMP FOR 0.240" CABLE: /675
SOURCE: W.W. FISCHER TEL 800-551-0121, FAX 404-551-6969

FRIES CONNECTOR: TMW R05-P88M
SOURCE: FRIES ENGINEERING, TEL 818-765-3600

IF YOU ARE USING A CINEMATOGRAPHY ELECTRONICS BASE, YOU MAY NEED TO PLACE A 2000 OHM RESISTOR IN SERIES WITH DB15 PIN 4

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Title
DB15 ACCESSORY CONNECTOR ON RTMC48 CARD

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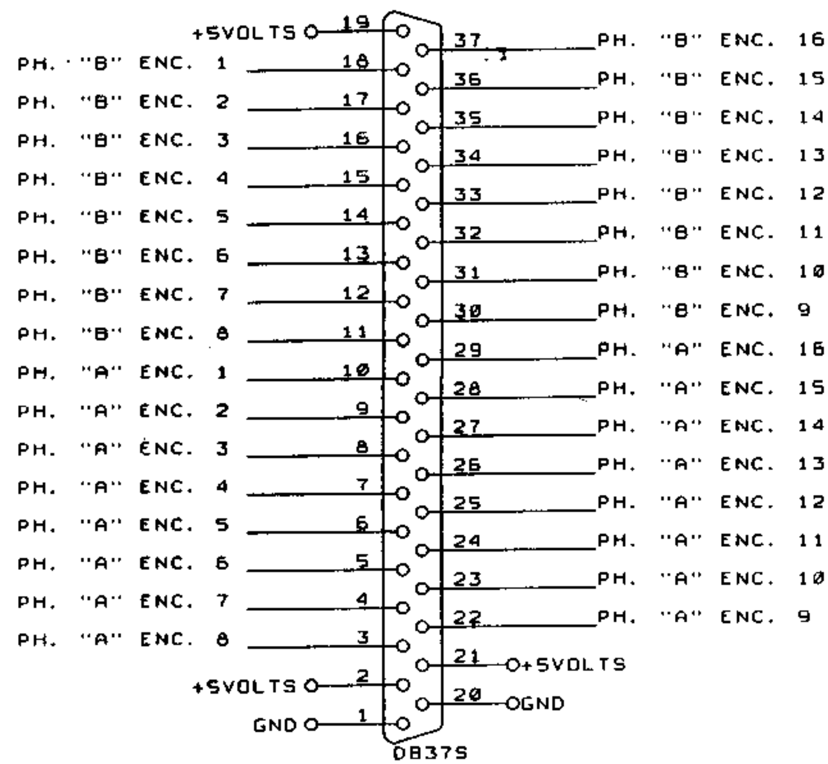
HOOKING UP ENCODERS WITHOUT A BLACK BOX.



WIRE COLOR SCHEME FOR
US DIGIPOT S2-2048 ENCODERS
USING "MC/4" CONNECTORS
SUPPLIED BY U.S. DIGITAL

+5 VOLTS	ORANGE
GROUND	BROWN
PHASE A	YELLOW
PHASE B	BLUE

IT IS POSSIBLE TO HOOK UP ENCODERS WITHOUT THE BLACK BOX. THE ABOVE SCHEMATIC SHOWS THE ENCODER CONNECTIONS WHEN CONNECTOR "JP4" ON THE RTMC48 CARD IS BROUGHT OUT TO A MALE DB37P CONNECTOR AT THE BACK OF THE COMPUTER. IT IS ASSUMED THAT PIN ONE OF JP4 AND PIN ONE OF THE DB37 ARE CONNECTED TOGETHER VIA THE RED WIRE ON THE RIBBON CABLE.

PLEASE NOTE THAT THIS SCHEME DERIVES THE ENCODER POWER DIRECTLY FROM THE COMPUTER POWER SUPPLY. BE VERY CAREFUL TO PREVENT THE POWER LEADS FROM SHORTING AGAINST ANYTHING, AND USE SHIELDED CABLE WITH THE SHIELD CONNECTED ONLY TO THE COMPUTER CASE.

KEEP ALL LEADS AS SHORT AS POSSIBLE.

EACH ENCODER REQUIRES A CONNECTION FOR:

+5VOLTS, GROUND, PHASE A, PHASE B

FOR ENCODER #1:

ENCODER +5VOLTS: DB37 PIN 2
ENCODER GROUND: DB37 PIN 1
ENCODER PHASE A: DB37 PIN 10
ENCODER PHASE B: DB37 PIN 18

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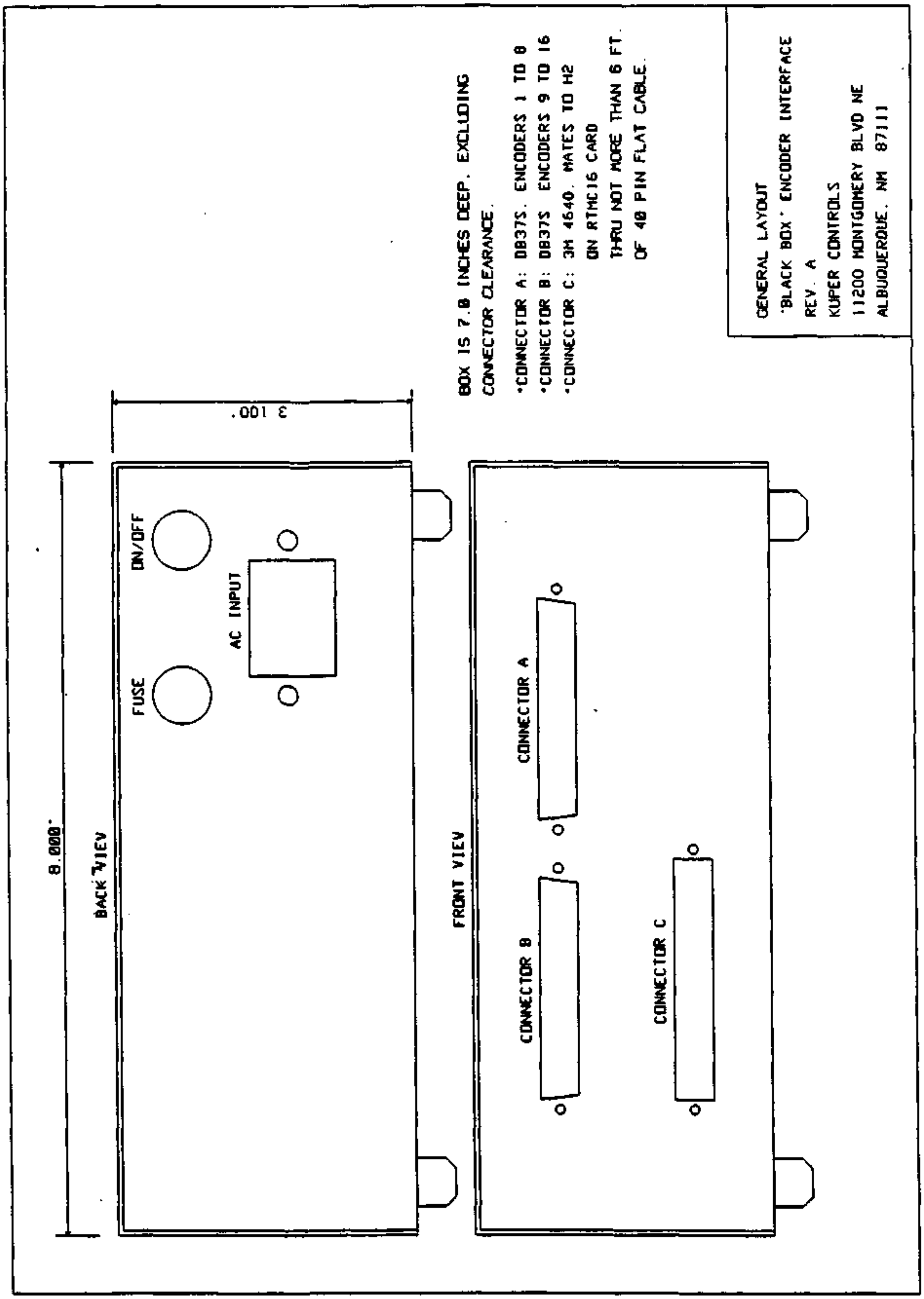
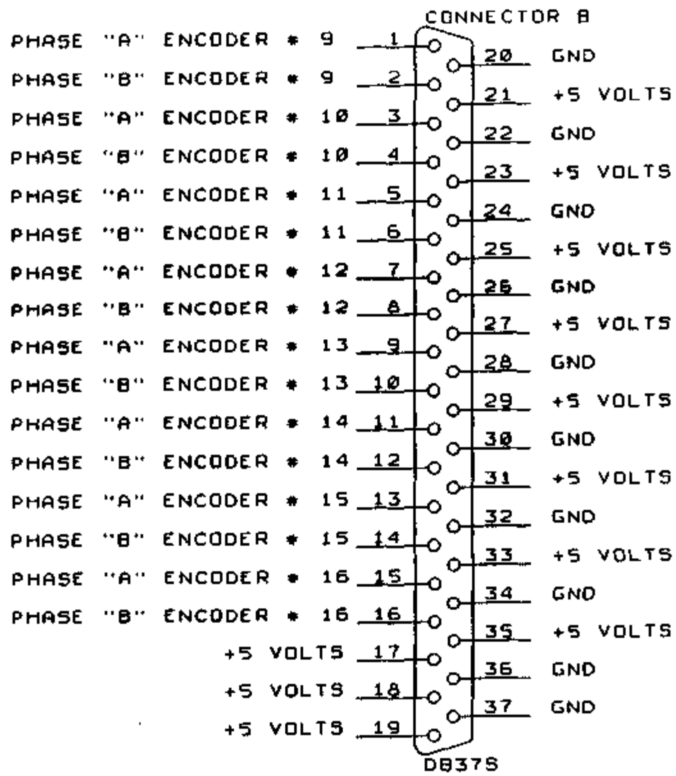
Title
ENCODER TO DB37 PINOUTS WITHOUT BLACK BOX

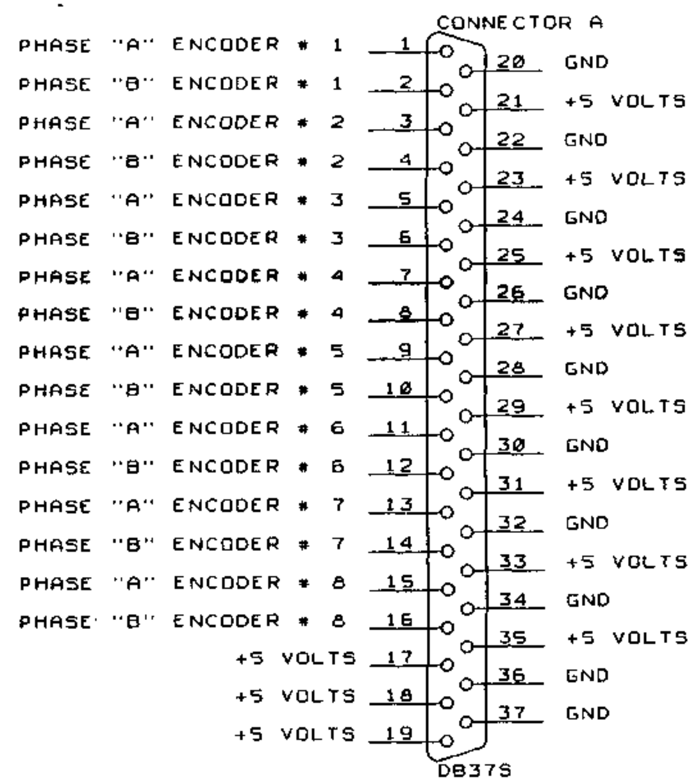
Size	Document Number	REV
A		0

Date: February 9, 1995 Sheet 1 of 1



BOX IS 7.8 INCHES DEEP, EXCLUDING
CONNECTOR CLEARANCE.
•CONNECTOR A: DB37S. ENCODERS 1 TO 8
•CONNECTOR B: DB37S ENCODERS 9 TO 16
•CONNECTOR C: 3M 4640. MATES TO H2
ON RTMC16 CARD
THRU NOT MORE THAN 6 FT.
OF 40 PIN FLAT CABLE.
GENERAL LAYOUT
'BLACK BOX' ENCODER INTERFACE
REV. A
KUPER CONTROLS
11200 MONTGOMERY BLVD NE
ALBUQUERQUE, NM 87111
3.100"
8.000"
BACK VIEW
ON/OFF
FUSE
AC INPUT
FRONT VIEW
CONNECTOR A
CONNECTOR B
CONNECTOR C





THE "BLACK BOX" ENCODER INTERFACE CONTAINS A 5 VOLT, 3 AMP LINEAR POWER SUPPLY WITH SHORT CIRCUIT PROTECTION.

ENCODER PHASE INPUTS ARE TO 74LS244 CHIPS PULLED HIGH THROUGH 2.2K RESISTORS. UP TO 30 FEET OF CABLE MAY BE USED TO CONNECT EACH INDIVIDUAL ENCODER.

CONNECTOR "C" IS A 3M CO. 4640 CONNECTOR, WHICH HAS THE SAME PINOUTS AS SHOWN IN THE DRAWING "RTMC16 ENCODER INTERFACE CONNECTOR H2"

THE 40 PIN FLAT CABLE BETWEEN CONNECTOR "C" AND THE COMPUTER SHOULD NOT EXCEED 5 FEET IN LENGTH.

USE EXTREME CARE WHEN HOOKING UP THE ENCODER +5 VOLT AND GROUND WIRES, BECAUSE REVERSING THE WIRES CAN DESTROY THE ENCODER. TRIPLE CHECK THESE CONNECTIONS BEFORE TURNING ON THE POWER SUPPLY.

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Title PINOUTS FOR "BLACK BOX" ENCODER CONNECTORS		
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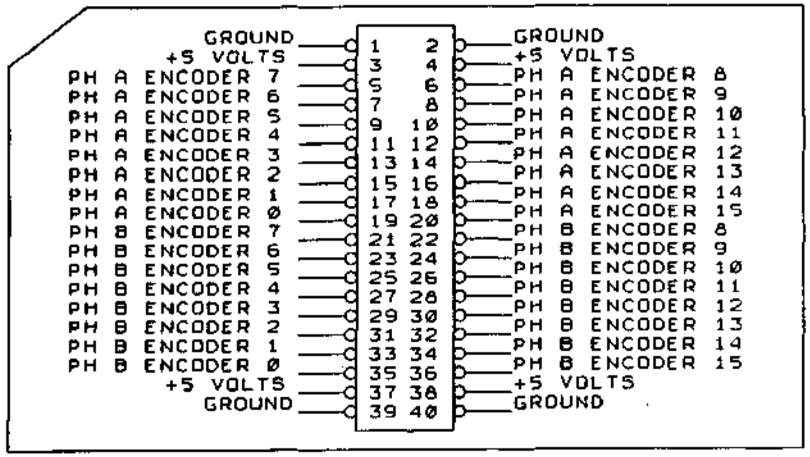
ENCODER CONNECTOR JP4 ON THE RTMC48 CARD

CONNECTOR IS A DUAL IN LINE PIN HEADER ON 0.1" CENTERS



TOP OF BOARD ->>

ALL ENCODER INPUTS ARE TTL LEVEL PULLED HIGH THROUGH 2.2K RESISTORS ON THE BOARD.

+5 VOLT AND GROUND VOLTAGES ARE OBTAINED FROM THE COMPUTER BUS POWER SUPPLY. USE GREAT CARE WHEN CONNECTING THESE VOLTAGES EXTERNALLY. THE MAXIMUM CURRENT WHICH SHOULD BE DRAWN IS 300 MILLIAMPRES, SUFFICIENT TO DRIVE 3 OR 4 NORMAL ENCODERS. IF YOU NEED TO USE MORE ENCODERS, USE AN EXTERNAL 5 VOLT SUPPLY OR KUPER BLACK BOX ENCODER INTERFACE.
WHEN USING AN EXTERNAL SUPPLY, CONNECT ALL FOUR GROUND PINS TO THE POWER SUPPLY GROUND, BUT LEAVE THE +5 PINS OF JP4 UNNCONNECTED.

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Title		
RTMC48 ENCODER INTERFACE CONNECTOR		
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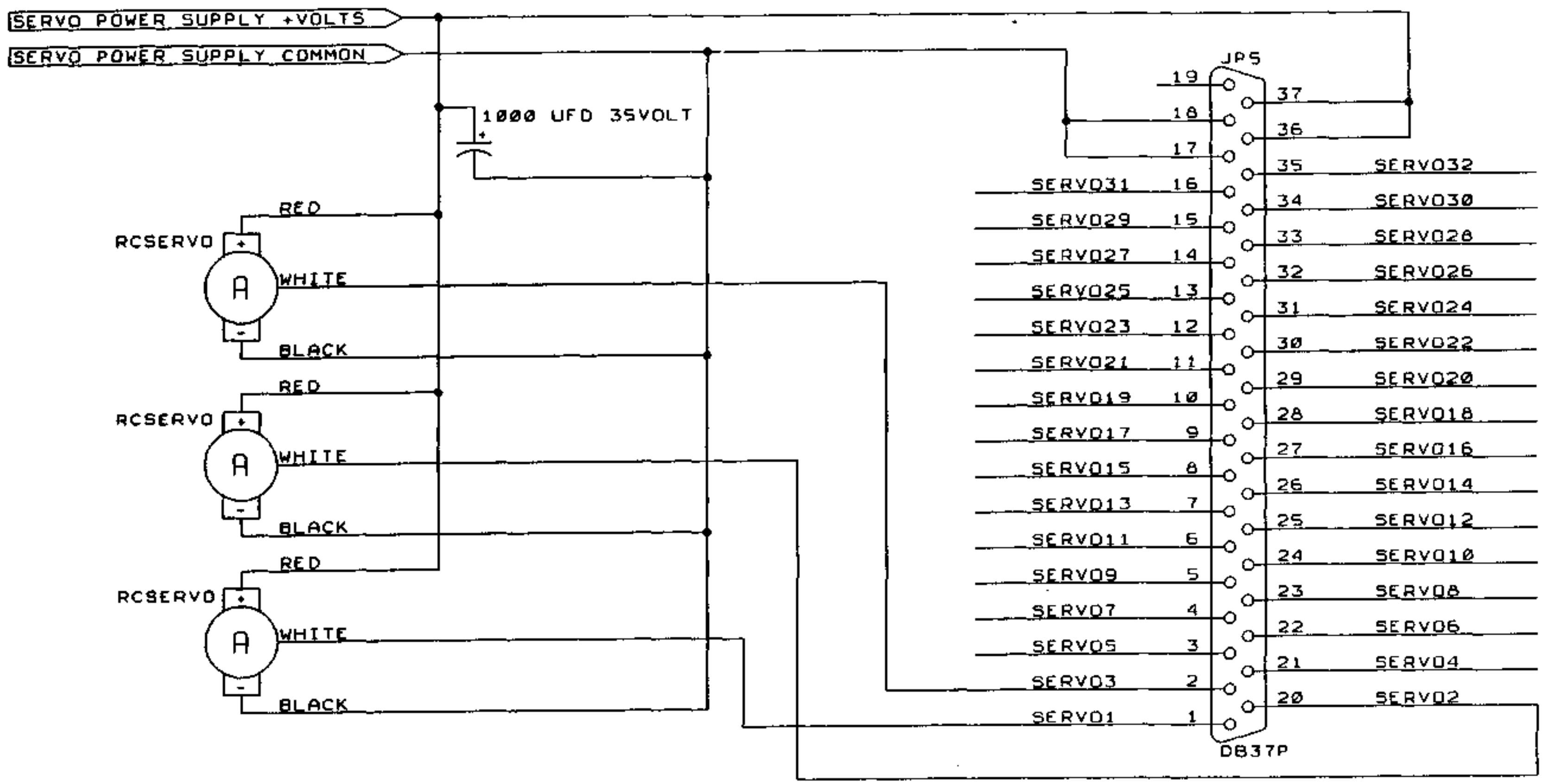

THIS DRAWING SHOWS THE DB37P CONNECTOR ON THE KUPER CREATURE CARD AS SEEN FROM THE BACK OF THE COMPUTER.

ALL LINES ARE OPTICALLY ISOLATED FROM THE COMPUTER.

"SERVO POWER SUPPLY COMMON" AND "SERVO POWER SUPPLY +VOLTS" ARE FROM THE EXTERNAL POWER SUPPLY USED TO SUPPLY OPERATING POWER TO THE SERVO ACTUATORS.

"SERVO POWER SUPPLY +VOLTS" MAY BE IN THE RANGE OF 5 TO 32 VOLTS DC AS REQUIRED BY THE PARTICULAR MOTORS BEING USED. DO NOT EXCEED THE MANUFACTURER'S SPECIFIED VOLTAGE. DO NOT COMMON MORE THAN 3 SERVO MOTORS TO A SINGLE PAIR OF + AND - POWER SUPPLY WIRES.

THE 1000UFD CAPACITOR PLACED AT THE SERVO MOTOR END OF THE CABLE IS OPTIONAL. IT ELIMINATES CROSS TALK WHEN SEVERAL MOTORS ARE ATTACHED TO A SINGLE PAIR OF POWER SUPPLY LEADS.

THE PWM SIGNALS SUPPLIED AT THE "SERVOXX" PINS ARE IN THE RANGE OF 0.003 TO 32 MILLISECONDS. THE OPERATOR SETS SOFTWARE LIMITS USING THE KUPER SOFTWARE.

THE "SERVO POWER SUPPLY" +VOLTS AND GROUND SIGNALS ARE USED ONLY TO OPERATE THE OPTO-ISOLATORS ON THE KRJ32 CARD. 24 GAUGE WIRE IS ADEQUATE. IF MOTORS OF DIFFERENT OPERATING VOLTAGES ARE USED TOGETHER, THE "SERVO POWER SUPPLY +VOLTS" PIN SHOULD BE CONNECTED TO THE +VOLTS FROM THE ->LOWEST<- VOLTAGE POWER SUPPLY BEING USED.

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Title		
KUPER KRJ32 CREATURE CARD PWM OUTPUT		
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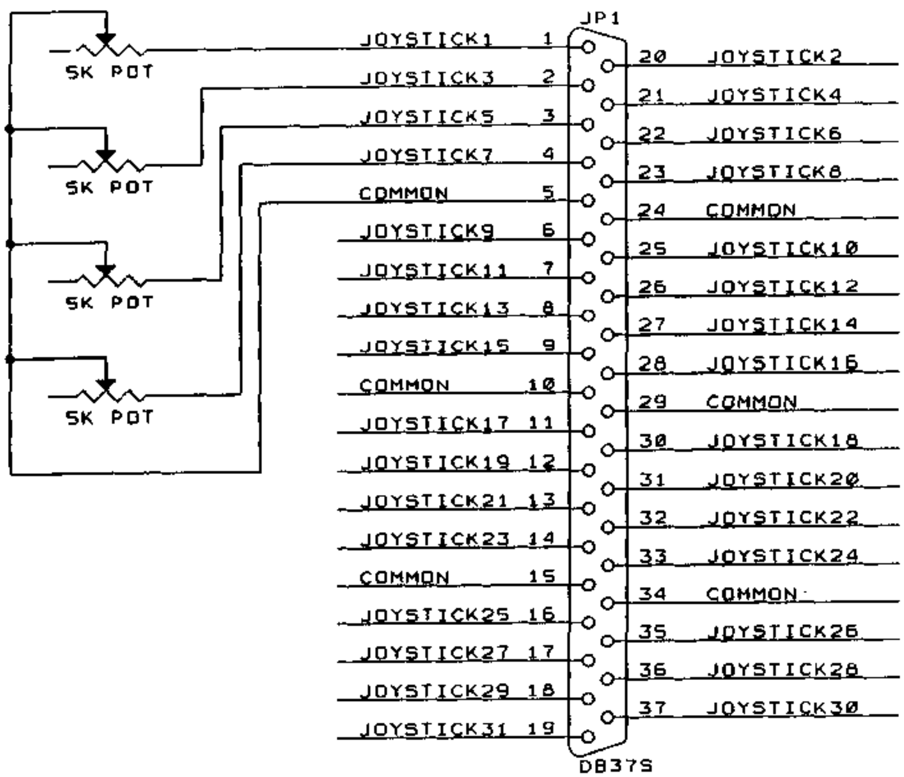

THIS PINOUT APPLIES WHEN THE 40 PIN JOYSTICK HEADER "JP1" IS BROUGHT OUT TO A DB37 CONNECTOR IN THE IBM I/O SLOT AT THE BACK OF THE COMPUTER. THE DRAWING SHOWS THE APPEARANCE OF THE CONNECTOR IS AS VIEWED FROM THE BACK OF THE COMPUTER.

FOUR OF 31 POSSIBLE JOYSTICK HOOKUPS ARE SHOWN.

NO MORE THAN 8 JOYSTICKS SHOULD BE CONNECTED TO A SINGLE "COMMON" PIN. ALL COMMONED ENCODERS MUST BE IN THE SAME GENERAL AREA.

JOYSTICK LINES SHOULD BE NO LONGER THAN NECESSARY, AND KEPT AWAY FROM SOURCES OF ELECTRICAL NOISE, SUCH AS MOTOR CABLES AND HIGH VOLTAGE LIGHTING CIRCUITS. JOYSTICK LINES SHOULD BE ELECTRICALLY SHIELDED FOR AS MUCH OF THEIR RUN AS POSSIBLE.

FOR THE CONVENIENCE OF USING A DB37S CONNECTOR, THIS PINOUT SACRIFICES MAKING THE "JOYSTICK32" SIGNAL AVAILABLE. CONTACT KUPER CONTROLS FOR INFORMATION ON USING "JOYSTICK32"

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Title		
KUPER KRJ32 CREATURE CARD JOYSTICK INPUTS		
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