LFI Player

Version 1.1.3

Laser Display Software Users Manual

Lazerus Laser Systems

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Introduction

LFI Player is a Windows based 3D laser display software program, designed to be used with a variety of laser display output devices, including the RIYA PCI Pro card, RIYA USB device, Laser Illusions GWS ISA card, and a number of BSOFT ISA cards. LFI Player now also supports a USB DAC board being developed by ACCES I/O.

It allows you to create free-running (i.e. unsynchronized) laser "shows" using a rich set of scripting commands. In addition, you can assign up to 48 "shows" (i.e. sequences of commands) to be triggered via live buttons on a GUI console, hot keys, or a MIDI device, giving you significant live performance control. LFI Player also provides hot key control of most of the on screen controls.

Other features of the software include:

* 3D laser display and extensive 3D manipulations, including (but not limited to) zoom, rotate (about each axis), and the ability to move the "from" (i.e. viewers) points and "at" (i.e. focal) points in all directions.
* Compound (i.e. simultaneous) display and 3D manipulations. For example you can rotate about multiple axes and zoom and fade in/out all at the same time.
* Independent multi-tracking up to 4 tracks.
* Simultaneous or independent manipulation of up to 4 tracks.
* Fades (in and out).
* Cross fading between tracks.
* True 3D edge clipping (especially useful if you want to zoom in and/or through an image).
* An abstract control console for creating full color 3D abstract patterns, including sine beams. Abstracts created or modified with the control console can be saved to different files, retrieved, and are treated like any other track so that they can be manipulated in 3D, faded, etc., and/or combined with other abstracts and/or ILDA frames.
* Ability to "record" the laser display to an ILDA file. This is a nifty way to create and store (in a standard format) ILDA animations and the cool LFI Player abstracts and sine beams you create.
* Drag and rotate/spin the images displayed in one or more tracks[1]. This can be done even when a script is executing. Variable drag speed and inertia values (selected from the user preferences) allow you to "grab" the objects in the tracks and not only rotate them, but to spin them in all axes (sort of like spin the bottle in 3D space) ☺

The actual laser display capabilities of LFI Player are going to be somewhat determined by the speed of the computer that you're using (I've used a Pentium III 500MHz with satisfactory results, though you wouldn't probably want to go much slower). This is

[1] Currently, the calculations to perform the rotations assume that the positive Y-axis is the "up vector", i.e. the +Y direction is "up". Note that if the up vector is set to something other than the +Y direction, drag and rotate will still work, but the results will not likely be what you would intuitively expect.

because, unlike a system such as Pangolin, in which the graphics processing is done on the QuadMod card's microprocessor, all off LFI Player's output processing work needs to be done by the host computer. While the software supports up to 4 tracks, in reality you'll often be limited to two or three simultaneous tracks, depending on the number of points in each track[1]. For actual laser display with slower computers, you can turn off the screen display, as drawing to the screen gobbles up as much CPU horsepower as drawing to laser. Note that since the rate of display is limited by how quickly points can be fed to the output device, the speed limitation also applies to the RIYA card[2] and other devices with constant point output rate.

This program is primarily designed to run shows written in its own scripting language, which will be described shortly. However, nearly all of the things you can do with the script can also now be done manually from the programs GUI and/or hot keys. This gives you the ability to try things out as you develop your script. This is also useful for determining appropriate delay values so your draw speed is correct when you run the script.

A couple of other notes:

Memory is not limited except by your machine and swap space[3].

Info and errors are logged to LFI_Player_log.txt. User settings and preferences are stored in LFI_Player.ini.

LFI Player uses the Pangolin color palette for ILDA frames by default, but also supports the Laser Illusions, X29, and ILDA color palettes.

Other than the ability to save the display to an ILDA file, LFI Player does not incorporate laser frame creation tools. There are a number of different software programs available to do this, and I saw no point in reinventing the wheel. If you want a nice, reasonably priced ILDA editor, buy yourself a copy of Anarchy.

Many thanks to Rick Gebhardt of Laser Illusions, for his technical assistance when I was getting started on this project.

[1] Note that this limitation is not just due to the computing horsepower. When displaying multiple tracks, the total number of points per "frame" is effectively the sum of the number of points associated with the active tracks. Even with good 30K scanners, there is a limit on the number of points per frame that can be displayed without unacceptable amounts of shimmer. From my own experience, and depending on the type of image or images being displayed, anything more than 1500 points per frame (30K PPS / 1500 points per frame = 20 frames per second) begins to look questionable.

[2] Though with the RIYA card, output is buffered and the points-per-second "fixed", resulting in smooth, consistent output regardless of the processor speed, so long as that speed is enough to "shovel coal into the furnace".

[3] Note that the RIYA card's internal buffers limit you to 0x1000 = 4096 points per frame. Since outputting this many points out would equate roughly to an unacceptable 7 frames per second, it is unlikely this limitation would ever cause any practical problems.

IMPORTANT DISCLAIMER!!!

LFI Player is provided “AS IS” without warranty of any kind, either express or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose. In no event shall Michael Svob and/or Lazerus Laser Systems be liable for any damages whatsoever, including direct, indirect, incidental, consequential, loss of business profits or special damages, even if Michael Svob and/or Lazerus Laser Systems has been advised of the possibility of such damages.

Please email comments, suggestions, etc. to:

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LFI Player User Interface

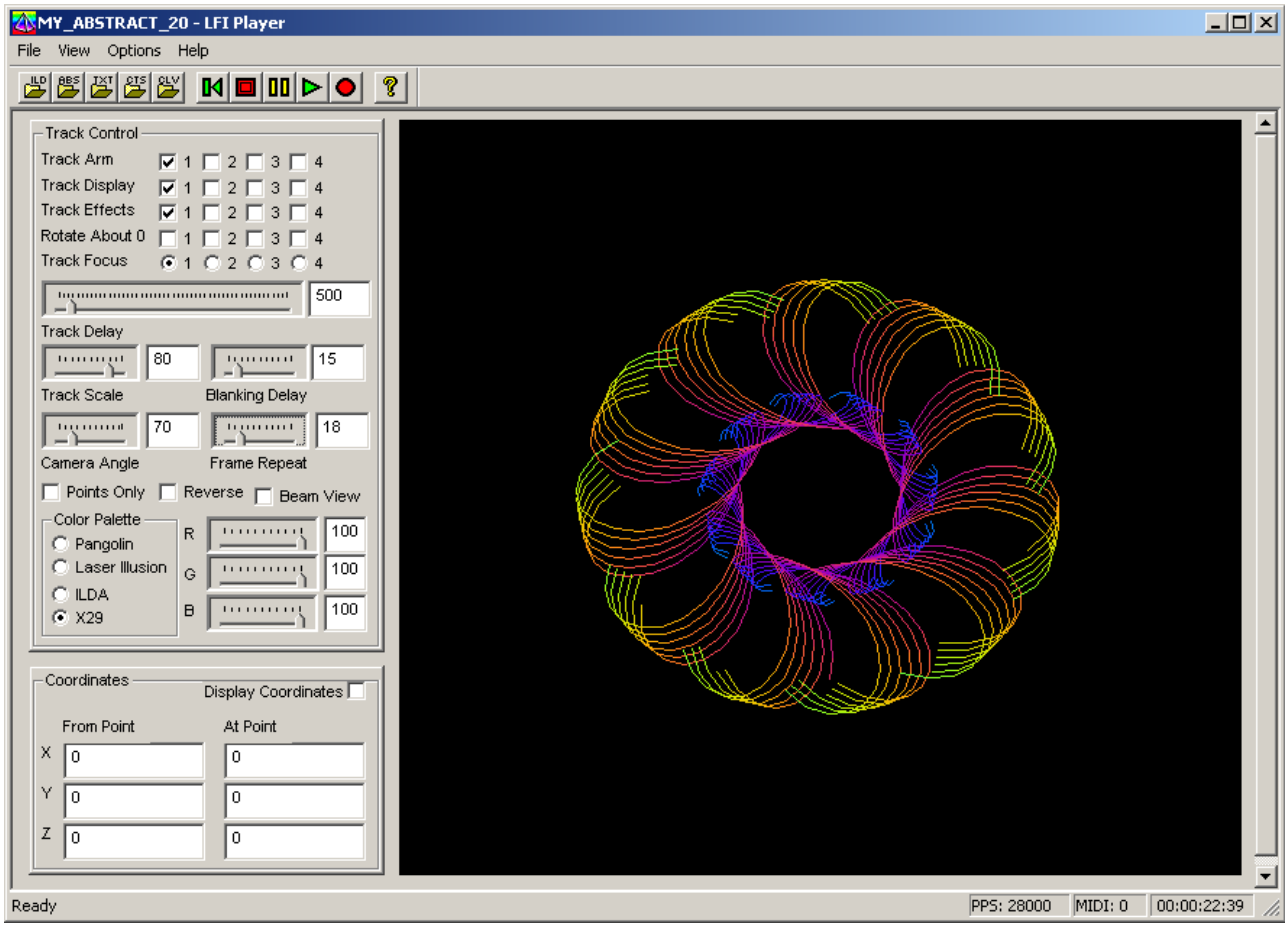


Figure 1 – LFI Player Main Screen

Menu Bar

File Menu

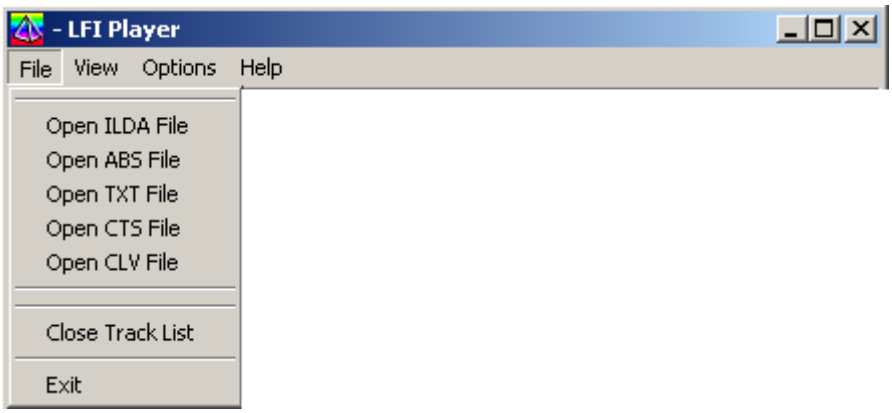


Figure 2 – File Menu

"Open XXX File" -

The File Menu (Figure 2) allows you to open any of the four file types supported by the LFI Player software. These are:

ILDA – Standard ILDA format laser display files having the extension '.ild'. Figure 3 shows what the corresponding "Open XXX File" dialog might look like (the dialogs for other supported file types will be similar, but showing the corresponding extension for that file type).

ABS – LFI Player abstract descriptor file. These are text files having the extension '.abs', and containing the numeric parameters which define abstracts and sine beam patterns in LFI Player.

CTS – LFI Player control script file. These are text files having the extension 'cts' , and which contain LFI Player free running laser show scripts (described later in this manual).

CLV – LFI Player live control file. These are text files having the extension '.clv', and which contain information about assignments of LFI Player control scripts to the live console buttons and corresponding hot keys.

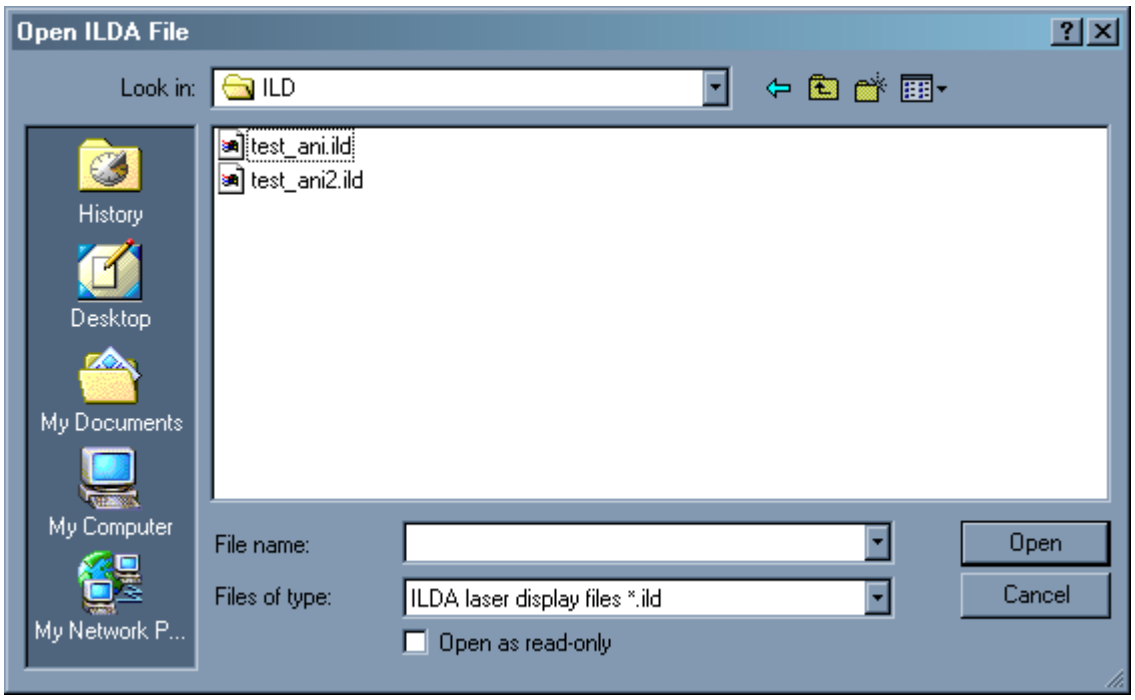


Figure 3 – File Open Dialog

"Close Track List" –

Terminates all active laser display, and clears all four tracks. Identical in functionality to pressing the red "Stop" button on the Toolbar, or pressing the 'CTRL-s" hot key sequence. Once the track list has been closed, a new file or files must be opened before laser display can occur.

"Exit" –

Terminates the Lazurus3D program, performs any necessary cleanup, and saves current user parameters to the 'LFI_Player.ini' file.

File Associations

As of Version 1.1, LFI Player has the ability to open files from the command line. What this means is that you can now use LFI Player as a file viewer for any of the file types supported by LFI Player:

ILDA File Format	.ILD
LFI Player Abstract	.ABS
Text (Scrolling)	.TXT
LFI Player Script	.CTS
LFI Player "Live Control"	.CLV

To set up an association between one of these file types and LFI Player, bring up Windows Explorer, and from the menu bar, select “Tools”->“Folder Options”. Select the “File Types” tab, and add the new association for the desired file type.

View Menu

Figure 4 – View Menu

“Toolbar” –

When checked, Toolbar is displayed. Otherwise, the Toolbar is hidden.

“Status Bar” –

When checked, the Status Bar at the bottom of the main window is displayed. Otherwise, the Status Bar is hidden.

Options Menu

Figure 5 – Options Menu

"Select Port" –

This menu option only appears for versions of LFI Player compiled for use with non-RIYA output devices. Opens a "Select Base Address" dialog, as shown in Figure 6. When you start LFI Player for the first time, the program will default to a value of 0x300. For reference, the radio buttons are organized into three groups; common base addresses, base addresses applicable to Graphic WorkStation only, and base addresses applicable to the BSOFT cards only.

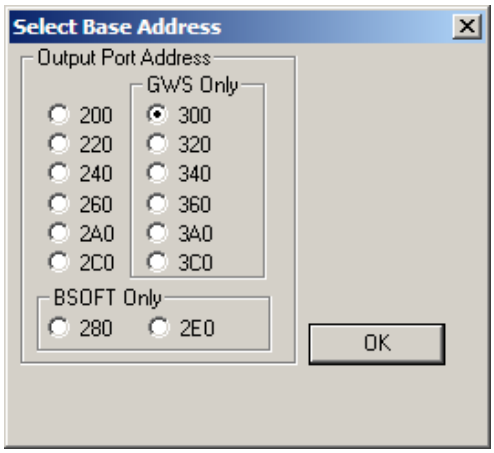


Figure 6 – Select Base Address Dialog

"Preferences" –

Opens a "Preferences" tabbed dialog box. Each tab represents a logical grouping of user preferences, which are in turn stored and retrieved from the LFI_Player.ini file.

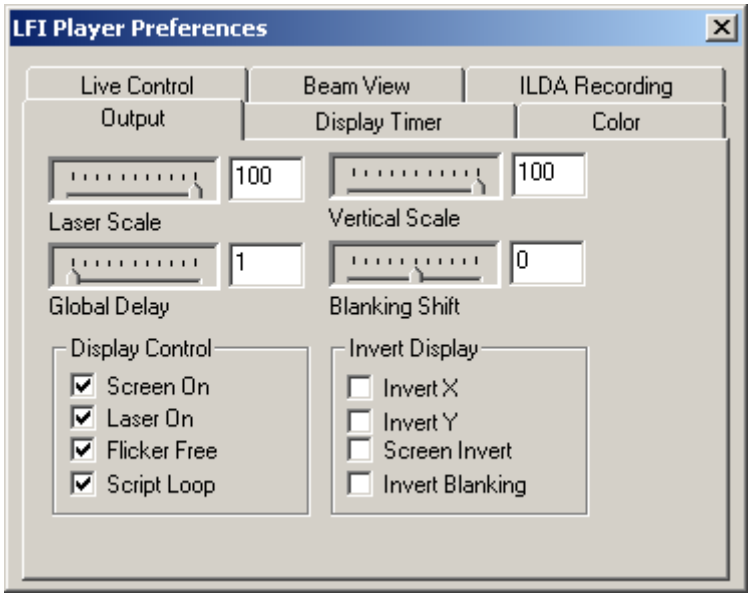


Figure 7 – Preferences: Output Tab

Output Tab

Laser Scale — Similar to "Track Scale", but with two important differences. First, laser scale applies to all tracks, not just the focus track. Second, laser scale only affects the laser display output, not the screen display. This control is used to adjust the overall size of the laser display, for example, to account for the projector's distance from the projection surface. For each track, the overall scale of the laser image projected will be the product of the "Laser Scale" and "Track Scale" values. So, for example, if the track scale is set to 75%, and the laser scale value is set to 85%, then the overall scale will be 75% of 85% of full size, or approximately 64%.

Vertical Scale — Allows for the global adjustment of the vertical scale of the image. Particularly useful for beam shows where audience separation is difficult to maintain with full vertical deflection.

Global Delay — When using a non-RIYA output device, where the draw speed is determined exclusively by the host computer, this setting provides for a way to compensate for the differing speeds between computers. The individual value track delay is multiplied by Global Delay to determine the total delay inserted between each point.

Blanking Shift — Used to compensate for the potential difference in speed, between a projector's XY scan system, and the projector's color and blanking control. Essentially determines the phase relationship between the two. A positive value (color/blanking

faster than XY) results in the color and blanking being delayed (with respect to XY) the specified number of frames. A negative value (XY faster than color/blanking) delays the XY with respect to color/blanking.

Screen On — Determines whether the display is output to the screen. Because of the calculations necessary to output a screen display, for slower computers it is suggested that the screen be used for script development, and turned off when actually displaying laser.

Laser On — Determines whether output data is sent to the laser control card.

Script Repeat — When executing a LFI Player Script (.cts) file, determines whether the script returns to the beginning and plays again when it reaches the end, or simply stops.

Flicker Free — When checked, all points in a frame (for all active tracks) are stored to a buffer and output to the screen all at once. This gives the screen display a smoother, flicker free appearance, but also takes slightly more CPU resources. Unchecked, the screen display will exhibit varying amounts of flicker, but will also be slightly faster.

Invert Display — Selects the display invert modes as follows:

Invert X - When checked, inverts the X-axis display output. Particularly useful when doing rear screen projections.

Invert Y - When checked, inverts the Y-axis display output.

Screen Invert - Determines whether or not the X and/or Y output inversion is reflected in the computer screen display. For example, when using Invert X while doing a rear screen projection, you may or may not want your computer display to be inverted as well. Checked means screen output is inverted.

Invert Blanking - Since the ILDA standard is not 100% clear on some issues (like that would ever happen), there is not universal consensus with respect to the blanking bit in the status field of the ILDA frame. When this box is checked, a logical low is output on the “intensity” (i.e. “I”) output when the blanking bit is cleared, and a logical high output on “I” when the bit is set (i.e. output on “I” follows blanking bit). When the check box is cleared, the output on “I” is essentially the inverse of the blanking bit.

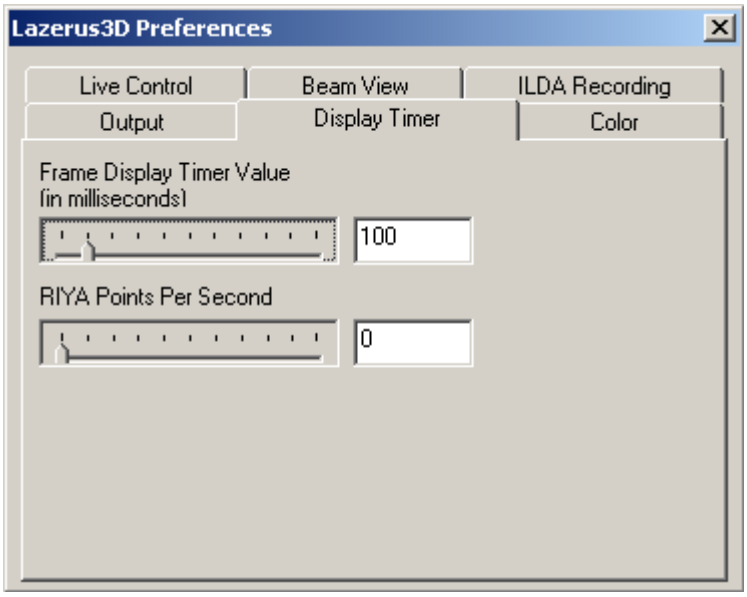


Figure 8 – Preferences: Display Timer Tab

Display Timer Tab

Display Timer Value — Sets the value of LFI Player's timer in milliseconds. This value, which can be set from 1 mSec to 1000 mSec (i.e. 1 second), is what determines the interval that 1 frame of each of the active tracks will be displayed. Too high of value and the display will appear jerky. Too low of value, and the timer may fire more often than the images can be output (particularly slower computers), with the possibility of some buffer-overflow. A value of approximately 50 mSec seems to be about right. Note that this value should generally be set to minimum when LFI Player is being used with the RIYA card

RIYA Points Per Second — Applies only when a RIYA card is being used, otherwise is ignored. When a RIYA card is used, this value determines the number of points per second the card will output. Under the hood, this value is actually used to calculate the delay inserted between the output of each point.

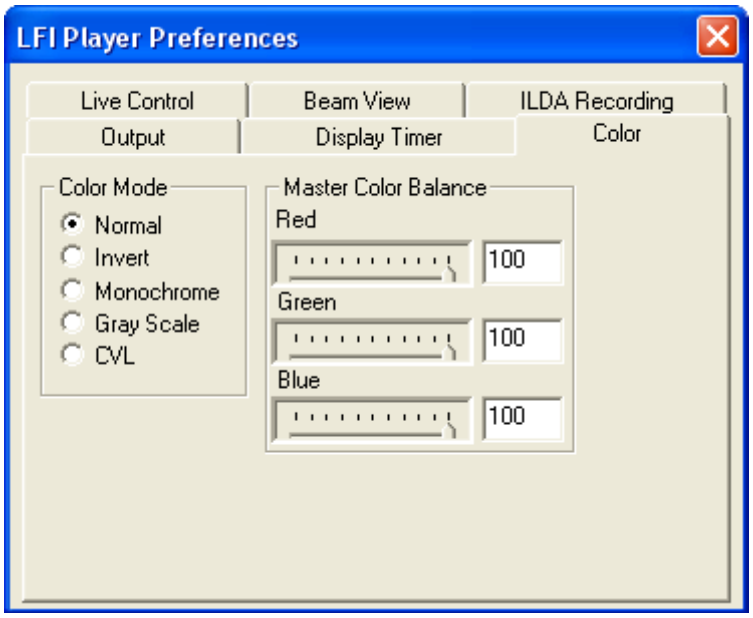


Figure 9 – Preferences: Color Tab

Color Tab

Color Output

Selects the mode of color output. These are:

Normal – When checked, outputs the actual RGB value associated with the image being displayed.

Invert – When checked, outputs the inverse color value of the image being displayed.

Monochrome – When checked, outputs full R, G, & B values when any of the color values are active, nothing otherwise (i.e. all outputs are full on or full off).

Gray Scale – When checked, outputs an approximate gray scale representation of the image being displayed. In this mode, for a given point, each RGB output is equally on, off, or somewhere in between).

CVL – When checked, modifies both screen and laser output to be geared towards use with a copper vapor laser. Assumes the red output controls the gold laser line, the green output the green laser line, and that the blue output is not used. However, the blue color information is “folded” into the red and green outputs rather than simply throwing it away.

Master Color Balance

Allows the global values of Red, Green, and Blue sent to the output device to be adjusted to compensate for the color balance of the laser source (or other factors affecting color balance.

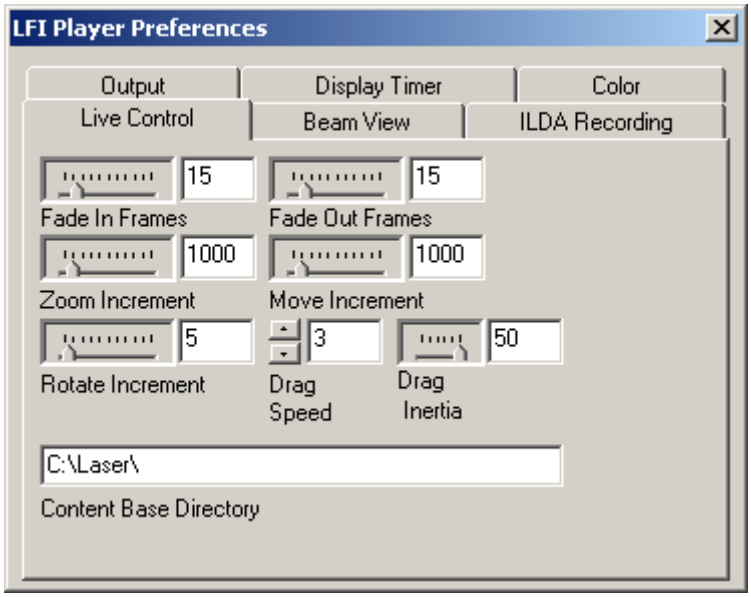


Figure 10 – Preferences: Live Control Tab

Live Control Tab

Fade In Frames — The number of frames which will be displayed during the course of "fading in" a tracks image when the "Track Display" box is checked. For example, if this value is set to 20, then the image will be faded in gradually over the course of 20 frames.

Fade Out Frames — The number of frames which will be displayed during the course of "fading out" a tracks image when the "Track Display" box is unchecked.

Zoom Increment — Used with the GUI zoom controls and hot keys to adjust the amount of incremental zoom movement for each click of the zoom button or press of the corresponding hot key.

Move Increment — Used with the move hot keys to adjust the amount of incremental movement for each press of the appropriate hot key.

Rotate Increment — Used with the GUI rotate controls and hot keys to adjust the amount of incremental rotation for each click of the button or press of the hot key[1].

Drag Speed — When utilizing the "drag and rotate" feature, this value determines how much rotation is applied for a full side-to-side

[1] If a hot key is held down continuously, the manipulation will continue until the key is released. You can adjust the keyboard "repeat" settings in the Windows Settings->Control Panel. Note that when holding down a hot key, the display timer value is bypassed. So if you have a long display timer value, you'll probably want to reduce the key press repeat rate, and visa-versa.

(of the screen display window) movement of the mouse. The mapping is as follows:

VALUE	ROTATION
1	1/4
2	1/3
3	1/2
4	1
5	2
6	3
7	4

Drag Inertia When utilizing the “drag and rotate” feature, this value determines the amount of inertia the objects in the active tracks have when the mouse button is released. Put another way, when you grab an object (or objects) and spin them using drag and rotate, this value can be thought of as the inverse of the friction that brings the rotation to a stop. The greater the inertia, the less the friction, and the longer the objects will spin after the mouse is released.

Content Base Directory Used to specify the relative location of laser display content (i.e. script files, ILDA files, etc.) used by the LFI Player software. Note that this string is pre-pended to the relative search path specified in the LFI Player script or live control file, which means the “\” at the end of the Content Base Directory string is required.

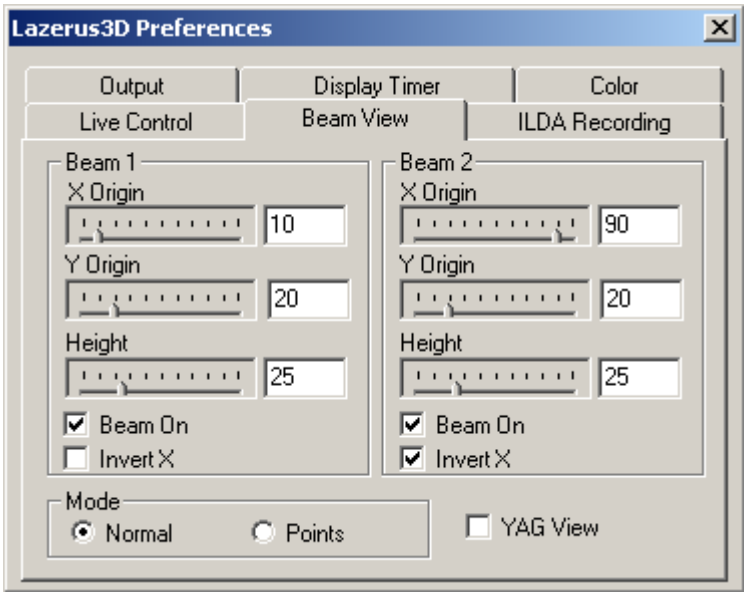


Figure 11 – Preferences: Beam View Tab

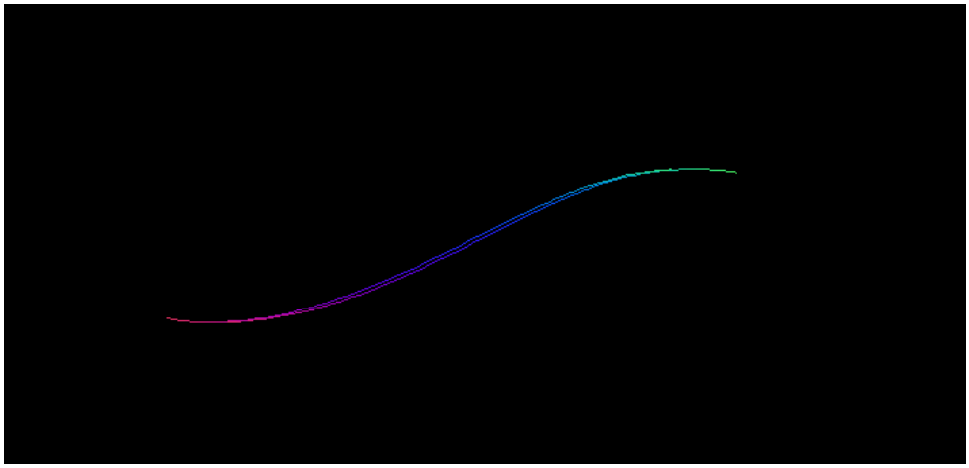
Beam View Tab

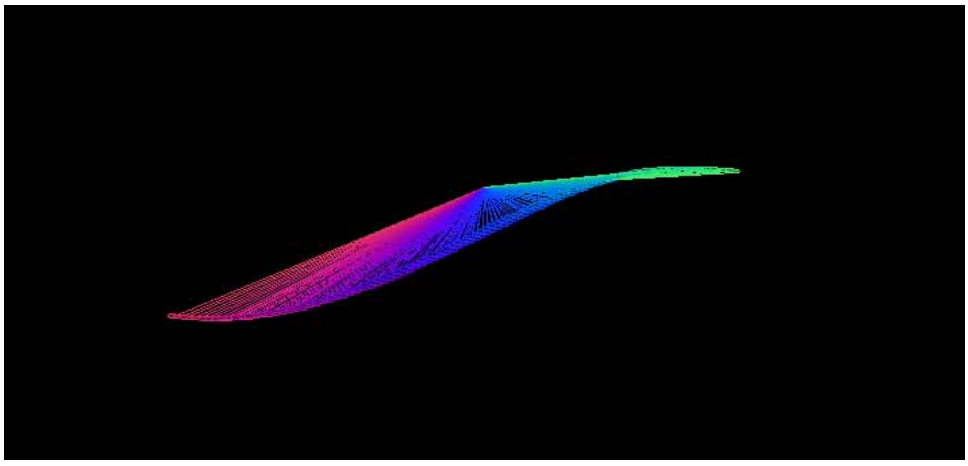
Aerial beam effects are (IMHO) where lasers really shine. Few things can match the intensity and beauty of a well-executed beam show, particularly in full color. Unfortunately, programming beam effects can be tricky, since the 3D qualities of laser beams slicing through the air can be difficult to visualize based on the 2D (i.e. X/Y) image coming out of the laser projector. While it's impossible to fully simulate on a computer screen what the beams are going to look like (some programs are more successful than others), LFI Player does provide a simple mechanism which allows the programmer the ability to preview the "essence" of the beam display on the computer screen. Since aerial beam effects are often scanned with the X-axis "wider" than in the Y-axis, the user may find it useful to resize the LFI Player display such that the aspect ratio of the preview window is exaggerated horizontally.

The following screen shots show exactly the same image, but using 5 different perspectives. The first (A) shows a simple color sine, as it appears as if it were being displayed as graphics on a projection screen. The second (B) shows the same image, but with Beam View enabled. In this instance, the Beam View Mode is Points, which means the 2D image is displayed with vertices connecting each point (marked by a small circle) to a single point of origin representing the laser projector. The remaining views are also a Beam View, but this time in what I call Normal Mode). The Normal Beam View Mode (C, D, & E) provides the best way to capture the "essence" of what the beams would look like. Note that in Points mode, the laser "beams" stop at the projection point. In reality, laser beams do not stop in mid-space, but continue on until they hit something. The Normal Beam View Mode simulates this by extending the "beam" from the point of origin (the virtual projector), through the projection point, and to the edge of the display boundaries as currently defined by the laser and track scale parameters. In addition, in Normal Mode, the user can simulate one or two laser projectors, allowing the preview of a beam show

utilizing (for example) two mirrored projectors or scan heads. LFI Player also provides a YAG view, which simulates the appearance of the same beam show using a frequency doubled ND:YAG laser and TTL blanking.

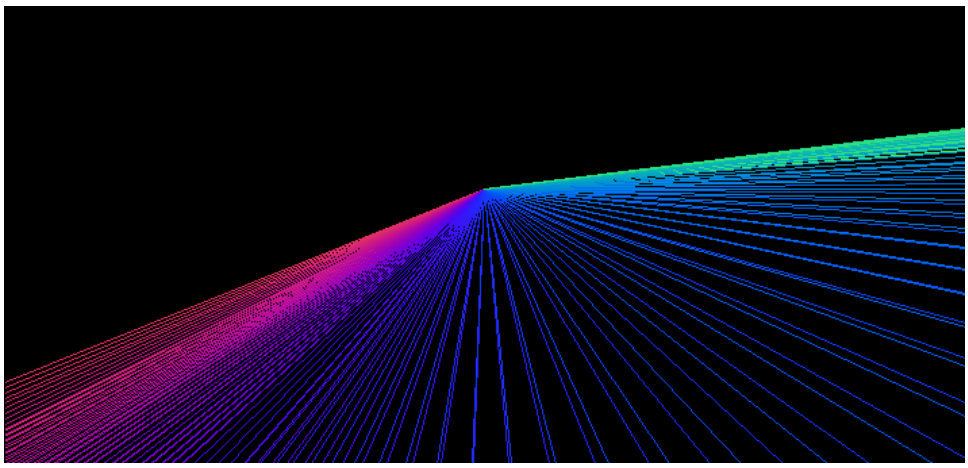
A. Beam View Off

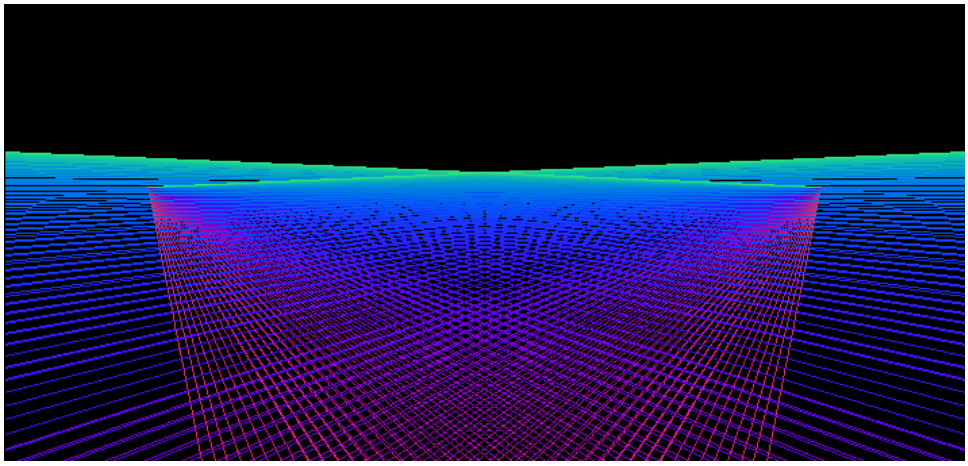




B. Beam View Points Mode

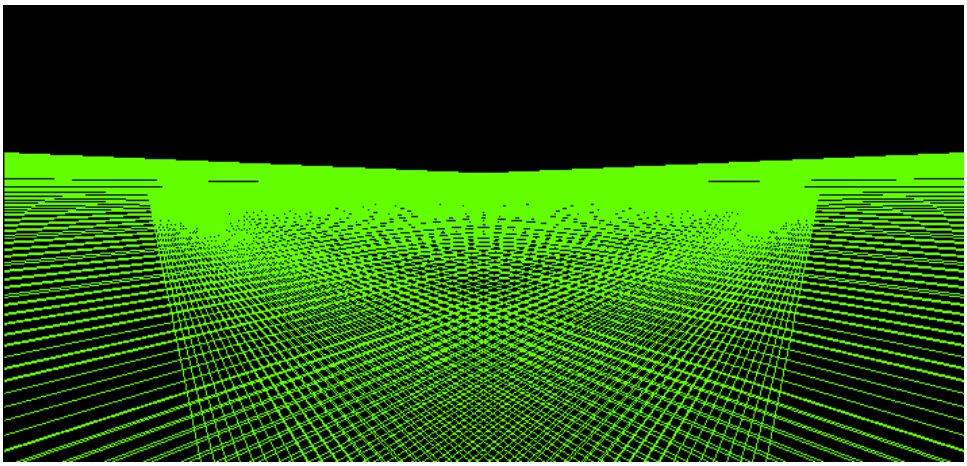
C. Beam View Normal Mode





D. Beam View Normal Mode, Both Beams On

E. Beam View Normal Mode with YAG View, Both Beams On



X Origin	A value of 1 to 100 indicating the position along the X-axis of the beam origin.
Y Origin	A value of 1 to 100 indicating the position along the Y-axis of the beam origin.
Height	A value of 1 to 100 indicating the positive offset along the Y-axis added to each point. This effectively determines the “lowest” point a beam can drop. For either Beam 1 or Beam 2 (when active), if the value of “Height” is greater than the value of Y Origin, the perspective is that of the beams traveling overhead.
Beam On	In “Normal” mode, determines whether Beam 1 or 2 is on or off (disabled).
Invert X	In “Normal” mode, determines whether Beam 1 and/or Beam 2 is inverted with respect to the X-axis.
Mode	Determines the mode of the beam view visualization. In normal mode, one or both simulated beam heads are active, and the beam is extended from the point of origin to the edge

of the laser preview window, adjusted for the laser and track scale settings. In Points mode, the beam extends from the point of origin to the point in the preview window where the corresponding point is displayed. A small circle is displayed around each point to further clarify where the point is located. Note that in Points mode, only Beam 1 is active, and that only X Origin and Y Origin controls for Beam 1 have an effect on the visualization.

YAG View Simulates YAG beams by displaying all beams as green regardless of the color settings. Currently, this setting displays the beams as on or off to simulate TTL blanking (as opposed to analog color control).

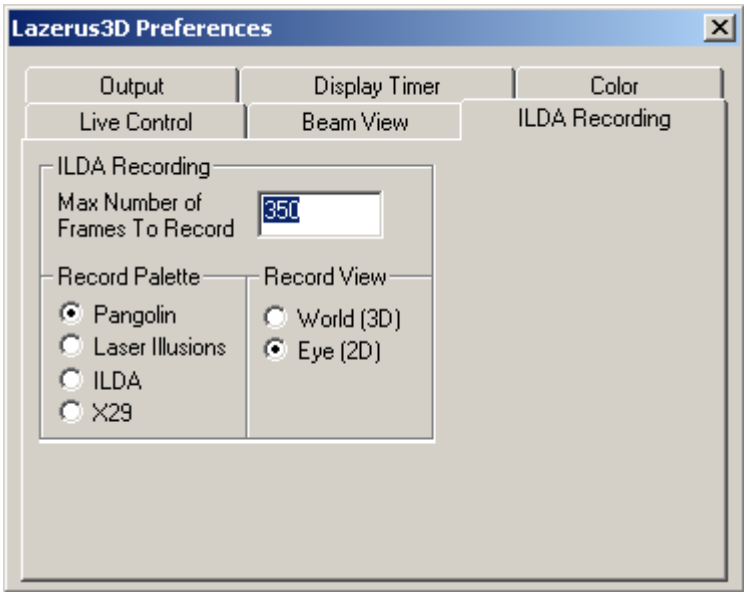


Figure 12 – Preferences: ILDA Recording Tab

ILDA Recording Tab

Max Number of Frames to Record Specifies the maximum number of frames to record to the desired ILDA file. While recording, if the "Stop" button is not pressed prior to this limit being reached, the recording process will be terminated automatically, and the file saved with the number of frames equal to the limit.

Record Palette Specifies the ILDA palette to be used for storing color values to the ILDA file being created. Note that the record palette is separate from the playback palette. For example, an image

being displayed using the Pangolin palette might be recorded to the new file using the Laser Illusions palette.

Record View Specifies the “view” to use when recording. The “World” view represents the actual object being displayed, regardless of the viewer’s perspective. In other words, it is the “raw” or absolute view of the object, and retains any 3D information contained in the image. The “Eye” view represents the viewer’s perspective, and is the view displayed in laser light and on the computer screen.

Help Menu[1]

Figure 13 – Help Menu

"About LFI Player" –

Opens an "About LFI Player" dialog, as shown in Figure 14.

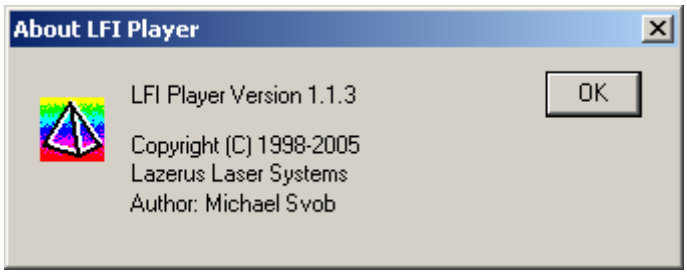


Figure 14 – About LFI Player Dialog

[1] There is currently no built in help with Lazerus3D...this manual is it. This feature will (hopefully) be added sometime soon.

Toolbar

File Open Buttons

Creates File Open dialogs for opening ILDA (.ild), abstract definition (.abs), plain text (.txt), show control script (.cts), or live control (.clv) files respectively.

When a show control script (.cts) is active, rewind to the beginning of that script.

Stop the display, and clear all of the track lists. Once this button (or corresponding hot key) is pressed, a new file or files must be loaded for display.

Pause laser display. Will continue where stopped when “start” button is pressed.

Start laser display, or continue laser display if paused. Somewhat analogous to the Play button on a tape recorder.

Record the laser display to an ILDA file. Pressing the record button results in a file save dialog box being opened. Once the desired ILDA file has been specified, the recording process will begin. For more control over the start of the recording, it is recommended that the display be paused prior to pressing record, and then pressing the play button to resume display (and begin the actual recording).

Opens an “About LFI Player” dialog.

Main Control Panel

Introduction

As you open ILDA or abstract definition files from the GUI, they will be added sequentially to the list of tracks. When you arm a track (assuming you've pressed the "Play" button), it is actually running, but is blanked (i.e. no color output). Once a track (or tracks) is armed, you can fade it in by clicking on the corresponding display check box. Note that when you load the first track from the GUI, the corresponding arm and display check boxes are already checked, so pressing play is all that is needed to start the display. On the loading of subsequent tracks, the arm and display buttons must be checked explicitly.

The number of frames needed to fade all the way in or all the way out is determined by the "Fade In Frames" and "Fade Out Frames" sliders, respectively. Cheap 3D allows you to manipulate (e.g. zoom, rotate, move) one or more of the tracks simultaneously. Which track (or tracks) the manipulations will be applied to is determined by clicking the "Track Effects" check boxes. Only one "Focus Track" can be selected at a time. The focus track is the one for which you can modify the track parameters, such as "Track Delay" (which determines draw speed), "Blanking Delay", and "Frame Repeat".

Note that when you arm a track, the computer begins performing all of the necessary display calculations for that track. If you are already in the process of displaying a track when you arm another track, the display speed of the first track will be reduced by an amount related to the number of points in the track being armed. When displaying multiple tracks, it's suggested that you arm those tracks you wish to display first, and then fade them in as desired. This way the draw speed of the images being displayed will not change as you fade the images in and out.

The 'Pause' button halts play, the 'Play' button (re)starts it. The 'Stop' button halts play and clears all the existing tracks from memory (i.e. wipes the slate clean).

There is currently no way to save manipulations made via the GUI to a '.CTS' file (maybe later).

PPS (Points Per Second Status Bar Pane)

When output is being generated to screen and/or laser output, calculates and displays the number of points generated during the prior second of time.

MIDI (MIDI Device Status Bar Pane)

Indicates the number of MIDI devices attached to the host computer at the time the Lazerus 3D software is launched. Note that Lazerus 3D currently does not dynamically detect when a MIDI device is added or removed while the software is running (i.e. if you plug in a device while the software is running, you will need to restart the software to detect the new device.

Track Control

A logical collection of controls, which define the behavior of the individual laser tracks.

“Track Arm” -

Four check boxes (one per track) which arm/disarm their respective tracks. When a track has been initialized (i.e. has been associated with either an ILDA file or an abstract definition), arming the track causes all of the points to be calculated and generated to the screen and/or laser display. However, when utilizing color control, the image is not actually displayed until the corresponding “Track Display” box is checked (see Track Display). Disarming (i.e. un-checking) a track causes the generation of points to be halted.

“Track Display” -

When using color control, and when the track is armed, checking a track’s Track Display check box causes the displayed image to fade in over the course of the number of frames determined by the “Fade In Frames” control (see Fade In Frames). Un-checking a corresponding check box causes the displayed image to fade out over the course of the number of frames specified by the “Fade Out Frames” control (see Fade Out Frames).

“Track Effects” -

Four check boxes (one per track) which identify which track or tracks (none to all four) will be effected by position related manipulations:

Rotate (X, Y, &Z)
Zoom (In & Out)
Move (FROM Point & AT Point)

“Rotate About 0” –

Provides an alternative as to the point about which the image is rotated. The physical center of an ILDA frame or abstract is normally 0,0,0. Normally, the image is rotated about the AT (or focal) point. Since LFI Player allows you to manipulate the position of the AT point, rotations may or may not be about the physical center of the object. Selecting the “Rotate About 0” checkbox for a track forces the rotation to be calculated about 0,0,0 regardless of the current AT point.

“Track Focus” -

Four radio buttons (one per track) which identifies which track (only one at a time) will be affected by the following track attribute controls:

Frame Repeat
Track Delay
Track Scale
Blanking Delay
Points Only
Reverse
Beam View
Color Palette
Color Balance

Note that when the file currently loaded for the focus track is a LFI Player abstract, pressing the Track Focus button for that track will cause the abstract control panel dialog to pop up. If the abstract control panel is already activated, and the Track Focus button is selected for another track associated with an abstract, then the settings in the abstract control panel will be automatically updated to reflect the currently selected abstract.

“Frame Repeat” -

For an animation sequence, determines how many times each frame in the animation will be displayed before proceeding to the next frame.

“Track Delay” -

Increases or decreases the amount of delay introduced between generation of each point for the track. The delay period associated with each increment or decrement of the delay value is machine dependent. Note that the delay is the converse of the draw speed, i.e. the greater the delay, the slower the draw speed.

“Track Scale” -

Allows the scale of images associated with the track to be scaled up or down.

“Blanking Delay” -

Allows an increase or decrease in the amount of delay introduced prior to un-blanking. Delay is increased by adding points to the “starting” position. This is done to give the scanners sufficient time to move into position before turning the laser output back on (because the scanners are generally slower than the color control).

Helpful Tip

For horizontal sliders, you can click on the slider you wish to adjust and then use the right and left arrow keys to increase and decrease the value, respectively.

For vertical sliders, you can click on the slider you wish to adjust and then use the up and down arrow keys to increase and decrease the value, respectively.

“Color Palette” -

Allows selection of the desired color palette used for performing color table lookups. LFI Player supports the following ILDA color palettes:

* Pangolin
* Laser Illusions
* ILDA
* X29

“Points Only” -

When checked, indicates that only the points in an image (and not the connecting lines) should be displayed.

“Reverse” -

When checked, indicates that the ILDA frame sequence should be displayed in reverse order (i.e. played backwards). Note that this functionality only applies to ILDA files, and not to Lazerus 3D abstract files.

“Beam View” -

A simple way of simulating the display of aerial beams on the computer screen. When checked, the points for that track will be displayed using the Beam View parameters set in the Beam View Preferences tab.

Coordinates

When the “Display Coordinates” button is selected, the current X, Y, and Z coordinates are displayed for both the “From Point” (i.e. the viewers position in space) and the “At Point” (i.e. the point in space at which the viewer is focusing). While the calculations take some extra processing, and should therefore not be used during normal display, this information is very useful when writing scripts. The GUI controls can be used to set the view position as desired, and the Display Coordinates feature can be used to determine the actual values to be entered into the script.

Abstract Control Panel

The abstracts work by feeding user defined parameters into mathematical formulas chosen by the user. All of the parameters which define a particular abstract are stored and retrieved in a file with the extension ".ABS".

The desired parameter values are stored in the ".ABS" file, and are modified using the Abstract Control Panel. The panel consists of eight groupings of controls:

* Channel 1
* Channel 2
* Channel 3
* Envelope
* Color
* Blanking
* Z Axis
* Formula
* 'The Rest'

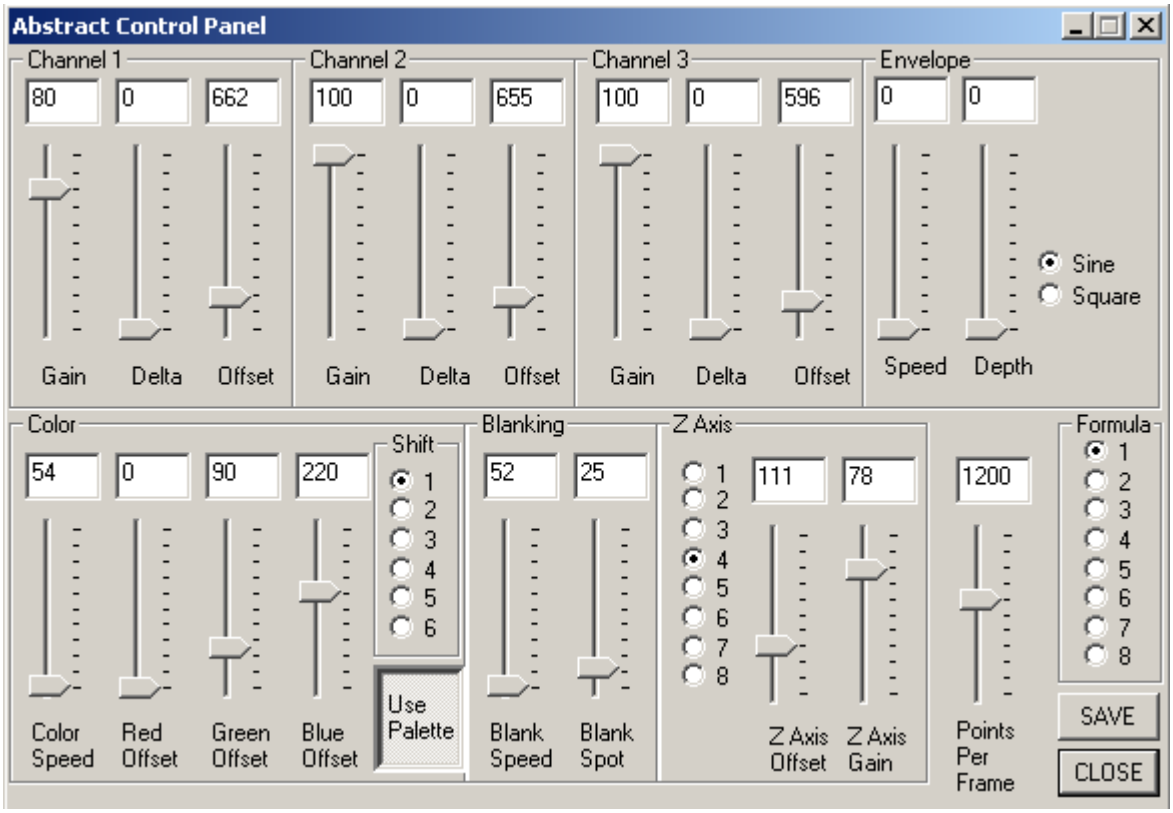


Figure 15 – Abstract Control Dialog

The Abstract Control Panel is launched when two conditions are met:

a LFI Player abstract is currently loaded and displaying
the “Track Focus” button corresponding to that abstract track is clicked

Note that if a different abstract is loaded, the appropriate Track Focus button must be re-clicked to load into the Control Panel the settings for that abstract. A BRIEF description of the controls is as follows:

Channels 1-3

Roughly equivalent to oscillators. Gain controls the amplitude of the “signal”, Delta controls the addition of auto modulation (for lack of a better term), and offset controls the phase shift between “oscillators”. One suggestion is to turn the Delta controls off, use the other controls to find a pattern that you like, and then set one or two of the Delta controls to a small value to create a slow, continuous shifting of the abstract design.
Gain: 0-100
Delta: 0-360
Offset: 0-3600

Color

Color Speed controls how fast the color shifts, Red, Green, and Blue Offsets control the phase shift (0 thru 360 degrees) between the primary colors. For a normal color balance, use a 90 degree phase shift between the colors. For example, Red Offset=0, Green Offset=90, and Blue Offset=180. If the Color Speed is set to 0, then the Red, Green, and Blue Offset controls "convert" to simple color mixer controls, with 0 being full off, and 360 being full on. The color “Shift” radio buttons select which color shift algorithm is applied. Only value 1 is set in stone; the remaining 5 are still being worked out. The “Use Palette” button determines whether a reverse color palette lookup is used to select the appropriate color, or the raw analog values calculated by the abstract algorithm. When pressed, the color selected for a given point will be the closest approximation to the analog value, based on the palette selected for that track. This allows for the choice of either discreet or analog color values.
Color Speed: 0-3600
RGB Offsets: 0-360
Shift: 1-6
Use Palette: Utilizes reverse color palette lookup (against palette selected for that track) when box is checked.

Blanking

Blank Speed controls how fast the blanking point moves, and Blank Spot controls the blanking threshold. In general, the most interesting effects are achieved when the blanking speed is either similar to, or a multiple of, the color speed.
Blank Speed: 0-3600
Blank Spot: 0-200

Envelope Applies either a square wave or sine wave to the gain of one or more of the “oscillator” channels, depending on which formula is selected. The speed slider controls the rate of the sine or square wave being applied, and the depth control determines how much of an impact the applied waveform has on the abstract in question.
Speed: 0-3600
Depth: 0-100
Sine/Square: Radio button determines the shape of the waveform applied.

Formula Allows the user to select the formula into which the abstract parameters are fed. This affects the X and Y abstract axes.
NOTE: Currently, values 1 thru 6 are “traditional” abstract formulas, while values 7 and 8 result in sine patterns ideal for beams.

Z Axis The radio buttons allow the user to select the formula used to calculate the Z-axis component of the abstract. The Z Axis Offset slider controls the “phasing” between the Z-axis values and the corresponding X/Y values. The Z Axis Gain slider controls the amplitude of the Z-axis abstract display.
Z Axis Offset: 0-360
Z Axis Gain: 0-100

Points Per Frame The number of abstract points displayed per abstract "frame". The greater the number of points per frame, the more "dense" the lines of the abstract appear. However, increasing the points per frame also increases the amount of time between track manipulations (since the entire frame is output), or the display of multiple tracks. For this reason, values over 400 should be used when only a single track is being displayed, and little or no track manipulations are being performed.
Points Per Frame: 1-2000

SAVE Saves the Control Panel parameters to a user selected “.ABS” abstract definition file.

CLOSE Closes the abstract control console window.

Show Scripting with LFI Player (.cts) File

LFI Player provides a relatively simple yet powerful scripting mechanism to create free-running laser shows. In general, displaying an image (either ILDA file or abstract) consists of several steps:

1) Read in an ILDA or abstract descriptor file, and assign the image to a track.
2) "Set" the initial track parameters (delay, color factor, etc.) and image orientation (AT point, FROM point).
3) Fade in the track (optional; can also initialize image to "full on" in step 2).
4) Display and "Manipulate" (e.g. rotate, zoom, move) the orientation as desired.

Multiple tracks can be opened and displayed simultaneously. The "manipulation" commands also provide an extremely powerful parameter called <read next command>. When a '1' value is passed in, the script parser will "postpone" displaying the image as directed by the command, and instead read in the subsequent command. This is useful for performing compound image manipulations on one or more tracks simultaneously. For example, if you wanted to zoom and fade in track 1 at the same time you were zooming out track 2, you could specify the desired SCFI and MZI commands for track 1 with <read next command> set to '1' (i.e. TRUE). Following this would be the corresponding MZO zoom out command for track 2 with the <read next command> parameter set to '0' (i.e. FALSE). LFI Player will save the information about track 1's manipulation, but not actually carry it out. When the command for track 2 is read, LFI Player will also save the information about the desired manipulation. However, since <read next track> is FALSE, it will then begin the "processing" (including display) of each track. The result is that track 1 will zoom and fade in at the same time track 2 zooms out.

Note that when the <read next command> parameter is set to '1', <number of frames> will often be set to '1' as well, since only one iteration of the manipulation is usually desired to be combined with the next manipulation. Note also that this feature is also normally used in conjunction with the loop feature, so as to be able to perform multiple compound manipulations in a row.

LFI Player provides a "looping" mechanism, which allows a block of commands to be repeated some predefined number of iterations. This can be used, for example to layer commands for a given track, providing relatively complex positioning manipulations (e.g. combine zoom-in with rotation of from point about the X axis).

NOTE: Spacing between parameters on given line not important. Blank lines are okay too. The filename must have the extension ".cts", and must have LAZERUS_3D_SCRIPT as the first line of the file.

Glossary of Command Parameters -

<abstract filename> Relative[1] path and filename of the abstract (.abs) file to be opened.

<arm state>
0 = Disarm Track
1 = Arm Track
2 = Toggle Arm/Disarm Track

<beam view>
0 = Normal Screen Display
1 = Beam View Display

<blanking delay> An unsigned integer between 1 and 100 which specifies the amount of time the system will pause proceeding a blanked point to give the scanners time to move into position prior to turning the blanking off. The higher the value, the greater the pause.

<color factor> Percentage (0.0 to 1.0) of RGB output.

<color factor increment> Value (0.0 to 1.0) to add (positive value) to or subtract (negative value) from the existing color factor.

<delay value> Increase to slow draw speed, decrease to increase draw speed.

<display mode>
0 = Display Off
1 = Normal Display
2 = Points Only Display

<fade in frames> The number of frames over which the process of fading the track in occurs. A value of 1 results in the track being brought to full brightness immediately (i.e. no fade). For the MFI and MCF commands, a value of 0 will cause the script interpreter to check the fade in value associated with the track, as set by the SNFF command. If this value is non-zero, it is used for the fade in value. If the value set by SNFF is also set to 0, then the global fade in value set by "Options -> Preferences -> Live Control -> Fade In Frames" is used for the fade in (or cross fade) value.

<fade in track> For the Manipulate Cross Fade (MCF) command, indicates which track will be fading in.

<fade out frames> The number of frames over which the process of fading the track out occurs. A value of 1 results in the track

	being brought to “black” brightness immediately (i.e. no fade). For the MFO command, a value of 0 will cause the script interpreter to check the fade out value associated with the track, as set by the SNFF command. If this value is non-zero, it is used for the fade out value. If the value set by SNFF is also set to 0, then the global fade out value set by “Options -> Preferences -> Live Control -> Fade Out Frames” is used for the fade out value.
<fade out track>	For the Manipulate Cross Fade (MCF) command, indicates which track will be fading out.
<font filename>	Relative[1] path and filename of the font file to be opened. A font file is actually an ILDA formatted file (.ild), containing 95 ASCII characters, “ “ thru “~”, each character in a separate ILDA file frame. On program startup, LFI Player attempts to load the default font file, “default_font.ild” and assign it to font number 0.
<font number>	An integral value, 0 thru 3, representing one of up to 4 fonts used for the generation of scrolling text. LFI Player can have up to 4 fonts loaded into memory at any given time. At startup, the default font file is assigned to font number 0. Using the Read Font File (RFF) command, the user can then open additional font files, and assign them a font number (including 0), which can be subsequently used to select the active font using the command Set Text Font (STF).
<frame number>	Refers to the frame number within a sequence of frames within a multi-frame ILDA file (e.g. an animation). First frame is numbered 0 to correspond to the Anarchy editor convention.
<frame repeat>	Number of times each frame image in an animation will display before proceeding to the next. Used to slow down an animation without changing the point delay value (i.e. draw speed). When this value is set to –1, the frame repeat value for the track will be determined by the “global” Frame Repeat value specified by the corresponding slider in the Live Control Panel.

<ilda filename>	Relative[1] path and filename of the ILDA (.ild) file to be opened.
<laser scale>	An integral percentage value between 1 and 100 representing the relative (compared to the maximum laser output) scale of the laser display output for each track. This value affects laser output only; not screen output.
<move increment>	Incremental distance to move forward or backward. A positive value means move forward, a negative value means move backward.
<number of frames>	Number of frames over which to execute command.
<number of loops>	An integral value representing the number of times to execute the commands contained within a "loop" block.
<palette type>	0 = Pangolin 1 = Laser Illusions 2 = ILDA 3 = X29
<read next command>	Causes the script "parser" to continue on and read the next command in the script rather than performing and displaying the indicated operation then and there. When the value is '0' (i.e. FALSE), the indicated operation is carried out and the results are displayed. When the value is '1' (i.e. TRUE), the operation is carried out on that track, but the result is not displayed. By "chaining" several operations together prior to displaying the result, complex compound manipulations can be performed on one or more tracks simultaneously. This parameter is very powerful when used to perform compound manipulations within a loop. For example, you could do a rotation about both the X and Z-axes while fading and zooming in track 1, and simultaneously fade and zoom out track 2.
<red> <green> <blue>	Percentage (0.0 to 1.0) of red, green, and blue output balance, respectively.

[1] Relative to the drive and path information stored in "Content Base Directory", under Options->Preferences->Live Control.

<reverse sequence>	Indicates whether or not the ILDA frame sequence should be displayed in reverse order (essentially played backwards). A “Boolean” value, where 0 means FALSE (i.e. display normally), and a 1 value means TRUE (i.e. display in reverse order).
<R incr> <G incr> <B incr>	A real number value (0.0 to 1.0) to add (positive value) to or subtract (negative value) from the existing red, green, and or blue color balance.
<rotate about zero>	A “Boolean” value, where 0 means FALSE, and a 1 value means TRUE.
<rotation angle>	Angular increment to rotate the view (can be positive or negative).
<start frame number>	Used with the Set Frame Display Range (SFDR) command to specify a subset of frames to display within a larger frame sequence. This parameter specifies the first frame number in the subset. Frame zero is the lowest number frame, as is the convention with the Anarchy Editor. A negative value disables the display subset feature (i.e. all frames will be displayed).
<stop frame number>	Also used with SFDR. Specifies the last frame number in the subset. For example, ‘SFDR 1 3 5’ will set the range of frames to be displayed for track 1 to frames 3 through 5 (inclusive). Normally, the stop frame number must be greater than the start frame number. However, if reverse sequence has been enabled, then the stop value must be less than the start value.
<text filename>	Relative[1] path and filename of the plain text (.txt) file to be opened.
<text scroll rate>	An integral value determining the rate of speed with which scrolling text moves across the display area. Specifically, this value determines how many ILDA “units” the text moves to the left each frame. A value of 0 results in no scrolling, and a value of 2000 is the default.
<track number>	Specifies for which track the command applies (valid integer values are 1 - 4).

<track scale>	Similar to laser scale. An integral percentage value, between 1 and 100, representing the relative scale of the overall display output (screen and laser) for each track.
<use defaults>	Determines whether or not the various parameters associated with a track (e.g. orientation data) are initialized when a new file is associated with that track. If <use defaults> is set to 1 (i.e. TRUE), then all track values will be set to a generic default state. Otherwise, all track information will be left as it was before the read XXX file command was executed (which may or may not be desirable if the track has previously been used, but definitely not desirable if the track is being used for the first time).
<view angle>	The camera angle (0 < angle < 90) in degrees.
<X at> <Y at> <Z at>	The focal point (X,Y,Z).
<X from> <Y from> <Z from>	The position (X,Y,Z) of the viewer.
<X incr> <Y incr> <Z incr>	X, Y, and Z increments to move the from or at point.
<X up> <Y up> <Z up>	A vector indicating which way is up (X,Y,Z).
<zoom increment>	Incremental distance to zoom in or out.
<z-axis formula>	Specifies the formula number to be applied for calculating the Z-axis component of LFI Player abstracts and scrolling text. As with the other “Z-axis” parameters, this one is used with the SZP command, which is still under development, and is subject to change. Further, the actual Z-axis formulas for scrolling text do not currently correspond to the Z-axis formulas for abstracts.
<z-axis offset>	An integral value, from 0 to 360, which determines the “phasing” between the Z-axis values and the corresponding X/Y values.
<z-axis gain>	An integral percentage value, from 0 to 100, which determines the amplitude of the Z-axis abstract and scrolling text displays.

<z-axis period>	An real number value which determines the period of the sinusoidal formula being applied to the Z-axis component. Currently, only one of the scrolling text formulas, and none of the abstracts, is affected by this parameter.

Glossary of Script Commands -

BL - Begin Loop

Usage: BL <number of loops>
Description: Denotes the beginning of a block of script code to be repeated the designated number of loops.

CAT – Clear All Tracks

Usage: CAT
Description: Removes all tracks and associated information from the track list.

C++ style comment

Usage: // Comment must be on a line (or lines) by itself.
Description: Used to comment out lines of script code for purposes of documentation or testing.

EL - End Loop

Usage: EL
Description: Denotes the end of a block of script code.

ES - End Script

Usage: ES
Description: Used to denote the end of the .cts script. While technically not necessary (i.e. software will detect end of file), it is nonetheless a good idea to include for completeness.

JD - Just Display

Usage: JD <number of frames>
Description: Display all active tracks for the number of frames specified.

MAP - Manipulate Move At Point

Usage: MAP <track number> <number of frames> <x increment> <y increment> <z increment> <read next command>
Description: Move the “at point”, for the specified track, in an arbitrary direction specified by the “x increment”, “y increment”, and “z increment” values, and perform this manipulation the specified number of frames.

MARX - Manipulate At Rotate X

Usage: MARX <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate the “at point”, for the indicated track, the specified number of degrees about the X-axis, and perform this manipulation the specified number of frames.

MARY - Manipulate At Rotate Y

Usage: MARY <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate the “at point”, for the indicated track, the specified number of degrees about the Y-axis, and perform this manipulation the specified number of frames.

MARZ - Manipulate At Rotate Z

Usage: MARZ <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate the “at point”, for the indicated track, the specified number of degrees about the Z-axis, and perform this manipulation the specified number of frames.

MBP - Manipulate Move Both Points

Usage: MBP <track number> <number of frames> <x increment> <y increment> <z increment> <read next command>
Description: Move both the “from point” and the “at point”, for the specified track, in an arbitrary direction specified by the “x increment”, “y increment”, and “z increment” values, and perform this manipulation the specified number of frames.

MBRX - Manipulate Both Rotate X

Usage: MBRX <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate both the “from point” and the “at point”, for the indicated track, the specified number of degrees about the X-axis, and perform this manipulation the specified number of frames.

MBRY - Manipulate Both Rotate Y

Usage: MBRY <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate both the “from point” and the “at point”, for the indicated track, the specified number of degrees about the Y-axis, and perform this manipulation the specified number of frames.

MBRZ - Manipulate Both Rotate Z

Usage: MBRZ <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate both the “from point” and the “at point”, for the indicated track, the specified number of degrees about the Z-axis, and perform this manipulation the specified number of frames.

MCF - Manipulate Cross Fade

Usage: MCF <fade in track> <fade out track> <fade in frames> <read next command>
Description: Causes the “fade in track” to be brought up in brightness from current to full brightness, while simultaneously bringing down “fade out track” from current brightness to black in the specified number of frames.

MFI - Manipulate Fade In

Usage: MFI <track number> <fade in frames> <read next command>
Description: Used to fade in a track, from the current brightness up to full brightness, in the specified number of frames. Currently, only a linear fade in is supported. As with all of the “Manipulate…” commands, the final parameter determines whether or not the next command should be read and processed prior to outputting the image to the display. Used almost exclusively in a loop, the final parameter is what enables compound manipulations of one or more tracks. In a loop, all but the final command can be specified with “read next command” set to TRUE (i.e. 1). When this is done, all but the last command is read and processed, and actual output is reserved for the last command (i.e. read next command equals 0). This effectively “sums up” the manipulations, allowing for relatively complex effects. Note also that when any of the “Manipulate…” commands are used inside a loop, “number of frames” should generally be set to 1, such that one manipulation is performed for each iteration of the containing loop block.

MFO - Manipulate Fade Out

Usage: MFO <track number> <fade in frames> <read next command>
Description: Used to fade out a track, from the current brightness down to zero brightness, in the specified number of frames. Currently, only a linear fade out is supported.

MFP - Manipulate Move From Point

Usage: MFP <track number> <number of frames> <x increment> <y increment> <z increment> <read next command>
Description: Move the “from point”, for the specified track, in an arbitrary direction specified by the “x increment”, “y increment”, and “z increment” values, and perform this manipulation the specified number of frames.

MFRX - Manipulate From Rotate X

Usage: MFRX <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate the “from point”, for the indicated track, the specified number of degrees about the X-axis, and perform this manipulation the specified number of frames.

MFRY - Manipulate From Rotate Y

Usage: MFRY <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate the “from point”, for the indicated track, the specified number of degrees about the Y-axis, and perform this manipulation the specified number of frames.

MFRZ - Manipulate From Rotate Z

Usage: MFRZ <track number> <number of frames> <rotation angle> <read next command>
Description: Rotate the “from point”, for the indicated track, the specified number of degrees about the Z-axis, and perform this manipulation the specified number of frames.

MMF - Manipulate Move Forward

Usage: MMF <track number> <number of frames> <move increment> <read next command>
Description: Similar to MZI, but instead of moving the “from point” closer to the “at point”, both points are moved forward along a line extending out from the line connecting them together. A positive “move increment” will result in “forward motion”, while a negative value will result in effectively moving backwards.

MZI - Manipulate Zoom In

Usage: MZI <track number> <number of frames> <zoom increment> <read next command>
Description: For the indicated track, perform a “zoom in” (i.e. move the “from point” closer to the “at point”) the distance indicated by “zoom increment”, and perform this manipulation the specified number of frames.

MZO - Manipulate Zoom Out

Usage: MZO <track number> <number of frames> <zoom increment> <read next command>
Description: For the indicated track, perform a “zoom out” (i.e. move the “from point” further away from the “at point”) the distance indicated by “zoom increment”, and perform this manipulation the specified number of frames.

RAD - Read Abstract Descriptor

Usage: RAD <track number> <abstract filename> <use defaults>
Description: Used to open a LFI Player abstract descriptor file and assign it to the designated track. If <use defaults> is set to 1 (i.e. TRUE), then all track values (e.g. orientation data) will be set to a generic default value. Otherwise, all track information will be left as it was before this command was.

RAT – Reset All Tracks

Usage: RAT
Description: Clears the current track manipulation settings for all tracks, while leaving the track frame and orientation data intact. For example, if tracks 1 and 2 were in the middle of rotating images 360 degrees, the rotation would be cancelled, but the frame itself and the current orientation (or view) would be retained.

RFF - Read Font File

Usage: RFF <font number> <font filename>
Description: Used to read in a new font file, specified by <font filename>, to be used to create scrolling text. LFI Player may have up to 4 different fonts, numbered 0 thru 3, and specified by <font number>, simultaneously loaded in memory.

RIF - Read ILDA File

Usage: RIF <track number> <ilda filename> <use defaults>
Description: Used to open an ILDA frame file and assign it to the designated track. If <use defaults> is set to 1 (i.e. TRUE), then all track values (e.g. orientation data) will be set to a generic default value. Otherwise, all track information will be left as it was before this command was executed (obviously not a good idea if the track has not been previously used).

RT - Remove Track

Usage: RT <track number>
Description: Removes the designated track and all associated information from the track list.

RTF - Read Text File

Usage: RTF <track number> <text filename> <use defaults>
Description: Used to open a text file to display scrolling text. The text file may contain up to 1000 ASCII characters. If <use defaults> is set to 1 (i.e. TRUE), then all track values (e.g. orientation data) will be set to a generic default value. Otherwise, all track information will be left as it was before this command was.

SAP - Set At Point

Usage: SAP <track number> <x at> <y at> <z at>
Description: Used to set the X, Y, and Z-axis coordinates of the “at point” for the designated track. The “at point” is the point in space at which the viewer is looking at the object or objects in the frame (e.g. could be at the center of the object, or off to one side).

SBD - Set Blanking Delay

Usage: SBD <track number> <blanking delay>
Description: Applicable primarily when a PCAOM or direct modulation is used for color control. Because the response of the PCAOM or direct modulation is much faster than the response of the scanners, it is possible (especially when the jump between points is large) for the laser light to be turned on before the scanners have moved to their next desired position. This can result in “tails” being displayed, particularly between two different objects (e.g. when using more than one track). The blanking delay determines the number of extra points inserted (and therefore the delay) at the point where the scanners

are moving to so that the scanners have time to get where they're going prior to the light being turned on.

SBV - Set Beam View

Usage: SBV <track number> <beam view>
Description: For the indicated track, determines whether the screen display utilizes the beam view simulation mode, or normal screen display mode.

SCA - Set Camera (View) Angle

Usage: SCA <track number> <view angle>
Description: In Pangolin, this is equivalent to perspective. If the software is considered a camera, then this command sets how wide the angle of the lens is. 45^o is a normal lens, and 180^o is an extremely wide-angle (think major fish eye) lens.

SCB - Set Color Balance

Usage: SCB <track number> <red> <green> <blue>
Description: Similar to SCF, but allows the brightness of each of the RGB components to be adjusted individually.

SCBI - Set Color Balance Incrementally

Usage: SCBI <track number> <R incr> <G incr> <B incr>
Description: Similar to SCF, but allows the brightness of each of the RGB components to be increased or decreased (generally in a loop) individually.

SCF - Set Color Factor

Usage: SCF <track number> <color factor>
Description: For the indicated track, effectively determines the brightness of the current point color, with 0 being completely off, and 1.0 being full brightness.

SCFI - Set Color Factor Incrementally

Usage: SCFI <track number> <color factor increment>
Description: Generally used in a loop to fade in multiple tracks simultaneously. For example (starting with a color factor of 0), in a loop of 10 iterations, you could increase the color factor increment by 0.1, so at the end of the 10 loops, the track will be at full brightness.

SCP - Set Color Palette

Usage: SCP <track number> <palette type>
Description: For the indicated track, determines which color palette (see <palette type> in section "Command Parameters") will be applied for color lookups.

SDM - Set Display Mode

Usage: SDM <track number> <display mode>
Description: For the indicated track, determines the laser display mode (e.g. off, normal, points only). Similar to STAS (which could probably be eliminated).

SFDR - Set Frame Display Range

Usage: SFDR <track number> <start frame number> <stop frame number>
Description: Applicable to ILDA frame files only. Allows you specify a subset of frames within a frame file to be displayed.

SFP - Set From Point

Usage: SFP <track number> <x from> <y from> <z from>
Description: Used to set the X, Y, and Z-axis coordinates of the "from point" for the designated track. The "from point" is the point in space from which the viewer is looking at the object or objects in the frame.

SFSR - Set Frame Sequence Reverse

Usage: SFSR <track number> <reverse sequence>
Description: For the indicated track (and for ILDA frame files only), determines whether the frame sequence is played backwards (reverse) or forwards (normal).

SGD – Set Global Delay

Usage: SGD <delay value>
Description: Not generally recommended. Used to override the global delay setting in the user preferences for the duration of the script. Once the script has completed execution, the global delay value reverts back to the value defined in the user preferences.

SLS – Set Laser Scale

Usage: SLS <laser scale>
Description: Not generally recommended. Used to override the global laser scale setting in the user preferences for the duration of the script. Once the script has completed execution, the global laser scale value reverts back to the value defined in the user preferences.

SNFF – Set Number of Fade Frames

Usage: SNFF <track number> <fade in frames> <fade out frames>
Description: This command is used in conjunction with the MFI, MFO, and MCF commands to set globally (for a particular script) the number of frames over which a fade

in, fade out, or cross fade occurs for a specified track[1]. A value of 0 for <fade in frames> will result in the value set by "Options -> Preferences -> Live Control -> Fade In Frames" to be used as the "global" fade in (or cross fade) value, thereby allowing real-time live control over the fade speed. Likewise, a value of 0 for <fade out frames> will result in the value set by "Options -> Preferences -> Live Control -> Fade Out Frames" to be used to control the "global" fade out speed.

SRAZ - Set Rotate About Zero

Usage: SRAZ <track number> <rotate about zero>
Description: For the indicated track, determines whether rotations are performed around the "0" point in 3D space (i.e. 0,0,0), or around the "at point" which may (or may not) be the zero point.

STAS - Set Track Arm State

Usage: STAS <track number> <arm state>
Description: For the indicated track, determines whether the track is "armed" (i.e. scanning) or not.

STD - Set Track Delay

Usage: STD <track number> <delay value>
Description: For the indicated track, specifies the amount of delay introduced between the output of each point. Note that, in general, this setting is more applicable to LFI Player applications using non-RIYA output cards, since this determines the amount of delay introduced by the computer.

STF - Set Text Font

Usage: STF <font number>
Description: Determines which of up to 4 text fonts stored in memory is the active font used for the creation of scrolling text. In general, there should always exist at least one font (the default font), which is assigned font number 0. Additional fonts can be read into memory and assigned a font number using the RFF command.

STR - Set Track Repeat

Usage: STR <track number> <frame repeat>
Description: For the specified track, determines the number of times each frame is repeated (effectively slowing down an animation). Can also be used with LFI Player abstracts.

STS - Set Track Scale

[1] For each instance in that script where a value of 0 is specified for the number of fade in or fade out frames for the MFI, MFO, and/or MCF command. Note that if the SNFF command is not used in a script, the "global" fade in and fade out values for each track are defaulted to 1 frame.

Usage: STS <track number> <track scale>
Description: For the indicated track, determines the overall percentage scale of both the screen and laser display.

STSR - Set Text Scroll Rate

Usage: STSR <track number> <text scroll rate>
Description: Applies only to tracks assigned scrolling text. Used to determine the speed at which the scrolling text scrolls across the display area. The integral value <text scroll rate> actually determines the number of ILDA "units" the text moves to the left each frame. A value of 2000 is the default, and a scroll rate of 0 results in the text not moving.

SUV - Set Up Vector

Usage: SUV <track number> <x up> <y up> <z up>
Description: Used to define which way is considered "up" for the designated track. In general, convention considers the +Y direction (or vector) up, but does not have to be. Setting the "up vector" to –Y for track 3, for example, would entail the command:

"SUV 3 0 –1 0"

SZP - Set Z-axis Parameters

Usage: SZP <track number> <z-axis formula> <z-axis offset> <z-axis gain> <z-axis period>
Description: **This command is still under development, and is subject to change.** Used to specify key Z-axis parameters affecting both scrolling text and abstracts (but currently not ILDA frames.

EXAMPLE: LFI Player “control script” (.cts) File

```
LFI_PLAYER_SCRIPT
// First line is the header, and must be 'LFI_PLAYER_SCRIPT'
// (note that 'LAZERUS_3D_SCRIPT' is also supported for older
// legacy scripts)

// Assign file mountain.ild to track 1 and use defaults.
RIF  1 mountain.ild 1

// Set the FROM point for track 1 to position
// X=130000.0, Y=0.0, and Z=130000.0
SFP  1 130000.0 0.0 130000.0

// Set the output delay value associated with track 1 to 600.
STD  1 600

// Set the blanking delay value associated with track 1 to 40.
SBD  1 40

// Fade in track 1 over the course of displaying 20 frames.
MFI  1 20 0

// Perform 40 zoom-in calculations on track 1, zooming in 50.0
// units each time and displaying after each incremental zoom.
MZI  1 40 50.0 0

// Rotate the FROM point of track 1 about the Y-axis.  Rotate
// -5.0 degrees each time, displaying after each manipulation.
// Do this 144 times.
MFRY  1 144 -5.0 0

// Following shows how to perform a compound manipulation using
// a loop and the "read next command" parameter.
// Loop through the following block 10 times...
BL 10
   // Move the AT point associated with track 1 1000 units
   // in the Y direction from its current location.  Move
   // it once per loop, and continue on to read the next
   // command without outputting display.
   MAP 1 1 0.0 1000.0 0.0 1

   // Move the FROM point associated with track 1 1000 units
   // in the Y direction from its current location.  Move
   // it once per loop, and display output after performing
   // calculation.
   MFP 1 1 0.0 1000.0 0.0 0

// End of loop.
EL

// End of script.
ES
```

Assigning LFI Player Scripts for Live Control (.clv file)

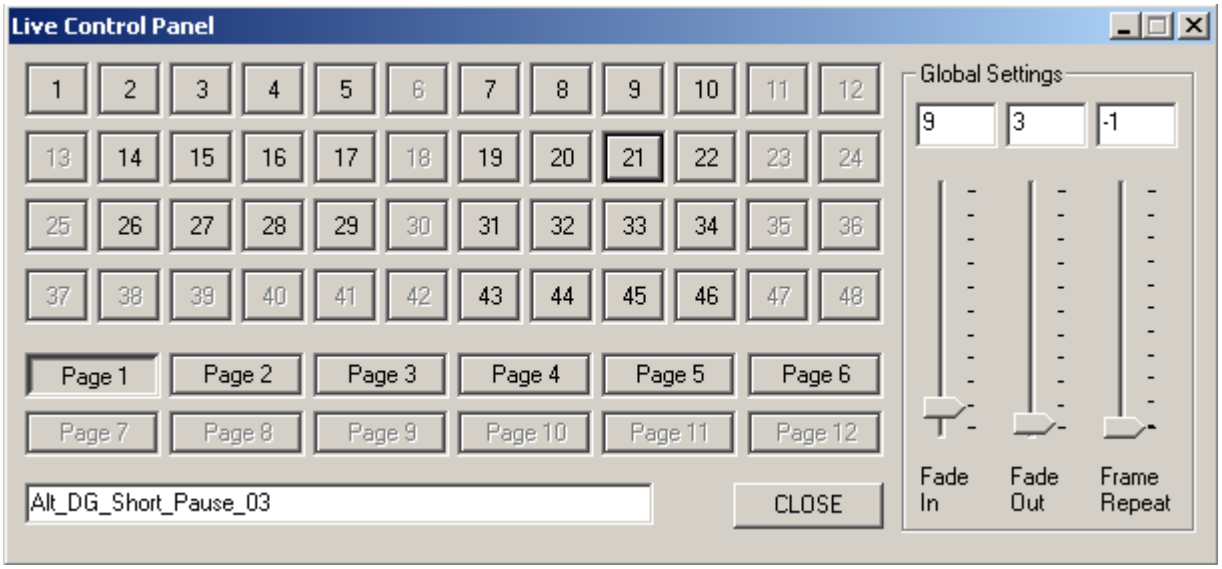


Figure 16 – Live Control Panel Dialog

LFI Player has a "live" control panel/console that allows you to trigger execution of free running '.cts' shows from cue push buttons in the console. The live console is organized into 12 pages of 48 cues, or trigger buttons, allowing you to launch up to 576 separate .cts scripts as shown in figure 16. When in "live" mode, the cues in the console can also be triggered using the keyboard functions keys[1] as follows:

1 - 12	F1 - F12
13 - 24	Shift F1 - Shift F12
25 - 36	Ctrl F1 - Ctrl F12
37 - 48	Alt F1 - Alt F12

As of version 1.1.3, LFI Player includes additional live control through the use of the "Global Settings" sliders. These sliders allow the setting of the global "Fade In", "Fade Out", and "Frame Repeat" values, which are applied to tracks designated accordingly in the corresponding .CTS script file (see MFI, MFO, SNFF, and STR). This allows, for example, "global" control over the number of frame repeats of an animation to match the tempo/BPM of certain music. The global "Frame Repeat" slider has the additional capability of setting the global frame repeat value to a "long hold" value (65535 repeats) by moving the slider all the way down to –1. Note also that the global Fade In and Fade Out frame values are shared with the corresponding user Preferences values under the "Live Control" tab in the LFI Player Preferences dialog. At this time, changes in one dialog

[1] There are currently no hot-keys assigned for triggering page changes. When using hot-keys for live control, window focus must be on the main application window, ***not*** the Live Control Panel dialog.

are not immediately reflected in the other dialog, so it is recommended that only one of the dialogs be used to change this information at a time.

The assignments are made by reading in a LFI Player “control live” (.clv) file. The file contains a header line, followed by a page number, followed by a line for each cue to be assigned. For example...

```
LFI_PLAYER_LIVE_CONTROL
Page 1
// this is a C++ style comment
1   FirstCoolScriptPage1.cts   a_page_1_cool_script_for_cue_1
       .
       .
       .
48  LastCoolScriptPage1.cts    a_page_1_cool_script_for_cue_12
          .
          .
          .
Page 12
1   FirstCoolScriptPage12.cts   a_page_12_cool_script_for_cue_1
       .
       .
       .
48  LastCoolScriptPage12.cts    a_page_12_cool_script_for_cue_12
```

The first line is the header and must be exactly as shown. Next comes the page number, followed by one or more subsequent lines correspond to the desired key assignments for cues on that page. The first cue parameter is the cue number (1 - 48). The second parameter is the fully defined file path to the .cts file to be assigned. The third parameter is a “description” string (NO spaces), which is displayed in the “Live Control” dialog box.

Note that it is not necessary to use all 12 pages, nor is it necessary to assign all 48 cues for a particular page. Those pages and cues which are not used will show up as grayed out (i.e. inactive), and will be ignored if pressed. In practice, it is not even necessary that the pages or cues by in ascending numeric order, though it will be easier to maintain the script file if it is organized that way.

Another useful “trick” to be aware of is the ability to assign live buttons to scripts that perform manipulations on tracks opened (and displayed) by a different live button. For example, live cue buttons 1 through 36 might be assigned to scripts that open and display various ILDA frames and/or LFI Player abstracts, while cue buttons 37 through 48 could be assigned to scripts which perform zooms, rotations, or other manipulations on the tracks opened by the first 36 cue buttons. Note that this is possible by **not** calling the Clear All Tracks (CAT) command at the beginning of a script that is to perform manipulations on a previously opened track. In the following example, the first script opens and displays an ILDA frame file called fan_ani1.ild, while the second script performs a series of rotations on the track opened with the first script. Each would then be assigned to a live cue button.

```
LFI_PLAYER_SCRIPT
```

```
CAT
RIF 1 C:\Laser\YAG_Files\Show_01\ILD_Files\fan_ani1.ild 1
SFP 1 0.0 0.0 35000.0
SBV 1 1
SBD 1 10
STS 1 100
STD 1 1000
SCASCA 1 90
STR 1 1
SCF 1 1.0
JD 1000000

ES

LFI_PLAYER_SCRIPT

BL 1000000
  MFRY 1 1 1.5 1
  MFRX 1 1 1.0 0
EL

ES
```

MIDI Key Assignments

If the Lazerus 3D software detects a MIDI device attached to the host computer when the software is launched, that MIDI device can be used to control certain software display functions. The number of MIDI devices detected will be displayed in the MIDI box on the Status Bar. Because only the key press (and release) values are used by the software, it is theoretically possible to use multiple MIDI devices concurrently for control, though I have not actually tested this. Note that use of the computer keyboard Hot Keys and other GUI controls is not affected by the presence and use of a MIDI device.

MIDI key press (and release when appropriate) values are currently hard coded (dynamic assignments are on my “To Do” list). Therefore, it is recommended that a minimum of a 61 note MIDI keyboard be used for control at this time. Note that for the live control keys, only the key press has any effect (key release is ignored). For the image manipulation controls, both key press and release are considered (i.e. the effect will continue until the key is released). If more than one live control key is pressed at the same time, the first key will be processed immediately followed by the second. If more than one image manipulation key is pressed, the second key will be ignored.

Live Control Console

Key Press Only -

C2	Live control cue button 1	C4	Live control cue button 25
C2#	Live control cue button 2	C4#	Live control cue button 26
D2	Live control cue button 3	D4	Live control cue button 27
D2#	Live control cue button 4	D4#	Live control cue button 28
E2	Live control cue button 5	E4	Live control cue button 29
F2	Live control cue button 6	F4	Live control cue button 30
F2#	Live control cue button 7	F4#	Live control cue button 31
G2	Live control cue button 8	G4	Live control cue button 32
G2#	Live control cue button 9	G4#	Live control cue button 33
A2	Live control cue button 10	A4	Live control cue button 34
A2#	Live control cue button 11	A4#	Live control cue button 35
B2	Live control cue button 12	B4	Live control cue button 36
C3	Live control cue button 13	C5	Live control cue button 37
C3#	Live control cue button 14	C5#	Live control cue button 38
D3	Live control cue button 15	D5	Live control cue button 39
D3#	Live control cue button 16	D5#	Live control cue button 40
E3	Live control cue button 17	E5	Live control cue button 41
F3	Live control cue button 18	F5	Live control cue button 42
F3#	Live control cue button 19	F5#	Live control cue button 43
G3	Live control cue button 20	G5	Live control cue button 44
G3#	Live control cue button 21	G5#	Live control cue button 45
A3	Live control cue button 22	A5	Live control cue button 46
A3#	Live control cue button 23	A5#	Live control cue button 47
B3	Live control cue button 24	B5	Live control cue button 48

Key Press & Release –

C6	Zoom In selected tracks
D6	Zoom Out selected tracks
E6	Rotate from point in plus direction about X axis
F6	Rotate from point in minus direction about X axis
G6	Rotate from point in plus direction about Y axis
A6	Rotate from point in minus direction about Y axis
B6	Rotate from point in plus direction about Z axis
C7	Rotate from point in minus direction about Z axis

Program Change –

Program 1	Live control page 1
Program 2	Live control page 2
Program 3	Live control page 3
Program 4	Live control page 4
Program 5	Live control page 5
Program 6	Live control page 6
Program 7	Live control page 7
Program 8	Live control page 8
Program 9	Live control page 9
Program 10	Live control page 10
Program 11	Live control page 11
Program 12	Live control page 12

Hot Keys

Live Control Console

F1 - F12	Live control buttons 1 thru 12 respectively
Shift F1 - Shift F12	Live control buttons 12 thru 24 respectively
Ctrl F1 - Ctrl F12	Live control buttons 25 thru 36 respectively
Alt F1 - Alt F12	Live control buttons 37 thru 48 respectively

Track Control

1 – 4	Select focus, tracks 1 thru 4 respectively
Ctrl 1 - Ctrl 4	Arm/disarm tracks 1 thru 4 respectively
Shift 1 - Shift 4	Start/stop display tracks 1 thru 4 respectively
Alt 1 – Alt 4	Enable/disable effects control for tracks 1 – 4 respectively
Shift Left Arrow	Reduce frame repeat value
Shift Right Arrow	Increase frame repeat value
Alt Left Arrow	Reduce track blanking delay value
Alt Right Arrow	Increase track blanking delay value
Ctrl Left Arrow	Reduce track delay value
Ctrl Right Arrow	Increase track delay value
Ctrl Up Arrow	Increase track scale value
Ctrl Down Arrow	Decrease track scale value
.	Toggle points-only mode.

System Control

Ctrl G	“Go”, i.e. “Play” button
Ctrl S	“Stop” button
Ctrl P	“Pause” button
Ctrl R	“Rewind” to beginning of current active CTS script
Ctrl U	“Restore track orientation to default values
Alt Up Arrow	Increase laser output scale
Alt Down Arrow	Decrease laser output scale
Alt Left Arrow	Reduce global delay value
Alt Right Arrow	Increase global delay value

Effects Increment Control

-	Decrease zoom increment value
=	Increase zoom increment value
_	Decrease move increment value
+	Increase move increment value
[	Decrease rotate increment value
]	Increase rotate increment value

Rotation Effects

Insert	Rotate from point in plus direction about X axis
Delete	Rotate from point in minus direction about X axis
Home	Rotate from point in plus direction about Y axis
End	Rotate from point in minus direction about Y axis
Page Up	Rotate from point in plus direction about Z axis
Page Down	Rotate from point in minus direction about Z axis

Object Orientation Effects

Down Arrow	Zoom out selected tracks
Up Arrow	Zoom in selected tracks
Shift Down Arrow	Move backward selected tracks
Shift Up Arrow	Move forward selected tracks
Shift Insert	Move both FROM & AT points in plus X direction
Shift Delete	Move both FROM & AT points in minus X direction
Shift Home	Move both FROM & AT points in plus Y direction
Shift End	Move both FROM & AT points in minus Y direction
Shift Page Up	Move both FROM & AT points in plus Z direction
Shift Page Down	Move both FROM & AT points in minus Z direction
Ctrl Insert	Move FROM point in plus X direction
Ctrl Delete	Move FROM point in minus X direction
Ctrl Home	Move FROM point in plus Y direction
Ctrl End	Move FROM point in minus Y direction
Ctrl Page Up	Move FROM point in plus Z direction
Ctrl Page Down	Move FROM point in minus Z direction
Alt Insert	Move AT point in plus X direction
Alt Delete	Move AT point in minus X direction
Alt Home	Move AT point in plus Y direction
Alt End	Move AT point in minus Y direction
Alt Page Up	Move AT point in plus Z direction
Alt Page Down	Move AT point in minus Z direction

Appendix A – Additional .CTS Script Examples

```
LAZERUS_3D_SCRIPT

// This script instantiates 3 different copies of ‘abstract01_200’
// at three different places in the display area.  Each begins as
// a single component RGB color (i.e. one is red, one is green, and
// one is blue).  After fading in, each is rotated individually,
// then simultaneously.  They are then “pulled” together in the
// center of the display area, merging into a single full color
// abstract.  A small 3D ILDA sphere (smallsphr.ild) is displayed
// in the center of the abstract, and both are rotated separately.
// Finally, the small sphere is faded out and the abstract splits
// back into its component colors.

// create the first abstract instance in the lower center
RAD  1 C:\Laser\ABS\Abstracts\abstract01_200.abs 1
SFP  1 0      0  120000
SAP  1 0  25000       0
STD  1 6000
// set the color balance to red only
SCB  1 1.0 0.0 0.0
SRAZ 1 1
SBD  1 50
STS  1 80

// create the second abstract instance in the upper left
RAD  2 C:\Laser\ABS\Abstracts\abstract01_200.abs 1
SFP  2      0      0 120000
SAP  2 -25000 -25000      0
STD  2 6000
// set the color balance to green only
SCB  2 0.0 1.0 0.0
SRAZ 2 1
SBD  2 50
STS  2 80

// create the third abstract instance in the upper right
RAD  3 C:\Laser\ABS\Abstracts\abstract01_200.abs 1
SFP  3     0      0 120000
SAP  3 25000 -25000      0
STD  3 6000
// set the color balance to blue only
SCB  3 0.0 0.0 1.0
SRAZ 3 1
SBD  3 50
STS  3 80

BL 15
  SCFI 1 0.0667
  SCFI 2 0.0667
  SCFI 3 0.0667
  JD 1
EL
```

```
JD 100

MBRY 3 100 3.6 0
MBRY 2 100 3.6 0
MBRY 1 100 3.6 0

BL 200
  MBRY 1 1 3.6 1
  MBRY 2 1 3.6 1
  MBRY 3 1 3.6 0
EL

BL 85
  MAP 1 1    0 -250    0 1
  MAP 2 1  250  250    0 1
  MAP 3 1 -250  250    0 1
  MFP 1 1    0    0 -600 1
  MFP 2 1    0    0 -600 1
  MFP 3 1    0    0 -600 0
EL

BL 15
  SCBI 1 0.0 0.0667 0.0667
  SCFI 2 -0.0667
  SCFI 3 -0.0667
  MAP 1 1    0 -250    0 1
  MAP 2 1  250  250    0 1
  MAP 3 1 -250  250    0 1
  MFP 1 1    0    0 -600 1
  MFP 2 1    0    0 -600 1
  MFP 3 1    0    0 -600 0
EL

RT 2
SDM 3 0
STD 1 11000

RIF 2 C:\Laser\ILD\Graphics\3D\Static\smallsphr.ild 1
SFP 2 15000    0 130000
SAP 2     0 1000      0
STD 2 11000
SBD 2 50
STS 2 80

BL 15
  SCFI 2 0.0667
  MFRY 2 1 2.0 0
EL

MFRY 2 100 2.0 0

BL 200
  MBRY 1 1 3.6 1
  MFRY 2 1 2.0 0
EL
```

```
MFRY 2 100 2.0 0

BL 15
  SCFI 2 -0.0667
  MFRY 2 1 2.0 0
EL

RT 2
SDM 3 1
STD 1 6000

RAD  2 C:\Laser\ABS\Abstracts\abstract01_200.abs 1
SFP  2 0  0  60000
STD  2 6000
SCB  2 0.0 1.0 0.0
SBD  2 50
STS  2 80

BL 15
  SCBI 1 0.0 -0.0667 -0.0667
  SCFI 2 0.0667
  SCFI 3 0.0667
  MAP 1 1    0  250   0 1
  MAP 2 1 -250 -250   0 1
  MAP 3 1  250 -250   0 1
  MFP 1 1    0    0 600 1
  MFP 2 1    0    0 600 1
  MFP 3 1    0    0 600 0
EL

BL 70
  MAP 1 1    0  250   0 1
  MAP 2 1 -250 -250   0 1
  MAP 3 1  250 -250   0 1
  MFP 1 1    0    0 600 1
  MFP 2 1    0    0 600 1
  MFP 3 1    0    0 600 0
EL

JD 25

BL 15
  SCFI 1 -0.0667
  SCFI 2 -0.0667
  SCFI 3 -0.0667
  MAP 1 1    0  250   0 1
  MAP 2 1 -250 -250   0 1
  MAP 3 1  250 -250   0 1
  MFP 1 1    0    0 600 1
  MFP 2 1    0    0 600 1
  MFP 3 1    0    0 600 0
EL

RT 2
RT 3

ES
```