

## FTA1000 Quick Start

Last updated October 19, 2005

### Unpacking

The instrument is shipped fully assembled, but you must remove plastic straps that hold the moving stages in place during shipment. These are brightly colored to make them easily visible.

If you observe any damage, or find anything loose, contact FTA before making adjustments or attempting repair. You may make things worse, not knowing the details of the instrument. Do not attempt to operate the instrument if it appears damaged.

### Software Installation

In general, install the software before connecting the instrument. This will let the Found New Hardware Wizards operate correctly. Typically in the case of USB devices, however, the software installation is done entirely through the Found New Hardware Wizard.

With the exception of the certain camera or frame grabber drivers, all drivers for the FTA1000 are loaded onto the computer when you install Fta32\_Video. This is a change from FTA's past installation procedures. In the future, Fta32\_Video will contain all drivers in order to simplify installation. Note that simply having the drivers on the hard disk is not sufficient: you still must run the Found New Hardware Wizard for each device when requested by Windows.

Extremely detailed instructions are provided in the *How to Install Fta32 Video* document. It is included in the main manual and may also be downloaded from the following link:

<http://www.firsttenangstroms.com/software/software.html>

The FTA1000 uses a USB device to provide two virtual serial ports to control the instrument. The Found New Hardware Wizard will request the driver to these when you first plug in the USB cable from the pump and electronics box to the computer. USBSerialPortInstallation.pdf is provided with the driver and will guide you. Note that instruments shipped after 15 October 2005 use the newer driver listed as FTC\_USB\_Serial\_Driver on the website. This newer driver is the *only* one included with Fta32 distributions. Those needing the older driver should download it from the website.

## Initial Startup

Prior to running Fta32 Video, you should have

- installed the camera or frame grabber driver and run the demo program included with the device to verify its nominal operation.
- installed the USB virtual serial port driver if your instrument contains any automation (motorized axes).
- installed the license file or be prepared to enter the license number when you start.
- loaded the Configuration File, default.mdb, on the hard disk in the application directory (where Fta32 is loaded). The Configuration file is specific to your machine and will make setup much easier. It is included on a CDROM in the documents with your instrument.
- at this point you can start Fta32 Video by double clicking the icon.

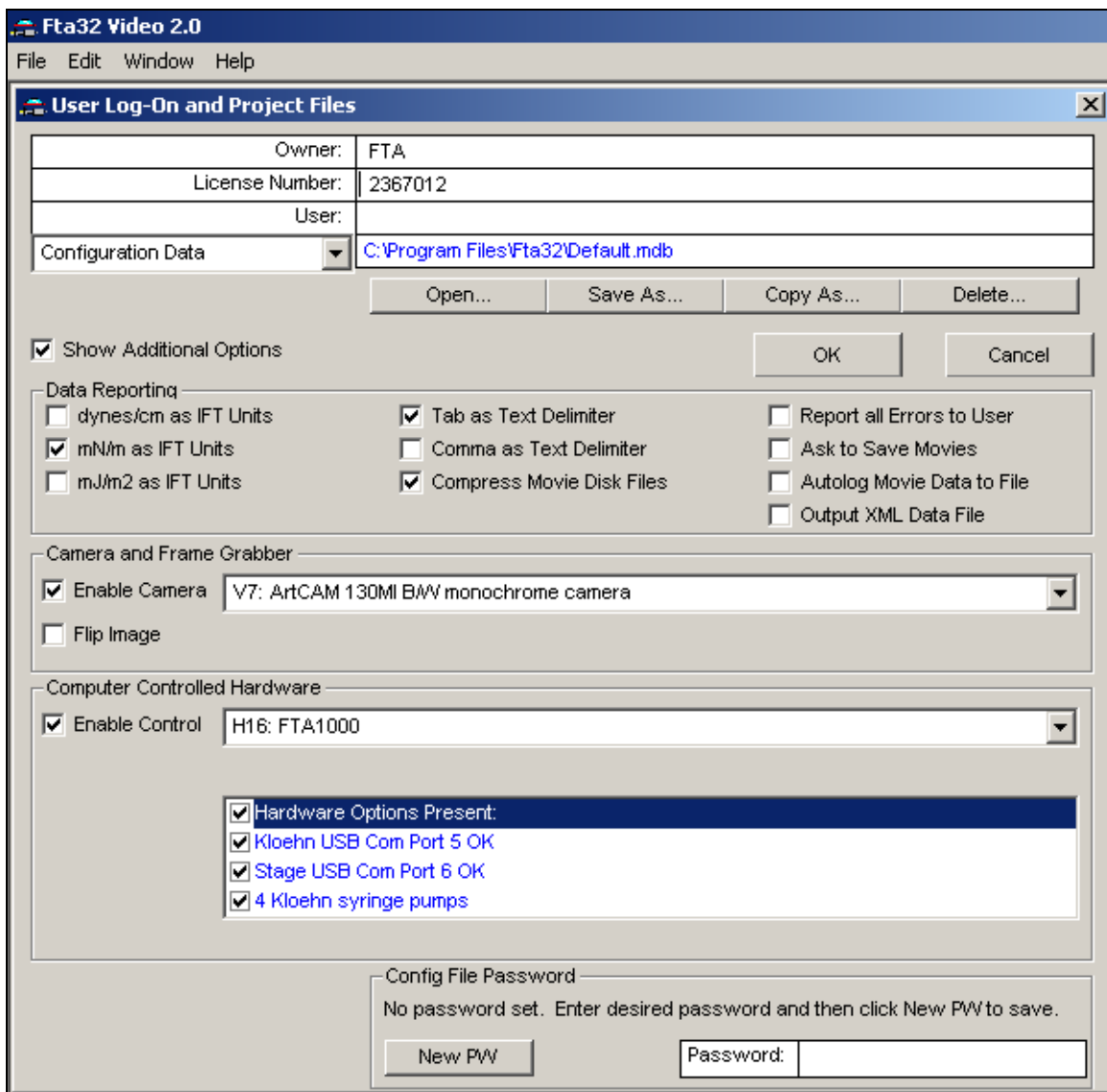
## Log On Screen

The FTA1000 is fully plug and play capable. This means it will communicate with the instrument and determine what devices are functioning, enumerate these in the list box, and adjust the subsequent software screens accordingly. You will know whether everything is OK by simply studying the Log On screen. Note you must select FTA1000 as your instrument type, if the config file has not already. The figure on the following page shows a typical Log On screen (the license number in the figure is not valid).

If you uncheck the Enable box in the hardware section, a default configuration will show so you can inspect the subsequent software screens as if these devices were installed. When you check Enable, only the actually present devices will show on the subsequent screens.

It takes a few seconds for the software to check for available devices, so the options list will update after a second or two.

Click OK to begin running the instrument.

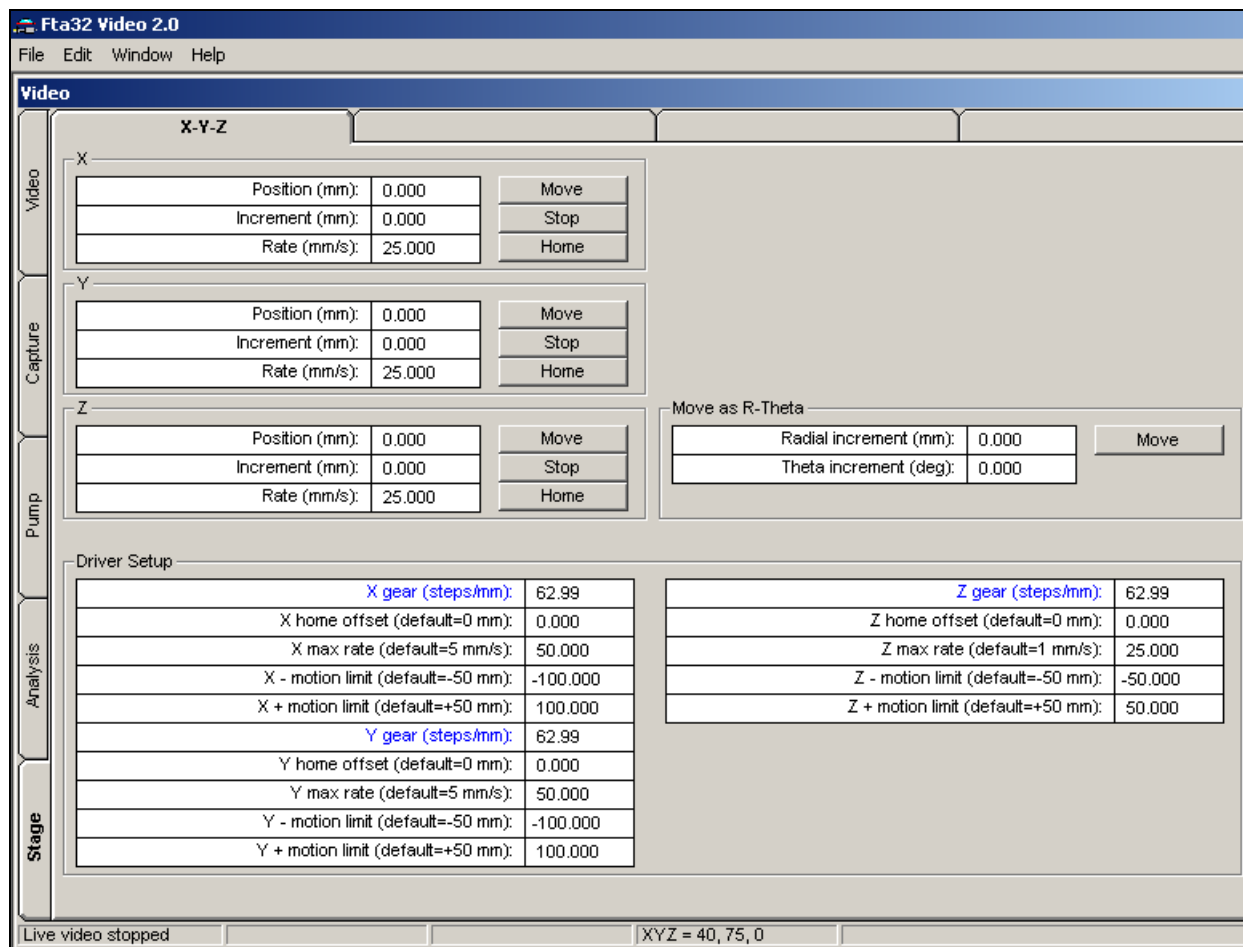


FTA1000 LogOn screen.

## Motion Axes Setup

Certain operating parameters of the pumps and motion axes can be changed by the user. This provides flexibility in running the instrument, but also is an opportunity for mischief. The numbers must be reasonable. Numbers which appear in blue are for information only – they may not be directly changed by the user.

The following parameter types appear for various axes. Any particular axis may have only a few or perhaps no adjustable parameters.



Stage tab.

**Pump “Total syringe capacity”:** This must match the capacity of the syringe to be driven by a motorized pump. You can change syringe sizes to scale the pump for very fast or slow operation. The value is in microliters.

**Pump “Automatic rate”:** This is the rate in microliters per second used in constant-rate dispenses which are run as part of capturing a Movie. The rate for manual “jogging” is separate, as is the rate used when the Pump Program is used. Rates which are too fast, typically above 50 $\mu$ l/s, may result in motor stalling or loss of steps. The Kloehn pumps have 12000 steps full scale.. The slowest rate is one step per minute.

**Pump “Manual rate”:** The rate used for user on/off control when clicking *Pump In* and *Pump Out* on the Live screen.

**Pump “Automatic volume”:** This is the volume to be dispensed during automatic constant-rate operation. Use a positive number for dispense (pumping out) and a negative number for aspirate (pumping in). It is possible for the pump to be stopped early if, say, the Movie is triggered.

Axis “Position”: This and the following apply to any motion axis, linear or rotary. Position is always the current position of the axis. It will be measured in millimeters or degrees, in the case of rotation. The user will change this only when wishing to declare the current position is to be called something else. Changing the value will not cause any immediate motion.

Axis “Increment”: Most motion is controlled by an increment. The motion is initiated when the *Move* button is clicked. The axis will move from its current position by the increment amount. Increment can be positive or negative.

Axis “Rate” and “Max rate”: These allows the user to specify motion at a particular rate. Rate must be positive. There is always a “Max rate” for the axis, whether or not such is visible to the user. The rate can not exceed the max rate. When no rate is made visible to the user, the axis travels at the max rate. The max rate that can be reliably used may depend on the load placed on the axis by the user. The consequence of too high a rate is missed steps (axis does not go as far as commanded) or actual stalling (with audible noise). The motors develop more torque when operating more slowly, so slowing down the rate will result in a stronger motion and less likelihood of missed steps or stalling.

Axis Rates		
Axis	Suggested Max Rate	Safe Rate
XYZ Stage: X	50mm/s	25mm/s
XYZ Stage: Y	75mm/s	40mm/s
XYZ Stage: Z	100mm/s	50mm/s

Axis “Gear”: This is the motor scaling expressed in steps per millimeter or steps per degree. In the FTA1000, this is for information only. The plug and play setup determines the correct value. The gear value lets you estimate motion resolution because the smallest movement is one step.

Axis “Home offset”: Most axes have an explicit *Home* operation. Generally speaking, you should home the axis before other work at the beginning of a session. The home operation moves the axis to a sensor and thereby determines its absolute position. Note, that when power is off, you can move most axes by manually turning the leadscrew. The Kloehn pump is an exception since you can not reach the leadscrew. The offset allows you to specify a location removed from the sensor location to be the origin of the axis. This becomes the “0” position.

Axis “- motion limit” and “+ motion limit”: These are software limits placed on axis motion. The axis will move up to the limit, but no further. Note that the actual physical location of the limit will depend on where you place the axis origin using the home offset. The “- motion limit” is the most negative position you can reach, and the “+ motion limit” is the most positive position you can reach. The FTA1000 uniformly employs a right-hand coordinate system when you look at the instrument with your eye (how it appears though the video camera may be different). Here is how to remember it:

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- Z is up and down, and +Z is up
  - look at your right hand with your thumb point up at +Z. Stick your fingers straight out. That will be +X. It may be necessary to rotate your body to line up your fingers with the physical axis. Curl your fingers in 90°. They now point to +Y. Examples:

XYZ stage: +X is towards the front of the instrument, +Y towards the light box, and +Z is up. Home for X is at far left, away from front. This is 0. Therefore, unless a home offset is employed, available motion is for  $X > 0$ . Home for Y is towards the camera. This is 0. Unless a home offset is employed, available motion is for  $Y > 0$ . Home for Z is all the way down. Unless a home offset is employed, available motion is for  $Z > 0$ .

Tip Rack: +X is towards the front of the instrument. Home is at 0, which is fully towards front of instrument. Available motion is for  $X < 0$ . There is no home offset.

Tip Z: +Z is up, -Z down. Home is at 0, which is full up. Available motion is for  $Z < 0$ .

## Kloehn Pump Setup

The Kloehn pump has a replaceable glass syringe with Teflon-tipped plunger. A valve at the top of the syringe directs the flow. The tip connects to the very top port (“A”). The source vial or bottle connects to the port 120° clockwise (“B”). Port “C: is not used at this time.

You must always click *Home* for the pump before requesting any syringe moves. The pump will automatically put the valve to port B, the right hand port, before homing. Home leaves the syringe near, but not exactly at the very top.

You can always manually click the valve position (to tip, “A”, or source, “B”). You should not do this during a move however. Stopping the pump during a valve move will generate an error. Errors are reported to the user and require a new Home for the pump.

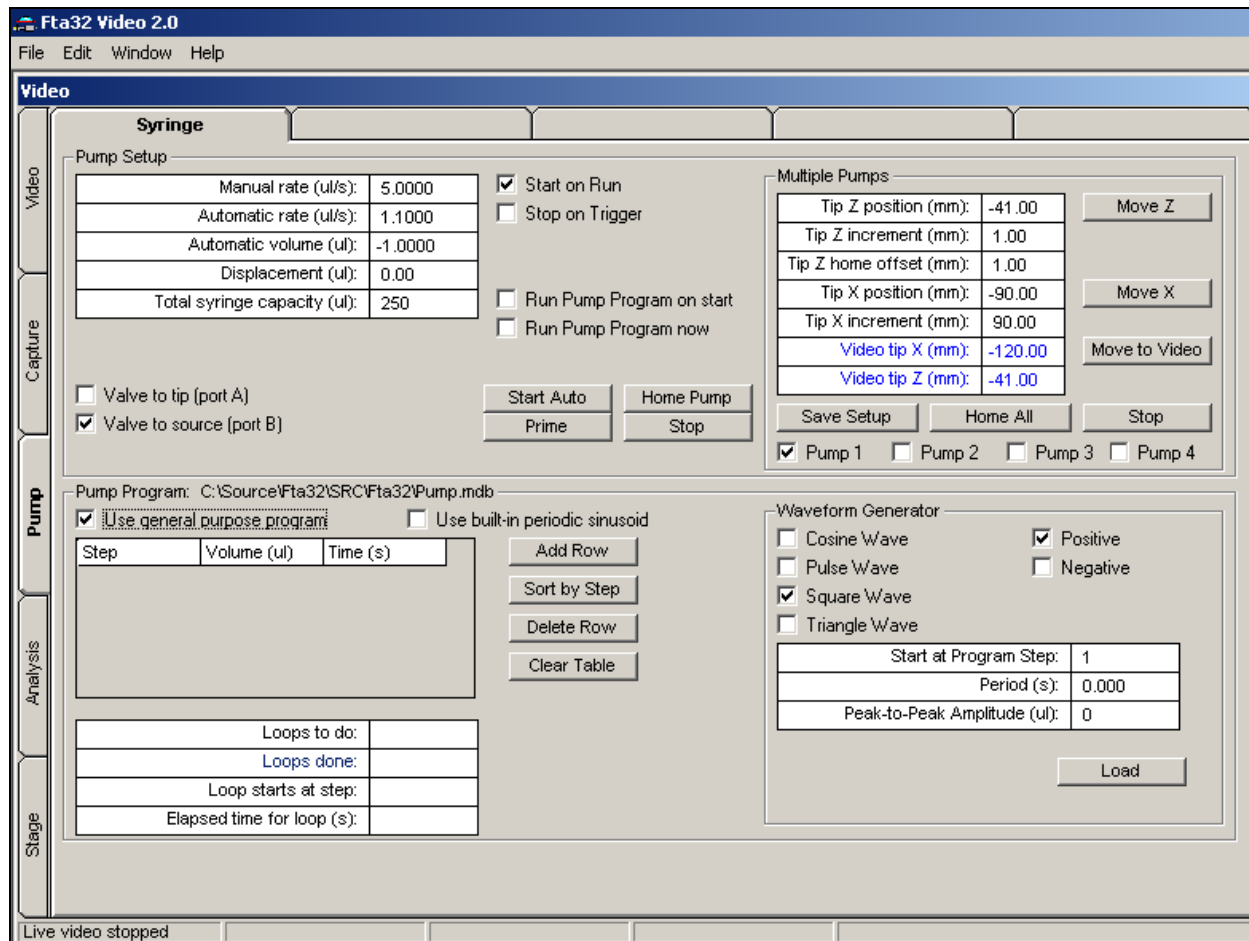
*Prime* will continuously prime liquid towards the tip. Click *Stop* to terminate the priming or any other move. There are no user-set parameters for prime. It will run until stopped by the user.

In multi-pump installations, the checkboxes for *Pump 1*, etc., will determine which pump moves when you click a command button.

*Displacement* is the current syringe position. It is setup so it shows how much of the current syringe has been dispensed. When the syringe tip is at the bottom, so it could dispense the entire capacity, the value is 0. When the syringe is at the top, the value is the capacity. Positive values of *Automatic volume* dispense and negative values aspirate.

Common Kloehn Pump Errors	
Code	Meaning
a	syringe failed to initialize
b	invalid command
c	invalid parameter value
d	communication error
i	syringe overload
j	valve overload
x	valve position error
y	syringe position corrupted
z	syringe may go past home = probably lost steps from load or too fast

*Start Auto* means to start an automatic pumping operation, just as you would expect if you had checked *Start on Run*. You can also *Run Pump Program now*.



Multi-pump tab.

## Multi-Pump Setup

You can independently move any Tip Z (selected by the *Pump* checkbox) and the Tip Rack X.

*Home All* homes each of the available tips to the top and also the rack to the right.

*Save Setup* saves the current X and Z positions for the checked pump as the position targets when you click *Move to Video*. All other values for the selected tip are automatically saved any time they are changed. Because these targets are less likely to change, even if you temporarily move the tip X or Z for a sample, they are saved separately by this command. They are shown in blue on the screen.

You must setup the correct values for each tip installed in your system. For each tip,

- check the desired pump checkbox.
- enter the correct X position for the tip rack in the *Tip X position* textbox. In the preceding figure, this is  $-90\text{mm}$ . (Note this is different from the current target value for the checked pump; this target value is  $=120\text{mm}$  and is shown in blue.)

Approximate Tip Rack X Positions (to place tip in front of camera)	
Tip	X Position
1	-27
2	-56
3	-85
4	-114

- enter the desired Z position in the *Tip Z position* textbox. In the preceding figure, this is  $-41\text{mm}$ .
- if desired, setup the liquid index for this solvent. To do this, open *any* Movie and set the liquids index on the Calibration tab. This will be immediately reflected in the configuration file, from which the index is fetched for this command. The liquids index automatically associates the liquid's parameters (say, density and IFT) with the pump.
- click *Save Setup*. This updates only the above values for the checked pump. All other values are left undisturbed.
- repeat for any other pumps and tips.
- Note that the following are automatically updated for the checked pump any time they are changed. These are stored independently of the *Save Setup* command.

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*Tip Z position*  
*Tip Z increment*  
*Tip Z home offset*  
*Tip X position*  
*Automatic rate*  
*Automatic volume*  
*Displacement (current syringe position)*  
*Total syringe capacity*

*Move to Video* moves the tip rack to the previously saved position so checked tip is within view of the video.

## Pump Tubing

The FTA1000 is shipped with 1/16" (1.6mm) push-on tubing barbs on both the Kloehn pump ports and the needle unions. Normally this is used with Tygon tubing, as this tubing is inexpensive, flexible, and commonly available. However, alternative tubing assemblies are available. The fittings are 1/4-28 threads. Hamilton and Upchurch, to name two well-known suppliers, offer fittings and tubing using Teflon or PEEK. FTA can also supply these. If you use a stuffer tubing, such as Teflon or PEEK, you may wish to route the tubing along the front of the instrument frame and not make the cosmetic loop that the factory makes with Tygon tubing. Note the black Delrin cable and tubing guides are mounted into the frame slots with M5 screws and T-nuts and can easily be re-positioned. Tygon tubing is sold by the major chemistry supply houses (Cole-Parmer, Fisher, VWR, etc.) and their catalogs describe its chemical compatibility.

## 20 Milliliter Bottle Tray

Standard 20cc bottles are provided to hold source liquids. A tray is provided in the accessories to hold these.

## Auto Zoom/Focus Setup

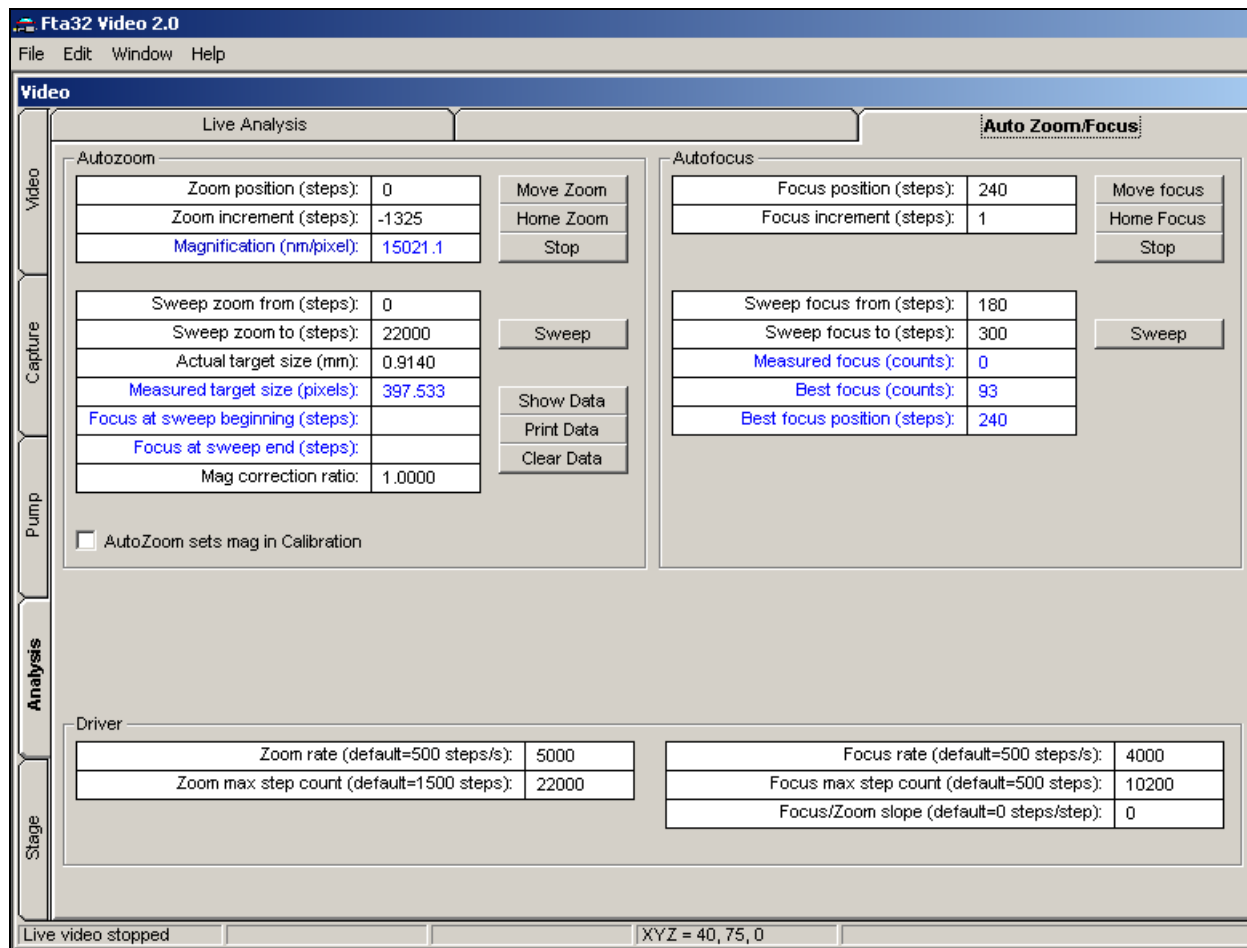
For the FTA1000, the following setup constants should be used:

- Zoom rate = 5000
- Zoom max step count = 22000
- Focus rate = 4000
- Focus max step count = 10200

*Show Data* will display the zoom calibration table as a function of zoom step. *Restore* will take you back to the current screen. The table is expressed in nanometers per pixel. You are advised

not to change or recalibrate this table (using *Autozoom Sweep*) without receiving instructions from FTA first. It can easily take 8 hours. This table is stored within your Config File. It is wise to keep a copy of your configuration file.

To automatically have the magnification in a new Movie set by the table according to the current zoom position, check the *Autozoom sets mag in Calibration* box. It happens to not be checked in the figure.



Auto Zoom/Focus tab.

You may find that the factory calibration is slightly imprecise, for whatever reason. This means that the scaling between the image and the table is not correct. *A common cause is using the zoom feature of the camera (as opposed to the optics).* The degree of focus can also have a small effect on the value. Any disassembly of the optics will also affect it. There is an easy way to compensate for all this, without destroying the underlying table. The Movie | Calibration tab now features a *Magnification ratio* that expresses the ratio between the local calibration in the Movie (presumed to be correct) and *what the above table indicates for the current Zoom position.* For this to make sense, the Zoom position is assumed to be the same as when the Movie was captured. Mag ratio is computed if the *AutoZoom sets mag* checkbox is checked. This is illustrated in the figure on the following page, where the ratio happens to be 1.0.

Assuming it is not 1.0, you can have this factor correct the table-derived value without changing the table. Manually copy the mag ratio you feel correct to the Auto Zoom/Focus tab, as illustrated above, and enter it in the *Mag correction ratio* text box. It will then multiply the table value to obtain what will be entered into new Movies.

The screenshot shows the 'Calibration' tab in the Fta32 Video 2.0 software. The 'Liquid Data' table is as follows:

Index	Liquid	Formula	Density	IFTension	Dispersive	Polar	Acid	Base
1	Water	H2O	0.9982	72.80	21.80	51.00	25.50	25.50
2	Air		0.0011	0	0	0	0	0
3	Formamide	H3CON	1.1300	58.00	39.00	19.00	2.280	39.60
4	Methylene Iodide (MI)	CH2I2	3.3200	50.80	50.80	0	0	0

Below the table, there are buttons for 'Add Row', 'Sort by Index', 'Sort by Col', 'Delete Row', and 'Clear Table'. The 'Magnification Calibration' section includes three methods: 'Calibration by Known Linear Distance' (Actual Distance: 0.9140 mm, Measured Distance: 0.9066 mm), 'Calibration by Known IFT' (Actual IFT: 72.00 mN/m, Measured IFT: 4.276E-7 mN/m), and 'Calibration by Directly Setting nm/pixel' (Magnification: 10556.5 nm/pixel). The 'Sample Fluid Constants' section includes tables for light and heavy phase properties. The 'Acceleration of Gravity and Image Aspect Ratio' section includes tables for gravitational acceleration, image aspect ratio, and auto zoom magnification ratio.

Movie Calibration tab showing Mag ratio.

File: FTA1000QuickStart.doc