

## FTA2000 Sequencer Instruction Set

Last updated 26 October 2004

The FTA Sequencer is used primarily on the FTA2000 but can be employed on other instruments also. In all cases, when your instrument does not contain optional hardware, the instructions referring to this hardware will be omitted or must be ignored if they are present.

Instruction	Parameters	Description
Program Control Instructions		
Go to line	Go to line number: <line number>	Jump to the line number in the program. An invalid line number will create an error.
Wait time	Wait time (0...60s): <time in seconds>	Wait here for the indicated number of seconds. Later versions will allow times longer than 60 seconds.
Wait for external device	Wait time (0...60s): <time in seconds>  On timeout or error go to: <line number>	Wait here for an "OK" from an external controller or robot. If a non-zero time is provided, wait up to this time, otherwise wait forever. Later versions will allow times longer than 60 seconds.  If there is a timeout, or the external device sends an error message (for example, it has stalled), go to the line provided. If no line, then do not go anywhere.
Begin loop	Loop number (1...100): <ID number>  Loop count: <number of loops to do>	Starts a loop. Up to 100 loops can be defined. Each is given a unique ID number by user. There will be a mating End loop for each Begin loop.  How many loops to do. An integer greater than zero. Upper limit is $2^{31}$ (a large number).

Loop if then	Loop number (1...100): <IID number>  If loop count: <loop count>  Go to line number: <line number>	The if/then test refers to this loop.  If the loop count of the selected loop is equal to the user set target, then do the go to.  Jump to this line if test satisfied.
End loop	Loop number (1..100): <ID number>	This line ends the selected loop.
Call subroutine	Subroutine line number: <line number>	Jump to the indicated line number to start a subroutine. When you return from the subroutine, you will go to the line following this call. There must be a mating return subroutine instruction for each call.
Return subroutine		Program flow returns to the instruction following the original call instruction.
Status info	Status message: <user text>	Message to output to event log
Liquids database	Liquids database: <path and filename>	Complete path for an alternative liquids database to the current default database. Normally the default is satisfactory. The liquids database holds surface tension data for standard test liquids.
Solids database	Solids database: <path and filename>	Complete path for an alternative solids database to the current default database. Normally the default is satisfactory. The solids database holds contact angle data for surface energy calculations.
Kill SolidsDB		Delete the current solids database file if it exists. This is used when you want to repeatedly use one solids database name (for contact angle data), but want to start over with no data.
Question	Question message: <user text>  If "Yes" GoTo line" <line number>  If "No" GoTo line: <line number>	This question allows the user to direct the program flow in one direction or another at some critical point. This text is the question to appear in a dialog box.  Jump to this line if user answers yes to the question.  Jump to this line if the user answers no to the question.

Begin cell		Begin a new cell. A cell is a group of drops to be considered in one surface energy equation. Typically each drop will be a different test liquid.
Cell number	Cell number: <ID number>	The ID number for this cell.
Index cell number		Increment the current cell number by one.
End cell		Mates with a begin cell instruction to set the range of measurements for this cell.
Begin no waiting for motion end		Normally each motor motion is completed before the Sequencer goes to the next instruction. This instruction starts a period when the Sequencer will continue with its next instruction before the motion started with this or a previous instruction is complete. The intended use is with tilt axis motions for tilting plate contact angle measurements.
End no waiting for motion end		Return to the normal mode of waiting for each motor motion to complete before moving to the next instruction.
Plot R/X		Cell data can be plotted as multi-dimensional point in an external graph. This instruction sets the radial (for cylindrical coordinates) or X (for Cartesian coordinates) axis value for this cell in the plot.
Plot Q/Y		Cell data can be plotted as multi-dimensional point in an external graph. This instruction sets the theta (for cylindrical coordinates) or Y (for Cartesian coordinates) axis value for this cell in the plot.
Index plot R/X		Increment the plot R/X value by one.
Index plot Q/Y		Increment the plot Q/Y value by one.
Name in movie	Sample name: <user text>	This sample name is stored in the Comments field of the Solids database entry for this drop. If the Solids database is not used, this sample name has no effect.
No operation		This instruction does nothing. Instead its place in the program allows the user to add comments.

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Break point		Ordinary Sequencer operation will stop at this point. This is useful for debugging. You can start the Sequencer again by clicking Resume.
Quit		Conclude Sequencer operation with this instruction. You will then Start over later.

Stage Moves Instructions		
Home autosampler		Home the Autosampler. This is equivalent of clicking the Home All button on the Pump   Autosampler tab.
Move tilt by	Move by (deg): <angle to increment> Rate (deg/s): <tilt rate>	Move the motor by the specified increment at the rate. This is a relative move from the current position.
Move tilt to	Move to (deg): <angle to increment> Rate (deg/s): <tilt rate>	Move the motor to a specific target location at the rate. It is OK if the motor is already there.
Home tilt stage		Home the tilt stage.
Move Z to	Move to (mm): <Z target>	Move the motor to a specific target location at the rate. It is OK if the motor is already there.
Move Z by	Move by (mm): <Z increment>	Move the motor by the specified increment at the rate. This is a relative move from the current position.
Move X to	Move to (mm): <X target>	Move the motor to a specific target location at the rate. It is OK if the motor is already there.
Move X by	Move by (mm): <X increment>	Move the motor by the specified increment at the rate. This is a relative move from the current position.
Move Y to	Move to (mm): <Y target>	Move the motor to a specific target location at the rate. It is OK if the motor is already there.
Move Y by	Move by (mm): <Y increment>	Move the motor by the specified increment at the rate. This is a relative move from the current position.
Home X stage		Home the X axis stage.
Home Y stage		Home the Y axis stage.
Home Z stage		Home the Z axis stage.
Move R (radial) to	Move to (mm): <R target>	Move the motor to a specific target location at the rate. It is OK if the motor is already there.
Move R (radial) by	Move by (mm): <R increment>	Move the motor by the specified increment at the rate. This is a relative move from the current position.
Move Q (theta) to	Move to (deg): <Q target>	Move the motor to a specific target location at the rate. It is OK if the motor is already there.
Move Q (theta) by	Move by (deg): <Q increment>	Move the motor by the specified increment at the rate. This is a relative move from the current position.
Move XY by	Move X by (mm): <X increment>	This instruction allows the R-

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	Move Y by (mm): <Y increment>	theta stage to behave like an X-Y stage. The motions must be increments from the current position.
Home R (radial) stage		Home the radial axis stage.
Home Q (theta) stage		Home the theta (rotation) axis stage.
Home Z stage		Home the Z axis stage.
Move external device	Parameter 0: <user text> Parameter 1: <user text> Parameter 2: <user text>	This instruction will send up to three user text strings to the external robot. The text has no meaning to the Sequencer but does have meaning presumably to the robot.
Home tip Z's		Home all six tip Z axes. This brings them to the top.

Liquid Dispense Instructions		
Liquid index	Set test liquid index: <index number>	Set the index number for the test liquid. This refers to the row number in the current Liquids database. This will provide specific gravity information to IFT measurements.
Inlet solenoid valve	Open=1, Closed=0: <0 or 1>	Manually force the inlet valve to the pump to be open (1) or closed (0). The inlet valve sits between the system liquid bottle and the pump. For most operation, this valve is closed. This instruction checks or unchecks the checkbox of the same name on the Pump   Autosampler tab.
Outlet solenoid valve	Open=1, Closed=0: <0 or 1>	Manually force the outlet valve to the pump to be open (1) or closed (0). The outlet valve sits between the pump and the dispense tips. For most operation, this valve is closed. This instruction checks or unchecks the checkbox of the same name on the Pump   Autosampler tab.
Valve to tip	Connect pump to tip: <1, 2... 6>	This instruction moves the Hamilton distribution valve to one of the six tips. The pump is then connected to a specific tip.
Pump volume, rate	Pump volume (ul): <dispense volume> Pump rate (ul/s): <dispense rate>	Move the pump so as to dispense (towards a more positive volume) or aspirate (towards a more negative volume). Excessive rates, above 20 microliters per second, will cause air bubbles to form in the system liquid.
Tip to vial	Set tip to use: (selected tip) Set vial: <target vial>	Move the selected tip to the specified vial. The tip is then the one which will be moved up or down with subsequent Tip Z moves. If you want to change the selected, or current, tip, do a Tip to vial or a Tip to video move, even if the tip in question is already at that location. this will make it the current tip.

Tip to video	Set tip to use: (selected tip)	Move the selected tip to the video position. The tip is then the one which will be moved up or down with subsequent Tip Z moves. If you want to change the selected, or current, tip, do a Tip to vial or a Tip to video move, even if the tip in question is already at that location. this will make it the current tip.
Move tip Z to	Move tip Z to (mm): <Z target>	Move the current tip to a specific Z height. The upper most position is 0. All target positions are below this, so they are negative.
Move tip Z by	Move tip Z by (mm): <Z increment>	Move the current tip by the specified Z increment. This moves an additional amount, rather than to a specific position.
Prime towards tips	Prime in volume (ul): <volume>	Carry out a prime in sequence from the system vial. This will move liquid towards the dispense tips.
Prime from tips	Prime out volume (ul): <volume>	Carry out a prime out sequence away from the tips. This will move liquid towards the dispense tips.
Drop tip		For systems with the automatic tip changer, discard the dispense tip from the active tip.
Pickup new tip		For systems with the automatic tip changer, pickup a new dispense tip on the active tip. The tip storage wheel will advance automatically to the next position.

Movie Capture Instructions		
Snap shot		Capture a single-image Movie now.
Run		Start the capture of a multiple image movie. This Movie must have a Trigger event to complete.
Restart Video after Movie	True=1, False=0: <0 or 1>	If set = 0, the Video will not be restarted automatically when the captured Movie is closed. If this instruction is not used, Video will be restarted after a Movie. If set = 1, it will also be restarted.
Video	On=1, Off=0: <0 or 1>	Turn on or off the Video checkbox on the Live Video tab. Video must be turned on to get a live image.
Back light	On=1, Off=0: <0 or 1>	Turn on or off the back light. The back light will normally be turned on automatically when Video is started. The back light is the one used to illuminate normal analysis images.
Front light	On=1, Off=0: <0 or 1>	Turn on or off the front light (if it exists). This is used for observing the general nature of the sample better.
Pretrigger images	Pretrigger images: <image count> Pretrigger image period (s): <period>	Setup the number and period of images before the Trigger in a multi-image Movie. These entries are just like those on the Capture tab.
Posttrigger images	Posttrigger images: <image count> Posttrigger image period (s): <period> Posttrigger period multiplier: <factor>	Setup the number and period of images after the Trigger in a multi-image Movie. These entries are just like those on the Capture tab. The post-trigger multiplier should be 1 unless you want the period to gradually increase after each image, in which case it should be slightly greater than 1, say 1.05.
Video trigger by gray level	On=1, Off=0: <0 or 1> X coordinate (pixels): <position> Y coordinate (pixels): <position>	Turn on or off the Video Trigger by Z < 120 checkbox on the Capture tab. If enabled, a cross-hairs will be placed in the image. If the gray scale of the image is darker than mid-gray, it will cause a Trigger.

Video trigger by gray change	On=1, Off=0: <0 or 1> X coordinate (pixels): <position> Y coordinate (pixels): <position>	Turn on or off the Video Trigger by Z < 120 checkbox on the Capture tab. If enabled, a cross-hairs will be placed in the image. If the gray scale of the image is darker than mid-gray, it will cause a Trigger.
Trigger on pump done	On=1, Off=0: <0 or 1>	Turn on or off the Trigger at Pump Completion checkbox on the Capture tab. If enabled, a Trigger will be generated when the pump finishes its motion.
Start pump on run	On=1, Off=0: <0 or 1>	If 1, start the pump when a Run is started. This will set the similarly named checkbox on the Pump   Syringe tab, if this tab is visible to the user.
Stop pump on trigger	On=1, Off=0: <0 or 1>	If 1, stop the pump whenever a Trigger occurs. This will set the similarly named checkbox on the Pump   Syringe tab, if this tab is visible to the user.
Do pump program on run	On=1, Off=0: <0 or 1>	If 1, start the pump program when a run starts. This will set the similarly named checkbox on the Pump   Syringe tab, if this tab is visible to the user.
Save movies as	Save movies as: <file name> First suffix number: <number>	This sets up a file name system by which a sequence of Movies can be saved to disk. The file name can be a complete path or just a name to be placed in the current directory. Suffix numbers are added to the base name so a sequence of Movies can have the same base name. This instruction must appear before the first Close Movie instruction that would use the file name. The instruction should normally appear only once because the suffix number sequence will be reset by it. If the instruction appears without any name specified, it assumes the name will be provided by the external robot serial interface.

Save BMP images	On=1, Off=0: <0 or 1>	If 1, save bmp images with the same name as the Save Movies As provides. Images are indexed, independently of Movies, with a suffix number. Images are saved when the Contact Angle measurement is made. Each image in the Movie will become a separate file.
Trigger		Trigger the Movie now, without any condition.
Open movie	Max time to wait (s): <time>	You must Open Movie after the movie is captured and before any analysis can be performed or reference to the Movie made. This instruction connects the two screens in Windows. The timeout parameter lets you establish a maximum time to wait for the Movie to be ready for opening. If you specify no time, then the instruction will wait as long as necessary for the Movie to be captured and ready. If, for example, no trigger ever occurs, then the Open Movie instruction (without a timeout) will never complete and the Sequencer program will hang.
Close movie		All Movies, including Snapshots, must be Closed before you can move on to capturing another Movie. The Movie is saved to a disk file at this time.
Open last movie		There are times it is useful to open the previous Movie for analysis. This instruction does that.
Close last movie		This instruction Closes any previous Movie you opened.
Autofocus		This instruction carries out an Autofocus sweep. You must setup the details of the sweep on the Analysis   Auto Zoom/Focus tab. The Autofocus routine takes a minute or so to execute.
Zoom position	Zoom position (steps): <position>	Move the zoom (magnification) motor to the specified position. Zero steps is the position of lowest magnification.
Focus position	Focus position (steps): <position>	Move the focus motor to the specified position.

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Focus step	Focus index (steps): <increment>	Increment the focus motor position by the specified steps.
Make directory	Results directory: <path>	Make a specific folder for data results. This instruction can also be executed by an external robot over the serial line.
Make drive path	Results drive path: <path>	Make a specific path for data results. This instruction can also be executed by an external robot over the serial line.

Movie Analysis Instructions		
ROI upper left point	Upper left X (pixels): <position> Upper left Y (pixels): <position>	You may specify a Region of Interest box for analysis. The analysis will ignore anything outside the box. Move the cursor over the image and read the X and Y values in the lower status bar. The origin (0, 0) is in the upper left hand corner of the image.
ROI lower right	Lower right X (pixels): <position> Lower right Y (pixels): <position>	This is the lower right hand corner for the ROI box.
Contact angle baseline	Left X (pixels); <position> Right X ([pixels): <position> Y (pixels): position	You may specify a starting baseline for contact angle measurements. The final line will be an extension of this line. The specified line must be horizontal, hence there is one common Y value. Move the cursor over the image and read the X and Y values in the lower status bar. The origin (0, 0) is in the upper left hand corner of the image.
Contact angle measurement set	Contact angle set number (1..6): <ID number>	Contact angle measurements can be grouped into sets. Up to 6 sets can be defined. This sets the ID number of the current set.
Index contact angle set		Increment the contact angle set index (ID number) by one.
Do contact angle measurement		Make a contact angle measurement on the current image in the Movie.
Data limits	Lower limit: <number> Upper limit: <number>	Contact Angle and IFT measurements may be checked by applying limits to their value. Data that fail are not included in the output set.
Baseline tilt limit	Limit: <degrees>	Contact angle data taken with tilting baselines allowed may be checked by applying a limit to the tilt. A reasonable value is 5 degrees. Angles that fail are not included in the output data set.
Left-right angle limit	Limit: <degrees>	Contact angle data taken in non-spherical mode may be checked by applying a limit to the difference between the left and right angles. A reasonable value would be 2 or 3 degrees. Angles that fail are not included in the output data set.

Edge sensitivity	Edge sensitivity (0..100%): <sensitivity>	Edge Sensitivity is a user parameter to adjust how the analysis handles imperfect drop profiles. It is normally left at the default 50%. A lower number will make the analysis more tolerant of imperfections or poor image quality. A higher number will make it less tolerant.
Simulation data	Mean value data: <number> Variance: <number>	You can simulate data to generate output files when no instrument is connected. This instruction will generate data in place of a Contact Angle or IFT measurement. The data can be pseudo-random by adding a varying amount according to the variance specified. Zero variance makes the data precisely equal to the mean value specified. You enable the simulation mode by having unchecking the Enable Camera box on the LogOn screen.
IFT measurement set	IFT set number (1..6): <ID number>	IFT measurements can be grouped into sets. Up to 6 sets can be defined. This sets the ID number of the current set.
Index IFT set		Increment the IFT set index (ID number) by one.
Do IFT measurement		Make an interfacial tension measurement on the current image in the Movie.
Spherical mode analysis	On=1, Off=0: <0 or 1>	Turn on or off the Spherical checkbox on the Contact Angle tab. When checked, the analysis will fit a portion of a circle to the liquid-vapor profile. This is the better fit for smaller drops which are not distorted by gravity.
Non-spherical mode analysis	On=1, Off=0: <0 or 1>	Turn on or off the Non-spherical checkbox on the Contact Angle tab. When checked, the analysis will fit polynomial curves to the liquid-vapor interface, on to each side.

Reflection image type baseline	On=1, Off=0: <0 or 1>	Turn on or off the Reflection Image Present checkbox on the Contact Angle tab. A reflection image is when you can see the sample surface in front of the drop and you can also see the drop's shadow or reflection, like the reflection of the shoreline on the surface of a small lake.
Touch-off reflection baseline	On=1, Off=0: <0 or 1>	Turn on or off the Touch-Off Reflection checkbox on the Contact Angle tab. If checked, the algorithm requires a full Movie with the first frames having the pendant drop above the sample. The algorithm determines the baseline location by watching the reflection image of the pendant drop as it comes down to the surface.
Horizon image type baseline	On=1, Off=0: <0 or 1>	Turn on or off the Use Horizon checkbox on the Contact Angle tab. A horizon image is when the sample edge and the liquid-solid baseline are coincident, or one on top of the other.
Tilting baseline OK	On=1, Off=0: <0 or 1>	Turn on or off the Tilting Baseline OK checkbox on the Contact Angle tab. Most baselines are horizontal and the analysis will assume that unless this box is checked.
Dispense tip in sessile drop	On=1, Off=0: <0 or 1>	Turn on or off the Dispense Tip in Drop checkbox on the Contact Angle tab. If the tip stays in the sessile drop, this must be checked for the analysis to find the profile correctly.
Upside down drop	On=1, Off=0: <0 or 1>	Turn on or off the Upside Down Drop checkbox on the Contact Angle tab. Normally off.
Complement measured angle	On=1, Off=0: <0 or 1>	Turn on or off the Complement Angle checkbox on the Contact Angle tab. Typical use of this is with air bubbles inside a liquid.
IF tension by pendant drop	On=1, Off=0: <0 or 1>	Turn on or off the IFT by Pendant Drop checkbox on the IFT tab. You must select one IFT method from the list. This is the normal choice.

IF tension by sessile drop	On=1, Off=0: <0 or 1>	Turn on or off the IFT by Sessile Drop checkbox on the IFT tab. You must select one IFT method from the list.
Dispense tip is tapered	On=1, Off=0: <0 or 1>	Turn on or off the Tapered Tip checkbox on the IFT tab. This helps the analysis find the tip to drop interfacial line.
Move to first image in movie		Move to the first image in the current Movie. This is the normal starting point in a movie. This is necessary only if you want to go back to the start after moving forward.
Move to next image in movie		Move to the next image in the current Movie. If you are already at the last image, you will simply stay there.
Surface energy set	Surface energy set number (1..3): <1, 2, or 3>	Select one of three possible surface energy calculations for the same data. This lets you use more than one model for the same data.
Index surface energy set		Increment the surface energy set number by one.
C.A. data to new angles table row		Transfer the current contact angle data to a new row in the angles table.
Angles row to surface energy set		Transfer the current angles table row to the current energies table row for a subsequent surface energy calculation.
Do surface energy calculation		Click the Calc button on the Surface Energy tab. This makes the calculation.

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Chambers Instructions		
Temperature measurement	On=1, Off=0: <0 or 1>	Turn on or off the Temperature Measurements checkbox. This enables making temperature measurements.
Humidity measurement	On=1, Off=0: <0 or 1>	Turn on or off the Humidity Measurements checkbox. This enables making humidity measurements.
Temperature controller setpoint	Temperature control setpoint (deg): <degrees>	Enter the temperature you wish for the enclosure. Must be above the ambient.
Temperature control by heater	On=1, Off=0: <0 or 1>	Turn on or off the Enable Controller checkbox. This enables power to the enclosure heater.