TecellaLab

Getting Started

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Tecella
97 Chaumont Cir
Foothill Ranch, CA 92610, USA
www.tecella.com
info@tecella.com
+1-714-641-1709
+1-714-641-1569 Fax

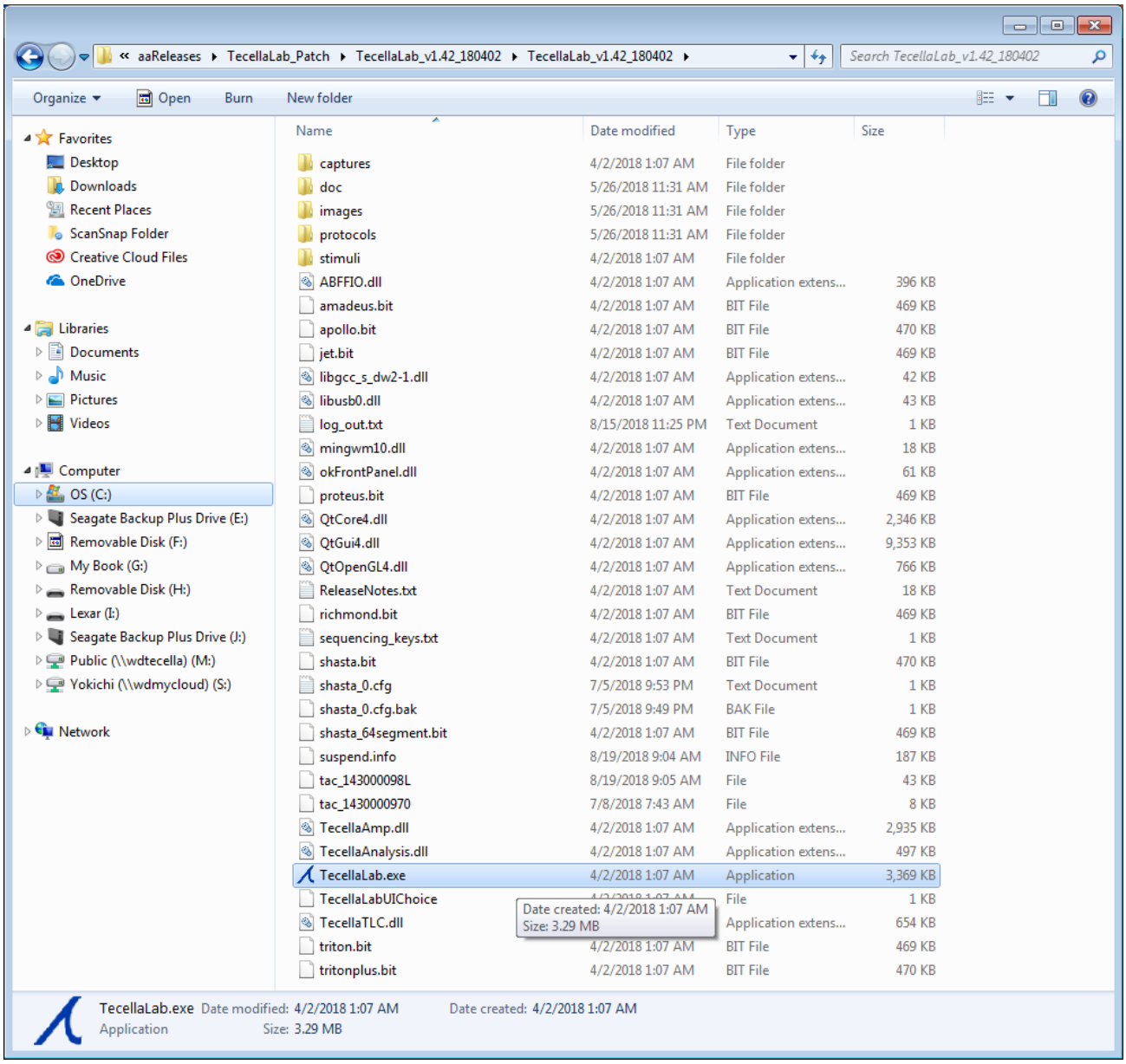
Zoom and Pan Control in the waveform window

The waveform can be zoomed and panned using the following actions. Hold down the right mouse button and move the mouse upward to zoom in vertically. Hold down the right mouse button and move the mouse to the right to zoom in horizontally. Hold down the left mouse button and drag the waveform to center it in the window, as shown. The following lists common waveform effects and corresponding mouse actions to achieve them.

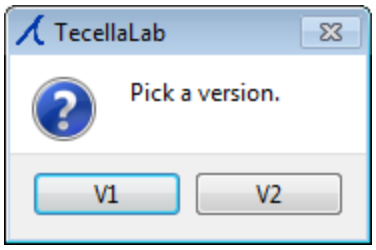
Fit-to-window	**Double-click L mouse button**
Zoom In Vertically	Hold R mouse button and drag up
Zoom Out Vertically	Hold R mouse button and drag down
Zoom In Horizontally	Hold R mouse button and drag right
Zoom Out Horizontally	Hold R mouse button and drag left
Pan (move) Waveform	Hold L mouse button and drag

Getting Started

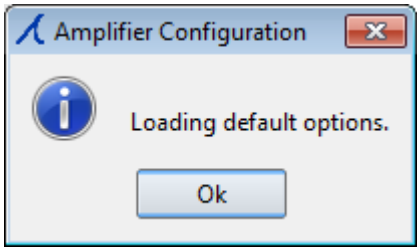
Go to the folder containing “TecellaLab.exe”, and double-click on “TecellaLab.exe”.



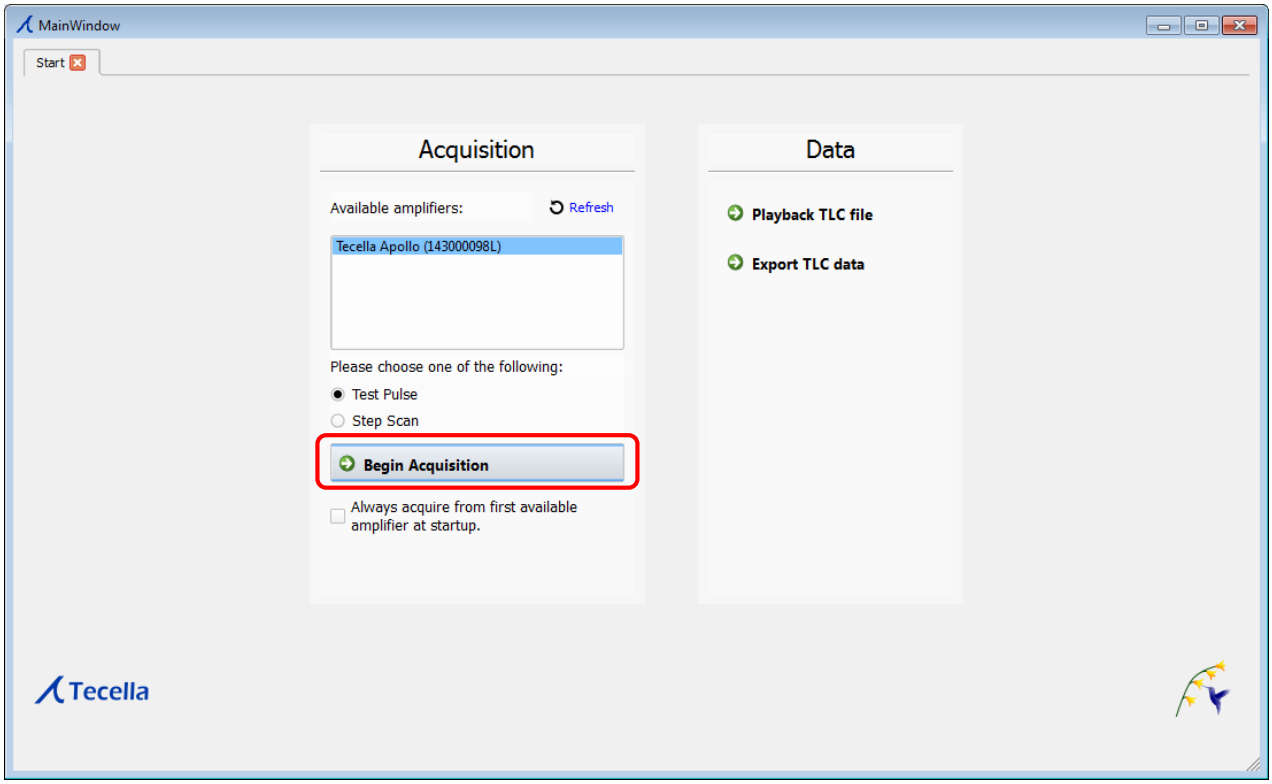
Pick “V1”.



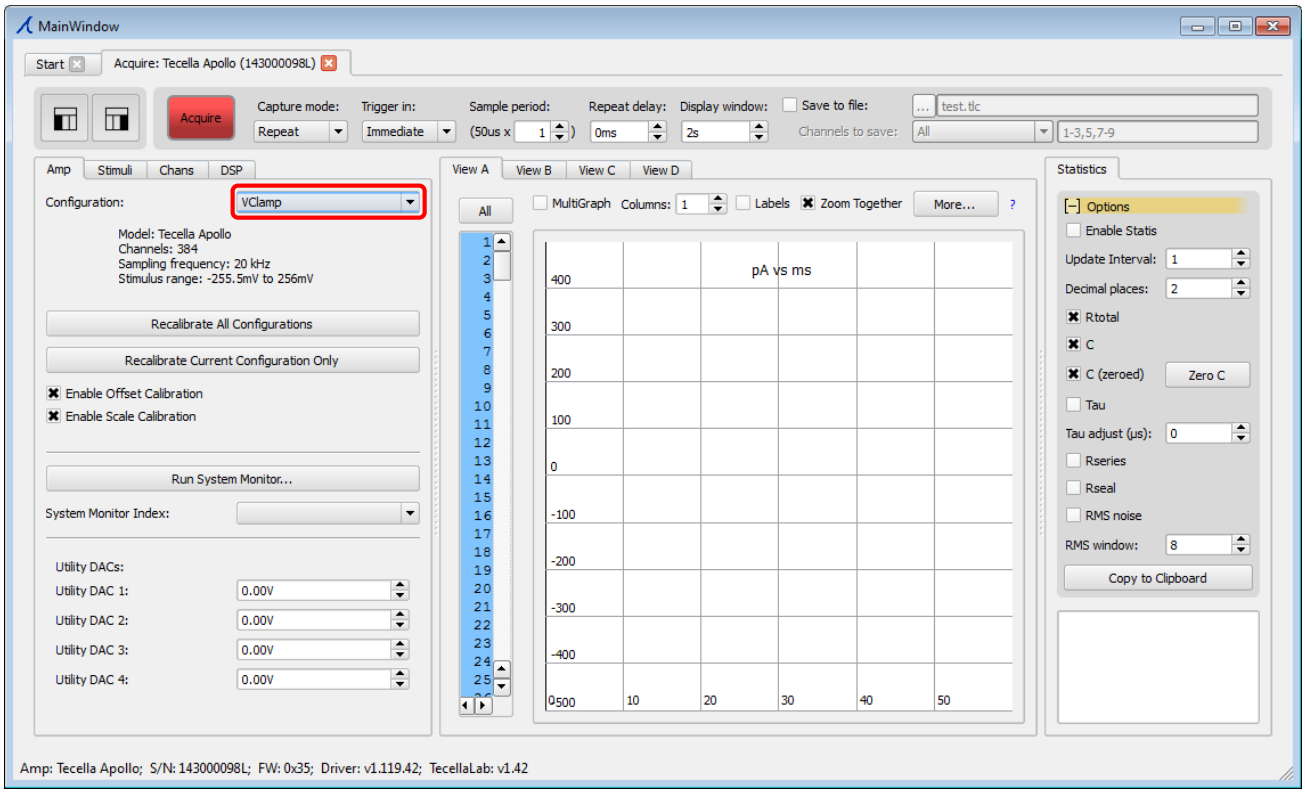
Click “OK”.



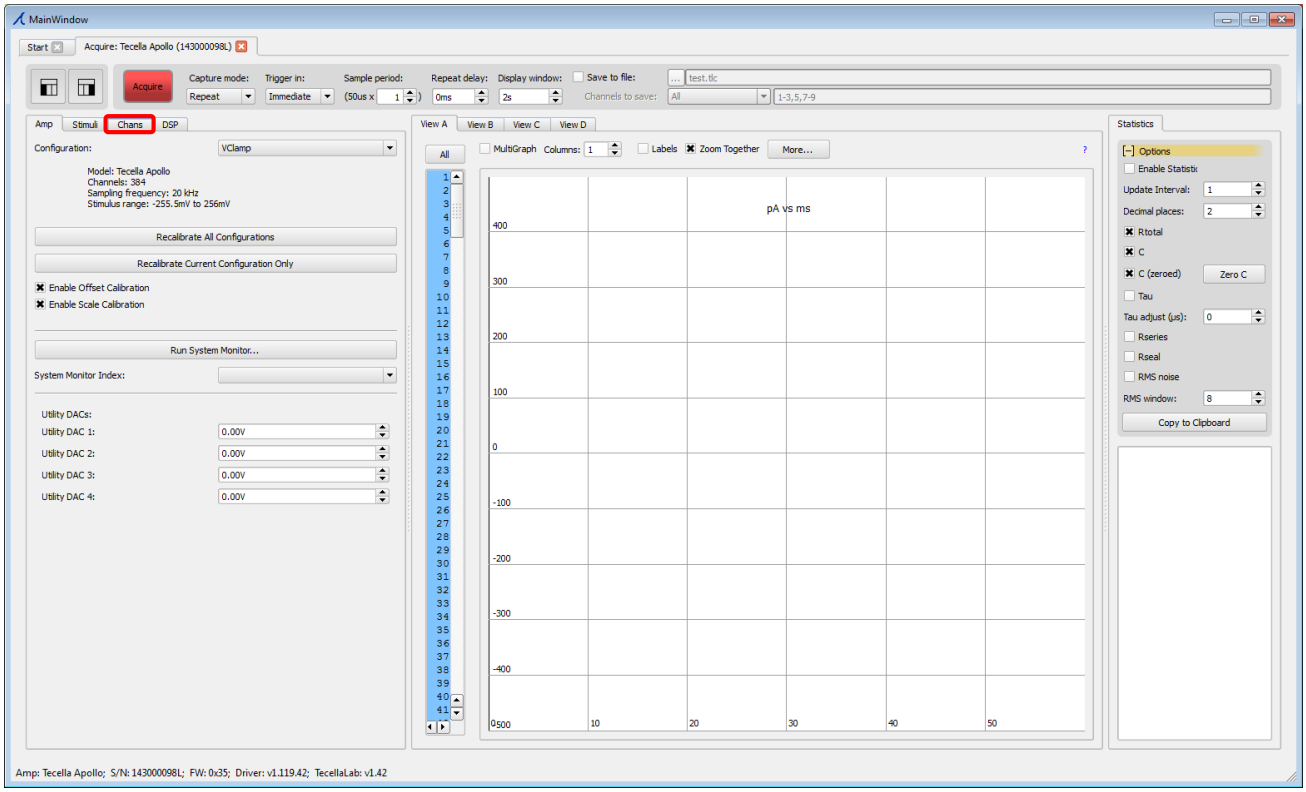
Click on “Begin Acquisition”.



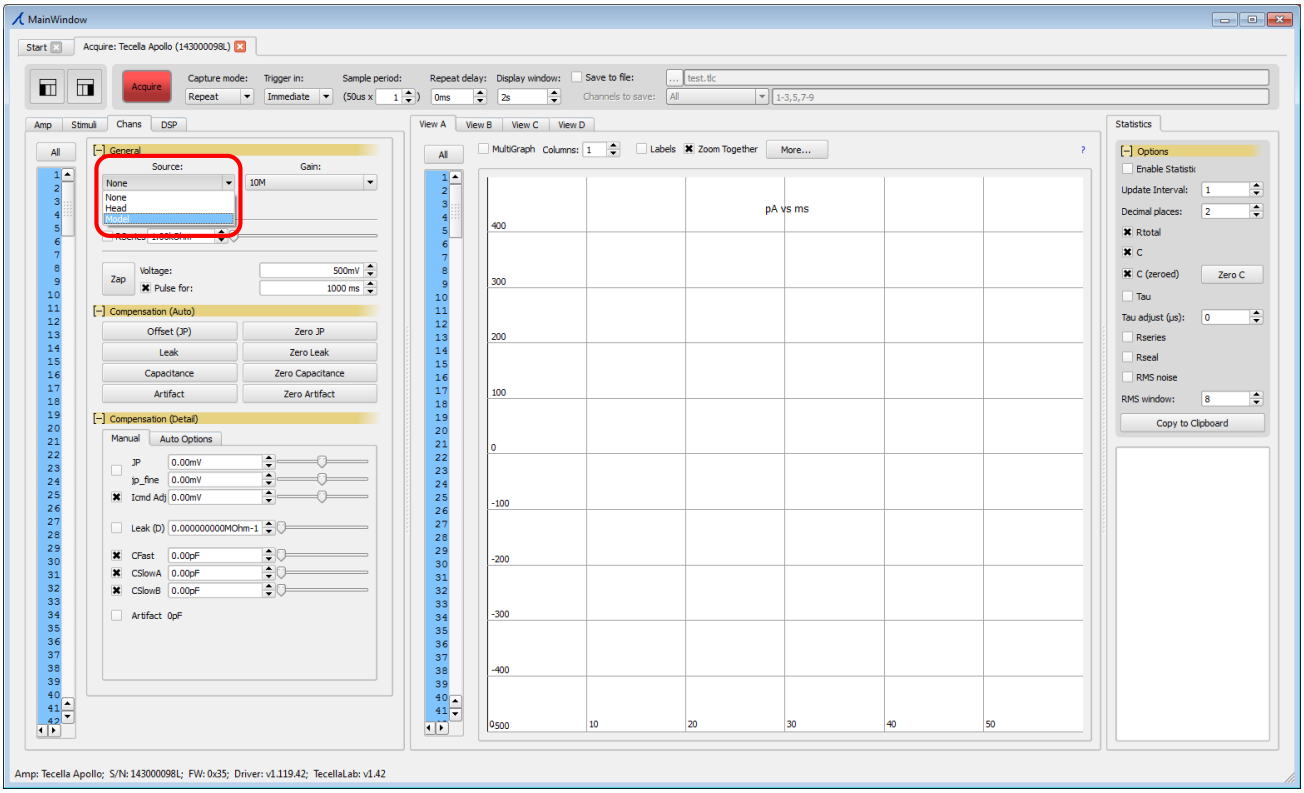
Confirm that the configuration is set to “VClamp”.



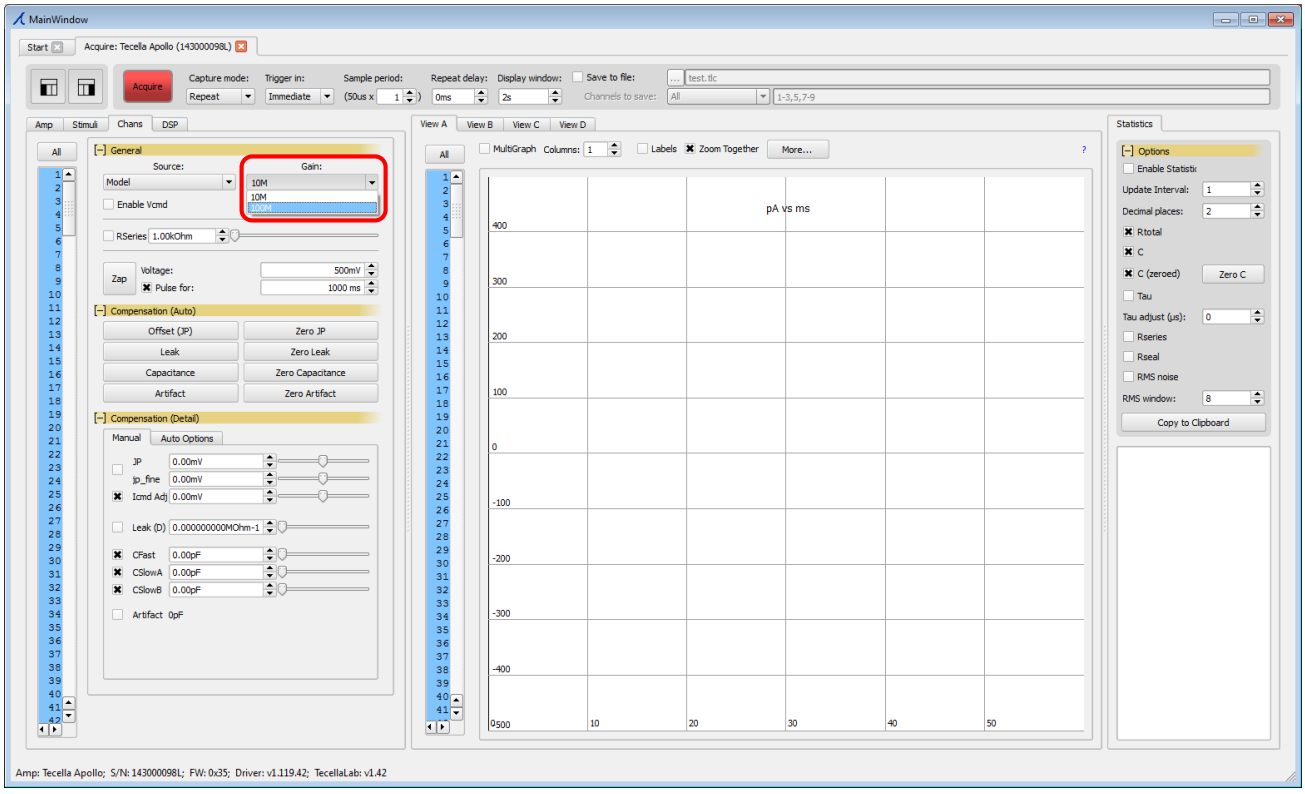
Resize the window bigger, for better visibility.
Select “Chans” tab.



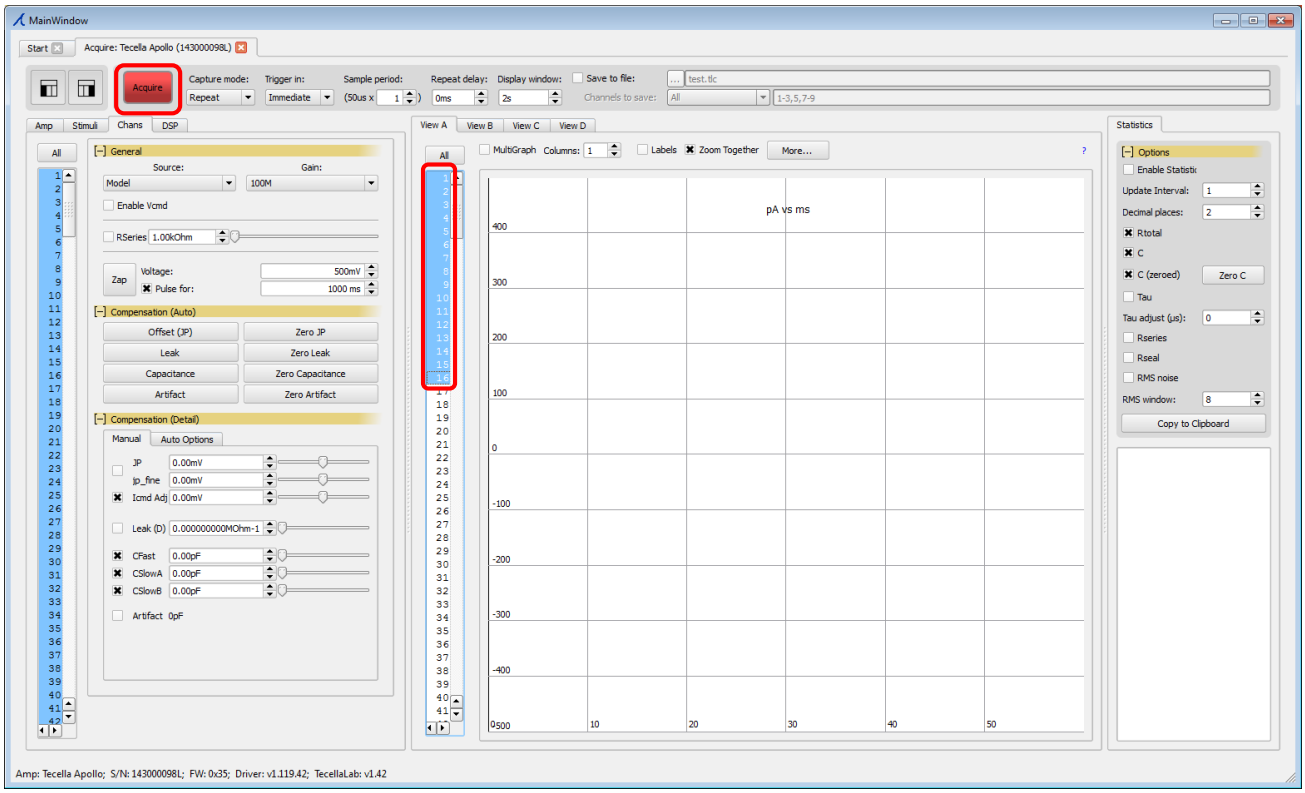
Set “Source” to “Model”. This connects the internal model cell which has 110Meg-ohm resistance.



Set “Gain” to a setting larger than 40Meg-ohm. In the example below, 100Meg-ohm is selected. Your amplifier may have different gain settings than shown below.

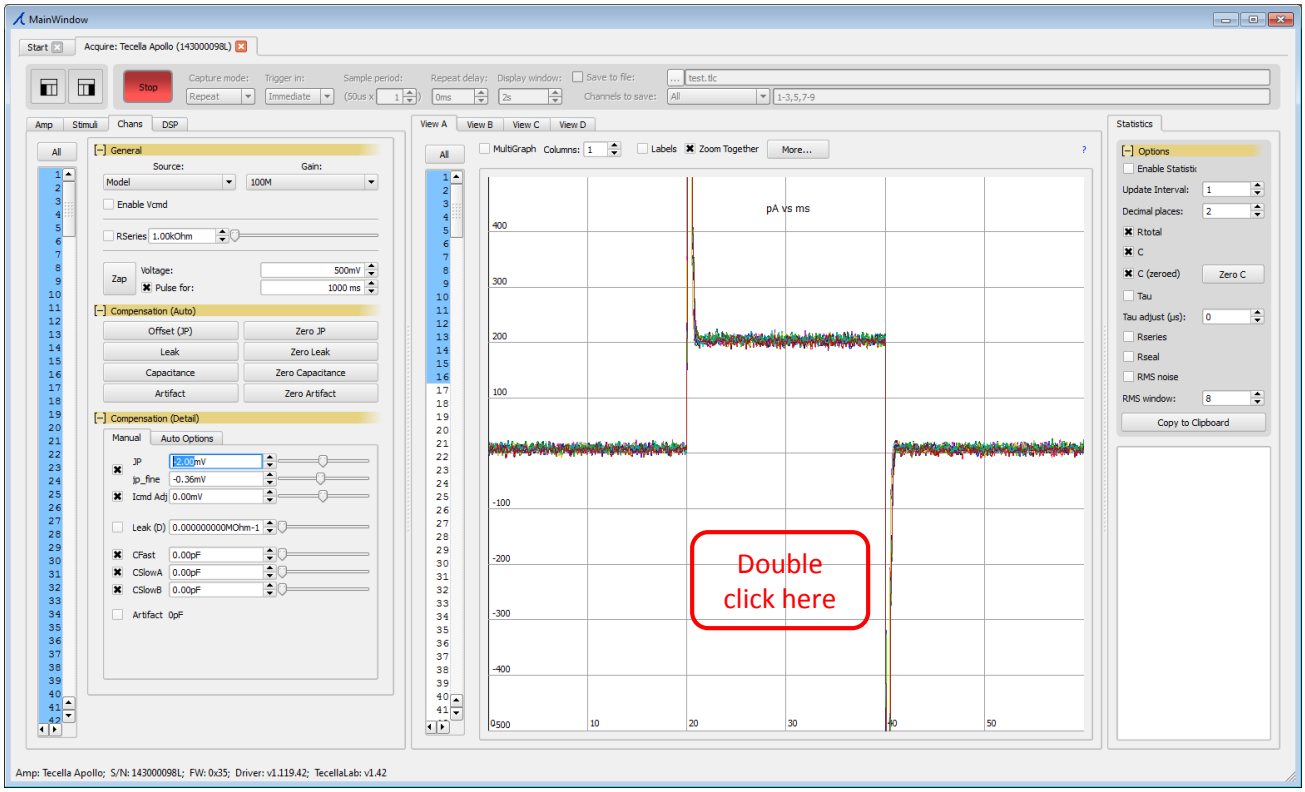


In the “View A” tab, select the channels that you want to observe. In the example below, channels 1 through 16. Click on the “Acquire” button.



You should see a waveform like below.

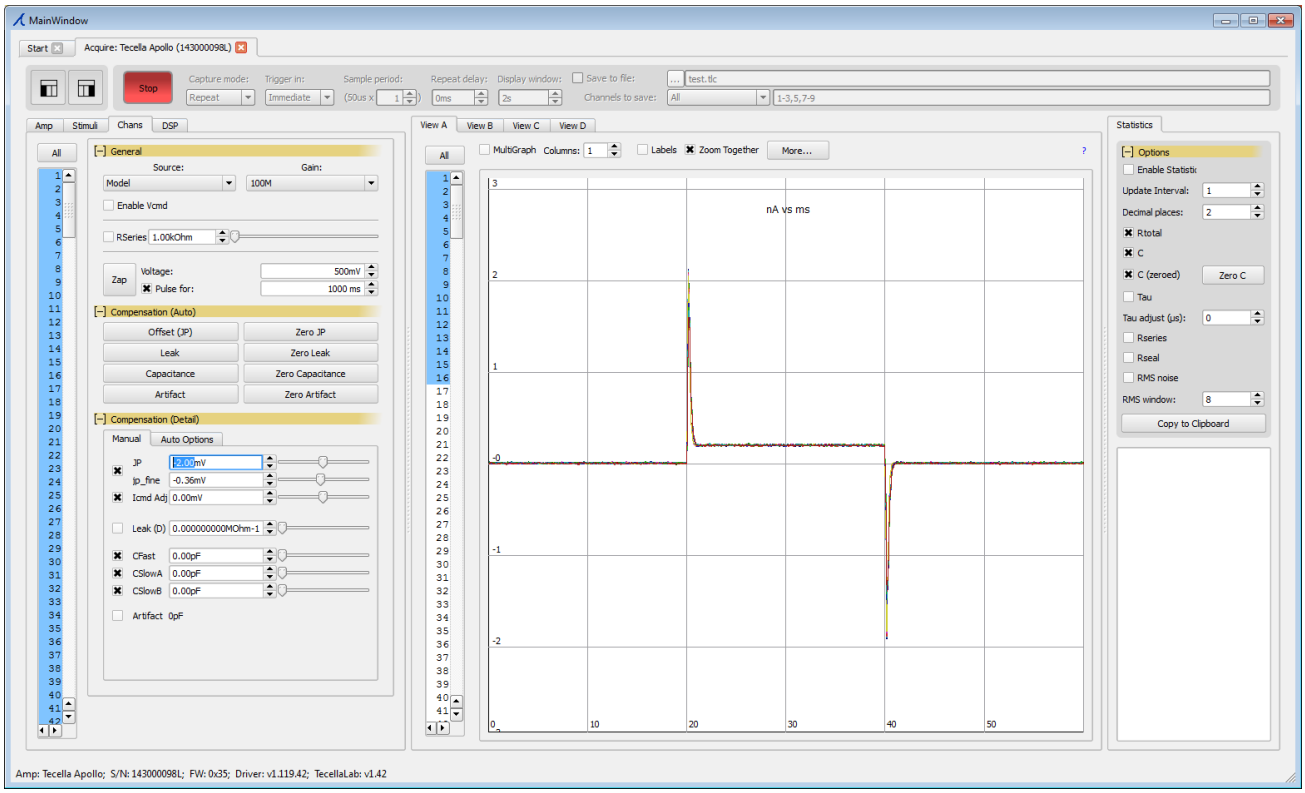
Double-click inside the “View A” window to “fit the waveform inside the window”.



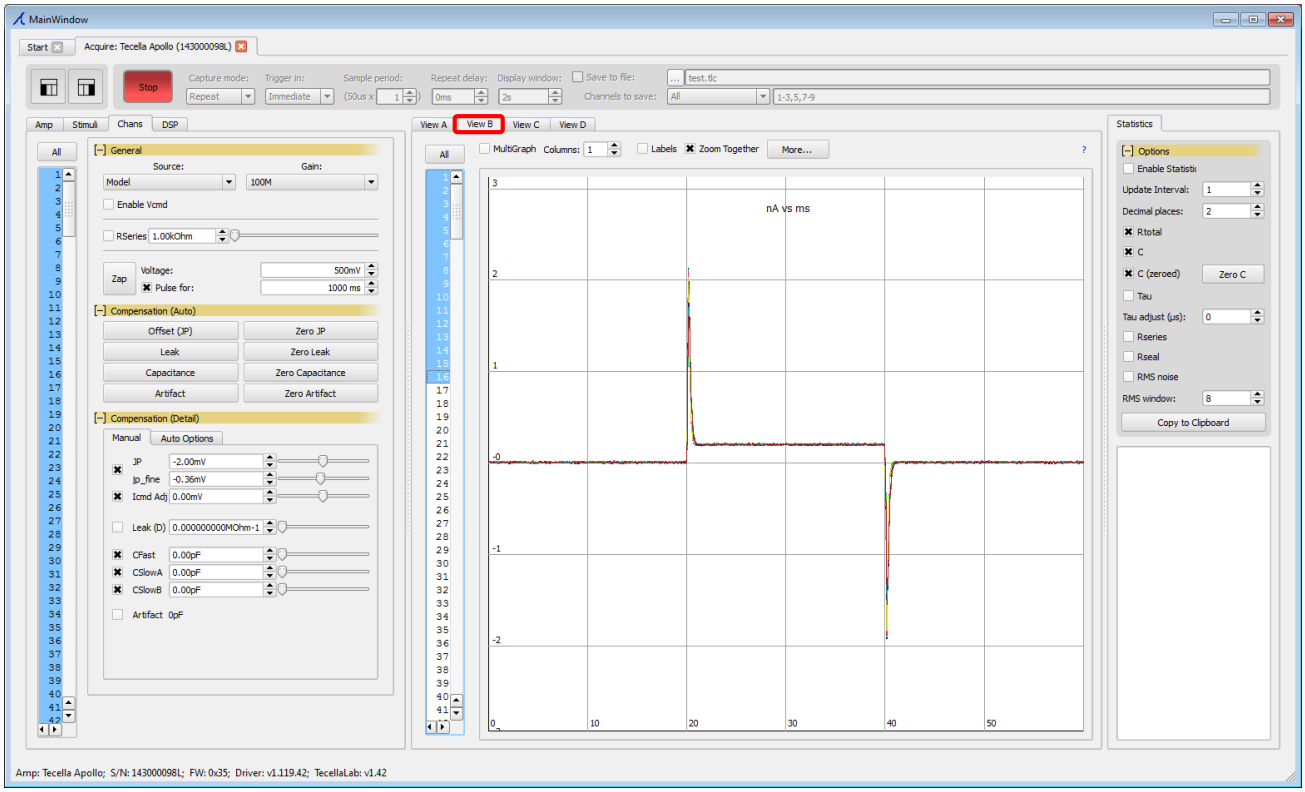
The waveform should now fit inside the window.

Hold-and-drag the left mouse button to MOVE the waveform.

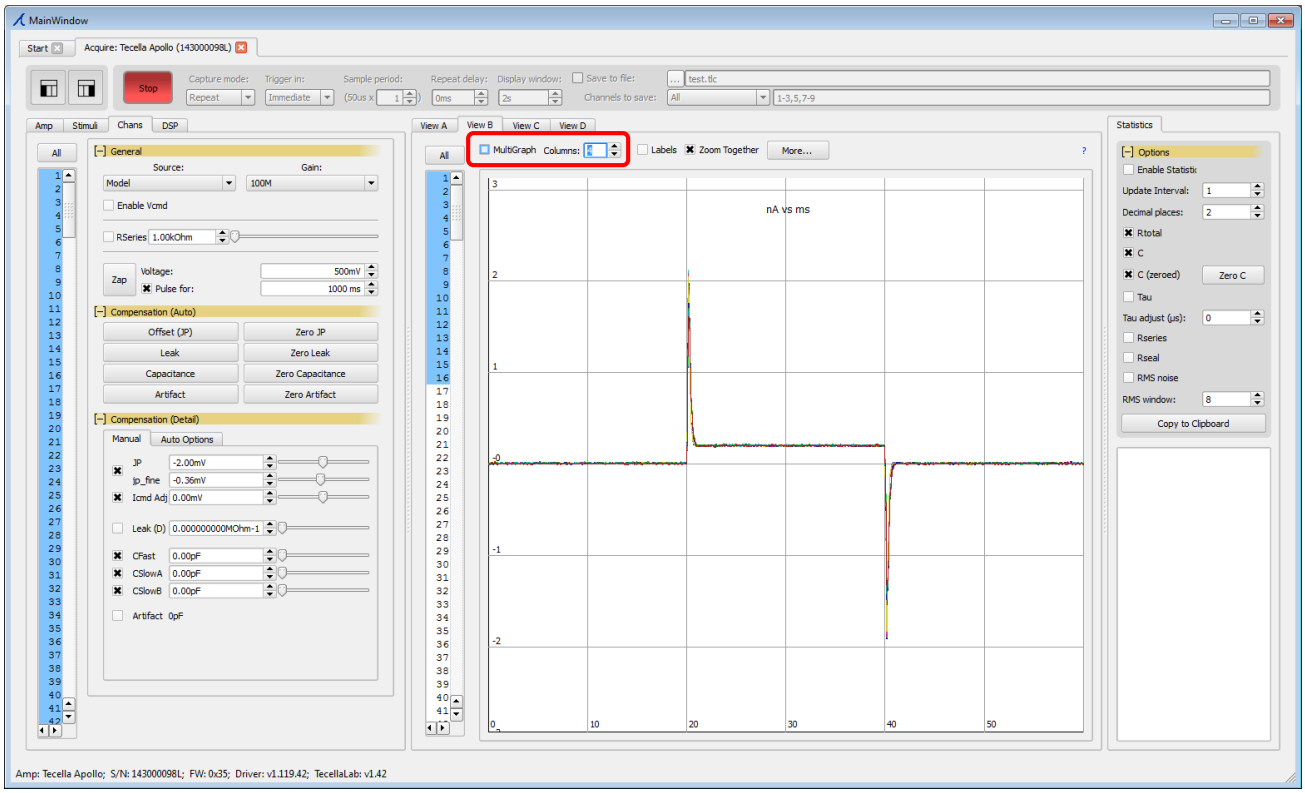
Hold-and-drag the right mouse button to ZOOM IN and ZOOM OUT the waveform in x and y directions.



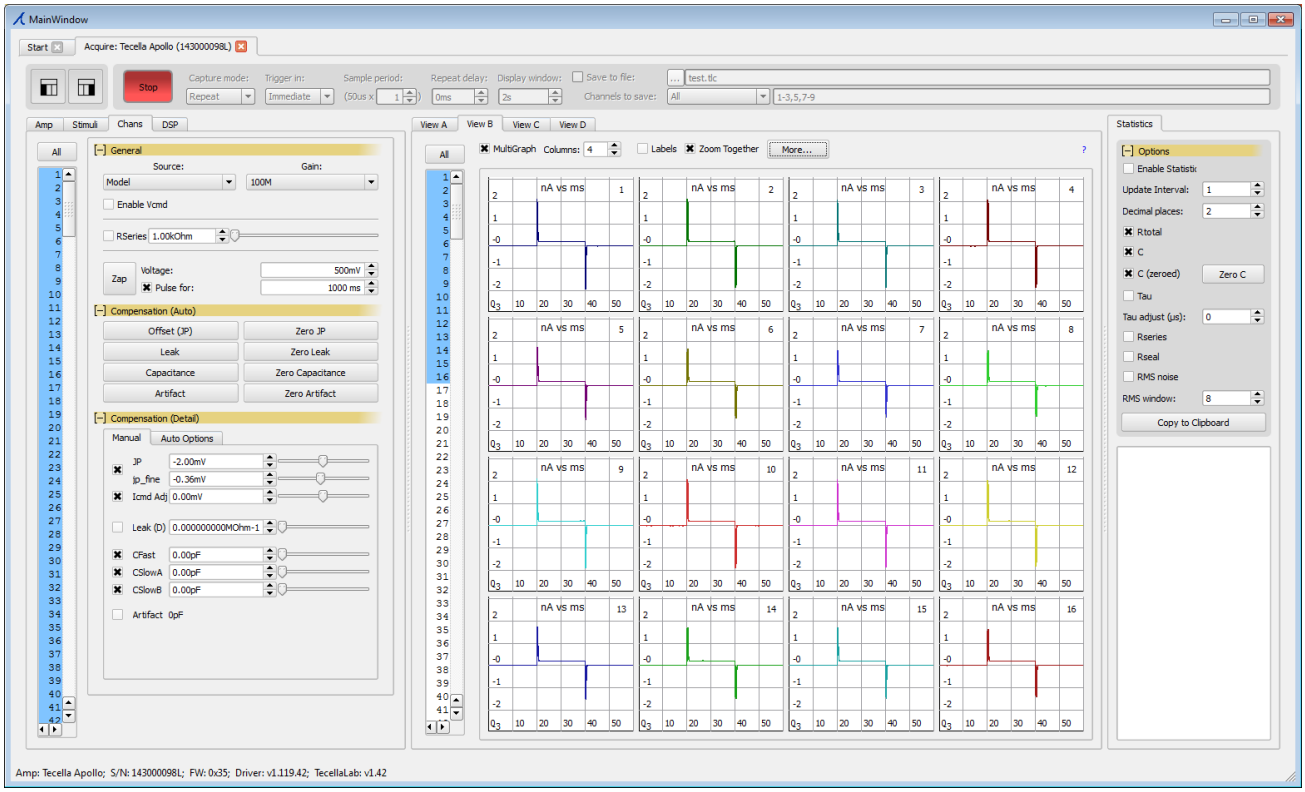
Select “View B” tab, and double-click inside the window to fit the waveform like the following.



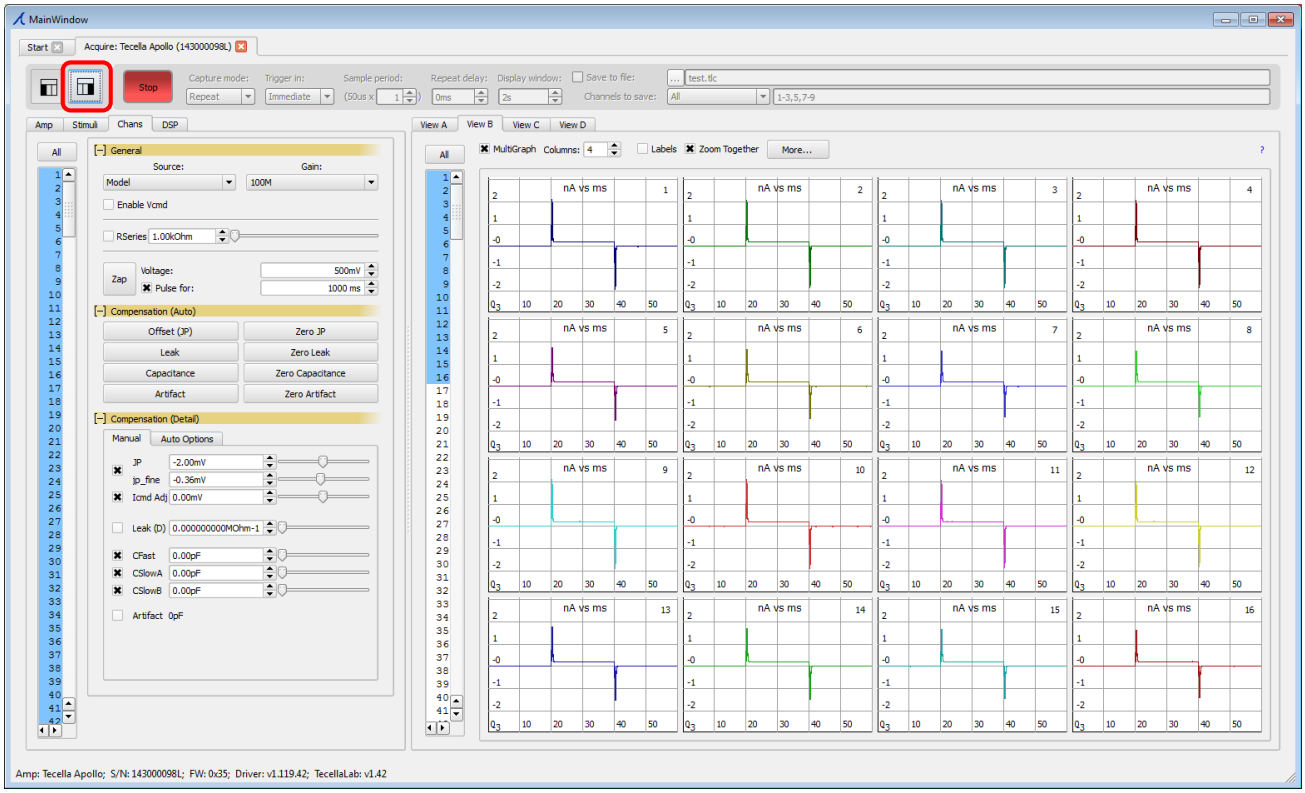
Set “Columns” to “4”, then click on “MultiGraph”.



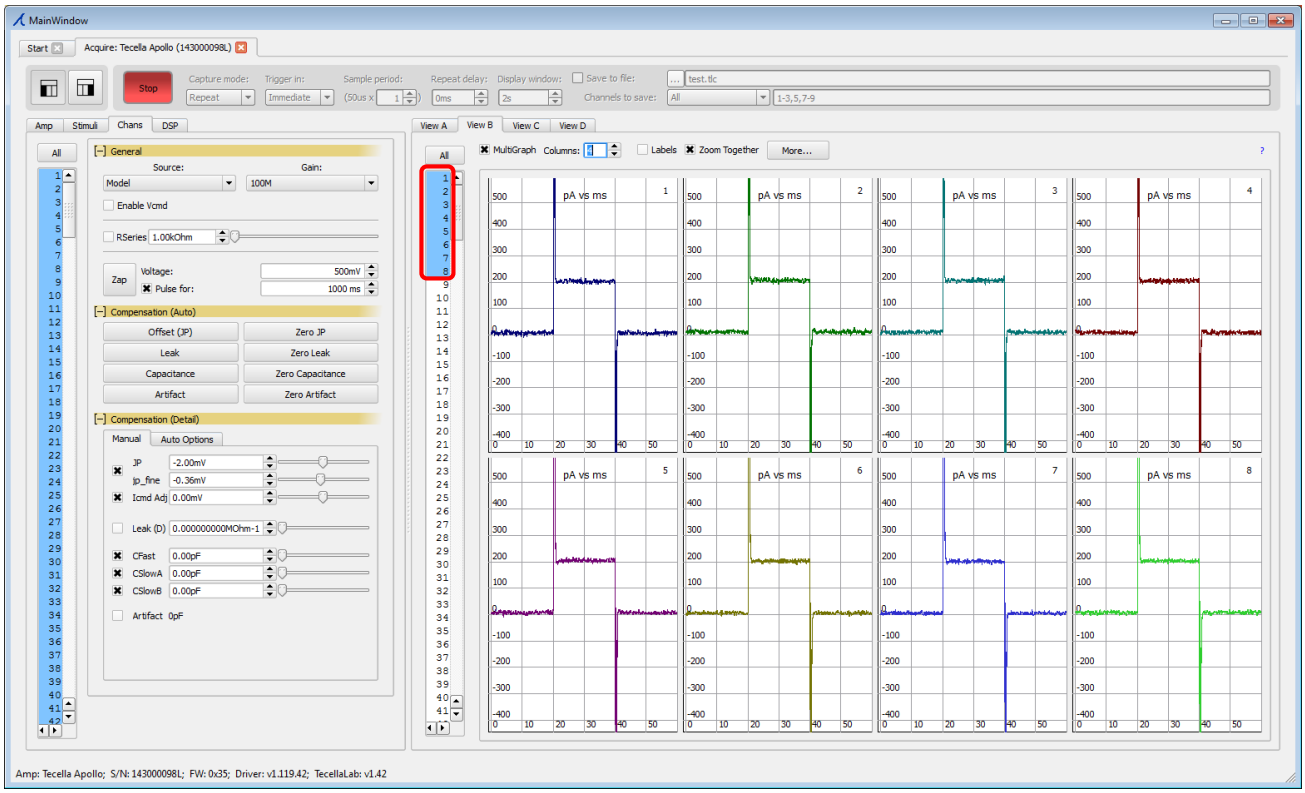
The 16 channels will be displayed in 4 columns and 4 rows as the following.



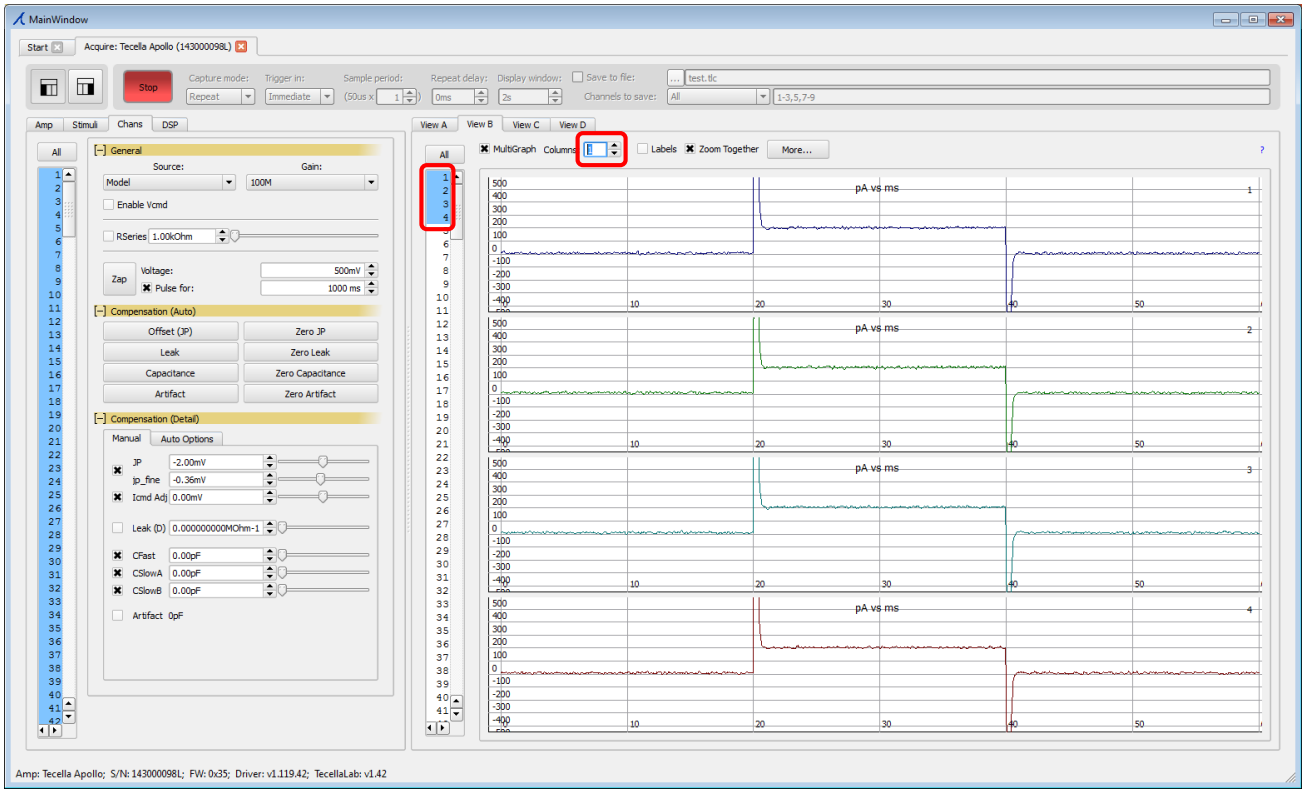
Click on highlighted button to hide the “Statistics” tab, in oder to provide more viewing space.



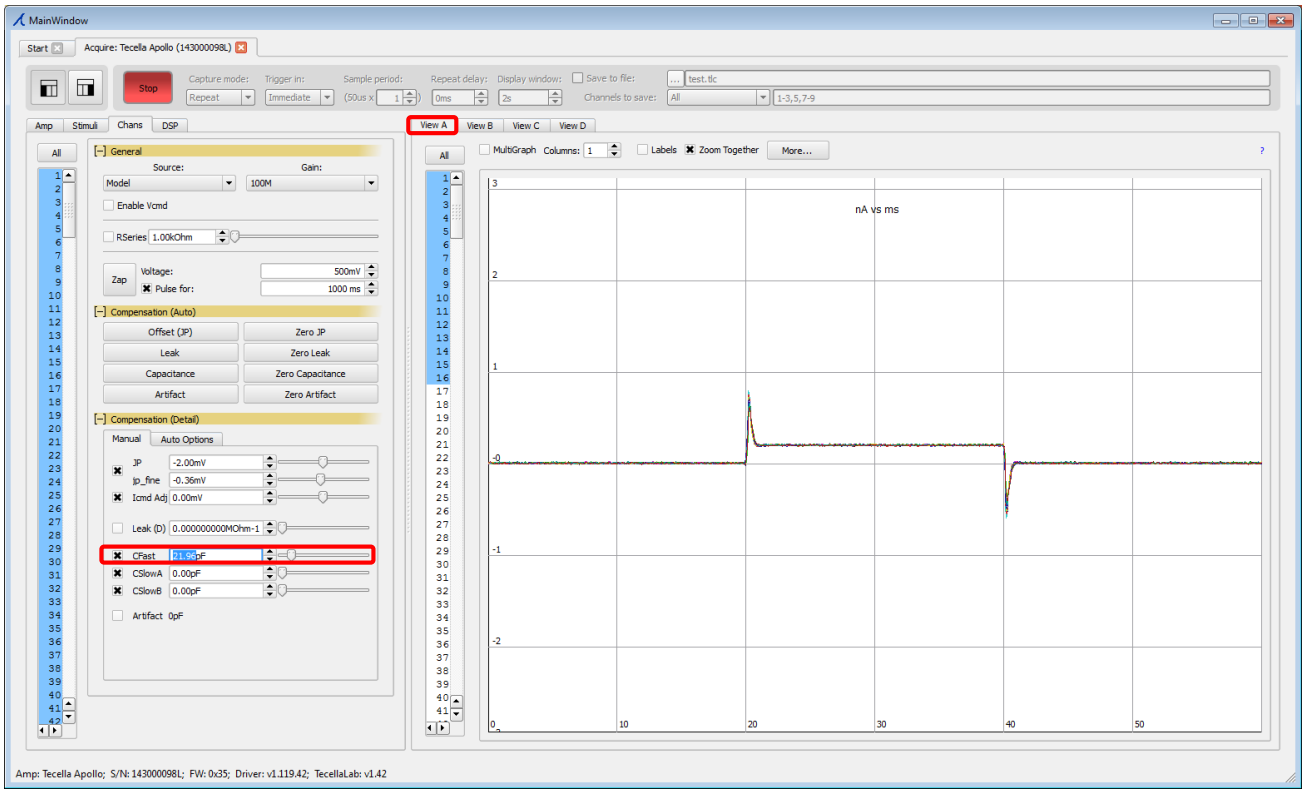
Select channels 1 through 8. Zoom in the y-direction, by holding-and-dragging the right mouse button “up”.



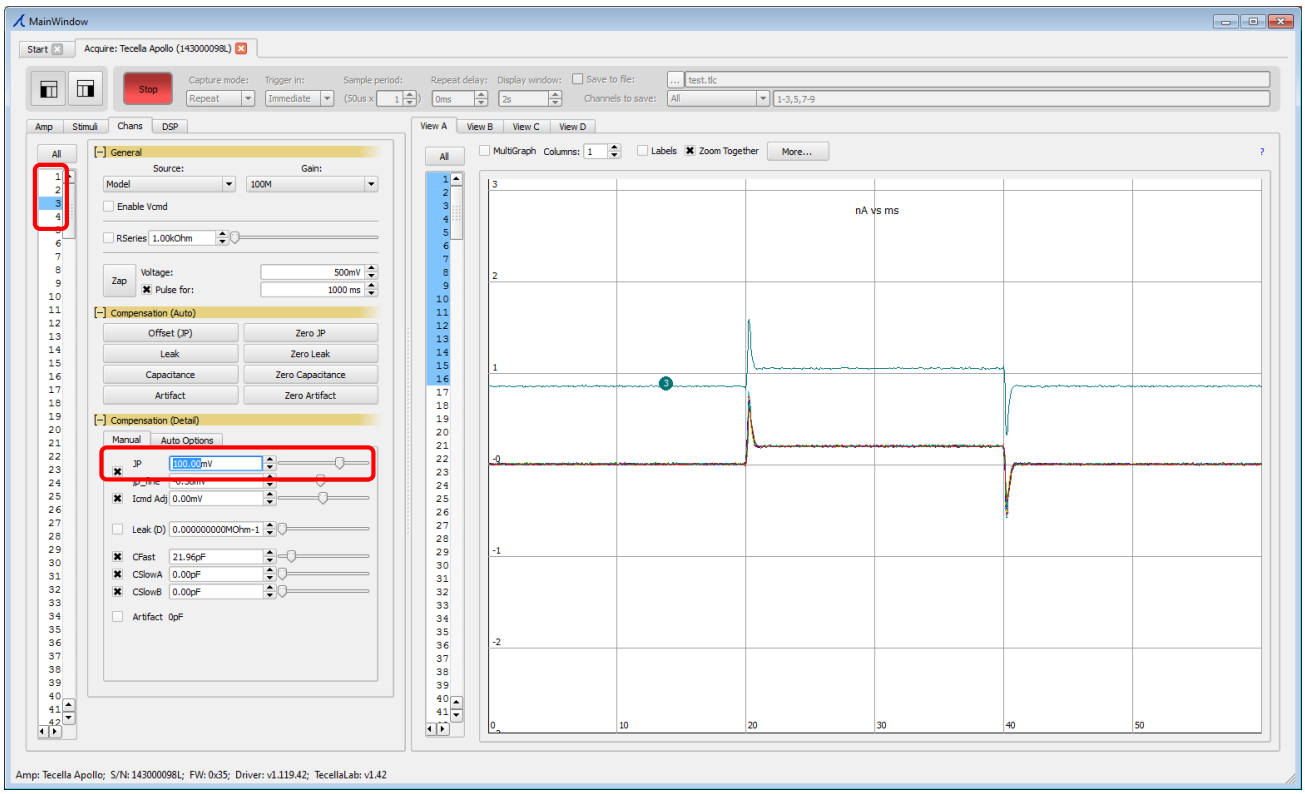
Select channels 1 through 4. Change “Columns” to “1” for a view such as the following.



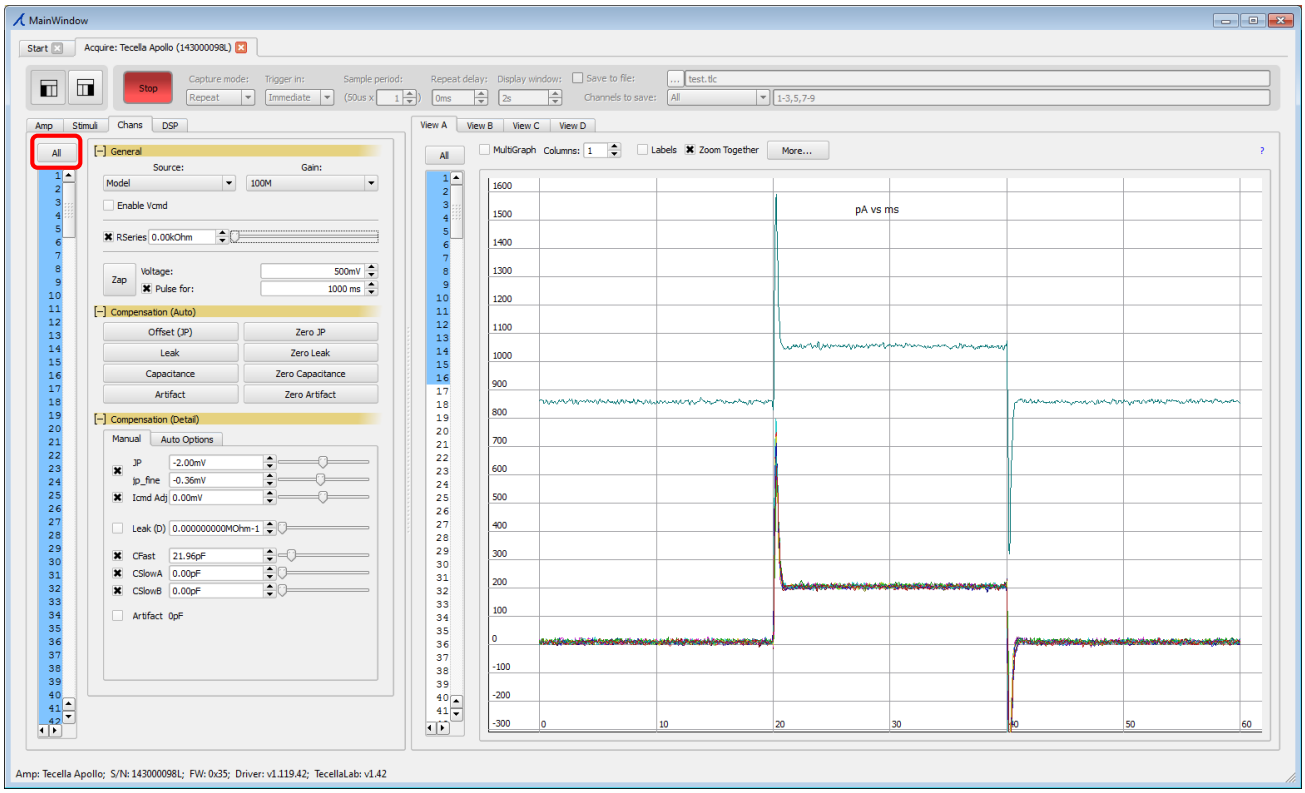
Select “View A” tab. Move “Cfast” slider to reduce the amplitude of the capacitive spike.



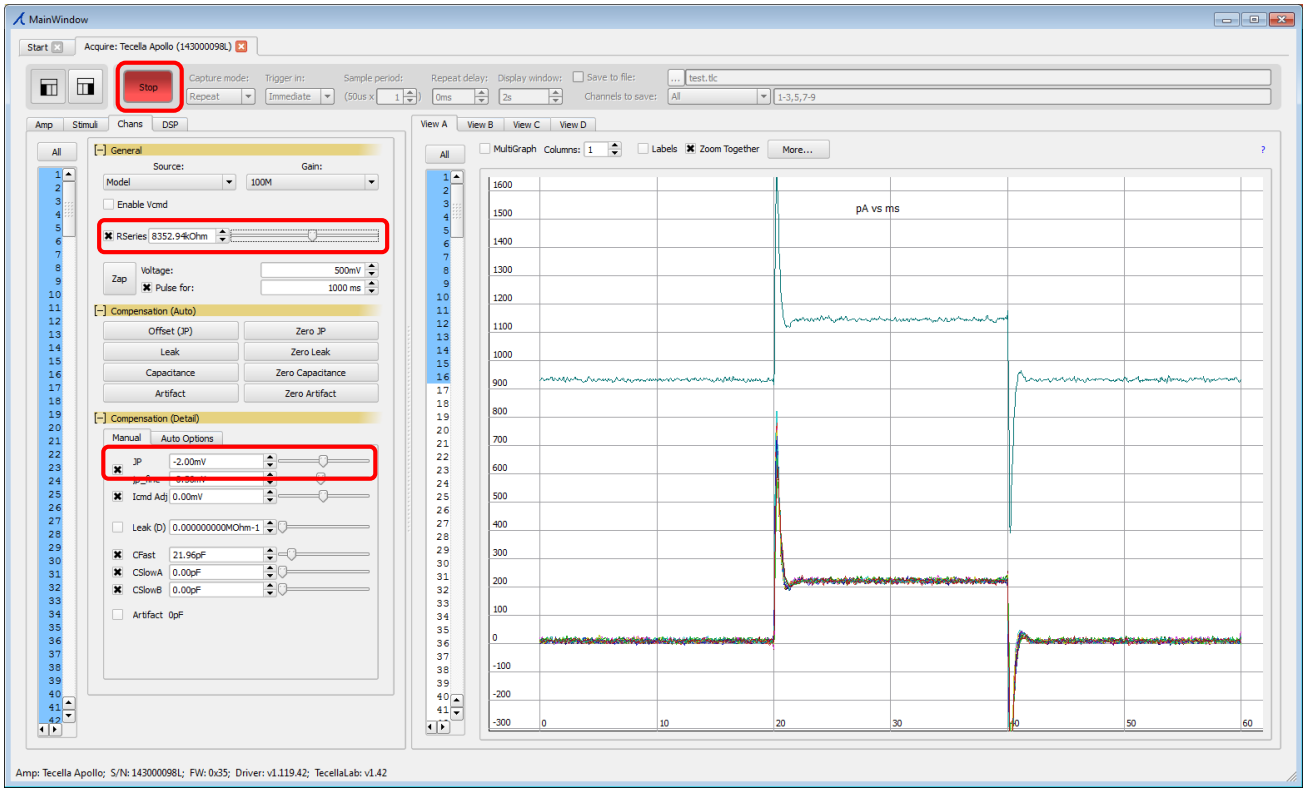
The left-most column is for selecting the channels to control. Select only channel 3.
Click on “JP”. Move the “JP” slider and observe that only channel 3 waveform is affected.
Placing the mouse pointer on top of the waveform will display the channel number.



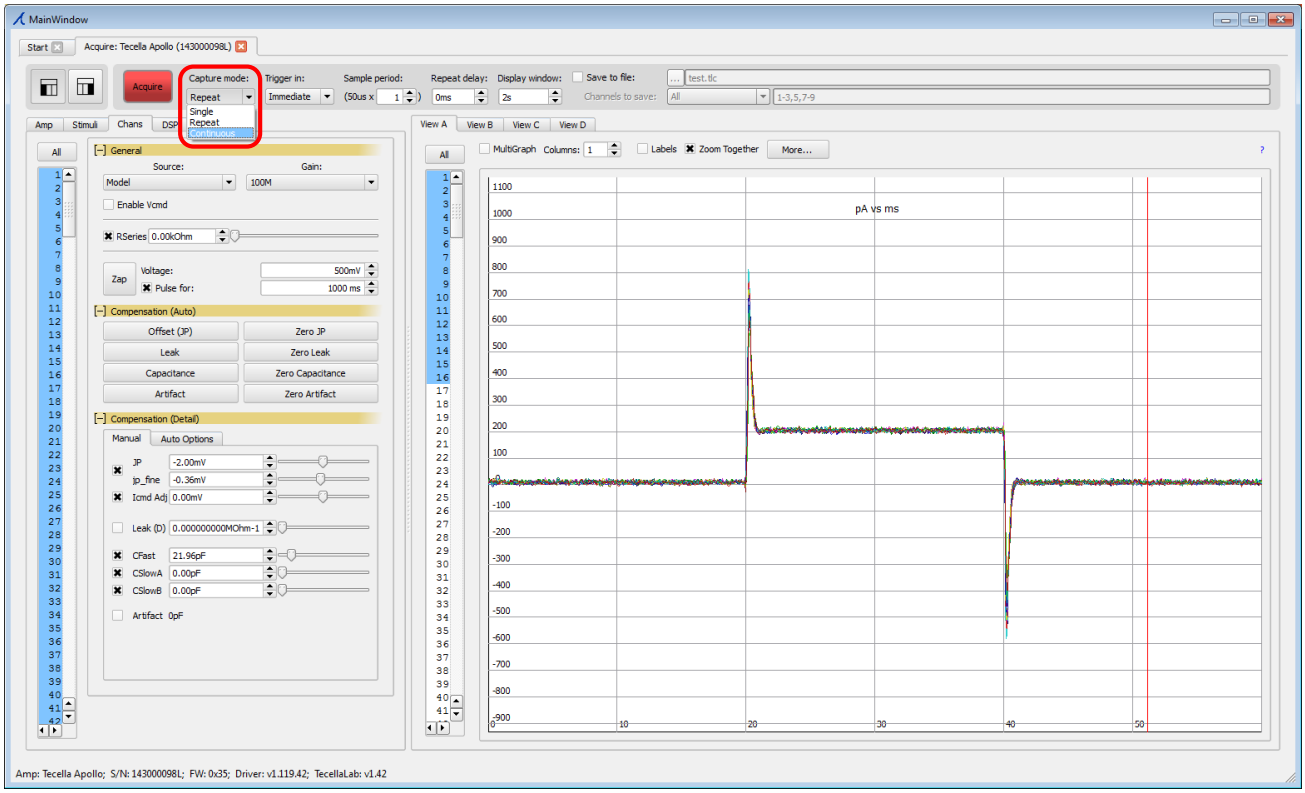
Select “All” channels for controlling. In order to observe the Rseries compensation effect, zoom in the y-direction, by holding-and-dragging the right mouse button “up”.



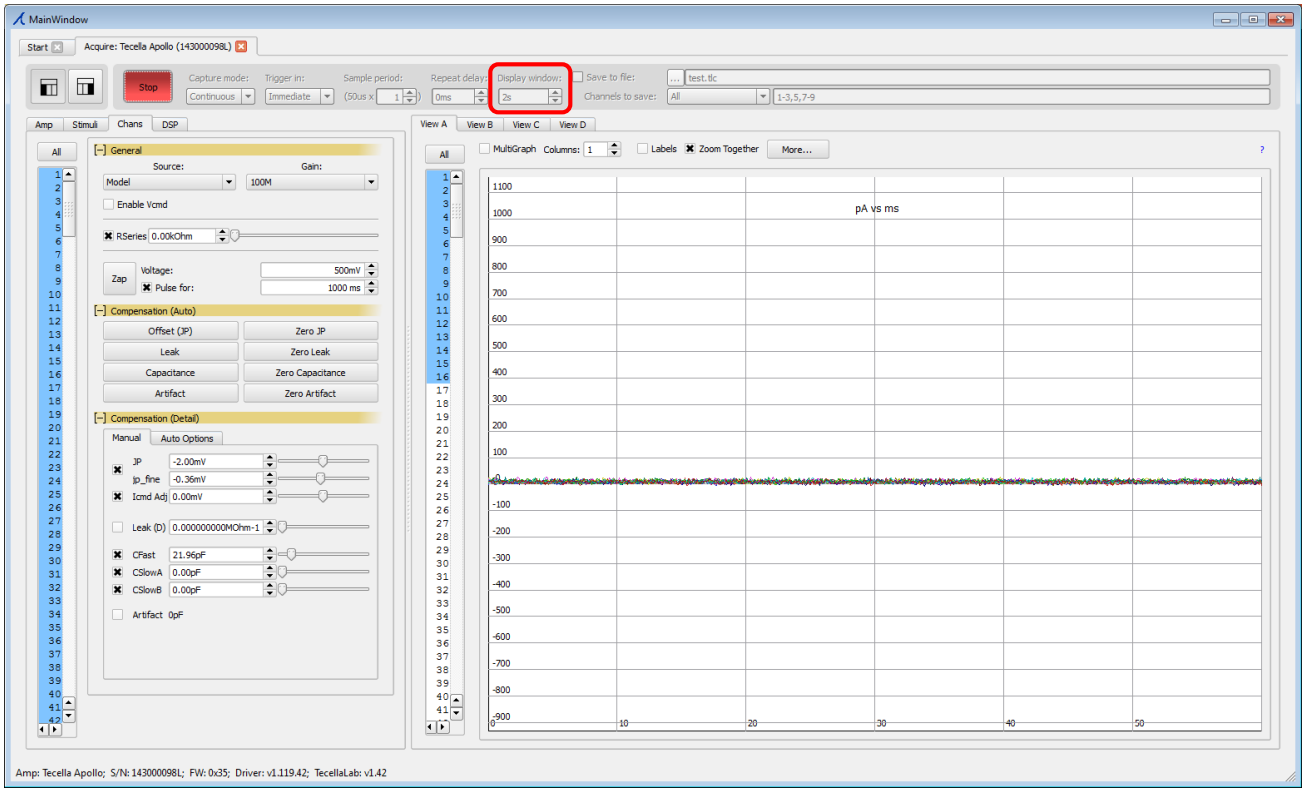
Click on “RSeries”. Move the slider to the right, and observe the effect.
Move “RSeries” back to “0”, and uncheck “Rseries”.
Set the “JP” for channel 3 back to the same value as the other channels.
Click on the “Stop” button, to stop the acquisition.



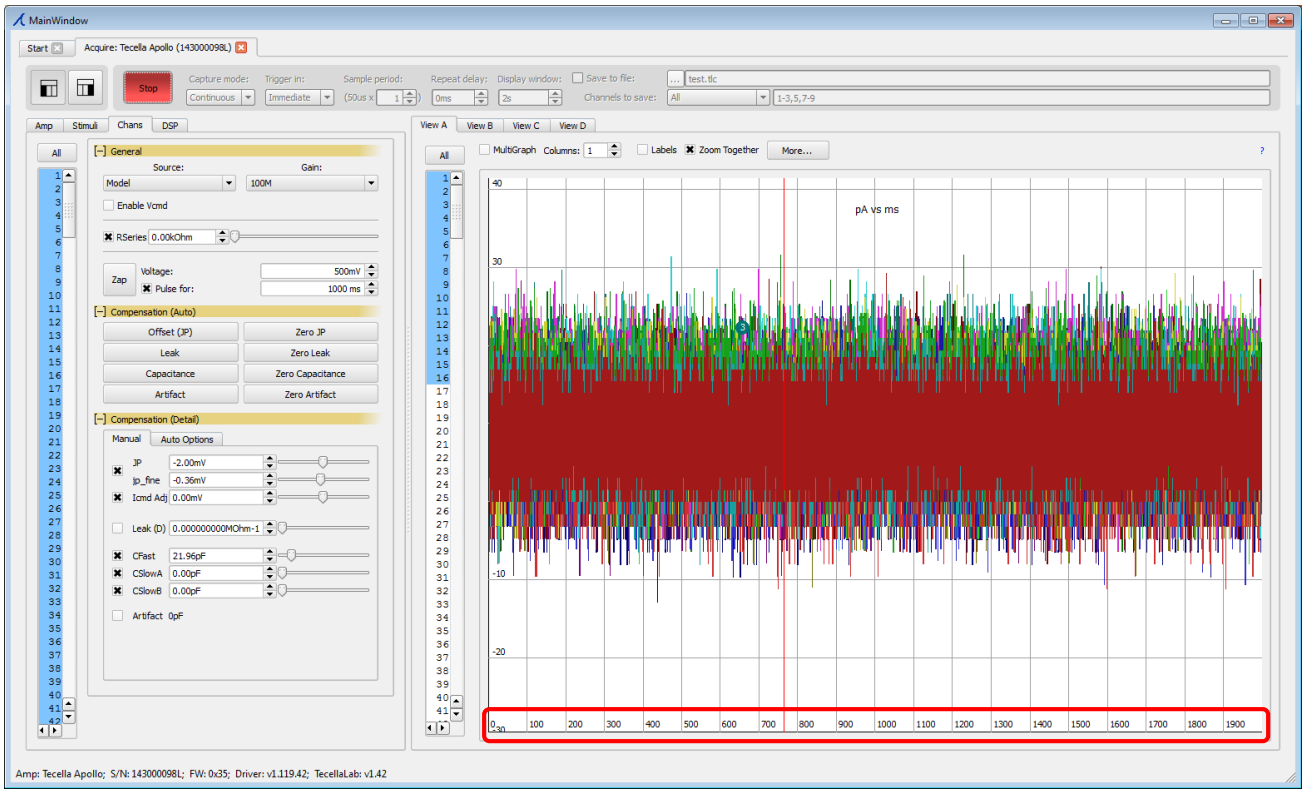
Set the “Capture mode” to “Continuous”.
Click on the “Acquire” button.



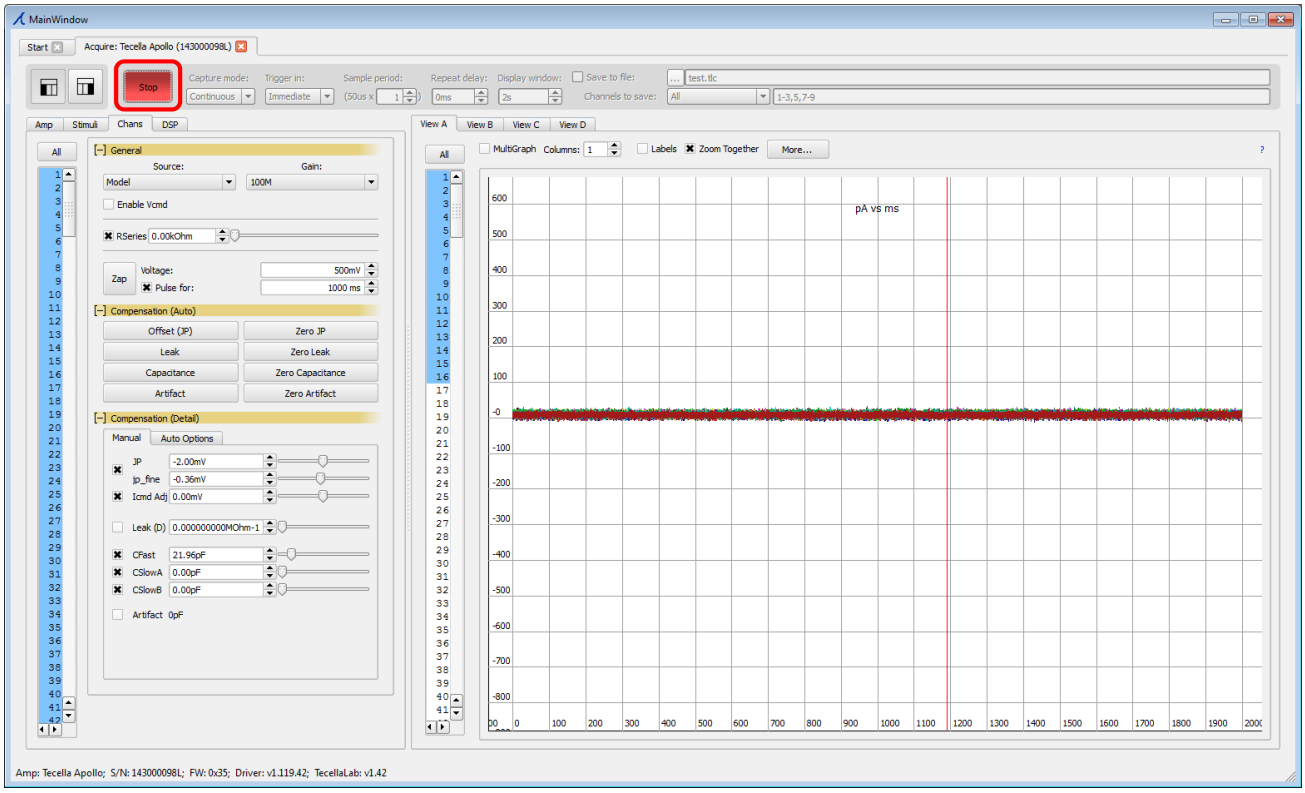
You will first see the test pulse. Then, 2 seconds later, the waveform will become flat.
The “Display window” is set to 2 seconds by default.
However, because the window was fitted to the test pulse, it is showing a shorter window.



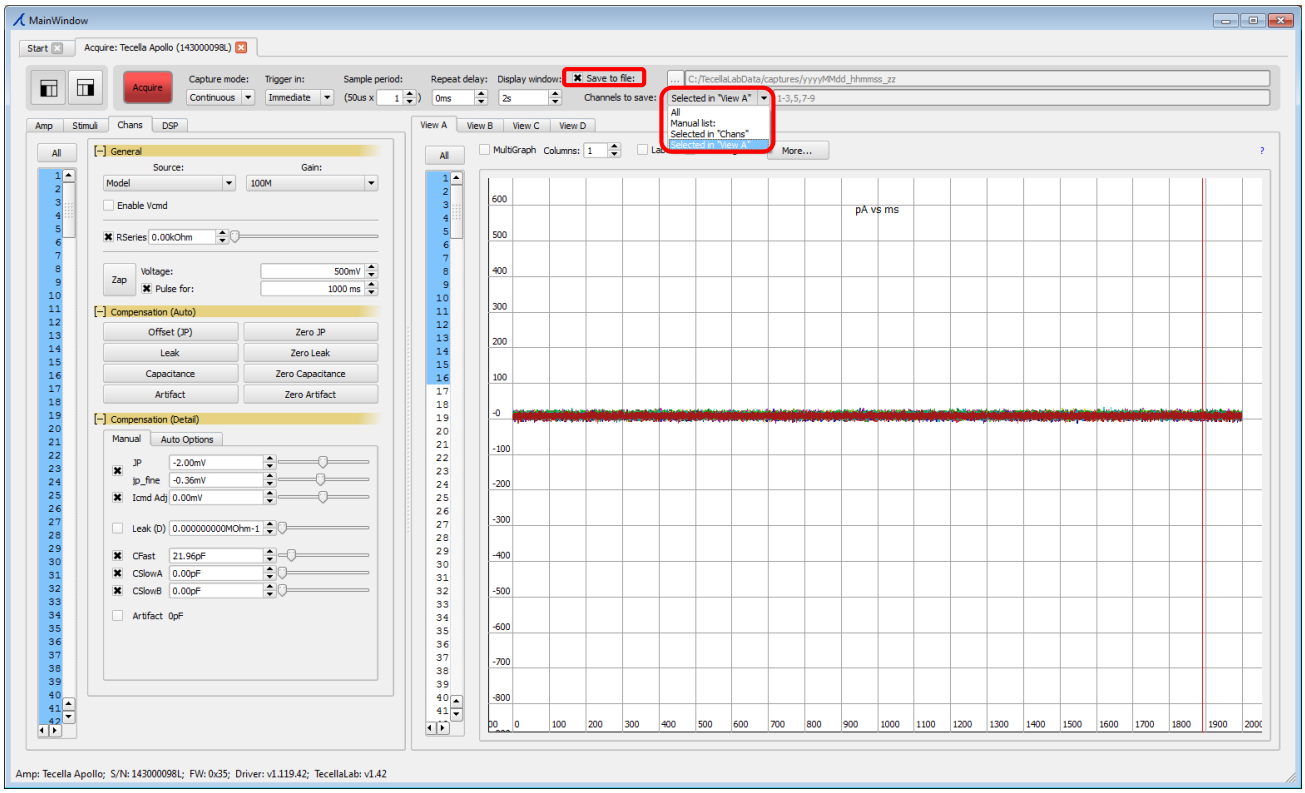
Double-click inside the view window.
The x-axis will become 2 seconds. The y-axis will zoom in to the noise level.



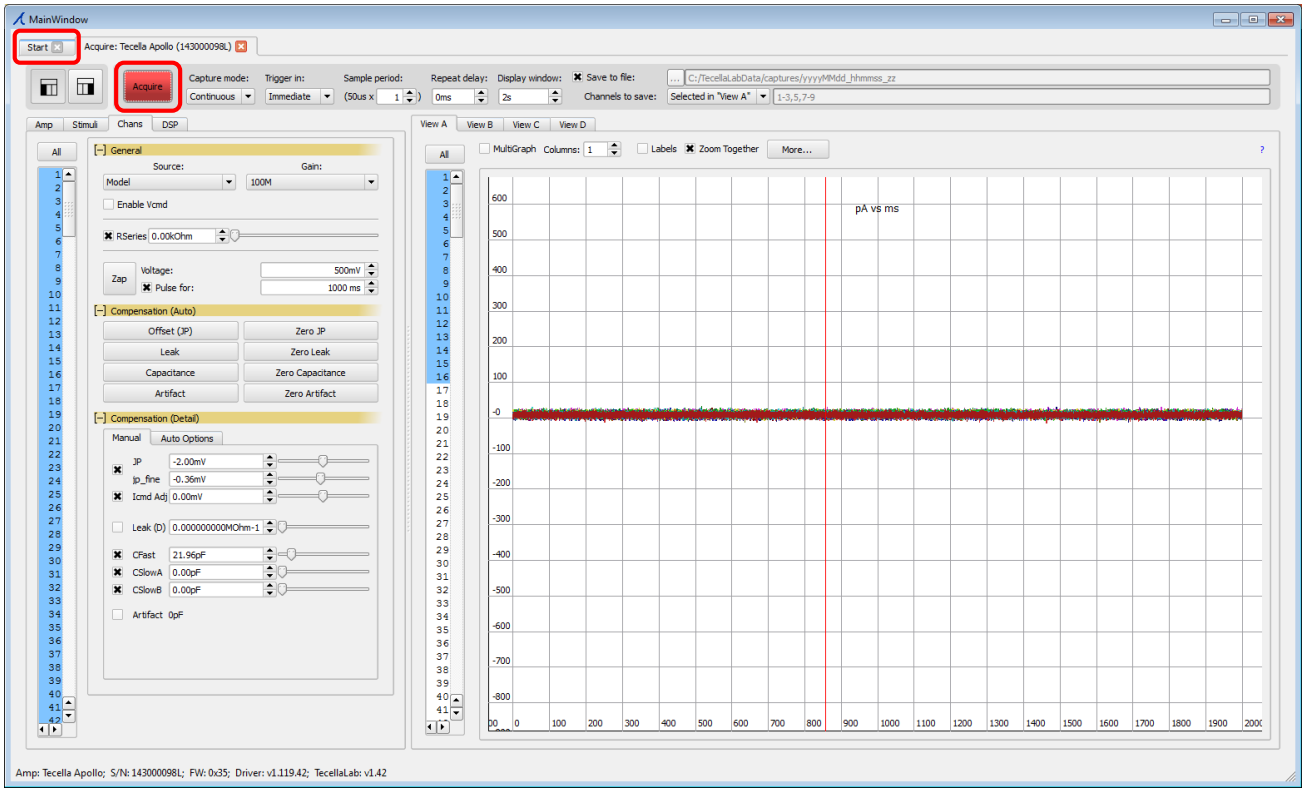
Hold-and-drag the right mouse button “down” to zoom out in the y-direction.
Click on the “Stop” button to stop the acquisition.



With the acquisition stopped, check “Save to file”.
Select “Selected in View A”.



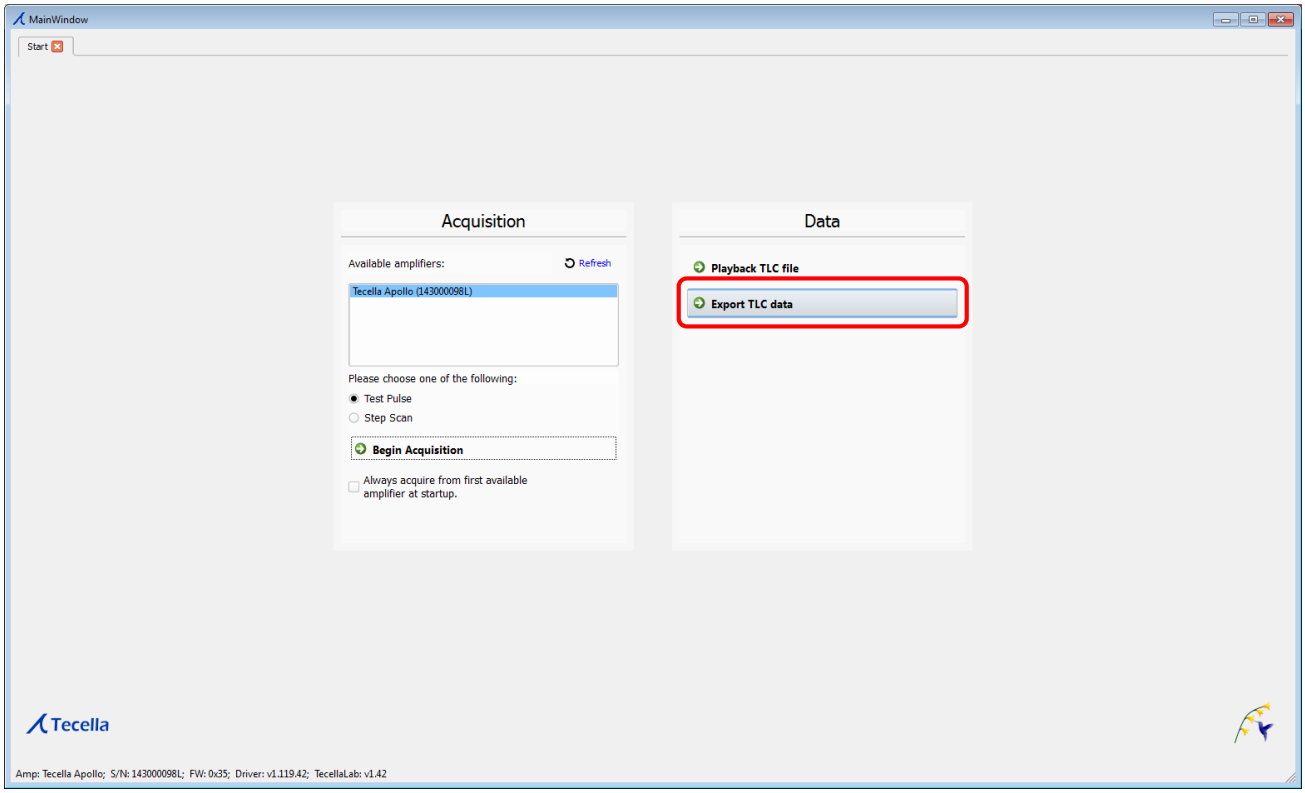
Click on the “Acquire” button to start the acquisition.
After about 5 to 10 seconds, click on the“Stop” button to stop the acquisition.
After stopping the acquisition, select the “Start” tab.



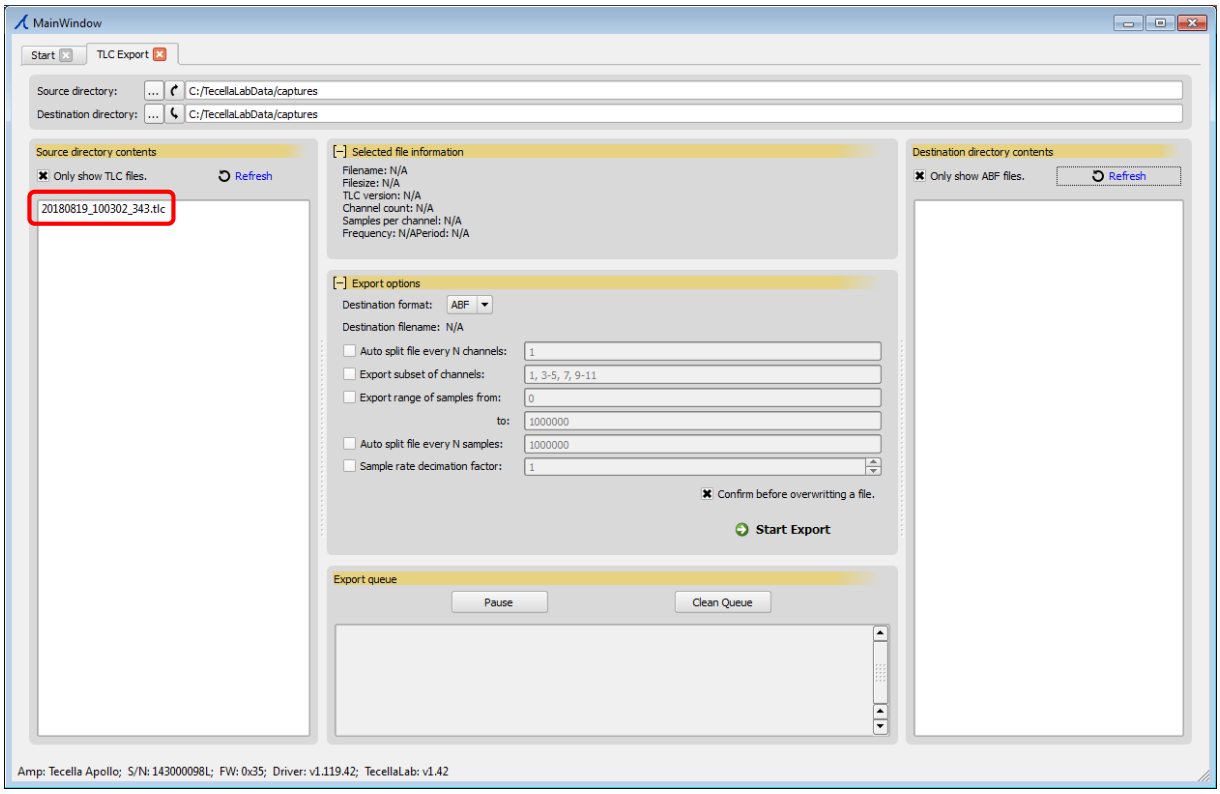
Exporting Data

The following pages describe how to export the recorded data to industry standard formats, such as ABF and tab delimited formats.

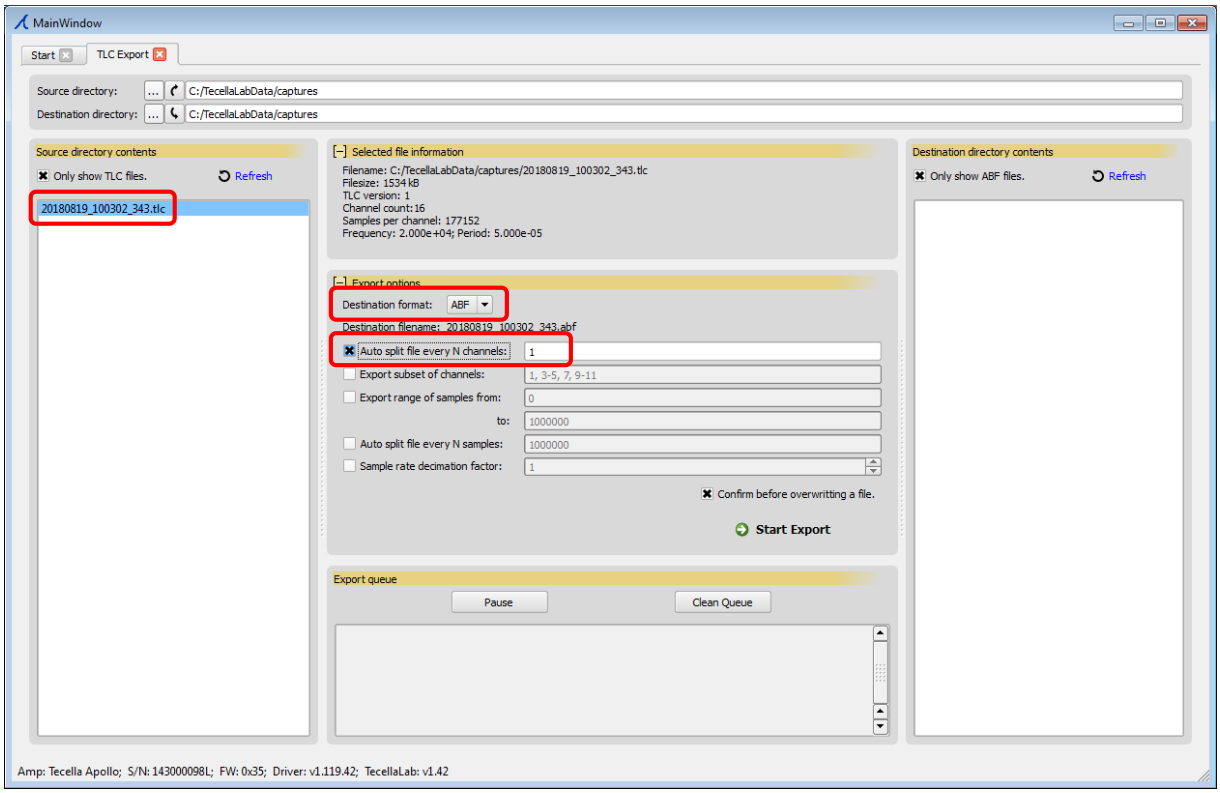
Select “Export TLC data”.



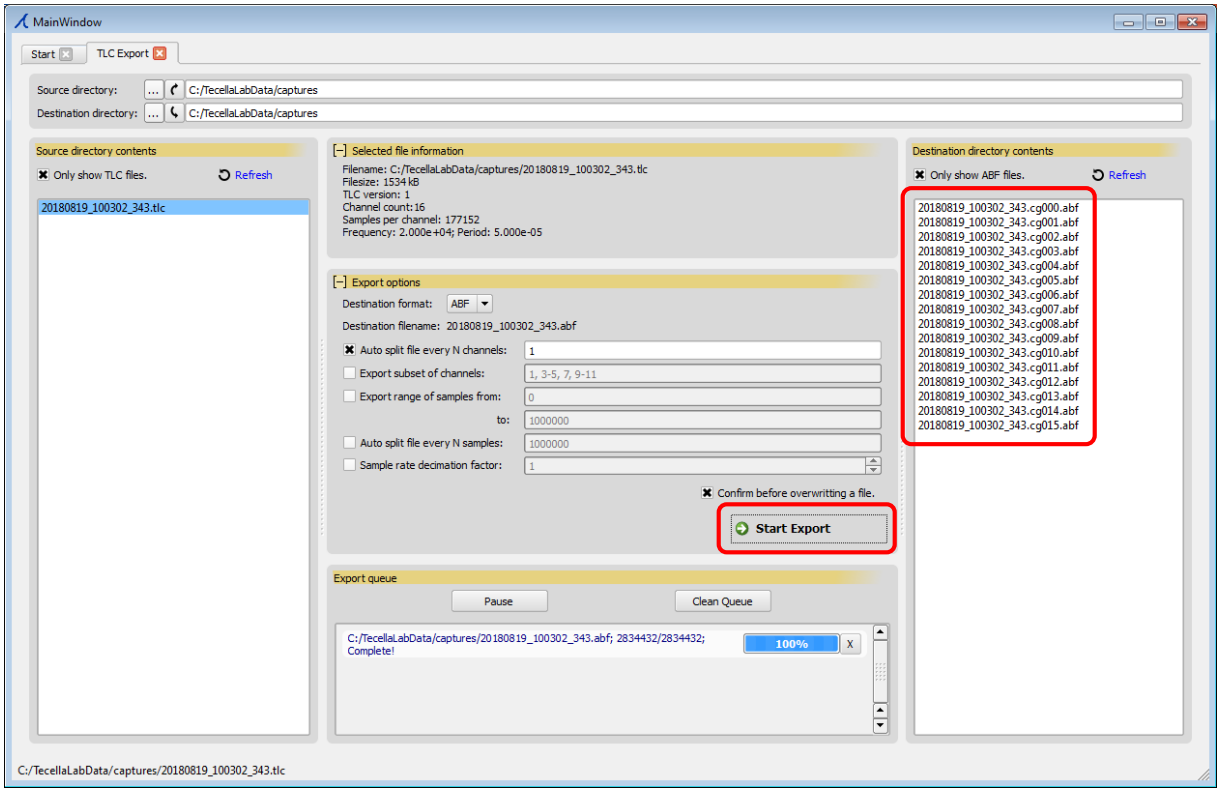
You should see the TLC file that was just created, in the “Source directory” window.



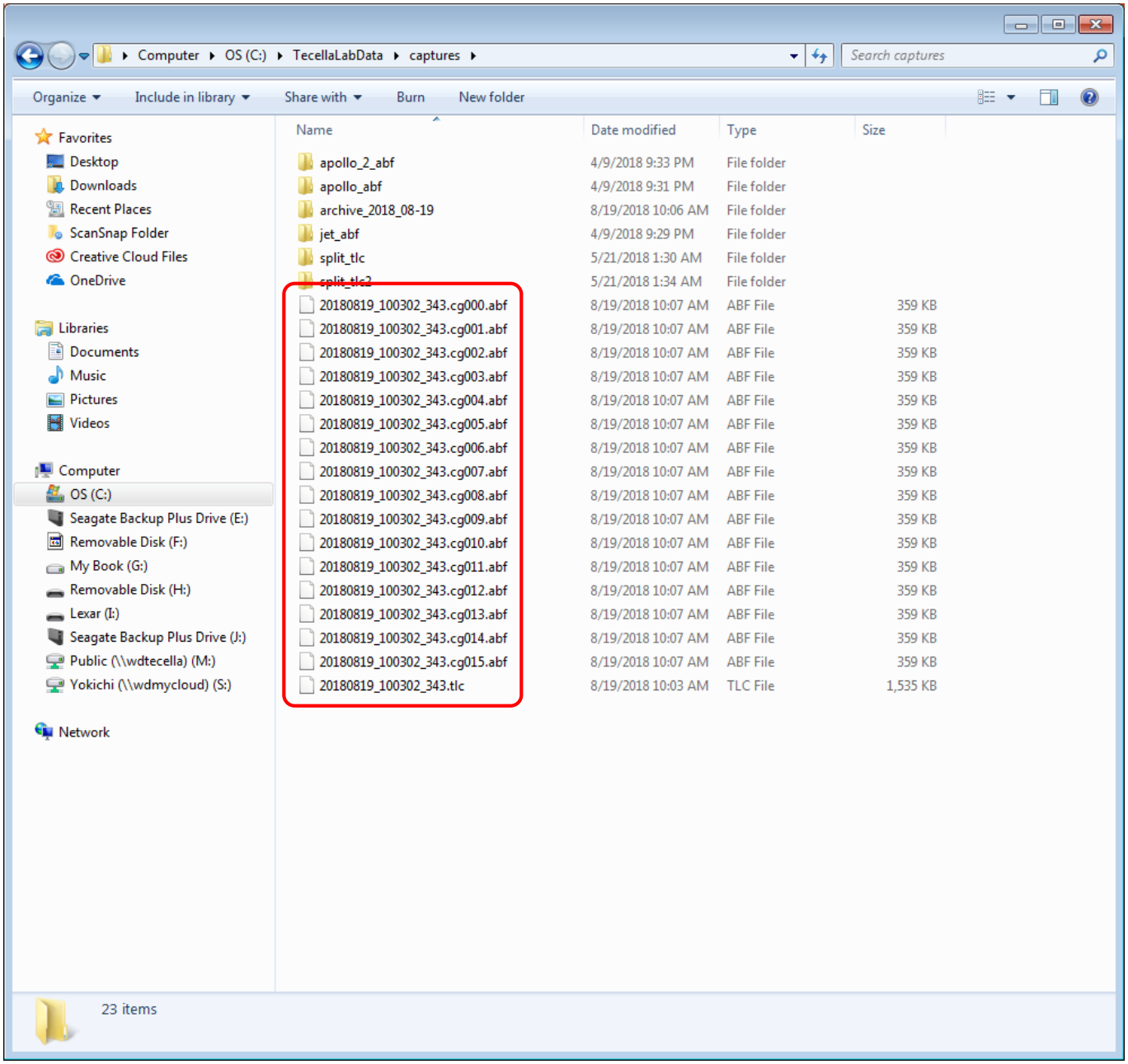
Select the TLC file to export.
Select the desired “Destination format”. ABF is selected below. Text file is another common option.
Check “Auto split for every N channels”, and enter “1”.



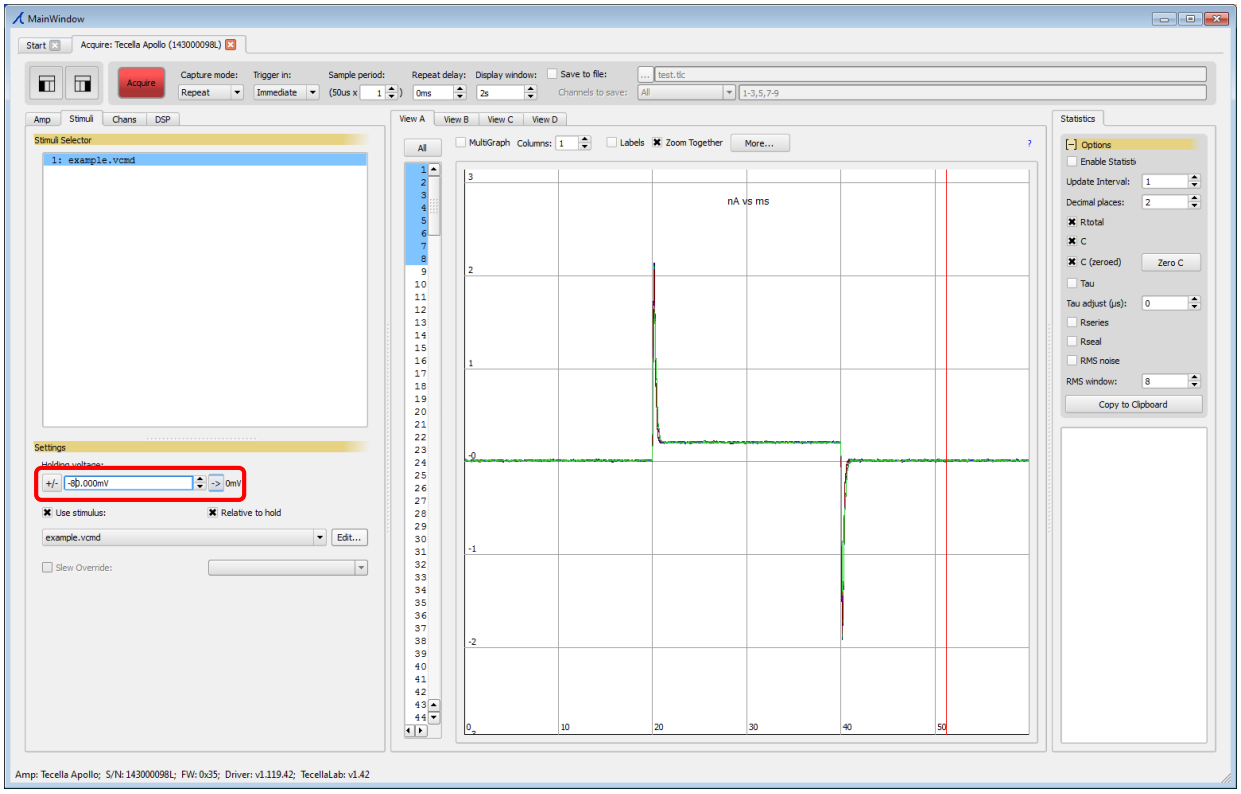
Click on the “Start “Export” button. The TLC file will be exported to the desired format.



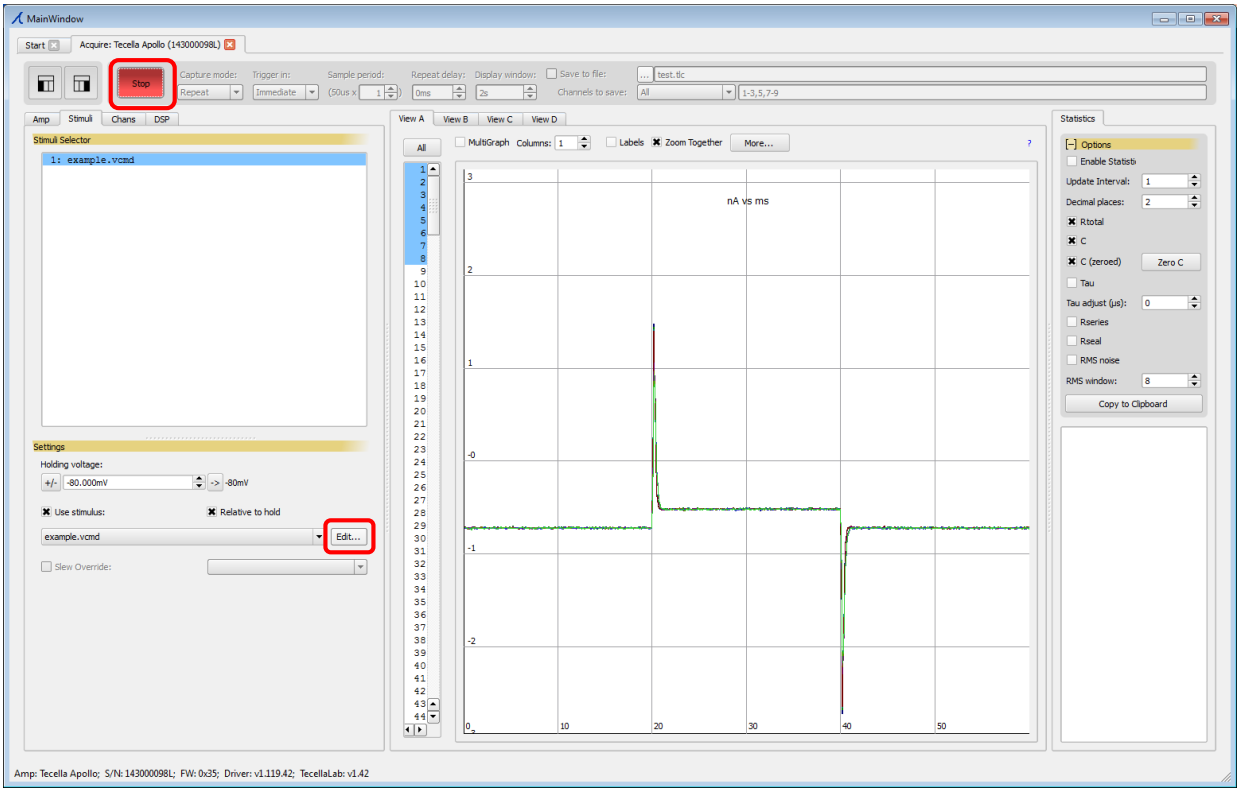
Go to C:\TecellaLabData\captuers.
You should see the exported files. Note that in this example, cg000 is channel 1, cg001 is channel 2, etc.



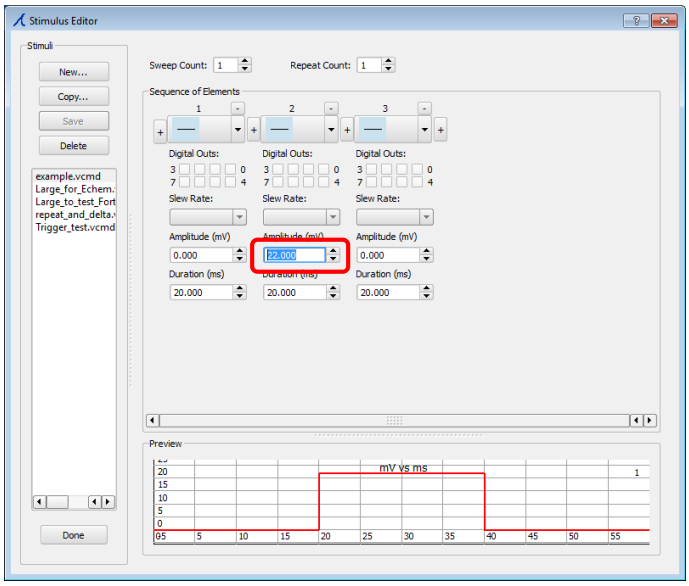
Go back, and run a test pulse.
Select the “Stimuli” tab.
For the “Holding voltage”, enter “-80” and click on the “right arrow” button to apply the holding voltage.
Make sure that “Relative to hold” is checked.



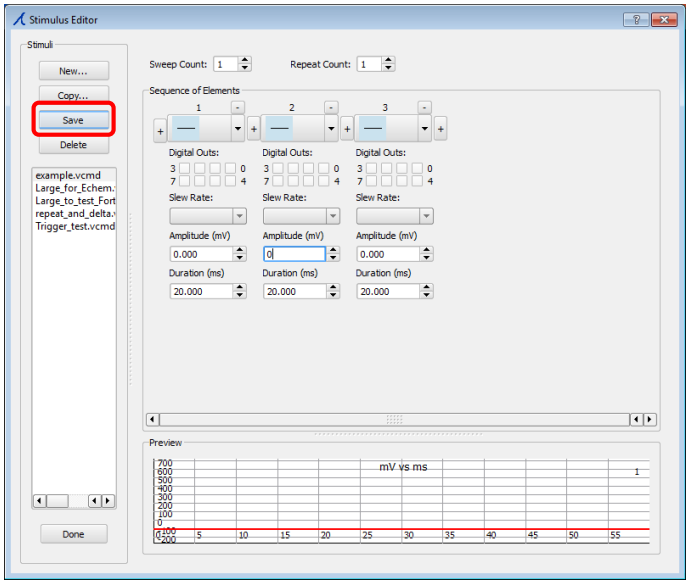
Observe the -80mV effect on the waveform.
Click on the “Stop” button to stop the acquisition.
Click on the “Edit…” button next to the vcmd file to open the Stimulus editor.

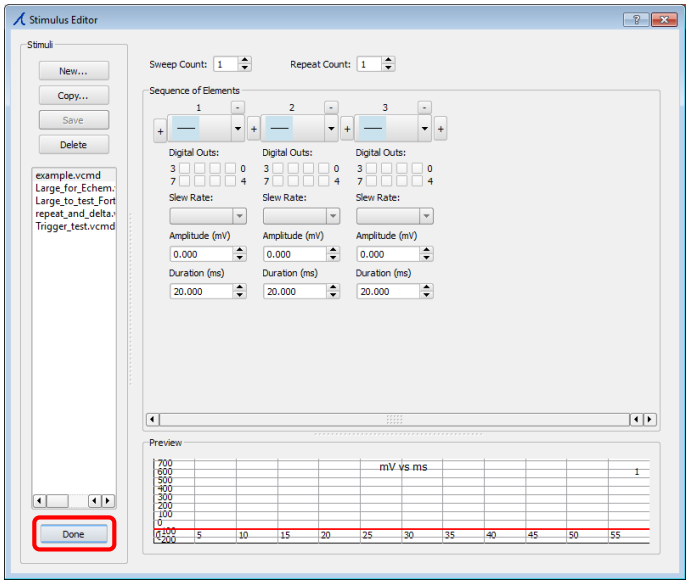


Set all amplitudes to 0mV.

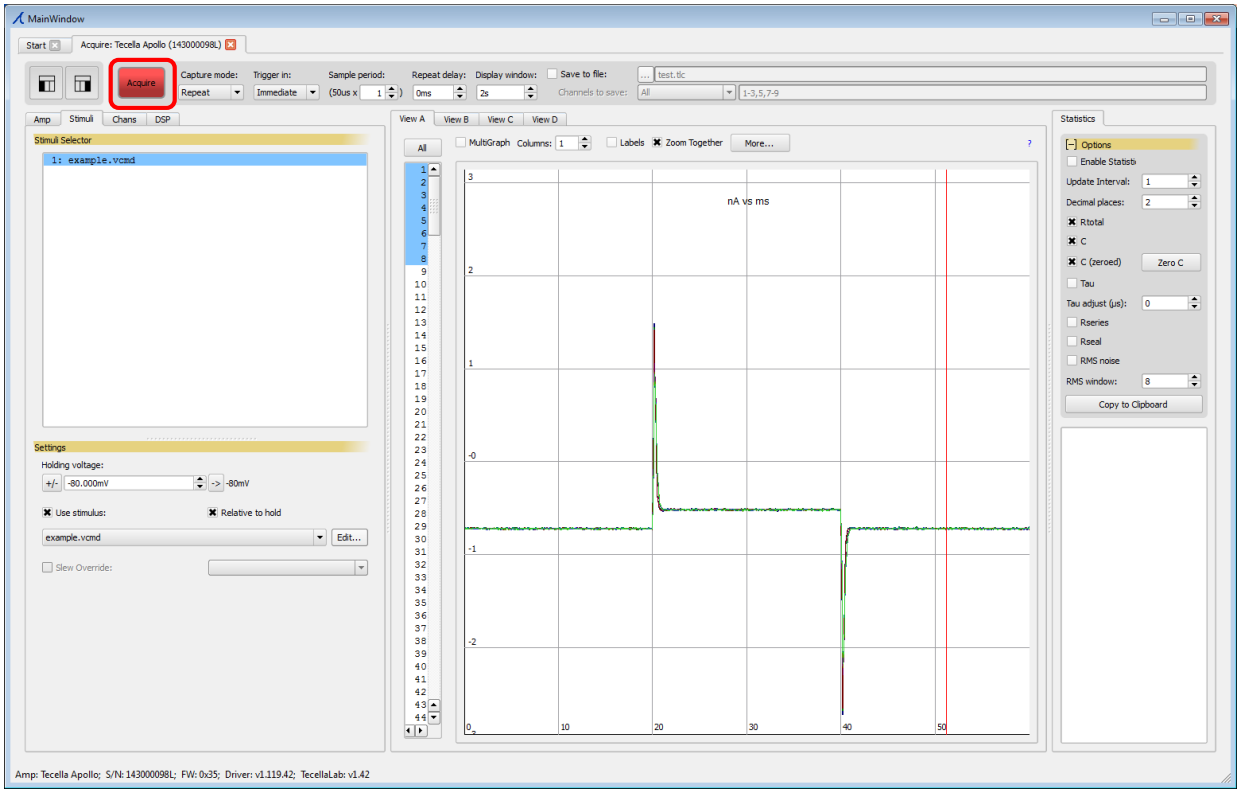


Click on “Save” to save the changes.
Click on “Done” to exit the Stimulus Editor.

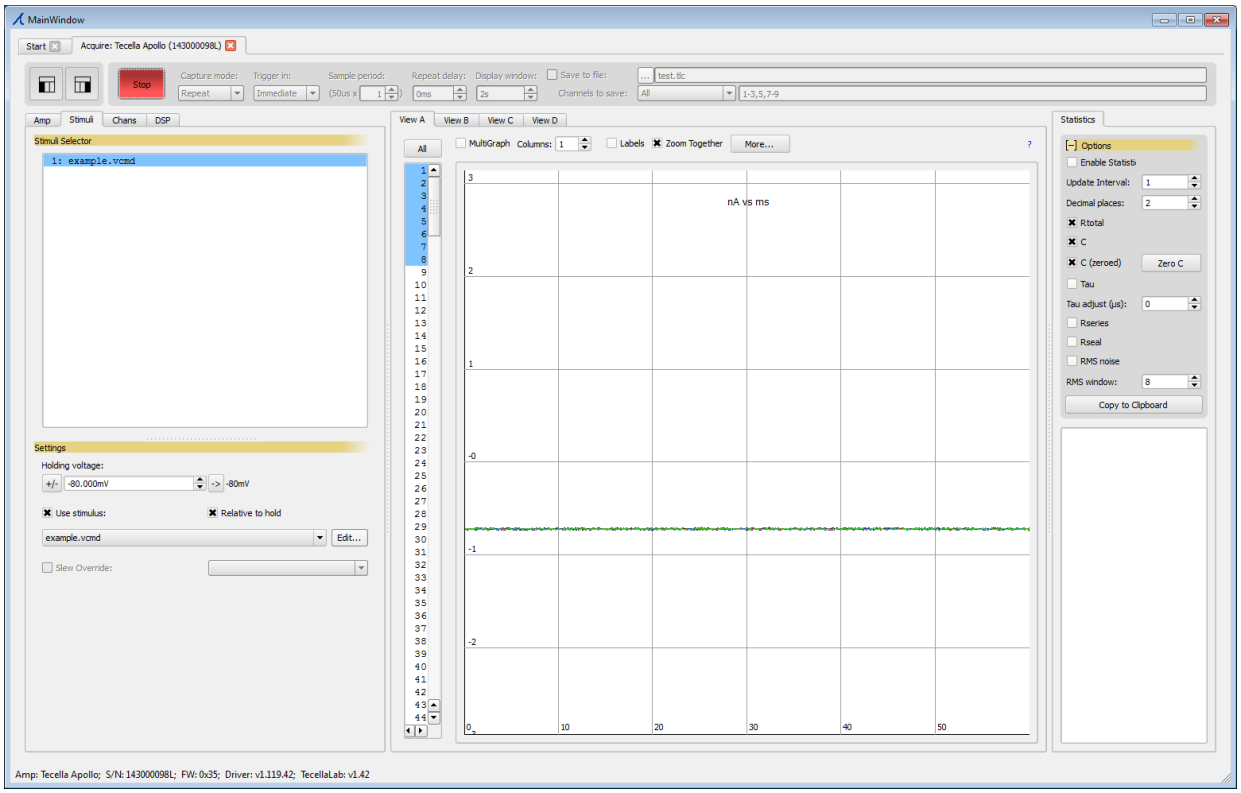




Click on “Acquire”.



Observe that the test pulse is no longer present.



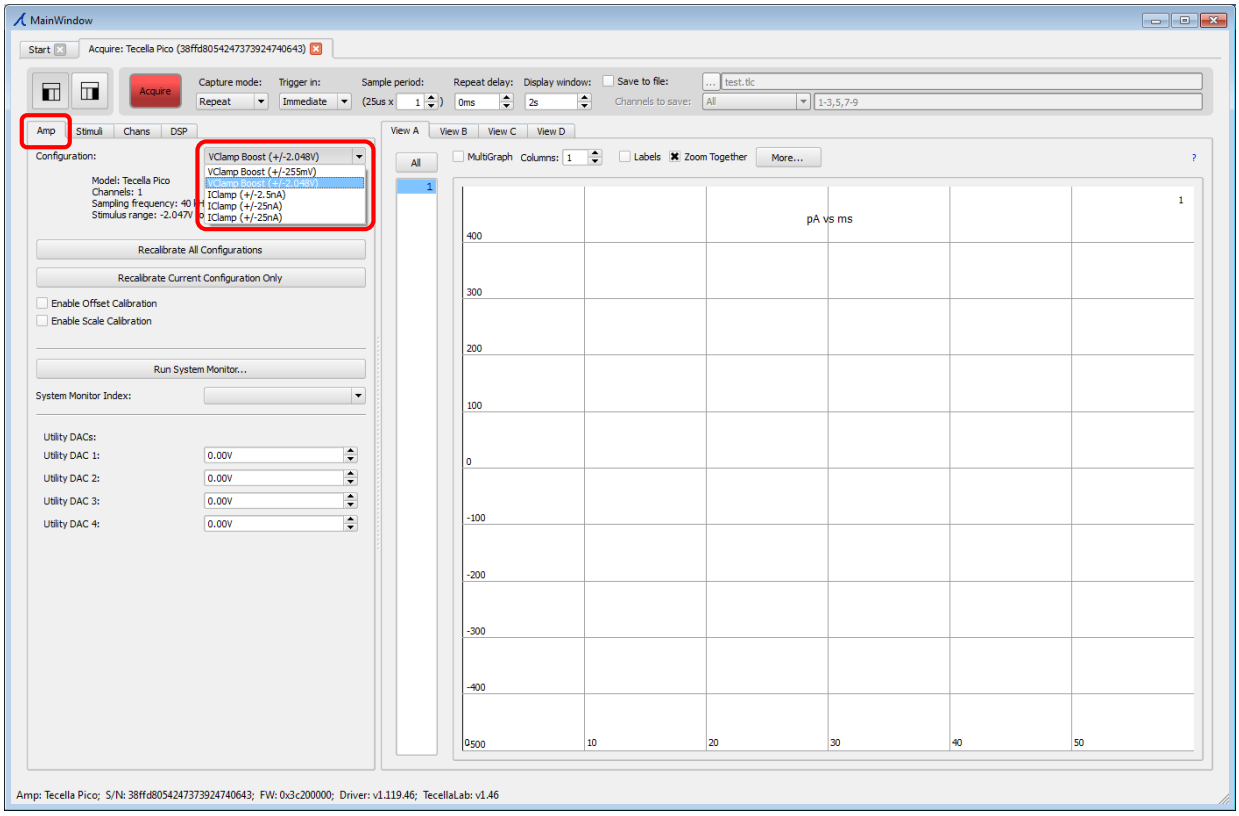
Changing Modes

The following pages describe how to change the mode of the amplifier, for amplifiers that support multiple modes.

For example, the Pico supports the following modes:

- Voltage Clamp with Vcmd range of ±255mV
- Voltage Clamp with Vcmd range of ±255mV
- Current Clamp with Icmd range of ±2.5nA
- Current Clamp with Icmd range of ±25nA

Click on the “Amp” tab.
Go to the “Configuration” pull down menu.
Select the desired mode.



Stimulus files

The following pages describe how to create stimulus files with a text editor.

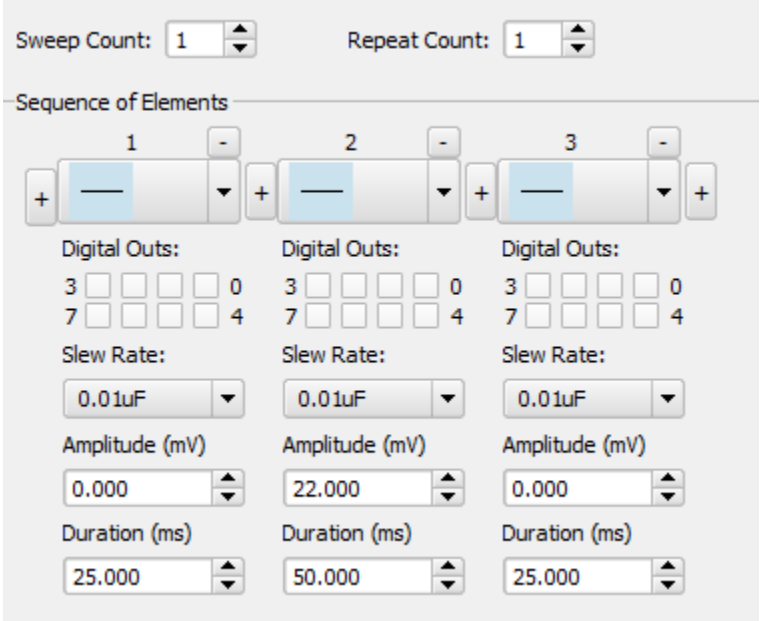
Stimulus files are located in the folder C:\TecellaLabData\stimuli

- For a voltage clamp stimulus, the file extension is .vcmd
- For a current clamp stimulus, the file extension is .icmd

In some cases, it may be more desirable to edit the stimulus file directly in a text editor. Below is an example of the stimulus text format.

Example: test_pulse.vcmd

```
TecellaLabStimulus
Version 4
value_scale 0.001
time_scale 0.001
delta_count 1
repeat_count 1
delta_delay_state 0
delta_delay_value 1000
flat 0 25 0 0
flat 22 50 0 0
flat 0 25 0 0
stimulus_end
```



In the above example, the data order is as follows:

- Segment type = “flat”
- Amplitude in milli-volts
- Duration in milli-seconds
- Slew rate (if supported)
- Digital Outs (if supported)

Best practices

- It is easiest to copy an existing stimulus file, and edit that.
- Do not modify the first two lines.
- Do not modify the last line.

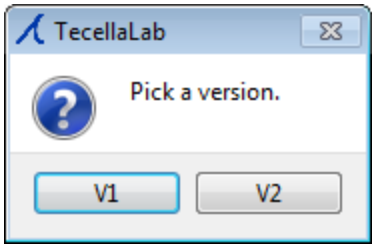
TecellaLab Version 2 GUI

Version 1 GUI is recommended for most applications.

Version 2 GUI does not support all features. The following pages describe features specific to the Version 2 GUI.

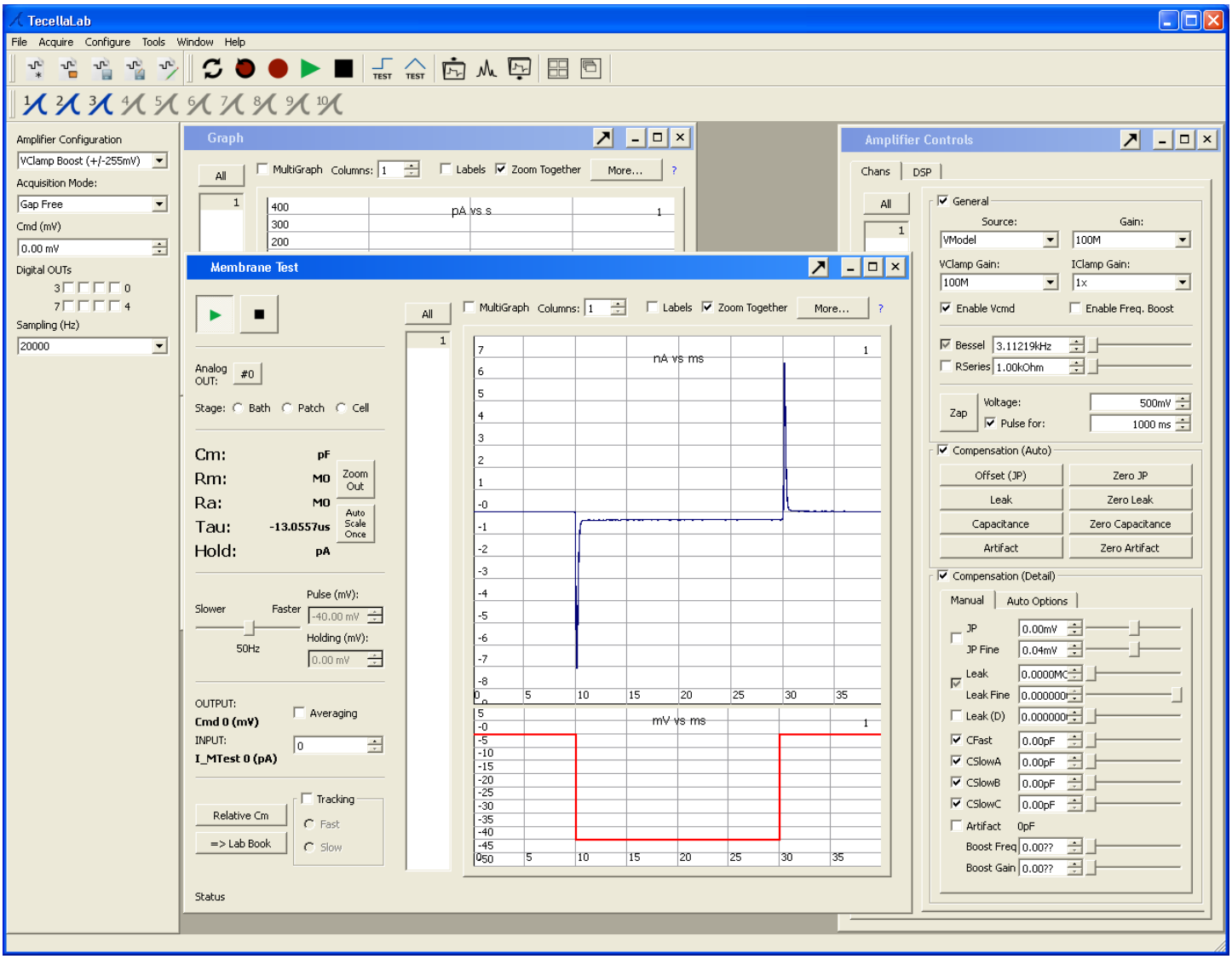
Version 2 GUI

Pick “V2” to use Version 2 GUI.



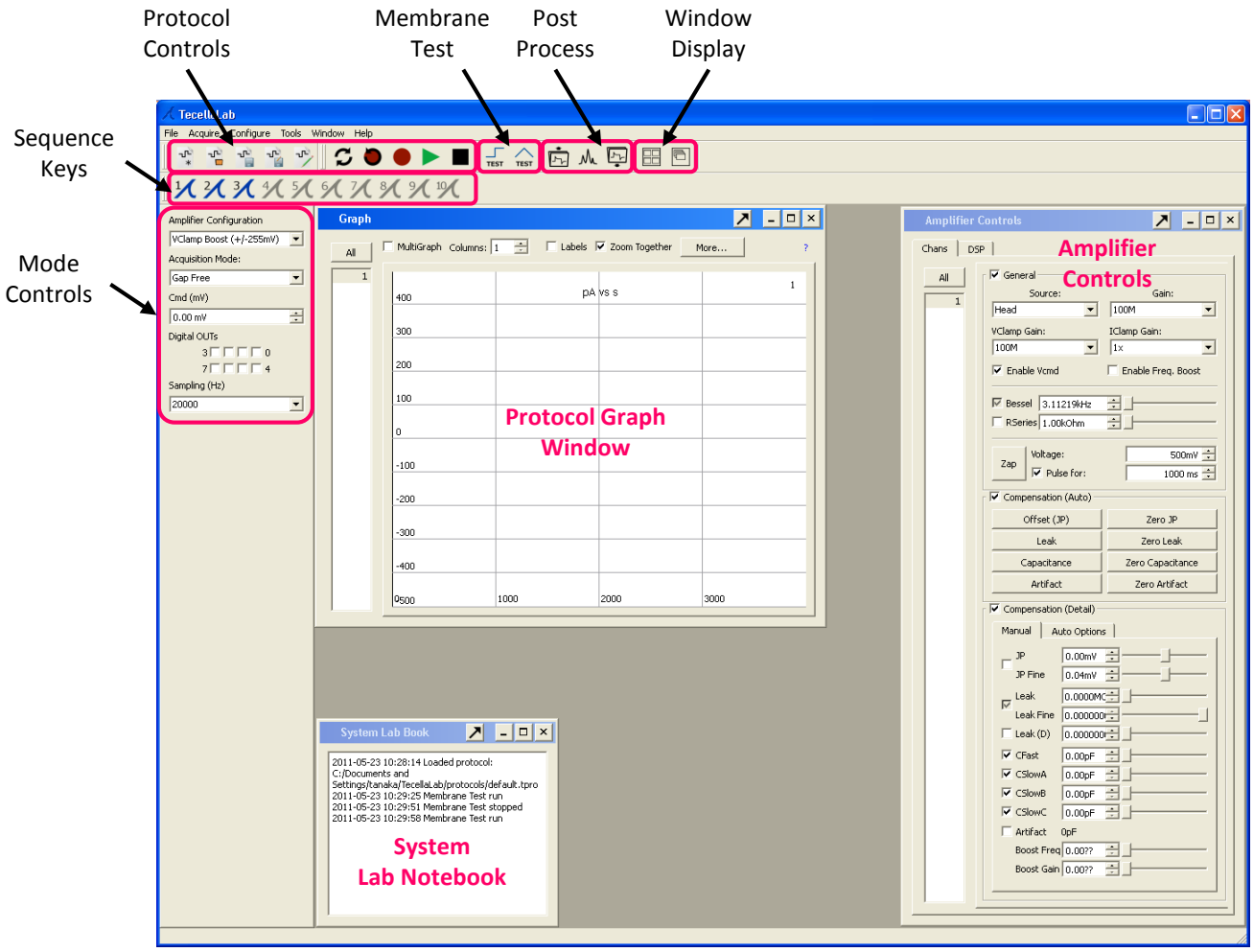
Although the GUI appears different from the V1 GUI, many of the controls are the same between the GUI versions. The differences will be highlighted.

The Main Window for the Version 2 GUI looks like the following:



Key sections of the Version 2 GUI

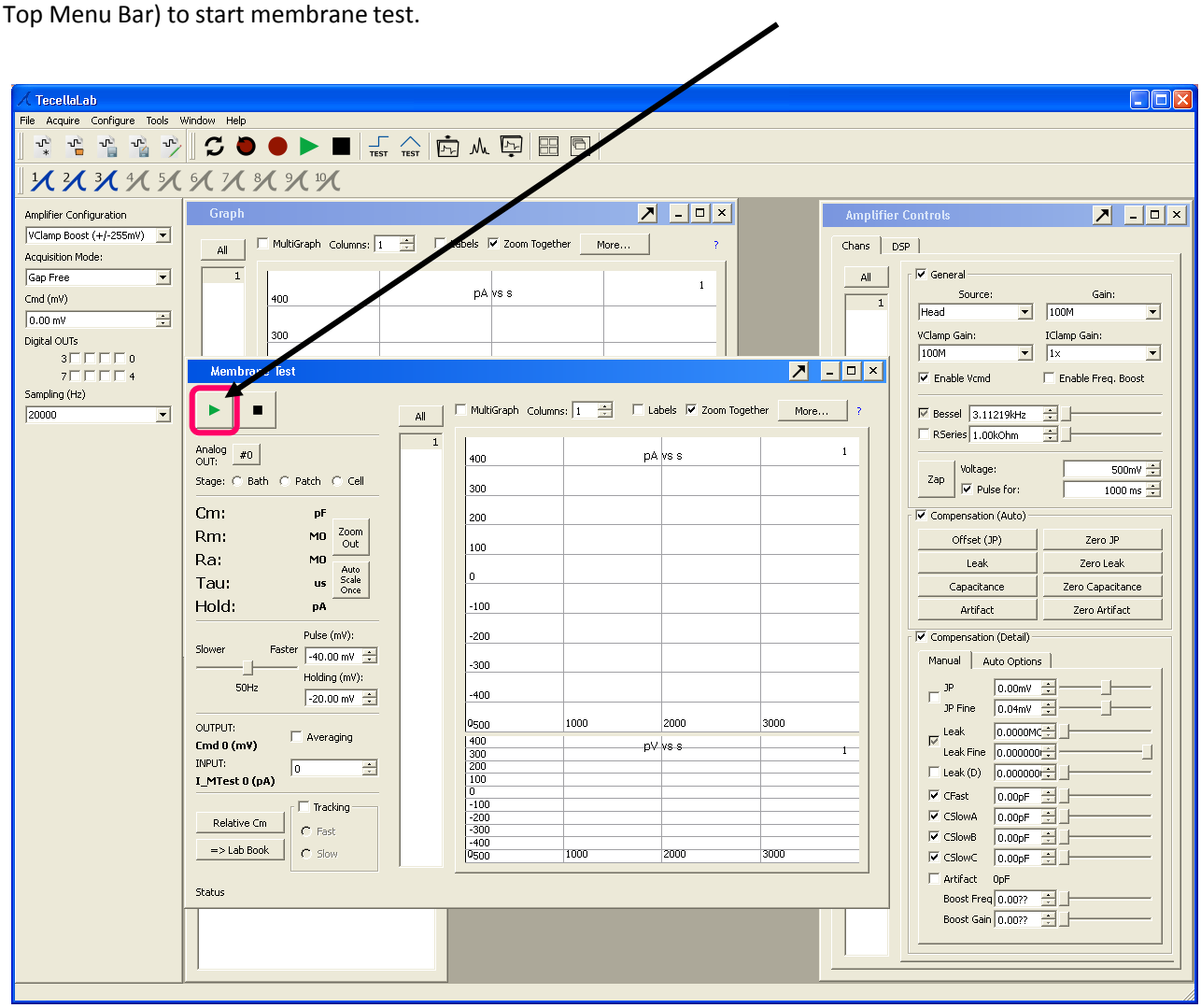
After the Version 2 GUI starts up, the following screen will appear. The key sections of the Version 2 GUI are labeled below. Each section is described in detail later.



Membrane Test

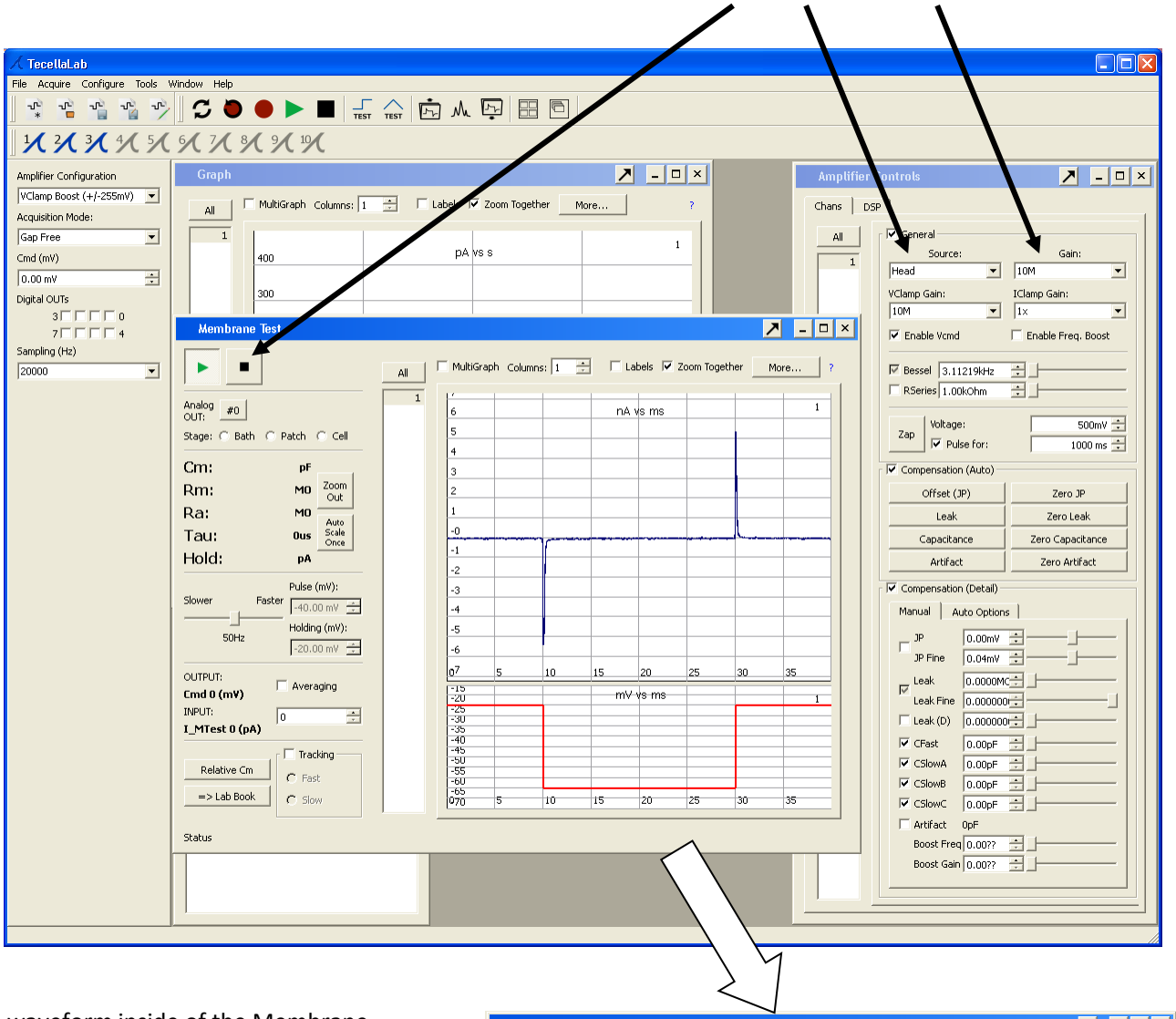
Membrane Test is a simple repeating waveform that is useful to verify the proper operation of the amplifier and the state of the cell membrane or other membrane-under-test. Click on the Membrane Test button to start the membrane test.

A Membrane Test window will appear as shown below. Click on the "play" button **inside the Membrane Test window** (not the Top Menu Bar) to start membrane test.

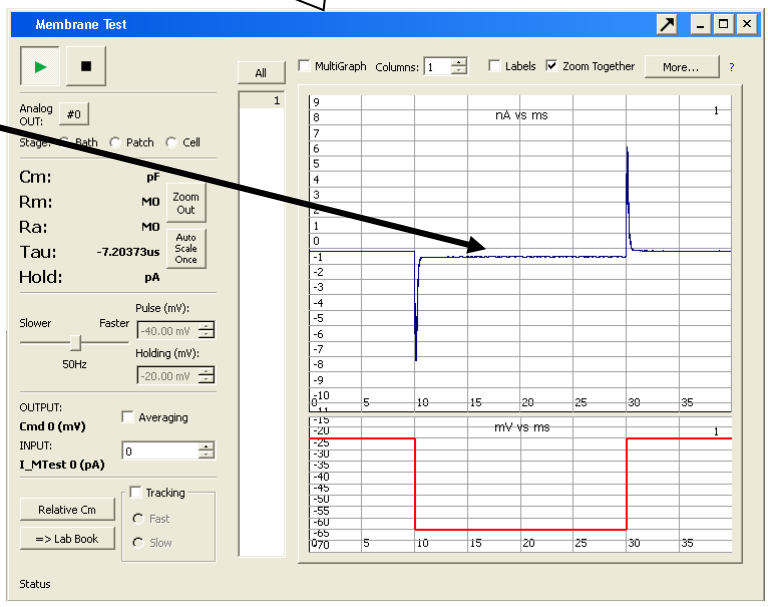


Verify Amplifier Using Membrane Test

Membrane Test can be used to verify proper operation of the amplifier. Stop the Membrane Test, then in Amplifier Controls window, change “Source” to “VModel” and “Gain” to “100M” (or any gain setting your amplifier supports).



The waveform inside of the Membrane Test window should now display some leakage current due the model cell, as shown on the right.



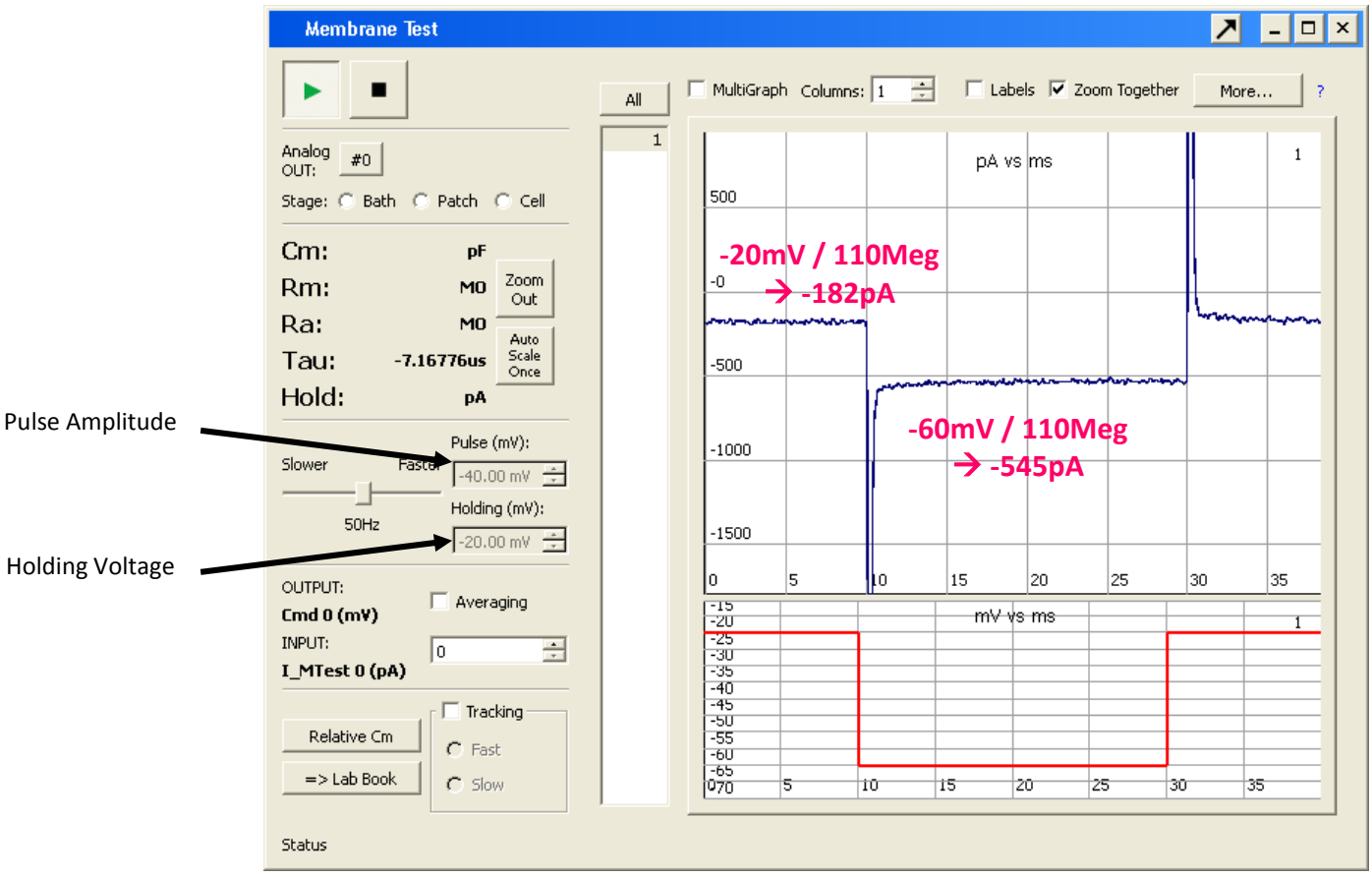
The internal model cells have 110Meg ohm resistance.

Zoom and Pan Control

Hold down the right mouse button and move the mouse upward to zoom in vertically. Hold down the right mouse button and move the mouse to the right to zoom in horizontally. Hold down the left mouse button and drag the waveform to center it in the window, as shown. The following lists common waveform effects and corresponding mouse actions to achieve them.

Zoom In Vertically	Hold R mouse button and drag up
Zoom Out Vertically	Hold R mouse button and drag down
Zoom In Horizontally	Hold R mouse button and drag right
Zoom Out Horizontally	Hold R mouse button and drag left
Pan Waveform	Hold L mouse button and drag
Fit-to-window	Double-click L mouse button

The default test pulse is a -40mV pulse with a -20mV holding voltage. With a 110Meg ohm internal model cell, the expected current is around -180pA at holding voltage and -545pA during the pulse. The waveform below confirms that the amplifier is functioning properly.



Amplifier Controls

Amplifier Controls consist of two tabs, “Chans” tab for all the channel controls and “DSP” tab for real-time DSP processing. The “Chans” tab consists of the following controls.

Channel Selector

Select the channels to apply the settings to.

Click on “All” button to select all channels.

“Shift-click” to select a range of channels.

“Control-click” to select/deselect individual channels.

Enable Vcmd

When selected, dynamic stimulus is delivered to the head. When deselected, holding voltage is delivered to the head. Except for unusual circumstances, Vcmd should **ALWAYS BE ENABLED**.

Bessel Low-Pass Filter

Use the slider or text box to set the frequency of the Bessel low-pass filter. This filter is implemented in hardware, and is defaulted to around 3kHz.

JP / JP Fine Compensation

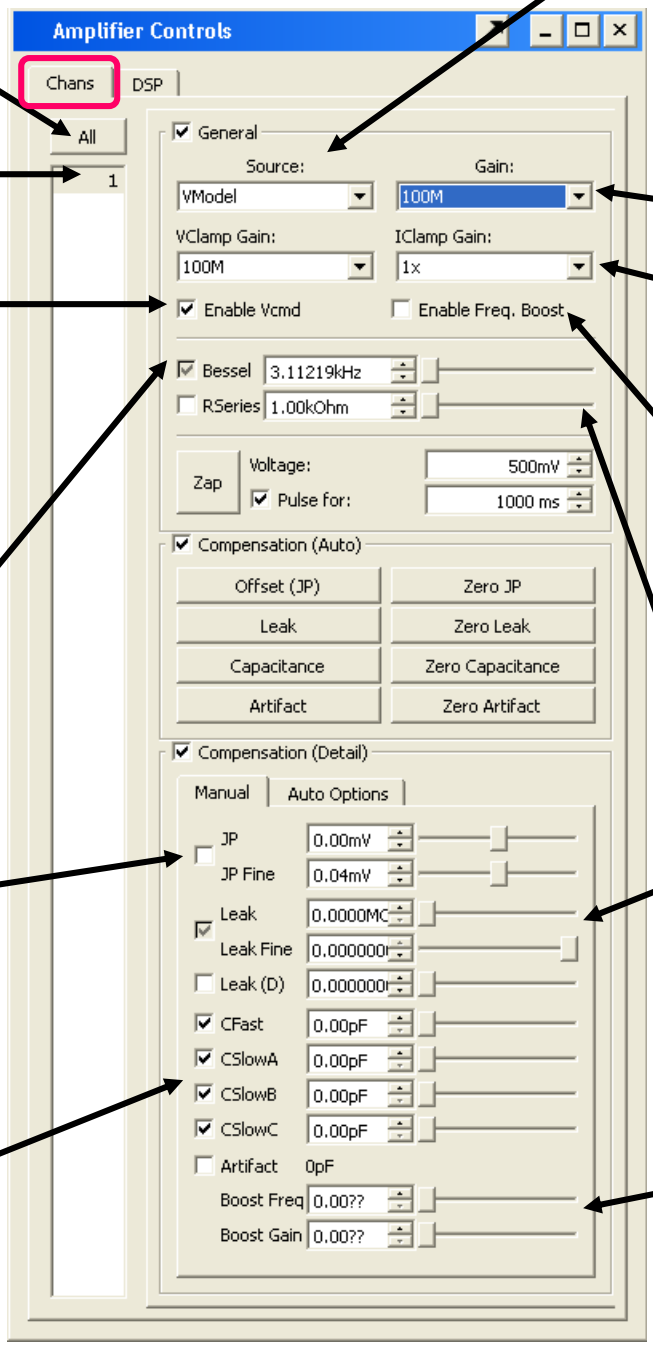
When checked, JP (Junction Potential) offset compensation is enabled. Top slider performs coarse control, and bottom slider performs fine control.

Capacitance Compensations

When checked, that particular capacitance compensation is enabled.

“Cfast” is typically used to cable, trace, and chip capacitances.

“Cslows” are typically used to compensate membrane capacitance behind a series resistance.



Source

Select what the amplifier input connects to.

None = Nothing. Head is isolated.

Head = Head is connected. For normal experiments.

VModel/IModel = Internal model cell is connected to verify hardware.

Gain

Select the gain of the amplifier.

VClamp Gain and IClamp Gain are redundant controls to the “Gain” control. These do not need to be used.

Enable High Frequency Boost

Enables the High Frequency Boost circuit that is used to increase bandwidth at the higher gain settings.

Rseries Compensation

Click on checkbox to enable Rseries compensation. Use the slider or text box to set the amount of Rseries to be compensated.

Leak Compensation

Provides leak current compensation in hardware. Top slider performs coarse control, and bottom slider performs fine control. There are no on/off controls for leak compensation.

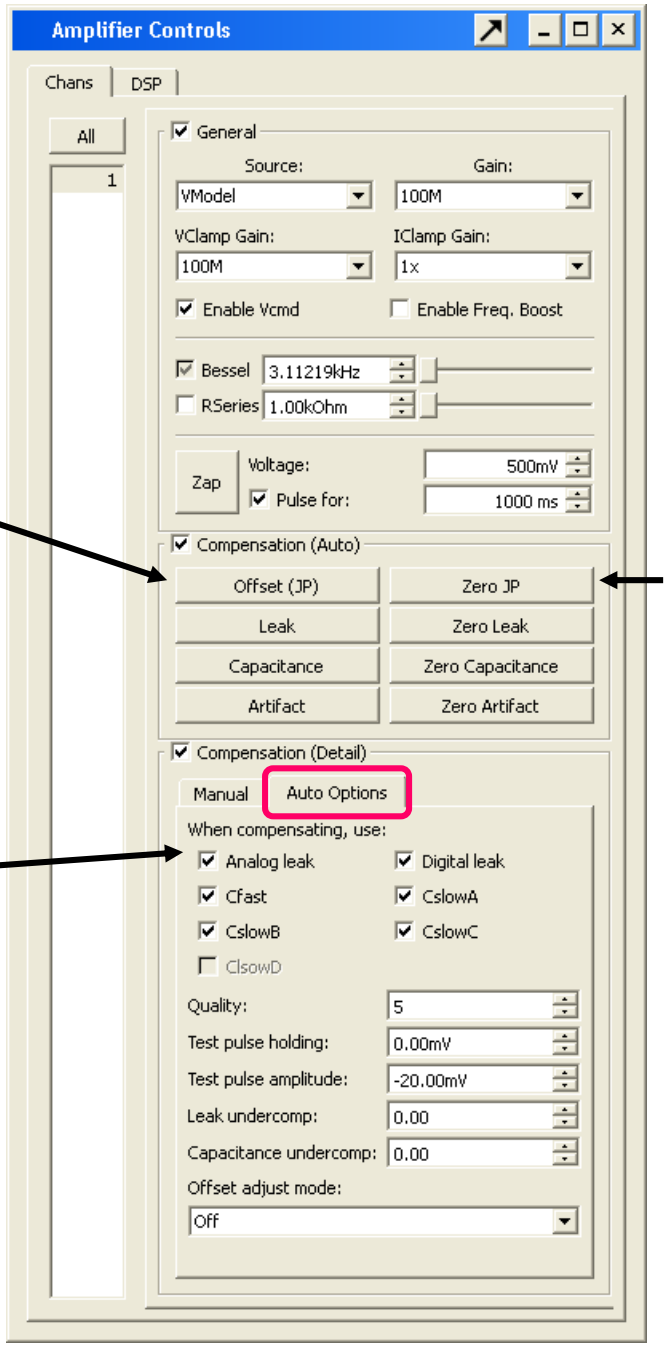
High Frequency Boost

“Boost Frequency” sets the frequency knee for boosting. Move the slider to the left for faster boost.

“Boost Gain” sets the gain for the boost circuitry. Move the slider to the right for more boost.

Auto Comp (Automatic Compensation)

TecellaLab can peform automatic compensations of various parameters.



Auto Comp

Click on a button on the left column to peform auto compensatin for any of the following:

- JP Offset
- Leak
- Capacitance
- Artifact

Auto Comp Options tab

When performing auto compensation, the checked items will be used to perform the auto compensation.

Zero (reset) Compensation

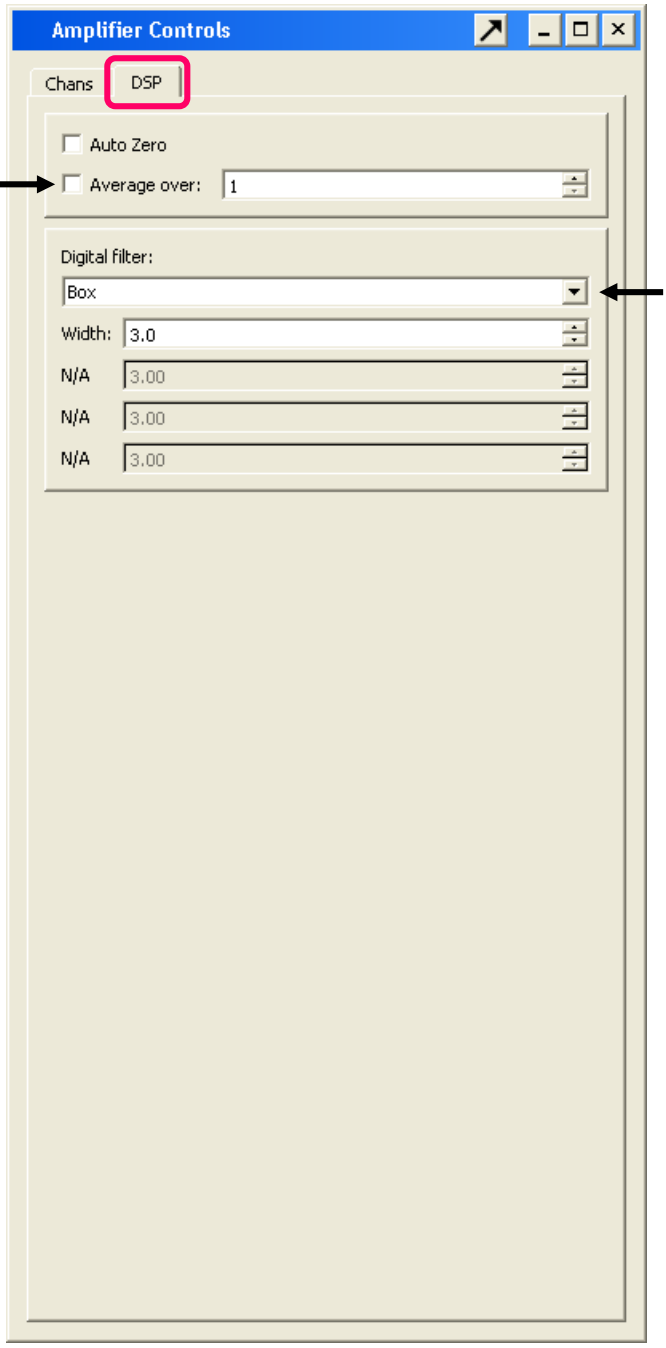
Click on a button on the right column to reset that parameter to uncompensated state.

DSP

TecellaLab can perform run-time digital signal processing (DSP).

Averaging

Performs averaging over multiple passes for repeating protocols or test pulses.

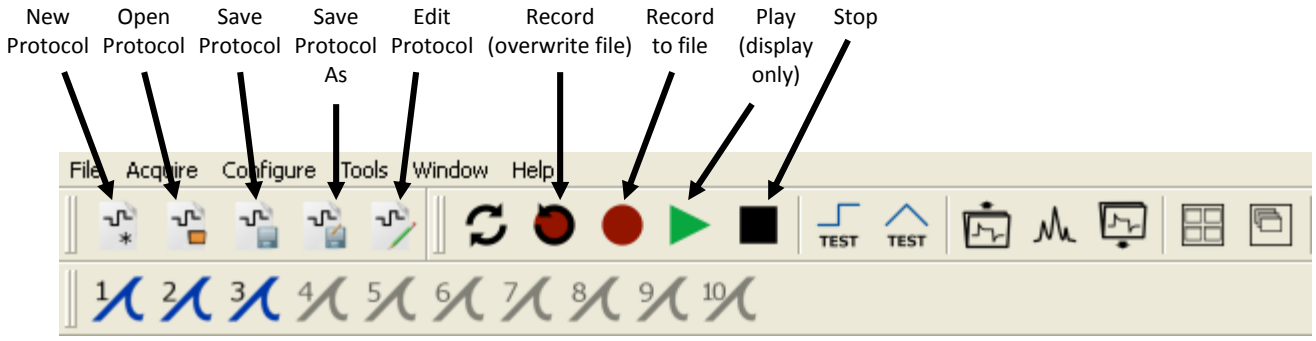


Digital Low-Pass Filter

Select method of low-pass filtering, and the sample width to filter over.

Protocols

TecellaLab offers a visually intuitive way to create, edit, and save protocols.

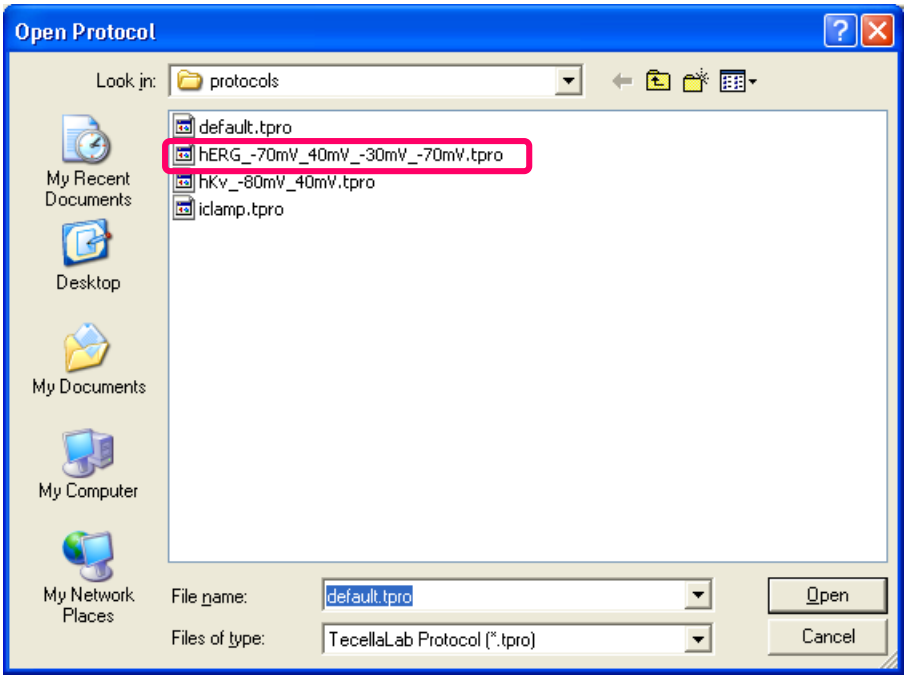


New Protocol	Create a new protocol.
Open Protocol	Open an existing protocol.
Save Protocol	Save the current protocol.
Save Protocol As	Save the current protocol to a new protocol file.
Edit Protocol	Edit the current protocol.

Opening and running a Protocol

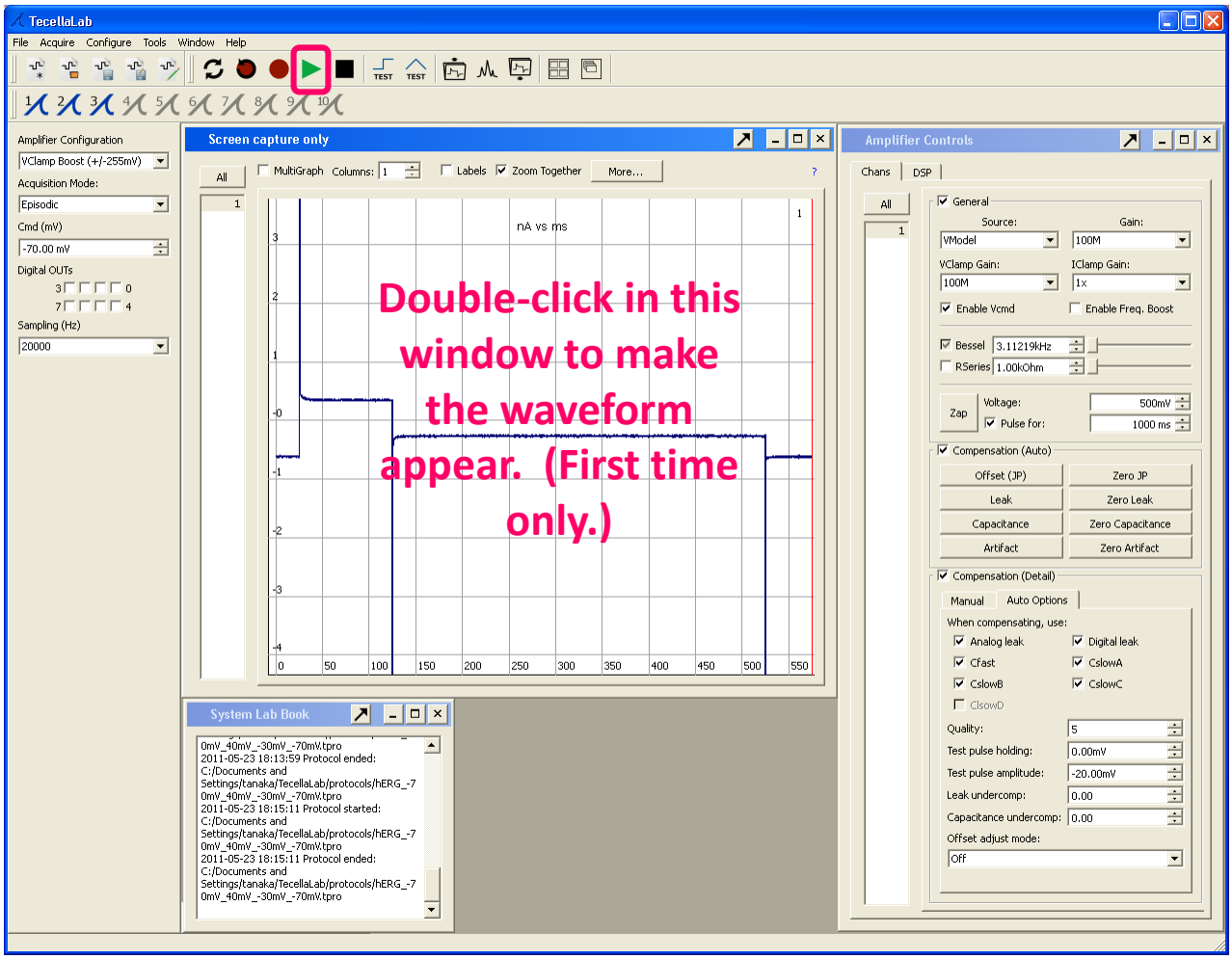
Click on the “Open Protocol” button. The following dialog box appears.

The following dialog box appears.



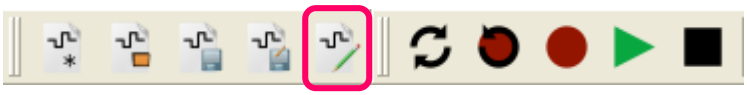
As an exercise, select hERG_-70mV_40mV_-30mV_-70mV.tpro and open that protocol. The protocol is now loaded.

Click on the “Play” button to run the protocol and display to screen. Sometimes the window fails to properly scale and display the waveform, so double-click anywhere inside the display window to make the waveform appear. This should only be necessary the first time.



Edit a Protocol

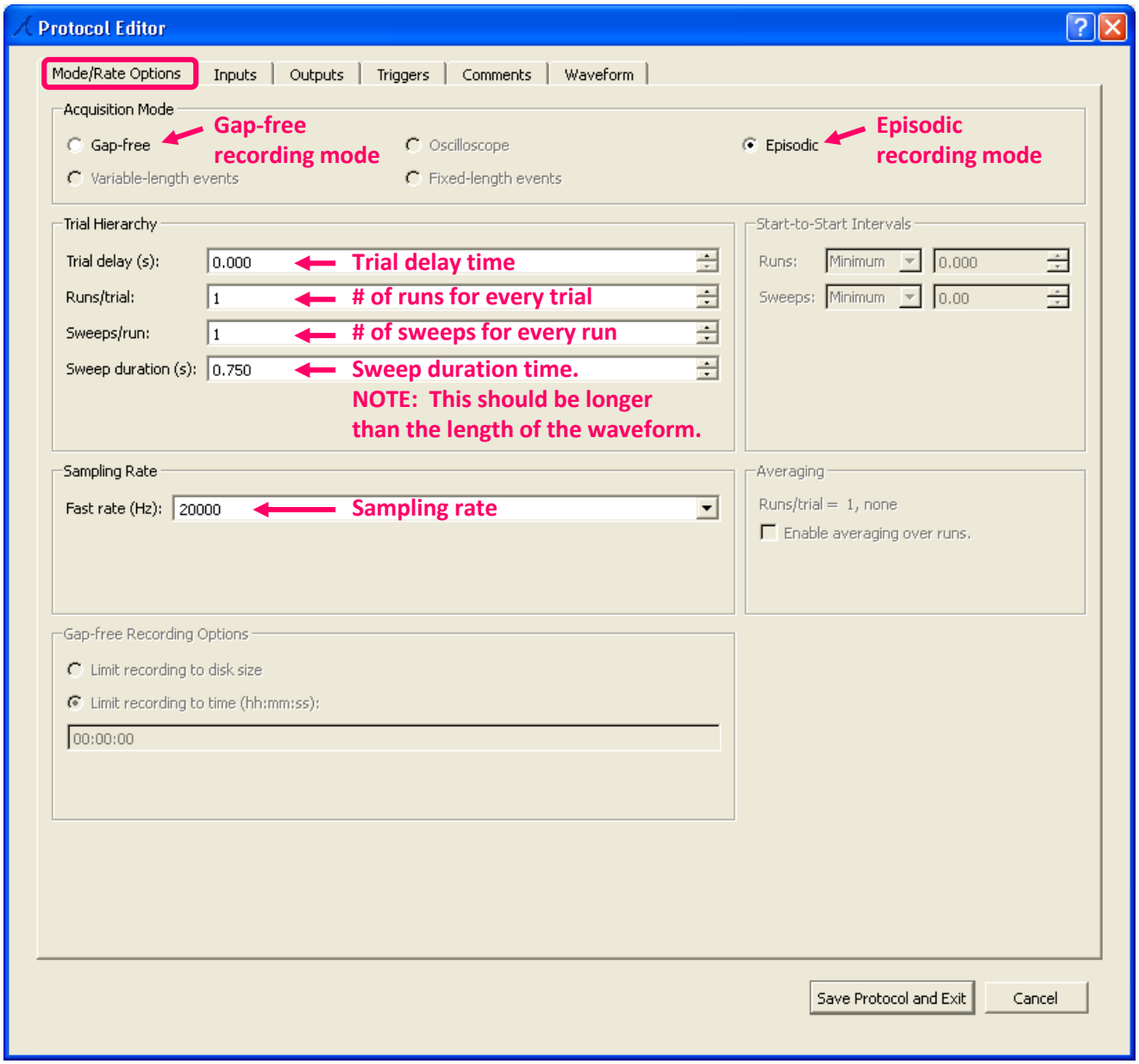
Click on the “Edit Protocol” button to edit the protocol currently loaded.



The “Protocol Editor” launches.

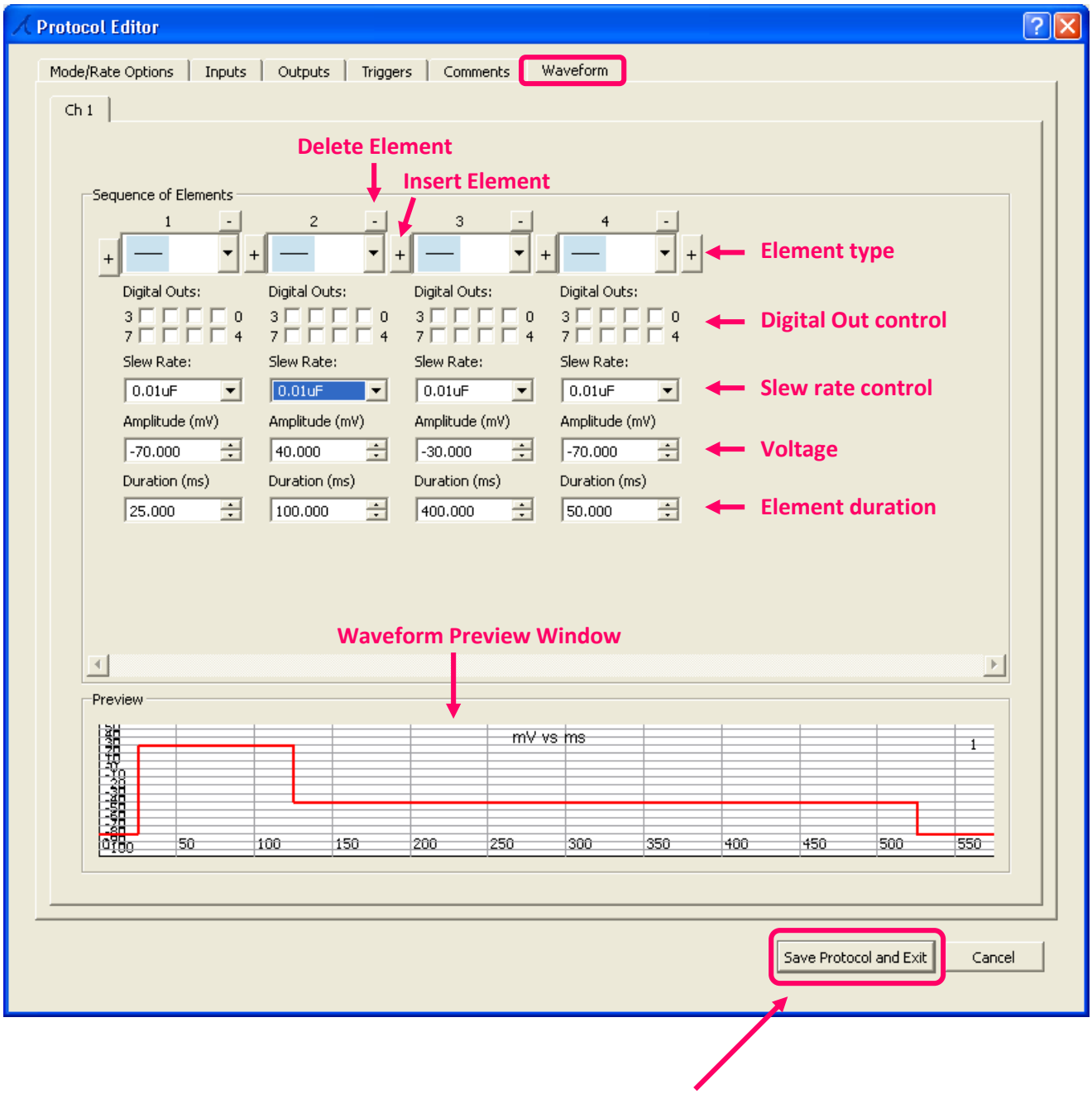
Edit Protocol – Mode/Rate Options tab

The “Mode/Rate Options” tab allows editing of the general protocol parameters.



Edit Protocol – Waveform tab

The “Waveform” tab allows editing of protocol waveform.

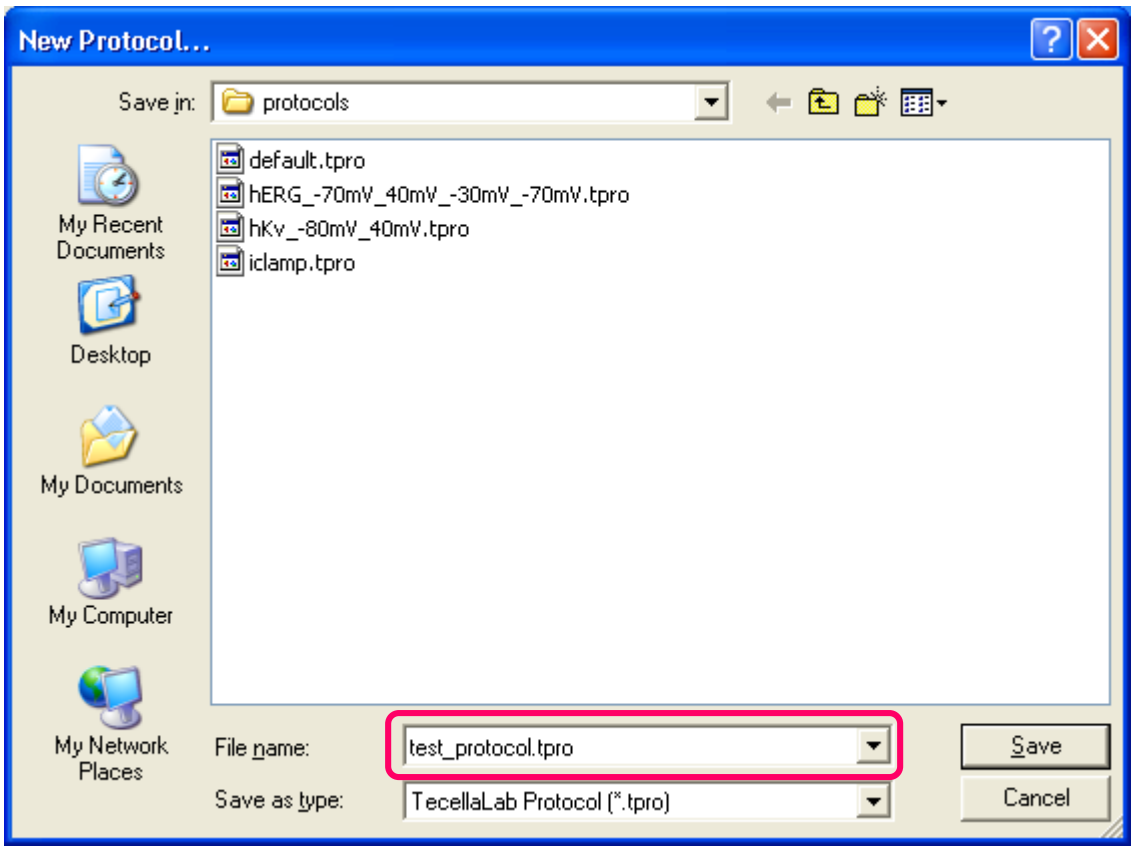


After you have finished editing your protocol, click on the “Save Protocol and Exit” button at the bottom of the window.

New Protocol

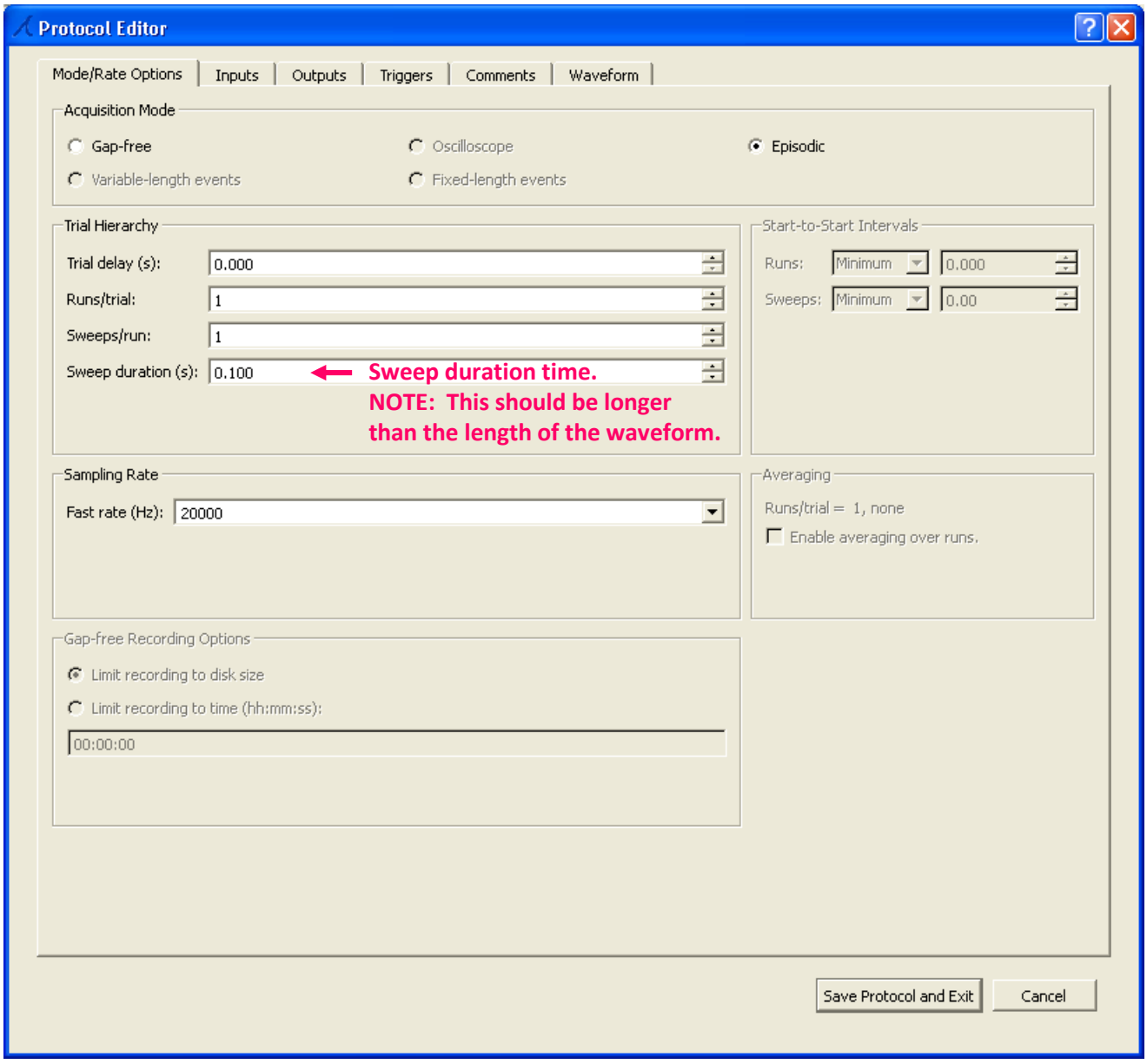
One way to create a new protocol is by editing an existing protocol, and saving the changes to a new protocol file. Another way is to click on the "New Protocol" button.

Create a new protocol file. In the example below, the new protocol will be saved as "test_protocol.tpro".



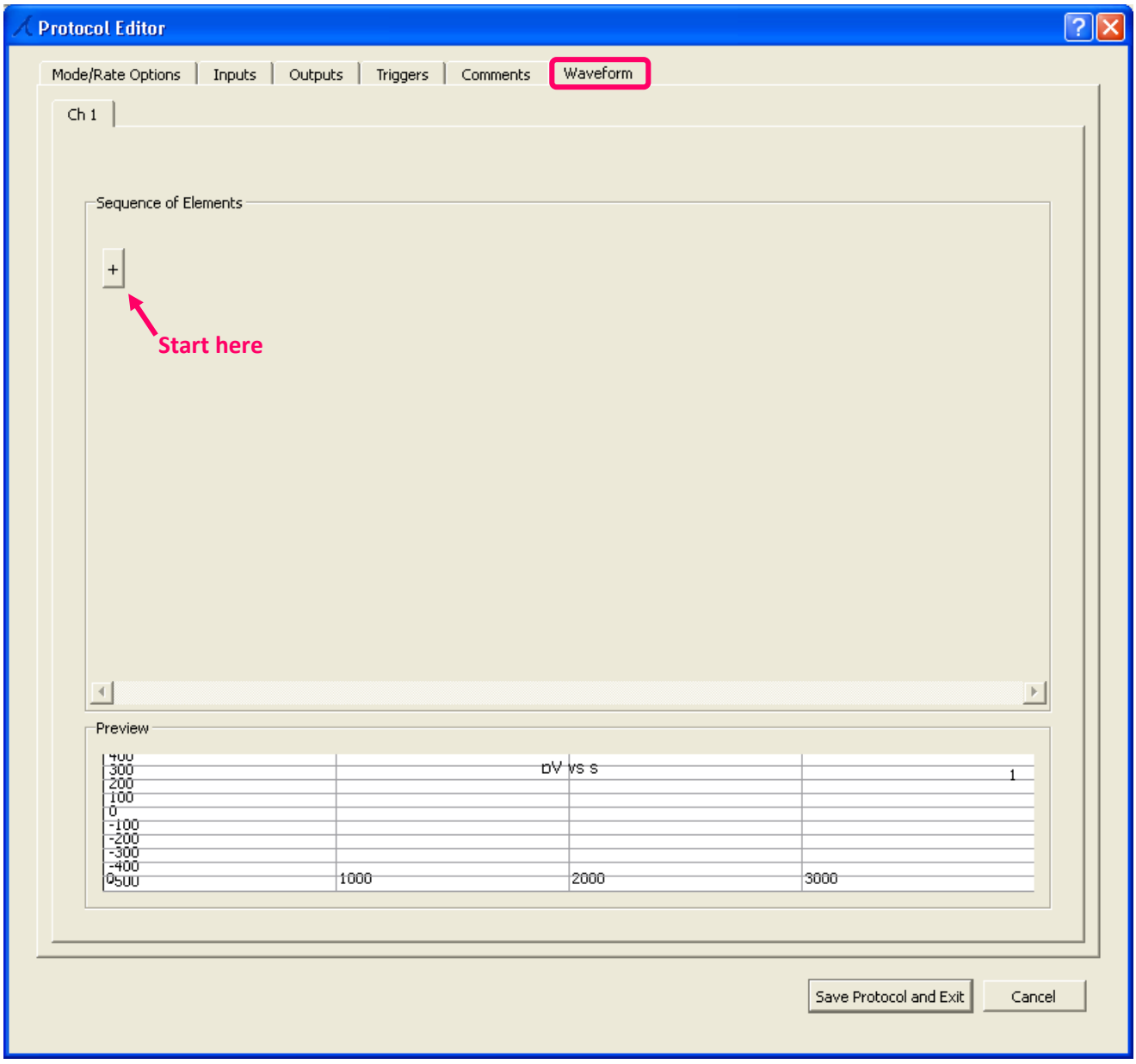
Click "Save" button to create the new protocol file. The Protocol Editor will launch with the "Mode/Rate Options" tab.

If you are creating an “Episodic” protocol, then please remember to program the “sweep duration” time to a longer value than the length of your waveform.

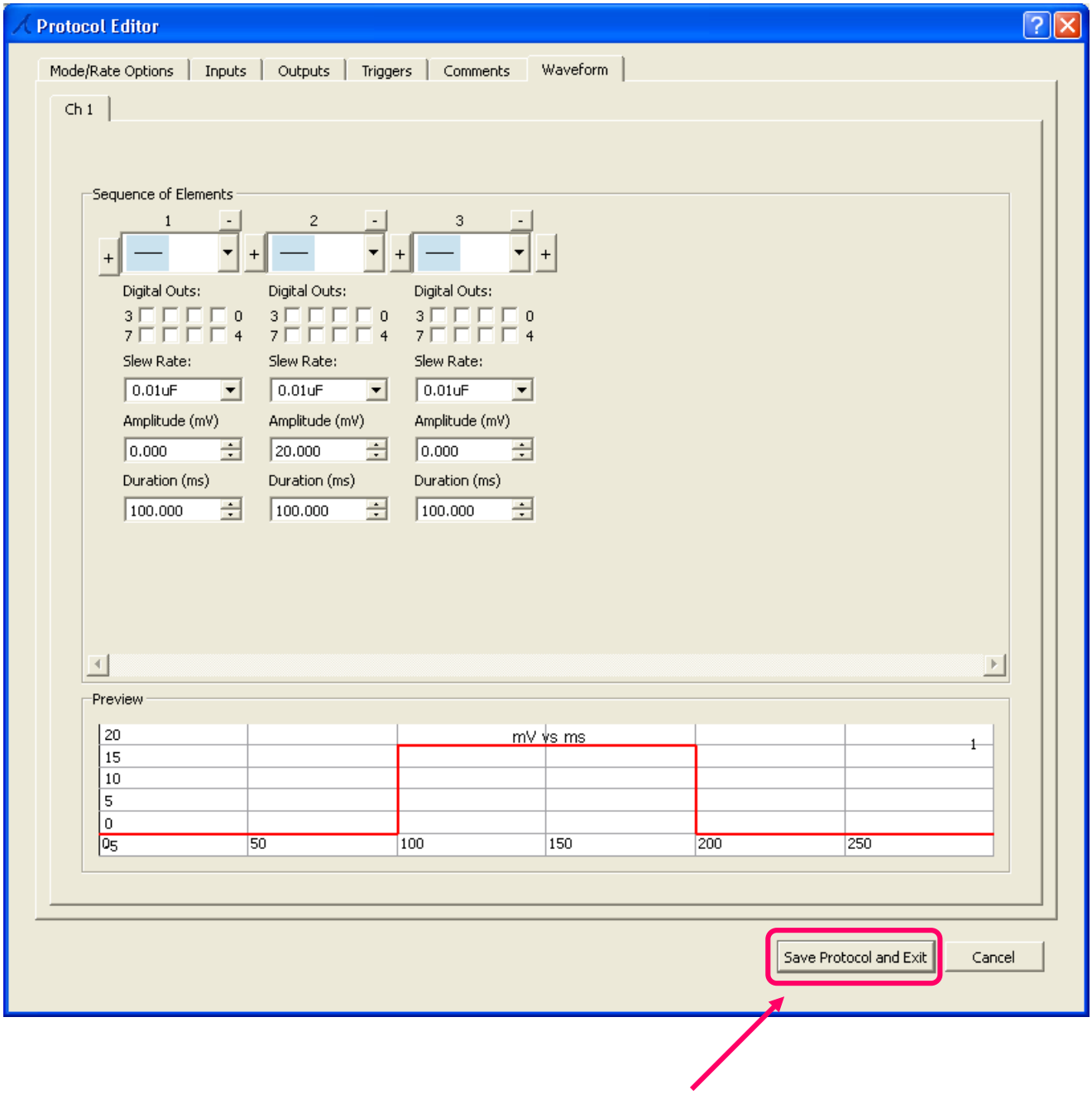


After editing the “Mode/Rate Options” tab, click on the “Waveform” tab.

You will see a blank waveform tab. Click on the "+" sign to add the first element. Refer to the "Edit Protocol" section to program each element.



The following is an example of a three element protocol.



After you have finished editing your protocol, click on the “Save Protocol and Exit” button at the bottom of the window.

Running the just created protocol, results in the following display.