ERG Analysis with LabScribe

Introduction

An electroretinogram (ERG) is a recording of the electrical responses of the cells of the retina to a light stimulus. ERG parameters are detected, and functions derived from those parameters are computed in *LabScribe's* **ERG Advanced Analysis Module**.

The **ERG Advanced Analysis Module** requires a separate license. The first time you select **Blood Pressure**, you will be asked for a username and a serial number. Contact iWorx Systems for more information.

This document includes a step by step tutorial for using most of the features of the **ERG Advanced Analysis Module**, as well as a more detailed **Reference** section that covers the material in the tutorial, and adds additional context and detail. To use the step by step guide, you will need an ERG recording that has been recorded in *LabScribe*'s sweep mode, with each sweep triggered by the light stimulus. The ERG can be from any mammalian species.This file can then be saved and used in the offline analysis tutorial.

ERG Analysis: Step by Step

ERG data are recorded in *LabScribe* in Scope mode, with the stimulus triggering each sweep. To use the ERG Advanced Analysis Module, open an ERG data file.

When **ERG Analysis** is chosen from the **Advanced** menu, the **Offline Calculations**.dialog opens.
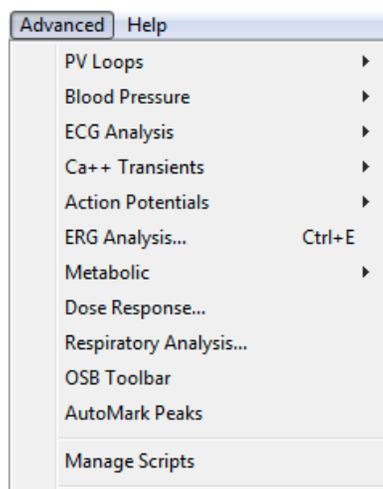

Advanced menu.

Offline ERG Calculations

The offline **ERG Calculations** dialog allows sophisticated offline analysis of previously recorded ERG data.

To perform offline ERG analysis**:**

1) Open a previously recorded ERG data file.

2) Choose **ERG Analysis** from the **Advanced** menu to open the offline **ERG Calculations** dialog. The panels of this dialog can be resized by moving the mouse cursor over the boundaries until a double-headed arrow appears, and dragging the boundaries to resize the panels.
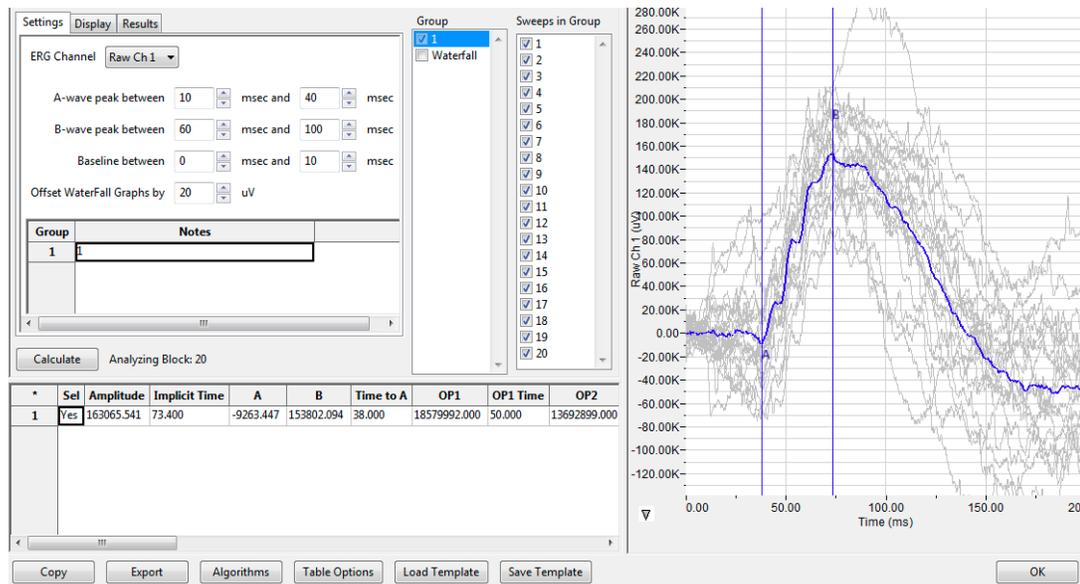

ERG Calculations dialog.

3) Familiarize yourself with the offline **ERG Calculations** dialog, pictured above.
   - The tabbed configuration dialogs are on the left side of the dialog.
   - An XY graph window on the right displays the **ERG Graph**, showing the selected cycle and the average of all checked cycles from the **Cycles Selected** list.
   - Between the configuration dialogs and the XY graph window are the **Group** and **Sweeps in Group** lists, editable lists of the groups and sweeps that can be displayed and analyzed.
   - The **Data Table** is located on the lower left part of the dialog.

To configure the **Settings:**

1) Click on the **Settings** tab, opening the **Settings** configuration dialog.
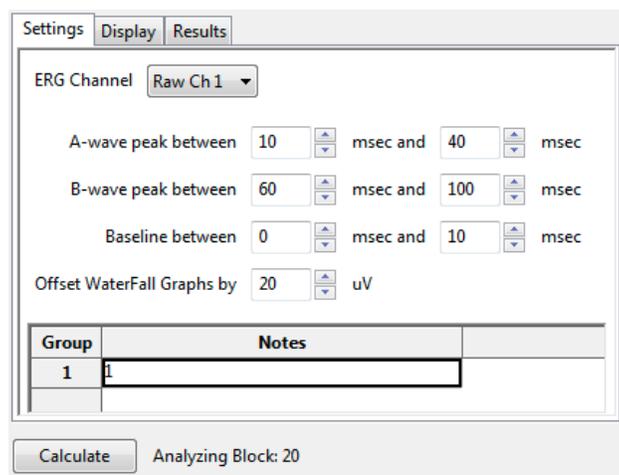
ERG Settings configuration dialog.

2) From the **ERG Channel** menu, choose the channel with the ERG recording.
3) Specify the intervals during which the A and B waves can be expected to be found, and enter the start and end times in the appropriate fields.
4) Specify the interval to be used as a baseline by entering the start and end times in the appropriate fields.
5) In a Waterfall graph of all the group averages, the group averages can be offset from each other. Enter the desired offset value in the **Offset Waterfall Graphs** field.
6) Distinguishing characteristics of the individual groups can be entered as notes in the table at the bottom of the **Settings** window.
7) Click the **Calculate** button above the **Data Table** to update all settings. Click **Calculate** whenever settings are updated.
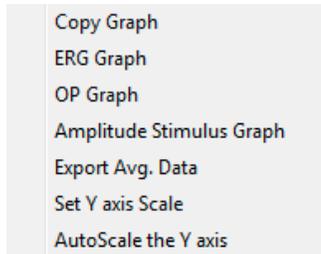
To display and analyze the **ERG Graph:**
1) Familiarize yourself with the **ERG Graph**, which will be displayed in the XY graph area and is illustrated below.
   • The average of the selected sweeps is shown in black, while the individual sweeps are displayed in grey.
   • Sweeps can be deselected (or selected) by clicking on the check box to the left of the sweep number in the **Sweeps in Group** list to the left of the graph. The UP and DOWN arrows on the computer keyboard can be used to move quickly through the individual sweeps. If a particular sweep is selected from the Sweeps list, that sweep is highlighted in black in the graph.
   • The specific parameters shown in the graph are chosen from the **Display** configuration dialog.

The ERG Graph.

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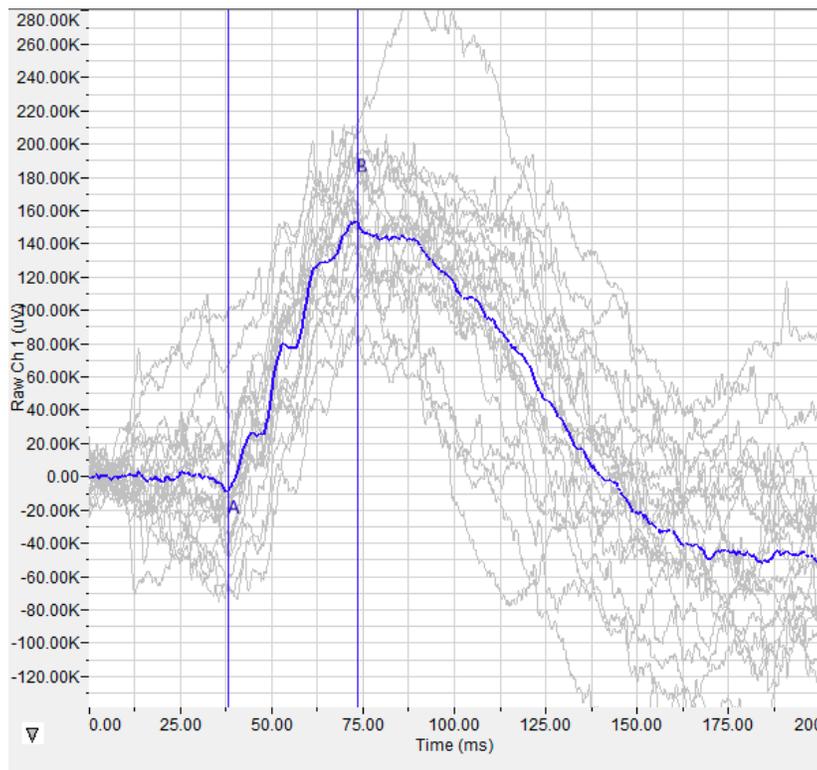
2) Click the arrow to the lower left of the XY graph window to open a menu with options for the displayed XY graph.

Copy Graph
ERG Graph
OP Graph
Amplitude Stimulus Graph
Export Avg. Data
Set Y axis Scale
AutoScale the Y axis

XY graph window menu.

3) Click **Copy Graph** to copy the **ERG Graph** to the computer clipboard. It can then be pasted into the **Journal** or an external application.
4) Click **ERG Graph** to display either the selected sweeps from one group, or a Waterfall graph of the averages of multiple groups. The graph that is displayed can be chosen from the options in the **Group** list.
5) Click **OP Graph** to display the oscillatory potentials that occur in the depolarization that occurs between the a-wave and b-wave.
6) Click **Amplitude Stimulus** to display a graph of the amplitude stimulus properties.
7) Click **Export Average Data** to export the average data of a group of sweeps as a text file that can be named and placed in a chosen location.
8) Click **Set Y-axis Scale** to set the Y-axis scale manually.
9) Click **AutoScale Y-axis** to optimize the display scale of the Y-axis.

To configure the **Display:**
1) Click on the **Display** tab to open the **ERG Display** configuration dialog.
   - Choose the parameters you would like displayed on the **ERG** or **OP Graph**. Observe the graph to see the addition or subtraction of the parameters as they are clicked and unclicked. The available options include the trough of the a-wave, the peak of the b-wave (on the ERG Graph), and the individual oscillatory potentials occurring between the a-wave and the b-wave (on the OP graph).

Settings | Display | Results
Show on Graph
☑ A wave
☑ B wave
☐ OP
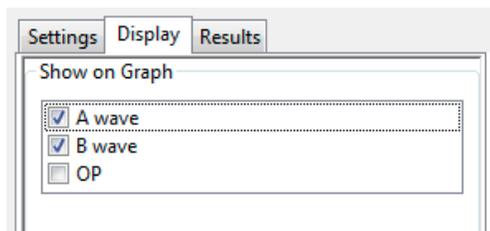
ERG Display configuration dialog.

To configure the **Results:**
1) Click on the **Results** tab to open the **ERG Results** configuration dialog. Here information about the original data file is displayed. Additional text can be entered into this dialog.
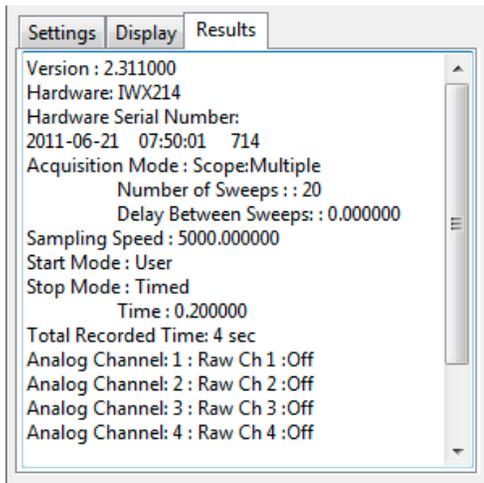
ERG Results configuration dialog.

To use the **Data Table:**

| *	Sel	Amplitude	Implicit Time	A	B	Time to A	OP1	OP1 Time	OP2	OP2 Time	Notes
1	Yes	163065.541	73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600	1
2											
3	#		1	1	1	1	1	1	1	1	
4	Mean		73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600	
5	SD		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
6	Max		73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600	0.000
7	Min		73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600	0.000

ERG Data Table.

1) Familiarize yourself with the **Data Table**.
   - The **Data Table** spans the lower left part of the **ERG Calculations** dialog and displays the average calculated values for the chosen parameters in each of the groups checked in the **Group** list.
   - The parameters displayed are chosen from the list of available parameters chosen from the list displayed by clicking the **Table Options** button at the bottom of the dialog.
2) Click the asterisk at the upper left of the **Data Table** to display two options: **Autosize** and **Copy Selection**. **Autosize** will optimize the size of the **Data Table** columns, and **Copy Selection** copies any selected **Data Table** cells to the clipboard. The width of the individual columns can also be adjusted manually.

There are six buttons beneath the **Data Table: Copy, Export, Algorithms, Table Options, Load Template,** and **Save Template:**

3) Click **Copy** to copy all the calculated data in the **Data Table** to the clipboard.
4) Click the **Export** button to export the data as a tab (*.txt) or comma (*.csv) separated text file. The currently displayed XY graph can be exported as a Portable Network Graphics (*.png) or JPEG (*.jpg) image.
5) Click **Algorithms** to display the mathematical definitions of the parameters included in the **Data Table**.

6) Click **Table Options** to open the **Offline Calculations Options Dialog**, which lists the functions from which the **Data Table** parameters can be chosen. All functions are described in the **ERG Analysis: Reference** section.
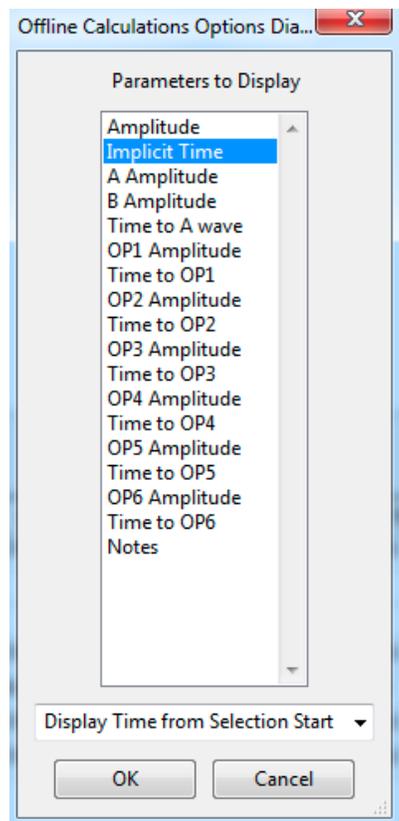
Complete list of Data Table parameters.

7) Click **Load Template** or **Save Template** to display a dialog allowing you to name and save a specific configuration for future use or to load a previously saved template.
8) Click **OK** to close the analysis.

ERG Analysis: Reference

When **ERG Analysis** is chosen from the **Advanced** menu while an ERG data file is displayed in the Main window, the **ERG Calculations** dialog opens.

Offline ERG Calculations

LabScribe can perform offline **ERG** calculations on previously recorded ERG traces, and display a number of XY graphs based on the ERG data.

Choosing **ERG Analysis** from the **Advanced** menu opens the **ERG Calculations** dialog. The panels of this dialog can be resized by moving the mouse cursor over the boundaries until a double-headed arrow appears, and dragging the boundaries to resize the panels.
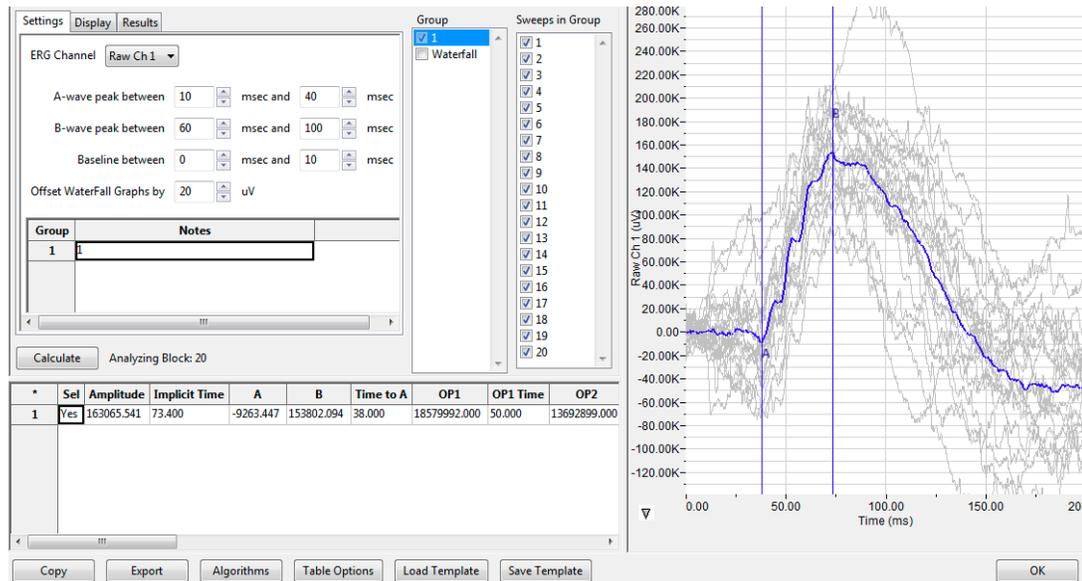
The ERG Calculations dialog.

The sections of the offline **ERG Calculations** dialog, each of which is described in more detail below:

- The tabbed configuration windows are on the left side of the upper part of the dialog.
- An XY graph window on the right displays XY graphs based on the ERG data.
- Between the configuration dialogs and the XY graph window are the **Group** list, an editable list of the groups that can be displayed and analyzed, and the **Sweeps in Group** list, and editable list of the sweeps to be displayed from a single group.
- The **Data Table** is located on the lower part of the dialog.

The Configuration Windows

There are three tabbed configuration dialogs: **Settings, Display, and Results.**

The Settings Configuration Dialog
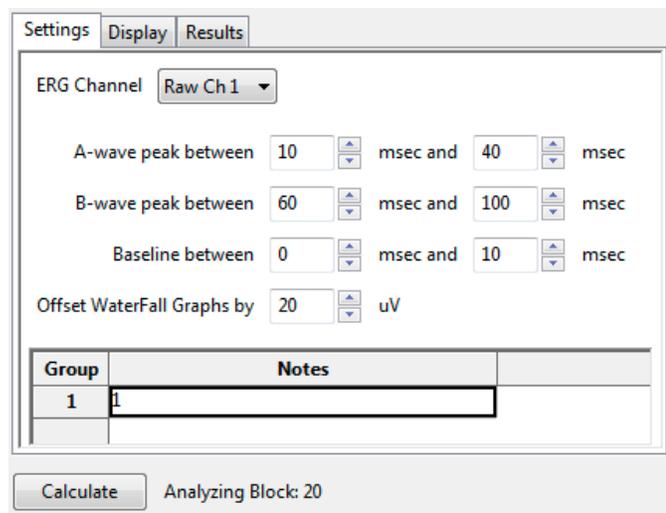
ERG Settings configuration dialog.

Starting at the top of the **ERG Settings** configuration dialog:

- The channel with the ERG raw data is specified.
- The time interval during which the a-wave trough can be expected to be found is specified.
- The time interval during which the b-wave peak can be expected to be found is specified.
- The amount of time before the ERG to be used as a baseline is specified.
- In a Waterfall graph of all the group averages, the group averages can be offset from each other. The desired offset value is entered in the **Offset Waterfall Graphs** field.
- Distinguishing characteristics of the individual groups can be entered as notes in the table at the bottom of the **Settings** window.
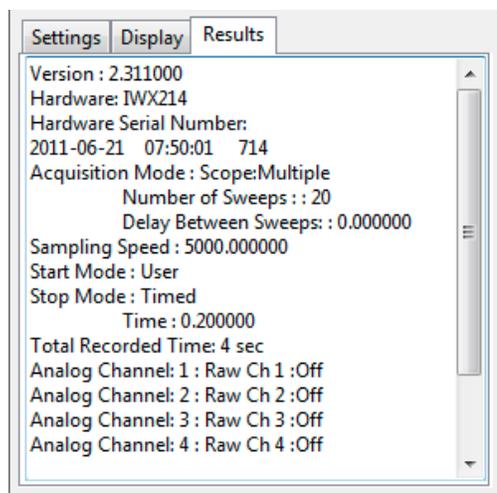
The Display Configuration Dialog
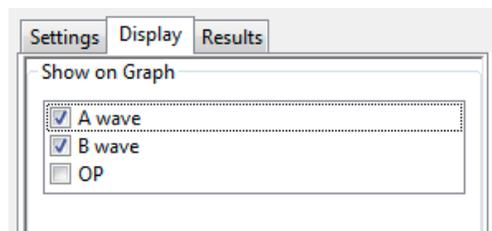
ERG Display configuration dialog.

- The parameters to be displayed on the **XY Graph** are chosen in this window. The options include the trough of the a-wave, the peak of the b-wave, and the individual oscillatory potentials occurring between the a-wave and the b-wave.
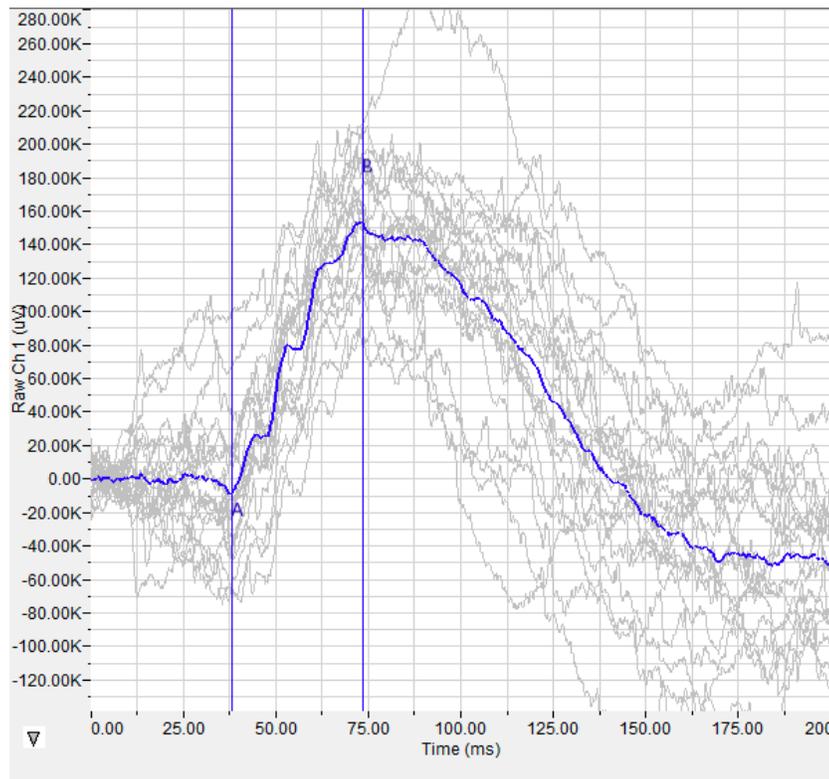
The Results Configuration Dialog

ERG Results configuration dialog.

- Information about the original ERG data file is displayed. Additional text can be entered into this dialog.
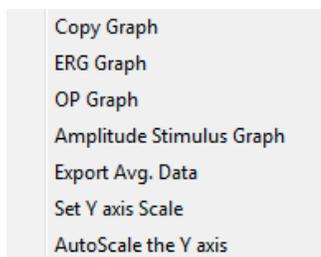
The XY Graph

The XY graph displays one of a number of graphs based on the ERG data. The specific graph displayed is chosen from the XY Graph menu found to the lower left of the graph.

The ERG Graph.

The XY Graph Menu: Clicking on the arrow in the lower left corner of the XY graph pane opens a menu that offers options for choosing the graph to be displayed and for scaling both the X-axis and Y-axis. There are also options to copy the graph to the clipboard and export the data as a text file.

Copy Graph
ERG Graph
OP Graph
Amplitude Stimulus Graph
Export Avg. Data
Set Y axis Scale
AutoScale the Y axis

The XY Graph menu.

The menu items are:

- **Copy graph**: Copies the current XY graph to the clipboard. It can then be pasted into the journal or an external application.

- **ERG Graph:** Displays either a graph of the individual sweeps and average of a specific group or a waterfall graph of the averages of a number of groups. The group to be displayed is chosen from the **Group** list and the sweeps to be displayed are chosen from the **Sweeps in Group** list. The choice of a waterfall graph is made in the **Group** list. The average of the selected sweeps is shown in blue, while the individual sweeps are displayed in grey. Sweeps can be deselected (or selected) by clicking on the check box to the left of the sweep number in the **Sweeps in Group** list to the left of the graph. The UP and DOWN arrows on the computer keyboard can be used to move quickly through the individual sweeps. If a particular sweep is selected from the Sweeps list, that sweep is highlighted in black in the graph.
- **OP Graph:** Displays a graph of the oscillatory potentials occurring during the depolarization between the a-wave and b-wave.
- **Amplitude Stimulus Graph**: Displays the stimulus amplitude changes.
- **Export Avg Data**: Exports the averaged data from a group to a text file.
- **Set Y-axis Scale**: Allows the user to set the Y-axis scale.
- **AutoScale Y-axis**: Optimizes the display scale of the Y-axis of the XY graph.
- The axes can also be re-scaled by left-clicking and dragging either of the axes.

The Data Table

The **Data Table** displays the chosen calculated values for each cycle.

| *	Sel	Amplitude	Implicit Time	A	B	Time to A	OP1	OP1 Time	OP2	OP2 Tin
1	Yes	163065.541	73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600
2										
3	#		1	1	1	1	1	1	1	1
4	Mean		73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600
5	SD		0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6	Max		73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600
7	Min		73.400	-9263.447	153802.094	38.000	18579992.000	50.000	13692899.000	58.600

The ERG Data Table.

Clicking the asterisk at the upper left of the **Data Table** displays two options: **Autosize** and **Copy Selection**. A**utosize** will optimize the size of the **Data Table** boxes, and **Copy Selection** copies any selected **Data Table** cells to the clipboard.

The **Data Table** displays the average calculated values for the chosen parameters in each of the groups checked in the **Group** list. The last few rows of the data table include column statistics for each of the parameters.

There are six buttons across the bottom of the **ERG Calculations Dialog: Copy, Export, Algorithms, Table Options, Save Template,** and **Load Template.**
- All the calculated data in the **Data Table** can be copied to the clipboard by clicking the **Copy** button, or exported by clicking the **Export** button. The data are exported in a tab (*.txt) or comma (*.csv) separated text file, and the XY graph can be exported as a Portable Network Graphics (*.png) or JPEG (*.jpg) image.
- Clicking **Algorithms** opens an information window describing the mathematical equations used to compute a number of the offline parameters.

- *LabScribe* is able to calculate a large number of ERG calculations for each cycle. By clicking **Table Options** at the bottom of the **ERG Calculations Dialog**, the **Offline Calculations Options Dialog** opens, and calculations to be displayed in the **Data Table** can be chosen from the list of all possible calculations.
- Clicking **Load Template** or **Save Template** displays a dialog allowing you to name and save a specific configuration for future use or to load a previously saved template.
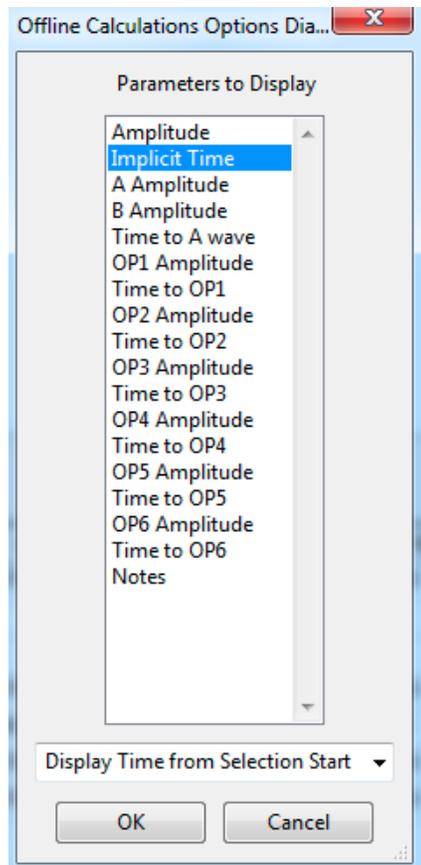
Offline Calculations Options dialog.

Offline Calculations:
- **Amplitude**: Change in amplitude from trough of a-wave to peak of b-wave.
- **Implicit Time**: Time from stimulus onset to peak of b-wave.
- **A Amplitude**: Amplitude at trough of a-wave.
- **B Amplitude**: Amplitude at peak of b-wave.
- **Time to A-wave**: Time from stimulus onset to peak of a-wave.
- **OP1 Amplitude**: Amplitude of Oscillatory Potential 1.
- **Time to OP1**: Time from stimulus onset to peak of Oscillatory Potential 1.
- **OP2 Amplitude**: Amplitude of Oscillatory Potential 2.
- **Time to OP2**: Time from stimulus onset to peak of Oscillatory Potential 2.
- **OP3 Amplitude**: Amplitude of Oscillatory Potential 3.
- **Time to OP3**: Time from stimulus onset to peak of Oscillatory Potential 3.
- **OP4 Amplitude**: Amplitude of Oscillatory Potential 4.

- **Time to OP4**:Time from stimulus onset to peak of Oscillatory Potential 4.
- **OP5 Amplitude**: Amplitude of Oscillatory Potential 5.
- **Time to OP5**: Time from stimulus onset to peak of Oscillatory Potential 5.
- **OP6 Amplitude**: Amplitude of Oscillatory Potential 6.
- **Time to OP6:** Time from stimulus onset to peak of Oscillatory Potential 6.
- **Notes**: Any notes entered into the Notes field in the Settings window.